

INSTRUCTION MANUAL

WITH

SCHEMATIC

FOR

NRI 2500

GOS-3310

S300A

CIE-3310

SINGLE TRACE -TRIGGERED SWEEP

10 MHz OSCILLOSCOPE

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## FEATURES

### General Description

The CIE-3310 oscilloscope is a general-purpose oscilloscope with features to make it a useful, versatile piece of test equipment offering waveform, frequency, and voltage analysis of frequencies up to 10MHz.

The vertical deflection system offers 4 calibrated ranges from 5mV to 5V/DIV in decade sequence. The vertical VARIABLE control allows continuously variable vertical deflection capability. The input signal may either be capacitively or directly coupled by use of the AC-GND-DC switch.

The horizontal amplifier features 6 calibrated sweep rates from 0.1 $\mu$ S to 10mSec/Div with a sweep VARIABLE control to allow continuous sweep rate variation. The sweep may be internally triggered from the vertical signal or may be externally triggered by a separate input signal. A free-running AUTO mode is provided for sweep without the presence of a triggering signal. A TV triggering mode is offered to aid in stable internal triggering on some television signals.

The horizontal deflection may also be used with an external input to allow frequency and phase comparison between two signals.

The CIE 3310 oscilloscope features a short length 75mm round CRT that allows the scope to be small and lightweight for easy use and minimum space requirement. The screen is covered with a graticule marked 10 units wide and 8 units high for convenience and accurate measurements.

A 1KHz 0.25v square wave is also available on the front panel to allow a quick calibration check of the vertical and horizontal amplifiers as well as probe compensation adjustment.

## SPECIFICATIONS

### 1. Vertical

#### Sensitivity range

5mV/DIV to 5V/DIV in 4 calibrated decade steps

#### Frequency range

AC Coupling: 2Hz to 10 MHz

DC Coupling: DC to 10 MHz

#### Input Impedance

1 Megohm  $\pm$ 5% with less than 35pF

#### Maximum Input Voltage

600V p-p (DC + AC peak, less than 1 minute and  
AC freq. less than 1KHz)

2. Horizontal

Sweep Rate

10mS/DIV to 0.1 $\mu$ S/DIV in 6 calibrated decade steps. Accuracy  $\pm$ 5%

External Input

Sensitivity: approximately 0.1V/DIV  
Frequency Range: DC to 500 KHz (-3dB)  
Input Impedance: 1 Megohm  $\pm$ 5% less than 35pF  
Maximum Input Voltage: 600Vp-p (DC+AC Peak)  
X-Y phase difference 3 $^\circ$  or less at 10KHz

Triggering

Internal Sensitivity: 0.5 DIV from 30 Hz to 2MHz  
1.5 DIV from 2MHz to 10 MHz

External Sensitivity: 0.5Vp-p from 30Hz to 2MHz  
1V p-p from 2MHz to 10MHz

External Trigger Input: Max. input Voltage: 600V p-p  
(DC + AC peak)  
Input impedance 1 Megohm  $\pm$ 5%  
with less than 35pF shunt capacitance

3. Amplitude calibrator

Output voltage: 0.25Vp-p square wave  $\pm$ 3%  
Repetition Rate: 1KHz  $\pm$ 5%

4. Cathode Ray Tube

Display Area: 75mm round screen  
Graticule: 8 DIV x 10 DIV (6mm/DIV)  
Accelerating Potential: Approx. 1.3KV

5. Power Requirements

Line Voltage: AC 110/220V -10%  
Line Frequency: 50-60 Hz  
Power Consumption: Approx. 15W

6. Dimensions and Weight

Dimensions: 202mm Wide x 160mm High x 305 mm Long  
7 3/4 in. Wide x 6 1/8 in. High x 12 1/8 in. Long  
Weight: Approx. 4.3kg (9 1/2 lb.)

## PANEL CONTROLS AND FUNCTIONS

1. POWER Switch: Turns oscilloscope on when in the ON position
2. Pilot Lamp: Lights red when power is supplied and turned on to the oscilloscope.
3. 0.25V CALIBRATOR: Provides a square wave signal of approximately 0.25V p-p at 1KHz for frequency compensation of the input probe and frequency calibration check.
4. LEVEL Control: Rotation performs trigger LEVEL adjustment and push-pull action changes SLOPE of triggering + or -.

LEVEL: Rotation of this control adjusts the voltage level of the input signal on which triggering takes place. CCW rotation (-) causes a more negative voltage point triggering and CW (+) rotation causes a more positive voltage point triggering.

SLOPE: The sweep is triggered on the positive-going slope of the triggering waveform when the switch is pushed in and on the negative-going slope of the triggering waveform when the switch is pulled out. (PULL, SLOPE (-) ).

5. SOURCE Selector Switch: Selects the source of the trigger signal.
  - INT: The trigger signal is derived from the displayed waveform.
  - EXT: The trigger signal is derived from a separate signal applied to the EXT. INPUT jack.

### 6. TRIG. MODE Selector

Selects the operating mode for the trigger circuit.

AUTO: Automatically provides sweep triggering in the absence of an input signal (free run). Provides triggered sweep operation to some degree when an input signal is present.

NORM: The sweep will not start without an input trigger signal. This is the normal triggerered sweep mode.

TV: The input signal is filtered before being fed to the triggering circuits to provide more stable triggering on some television video signals.

X-Y: This position of the switch disconnects the sweep circuits and allows a signal to be applied to the horizontal circuits from the EXT INPUT jack.

7. TIME/DIV Selector:  
Selects calibrated horizontal sweep rates from 0.1 S/DIV to 10m S/DIV in 6 decade ranges when the sweep VARIABLE control is in the CAL position.
8. Sweep VARIABLE:  
Varies the sweep rates to values between the settings of the TIME/DIV Selector. Sweep rates are CALIBRATED when this control is rotated fully clockwise.
9. Horizontal POSITION Control:  
This will move the display left or right.
10. VOLTS/DIV selector:  
This varies the vertical deflection height of an input voltage. It provides 4 decade ranges from 5mV/DIV to 5V/DIV when the vertical VARIABLE control is in the CAL position.
11. Vertical VARIABLE control:  
This varies the vertical deflection height between the settings of the VOLTS/DIV selector. The vertical deflection is calibrated when this control is in the fully clockwise CAL position.
12. Vertical POSITION control:  
Allows movement of the display up or down.
13. INPUT connector:  
This is where vertical input signals are applied.
14. AC-GND-DC selector:  
Selects the input coupling mode  
AC: Vertical input is capacitively coupled so that the DC component is blocked.  
GND: Connects the input to the vertical amplifier to ground for an interference-free reference display.  
In this position the vertical input jack is disconnected.  
DC: The input signal is directly coupled to the vertical amplifier and both AC and DC input will cause vertical deflection.

## REAR PANEL CONTROLS

15. INTENSITY Control:  
Used to adjust the brightness of the display. The display becomes brighter when the knob is rotated clockwise.
16. FOCUS Control:  
Adjusts the focus of the trace or spot.
17. EXT INPUT Connector:  
Input jack for external horizontal input or external trigger.

## GENERAL EQUIPMENT SAFETY

In order to test electrical and electronic equipment, it is often necessary to remove protective cabinets and coverings, thus exposing voltages capable of producing electrical shock if contacted by the technician.

An electrical shock resulting in 10 milliamperes of current passing through the human heart area can cause the heart to stop beating. Current from one body extremity to another can pass through the heart and produce this hazard. Working with one hand while standing or sitting on an insulated surface significantly reduces this risk. Voltages as low as 35 Volts DC or AC can produce lethal current under certain conditions. Higher voltages can even more easily produce lethal current in the body. Following the safety rules below will significantly reduce the possibility of fatal shock.

1. Don't expose yourself to high voltages unnecessarily. Remove protective housings and covers only as necessary. Don't make test connections when the circuit is energized. Discharge high-voltage capacitors after equipment is de-energized.
2. Try to use only one hand when making adjustments on live circuits. Avoid inadvertent contact with any parts of the equipment because certain faults may cause high voltages to be present at unexpected locations.
3. Work in an area with dry insulative floor material if possible or use a large mat of insulating material to stand on or put under your chair and feet. If equipment is moveable, place it on an insulated surface while servicing it.
4. When using a probe, touch only the insulated portion.
5. Know the circuits you are working on and avoid areas of especially high voltages. Remember that line voltages may be present in some places even with the equipment turned off.
6. Metal parts of equipment with two-wire AC power cords, even with polarized plugs, may not be at ground potential. This not only presents a shock hazard but also may cause test equipment damage if chassis potentials are different. On two wire equipment it is a good idea to use an isolation transformer in the AC supply.
7. Never work alone. Someone trained in CPR first aid should be close enough to render aid if necessary.

SPECIAL SAFETY NOTES  
ABOUT YOUR OSCILLOSCOPE

1. Operation of this scope with the cover removed exposes voltages as high as 1500 volts. Applicable safety precautions for working around high voltages must be observed.
2. Be sure that the ground prong of the AC power cord is properly grounded. Defeating this feature by use of an improperly-connected adapter or non-grounded extension cord or other means may pose a potential shock hazard.
3. When the oscilloscope is used to measure line signals, special precautions are required. Do not connect the input lead grounding clip to either side of the line. The clip is already connected through the scope line cord to earth ground, which is common to one side of the line. It may not be readily apparent which side is common, and connecting the ground clip to the wrong side of the line will result in a "short circuit". Bear in mind that many buildings (especially residential) may not be correctly wired.

Precautions to Protect Your Oscilloscope

The following precautions will help prevent scope damage

1. This scope is designed to be operated on nominal line voltage of either 100-120V or 200-240V at 50 or 60 Hz depending on how the internal circuit connections are made. Make sure the scope is set up to use your particular line voltage. Also, the internal line fuse should be 0.5A for 100-120V operation and 0.3A for 200-240V operation. To change the operating voltage see the calibration and adjustment section of this manual.
2. Never allow a small spot of high brilliance to remain stationary on the screen for more than a few seconds. The phosphor of the screen may become permanently damaged in that spot. Either reduce the intensity so the spot is barely visible, de-energize the scope, apply a signal, or place the scope in auto sweep mode. To assure good phosphor life of the CRT it is always advisable to use minimum adequate intensity.
3. Do not apply excessive voltages to the scope input jacks. The maximum ratings of all inputs is 600Vp-p (DC + AC peak) or 212V AC RMS.
4. Never apply an external voltage to the CAL output terminal.
5. Always connect a cable from the ground terminal of the oscilloscope to the chassis of the equipment being tested. Make sure the chassis' are not at different potentials before attaching the ground. If only the probe ground clip is used, there is a possibility of drawing power through the probe ground clip, which could pose a safety hazard in certain circumstances.
6. Do not place objects on top of the oscilloscope or otherwise obstruct the ventilation of the case. This may cause excessive internal temperatures and premature component failure.
7. Avoid the following operating conditions:
  - a. Direct sunlight
  - b. High working environment temperature and humidity
  - c. Vibration or mechanical shock
  - d. Operation near high-voltage or high-current electrical equipment
  - e. Operation near strong magnetic fields

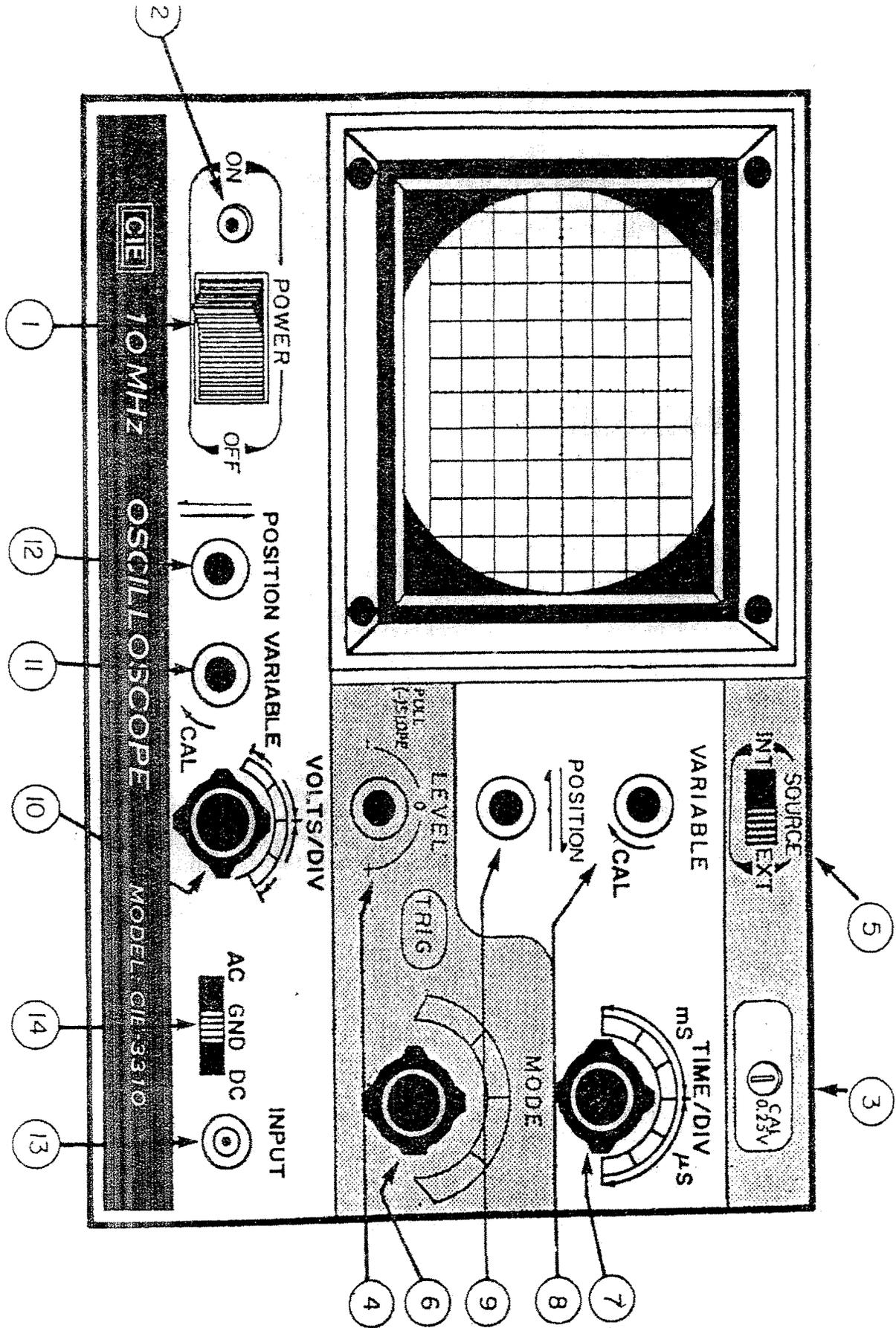


Fig. 1 Front of oscilloscope

## GENERAL OPERATION

### 1. Initial Set-Up

1. Familiarize yourself with the control locations and functions given in the panel controls and Functions section in the front of this manual.
2. To obtain a basic sweep display  
(numbers in parentheses indicate numbered positions on Fig. 1 and 2)
  1. Plug the AC power cord into a properly grounded outlet. See the precautions section concerning outlets.
  2. Move the POWER switch (1) to the ON position. The red LED indicator (2) should light; if it fails to light check that there is power to the outlet you are using.
  3. Allow at least 20 seconds for warm-up of the CRT, then set the front panel controls as follows:
    - INTENSITY control (15) fully clockwise
    - AC-GND-DC switch (14) in GND position
    - POSITION (12) (vertical position control) in approximate center
    - POSITION (9) (horizontal position control) in approximate center
    - TIME/DIV selector (7) in 1mS position
    - MODE selector (6) in AUTO Position
    - Sweep VARIABLE Control (8) fully clockwise
  4. If a straight line trace is not visible, move the  $\updownarrow$ POSITION (V.POSITION) control (12) clockwise or counterclockwise until it is visible.
  5. Adjust the  $\rightleftarrows$  POSITION (H.POSITION) control (9) so that the sweep line starts at the left-most vertical graticule line. Use these control positions whenever a basic sweep display is desired.
3. To obtain a basic signal waveform display:
  1. Set the scope controls for a basic sweep display.
  2. Observe applicable precautions and connect the signal to be observed to the INPUT connector (13).
  3. Set the VOLTS/DIV switch and the VARIABLE control until the trace is of the desired height.
  4. Set the TIME/DIV switch and the sweep VARIABLE controls until the desired portion of the waveform is displayed.

### 2. Using Different Triggering Modes

#### 1. SOURCE of triggering

With the SOURCE selector (5) in the INTERNAL position the triggering signal is derived from the signal being displayed. If the SOURCE selector is in the EXTERNAL position the triggering pulse is derived from a signal input to the EXTERNAL INPUT jack on the back of the scope (17 in Fig. 2).

The triggering mode functions with the SOURCE switch in EXT are the same as given above, except that triggering does not take place because of the observed waveform. The LEVEL control functions the same on an external trigger input as it does on internal.

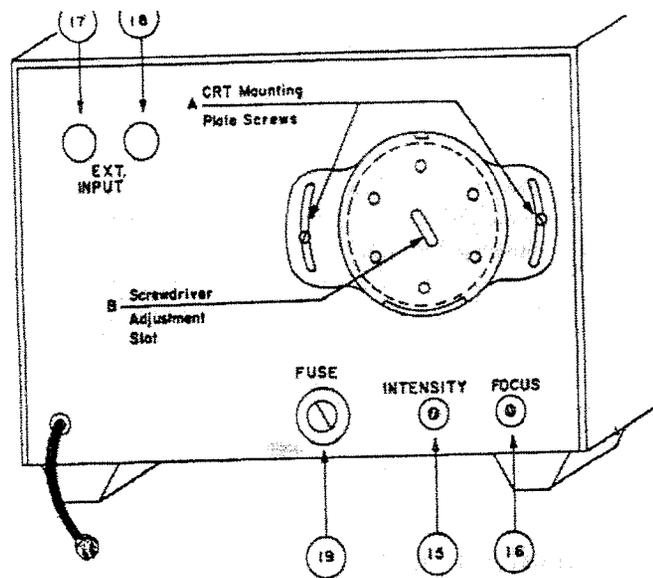


Fig. 2 Rear of oscilloscope

2. LEVEL control - See NORMAL triggering mode.

3. AUTO triggering

In this mode the sweep is automatically internally triggered in the absence of a triggering signal. It will synchronize to a triggering signal and it may be triggered on either the positive or negative going slope of the incoming vertical signal by pushing or pulling the LEVEL control (4), however the actual LEVEL control rotation has no effect on the triggering point. The AUTO mode will function if the SOURCE is in either INTERNAL or EXTERNAL.

4. NORMAL triggering mode with SOURCE switch in INT.

To use normal triggering mode, apply a vertical input signal to the INPUT connector (13). Set the scope controls for a basic signal display. Set the MODE switch to the NORM position. The voltage level of the displayed waveform that triggers the horizontal sweep is now controlled by the LEVEL control (4). If the input is a sine wave, the function of the LEVEL control is shown in Fig. 3.

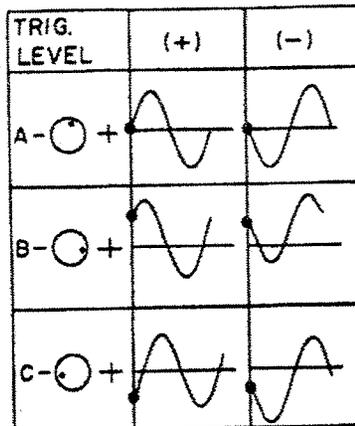


Fig. 3 Effects of triggering LEVEL control

With the LEVEL control pushed in (column (+) in Fig. 3) the trigger will occur on the positive-going portion of the waveform. When the LEVEL control is pulled out, the trigger will occur on the negative-going slope of the waveform (column (-) in Fig. 3). When the LEVEL control is moved clockwise, the triggering point will move more positive on the waveform (line B on Fig. 3). If the LEVEL control is turned counterclockwise, the triggering point will move more negative on the waveform (line C on Fig. 3). The display must be at least one division high to obtain proper triggering. Turning the trigger LEVEL control to the extremes may cause the trigger level to be set beyond the voltages of the displayed signal, which will result in cessation of the sweep.

In the normal trigger mode, the horizontal sweep will not begin without a trigger. Once the sweep is triggered, it will make one sweep at the rate set by the TIME/DIV and the sweep VARIABLE control, then it will wait for the next trigger pulse.

5. TV triggering mode

A television video signal contains several frequencies. It may be difficult to get a stable triggered display in the NORM mode because triggering may take place on different signal components from sweep to sweep. The TV mode filters out some of the signal components to provide more stable triggering. This mode is functional on both internal and external trigger sources.

6. X-Y position of the MODE Selector

This is not a triggering mode. When the MODE selector switch is in the X-Y position, the sweep circuits are disconnected from the horizontal amplifier and an external signal may be applied to the horizontal circuits through the EXT INPUT (17 on Fig. 2). For use of this function see the procedure on relative measurements in this instruction manual.

## APPLICATIONS

1. DC Voltage Measurement

(Signal within one of the VOLTS/DIV ranges.)

1. Connect the signal to be measured to the vertical INPUT jack. Use the X10 probe if the voltage to be measured is higher than 40 Volts p-p, or refer to the section covering signals not within one of the VOLTS/DIV ranges. Be sure to observe input voltage limitations.

2. Set the scope controls to obtain a good waveform display, or, if the signal is DC, a sweep line display. Set the VOLTS/DIV Control to a value to show a measureable height of display on the screen. The vertical VARIABLE control should be fully clockwise CAL position. A voltage of 15V to 40V may be displayed on the 5V/DIV range, 1.5V to 4V on the 0.5V/DIV range, 150mV to 0.4V on the 50mV range, and 15mV to 40mV on the 5MV/DIV range. Each of these ranges may be multiplied by 10 if a X10 probe is used. If the voltage to be measured is not within one of these ranges, refer to the section concerning signals not within one of the VOLTS/DIV ranges.
3. Place the INPUT switch in the GND position.
4. Adjust the V. POSITION control so that the base level line is on one of the vertical graticule divisions low enough to allow vertical display of the entire signal to be measured. Do not disturb this setting while measurement is being made.
5. Move the AC-GND-DC Switch to the DC position and note the sweep line displacement for a DC signal (see Fig. 4) or total signal height to the level where measurement is desired. (see Fig. 5) A vertical displacement of at least 3 divisions is suggested for optimum accuracy of measurement. The reference level may be re-checked by returning the AC-GND-DC switch to the GND position.

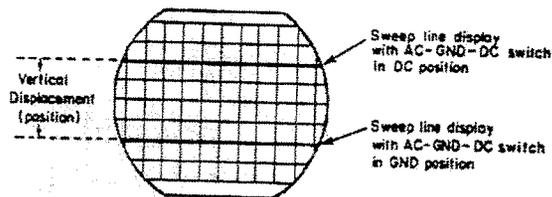


Fig. 4 DC voltage measurement

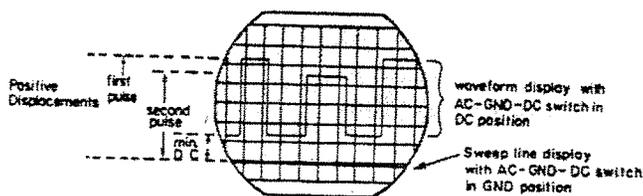


Fig. 5 DC level of waveform measurement

6. Calculate the displayed voltage by multiplying the number of divisions of vertical displacement times the setting of the VOLTS/DIV switch times the probe attenuation factor. For example for Fig. 4 if the VOLTS/DIV switch were set to 0.5V/DIV and the X10 probe used, the displayed voltage would be 5 DIV X 0.5V/DIV X 10 (probe factor) = 25 volts.

## 2. Peak-to-Peak Voltage Measurements

(Voltage displayable using one of the VOLTS/DIV ranges)

1. Connect the signal to be measured to the vertical INPUT jack. Be sure to observe input voltage limitations. Set up the scope to obtain a good waveform display with the AC-GND-DC switch in the AC position. Set the vertical VARIABLE control fully clockwise to the CAL position. If the waveform cannot be adequately displayed because it's too high on one VOLTS/DIV scale and too low (less than 3 divisions vertical deflection) on the next lower VOLTS/DIV ranges, then see the procedure for voltage not within one of the VOLTS/DIV ranges.
2. For optimum measurement, the portion of the waveform to be measured should be as centered as possible both horizontally and vertically.
3. Adjust the V. POSITION control until the lowest point of the waveform falls on one of the horizontal graticule lines, keeping the waveform as close to being centered as possible. (see Fig. 6)

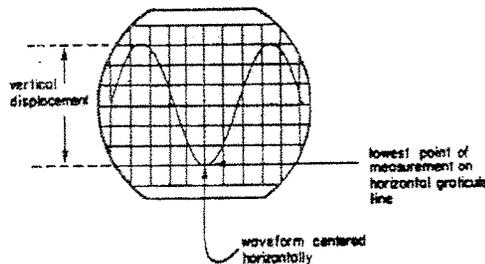


Fig. 6 Peak-to-peak voltage measurement

4. Note the number of divisions of vertical displacement between the upper and lower points of the waveform where measurement is desired, and multiply this times the setting of the VOLTS/DIV selector times the probe attenuation factor.

For example, in Fig. 6 if the VOLTS/DIV selector was in the 5mV/DIV position using the X1 probe then the voltage of the waveform peak to peak would be 6 DIV of vertical displacement times 50mV/DIV x 1 (probe factor)=300mV peak-to-peak.

## 3. Peak-to-Peak Voltage Measurements

(Voltage measurements when voltage being measured cannot be displayed on one of the VOLTS/DIV selector positions with the vertical VARIABLE fully clockwise)

This added procedure should be used when the vertical deflection obtained from the input signal is too high for the screen on one VOLTS/DIV scale and less than 3 div high on the next lower VOLTS/DIV scale with the vertical VARIABLE control in the fully clockwise CAL position..

1. Set up the scope controls for a normal sweep line display.
2. Connect the X1 input lead to the 0.25V CAL signal on the front panel. (Another reference voltage may be used if higher accuracy is desired)
3. Set the scope controls as follows:
  - Sweep VARIABLE to CAL
  - TIME/DIV to 0.1ms
  - VOLTS/DIV to 50mV
  - V.VARIABLE to CAL
4. The displayed square wave should be about 5 divisions high. 5 divisions times 50mV per divisions times 1 (probe factor) is 250mV or 0.25V. This is not extremely accurate, but it should be  $\pm 3\%$
5. Adjust the vertical VARIABLE control until the square wave is 2.5 divisions high. With the VARIABLE control left in this position, all of the VOLTS/DIV ranges are multiplied by 2. The 5V/DIV range is now 10V per division and the 0.5V/DIV range is now 1.0V/DIV etc., as long as the VARIABLE control is left in this newly-calibrated position. This should be accurate enough to make measurements to within  $\pm 10\%$ .
6. With the VARIABLE control left in this position, follow the procedures for AC or DC voltage measurements and multiply the VOLTS/DIV control ranges times 2.

#### 4. Waveform Period Measurements

This procedure can be used to measure the period of a complete waveform, or the duration of any part of a waveform. The period of the waveform can then be used to calculate the frequency.

1. Connect the signal to be measure to the INPUT jack.
2. Set the scope controls to obtain a good display of the waveform with the sweep VARIABLE control in the fully clockwise CAL position. Be sure that the complete section of the waveform that you want to measure is displayed on the screen at least once. If the waveform section to be measured is too long on one TIME/DIV scale and too short (less than 3 div.) on the next higher TIME/DIV scale, see the procedure for temporarily recalibrating the sweep ranges and then return to this procedure.
3. Move the H. POSITION control until the front part of the waveform section to be measured is on a vertical graticule line. (see Fig. 7)
4. If accurate waveform frequency or period measurement is to be made, center the waveform vertically. The complete period must be measured from one point or the beginning of the waveform to the same point beginning the next waveform. (see Fig. 8)
5. Note the number of horizontal divisions of the period being measured.
6. Calculate the period by multiplying the number of horizontal divisions of the measured period times the setting of the TIME/DIV Selector.

For example, the period of the pulse in Fig. 7 is 3.75 divisions. If the TIME/DIV Selector is in the 1mS/DIV then the period is 3.75 divisions x 1mS/DIV=3.75mS.

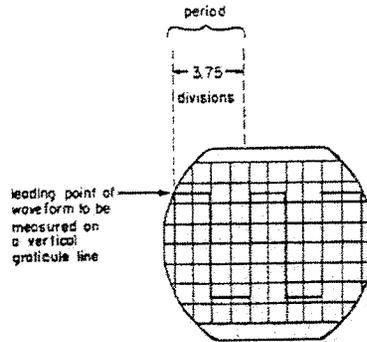


Fig. 7 Square wave period measurement

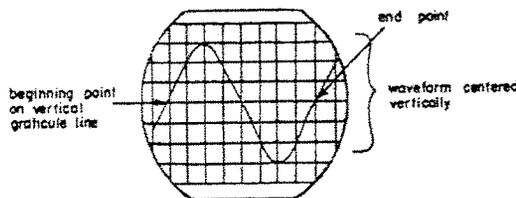


Fig. 8 Sine wave period measurement

- For frequency measurement, multiply the number of horizontal divisions covered by one complete cycle times the TIME/DIV switch setting. That gives the period of the wave. To convert to frequency, divide the period into 1.

$$\text{Frequency} = \frac{1}{\text{period}}$$

For example if the VOLTS/DIV setting for Fig. 8 is 0.1mS/DIV then the period is 8 DIV/cycle times 0.1mS/DIV = 0.8mS/cycle. The frequency is then

$$\frac{1}{0.8 \times 10^{-3}} = 1.25 \times 10^3 \text{ Hz or } 1.25 \text{ KHz}$$