Oscilloscope

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Objectives

The goal of this work is to manipulate the oscilloscope and the GBF (Low Frequency Generator). Through:

- Know how to use the multiple controls visible on the front of each device.
- Know how to measure amplitude (voltage), frequency and phase shift.

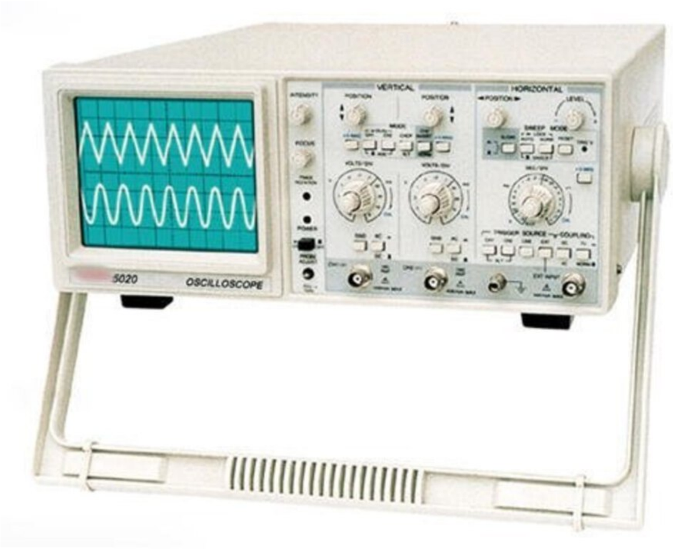
I Concepts and preparation work

1. Definition and Description

1.1. Introduction

Oscilloscope is an electrical test device used to produce waveforms in response to several input signals. It was originally known as an oscillograph. The standard four components of an oscilloscope. Display, vertical controllers, horizontal controllers, and triggers.

Cathode Ray Oscilloscopes (CROs) are mostly used in radio and television receivers, as well as in laboratory activities that require research and design. The CRO is one of the crucial components of electronic circuits in modern electronics.



Oscilloscope Fig1

1.2. Cathode Ray Oscilloscope

Definition Az Definition

The Cathode Ray Oscilloscope (CRO) is a versatile electrical instrument used for displaying, measuring, and analyzing waveforms and various other electrical phenomena. It functions as a fast X-Y plotter, displaying input signals versus time or other signals. The CRO is typically divided into four sections: display, vertical controllers, horizontal controllers, and triggers. Probes are often utilized for input and enable the analysis of waveforms by plotting amplitude along the X and Y axes.

With applications in radio, TV receivers, and laboratory research and design, the CRO plays a significant role in modern electronics. Its accuracy, stability, and ease of operation make it an ideal general-purpose laboratory instrument, capable of handling a broad range of frequencies.

1.3. What is Cathode Ray Oscilloscope (CRO)?

A Cathode Ray Oscilloscope (CRO) is an instrument that makes use of an electron beam and a cathode ray tube to display and analyze waveforms from electrical circuits. It is basically a very fast X-Y plotter that can display an input signal versus time or another signal. The voltage and time describe a shape and are continually graphed next to a scale because the oscilloscope monitors change in electrical signals over time.

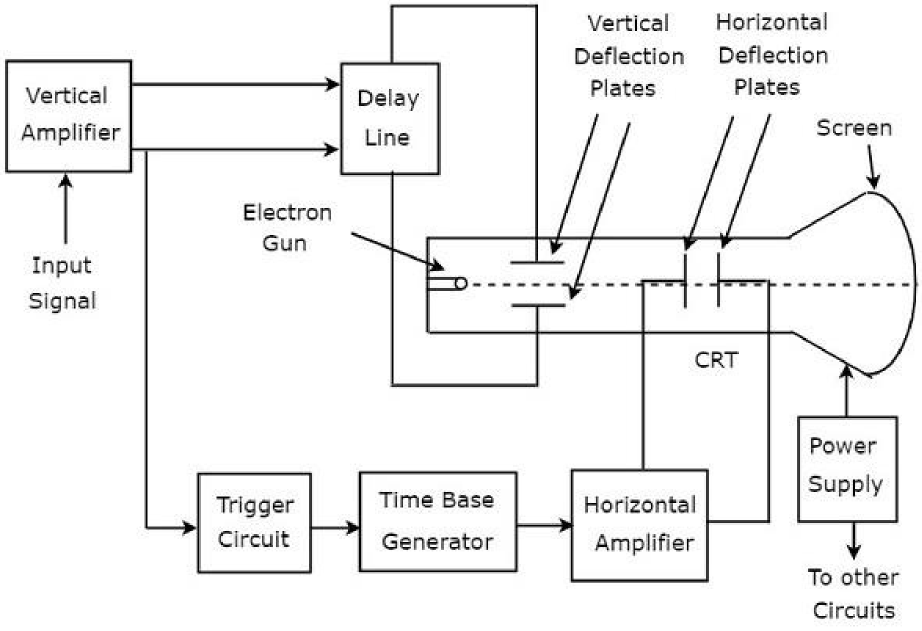
and the current *i* to the quantity of electricity (or charge) is given by the relation

> ⊕ Extra
>
> We can examine parameters, such as amplitude, frequency, rising time, distortion, time interval, and others, by studying the waveform.

1.4. Block Diagram of Cathode Ray Oscilloscope

The general block diagram of *CRO* [p.15] is shown below. It usually consists of the major blocks namely:

- The Vertical Amplifier
- Delay line
- Trigger circuit
- Time base generator
- Horizontal Amplifier
- Cathode Ray Tube (CRT)



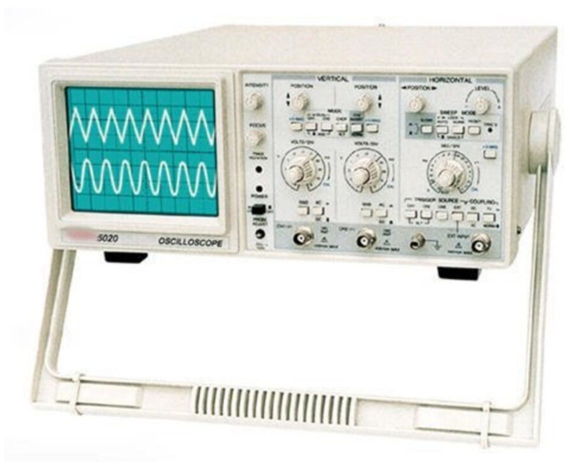
2. Electrical Quantities Measurements

2.1. Introduction

The CRO may be used to measure electrical quantities like amplitude, time period, and frequency.

The CRO is used to measure various electrical quantities such as voltage, current, and frequency. The electron beam is directed at a phosphor-coated screen to produce a visual representation of the electrical signal. To measure a specific electrical quantity,

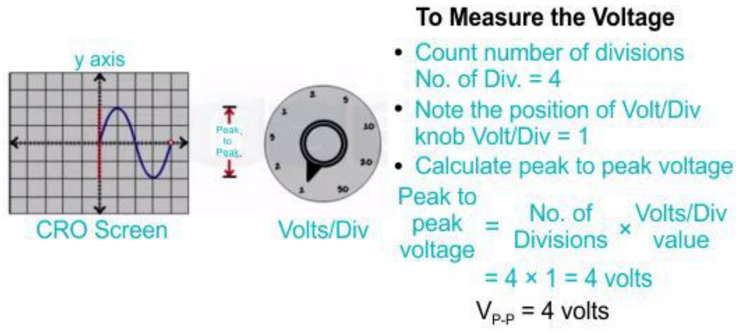
the *CRO* p.15 is connected in parallel or series with the circuit under test and the voltage or current waveform is displayed on the screen. By analyzing the waveform, the CRO can provide accurate readings of various electrical quantities such as peak voltage, frequency, and duty cycle



Oscilloscope Fig1

2.2. Amplitude

The voltage signal is displayed on the screen as if it was a time function. The signal's amplitude is consistent, but using the volt/division button on top of the CRO board, we can adjust how many divisions are used to conceal the voltage signal in a vertical direction using the method below, we can measure the signal's amplitude as it appears on the *CRO* p.15 screen. voltage=distance in cm×volts/cm



Extra

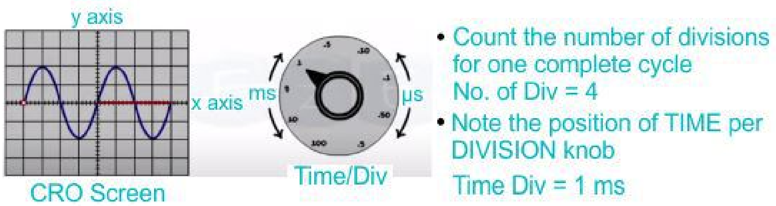
voltage=distance in cm×volts/cm

2.3. Time period

Definition

On its screen, CRO shows the voltage signal as a function of time. The time duration of that periodic voltage signal is fixed, but by adjusting the time/division knob on the CRO panel, we may change the number of divisions that span one full cycle of the voltage signal in the horizontal direction.

using the method below, we can measure the signal's amplitude as it appears on the CRO screen.

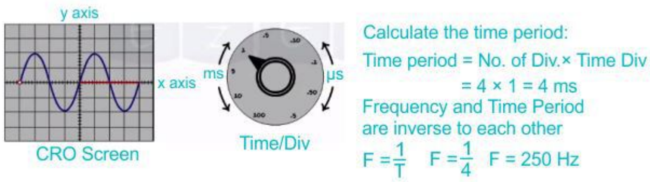


2.4. Frequency

Definition

The horizontal scale on the *CRO* p.15 screen makes it very simple to measure time and frequency. The size of the signal on your CRO display should be increased if you want to ensure precision while measuring a frequency so that the waveform can be converted more easily. Initially, the time can be determined by counting the number of flat partitions from one end of the signal to the other whenever it passes the flat line and using the horizontal scale on the CRO

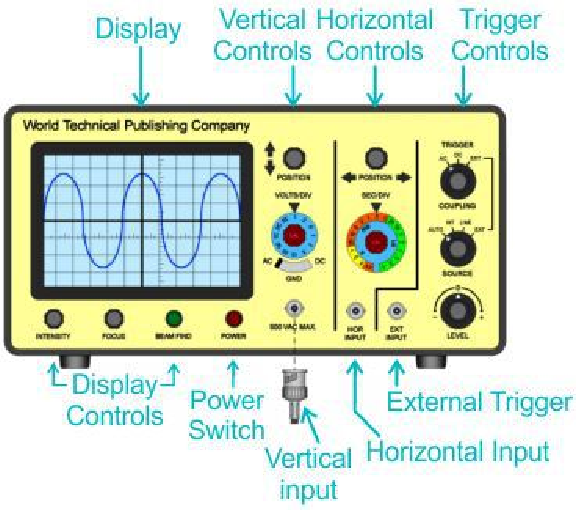
The signal's time period can then be determined by increasing the number of flat segments through time or division.



3. Controls of Oscilloscope

3.1. Introduction

Position, brightness, focus, astigmatism, blanking, and calibration are the primary controls of a CRO (Cathode Ray Oscilloscope).



3.2. Controls of Cathode Ray Oscilloscope (CRO)

Position

The position control knob on an oscilloscope is mostly used to move the intense point from the left to the right. One can easily move the place from the left side to the right side by using the knob.

Brightness

The electron's intensity has a significant impact on the ray's brightness. The electron ray's electron intensity is determined by the control grids. As a result, the brightness of the electron rays can be changed and adjusted accordingly to control the grid voltage.

Focus

By adjusting the applied voltage to the CRO's center anode, the focus can be controlled. The electrostatic lens can be created using the center and additional anodes nearby. As a result, by adjusting the voltage across the center anode, the main length of the lens can be altered.

Astigmatism and Blanking circuit

The CRO oscilloscope's time base generator produced the blanking voltage. This additional focusing control in CRO is comparable to astigmatism in optical lenses.

Due to the different lengths of the electron pathways at the center and the corners of the screen, a beam that is focussed in the monitor's middle would be defocused here. The oscilloscope's time base generator produced the blanking voltage.

Graticule

It is the grid on the display screen of the CRO that consists of the horizontal and vertical axis.

Input impedance

The input impedance is greater than 1 Megaohms, a high value of impedance is used to prevent the circuit from the scope from being tested. To match fast amplifiers and other devices.

4. Additional resources

4.1. Learn more

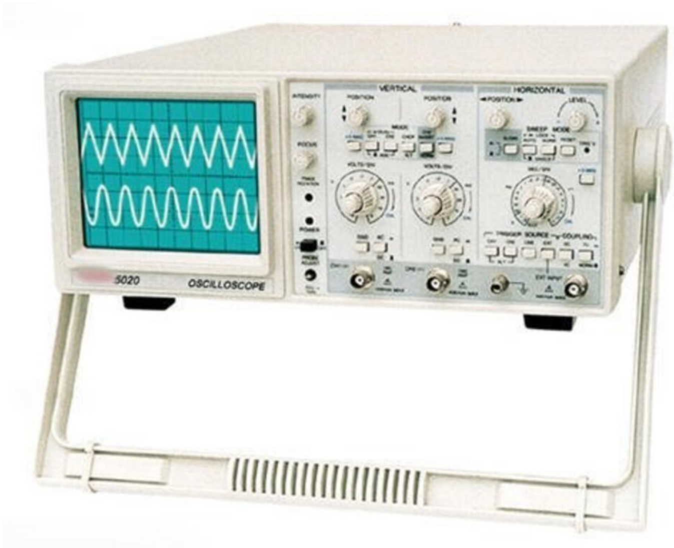
To learn more about oscilloscopes you find here some videos explaining this device in depth :

(see Oscilloscope Tutorial (Basics 101)[watch])
(see Oscilloscope Basics Tutorial[watch])

II Pracical work

1. Materials used

A cathode oscilloscope



Oscilloscope Fig1

A DC and AC voltage generator

A low frequency generator (GBF),

Resistor and capacitor boxes

Oscilloscope Fig1

2. Before you start

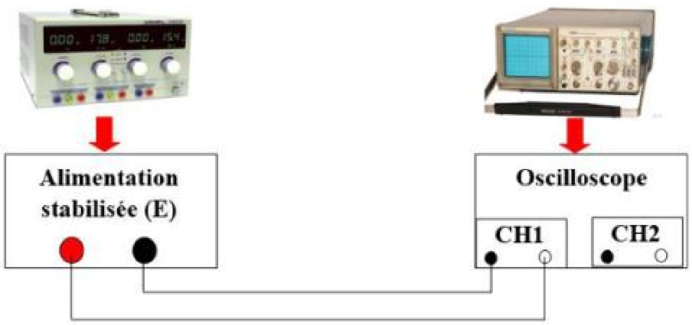
Locate the buttons on the oscilloscope that allow:

Method

- Turn on the device.
- To adjust the brightness and fineness of the “line or spot”.
- To adjust the fineness of the “line or spot”.
- To center the “line or spot” on the screen, in X , and in Y
- To change the scanning speed of the spot.
- To change the vertical sensitivity of channel A (or 1).

3. Measuring a DC voltage

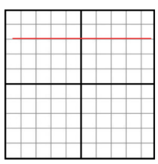
As give the following assembly:



According to the oscilloscope setting, note: Method

- The time base used for this application
- Measure the value of E with a voltmeter (or multimeter).
- Connect the oscilloscope to the generator according to the assembly shown in Setup 1.
- Operate the oscilloscope, then set the axes, the origin of the axes, light spot, etc.
- put the oscilloscope in the DC position, and draw the resulting signal in table1.
- Vary the generator output voltage and observe the signal obtained and complete table 1.

3.1. Table 1

Continuous regime (DC)	U generator (V)	U voltmeter (V)	U oscilloscope (V)
	4 6 10 12	4.2 6.79 11.18 12.80	4 6.2 11 12.0
S_h= ms/div Sv= 3v/div			

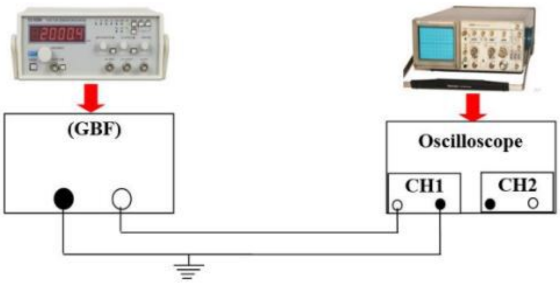
4. Measuring frequency and period:

Reminder

We recall that the frequency f=1/T where T is the period of the signal.

Note

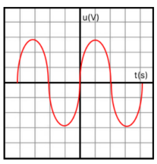
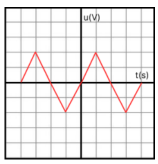
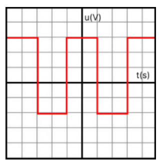
As give the following assembly:



Method

- Do the same work, for an alternative generator.
- From the GBF, choose a sinusoidal signal, then complete the following table 2:
- Measure the amplitude (Ucàc), the maximum value Umax, the period T and the frequency f ?
- What does the value measured by the voltmeter (or multimeter) mean in the three cases?
- Put the oscilloscope in the AC position,
- Vary the generator output voltage, observe and draw the signal obtained.
- Complete table 2 :

4.1. Table 2

	Sinusoidal	Triangular	Square
The Signal			
	S_h=5 ms/div S_v=2 v/div	S_h= 5 ms/div S_v= 2 v/div	S_h= 5ms/div S_v= 2 v/div
$U_{voltmeter}$	3.37	2.75	6.76
U_{c-t-c}	8	8	8.4
U_{Max}	4	4	4.2
U_{eff}	2.82	2.3	4.2
T	0.02	0.02	.02
f_1/T (Hz)	0.02	50	47.61
f_{GBF} (Hz)	50	50	49.99

Conclusion

In this practical work, we have learned how to use the oscilloscope by measuring the periods and amplitudes of various waveforms as well as analyzing a sound wave.

Abbreviation

CRO : Cathode Ray Oscilloscope

References

[1] Serway, R, Beichner,R. Physics for Scientists ans engineers with modern physics, Fifth edition. 2000.

[2] Rentech. Experiments in electricity, student guide. 2013.