Objectives

- This exercise is of a particularly practical nature, namely, introducing the use of the oscilloscope. The various input scaling, coupling, and triggering settings are examined along with a few specialty features.

Equipment

1. DC Power Supply
2. AC Function Generator
3. Digital Multimeter
4. Oscilloscope

Oscilloscope

The cathode ray oscilloscope is a vital piece of diagnostic lab equipment for observing and measuring electrical signals at frequencies ranging from dc to GHz. It comes handy when electrical voltage varies rapidly in time. It can also be used to diagnose different electrical circuits by observing their output wave form. We can also measure, time period, and rate of repeating of a signal if signal is periodic. It actually plots voltage as a function of time in two dimensions. Oscilloscope can be off capable of measuring from signal to multi-channel frequencies.

On contrary to portable DMMs, most oscilloscopes measure voltage to ground. That is, the input is not floating, so the black or ground line is always connected to the circuit ground or a common node. This is a very important point as components can inadvertently short-circuit during measurement if this advice is not followed. The standard accepted method for measuring the ungrounded reference potential of the is to use two probes, one connected to each node of interest, and an oscilloscope configured to separate the two channels individually. Is to subtract rather than display in.

The main component of the scope is the cathode-ray tube. The CRT consists of a vacuum tube in which electrons are accelerated, using an electric field, towards a phosphorescent screen. When the electrons strike the screen, a burst of light is given off. The beam is deflected along the way by vertical and horizontal plates that use electric fields to deflect the electrons. The screen of the oscilloscope has a grid on it. The grid is used to read information from the screen of the oscilloscope. The dials on the oscilloscope give the scale in VOLTS/DIVISION in the vertical direction and SECONDS/DIVISION in the horizontal direction.

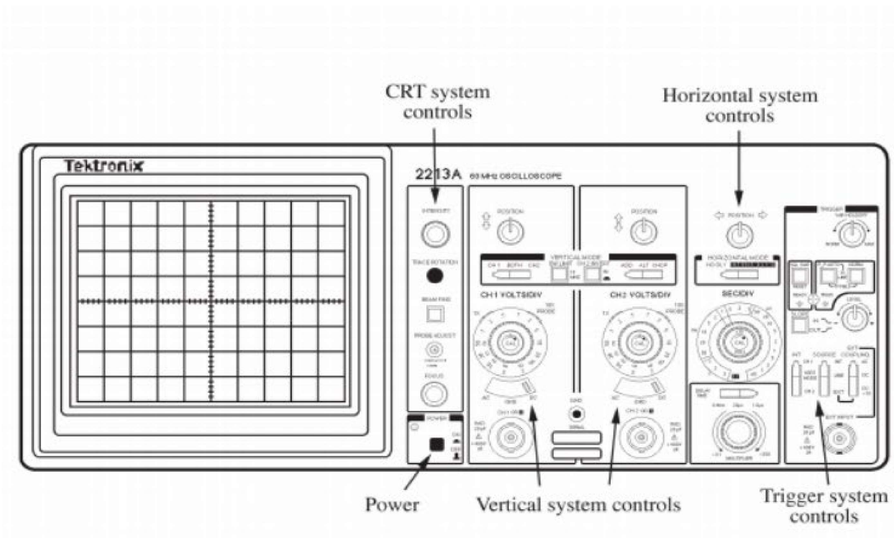

Figure 1 Cathode Ray Oscilloscope

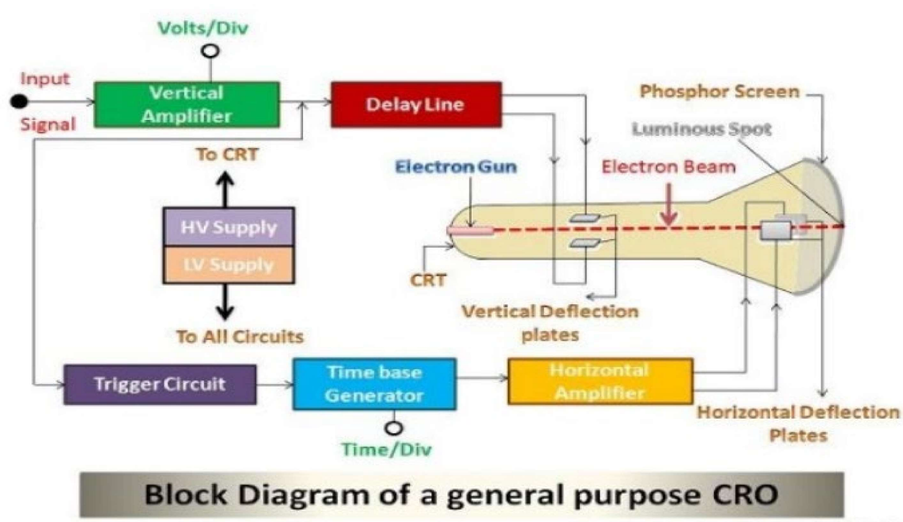

Figure 2

Function Generator

A function generator can generate different wave forms. This instrument outputs a time-varying periodic voltage signal. By pushing the appropriate buttons on the front panel, the user can specify various characteristics of the signal.

<u>The main characteristics are:</u>

• Wave Form: sine, square, or triangular waves

• Frequency: inverse of the period of the signal; units are cycles per second (Hz).

• V peek-to-peek: peak to peak Voltage value of the signal

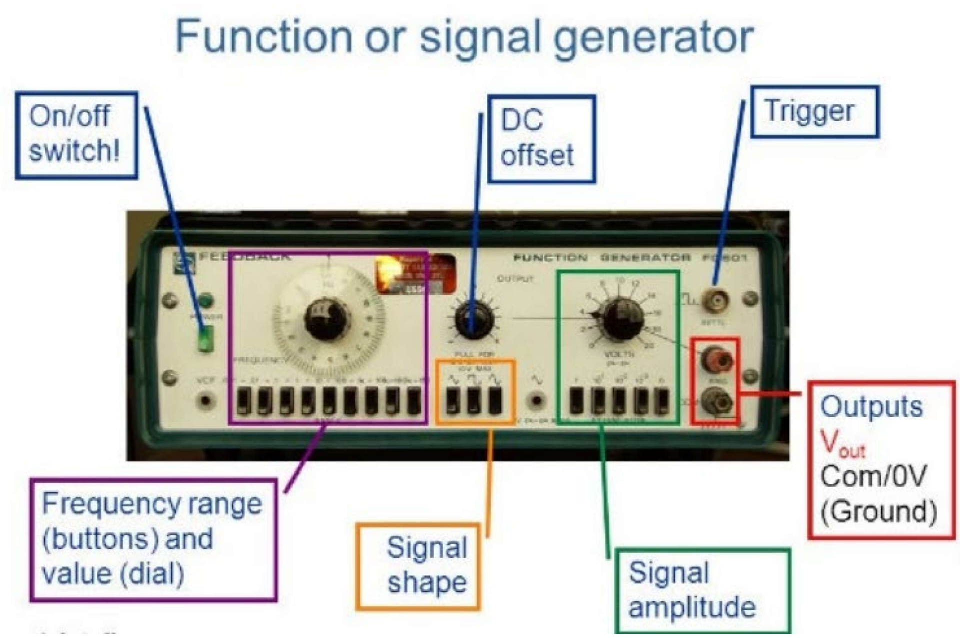

Figure 3: Function Generator

Experiment Procedure

1. Finding the mentioned below knobs and input convectors on the front side of oscilloscope

• Channel-1 and Channel-2 BNC input connectors.

• Trigger BNC input connector.

• Channel-1 and Channel-2 select buttons.

• Horizontal Sensitivity (or Scale) and Position knobs.

• Vertical Sensitivity (or Scale) and Position knobs.

• Trigger Level knob.

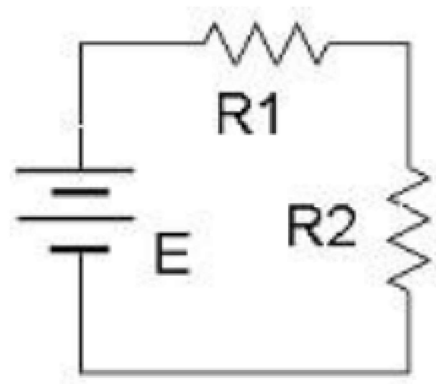

Figure 4: Circuit Diagram

2. Just like the sheet of graph paper, oscilloscope screen is also like a grid graph. Each square of the grid represents the scaling factor or weightage. Vertically it shows voltage and horizontally it shows time also known as time period of the wave if counted for a single full waveform. The values each square of the grid represent can be changed and set as per requirement using knobs available on the oscilloscope.
3. Now connector BNC connector to channel one and channel two of the oscilloscope input.
4. Now, set coupling of oscilloscope to Ground. And then set the main channels on the screen of oscilloscope in such a way that it is later convenient for taking reading. The other coupling options available on oscilloscope are AC, DC
5. Set the channel-1 Vertical Scale to 5 volts per division. Set the channel-2 Scale to 2 volts per division. Set the Time (Horizontal) Scale to 1 millisecond per division. Finally, set the input coupling to Ground for both input channels and align the two lines to the center line of the display via the Vertical Position knob.
6. Build the circuit shown in the figure using E=**5V,** R1=10kΩ and R2= 33kΩ. Connect a probe from the channel-1 input to the power supply. Connect a second probe from channel-2 to R2.
7. When everything else is set, its time to switch both inputs from GND to DC. Doing so will result in upward deflection on oscilloscope screen. Now, measure the voltage across R2 using oscilloscope. Also, measure the voltage across R2 with the help of Digital Multimeter.
8. Now, replace the DC supply which was previously connected to the circuit and exchange it with function generator.

9. Set the function generator for a 1-volt peak sine wave at 1 kHz and apply it to the resistor network. The display should now show two small sine waves. Adjust the Vertical Scale settings for the two inputs so that the waves take up the majority of the display. For blurry display, use trigger knob to fix that along with time scale knob so that only two waves are shown on the screen at a time.
10. In order to find the voltage across R1, the channel-2 voltage (VR2) may be subtracted from channel-1 (E source).

Experimental Results

NOTE: While performing experiment, E (voltage) was taken 5V.

V_{R2}	Scale (V/Div)	Number of Divisions	Voltage Scope	Voltage DMM
Oscilloscope	2	1.9	3.8	3.81V
Theory	X	X	3.83V	3.83V

Table 1

	Scale (V/Div)	Number of Divisions	Voltage Peek	Voltage RMS
E Oscilloscope	0.2V	5	$1V_{pk}$	$0.707V_{rms}$
E Theory	X	X	$1V_{pk}$	$0.707V_{rms}$
V_{R2} Oscilloscope	0.2V	3.8	$0.76V_{pk}$	$0.54V_{rms}$
V_{R2} Theory	X	X	$0.761V_{pk}$	$0.537V_{rms}$

Table 2

	Scale(V/Div)	Number of Divisions	Period	Frequency
E Oscilloscope	0.1V	5	1ms	1KHz
E Theory	X	X	1ms	1KHz

Table 3