Date : 24-10-‘22

Experiment No : 3

Experiment Name: Study of basic operations of oscilloscope required in communication engineering.

Theory:

An oscilloscope is a laboratory test equipment which is commonly used to show and analyze the waveform of electrical signals. This device can draw a graph of instantaneous signal voltage as a function of time. A typical oscilloscope displays alternating current or pulsating direct current waveforms which have a frequency as low as approximately 1 Hz or as high as several megahertz MHz. High-end oscilloscope displays signals which have frequency up to several hundred Gigahertz GHz. The display of oscilloscope is broken up into so called horizontal divisions and vertical divisions and time is displayed from left to right on the horizontal scale. Instantaneous voltage is shown on the vertical scale, with positive values going upward and negative values going downward. There are also some applications where other vertical axes such as current may be used and other horizontal axes such as frequency or another voltage may be used.The core of an analog oscilloscope is a special type of vacuum tube known as a Cathode Ray Tube, or CRT. While similar in function to the CRT used in televisions, oscilloscope display tubes are specially built for the purpose of serving a measuring instrument. Looking at the face of the instrument, you are viewing the screen that the electron beam strikes.

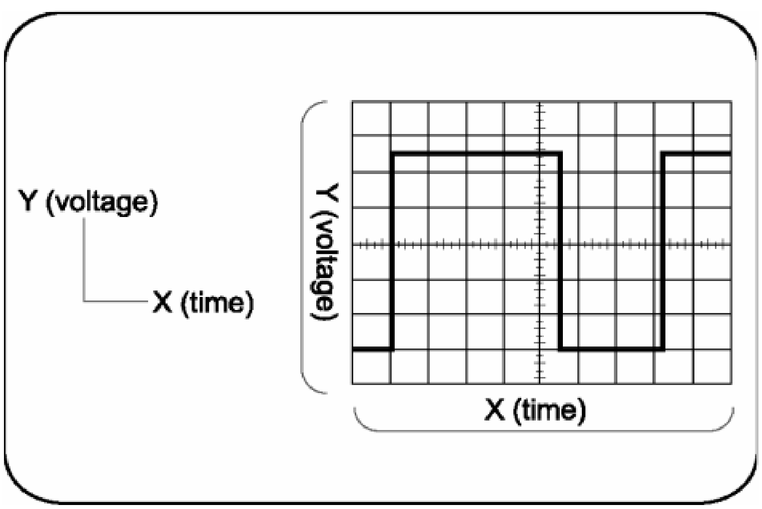

Figure 0.1: Typical Oscilloscope display

Oscilloscope are mainly used for :

- observing the wave shape of a signal
- measuring the amplitude of a signal
- measuring the frequency of measuring
- measuring the time between two events
- observing whether the signal is direct current (DC) or alternating
- current (AC)
- observing noise on a signal

Oscilloscopes are also used to measure electrical signals in response to physical stimuli, such as sound, mechanical stress, pressure, light, or heat. For example, a television technician can use an oscilloscope to measure signals from a television circuit board while a medical researcher can use an oscilloscope to measure brain waves.

Here is the front panel of oscilloscope.

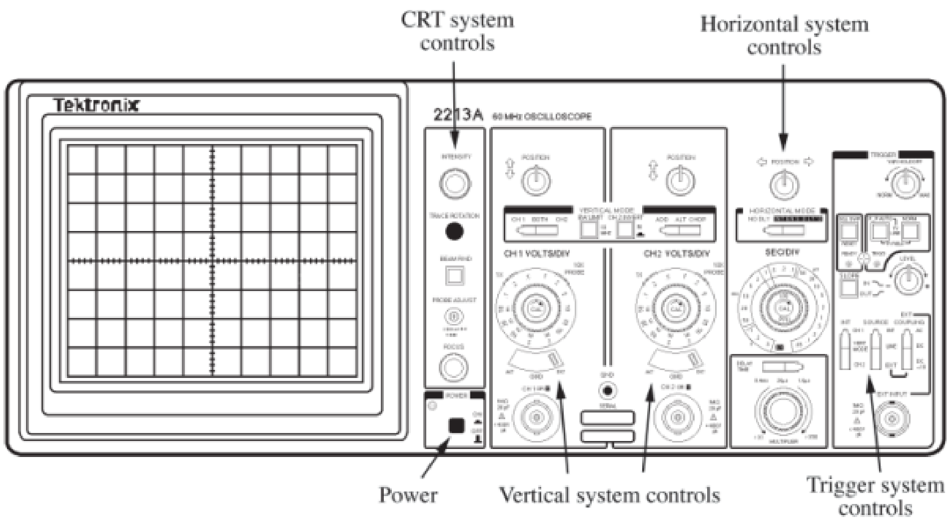

Figure 0.2: Oscilloscope front panel with functional blocks marked

Button & Functionalities:

Power Button: Power up the MSO/DPO2000 Series oscilloscope by pressing the power button on the lower left corner of the instrument.

Default Setup: Press the front panel Default Setup button to set the oscilloscope to a known starting point.

Channel 1 Input: Connect a P2221 1X/10X passive probe to the channel 1 input. To connect a BNC connector, push and turn the probe connector until it slides on the connector. Then, turn the locking ring clockwise to lock the connector in place.

Autoset: Press the front panel Autoset button to cause the oscilloscope to automatically set the vertical, horizontal and trigger settings for a stable display of the PROBE COMP 1 kHz square wave.

Controls:

The controls of a typical oscilloscope can be grouped into three major categories: vertical, horizontal, and trigger. These are the three main functions that are used to set up an oscilloscope.

1.)Horizontal Control: The horizontal controls are used to scale and position the time axis of the oscilloscope display. There is a dedicated front panel control for setting the horizontal scale (time/division) of the display and another for setting the horizontal position of the displayed signals. The Acquire menu offers additional options for modifying the waveform display, as well as setting the record length.

2)Vertical Control: The vertical controls set or modify the vertical scale, position, and other signal conditioning for each of the analog input channels. There is a set of vertical controls for each input channel. These controls are used to scale, position, and modify that channel’s input signal so it can be viewed appropriately on the oscilloscope display. In addition to the dedicated vertical controls for each channel, there are also buttons to access the math menu, reference menu and bus menus.

3)Trigger Controls: The trigger defines when a signal is acquired and stored in memory. For a repetitive signal, a trigger is required to stabilize the display. There is a front panel control to set the trigger level and a button to force the oscilloscope to trigger. The Trigger menu offers different trigger types and allows you to set the conditions of the trigger. In the default trigger setting, the oscilloscope looks for a rising edge on the channel 1 input signal. The trigger level control is used to set the voltage at which the oscilloscope triggers. The waveform is displayed with the rising edge aligned with the trigger point (indicated by the orange T icon at the top of the display). The trigger voltage level is shown by a yellow arrow on the right side of the display. In this case, the arrow is slightly above the vertical axis midpoint.

Measuring Voltage level and Frequency:

Required Apparatus:

1. Function Generator
2. Connecting wires
3. Oscilloscope
4. Power supply

Operations:

For taking measurements with an oscilloscope, Firstly, you plug the electrical signal you’d like to view into one of the oscilloscope’s inputs of which there are typically two, labeled A and B. Noted:

when we first switch on the oscilloscope, the signal won't be visible until we adjust two settings: volts/division and time/division (or time base). Secondly, when measuring the vertical scale, the volts/division determines the number of volts for each vertical division. The time/division controls the horizontal scale. The amount of time each horizontal division shows is commensurately changed when you adjust the time/division. Adjust these two settings until the signal is clearly displayed on the oscilloscope's screen.

Voltage Mesurement:

1. First, we need to create a sine wave. We want to measure the peak to peak voltage of that sine wave.

2. The vertical position of the sine wave is set in a manner by changing vertical position knob so that the lower peak is on any line.

3. Same thing goes for the horizontal position by changing horizontal position knob so that the upper peak is on the vertical line.

4. Now we have to count the square from the lower peak to upper peak.

5. Finally, we have to multiply the number of squares with the value of each square. So, we will get the voltage level. This measurement is done in manually. Besides, we can do the same task by using cursor function of vertical position.

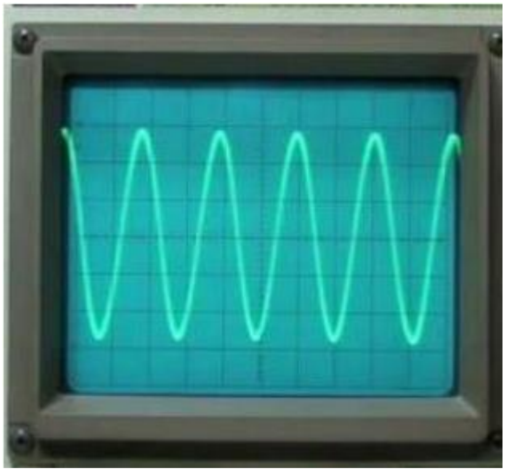

Fig. 03 : Voltage level detection of sine wave

Frequency Measurement:

1. At first, we have to adjust the top peak with any vertical line.

2. Then the next peak need to adjust with any horizontal line.

3. Now the distance between the peaks need to count. We will get

the number of square to know the distance.

4. By multiplying the number of squares with the value of each

square in vertical position we will get the time period.

5. From time period, we can easily calculate the frequency.

As, f = 1

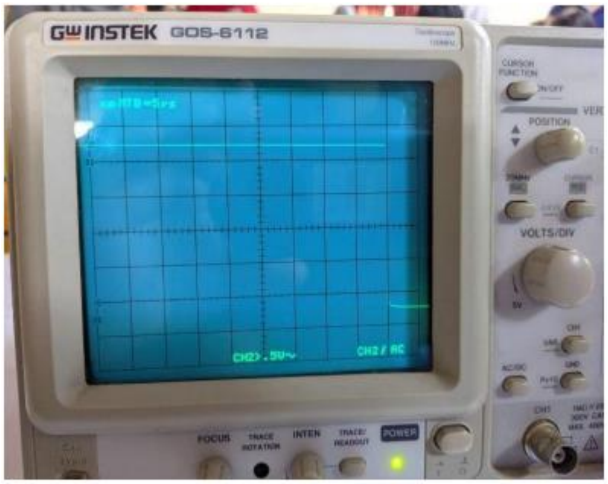

Fig. 04 : Frequency Measurement .

Discussion:

From this experiment we came to know to operate oscilloscope. we have known some of the functionalities of oscilloscope and done some wave measurements like finding the peak to peak voltage. In these case every square of oscilloscope was considered as a one unit.Similarly we have also measure frequency of wave shape by seeing number of room that taken by a period then using (f=1/T) formula. We also know how to deal with different types of signal and wave shape.

Conclusion:

The feature we have learnt will help us in communication engineering course. We will perform measurement and will observe the wave shape in communication lab.

Department of Electrical & Computer Engineering

Course No: ECE 3208

Course Title: Communication Engineering Sessional

Submitted To :

Milton Kumar Kundu

Assistant Professor

Dept of ECE, RUET

Submitted By:

Tamim Hasan

Roll : 1810044