College of Engineering

Electrical and Computer Engineering Department

Lab01

Familiarization with Lab Instruments

Objectives:

Introducing the laboratory instruments and familiarizing with the basic instruments.

Introduction:

All experiments in the laboratory will be performed at a test bench which has several basic electronic instruments. They include: **(1)** A DC power supply. **(2)** A function generator. **(3)** A digital multi-meter (DMM). **(4)** An oscilloscope (analog/DSO).

On one hand, DC power supplies and function generators are power sources. It means that they generate power. In other words, they supply us with the power needed to perform experiments and tests. On the other hand, digital voltmeters and oscilloscopes are measuring devices that measure different electrical quantities such as voltage, resistance, current, etc.

DC Power Supply:

The DC power supply output consists of two independent units which can be connected in different configurations such as series, parallel, or used independently. Some DC power supplies found in the lab have a third unit which gives a fixed 5 Volts 3 Amperes that is not adjustable. This dedication of 5-volts unit is important since it is frequently needed in electronic experiments.

Function Generator:

A function generator is usually a piece of electronic test equipment or software used to generate different types of electrical waveforms over a wide range of frequencies. Some of the most common waveforms produced by the function generator are the sine, square, triangular shapes (See Fig.1). These waveforms can be either repetitive or single-shot (which requires an internal or external trigger source). Integrated circuits used to generate waveforms may also be described as function generator ICs.

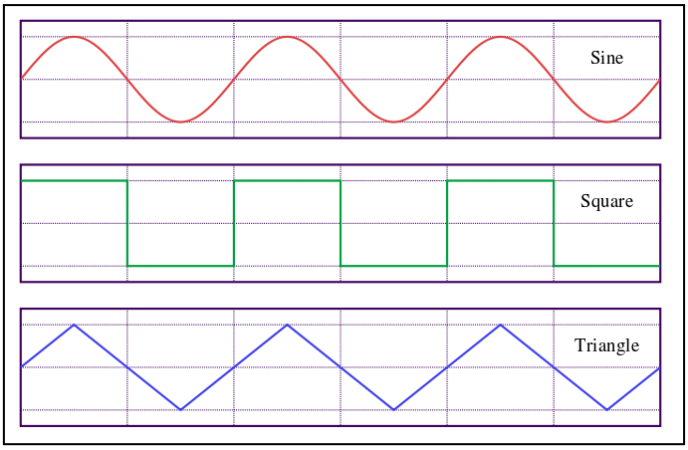


Fig. 1: Different waveforms generated by a function generator

Digital Multi-Meter:

A DMM is a universal meter which measure voltage and current (both DC and AC) and resistance, with high precision. Some DMMs measure capacitance, inductance, frequency, and temperature.

A multi-meter or a multi-tester, also known as a VOM (Volt-Ohm meter), is an electronic measuring instrument that combines several measurement functions in one unit. A typical multi-meter would include basic features such as the ability to measure voltage, current, and resistance. Analog multi-meters use a micro-ammeter whose pointer moves over a scale calibrated for all the different measurements that can be made. Digital multi-meters (DMM, DVOM) display the measured value in numerals, and may also display a bar of a length proportional to the quantity being measured.

When a DMM is used to measure an AC quantity, it actually measures the RMS value of it. Different waveforms have different RMS values. The commonly-encountered sinusoidal wave has an RMS value of $V_p / \sqrt{2}$ where V_p is the peak voltage of the sine wave.

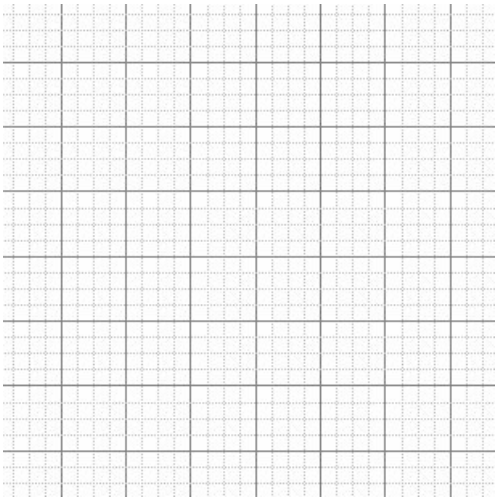
Oscilloscope:

An oscilloscope is a type of electronic test instrument that allows observation of constantly varying signal voltages, usually as a two-dimensional plot of one or more signals as a function of time. Non-electrical signals (such as sound or vibration) can be converted to voltages and displayed. Some oscilloscopes can only display one signal at a time, while others can display up to 2, 3, and 4 channels simultaneously. In our lab the oscilloscopes have two channels that allow us to display two signals in order to compare them. Those signals are the input and output voltages. The oscilloscope has vertical and horizontal scale adjustors that permit us to change the time scale (the horizontal axis) and the voltage scale (the vertical axis) in order to show the signals clearly so that the user can read the values displayed on the screen with ease.

LAB ACTIVITIES

(1)

(1a) Generate a sinusoidal signal with a peak-to-peak voltage of 10 V and a frequency of 10 kHz and show the waveform on the proper instrument. Roughly sketch the waveform on the following grid lines and write down what is displayed on the screen.



(1b) Measure the RMS value of the same sinusoidal signal on the DMM. It should be close to the theoretical value of $V_p / \sqrt{2}$.

Theoretical value_____

Measured value_____

(2) Change the frequency of the same signal to 15 kHz.

(3) Change the signal to square and triangular waveforms. Keep in mind that when you change the waveform of the signal recheck that the peak-to-peak voltage is still 10 V. If not, adjust the voltage to get the required value.

(4)

(4a) In the DC power supply, turn the voltage adjustment knob to get several different voltage values of 1.5V, 14V, 22V. Compare readings on the power supply display with readings on the DVM. Make sure also that the DVM is set for DC measurements.

(4b) Notice the readings of the voltmeter on different ranges of the instrument. Which voltmeter range should be selected to read best a given voltage? Comment on the precision of voltage measurements on different ranges of the DVM.

(5)

(5a) Generate a DC voltage of 5 V and show it on the oscilloscope.

(5b) Reverse the order of the terminals at the power supply. What happens to the signal?

LAB HOMEWORK

Q1) What is the name of the instrument that generates AC signals?

Q2) Can you get a DC signal from the DMM? If not, why?

Q3) Does the voltage across the output of the DC power supply changes if more load is added? Why?

Q4) What is the maximum range of the DC voltage that you can get out of the DC power supply?

Q5) If you are asked to get a sine wave what information you should be provided with?

Q6) What is the relation between the peak voltage and RMS value of a sine wave?

Q7) Write the formula that relates frequency with the time period.

Q8) The DMM is used to measure different quantities, what are these quantities?

Q9) There are two axes in the display of the oscilloscope, what variables do they represent?

BY THE END OF THIS LAB

You should be able to do the following:

- ☐ Get any given DC voltage from the proper instrument.
- ☐ Show that DC value on the right instrument(s).
- ☐ Generate an AC signal and show it on the proper instrument(s).
- ☐ Know how to connect the DC power supply ports in series and in parallel and know the benefit of that.
- ☐ Read different values of voltage, current, and resistance on the DMM.
- ☐ Read the voltages on the scope.
- ☐ Read the frequency of any signal on the scope (=oscilloscope).