

LABORATORY #3

Learning to Build and Measure Resistive Circuits

OBJECTIVE:

The main objective of this laboratory exercise is to allow the student to become familiar with some common measurement equipment used by the engineer, such as the oscilloscopes and the digital multi-meter. The student will learn how to use the oscilloscope and to properly trigger it so that a steady display is obtained.

EQUIPMENT REQUIRED:

- Oscilloscope
- DC power supply
- Benchtop Digital Multimeter
- Assorted resistances
- Breadboard
- Test leads

PRE-LAB:

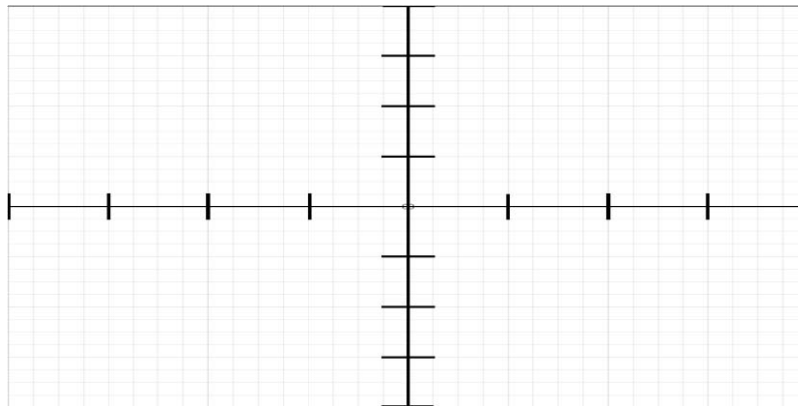
Do some research and read about an oscilloscope. For prelab describe in your own words how an oscilloscope works and how it might be used to display a waveform from a function generator. Use diagrams to help in your explanation.

For Prelab write a procedure (with diagrams showing circuits, connection, expected results) for performing the following experiments.

1. You are given a 15 volt DC power supply and it is attached to a series circuit consisting of three 10K ohm resistances. Draw your circuit and calculate the voltage drops across each resistor and the total current in the circuit.
 - a) Now change the resistances so that $R_1=10\text{K ohm}$, $R_2=20\text{K ohm}$, and $R_3=30\text{K ohm}$. Recalculate for the total current and the voltage drops across each resistance.
 - b) Comment on what will happen if the voltage of 15 volts DC is changed to 20 volts DC. What will happen if it is changed to 7.5 volts DC?
2. You are given a 15 volt DC power supply and it is attached to a parallel circuit consisting of three 10K ohm resistances. Draw your circuit and calculate the voltage drops across each resistor and the total current in each resistance. What can be said about the current through each resistor?
 - a) Now change the resistances so that $R_1=10\text{K ohm}$, $R_2=20\text{K ohm}$, and $R_3=30\text{K ohm}$. Recalculate for the total current through each resistance and the voltage drop across

each resistance. What can be said about the current through each resistance?

- b) What would happen if a fourth resistance of 1Meg ohm is attached in parallel? Does this significantly affect your equivalent resistance for the four parallel resistances? Explain why or why not. (hint: you may want to do the calculations out to prove your thought)
- c) Comment on what will happen if the voltage of 15 volts DC is changed to 20 volts DC. What will happen if it is changed to 7.5 volts DC?
3. Assume you are given a function generator that is outputting a sine wave with amplitude of 15 volts peak to peak with a frequency of 60 Hz. This output is then attached to an oscilloscope. Using the graph below, sketch what you would expect to observe on the oscilloscope and comment on what happens as you change the horizontal time base. Assume that each major vertical tic mark represents 5 volts and every horizontal tic mark represents 5 milliseconds.

**LAB:**

Use your Pre-Lab as a guide to build your circuits and make the appropriate measurements. Explore the triggering mechanism of the oscilloscope and comment on what you did to make your waveforms stable for both the DC and the AC portion of the laboratory. Make sure you provide all your schematics showing where you placed your test leads for measurement, your expected measurements from Pre-Lab, your measured values including waveform sketches you observed on the oscilloscope, and all oscilloscope settings used for each measurement. Finally, write conclusions regarding your lab and how it compared to what you expected from your calculations.