

Başkent University
Department of Electrical and Electronics Engineering
EEM 214 Electronics I
Experiment I

Oscilloscopes, DMM, Function Generator, Potentiometer

Aim:

The aim of this experiment is to gain some experience in the use of the digital oscilloscope, DMM and function generators. Try to become comfortable using the oscilloscope DMM and Function generators as it will be used often in this lab, and they are an important instruments in electronics diagnostics. You will also wire up a breadboard circuit that uses a potentiometer to control the voltage across a resistor

Supplementary Notes for the Experiment:

The **oscilloscope** is used to measure and view voltage as a function of time. A voltage waveform such as $v(t)=a \sin \omega t$ will appear on the scope's cathode ray tube much like you would plot it on a piece of paper. The voltage at which the trace begins is adjusted with the *trigger level*. The duration of the waveform that appears on the screen is determined by the *sweep rate* (or time scale) of the scope.

A **function generator** is a device that produces voltage waveforms such as sine, square, and triangle waves, all with variable amplitude, frequency, and offset. A function generator is often used to provide an input signal to the oscilloscope. For example, the function generator can produce a voltage with the form

$$v(t) = v_{offset} + a \sin \omega t$$

where the amplitude a , the frequency ω , and the offset v_{offset} are all adjustable.

A **DMM** is a device used to measure voltage, resistance, current and other circuit characteristics. Readings are displayed on a digital LCD panel on the DMM.

Preliminary Work:

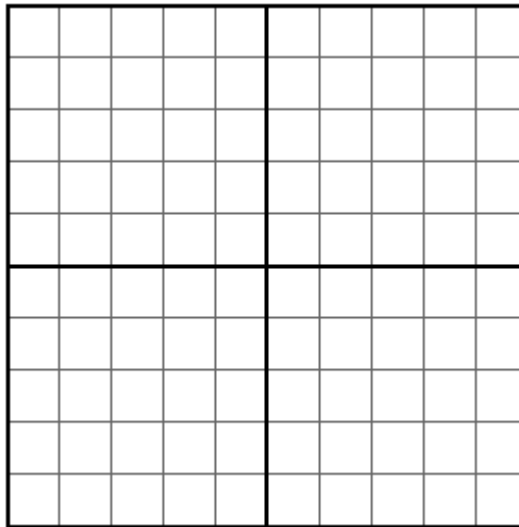
Read the experiment.

Experimental Work:

Part_1

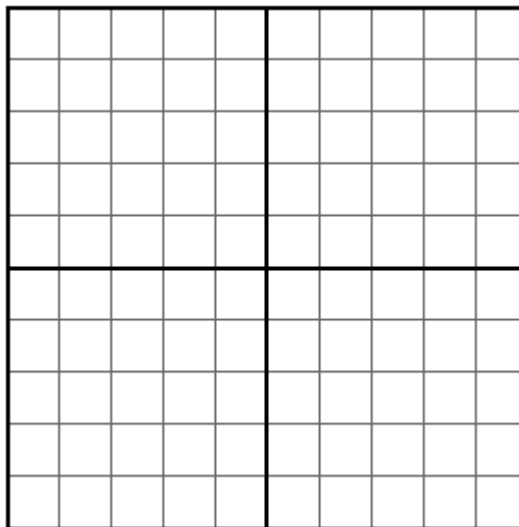
- 1- **a.** Connect the function generator output to the oscilloscope channel 1 input using BNC connectors. Set the function generator to output a sine wave at about 100 Hz. Press the **Auto-scale** button on the scope. When you push the button, the scope measures the maximum and minimum values of the current signal, and sets the screen scaling to match these values. Get the scope to display the peak-to-peak voltage of the sine wave by pressing **Voltage** and then **Vp-p** (make sure the **Source** option for the **Voltage** function measurement is set at **CH1** – this will use channel 1 as the input line).

Plot the trace on the scope. Label plot with the voltage and time scales.



b. Now adjust the function generator to output a 2 V_{pp} (volts peak-to-peak) sine wave at 100 Hz with no offset (DC offset button in). On the scope, make sure the Probe setting is 1 (so voltage is multiplied by 1; as explained, some probes divide the voltage by 10, and if you are using those probes rather than BNC cables, the Probe setting should be 10X). Make sure the coupling is set to DC (under channel 1).

Plot the trace on the scope. Label plot with the voltage and time scales.



2- Using the utilities on the scope, obtain and record v_{max} , v_{min} , v_{p-p} , v_{avg} , Period, frequency, v_{rms} . Using DMM obtain the v_{rms} .

$v_{max} =$

$v_{min} =$

$v_{p-p} =$

$v_{avg} =$

$v_{rms} =$

Period =

Frequency =

- 3- Turn the **Volts/Div**, **Sec/Div**, and **position** dials on scope. Does **Volts/Div** dial change the amplitude of the sine wave? Does the **Sec/Div** dial change the frequency of the sine wave? Does the **position** dial add a constant voltage to the signal? What do these dials do?

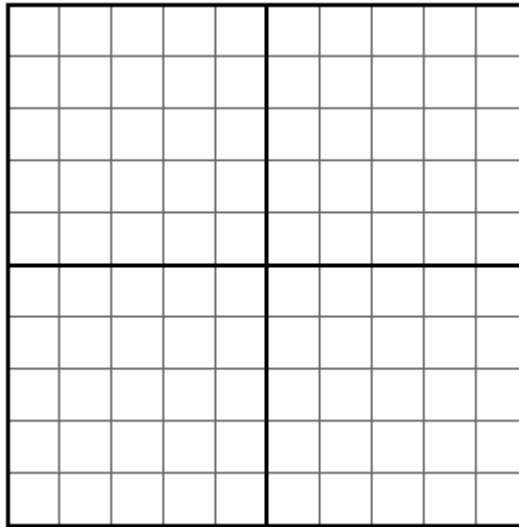
- 4- Adjust the sine wave amplitude to 1Vpp at 200 Hz. Plot (on the same plot as for experimental work 1) the trace on scope using the same voltage/time scales as before.

- 5- With the voltage scale at 2V/div, maximize the sine wave amplitude on the function generator. Why can't the peak-to-peak voltage be read?

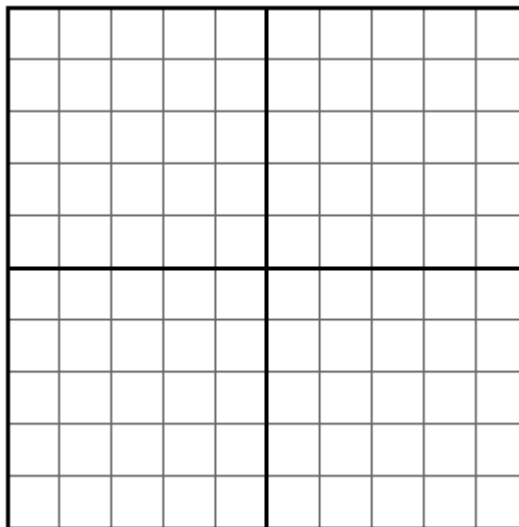
- 6- Change trigger from channel 1 to 2. What happened to the sine wave? Change it back to 1. Why does it do this? Hint: think about what the scope must do to make a sine wave appear without moving (rolling) across the screen.

- 7- Offset the sine wave by pulling the **DC offset** button on the function generator and adjusting the dial. What does the trace do? On the scope, set the coupling to AC (under channel 1). Now what does the trace do when adjusting the DC offset? What is the purpose of using AC coupling?

- 8- Remove the DC offset (**DC offset** button in) and get the function generator to output square and then triangle waves. Plot the traces in **one** plot.



- 9- Get the function generator to output a constant voltage. With the analog function generators, you can do this by getting all of the wave buttons to stay popped out by half pushing one of those buttons. Push out **DC offset** and adjust the dial to change the constant voltage value. Read the constant voltage value and adjust the voltage to be 5 V. Plot the resulting trace with voltage scale at 5V/div.



Part_2

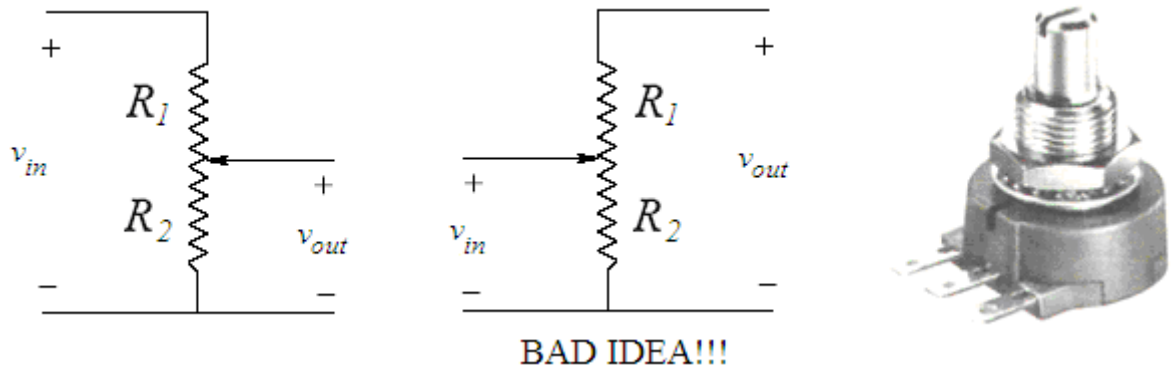
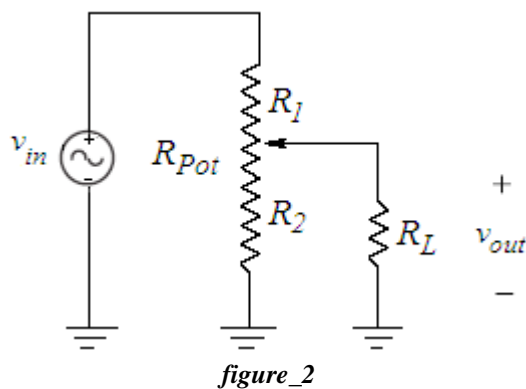


Figure 1A & 1B & 1C– Potentiometer circuits, and actual potentiometer. In the circuit diagrams, the wiper is the wire with an arrow on it. For the actual pot, unless otherwise labeled, the wiper is usually the middle connector

A potentiometer (also called *pot*) is a device that can provide a variable resistance between 2 of its leads. As you turn the knob of a pot, the wiper moves along a resistive element. Fig.1A shows a pot being used to produce a variable output voltage.

- 1- Derive v_{out} as a function of v_{in} , R_1 , and R_2 for Fig.1A.

- 2- Explain why you should never use the circuit in Fig.1B. (try the circuit)



- 3- Measure and record resistor values using a DMM. Then wire the circuit shown in Fig.2 on the breadboard ($R_{Pot} = 5k$). Apply a sine wave input of $10 V_{peak}$ with a frequency of $1kHz$ ($v_{in} = 10V_{peak}$). With $R_L = \infty$ (i.e. an open circuit), measure peak value of v_{out} , R_1 and R_2 in 3 potentiometer positions (full clockwise, full counter-clockwise, the center). Repeat the measurement with $R_L = 150\Omega$.

	R_1	R_2	$v_{out} (R_L = \infty)$	$v_{out} (R_L = 150\Omega)$
full clockwise				
the center				
full counter-clockwise				

- 4- Are the measurement values of v_{out} same with expected values, explain briefly?
(**Hint** : Are the measurement values of R_1 and R_2 same with the expected values...)

Lab Instruments: Breadboard Oscilloscope Signal Generator Multimeter DC Power Supply	Components: 1 5k Pot 1 150 Ω
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