ENGR 221, Lab 2: Oscilloscopes and Time Varying Signals

Objectives:

1) To gain experience using the oscilloscope as an instrument for viewing and measuring time varying signals.
2) To gain experience in using and configuring the function generator to output standard test signals such as sinusoidal, square and triangular waves.
3) To gain experience in working with the Boe-Bot, integrated circuits (ICs) and solder-less breadboards for prototyping electrical circuits.
4) To gain experience in experimentally estimating the capacitance from a time domain measurement using the oscilloscope.

Procedure:

1) Each group will get an oscilloscope and a function generator from the instructor.
2) Configure the function generator to output a 2V peak to peak sinusoidal waveform with a frequency of 1 kHz and 0V DC offset.
3) Use Channel 1 of the oscilloscope to measure the signal from the function generator. **(Make sure your oscilloscope probe is configured with the ×1 setting and that the attenuation calibration on the oscilloscope is set to ×1.)**
4) Adjust the time base of the oscilloscope until a few periods of the sinusoidal waveform are visible on the screen. Adjust the Channel 1 vertical attenuator until the sinusoidal waveform fills up most of the oscilloscope screen. Make sure to center the trace on the screen using the vertical position control for Channel 1.
5) Sketch a graph of the waveform, capturing all relevant information from the oscilloscope such as time per division and volts per division.

6) Configure the function generator to output a 2V peak to peak square waveform with a frequency of 10 kHz and a 0V DC offset.
7) Repeat steps 4 and 5 for this waveform.

8) Configure the function generator to output a 5V peak to peak triangular waveform with a frequency of 5 kHz and 0V DC offset.
9) Repeat steps 4 and 5 for this waveform.

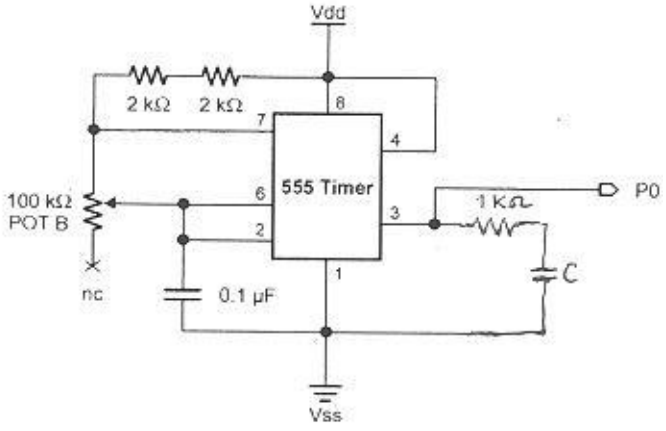
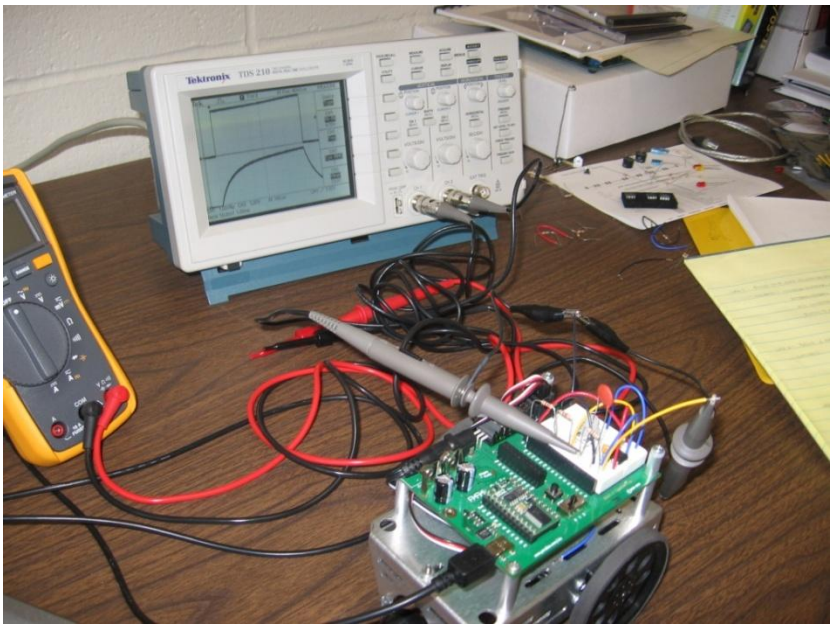


Figure 1 – Schematic for Laboratory Exercise 2

10) Obtain a 555 timer, two 2 KΩ resistors, one 1 KΩ resistor, one 100 KΩ potentiometer, one 0.1 µF capacitor, one capacitor of unknown value and wires as necessary.
11) Using the breadboard on the Board of Education, set up the circuit shown in Figure 1, including the unknown capacitor C.
12) Enter the code provided below.
13) Connect the probe for Channel 1 of the oscilloscope to the output signal of the 555 timer and adjust the potentiometer and the scope so that one cycle of the signal can be seen on the display (see upper trace in photo below).
14) Move the probe for Channel 1 of the oscilloscope to the voltage signal across the unknown capacitor (see lower trace in photo below).
15) Measure the time it takes for this voltage signal to increase to 0.632 times the peak value of the 555 output signal (Vdd). Using this time value, determine the value of the unknown capacitor.



This picture shows two traces on the oscilloscope.

The upper trace is the output of the 555 timer, adjusted so that one cycle is seen on the display.

The lower trace is the voltage signal across the unknown capacitor.

Code Listing for Laboratory Exercise 2

```
' {$STAMP BS2}
' {$PBASIC 2.5}

n               VAR Word

DEBUG CLS

DO
  COUNT 0, 1000, n
  DEBUG HOME, "Frequency:  ", DEC4 n, " Hz"
LOOP
```

Lab report guidelines for Lab Exercise #2

1. Title Sheet - (5 pts). Must contain the lab number, the lab experiment title, the date of the lab experiment, your name, and the names of your coworkers with your name distinguished from the others.
2. Experiment Setup - (10 pts). Details of the setup used. Including any diagrams / schematics. Detailed enough to repeat the experiment.
3. Equipment List - (5 pts) List of all equipment used including model numbers.
    a. Go to digikey.com and search for the 555 timer. Determine the cost and availability of this part and include this information in this section of the report.
4. Procedure - (10 pts) Detailed steps of what was done. The steps should be complete enough for anyone to repeat the process. Do not include any data in this section, that comes in the next section.

    DO NOT JUST COPY THE HANDOUT!!! WRITE OUT THE PROCEDURE IN YOUR OWN WORDS!

    a. Since one of the pins of the 100 kΩ potentiometer is not connected, what physical component was being changed as you adjusted the potentiometer (i.e. voltage, current or resistance)? Include this information in this section of the report.
5. Data - (25 pts) All data collected. Tables, Graphs Formatted for neatness, ease of comparison, and readability.
    a. For this lab exercise, include sketches of the sinusoidal waveform, the square waveform and the triangular waveform you generated with the signal generator. NOTE: These sketches must be digital, not hand-drawn. Be sure to include all of the details from the oscilloscope display such as the time value per division and the voltage value per division. Then include the sketch of the waveform of the voltage signal across the unknown capacitor. This sketch can be hand-drawn or digital.
6. Analysis - (20 pts). An analysis of the results obtained in the laboratory. What does the data mean? What is significant, interesting, or odd? How does it compare to the expected results? Try to justify your answers mathematically. If you feel that equipment is at fault for poor data, you must try to defend this claim. Saying equipment didn't work correctly is not an acceptable statement. What went wrong? Why did something go wrong?

    For this lab exercise, provide include the following in this section:

    a. Show your calculations for determining the value of the capacitor based on the time value you measured. Show the significance of the value of 0.632 and where this number comes from.
7. Original Data Sheets - (5 pts). Hand written sheets or unformatted printout of spreadsheet that the original data was collected on.
8. Format – (10 pts). Figures, graphs, charts are neat and laid out and labeled properly. Section headings are there. Cover sheet has all necessary information.
9. Grammar – (10 pts). Spelling, complete sentences, sentence structure. Using proper grammar.