Professor Hasler
ECE 2040-C
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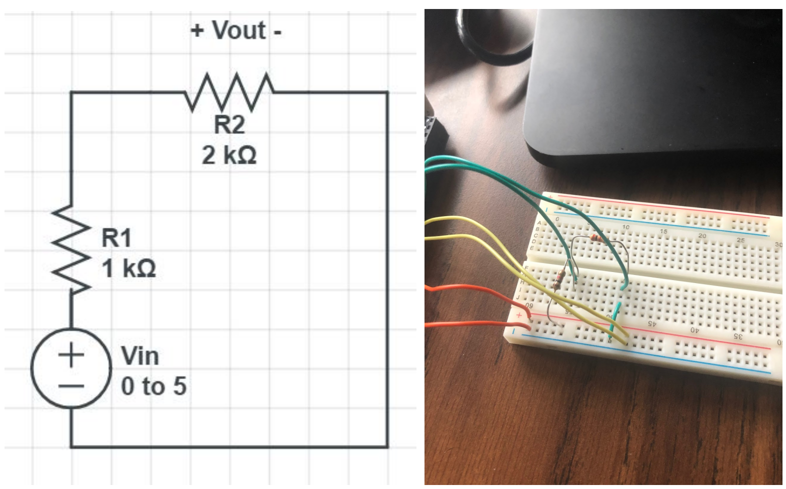
Project 1

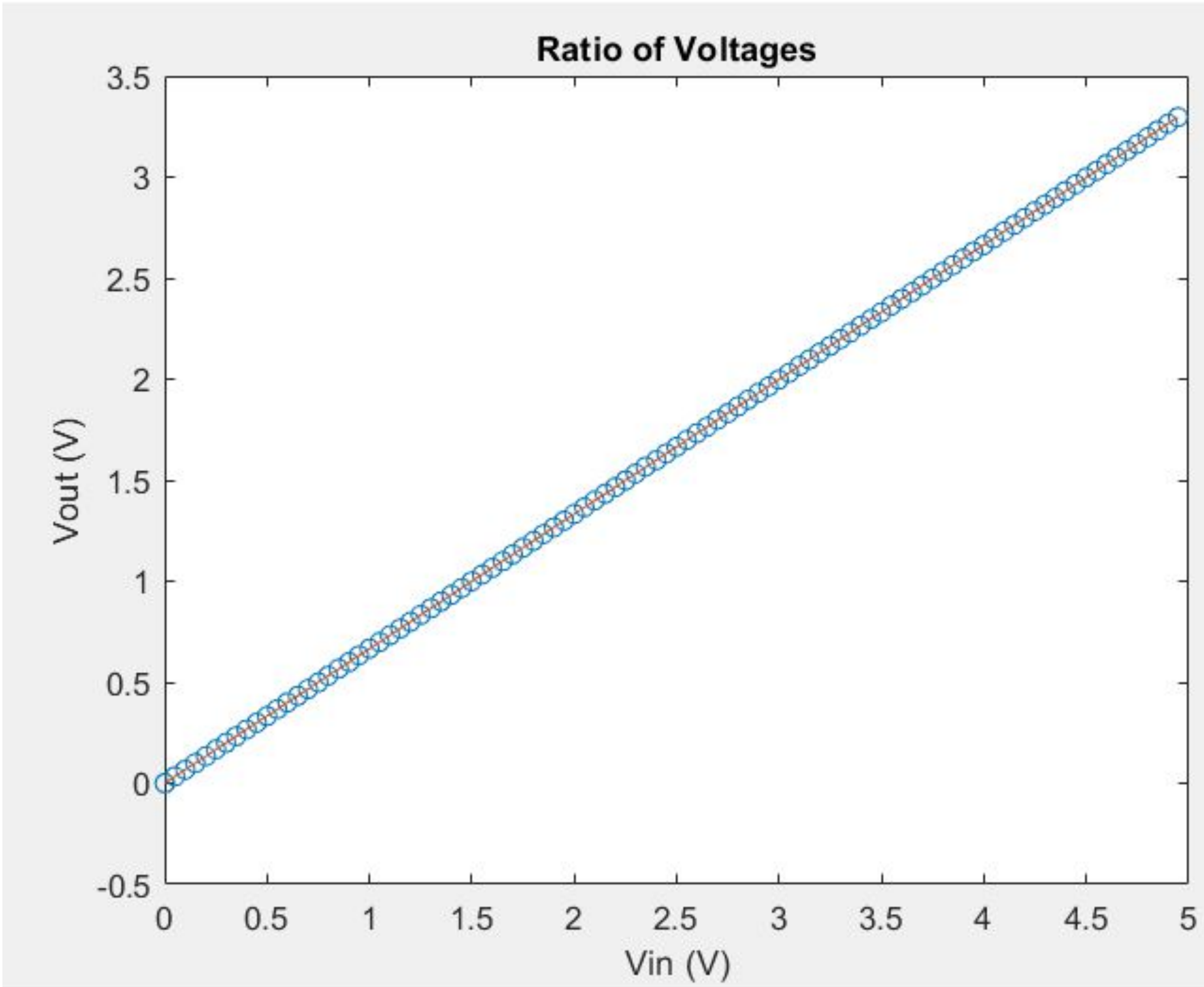
In the lab we created a resistive voltage divider using the myDAQ and we measured our data using the device's analog inputs and outputs. We set up our circuit with a 1 kilo ohm resistor in series with a 2 kilo ohm resistor, input voltages into power, and measured the voltage into the circuit and the voltage across the circuit.

Figure 1: Voltage divider diagram and circuit



Using the arbitrary waveform generator and the data logger ELVIS software, we recorded a DC sweep of voltage values from 0 to 5 volts and created a linear ramp of values of voltages in and voltages out. We input the data values into an lvm file, imported the lvm file into Excel, and imported the data from Excel into MATLAB. Using MATLAB we wrote code to decrease the number of points that we got from Excel from 1060 to 106 points and then we used the plot function to plot the raw values. Afterwards, we used polyfit using the first order and polyval to plot the linear curve fit.

Figure 2: Linear curve fit of the output voltage to the input voltage



According to the slope of the curve fit, the gain or the ratio of output voltage to input voltage was 0.6663 siemens. Using circuit analysis for the resistive voltage divider circuit for the lab measurement on the course website, voltage out should theoretically be equal to two thirds times the voltage in, which is very close to the value that we got for the gain.

$$\left|\frac{experimental - theoretical}{theoretical}\right| = \left|\frac{0.6663 - (2/3)}{(2/3)}\right| \approx 0.055\%\ error$$

Using the DC voltage sweep experimental values and linear curve fit, we found a voltage offset of -0.000074893 V. Even though this voltage offset is very close to zero, we theoretically should not have gotten an offset voltage. The offset is very small so it could have been a result of systematic error with the myDAQ. The myDAQ has accuracy within +/- 0.5% + 2 mV of the reading values. Our offset value falls within this range. Another reason our offset value could be nonzero is because there may be leftover charge in the breadboard since we ran the circuit multiple times before we settled on the values we have here. There could also be a small amount of impedance in the wires or resistors that may have contributed to there being an offset voltage.

Figure 3: Voltage tolerances for the myDAQ

Accuracy

Function	Range	Resolution	Accuracy ± ([% of Reading] + Offset)	
DC Volts	200.0 mV	0.1 mV	0.5% + 0.2 mV	
	2.000 V	0.001 V	0.5% + 2 mV	
	20.00 V	0.01 V	0.5% + 20 mV	
	60.0 V	0.1 V	0.5% + 200 mV	
			40 to 400 Hz	**400 to 2,000 Hz**
AC Volts	200.0 mV	0.1 mV	1.4% + 0.6 mV*	—
	2.000 V	0.001 V	1.4% + 0.005 V	5.4% + 0.005 V
	20.00 V	0.01 V	1.5% + 0.05 V	5.5% + 0.05 V

* The accuracy for AC Volts 200.0 mV range is in the frequency range of 40 Hz to 100 Hz. For example, for a 10 V using the DC Volts function in the 20.00 V range, calculate the accuracy using the following equation:

$$10\text{ V} \times 0.5\% + 20\text{ mV} = 0.07\text{ V}$$

We used a 1 kilo ohm resistor and 2 kilo ohm resistor to build this circuit. Using the multimeter and the probes, we measured a resistance of 994 ohms for the 1 kilo ohm resistor and 1981 ohms for the 2 kilo ohm resistor. Both resistors have a gold band which indicates a tolerance of +/-5%. Both resistor values fall within this range.

$$\left|\frac{994 - 1000}{1000}\right| \approx 0.6\%\ error\ for\ 1\ k\Omega\ resistor$$

$$\left|\frac{1981 - 2000}{2000}\right| \approx 0.95\%\ error\ for\ 2\ k\Omega\ resistor$$

To compare the gain and the resistor values, we found the ratio of resistors using the measured resistor values: 994 and 1981 ohms. The percent error for the gain is lower than the percent error from the measured resistors, which means the gain is closer to the theoretical value.

$$\frac{1981}{994+1981} \approx 0.66588$$

$$\left|\frac{0.66588 - (2/3)}{(2/3)}\right| \approx 0.118\%\ error$$