ECE 2040 Lab 1 Report

The purpose of this lab was to analyze a resistive voltage divider circuit. Using the circuit displayed in figure 1, we swept V_{in} from 0 V to 5 V taking fifty-one measurements. As shown in figure 2, the gain is 0.6649 and the offset is -0.00068 V. They were calculated from the linear curve fit, the gain is the slope and the offset is the y-intercept. Using the resistive voltage divider formula we can calculate the theoretical gain of the circuit:

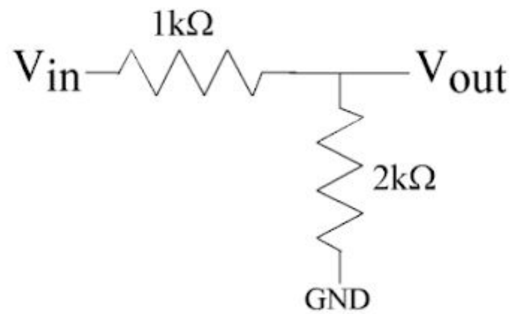

Figure 1: Resistive divider circuit for lab measurement.

$$V_{out} = Gain \times V_{in}$$

$$Gain\ in\ an\ ideal\ circuit = \frac{R_2}{R_1 + R_2} = \frac{2\ k\Omega}{2\ k\Omega + 1\ k\Omega} = \frac{2}{3}$$

Ideally our circuit should not contain an offset, but this arose from the internal resistance within the myDAQ. The deviation of the gain in our circuit when compared to the theoretical value is:

$$Deviation\ of\ measured\ gain = \frac{Measured\ Gain - Ideal\ Gain}{Ideal\ Gain} = \frac{0.6649 - 2/3}{2/3} = -0.0026$$

The difference between the theoretical gain and our measured gain could be caused by the 5% tolerance rate of our resistors. We measured the actual resistances of our resistors. They were both lower than the expected resistance. The 1 kΩ resistor had an actual resistance of 0.986 kΩ and the 2 kΩ resistor had an actual resistance of 1.96 kΩ. This created the following deviations:

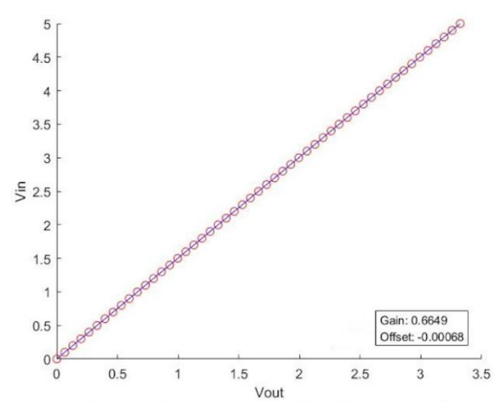

Figure 2: Graph of the Vin v Vout data and the linear curve fit of the data collected from the circuit in figure 1.

$$Deviation\ of\ resistance\ value\ (R_1) = \frac{Actual\ R_1 - Ideal\ R_1}{Ideal\ R_1} = \frac{0.986\ k\Omega - 1\ k\Omega}{1\ k\Omega} = -0.014 = -1.4\%$$

$$Deviation\ of\ resistance\ value\ (R_2)\ =\ \frac{Actual\ R_2 - Ideal\ R_2}{Ideal\ R_2} = \frac{1.96\ k\Omega - 2\ k\Omega}{2\ k\Omega} = -0.02 = -2\%$$

The deviations were as expected, both were below 5% tolerance of the gold band. Using the measured resistance values yields an expected gain of:

$$Expected\ circuit\ gain\ =\ \frac{Real\ R_2}{Real\ R_1 + Real\ R_2} = \frac{1.96\ k\Omega}{0.986\ k\Omega} = 0.6653$$

Then comparing this expected gain to our measured gain, we find the following deviation:

$$Deviation\ of\ measured\ gain\ =\ \frac{Measured\ Gain - Expected\ Gain}{Expected\ Gain} = \frac{0.6649 - 0.6653}{0.6653} = -0.000601$$

The cause of this 0.06% deviation can be attributed to the internal resistance of the myDAQ. There is a 1Ω analog output impedence[1] that causes an extra voltage drop of $\frac{1}{1000} \times Gain$. Together, these deviations plus the output impedance cause our measured gain to be off by the 0.26% calculated above.

References:

[1] http://www.ni.com/pdf/manuals/373061f.pdf