Wheatstone Bridge Experiment

A measurement ***bridge*** is used to convert a resistance (or impedance) to a measurable voltage or current. Typically, the resistance is that of a transducer such as a temperature or strain sensor. Often, the change in resistance over the range of use is very small. A sensor is placed in a bridge circuit to help exaggerate the small resistance change so that it can be more easily measured as either a voltage or current.

Figure 1 shows a Wheatstone bridge. The input voltage, Vin, and the output voltage, Vo, will be measured with a digital multi-meter (DMM). If all resistances are exactly equal, the measured output voltage would be zero indicating that the bridge is balanced or ***nulled.*** Any deviation (deflection) from this nulled condition is an indication that one or more of the resistances has changed.

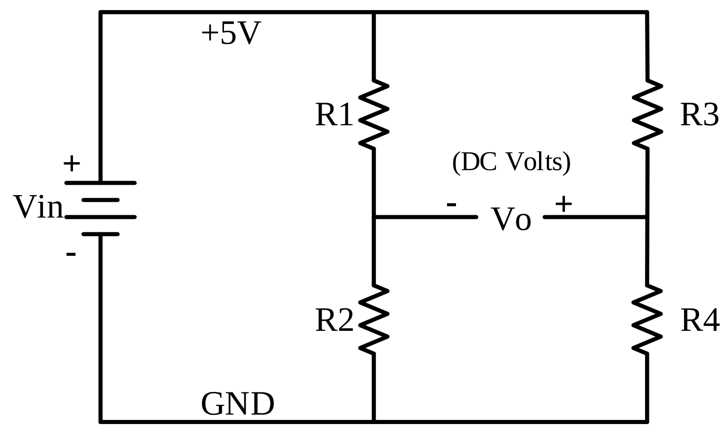

Figure 1. Wheatstone Bridge Circuit

In this experiment, the *Deflection Method* will be investigated. R1, R2, and R3 are 110Ω fixed resistors and R4 is a "decade box" adjustable resistance. The bridge unbalance voltage will be observed as a function of the value of R4 over the range of resistances from 100Ω to 120Ω. By plotting this relationship, a calibration curve can be created. The value of an unknown R4 (such as a sensor resistance) can then be determined by measuring the bridge unbalance voltage and using the plot to find the corresponding resistance value.

Procedure

1. **Before connecting the power supply to the PCB and without removing the resistors from the terminals**, measure and record the values of R1, R2, and R3 using an ohmmeter. (Just press the tips of the ohmmeter leads against the top of the appropriate pair of screw terminals to make the measurement)

2. Construct/verify the Wheatstone bridge circuit shown in Figure 1 with Vin = 5V, R1 = 110Ω, R2 = 110Ω, R3 = 110Ω, and a decade box adjustable resistance for R4.

3. Adjust the decade box resistance (R4) from 100Ω to 120Ω in 1Ω increments. Record the decade box resistance indication (based on the knob settings), the actual +5V supply voltage (Vin), and the bridge unbalance voltage (Vo) for each increment of resistance in a spreadsheet file. Create a plot of Vo/Vin versus R4 using these values. Place a linear best-fit line through the data.

4. Add a second line to the plot of the expected values for Vo/Vin versus R4. Use your measured values for R1, R2, R3, and Vin for each calculated data point.

<u>Homework Submission</u>

Include the measured values for R1-R3, the table of measured data, and the plot with both the measured and the expected (calculated) values of Vo/Vin versus R4. Also include the percent error between the slopes of the measured and expected lines.

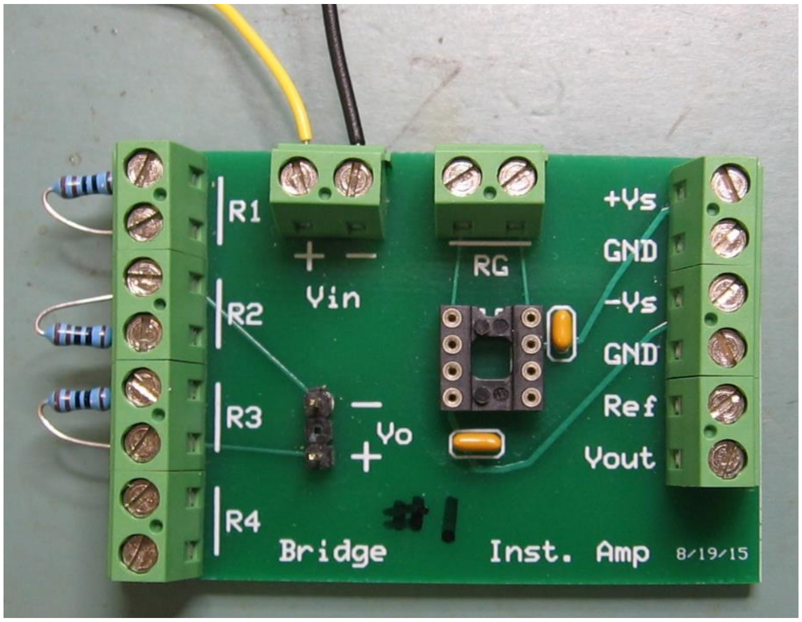

Figure 2. Photo of Wheatstone bridge and instrumentation amplifier PCB

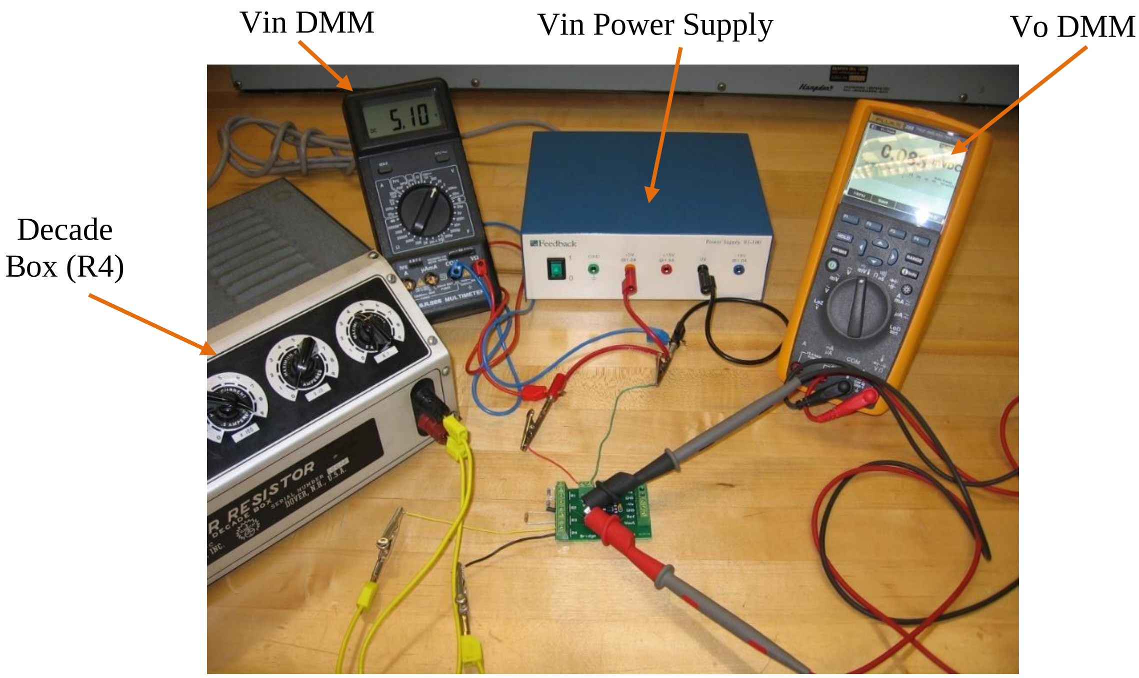

Figure 3. Photo of complete test setup for Wheatstone bridge experiment