ECSE 2010 Alpha Lab 01 Proof of Concepts Sec 2

[redacted]

TOTAL POINTS

10 / 10

QUESTION 1

1 I can use a bridge circuit to measure small variations of resistance **1 / 1**

✓ **- 0 pts** **Correct**

- 1 pts One or more Screenshots missing

- 2 pts Several Screenshots missing

- 3 pts Missing

QUESTION 2

2 I can make a reference voltage with a comparator to help make decisions **1 / 1**

✓ **- 0 pts** **Correct**

- 1 pts One wrong or incomplete answer

- 2 pts Two or more wrong or incomplete answers

- 2 pts Missing

QUESTION 3

3 I can multiply or divide a signal with a gain that I specify by changing component values in an op amp circuit. **1 / 1**

✓ **- 0 pts** **Correct**

- 1 pts screenshot missing

- 2 pts 2 or more screenshots are not clear

- 2 pts Missing

- 1 pts Incorrect format of document

- 1 pts Nodes are not labelled or inconsistent with results

- 1 pts Screenshot missing captions or labels

QUESTION 4

4 I can integrate or differentiate a signal by changing component values and positions in an op amp circuits. **1 / 1**

✓ **- 0 pts** **Correct**

- 1 pts Not Adequate Expnanation for one or more comparisions

- 2 pts Missing several comparisons of analytical, simulation and experiment results

- 3 pts Missing

QUESTION 5

5 I can design a potential solution to a sensor problem by integrating two or circuits learned in this lab. **1 / 1**

✓ **- 0 pts** **Correct**

- 0.5 pts build the circuit

- 0.5 pts simulation

QUESTION 6

6 I can identify non-idealities or unexpected results and attempt to explain why they may exist. **1 / 1**

✓ **- 0 pts** **Correct**

QUESTION 7

7 I can answer for myself “Is this right?” by comparing mathematical calculations to simulation and experimental results. **1 / 1**

✓ **- 0 pts** **Correct**

- 1 pts missing mathematical calculations

QUESTION 8

8 I can show plots and diagrams that are easy to read, scaled correctly and clearly labeled. **1 / 1**

✓ **- 0 pts** **Correct**

- 1 pts several plots/diagrams not clear

- 1 pts missing simulation results/plots

QUESTION 9

9 I can use consistent variable labels and component values in mathematical calculation, simulation and experimental results for easy comparison. **1 / 1**

✓ **- 0 pts** **Correct**

QUESTION 10

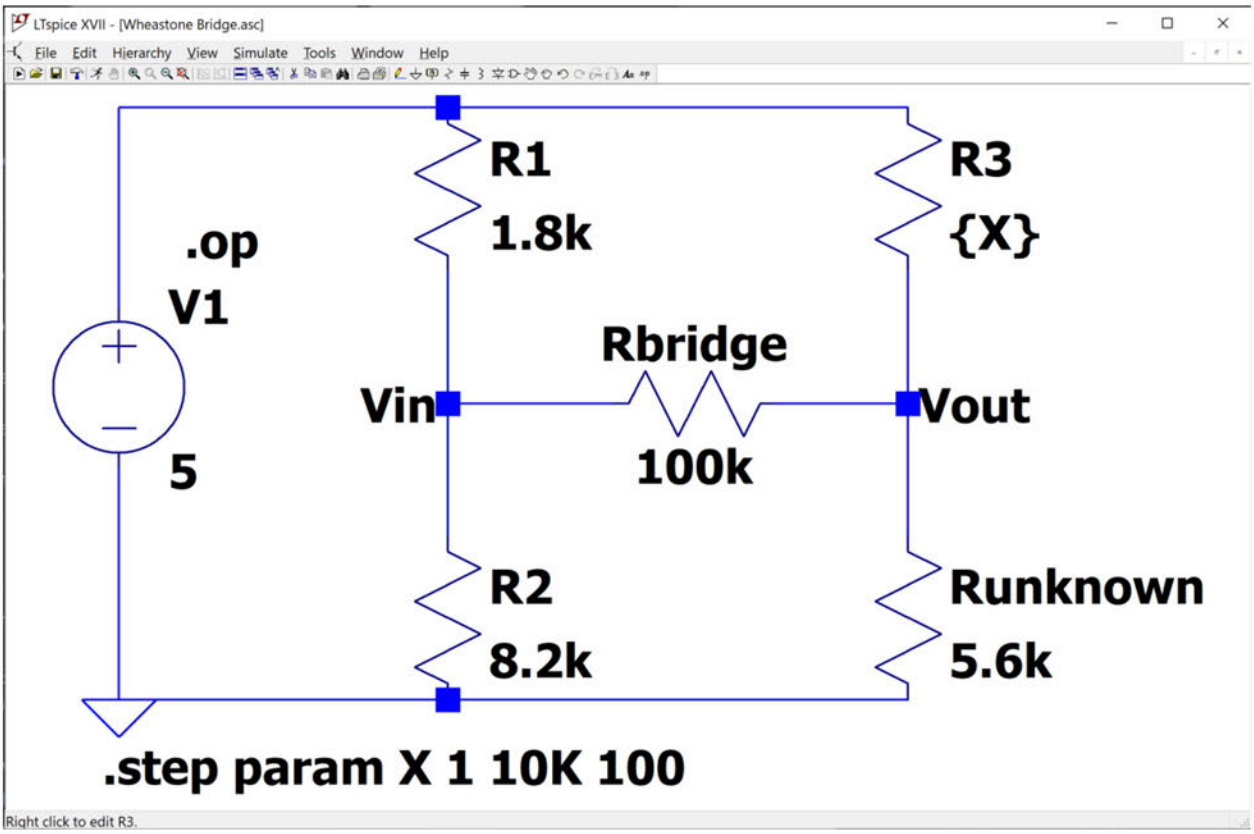
10 I can accurately answer conceptual questions found throughout the lab. **1 / 1**

✓ **- 0 pts** **Correct**

Proof of Concepts

1. **Proof of concept (A1):** Prove the concept of a balanced bridge
2. **Building Block:** Short description and schematic

Clearly label all nodes you will reference for example



The above schematics shows a typical representation of Wheatstone bridge. V1, R1, R2 and Rbridge has known value. Runkown has a value of 1k so that when parametric simulation is done on R3, the response of voltage across Rbridge can be observed.

3. Analysis:

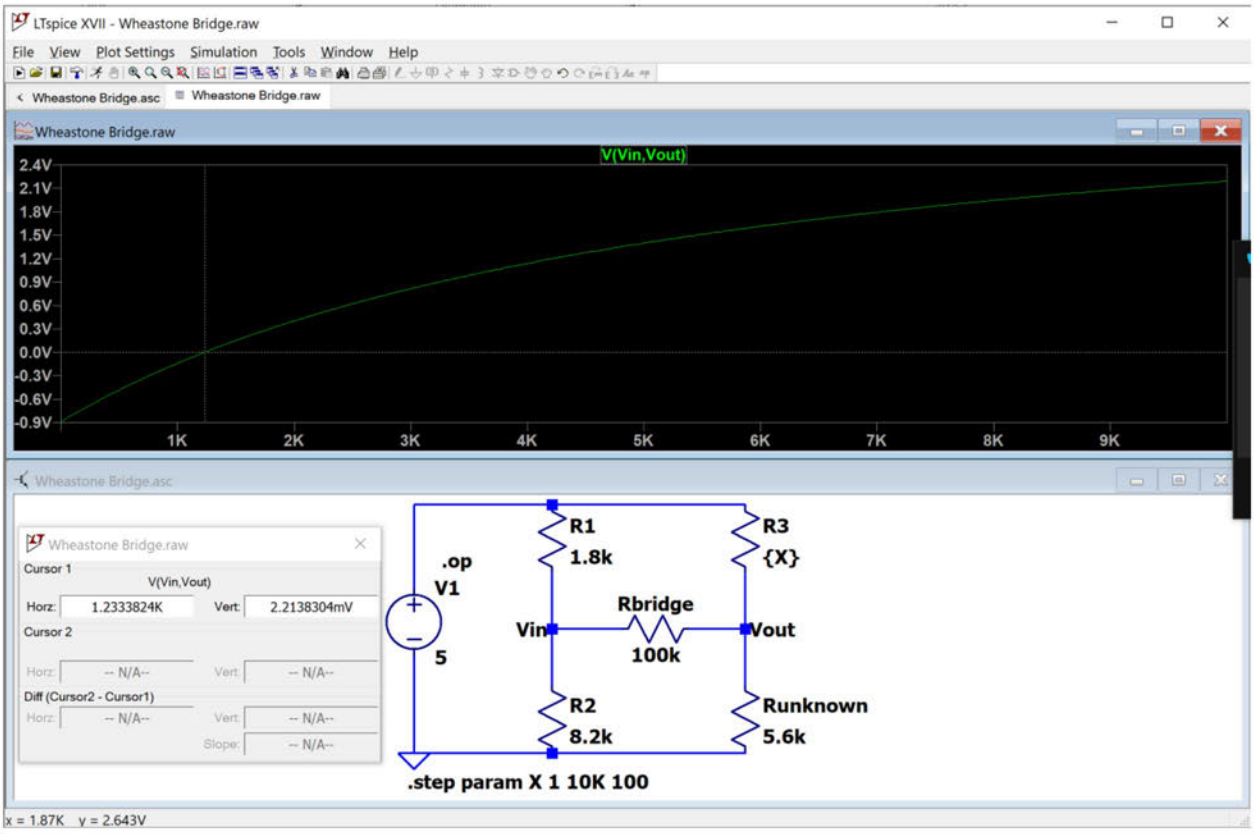
Equation and short description.

In order for the bridge to be balanced, in another sense no current flowing through Rbridge, the voltage at Vin and Vout must be equal to each other. Since without Rbridge, R1 and R2, and R3 and R4 are in parallel with each other, the voltage across each pair of the resistor is the same. To achieve a balanced bridge, the voltage across Vin and Vout as labeled on the schematic must be same. This derived the equation:

$$\frac{R2}{R1 + R2} = \frac{Ru}{Ru + R3}$$

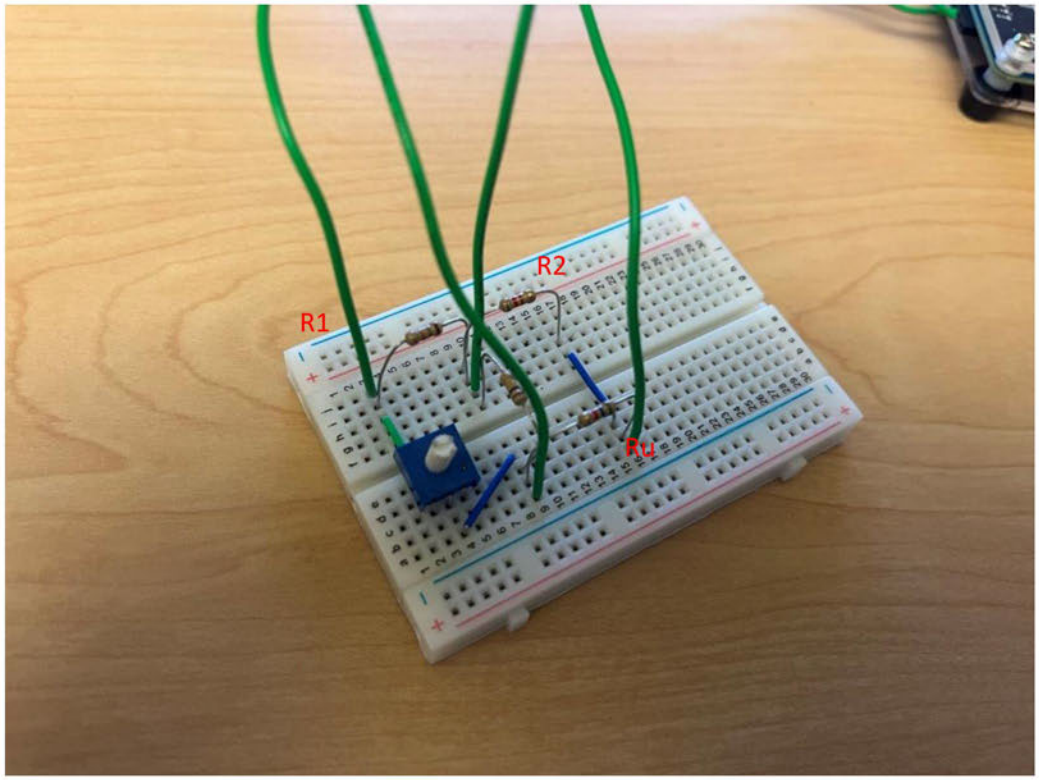
4. Simulation:

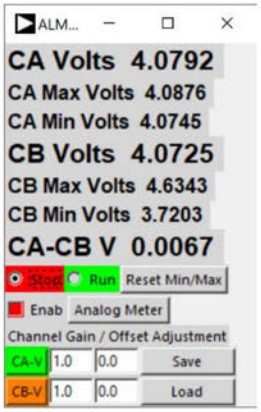
Screenshot of simulation



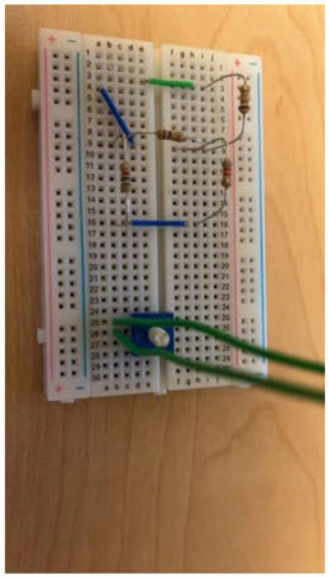
5. Measurement:

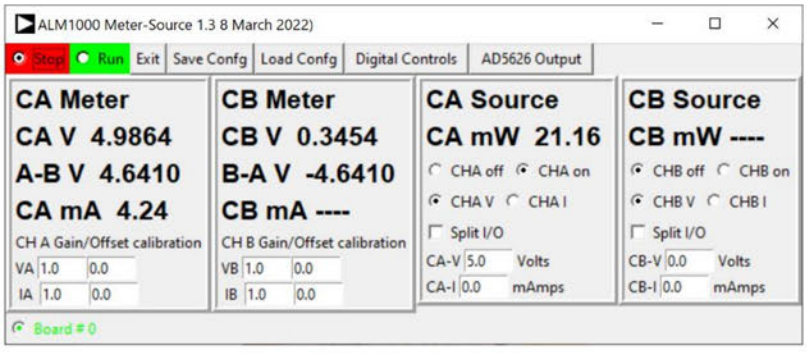
Balanced bridge





Measuring the Resistance of the potentiometer





6. Discussion (and answer related questions in Alpha Lab):

The LT spice simulation shows that to achieve a balanced bridge, R3 must have a value around 1.23KΩ. Using an potentiometer, under the same circuit composition, the resistance of te potentiometer equals to $\frac{4.9864V}{4.24mA} = 1.18k\Omega$. Based on mathematical calculation, a balanced bridge need to satisfy relationship:

$$\frac{R2}{R1 + R2} = \frac{Ru}{Ru + R3}$$

Substituting the resistor value from the circuit schematics, $\frac{8.2K}{1.8K+8.2K} = \frac{5.6K}{R3+5.6K} \rightarrow R3 = 1.23K$

Simulation result matches with the mathematical expression of an balanced circuit. The measurement result would be reflective of the simulation result because the resistor used in the experiment has a tolerance of 5%. The variation between resistances in the simulation and experiment is within such tolerance. The error can also be coming from potentiometer and LT spice readout. As shown in the above pictures, it is difficult to balance the bridge and achieve 0 voltage across difference. And the voltage across the bridge resistor can't be adjust to matched exactly due to the precision of potentiometer and LT spice cursor.