Title: **Wheatstone Bridge** Lab: 20

Course: Electrical Applications Unit: Electrical Lab CLO: 2, 3, 4

Name ANSWER KEY Grade 58pts Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Objectives**

1. Student shall calculate a Wheatstone bridge balanced circuit’s resistance values.
2. Student shall construct a Wheatstone bridge and observe itsg behavior.
3. Student shall measure bridge voltage and adjust bridge resistance to obtain the unknown resistance value.

**Assessment**

Students shall demonstrate a comprehension of the objectives listed above by scoring a minimum of 75% on this Lab. Grading shall be based on instructor evaluation.

**Materials**

|  |  |
| --- | --- |
| Student Provided Materials | Department Provided |
| Proto board | Power Supply |
| Multimeter |  |
| Resistor Kit |  |
| Calculator |  |

**Theory**

A Wheatstone bridge is an electrical circuit used to measure an unknown electrical resistance by balancing two legs of a bridge circuit, one leg is composed of two known resistance values while the other leg typically includes an adjustable resistor and an unknown resistance. The primary benefit of the circuit is its ability to provide extremely accurate measurements.



To determine the value of the unknown resistance, a voltage measurement circuit is placed across the bridge. If a voltage is present, the bridge is said to be “unbalanced”. The value of R3 is adjusted until no potential difference exists across the bridge. Once no voltage is detected between points E and F, the circuit is said to be balanced. It is then possible to determine the value of the unknown resistance.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

**Circuit**



Where;

Discovery

1. What should the voltage reading between points *E* and *F* (EEF) read if the Wheatstone bridge circuit was balanced? 0V

Calculations

If R3 was set to 10kΩ, complete the following table using the given quantities above.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | P | I | R | E |
| R1 | 12.755mW | 3.571mA | 1kΩ | 3.571V |
| R2 | 22.959mW | 1.8kΩ | 6.429V |
| R3 | 6.719mW | 819.672μA | 10kΩ | 8.197V |
| R4 | 1.478mW | 2.2kΩ | 1.803V |
| Total | 43.911mW | 4.391mA | 2.277kΩ | 10V |

1. Based on the calculations above, what should be the expected bridge voltage (EEF)? 4.626V

Measurement

Adjust R3 to 10kΩ. Build the circuit should above. Measure and record each component in the circuit and complete the following table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | P | I | R | E |
| R1 |  |  |  |  |
| R2 |  |  |  |  |
| R3 |  |  |  |  |
| R4 |  |  |  |  |
| Total |  |  |  |  |

1. Measure and record the bridge voltage (EEF)? \_\_\_\_\_\_\_\_\_\_

**NOTE:** When taking readings like EEF, the red lead of your meter is placed on the first reference point *“E”* and the black lead is placed on the second reference point *“F”*. Bridge voltages can be negative.

1. Is the bridge voltage calculated in step 2 comparable to the measured bridge voltage in step 3? Why or why not?
2. Using the measured quantities above, calculate the appropriate value that R3 should be adjusted to obtain a balanced bridge.

Calculated R3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. Place your voltmeter to measure bridge voltage and adjust R3 until the voltmeter reads zero volts. Turn off your power supply, remove R3 and measure the resistance value.

Measured R3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. Is the calculated value of R3 in step 5 comparable to the measured value of R3 in step 6?   
   Why or why not?

Evaluations

1. If the value of R4 increased, to obtain a balanced bridge R3 would have to?
   1. Increase
   2. Decrease
   3. Remain the same
2. If the value of R3 decreased, the current IAB would?
3. Increase
4. Decrease
5. Remain the same
6. If the value of EF was larger than that of EE, the bridge voltage would be?
7. Positive
8. Negative
9. Zero
10. If the bridge is balanced and the supply voltage ES is increased, the bridge voltage would?
11. Increase
12. Decrease
13. Remain the same

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