German – Jordanian University (GJU)

Electrical Circuits 1 Laboratory

Section 3

Experiment 4

Potentiometers and the Wheatstone Bridge

Post lab Report

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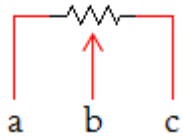
Objectives:

- ✓ To learn about potentiometers and their use.
- ✓ To build a Wheatstone bridge to measure an unknown resistance.

Introduction and Theory:

- A potentiometer is a variable resistor consists usually of a turning dial to change the value of its resistance between two of its terminals.

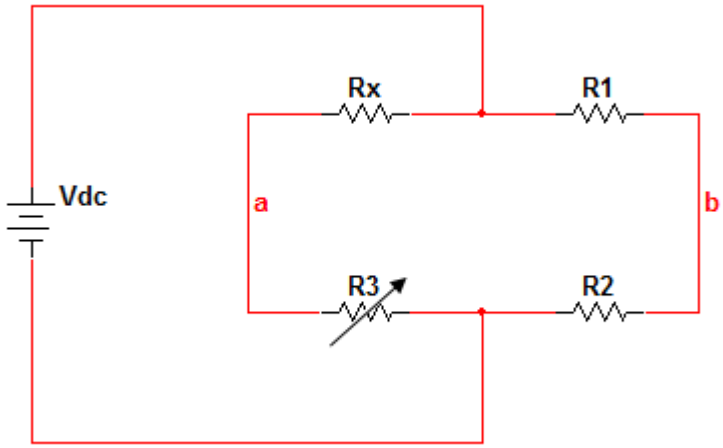


- A Potentiometer -

- The resistance between the wiper (b) and either side of the outer terminals (a or c) varies from zero to a maximum of the full rating of the POT.

$$\mathbf{R_{max} = R_{ac} = R_{ab} + R_{bc}}$$

- A Wheatstone bridge is a circuit used to measure the resistance of an unknown resistor.



- In the Wheatstone bridge we adjust the value of POT (R3) until the voltage across a & b is zero, then we can calculate the unknown resistance Rx from this equation.

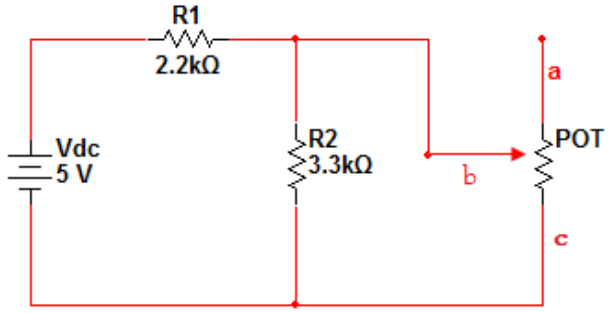
$$Rx = \frac{R1}{R2} R3$$

✓ <u>This experiment consists of two parts:</u>

<u>Part A:</u>

<u>Procedure:</u>

1. Connect the circuit shown in the *figure 1*.



- *Figure 1* -

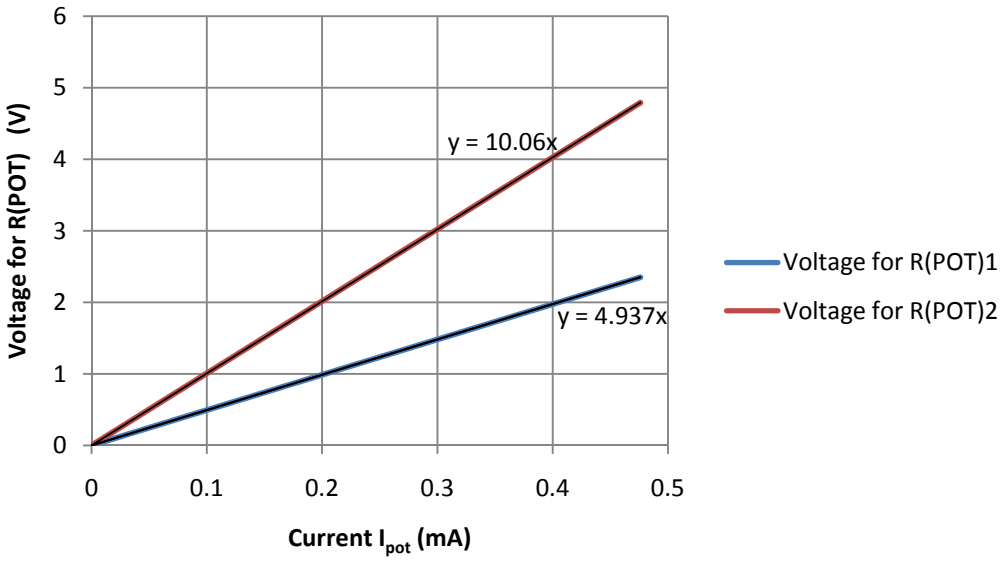
2. Measure V2 for different values of R_{pot}.
3. Calculate I_{pot} using Ohm's law.
4. Make a table of results and plot the current (I) vs. voltage (V) for R_{pot}.
5. Calculate the resistance from the curves.

<u>Results:</u>

❖ The results of this part are shown in this table:

Resistance of R_{pot}	Voltage V (V)	Current I (mA)
R(POT)1 = 4.94 kΩ	2.35	0.476
R(POT)2 = 10.07 kΩ	2.63	0.261

❖ This graph below shows the current (I) vs. voltage (V) for R_{pot}.

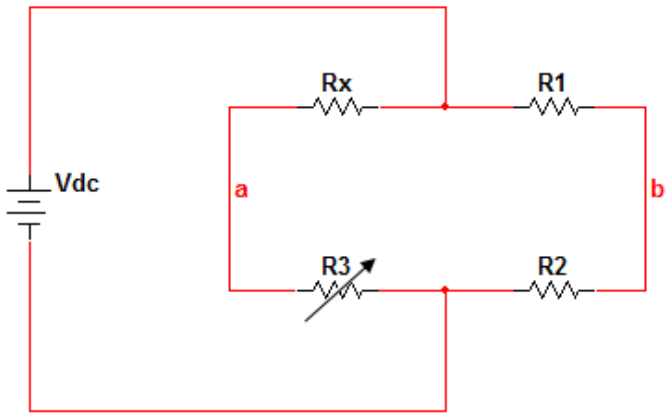


❖ From this graph **R_{pot1}=4.937 kΩ** , and **R_{pot2}=10.06 kΩ**

Part B:

Procedure:

1. Connect the circuit shown in the *figure 2* on the bread board, with R1=3.3kΩ, R2=4.7kΩ, Rx is an unknown resistance, R3 is a potentiometer.



- *Figure 2* -

2. Adjust the POT (R3) until V_{ab}=Zero.
3. Measure R for POT.
4. Calculate Rx.
5. Measure Rx.
6. Calculate the %difference.

Results:

When V_{ab}=Zero:

- ✓ R(POT)=0.948kΩ
- ✓ **Rx=0.666kΩ=666Ω**
- ✓ **Measured value of Rx=670Ω**
- ✓ %difference=0.6%

Discussion

We can derive the equation: $Rx = \frac{R1}{R2} R3$ as follows:

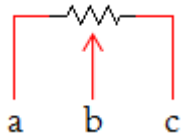
- when Vab=zero : Vx=V1 and V2=V3 *(parallel)*
- when we multiply these two equations the result will be: Vx V2 = V1 V3
- dividing this equation by Ix I1 results in : Rx R2 = R1 R3
- divide the equation by R2 ,the result is $Rx = \frac{R1}{R2} R3$

In this experiment (Part B) we had % difference in the value of Rx; this might be because one of these reasons:

1. It is not easy to adjust the POT accurately.
2. The resistance of wires used to make the circuits.
3. The resistance of the used resistors was slightly less than its theoretical value.
4. Systematic errors.

Conclusion

- ✓ A potentiometer is a variable resistor



$$\mathbf{R_{max} = R_{ac} = R_{ab} + R_{bc}}$$

- ✓ A Wheatstone bridge is a circuit used to measure the resistance of an unknown resistor.

$$Rx = \frac{R1}{R2}\, R3$$