Engineering 65 - Circuit Theory

ID no. 100340871

Lab no. 3

“Resistor Combinations, KCL, KVL, Voltage and Current Dividers, and Wheatstone Bridge”

Lab Report By:

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Section

Friday 9:00 am - 11:50 am

Date

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Objectives

- Through the construction of a given circuit model, the goal is to supply these circuits with specific voltage and resistor with the purpose to exemplify the Kirchoff's formula of voltage and current and compare it to an ideal experimental value.
- By using the given circuit model, derive the internal resistance through the calculation and manipulation of the circuit elements.
- Measuring the branch and the nodes within the circuit given the supply of voltage and the flow of the current.
- Construction a model that resembles the wheatstone bridge which will allow for the measurement of the internal resistance of the circuit.

Introduction

The objective of this lab is to compare and validate the accuracy of the solutions we have derived from the empirical circuit theory formula; ergo, the kirchhoff's law of voltage and current. Given a circuit model as a starting print, we shall construct a replica of the circuits using a breadboard, resistors and wires in order to take the true measured values of the circuit. Furthermore, additional circuits will be constructed along with other resistors to further measure the current and voltage flowing through each resistor and element as emphasis in understanding the subject matter. The idea is to prove that in theory, mathematically finding the voltage and current using Kirchoff's voltage and current formula, the recorded values are ideal; albeit, in actuality when the circuits are constructed and measured, the values recorded will be in proximity but not exact due to margin of errors as a result of energy loss during transmission and measurement error from measuring device.

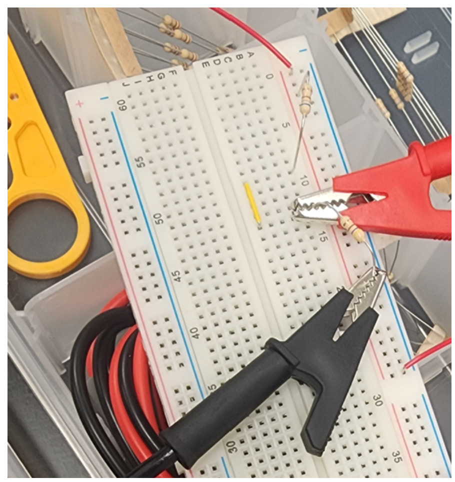
Method and procedure

The first part is to identify three resistors which R1 is 470 ohms, R2 is 100 ohms while R3 is 100 kilo-ohms. Then we will consider the circuit model A in which there is a 10V power source, in which R1 and R2 are in parallel with each other with the current flowing clockwise. Mentally divide the circuits into 4 segments and at each linking segment.. Then by using a power source, we will supply the circuit with 10 V. The last step is to use a voltmeter to measure the circuit at each desired point to retrieve data. The next procedure is to construct another circuit with three resistors as mentioned in the first part. This time, R1 will be in series with R2 while R3 will be in parallel with R2. Again, the same measurement rule will be applied to each segment of the circuits to find both the current and voltage. The third step is by using the same circuit, the resistors that are being used will be replaced with R1 with 470 ohms, R2 with 680 ohms and R3 as 1 kilo-Ohms. Once the resistor has been integrated, we shall take the measurement of both the current and voltage of the circuit as we have done in the second procedure. Leading into the fourth part of the lab consist of constructing another circuit with 10 and 5.6 kilo-ohms resistors in series to each other, we know that when resistors are in series, then we can simplified the circuit into one resistors by adding the two, which will then be compared to the measured value in which we will also measure the voltage, resistance and ampere to compare how the measured total resistance is compared to the theoretical mathematical computation of the circuit. The Fifth component is a repeat of step four; however instead of resistors being in series, the resistors will be in parallel instead. We know that in parallel, the circuit may be simplified by using the formula “R1//R2” - for this aspect, we can then measured each segment of the circuits to find the voltage and current which we can use to compute for the internal resistance of the circuit to emphasis the difference between actually conducting the trails and mathematically computing the resistance of the circuits. The last part of the consist of construction a whole new model of circuits with R1 being 3.3 kilo-Ohms, R2 being 2.2 Kilo-Ohms and Rx is 5.6 kilo-ohms; the goal is being given a pseudo model of the circuit, we will construct a physical model and through measure of the voltage and currents, be able to compute Rx value of the model.

Results and Data Discussion

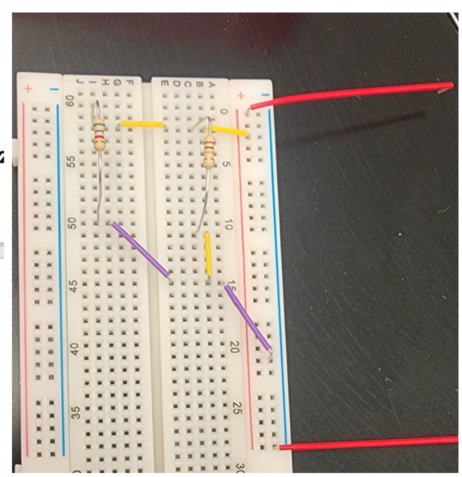
- **R1 = 470 Ohm R2 = 100 Ohm (Parallel Circuit)**

Variable	Theoretic Calculation*	Measured Value
v_{AE}	10V	10.04 V
v_{AB}	8.246 V	8.28 V
v_{BD}	0V	3.6 mV
v_{DE}	1.754 V	1.768 V
i	0.0175 A	0.01448 A



- **R1 = 470 Ohms R2 = 100 Ohms R3 = 100 kOhm (series - parallel Circuit)**

	Theoretic Calculation*	Measured Value
I_{R1}	0.0175 A	0.01342 A
I_{R2}	0.0175A	0.01349 A
I_{R3}	0.0000175 A	0.0000176 A



- **R1 = 470 Ohm R2 = 680 Ohm R3 = 1 kOhm (series - parallel Circuit)**

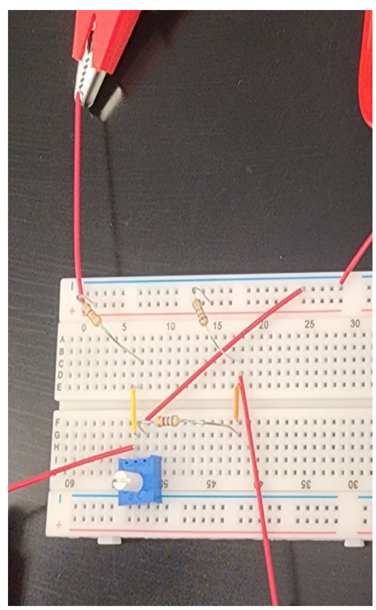
Variable	Theoretic Calculation*	Measured Value
v_{AE}	10V	10.05 V
v_{AB}	4.087 V	4.10 V
v_{BD}	0V	2.7 mV
v_{DE}	5.913 V	5.95 V
i	0.0869A	0.0719 A

	Theoretic Calculation*	Measured Value
I_{R1}	0.0114 A	0.00941 A
I_{R2}	0.00680 A	0.00559 A
I_{R3}	0.00463 A	0.00383 A

- **R1 = 5.6 KOhm R2 = 10 kOhm (Series)**

Theoretical equivalent resistance* =	15600 Ohm
Measured equivalent resistance	A = 627 uA, V = 10.04 V, R = 16012 Measured: 15.47 kOhm

- **R1 = 5.6 KOhm R2 = 10 kOhm (Parallel)**



Theoretical equivalent resistance* =	3590 Ohm
Measured equivalent resistance	V = 10.03 V, A = 3.35 mA, R = 4272 Measured: 3.553 kOhm

Data Summary

Within the first construction of the circuit of 470 and 100 Ohms resistors, we laid the resistors in series to each other, thus by simplifying the circuit using series addition, we then apply the formula v_s = (R1)/(R1+R2) to each of the link segments within the series. The answer can be seen in the theoretical columb while the measured and computed value using the same formula with the only difference of actually measuring the resistance and current of the circuit. The values compared to the theoretical are closed with margins of four to five percent in errors. Theme applying the same concept, we rearranged the first two resistors in parallel and introduced a third resistors consisting of 100 kOhms. While R1 and R2 are in series, R3 will be in parallel. Thus, we are tasked with finding the current that is running to each resistors; thereby, through the application of the Kirchoff's current law, the derived values compared to the theoretical value are also the same - both are in the same range- within the thousands and millionth decimal points. The Next depiction shows the construction of 5.6 kOhm and 10 kOhm resistors in which we will measure the voltage and current to find the resistance by applying the resistance formula - R = V/I. The same procedure will then be done to a circuit with the resistors laying in the parallel to each other. Both the table shows the computed using the measured values to be within the same proximity as the theoretical computations.The Last procedure is constructing a circuit with supply at two points with four resistors in series of a squared figure. The goal is to measured to the resistance of each resistors and by using the formula, Rx = (R2/R1)R3 we can find the fourth unidentified resistors - nonetheless, we will measured the unknown resistors, as for reference, since once we have measured the three other resistors within the circuit, by using the formula, we shall have the unknown calculation closed to that of the measured unknown resistor. Hence, just as expected, both the theoretical and measured computation are aligned with each other, for theoretical is 8.28 kOhms whilst the computed value is 8.4 kOhms

Conclusion

The first circuit model has served as proof to Kirchoff's voltage and current theory, including the various formulas whose derivatives employ the bridge between finding the elementary component of the circuit through mathematical means to identify and understand the behavior of circuits. The five experiments recorded and depicted above substantiate the applicability of circuit's simplification into elementary components with measurement of current and voltage flowing through it will enable us to see how the interconnection of the circuit conforms to the theoretical computation as seen within the lab data. Though the value of the two compared data are not identical, this should be the cause. Error margins to some degree is possible; however anything over single digit percentage should be considered for evaluation.