ECE-LAB-1

I: Cover Page

ECE 101-203

Lab No.2 – Laboratory 3 - Combination Series/Parallel Circuits

Name: Eashan Gupta

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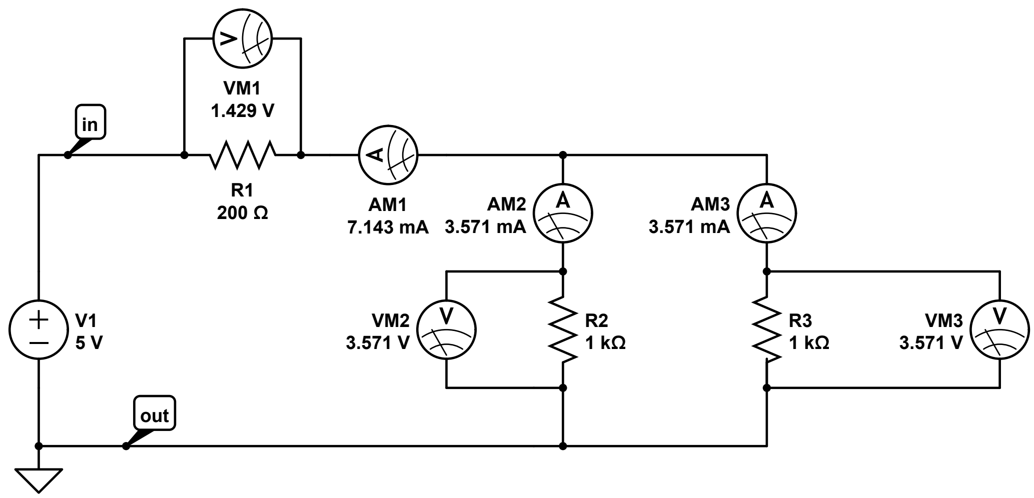
II: Objectives

To learn how circuits with a combination of series and parallel resistors work and how to measure the values in the circuit.

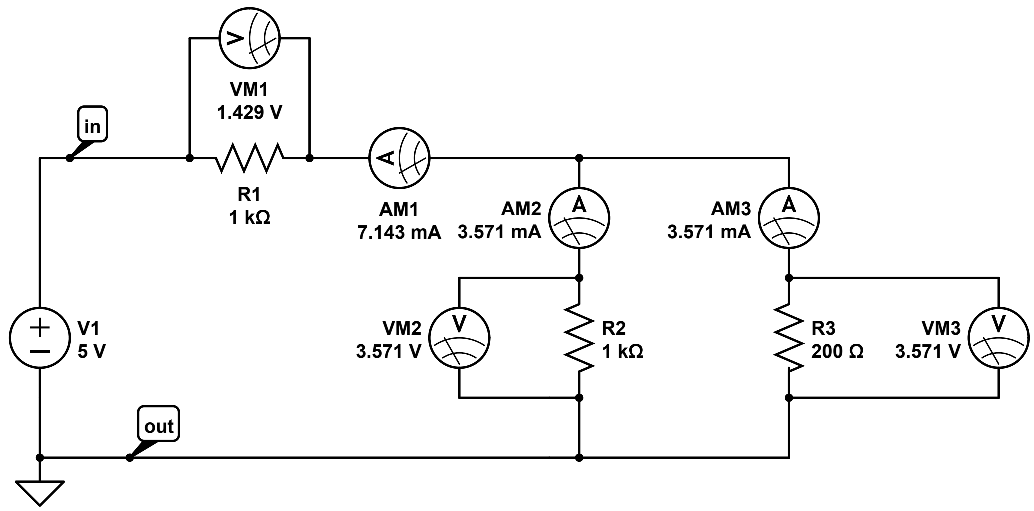
III: Materials and Equipment

- 1 potentiometer
- Brown-Black-Red-Gold resistor(1.0kΩ) 2x
- Red-Black-Brown-Gold Resistor(200Ω)
- Analog Discovery 2
- Two banana to alligator plug wires (one red one black)
- Multi-meter
- Breadboard
- Wire Jumper
- AD2 pin array

IV: Circuit Simulations

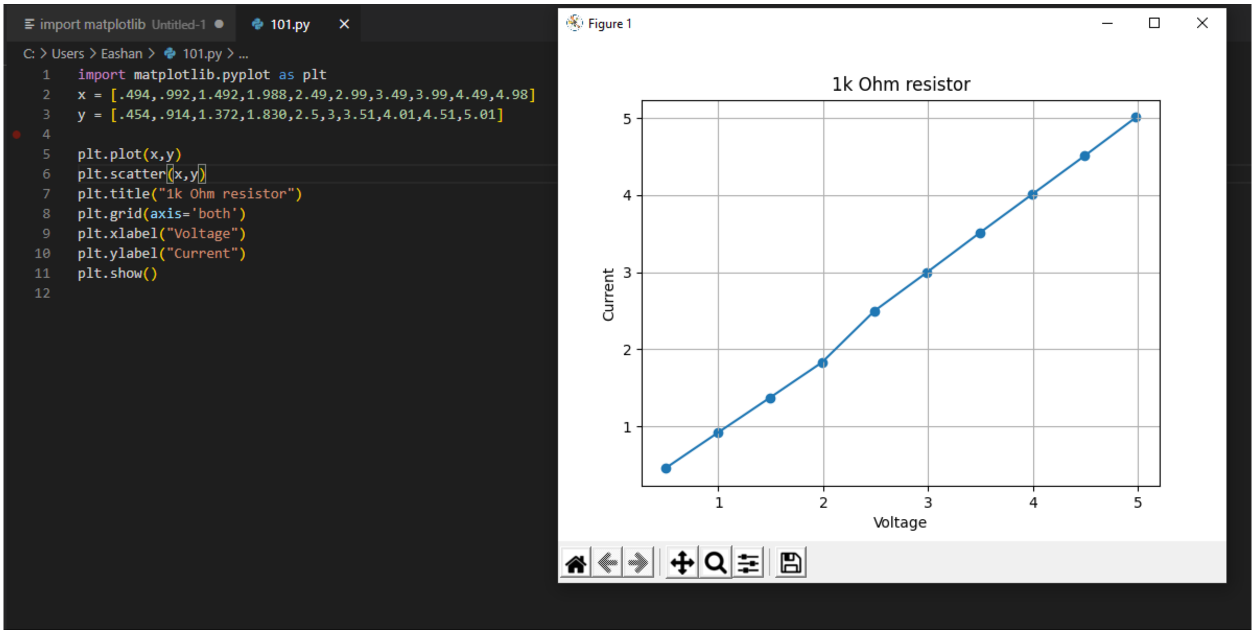


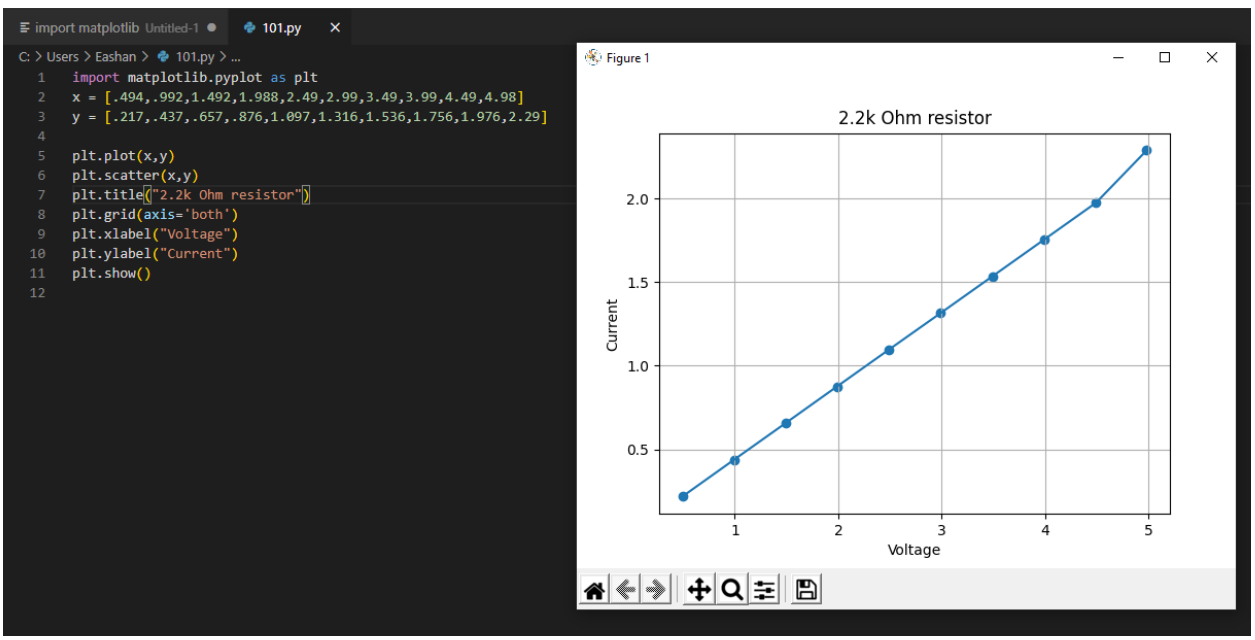
two 1k ohm in series 200 ohm



200ohm and 1k ohm in parallel, in series with 1k ohm

V: Laboratory Data





measurements in total.

2.2 kΩ R	Source Voltage	1 kΩ R	Measured Current (I)	Measured Voltage Drop Across Resistor (V)	Voltage for both resistors	Computed Value of V/I (1000 Ω R)	2.2 kΩ R
.217	0.5 V	.454	~~0.5 mA~~	~~.242 v~~	.494	1088.11 Ω	2276.5 Ω
.437	1.0 V	.914	~~1.0 mA~~	~~.487 v~~	.992	1085.34 Ω	2270.02 Ω
.657	1.5 V	1.372	~~1.4 mA~~	~~.732 v~~	1.492	1087.46 Ω	2270.9 Ω
.876	2.0 V	1.830	~~1.9 mA~~	~~.977 v~~	1.988	1086.34 Ω	2269.4
1.097	2.5 V	2.5	~~2.4 mA~~	~~1.22 v~~	2.49	996	2269.82
1.316	3.0 V	3.0	~~2.9 mA~~	~~1.466 v~~	2.99	996.67	2272.03
1.536	3.5 V	3.51	~~3.3 mA~~	~~1.71 v~~	3.49	994.3	2272.14
1.756	4.0 V	4.01	~~3.8 mA~~	~~1.954 v~~	3.99	995.01	2272.21
1.976	4.5 V	4.51	~~4.3 mA~~	~~2.2 v~~	4.49	995.57	2272.27
2.21	5.0 V	5.01	~~4.8 mA~~	~~2.45 v~~	4.98	994.01	2174.67

This table shows the measured current, measured voltage and the calculated resistance for both the 1k ohm resistor and the 2.2k ohm resistor. The source voltage is the voltage put into the circuit by the AD2. The current for the 1k ohm resistor and the 2.2k ohm resistor are measured using the multimeter. The voltage drop across the resistors is measured with the multimeter too by setting the multimeter to measure volts. The measured voltage drop for both resistors is the same which is why they are displayed in one column. With the values obtained from the voltage drop and current for each resistor the resistance is calculated.

Measurements for part b			Measurements for part c		
I= 1.533mA	V1=3.423	V2=1.646	I=2.53mA	V1=2.482	V2=2.475

This table shows the measured voltage and current for 2 resistors in series. In part b one of the resistor is 1k ohm and the other is 2.2k ohm. The software is used to measure the voltage across each resistor as each resistor is attached to a channel. The multimeter is used to measure the current in the circuit. This is repeated again for part c but the 2.2k ohm resistor is replaced for a second 1k ohm resistor.

in part b.

Measurements for part b					Measurements for part c				
I= 7.27	I1=2.29	I2=5.02	V1=4.908	V2=4.911	I=9.92	I1=5.01	I2=5.01	V1=4.876	V2=4.878

This table shows us how current and voltage are affected when 2 resistors are placed in parallel. When the 1k ohm resistor and 2.2k ohm resistor are placed in parallel we see that the current through both of them are different but the voltage through both are the same. We use the multimeter to measure the current through the resistors and the waveforms to measure the voltage through each resistor. This is again repeated with two 1k ohm resistors.

VI: Theoretical vs Experimental Data

It is theoretically known that the voltage divided by the current results in the resistance. We use our experiment to analyze whether it matches this theory. It is noticed that when the voltage and the current for the 1k ohm resistor are divided a value is attained that is consistently similar to the actual resistance of the resistor. This is repeated with multiple source voltages to see if the results are consitent. It is noticed that with multiple voltages this is consitent thus further proving the rleation between voltage, current, and resistance.

When resistors are in series the voltage across the resistors are distributed in proportion to resistance of the resistors. This is tested in part 2 of the lab. We use the multimeter to measure a value of the current travelling through the circuit. We then use the waveforms software to check the voltage across each channel. Each channel is connected to a resistor thus showing the voltage drop across the individual resistor. The values attained in the experiment match the theory that the voltage drop will be proportional to the resistance. This is tested with a 1k ohm resistor and a 2.2k ohm resistor initially which lead to voltage drops of 1.546v and 3.423v. This is again repeated with both the resistors being 1k ohm and in this case the voltage drop across the resistors is the same. With our experiments it is once again shown that the theoretical data matches the experimental data.

When resistors are in parallel the the voltage across them is the same. If there are x volts going through the wire before it splits into parallel wires then both the wires will have x volts going through them. But, in parallel, the current isn't divided evenly. In the experiment a 1k ohm resistor and a 2.2k ohm resistor are placed in parallel. The multimeter is used to record the current passing through the resistors and as expected the values for both the resistors are not equal. The waveforms software is used to measure the voltage across each resistor and they are equal as expected. This is repeated again with two 1k ohm resistors. In this case the current and the voltage are same for both resistors as expected.

VII: Conclusions and Comments

From the observations made from the theoretical data and the experimental data and how they relate with each other, it is safe to say that the results of this lab could be predicted and in fact were predicted and correct. All the experimental data was correct and was completed as expected. We were able to confirm Kirchoff's Voltage law in part 2 by looking at how the voltage was distributed based on the proportion of the resistance. In part 3 we were able to confirm Kirchoff's current law in the parallel circuit by looking at how in a parallel circuit with 2 different resistances across the parallel wires the voltage was the same but the current wasn't. This experiment was successful in helping to learm more about KVL and KCL and successfully demonstrated how they work. In the lab we weren't able to test KCL and KVL for multiple different voltages which may serve as a limitation.

IX: Answers to Questions

1. The voltage drop across the resistor divided by the current flowing through it equals the resistance of the resistor. ($V/I = R$)
2. As the voltage increases the resistance increases, whereas as the current increases the resistance decreases
3. Yes this experiment does verify Ohm's law because Ohms law states that $I = V/R$ and in this experiment we can see the same relationship between Resistance, Current and Voltage. In our experiment the voltage divided by the current consistently was similar to the actual resistance.
4. Yes, there were slight differences of .01 volts between the source voltage and the resistance drop across the resistor. The reason for the difference in voltage drop across the resistor and the source voltage could be because of the resistance in the wire.
5. The sum of V1 and V2 is equal to the source voltage in both parts.
6. Based on Kirchoff's Voltage law the sum of the voltage drop across resistors in a series will be equal to the source voltage. We can see in this case that that holds true as the sum of V1 and V2 in both cases does equal the source voltage.
7. Vs/I = Req V1/I = R1 V2/I = R3

R1 + R3 = Req

We can see a clear relation between the resistance of the resistor and the voltage drop across the resistor. The voltage drop across the resistors is in proportion with the resistance of the resistor when in series.

8. The resistor would be 3.2k ohms
9. I2 + I3 is equal to I in both parts b and c
10. V1 and V2 are equal to the source voltage in both parts
11. Kirchoff's current law states that at a junction the current in will be equal to the current out. Also, current will be divided in a parallel circuit. In this experiment we can see that the current that enters the junction is equal to the current that leaves the junction thus following Kirchoff's current law.
12. I1xR1 is equal to the voltage across resistor 1 and I2xR2 is equal to Voltage across R2
13. 687.5 Ohm resistor