Experiment 1

Electronics Lab Review

EGT 243 - AC Circuit Analysis

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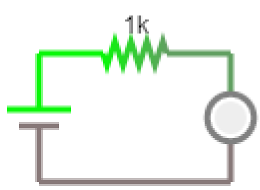
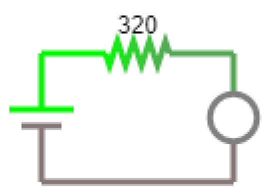
Introduction
The purposes of this experiment are as follows: allow students to build a physical circuit using multiple different components, build familiarity with lab equipment and the mentioned components, and utilize the learned formulae to compute theoretical circuit values, then test those values against real-world models.

Required Components

- 1KΩ resistor
- 320Ω resistor (or 100Ω & 120Ω in series)
- White LED
- Breadboard with Jumper Wires
- Multimeter with Probes
- DC Power Supply

Schematic Design

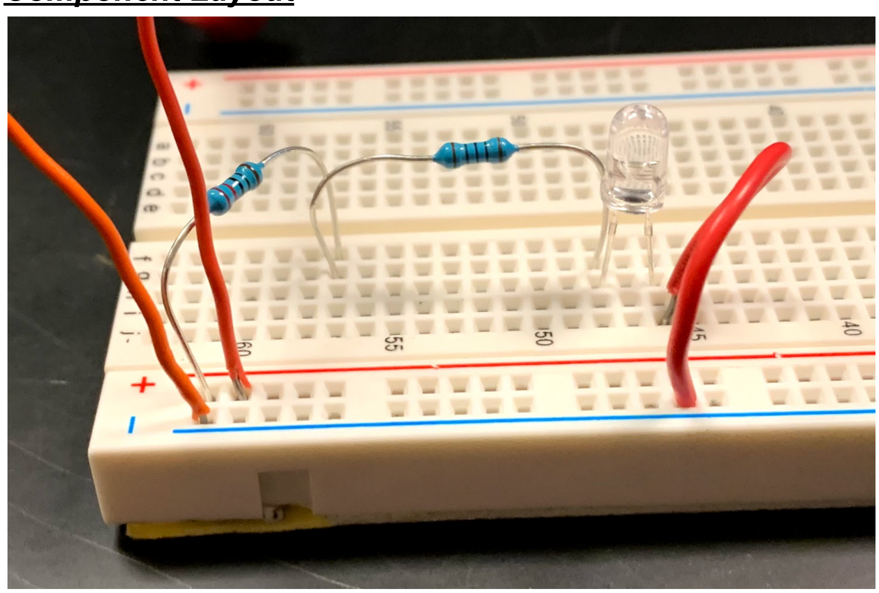




^ Used in part 1, 2, and 3

^ Used in part 4

Component Layout



Procedure

Part 1:

1. Using the provided schematic write out the known values to the circuit.
2. Taking the known values, calculate the unknowns using Ohm's Law.
3. Report the calculated values in a table.

Part 2:

1. Rebuild the circuit using the schematic provided in part I on the "Falstad" online simulator.
2. Simulate the circuit and find out the values that it would yield.
3. Report the results in a table.

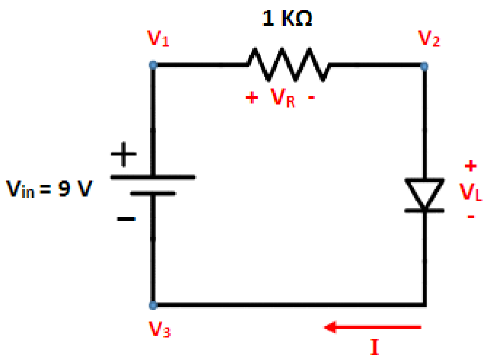
Part 3:

1. Build the circuit provided from the schematic and with a specified resistor.
2. Measure the value of the resistor and record the value.
3. Add the resistor to the circuit and measure values across the components.
4. Report the results in a table.

Part 4:

1. Using the provided schematic write out the known values to the circuit.
2. Using Ohm's Law, calculate how much resistance is needed to limit the current of the circuit to 30 mA.
3. Report the results and calculations.
4. Using the resistor value that the instructor provided, calculate how much voltage was needed to provide 40 mA of current.
5. Report the results and calculations.
6. Using the results from the previous calculations simulate the circuit on the "Falstad" online simulator.
7. Report the simulation results.
8. Build the circuit from the simulation and increase the voltage to reach 40mA of current.
9. Report the results and compare them all in one table using the past calculated and simulated values.

Calculations



Part 1:

- $VR = (Vin - VL) = (9 - 3 = 6)$
- $VL = 3$
- $V1 = Vin$
- $V2 = (V1 - VR) = (9 - 6 = 3)$
- $V3 = (Vin - VR - VL) = (9 - 6 - 3 = 0)$
- $I = (VR / R) = (6 / 1000 = 0.006)$

Part 4:

- $R \text{ to limit } I \text{ to } 30mA \text{ (with } Vin = 12V) = ((Vin - VL) / 0.03) = ((12 - 3) / 0.03 = 300$
- $Vin \text{ to draw } 40mA \text{ (with } R = 320) = ((R * 0.04) + VL) = ((320 * 0.04) + 3 = 15.8$
  - $VR = (Vin - VL) = (15.8 - 3 = 12.8)$

Experimental Results

Part 1: Calculated Values					
V_R	V_L	V_1	V_2	V_3	I
6V	3V	9V	3V	0V	6mA

Part 2: Simulated Values					
V_R	V_L	V_1	V_2	V_3	I
7.247V	1.753V	9V	1.753V	0V	7.247mA

Part 3: Measured Values						
R	V_R	V_L	V_1	V_2	V_3	I

997Ω	6.13V	2.77V	8.9V	2.77V	0V	6.08mA

Part 4	V_{in}	V_R	V_L	I
Calculated	15.8V	12.8V	3V	40mA
Simulated	15.4V	12.82V	2.58V	40.05mA
Actual	16.7V	13.29V	3.21V	40.05mA

Discussion

Using the values from the schematic that was provided we expected to need between 15.4V and 15.8V to obtain the 40mA of current. This hypothesis was based on the calculated and simulated values we obtained and tested. The difference between these values and the actual value was pretty big considering the amount of current we were aiming for. The first difference was in the amount of voltage drop we obtained from the resistor as well as the voltage load the LED went through, this difference was the cause of needing more volts to obtain the desired voltage. Since the difference was pretty big I believe the results did not support our hypothesis and were most likely caused by the physical component's tolerance and the unaccounted for extra resistance of the breadboard.

Conclusion

In summary, we were able to review the implementation of Ohm's Law and the rules/functions of breadboard circuits. Given the components and tools, we were able to measure the voltage drops, voltage loads, and resistance of various components. Along with comparing values that are calculated, simulated, and actually tested. This yielded us an understanding of the differences and unexpected results one may get by unexpecting variables such as unaccountable extra resistance. These results allow us to plan for the future where we take the extra resistance into the overall resistance and tolerance of the components into consideration to produce a higher quality of results.

References

Principles of Electric Circuits: Conventional Current Version, 10th Edition, Thomas L. Floyd, Pearson, 2019. (ISBN-13: 9780134879482)

Appendices

1A. Ohm's Law - a law stating that electric current is proportional to voltage and inversely proportional to resistance. (Oxford Languages, 2021)

1B. Breadboard - a construction base for practicing electronic circuits.
1C. Falsad Online Circuit Simulator: https://www.falstad.com/circuit/