

To: Dr. Evans and Ms. Kolesnikov
From: Luke DeVries
Date: October 1, 2024
Re: Electrical Project Test Results Analysis

Purpose

This project was designed to expose students to the design process and concepts of electrical circuits and test their math skills over circuits. This memo will be focused on the testing of the designed circuit and understanding the results that were found. The circuit was built within the following constraints of only 25 resistors to build from and specified voltages at each of 5 nodes to an accuracy within 5% of those specifications.

Introduction

Testing was done by either the professor or the teacher's assistant. After receiving the student's circuit, they would connect the 18 V DC power with a current of 0.0009 A. By using a multimeter, they would test the voltage from the beginning of the circuit to the end of each node. Students were asked to write down these test results at each node to compare to their specification values. Once all nodes were tested and confirmed to be within 5% of the specifications, the professor or teacher's assistant would sign off on the student's test sheet, confirming that they passed testing.

Test Results

Table 1 below shows the information from the design specifications, designed calculations, and tested values. This information is used to identify if the design successfully passed its test, and also allowed for the calculation of percent differences. Values for DeSpecV were given from the specifications for circuit network 37, and values for ExpectV were found during the design step of the project (DeVries 2024). ActualV values were found during the testing procedure and shown in appendix A (page 4). Appendix B (page 5) shows all remaining calculations for the %Diff values. Appendix C (page 6) contains figure 1, a digital schematic for the designed circuit of network 37. Appendix C (page 6-7) also contains figure 2.1 and 2.2, the physical breadboard of the circuit used for real world testing.

Table 1. Values found for electrical circuit voltages and percent differences.

Node	DeSpecV	ExpectV	ActualV	%Diff (ActualV vs DeSpecV)	%Diff (ExpectV vs ActualV)
1	17.276 V	17.2575 V	17.32 V	0.25%	-0.36%
2	9.4742 V	9.4905 V	9.49 V	0.17%	0.01%
3	4.1538 V	4.1445 V	4.16 V	0.15%	-0.37%
4	1.8978 V	1.8945 V	1.91 V	0.64%	-0.81%
5	0 V	-0.0135 V	0 V	undef	undef

Values and Calculations

Equation 1 $V_2 = V_1 - \Delta V$

Equation 2 $\%Diff (A \text{ vs } B) = \frac{(A-B)}{B} * 100\%$

Following the row for node 1, calculations for the values were found through the following steps. First, DeSpecV was given in the circuit specifications for network 37 as described in the design memo (DeVries 2024). Values for ExpectV were found through equation 1, by taking V_1 = the voltage in and ΔV = the voltage drop at the node as found in the design memo which resulted in $V_2 = 17.2575 \text{ V}$ (DeVries 2024). ActualV values were taken from the real-world testing, as documented in appendix A on page 4. Percent difference values were all found using equation 2. For ActualV vs DeSpecV, the variables were $A = 17.32 \text{ V}$ and $B = 17.276 \text{ V}$ which yielded 0.25%. For ExpectV vs ActualV, the variables were $A = 17.2575 \text{ V}$ and $B = 17.32 \text{ V}$ which yielded -0.36%.

Percent Difference Results

The most important set of percent difference values was the ActualV vs DeSpecV, since this column was the deviation from the specifications of the design project and confirmed either a pass or fail for the testing. As table 1 shows, the test was within the 5% tolerance for all five nodes in that column, which resulted in a pass for the test. The differences between DeSpecV, ExpectV, and ActualV were due to the ways in which they were found. For DeSpecV, the values were simply given in the project specifications and were the ideal values to aim for in the design. ExpectV was calculated using the designed resistor configurations which yielded a voltage drop which was subtracted from the voltage in. This was the design's idealistic values assuming that the resistors were exact with no tolerance. ActualV was tested in the real-world using resistors with tolerances of 5%. These values should be the closest to ExpectV, but due to the reality of tolerances, they were not able to precisely meet those values.

What Would I do Differently if Done a Second Time?

If given a second chance at doing the project, there is not much I would need to change. Since it resulted in a successful test, the design itself has no real issues, but there are ways to make it better. I utilized nearly all the resistors that were given in the constraints (19/25), which meant that I almost depleted all the resources of the project. To once again challenge myself and learn the skill of cost-effectiveness, I would choose to reduce the number of resistors I used, while trying not to compromise the design and still successfully meeting requirements within the 5% bounds.

I have neither given nor received any unauthorized help on this assignment, nor witnessed any violation of the UNC Charlotte Code of Student Academic Integrity.

Luke DeVries 10/1/2024

References

DeVries, Luke. 2024. Memorandum to Dr. Evans and Ms. Kolesnikov. "Electrical Design Project," September 26.

Appendix A. Values found during testing.

Electrical Test Data Sheet
Individual Assignment

Name: Luke DeVries Circuit#: 37 Section: 015

Enter required node voltages at each node in the first column (from your design requirements sheet). Record test results in the Test 1 column. If these results are not within 5 percent, then use Test 2, and (if needed) Test 3 columns. There will be a point deduction for each subsequent test after Test 1. During the test, have access to your calculations and "as built" circuit diagram.

This will be submitted as an Appendix to your Electrical Lab Report

Electrical Project Test Results Table

Node	Required Node Voltage (V) (from Circuit Sheet)	Test 1 Voltage (V)	Test 2 Voltage (V)	Test 3 Voltage (V)
Node 1	+18.1398 V -16.4122 V 17.276V	17.32 V		
Node 2	+9.94791V -9.00049V 9.4742V	9.49 V		
Node 3	+4.36144V -3.94611V 4.1538	4.16 V		
Node 4	+1.99269V -1.80291V 1.8978	1.91 V		
Node 5	0 + 0V - 0	0 V		

Test 1 notes: Passed

Tester: Anastasia K. Score (100 maximum): 100

Test 2 notes: _____

Tester: _____ Score (70 maximum): _____

Test 3 notes: _____

Tester: _____ Score (40 maximum): _____

Figure 1. Electrical Test Data Sheet.

Appendix B. Table Calculations.

Equations Used

Equation 1 $V_2 = V_1 - \Delta V$

Equation 2 $\%Diff (A \text{ vs } B) = \frac{(A-B)}{B} * 100\%$

ExpectV

Node 1: $ExpectV = 18 \text{ V} - 0.7425 \text{ V} = 17.2575 \text{ V}$

Node 2: $ExpectV = 17.2575 \text{ V} - 7.767 \text{ V} = 9.4905 \text{ V}$

Node 3: $ExpectV = 9.4905 \text{ V} - 5.346 \text{ V} = 4.1445 \text{ V}$

Node 4: $ExpectV = 4.1445 \text{ V} - 2.25 \text{ V} = 1.8945 \text{ V}$

Node 5: $ExpectV = 1.8945 \text{ V} - 1.908 \text{ V} = -0.0135 \text{ V}$

ActualV vs DeSpecV

Node1: $\%Diff (ActualV \text{ vs } DeSpecV) = \frac{(17.32 \text{ V} - 17.276 \text{ V})}{17.276 \text{ V}} * 100\% = 0.25\%$

Node 2: $\%Diff (ActualV \text{ vs } DeSpecV) = \frac{(9.49 \text{ V} - 9.4742 \text{ V})}{9.4742 \text{ V}} * 100\% = 0.17\%$

Node 3: $\%Diff (ActualV \text{ vs } DeSpecV) = \frac{(4.16 \text{ V} - 4.1538 \text{ V})}{4.1538 \text{ V}} * 100\% = 0.15\%$

Node 4: $\%Diff (ActualV \text{ vs } DeSpecV) = \frac{(1.91 \text{ V} - 1.8978 \text{ V})}{1.8978 \text{ V}} * 100\% = 0.64\%$

Node 5: $\%Diff (ActualV \text{ vs } DeSpecV) = \frac{(0 \text{ V} - 0 \text{ V})}{0 \text{ V}} * 100\% = \text{undef}$

ExpectV vs Actual V

Node1: $\%Diff (ExpectV \text{ vs } ActualV) = \frac{(17.2575 \text{ V} - 17.32 \text{ V})}{17.32 \text{ V}} * 100\% = -0.36\%$

Node 2: $\%Diff (ExpectV \text{ vs } ActualV) = \frac{(9.4905 \text{ V} - 9.49 \text{ V})}{9.49 \text{ V}} * 100\% = 0.01\%$

Node 3: $\%Diff (ExpectV \text{ vs } ActualV) = \frac{(4.1445 \text{ V} - 4.16 \text{ V})}{4.16 \text{ V}} * 100\% = -0.37\%$

Node 4: $\%Diff (ExpectV \text{ vs } ActualV) = \frac{(1.8945 \text{ V} - 1.91 \text{ V})}{1.91 \text{ V}} * 100\% = -0.81\%$

Node 5: $\%Diff (ExpectV \text{ vs } ActualV) = \frac{(-0.0135 \text{ V} - 0 \text{ V})}{0 \text{ V}} * 100\% = \text{undef}$

Appendix C. Circuit Network 37.

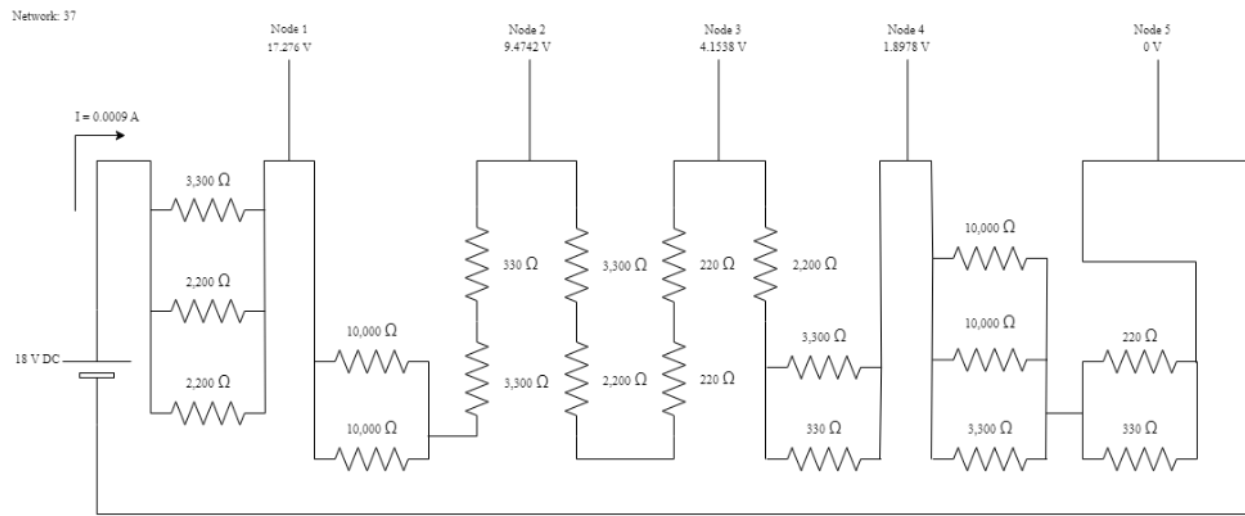


Figure 2.1. Designed computer generated schematic of network 37.

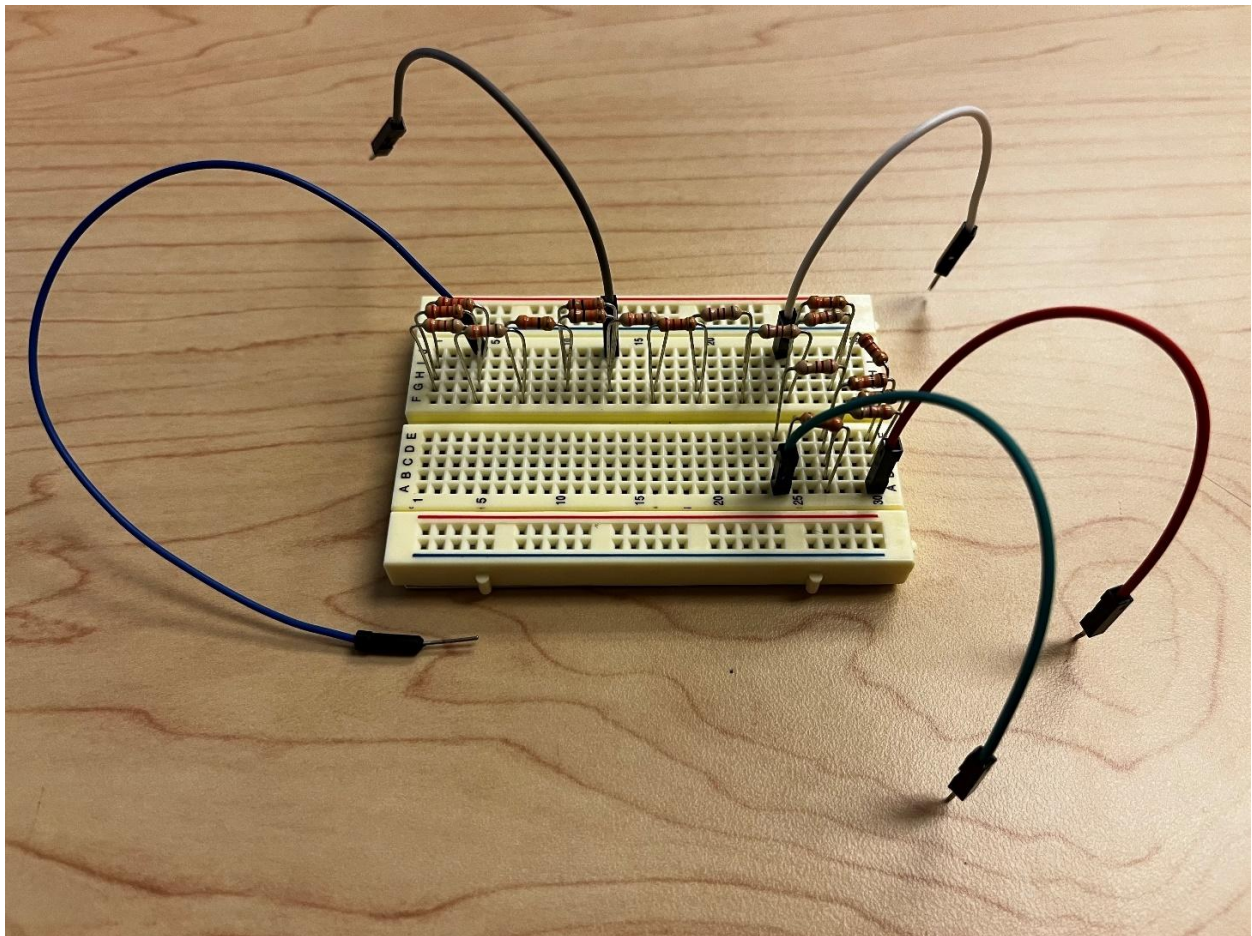


Figure 2.1. Physical design of network 37 on breadboard.

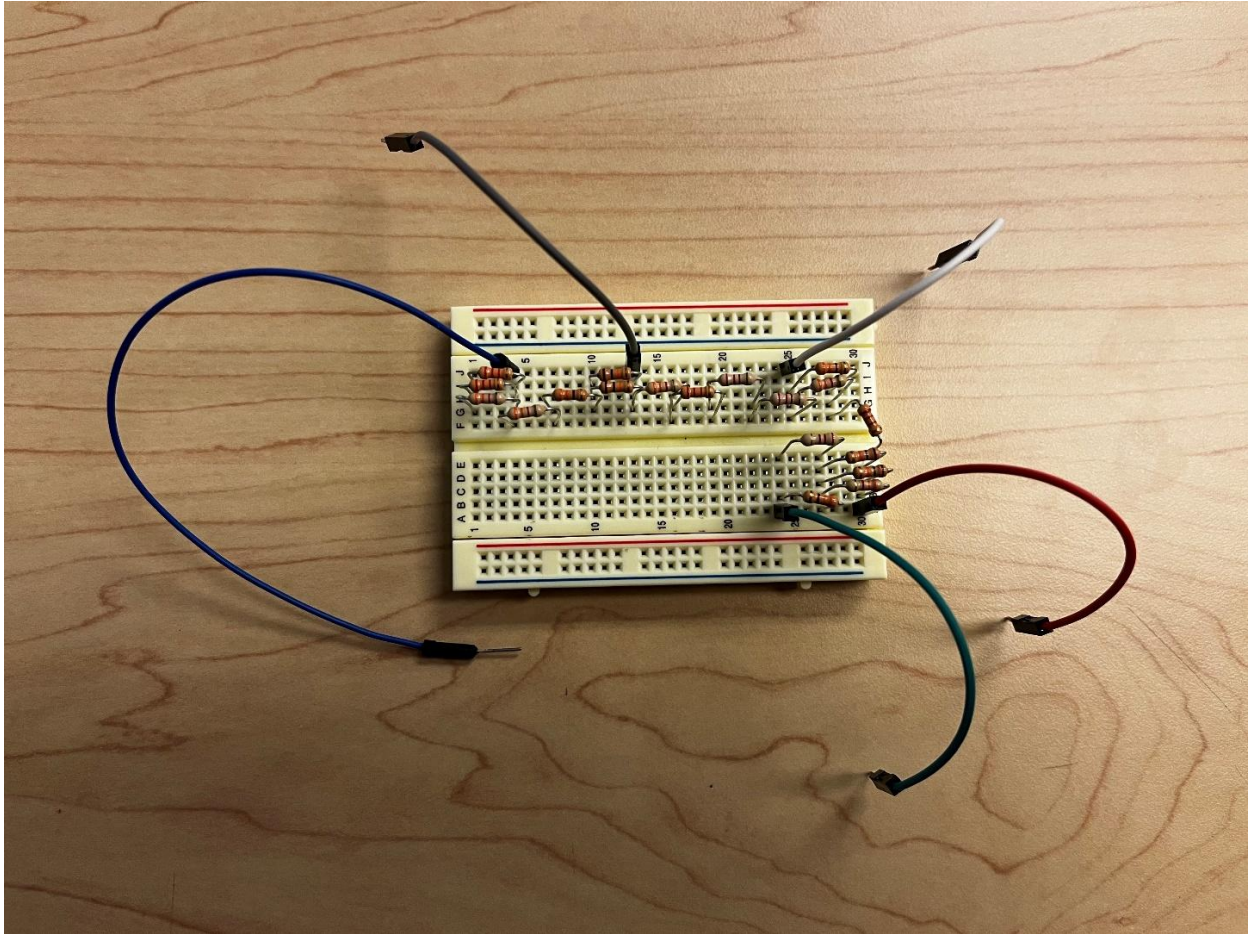


Figure 2.2 Top-down view of physical design of network 37 on breadboard.