ELEC-2110

Electric Circuit Analysis

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LAB SECTION: 002

Electrical Measurements: More Practice with DC Measurements

Introduction

The Objective of this lab was to practice more with the Elvis board and learn how to use its software. The Elvis board computer software comes with a variety of tools that are very helpful with circuits constructed on the board. The "Variable Power Suppies" app was mostly used in this lab to set a variable voltage of 7 volts.

Exercise 1

1. In exercise 1, we were asked to use the NI ELVIS board's 5 V [fixed] power supply and variable power supply (set at 7 V). We then set up the variable power supply as shown in Figure 1 (shown below) and verify the voltage with a DMM as shown in Figure 2 below. We were then also asked to verify the voltage of the 5 V supply and record the measured values of the power supplies in your lab report [1]. Measured value of variable voltage is below in Table 1.

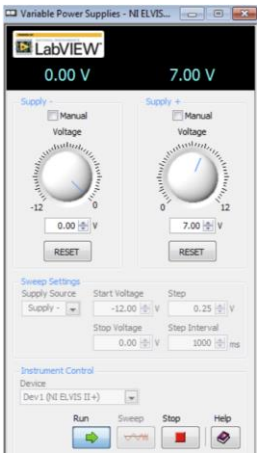


Figure 1

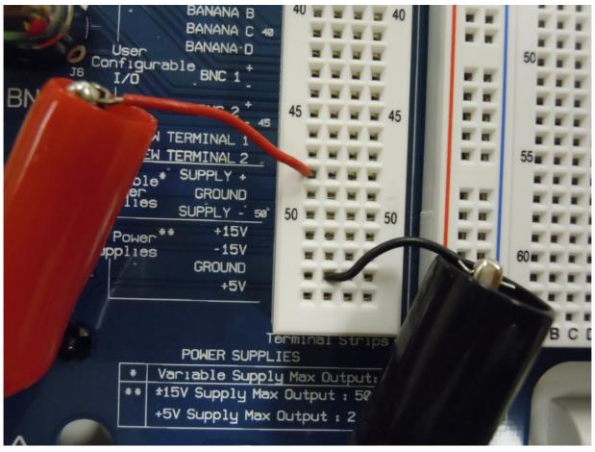


Figure 2

Variable Voltage	6.98V

Table 1

Exercise 2

All resistors used in the exercises will be theoretically 330 Ω. We were asked to create a table of the resistors measured values (R1 through R7) [1]. The measured resistance is shown below in Table 2.

Theoretical Resistance 330 Ohm	**Actual Resistance**
R1	322.13
R2	326.93
R3	326.80
R4	326.69
R5	321.67
R6	326.61
R7	320.95

Table 2

Exercise 3

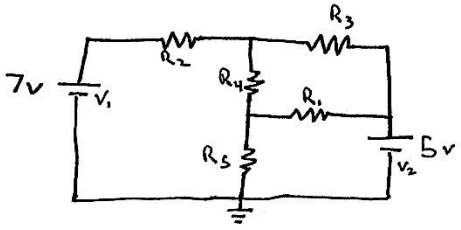
In exercise 3, we were asked to Breadboard the circuit in Figure 3 below. We were the asked to [1]:

- Measure V_A, V_B, V_C, V_D, V_{AC}, and V_{BC}. We also we to verify Kirchhoff's Voltage Law using V_A, V_C, and V_{AC}.
- Verify Kirchhoff's Voltage law using VB, VD, and VBD.
    - $V_{AC} = V_A - V_C$
    - $V_{BD} = V_B - V_D$
- Using the measurement for I_{DC}, calculate the value for I_{AB} (do not use your voltage measurements from this exercise in this calculation).

Measurements are below in Table 3 and equations and work used are in Equations 1.

Variables	Measured Values	Calculated Value
V_A	6.9259v	-------
V_B	5.0855	-------
V_C	4.9042	-------
V_D	3.3259	-------
V_{AC}	2.0447	1.84
V_{BD}	1.7558	1.7596
I_{DC}	-4.9mA	-------
I_{AB}	-------	5.94

Table 3



$I = \frac{V}{R}$

$V_{AB} = V_A - V_B$

$V_{AB} = 1.8404$

$I_{AB} = \frac{V_{AB}}{R_2} \Rightarrow \frac{1.84}{326.93}$

$I_{AB} = 5.63mA \Rightarrow 5.62934$

$V_{BD} = 1.7596$

$I_{BD} = \frac{1.76}{R4(326.69)}$

$I_{BD} = 5.386146$

$I_{BC} = \frac{V_{BC}}{R_3}$

$V_{BC} = V_B - V_C$

$I_{BC} = \frac{0.18}{326.8}$

$V_{BC} = 0.18$

$I_{BC} = 0.55\ldots$

$I_{AB} = I_{BC} + I_{BD}$

$I_{AB} = 0.55\ldots + 5.48mA$

$I_{AB} = 5.9409\ mA$

Equations 2

Exercise 4

In exercise 4, we were asked to breadboard the circuit in Figure 3 below. We were then asked to [1]:

- Measure V_A, V_B, and V_C. Verify these node voltages using nodal analysis.
- Measure I_{BA}, I_{B0}, and I_{BC}. Verify using Kirchhoff's Current Law at node B.
- Calculate I_{BA}, I_{B0}, and I_{BC} using your measured node voltages and resistor values (Ohm's Law).

All Values are listed in Table 4 below and equations used are in Equations 2.

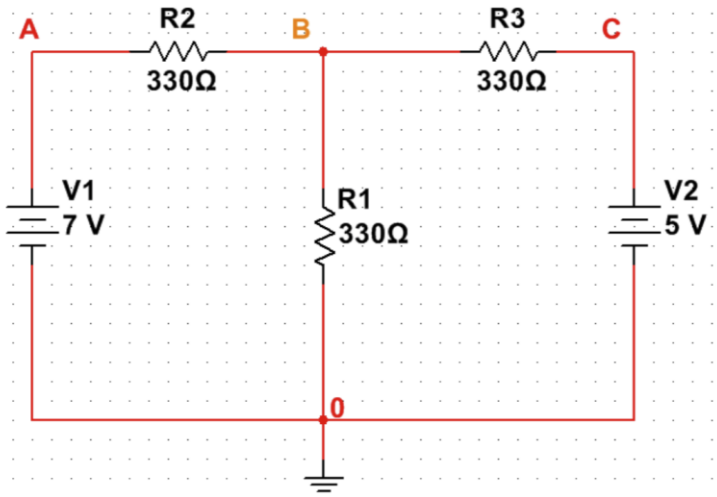
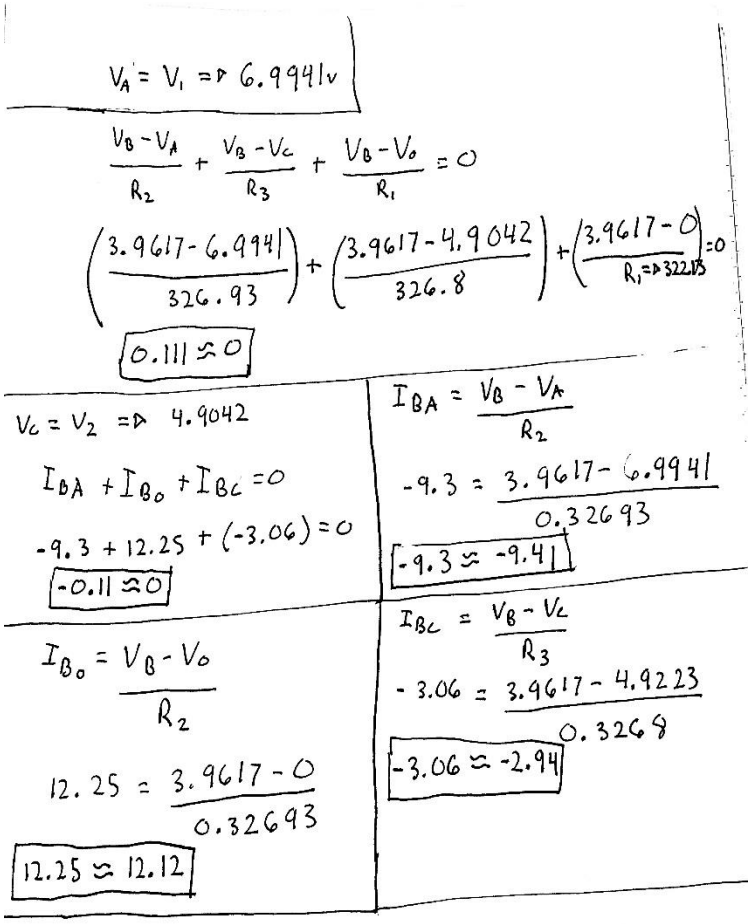


Figure 3

Variables	Measured Values
Va	6.9941v
Vb	3.9617
Vc	4.9523
I_{BA}	-9.3mA
I_{B0}	12.25 mA
I_{BC}	-3.06 mA

Table 4



Equations 2

Exercise 5

In exercise 5, we were asked to Breadboard the circuit in Figure 4 shown below. Using the circuit constructed on the Elvis Board, we were asked to [1]:

- Measure V_{AC}, V_{AB}, V_{AD}, V_B, V_C, V_{CE}, V_D, V_{DE}, and V_E.
- Measure I_{AC}, I_{AB}, I_{AD}, I_{C0}, I_{CE}, I_{D0}, I_{DE}, and I_{E0}.
- Calculate the power absorbed by every element in the circuit.
- Verify that the sum of power absorbed by all circuit elements equals 0 W.

Data is shown below in Table 5 and formulae and equations used are in Equations 3.

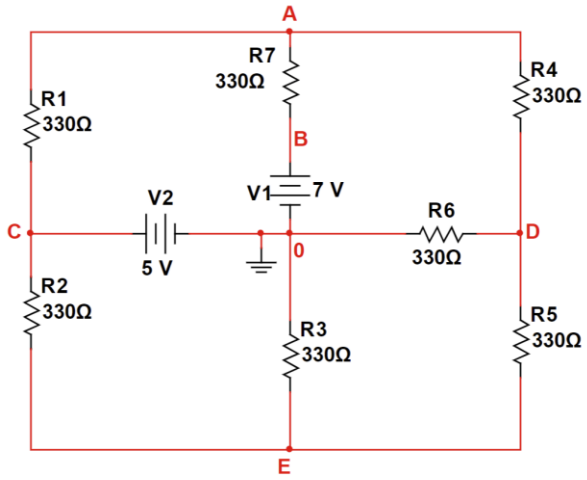


Figure 4

Voltage	Values (in Volts)
V_{AC}	0.16361V
V_{AB}	-2.1933 V
V_{AD}	-2.3815 V
V_{B}	6.9928 V
V_{C}	4.8003 V
V_{CE}	2.3482 V
V_{D}	2.4177 V
V_{DE}	-35.827 mV
V_{E}	2.4532 V

Table 5

Current	Value
I_{AC}	-0.42mA
I_{AB}	-6.88mA
I_{AD}	7.25mA
I_{C0}	-8.01mA
I_{CE}	7.65mA
I_{D0}	7.36mA
I_{DE}	-0.13mA
I_{E0}	7.56mA

Table 6

$P_{R_1} = \frac{V_{AC}^2}{R_1}$ $P_{R_2} = \frac{V_{CE}^2}{R_2}$ $P_{R_3} = \frac{V_E^2}{R_3}$ $P_{R_4} = \frac{V_{AD}^2}{R_4}$

$P_{R5} = \frac{V_{DE}^2}{R_5}$

$P_{R_1} = 0.083\,mW$ $P_{R_2} = 16.866\,mW$ $P_{R_3} = 18.4155\,mW$ $P_{R_4} = 17.36\,mW$

$P_{R5} = 3.99\,MW$

$P_{RG} = \frac{V_D^2}{R_G}$ $P_{R_7} = \frac{V_{AB}^2}{R_7}$

$P_{RG} = 17.897\,mW$ $P_{R_7} = 14.9885\,mW$

$P_{V_1} = I_{AB} V_1$ $P_{V_2} = I_{C0} V_2$

$P_{V1} = -48.1194\,mW$ $P_{V2} = -40.734855\,mW$

- $P_{R_1} + P_{R_2} + P_{R_3} + P_{R_4} + P_{R5} + P_{RG} + P_{R_7} + V_1 + V_2$

Equations 3

Conclusion

This lab was used as an overview and refresher with the Elvis Board and breadboarding circuits. The circuits and calculations were slightly more advanced than previous labs and I did run into some difficulties along the way. My TA was able to help with measuring the voltage and currents correctly and some peers were able to show how to check my measurements with calculations correctly. This lab was a good refresher for breadboarding and using formulae to verify measured information.

Bibliography

[1] Eidson, Brandon, and Elizabeth Devore. *EXPERIMENT 3 Electrical Measurements: More Practice With DC Measurements*. 2016, p. 5, Accessed 4 Sept 2019.