Memorandum

Date: September 29th , 2014
To: EE 222 Insturctors
From: Aly Shehata
Subject: EE2 222 Laboratory Experiment 3

Introduction:

In this experiment we evaluate a multiple resistive circuit for its Thevenin and Norton Equivalence. We were also introduced to the concept of load lines.

Experiment:

A. Measuring our Circuit:

For this part of the lab we connected the Bench Power Supply V+ as Vin and used the substation box as RL. The circuit is shown below.

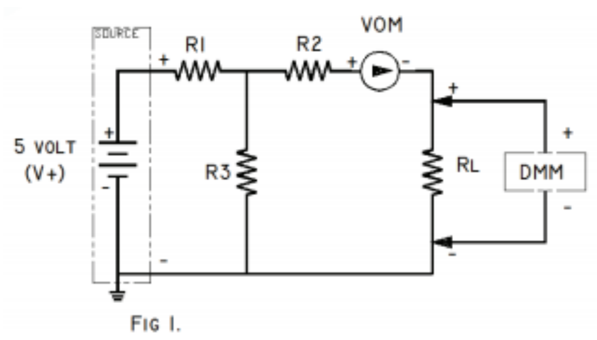

Figure 1: Circuit 1 (Source: Experiment Info)

We inserted the VOM in series with RL to measure the current and the DMM across RL to measure Vo.
The results are shown below.

Table 1

V_{oc}	5.06V
V_l	2.685

We then set RL equal to each of the required values and measured the current and the DMM across RL to measure Vo. The results are shown below.

Table 2

R_L	V_{Dmm}	I_{vom}
∞	2.532V	0A
10KΩ	2.2V	0.21mA
1KΩ	1.011V	1mA
100Ω	0.158V	1.5mA
0Ω	0	1.6mA

We were then able to calculate Rth using the formula shown below:

$$\boldsymbol{R_{th} = \frac{V_{oc}}{I_{sc}} = \frac{2.532V}{1.6mA} = 1.58k\Omega}$$

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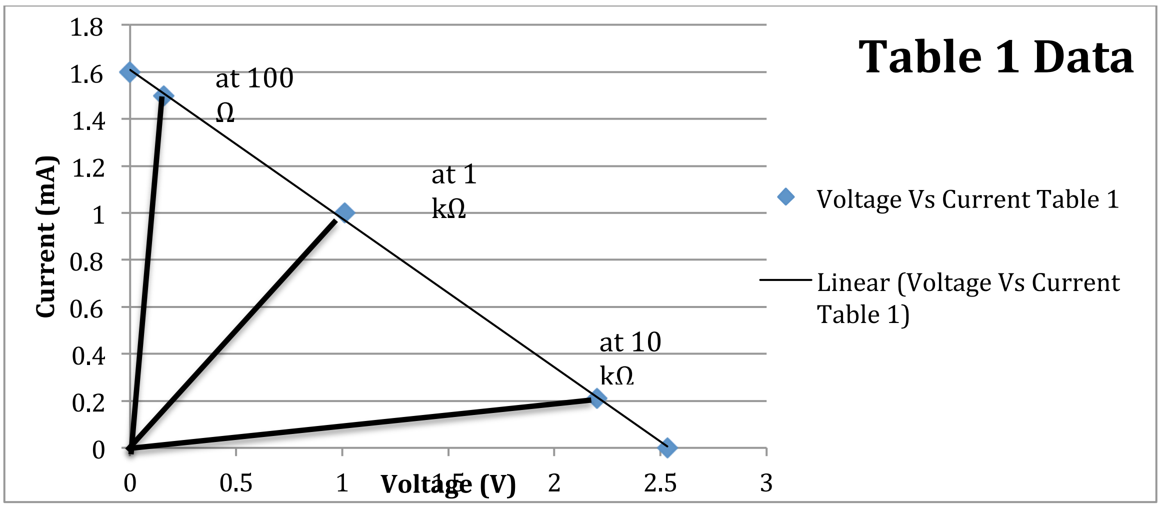
Eq. 1

We then plotted the Io vs Vo curve. The y-axis represented the current and the x-axis represented the voltage. We drew a line between the open circuit voltage and short circuit current to indicated the load line. We then drew a line from the origin through each of the data points. These represent the resistance.

Figure 2



B. Constructing Thevenin Equivalent Circuit:

Using this information we were able to construct the Thevenin Equivalen circuit that contained our voltage source, Thevenin resistance and a load resistance. Our Vin was approximately 5.05 V.

We inserted the VOM in series with RL and the DMM across Rl. We repeated the measurements as the original circuit and plotted the data points on the graph.

Below are the measurements and the graph that represents both tables.

Table 3

R_L	V_{Dmm}	I_{vom}
∞	2.523V	0A
10KΩ	2.195V	0.21mA
1KΩ	1.012V	0.95mA
100Ω	0.159V	1.5mA
0Ω	0	1.6mA

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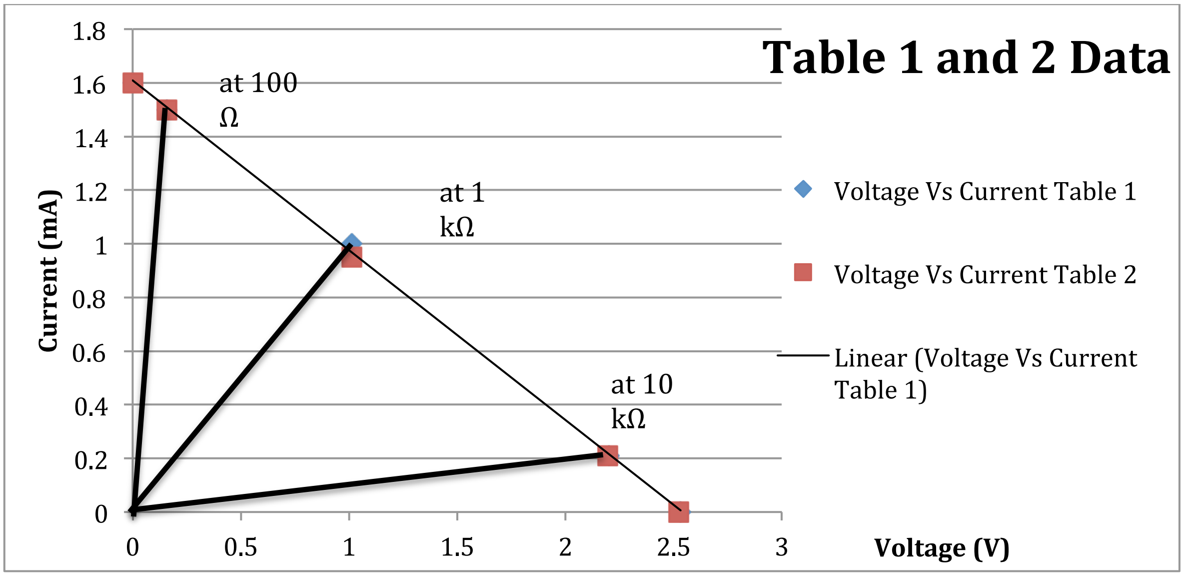

Figure 3

Our lines basically entirely overlapped. This means that our measurements in Part A and Part B were accurate and precise since we were able to product the Thevenin Equivalent.

C. Interpretting Graph for RL = 500Ω :

a) For this part, we estimated where the line would be for a load of 500Ω. The result was at 0.6V with 1.2 mA.

b) For part B we reconstructed both the original and Thevenin equivalent circuits and measured the results to confirm our estimate. The results were as follows:

Table 4

Thevenin	0.632V	1.2mA
Original	0.612	1.2mA

To confirm our result, we plotted the line for a load of 500 and it falls exactly on our load line.

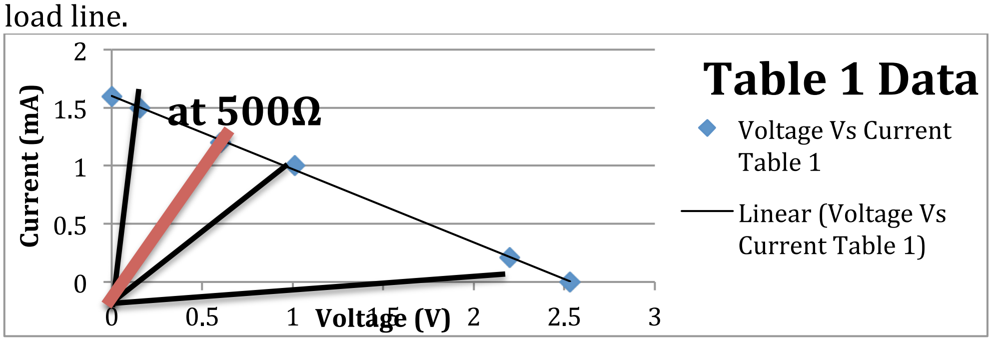

Figure 4

Memorandum

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D. Semiconductor Diode

For this part of the experiment was measured the voltage drop across the diode and the current flowing in the data. We collected data over a range of current from 100 mA to about 50 mA.

We first constructed the circuit as shown below.

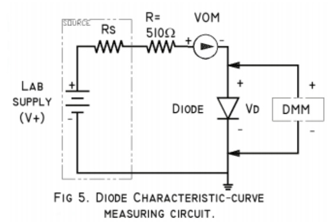

Figure 5

d) The data points we measured are shown below:

Table 5

Current (ma)	Voltage (V)
0.1	0.523
0.2	0.550
0.3	0.566
1	0.622
2	0.653
3	0.672
4	0.686
10	0.735
15	0.758
20	0.773
30	0.797
35	0.805

The plot of the graph is shown below:

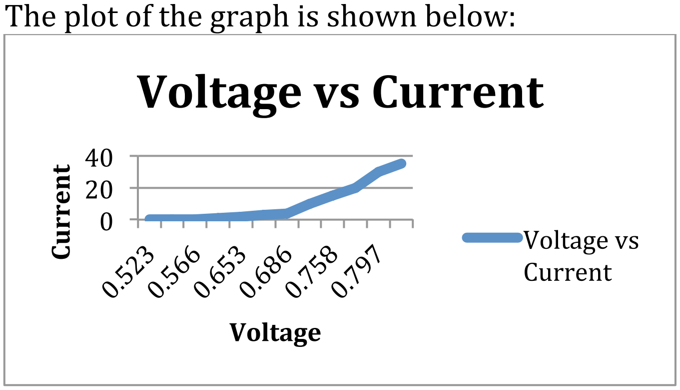

Figure 6

Memorandum

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The logarithmic graph is shown below:

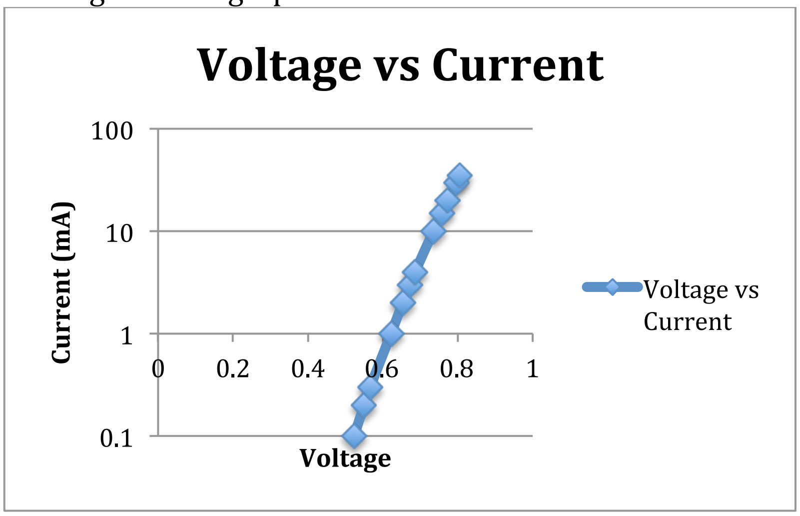

Figure 7

Using the logarithmic graph, we are able to calculate the current saturation. Using the two endpoints of the best fitting line, we got the slope to equal 1.67. The formula for current saturation is shown below:

$$I = I_s * e^{\frac{qv}{mKT}}$$

Eq. 2 (m, K, T, and q are constants)

Below is the table of our results for 3 different combinations of Voltage/Current:

Voltage	Current	Current Saturation
0.622	1mA	0.6nA
0.735	10mA	0.8nA
0.805	30mA	0.32nA

Conclusion:

Throughout performing this lab, we perform measurements and calculate errors that show how to apply Thevenin's and Norton's theorems to construct an equivalent circuit. All of our calculated values are extremely close to our expected values, which indicate that our group performed the experiment accurately and precisely. In the first 2 parts, our measurements and graph are almost exactly what was expected. We also confirmed the results of part 3 with our TA to ensure that we have successfully completed the experiment.