Lab 9 - Ohm's Law

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Objectives

1. Observe that the current is inversely proportional to resistance
2. Observe that voltage and current are proportional
3. Observe that voltage and resistance are proportional

Procedure:

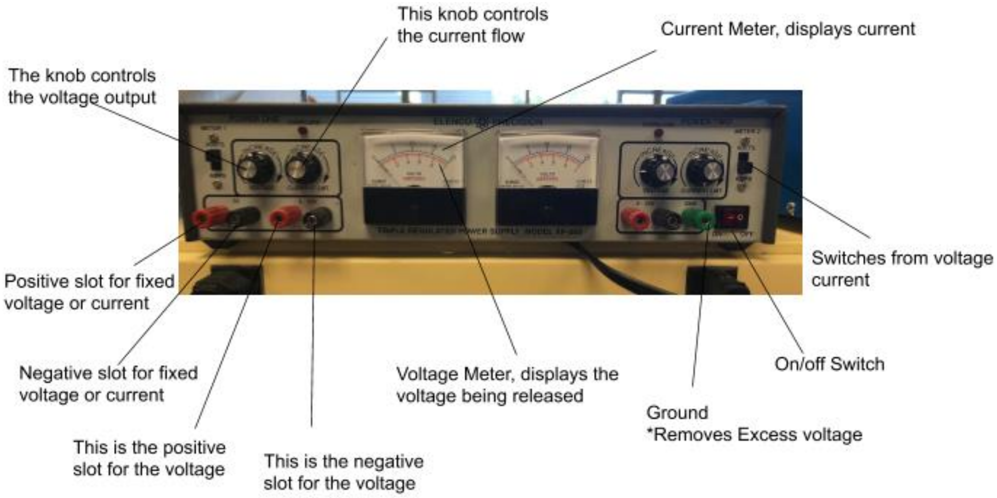


Figure 1-1

First, we made sure that the power supply was turned off (Figure 1-1), then placed the voltmeter test leads (Figure 1-2) on the terminals that matched the color of the test leads; reversing the terminals would just result in a negative reading. The power supply was then turned on, and the voltage was adjusted until the voltmeter indicated 6 volts.

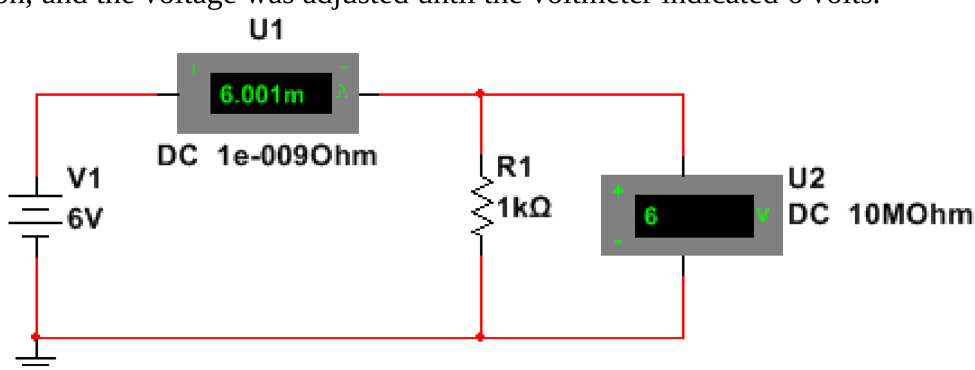


Figure 1-2

Multimeter

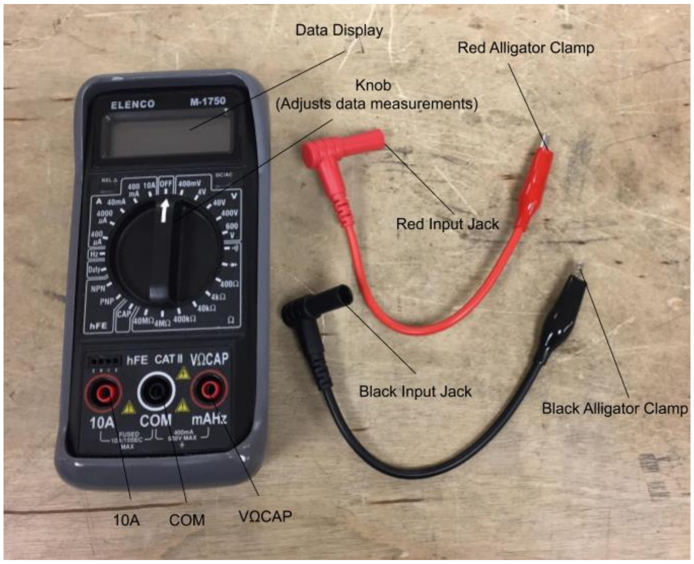


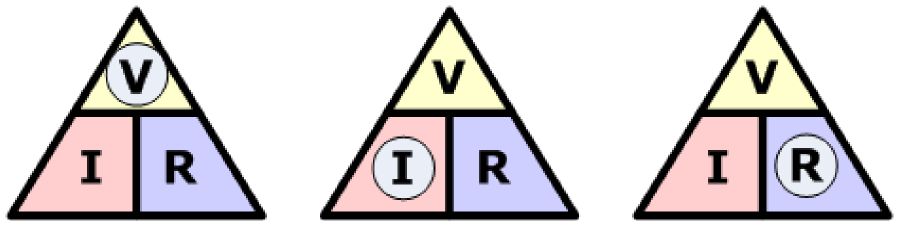
Figure 1-3

The circuit in Figure 1-2 was constructed, where the amp meter is part of the circuit in series, and the voltmeter in parallel. The positive test lead of the current meter (Figure 1-3) was connected to the positive terminal of the power supply, with the negative terminal connected to one end of the 1k resistor (Figure 1-2). The positive test lead of the voltmeter was connected to the end of the resistor connected with the current meter, with the negative test lead on the other end of the resistor (Figure 1-2). The end of the resistor that was connecting to the negative test lead of the voltmeter was then connected to the negative terminal of the battery.

Resistor Value	Measured Resistance
1kΩ	0.982kΩ
2.2kΩ	2.207kΩ
5.6kΩ	5.57kΩ
8.2kΩ	8.04kΩ
10kΩ	10.341kΩ

Table 1-1

Using the current meter, we measured 6.001mA, and using the voltmeter, we got a 6V drop between the resistors (Table 1-2).



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

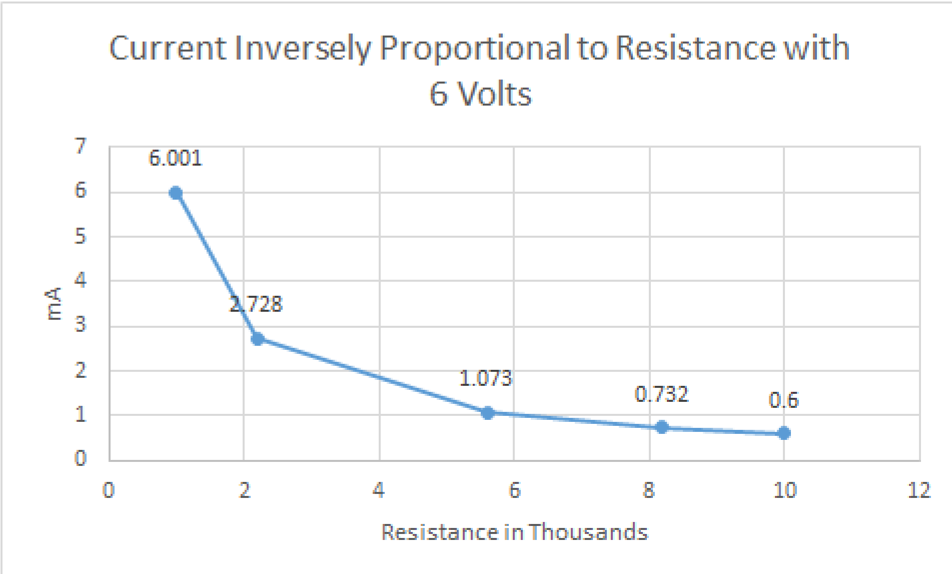
Equation 1-1

To check these measurements, we plugged in the values into ohm’s law (Equation 1-1). Dividing the voltage by the resistance gave us 6mA and multiplying the current by the resistance gave us 6V; these results match well to what we measured. The previous steps were repeated with the other four resistors (Table 1-2). The results of the current and voltage of these circuits are listed below:

Resistor Value	Current	Voltage
1kΩ	6.001mA	6V
2.2kΩ	2.728mA	6V
5.6kΩ	1.071mA	6V
8.2kΩ	0.74mA	6V
10kΩ	0.58mA	6V

Table 1-2

Based on our measurements from Table 1-2, the voltage remains the same among all the resistors while the current is getting lower as the resistance increases. On Graph 1-1, the correlation on the graph matches with ohm’s law, which states that the resistance is proportional to the voltage and inversely proportional to the current.



Graph 1-1

The previous steps were repeated, but instead with an applied voltage of 2V. The results are listed below:

Resistor Value	Current	Voltage
1kΩ	2.01mA	2V
2.2kΩ	0.909mA	2V
5.6kΩ	0.357mA	2V
8.2kΩ	0.244mA	2V
10kΩ	0.2mA	2V

Table 1-3

Based on Table 1-3, the voltages continue to remain the same; however, the current is three times lower than it was on Table 1-2, just as the voltage is three times lower. On Graph 1-2, the correlation on the graph matches with ohm's law, which states that the resistance is proportional to the voltage, and inversely, proportional to the current.

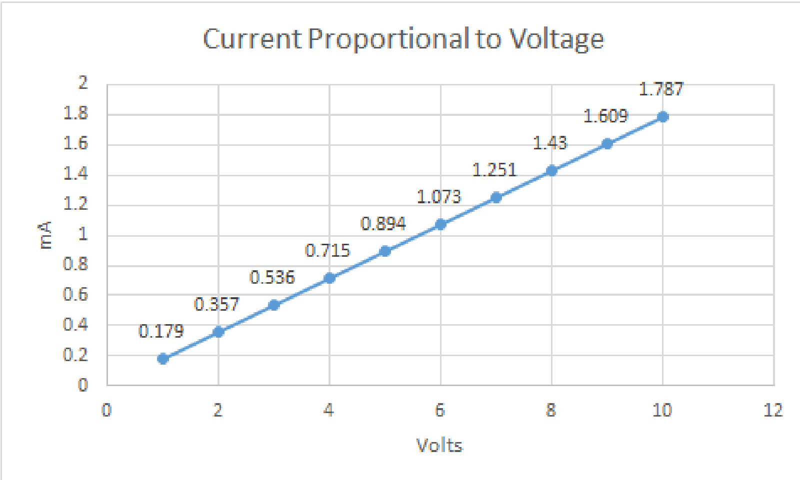
Graph 1-2

Using a 5.6kΩ resistor, we measured the current that it would be if set to voltages ranging from 1-10V. These values are listed down below:

Current	Voltage
0.179mA	1V
0.357mA	2V
0.536mA	3V
0.715mA	4V
0.894mA	5V
1.078mA	6V
1.251mA	7V
1.48mA	8V
1.609mA	9V
1.787mA	10V

Table 1-4

According to Table 1-4, as the voltage increases, so does the current. On Graph 1-3, the correlation on the graph matches with ohm's law, which states that the current is proportional to the voltage.



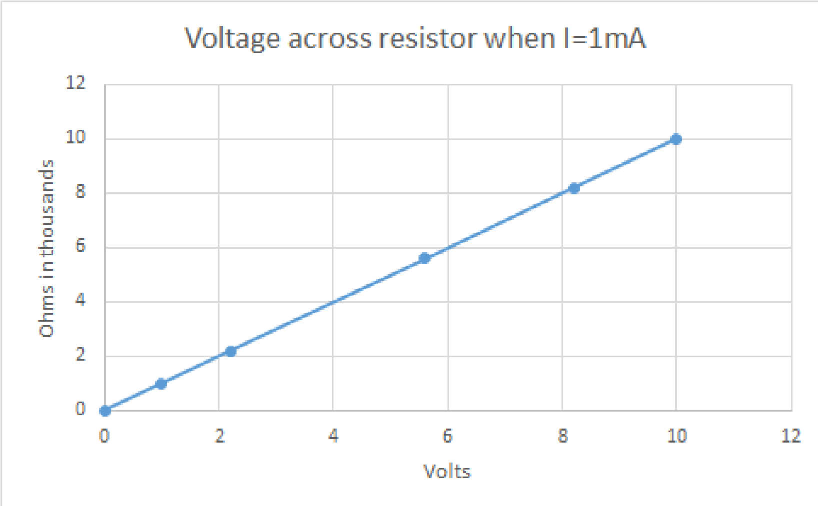
Graph 1-3

Next, for each resistor, we adjusted the voltage so that it will result in one mA. The results are listed below:

Resistor Value	Voltage
1kΩ	1V
2.2kΩ	2.2V
5.6kΩ	5.6V
8.2kΩ	8.2V
10kΩ	10V

Table 1-5

Based on the results from Table 1-5, as the resistance increases so does the voltage. On Graph 1-4, the correlation on the graph matches with ohm's law, which states that the resistance is proportional to the voltage. Since, the current remains the same, the voltage; the ratio remains the same as 1 thousandth.



Graph 1-4

Discussion:
This lab went very well, other than one confusion, which we had that was solved when we figured out the problem. This problem was that the people working at the bench had different data compared to the people working at the computers on Multisim. To figure out our problem, we first asked another group to see if how we had the circuit made was correct. We had the whole thing correct, meaning that the problem was with either the multimeter or the power supply. We then made sure if our mustimeter were working properly, which they were. We then decided to use a different port on the power supply to find our data and in the end, our data matched up. We learned how to do all of the objectives in the experiment, which made us all feel better about using the DMM to measure current and adjusting it to see the difference in the current and voltage. The objectives were to observe that the current is inversely proportional to resistance, observe that voltage and current are proportional, and to observe that voltage and resistance are proportional.

Conclusion:
In conclusion, for a resistor to be measured it has to be removed from the circuit and one lead has to be on each side. For current, it has to be part of the circuit in series. While for voltage, it is connected parallel. In a series circuit, the voltage and current are proportional to each other, if one increases or decreases so does the other; which is stated within ohm's law and is shown in graph 1-3, which is a linear relationship of voltage and current. Voltage and resistance are also proportional, with graph 1-4 showing a linear relationship between voltage and resistance. Current is inversely proportional to resistance. If one goes up the other goes down, which is shown in graph 1-1 and 1-2 that show exponential decay.