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Results and Analysis of Ohm's Law Experiment Simply Using Series Resistor Circuits

Nur Aisyah As'adi[1*], Faridhatu Allyah[1], Selvia Tin Sintia[1], Sinta Mayasari[1], Meylan Kharisma Putri[1], Hita Mara Cecilia[1], Sudarti[1]

[1]Physics Education Study Program, University of Jember, Indonesia

**E-mail: nuraisyahasadi6@gmail.com*

Telp. 085230768842

ABSTRACT

Ohm's law is a basic principle in electronics that describes the relationship between voltage, current strength, and resistance in an electrical circuit. This practicum aims to determine the characteristics of resistors and their uses in electrical circuits, determine the resistance value of resistors through color bands on resistors, understand the use of Ohm's law in resistor circuits, and show the relationship of voltage and current strength to the amount of resistance in each circuit. This type of research is laboratory experimental research using an experimental research design. By completing this practicum, students are expected to have a deeper understanding of the concept of Ohm's law in electrical circuits. Students can understand the concept of Ohm's law, about how Ohm's law can be applied in the calculation of resistor circuits. The students can show the relationship between voltage and current strength in a resistor circuit.

Keywords: Ohm's law, series circuit, resistor

INTRODUCTION

All events in everyday life always have a close relationship with physics. As in the use of electrical appliances, lights, TVs, refrigerators, irons, and also other electronic devices that must be adjusted to the voltage. In physics, some properties studied are those that exist in all material systems. These properties are often referred to as physical laws, such as Newton's laws, the law of conservation of energy, the law of reflection of waves, etc [1]. Ohm's law provides information about the current or voltage strength of an electrical appliance [2].

Human life is always related to electricity. In electricity, there are two terms: electric current (I) and voltage (V). Current is the change in speed of charge flowing with time. Current is divided into two categories: direct current and alternating current. Direct current is always constant with respect to a unit of time. Voltage is something that is used to move charge. The value of both electrical quantities depends on the type of electrical circuit [3].

Energy, especially electricity, is essential for human life. All aspects of human life require electricity, such as agriculture, education, health, transportation, and the economy [4]. Modern tools that help human life mostly operate with the help of electricity. Every material through which an electric current passes has the capacity to inhibit the rate of electric current. In metallic conductor materials, the moving electric charge is actually a negative charge, or electron. As a result, the direction of electric current propagation is opposite to the direction of the movement of electric charge [5].

An electrical circuit allows electrons to flow from an electric current source. Electrons can

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flow through conductors or materials that conduct electric current. Therefore, copper wires are used in electrical circuits. One of the functions of the switch is to cut off and connect electricity. Electrical circuits are of two types. Series circuits have obstacles arranged in parallel, while parallel circuits have obstacles arranged in branches [6].

The ease with which electric current flows through a conductor depends on the type of conductor. The ability of conductors to conduct electric current is called conductivity. The opposite is resistivity, more commonly known as resistance (R) [7].

A resistor, often also called a barrier, is an electronic component that can inhibit the movement of electric current. Resistors are abbreviated by the letter "R". As the name suggests, the function of a resistor is resistive, and a resistor is a passive component in an electronic circuit [8]. The ability to inhibit a resistor is also called resistance. Its dimensions are expressed in ohms [9].

The function of resistors is to limit the amount of current flowing in the circuit. The presence of resistors allows electricity to be distributed as needed. All functions of resistors are as follows: 1. Partially resist electric current to meet the needs of electronic circuits; 2. Lowering the voltage according to the needs of the electronic circuit; and 3. Produce high and low frequencies with the help of transistors and condensers [10].

A resistor is a passive electronic component that can only absorb electrical power but cannot store or provide electrical power because it cannot amplify the signal. Depending on the goals and needs of the electronics industry, resistors in electrical circuits can be arranged in series, parallel, or in combination. There are two types of resistors used in the electronics industry: fixed resistors and variable resistors [11].

A resistor is an electronic component with two poles that creates an electric voltage between its poles to withstand the electric current flowing through an electronic circuit. The most common type of resistor is a tube with two copper legs. The resistance value of a resistor is affected by the color of its band. These colors include Orange, Green, White, Gold, Silver, Red, Yellow, Brown, and Black. This kind of resistor's primary components are carbon and an iron wire core, where the carbon provides the resistance value and the iron core conducts DC current [12]. The value of the resistor can be calculated in two ways: by calculation formulas or by tools. The first method involves determining the position of the color band on the resistor. The second method is to use analog and digital multimeters in various procedures [13].

Multimeters can be used to measure resistance, capacitance, amperage, AC and DC voltage, check component quality, find out circuit connections, and more [14]. These multimeters fall into two categories: analog and digital. Analog multimeters have a clockwork display and a range of measured numbers. Digital multimeters are easier to use and more accurate, but the calculation results are less accurate. The measurement results can be read easily on a digital screen [15].

RESEARCH METHODS

This type of research is laboratory experimental research using experimental research design. This research uses material tools including 1 power supply, 3 resistors, 1 multimeter, 2 pairs of multimeter connecting cables, and 5 crocodile clamp cables.

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Figure 1. Research Tools and Materials

Ohm's research procedure begins by checking the condition of the crocodile clamp cable using a multimeter. Then arrange the series in series. Followed by measuring the resistance value on each resistor using a bracelet calculation and using measurements with a multimeter. Then determine the total resistance value in the circuit.

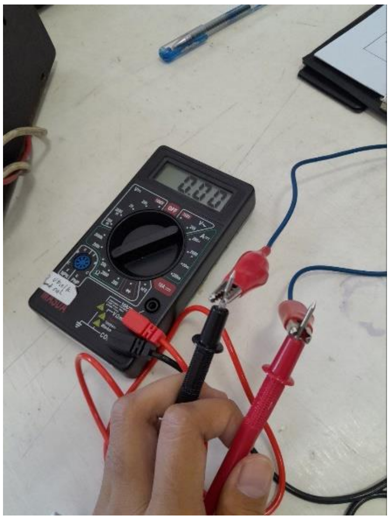

Figure 2. Checking the Condition of the Crocodile Clamp Cable

Find the value of voltage resistance (R_I) on each resistor (V_{R1}, V_{R2}, V_{R3}) current flowing in the circuit (I) using the Ohm's law formula. Set the power supply voltage to 3.5V then measure the voltage on each resistor (V_{R1}, V_{R2}, V_{R3}) and total voltage (V_{total}) on the circuit

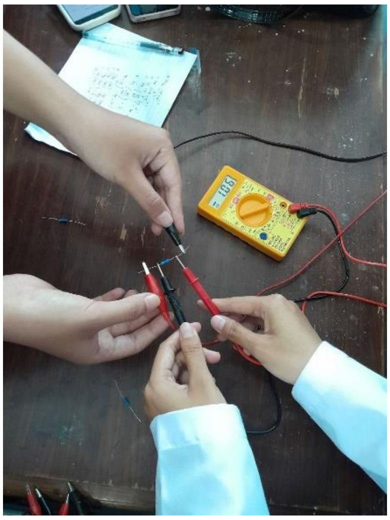

Figure 3. Measuring the Voltage Using an Analog Multimeter

RESULTS AND DISCUSSION

Georg Simon Ohm discovered Ohm's law in 1827, which is a fundamental law in physics that explains how voltage, resistance, and electric current interact in an electrical circuit. Ohm's law says that if the temperature is kept consistent, the amount of electric current flowing through a conductor is proportional to the potential difference between the conducting ends and inversely proportional to the amount of resistance. The formula V = IR shows Ohm's law, where V is voltage, I is electric current, and R is resistance

The fixed variable in this experiment is the material tool used in the experiment and the amount of voltage exerted by the power supply, which is 3.5V. For the free variable there is no because all practicum steps are made constant. As for the dependent variables, namely the final results of practicum, such as the results of measuring voltage, resistance, and electric current strength.

Table 1. Series Circuit (using 1 resistor)

No	V_{count}	$R_{measure}$	R_{count}	$I_{measure}$	I_{count}
1.	3,20V	5560 Ω	5614 Ω	0,00057A	0,00057A
	V_{total}=3,20V	R_{total}=5560Ω	R_{total}=5614 Ω	I_{total}=0,00057A	I_{total}=0,00057A

After we made measurements using a

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multimeter and with calculations using Ohm's law, the following results were obtained. The size of V_{count} is 3,20 V. The size of $R_{measure}$ is 5560 Ω. The size of R_{count} is 5614 Ω. The size of $I_{measure}$ is 0,00057A. The size of I_{count} is 0,00057A.

Table 2. Series Circuit (using 2 resistors)

No	V_{count}	$R_{measure}$	R_{count}	$I_{measure}$	I_{count}
1.	1,49V	3040 Ω	3040 Ω	0,00049A	0,00049A
2.	1,71V	2380 Ω	2380 Ω	0,00072A	0,00072A
	V_{total}=3,20V	R_{total}=5420Ω	R_{total}=5420Ω	I_{total}=0,000121A	I_{total}=0,000121A

After we made measurements using a multimeter and with calculations using Ohm's law, the following results were obtained. The size of V_{count1} is 1,49 V. The size of V_{count2} is 1,71 V. V_{total} are 3,20 V. The size of $R_{measure1}$ is 3040 Ω. The size of $R_{measure2}$ is 2380 Ω. R_{total} are 5420 Ω. The size of R_{count1} is 3040 Ω. The size of R_{count2} is 2380 Ω. R_{total} are 5420 Ω. The size of $I_{measure1}$ is 0,00049 A. The size of $I_{measure2}$ is 0,00072 A. I_{total} are 0,000121 A. The size of I_{count1} is 0,00049 A. The size of I_{count2} is 0,00072 A. I_{total} are 0,000121 A.

Table 3. Series Circuit (using 3 resistors)

No	V_{count}	$R_{measure}$	R_{count}	$I_{measure}$	I_{count}
1.	1,05V	1780 Ω	1780 Ω	0,00059A	0,00059A
2.	1,04V	1420 Ω	1420 Ω	0,00073A	0,00073A
3.	1,18V	2190 Ω	2190 Ω	0,00054A	0,00054A
	V_{total}=3,20V	R_{total}=5390Ω	R_{total}=5390Ω	I_{total}=0,00186A	I_{total}=0,00186A

After we made measurements using a multimeter and with calculations using Ohm's law, the following results were obtained. The size of V_{count1} is 1,05 V. The size of V_{count2} is 1,04 V. The size of V_{count3} is 1,18 V. V_{total} are 3.20 V. The size of $R_{measure1}$ is 1780 Ω. The size of $R_{measure2}$ is 1420 Ω. The size of $R_{measure3}$ is 2190 Ω. R_{total} are 5390 Ω. The size of R_{count1} is 1780 Ω. The size of R_{count2} is 1420 Ω. The size of R_{count3} is 2190 Ω. R_{total} are 5390 Ω. The size of $I_{measure1}$ is 0,00059 A. The size of $I_{measure2}$ is 0,00073 A. The size of $I_{measure3}$ is 0,00054 A. I_{total} are 0,00186 A. The size of I_{count1} is 0,00059 A. The size of I_{count2} is 0,00073 A. The size of I_{count3} is 0,00054 A. I_{total} are 0,00186 A.

Figure 4. Relatonship of Electric Current (I) with Voltage Using 2 resistors

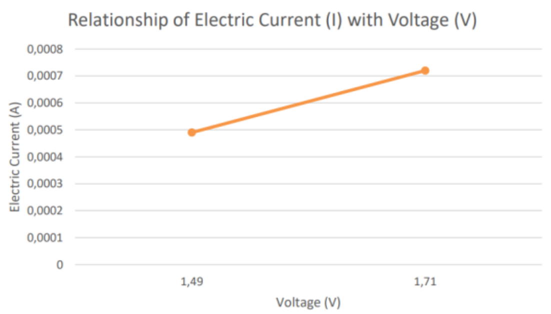

Figure 5. Relatonship of Electric Current (I) with Voltage Using 3 resistors

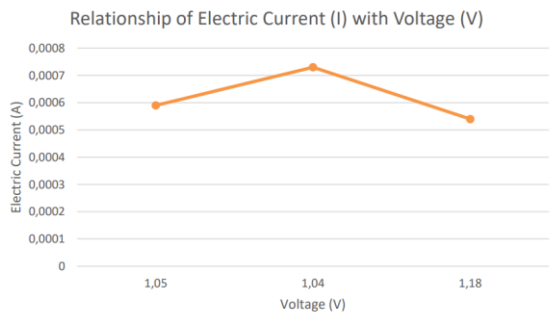

Figure 6. Relationship of Resistance (R) with Electric Current (I) Using 2 resistors

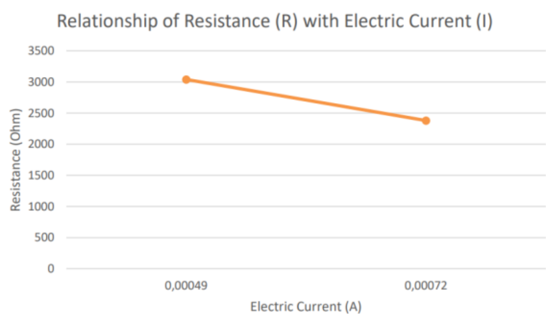

Figure 7. Relationship of Resistance (R) with

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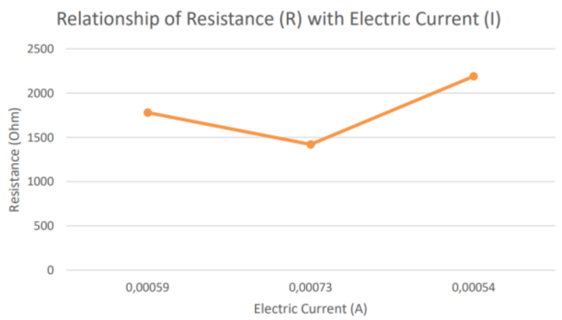
Electric Current (I) Using 3 resistors



Practicum data that are in accordance with the theory are only in experiments using 2 resistors. This can be proven. In the graph of the relationship between V and I using 2 resistors, a straight line slopes towards the upper right of the positive quadrant x axis. This straight line shows that the greater the potential difference applied to the circuit, the greater the current flowing. This shows that the magnitude of the voltage (V) is directly proportional to the strength of the electric current (I).

In the graph of the relationship R and I using 2 resistors, a straight line slopes towards the bottom right of the positive quadrant x axis. This straight line shows that the greater the resistance of a conductor, the smaller the electric current flowing through the conductor. This shows that the amount of resistance (R) is inversely proportional to the strength of the electric current (I). For practicum data using 3 resistors, the results are not very valid. This is likely due to a practical error. It could also be caused because the tools used in practicum are poorly calibrated.

The error in this research is most likely due to several factors. For example, a measured resistor has slightly lost its resistance because it has been used. Other factors may come from multimeters used in lab work in poor or uncalibrated conditions. Another possibility could come from practical inaccuracy when calculating and reading measurement results on a multimeter.

CONCLUSION

We can tell that resistors are able to control electric current, reduce voltage, and protect other components in the overcurrent circuit. We can find out how to identify the resistance value of a resistor by observing the color band on the resistor body. The color band on the resistor encodes information about the resistance and tolerance of the resistor. We can understand the concept of Ohm's law, about how Ohm's law can be applied in the calculation of resistor circuits. We can show the relationship between voltage and current strength in a resistor circuit. The higher the resistance, the greater the voltage required to produce a certain current. The lower the resistance, the greater the current that will flow with a certain voltage.

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