Report on experiment: kirchhoffs circuit rules

Sociology, Social Issues

Lab Report (Kirchhoff's Laws)

Introduction

This lab experiment was intended to learn and apply Kirchhoff's Rules in calculating the current and voltages in a circuit. To achieve this, a circuit is built consisting of resistors that are in parallel and series which will aid to test the different aspects of Kirchhoff's Rule.

The simplest circuit is that which can be reduced to an equivalent circuit having a single resistance

and a single voltage source. Many circuits are not simple and require the use of Kirchhoff's

Laws to determine voltage, current, or resistance.

Objectives:

forecast by Kirchhoff's Laws.

Theory:

A junction is a point in a circuit where more than three wires join or where a current gets divided.

A loop is a path which is closed by two or more branches.

A branch is a connection of two junctions making a path and it must contain two or more elements.

Kirchhoff's rules:

- Voltage Rule
- Current Rule

Voltage Rule: States that the sum of voltages around a closed circuit equals to zero.

Current Rule: States that the sum of currents entering a junction equals to the sum leaving the junction.

Analysis of Resistors

Resistors are analyzed the way they are connected in the circuit either in series or parallel as explained below:

- Resistors in Series

Resistors in series

Vsource - V(lost to resistor 1) – V(lost to resistor 2) = 0.

Applying Ohm's Law, V= IR it will replace the V from the above equation

Since the resistors are in series, therefore:

Rseries = R1 + R2 + R3 +Rn where Rn is the nth resistor.

The circuit was set up including the resistors in series where we were to test the Kirchhoff's Loop rule. We carried out the experiment by first assembling the resistors in series in the circuit built as shown in the diagram below:

Fig 1: Circuit Diagram

- Kirchhoff's Zeroth Rule

This was carried out to determine the current and potential drops and increases through different wires in the circuit testing different components. This was determined by the use of the ampmeter which was positioned in different locations.

Figure 2: Circuit diagram

Figure 3: Circuit diagram

Figure 4: Circuit diagram

Kirchhoff’s Zeroth rule: It states that the current never changes around a corner in any given circuit diagram.

Figure 5: Circuit diagram

In the above diagram, the circuit does not have the junction but only the corners thus the Kirchhoff’s Zeroth rule applies. From the experiment, it was indicated that all current are equal passing through various resistors given that the EMF is constant.

- Kirchhoff’s Loop Rule

The rule states that: The sum of the potential drops and increases around the closed loop add up to zero (Kirchhoff's Rules, 2013).

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Figure 6: Application of Kirchhoff’s Loop Rule

Parallel Resistors

Connecting the resistor in parallel, the voltage is the same for all resistances.

Applying the current rule; I = I1 + I2, and V = IR

Then

I= VR1+VR2= V(1R1+1R2)

I= V(1Rparallel)

1Rparallel= 1R1+1R2+1R3++1Rn

Junction

Icase2+Icase3= Icase4

EXPERIMENT.

Apparatus

- Resistors
- Circuit board
- Adjustable power supply
- Wire leads
- Alligator clips

The experiment that was carried out, we constructed one circuit that comprises of six resistors and a DC voltage source. The circuit was analyzed by use of Kirchhoff's law and by the use of a digital multi-meter to compare various values. The Kirchhoff's Law was used to calculate the values of each resistor used in the experiment and get compared by the use of the colour code.

Procedure

- Construct the circuit using the breadboard, resistors, variable power, alligator clips and wire leads
- Switch on the source of power supply.
- Connect the multi-meter across the power supply
- Adjust the voltage to 5. 0 volts
- Read the values of each resistor by the use of the multi-meter. Record the voltage values in the data table.
- Turn the power off.
- Analyze the result using the Kirchhoff's Law.

Results

Color coding

Color coding can be used to determine the resistance value of a resistor. This is achieved by clear observation on the resistors color

(Resistor colour code, 2013).

Below is the table that is used to calculate the resistance value.

Calculations

Calculation of the resistor values using colour codes

The color band of the resistors can be used to determine the value of the resistor by carefully observing its bands as they are arranged. This is achieved by reading their color bands as they are arranged from the first band, second, third and the forth band.

- Resistor ; R1 : red, red, brown.; Where red= 2, red= 1 and brown= 1 therefore the value for R1= 221Ọ

- Resistor (R2): brown, orange, brown; where brown = 1, orange = 3 and brown = 1; therefore the value for R2= 131 Ọ

- Resistor (R3): yellow, violet, black; where yellow= 4, violet= 7 and black = 0; therefore the value for R3= 470 Ọ

- Resistor (R4): brown, orange, black; where brown= 1, orange= 3 and black = 0; therefore the value for R4= 130 Ọ

- Resistor (R5): red, red, brown; where red= 2, red = 2 and brown = 1; therefore the value for R5= 221 Ọ

- Resistor (R6): orange, orange, black; where orange= 3, orange= 3 and black = 1; therefore the value for R6= 330.

Circuit analysis

The circuit was analyzed using the loop method as follows in the clockwise direction;

Loop1

220i1 + 130(i1-i2) + 470(i1-i3)= 5V

220i1 + 130i1 – 130i2 + 470i1 – 470i3= 5V

220i1 + 130i1 + 470i1- 130i2 – 470i3 = 5V

820i1 – 130i2 -470i3= 5V(i)

Loop 2

130(i2-i1) + 130i3 +330(i2-i3)= 0

130i2 – 130i1 + 130i2 + 330i2 - 330i3= 0

130i2 + 130i2 + 330i2 -130i1 -330i3= 0

-130i1 + 590i2 – 330i3= 0(ii)

Loop 3

470(i3-i1) + 330(i3-i2) + 220i3= 0

470i3 – 470i1 + 330i3 -330i2 + 220i3= 0

-470i1 – 330i2 + 470i3 + 330i3 + 220i3= 0

-470i1 – 330i2 + 1020i3 = 0.(iii)

Junction analysis

J1: I1= I2 + I4

I1= 0. 0227A, I4= 0. 0133A

Therefore

I1= I2 +I4

0. 0227= I2 + I4

0. 0227= I2 + 0. 0133

I2= 0. 0227-0. 0133, I2= 0. 0094A

J2; I2 = I3 +I6

I2= 0. 0094A

I1 = I2 + I4

0. 0227= I2 +I4

0. 0227= 0. 0133 + I4

I4 = 0. 0227- 0. 0133

I4 = 0. 0133A

J3; I5= I6 + I4

I5= 0. 0148A, I4= 0. 0133A

0. 0148= I6 + 0. 0133

I6= 0. 0148 – 0. 0133

I6= 0. 0015A

J4; I0= I5 +I3

I5= 0. 0148A, I3= 0. 0079A

I0= 0. 0148 + 0. 0. 079

I0 = 0. 0227A

Voltage across each resistor

VR1 = 0. 022 * 220

= 4. 994V

VR2 = 130 * 0. 0094

= 1. 222V

VR3 = 470 * 0. 0079

= 3. 713V

VR4= 130 * 0. 0133A

= 1. 729V

VR5 = 220 * 0. 0148

= 3. 256V

VR6 = 330 *0. 0015

= 0. 495V

Error analysis

Calculations

Voltage error analysis

VR1= 4. 994-2. 454. 994= 0. 509

VR2= 1. 222-0. 601. 222= 0. 509

VR3= 3. 713-1. 823. 713= 0. 509

VR4= 1. 729-0. 841. 729= 0. 514

VR5= 3. 256-1. 583. 256= 0. 514

Conclusion

Kirchhoff's laws are used to analyze the circuit to show the values of each resistor, the voltage drop across the resistors and the current.

References

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