Dhaka International University

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LAB REPORT

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REPORT ON : Varification of Kirchhoff's Voltage Law (KVL) and Voltage divider rule (VDR)

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Lab Report: Verification of Kirchhoffs Voltage Law (KVL) and Voltage Divider Rule (VDR).

Objective:

- To investigate circuits with resistors connected in series.
- To verify Kirchhoff's Voltage Law (KVL)
- To verify Voltage Divider Rule (VDR)

Theory:

... Series Circuit:

Figure: 1 shows three resistors, R_1, R_2 and R_3, connected in series in a closed circuit powered by a single battery or emf source. In this circuit the current supplied by the battery flows through each resistor, with the current in each resistor being the same. If the current supplied by the battery is I_T, the current in each resistor is I_1, I_2 and I_3 and they all are one and the same, then

$$I_T = I_1 = I_2 = I_3$$

The voltage drop across the battery V_T will be the total sum of the individual drops across each of the three resistors, and

$$V_T = V_1 + V_2 + V_3$$

where V_1 is the potential difference across R_1, V_2 is the potential difference across R_2 and V_3 is the potential difference across R_3, by using Ohm's Law

$$V_T = I_T \times R_T$$

$$V_1 = I_1 \times R_1$$

$$V_2 = I_2 \times R_2$$

$$V_3 = I_3 \times R_3$$

finally, $I_T R_T = I_1 R_1 + I_2 R_2 + I_3 R_3$

Since, $I_T = I_1 = I_2 = I_3$

$$\therefore R_T = R_1 + R_2 + R_3$$

Therefore when resistors are connected in series, the total resistance is just the sum of the individual resistances. While this has been shown for 3 resistors, the total resistance of any number N ($N \geq 2$) of resistors connected in series, end to end, can be found using the same general procedure. Therefor the resistor connected in series

$$R_T = \sum_{i=1}^{N} R_i$$

... Kirchhoff's Voltage Law (KVL):

The algebraic sum of the voltage rises equal the algebric sum of the voltage drops around any closed path of an electric circuit.

Applying KVL around closed loop of figure: 1, we find

$$V_T = V_1 + V_2 + V_3$$

where, $V_1 = IR_1$, $V_2 = IR_2$, $V_3 = IR_3$

current I is same throughout the circuit for figure 1

The current is calculated by using Ohm's Law,

$$I = \frac{V_T}{R_T}$$

The voltage divider rule states that the voltage across an an element or across series combination of elements in series circuit is equals to the resistance of the element divided by total resistance of the series circuit and multiplied by the total impressed voltage. For the elements of Figure 1.

$$V_1 = \frac{R_1 E}{R_T}, \quad V_2 = \frac{R_2 E}{R_T}, \quad V_3 = \frac{R_3 E}{R_T}$$

Equipments:

- Variable DC power supply
- Digital multimeter
- Resistance - 3 pieces
- Trainer Board
- connecting wires

Circuit Diagram:

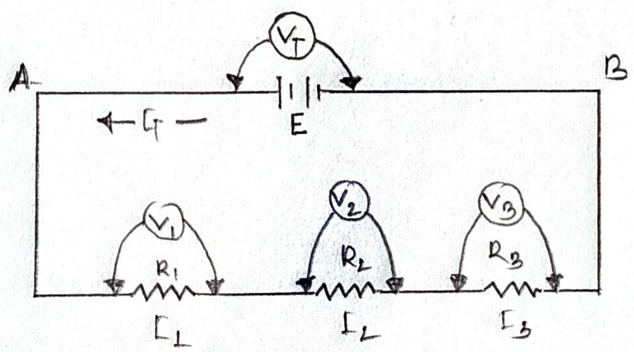

Figure: 1 - Three Resistors R_1, R_2, R_3 connected in series.

Procedure:

01. Measure the resistance by using ohm's meter and record the value in table 1.

02. Construct the circuit as shown in figure 1

03. Then measure input resistance R_T across points A-B using ohmmeter and record that value in table 1.

04. Turn on the DC power supply and set the DC power supply to 10.01 volt by using voltmeter.

05. Measure voltage across each resistor with voltmeter and record in the table 1.

06. Calculate V_1, V_2, V_3 using Voltage Divider Rule (VDR)

Experimental Data: Table 1-

Resistance	Equivalent Resistance, R_T		Supply Voltage	Voltage drop		Error %
	Masured by Multimeter	Masured by calculator		Masured by Multimeter	Using VDR	
$R_1 = 0.97$ KΩ	6.34 KΩ	6.32 KΩ	10.01 V	$V_1 = 1.53$ V	1.53 V	0
$R_2 = 3.2$ KΩ				$V_2 = 5.06$ V	5.06 V	0
$R_3 = 2.15$ KΩ				$V_3 = 3.4$ V	3.4 V	0

Calculation:

using VDR,

$$V_1 = \frac{R_1}{R_{T(cal)}} \cdot V = \frac{0.97}{6.32} \times 10.01 = 1.53V$$

$$V_2 = \frac{R_2}{R_{T(cal)}} \cdot V = \frac{3.2}{6.32} \times 10.01 = 5.06V$$

$$V_3 = \frac{R_3}{R_{T(cal)}} \cdot V = \frac{2.15}{6.32} \times 10.01 = 3.4V$$

$$\text{Error \%} = \frac{V_x\,(\text{mesured}) - V_x\,(\text{calculated})}{V_x\,(\text{calculated})} \times 100\%$$

$$\therefore \text{Error in } V_1\,\% = \frac{V_1\,(\text{mesured}) - V_1\,(\text{cal})}{V_1\,(\text{cal})} \times 100\%$$

$$= \frac{1.53 - 1.53}{1.53} \times 100\% = 0$$

$$\therefore \text{Error in } V_2\,\% = \frac{V_2\,(\text{mes}) - V_2\,(\text{cal})}{V_2\,(\text{cal})}$$

$$= \frac{5.06 - 5.06}{5.06} \times 100\% = 0$$

$$\therefore \text{Error in } V_3\,\% = \frac{V_3\,(\text{mes}) - V_3\,(\text{cal})}{V_3\,(\text{cal})} \times 100\%$$

$$= \frac{3.4 - 3.4}{3.4} \times 100\% = 0$$

Conclusion:

From the above experiment we have studied and varified that the observation value is approximately same to the calculation values in series circuit.

Precautions:

01. check circuit connections carefully
02. use a calibrated multimeter
03. Avoid overheatin resistors.
04. Turn off power when adjusting the circuit
05. Tighten all connection properly
06. Do no exceed voltage limits.