Experiment No. 05

Name of the Experiment: Verification of Ohm's Law.

OBJECTIVE:

To verify the following two equivalent forms of Ohm's Law:

a. Express I as a function of V and R.
b. Express V as a function of I and R.

THEORY:

Ohm's law describes mathematically how voltage 'V', current 'I' and resistance 'R' in a circuit are related. According to this law:

"The current in a circuit is directly proportional to the applied voltage and inversely proportional to the circuit resistance".

Formula for voltage:
For a constant value of R, V is directly proportional to I
i.e. $V = IR$

Formula for current:
For a constant value of V, I is inversely proportional to R
i.e. $I = V/R$

EQUIPMENTS:

- Variable DC power supply -1piece.
- Digital multimeter (DMM)/ Analog multimeter-1piece.
- Resistances: 1KΩ, 2.2KΩ, 3.3KΩ, 4.7KΩ, 5.6KΩ, 10KΩ-1piece each.
- Trainer Board.
- Connecting Wires.

CIRCUIT DIAGRAM:

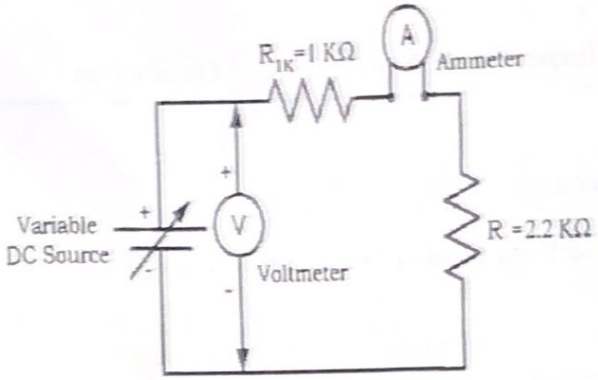

Figure 1: Verification of Ohm's Law

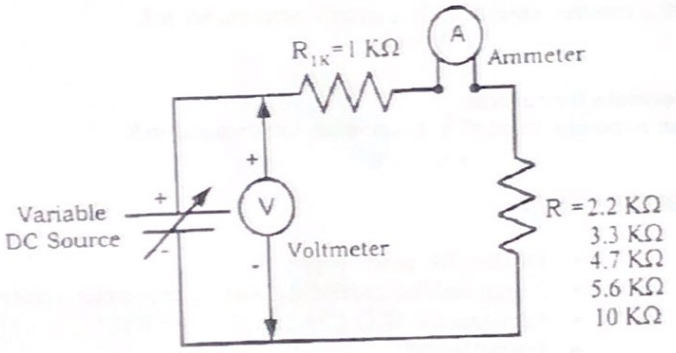

Figure 2 : Verification of Ohm's Law

PROCEDURES:

Current versus voltage:

a. Find out the individual resistances by using Ohmmeter and place the value in Table 1. Measure the resistances by constructing a series circuit which is the equivalent resistance from the circuit.

b. Construct the circuit of Figure 1. Do not switch on the power supply.

c. Tum on the power supply and adjust it to 5V by using Voltmeter. Measure the current I by ammeter and record it in the Table 2.

d. Increase the values of voltage as shown in the Table 2. Measure the current I in tum and record the values in Table 2.

e. Calculate the values of current I by using $I=V/R_T$. Use measured values of resistances.

Current versus resistance:

a. Construct the circuit of Figure 2. Do not switch on the power supply.

b. Tum on the power supply and adjust it to 20V by using Voltmeter. Measure the current I by ammeter for R=2.2 KΩ (Use measured values) and record it in the Table 3.

c. Tum off the power supply and remove the resistance 2.2 KΩ. Replace it by resistor 3.3 KΩ.

d. Now turn on the power supply. Measure and record the current I in tum, at each of the resistance settings shown in the Figure 2.

e. Calculate the values of resistance R_T by using $R_T=V/I$. Use measured values of voltage and current.

DATA SHEET:

Table 1: Measuring Resistances by using Ohmmeter

Nominal values of R (KΩ)	Measured values of R (KΩ) by using Ohmmeter	Measured equivalent resistance value of R (KΩ) from circuit
1	0.99	
2.2	2.17	
3.3	3.24	
4.7	4.7	
5.6	5.57	
10	9.74	
$R_s=R_{eq}=R_{nom}=R_T=$	$R_{mes}=$	$R_{eq}=R_{ckt}=$

Table 2: Current versus Voltage reading

Supply Voltage (V)	Measured I by using Ammeter (mA)	$R_T= R_{1K\Omega} + R_{2.2K\Omega}$ [Use measured values of R] (kΩ)	Calculate Current, I $I=V/R_T$ (mA)	Measured Resistance, $R_T=V/I$ (kΩ)
5	1.5		1.58	
10	3	〃	3.16	〃
15	4.5	3.16	4.74	3.17
20	6	〃	6.33	
25	7.5		7.91	〃

Table 3: Current versus Resistance reading

Supply Voltage (V)	Measured I by using Ammeter (mA)	R_T [Use measured values of R] (KΩ)	Resistance, $R_T=V/I$ (KΩ)
20	6	$R_T=R_{1K}+R_{2.2K}$	3.33
		$R_T=$ 3.16	
20	4.5	$R_T=R_{1K}+R_{33K}$	4.4
		$R_T=$ 4.23	
20	3	$R_T=R_{1K}+R_{47K}$	6.6
		$R_T=$ 5.69	
20	2.5	$R_T=R_{1K}+R_{56K}$	8
		$R_T=$ 6.56	
20	1.8	$R_T=R_{1K}+R_{10K}$	11.11
		$R_T=$ 10.73	

Signature of the Teacher

Discussions:

Q:What can you say about the relationship between the voltage and current, provided that the resistance is fixed?

from ohm's law we get $V = IR$. If R is fixed then we can write $V \propto I$. That is to say, with increase of supplied voltage the current following through the circuit will increase and with the decrease of supplied voltage value of current will also decrease.

Q: Plot a graph of I versus V keeping the value of resistance constant. Use measured values of I and V. Comment on the graph briefly.

$\tan\theta \frac{dx}{dy}$ = slope $\Rightarrow \frac{I}{V} = \frac{y}{x} = \frac{6-3}{20-10} = 0.32$ mA/V

$R = \frac{V}{I} = \frac{5}{1.6} = 3.125\ k\Omega$

The graph will be straight line.

R graph = 3.33 kΩ
R measured = 3.17 kΩ
In all case proves $V = IR$

Q: Plot a graph of I versus R_T keeping the value of supply voltage constant. Use measured values of I and R_T. Comment on the graph briefly.

we know, $V = IR$

$\therefore V_1 = I_1 R_1$
$= 6.4 \times 3.17$
$= 20.28$

$V_2 = 4.5 \times 4.29$
$= 19.04$

$V_3 = 3 \times 5.69$
$= 17.07$

$V_4 = 2.5 \times 6.56 = 16.4$

$\therefore V_5 = \frac{V_1 + V_2 + V_3 + V_4}{4}$

$\therefore V$ graph $= 18.18$

~~V supply =~~