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LAB-1

Spring 2022
EEE/ETE 141L
Electrical Circuits-I Lab(Sec-10)
Faculty : Md. Abu Obaidah (AbO)
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Lab No.: 01

Date of Performance :16/02/2022 Date of Submission :23/02/2022	**Name:** 1. **Bushra Hossain** 2. **Md. Ishtiaq Ahamed Fahim** 3. **Tajrian Al Israq** **ID:** 1. **2031346642** 2. **2012518642** 3. **2021536643**

E-1

Objective:

① We have to find the resistance of a resistor from its color code.

② We have to measure voltage, current and resistance values using a digital multimeter.

③ We have to verify the validity of ohm's law.

④ We have to test the voltage divider rule in a series circuit.

Component list:

- Trainer board
- Resistors (3.3 KΩ, 5.6 KΩ)

- Digital Multimeter (DMM)
- connecting wire
- Multisim

Circuit diagram:

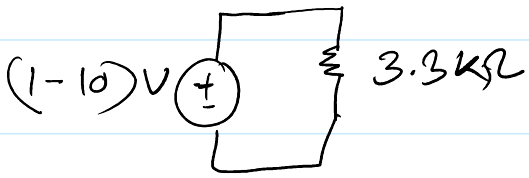


Fig: circuit: 1

Table-1

Resistance using color				Resistance ± tol	Resistance using DMM	% Error
Band 1	Band-2	Band-3	Band-4			
Orange	Orange	Red	Gold	3.3 ± 5%	3.3k	0%
Green	Blue	Red	Gold	5.6 ± 5%	5.6k	0%

Table-2

3.3kΩ	Experimental		Reading
voltage	Current I 10^{-4}	voltage IR V	Power I^2R mW
2	6	2	1.21
4	12	4	4.85
6	18	6	10.9
8	2.4	8	19.4
10	3	10	30.303

Table - 3

5.6kΩ	Experimental		Reading
voltage	Current I 10^{-4}	voltage IR V	Power I^2R mW
2	3.5	2	0.71
4	7.1	4	2.85
6	10	6	6.43
8	14	8	11.43
10	1.7	10	17.86

Results : From table 2,

when, $V = 2V$, $I = 0.606\ mA$, $R = 3.3\ k\Omega$

Power, $I^2R = (0.606)^2 \times 3.3\ mW$

$= 1.212\ mW$

when, $V = 4V$, $I = 1.212mA$, $R = 3.3k\Omega$

Power, $I^2R = (1.212 mA)^2 \times 3.3 k\Omega$

$= 4.818 mW$

Power$_6$ $= I_6^2 R = (1.818)^2 \times 3.3$

$= 10.908 mW$

Power$_8$ $= I_8^2 R = (2.424)^2 \times 3.3$

$= 19.392$

Power$_{10}$ $= I_{10}^2 R = (3.030)^2 \times 3.3$

$= 30.3 mW$

For Table 3,

Power$_2$ $= I_2^2 R = (0.357)^2 \times 5.6$

$= 0.716 mW$

Power$_4$ $= I_4^2 R = (0.714)^2 \times 5.6$

$= 2.856 mW$

Power$_6$ $= I_6^2 R = (1.071)^2 \times 5.6$

$= 6.426 mW$

Power$_8$ $= I_8^2 R = (1.429)^2 \times 5.6$

11.432

$Power_{10} = I_{10}^2 R = (1.786)^2 \times 5.6$

$= 17.86\ mA$

Question / Answer:

1

1. State Ohm's law

State ohm's law:

Current through a conductor between two points is directly proportional to the voltage across the two points

$$I \propto V$$

Which with a constent Resistenn yeild

$$V = RI$$

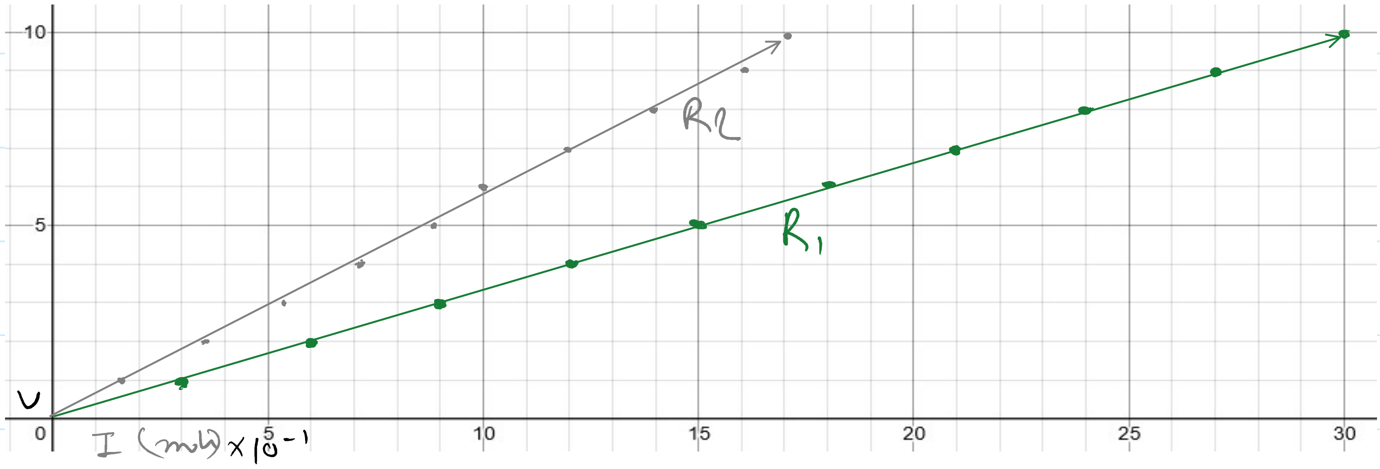
2

2. Plot V vs I graph for each resistor value in same graph

Ploting V vs I graph for each resistor value in graph

As we getting Data form mullisim we get the value form multi-meter and ploating the value on graph

V	$I_{3.3}(10^{-4})$	$I_{5.6}(10^{-4})$
1	3	1.7
2	6	3.5
3	9	5.3
4	12	7.1
5	15	8.9
6	18	10
7	21	12
8	24	14
9	27	16
10	30	17



3

3. Does your experimental circuit follow ohm's law? Explain how you figured it out.

given variable voltage V {1-10}, while R = {3.3 kΩ, 5.6 kΩ}

As we know,

$$V = IR$$

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

V	$I = \frac{V}{R_1}$ (10^{-9}) $R_1 = 3.3\,k\Omega$	$I = \frac{V}{R_2}$ (10^{-9}) $R_2 = 5.6\,k\Omega$
1	3	1.7
2	6	3.5
3	9	5.3
4	12	7.1
5	15	8.9
6	18	10

5	15	8.9
6	18	10
7	21	12
8	24	14
9	27	16
10	30	17

This graph is indentical to (ex-2) making it so that mutimeter form multiom is same Ohom law.

4

4. Calculate the resistance of each circuit using the slope of your V vs I graphs. Compare these graph values to the measured R values using DMM. Find the percentage difference.

we know that

$$\text{slope}(m) = \frac{\text{Rise}}{\text{Run}}$$

Here we get

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

form graph in mutlimeter

	mutimeter		ohoms law	
	R (kΩ)	R´ (kΩ)	R (kΩ)	R´ (kΩ)
1	3.3	5.6	3.3	5.6
2	3.3	5.6	3.3	5.6
3	3.3	5.6	3.3	5.6
4	3.3	5.6	3.3	5.6
5	3.3	5.6	3.3	5.6

4	3.3	5.6	3.3	5.6
5	3.3	5.6	3.3	5.6
6	3.3	5.6	3.3	5.6
7	3.3	5.6	3.3	5.6
8	3.3	5.6	3.3	5.6
9	3.3	5.6	3.3	5.6
10	3.3	5.6	3.3	5.6

$\Sigma R = 33$ $\Sigma R' = 56$ $\Sigma R = 3.3$ $\Sigma R' = 5.6$

multimeter mean

$$M_R = \frac{\sum^{N} R}{N} = \frac{33}{10} = 3.3$$

$$M_{R'} = \frac{\sum^{N} R}{N} = \frac{56}{10} = 5.6$$

ohm meter:

$$M_{\bar{R}} = \frac{\sum^{N} \bar{R}}{N} = \frac{33}{10} = 3.3$$

$$M_{\bar{R}'} = \frac{\sum^{N} \bar{R}}{N} = \frac{56}{10} = 5.6$$

difference $R_{3.3} = (M_R - M_{\bar{R}}) = \frac{(3.3 - 3.3)}{10}\%$

$= 0\%$

diffenee $\bar{R}_{5.6} = (M_{R'} - M_{\bar{R}'}) = (5.6 - 5.6)\%$

$= 0\%$

So there is no differnee betteewn as they identical

E-2

Objective :

- learn How to connect a serise circuit a breadboard
- Validate the voltage divider rules
- verify Kirchhoff's voltage law

Component list:

- Trainer board
- Resistor (3.3KΩ, 4.7KΩ, 5.6KΩ)
- Digital Multimeter (DMM)
- Connecting wire

Circuit Diagram:

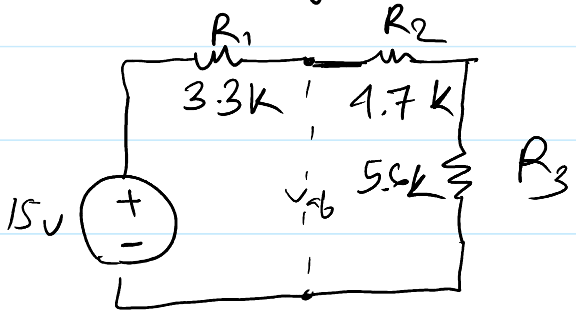


Fig: circuit

Table-1

Resistance using colour coding					Resitene of DMM	%Error
Band-1	Band-2	Band-3	Band-4	Ristance ± tol		
Orange	Orange	Red	Gold	3.3 ±5%	3.3	0
Yellow	Violet	Red	Gold	4.7 ±5%	4.7	0
Green	Blue	Red	Gold	5.6 ±5%	5.6	0

Table-2

Experimental readings				Theoretical values			
V_S	V_{R_1}	V_{R_2}	V_{R_3}	V_S	V_{R_1}	V_{R_2}	V_{R_3}
15	3.640	5.184	6.176	3.640		5.184	6.176
% Error							
V_S		V_{R_1}		V_{R_2}		V_{R_3}	
15		0		0.0779%		0.065%	

Table-3

Potential rise	Potential drop $(V_{R_1}+V_{R_2}+V_{R_3})$	Are voltage rises and drops equal
15 V	$(3.64 + 5.184 + 6.176) = 15$ V	yes

Table-4

Experimental reading		Theoretical values	
Vab	Req	Vab	Req
11.36V	13.6Ω	11.36V	13.6Ω
% Error			
Vab		Req	
0%		0%	

Results: we know, $V_x = \frac{E \times R_x}{R_T}$

$R_T = R_1 + R_2 + R_3 = 3.3 + 4.7 + 5.6\ K\Omega$
$= 13.6\ K\Omega$

$V_{R_1} = \frac{3.3 \times 15}{13.6} = 3.64\ K\Omega$

$V_{R_2} = \frac{4.7 \times 15}{13.6} = 5.18\ K\Omega$

$V_{R_3} = \frac{5.6 \times 15}{13.6} = 6.18\ K\Omega$

$\%\ Error = \frac{\text{Theoretical value} - \text{Experiment value}}{\text{Theoretical value}} \times 100\%$

For V_S, $\%\ Error = \frac{15 - 15}{15} \times 100\%$
$= 0\%$

For V_{R_1}, $\%\ Error = \frac{3.64 - 3.64}{3.64} \times 100\%$
$= 0\%$

For V_{R_2}, $\%\ Error = \frac{5.184 - 5.18}{5.184} \times 100\%$
$= 0.077\%$

For V_{R_3}, $\%\ Error = \frac{6.18 - 6.176}{6.18} \times 100\%$
$= 0.065\%$

$V_{ab} = 5.18 + 6.18 = 11.36\ V$

$R_{eq} = 3.3\ K\Omega + 4.7\ K\Omega + 5.6\ K\Omega$
$= 13.6\ K\Omega$

Question/Answer:

1

1. State the voltage division rule.

Voltage division Rule:

When in a series circuit is connected the current remain the same but voltage is devided by by the multitude of each resistor

Voltage of circuit

magnatude of X Resistor

$$V_x = \frac{E R_x}{R_T}$$

Voltage of X Resistor

Total Resitor of circuit

2

2. State the Kirchhoff's voltage law (KVL)

Kirchhoff's voltage law (KVL) states that the voltage around a closed path algebraically sum to zero. In other words, the sum of voltage rise equals the sum of voltage rise equals the sum of voltage drop.

The equation is:

$$\sum_{M=0}^{m} V_m = 0$$

3

3. Showing all steps, calculate the theoretical values in Table 2. Compare theoretical values to your experimental values and explain whether your circuit follows KVL or not

Table-2

Experimental reeding:

R_S (total Resistence) $= R_1 + R_2 + R_3$

$= 3.3 + 4.7 + 5.6$

$= 13.6\,\Omega$

$V_S = I_S R_S$

$I_S = \frac{V}{R_S} = \frac{15}{13.6} = 1.103\,A$

$V_{R_1} = I_S R_1 = 3.640\,V$

$V_{R_2} = I_S R_2 = 5.184\,V$

$V_{R_3} = I_S R_3 = 6.176\,V$

theoratical value:

R_S' (total Resistence) $= R_1 + R_2 + R_3$

$= 3.3 + 4.7 + 5.6$

$= 13.6\,\Omega$

$V_S' = I_S' R_S'$

$I_S' = \frac{V_S'}{R_S'} = \frac{15}{13.6} = 1.103\,A$

$V_{R_1}' = I_S R_1 = 3.640\,V$

$V_{R_2}' = I_S R_2 = 5.184\,V$

$V_{R_3}' = I_S R_3 = 6.176\,V$

Error:

$V_S = \frac{(V_S - V_S')}{V_S} \times 100\% = \frac{15-15}{V_1} \times 100\%$

$= 0\%$

$$v_1 = \frac{(v_1 - v_1')}{v_1} \times 100\% = \frac{3.64 - 3.64}{v_1} \times 100\%$$
$$= 0\%$$

$$v_2 = \left(\frac{v_2 - v_2'}{v_1}\right) 100\% = \frac{5.184 - 5.18}{\cancel{v_1}\ 2} \times 100\%$$
$$= 0.077\%$$

$$v_3 = \left(\frac{v_3 - v_3'}{v_3}\right) 100\% = \frac{0}{v_3} \times 100\%$$
$$= 0.065\%$$

So, voltage Rise = 15 V

voltage drop = $v_1 + v_2 + v_3 = 15$ V

voltage Rise = voltage drop

which follow KVL

4

4. Showing all the calculations, theoretically calculate Vab. Compare with the experimental value and
verify the voltage division rule at the terminal a-b.

Theoritical calculation:

$$V_{ab} = V - V_a$$
$$= 15 - I_s R_1$$
$$= 15 - 3.64 = 13.36\,V$$

To measure Theoratical value we use multimiter place between ab and by measuring voltage we get

$$V'_{ab} = 13.36V$$

Error:

$$\text{Error} = \frac{\text{Theoratical} - \text{Experimint}}{\text{Theoratial}} \times 100\%$$
$$= \frac{V_{ab} - V'_{ab}}{V_{ab}} \times 100\% = 0\%$$

As the result is almost same we can say that voltage divition rule at The terminal a-b is verified.

5

5. Showing all the steps, calculate Req. Compare with the experimental value.

Req by Theoretical value:

$R_{eq} = R_1 + R_2 + R_3 = 3.3 + 4.7 + 5.6 = 13.6\,\Omega$

Req by Experimental value:

R'eq by measuring via multimeter we get

$R'_{eq} = R_1' + R_2' + R_3' = 3.3 + 4.7 + 5.6 = 13.6\,\Omega$

So, theoritical and experimental value for are same.

Discussion:

From the lab 1. we learned about ohm's law, kirchoff's voltage law and voltage divider rule using series circuit.

As, it was an online lab, we had to use multisim to do the experiments.

So, we didn't have to face many error

Both multisim and ohms law had same result as its doesn't have flaws which is present in real world which could be coming form tollerene equipment in accurey and also form lose connection. But it help creating proof and validation of ohms law.