North South University
Department of Electrical & Computer Engineering

LAB REPORT

Course Code : EEE 141L

Course Title: Electrical Circuits Lab

Course Instructor: Faculty Name M Abu Obaidah

Experiment Number: 01

Experiment Name:

Ohm's Law, KVL, and Voltage Divider Rule using Series Circuit

Experiment Date: 6/6/18

Date of Submission: 27/6/18

Section: 8

Group Number: 07

Submitted To: Lab Instructor Name Sanjida Islam

Submitted By	Score
Student Name and ID: 1. Tasnim Faisal, 1721327042 2. 3. 4. 5. 6.	

Objectives:

- Find the resistance of a resistor from its color code.
- Measure voltage, current and resistance values using a digital multimeter.
- Verify the validity of ohm's law.
- Test the voltage divider rule in a sereis circuit

Theory:

Ohm's law states that the current through a conductor between two points is directly proportional to the voltage across the two points. Introducing the constant of proportionally, the resistance, one arrives at the usual mathematical equation that describes the relationship. $I = \frac{V}{R}$, where I is the current through conductor in units of amperes, V is the voltage measured across the conductor in units of volts, R is the resistance of conductors in units of ohms.

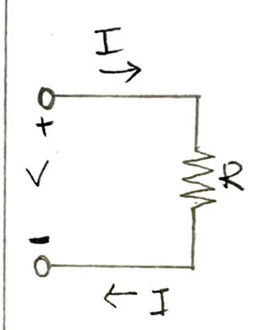

Fig: ohm's law

Voltage divider rule is that rule if a sereis circuit has more than one resistor, the voltage across of each resistor is the ratio of resistor value multiplied with voltage source to total resistance value. Let us consider beside circuit there is three resistance. Using voltage divider rule, we get

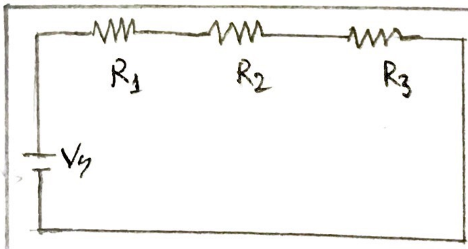

Fig: Voltage divider rule

$$V_1 = \frac{R_1}{R_1+R_2+R_3} V_s \quad , \quad V_2 = \frac{R_2}{R_1+R_2+R_3} V_s \quad , \quad V_3 = \frac{R_3}{R_1+R_2+R_3} V_s$$

Resistor values are often indicated with color codes. The coding is defined in the international Standard IEC 60062. From the figure, for the 4 band resistor there are 4 colors, each color represents a number. The order in which the colors are arranged, gives the value of resistor. For a 4 band resistor, $AB \times 10^C \Omega$ with the tolerance of $\pm t\%$ is the value of resistor.

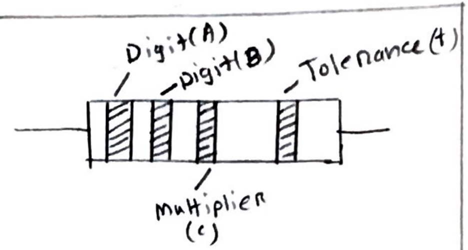

Fig: 4 band resistor code

We can measure resistance theoretically by using the Ohm's law, which is $V = iR \Rightarrow R = \frac{V}{i}$. Also, we can calculate from power, $P = i^2R \Rightarrow R = \frac{P}{i^2}$

Kirchof's Voltage Law (KVL) states that the algebraic sum of all voltages around a closed path is zero. KVL states that which is expressed mathematically, $\sum_{m=1}^{M} V_m = 0$, where M is the number of voltages in the loop and V_m is the mth voltage.

A breadboard is a solderless device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connection through wires where appropriate. The breadboard has strips of metal underneath the board and connects the holes on the top of the board. The top and bottom rows of holes are connected horizontally and split in the middle while the remaining holes are connected vertically.

The digital multimeter (DMM) is one of the most useful devices to measure current, voltage and resistance. Most DMM has three terminals and two probes. One black terminal is zero potential / ground, One red terminal is for measuring voltage, one red terminal is for measuring current. One probe is continuously connected to the black terminal and another probe connects to one of the two red terminals depending on the measurement mode. Theoretically, Voltage, $V = \frac{W}{Q}$, where W = Energy in joules and Q = Charge in coloumbs. and if we know the resistance and the current, voltage, $V = iR$. And theoretically, Current $I = \frac{Q}{t}$; where Q = charge in coloumbs and t = time in seconds and current, $I = \frac{V}{R}$ if we know the resistance and voltage.

Percentage error is the difference between approximate and exact value, as a percentage of the exact value.

$$\text{Percentage error} = \frac{|\text{Practical value} - \text{Theoretical value}|}{\text{Theoretical value}} \times 100$$

Ohm's law states the relationship between voltage, current and resistance. It is beneficial because it helps to calculate current, voltage and resistance in circuits.

Apparatus list:

For experiment 1,

(i) Trainer board

(ii) Resistor (3.3 KΩ)

(iii) Digital multimeter (DMM)

(iv) Connecting wire

For experiment 2,

(i) Trainer board

(ii) Resistors (3.3, 4.7, 5.6 KΩ)

(iii) Digital multimeter (DMM)

(iv) Connecting wire

Circuit Diagram:

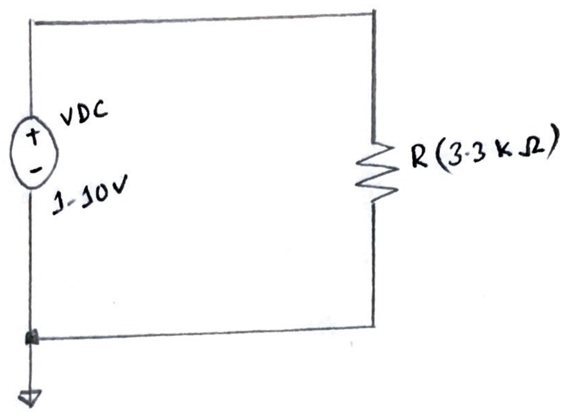

Fig: Circuit of experiment 1

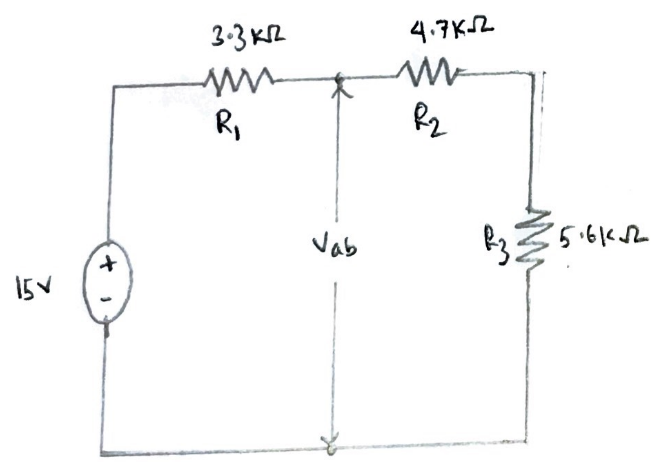

Fig: Circuit of experiment 2

Data & Results:

Experiment 1:

Resistance using color coding					Resistance using DMM (KΩ)	% error
Band 1	Band 2	Band 3	Band 4	Resistance ± tol (KΩ)		
Orange	Orange	Red	Golden	$33\times10^2 \pm 5\%$ (3.465~3.135)	3.22	2.4%

3.3 KΩ Supply Voltage	Experimental readings		
	DMM current, I	DMM Voltage, IR	Power, I^2R
2	0.6 mA	1.95 V	1.7×10^{-3}
4	1.2 mA	3.98 V	4.77×10^{-3}
6	1.9 mA	5.98 V	0.011
8	2.5 mA	7.98 V	0.019
10	3.1 mA	10.01 V	0.03

Experiment 2:

Practical					Theoretical			
V_s	V_{R_1}	V_{R_2}	V_{R_3}	V_{ab}	V_{R_1}	V_{R_2}	V_{R_3}	V_{ab}
5V	1.18	1.67	2.08	3.88	1.21	1.72	2.06	3.78
8V	1.9	2.79	3.09	5.82	1.94	2.76	3.29	6.05
11V	2.62	3.7	4.9	8.15	2.66	3.8	4.52	8.32
13V	3.09	4.98	5.28	9.75	3.15	4.99	5.35	9.84
15V	3.58	5.19	6.11	11.30	3.63	5.18	6.17	11.35

5V	Potential rise	4.96V	almost equal
	Potential drop ($V_{R_1}+V_{R_2}+V_{R_3}$)	4.93V	
8V	Potential rise	7.93V	almost same
	Potential drop ($V_{R_1}+V_{R_2}+V_{R_3}$)	7.33V	
11V	Potential rise	10.99V	almost same
	Potential drop ($V_{R_1}+V_{R_2}+V_{R_3}$)	10.72V	
13V	Potential rise	12.85V	almost equal
	Potential drop ($V_{R_1}+V_{R_2}+V_{R_3}$)	12.84V	
15V	Potential rise	14.87V	almost equal
	Potential drop ($V_{R_1}+V_{R_2}+V_{R_3}$)	14.88V	

Experimental readings

Req

13.39

Roll No. ....

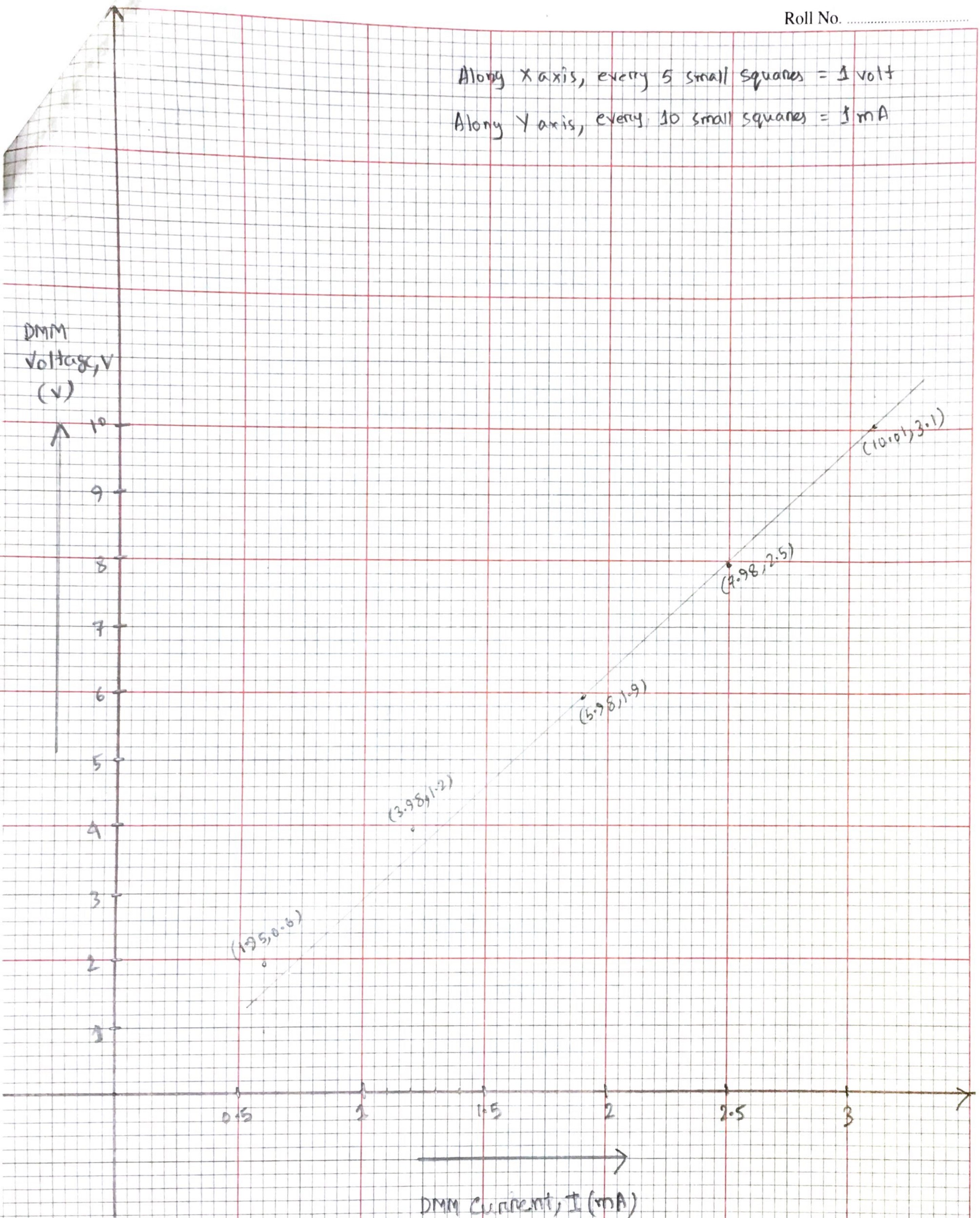

Fig: V vs I graph

Calculation:

For experiment 1, Resistance

$$R = \frac{V}{I} = \frac{1.95V}{0.6\times10^{-3}\,amp} = 3250\,\Omega = 3.25\,K\Omega$$

$$R = \frac{V}{I} = \frac{3.98V}{1.2\times10^{-3}\,amp} = 3316.67\,\Omega = 3.3\,K\Omega$$

$$R = \frac{V}{I} = \frac{5.98V}{1.9\times10^{-3}\,amp} = 3147.36\,\Omega = 3.14K\,\Omega$$

$$R = \frac{V}{I} = \frac{7.98V}{2.5\times10^{-3}\,amp} = 3192\,\Omega = 3.19K\,\Omega$$

$$R = \frac{V}{I} = \frac{10.01V}{3.1\times10^{-3}\,amp} = 3229.03\,\Omega = 3.23\,K\Omega$$

For experiment 2,

Total resistance, $R_T = R_1 + R_2 + R_3$

$= 3.3 + 4.7 + 5.6\ K\Omega$

$= 13.6\ K\Omega$

For $V_s = 5\ V$, $V_{R_1} = V_s \times \frac{R_1}{R_T}$

$= 5 \times \frac{3.3}{13.6} = 1.21V$

$V_{R_2} = V_s \times \frac{R_2}{R_T}$

$= 5 \times \frac{4.7}{13.6} = 1.72\ V$

$$V_{R_3} = V_s \times \frac{R_3}{R_T}$$

$$= 5 \times \frac{5.6}{13.6} = 2.06\ V$$

$$V_{ab} = V_{R_2} + V_{R_3} = 1.72 + 2.06 = 3.78\ V$$

Result Analysis & Discussion:

In experiment 1, we have opened circuit before taking source voltage reading. Because of avoiding loading effect of internal resistance, we have opened circuit.

According to KVL, potential drop and rise should be equal in the circuit. But we know that, as temperature rises, resistance goes up. Also there are resistances in wire and our body. So, we have not got equal potential drop and rise.

In experiment 2, we have seen that as resistance goes up, the voltage also goes up. As the circuit is series, the current is same flowing through each resistors. According to Ohm's law, the voltage goes up as the resistance goes up.

We have measured current only one time in experiment 2. Because we know that in series circuit, current is same

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Data Collection for Exp1:

Lab 1: Exp1

Group No. ________

Instructor's Signature ________

Table 1:

Resistance using colour coding					Resistance using DMM (kΩ)	% Error
Band 1	Band 2	Band 3	Band 4	Resistance ± tol (kΩ)		
orange	orange	Red	Golden	$33 \times 10^2 \pm 5\%$	3.22	2.4%

3.3 kΩ ± 0.165 kΩ

(3.465 ~ 3.135)

Table 2:

3.3 KΩ Supply Voltage	Experimental readings		
	DMM Current, I	DMM Voltage, I R	Power, I^2R
2	0.6 mA	1.95 V	1.17×10^{-3}
4	1.2 mA	3.98 V	4.77×10^{-3}
6	1.9 mA	5.98 V	0.011
8	2.5 mA	7.98 V	0.019
10	3.1 mA	10.03 V	0.03

X Table 3

5.6 KΩ Voltage	Experimental readings		
	Current, I	Voltage, I R	Power, I^2R
2			
4			
6			
8			
10			

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EEE41L/ETE141L Updated By: Maria Moosa

Data Collection for Exp2:

Lab 1: Exp2
Group No. ________
Instructor's Signature __________

Table 1:

Resistance using colour coding					Resistance using DMM	% Error
Band 1	**Band 2**	**Band 3**	**Band 4**	**Resistance ± tol**		

Table 2:

Experimental readings				**Theoretical values**			
V_S	V_{R1}	V_{R2}	V_{R3}	V_S	V_{R1}	V_{R2}	V_{R3}

% Error			
V_S	V_{R1}	V_{R2}	V_{R3}

Table 3:

Potential rise V_S		**Are the voltage rises and drops equal?**
Potential drops ($V_{R1} + V_{R1} + V_{R3}$)		

Table 4

Experimental readings		**Theoretical values**	
V_{ab}	R_{eq}	V_{ab}	R_{eq}
	13.39		

% Error	
V_{ab}	R_{eq}

Practical					Theoretical				
V_s	V_{R_1}	V_{R_2}	V_{R_3}	V_{ab}	V_s	V_{R_1}	V_{R_2}	V_{R_3}	V_{ab}
5V	1.18	1.67	2.08	3.88		1.21	1.72	2.06	3.78
8V	1.9	2.74	3.09	5.82		1.94	2.76	3.29	6.05
11V	2.62	3.7	4.4	8.15		2.66	3.8	4.52	8.32
13V	3.09	4.48	5.28	9.75		3.15	4.49	5.35	9.84
15V.	2.58	5.19	6.11	11.30		3.63	5.18	6.17	11.35

5V	Potential rise	4.96V	almost equal
	Potential drop $V_{R_1} + V_{R_2} + V_{R_3}$	4.93V	
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	Potential drop $V_{R_1} + V_{R_2} + V_{R_3}$	7.73V	
11V	Potential rise	10.99V	Almost same
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06/06/18