East West University
Department of CSE

LAB REPORT

Course Code and Name: CSE 209 ; ELECTRICAL CIRCUIT
Experiment no: 02 **Group no: 01**
Experiment name: Series-Parallel DC Circuit and Verification of Kirchhoff's Laws

Name of students & Id:	
1. B M Sharhia Alam	**ID:** 2021-3-60-016
2. Sidratul Moontaha	**ID:** 2021-3-60-048
3. Antara Sarkar Rupa	**ID:** 2021-3-60-056

Course Instructor information: M Saddam Hossain Khan(SHK) Senior Lecturer Department of Computer Science and Engineering East West University
Date of Report Submitted:

ABSTRACT:

This lab experience name is "Series-Parallel DC Circuit and Verification of Kirchhoff's laws". For doing this lab simulation firstly we should open our PSpice software and draw a diagram figure-4 and simulate the values of V_1, V_2, V_3, I_1, I_2, and I_3. Then we have to calculate the values V_1, V_2, V_3, I_1, I_2, and I_3 and compare the simulated value and calculated value.

OBJECTIVE:

1. Dc series-parallel circuit is analyzed to learn.
2. Kirchhoff's Voltage Law (KVL) is verified.
3. Kirchhoff's Current Law (KCL) is verified.

THEORY AND EXPERIMENTAL METHODS:

Kirchhoff's Voltage Law (KVL) states that the sum of the voltage rises around a closed path is equal to the sum of the voltage drops. The KVL can be written in the following mathematical form:

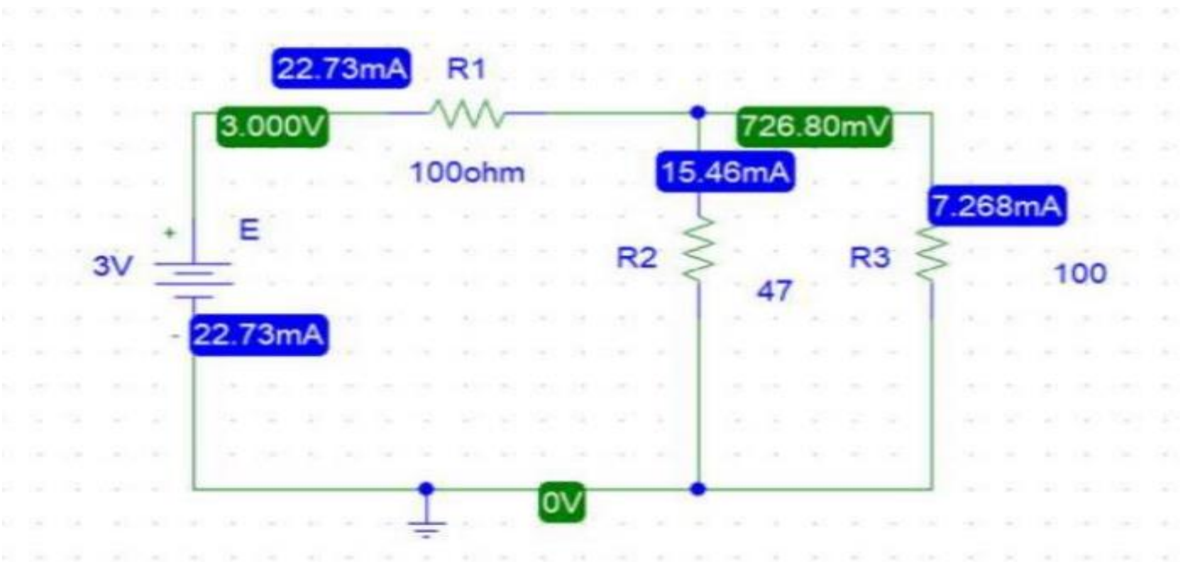
$\sum V_{rises} = \sum V_{drops}$

Kirchhoff's Current Law (KCL) states that the sum of the currents entering a node of a circuit is equal to the sum of the currents leaving the node. The KCL can be written in the following mathematical form:

$\sum I_{in} = \sum I_{out}$

A series-parallel circuit is one that is formed by a combination of series and parallel resistors. For solving series-parallel circuits, parallel combinations of resistors and series combinations of resistors are clearly identified. Then series-parallel reduction method is used to determine the values of the circuit variables.

CIRCUIT DIAGRAM:



EQUIPMENTS AND COMPONENTS NEEDED:

1. DC power supply
2. DC voltmeter
3. DC ammeter
4. Multimeter
5. Resistor 100 Ω (two) and 47 Ω (one)
6. Breadboard
7. Connecting wires

LAB PROCEDURE:

From the simulated data,

1. $V_2 = V_3 = 0.73$V
2. $E = V_1 + V_2 = (2.27 + 0.73)$ V= 3V
3. $I_1 = I_2 + I_3 = (16 + 8)$ mA = 24mA ≈ 23.5mA= I_1

Table 1. Experimental Datasheet

Group - 01

Table 01 : Experimental Datasheet :

Measured value of E (V)	Measured value of V_1 (V)	Measured value of V_2 (V)	Measured value of V_3 (V)	Measured value of I_1 (mA)	Measured value of I_2 (mA)	Measured value of I_3 (mA)	Measured value of Resistance (Ω)
3	2.27	0.73	0.73	23.5	16	8	R_1 = 0.09 R_2 = 0.04 R_3 = 0.09

Name : ~~Sha~~ B M Shahria Alam
ID : 2021 - 3 - 60 - 016

21/11/22

Name : Sidratul Moontaha
ID : 2021 - 3 - 60 - 048

Name : Antara Sarkar Rupa
ID : 2021 - 3 - 60 - 056

(i) from the Data sheet, we can see

$V_2 = 0.73V$, $V_3 = 0.73V$

~~(ii) E = 2.27 + 0.73~~

(ii) $E = V_1 + V_2$

$= 2.27 + 0.73$

$= 3V$

(iii) $I_1 = I_2 + I_3$

$\Rightarrow 23.5 = 16 + 8$

$\Rightarrow 23.5\,mA \approx 24mA$

RESULTS AND DISCUSSIONS:

Here, we can see that the theoretical values and the experimental values are the same. So, we can say there are no discrepancies between the simulated value and the calculated value.

POST-LAB SOLUTION:

1.

Here,

$R_1=100\Omega$,

$R_2=47\Omega$,

$R_3=100\Omega$

From ohm's law we know that,

V=IR

Or, I=V/R

Here,

R1 and R2 is in parallel,

Rp = 47*100/47+100= 4700 / 147 = 31.97Ω

Then, Rp and R_1 is in series,

Req= 100+31.97 = 131.97Ω

Here,

E=3V

and Req=131.97Ω

So, I_1= 3131.97 =0.0227A = 22.73mA

$V_1= I_1R_1$ = 0.0227*100 =2.27V

Here, Applying KVL, V_2 and V_3 are parallel so their value will be the same,

$V_2 = V_3 = I_1$Req = 0.0227*31.97 = 0.703V

I2 = V2/R2 = 0.726847 = 0.015A

I3 = V2/R2 = 0.7268100 = 0.00703A

So, we can say that there is no discrepancy found because all the value of I_1, I_2, I_3 and V_1, V_2, V_3 are the same with measured values by Pspice simulation.

2.

(i) We know that from KVL that two different value of voltage cannot be connect in parallel. If they are connecting in parallel then their value will be same.

$-V_2+V_3=0$

Or, $V_2=V_3$

Calculating V_2 and V_3,

$V_2= I_2R_2$ = 0.01546*47 V =0.703V

$V_3= I_3R_3$ = 0.00703*100 V =0.703V

So, $V_2=V_3$ (Showed)

(ii) From KVL we can calculate that,

Total sum of rising voltage and dropping voltage =0

$$\text{Or, } -E+V_1+V_2=0$$

$$\text{Or, } 3=V_1+V_2$$

From Question 1, we know, V1= 2.273V and V2= 0.7268

$$V_1+V_2= 2.99$$

$$\text{Or, } V_1+V_2= 3 \text{ (Showed)}$$

(iii) From KCL we can calculate the Total sum of entering current and leaving current=0

$$\text{Or, } I_1=I_2+I_3$$

From Question 1, we know,

$$I_2+I_3= (0.01546+0.00703)$$

$$\text{Or, } I_2+I_3= 0.022 =I_1$$

$$I_1=I_2+I_3 \text{ (Showed)}$$

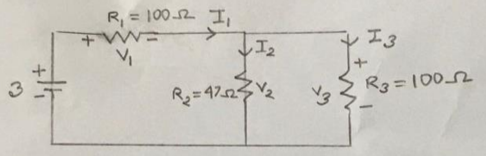
Conclusion: In this experiment, we verified the Kirchhoff's current law (KCL) and Kirchhoff's voltage law (KVL). Here for measuring current, we connected ammeter (Iprobe) in series with the resistors. For measuring voltage, we connected the bubbles accross with the resistors. After getting all the voltages and currents then we can easily verify the Kirchhoff's current law and Kirchhoff's voltage law.

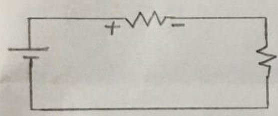
PRE-LAB SOLUTION:

Name : B M Shahria Alam
ID: 2021-3-60-016
Course: 209 (2)
Lab : 2

Lab-2 Pre lab report

Q. Theoritically calculate the values of V_1, V_2, V_3, I_1, I_2 and I_3 for the circuit of figure 4 with $E = 3V$.





$R_P = R_2 \parallel R_3$
$= 47 \parallel 100$
$= 31.97\Omega$

$\therefore R_{eq} = R_1 + R_P$
$= (100 + 31.97)\Omega$
$= 131.97\Omega$

Here, $E = 3V$

we know, $I_1 = \frac{V}{R_{eq}} = \frac{3}{131.97} = 0.0227A$

Now, $V_1 = I_1 R_1$
$= (0.0227 \times 100) V$
$= 2.27V$

Applying C.D.R –

$I_2 = \frac{R_3}{R_2 + R_3} \times I_1$
$= \frac{100}{47 + 100} \times 0.0227$
$= 0.015A$

$\therefore V_2 = I_2 R_2$

$= 0.015 \times 47$

$= 0.703 V$

Now, $I_3 = \frac{R_2}{R_2 \times R_3} \times I_1$

$= \frac{47}{47+100} \times 0.0227$

$= 0.00703 A$

$\therefore V_3 = I_3 R_3$

$= 0.00703 \times 100$

$= 0.703 V$

So, $V_1 = 2.27V$ $\quad$ $I_1 = 0.022A$

$V_2 = 0.703 V$ $\quad$ $I_2 = 0.015A$

$V_3 = 0.703 V$ $\quad$ $I_3 = 0.00703 A$

Q.2: From the calculated values, show that (i) $V_2 = V_3$;

(ii) KVL holds, that is $E = V_1 + V_2$

(iii) KCL holds, that is $I_1 = I_2 + I_3$

(i) Applying KVL at loop 2 -

$-V_2 + V_3 = 0$

$\therefore V_2 = V_3$

Also, from calculated value,

$V_2 = I_2 R_2 = 0.703$

$V_3 = I_3 R_3 = 0.703$

$\therefore V_2 = V_3$ $\quad$ [Showed]

(ii) Applying KVL at loop 1;

$$-3 + V_1 + V_2 = 0$$

$$\Rightarrow V_1 + V_2 = 3$$

from (i) we get –

$$V_1 = 2.27 \text{ V}$$

$$V_2 = 0.703 \text{ V}$$

$$\therefore V_1 + V_2 = 2.27 + 0.703$$

$$= 2.97$$

$$\approx 3 \text{V}$$

$$= E$$

[Showed]

(iii) Applying KCL at 1 –

from (i) we get,

$$I_2 = 0.015 A$$

$$I_3 = 0.00703 A$$

So, $I_1 = I_2 + I_3$

$$= (0.015 + 0.00703) A$$

$$= 0.002203 A$$

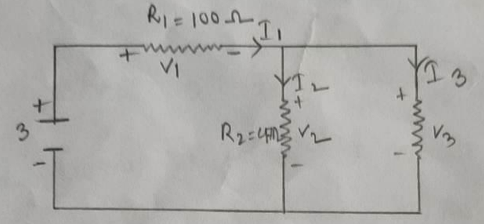
$$= I_1$$

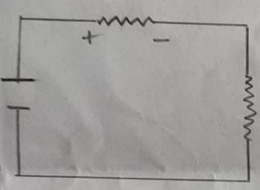
[Showed]

Name:- Sidratul Moontaha
ID:- 2021-3-60-048

Q.11. Theoritically calculate the values of $V_1, V_2, V_3, I_1, I_2, I_3$ of the circuit of figure 4 with $E = 3V$.

Ans:-





$R_p = R_2 \| R_3$

$= 47 \| 100 = 31.97\,\Omega$

$R_{eq} = R_1 + R_p$

$= (100 + 31.97) = 131.97\,\Omega$

Here, $E = 3V$

we know, $I_1 = \frac{V}{R_{eq}} = \frac{3}{131.97} = 0.0227A$

Now, $V_1 = I_1 R_1$

$= (0.0227 \times 100) = 2.27V$

Applying C.D.R :- $\frac{R_3}{R_2 + R_3} \times I_1$

$= \frac{100}{47+100} \times 0.0227$

$= 0.015A$

$V_2 = I_2 R_2$

$= 0.015 \times 47 = 0.703V$

$$I_3 = \frac{R_2}{R_2+R_3} \times I_1$$

$$= \frac{47}{47+100} \times 0.0227 = 0.00703\,A$$

$$V_3 = I_3 R_3 = 0.00703 \times 100 = 0.703\,V$$

Q.21 From the calculated values, show that, i) $V_2 = V_3$, ii) KVL holds, that is $E = V_1 + V_2$, iii) KCL holds, that is $I_1 = I_2 + I_3$

i) Applying KVL at loop 2,

$$-V_2 + V_3 = 0$$

$$\Rightarrow V_2 = V_3$$

From calculated value, $V_2 = 0.703\,V$, $V_3 = 0.703\,V$

$\therefore V_2 = V_3$ (showed)

ii) Applying KVL at loop 1,

$$-3 + V_1 + V_2 = 0$$

$$\Rightarrow V_1 + V_2 = 3$$

$$\Rightarrow 2.27 + 0.703 = 3$$

$$\Rightarrow 2.97 \approx 3V = E$$

(showed)

iii) Applying KCL at 1 →

$$I_1 = I_2 + I_3$$

$$= (0.015 + 0.00703)\,A$$

$$= 0.02203\,A$$

$$= I_1$$

$$I_2 + I_3 = 0.015 + 0.00703 = 0.02203\,A$$

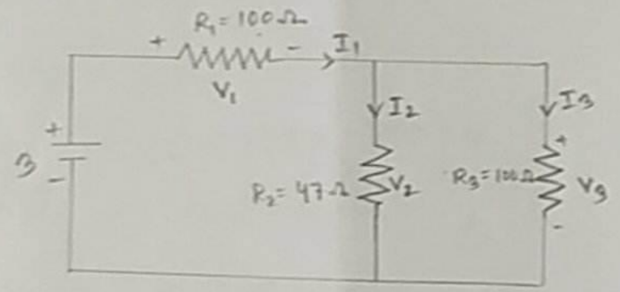
— o —

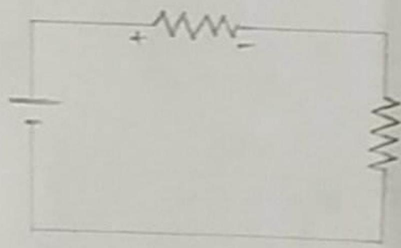
(showed)

Name: Antara Sarkar Rupa.
ID : 2021-3-60-056
Group no: 01

<u>Ques:</u> (1) Theoritically calculate the values of V_1, V_2, V_3, I_1, I_2, and I_3 of the circuit of figure 4 with $E = 3V$.

⇒





$$R_p = R_2 \parallel R_3$$
$$= 47 \parallel 100$$
$$= 31.97\ \Omega$$

$$\therefore R_{eq} = R_1 + R_p$$
$$= (100 + 31.97)$$
$$= 131.97\ \Omega$$

Here,

$E = 3V$

We know,

$$I_1 = \frac{V}{R_{eq}}$$

$$= \frac{3}{131.97}$$

$$= 0.0227A$$

$$\cancel{= 22\ mA}$$

Now, $V_1 = I_1 R_1$

$$= (0.0227 \times 100)\ V$$

$$= 2.27V$$

Applying C.D.R. —

$$I_2 = \frac{R_3}{R_2 + R_3} \times I_1$$

$$= \frac{100}{47 + 100} \times 0.0227$$

$$= 0.015\ A$$

$$\therefore V_2 = I_2 R_2$$

$$= 0.015 \times 47$$

$$= 0.703\ V$$

Now,

$$I_3 = \frac{R_2}{R_2 + R_3} \times I_1$$

$$= \frac{47}{47 + 100} \times 0.0227$$

$$= 0.00703 \text{ A}$$

$$\therefore V_3 = I_3 R_3$$

$$= 0.00703 \times 100$$

$$= 0.703 \text{ V}$$

So,

$V_1 = 2.27\text{V}$

$V_2 = 0.703\text{ V}$

$V_3 = 0.703\text{ V}$

$I_1 = 0.022\text{A}$

$I_2 = 0.015\text{ A}$

$I_3 = 0.00703\text{ A}$

2 From the calculated values, show that (i) $V_2 = V_3$, (ii) KVL holds, that is, $E = V_1 + V_2$, and (iii) KCL holds, that is, $I_1 = I_2 + I_3$.

(i) Applying KVL at loop 2 —

$$-V_2 + V_3 = 0$$

$$\Rightarrow V_2 = V_3$$

Also from calculated value,

$V_2 = I_2R_2 = 0.703$

$V_3 = I_3R_3 = 0.703$

$\therefore V_2 = V_3$ [Showed]

(ii) Applying KVL at loop 1,

~~$V_1 = 2.27$~~

$-3 + V_1 + V_2 = 0$

$\Rightarrow V_1 + V_2 = 3$

from (i) we get —

$V_1 = 2.27\ V$

$V_2 = 0.703\ V$

$\therefore V_1 + V_2 = 2.27 + 0.703$

$= 2.97 \approx 3V = E$

[Showed]

(iii) Applying KCL at 1 —

$I_1 = I_2 + I_3$

$= (0.015 + 0.00703)\ A$

$= 0.02203\ A$

$= I_1$

from (1) we get —

$I_2 = 0.015\ A$

$I_3 = 0.00703\ A$

[Showed]