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Course Code: CSE250
Experiment no: 02
Experiment name: Introduction to series and parallel circuits.

1. Objective:

The experiment is to acquaint the students with series-parallel circuits and to give them the idea about how to connect different circuits in bread board.

2. Apparatus:

→ DC power supplies
→ Resistors
→ Bread board / Trainer board
→ Multimeter

3. Circuit / Block / System Diagram

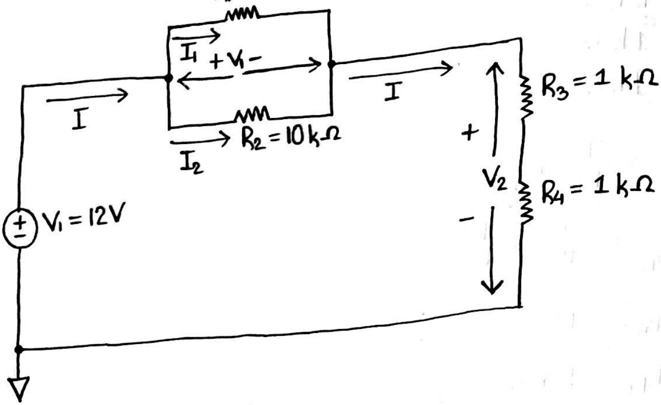


Figure-1

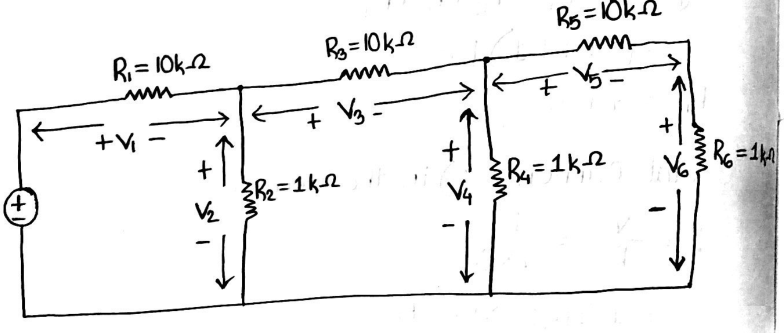


Figure-2

4. Result: For Figure 1,

$V_1 = 12 V$

$R_1 = 10 k\Omega$

$R_2 = 10 k\Omega$

$R_3 = 1 k\Omega$

$R_4 = 1 k\Omega$

$$\frac{1}{R_{P_{12}}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_{P_{12}}} = \frac{1}{10} + \frac{1}{10}$$

$$\frac{1}{R_{P_{12}}} = \frac{2}{10}$$

$$\therefore R_{P_{12}} = 5 k\Omega$$

Again, $R_P = R_{P_{12}} + R_3 + R_4$

$$= (5 + 1 + 1) k\Omega$$

$$R_P = 7 k\Omega$$

Total Current (I) in the circuit,

$$I = \frac{V}{R} = \frac{12}{7 \times 10^3}$$

$$= 1.71428 \times 10^{-3} A$$

$$\therefore I = 1.714 mA$$

We get the same value of I from PSpice Simulation too.

Now, here R_3 & R_4 are in series, so their Current (I) will be same, but there will be some voltage drop,

$$V_2 = I(R_1 + R_2)$$
$$= 1.714 \times (1+1)$$
$$\therefore V_2 = 3.42857$$

Total Voltage $V = 12V$

$$V_1 = (12 - 3.42857)$$
$$= 8.57143 \text{ V}$$

Now, Current through R_1

$$I_1 = \frac{V_1}{R_1}$$
$$= \frac{8.57143 \text{ V}}{10 \text{ k}\Omega}$$
$$I_1 = 857.1428572 \ \mu A$$

Current through R_2,

$$I_2 = \frac{V_2}{R_2}$$
$$= \frac{8.57143}{10}$$
$$= 857.1428572 \ \mu A$$

Data Table:

V_1 (V)	V_2 (V)	(V_1+V_2)	I_1 (μA)	I_2 (μA)	I (mA)
8.5714	3.42857	11.99 ~ 12	857.14	857.14	1.714

For Figure-2

$V_1 = 12V$

$R_1 = 10 k\Omega$

$R_2 = 1 k\Omega$

$R_3 = 10 k\Omega$

$R_4 = 1 k\Omega$

$R_5 = 10 k\Omega$

$R_6 = 1 k\Omega$

$$R_{S56} = (10 + 1) k\Omega$$
$$= 11 k\Omega$$

$$R_{P456} = \left(\frac{1}{1} + \frac{1}{11}\right)^{-1}$$
$$= 0.91667 k\Omega$$

$$R_{S3456} = R_3 + R_{S456}$$
$$= (10 + 0.91667) k\Omega$$
$$= 10.91667 k\Omega$$

$$R_{P23456} = \left(1 + \frac{1}{10.91667}\right)^{-1}$$
$$= 0.9160839396 k\Omega$$

$$\therefore R_S = R_1 + R_{P23456}$$
$$= (10 + 0.9160839396) k\Omega$$
$$= 10.916 k\Omega$$

Total Current, $I = \frac{V}{R_5}$

$$= \frac{12}{10 \cdot 91608}$$

$$I = 1 \cdot 099295718 \ mA$$

This is similar to the value of PSpice.

In R_1,

Voltage, $V_1 = I \times R_1$

$$= 1 \cdot 099 \times 10^{-3} \times 10 \times 10^3$$

$$= 10 \cdot 992957$$

After Voltage drop in R_1,

$$V_2 = (12 - 10 \cdot 992957) V$$

$$= 1 \cdot 007 \ V$$

In R_2, $I_2 = \frac{V_2}{R_2}$

$$= \frac{1 \cdot 007}{1 \times 10^{-3}}$$

$$= 1 \cdot 007 \ mA$$

$$I_3 = \frac{V_2}{R_{53456}}$$

$$= \frac{1 \cdot 007}{10 \cdot 917 \times 10^3}$$

$$= 9 \cdot 22414 \times 10^{-5}$$

$$= 92 \cdot 2415 \ \mu A$$

After passing R_3, because of voltage drop,

$$V_3 = (1.007 - (92.2415 \times 10^{-6} \times 10 \times 10^{-3}))$$

$$= 0.0845 \text{ V}$$

In R_4, $I_4 = \frac{V_3}{R_4}$

$$= \frac{0.0845}{1 \times 10^{-3}}$$

$$= 84.5 \ \mu A$$

Current running in R_{S56},

$$I_{56} = \frac{V_3}{R_{S56}}$$

$$= \frac{0.0845}{11 \times 10^{3}}$$

$$I_{56} = 7.6818 \ \mu A$$

While passing R_5, there will be a voltage drop,

$$V_4 = (0.0845 - (7.6818 \times 10^{-6} \times 10 \times 10^{3}))$$

$$= 7.682 \text{ mV}$$

$$= 0.00768 \text{ V}$$

R_5 and R_6 are in series, so current will be same for those two.

$$I_6 = 7.682 \text{ mA}$$

Data Table:

V_1	V_2	V_3	V_4	V	I_1	I_2	I_3	I_4	I_5	I_6	I
10.993	1.007	0.0845	0.00768	12	1.099	1.007	0.092	0.084	0.00763	0.00768	1.099

5. Questions & Answers

(1) We have calculated the currents, and implemented in circuit. Both the values of currents from formula and circuits were same.

(2) Six $100\,\Omega$ resistors,

If R_2 and R_3 are in series,

$R_{S23} = 200\,\Omega$

If R_4 and R_5 are in parallel,

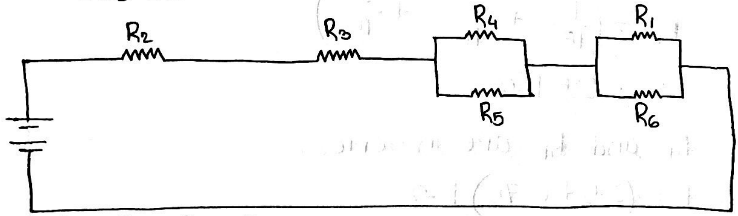
$$R_{P45} = \left(\frac{1}{100} + \frac{1}{100}\right)^{-1}$$
$$= 50\,\Omega$$

Now, R_1 and R_6 are in parallel,

$$R_{P16} = \left(\frac{1}{100} + \frac{1}{100}\right)^{-1}$$
$$= 50\,\Omega$$

Now, taking R_{S23}, R_{P45} & R_{P16} in series,

$$R = (200 + 50 + 50)\,\Omega$$
$$= 300\,\Omega$$



$R_1 = R_2 = R_3 = R_4 = R_5 = R_6 = 100\,\Omega$

(3) Given that,

Two $1.5\ k\Omega$ resistors

Six $15\ k\Omega$ "

R_1 and R_2 are in parallel,

$$R_{12} = \left(\frac{1}{1.5\times10^3} + \frac{1}{1.5\times10^3}\right)^{-1}$$

$$= 750\Omega$$

$$= 0.75\ k\Omega$$

R_3 & R_4 are in parallel,

$$R_{P_{34}} = \left(\frac{1}{15} + \frac{1}{15}\right)^{-1}$$

$$= \frac{15}{2}\ k\Omega$$

$$= 7.5\ k\Omega$$

R_6, R_7, R_8 are in parallel

$$R_{678} = \left(15^{-1} + 15^{-1} + 15^{-1}\right)^{-1}$$

$$= \frac{15}{3} = 5\ k\Omega$$

$R_5, R_{P_{34}}, R_{678}$ are in parallel,

$$R_P = \left(\frac{1}{15} + \frac{2}{15} + \frac{3}{15}\right)^{-1}$$

$$= 2.5\ k\Omega$$

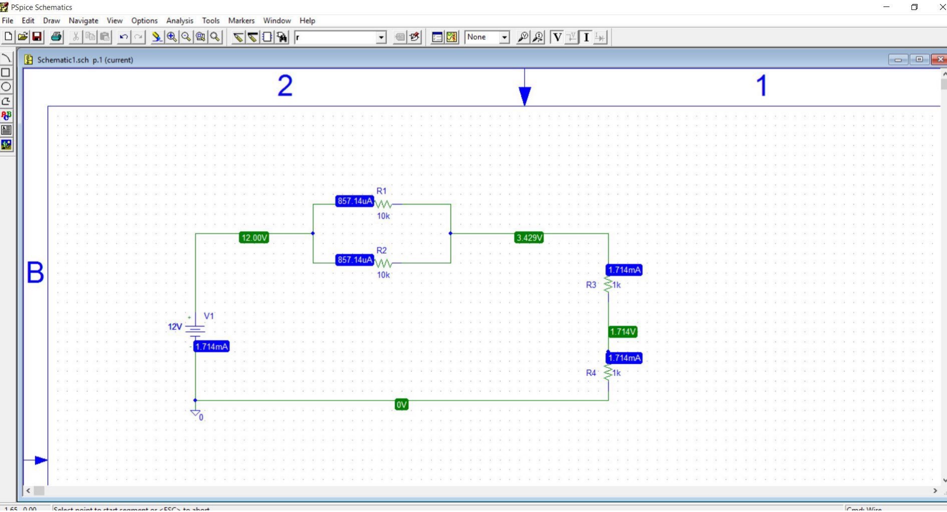
R_{12} and R_P are in series,

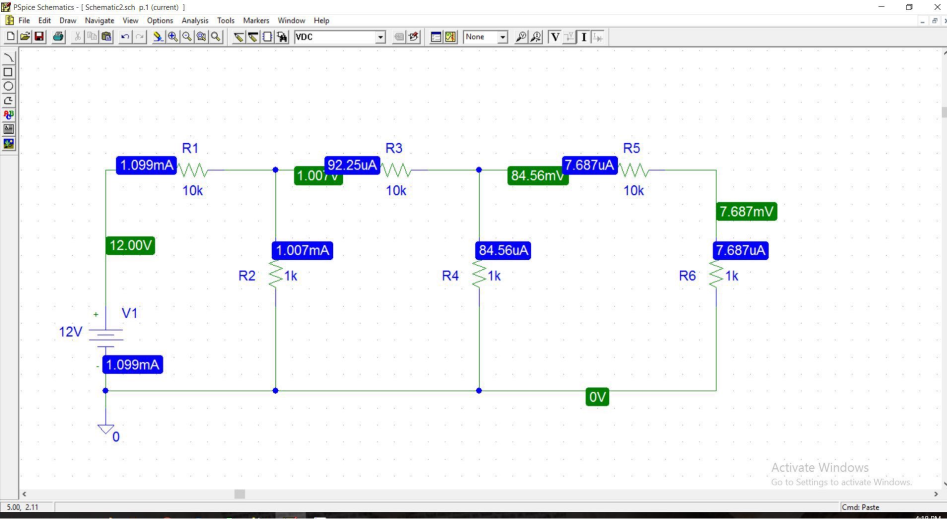
$$R = (2.5 + 0.75)\ k\Omega$$

$$= 3.25\ k\Omega$$

6. Discussion

Through this lab, we learnt how to build series and parallel circuit. We learnt to measure current and voltage, voltage drop. We proved that current is same in the resistors when they are in series and voltage is same when they are in parallel. That was the main goal of this lab.


PSpice Schematics
File Edit Draw Navigate View Options Analysis Tools Markers Window Help
None
Schematic1.sch p.1 (current)
2
1
B
R1
857.14uA
10k
R2
857.14uA
10k
12.00V
3.429V
V1
12V
1.714mA
R3
1.714mA
1k
1.714V
R4
1.714mA
1k
0V
0


PSpice Schematics - [Schematic2.sch p.1 (current)]
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VDC
None
R1
1.099mA
10k
1.007V
R3
92.25uA
10k
84.56mV
R5
7.687uA
10k
7.687mV
12.00V
1.007mA
R2
1k
84.56uA
R4
1k
7.687uA
R6
1k
V1
12V
1.099mA
0V
0
Activate Windows
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5.00, 2.11
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