

Name: Tanjim Reza

Student ID: 20101065

Course: CSE250

Experiment no: 02

Name of the Experiment: Introduction to
Series and parallel circuits.

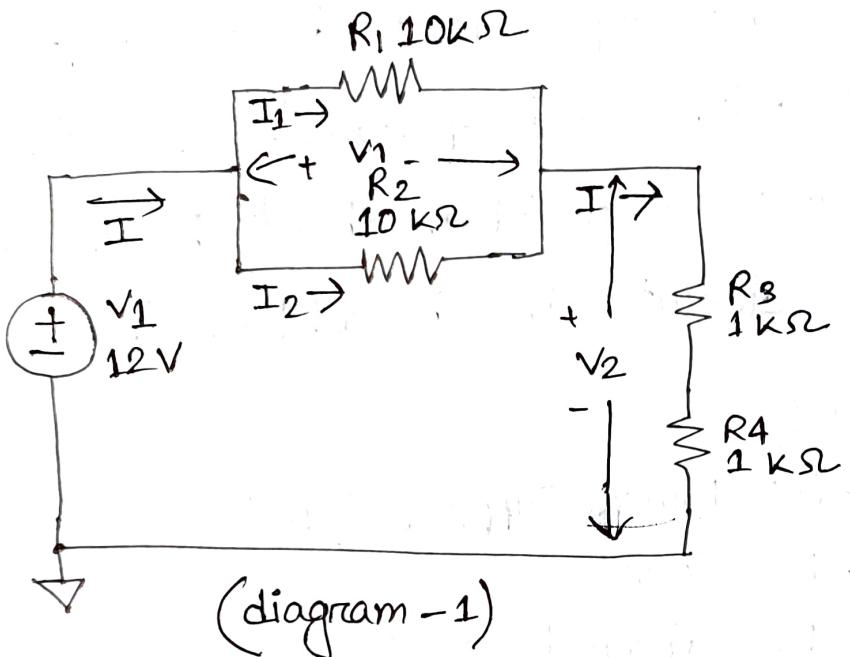
Name of the experiment: Introduction
to series and parallel circuits.

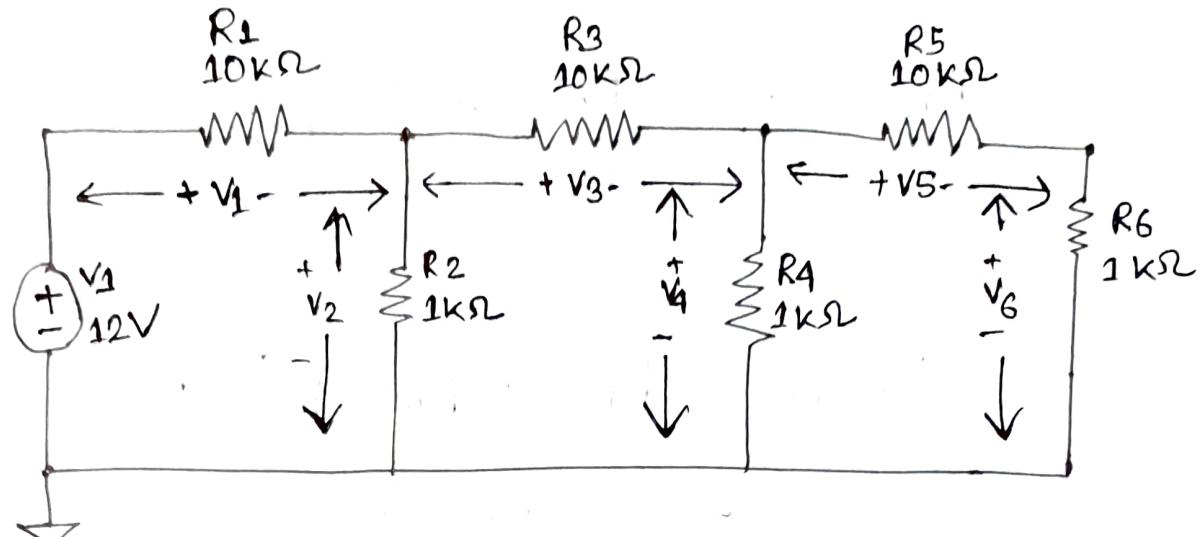
Objectives: The experiment is to acquaint the students with series-parallel circuits and to give them (us) the idea about how to connect different circuits in bread board.

Apparatus:

1. DC Power Supplies (vdc)
2. Resistors
3. Breadboard (PSPice)
4. Multimeter

Circuit Diagram: (for diagram-1) Using pen to draw here as pencil marks are hard to see when converted to pdf





(diagram - 2)

Result:

for figure/diagram/circuit diagram - 1°

Given,

$$R_1 = 10\text{ k}\Omega, R_2 = 10\text{ k}\Omega$$

$$R_3 = 1\text{ k}\Omega, R_4 = 1\text{ k}\Omega$$

$$V = 12\text{ V}$$

Now,

As R_1 and R_2 are in parallel connection

$$R_{12} = \left(\frac{1}{10} + \frac{1}{10} \right)^{-1} \text{ k}\Omega$$

$$= 5\text{ k}\Omega$$

Again,

R_{12} and R_3 and R_4 are in series connection,

$$\begin{aligned}\therefore R &= (R_{12} + R_3 + R_4) \text{ k}\Omega \\ &= (5 + 1 + 1) \text{ k}\Omega \\ &= 7 \text{ k}\Omega\end{aligned}$$

We know

$$\begin{aligned}V &= IR \\ \Rightarrow I &= \frac{V}{R} \\ &= \frac{12}{7} \text{ mA} \\ &= 1.7142 \text{ mA}\end{aligned}$$

According to the diagram, the current I flows through R_3 and R_4 .

The value or the current passing through these two will be the same as they are in series.

$$\therefore \text{for, } R_3, I_3 = I = 1.7142 \text{ mA}$$

$$\text{for, } R_4, I_4 = I = 1.7142 \text{ mA}$$

Now

If we want to find V_2 then, we see V_2 is found when we combine R_3 and R_4 and take from there.

$$\text{So, } R_{34} = 1 + 1 = 2 \quad (\text{Series})$$

$$\begin{aligned}\therefore V_2 &= I R_{34} \\ &= 1.7142 \times 2 \\ &= 3.4284 \text{ V}\end{aligned}$$

| Same. I passing
through

Now, we have our V and V_2 ,
so,

$$\begin{aligned}V_1 &= V - V_2 \\&= 12 - 3.4284 \\&= 8.5716 \text{ V}\end{aligned}$$

Now
for

$$R_1, \quad R_1 = 10 \text{ k}\Omega$$

$$\begin{aligned}I_1 &= \frac{V_1}{R_1} \\&= \frac{8.5716}{10} \\&= 0.85716 \text{ mA} \\&= 857.16 \mu\text{A}\end{aligned}$$

for R_2 , $R_2 = 10 \text{ k}\Omega$

$$\begin{aligned}I_2 &= \frac{V_1}{R_1} \\&= 857.16 \mu\text{A}\end{aligned}$$

For, R_3 ,

$$R_3 = 1\text{k}\Omega$$

$$I_3 = I = 1.7142 \text{ mA}$$

$$V_3 = 1.7142 \times 1$$

$$= 1.714 \checkmark$$

[Even though I submitted as Pspice, I have checked all using Proteus.]

For R_4 ,

$$R_4 = 1\text{k}\Omega$$

$$V_4 = 1.714$$

$$I_4 = I = 1.7142 \text{ mA}$$

Data Table for diagram-1 :

$V_1(\text{v})$	$V_2(\text{v})$	V_{total}	$I_1(\mu\text{A})$	$I_2(\mu\text{A})$	$I_{\text{total}}(\mu\text{A})$
8.5716	3.4284	12	857.16	857.16	1714.32 μA

$$1714.32 \mu\text{A}$$

$$= 1.71432 \text{ mA}$$

For diagram-2

Given,

$$R_1 = 10 \text{ k}\Omega; R_3 = 10 \text{ k}\Omega$$

$$R_5 = 10 \text{ k}\Omega;$$

$$R_2 = R_4 = R_6 = 1 \text{ k}\Omega$$

$$V_1 = 12 \text{ V}$$

Now

Firstly, R_5 and R_6 are in series connection.

$$\begin{aligned} R_{56} &= (10 + 1) \\ &= 11 \text{ k}\Omega \end{aligned}$$

Now

R_{56} and R_4 are in parallel

$$\begin{aligned} R_{456} &= \left(\frac{1}{R_{56}} + \frac{1}{R_4} \right)^{-1} \\ &= \left(\frac{1}{11} + 1 \right)^{-1} \\ &= 0.9167 \text{ k}\Omega \end{aligned}$$

w3

Now

R_3 and R_{456} are in series connection

$$\begin{aligned} R_{3456} &= R_3 + R_{456} \\ &= 10 + 0.9167 \\ &= 10.9167 \text{ k}\Omega \end{aligned}$$

w3

R_{3456} and R_2 are in parallel connection

$$\begin{aligned} R_{23456} &= \left(\frac{1}{R_2} + \frac{1}{R_{3456}} \right)^{-1} \quad | R_2 = 1 \\ &= \left(1 + \frac{1}{10.9167} \right)^{-1} \\ &= 0.9160 \text{ k}\Omega \end{aligned}$$

w3

R_1 and R_{23456} are in series connection

$$\begin{aligned} R_{123456} &= R_{\text{total}} = (10 + 0.9160) \\ &= 10.9160 \text{ k}\Omega \end{aligned}$$

Now

We know,

$$V = IR$$

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

$$= \frac{12}{10.9160}$$

$$= 1.0993 \text{ mA}$$

According to the diagram,

$$V_1 = I_1 R_1$$

$$= IR_1$$

$$= 1.0993 \times 10$$

$$= 10.993 V$$

$$\text{So, } V_2 = V - V_1$$

$$= 12 - 10.993$$

$$= 1.007 V$$

Now, we see I and I_1 are same

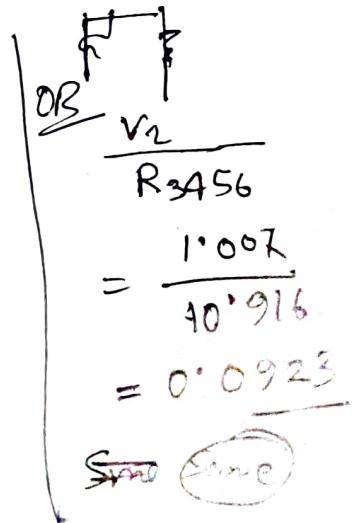
$$\therefore I_1 = I \\ = 1.0993 \text{ mA}$$

Now, for R_2 ,

$$V_2 = I_2 R_2 \\ \Rightarrow I_2 = \frac{V_2}{R_2} \\ = \frac{1.007}{1} \\ = 1.007 \text{ mA}$$

For, R_3

$$I_3 = I - I_2 \\ = 1.0993 - 1.007 \\ = 0.0923$$


$$\frac{V_2}{R_{3456}} \\ = \frac{1.007}{40.916} \\ = 0.0923$$

~~Start~~ Since

$$\begin{aligned}\therefore V_3 &= I_3 R_3 \\ &= 0.0923 \times 10 \\ &= 0.923 \text{ V}\end{aligned}$$

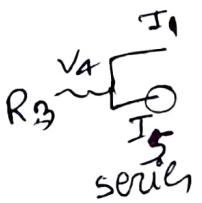
Now

$$\begin{aligned}V_4 &= (V_2 - V_3) \\ &= (1.007 - 0.923) \\ &= 0.084 \text{ V} = 84.56 \text{ mV}\end{aligned}$$

$$\begin{aligned}\text{So, } I_4 &= \frac{V_4}{R_4} \\ &= \frac{0.084}{1} \\ &= 0.084 \text{ mA}\end{aligned}$$

Again

$$\begin{aligned}I_5 &= \frac{V_4}{(10+1)} \\ &= \frac{0.084}{11} \\ &= 7.63 \times 10^{-3} \\ &= 0.00769 \text{ mA}\end{aligned}$$



Now

$$\begin{aligned}V_5 &= I_5 R_5 \\&= 0.00764 \times 10 \\&= 0.0764\end{aligned}$$

Again

$$\begin{aligned}V_6 &= V_4 - V_5 \\&= 0.084 - 0.0764 \\&= 7.6 \times 10^{-3} \\&= 0.0076 \text{ V} \\&= 7.6 \text{ mV} \quad (\text{for future help (PSpice)})\end{aligned}$$

Finally

$$\begin{aligned}I_6 &= \frac{V_6}{R_6} \\&= \frac{0.0076}{1} \\&= 0.0076 \text{ mA} \\&= 7.6 \mu\text{A}\end{aligned}$$

Data Table:
(Volts)

V ₁	V ₂	V ₃	V ₄	V ₅	V ₆	V _{total}
1.0993	1.007	0.923	0.084	0.00764	0.0076	13.091

for I (All mA)

I ₁	I ₂	I ₃	I ₄	I ₅	I ₆	I _{total}
1.0993	1.007	0.923	0.084	0.00764	0.00764	2.0985 <small>(except I=1)</small>

Here, 1.09 is almost same as 1.1

Discussions

For diagram - 1 :

From my hand calculation, the value of V_{total} is 12. The value exactly matches with my PSpice file. Also, my calculated value for I_{total} is 1714.32 mA or 1.71432 mA, the value

on pspice is 1.714mA . This exactly matches.

For diagram - 2:

Now, the volts that I have hard calculated sums to 13.091V which should have been 12V according to the PSpice file that I ran. Also the I is a bit different than what I ran. Initially, this could be because of the decimal points or some other factors.

Discussions

In this lab I was introduced to pspice. Apart from learning how to properly use the tool to get our desired circuits and results, I learnt the program wait chain analysis which ~~mi~~ might be out of context. Also, I learnt that there could be errors in manual and program simulation data.

Ans: to the que no: 01

According to box instructions, I have already added the recorded register values in the data tables. I have also calculated the current values. Now, further analysing shows some or slight discrepancies in the records such as, In pspice file the value of voltage(total) is slightly ($13.091 - 12$) = 1.091 lower than what I have calculated in hand.

Ans: to the que no: 02

We have 6 ~~regist~~ resistors.

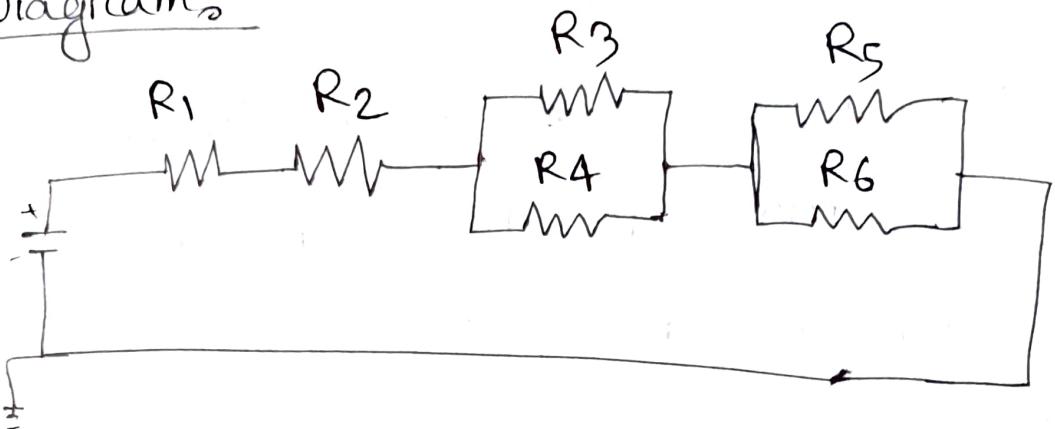
$$R_1 = 100\Omega, R_2 = 100\Omega, R_3 = 100\Omega$$

$$R_4 = R_5 = R_6 = 100\Omega$$

Now

Our target is to get 300Ω combining all of them. (It would have used 3 in series and keep the rest 3 but that is not possible here). So, according to my calculations or what I have noticed, If we parallel connect two same value resistor, the combined resistance becomes half. So we can get $(\frac{100}{2}) \times 2 = 100\Omega$ then $(100 + 100 + 100)$ in series. So, this is the simplest diagram I can think of right now.

Diagrams



So, R_1 and R_2 in series

$$R_{12} = (100 + 100) = 200 \Omega$$

R_3 and R_4 parallel

$$R_{34} = \left(\frac{1}{100} + \frac{1}{100} \right)^{-1} = 50 \Omega$$

Same for R_5, R_6 , $R_{56} = 50 \Omega$

$$\therefore R_{\text{total}} = 200 \Omega + 50 \Omega + 50 \Omega$$

$$= 300 \Omega$$

A

Ans: to the que no: 03

we have,

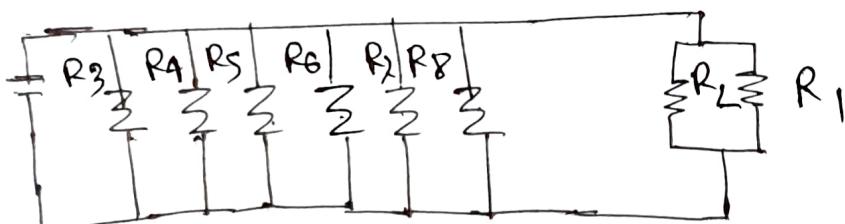
$$R_1 = 1.5 \text{ k}\Omega$$

$$R_2 = 1.5 \text{ k}\Omega$$

and

$$R_3 = R_4 = R_5 = R_6 = R_7 = R_8 = 15 \text{ k}\Omega$$

The simplest diagram idea is to ~~(y₄₅)⁻¹~~
parallel connect the different types and
the ~~series~~ connect them in series.



$$\therefore R_1 \text{ and } R_2 \text{ in parallel } \left(\frac{1}{1.5} \times 2\right)^{-1} = 0.75 \text{ }\Omega$$

$$R_3 \text{ to } R_8 \text{ are in parallel } \left(\frac{1}{15} \times 6\right)^{-1} = 2.5 \text{ k}\Omega$$

$$R_{12} \text{ and } R_{38} \text{ in series} = (0.75 + 2.5) \text{ k}\Omega \\ = 3.25 \text{ k}\Omega$$