Week-7

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Course Code: Cse 250

Experiment No: 4

Experiment Name:

Verification of Superposition Principle

Deadline: 8th Dec 2021

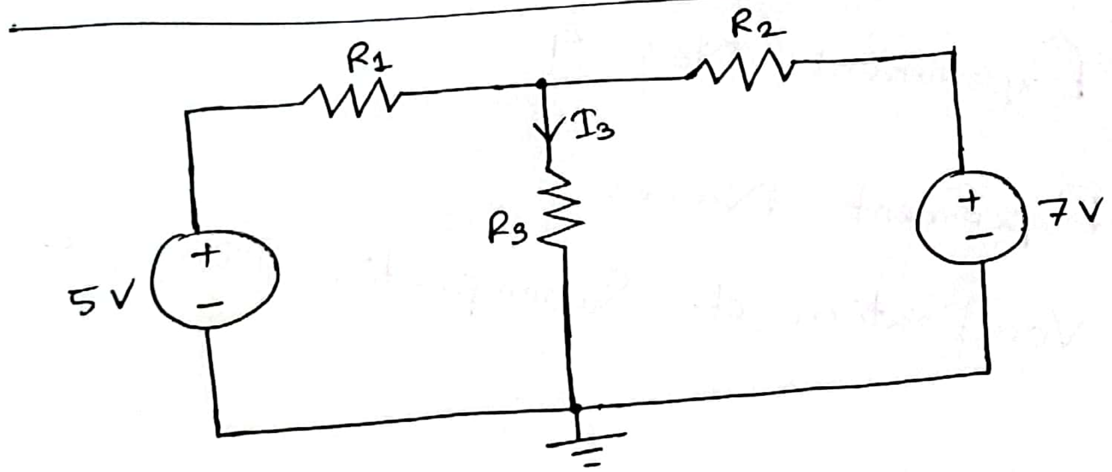
1) Objective:

To verify experimentally the Superposition theorem which is an analytical technique of determining currents in a circuit with more than one emf Source

2) Apparatus:

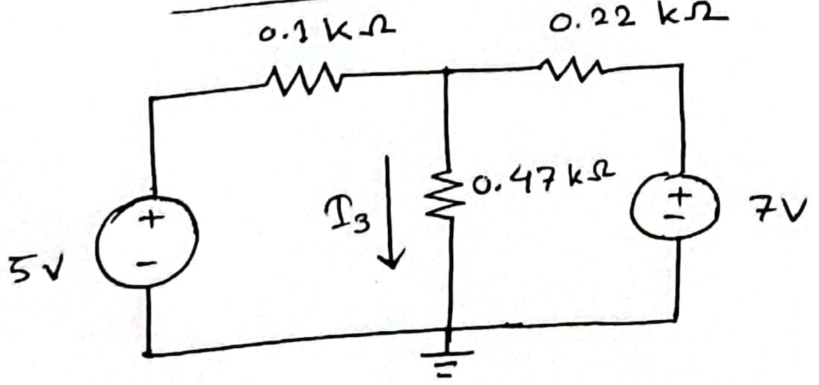
- Two DC power supplies.
- One multimeter

3) Circuit / Block / System Diagram:



4) Result / Analysis:

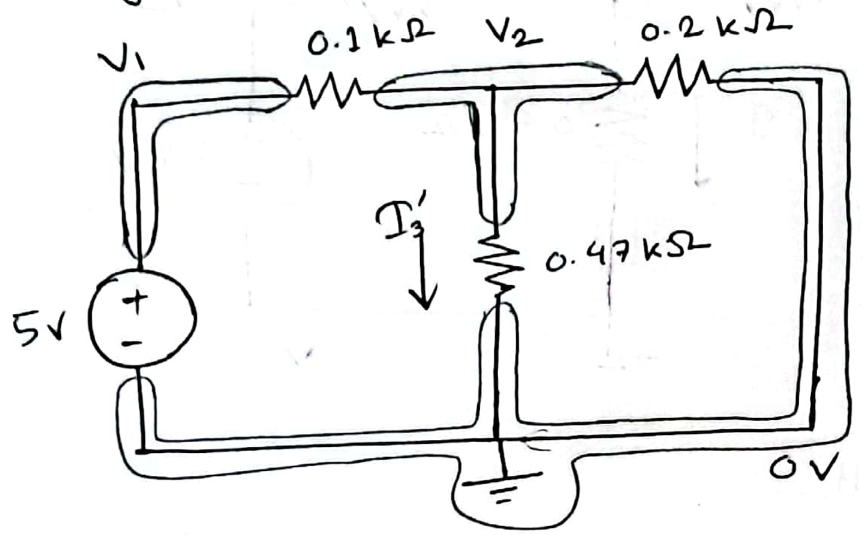
Circuit No - 1:



$$I_3 = I_3' + I_3''$$

4 → Continuation.

Considering 5 V voltage source active/alive only,



$V_1 = 5$ Volt.

$$V_2\left(\frac{1}{0.1}+\frac{1}{0.22}+\frac{1}{0.47}\right)-\frac{V_1}{0.1}-\frac{0}{0.22}-\frac{0}{0.47}=0$$

$$\Rightarrow V_2 \times \left(\frac{8620}{517}\right) = 0.05$$

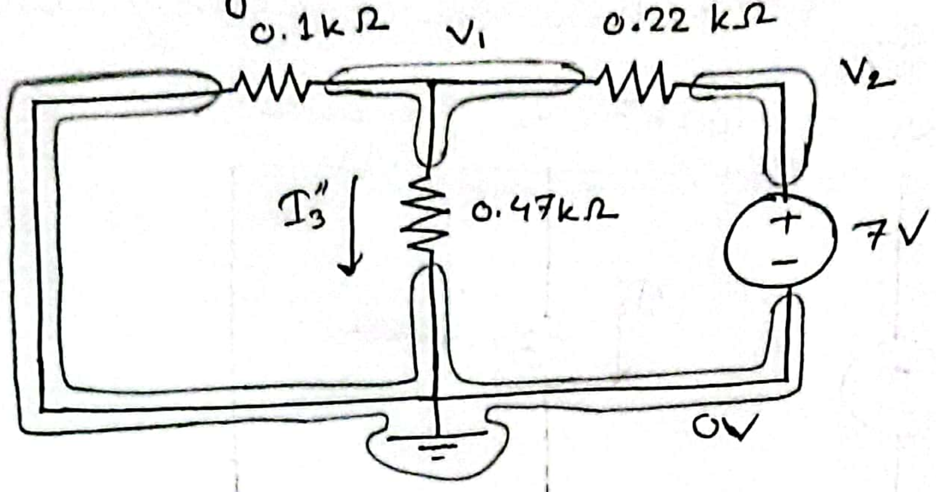
$$\Rightarrow V_2 = 2.9988 \text{ Volt.}$$

$$\therefore I_3' = \frac{2.9988-0}{0.47\times10^3}$$

$$\Rightarrow I_3' = 6.3805 \times 10^{-3} \text{ A}$$

4 → contd.

Now, Considering 7V voltage source active only,



$V_2 = 7$ Volt.

$$V_1\left(\frac{1}{0.1}+\frac{1}{0.22}+\frac{1}{0.47}\right)-\frac{0}{0.1}-\frac{7}{0.22}-\frac{0}{0.47}=0$$

$$\Rightarrow V_1 = \frac{7}{0.22\times10^3}\times\frac{25850}{431}$$

$V_1 = 1.90835$ Volt

$$\therefore I_3'' = \frac{1.90835-0}{0.47\times10^3}$$

$= 4.0603 \times 10^{-3}$ A

We know,

$I_3 = I_3' + I_3''$

$= (6.3805\times10^{-3}) + (4.0603\times10^{-3})$

$= 10.4408\times10^{-3}$ A

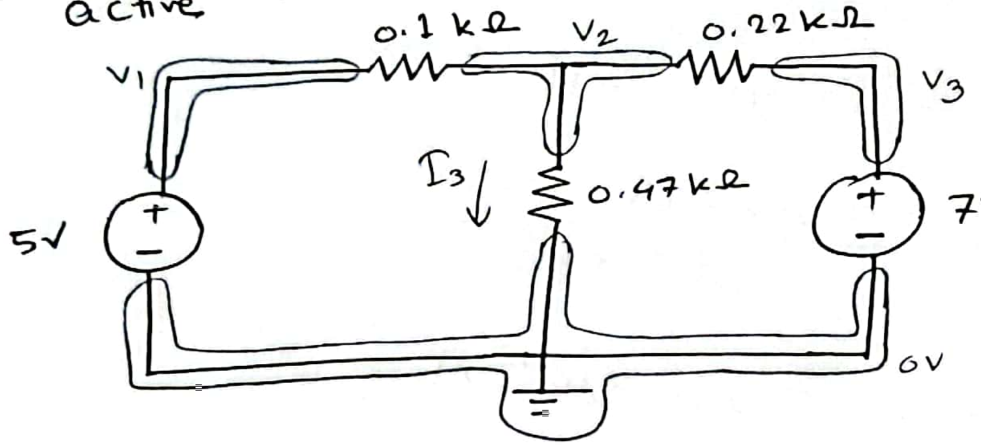
$= 0.0104408$ A.

4 → continuation.

Table -1 :

Observation	R_1 (kΩ)	R_2 (kΩ)	R_3 (kΩ)	I_3' (mA) (only E_1 is active)	I_3'' (mA) (only E_2 is active)	$I_3' + I_3''$ (mA)	I_3 (mA) (both active)
Simulation	0.1	0.22	0.47	6.38	4.06	10.4	10.4
Theoretical	0.1	0.22	0.47	6.3805	4.0603	10.4408	10.4408

Considering both 5V and 7V voltage sources are active —



$V_1 = 5$ Volt , $V_3 = \cancel{0}$ 7 Volt

$$V_2\left(\frac{1}{0.1}+\frac{1}{0.22}+\frac{1}{0.47}\right)-\frac{5}{0.1}-\frac{0}{0.47}-\frac{7}{0.22}=0$$

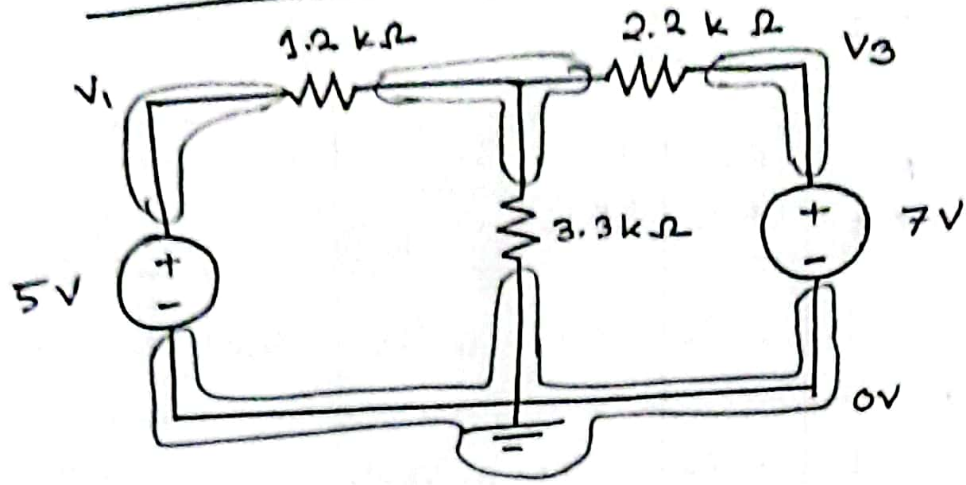
$$V_2 \times \frac{431}{25850} = \frac{9}{110}$$

~~$V_2 = 4.907192575$~~

$$V_2 = 4.90719 \text{ Volt}$$

$$I_3 = \frac{V_2}{R_3} = \frac{4.90719}{0.47\times10^3} = 10.4408\times10^{-3} A$$

Circuit No. - 2 :



Here, $V_1 = 5$ Volt , $V_3 = 7$ Volt .

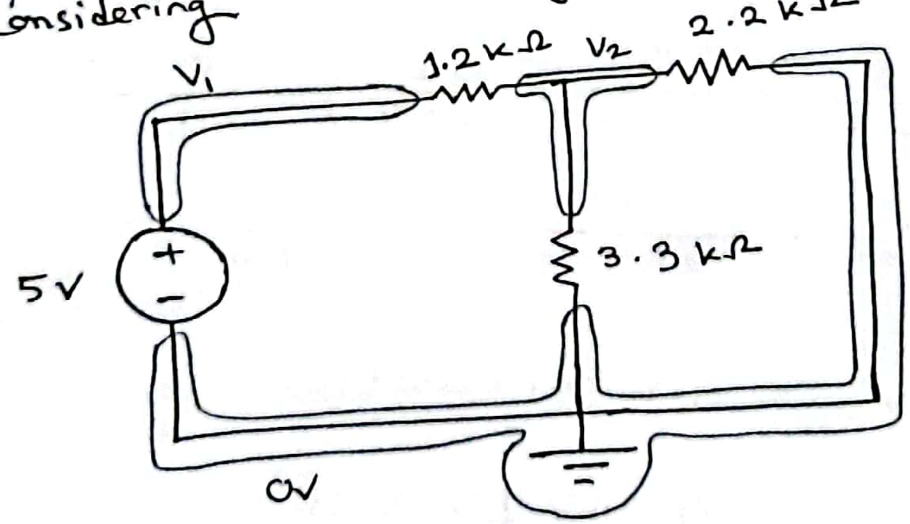
$$V_2 \times \frac{7}{4400} = \frac{97}{13200}$$

$$\Rightarrow V_2 = 4.619048 \text{ Volt}$$

$$\therefore I_3 = \frac{4.619048 - 0}{3.3 \times 10^3}$$

$$= 1.3997 \times 10^{-3} \text{ A}$$

☐ Considering 5 V only :



Here, $V_1 = 5$ Volt .

$$V_2 \left(\frac{1}{1.2} + \frac{1}{2.2} + \frac{1}{3.3}\right) - \frac{5}{1.2} = 0$$

$$\Rightarrow V_2 \times \frac{7}{4400} = \frac{5}{1.2\times10^3}$$

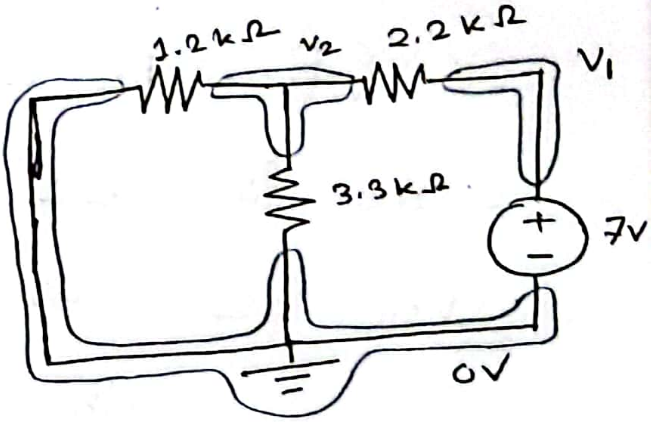
$$\therefore V_2 = 2.619048 \text{ Volt}.$$

$$\therefore I_3' = \frac{2.619048 - 0}{3.3 \times 10^3} \text{ A}$$

$$\cancel{= 79.365079 \times 10^{-3} \text{ A}}.$$

$$= 7.936507936 \times 10^{-4} \text{ A}.$$

Considering 7V only:



Here, $V_1 = 7$ Volt

$$V_2 = \frac{7}{\cancel{7}2.2\times10^3} \times \frac{4400}{7}$$

$$= 2 \text{ volt}$$

$$\therefore I_3'' = \frac{2-0}{3.3\times10^3} \text{ A}$$

$$= 6.0606060 \times 10^{-4} \text{ A}.$$

$$\therefore I_3 = I_3' + I_3''$$

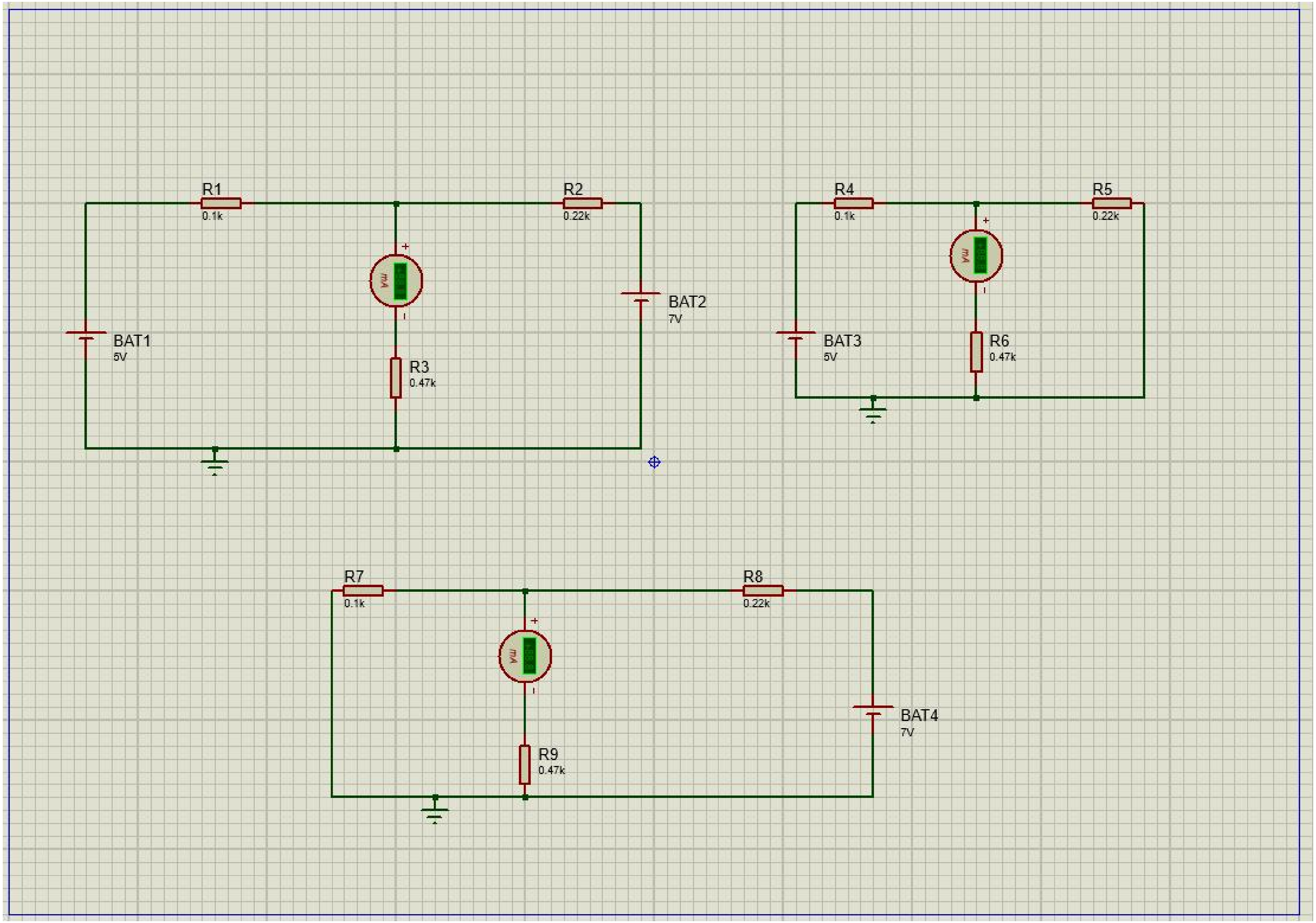
$$= (7.936507936\times10^{-4}) + (6.06060\overset{60}{}\times10^{-4})$$

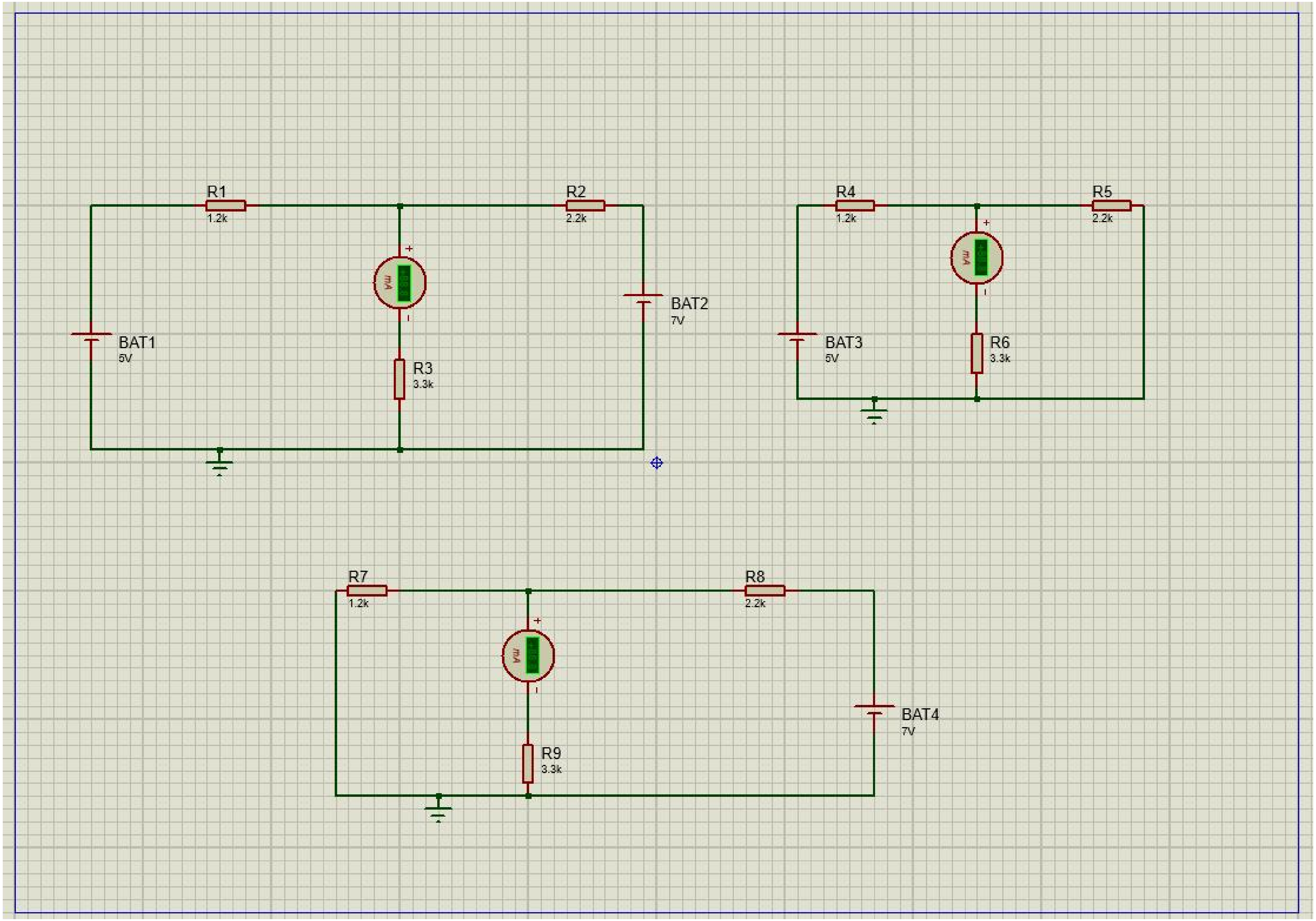
$$= 1.3997114 \times 10^{-3} \text{ A}.$$

observation	R1 (kΩ)	R2 (kΩ)	R3 (kΩ)	I_3' (mA)	I_3'' (mA)	$I_3' + I_3''$ (mA)	I_3 (mA)
Simulation	1.2	2.2	3.3	0.79	0.61	1.40	1.40
theoretical	1.2	2.2	3.3	0.7936	0.60606	1.39971	1.39971

6 Discussion:

For both of the circuits, if we keep both power sources alive and calculate I_3, then it will be equal to the added value of I_3' and I_3'' (from the above Superposition circuits where first E1 was active only and then E2 was active only). So, we can say with absolute certainty that the Superposition Principle is accurate and verified. i-e it is verified twice.


R1
0.1k
R2
0.22k
BAT2
7V
BAT1
5V
R3
0.47k
R4
0.1k
R5
0.22k
BAT3
5V
R6
0.47k
R7
0.1k
R8
0.22k
BAT4
7V
R9
0.47k


R1
1.2k
R2
2.2k
BAT2
7V
BAT1
5V
R3
3.3k
R4
1.2k
R5
2.2k
BAT3
5V
R6
3.3k
R7
1.2k
R8
2.2k
BAT4
7V
R9
3.3k