Name : Ms Rodsy Tahmid

ID : 20101021

Course Code : Cse250

Experiment No : 3

Experiment Name :

Verification of KCL & KVL

Ans: 3.1

(1) Objective:

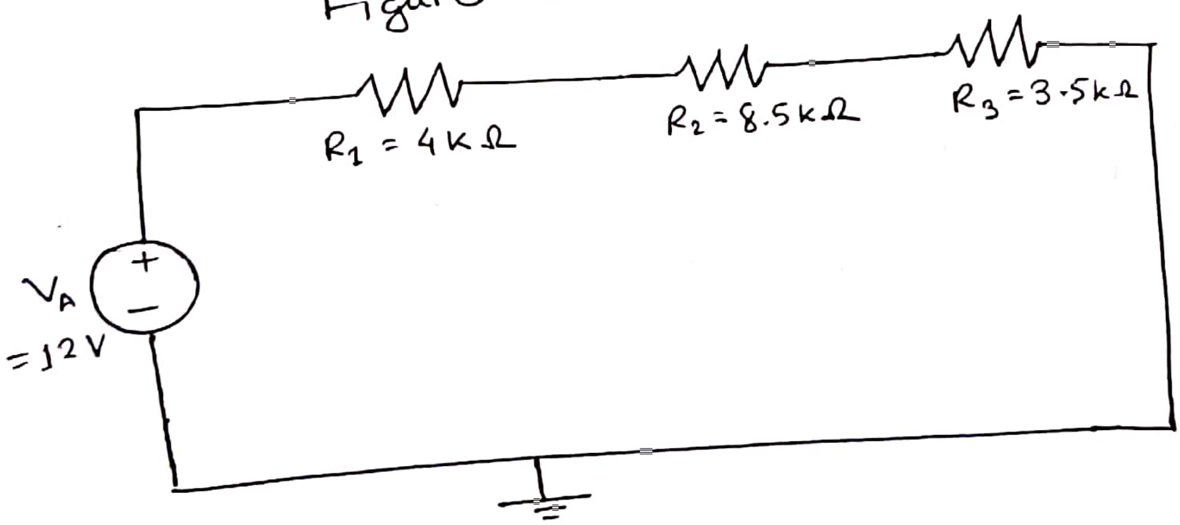
This experiment is intended to verify Kirchhoff's voltage law (KVL) with the ~~help~~ help of series circuits.

(2) ~~Apparature~~ Apparatus:

- ~~DC power supplies~~
- ~~Resistors~~
- ~~Ground / Earthing~~
- One DC Ammeter (0 - 1 A)
- One multimeter
- Three Resistors
- One DC power supply

(3) Circuit / Block / System Diagram:

Figure-1: KVL verification.



$V_1 = 12 - 9 = 3\ V$

$V_2 = 9 - 2.625 = 6.375\ V$

$V_3 = 2.625 - 0 = 2.625\ V$

$V_1 + V_2 + V_3 = 3 + 6.375 + 2.625\ V$

$= 12\ V$

P.T.O

3.1

4 Result / Analysis:

(i) $V_1 = 12 - 9 = 3$

$V_2 = 9 - 2.625 = 6.375$

$V_3 = 2.625 - 0 = 2.625$

(ii) Done in PSpice.

(iii) KVL Verification:

Observation	R_1 (kΩ)	R_2 (kΩ)	R_3 (kΩ)	V_A (V)	V_1 (V)	V_2 (V)	V_3 (V)
Simulation	4	8.5	3.5	12	3	6.375	2.625
Theoretical	4	8.5	3.5	12	3	6.375	2.625

$V_1 + V_2 + V_3$ (V)
12
12

(i) Theoretical:

$R = 4 + 8.5 + 3.5 = 16\ k\Omega = 16 \times 10^3\ \Omega$

$I = \frac{V}{R} = \frac{12}{16 \times 10^3} = 7.5 \times 10^{-4}\ A.$

$V_1 = IR_1 = (7.5 \times 10^{-4})(4 \times 10^3) = 3$

$V_2 = IR_2 = (7.5 \times 10^{-4})(8.5 \times 10^3) = 6.375$

$V_3 = IR_3 = (7.5 \times 10^{-4})(3.5 \times 10^3) = 2.625$

$V_1 + V_2 + V_3 = 3 + 6.375 + 2.625 = 12$

(5) Questions & Answers:

Q1) What does KVL predict about the circuit?

Ans: $V_A = V_1 + V_2 + V_3$

Q2) Does your calculation of $V_1 + V_2 + V_3$ matches the value of V_A?

Ans: Matches exactly.

(6) Discussion:

All the results are exactly the same both in Simulation and theory which does not usually happen in practical (applied Physics).

Ground / Earthing is done in Simulation in Pspice for both the figures as it is necessary. (otherwise PSpice wouldn't work).

Ans: <u>3.2</u>

(1) Objective:

This experiment is intended to verify Kirchhoff's current law (KCL) with the help of a ~~samp~~ simple parallel circuit.

(2) Apparatus:

- One DC Ammeter (0 - 1 A)
- Three Resistors
- One multimeter
- One DC power

~~(5)~~ (3) no. done later.

(4) Result / Analysis:

(i) $V = IR \Rightarrow I = \frac{V}{R}$.

$$I = \frac{V_A}{R}.$$

~~R =~~

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

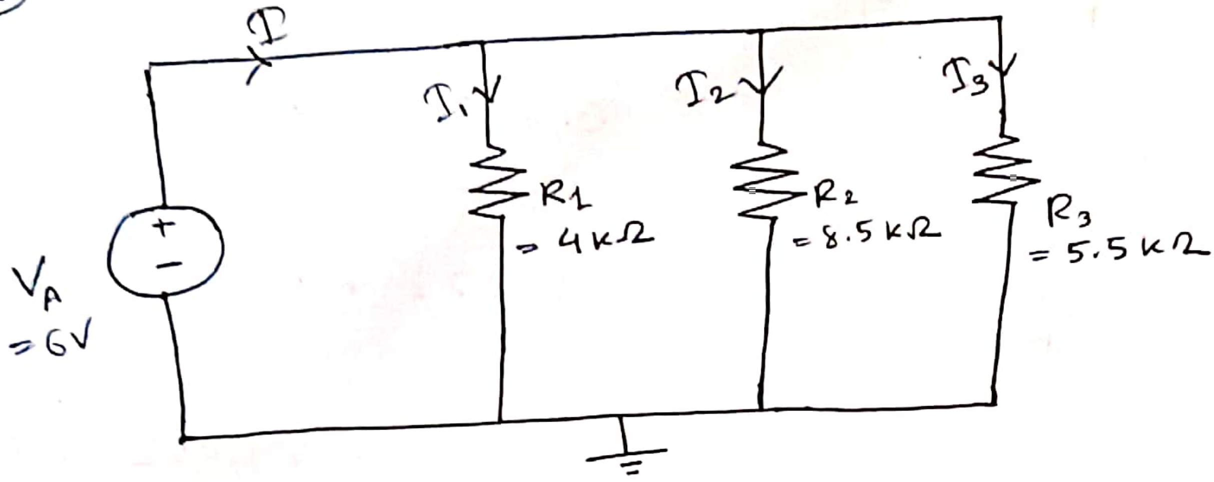
$$\frac{1}{R_p} = \frac{R_2 R_3 + R_1 R_3 + R_1 R_2}{R_1 + R_2 + R_3}$$

$$R_p = \frac{R_1 + R_2 + R_3}{R_2 R_3 + R_1 R_3 + R_1 R_2}$$

$$= \frac{4 + 8.5 + 5.5}{(8.5 \times 5.5) + (4 \times 5.5) + (4 \times 8.5)}$$

3 ~~Continuation~~ 3.2 Circuit / Block / System Diagram:

Figure - 2: KCL Verification.



- $I = 3.297$ mA
  $I_2 = 1.500$ mA
  $I_3 = 0.70588$ mA
  $I_1 + I_2 + I_3 = 1.5 + 0.70588 + 1.091$
  $= 3.29688$

→ Continuation.

- 4i) ~~$R_p = 0.17518$~~

$$\frac{1}{R_p} = \frac{1}{4} + \frac{1}{8.5} + \frac{1}{5.5}$$

$$\frac{1}{R_p} = \frac{411}{748} \Rightarrow R_p = \frac{748}{411} = 1.8199 \approx 1.82\,k\Omega$$

$$\therefore I = \frac{V_A}{R_p} = \frac{6\ V}{1.82\,k\Omega} = 3.2967\ mA$$

→ cont.

3.2

4 i)

$$I_1 = \frac{V}{R_1} = \frac{6}{4} = 1.5 \text{ mA}$$

$$I_2 = \frac{V}{R_2} = \frac{6}{8.5} = 0.70588 \text{ mA}$$

$$I_3 = \frac{V}{R_3} = \frac{6}{5.5} = 1.091 \text{ mA}.$$

$$I_1 + I_2 + I_3 = 1.5 + 0.70588 + 1.091 \text{ mA}$$
$$= 3.29688 \text{ mA}.$$

(ii) Done in PSpice.

(iii) KCL verification:

Observation	R_1 (kΩ)	R_2 (kΩ)	R_3 (kΩ)	I (mA)	I_1 (mA)	I_2 (mA)	I_3 (mA)
Simulation	4	8.5	5.5	3.297	1.5	0.70588	1.091
Theoretical	4	8.5	5.5	3.2967	1.5	0.70588	1.091

$I_1 + I_2 + I_3$ (mA)
3.29688
3.29688

3.2 ⇒ KCL

5 Questions && Answers :

Q1) What does KCL predict about the circuit?

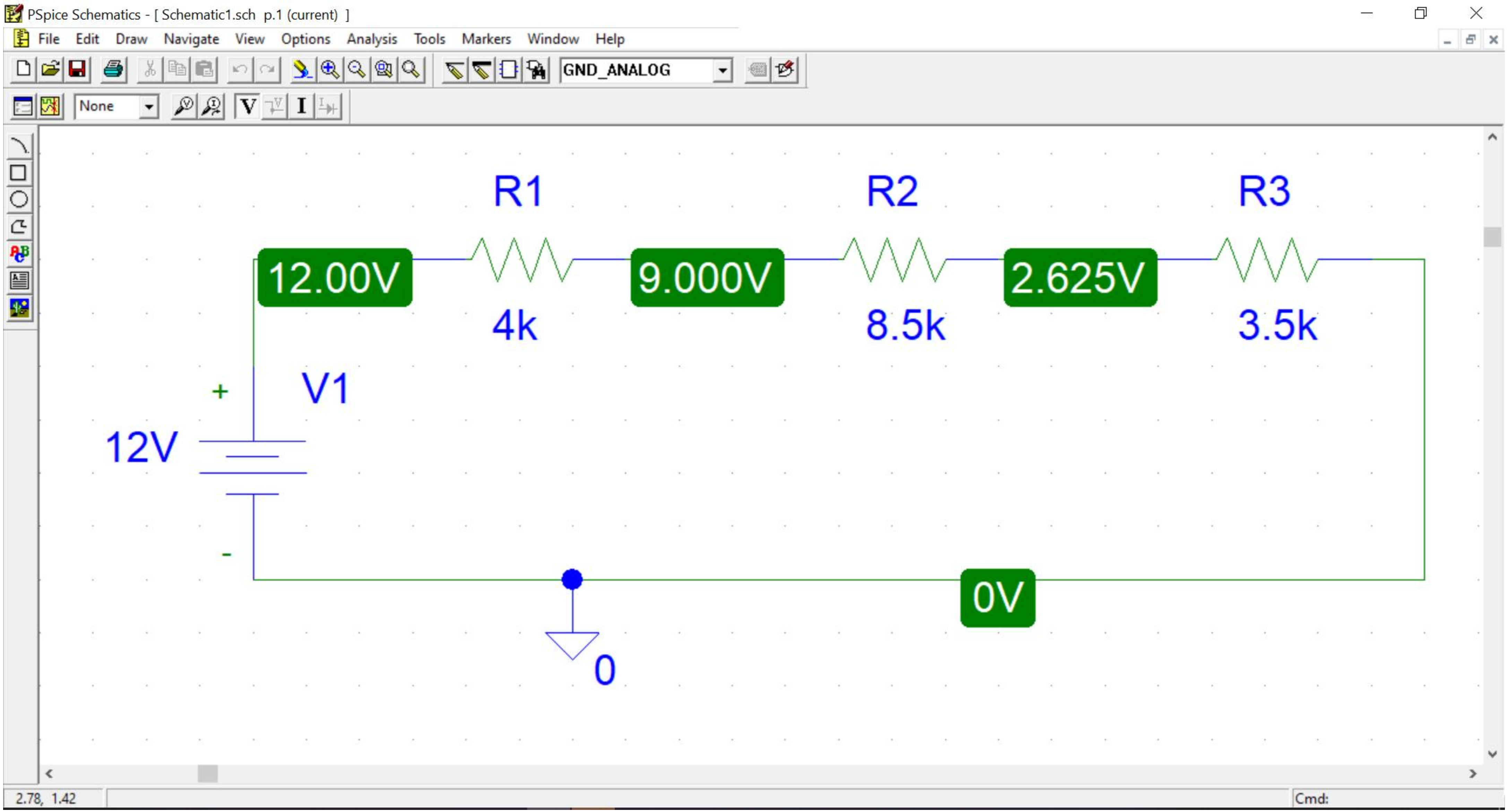
Ans: $I = I_1 + I_2 + I_3$.

Q2) Does your calculation of $I_1 + I_2 + I_3$ matches the value of I?

Ans: Close enough .

6 Discussion :

Due to change in decimal places, i.e three decimal places taken in simulation ~~and~~ whereas four decimal places taken in theoretical value, precision is not obtained, i.e, the results are close enough but ~~not exactly~~ does not match exactly.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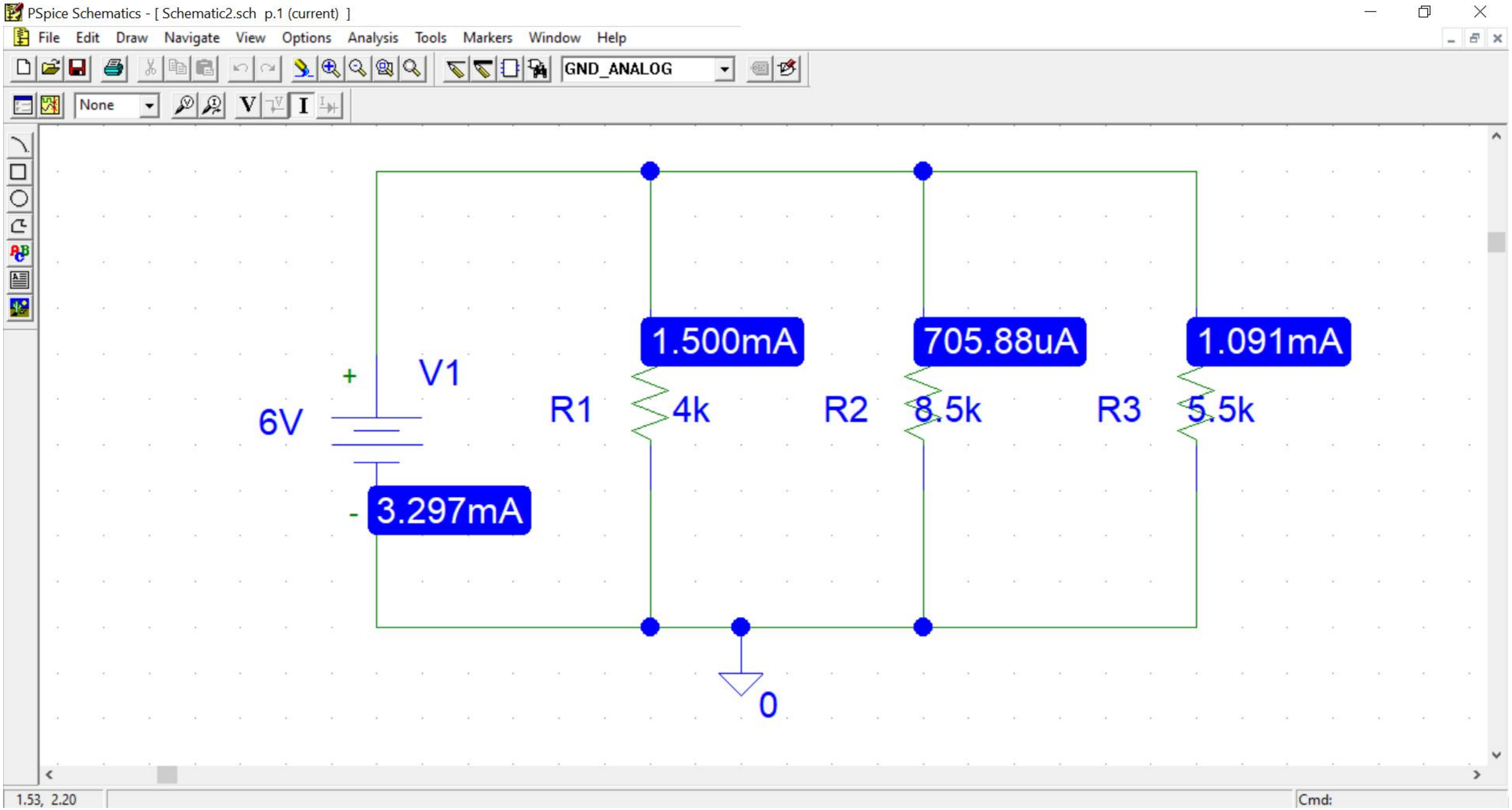
File Edit Draw Navigate View Options Analysis Tools Markers Window Help
GND_ANALOG
None
R1
R2
R3
12.00V
9.000V
2.625V
4k
8.5k
3.5k
V1
12V
+
-
0V
0
2.78, 1.42
Cmd:


PSpice Schematics - [Schematic2.sch p.1 (current)]
File Edit Draw Navigate View Options Analysis Tools Markers Window Help
GND_ANALOG
None
V
I
1.500mA
705.88uA
1.091mA
V1
6V
R1
4k
R2
8.5k
R3
5.5k
3.297mA
0
1.53, 2.20
Cmd: