EE281 EXPERIMENT 3

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28th of November 2020(Took 6 Hours)

1 Preliminary Work

1.1

1.1.1 Analyze the circuit given in Figure 1 using Thevenin theorem and calculate the Thevenin equivalent voltage (ETH) and resistance (RTH) between a and b terminals where $R1 = 3.3k\Omega, R2 = 33k\Omega, R3 = R4 = 1k\Omega$

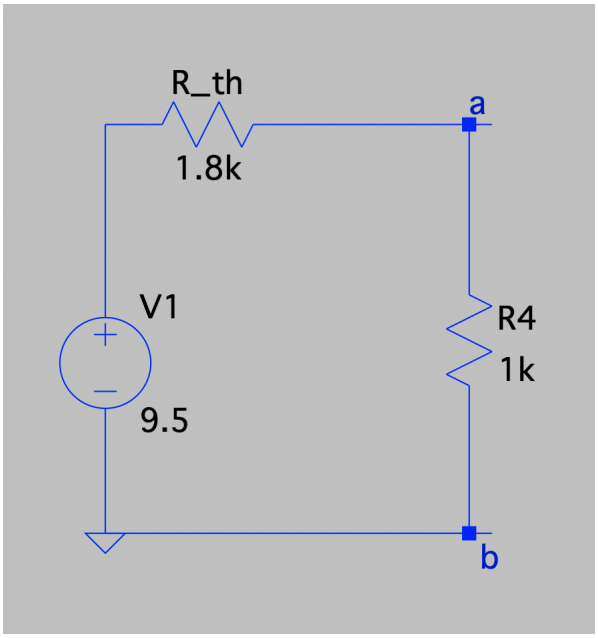
1.1.2 Draw the Thevenin equivalent of the circuit in Figure 1 and calculate voltage and current values on R4.

$R_{th} = (R_3 + (R_1//R_2)//R_1 == 1.8k\Omega$

Multiplying this value by the $R_{th}, 5.26 * 1.8 = 9.5$

$V_{th} = 9.5V, R_{th} = 1.8$

According to this calculations, circuit must formed like this:



1.1.3 Calculate voltage and current values on R4 using Node analysis method. Compare your calculations found in part ii.

I call the middle node V_1

$1/4 * (V_1 - 15) + 1/3.3 * (V_1 - 5) + 1 * (V_1) = 0$

$V_1 = 3.39V$

$I_{R4} = V_1 * R_4 = 3.39mA$

Calculations are very similar, and we want this because thevenin circuit is nothing but the main circuits simpler visualization.

1.2

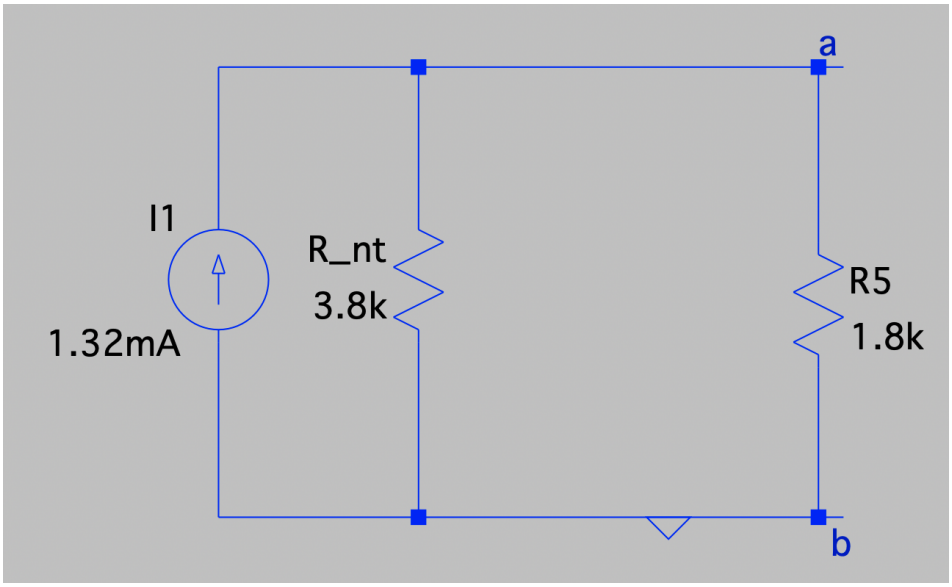
1.2.1 Analyze the circuit given in Figure 1 using Thevenin theorem and calculate the Thevenin equivalent voltage (ETH) and resistance (RTH) between a and b terminals where $R1 = 3.3k\Omega, R2 = 33k\Omega, R3 = R4 = 1k\Omega$

1.2.2 Draw the Thevenin equivalent of the circuit in Figure 1 and calculate voltage and current values on R4.

$R_{nt} = R_1 + (R_3//R_3) = 3.8k\Omega$

Finding the current through a-b accepting short circuit. I take 2 loops, left and right one. Left one is clockwise, right one is counter clockwise. Since loops are completely identical, I call the current I for both. Here is mesh for just one loop:

$I * R_3 + 2 * I * R_1 = 5 where I = 0.66$ but we need to multiply I by 2 because 2 loops contribute to a-b current.
$I_{nt} = 1.32$



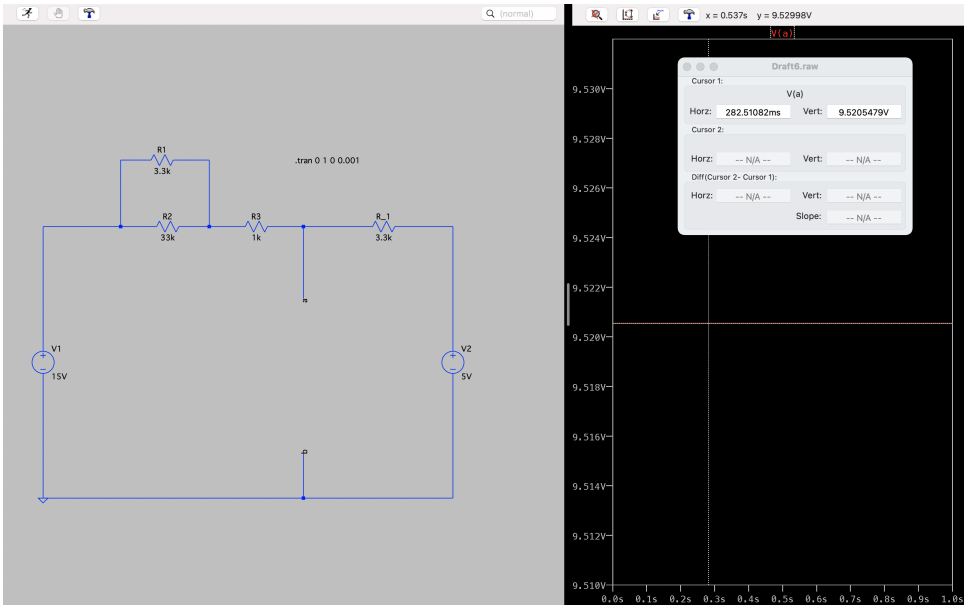
1.2.3 Calculate voltage and current values on R4 using Node analysis method. Compare your calculations found in part ii.

Finding the current through a-b accepting short circuit. I take 2 loops, left and right one. Left one is clockwise, right one is counter clockwise. Since loops are completely identical, I call the current I for both. Here is mesh for just one loop:

$I * 1 + 6.6I + 3.6I = 5 where. I = 0.45mA$
Multiply by 2 = 0.89mA
Checking with current division on the Northon circuit.
$I_{nt} * (3.8/5.6) = 0.89mA$ which is similar to Mesh Analysis' result.

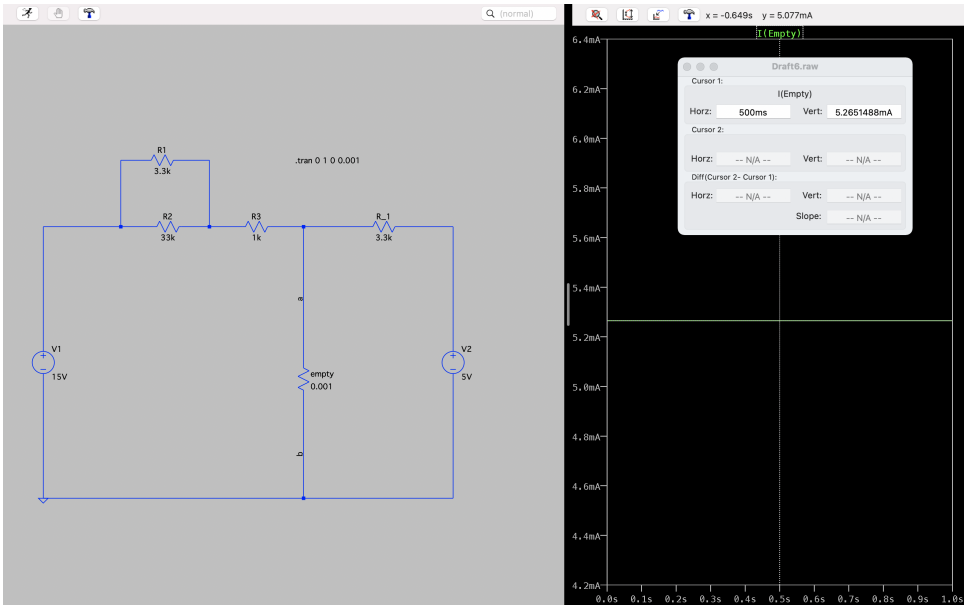
2 Experimental Work

2.1 Take the screenshots of both circuit and DC operating point simulation results and fill the table given below with calculated and measured values.



	Calculated	Measured
E_{th}	9.52 V	9.52 V

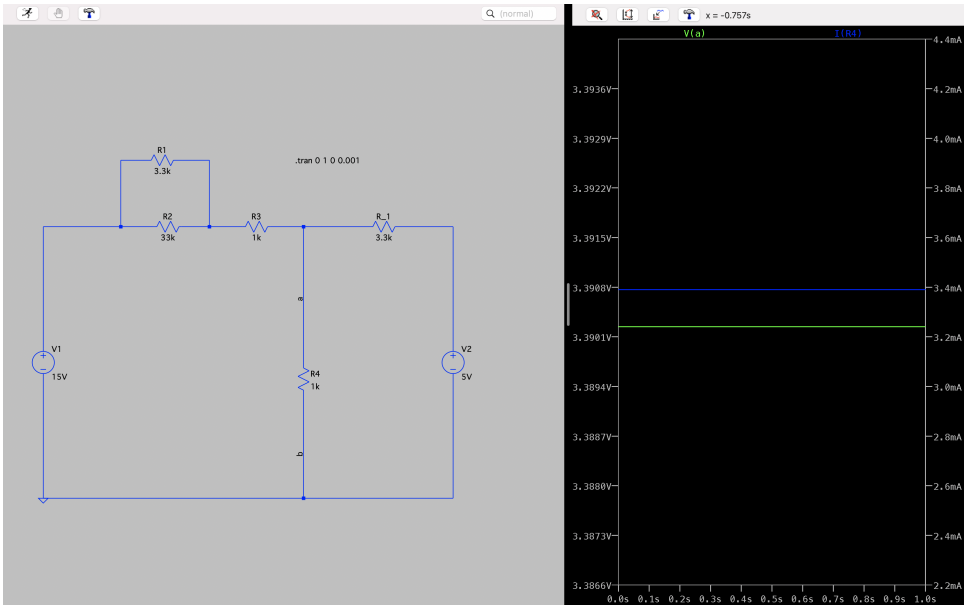
2.2 Take the screenshots of both circuit and DC operating point simulation results and fill the table given below with calculated and measured values.



They are very similar results. I did the computations with 3 significant figure. That might be the reason why they are same.

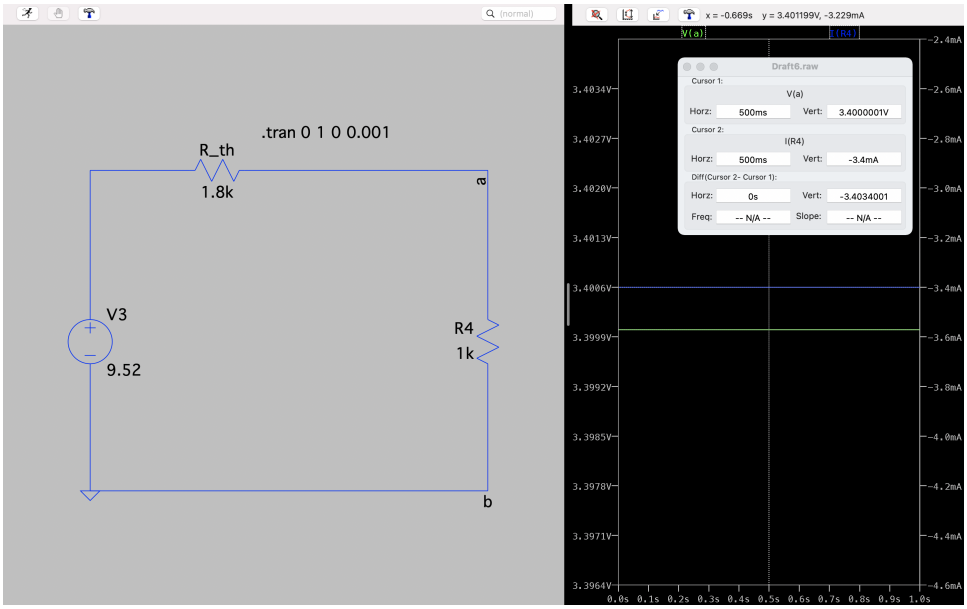
	Calculated in Preliminary Work	Measured/Calculated in LTSpice
ISC	5.28 mA	5.28 mA
RTH	$1.8k\Omega$	$1.8k\Omega$

2.3 Take the screenshots of both circuit and transient simulation results.



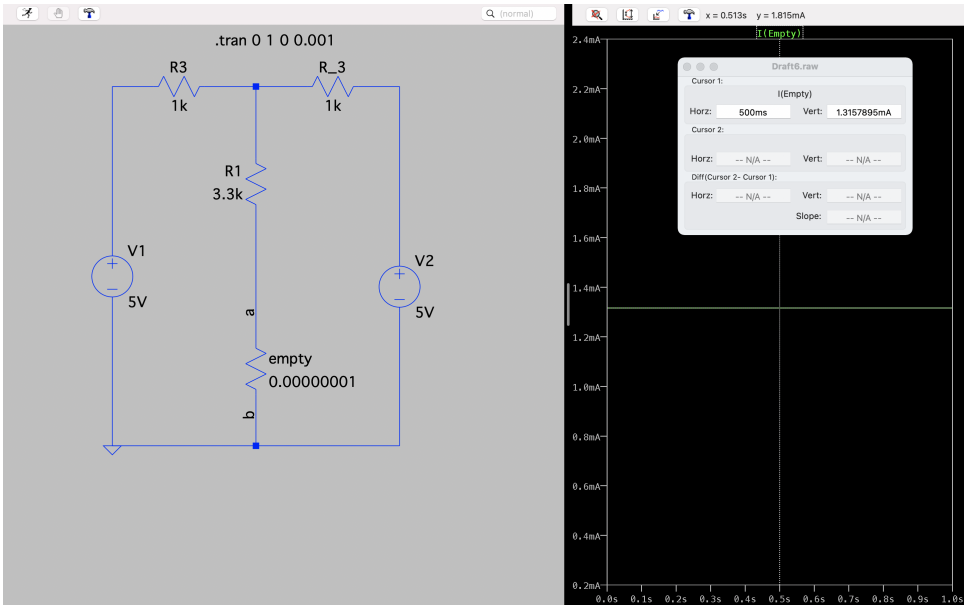
Voltage: 3.4V
Current:3.4mA

2.4 Take the screenshots of both circuit and transient simulation results.

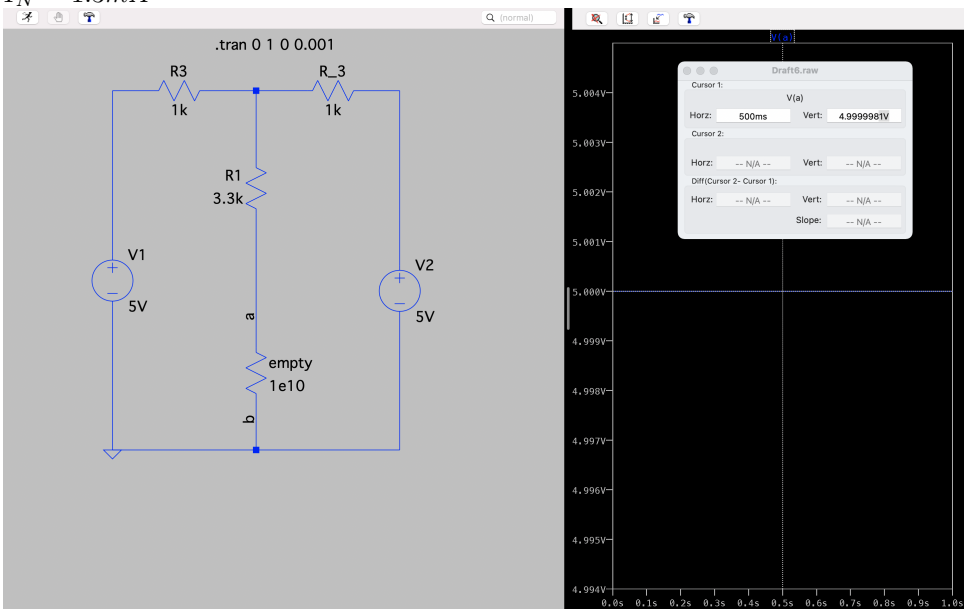


Voltage: 3.4V
Current: 3.4mA(-3.4 writes on the panel but it is about resistor direction in ltspice)

2.5 Take the screenshots of both circuits and DC operating point simulation results and fill the table given below with calculated and measured values. Compare your results with previous step.

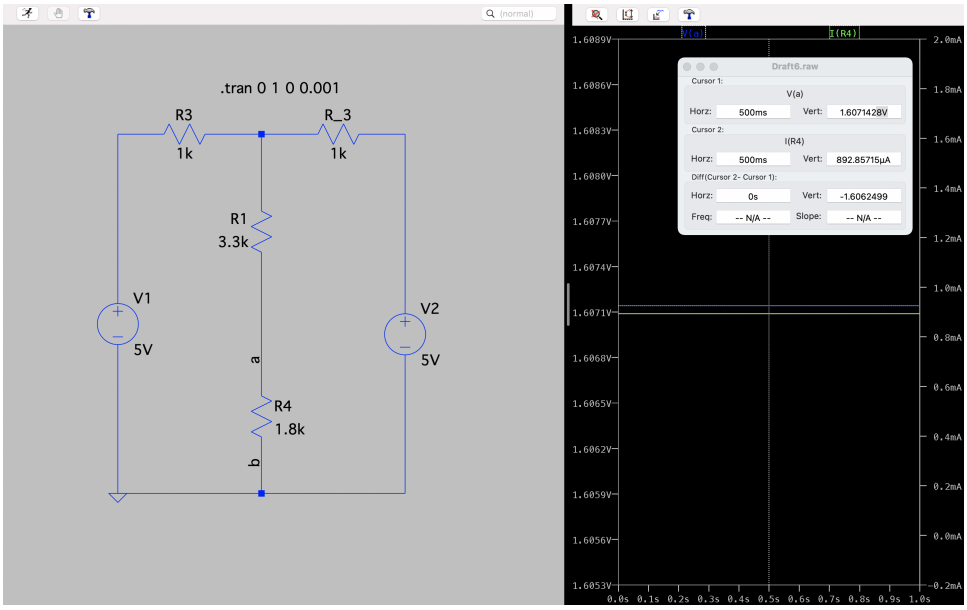


$I_N = 1.3mA$



	Calculated in Preliminary Work	Measured/Calculated in LTSpice
IN	1.32 mA	1.3mA
RN	3.8k	3.8k

2.6



Voltage: 1.6V
Current: 0.89mA

3 Conclusion

Discuss experimental results from Norton and Thevenin equivalent circuits. The results of the thevenin circuit and the real circuit was so close, nearly similar. We expected this because the thevenin circuit is just simpler form of the real circuit. The results were not exactly the same due to the sensitivity of dc source and real life conditions. Northon equivalent circuit was so similar to the thevenin one, we just need to connect a current source instead of voltage source. There was no current source, we were not able to build the Northon equivalent circuit.

Compare Thevenin and Norton equivalent circuit results with your calculation and simulation results. Even the experiment's results and my calculated results were so similar, there were some differences due to the real life conditions and tolerances. For example, my calculated thevenin voltage was 9.52 and in the experiment it was 9.59.