Santa Clara University	ELEN 115 Spring 2023	Dr. Shoba Krishnan
Laboratory #1: Circuit Analysis using LTSpice		

I. Objectives

- To familiarize yourself with SPICE circuit simulators (LTSpice)
- To construct a simple voltage divider network and do analysis in LTSpice.
- To gather simulation results and make measurements.

II. Pre-lab: No prelab due.

III. Laboratory Procedure:

Review the Manual for LTSpice posted on Camino while you do this lab.

Part 1: Schematic Capture

For this section of the lab, please create the voltage divider circuit shown in Figure 1 in LTSpice. The voltage divider is the electrical engineering equivalent of the computer engineering "hello world!" function. Its simplicity makes it a great reference point for starting out with a circuit simulator as it allows us to validate our implementation of the circuit.

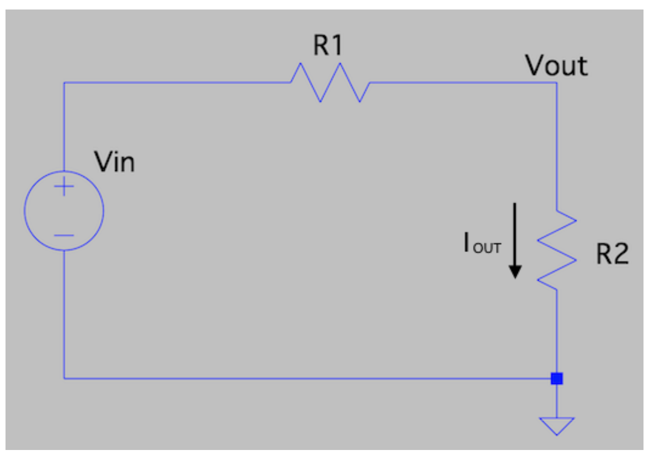

Figure 1. Voltage divider

Part 2: DC Analysis

(1) Assign component value for R1 = 1kΩ and R2 = 3kΩ.

(2) Run a DC Sweep simulation on Vin from 0V to 10V in 100mV increments.

(3) Plot V_{IN} on the x axis and V_{OUT} on the y axis.

What is the slope of this curve? What does it represent?
Do the results look as expected? Why or why not?
Make sure to take a screen capture of the simulation waveforms.

(4) Modify the value of R2 = 4kΩ. Rerun the DC sweep and replot the signals.

How did the slope change? Explain why?
Make sure to take a screen capture of the simulation waveforms.

(5) Let us now measure the current I_{OUT} by placing a current measurement tool.
Plot voltage V_{OUT} (on y axis) vs. the current I_{OUT} (on x-axis).
What does the plot show?
Make sure to take a screen capture of the simulation waveforms.

TA Check Point: Complete Part 1 and Part 2 and demo the results to your TA.

Part 3: Transient Analysis

(1) Assign component value for R1 = 1kΩ and R2 = 3kΩ.
(2) Make the voltage source V_{IN} a sinusoidal source with 1V amplitude and 1 kHz frequency.
(3) Run a Transient Analysis for 5ms, using 10us time steps.
(4) Plot V_{IN} and V_{OUT} as a function of time.
Do the results look as expected? Why or why not?
Make sure to take a screen capture of the simulation waveforms.
(5) Plot current I_{OUT} as a function of time.
What does the plot show?
Make sure to take a screen capture of the simulation waveforms.
(6) Plot the power delivered by V_{IN} and power delivered to R2 as a function of time.
Explain the relationship between the two power plots.
Make sure to take a screen capture of the simulation waveforms.
(7) Modify the value of R2 = 4kΩ. Rerun the transient simulations and replot the signals.
How did the waveforms change? Explain why?
Make sure to take a screen capture of the simulation waveforms.

TA Check Point: Complete Part 3 and demo the results to your TA.

Part 4: Parallel Circuit

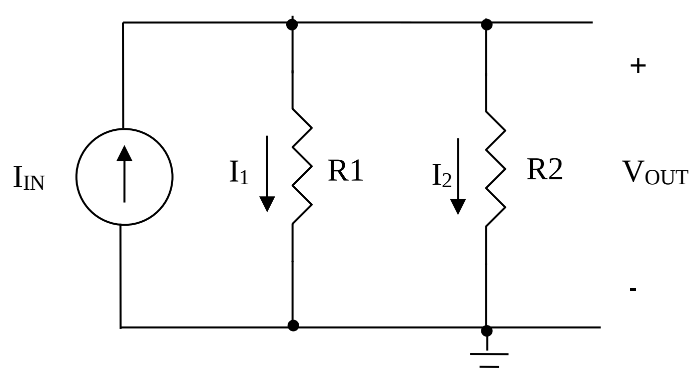

Figure 2. Current divider

(1) Draw the current divider schematic in Figure 2.
(2) Assign component value for R1 = 1kΩ and R2 = 3kΩ.
(3) Run a DC Sweep simulation on I_{IN} from 0A to 2A in 100mA increments.
(4) Plot I_{IN} on the x axis and I_1 and I_2 on the y axis.

What is the slope of the curves? What does it represent?
Do the results look as expected? Why or why not?
Make sure to take a screen capture of the simulation waveforms.

(5) Plot V_{OUT}.
What is the slope of the curve?
Explain what the slope represents.
Make sure to take a screen capture of the simulation waveforms.

TA Check Point: Complete Part 4 and demo the results to your TA.

Part 5: Physical Circuit Build

Use the document "Introduction to Lab Equipment – Part 1" posted on Camino while you do this lab.

Build the circuit in Figure 1 with components R1 = 1kΩ and R2 = 3KΩ.

Hook up the resistor network voltage supply to the power supply. Once everything is properly connected, set the voltage to 2Volts. Increase the voltage to the following voltage levels (4V, 6V, 8V and 10V) and note at each point the voltage Vout using the DMM.
Plot Vin vs. Vout and see if it matches your simulation plot.

Where do you place the ammeter when measuring the current I_{out} through R2 in Figure 1? Draw a schematic showing the placement.

TA Check Point: Complete Part 5 and show the plot and the ammeter placement to your TA.

Part 6: Lab extension For lab report)

(1) For Figure 2: V_{IN} is a sinusoidal source with 1V amplitude and 1 kHz frequency. R1 = 1kΩ and R2 =3kΩ.What value would V_{OUT} have if another resistor R3 of 6KΩ is added in parallel to R1 or R2?
(2) For Figure 2: Where do you place the ammeter when measuring the current I_1 through R1 in Figure 2. Draw a schematic showing the placement.
(3) Please include your response to this section in your lab report.

IV. REPORT

Write a laboratory report that details all the work done. Use the lab reporting guidelines published to complete the report.