UNIVERSITY OF CALIFORNIA, BERKELEY
EE40: Introduction to Microelectronic Circuits

Equivalent Circuits Guide

Important Notes

- Please make sure the current limit set higher than the current required by the circuit but lower than 2amps. This is to ensure you provide your circuit with enough power without damaging the equipment.
- Always use measuring devices (DMM) to take your measurements. Do not depend on the power supply to report accurate voltage and current values.
- In this lab, you will use 1.2kΩ, 2.2kΩ, 220Ω, and 1kΩ resistors. For this lab, you can use resistor values are at within 10% of your theoretical value. If you require the use of other valued resistors, than your theoretical calculations are incorrect.
- These circuits are complicated. Good breadboard practice will be key in completing this lab.

Equivalent Resistor Networks

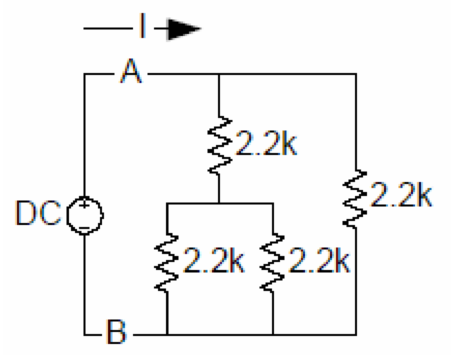

Figure 1

1. Build the circuit shown in Figure 1. Please use the breadboard to build this circuit. Assuming a maximum of 10 volts, what is the maximum amount of current supplied by the power supply?
2. From your prelab, you calculated the theoretical resistance across **A** and **B**. Disconnect the circuit from the power supply and use the DMM to measure the actual resistance across terminals **A** and **B**.
3. Reconnect the power supply, and record $\mathbf{V_{AB}}$ and **I** for 5 different supply voltages between 0 and 10 volts. Plot the IV curve of this circuit.
    a. When recording the value of $\mathbf{V_{AB}}$ and **I**, it is important that you use the digital multimeter (DMM) to take your measurements. The readings from the power supply are inaccurate.
    b. Please set the current limit of the power supply to a value higher than that calculated in Step 1, but lower than 2 amps.

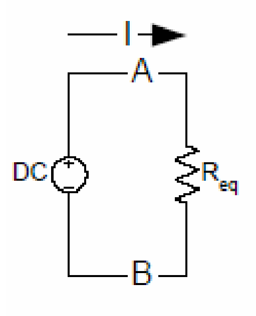

Figure 2

4. Build the circuit shown in Figure 2. Use the value of R_{eq} calculated in the prelab exercises and measured in step 2.
5. Using the power supply, record $\mathbf{V_{AB}}$ and **I** for 5 different supply voltages between 0 and 10 volts. Plot the IV curve of this circuit.

Thévenin's and Norton's Equivalence

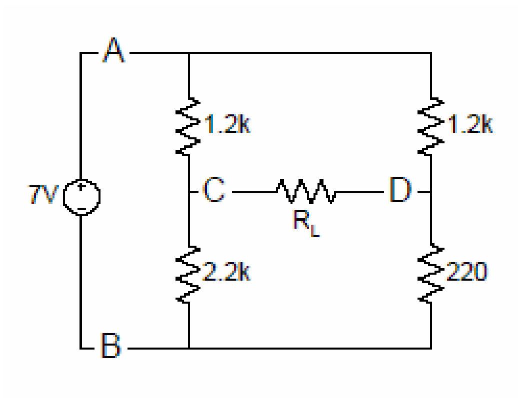

Figure 3

6. Build the circuit shown in Figure 3 *leaving out the resistor labeled* R_L for now. Measure the voltage across terminals **C** and **D**. This is your open circuit voltage ($\mathbf{V_{TH}}$) and should be the same as you calculated in your prelab.
7. Now measure the current flowing through terminals **C** and **D**. Remember, when measuring current using the DMM, there is 0-resistance across the probes. So you are essentially measuring the short circuit current ($\mathbf{I_{SC}}$) and should be the same as you calculated in your prelab.
8. Disconnect the power supply, and short terminals **A** and **B**. You *killed* the voltage source. Measure the resistance across terminals **C** and **D**. This is your Thévenin resistance ($\mathbf{R_{TH}}$) and should be the same as what you calculated in prelab.

9. Now, “unshort” terminals **A** and **B** and reconnect the power supply (thus restoring the circuit in figure 3). For 3 different values of R_L=220Ω, 1.2kΩ, and 2.2kΩ, install the resistor and measure the voltage across and the current through R_L.

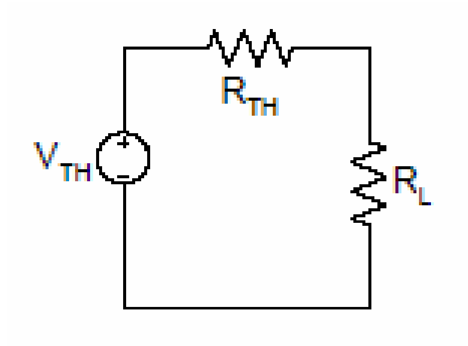

Figure 4

10. Build the circuit shown in figure 4 with the appropriate values of $\mathbf{V_{TH}}$ and $\mathbf{R_{TH}}$ you calculated in your prelab and measured in steps 6 and 8.
11. For the three values of R_L, measure the voltage across and current through R_L.

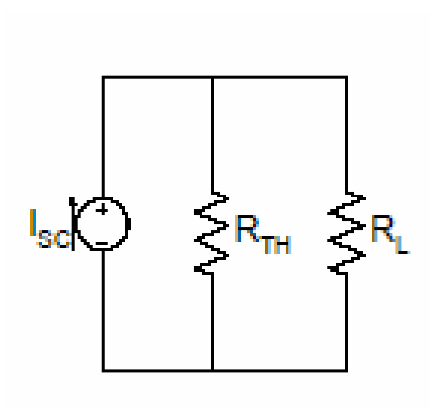

Figure 5

12. Build the circuit shown in figure 5 with the appropriate values of I_{SC} and R_{TH} you calculated in your prelab and measured in steps 7 and 8.
13. For the three values of R_L, measure the voltage across and current through R_L.