UNIVERSITY OF CALIFORNIA, BERKELEY EE100 Summer 2008 Lab 2

Equivalent Circuits Guide

Important Notes

- Please make sure the current limit set higher than the current required by the circuit but lower than 2 amps. This is to ensure that 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, then your theoretical calculations are incorrect.
- These circuits are complicated. Good breadboard practice will be key in completing this lab.

Equivalent Resistor Networks



- 1. Build the circuit shown in Figure 1. To demonstrate the importance of a neat and orderly breadboard layout, use only the resistors and no extra wires (except those connecting o the power supply) 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 VAB 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 **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 **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

 Build the circuit shown in Figure 3 *leaving out the resistor labeled R*[⊥] for now. Again, use only the resistors and no extra wires to build this circuit. Measure the voltage across terminals C and D. This is your open circuit voltage (Vтн) 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. Then you are essentially measuring the short-circuit current (**I**sc) and should be the same as you calculated in your prelab.
- 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 (Rтн) and should be the same as what you calculated in prelab.
- 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=220., 1.2k., and 2.2k., 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 **V**тн and **R**тн you calculated in your prelab and measured in steps 6 and 8.
- 11. For the three values of RL, measure the voltage across and current through RL.



Figure 5

12. Build the circuit shown in Figure 5 with the appropriate values of Isc and RTH that you calculated in your prelab and measured in steps 7 and 8.

(Hint : to make a viable current source, connect a large (>> R_{TH}) resistor in series with the power supply and adjust the voltage of the power supply until the current through the resistor is Isc.)

13. For the three values of R_{L} , measure the voltage across and current through R_{L} .

Pure Resistive Networks and Frequency

- 14. Attach the oscilloscope channel across points C and D (on figure 3). This is the system output. Disconnect the power supply, and instead attach points A and B to the function generator. This will apply an AC, rather than DC input to the system. Attach a second oscilloscope channel across points A and B.
- 15. Output a 1 kilohertz sinusoidal wave with function generator.
- 16. Observe both input and output waveforms together on the oscilloscope screen. Vary the frequency of the sine wave.

Circuit Simplification and Symmetry



17. Build the circuit in figure 6 on the breadboard. Make all resistor values 1k. As mentioned in the prelab, this circuit should be constructed in a neat and orderly fashion using only the resistors and no extra wires. (Hint: node A and F are the voltage source and ground respectively. Remember the breadboard configuration need not resemble the circuit's spatial configuration. Only the connections between nodes matters)

- 18. Measure \mathbf{R}_{eq} between points A and F. Compare this to the value you calculated in the prelab.
- 19. Reconnect the power supply to points A and F. Adjust the voltage such that the total current supplied is 10 mA. Measure the current through the resistor between point A and D.