

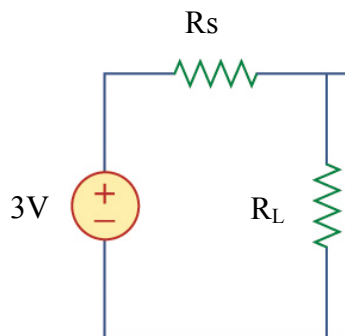
EGR 220: Engineering Circuit Theory**Lab 3: Maximum Power Transfer and Thevenin Equivalent Circuit****Part I: Verify Maximum Power Transfer**Objective

The objective of this experiment is to verify the maximum power transfer theorem.

Laboratory Experiment

The theory of maximum power transfer, discussed in Chapter 4 of the text, defines the maximum amount of power that can be delivered to an electrical load by a given power source and circuit. For this experiment follow the steps below. Note any observations you make and record your results as you perform the experiment.

1. Build the circuit shown in the figure below, with the source resistor $R_s = 2\text{k}\Omega$ and the load resistor $R_L = 510\Omega$.
2. Measure the power delivered to the load resistor, R_L . To do this you need to measure other quantities and use them to calculate power. Measure V and I , and along with R_L , calculate power delivered to each R_L using $P = V \cdot I$ and *one other expression* for calculating power.
 - a. **BE VERY CAREFUL** measuring current. We need to stop going through fuses quite so fast! Be sure you have the ammeter connected **in series** in your circuit. Ask if you have any questions about the connections. Also, use the Agilent meter for current and the handheld Fluke meter for measuring voltage.
3. Repeat steps 1 and 2 with $R_L = 1\text{k}\Omega$; $R_L = 2\text{k}\Omega$; $R_L = 3\text{k}\Omega$; $R_L = 6.2\text{k}\Omega$.
4. Plot your results.
5. Comment upon your results, explaining the significance of these results, and draw brief conclusions.
6. **Pre-lab:** Calculate the V and I expected for each R_L , and put these values in a table.

**Part II: Build and test a Thevenin Equivalent Circuit**Objective

The objective of this experiment is to verify that a circuit and its Thevenin equivalent have the same $v-i$ characteristics.

Laboratory Experiment

In the steps below, you will determine the values for V_{Th} and R_{Th} for figure 2, such that the circuits in figures 1 and 2 are equivalent at their output terminals, a , b . Report any observations, your results, and draw brief conclusions.

1. **Pre-lab:** Calculate V_{Th} and I_{Th} as in figure 2 so that figures 1 and 2 are equivalent circuits.
2. Determine R_{Th} with two experimental methods:
 - a. Method 1:
 - i. Measure the “open circuit voltage,” V_{oc} , across terminals $a-b$. (The open circuit voltage is the Thevenin equivalent voltage, V_{Th} .)
 - ii. Measure the “short circuit current,” I_{sc} , across terminals $a-b$.
 - iii. Calculate the Thevenin equivalent resistance, R_{Th} , as the ratio of the open circuit voltage to the short circuit current.
 - b. Method 2: Using the Ohmmeter, measure R_{Th} . Remember that the voltage source must be ‘zeroed.’ Be sure to describe your method for this step clearly (you might want to double-check that you are doing this correctly).
3. On a different place on the breadboard, build the circuit in figure 2, using the values you have determined for V_{Th} and R_{Th} . For R_{Th} , use series and/or parallel resistor combinations to create the correct value.
4. Measure the open circuit voltage and the short circuit current for the circuit in figure 2. Compare these to the values you found for the circuit in figure 1.
5. Select a load resistor value, R_L , of value between $1k\Omega$ and $4k\Omega$, to place across terminals $a-b$ – to be used in both circuits.
6. Obtain two such resistors and place one across terminals $a-b$ in each circuit.
7. Measure the voltage across and the current through this load resistor for both circuits. You should obtain the same values for both circuits – explain why.
 - a. **Pre-lab:** Calculate the expected values for V_L and I_L for each circuit, given the load resistor, R_L , you selected to use.

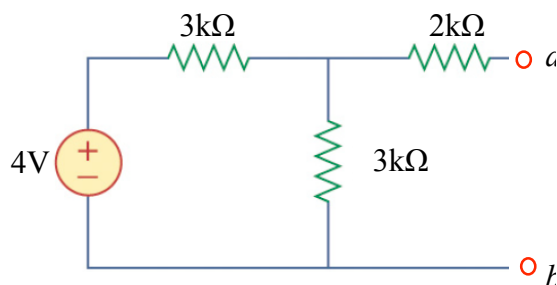


Figure 1

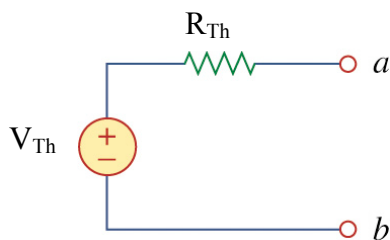


Figure 2