

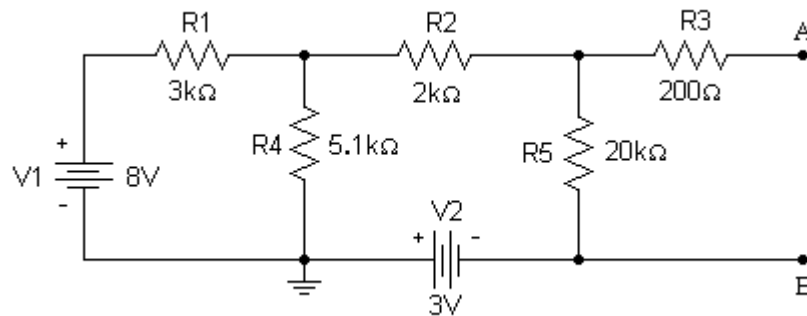
## Lab3: Thévenin's Theorem, Superposition

**Objectives:** To use several techniques to determine Thévenin's equivalent circuit and to experimentally verify superposition.

**Equipment needed:** Lab kit, CADET, multimeter (DMM), variable resistor.

### Part I. Thévenin's Equivalent Circuit:

A. Using resistors and the protoboard from your lab kit, construct the following circuit. Use the power supplies on the CADET for the voltage sources. (Create the 2 kΩ resistor by using two 1 kΩ resistors.)



B. Make the following measurements with the DMM:

1. Measure the *open circuit voltage* and the *short circuit current* at terminals A-B.
2. Short V1 and V2, then measure the circuit's equivalent resistance seen at terminals A and B. (*Note: Do not* actually short the voltage supplies; instead disconnect the supplies from your circuit and insert a wire in place of each supply in the circuit.)
3. Remove the short circuits and reconnect the voltage supplies. Connect a variable resistor between terminals A and B. Adjust the variable resistor's value until the voltage between terminals A and B is one half the *open circuit voltage* that was measured in Step B1. Disconnect the variable resistor and measure its value.

C. Determine the Thévenin equivalent of the circuit to the left of terminals A and B by using the values indicated and the appropriate calculation (if needed) and compare the results:

1. From the measurements of B1.
2. From the measurements of the *open circuit voltage* of B1 and resistance of B2.
3. From the measurements of the *open circuit voltage* of B1 and resistance of B3.
4. Analytically.

- D. Construct the Thévenin equivalent circuit based upon the values obtained in C using the appropriate voltage value from the CADET and the variable resistor set to  $R_{TH}$ .
1. Measure the open circuit voltage and the short circuit current at the terminals of the Thévenin equivalent circuit using the DMM.
  2. “Short” the voltage source and use the DMM to measure the resistance at the terminals of the Thévenin equivalent circuit.
  3. Compare the results you just obtained to the measurements you made in B1 and B2. Explain the results.

## Part II. Superposition:

- A. Return the circuit of Part I to its original state.
1. Remove V1 and replace it with a short. Measure all of the node voltages using the DMM.
  2. Remove the short circuit and restore V1. Replace V2 with a short circuit. Measure all of the node voltages using the DMM.
  3. Determine the actual node voltages in the original circuit by using the principle of *superposition*.
  4. Remove the short circuit and restore V2. Measure all of the node voltages using the DMM.
- B. Analytically solve the original circuit for each of the node voltages by using *superposition*.
- C. Compare your experimental results to the analytical results. Show that *superposition* holds from your experimental results.

## Report:

- A. Analytically determine the *open circuit voltage* and the *short circuit current* for Part I using the *superposition* principle.
- B. Include all of your analytical solutions along with your experimental data and comparisons. Discuss possible sources of errors between your measured values and the calculated values. (For example, consider the effect of resistor tolerance.)

*Follow the same format for your report as used in labs 1 and 2. Your lab report is due at the beginning of the next recitation period.*