Thevenin Equivalent Circuits

Motivation:

In this lab, we will work with the resistive circuits and measure their open circuit voltages and short circuit currents to obtain their equivalent resistances.

Related Lecture Content:

- Thevenin's and Norton's Theorem
- Maximum Power transfer

Experiment:

Please fill out the experimental report while going through the lab and submit it to the TA by the end of the lab for grading.

Part 1

1.1 Build the circuit shown in Figure 1 on the breadboard using the specified resistors without connecting a load circuit. Set the values of both power supply channels V_{P1} and V_{P2} to 10 V, record their values with the multimeter. Measure and record the voltage drop V_{AB}.

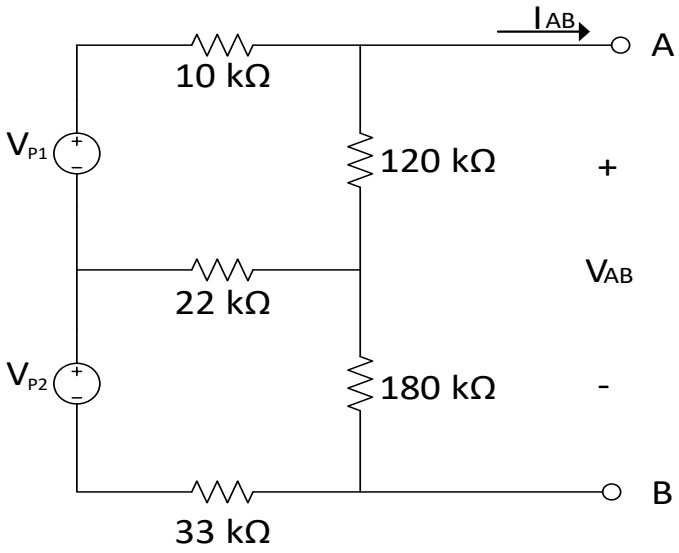

Figure 1: Resistive Circuit with Two Power Supplies

1.2 Keep both V_{P1} and V_{P2} at 10 V. Measure the open circuit voltage V_{oc} and the short circuit current I_{sc} between terminals A-B using the multimeter. Calculate the Thevenin resistance R_{Th} across the terminals A-B using your measured V_{oc} and I_{sc}. Use these values to find the maximum power that could be delivered to a load across terminals A-B.

1.3 Set V_{P2} to 0 V and keep V_{P1} at 10 V. Measure the open circuit voltage V_{oc} and the short circuit current I_{sc} between terminals A-B using the multimeter. Calculate the Thevenin resistance R_{Th} across terminals A-B using your measured V_{oc} and I_{sc}. Use these values to find the maximum power that could be delivered to a load across terminals A-B.

1.4 Set V_{P1} to 0 V and V_{P2} to 10 V. Measure the open circuit voltage V_{oc} and short circuit current I_{sc} between terminals A-B using the multimeter. Calculate the Thevenin resistance R_{Th} across the terminals A-B using your measured V_{oc} and $I_{sc.}$ Use these values to find the maximum power that could be delivered to a load across terminals A-B. To think about: compare the measured values between the three setups.

1.5 **Make sure you disconnect the power supply for this step**. Replace V_{P1} and V_{P2} with short circuits. Use the ohm-meter function of the multimeter to measure the resistance between terminals A-B.

1.6 Set V_{P1} and V_{P2} to 10 V. Add a load resistor (R_L) of 10 kΩ across terminals A-B. Measure the voltage V_{AB} and current I_{AB} supplied to R_L. Calculate the power consumed by $R_{L.}$

1.7 Replace the load resistor of 10 kΩ by a 120 kΩ load resistor. Measure the voltage V_{AB} and current I_{AB} supplied to the new R_L. Calculate the power consumed by $R_{L.}$

1.8 Use your answers (for questions 1.2, 1.6 and 1.7) to plot the (I-V) curve of the A-B terminals of Figure 1. Identify on your graph the four following points: V_{oc}, I_{sc}, the circuit operating points for R_L of 10 kΩ and of 120 kΩ. To think about: compare your (I-V) graph to the (I-V) graph of the Thevenin equivalent circuit of terminals A-B.