

## 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  $V_{AB}$ .

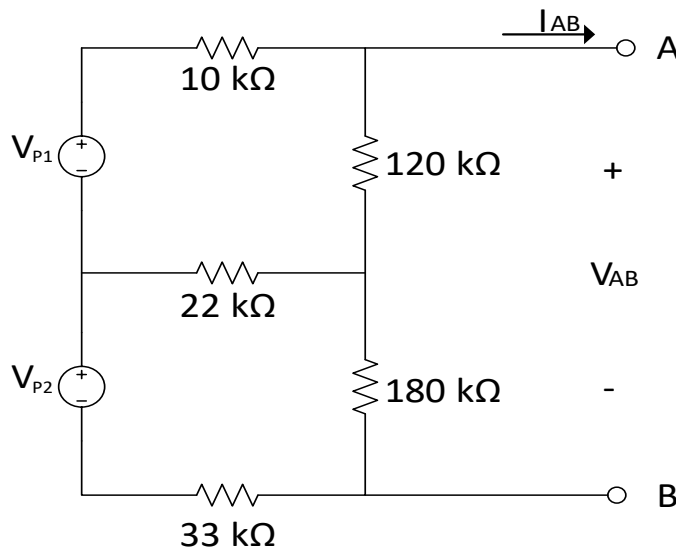


Figure 1: Resistive Circuit with Two Power Supplies

- 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 k $\Omega$  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 k $\Omega$  by a 120 k $\Omega$  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 k $\Omega$  and of 120 k $\Omega$ . To think about: compare your (I-V) graph to the (I-V) graph of the Thevenin equivalent circuit of terminals A-B.