California State University, Fresno
Department of Electrical and Computer Engineering

ECE 90L Principles of Electronic Circuits Laboratory

Experiment No. 5: Thévenin's Theorem and Maximum Power Transfer

Objective

The objective of this laboratory is to study the application of Thévenin's theorem to DC circuits, and to determine the conditions under which maximum power is transferred to a load.

Prelab

1.) For the circuit shown in Figure 1, calculate the open circuit voltage V_{OC}, the short circuit current I_{SC}, and the Thévenin resistance R_{TH}. Use whatever circuit analysis method you prefer to make your calculations. Please remember that when calculating the Thévenin parameters, you will have to remove (and ignore) the load resistance R_L.
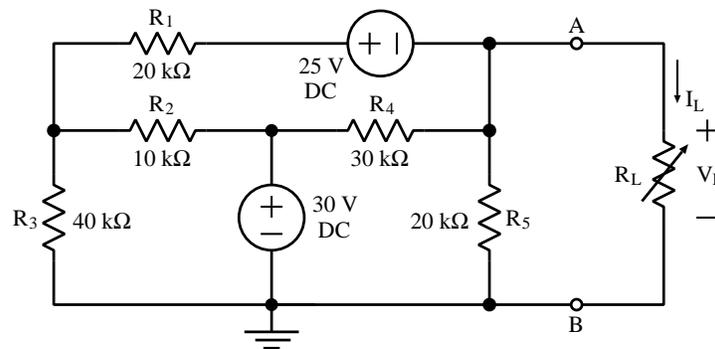

Figure 1: Thévenin Circuit

Procedure

1.) Measure all of the resistances to be used in the circuit shown in Figure 1, and measure the actual values of the load resistance R_L that will be used in Part 2.

2.) Connect the given circuit and measure I_L and V_L for 10 values of R_L between 1 kΩ and 10 kΩ using increments of 1 kΩ. Then, continue to make measurements out to 50 kΩ using 10 kΩ steps. Make power calculations to identify the region of maximum power and take additional I_L and V_L reading in this region. Use ± 5 readings using 100 Ω increments.

3.) Make experimental measurements necessary to determine the Thévenin equivalent of the given circuit, (i.e., V_{OC}, I_{SC}, and R_L removed). Compare these results to your theoretical calculations obtained from Prelab. Set up the equivalent circuit and measure I_L and V_L for the same variation of R_L as Part 2.

Conclusion

What conclusions can you draw from Thévenin's Theorem? How accurate is it? Does linearity still apply? Why?

Group Report

1.) Using measured values of the resistance, re-calculate and draw the Thévenin equivalent of your circuit. In addition, show the calculation for V_{OC} and R_{TH}.

2.) For the data obtained in Part 2 of the procedure, using a **single sheet** of graph paper, plot the curves of I_L, V_L, and P_L versus R_L (abscissa, or x axis), where P_L denotes the power absorbed by the load and R_L is the measured load resistance.

3.) From the three curves, identify the value of R_L for which maximum power transfer occurs, and the value of maximum power transferred. Compare the value of R_L with the results obtained by the calculation in Step 1 of the report. Repeat for the data obtained in Part 3 of the procedure.

4.) Compare and discuss the experimental and calculated results that you obtained. What conclusions can you draw from your data?