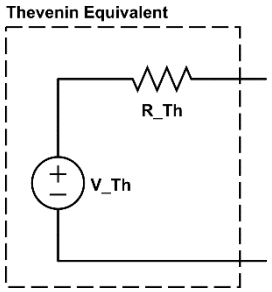
ECE 205 Lab – Thevenin Theorem

Introduction



In ECE 205 lecture, we learned about Thevenin (and Norton) equivalent circuits. The idea is that any **linear** circuit may be reduced to an equivalent circuit consisting of a voltage source in series with a resistor. This is a very important concept in circuit theory, as this relatively simple circuit may be used to model the behavior of complex circuits.

In practical circuit design and analysis, Thevenin equivalents are even used to model non-linear devices with some approximation. For example, it is common to characterize amplifiers, batteries, generators, and so forth in terms of their open-circuit voltage and internal resistance, although they are not purely linear devices. The simplicity of the Thevenin theorem allows it to be a useful model for any non-ideal voltage source.

The maximum power transfer theorem states that for a given Thevenin equivalent circuit, the maximum amount of power transferred into a load resistance when the load resistance is equivalent to the Thevenin resistance. This was stated in class, but not proven. Your goal for this lab is to illustrate the maximum power transfer theorem using LTSpice, a computer-based circuit simulator.

LTSpice

For this semester, we will be using the LTSpice software to perform circuit simulations. LTSpice is a free implementation of the popular PSPICE simulation engine, available for both Windows and Mac computers. Please see the LTSpice tutorial for some basic setup instructions.

You goal is to first create a Thevenin equivalent circuit using LTSpice. For the purposes of this lab, use $V_{Th} = 10V$ and $R_{Th} = 100\Omega$. Then create a load resistor (R_{Load}), starting at 10 Ω. Use the **.step** directive to sweep the load resistance between 10 Ω and 1kΩ. Use LTSpice to simulate the circuit (with the changing value of R_{Load}) by using the Alt key and clicking on the relevant element.

Prelab

Typically, we will ask students to turn in a pre-lab on Compass the night before the demo. Since this is an online lab you can turn in pre-lab as a part of your final report. Lab 1 does not have any pre-lab questions!

Deliverables

For this lab you will need plot the power in R_{Load} as function of the value of R_{Load}. Use this plot to confirm that the maximum power transfer theorem is true, that power is maximized when $R_{Load} = R_{Th}$.

- Schematic as drawn in LTSpice
- Power in R_{Load} as a function of R_{Load} graph

Writing the lab Report

For your lab report, you will need to include as follows:

- Statement of purpose (this should be rewritten in your own words)
- Procedure (circuit schematics, tests performed) – may be elaborated from the pre-lab
- Raw data (this may be a table, or in the form of simulation captures in later labs)
- Analysis (interpretations of the raw data, including calculations done to obtain values of Voc and Rint)
- Conclusion (what went right, what went wrong, additional observations, application of the principle learned)

Make sure all images and tables are captioned. You should upload your lab report to Compass before your next lab session.