1 Lab 1: Thevenin and Simple Components

Due Friday, February 6, at midnight

Note: This lab is vague in some areas. We would very much appreciate active feedback and questions to help us learn to better design future labs.

In this lab you will work in pairs to understand the behavior of simple components and the purpose of Thevenin-equivalent circuits. Read through the entire lab beforehand to use your collective time effectively.

Lab stations are set up in the back of room 304. Because this room is used by other classes, please keep the stations tidy and do not leave out your own work.

Choose your own lab partner; turn in one lab report between the two of you. Gill or Jimmy will be available for help at the Lab Help times listed at `http://ice.ece.olin.edu/meeting_times_and_places.shtml`.

1.1 Potentiometers

Potentiometers are three-terminal devices and as such can fit into a circuit many ways. Plug a **yellow potentiometer** into your breadboard and wire it up to perform some simple experiments to figure out what each terminal leads to, or what each terminal pair "looks like", in the Thevenin sense. You can use a multimeter to measure resistance, or the power supply to provide voltage (a few volts) or current (in milliamps) and measure the response on a multimeter or the oscilloscope.

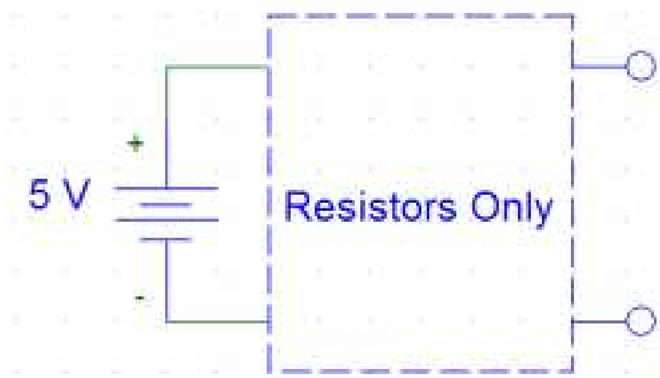
In your experiments, make sure that the potentiometer knob is at neither of its extreme positions before trying to apply voltage. Only try applying voltage at these extremes after you have determined that there will be resistance there.

Predict what will happen if you apply a voltage across two terminals on the potentiometer and then turn the knob to reduce the resistance between them to zero. Try it and see.

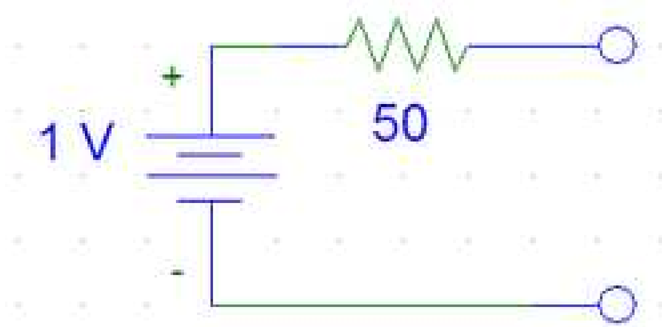
Record all of your results, including your evidence for how the different pairs of terminals on the potentiometer work.

1.2 Black-Box Circuits

Using a 5 V power supply and a collection of resistors, design a two-terminal "black-box" which acts identical to a 1 V, 50 Ω source. In other words, on your breadboard, complete the following,



so that it looks like,



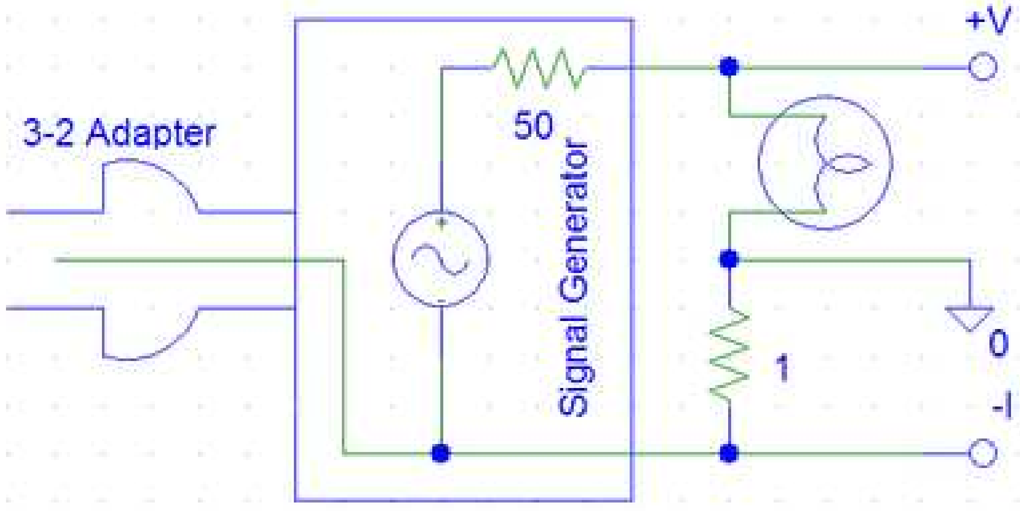
1.3 Voltage vs. Current (V-I) Curves

1.3.1 Light Bulb Heating

Many components are non-linear in their response to voltage or current. Some non-linear components exhibit this behavior because they contain "memory" of recent events to effect their current responses.

1. Solder wires to two contacts at the base of the **tiny lamp**. One connection is the bulb screw itself; the other is the circle of metal underneath.

2. Connect the signal generator and a 1 Ω resistor in the configuration below.



Note the use of the 3-2 prong adapter to float the signal generator (allow it to have a different ground voltage than the oscilloscope). The ground shown in the diagram (labeled 0) should be shared with the oscilloscope.

3. Select a triangle wave that oscillates between $-5V$ and $5V$, with a frequency of about 100 Hz.

4. Connect channel 1 of your oscilloscope between the internal ground voltage (denoted 0 volts) and other light bulb terminal; connect channel 2 between the internal ground and the connection marked "-I". Channel 1 will measure the voltage across the light bulb. Because channel 2 is across a 1Ω resistor, it will measure the current through the bulb, as a voltage.

5. Set up your oscilloscope to plot channel 1 vs. channel 2. Observe the results.

6. Decrease the period of your driving triangle wave and observe how the voltage vs. current curve changes.

Does the light bulb have different behavior depending on which terminal has positive voltage?

Is this behavior desireable for the light bulb?

Why do you think this happens to the light bulb?