Name: 1._____ 2._____ 3._____
Lab Day, Time, and Date: _____

Warm-up:

Take data for a light bulb that we used in the previous lab. How do you get both positive and negative data? Make some observations and write them here. Try to experiment with the set-up. What are some of the variables that can affect the outcome? Are there any assumptions that we are making?

Laboratory Exercise 3

An Exploration in Measurement, Classification and Characterization

Your Mission: Initiate the process of understanding alien technology.

A robotic alien spaceship crashed in the remote Rocky Mountains. Unfortunately there was no documentation found, and much of the hardware was destroyed.[1] We did recover a number of devices that were clearly part of some kind of electrical or electronic apparatus. Your task today is to begin the process of understanding the nature of these devices, with the long-term goal of helping us reverse engineering the entire alien technology.

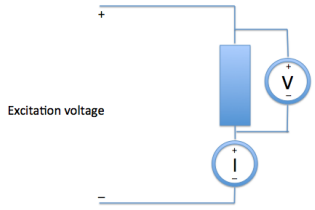
About a dozen alien electrical devices were found to be modular in design, with identical connectors. They have been provided in the laboratory. We are therefore at the very initial stages of the scientific process, which includes the following steps

- Discovery of a phenomenon or process or object (in this case the alien craft).
- Characterization by quantitative measurement and observation (that will happen in this lab session).
- Classification by shared properties or attributes (we'll work on this next week in class).
- Placing the objects or behavior into a broader theoretical context, or (as a fall-back position) come up with some appropriate data-driven model of properties. (We'll try to construct some simple models that capture the observed properties.)

Our primary goal in this lab is to obtain data to allow us to classify these devices into different categories. We will also then see if we can figure out some simple models to characterize the behavior of these components.

A good first step is to determine the relationship between current and voltage for these two-terminal alien devices. This requires 1) a source that produces some excitation voltage (or current) connected as a circuit to the device under test, 2) a way of measuring voltage across the device, and 3) a way to measure the current flowing through the circuit. Figure 1 shows the configuration that will produce the data we require.

A photograph of one of the alien devices is shown in Figure 2. The personnel who recovered the devices from the crash site stamped unique numbers at the bottom right of the tags, which we presume are some kind of alien labeling system.



[1] One digital data set was discovered, and we suspect it contains Elvis Presley music. This has led to a renewal of suspicion that Elvis was an alien.

Figure 1. This conceptual illustration shows how to connect the Voltmeter (V), current meter (I) and the two-terminal alien device (shown as a blue rectangle).

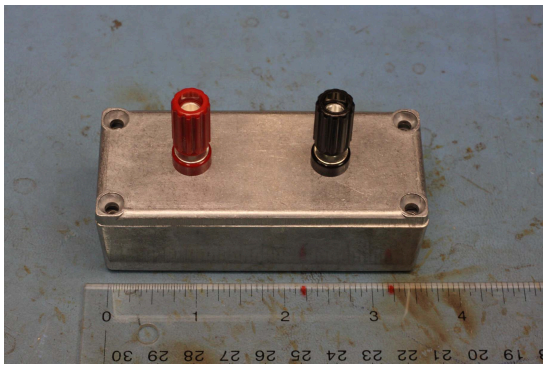


Figure 2. Photograph of a two-terminal alien device!

Voltmeter Basics.

Voltmeters measure the difference in electrical potential *across* circuit elements, in units of Volts. The ones we use have a maximum input of 6 Volts, and could be damaged if you exceed that value. There are two leads that you use to place the meter in parallel with the circuit element of interest.

In our case here, we are interested in knowing the voltage across the unknown alien gizmo, so you should connect the voltmeter to the two terminals of the device of interest.

It's best to turn off the excitation voltage whenever you're connecting or disconnecting anything.

Current Meter (also called an Ammeter) Basics.

Current meters are placed in series with the circuit element of interest. Since the same current then flows through the ammeter and the circuit element, we can measure the current flowing in the circuit loop. Connect the current meter in the loop as shown in Figure 1, with the (-) side connected to the (-) terminal of the excitation voltage.

Current meters usually have in-line fuses to protect the meter from having too much current flowing. Our current meters get very unhappy with currents above 0.6 Amps (or 600 mA).

Again, turn off the excitation voltage when re-arranging anything in the circuit.

Our current and voltage meters are connected to the lab computers so that we can easily capture and store digital data.

Some suggestions:

Figure out how to operate the current and voltage measurement devices, and how to obtain and store data in a computer file. Establish a methodology for file naming conventions, for everyone in the lab, and the definition of polarity (which end is connected to +) of the devices being tested. Be sure each lab group makes measurements with both polarities on at least 5 different alien devices.

Keep an electronic logbook that includes descriptions of what you see, the sequence of operations you undertake, and any observations you might have. Consult with your labmates to arrive at a sensible convention for naming logbooks as well.

Upload your data files and logbook to the dropbox that is appropriate for your lab session.

Also, download all the accumulated data files there, and start making plots that put all the devices on the same I(V) plane. Do you see any patterns?