Measurements Using Voltage Probes
and the LabPro Interface

**Purpose:** To become familiar with the use of voltage probes, together with the Vernier computer interface (LabPro), to measure both DC and time-varying electrical signals.

**Apparatus:** Vernier LabPro Interface, Dual Voltage Probes, Variable DC voltage source, Decade Resistance Box, Voltmeter, Function Generator, Fixed-phase / Variable-phase 60 cycle source.

**References:** Refer to your text for a discussion of DC and AC circuits.

**Introduction:** Some of the terms used in this exercise will perhaps not be completely understood until AC electrical circuits have been discussed in lecture. For the present, a partial understanding will suffice. In this exercise, no damage or shock of any kind can result from errors in electrical connections. We will be using voltage probes, interfaced to a computer, to measure both DC and time-varying voltages. The equipment is not capable of measuring very rapidly time-varying signals - for that one needs to use an oscilloscope or a faster interface. The maximum frequencies that we can study without serious distortion are approximately 5,000 Hz with a single probe and 1000 Hz with dual probes. The computer interfacing and software allows us to analyze the data quickly and easily.

**Procedure:**

**I. Measurement of DC voltages.**

1. The computer and interface should already be turned on. Double-click on the Logger Pro icon labeled “Voltage - 1 Probe” to open the software for this part of the experiment.

2. Connect the #1 Voltage Probe across the terminals of the Variable DC Voltage Source.

3. Set the voltage on the Variable DC voltage source to +5.00 Volts as determined by a measurement using the digital voltmeter. Now measure the same voltage using the LabPro voltage probe. Use the “Examine” option under “Analyze” to determine the voltage of a particular point on the graph. You can also determine the average reading by clicking on “Statistics” under “Analyze”. Record all measurements, including the digital voltmeter reading, and the average LabPro measurement. If the various measurements differ significantly, speak to your lab instructor.

4. Do the above measurements and record all data for voltage settings of +5.00V, +2.50V, -2.50V, and -5.00V. For a measurement of 0 Volts, connect the probes to each other. What do you conclude from the set of measurements?

**II. Measurement of time-varying signals.**
1. Connect the probe wires to the output from the function generator. DO NOT REMOVE THE CONNECTOR THAT IS ON THE FUNCTION GENERATOR! Set the function generator frequency control to approximately 500 Hz on the 1 kHz range. Select the square wave output form and observe the pattern when you collect the data. Adjust the amplitude so that it is approximately 5 Volts. Switch to the sine wave output form and observe that as well.

2. Measure the period and amplitude of both square waves and sine waves using the “examine” option in the analysis software. For the sine waves only, use the “automatic curve-fitting” software to make a second determination of the frequency and amplitude. Select “sine wave” and then click “try fit” followed by OK if the fit looks good. Record data for the following dial settings on the function generator:
   100 Hz, 500 Hz, 1000 Hz, 5000 Hz.
   and enter your data in a table. Note that the curve-fitting software gives you the value of omega, not f, where \( \omega = 2\pi f \). In the manual determination of f, use the fact that \( f = \frac{1}{T} \).

III. Measurement of line frequency and observation of relative phase.

1. Close the program that you have been using in parts I and II (Please do not save!). Double click on the Logger Pro icon labeled “Voltage - 2 Probes” to open the software for this part of the experiment.

2. Attach Probe #1 to the “fixed” output of the 60-cycle source and attach Probe #2 to the variable phase output. Measure the frequency of each signal as precisely as possible, using the same techniques employed in Part II above. Is Con Edison keeping to 60.0 Hz?

3. Vary the phase of the variable-phase output and observe the relationship between output #1 and output #2. What is changing? What is not changing?

In your report:

Describe your measurements in each part above and discuss their significance. How do the various measurements in Parts I and II compare with each other? Answer all of the questions posed. Discuss the advantages and disadvantages of using the methods of this experiment to measure electrical signals, as opposed to using meters.