Name: _____

Resistors and Basic Resistive Circuits

Objective: To gain experience with
- data acquisition
- proto-boards
- physical resistors

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Pre-Lab Assignment

1) Every Student needs to download the NI ELVISmx software, install it on your laptop, and bring your laptop to class. Failure to do this may result in not being able to perform the laboratory exercise. The software can be found on the National Instruments website at: http://joule.ni.com/nidu/cds/view/p/id/2157/lang/en
2) View the National Instruments videos on protoboards, resistors, MyDAQ.
3) Read the Background section of this laboratory exercise.
4) Perform hand calculations on the circuits in part B6 and B8 to determine the expected values for the empirically determined unknowns.

Background

National Instruments MyDAQ

Digital Acquisition Boards (DAQs) are used to measure physical electrical signals and convert them into a form that can be viewed and stored digitally. The National Instruments MyDAQ also has analog and digital output signals. The MyDAQ comes with several software instrument panels including a digital multimeter (DMM), an oscilloscope (Scope), and a function generator (FGEN).

DMM: Digital multimeters measure voltage, current, and resistance and can be purchased as self-contained units from hardware stores. The symbols typically used on DMMs to represent different signal types are shown in the table.

Symbol	Definition
V - -	DC voltage
V~	AC voltage
A- -	DC current
A~	AC current
Ω	Resistance in ohms

Scope: An oscilloscope is a measurement instrument used to display how a measured voltage varies with time. On the oscilloscope display, the y axis is voltage and the x axis is time. The inputs to the oscilloscope are called channels. A two channel oscilloscope can simultaneously display two measured voltages. The scales of the display axes may be varied to display the voltage waveforms better by adjusting the volts per division (y axis) and time per division (x axis) knobs. A trigger is an event that starts displaying the signal. In the picture below, the trigger event is a rising edge with a trigger level of 0V. The signal is displayed from the moment it increases to more than 0V.
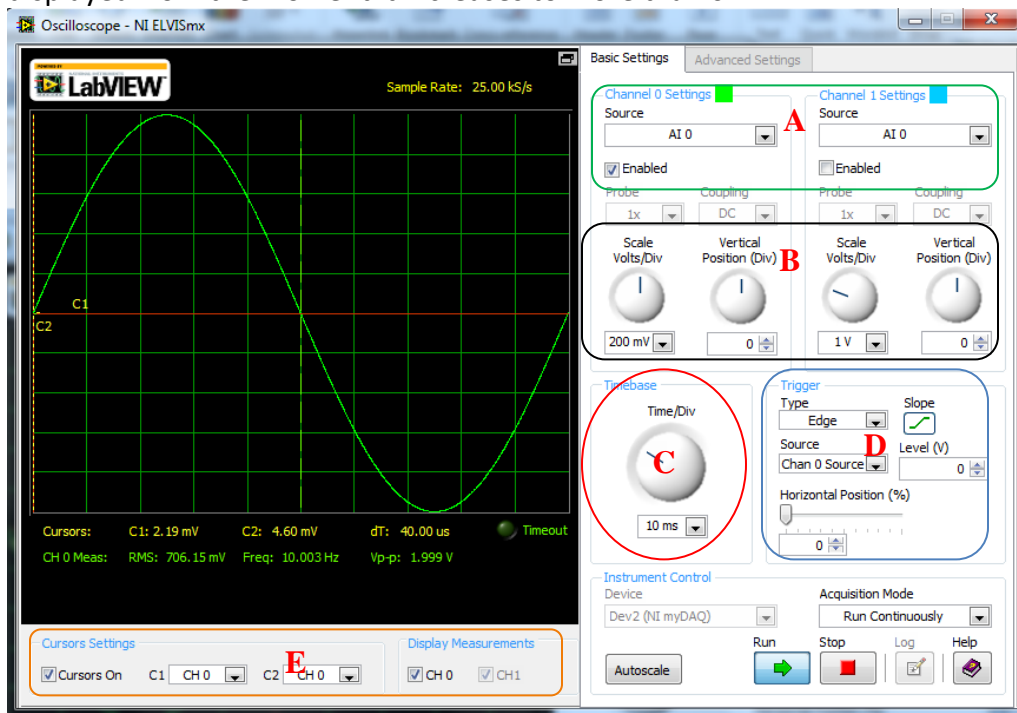
A: Control the channel source.

B: Control the vertical scale and position.

C: Control the horizontal scale.

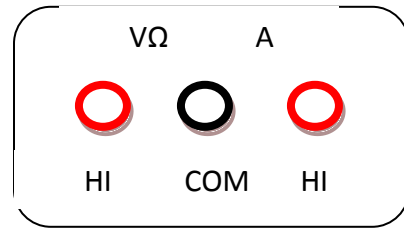D: Control the trigger event and horizontal position.

E: Enable/Select the cursors.

FGEN: A function generator is a test instrument that generates a voltage that varies with time. Typical generated functions are sine waves, square waves, and triangle waves.

Input/Output Interfaces:

The DMM interface is on one end of the MyDAQ:

VΩ	A
HI	COM	HI

The left two connectors are for measuring voltage and resistance. The remaining connector is used for measuring the current.

The MyDAQ has an interface on one side with +15v, -15v, Analog Output (AO), Analog Input (AI), and digital input/outputs. The part of the interface that will be used in this experiment is shown below.

+15v	-15v	AGND	0	1	AGND	0+	0-	1+	1-
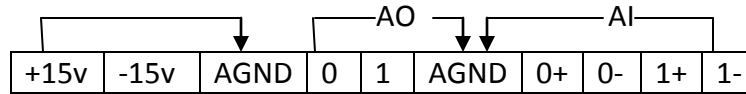
Resistors

The resistance of physical resistors is denoted by four color bands on the resistor. The color code for bands 1-3 is

Color	Value
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Purple	7
Grey	8
White	9

1st band and 2nd band give the first two significant numbers of the resistance
3rd band gives the base 10 multiplier, $x10^n$
4th band gives the tolerance (silver is ±10% and gold is ±5%)

A resistor with bands (yellow, red, orange, silver) is a 42,000 Ω resistor with a tolerance of ±10%.

Lab Procedures

The lab procedures familiarize the student with the MyDAQ system, the proto-boards, and resistors.

Part A) MyDAQ

Learning how to use the DMM

1. To set up the DMM for measuring voltage:
   - Plug the MyDAQ into a USB port on your computer

- Start the NI ELVISmx Instrument Launcher software.
- Click on the DMM icon to open the DMM screen shown below.
- Match the settings in the screen below (Run Continuously, and Auto mode).
- Click on the symbol V -- on the DMM screen.
- Plug the black DMM lead into the COM plug on side of the MyDAQ.
- Plug the red DMM lead into the red terminal to the left of the COM terminal (marked with a VΩ label).
- Click on "Run".
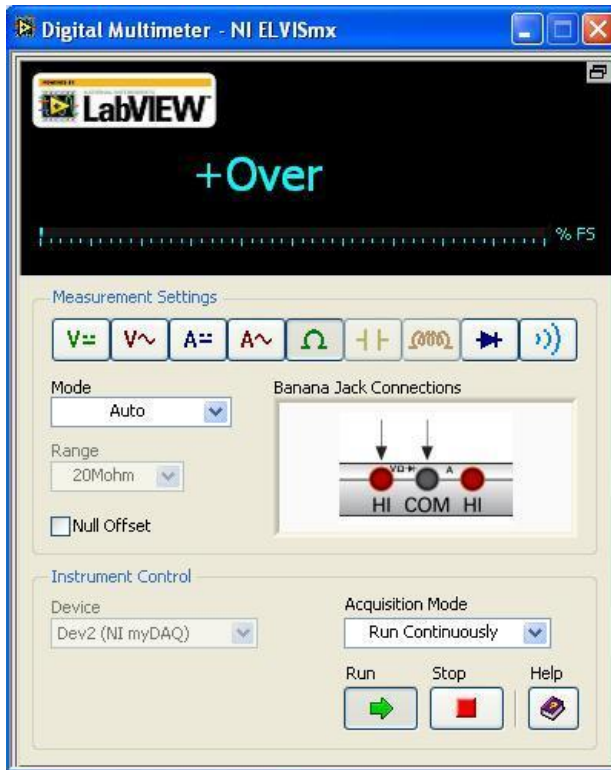
2. To use the DMM to measure the voltage difference between the +15 volt terminal and the Analog Ground (AGND):

- Touch the red DMM lead to the red coated +15v wire and touch the black DMM lead to the analog ground (AGND). Read the voltage.

Voltage measured by the DMM: _____

- Reverse the leads so that the red DMM lead touches the black-coated analog ground wire and the black lead touches the red-coated +15v wire.

Voltage measured by the DMM: _____

Not working?

- Make sure you click on the [V=] button to measure DC voltages.
- If the voltage measurement is slow to register, you may turn off the "Auto" mode and select a range of 20V.
- Make sure the [Run →] button is pressed on the DMM.

Part B) Resistors

Measuring Resistance

1. Turn the DMM dial to Ohms (Ω) and touch the leads to both sides of a 1k Ω resistor. Measure the resistance. It does not matter which color lead goes to which end of the resistor. If the DMM is slow to register, switch the mode to "Specify Range" and select 20kΩ.

    a. Measured Resistance = _____

    b. What percent tolerance is this resistor supposed to have (from band 4)? _____

    c. Is the measured value within tolerance? _____

2. Measure the actual resistance of a 2k Ω resistor.

    a. Measured Resistance = _____

    Not working?

   Make sure you click on the [Ω] button to measure resistance.

    Make sure the [Run →] button is pressed on the DMM.

*Determining Current by Measuring Voltage Across a Resistor*

Current can be measured directly by placing an ammeter in series in the circuit. Current can also be determined by using Ohm's Law on the voltage measured across a known resistor, as will be done in this part.

3. Build the following circuit on the protoboard using the resistors measured in Parts 3 and 4, where R_1 = 2kΩ and R_2 = 1 kΩ resistors.

4. Use the +15v and AGND wires from the MyDAQ for the voltage supply V_s

Name: _____
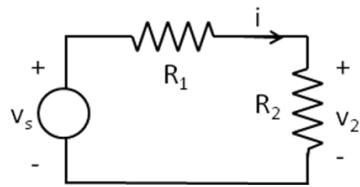
Circuit Schematic
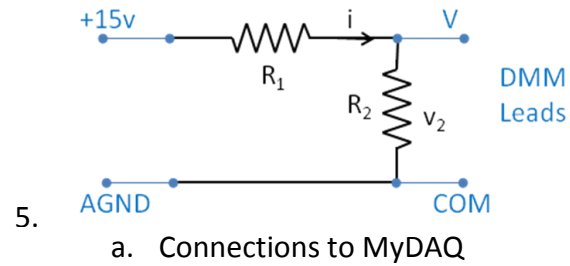
5.

a. Connections to MyDAQ

6. Calculate the voltage across R_2 .

    a. v_2= _____volts

7. Measure the voltage across R_2 using the DMM, using the MyDAQ connections as shown below.

    a. v_2= _____volts

8. Calculate the current from Ohm's Law: $i=v_2/R_2$ where R_2 is the ideal resistance and v_2 is the ideal voltage measured across the ideal resistance, R_2.

    a. i = _____ amps

9. Measure the current passing through R_2.

    a. i = _____ amps

10. What is the % deviation from calculated to real measurement of the voltage from 6 & 7.

    a. % deviation = _____
    b. What are the sources of deviation? _____

    _____

11. What is the % devation from calculated to real measurement of the current from 8 & 9.

    a. % deviation = _____
    b. What are the sources of deviation? _____

    _____