

## **EE426: Principles of Electronic Instrumentation**

### **Lab 1: Thermometer**

The purpose of this lab is to review your knowledge of electronics, learn how to use virtual instrumentation software, and also to better understand calibration procedures and measurement accuracy.

#### Part A: Sensor and signal conditioning circuit

Using a 5V power supply, thermistor, and resistors, design a circuit that produces a voltage output that is low for low temperatures and high for high temperatures. Your sensor should operate over the range of 0 to 100 °C. Document your design and the design process as you work—you'll need it for your report!

Calibrate your sensor and signal conditioning circuit using water samples of different temperatures (the instructor will provide ice, an electric kettle, and insulated cups) and the provided thermometers. (You may need to use tape to shield your thermistor leads from the water). Document, document, document—you'll need it for your report.

#### Part B: Introduction to LABVIEW

1. Launch LabVIEW on your computer. On the “Getting Started” page, select “Getting Started with LabVIEW” this will bring up a pdf file with a number of useful tutorials.
2. Follow the directions for “Chapter 3 Full and Professional: Analyzing and Saving a Signal.” Note that there is a small typo in number 3 of “Modifying the Appearance of Graphs”—if you don't see the “Type” list, make sure you're in the “default editing mode.”
3. If you still feel uneasy working with the software, try some of the other tutorials, particularly Chapter 1 and Chapter 2.

#### Part C: Introduction to the DAQ unit

1. Look at the diagram on the front of the myDAQ. Note that it provides +/- 15 and +5 V DC supplies, a built-in multimeter, and a number of digital and analog inputs and outputs.
2. Connect the DAQ card to the computer with the USB cable. The blue light next to the USB port on the myDAQ should glow.
3. Open up a new blank VI. Follow the first section in the “Chapter 4 Hardware: Acquiring Data and Communicating with Instruments” tutorial. Use the “DMM” input port (you get there using “Acquire signals” then “Analog Input” then “Voltage”). For acquisition mode, use “On Demand”. Stop at the end of that section—this manual seems to be for a different version of LabVIEW. Note that there were many options for the supported physical channel. Here we'll use the DMM because the cables are easy to use, but you could also use ai0 or ai1, which also represent analog inputs.
4. Right click on the front panel and select a “Numeric Indicator”. On the block diagram, wire the output of the “DAQ assistant” to the indicator.
5. Generate a small voltage (<5 V) with a power supply, plug in the DMM cables from the myDAQ and hold them to the power supply, then hit the “run” arrow on the front panel to see if your system is working.

#### Part D: Completing the Thermometer

Now put it all together to create a virtual instrument in LABVIEW that displays temperature in Celsius on the control panel in an easy-to-read format for the user. Take sufficient data to characterize the measurement error and time response for your measurement system.

Write a report on your thermometer design, including both the hardware and virtual instrumentation portions of the design. You should also report on the uncertainty and time response for your measurement system. In your report, evaluate your system and make recommendations for improvements.