1. **OBJECTIVES**

The objectives for lab 9 were to study ADC conversion, the Nyquist Theorem, aliasing, analog amplifiers, low pass filters, data acquisition systems, and to develop a temperature measurement system using a thermistor.

1. **HARDWARE DESIGN**

See the schematic file

1. **SOFTWARE DESIGN**

See the software files

1. **MEASUREMENT DATA**
   1. Three Waveforms (Procedure 1)

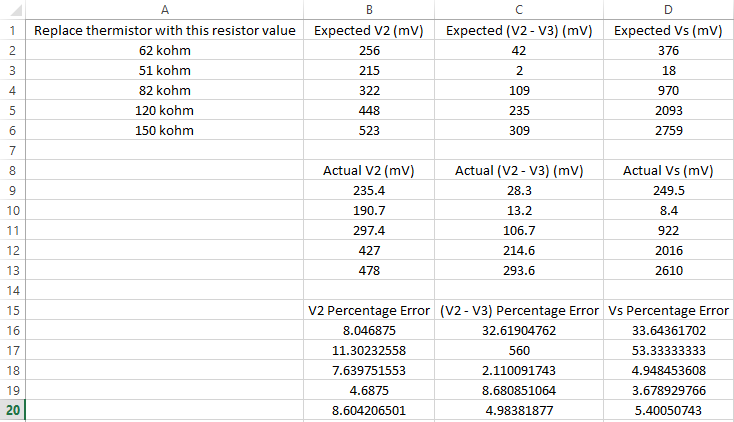
To see the data points given in the graphs below, please see Procedure1.xls

*Figure 1: Sampling at 10x the signal frequency gives a nice sine wave and seems to represent the signal rather well.*

*Figure 2: Sampling at greater than 2x the signal frequency seems to capture the data reasonably well, but doesn’t give a nice sine wave (this one appears rather jagged).*

*Figure 3: Sampling at 0.5x the signal frequency shows the horrid results of the aliasing effect. The data does not reflect the signal at all. It’s not even a sine wave.*

* 1. **Static Circuit Performance (Procedure 2)**



*Figure 4: shows the measurements at strategic locations when the thermistor was replaced with the above values. V2, V2-V3, Vs are the voltages indicated in the Therm12.xls file. V2 is the voltage drop from the positive terminal of the INA122P to ground. V2-V3 is the voltage drop from the positive terminal to negative terminal of the INA122P. Vs is the INA122P’s output voltage*

*Note: the huge percentage error in C17 and D17 is due to the fact that voltmeter isn’t accurate when reading such low voltages (it reads about 20 mV of noise when not connected to anything) (which makes those values recorded not really useable). Figure 5 indicates this.*

Voltage out when thermistor disconnected = 3.2 V

Voltage out when thermistor wires are shorted = 22 mV. This value is basically noise (as in zero volts).



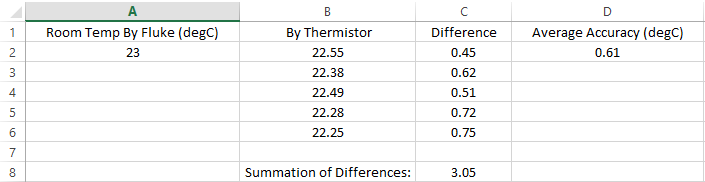
*Figure 5: shows voltage reading when not connected to anything (~20 mV of noise)*

* 1. **Dynamic Circuit Performance (Procedure 3)**

*Figure 6: For specific values, see Procedure3.xls. The gain starts to roll off around 10kHz and approaches one as frequency approaches infinity.*

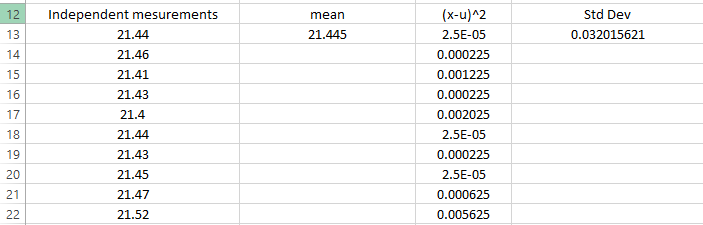
*Figure 7: For specific values, see Procedure3.xls. The gain starts to roll off almost immediately and approaches one as frequency approaches infinity.*

* 1. **Accuracy (Procedure 6)**



*Figure 8: The table above shows 5 measurements taken at room temperature. It shows the differences between our thermistor’s readings and our fluke meter’s readings as well as our average accuracy. The table shows that our values are, on average, within one degree of the “true” room temperature.*

* 1. **Reproducibility (Procedure 7)**



*Figure 9: The table above shows 10 measurements taken at room temperature (in a different room) and shows that our data is quite reproducible.*

1. **ANALYSIS AND DISCUSSION**

None