Due: September 17, 2015 at 5:00pm.

INDIVIDUAL WORK ONLY!

Goal of assignment: The goal of this assignment is to understand the effect of quantization and resolution of the ADC relative to number of bits.

Lab Component:

1. Configure the signal generator to output a waveform with the following properties:
   Voltage Amplitude: 1.24 volts rms
   Waveform shape: Sine wave
   Frequency: 356 Hz.

2. Capture the signal from the signal generator on both the Oscilloscope directly the NI system. Use the appropriate sampling parameters such that you characterize the shape of the waveform and have no under or over range issues on either acquisition system.

3. Reduce the amplitude of the signal until you can no longer identify it in the noise floor, in either the time or the frequency domains. Increase the amplitude just enough to identify it. Can you identify a smaller signal in the time or the frequency domain?

4. What is the difference between the largest and smallest signals you can acquire on both the Oscilloscope and the NI system with the same range? Which has a greater signal to noise ratio?

Matlab Component:

5. Generate both the x-axis (time), and the y-axis components of the signals described above in the Lab Component of this assignment in Matlab. Generate the signals at the same sample rate used in the Lab component.

   Generate a plot that displays the experimental data overlayed with the quantized version of the data generated in Matlab using a virtual ADC with 8, 12, and 24 bits with the same ranges used in the Lab component. Zoom to a level in the plot where any differences are apparent.

6. Repeat all portions of problem #5 with an ADC range of +/- 300 volts.

7. Repeat all portions of problem #5 with an ADC range of +/- 0.75 volts.

8. Describe the effect of the number of bits and range used in the quantization process.

9. Are there differences between the experimental and analytically generated signals? Why? Discuss what was learned about the architecture and accuracy of the Oscilloscope, the NI system, and the other components of the experimental system.

Critical Thinking:

10. Given a signal described by the following parameters, describe the optimal sample rate, # of ADC bits, and ranges to acquire this data. Assume that your sample rate must be a power of 2 and that you must acquire at least 20 points/cycle. You have potential ranges of 100mv, 200mv, 500mv, 1v, 2.5v, and 5volts. Justify all of your decisions and show all work required to make these decisions.

    Compute the properties below based on your M-number
    Period of waveform: $2^{nd}5^{th}$ digit of your M-number in microseconds.
    Amplitude of waveform: ($2^{nd}6^{th}$ digits of your M-number)/100 gives volts-rms +0.25 volts-rms.

    Example: M-number = M35238516
    Period = 13 microseconds
    Amplitude = .12 volts-rms+0.25 volts-rms = 0.37 volts-rms

Deliverables:

Submit a report that describes the work you have completed along with answers to the questions. The text of your write-up should be **no more than three pages.** You **do not need to include all plots** which you generated in the report, only include plots necessary to support your discussion and conclusions. ***Please use the grammar and spell checker in your word processing program.***

Reports will be accepted only in the form of the posted template and submitted electronically in .pdf format. The grading rubric for this report is posted in the CANVAS page.

Hints:

Use “uencode” with “udecode” to simulate the ADC.