THE CITY COLLEGE OF NEW YORK
Department of Electrical Engineering

EE425 Computer Engineering Laboratory (1XB) – Summer 2016

Experiment 2 – Analog-to-Digital and Digital-to-Analog Conversions

Objective: This experiment is designed to exhibit some of the capabilities of the Analog-to-Digital (A/D) converter module of the PIC18F4520 and the Digital-to-Analog (D/A) converter module MAX232 .

Specific Tasks:

Part 1:

1. Connect the QwikFlash board so that a variable analog voltage can be sent to any of the available inputs of the A/D converter module. Input the analog voltage from a potentiometer.
2. Program the microcontroller so that it converts the analog input into a binary number.
3. Display the result of the conversion (8-bits) in the LCD screen.
4. Use a voltmeter to monitor the input voltage and compare it with the value shown in the LCD screen. Collect different voltage readings in order to calculate the error of the converter (to include in the report).

Part 2:

5. Change the code so that all the 10 bits produced by the A/D module are displayed in the LCD screen.
6. Use a voltmeter to monitor the input voltage and compare it with the value shown in the LCD screen. Collect different voltage readings in order to calculate the error of the converter (to include in the report).

Part 3:

7. Use the MAX232 IC on the QwikFlash board to convert the result of the A/D conversion (8 MSB) into an analog voltage.
8. Input an AC signal (sinusoid) into the A/D conversion and then convert it back to an analog signal through a D/A conversion. Display both the original input and the *processed* output signals in the oscilloscope.
9. Find out how fast you can sample in the A/D-D/A process before causing distortion to the output signal.
10. Find the Nyquist frequency, $f_{NYQUIST}$, of the process.
11. Sweep the frequency of the AC analog input signal (0 Hz → $f_{NYQUIST}$) and record observations. Save all important oscilloscope images and discuss them in the report.

There are three distinct phases for the A/D conversion:

1. The A/D converter module must be enabled.
2. If continuous scan is not enabled, the converter must receive a command to start.
3. Constantly monitor the module to determine when the conversion is complete (so that the result of the conversion can be displayed).

In general, the A/D process can be summarized as follows:

- Configure I/O pins.
- Select the channel to convert.
- Configure and enable the A/D converter module.
- Wait the required acquisition time.
- Initiate the conversion.
- Wait for the conversion to be completed.
- Send the result to your output device.

For the D/A conversion:

1. Establish the interface between the PIC18F4520 and the MAX232 IC.
2. Use the SPI interface to transfer the binary data and generate the analog input, as discussed in **Ch. 15 of the Textbook**.
3. Use one of the outputs of the MAX232 IC to generate the analog output signal.