THE CITY COLLEGE OF NEW YORK
Department of Electrical Engineering

EE425 Computer Engineering Laboratory – Spring 2020

Experiment 2 – Data Acquisition: Analog-to-Digital and Digital-to-Analog Conversions

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

Specific Tasks:

Part 1:

1. Program the microcontroller to perform an Analog-to-Digital (A/D) conversion, i.e., convert an analog input voltage into a **10-bit** binary number.
2. Use the voltage from a potentiometer as the analog input voltage and connect it to any of the available inputs of the A/D converter module.
3. Display the result of the A/D conversion (10-bits) on the LCD screen.
4. Use the voltmeter to monitor the input voltage from the potentiometer and compare it to the value shown on the LCD screen. Collect different voltage readings in order to calculate the error of the converter (to include in the report).

Part 2:

1. Configure the D/A module on the QwikFlash board to perform a Digital-to-Analog (D/A) conversion, i.e., convert an **8-bit** binary number into an analog output voltage.
2. Set the function generator as follows:
    a. High Z mode.
    b. 5 Vpp sine wave with a 2.5 V offset.
3. Instead of using an analog voltage from a potentiometer, input the AC signal from step 2 to the A/D conversion and then convert it back to an analog signal using a D/A conversion. Display both the original input and the *recovered* output signals on the oscilloscope.
4. Find out how fast you can sample in the A/D-D/A process. (Must compare Figures 10-7 and 10-9 in the textbook to Table 26-25 in the PIC18F4520 datasheet.)
5. Find the Nyquist frequency, $f_{NYQUIST}$, of the process.
6. Sweep the frequency of the AC analog input signal from 1Hz to $f_{NYQUIST}$ and record your observations. Save all important oscilloscope images and discuss them in the report.

Guidelines:

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).
4. All relevant information is found in **Chapters 7 and 10 in the textbook** and **Ch. 19 in the PIC18F4520 datasheet**.

    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 D/A module located on the QwikFlash board.
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 D/A module to generate the analog output signal.