ME 461 Prelab #4
Fall 2016
Due at the start of class on 9/28/2016

Suggested Reading:

USCI, SPI Mode chapter in MSP430x2xx user's guide.
Texas Instruments TLV5606 datasheet.
Lab 4 manual.

1. You and your partner solder the DAC chip and its components along with the headphone jack and resistors to your board. Use the demo board as a guide.

2. List whether the following serial protocols are synchronous or asynchronous, full-duplex or half-duplex, and also list the number of wires required for each and the signals they carry: UART (e.g. RS-232), SPI (4-wire), and I^{2}C.

3. You will be interfacing your MSP430F2272 to a Texas Instruments TLV5606 DAC using a slightly modified SPI protocol. (The TLV5606's CS pin will always be enabled by connecting it directly to GND. The TLV5606 only receives data so the MSP430F2272's receive line will not be connected. A GPIO will be used to produce a pulse to generate the FS (Frame Sync) signal.) Draw the wiring diagram for the interface by labeling the relevant pins on each of the chips and drawing wires to connect them. You do not need to wire the OUT and REFIN pings but do wire the power and ground pins.

4. In the USCI_B serial port peripheral, what register accepts data to be sent (or transmitted) serially from the microcontroller? What register contains the data received? How wide (bits) are these registers? What action (to a register) triggers (starts) transmission of serial data from the F2272 in SPI master mode?

5. In general terms, when is the USCI TX interrupt service routine called in SPI master mode? When is the RX ISR called?

6. If you want the full-scale range of the TLV5606 DAC to be 0V-V$_{CC}$, what should you set the reference voltage to?

7. Suppose you set the TLV5606 reference voltage to 1.2V and you want the DAC to output 1.62V. What 10-bit value would you want to send to the DAC? Reading the TLV5606 data sheet you will find that the TLV5606 requires a 16 bit command sent to it to command a change in the output voltage of the DAC. (TLV5606 Datasheet Page 12) What would this 16

bit command be if 1.62V is desired and you want the DAC in "fast" mode? You may write your answer in binary or hexadecimal.

8. Put the following events associated with communicating to the TLV5606 in chronological order. You may use some events more than once or not at all.

   a. Fill UCB0TXBUF with most significant 8 bits of word
   b. Generate a high then low transition (high pulse) of the FS pin
   c. Format data to be sent to DAC and store in 16-bit variable
   d. RX interrupt is called
   e. Clear UCB0RXIFG
   f. TX interrupt is called
   g. Clear UCB0TXIFG
   h. Fill UCB0TXBUF with least significant 8 bits of word

9. Configure the F2272's USCI module for SPI communication with the TLV5606 DAC. You should determine the contents of the UCB0CTL0, UCB0CTL1, UCB0BR0, UCB0BR1, IE2, and IFG2 registers. Use a bit rate of 1MHz. Use the timing diagram (Page 6) in the TLV5606 datasheet to determine some of these settings. Write out the lines of C code that would accomplish the configuration in the proper order (pay attention to bits that are locked in certain configurations). Also, configure the appropriate pins on the microcontroller to output the SPI signals.

10. What is the Nyquist frequency of code sampling an ADC at a rate of 8KHz?