Embedded Systems Interfacing Assignment 10

Due: 24 November 2013

Problem 01: Design of an Amplifier

Consider the noninverting amplifier circuit given in Figure 1. The gain of the amplifier is

$$v_{out} = \left(1 + \frac{R_2}{R_1}\right) v_{in}.$$

Suppose it is desired to amplify a signal with a gain K where $1 \leq K \leq 3$. To do this the value of R_1 will be fixed. R_2 will be a digital potentiometer whose value may vary. The wiper settings of the digital potentiometer to be used, the $AD5161BRZ10-ND$, are controllable through either an SPI or an I^2C interface.

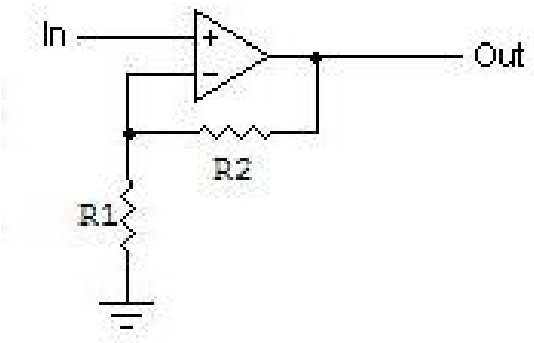

Figure 1: Noninverting Amplifier.

Looking at the data sheet, answer the following questions:

1. Determine the minimum and maximum values of resistance for the $AD5161BRZ10-ND$.

2. Determine the value of R_1 so the gain of the amplifer can range between 1 and 3.

3. Determine the pin numbers on the $AD5161BRZ10 - ND$ for the chip select, serial data out, serial data in, and the serial clock.

4. Determine the pin numbers on the $PIC24FJ128GA010$ for the chip select, serial data out, serial data in, and the serial clock for using the $SPI1$ module.

5. How many bits are used in each register swap?

6. Is the idle mode a high or low voltage? To what should CKP be set to communicate with this device?

7. Do bit transitions happen on an active-to-idle transition or an idle-to-active transition? To what should CKE be set to communicate with this device?

Problem 02: Potentiometer Library

Create functions that do the following:

1. *void initResistor*(*void*) - Create a function that initializes SPI module 1 using the number of bits, CKP, and CKE determined from the previous question. This function also ought to enable the SPI port and clear any prior status.

2. *int writeSPI1*(*int i*) - Create a function that sends one byte of data and receives one back at the same time.

3. *int setResistance*(*int N2*) - Create a function that send the value $N1$ to the potentiometer via the SPI port and returns the value of resistance, $R2$, that the potentiometer should have.

Problem 03: Serial Seven-Segment Display

The OpenSegment serial seven segment display (https://www.sparkfun.com/products/11644) is a device that will display up to four symbols of data (these symbols can have hexadecimal values). This serial display can be given data over the SPI, I^2C, and UART communications protocols. Find the datasheet for this device and determine the following:

1. Is the idle mode a high or low voltage? To what should CKP be set to communicate with this device?

2. Do bit transitions happen on an active-to-idle transition or an idle-to-active transition? To what should CKE be set to communicate with this device?

Create a function that does the following:

1. *void initSevenSeg(void)* - Create a function that initializes SPI module 1 using the number of bits, CKP, and CKE required for the serial seven-segent display. This function also ought to enable the SPI port and clear any prior status.

Write a *main* function that initializes the seven-segment display and in an endless loop clears the display, displays the hexadecimal characters $0x2d40$ on the display waits for a second, clears the display, displays the hexadecimal characters $0xd2bf$ on the display, and waits for a second. Use any functions that you have previously written to accomplish this task.