

CSCE 236 Embedded Systems, Spring 2012

Homework 4

Started: Tuesday, March 27, 2012
Due: Beginning of class Thursday, April 5, 2012

Instructions: This homework is an individual assignment, collaboration is not allowed. If you discuss any problems with others, please note this on the assignment as described in the syllabus. Also note any materials outside of lecture notes, course textbooks, and datasheets that you used. Show your work and describe your reasoning to get partial credit if your solution is incorrect. Unless otherwise specified, assume problems refer to the Arduino board we are using. This homework is due on the date listed above before the start of class.

Name:

Problem 1 (5pts). *(To be completed at end of assignment) Approximately how much time did the total assignment take? Which problem took longest and how much time did it take?*

Problem 2. *Analog to Digital Converters (ADC)*

a) (5pts). *On the Arduino, if the ADC reports a value of 914, what is the voltage on the ADC pin?*

b) (5pts). *Write the Arduino C code to setup and then read the analog value on pin A3. Assume the pin is initially in an unknown configuration.*

c) (5pts). *On a processor with a 12-bit ADC and a 3.3V reference voltage, what is the voltage resolution?*

d) (5pts). *What is the maximum number of conversions per second you can perform on the Atmel ADC with a 10MHz clock while still maintaining full accuracy? Explain your answer (hint, make sure to take into account the ADC prescaler).*

Problem 3. *Timers and PWM. For this problem assume a CPU frequency of 10MHz.*

a) (5pts). *Give the C code to configure the registers (e.g. TCCR0A) to set the 8-bit Timer0 in Fast PWM mode with a frequency as close to 1KHz as possible. Comment each line of code to indicate how you are configuring it. Remember to assume a 10MHz clock frequency.*

b) (5pts). *What is the actual frequency the timer will run at?*

c) (5pts). *If you used Timer1 instead, could you get closer to an actual frequency of 1KHz? Configure the registers for Timer1 for 1KHz and make sure to comment your code.*

d) (5pts). *What would the frequency be if you switched from Fast PWM to Phase Correct PWM mode without changing other settings?*

e) (5pts). *Describe the differences between Fast PWM and Phase Correct PWM mode and why you may want to use Phase Correct PWM in some circumstances. You may want to include a picture of the signals to help with your description.*

Problem 4. Interrupts

a) (5pts). Give the C code to configure the registers to generate an interrupt from `Timer0`. Also give function definition for the interrupt handler for this interrupt.

b) (5pts). What are the steps that occur to switch from executing the main code to executing an interrupt handler code when an interrupt occurs?

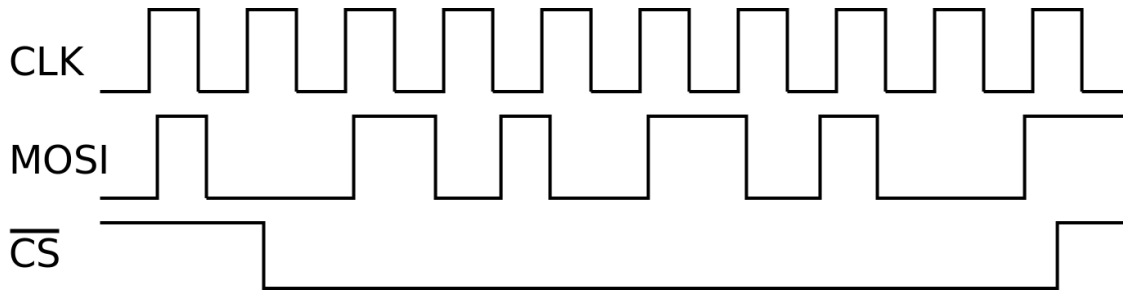
c) (5pts). If an interrupt requires 12 clock cycles to enter the interrupt handler, 28 clock cycles for the code to execute, and 10 to return to the prior code execution, then what is the maximum frequency that this interrupt can be handled?

d) (5pts). Describe two benefits of using interrupts in your code.

e) (5pts). Describe two problems and their causes that can occur when using interrupts in your code.

Problem 5. Communication

a) (5pts). What are two advantages of parallel communication over serial communication methods?



b) (5pts). In the above signal, what is the data stream (bit values) processed by the slave device if it is configured for data to be valid on the rising edge? What about for falling edge? Note that the \overline{CS} ("not CS") line means the device is active low, in other words it is selected when the line is low.

c) (5pts). Describe how SPI supports multiple slave devices.

d) (5pts). On an Arduino with a clock speed of 8MHz, what value does the serial port UBRR0 register need to be set to in order to communicate with a baud rate of 19200 when in normal speed mode? What is the error associated with this setting?

e) (5pts). In I²C, describe how arbitration works when there are multiple masters?

Do not forget to fill in the amount of time you spent on this assignment in Question 1.