Embedded Systems (CS 503/591C)
Homework 3

November 23, 2003

This homework assignment is due Thursday, December 4. Feel free to discuss this assignment with the TAs, the instructor, or your fellow students. But - the work that you hand in must be your own.

Question 1: Synchronous Serial Protocols

1. Explain in brief the role of the clock signal in synchronous serial protocols.
2. List the pros and cons of the SPI protocol over I2C (at least 2 each).
3. Assume a 16f876 master with no other components. How many devices can be addressed with SPI? (assume no daisy-chaining)
4. How many devices can be addressed with I2C?
5. T/F: In SPI, both the slave and master generate a clock signal.
6. Assume an SPI master connected to a daisy-chained set of slaves. How is the chip select line used relative to the clock and data signals?
7. T/F: In I2C, the data must be valid on the high-to-low transition.
8. Explain in brief how an I2C master can detect that it is colliding on the bus with another master.

9. In I2C, outline the sequence of operations that a master performs when sending a single-byte command to a slave and then receiving two response bytes from the slave.

Question 2: Semiconductors

1. What conditions must exist in order for electrons to move across a conductor or a semiconductor?

2. Explain in brief why a silicon crystal is an insulator.

3. Aluminum atoms have a valence of 3. What does this mean when aluminum is inserted as an impurity into a silicon crystal?

4. Define a depletion region. Why is it difficult for electrons to cross the depletion region?

5. Current flows through the transistor when the potential difference between the base and the emitter achieves a certain level. Explain this effect (in brief) in terms of the depletion region.

6. T/F: with PNP transistors, (non-trivial) current can only flow when the base voltage is less than the emitter voltage.

7. Give a simple implementation of an AND gate using only NPN transistors.

Question 3

How much time did you spend on this assignment?