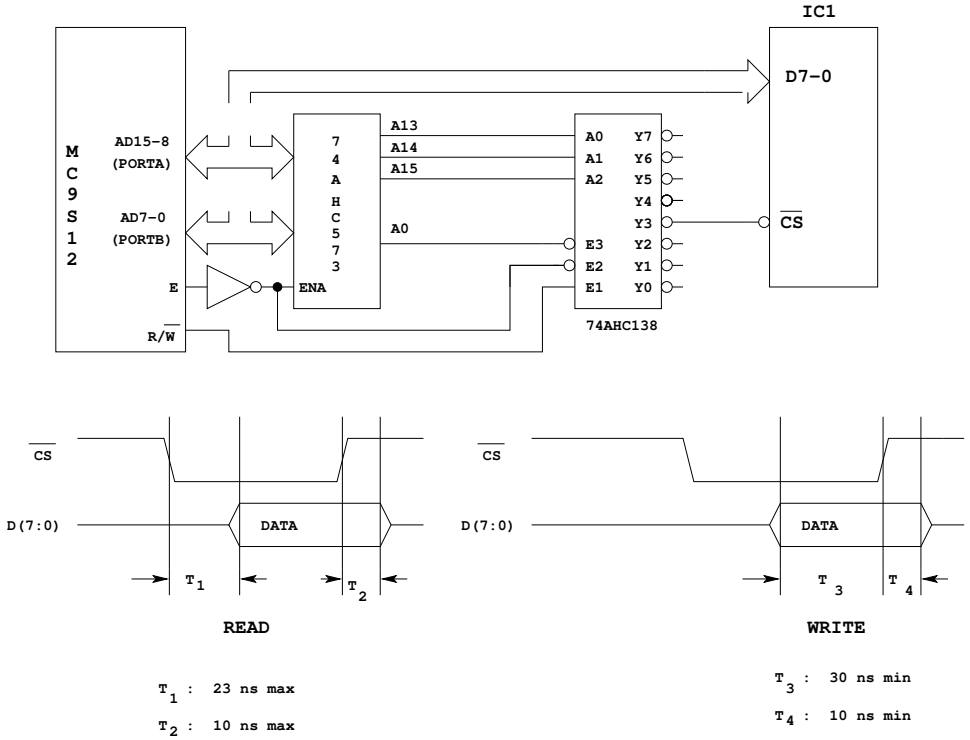
EE 308 – Homework 12

Due Apr. 19, 2010

For all problems below assume your are using a MCS12DP256 chip with a 24 MHz bus clock and a 8 MHz oscillator clock.

1. An engineer drew a quick sketch of an IC interfaced to the MC9S12. She accidentally spilled some coffee on the sketch, and some details were lost. On the same piece of paper she drew the timing diagram for an input IC and output IC. but forgot to label which diagram corresponds to IC1 interfaced to the MC9S12. The figure below shows her sketch:



   (a) Is IC1 an input or an output port? Explain.

   (b) Should the data lines of IC1 be connected to AD[15:8] (Port A) or AD[7:0] (Port B)? Explain.

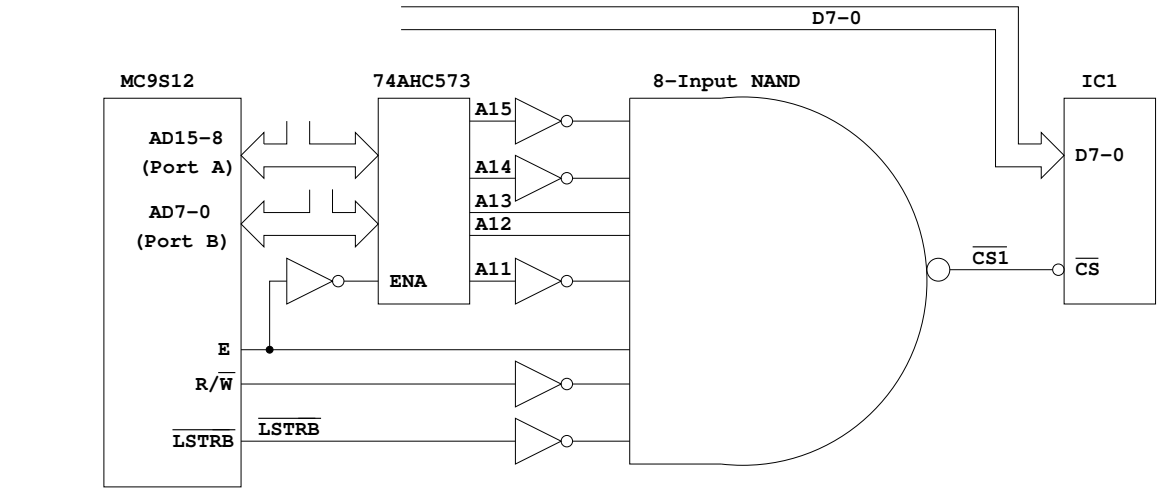
   (c) For what range of addresses will IC1 be selected? Explain.

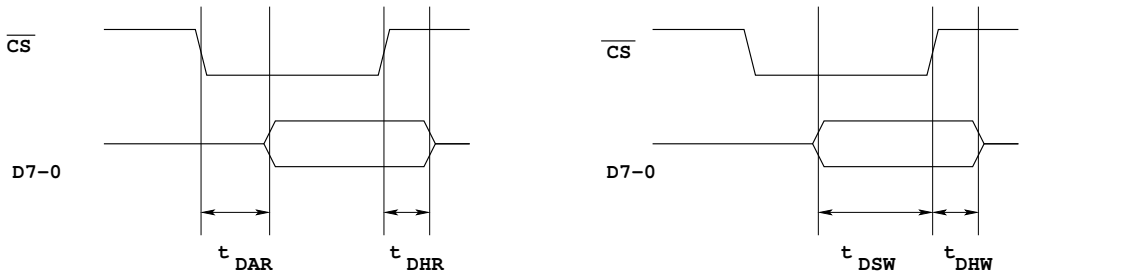
   (d) If IC1 is an input port, write some C code to read a byte of data from IC1 and save it in a variable called `data`. If IC1 is an output port, write some C code to write a 0x55 to IC1. (Do only one of these, based on your answer to Part (a).)

   (e) Is the timing of IC1 compatible with an MC9S12 with an 24 MHz E-clock, and no E-clock stretches? Explain. (Assume the propagation delays through each glue logic chip is 2 ns.)

   (f) Is the timing of IC1 compatible with an MC9S12 with an 24 MHz E-clock, and one E-clock stretch? Explain.

2. The figure below shows a peripheral chip connected to an MC9S12 using some standard CMOS logic chips. For this problem assume that the propagation delay through each CMOS logic chip is 2 ns.





(a) Will IC1 be an input device or an output device? Explain

(b) Should the data lines of IC1 be connected to AD[15:8] (Port A) or AD[7:0] (Port B) on the MC9S12? Explain.

(c) For what range of addresses will IC1 be selected?

(d) Sketch the signals on the E, R/$\overline{\text{W}}$, $\overline{\text{LSTRB}}$, $\overline{\text{CS1}}$ and D7 − 0 lines for the following actions:

- If IC1 is an input device, the MC9S12 reads from IC1, and IC1 returns an 0x55.
- If IC1 is an output device, the MC9S12 writes an 0xAA to IC1.

Note: Only do one of these, based on your answer to Part (a) above.

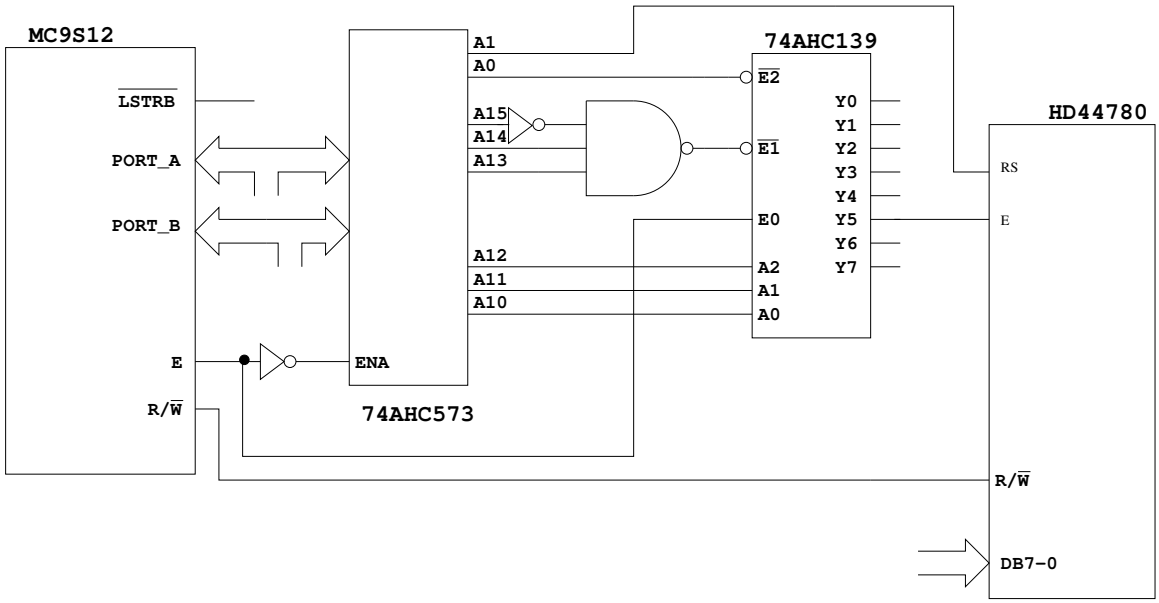
(e) Will the circuit shown work reliably with an MC9S12 running with an 24 MHz E-clock, and no E-clock stretches? Explain.

(f) Will the circuit shown work reliably with an MC9S12 running with an 24 MHz E-clock, and one E-clock stretch? Explain.

3. The Hitachi HD44780 is a chip to control LCD displays. The figure below shows a possible way to connect the HD44780 to an MC9S12.

   The HD44780 is enabled when its E input is high. (This is not the same as the E clock for the MC9S12.) The HD44780 has two internal registers, Register 0 and Register 1. The RS input to the HD44780 is a register select. If RS is low, Register 0 is selected. If RS is high, Register 1 is selected. R/$\overline{\text{W}}$ is the Read/Write line. If R/$\overline{\text{W}}$ is high, the chip is in read mode. R/$\overline{\text{W}}$ is low, the chip is in write mode.

   The 74AHC139 is the same as the 74AHC138, except the selected output is active high rather than low. That is, when the chip is not enabled, all eight outputs are low. When the chip is enabled, The output corresponding to A_2 A_1 A_0 is high, and the other seven outputs are low. The 74AHC573 is an eight-bit transparent latch. When ENA is high, the data inputs are transfered into the data outputs. When ENA goes low, the data doesn't change even if the data inputs change.



(a) For what range of addresses will the HD44780 be selected? Explain.

(b) Should the data lines of the HC44780 be connected to AD[15:8] (Port A) or AD[7:0] (Port B)? Explain.

(c) Explain how you can access Register 0, and how you can access Register 1.

(d) Write some C code which will write the 8-bit value 0xAA to Register 0.

(e) Write some C code which will read the 8-bit value from Register 1, and save it in a variable called `Reg_1`.

(f) The timing diagrams for the HC44780 chip are attached. Assume that the propagation delays through each glue logic chip is 2 ns. Is the time t_{AS} on the HC44780 data sheet compatible with an MC9S12 with a 24 MHz bus clock, and no E-clock stretches? If the time is not compatible, can you make it compatible by changing the bus clock frequency or adding E-clock stretches? Explain.

(g) Is the time t_{DSW} on the HC44780 data sheet compatible with an MC9S12 with a 24 MHz bus clock, and no E-clock stretches? If the time is not compatible, can you make it compatible by changing the bus clock frequency or adding E-clock stretches? Explain.

4. The Lecture Notes for April 14 gave some MATLAB code which simulated the closed-loop integral control of a motor. The motor characteristics in the Notes were different than those of the motor you will use in the lab. Redo the simulation using characteristics which are closer to the motor you will use. Use the results from Part 1 of Lab 4 for the slope and y-intercept of the motor for final speed vs. duty cycle. Assume the time constant of the motor is about 100 ms. Use the MATLAB simulation to find a value for k which gives a "good" response — i.e., a response where the motor gets to the final speed fairly quickly, but without more than about 10% overshoot.