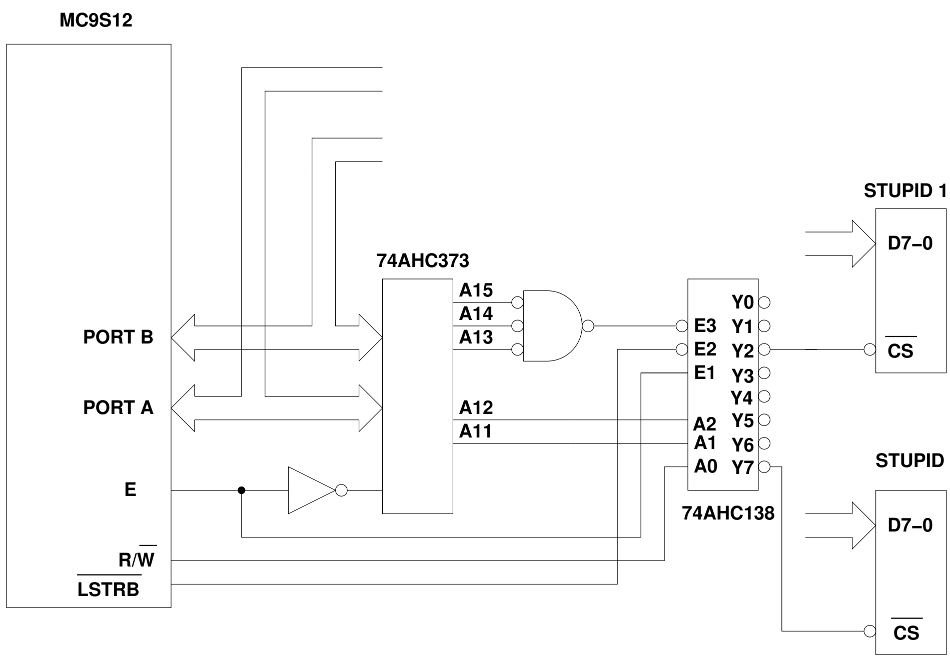
EE 308 – Homework 12

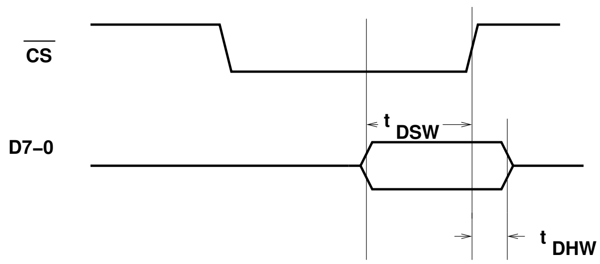
Due Apr. 20, 2009

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

1. A new startup company designs a series of peripheral chips they call the Super Terrific Universal Peripheral Interface Device (STUPID) chips. The figure below shows two STUPID chips connected to an HC12. One is an input chip, the other is an output chip. (The 74AHC374 is a D latch – it passes the inputs through to the outputs when ENA is high, and holds the outputs when ENA is low.) For the timing problems below, assume that the propagation delay through each of the glue logic chips is 4 ns.



STUPID OUTPUT BUS TIMING



t_{DSW} = 40 ns Min Data Setup Time, Write

t_{DHW} = 5 ns Min Data Hold Time, Write

(a) What range of addresses will select STUPID 1 chip? Is it an input chip or an output chip.

(b) Should `D7-0` of STUPID 1 be connected to Port A or Port B? Why?

(c) What range of addresses will select STUPID 2 chip? Is it an input chip or an output chip.

(d) Should `D7-0` of STUPID 2 be connected to Port A or Port B? Why?

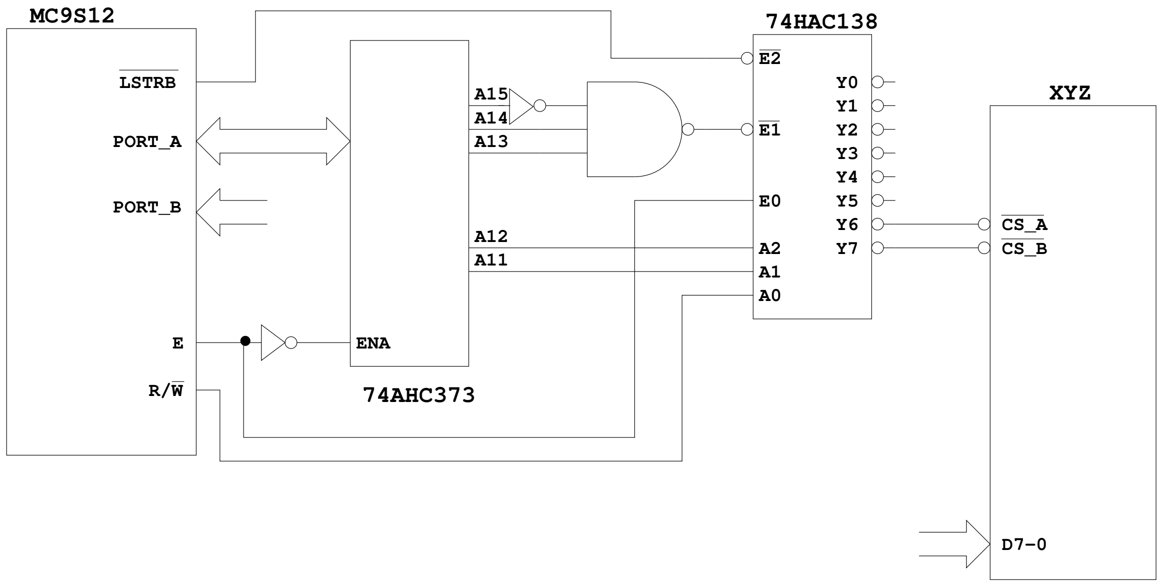
(e) Is $\mathtt{t_{DSW}}$ for the output chip compatible with the MC9S12 with a 24 MHz bus clock? Why or why not? What is the corresponding time for an MC9S12 with a 24 MHz bus clock?

(f) Is $\mathtt{t_{DHW}}$ for the output chip compatible with the 68HC12? Why or why not? What is the corresponding time for an MC9S12 with a 24 MHz bus clock2?

(g) Explain in words what $\mathtt{t_{DSW}}$ means.

(h) Write some C code to write an 0x55 to the output STUPID chip.

2. A MC9S12 is interfaced to a XYZ chip as shown below. Note that there are two different chip selects on the XYZ chip.



   (a) For what range of addresses will XYZ be selected?

   (b) What is the difference between $\overline{CS\_A}$ and $\overline{CS\_B}$? I.e., when will $\overline{CS\_A}$ be selected, and when will $\overline{CS\_B}$ be selected?

   (c) Should the data lines of XYZ be connected to Port A or Port B on the MC9S12? Why?

   (d) Write a C-language define which will allow you to access XYZ.

   `# define XYX`

   (e) Write a line of C code which will write the number `0xaa` to XYZ using your define from Part d.

3. Write some C code to convert the difference between two IC capture times into speed in RPM. Assume the timer prescaler is set as you had it in Lab 4, and that there are 15 pulses per revolution. You can use floating point numbers to do the calculation. If the two IC values are the same, set the motor speed to zero (since the motor has turned less than 1/15 of a revolution in the 8 ms).

4. The Lecture Notes for April 15 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.