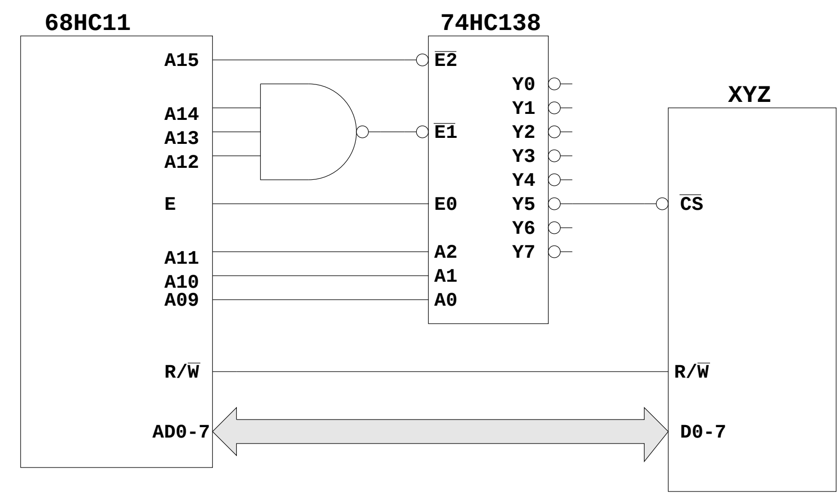
EE 308 - Exam 3

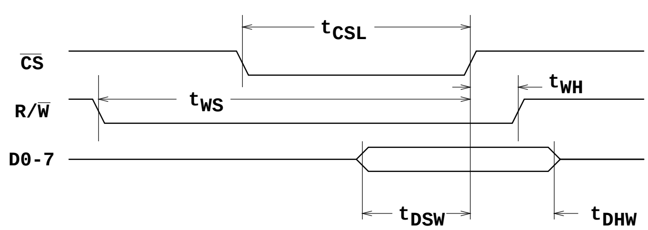
April 11, 1997

Name: ____

You may use any of the Motorola data books. No calculators allowed. Show all work. Partial credit will be given. No credit will be given if an answer appears with no supporting work.

1. A MC68HC11 with a 2 MHz E-clock is interfaced to a XYZ chip as shown below. Assume the propagation times through the 74HC138 are all 15 ns.





t_{CSL}	100 ns	Min
t_{WS}	300 ns	Min
t_{WH}	20 ns	Min
t_{DSW}	75 ns	Min
t_{DHW}	40 ns	Min

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

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

```
# define XYX
```

(c) Write a line of C code which will write the number `0xaa` to XYZ using your define from part b.

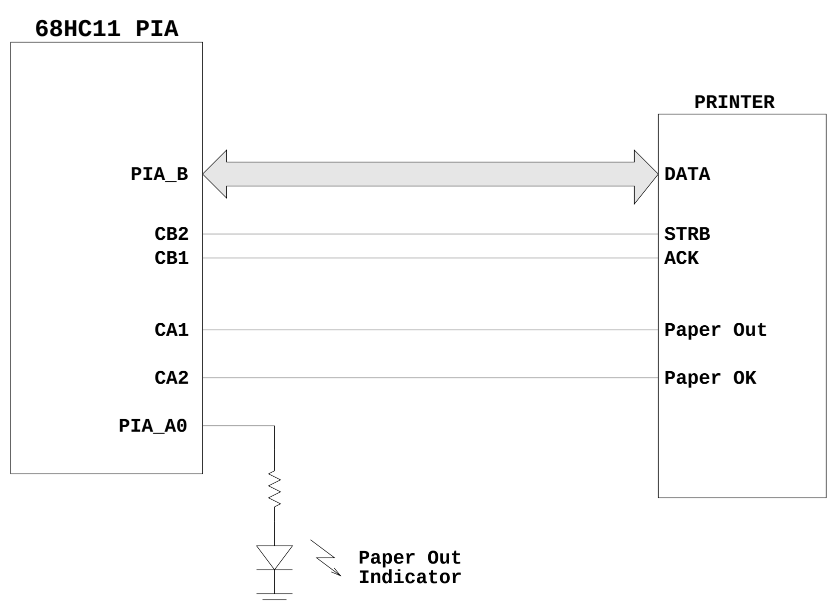
(d) Explain in words what t_{DSW} means. Will this parameter be met with the interface circuitry shown?

(e) Explain in words what t_{DHW} means. Will this parameter be met with the interface circuitry shown?

(f) Explain in words what t_{CSL} means. Will this parameter be met with the interface circuitry shown?

(g) Explain in words what t_{WS} means. Will this parameter be met with the interface circuitry shown?

2. An HC11 uses a 6821 PIA to send data to a printer. It uses PIA Port B to send the data, using interlock handshaking. It wants an interrupt on CB1 (active on falling edge) when the printer is ready for the next byte to print. It uses CA1 as an interrupt input (active on falling edge) so the printer can tell the HC11 that the printer is out of paper. It uses CA2 as an interrupt input (active on falling edge) so the printer can tell the HC11 when the paper has been replenished. It uses Bit 0 of PIA Port A to turn on an LED indicator to warn the operator when the printer is out of paper.



(a) Write some C code to set up PIA Port B as described above (Port B output, interlock handshaking, interrupt enabled on CB1).

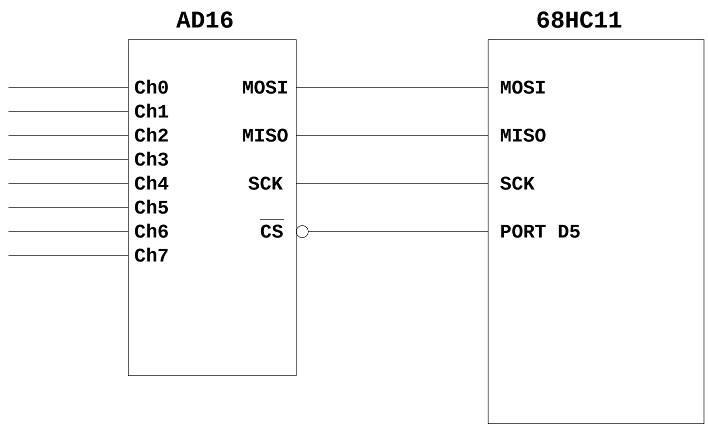
(b) How is the interrupt flag for CB1 cleared?

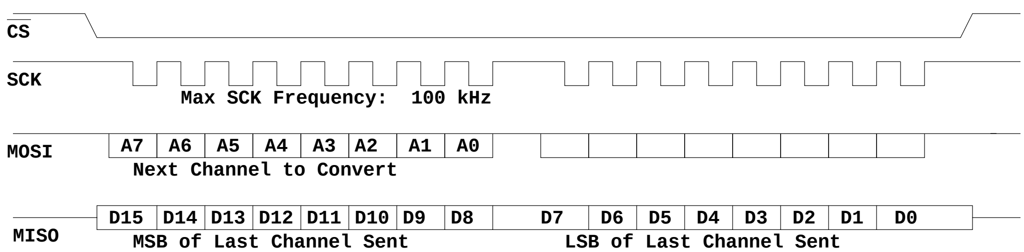
(c) Draw a simple timing diagram showing what is on PIA Port B, CB2, and CB1 when the HC11 sends the printer the byte `0xaa`, and the printer acknowledges that it has printed the byte.

(d) Write some C code to set up PIA Port A as described above (Port A Bit 0 an output, CA1 an input with interrupts enabled, CA2 an input with interrupts enabled).

(e) Write an interrupt service routine for CA2 which will write a 0 to Bit 0 of Port A to turn off the LED after the paper has been replenished.

3. An HC11 with a 2 MHz E-clock is connected to an AD16 A/D converter chip over the SPI bus. This chip will convert an analog voltage into a 16-bit digital number. The chip can convert the voltage on one of 8 inputs. To convert a channel, the HC11 must select the chip and write an eight-bit number telling the AD16 which of the eight input channels to convert next. The AD16 will send back to the HC11 the value of its last conversion. For example, to convert Channel 2, then Channel 3, the HC11 will select the AD16, send it a `0x02`, and deselect it. It will then select the AD16, send it a `0x03`, while reading 16 bits from the AD16. These 16 bits will be the digital value of the voltage on Channel 2.



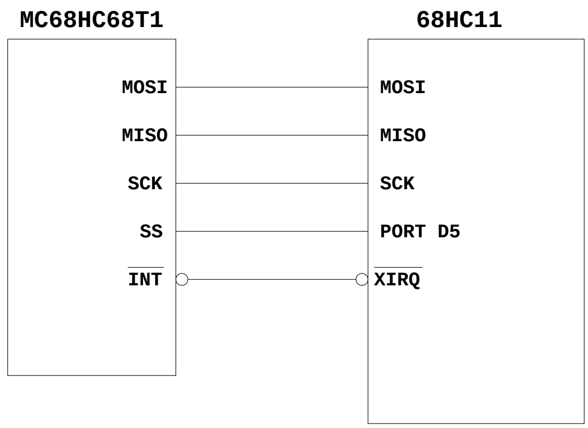


(a) Write some C code to set up the HC11 to talk to the AD16 over the SPI.

(b) Write some C code to tell the AD16 to convert Channel 7 next, and to read the result from the last conversion and assign it to a 16-bit integer called `ch6_val`.

(c) How do you clear the SPI Flag?

4. The following questions refer to the MC68HC68T1 Real Time Clock. Assume the RTC is connected to the 68HC11 as shown, and that the SPI is already set up correctly. The SPI uses a crystal frequency of 2.097152 MHz. You want the RTC to generate a periodic interrupt every 250 ms, and to generate a 2 Hz square wave on its CLKOUT pin.



(a) What do you need to write to the RTC to set it up as described above? Write some C code to do this.

(b) How do you clear the RTC interrupt flag? Write some C code to do this.