EE 308 Exam 3 May 6, 1999

Name:

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

For all the problems in this exam, assume you are using an HC12 with a 16 MHz crystal, resulting in a 8 MHz processor clock.

Also assume that hc12.h has been included, so you can refer any register in the HC12 by name rather than by address.

- 1. Signals from eight sensors are connected to bits 0 through 7 of Port AD of a 68HC12. The A/D reference voltages are $V_{RH} = 5$ V and $V_{RL} = 0$ V. You want to set up the A/D converter to convert all of these channels one time, then stop.
 - (a) How do you set up the A/D converter to do this? I.e., what values do you write to which registers?

(b) Write some C code which will do the conversions as described above.

- (c) How can you tell when the sequence of conversions is done?
- (d) After the conversion is done, the A/D result registers have the following values:

ADROH	ADR1H	ADR2H	ADR3H	ADR4H	ADR5H	ADR6H	ADR7H
05	F7	6A	42	C2	A5	71	39

What is voltage on bit 6 of Port A/D?

- LCD ss PP4 MISO MOSI DIN SCK SCK н C GP2D 1 2 DOUT SCK PP5 SS
- 2. A 68HC12 is being used to communicate with two devices over the SPI. The devices are connected as shown below:

Each byte you write to the LCD chip is displayed on an LCD display. The following shows how to write to the LCD chip over the SPI:



Maximum SCK = 500 kHz

The GP2D device is a distance sensor. When the HC12 reads from the GP2D chip, the GP2D sends it a byte which tells it how far it is from an object (such as a wall). The GP2D sends a 0x00 when it is almost touching the object. It sends a 0xFF when it is 2 feet (or more) from the object. The following shows how to read from the GP2D chip over the SPI:



(a) How do you set up the HC12 to communicate with the LCD and the GP2D? Explain what values you need to write to which registers.

(b) Write some C code to set up the HC12 to communicate with the LCD chip and the GP2D chip.

(c) Write some C code to read the distance from the GP2D. Make sure the LCD chip is deselected while you are doing this.

(d) Explain how the SPIF (SPI Flag) is set. Also, explain how to clear this flag..

3. An HC12 is connected to a peripheral chip as shown:



(a) Explain the purpose of the 74AHC374 chip.

- (b) Explain the purpose of the 74AHC138 chip.
- (c) For what range of addresses will the Super Chip be selected?
- (d) Is the Super Chip an input or output chip? How can you tell?
- (e) If the Super Chip is an input chip write some C code which will read a byte of data from the chip and store it in a variable called data. If the Super Chip is an output chip write some C code which will write a 0xa5 to it.
- (f) On the above figure two timing diagrams are shown. Only one of them applies to the Super Chip – the upper one if the Super Chip is an output device; the lower one if the Super Chip is an input device. Consider the relevant diagram from your answer to the previous part. Based on the timing diagram is the Super Chip compatible with the HC12? Explain in detail – draw a timing diagram which shows how the chip select is generated from the HC12 bus signals, and explain why the chip is or is not compatible based on the times in the figure above. Assume the propagation delays for the 74AHC374 and 74AHC138 chips are 10 ns.

- 4. The following problem deals with interrupts.
 - (a) How do you set up the IRQ interrupt to respond to a falling edge, and enable the IRQ interrupt? I.e., what values to you write to which registers?
 - (b) Explain the differences between the IRQ interrupt and the XIRQ interrupt.