

**Carleton University**  
**Department of Systems and Computer Engineering**  
**SYSC-2003 Assignment 1, Winter 2014**

Mark : \_\_\_\_\_ / 26

Name : \_\_\_\_\_ Number : \_\_\_\_\_

Print the assignment. Complete. Submit the paper in the locked boxes outside ME4499.

**Question 1** [11 marks] Technical Reading on the HC12

Read the board's documentation. The complete manual is in the Course Resources directory.

- Unzip 9S12DP256B-ZIP.zip
- Open the file [9S12DP256BDGV2.PDF](#).

Based on the information found in that manual, answer the following questions:

- a) [1 mark] What is the name of the manual?
- b) [1 mark] What chapter do you find the following topics in?
  - Interrupts
  - Analog-Digital Converters
  - Pulse-Width Modulation
- c) [2 marks] From the Device Memory Map, where is the RAM located and how much is there?
- d) [3 marks] From the HCS12 Core Block Description,
  - How many A/D converters are present?
  - How many Serial Communication Interface Channels are present?
  - How many Serial Peripheral Interface Channels are present?
- e) [4 marks] What signals are on Pin 1 on the MC9S12DP256? What does it mean to have Pin 57 associated with more than one signal? (How can more than one signal be on one pin?). On what pin is the signal non-maskable Interrupt (XIRQ)? What does it mean when a signal name is "barred" (Example: It is  $\overline{\text{XIRQ}}$ , not XIRQ)?

## Question 2 [15 marks] Technical Reading and Instruction Encoding

Using Appendix A in the textbook or the online resource [http://www.freescale.com/files/microcontrollers/doc/ref\\_manual/CPU12RG.pdf](http://www.freescale.com/files/microcontrollers/doc/ref_manual/CPU12RG.pdf) (Google: Freescale HC12 Instruction Set Reference), answer the following questions about instruction encoding.

- [2 marks] In the condition code register, what is the H flag called and what does it do?
- [3 marks] *opr<sub>x</sub>16* is a notation used in the Instruction Set Notation. What addressing mode(s) is it used in? Is the quantity that it represents signed or unsigned?
- [3 marks] Describe the effect of the ADCA instruction on the flags.
- [7 marks] For the program below, use the Instruction Set Reference to write the **machine instructions** corresponding to the given assembly instructions. For the *xb* byte, you will need Table 1.3 in the textbook or Table 2 online (Indexed Addressing Mode Summary)

The program itself is a basic exercise in big endian, writing the individual **bytes** \$1E and \$78 to memory addresses *n* and *n+1*, respectively, and then reading a **word** from address *n* into register Y. Because we want to run this code with different addresses, you have used index addressing modes with register X holding the address *n*. Notice that X has not been initialized (yet).

<u>Assembly Instructions</u>	<u>Machine Instructions (You complete)</u>
LDAA # \$1E	
STAA 0, X	
LDAA # \$78	
STAA 1, X	
LDY 0, X	

- [0 mark] Start the simulator. Using the memory window, starting at address \$4000, “load your code” into memory by typing the numbers into the proper location. Then open the code window to verify your encoding is correct: You should see the exact same instructions as above at address \$4000.
- [1 mark] **Set PC=\$4000 and X to \$800.** Set the memory window to display address \$800. **Step** through your code (do NOT run). Upon completion, what is the content of register Y?

- g) [1 mark] What are the contents of address \$800 and \$801 ? Notice the big endian format.

\$800 =

\$801 =

- h) [3 marks] Reset the simulator (File->Reset). Are the data still there (Click on the SHOW button to refresh the memory display)? Is the code still there? **Explain**.
- i) [2 marks] Repeat again (reset PC=\$4000) but **set X to \$1000**. Step through your code (do NOT run). What is the content of Y this time? **Explain** why the content of Y is different than in the first run (with X set to \$800).