Module Name: Microprocessor Systems Laboratory

Module Code: ELCE333

Laboratory Experiment No. 3

Pre-Lab Report

Experiment Title:

HCS12 Input and Output Ports

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Pre-Lab Questions:

1. List six of the Dragon12-Plus board features.

   <u>On-board hardware features:</u>

   The Dragon12-Plus board includes the following features:

   1. Dual RS232 communication ports
   2. RS485 communication port
   3. Four digit 7-segment LED display for learning multiplexing technique
   4. Eight LEDs
   5. Eight-position DIP switch
   6. Four push button switches

2. Open the ***mc9s12dg256.inc*** under your includes directory and list the port address of the Ports A,J,B and P

   ```
   PORTA:    equ  $00000000
   Vportj:   equ  $0000FFCE
   PORTB:    equ  $00000001
   Vportp:   equ  $0000FF8E
   ```

3. Consider the code given below, how many cycles (single step execution) will it take to execute this program? How long will this take on the Dragon Plus Trainer board?

```
      ldab #10
loop1: ldx  #1000
loop2: dex
       bne loop2

       decb

       bne loop1
```

DEX is a 1 cycle instruction

BNE is a 3 cycles instruction

The inner needs 4 cycles to be executed

The inner loop is repeated 10000 times until IX is equal to zero

The outer loop then begins with another 1 cycle instruction and 3 cycle instruction which leads again to the inner loop

Number of cycles in a single inner loop = [(1+3)*10000] + (1+3) = 40004 cycles

The outer loop must be repeated until the value of B reaches zero, which corresponds to 10 outer loops

Whole program is taking approximately= 40004*10 = 400040 cycles

Instruction Clock Cycle is 24MHz

The time this program takes to execute can be determined using the following formula:

$$\text{Delay } = \frac{1\text{cycle}}{24\text{MHz}} \times 400040 \text{ cycle} = \ 167 \text{ ms}$$