

EMBEDDED EXAM

SUMMER - 2010



Time: 10 Min

Embedded Systems Quiz

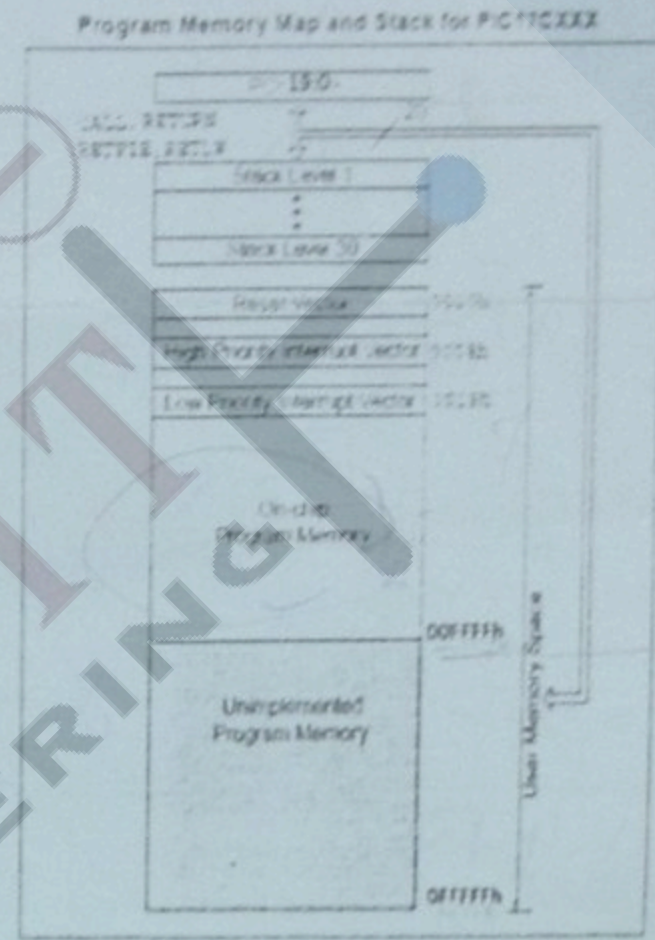
2/20 Date: 4-7-2010

الرقم الجامعي:

الاسم:

Q1) Study the following figure then answer the questions:

1. The size of program memory data bus is 14 bits
 can't determined.
2. The size of program memory address bus is 13 bit
 20
3. The size of total memory on the figure is 8K
 2²⁰ = 1M
4. The microcontroller implemented memory size is 1K
 2¹⁶ = 64K
5. If a programmer made a 31 call instructions after each other then the stack will be empty
 nested or not.

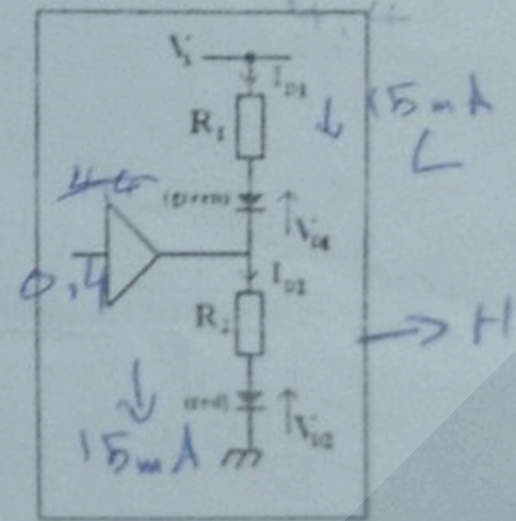


Q2) State if the following statement True or False then correct the False ones:

1. In the Intel microprocessors the program memory address bus is bidirectional.

2 False *data memory or unidirectional*

Q3) The following Figure shows the output logic for pin in the PIC16F84, when the output logic high the red LED emits light, and when the output logic low the green LED emits light. If: The supply voltage is 4.4V, the red LED requires 15mA drive current, green LED requires 15 mA. At these currents each LED has XV of forward voltage, at typical room temperature Calculate?



1. The Value of R1 if you know that R1=1.4R2
2. The Value of VD. 0.6V
3. If the PIC switched off what the new value of ID?

Handwritten calculations:

$$\frac{4.4 - V_{D1}}{15} = R_1$$

$$\frac{4.4 - V_{D2}}{15} = R_2$$

$$R_1 = 1.4 R_2$$

$$\frac{4.4 - V_{D1}}{15} = 1.4 \frac{4.4 - V_{D2}}{15}$$

$$4.4 - V_{D1} = 1.4(4.4 - V_{D2})$$

$$4.4 - V_{D1} = 6.16 - 1.4V_{D2}$$

$$-V_{D1} + 1.4V_{D2} = 1.76$$

$$1.4V_{D2} - V_{D1} = 1.76$$

$$V_{D1} = 1.4V_{D2} - 1.76$$

$$4.4 - (1.4V_{D2} - 1.76) = 1.4(4.4 - V_{D2})$$

$$4.4 - 1.4V_{D2} + 1.76 = 6.16 - 1.4V_{D2}$$

$$6.16 - 1.4V_{D2} = 6.16 - 1.4V_{D2}$$

$$0 = 0$$



25
30

(2009/2010)

Midterm Exam

Summer Semester

Section: 1 (8:00-9:00)

Student ID: [redacted]

Name: [redacted]

2 (10:20-11:20)

Answer All Questions

(10 Marks)

Q1) Fill in the blanks

- A) Describe briefly four different conditions or events in a PIC-based embedded system that can cause the microcontroller to be or go to a reset state?
 a) Watchdog timer overflow b) master clear pin resets (bring logic "0" to MCLR pin)
 c) Power up reset (at starting) d) Brown-out reset (voltage drop down) (< 1.5V)
- B) In PIC 16F84 the Special Function Registers (SFR) located in data memory are divided into:
 a) data instructions b) port situation (control) registers
 (TRISA, B, C --- => in bank 1)
- C) The disadvantages of software generated delays are:
 a) disable interrupts b) it will make the system busy (system can't make any instruction during delay)
- D) What is the effect of changing the system frequency on the operation and timing of the Watchdog timer? Explain briefly.
 there is no effect because WDT uses its own RC oscillator
- E) In an ISR, what is the reason for having the interrupt sources flags checked in a particular order?
 in order to know the actual source of the interrupt and to determine the flag which have to be cleared during ISR

Q2) Answer the following questions. (no info happens) (10 Marks)

- a) If Mul is a macro consist of five instructions then how many places will be reserve for the following segment of code in the program memory:

```
Mul 5
addwf PORTA, F
Mul 8
btfss PORTA, 0
```

~~is bit "0" in PORTA set (one)~~
~~13 places~~
~~is bit "0" in PORTA clear (Zero)~~
 12 places

- b) Show how a look-up table can be formed and what instructions can be used to transfer a look-up table element to an output port (say Port B of the PIC 16F84 microcontroller).

```
e.g.
movf num, w
call look
movwf PORTB

look
addwf PCL, f
retlw 00
retlw 01
retlw 02
!
```

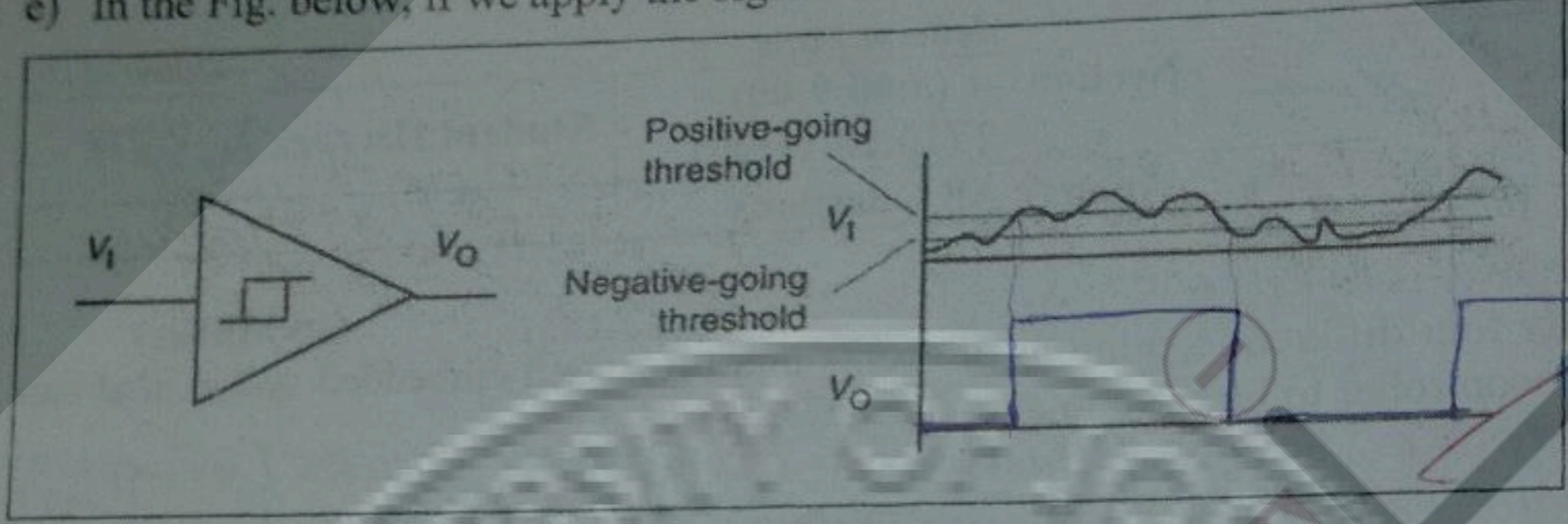
- c) The PIC 16F84 instructions that are related to the literal and control operations can be represented by either an OPCODE and 8-bit literal or an OPCODE and 11-bit literal. The difference between them is (are):

literal => (k) is 8 bit word (data) used as data
 control => (k) is 11 bit word (address) of the program memory
 PC = 13 bit = 11 bit from instruction + 2 bits
 call k

↳ to determine bank

d) The difference(s) between SFR and FSR registers of the PIC 16F84 microcontroller is (are):
 SFR = special function register registers in the DM have direct access to the input/output ports.
 FSR = is a register used in indirect addressing and it contains the address for the place to save data in.

e) In the Fig. below, if we apply the signal VI draw the wave form for VO we want to save data in.



6

Q3. Answer the following questions with reference to the PIC 16F84 program list given below. Assume that the microcontroller is running from a crystal clock frequency of 4 MHz.

- a) The program involves two programming errors. Identify these errors and make appropriate corrections directly on the program list. (2 marks)
- b) Write detailed comments on the instructions given in Box 1 (Use space given in Box 1 to answer this question) (1 mark)
- c) Identify the function accomplished by the code given in Box 2 (2 marks)
 tests the value of (number) if it equal (a) number will be cleared and then (return) from interrupt and not. just return without clear (number)

d) Calculate the interrupt latency for Port change interrupt (2 mark)
 $2 + 1 + 2 + 1 + 2 = 8 \text{ cycles}$
 $= 8 \times 1 \mu\text{s} = 8 \mu\text{s}$

e) Modify the code by adding instructions to have Timer0 overflow Interrupt with highest priority Identify these modifications directly on the program list. (3 marks)

INTCON REGISTER (ADDRESS 0Bh, 8Bh)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-x
GIE	EEIE	TOIE	INTE	RBIE	TDIF	INTF	RBIF
bit 7							bit 0

The Program List

```

;*****
#include <p16f84.inc>
;*****
cblock    0x20
    temp
endc number
;*****
ORG    0x00
GOTO  INITIAL -
;*****
ORG    0x04
NOP
CALL  ISR
;*****
INITIAL
    BSF    STATUS, RP0
    CLRF   TRISA
    MOVLW  B'11110001' ; set pins 0, 4, 5, 6, and 7 as input and
    MOVWF  TRISB       ; pins 1, 2, and 3 as output of PORTB
    BCF    STATUS, RP0
    CLRF   PORTB
    CLRF   PORTA
    BSF    INTCON, RBIE
    BSF    INTCON, INTE
    BSF    INTCON, GIE
    LOOP  GOTO  LOOP
;*****
ISR    number
    INCF   number, F
    BTFSC  INTCON, INTF
    goto   External
    BTFSC  INTCON, RBIF
    goto   Change
Change
    MOVF   PORTB, W
    ANDLW  b'11110000'
    SWAPF  temp, F
    MOVF   PORTB, W
    BCF    INTCON, RBIF
Exit   RETFIE
;*****
External
    CALL   Save
    GOTO   Exit
;*****
Save
    bcf    INTCON, INTF
    movf   number, W
    sublw  D'9'
    btfss  STATUS, Z
Finish RETURN
    clrf   number
    GOTO   Finish
;*****
end
;*****

```

*at interrupt no operation happend
nop should be deleted*

Box1

*set pins 0, 4, 5, 6, and 7 as input and
pins 1, 2, and 3 as output of PORTB*

BSF INTCON, TOIE

*undefined life register
we have to add number to
cblock directive
and we have to clear it*

*BTFSC INTCON, TOIF
goto timerZ*

*timerZ bcf INTCON, TOIF
goto Exit*

Box2

*w = 9 - w
if num = 9*