Microprocessor Lab-work #2.3

dot-matrix LEDs 100-11-14

[1] **Subject and goals**

(a) How to access every individual LED-dot for ON/OFF and color control when operating with the 16x16 tri-colored dot-matrix LED module.

(b) Coding capacity of organizing display patterns in static or dynamic form as required.

[2] **Preparations**

(a) **Refer to the ckt schematic diagram**:

(a.1) how the 16x16 LED module may operate (the inputs for column/row/color selection)?

(a.2) functions of TTLs 74138, 74244 and 74373?

(a.3) data path from 51CPU to the 16x16 LED modules?

(b) **Datasheets reading**:

(b.1) 74138 and 74373

(c) **Readiness evaluation:**

16x16 LED module physically consists of four 8x8 tri-colored dot-matrix LED components, interconnected in such a way that any of the 4 operating modes are allowed --

** operation on any single 8x8 LED component (one in four),

** operation on any two LED components in 8x16 dot format (i.e., selection between upper/lower half of the 16x16 module),

** operation on any two LED components in 16x8 dot format (i.e., selection between left/right half of the 16x16 module),

** operation on the entire module in 16x16 dot format.

Can you or can you not

(c.1) handle the jumper-wiring of the 16x16 LED module for any of the 4 operating modes?

(c.2) write the codes for any static/dynamic pattern display after step (c.1) is done?

(c.3) describe the operational limits of the 16x16 LED module imposed by the circuitry?

(c.4) check the discrete LED module to see if it's working or not by manual wiring the circuitry? (e.g., turn on an 8x1 or a 16x1 LED column in the left-half of the 16x16 module in RED manually? In Green? In Orange?)

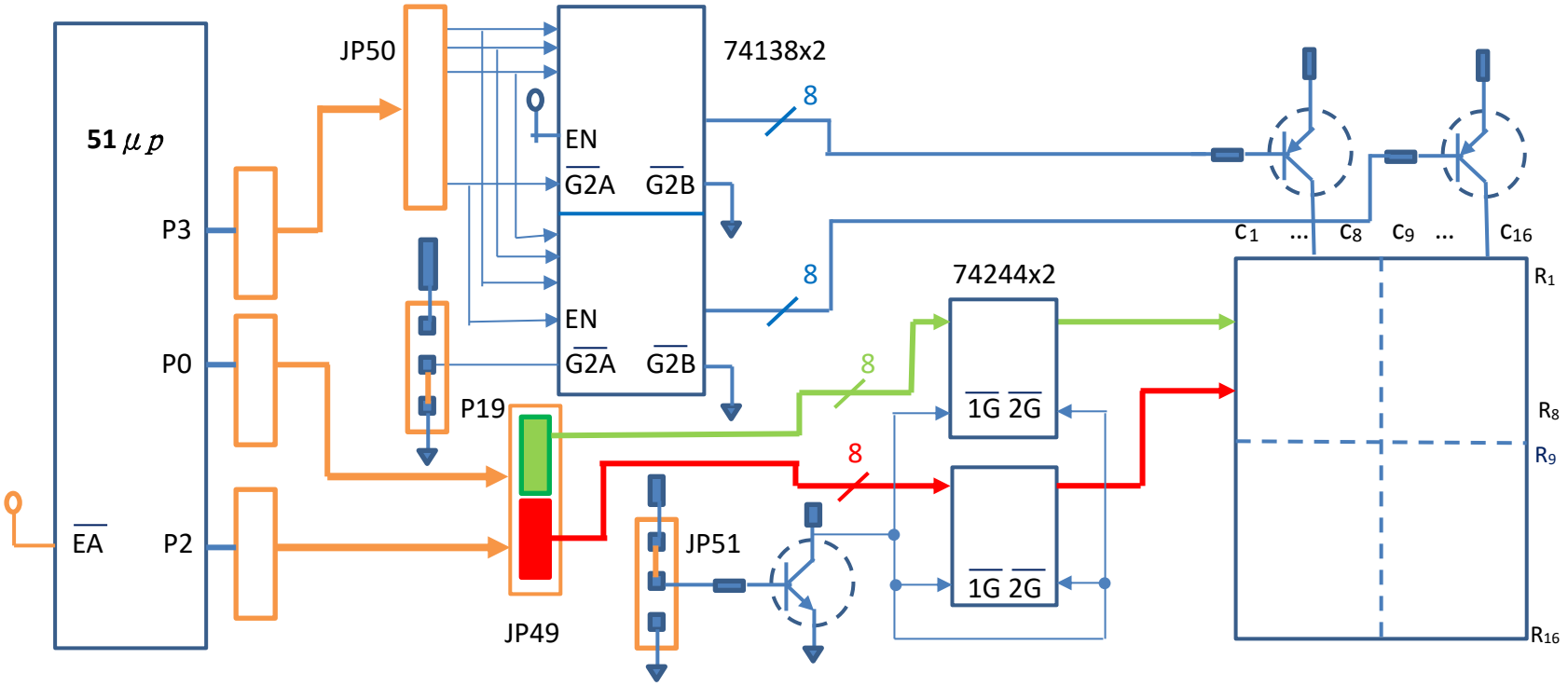
(c.5) do the same as in (c.4), but for the right-half of the 16x16 module?

[3] **Lab-exercise for all: simple demonstration on one single 8x8 LED component**

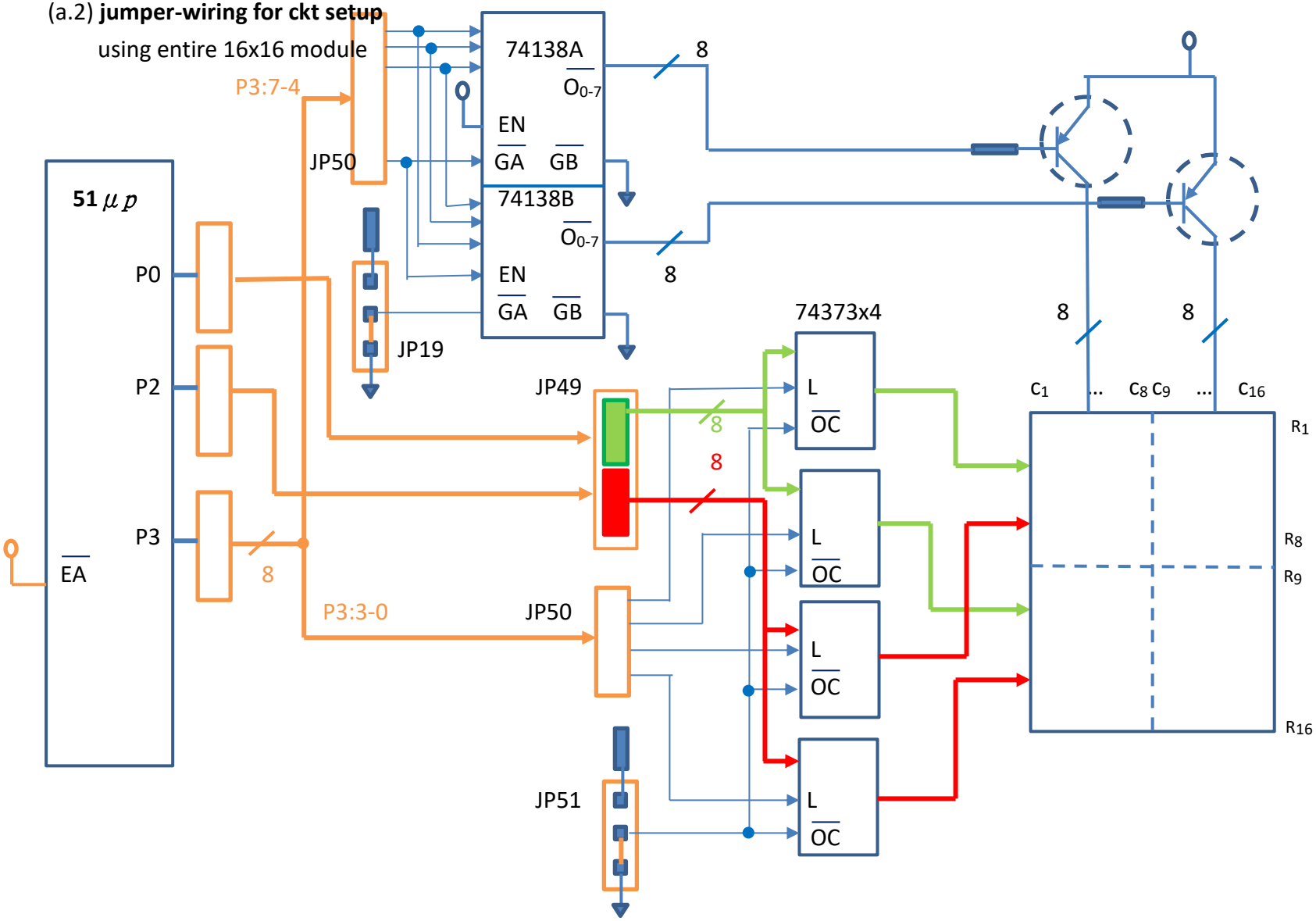
(a)**Operating Procedure**

(a.1) **jumper-wiring for ckt setup**

for using upper-half of 16x16 LED module (8*16 unit)



(a.2) **jumper-wiring for ckt setup**
using entire 16x16 module



(a.3) **code preparation**:

** edit the following sample 51 assembly codes

** get the code ready for execution under IDE51 emulator.

```
; the sample code is intended for displaying a decimal "2" on the upper-left 8x8 LED component in green, red and yellow color
; alternately, with the 16x16 LED module wired for the 16*16 operation as shown in (a.2) .
; the sample code guarantees neither syntax error free nor bug free; fix all errors encountered.
; code testing procedure (strongly recommended)
; (1) first run the green_2 loop alone, making sure that you see a "2" in green appear on the designated 8x8 LED
; (2) then run the red_2 loop alone to see what should appear.
; (3) finally run the entire code altogether.

; P0:    GREEN [why????]                          ;    P3[6] 138-2^2    P3[2]    Latch: Red for row1-8
; P2:    RED     [why????]                        ;    P3[5] 138-2^1    P3[1]    Latch: Green for row9-16
; P3[7] 138A-GA        P3[3]    Latch: Red for row9-16   ;    P3[4] 138-2^0    P3[0]    Latch: Green for row1-8
org     0
mov    SP, #50H                                          mov    P3, #0
mov    P3, #0                                    start:
;call delay                                              mov    R6, #250
mov    P0, #0FFH                                 green_2:
mov    P2, #0FFH                                         mov    P3, #0
mov    P3, #5H                                           mov    P0, #0H
```

```
        mov    A, #1H
        mov    P3, A
        call   delay          ; col1 done
        anl    P3, #0F0H      ; ==XXX==
        mov    P0, #7aH
        add    A, #10H
        mov    P3, A          ; A:= ???
        call   delay          ; col2 done

        mov    R7, #4
g2_loop:
        anl    P3, #0F0H      ; ==XXX==
        mov    P0, #4AH
        add    A, #10H
        mov    P3, A          ; A:= ???
        call   delay          ; col3-6 done in sequence
        djnz   R7, g2_loop

        anl    P3, #0F0H      ; ==XXX==
        mov    P0, #4EH
        add    A, #10H
        mov    P3, A
        call   delay          ; col7 done
        anl    P3, #0F0H      ; ==XXX==
        mov    P0, #0H
        add    A, #10H        ; A:= ???
        mov    P3, A
        call   delay          ; col8 done
        djnz   R6, green_2

        anl    P3, #0F0H      ; ==AA==
        mov    P0, #0FFH      ; ==AA==
        mov    P3, A          ; ==AA==
        call   delay

redd:
        mov    R6, #250
red_2:
        mov    P3, #0
        mov    P2, #0H
        mov    A, #4H
        mov    P3, A
        call   delay          ; col1 done
        anl    P3, #0F0H      ; ==XXX==
        mov    P2, #7AH
        add    A, #10H        ; A:= ???
```

```
        mov    P3, A
        call   delay            ; col2 done

        mov    R7, #4
r2_loop:
        anl    P3, #0F0H        ; ==XXX==
        mov    P2, #4AH
        add    A, #10H          ; A:= ???
        mov    P3, A
        call   delay            ; col3-6 done
        djnz   R7, r2_loop

        anl    P3, #0F0H        ; ==XXX==
        mov    P2, #4EH
        add    A, #10H          ; A:= ???
        mov    P3, A
        call   delay            ; col7 done
        anl    P3, #0F0H        ; ==XXX==
        mov    P2, #0H
        add    A, #10H          ; A:= ???
        mov    P3, A
        call   delay            ; col8 done
        djnz   R6, red_2
```

```
        anl    P3, #0F0H        ; ==BB==
        mov    P2, #0FFH        ; ==BB==
        mov    P3, A            ; ==BB==
        call   delay

        mov    R6, #250
yellow_2:
        mov    P0, #0H
        mov    P2, #0H
        mov    A, #5H
        mov    P3, A
        call   delay            ; col1 done
        anl    P3, #0F0H        ; ==XXX==
        mov    P0, #7AH
        mov    P2, #7AH
        add    A, #10H          ; A:= ???
        mov    P3, A
        call   delay            ; col2 done

        mov    R7, #4
y2_loop:
        anl    P3, #0F0H        ; ==XXX==
```

```
    mov    P0, #4AH
    mov    P2, #4AH
    add    A, #10H          ; A:= ???
    mov    P3, A
    call   delay            ; col3-6 done
    djnz   R7, y2_loop

    anl    P3, #0F0H        ; ==XXX==
    mov    P0, #4EH
    mov    P2, #4EH
    add    A, #10H          ; A:= ???
    mov    P3, A
    call   delay            ; col7 done
    anl    P3, #0F0H        ; ==XXX==
    mov    P0, #0H
    mov    P2, #0H
    add    A, #10H          ; A:= ???
    mov    P3, A
    call   delay            ; col8 done
    djnz   R6, yellow_2
    anl    P3, #0F0H        ; ==CC==
    mov    P0, #0FFH        ; ==CC==
    mov    P2, #0FFH        ; ==CC==
    mov    P3, A            ; ==CC==
    call   delay
    jmp    start

delay:  push   2
        push   3
        mov    R2, #2
dd1:    mov    R3, #250
        djnz   R3, $
        djnz   R2, dd1
        pop    3
        pop    2
        ret
        end
```

** The sample codes guarantee neither syntax err-free nor runtime err-free. Fix all syntax errs due to typo or whatever causes.

(a.4) **task execution:**

** **using ckt wiring for the 16x16 module operation as in (a.2)**

** start IDE51 emulation for the code prepared at (a.3)

** start trouble-shooting if necessary

(b) Observations

(b.1) Is the code running well? Why or why not?

(b.2) What may happen to the display if the instructions marked by **==AA==** being omitted? Why so?
And the omission of code lines marked by **==BB==**? And those by **==CC==**?

(b.3) Will the omission of the instruction marked by **==XXX==** cause any undesired effect to the display? Why so or why not so?

(b.4) Can you modify the code so as to make it shorter, quicker, in better code structure, or produce a more steady display?

(b.4) In which step(s) of the code, the 74138 handling the power for the right half of the 16x16 LED is shut down? What may be the side effect of this particular step?

(b.5) Using the circuit wiring to drive only the upper-half of the 16x16 module, as given in step [3](a.1), is it possible to run the same codes without any modification for the same display sequence on the upper-left 8x8 LED module?

[4] **Comprehension evaluation:**

(a) Is it possible to turn on simultaneously one row of LEDs on the upper-left 8x8 LED component? Why or why not?
What about simultaneously turning on one row of LED on any of the rest three 8x8 modules? The upper 8x16 module? The lower 8x16 module? The left 16x8 module? The right 16x8 module?

(b) Can you turn on one column of LEDs on the upper-left 8x8 component by wiring jumpers manually? How?

(c) Using exactly the same code, is it possible to get the decimal “2” displayed on the upper-right 8x8 LED by simply rewiring the jumpers? Why or why not?

[5] **Designated Assignment**

Let **k**=mod(ID, 3), where ID is the table # of yours in the laboratory. Please write a simple 51 assembly code to fulfill the assignment given in the question Q(**k**).

The coding requirements concern the driving of 16x16 dot-matrix LEDs on the ckt board, wired as in [3](a.2).

Q(0) Modify the codes so that the same display sequence appears on the upper-right 8x8 module.

Q(1) Modify the codes so that the same display sequence appears on the lower-left 8x8 module.

Q(2) Modify the codes so that the same display sequence appears on the lower-right 8x8 module.