Name: _____ Student ID: _____ Date: _____
Name: _____ Student ID: _____

Worksheet #10
Interfacing Output Devices

Objectives

- Understand the structure of GPIO in ARM processor
- Comprehend a technique for output devices interfacing
- Apply the C language to program GPIO in ARM processor

1. Connect LED1 and LED2 to port P0.29 and P0.30 of LPC2388 board as shown in Figure 10.1. (**Do not forget** to connect the ground terminal of LED with the ground terminal of the board).

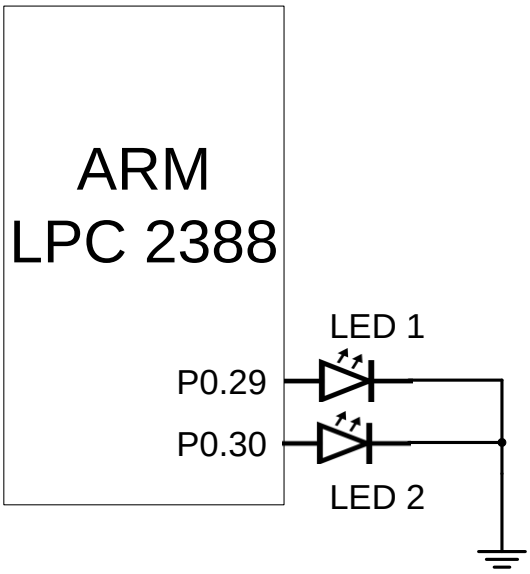


Figure 10.1

2. Create a new project and add **the startup file** to the project, then type and add the following code to the project.

```
#include <LPC23xx.h>

int  main(void) {
    unsigned int  P0_29 = (1 << 29);
    unsigned int  P0_30 = (1 << 30);
    int i;
    IODIR0 =  P0_29  |  P0_30;
    while(1) {
        IOSET0 = P0_29 | P0_30;
        for(i = 0; i < 10000; i++);
        IOCLR0 = P0_29 | P0_30;
        for(i = 0; i < 10000; i++)
    }
}
```

Program 10.1

3. Build the program in order to create a HEX file.
4. Connect a computer and the LPC2388 board using the USB-RS232 cable.
5. Transfer the program in HEX file format to the board using the Flash Magic program.
6. Observe the result and answer the following questions.

   What values are stored in these registers?
   P0_29 = (1 << 29) is equal to _____.(Base-2)
   P0_30 = (1 << 29) is equal to _____.(Base-2)
   IODIR0 = P0_29 | P0_30 is equal to _____.(Base-2)

   What does the program do?

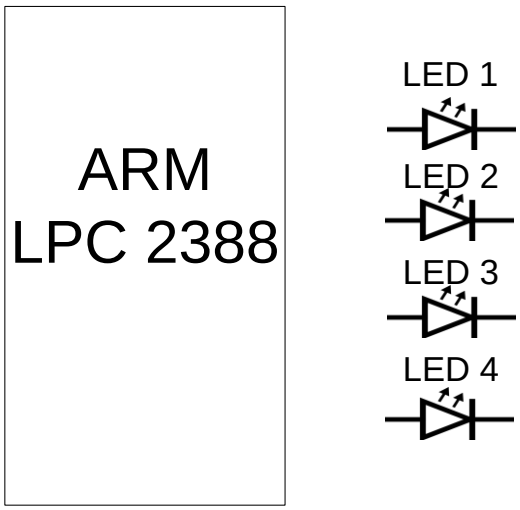
_____
_____
_____

7. Design a microprocessor circuit that connects 4 LEDs (LED1 – LED4). Then write a C program that turns on-off these 4 LEDs in turn as sequence shown below.

   "LED1" → "LED2" →"LED3" →"LED4" →"LED4" →"LED3" →"LED2" → "LED1" → "LED1" → "LED2" →"LED3" ….

   The program will turn on and off the LEDs as mentioned above over and over.

   Schematic diagram



Which port of microprocessor do you use to connect the LEDs?

_____

Program

8. Connect 7-SEG Display to port P1.24 to P1.31 of LPC2388 board as shown in Figure 10.2. (**Do not forget** to connect the common pin of 7-SEG with the ground terminal of the board).

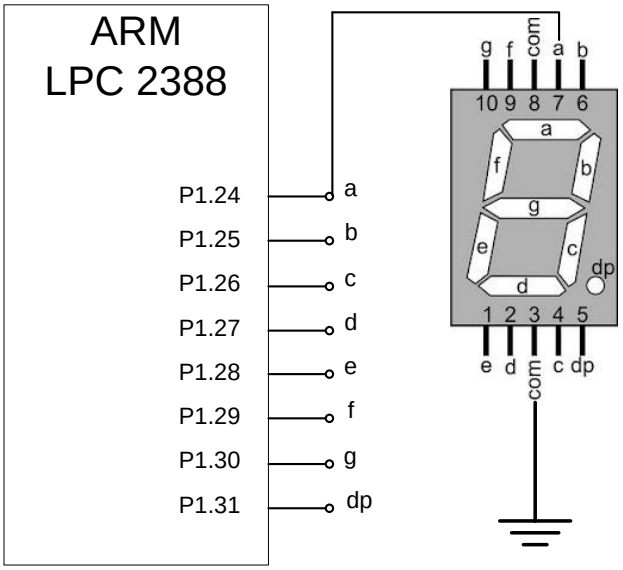


Figure 10.2

9. Create a new project and add **the startup file** to the project, then type and add the following code to the project.

```
#define “LPC23XX.h”

int  main(void)
{
        unsigned int  P1_24TO31 = 0xFF000000;

        IODIR1 =  P1_24TO31;

        IOCLR1 = P1_24TO31;

        IOSET1 = 0xFC000000;

        while(1);
}
```

Program 10.2

10. Build the program in order to create a HEX file.
11. Connect a computer and the LPC2388 board using the USB-RS232 cable.
12. Transfer the program in HEX file format to the board using the Flash Magic program.
13. Observe the result and answer the following questions.

If we want to display the character “8”, what lines of the program must we change?

_____

_____

If we change the port connected to 7-SEG from P1.24 – P1.31 to P1.16 – P1.23, what lines of the program must we change?

```
#define “LPC23XX.h”

int  main(void)
{
        _____

        _____

        _____

        _____

        while(1);
}
```

14. From Figure 10.2 replace Program 10.2 with the program shown below.

```
#define “LPC23XX.h”

int  main(void) {
     unsigned int  P1_24TO31 = 0xFF000000;
     int   num = 0;
     IODIR1 =  P1_24TO31;
     IOCLR1 = P1_24TO31;

     switch(num) {
       case 2 : IO1SET = 0xDA000000; break;
       case 4 : IO1SET = 0x66000000; break;
       case 6 : IO1SET = 0xBE0000000; break;
       case 8 : IO1SET = 0xFE000000; break;

     while(1);
}
```

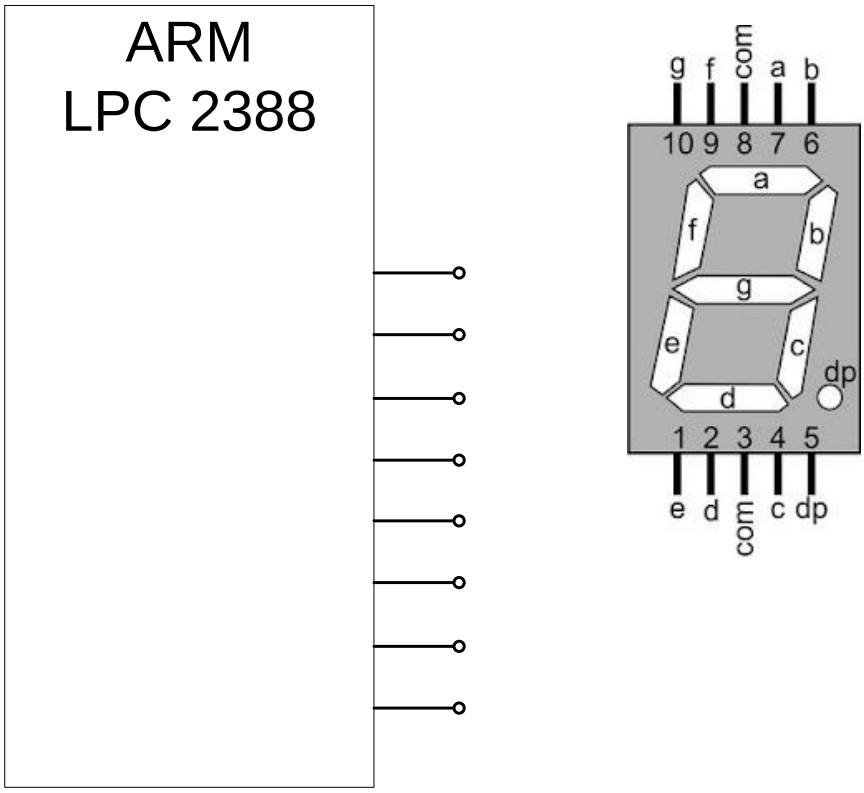
15. Build and Transfer the program in HEX file format to the board using the Flash Magic program.
16. Observe the result and answer the following questions.

    Modify the program above in order to display the characters “0” – “9”.

17. Design a microprocessor circuit that connects a 7-SEG to the microprocessor's port. Then write a C program that counts down the number from "9" to "0" and display the result to the 7-SEG.

    The program will display the number as mentioned above over and over.

    Schematic diagram



Which port of microprocessor do you use to connect the LEDs?

_____

Program

18. Given that a variable *x* in a C program is declared and initialized as follows:

unsigned int *x* = 0x13579bd0;.

Design a microprocessor circuit and **write a program** in C language that displays each digit in *x* in turn on a 7-SEGMENT display.