GROUP 31- LAB 3

Exercise 1

Write a C program to toggle an LED connected to pin 5 of PORTB register (PB5) every 2ms. Use TIMER0, normal mode, and a suitable pre-scalar to create the delay. Assume XTAL= 16 MHz. What is the selected pre-scaler? What is the initial counter value? Explain the output. What is the reason for it?

T_{XTAL} = 1/16 µs

Let's take the pre-scaler as 1:256

$T_{Counter\_clock}$ = 256/16 = 16 µs

Counter increment needed = 2000µs / 16µs = 125

Initial counter value = 1+255-125 = 131 = 0x83

The bulb is always on (Can't see the toggling)

This is due to the small delay length

Exercise 2

Try to increase the delay in Exercise 2 to 500ms. Talk to an instructor and explain how this can be done, or why this cannot be done.

Let's take the maximum pre-scaler value , 1:1024

T_{XTAL} = 1/16 µs

$T_{Counter\_clock}$ = 1024/16 = 64µs

If delay = 500ms ,

Counter increment needed = 500,000/64 = 7812.5 > 256

This exceeds the maximum value that counter can hold.

To increase the delay to 500ms using timer0, we can choose a less delay and do looping until the required delay achieved.

For that, lets take the delay as 2ms. (Loop = 250)

T_{XTAL} = 1/16µs

Pre-scaler = 1:256

$T_{Counter\_clock}$ = 256/16 = 16

Number of increments = 2000/16 = 125

Initial value = 1+255-125 = 131 = 0x83

Loop = 250

Exercise 3

Find out the highest possible countable time interval using TIMER0, normal mode, and a suitable pre-scalar. Assume XTAL= 16MHz. What is the selected prescaler? What is the highest countable time interval?

To find the highest possible countable time interval, let's take the highest scaler as the pre-scaler.(1:1024)

$T_{counter\_clock}$ = 1024 / 16 = 16µs

So, highest countable interval = 256*64 = 16384 µs = 16.384ms

Exercise4

Delay = 1s = 10^6µs

T_{XTAL} = 1/16µs

Pre-scaler = 1:256

$T_{Counter\_clock}$ = 256/16 = 16

Counter increment needed = 10^6/16 = 62500

Initial counter value = 1+65535 = 3036 = BDC

Exercise5

Delay = 100ms

Lets take delay = 4ms and loop =25

T_{XTAL} = 1/16µs

Pre-scaler = 1:256

$T_{Counter\_clock}$ = 256/16 = 16

Number of increments = 4000/16 = 250

Initial value = 1+255-250 = 6 =0x06

Exercise6

Delay 50ms by timer0

Let's take delay = 2ms (loop for 25 times)

T_{XTAL} = 1/16µs

Pre-scaler = 1:256

$T_{Counter\_clock}$ = 256/16 = 16

Number of increments needed = 2000/16 = 125

Initial timer reg value = 1+255-125 = 131 = 0x83

Delay 500ms by timer1

T_{XTAL} = 1/16µs

Pre-scaler = 1:256

$T_{Counter\_clock}$ = 256/16 = 16

Number of increments = $500*10^3/16$ = 31250

Initial value = 1+65535-31250 = 34286 = 0x85EE