AFEKA המכללה האקדמית להנדסה בתל-אביב
TEL-AVIV ACADEMIC COLLEGE OF ENGINEERING אפקה

הנדסת תוכנה
Software Engineering
מערכות משובצות מחשב (קורס מס' 10110_)

הרצאה מספר 6 א–מונה-TIMER

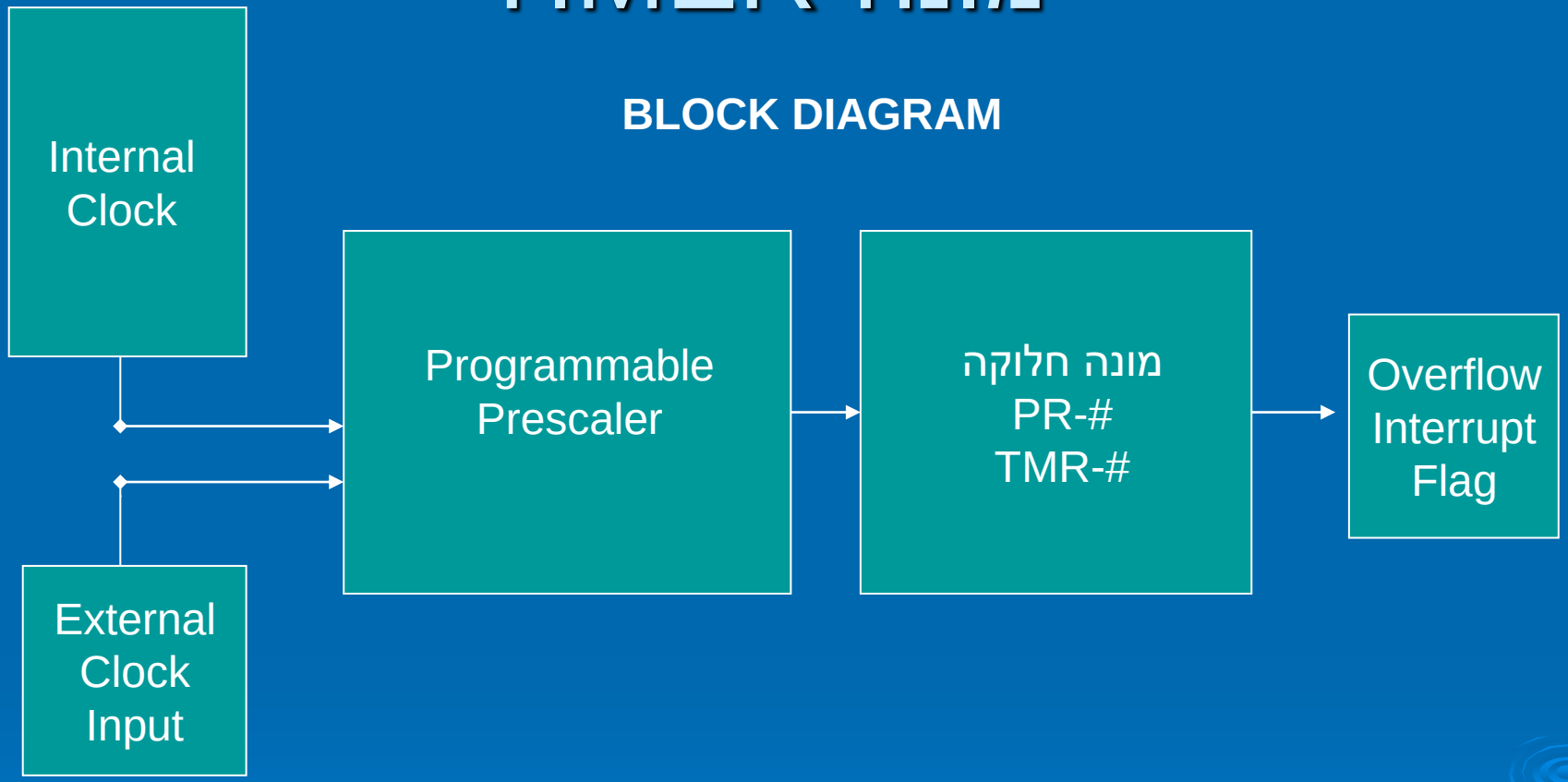
PIC32

בקורס מערכות משובצות מחשב

כתב: ד"ר מנחם אפשטיין

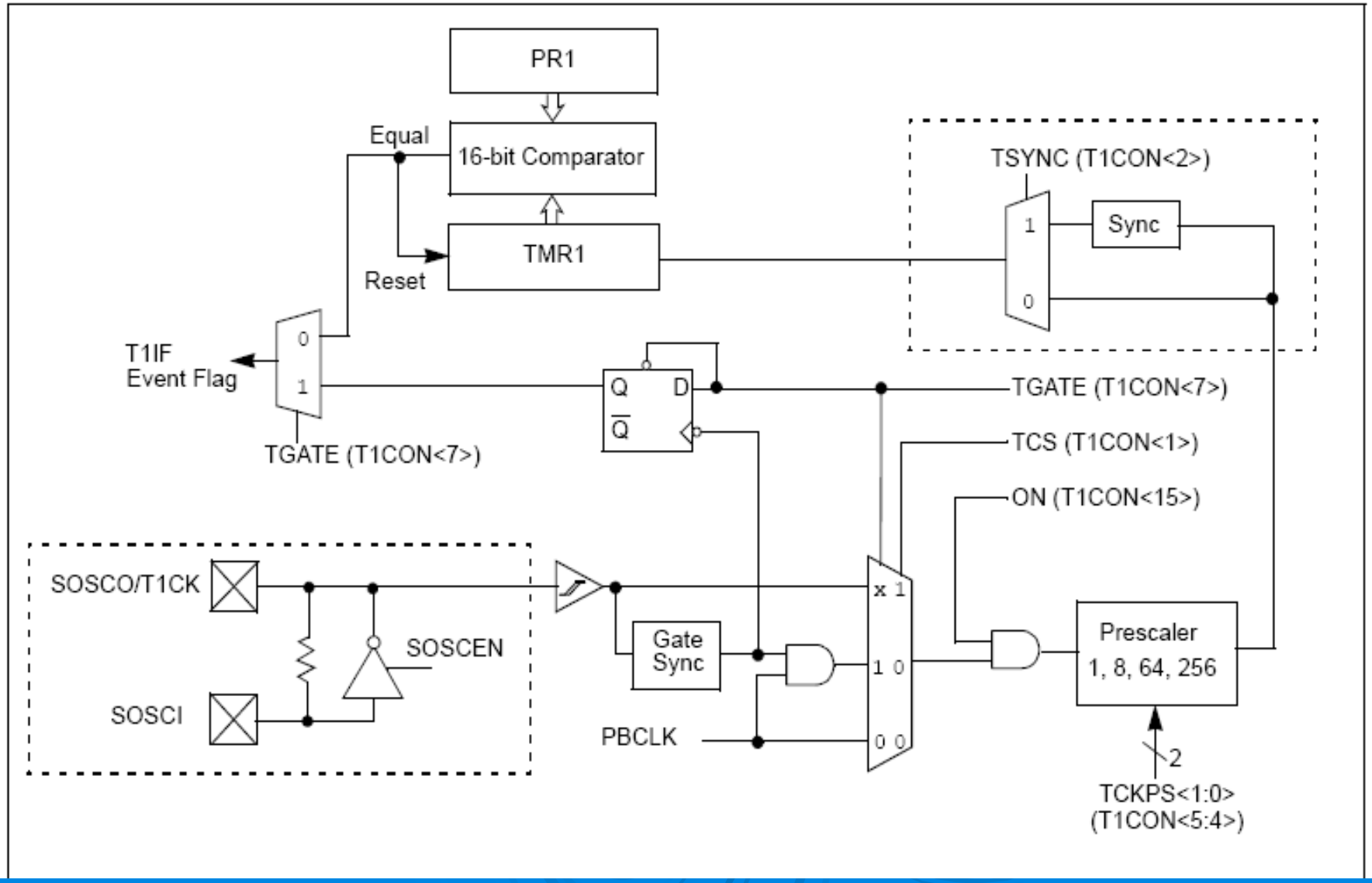
מונה-TIMER

BLOCK DIAGRAM



ערך : ד"ר מנחם אפשטיין

FIGURE 13-1: TIMER1 BLOCK DIAGRAM(1)



REGISTER 13-1: T1CON: TIMER1 CONTROL REGISTER

r-x	r-x	r-x	r-x	r-x	r-x	r-x	r-x
—	—	—	—	—	—	—	—
bit 31							bit 24

r-x	r-x	r-x	r-x	r-x	r-x	r-x	r-x
—	—	—	—	—	—	—	—
bit 23							bit 16

R/W-0	R/W-0	R/W-0	R/W-0	R-0	r-x	r-x	r-x
ON	FRZ	SIDL	TWDIS	TWIP	—	—	—
bit 15							bit 8

R/W-0	r-x	R/W-0	R/W-0	r-x	R/W-0	R/W-0	r-x
TGATE	—	TCKPS<1:0>		—	TSYNC	TCS	—
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	P = Programmable bit	r = Reserved bit
U = Unimplemented bit	-n = Bit Value at POR: (‘0’, ‘1’, x = Unknown)		

bit 31-16 **Reserved:** Write ‘0’; ignore read

bit 15 **ON:** Timer On bit
1 = Timer is enabled
0 = Timer is disabled

bit 14 **FRZ:** Freeze in Debug Exception Mode bit
1 = Freeze operation when CPU is in Debug Exception mode
0 = Continue operation when CPU is in Debug Exception mode
Note: FRZ is writable in Debug Exception mode only, it is forced to ‘0’ in normal mode.

bit 13 **SIDL:** Stop in Idle Mode bit
1 = Discontinue operation when device enters Idle mode
0 = Continue operation in Idle mode

bit 12 **TWDIS:** Asynchronous Timer Write Disable bit
In Asynchronous Timer mode:
1 = Writes to asynchronous TMR1 are ignored until pending write operation completes
0 = Back-to-back writes are enabled (legacy asynchronous timer functionality)
In Synchronous Timer mode:
This bit has no effect.

bit 11 **TWIP:** Asynchronous Timer Write in Progress bit
In Asynchronous Timer mode:
1 = Asynchronous write to TMR1 register in progress
0 = Asynchronous write to TMR1 register complete
In Synchronous Timer mode:
This bit is read as ‘0’.

bit 10-8 **Reserved:** Write ‘0’; ignore read

REGISTER 13-1: T1CON: TIMER1 CONTROL REGISTER (CONTINUED)

bit 7 **TGATE:** Gated Time Accumulation Enable bit

When TCS = 1:
This bit is ignored and read '0'.

When TCS = 0:
1 = Gated time accumulation is enabled
0 = Gated time accumulation is disabled

bit 6 **Reserved:** Write '0'; ignore read

bit 5-4 **TCKPS<1:0>:** Timer Input Clock prescaler Select bits

11 = 1:256 prescale value
10 = 1:64 prescale value
01 = 1:8 prescale value
00 = 1:1 prescale value

bit 3 **Reserved:** Write '0'; ignore read

bit 2 **TSYNC:** Timer External Clock Input Synchronization Selection bit

When TCS = 1:
1 = External clock input is synchronized
0 = External clock input is not synchronized

When TCS = 0:
This bit is ignored and read '0'.

bit 1 **TCS:** Timer Clock Source Select bit

1 = External clock from T1CKI pin
0 = Internal peripheral clock

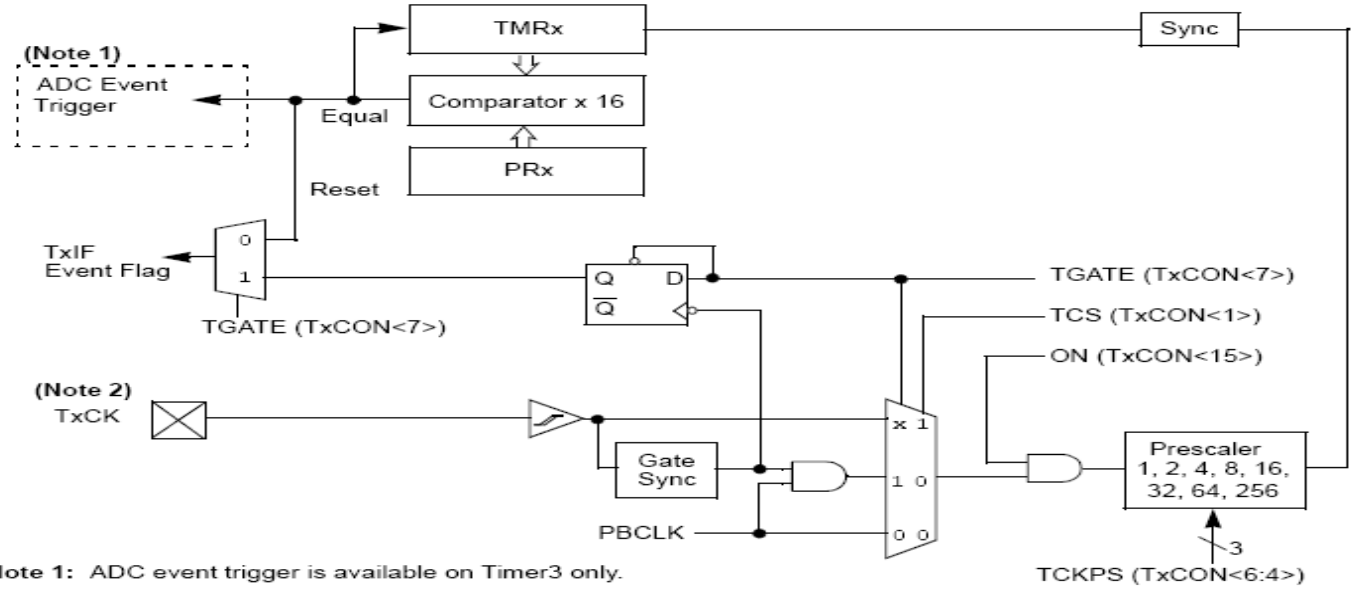
bit 0 **Reserved:** Write '0'; ignore read

```
#include <xc.h>
#pragma config JTAGEN = OFF
#pragma config FWDTEN = OFF
#pragma config FNOSC =          FRCPLL
#pragma config FSOSCEN =        OFF
#pragma config POSCMOD =        EC
#pragma config OSCIOFNC =       ON
#pragma config FPBDIV =     DIV_1
#pragma config FPLLIDIV =       DIV_2
#pragma config FPLLMUL =        MUL_20
#pragma config FPLLODIV =       DIV_1
void delay();
void main()
{ int j;
    TRISA &= 0xff00;
     while(1)
     {
    PORTA ++;
   // for(j=0;j<64000;j++);
    delay();
     }
}
```

הפעלת TIMER1 כמונה השהייה 16bit
(פעילות LEDS)

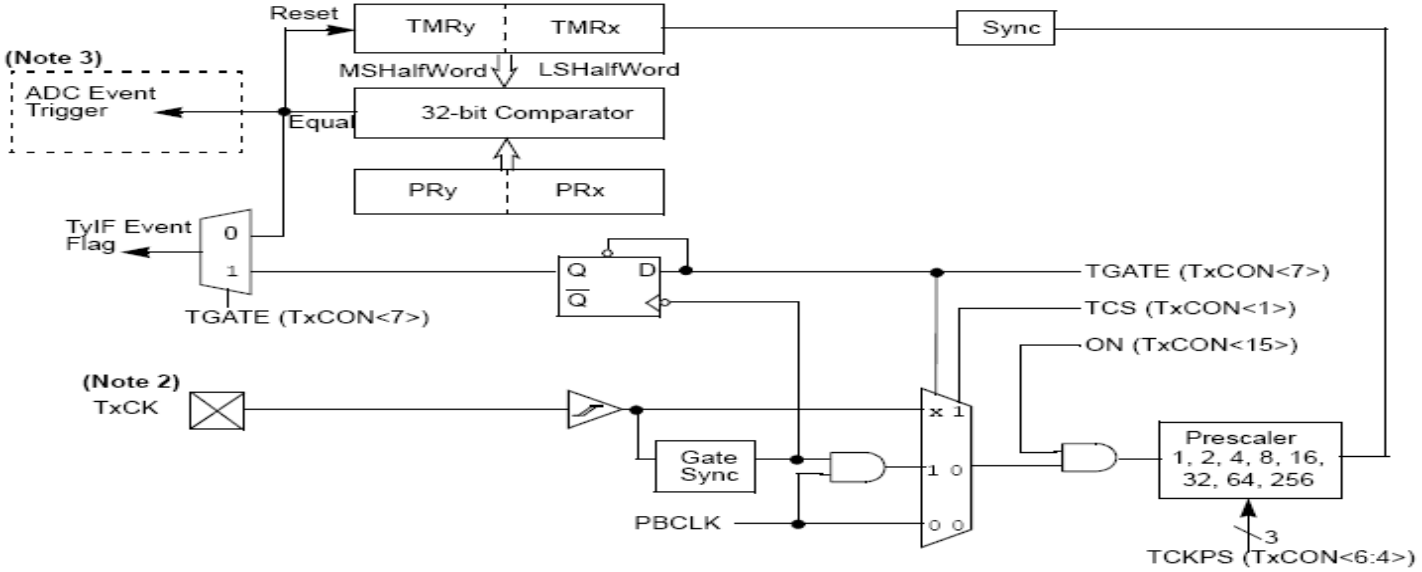
```
void delay(void)
        {
T1CONbits.ON=0;
T1CONbits.TGATE=0;
T1CONbits.TCS=1;//in clock
T1CONbits.TCKPS0=1;
T1CONbits.TCKPS1=1;
T1CONbits.TSYNC=1;
TMR1=0;
PR1=0X04FF;
T1CONbits.ON=1;
IFS0bits.T1IF=0;
while(!IFS0bits.T1IF);
      }
```

FIGURE 14-1: TIMER2, 3, 4, 5 BLOCK DIAGRAM (16-BIT)



Note 1: ADC event trigger is available on Timer3 only.
2: TxCK pins not available on 64-pin devices.

FIGURE 14-2: TIMER2/3, 4/5 BLOCK DIAGRAM (32-BIT)



Note 1: In this diagram, the use of "x' in registers TxCON, TMRx, PRx, TxCK refers to either Timer2 or Timer4; the use of 'y' in registers TyCON, TMRy, PRy, TyIF refers to either Timer3 or Timer5.
2: TxCK pins not available on 64-pin devices.
3: ADC event trigger is available only on Timer2/3 pair.

REGISTER 14-9: T2CON, T4CON: TIMER2 AND TIMER4 CONTROL REGISTER

r-x	r-x	r-x	r-x	r-x	r-x	r-x	r-x
—	—	—	—	—	—	—	—
bit 31							bit 24

r-x	r-x	r-x	r-x	r-x	r-x	r-x	r-x
—	—	—	—	—	—	—	—
bit 23							bit 16

R/W-0	R/W-0	R/W-0	r-x	r-x	r-x	r-x	r-x
ON	FRZ	SIDL	—	—	—	—	—
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	r-x	R/W-0	r-x
TGATE	TCKPS<2:0>			T32	—	TCS	—
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	P = Programmable bit	r = Reserved bit
U = Unimplemented bit	-n = Bit Value at POR: (‘0’, ‘1’, x = Unknown)		

bit 31-16 **Reserved:** Write ‘0’; ignore read

bit 15 **ON:** Timer On bit
1 = Timer is enabled
0 = Timer is disabled

bit 14 **FRZ:** Freeze in Debug Exception Mode bit
1 = Freeze operation when CPU is in Debug Exception mode
0 = Continue operation when CPU is in Debug Exception mode
Note: FRZ is writable in Debug Exception mode only, it is forced to ‘0’ in normal mode.

bit 13 **SIDL:** Stop in Idle Mode bit
1 = Discontinue operation when device enters Idle mode
0 = Continue operation in Idle mode

bit 12-8 **Reserved:** Write ‘0’; ignore read

bit 7 **TGATE:** Gated Time Accumulation Enable bit
When TCS = 1:
This bit is ignored and read ‘0’.
When TCS = 0:
1 = Gated time accumulation is enabled
0 = Gated time accumulation is disabled

bit 6-4 **TCKPS<2:0>:** Timer Input Clock prescaler Select bits
111 = 1:256 prescale value
110 = 1:64 prescale value
101 = 1:32 prescale value
100 = 1:16 prescale value
011 = 1:8 prescale value
010 = 1:4 prescale value
001 = 1:2 prescale value
000 = 1:1 prescale value

bit 3 **T32:** 32-bit Timer Mode Select bits
1 = TMRx and TMRy form a 32-bit timer
0 = TMRx and TMRy form separate 16-bit timers

bit 2 **Reserved:** Write ‘0’; ignore read

bit 1 **TCS:** Timer Clock Source Select bit
1 = External clock from TxCK pin
0 = Internal peripheral clock

bit 0 **Reserved:** Write ‘0’; ignore read

הפעלת TIMER23 כמונה השהייה 32bit

```
void delay(void)
      {
T2CONbits.ON=0;
T2CONbits.TGATE=0;
T2CONbits.TCS=0;
T2CONbits.T32=1;//mode 32bit
T2CONbits.TCKPS0=1;//256 חלוקה
T2CONbits.TCKPS1=1;
T2CONbits.TCKPS2=1;
T3CONbits.ON=0;
TMR3=0;//TMRy
TMR2=0;//TMRx
PR2=0X5000;//PR2x
PR3=0;//PR2y
T2CONbits.ON=1;//start timer
IFS0bits.T2IF=0;
IFS0bits.T3IF=0;//
while(!IFS0bits.T3IF);//timer stop
    }
```

Jio