



SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

19ECB211 – MICROCONTROLLER PROGRAMMING & INTERFACING

II YEAR IV SEM

UNIT II – PIC TIMER, SERIAL PORT AND INTERRUPT

TOPIC 4 – PIC Counters



Timer/Counter - Basics



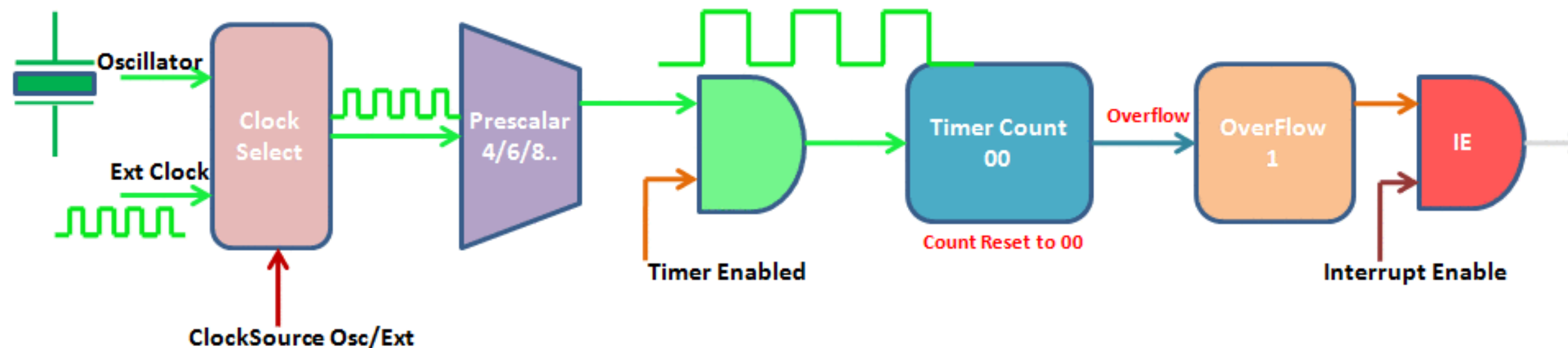
- As the name suggests these are used to measure the time or generate the accurate time delay.
- The microcontroller can also generate/measure the required time delays by running loops, but the timer/counter relieves the CPU from that redundant and repetitive task, allowing it to allocate maximum processing time for other tasks.





Timer/Counter - Basics

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PIC-Timer Module

- Pic16f877a has three independent timer which can be used as timer, Counters or for PWM generation.

Timer	Size	Control Register	Count Register	Min Delay	Max Delay
TIMER0	8-bit	OPTION_REG	TMR0	0.2usec	13.107ms
TIMER1	16-bit	T1CON	TMR1H,TMR1L	0.2usec	104.857ms
TIMER2	8-bit	T2CON	TMR2	0.2usec	819usec

Timer Calculation

PIC Oscillator frequency is divided by 4 and then fed to the controller,
Now this freq can be further divided by prescalar to generate the range of delays.
Time to increment the Timer count by one(timer tick) can be determined as below.

$$\text{tick} = (\text{Prescalar}/(\text{Fosc}/4))$$

$$\text{tick} = (\text{Prescalar}/(20\text{Mhz}/4))$$

$$\text{tick} = (\text{Prescalar} * 4)/\text{Fosc}$$



PIC-Timer

The TMR0 module is an 8-bit timer/counter with the following features:

- 8-bit timer/counter
- Readable and writable
- 8-bit software programmable prescaler
- Internal or external clock select
- Interrupt on overflow from FFh to 00h
- Edge select for external clock

Timer0 Registers

The below table shows the registers associated with PIC16f877A Timer0 module.

Register	Description
OPTION_REG	This registers is used to configure the TIMERO Prescalar, Clock Source etc
TMR0	This register holds the timer count value which will be incremented depending on prescalar configuration
INTCON	This register contains the Timer0 overflow flag(TMR0IF) and corresponding Inetrrupt Enable flag(TMR0IE).



PIC - Timer/Counter



OPTION_REG							
7	6	5	4	3	2	1	0
RBPU	INTEDG	TOCS	TOSE	PSA	PS2	PS1	PS0

RBPU: NA for Timers

INTEDG: NA for Timers

TOCS: TMR0 Clock Source Select bit

1-Transition on TOCKI pin

0-Internal instruction cycle clock (CLKO)

TOSE: TMR0 Source Edge Select bit

1-Increment on high-to-low transition on TOCKI pin

0-Increment on low-to-high transition on TOCKI pin

PSA: Prescaler Assignment bit

1-Prescaler is assigned to the WDT

0-Prescaler is assigned to the Timer0

PS2:PS0: Prescaler Rate Select bits

Bit Value	TMR0 Rate	WDT Rate
000	1 : 2	1 : 1
001	1 : 4	1 : 2
010	1 : 8	1 : 4
011	1 : 16	1 : 8
100	1 : 32	1 : 16
101	1 : 64	1 : 32
110	1 : 128	1 : 64
111	1 : 256	1 : 128



PIC -Timers/Counters



INTCON							
7	6	5	4	3	2	1	0
GIE	PIE	TMROIE	INTE	RBIE	TMROIF	INTF	RBIF

GIE: Global Interrupt Enable bit

1-Enables all unmasked interrupts

0-Disables all interrupts

PIE: Peripheral Interrupt Enable bit

1-Enables all unmasked peripheral interrupts

0-Disables all peripheral interrupts

TMROIE: TMR0 Overflow Interrupt Enable bit

1-Enables the TMR0 interrupt

0-Disables the TMR0 interrupt

INTE: NA for Timers

RBIE: NA for Timers

TMROIF: TMR0 Overflow Interrupt Flag bit

1-TMR0 register has overflowed (must be cleared in software)

0-TMR0 register did not overflow

INTF: NA for Timers

RBIF: NA for Timers



PIC –Timers/Counters



Timer 1

The timer TMR1 module is an 16-bit timer/counter with the following features:

- 16-bit timer/counter with two 8-Bit register TMR1H/TMR1L
- Readable and writable
- software programmable prescaler upto 1:8
- Internal or external clock select
- Interrupt on overflow from FFFFh to 00h
- Edge select for external clock

Timer1 Registers

The below table shows the registers associated with PIC16f877A Timer1 module.

Register	Description
T1CON:	This registers is used to configure the TIMER1 Prescalar, Clock Source etc
TMRIH	This register holds the higher 8-bits of timer value. TMR1H and TMR1L are used in pair to increment from 0000 - FFFFh
TMRIL	This register holds the lower 8-bits of timer value. TMR1H and TMR1L are used in pair to increment from 0000 - FFFFh
PIR1	This register contains the Timer1 overflow flag(TMR1IF).
PIE1	This register contains the Timer1 Interrupt Enable flag(TMR1IE).

T1CON							
7	6	5	4	3	2	1	0
—	—	T1CKPS1	T1CKPS0	T1OSCEN	T1SYNC	TMR1CS	TMR1ON



PIC -Timers 2



Timer 2

The Timer2 module is an 8-bit timer/counter with the following features:

- 8-bit timer/counter
- Readable and writable
- Software programmable prescaler/PostScaler upto 1:16
- Interrupt on overflow from FFh to 00h

Timer2 Registers

The below table shows the registers associated with PIC16f877A Timer0 module.

Register	Description
T2CON	This registers is used to configure the TIMER2 Prescalar, Clock Source etc
TMR2	This register holds the timer count value which will be incremented depending on prescalar configuration
PIR1	This register contains the Timer2 overflow flag(TMR2IF).
PIE1	This register contains the Timer2 Interrupt Enable flag(TMR2IE).

T2CON							
7	6	5	4	3	2	1	0
—	TOUTPS3	TOUTPS2	TOUTPS1	TOUTPS0	TMR2ON	T2CKPS1	T2CKPS0



References

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Thank You