Microprocessor based digital Systems

Basic I/O Peripherals: **Ports & Timers**

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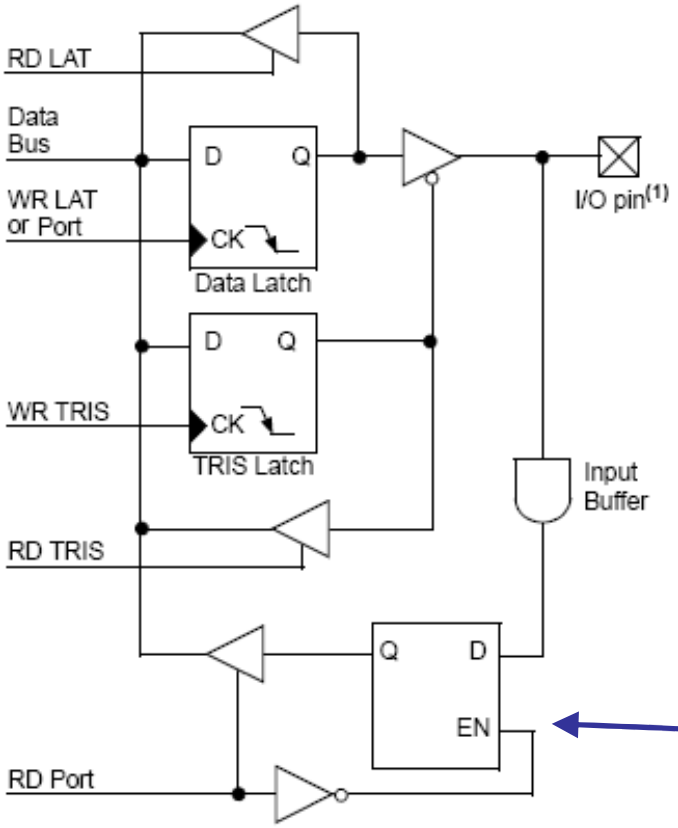
Figura del "PIC18F2525/2620/4525/4620 Data Sheet"
Con permiso de MICROCHIP

I/O Ports

Recall the PORT structure

Each bit has:



Registers

LATx Data Latch register.
Read-modify-write operations on LATB

TRISx 0 – Output
1 – Input

HOMEWORK

What is this register for?

I/O Ports, PORTA

PORTA is a bitirectional 8-bit port.

Registers

PORTA	F80h
LATA	F89h
TRISA	F92h

Function

	AD Converter	Oscillator	Timer
RA0	AN0		
RA1	AN1		
RA2	AN2/VREF-		
RA3	AN3/VREF+		
RA4			T0CKI/C1OUT
RA5	AN4		SS/HLVDIN/C2OUT
RA6		OSC2/CLKO	
RA7		OSC1/CLKI	
	ADCON1		

I/O Ports, PORTB

PORTB is a bidirectional 8-bit port.
with internal pull-ups in all pins when RBPU (INTCON2<7>)=0

Registers

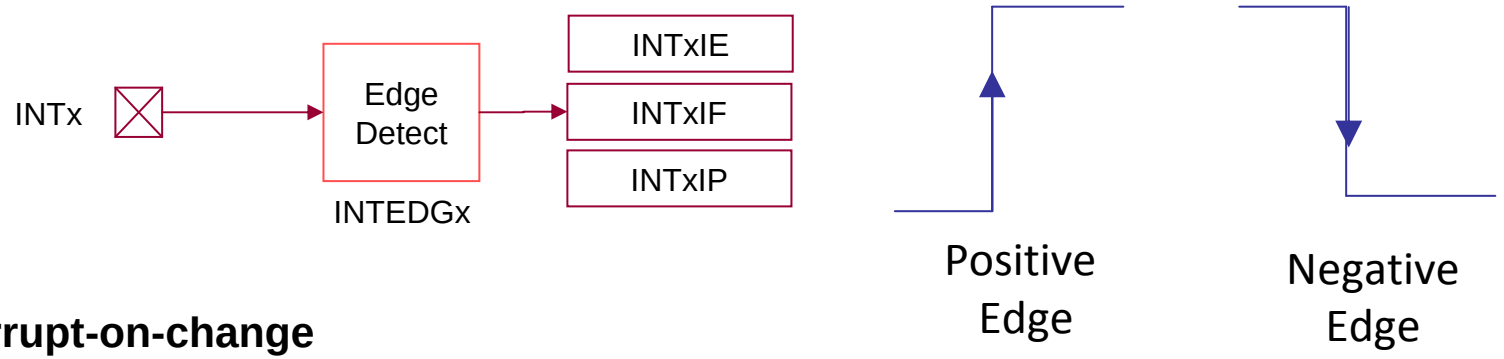
PORTB	F81h
LATB	F8Ah
TRISB	F93h

Functions

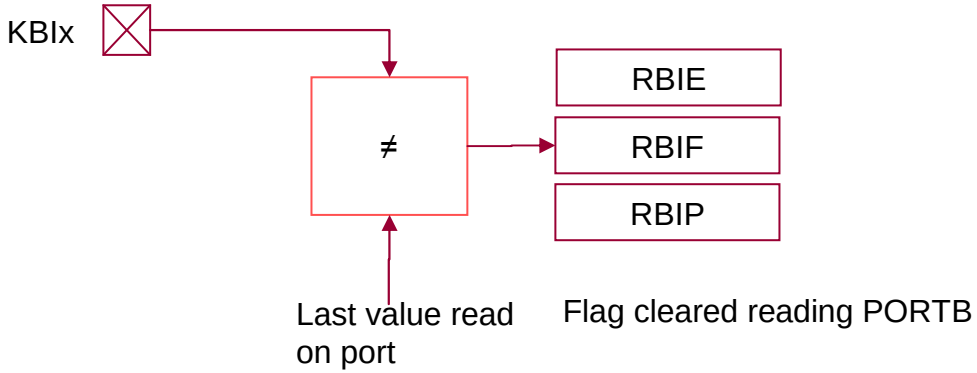
	AD Converter	External Interrupt	Interrupt-on-change	ICSP	Timers
RB0	AN12	INT0			
RB1	AN10	INT1			
RB2	AN8	INT2			
RB3	AN9				CCP2
RB4	AN11		KBI0		
RB5			KBI1	PGM	
RB6			KBI2	PGC	
RB7			KBI3	PGD	

I/O Ports, PORTB

External Interrupt



Interrupt-on-change



Which are the bits involved in the PORTB management?

I/O Ports, PORTB

General collection of all bits involved by register

INTCON	GIE/GIEH	PEIE/GIEL	TMR0IE	INT0IE	RBIE	TMR0IF	INT0IF	RBIF
INTCON2	$\overline{\text{RBPU}}$	INTEDG0	INTEDG1	INTEDG2	—	TMR0IP	—	RBIP
INTCON3	INT2IP	INT1IP	—	INT2IE	INT1IE	—	INT2IF	INT1IF
ADCON1	—	—	VCFG1	VCFG0	PCFG3	PCFG2	PCFG1	PCFG0

Detailed description

REGISTER 10-2: INTCON2: INTERRUPT CONTROL REGISTER 2

R/W-1	R/W-1	R/W-1	R/W-1	U-0	R/W-1	U-0	R/W-1
$\overline{\text{RBPU}}$	INTEDG0	INTEDG1	INTEDG2	—	TMR0IP	—	RBIP
bit 7							bit 0

bit 7 **$\overline{\text{RBPU}}$:** PORTB Pull-up Enable bit
1 = All PORTB pull-ups are disabled
0 = PORTB pull-ups are enabled by individual port latch values

bit 6 **INTEDG0:** External Interrupt 0 Edge Select bit
1 = Interrupt on rising edge
0 = Interrupt on falling edge

bit 5 **INTEDG1:** External Interrupt 1 Edge Select bit
1 = Interrupt on rising edge
0 = Interrupt on falling edge

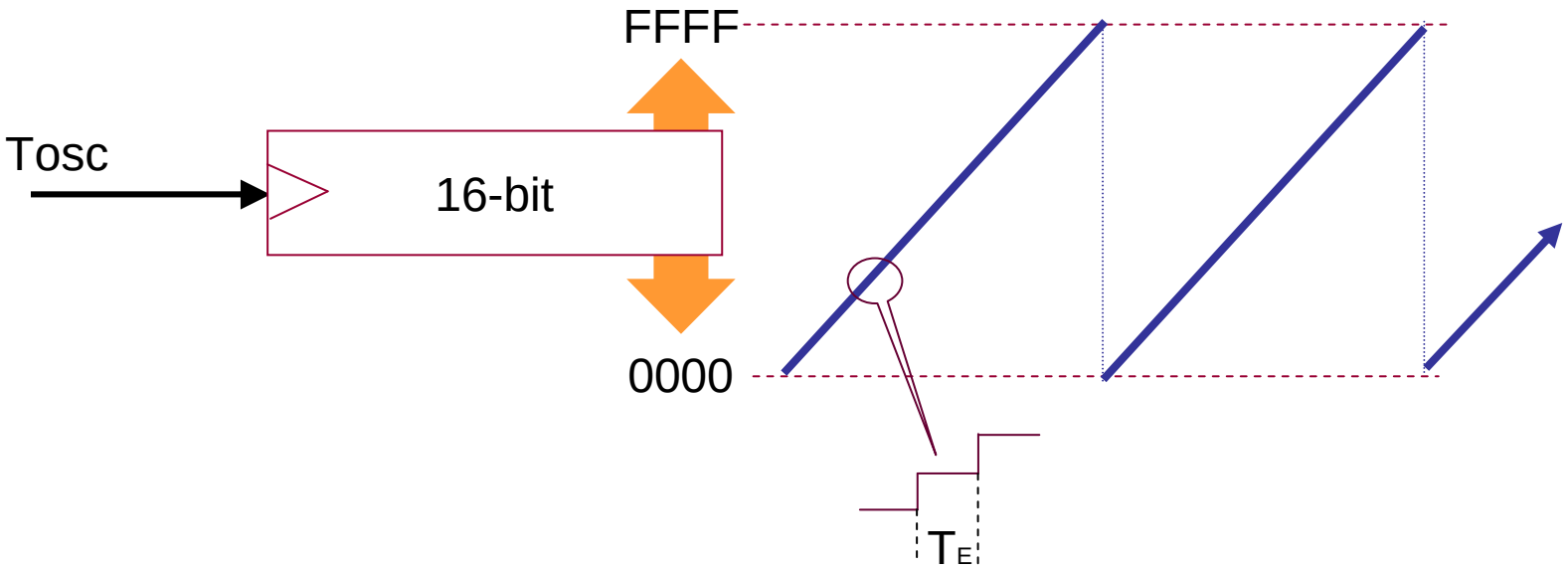
bit 4 **INTEDG2:** External Interrupt 2 Edge Select bit
1 = Interrupt on rising edge
0 = Interrupt on falling edge

Timers , Basics

Operating Principle

Timers are peripherals that are used to control time.

Time is measured in the smallest units in the system, the instruction cycle

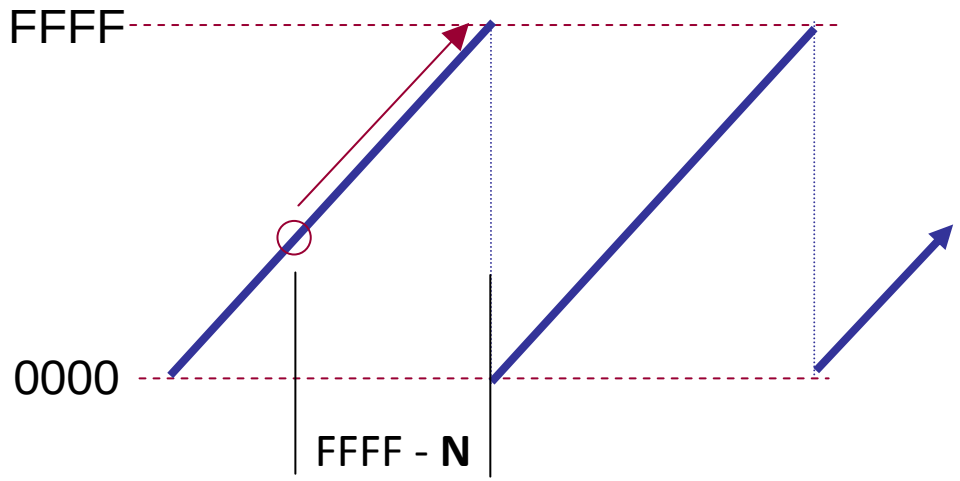


Timers , Basics

Upcount

The timer counts upwards, 00 -> 01 -> 02 -> 03 . . . . .

From a given initial value, when the timer rolls over (FFFF to 0000), generates an Interrupt



Downcount

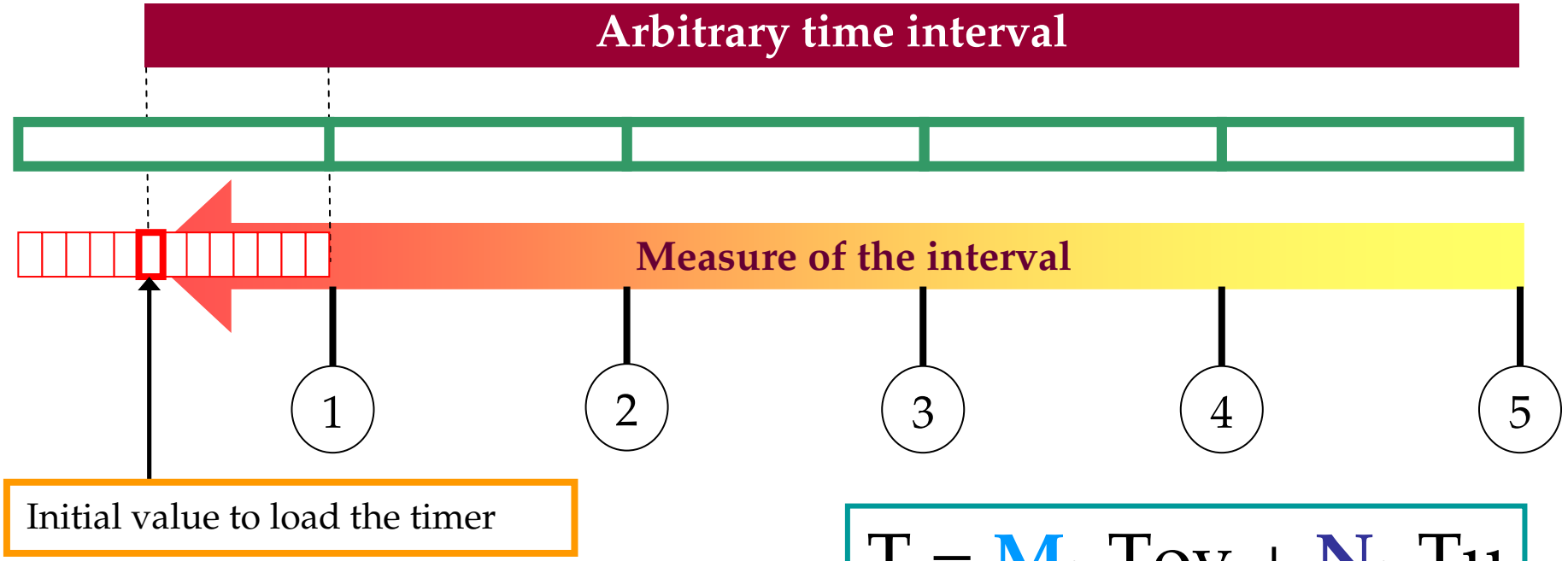
Based in a downward counter.

From a given initial value, an interrupt appears when the counter goes from FFFF to 0000.

Timers , Basics

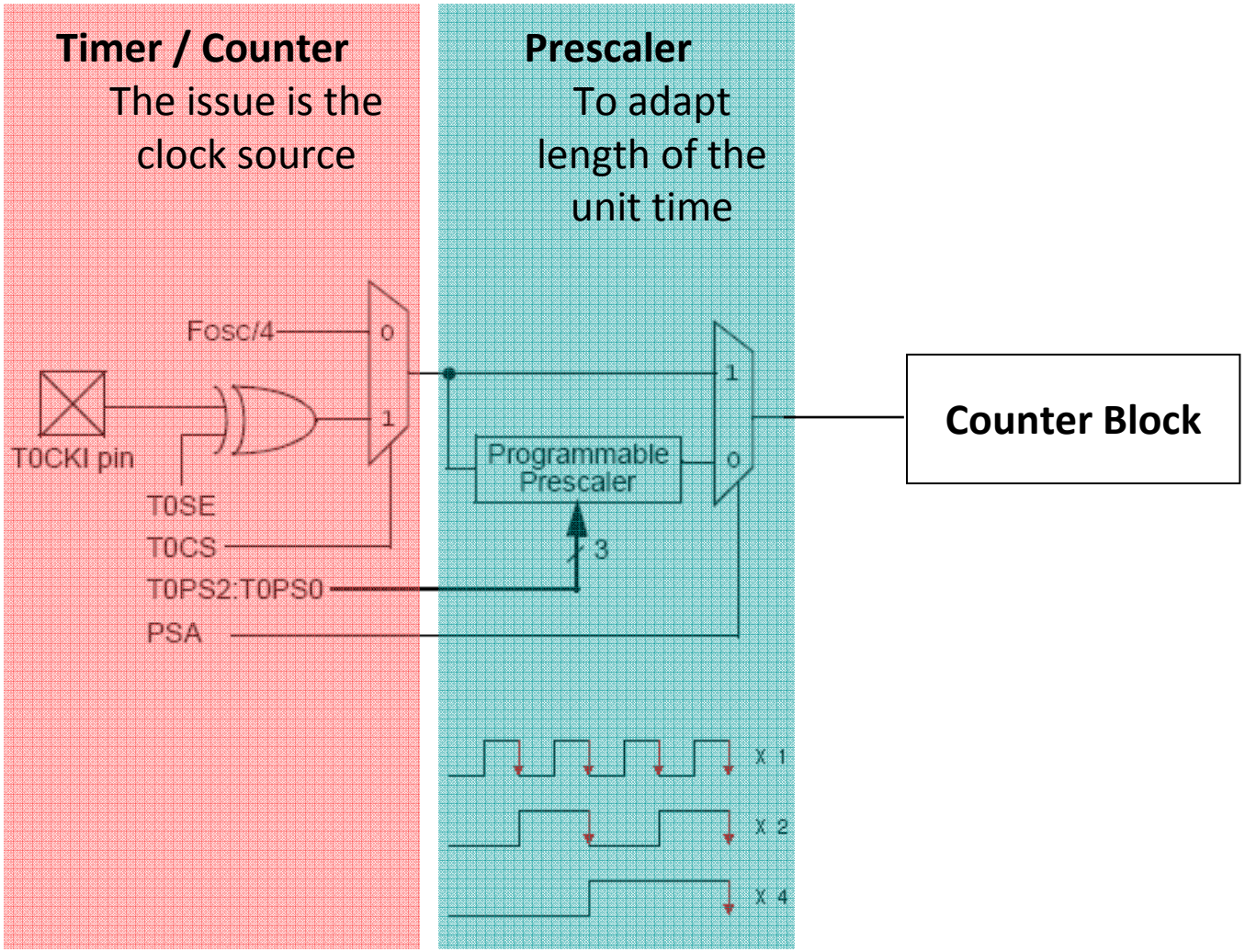
Units with which we measure time intervals

Gross Unit:	Overflow time	**Tov**
Fine Unit:	Unit time	**Tu**



$$T = M \cdot Tov + N \cdot Tu$$

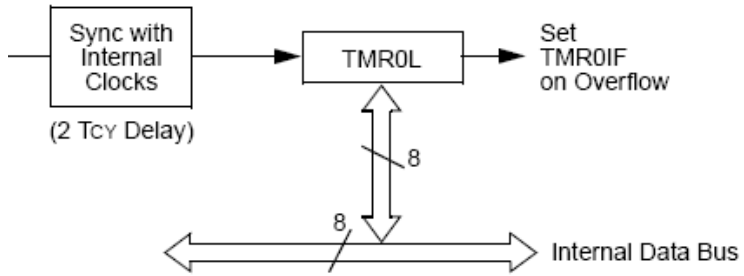
Timers , Building Blocks



Timers , Modes of operation

Depends on the Counter Block implementation

1



2

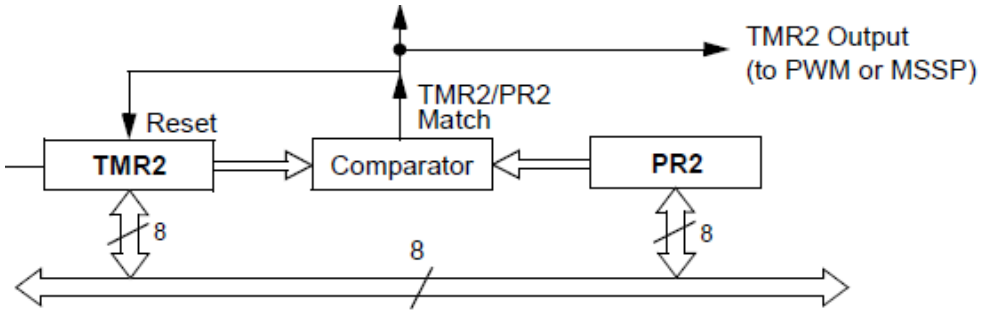
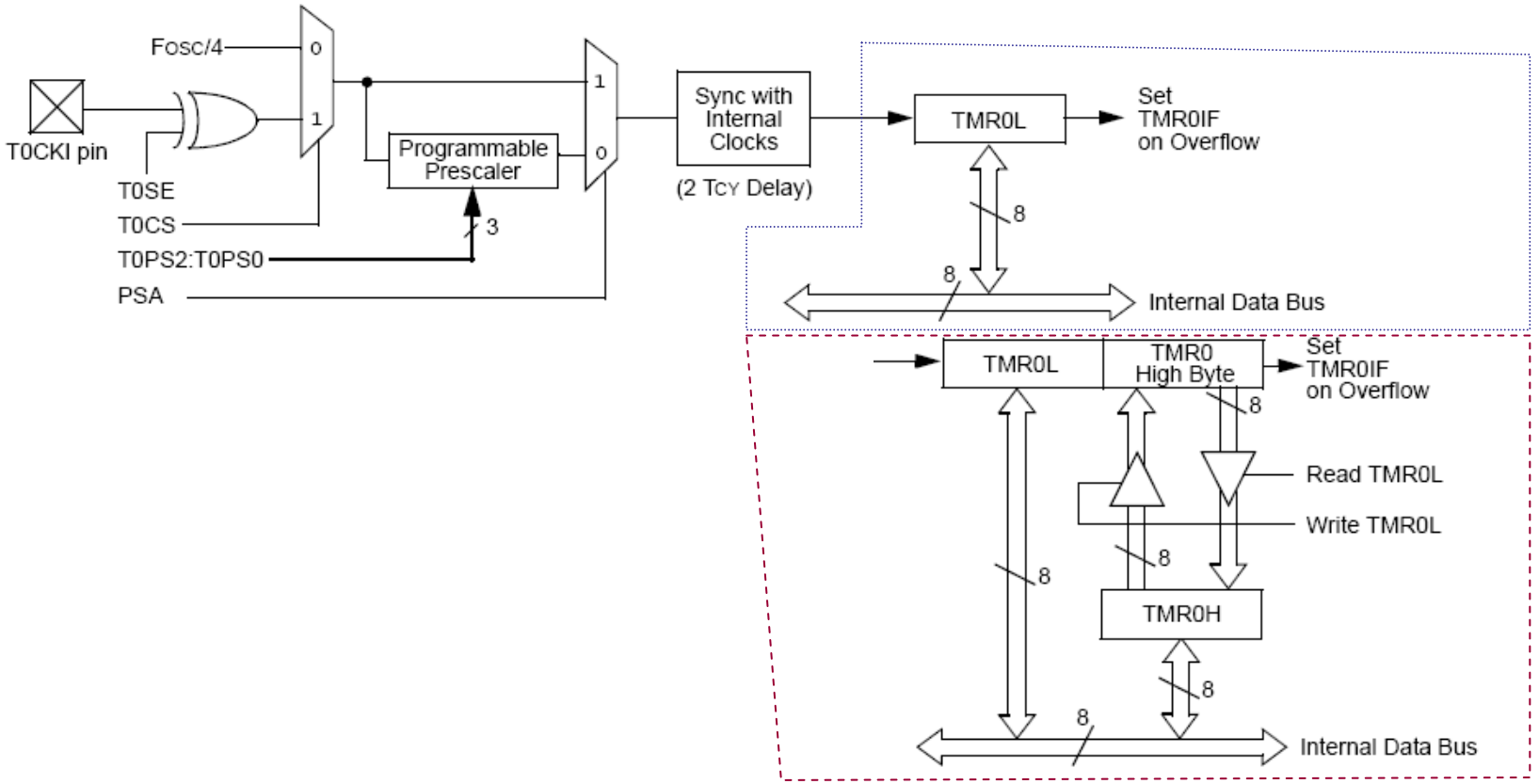


Figura del “PIC18F2525/2620/4525/4620 Data Sheet”
Con permiso de MICROCHIP

Timers , Timer 0

Timer0 module incorporates the following features:

- Software selectable operation as a timer or counter in both 8-bit or 16-bit
- Selectable clock source (internal or external)
- Readable and writable registers
- Dedicated 8-bit, software programmable prescaler
- Edge select for external



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Timers , Timer 0

TMR0L	Timer0 Register Low Byte							
TMR0H	Timer0 Register High Byte							
INTCON	GIE/GIEH	PEIE/GIEL	TMR0IE	INT0IE	RBIE	TMR0IF	INT0IF	RBIF
T0CON	TMR0ON	T08BIT	T0CS	T0SE	PSA	T0PS2	T0PS1	T0PS0
TRISA	RA7(1)	RA6(1)	RA5	RA4	RA3	RA2	RA1	RA0

REGISTER 11-1: T0CON: TIMER0 CONTROL REGISTER

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
TMR0ON	T08BIT	T0CS	T0SE	PSA	T0PS2	T0PS1	T0PS0
bit 7							bit 0

bit 7 **TMR0ON:** Timer0 On/Off Control bit
1 = Enables Timer0
0 = Stops Timer0

bit 6 **T08BIT**: Timer0 8-bit/16-bit Control bit
1 = Timer0 is configured as an 8-bit timer/counter
0 = Timer0 is configured as a 16-bit timer/counter

bit 5 **T0CS**: Timer0 Clock Source Select bit
1 = Transition on T0CKI pin
0 = Internal instruction cycle clock (CLKO)

bit 4 **T0SE**: Timer0 Source Edge Select bit
1 = Increment on high-to-low transition on T0CKI pin
0 = Increment on low-to-high transition on T0CKI pin

bit 3 **PSA**: Timer0 Prescaler Assignment bit
1 = TImer0 prescaler is NOT assigned. Timer0 clock input bypasses prescaler.
0 = Timer0 prescaler is assigned. Timer0 clock input comes from prescaler output.

bit 2-0 **T0PS2:T0PS0**: Timer0 Prescaler Select bits
111 = 1:256 Prescale value
110 = 1:128 Prescale value
101 = 1:64 Prescale value
100 = 1:32 Prescale value
011 = 1:16 Prescale value
010 = 1:8 Prescale value
001 = 1:4 Prescale value
000 = 1:2 Prescale value