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Details

Product Status	Active
Core Processor	PIC
Core Size	8-Bit
Speed	4MHz
Connectivity	UART/USART
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	16
Program Memory Size	3.5KB (2K x 14)
Program Memory Type	FLASH
EEPROM Size	128 x 8
RAM Size	224 x 8
Voltage - Supply (Vcc/Vdd)	2V ~ 5.5V
Data Converters	-
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	18-SOIC (0.295", 7.50mm Width)
Supplier Device Package	18-SOIC
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic16lf628-04i-so

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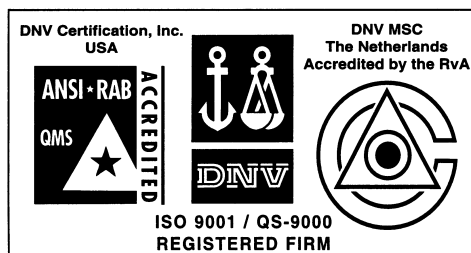
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TABLE 2-1: PIC16F62X PINOUT DESCRIPTION

Name	Function	Input Type	Output Type	Description
RA0/AN0	RA0	ST	CMOS	Bi-directional I/O port
	AN0	AN	—	Analog comparator input
RA1/AN1	RA1	ST	CMOS	Bi-directional I/O port
	AN1	AN	—	Analog comparator input
RA2/AN2/VREF	RA2	ST	CMOS	Bi-directional I/O port
	AN2	AN	—	Analog comparator input
	VREF	—	AN	VREF output
RA3/AN3/CMP1	RA3	ST	CMOS	Bi-directional I/O port
	AN3	AN	—	Analog comparator input
	CMP1	—	CMOS	Comparator 1 output
RA4/T0CKI/CMP2	RA4	ST	OD	Bi-directional I/O port
	T0CKI	ST	—	Timer0 clock input
	CMP2	—	OD	Comparator 2 output
RA5/MCLR/VPP	RA5	ST	—	Input port
	MCLR	ST	—	Master clear
	VPP	—	—	Programming voltage input. When configured as MCLR, this pin is an active low RESET to the device. Voltage on MCLR/VPP must not exceed VDD during normal device operation.
RA6/OSC2/CLKOUT	RA6	ST	CMOS	Bi-directional I/O port
	OSC2	XTAL	—	Oscillator crystal output. Connects to crystal or resonator in Crystal Oscillator mode.
	CLKOUT	—	CMOS	In ER/INTRC mode, OSC2 pin can output CLKOUT, which has 1/4 the frequency of OSC1
RA7/OSC1/CLKIN	RA7	ST	CMOS	Bi-directional I/O port
	OSC1	XTAL	—	Oscillator crystal input
	CLKIN	ST	—	External clock source input. ER biasing pin.
RB0/INT	RB0	TTL	CMOS	Bi-directional I/O port. Can be software programmed for internal weak pull-up.
	INT	ST	—	External interrupt.
RB1/RX/DT	RB1	TTL	CMOS	Bi-directional I/O port. Can be software programmed for internal weak pull-up.
	RX	ST	—	USART receive pin
	DT	ST	CMOS	Synchronous data I/O.
RB2/TX/CK	RB2	TTL	CMOS	Bi-directional I/O port.
	TX	—	CMOS	USART transmit pin
	CK	ST	CMOS	Synchronous clock I/O. Can be software programmed for internal weak pull-up.
RB3/CCP1	RB3	TTL	CMOS	Bi-directional I/O port. Can be software programmed for internal weak pull-up.
	CCP1	ST	CMOS	Capture/Compare/PWM I/O

Legend: O = Output
 — = Not used
 TTL = TTL Input

CMOS = CMOS Output
 I = Input
 OD = Open Drain Output

P = Power
 ST = Schmitt Trigger Input
 AN = Analog

3.2.2.1 STATUS Register

The STATUS register, shown in Register 3-1, contains the arithmetic status of the ALU, the RESET status and the bank select bits for data memory (SRAM).

The STATUS register can be the destination for any instruction, like any other register. If the STATUS register is the destination for an instruction that affects the Z, DC or C bits, then the write to these three bits is disabled. These bits are set or cleared according to the device logic. Furthermore, the $\overline{\text{TO}}$ and $\overline{\text{PD}}$ bits are not writable. Therefore, the result of an instruction with the STATUS register as destination may be different than intended.

For example, `CLRF STATUS` will clear the upper-three bits and set the Z bit. This leaves the STATUS register as `000uu1uu` (where `u` = unchanged).

It is recommended, therefore, that only `BCF`, `BSF`, `SWAPF` and `MOVWF` instructions are used to alter the STATUS register because these instructions do not affect any STATUS bit. For other instructions, not affecting any STATUS bits, see the "Instruction Set Summary".

Note 1: The C and DC bits operate as a Borrow and Digit Borrow out bit, respectively, in subtraction. See the `SUBLW` and `SUBWF` instructions for examples.

REGISTER 3-1: STATUS REGISTER (ADDRESS: 03h, 83h, 103h, 183h)

R/W-0	R/W-0	R/W-0	R-1	R-1	R/W-x	R/W-x	R/W-x
IRP	RP1	RP0	$\overline{\text{TO}}$	$\overline{\text{PD}}$	Z	DC	C
bit 7							bit 0

- bit 7 **IRP:** Register Bank Select bit (used for indirect addressing)
 1 = Bank 2, 3 (100h - 1FFh)
 0 = Bank 0, 1 (00h - FFh)
- bit 6-5 **RP1:RP0:** Register Bank Select bits (used for direct addressing)
 00 = Bank 0 (00h - 7Fh)
 01 = Bank 1 (80h - FFh)
 10 = Bank 2 (100h - 17Fh)
 11 = Bank 3 (180h - 1FFh)
- bit 4 **$\overline{\text{TO}}$:** Timeout bit
 1 = After power-up, `CLRWD` instruction, or `SLEEP` instruction
 0 = A WDT timeout occurred
- bit 3 **$\overline{\text{PD}}$:** Power-down bit
 1 = After power-up or by the `CLRWD` instruction
 0 = By execution of the `SLEEP` instruction
- bit 2 **Z:** Zero bit
 1 = The result of an arithmetic or logic operation is zero
 0 = The result of an arithmetic or logic operation is not zero
- bit 1 **DC:** Digit carry/borrow bit (`ADDWF`, `ADDLW`, `SUBLW`, `SUBWF` instructions) (for borrow the polarity is reversed)
 1 = A carry-out from the 4th low order bit of the result occurred
 0 = No carry-out from the 4th low order bit of the result
- bit 0 **C:** Carry/borrow bit (`ADDWF`, `ADDLW`, `SUBLW`, `SUBWF` instructions)
 1 = A carry-out from the Most Significant bit of the result occurred
 0 = No carry-out from the Most Significant bit of the result occurred

Note 1: For borrow the polarity is reversed. A subtraction is executed by adding the two's complement of the second operand. For rotate (`RRF`, `RLF`) instructions, this bit is loaded with either the high or low order bit of the source register.

Legend:

R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared x = Bit is unknown

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NOTES:

The diagram illustrates the logic for the RA4 Pin driver. Key components and connections include:

- Data Bus:** Connected to the D inputs of the Data Latch and TRIS Latch.
- WR PORTA:** Connected to the CK input of the Data Latch.
- WR TRISA:** Connected to the CK input of the TRIS Latch.
- RD PORTA:** Connected to the input of a buffer, which then feeds into the D input of a D flip-flop.
- TMR0 Clock Input:** Connected to the clock input of the D flip-flop.
- Comparator Mode = 110:** A constant value connected to the Comparator Output.
- Data Latch:** Its Q output is connected to the Comparator Output.
- TRIS Latch:** Its Q output is connected to the input of an OR gate.
- Comparator Output:** Its output is connected to the input of an OR gate.
- OR Gate:** Its output is connected to the input of a Schmitt Trigger Input Buffer.
- Schmitt Trigger Input Buffer:** Its output is connected to the RA4 Pin.
- RA4 Pin:** Connected to VDD and VSS.

[illegible]

FIGURE 5-10: BLOCK DIAGRAM OF RB2/TX/CK PIN

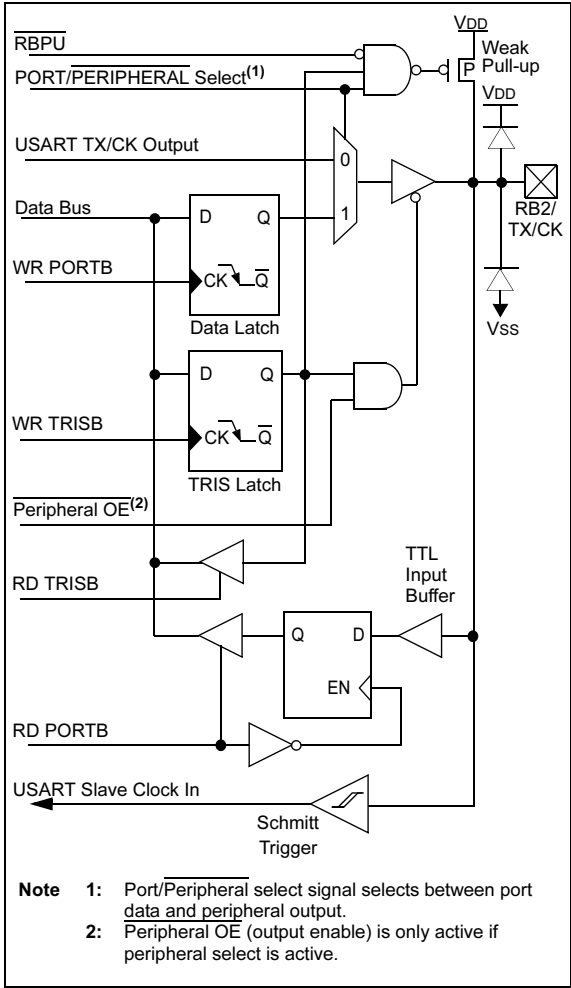
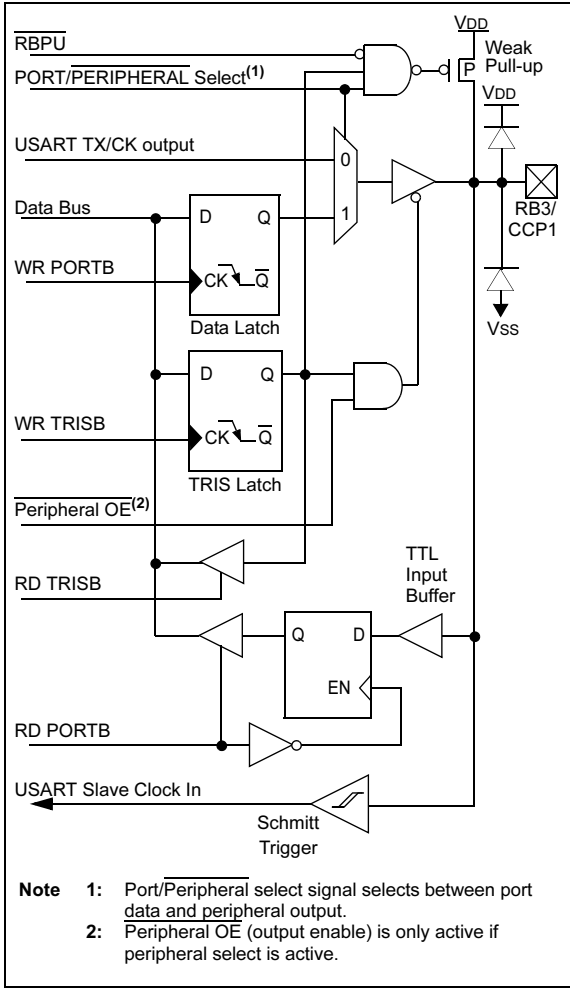


FIGURE 5-11: BLOCK DIAGRAM OF RB3/CCP1 PIN



PIC16F62X

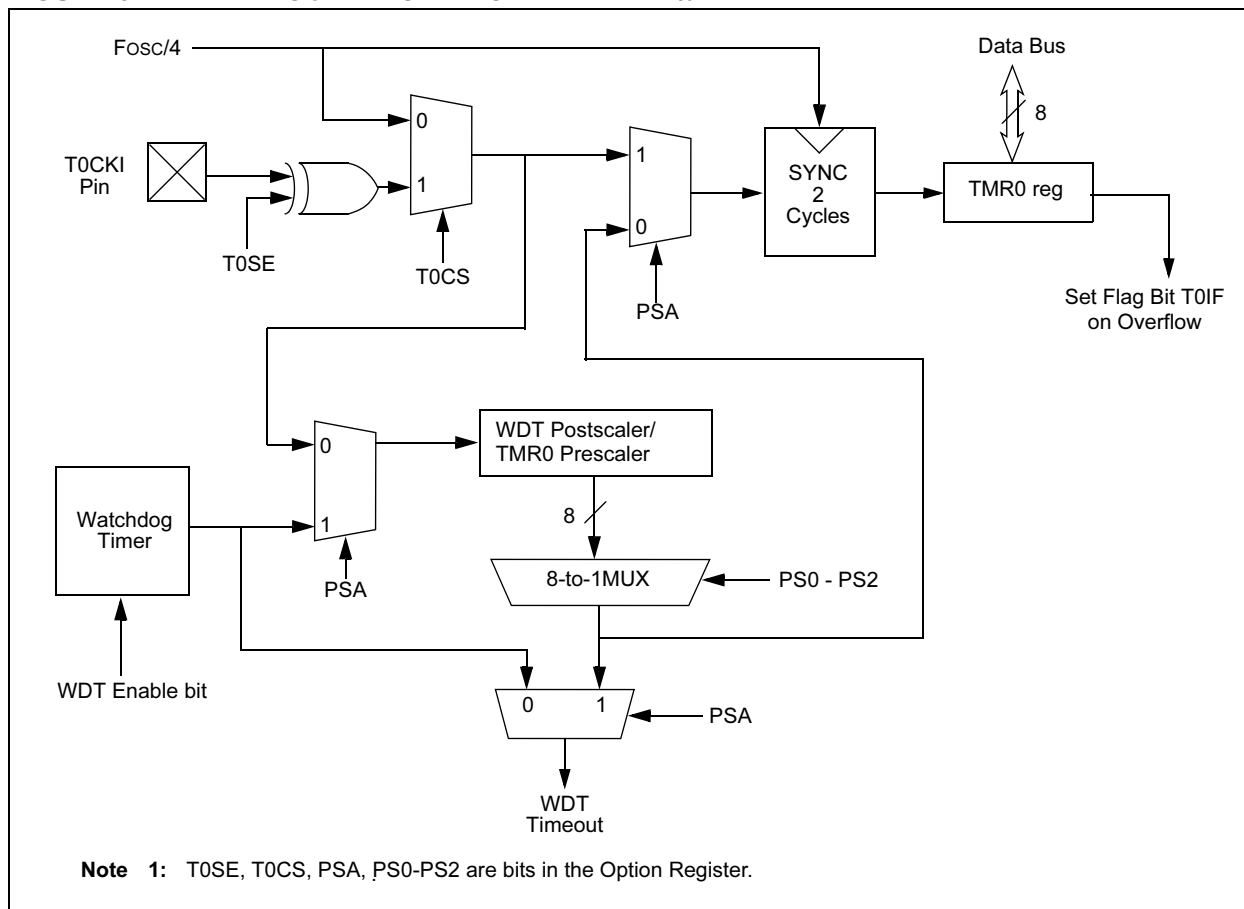
6.3 Timer0 Prescaler

An 8-bit counter is available as a prescaler for the Timer0 module, or as a postscaler for the Watchdog Timer. A prescaler assignment for the Timer0 module means that there is no postscaler for the Watchdog Timer, and vice-versa.

The PSA and PS2:PS0 bits (OPTION<3:0>) determine the prescaler assignment and prescale ratio.

When assigned to the Timer0 module, all instructions writing to the TMR0 register (e.g., CLRF 1, MOVWF 1, BSF 1, x...etc.) will clear the prescaler. When assigned to WDT, a CLRWDI instruction will clear the prescaler along with the Watchdog Timer. The prescaler is not readable or writable.

FIGURE 6-1: BLOCK DIAGRAM OF THE TIMER0/WDT



6.3.1 SWITCHING PRESCALER ASSIGNMENT

The prescaler assignment is fully under software control (i.e., it can be changed “on the fly” during program execution). Use the instruction sequences, shown in Example 6-1, when changing the prescaler assignment from Timer0 to WDT, to avoid an unintended device RESET.

EXAMPLE 6-1: CHANGING PRESCALER (TIMER0→WDT)

```
BCF      STATUS, RP0    ;Skip if already in
                        ;Bank 0
CLRWDT   ;Clear WDT
CLRWF    TMR0           ;Clear TMR0 & Prescaler
BSF      STATUS, RP0    ;Bank 1
MOVLW    '00101111'b    ;These 3 lines
                        ;(5, 6, 7)
MOVWF    OPTION_REG     ;are required only
                        ;if desired PS<2:0>
                        ;are
CLRWDT   ;000 or 001
MOVLW    '00101xxx'b    ;Set Postscaler to
MOVWF    OPTION_REG     ;desired WDT rate
BCF      STATUS, RP0    ;Return to Bank 0
```

To change prescaler from the WDT to the TMR0 module use the sequence shown in Example 6-2. This precaution must be taken even if the WDT is disabled.

EXAMPLE 6-2: CHANGING PRESCALER (WDT→TIMER0)

```
CLRWDT   ;Clear WDT and
          ;prescaler
BSF      STATUS, RP0
MOVLW    b'xxxx0xxx'    ;Select TMR0, new
                        ;prescale value and
                        ;clock source
MOVWF    OPTION_REG
BCF      STATUS, RP0
```

TABLE 6-1: REGISTERS ASSOCIATED WITH TIMER0

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR	Value on All Other RESETS
01h	TMR0	Timer0 module register								xxxx xxxx	uuuu uuuu
0Bh/8Bh/ 10Bh/18Bh	INTCON	GIE	PEIE	T0IE	INTE	RBIE	T0IF	INTF	RBIF	0000 000x	0000 000u
81h, 181h	OPTION ⁽²⁾	<u>RBPU</u>	INTEDG	T0CS	T0SE	PSA	PS2	PS1	PS0	1111 1111	1111 1111
85h	TRISA	TRISA7	TRISA6	TRISA5	TRISA4	TRISA3	TRISA2	TRISA1	TRISA0	1111 1111	1111 1111

Legend: — = Unimplemented locations, read as '0', u = unchanged, x = unknown

Note 1: Shaded bits are not used by TMR0 module.

2: Option is referred by OPTION_REG in MPLAB.

REGISTER 8-1: T2CON: TIMER CONTROL REGISTER (ADDRESS: 12h)

U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	TOUTPS3	TOUTPS2	TOUTPS1	TOUTPS0	TMR2ON	T2CKPS1	T2CKPS0
bit 7							bit 0

bit 7 **Unimplemented:** Read as '0'

bit 6-3 **TOUTPS3:TOUTPS0:** Timer2 Output Postscale Select bits

0000 = 1:1 Postscale Value

0001 = 1:2 Postscale Value

•

•

•

1111 = 1:16 Postscale

bit 2 **TMR2ON:** Timer2 On bit

1 = Timer2 is on

0 = Timer2 is off

bit 1-0 **T2CKPS1:T2CKPS0:** Timer2 Clock Prescale Select bits

00 = 1:1 Prescaler Value

01 = 1:4 Prescaler Value

1x = 1:16 Prescaler Value

Legend:

R = Readable bit

W = Writable bit

U = Unimplemented bit, read as '0'

-n = Value at POR

'1' = Bit is set

'0' = Bit is cleared

x = Bit is unknown

TABLE 8-1: REGISTERS ASSOCIATED WITH TIMER2 AS A TIMER/COUNTER

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR	Value on all other RESETS
0Bh/8Bh/10Bh/18Bh	INTCON	GIE	PEIE	TOIE	INTE	RBIE	TOIF	INTF	RBIF	0000 000x	0000 000u
0Ch	PIR1	EEIF	CMIF	RCIF	TXIF	—	CCP1IF	TMR2IF	TMR1IF	0000 -000	0000 -000
8Ch	PIE1	EEIE	CMIE	RCIE	TXIE	—	CCP1IE	TMR2IE	TMR1IE	0000 -000	0000 -000
11h	TMR2	Timer2 module's register								0000 0000	0000 0000
12h	T2CON	—	TOUTPS3	TOUTPS2	TOUTPS1	TOUTPS0	TMR2ON	T2CKPS1	T2CKPS0	-000 0000	-000 0000
92h	PR2	Timer2 Period Register								1111 1111	1111 1111

Legend: x = unknown, u = unchanged, - = unimplemented read as '0'. Shaded cells are not used by the Timer2 module.

The code example in Example 9-1 depicts the steps required to configure the Comparator module. RA3 and RA4 are configured as digital output. RA0 and RA1 are configured as the V- inputs and RA2 as the V+ input to both comparators.

EXAMPLE 9-1: INITIALIZING COMPARATOR MODULE

```
FLAG_REG EQU      0X20
CLRF    FLAG_REG    ;Init flag register
CLRF    PORTA        ;Init PORTA
MOVF    CMCON, W     ;Load comparator bits
ANDLW   0xC0         ;Mask comparator bits
IORWF   FLAG_REG, F  ;Store bits in flag register
MOVLW   0x03         ;Init comparator mode
MOVWF   CMCON        ;CM<2:0> = 011
BSF     STATUS, RP0  ;Select Bank 1
MOVLW   0x07         ;Initialize data direction
MOVWF   TRISA        ;Set RA<2:0> as inputs
                        ;RA<4:3> as outputs
                        ;TRISA<7:5> always read '0'
BCF     STATUS, RP0  ;Select Bank 0
CALL    DELAY10      ;10µs delay
MOVF    CMCON, F     ;Read CMCON to end change condition
BCF     PIR1, CMIF    ;Clear pending interrupts
BSF     STATUS, RP0  ;Select Bank 1
BSF     PIE1, CMIE    ;Enable comparator interrupts
BCF     STATUS, RP0  ;Select Bank 0
BSF     INTCON, PEIE  ;Enable peripheral interrupts
BSF     INTCON, GIE   ;Global interrupt enable
```

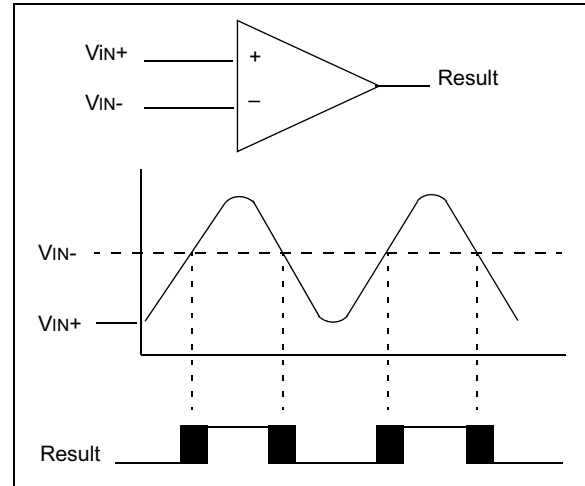
9.2 Comparator Operation

A single comparator is shown in Figure 9-2 along with the relationship between the analog input levels and the digital output. When the analog input at VIN+ is less than the analog input VIN-, the output of the comparator is a digital low level. When the analog input at VIN+ is greater than the analog input VIN-, the output of the comparator is a digital high level. The shaded areas of the output of the comparator in Figure 9-2 represent the uncertainty due to input offsets and response time.

9.3 Comparator Reference

An external or internal reference signal may be used depending on the Comparator Operating mode. The analog signal that is present at VIN- is compared to the signal at VIN+, and the digital output of the comparator is adjusted accordingly (Figure 9-2).

FIGURE 9-2: SINGLE COMPARATOR



9.3.1 EXTERNAL REFERENCE SIGNAL

When external voltage references are used, the comparator module can be configured to have the comparators operate from the same or different reference sources. However, threshold detector applications may require the same reference. The reference signal must be between VSS and VDD, and can be applied to either pin of the comparator(s).

9.3.2 INTERNAL REFERENCE SIGNAL

The Comparator module also allows the selection of an internally generated voltage reference for the comparators. Section 10.0, Voltage Reference Manual, contains a detailed description of the Voltage Reference module that provides this signal. The internal reference signal is used when the comparators are in mode CM<2:0>=010 (Figure 9-1). In this mode, the internal voltage reference is applied to the VIN+ pin of both comparators.

9.4 Comparator Response Time

Response time is the minimum time, after selecting a new reference voltage or input source, before the comparator output is ensured to have a valid level. If the internal reference is changed, the maximum delay of the internal voltage reference must be considered when using the comparator outputs. Otherwise the maximum delay of the comparators should be used (Table 17-1).

The data on the RB1/RX/DT pin is sampled three times by a majority detect circuit to determine if a high or a low level is present at the RX pin. If bit BRGH (TXSTA<2>) is clear (i.e., at the low baud rates), the sampling is done on the seventh, eighth and ninth falling edges of a x16 clock (Figure 12-3). If bit BRGH is set (i.e., at the high baud rates), the sampling is done on the 3 clock edges preceding the second rising edge after the first falling edge of a x4 clock (Figure 12-4 and Figure 12-5).

FIGURE 12-1: RX PIN SAMPLING SCHEME, BRGH = 0

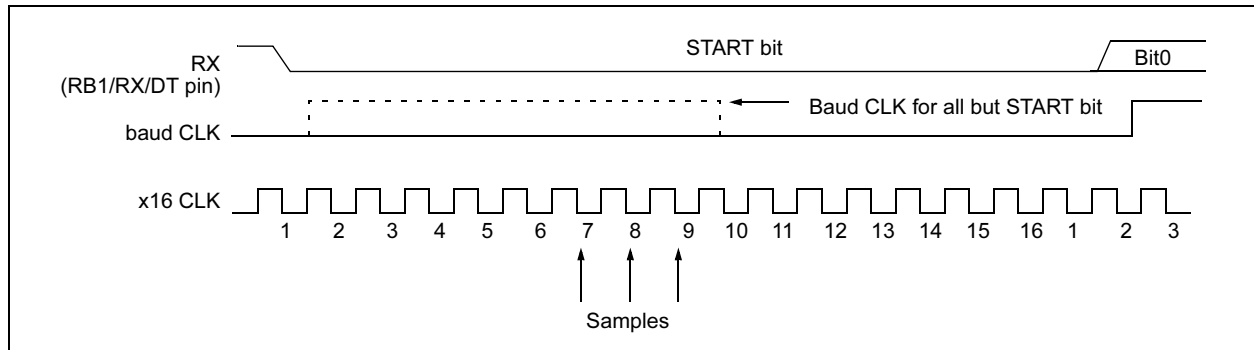


FIGURE 12-2: RX PIN SAMPLING SCHEME, BRGH = 1

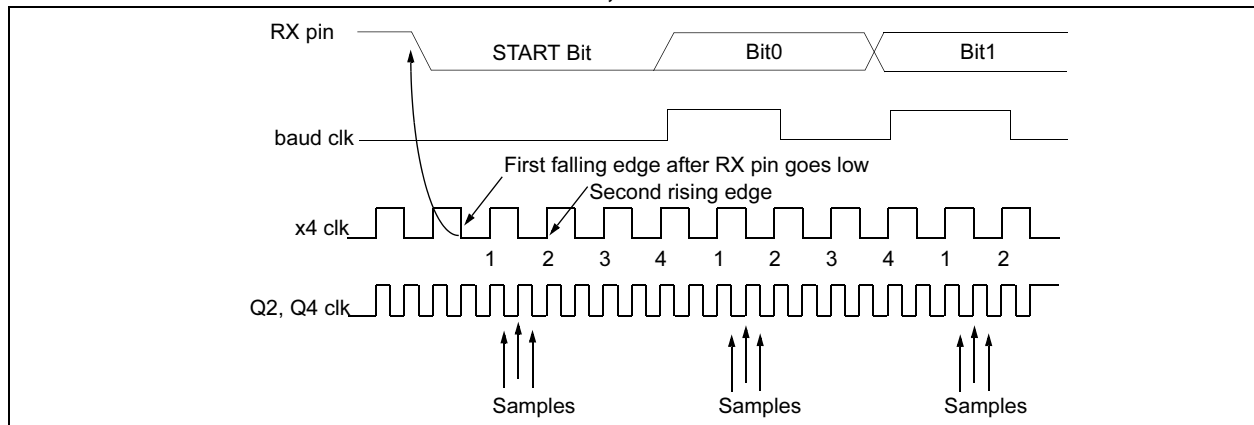
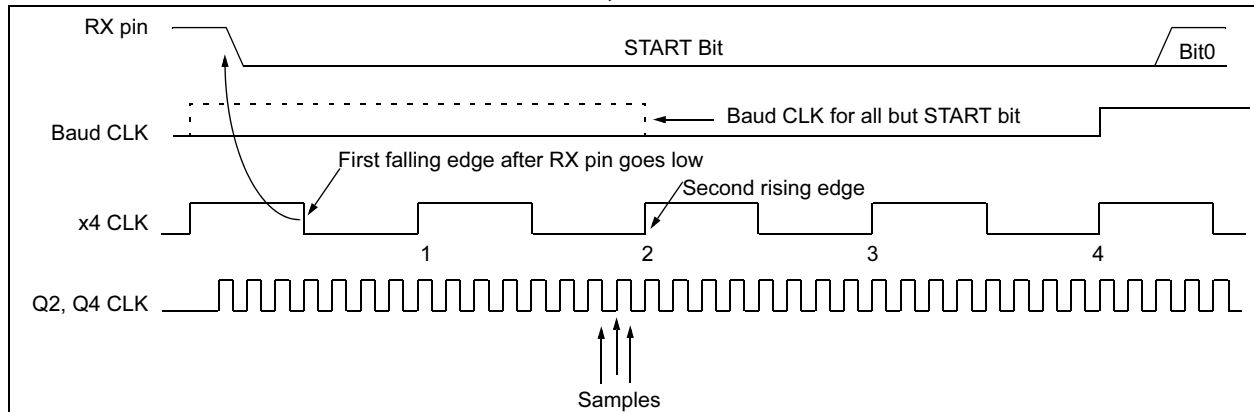


FIGURE 12-3: RX PIN SAMPLING SCHEME, BRGH = 1



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12.3 USART Function

The USART function is similar to that on the PIC16C74B, which includes the BRGH = 1 fix.

12.3.1 USART 9-BIT RECEIVER WITH ADDRESS DETECT

When the RX9 bit is set in the RCSTA register, 9 bits are received and the ninth bit is placed in the RX9D bit of the RCSTA register. The USART module has a special provision for multiprocessor communication. Multiprocessor communication is enabled by setting the ADEN bit (RCSTA<3>) along with the RX9 bit. The port is now programmed so when the last bit is received, the contents of the Receive Shift Register (RSR) are transferred to the receive buffer. The ninth bit of the RSR (RSR<8>) is transferred to RX9D, and the receive interrupt is set if, and only, if RSR<8> = 1. This feature can be used in a multiprocessor system as follows:

A master processor intends to transmit a block of data to one of many slaves. It must first send out an address byte that identifies the target slave. An address byte is identified by setting the ninth bit (RSR<8>) to a '1' (instead of a '0' for a data byte). If the ADEN and RX9 bits are set in the slave's RCSTA register, enabling multiprocessor communication, all data bytes will be ignored. However, if the ninth received bit is equal to a '1', indicating that the received byte is an address, the slave will be interrupted and the contents of the RSR register will be transferred into the receive buffer. This allows the slave to be interrupted only by addresses, so that the slave can examine the received byte to see if it is being addressed. The addressed slave will then clear its ADEN bit and prepare to receive data bytes from the master.

When ADEN is enabled (= '1'), all data bytes are ignored. Following the STOP bit, the data will not be loaded into the receive buffer, and no interrupt will occur. If another byte is shifted into the RSR register, the previous data byte will be lost.

The ADEN bit will only take effect when the receiver is configured in 9-bit mode (RX9 = '1'). When ADEN is disabled (= '0'), all data bytes are received and the 9th bit can be used as the PARITY bit.

The USART Receive Block Diagram is shown in Figure 12-8.

Reception is enabled by setting bit CREN (RCSTA<4>).

12.3.1.1 Setting up 9-bit mode with Address Detect

Steps to follow when setting up an Asynchronous or Synchronous Reception with Address Detect Enabled:

1. Initialize the SPBRG register for the appropriate baud rate. If a high speed baud rate is desired, set bit BRGH.
2. Enable asynchronous or synchronous communication by setting or clearing bit SYNC and setting bit SPEN.
3. If interrupts are desired, then set enable bit RCIE.
4. Set bit RX9 to enable 9-bit reception.
5. Set ADEN to enable address detect.
6. Enable the reception by setting enable bit CREN or SREN.
7. Flag bit RCIF will be set when reception is complete, and an interrupt will be generated if enable bit RCIE was set.
8. Read the 8-bit received data by reading the RCREG register to determine if the device is being addressed.
9. If any error occurred, clear the error by clearing enable bit CREN if it was already set.
10. If the device has been addressed (RSR<8> = 1 with address match enabled), clear the ADEN and RCIF bits to allow data bytes and address bytes to be read into the receive buffer and interrupt the CPU.

TABLE 12-8: REGISTERS ASSOCIATED WITH ASYNCHRONOUS RECEPTION

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR	Value on all other RESETS
0Ch	PIR1	EEIF	CMIF	RCIF	TXIF	—	CCP1IF	TMR2IF	TMR1IF	0000 - 000	0000 - 000
18h	RCSTA	SPEN	RX9	SREN	CREN	ADEN	FERR	OERR	RX9D	0000 - 00x	0000 - 00x
1Ah	RCREG	RX7	RX6	RX5	RX4	RX3	RX2	RX1	RX0	0000 0000	0000 0000
8Ch	PIE1	EEIE	CMIE	RCIE	TXIE	—	CCP1IE	TMR2IE	TMR1IE	0000 - 000	0000 - 000
98h	TXSTA	CSRC	TX9	TXEN	SYNC	—	BRGH	TRMT	TX9D	0000 - 010	0000 - 010
99h	SPBRG	Baud Rate Generator Register								0000 0000	0000 0000

Legend: x = unknown, - = unimplemented locations read as '0'. Shaded cells are not used for Asynchronous Reception.

PIC16F62X

REGISTER 13-2: EECON1 REGISTER (ADDRESS: 9Ch)

U-0	U-0	U-0	U-0	R/W-x	R/W-0	R/S-0	R/S-x
—	—	—	—	WRERR	WREN	WR	RD
bit 7				bit 0			

bit 7-4 **Unimplemented:** Read as '0'

bit 3 **WRERR:** EEPROM Error Flag bit

1 = A write operation is prematurely terminated (any $\overline{\text{MCLR}}$ Reset, any WDT Reset during normal operation or BOD Reset)

0 = The write operation completed

bit 2 **WREN:** EEPROM Write Enable bit

1 = Allows write cycles

0 = Inhibits write to the data EEPROM

bit 1 **WR:** Write Control bit

1 = Initiates a write cycle. (The bit is cleared by hardware once write is complete. The WR bit can only be set (not cleared) in software.

0 = Write cycle to the data EEPROM is complete

bit 0 **RD:** Read Control bit

1 = Initiates an EEPROM read (read takes one cycle. RD is cleared in hardware. The RD bit can only be set (not cleared) in software).

0 = Does not initiate an EEPROM read

Legend:

R = Readable bit

W = Writable bit

U = Unimplemented bit, read as '0'

-n = Value at POR

'1' = Bit is set

'0' = Bit is cleared

x = Bit is unknown

14.0 SPECIAL FEATURES OF THE CPU

Special circuits to deal with the needs of real-time applications are what sets a microcontroller apart from other processors. The PIC16F62X family has a host of such features intended to maximize system reliability, minimize cost through elimination of external components, provide power saving Operating modes and offer code protection.

These are:

1. OSC selection
2. RESET
3. Power-on Reset (POR)
4. Power-up Timer (PWRT)
5. Oscillator Start-Up Timer (OST)
6. Brown-out Reset (BOD)
7. Interrupts
8. Watchdog Timer (WDT)
9. SLEEP
10. Code protection
11. ID Locations
12. In-circuit Serial Programming

The PIC16F62X has a Watchdog Timer which is controlled by configuration bits. It runs off its own RC oscillator for added reliability. There are two timers that offer necessary delays on power-up. One is the Oscillator Start-up Timer (OST), intended to keep the chip in RESET until the crystal oscillator is stable. The other is the Power-up Timer (PWRT), which provides a fixed delay of 72 ms (nominal) on power-up only, designed to keep the part in RESET while the power supply stabilizes. There is also circuitry to RESET the device if a Brown-out occurs, which provides at least a 72 ms RESET. With these three functions on-chip, most applications need no external RESET circuitry.

The SLEEP mode is designed to offer a very low current Power-down mode. The user can wake-up from SLEEP through external RESET, Watchdog Timer wake-up or through an interrupt. Several oscillator options are also made available to allow the part to fit the application. The ER oscillator option saves system cost while the LP crystal option saves power. A set of configuration bits are used to select various options.

14.1 Configuration Bits

The configuration bits can be programmed (read as '0') or left unprogrammed (read as '1') to select various device configurations. These bits are mapped in program memory location 2007h.

The user will note that address 2007h is beyond the user program memory space. In fact, it belongs to the special configuration memory space (2000h – 3FFFh), which can be accessed only during programming. See Programming Specification.

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REGISTER 14-1: CONFIGURATION WORD

CP1	CP0	CP1	CP0	—	CPD	LVP	BODEN	MCLR $\overline{\text{E}}$	FOSC2	$\overline{\text{PWRT}}\overline{\text{E}}$	WDTE	FOSC1	FOSC0
bit 13											bit 0		

bit 13-10: **CP1:CP0:** Code Protection bits ⁽²⁾

Code protection for 2K program memory

11 = Program memory code protection off

10 = 0400h-07FFh code protected

01 = 0200h-07FFh code protected

00 = 0000h-07FFh code protected

Code protection for 1K program memory

11 = Program memory code protection off

10 = Program memory code protection off

01 = 0200h-03FFh code protected

00 = 0000h-03FFh code protected

bit 9: **Unimplemented:** Read as '0'

bit 8: **CPD:** Data Code Protection bit ⁽³⁾

1 = Data memory code protection off

0 = Data memory code protected

bit 7: **LVP:** Low Voltage Programming Enable

1 = RB4/PGM pin has PGM function, low voltage programming enabled

0 = RB4/PGM is digital I/O, HV on $\overline{\text{MCLR}}$ must be used for programming

bit 6: **BODEN:** Brown-out Detect Reset Enable bit ⁽¹⁾

1 = BOD Reset enabled

0 = BOD Reset disabled

bit 5: **MCLR $\overline{\text{E}}$:** RA5/ $\overline{\text{MCLR}}$ pin function select

1 = RA5/ $\overline{\text{MCLR}}$ pin function is $\overline{\text{MCLR}}$

0 = RA5/ $\overline{\text{MCLR}}$ pin function is digital Input, $\overline{\text{MCLR}}$ internally tied to VDD

bit 3: **$\overline{\text{PWRT}}\overline{\text{E}}$:** Power-up Timer Enable bit ⁽¹⁾

1 = PWRT disabled

0 = PWRT enabled

bit 2: **WDTE:** Watchdog Timer Enable bit

1 = WDT enabled

0 = WDT disabled

bit 4, 1-0: **FOSC2:FOSC0:** Oscillator Selection bits ⁽⁴⁾

111 = ER oscillator: CLKOUT function on RA6/OSC2/CLKOUT pin, Resistor on RA7/OSC1/CLKIN

110 = ER oscillator: I/O function on RA6/OSC2/CLKOUT pin, Resistor on RA7/OSC1/CLKIN

101 = INTRC oscillator: CLKOUT function on RA6/OSC2/CLKOUT pin, I/O function on RA7/OSC1/CLKIN

100 = INTRC oscillator: I/O function on RA6/OSC2/CLKOUT pin, I/O function on RA7/OSC1/CLKIN

011 = EC: I/O function on RA6/OSC2/CLKOUT pin, CLKIN on RA7/OSC1/CLKIN

010 = HS oscillator: High speed crystal/resonator on RA6/OSC2/CLKOUT and RA7/OSC1/CLKIN

001 = XT oscillator: Crystal/resonator on RA6/OSC2/CLKOUT and RA7/OSC1/CLKIN

000 = LP oscillator: Low power crystal on RA6/OSC2/CLKOUT and RA7/OSC1/CLKIN

Note 1: Enabling Brown-out Detect Reset automatically enables Power-up Timer (PWRT) regardless of the value of bit $\overline{\text{PWRT}}\overline{\text{E}}$. Ensure the Power-up Timer is enabled anytime Brown-out Detect Reset is enabled.

2: All of the CP1:CP0 pairs have to be given the same value to enable the code protection scheme listed.

3: The entire data EEPROM will be erased when the code protection is turned off.

4: When $\overline{\text{MCLR}}$ is asserted in INTRC or ER mode, the internal clock oscillator is disabled.

Legend

R = Readable bit

W = Writable bit

U = Unimplemented bit, read as '0'

-n = Value at POR

1 = bit is set

0 = bit is cleared

x = bit is unknown

14.5.5 TIMEOUT SEQUENCE

On power-up the timeout sequence is as follows: First PWRT timeout is invoked after POR has expired. Then OST is activated. The total timeout will vary based on oscillator configuration and PWRTE bit status. For example, in ER mode with PWRTE bit erased (PWRT disabled), there will be no timeout at all. Figure 14-8, Figure 14-9 and Figure 14-10 depict timeout sequences.

Since the timeouts occur from the POR pulse, if $\overline{\text{MCLR}}$ is kept low long enough, the timeouts will expire. Then bringing $\overline{\text{MCLR}}$ high will begin execution immediately (see Figure 14-9). This is useful for testing purposes or to synchronize more than one PIC16F62X device operating in parallel.

Table 14-7 shows the RESET conditions for some special registers, while Table 14-8 shows the RESET conditions for all the registers.

14.5.6 POWER CONTROL (PCON) STATUS REGISTER

The Power Control/STATUS register, PCON (address 8Eh) has two bits.

Bit0 is $\overline{\text{BOD}}$ (Brown-out). $\overline{\text{BOD}}$ is unknown on Power-on Reset. It must then be set by the user and checked on subsequent RESETS to see if $\overline{\text{BOD}} = 0$ indicating that a brown-out has occurred. The $\overline{\text{BOD}}$ STATUS bit is a don't care and is not necessarily predictable if the brown-out circuit is disabled (by setting BODEN bit = 0 in the Configuration word).

Bit1 is $\overline{\text{POR}}$ (Power-on Reset). It is a '0' on Power-on Reset and unaffected otherwise. The user must write a '1' to this bit following a Power-on Reset. On a subsequent RESET if $\overline{\text{POR}}$ is '0', it will indicate that a Power-on Reset must have occurred (VDD may have gone too low).

TABLE 14-4: TIMEOUT IN VARIOUS SITUATIONS

Oscillator Configuration	Power-up		Brown-out Detect Reset	Wake-up from SLEEP
	$\overline{\text{PWRTE}} = 0$	$\overline{\text{PWRTE}} = 1$		
XT, HS, LP	72 ms + 1024 TOSC	1024 TOSC	72 ms + 1024 TOSC	1024 TOSC
ER, INTRC, EC	72 ms	—	72 ms	—

TABLE 14-5: STATUS/PCON BITS AND THEIR SIGNIFICANCE

$\overline{\text{POR}}$	$\overline{\text{BOD}}$	$\overline{\text{TO}}$	$\overline{\text{PD}}$	
0	X	1	1	Power-on Reset
0	X	0	X	Illegal, $\overline{\text{TO}}$ is set on $\overline{\text{POR}}$
0	X	X	0	Illegal, $\overline{\text{PD}}$ is set on $\overline{\text{POR}}$
1	0	X	X	Brown-out Detect Reset
1	1	0	u	WDT Reset
1	1	0	0	WDT Wake-up
1	1	u	u	$\overline{\text{MCLR}}$ Reset during normal operation
1	1	1	0	$\overline{\text{MCLR}}$ Reset during SLEEP

Legend: u = unchanged, x = unknown.

TABLE 14-6: SUMMARY OF REGISTERS ASSOCIATED WITH BROWN-OUT

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR Reset	Value on all other RESETS ⁽¹⁾
03h	STATUS	IRP	RP1	RPO	$\overline{\text{TO}}$	$\overline{\text{PD}}$	Z	DC	C	0001 1xxx	000q quuu
8Eh	PCON	—	—	—	—	OSCF	Reset	$\overline{\text{POR}}$	$\overline{\text{BOD}}$	---- 1-0x	---- u-uq

Note 1: Other (non Power-up) Resets include $\overline{\text{MCLR}}$ Reset, Brown-out Detect Reset and Watchdog Timer Reset during normal operation.

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14.6.1 RB0/INT INTERRUPT

External interrupt on RB0/INT pin is edge triggered: either rising if INTEDG bit (OPTION<6>) is set, or falling, if INTEDG bit is clear. When a valid edge appears on the RB0/INT pin, the INTF bit (INTCON<1>) is set. This interrupt can be disabled by clearing the INTE control bit (INTCON<4>). The INTF bit must be cleared in software in the interrupt service routine before re-enabling this interrupt. The RB0/INT interrupt can wake-up the processor from SLEEP, if the INTE bit was set prior to going into SLEEP. The status of the GIE bit decides whether or not the processor branches to the interrupt vector following wake-up. See Section 14.9 for details on SLEEP, and Figure 14-17 for timing of wake-up from SLEEP through RB0/INT interrupt.

14.6.2 TMR0 INTERRUPT

An overflow (FFh → 00h) in the TMR0 register will set the T0IF (INTCON<2>) bit. The interrupt can be enabled/disabled by setting/clearing T0IE (INTCON<5>) bit. For operation of the Timer0 module, see Section 6.0.

14.6.3 PORTB INTERRUPT

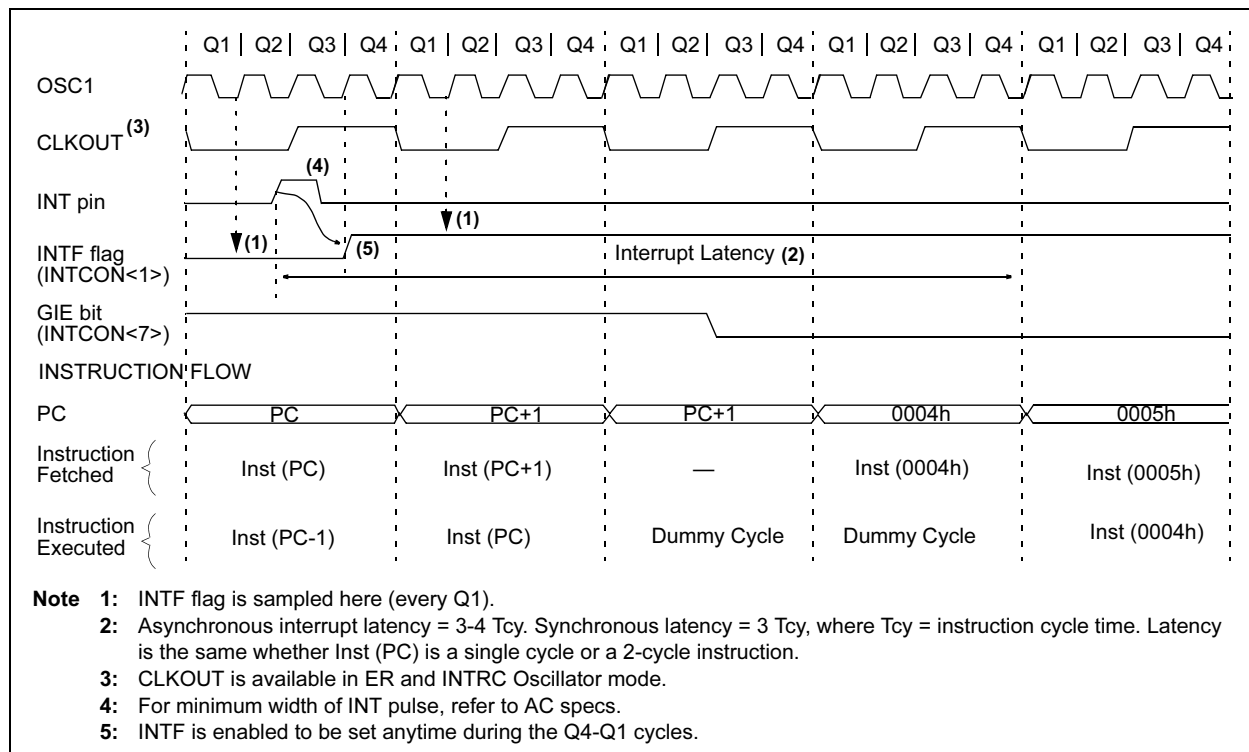
An input change on PORTB <7:4> sets the RBIF (INTCON<0>) bit. The interrupt can be enabled/disabled by setting/clearing the RBIE (INTCON<4>) bit. For operation of PORTB (Section 5.2).

Note: If a change on the I/O pin should occur when the read operation is being executed (start of the Q2 cycle), then the RBIF interrupt flag may not get set.

14.6.4 COMPARATOR INTERRUPT

See Section 9.6 for complete description of comparator interrupts.

FIGURE 14-15: INT PIN INTERRUPT TIMING



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FIGURE 14-16: WATCHDOG TIMER BLOCK DIAGRAM

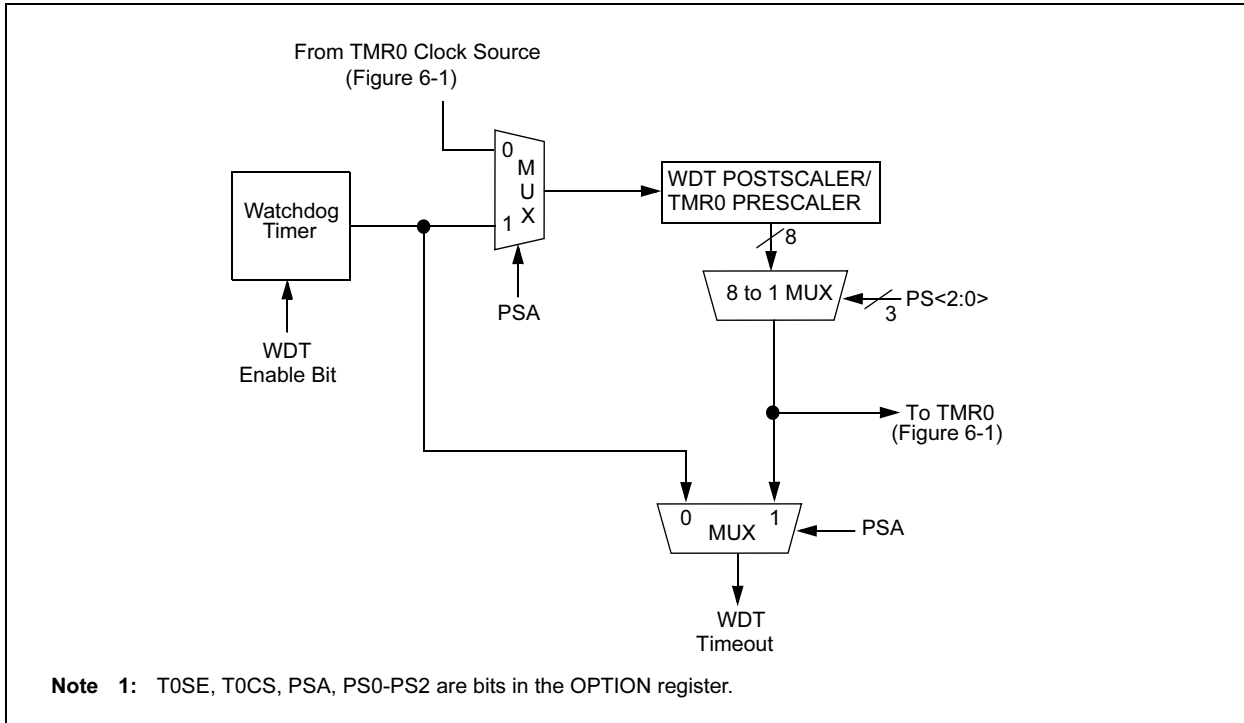


TABLE 14-10: SUMMARY OF WATCHDOG TIMER REGISTERS

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR Reset	Value on all other RESETS
2007h	Config. bits	LVP	BODEN	MCLRE	FOSC2	$\overline{\text{PWRTE}}$	WDTE	FOSC1	FOSC0	uuuu uuuu	uuuu uuuu
81h	OPTION	$\overline{\text{RBPU}}$	INTEDG	T0CS	T0SE	PSA	PS2	PS1	PS0	1111 1111	1111 1111

Legend: – = Unimplemented location, read as “0”, + = Reserved for future use

Note 1: Shaded cells are not used by the Watchdog Timer.

14.9 Power-Down Mode (SLEEP)

The Power-down mode is entered by executing a **SLEEP** instruction.

If enabled, the Watchdog Timer will be cleared but keeps running, the PD bit in the STATUS register is cleared, the TO bit is set, and the oscillator driver is turned off. The I/O ports maintain the status they had, before **SLEEP** was executed (driving high, low, or hi-impedance).

For lowest current consumption in this mode, all I/O pins should be either at VDD, or VSS, with no external circuitry drawing current from the I/O pin and the comparators, and VREF should be disabled. I/O pins that are hi-impedance inputs should be pulled high or low externally to avoid switching currents caused by floating inputs. The T0CKI input should also be at VDD or VSS for lowest current consumption. The contribution from on-chip pull-ups on PORTB should be considered.

The $\overline{\text{MCLR}}$ pin must be at a logic high level (VIHMC).

Note: It should be noted that a RESET generated by a WDT timeout does not drive $\overline{\text{MCLR}}$ pin low.

PIC16F62X

CLRW

Clear W

Syntax: [*label*] CLRW

Operands: None

Operation: 00h → (W)
1 → Z

Status Affected: Z

Encoding:

00	0001	0000	0011
----	------	------	------

Description: W register is cleared. Zero bit (Z) is set.

Words: 1

Cycles: 1

Example CLRW

Before Instruction
W = 0x5A

After Instruction
W = 0x00
Z = 1

COMF

Complement f

Syntax: [*label*] COMF f,d

Operands: $0 \leq f \leq 127$
 $d \in [0,1]$

Operation: $(\bar{f}) \rightarrow (\text{dest})$

Status Affected: Z

Encoding:

00	1001	dfff	ffff
----	------	------	------

Description: The contents of register 'f' are complemented. If 'd' is 0 the result is stored in W. If 'd' is 1 the result is stored back in register 'f'.

Words: 1

Cycles: 1

Example COMF REG1, 0

Before Instruction
REG1 = 0x13
After Instruction
REG1 = 0x13
W = 0xEC

CLRWDT

Clear Watchdog Timer

Syntax: [*label*] CLRWDT

Operands: None

Operation: 00h → WDT
0 → WDT prescaler,
1 → $\overline{\text{TO}}$
1 → $\overline{\text{PD}}$

Status Affected: $\overline{\text{TO}}$, $\overline{\text{PD}}$

Encoding:

00	0000	0110	0100
----	------	------	------

Description: CLRWDT instruction resets the Watchdog Timer. It also resets the prescaler of the WDT. STATUS bits $\overline{\text{TO}}$ and $\overline{\text{PD}}$ are set.

Words: 1

Cycles: 1

Example CLRWDT

Before Instruction
WDT counter = ?
After Instruction
WDT counter = 0x00
WDT prescaler = 0
 $\overline{\text{TO}}$ = 1
 $\overline{\text{PD}}$ = 1

DECF

Decrement f

Syntax: [*label*] DECF f,d

Operands: $0 \leq f \leq 127$
 $d \in [0,1]$

Operation: $(f) - 1 \rightarrow (\text{dest})$

Status Affected: Z

Encoding:

00	0011	dfff	ffff
----	------	------	------

Description: Decrement register 'f'. If 'd' is 0 the result is stored in the W register. If 'd' is 1 the result is stored back in register 'f'.

Words: 1

Cycles: 1

Example DECF CNT, 1

Before Instruction
CNT = 0x01
Z = 0
After Instruction
CNT = 0x00
Z = 1

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17.1 DC Characteristics: PIC16F62X-04 (Commercial, Industrial, Extended) PIC16F62X-20 (Commercial, Industrial, Extended) PIC16LF62X-04 (Commercial, Industrial)

PIC16LF62X-04 (Commercial, Industrial)		Standard Operating Conditions (unless otherwise stated) Operating temperature $-40^{\circ}\text{C} \leq T_a \leq +85^{\circ}\text{C}$ for industrial and $0^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$ for commercial					
PIC16F62X-04 PIC16F62X-20 (Commercial, Industrial, Extended)		Standard Operating Conditions (unless otherwise stated) Operating temperature $-40^{\circ}\text{C} \leq T_a \leq +85^{\circ}\text{C}$ for industrial and $0^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$ for commercial and $-40^{\circ}\text{C} \leq T_a \leq +125^{\circ}\text{C}$ for extended					
Param No.	Sym	Characteristic/Device	Min	Typ†	Max	Units	Conditions
D001	VDD	Supply Voltage					
		PIC16LF62X	2.0	—	5.5	V	
		PIC16F62X	3.0	—	5.5	V	
D002	VDR	RAM Data Retention Voltage⁽¹⁾	—	1.5	—	V	Device in SLEEP mode*
D003	VPOR	VDD Start Voltage to ensure Power-on Reset	—	VSS	—	V	See section on Power-on Reset for details
D004	SVDD	VDD Rise Rate to ensure Power-on Reset	0.05	—	—	V/ms	See section on Power-on Reset for details*
D005	VBOD	Brown-out Detect Voltage	3.65	4.0	4.35	V	BODEN configuration bit is set BODEN configuration bit is set, Extended
			3.65	—	4.4	V	
D010 D013	IDD	Supply Current^{(2), (5)}					
		PIC16LF62X	—	0.30	0.6	mA	Fosc = 4.0 MHz, VDD = 2.0 ⁽⁵⁾
			—	1.10	2.0	mA	Fosc = 4.0 MHz, VDD = 5.5*
			—	4.0	7.0	mA	Fosc = 20.0 MHz, VDD = 5.5
			—	3.80	6.0	mA	Fosc = 20.0 MHz, VDD = 4.5*
			—	—	2.0	mA	Fosc = 10.0 MHz, VDD = 3.0 ⁽⁶⁾
			—	20	30	μA	Fosc = 32 kHz, VDD = 2.0
D010 D013 D014		PIC16F62X	—	0.60	0.7	mA	Fosc = 4.0 MHz, VDD = 3.0
			—	1.10	2.0	mA	Fosc = 4.0 MHz, VDD = 5.5*
			—	4.0	7.0	mA	Fosc = 20.0 MHz, VDD = 5.5
			—	3.80	6.0	mA	Fosc = 20.0 MHz, VDD = 4.5*
			—	—	2.0	mA	Fosc = 10.0 MHz, VDD = 3.0 ⁽⁶⁾
			—	20	30	μA	Fosc = 32 kHz, VDD = 3.0*

Legend: Rows with standard voltage device data only are shaded for improved readability.

* These parameters are characterized but not tested.

† Data in "Typ" column is at 5.0V, 25°C, unless otherwise stated. These parameters are for design guidance only and are not tested.

- Note**
- This is the limit to which VDD can be lowered in SLEEP mode without losing RAM data.
 - The supply current is mainly a function of the operating voltage and frequency. Other factors such as I/O pin loading and switching rate, oscillator type, internal code execution pattern, and temperature also have an impact on the current consumption.

The test conditions for all IDD measurements in active Operation mode are:

OSC1 = external square wave, from rail to rail; all I/O pins tri-stated, pulled to VDD,

MCLR = VDD; WDT enabled/disabled as specified.

- The power-down current in SLEEP mode does not depend on the oscillator type. Power-down current is measured with the part in SLEEP mode, with all I/O pins in hi-impedance state and tied to VDD or VSS.
- The Δ current is the additional current consumed when this peripheral is enabled. This current should be added to the base IDD or IPD measurement.
- For RC osc configuration, current through REXT is not included. The current through the resistor can be estimated by the formula $I_r = V_{DD}/2R_{EXT}$ (mA) with REXT in kΩ.
- Commercial temperature only.