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"[Embedded - Microcontrollers](#)" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

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Details

Product Status	Obsolete
Core Processor	PIC
Core Size	8-Bit
Speed	4MHz
Connectivity	I ² C, SPI
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	22
Program Memory Size	3.5KB (2K x 14)
Program Memory Type	OTP
EEPROM Size	-
RAM Size	128 x 8
Voltage - Supply (Vcc/Vdd)	2.5V ~ 5.5V
Data Converters	-
Oscillator Type	External
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	28-VQFN Exposed Pad
Supplier Device Package	28-QFN (6x6)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic16lc62b-04i-ml

2.0 MEMORY ORGANIZATION

There are two memory blocks in each of these micro-controllers. Each block (Program Memory and Data Memory) has its own bus, so that concurrent access can occur.

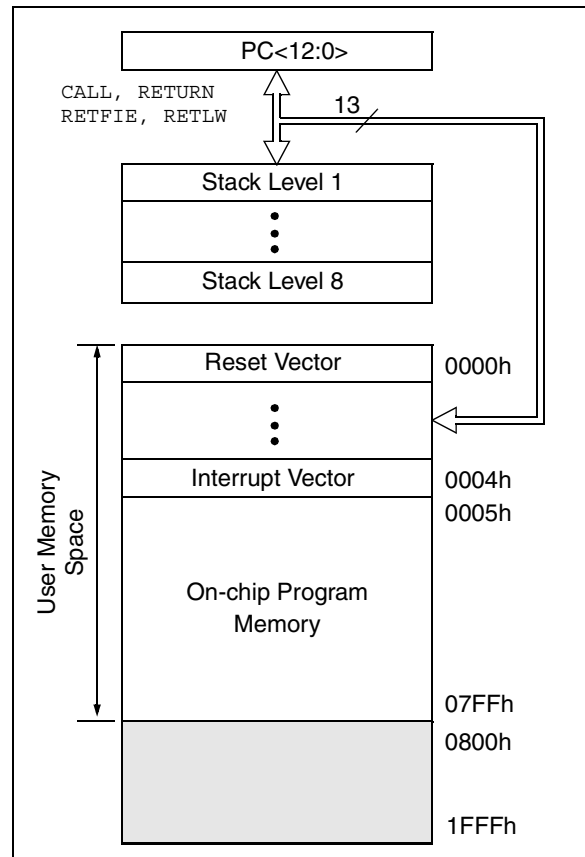
Additional information on device memory may be found in the PICmicro™ Mid-Range Reference Manual, (DS33023).

2.1 Program Memory Organization

The PIC16C62B/72A devices have a 13-bit program counter capable of addressing an 8K x 14 program memory space. Each device has 2K x 14 words of program memory. Accessing a location above 07FFh will cause a wraparound.

The reset vector is at 0000h and the interrupt vector is at 0004h.

FIGURE 2-1: PROGRAM MEMORY MAP AND STACK



2.2.2.1 STATUS REGISTER

The STATUS register, shown in Register 2-1, contains the arithmetic status of the ALU, the RESET status and the bank select bits for data memory.

The STATUS register can be the destination for any instruction, as with any other register. If the STATUS register is the destination for an instruction that affects the Z, DC or C bits, the write to these three bits is disabled. These bits are set or cleared according to the device logic. The $\overline{\text{TO}}$ and $\overline{\text{PD}}$ bits are not writable. 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 `000u u1uu` (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 the Z, C or DC bits from the STATUS register. For other instructions, not affecting any status bits, see the "Instruction Set Summary."

Note 1: The IRP and RP1 bits are reserved. Maintain these bits clear to ensure upward compatibility with future products.

Note 2: The C and DC bits operate as a borrow and digit borrow bit, respectively, in subtraction. See the `SUBLW` and `SUBWF` instructions.

REGISTER 2-1: STATUS REGISTER (ADDRESS 03h, 83h)

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
bit7							bit0

R = Readable bit
W = Writable bit
U = Unimplemented bit, read as '0'
- n = Value at POR reset

- bit 7: **IRP:** Register Bank Select bit (used for indirect addressing) (reserved, maintain clear)
- bit 6-5: **RP1:RP0:** Register Bank Select bits (used for direct addressing)
 - 01 = Bank 1 (80h - FFh)
 - 00 = Bank 0 (00h - 7Fh)
 - Each bank is 128 bytes
 - Note:** RP1 is reserved, maintain clear
- bit 4: **$\overline{\text{TO}}$:** Time-out bit
 - 1 = After power-up, `CLRWDT` instruction, or `SLEEP` instruction
 - 0 = A WDT time-out occurred
- bit 3: **$\overline{\text{PD}}$:** Power-down bit
 - 1 = After power-up or by the `CLRWDT` 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) (for borrow, the polarity is reversed)
 - 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: 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.

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2.2.2.2 OPTION_REG REGISTER

The OPTION_REG register is a readable and writable register, which contains various control bits to configure the TMR0 prescaler/WDT postscaler (single assignable register known as the prescaler), the External INT Interrupt, TMR0 and the weak pull-ups on PORTB.

Note: To achieve a 1:1 prescaler assignment for the TMR0 register, assign the prescaler to the Watchdog Timer.

REGISTER 2-2: OPTION_REG REGISTER (ADDRESS 81h)

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
RBPU	INTEDG	T0CS	T0SE	PSA	PS2	PS1	PS0
bit7							bit0

R = Readable bit
W = Writable bit
- n = Value at POR reset

bit 7: **RBPU**: PORTB Pull-up Enable bit
1 = PORTB pull-ups are disabled
0 = PORTB pull-ups are enabled for all PORTB inputs

bit 6: **INTEDG**: Interrupt Edge Select bit
1 = Interrupt on rising edge of RB0/INT pin
0 = Interrupt on falling edge of RB0/INT pin

bit 5: **T0CS**: TMR0 Clock Source Select bit
1 = Transition on RA4/T0CKI pin
0 = Internal instruction cycle clock (CLKOUT)

bit 4: **T0SE**: TMR0 Source Edge Select bit
1 = Increment on high-to-low transition on RA4/T0CKI pin
0 = Increment on low-to-high transition on RA4/T0CKI pin

bit 3: **PSA**: Prescaler Assignment bit
1 = Prescaler is assigned to the WDT
0 = Prescaler is assigned to the Timer0 module

bit 2-0: **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

2.2.2.6 PCON REGISTER

The Power Control register (PCON) contains flag bits to allow differentiation between a Power-on Reset (POR), Brown-Out Reset (BOR) and resets from other sources. .

Note: On Power-on Reset, the state of the BOR bit is unknown and is not predictable.
If the BODEN bit in the configuration word is set, the user must first set the BOR bit on a POR, and check it on subsequent resets. If BOR is cleared while POR remains set, a Brown-out reset has occurred.
If the BODEN bit is clear, the BOR bit may be ignored.

REGISTER 2-6: PCON REGISTER (ADDRESS 8Eh)

U-0	U-0	U-0	U-0	U-0	U-0	R/W-0	R/W-q
—	—	—	—	—	—	POR	BOR

bit7

bit0

R = Readable bit
W = Writable bit
U = Unimplemented bit, read as '0'
- n = Value at POR reset

bit 7-2: **Unimplemented:** Read as '0'

bit 1: **POR:** Power-on Reset Status bit
1 = No Power-on Reset occurred
0 = A Power-on Reset occurred (must be set in software after a Power-on Reset occurs)

bit 0: **BOR:** Brown-out Reset Status bit
1 = No Brown-out Reset occurred
0 = A Brown-out Reset occurred (must be set in software after a Brown-out Reset occurs)

4.0 TIMER0 MODULE

The Timer0 module timer/counter has the following features:

- 8-bit timer/counter
 - Read and write
 - INT on overflow
- 8-bit software programmable prescaler
- INT or EXT clock select
 - EXT clock edge select

Figure 4-1 is a simplified block diagram of the Timer0 module.

Additional information on timer modules is available in the PIC® MCU Mid-Range Reference Manual, (DS33023).

4.1 Timer0 Operation

Timer0 can operate as a timer or as a counter.

Timer mode is selected by clearing bit T0CS (OPTION_REG<5>). In timer mode, the Timer0 module will increment every instruction cycle (without prescaler). If the TMR0 register is written, the increment is inhibited for the following two instruction cycles. The user can work around this by writing an adjusted value to the TMR0 register.

Counter mode is selected by setting bit T0CS (OPTION_REG<5>). In counter mode, Timer0 will increment either on every rising or falling edge of pin RA4/T0CKI. The incrementing edge is determined by the Timer0 Source Edge Select bit T0SE (OPTION_REG<4>). Clearing bit T0SE selects the rising edge. Restrictions on the external clock input are discussed below.

When an external clock input is used for Timer0, it must meet certain requirements. The requirements ensure the external clock can be synchronized with the internal phase clock (Tosc). Also, there is a delay in the actual incrementing of Timer0 after synchronization.

Additional information on external clock requirements is available in the Electrical Specifications section of this manual, and in the PIC® MCU Mid-Range Reference Manual, (DS33023).

4.2 Prescaler

An 8-bit counter is available as a prescaler for the Timer0 module, or as a postscale for the Watchdog Timer, respectively (Figure 4-2). For simplicity, this counter is being referred to as “prescaler” throughout this data sheet. There is only one prescaler available which is shared between the Timer0 module and the Watchdog Timer. A prescaler assignment for the Timer0 module means that there is no prescaler for the Watchdog Timer, and vice-versa.

The prescaler is not readable or writable.

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

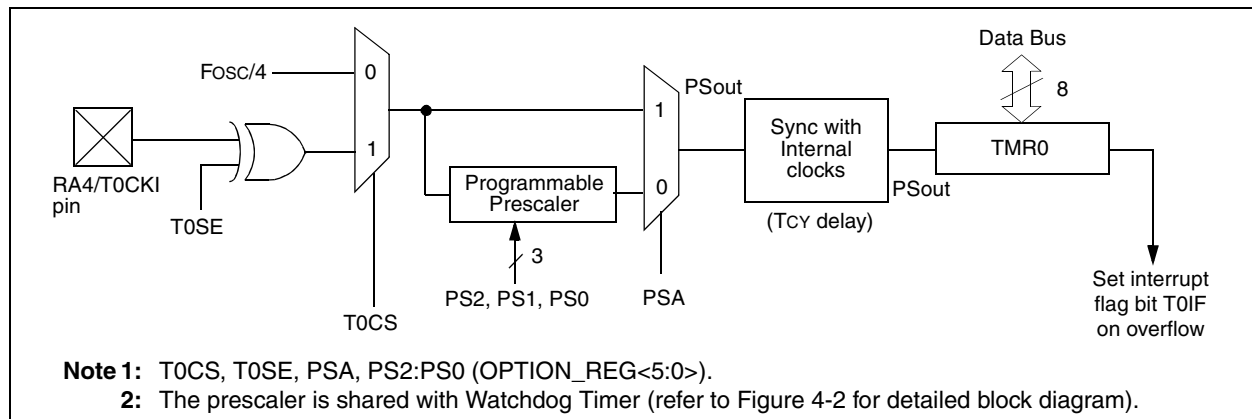
Clearing bit PSA will assign the prescaler to the Timer0 module. When the prescaler is assigned to the Timer0 module, prescale values of 1:2, 1:4, ..., 1:256 are selectable.

Setting bit PSA will assign the prescaler to the Watchdog Timer (WDT). When the prescaler is assigned to the WDT, prescale values of 1:1, 1:2, ..., 1:128 are selectable.

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 WDT.

Note: Writing to TMR0 when the prescaler is assigned to Timer0 will clear the prescaler count, but will not change the prescaler assignment or ratio.

FIGURE 4-1: TIMER0 BLOCK DIAGRAM



7.0 CAPTURE/COMPARE/PWM (CCP) MODULE

The CCP (Capture/Compare/PWM) module contains a 16-bit register, which can operate as a 16-bit capture register, as a 16-bit compare register or as a PWM master/slave duty cycle register. Table 7-1 shows the timer resources of the CCP module modes.

Capture/Compare/PWM Register 1 (CCPR1) is comprised of two 8-bit registers: CCPR1L (low byte) and CCPR1H (high byte). The CCP1CON register controls the operation of CCP1. All are readable and writable.

Additional information on the CCP module is available in the PIC® MCU Mid-Range Reference Manual, (DS33023).

TABLE 7-1 CCP MODE - TIMER RESOURCE

CCP Mode	Timer Resource
Capture	Timer1
Compare	Timer1
PWM	Timer2

TABLE 7-2 INTERACTION OF TWO CCP MODULES

CCPx Mode	CCPy Mode	Interaction
Capture	Capture	Same TMR1 time-base.
Capture	Compare	The compare should be configured for the special event trigger, which clears TMR1.
Compare	Compare	The compare(s) should be configured for the special event trigger, which clears TMR1.
PWM	PWM	The PWMs will have the same frequency and update rate (TMR2 interrupt).
PWM	Capture	None.
PWM	Compare	None.

REGISTER 7-1: CCP1CON REGISTER (ADDRESS 17h)

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	CCP1X	CCP1Y	CCP1M3	CCP1M2	CCP1M1	CCP1M0
bit7							bit0

R = Readable bit
W = Writable bit
U = Unimplemented bit, read as '0'
- n = Value at POR reset

bit 7-6: **Unimplemented:** Read as '0'

bit 5-4: **CCP1X:CCP1Y:** PWM Least Significant bits
Capture Mode: Unused
Compare Mode: Unused
PWM Mode: These bits are the two LSBs of the PWM duty cycle. The eight MSBs are found in CCPR1L.

bit 3-0: **CCP1M3:CCP1M0:** CCP1 Mode Select bits
0000 = Capture/Compare/PWM off (resets CCP1 module)
0100 = Capture mode, every falling edge
0101 = Capture mode, every rising edge
0110 = Capture mode, every 4th rising edge
0111 = Capture mode, every 16th rising edge
1000 = Compare mode, set output on match (CCP1IF bit is set)
1001 = Compare mode, clear output on match (CCP1IF bit is set)
1010 = Compare mode, generate software interrupt on match (CCP1IF bit is set, CCP1 pin is unaffected)
1011 = Compare mode, trigger special event (CCP1IF bit is set; CCP1 resets TMR1 and starts an A/D conversion (if A/D module is enabled))
11xx = PWM mode

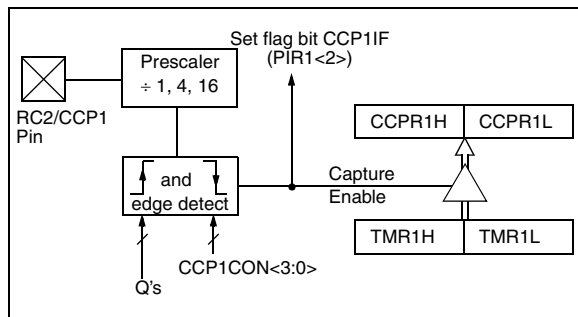
7.1 Capture Mode

In Capture mode, CCP1H:CCP1L captures the 16-bit value of the TMR1 register, when an event occurs on pin RC2/CCP1. An event is defined as:

- every falling edge
- every rising edge
- every 4th rising edge
- every 16th rising edge

An event is selected by control bits CCP1M3:CCP1M0 (CCP1CON<3:0>). When a capture is made, the interrupt request flag bit, CCP1IF (PIR1<2>), is set. It must be cleared in software. If another capture occurs before the value in register CCP1 is read, the old captured value will be lost.

FIGURE 7-1: CAPTURE MODE OPERATION BLOCK DIAGRAM



7.1.1 CCP PIN CONFIGURATION

In Capture mode, the RC2/CCP1 pin should be configured as an input by setting the TRISC<2> bit.

Note: If the RC2/CCP1 is configured as an output, a write to the port can cause a capture condition.

7.1.2 TIMER1 MODE SELECTION

Timer1 must be running in timer mode or synchronized counter mode for the CCP module to use the capture feature. In asynchronous counter mode, the capture operation may not work consistently.

7.1.3 SOFTWARE INTERRUPT

When the Capture mode is changed, a false capture interrupt may be generated. The user should clear CCP1IE (PIE1<2>) before changing the capture mode to avoid false interrupts. Clear the interrupt flag bit, CCP1IF before setting CCP1IE.

7.1.4 CCP PRESCALER

There are four prescaler settings, specified by bits CCP1M3:CCP1M0. Whenever the CCP module is turned off, or the CCP module is not in capture mode, the prescaler counter is cleared. This means that any reset will clear the prescaler counter.

Switching from one capture prescaler to another may generate an interrupt. Also, the prescaler counter will not be cleared, therefore the first capture may be from a non-zero prescaler. Example 7-1 shows the recommended method for switching between capture prescalers. This example also clears the prescaler counter and will not generate the “false” interrupt.

EXAMPLE 7-1: CHANGING BETWEEN CAPTURE PRESCALERS

```
CLRF    CCP1CON    ;Turn CCP module off
MOVLW   NEW_CAPT_PS ;Load the W reg with
                        ; the new prescaler
                        ; mode value and CCP ON
MOVWF   CCP1CON    ;Load CCP1CON with this
                        ; value
```


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NOTES:

8.3.2 MASTER OPERATION

Master operation is supported in firmware using interrupt generation on the detection of the START and STOP conditions. The STOP (P) and START (S) bits are cleared by a reset or when the SSP module is disabled. The STOP (P) and START (S) bits will toggle based on the START and STOP conditions. Control of the I²C bus may be taken when the P bit is set, or the bus is idle and both the S and P bits are clear.

In master operation, the SCL and SDA lines are manipulated in software by clearing the corresponding TRISC<4:3> bit(s). The output level is always low, irrespective of the value(s) in PORTC<4:3>. So when transmitting data, a '1' data bit must have the TRISC<4> bit set (input) and a '0' data bit must have the TRISC<4> bit cleared (output). The same scenario is true for the SCL line with the TRISC<3> bit.

The following events will cause SSP Interrupt Flag bit, SSPIF, to be set (SSP Interrupt if enabled):

- START condition
- STOP condition
- Byte transfer completed

Master operation can be done with either the slave mode idle (SSPM3:SSPM0 = 1011) or with the slave active. When both master operation and slave modes are used, the software needs to differentiate the source(s) of the interrupt.

For more information on master operation, see AN554 - *Software Implementation of I²C Bus Master*.

8.3.3 MULTI-MASTER OPERATION

In multi-master operation, the interrupt generation on the detection of the START and STOP conditions allows the determination of when the bus is free. The STOP (P) and START (S) bits are cleared from a reset or when the SSP module is disabled. The STOP (P) and START (S) bits will toggle based on the START and STOP conditions. Control of the I²C bus may be taken when bit P (SSPSTAT<4>) is set, or the bus is idle and both the S and P bits clear. When the bus is busy, enabling the SSP Interrupt will generate the interrupt when the STOP condition occurs.

In multi-master operation, the SDA line must be monitored to see if the signal level is the expected output level. This check only needs to be done when a high level is output. If a high level is expected and a low level is present, the device needs to release the SDA and SCL lines (set TRISC<4:3>). There are two stages where this arbitration can be lost, these are:

- Address Transfer
- Data Transfer

When the slave logic is enabled, the slave continues to receive. If arbitration was lost during the address transfer stage, communication to the device may be in progress. If addressed, an ACK pulse will be generated. If arbitration was lost during the data transfer stage, the device will need to re-transfer the data at a later time.

For more information on master operation, see AN578 - *Use of the SSP Module in the of I²C Multi-Master Environment*.

TABLE 8-3 REGISTERS ASSOCIATED WITH I²C OPERATION

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR, BOR	Value on all other resets
0Bh, 8Bh	INTCON	GIE	PEIE	T0IE	INTE	RBIE	T0IF	INTF	RBIF	0000 000x	0000 000u
0Ch	PIR1	—	ADIF	—	—	SSPIF	CCP1IF	TMR2IF	TMR1IF	-0-- 0000	-0-- 0000
8Ch	PIE1	—	ADIE	—	—	SSPIE	CCP1IE	TMR2IE	TMR1IE	-0-- 0000	-0-- 0000
13h	SSPBUF	Synchronous Serial Port Receive Buffer/Transmit Register								xxxx xxxx	uuuu uuuu
93h	SSPADD	Synchronous Serial Port (I ² C mode) Address Register								0000 0000	0000 0000
14h	SSPCON	WCOL	SSPOV	SSPEN	CKP	SSPM3	SSPM2	SSPM1	SSPM0	0000 0000	0000 0000
94h	SSPSTAT	SMP ⁽¹⁾	CKE ⁽¹⁾	D/ \bar{A}	P	S	R/ \bar{W}	UA	BF	0000 0000	0000 0000
87h	TRISC	PORTC Data Direction register								1111 1111	1111 1111

Legend: x = unknown, u = unchanged, - = unimplemented locations read as '0'.
Shaded cells are not used by SSP module in SPI mode.

Note 1: Maintain these bits clear in I²C mode.

When the A/D conversion is complete, the result is loaded into the ADRES register, the $\overline{\text{GO/DONE}}$ bit, $\text{ADCON0}<2>$, is cleared, and the A/D interrupt flag bit, ADIF, is set. The block diagram of the A/D module is shown in Figure 9-1.

The value that is in the ADRES register is not modified for a Power-on Reset. The ADRES register will contain unknown data after a Power-on Reset.

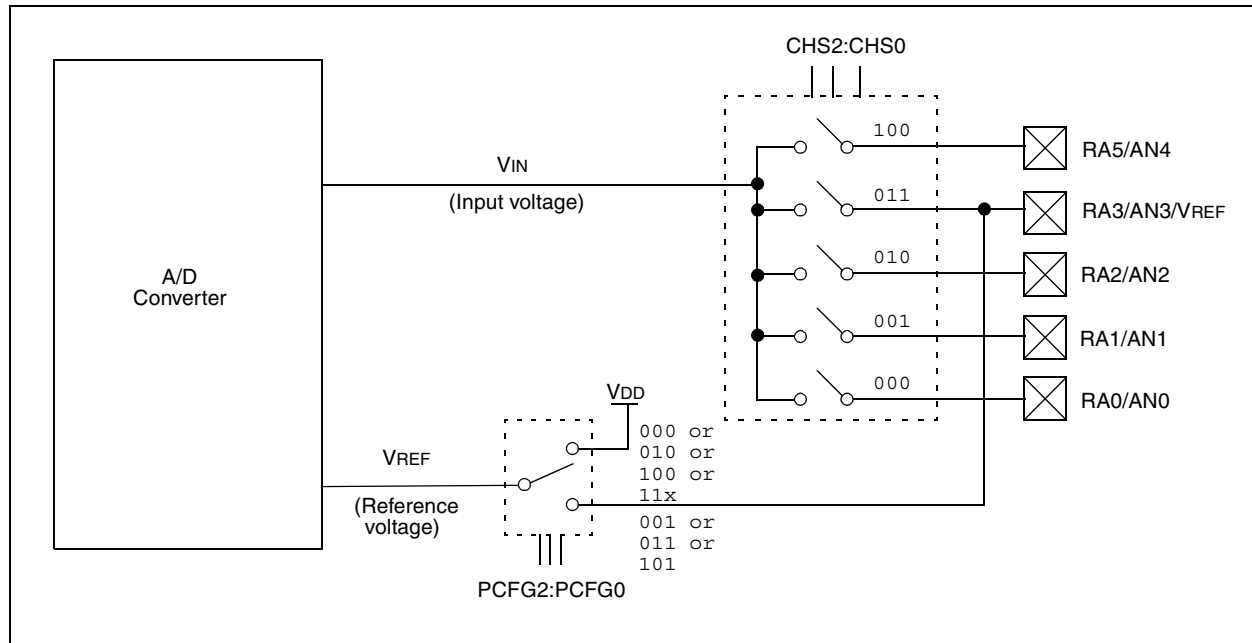
After the A/D module has been configured as desired, the selected channel must be acquired before the conversion is started. The analog input channels must have their corresponding TRIS bits selected as an input. To determine acquisition time, see Section 9.1. After this acquisition time has elapsed, the A/D conversion can be started. The following steps should be followed for doing an A/D conversion:

1. Configure the A/D module:
 - Configure analog pins / voltage reference / and digital I/O (ADCON1)
 - Select A/D input channel (ADCON0)
 - Select A/D conversion clock (ADCON0)
 - Turn on A/D module (ADCON0)
2. Configure A/D interrupt (if desired):
 - Clear ADIF bit
 - Set ADIE bit
 - Set GIE bit
3. Wait the required acquisition time.
4. Start conversion:
 - Set $\overline{\text{GO/DONE}}$ bit (ADCON0)
5. Wait for A/D conversion to complete, by either:
 - Polling for the $\overline{\text{GO/DONE}}$ bit to be cleared

OR

 - Waiting for the A/D interrupt
6. Read A/D Result register (ADRES), clear bit ADIF if required.
7. For next conversion, go to step 1 or step 2 as required. The A/D conversion time per bit is defined as T_{AD} . A minimum wait of $2T_{AD}$ is required before next acquisition starts.

FIGURE 9-1: A/D BLOCK DIAGRAM



11.0 INSTRUCTION SET SUMMARY

Each PIC16CXXX instruction is a 14-bit word divided into an OPCODE which specifies the instruction type and one or more operands which further specify the operation of the instruction. The PIC16CXX instruction set summary in Table 11-2 lists **byte-oriented**, **bit-oriented**, and **literal and control** operations. Table 11-1 shows the opcode field descriptions.

For **byte-oriented** instructions, 'f' represents a file register designator and 'd' represents a destination designator. The file register designator specifies which file register is to be used by the instruction.

The destination designator specifies where the result of the operation is to be placed. If 'd' is zero, the result is placed in the W register. If 'd' is one, the result is placed in the file register specified in the instruction.

For **bit-oriented** instructions, 'b' represents a bit field designator which selects the number of the bit affected by the operation, while 'f' represents the number of the file in which the bit is located.

For **literal and control** operations, 'k' represents an eight or eleven bit constant or literal value.

TABLE 11-1 OPCODE FIELD DESCRIPTIONS

Field	Description
f	Register file address (0x00 to 0x7F)
w	Working register (accumulator)
b	Bit address within an 8-bit file register
k	Literal field, constant data or label
x	Don't care location (= 0 or 1) The assembler will generate code with x = 0. It is the recommended form of use for compatibility with all Microchip software tools.
d	Destination select; d = 0: store result in W, d = 1: store result in file register f. Default is d = 1
PC	Program Counter
TO	Time-out bit
PD	Power-down bit
Z	Zero bit
DC	Digit Carry bit
C	Carry bit

The instruction set is highly orthogonal and is grouped into three basic categories:

- **Byte-oriented** operations
- **Bit-oriented** operations
- **Literal and control** operations

All instructions are executed within one single instruction cycle, unless a conditional test is true or the program counter is changed as a result of an instruction. In this case, the execution takes two instruction cycles with the second cycle executed as a NOP. One instruction cycle consists of four oscillator periods. Thus, for an oscillator frequency of 4 MHz, the normal instruction

execution time is 1 μ s. If a conditional test is true or the program counter is changed as a result of an instruction, the instruction execution time is 2 μ s.

Table 11-2 lists the instructions recognized by the MPASM assembler.

Figure 11-1 shows the general formats that the instructions can have.

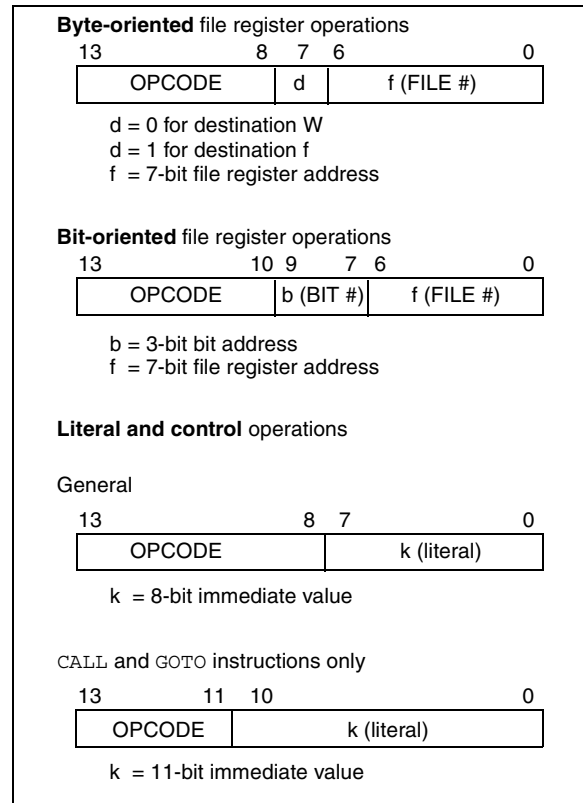
Note: To maintain upward compatibility with future PIC16CXXX products, do not use the **OPTION** and **TRIS** instructions.

All examples use the following format to represent a hexadecimal number:

0xhh

where h signifies a hexadecimal digit.

FIGURE 11-1: GENERAL FORMAT FOR INSTRUCTIONS



A description of each instruction is available in the PIC[®] MCU Mid-Range Reference Manual, (DS33023).

11.1 Instruction Descriptions

ADDLW Add Literal and W

Syntax: *[label]* ADDLW *k*

Operands: $0 \leq k \leq 255$

Operation: $(W) + k \rightarrow (W)$

Status Affected: C, DC, Z

Description: The contents of the W register are added to the eight bit literal 'k' and the result is placed in the W register.

ANDWF AND W with f

Syntax: *[label]* ANDWF *f,d*

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

Operation: $(W) .AND. (f) \rightarrow (\text{destination})$

Status Affected: Z

Description: AND the W register with 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'.

ADDWF Add W and f

Syntax: *[label]* ADDWF *f,d*

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

Operation: $(W) + (f) \rightarrow (\text{destination})$

Status Affected: C, DC, Z

Description: Add the contents of the W register with 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'.

BCF Bit Clear f

Syntax: *[label]* BCF *f,b*

Operands: $0 \leq f \leq 127$
 $0 \leq b \leq 7$

Operation: $0 \rightarrow (f)$

Status Affected: None

Description: Bit 'b' in register 'f' is cleared.

ANDLW AND Literal with W

Syntax: *[label]* ANDLW *k*

Operands: $0 \leq k \leq 255$

Operation: $(W) .AND. (k) \rightarrow (W)$

Status Affected: Z

Description: The contents of W register are AND'ed with the eight bit literal 'k'. The result is placed in the W register.

BSF Bit Set f

Syntax: *[label]* BSF *f,b*

Operands: $0 \leq f \leq 127$
 $0 \leq b \leq 7$

Operation: $1 \rightarrow (f)$

Status Affected: None

Description: Bit 'b' in register 'f' is set.

PIC16C62B/72A

FIGURE 13-1: PIC16C62B/72A-20 VOLTAGE-FREQUENCY GRAPH

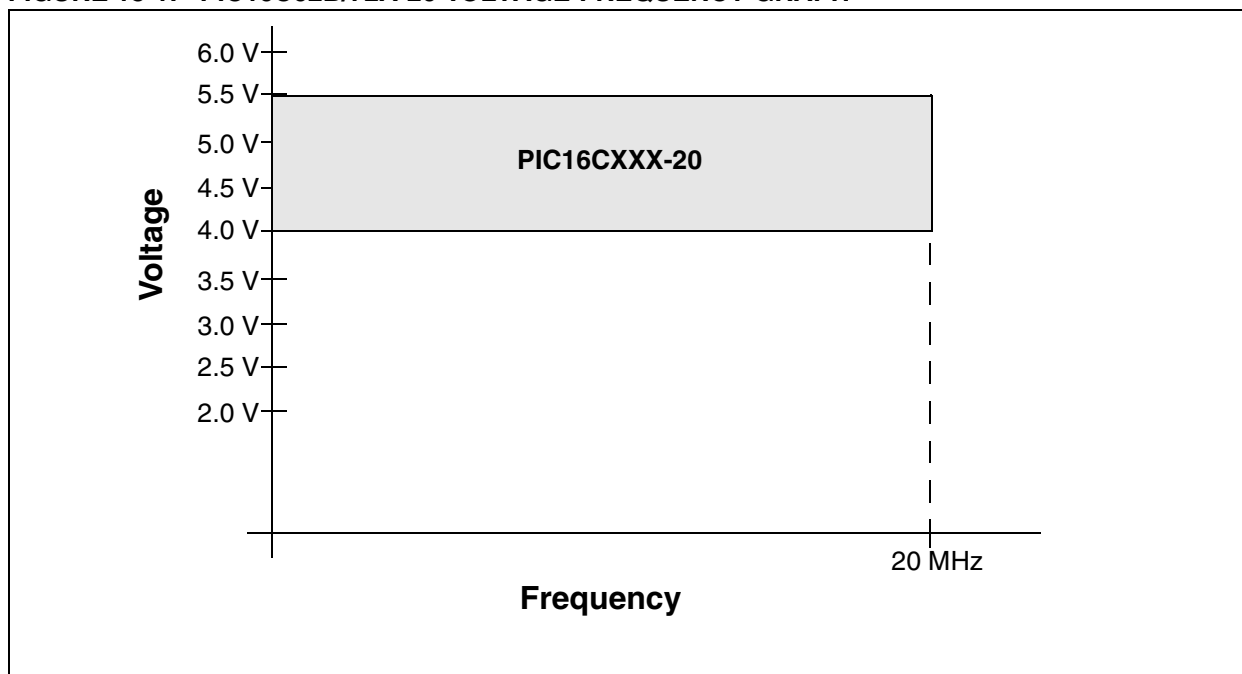


FIGURE 13-2: PIC16LC62B/72A AND PIC16C62B/72A/JW VOLTAGE-FREQUENCY GRAPH

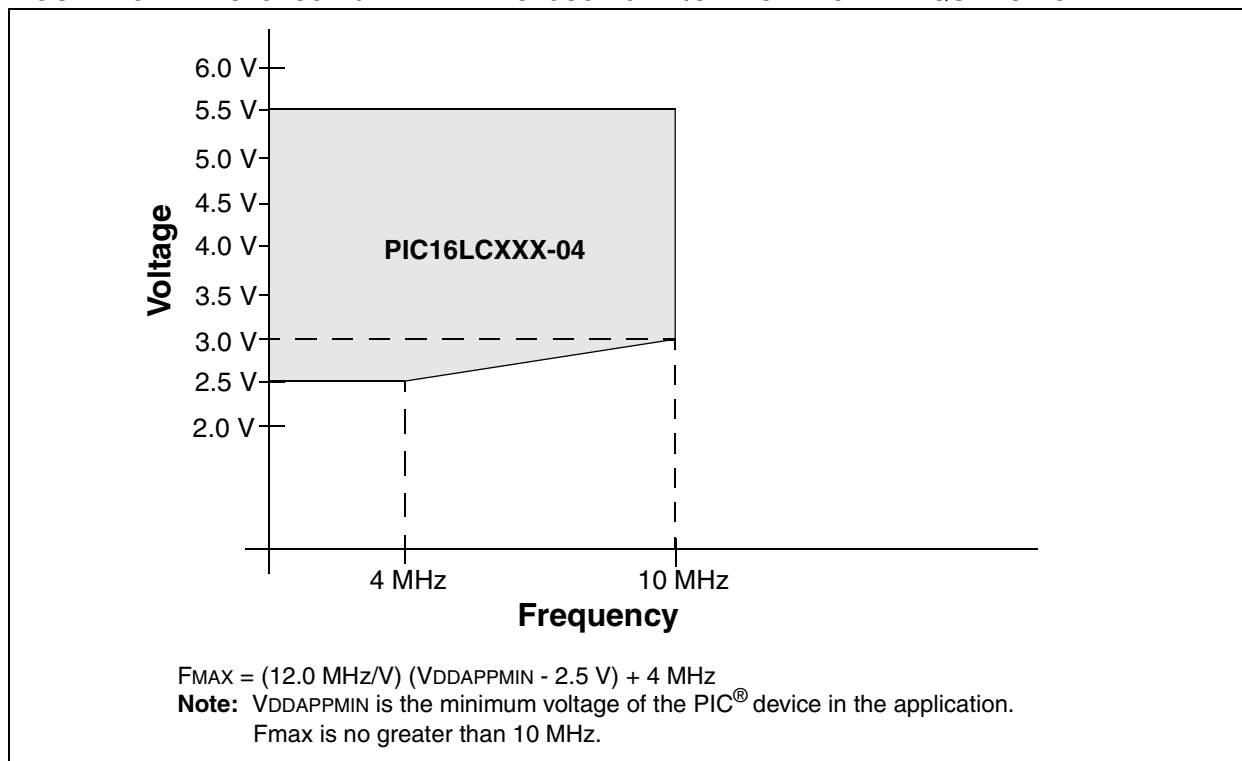


FIGURE 13-7: RESET, WATCHDOG TIMER, OSCILLATOR START-UP TIMER AND POWER-UP TIMER TIMING

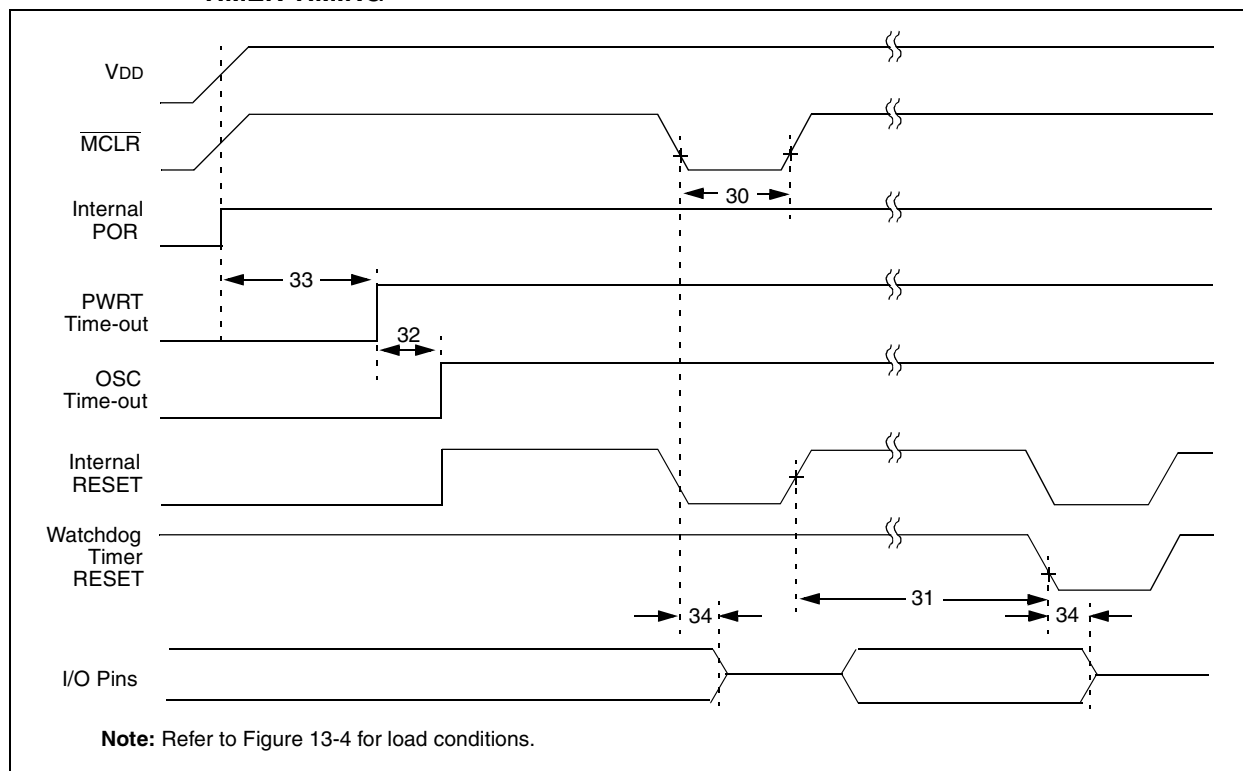


FIGURE 13-8: BROWN-OUT RESET TIMING

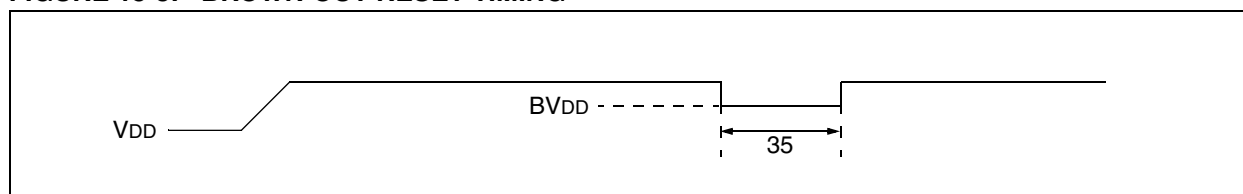


TABLE 13-4: RESET, WATCHDOG TIMER, OSCILLATOR START-UP TIMER, POWER-UP TIMER AND BROWN-OUT RESET REQUIREMENTS

Param No.	Sym	Characteristic	Min	Typ†	Max	Units	Conditions
30	T _{mcL}	MCLR Pulse Width (low)	2	—	—	μs	V _{DD} = 5V, -40°C to +125°C
31*	T _{wdt}	Watchdog Timer Time-out Period (No Prescaler)	7	18	33	ms	V _{DD} = 5V, -40°C to +125°C
32	T _{ost}	Oscillator Start-up Timer Period	—	1024 T _{osc}	—	—	T _{osc} = OSC1 period
33*	T _{pwrt}	Power-up Timer Period	28	72	132	ms	V _{DD} = 5V, -40°C to +125°C
34	T _{ioz}	I/O Hi-impedance from MCLR Low or WDT reset	—	—	2.1	μs	
35	T _{bor}	Brown-out Reset Pulse Width	100	—	—	μs	V _{DD} ≤ BV _{DD} (D005)

* These parameters are characterized but not tested.

† Data in "Typ" column is at 5V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

FIGURE 13-10: CAPTURE/COMPARE/PWM TIMINGS

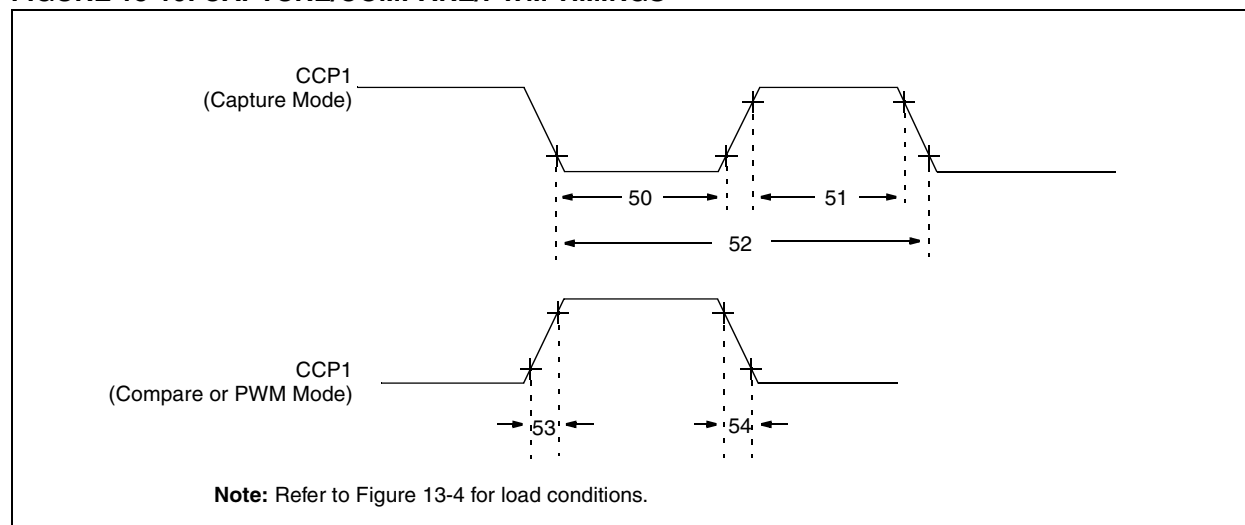


TABLE 13-6: CAPTURE/COMPARE/PWM REQUIREMENTS

Param No.	Sym	Characteristic			Min	Typ†	Max	Units	Conditions
50*	TccL	CCP1 input low time	No Prescaler		0.5Tcy + 20	—	—	ns	
			With Prescaler	PIC16CXX	10	—	—	ns	
				PIC16LCXX	20	—	—	ns	
51*	TccH	CCP1 input high time	No Prescaler		0.5Tcy + 20	—	—	ns	
			With Prescaler	PIC16CXX	10	—	—	ns	
				PIC16LCXX	20	—	—	ns	
52*	TccP	CCP1 input period			$\frac{3Tcy + 40}{N}$	—	—	ns	N = prescale value (1,4, or 16)
53*	TccR	CCP1 output rise time		PIC16CXX	—	10	25	ns	
				PIC16LCXX	—	25	45	ns	
54*	TccF	CCP1 output fall time		PIC16CXX	—	10	25	ns	
				PIC16LCXX	—	25	45	ns	

* These parameters are characterized but not tested.

† Data in "Typ" column is at 5V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

TABLE 13-13: A/D CONVERTER CHARACTERISTICS:
PIC16C72A-04 (COMMERCIAL, INDUSTRIAL, EXTENDED)
PIC16C72A-20 (COMMERCIAL, INDUSTRIAL, EXTENDED)
PIC16LC72A-04 (COMMERCIAL, INDUSTRIAL)

Param No.	Sym	Characteristic		Min	Typ†	Max	Units	Conditions
A01	NR	Resolution		—	—	8-bits	bit	VREF = VDD = 5.12V, VSS ≤ VAIN ≤ VREF
A02	EABS	Total Absolute error		—	—	< ± 1	LSB	VREF = VDD = 5.12V, VSS ≤ VAIN ≤ VREF
A03	EIL	Integral linearity error		—	—	< ± 1	LSB	VREF = VDD = 5.12V, VSS ≤ VAIN ≤ VREF
A04	EDL	Differential linearity error		—	—	< ± 1	LSB	VREF = VDD = 5.12V, VSS ≤ VAIN ≤ VREF
A05	EFS	Full scale error		—	—	< ± 1	LSB	VREF = VDD = 5.12V, VSS ≤ VAIN ≤ VREF
A06	EOFF	Offset error		—	—	< ± 1	LSB	VREF = VDD = 5.12V, VSS ≤ VAIN ≤ VREF
A10	—	Monotonicity		—	guaranteed (Note 3)	—	—	VSS ≤ VAIN ≤ VREF
A20	VREF	Reference voltage		2.5V	—	VDD + 0.3	V	
A25	VAIN	Analog input voltage		VSS - 0.3	—	VREF + 0.3	V	
A30	ZAIN	Recommended impedance of analog voltage source		—	—	10.0	kΩ	
A40	IAD	A/D conversion current (VDD)	PIC16CXX	—	180	—	μA	Average current consumption when A/D is on. (Note 1)
			PIC16LCXX	—	90	—	μA	
A50	IREF	VREF input current (Note 2)		10	—	1000	μA	During VAIN acquisition. Based on differential of VHOLD to VAIN to charge CHOLD, see Section 9.1. During A/D conversion cycle
				—	—	10	μA	

* These parameters are characterized but not tested.

† Data in “Typ” column is at 5V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

Note 1: When A/D is off, it will not consume any current other than minor leakage current.

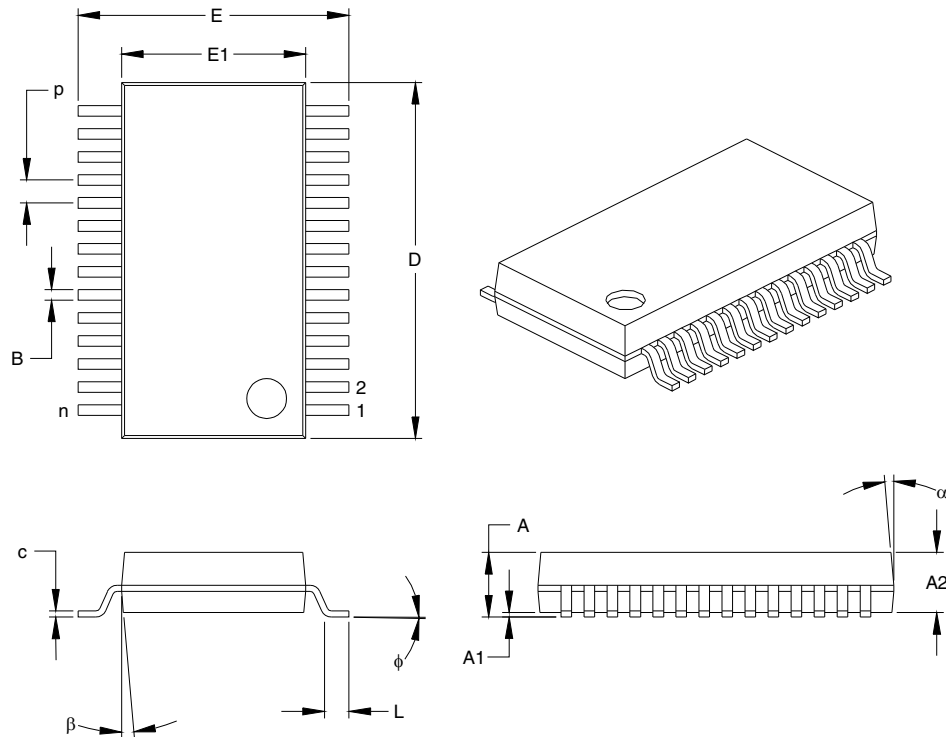
The power-down current spec includes any such leakage from the A/D module.

2: VREF current is from RA3 pin or VDD pin, whichever is selected as reference input.

3: The A/D conversion result never decreases with an increase in the Input Voltage and has no missing codes.

NOTES:

15.5 28-Lead Plastic Shrink Small Outline (SS) – 209 mil, 5.30 mm (SSOP)



Units		INCHES			MILLIMETERS*		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		28			28	
Pitch	P		.026			0.66	
Overall Height	A	.068	.073	.078	1.73	1.85	1.98
Molded Package Thickness	A2	.064	.068	.072	1.63	1.73	1.83
Standoff	A1	.002	.006	.010	0.05	0.15	0.25
Overall Width	E	.299	.309	.319	7.59	7.85	8.10
Molded Package Width	E1	.201	.207	.212	5.11	5.25	5.38
Overall Length	D	.396	.402	.407	10.06	10.20	10.34
Foot Length	L	.022	.030	.037	0.56	0.75	0.94
Lead Thickness	c	.004	.007	.010	0.10	0.18	0.25
Foot Angle	φ	0	4	8	0.00	101.60	203.20
Lead Width	B	.010	.013	.015	0.25	0.32	0.38
Mold Draft Angle Top	α	0	5	10	0	5	10
Mold Draft Angle Bottom	β	0	5	10	0	5	10

*Controlling Parameter

Notes:

Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254mm) per side.

JEDEC Equivalent: MS-150

Drawing No. C04-073

APPENDIX A: REVISION HISTORY

Version	Date	Revision Description
A	7/98	This is a new data sheet. However, the devices described in this data sheet are the upgrades to the devices found in the <i>PIC16C6X Data Sheet</i> , DS30234, and the <i>PIC16C7X Data Sheet</i> , DS30390.

APPENDIX B: CONVERSION CONSIDERATIONS

Considerations for converting from previous versions of devices to the ones listed in this data sheet are listed in Table B-1.

TABLE B-1: CONVERSION CONSIDERATIONS

Difference	PIC16C62A/72	PIC16C62B/72A
Voltage Range	2.5V - 6.0V	2.5V - 5.5V
SSP module	Basic SSP (2 mode SPI)	SSP (4 mode SPI)
CCP module	CCP does not reset TMR1 when in special event trigger mode.	N/A
Timer1 module	Writing to TMR1L register can cause overflow in TMR1H register.	N/A

PIC16C62B/72A

SSP	39	Timer1	27
Enable (SSPIE Bit)	14	Block Diagram	28
Flag (SSPIF Bit)	15	Capacitor Selection	29
RA5/SS/AN4 Pin	6	Clock Source Select (TMR1CS Bit)	27
RC3/SCK/SCL Pin	6	External Clock Input Sync (T1SYNC Bit)	27
RC4/SDI/SDA Pin	6	Module On/Off (TMR1ON Bit)	27
RC5/SDO Pin	6	Oscillator	27, 29
SSPADD Register	10	Oscillator Enable (T1OSCEN Bit)	27
SSPBUF Register	9	Overflow Enable (TMR1IE Bit)	14
SSPCON Register	9, 47	Overflow Flag (TMR1IF Bit)	15
SSPSTAT Register	10, 46	Overflow Interrupt	27, 29
TMR2 Output for Clock Shift	32	RC0/T1OSO/T1CKI Pin	6
Write Collision Detect (WCOL Bit)	47	RC1/T1OSI	6
SSPCON Register	47	Special Event Trigger (CCP)	29, 35
CKP Bit	47	T1CON Register	9, 27
SSPEN Bit	47	Timing Diagram	93
SSPM3:SSPM0 Bits	47	TMR1H Register	9
SSPOV Bit	47	TMR1L Register	9
WCOL Bit	47	Timer2	
SSPSTAT Register	46	Block Diagram	32
BF Bit	46	PR2 Register	10, 31, 36
CKE Bit	46	SSP Clock Shift	32
D/A Bit	46	T2CON Register	9, 31
P bit	45, 46	TMR2 Register	9, 31
R/W Bit	42, 43, 44, 46	TMR2 to PR2 Match Enable (TMR2IE Bit)	14
S Bit	45, 46	TMR2 to PR2 Match Flag (TMR2IF Bit)	15
SMP Bit	46	TMR2 to PR2 Match Interrupt	31, 32, 36
UA Bit	46	Timing Diagrams	
Stack	17	I ² C Reception (7-bit Address)	43
STATUS Register	9, 11, 63	Wake-up from SLEEP via Interrupt	66
C Bit	11	Timing Diagrams and Specifications	90
DC Bit	11	A/D Conversion	102
IRP Bit	11	Brown-out Reset (BOR)	92
PD Bit	11, 57	Capture/Compare/PWM (CCP)	94
RP1:RP0 Bits	11	CLKOUT and I/O	91
TO Bit	11, 57	External Clock	90
Z Bit	11	I ² C Bus Data	100
T		I ² C Bus Start/Stop Bits	99
T1CON Register	9, 27	Oscillator Start-up Timer (OST)	92
T1CKPS1:T1CKPS0 Bits	27	Power-up Timer (PWRT)	92
T1OSCEN Bit	27	Reset	2
T1SYNC Bit	27	Timer0 and Timer1	93
TMR1CS Bit	27	Watchdog Timer (WDT)	92
TMR1ON Bit	27	W	
T2CON Register	9, 31	W Register	63
T2CKPS1:T2CKPS0 Bits	31	Wake-up from SLEEP	55, 65
TMR2ON Bit	31	Interrupts	60, 61
TOUTPS3:TOUTPS0 Bits	31	MCLR Reset	61
Timer0	25	Timing Diagram	66
Block Diagram	25	WDT Reset	61
Clock Source Edge Select (T0SE Bit)	12, 25	Watchdog Timer (WDT)	55, 64
Clock Source Select (T0CS Bit)	12, 25	Block Diagram	64
Overflow Enable (T0IE Bit)	13	Enable (WDTE Bit)	55, 64
Overflow Flag (T0IF Bit)	13, 63	Programming Considerations	64
Overflow Interrupt	26, 63	RC Oscillator	64
RA4/T0CKI Pin, External Clock	6	Timing Diagram	92
Timing Diagram	93	WDT Reset, Normal Operation	57, 60, 61
TMR0 Register	9	WDT Reset, SLEEP	57, 60, 61
		WWW, On-Line Support	3