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Details

Product Status	Active
Core Processor	PIC
Core Size	8-Bit
Speed	20MHz
Connectivity	I ² C, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	22
Program Memory Size	7KB (4K x 14)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	192 x 8
Voltage - Supply (Vcc/Vdd)	4V ~ 5.5V
Data Converters	A/D 5x8b
Oscillator Type	External
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	28-SSOP (0.209", 5.30mm Width)
Supplier Device Package	28-SSOP
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic16f73t-e-ss

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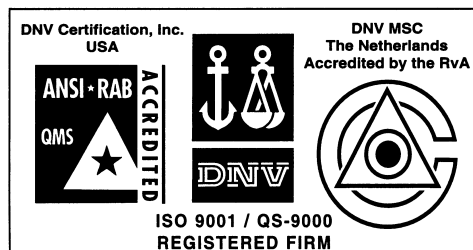
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TABLE 1-3: PIC16F74 AND PIC16F77 PINOUT DESCRIPTION (CONTINUED)

Pin Name	DIP Pin#	PLCC Pin#	QFP Pin#	I/O/P Type	Buffer Type	Description
RB0/INT RB0 INT	33	36	8	I/O I	TTL/ST ⁽¹⁾	PORTB is a bi-directional I/O port. PORTB can be software programmed for internal weak pull-up on all inputs. Digital I/O. External interrupt.
RB1	34	37	9	I/O	TTL	Digital I/O.
RB2	35	38	10	I/O	TTL	Digital I/O.
RB3/PGM RB3 PGM	36	39	11	I/O I/O	TTL	Digital I/O. Low voltage ICSP programming enable pin.
RB4	37	41	14	I/O	TTL	Digital I/O.
RB5	38	42	15	I/O	TTL	Digital I/O.
RB6/PGC RB6 PGC	39	43	16	I/O I/O	TTL/ST ⁽²⁾	Digital I/O. In-Circuit Debugger and ICSP programming clock.
RB7/PGD RB7 PGD	40	44	17	I/O I/O	TTL/ST ⁽²⁾	Digital I/O. In-Circuit Debugger and ICSP programming data.
RC0/T1OSO/T1CKI RC0 T1OSO T1CKI	15	16	32	I/O O I	ST	PORTC is a bi-directional I/O port. Digital I/O. Timer1 oscillator output. Timer1 external clock input.
RC1/T1OSI/CCP2 RC1 T1OSI CCP2	16	18	35	I/O I I/O	ST	Digital I/O. Timer1 oscillator input. Capture2 input, Compare2 output, PWM2 output.
RC2/CCP1 RC2 CCP1	17	19	36	I/O I/O	ST	Digital I/O. Capture1 input/Compare1 output/PWM1 output
RC3/SCK/SCL RC3 SCK SCL	18	20	37	I/O I/O I/O	ST	Digital I/O Synchronous serial clock input/output for SPI mode. Synchronous serial clock input/output for I ² C mode.
RC4/SDI/SDA RC4 SDI SDA	23	25	42	I/O I I/O	ST	Digital I/O. SPI data in. I ² C data I/O.
RC5/SDO RC5 SDO	24	26	43	I/O O	ST	Digital I/O. SPI data out.
RC6/TX/CK RC6 TX CK	25	27	44	I/O O I/O	ST	Digital I/O. USART asynchronous transmit. USART 1 synchronous clock.
RC7/RX/DT RC7 RX DT	26	29	1	I/O I I/O	ST	Digital I/O. USART asynchronous receive. USART synchronous data.

Legend: I = input O = output I/O = input/output P = power
 — = Not used TTL = TTL input ST = Schmitt Trigger input

- Note**
- 1: This buffer is a Schmitt Trigger input when configured as an external interrupt.
 - 2: This buffer is a Schmitt Trigger input when used in Serial Programming mode.
 - 3: This buffer is a Schmitt Trigger input when configured as general purpose I/O and a TTL input when used in the Parallel Slave Port mode (for interfacing to a microprocessor bus).
 - 4: This buffer is a Schmitt Trigger input when configured in RC Oscillator mode and a CMOS input otherwise.

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2.2.2 SPECIAL FUNCTION REGISTERS

The Special Function Registers are registers used by the CPU and peripheral modules for controlling the desired operation of the device. These registers are implemented as static RAM. A list of these registers is given in Table 2-1.

The Special Function Registers can be classified into two sets: core (CPU) and peripheral. Those registers associated with the core functions are described in detail in this section. Those related to the operation of the peripheral features are described in detail in the peripheral feature section.

TABLE 2-1: SPECIAL FUNCTION REGISTER SUMMARY

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on: POR, BOR	Details on page
Bank 0											
00h ⁽⁴⁾	INDF	Addressing this location uses contents of FSR to address data memory (not a physical register)								0000 0000	27, 96
01h	TMR0	Timer0 Module Register								xxxx xxxx	45, 96
02h ⁽⁴⁾	PCL	Program Counter (PC) Least Significant Byte								0000 0000	26, 96
03h ⁽⁴⁾	STATUS	IRP	RP1	RP0	\overline{TO}	\overline{PD}	Z	DC	C	0001 1xxxx	19, 96
04h ⁽⁴⁾	FSR	Indirect Data Memory Address Pointer								xxxx xxxx	27, 96
05h	PORTA	—	—	PORTA Data Latch when written: PORTA pins when read						--0x 0000	32, 96
06h	PORTB	PORTB Data Latch when written: PORTB pins when read								xxxx xxxx	34, 96
07h	PORTC	PORTC Data Latch when written: PORTC pins when read								xxxx xxxx	35, 96
08h ⁽⁵⁾	PORTD	PORTD Data Latch when written: PORTD pins when read								xxxx xxxx	36, 96
09h ⁽⁵⁾	PORTE	—	—	—	—	—	RE2	RE1	RE0	---- -xxxx	39, 96
0Ah ^(1,4)	PCLATH	—	—	—	Write Buffer for the upper 5 bits of the Program Counter					---0 0000	26, 96
0Bh ⁽⁴⁾	INTCON	GIE	PEIE	TMR0IE	INTE	RBIE	TMR0IF	INTF	RBIF	0000 000x	21, 96
0Ch	PIR1	PSPIF ⁽³⁾	ADIF	RCIF	TXIF	SSPIF	CCP1IF	TMR2IF	TMR1IF	0000 0000	23, 96
0Dh	PIR2	—	—	—	—	—	—	—	CCP2IF	---- ---0	24, 96
0Eh	TMR1L	Holding Register for the Least Significant Byte of the 16-bit TMR1 Register								xxxx xxxx	50, 96
0Fh	TMR1H	Holding Register for the Most Significant Byte of the 16-bit TMR1 Register								xxxx xxxx	50, 96
10h	T1CON	—	—	T1CKPS1	T1CKPS0	T1OSCEN	$\overline{T1SYNC}$	TMR1CS	TMR1ON	--00 0000	47, 96
11h	TMR2	Timer2 Module Register								0000 0000	52, 96
12h	T2CON	—	TOUTPS3	TOUTPS2	TOUTPS	TOUTPS0	TMR2ON	T2CKPS1	T2CKPS0	-000 0000	52, 96
13h	SSPBUF	Synchronous Serial Port Receive Buffer/Transmit Register								xxxx xxxx	64, 68, 96
14h	SSPCON	WCOL	SSPOV	SSPEN	CKP	SSPM3	SSPM2	SSPM1	SSPM0	0000 0000	61, 96
15h	CCPR1L	Capture/Compare/PWM Register1 (LSB)								xxxx xxxx	56, 96
16h	CCPR1H	Capture/Compare/PWM Register1 (MSB)								xxxx xxxx	56, 96
17h	CCP1CON	—	—	CCP1X	CCP1Y	CCP1M3	CCP1M2	CCP1M1	CCP1M0	--00 0000	54, 96
18h	RCSTA	SPEN	RX9	SREN	CREN	—	FERR	OERR	RX9D	0000 -00x	70, 96
19h	TXREG	USART Transmit Data Register								0000 0000	74, 96
1Ah	RCREG	USART Receive Data Register								0000 0000	76, 96
1Bh	CCPR2L	Capture/Compare/PWM Register2 (LSB)								xxxx xxxx	58, 96
1Ch	CCPR2H	Capture/Compare/PWM Register2 (MSB)								xxxx xxxx	58, 96
1Dh	CCP2CON	—	—	CCP2X	CCP2Y	CCP2M3	CCP2M2	CCP2M1	CCP2M0	--00 0000	54, 96
1Eh	ADRES	A/D Result Register Byte								xxxx xxxx	88, 96
1Fh	ADCON0	ADCS1	ADCS0	CHS2	CHS1	CHS0	$\frac{GO}{DONE}$	—	ADON	0000 00-0	83, 96

Legend: x = unknown, u = unchanged, q = value depends on condition, - = unimplemented, read as '0', r = reserved.
Shaded locations are unimplemented, read as '0'.

- Note 1:** The upper byte of the program counter is not directly accessible. PCLATH is a holding register for the PC<12:8>, whose contents are transferred to the upper byte of the program counter during branches (CALL or GOTO).
- 2:** Other (non power-up) RESETS include external RESET through MCLR and Watchdog Timer Reset.
- 3:** Bits PSPIE and PSPIF are reserved on the 28-pin devices; always maintain these bits clear.
- 4:** These registers can be addressed from any bank.
- 5:** PORTD, PORTE, TRISD, and TRISE are not physically implemented on the 28-pin devices, read as '0'.
- 6:** This bit always reads as a '1'.

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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 also 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, 181h)

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
<u>RBPU</u>	INTEDG	T0CS	T0SE	PSA	PS2	PS1	PS0
bit 7							bit 0

- bit 7 **RBPU:** PORTB Pull-up Enable bit
1 = PORTB pull-ups are disabled
0 = PORTB pull-ups are enabled by individual port latch values
- 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

Legend:

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

A read from the PSP occurs when both the $\overline{\text{CS}}$ and $\overline{\text{RD}}$ lines are detected low. The data in the PORTD output latch is output to the PORTD pins. The Output Buffer Full (OBF) status flag bit (TRISE<6>) is cleared immediately (Figure 4-10), indicating that the PORTD latch is being read, or has been read by the external bus. If firmware writes new data to the output latch during this time, it is immediately output to the PORTD pins, but OBF will remain cleared.

When not in PSP mode, the IBF and OBF bits are held clear. Flag bit IBOV remains unchanged. The PSPIF bit must be cleared by the user in firmware; the interrupt can be disabled by clearing the interrupt enable bit PSPIE (PIE1<7>).

FIGURE 4-9: PARALLEL SLAVE PORT WRITE WAVEFORMS

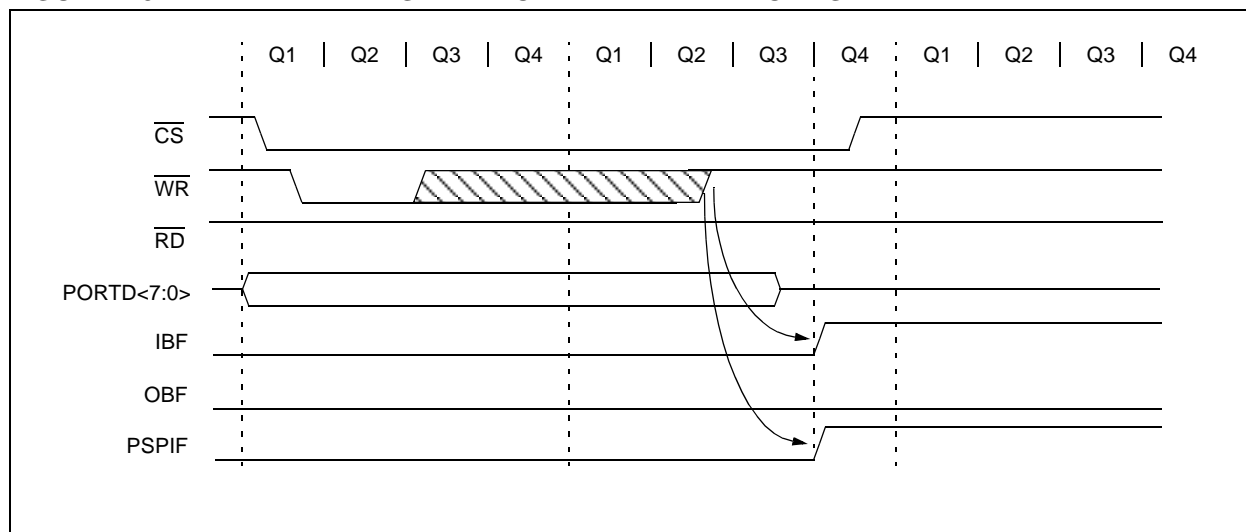


FIGURE 4-10: PARALLEL SLAVE PORT READ WAVEFORMS

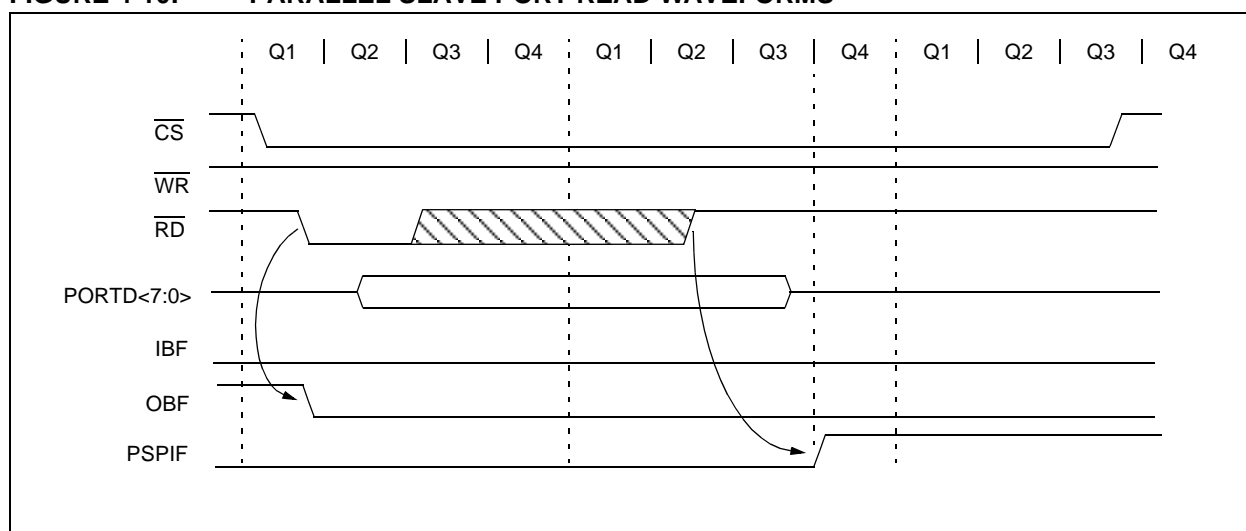


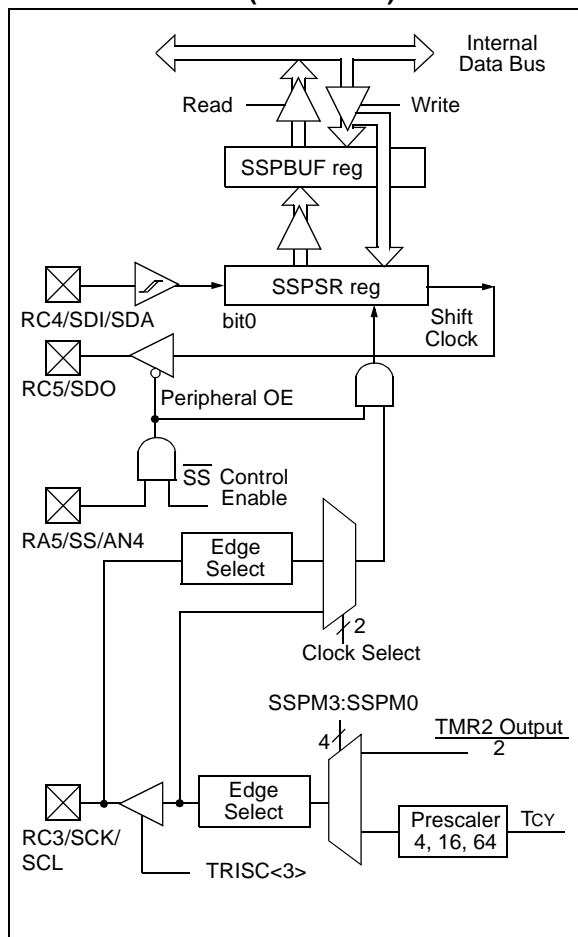
TABLE 4-11: REGISTERS ASSOCIATED WITH PARALLEL SLAVE PORT

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
08h	PORTD	Port data latch when written: Port pins when read								xxxx xxxx	uuuu uuuu
09h	PORTE	—	—	—	—	—	RE2	RE1	RE0	---- -xxx	---- -uuu
89h	TRISE	IBF	OBF	IBOV	PSPMODE	—	PORTE Data Direction Bits			0000 -111	0000 -111
0Ch	PIR1	PSPIF ⁽¹⁾	ADIF	RCIF	TXIF	SSPIF	CCP1IF	TMR2IF	TMR1IF	0000 0000	0000 0000
8Ch	PIE1	PSPIE ⁽¹⁾	ADIE	RCIE	TXIE	SSPIE	CCP1IE	TMR2IE	TMR1IE	0000 0000	0000 0000
9Fh	ADCON1	—	—	—	—	—	PCFG2	PCFG1	PCFG0	---- -000	---- -000

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

Note 1: Bits PSPIE and PSPIF are reserved on the PIC16F73/76; always maintain these bits clear.

FIGURE 9-1: SSP BLOCK DIAGRAM (SPI MODE)



To enable the serial port, SSP enable bit, SSPEN (SSPCON<5>) must be set. To reset or reconfigure SPI mode, clear bit SSPEN, re-initialize the SSPCON register, and then set bit SSPEN. This configures the SDI, SDO, SCK, and \overline{SS} pins as serial port pins. For the pins to behave as the serial port function, they must have their data direction bits (in the TRISC register) appropriately programmed. That is:

- SDI must have TRISC<4> set
- SDO must have TRISC<5> cleared
- SCK (Master mode) must have TRISC<3> cleared
- SCK (Slave mode) must have TRISC<3> set
- \overline{SS} must have TRISA<5> set and ADCON must be configured such that RA5 is a digital I/O

Note 1: When the SPI is in Slave mode with \overline{SS} pin control enabled (SSPCON<3:0> = 0100), the SPI module will reset if the \overline{SS} pin is set to VDD.

2: If the SPI is used in Slave mode with CKE = '1', then the \overline{SS} pin control must be enabled.

3: When the SPI is in Slave mode with \overline{SS} pin control enabled (SSPCON<3:0> = '0100'), the state of the \overline{SS} pin can affect the state read back from the TRISC<5> bit. The Peripheral OE signal from the SSP module into PORTC controls the state that is read back from the TRISC<5> bit (see Section 4.3 for information on PORTC). If Read-Modify-Write instructions, such as BSF are performed on the TRISC register while the \overline{SS} pin is high, this will cause the TRISC<5> bit to be set, thus disabling the SDO output.

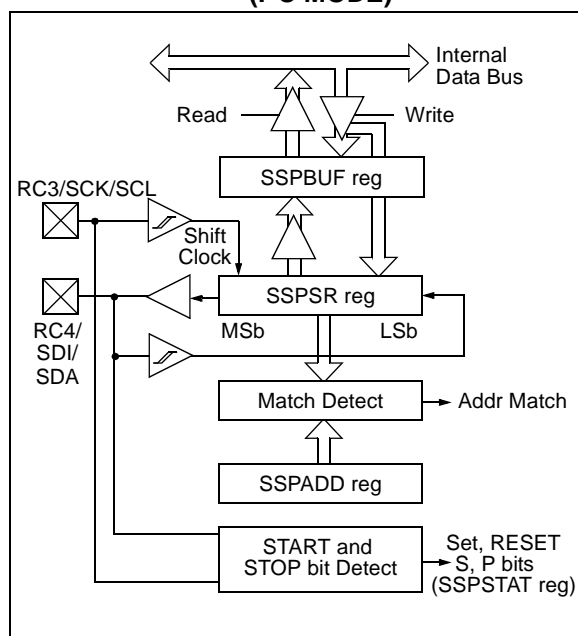
9.3 SSP I²C Operation

The SSP module in I²C mode, fully implements all slave functions, except general call support, and provides interrupts on START and STOP bits in hardware to facilitate firmware implementations of the master functions. The SSP module implements the standard mode specifications as well as 7-bit and 10-bit addressing.

Two pins are used for data transfer. These are the RC3/SCK/SCL pin, which is the clock (SCL), and the RC4/SDI/SDA pin, which is the data (SDA). The user must configure these pins as inputs or outputs through the TRISC<4:3> bits.

The SSP module functions are enabled by setting SSP enable bit SSPEN (SSPCON<5>).

FIGURE 9-5: SSP BLOCK DIAGRAM (I²C MODE)



The SSP module has five registers for I²C operation. These are the:

- SSP Control Register (SSPCON)
- SSP Status Register (SSPSTAT)
- Serial Receive/Transmit Buffer (SSPBUF)
- SSP Shift Register (SSPSR) - Not directly accessible
- SSP Address Register (SSPADD)

The SSPCON register allows control of the I²C operation. Four mode selection bits (SSPCON<3:0>) allow one of the following I²C modes to be selected:

- I²C Slave mode (7-bit address)
- I²C Slave mode (10-bit address)
- I²C Slave mode (7-bit address), with START and STOP bit interrupts enabled to support Firmware Master mode
- I²C Slave mode (10-bit address), with START and STOP bit interrupts enabled to support Firmware Master mode
- I²C START and STOP bit interrupts enabled to support Firmware Master mode, Slave is IDLE

Selection of any I²C mode with the SSPEN bit set, forces the SCL and SDA pins to be open drain, provided these pins are programmed to inputs by setting the appropriate TRISC bits. Pull-up resistors must be provided externally to the SCL and SDA pins for proper operation of the I²C module.

Additional information on SSP I²C operation can be found in the PICmicro™ Mid-Range MCU Family Reference Manual (DS33023A).

9.3.1 SLAVE MODE

In Slave mode, the SCL and SDA pins must be configured as inputs (TRISC<4:3> set). The SSP module will override the input state with the output data when required (slave-transmitter).

When an address is matched, or the data transfer after an address match is received, the hardware automatically will generate the Acknowledge (ACK) pulse, and then load the SSPBUF register with the received value currently in the SSPSR register.

There are certain conditions that will cause the SSP module not to give this ACK pulse. They include (either or both):

- The buffer full bit BF (SSPSTAT<0>) was set before the transfer was received.
- The overflow bit SSPOV (SSPCON<6>) was set before the transfer was received.

In this case, the SSPSR register value is not loaded into the SSPBUF, but bit SSPIF (PIR1<3>) is set. Table 9-2 shows what happens when a data transfer byte is received, given the status of bits BF and SSPOV. The shaded cells show the condition where user software did not properly clear the overflow condition. Flag bit BF is cleared by reading the SSPBUF register, while bit SSPOV is cleared through software.

The SCL clock input must have a minimum high and low for proper operation. The high and low times of the I²C specification, as well as the requirements of the SSP module, are shown in timing parameter #100 and parameter #101.

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REGISTER 11-2: ADCON1 REGISTER (ADDRESS 9Fh)

U-0	U-0	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0
—	—	—	—	—	PCFG2	PCFG1	PCFG0
bit 7					bit 0		

bit 7-3 **Unimplemented:** Read as '0'

bit 2-0 **PCFG2:PCFG0:** A/D Port Configuration Control bits

PCFG2:PCFG0	RA0	RA1	RA2	RA5	RA3	RE0 ⁽¹⁾	RE1 ⁽¹⁾	RE2 ⁽¹⁾	VREF
000	A	A	A	A	A	A	A	A	VDD
001	A	A	A	A	VREF	A	A	A	RA3
010	A	A	A	A	A	D	D	D	VDD
011	A	A	A	A	VREF	D	D	D	RA3
100	A	A	D	D	A	D	D	D	VDD
101	A	A	D	D	VREF	D	D	D	RA3
11x	D	D	D	D	D	D	D	D	VDD

A = Analog input

D = Digital I/O

Note 1: RE0, RE1 and RE2 are implemented on the PIC16F74/77 only.

Legend:

R = Readable bit

W = Writable bit

U = Unimplemented bit, read as '0'

- n = Value at POR reset

'1' = Bit is set

'0' = Bit is cleared

x = Bit is unknown

12.10 Power Control/Status Register (PCON)

The Power Control/Status Register, PCON, has two bits to indicate the type of RESET that last occurred.

Bit0 is Brown-out Reset Status bit, $\overline{\text{BOR}}$. Bit $\overline{\text{BOR}}$ is unknown on a Power-on Reset. It must then be set by the user and checked on subsequent RESETS to see

if bit $\overline{\text{BOR}}$ cleared, indicating a Brown-out Reset occurred. When the Brown-out Reset is disabled, the state of the $\overline{\text{BOR}}$ bit is unpredictable.

Bit1 is $\overline{\text{POR}}$ (Power-on Reset Status bit). It is cleared on a Power-on Reset and unaffected otherwise. The user must set this bit following a Power-on Reset.

TABLE 12-3: TIME-OUT IN VARIOUS SITUATIONS

Oscillator Configuration	Power-up		Brown-out	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
RC	72 ms	—	72 ms	—

TABLE 12-4: STATUS BITS AND THEIR SIGNIFICANCE

$\overline{\text{POR}}$ (PCON<1>)	$\overline{\text{BOR}}$ (PCON<0>)	$\overline{\text{TO}}$ (STATUS<4>)	$\overline{\text{PD}}$ (STATUS<3>)	Significance
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	1	1	Brown-out Reset
1	1	0	1	WDT Reset
1	1	0	0	WDT Wake-up
1	1	u	u	MCLR Reset during normal operation
1	1	1	0	MCLR Reset during SLEEP or interrupt wake-up from SLEEP

TABLE 12-5: RESET CONDITION FOR SPECIAL REGISTERS

Condition	Program Counter	STATUS Register	PCON Register
Power-on Reset	000h	0001 1xxx	---- --0x
MCLR Reset during normal operation	000h	000u uuuu	---- --uu
MCLR Reset during SLEEP	000h	0001 0uuu	---- --uu
WDT Reset	000h	0000 1uuu	---- --uu
WDT Wake-up	PC + 1	uuu0 0uuu	---- --uu
Brown-out Reset	000h	0001 1uuu	---- --u0
Interrupt wake-up from SLEEP	PC + 1 ⁽¹⁾	uuu1 0uuu	---- --uu

Legend: u = unchanged, x = unknown, - = unimplemented bit, read as '0'

Note 1: When the wake-up is due to an interrupt and the GIE bit is set, the PC is loaded with the interrupt vector (0004h).

12.11 Interrupts

The PIC16F7X family has up to 12 sources of interrupt. The interrupt control register (INTCON) records individual interrupt requests in flag bits. It also has individual and global interrupt enable bits.

Note: Individual interrupt flag bits are set, regardless of the status of their corresponding mask bit or the GIE bit.

A global interrupt enable bit, GIE (INTCON<7>) enables (if set) all unmasked interrupts, or disables (if cleared) all interrupts. When bit GIE is enabled and an interrupt's flag bit and mask bit are set, the interrupt will vector immediately. Individual interrupts can be disabled through their corresponding enable bits in various registers. Individual interrupt bits are set, regardless of the status of the GIE bit. The GIE bit is cleared on RESET.

The "return from interrupt" instruction, RETFIE, exits the interrupt routine, as well as sets the GIE bit, which re-enables interrupts.

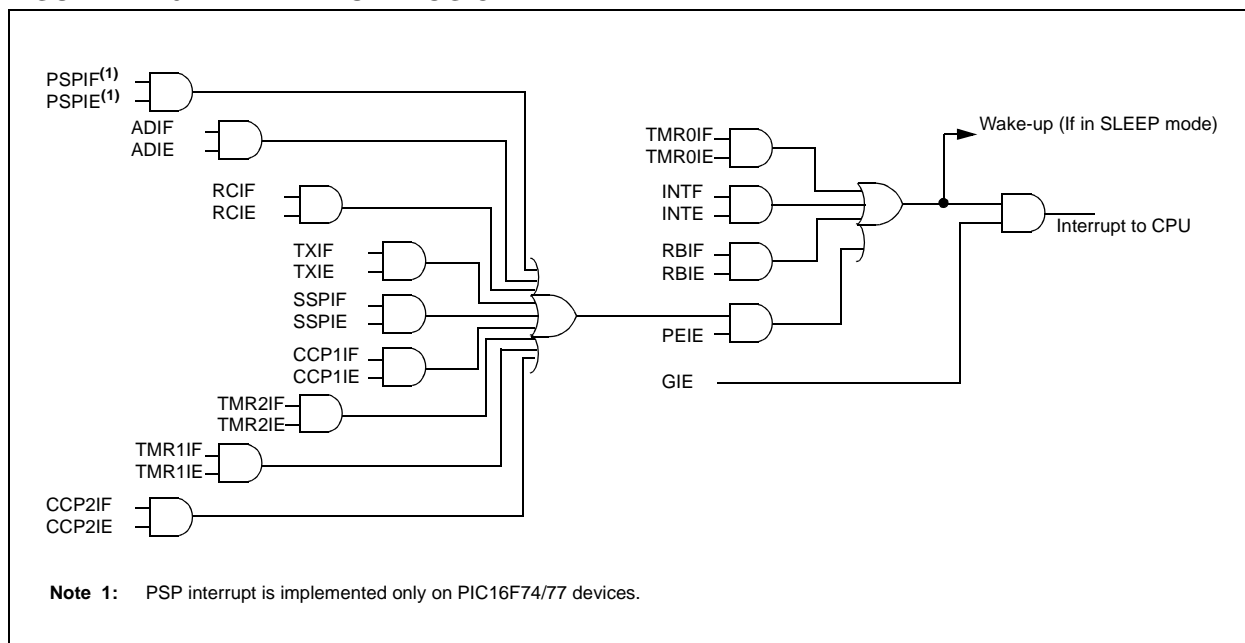
The RB0/INT pin interrupt, the RB port change interrupt and the TMR0 overflow interrupt flags are contained in the INTCON register.

The peripheral interrupt flags are contained in the Special Function Registers, PIR1 and PIR2. The corresponding interrupt enable bits are contained in Special Function Registers, PIE1 and PIE2, and the peripheral interrupt enable bit is contained in Special Function Register, INTCON.

When an interrupt is responded to, the GIE bit is cleared to disable any further interrupt, the return address is pushed onto the stack and the PC is loaded with 0004h. Once in the Interrupt Service Routine, the source(s) of the interrupt can be determined by polling the interrupt flag bits. The interrupt flag bit(s) must be cleared in software before re-enabling interrupts to avoid recursive interrupts.

For external interrupt events, such as the INT pin or PORTB change interrupt, the interrupt latency will be three or four instruction cycles. The exact latency depends when the interrupt event occurs, relative to the current Q cycle. The latency is the same for one or two-cycle instructions. Individual interrupt flag bits are set, regardless of the status of their corresponding mask bit, PEIE bit, or the GIE bit.

FIGURE 12-10: INTERRUPT LOGIC



PIC16F7X

SWAPF **Swap Nibbles in f**

Syntax: [*label*] SWAPF f,d

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

Operation: $(f<3:0>) \rightarrow (\text{destination}<7:4>)$,
 $(f<7:4>) \rightarrow (\text{destination}<3:0>)$

Status Affected: None

Description: The upper and lower nibbles of register 'f' are exchanged. If 'd' is 0, the result is placed in the W register. If 'd' is 1, the result is placed in register 'f'.

XORWF **Exclusive OR W with f**

Syntax: [*label*] XORWF f,d

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

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

Status Affected: Z

Description: Exclusive OR 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'.

XORLW **Exclusive OR Literal with W**

Syntax: [*label*] XORLW k

Operands: $0 \leq k \leq 255$

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

Status Affected: Z

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

14.13 PICDEM 3 Low Cost PIC16CXXX Demonstration Board

The PICDEM 3 demonstration board is a simple demonstration board that supports the PIC16C923 and PIC16C924 in the PLCC package. It will also support future 44-pin PLCC microcontrollers with an LCD Module. All the necessary hardware and software is included to run the basic demonstration programs. The user can program the sample microcontrollers provided with the PICDEM 3 demonstration board on a PRO MATE II device programmer, or a PICSTART Plus development programmer with an adapter socket, and easily test firmware. The MPLAB ICE in-circuit emulator may also be used with the PICDEM 3 demonstration board to test firmware. A prototype area has been provided to the user for adding hardware and connecting it to the microcontroller socket(s). Some of the features include a RS-232 interface, push button switches, a potentiometer for simulated analog input, a thermistor and separate headers for connection to an external LCD module and a keypad. Also provided on the PICDEM 3 demonstration board is a LCD panel, with 4 commons and 12 segments, that is capable of displaying time, temperature and day of the week. The PICDEM 3 demonstration board provides an additional RS-232 interface and Windows software for showing the demultiplexed LCD signals on a PC. A simple serial interface allows the user to construct a hardware demultiplexer for the LCD signals.

14.14 PICDEM 17 Demonstration Board

The PICDEM 17 demonstration board is an evaluation board that demonstrates the capabilities of several Microchip microcontrollers, including PIC17C752, PIC17C756A, PIC17C762 and PIC17C766. All necessary hardware is included to run basic demo programs, which are supplied on a 3.5-inch disk. A programmed sample is included and the user may erase it and program it with the other sample programs using the PRO MATE II device programmer, or the PICSTART Plus development programmer, and easily debug and test the sample code. In addition, the PICDEM 17 demonstration board supports downloading of programs to and executing out of external FLASH memory on board. The PICDEM 17 demonstration board is also usable with the MPLAB ICE in-circuit emulator, or the PICMASTER emulator and all of the sample programs can be run and modified using either emulator. Additionally, a generous prototype area is available for user hardware.

14.15 KEELoQ Evaluation and Programming Tools

KEELOQ evaluation and programming tools support Microchip's HCS Secure Data Products. The HCS evaluation kit includes a LCD display to show changing codes, a decoder to decode transmissions and a programming interface to program test transmitters.

PIC16F7X

FIGURE 15-6: RESET, WATCHDOG TIMER, OSCILLATOR START-UP TIMER AND POWER-UP TIMER TIMING

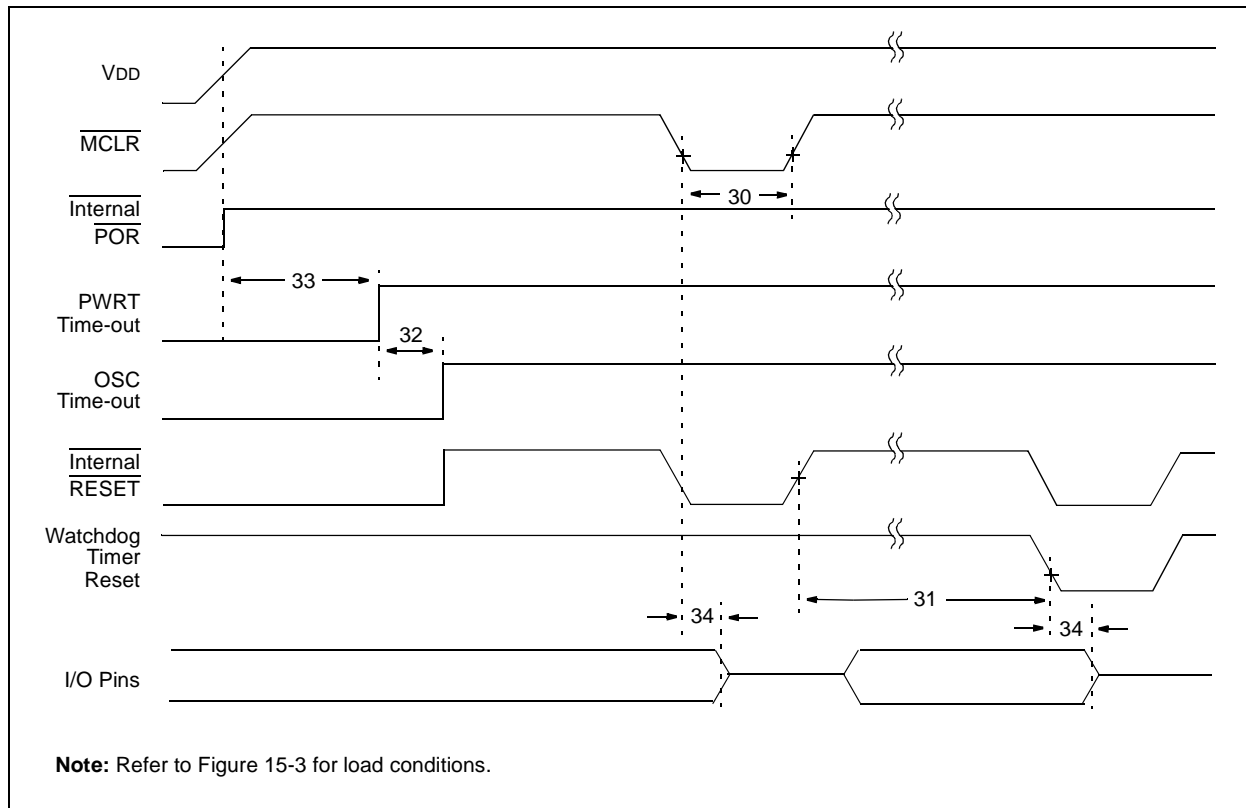


FIGURE 15-7: BROWN-OUT RESET TIMING

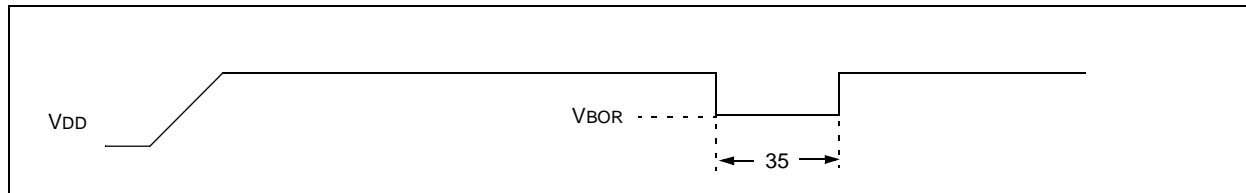


TABLE 15-3: RESET, WATCHDOG TIMER, OSCILLATOR START-UP TIMER, POWER-UP TIMER, AND BROWN-OUT RESET REQUIREMENTS

Parameter No.	Sym	Characteristic	Min	Typ†	Max	Units	Conditions
30	TmCL	MCLR Pulse Width (low)	2	—	—	μs	VDD = 5V, -40°C to +85°C
31*	TWDT	Watchdog Timer Time-out Period (No Prescaler)	7	18	33	ms	VDD = 5V, -40°C to +85°C
32	TOST	Oscillation Start-up Timer Period	—	1024 TOSC	—	—	TOSC = OSC1 period
33*	TPWRT	Power-up Timer Period	28	72	132	ms	VDD = 5V, -40°C to +85°C
34	TIOZ	I/O Hi-Impedance from MCLR Low or Watchdog Timer Reset	—	—	2.1	μs	
35	TBOR	Brown-out Reset Pulse Width	100	—	—	μs	VDD ≤ VBOR (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.

PIC16F7X

**TABLE 15-12: A/D CONVERTER CHARACTERISTICS: PIC16F7X (INDUSTRIAL, EXTENDED)
PIC16LF7X (INDUSTRIAL)**

Param No.	Sym	Characteristic		Min	Typ†	Max	Units	Conditions
A01	NR	Resolution	PIC16F7X	—	—	8 bits	bit	VREF = VDD = 5.12V, VSS ≤ VAIN ≤ VREF
			PIC16LF7X	—	—	8 bits	bit	VREF = VDD = 2.2V
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 (Note 3)		—	guaranteed	—	—	VSS ≤ VAIN ≤ VREF
A20	VREF	Reference voltage		2.5	—	5.5	V	-40°C to +125°C
				2.2	—	5.5	V	0°C to +125°C
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)	PIC16F7X	—	180	—	μA	Average current consumption when A/D is on (Note 1).
			PIC16LF7X	—	90	—	μA	
A50	IREF	VREF input current (Note 2)		N/A —	— —	±5 500	μA μA	During VAIN acquisition. During A/D Conversion cycle.

* 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 the RA3 pin or the VDD pin, whichever is selected as a reference input.

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

PIC16F7X

FIGURE 16-3: TYPICAL I_{DD} vs. F_{osc} OVER V_{DD} (XT MODE)

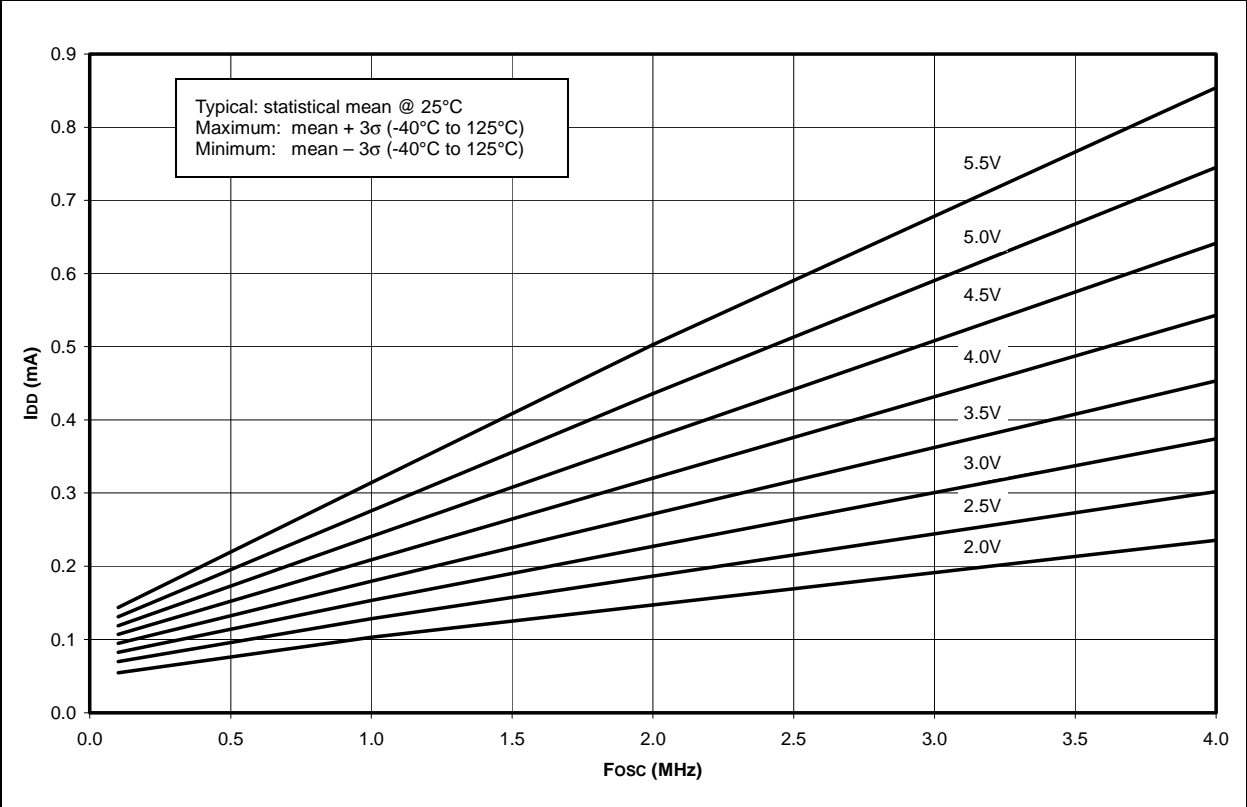
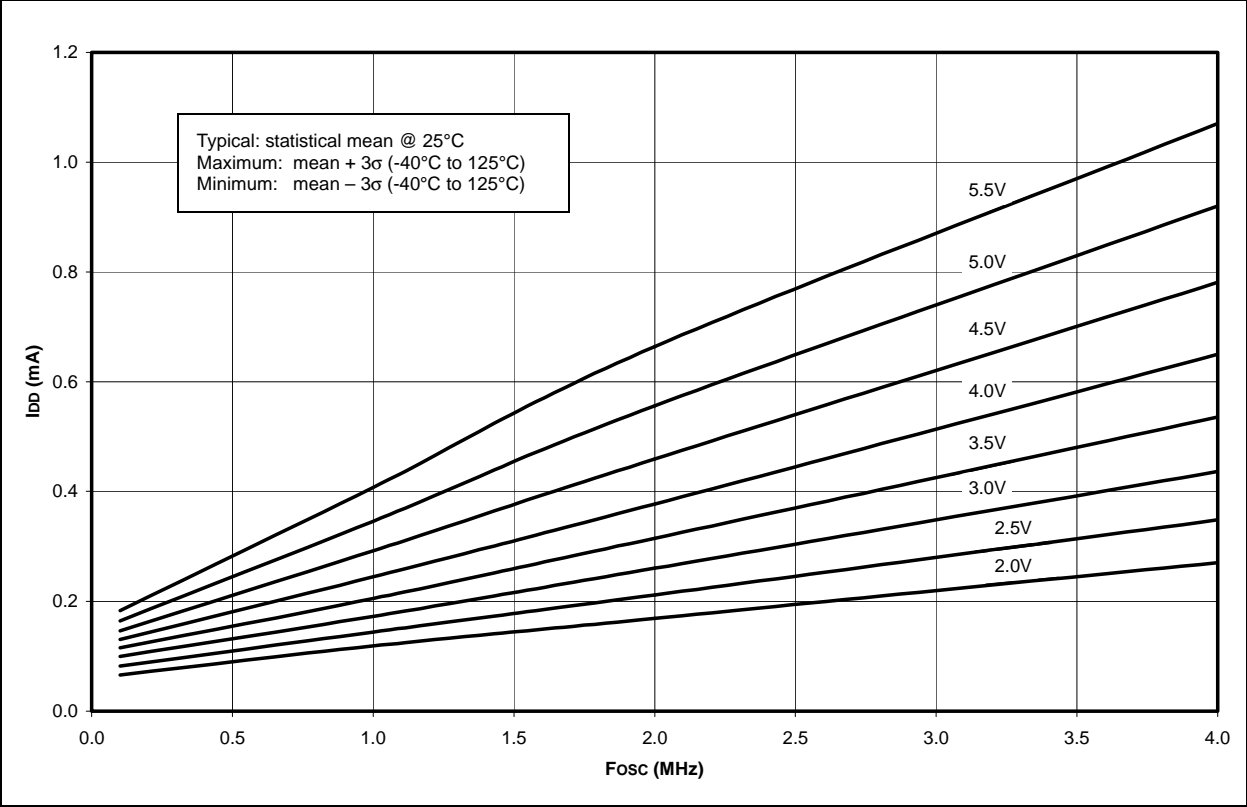
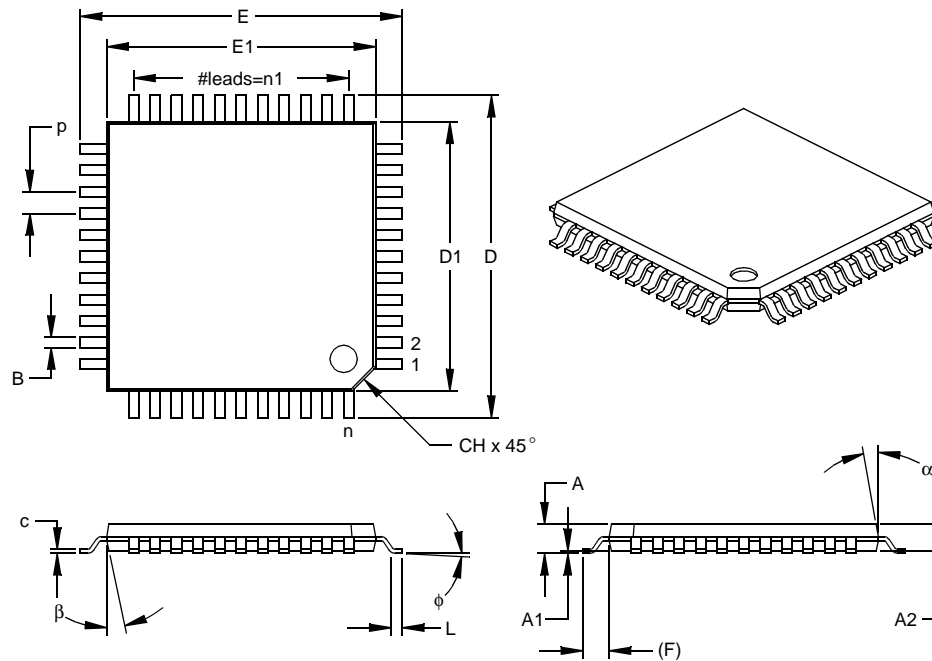


FIGURE 16-4: MAXIMUM I_{DD} vs. F_{osc} OVER V_{DD} (XT MODE)



44-Lead Plastic Thin Quad Flatpack (PT) 10x10x1 mm Body, 1.0/0.10 mm Lead Form (TQFP)



Units		INCHES			MILLIMETERS*		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		44			44	
Pitch	p		.031			0.80	
Pins per Side	n1		11			11	
Overall Height	A	.039	.043	.047	1.00	1.10	1.20
Molded Package Thickness	A2	.037	.039	.041	0.95	1.00	1.05
Standoff §	A1	.002	.004	.006	0.05	0.10	0.15
Foot Length	L	.018	.024	.030	0.45	0.60	0.75
Footprint (Reference)	(F)		.039		1.00		
Foot Angle	φ	0	3.5	7	0	3.5	7
Overall Width	E	.463	.472	.482	11.75	12.00	12.25
Overall Length	D	.463	.472	.482	11.75	12.00	12.25
Molded Package Width	E1	.390	.394	.398	9.90	10.00	10.10
Molded Package Length	D1	.390	.394	.398	9.90	10.00	10.10
Lead Thickness	c	.004	.006	.008	0.09	0.15	0.20
Lead Width	B	.012	.015	.017	0.30	0.38	0.44
Pin 1 Corner Chamfer	CH	.025	.035	.045	0.64	0.89	1.14
Mold Draft Angle Top	α	5	10	15	5	10	15
Mold Draft Angle Bottom	β	5	10	15	5	10	15

* Controlling Parameter
§ Significant Characteristic

Notes:

Dimensions D1 and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254mm) per side.

JEDEC Equivalent: MS-026

Drawing No. C04-076

PIC16F7X

PORTE Register	37	RCSTA Register	
Postscaler, WDT		CREN bit	70
Assignment (PSA bit)	20	OERR bit	70
Rate Select (PS2:PS0 bits)	20	SPEN bit	69
Power-down Mode. See SLEEP		SREN bit	70
Power-on Reset (POR)	89, 93, 95, 96	RD0/PSP0 Pin	12
Oscillator Start-up Timer (OST)	89, 94	RD1/PSP1 Pin	12
POR Status ($\overline{\text{POR}}$ bit)	25	RD2/PSP2 Pin	12
Power Control (PCON) Register	95	RD3/PSP3 Pin	12
Power-down ($\overline{\text{PD}}$ bit)	93	RD4/PSP4 Pin	12
Power-up Timer (PWRT)	89, 94	RD5/PSP5 Pin	12
Time-out (TO bit)	19, 93	RD6/PSP6 Pin	12
PR2 Register	51	RD7/PSP7 Pin	12
Prescaler, Timer0		RE0/RD/AN5 Pin	12
Assignment (PSA bit)	20	RE1/WR/AN6 Pin	12
Rate Select (PS2:PS0 bits)	20	RE2/ $\overline{\text{CS}}$ /AN7 Pin	12
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RB2 Pin	9, 11	T2CON (Timer2 Control) Register	52
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