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### What is "[Embedded - Microcontrollers](#)"?

"[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.

### Applications of "[Embedded - Microcontrollers](#)"

#### Details

Product Status	Obsolete
Core Processor	PIC
Core Size	8-Bit
Speed	33MHz
Connectivity	UART/USART
Peripherals	POR, PWM, WDT
Number of I/O	33
Program Memory Size	8KB (4K x 16)
Program Memory Type	OTP
EEPROM Size	-
RAM Size	454 x 8
Voltage - Supply (Vcc/Vdd)	4.5V ~ 6V
Data Converters	-
Oscillator Type	External
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Through Hole
Package / Case	40-DIP (0.600", 15.24mm)
Supplier Device Package	40-PDIP
Purchase URL	<a href="https://www.e-xfl.com/product-detail/microchip-technology/pic17c43-33e-p">https://www.e-xfl.com/product-detail/microchip-technology/pic17c43-33e-p</a>

## 5.3 Peripheral Interrupt Request Register (PIR)

This register contains the individual flag bits for the peripheral interrupts.

**Note:** These bits will be set by the specified condition, even if the corresponding interrupt enable bit is cleared (interrupt disabled), or the GLINTD bit is set (all interrupts disabled). Before enabling an interrupt, the user may wish to clear the interrupt flag to ensure that the program does not immediately branch to the peripheral interrupt service routine.

**FIGURE 5-4: PIR REGISTER (ADDRESS: 16h, BANK 1)**

R/W - 0	R/W - 0	R/W - 0	R/W - 0	R/W - 0	R/W - 0	R - 1	R - 0
RBIF	TMR3IF	TMR2IF	TMR1IF	CA2IF	CA1IF	TXIF	RCIF
bit7							bit0
<p><b>bit 7: RBIF:</b> PORTB Interrupt on Change Flag bit  1 = One of the PORTB inputs changed (Software must end the mismatch condition)  0 = None of the PORTB inputs have changed</p> <p><b>bit 6: TMR3IF:</b> Timer3 Interrupt Flag bit  If Capture1 is enabled (<math>CA1/\overline{PR3} = 1</math>)  1 = Timer3 overflowed  0 = Timer3 did not overflow  If Capture1 is disabled (<math>CA1/\overline{PR3} = 0</math>)  1 = Timer3 value has rolled over to 0000h from equalling the period register (PR3H:PR3L) value  0 = Timer3 value has not rolled over to 0000h from equalling the period register (PR3H:PR3L) value</p> <p><b>bit 5: TMR2IF:</b> Timer2 Interrupt Flag bit  1 = Timer2 value has rolled over to 0000h from equalling the period register (PR2) value  0 = Timer2 value has not rolled over to 0000h from equalling the period register (PR2) value</p> <p><b>bit 4: TMR1IF:</b> Timer1 Interrupt Flag bit  If Timer1 is in 8-bit mode (<math>T16 = 0</math>)  1 = Timer1 value has rolled over to 0000h from equalling the period register (PR) value  0 = Timer1 value has not rolled over to 0000h from equalling the period register (PR2) value  If Timer1 is in 16-bit mode (<math>T16 = 1</math>)  1 = TMR1:TMR2 value has rolled over to 0000h from equalling the period register (PR1:PR2) value  0 = TMR1:TMR2 value has not rolled over to 0000h from equalling the period register (PR1:PR2) value</p> <p><b>bit 3: CA2IF:</b> Capture2 Interrupt Flag bit  1 = Capture event occurred on RB1/CAP2 pin  0 = Capture event did not occur on RB1/CAP2 pin</p> <p><b>bit 2: CA1IF:</b> Capture1 Interrupt Flag bit  1 = Capture event occurred on RB0/CAP1 pin  0 = Capture event did not occur on RB0/CAP1 pin</p> <p><b>bit 1: TXIF:</b> USART Transmit Interrupt Flag bit  1 = Transmit buffer is empty  0 = Transmit buffer is full</p> <p><b>bit 0: RCIF:</b> USART Receive Interrupt Flag bit  1 = Receive buffer is full  0 = Receive buffer is empty</p>							
<p>R = Readable bit  W = Writable bit  -n = Value at POR reset</p>							

## 8.0 HARDWARE MULTIPLIER

All PIC17C4X devices except the PIC17C42, have an 8 x 8 hardware multiplier included in the ALU of the device. By making the multiply a hardware operation, it completes in a single instruction cycle. This is an unsigned multiply that gives a 16-bit result. The result is stored into the 16-bit PRODUct register (PRODH:PRODL). The multiplier does not affect any flags in the ALUSTA register.

Making the 8 x 8 multiplier execute in a single cycle gives the following advantages:

- Higher computational throughput
- Reduces code size requirements for multiply algorithms

The performance increase allows the device to be used in applications previously reserved for Digital Signal Processors.

Table 8-1 shows a performance comparison between the PIC17C42 and all other PIC17CXX devices, which have the single cycle hardware multiply.

Example 8-1 shows the sequence to do an 8 x 8 unsigned multiply. Only one instruction is required when one argument of the multiply is already loaded in the WREG register.

Example 8-2 shows the sequence to do an 8 x 8 signed multiply. To account for the sign bits of the arguments, each argument's most significant bit (MSb) is tested and the appropriate subtractions are done.

### EXAMPLE 8-1: 8 x 8 MULTIPLY ROUTINE

```
MOVFP    ARG1, WREG
MULWF    ARG2          ; ARG1 * ARG2 ->
                        ; PRODH:PRODL
```

### EXAMPLE 8-2: 8 x 8 SIGNED MULTIPLY ROUTINE

```
MOVFP    ARG1, WREG
MULWF    ARG2          ; ARG1 * ARG2 ->
                        ; PRODH:PRODL

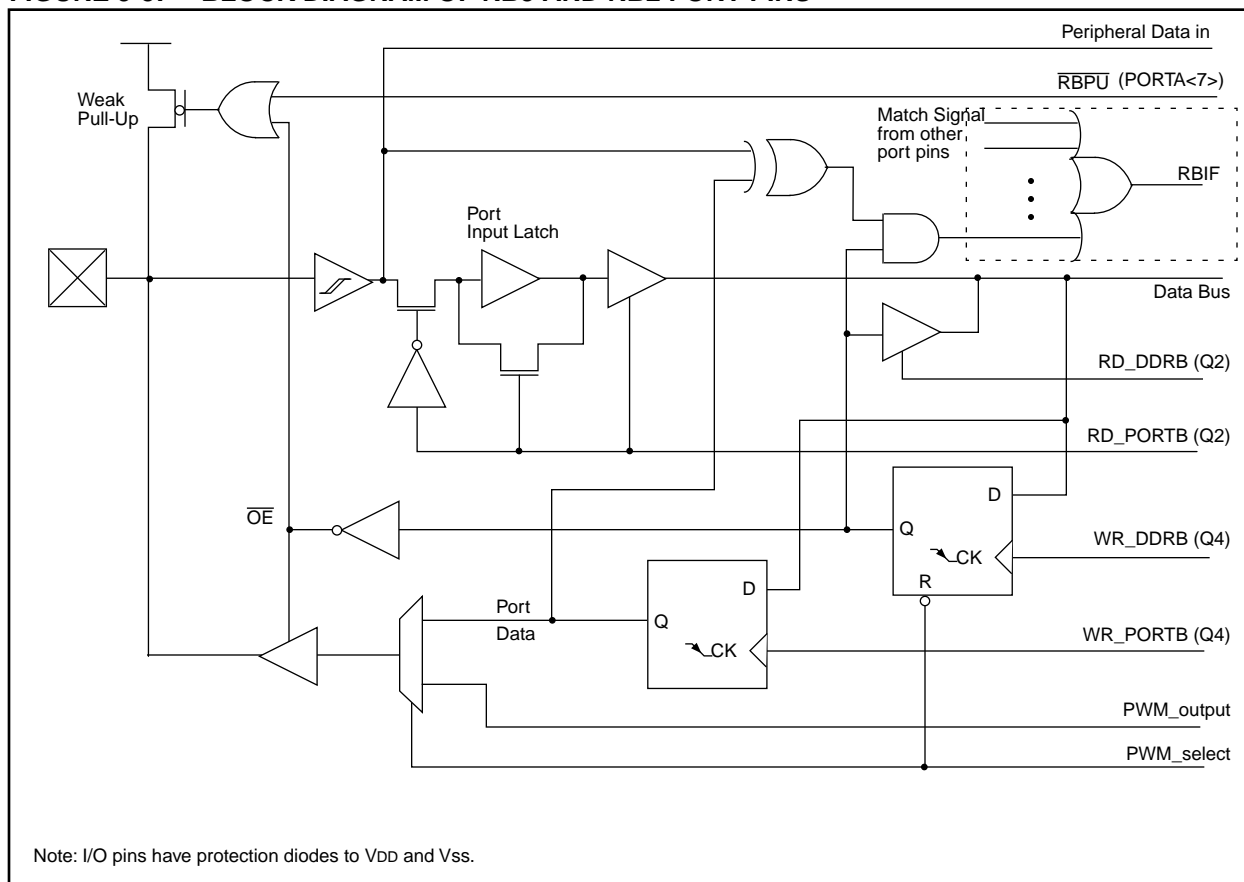
BTFSC    ARG2, SB      ; Test Sign Bit
SUBWF    PRODH, F       ; PRODH = PRODH
                        ; - ARG1

MOVFP    ARG2, WREG
BTFSC    ARG1, SB      ; Test Sign Bit
SUBWF    PRODH, F       ; PRODH = PRODH
                        ; - ARG2
```

**TABLE 8-1: PERFORMANCE COMPARISON**

Routine	Device	Program Memory (Words)	Cycles (Max)	Time	
				@ 25 MHz	@ 33 MHz
8 x 8 unsigned	PIC17C42	13	69	11.04 $\mu$ s	N/A
	All other PIC17CXX devices	1	1	160 ns	121 ns
8 x 8 signed	PIC17C42	—	—	—	N/A
	All other PIC17CXX devices	6	6	960 ns	727 ns
16 x 16 unsigned	PIC17C42	21	242	38.72 $\mu$ s	N/A
	All other PIC17CXX devices	24	24	3.84 $\mu$ s	2.91 $\mu$ s
16 x 16 signed	PIC17C42	52	254	40.64 $\mu$ s	N/A
	All other PIC17CXX devices	36	36	5.76 $\mu$ s	4.36 $\mu$ s

**FIGURE 9-5: BLOCK DIAGRAM OF RB3 AND RB2 PORT PINS**



Example 9-1 shows the instruction sequence to initialize PORTB. The Bank Select Register (BSR) must be selected to Bank 0 for the port to be initialized.

## EXAMPLE 9-1: INITIALIZING PORTB

```
MOVLB 0      ; Select Bank 0
CLRF  PORTB  ; Initialize PORTB by clearing
              ; output data latches
MOVLW 0xCF   ; Value used to initialize
              ; data direction
MOVWF DDRB   ; Set RB<3:0> as inputs
              ; RB<5:4> as outputs
              ; RB<7:6> as inputs
```

**TABLE 9-3: PORTB FUNCTIONS**

Name	Bit	Buffer Type	Function
RB0/CAP1	bit0	ST	Input/Output or the RB0/CAP1 input pin. Software programmable weak pull-up and interrupt on change features.
RB1/CAP2	bit1	ST	Input/Output or the RB1/CAP2 input pin. Software programmable weak pull-up and interrupt on change features.
RB2/PWM1	bit2	ST	Input/Output or the RB2/PWM1 output pin. Software programmable weak pull-up and interrupt on change features.
RB3/PWM2	bit3	ST	Input/Output or the RB3/PWM2 output pin. Software programmable weak pull-up and interrupt on change features.
RB4/TCLK12	bit4	ST	Input/Output or the external clock input to Timer1 and Timer2. Software programmable weak pull-up and interrupt on change features.
RB5/TCLK3	bit5	ST	Input/Output or the external clock input to Timer3. Software programmable weak pull-up and interrupt on change features.
RB6	bit6	ST	Input/Output pin. Software programmable weak pull-up and interrupt on change features.
RB7	bit7	ST	Input/Output pin. Software programmable weak pull-up and interrupt on change features.

Legend: ST = Schmitt Trigger input.

**TABLE 9-4: REGISTERS/BITS ASSOCIATED WITH PORTB**

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on Power-on Reset	Value on all other resets (Note1)
12h, Bank 0	PORTB	PORTB data latch								xxxx xxxx	uuuu uuuu
11h, Bank 0	DDRB	Data direction register for PORTB								1111 1111	1111 1111
10h, Bank 0	PORTA	RBPU	—	RA5	RA4	RA3	RA2	RA1/T0CKI	RA0/INT	0-xx xxxx	0-uu uuuu
06h, Unbanked	CPUSTA	—	—	STKAV	GLINTD	T0	PD	—	—	--11 11--	--11 qq--
07h, Unbanked	INTSTA	PEIF	T0CKIF	T0IF	INTF	PEIE	T0CKIE	T0IE	INTE	0000 0000	0000 0000
16h, Bank 1	PIR	RBIF	TMR3IF	TMR2IF	TMR1IF	CA2IF	CA1IF	TXIF	RCIF	0000 0010	0000 0010
17h, Bank 1	PIE	RBIE	TMR3IE	TMR2IE	TMR1IE	CA2IE	CA1IE	TXIE	RCIE	0000 0000	0000 0000
16h, Bank 3	TCON1	CA2ED1	CA2ED0	CA1ED1	CA1ED0	T16	TMR3CS	TMR2CS	TMR1CS	0000 0000	0000 0000
17h, Bank 3	TCON2	CA2OVF	CA1OVF	PWM2ON	PWM1ON	CA1/PR3	TMR3ON	TMR2ON	TMR1ON	0000 0000	0000 0000

Legend: x = unknown, u = unchanged, - = unimplemented read as '0', q = Value depends on condition.

Shaded cells are not used by PORTB.

Note 1: Other (non power-up) resets include: external reset through  $\overline{\text{MCLR}}$  and the Watchdog Timer Reset.

## 14.0 SPECIAL FEATURES OF THE CPU

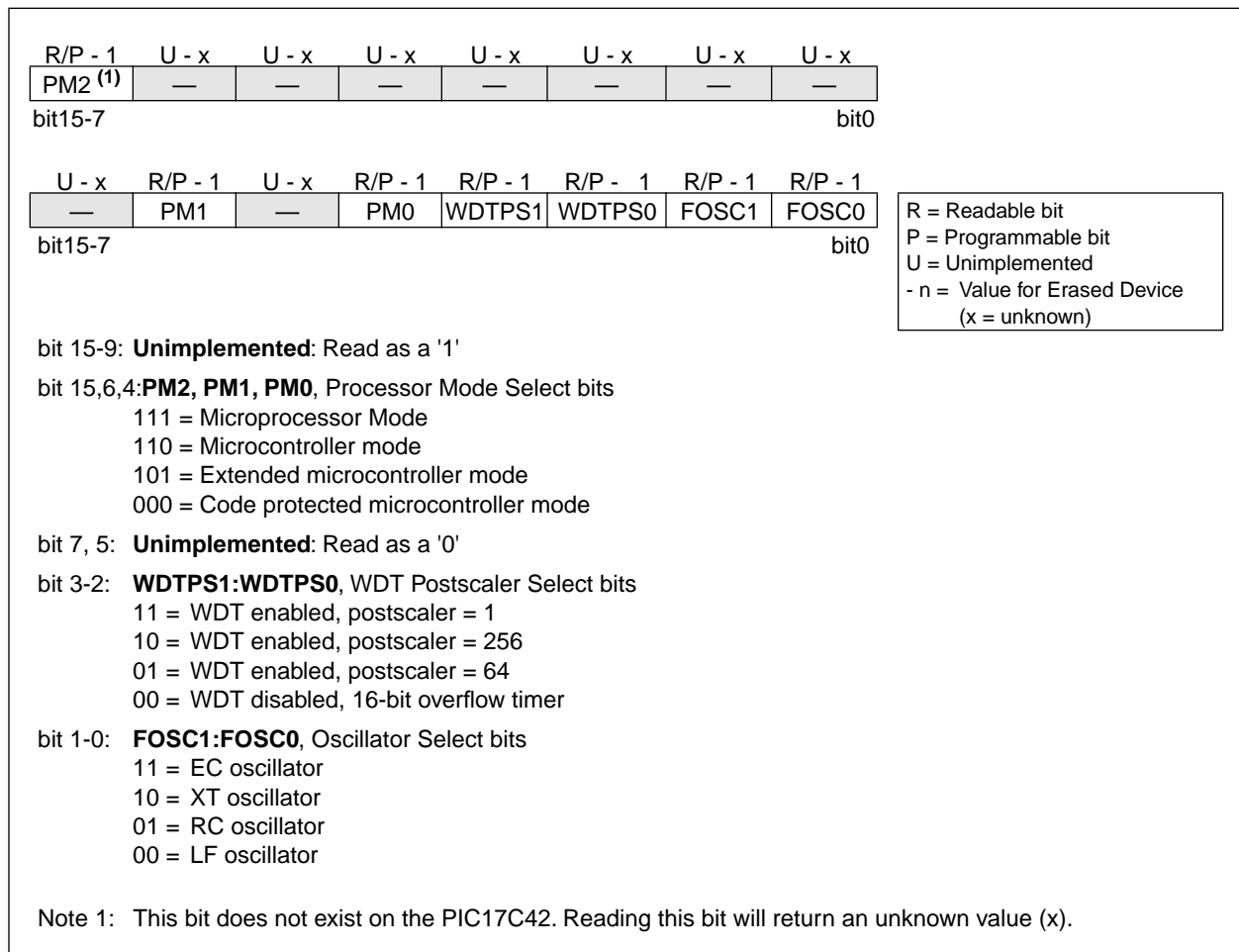
What sets a microcontroller apart from other processors are special circuits to deal with the needs of real time applications. The PIC17CXX family has a host of such features intended to maximize system reliability, minimize cost through elimination of external components, provide power saving operating modes and offer code protection. These are:

- OSC selection
- Reset
  - Power-on Reset (POR)
  - Power-up Timer (PWRT)
  - Oscillator Start-up Timer (OST)
- Interrupts
- Watchdog Timer (WDT)
- SLEEP
- Code protection

The PIC17CXX has a Watchdog Timer which can be shut off only through EPROM 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 96 ms (nominal) on power-up only, designed to keep the part in RESET while the power supply stabilizes. With these two timers 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 from SLEEP through external reset, Watchdog Timer Reset or through an interrupt. Several oscillator options are also made available to allow the part to fit the application. The RC oscillator option saves system cost while the LF crystal option saves power. Configuration bits are used to select various options. This configuration word has the format shown in Figure 14-1.

**FIGURE 14-1: CONFIGURATION WORD**



# PIC17C4X

## MOVFP Move f to p

Syntax: `[label] MOVFP f,p`

Operands:  $0 \leq f \leq 255$   
 $0 \leq p \leq 31$

Operation:  $(f) \rightarrow (p)$

Status Affected: None

Encoding: 

011p	pppp	ffff	ffff
------	------	------	------

Description: Move data from data memory location 'f' to data memory location 'p'. Location 'f' can be anywhere in the 256 word data space (00h to FFh) while 'p' can be 00h to 1Fh.

Either 'p' or 'f' can be WREG (a useful special situation).

MOVFP is particularly useful for transferring a data memory location to a peripheral register (such as the transmit buffer or an I/O port). Both 'f' and 'p' can be indirectly addressed.

Words: 1

Cycles: 1

Q Cycle Activity:

Q1	Q2	Q3	Q4
Decode	Read register 'f'	Execute	Write register 'p'

**Example:** `MOVFP REG1, REG2`

Before Instruction

REG1 = 0x33,  
 REG2 = 0x11

After Instruction

REG1 = 0x33,  
 REG2 = 0x33

## MOVLB Move Literal to low nibble in BSR

Syntax: `[label] MOVLB k`

Operands:  $0 \leq k \leq 15$

Operation:  $k \rightarrow (\text{BSR}<3:0>)$

Status Affected: None

Encoding: 

1011	1000	uuuu	kkkk
------	------	------	------

Description: The four bit literal 'k' is loaded in the Bank Select Register (BSR). Only the low 4-bits of the Bank Select Register are affected. The upper half of the BSR is unchanged. The assembler will encode the "u" fields as '0'.

Words: 1

Cycles: 1

Q Cycle Activity:

Q1	Q2	Q3	Q4
Decode	Read literal 'u:k'	Execute	Write literal 'k' to BSR<3:0>

**Example:** `MOVLB 0x5`

Before Instruction

BSR register = 0x22

After Instruction

BSR register = 0x25

**Note:** For the PIC17C42, only the low four bits of the BSR register are physically implemented. The upper nibble is read as '0'.

# PIC17C4X

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NOTES:



## 17.1 DC CHARACTERISTICS: PIC17C42-16 (Commercial, Industrial) PIC17C42-25 (Commercial, Industrial)

Standard Operating Conditions (unless otherwise stated)							
DC CHARACTERISTICS							
Operating temperature							
-40°C ≤ TA ≤ +85°C for industrial and 0°C ≤ TA ≤ +70°C for commercial							
Parameter No.	Sym	Characteristic	Min	Typ†	Max	Units	Conditions
D001	VDD	Supply Voltage	4.5	–	5.5	V	
D002	VDR	RAM Data Retention Voltage (Note 1)	1.5 *	–	–	V	Device in SLEEP mode
D003	VPOR	VDD start voltage to ensure internal Power-on Reset signal	–	VSS	–	V	See section on Power-on Reset for details
D004	SVDD	VDD rise rate to ensure internal Power-on Reset signal	0.060*	–	–	mV/ms	See section on Power-on Reset for details
D010 D011 D012 D013 D014	IDD	Supply Current (Note 2)	–	3 6 11 19 95	6 12 * 24 * 38 150	mA mA mA mA μA	FOSC = 4 MHz (Note 4) FOSC = 8 MHz FOSC = 16 MHz FOSC = 25 MHz FOSC = 32 kHz WDT enabled (EC osc configuration)
D020 D021	IPD	Power-down Current (Note 3)	–	10 < 1	40 5	μA μA	VDD = 5.5V, WDT enabled VDD = 5.5V, WDT disabled

\* 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: This is the limit to which VDD can be lowered in SLEEP mode without losing RAM data.

2: 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 tristated, pulled to VDD or VSS, T0CKI = VDD, MCLR = VDD; WDT enabled/disabled as specified.

Current consumed from the oscillator and I/O's driving external capacitive or resistive loads need to be considered.

For the RC oscillator, the current through the external pull-up resistor (R) can be estimated as:  $V_{DD} / (2 \cdot R)$ .

For capacitive loads, The current can be estimated (for an individual I/O pin) as  $(C_L \cdot V_{DD}) \cdot f$

$C_L$  = Total capacitive load on the I/O pin;  $f$  = average frequency on the I/O pin switches.

The capacitive currents are most significant when the device is configured for external execution (includes extended microcontroller mode).

3: 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, all I/O pins in hi-impedance state and tied to VDD or VSS.

4: 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 kOhm.

# PIC17C4X

Applicable Devices 42 R42 42A 43 R43 44

FIGURE 18-2: TYPICAL RC OSCILLATOR FREQUENCY vs. VDD

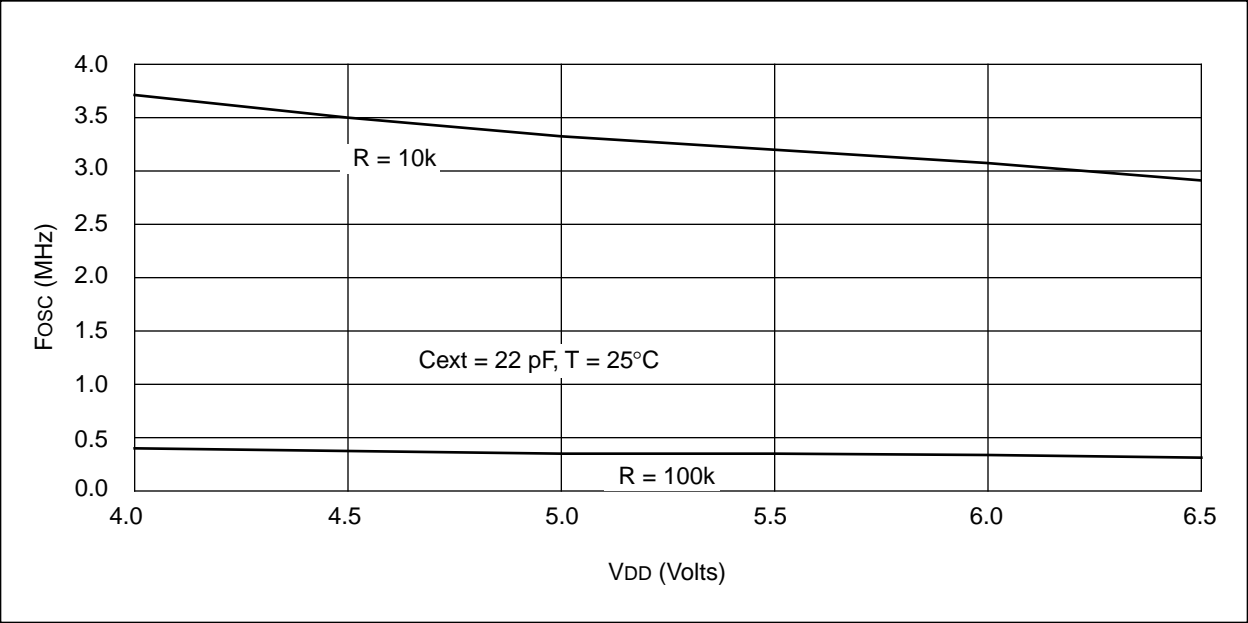
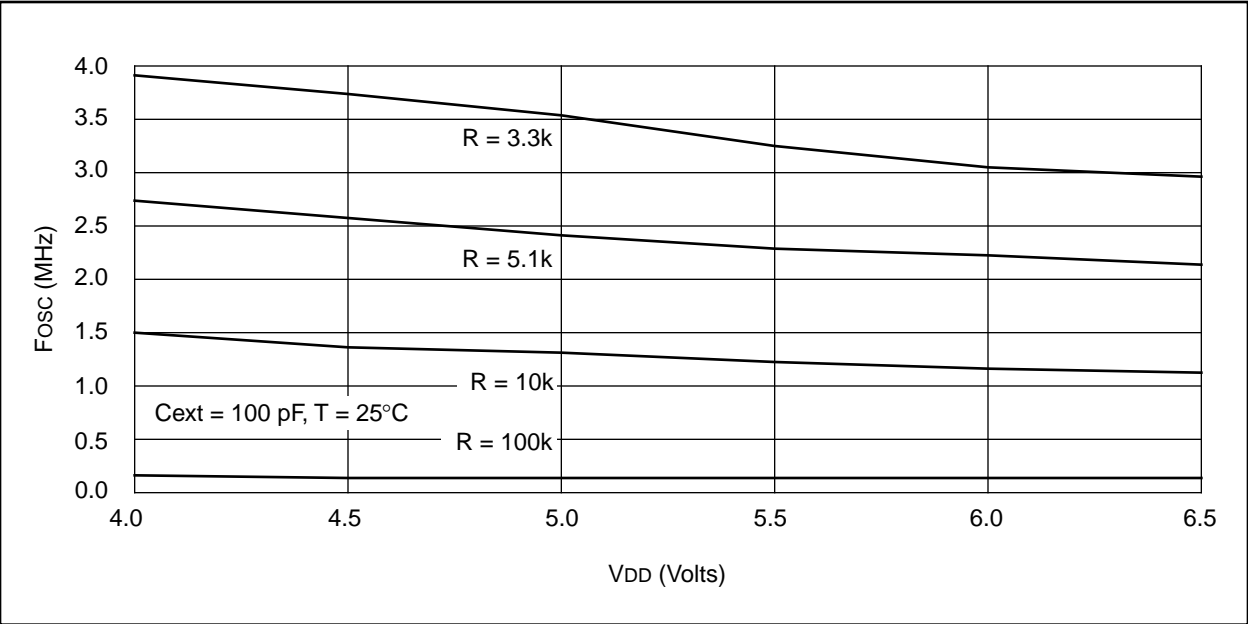


FIGURE 18-3: TYPICAL RC OSCILLATOR FREQUENCY vs. VDD



# PIC17C4X

Applicable Devices 42 R42 42A 43 R43 44

FIGURE 18-13: WDT TIMER TIME-OUT PERIOD vs. VDD

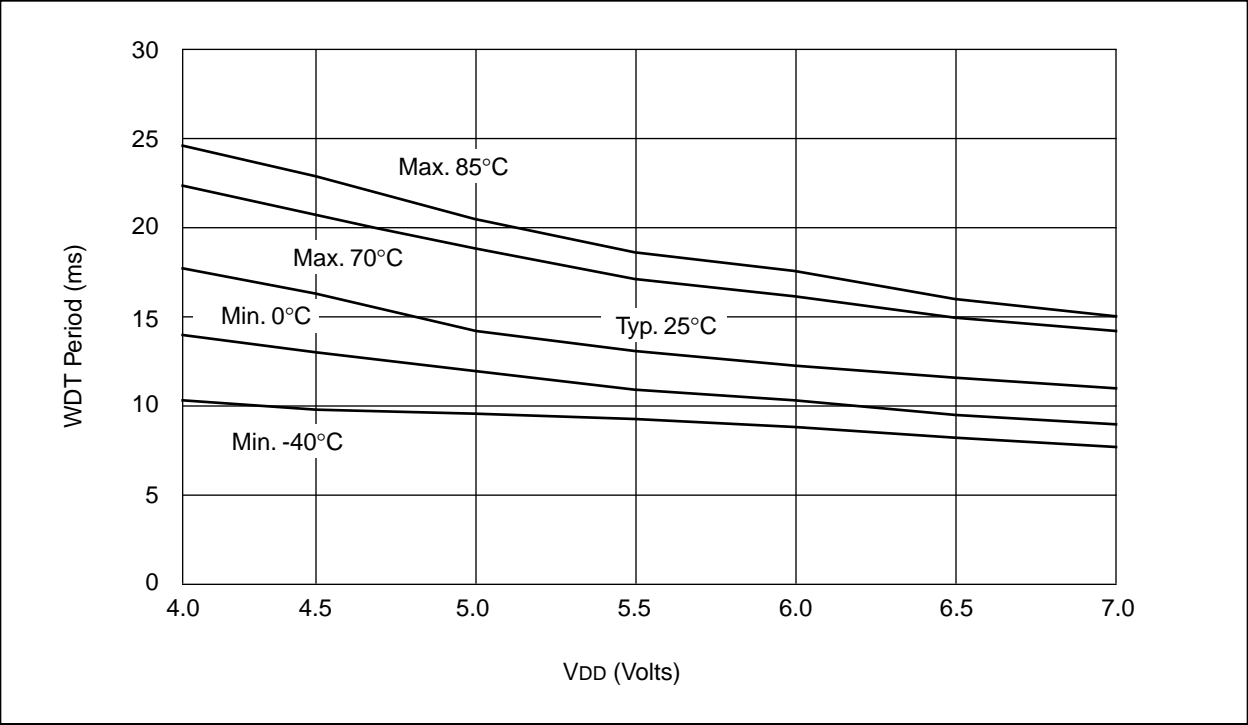
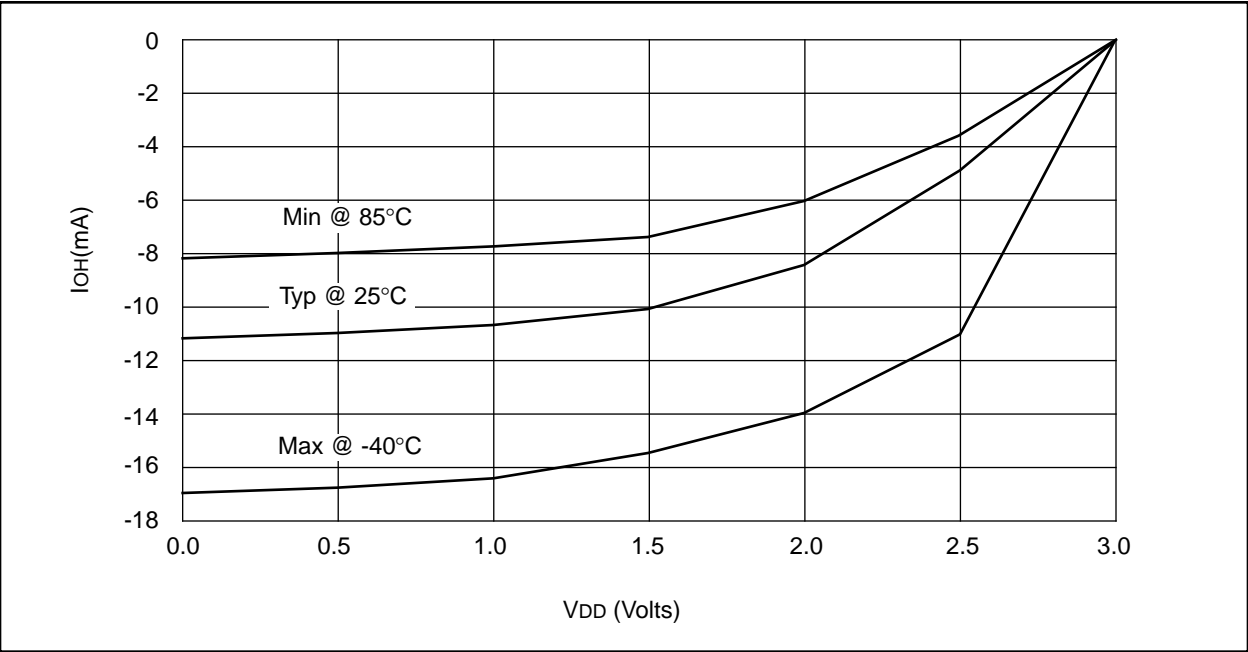
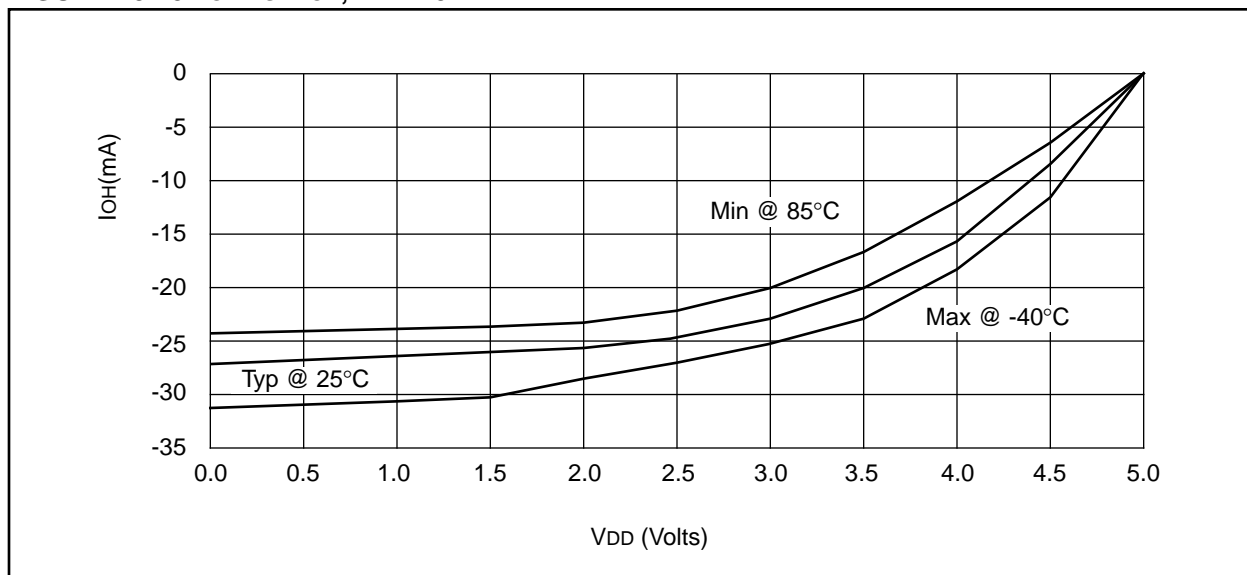


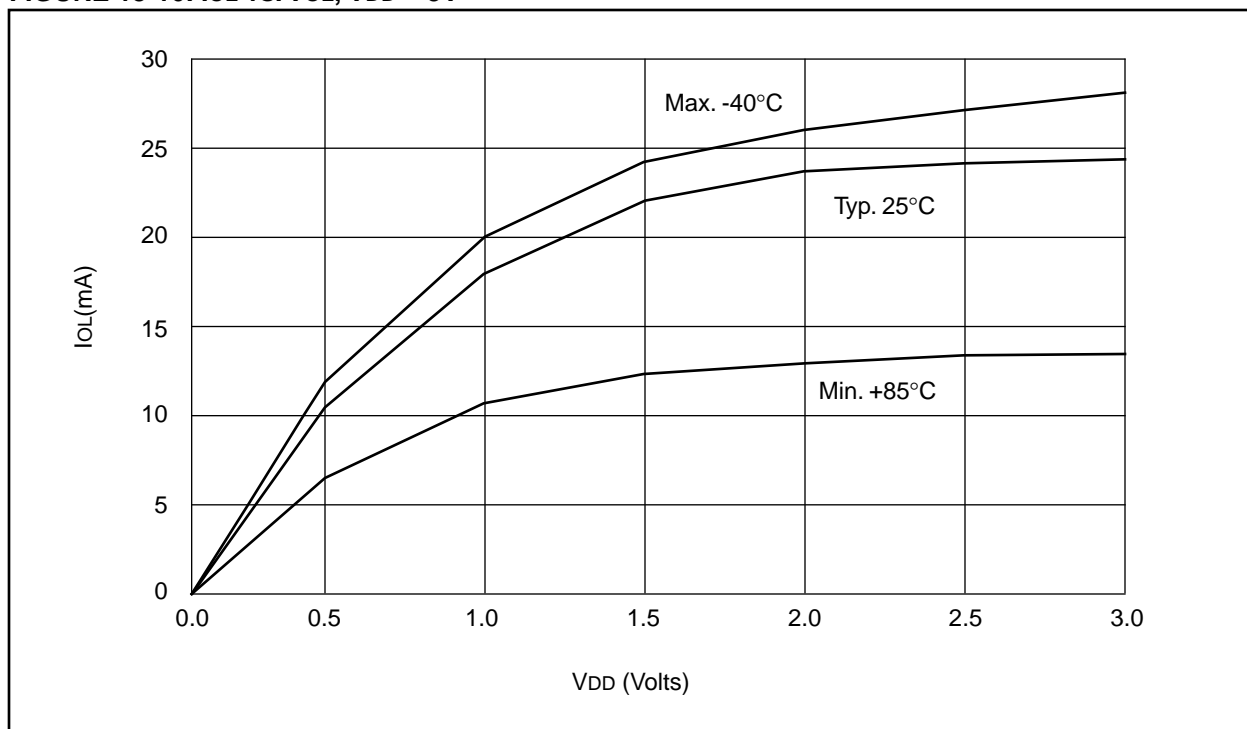
FIGURE 18-14: IOH vs. VOH, VDD = 3V



**FIGURE 18-15:  $I_{OH}$  vs.  $V_{OH}$ ,  $V_{DD} = 5V$**



**FIGURE 18-16:  $I_{OL}$  vs.  $V_{OL}$ ,  $V_{DD} = 3V$**



# PIC17C4X

Applicable Devices 42 R42 42A 43 R43 44

FIGURE 18-17:  $I_{OH}$  vs.  $V_{OL}$ ,  $V_{DD} = 5V$

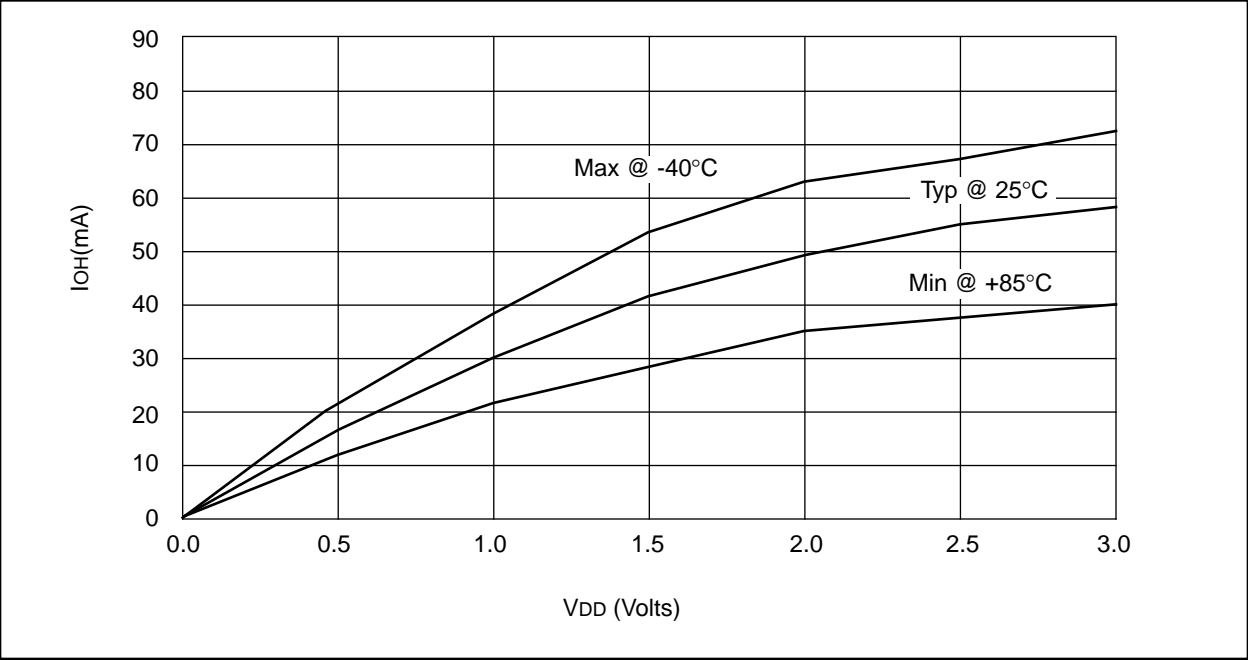
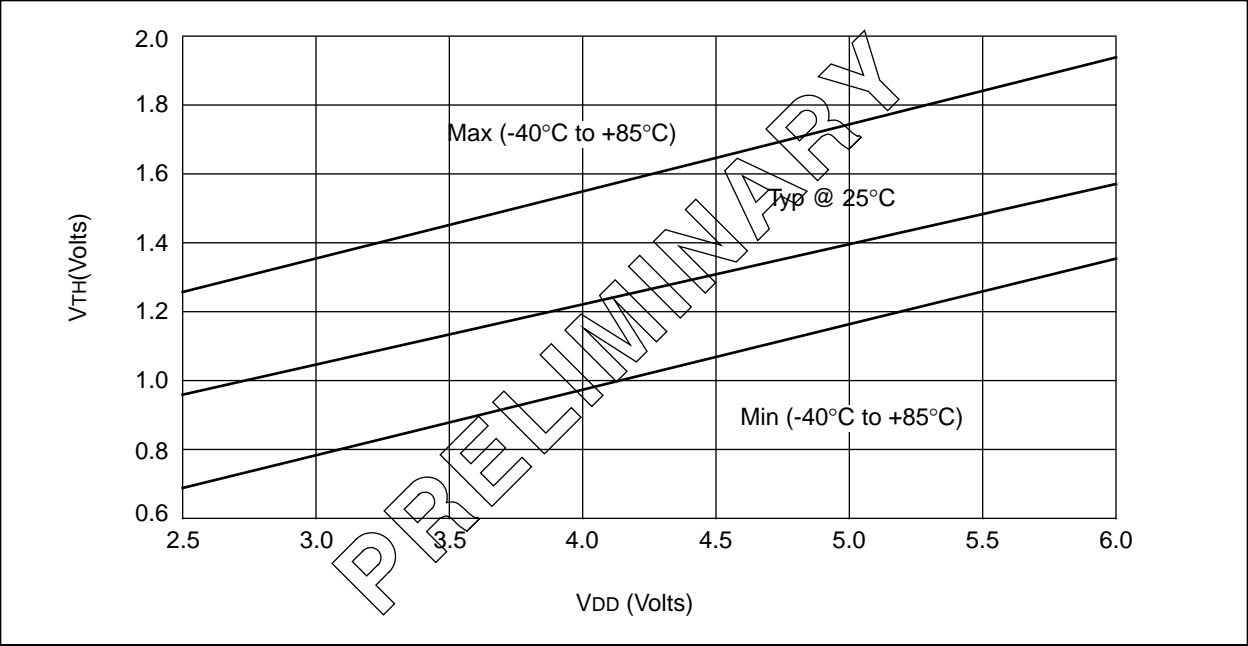


FIGURE 18-18:  $V_{TH}$  (INPUT THRESHOLD VOLTAGE) OF I/O PINS (TTL) vs.  $V_{DD}$

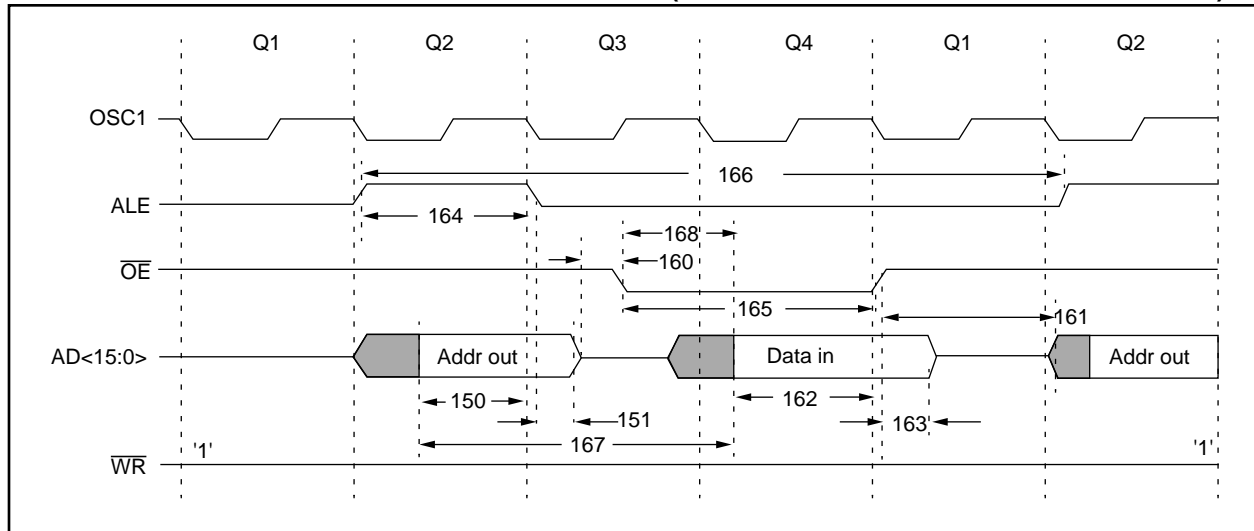


# PIC17C4X

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NOTES:

**FIGURE 19-12: MEMORY INTERFACE READ TIMING (NOT SUPPORTED IN PIC17LC4X DEVICES)**



**TABLE 19-12: MEMORY INTERFACE READ REQUIREMENTS (NOT SUPPORTED IN PIC17LC4X DEVICES)**

Parameter No.	Sym	Characteristic	Min	Typ†	Max	Units	Conditions
150	TadV2aIL	AD15:AD0 (address) valid to ALE↓ (address setup time)	0.25Tcy - 10	—	—	ns	
151	TalL2adI	ALE↓ to address out invalid (address hold time)	5*	—	—	ns	
160	TadZ2oeL	AD15:AD0 hi-impedance to OE↓	0*	—	—	ns	
161	ToeH2adD	OE↑ to AD15:AD0 driven	0.25Tcy - 15	—	—	ns	
162	TadV2oeH	Data in valid before OE↑ (data setup time)	35	—	—	ns	
163	ToeH2adI	OE↑ to data in invalid (data hold time)	0	—	—	ns	
164	TalH	ALE pulse width	—	0.25Tcy §	—	ns	
165	ToeL	OE pulse width	0.5Tcy - 35 §	—	—	ns	
166	TalH2alH	ALE↑ to ALE↑ (cycle time)	—	Tcy §	—	ns	
167	Tacc	Address access time	—	—	0.75Tcy - 30	ns	
168	Toe	Output enable access time (OE low to Data Valid)	—	—	0.5Tcy - 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.

§ This specification ensured by design.

# PIC17C4X

Applicable Devices 42 R42 42A 43 R43 44

FIGURE 20-5: TRANSCONDUCTANCE (gm) OF LF OSCILLATOR vs. VDD

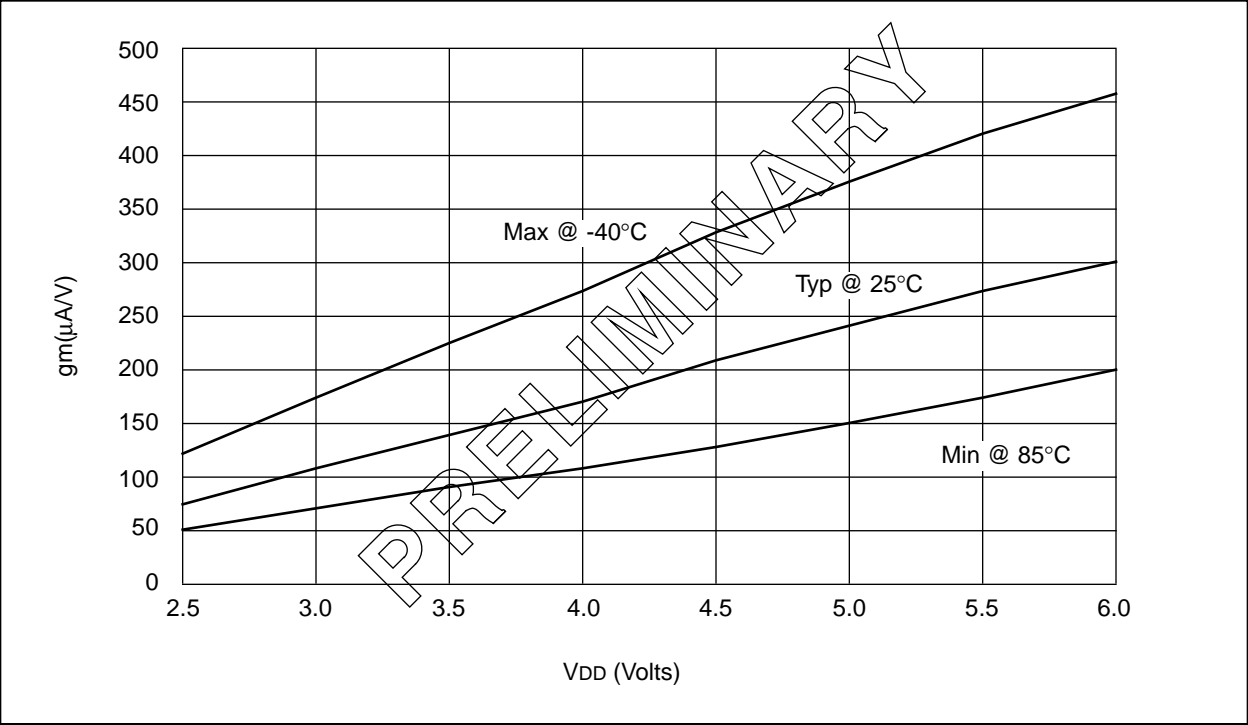
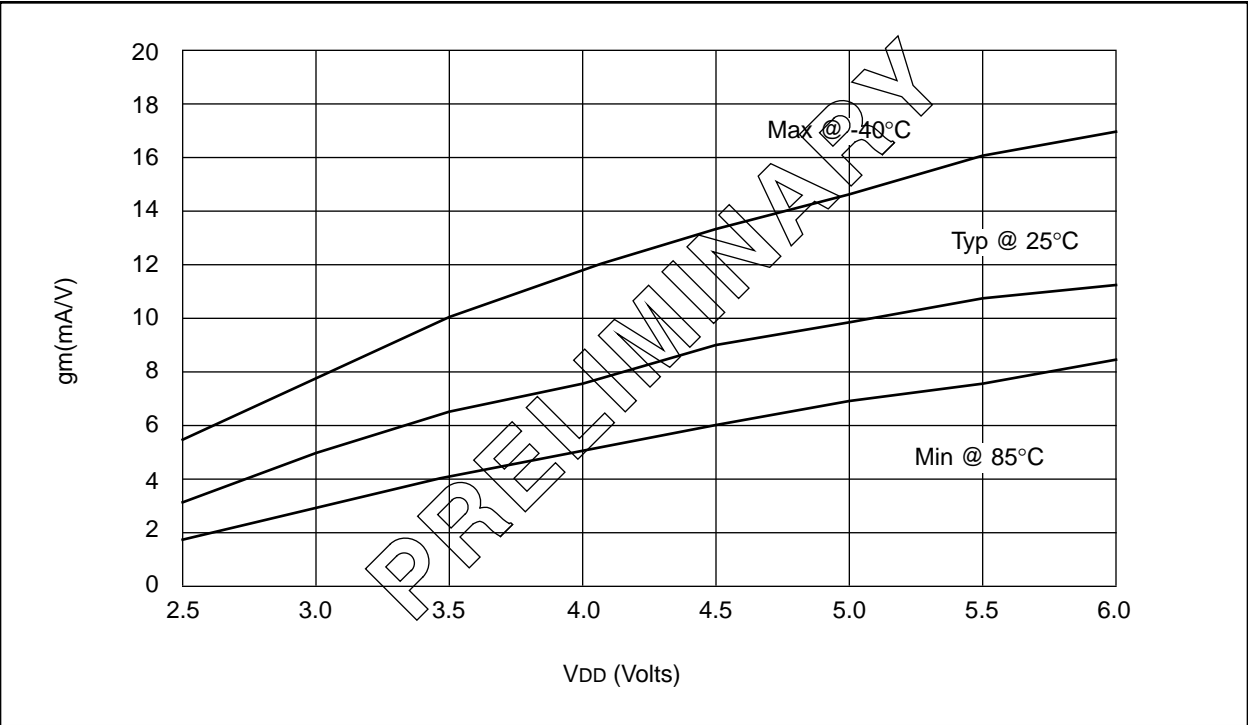


FIGURE 20-6: TRANSCONDUCTANCE (gm) OF XT OSCILLATOR vs. VDD





## E.3 PIC16CXXX Family of Devices

	Clock			Memory			Peripherals			Features		
	Maximum Frequency of Operation (MHz)	EPROM	Data Memory (bytes)	Program Memory (K14 words)	Timer Modules	Comparators	Internal Reference Voltage	Interrupt Sources	I/O Pins	Voltage Range (Volts)	Brown-out Reset	Packages
PIC16C554	20	512	80	TMR0	—	—	3	13	2.5-6.0	—	—	18-pin DIP; SOIC; 20-pin SSOP
PIC16C556	20	1K	80	TMR0	—	—	3	13	2.5-6.0	—	—	18-pin DIP; SOIC; 20-pin SSOP
PIC16C558	20	2K	128	TMR0	—	—	3	13	2.5-6.0	—	—	18-pin DIP; SOIC; 20-pin SSOP
PIC16C620	20	512	80	TMR0	2	Yes	4	13	2.5-6.0	Yes	Yes	18-pin DIP; SOIC; 20-pin SSOP
PIC16C621	20	1K	80	TMR0	2	Yes	4	13	2.5-6.0	Yes	Yes	18-pin DIP; SOIC; 20-pin SSOP
PIC16C622	20	2K	128	TMR0	2	Yes	4	13	2.5-6.0	Yes	Yes	18-pin DIP; SOIC; 20-pin SSOP

All PIC16/17 Family devices have Power-on Reset, selectable Watchdog Timer, selectable code protect and high I/O current capability.

All PIC16C6XXX Family devices use serial programming with clock pin RB6 and data pin RB7.

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