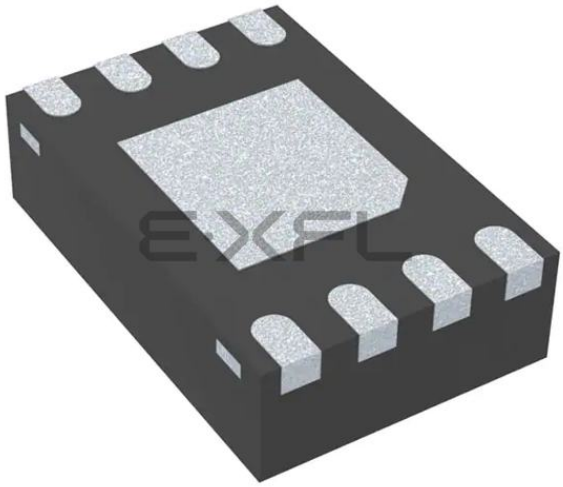

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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	PIC
Core Size	8-Bit
Speed	4MHz
Connectivity	-
Peripherals	POR, WDT
Number of I/O	5
Program Memory Size	1.5KB (1K x 12)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	41 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	8-VFDFN Exposed Pad
Supplier Device Package	8-DFN (2x3)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic12f509t-i-mc

PIC12F508/509/16F505

8/14-Pin, 8-Bit Flash Microcontrollers

Devices Included In This Data Sheet:

- PIC12F508
- PIC12F509
- PIC16F505

High-Performance RISC CPU:

- Only 33 Single-Word Instructions to Learn
- All Single-Cycle Instructions Except for Program Branches, which are Two-Cycle
- 12-Bit Wide Instructions
- 2-Level Deep Hardware Stack
- Direct, Indirect and Relative Addressing modes for Data and Instructions
- 8-Bit Wide Data Path
- 8 Special Function Hardware Registers
- Operating Speed:
  - DC – 20 MHz clock input (PIC16F505 only)
  - DC – 200 ns instruction cycle (PIC16F505 only)
  - DC – 4 MHz clock input
  - DC – 1000 ns instruction cycle

Special Microcontroller Features:

- 4 MHz Precision Internal Oscillator:
  - Factory calibrated to ±1%
- In-Circuit Serial Programming™ (ICSP™)
- In-Circuit Debugging (ICD) Support
- Power-On Reset (POR)
- Device Reset Timer (DRT)
- Watchdog Timer (WDT) with Dedicated On-Chip RC Oscillator for Reliable Operation
- Programmable Code Protection
- Multiplexed $\overline{\text{MCLR}}$ Input Pin
- Internal Weak Pull-Ups on I/O Pins
- Power-Saving Sleep mode
- Wake-Wp from Sleep on Pin Change
- Selectable Oscillator Options:
  - INTRC: 4 MHz precision Internal oscillator
  - EXTRC: External low-cost RC oscillator
  - XT: Standard crystal/resonator
  - HS: High-speed crystal/resonator (PIC16F505 only)
  - LP: Power-saving, low-frequency crystal
  - EC: High-speed external clock input (PIC16F505 only)

Low-Power Features/CMOS Technology:

- Operating Current:
  - < 175 µA @ 2V, 4 MHz, typical
- Standby Current:
  - 100 nA @ 2V, typical
- Low-Power, High-Speed Flash Technology:
  - 100,000 Flash endurance
  - > 40 year retention
- Fully Static Design
- Wide Operating Voltage Range: 2.0V to 5.5V
- Wide Temperature Range:
  - Industrial: -40°C to +85°C
  - Extended: -40°C to +125°C

Peripheral Features (PIC12F508/509):

- 6 I/O Pins:
  - 5 I/O pins with individual direction control
  - 1 input only pin
  - High current sink/source for direct LED drive
  - Wake-on-change
  - Weak pull-ups
- 8-Bit Real-Time Clock/Counter (TMR0) with 8-Bit Programmable Prescaler

Peripheral Features (PIC16F505):

- 12 I/O Pins:
  - 11 I/O pins with individual direction control
  - 1 input only pin
  - High current sink/source for direct LED drive
  - Wake-on-change
  - Weak pull-ups
- 8-Bit Real-Time Clock/Counter (TMR0) with 8-Bit Programmable Prescaler

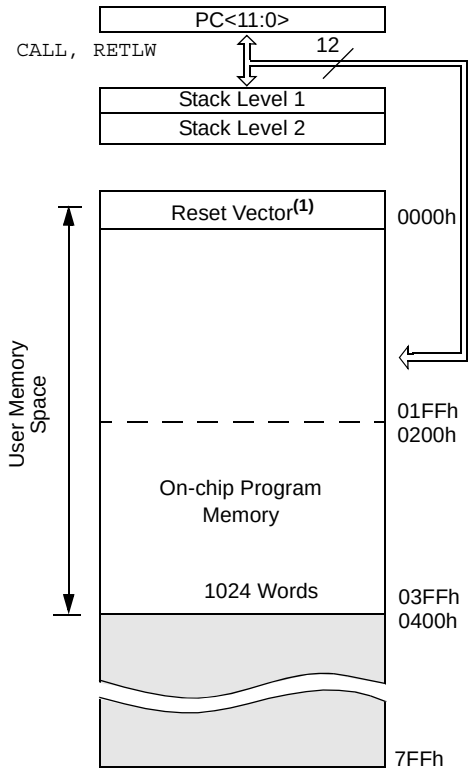
NOTES:

4.2 Program Memory Organization For The PIC16F505

The PIC16F505 device has a 11-bit Program Counter (PC) capable of addressing a 2K x 12 program memory space.

The 1K x 12 (0000h-03FFh) for the PIC16F505 are physically implemented. Refer to Figure 4-2. Accessing a location above this boundary will cause a wrap-around within the first 1K x 12 space. The effective Reset vector is at 0000h (see Figure 4-2). Location 03FFh contains the internal oscillator calibration value. This value should never be overwritten.

FIGURE 4-2: PROGRAM MEMORY MAP AND STACK FOR THE PIC16F505



Note 1: Address 0000h becomes the effective Reset vector. Location 03FFh contains the `MOVLW XX` internal oscillator calibration value.

4.3 Data Memory Organization

Data memory is composed of registers or bytes of RAM. Therefore, data memory for a device is specified by its register file. The register file is divided into two functional groups: Special Function Registers (SFR) and General Purpose Registers (GPR).

The Special Function Registers include the TMR0 register, the Program Counter (PCL), the STATUS register, the I/O registers (ports) and the File Select Register (FSR). In addition, Special Function Registers are used to control the I/O port configuration and prescaler options.

The General Purpose Registers are used for data and control information under command of the instructions.

For the PIC12F508/509, the register file is composed of 7 Special Function Registers, 9 General Purpose Registers and 16 or 32 General Purpose Registers accessed by banking (see Figure 4-3 and Figure 4-4).

For the PIC16F505, the register file is composed of 8 Special Function Registers, 8 General Purpose Registers and 64 General Purpose Registers accessed by banking (Figure 4-5).

4.3.1 GENERAL PURPOSE REGISTER FILE

The General Purpose Register file is accessed, either directly or indirectly, through the File Select Register (FSR). See **Section 4.9 “Indirect Data Addressing: INDF and FSR Registers”**.

4.3.2 SPECIAL FUNCTION REGISTERS

The Special Function Registers (SFRs) are registers used by the CPU and peripheral functions to control the operation of the device (Table 4-1).

The Special Function Registers can be classified into two sets. The Special Function Registers associated with the “core” functions are described in this section. Those related to the operation of the peripheral features are described in the section for each peripheral feature.

TABLE 4-1: SPECIAL FUNCTION REGISTER (SFR) SUMMARY (PIC12F508/509)

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on Power-On Reset(2)	Page #
00h	INDF	Uses Contents of FSR to Address Data Memory (not a physical register)								xxxx xxxx	28
01h	TMR0	8-bit Real-Time Clock/Counter								xxxx xxxx	35
02h(1)	PCL	Low-order 8 bits of PC								1111 1111	27
03h	STATUS	GPWUF	—	PA0(5)	$\overline{TO}$	$\overline{PD}$	Z	DC	C	0-01 1xxx(3)	22
04h	FSR	Indirect Data Memory Address Pointer								111x xxxx	28
04h(4)	FSR	Indirect Data Memory Address Pointer								110x xxxx	28
05h	OSCCAL	CAL6	CAL5	CAL4	CAL3	CAL2	CAL1	CAL0	—	1111 111-	26
06h	GPIO	—	—	GP5	GP4	GP3	GP2	GP1	GP0	--xx xxxx	31
N/A	TRISGPIO	—	—	I/O Control Register						--11 1111	31
N/A	OPTION	$\overline{GPWU}$	$\overline{GPPU}$	TOCS	TOSE	PSA	PS2	PS1	PS0	1111 1111	24

Legend: – = unimplemented, read as ‘0’, x = unknown, u = unchanged, q = value depends on condition.

Note 1: The upper byte of the Program Counter is not directly accessible. See **Section 4.7 “Program Counter”** for an explanation of how to access these bits.

2: Other (non Power-up) Resets include external Reset through $\overline{MCLR}$, Watchdog Timer and wake-up on pin change Reset.

3: If Reset was due to wake-up on pin change, then bit 7 = 1. All other Resets will cause bit 7 = 0.

4: PIC12F509 only.

5: This bit is used on the PIC12F509. For code compatibility do not use this bit on the PIC12F508.

REGISTER 4-2: STATUS REGISTER (ADDRESS: 03h) (PIC16F505)

R/W-0	R/W-0	R/W-0	R-1	R-1	R/W-x	R/W-x	R/W-x
RBWUF	—	PA0	$\overline{TO}$	$\overline{PD}$	Z	DC	C
bit 7							bit 0

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

bit 7 **RBWUF:** PORTB Reset bit
1 = Reset due to wake-up from Sleep on pin change
0 = After power-up or other Reset

bit 6 **Reserved**: Do not use

bit 5 **PA0**: Program Page Preselect bits
1 = Page 1 (200h-3FFh)
0 = Page 0 (000h-1FFh)
Each page is 512 bytes.
Using the PA0 bit as a general purpose read/write bit in devices which do not use it for program page preselect is not recommended, since this may affect upward compatibility with future products.

bit 4 **$\overline{TO}$**: Time-Out bit
1 = After power-up, CLRWDT instruction, or SLEEP instruction
0 = A WDT time-out occurred

bit 3 **$\overline{PD}$**: 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/$\overline{Borrow}$ bit (for ADDWF and SUBWF instructions)
ADDWF:
1 = A carry from the 4th low-order bit of the result occurred
0 = A carry from the 4th low-order bit of the result did not occur
SUBWF:
1 = A borrow from the 4th low-order bit of the result did not occur
0 = A borrow from the 4th low-order bit of the result occurred

bit 0 **C**: Carry/$\overline{Borrow}$ bit (for ADDWF, SUBWF and RRF, RLF instructions)

ADDWF:	SUBWF:	RRF or RLF:
1 = A carry occurred	1 = A borrow did not occur	Load bit with LSb or MSb, respectively
0 = A carry did not occur	0 = A borrow occurred	

4.5 OPTION Register

The OPTION register is a 8-bit wide, write-only register, which contains various control bits to configure the Timer0/WDT prescaler and Timer0.

By executing the OPTION instruction, the contents of the W register will be transferred to the OPTION register. A Reset sets the OPTION<7:0> bits.

Note: If TRIS bit is set to '0', the wake-up on change and pull-up functions are disabled for that pin (i.e., note that TRIS overrides Option control of $\overline{GPPU}$/RBPU and $\overline{GPWU}$/RBWU).

Note: If the T0CS bit is set to '1', it will override the TRIS function on the T0CKI pin.

REGISTER 4-3: OPTION REGISTER (PIC12F508/509)

W-1	W-1	W-1	W-1	W-1	W-1	W-1	W-1
$\overline{GPWU}$	$\overline{GPPU}$	T0CS	T0SE	PSA	PS2	PS1	PS0
bit 7							bit 0

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

bit 7 **$\overline{GPWU}$:** Enable Wake-up on Pin Change bit (GP0, GP1, GP3)
1 = Disabled
0 = Enabled

bit 6 **$\overline{GPPU}$**: Enable Weak Pull-ups bit (GP0, GP1, GP3)
1 = Disabled
0 = Enabled

bit 5 **T0CS**: Timer0 Clock Source Select bit
1 = Transition on T0CKI pin (overrides TRIS on the T0CKI pin)
0 = Transition on internal instruction cycle clock, FOSC/4

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

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

bit 2-0 **PS<2:0>:** Prescaler Rate Select bits

Bit Value	Timer0 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

NOTES:

6.0 TIMER0 MODULE AND TMR0 REGISTER

The Timer0 module has the following features:

- 8-bit timer/counter register, TMR0
- Readable and writable
- 8-bit software programmable prescaler
- Internal or external clock select:
  - Edge select for external clock

Figure 6-1 is a simplified block diagram of the Timer0 module.

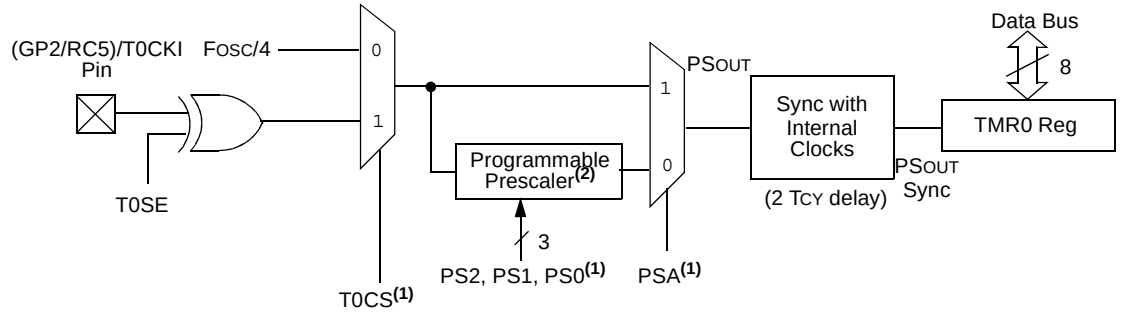
Timer mode is selected by clearing the T0CS bit (OPTION<5>). In Timer mode, the Timer0 module will increment every instruction cycle (without prescaler). If TMR0 register is written, the increment is inhibited for the following two cycles (Figure 6-2 and Figure 6-3). The user can work around this by writing an adjusted value to the TMR0 register.

Counter mode is selected by setting the T0CS bit (OPTION<5>). In this mode, Timer0 will increment either on every rising or falling edge of pin T0CKI. The T0SE bit (OPTION<4>) determines the source edge. Clearing the T0SE bit selects the rising edge. Restrictions on the external clock input are discussed in detail in **Section 6.1 "Using Timer0 with an External Clock"**.

The prescaler may be used by either the Timer0 module or the Watchdog Timer, but not both. The prescaler assignment is controlled in software by the control bit, PSA (OPTION<3>). Clearing the PSA bit will assign the prescaler to Timer0. The prescaler is not readable or writable. When the prescaler is assigned to the Timer0 module, prescale values of 1:2, 1:4,..., 1:256 are selectable. **Section 6.2 "Prescaler"** details the operation of the prescaler.

A summary of registers associated with the Timer0 module is found in Table 6-1.

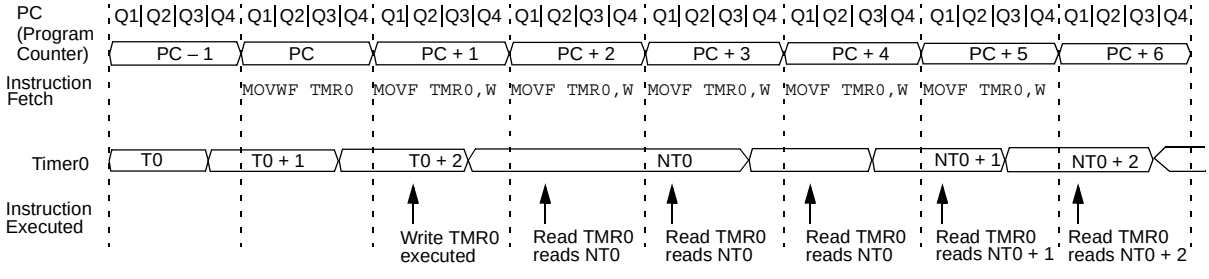
FIGURE 6-1: TIMER0 BLOCK DIAGRAM



Note 1: Bits T0CS, T0SE, PSA, PS2, PS1 and PS0 are located in the OPTION register.

2: The prescaler is shared with the Watchdog Timer (Figure 6-5).

FIGURE 6-2: TIMER0 TIMING: INTERNAL CLOCK/NO PRESCALE



REGISTER 7-2: CONFIGURATION WORD FOR PIC16F505(1)

—	—	—	—	—	—	MCLRE	$\overline{CP}$	WDTE	FOSC2	FOSC1	FOSC0
bit 11											bit 0

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

bit 11-6 **Unimplemented**: Read as '0'

bit 5 **MCLRE:** RB3/$\overline{MCLR}$ Pin Function Select bit
1 = RB3/$\overline{MCLR}$ pin function is $\overline{MCLR}$
0 = RB3/$\overline{MCLR}$ pin function is digital input, $\overline{MCLR}$ internally tied to V_{DD}

bit 4 **$\overline{CP}$:** Code Protection bit
1 = Code protection off
0 = Code protection on

bit 3 **WDTE:** Watchdog Timer Enable bit
1 = WDT enabled
0 = WDT disabled

bit 2-0 **FOSC<1:0>:** Oscillator Selection bits
111 = External RC oscillator/CLKOUT function on RB4/OSC2/CLKOUT pin
110 = External RC oscillator/RB4 function on RB4/OSC2/CLKOUT pin
101 = Internal RC oscillator/CLKOUT function on RB4/OSC2/CLKOUT pin
100 = Internal RC oscillator/RB4 function on RB4/OSC2/CLKOUT pin
011 = EC oscillator/RB4 function on RB4/OSC2/CLKOUT pin
010 = HS oscillator
001 = XT oscillator
000 = LP oscillator

Note 1: Refer to the "*PIC16F505 Memory Programming Specifications*" (DS41226) to determine how to access the Configuration Word. The Configuration Word is not user addressable during device operation.

7.9 Power-down Mode (Sleep)

A device may be powered down (Sleep) and later powered up (wake-up from Sleep).

7.9.1 SLEEP

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

If enabled, the Watchdog Timer will be cleared but keeps running, the $\overline{TO}$ bit (STATUS<4>) is set, the $\overline{PD}$ bit (STATUS<3>) is cleared and the oscillator driver is turned off. The I/O ports maintain the status they had before the SLEEP instruction was executed (driving high, driving low or high-impedance).

Note:	A Reset generated by a WDT time-out does not drive the $\overline{MCLR}$ pin low.

For lowest current consumption while powered down, the T0CKI input should be at V_{DD} or V_{SS} and the (GP3/RB3)/$\overline{MCLR}$/V_{PP} pin must be at a logic high level if $\overline{MCLR}$ is enabled.

7.9.2 WAKE-UP FROM SLEEP

The device can wake-up from Sleep through one of the following events:

1. An external Reset input on (GP3/RB3)/$\overline{MCLR}$/V_{PP} pin, when configured as $\overline{MCLR}$.
2. A Watchdog Timer time-out Reset (if WDT was enabled).
3. A change on input pin GP0/RB0, GP1/RB1, GP3/RB3 or RB4 when wake-up on change is enabled.

These events cause a device Reset. The $\overline{TO}$, $\overline{PD}$ and GPWUF/RBWUF bits can be used to determine the cause of device Reset. The $\overline{TO}$ bit is cleared if a WDT time-out occurred (and caused wake-up). The $\overline{PD}$ bit, which is set on power-up, is cleared when SLEEP is invoked. The GPWUF/RBWUF bit indicates a change in state while in Sleep at pins GP0/RB0, GP1/RB1, GP3/RB3 or RB4 (since the last file or bit operation on GP/RB port).

Note:	**Caution:** Right before entering Sleep, read the input pins. When in Sleep, wake-up occurs when the values at the pins change from the state they were in at the last reading. If a wake-up on change occurs and the pins are not read before re-entering Sleep, a wake-up will occur immediately even if no pins change while in Sleep mode.

The WDT is cleared when the device wakes from Sleep, regardless of the wake-up source.

7.10 Program Verification/Code Protection

If the code protection bit has not been programmed, the on-chip program memory can be read out for verification purposes.

The first 64 locations and the last location (OSCCAL) can be read, regardless of the code protection bit setting.

The last memory location can be read regardless of the code protection bit setting on the PIC12F508/509/16F505 devices.

7.11 ID Locations

Four memory locations are designated as ID locations where the user can store checksum or other code identification numbers. These locations are not accessible during normal execution, but are readable and writable during Program/Verify.

Use only the lower 4 bits of the ID locations and always program the upper 8 bits as '0's.

7.12 In-Circuit Serial Programming™

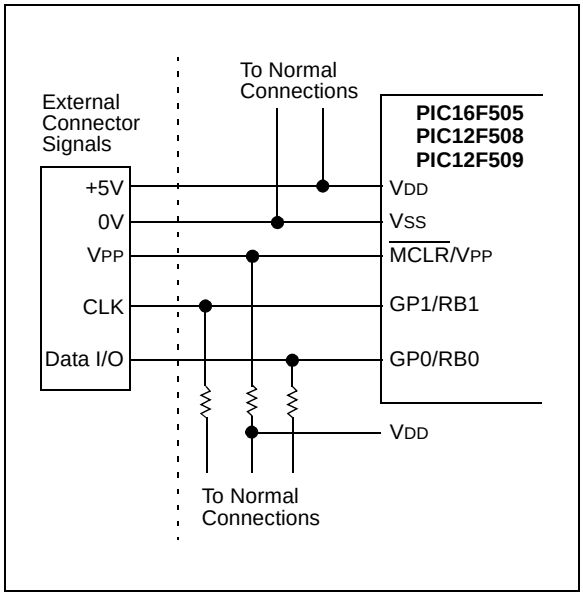
The PIC12F508/509/16F505 microcontrollers can be serially programmed while in the end application circuit. This is simply done with two lines for clock and data, and three other lines for power, ground and the programming voltage. This allows customers to manufacture boards with unprogrammed devices and then program the microcontroller just before shipping the product. This also allows the most recent firmware, or a custom firmware, to be programmed.

The devices are placed into a Program/Verify mode by holding the GP1/RB1 and GP0/RB0 pins low while raising the $\overline{MCLR}$ (V_{PP}) pin from V_{IL} to V_{IHH} (see programming specification). GP1/RB1 becomes the programming clock and GP0/RB0 becomes the programming data. Both GP1/RB1 and GP0/RB0 are Schmitt Trigger inputs in this mode.

After Reset, a 6-bit command is then supplied to the device. Depending on the command, 14 bits of program data are then supplied to or from the device, depending if the command was a Load or a Read. For complete details of serial programming, please refer to the PIC12F508/509/16F505 Programming Specifications.

A typical In-Circuit Serial Programming connection is shown in Figure 7-15.

FIGURE 7-15: TYPICAL IN-CIRCUIT SERIAL PROGRAMMING CONNECTION



ADDWF **Add W and f**

Syntax:	[*label*] ADDWF f,d
Operands:	0 ≤ f ≤ 31 d ∈ [0,1]
Operation:	(W) + (f) → (dest)
Status Affected:	C, DC, Z
Description:	Add the contents of the W register and 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'.

ANDLW **AND literal with W**

Syntax:	[*label*] ANDLW k
Operands:	0 ≤ k ≤ 255
Operation:	(W).AND. (k) → (W)
Status Affected:	Z
Description:	The contents of the W register are AND'ed with the eight-bit literal 'k'. The result is placed in the W register.

ANDWF **AND W with f**

Syntax:	[*label*] ANDWF f,d
Operands:	0 ≤ f ≤ 31 d ∈ [0,1]
Operation:	(W) .AND. (f) → (dest)
Status Affected:	Z
Description:	The contents of the W register are AND'ed 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 ≤ f ≤ 31 0 ≤ b ≤ 7
Operation:	0 → (f<b>)
Status Affected:	None
Description:	Bit 'b' in register 'f' is cleared.

BSF **Bit Set f**

Syntax:	[*label*] BSF f,b
Operands:	0 ≤ f ≤ 31 0 ≤ b ≤ 7
Operation:	1 → (f<b>)
Status Affected:	None
Description:	Bit 'b' in register 'f' is set.

BTFSC **Bit Test f, Skip if Clear**

Syntax:	[*label*] BTFSC f,b
Operands:	0 ≤ f ≤ 31 0 ≤ b ≤ 7
Operation:	skip if (f<b>) = 0
Status Affected:	None
Description:	If bit 'b' in register 'f' is '0', then the next instruction is skipped. If bit 'b' is '0', then the next instruction fetched during the current instruction execution is discarded, and a NOP is executed instead, making this a two-cycle instruction.

TABLE 10-6: RESET, WATCHDOG TIMER AND DEVICE RESET TIMER – PIC12F508/509/16F505

AC CHARACTERISTICS			Standard Operating Conditions (unless otherwise specified) Operating Temperature -40°C ≤ TA ≤ +85°C (industrial) -40°C ≤ TA ≤ +125°C (extended)				
Param No.	**Sym.**	**Characteristic**	**Min.**	**Typ(1)**	**Max.**	**Units**	**Conditions**
30	TMCL	$\overline{\text{MCLR}}$ Pulse Width (low)	2000*	—	—	ns	VDD = 5.0V
31	TWDT	Watchdog Timer Time-out Period (no prescaler)	9* 9*	18* 18*	30* 40*	ms ms	VDD = 5.0V (Industrial) VDD = 5.0V (Extended)
32	TDRT	Device Reset Timer Period(2)	9* 9*	18* 18*	30* 40*	ms ms	VDD = 5.0V (Industrial) VDD = 5.0V (Extended)
34	TIOZ	I/O High-impedance from $\overline{\text{MCLR}}$ low	—	—	2000*	ns	

* These parameters are characterized but not tested.

Note 1: Data in the Typical ("Typ") column is at 5V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

FIGURE 10-7: TIMER0 CLOCK TIMINGS – PIC12F508/509/16F505

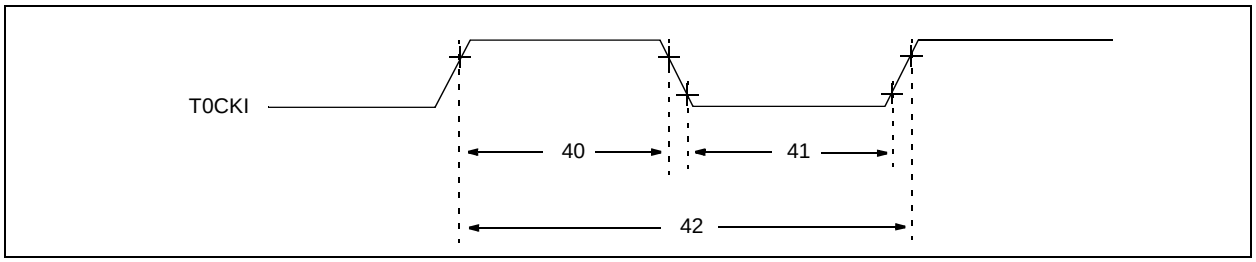


TABLE 10-7: TIMER0 CLOCK REQUIREMENTS – PIC12F508/509/16F505

AC CHARACTERISTICS				**Standard Operating Conditions (unless otherwise specified)** Operating Temperature -40°C ≤ TA ≤ +85°C (industrial) -40°C ≤ TA ≤ +125°C (extended) Operating Voltage VDD range is described in **Section 10.1 "Power-on Reset (POR)"**				
Param No.	**Sym.**	**Characteristic**		**Min.**	**Typ(1)**	**Max.**	**Units**	**Conditions**
40	Tt0H	T0CKI High Pulse Width	No Prescaler	0.5 TCY + 20*	—	—	ns	
			With Prescaler	10*	—	—	ns	
41	Tt0L	T0CKI Low Pulse Width	No Prescaler	0.5 TCY + 20*	—	—	ns	
			With Prescaler	10*	—	—	ns	
42	Tt0P	T0CKI Period		20 or TCY + 40* N	—	—	ns	Whichever is greater. N = Prescale Value (1, 2, 4,..., 256)

* These parameters are characterized but not tested.

Note 1: Data in the Typical (“Typ”) column is at 5V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

11.0 DC AND AC CHARACTERISTICS GRAPHS AND CHARTS

Note:	The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore, outside the warranted range.

"Typical" represents the mean of the distribution at 25°C. "Maximum" or "minimum" represents (mean + 3σ) or (mean - 3σ) respectively, where s is a standard deviation, over each temperature range.

FIGURE 11-1: IDD vs. VDD at FOSC = 4 MHz

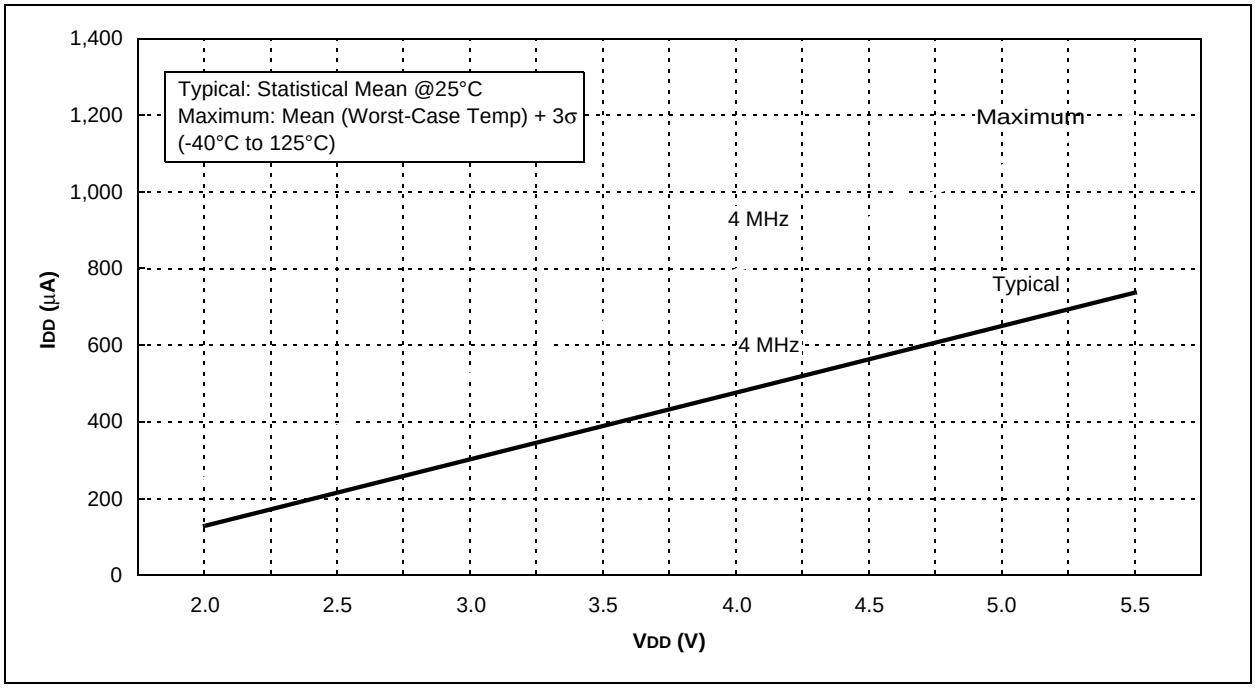


FIGURE 11-4: MAXIMUM IPD VS. VDD (SLEEP MODE, ALL PERIPHERALS DISABLED)

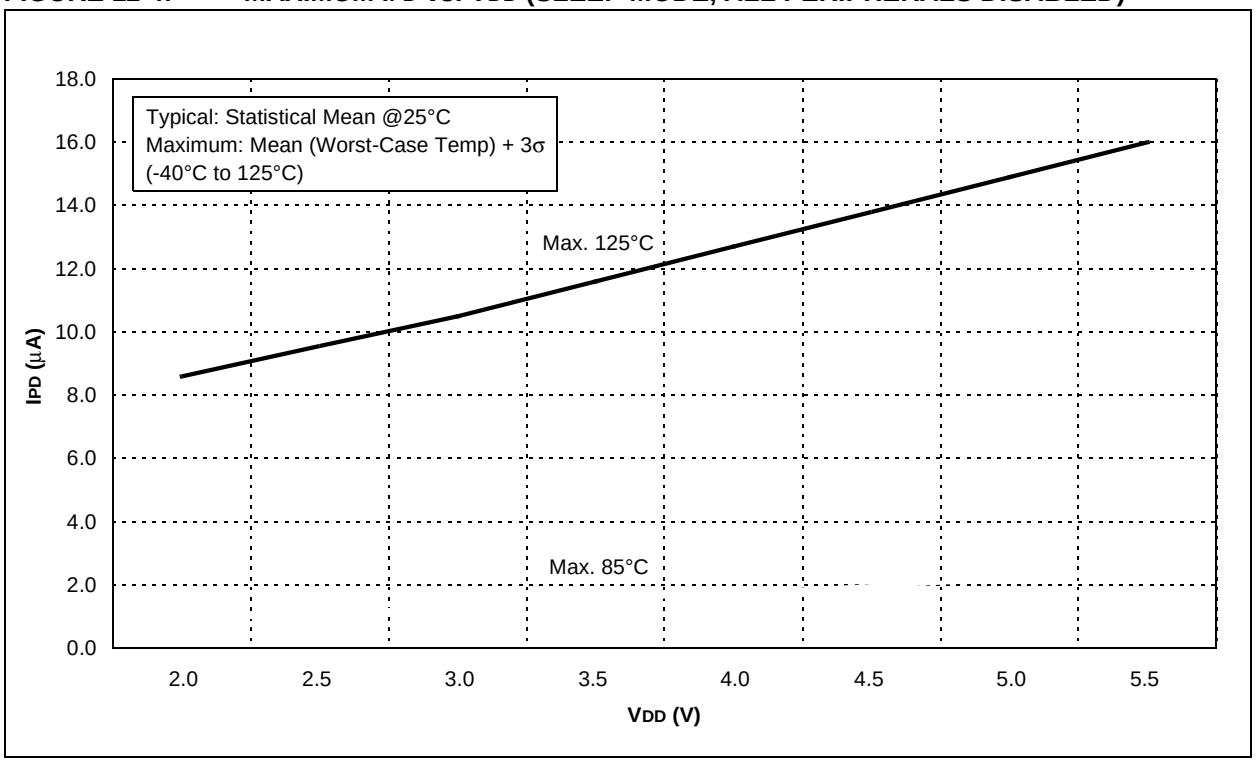


FIGURE 11-5: TYPICAL WDT IPD VS. VDD

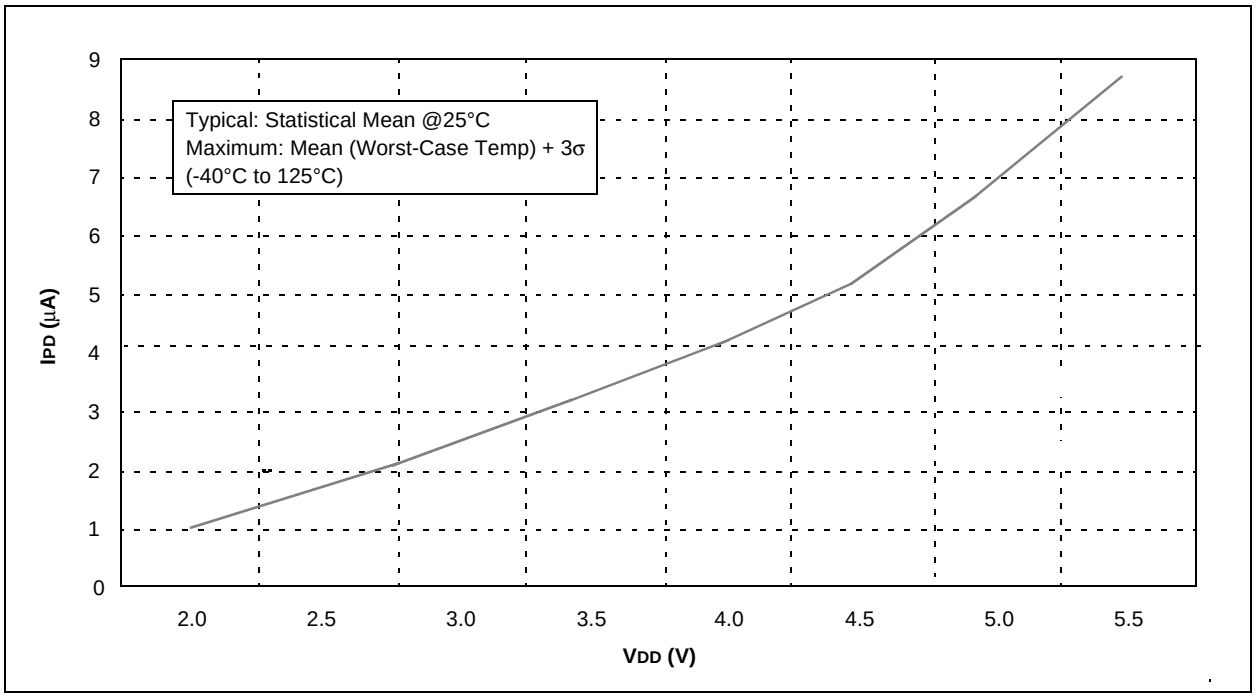


FIGURE 11-6: MAXIMUM WDT I_{PD} vs. V_{DD} OVER TEMPERATURE

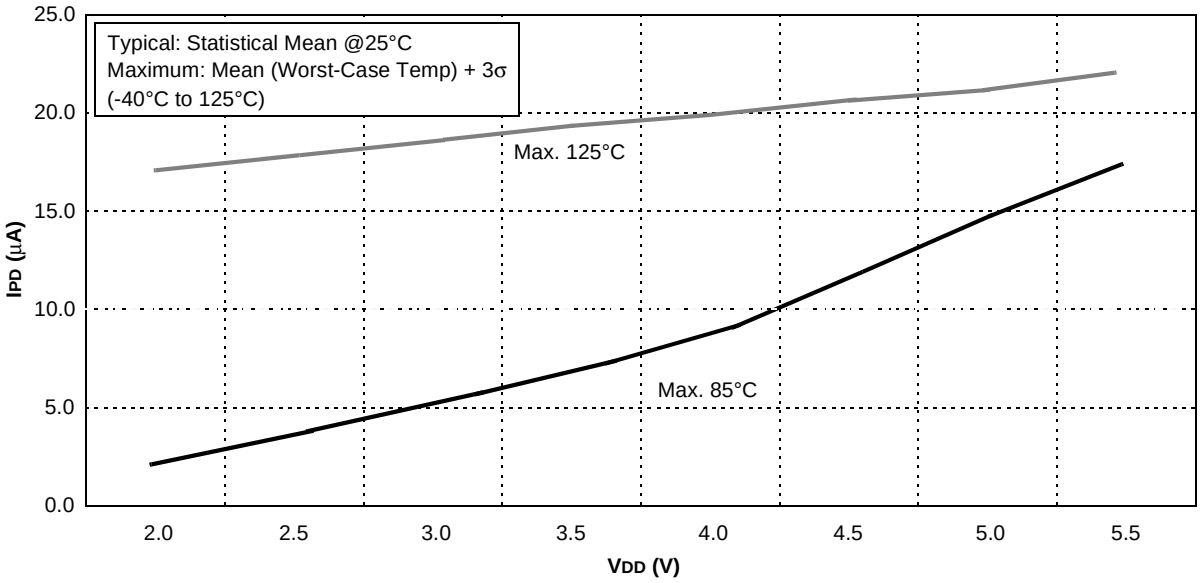
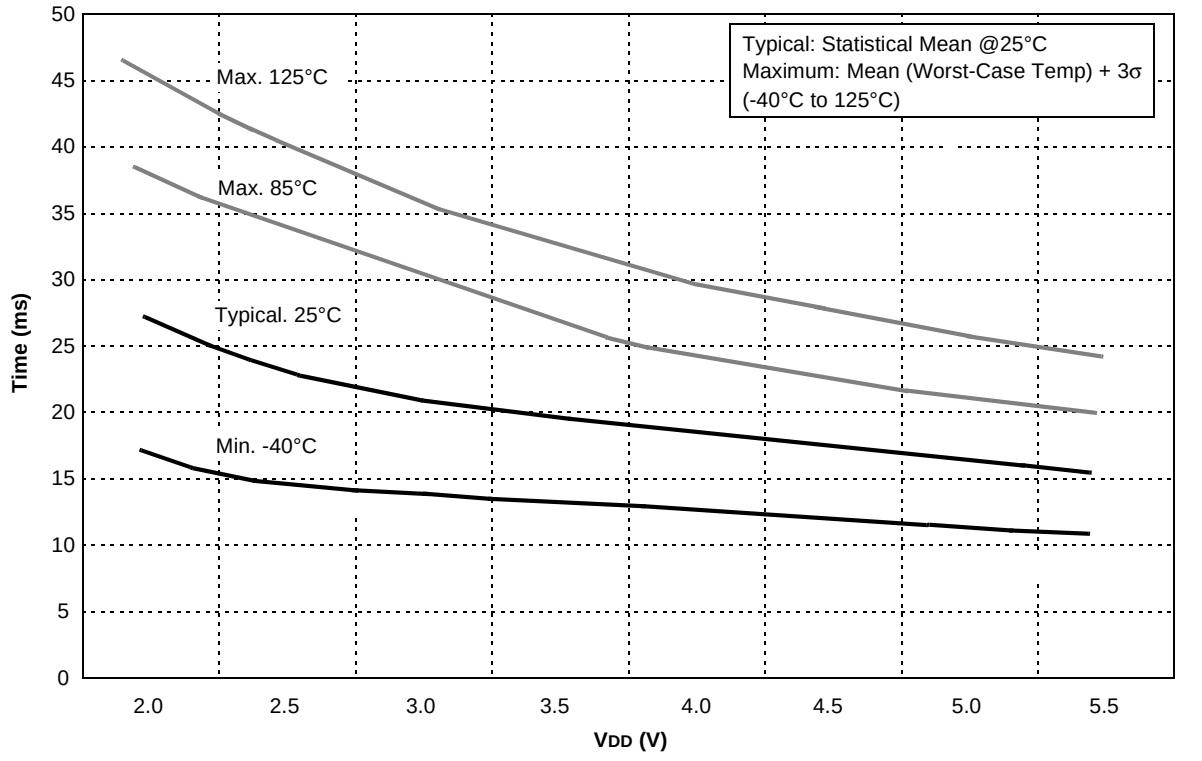


FIGURE 11-7: WDT TIME-OUT or DEVICE RESET TIMER vs. V_{DD} OVER TEMPERATURE (NO WDT PRESCALER)(1)



Note 1: Device Reset Timer (DRT) values are for case of Reset of power-up. Table 7-6 shows DRT values for the case of other types of Reset events.

FIGURE 11-16: TYPICAL INTOSC FREQUENCY CHANGE vs VDD (85°C)

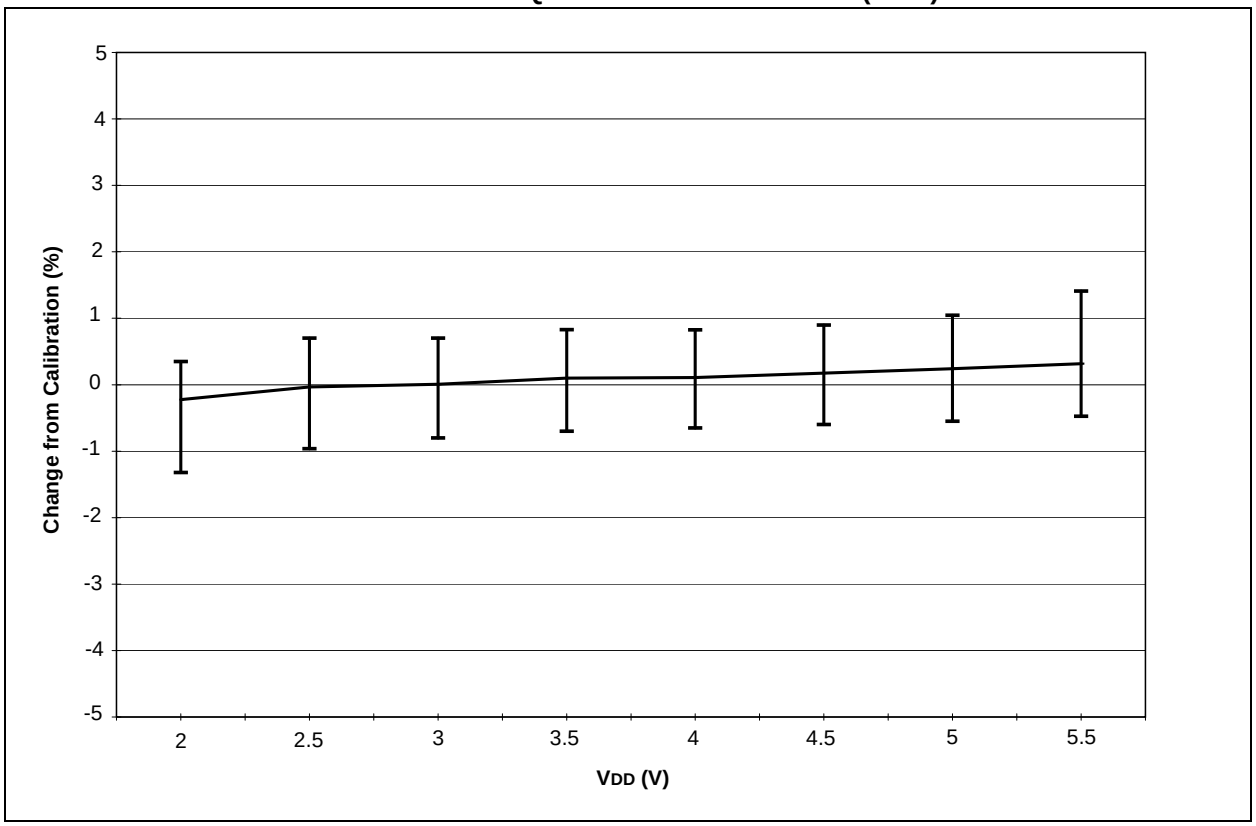
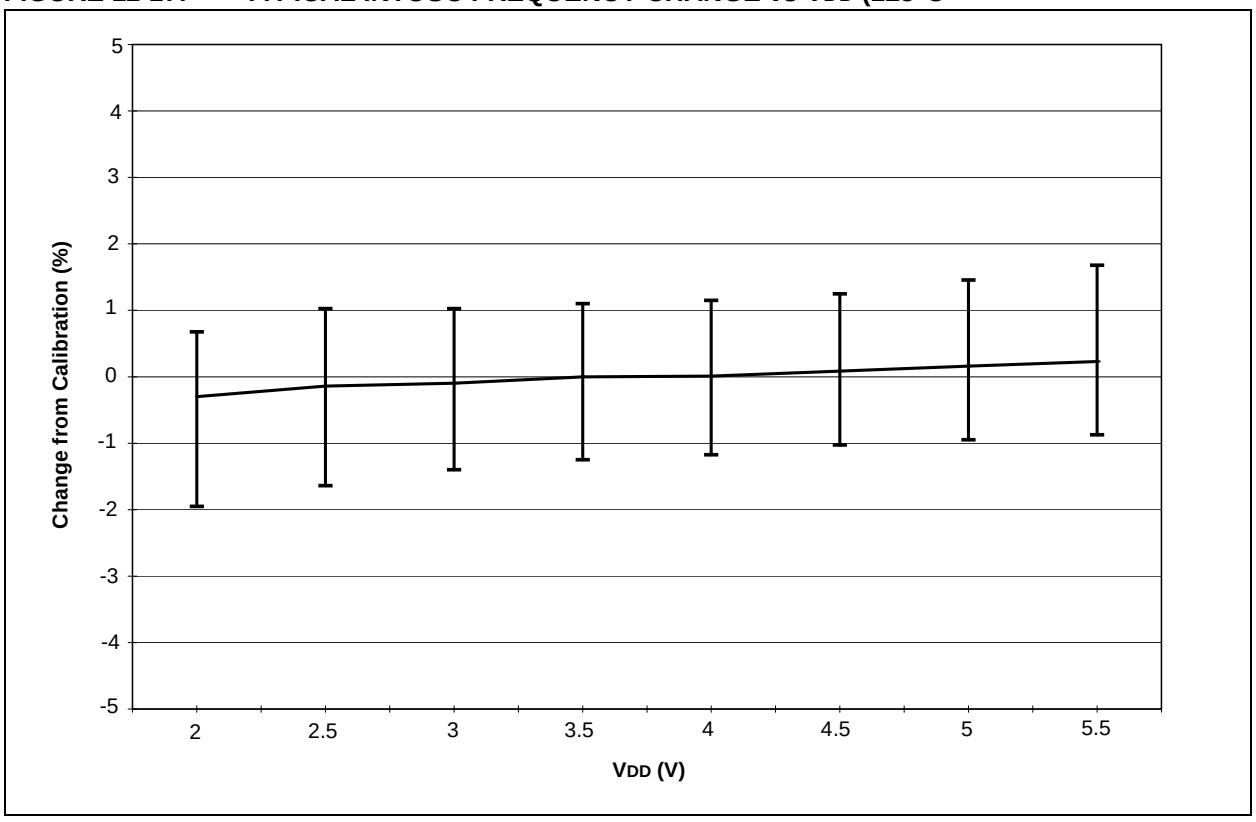
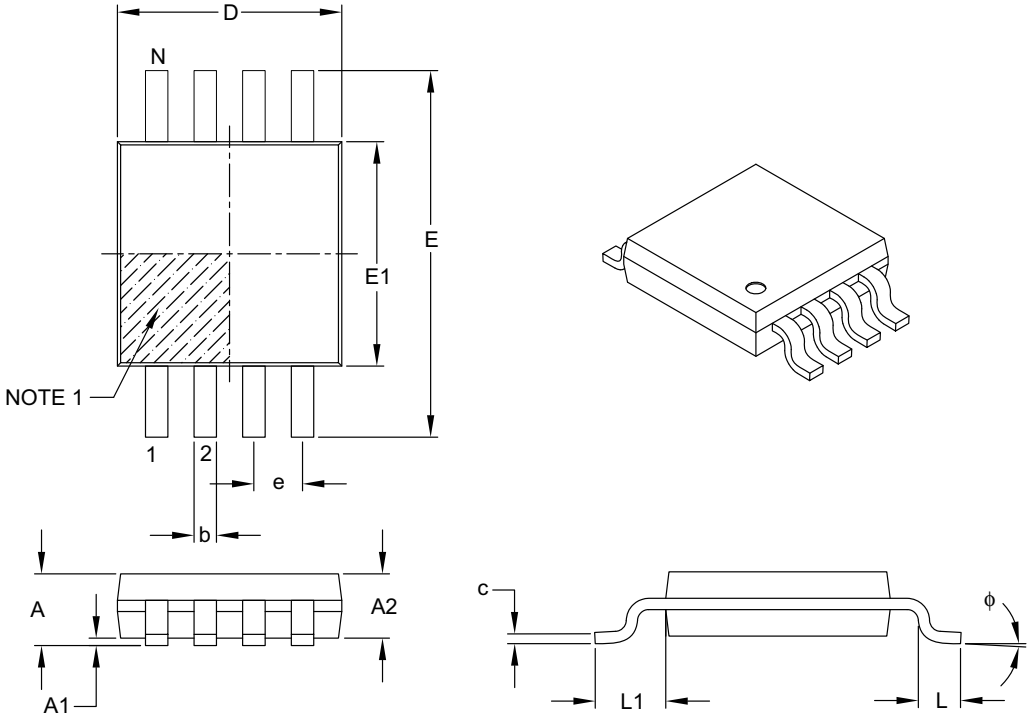


FIGURE 11-17: TYPICAL INTOSC FREQUENCY CHANGE vs VDD (125°C



8-Lead Plastic Micro Small Outline Package (MS) [MSOP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		0.65 BSC	
Overall Height	A	–	–	1.10
Molded Package Thickness	A2	0.75	0.85	0.95
Standoff	A1	0.00	–	0.15
Overall Width	E		4.90 BSC	
Molded Package Width	E1		3.00 BSC	
Overall Length	D		3.00 BSC	
Foot Length	L	0.40	0.60	0.80
Footprint	L1		0.95 REF	
Foot Angle	ϕ	0°	–	8°
Lead Thickness	c	0.08	–	0.23
Lead Width	b	0.22	–	0.40

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
3. Dimensioning and tolerancing per ASME Y14.5M.

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-111B

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