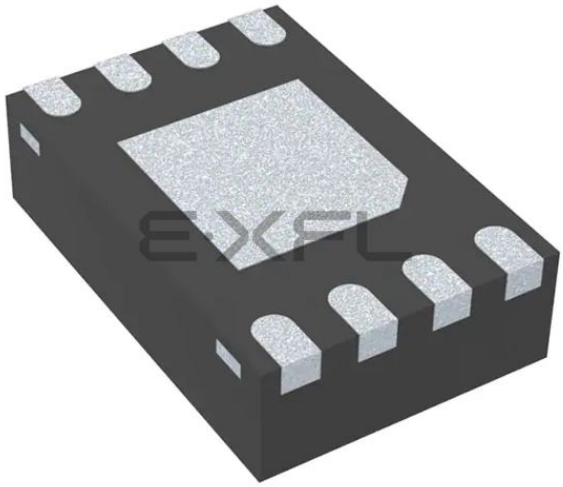


Welcome to E-XFL.COM

What is "Embedded - Microcontrollers"?

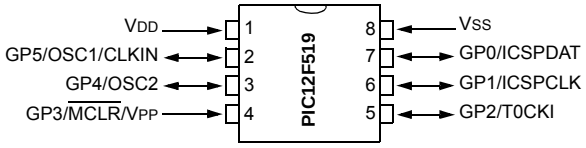
"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" 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"

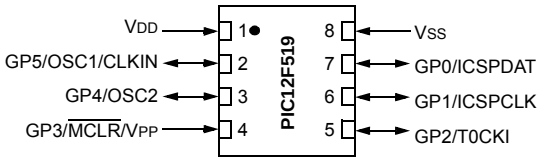
Details	
Product Status	Active
Core Processor	PIC
Core Size	8-Bit
Speed	8MHz
Connectivity	-
Peripherals	POR, WDT
Number of I/O	5
Program Memory Size	1.5KB (1K x 12)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	41 x 8
Voltage - Supply (Vcc/Vdd)	2V ~ 5.5V
Data Converters	-
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°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/pic12f519-e-mc

FIGURE 1: PIC12F519 8-PIN PDIP, SOIC, MSOP, 2X3 DFN DIAGRAM

PDIP, SOIC, MSOP



DFN



Device	Program Memory	Data Memory		I/O	Timers 8-bit
	Flash (words)	SRAM (bytes)	Flash (bytes)		
PIC12F519	1024	41	64	6	1

© 2008 Microchip Technology Inc.

1.0 GENERAL DESCRIPTION

The PIC12F519 device from Microchip Technology is low-cost, high-performance, 8-bit, fully-static, Flash-based CMOS microcontrollers. They employ a RISC architecture with only 33 single-word/single-cycle instructions. All instructions are single cycle except for program branches, which take two cycles. The PIC12F519 device delivers performance an order of magnitude higher than their competitors in the same price category. The 12-bit wide instructions are highly symmetrical, resulting in a typical 2:1 code compression over other 8-bit microcontrollers in its class. The easy-to-use and easy to remember instruction set reduces development time significantly.

The PIC12F519 product is equipped with special features that reduce system cost and power requirements. The Power-on Reset (POR) and Device Reset Timer (DRT) eliminate the need for external Reset circuitry. There are four oscillator configurations to choose from including INTRC Internal Oscillator mode and the power-saving LP (Low-power) Oscillator mode. Power-Saving Sleep mode, Watchdog Timer and code protection features improve system cost, power and reliability.

The PIC12F519 device is available in the cost-effective Flash programmable version, which is suitable for production in any volume. The customer can take full advantage of Microchip's price leadership in Flash programmable microcontrollers, while benefiting from the Flash programmable flexibility.

The PIC12F519 product is supported by a full-featured macro assembler, a software simulator, an in-circuit emulator, a low-cost development programmer and a full featured programmer. All the tools are supported on PC and compatible machines.

1.1 Applications

The PIC12F519 device fits in applications ranging from personal care appliances and security systems to low-power remote transmitters/receivers. The Flash technology makes customizing application programs (transmitter codes, appliance settings, receiver frequencies, etc.) extremely fast and convenient. The small footprint packages, for through hole or surface mounting, make these microcontrollers perfect for applications with space limitations. Low cost, low power, high performance, ease of use and I/O flexibility make the PIC12F519 device very versatile even in areas where no microcontroller use has been considered before (e.g., timer functions, logic and PLDs in larger systems and coprocessor applications).

TABLE 1-1: FEATURES AND MEMORY OF PIC12F519

		PIC12F519
Clock	Maximum Frequency of Operation (MHz)	8
Memory	Flash Program Memory	1024
	SRAM Data Memory (bytes)	41
	Flash Data Memory (bytes)	64
Peripherals	Timer Module(s)	TMR0
	Wake-up from Sleep on Pin Change	Yes
Features	I/O Pins	5
	Input Pins	1
	Internal Pull-ups	Yes
	In-Circuit Serial Programming™	Yes
	Number of Instructions	33
	Packages	8-pin PDIP, SOIC, MSOP, 2X3 DFN

The PIC12F519 device has Power-on Reset, selectable Watchdog Timer, selectable code-protect, high I/O current capability and precision internal oscillator.
The PIC12F519 device uses serial programming with data pin GP0 and clock pin GP1.

3.1 Clocking Scheme/Instruction Cycle

The clock input (OSC1/CLKIN pin) is internally divided by four to generate four non-overlapping quadrature clocks, namely Q1, Q2, Q3 and Q4. Internally, the PC is incremented every Q1 and the instruction is fetched from program memory and latched into the instruction register in Q4. It is decoded and executed during the following Q1 through Q4. The clocks and instruction execution flow is shown in Figure 3-2 and Example 3-1.

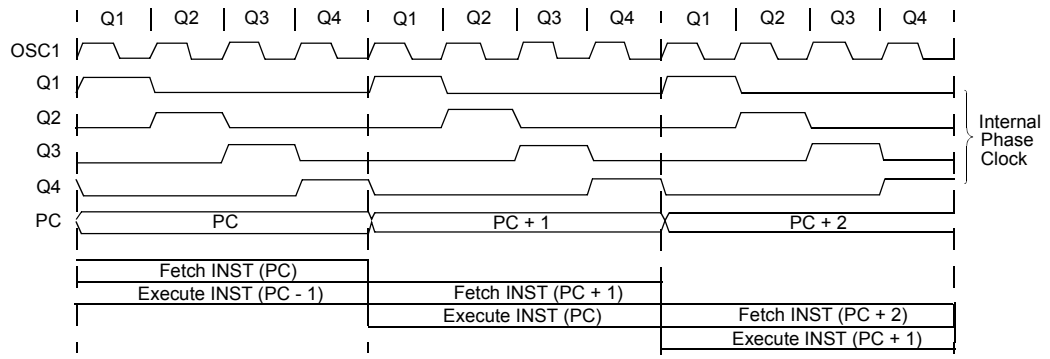
3.2 Instruction Flow/Pipelining

An instruction cycle consists of four Q cycles (Q1, Q2, Q3 and Q4). The instruction fetch and execute are pipelined such that fetch takes one instruction cycle, while decode and execute take another instruction cycle. However, due to the pipelining, each instruction effectively executes in one cycle. If an instruction causes the PC to change (e.g., GOTO), then two cycles are required to complete the instruction (Example 3-1).

A fetch cycle begins with the PC incrementing in Q1.

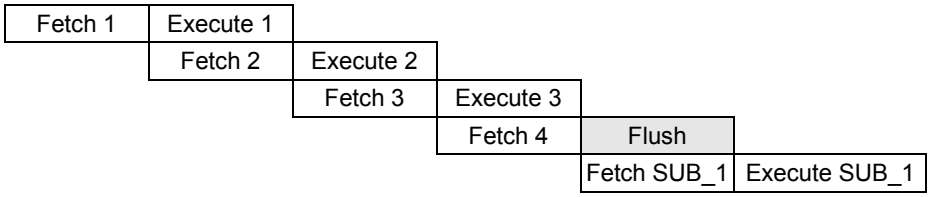
In the execution cycle, the fetched instruction is latched into the Instruction Register (IR) in cycle Q1. This instruction is then decoded and executed during the Q2, Q3 and Q4 cycles. Data memory is read during Q2 (operand read) and written during Q4 (destination write).

FIGURE 3-2: CLOCK/INSTRUCTION CYCLE



EXAMPLE 3-1: INSTRUCTION PIPELINE FLOW

```
1. MOVLW 03H
2. MOVWF GPIO
3. CALL  SUB_1
4. BSF  GPIO, 1
```



All instructions are single cycle, except for any program branches. These take two cycles, since the fetch instruction is “flushed” from the pipeline, while the new instruction is being fetched and then executed.

© 2008 Microchip Technology Inc.

FIGURE 7-3: TIMER0 TIMING: INTERNAL CLOCK/PRESCALE 1:2

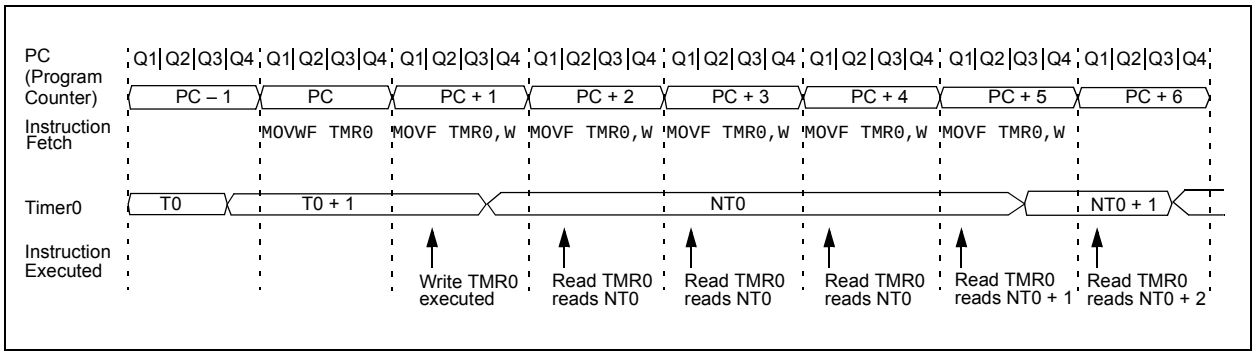


TABLE 7-1: REGISTERS ASSOCIATED WITH TIMER0

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on Power-on Reset	Value on All Other Resets
01h	TMR0	Timer0 – 8-bit Real-Time Clock/Counter								xxxx xxxx	uuuu uuuu
N/A	OPTION	$\overline{GPWU}$	$\overline{GPPU}$	T0CS	T0SE	PSA	PS2	PS1	PS0	1111 1111	1111 1111
N/A	TRISGPIO	—	—	TRISGPIO5	TRISGPIO4	TRISGPIO3	TRISGPIO2	TRISGPIO1	TRISGPIO0	--11 1111	--11 1111

Legend: x = unknown, u = unchanged, – = unimplemented, read as '0', Shaded cells = unimplemented, read as '0'

© 2008 Microchip Technology Inc.

REGISTER 8-1: CONFIG: CONFIGURATION WORD REGISTER(1)

—	$\overline{\text{CPDF}}$	IOSCFS	MCLRE	$\overline{\text{CP}}$	WDTE	FOSC1	FOSC0
bit 7							bit 0

bit 7 **Unimplemented**: Read as '1'

bit 6 **$\overline{\text{CPDF}}$:** Code Protection bit - Flash Data Memory
1 = Code protection off
0 = Code protection on

bit 5 **IOSCFS:** Internal Oscillator Frequency Select bit
1 = 8 MHz INTOSC frequency
0 = 4 MHz INTOSC frequency

bit 4 **MCLRE:** Master Clear Enable bit
1 = GP3/$\overline{\text{MCLR}}$ pin functions as $\overline{\text{MCLR}}$
0 = GP3/$\overline{\text{MCLR}}$ pin functions as GP3, $\overline{\text{MCLR}}$ internally tied to V_{DD}

bit 3 **$\overline{\text{CP}}$:** Code Protection bit - User Program Memory
1 = Code protection off
0 = Code protection on

bit 2 **WDTE:** Watchdog Timer Enable bit
1 = WDT enabled
0 = WDT disabled

bit 1-0 **FOSC<1:0>:** Oscillator Selection bits
00 = LP oscillator with 18 ms DRT(2)
01 = XT oscillator with 18 ms DRT(2)
10 = INTOSC with 1 ms DRT(2)
11 = EXTRC with 1 ms DRT(2)

Note 1: Refer to the "*PIC12F519 Memory Programming Specification*", DS41316 to determine how to program/erase the Configuration Word.

2: DRT length (18 ms or 1 ms) is a function of clock mode selection. It is the responsibility of the application designer to ensure the use of either 18 ms (nominal) DRT or the 1 ms (nominal) DRT will result in acceptable operation. Refer to Figure 11-1 and Table 11-2 for V_{DD} rise time and stability requirements for this mode of operation.

© 2008 Microchip Technology Inc.

TABLE 8-4: RESET CONDITION FOR SPECIAL REGISTERS

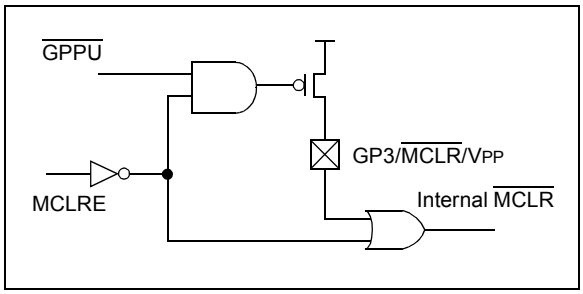
	STATUS Addr: 03h
Power-on Reset	0-01 1xxx
$\overline{MCLR}$ Reset during normal operation	0-0u uuuu
$\overline{MCLR}$ Reset during Sleep	0-01 0uuu
WDT Reset during Sleep	0-00 0uuu
WDT Reset normal operation	0-00 uuuu
Wake-up from Sleep on pin change	1-01 0uuu

Legend: u = unchanged, x = unknown

8.3.1 $\overline{MCLR}$ ENABLE

This Configuration bit, when unprogrammed (left in the '1' state), enables the external $\overline{MCLR}$ function. When programmed, the $\overline{MCLR}$ function is tied to the internal VDD and the pin is assigned to be a I/O. See Figure 8-6.

FIGURE 8-6: $\overline{MCLR}$ SELECT



8.4 Power-on Reset (POR)

The PIC12F519 device incorporates an on-chip Power-on Reset (POR) circuitry, which provides an internal chip Reset for most power-up situations.

The on-chip POR circuit holds the chip in Reset until VDD has reached a high enough level for proper operation. To take advantage of the internal POR, program the GP3/$\overline{MCLR}$/VPP pin as $\overline{MCLR}$ and tie through a resistor to VDD, or program the pin as GP3, in which case, an internal weak pull-up resistor is implemented using a transistor (refer to Table 11-4 for the pull-up resistor ranges). This will eliminate external RC components usually needed to create a Power-on Reset. A maximum rise time for VDD is specified. See **Section 11.0 "Electrical Characteristics"** for details.

When the devices start normal operation (exit the Reset condition), device operating parameters (voltage, frequency, temperature,...) must be met to ensure operation. If these conditions are not met, the devices must be held in Reset until the operating parameters are met.

A simplified block diagram of the on-chip Power-on Reset circuit is shown in Figure 8-7.

The Power-on Reset circuit and the Device Reset Timer (see **Section 8.5 "Device Reset Timer (DRT)"**) circuit are closely related. On power-up, the Reset latch is set and the DRT is reset. The DRT timer begins counting once it detects $\overline{MCLR}$ to be high. After the time-out period, which is typically 18 ms or 1 ms, it will reset the Reset latch and thus end the on-chip Reset signal.

A power-up example where $\overline{MCLR}$ is held low is shown in Figure 8-8. VDD is allowed to rise and stabilize before bringing $\overline{MCLR}$ high. The chip will actually come out of Reset TDRT after $\overline{MCLR}$ goes high.

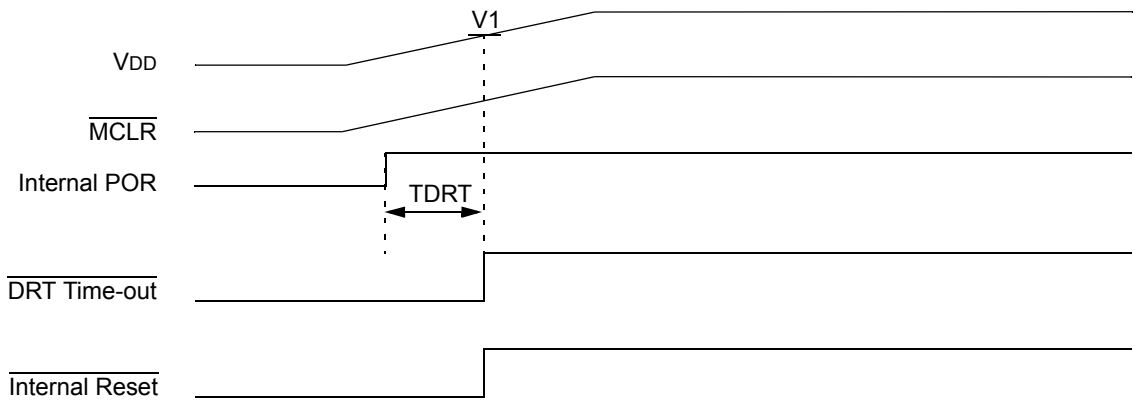
In Figure 8-9, the on-chip Power-on Reset feature is being used ($\overline{MCLR}$ and VDD are tied together or the pin is programmed to be GP3). The VDD is stable before the Start-up timer times out and there is no problem in getting a proper Reset. However, Figure 8-10 depicts a problem situation where VDD rises too slowly. The time between when the DRT senses that $\overline{MCLR}$ is high and when $\overline{MCLR}$ and VDD actually reach their full value, is too long. In this situation, when the start-up timer times out, VDD has not reached the VDD (min) value and the chip may not function correctly. For such situations, we recommend that external RC circuits be used to achieve longer POR delay times (Figure 8-9).

Note:	When the devices start normal operation (exit the Reset condition), device operating parameters (voltage, frequency, temperature, etc.) must be met to ensure operation. If these conditions are not met, the device must be held in Reset until the operating conditions are met.

For additional information, refer to Application Note AN522, "*Power-Up Considerations*" (DS00522)

© 2008 Microchip Technology Inc.

FIGURE 8-10: TIME-OUT SEQUENCE ON POWER-UP ($\overline{MCLR}$ TIED TO V_{DD}): SLOW V_{DD} RISE TIME



Note: When V_{DD} rises slowly, the T_{DRT} time-out expires long before V_{DD} has reached its final value. In this example, the chip will reset properly if, and only if, V1 ≥ V_{DD} min.

© 2008 Microchip Technology Inc.

8.9 Program Verification/Code Protection

If the code protection bits have not been programmed, the on-chip program and data memory can be read out for verification purposes.

The first 64 locations and the last location (OSCCAL) can be read, regardless of the setting of the program memory's code protection bit. If the code protect bit specific to the FLASH data memory is programmed, then none of the contents of this memory region can be verified externally.

8.10 ID Locations

Four memory locations are designated as ID locations where users 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. The upper bits should be programmed as 0s.

8.11 In-Circuit Serial Programming™

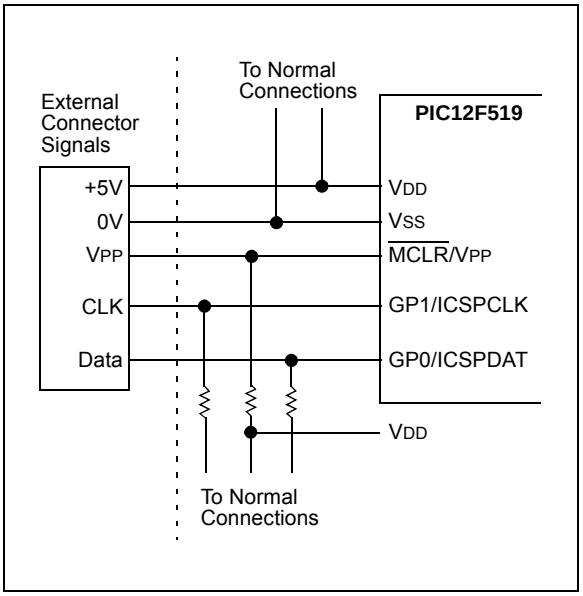
The PIC12F519 device can be serially programmed while in the end application circuit. This is simply done with two lines for clock and data, and three other lines for power, ground and the programming voltage. This allows users to manufacture boards with unprogrammed PIC12F519 device and then program the PIC12F519 device just before shipping the product. This also allows the most recent firmware, or a custom firmware, to be programmed.

The PIC12F519 device is placed into a Program/Verify mode by holding the GP1 and GP0 pins low while raising the $\overline{MCLR}$ (V_{PP}) pin from V_{IL} to V_{IHH} (see programming specification). The GP1 pin becomes the programming clock, and the GP0 pin becomes the programming data. Both GP1 and GP0 pins 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 "*PIC12F519 Memory Programming Specification*," (DS41316).

A typical In-Circuit Serial Programming connection is shown in Figure 8-12.

FIGURE 8-12: TYPICAL IN-CIRCUIT SERIAL PROGRAMMING CONNECTION



© 2008 Microchip Technology Inc.

9.0 INSTRUCTION SET SUMMARY

The PIC12F519 instruction set is highly orthogonal and is comprised of three basic categories.

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

Each PIC12F519 instruction is a 12-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 formats for each of the categories is presented in Figure 9-1, while the various opcode fields are summarized in Table 9-1.

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 '0', the result is placed in the W register. If 'd' is '1', 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 8 or 9-bit constant or literal value.

TABLE 9-1: 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
label	Label name
TOS	Top-of-Stack
PC	Program Counter
WDT	Watchdog Timer counter
$\overline{TO}$	Time-out bit
$\overline{PD}$	Power-down bit
dest	Destination, either the W register or the specified register file location
[ ]	Options
( )	Contents
→	Assigned to
< >	Register bit field
∈	In the set of
italics	User defined term (font is courier)

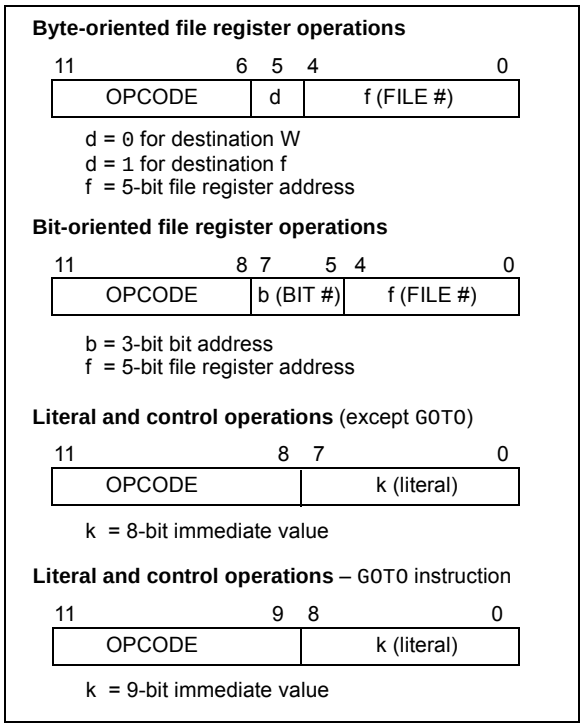
All instructions are executed within a single instruction cycle, unless a conditional test is true or the program counter is changed as a result of an instruction. In this case, the execution takes two instruction cycles. One instruction cycle consists of four oscillator periods. Thus, for an oscillator frequency of 4 MHz, the normal instruction execution time is 1 μs. If a conditional test is true or the program counter is changed as a result of an instruction, the instruction execution time is 2 μs.

Figure 9-1 shows the three general formats that the instructions can have. All examples in the figure use the following format to represent a hexadecimal number:

0xhhh

where 'h' signifies a hexadecimal digit.

FIGURE 9-1: GENERAL FORMAT FOR INSTRUCTIONS



RETLW **Return with Literal in W**

Syntax: [*label*] RETLW k

Operands: $0 \le k \le 255$

Operation: $k \rightarrow (W)$;
$TOS \rightarrow PC$

Status Affected: None

Description: The W register is loaded with the eight-bit literal 'k'. The program counter is loaded from the top of the stack (the return address). This is a two-cycle instruction.

RLF **Rotate Left f through Carry**

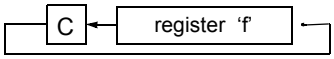
Syntax: [*label*] RLF f,d

Operands: $0 \le f \le 31$
$d \in [0,1]$

Operation: See description below

Status Affected: C

Description: The contents of register 'f' are rotated one bit to the left through the Carry flag. If 'd' is '0', the result is placed in the W register. If 'd' is '1', the result is stored back in register 'f'.



RRF **Rotate Right f through Carry**

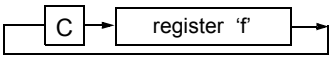
Syntax: [*label*] RRF f,d

Operands: $0 \le f \le 31$
$d \in [0,1]$

Operation: See description below

Status Affected: C

Description: The contents of register 'f' are rotated one bit to the right through the Carry flag. If 'd' is '0', the result is placed in the W register. If 'd' is '1', the result is placed back in register 'f'.



SLEEP **Enter SLEEP Mode**

Syntax: [*label*] SLEEP

Operands: None

Operation: $00h \rightarrow WDT$;
$0 \rightarrow \overline{WDT}$ prescaler;
$1 \rightarrow \overline{TO}$;
$0 \rightarrow \overline{PD}$

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

Description: Time-out Status bit ($\overline{TO}$) is set. The Power-down Status bit ($\overline{PD}$) is cleared.

GPWUF is unaffected.

The WDT and its prescaler are cleared.

The processor is put into Sleep mode with the oscillator stopped. See **Section 8.8 "Power-down Mode (Sleep)"** on Sleep for more details.

SUBWF **Subtract W from f**

Syntax: [*label*] SUBWF f,d

Operands: $0 \le f \le 31$
$d \in [0,1]$

Operation: $(f) - (W) \rightarrow (dest)$

Status Affected: C, DC, Z

Description: Subtract (two's complement method) the W register from 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'.

SWAPF **Swap Nibbles in f**

Syntax: [*label*] SWAPF f,d

Operands: $0 \le f \le 31$
$d \in [0,1]$

Operation: $(f<3:0>) \rightarrow (dest<7:4>)$;
$(f<7:4>) \rightarrow (dest<3:0>)$

Status Affected: None

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

11.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings(†)

Ambient temperature under bias ..... -40°C to +125°C
Storage temperature ..... -65°C to +150°C
Voltage on V_{DD} with respect to V_{SS} ..... 0 to +6.5V
Voltage on $\overline{MCLR}$ with respect to V_{SS} ..... 0 to +13.5V
Voltage on all other pins with respect to V_{SS} ..... -0.3V to (V_{DD} + 0.3V)
Total power dissipation(1) ..... 700 mW
Max. current out of V_{SS} pin ..... 200 mA
Max. current into V_{DD} pin ..... 150 mA
Input clamp current, I_{IK} (V_I < 0 or V_I > V_{DD}) ..... ±20 mA
Output clamp current, I_{OK} (V_O < 0 or V_O > V_{DD}) ..... ±20 mA
Max. output current sunk by any I/O pin ..... 25 mA
Max. output current sourced by any I/O pin ..... 25 mA
Max. output current sourced by I/O port ..... 75 mA
Max. output current sunk by I/O port ..... 75 mA

Note 1: Power dissipation is calculated as follows: $P_{DIS} = V_{DD} \times \{I_{DD} - \sum I_{OH}\} + \sum \{(V_{DD} - V_{OH}) \times I_{OH}\} + \sum(V_{OL} \times I_{OL})$

†NOTICE: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

11.1 DC Characteristics

TABLE 11-1: DC CHARACTERISTICS: PIC12F519 (INDUSTRIAL)

DC CHARACTERISTICS			Standard Operating Conditions (unless otherwise specified) Operating Temperature -40°C ≤ TA ≤ +85°C (industrial)				
Param No.	**Sym.**	**Characteristic**	**Min.**	**Typ(1)**	**Max.**	**Units**	**Conditions**
D001	VDD	**Supply Voltage**	2.0		5.5	V	See **Figure 11-1**
D002	VDR	**RAM Data Retention Voltage(2)**	—	1.5*	—	V	Device in Sleep mode
D003	VPOR	**VDD Start Voltage** to ensure Power-on Reset	—	Vss	—	V	See **Section 8.4 "Power-on Reset (POR)"** for details
D004	SVDD	**VDD Rise Rate** to ensure Power-on Reset	0.05*	—	—	V/ms	See **Section 8.4 "Power-on Reset (POR)"** for details
D005	IDDP	**Supply Current** During Prog/ Erase.	—	250*	—	µA	
D010	IDD	**Supply Current(3,4)**	— —	175 400	250 700	µA µA	FOSC = 4 MHz, VDD = 2.0V FOSC = 4 MHz, VDD = 5.0V
			— —	250 0.75	400 1.2	µA mA	FOSC = 8 MHz, VDD = 2.0V FOSC = 8 MHz, VDD = 5.0V
			— —	11 38	20 54	µA µA	FOSC = 32 kHz, VDD = 2.0V FOSC = 32 kHz, VDD = 5.0V
D020	IPD	**Power-down Current(5)**	— —	0.1 0.35	1.2 2.2	µA µA	VDD = 2.0V VDD = 5.0V
D022	IWDT	**WDT Current**	— —	1.0 7.0	3.0 16.0	µA µA	VDD = 2.0V VDD = 5.0V

* These parameters are characterized but not tested.

Note 1: Data in the Typical ("Typ") column is based on characterization results at 25°C. This data is for design guidance only and is not tested.

2: This is the limit to which VDD can be lowered in Sleep mode without losing RAM data.

3: The supply current is mainly a function of the operating voltage and frequency. Other factors such as bus loading, oscillator type, bus rate, internal code execution pattern and temperature also have an impact on the current consumption.

4: The test conditions for all IDD measurements in active operation mode are:
OSC1 = external square wave, from rail-to-rail for external clock modes; all I/O pins tri-stated, pulled to VSS, T0CKI = VDD, $\overline{MCLR}$ = VDD; WDT enabled/disabled as specified.

5: For standby current measurements, the conditions are the same as IDD, except that the device is in Sleep mode. If a module current is listed, the current is for that specific module enabled and the device in Sleep.

11.3 AC Characteristics

TABLE 11-5: EXTERNAL CLOCK TIMING REQUIREMENTS

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 11.0 "Electrical Characteristics"**				
Param No.	**Sym.**	**Characteristic**	**Min.**	**Typ(1)**	**Max.**	**Units**	**Conditions**
1A	FOSC	External CLKIN Frequency(2)	DC	—	4	MHz	XT Oscillator mode
			DC	—	200	kHz	LP Oscillator mode
		Oscillator Frequency(2)	DC	—	4	MHz	EXTRC Oscillator mode
			0.1	—	4	MHz	XT Oscillator mode
			DC	—	200	kHz	LP Oscillator mode
1	TOSC	External CLKIN Period(2)	250	—	—	ns	XT Oscillator mode
			5	—	—	μs	LP Oscillator mode
		Oscillator Period(2)	250	—	—	ns	EXTRC Oscillator mode
			250	—	10,000	ns	XT Oscillator mode
			5	—	—	μs	LP Oscillator mode
2	TCY	Instruction Cycle Time	200	4/FOSC	DC	ns	
3	TosL, TosH	Clock in (OSC1) Low or High Time	50*	—	—	ns	XT Oscillator
			2*	—	—	μs	LP Oscillator
4	TosR, TosF	Clock in (OSC1) Rise or Fall Time	—	—	25*	ns	XT Oscillator
			—	—	50*	ns	LP Oscillator

* 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.

2: All specified values are based on characterization data for that particular oscillator type under standard operating conditions with the device executing code. Exceeding these specified limits may result in an unstable oscillator operation and/or higher than expected current consumption. When an external clock input is used, the "max" cycle time limit is "DC" (no clock) for all devices.

© 2008 Microchip Technology Inc.

TABLE 11-7: TIMING REQUIREMENTS

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				
Param No.	**Sym.**	**Characteristic**	**Min.**	**Typ(1)**	**Max.**	**Units**
17	TOSH2IOV	OSC1↑ (Q1 cycle) to Port Out Valid(2), (3)	—	—	100*	ns
18	TOSH2IOI	OSC1↑ (Q2 cycle) to Port Input Invalid (I/O in hold time)(2)	50	—	—	ns
19	TIOV2OSH	Port Input Valid to OSC1↑ (I/O in setup time)	20	—	—	ns
20	TIOR	Port Output Rise Time(3)	—	10	50**	ns
21	TIOF	Port Output Fall Time(3)	—	10	50**	ns

TBD = To be determined.

* These parameters are characterized but not tested.

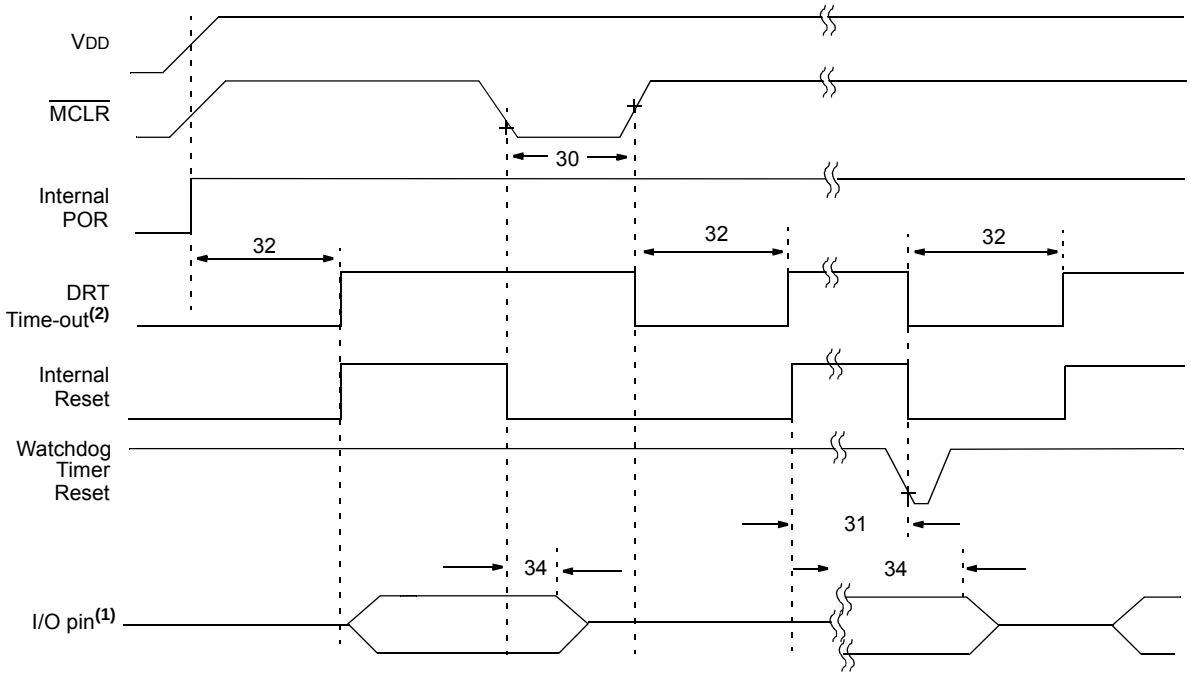
** These parameters are design targets and are not tested.

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.

2: Measurements are taken in EXTRC mode.

3: See Figure 11-3 for loading conditions.

FIGURE 11-6: RESET, WATCHDOG TIMER AND DEVICE RESET TIMER TIMING



Note 1: I/O pins must be taken out of High-Impedance mode by enabling the output drivers in software.

2: Runs in MCLR or WDT Reset only in XT and LP.

© 2008 Microchip Technology Inc.

FIGURE 12-8: WDT TIME-OUT vs. VDD OVER TEMPERATURE (NO PRESCALER)

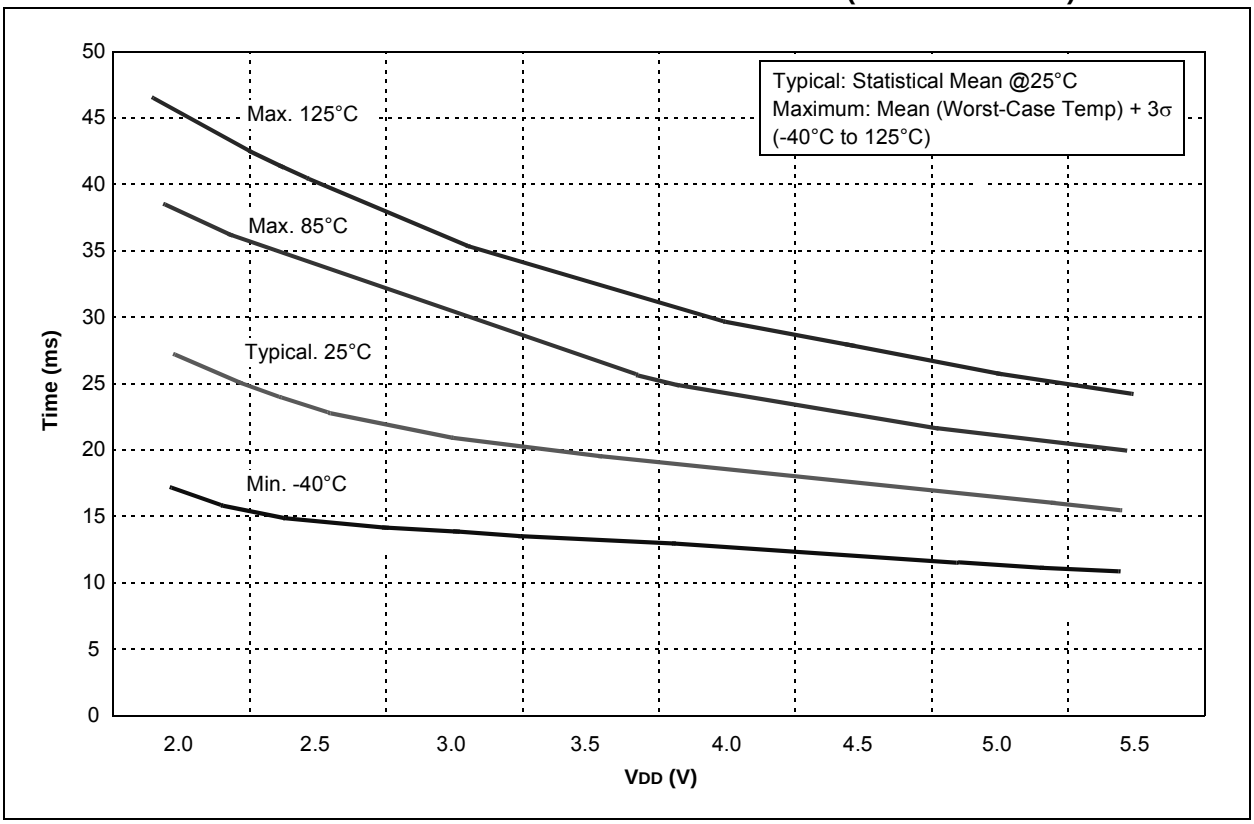


FIGURE 12-9: VOL vs. IOL OVER TEMPERATURE (VDD = 3.0V)

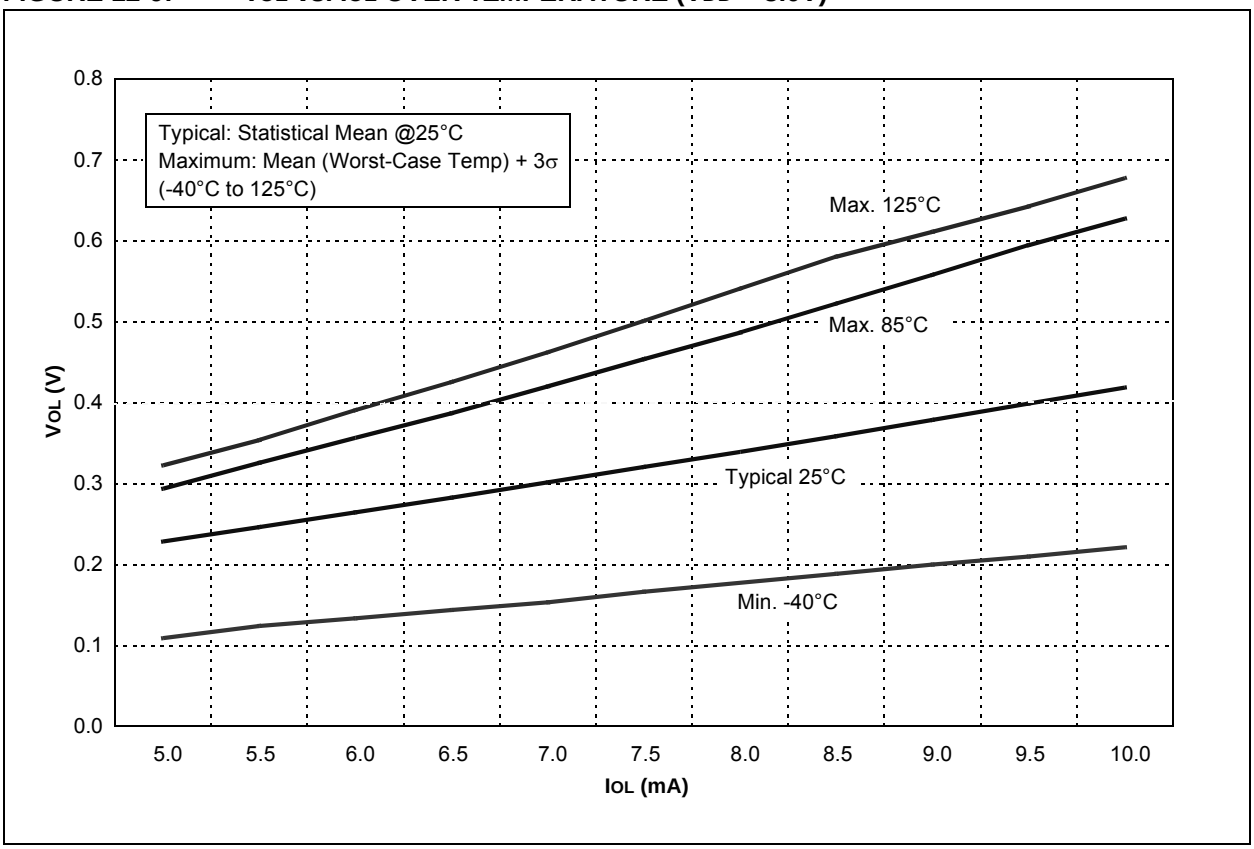


FIGURE 12-10: V_{OL} vs. I_{OL} OVER TEMPERATURE (V_{DD} = 5.0V)

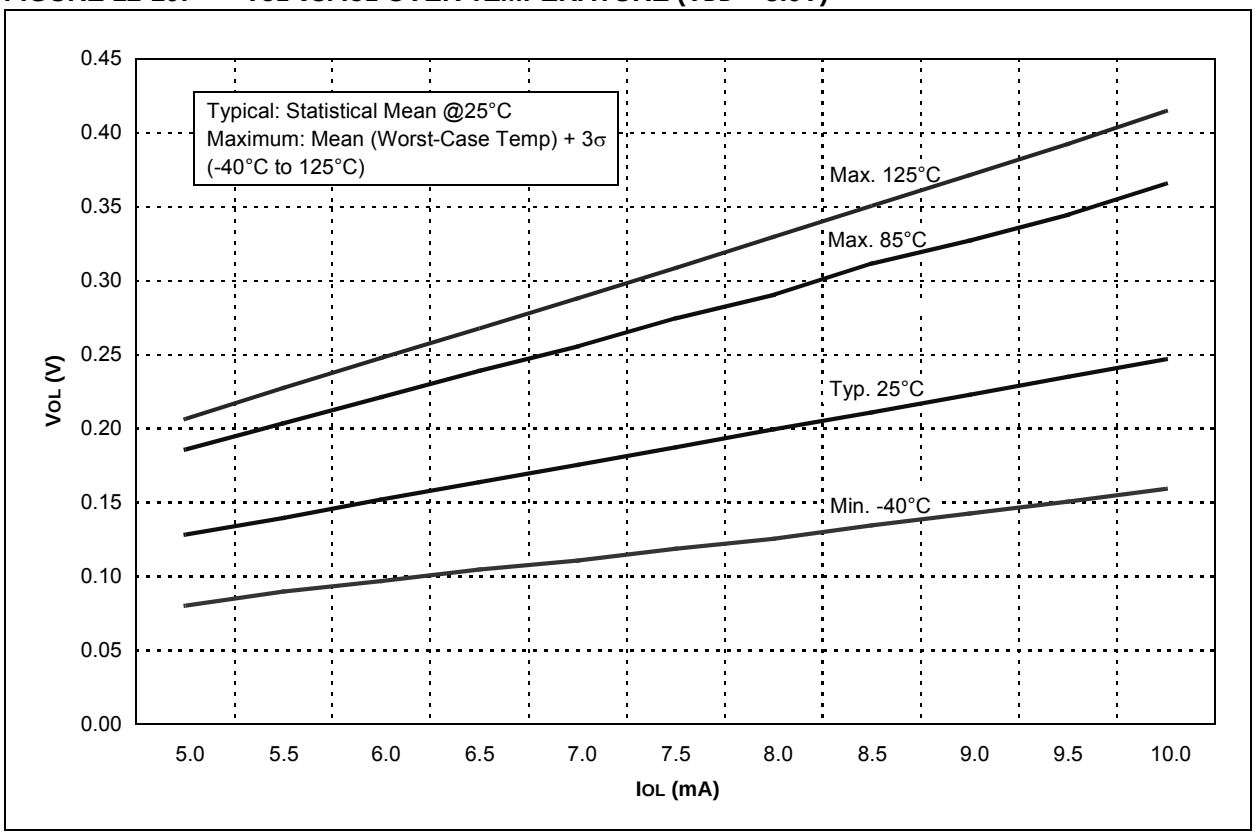
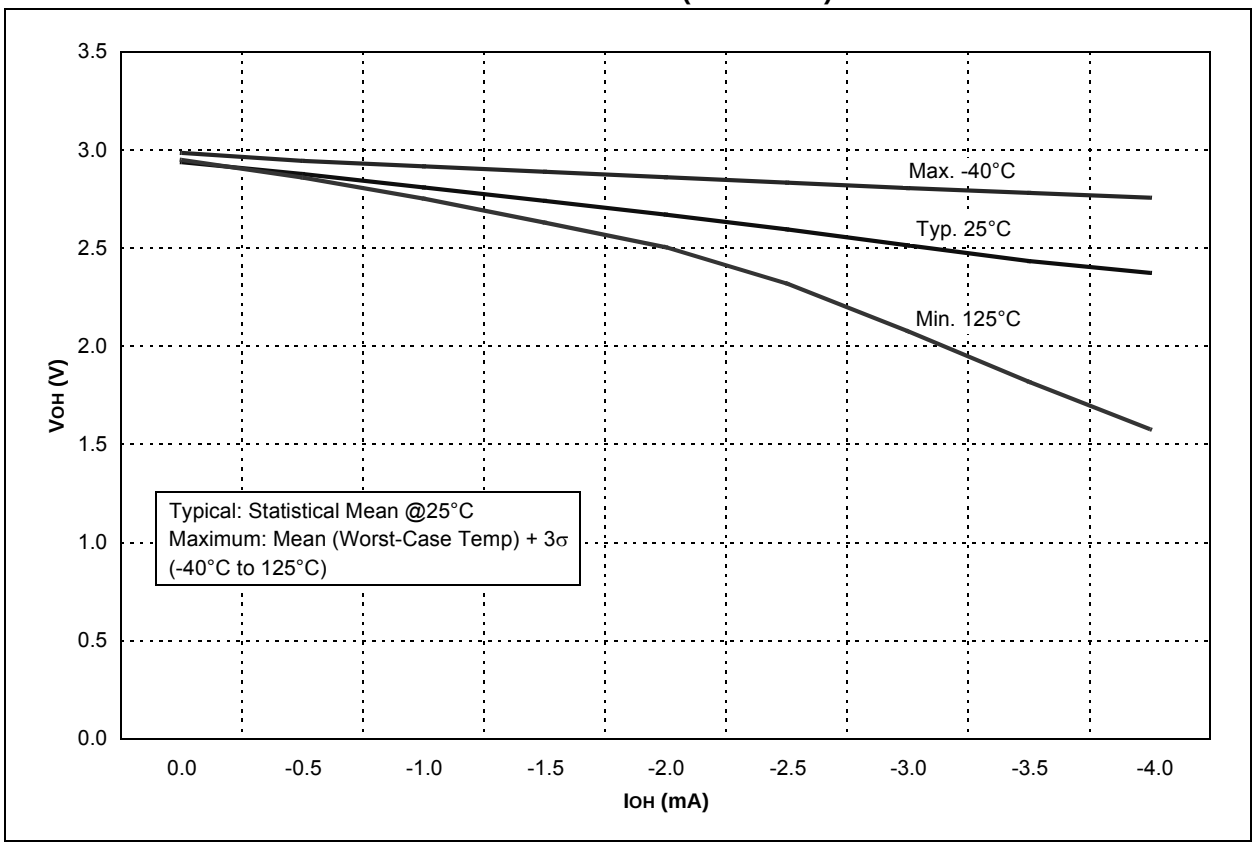


FIGURE 12-11: V_{OH} vs. I_{OH} OVER TEMPERATURE (V_{DD} = 3.0V)



© 2008 Microchip Technology Inc.

FIGURE 12-12: VOH vs. IOH OVER TEMPERATURE (VDD = 5.0V)

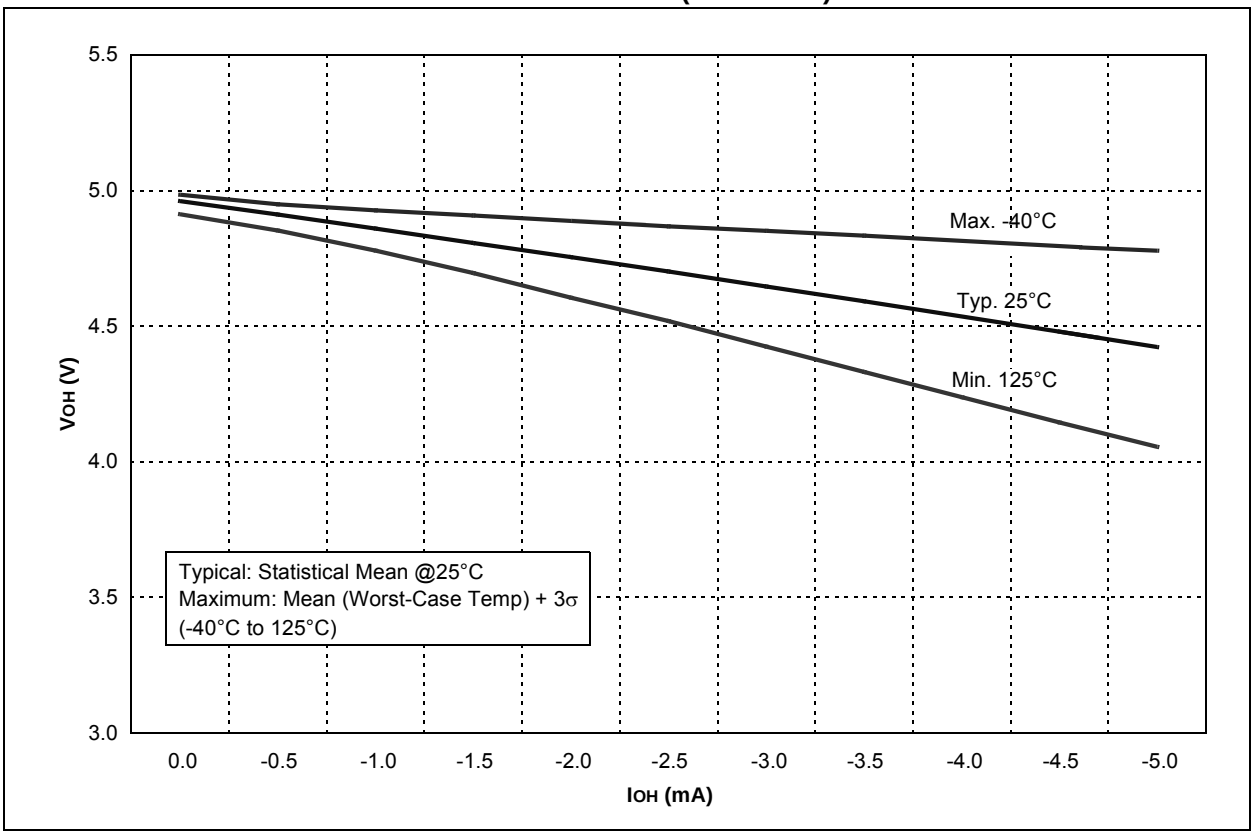
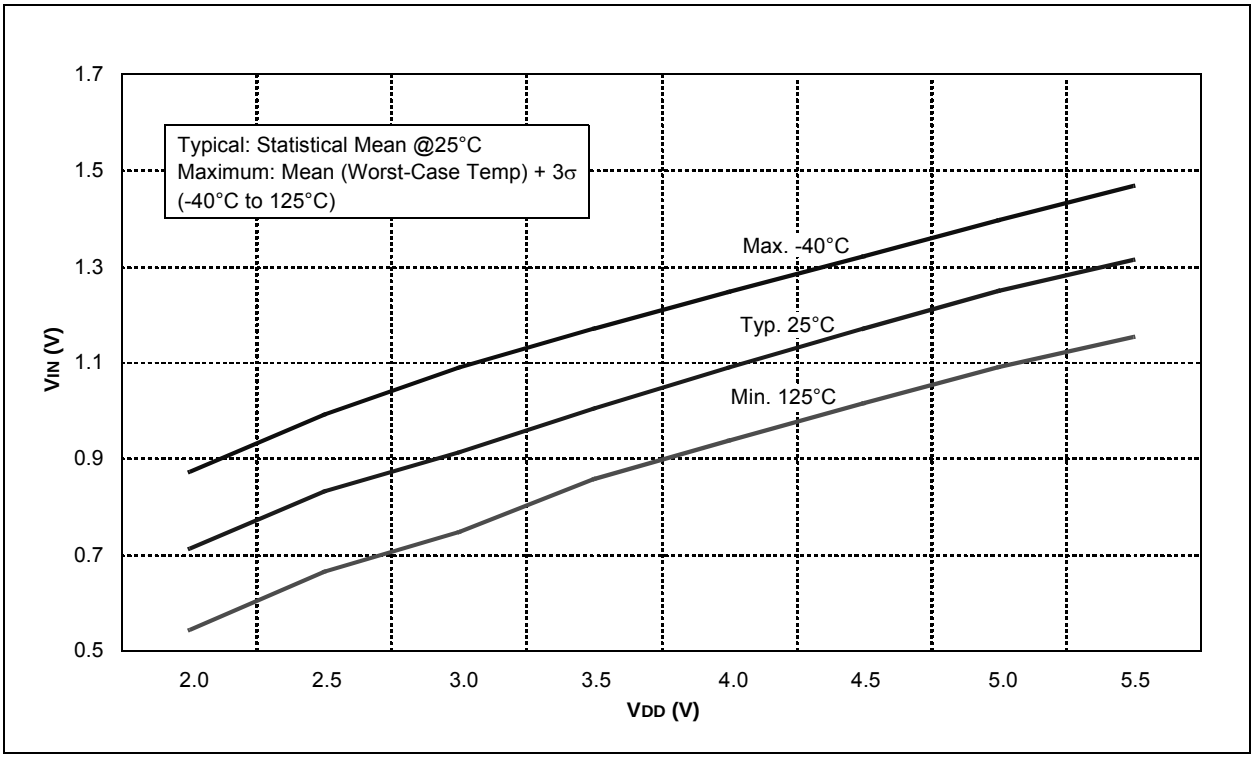
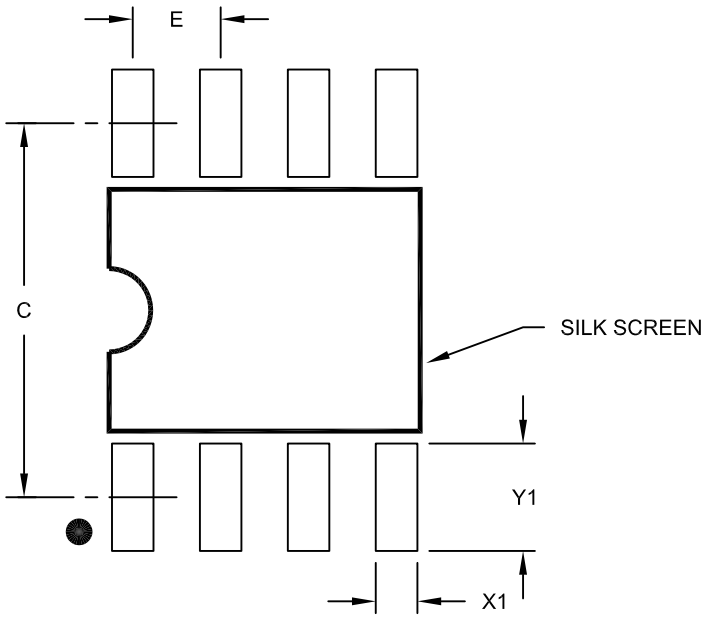


FIGURE 12-13: TTL INPUT THRESHOLD VIN vs. VDD



8-Lead Plastic Small Outline (SN) – Narrow, 3.90 mm Body [SOIC]

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



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		1.27 BSC	
Contact Pad Spacing	C		5.40	
Contact Pad Width (X8)	X1			0.60
Contact Pad Length (X8)	Y1			1.55

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2057A

© 2008 Microchip Technology Inc.

APPENDIX A: REVISION HISTORY

Revision A (May 2007)

Original release of this document.

Revision B (September 2008)

Added DC and AC Characteristics graphs; Updated Electrical Characteristics section; Updated Package Drawings and made general edits.

© 2008 Microchip Technology Inc.

WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://support.microchip.com
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

Kokomo
Kokomo, IN
Tel: 765-864-8360
Fax: 765-864-8387

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

Santa Clara
Santa Clara, CA
Tel: 408-961-6444
Fax: 408-961-6445

Toronto
Mississauga, Ontario,
Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8528-2100
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8203-2660
Fax: 86-755-8203-1760

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-4182-8400
Fax: 91-80-4182-8422

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

Japan - Yokohama
Tel: 81-45-471- 6166
Fax: 81-45-471-6122

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-572-9526
Fax: 886-3-572-6459

Taiwan - Kaohsiung
Tel: 886-7-536-4818
Fax: 886-7-536-4803

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

01/02/08

© 2008 Microchip Technology Inc.