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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 | Active |
| Core Processor | PIC |
| Core Size | 8-Bit |
| Speed | 4MHz |
| Connectivity | - |
| Peripherals | POR, WDT |
| Number of I/O | 20 |
| Program Memory Size | 768B (512 x 12) |
| Program Memory Type | OTP |
| EEPROM Size | - |
| RAM Size | 24 x 8 |
| Voltage - Supply (Vcc/Vdd) | 3V ~ 6.25V |
| Data Converters | - |
| Oscillator Type | External |
| Operating Temperature | 0°C ~ 70°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/pic16c55-xt-ss |

## 3.0 ARCHITECTURAL OVERVIEW

The high performance of the PIC16C5X family can be attributed to a number of architectural features commonly found in RISC microprocessors. To begin with, the PIC16C5X uses a Harvard architecture in which program and data are accessed on separate buses. This improves bandwidth over traditional von Neumann architecture where program and data are fetched on the same bus. Separating program and data memory further allows instructions to be sized differently than the 8-bit wide data word. Instruction opcodes are 12 bits wide making it possible to have all single word instructions. A 12-bit wide program memory access bus fetches a 12-bit instruction in a single cycle. A two-stage pipeline overlaps fetch and execution of instructions. Consequently, all instructions (33) execute in a single cycle except for program branches.

The PIC16C54/CR54 and PIC16C55 address 512 x 12 of program memory, the PIC16C56/CR56 address 1K x 12 of program memory, and the PIC16C57/CR57 and PIC16C58/CR58 address 2K x 12 of program memory. All program memory is internal.

The PIC16C5X can directly or indirectly address its register files and data memory. All special function registers including the program counter are mapped in the data memory. The PIC16C5X has a highly orthogonal (symmetrical) instruction set that makes it possible to carry out any operation on any register using any addressing mode. This symmetrical nature and lack of ‘special optimal situations’ make programming with the PIC16C5X simple yet efficient. In addition, the learning curve is reduced significantly.

The PIC16C5X device contains an 8-bit ALU and working register. The ALU is a general purpose arithmetic unit. It performs arithmetic and Boolean functions between data in the working register and any register file.

The ALU is 8 bits wide and capable of addition, subtraction, shift and logical operations. Unless otherwise mentioned, arithmetic operations are two's complement in nature. In two-operand instructions, typically one operand is the W (working) register. The other operand is either a file register or an immediate constant. In single operand instructions, the operand is either the W register or a file register.

The W register is an 8-bit working register used for ALU operations. It is not an addressable register.

Depending on the instruction executed, the ALU may affect the values of the Carry (C), Digit Carry (DC), and Zero (Z) bits in the STATUS register. The C and DC bits operate as a borrow and digit borrow out bit, respectively, in subtraction. See the `SUBWF` and `ADDWF` instructions for examples.

A simplified block diagram is shown in Figure 3-1, with the corresponding device pins described in Table 3-1 (for PIC16C54/56/58) and Table 3-2 (for PIC16C55/57).

## 4.4 RC Oscillator

For timing insensitive applications, the RC device option offers additional cost savings. The RC oscillator frequency is a function of the supply voltage, the resistor (REXT) and capacitor (CEXT) values, and the operating temperature. In addition to this, the oscillator frequency will vary from unit to unit due to normal process parameter variation. Furthermore, the difference in lead frame capacitance between package types will also affect the oscillation frequency, especially for low CEXT values. The user also needs to take into account variation due to tolerance of external R and C components used.

Figure 4-5 shows how the R/C combination is connected to the PIC16C5X. For REXT values below 2.2 kΩ, the oscillator operation may become unstable, or stop completely. For very high REXT values (e.g., 1 MΩ) the oscillator becomes sensitive to noise, humidity and leakage. Thus, we recommend keeping REXT between 3 kΩ and 100 kΩ.

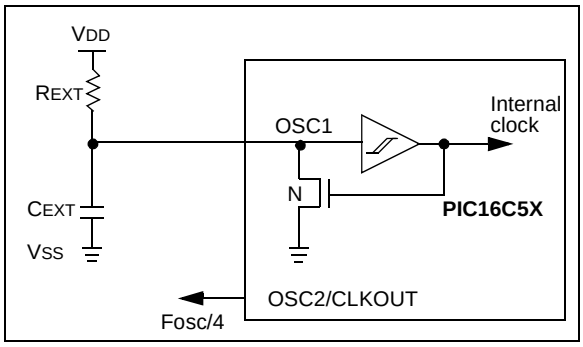
Although the oscillator will operate with no external capacitor (CEXT = 0 pF), we recommend using values above 20 pF for noise and stability reasons. With no or small external capacitance, the oscillation frequency can vary dramatically due to changes in external capacitances, such as PCB trace capacitance or package lead frame capacitance.

The Electrical Specifications sections show RC frequency variation from part to part due to normal process variation. The variation is larger for larger R (since leakage current variation will affect RC frequency more for large R) and for smaller C (since variation of input capacitance will affect RC frequency more).

Also, see the Electrical Specifications sections for variation of oscillator frequency due to VDD for given REXT/CEXT values as well as frequency variation due to operating temperature for given R, C, and VDD values.

The oscillator frequency, divided by 4, is available on the OSC2/CLKOUT pin, and can be used for test purposes or to synchronize other logic.

**FIGURE 4-5: RC OSCILLATOR MODE**




| **Note:** | If you change from this device to another device, please verify oscillator characteristics in your application. |
|---|---|

## 6.3 STATUS Register

This register contains the arithmetic status of the ALU, the RESET status and the page preselect bits for program memories larger than 512 words.

The STATUS Register can be the destination for any instruction, as with any other register. If the STATUS Register is the destination for an instruction that affects the Z, DC or C bits, then the write to these three bits is disabled. These bits are set or cleared according to the device logic. Furthermore, the $\overline{TO}$ and $\overline{PD}$ bits are not writable. Therefore, the result of an instruction with the STATUS Register as destination may be different than intended.

For example, `CLRF STATUS` will clear the upper three bits and set the Z bit. This leaves the STATUS Register as `000u u1uu` (where `u` = unchanged).

It is recommended, therefore, that only `BCF`, `BSF` and `MOVWF` instructions be used to alter the STATUS Register because these instructions do not affect the Z, DC or C bits from the STATUS Register. For other instructions which do affect STATUS Bits, see Section 10.0, Instruction Set Summary.

**REGISTER 6-1: STATUS REGISTER (ADDRESS: 03h)**

| R/W-0 | R/W-0 | R/W-0 | R-1 | R-1 | R/W-x | R/W-x | R/W-x |
|---|---|---|---|---|---|---|---|
| PA2 | PA1 | PA0 | $\overline{TO}$ | $\overline{PD}$ | Z | DC | C |
| bit 7 | | | | | | | bit 0 |

bit 7: **PA2**: This bit unused at this time.
Use of the PA2 bit as a general purpose read/write bit is not recommended, since this may affect upward compatibility with future products.

bit 6-5: **PA<1:0>**: Program page preselect bits (PIC16C56/CR56)(PIC16C57/CR57)(PIC16C58/CR58)
`00` = Page 0 (000h - 1FFh) - PIC16C56/CR56, PIC16C57/CR57, PIC16C58/CR58
`01` = Page 1 (200h - 3FFh) - PIC16C56/CR56, PIC16C57/CR57, PIC16C58/CR58
`10` = Page 2 (400h - 5FFh) - PIC16C57/CR57, PIC16C58/CR58
`11` = Page 3 (600h - 7FFh) - PIC16C57/CR57, PIC16C58/CR58
Each page is 512 words.
Using the PA<1:0> bits as general purpose read/write bits in devices which do not use them 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 | Loaded with LSb or MSb, respectively |
| `0` = A carry did not occur | `0` = A borrow occurred | |

| 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 |

## 9.1 Configuration Bits

Configuration bits can be programmed to select various device configurations. Two bits are for the selection of the oscillator type and one bit is the Watchdog Timer enable bit. Nine bits are code protection bits for the PIC16C54A, PIC16CR54A, PIC16C54C, PIC16CR54C, PIC16C55A, PIC16C56A, PIC16CR56A, PIC16C57C, PIC16CR57C, PIC16C58B, and PIC16CR58B devices (Register 9-1). One bit is for code protection for the PIC16C54, PIC16C55, PIC16C56 and PIC16C57 devices (Register 9-2).

QTP or ROM devices have the oscillator configuration programmed at the factory and these parts are tested accordingly (see "Product Identification System" diagrams in the back of this data sheet).

**REGISTER 9-1: CONFIGURATION WORD FOR PIC16C54A/CR54A/C54C/CR54C/C55A/C56A/ CR56A/C57C/CR57C/C58B/CR58B**

| CP | CP | CP | CP | CP | CP | CP | CP | CP | WDTE | FOSC1 | FOSC0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| bit 11 | | | | | | | | | | | bit 0 |

bit 11-3: **CP**: Code Protection Bit
1 = Code protection off
0 = Code protection on

bit 2: **WDTE**: Watchdog timer enable bit
1 = WDT enabled
0 = WDT disabled

bit 1-0: **FOSC1:FOSC0**: Oscillator Selection Bit
00 = LP oscillator
01 = XT oscillator
10 = HS oscillator
11 = RC oscillator

**Note 1:** Refer to the PIC16C5X Programming Specification (Literature Number DS30190) to determine how to access the configuration word.

| 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 |

**TABLE 12-1: EXTERNAL CLOCK TIMING REQUIREMENTS - PIC16C54/55/56/57**

| AC Characteristics | | Standard Operating Conditions (unless otherwise specified)<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial<br>–40°C ≤ TA ≤ +125°C for extended | | | | | |
|---|---|---|---|---|---|---|---|
| **Param No.** | **Symbol** | **Characteristic** | **Min** | **Typ†** | **Max** | **Units** | **Conditions** |
| 1 | TOSC | External CLKIN Period(1) | 250 | — | — | ns | XT OSC mode |
| | | | 100 | — | — | ns | 10 MHz mode |
| | | | 50 | — | — | ns | HS OSC mode (Comm/Ind) |
| | | | 62.5 | — | — | ns | HS OSC mode (Ext) |
| | | | 25 | — | — | µs | LP OSC mode |
| | | Oscillator Period(1) | 250 | — | — | ns | RC OSC mode |
| | | | 250 | — | 10,000 | ns | XT OSC mode |
| | | | 100 | — | 250 | ns | 10 MHz mode |
| | | | 50 | — | 250 | ns | HS OSC mode (Comm/Ind) |
| | | | 62.5 | — | 250 | ns | HS OSC mode (Ext) |
| | | | 25 | — | — | µs | LP OSC mode |
| 2 | Tcy | Instruction Cycle Time(2) | — | 4/FOSC | — | — | |
| 3 | TosL, TosH | Clock in (OSC1) Low or High Time | 85* | — | — | ns | XT oscillator |
| | | | 20* | — | — | ns | HS oscillator |
| | | | 2.0* | — | — | µs | LP oscillator |
| 4 | TosR, TosF | Clock in (OSC1) Rise or Fall Time | — | — | 25* | ns | XT oscillator |
| | | | — | — | 25* | ns | HS oscillator |
| | | | — | — | 50* | ns | LP oscillator |

* These parameters are characterized but not tested.

† Data in the Typical ("Typ") column is at 5.0V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

**Note 1:** 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.

**2:** Instruction cycle period (TCY) equals four times the input oscillator time base period.

## 13.1 DC Characteristics: PIC16CR54A-04, 10, 20, PIC16LCR54A-04 (Commercial) PIC16CR54A-04I, 10I, 20I, PIC16LCR54A-04I (Industrial)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PIC16LCR54A-04**<br>**PIC16LCR54A-04I**<br>(Commercial, Industrial) | | | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial | | | | |
| **PIC16CR54A-04, 10, 20**<br>**PIC16CR54A-04I, 10I, 20I**<br>(Commercial, Industrial) | | | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial | | | | |
| **Param No.** | **Symbol** | **Characteristic/Device** | **Min** | **Typ†** | **Max** | **Units** | **Conditions** |
| | IPD | **Power-down Current(2)** | | | | | |
| D006 | | PIC16LCR54A-Commercial | — | 1.0 | 6.0 | µA | VDD = 2.5V, WDT disabled |
| | | | — | 2.0 | 8.0* | µA | VDD = 4.0V, WDT disabled |
| | | | — | 3.0 | 15 | µA | VDD = 6.0V, WDT disabled |
| | | | — | 5.0 | 25 | µA | VDD = 6.0V, WDT enabled |
| D006A | | PIC16CR54A-Commercial | — | 1.0 | 6.0 | µA | VDD = 2.5V, WDT disabled |
| | | | — | 2.0 | 8.0* | µA | VDD = 4.0V, WDT disabled |
| | | | — | 3.0 | 15 | µA | VDD = 6.0V, WDT disabled |
| | | | — | 5.0 | 25 | µA | VDD = 6.0V, WDT enabled |
| D007 | | PIC16LCR54A-Industrial | — | 1.0 | 8.0 | µA | VDD = 2.5V, WDT disabled |
| | | | — | 2.0 | 10* | µA | VDD = 4.0V, WDT disabled |
| | | | — | 3.0 | 20* | µA | VDD = 4.0V, WDT enabled |
| | | | — | 3.0 | 18 | µA | VDD = 6.0V, WDT disabled |
| | | | — | 5.0 | 45 | µA | VDD = 6.0V, WDT enabled |
| D007A | | PIC16CR54A-Industrial | — | 1.0 | 8.0 | µA | VDD = 2.5V, WDT disabled |
| | | | — | 2.0 | 10* | µA | VDD = 4.0V, WDT disabled |
| | | | — | 3.0 | 20* | µA | VDD = 4.0V, WDT enabled |
| | | | — | 3.0 | 18 | µA | VDD = 6.0V, WDT disabled |
| | | | — | 5.0 | 45 | µA | VDD = 6.0V, WDT enabled |

Legend: Rows with standard voltage device data only are shaded for improved readability.

* 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.

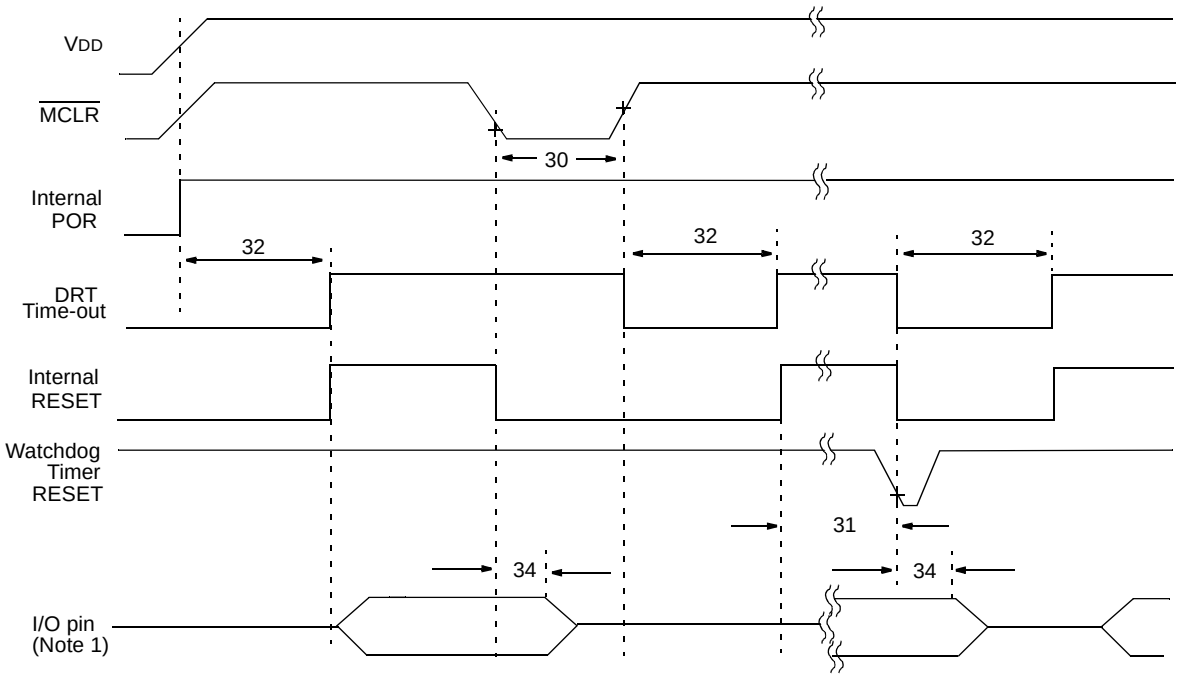
**2:** The supply current is mainly a function of the operating voltage and frequency. Other factors such as bus loading, oscillator type, bus rate, internal code execution pattern and temperature also have an impact on the current consumption.

a) 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 VSS, T0CKI = VDD, $\overline{MCLR}$ = VDD; WDT enabled/disabled as specified.

b) For standby current measurements, the conditions are the same, except that the device is in SLEEP mode. The power-down current in SLEEP mode does not depend on the oscillator type.

**3:** Does not include current through REXT. The current through the resistor can be estimated by the formula: IR = VDD/2REXT (mA) with REXT in kΩ.

**FIGURE 13-4: RESET, WATCHDOG TIMER, AND DEVICE RESET TIMER TIMING - PIC16CR54A**




**Note 1:** Please refer to Figure 13.1 for load conditions.

**TABLE 13-3: RESET, WATCHDOG TIMER, AND DEVICE RESET TIMER - PIC16CR54A**

| **AC Characteristics** | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial<br>–40°C ≤ TA ≤ +125°C for extended | | | | | | |
|---|---|---|---|---|---|---|---|
| **Param No.** | **Symbol** | **Characteristic** | **Min** | **Typ†** | **Max** | **Units** | **Conditions** |
| 30 | TmcL | $\overline{\text{MCLR}}$ Pulse Width (low) | 1.0* | — | — | μs | VDD = 5.0V |
| 31 | Twdt | Watchdog Timer Time-out Period (No Prescaler) | 7.0* | 18* | 40* | ms | VDD = 5.0V (Comm) |
| 32 | TDRT | Device Reset Timer Period | 7.0* | 18* | 30* | ms | VDD = 5.0V (Comm) |
| 34 | Tioz | I/O Hi-impedance from $\overline{\text{MCLR}}$ Low | — | — | 1.0* | μs | |

* These parameters are characterized but not tested.

† Data in the Typical ("Typ") column is at 5.0V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

**FIGURE 14-11: $V_{TH}$ (INPUT THRESHOLD VOLTAGE) OF OSC1 INPUT (XT, HS, AND LP MODES) vs. $V_{DD}$**

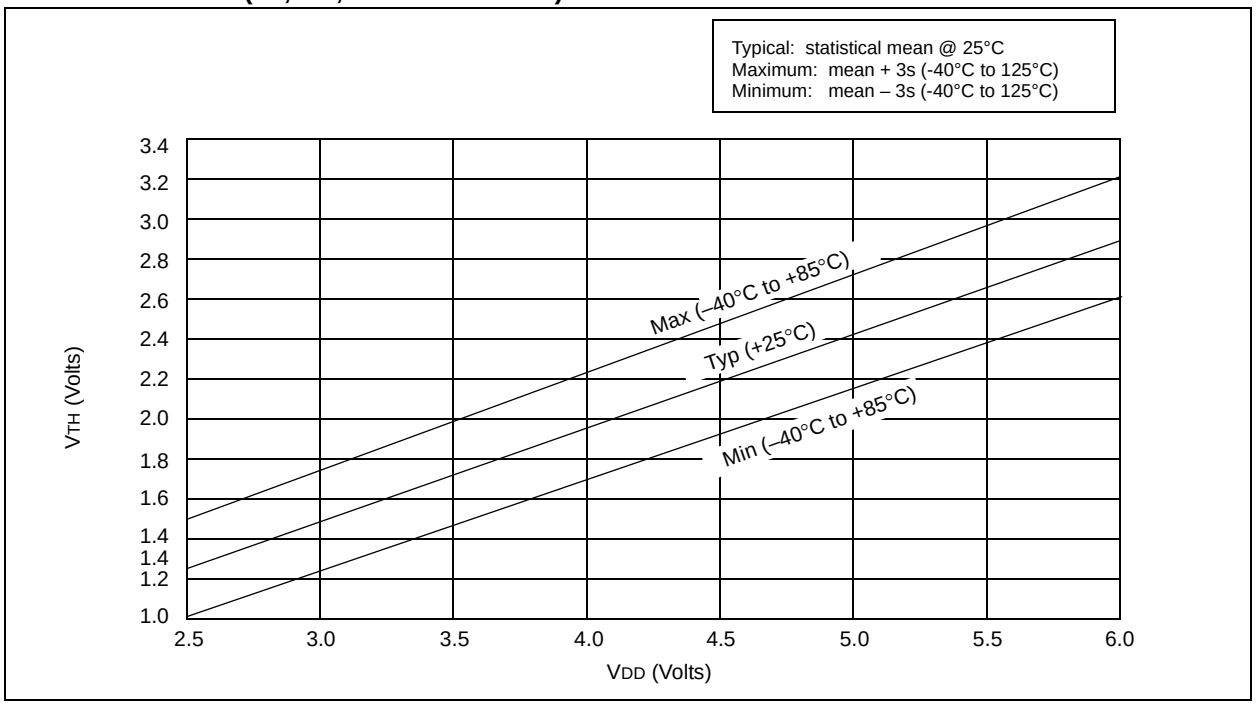
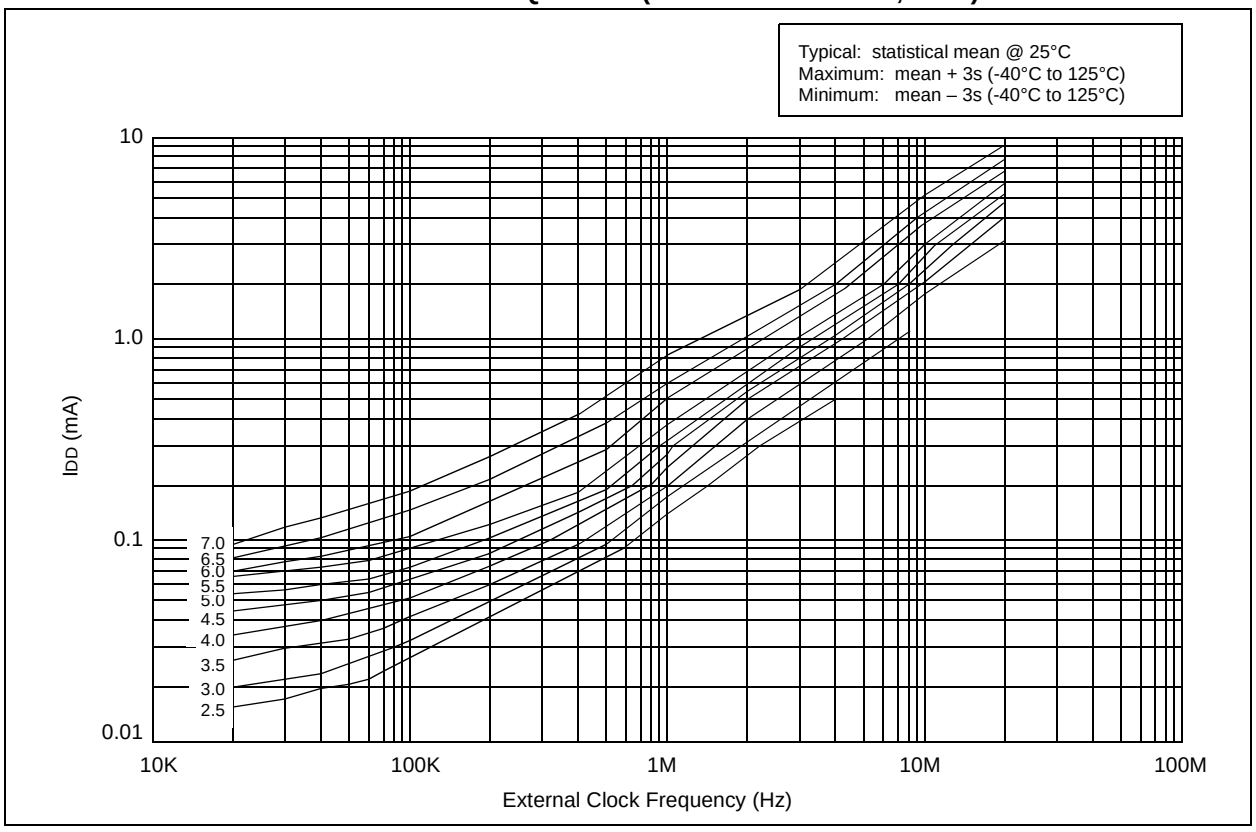



**FIGURE 14-12: TYPICAL IDD VS. FREQUENCY (EXTERNAL CLOCK, 25°C)**



## 15.1 DC Characteristics: PIC16C54A-04, 10, 20 (Commercial)
## PIC16C54A-04I, 10I, 20I (Industrial)
## PIC16LC54A-04 (Commercial)
## PIC16LC54A-04I (Industrial)

| | |
|---|---|
| **PIC16LC54A-04**<br>**PIC16LC54A-04I**<br>(Commercial, Industrial) | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial |
| **PIC16C54A-04, 10, 20**<br>**PIC16C54A-04I, 10I, 20I**<br>(Commercial, Industrial) | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial |

| Param No. | Symbol | Characteristic/Device | Min | Typ† | Max | Units | Conditions |
|---|---|---|---|---|---|---|---|
| | IPD | **Power-down Current(2)** | | | | | |
| D006 | | PIC16LC5X | — | 2.5 | 12 | µA | VDD = 2.5V, WDT enabled, Commercial |
| | | | — | 0.25 | 4.0 | µA | VDD = 2.5V, WDT disabled, Commercial |
| | | | — | 2.5 | 14 | µA | VDD = 2.5V, WDT enabled, Industrial |
| | | | — | 0.25 | 5.0 | µA | VDD = 2.5V, WDT disabled, Industrial |
| D006A | | PIC16C5X | — | 4.0 | 12 | µA | VDD = 3.0V, WDT enabled, Commercial |
| | | | — | 0.25 | 4.0 | µA | VDD = 3.0V, WDT disabled, Commercial |
| | | | — | 5.0 | 14 | µA | VDD = 3.0V, WDT enabled, Industrial |
| | | | — | 0.3 | 5.0 | µA | VDD = 3.0V, WDT disabled, Industrial |

Legend: Rows with standard voltage device data only are shaded for improved readability.

* These parameters are characterized but not tested.

† Data in "Typ" column is based on characterization results at 25°C. This data is for design guidance only and is 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 bus loading, oscillator type, bus rate, internal code execution pattern and temperature also have an impact on the current consumption.

a) 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 VSS, T0CKI = VDD, $\overline{MCLR}$ = VDD; WDT enabled/disabled as specified.

b) For standby current measurements, the conditions are the same, except that the device is in SLEEP mode. The power-down current in SLEEP mode does not depend on the oscillator type.

**3:** Does not include current through REXT. The current through the resistor can be estimated by the formula: IR = VDD/2REXT (mA) with REXT in kΩ.

**NOTES:**

**FIGURE 16-20: PORTA, B AND C $I_{OH}$ vs. $V_{OH}$, $V_{DD}$ = 3V**

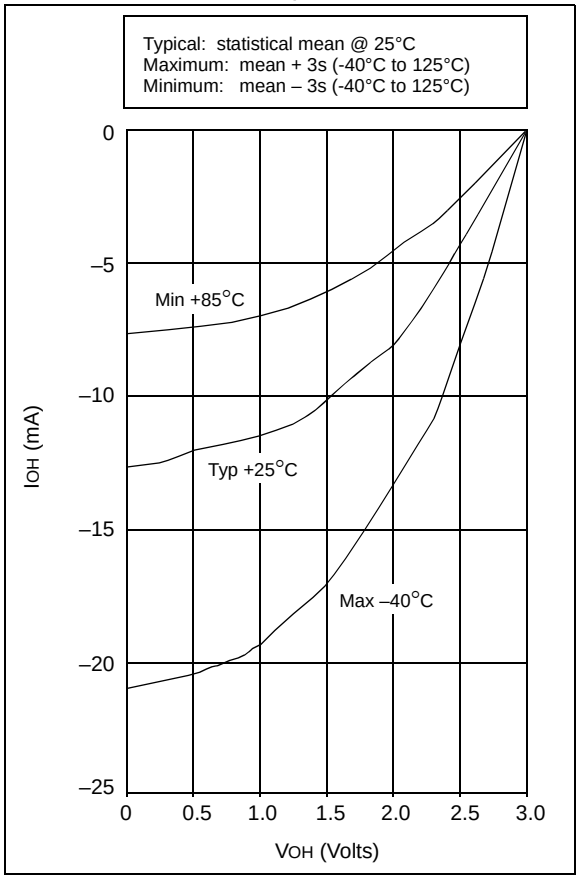



**FIGURE 16-21: PORTA, B AND C $I_{OH}$ vs. $V_{OH}$, $V_{DD}$ = 5V**

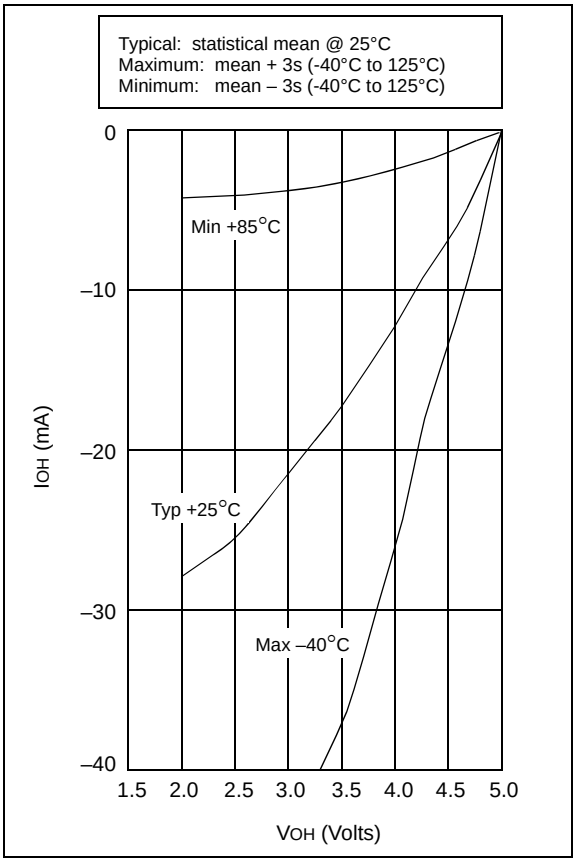
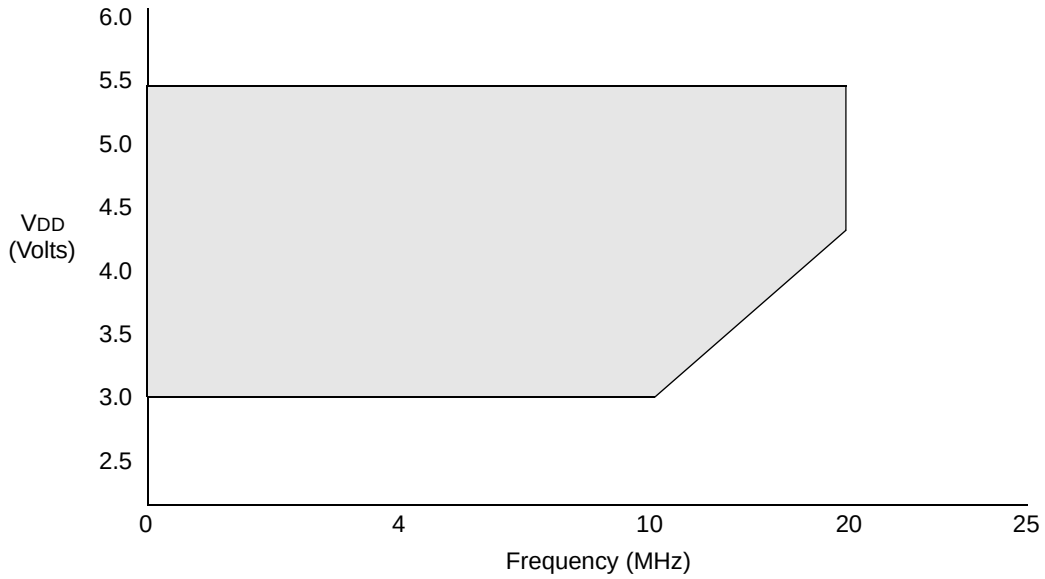


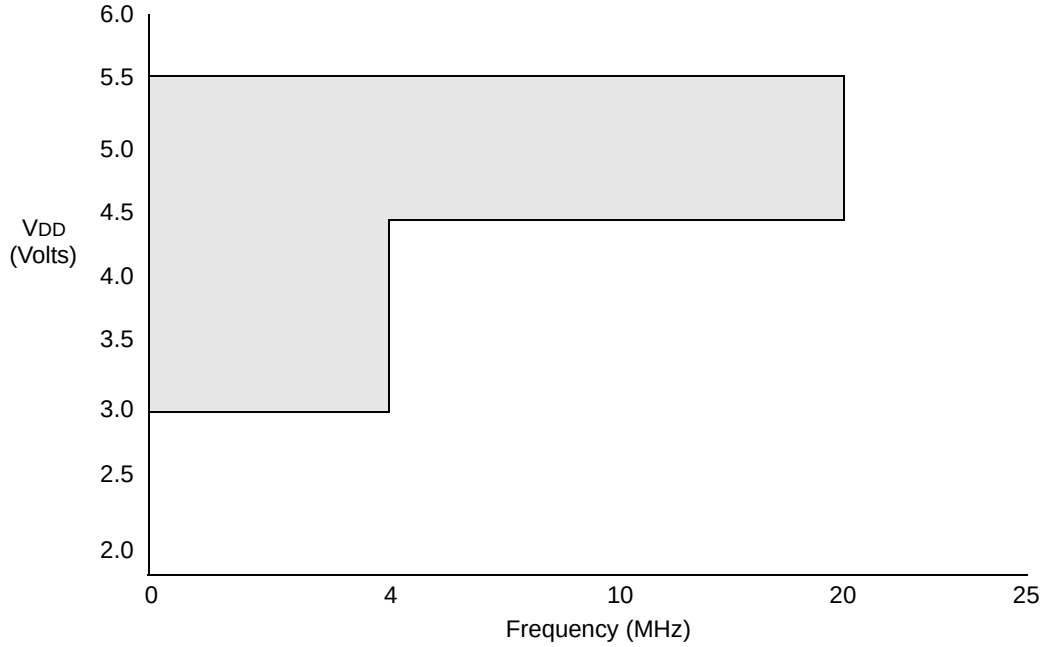
**FIGURE 17-1: PIC16C54C/55A/56A/57C/58B-04, 20 VOLTAGE-FREQUENCY GRAPH, 0°C ≤ $T_A$ ≤ +70°C (COMMERCIAL TEMPS)**




**Note 1:** The shaded region indicates the permissible combinations of voltage and frequency.

**2:** The maximum rated speed of the part limits the permissible combinations of voltage and frequency. Please reference the Product Identification System section for the maximum rated speed of the parts.

**FIGURE 17-2: PIC16C54C/55A/56A/57C/58B-04, 20 VOLTAGE-FREQUENCY GRAPH, -40°C ≤ $T_A$ < 0°C, +70°C < $T_A$ ≤ +125°C (OUTSIDE OF COMMERCIAL TEMPS)**




**Note 1:** The shaded region indicates the permissible combinations of voltage and frequency.

**2:** The maximum rated speed of the part limits the permissible combinations of voltage and frequency. Please reference the Product Identification System section for the maximum rated speed of the parts.

## 17.1 DC Characteristics: PIC16C54C/C55A/C56A/C57C/C58B-04, 20 (Commercial, Industrial)
## PIC16LC54C/LC55A/LC56A/LC57C/LC58B-04 (Commercial, Industrial)
## PIC16CR54C/CR56A/CR57C/CR58B-04, 20 (Commercial, Industrial)
## PIC16LCR54C/LCR56A/LCR57C/LCR58B-04 (Commercial, Industrial)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PIC16LC5X**<br>**PIC16LCR5X**<br>(Commercial, Industrial) | | | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial | | | | |
| **PIC16C5X**<br>**PIC16CR5X**<br>(Commercial, Industrial) | | | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial | | | | |
| **Param No.** | **Symbol** | **Characteristic/Device** | **Min** | **Typ†** | **Max** | **Units** | **Conditions** |
| | IDD | **Supply Current(2,3)** | | | | | |
| D010 | | PIC16LC5X | — | 0.5 | 2.4 | mA | FOSC = 4.0 MHz, VDD = 5.5V, XT and RC modes |
| | | | — | 11 | 27 | µA | FOSC = 32 kHz, VDD = 2.5V, LP mode, Commercial |
| | | | — | 14 | 35 | µA | FOSC = 32 kHz, VDD = 2.5V, LP mode, Industrial |
| D010A | | PIC16C5X | — | 1.8 | 2.4 | mA | FOSC = 4 MHz, VDD = 5.5V, XT and RC modes |
| | | | — | 2.6 | 3.6* | mA | |
| | | | — | 4.5 | 16 | mA | FOSC = 10 MHz, VDD = 3.0V, HS mode |
| | | | — | 14 | 32 | µA | FOSC = 20 MHz, VDD = 5.5V, HS mode |
| | | | — | 17 | 40 | µA | FOSC = 32 kHz, VDD = 3.0V, LP mode, Commercial |
| | | | | | | | FOSC = 32 kHz, VDD = 3.0V, LP mode, Industrial |

Legend: Rows with standard voltage device data only are shaded for improved readability.

* 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 bus loading, oscillator type, bus rate, internal code execution pattern and temperature also have an impact on the current consumption.

a) 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 VSS, T0CKI = VDD, $\overline{MCLR}$ = VDD; WDT enabled/disabled as specified.

b) For standby current measurements, the conditions are the same, except that the device is in SLEEP mode. The power-down current in SLEEP mode does not depend on the oscillator type.

**3:** Does not include current through REXT. The current through the resistor can be estimated by the formula: IR = VDD/2REXT (mA) with REXT in kΩ.

## 17.4 Timing Parameter Symbology and Load Conditions

The timing parameter symbols have been created with one of the following formats:

1. TppS2ppS
2. TppS

| | |
|---|---|
| T | |
| F Frequency | T Time |

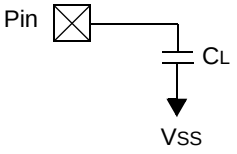
Lowercase letters (pp) and their meanings:

| | |
|---|---|
| pp | |
| 2 to | mc $\overline{\text{MCLR}}$ |
| ck CLKOUT | osc oscillator |
| cy cycle time | os OSC1 |
| drt device reset timer | t0 T0CKI |
| io I/O port | wdt watchdog timer |

Uppercase letters and their meanings:

| | |
|---|---|
| S | |
| F Fall | P Period |
| H High | R Rise |
| I Invalid (Hi-impedance) | V Valid |
| L Low | Z Hi-impedance |

**FIGURE 17-5: LOAD CONDITIONS FOR DEVICE TIMING SPECIFICATIONS - PIC16C54C/CR54C/C55A/C56A/CR56A/C57C/CR57C/C58B/CR58B-04, 20**




$C_L$ = 50 pF for all pins and OSC2 for RC mode

0 -15 pF for OSC2 in XT, HS or LP modes when external clock is used to drive OSC1

**FIGURE 18-8: VTH (INPUT THRESHOLD TRIP POINT VOLTAGE) OF I/O PINS vs. VDD**

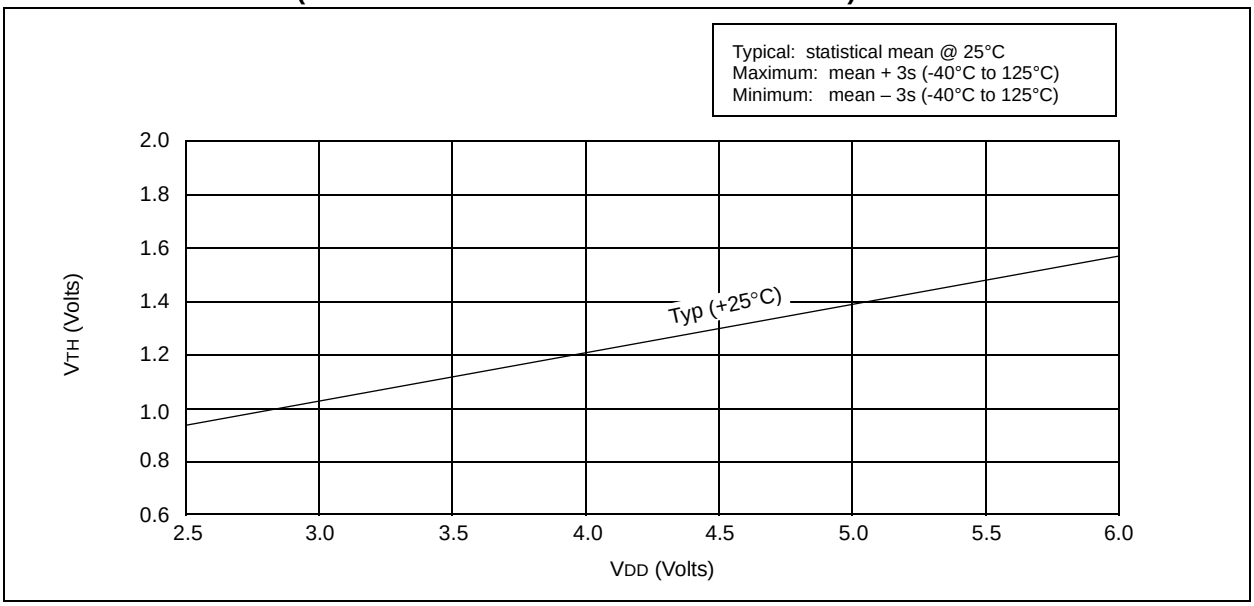
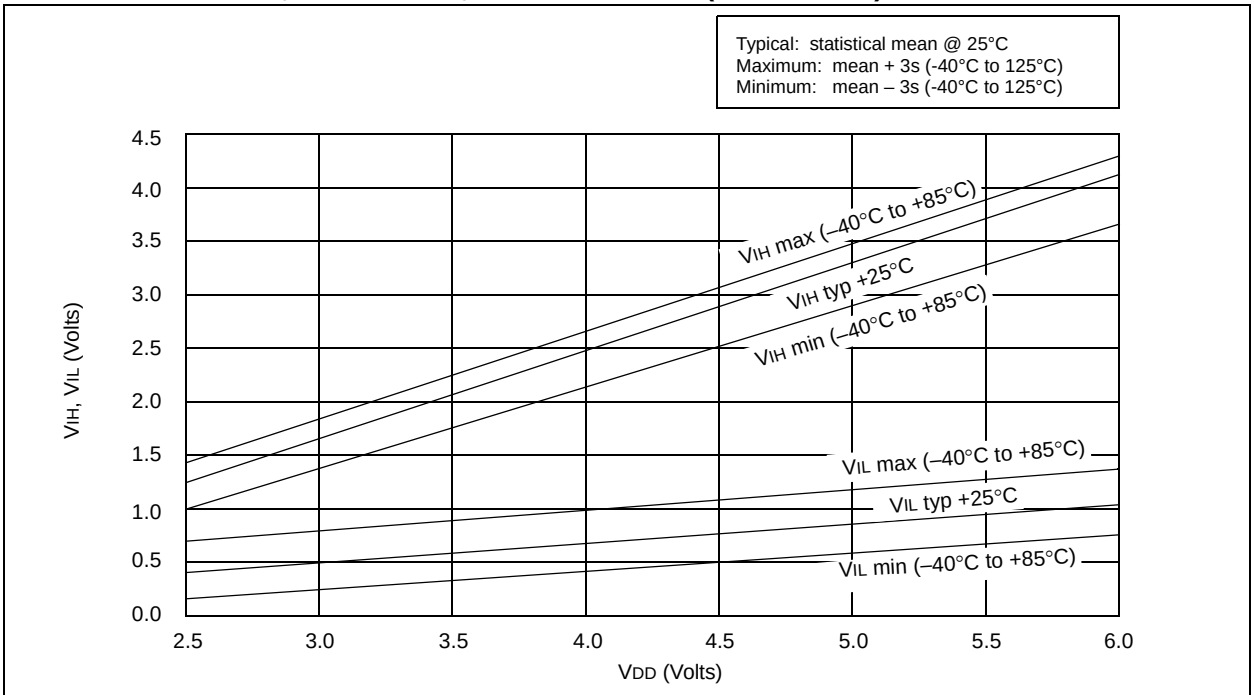



**FIGURE 18-9: VIH, VIL OF $\overline{\text{MCLR}}$, T0CKI AND OSC1 (IN RC MODE) vs. VDD**




**Note:** These input pins have Schmitt Trigger input buffers.

**FIGURE 18-18: PORTA, B AND C $I_{OL}$ vs. $V_{OL}$, $V_{DD}$ = 5 V**

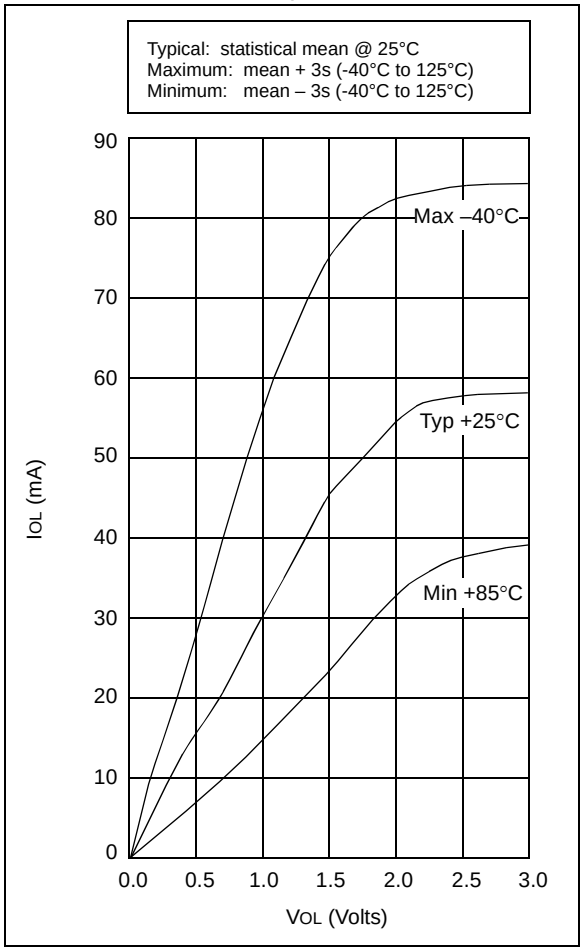


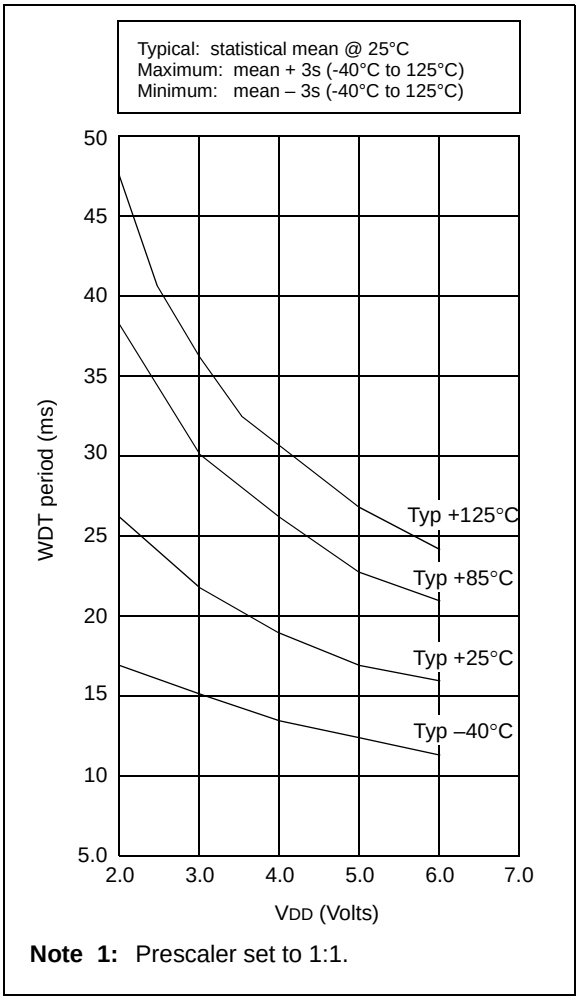

**TABLE 18-2: INPUT CAPACITANCE**

| Pin | Typical Capacitance (pF) | |
|---|---|---|
| | 18L PDIP | 18L SOIC |
| RA port | 5.0 | 4.3 |
| RB port | 5.0 | 4.3 |
| $\overline{MCLR}$ | 17.0 | 17.0 |
| OSC1 | 4.0 | 3.5 |
| OSC2/CLKOUT | 4.3 | 3.5 |
| T0CKI | 3.2 | 2.8 |

All capacitance values are typical at 25°C. A part-to-part variation of ±25% (three standard deviations) should be taken into account.

**FIGURE 20-7: WDT TIMER TIME-OUT PERIOD vs. $V_{DD}$(1)**




**Note 1:** Prescaler set to 1:1.

**FIGURE 20-8: $I_{OH}$ vs. $V_{OH}$, $V_{DD}$ = 5 V**

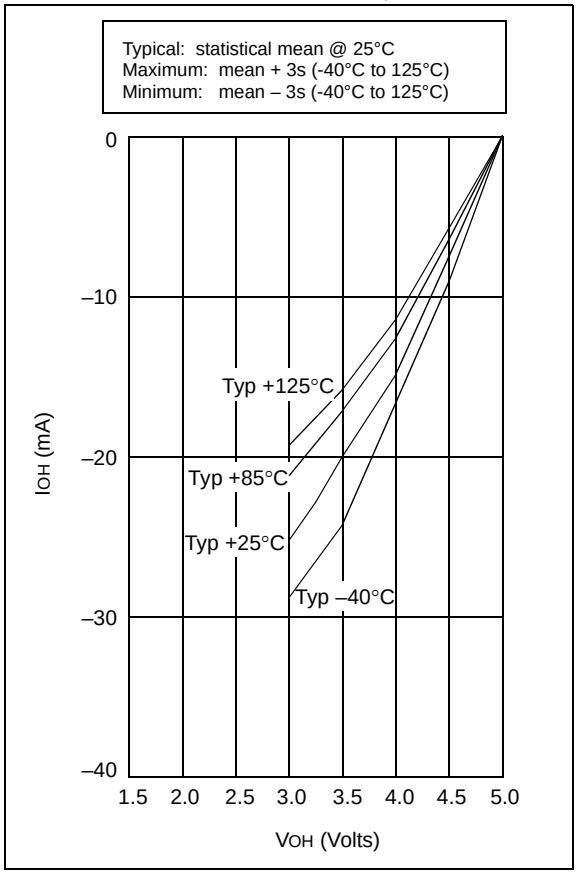


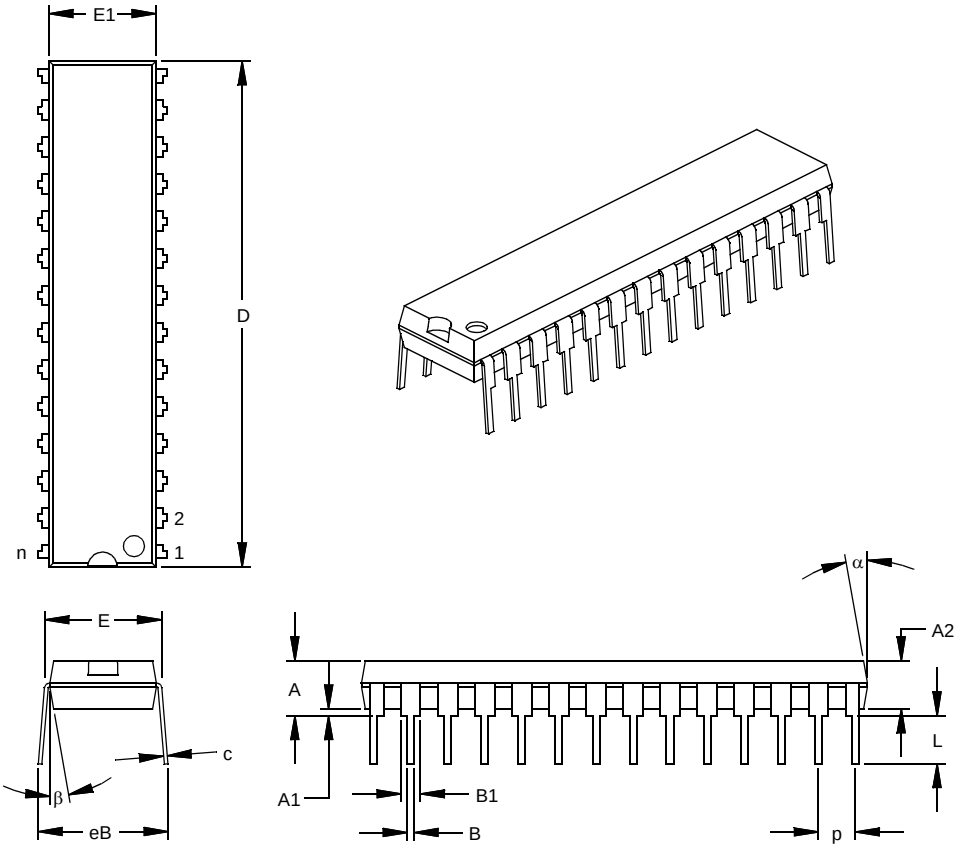

**TABLE 20-1: INPUT CAPACITANCE**

| Pin | Typical Capacitance (pF) | |
|---|---|---|
| | 18L PDIP | 18L SOIC |
| RA port | 5.0 | 4.3 |
| RB port | 5.0 | 4.3 |
| $\overline{MCLR}$ | 17.0 | 17.0 |
| OSC1 | 4.0 | 3.5 |
| OSC2/CLKOUT | 4.3 | 3.5 |
| T0CKI | 3.2 | 2.8 |

All capacitance values are typical at 25°C. A part-to-part variation of ±25% (three standard deviations) should be taken into account.

### 28-Lead Skinny Plastic Dual In-line (SP) – 300 mil (PDIP)

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



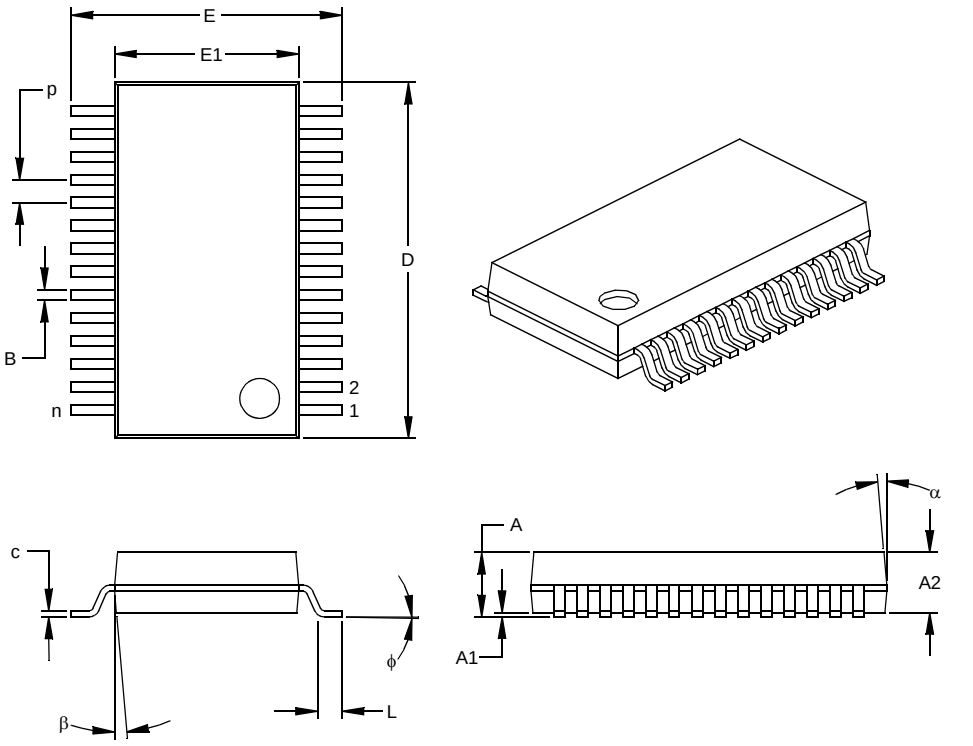

| Units | | INCHES* | | | MILLIMETERS | | |
|---|---|---|---|---|---|---|---|
| Dimension Limits | | MIN | NOM | MAX | MIN | NOM | MAX |
| Number of Pins | n | | 28 | | | 28 | |
| Pitch | p | | .100 | | | 2.54 | |
| Top to Seating Plane | A | .140 | .150 | .160 | 3.56 | 3.81 | 4.06 |
| Molded Package Thickness | A2 | .125 | .130 | .135 | 3.18 | 3.30 | 3.43 |
| Base to Seating Plane | A1 | .015 | | | 0.38 | | |
| Shoulder to Shoulder Width | E | .300 | .310 | .325 | 7.62 | 7.87 | 8.26 |
| Molded Package Width | E1 | .275 | .285 | .295 | 6.99 | 7.24 | 7.49 |
| Overall Length | D | 1.345 | 1.365 | 1.385 | 34.16 | 34.67 | 35.18 |
| Tip to Seating Plane | L | .125 | .130 | .135 | 3.18 | 3.30 | 3.43 |
| Lead Thickness | c | .008 | .012 | .015 | 0.20 | 0.29 | 0.38 |
| Upper Lead Width | B1 | .040 | .053 | .065 | 1.02 | 1.33 | 1.65 |
| Lower Lead Width | B | .016 | .019 | .022 | 0.41 | 0.48 | 0.56 |
| Overall Row Spacing § | eB | .320 | .350 | .430 | 8.13 | 8.89 | 10.92 |
| 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:
Dimension D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010” (0.254mm) per side.
JEDEC Equivalent: MO-095
Drawing No. C04-070

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

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




| Units | | INCHES | | | MILLIMETERS* | | |
|---|---|---|---|---|---|---|---|
| Dimension Limits | | MIN | NOM | MAX | MIN | NOM | MAX |
| Number of Pins | n | | 28 | | | 28 | |
| Pitch | p | | .026 | | | 0.65 | |
| Overall Height | A | .068 | .073 | .078 | 1.73 | 1.85 | 1.98 |
| Molded Package Thickness | A2 | .064 | .068 | .072 | 1.63 | 1.73 | 1.83 |
| Standoff § | A1 | .002 | .006 | .010 | 0.05 | 0.15 | 0.25 |
| Overall Width | E | .299 | .309 | .319 | 7.59 | 7.85 | 8.10 |
| Molded Package Width | E1 | .201 | .207 | .212 | 5.11 | 5.25 | 5.38 |
| Overall Length | D | .396 | .402 | .407 | 10.06 | 10.20 | 10.34 |
| Foot Length | L | .022 | .030 | .037 | 0.56 | 0.75 | 0.94 |
| Lead Thickness | c | .004 | .007 | .010 | 0.10 | 0.18 | 0.25 |
| Foot Angle | ϕ | 0 | 4 | 8 | 0.00 | 101.60 | 203.20 |
| Lead Width | B | .010 | .013 | .015 | 0.25 | 0.32 | 0.38 |
| Mold Draft Angle Top | α | 0 | 5 | 10 | 0 | 5 | 10 |
| Mold Draft Angle Bottom | β | 0 | 5 | 10 | 0 | 5 | 10 |

* Controlling Parameter
§ Significant Characteristic

Notes:
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010” (0.254mm) per side.
JEDEC Equivalent: MS-150
Drawing No. C04-073

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