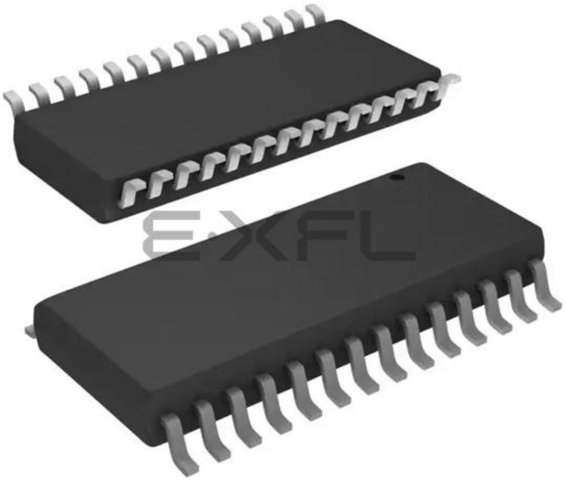


**Welcome to E-XFL.COM**

## 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 | 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 | 25 x 8 |
| Voltage - Supply (Vcc/Vdd) | 2.5V ~ 5.5V |
| Data Converters | - |
| Oscillator Type | External |
| Operating Temperature | 0°C ~ 70°C (TA) |
| Mounting Type | Surface Mount |
| Package / Case | 28-SOIC (0.295", 7.50mm Width) |
| Supplier Device Package | 28-SOIC |
| Purchase URL | https://www.e-xfl.com/product-detail/microchip-technology/pic16lc55a-04-so |

## Table of Contents

## TO OUR VALUED CUSTOMERS

It is our intention to provide our valued customers with the best documentation possible to ensure successful use of your Microchip products. To this end, we will continue to improve our publications to better suit your needs. Our publications will be refined and enhanced as new volumes and updates are introduced.

If you have any questions or comments regarding this publication, please contact the Marketing Communications Department via E-mail at **docerrors@mail.microchip.com** or fax the **Reader Response Form** in the back of this data sheet to (480) 792-4150. We welcome your feedback.

### Most Current Data Sheet

To obtain the most up-to-date version of this data sheet, please register at our Worldwide Web site at:

http://www.microchip.com

You can determine the version of a data sheet by examining its literature number found on the bottom outside corner of any page. The last character of the literature number is the version number, (e.g., DS30000A is version A of document DS30000).

### Errata

An errata sheet, describing minor operational differences from the data sheet and recommended workarounds, may exist for current devices. As device/documentation issues become known to us, we will publish an errata sheet. The errata will specify the revision of silicon and revision of document to which it applies.

To determine if an errata sheet exists for a particular device, please check with one of the following:

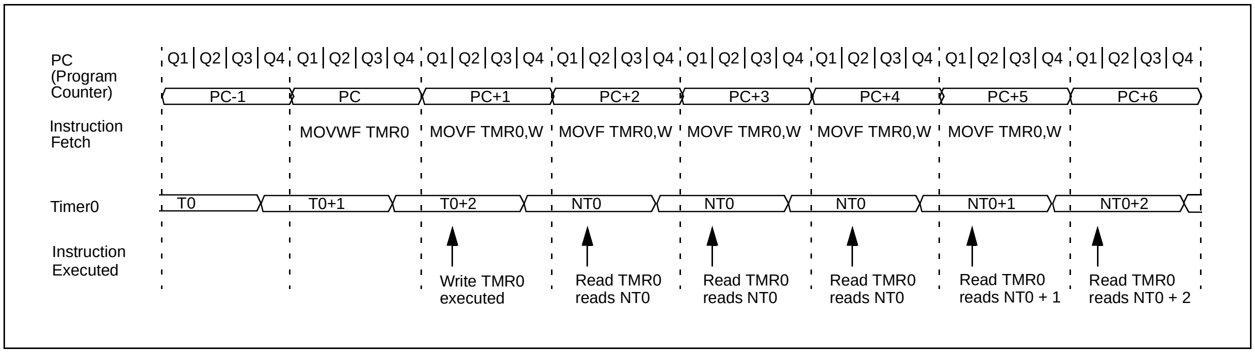
- Microchip's Worldwide Web site; http://www.microchip.com
- Your local Microchip sales office (see last page)
- The Microchip Corporate Literature Center; U.S. FAX: (480) 792-7277

When contacting a sales office or the literature center, please specify which device, revision of silicon and data sheet (include literature number) you are using.

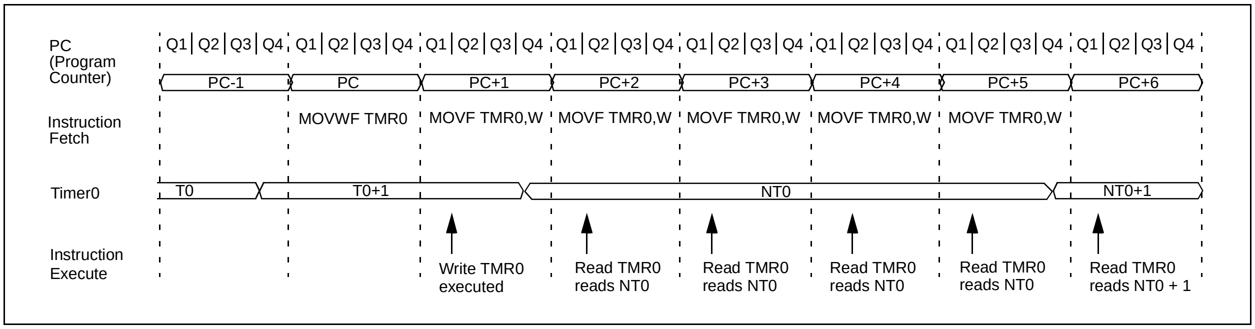
### Customer Notification System

Register on our web site at **www.microchip.com/cn** to receive the most current information on all of our products.

### FIGURE 8-3: TIMER0 TIMING: INTERNAL CLOCK/NO PRESCALER



### FIGURE 8-4: TIMER0 TIMING: INTERNAL CLOCK/PRESCALER 1:2

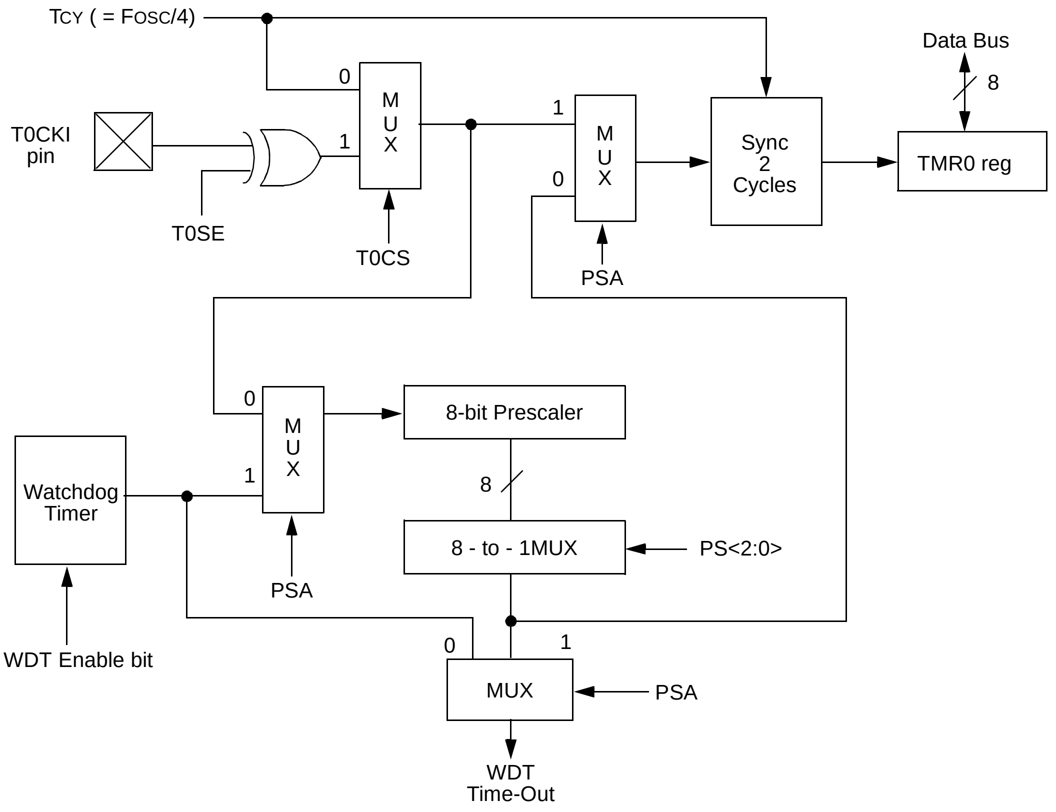


### TABLE 8-1: REGISTERS ASSOCIATED WITH TIMER0

| 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 MCLR and WDT Reset |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01h | TMR0 | Timer0 - 8-bit real-time clock/counter | | | | | | | | `xxxx xxxx` | `uuuu uuuu` |
| N/A | OPTION | — | — | T0CS | T0SE | PSA | PS2 | PS1 | PS0 | `--11 1111` | `--11 1111` |

Legend: `x` = unknown, `u` = unchanged, `-` = unimplemented. Shaded cells not used by Timer0.

FIGURE 8-6: BLOCK DIAGRAM OF THE TIMER0/WDT PRESCALER



**Note:** T0CS, T0SE, PSA, PS<2:0> are bits in the OPTION register.

## 9.0 SPECIAL FEATURES OF THE CPU

What sets a microcontroller apart from other processors are special circuits that deal with the needs of real-time applications. The PIC16C5X family of microcontrollers have a host of such features intended to maximize system reliability, minimize cost through elimination of external components, provide power saving operating modes and offer code protection. These features are:

- Oscillator Selection (Section 4.0)
- RESET (Section 5.0)
- Power-On Reset (Section 5.1)
- Device Reset Timer (Section 5.2)
- Watchdog Timer (WDT) (Section 9.2)
- SLEEP (Section 9.3)
- Code protection (Section 9.4)
- ID locations (Section 9.5)

The PIC16C5X Family has a Watchdog Timer which can be shut off only through configuration bit WDTE. It runs off of its own RC oscillator for added reliability. There is an 18 ms delay provided by the Device Reset Timer (DRT), intended to keep the chip in RESET until the crystal oscillator is stable. With this timer on-chip, most applications need no external RESET circuitry.

The SLEEP mode is designed to offer a very low current Power-down mode. The user can wake up from SLEEP through external RESET or through a Watchdog Timer time-out. Several oscillator options are also made available to allow the part to fit the application. The RC oscillator option saves system cost while the LP crystal option saves power. A set of configuration bits are used to select various options.

| **XORLW** | **Exclusive OR literal with W** |
|---|---|
| Syntax: | [*label*] XORLW k |
| Operands: | $0 \le k \le 255$ |
| Operation: | (W) .XOR. k → (W) |
| Status Affected: | Z |
| Encoding: | `1111` `kkkk` `kkkk` |
| Description: | The contents of the W register are XOR'ed with the eight bit literal 'k'. The result is placed in the W register. |
| Words: | 1 |
| Cycles: | 1 |
| Example: | `XORLW` 0xAF |

Before Instruction
W = 0xB5
After Instruction
W = 0x1A

| **XORWF** | **Exclusive OR W with f** |
|---|---|
| Syntax: | [ *label* ] XORWF f,d |
| Operands: | $0 \le f \le 31$<br>$d \in [0,1]$ |
| Operation: | (W) .XOR. (f) → (dest) |
| Status Affected: | Z |
| Encoding: | `0001` `10df` `ffff` |
| Description: | Exclusive OR the contents of the W register with register 'f'. If 'd' is 0 the result is stored in the W register. If 'd' is 1 the result is stored back in register 'f'. |
| Words: | 1 |
| Cycles: | 1 |
| Example | `XORWF REG,1` |

Before Instruction
REG = 0xAF
W = 0xB5
After Instruction
REG = 0x1A
W = 0xB5

## 11.4 MPLINK Object Linker/ MPLIB Object Librarian

The MPLINK object linker combines relocatable objects created by the MPASM assembler and the MPLAB C17 and MPLAB C18 C compilers. It can also link relocatable objects from pre-compiled libraries, using directives from a linker script.

The MPLIB object librarian is a librarian for pre-compiled code to be used with the MPLINK object linker. When a routine from a library is called from another source file, only the modules that contain that routine will be linked in with the application. This allows large libraries to be used efficiently in many different applications. The MPLIB object librarian manages the creation and modification of library files.

The MPLINK object linker features include:

- Integration with MPASM assembler and MPLAB C17 and MPLAB C18 C compilers.
- Allows all memory areas to be defined as sections to provide link-time flexibility.

The MPLIB object librarian features include:

- Easier linking because single libraries can be included instead of many smaller files.
- Helps keep code maintainable by grouping related modules together.
- Allows libraries to be created and modules to be added, listed, replaced, deleted or extracted.

## 11.5 MPLAB SIM Software Simulator

The MPLAB SIM software simulator allows code development in a PC-hosted environment by simulating the PIC series microcontrollers on an instruction level. On any given instruction, the data areas can be examined or modified and stimuli can be applied from a file, or user-defined key press, to any of the pins. The execution can be performed in single step, execute until break, or trace mode.

The MPLAB SIM simulator fully supports symbolic debugging using the MPLAB C17 and the MPLAB C18 C compilers and the MPASM assembler. The software simulator offers the flexibility to develop and debug code outside of the laboratory environment, making it an excellent multi-project software development tool.

## 11.6 MPLAB ICE High Performance Universal In-Circuit Emulator with MPLAB IDE

The MPLAB ICE universal in-circuit emulator is intended to provide the product development engineer with a complete microcontroller design tool set for PIC microcontrollers (MCUs). Software control of the MPLAB ICE in-circuit emulator is provided by the MPLAB Integrated Development Environment (IDE), which allows editing, building, downloading and source debugging from a single environment.

The MPLAB ICE 2000 is a full-featured emulator system with enhanced trace, trigger and data monitoring features. Interchangeable processor modules allow the system to be easily reconfigured for emulation of different processors. The universal architecture of the MPLAB ICE in-circuit emulator allows expansion to support new PIC microcontrollers.

The MPLAB ICE in-circuit emulator system has been designed as a real-time emulation system, with advanced features that are generally found on more expensive development tools. The PC platform and Microsoft® Windows environment were chosen to best make these features available to you, the end user.

## 11.7 ICEPIC In-Circuit Emulator

The ICEPIC low cost, in-circuit emulator is a solution for the Microchip Technology PIC16C5X, PIC16C6X, PIC16C7X and PIC16CXXX families of 8-bit One-Time-Programmable (OTP) microcontrollers. The modular system can support different subsets of PIC16C5X or PIC16CXXX products through the use of interchangeable personality modules, or daughter boards. The emulator is capable of emulating without target application circuitry being present.

## 12.0 ELECTRICAL CHARACTERISTICS - PIC16C54A

**Absolute Maximum Ratings(†)**

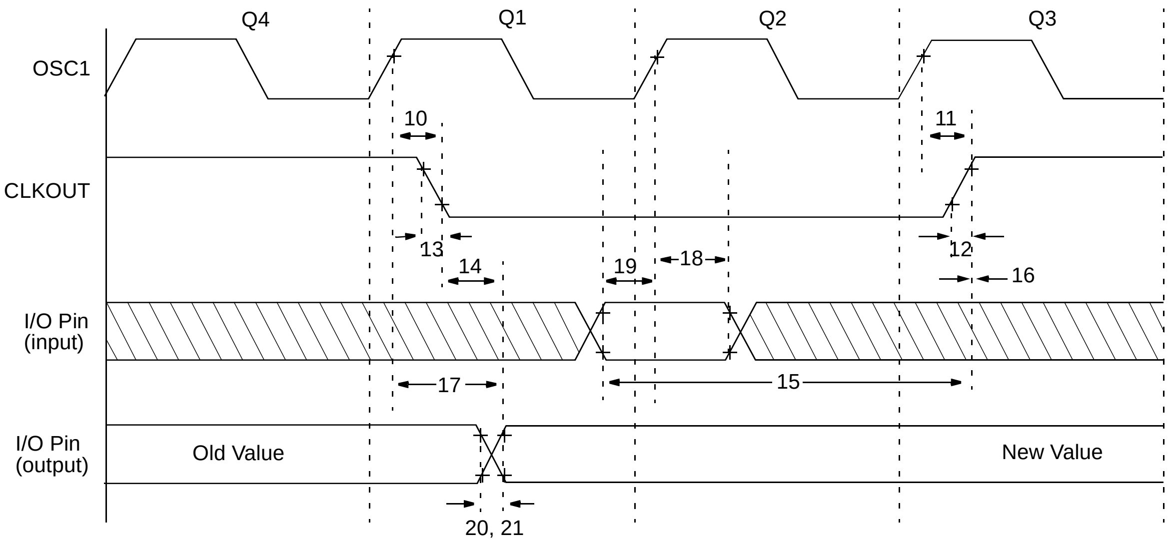
| | |
|---|---|
| Ambient Temperature under bias | –55°C to +125°C |
| Storage Temperature | –65°C to +150°C |
| Voltage on $V_{DD}$ with respect to $V_{SS}$ | 0V to +7.5V |
| Voltage on $\overline{\text{MCLR}}$ with respect to $V_{SS}$(1) | 0V to +14V |
| Voltage on all other pins with respect to $V_{SS}$ | –0.6V to ($V_{DD}$ + 0.6V) |
| Total power dissipation(2) | 800 mW |
| Max. current out of $V_{SS}$ pin | 150 mA |
| Max. current into $V_{DD}$ pin | 100 mA |
| Max. current into an input pin (T0CKI only) | ±500 μA |
| 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 | 20 mA |
| Max. output current sourced by a single I/O port (PORTA, B or C) | 40 mA |
| Max. output current sunk by a single I/O port (PORTA, B or C) | 50 mA |

**Note 1:** Voltage spikes below $V_{SS}$ at the $\overline{\text{MCLR}}$ pin, inducing currents greater than 80 mA, may cause latch-up. Thus, a series resistor of 50 to 100 Ω should be used when applying a “low” level to the $\overline{\text{MCLR}}$ pin rather than pulling this pin directly to $V_{SS}$.

**2:** 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 “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.

**FIGURE 12-3: CLKOUT AND I/O TIMING - PIC16C54/55/56/57**



**Note:** Please refer to Figure 12-1 for load conditions.

**TABLE 12-2: CLKOUT AND I/O TIMING REQUIREMENTS - PIC16C54/55/56/57**

| **AC Characteristics** | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ $T_A$ ≤ +70°C for commercial<br>–40°C ≤ $T_A$ ≤ +85°C for industrial<br>–40°C ≤ $T_A$ ≤ +125°C for extended | | | | | |
|---|---|---|---|---|---|---|
| **Param No.** | **Symbol** | **Characteristic** | **Min** | **Typ†** | **Max** | **Units** |
| 10 | TosH2ckL | OSC1↑ to CLKOUT↓(1) | — | 15 | 30** | ns |
| 11 | TosH2ckH | OSC1↑ to CLKOUT↑(1) | — | 15 | 30** | ns |
| 12 | TckR | CLKOUT rise time(1) | — | 5.0 | 15** | ns |
| 13 | TckF | CLKOUT fall time(1) | — | 5.0 | 15** | ns |
| 14 | TckL2ioV | CLKOUT↓ to Port out valid(1) | — | — | 40** | ns |
| 15 | TioV2ckH | Port in valid before CLKOUT↑(1) | 0.25 TCY+30* | — | — | ns |
| 16 | TckH2ioI | Port in hold after CLKOUT↑(1) | 0* | — | — | ns |
| 17 | TosH2ioV | OSC1↑ (Q1 cycle) to Port out valid(2) | — | — | 100* | ns |
| 18 | TosH2ioI | OSC1↑ (Q2 cycle) to Port input invalid (I/O in hold time) | TBD | — | — | ns |
| 19 | TioV2osH | Port input valid to OSC1↑ (I/O in setup time) | TBD | — | — | ns |
| 20 | TioR | Port output rise time(2) | — | 10 | 25** | ns |
| 21 | TioF | Port output fall time(2) | — | 10 | 25** | ns |

* These parameters are characterized but not tested.

** These parameters are design targets and are not tested. No characterization data available at this time.

† 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:** Measurements are taken in RC Mode where CLKOUT output is 4 x Tosc.

**2:** Please refer to Figure 12-1 for load conditions.

## 13.2 DC Characteristics: PIC16CR54A-04E, 10E, 20E (Extended)

| **PIC16CR54A-04E, 10E, 20E**<br>(Extended) | | | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature –40°C ≤ TA ≤ +125°C for extended | | | | |
|---|---|---|---|---|---|---|---|
| **Param No.** | **Symbol** | **Characteristic** | **Min** | **Typ†** | **Max** | **Units** | **Conditions** |
| D001 | VDD | **Supply Voltage**<br>RC, XT and LP modes<br>HS mode | <br>3.25<br>4.5 | <br>—<br>— | <br>6.0<br>5.5 | <br>V<br>V | |
| D002 | VDR | **RAM Data Retention Voltage**(1) | — | 1.5* | — | V | Device in SLEEP mode |
| D003 | VPOR | **VDD Start Voltage** to ensure Power-on Reset | — | VSS | — | V | See Section 5.1 for details on Power-on Reset |
| D004 | SVDD | **VDD Rise Rate** to ensure Power-on Reset | 0.05* | — | — | V/ms | See Section 5.1 for details on Power-on Reset |
| D010 | IDD | **Supply Current**(2)<br>RC(3) and XT modes<br>HS mode<br>HS mode | <br>—<br>—<br>— | <br>1.8<br>4.8<br>9.0 | <br>3.3<br>10<br>20 | <br>mA<br>mA<br>mA | <br>FOSC = 4.0 MHz, VDD = 5.5V<br>FOSC = 10 MHz, VDD = 5.5V<br>FOSC = 16 MHz, VDD = 5.5V |
| D020 | IPD | **Power-down Current**(2) | —<br>— | 5.0<br>0.8 | 22<br>18 | μA<br>μA | VDD = 3.25V, WDT enabled<br>VDD = 3.25V, WDT disabled |

* These parameters are characterized but not tested.

† 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.

**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, $\overline{\text{MCLR}}$ = 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.

## 14.0 DEVICE CHARACTERIZATION - PIC16C54A

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 σ is a standard deviation, over the whole temperature range.

**FIGURE 14-1: TYPICAL RC OSCILLATOR FREQUENCY vs. TEMPERATURE**

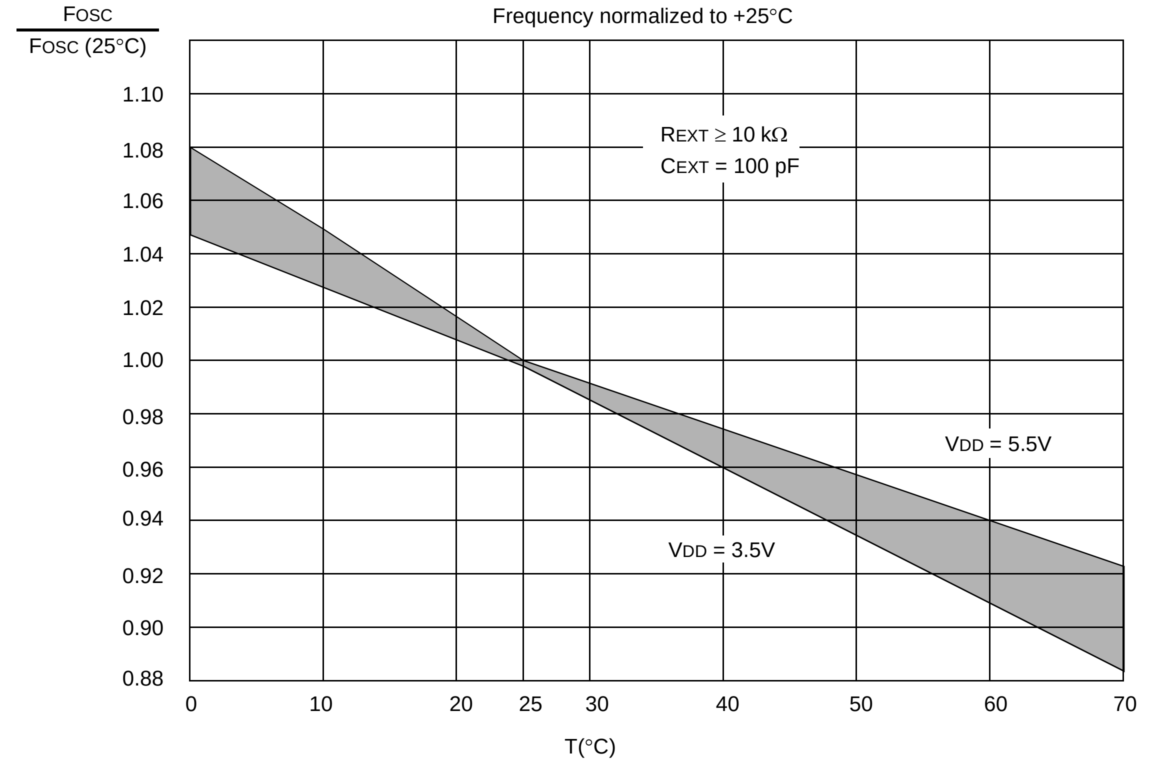


**TABLE 14-1: RC OSCILLATOR FREQUENCIES**

| CEXT | REXT | Average<br>FOSC @ 5 V, 25°C | |
|---|---|---|---|
| 20 pF | 3.3K | 5 MHz | ± 27% |
| | 5K | 3.8 MHz | ± 21% |
| | 10K | 2.2 MHz | ± 21% |
| | 100K | 262 kHz | ± 31% |
| 100 pF | 3.3K | 1.6 MHz | ± 13% |
| | 5K | 1.2 MHz | ± 13% |
| | 10K | 684 kHz | ± 18% |
| | 100K | 71 kHz | ± 25% |
| 300 pF | 3.3K | 660 kHz | ± 10% |
| | 5.0K | 484 kHz | ± 14% |
| | 10K | 267 kHz | ± 15% |
| | 100K | 29 kHz | ± 19% |

The frequencies are measured on DIP packages.

The percentage variation indicated here is part-to-part variation due to normal process distribution. The variation indicated is ±3 standard deviations from the average value for VDD = 5V.

## 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, $\overline{\text{MCLR}}$ = 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.

## 15.3 DC Characteristics: PIC16LV54A-02 (Commercial) PIC16LV54A-02I (Industrial)

| **PIC16LV54A-02**<br>**PIC16LV54A-02I**<br>**(**Commercial, Industrial) | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–20°C ≤ TA ≤ +85°C for industrial |
|---|---|

| Param No. | Symbol | Characteristic | Min | Typ† | Max | Units | Conditions |
|---|---|---|---|---|---|---|---|
| D001 | VDD | **Supply Voltage**<br>RC and XT modes | 2.0 | — | 3.8 | V | |
| D002 | VDR | **RAM Data Retention Voltage**[(1)] | — | 1.5* | — | V | Device in SLEEP mode |
| D003 | VPOR | **VDD Start Voltage** to ensure Power-on Reset | — | Vss | — | V | See Section 5.1 for details on Power-on Reset |
| D004 | SVDD | **VDD Rise Rate** to ensure Power-on Reset | 0.05* | — | — | V/ms | See Section 5.1 for details on Power-on Reset |
| D010 | IDD | **Supply Current**[(2)] | | | | | |
| | | RC[(3)] and XT modes | — | 0.5 | — | mA | FOSC = 2.0 MHz, VDD = 3.0V |
| | | LP mode, Commercial | — | 11 | 27 | µA | FOSC = 32 kHz, VDD = 2.5V WDT disabled |
| | | LP mode, Industrial | — | 14 | 35 | µA | FOSC = 32 kHz, VDD = 2.5V WDT disabled |
| D020 | IPD | **Power-down Current**[(2,4)] | | | | | |
| | | Commercial | — | 2.5 | 12 | µA | VDD = 2.5V, WDT enabled |
| | | Commercial | — | 0.25 | 4.0 | µA | VDD = 2.5V, WDT disabled |
| | | Industrial | — | 3.5 | 14 | µA | VDD = 2.5V, WDT enabled |
| | | Industrial | — | 0.3 | 5.0 | µA | VDD = 2.5V, WDT disabled |

* These parameters are characterized but not tested.

† 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.

**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, $\overline{\text{MCLR}}$ = 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.

**4:** The oscillator start-up time can be as much as 8 seconds for XT and LP oscillator selection on wake-up from SLEEP mode or during initial power-up.

**FIGURE 16-14: TYPICAL IDD vs. FREQUENCY (WDT DISABLED, RC MODE @ 300 pF, 25°C)**

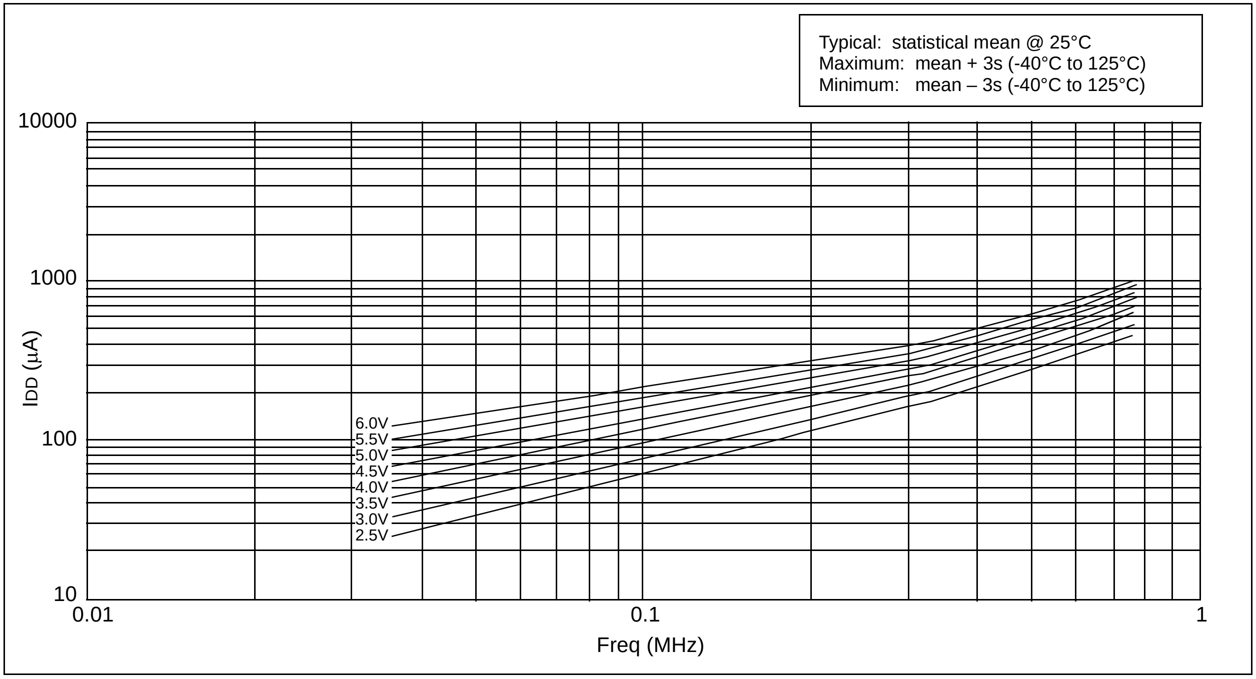


**FIGURE 16-15: MAXIMUM IDD vs. FREQUENCY (WDT DISABLED, RC MODE @ 300 pF, –40°C to +85°C)**

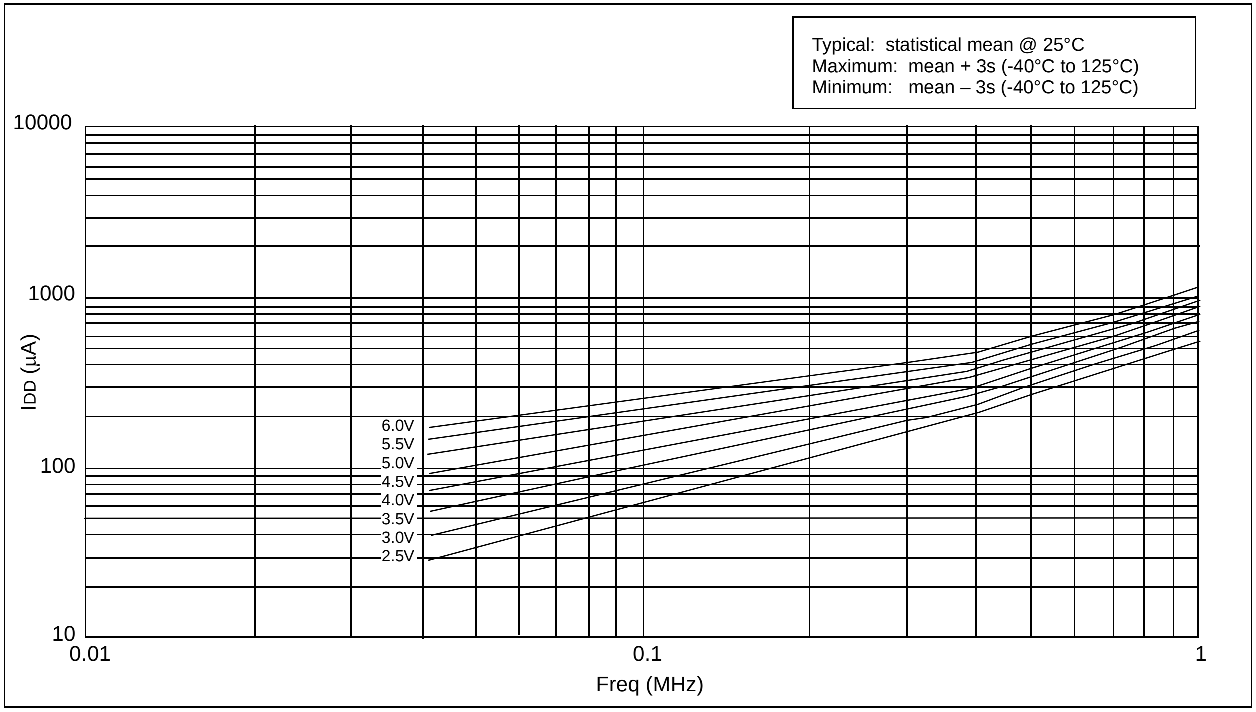
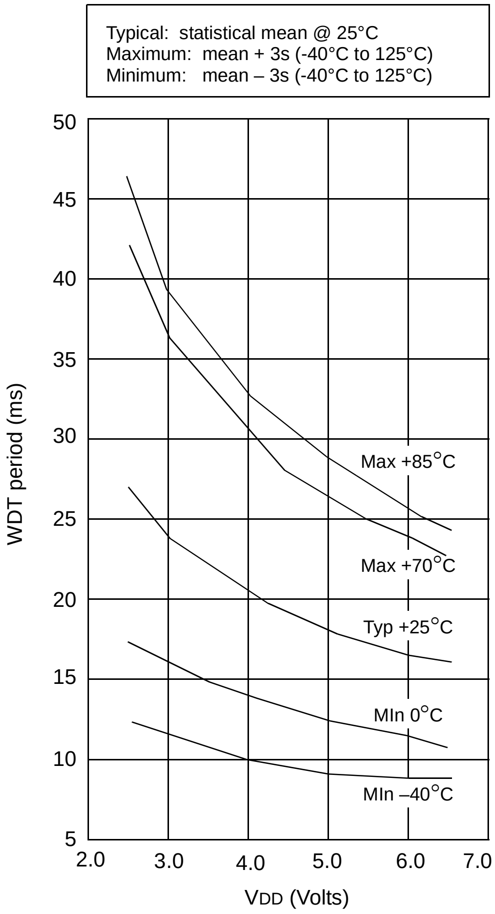
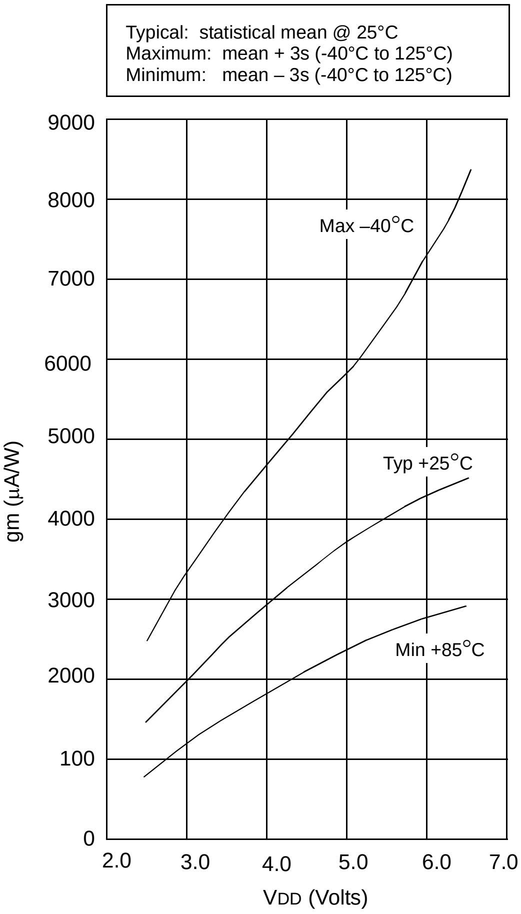


**FIGURE 16-16: WDT TIMER TIME-OUT PERIOD vs. VDD(1)**

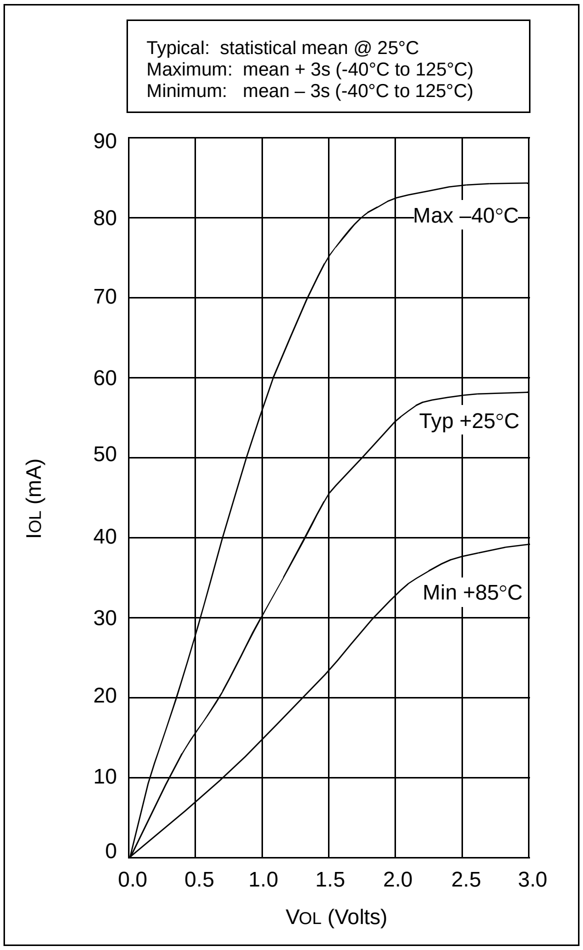


**Note 1:** Prescaler set to 1:1.

**FIGURE 16-17: TRANSCONDUCTANCE (gm) OF HS OSCILLATOR vs. VDD**



### FIGURE 18-18: PORTA, B AND C IOL vs. VOL, VDD = 5 V

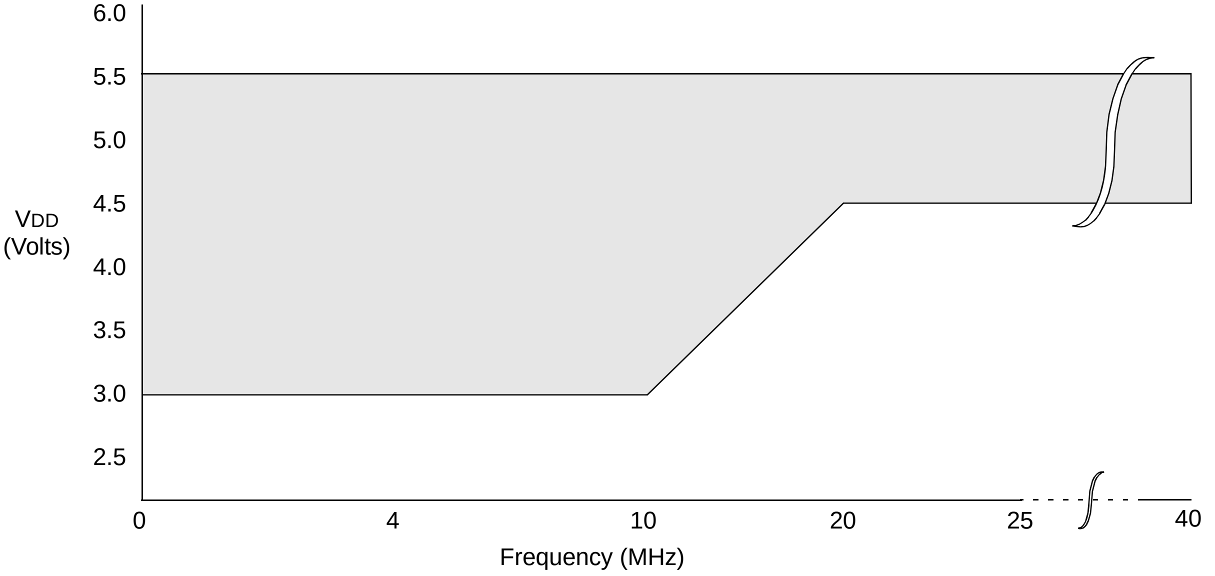


### TABLE 18-2: INPUT CAPACITANCE

| Pin | Typical Capacitance (pF) | |
|---|---|---|
| | 18L PDIP | 18L SOIC |
| RA port | 5.0 | 4.3 |
| RB port | 5.0 | 4.3 |
| $\overline{\text{MCLR}}$ | 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 19-1: PIC16C54C/C55A/C56A/C57C/C58B-40 VOLTAGE-FREQUENCY GRAPH, $0°C \leq T_A \leq +70°C$**



**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.

**3:** Operation between 20 to 40 MHz requires the following:

- VDD between 4.5V. and 5.5V
- OSC1 externally driven
- OSC2 not connected
- HS mode
- Commercial temperatures

Devices qualified for 40 MHz operation have -40 designation (ex: PIC16C54C-40/P).

**4:** For operation between DC and 20 MHz, see Section 17.1.

## 19.1 DC Characteristics:PIC16C54C/C55A/C56A/C57C/C58B-40 (Commercial)(1)

| **PIC16C54C/C55A/C56A/C57C/C58B-40**<br>(Commercial) | | | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial | | | | |
|---|---|---|---|---|---|---|---|
| **Param No.** | **Symbol** | **Characteristic** | **Min** | **Typ†** | **Max** | **Units** | **Conditions** |
| D001 | VDD | **Supply Voltage** | 4.5 | — | 5.5 | V | HS mode from 20 - 40 MHz |
| 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 5.1 for details on Power-on Reset |
| D004 | SVDD | **VDD Rise Rate** to ensure Power-on Reset | 0.05* | — | — | V/ms | See Section 5.1 for details on Power-on Reset |
| D010 | IDD | **Supply Current(3)** | —<br>— | 5.2<br>6.8 | 12.3<br>16 | mA<br>mA | FOSC = 40 MHz, VDD = 4.5V, HS mode<br>FOSC = 40 MHz, VDD = 5.5V, HS mode |
| D020 | IPD | **Power-down Current(3)** | —<br>— | 1.8<br>9.8 | 7.0<br>27* | μA<br>μA | VDD = 5.5V, WDT disabled, Commercial<br>VDD = 5.5V, WDT enabled, Commercial |

* These parameters are characterized but not tested.

† 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.

**Note 1:** Device operation between 20 MHz to 40 MHz requires the following: VDD between 4.5V to 5.5V, OSC1 pin externally driven, OSC2 pin not connected, HS oscillator mode and commercial temperatures. For operation between DC and 20 MHz, See Section 19.1.

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

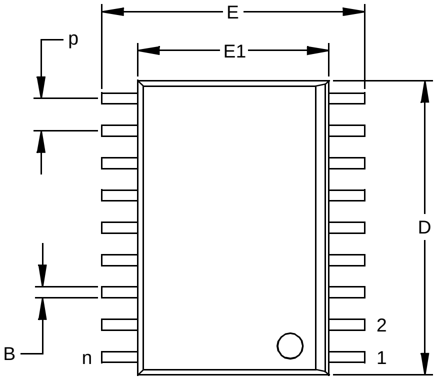
**3:** The supply current is mainly a function of the operating voltage and frequency. Other factors such as bus loading, oscillator type, bus rate, internal code execution pattern and temperature also have an impact on the current consumption.

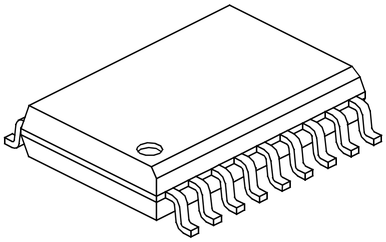
a) The test conditions for all IDD measurements in active Operation mode are: OSC1 = external square wave, from rail-to-rail; all I/O pins tristated, pulled to Vss, T0CKI = VDD, $\overline{\text{MCLR}}$ = VDD; WDT enabled/disabled as specified.

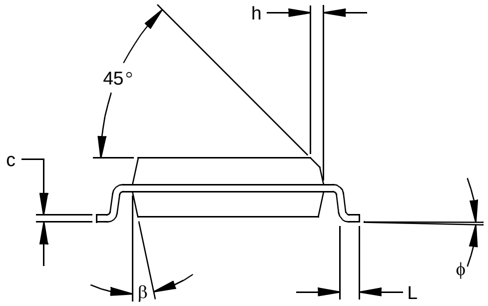
b) For standby current measurements, the conditions are the same, except that the device is in SLEEP mode. The power-down current in SLEEP mode does not depend on the oscillator type.

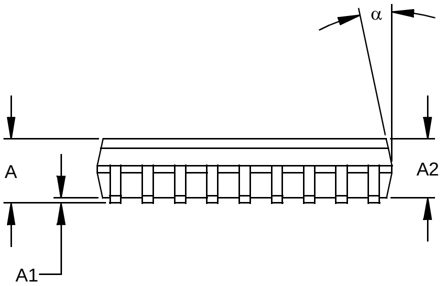
## 18-Lead Plastic Small Outline (SO) – Wide, 300 mil (SOIC)

**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 | | 18 | | | 18 | |
| Pitch | p | | .050 | | | 1.27 | |
| Overall Height | A | .093 | .099 | .104 | 2.36 | 2.50 | 2.64 |
| Molded Package Thickness | A2 | .088 | .091 | .094 | 2.24 | 2.31 | 2.39 |
| Standoff § | A1 | .004 | .008 | .012 | 0.10 | 0.20 | 0.30 |
| Overall Width | E | .394 | .407 | .420 | 10.01 | 10.34 | 10.67 |
| Molded Package Width | E1 | .291 | .295 | .299 | 7.39 | 7.49 | 7.59 |
| Overall Length | D | .446 | .454 | .462 | 11.33 | 11.53 | 11.73 |
| Chamfer Distance | h | .010 | .020 | .029 | 0.25 | 0.50 | 0.74 |
| Foot Length | L | .016 | .033 | .050 | 0.41 | 0.84 | 1.27 |
| Foot Angle | φ | 0 | 4 | 8 | 0 | 4 | 8 |
| Lead Thickness | c | .009 | .011 | .012 | 0.23 | 0.27 | 0.30 |
| Lead Width | B | .014 | .017 | .020 | 0.36 | 0.42 | 0.51 |
| Mold Draft Angle Top | α | 0 | 12 | 15 | 0 | 12 | 15 |
| Mold Draft Angle Bottom | β | 0 | 12 | 15 | 0 | 12 | 15 |

* 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-013
Drawing No. C04-051

## INDEX

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

| PART NO. | - | XX | X | /XX | XXX |
|---|---|---|---|---|---|
| Device | | Frequency Range/OSC Type | Temperature Range | Package | Pattern |

Device

| | |
|---|---|
| PIC16C54 | PIC16C54T(2) |
| PIC16C54A | PIC16C54AT(2) |
| PIC16CR54A | PIC16CR54AT(2) |
| PIC16C54C | PIC16C54CT(2) |
| PIC16CR54C | PIC16CR54CT(2) |
| PIC16C55 | PIC16C55T(2) |
| PIC16C55A | PIC16C55AT(2) |
| PIC16C56 | PIC16C56T(2) |
| PIC16C56A | PIC16C56AT(2) |
| PIC16CR56A | PIC16CR56AT(2) |
| PIC16C57 | PIC16C57T(2) |
| PIC16C57C | PIC16C57CT(2) |
| PIC16CR57C | PIC16CR57CT(2) |
| PIC16C58B | PIC16C58BT(2) |
| PIC16CR58B | PIC16CR58BT(2) |

Frequency Range/ Oscillator Type

| | |
|---|---|
| RC | Resistor Capacitor |
| LP | Low Power Crystal |
| XT | Standard Crystal/Resonator |
| HS | High Speed Crystal |
| 02 | 200 KHz (LP) or 2 MHz (XT and RC) |
| 04 | 200 KHz (LP) or 4 MHz (XT and RC) |
| 10 | 10 MHz (HS only) |
| 20 | 20 MHz (HS only) |
| 40 | 40 MHz (HS only) |
| b(4) | No oscillator type for JW packages(3) |

*RC/LP/XT/HS are for 16C54/55/56/57 devices only
-02 is available for 16LV54A only
-04/10/20 options are available for all other devices
-40 is available for 16C54C/55A/56A/57C/58B devices only

Temperature Range

b(4) = 0°C to +70°C
I = -40°C to +85°C
E = -40°C to +125°C

Package

S = Die in Waffle Pack
JW = 28-pin 600 mil/18-pin 300 mil windowed CERDIP(3)
P = 28-pin 600 mil/18-pin 300 mil PDIP
SO = 300 mil SOIC
SS = 209 mil SSOP
SP = 28-pin 300 mil Skinny PDIP

*See Section 21 for additional package information.

Pattern

QTP, SQTP, ROM code (factory specified) or Special Requirements. Blank for OTP and Windowed devices.

**Examples:**

a) PIC16C55A - 04/P 301 = Commercial Temp., PDIP package, 4 MHz, standard VDD limits, QTP pattern #301
b) PIC16LC54C - 04I/SO Industrial Temp., SOIC package, 200 kHz, extended VDD limits
c) PIC16C57 - RC/SP = RC Oscillator, commercial temp, skinny PDIP package, 4 MHz, standard VDD limits
d) PIC16C58BT -40/SS 123 = commercial temp, SSOP package in tape and reel, 4 MHz, extended VDD limits, ROM pattern #123

**Note 1:** C = normal voltage range
LC = extended
**2:** T = in tape and reel - SOIC and SSOP packages only
**3:** JW Devices are UV erasable and can be programmed to any device configuration. JW Devices meet the electrical requirements of each oscillator type, including LC devices.
**4:** b = Blank

## Sales and Support

**Data Sheets**
Products supported by a preliminary Data Sheet may have an errata sheet describing minor operational differences and recommended workarounds. To determine if an errata sheet exists for a particular device, please contact one of the following:

1. Your local Microchip sales office
2. The Microchip Worldwide Site (www.microchip.com)