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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	12
Program Memory Size	768B (512 x 12)
Program Memory Type	OTP
EEPROM Size	-
RAM Size	25 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	18-SOIC (0.295", 7.50mm Width)
Supplier Device Package	18-SOIC
Purchase URL	<a href="https://www.e-xfl.com/product-detail/microchip-technology/pic16c54t-xt-so">https://www.e-xfl.com/product-detail/microchip-technology/pic16c54t-xt-so</a>



# PIC16C5X

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## 8-Bit EPROM/ROM-Based CMOS Microcontrollers

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### 1.0 GENERAL DESCRIPTION

The PIC16C5X from Microchip Technology is a family of low cost, high performance, 8-bit fully static, EPROM/ROM-based CMOS microcontrollers. It employs 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 PIC16C5X delivers performance in an order of magnitude higher than its competitors in the same price category. The 12-bit wide instructions are highly symmetrical resulting in 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 PIC16C5X products are 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 the power saving LP (Low Power) oscillator and cost saving RC oscillator. Power saving SLEEP mode, Watchdog Timer and Code Protection features improve system cost, power and reliability.

The UV erasable Cerdip packaged versions are ideal for code development, while the cost effective One Time Programmable (OTP) versions are suitable for production in any volume. The customer can take full advantage of Microchip's price leadership in OTP microcontrollers, while benefiting from the OTP's flexibility.

The PIC16C5X products are 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 IBM® PC and compatible machines.

### 1.1 Applications

The PIC16C5X series fits perfectly in applications ranging from high speed automotive and appliance motor control to low power remote transmitters/receivers, pointing devices and telecom processors. The EPROM technology makes customizing application programs (transmitter codes, motor speeds, receiver frequencies, etc.) extremely fast and convenient. The small footprint packages, for through hole or surface mounting, make this microcontroller series perfect for applications with space limitations. Low cost, low power, high performance ease of use and I/O flexibility make the PIC16C5X series very versatile even in areas where no microcontroller use has been considered before (e.g., timer functions, replacement of "glue" logic in larger systems, co-processor applications).

# PIC16C5X

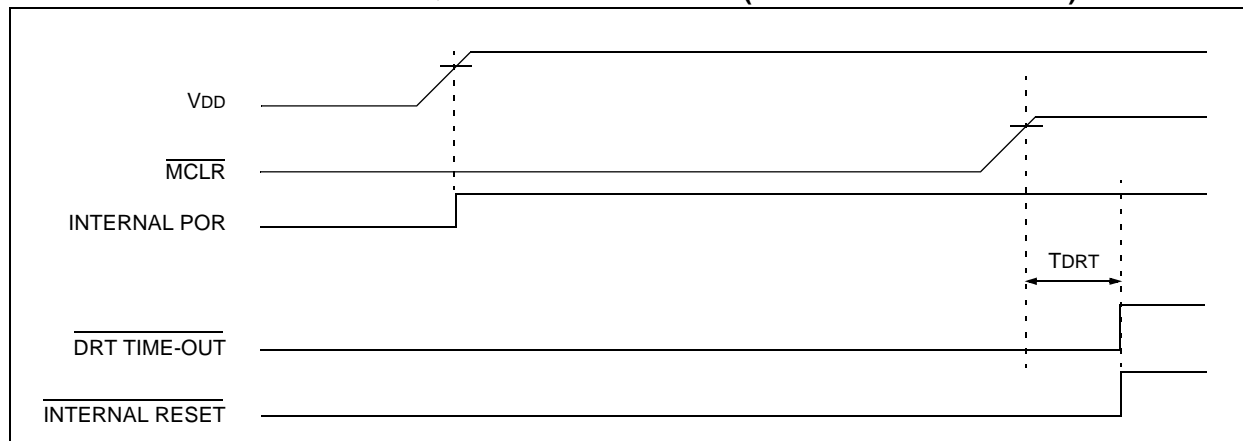
**TABLE 1-1: PIC16C5X FAMILY OF DEVICES**

Features	PIC16C54	PIC16CR54	PIC16C55	PIC16C56	PIC16CR56
Maximum Operation Frequency	40 MHz	20 MHz	40 MHz	40 MHz	20 MHz
EPROM Program Memory (x12 words)	512	—	512	1K	—
ROM Program Memory (x12 words)	—	512	—	—	1K
RAM Data Memory (bytes)	25	25	24	25	25
Timer Module(s)	TMR0	TMR0	TMR0	TMR0	TMR0
I/O Pins	12	12	20	12	12
Number of Instructions	33	33	33	33	33
Packages	18-pin DIP, SOIC; 20-pin SSOP	18-pin DIP, SOIC; 20-pin SSOP	28-pin DIP, SOIC; 28-pin SSOP	18-pin DIP, SOIC; 20-pin SSOP	18-pin DIP, SOIC; 20-pin SSOP
All PIC® Family devices have Power-on Reset, selectable Watchdog Timer, selectable Code Protect and high I/O current capability.					

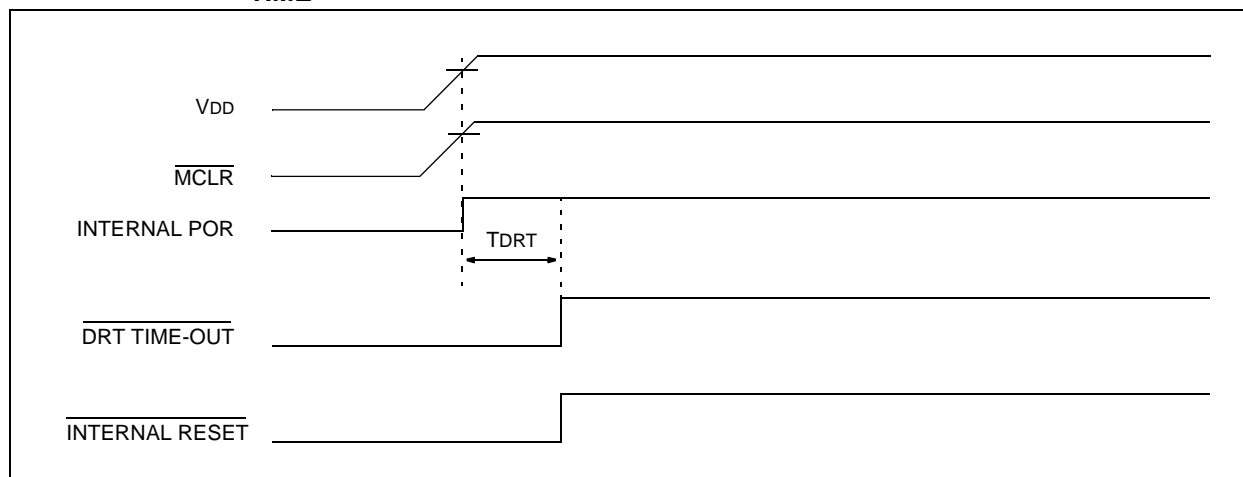
Features	PIC16C57	PIC16CR57	PIC16C58	PIC16CR58
Maximum Operation Frequency	40 MHz	20 MHz	40 MHz	20 MHz
EPROM Program Memory (x12 words)	2K	—	2K	—
ROM Program Memory (x12 words)	—	2K	—	2K
RAM Data Memory (bytes)	72	72	73	73
Timer Module(s)	TMR0	TMR0	TMR0	TMR0
I/O Pins	20	20	12	12
Number of Instructions	33	33	33	33
Packages	28-pin DIP, SOIC; 28-pin SSOP	28-pin DIP, SOIC; 28-pin SSOP	18-pin DIP, SOIC; 20-pin SSOP	18-pin DIP, SOIC; 20-pin SSOP
All PIC® Family devices have Power-on Reset, selectable Watchdog Timer, selectable Code Protect and high I/O current capability.				

# PIC16C5X

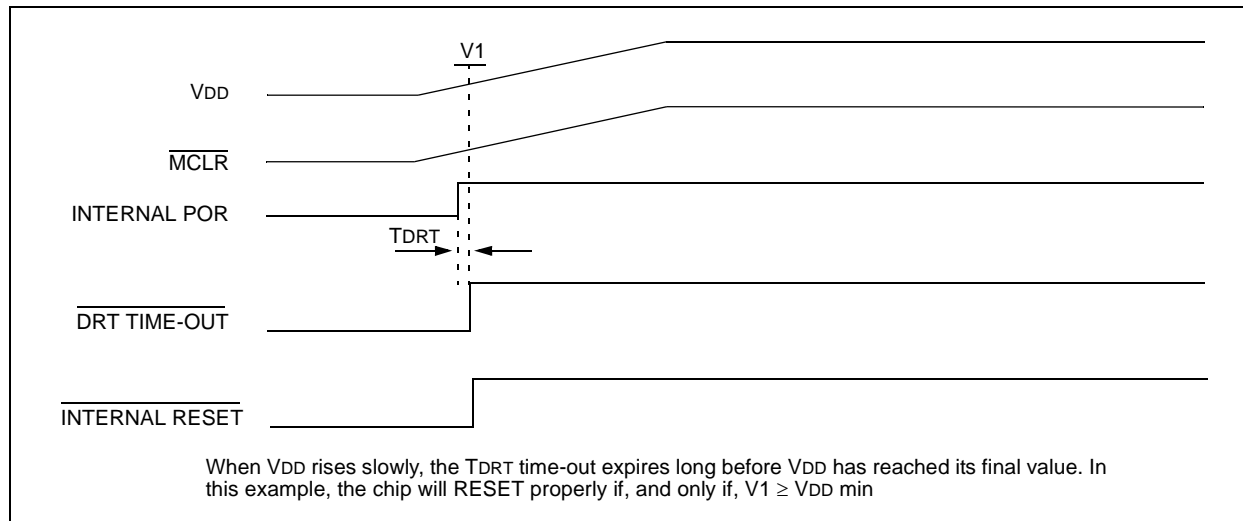
**FIGURE 5-3: TIME-OUT SEQUENCE ON POWER-UP ( $\overline{\text{MCLR}}$  NOT TIED TO VDD)**



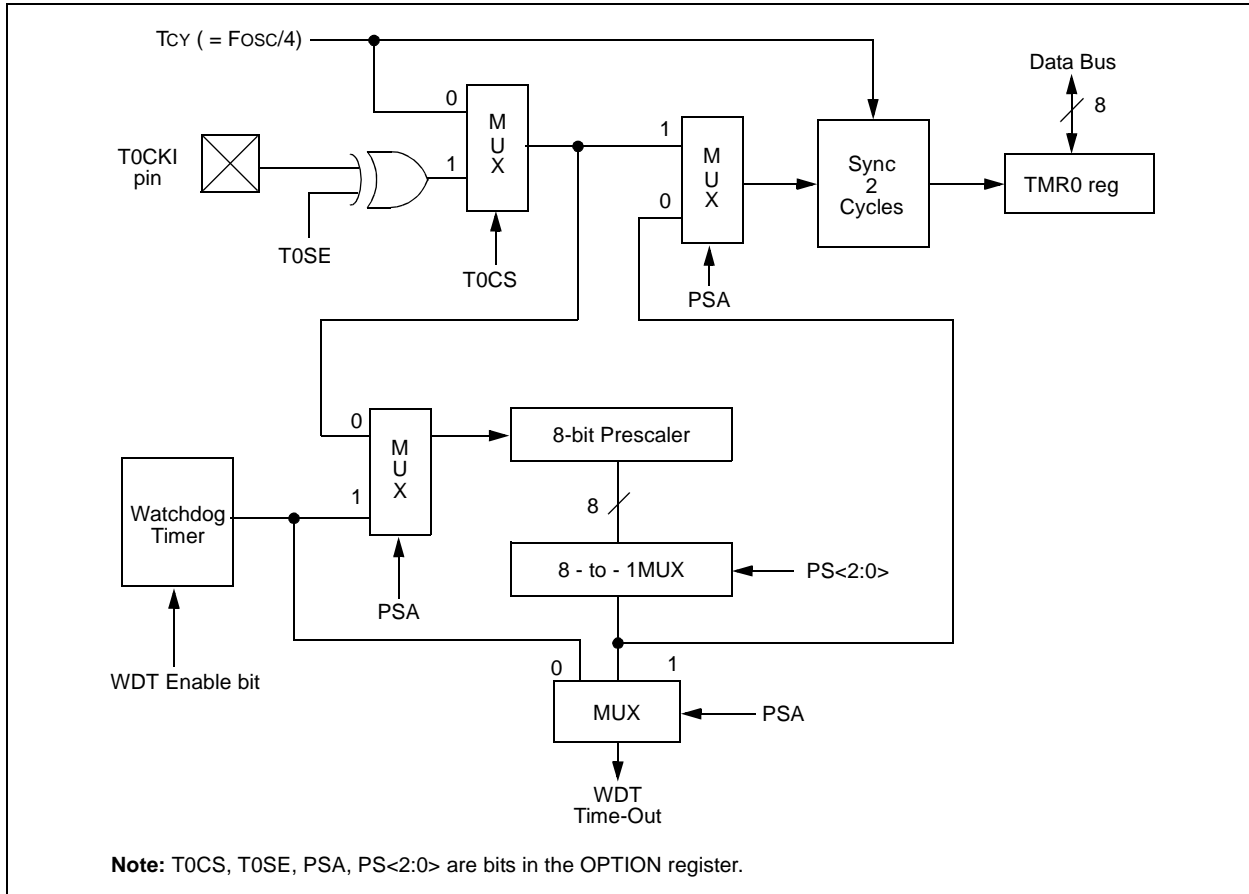
**FIGURE 5-4: TIME-OUT SEQUENCE ON POWER-UP ( $\overline{\text{MCLR}}$  TIED TO VDD): FAST VDD RISE TIME**



**FIGURE 5-5: TIME-OUT SEQUENCE ON POWER-UP ( $\overline{\text{MCLR}}$  TIED TO VDD): SLOW VDD RISE TIME**



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



## REGISTER 9-2: CONFIGURATION WORD FOR PIC16C54/C55/C56/C57

—	—	—	—	—	—	—	—	CP	WDTE	FOSC1	FOSC0
bit 11											bit 0

bit 11-4: **Unimplemented:** Read as '0'

bit 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 bits<sup>(2)</sup>  
 00 = LP oscillator  
 01 = XT oscillator  
 10 = HS oscillator  
 11 = RC oscillator

- Note 1:** Refer to the PIC16C5X Programming Specifications (Literature Number DS30190) to determine how to access the configuration word.  
**2:** PIC16LV54A supports XT, RC and LP oscillator only.

<b>Legend:</b>			
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

## 11.8 MPLAB ICD In-Circuit Debugger

Microchip's In-Circuit Debugger, MPLAB ICD, is a powerful, low cost, run-time development tool. This tool is based on the FLASH PIC MCUs and can be used to develop for this and other PIC microcontrollers. The MPLAB ICD utilizes the in-circuit debugging capability built into the FLASH devices. This feature, along with Microchip's In-Circuit Serial Programming™ protocol, offers cost-effective in-circuit FLASH debugging from the graphical user interface of the MPLAB Integrated Development Environment. This enables a designer to develop and debug source code by watching variables, single-stepping and setting break points. Running at full speed enables testing hardware in real-time.

## 11.9 PRO MATE II Universal Device Programmer

The PRO MATE II universal device programmer is a full-featured programmer, capable of operating in Stand-alone mode, as well as PC-hosted mode. The PRO MATE II device programmer is CE compliant.

The PRO MATE II device programmer has programmable VDD and VPP supplies, which allow it to verify programmed memory at VDD min and VDD max for maximum reliability. It has an LCD display for instructions and error messages, keys to enter commands and a modular detachable socket assembly to support various package types. In Stand-alone mode, the PRO MATE II device programmer can read, verify, or program PIC devices. It can also set code protection in this mode.

## 11.10 PICSTART Plus Entry Level Development Programmer

The PICSTART Plus development programmer is an easy-to-use, low cost, prototype programmer. It connects to the PC via a COM (RS-232) port. MPLAB Integrated Development Environment software makes using the programmer simple and efficient.

The PICSTART Plus development programmer supports all PIC devices with up to 40 pins. Larger pin count devices, such as the PIC16C92X and PIC17C76X, may be supported with an adapter socket. The PICSTART Plus development programmer is CE compliant.

## 11.11 PICDEM 1 Low Cost PIC MCU Demonstration Board

The PICDEM 1 demonstration board is a simple board which demonstrates the capabilities of several of Microchip's microcontrollers. The microcontrollers supported are: PIC16C5X (PIC16C54 to PIC16C58A), PIC16C61, PIC16C62X, PIC16C71, PIC16C8X, PIC17C42, PIC17C43 and PIC17C44. All necessary hardware and software is included to run basic demo programs. The user can program the sample microcontrollers provided with the PICDEM 1 demonstration board on a PRO MATE II device programmer, or a PICSTART Plus development programmer, and easily test firmware. The user can also connect the PICDEM 1 demonstration board to the MPLAB ICE in-circuit emulator and download the firmware to the emulator for testing. A prototype area is available for the user to build some additional hardware and connect it to the microcontroller socket(s). Some of the features include an RS-232 interface, a potentiometer for simulated analog input, push button switches and eight LEDs connected to PORTB.

## 11.12 PICDEM 2 Low Cost PIC16CXX Demonstration Board

The PICDEM 2 demonstration board is a simple demonstration board that supports the PIC16C62, PIC16C64, PIC16C65, PIC16C73 and PIC16C74 microcontrollers. All the necessary hardware and software is included to run the basic demonstration programs. The user can program the sample microcontrollers provided with the PICDEM 2 demonstration board on a PRO MATE II device programmer, or a PICSTART Plus development programmer, and easily test firmware. The MPLAB ICE in-circuit emulator may also be used with the PICDEM 2 demonstration board to test firmware. A prototype area has been provided to the user for adding additional hardware and connecting it to the microcontroller socket(s). Some of the features include a RS-232 interface, push button switches, a potentiometer for simulated analog input, a serial EEPROM to demonstrate usage of the I<sup>2</sup>C™ bus and separate headers for connection to an LCD module and a keypad.

## 12.4 DC Characteristics: PIC16C54/55/56/57-RC, XT, 10, HS, LP (Commercial) PIC16C54/55/56/57-RCI, XTI, 10I, HSI, LPI (Industrial)

DC CHARACTERISTICS			Standard Operating Conditions (unless otherwise specified) Operating Temperature 0°C ≤ TA ≤ +70°C for commercial –40°C ≤ TA ≤ +85°C for industrial				
Param No.	Symbol	Characteristic/Device	Min	Typ†	Max	Units	Conditions
D030	V <sub>IL</sub>	<b>Input Low Voltage</b>					
		I/O ports	V <sub>SS</sub>	—	0.2 V <sub>DD</sub>	V	Pin at hi-impedance
		MCLR (Schmitt Trigger)	V <sub>SS</sub>	—	0.15 V <sub>DD</sub>	V	
		T0CKI (Schmitt Trigger)	V <sub>SS</sub>	—	0.15 V <sub>DD</sub>	V	
		OSC1 (Schmitt Trigger)	V <sub>SS</sub>	—	0.15 V <sub>DD</sub>	V	PIC16C5X-RC only <sup>(3)</sup>
		OSC1 (Schmitt Trigger)	V <sub>SS</sub>	—	0.3 V <sub>DD</sub>	V	PIC16C5X-XT, 10, HS, LP
D040	V <sub>IH</sub>	<b>Input High Voltage</b>					
		I/O ports	0.45 V <sub>DD</sub>	—	V <sub>DD</sub>	V	For all V <sub>DD</sub> <sup>(4)</sup>
		I/O ports	2.0	—	V <sub>DD</sub>	V	4.0V < V <sub>DD</sub> ≤ 5.5V <sup>(4)</sup>
		I/O ports	0.36 V <sub>DD</sub>	—	V <sub>DD</sub>	V	V <sub>DD</sub> > 5.5V
		MCLR (Schmitt Trigger)	0.85 V <sub>DD</sub>	—	V <sub>DD</sub>	V	
		T0CKI (Schmitt Trigger)	0.85 V <sub>DD</sub>	—	V <sub>DD</sub>	V	
		OSC1 (Schmitt Trigger)	0.85 V <sub>DD</sub>	—	V <sub>DD</sub>	V	PIC16C5X-RC only <sup>(3)</sup>
		OSC1 (Schmitt Trigger)	0.7 V <sub>DD</sub>	—	V <sub>DD</sub>	V	PIC16C5X-XT, 10, HS, LP
D050	V <sub>HYS</sub>	<b>Hysteresis of Schmitt Trigger inputs</b>	0.15 V <sub>DD</sub> *	—	—	V	
D060	I <sub>IL</sub>	<b>Input Leakage Current<sup>(1,2)</sup></b>					
		I/O ports	–1	0.5	+1	μA	<b>For V<sub>DD</sub> ≤ 5.5V:</b> V <sub>SS</sub> ≤ V <sub>PIN</sub> ≤ V <sub>DD</sub> , pin at hi-impedance
		MCLR	–5	—	—	μA	V <sub>PIN</sub> = V <sub>SS</sub> + 0.25V
		MCLR	—	0.5	+5	μA	V <sub>PIN</sub> = V <sub>DD</sub>
		T0CKI	–3	0.5	+3	μA	V <sub>SS</sub> ≤ V <sub>PIN</sub> ≤ V <sub>DD</sub>
		OSC1	–3	0.5	+3	μA	V <sub>SS</sub> ≤ V <sub>PIN</sub> ≤ V <sub>DD</sub> , PIC16C5X-XT, 10, HS, LP
D080	V <sub>OL</sub>	<b>Output Low Voltage</b>					
		I/O ports	—	—	0.6	V	I <sub>OL</sub> = 8.7 mA, V <sub>DD</sub> = 4.5V
		OSC2/CLKOUT	—	—	0.6	V	I <sub>OL</sub> = 1.6 mA, V <sub>DD</sub> = 4.5V, PIC16C5X-RC
D090	V <sub>OH</sub>	<b>Output High Voltage<sup>(2)</sup></b>					
		I/O ports	V <sub>DD</sub> – 0.7	—	—	V	I <sub>OH</sub> = –5.4 mA, V <sub>DD</sub> = 4.5V
		OSC2/CLKOUT	V <sub>DD</sub> – 0.7	—	—	V	I <sub>OH</sub> = –1.0 mA, V <sub>DD</sub> = 4.5V, PIC16C5X-RC

\* 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:** The leakage current on the MCLR/V<sub>PP</sub> pin is strongly dependent on the applied voltage level. The specified levels represent normal operating conditions. Higher leakage current may be measured at different input voltage.

**2:** Negative current is defined as coming out of the pin.

**3:** For PIC16C5X-RC devices, the OSC1/CLKIN pin is a Schmitt Trigger input. It is not recommended that the PIC16C5X be driven with external clock in RC mode.

**4:** The user may use the better of the two specifications.



# PIC16C5X

## 12.5 DC Characteristics: PIC16C54/55/56/57-RCE, XTE, 10E, HSE, LPE (Extended)

DC CHARACTERISTICS			Standard Operating Conditions (unless otherwise specified)				
			Operating Temperature $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ for extended				
Param No.	Symbol	Characteristic	Min	Typ†	Max	Units	Conditions
D030	V <sub>IL</sub>	<b>Input Low Voltage</b>					
		I/O ports	V <sub>SS</sub>	—	0.15 V <sub>DD</sub>	V	Pin at hi-impedance
		MCLR (Schmitt Trigger)	V <sub>SS</sub>	—	0.15 V <sub>DD</sub>	V	
		T0CKI (Schmitt Trigger)	V <sub>SS</sub>	—	0.15 V <sub>DD</sub>	V	
		OSC1 (Schmitt Trigger)	V <sub>SS</sub>	—	0.15 V <sub>DD</sub>	V	PIC16C5X-RC only <sup>(3)</sup>
		OSC1 (Schmitt Trigger)	V <sub>SS</sub>	—	0.3 V <sub>DD</sub>	V	PIC16C5X-XT, 10, HS, LP
D040	V <sub>IH</sub>	<b>Input High Voltage</b>					
		I/O ports	0.45 V <sub>DD</sub>	—	V <sub>DD</sub>	V	For all V <sub>DD</sub> <sup>(4)</sup>
		I/O ports	2.0	—	V <sub>DD</sub>	V	4.0V < V <sub>DD</sub> ≤ 5.5V <sup>(4)</sup>
		I/O ports	0.36 V <sub>DD</sub>	—	V <sub>DD</sub>	V	V <sub>DD</sub> > 5.5 V
		MCLR (Schmitt Trigger)	0.85 V <sub>DD</sub>	—	V <sub>DD</sub>	V	
		T0CKI (Schmitt Trigger)	0.85 V <sub>DD</sub>	—	V <sub>DD</sub>	V	
		OSC1 (Schmitt Trigger)	0.85 V <sub>DD</sub>	—	V <sub>DD</sub>	V	PIC16C5X-RC only <sup>(3)</sup>
		OSC1 (Schmitt Trigger)	0.7 V <sub>DD</sub>	—	V <sub>DD</sub>	V	PIC16C5X-XT, 10, HS, LP
D050	V <sub>HYS</sub>	<b>Hysteresis of Schmitt Trigger inputs</b>	0.15 V <sub>DD</sub> *	—	—	V	
D060	I <sub>IL</sub>	<b>Input Leakage Current</b> <sup>(1,2)</sup>					<b>For V<sub>DD</sub> ≤ 5.5 V:</b>
		I/O ports	−1	0.5	+1	μA	V <sub>SS</sub> ≤ V <sub>PIN</sub> ≤ V <sub>DD</sub> , pin at hi-impedance
		MCLR	−5	—	—	μA	V <sub>PIN</sub> = V <sub>SS</sub> + 0.25V
		MCLR	—	0.5	+5	μA	V <sub>PIN</sub> = V <sub>DD</sub>
		T0CKI	−3	0.5	+3	μA	V <sub>SS</sub> ≤ V <sub>PIN</sub> ≤ V <sub>DD</sub>
		OSC1	−3	0.5	+3	μA	V <sub>SS</sub> ≤ V <sub>PIN</sub> ≤ V <sub>DD</sub> , PIC16C5X-XT, 10, HS, LP
D080	V <sub>OL</sub>	<b>Output Low Voltage</b>					
		I/O ports	—	—	0.6	V	I <sub>OL</sub> = 8.7 mA, V <sub>DD</sub> = 4.5V
		OSC2/CLKOUT	—	—	0.6	V	I <sub>OL</sub> = 1.6 mA, V <sub>DD</sub> = 4.5V, PIC16C5X-RC
D090	V <sub>OH</sub>	<b>Output High Voltage</b> <sup>(2)</sup>					
		I/O ports	V <sub>DD</sub> − 0.7	—	—	V	I <sub>OH</sub> = −5.4 mA, V <sub>DD</sub> = 4.5V
		OSC2/CLKOUT	V <sub>DD</sub> − 0.7	—	—	V	I <sub>OH</sub> = −1.0 mA, V <sub>DD</sub> = 4.5V, PIC16C5X-RC

\* 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:** The leakage current on the MCLR/VPP pin is strongly dependent on the applied voltage level. The specified levels represent normal operating conditions. Higher leakage current may be measured at different input voltage.

**2:** Negative current is defined as coming out of the pin.

**3:** For PIC16C5X-RC devices, the OSC1/CLKIN pin is a Schmitt Trigger input. It is not recommended that the PIC16C5X be driven with external clock in RC mode.

**4:** The user may use the better of the two specifications.

12.6 Timing Parameter Symbolology and Load Conditions

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

- 1. TppS2ppS
- 2. TppS

T		T
F	Frequency	Time

Lowercase letters (pp) and their meanings:

pp		mc	MCLR
2	to	osc	oscillator
ck	CLKOUT	os	OSC1
cy	cycle time	t0	T0CKI
drt	device reset timer	wdt	watchdog timer
io	I/O port		

Uppercase letters and their meanings:

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

FIGURE 12-1: LOAD CONDITIONS FOR DEVICE TIMING SPECIFICATIONS - PIC16C54/55/56/57

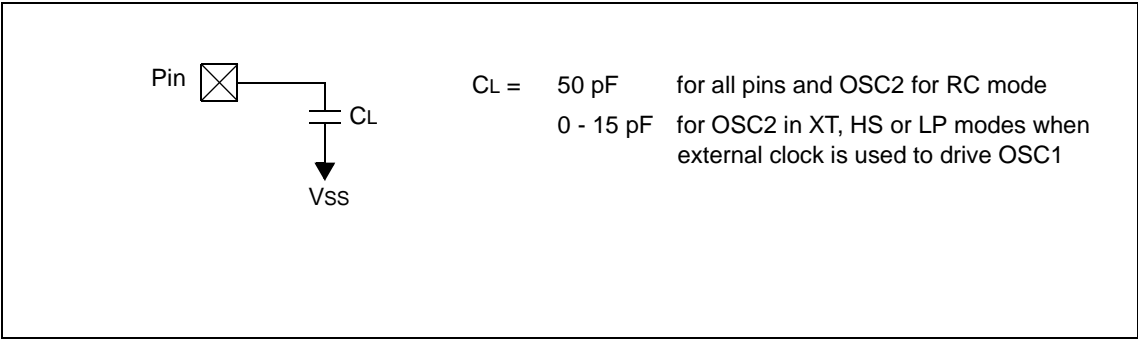


FIGURE 14-2: TYPICAL RC OSC FREQUENCY vs. VDD, CEXT = 20 PF

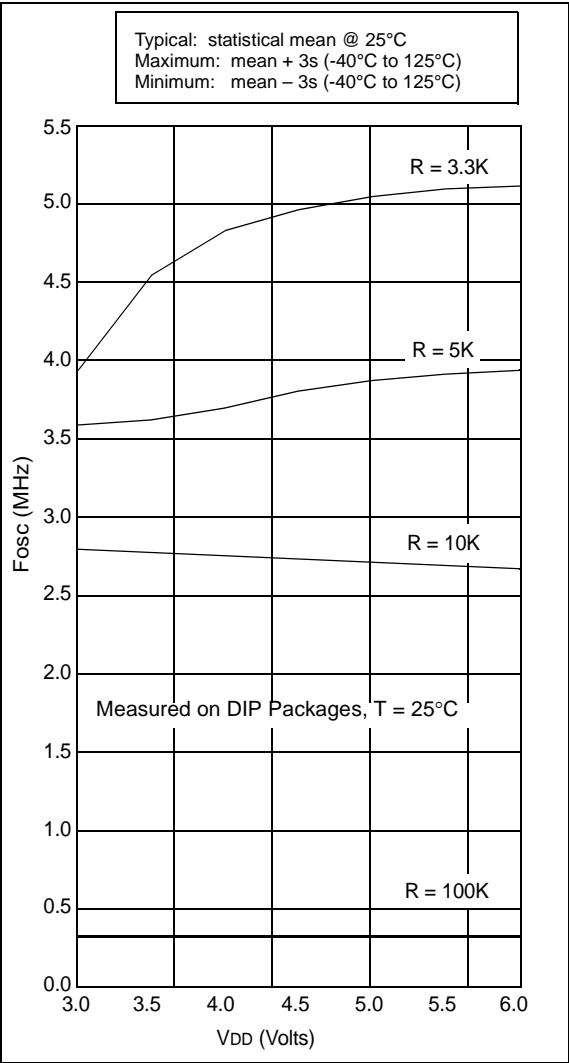
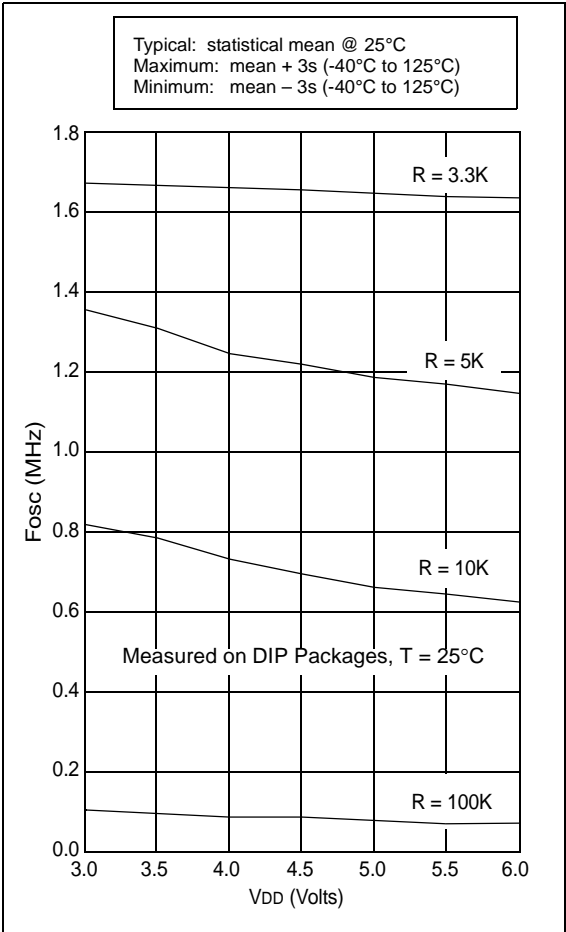


FIGURE 14-3: TYPICAL RC OSC FREQUENCY vs. VDD, CEXT = 100 PF



## 15.4 DC Characteristics: PIC16C54A-04, 10, 20, PIC16LC54A-04, PIC16LV54A-02 (Commercial) PIC16C54A-04I, 10I, 20I, PIC16LC54A-04I, PIC16LV54A-02I (Industrial) PIC16C54A-04E, 10E, 20E, PIC16LC54A-04E (Extended)

DC CHARACTERISTICS			Standard Operating Conditions (unless otherwise specified)				
			Operating Temperature $0^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$ for commercial $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for industrial $-20^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for industrial-PIC16LV54A-02I $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ for extended				
Param No.	Symbol	Characteristic	Min	Typ†	Max	Units	Conditions
D030	VIL	<b>Input Low Voltage</b> I/O ports MCLR (Schmitt Trigger) T0CKI (Schmitt Trigger) OSC1 (Schmitt Trigger) OSC1	VSS VSS VSS VSS VSS	— — — — —	0.2 VDD 0.15 VDD 0.15 VDD 0.15 VDD 0.3 VDD	V V V V V	Pin at hi-impedance  RC mode only <sup>(3)</sup> XT, HS and LP modes
D040	VIH	<b>Input High Voltage</b> I/O ports I/O ports MCLR (Schmitt Trigger) T0CKI (Schmitt Trigger) OSC1 (Schmitt Trigger) OSC1	0.2 VDD + 1 2.0 0.85 VDD 0.85 VDD 0.85 VDD 0.7 VDD	— — — — — —	VDD VDD VDD VDD VDD VDD	V V V V V V	For all VDD <sup>(4)</sup> 4.0V < VDD ≤ 5.5V <sup>(4)</sup>  RC mode only <sup>(3)</sup> XT, HS and LP modes
D050	VHYS	<b>Hysteresis of Schmitt Trigger inputs</b>	0.15 VDD*	—	—	V	
D060	IIL	<b>Input Leakage Current<sup>(1,2)</sup></b> I/O ports  MCLR MCLR T0CKI OSC1	-1.0 -5.0 — -3.0 -3.0	0.5 — 0.5 0.5 0.5	+1.0 +5.0 +3.0 +3.0 —	μA μA μA μA μA	<b>For VDD ≤ 5.5V:</b> VSS ≤ VPIN ≤ VDD, pin at hi-impedance VPIN = VSS + 0.25V VPIN = VDD VSS ≤ VPIN ≤ VDD VSS ≤ VPIN ≤ VDD, XT, HS and LP modes
D080	VOL	<b>Output Low Voltage</b> I/O ports OSC2/CLKOUT	— —	— —	0.6 0.6	V V	IOH = 8.7 mA, VDD = 4.5V IOH = 1.6 mA, VDD = 4.5V, RC mode only
	VOH	<b>Output High Voltage<sup>(2)</sup></b> I/O ports OSC2/CLKOUT	VDD - 0.7 VDD - 0.7	— —	— —	V V	IOH = -5.4 mA, VDD = 4.5V IOH = -1.0 mA, VDD = 4.5V, RC mode only

\* 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.

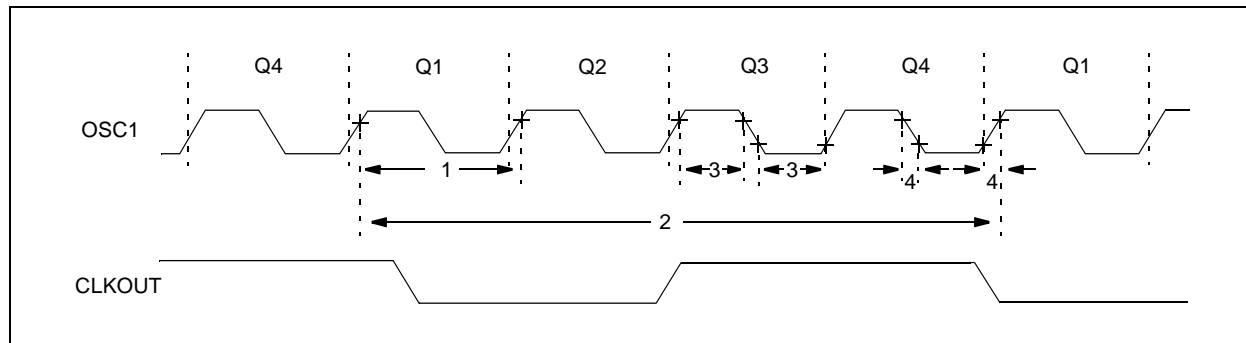
**Note 1:** The leakage current on the MCLR/VPP pin is strongly dependent on the applied voltage level. The specified levels represent normal operating conditions. Higher leakage current may be measured at different input voltage.

**2:** Negative current is defined as coming out of the pin.

**3:** For the RC mode, the OSC1/CLKIN pin is a Schmitt Trigger input. It is not recommended that the PIC16C5X be driven with external clock in RC mode.

## 15.6 Timing Diagrams and Specifications

**FIGURE 15-2: EXTERNAL CLOCK TIMING - PIC16C54A**



**TABLE 15-1: EXTERNAL CLOCK TIMING REQUIREMENTS - PIC16C54A**

<b>Standard Operating Conditions (unless otherwise specified)</b> Operating Temperature $0^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$ for commercial $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for industrial $-20^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for industrial - PIC16LV54A-02I $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ for extended							
<b>AC Characteristics</b>							
Param No.	Symbol	Characteristic	Min	Typ†	Max	Units	Conditions
	FOSC	External CLKIN Frequency <sup>(1)</sup>	DC	—	4.0	MHz	XT osc mode
			DC	—	2.0	MHz	XT osc mode (PIC16LV54A)
			DC	—	4.0	MHz	HS osc mode (04)
			DC	—	10	MHz	HS osc mode (10)
			DC	—	20	MHz	HS osc mode (20)
			DC	—	200	kHz	LP osc mode
		Oscillator Frequency <sup>(1)</sup>	DC	—	4.0	MHz	RC osc mode
			DC	—	2.0	MHz	RC osc mode (PIC16LV54A)
			0.1	—	4.0	MHz	XT osc mode
			0.1	—	2.0	MHz	XT osc mode (PIC16LV54A)
			4.0	—	4.0	MHz	HS osc mode (04)
			4.0	—	10	MHz	HS osc mode (10)
			4.0	—	20	MHz	HS osc mode (20)
			5.0	—	200	kHz	LP osc mode

\* 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:** 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.

FIGURE 16-18: TRANSCONDUCTANCE (gm) OF LP OSCILLATOR vs. VDD

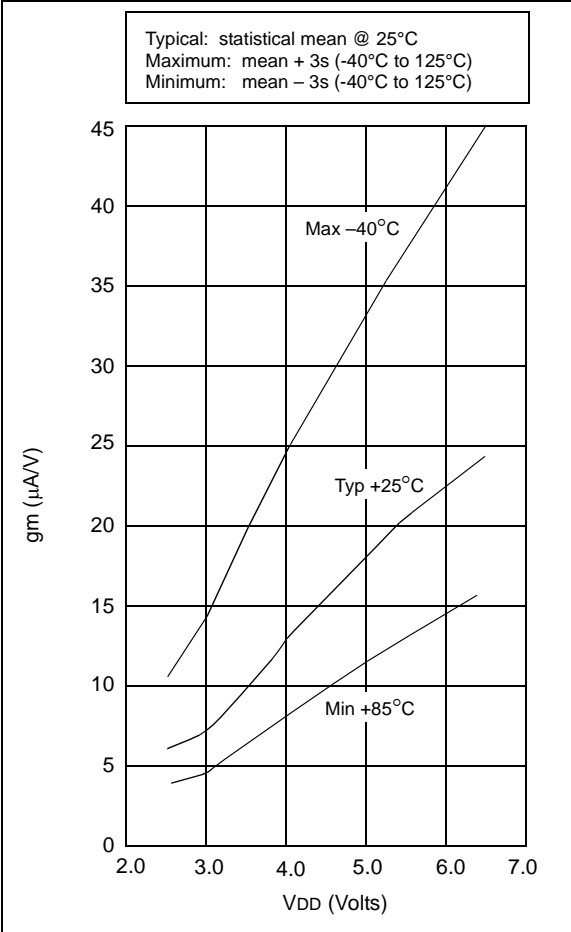
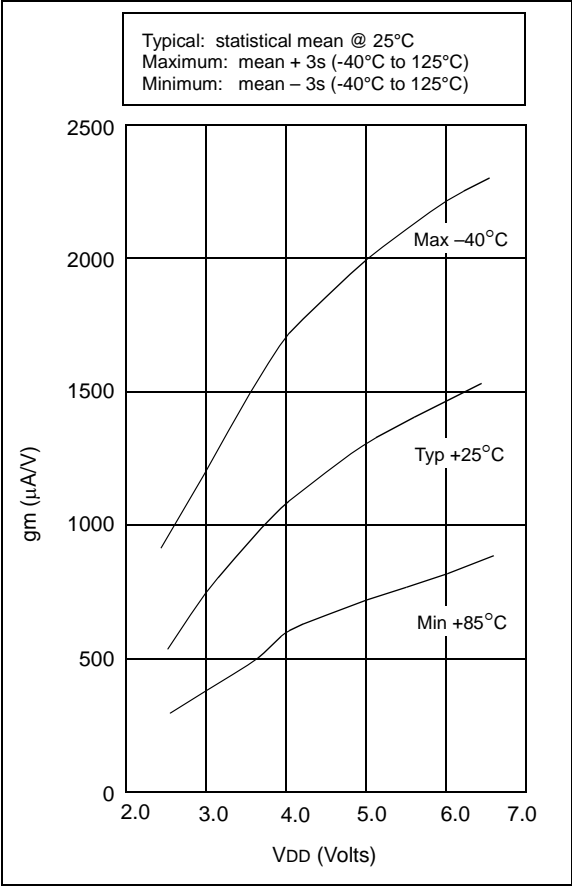
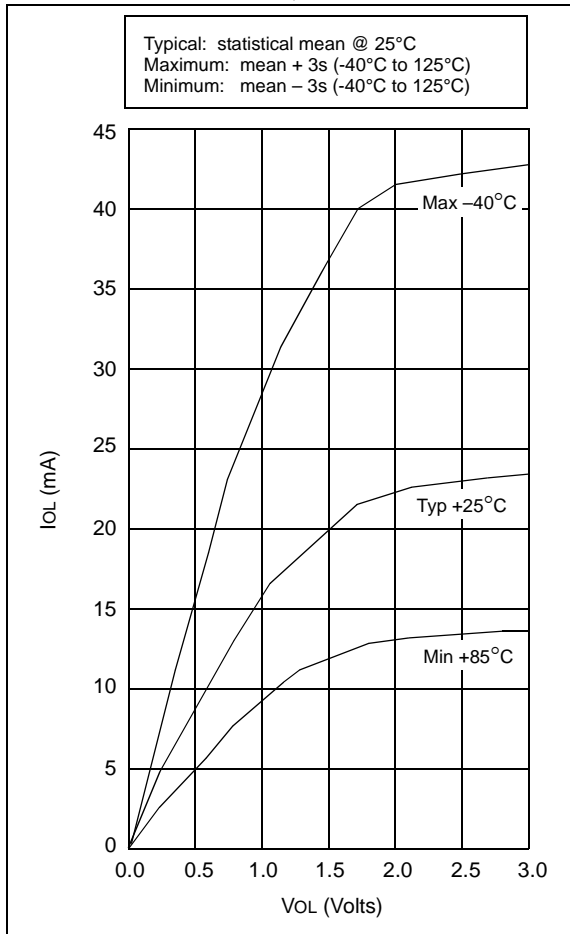


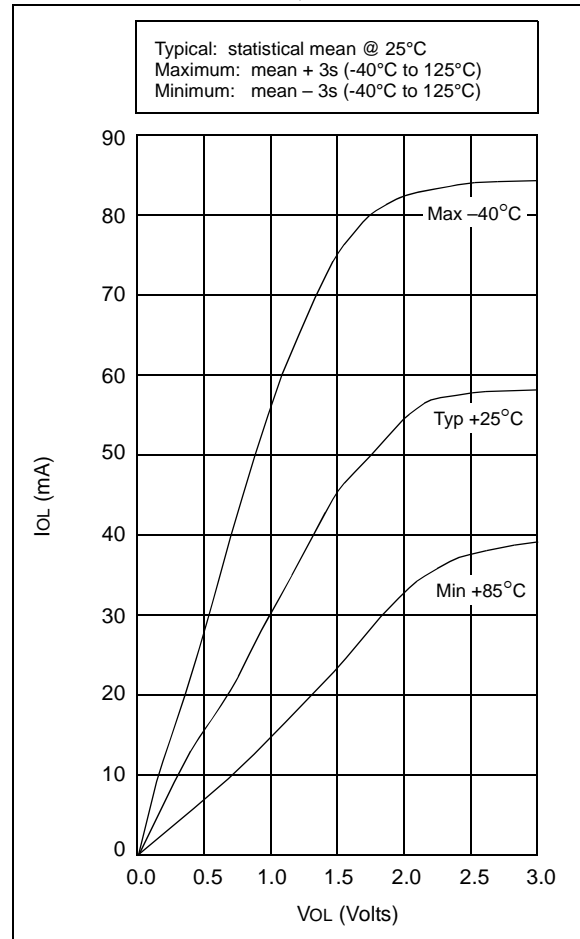
FIGURE 16-19: TRANSCONDUCTANCE (gm) OF XT OSCILLATOR vs. VDD



**FIGURE 16-22: PORTA, B AND C IoL vs. VOL, VDD = 3V**



**FIGURE 16-23: PORTA, B AND C IoL vs. VOL, VDD = 5V**



**TABLE 16-2: INPUT CAPACITANCE FOR PIC16C54A/C58A**

Pin	Typical Capacitance (pF)	
	18L PDIP	18L SOIC
RA port	5.0	4.3
RB port	5.0	4.3
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  $\pm 25\%$  (three standard deviations) should be taken into account.

# PIC16C5X

## 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)

<b>PIC16C5X</b> <b>PIC16LCR5X</b> (Commercial, Industrial)		<b>Standard Operating Conditions (unless otherwise specified)</b> Operating Temperature $0^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$ for commercial $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for industrial					
<b>PIC16C5X</b> <b>PIC16CR5X</b> (Commercial, Industrial)		<b>Standard Operating Conditions (unless otherwise specified)</b> Operating Temperature $0^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$ for commercial $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for industrial					
Param No.	Symbol	Characteristic/Device	Min	Typ†	Max	Units	Conditions
D020	IPD	<b>Power-down Current<sup>(2)</sup></b>					
		PIC16LC5X	—	0.25	2	μA	VDD = 2.5V, WDT disabled, Commercial
			—	0.25	3	μA	VDD = 2.5V, WDT disabled, Industrial
			—	1	5	μA	VDD = 2.5V, WDT enabled, Commercial
			—	1.25	8	μA	VDD = 2.5V, WDT enabled, Industrial
D020A		PIC16C5X	—	0.25	4.0	μA	VDD = 3.0V, WDT disabled, Commercial
			—	0.25	5.0	μA	VDD = 3.0V, WDT disabled, Industrial
			—	1.8	7.0*	μA	VDD = 5.5V, WDT disabled, Commercial
			—	2.0	8.0*	μA	VDD = 5.5V, WDT disabled, Industrial
			—	4	12*	μA	VDD = 3.0V, WDT enabled, Commercial
			—	4	14*	μA	VDD = 3.0V, WDT enabled, Industrial
			—	9.8	27*	μA	VDD = 5.5V, WDT enabled, Commercial
			—	12	30*	μA	VDD = 5.5V, WDT enabled, 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.

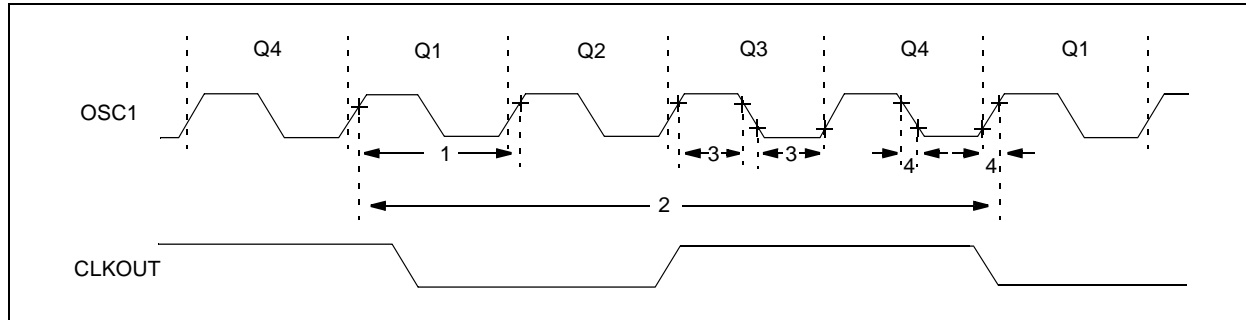
- Note 1:** This is the limit to which VDD can be lowered in SLEEP mode without losing RAM data.
- Note 2:** The supply current is mainly a function of the operating voltage and frequency. Other factors such as bus loading, oscillator type, bus rate, internal code execution pattern and temperature also 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, 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.
- Note 3:** Does not include current through REXT. The current through the resistor can be estimated by the formula:  
 $I_R = V_{DD}/2R_{EXT}$  (mA) with REXT in kΩ.



# PIC16C5X

## 17.5 Timing Diagrams and Specifications

**FIGURE 17-6: EXTERNAL CLOCK TIMING - PIC16C5X, PIC16CR5X**



**TABLE 17-1: EXTERNAL CLOCK TIMING REQUIREMENTS - PIC16C5X, PIC16CR5X**

<b>Standard Operating Conditions (unless otherwise specified)</b> Operating Temperature $0^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$ for commercial $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for industrial $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ for extended							
<b>AC Characteristics</b>							
Param No.	Symbol	Characteristic	Min	Typ†	Max	Units	Conditions
	FOSC	External CLKIN Frequency <sup>(1)</sup>	DC	—	4.0	MHz	XT osc mode
			DC	—	4.0	MHz	HS osc mode (04)
			DC	—	20	MHz	HS osc mode (20)
			DC	—	200	kHz	LP osc mode
		Oscillator Frequency <sup>(1)</sup>	DC	—	4.0	MHz	RC osc mode
			0.45	—	4.0	MHz	XT osc mode
			4.0	—	4.0	MHz	HS osc mode (04)
			4.0	—	20	MHz	HS osc mode (20)
			5.0	—	200	kHz	LP osc mode
1	TOSC	External CLKIN Period <sup>(1)</sup>	250	—	—	ns	XT osc mode
			250	—	—	ns	HS osc mode (04)
			50	—	—	ns	HS osc mode (20)
			5.0	—	—	μs	LP osc mode
		Oscillator Period <sup>(1)</sup>	250	—	—	ns	RC osc mode
			250	—	2,200	ns	XT osc mode
			250	—	250	ns	HS osc mode (04)
			50	—	250	ns	HS osc mode (20)
			5.0	—	200	μs	LP osc mode

\* These parameters are characterized but not tested.

† 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.

**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.

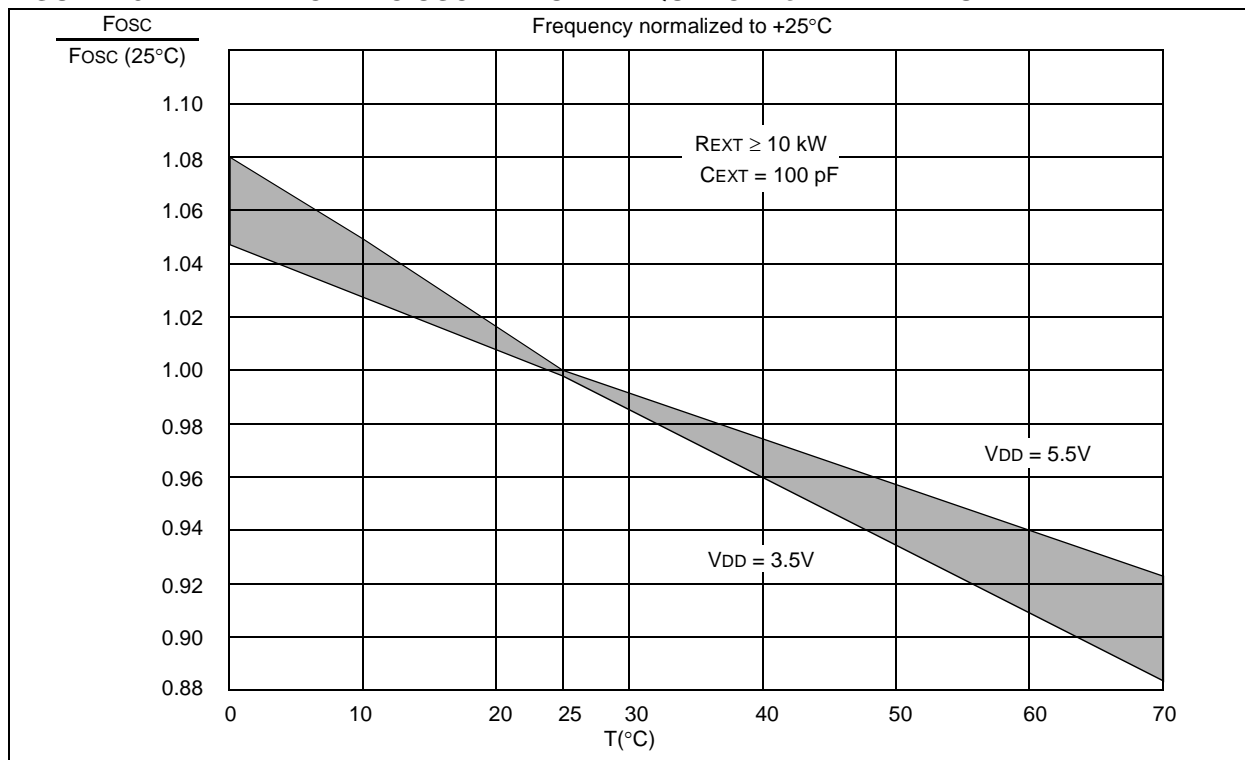
**2:** Instruction cycle period (TCY) equals four times the input oscillator time base period.

## 18.0 DEVICE CHARACTERIZATION - PIC16LC54A

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 + 3 $\sigma$ ) or (mean – 3 $\sigma$ ) respectively, where  $\sigma$  is a standard deviation, over the whole temperature range.

**FIGURE 18-1: TYPICAL RC OSCILLATOR FREQUENCY vs. TEMPERATURE**



**TABLE 18-1: RC OSCILLATOR FREQUENCIES**

$C_{EXT}$	$R_{EXT}$	Average $F_{osc}$ @ 5V, 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	1.63 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  $\pm 3$  standard deviation from average value for  $V_{DD} = 5\text{V}$ .

# PIC16C5X

## 19.2 DC Characteristics: PIC16C54C/C55A/C56A/C57C/C58B-40 (Commercial)<sup>(1)</sup>

DC CHARACTERISTICS			Standard Operating Conditions (unless otherwise specified)				
			Operating Temperature 0°C ≤ TA ≤ +70°C for commercial				
Param No.	Symbol	Characteristic	Min	Typ†	Max	Units	Conditions
D030	VIL	<b>Input Low Voltage</b> I/O Ports MCLR (Schmitt Trigger) T0CKI (Schmitt Trigger) OSC1	VSS VSS VSS VSS	— — — —	0.8 0.15 VDD 0.15 VDD 0.2 VDD	V V V V	4.5V < VDD ≤ 5.5V HS, 20 MHz ≤ FOSC ≤ 40 MHz
D040	VIH	<b>Input High Voltage</b> I/O ports MCLR (Schmitt Trigger) T0CKI (Schmitt Trigger) OSC1	2.0 0.85 VDD 0.85 VDD 0.8 VDD	— — — —	VDD VDD VDD VDD	V V V V	4.5V < VDD ≤ 5.5V HS, 20 MHz ≤ FOSC ≤ 40 MHz
D050	VHYS	<b>Hysteresis of Schmitt Trigger inputs</b>	0.15 VDD*	—	—	V	
D060	IIL	<b>Input Leakage Current<sup>(2,3)</sup></b> I/O ports  MCLR MCLR T0CKI OSC1	-1.0 -5.0 — -3.0 -3.0	0.5 — 0.5 0.5 0.5	+1.0 +5.0 +3.0 +3.0 —	μA μA μA μA μA	<b>For VDD ≤ 5.5V:</b> VSS ≤ VPIN ≤ VDD, pin at hi-impedance VPIN = VSS + 0.25V VPIN = VDD VSS ≤ VPIN ≤ VDD VSS ≤ VPIN ≤ VDD, HS
D080	VOL	<b>Output Low Voltage</b> I/O ports	—	—	0.6	V	IOL = 8.7 mA, VDD = 4.5V
D090	VOH	<b>Output High Voltage<sup>(3)</sup></b> I/O ports	VDD - 0.7	—	—	V	IOH = -5.4 mA, VDD = 4.5V

\* These parameters are characterized but not tested.

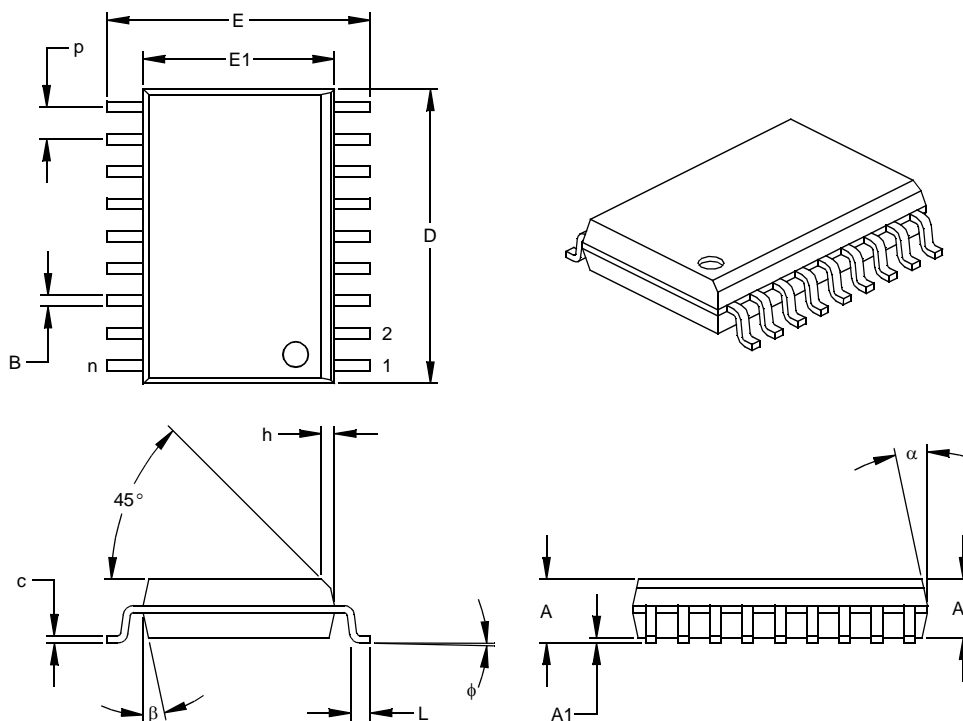
† Data in the Typical ("Typ") column is based on characterization results at 25°C. This data is for design guidance only and is not tested.

- 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 and HS oscillator mode and commercial temperatures. For operation between DC and 20 MHz, See Section 17.3.
- 2:** The leakage current on the MCLR/VPP pin is strongly dependent on the applied voltage level. The specified levels represent normal operating conditions. Higher leakage current may be measured at different input voltage.
- 3:** Negative current is defined as coming out of the pin.

# PIC16C5X

## 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.

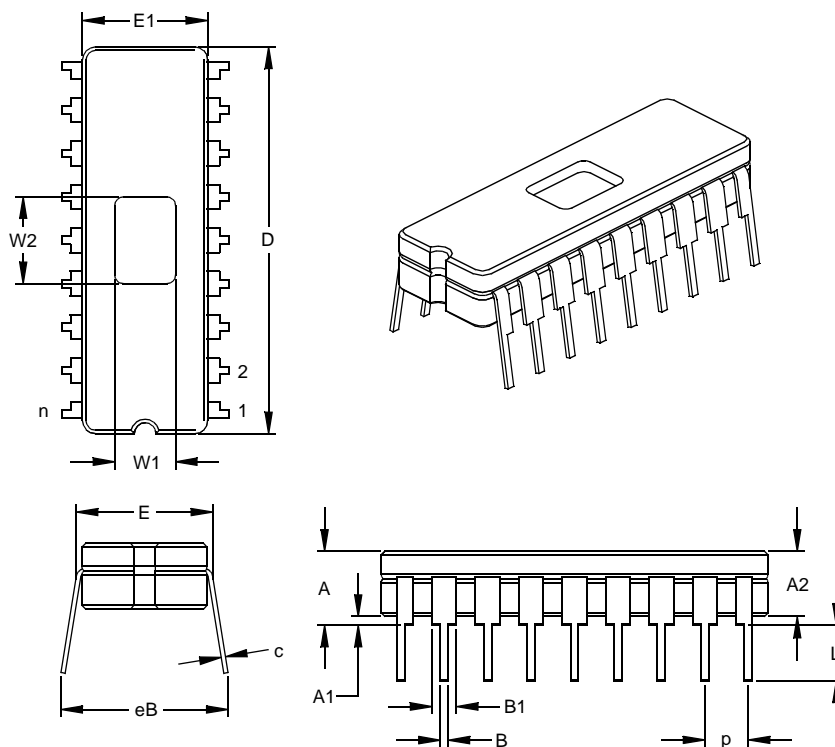
JEDEC Equivalent: MS-013

Drawing No. C04-051

# PIC16C5X

## 18-Lead Ceramic Dual In-line with Window (JW) – 300 mil (CERDIP)

**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		.100			2.54	
Top to Seating Plane	A	.170	.183	.195	4.32	4.64	4.95
Ceramic Package Height	A2	.155	.160	.165	3.94	4.06	4.19
Standoff	A1	.015	.023	.030	0.38	0.57	0.76
Shoulder to Shoulder Width	E	.300	.313	.325	7.62	7.94	8.26
Ceramic Pkg. Width	E1	.285	.290	.295	7.24	7.37	7.49
Overall Length	D	.880	.900	.920	22.35	22.86	23.37
Tip to Seating Plane	L	.125	.138	.150	3.18	3.49	3.81
Lead Thickness	c	.008	.010	.012	0.20	0.25	0.30
Upper Lead Width	B1	.050	.055	.060	1.27	1.40	1.52
Lower Lead Width	B	.016	.019	.021	0.41	0.47	0.53
Overall Row Spacing	§ eB	.345	.385	.425	8.76	9.78	10.80
Window Width	W1	.130	.140	.150	3.30	3.56	3.81
Window Length	W2	.190	.200	.210	4.83	5.08	5.33

\* Controlling Parameter

§ Significant Characteristic

JEDEC Equivalent: MO-036

Drawing No. C04-010