

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 "<u>Embedded -</u> <u>Microcontrollers</u>"

Details

E·XFI

Product Status	Obsolete
Core Processor	PIC
Core Size	8-Bit
Speed	4MHz
Connectivity	-
Peripherals	POR, WDT
Number of I/O	12
Program Memory Size	3KB (2K x 12)
Program Memory Type	ОТР
EEPROM Size	-
RAM Size	73 x 8
Voltage - Supply (Vcc/Vdd)	2.5V ~ 5.5V
Data Converters	-
Oscillator Type	External
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	20-SSOP (0.209", 5.30mm Width)
Supplier Device Package	20-SSOP
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic16lc58bt-04i-ss

Email: info@E-XFL.COM

Address: Room A, 16/F, Full Win Commercial Centre, 573 Nathan Road, Mongkok, Hong Kong



PIC16C5X

8-Bit EPROM/ROM-Based CMOS Microcontrollers

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).

4.0 OSCILLATOR CONFIGURATIONS

4.1 Oscillator Types

PIC16C5Xs can be operated in four different oscillator modes. The user can program two configuration bits (FOSC1:FOSC0) to select one of these four modes:

- 1. LP: Low Power Crystal
- 2. XT: Crystal/Resonator
- 3. HS: High Speed Crystal/Resonator
- 4. RC: Resistor/Capacitor

Note: Not all oscillator selections available for all parts. See Section 9.1.

4.2 Crystal Oscillator/Ceramic Resonators

In XT, LP or HS modes, a crystal or ceramic resonator is connected to the OSC1/CLKIN and OSC2/CLKOUT pins to establish oscillation (Figure 4-1). The PIC16C5X oscillator design requires the use of a parallel cut crystal. Use of a series cut crystal may give a frequency out of the crystal manufacturers specifications. When in XT, LP or HS modes, the device can have an external clock source drive the OSC1/CLKIN pin (Figure 4-2).

FIGURE 4-1: CRYSTAL/CERAMIC RESONATOR OPERATION (HS, XT OR LP OSC CONFIGURATION)



FIGURE 4-2:

EXTERNAL CLOCK INPUT OPERATION (HS, XT OR LP OSC CONFIGURATION)



TABLE 4-1: CAPACITOR SELECTION FOR CERAMIC RESONATORS -PIC16C5X, PIC16CR5X

Osc Type	Resonator Freq	Cap. Range C1	Cap. Range C2
XT	455 kHz	68-100 pF	68-100 pF
	2.0 MHz	15-33 pF	15-33 pF
	4.0 MHz	10-22 pF	10-22 pF
HS	8.0 MHz	10-22 pF	10-22 pF
	16.0 MHz	10 pF	10 pF

These values are for design guidance only. Since each resonator has its own characteristics, the user should consult the resonator manufacturer for appropriate values of external components.

TABLE 4-2: CAPACITOR SELECTION FOR CRYSTAL OSCILLATOR -PIC16C5X. PIC16CR5X

Osc Type	Crystal Freq	Cap.Range C1	Cap. Range C2						
LP	32 kHz ⁽¹⁾	15 pF	15 pF						
XT	100 kHz	15-30 pF	200-300 pF						
	200 kHz	15-30 pF	100-200 pF						
	455 kHz	15-30 pF	15-100 pF						
	1 MHz	15-30 pF	15-30 pF						
	2 MHz	15 pF	15 pF						
	4 MHz	15 pF	15 pF						
HS	4 MHz	15 pF	15 pF						
	8 MHz	15 pF	15 pF						
	20 MHz	15 pF	15 pF						

Note 1: For VDD > 4.5V, C1 = C2 \approx 30 pF is recommended.

These values are for design guidance only. Rs may be required in HS mode as well as XT mode to avoid overdriving crystals with low drive level specification. Since each crystal has its own characteristics, the user should consult the crystal manufacturer for appropriate values of external components.

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

5.0 RESET

PIC16C5X devices may be RESET in one of the following ways:

- Power-On Reset (POR)
- MCLR Reset (normal operation)
- MCLR Wake-up Reset (from SLEEP)
- WDT Reset (normal operation)
- WDT Wake-up Reset (from SLEEP)

Table 5-1 shows these RESET conditions for the PCL and STATUS registers.

Some registers are not affected in any RESET condition. Their status is unknown on POR and unchanged in any other RESET. Most other registers are reset to a "RESET state" on Power-On Reset (POR), MCLR or WDT Reset. A MCLR or WDT wake-up from SLEEP also results in a device RESET, and not a continuation of operation before SLEEP. The $\overline{\text{TO}}$ and $\overline{\text{PD}}$ bits (STATUS <4:3>) are set or cleared depending on the different RESET conditions (Table 5-1). These bits may be used to determine the nature of the RESET.

Table 5-3 lists a full description of RESET states of all registers. Figure 5-1 shows a simplified block diagram of the On-chip Reset circuit.

TABLE 5-1: STATUS BITS AND THEIR SIGNIFICANCE

Condition	ТО	PD
Power-On Reset	1	1
MCLR Reset (normal operation)	u	u
MCLR Wake-up (from SLEEP)	1	0
WDT Reset (normal operation)	0	1
WDT Wake-up (from SLEEP)	0	0

Legend: u = unchanged, x = unknown, - = unimplemented read as '0'.

TABLE 5-2: SUMMARY OF REGISTERS ASSOCIATED WITH RESET

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR	<u>Value</u> on MCLR and WDT Reset
03h	STATUS	PA2	PA1	PA0	TO	PD	Z	DC	С	0001 1xxx	000q quuu

Legend: u = unchanged, x = unknown, q = see Table 5-1 for possible values.

NOTES:

6.2 Data Memory Organization

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

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

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

For the PIC16C54, PIC16CR54, PIC16C56 and PIC16CR56, the register file is composed of 7 Special Function Registers and 25 General Purpose Registers (Figure 6-4).

For the PIC16C55, the register file is composed of 8 Special Function Registers and 24 General Purpose Registers.

For the PIC16C57 and PIC16CR57, the register file is composed of 8 Special Function Registers, 24 General Purpose Registers and up to 48 additional General Purpose Registers that may be addressed using a banking scheme (Figure 6-5).

For the PIC16C58 and PIC16CR58, the register file is composed of 7 Special Function Registers, 25 General Purpose Registers and up to 48 additional General Purpose Registers that may be addressed using a banking scheme (Figure 6-6).

6.2.1 GENERAL PURPOSE REGISTER FILE

The register file is accessed either directly or indirectly through the File Select Register (FSR). The FSR Register is described in Section 6.7.

FIGURE 6-4: PIC16C54, PIC16CR54, PIC16C55, PIC16C56, PIC16CR56 REGISTER



PIC16C5X

IORLW	Inclusive OR literal with W						
Syntax:	[<i>label</i>] IORLW k						
Operands:	$0 \leq k \leq 255$						
Operation:	(W) .OR. (k) \rightarrow (W)						
Status Affected:	Z						
Encoding:	1101 kkkk kkkk						
Description: The contents of the W register at OR'ed with the eight bit literal 'k'. The result is placed in the W reg ter.							
Words:	1						
Cycles:	1						
Example:	IORLW 0x35						
Before Instru W = After Instruc W = Z =	0x9A tion						

IORWF	Inclusive OR W with f						
Syntax:	[<i>label</i>] IORWF f,d						
Operands:	$\begin{array}{l} 0\leq f\leq 31\\ d\in [0,1] \end{array}$						
Operation:	(W).OR. (f) \rightarrow (dest)						
Status Affected:	Z						
Encoding:	0001 00df ffff						
Description:	Inclusive OR the W register with register 'f'. If 'd' is 0 the result is placed in the W register. If 'd' is 1 the result is placed back in register 'f'.						
Words:	1						
Cycles:	1						
Example:	IORWF RESULT, 0						
Before Instru RESUL W After Instruct RESUL W Z	Γ = 0x13 = 0x91 tion						

MOVF	Move f						
Syntax:	[<i>label</i>] MOVF f,d						
Operands:	$\begin{array}{l} 0 \leq f \leq 31 \\ d \in [0,1] \end{array}$						
Operation:	$(f) \rightarrow (dest)$						
Status Affected:	Z						
Encoding:	0010 00df ffff						
Description:	The contents of register 'f' is moved to destination 'd'. If 'd' is 0, destination is the W register. If 'd' is 1, the destination is file register 'f'. 'd' is 1 is useful to test a file register since status flag Z is affected.						
Words:	1						
Cycles:	1						
Example:	MOVF FSR, 0						
After Instruction W = value in FSR register							

MOVLW	Move Literal to W									
Syntax:	[label]	MOVLW	k							
Operands:	$0 \leq k \leq 2$	55								
Operation:	$k \rightarrow (W)$									
Status Affected:	None									
Encoding:	1100	kkkk	kkkk							
Description:	The eigh the W re		'k' is loaded	d into						
Words:	1									
Cycles:	1									
Example:	MOVLW	0x5A								
After Instruction W = 0x5A										

12.7 Timing Diagrams and Specifications

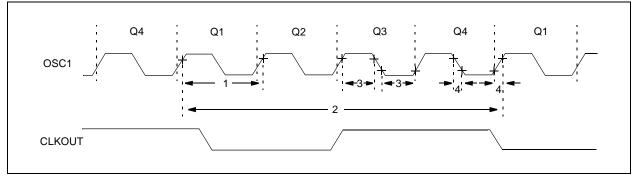


FIGURE 12-2: EXTERNAL CLOCK TIMING - PIC16C54/55/56/57

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

AC Chara	acteristics	$\begin{array}{llllllllllllllllllllllllllllllllllll$					·
Param No.	Symbol	Characteristic	Min	Тур†	Max	Units	Conditions
1A	Fosc	External CLKIN Frequency ⁽¹⁾	DC		4.0	MHz	XT OSC mode
			DC	—	10	MHz	10 MHz mode
			DC	_	20	MHz	HS osc mode (Comm/Ind)
			DC	_	16	MHz	HS osc mode (Ext)
			DC	—	40	kHz	LP osc mode
		Oscillator Frequency ⁽¹⁾	DC	_	4.0	MHz	RC osc mode
			0.1	_	4.0	MHz	XT OSC mode
			4.0	_	10	MHz	10 MHz mode
			4.0	—	20	MHz	HS OSC mode (Comm/Ind)
			4.0	_	16	MHz	HS osc mode (Ext)
			DC	—	40	kHz	LP osc mode

* 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.

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

DC CHARACTERISTICS			Standard Operating Conditions (unless otherwise specified)Operating Temperature $-40^{\circ}C \le TA \le +125^{\circ}C$ for extended						
Param No.	Symbol	Characteristic	Min	Тур†	Мах	Units	Conditions		
D030	VIL	Input Low Voltage							
		I/O ports	Vss		0.15 Vdd	V	Pin at hi-impedance		
		MCLR (Schmitt Trigger)	Vss		0.15 VDD	V			
		T0CKI (Schmitt Trigger)	Vss		0.15 VDD	V			
		OSC1 (Schmitt Trigger)	Vss		0.15 VDD	V	RC mode only ⁽³⁾		
		OSC1	Vss	—	0.3 Vdd	V	XT, HS and LP modes		
D040	Vін	Input High Voltage							
		I/O ports	0.45 Vdd		Vdd	V	For all VDD ⁽⁴⁾		
		I/O ports	2.0		Vdd	V	$4.0V < VDD \le 5.5V^{(4)}$		
		I/O ports	0.36 Vdd		Vdd	V	VDD > 5.5V		
		MCLR (Schmitt Trigger)	0.85 VDD		Vdd	V			
		T0CKI (Schmitt Trigger)	0.85 VDD		Vdd	V			
		OSC1 (Schmitt Trigger)	0.85 VDD		Vdd	V	RC mode only ⁽³⁾		
		OSC1	0.7 Vdd	—	Vdd	V	XT, HS and LP modes		
D050	VHYS	Hysteresis of Schmitt Trigger inputs	0.15 Vdd*	—	_	V			
D060	lı∟	Input Leakage Current ^(1,2)					For VDD ≤ 5.5 V:		
		I/O ports	-1.0	0.5	+1.0	μA	$VSS \leq VPIN \leq VDD$,		
							pin at hi-impedance		
		MCLR	-5.0		_	μA	VPIN = VSS + 0.25V		
		MCLR	_	0.5	+5.0	μΑ	VPIN = VDD		
		TOCKI	-3.0	0.5	+3.0	μΑ	$VSS \leq VPIN \leq VDD$		
		OSC1	-3.0	0.5	+3.0	μA	$VSS \leq VPIN \leq VDD$,		
							XT, HS and LP modes		
D080	Vol	Output Low Voltage							
		I/O ports	I —	—	0.6	V	IOL = 8.7 mA, VDD = 4.5V		
		OSC2/CLKOUT			0.6	V	IOL = 1.6 mA, VDD = 4.5 V,		
							RC mode only		
D090	Voh	Output High Voltage ⁽²⁾							
		I/O ports	Vdd - 0.7	—	—	V	IOH = −5.4 mA, VDD = 4.5\		
		OSC2/CLKOUT	Vdd - 0.7	—	-	V	IOH = -1.0 mA, VDD = 4.5 V RC mode only		

† 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.

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



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

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

AC CharacteristicsStandard Operating Conditions (unless otherwise specified) Operating Temperature $0^{\circ}C \le TA \le +70^{\circ}C$ for commercial $-40^{\circ}C \le TA \le +85^{\circ}C$ for industrial $-40^{\circ}C \le TA \le +125^{\circ}C$ for extended							
Param No.	Symbol	Characteristic Min Typ† Max Units Conditions					
30	TmcL	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 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.

PIC16C5X

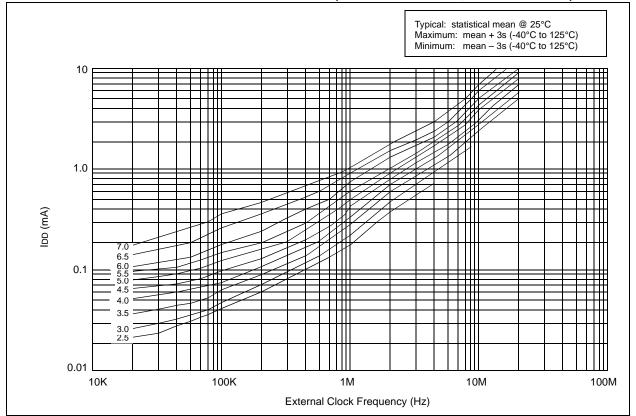
FIGURE 14-2: TYPICAL RC OSC FREQUENCY vs. VDD, CEXT = 20 PF Typical: statistical mean @ 25°C Maximum: mean + 3s (-40°C to 125°C) Minimum: mean – 3s (-40°C to 125°C) 5.5 R = 3.3K5.0 4.5 R = 5K 4.0 3.5 Fosc (MHz) 3.0 R = 10K 2.5 2.0 Measured on DIP Packages, $T = 25^{\circ}C$ 1.5 1.0 R = 100K 0.5 0.0 3.0 3.5 4.0 4.5 5.0 5.5 6.0 VDD (Volts)

FIGURE 14-3:

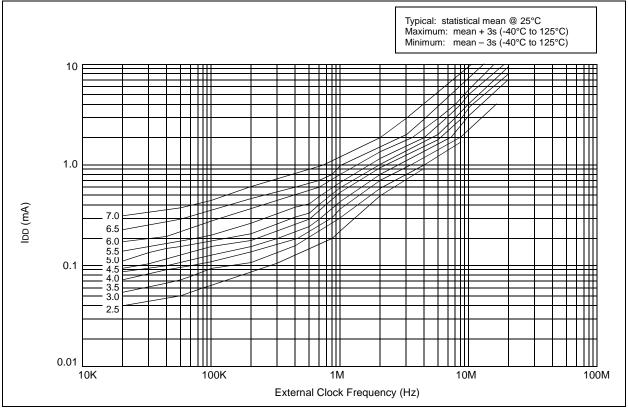
TYPICAL RC OSC FREQUENCY vs. VDD, CEXT = 100 PF













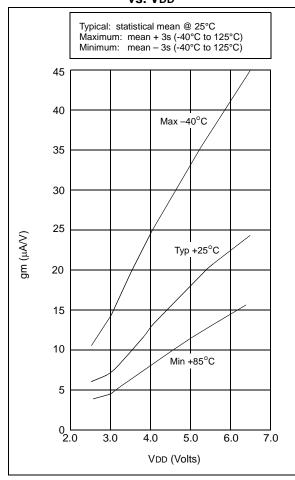


FIGURE 14-18:

TRANSCONDUCTANCE (gm) OF XT OSCILLATOR vs. VDD

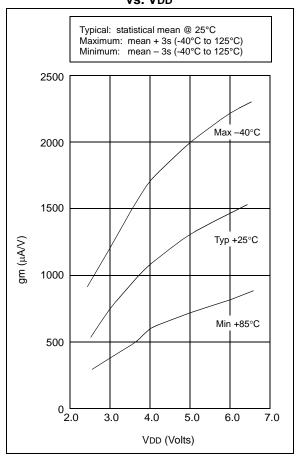




FIGURE 15-4: RESET, WATCHDOG TIMER, AND DEVICE RESET TIMER TIMING - PIC16C54A

TABLE 15-3: RESET, WATCHDOG TIMER, AND DEVICE RESET TIMER - PIC16C54A

Standard Operating Conditions (unless otherwise specified)											
AC Characteristics		Operating Temperature $0^{\circ}C \le TA \le +70^{\circ}C$ for commercial									
		$-40^{\circ}C \le TA \le +85^{\circ}C$ for industrial									
		$-20^{\circ}C \le TA \le +85^{\circ}C$ for industrial - PIC16LV54A-02I									
		$-40^{\circ}C \le TA \le +125^{\circ}C$ for extended									
Param											
No.	Symbol	Characteristic	Min	Тур†	Мах	Units	Conditions				
30	TmcL	MCLR Pulse Width (low)	100*	_	_	ns	VDD = 5.0V				
			1	—	—	μS	VDD = 5.0V (PIC16LV54A only)				
31	Twdt	Watchdog Timer Time-out	9.0*	18*	30*	ms	VDD = 5.0V (Comm)				
		Period (No Prescaler)									
32	TDRT	Device Reset Timer Period	9.0*	18*	30*	ms	VDD = 5.0V (Comm)				
34	Tioz	I/O Hi-impedance from MCLR	_	_	100*	ns					
		Low	—		1μs	—	(PIC16LV54A only)				

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.

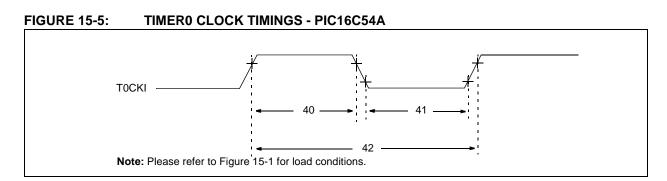


TABLE 15-4: TIMER0 CLOCK REQUIREMENTS - PIC16C54A

		Standard Operating	g Conditions (ur	nless o	therw	ise spe	ecified)			
		Operating Temperat	ture $0^{\circ}C \le TA \le +70^{\circ}C$ for commercial $-40^{\circ}C \le TA \le +85^{\circ}C$ for industrial							
1	AC Chara	octeristics								
			$-20^{\circ}C \le$	TA ≤ +8	85°C fc	or indus	trial - PIC16LV54A-02I			
			$-40^{\circ}C \le$	Ta ≤ +1	25°C	for exte	nded			
Param No.	Symbol	Characteristic	Min	Тур†	Max	Units	Conditions			
40	Tt0H	T0CKI High Pulse Width								
		- No Prescaler	0.5 TCY + 20*	—	—	ns				
		- With Prescaler	10*	—	_	ns				
41	Tt0L	T0CKI Low Pulse Width								
		- No Prescaler	0.5 TCY + 20*	—	—	ns				
		- With Prescaler	10*	—	_	ns				
42	Tt0P	T0CKI Period	20 or <u>TCY + 40</u> *	—	_	ns	Whichever is greater.			
			N				N = Prescale Value			
							(1, 2, 4,, 256)			

* 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.

17.2 DC Characteristics: PIC16C54C/C55A/C56A/C57C/C58B-04E, 20E (Extended) PIC16CR54C/CR56A/CR57C/CR58B-04E, 20E (Extended)

PIC16C54C/C55A/C56A/C57C/C58B-04E, 20E PIC16CR54C/CR56A/CR57C/CR58B-04E, 20E (Extended)			Standard Operating Conditions (unless otherwise specified)Operating Temperature $-40^{\circ}C \le TA \le +125^{\circ}C$ for extended						
Param No.	Symbol	Characteristic	haracteristic Min Typ† Max U		Units	Conditions			
D001	Vdd	Supply Voltage	3.0 4.5		5.5 5.5		RC, XT, LP, and HS mode from 0 - 10 MHz from 10 - 20 MHz		
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⁾ XT and RC ⁽³⁾ modes HS mode	_	1.8 9.0	3.3 20	mA mA	Fosc = 4.0 MHz, VDD = 5.5V Fosc = 20 MHz, VDD = 5.5V		
D020	IPD	Power-down Current ⁽²⁾		0.3 10 12 4.8 18 26	17 50* 60* 31* 68* 90*	μΑ μΑ μΑ μΑ μΑ μΑ	VDD = 3.0V, WDT disabled VDD = 4.5V, WDT disabled VDD = 5.5V, WDT disabled VDD = 3.0V, WDT enabled VDD = 4.5V, WDT enabled VDD = 5.5V, WDT enabled		

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, TOCKI = 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.
 - **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.

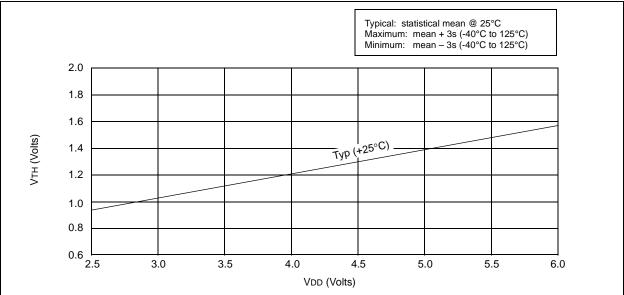
17.3 DC Characteristics: PIC16C54C/C55A/C56A/C57C/C58B-04, 20 (Commercial, Industrial, Extended) PIC16LC54C/LC55A/LC56A/LC57C/LC58B-04 (Commercial, Industrial) PIC16CR54C/CR56A/CR57C/CR58B-04, 20 (Commercial, Industrial, Extended) PIC16LCR54C/LCR56A/LCR57C/LCR58B-04 (Commercial, Industrial)

DC CHARACTERISTICS		Standard Operating Con Operating Temperature		0°C ≤ 1 –40°C ≤	otherwise specified))°C for commercial 5°C for industrial 25°C for extended		
Param No.	Symbol	Characteristic	Min	Тур†	Max	Units	Conditions
D030	VIL	Input Low Voltage I/O Ports I/O Ports MCLR (Schmitt Trigger) T0CKI (Schmitt Trigger) OSC1 (Schmitt Trigger) OSC1	Vss Vss Vss Vss Vss Vss Vss		0.8 V 0.15 VDD 0.15 VDD 0.15 VDD 0.15 VDD 0.3 VDD	V V V V V V	4.5V <v<sub>DD \leq 5.5V Otherwise RC mode only⁽³⁾ XT, HS and LP modes</v<sub>
D040	Viн	Input High Voltage I/O ports I/O ports MCLR (Schmitt Trigger) TOCKI (Schmitt Trigger) OSC1 (Schmitt Trigger) OSC1	2.0 0.25 Vdd+0.8 0.85 Vdd 0.85 Vdd 0.85 Vdd 0.85 Vdd 0.7 Vdd	 	Vdd Vdd Vdd Vdd Vdd Vdd Vdd	V V V V V	4.5V < VDD ≤ 5.5V Otherwise RC mode only ⁽³⁾ XT, HS and LP modes
D050	VHYS	Hysteresis of Schmitt Trigger inputs	0.15 Vdd*	—	_	V	
D060	Ιι∟	Input Leakage Current ^(1,2) 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 —	μΑ μΑ μΑ μΑ μΑ	For VDD \leq 5.5V: VSS \leq VPIN \leq VDD, pin at hi-impedance VPIN = VSS +0.25V VPIN = VDD VSS \leq VPIN \leq VDD VSS \leq VPIN \leq VDD, XT, HS and LP modes
D080	Vol	Output Low Voltage I/O ports OSC2/CLKOUT		_	0.6 0.6	V V	IOL = 8.7 mA, VDD = 4.5V IOL = 1.6 mA, VDD = 4.5V, RC mode only
D090	Vон	Output High Voltage ⁽²⁾ 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

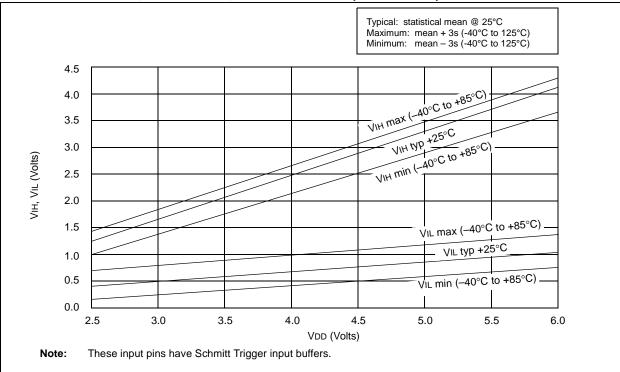
† Data in the Typical ("Typ") column is based on characterization results at 25°C. This data is for design guidance only and is not tested.

- 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.









© 1997-2013 Microchip Technology Inc.

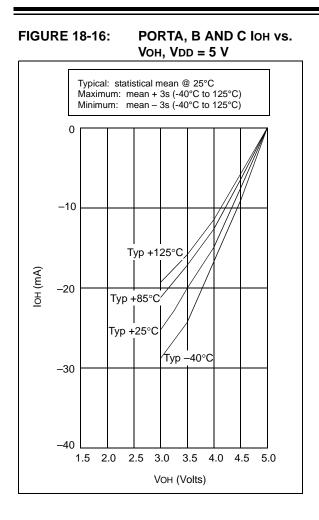
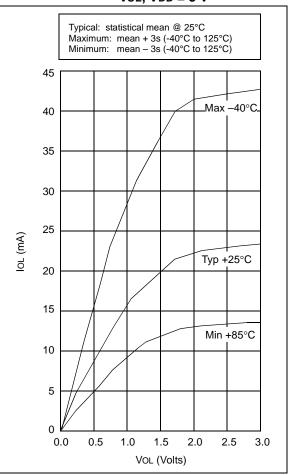


FIGURE 18-17: PORTA, B AND C IOL vs. Vol, VDD = 3 V



19.4 **Timing Diagrams and Specifications**

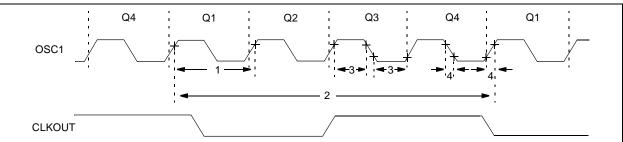


FIGURE 19-3: EXTERNAL CLOCK TIMING - PIC16C5X-40

EXTERNAL CLOCK TIMING REQUIREMENTS - PIC16C5X-40 TABLE 19-1:

AC Characteristics		Standard Operating Conditions (unless otherwise specified)Operating Temperature $0^{\circ}C \le TA \le +70^{\circ}C$ for commercial							
Param No.	Symbol	Characteristic	Min	Тур†	Max	Units	Conditions		
	Fosc	External CLKIN Frequency ⁽¹⁾	20	_	40	MHz	HS osc mode		
1	Tosc	External CLKIN Period ⁽¹⁾	25	_	_	ns	HS OSC mode		
2	Тсу	Instruction Cycle Time ⁽²⁾	—	4/Fosc	_	—			
3	TosL, TosH	Clock in (OSC1) Low or High Time	6.0*	_	_	ns	HS oscillator		
4	TosR, TosF	Clock in (OSC1) Rise or Fall Time	—	_	6.5*	ns	HS oscillator		

- * 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.

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights.

QUALITY MANAGEMENT SYSTEM CERTIFIED BY DNV = ISO/TS 16949=

Trademarks

The Microchip name and logo, the Microchip logo, dsPIC, FlashFlex, KEELOQ, KEELOQ logo, MPLAB, PIC, PICmicro, PICSTART, PIC³² logo, rfPIC, SST, SST Logo, SuperFlash and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

FilterLab, Hampshire, HI-TECH C, Linear Active Thermistor, MTP, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

Analog-for-the-Digital Age, Application Maestro, BodyCom, chipKIT, chipKIT logo, CodeGuard, dsPICDEM, dsPICDEM.net, dsPICworks, dsSPEAK, ECAN, ECONOMONITOR, FanSense, HI-TIDE, In-Circuit Serial Programming, ICSP, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, mTouch, Omniscient Code Generation, PICC, PICC-18, PICDEM, PICDEM.net, PICkit, PICtail, REAL ICE, rfLAB, Select Mode, SQI, Serial Quad I/O, Total Endurance, TSHARC, UniWinDriver, WiperLock, ZENA and Z-Scale are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

GestIC and ULPP are registered trademarks of Microchip Technology Germany II GmbH & Co. & KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 1997-2013, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

Printed on recycled paper.

ISBN: 9781620769355

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and mulfacture of development systems is ISO 9001:2000 certified.