9.0 ELECTRICAL CHARACTERISTICS

9.1 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} ..... 0 to +7.5V
Voltage on $\overline{MCLR}$ with respect to V_{SS} ..... 0 to +14V
Voltage on all other pins with respect to V_{SS} ..... -0.6V to V_{DD} + 0.6V
Total power dissipation (Note 1) ..... 800 mW
Max. current out of V_{SS} pin ..... 150 mA
Max. current into V_{DD} pin ..... 50 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_0 < 0 or V_0 > 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: Total power dissipation should not exceed 800 mW for the package. Power dissipation is calculated as follows:

$$P_{dis} = V_{DD} \times \{I_{DD} - \Sigma I_{OH}\} + \Sigma \{(V_{DD}-V_{OH}) \times I_{OH}\} + \Sigma(V_{OL} \times I_{OL})$$

†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.

TABLE 9-1: CROSS REFERENCE OF DEVICE SPECS FOR OSCILLATOR CONFIGURATIONS AND FREQUENCIES OF OPERATION (COMMERCIAL DEVICES)

OSC	16C5X-04	16C5X-10	16C5X-20	16LC5X-04
RC	V_{DD}: 3.0V to 6.25V I_{DD}: 2.4 mA Max. at 5.5V I_{PD}: 4 µA Max. at 3.0V WDT dis Freq: 4 MHz Max.	V_{DD}: 4.5V to 5.5V I_{DD}: 1.7 mA typ. at 5.5V I_{PD}: 0.25 µA typ. at 3.0V WDT dis Freq: 4 MHz Max.	V_{DD}: 4.5V to 5.5V I_{DD}: 1.7 mA typ. at 5.5V I_{PD}: 0.25 µA typ. at 3.0V WDT dis Freq: 4 MHz Max.	V_{DD}: 2.5V to 6.25V I_{DD}: 0.5 mA typ. at 5.5V I_{PD}: 4 µA Max. at 2.5V WDT dis Freq: 2 MHz Max.
XT	V_{DD}: 3.0V to 6.25V I_{DD}: 2.4 mA Max. at 5.5V I_{PD}: 5 µA Max. at 3.0V WDT dis Freq: 4 MHz Max.	V_{DD}: 4.5V to 5.5V I_{DD}: 1.7 mA typ. at 5.5V I_{PD}: 0.25 µA typ. at 3.0V WDT dis Freq: 4 MHz Max.	V_{DD}: 4.5V to 5.5V I_{DD}: 1.7 mA typ. at 5.5V I_{PD}: 0.25 µA typ. at 3.0V WDT dis Freq: 4 MHz Max.	V_{DD}: 2.5V to 6.25V I_{DD} 0.5 mA typ. at 5.5V I_{PD}: 4 µA Max. at 2.5V WDT dis Freq: 4 MHz Max.
HS	V_{DD}: 4.5V to 5.5V I_{DD}: 1.8 mA typ. at 5.5V I_{PD}: 0.3 µA typ. at 3.0V WDT dis Freq: 4 MHz Max.	V_{DD}: 4.5V to 5.5V I_{DD}: 8 mA Max. at 5.5V I_{PD}: 4 µA Max. at 3.0V WDT dis Freq: 10 MHz Max.	V_{DD}: 4.5V to 5.5V I_{DD}: 16 mA Max. at 5.5V I_{PD}: 4 µA Max. at 3.0V WDT dis Freq: 20 MHz Max.	Do not use in HS mode
LP	V_{DD}: 4.5V to 5.5V I_{DD}: 17 µA typ. at 32 kHz, 3.0V I_{PD}: 0.3 µA typ. at 3.0V WDT dis Freq: 200 kHz typ.	Do not use in LP mode	Do not use in LP mode	V_{DD}: 2.5V to 6.25V I_{DD}: 11 µA typ. at 32 kHz, 2.5V I_{PD}: 0.25 µA typ. at 2.5V WDT dis Freq: 200 kHz typ.

The shaded sections indicate oscillator selections which are tested for functionality, but not for MIN/MAX specifications. It is recommended that the user select the device type that guarantees the specifications required.

TABLE 9-2: DC CHARACTERISTICS: PIC16C5X-RC, XT, HS, LP (COMMERCIAL)

DC Characteristics Power Supply Pins		Standard Operating Conditions Operating Temperature 0°C ≤ TA ≤ +70°C, unless otherwise stated. Operating Voltage VDD = 3.0V to 5.5V, unless otherwise stated.				
Characteristic	**Sym**	**Min**	**Typ (Note 1)**	**Max**	**Units**	**Conditions**
Supply Voltage						
PIC16C5X-XT	VDD	3.0		6.25	V	FOSC = DC to 4 MHz
PIC16C5X-RC		3.0		6.25	V	FOSC = DC to 4 MHz
PIC16C5X-HS		4.5		5.5	V	FOSC = DC to 20 MHz
PIC16C5X-LP		2.5		6.25	V	FOSC = DC to 40 kHz
RAM Data Retention Voltage (Note 3)	VDR		1.5		V	Device in SLEEP mode
VDD start voltage to guarantee Power-On Reset	VPOR		VSS		V	See Section 7.4 for details on Power-On Reset
VDD rise rate to guarantee Power-On Reset	SVDD	0.05*			V/ms	See Section 7.4 for details on Power-On Reset
Supply Current (Note 2)						
PIC16C5X-XT	IDD		1.8	3.3	mA	FOSC = 4 MHz, VDD = 5.5V
PIC16C5X-RC (Note 5)			1.8	3.3	mA	FOSC = 4 MHz, VDD = 5.5V
PIC16C5X-HS			4.8	10	mA	FOSC = 10 MHz, VDD = 5.5V
			9.0	20	mA	FOSC = 20 MHz, VDD = 5.5V
PIC16C5X-LP			15	32	µA	FOSC = 32 kHz, VDD = 3.0V, WDT disabled
Power Down Current (Note 4)						
PIC16C5X	IPD		4	12	µA	VDD = 3.0V, WDT enabled
			0.6	9	µA	VDD = 3.0V, WDT disabled

* These parameters are based on characterization and are not tested.

Note 1: Data in the column labeled "Typical" is based on characterization results at 25°C. This data is for design guidance only and is not tested for, or guaranteed by Microchip Technology.

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 VDD, T0CKI = VDD, $\overline{MCLR}$ = VDD; WDT enabled/disabled as specified.
b) For stand-by current measurements, the conditions are the same, except that the device is in SLEEP mode.

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

4: The power down current in SLEEP mode does not depend on the oscillator type. Power down current is measured with the part in SLEEP mode, with all I/O pins in hi-impedance state and tied to VDD and VSS.

5: Does not include current through Rext. The current through the resistor can be estimated by the formula: IR = VDD/2Rext (mA) with Rext in kOhm.

TABLE 9-3: DC CHARACTERISTICS: PIC16C5XI-RC, XT, HS, LP (INDUSTRIAL)

DC Characteristics Power Supply Pins		Standard Operating Conditions Operating Temperature -40°C ≤ TA ≤ +85°C, unless otherwise stated. Operating Voltage VDD = 3.5V to 5.5V, unless otherwise stated.				
Characteristic	**Sym**	**Min**	**Typ (Note 1)**	**Max**	**Units**	**Conditions**
Supply Voltage						
PIC16C5XI-XT	VDD	3.0		6.25	V	FOSC = DC to 4 MHz
PIC16C5XI-RC		3.0		6.25	V	FOSC = DC to 4 MHz
PIC16C5XI-HS		4.5		5.5	V	FOSC = DC to 20 MHz
PIC16C5XI-LP		2.5		6.25	V	FOSC = DC to 40 kHz
RAM Data Retention Voltage (Note 3)	VDR		1.5		V	Device in SLEEP mode
VDD start voltage to guarantee Power-On Reset	VPOR		VSS		V	See Section 7.4 for details on Power-On Reset
VDD rise rate to guarantee Power-On Reset	SVDD	0.05*			V/ms	See Section 7.4 for details on Power-On Reset
Supply Current (Note 2)						
PIC16C5XI-XT	IDD		1.8	3.3	mA	FOSC = 4 MHz, VDD = 5.5V
PIC16C5XI-RC (Note 5)			1.8	3.3	mA	FOSC = 4 MHz, VDD = 5.5V
PIC16C5XI-HS			4.8	10	mA	FOSC = 10 MHz, VDD = 5.5V
			9.0	20	mA	FOSC = 20 MHz, VDD = 5.5V
PIC16C5XI-LP			19	40	µA	FOSC = 32 kHz, VDD = 3.0V, WDT disabled
Power Down Current (Note 4)						
PIC16C5XI	IPD		5	14	µA	VDD = 3.0V, WDT enabled
			0.6	12	µA	VDD = 3.0V, WDT disabled

* These parameters are based on characterization and are not tested.

Note 1: Data in the column labeled "Typical" is based on characterization results at 25°C. This data is for design guidance only and is not tested for, or guaranteed by Microchip Technology.

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 VDD, T0CKI = VDD, $\overline{MCLR}$ = VDD; WDT enabled/disabled as specified.
b) For stand-by current measurements, the conditions are the same, except that the device is in SLEEP mode.

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

4: The power down current in SLEEP mode does not depend on the oscillator type. Power down current is measured with the part in SLEEP mode, with all I/O pins in hi-impedance state and tied to VDD and VSS.

5: Does not include current through Rext. The current through the resistor can be estimated by the formula: IR = VDD/2Rext (mA) with Rext in kOhm.

2

TABLE 9-4: DC CHARACTERISTICS: PIC16C5XE-RC, XT, HS, LP (AUTOMOTIVE)

DC Characteristics Power Supply Pins		Standard Operating Conditions Operating Temperature -40°C ≤ TA ≤ +125°C, unless otherwise stated. Operating Voltage VDD = 3.5V to 5.5V, unless otherwise stated.				
Characteristic	**Sym**	**Min**	**Typ (Note 1)**	**Max**	**Units**	**Conditions**
Supply Voltage						
PIC16C5XE-XT	VDD	3.25		6.0	V	FOSC = DC to 4 MHz
PIC16C5XE-RC		3.25		6.0	V	FOSC = DC to 4 MHz
PIC16C5XE-HS		4.5		5.5	V	FOSC = DC to 20 MHz
PIC16C5XE-LP		2.5		6.0	V	FOSC = DC to 40 kHz
RAM Data Retention Voltage (Note 3)	VDR		1.5		V	Device in SLEEP mode
VDD Start Voltage to Guarantee Power-On Reset	VPOR		VSS		V	See Section 7.4 for details on Power-On Reset
VDD rise rate to guarantee Power-On Reset	SVDD	0.05*			V/ms	See Section 7.4 for details on Power-On Reset
Supply Current (Note 2)						
PIC16C5XE-XT	IDD		1.8	3.3	mA	FOSC = 4 MHz, VDD = 5.5V
PIC16C5XE-RC (Note 5)			1.8	3.3	mA	FOSC = 4 MHz, VDD = 5.5V
PIC16C5XE-HS			4.8	10	mA	FOSC = 10 MHz, VDD = 5.5V
			9.0	20	mA	FOSC = 16 MHz, VDD = 5.5V
PIC16C5XE-LP			25	55	µA	FOSC = 32 kHz, VDD = 3.25V, WDT disabled
Power Down Current (Note 4)						
PIC16C5XE	IPD		5	22	µA	VDD = 3.25V, WDT enabled
			0.8	18	µA	VDD = 3.25V, WDT disabled

* These parameters are based on characterization and are not tested.

Note 1: Data in the column labeled "Typical" is based on characterization results at 25°C. This data is for design guidance only and is not tested for, or guaranteed by Microchip Technology.

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 VDD, T0CKI = VDD, $\overline{MCLR}$ = VDD; WDT enabled/disabled as specified.
b) For stand-by current measurements, the conditions are the same, except that the device is in SLEEP mode.

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

4: The power down current in SLEEP mode does not depend on the oscillator type. Power down current is measured with the part in SLEEP mode, with all I/O pins in hi-impedance state and tied to VDD and VSS.

5: Does not include current through Rext. The current through the resistor can be estimated by the formula: IR = VDD/2Rext (mA) with Rext in kOhm.

TABLE 9-5: DC CHARACTERISTICS:PIC16C5X-RC, XT, HS, LP (COMMERCIAL) PIC16C5XI-RC, XT, HS, LP (INDUSTRIAL)

DC Characteristics All Pins Except Power Supply Pins		Standard Operating Conditions Operating Temperature -40°C ≤ TA ≤ +85°C (for industrial) 0°C ≤ TA ≤ +70°C (for commercial) Operating Voltage VDD range is described in Section 9.1 and Section 9.2.				
Characteristic	**Sym**	**Min**	**Typ (Note 1)**	**Max**	**Units**	**Conditions**
Input Low Voltage						
I/O ports	VIL	VSS		0.2 VDD	V	Pin at hi-impedance
$\overline{MCLR}$ (Schmitt Trigger)		VSS		0.15 VDD	V	
T0CKI (Schmitt Trigger)		VSS		0.15 VDD	V	
OSC1 (Schmitt Trigger)		VSS		0.15 VDD	V	PIC16C5X-RC only (Note 5)
OSC1		VSS		0.3 VDD	V	PIC16C5X-XT, HS, LP
Input High Voltage						
I/O ports	VIH	0.45 VDD		VDD	V	For all VDD (Note 6)
		2.0		VDD	V	4.0V < VDD ≤ 5.5V (Note 6)
		0.36 VDD		VDD	V	VDD > 5.5V
$\overline{MCLR}$ (Schmitt Trigger)		0.85 VDD		VDD	V	
T0CKI (Schmitt Trigger)		0.85 VDD		VDD	V	
OSC1 (Schmitt Trigger)		0.85 VDD		VDD	V	PIC16C5X-RC only (Note 5)
OSC1		0.7 VDD		VDD	V	PIC16C5X-XT, HS, LP
Input Leakage Current (Notes 3,4)						**For VDD ≤ 5.5V**
I/O ports	IIL	-1	0.5	+1	µA	VSS ≤ VPIN ≤ VDD, Pin at hi-impedance
$\overline{MCLR}$		-5			µA	VPIN = VSS + 0.25V
$\overline{MCLR}$			0.5	+5	µA	VPIN = VDD
T0CKI		-3	0.5	+3	µA	VSS ≤ VPIN ≤ VDD
OSC1		-3	0.5	+3	µA	VSS ≤ VPIN ≤ VDD PIC16C5X-XT, HS, LP
Output Low Voltage						
I/O ports	VOL			0.6	V	IOL = 8.7 mA, VDD = 4.5V
OSC2/CLKOUT (PIC16C5X-RC)				0.6	V	IOL = 1.6 mA, VDD = 4.5V
Output High Voltage						
I/O ports (Note 4)	VOH	VDD-0.7			V	IOH = -5.4 mA, VDD = 4.5V
OSC2/CLKOUT (PIC16C5X-RC)		VDD-0.7			V	IOH = -1.0 mA, VDD = 4.5V

Note 1: Data in the column labeled "Typical" is based on characterization results at 25°C. This data is for design guidance only and is not tested for, or guaranteed by Microchip Technology.

2: Total power dissipation as stated under absolute maximum ratings must not be exceeded.

3: The leakage current on the $\overline{MCLR}$/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.

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

5: 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.

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

TABLE 9-6: DC CHARACTERISTICS: PIC16C5X-RC, XT, HS, LP (AUTOMOTIVE)

DC Characteristics All Pins Except Power Supply Pins	Standard Operating Conditions Operating Temperature -40°C ≤ TA ≤ +125°C Operating Voltage VDD range is described in Section 9.1 and Section 9.2.					
Characteristic	**Sym**	**Min**	**Typ (Note 1)**	**Max**	**Units**	**Conditions**
Input Low Voltage						
I/O ports	VIL	VSS		0.15 VDD	V	Pin at hi-impedance
$\overline{MCLR}$ (Schmitt Trigger)		VSS		0.15 VDD	V	
T0CKI (Schmitt Trigger)		VSS		0.15 VDD	V	
OSC1 (Schmitt Trigger)		VSS		0.15 VDD	V	PIC16C5X-RC only (Note 5)
OSC1		VSS		0.3 VDD	V	PIC16C5X-XT, HS, LP
Input High Voltage						
I/O ports	VIH	0.45 VDD		VDD	V	For all VDD (Note 6)
		2.0		VDD	V	4.0V < VDD ≤ 5.5V (Note 6)
		0.36 VDD		VDD	V	VDD > 5.5V
$\overline{MCLR}$ (Schmitt Trigger)		0.85 VDD		VDD	V	
T0CKI (Schmitt Trigger)		0.85 VDD		VDD	V	
OSC1 (Schmitt Trigger)		0.85 VDD		VDD	V	PIC16C5X-RC only (Note 5)
OSC1		0.7 VDD		VDD	V	PIC16C5X-XT, HS, LP
Input Leakage Current (Notes 3,4)						**For VDD ≤ 5.5V**
I/O ports	IIL	-1	0.5	+1	µA	VSS ≤ VPIN ≤ VDD, Pin at hi-impedance
$\overline{MCLR}$		-5			µA	VPIN = VSS + 0.25V
$\overline{MCLR}$			0.5	+5	µA	VPIN = VDD
T0CKI		-3	0.5	+3	µA	VSS ≤ VPIN ≤ VDD
OSC1		-3	0.5	+3	µA	VSS ≤ VPIN ≤ VDD PIC16C5X-XT, HS, LP
Output Low Voltage						
I/O ports	VOL			0.6	V	IOL = 8.7 mA, VDD = 4.5V
OSC2/CLKOUT (PIC16C5X-RC)				0.6	V	IOL = 1.6 mA, VDD = 4.5V
Output High Voltage						
I/O ports (Note 4)	VOH	VDD-0.7			V	IOH = -5.4 mA, VDD = 4.5V
OSC2/CLKOUT (PIC16C5X-RC)		VDD-0.7			V	IOH = -1.0 mA, VDD = 4.5V

Note 1: Data in the column labeled Typical is based on characterization results at 25°C. This data is for design guidance only and is not tested for, or guaranteed by Microchip Technology.

2: Total power dissipation as stated under absolute maximum ratings must not be exceeded.

3: The leakage current on the $\overline{MCLR}$/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.

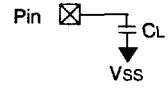
4: Negative current is defined as coming out of the pin.

5: 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.

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

9.2 Timing Diagrams and Specifications

FIGURE 9-1: LOAD CONDITIONS



C_L = 50 pF for all pins except OSC2
15 pF for OSC2 in XT, HS or LP modes when external clock is used to drive OSC1

FIGURE 9-2: EXTERNAL CLOCK TIMING

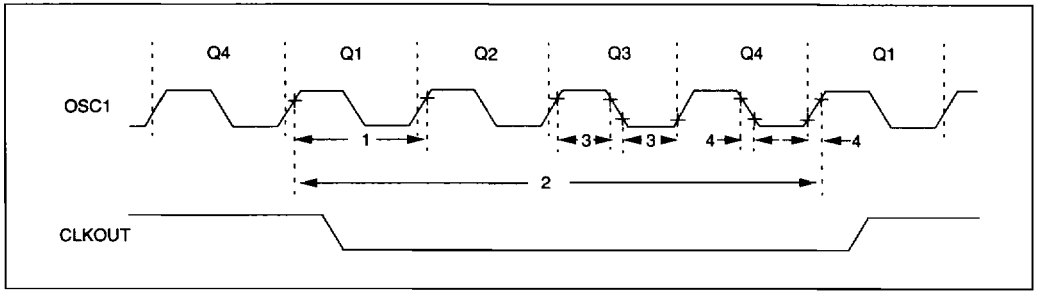


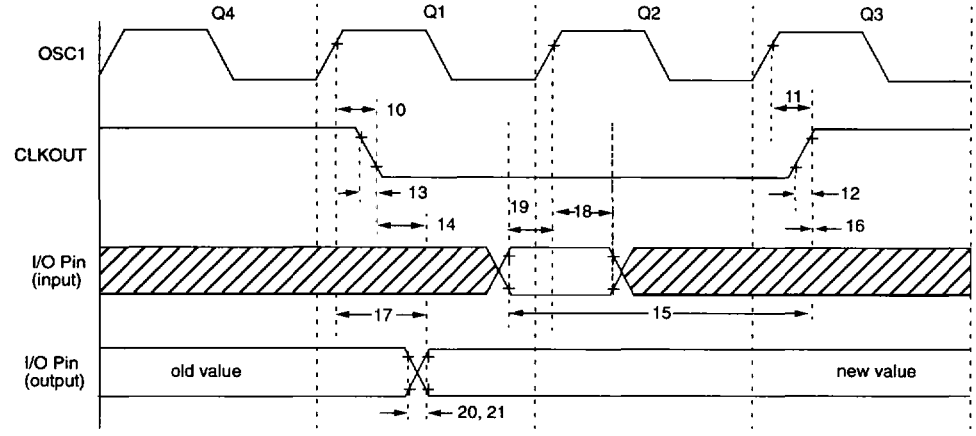
TABLE 9-7: EXTERNAL CLOCK TIMING REQUIREMENTS

Parameter No.	Sym	Characteristic	Min	Typ†	Max	Units	Conditions
	Fosc	External CLKIN Frequency (Note 1)	DC	—	4	MHz	RC osc mode
			DC	—	4	MHz	XT osc mode
			DC	—	20	MHz	HS osc mode (Comm/Indust)
			DC	—	16	MHz	HS osc mode (Automotive)
			DC	—	40	kHz	LP osc mode
		Oscillator Frequency (Note 1)	DC	—	4	MHz	RC osc mode
			0.1	—	4	MHz	XT osc mode
			4	—	20	MHz	HS osc mode (Comm/Indust)
			4	—	16	MHz	HS osc mode (Automotive)
			5	—	40	kHz	LP osc mode
1	Tosc	External CLKIN Period (Note 1)	250	—	—	ns	RC osc mode
			250	—	—	ns	XT osc mode
			50	—	—	ns	HS osc mode
			100	—	—	µs	LP osc mode
		Oscillator Period (Note 1)	250	—	—	ns	RC osc mode
			250	—	10,000	ns	XT osc mode
			62.5	—	250	ns	HS osc mode (Comm/Indust)
			50	—	250	ns	HS osc mode (Automotive)
			100	—	200	µs	LP osc mode
2	Tcy	Instruction Cycle Time (Note 1)	1.0	—	DC	µs	
3	TosL, TosH	Clock in (OSC1) Low or High Time	50	—	—	ns	XT oscillator
			2.5	—	—	µs	LP oscillator
			10	—	—	ns	HS oscillator
4	TosR, TosF	Clock in (OSC1) Rise or Fall Time	25	—	—	ns	XT oscillator
			50	—	—	ns	LP oscillator
			15	—	—	ns	HS oscillator

† 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: Instruction cycle period (Tcy) equals four times the input oscillator time base period. 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. All devices are tested to operate at "min." values with an external clock applied to the OSC1/CLKIN pin.
When an external clock input is used, the "Max." cycle time limit is "DC" (no clock) for all devices.

FIGURE 9-3: CLKOUT AND I/O TIMING



Note: All tests must be done with specified capacitive loads (see datasheet) 50 pF on I/O pins and CLKOUT.

TABLE 9-8: CLKOUT AND I/O TIMING REQUIREMENTS

Parameter No.	Sym	Characteristic	Min	Typ†	Max	Units	Conditions
10	TosH2ckL	OSC1↑ to CLKOUT↓	—	15	30	ns	Note 1
11	TosH2ckH	OSC1↑ to CLKOUT↑	—	15	30	ns	Note 1
12	TckR	CLKOUT rise time	—	5	15	ns	Note 1
13	TckF	CLKOUT fall time	—	5	15	ns	Note 1
14	TckL2ioV	CLKOUT↓ to Port out valid	—	—	0.5 TCY+20	ns	Note 1
15	TioV2ckH	Port in valid before CLKOUT↑	0.25 TCY+25	—	—	ns	Note 1
16	TckH2iol	Port in hold after CLKOUT↑	0	—	—	ns	Note 1
17	TosH2ioV	OSC1↑ (Q1 cycle) to Port out valid	—	—	80 - 100	ns	Note 2
18	TosH2iol	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	—	10	25	ns	Note 2
21	TioF	Port output fall time	—	10	25	ns	Note 2

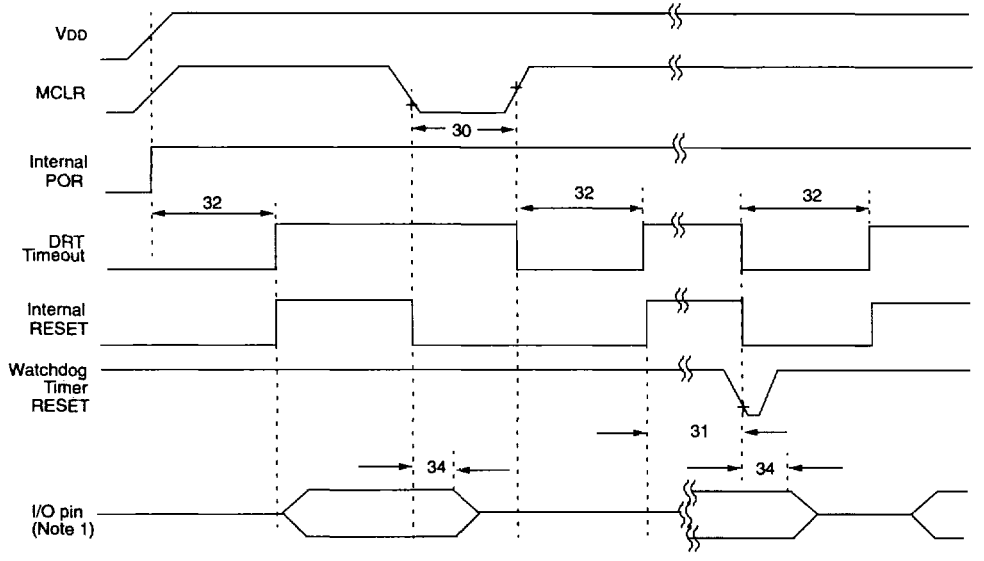
* These parameters are characterized but not tested.

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

2: See Figure 9-1 for loading conditions.

FIGURE 9-4: RESET, WATCHDOG TIMER, AND DEVICE RESET TIMER TIMING



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

TABLE 9-9: RESET, WATCHDOG TIMER, AND DEVICE RESET TIMER

Parameter No.	Sym	Characteristic	Min	Typ†	Max	Units	Conditions
30	TmcL	$\overline{\text{MCLR}}$ Pulse Width (low)	100	—	—	ns	VDD = 5V, -40°C to +125°C
31	Twdt	Watchdog Timer Timeout Period (No Prescaler)	9*	18	30*	ms	VDD = 5V, -40°C to +125°C
32	TDRT	Device Reset Timer Period	9*	18*	30*	ms	VDD = 5V, -40°C to +125°C
34	TioZ	I/O Hi-impedance from $\overline{\text{MCLR}}$ Low			100	ns	

* 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.

FIGURE 9-5: TIMER0 CLOCK TIMINGS

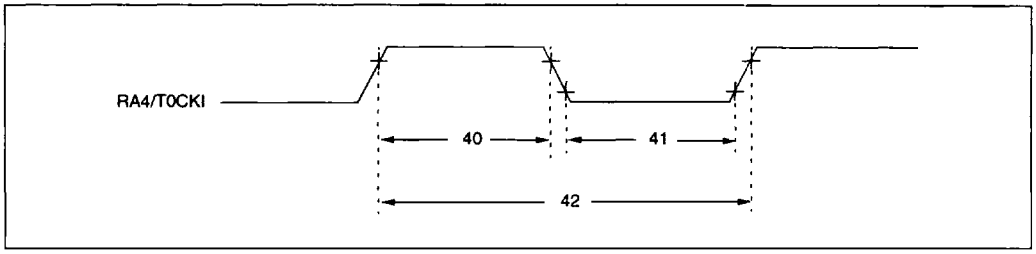


TABLE 9-10: TIMER0 CLOCK REQUIREMENTS

Parameter No.	Sym	Characteristic		Min	Typ†	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		$\frac{T_{CY} + 40^*}{N}$	—	—	ns	N = prescale value (1, 2, 4, ..., 256)

* 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.