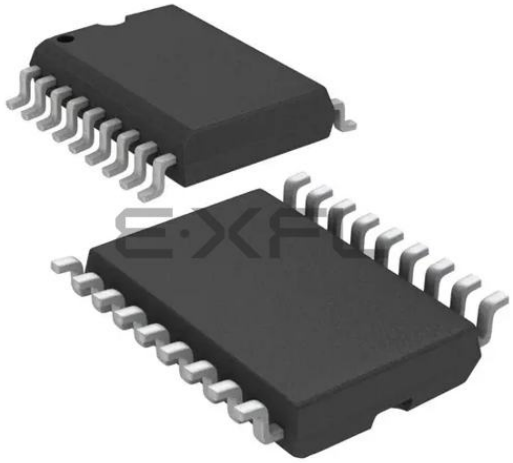

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## What is "Embedded - Microcontrollers"?

"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 | 3KB (2K x 12) |
| Program Memory Type | OTP |
| EEPROM Size | - |
| RAM Size | 73 x 8 |
| Voltage - Supply (Vcc/Vdd) | 3V ~ 5.5V |
| Data Converters | - |
| Oscillator Type | External |
| Operating Temperature | -40°C ~ 85°C (TA) |
| Mounting Type | Surface Mount |
| Package / Case | 18-SOIC (0.295", 7.50mm Width) |
| Supplier Device Package | 18-SOIC |
| Purchase URL | https://www.e-xfl.com/product-detail/microchip-technology/pic16c58b-04i-so |

**NOTES:**

**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(2)
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.

| Legend: | | | |
|---|---|---|---|
| R = Readable bit | W = Writable bit | U = Unimplemented bit, read as '0' | |
| -n = Value at POR | 1 = bit is set | 0 = bit is cleared | x = bit is unknown |

**RLF** **Rotate Left f through Carry**

Syntax: [ *label* ] RLF f,d

Operands: $0 \le f \le 31$
$d \in [0,1]$

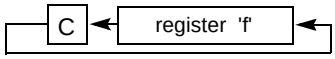
Operation: See description below

Status Affected: C

Encoding:

| 0011 | 01df | ffff |
|---|---|---|

Description: The contents of register 'f' are rotated one bit to the left through the Carry Flag (STATUS<0>). If 'd' is 0 the result is placed in the W register. If 'd' is 1 the result is stored back in register 'f'.




Words: 1

Cycles: 1

Example:
```
RLF    REG1,0
```
Before Instruction
```
REG1    =  1110 0110
C       =  0
```
After Instruction
```
REG1    =  1110 0110
W       =  1100 1100
C       =  1
```

**RRF** **Rotate Right f through Carry**

Syntax: [ *label* ] RRF f,d

Operands: $0 \le f \le 31$
$d \in [0,1]$

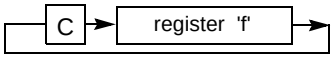
Operation: See description below

Status Affected: C

Encoding:

| 0011 | 00df | ffff |
|---|---|---|

Description: The contents of register 'f' are rotated one bit to the right through the Carry Flag (STATUS<0>). 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:
```
RRF    REG1,0
```
Before Instruction
```
REG1    =  1110 0110
C       =  0
```
After Instruction
```
REG1    =  1110 0110
W       =  0111 0011
C       =  0
```

**SLEEP** **Enter SLEEP Mode**

Syntax: [*label*] SLEEP

Operands: None

Operation: 00h → WDT;
0 → WDT prescaler; if assigned
1 → $\overline{TO}$;
0 → $\overline{PD}$

Status Affected: $\overline{TO}$, $\overline{PD}$

Encoding:

| 0000 | 0000 | 0011 |
|---|---|---|

Description: Time-out status bit ($\overline{TO}$) is set. The power-down status bit ($\overline{PD}$) is cleared. The WDT and its prescaler are cleared.
The processor is put into SLEEP mode with the oscillator stopped. See section on SLEEP for more details.

Words: 1

Cycles: 1

Example:
```
SLEEP
```

**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: $0 \le f \le 31$
$d \in [0,1]$

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

## 11.13 PICDEM 3 Low Cost PIC16CXXX Demonstration Board

The PICDEM 3 demonstration board is a simple demonstration board that supports the PIC16C923 and PIC16C924 in the PLCC package. It will also support future 44-pin PLCC microcontrollers with an LCD Module. 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 3 demonstration board on a PRO MATE II device programmer, or a PICSTART Plus development programmer with an adapter socket, and easily test firmware. The MPLAB ICE in-circuit emulator may also be used with the PICDEM 3 demonstration board to test firmware. A prototype area has been provided to the user for adding 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 thermistor and separate headers for connection to an external LCD module and a keypad. Also provided on the PICDEM 3 demonstration board is a LCD panel, with 4 commons and 12 segments, that is capable of displaying time, temperature and day of the week. The PICDEM 3 demonstration board provides an additional RS-232 interface and Windows software for showing the demultiplexed LCD signals on a PC. A simple serial interface allows the user to construct a hardware demultiplexer for the LCD signals.

## 11.14 PICDEM 17 Demonstration Board

The PICDEM 17 demonstration board is an evaluation board that demonstrates the capabilities of several Microchip microcontrollers, including PIC17C752, PIC17C756A, PIC17C762 and PIC17C766. All necessary hardware is included to run basic demo programs, which are supplied on a 3.5-inch disk. A programmed sample is included and the user may erase it and program it with the other sample programs using the PRO MATE II device programmer, or the PICSTART Plus development programmer, and easily debug and test the sample code. In addition, the PICDEM 17 demonstration board supports downloading of programs to and executing out of external FLASH memory on board. The PICDEM 17 demonstration board is also usable with the MPLAB ICE in-circuit emulator, or the PICMASTER emulator and all of the sample programs can be run and modified using either emulator. Additionally, a generous prototype area is available for user hardware.

## 11.15 KEELOQ Evaluation and Programming Tools

KEELOQ evaluation and programming tools support Microchip's HCS Secure Data Products. The HCS evaluation kit includes a LCD display to show changing codes, a decoder to decode transmissions and a programming interface to program test transmitters.

## 13.0 ELECTRICAL CHARACTERISTICS - PIC16CR54A

### 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 $V_{SS}$(1) ..... 0 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 ..... 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 or B) ..... 40 mA

Max. output current sunk by a single I/O port (PORTA or B) ..... 50 mA

**Note 1:** Voltage spikes below Vss at the $\overline{MCLR}$ 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 $\overline{MCLR}$ pin rather than pulling this pin directly to Vss.

**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.

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

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

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

* These parameters are characterized but not tested.

† Data in "Typ" column is at 5V, 25°C, unless otherwise stated. These parameters are for design guidance only, and are not tested.

**Note 1:** This is the limit to which VDD can be lowered in SLEEP mode without losing RAM data.

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

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

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

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

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

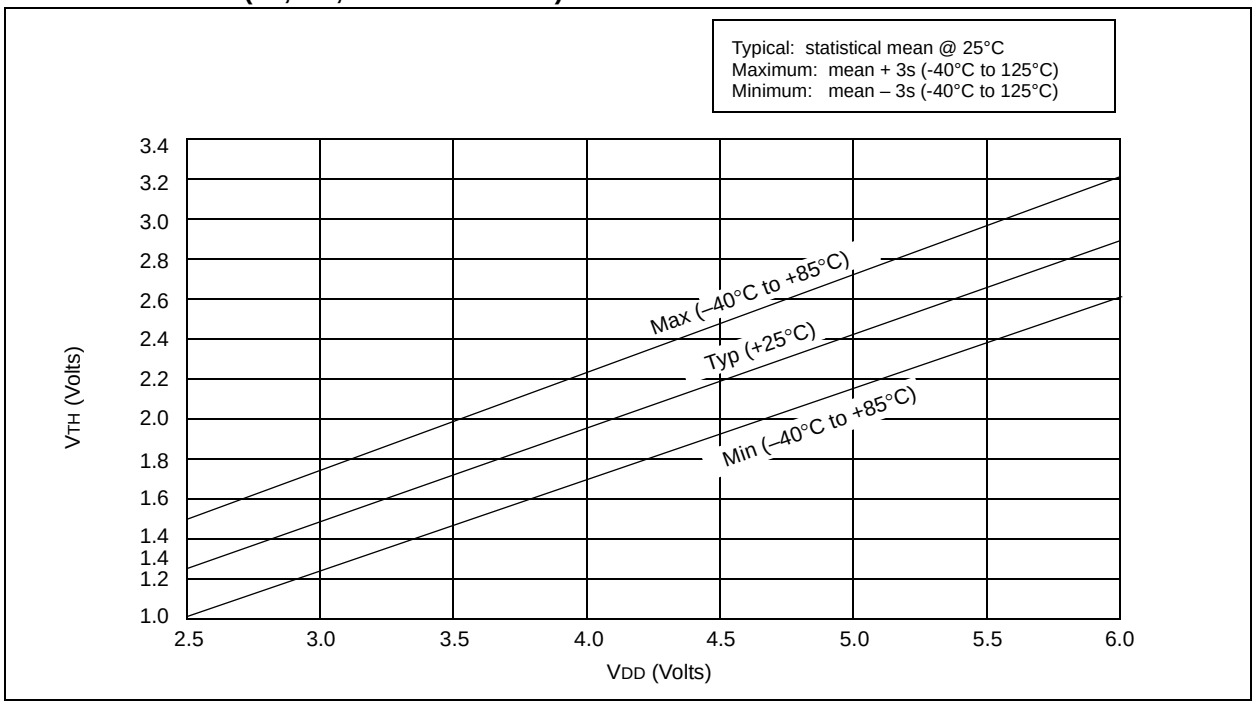



**FIGURE 14-12: TYPICAL IDD VS. FREQUENCY (EXTERNAL CLOCK, 25°C)**

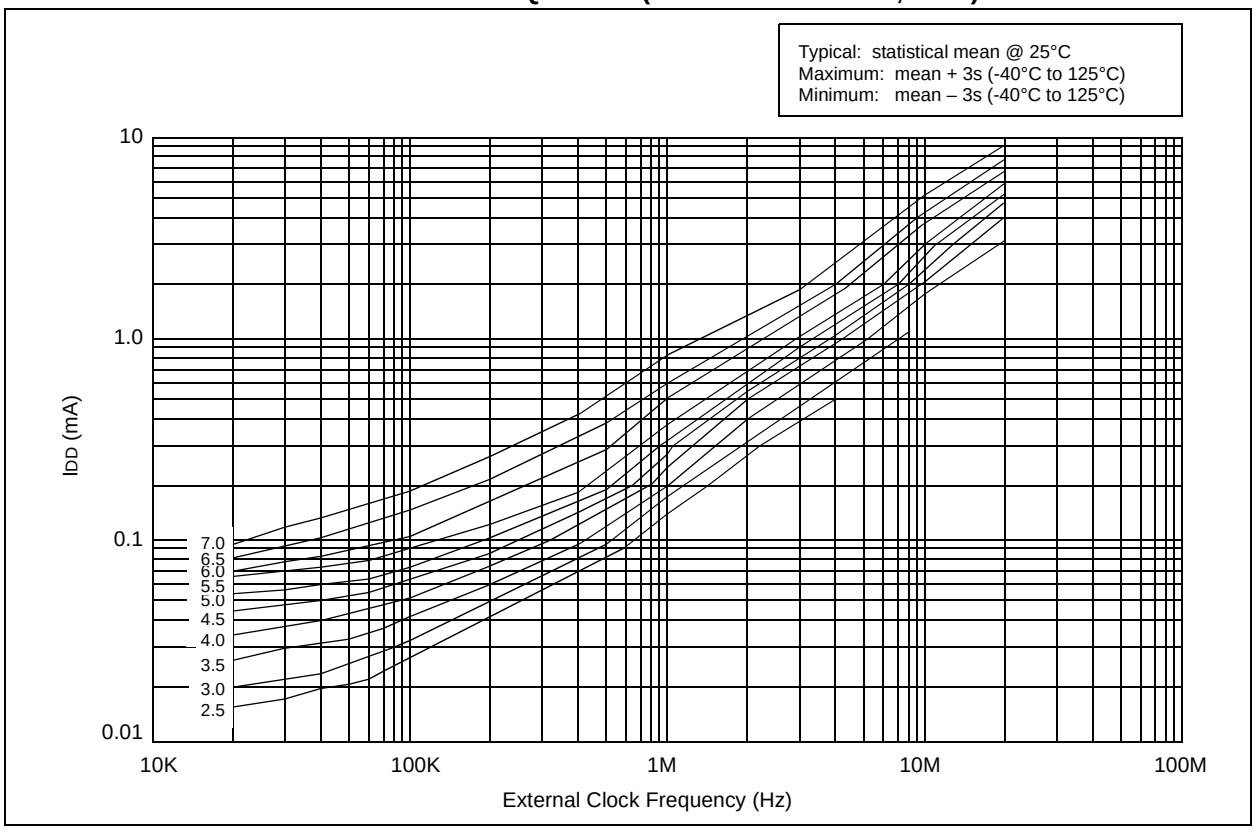


**FIGURE 14-21: PORTA, B AND C $I_{OL}$ vs. $V_{OL}$, $V_{DD}$ = 3 V**

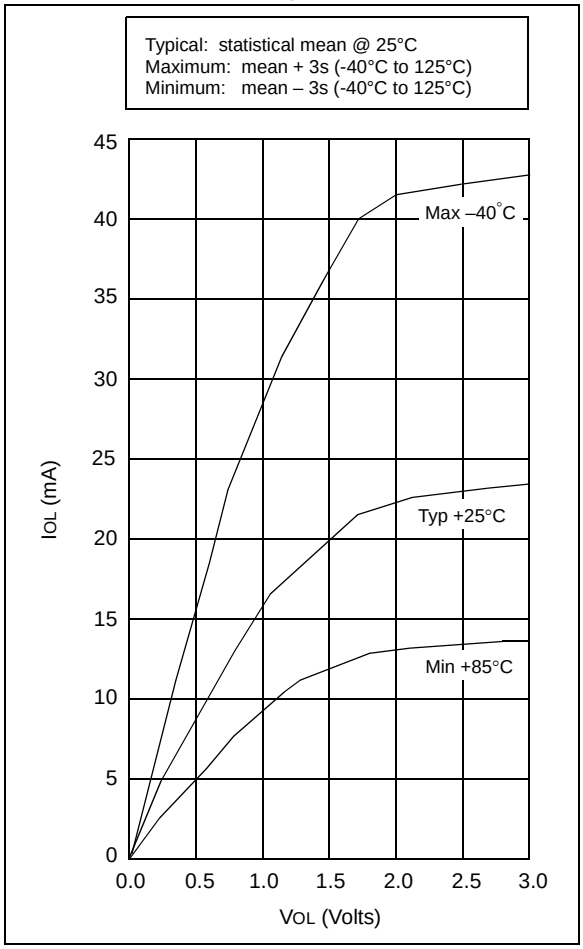
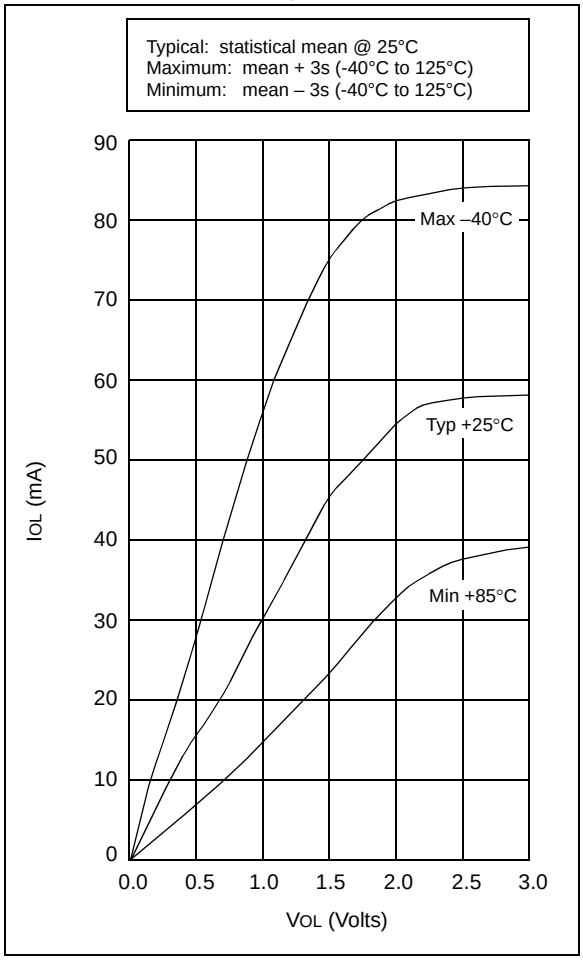



**FIGURE 14-22: PORTA, B AND C $I_{OL}$ vs. $V_{OL}$, $V_{DD}$ = 5 V**



## 15.2 DC Characteristics: PIC16C54A-04E, 10E, 20E (Extended) PIC16LC54A-04E (Extended)

| **PIC16LC54A-04E** (Extended) | | | **Standard Operating Conditions (unless otherwise specified)** Operating Temperature –40°C ≤ TA ≤ +125°C for extended | | | | |
|---|---|---|---|---|---|---|---|
| **PIC16C54A-04E, 10E, 20E** (Extended) | | | **Standard Operating Conditions (unless otherwise specified)** Operating Temperature –40°C ≤ TA ≤ +125°C for extended | | | | |
| **Param No.** | **Symbol** | **Characteristic** | **Min** | **Typ†** | **Max** | **Units** | **Conditions** |
| | VDD | **Supply Voltage** | | | | | |
| D001 | | PIC16LC54A | 3.0<br>2.5 | —<br>— | 6.25<br>6.25 | V<br>V | XT and RC modes<br>LP mode |
| D001A | | PIC16C54A | 3.5<br>4.5 | —<br>— | 5.5<br>5.5 | V<br>V | RC and XT modes<br>HS mode |
| 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 |
| | IDD | **Supply Current(2)** | | | | | |
| D010 | | PIC16LC54A | — | 0.5 | 25 | mA | FOSC = 4.0 MHz, VDD = 5.5V, RC(3) and XT modes |
| | | | — | 11 | 27 | µA | FOSC = 32 kHz, VDD = 2.5V, LP mode, Commercial |
| | | | — | 11 | 35 | µA | FOSC = 32 kHz, VDD = 2.5V, LP mode, Industrial |
| | | | — | 11 | 37 | µA | FOSC = 32 kHz, VDD = 2.5V, LP mode, Extended |
| D010A | | PIC16C54A | — | 1.8 | 3.3 | mA | FOSC = 4.0 MHz, VDD = 5.5V, RC(3) and XT modes |
| | | | — | 4.8 | 10 | mA | FOSC = 10 MHz, VDD = 5.5V, HS mode |
| | | | — | 9.0 | 20 | mA | FOSC = 20 MHz, VDD = 5.5V, HS mode |

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

* 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, $\overline{MCLR}$ = 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)**<br>RC(3) and XT modes<br>LP mode, Commercial<br>LP mode, Industrial | <br>—<br>—<br>— | <br>0.5<br>11<br>14 | <br>—<br>27<br>35 | <br>mA<br>µA<br>µA | <br>FOSC = 2.0 MHz, VDD = 3.0V<br>FOSC = 32 kHz, VDD = 2.5V WDT disabled<br>FOSC = 32 kHz, VDD = 2.5V WDT disabled |
| D020 | IPD | **Power-down Current(2,4)**<br>Commercial<br>Commercial<br>Industrial<br>Industrial | <br>—<br>—<br>—<br>— | <br>2.5<br>0.25<br>3.5<br>0.3 | <br>12<br>4.0<br>14<br>5.0 | <br>µA<br>µA<br>µA<br>µA | <br>VDD = 2.5V, WDT enabled<br>VDD = 2.5V, WDT disabled<br>VDD = 2.5V, WDT enabled<br>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, $\overline{MCLR}$ = 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.

## 15.6 Timing Diagrams and Specifications

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

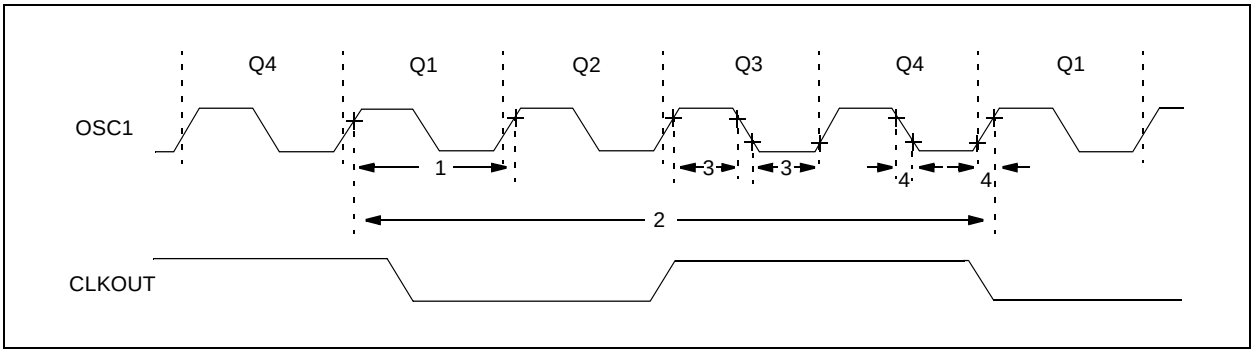



**TABLE 15-1: EXTERNAL CLOCK TIMING REQUIREMENTS - PIC16C54A**

| AC Characteristics | | Standard Operating Conditions (unless otherwise specified)<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial<br>–20°C ≤ TA ≤ +85°C for industrial - PIC16LV54A-02I<br>–40°C ≤ TA ≤ +125°C for extended | | | | | |
|---|---|---|---|---|---|---|---|
| **Param No.** | **Symbol** | **Characteristic** | **Min** | **Typ†** | **Max** | **Units** | **Conditions** |
| | FOSC | External CLKIN Frequency(1) | 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(1) | 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 |

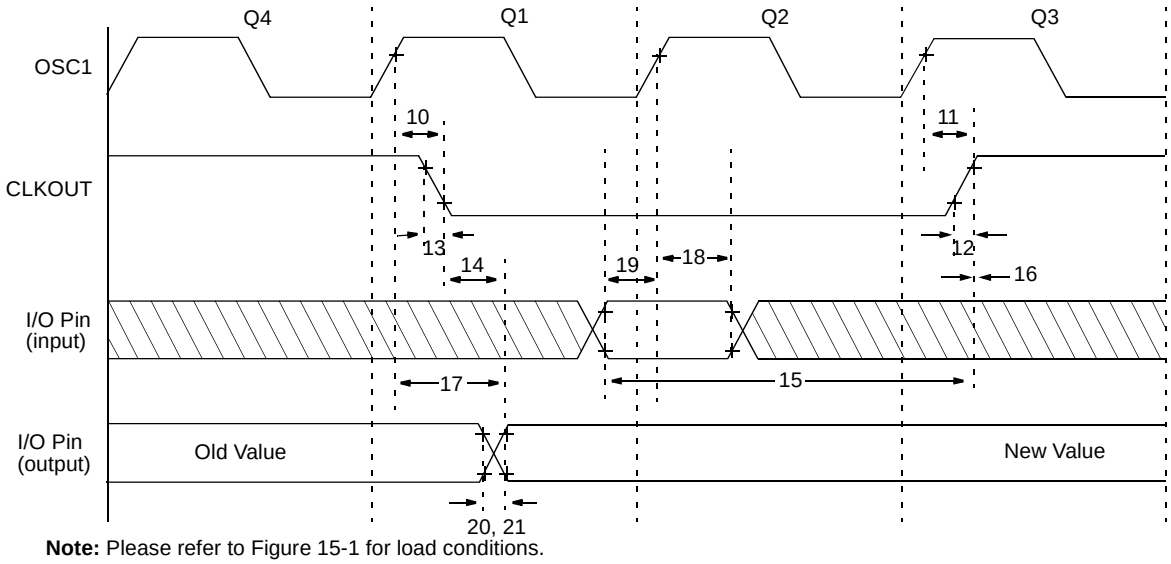
* These parameters are characterized but not tested.

† 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 15-3: CLKOUT AND I/O TIMING - PIC16C54A**




**Note:** Please refer to Figure 15-1 for load conditions.

**TABLE 15-2: CLKOUT AND I/O TIMING REQUIREMENTS - PIC16C54A**

| AC Characteristics | Standard Operating Conditions (unless otherwise specified)<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial<br>–20°C ≤ TA ≤ +85°C for industrial - PIC16LV54A-02I<br>–40°C ≤ TA ≤ +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 based on characterization results at 25°C. This data is for design guidance only and is not tested.

**Note 1:** Measurements are taken in RC Mode where CLKOUT output is 4 x TOSC.

**2:** Please refer to Figure 15-1 for load conditions.

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

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PIC16LC5X**<br>**PIC16LCR5X**<br>(Commercial, Industrial) | | | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial | | | | |
| **PIC16C5X**<br>**PIC16CR5X**<br>(Commercial, Industrial) | | | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial | | | | |
| **Param No.** | **Symbol** | **Characteristic/Device** | **Min** | **Typ†** | **Max** | **Units** | **Conditions** |
| | VDD | **Supply Voltage** | | | | | |
| D001 | | PIC16LC5X | 2.5<br>2.7<br>2.5 | —<br>—<br>— | 5.5<br>5.5<br>5.5 | V<br>V<br>V | –40°C ≤ TA ≤ + 85°C, 16LCR5X<br>–40°C ≤ TA ≤ 0°C, 16LC5X<br>0°C ≤ TA ≤ + 85°C 16LC5X |
| D001A | | PIC16C5X | <br>3.0<br>4.5 | <br>—<br>— | <br>5.5<br>5.5 | <br>V<br>V | RC, XT, LP and HS mode<br>from 0 - 10 MHz<br>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 |

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

* These parameters are characterized but not tested.

† Data in "Typ" column is at 5V, 25°C, unless otherwise stated. These parameters are for design guidance only, and are not tested.

**Note 1:** This is the limit to which VDD can be lowered in SLEEP mode without losing RAM data.

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

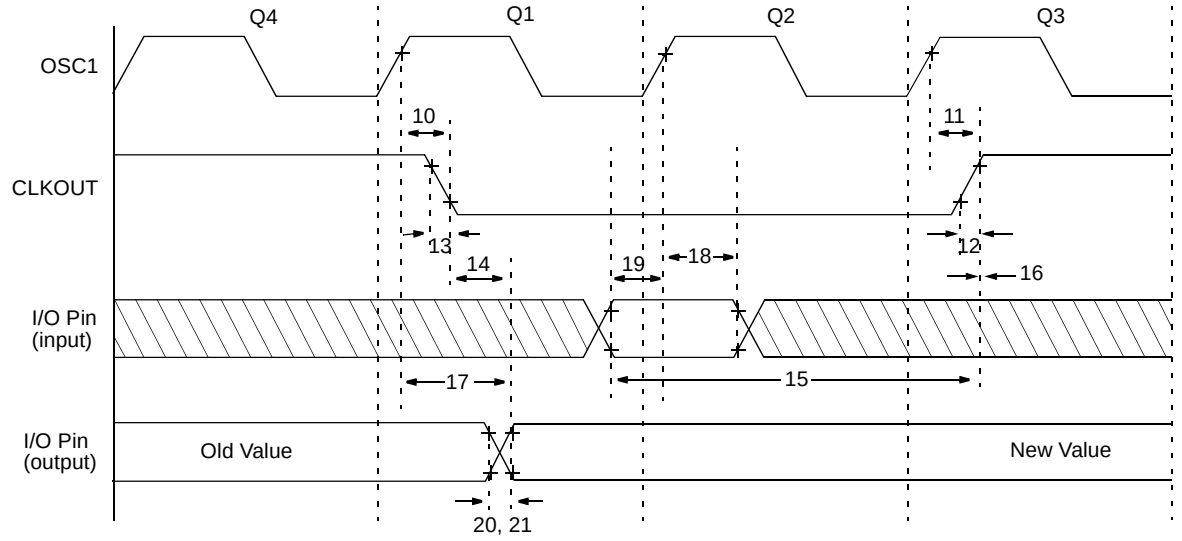
a) The test conditions for all IDD measurements in active Operation mode are: OSC1 = external square wave, from rail-to-rail; all I/O pins tristated, pulled to VSS, T0CKI = VDD, $\overline{MCLR}$ = VDD; WDT enabled/disabled as specified.

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

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

**FIGURE 17-7: CLKOUT AND I/O TIMING - PIC16C5X, PIC16CR5X**




**Note:** Refer to Figure 17-5 for load conditions.

**TABLE 17-2: CLKOUT AND I/O TIMING REQUIREMENTS - PIC16C5X, PIC16CR5X**

| **AC Characteristics** | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C for commercial<br>–40°C ≤ TA ≤ +85°C for industrial<br>–40°C ≤ TA ≤ +125°C for extended | | | | | |
|---|---|---|---|---|---|---|
| **Param No.** | **Symbol** | **Characteristic** | **Min** | **Typ†** | **Max** | **Units** |
| 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 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:** Refer to Figure 17-5 for load conditions.

## 19.0 ELECTRICAL CHARACTERISTICS - PIC16LC54C 40MHz

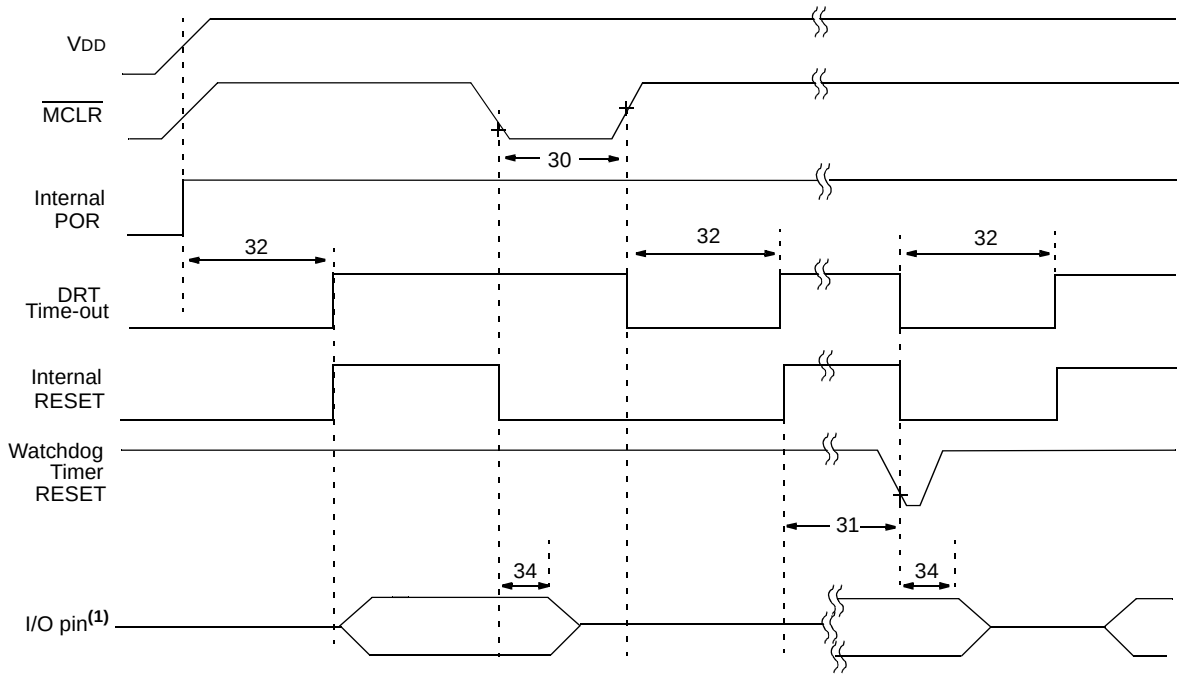
**Absolute Maximum Ratings(†)**

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(1) ..... 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 A, B or C) ..... 50 mA
Max. output current sunk by a single I/O (Port A, B or C) ..... 50 mA

**Note 1:** 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 19-5: RESET, WATCHDOG TIMER, AND DEVICE RESET TIMER TIMING - PIC16C5X-40**




**Note 1:** Please refer to Figure 19-2 for load conditions.

**TABLE 19-3: RESET, WATCHDOG TIMER, AND DEVICE RESET TIMER - PIC16C5X-40**

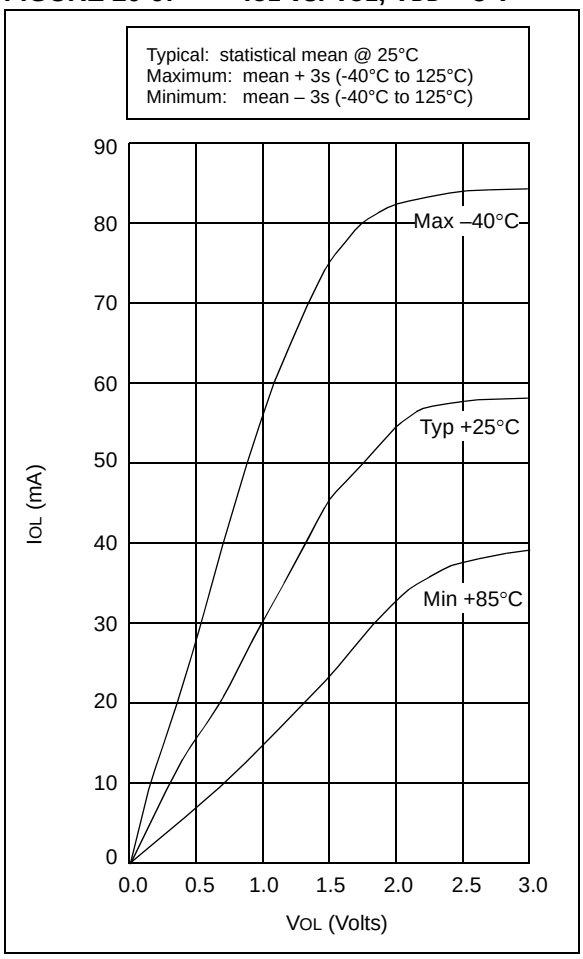
| **AC Characteristics** | | **Standard Operating Conditions (unless otherwise specified)**<br>Operating Temperature 0°C ≤ TA ≤ +70°C (commercial)<br>Operating Voltage VDD range is described in Section 19.1. | | | | | |
|---|---|---|---|---|---|---|---|
| **Param No.** | **Symbol** | **Characteristic** | **Min** | **Typ†** | **Max** | **Units** | **Conditions** |
| 30 | TmcL | $\overline{\text{MCLR}}$ Pulse Width (low) | 1000* | — | — | ns | VDD = 5.0V |
| 31 | Twdt | Watchdog Timer Time-out Period (No Prescaler) | 9.0* | 18* | 30* | ms | VDD = 5.0V (Comm) |
| 32 | TDRT | Device Reset Timer Period | 9.0* | 18* | 30* | ms | VDD = 5.0V (Comm) |
| 34 | Tioz | I/O Hi-impedance from $\overline{\text{MCLR}}$ Low | 100* | 300* | 1000* | ns | |

* 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.

**FIGURE 20-9: $I_{OL}$ vs. $V_{OL}$, $V_{DD}$ = 5 V**



## W



## X



## Z

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