



This document includes the programming specifications for the following devices:

- ## 1.0 PROGRAMMING THE PIC16C50X

1.1 Hardware Requirements

1.2 Programming Mode

Pin Diagram

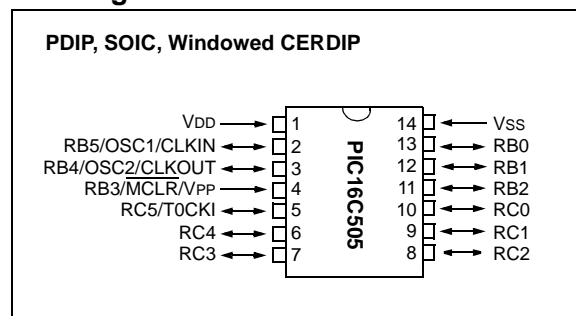


TABLE 1-1: PIN DESCRIPTIONS (DURING PROGRAMMING): PIC16C50X

Pin Name	During Programming		
	Pin Name	Pin Type	Pin Description
RB1	CLOCK	I	Clock Input
RB0	DATA	I/O	Data Input/Output
RB3/ $\overline{\text{MCLR}}$ /VPP	VPP	P	Programming Power
VDD	VDD	P	Power Supply
VSS	VSS	P	Ground

Legend: I = Input, O = Output, P = Power

PIC16C50X

2.0 PROGRAM MODE ENTRY

The Program/Verify Test mode is entered by holding pins RB0 and RB1 low, while raising $\overline{\text{MCLR}}$ pin from V_{IL} to V_{IH} . Once in this Test mode, the user program memory and the test program memory can be accessed and programmed in a serial fashion. The first selected memory location is the configuration word. **RB0 and RB1 are Schmitt Trigger inputs in this mode.**

Incrementing the PC once (using the increment address command) selects location 0x000 of the regular program memory. Afterwards, all other memory locations from 0x001-03FF can be addressed by incrementing the PC.

If the program counter has reached the last user program location and is incremented again, the on-chip special EPROM area will be addressed. (See Figure 2-2 to determine where the special EPROM area is located for the various PIC16C50X devices.)

2.1 Programming Method

The programming technique is described in the following section. It is designed to guarantee good programming margins. It does, however, require a variable power supply for V_{CC} .

2.1.1 PROGRAMMING METHOD DETAILS

Essentially, this technique includes the following steps:

1. Perform blank check at $V_{DD} = V_{DDMIN}$. Report failure. The device may not be properly erased.
2. Program location with pulses and verify after each pulse at $V_{DD} = V_{DDP}$: where $V_{DDP} = V_{DD}$ range required during programming (4.5V - 5.5V).
 - a) Programming condition:
 $V_{PP} = 12.75V$ to $13.25V$
 $V_{DD} = V_{DDP} = 4.5V$ to $5.5V$
 V_{PP} must be $\geq V_{DD} + 7.25V$ to keep "Programming mode" active.
 - b) Verify condition:
 $V_{DD} = V_{DDP}$
 $V_{PP} \geq V_{DD} + 7.5V$ but not to exceed $13.25V$
If location fails to program after "N" pulses (suggested maximum program pulses of 8), then report error as a programming failure.

Note: Device must be verified at minimum and maximum specified operating voltages as specified in the data sheet.

3. Once location passes 'Step 2', apply 11X over-programming, i.e., apply 11 times the number of pulses that were required to program the location. This will insure a solid programming margin. The overprogramming should be made "software programmable" for easy updates.
4. Program all locations.
5. Verify all locations (using Speed Verify mode) at $V_{DD} = V_{DDMIN}$.

6. Verify all locations at $V_{DD} = V_{DDMAX}$.
 V_{DDMIN} is the minimum operating voltage spec. for the part. V_{DDMAX} is the maximum operating voltage spec. for the part.

2.1.2 SYSTEM REQUIREMENTS

Clearly, to implement this technique, the most stringent requirements will be that of the power supplies:

VPP: VPP can be a fixed 13.0V to 13.25V supply. It must not exceed 14.0V to avoid damage to the pin and should be current limited to approximately 100mA.

VDD: 2.0V to 6.5V with 0.25V granularity. Since this method calls for verification at different VDD values, a programmable VDD power supply is needed.

Current Requirement: 40 mA maximum

Microchip may release devices in the future with different VDD ranges which make it necessary to have a programmable VDD.

It is important to verify an EPROM at the voltages specified in this method to remain consistent with Microchip's test screening. For example, a PIC16C50X specified for 4.5V to 5.5V should be tested for proper programming from 4.5V to 5.5V.

Note: Any programmer not meeting the programmable VDD requirement and the verify at V_{DDMAX} and V_{DDMIN} requirement, may only be classified as a "prototype" or "development" programmer, but not a production programmer.

2.1.3 SOFTWARE REQUIREMENTS

Certain parameters should be programmable (and therefore, easily modified) for easy upgrade.

- a) Pulse width.
- b) Maximum number of pulses, present limit 8.
- c) Number of over-programming pulses: should be $= (A \cdot N) + B$, where N = number of pulses required in regular programming. In our current algorithm $A = 11$, $B = 0$.

2.2 Programming Pulse Width

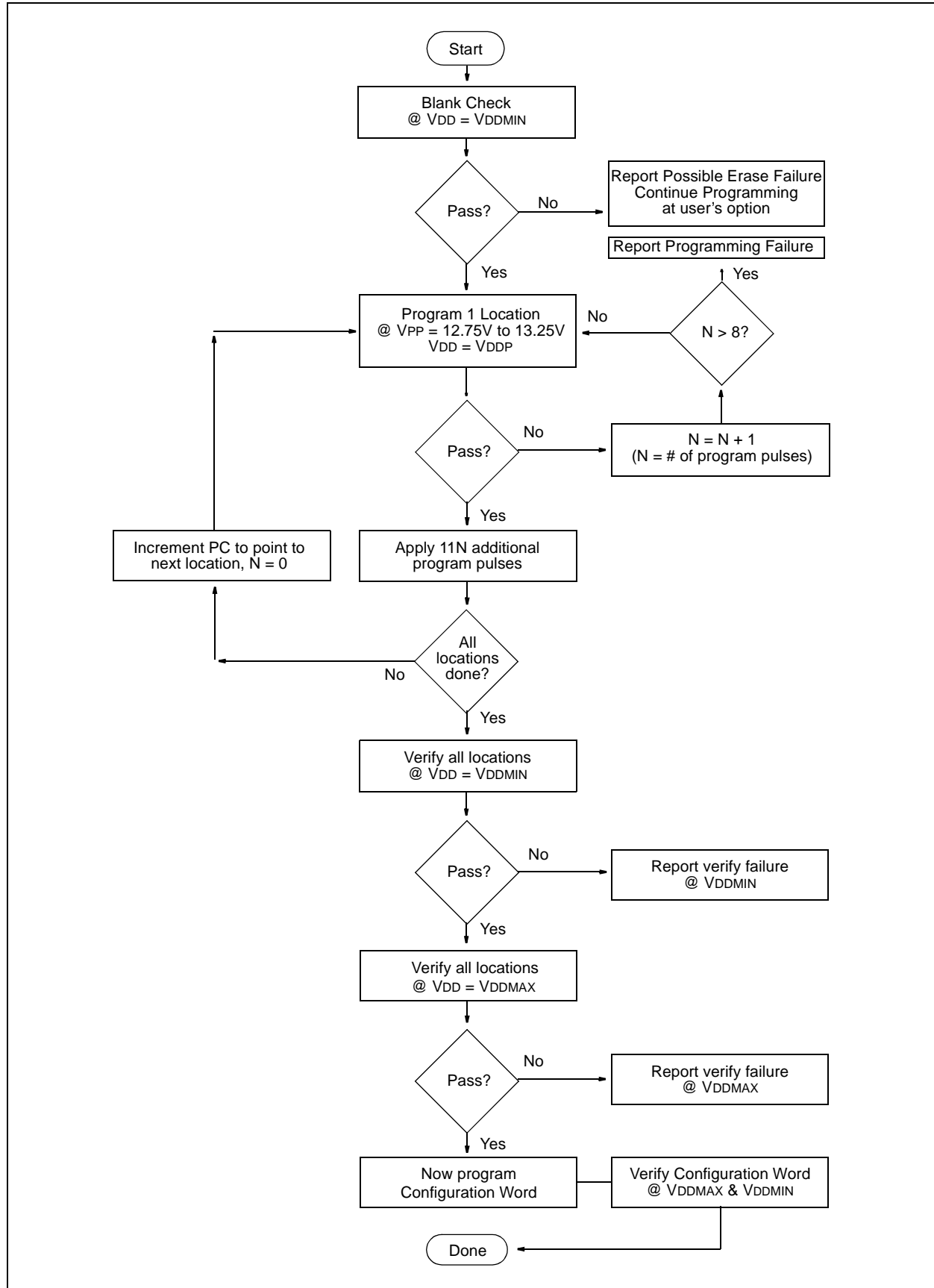
Program Memory Cells: When programming one word of EPROM, a programming pulse width (TPW) of 100 μs is recommended.

The maximum number of programming attempts should be limited to 8 per word.

After the first successful verify, the same location should be over-programmed with 11X over-programming.

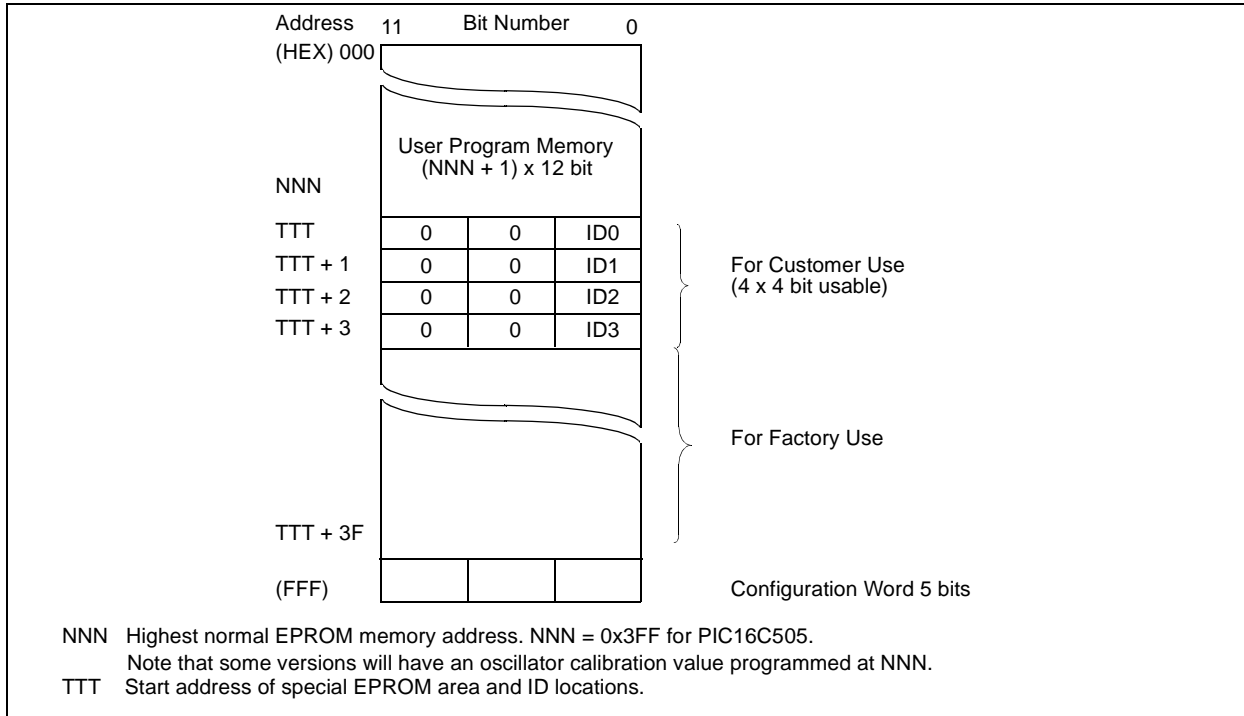
Configuration Word: The configuration word for oscillator selection, WDT (Watchdog Timer) disable and code protection, and $\overline{\text{MCLR}}$ enable, requires a programming pulse width (TPWF) of 10 ms. A series of 100 μs pulses is preferred over a single 10 ms pulse.

FIGURE 2-1: PROGRAMMING METHOD FLOW CHART



PIC16C50X

FIGURE 2-2: PIC16C50X SERIES PROGRAM MEMORY MAP IN PROGRAM/VERIFY MODE



2.3 Special Memory Locations

The highest address of program memory space is reserved for the internal RC oscillator calibration value. This location should not be overwritten except when this location is blank, and it should be verified, when programmed, that it is a `MOVLW XX` instruction.

The ID Locations area is only enabled if the device is in Programming/Verify mode. Thus, in normal operation mode, only the memory location 0x000 to 0xNNN will be accessed and the Program Counter will just rollover from address 0xNNN to 0x000 when incremented.

The configuration word can only be accessed immediately after `MCLR`, going from `VIL` to `VHH`. The Program Counter will be set to all '1's upon `MCLR = VIL`. Thus, it has the value "0xFFFF" when accessing the configuration EPROM. Incrementing the Program Counter once causes the Program Counter to rollover to all '0's. Incrementing the Program Counter 4K times after `RESET` (`MCLR = VIL`) does not allow access to the configuration EPROM.

2.3.1 CUSTOMER ID CODE LOCATIONS

Per definition, the first four words (address TTT to TTT + 3) are reserved for customer use. It is recommended that the customer use only the four lower order bits (bits 0 through 3) of each word and filling the eight higher order bits with '0's.

A user may want to store an identification code (ID) in the ID locations and still be able to read this code after the code protection bit was programmed.

EXAMPLE 2-1: CUSTOMER CODE 0xD1E2

The Customer ID code "0xD1E2" should be stored in the ID locations 400-403 like this:

```
400: 0000 0000 1101
401: 0000 0000 0001
402: 0000 0000 1110
403: 0000 0000 0010
```

Reading these four memory locations, even with the code protection bit programmed, would still output on PORTA the bit sequence "1101", "0001", "1110", "0010" which is "0xD1E2".

Note: All other locations in PICmicro® configuration memory are reserved and should not be programmed.

2.4 Program/Verify Mode

The Program/Verify mode is entered by holding pins RB1 and RB0 low, while raising $\overline{\text{MCLR}}$ pin from V_{IL} to V_{IH} (high voltage). Once in this mode, the user program memory and the configuration memory can be accessed and programmed in serial fashion. The mode of operation is serial, and the memory that is accessed is the user program memory. RB0 and RB1 are Schmitt Trigger inputs in this mode.

The sequence that enters the device into the Programming/Verify mode places all other logic into the RESET state (the $\overline{\text{MCLR}}$ pin was initially at V_{IL}). This means that all I/O are in the RESET state (High impedance inputs).

Note: The $\overline{\text{MCLR}}$ pin should be raised from V_{IL} to V_{IH} within 9 ms of V_{DD} rise. This is to ensure that the device does not have the PC incremented while in valid operation range.

2.4.1 PROGRAM/VERIFY OPERATION

The RB1 pin is used as a clock input pin, and the RB0 pin is used for entering command bits and data input/output during serial operation. To input a command, the clock pin (RB1) is cycled six times. Each command bit is latched on the falling edge of the clock with the least significant bit (LSb) of the command being input first. The data on pin RB0 is required to have a minimum setup and hold time (see AC/DC specs), with respect to the falling edge of the clock. Commands that have data associated with them (read and load) are specified to have a minimum delay of 1 μ s between the command and the data. After this delay the clock pin is cycled 16 times with the first cycle being a START bit and the last cycle being a STOP bit. Data is also input and output LSb first. Therefore, during a read operation, the LSb will be transmitted onto pin RB0 on the rising edge of the second cycle, and during a load operation, the LSb will be latched on the falling edge of the second cycle. A minimum 1 μ s delay is also specified between consecutive commands.

All commands are transmitted LSb first. Data words are also transmitted LSb first. The data is transmitted on the rising edge and latched on the falling edge of the clock. To allow for decoding of commands and reversal of data pin configuration, a time separation of at least 1 μ s is required between a command and a data word (or another command).

The commands that are available are listed in Table 2-1.

TABLE 2-1: COMMAND MAPPING

Command	Mapping (MSb ... LSb)						Data
Load Data	0	0	0	0	1	0	0, data(14), 0
Read Data	0	0	0	1	0	0	0, data(14), 0
Increment Address	0	0	0	1	1	0	
Begin programming	0	0	1	0	0	0	
End Programming	0	0	1	1	1	0	

Note: The clock must be disabled during in-circuit programming.

PIC16C50X

2.4.1.1 Load Data

After receiving this command, the chip will load in a 14-bit “data word” when 16 cycles are applied, as described previously. Because this is a 12-bit core, the two MSb’s of the data word are ignored. A timing diagram for the load data command is shown in Figure 5-1.

2.4.1.2 Read Data

After receiving this command, the chip will transmit data bits out of the memory currently accessed, starting with the second rising edge of the clock input. The RB0 pin will go into output mode on the second rising clock edge, and it will revert back to input mode (hi-impedance) after the 16th rising edge. A timing diagram of this command is shown in Figure 5-2.

2.4.1.3 Increment Address

The PC is incremented when this command is received. A timing diagram of this command is shown in Figure 5-3.

2.4.1.4 Begin Programming

A load data command must be given before every begin programming command. Programming of the appropriate memory (test program memory or user program memory) will begin after this command is received and decoded. Programming should be performed with a series of 100µs programming pulses. A programming pulse is defined as the time between the begin programming command and the end programming command.

2.4.1.5 End Programming

After receiving this command, the chip stops programming the memory (configuration program memory or user program memory) that it was programming at the time.

2.5 Programming Algorithm Requires Variable VDD

The PIC16C50X uses an intelligent algorithm. The algorithm calls for program verification at VDDMIN, as well as VDDMAX. Verification at VDDMIN insures good “erase margin”. Verification at VDDMAX insures good “program margin”.

The actual programming must be done with VDD in the VDDP range (4.75 - 5.25V).

VDDP = VCC range required during programming.

VDDMIN = minimum operating VDD spec for the part.

VDDMAX = maximum operating VDD spec for the part.

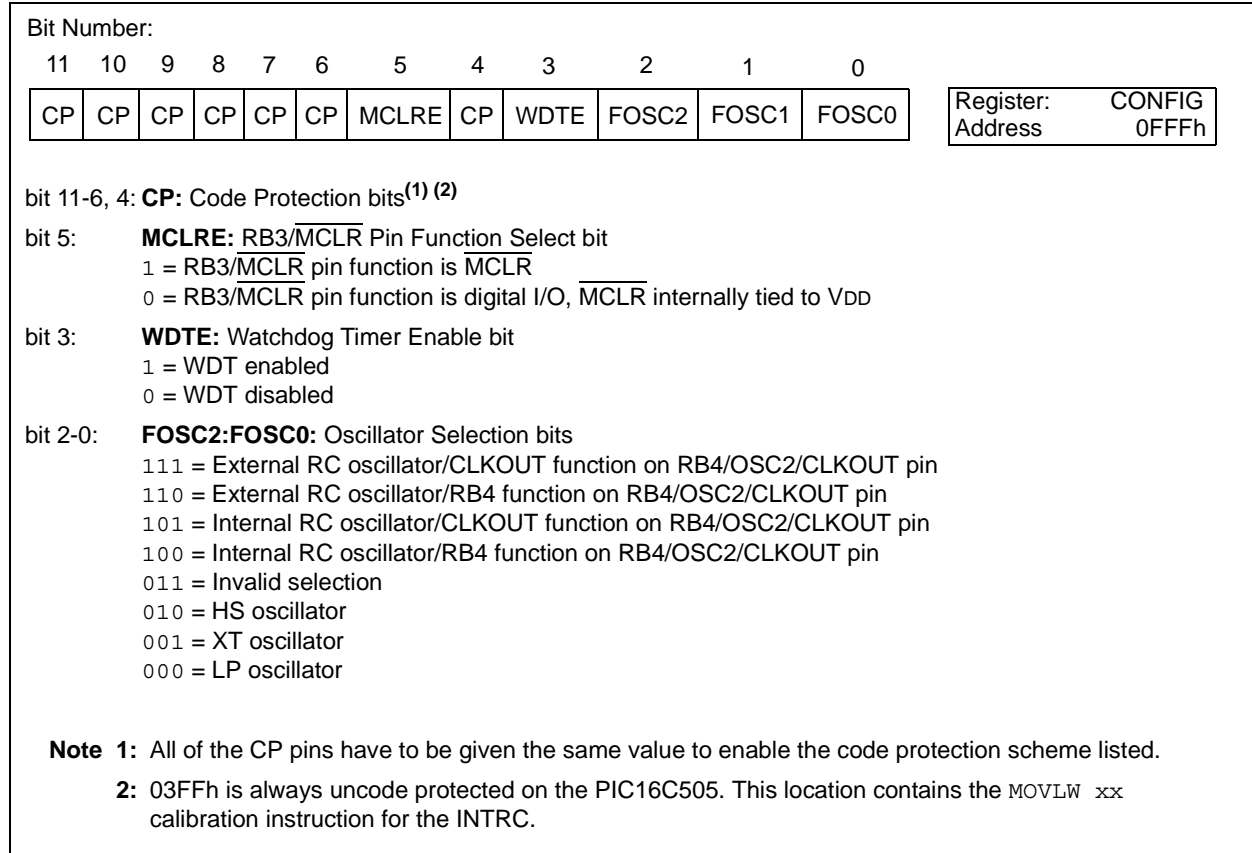
Programmers must verify the PIC16C50X at its specified VDDMAX and VDDMIN levels. Since Microchip may introduce future versions of the PIC16C50X with a broader VDD range, it is best that these levels are user selectable (defaults are ok).

Note: Any programmer not meeting these requirements may only be classified as a “prototype” or “development” programmer, but not a “production” quality programmer.
--

3.0 CONFIGURATION WORD

The PIC16C50X family members have several configuration bits. These bits can be programmed (reads '0'), or left unprogrammed (reads '1'), to select various device configurations. Figure 3-1 provides an overview of configuration bits.

FIGURE 3-1: CONFIGURATION WORD BIT MAP



PIC16C50X

4.0 CODE PROTECTION

The program code written into the EPROM can be protected by writing to the CP bit of the configuration word.

In PIC16C50X, it is still possible to program and read locations 0x000 through 0x03F, after code protection. Once code protection is enabled, all protected segments read '0's (or "garbage values") and are prevented from further programming. All unprotected

segments, including ID locations and configuration word, read normally. These locations can be programmed.

Once code protection is enabled, all code protected locations (0x040 to 0x3FE) read 0's. All unprotected segments, including the internal oscillator calibration value (0x3FF location), ID and config word read as normal.

4.1 Embedding Configuration Word and ID Information in the HEX File

To allow portability of code, the programmer is required to read the configuration word and ID locations from the HEX file when loading the HEX file. If configuration word information was not present in the HEX file, then a simple warning message may be issued. Similarly, while saving a HEX file, configuration word and ID information must be included. An option to not include this information may be provided.

Microchip Technology Inc. feels strongly that this feature is important for the benefit of the end customer.

TABLE 4-1: CODE PROTECTION: PIC16C505

To code protect:

(CP enable pattern: 000000X0XXXX)

Program Memory Segment	R/W in Protected Mode	R/W in Unprotected Mode
Configuration Word (0xFFFF)	Read Enabled, Write Enabled	Read Enabled, Write Enabled
[0x00:0x3F]	Read Enabled, Write Enabled	Read Enabled, Write Enabled
[0x40:0x3FE]	Read Disabled (all 0's), Write Disabled	Read Enabled, Write Enabled
0x3FF	Read Enabled, Write Enabled	Read Enabled, Write Enabled
ID Locations (0x400 : 0x403)	Read Enabled, Write Enabled	Read Enabled, Write Enabled

4.2 Checksum

4.2.1 CHECKSUM CALCULATIONS

Checksum is calculated by reading the contents of the PIC16C50X memory locations and adding up the opcodes up to the maximum user addressable location (not including the last location which is reserved for the oscillator calibration value), e.g., 0x3FE for the PIC16C505. Any carry bits exceeding 16-bits are neglected. Finally, the configuration word (appropriately masked) is added to the checksum. Checksum computation for each member of the PIC16C50X family is shown in Table 4-2.

The checksum is calculated by summing the following:

- The contents of all program memory locations
- The configuration word, appropriately masked
- Masked ID locations (when applicable)

The Least Significant 16-bits of this sum are the checksum.

The following table describes how to calculate the checksum for each device. Note that the checksum calculation differs, depending on the code protect setting. Since the program memory locations read out differently, depending on the code protect setting, the table describes how to manipulate the actual program memory values to simulate the values that would be read from a protected device. When calculating a checksum by reading a device, the entire program memory can simply be read and summed. The configuration word and ID locations can always be read.

The oscillator calibration value location is not used in the above checksums.

TABLE 4-2: CHECKSUM COMPUTATION

Device	Code Protect	Checksum*	Blank Value	0x723 at 0 and Max Address
PIC16C505	OFF ON	SUM[0x000:0x3FE] + CFGW & 0xFFF SUM[0x000:0x03F] + CFGW & 0xFFF + SUM(IDS)	FC00 FBEF	EA48 E15B

Legend: CFGW = Configuration Word

SUM[a:b] = [Sum of locations a through b inclusive]

SUM_ID = ID locations masked by 0xF then made into a 16-bit value with ID0 as the most significant nibble.

For example,

ID0 = 0x12, ID1 = 0x37, ID2 = 0x4, ID3 = 0x26, then SUM_ID = 0x2746.

*Checksum = [Sum of all the individual expressions] **MODULO** [0xFFFF]

+ = Addition

& = Bitwise AND

PIC16C50X

5.0 PROGRAM/VERIFY MODE ELECTRICAL CHARACTERISTICS

**TABLE 5-1: AC/DC CHARACTERISTICS
TIMING REQUIREMENTS FOR PROGRAM/VERIFY MODE**

Standard Operating Conditions							
Operating Temperature: $+10^{\circ}\text{C} \leq T_A \leq +40^{\circ}\text{C}$, unless otherwise stated, (20°C recommended)							
Operating Voltage: $4.5\text{V} \leq V_{DD} \leq 5.5\text{V}$, unless otherwise stated.							
Parameter No.	Sym.	Characteristic	Min.	Typ.	Max.	Units	Conditions
General							
PD1	VDDP	Supply voltage during programming	4.75	5.0	5.25	V	
PD2	IDDP	Supply current (from VDD) during programming			20	mA	
PD3	VDDV	Supply voltage during verify	VDDMIN		VDDMAX	V	(Note 1)
PD4	VIHH1	Voltage on $\overline{\text{MCLR}}$ /VPP during programming	12.75		13.25	V	(Note 2)
PD5	VIHH2	Voltage on $\overline{\text{MCLR}}$ /VPP during verify	VDD + 4.0		13.5		
PD6	I _{PP}	Programming supply current (from VPP)			50	mA	
PD9	VIH1	(RB1, RB0) input high level	0.8 VDD			V	Schmitt Trigger input
PD8	VIL1	(RB1, RB0) input low level	0.2 VDD			V	Schmitt Trigger input

Serial Program Verify							
P1	TR	$\overline{\text{MCLR}}$ /VPP rise time (VSS to VHH)			8.0	μs	
P2	Tf	$\overline{\text{MCLR}}$ fall time			8.0	μs	
P3	Tset1	Data in setup time before clock \downarrow	100			ns	
P4	Thld1	Data in hold time after clock \downarrow	100			ns	
P5	Tdly1	Data input not driven to next clock input (delay required between command/data or command/command)	1.0			μs	
P6	Tdly2	Delay between clock \downarrow to clock \uparrow of next command or data	1.0			μs	
P7	Tdly3	Clock \uparrow to data out valid (during read data)	200			ns	
P8	Thld0	Hold time after $\overline{\text{MCLR}}$ \uparrow	2			μs	

Note 1: Program must be verified at the minimum and maximum VDD limits for the part.

Note 2: VIHH must be greater than VDD + 4.5V to stay in Programming/Verify mode.

PIC16C50X

NOTES:

"All rights reserved. Copyright © 2001, Microchip Technology Incorporated, USA. Information contained in this publication regarding device applications and the like is intended through suggestion only and may be superseded by updates. No representation or warranty is given and no liability is assumed by Microchip Technology Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Use of Microchip's products as critical components in life support systems is not authorized except with express written approval by Microchip. No licenses are conveyed, implicitly or otherwise, under any intellectual property rights. The Microchip logo and name are registered trademarks of Microchip Technology Inc. in the U.S.A. and other countries. All rights reserved. All other trademarks mentioned herein are the property of their respective companies. No licenses are conveyed, implicitly or otherwise, under any intellectual property rights."

Trademarks

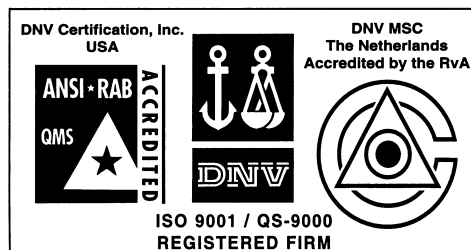
The Microchip name, logo, PIC, PICmicro, PICMASTER, PICSTART, PRO MATE, KEELOQ, SEEVAL, MPLAB and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

Total Endurance, ICSP, In-Circuit Serial Programming, Filter-Lab, MXDEV, microID, *FlexROM*, *fuzzyLAB*, MPASM, MPLINK, MPLIB, PICDEM, ICEPIC, Migratable Memory, FanSense, ECONOMONITOR and SelectMode are trademarks of Microchip Technology Incorporated in the U.S.A.

Serialized Quick Term Programming (SQTP) is a service mark of Microchip Technology Incorporated in the U.S.A.

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

© 2001, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.



Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELoq® code hopping devices, Serial EEPROMs and microperipheral products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 certified.



WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200 Fax: 480-792-7277
Technical Support: 480-792-7627
Web Address: <http://www.microchip.com>

Rocky Mountain

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7966 Fax: 480-792-7456

Atlanta

500 Sugar Mill Road, Suite 200B
Atlanta, GA 30350
Tel: 770-640-0034 Fax: 770-640-0307

Austin

Analog Product Sales
8303 MoPac Expressway North
Suite A-201
Austin, TX 78759
Tel: 512-345-2030 Fax: 512-345-6085

Boston

2 Lan Drive, Suite 120
Westford, MA 01886
Tel: 978-692-3848 Fax: 978-692-3821

Boston

Analog Product Sales
Unit A-8-1 Millbrook Tarry Condominium
97 Lowell Road
Concord, MA 01742
Tel: 978-371-6400 Fax: 978-371-0050

Chicago

333 Pierce Road, Suite 180
Itasca, IL 60143
Tel: 630-285-0071 Fax: 630-285-0075

Dallas

4570 Westgrove Drive, Suite 160
Addison, TX 75001
Tel: 972-818-7423 Fax: 972-818-2924

Dayton

Two Prestige Place, Suite 130
Miamisburg, OH 45342
Tel: 937-291-1654 Fax: 937-291-9175

Detroit

Tri-Atria Office Building
32255 Northwestern Highway, Suite 190
Farmington Hills, MI 48334
Tel: 248-538-2250 Fax: 248-538-2260

Los Angeles

18201 Von Karman, Suite 1090
Irvine, CA 92612
Tel: 949-263-1888 Fax: 949-263-1338

Mountain View

Analog Product Sales
1300 Terra Bella Avenue
Mountain View, CA 94043-1836
Tel: 650-968-9241 Fax: 650-967-1590

New York

150 Motor Parkway, Suite 202
Hauppauge, NY 11788
Tel: 631-273-5305 Fax: 631-273-5335

San Jose

Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408-436-7950 Fax: 408-436-7955

Toronto

6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699 Fax: 905-673-6509

ASIA/PACIFIC

Australia

Microchip Technology Australia Pty Ltd
Suite 22, 41 Rawson Street
Epping 2121, NSW
Australia
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

China - Beijing

Microchip Technology Beijing Office
Unit 915
New China Hong Kong Manhattan Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Shanghai

Microchip Technology Shanghai Office
Room 701, Bldg. B
Far East International Plaza
No. 317 Xian Xia Road
Shanghai, 200051
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

Hong Kong

Microchip Asia Pacific
RM 2101, Tower 2, Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2401-1200 Fax: 852-2401-3431

India

Microchip Technology Inc.
India Liaison Office
Divyasree Chambers
1 Floor, Wing A (A3/A4)
No. 11, O'Shaughnessey Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

Japan

Microchip Technology Intl. Inc.
Benex S-1 6F
3-18-20, Shinyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa, 222-0033, Japan
Tel: 81-45-471-6166 Fax: 81-45-471-6122

ASIA/PACIFIC (continued)

Korea

Microchip Technology Korea
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea
Tel: 82-2-554-7200 Fax: 82-2-558-5934

Singapore

Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-334-8870 Fax: 65-334-8850

Taiwan

Microchip Technology Taiwan
11F-3, No. 207
Tung Hua North Road
Taipei, 105, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Denmark

Microchip Technology Denmark ApS
Regus Business Centre
Lautrup høj 1-3
Ballerup DK-2750 Denmark
Tel: 45 4420 9895 Fax: 45 4420 9910

France

Arizona Microchip Technology SARL
Parc d'Activite du Moulin de Massy
43 Rue du Saule Trapu
Batiment A - 1er Etage
91300 Massy, France
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

Germany

Arizona Microchip Technology GmbH
Gustav-Heinemann Ring 125
D-81739 Munich, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

Germany

Analog Product Sales
Lochamer Strasse 13
D-82152 Martinsried, Germany
Tel: 49-89-895650-0 Fax: 49-89-895650-22

Italy

Arizona Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-039-65791-1 Fax: 39-039-6899883

United Kingdom

Arizona Microchip Technology Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5869 Fax: 44-118 921-5820

01/30/01

All rights reserved. © 2001 Microchip Technology Incorporated. Printed in the USA. 2/01  Printed on recycled paper.

Information contained in this publication regarding device applications and the like is intended through suggestion only and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. No representation or warranty is given and no liability is assumed by Microchip Technology Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Use of Microchip's products as critical components in life support systems is not authorized except with express written approval by Microchip. No licenses are conveyed, implicitly or otherwise, except as maybe explicitly expressed herein, under any intellectual property rights. The Microchip logo and name are registered trademarks of Microchip Technology Inc. in the U.S.A. and other countries. All rights reserved. All other trademarks mentioned herein are the property of their respective companies.