

## Flash Memory Programming Specification

**This document includes programming specifications for the following devices:**

- PIC16F818
- PIC16F819

### 1.0 PROGRAMMING THE PIC16F818/819

The PIC16F818/819 is programmed using a serial method. The Serial mode will allow the PIC16F818/819 to be programmed while in the user's system, which allows for increased design flexibility. This programming specification applies to PIC16F818/819 devices in all packages.

#### 1.1 Programming Algorithm Requirements

The programming algorithm used depends on the operating voltage ( $V_{DD}$ ) of the PIC16F818/819 device.

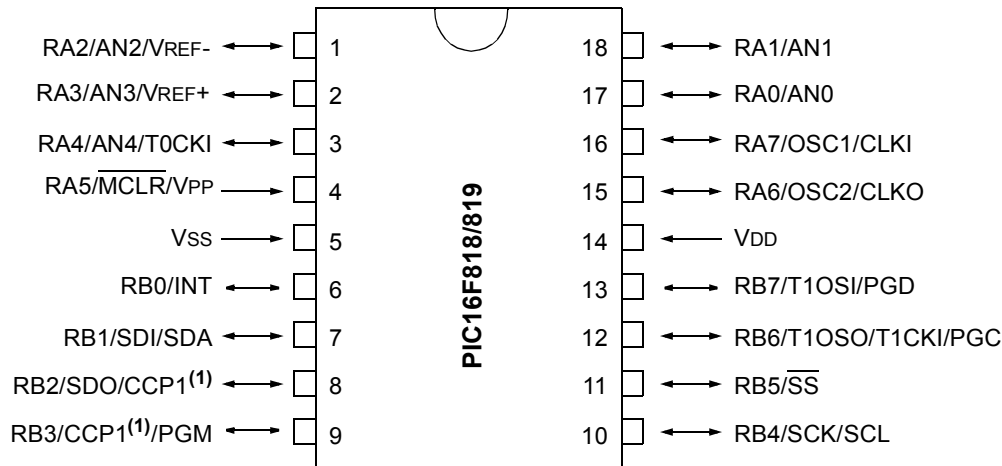
Algorithm #	$V_{DD}$ Range
1	$2.0V \leq V_{DD} < 5.5V$
2	$4.5V \leq V_{DD} \leq 5.5V$

Both algorithms can be used with the two available programming entry methods. The first method, called Low-Voltage ICSP™ (LVP for short), applies  $V_{DD}$  to MCLR and uses the I/O pin RB3 to enter Programming mode. When RB3 is driven to  $V_{DD}$  from ground, the PIC16F818/819 device enters Programming mode. The second method follows the normal Microchip Programming mode entry of holding pins RB6 and RB7 low, while raising the MCLR pin from  $V_{IL}$  to  $V_{IH}$  ( $13V \pm 0.5V$ ).

#### 1.2 Programming Mode

The Programming mode for the PIC16F818/819 allows programming of user program memory, data memory, special locations used for ID, and the configuration word.

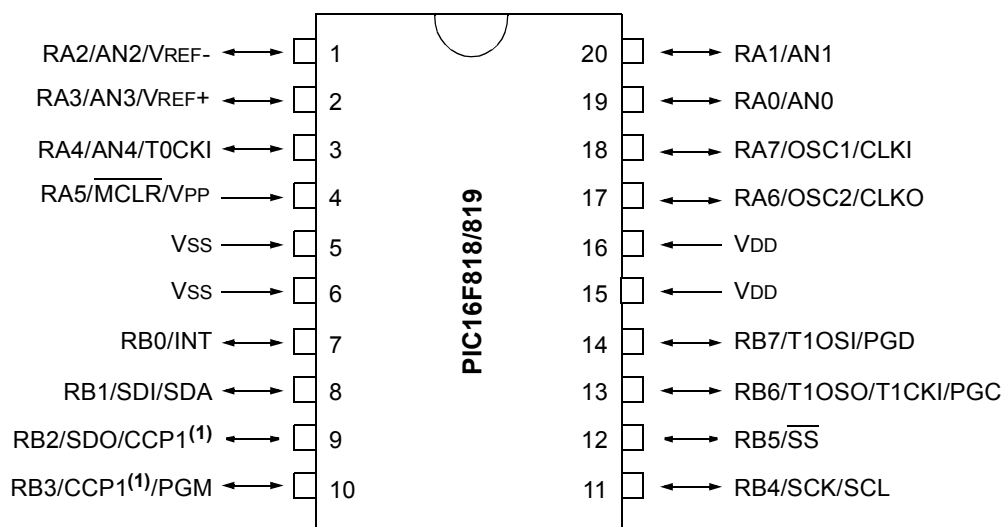
### PIC16F818/819 18-Pin DIP, SOIC



**Note 1:** Location of CCP1 function is determined by CCPMX.

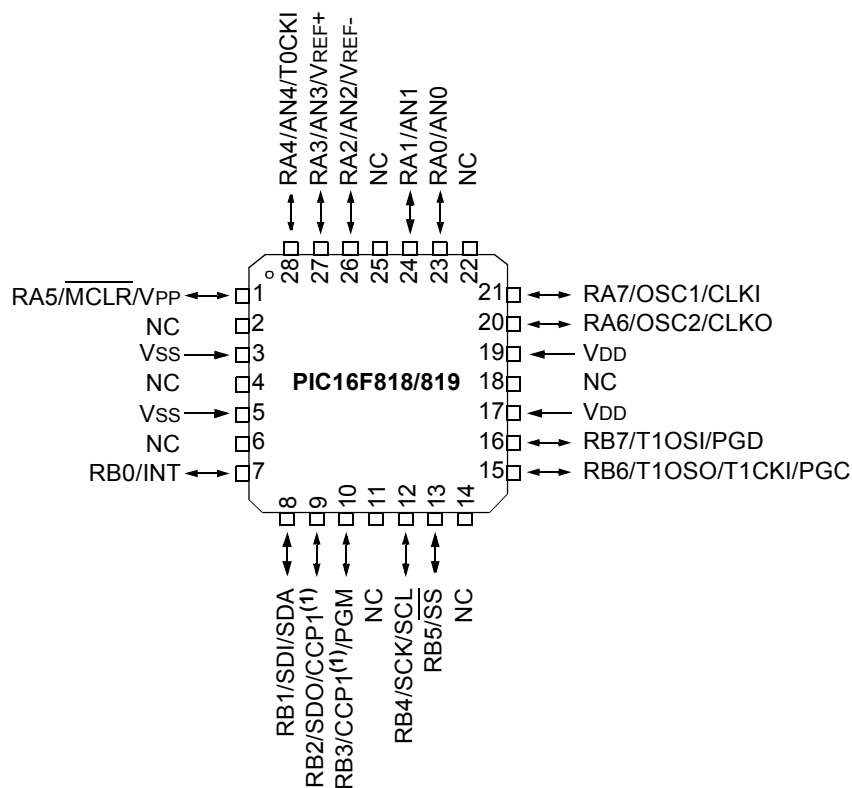
# PIC16F818/819

## PIC16F818/819 20-Pin SSOP



**Note 1:** Location of CCP1 function is determined by CCPMX.

## PIC16F818/819 28-Pin QFN



**Note 1:** Location of CCP1 function is determined by CCPMX.

**TABLE 1-1: PIN DESCRIPTIONS (DURING PROGRAMMING): PIC16F818/819**

Pin Name	During Programming		
	Function	Pin Type	Pin Description
RB3	PGM	I	Low-Voltage ICSP Programming input if LVP configuration bit equals '1'
RB6	CLOCK	I	Clock input
RB7	DATA	I/O	Data input/output
$\overline{\text{MCLR}}$	V <sub>PP</sub>	P*	Program Mode Select
V <sub>DD</sub>	V <sub>DD</sub>	P	Power Supply
V <sub>SS</sub>	V <sub>SS</sub>	P	Ground

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

\* To activate the Programming mode, high voltage needs to be applied to the  $\overline{\text{MCLR}}$  input. Since  $\overline{\text{MCLR}}$  is used for a level source, this means that  $\overline{\text{MCLR}}$  does not draw any significant current.

## 2.0 PROGRAM MODE ENTRY

### 2.1 User Program Memory Map

The user memory space extends from 0x0000 to 0x1FFF (8K). In Programming mode, the program memory space extends from 0x0000 to 0x3FFF, with the first half (0x0000-0x1FFF) being user program memory and the second half (0x2000-0x3FFF) being configuration memory. The PC will increment from 0x0000 to 0x07FF, then increment to 0x0800 and access 0x0000. Once the PC reaches 0x1FFF, it will increment to 0x2000. From 0x2000, the PC will increment up to 0x3FFF and wrap around to 0x2000 (not to 0x0000). Once in configuration memory, the highest bit of the PC remains a '1', always pointing to the configuration memory. The only way to point to user program memory is to reset the part and re-enter Program mode, as described in **Section 2.4 "Program Mode"**.

Device	Program Flash
PIC16F818	1K
PIC16F819	2K

In the configuration memory space, 0x2000-0x201F are physically implemented. However, only locations 0x2000 through 0x2007 are available. Other locations are reserved. Locations beyond 0x201F will physically access user memory (see Figure 2-1).

### 2.2 Data EEPROM Memory

The EEPROM data memory space is a separate block of high-endurance memory that the user accesses using a special sequence of instructions. The amount of data EEPROM memory depends on the device and is shown below in number-of-bytes.

Device	# of Bytes
PIC16F818	128
PIC16F819	256

The contents of data EEPROM memory have the capability to be embedded into the HEX file.

The programmer should be able to read data EEPROM information from a HEX file and, conversely (as an option), write data EEPROM contents to a HEX file, along with program memory information and configuration bit information.

The 256 data memory locations are logically mapped and use PC<7:0>. The format for data memory storage is one data byte per address location, LSb aligned.

# PIC16F818/819

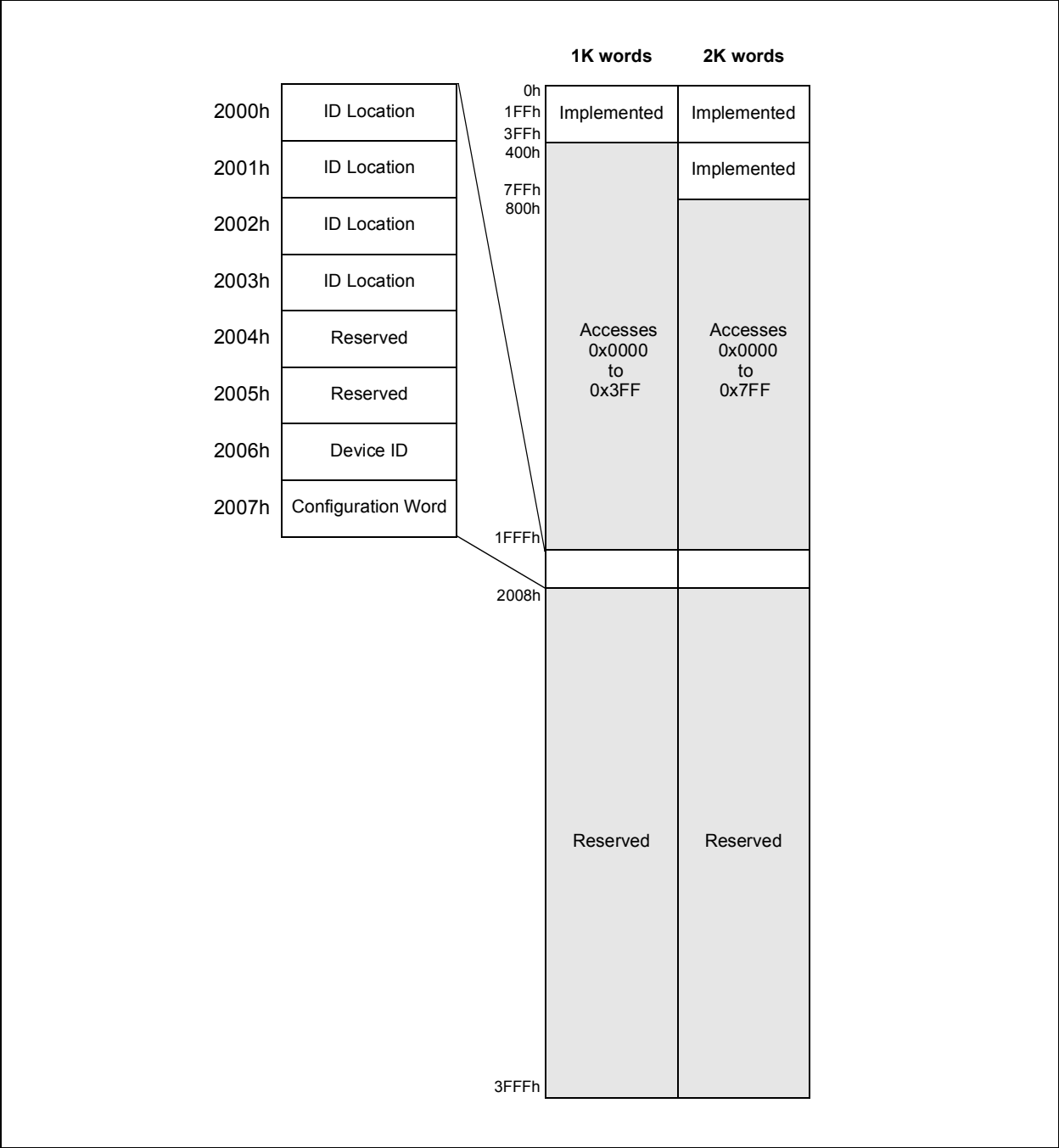
## 2.3 ID Locations

A user may store identification information (ID) in four ID locations. The ID locations are mapped in [0x2000 : 0x2003]. It is recommended that the user use only the four Least Significant bits of each ID location. In some devices, the ID locations read out in an unscrambled fashion after code protection is enabled.

For these devices, it is recommended that ID location is written as “11 1111 1000 bbbb”, where ‘bbbb’ is ID information.

In other devices, the ID locations read out normally, even after code protection. To understand how the devices behave, refer to Table 5-1.

**FIGURE 2-1: PROGRAM MEMORY MAPPING**



## 2.4 Program Mode

Program mode is entered by holding pins RB6 and RB7 low, while raising  $\overline{\text{MCLR}}$  pin from  $V_{IL}$  to  $V_{IH}$  (high voltage). In this mode, the state of the RB3 pin does not affect programming, which is used for Low-Voltage ICSP Programming. Once in Program 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 accessed is the user program memory. RB6 and RB7 are Schmitt Trigger inputs in this mode.

**Note:** The OSC must not have 72 osc clocks while the device  $\overline{\text{MCLR}}$  is between  $V_{IL}$  and  $V_{IH}$ .

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

**Note:** The  $\overline{\text{MCLR}}$  pin should be raised from below  $V_{IL}$  to above the minimum  $V_{IH}$  ( $V_{PP}$ ), within 250  $\mu\text{s}$  of  $V_{DD}$  rise. This ensures that the device always enters Programming mode before any instructions that may be in program memory can be executed. Otherwise, unintended instruction execution could occur when the INTRC clock source is configured as the primary clock. Refer to **Figure 6-1**.

A device Reset will clear the PC and set the address to '0'. The 'Increment Address' command will increment the PC. The 'Load Configuration' command will set the PC to 0x2000. The available commands are shown in Table 2-1.

The normal sequence for programming four program memory words at a time is as follows:

1. Set pointer to row location.
2. Issue a 'Begin Erase' command.
3. Wait  $t_{\text{prog2}}$ .
4. Issue an 'End Programming' command.
5. Load a word at the current program memory address using the 'Load Data' command.
6. Issue an 'Increment Address' command.
7. Load a word at the current program memory address using the 'Load Data' command.
8. Repeat Step 6 and Step 7 two times.
9. Issue a 'Begin Programming' command to begin programming.
10. Wait  $t_{\text{prog1}}$ .
11. Issue an 'End Programming' command.
12. Increment to the next address.
13. Repeat steps 5 through 12 seven times to program one row.

The address and program counter are reset to 0x0000 by resetting the device (taking  $\overline{\text{MCLR}}$  below  $V_{IL}$ ) and re-entering Programming mode. Program and configuration memory may then be read or verified using the 'Read Data' and 'Increment Address' commands.

### 2.4.1 LOW-VOLTAGE ICSP PROGRAMMING MODE

Low-Voltage ICSP Programming mode allows a PIC16F818/819 device to be programmed using  $V_{DD}$  only. However, when this mode is enabled by a configuration bit (LVP), the PIC16F818/819 device dedicates RB3 to control entry/exit into Programming mode.

When the LVP bit is set to '1', the Low-Voltage ICSP Programming entry is enabled. Since the LVP configuration bit allows Low-Voltage ICSP Programming entry in its erased state, an erased device will have the LVP bit enabled at the factory. While LVP is '1', RB3 is dedicated to Low-Voltage ICSP Programming. The following LVP steps assume the LVP bit is set in the Configuration register.

1. Apply  $V_{DD}$  to the  $V_{DD}$  pin.
2. Drive  $\overline{\text{MCLR}}$  low.
3. Apply  $V_{DD}$  to the RB3/PGM pin.
4. Apply  $V_{DD}$  to the  $\overline{\text{MCLR}}$  pin.

All other specifications for high-voltage ICSP apply.

To disable Low Voltage ICSP mode, the LVP bit must be programmed to '0'. This must be done while entered with the High-Voltage Entry mode (LVP bit = 1). RB3 is now a general purpose I/O pin.

## 2.4.2 SERIAL PROGRAM OPERATION

The RB6 pin is used as a clock input pin, while the RB7 pin is used to enter command bits, and input or output data during serial operation. To input a command, the clock pin (RB6) 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 RB7 is required to have a minimum setup (tset1) and hold (thold1) time (see AC/DC specifications), with respect to the falling edge of the clock. Commands with associated data (read and load) are specified to have a minimum delay (tdly1) of 1  $\mu$ 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 (0) and the last cycle being a Stop bit (0). Data is transferred LSb first.

During a read operation, the LSb will be transmitted onto RB7 on the rising edge of the second cycle, while, during a load operation, the LSb will be latched on the falling edge of the second cycle. A minimum 1  $\mu$ s delay (tdly2) is specified between consecutive commands.

All commands and data words are transmitted LSb first. The data is transmitted on the rising edge, and latched on the falling edge of the clock. To allow decoding of commands and reversal of data pin configuration, a time separation of at least 1  $\mu$ s (tdly1) is required between a command and a data word, or another command.

The available commands are described in the following paragraphs and listed in Table 2-1.

### 2.4.2.1 Load Configuration

Upon receipt of the Load Configuration command, the PC will be set to 0x2000 and the data sent with the command is discarded. The four ID locations and the configuration word can then be programmed using the normal programming sequence, as described in **Section 2.4 "Program Mode"**. A description of the memory mapping schemes of the program memory for normal operation and Configuration mode operation is shown in Figure 2-1. Once the configuration memory is entered, the only way to get back to the user program memory is to exit the Program/Verify Test mode by taking MCLR low (VIL).

### 2.4.2.2 Load Data for Program Memory

After receiving this command, the chip will load one word (with 14 bits as a "data word") to be programmed into user program memory when 16 cycles are applied. A timing diagram for this command is shown in Figure 6-1.

### 2.4.2.3 Load Data for Data Memory

After receiving this command, the chip will load a 14-bit "data word" when 16 cycles are applied. However, the data memory is only 8 bits wide and, thus, only the first 8 bits of data after the Start bit will be programmed into the data memory (8 data bits and 6 zeros). It is still necessary to cycle the clock the full 16 cycles in order to allow the internal circuitry to reset properly. The data memory contains up to 256 bytes. If the device is code protected, the data is read as all zeros. A timing diagram for this command is shown in Figure 6-2.

### 2.4.2.4 Read Data from Program Memory

After receiving this command, the chip will transmit data bits out of the program memory (user or configuration) currently accessed, starting with the second rising edge of the clock input. The RB7 pin will go into Output mode on the second rising clock edge, reverting back to Input mode (high-impedance) after the 16th rising edge. A timing diagram of this command is shown in Figure 6-3.

### 2.4.2.5 Read Data from Data Memory

After receiving this command, the chip will transmit data bits out of the data memory, starting with the second rising edge of the clock input. The RB7 pin will go into Output mode on the second rising edge, reverting back to Input mode (high-impedance) after the 16th rising edge. As previously stated, the data memory is 8-bits wide and, therefore, only the first 8 bits that are output are actual data. A timing diagram for this command is shown in Figure 6-4.

### 2.4.2.6 Increment Address

The PC is incremented when this command is received. A timing diagram of this command is shown in Figure 6-5.

<b>Note:</b> Upon entry into Programming mode, a "Load Data for Program Memory" or "Load Data for Data Memory" command of 0x01 must be given before a Begin Erase or Begin Programming command is initiated. This will ensure that the programming pointer is pointing to the correct location in data or program memory.
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## 2.4.2.7 Begin Erase (Program and Data Memory)

The erase block size for program memory is 32 words (row) and 1 word for data memory. The row or word to be programmed must first be erased. This is done by setting the pointer to a location in the row or word and then performing a 'Begin Erase' command. The row or word is then erased. The user must allow the combined time for row erase and programming, as specified in the electrical specifications, for programming to complete. This is an externally timed event.

The internal timer is not used for this command, so the 'End Programming' command must be used to stop erase.

- Note 1:** The code-protect bits cannot be erased with this command.
- 2:** All Begin Erase operations can take place over the entire VDD range.

A timing diagram for this command is shown in Figure 6-6.

## 2.4.2.8 Begin Programming Only

Programming of program and data memory will begin after this command is received and decoded. The user must allow the time for programming, as specified in the electrical specifications, for programming to complete. An 'End Programming' command is required.

The internal timer is not used for this command, so the 'End Programming' command must be used to stop programming.

1. If the address is pointing to user memory, the user memory alone will be affected.
2. If the address is pointing to the physically implemented configuration memory (2000h - 2007h), the configuration memory will be written. The configuration word will not be written unless the address is specifically pointing to 2007h.

A timing diagram for this command is shown in Figure 6-7.

## 2.4.2.9 End Programming

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

- Note:** This command will also set the write data shift latches to all '1's to avoid issues with downloading only one word before the write.

**TABLE 2-1: COMMAND MAPPING FOR PIC16F818/819**

Command	Mapping (MSB ... LSB)					Data	Voltage Range
Load Configuration	0	0	0	0	0	0, data (14), 0	2.0V – 5.5V
Load Data for Program Memory	0	0	0	1	0	0, data (14), 0	2.0V – 5.5V
Read Data from Program Memory	0	0	1	0	0	0, data (14), 0	2.0V – 5.5V
Increment Address	0	0	1	1	0		2.0V – 5.5V
Begin Erase	0	1	0	0	0	externally timed	2.0V – 5.5V
Begin Programming Only Cycle	1	1	0	0	0	externally timed	2.0V – 5.5V
Bulk Erase Program Memory	0	1	0	0	1	externally timed	4.5V – 5.5V
Bulk Erase Data Memory	0	1	0	1	1	externally timed	4.5V – 5.5V
Chip Erase	1	1	1	1	1	internally timed	4.5V – 5.5V
Load Data for Data Memory	0	0	0	1	1	0, zeroes (6), data (8), 0	2.0V – 5.5V
Read Data from Data Memory	0	0	1	0	1	0, zeroes (6), data (8), 0	2.0V – 5.5V
End Programming	1	0	1	1	1		

## 2.5 Erasing Program and Data Memory

Depending on the state of the code protection bits, program and data memory will be erased using different methods. The first two commands are used when both program and data memories are not code protected. The third command is used when either memory is code-protected, or if you want to also erase the code protect bits. A device programmer should determine the state of the code protection bits and then apply the proper command to erase the desired memory.

### 2.5.1 ERASING NON CODE-PROTECTED PROGRAM AND DATA MEMORY

When both program and data memories are not code-protected, they must be individually erased using the following commands. The only way that both memories are erased using a single command is if code protection is enabled for one of the memories. These commands do not erase the configuration word or ID locations.

#### 2.5.1.1 Bulk Erase Program Memory

When this command is performed, and is followed by a 'Begin Erase' command, the entire program memory will be erased.

If the address is pointing to user memory, only the user memory will be erased.

If the address is pointing to the configuration memory (2000h - 2007h), both the user memory and the configuration memory will be erased. The configuration word will not be erased, even if the address is pointing to location 2007h.

Previously, a load data with 0FFh command was recommended before any Bulk Erase. On these devices, this will not be required.

The Bulk Erase command is disabled when the CP bit is programmed to '0', enabling code-protect.

A timing diagram for this command is shown in Figure 6-8.

#### 2.5.1.2 Bulk Erase Data Memory

When this command is performed, and is followed by a 'Begin Erase' command, the entire data memory will be erased.

The Bulk Erase Data command is disabled when the CPD bit is programmed to '0', enabling protected data memory. A timing diagram for this command is shown in Figure 6-9.

<b>Note:</b> All Bulk Erase operations must take place at the 4.5V to 5.5V VDD range.
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#### 2.5.1.3 Chip Erase

This command, when performed, will erase the program memory, EE data memory, and all of the code-protection bits. All on-chip Flash and EEPROM memory is erased, regardless of the address contained in the PC.

When a Chip Erase command is issued and the PC points to (0000h - 1FFFh), the configuration word (2007h) and the user program memory will be erased. When a Chip Erase command is issued and the PC points to (2000h - 2007h), all of the configuration memory, program memory, and data memory will be erased.

The Chip Erase is internally self-timed to ensure that all program and data memory are erased before the code protect bits are erased. A timing diagram for this command is shown in Figure 6-10.

<b>Note:</b> The Chip Erase operation must take place at the 4.5V to 5.5V VDD range.
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### 2.5.2 ERASING CODE-PROTECTED MEMORY

For the PIC16F818/819 devices, once code-protection is enabled, all protected program and data memory locations read all '0's and further programming is disabled. The ID locations and configuration word read out unscrambled and can be reprogrammed normally. The only command to erase a code-protected PIC16F818/819 device is the Chip Erase. This erases program memory, data memory, configuration bits and ID locations, as described in **Section 2.5.1.3 "Chip Erase"**. **Since all data within the program and data memory will be erased when this command is executed, the security of the data or code is not compromised.**



**FIGURE 2-2: ALGORITHM 1 FLOW CHART – PROGRAM MEMORY ( $2.0V \leq V_{DD} < 5.5V$ )**

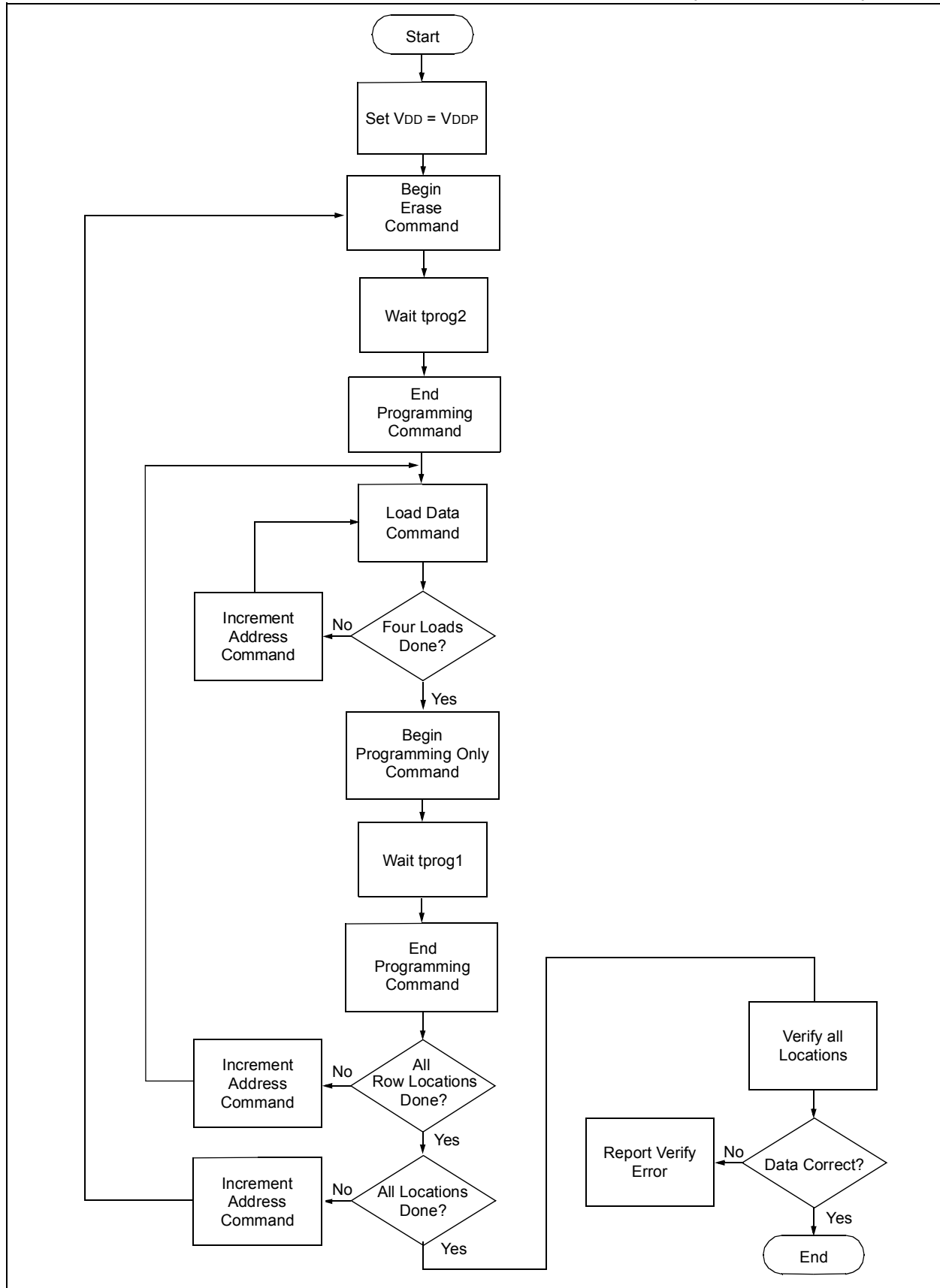
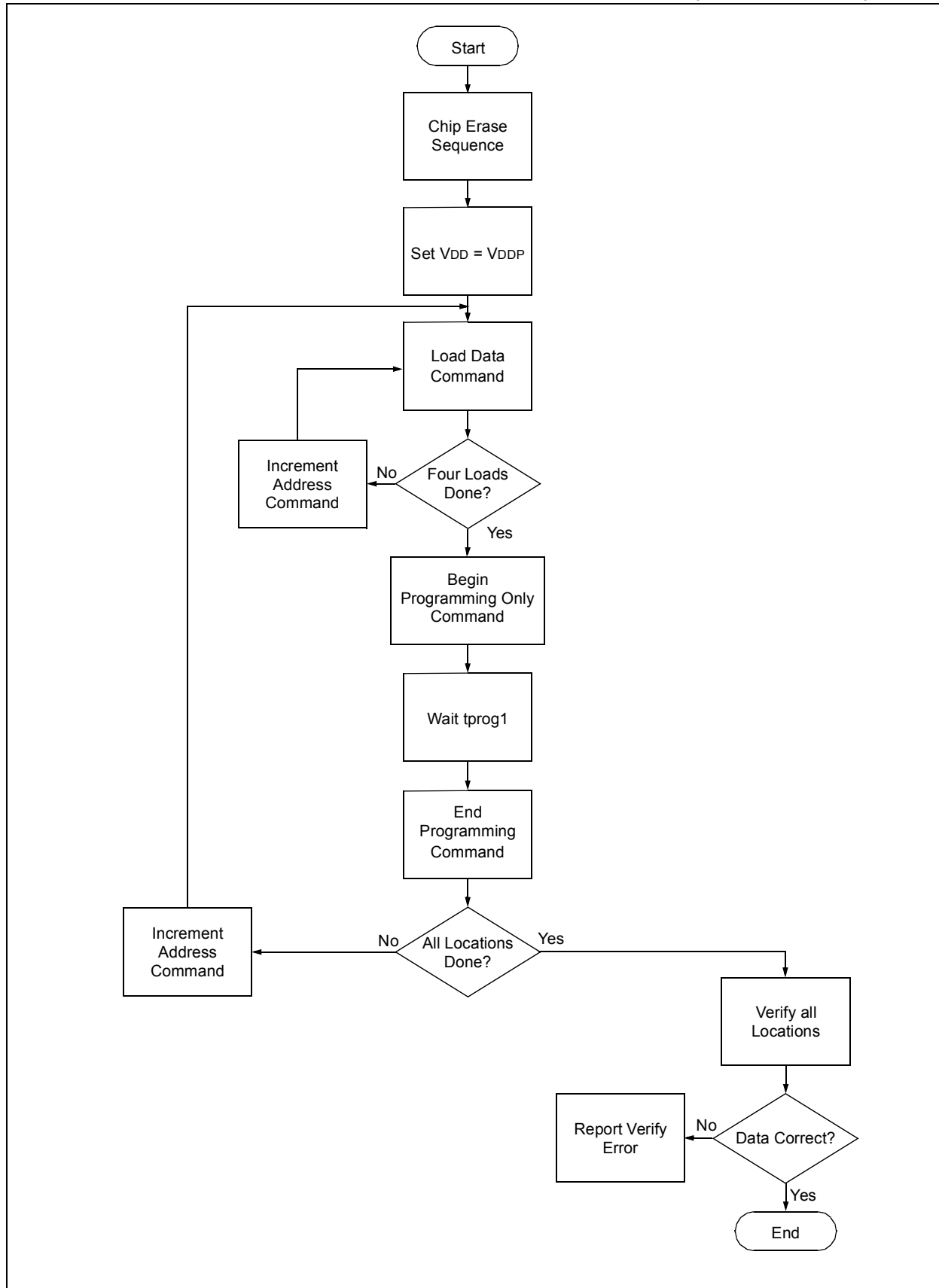
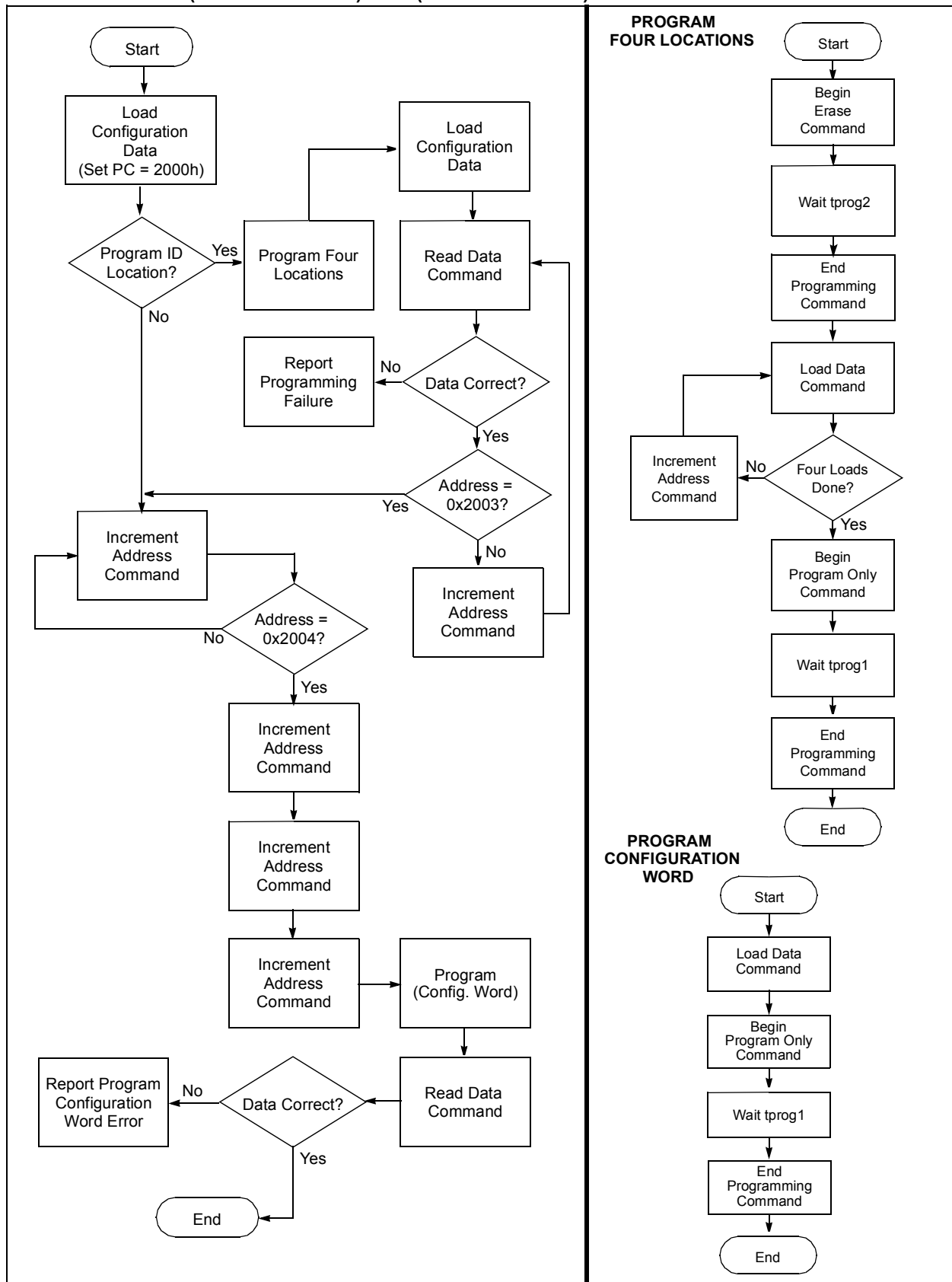


FIGURE 2-3: ALGORITHM 2 FLOW CHART – PROGRAM MEMORY ( $4.5V \leq V_{DD} \leq 5.5V$ )



**FIGURE 2-4: FLOW CHART – PIC16F818/819 CONFIGURATION MEMORY**  
( $2.0V \leq V_{DD} < 5.5V$ ) AND ( $4.5V \leq V_{DD} < 5.5V$ )



# PIC16F818/819

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## 3.0 CONFIGURATION WORD

The PIC16F818/819 has several configuration bits. These bits can be written to '0' or '1' with the Begin Program Only command. A Begin Erase command is not required when programming configuration memory.

### 3.1 Device ID Word

The device ID word for the PIC16F818/819 is located at 2006h.

**TABLE 3-1: DEVICE ID VALUE**

Device	Device ID Value	
	Dev	Rev
PIC16F818	00 0100 1100	XXXX
PIC16F819	00 0100 1110	XXXX

## REGISTER 3-1: CONFIGURATION WORD (ADDRESS 2007h)<sup>(1)</sup>

u-1	u-1	u-1	u-1	u-1	u-1	u-1	u-1	u-1	u-1	u-1	u-1	u-1	u-1
CP	CCPMX	DEBUG	WRT1	WRT0	CPD	LVP	BOREN	MCLR $\overline{\text{E}}$	FOSC2	PWRTEN	WDTEN	FOSC1	FOSC0
bit13													bit 0

bit 13	<b>CP:</b> Flash Program Memory Code Protection bit 1 = Code protection off 0 = All memory locations code-protected
bit 12	<b>CCPMX:</b> CCP1 Pin Selection bit 1 = CCP1 function on RB2 0 = CCP1 function on RB3
bit 11	<b>DEBUG:</b> In-Circuit Debugger Mode bit 1 = In-Circuit Debugger disabled, RB6 and RB7 are general purpose I/O pins 0 = In-Circuit Debugger enabled, RB6 and RB7 are dedicated to the debugger
bit 10-9	<b>WRT1:WRT0:</b> Flash Program Memory Write Enable bits 11 = Write protection off 10 = 0000h to 01FFh write-protected, 0200h to 07FFh may be modified by EECON control 01 = 0000h to 03FFh write-protected, 0400h to 07FFh may be modified by EECON control 00 = 0000h to 05FFh write-protected, 0600h to 07FFh may be modified by EECON control
bit 8	<b>CPD:</b> Data EE Memory Code Protection bit 1 = Code protection off 0 = Data EE memory locations code-protected
bit 7	<b>LVP:</b> Low-Voltage Programming Enable bit 1 = RB3/PGM pin has PGM function, Low-Voltage Programming enabled 0 = RB3/PGM pin has digital I/O function, HV on MCLR must be used for programming
bit 6	<b>BOREN:</b> Brown-out Reset Enable bit 1 = BOR enabled 0 = BOR disabled
bit 5	<b>MCLR<math>\overline{\text{E}}</math>:</b> RA5/MCLR Pin Function Select bit 1 = RA5/MCLR pin function is MCLR 0 = RA5/MCLR pin function is digital I/O, MCLR internally tied to VDD
bit 3	<b>PWRTEN:</b> Power-up Timer Enable bit 1 = PWRT disabled 0 = PWRT enabled
bit 2	<b>WDTEN:</b> Watchdog Timer Enable bit 1 = WDT enabled 0 = WDT disabled
bit 4, 1-0	<b>FOSC2:FOSC0:</b> Oscillator Selection bits 111 = EXTRC oscillator; CLKO function on RA6/OSC2/CLKO pin 110 = EXTRC oscillator; port I/O function on RA6/OSC2/CLKO pin 101 = INTRC oscillator; CLKO function on RA6/OSC2/CLKO pin and port I/O function on RA7/OSC1/CLKI pin 100 = INTRC oscillator; port I/O function on both RA6/OSC2/CLKO pin and RA7/OSC1/CLKI pin 011 = EXTCLK; port I/O function on RA6/OSC2/CLKO pin 010 = HS oscillator 001 = XT oscillator 000 = LP oscillator

**Note 1:** The erased (unprogrammed) value of the configuration word is 3FFFh.

### Legend:

R = Readable bit	P = Programmable bit	U = Unimplemented bit, read as '1'
- n = Value when device is unprogrammed		u = Unchanged from programmed state

# PIC16F818/819

## 4.0 EMBEDDING CONFIGURATION WORD AND ID INFORMATION IN 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, 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.

Specifically for the PIC16F818/819, the EEPROM data memory should also be embedded in the HEX file (see **Section 2.2 “Data EEPROM Memory”**).

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

## 5.0 CHECKSUM COMPUTATION

Checksum is calculated by reading the contents of the PIC16F818/819 memory locations and totaling the opcodes, up to the maximum user-addressable location (e.g., 0x1FF for the PIC16F818/819). 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 PIC16F818/819 devices is shown in Table 5-1.

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.

Note that some older devices have an additional value added in the checksum. This is to maintain compatibility with older device programmer checksums.

**TABLE 5-1: CHECKSUM COMPUTATION**

Device	Code Protect	Checksum*	Blank Value	0x25E6 at 0 and Max Address
PIC16F818	OFF	SUM[0000:03FF] + (CFGW & 3FFF)	3BFF	07CD
	ON	(CFGW & 3FFF) + SUM_ID	5BFE	27CC
PIC16F819	OFF	SUM[0000:07FF] + (CFGW & 3FFF)	37FF	03CD
	ON	(CFGW & 3FFF) + SUM_ID	57FE	23CC

**Legend:** CFGW = Configuration Word  
SUM[a:b] = [Sum of locations a to 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 = 0x1, ID1 = 0x2, ID3 = 0x3, ID4 = 0x4, then SUM\_ID = 0x1234.  
\*Checksum = [Sum of all the individual expressions] **MODULO** [0xFFFF]  
+ = Addition  
& = Bitwise AND

## 6.0 PROGRAM MODE ELECTRICAL CHARACTERISTICS

**TABLE 6-1: TIMING REQUIREMENTS FOR PROGRAM MODE**

AC/DC CHARACTERISTICS POWER SUPPLY PINS	Standard Operating Procedure (unless otherwise stated)					
	Operating temperature		$0 \leq T_A \leq +70^{\circ}\text{C}$			
	Operating Voltage		$2.0\text{V} \leq V_{DD} \leq 5.5\text{V}$			
Characteristics	Sym	Min	Typ	Max	Units	Conditions/Comments
<b>General</b>						
VDD level for Begin Erase, Begin Program operations and EECON1 writes of program memory	VDD	2.0	—	5.5	V	
VDD level for Begin Erase, Begin Program operations and EECON1 writes of data memory	VDD	2.0	—	5.5	V	
VDD level for Bulk Erase, Chip Erase, and Begin Program operations of program and data memory	VDD	4.5	—	5.5	V	
Begin Programming Only cycle time	tprog1	1	—	—	ms	Externally Timed, > 4.5V
		2	—	—	ms	Externally Timed, < 4.5V
Begin Erase	tprog2	1	—	—	ms	Externally Timed, > 4.5V
		2	—	—	ms	Externally Timed, < 4.5V
Bulk Erase cycle time	tprog3	2	—	—	ms	Externally Timed
Chip Erase cycle time	tprog4	8	—	—	ms	Internally Timed
High voltage on $\overline{\text{MCLR}}$ and RA4/T0CKI for Program mode entry	VIHH	$V_{DD} + 3.5$	—	13.5	V	
$\overline{\text{MCLR}}$ rise time ( $V_{SS}$ to $V_{HH}$ ) for Program mode entry	tVHHR	—	—	1.0	$\mu\text{s}$	
(RB6, RB7) input high level	VIH1	$0.8 V_{DD}$	—	—	V	Schmitt Trigger input
(RB6, RB7) input low level	VIL1	$0.2 V_{DD}$	—	—	V	Schmitt Trigger input
RB<7:4> setup time before $\overline{\text{MCLR}}\uparrow$ (Program mode selection pattern setup time)	tset0	100	—	—	ns	
RB<7:4> hold time after $\overline{\text{MCLR}}\uparrow$ (Program mode selection pattern setup time)	thld0	5	—	—	$\mu\text{s}$	
<b>Serial Program</b>						
Data in setup time before clock $\downarrow$	tset1	100	—	—	ns	
Data in hold time after clock $\downarrow$	thld1	100	—	—	ns	
Data input not driven to next clock input (delay required between command/data or command/command)	tdly1	1.0	—	—	$\mu\text{s}$	$2.0\text{V} \leq V_{DD} < 4.5\text{V}$
		100	—	—	ns	$4.5\text{V} \leq V_{DD} \leq 5.5\text{V}$
Delay between clock $\downarrow$ to clock $\uparrow$ of next command or data	tdly2	1.0	—	—	$\mu\text{s}$	$2.0\text{V} \leq V_{DD} < 4.5\text{V}$
		100	—	—	ns	$4.5\text{V} \leq V_{DD} \leq 5.5\text{V}$
Clock $\uparrow$ to data out valid (during read data)	tdly3	80	—	—	ns	
Setup time between VDD rise and $\overline{\text{MCLR}}$ rise	tpu	tset0	—	250	$\mu\text{s}$	

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FIGURE 6-1: LOAD DATA FOR USER PROGRAM MEMORY COMMAND (PROGRAM)

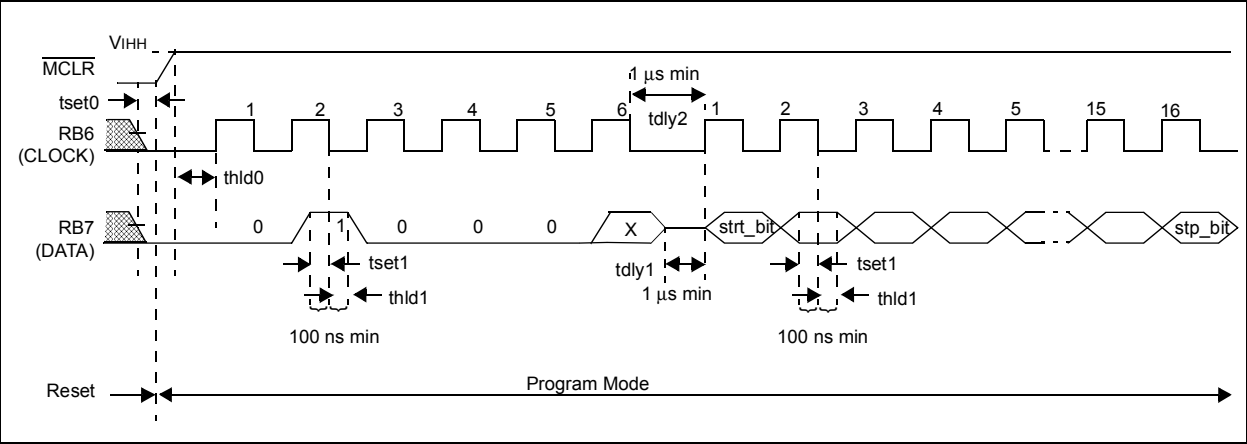


FIGURE 6-2: LOAD DATA FOR USER DATA MEMORY COMMAND (PROGRAM)

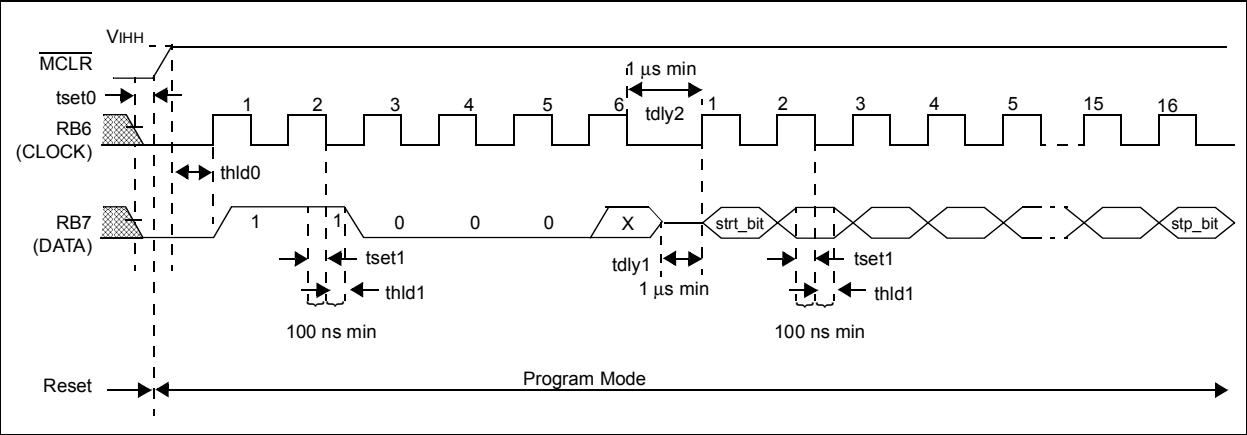
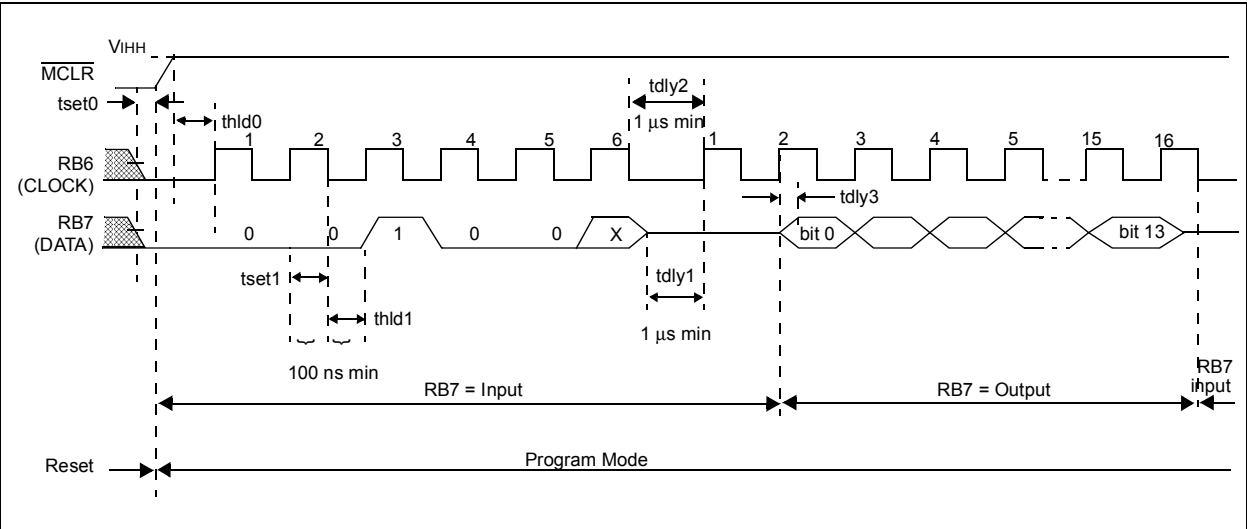
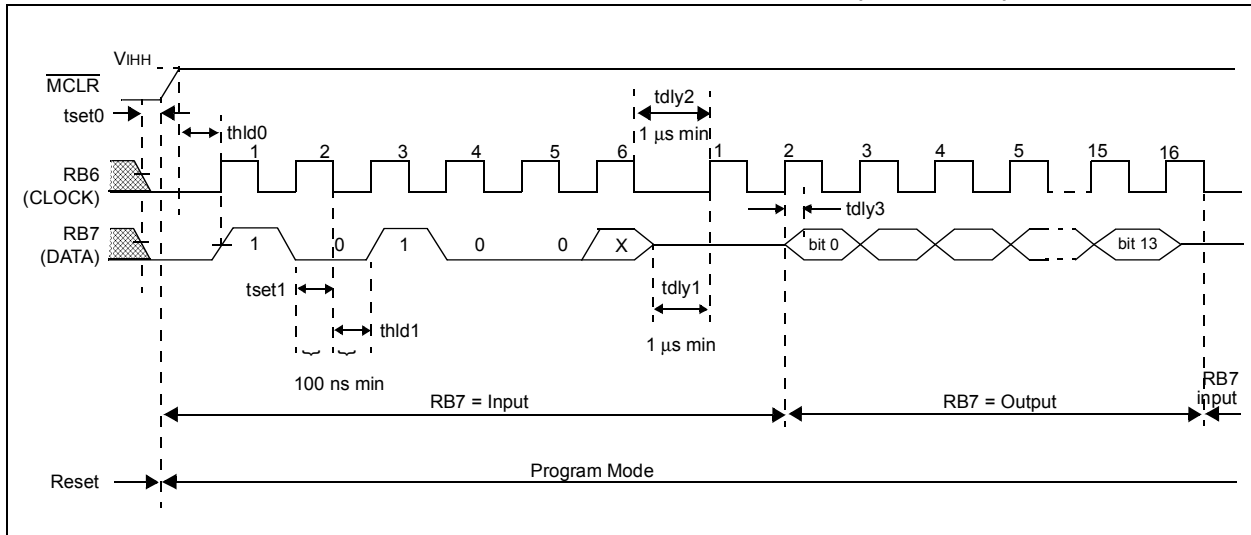


FIGURE 6-3: READ DATA FROM PROGRAM MEMORY COMMAND (PROGRAM)

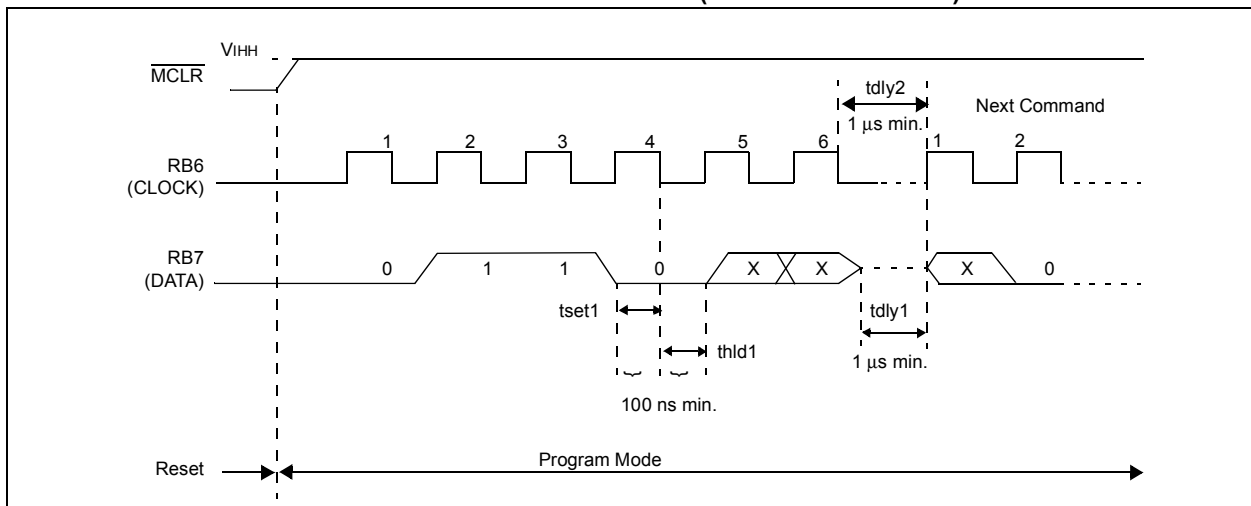




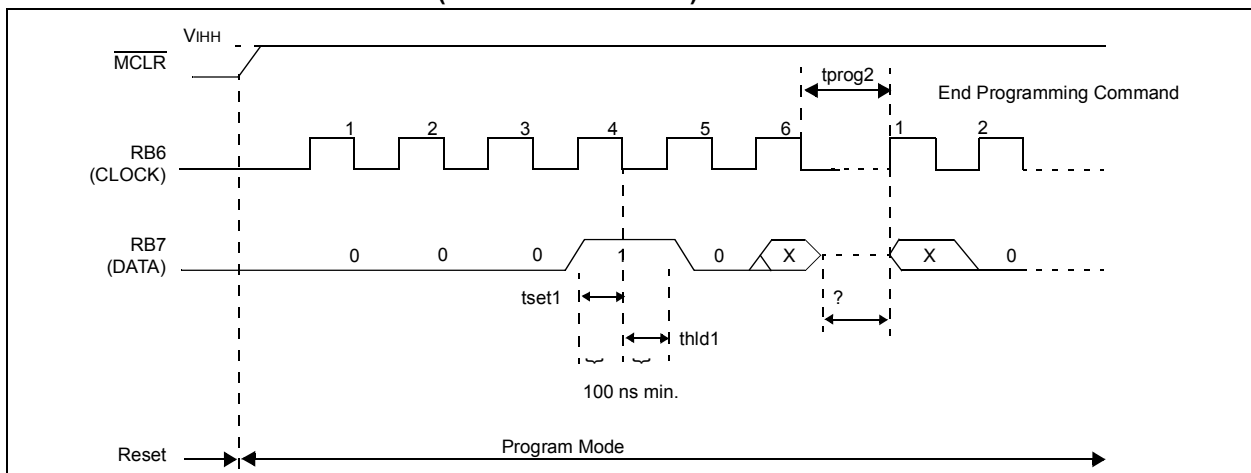
**FIGURE 6-4: READ DATA FROM DATA MEMORY COMMAND (PROGRAM)**



**FIGURE 6-5: INCREMENT ADDRESS COMMAND (SERIAL PROGRAM)**



**FIGURE 6-6: BEGIN ERASE (SERIAL PROGRAM)**



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FIGURE 6-7: BEGIN PROGRAMING ONLY COMMAND (SERIAL PROGRAM)

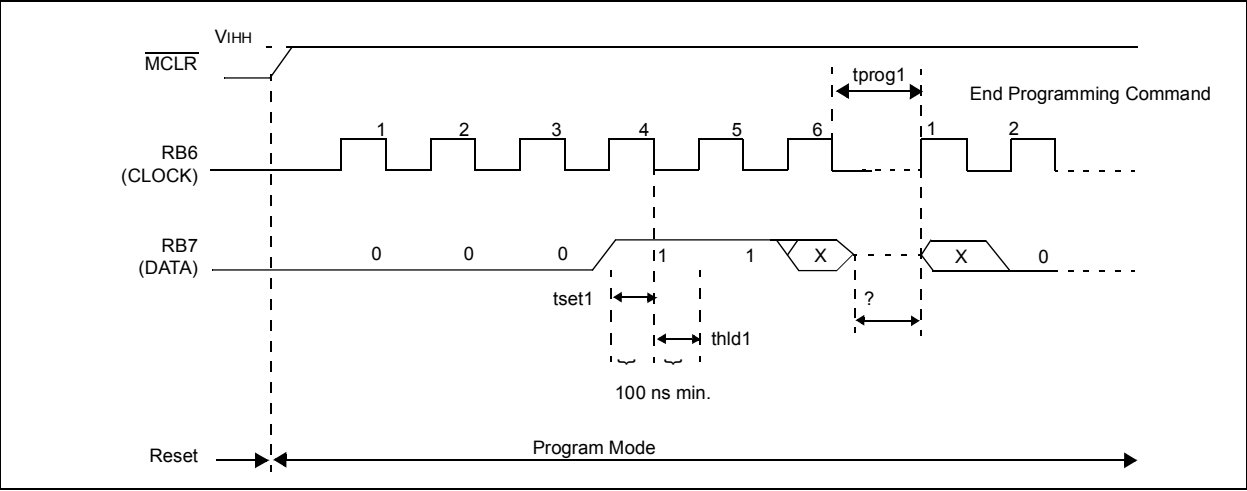


FIGURE 6-8: BULK ERASE PROGRAM MEMORY COMMAND (SERIAL PROGRAM/VERIFY)

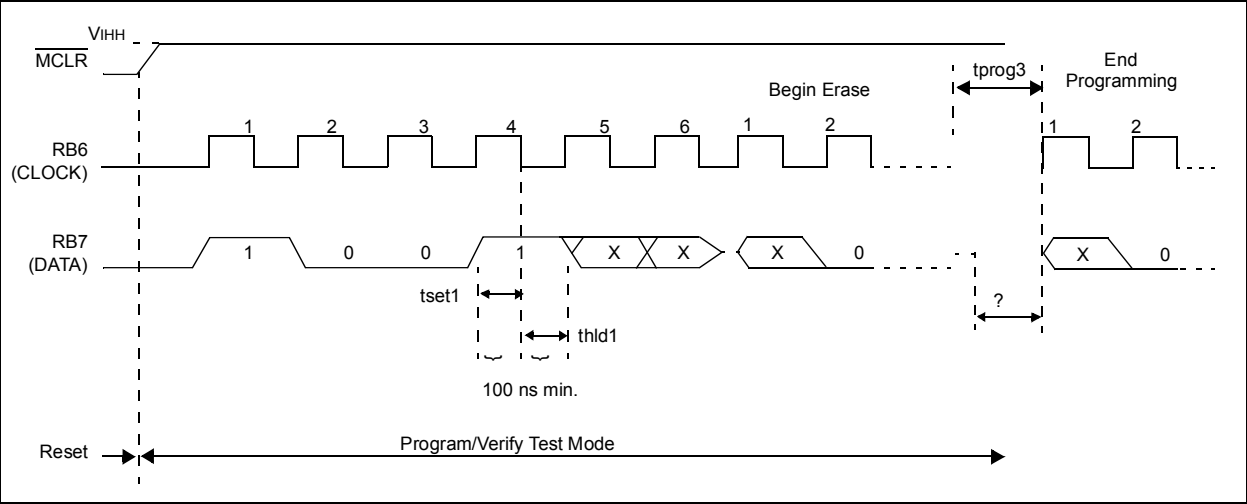
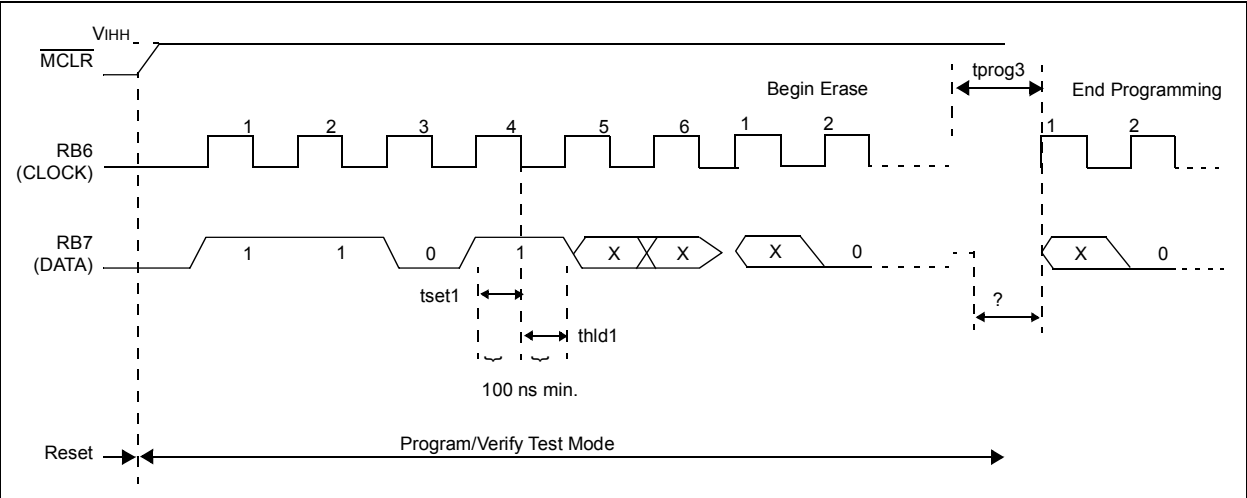


FIGURE 6-9: BULK ERASE DATA MEMORY COMMAND (SERIAL PROGRAM/VERIFY)





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NOTES:

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