
Programming Flash Memory at Program Time

*Author: Stan D'Souza
Microchip Technology Inc.*

INTRODUCTION

Some PIC16F1XXX devices do not have EEPROM memory to save and retrieve user-specified data. Instead, these devices allocate sections of the program memory (PM) as high-read/write capability (100K minimum) and use these locations for saving and writing special data. This data may be calibration constants or default values for some parameters used in an application. Since PM in PIC16F1XXX is 14 bits wide, full-integer (16-bit) values cannot be saved in these locations. However, the user may want to save ADC values, which are 10-bit and sometimes 12-bit or PWM values which are also 10-bit. The challenge is trying to program these default values in PM at program time or at the factory. This technical brief will demonstrate, using a simple example, how to save 32 “words” of data information to PM.

Note: The “words” of data have to be 14-bit or less.

THE CHALLENGE

MPLAB[®] XC8 does support constants in PM, however, when defined as `const char foo @ 1f80h`, the 8-bit char value ‘foo’ is saved at location 1f80h as a `retlw foo` instruction. The first problem is that the user will have to mask the `retlw` instruction overhead to retrieve the 8-bit ‘foo’ value, which would involve additional code. The user will not be able to read/write 10-bit ADC or PWM values with this method. Subsequent read/write during runtime to these locations may not involve the `retlw` instruction overhead.

Using assembly instructions, the user can save data “words” in PM and create a linker script to locate these words at a certain location in PM. See [Example 1](#) for implementation.

EXAMPLE 1: LINE ASSEMBLY COMMANDS

```
asm("psect  
myconst1,global,class=CODE,delta=2")  
asm("dw0x1234")  
asm("dw0x1342")
```

The linker script would be `-L -pmyconst1=01f80h` in the Edit window located at the following path in MPLAB[®] X: Project Properties → XC8 Global Options → XC8 linker.

This method will work and the user will be able to load the appropriate data words starting at location 0x1f80. However, the C compiler does not support in-line assembly code, thus, an alternative method is recommended, especially if there is a need to allocate a fairly large number of parameters (up to 128 or more are allowed in most devices).

IMPLEMENTATION

The solution is to create and add an assembly file to the project. This file will be called `flash.as` and will be included as one of the files in the MPLAB[®] X source directory. This file will look like any other assembly file. A large number of assembly templates are available in `C:\ProgramFiles\Microchip\MPASMSuite\Template\code\`. This file will contain the data “words” which will be programmed into the device during the programming of the device using MPLAB X.

The file will contain code as shown in [Example 2](#).

EXAMPLE 2: ASSEMBLY CODE

```
V1 EQU 123
V2 EQU 345
;First segment of data located at starting address 0x1f80
    psect myconst1,global,class=CODE,delta=2
    dw V1
    dw 0x0DEF
    dw 0x0ABD
    dw 0x0BCE
    dw 0,0,0,0;fill with 4 zero values
    dw 0x1324
    dw 0x1423
;Second segment of data located at starting address 0x1fA0
    psect myconst2,global,class=CODE,delta=2
    dw V2
    dw 0x0ABD
    dw 0x0BCE
    dw 0x1234
    dw 0x1324
    dw 0x1423
    dw 0x1243
```

Using this example, the user can save values at different locations, and as shown above, the two segments are called **myconst1** and **myconst2**. In the linker script the user will have to instruct the linker to allocate these segments to the right locations. The linker command will be:

```
-L -pmyconst1=01f80h -L -pmyconst2=01fA0h
```

The two data segments will be programmed with the first **myconst1** being programmed starting at 0x1f80 and the second segment **myconst2** being programmed starting at 0x1fA0, as shown in [Table 1](#).

TABLE 1: PIC16F1XXX FLASH PROGRAM MEMORY

Address	Flash PM
0	Instruction1
1	Instruction2
2	Instruction3
3	Instruction4
4	Instruction5
...	...
...	...
0x1f80	V1
0x1f81	0x0DEF
0x1f82	0x0ABD
0x1f83	0x0BCE
0x1f84	0
0x1f85	0
0x1f86	0
0x1f87	0
0x1f88	0x1324
0x1f89	0x1423
...	...
...	...
0x1fA0	V2
0x1fA1	0x0ABD
0x1fA2	0x0BCE
0x1fA3	0x1234
0x1fA4	0x1324
0x1fA5	0x1423
0x1fA6	0x1243
...	...

Note: The linker uses space to separate between two consecutive commands. Use spaces for this purpose only. This is very important and if not followed will result in an incorrect operation or error.

The user can add as many data segments as desired and use the linker script to allocate the start for these data segments.

CONCLUSION

Using the method shown above, the user can program Flash memory during programming time for data values and constants, which can be later retrieved during run-time.

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