

## Use PIC32 Boot Flash to Expand Program Memory

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### INTRODUCTION

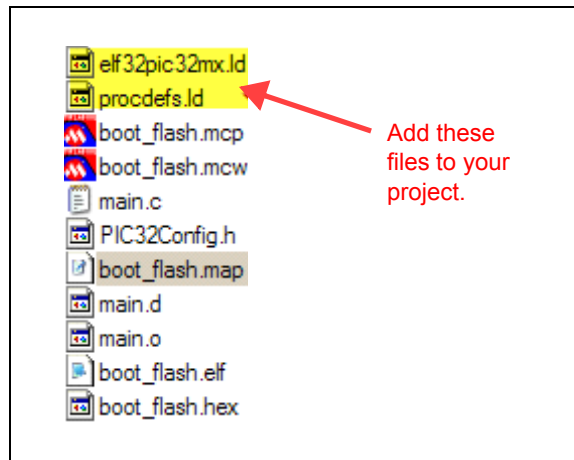
One of the best kept secrets of the PIC32 microcontroller is the availability of an additional 12 Kbytes of Flash memory called the “boot flash”. Traditionally, the boot flash is used to store startup code and the interrupt exception table. And, during the development stage, the debug executive resides there. Through a simple modification to the linker script, you can place routines and constant data into boot flash; thus, expanding the program memory of the PIC32 MCU. For example, a part with 128 kbytes of Flash memory actually has 140 kbytes available. There is no downside to using the boot flash, as it is located in the cacheable memory.

This document illustrates how to appropriate half of the boot flash memory for application code. The remaining portion of the boot flash is reserved for the startup code and interrupt vector table. The project, `boot_flash`, shows an example of how to place a routine in the boot flash. This project will be referenced throughout this paper.

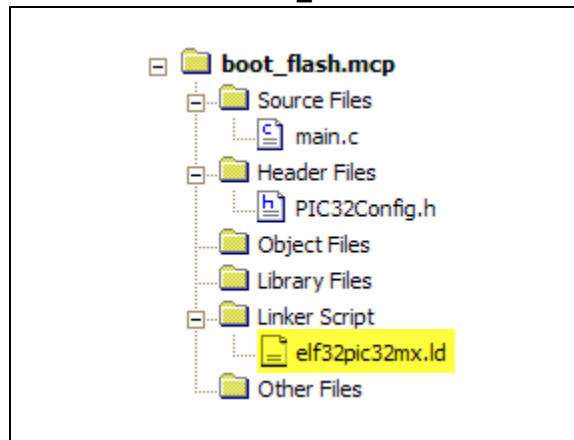
### PLACING ROUTINES AND DATA INTO BOOT FLASH

To place routines and constant data into the boot flash, you need to use a custom linker script. In the `boot_flash` project directory, there are two linker script files: `procdefs.ld` and `elf32pic32mx.ld`. (See Figure 1.) The linker script `procdefs.ld` defines the memory regions of the part, and `elf32pic32mx.ld` places the code and data into those regions. You must include `elf32pic32mx.ld` in your project to be able to place routines and data into the boot flash. (See Figure 2.) Make sure that `procdefs.ld` has the correct memory sections defined per your part.

**FIGURE 1: PROJECT DIRECTORY**



**FIGURE 2: LINKER SCRIPT IN BOOT\_FLASH PROJECT**



# TB3015

To place the routines and data into the boot flash, you need to add the section attribute to the source file. The section attribute will place a routine or data into the section that is defined in the `elf32pic32mx.ld` linker script.

In the source file `main.c`, the routine “foo” is placed in the “extra\_prm\_mem” section. (Figure 3.)

**FIGURE 3: ROUTINE IS ADDED TO CODE IN SOURCE FILE**

```
29 *****
30 * File Description:
31 *
32 * HTTP Server Application
33 *
34 * Change History:
35 * Name      Date      Changes
36 *****/
37 #include "PIC32Config.h"
38 #include <plib.h>
39
40 int main(void)
41 {
42     while(1)
43     {
44
45     }
46
47     return -1;
48 }
49
50 void __attribute__((section("extra_prm_mem"))) foo(void)
51 {
52     // set PORT B to outputs
53     mPORTBSetPinsDigitalOut(BIT_0 | BIT_1 | BIT_2);
54 }
```

In `elf32pic32mx.ld`, the “extra\_prm\_mem” section is placed in the boot flash section of memory (See Figure 4.)

**FIGURE 4: LINKER SCRIPT CODE**

```
.extra_prm_mem :
{
    *(extra_prm_mem)
} >kseg0_boot_mem
```

After compiling the `boot_flash` project, the map file, `boot_flash.map`, shows `foo` located at memory address `0x9FC00670`, which is located in the boot flash. (See Figure 5.)

**FIGURE 5: LOCATION OF ROUTINE IN BOOT FLASH**

```
0x9fc00670      0x38
*(extra_prm_mem)
extra_prm_mem
0x9fc00670      0x38 main.o
0x9fc00670      foo
```

## CONCLUSION

By using the attribute, section, and a custom linker script, you can place routines and data into PIC32MX boot flash.

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