TMS320F28xx SDFlash Serial RS232 Flash Programming Reference Guide

Table of Contents

Revision History

v3.1: March 28, 2007. *(D. Alter)*

- Added support for F28044 using F2804x Flash API algorithms v1.00.
- Added support for F28016 and F28015 using F2801x Flash API algorithms v1.00.
- Added support for F2809 using F2809 Flash API algorithms v1.00.
- Added support for F2802 and F2802-60 using F280x Flash API algorithms v3.02.
- Added support for F2801-60 using F280x Flash API algorithms v3.02.
- Upgraded F2808, F2806, and F2801 support to use F280x Flash API algorithms v3.02.
- Modified the code security unlocking routine to overwrite the downloaded passwords located in RAM after unlocking the CSM. This applies to all devices.
- Added support for 115200, 4800, 2400, and 1200 baud.
- Added Appendix A that describes SDFlash Serial customization. *(C. Peng)*

v3.0: September 01, 2005. *(D. Alter)*

- Added support for F2808, F2806, F2801 using F280x Flash API algorithms v3.00.
- Upgraded F281x API Flash algorithms to v2.10.
- Removed SDFlash executable from bundle.
- Removed Win32 console test program from bundle.
- Consolidated all documentation files into this document
- Fixed linker command file for F281x algorithm build to properly include all .obj files.
- Adjusted descriptions and default values for the ERASE TIMEOUT, PROGRAM TIMEOUT, and VERIFY TIMEOUT SDFlash project options.
- Added use of Erase User Options #4 and Programming User Options #4 to specify the Host PC loop retry for erase and programming acknowledgement.

v2.2: October 15, 2004. Original release.

- Support for F2812, F2811, F2810 using F281x Flash API algorithms v1.00.

Limitations and Assumptions

The SDFlash RS232 Serial patch is provided by Spectrum Digital and Texas Instruments as an “as is” proof of concept example of serial programming for the F28xxx flash DSPs. The utility as well as the source code is provided as is, without any technical support.

The patch requires use of SDFlash v1.60 or later. These versions of SDFlash support a generic communications interface that is used to communicate over the RS232 serial link.

All of the source code, project files, and documentation needed to build the .dll files for SDFlash (e.g., F281xRS232Flash.dll and F280xRS232Flash.dll), the flash programming DSP download F28yyySerialFlash.out (e.g., F2812SerialFlash.out for F2812 device), and the code security password match flow DSP download (e.g., F28xxPasswordMF.out) are available in the following directories:

TMS320F281x devices: <SDFlash_install_dir>\sdflash\mydrivers\DSP281x_v3_1

TMS320F280x devices: <SDFlash_install_dir>\sdflash\mydrivers\DSP280x_v3_1

TMS320F2801x devices: <SDFlash_install_dir>\sdflash\mydrivers\DSP2801x_v3_1

TMS320F2804x devices: <SDFlash_install_dir>\sdflash\mydrivers\DSP2804x_v3_1

The v3.1 SDFlash Serial utility supports the following devices:

TMS320F281x devices: F2812, F2811, F2810

TMS320F280x devices: F2809, F2808, F2806, F2802, F2802-60, F2801, F2801-60

TMS320F2801x devices: F28015, F28016

TMS320F2804x devices: F28044

The SDFlash driver files F281xRS232Flash.dll (for all F281x devices) and F280xRS232Flash.dll (for all F280x, F2801x, and F2804x devices) were built using Microsoft Visual C++ v6.00. The flash programming DSP downloads F28yyySerialFlash.out and the code security password match flow DSP download F28xxPasswordMF.out (for all F280x, F2801x, and F2804x devices) were built using Code Composer Studio™ v3.3 with C28xx C compiler v4.1.3.

This document assumes the reader has some familiarity with the following:

- SDFlash v1.60 or later for JTAG programming of the F28xxx family.
- The “TMS320F281x Flash API” (SPRC125), the “TMSF280x Flash API” (SPRC193) , the “TMS320F2801x Flash API” (SPRC327), or the “TMS320F2804x Flash API” (SPRC325) available on TI’s website, http://www.ti.com

™ Code Composer Studio is a trademark of Texas Instruments Incorporated.

Installation Instructions

Step 1. Install SDFlash V1.60 or higher.

In version 1.60 and above Spectrum Digital exposed a generic interface that can support programming via non-JTAG interfaces. The latest SDFlash can be downloaded from the Spectrum Digital website.

– Go to www.spectrumdigital.com and register, or login if you have previously registered. The login button is at the top right of the webpage.

– Click *“Drivers and Config Utilities”*

– Click *“C2000 Products”* on the list on the left-hand side of the screen

– Click *“Utilities”* on the list on the left-hand side of the screen.

– Click *“Install/Download”* for the SDFlash utility. This will open the following webpage:

  http://emulators.spectrumdigital.com/utilities/sdflash/

– Download and install on your PC the latest SDFlash utility (at least v1.60).

Step 2. Install the SDFlash algorithms for F28xxx flash programming via an RS232 serial link.

– Go to www.spectrumdigital.com and register, or login if you have previously registered. The login button is at the top right of the webpage.

– Click *“Drivers and Config Utilities”*

– Click *“C2000 Products”* on the list on the left-hand side of the screen

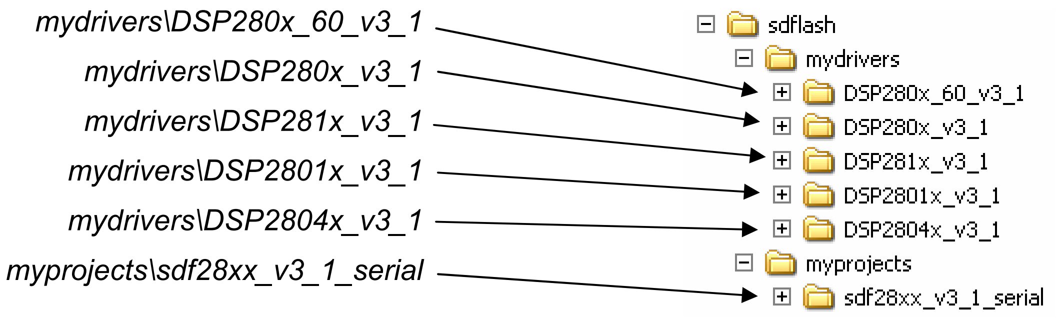
– Click *“Utilities”* on the list on the left-hand side of the screen.

– Click *“Install/Download”* for the SDFlash utility. This will open the following webpage:

  http://emulators.spectrumdigital.com/utilities/sdflash/

– Download the latest SDFlash algorithms for F28xxx flash programming via an RS232 serial link.

– It is recommended to install the patch in the root directory of your SDFlash installation. For example, if SDFlash is installed in *C:\CCStudio_v3.1\specdig\sdflash*, unzip the patch in the *C:\CCStudio_v3.1\specdig\sdflash*. This will create five new sub-directories under *mydrivers*\, and one new sub-directory under *myprojects*\ as follows:



– The *sdflash\mydrivers\* sub-directories *DSP280x_60_v3_1*, *DSP280x_v3_1*, *DSP281x_v3_1*, *DSP2801x_v3_1*, and *DSP2804x_v3_1* contain the RS232 interface example code for F280x-60, F280x, F281x, F2801x, and F2804x devices, respectively. This code is supplied as an as-is example of how to perform programming over the RS232 communications channel. This sample code is provided without technical support.

– The directory *myprojects\sdf28xx_v3_1_serial* contains all of the files specific to executing serial programming. Each flash device currently in the F28xxx family has it's own specific sub directory.

The files required to use SDFlash over a serial link are:

- The SDFlash Serial project file for the device in use:
  - ❖ F2801SerialFlash.sdp (for F2801 device)
  - ❖ F2801_60SerialFlash.sdp (for F2801-60 device)
  - ❖ F2802SerialFlash.sdp (for F2802 device)
  - ❖ F2802_60SerialFlash.sdp (for F2802-60 device)
  - ❖ F2806SerialFlash.sdp
  - ❖ F2808SerialFlash.sdp
  - ❖ F2809SerialFlash.sdp
  - ❖ F2810SerialFlash.sdp
  - ❖ F2811SerialFlash.sdp
  - ❖ F2812SerialFlash.sdp
  - ❖ F28015SerialFlash.sdp
  - ❖ F28016SerialFlash.sdp
  - ❖ F28044SerialFlash.sdp
- The SDFlash driver file for the device in use:
  - ❖ F281xRS232Flash.dll (for F281x devices)
  - ❖ F280xRS232Flash.dll (for F280x, F2801x, and F2804x devices)

- The SDFlash Serial flash algorithm file for the device in use:
    - ❖ F2801SerialFlash.out (for F2801 device)
    - ❖ F2801_60SerialFlash.out (for F2801-60 device)
    - ❖ F2802SerialFlash.out (for F2802 device)
    - ❖ F2802_60SerialFlash.out (for F2802-60 device)
    - ❖ F2806SerialFlash.out
    - ❖ F2808SerialFlash.out
    - ❖ F2809SerialFlash.out
    - ❖ F2810SerialFlash.out
    - ❖ F2811SerialFlash.out
    - ❖ F2812SerialFlash.out
    - ❖ F28015SerialFlash.out
    - ❖ F28016SerialFlash.out
    - ❖ F28044SerialFlash.out
- The code security password match flow file (applies to F280x, F2801x, and F2804x devices only):
    - ❖ F28xxPasswordMF.out
- The CCS board.dat file. The contents of this file is not actually used, but rather is needed to satisfy a project option in SDFlash.
    - ❖ ccBrd028x.dat
- The sdopts.cfg setup parameters.
    - ❖ AddToSdOpts.cfg
- The .out file containing the user code/data that is to be programmed into the DSP flash. This file is produced from the user's source code by the code generation tools in Code Composer Studio. For test purposes, a sample .out file is provided for each device that will load each flash location with a value equal to the least-significant 16 bits of the address. For example, address 0x3F7123 in flash will be programmed with the value 0x7123. The code security password locations at addresses 0x3F7FF8 – 0x3F7FFF have been deliberately left unprogrammed (i.e., they will be left as 0xFFFF, which are dummy passwords). The sample .out files are:

- ❖ F2801FlashTest.out (for both F2801 and F2801-60)
- ❖ F2802FlashTest.out (for both F2802 and F2802-60)
- ❖ F2806FlashTest.out
- ❖ F2808FlashTest.out
- ❖ F2809FlashTest.out
- ❖ F2810FlashTest.out
- ❖ F2811FlashTest.out
- ❖ F2812FlashTest.out
- ❖ F28015FlashTest.out
- ❖ F28016FlashTest.out
- ❖ F28044FlashTest.out

Step 3. Modify and rebuild the SDFlash Serial algorithm file, if necessary (i.e., file F28yyySerialFlash.out, where yyy is specific to the device you are using). The SDFlash v3.1 serial algorithm software is configured for the following:

- – Flash API versions:
  - – F280x flash API v3.02
  - – F281x flash API v2.10 (requires F281x silicon revision C or later)
  - – F2801x flash API v1.00
  - – F2804x flash API v1.00
- – For F281x: A crystal/oscillator for the DSP of 30 MHz. This is because the software will configure the DSP for PLL = x10/2, and the flash API algorithms are configured for 150 MHz operation.
- – For F280x and F2804x: A crystal/oscillator for the DSP of 20 MHz. This is because the software will configure the DSP for PLL = x10/2, and the flash API algorithms are configured for 100 MHz operation.
- – For F280x-60 and F2801x: A crystal/oscillator for the DSP of 20 MHz. This is because the software will configure the DSP for PLL = x10/2, and the flash API algorithms are configured for 60 MHz operation.
- – All code security passwords assumed to be erased (0xFFFF).

If your system does not meet the above configuration, you must make changes to the SDFlash Serial algorithm file and rebuild it. See the section “Rebuilding the SDFlash Serial Flash Algorithm File” later in this document for information on rebuilding this file.

IMPORTANT: *It is strongly recommended that the Toggle Test first be run on your board to confirm that the flash algorithms are configured properly for your system. See the section “Using SDFlash Serial,” Step 6, Erase Tab options, User Options 2 for information on the Toggle Test.*

Step 4. **Setup the sdopts.cfg file.** Search on your PC for the file sdopts.cfg. On a Windows XP PC, this file will be found in the C:\WINDOWS\SYSTEM32 directory. Spectrum Digital tools store emulator setup and configuration information in sdopts.cfg which is generally configured by SDConfig. SDConfig will NOT configure a non-JTAG tool so this has to be done manually. Add the following text to sdopts.cfg **before** the existing comment line "# End of sdopts.cfg".

```
[EmulatorId=C1]
EmuPortAddr=0xC1
EmuPortMode=RS232
EmuProductName=SERIAL_FLASH

[EmulatorId=C2]
EmuPortAddr=0xC2
EmuPortMode=RS232
EmuProductName=SERIAL_FLASH

[EmulatorId=C3]
EmuPortAddr=0xC3
EmuPortMode=RS232
EmuProductName=SERIAL_FLASH

[EmulatorId=C4]
EmuPortAddr=0xC4
EmuPortMode=RS232
EmuProductName=SERIAL_FLASH
```

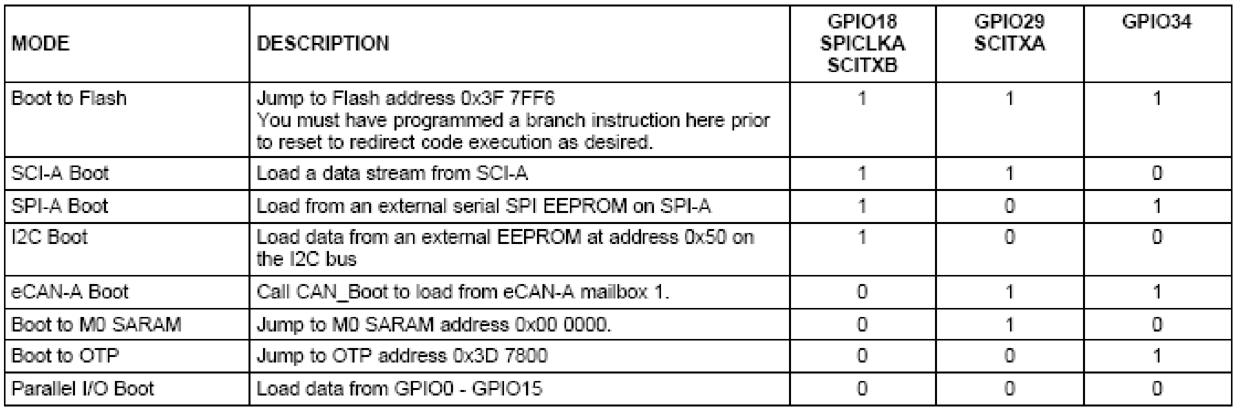
This text can be conveniently copied and pasted from the file *AddToSdOpts.cfg*.

Using SDFlash Serial

Step 1. **Connect a serial cable between the DSP serial port (SCI-A) and the host PC.** The connection must be made through a RS232 transceiver. Note that the eZdspF2808™ and eZdspF28044 development boards do come equipped with this transceiver, while the eZdspF2812 development board does not.

Step 2. **Set the F28xxx device for boot to SCI-A serial bootload**. This entails having specific GPIO pins high/low at device reset. The eZdsp boards have jumpers or dip switches that allow one to configure the boot mode (see the user's manual for the eZdsp you are using for details). On your own target board, you will need to make arrangements to configure the boot mode, if necessary. The following two tables show the GPIO pin settings needed to configure the boot modes.

For F280x and F2801x devices, configure the GPIO according to the following boot mode table (excerpt from the TMS320F2809/2808/2806/2802/2801/28015/28016 datasheet, SPRS230):



MODE	DESCRIPTION	GPIO18 SPICLKA SCITXB	GPIO29 SCITXA	GPIO34
Boot to Flash	Jump to Flash address 0x3F 7FF6 You must have programmed a branch instruction here prior to reset to redirect code execution as desired.	1	1	1
SCI-A Boot	Load a data stream from SCI-A	1	1	0
SPI-A Boot	Load from an external serial SPI EEPROM on SPI-A	1	0	1
I2C Boot	Load data from an external EEPROM at address 0x50 on the I2C bus	1	0	0
eCAN-A Boot	Call CAN_Boot to load from eCAN-A mailbox 1.	0	1	1
Boot to M0 SARAM	Jump to M0 SARAM address 0x00 0000.	0	1	0
Boot to OTP	Jump to OTP address 0x3D 7800	0	0	1
Parallel I/O Boot	Load data from GPIO0 - GPIO15	0	0	0

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For F281x devices, configure the GPIO according to the following boot mode table (excerpt from the TMS320F2812/2811/2810 datasheet, SPRS174):

	GPIOF4	GPIOF12	GPIOF3	GPIOF2
	(SCITXDA)	(MDXA)	(SPISTEA)	(SPICLK)
Mode Selected†	PU	No PU	No PU	No PU
Jump to Flash/ROM address 0x3F 7FF6 A branch instruction must have been programmed here prior to reset to re−direct code excution as desired.	1	x	x	x
Call SPI_Boot to load from an external serial SPI EEPROM	0	1	x	x
Call SCI_Boot to load from SCI-A	0	0	1	1
Jump to H0 SARAM address 0x3F 8000	0	0	1	0
Jump to OTP address 0x3D 7800	0	0	0	1
Call Parallel_Boot to load from GPIO Port B	0	0	0	0

† PU = pin has an internal pullup No PU = pin does not have an internal pullup
‡ Extra care must be taken due to any affect toggling SPICLK to select a boot mode may have on external logic.
§ If the boot mode selected is Flash, H0, or OTP, then no external code is loaded by the bootloader.

For F2804x devices, configure the GPIO according to the following boot mode table (excerpt from the TMS320F28044 datasheet, SPRS357):

MODE	DESCRIPTION	GPIO18 SPICLKA	GPIO29 SCITXDA	GPIO34
Boot to Flash/ROM	Jump to Flash/ROM address 0x3F 7FF6 You must have programmed a branch instruction here prior to reset to redirect code execution as desired.	1	1	1
SCI-A Boot	Load a data stream from SCI-A	1	1	0
SPI-A Boot	Load from an external serial SPI EEPROM on SPI-A	1	0	1
I²C Boot	Load data from an external EEPROM at address 0x50 on the I²C bus	1	0	0
eCAN-A Boot	Reserved. This mode should not be used.	0	1	1
Boot to M0 SARAM	Jump to M0 SARAM address 0x00 0000.	0	1	0
Boot to OTP	Jump to OTP address 0x3D 7800	0	0	1
Parallel I/O Boot	Load data from GPIO0 - GPIO15	0	0	0

NOTE: When configuring the bootmode, the SCITXDA must be pulled down through a resistor so that the F28xx can still drive the pin once the bootload process begins.

Step 3. **If programming the F2812, make sure that the XMP/MCn pin is pulled low to access the boot ROM.** On all other devices (without an XMIF), this signal is tied low internally such that the boot ROM is always active.

Step 4. **Disconnect any JTAG emulator that may be connected to the DSP board, such as a XDS510PP+ emulator.** An emulator connected to the JTAG port may hold the device in reset and thus the bootloader will not start when the device is reset.

Step 5. **Start SDFlash and load the appropriate project file.** This will be one of the following:

myprojects\sdf28xx_v3_1_serial\f2812\F2801SerialFlash.sdp

myprojects\sdf28xx_v3_1_serial\f2811\F2801_60SerialFlash.sdp

myprojects\sdf28xx_v3_1_serial\f2810\F2802SerialFlash.sdp

myprojects\sdf28xx_v3_1_serial\f2808\F2802_60SerialFlash.sdp

myprojects\sdf28xx_v3_1_serial\f2806\F2806SerialFlash.sdp

myprojects\sdf28xx_v3_1_serial\f2801\F2808SerialFlash.sdp

myprojects\sdf28xx_v3_1_serial\f2801\F2809SerialFlash.sdp

myprojects\sdf28xx_v3_1_serial\f2801\F2810SerialFlash.sdp

myprojects\sdf28xx_v3_1_serial\f2801\F2811SerialFlash.sdp

myprojects\sdf28xx_v3_1_serial\f2801\F2812SerialFlash.sdp

myprojects\sdf28xx_v3_1_serial\f2801\F28015SerialFlash.sdp

myprojects\sdf28xx_v3_1_serial\f2801\F28016SerialFlash.sdp

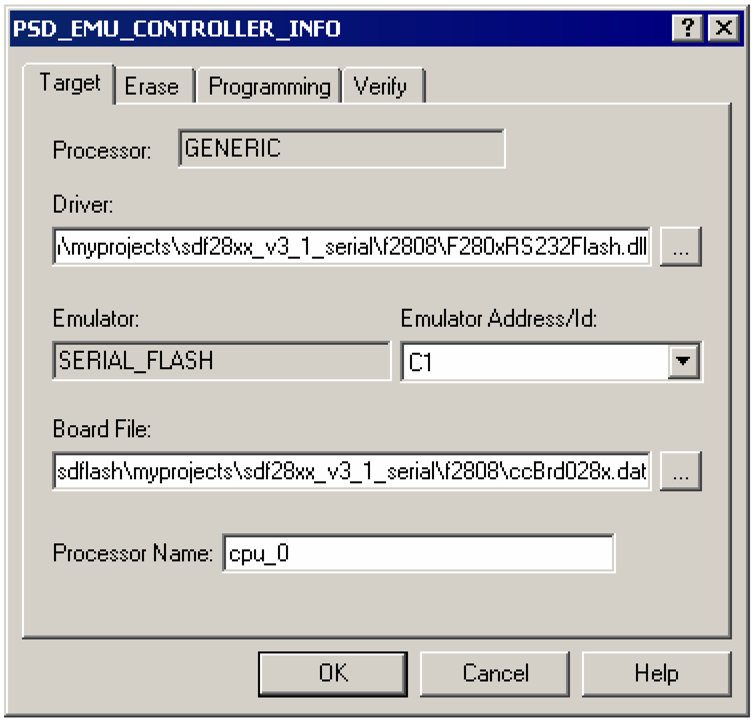
myprojects\sdf28xx_v3_1_serial\f2801\F28044SerialFlash.sdp

Step 6. **Modify the SDFlash project options (if necessary) to locate the various elements such as the device driver, algorithm file and flash data file.** The directory paths to these files assume the SDFlash is installed in the *C:\CCStudio_v3.3\specdig\sdflash* directory. To change any of the directory paths or project settings from their default values, open the project settings dialog box: *Project->Settings.* The project options that follow are specific to the SDFlash Serial Patch.

IMPORTANT

This is a very important step. If you did not install the SDFlash Serial utility in the default directory of *C:\CCStudio_v3.3\specdig\sdflash*, then YOU MUST modify the file paths in the SDFlash project. Be sure that you check each tab in the project options. There are multiple places that the file paths are specified. If the wrong paths are specified, SDFlash Serial may simply report a failure to connect to the DSP via the serial link, rather than telling you that your project option paths are incorrect.

__Target Tab:__ (image shown for F2808 device)


PSD_EMU_CONTROLLER_INFO

Processor: GENERIC

Driver: i\myprojects\sdf28xx_v3_1_serial\f2808\F280xRS232Flash.dll

Emulator: SERIAL_FLASH

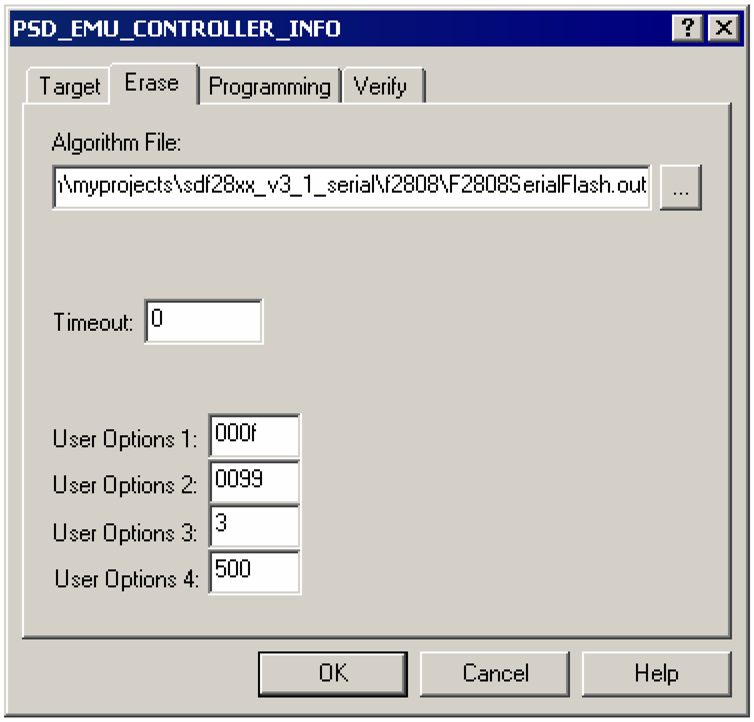
Emulator Address/Id: C1

Board File: sdflash\myprojects\sdf28xx_v3_1_serial\f2808\ccBrd028x.dat

Processor Name: cpu_0

- **Driver:** This must point to either *F281xRS232Flash.dll* (for F281x devices) or to *F280xRS232Flash.dll* (for F280x, F2801x, and F2804x devices).
- **Emulator Address/ID:** This is the COM port on your PC that you are using to connect to the DSP. If COM1, COM2, COM3 and COM4 do not appear as options, modify the sdopts.cfg file as described previously in step 4.
- **Board file:** Leave as *ccBrd028x.dat*
- **Processor name:** Leave as *cpu_0*

Erase Tab: (image shown for F2808 device)


PSD_EMU_CONTROLLER_INFO

Target | Erase | Programming | Verify

Algorithm File: \myprojects\sdf28xx_v3_1_serial\f2808\F2808SerialFlash.out

Timeout: 0

User Options 1: 000f
User Options 2: 0099
User Options 3: 3
User Options 4: 500

- ***Algorithm File:*** use the appropriate file for your device:

  myprojects\sdf28xx_v3_1_serial\f2801\F2801SerialFlash.out
  myprojects\sdf28xx_v3_1_serial\f2806\F2801_60SerialFlash.out
  myprojects\sdf28xx_v3_1_serial\f2806\F2802SerialFlash.out
  myprojects\sdf28xx_v3_1_serial\f2806\F2802_60SerialFlash.out
  myprojects\sdf28xx_v3_1_serial\f2806\F2806SerialFlash.out
  myprojects\sdf28xx_v3_1_serial\f2808\F2808SerialFlash.out
  myprojects\sdf28xx_v3_1_serial\f2806\F2809SerialFlash.out
  myprojects\sdf28xx_v3_1_serial\f2810\F2810SerialFlash.out
  myprojects\sdf28xx_v3_1_serial\f2811\F2811SerialFlash.out
  myprojects\sdf28xx_v3_1_serial\f2812\F2812SerialFlash.out
  myprojects\sdf28xx_v3_1_serial\f2806\F28015SerialFlash.out
  myprojects\sdf28xx_v3_1_serial\f2806\F28016SerialFlash.out
  myprojects\sdf28xx_v3_1_serial\f2806\F28044SerialFlash.out

- ***Timeout:*** This can be left as 0. This value specifies the amount of time per flash sector (in 10's of milliseconds) that the host PC waits after sending the DSP an erase command before it checks for an acknowledge. This option has been superseded by Erase User Options #4. See the description for Erase User Options #4 below for more information.

- ***User Options 1:*** Sector Mask for erase. Default value is set to erase all sectors.
  Set Bit 0 = erase Sector A
  Set Bit 1 = erase Sector B
  ...

For example:	000f will erase all 4 sectors in a F2808 device
	0001 will erase only sector A in a F2801 device
	001f will erase all 5 sectors in a F2810 device
	03ff will erase all 10 sectors in a F2812 device

- ***User Options 2:*** Toggle Test pin select. The toggle test toggles a selected pin at a known frequency in order to confirm proper configuration of the flash programming algorithms. While the test runs, monitor the selected pin using an oscilloscope. If the algorithms are configured correctly for your CPU rate then the pin will toggle near 10kHz (100µS +/- 10µS cycle time). If the pin is toggling at a different rate, then the algorithms are not configured correctly. The pin selection is made as follows:

For F281x devices:
Leave User Options 2 blank or 0000 for normal operation. To run the toggle test, set User Option 2 to a value of 0001 to 0005, per the below table to select the desired pin that will toggle. This will invoke the toggle test instead of the erase operation, and SDFlash will harmlessly timeout eventually. The user can click *Stop* to halt the toggle test sooner. Note that the DSP continues to run the Toggle test even after SDFlash has timed out.

Blank	Test not run
0000	Test not run
0001	GPIOF14_XF
0002	GPIOA0_PWM1
0003	Test not run
0004	GPIOG4_SCITXDB
0005	GPIOF12_MDXA
0006-FFFF	Test not run

For F280x, F2801x, and F2804x devices:
Set User Options 2 to a number greater than 0022 for normal operation (e.g., default is 0099). To run the toggle test, set User Options 2 to a hexadecimal value equal to the GPIO pin number that you want to toggle. For example:

0000 toggles GPIO0
0001 toggles GPIO1
...
0010 toggles GPIO16
...
0022 toggles GPIO34

Greater than 0022 toggle test does not run.

This will invoke the toggle test instead of the erase operation, and SDFlash will harmlessly timeout eventually. The user can click *Stop* to halt the toggle test sooner. Note that the DSP continues to run the Toggle test even after SDFlash has timed out.

If the toggling does not occur at the expected frequency, changes need to be made to the SDFlash Serial algorithm file, per the previous step 3.

- ❑ **User Options 3:** Default Autobaud setting. Although this is on the Erase tab, it applies to all operations (toggle test, Erase, Program and Verify). Enter a number 0001 - 0004 that sets the default baud rate that SDFlash will attempt to autobaud lock with the DSP boot loader:

0001	57600 baud	
0002	38400 baud	
0003	19200 baud	(Default)
0004	9600 baud	
0005	4800 baud	
0006	2400 baud	
0007	1200 baud	
0008	115200 baud	
Other	38400 baud	

Due to hardware, connectors, transceiver, PC UART, etc., you may need to lower the autobaud rate in order to successfully autobaud lock with the DSP. Tabulated below are very rough estimates on the expected programming times at various baud rates:

Baud Rate	Time to 'Connect'	Time to Transfer 1 KB of flash data	Minimum Total Time to Program 32 KB	Minimum Total Time to Program 64 KB	Minimum Total Time to Program 128 KB
115200	12 sec	96 ms	15 sec	18 sec	24 sec
57600	13 sec	193 ms	19 sec	25 sec	38 sec
38400	15 sec	290 ms	24 sec	34 sec	52 sec
19200	28 sec	580 ms	47 sec	1.1 min	1.7 min
9600	52 sec	1.2 sec	1.5 min	2.2 min	3.4 min
4800	1.7 min	2.3 sec	2.9 min	4.1 min	6.6 min
2400	3.3 min	4.6 sec	5.8 min	8.2 min	13 min
1200	6.5 min	9.3 sec	12 min	17 min	26 min

In the table, the *Time to 'Connect'* is how long SDFlash Serial will display the "Connect..." message. This portion of the programming involves downloading the flash programming algorithms and kernel to the DSP. There is some inefficiency here having to do with single byte transmission delay times inherent to the serial port drivers on a Windows PC. After this phase, the *Erase* phase will be entered, followed by the *Programming* phase. The Erase phase does not involve further data transfer from the host PC, and will occur relatively quickly. The *Programming* phase involves the transfer of the user's program that is to be put into the flash. The Total Time to Program entries in the table are computed as:

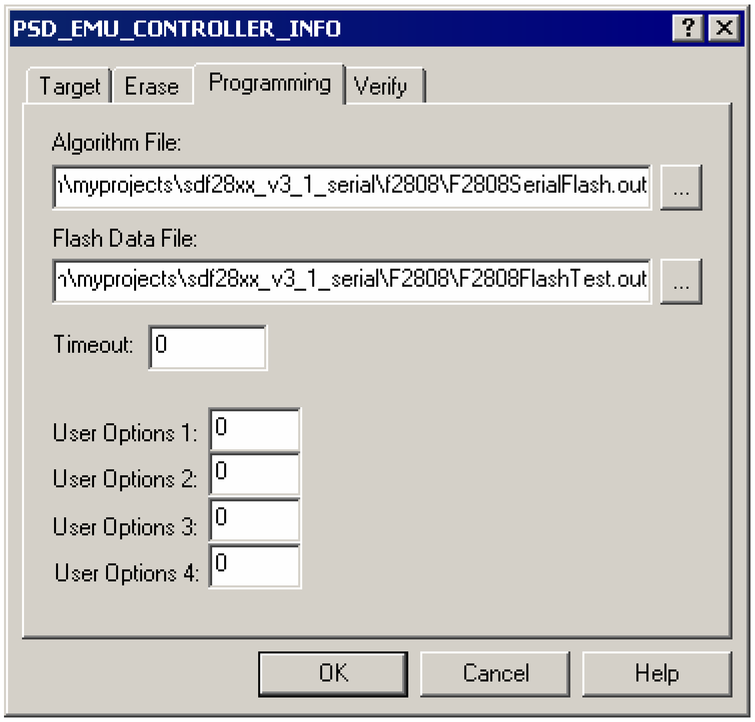
Minimum Total Time to Program =
(# KB to program)(Time to Transfer 1 KB) + (Time to Connect)*

The reason the above is labeled "Minimum" Total Time to Program is because it neglects the time needed to actually erase and program each bit in the flash. As a data point, the F2808FlashTest.out file (i.e., 64KB size) was programmed into a F2808 at 9600 baud, and observed to take 4.0 minutes from start to finish (compared with 3.4 minutes in the table).

The data in the table was compiled using a 2.1 MHz Pentium PC running Windows XP SP2. The PC speed is not expected to be a factor in determining the programming times, however.

- **User Options 4:** Erase acknowledge retry specifier. After sending the DSP an erase command, the PC runs a loop that checks for an erase acknowledge from the DSP. This option controls the maximum number of times the PC will loop. It is generally best to make this option large (e.g., 500 is the default value), which gives the DSP plenty of time to erase the flash. SDFlash will complete the erase operation as soon as the DSP reports that it is finished. In SDFlash Serial versions prior to v3.0, the user would specify a fixed amount of time for the PC to wait for the acknowledge via the Erase Timeout option. This had the disadvantage that SDFlash erase would always take the specified amount of time even if the DSP finished erasing sooner.

Programming Tab: (image shown for F2808 device)


PSD_EMU_CONTROLLER_INFO

Algorithm File: ı\myprojects\sdf28xx_v3_1_serial\f2808\F2808SerialFlash.out

Flash Data File: ı\myprojects\sdf28xx_v3_1_serial\F2808\F2808FlashTest.out

Timeout: 0

User Options 1: 0

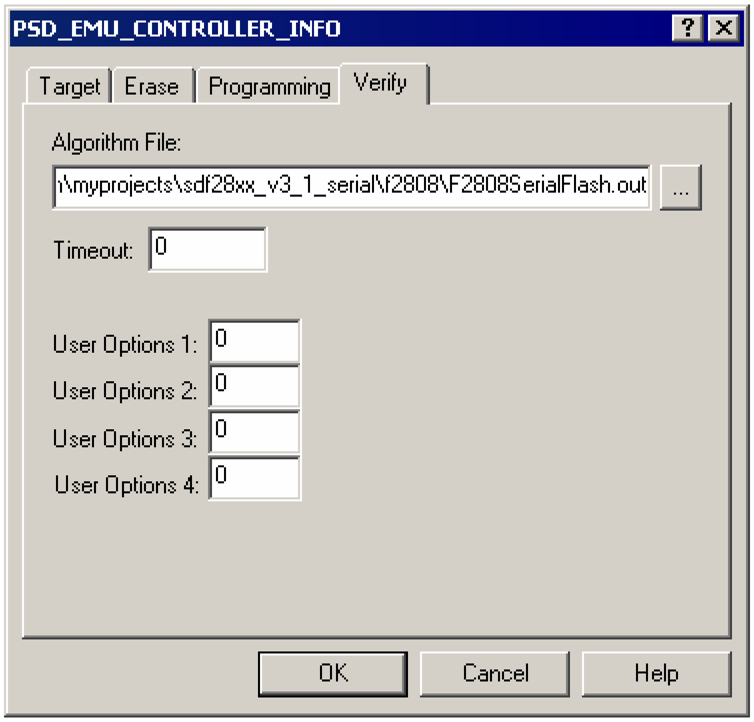
User Options 2: 0

User Options 3: 0

User Options 4: 0

- **Algorithm File***:* Use the same algorithm file that you specified on the Erase Tab.
- **Flash Data File:** This is the .out file that you want to program into the flash.
- **Timeout:** Leave as 0. This option has been superseded by Programming User Options 4.
- **User Options 1 through 3**: Unused.
- **User Options 4: :** Program acknowledge retry specifier. After sending the DSP a packet of data to program into the flash, the PC runs a loop that checks for a program acknowledge from the DSP. This option controls the maximum number of times the PC will loop. It can generally be left at the default value of 0.

Verify Tab:



Algorithm File: i\myprojects\sdf28xx_v3_1_serial\f2808\F2808SerialFlash.out

Timeout: 0

User Options 1: 0
User Options 2: 0
User Options 3: 0
User Options 4: 0

- **Algorithm File:** Use the same algorithm file that you specified on the Erase Tab.

- **Timeout:** Leave as 0.

- **User Options 1 and 2:** Unused.
  Note: In the JTAG version of SDFlash, these options specify the wait-states for the OTP and Flash memory to be set before the verify operation starts. The serial version of SDFlash does not use these options however, and instead the wait-states remain set to their reset defaults (which are the maximum values).

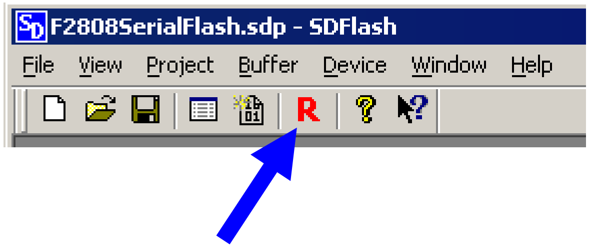
- **User Options 3 and 4:** Unused

Note that the Verify operation **does not** perform the word-by-word verify operation from the Flash API algorithm library. Rather, it performs a simple 16-bit checksum on the programmed data. Verify is done COFF section by COFF section after all sections have been programmed. A more complex verify is left to the user to implement, if desired.

Step 7. Save the SDFlash project file: Use *File->Save Project*. Alternately, you can change the project name at this point if desired by using *File->Save Project As.*

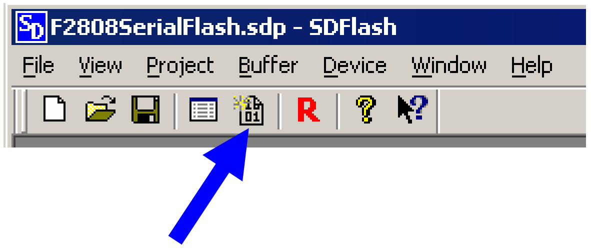
Step 8. Power up the DSP and/or reset it so that the bootloader will start. The Bootloader will wait to Autobaud lock with the host PC.

Step 9. Reset SDFlash: Click the large red R button in the SDFlash GUI, or you can use the menus: Device->Reset.

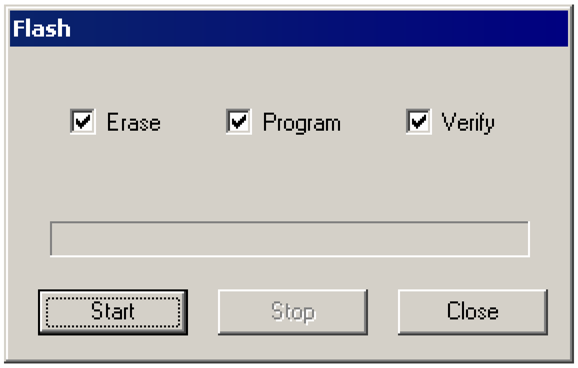

F2808SerialFlash.sdp - SDFlash
File View Project Buffer Device Window Help
R

NOTE: The reset button of SDFlash Serial CANNOT reset the DSP target. If the target is in a bad state or not in bootloader mode then user must use a hardware reset to get target back to bootloader mode (per step 12). Once that is done the reset button is used to inform SDFlash that target is in bootloader mode.

Step 10. Erase/Program/Verify the flash. Click the FLASH button on the SDFlash GUI, or you can use the menus: Device -> Flash.


F2808SerialFlash.sdp - SDFlash
File View Project Buffer Device Window Help
R

Clicking the FLASH button will bring up the following pop-up window:



Select the desired operations and then click the “Start” button to execute them.

Rebuilding the SDFlash Serial Files

The user will need to rebuild the SDFlash Serial files in the following three situations:

Case 1: You are using a crystal/oscillator for the DSP that does not match the assumed value. The assumed value is 30 MHz for F281x, and 20 MHz for F280x, F2801x, and F2804x. If using a different value, the algorithm file *F28yyySerialFlash.out* will need to be rebuilt to use a different PLL value.

Case 2: The code security passwords on the device are not all erased (0xFFFF). For F281x devices, the algorithm file *F28yySerialFlash.out* will need to be rebuilt to reflect the passwords in use. For F280x, F2801x, and F2804x devices, the code security password match flow file *F28xxPasswordMF.out* will need to be rebuilt to reflect the passwords in use.

Case 3: You are using a DSP device silicon revision that is not supported by this version of SDFlash Serial. The SDFlash Serial v3.1 release supports revision C and later of F2812, F2811, and F2810 devices, and all revisions of F2801, F2801-60, F2802, F2802-60, F2806, F2808, F2809, F28015, F28016, and F28044 devices. If using an unsupported silicon revision, the algorithm file *F28yyySerialFlash.out* will need to be rebuilt with the appropriate flash programming algorithm APIs.

The Code Composer Studio project file and the source code for the SDFlash Serial algorithm files are located in:

For F280x-60 devices:

mydrivers\DSP280x_60_v3_1\DSP280x_60_serial\build\F28xxSerialFlash

mydrivers\DSP280x_60_v3_1\DSP280x_60_serial\src

For F280x devices:

mydrivers\DSP280x_v3_1\DSP280x_serial\build\F28xxSerialFlash

mydrivers\DSP280x_v3_1\DSP280x_serial\src

For F281x devices:

mydrivers\DSP281x_v3_1\DSP281x_serial\build\F28xxSerialFlash

mydrivers\DSP281x_v3_1\DSP281x_serial\src

For F2801x devices:

mydrivers\DSP2801x_v3_1\DSP2801x_serial\build\F28xxSerialFlash

mydrivers\DSP2801x_v3_1\DSP2801x_serial\src

For F2804x devices:

mydrivers\DSP2804x_v3_1\DSP2804x_serial\build\F28xxSerialFlash

mydrivers\DSP2804x_v3_1\DSP2804x_serial\src

General instructions for rebuilding the files for the above 3 cases will now be provided.

Instructions for Case 1: You are using a crystal/oscillator for the DSP that does not match the assumed value.

1) Start Code Composer Studio.

2) Open the CCS project that corresponds to the device you are using, e.g. *F2808SerialFlash.pjt* for F2808, located in one of the following sub-directories:

   mydrivers\DSP280x_60_v3_1\DSP280x_60_serial\build\F28xxSerialFlash

   mydrivers\DSP280x_v3_1\DSP280x_serial\build\F28xxSerialFlash

   mydrivers\DSP281x_v3_1\DSP281x_serial\build\F28xxSerialFlash

   mydrivers\DSP2801x_v3_1\DSP2801x_serial\build\F28xxSerialFlash

   mydrivers\DSP2804x_v3_1\DSP2804x_serial\build\F28xxSerialFlash

3) Edit the constant ‘CPU_RATE’ in the corresponding file *Flash280x_Config_API.h*, *Flash281x_Config_API.h*, *Flash2801x_Config_API.h*, or *Flash2804x_Config_API.h*, and also edit the setting for the PLLCR register in the function InitSysCtrl() in the file *f28xx_main.c* to reflect the crystal/oscillator in use. The relevant lines of code are:

   Flash28yyx_Config_API.h:

   ```
   #define CPU_RATE   10.000L
   ```

   f28xx_main.c:

   ```
   SysCtrlRegs.PLLCR.bit.DIV = 0x000A;      // PLLx5
   ```

4) Rebuild the project. The output file, *F28yyySerialFlash.out* (e.g., *F2808SerialFlash.out* for F2808) will appear in the relevant \bin directory:

   mydrivers\DSP280x_60_v3_1\DSP280x_60_serial\bin

   mydrivers\DSP280x_v3_1\DSP280x_serial\bin

   mydrivers\DSP281x_v3_1\DSP281x_serial\bin

   mydrivers\DSP2801x_v3_1\DSP2801x_serial\bin

   mydrivers\DSP2804x_v3_1\DSP2804x_serial\bin

5) Quit Code Composer Studio.

6) Copy *F28yyySerialFlash.out* to overwrite the file of the same name in the SDFlash project directory you are using, e.g. one of:

   myprojects\sdf28xx_v3_1_serial\F2801\F2801SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2801_60\F2801_60SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2802\F2802SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2802_60\F2802_60SerialFlash.out *myprojects\sdf28xx_v3_1_serial\F2806\F2806SerialFlash.out*

myprojects\sdf28xx_v3_1_serial\F2808\F2808SerialFlash.out

myprojects\sdf28xx_v3_1_serial\F2809\F2809SerialFlash.out

myprojects\sdf28xx_v3_1_serial\F2810\F2810SerialFlash.out

myprojects\sdf28xx_v3_1_serial\F2811\F2811SerialFlash.out

myprojects\sdf28xx_v3_1_serial\F2812\F2812SerialFlash.out

myprojects\sdf28xx_v3_1_serial\F28015\F28015SerialFlash.out

myprojects\sdf28xx_v3_1_serial\F28016\F28016SerialFlash.out

myprojects\sdf28xx_v3_1_serial\F28044\F28044SerialFlash.out

7) Start and use SDFlash Serial as normal.

Instructions for Case 2: The code security passwords on the device are not all erased (0xFFFF). The instructions differ here for F281x and F280x devices.

For F281x devices:

1) Start Code Composer Studio.
2) Open the CCS project that corresponds to the device you are using, e.g. F2812SerialFlash.pjt for F2812, located in the following sub-directory:

   mydrivers\DSP281x_v3_1\DSP281x_serial\build\F28xxSerialFlash

3) Edit the file *Flash2812_API.c* so that the defined code security passwords reflect the passwords in use. All passwords are currently set to the value 0xFFFF. The relevant lines of code begin at roughly line 63 of the file:

```
// For erased flash the password locations will all be 0xFFFF
const  Uint16   PRG_key0  = 0xFFFF;    // PSWD bits 15-0
const  Uint16   PRG_key1  = 0xFFFF;    // PSWD bits 31-16
const  Uint16   PRG_key2  = 0xFFFF;    // PSWD bits 47-32
const  Uint16   PRG_key3  = 0xFFFF;    // PSWD bits 63-48
const  Uint16   PRG_key4  = 0xFFFF;    // PSWD bits 79-64
const  Uint16   PRG_key5  = 0xFFFF;    // PSWD bits 95-80
const  Uint16   PRG_key6  = 0xFFFF;    // PSWD bits 111-96
const  Uint16   PRG_key7  = 0xFFFF;    // PSWD bits 127-112
```

4) Rebuild the project. The output file, *F28yyySerialFlash.out* (e.g., *F2812SerialFlash.out* for F2812) will appear in the \bin directory:

   mydrivers\DSP281x_v3_1\DSP281x_serial\bin

5) Quit Code Composer Studio.
6) Copy *F28yySerialFlash.out* to overwrite the file of the same name in the SDFlash project directory you are using, e.g. one of:

   myprojects\sdf28xx_v3_1_serial\F2810\F2810SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2811\F2811SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2812\F2812SerialFlash.out

7) Start and use SDFlash Serial as normal.

For F280x, F2801x, and F2804x devices:

1) Start Code Composer Studio.
2) Open the CCS project F28xxPasswordMF.pjt, located in the following corresponding directory:

   mydrivers\DSP280x_60_v3_1\DSP280x_60_serial\build\F28xxPasswordMF

   mydrivers\DSP280x_v3_1\DSP280x_serial\build\F28xxPasswordMF

   mydrivers\DSP280x_v3_1\DSP2801x_serial\build\F28xxPasswordMF

   mydrivers\DSP280x_v3_1\DSP2804x_serial\build\F28xxPasswordMF

3) Edit the file *passwords.inc* so that the defined code security passwords reflect the passwords in use. All passwords currently are set to the value 0xFFFF. The relevant lines of code are:

```
     .int     0xFFFF              ;PWL0  (LSW of 128-bit password)
     .int     0xFFFF              ;PWL1
     .int     0xFFFF              ;PWL2
     .int     0xFFFF              ;PWL3
     .int     0xFFFF              ;PWL4
     .int     0xFFFF              ;PWL5
     .int     0xFFFF              ;PWL6
     .int     0xFFFF              ;PWL7  (MSW of 128-bit password)
```

4) Rebuild the project. The output file, *F28xxPasswordMF.out* will appear in the corresponding \bin directory:

   mydrivers\DSP280x_60_v3_1\DSP280x_60_serial\bin

   mydrivers\DSP280x_v3_1\DSP280x_serial\bin

   mydrivers\DSP2801x_v3_1\DSP2801x_serial\bin

   mydrivers\DSP2804x_v3_1\DSP2804x_serial\bin

5) Quit Code Composer Studio.
6) Copy *F28xxPasswordMF.out* to overwrite the file of the same name in the SDFlash project directory you are using, e.g. one of:

   myprojects\sdf28xx_v3_1_serial\F2801\F28xxPasswordMF.out

   myprojects\sdf28xx_v3_1_serial\F2801_60\F28xxPasswordMF.out

   myprojects\sdf28xx_v3_1_serial\F2802\F28xxPasswordMF.out

   myprojects\sdf28xx_v3_1_serial\F2802_60\F28xxPasswordMF.out

   myprojects\sdf28xx_v3_1_serial\F2806\F28xxPasswordMF.out

   myprojects\sdf28xx_v3_1_serial\F2808\F28xxPasswordMF.out *myprojects\sdf28xx_v3_1_serial\F2809\F28xxPasswordMF.out*

myprojects\sdf28xx_v3_1_serial\F28015\F28xxPasswordMF.out

myprojects\sdf28xx_v3_1_serial\F28016\F28xxPasswordMF.out

myprojects\sdf28xx_v3_1_serial\F28044\F28xxPasswordMF.out

7) Start and use SDFlash Serial as normal.

Instructions for Case 3: You are using a DSP device or silicon revision that is not supported by this version of SDFlash Serial. For example, you may be using a new DSP. To adopt SDFlash Serial for the unsupported device, you will need to obtain from Texas Instruments the Flash Programming API algorithms for that device. In addition, these API algorithms must have the same function naming convention used by the API algorithms originally used to build this version of SDFlash Serial. Assuming this the case, then:

1) Start Code Composer Studio.
2) If using an unsupported silicon revision: Open the CCS project that corresponds to the device you are using, e.g. *F2808SerialFlash.pjt* for F2808, located in one of the following four sub-directories:

   mydrivers\DSP280x_60_v3_1\DSP280x_60_serial\build\F28xxSerialFlash

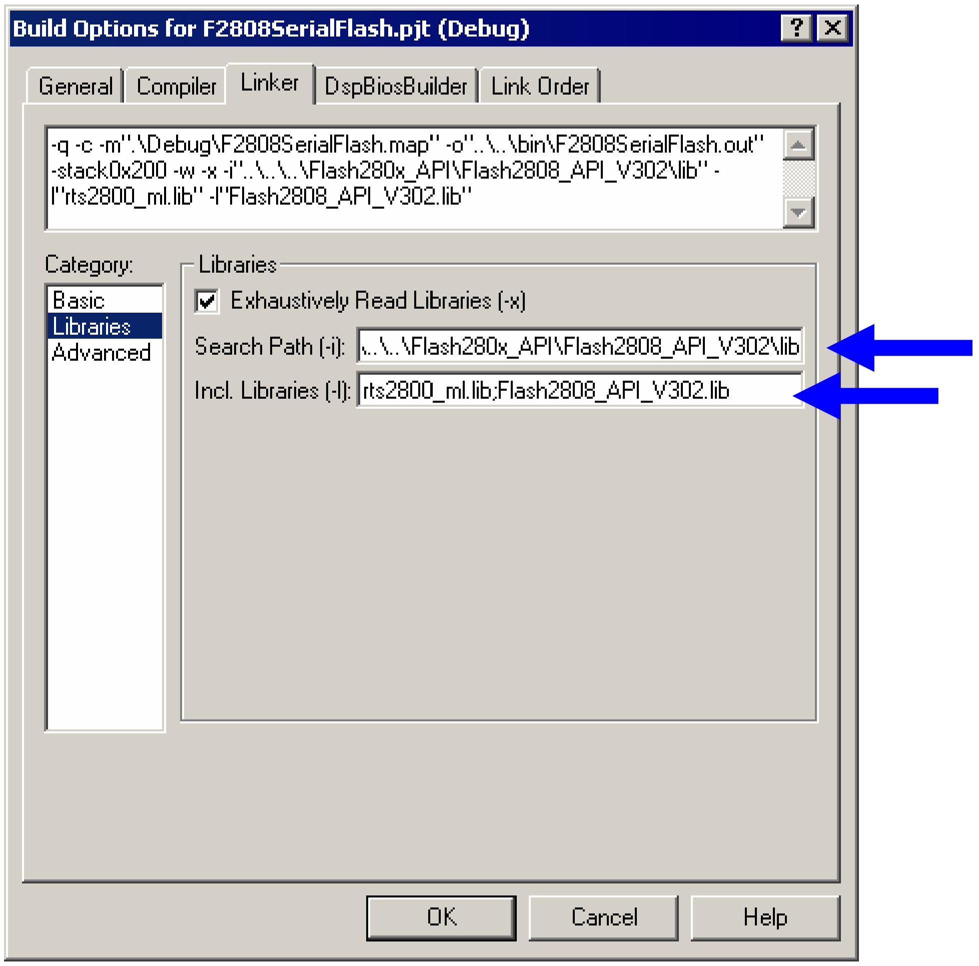
   mydrivers\DSP280x_v3_1\DSP280x_serial\build\F28xxSerialFlash

   mydrivers\DSP281x_v3_1\DSP281x_serial\build\F28xxSerialFlash

   mydrivers\DSP2801x_v3_1\DSP2801x_serial\build\F28xxSerialFlash

   mydrivers\DSP2804x_v3_1\DSP2804x_serial\build\F28xxSerialFlash

3) In Code Composer Studio, click on the menu *Project->Build_Options*. Select the *Linker* tab on the pop-up window, and choose the *Libraries* Category. Change the *Search_Path* and the *Incl._Libraries* option boxes to reflect the flash API algorithm library in use:



```
-q -c -m".\Debug\F2808SerialFlash.map" -o"..\..\bin\F2808SerialFlash.out"
-stack0x200 -w -x -i"..\..\..\Flash280x_API\Flash2808_API_V302\lib" -
l"rts2800_ml.lib" -l"Flash2808_API_V302.lib"
```

Libraries

- [✓] Exhaustively Read Libraries (-x)
- Search Path (-i): ..\..\Flash280x_API\Flash2808_API_V302\lib
- Incl. Libraries (-l): rts2800_ml.lib;Flash2808_API_V302.lib

4) You may also need to modify needed include files or other files used by the flash API algorithms, e.g., *Flash28yyy_API_Config.h*. See the documentation provided with the flash API algorithms for details on this step.

5) Rebuild the project. The output file, *F28yyySerialFlash.out* (e.g., *F2808SerialFlash.out* for F2808) will appear in the relevant \bin directory:

mydrivers\DSP280x_60_v3_1\DSP280x_60_serial\bin

mydrivers\DSP280x_v3_1\DSP280x_serial\bin

mydrivers\DSP281x_v3_1\DSP281x_serial\bin

mydrivers\DSP2801x_v3_1\DSP2801x_serial\bin

mydrivers\DSP2804x_v3_1\DSP2804x_serial\bin

6) Quit Code Composer Studio.

7) Copy *F28yyySerialFlash.out* to overwrite the file of the same name in the SDFlash project directory you are using, e.g. one of:

   myprojects\sdf28xx_v3_1_serial\F2801\F2801SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2801_60\F2801_60SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2802\F2802SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2802_60\F2802_60SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2806\F2806SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2808\F2808SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2809\F2809SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2810\F2810SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2811\F2811SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F2812\F2812SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F28015\F28015SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F28016\F28016SerialFlash.out

   myprojects\sdf28xx_v3_1_serial\F28044\F28044SerialFlash.out

8) Start and use SDFlash Serial as normal.

SDFlash Serial Source File Information

The following is a list of source files used in to make the SDFlash driver file (F28yxRS232Flash.dll) and the SDFlash Serial flash algorithm file (F28yyySerialFlash.out), along with a brief description of the files.

Directories: ***\mydrivers\DSP280x_60_v3_1\DSP280x_60_serial\src***

\mydrivers\DSP280x_v3_1\DSP280x_serial\src

\mydrivers\DSP281x_v3_1\DSP281x_serial\src

\mydrivers\DSP2801x_v3_1\DSP2801x_serial\src

\mydrivers\DSP2804x_v3_1\DSP2804x_serial\src

contain Win32 and F28xx shared source files:

drv2808sci.c, drv2808sci.h, drv2812sci.c, drv2812sci.h, drv2801xsci.c, drv2801xsci.h, drv2804xsci.c, drv2804xsci.h: Low level F28xx serial port driver.

f28xxpkt.c, f28xxpkt.h: Mid level packet code. Supports both Win32 and F28xx build.

lowlev.c, file.h: Optional cio level interface. Ported from TI rts28xx_ml library to support standard open, close, read, write file functions.

Flash2808_API.c, Flash2812_API.c, Flash2801x_API.c, and Flash2804x_API.c: Thin wrapper between f28xx_main.c and TI FLASH API. Formats SDFlash arguments into those required by the TI FLASH API. Ported from TI FLASH API example.

f28xx_main.c, flash.h: Highest level interface for F28xx SDFlash/Serial interface.

Directories: ***\mydrivers\DSP280x_60_v3_1\DSP280x_60_serial\src_host***

\mydrivers\DSP280x_v3_1\DSP280x_serial\src_host

\mydrivers\DSP281x_v3_1\DSP281x_serial\src_host

\mydrivers\DSP2801x_v3_1\DSP2801x_serial\src_host

\mydrivers\DSP2804x_v3_1\DSP2804x_serial\src_host

contain Win32 source files to build the interface between the serial port and SDFlash:

f28xxsio.c, f28xxsio.h: Low level Win32 serial port interface. Uses standard Win32 communications interface.

cofflib.c, coffdefs.h, coff.h, cofflib.h: Spectrum Digital version of TI COFF reader.

f28xxprg.c, f28xxprg.h: The Spectrum Digital PRG interface files. Provides a generic interface for SDFlash to call. The interface is device independent and could be used to create any SDFlash based driver.

Troubleshooting Tips

If CONNECTING to the DSP via the serial link fails:

- Reset the DSP with a hardware reset (i.e., power-cycle the DSP if needed) to be sure that the bootloader was properly invoked.
- Check that the DSP is configured for SCI-A bootloader mode.
- Check that the serial port cable from the host (PC) is connected to SCI-A (as opposed to SCI-B).
- Check that the correct host (PC) communications port has been selected in the SDFlash project settings. In SDFlash, select Project->Settings, and then adjust Emulator Address/ID on the Target tab.
- Check that each file specified in the various SDFlash project settings is correct, especially the paths. Do this carefully, as the eyes can play tricks on you! Specifying a bad path can result in SDFlash simply reporting a failure to connect.
- Try lowering the serial baud rate on in the SDFlash project settings. In SDFlash, select Project->Settings, and then adjust User_Options_3 on the Erase tab. Baud rate options are described earlier in this document.
- Make sure the SDFlash Serial algorithms have been re-built to reflect the code security passwords that you are using. This was discussed earlier in this document. If you have already rebuilt the algorithms, or are not using the code security passwords (i.e., all passwords are 0xFFFF), confirm this using Code Composer Studio and an emulator to unlock the security and view the flash contents. If you cannot view the flash contents, then there is some sort of code security problem (e.g., the actual passwords are different than what is thought).
- Make sure the SDFlash Serial algorithms have been re-built to reflect the DSP input clock you are using, and an appropriate PLL value. This was discussed earlier in this document.
- If using the serial port on the docking station for a laptop PC, try undocking the laptop and connecting directly to the serial port on the laptop.
- If you don't get a failure to connect message, but rather just think SDFlash Serial has hung (since connecting seems to be taking a long time), make sure you are waiting long enough before drawing that conclusion. There is a table on page 15 of this document that provides an estimate on the connecting time.

If ERASE fails:

- Increase the value of *Erase User Options #4* in the SDFlash project settings.

If PROGRAM fails:

- Increase the value of *Program User Options #4* in the SDFlash project settings.

References

- **F280x Flash API**: Download SPRC193 from the TI website:

  http://focus.ti.com/docs/toolsw/folders/print/sprc193.html

- **F281x Flash API**: Download SPRC125 from the TI website:

  http://focus.ti.com/docs/toolsw/folders/print/sprc125.html

- **F2801x Flash API**: Download SPRC327 from the TI website:

  http://focus.ti.com/docs/toolsw/folders/print/sprc327.html

- **F2804x Flash API**: Download SPRC325 from the TI website:

  http://focus.ti.com/docs/toolsw/folders/print/sprc325.html

- **F280x, F2801x, and F2804x Boot ROM and Bootloader info**: Download SPRU722 from the TI website:

  http://focus.ti.com/docs/prod/folders/print/tms320f2808.html#technicaldocuments

- **F281x Boot ROM and Bootloader info**: Download SPRU095 from the TI website:

  http://focus.ti.com/docs/prod/folders/print/tms320f2812.html#technicaldocuments

Appendix A: Customizing SDFlash Serial for User Applications

SDFlash Serial is designed as a stand alone utility for programming the flash on TMS320F28xx. It is assumed that the F28xx device undergoes a reset immediately before SDFlash Serial is invoked (which starts the ROM bootloader in the F28xx), and also that the F28xx device is manually reset upon completion of the flash programming (to begin execution of the code just programmed into the flash). In some applications, it is desired to use SDFlash Serial to re-program the flash (in the field, for example) without undergoing one or both of these resets. This Appendix contains information on how to customize SDFlash to do the following:

- Invoke SDFlash Serial at Any Time Other Than After a Device Reset
- Generate a Device Reset After SDFlash Serial Completes

DISCLAIMER: The methods described in this section have undergone only limited testing, and do alter the original SDFlash Serial source code. They are provided with no claims made on their proper operation in the user's application, nor on their suitability for a particular application. Further, they are included in this documentation only as suggestions if such features are needed by the user, and are provided without support. All responsibilities concerning their use lies with the user.

Invoke SDFlash Serial at any Time Other Than After a Device *Reset*

In the F28xxPasswordMF.pjt project, the file *main.asm* includes a `TRAP #0` instruction at the end of the password match flow. Normally, if SDFlash Serial is run immediately after a device reset, the PIE (Peripheral Interrupt Expansion module) is disabled. Therefore, the `TRAP #0` instruction will return a vector value of 0, which traps to the reset vector at 0x3FFFC0 and returns program control to the Boot ROM.

If the PIE is enabled, the TRAP #0 instruction is not allowed and will give indeterminate results. Therefore, if you invoke SDFlash Serial at any time other than after a device reset, make sure the PIE is disabled before branching to the start of the bootloader. This can be done in the user code. Alternately, if the device had been booted from SCI-A previously and the appropriate boot mode GPIO pins are still externally set to boot from SCI-A, one could simply force a watchdog reset (e.g., by writing a bad value for the WDCHK bits in the WDCR register). This will disable the PIE and also invoke the bootloader.

Generate a Device *Reset* After SDFlash Serial Completes

Upon completion of flash programming, the F28xx device is left in an endless loop by SDFlash Serial. Typically, a hardware device reset (e.g., XRSn\ pin) is used to begin code execution. To have SDFlash Serial automatically generate a reset upon completion, the user must modify and rebuild the Code Composer Studio F28yxSerialFlash.pjt project located in the folder *\mydrivers\DSP28yx_v3_1\DSP28yx_serial\build\F28xxSerialFlash*. Specifically, the source file f28xx_main.c must be modified.

Two possible modifications will be described, both of which will generate a device reset. The first method can introduce a delay between the completion of SDFlash Serial verify step and the device reset, but it will work for almost any program the user might program into the device. The second method will reset immediately after SDFlash Serial completes, but must be customized for every different program that SDFlash Serial programs into the device.

Both methods assume that SDFlash Serial will be used to Erase, Program, and Verify the device all at once before resetting the device. Although these solutions are tailored for a Reset after the Verify stage, they can be slightly modified to occur after the Program or Erase stage if desired.

Brief Description of f28xx_main.c:

Before going into the details of the two methods, some understanding of the f28xx_main.c file is required. The *main()* function in *f28xx_main.c* includes an infinite for-loop in which there is an event loop and then an IDLE instruction. The event loop triggers on every SCI interrupt event, checks for incoming packet data, and processes that data. The program will then sit at the IDLE instruction until another packet triggers the event loop. Once SDFlash Serial finishes, it sits at the IDLE instruction forever.

Modification Method 1:

Instead of sitting at the IDLE instruction forever after the Erase-Program-Verify sequence has completed, *f28xx_main.c* can be modified to reset the device after the Verify step completes. To do this, a count variable can be introduced which is reset to 0 inside of the event loop. During the Verify stage (last stage in the process), instead of sitting at the IDLE instruction and waiting for each SCI event, the program will continuously loop in the infinite for loop and increment the count variable (outside the event loop). As soon as a new SCI event occurs, indicating there is still incoming packet data, the count variable is reset to zero. When the Verify step has completed, no new SCI events will occur. Therefore, the count variable will continue to increase until it reaches some user defined timeout value. Once the timeout occurs, the program can re-configure GPIO pins as necessary to configure the bootmode, disable the PIE, and then either branch to the boot ROM or force a watchdog reset by writing an incorrect value to the WDCHK bits in the WDCR register.

Code snippets of the above explanation is shown below. The code below includes only the alterations made to *f28xx_main.c* and not the entire file. Notice that the count variable timeout is set at `0x00FFFFFF` by default to ensure a suitable timeout period for almost any program that SDFlash Serial may be programming into the flash (since the amount of time to program depends on the data being programmed). This timeout value can be customized by the user to a smaller value if desired.

```
// CODE CHANGES MADE TO F28XX_MAIN.C FOR METHOD 1

// As a global variable:
        Uint32 count;

// In the main() function before the infinite for loop:
        PRG_command = 0; //Initilize PRG_command to a null value
        count =0; // Initialize count to zero

// In the for loop in main:
  //SCI event loop - stripped out everything except what is
        //     changed/added for simplicity
  while(( gPostedEvents & SCI_EVT_DATA ) == SCI_EVT_DATA )

  {
    ……
    count = 0;
    //Initialize count to 0 every time an SCI event occurs
         ……
        }

        //AFTER SCI event loop, replace the current LED and IDLE
        //instructions with:

        if (PRG_command == CMD_FLASH_VERIFY) {  // Only in Verify Stage
          if (count==0x00FFFFFF) {
          // if no event has occurred for timeout period
            PieCtrlRegs.PIECTRL.bit.ENPIE = 0; // Disable the PIE
            asm("  LB    0x003FFB50");  //jump to boot loader in ROM
           // above instruction can be replaced by watchdog reset code
         } // end count timeout
         count++;  // if no SCI interrupt, increment count and loop
       } //end if verify stage
       else {// Idle time btwn pkts in "Program" and "Erase" stages
         STATUS_LED_OFF;
         asm("  IDLE");
         STATUS_LED_ON;
      }
```

After the modifications to *f28xx_main.c* are complete, the *F28xxSerialFlash.pjt* project must be rebuilt using Code Composer Studio. The resulting .out file will appear in the \bin folder on the same directory level as the \build and \src directories. Copy the .out file to overwrite the file of the same name in the corresponding device subfolder in the *\myprojects\sdf28xx_v3_1_serial\* directory.

Method 1 is useful in situations where SDFlash Serial might program a variety of different programs into the device. Therefore, at the end of the Verify stage, for some programs, there will be some delay while the count variable is timing out before the device is reset. Once Method 1 is used though, the f28xx_main.c file does not need to be touched again, even if programming a different file to the device using SDFlash Serial.

Modification Method 2:

Method 2 is a two-stage process which introduces no delay and resets the device immediately after the Verify step completes, but it requires the *f28xx_main.c* file to be customized for each program that is programmed using SDFlash Serial. Therefore, Method 2 is only useful if the same program is being programmed to multiple devices or to the same device over and over again. Method 1 is generally preferable unless there is a requirement for no delay between the completion of the Verify stage and the device reset.

Stage 1:

First, a *verify_count* variable is introduced and initialized to 0 at the beginning of the function *main()*. The verify_count variable is then incremented within the *FlashExecuteCommand()* routine during the Verify step only. In other words, the *verify_count* variable is incremented once per receive packet during the Verify step. The code snippet below shows the declaration and handling of *verify_count*:

```
// CODE CHANGES MADE TO F28XX_MAIN.C IN STAGE 1 OF METHOD 2

// As a global variable:
        Uint16 verify_count;

// In the main() function before the infinite for loop:
        verify_count =0;        // Initialize verify_count to zero

// In the FlashExecuteCommand() function Verify case
        case CMD_FLASH_VERIFY:
        PRG_status = FLASH28_Verify();
        verify_count++;         //Increment verify_count for each packet
        EINT;
```

After the modifications to f28xx_main.c are complete, the F28xxSerialFlash project must be rebuilt with the new file, and SDFlash Serial must then be run to determine the final value of *verify_count*, as follows:

1. Use Code Composer Studio to open the appropriate device project in the /build/ F28xxSerialFlash/ folder.
2. Re-build the project using the new *f28xxmain.c* file.
3. Find the appropriate .out file in the /bin folder (same directory level as the /build and /src directories).
4. Copy the .out file to overwrite the file of the same name in the device specific sub-folder in the sdflash\myprojects\sdf28xx_v3_1_serial\ directory.
5. In Code Composer Studio, under the File Menu, click “Load Symbols…”

6. Select the .out file you copied previously and click ok.
7. Reset the device in the debugger and hit Run.
8. Run SDFlash Serial to program the flash with the specific code of interest.
9. Once SDFlash Serial finishes, add *verify_count* to a watch or memory window and record its value.

Stage 2:

The file *f28xxmain.c* must be modified again. In *main()*, before the LED and IDLE instructions, and after the event loop, add code which performs the desired configuration and reset actions only if *verify_count* equals the number found in Stage 1. Basically, the *f28xx_main.c* program will run until the last verify packet has been received and processed. At that point, the program can re-configure GPIO pins as necessary to configure the bootmode, disable the PIE, and then either branch to the boot ROM or force a watchdog reset by writing an incorrect value to the WDCHK bits in the WDCR register. The code required for this stage is shown below:

```
// CODE CHANGES MADE TO F28XX_MAIN.C IN STAGE 2 OF METHOD 2

// After the event loop and before the LED_STATUS and

   if(verify_count==XNUMBER){          // where XNUMBER is replaced by
                                       // the number recorded in Stage 1
   PieCtrlRegs.PIECTRL.bit.ENPIE = 0;  // Disable the PIE
   asm("     LB   0x003FFB50");        // Jump to bootloader in ROM
   }
```

After the modifications to f28xx_main.c are complete, the F28xxSerialFlash project must be rebuilt again with the new file:

1. Use Code Composer Studio to open the appropriate device project in the */build/F28xxSerialFlash/* folder.
2. Re-build the project using the new *f28xxmain.c* file.
3. Find the appropriate .out file in the /bin folder (same directory level as the /build and /src directories).
4. Copy the .out file to overwrite the file of the same name in the device specific sub-folder in the sdflash\myprojects\sdf28xx_v3_1_serial\ directory.
5. Run SDFlash Serial as normal.

As long as the same file is being programmed to the device with SDFlash Serial, no modifications need to be made to *f28xx_main.c*. If a different file is being programmed, the two-stage procedure must be performed again.