UniFlash is a stand-alone tool that can program the on-chip flash memory on TI MCUs and on-board flash memory for Sitara processors. UniFlash has a GUI, a command line, and a scripting interface. For a full description of UniFlash, see the UniFlash Standalone Flash Tool page.

This user's guide describes how to use UniFlash with MSP430™ microcontrollers (MCUs) and select SimpleLink™ MCUs.

Contents

1 Introduction ................................................................................................................... 2
2 Preparing the Image ................................................................................................. 2
3 Supported Devices .................................................................................................... 3
4 GUI Default Settings ............................................................................................... 3
5 Bootloader Programming of MSP430 MCUs .......................................................... 4
  5.1 Programming the Firmware Image to the Target Bootloader ............................... 4
  5.2 Reading the Memory of the Target Bootloader ..................................................... 7
6 Bootloader Programming for SimpleLink MSP432P4 MCUs ..................................... 8
  6.1 Programming the Firmware Image to the Target Bootloader ............................... 8
  6.2 Reading the Memory of the Target Bootloader ..................................................... 10
7 Bootloader Programming for SimpleLink MSP432E4 MCUs ..................................... 12
  7.1 Programming the Firmware Image to the Target Bootloader ............................... 12
8 Bootloader Programming for SimpleLink CC13xx and CC26xx MCUs .................... 14
  8.1 Handling the CCFG Configuration Under Firmware Image ................................. 14
  8.2 Programming the Firmware Image Into the Target Bootloader ......................... 15
  8.3 Reading the Memory of the Target Bootloader ..................................................... 17
9 Bootloader Programming for SimpleLink CC32xx Family ......................................... 18
  9.1 Preparing the .SLI Firmware Image for Bootloader Programming ....................... 18
  9.2 Programming the Firmware Image Into the Target Bootloader ......................... 18
10 Related Documents ................................................................................................ 20

List of Figures

1 Device Selection ......................................................................................................... 3
2 Select the Device MSP430FR2355 ........................................................................... 4
3 Enter the File of password.txt and the Firmware Image of Blink LED ..................... 4
4 Content of password.txt ........................................................................................... 4
5 Content of blink_2355.txt ........................................................................................ 5
6 Setting COM Port Number in the Settings & Utilities Tab ....................................... 5
7 Wrong Password Execution ...................................................................................... 6
8 Correct Password Execution Followed by Successful Programming ....................... 6
9 Concatenation of the Bytes Into Password Format ................................................. 7
10 Enter the Configuration on Read Section .................................................................... 7
11 Console View for Reading the Memory Successfully .............................................. 7
12 Select the Device MSP432P4111 .............................................................................. 8
Introduction

This document describes how to use UniFlash to program the bootloader of the following MCUs.

UniFlash 4.6.0 supports:
- MSP430 microcontrollers
- SimpleLink MSP432P4 microcontrollers
- SimpleLink MSP432E4 microcontrollers

UniFlash 5.0.0 adds support for:
- SimpleLink CC13xx microcontrollers
- SimpleLink CC26xx microcontrollers

2 Preparing the Image

Bootloader programming supports the following firmware image file formats:
- TI TXT file (.txt)
- Intel Hex file (.hex)
3 Supported Devices

In UniFlash, devices with bootloader support are listed with the suffix (BOOTLOADER) in the device selection (see Figure 1). The "Serial" label means that the supported protocol is serial communication, such as UART, I2C, or SPI. The "On-Chip" label means that the debug programming is already available in UniFlash.

![Device Selection](image)

**Figure 1. Device Selection**

4 GUI Default Settings

The GUI has been configured with default values. Therefore, the only configurations required are selecting the firmware image to download and the COM port number that is connected to the target device.
5 Bootloader Programming of MSP430 MCUs

5.1 Programming the Firmware Image to the Target Bootloader

For the MSP430 MCUs, the following example downloads a blink LED application to an MSP430FR2355 MCU.

The Program tab displays three text fields for the firmware image. The Password field is to load the image of the bootloader password, to unlock the bootloader before the communication is established. The password is the first 32 bytes of data starting at memory address 0xFFE0h, where the interrupt vector is located. For more information about the password for the bootloader, see the MSP430™ Flash Device Bootloader (BSL) User’s Guide or the MSP430™ FRAM Device Bootloader (BSL) User’s Guide.

When the Password field is empty, the default password is used during execution. The default password is 0xFF for all 32 bytes.

This example uses the default password, which is stored in the file password.txt.

For the following example, Figure 4 shows the content of password.txt, and Figure 5 shows the content of blink_2355.txt.
The minimum requirement in the Settings & Utilities tab is the COM port and correct protocol.

Figure 5. Content of blink_2355.txt

```
$8000
11 80 04 00 3E 40 00 00 00 00 00 01 4E 00 00
1F 4E 01 00 1F F3 81 6F 02 00 0D 40 01 00 1D F3
1E 4E 04 00 02 0E 5F 02 0F D3 1F D1 04 00 3F D0
00 A3 82 4F 60 08 01 37 00 00 00 00 00 00 00 00
00 DA 80 01 02 03 00 02 04 02 02 02 01 02 03 02 02
01 4E 10 27 00 00 01 33 00 00 81 93 00 00 01 86 27
0F 3F 03 43 03 43 3F 3F 03 43 43 1C 43 43 10 01 31 40
00 00 00 01 13 00 01 01 02 01 02 01 02 02 02 01 02
10 43 80 13 64 80 32 10 00 FD 3F 03 43
11 4F80
12 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
13 00 00
14 00 FF
15 FF
16 00 00
17 00 00
18 00 00
19 00 00
20 00 00
```

Figure 6. Setting COM Port Number in the Settings & Utilities Tab
If the device was programmed and the interrupt vector sector is not empty, an error will be returned with status "BSL Password is incorrect!" (see Figure 7). Sending a wrong password triggers a mass erase on the device.

If the device is empty, the programming is successfully executed and the console shows the log result (see Figure 8).
5.2 **Reading the Memory of the Target Bootloader**

To be able to read the content of the memory of target bootloader, the bootloader must be unlocked using the password. The password is 32 bytes that are entered manually in a 32-bit word format (see Figure 9). Concatenate the bytes into 32-bit format using the LSB format with separation of 32 bytes each. The password translates into the hex format in Figure 9.

![Figure 9. Concatenation of the Bytes Into Password Format](image)

Copy the password to the Read section in the Settings & Utilities tab. The Read Image File field specifies the file where UniFlash writes the binary. Enter the start address and number of bytes to read in the following fields.

![Figure 10. Enter the Configuration on Read Section](image)

Successful reading memory execution show the log in Figure 11.

![Figure 11. Console View for Reading the Memory Successfully](image)
6  Bootloader Programming for SimpleLink MSP432P4 MCUs

6.1  Programming the Firmware Image to the Target Bootloader

For the MSP432P4 family, the following example downloads a data block to the memory and reads back the programmed area.

![Figure 12. Select the Device MSP432P4111](image)

The Program tab has three text fields for the firmware image. The Password field specifies a file with the bootloader password, to unlock the bootloader before the communication is established. The password is the first 256 bytes of data starting at memory address 0x0. For more information about the password for the bootloader, see *MSP432P4xx SimpleLink™ Microcontrollers Bootloader (BSL) User's Guide*.

If the Password field is empty, the default password is used during execution. The default password is 0xFF for all 256 bytes.

![Figure 13. Loading a File Using the 256-Byte Default Password](image)
The minimum configuration to enter in the Setting & Utilities tab is the COM port (see Figure 14).

![Figure 14. Setting COM Port Number in the Settings & Utilities Tab](image)

If the device is not empty, sending the default password is the same as sending a wrong password. The console shows the BSL password is incorrect, and the program stops execution. When the bootloader receives the wrong password, a mass erase is executed for all of the main memory area.

![Figure 15. Sending Wrong Password Case](image)
If you repeat the process with the same configuration, the process executes successfully, because the memory is now empty.

6.2 Reading the Memory of the Target Bootloader

To read the contents of the target bootloader from memory, the bootloader must be unlocked using the password. The password is 256 bytes that are entered manually in a 32-bit word format.

The image loaded in the MCU starts at address 0x0 and is 128KB long. The password is the first 256 bytes (see Figure 17).

Figure 16. Console View for Programming the Data Block Successfully With the 256-Byte Default Password

Figure 17. Loaded Image on the Target Device

Concatenate the bytes into a 32-bit format using the LSB format with separation of 32 bytes each. The password in Figure 17 is translated into hex format as shown in Figure 18.

Figure 18. Concatenation of the Bytes Into Password Format
Copy the password to the Read section in the Settings & Utilities tab. The filename specifies a file where UniFlash can write the binary and save in the users folder automatically. Type the start address and how many bytes to read in the following text fields.

Figure 19. Enter the Configuration on Read Section

Figure 20 shows the console view after successful reading of the memory.

Figure 20. Console View for Reading the Memory Successfully
7 Bootloader Programming for SimpleLink MSP432E4 MCUs

7.1 Programming the Firmware Image to the Target Bootloader

For the MSP432E4 MCU, the following example downloads the UART bootloader flash-based application from the SDK. The device must be fully erased to run this example.

Figure 21. Select the Device MSP432E401Y

Figure 22. Enter the Firmware Image

Figure 23. Configure the COM Port and Use the Default Settings for Other Configurations
Select Load Image to start the programming process. The console shows the log of each operation (see Figure 24).

**Figure 24. Console View of Downloading the UART Bootloader Flash-Based Application**

After the first programming successfully executes, the UART bootloader flash-based application runs each time the device is reset. The next step is to program a blink LED application that is provided in the SDK examples with no auto-baud rate configuration.

**Figure 25. Uncheck “Apply auto baud rate for speed initialization”**

**Figure 26. Select the Firmware Image of Blink Application**
The console output after a successful operation shows that the initialization only executes the PING command without auto baud rate (see Figure 27).

Figure 27. Console View of Downloading the Blink Application

8 Bootloader Programming for SimpleLink CC13xx and CC26xx MCUs

8.1 Handling the CCFG Configuration Under Firmware Image

By default, creating a firmware image based on examples in the SDK create the CCFG configuration. CCFG configuration is programmed at these addresses:

- 0x57FA8h for CC13x2 and CC26x2 devices
- 0x1FFA8h for CC13x0 and CC26x0 devices

UniFlash supports CCFG configuration during bootloader programming. Therefore, any CCFG configuration from the firmware image is discarded. To not build the CCFG section during compilation, set the "Exclude from Build" option on the ccfg.c file that is automatically imported to the project when using the example from the SDK.

Figure 28. Apply "Exclude from Build" for ccfg.c

Another option to is to manually delete the CCFG section from the generated firmware image. The CCFG section is last in the file (see Figure 29).
Programming the Firmware Image Into the Target Bootloader

To select one of the CC13xx and CC26xx wireless MCUs, type the device name and then select the entry that ends with "(BOOTLOADER)" and that has a label of "Serial" next to it (see Figure 30). The "On-Chip" label is a programming feature that uses a supported debugger. On this example, the LaunchXL-CC26x2R1 with CC2652R1F is used.

Figure 30. Select Device CC2652R1F

Up to three separated images can be programmed on the device.
After you click "Load Image", UniFlash starts the programming process and the console shows the log of each operation.

In the default setting of CCFG, the Image Valid Configuration in the CCFG section is required. Set the Image Valid Configuration to 0x0000:0000 to enable the boot sequence to transfer control to the user application image. Any other value forces the boot sequence to call the bootloader instead.
8.3 Reading the Memory of the Target Bootloader

Reading the programmed memory is possible by using the bootloader backdoor invocation. To enable bootloader backdoor invocation, the CCFG configuration must be done during the initial programming.

Parameters needed to do the reading are:

- File name that ends with .txt, .hex, or .bin according with the expected file format
- Start address of the memory to read
- Number of bytes to read

Successful reading memory execution will show the log in the console as shown below.
9 Bootloader Programming for SimpleLink CC32xx Family

9.1 Preparing the .SLI Firmware Image for Bootloader Programming

Bootloader programming requires the .SLI image that is generated by the Image Creator tool, which is available with UniFlash. The CC2564B to CC2564C Migration Guide, SimpleLink Wi-Fi® and Internet-on-a chip™ Solution Image Creator and Programming Tool explains the process to generate the .SLI image.

9.2 Programming the Firmware Image Into the Target Bootloader

UniFlash 5.1.0 supports bootloader programming for the CC3220S, CC3220SF, CC3235S, and CC3235SF MCUs. As shown in Figure 37, select the device by typing the device name, and then select the listing that ends with "(BOOTLOADER)" and that has a "Serial" label. In this example, CC3235S(BOOTLOADER) is chosen.

![Figure 37. Select the CC3235S MCU for Bootloader Programming](image)

After you select the device, UniFlash shows the "Program" tab with a file browser field. Enter the firmware image to be programmed. Select the .SLI image, which in the example in Figure 38 is 3235S_Board1_Programming_PwmLedExample.sli.

![Figure 38. Enter the Firmware Image](image)

UniFlash 5.1.0 supports bootloader programming for only the CC3220S-LAUNCHXL, CC3220SF-LAUNCHXL, LAUNCHXL-CC3235SF, and LAUNCHXL-CC3235SF. The bootloader invocation requires the reset sequence that is generated by the XDS110 on the LaunchPad™ development kits.

**NOTE:** For LaunchPad kit versions other than Rev.A, the programming might encounter known timing problems. Therefore, TI recommends using the Image Creator to run the programming with LaunchPad kits other than Rev.A.
Under the Settings & Utilities tab, the COM port configuration needs to be specified (see Figure 39).

![Image of UniFlash interface with settings and utilities]

**Figure 39. XDS COM Port Manual Selection With Given COM Port Number**

After configuration is complete, select the "Load Image" button on the "Program" tab to load the program into the target device. Figure 40 shows an example of the console output during programming.

![Image of console output during programming]

**Figure 40. Console View of Downloading the UART Bootloader Application**
10 Related Documents

The following documents include additional information about the bootloader protocol for the MCUs mentioned in this guide.
1. MSP430™ Flash Device Bootloader (BSL) User’s Guide
2. MSP430™ FRAM Device Bootloader (BSL) User’s Guide
4. MSP432E4 SimpleLink™ Microcontrollers Bootloader (BSL) User’s Guide
6. CC13x0, CC26x0 SimpleLink™ Wireless MCU Technical Reference Manual
7. CC2538/CC26x0/CC26x2 Serial Bootloader Interface
8. CC2564B to CC2564C Migration Guide
9. CC3120 and CC3220 Simplelink™ Wi-Fi® Embedded Programming User’s Guide
10. CC313x and CC323x Simplelink™ Wi-Fi® Embedded Programming User’s Guide
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- Added Section 9, Bootloader Programming for SimpleLink CC32xx Family........................................ 18
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