802.15.4/Zigbee Embedded Bootloader

Reference Manual

802154EBRM/D

Rev. 0.0, 09/2004

Launched by Motorola
freescale™
semiconductor

Contents

About This Book vi

Audience vi

Organization vi

Conventions vii

Definitions, Acronyms, and Abbreviations vii

References viii

Revision History viii

Chapter 1 Embedded Bootloader Description 1-1

1.1 Target 1-1

1.1.1 Ported Targets 1-2

1.2 Features 1-3

1.3 Benefits 1-3

1.4 Potential Issues 1-3

1.4.1 Optional Firmware Upload Settings 1-4

Chapter 2 Using the Embedded Bootloader 2-1

2.1 Upload Firmware 2-1

2.1.1 Use Case One 2-1

2.1.2 Use Case Two 2-2

2.1.3 Safe Mode Boot 2-2

2.2 Updating Non-volatile Memory (NVM) 2-3

2.2.1 An Example of How to Change the MAC Address 2-3

2.3 System Bus Frequency 2-4

2.4 UART Baud Rate 2-4

Chapter 3 Test Tool – Zigbee Flash Tool 3-1

3.1 Graphical User Interface (GUI) Version 3-2

3.1.1 Using the Tools Menu Option 3-2

3.1.2 Using the View Menu Option 3-3

3.1.3 Selecting the Firmware File to Upload 3-4

3.1.4 Using the Help Menu 3-6

3.1.5 Changing the NVM Data in Flash or File 3-6

3.2 Command Line Version (CMD) 3-8

3.2.1 Normal Use Example (Default) 3-9

3.2.2 Flash Erase Disabled Example....................3-9

Chapter 4 Embedded Bootloader Programming.................... 4-1

4.1 Programming To An Empty (Erased) Board 4-1

4.2 Upgrading The Embedded Bootloader 4-5

Chapter 5 Application Integration Reference Guide.................... 5-1

5.1 Product Deliverables....................5-1

5.1.1 Embedded Bootloader Image....................5-1

5.1.2 Application Support Files 5-1

5.1.3 Application Linker File....................5-2

5.2 Application....................5-2

5.2.1 Compiler Defines 5-2

5.2.2 Unreferenced Symbols....................5-2

5.2.3 System Clock Setup 5-3

5.3 Application Support Files 5-3

5.3.1 DigiType.h 5-3

5.3.2 Gb60_io.h 5-3

5.3.3 Crt0.c and Crt.h....................5-4

5.3.4 Embedded_Bootloader.h and Embedded_Bootloader.c 5-5

5.3.5 NV_Data.c and NV_Data.h 5-5

5.3.6 ISR_Vectors.c 5-5

5.3.7 DummyIsr.c 5-6

Chapter 6 Port Integration Reference Guide.................... 6-1

6.1 Embedded Bootloader Build Environment....................6-1

6.1.1 HCS08 Compiler....................6-1

6.1.2 HCS08 Linker 6-1

6.1.3 HCS08 LibMaker....................6-1

6.2 Product Deliverables....................6-2

6.2.1 Embedded_Bootloader.mcp....................6-2

6.2.2 HCS08_Flash_Lib.Lib 6-2

6.2.3 Embedded_Bootloader_Functionality_Lib.Lib 6-2

6.2.4 Source Files....................6-2

6.3 Porting to a Specific Target 6-3
6.3.1 Code and Data Segments 6-3
6.3.2 Standard Libraries 6-3
6.3.3 Compiler #defines 6-3
6.4 Source Files 6-4
6.4.1 Target.h 6-4
6.4.2 Reset_Vector.c 6-5
6.4.3 Embedded_Bootloader_Target.h 6-5
6.4.4 HW_Init.h 6-6
6.4.5 HW_Init.c 6-6
6.4.6 main.c 6-6
Chapter 7 Embedded Bootloader Public Function Description 7-1
7.1 802.15.4/Zigbee Application Accessible Functions 7-1
7.1.1 Enable_Download_Firmware 7-1
7.1.2 Hard_Reset 7-3
7.1.3 Update_NV_RAM 7-3
7.1.4 NV_Flash_Setup 7-4
7.1.5 FL_ICG_Setup 7-4
7.1.6 UART_Port_Select 7-5
Chapter 8 Embedded Bootloader Memory Map 8-1
Appendix A Release Folder and File Structure A-1
A.1. Folder Structure A-1
A.2. File Structure A-2

About This Book

This guide provides a detailed description of Freescale's Embedded Bootloader and describes how to port Freescale's Embedded Bootloader to a specific PCB/target..

The Embedded Bootloader is intended for use with the IEEE® 802.15.4 evaluation kits (EVK). However, it is possible to upload applications with the Embedded Bootloader in the development phase, but the Embedded Bootloader will not provide any debug functions.

The Embedded Bootloader provides an easy and inexpensive way to upload new firmware and eliminate the requirements for expensive debug/development tools. The only requirement is a standard PC with an RS232 UART/USB interface running Windows 2000 or XP.

The Embedded Bootloader must be used with the Zigbee Flash Tool which can be found in the Test Tool Suite 'Test Tool.exe'.

This document describes Embedded Bootloader version 5.01.

Audience

This document is intended for application developers.

Organization

This document is organized into eight chapters and one appendix.

Chapter 1	**Embedded Bootloader Description** — This chapter gives an overview of the Embedded Bootloader.
Chapter 2	**Using the Embedded Bootloader** — This chapter describes the basic functionality of the Embedded Bootloader.
Chapter 3	**Test Tool, Zigbee Flash Tool** — This chapter describes the Zigbee Flash Tool. The GUI and Command Line versions are covered.
Chapter 4	**Programming the Embedded Bootloader** — This chapter describes how to program the Embedded Bootloader to flash memory.
Chapter 5	**Application Integration Reference Guide** — This chapter describes the deliverables required to build an 802.15.4/Zigbee Application with the Embedded Bootloader.
Chapter 6	**Port Integration Reference Guide** — This chapter describes the deliverables required and how to integrate them to make an executable Embedded Bootloader for a specific PCB.
Chapter 7	**Embedded Bootloader Public Function Description** — This chapter provides a description of the, from an 802.15.4/Zigbee application, accessible functions in the Embedded Bootloader.
Chapter 8	**Memory Map** — This chapter describes the Bootloader Memory Map.
Appendix A	**Release Folder and File Structure** — This appendix shows the folder and file structure for this release.

Conventions

This document uses the following notational conventions:

- Courier monospaced type indicates commands, command parameters, code examples, expressions, data types, and directives.
- Italic type indicates replaceable command parameters.
- All source code examples are in C.

Definitions, Acronyms, and Abbreviations

BDM debugger	A debugger using the BDM interface for communication with the MCU. An example is the P&E BDM Multilink debugger for HCS08.
BDM	Background Debug Module
EVB	Evaluation Boards - this term covers the DIG-528-2 (EVK) and DIG536-2 (SARD) boards.
EVK	Evaluation Kit
GUI	Graphical User Interface
MAC	Medium Access Control
MCU	MicroController Unit
NVM	None-Volatile Memory
PC	Personal Computer
PCB	Printed Circuit Board
S19	'S19' is the file extension used for the Motorola binary image format. The S19 file encapsulates the binary image as a list of ASCII records. Each record contains a length -, address -, data - and checksum field. The 16 bit address field allows a memory space for up to 64 KB. The S19 can be generated with Metroworks Codewarrior IDE and is the product from the linking process. S19 does not contain additional information to a debugger (where to look for source files).
Safe Mode Boot	The Embedded Bootloader boots up using safe default system values.
HIWAVE	P&E HCS08 debugger GUI.
CPROG	P&E HCS08 flash programming tool called from HIWAVE. The tool is also available in a command line version where scripts can be made.

References

[1] Freescale 802.15.4 MAC/PHY Software Reference Manual, 802154MPSRM/D

[2] Zigbee.hlp (see Test Tool installation directory .\help)

[3] Freescale MC908HCS08GB60/GT60 MCU Data Sheet, MC9S08GB60/D

[4] Freescale Application Note, Handling MAC Address Erasure, AN2825/D

[5] Freescale Application Note, Zigbee/802.15.4 Evaluation Kit, Quick Start Guide, AN2772/D

[6] Freescale Embedded Bootloader User's Guide, MC13192FLUG/D

[7] Freescale Switch Demo Application, AN2773/D

Revision History

The following table summarizes revisions to this manual since the previous release (Rev. 0.0).

Revision History

Location	Revision
Entire Document	This document supercedes revision 2.4 of the Freescale Embedded Bootloader User's Guide, MC13192FLUG/D.

Chapter 1
Embedded Bootloader Description

The Embedded Bootloader is intended for use with the IEEE® 802.15.4 evaluation kits (EVK). However, it is possible to upload applications with the Embedded Bootloader in the development phase, but the Embedded Bootloader will not provide any debug functions.

The Embedded Bootloader provides an easy and inexpensive way to upload new firmware and eliminate the requirements for expensive debug/development tools. The only requirement is a standard PC with an RS232 UART/USB[1)] interface running Windows 2000 or XP.

The Embedded Bootloader must be used with the Zigbee Flash Tool which can be found in the Test Tool Suite ‘Test Tool.exe’.

This document describes Embedded Bootloader version 5.01.

The Embedded Bootloader is located in a protected 4 KB flash block in the highest memory area (0xF000-0xFFFF) of the Freescale MC908HCS08GB60/GT60 microcontroller. (It cannot be accidentally erased.) A BDM debugger is required to erase the Embedded Bootloader. See the *Handling MAC Address Erasure Application Note*, AN2825/D

[1)] At least one of these communication interfaces must be supported by the target PCB.

1.1 Target

The Embedded Bootloader runs on the Freescale MC908HCS08GB60/GT60 MCU.

The MC908HCS08GB60/GT60 is a member of Freescale’s low-cost, high-performance HCS08 family. It has 60 KB embedded flash (flash sector size of 512 bytes) and 4 KB embedded RAM..

The Embedded Bootloader uses the MC13192 CLKO. See Chapter 2 for more information.

1.1.1 Ported Targets

The Embedded Bootloader must be ported (I/O mapped) to a specific PCB for proper functionality and is currently ported to the following Freescale PCBs:

Axiom AXM-0308:

• PC Communication Interface:	RS232/UART on COM1 (SCI1)/ RS232/UART on COM2 (SCI2)
• Safe Mode Boot	Short pins 2-3 on COM1 (SCI1)/ COM2 (SCI2)
• Version Number	"AX-0308 Ver 5.01"

DIG528-2 EVK

• PC Communication Interface:	RS232/UART on COM1 (SCI1)/ USB (SCI2)
• Safe Mode Boot	Short pins 2-3 on COM1-port (SCI1)
• Version Number	"528&536 Ver 5.01"

DIG536-2 SARD

• PC Communication Interface:	RS232/UART on COM1 (SCI1)
• Safe Mode Boot	Short pins 2-3 on COM1-port (SCI1)
• Version Number	"528&536 Ver 5.01"

RD01

• PC Communication Interface:	RS232/UART/USB on COM1 (SCI1)/ RS232/UART/USB on COM2 (SCI2)
• Safe Mode Boot	Short pins 2-3 on COM1 (SCI1)/ COM2 (SCI2)
• Version Number	" RD01 Ver 5.01"

NOTE

The generic RD01 target can be used with any PCB using the Freescale Reference Design version 01 I/O layout. The PCB must support at least one communication interface. If a USB is the only interface, use a jumper to short SCI pins 2 and 3 to make Safe Mode Boot available.

Refer to Section 6.3 for details on how to port the Embedded Bootloader to a specific PCB.

1.2 Features

The following features are supported:

- Upload firmware (802.15.4/Zigbee application) in Motorola S19 record format through UART/USB. The S1 data record length must be set to 32 bytes
- Auto-Detection of the PC communication interface (see Section 1.1.1, Ported Targets).
- Initialize memory including stack of uploaded firmware
- Initialize the system clock. Self clocked mode and MC13192 clock setup. Power save mode supported
- Run time update/change of the NVM

NOTE

See the *Freescale 802.15.4 MAC/PHY Software Reference Manual*, 802154MPSRM/D, for a detailed description on NVM layout and values.

1.3 Benefits

- Users do not have to buy expensive third party debug/development tools to get started.
- Users can update the 802.15.4/Zigbee application firmware without having to build in additional code for interfacing to the Embedded Bootloader (See Section 2.1.3, Safe Mode Boot).
- Application firmware can be updated after production by users. However, this requires that the final product has a communication interface (UART/USB).
- Users can update the 802.15.4/Zigbee application firmware even when it is malfunctioning (See Section 2.1.3, Safe Mode Boot).
- The 802.15.4/Zigbee application firmware does not have to include initializing or flash programming code and can thereby minimize code size.
- Can update any NVM data specified by the 802.15.4/Zigbee application.

1.4 Potential Issues

- Uses 4 KB of flash (~6.7 % on a MC908HCS08GB60/GT60) and 93 bytes of RAM (~2,3 % on a MC908HCS08GB60/GT60)
- Extended power/boot up time (~17ms) because the Embedded Bootloader must detect the presence of an application.

1.4.1 Optional Firmware Upload Settings

- Skip flash erase
  - Disabled — The 802.15.4/Application/NVM (except production data section) is erased (default)
  - Enabled — The 802.15.4/Application/NVM is NOT erased

- Erase production data (get production data from firmware file)
  - Disabled — The production data section (with MAC address) in NVM are preserved. All other NVM values are updated with the values from the S19 record file (default)
  - Enabled — The production data (with MAC address) and all other values in NVM are erased. All NVM values are updated with the values from the S19 record file

NOTE

Care must be taken when enabling this option. The user must save a backup of vital production data (MAC address). The production data can be manually added to the NVM structure in the NV_Data.c file.

- Do not reset after upload
  - Disabled — The system is automatically reset after upload (default)
  - Enabled — The system must be manually reset by user

- Skip firmware checksum verification
  - Disabled — A checksum verification of the S19 file data record is performed [2] (default).

NOTE

The Embedded Bootloader will report the address of the first data mismatch found in the current S19 data record. System must be reset if an error is reported. Check the optional settings and try again.

  - Enabled — No checksum verification is performed. Flash programming errors cannot be detected.

[2] The UART/USB communication channel is also protected with a protocol checksum.

Chapter 2
Using the Embedded Bootloader

This chapter describes the Embedded Bootloader functionality. A detailed description of the functions briefly mentioned in this chapter can be found in Chapter 7.

2.1 Upload Firmware

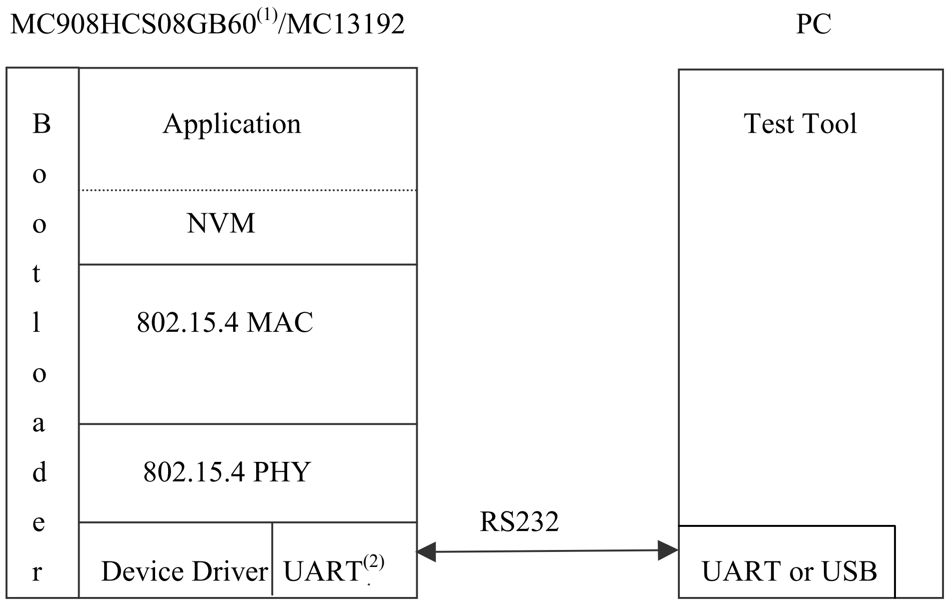
The Embedded Bootloader can be used in different system configurations depending on the PCB and the application. The application should have a user interface feature that makes it possible for the application to call the Enable_Download_Firmware() function:

The application can optionally call the Hard_Reset() function to perform a reset, or the board can be reset manually. The board will now start up in Embedded Bootloader mode.

Start the PC-Tool. See Chapter 3 for more information.

2.1.1 Use Case One

In this case, users send a specific command via the UART to enable firmware upload



[1] Or MC908HCS08GT60

[2] Or USB

Figure 1 Application Supporting RS232 UART or USB Interface

2.1.2 Use Case Two

In this use case, users push a button on the board to enable firmware upload.

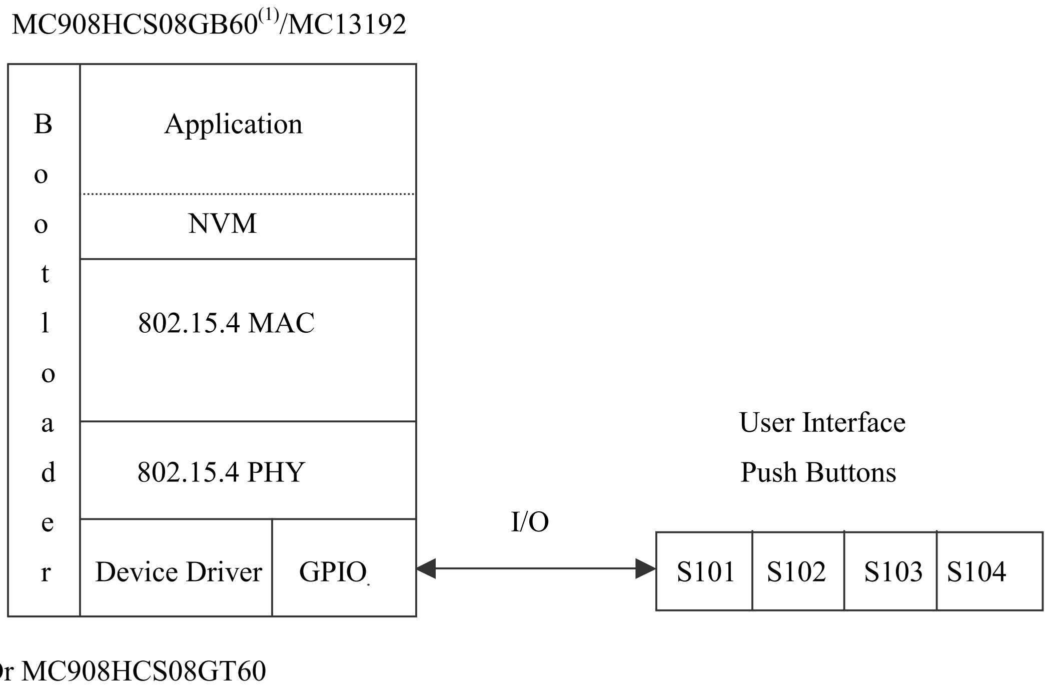


Figure 2 Application Supporting an I/O Interface

2.1.3 Safe Mode Boot

The Safe Mode Boot Mode is a special startup mode where the Embedded Bootloader boots using safe system settings thereby resetting the system to a known (default) state.

The Safe Mode Boot can be used to disable the detection of an invalid/malfunctioning application due to items such as code errors, corrupt NVM data, or internal flash programming errors among others. All the NVM memory (except production data and MAC address) is completely erased.

The Safe Mode Boot can also be used to upload firmware without first calling the Enable_Download_Firmware() function. This could be useful if the use cases (as shown in Section 2.1, Upload Firmware) are not applicable.

Users must perform the following steps to conduct a Safe Mode Boot.

1. Power off the board
2. Disconnect RS232 UART cable (if the RS232 UART interface is used)
3. Short UART TX and RX (pin 2-3) (This works even though the 802.15.4/Zigbee application does not use the UART interface.)
4. Power up again. All LEDs are off.
5. Wait until LED1 goes on (< 1 second)
6. Power off the board

7. Remove short from UART TX and RX and connect UART cable again (if the RS232 UART interface is used)
8. Power up again
9. Embedded Bootloader is ready to receive new firmware (all LEDs on)
10. Start the PC-Tool. See Chapter 3, for more information.

NOTE

The Safe Mode Boot description is only valid for the Freescale ported versions of the Embedded Bootloader. Refer to the *802.15.4 Embedded Bootloader Reference Manual*, 802154EBRM/D, for more details about a specific port of the Embedded Bootloader.

2.2 Updating Non-volatile Memory (NVM)

The following steps show how to update the NVM data from an application (code).

1. The Embedded Bootloader must be present on the board.

NOTE

All EVBs are shipped with the Embedded Bootloader pre-programmed in flash. The Embedded Bootloader can only be erased/programmed with a BDM debugger.

2. Call the Update_NV_RAM() function. This function can change any NVM data.

2.2.1 An Example of How to Change the MAC Address

The following code shows an example of how to change the MAC address.

```
Update_NV_RAM(&(NV_RAM_ptr->MAC_Address)[0], &pPacket[DATA_INDEX], 8);
```

NOTE

pPacket – contains the new MAC address.

Any NVM data can in code be read as a normal construct. For example, use the NV_RAM_ptr to get access to individual data.

2.3 System Bus Frequency

The MC908HCS08GB60/GT60 starts in 4 MHz self clocked mode. The init code changes this to 8 MHz after a few instructions from reset.

If NVM data is found, the system clock (MC908HCS08GB60/GT60 ICG module and MC13192 CLKO) and other options are setup as specified by the uploaded application. See the Freescale *802.15.4 MAC/PHY Software Reference Manual*, 802154MPSRM/D, for more details.

If no NVM data can be found, the following (safe mode boot) values are used:

- MC13192 CLKO = 62.5 KHz
- MC908HCS08GB60/GT60 bus clock = 16 MHz

2.4 UART Baud Rate

If NVM data is found, the UART baud rate is setup as specified by the uploaded application. Several values can be used. See the *MC908HCS08GB60/GT60 MCU Data Sheet*, MC9S08GB60/D for more information.

The baud rate depends on the NVM values specified by the application. See the Freescale *802.15.4 MAC/PHY Software Reference Manual*, 802154MPSRM/D, for more details.

If no NVM data is found, the following (safe mode boot) values are used:

- UART baud rate 19200 kbps, 8 data, 1 start, 1 stop, none parity.

Chapter 3
Test Tool – Zigbee Flash Tool

The Zigbee flash tool is a part of the general Zigbee Test Tool. This chapter provides a brief description of how to use the Zigbee Test Tool to upload new firmware. For more details about installation and other features, see the documentation for the Zigbee Test Tool and the Zigbee.hlp file in Test Tool installation directory .\help.

The flash programming part of the Test Tool can be used with two different user interfaces.

1. The GUI-version in 'Test Tool.exe'
2. The command line version in 'Bootloader.exe' in the 'S19' folder.

This description covers Embedded Bootloader version 5.00 of the Zigbee Test Tool.

Uploadable applications in Motorola S19 file format must be copied to the
[installation directory]\Freescale\Test Tool\S19 directory in advance.
Copy any new applications in S19 format to this folder.

NOTE

The actual window layout may differ from the figures shown in this document. Refer to the Freescale Zigbee/802.15.4 web page for new or updated applications.

3.1 Graphical User Interface (GUI) Version

To use the GUI version of the Test Tool, execute the following file:

```
[installation directory]\Freescale\Test Tool\Test Tool.exe
```

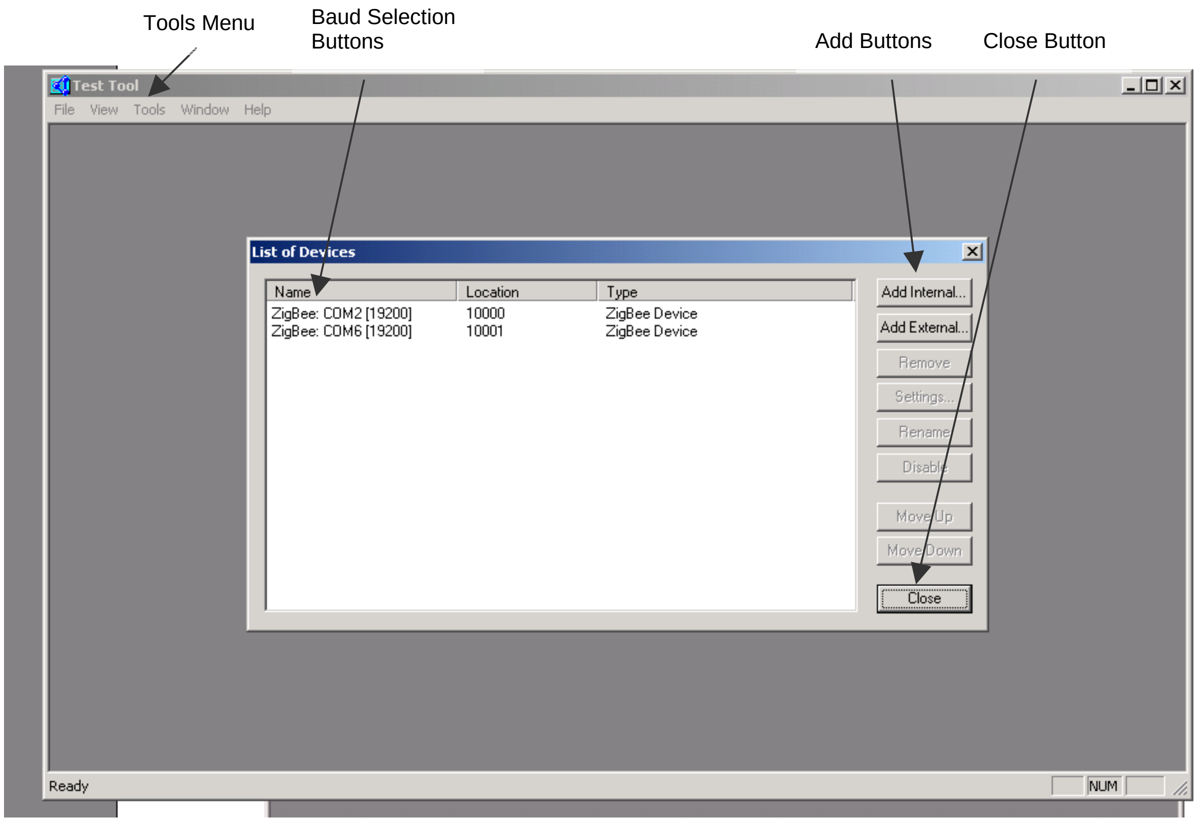
3.1.1 Using the Tools Menu Option

After clicking on the Tools menu option, click the Communication Settings option to choose the baud rate specified for the current embedded application.

Notice that applications require that you push one or more buttons or some other functions to enable upload of new firmware. See the *Zigbee/802.15.4 Evaluation Kit Quick Start Guide*, AN2772/D, for a description of what to do for a specific application.

If no application is downloaded, use the default settings specified for the Embedded Bootloader. See Chapter 2 for more information.

Use the Add… buttons. Click “Close”.



Name	Location	Type
ZigBee: COM2 [19200]	10000	ZigBee Device
ZigBee: COM6 [19200]	10001	ZigBee Device

Figure 3 Tools Menu Selection

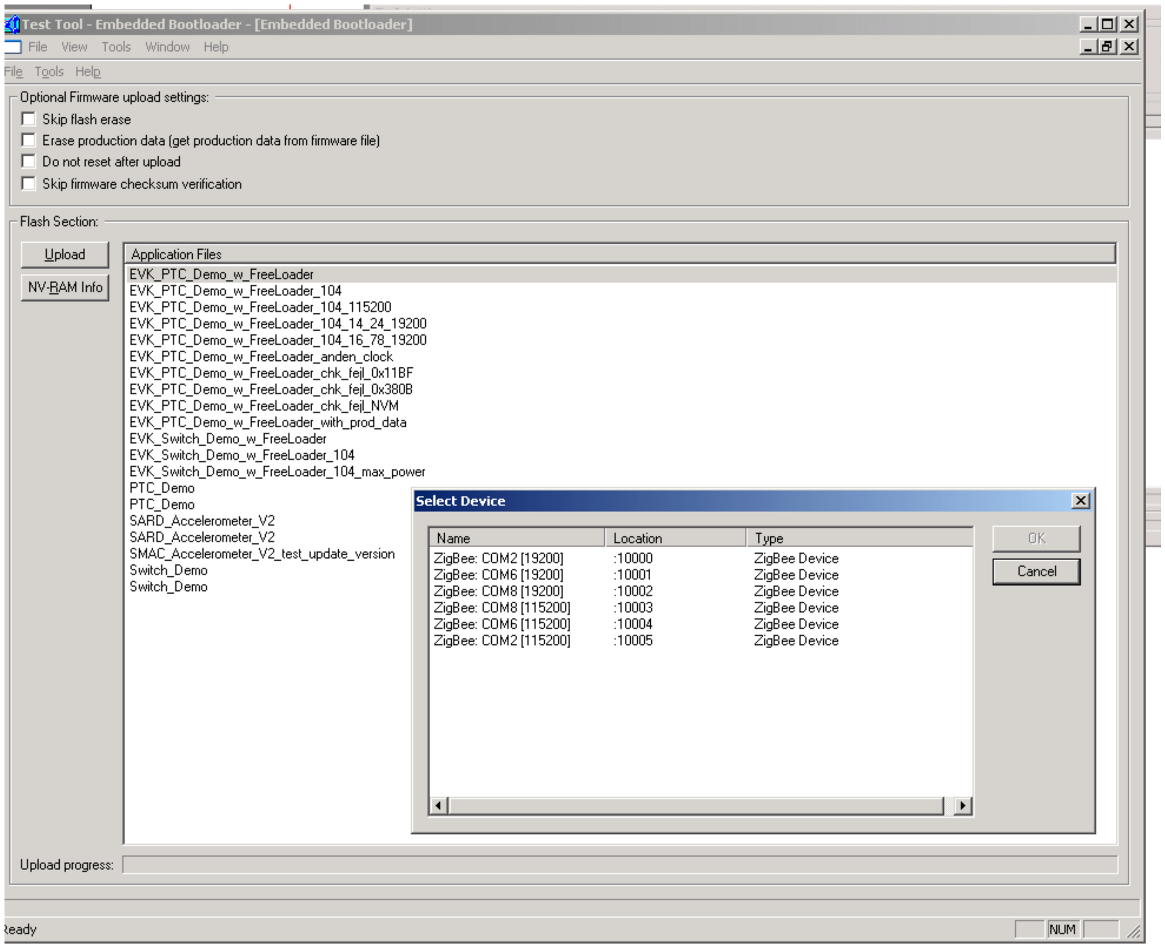
3.1.2 Using the View Menu Option

After clicking the View menu option, select port COMx and click “OK”. Choose the baud rate specified for the current embedded application. See the *Zigbee/802.15.4 Evaluation Kit Quick Start Guide*, AN2772/D, for a description of what to do for a specific application.

If no application is uploaded, you must use the default settings specified for the Embedded Bootloader. See Chapter 2 for more information.

NOTE

If the USB interface is used, the USB option appears as a new COM port.


Test Tool - Embedded Bootloader - [Embedded Bootloader]
File View Tools Window Help
File Tools Help
Upload
NV-RAM Info
Select Device
OK
Cancel
Upload progress:
Ready
NUM

Optional Firmware upload settings:
- ☐ Skip flash erase
- ☐ Erase production data (get production data from firmware file)
- ☐ Do not reset after upload
- ☐ Skip firmware checksum verification

Flash Section:

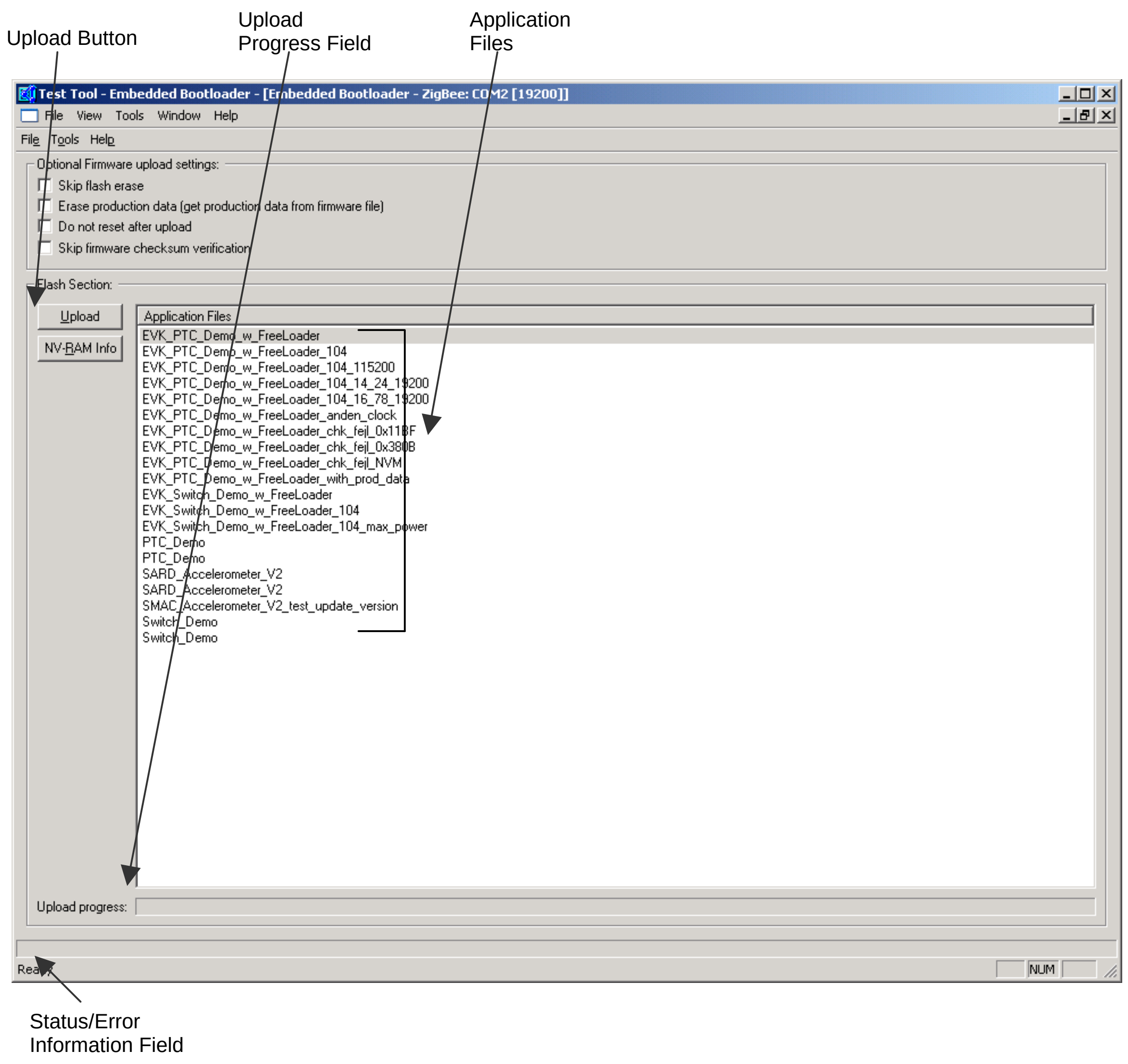
```
Application Files
EVK_PTC_Demo_w_FreeLoader
EVK_PTC_Demo_w_FreeLoader_104
EVK_PTC_Demo_w_FreeLoader_104_115200
EVK_PTC_Demo_w_FreeLoader_104_14_24_19200
EVK_PTC_Demo_w_FreeLoader_104_16_78_19200
EVK_PTC_Demo_w_FreeLoader_anden_clock
EVK_PTC_Demo_w_FreeLoader_chk_fejl_0x11BF
EVK_PTC_Demo_w_FreeLoader_chk_fejl_0x380B
EVK_PTC_Demo_w_FreeLoader_chk_fejl_NVM
EVK_PTC_Demo_w_FreeLoader_with_prod_data
EVK_Switch_Demo_w_FreeLoader
EVK_Switch_Demo_w_FreeLoader_104
EVK_Switch_Demo_w_FreeLoader_104_max_power
PTC_Demo
PTC_Demo
SARD_Accelerometer_V2
SARD_Accelerometer_V2
SMAC_Accelerometer_V2_test_update_version
Switch_Demo
Switch_Demo
```

Name	Location	Type
ZigBee: COM2 [19200]	:10000	ZigBee Device
ZigBee: COM6 [19200]	:10001	ZigBee Device
ZigBee: COM8 [19200]	:10002	ZigBee Device
ZigBee: COM8 [115200]	:10003	ZigBee Device
ZigBee: COM6 [115200]	:10004	ZigBee Device
ZigBee: COM2 [115200]	:10005	ZigBee Device

Figure 4 View Menu Option

3.1.3 Selecting the Firmware File to Upload

In the ‘Flash Section’ window, click on the application file to upload and then click on the “Upload” button. The upload progress bar begins to indicate upload progress.



Optional Firmware upload settings:

- Skip flash erase
- Erase production data (get production data from firmware file)
- Do not reset after upload
- Skip firmware checksum verification

EVK_PTC_Demo_w_FreeLoader
EVK_PTC_Demo_w_FreeLoader_104
EVK_PTC_Demo_w_FreeLoader_104_115200
EVK_PTC_Demo_w_FreeLoader_104_14_24_19200
EVK_PTC_Demo_w_FreeLoader_104_16_78_19200
EVK_PTC_Demo_w_FreeLoader_anden_clock
EVK_PTC_Demo_w_FreeLoader_chk_fejl_0x11BF
EVK_PTC_Demo_w_FreeLoader_chk_fejl_0x380B
EVK_PTC_Demo_w_FreeLoader_chk_fejl_NVM
EVK_PTC_Demo_w_FreeLoader_with_prod_data
EVK_Switch_Demo_w_FreeLoader
EVK_Switch_Demo_w_FreeLoader_104
EVK_Switch_Demo_w_FreeLoader_104_max_power
PTC_Demo
PTC_Demo
SARD_Accelerometer_V2
SARD_Accelerometer_V2
SMAC_Accelerometer_V2_test_update_version
Switch_Demo
Switch_Demo

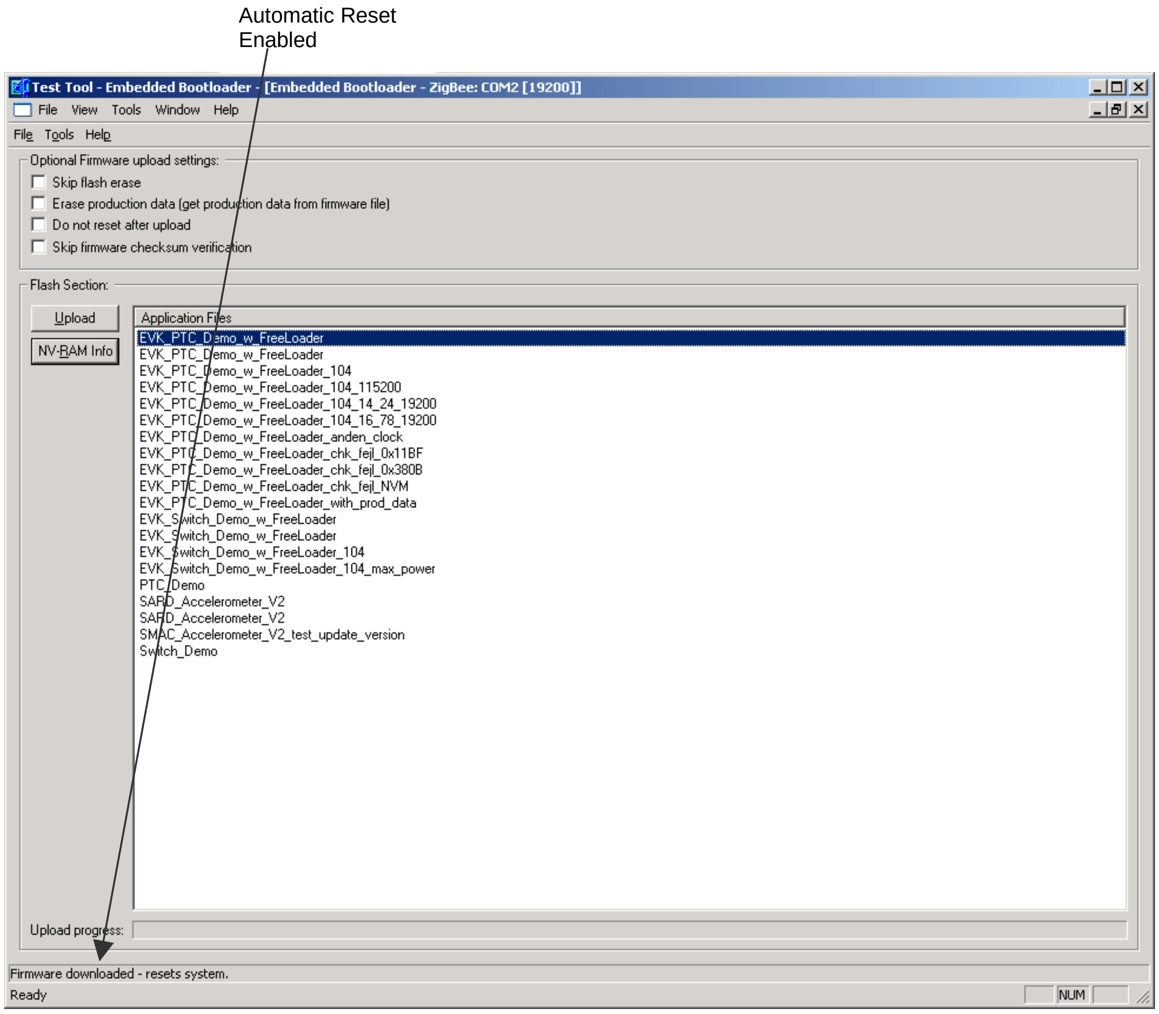
Figure 5 Firmware Upload

The Status/Error Information Field shows the Status/Error Information received from the Embedded Bootloader.

After a successful upload of the firmware, the window appears as shown in Figure 6.

NOTE

A system reset is performed (default) after upload as shown in Figure 6.


Automatic Reset Enabled
Test Tool - Embedded Bootloader - [Embedded Bootloader - ZigBee: COM2 [19200]]
File View Tools Window Help
File Tools Help
Upload
NV-RAM Info
NUM

Optional Firmware upload settings:
- [ ] Skip flash erase
- [ ] Erase production data (get production data from firmware file)
- [ ] Do not reset after upload
- [ ] Skip firmware checksum verification

Flash Section:

Application Files
EVK_PTC_Demo_w_FreeLoader
EVK_PTC_Demo_w_FreeLoader
EVK_PTC_Demo_w_FreeLoader_104
EVK_PTC_Demo_w_FreeLoader_104_115200
EVK_PTC_Demo_w_FreeLoader_104_14_24_19200
EVK_PTC_Demo_w_FreeLoader_104_16_78_19200
EVK_PTC_Demo_w_FreeLoader_anden_clock
EVK_PTC_Demo_w_FreeLoader_chk_fejl_0x11BF
EVK_PTC_Demo_w_FreeLoader_chk_fejl_0x380B
EVK_PTC_Demo_w_FreeLoader_chk_fejl_NVM
EVK_PTC_Demo_w_FreeLoader_with_prod_data
EVK_Switch_Demo_w_FreeLoader
EVK_Switch_Demo_w_FreeLoader
EVK_Switch_Demo_w_FreeLoader_104
EVK_Switch_Demo_w_FreeLoader_104_max_power
PTC_Demo
SARD_Accelerometer_V2
SARD_Accelerometer_V2
SMAC_Accelerometer_V2_test_update_version
Switch_Demo

Upload progress:

Firmware downloaded - resets system.
Ready

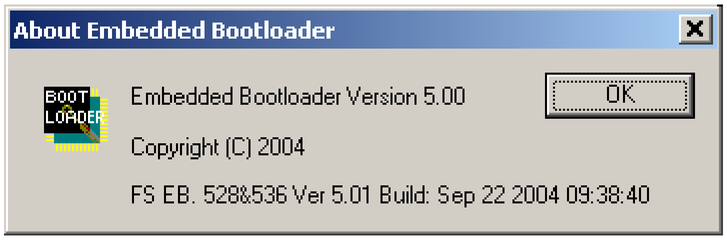
Figure 6 After a Successful Firmware Upload

NOTE

If the uploaded application uses another baud rate, it is required to change baud rate values in order to be able to communicate with the board.

3.1.4 Using the Help Menu

Click on the Embedded Bootloader About box to see the Embedded Bootloader sub version number.



Embedded Bootloader Version 5.00

Copyright (C) 2004

FS EB. 528&536 Ver 5.01 Build: Sep 22 2004 09:38:40

Figure 7 Embedded Bootloader Tool Version

NOTE

The last line is reported from the Embedded Bootloader on the PCB. This version number is only sent to the PC from power up (not on reset).

3.1.5 Changing the NVM Data in Flash or File

If users click on an application in the list, it displays the NVM values in the selected application file. If the uploaded application supports NVM dump, it is possible to read the NVM from the board.

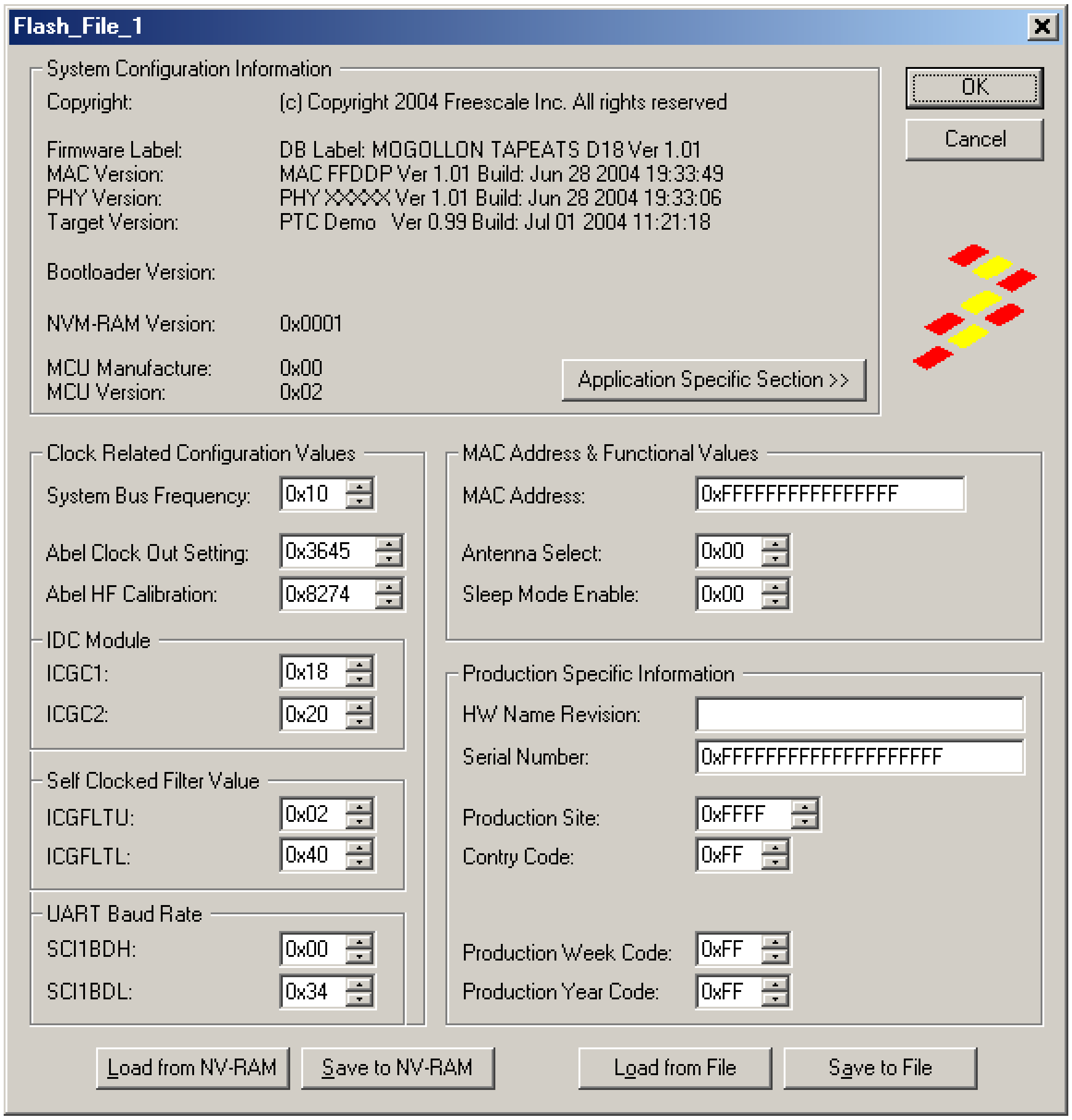
The NVM data can be changed in two different ways:

1. If the uploaded application does not support NVM data editing it is possible to edit the NVM data in the application file before it is uploaded to the board and save it back in the application file for later upload.
2. If the uploaded application does support NVM data editing it is possible to edit the NVM data after the board has been uploaded with the application. For example, the file contains default values. The Freescale EVK PTC application supports this feature.

NOTE

No production specific information is available in this example window.

Use caution when editing the clock related configuration values. The values must match each other. There is no sanity check on the user entered values, though there is a check on length. See the *MC908HCS08GB60/GT60 MCU Data Sheet*, MC9S08GB60/D about how to specify valid register values for the HCS08.



Flash_File_1

System Configuration Information

Copyright:	(c) Copyright 2004 Freescale Inc. All rights reserved
Firmware Label:	DB Label: MOGOLLON TAPEATS D18 Ver 1.01
MAC Version:	MAC FFDDP Ver 1.01 Build: Jun 28 2004 19:33:49
PHY Version:	PHY XXXXX Ver 1.01 Build: Jun 28 2004 19:33:06
Target Version:	PTC Demo Ver 0.99 Build: Jul 01 2004 11:21:18
Bootloader Version:	
NVM-RAM Version:	0x0001
MCU Manufacture:	0x00
MCU Version:	0x02

Clock Related Configuration Values

System Bus Frequency:	0x10
Abel Clock Out Setting:	0x3645
Abel HF Calibration:	0x8274

IDC Module

ICGC1:	0x18
ICGC2:	0x20

Self Clocked Filter Value

ICGFLTU:	0x02
ICGFLTL:	0x40

UART Baud Rate

SCI1BDH:	0x00
SCI1BDL:	0x34

MAC Address & Functional Values

MAC Address:	0xFFFFFFFFFFFFFFFF
Antenna Select:	0x00
Sleep Mode Enable:	0x00

Production Specific Information

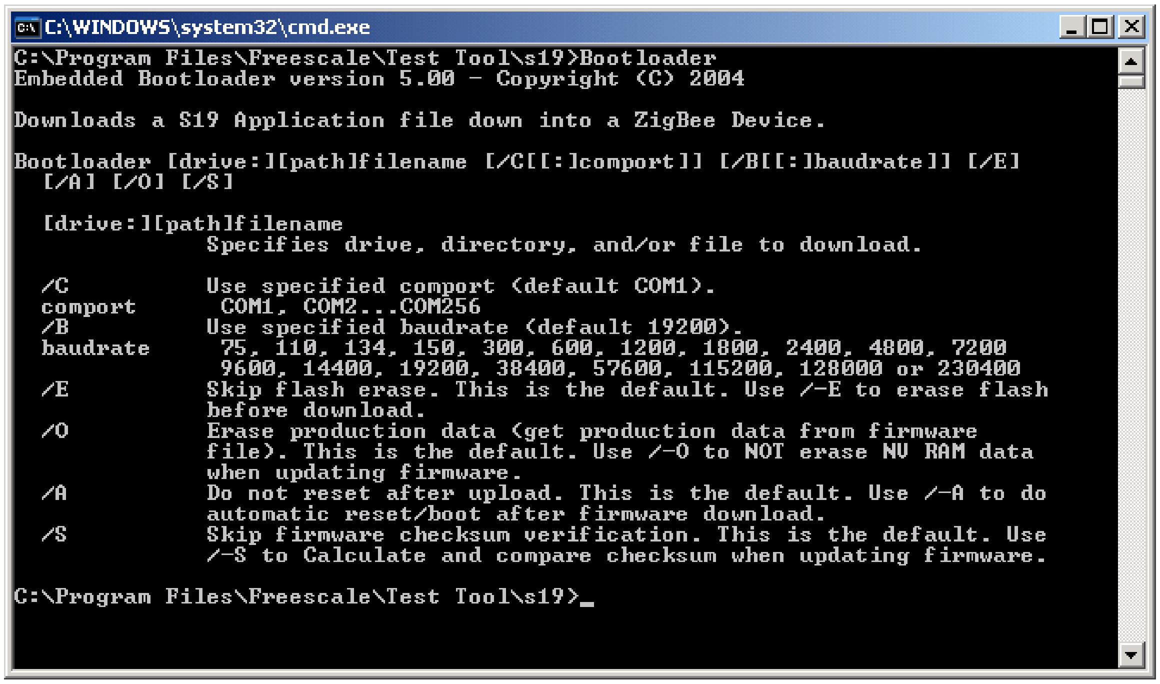
HW Name Revision:	
Serial Number:	0xFFFFFFFFFFFFFFFFFFFF
Production Site:	0xFFFF
Contry Code:	0xFF
Production Week Code:	0xFF
Production Year Code:	0xFF

Figure 8 System Configuration Window

3.2 Command Line Version (CMD)

The command line version of the Embedded Bootloader flash programming tool must be called with parameters:

Execute ‘Bootloader.exe’ without parameters to show a parameter list:



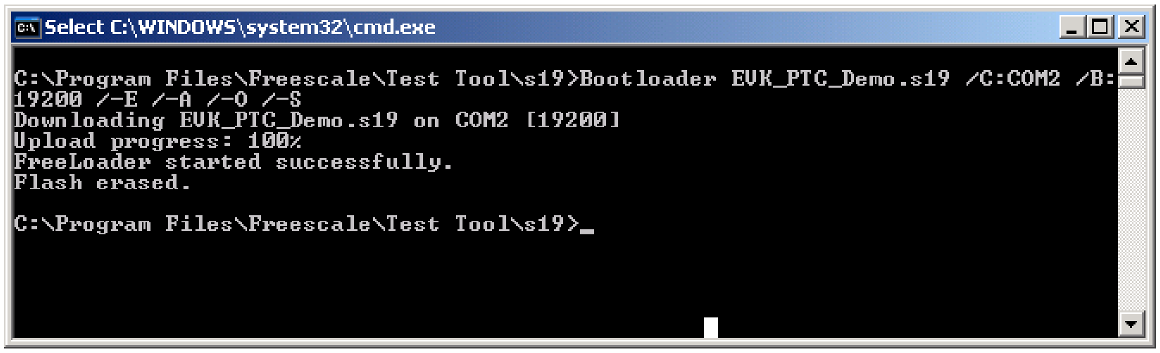
```
C:\Program Files\Freescale\Test Tool\s19>Bootloader
Embedded Bootloader version 5.00 - Copyright (C) 2004

Downloads a S19 Application file down into a ZigBee Device.

Bootloader [drive:][path]filename [/C[[:]comport]] [/B[[:]baudrate]] [/E]
  [/A] [/O] [/S]

  [drive:][path]filename
              Specifies drive, directory, and/or file to download.

  /C          Use specified comport (default COM1).
  comport      COM1, COM2...COM256
  /B          Use specified baudrate (default 19200).
  baudrate     75, 110, 134, 150, 300, 600, 1200, 1800, 2400, 4800, 7200
               9600, 14400, 19200, 38400, 57600, 115200, 128000 or 230400
  /E          Skip flash erase. This is the default. Use /-E to erase flash
              before download.
  /O          Erase production data (get production data from firmware
              file). This is the default. Use /-O to NOT erase NV RAM data
              when updating firmware.
  /A          Do not reset after upload. This is the default. Use /-A to do
              automatic reset/boot after firmware download.
  /S          Skip firmware checksum verification. This is the default. Use
              /-S to Calculate and compare checksum when updating firmware.

C:\Program Files\Freescale\Test Tool\s19>_
```

Figure 9 Command Line Version (Parameter List)

3.2.1 Normal Use Example (Default)

Normal use example (default).

”Bootloader EVK_PTC_Demo.s19 /C:COM2 /B:19200 /-E /-A /-O /-S”



```
C:\Program Files\Freescale\Test Tool\s19>Bootloader EVK_PTC_Demo.s19 /C:COM2 /B:
19200 /-E /-A /-O /-S
Downloading EVK_PTC_Demo.s19 on COM2 [19200]
Upload progress: 100%
FreeLoader started successfully.
Flash erased.

C:\Program Files\Freescale\Test Tool\s19>_
```

Figure 10 Command Line Version (Using Several Options)

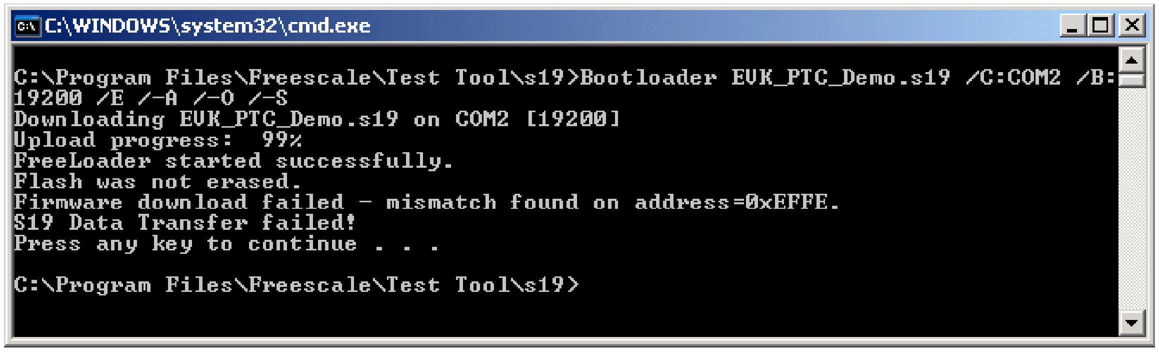
NOTE

It is not possible to edit NVM data with the CMD version.

3.2.2 Flash Erase Disabled Example

Flash erase disabled example.

”Bootloader EVK_PTC_Demo.s19 /C:COM2 /B:19200 /E /-A /-O /-S ”



```
C:\Program Files\Freescale\Test Tool\s19>Bootloader EVK_PTC_Demo.s19 /C:COM2 /B:
19200 /E /-A /-O /-S
Downloading EVK_PTC_Demo.s19 on COM2 [19200]
Upload progress:  99%
FreeLoader started successfully.
Flash was not erased.
Firmware download failed - mismatch found on address=0xEFFE.
S19 Data Transfer failed!
Press any key to continue . . .

C:\Program Files\Freescale\Test Tool\s19>
```

Figure 11 Command Line Version (Flash Erase Disable Option)

NOTE

The flash is not erased and a flash programming error is detected at address 0xEFFE. This is the address of the Embedded Bootloader control flags, which was not erased. The error message is expected.

Chapter 4
Embedded Bootloader Programming

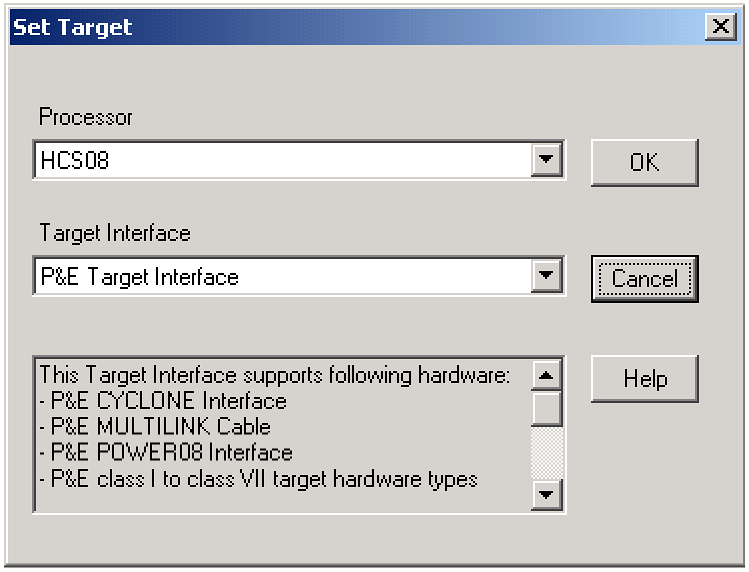
This chapter describes how to program the Embedded Bootloader with a P&E Multilink for HCS08 BDM debugger. The Embedded Bootloader is normally downloaded to the PCB where production data is also written. Users must employ different procedures depending on what needs to be programmed. Users can program the Embedded Bootloader to an empty (erased) PCB or they can upgrade to a newer version of the Embedded Bootloader. Follow the procedures in Section 4.1, Programming To An Empty (Erased) Board if the PCB is empty (erased).

Users must make a copy of the production data section in the NVM (see Section 5.3.5, NV_Data.c and NV_Data.h) if they need to upgrade the Embedded Bootloader. This can be done either manually or automatically by a custom made script with the command line version of the CPROG tool. The command line version is not described further. Follow the procedures as shown in Section 4.2 on how to make a copy of the production data.

4.1 Programming To An Empty (Erased) Board

This section describes how to program the Embedded Bootloader to an empty (erased) board.

1. Execute the HIWAVE.EXE file from your chosen installation directory. For example, [installation directory]\Metrowerks\CodeWarrior_CW08_V3.0\Prog\
2. From the main window, setup the target by selecting the "Component" menu, then click on "Set Target". The "Set Target" window appears as shown in Figure 12.

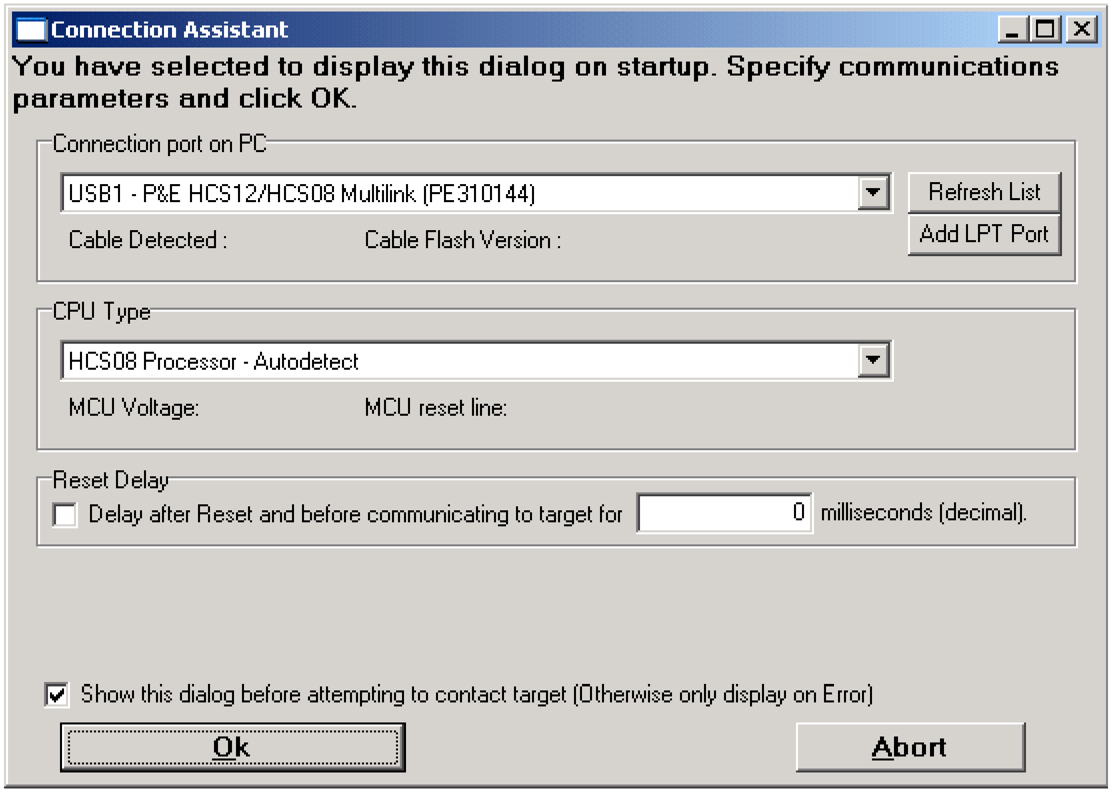


This Target Interface supports following hardware:
- P&E CYCLONE Interface
- P&E MULTILINK Cable
- P&E POWER08 Interface
- P&E class I to class VII target hardware types

Figure 12 Set Target Window

3. In the "Processor" drop down menu, select HCS08. From the "Target Interface" drop down menu, select P&E Target Interface, the click on the "OK" button.

The “Connection Assistant” window appears where you can select the debugger interface connection. As shown in Figure 13, a USB connection was chosen and the HCS08 was selected as the CPU type. Click the “OK” button.



Connection Assistant

You have selected to display this dialog on startup. Specify communications parameters and click OK.

Connection port on PC: USB1 - P&E HCS12/HCS08 Multilink (PE310144)

Cable Detected :

Cable Flash Version :

CPU Type: HCS08 Processor - Autodetect

MCU Voltage:

MCU reset line:

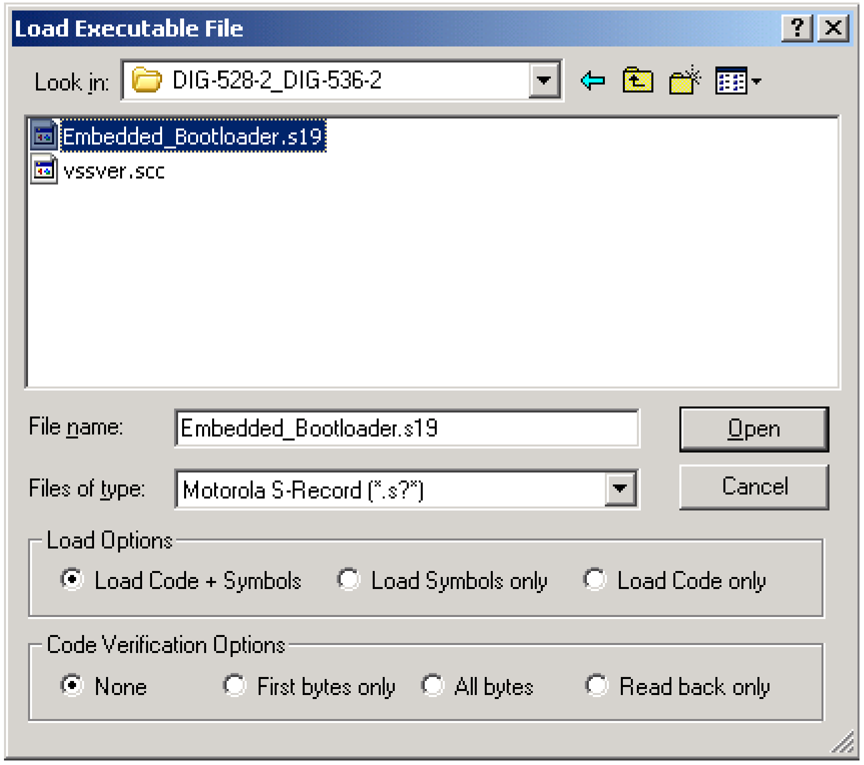
Reset Delay

☐ Delay after Reset and before communicating to target for 0 milliseconds (decimal).

☑ Show this dialog before attempting to contact target (Otherwise only display on Error)

Figure 13 Connection Assistant Window

4. Click on “Load Application” under the “File” menu to open the “Load Executable File” window. Specify application file to program in the “Load Executable File” window as shown in Figure 14. Select “Motorola S-Record (*.s19)” using the “Files of type:” drop down menu. Navigate to the folder where a copy of the Embedded Bootloader is located. Select the “Embedded Bootloader.s19” file and click the “Open” button.


Load Executable File

Look in: DIG-528-2_DIG-536-2

Embedded_Bootloader.s19
vssver.scc

File name: Embedded_Bootloader.s19

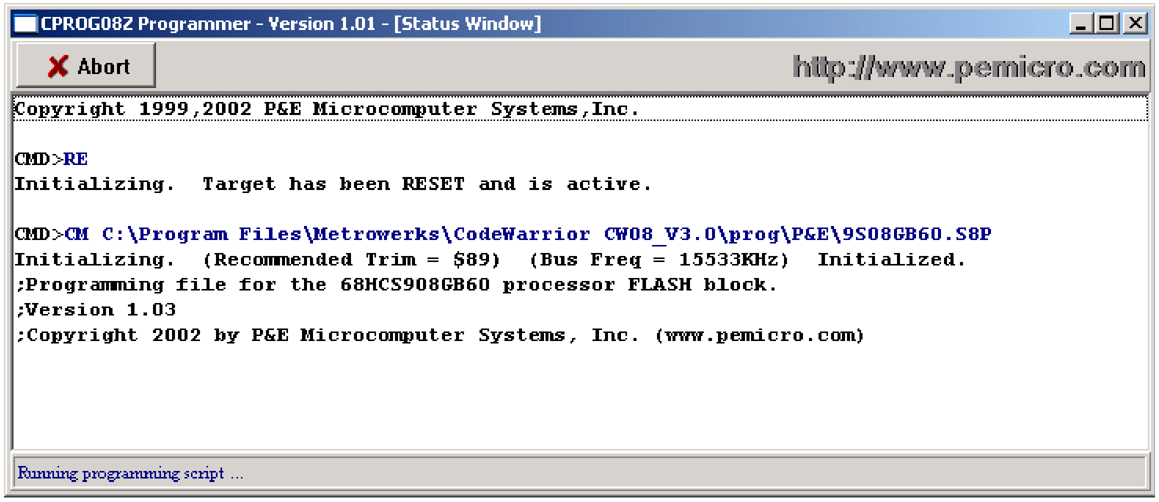
Files of type: Motorola S-Record (*.s?*)

Load Options: [✓ Load Code + Symbols] Load Symbols only Load Code only

Code Verification Options: [✓ None] First bytes only All bytes Read back only

Figure 14 Load Executable Window

The Embedded Bootloader is now programmed to the PCB as shown in the Status Window in Figure 15.



```
Copyright 1999,2002 P&E Microcomputer Systems,Inc.

CMD>RE
Initializing.  Target has been RESET and is active.

CMD>CM C:\Program Files\Metrowerks\CodeWarrior CW08_V3.0\prog\P&E\9S08GB60.S8P
Initializing.  (Recommended Trim = $89)  (Bus Freq = 15533KHz)  Initialized.
;Programming file for the 68HCS908GB60 processor FLASH block.
;Version 1.03
;Copyright 2002 by P&E Microcomputer Systems, Inc. (www.pemicro.com)
```

```
Running programming script ...
```

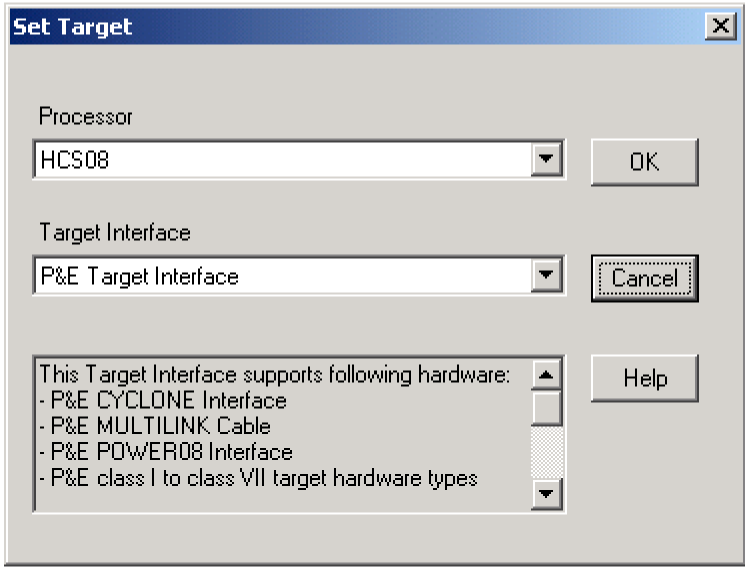
Figure 15 Status Window

5. Remove power and disconnect the BDM cable from the PCB. Next, power up the PCB. The PCB is now ready to upload an application. See Chapter 2 for details about how to upload an application.

4.2 Upgrading The Embedded Bootloader

This section describes how to upgrade the Embedded Bootloader to a newer version with the P&E Multilink BDM debugger.

1. Execute the HIWAVE.EXE file from your chosen installation directory. For example, [installation directory]\Metrowerks\CodeWarrior_CW08_V3.0\Prog\
2. From the main window, setup the target by selecting Setup Target, the select the "Component" menu, and click on "Set Target". The "Set Target" window appears as shown in Figure 16.



HCS08

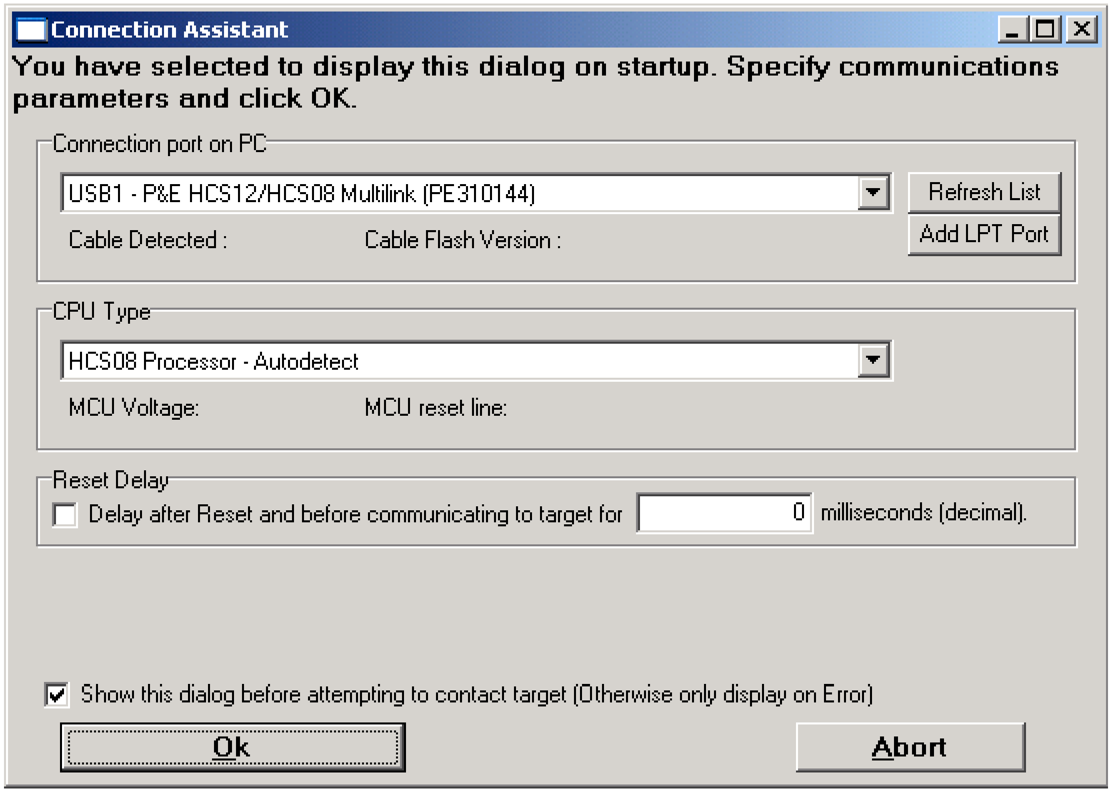
P&E Target Interface

This Target Interface supports following hardware:
- P&E CYCLONE Interface
- P&E MULTILINK Cable
- P&E POWER08 Interface
- P&E class I to class VII target hardware types

Figure 16 Set Target Window

3. From the "Processor" drop down menu, select HCS08. From the "Target Interface" drop down menu, select P&E Target Interface, then click the "OK" button.

4. The “Connection Assistant” window appears where you can select the debugger interface connection. As shown in Figure 17, a USB connection was chosen and the HCS08 was selected as the CPU type. Click the “OK” button.


Connection Assistant

You have selected to display this dialog on startup. Specify communications parameters and click OK.

Connection port on PC: USB1 - P&E HCS12/HCS08 Multilink (PE310144)

Cable Detected :

Cable Flash Version :

CPU Type: HCS08 Processor - Autodetect

MCU Voltage:

MCU reset line:

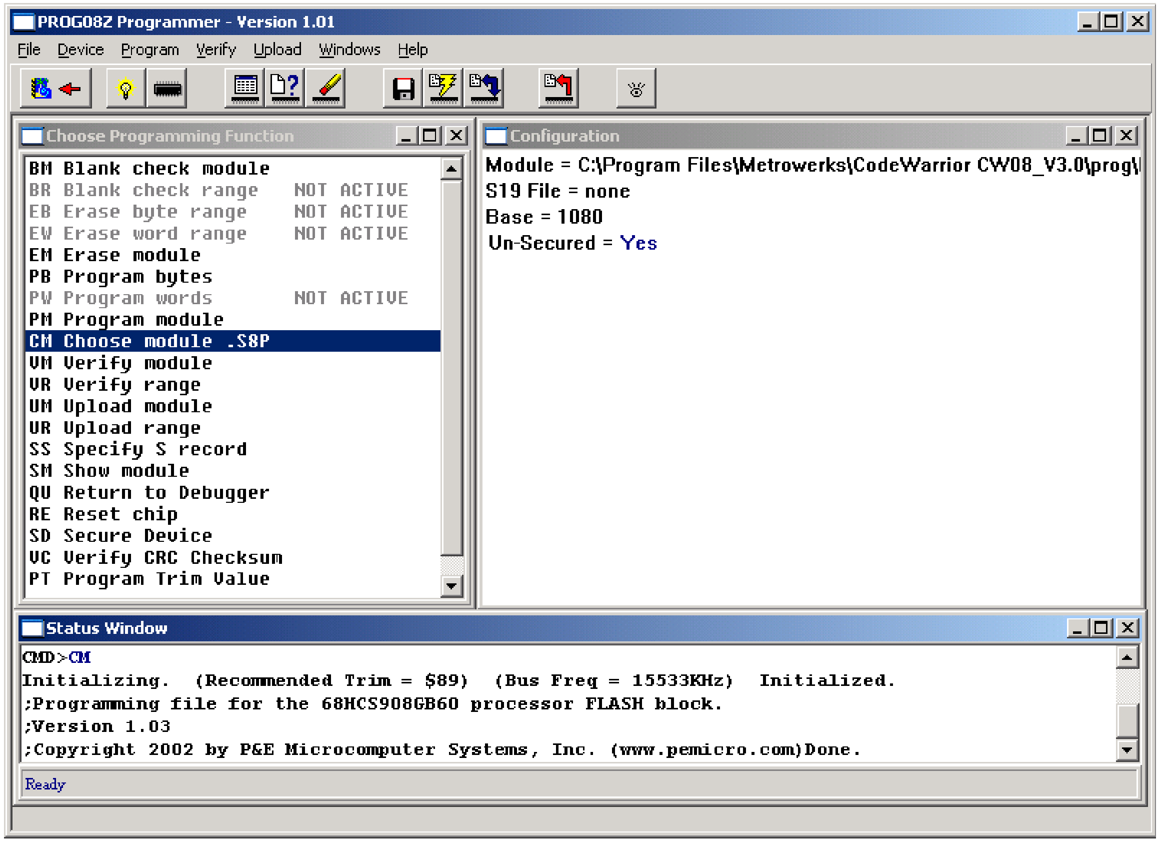
Reset Delay

☐ Delay after Reset and before communicating to target for 0 milliseconds (decimal).

☑ Show this dialog before attempting to contact target (Otherwise only display on Error)

Figure 17 Connection Assistant Window

5. Make a copy of the NVM sector (both NVM0 and NVM1) with the production data.
   Select the “PEDebug” menu, select “Programming Options”, and then choose “Start Expert Mode Programmer”. The “Programmer Expert” window appears as shown in Figure 18.


PROG08Z Programmer - Version 1.01
File Device Program Verify Upload Windows Help
Choose Programming Function
Configuration
Status Window
Ready

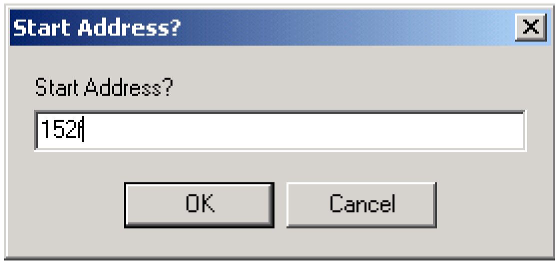
```
BM Blank check module
BR Blank check range     NOT ACTIVE
EB Erase byte range      NOT ACTIVE
EW Erase word range      NOT ACTIVE
EM Erase module
PB Program bytes
PW Program words         NOT ACTIVE
PM Program module
CM Choose module .S8P
VM Verify module
VR Verify range
UM Upload module
UR Upload range
SS Specify S record
SM Show module
QU Return to Debugger
RE Reset chip
SD Secure Device
VC Verify CRC Checksum
PT Program Trim Value
```

```
Module = C:\Program Files\Metrowerks\CodeWarrior CW08_V3.0\prog\
S19 File = none
Base = 1080
Un-Secured = Yes
```

```
CMD>CM
Initializing.  (Recommended Trim = $89)  (Bus Freq = 15533KHz)  Initialized.
;Programming file for the 68HCS908GB60 processor FLASH block.
;Version 1.03
;Copyright 2002 by P&E Microcomputer Systems, Inc. (www.pemicro.com)Done.
```

Figure 18 Programmer Expert Window

6. In the “Programmer Expert” window, click on “UR Upload Range”. The “Start Address” window appears as shown in Figure 19. Here you specify the start address for the NVM section. Click the “OK” button. For NVM0 use 0x152F and for NVM1 use 0x172F.

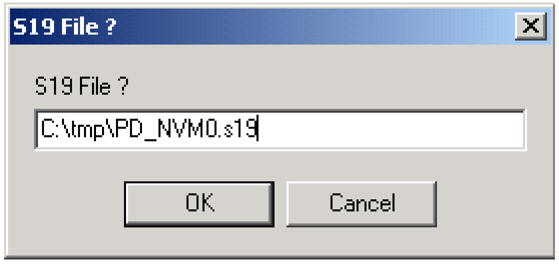


152f

Figure 19 Start Address Window

7. In the “End Address” window, which looks very similar to the “Start Address” window, specify the end address for the NVM section and then click the “OK” button. For NVM0 use 0x155B and for NVM1 use 0x175B.

8. As shown in Figure 20, use the S19 window to specify which S19 file to store active NVM data to and then click the “OK” button. For NVM0 use ‘PD_NVM0.s19’ and for NVM1 use ‘PD_NVM1.s19’.



C:\tmp\PD_NVM0.s19

Figure 20 S19 File Window

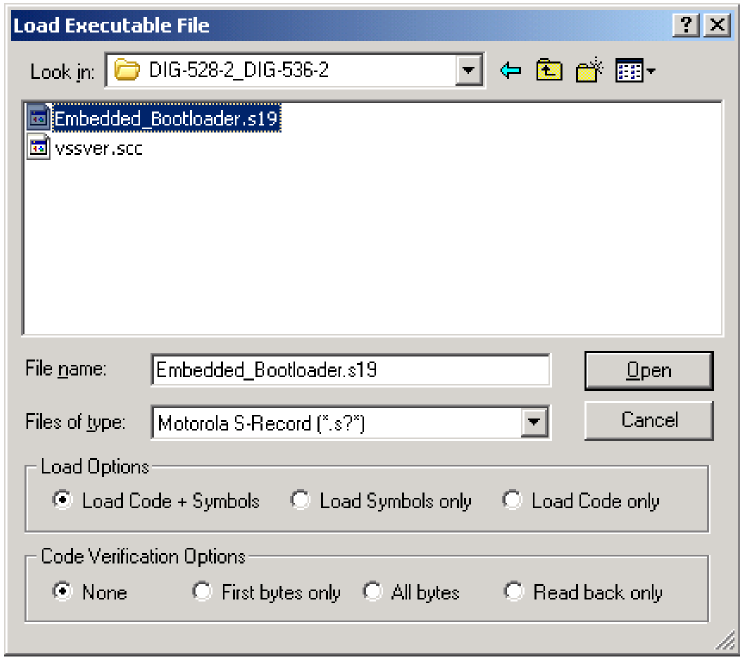
9. Close “Programmer Expert” window.

10. Use the PC tool “Production_Data_Converter.exe” to convert the production data in NVM to default NVM sector NVM0. Copy the “Production_Data_Converter.exe” tool to the folder that contains the PD_NVM0.s19 and PD_NVM1.s19 files. Execute the ‘Production_Data_Converter.exe’. The output is an PD_NVM.s19 file containing the production data from the active NVM sector.

NOTE

The “Production_Data_Converter.exe” tool can be found in the EVK release “EVK_3_0B” in folder .\source\Zigbee_EVK\EVK_Common\CPROG_Tool\Scripts\

11. Click on “Load Application” under the “File” menu to open the “Load Executable File” window. Specify the application file to program using the “Load Executable” window as shown in Figure 21. Select the “Motorola S-Record (*.s19)” under “Files of type:”, then navigate to the folder where a copy of the Embedded Bootloader is located. Select the “Embedded Bootloader.s19” file and click the “Open” button.



Look in: DIG-528-2_DIG-536-2

Embedded_Bootloader.s19
vssver.scc

File name: Embedded_Bootloader.s19

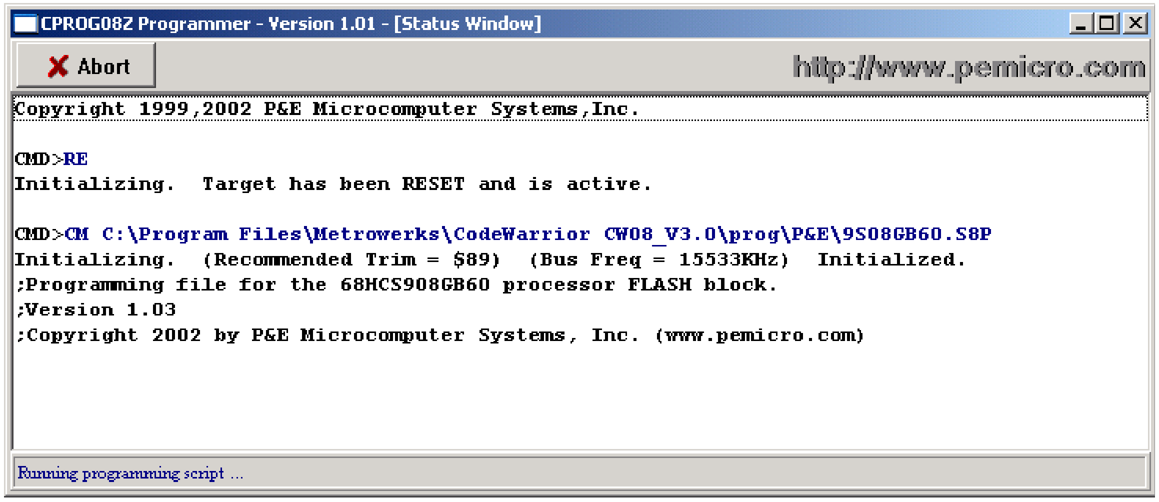
Files of type: Motorola S-Record (*.s?*)

Load Options: [✓ Load Code + Symbols] Load Symbols only Load Code only

Code Verification Options: [✓ None] First bytes only All bytes Read back only

Figure 21 Load Executable File Window

The Embedded Bootloader is now programmed to the PCB as shown in Figure 22.



```
Copyright 1999,2002 P&E Microcomputer Systems,Inc.

CMD>RE
Initializing.  Target has been RESET and is active.

CMD>CM C:\Program Files\Metrowerks\CodeWarrior CW08_V3.0\prog\P&E\9S08GB60.S8P
Initializing.  (Recommended Trim = $89)  (Bus Freq = 15533KHz)  Initialized.
;Programming file for the 68HCS908GB60 processor FLASH block.
;Version 1.03
;Copyright 2002 by P&E Microcomputer Systems, Inc. (www.pemicro.com)
```

Running programming script ...

Figure 22 Status Window

12. Write NVM production data back by selecting the “PEDebug” menu. Then select “Programming Options” and “Start Expert Mode Programmer”. Select “SS Specify S-record” and locate the PD_NVM.s19 file built in Step 10. Select the “PM Program Module” option and production data is written to flash.
13. Remove power and disconnect the BDM cable from PCB. Next, power up the PCB.
    The PCB is now ready to upload an application. See Chapter 2 for more information about how to upload an application.

NOTE

The applications must have the production section in the NVM cleared. That is, the application image must contain 0xFF's in the production data section of the NVM.

Chapter 5
Application Integration Reference Guide

This chapter describes the deliverables required to build an 802.15.4/Zigbee Application with the Embedded Bootloader.

NOTE

The Freescale Switch Demonstration application is available with complete source code. The Switch Demonsration shows how to make an 802.15.4 application with the Embedded Bootloader. Refer to the *Switch Demonstration Application Note*, AN2773, for more details.

5.1 Product Deliverables

To be able to make an application with the Freescale Embedded Bootloader, you need three major components.

- Embedded Bootloader Image
- Application Support Files
- Application Linker File

5.1.1 Embedded Bootloader Image

The Embedded Booloader executable image for a specific PCB must exist on the PCB in advance. If not, it must be downloaded to the PCB with a BDM debugger like the P&E Multilink BDM debugger for HCS08. See Section 1.1.1 Ported Targets for more details.

NOTE

Use caution when making an 802.15.4/Zigbee Application with the Embedded Bootloader. Several versions (different version numbers) exist with different supported features. Ensure that you do not use a feature that is not supported by the Embedded Bootloader version on the PCB and that a version of the Embedded Bootloader is preloaded on the PCB.

5.1.2 Application Support Files

A few application source files must be included in the 802.15.4/Zigbee application for proper interface to the Embedded Bootloader. See Section 5.3, Application Support Files for more details.

5.1.3 Application Linker File

The 802.15.4/Zigbee application code must be linked with the following linker file in order to work with the Embedded Bootloader interface. The linker file specifies fixed data and code segments. See linker file for more details. Make sure to use the linker file matching the Embedded Bootloader on the PCB:

```
Ptc_w_Embedded_Bootloader.ach
```

NOTE

This file can be used with the MC908HCS08GB60/GT60 MCU.

5.2 Application

This section describes build environment topics and source files necessary to build a working 802.15.4/Zigbee application with the Embedded Bootloader.

5.2.1 Compiler Defines

The following compiler #define must be specified to enable Embedded Bootloader functionality in an 802.15.4/Zigbee application:

```
#define BOOTLOADER_ENABLED
```

5.2.2 Unreferenced Symbols

The Embedded Bootloader interface variables, NVM, and strings with version numbers, are not referenced directly from the 802.15.4/Zigbee application code. Because of this, it is required to add dummy references to these (and other) unreferenced symbols to prevent the linker file from removing the symbols during optimization. The dummy references can be placed in any reference function, but Freescale recommends adding them to the main() function.

The following code is an example from a SMAC application main() function:

```
#ifdef BOOTLOADER_ENABLED
  if( (Freescale_Copyright[0] == 0x00) ||
      (Firmware_Database_Label[0] == 0x00) ||
      (SMAC_Version[0] == 0x00) ||
      (SPHY_Version[0] == 0x00) ||
      (NV_RAM_ptr->Freescale_Copyright[0] == 0x00) ||
      (NV_RAM0.MAC_Address[0] == 0x00) ||
      (NV_RAM1.MAC_Address[0] == 0x00) ||
      (boot_loader_control == ((uint8_t)0x00)) ||
      (boot_loader_flag == ((uint8_t)0x00))
    )
```

```
{
  // Do something to aviod that code is removed by linker
}
```

5.2.3 System Clock Setup

The Embedded Bootloader contains the ICG_Setup() function which is called if the Embedded Bootloader must start. The Embedded Bootloader sets up the system clock as specified in the NVM section (ICG) if available. If not a default value is used.

The 802.15.4/Zigbee application must include a system clock setup function. The 802.15.4/Zigbee application can access the clock setup FL_ICG_Setup() function in the Embedded Bootloader. This allows the application to save code space for implementing a system clock setup function. Any clock setting can be setup by specifying the proper ICG register values in the NVM data section.

The 802.15.4/Zigbee application should also have a “lost clock lock” ISR function which calls the FL_ICG_Setup() function. This function must be added to the ISR vector table.

The following is an example of an ISR function to handle lost lock of clock (CLKO).

```
__interrupt void FLL_Lost_Lock_ISR(void)
{
// Setup ICG module again to prevent that system hangs forever.
ICGS1 |= 0x01; // Clear FLL lost lock interrupt
#if defined BOOTLOADER_ENABLED
FL_ICG_Setup(); // Call ICG_Setup()in Embedded Bootloader
#endif defined BOOTLOADER_ENABLED
}
```

5.3 Application Support Files

The 802.15.4/Zigbee application must include some support source code to make an interface to the Embedded Bootloader application. The needed files are delivered to users who want to use the Embedded Bootloader in their system.

NOTE

Some of the files are global header files from the 802.15.4 MAC/PHY release. Look for new or updated application support files at the Freescale Zigbee/802.15.4 web page.

5.3.1 DigiType.h

This file contains some C-language type definitions used in the source files.

5.3.2 Gb60_io.h

This is an MC908HCS08GB60 MCU interface file. All peripherals embedded in the MCU are listed with their absolute addresses.

NOTE

This file can also be used with the MC908HCS08GT60 MCU.

5.3.3 Crt0.c and Crt.h

These files contain the basic initialization code (basic system clock, memory and stack setup). The normal basic init file(s) (like the start08.c from Metrowerks) is not needed when the Embedded Bootloader is embedded.

In an 802.15.4/Zigbee application with Embedded Bootloader, these files only contain the _startupdata structure. The Embedded Bootloader handles all the basic initialization (memory and stack setup) of the application. That is, the application's main() function will be the first item called (entry point).

NOTE

Do not include basic initialization (memory and stack setup) when building an application with the Embedded Bootloader. Place any necessary initialization function calls in the main() function. Whatever, the initialization function or only the _startupdata structure is included is controlled by compiler #defines. See Section 5.2.1, Compiler Defines Application for more information.

5.3.4 Embedded_Bootloader.h and Embedded_Bootloader.c

These are the interface files for the 802.14.4/Zigbee application. They contain function pointers to functions accessible in the Embedded Bootloader. These files also contain absolute addresses, which should not be changed.

Ensure that the two Embedded Bootloader control flags, which control whether the 802.15.4/Zigbee application starts or not, are included in the 802.15.4/Zigbee application build. See Section 5.2.2 for more details.

```
#pragma CONST_SEG APP_BOOTLOADER_FLAGS

// Default setting for how BootLoader downloads firmware
const uint8_t boot_loader_control = ALL_BIT_ENABLED;
const uint8_t boot_loader_flag = EXECUTE_APPLICATION;

#pragma CONST_SEG DEFAULT
```

The 802.15.4/Zigbee application must also call the "void BootLoader_Interface_Init(void)" function to set up pointers to the Embedded Bootloader accessible function. The function must be called once during system initialization.

NOTE

In earlier versions, these files were titled "FreeLoader_inf.c" and "FreeLoader_inf.h". Do not user the "FreeLoader_inf.c" and "FreeLoader_inf.h" files with the Embedded Bootloader.

5.3.5 NV_Data.c and NV_Data.h

The NVM is not a part of the Embedded Bootloader. However, it is advised to make the NVM a part of the 802.15.4/Zigbee application.

The Embedded Bootloader can use the information in NV memory, but it has default values (safe mode boot) to cover scenarios where no NV memory is available, that is, the Embedded Bootloader would be locked to use the default values.

5.3.6 ISR_Vectors.c

The Embedded Bootloader redirects the ISR vector table to 0x0EFC0, i.e. the 802.15.4/Zigbee application ISR vector table must be locate at 0x0EFC0 to 0xEFFD (see linker file).

The file also contains a reset vector. The reset vector is not used (defined out) when using the Embedded Bootloader. The system reset vector is in the Embedded Bootloader address space (0xFFFE). The Embedded Bootloader has two system variables located where the redirected "reset vector" is locate at 0xEFFE to 0xEFFF. The variables control the startup of the Embedded Bootloader.

5.3.7 DummyIsr.c

This file contains a dummy ISR function which makes a break if a BDM debugger is attached to the BDM connector. An illegal instruction reset occurs if no BDM debugger is attached. The function is added to all unused ISR vectors in the ISR_Vector.c file.

NOTE

Users can change this function to any desired functionality.

Chapter 6
Port Integration Reference Guide

This chapter describes the Embedded Bootloader source code release deliverables and how to integrate them to make an executable Embedded Bootloader for a specific PCB.

NOTE

For user convenience, several readme.txt files containing more information are located in various subfolders.

6.1 Embedded Bootloader Build Environment

This chapter describes the Embedded Bootloader build environment. The Embedded Bootloader application is built under the Metrowerks IDE CodeWarrior Development Studio for Freescale HC08 3.0, build 030506.

6.1.1 HCS08 Compiler

All Embedded Bootloader source files are compiled with the following compiler and with the 'Generate Code for HCS08' Code Generation option enabled.

```
Source file:      hw_hc08_compiler.dll, version 5.0.8.0
Setting:    -Cs08 -CswMaxLF0 -CswMinLF0 -CswMinSLB9999 -Lasm=%n.lst -Lasmc=h -
            Ot -Ou -Onf -OnB=alr -OnCstVar -OnPMNC -Or -TE1uE -WmsgNu=acdet
```

6.1.2 HCS08 Linker

All Embedded Bootloader object files are linked with the following linker to build an executable file.

```
Source file:      hw_hc08_linker.dll, version 5.0.8.0
Setting:          -B -EnvSRECORD=s19 -EnvTEXTPATH=Zigbee_Data\Zigbee_Debug\ -
                  WStdoutOn
```

The Embedded Bootlaoder MUST be linked with the following linker file.

```
.\Embedded_Bootloader\prm\Embedded_Bootloader_HCS08.ach
```

Specific allocated code and variables must not be reallocated, but users can add new code and data segments.

NOTE

The 802.15.4 and Zigbee applications that interface to the Embedded Bootloader must be linked with the "Ptc_w_Embedded_Bootloader.ach" file for proper functionality.

6.1.3 HCS08 LibMaker

The delivered libraries were made with the following libmaker.

```
Source file:      hw_hc08_libmaker.dll, version 5.0.8.0
Setting:          None
```

6.2 Product Deliverables

The Freescale Embedded Bootloaader consists of four major components. Refer to Appendix A for a complete list of released files.

6.2.1 Embedded_Bootloader.mcp

This is the Metrowerks Codewarrior mcp project file. This file is used to build the release of the Embedded Bootloader.

NOTE

It is required that you have Metrowerks Codewarrior installed on your PC to build the Embedded Bootloader.

6.2.2 HCS08_Flash_Lib.Lib

The library contains functions to write to the internal flash of the HCS08 MCU. The library also contains functions to handle NVM run-time updates.

The flash library version number is found by searching for the ASCII text string "HCS08 Flash Lib" in the 'HCS08_Flash_Lib.Lib'. The version number is only available from flash library version 5.00.

NOTE

The HCS0_Flash_Lib.Lib can also be included directly in an application for run-time update of NVM. Refer to the HCSO8 Flash Application Note, AN2770/D for more information.

6.2.3 Embedded_Bootloader_Functionality_Lib.Lib

The library contains the internal functionality of the Embedded Bootloader. For example, the state machine which handles the firmware download, the UART drivers, checksum verification functions and others.

The Embedded Bootloader functionality library version number is found by searching for the ASCII text string "EB Func Lib" in the 'Embedded_Bootloader_Functionality_Lib.Lib' file.

6.2.4 Source Files

This section provides a brief description of the source files. Refer to Appendix A for more details. The source files described are those which define the PCB interface. For example, the I/O mapping that connects the MCU and RF chip.

Embedded_Bootloader_Target.h	Specific Embedded Bootloader defines For example, the Embedded Bootloader version number.

HW_Init.c	Hardware init functions
HW_Init.h	Init function prototypes and defines.
Reset_Vector.c	System reset vector.
main.c	Embedded Bootloader main function.

6.3 Porting to a Specific Target

This section provides guidelines on how to port the Embedded Bootloader to a specific PCB/target.

6.3.1 Code and Data Segments

The Embedded Bootloader must be linked with the linker file as specified in Section 6.1.2. Several code and data segments are listed and must not be changed. Refer to the map file as described in Chapter 8 for more details.

6.3.2 Standard Libraries

The Embedded Bootloader must include the `ansiis.lib` from Metrowerks for a successful build. The library is part of the Metrowerks CodeWarrior installation and is located in the following path:

```
[Install Folder]\Metrowerks\CodeWarrior CW08_V3.0\lib\HC08c\*.*
```

6.3.3 Compiler #defines

No compiler #defines are necessary.

6.4 Source Files

This section describes the source files.

6.4.1 Target.h

The user must define the PCB target specific #defines in the `Target.h` in the `.\802.15.4_Headers\Ghdr`. file for a successful port.

NOTE

> Several other #defines are made in the target description in target.h. The #defines are used by the 802.15.4 MAC/PHY build. The listed #defines are the ones which must (also) be defined for the Embedded Bootloader:

Example for the Freescale TARGET_DIG528_2 and TARGET_DIG536_2:

MC13192 reset pin connection:

```
#define HWAssertAbelReset        PTCD &= ~0x10;    // Reset = 0;
#define HWDeAssertAbelReset      PTCD |=  0x10;    // Reset = 1;
```

Optional for Safe Mode Boot indicator function (LED pin connections):

```
#define LED1ON  PTDD &= 0xFE;
#define LED1OFF PTDD |= 0x01;
#define LED1TOGGLE PTDD ^= 0x01;

#define LED2ON  PTDD & = 0xFD;
#define LED2OFF PTDD | = 0x02;
#define LED2TOGGLE PTDD ^ = 0x02;

#define LED3ON  PTDD & = 0xF7;
#define LED3OFF PTDD | = 0x08;
#define LED3TOGGLE PTDD ^ = 0x08;

#define LED4ON  PTDD & = 0xEF;
#define LED4OFF PTDD | = 0x10;
#define LED4TOGGLE PTDD ^ = 0x10;
```

The MC13192 attention and reset pin (bit) positions:

```
#define ABEL_ATT_PIN          (1<<2)
#define ABEL_RESET_PIN  (1<<4)
```

HCS08 port setup macros:

```
#define  mSETUP_PORT_A  //PTAPE = 0x3C;\
                        //PTADD = 0x00;         //All Port A input

#define  mSETUP_PORT_B  //PTBD = 0x00;\
                        //PTBPE = 0x00;\
                        //PTBDD = 0x00;
#define  mSETUP_PORT_C  PTCDD = (ABEL_RESET_PIN | ABEL_ATT_PIN );
```

Optional for Safe Mode Boot indicator function (LEDs as output):

```
#define  mSETUP_PORT_D  PTDPE = 0x00;\
PTDDD = (0x01 | 0x02| 0x08 | 0x10);
```

6.4.2 Reset_Vector.c

The system reset vector.

NOTE

The application does not have a reset vector. If a reset occurs in an application, the Embedded Bootloader's reset vector is called.

6.4.3 Embedded_Bootloader_Target.h

Users must define the following #defines in the `Embedded_Bootloader_Target.h` to achieve a successful port.

Version number of the build:

```
// Version number update:
//   - Big change (interface/main code structure/new feature) Y.xx, increment
Y
//   - Smaller change (function code structure/bug fix) x.Yx, increment Y
//   - Small change (bug fix) x.xY, increment Y
#define EMBEDDED_BOOTLOADER_VERSION "5.01" // Number used with all PCB/Targets
```

NOTE

Use caution if the version number is changed. You should only change the PCB board number (`#define EMBEDDED_BOOTLOADER_TARGET`) to indicate a special PCB version.

Example for the TARGET_DIG528_2 and TARGET_DIG536_2:

```
#if defined TARGET_DIG528_2 || defined TARGET_DIG536_2
      // PCB board number for release
      #define EMBEDDED_BOOTLOADER_TARGET "528&536"
    // Setup port as output where "signal" must be set/cleared to indicate
safe mode boot
    #define SAFE_MODE_PORT_SETUP PTDDD |= 0x01; // Port D bit 0
    #define SET_OUTPUT  LED1ON // Defined in Target.h

#endif defined TARGET_DIG528_2 || defined TARGET_DIG536_2
```

6.4.4 HW_Init.h

This file contains prototypes of all the init functions and defines.

6.4.5 HW_Init.c

This file contains some hardware init functions which depend on the PCB layout.

`void HWResetAbel(void)`	Reset of MC13192 RF chip (do not change)
`void Safe_Boot_Mode_Indicator(void)`	Users can change this function so it matches the functions available for a particular PCB. The function can also be left empty. Default is a GPIO pin set low to light an LED.
`void HW_Init()`	The init main function.

NOTE

User can add more functions if required for a particular PCB.
Do not change the calling sequence.

6.4.6 main.c

This file contains the Embedded Bootloader main function and the Embedded version number.

`void main(void)`	It calls the hardware init function and then the Embedded Bootloader state machine. The state machine never returns.

NOTE

Dummy references are made to the version number strings for the Embedded_Bootloader_Functionality_Lib and HCS08_Flash_Lib to place the numbers in the executable image. If the version numbers are not required, they can be removed by removing the reference to the version number which frees up more code memory for user code.

Chapter 7
Embedded Bootloader Public Function Description

This section describes the public functions which the 802.15.4/Zigbee application can call in the Embedded Bootloader.

7.1 802.15.4/Zigbee Application Accessible Functions

The following functions, located in the Embedded Bootloader, are made accessible for 802.15.4/Zigbee applications. For example, an 802.15.4/Zigbee application is not required to have programming routines to store NVM data in flash. A function pointer, for each function of the below listed functions, is defined in Embedded Bootloader.c:

```
Enable_Download_Firmware()
Hard_Reset()
NV_Flash_Setup()
Update_NV_RAM()
FL_ICG_Setup()
UART_Port_Select();
```

The Embedded_Bootloader.h file contains function pointer prototypes and must be included in source files calling these functions. The function pointers are setup to point to functions with the same name in the Embedded Bootloader.

```
extern Enable_Download_Firmware_ptr_t Enable_Download_Firmware;
extern Hard_Reset_ptr_t Hard_Reset;
extern NV_Flash_Setup_ptr_t NV_Flash_Setup;
extern Update_NV_RAM_ptr_t Update_NV_RAM;
extern ICG_Setup_ptr_t FL_ICG_Setup;
extern UART_Port_Select_ptr_t UART_Port_Select;
```

7.1.1 Enable_Download_Firmware

Prototype:

```
bool_t Enable_Download_Firmware
(
uint8_t interface_state,
uint8_t firmware_state
)
```

Description:

The application must call this function to make the system ready for a new firmware download. The application must provide a way for the user to interact with the system to call this function.

NOTE

All bits are enabled by default. Bits can only be disabled (erased in flash) – never enabled. The bits are enabled again by the new firmware.

```
Input:
interface_state - The user selectable options. The below values should be
OR’ed together:
Embedded Bootloader control flags:
#define NO_BIT_ENABLED               ((uint8_t)0x00)

// Option: “Skip flash erase”
#define ERASE_FLASH                  ((uint8_t)0x01)

// Option: “Do not reset after upload”
#define BOOT_AFTER_DOWNLOAD          ((uint8_t)0x02)

// Option: “Erase production data”
#define KEEP_NV_RAM                  ((uint8_t)0x04)

// Option: “Skip firmware checksum verification”
#define PERFORM_FLASH_VERIFICATION  ((uint8_t)0x08)
```

NOTE

The Embedded Bootloader control flags correspond to the “optional firmware upload settings” which can be disabled/enabled in the Zigbee Flash Tool. See Section 1.4.1, Embedded Bootloader Description for details.
The value is inverted. To enable the bit mask option, the setting must be set to 0. To disable the bit mask option, the setting must be set to 1.

Use firmware_state – control if Embedded Bootloader or the application must be started.

To enable download, the setting must be = DO_UPDATE_FIRMWARE.

```
Embedded Bootloader boot flag:
      #define EXECUTE_APPLICATION        ((uint8_t)0x55)
      #define DO_UPDATE_FIRMWARE         ((uint8_t)0x00)
      #define FLASH_EMPTY                ((uint8_t)0xFF)
```

Output:

True - Ready for reset.

False - Something went wrong in changing the state.

7.1.2 Hard_Reset

Prototype:

```
void Hard_Reset(void)
```

Description:

The application can call this function to make a system reset. The reset is done by executing an illegal instruction.

Input:

None

Output:

None

7.1.3 Update_NV_RAM

Prototype:

```
bool_t Update_NV_RAM
(
NV_RAM_Struct_t const *NV_RAM_Distination_ptr,
uint8_t *Source_ptr,
uint16_t Source_Length
)
```

Description:

The application can call this function to update any NVM parameter with new values specified in the input parameters. There is no validation of input parameters.

NOTE

NVM can in code be read as a normal construct.

Input:

NV_RAM_Distination_ptr	A pointer to current NV RAM data (ex. The MAC address), which must be changed.
Source_ptr	A pointer to new NVM data, which must be stored.
Source_Length	The length (number of bytes) of the new NVM data to store.

Output:

True – NVM data stored.

False - Something went wrong (should never happen).

7.1.4 NV_Flash_Setup

Prototype:

```
void NV_Flash_Setup(void)
```

Description:

This function should never be called under normal conditions. However, it should be called if any of the other Embedded Bootloader functions malfunctions. The function sets up the flash functions (again), i.e. copies the flash routines to RAM for execution and initialize the HCS08 flash module.

Input:

None

Output

None

7.1.5 FL_ICG_Setup

Prototype:

```
void FL_ICG_Setup(void)
```

Description:

This function can be called by the application. The function could be automatically called if the external system clock is unstable/removed (from ISR function) and on power down/up (doze). This requires that the FL_ICG_Setup is called from an ISR function.

NOTE

Application programmers can make their own system clock setup function or call this function and just modify the ICG and MC13192 register values in the NVM section.

Input:

None

Output

None

7.1.6 UART_Port_Select

Prototype:

```
void FL_ICG_Setup
(
uint8_t data_reg_address,
uint8_t status_reg_address
)
```

Description:

This function can be called when the application has detected the active communication interface if used by the application. The communication interface can be any of the two SCI-ports (SCI1 or SCI2). When called with the proper parameters the Embedded Bootloader knows the active communication interface.

Input:

data_reg_address	the address of the active SCI port data register (SCI1 = 0x1F or SCI2 = 0x27)
status_reg_address	the address of the active SCI port status 1 register (SCI1 = 0x1C or SCI2 = 0x24)

Output

None

Chapter 8
Embedded Bootloader Memory Map

Table 1. Zigbee (MC9S08GB60/GT60) 802.15.4 Embedded Bootloader Memory Map

512 Bytes in a physical flash sector

Sector Number	Address in hex start	Address in hex end (sector erase address)	Size in bytes	General HCS08 Map and Usage	Embedded Bootloader Map
NM	*0*	*7F*	*128*	*Direct Port Registers*	*Direct Port Registers*
NM	80	FE	127	Direct Addressing RAM "Fast memory"	Direct Addressing RAM "Fast memory"
NM	**FF**	**FF**	**1**	**Direct Addressing RAM "Fast memory"**	**Sleep variable: gSeqPowerSaveMode**
NM	**100**	**1FF**	**256**	**RAM**	**Embedded Bootloader stack**
NM	200	F5F	3424	RAM	
NM	**F60**	**F6F**	**16**	**RAM**	**Unint RAM for init structure**
NM	**F70**	**F71**	**2**	**RAM**	**NV_RAM_ptr**
NM	**F72**	**F7F**	**14**	**RAM**	**Flash routines data**
NM	**F80**	**FBC**	**61**	**RAM**	**Flash routines critical code**
NM	FBD	106F	179	RAM	
NM	**1070**	**1077**	**8**	**RAM**	**Static variables**
NM	**1078**	**107F**	**8**	**RAM**	**Static no init variables**
8	**1080**	**109E**	**31**	**FLASH (section 1)**	
8	109F	11FF	353	FLASH (section 1)	
9	1200	13FF	512	FLASH (section 1)	
10	**1400**	**15FF**	**512**	**FLASH (section 1)**	**802.15.4/App. NV RAM block 0 (share)**
11	**1600**	**17FF**	**512**	**FLASH (section 1)**	**802.15.4/App. NV RAM block 1 (share)**

					1 (share)
12	***1800***	***182B***	***44***	***High Page Registers (COP, Flash etc.)***	***High Page Registers (COP, Flash etc.)***
12	182C	19FF	468	FLASH (section 2)	
13	1A00	1BFF	512	FLASH (section 2)	
14	1C00	1DFF	512	FLASH (section 2)	
15	1E00	1FFF	512	FLASH (section 2)	
16	2000	21FF	512	FLASH (section 2)	
17	2200	23FF	512	FLASH (section 2)	
18	2400	25FF	512	FLASH (section 2)	
19	2600	27FF	512	FLASH (section 2)	
20	2800	29FF	512	FLASH (section 2)	
21	2A00	2BFF	512	FLASH (section 2)	
22	2C00	2DFF	512	FLASH (section 2)	
23	2E00	2FFF	512	FLASH (section 2)	
24	3000	31FF	512	FLASH (section 2)	
25	3200	33FF	512	FLASH (section 2)	
26	3400	35FF	512	FLASH (section 2)	
27	3600	37FF	512	FLASH (section 2)	
28	3800	39FF	512	FLASH (section 2)	
29	3A00	3BFF	512	FLASH (section 2)	
30	3C00	3DFF	512	FLASH (section 2)	
31	3E00	3FFF	512	FLASH (section 2)	
32	4000	41FF	512	FLASH (section 2)	
33	4200	43FF	512	FLASH (section 2)	
34	4400	45FF	512	FLASH (section 2)	
35	4600	47FF	512	FLASH (section 2)	
36	4800	49FF	512	FLASH (section 2)	

37	4A00	4BFF	512	FLASH (section 2)	
38	4C00	4DFF	512	FLASH (section 2)	
39	4E00	4FFF	512	FLASH (section 2)	
40	5000	51FF	512	FLASH (section 2)	
41	5200	53FF	512	FLASH (section 2)	
42	5400	55FF	512	FLASH (section 2)	
43	5600	57FF	512	FLASH (section 2)	
44	5800	59FF	512	FLASH (section 2)	
45	5A00	5BFF	512	FLASH (section 2)	
46	5C00	5DFF	512	FLASH (section 2)	
47	5E00	5FFF	512	FLASH (section 2)	
48	6000	61FF	512	FLASH (section 2)	
49	6200	63FF	512	FLASH (section 2)	
50	6400	65FF	512	FLASH (section 2)	
51	6600	67FF	512	FLASH (section 2)	
52	6800	69FF	512	FLASH (section 2)	
53	6A00	6BFF	512	FLASH (section 2)	
54	6C00	6DFF	512	FLASH (section 2)	
55	6E00	6FFF	512	FLASH (section 2)	
56	7000	71FF	512	FLASH (section 2)	
57	7200	73FF	512	FLASH (section 2)	
58	7400	75FF	512	FLASH (section 2)	
59	7600	77FF	512	FLASH (section 2)	
60	7800	79FF	512	FLASH (section 2)	
61	7A00	7BFF	512	FLASH (section 2)	
62	7C00	7DFF	512	FLASH (section 2)	
63	7E00	7FFF	512	FLASH (section 2)	

64	8000	81FF	512	FLASH (section 2)	
65	8200	83FF	512	FLASH (section 2)	
66	8400	85FF	512	FLASH (section 2)	
67	8600	87FF	512	FLASH (section 2)	
68	8800	89FF	512	FLASH (section 2)	
69	8A00	8BFF	512	FLASH (section 2)	
70	8C00	8DFF	512	FLASH (section 2)	
71	8E00	8FFF	512	FLASH (section 2)	
72	9000	91FF	512	FLASH (section 2)	
73	9200	93FF	512	FLASH (section 2)	
74	9400	95FF	512	FLASH (section 2)	
75	9600	97FF	512	FLASH (section 2)	
76	9800	99FF	512	FLASH (section 2)	
77	9A00	9BFF	512	FLASH (section 2)	
78	9C00	9DFF	512	FLASH (section 2)	
79	9E00	9FFF	512	FLASH (section 2)	
80	A000	A1FF	512	FLASH (section 2)	
81	A200	A3FF	512	FLASH (section 2)	
82	A400	A5FF	512	FLASH (section 2)	
83	A600	A7FF	512	FLASH (section 2)	
84	A800	A9FF	512	FLASH (section 2)	
85	AA00	ABFF	512	FLASH (section 2)	
86	AC00	ADFF	512	FLASH (section 2)	
87	AE00	AFFF	512	FLASH (section 2)	
88	B000	B1FF	512	FLASH (section 2)	
89	B200	B3FF	512	FLASH (section 2)	
90	B400	B5FF	512	FLASH (section 2)	

91	B600	B7FF	512	FLASH (section 2)	
92	B800	B9FF	512	FLASH (section 2)	
93	BA00	BBFF	512	FLASH (section 2)	
94	BC00	BDFF	512	FLASH (section 2)	
95	BE00	BFFF	512	FLASH (section 2)	
96	C000	C1FF	512	FLASH (section 2)	
97	C200	C3FF	512	FLASH (section 2)	
98	C400	C5FF	512	FLASH (section 2)	
99	C600	C7FF	512	FLASH (section 2)	
100	C800	C9FF	512	FLASH (section 2)	
101	CA00	CBFF	512	FLASH (section 2)	
102	CC00	CDFF	512	FLASH (section 2)	
103	CE00	CFFF	512	FLASH (section 2)	
104	D000	D1FF	512	FLASH (section 2)	
105	D200	D3FF	512	FLASH (section 2)	
106	D400	D5FF	512	FLASH (section 2)	
107	D600	D7FF	512	FLASH (section 2)	
108	D800	D9FF	512	FLASH (section 2)	
109	DA00	DBFF	512	FLASH (section 2)	
110	DC00	DDFF	512	FLASH (section 2)	
111	DE00	DFFF	512	FLASH (section 2)	
112	E000	E1FF	512	FLASH (section 2)	
113	E200	E3FF	512	FLASH (section 2)	
114	E400	E5FF	512	FLASH (section 2)	
115	E600	E7FF	512	FLASH (section 2)	
116	E800	E9FF	512	FLASH (section 2)	
117	EA00	EBFF	512	FLASH (section 2)	

118	EC00	EDFF	512	FLASH (section 2)	
119	EE00	EFBF	448	FLASH (section 2)	
119	**EFC0**	**EFFD**	**62**	**FLASH (section 2)**	**802.15.4 app. ISR vectors**
119	**EFFE**	**EFFF**	**2**	**FLASH (section 2)**	**Embedded Bootloader system flags (placed by 802.15.4 application)**
120	**F000**	**F00F**	**16**	**FLASH (section 2)**	**Embedded Bootloader function ptrs (8 pieces)**
120	**F010**	**F013**	**4**	**FLASH (section 2)**	**Illegal opcode instruction**
120	**F014**	**F050**	**61**	**FLASH (section 2)**	**Flash routines critical code (copy to RAM)**
120	F051	F1FF	431	FLASH (section 2)	
121	F200	F3FF	512	FLASH (section 2)	
122	F400	F5FF	512	FLASH (section 2)	
123	F600	F7FF	512	FLASH (section 2)	
124	F800	F9FF	512	FLASH (section 2)	
125	FA00	FBFF	512	FLASH (section 2)	
126	FC00	FDFF	512	FLASH (section 2)	
127	FE00	FF1D	286	FLASH (section 2)	
127	FF1E	FFAF	146	FLASH (section 2)	**Embedded Bootloader version number string**
127	***FFB0***	***FFBF***	***16***	***NV Registers***	***NV Registers***
127	***FFC0***	***FFFD***	***62***	***ISR vectors (31 vectors - 25 implemented)***	***ISR vectors (31 vectors - 25 implemented)***
127	***FFFE***	***FFFF***	***2***	***Reset vector "address in Bootloader"***	***Reset vector "address in Bootloader"***
			65535		
			FFFF	Must be = FFFF for valid memory map.	

NM = No meaning

🟧 = May be used by Embedded Bootloader. 802.15.4/App. can reuse this space (overwrite).

🟫 = Used by Embedded Bootloader. Data/code which must be located on the specified address and (must/will) exists when the application is running

🟪 = May be used by 802.15.4/App.

🟪 = Used by 802.15.4/App. Data/code which must be located on the specified address

If either the Embedded Bootloader and/or the 802.15.4/App. must not use a particular resource the color from the "General HCS08 Map and Usage" is kept.

Cursive = fixed register and vectors in flash

Bold = MUST be located on this particular address - DO NOT CHANGE.

Flash sector 120-127 is block protected and cannot be erased by SW.

Embedded Bootloader Application

RAM	4096	bytes available
Code	4016	bytes available (not including ISR vectors and reset vector)
NV-RAM	1024	bytes available. Read and written by Embedded Bootloader (2 sectors are used, so it occupies 1024 bytes flash).

Appendix A
Release Folder and File Structure

This appendix describes the folder and file structure for this release.

A.1. Folder Structure

```
├──── 802.15.4_Headers
│   └──── Ghdr                              Global headers from the 802.15.4 MAC/PHY Release
├──── Bin
│   ├── Embedded_Bootloader                 When target is built, the output files are stored here.
│   │   ├── AX-0308RevC                     Freescale’s reference build of the Embedded Bootloader
│   │   │                                   for the Axiom AXM-0308
│   │   │                                   development board
│   │   └── DIG-528-2_DIG-536-2_RD01        DIG-528-2 and DIG-536-2 are Freescale’s reference
│   │                                       build for the DIG-528-2 and DIG-536-2 EVB’s.
│   │                                       RD01 is Freescale's reference build for all PCB's using
│   │                                       the Freescale Reference Design version 01.
│   ├── Embedded_Bootloader_Functionality_Lib Embedded Bootloader functionality library
│   │                                         (source code not released)
│   └── HCS08_Flash_Lib                     Embedded Bootloader HCS08 flash library
│                                           (source code not released)
├────prm                                    Linker file
└────sources                                Source code
```

A.2. File Structure

This section describes all of the files in the Embedded Bootloader release.

`.\Embedded_Bootloader`

Embedded_Bootloader.mcp	Metrowerks Codewarrior project file
flash.hwc	Hiwave system file
flash.hwl	Hiwave system file
flash.ini	Hiwave system file

`.\Embedded_Bootloader\802.15.4_Headers\Ghdr`

AbelReg.h	
AppAspInterface.h	
Debug.h	
DigiType.h	Defined C data types
Embedded_Bootloader.h	New interface file to Embedded Bootloader (after version 5.00)
FreeLoader_inf.h	Embedded Bootloader interface file (Freeloader) (before version 5.00)
FunctionalityDefines.h	
Gb60_io.h	Register mapping for HCS08
hwdrv_hcs08.h	
MacPhy.h	
NV_Data.h	NVM data structure
NwkMacInterface.h	
Phy_Spi.h	
PhyMacMsg.h	
PublicConst.h	
Target.h	PCB target definition (I/O mapping)

`.\Embedded_Bootloader\Bin\Embedded_Bootloader\AX-0308RevC`

Embedded_Bootloader.elf	Elf format file
Embedded_Bootloader.map	Map file
Embedded_Bootloader.s19	Freescale S19 file

`.\Embedded_Bootloader\Bin\Embedded_Bootloader\DIG-528-2_DIG-536-2`

Embedded_Bootloader.elf	Elf format file
Embedded_Bootloader.map	Map file
Embedded_Bootloader.s19	Freescale S19 file

`.\Embedded_Bootloader\Bin\Embedded_Bootloader_Functionality_Lib`

Embedded_Bootloader_Functionality_Lib.Lib	Functionality library

`.\Embedded_Bootloader\Bin\HCS08_Flash_Lib`

HCS08_Flash_Lib.Lib	HCS08 flash library

`.\Embedded_Bootloader\prm`

Embedded_Bootloader_HCS08.ach	HCS08 GT60/GB60 linker file

`.\Embedded_Bootloader\sources`

Embedded_Bootloader_Target.h

HW_Init.c

HW_Init.h

Reset_Vector.c

main.c