13193 Evaluation Board Development Kit

(13193EVB) User's Guide

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About This Book

This guide provides a detailed description of how to use the Freescale IEEE® 13193 Evaluation Board Development Kit (13193EVB-A00).

The 13193EVB contains two 13192-EVB evaluation boards, the Freescale BeeKit Wireless Connectivity Toolkit software CD, cables, power supplies, CodeWarrier™ and the Freescale BeeStack software. The 13193EVB provides a flexible demonstration and development environment for the Freescale ZigBee family of products. Along with the hardware, the kit provides utilities and sample applications that demonstrate functionality from simple proprietary applications, 802.15.4 applications, all the way to full ZigBee compatible solutions.

Refer to the BeeKit User's Guide (BKWCTKUG) for a complete description of how to install all of the software.

Audience

This document is intended for application developers.

Organization

This document is organized into 6 chapters.

Chapter 1 **Safety Information** - This chapter provides operating guidelines for the 13193EVB.

Chapter 2 **13192-EVB Board Overview** - This chapter describes the 13192-EVB board and 13193EVB system components.

Chapter 3 **Embedded Bootloader Utility and Programming** - This chapter describes the Test Tool Utility's Embedded Bootloader application.

Chapter 4 **Evaluation Kit Demonstration Applications** - This chapter describes the various demonstration applications pre-loaded on the boards.

Chapter 5 **Solution Development** - This chapter shows users how to begin development of an MC13192 system solution.

Chapter 6 **Test Tool Utility** - This chapter shows users how to use the Test Tool utility.

Revision History

The following table summarizes revisions to this document since the previous release (Rev 1.1).

Revision History

Location	Revision
Entire Document	Update for BeeKit integration

Conventions

This document uses the following notational conventions:

- `Courier monospaced type` indicate commands, command parameters, code examples, expressions, datatypes, and directives.
- *Italic type* indicates replaceable command parameters.
- All source code examples are in C.

Definitions, Acronyms, and Abbreviations

The following list defines the acronyms and abbreviations used in this document.

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
13193EVB	The 13193 Evaluation Board Development Kit
13192-EVB	The 13192 Evaluation Board
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 Freescale 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 the 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

The following sources were referenced to produce this book:

[1] ZigBee.hlp (see Test Tool installation directory .\help)

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

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

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

[6] Freescale Embedded Bootloader Reference Manual, MC13192EBRM

[7] Freescale Compact, Integrated Antennas, Designs and Applications, AN2731

[8] IEEE™ 802.15.4 specification 1.0

Chapter 1
Safety Information

Any modifications to this product may violate the rules of the Federal Communications Commission and make operation of the product unlawful.

47 C.F.R. Sec. 15.21

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

47 C.F.R. Sec.15.105(b)

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. The antenna(s) used for this equipment must be installed to provide a separation distance of at least 8 inches (20cm) from all persons.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.
3. This device is susceptible to electrostatic discharge (ESD) and surge phenomenon.

Chapter 2
13192-EVB Board Overview

The 13193EVB contains two 13192-EVBs.

These boards include the following on-board components:

- MC13192, 2.4GHz transceiver
- MC9S08GT60 Micro Controller Unit (MCU)

2.1 Board Overview

The boards shipped with the 13193EVB are delivered with the Range Demo Plus application. More applications can be uploaded with either the Embedded Bootloader utility which is part of the Freescale Test Tool application, or with CodeWarrior using the USB Multilink programmer (provided in the 13193EVB-BDM only). The CodeWarrior CD (provided) requires users to register for a 30-day evaluation key. After this time, users must purchase a standard key to use the CodeWarrior Software (see the CodeWarrior documentation for detailed information).

Refer to the packing list that ships with the 13193EVB for a complete list of hardware components.

Refer to the *BeeKit Wireless Connectivity Toolkit User's Guide* (BKWCTKUG) for a complete description of how to install all of the software.

2.2 Common Board Components

2.2.1 MC9S08GT60 MCU

The MC9S08GT60 MCU is located on the 13192-EVBs. The MC9S08GT60 MCU is a member of Freescale's 8-bit, low cost, low power family of HCS08 MCUs. It has 60KB of embedded flash and 4KB of RAM. For more information, refer to the MC9S08GB60 data sheet at www.freescale.com/mcu.

2.2.2 MC13192 RF Data Modem

The MC13192 is contained on the 13192-EVBs. The MC13192 is an 802.15.4 compliant, ZigBee-ready transceiver. It has a four-wire SPI interface to connect to a variety of microcontrollers, creating a low power, low cost solution for a range of applications. For more information on the MC13192, see the appropriate MC13192 data sheet at www.freescale.com/Zigbee.

2.3 13192-EVB Evaluation Board Description

The 13192-EVB is an 802.15.4/ZigBee evaluation board based on the MC13192, 2.4GHz transceiver and the MC9S08GT60 MCU. The 13192-EVB provides both serial and USB connectivity to a PC for easy evaluation. For improved sensitivity and range evaluations, the 13192-EVB includes the necessary circuitry to enable the MBC13900 Low Noise Amplifier (LNA). It is also equipped with an external SMA connector for an external antenna connection allowing easy connectivity to a scope for test and measurement. The 13192-EVB contains the following interfaces:

- 1.1 USB port
- RS232 Serial Connection
- 4 push buttons (S1, S2, S3, S4)
- 1 Reset button (Reset)
- 4 LEDs, (LED1, LED2, LED3, LED4)
- One power switch (S106)
- Printed F antenna (refer to AN2731 for more information)
- Optional MBC13900 LNA (disabled by default, visit www.freescale.com/rf for more information)
- SMA RF connector (disabled by default)
- Background Debug Module (BDM) connection allowing flash programming and in-circuit debug via the included USB Multilink Cable (see the USBMULTECHSUM document included in the kit for more details).
- Power connector (5-9 Volts)
- 10-pin header strip for access to specific MCU and RF pins

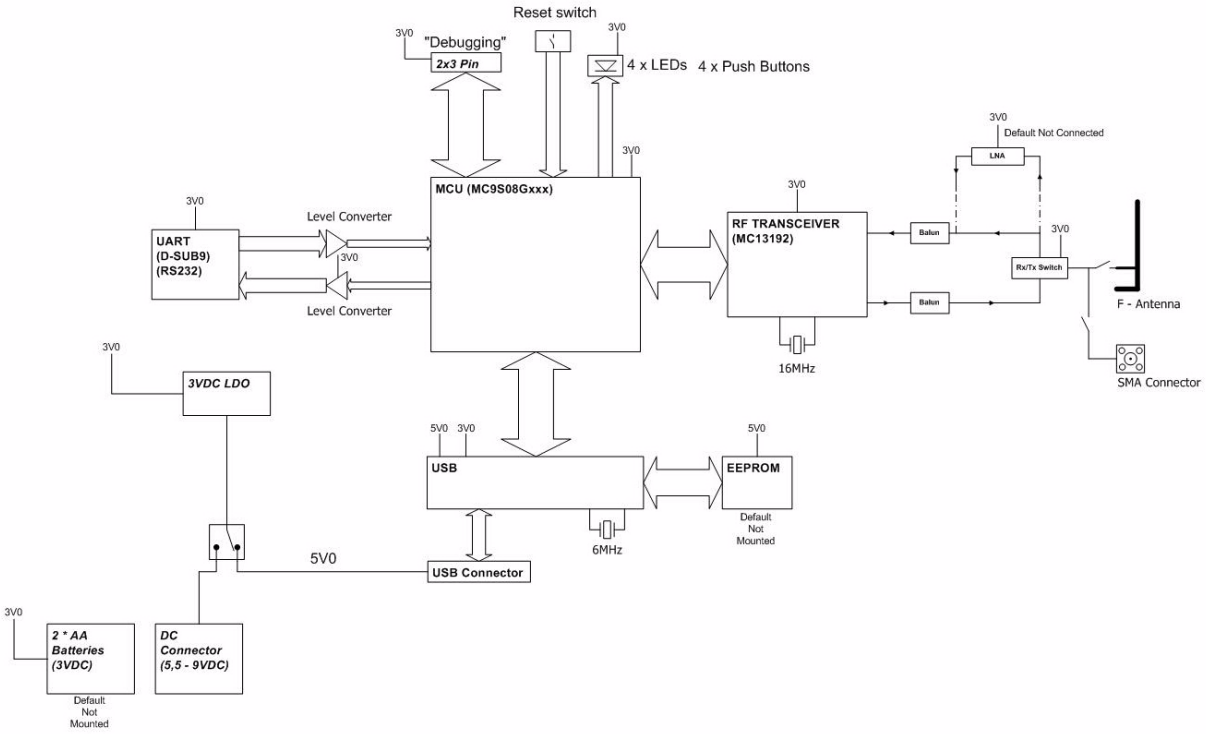

Figure 2-1. 13192-EVB Block Diagram

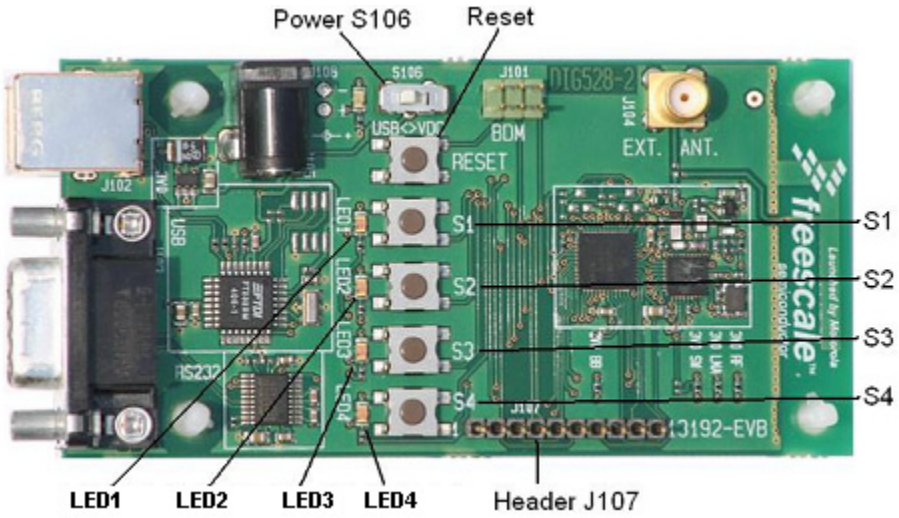

Figure 2-2. 13192-EVB Board Layout

Table 2-1. 13192-EVB Board Labels

Common Name	Board Designation
LED 1	LED1
LED 2	LED2
LED 3	LED3

Table 2-1. 13192-EVB Board Labels (continued)

LED 4	LED4
Button 1	S1
Button 2	S2
Button 3	S3
Button 4	S4
Reset Button	Reset
Power Toggle	S106

NOTE

Switch S106 toggles power between the USB connector and the power connector. Refer to the *MC13192 Evaluation Board Reference Manual*, (13192EVBRM) for more info.

Chapter 3
Embedded Bootloader Utility and Programming

The 13192-EVBs come pre-loaded with the Range Demo Plus application. See AN3231 for information on how to setup and run the Range Demo Plus application. This chapter describes how to load additional applications included on the BeeKit CDs.

There are two methods of loading application code into the 13192-EVBs. The first method uses the Test Tool's Embedded Bootloader application utility (the Test Tool installation is described in Chapter 4, "13193EVK Software Installation"). The second method uses the supplied Background Debug Module (BDM) programmer cable and CodeWarrior IDE.

3.1 Test Tool's Embedded Bootloader Application

This section describes the use of the Test Tool's Embedded Bootloader application to flash new firmware into the 13192-EVBs. The Embedded Bootloader utility allows users to flash different application code into the boards without the use of a BDM programmer/debugger.

The Embedded Bootloader is located in a protected 4KB flash block in the highest memory area (0xF000-0xFFFF) of the MC9S08GT60 MCU.

NOTE

If the boards are flashed with a BDM cable, the BDM erases the Embedded Bootloader code and as a result, the Test Tool's Embedded Bootloader utility cannot be used until the Embedded Bootloader code is re-flashed (see Section 3.2, "Using the BDM Programmer")

3.1.1 Test Tool Embedded Bootloader Features

- Can upload firmware in Freescale S19 record format through the UART/USB
- Can initialize memory of upload firmware
- Can initialize the system clock frequency
- Can make run-time updates to the non-volatile memory (NVM)

3.1.2 Flash Programming the 13192-EVB

To flash program the 13192-EVBs, perform the following steps:

1. Connect the 13192-EVB to an RS232 serial COM port on the PC via the included serial cable.
2. Connect a power source (9V battery or the 9V power supply) to the board.

3. Power on the board. If all four LEDs are not on, press and hold all four buttons (S1-S4 on the 13192-EVB) simultaneously. Press and release the Reset Button, then release the four push buttons. All four LEDs should now be on. The board is now ready for flash programming.

NOTE

The SMAC applications call the Test Tool's Embedded Bootloader with two buttons presses. The 13192-EVB uses S2 and S4.

4. To run the Test Tool utility from Windows, click on Start->Programs->Freescale Zigbee->Test Tool. The Test Tool main window appears as shown in Figure 3-1.
5. To setup the board connection, from the toolbar, click on Tools->Communications Settings, as shown in Figure 3-1.

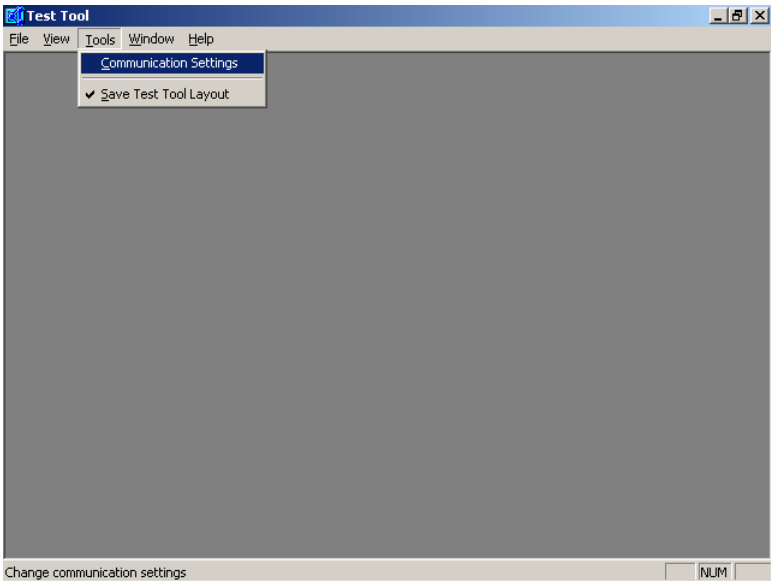

Figure 3-1. Test Tool Window (Configuration Settings Option)

6. The List of Devices screen appears as shown in Figure 3-2. Click on the Add Internal button and the Device Settings window appears as shown in Figure 3-2.
7. In the Device Settings window, click on the Serial button, choose the appropriate Com Port. Leave the Baudrate set to 19200.
8. Click on the OK button.

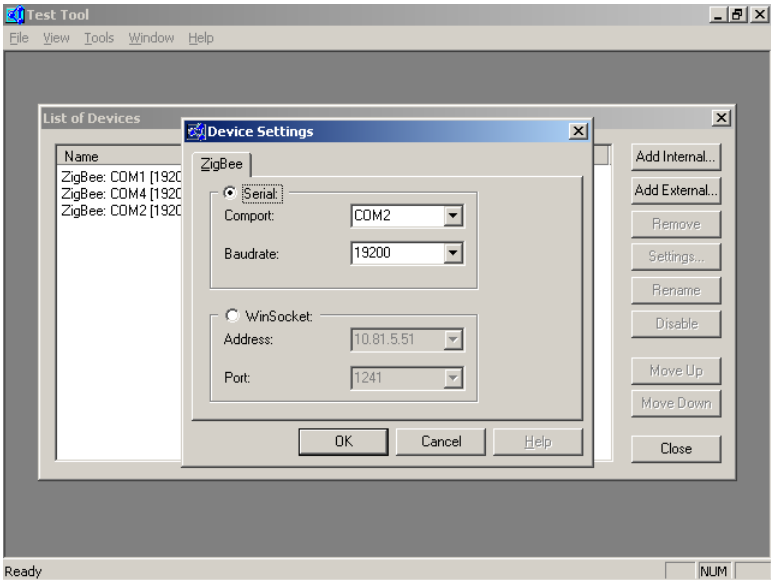

Figure 3-2. List of Devices and Device Settings Windows

9. In the List of Devices window, click on the Close button.
10. As shown in Figure 3-3, launch the Embedded Bootloader from the Test Tool window toolbar by clicking on View->Embedded Bootloader.

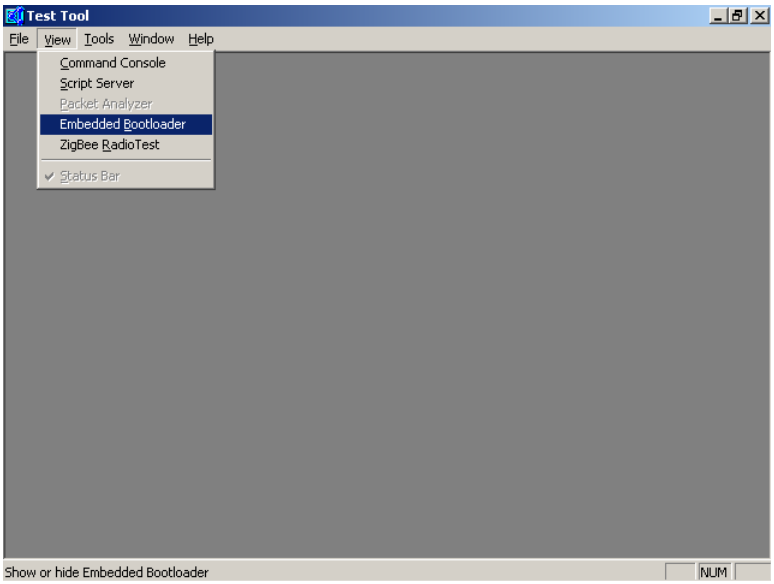

Figure 3-3. Test Tool Window (Choosing Embedded Bootloader)

The Embedded Bootloader Select Devices window appears as shown in Figure 3-4.

11. Choose the COM port for the device and click the OK button.

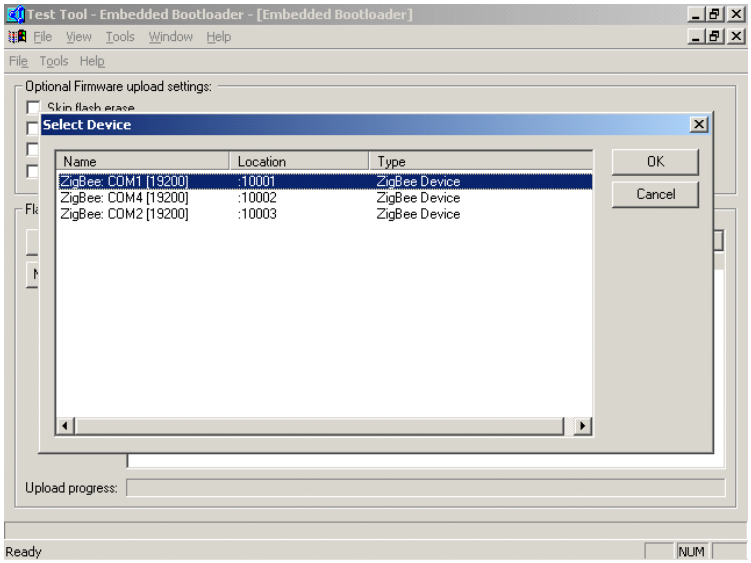

Figure 3-4. Test Tool Window (Embedded Bootloader)

12. As shown in Figure 3-5, select the desired application for flashing from the Application Files menu and click on the Upload button.

NOTE

- If users want to flash their own project, they must save it as an S19 record and copy to the S19 directory (`C:\Program Files\Freescale\Test Tool\s19`).
- If a time-out error occurs, highlight the file and click the Upload button again.

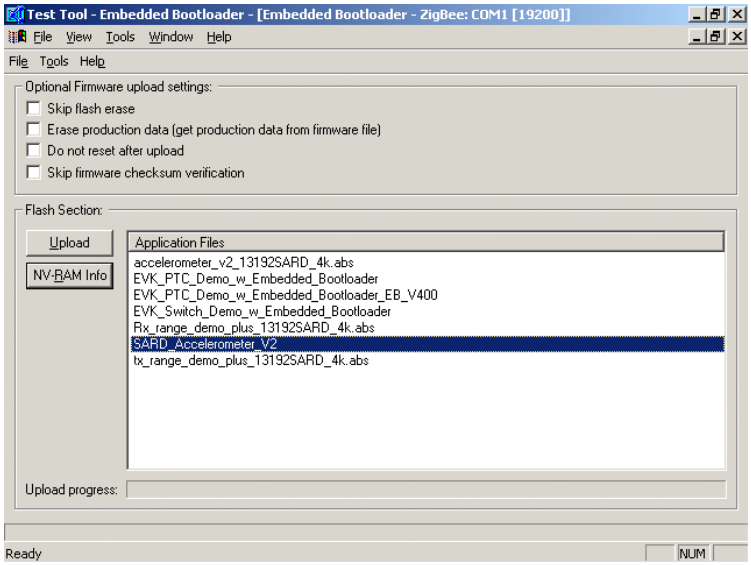

Figure 3-5. Test Tool Window (Bootloader Application Select)

A progress indicator appears in the Embedded Bootloader application window while the board is being flash programmed. After the board is flashed, press and release the reset button on the board. At this point, the application code has been flashed into the target and the demo is ready for use.

3.2 Using the BDM Programmer

The BDM programmer/debugger provides another method to load application code into the 13192-EVBs. Review the following two documents to learn how to use the BDM programmer/debugger.

- The USB HCS08/HCS12 Multilink Rev B Technical Summary
- The CodeWarrior™ Development Studio for 68HC08 Quick Start Guide.

The USB HCS08/HCS12 Multilink Rev B Technical Summary describes the usage, setup, and driver installation details. It also provides P&E Microsystems web site for firmware updates and additional information.

The CodeWarrior™ Development Studio for 68HC08 Quick Start Guide is coupled with the CodeWarrior Development Studio installation CD ROM. The Quick Start Guide describes the basic system requirements, software installation, license key registration and installation and additional software support.

NOTE

Flashing the boards with the BDM programmer erases all of the embedded flash, including the Embedded Bootloader code.

In order to re-use the Test Tool's Embedded Bootloader utility to flash the boards, the Embedded Bootloader code must be reloaded via the BDM.

3.3 Installing the Embedded Bootloader Code

This section describes the installation of the Embedded Bootloader code using the P&E Multilink for HCS08 BDM programmer. As mentioned, two methods can be used to load application code into the 13192-EVBs. The use of the BDM programmer allows one to flash their application code into the target but as a result, erases the Embedded Bootloader code required to use the Test Tool's Embedded Bootloader utility.

Users can program the Embedded Bootloader to an erased PCB or they can upgrade to a newer version of the Embedded Bootloader. To re-install the Embedded Bootloader code into the target, follow the procedures in the next few sections.

3.3.1 Programming to an Erased Board

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

1. Execute the `hiwave.exe` file from the chosen CodeWarrior installation directory. For example, `[installation directory] \CodeWarrior_CW08_Vx.x\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 3-7. In the Processor drop down menu, select HCS08. From the Target Interface drop down menu, select P&E Target Interface, then click the OK button.

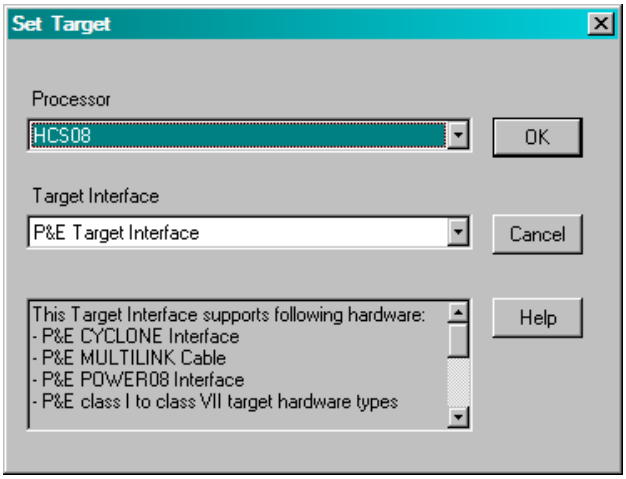

Figure 3-6. Set Target Window

3. When connecting for the first time, the Connection Assistant window appears prompting to select the debugger interface connection. As shown in Figure 3-7, a USB connection was chosen and the HCS08 was selected as the CPU type. Click the OK button.

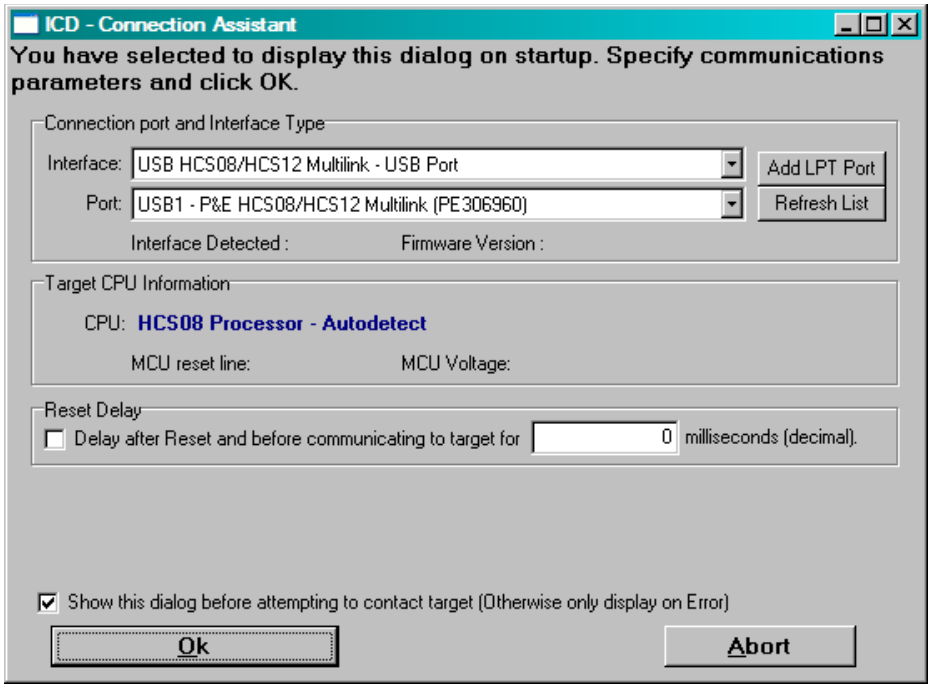

Figure 3-7. Connection Wizard Window

4. Under the File menu, click on Load Application to open the Load Executable File window as shown in Figure 3-8. Select Freescale S-Record (`*.s19`) using the Files of type: drop down menu. Navigate to the folder where the `Embedded Bootloader.s19` file is located. Select the file and click the Open button.

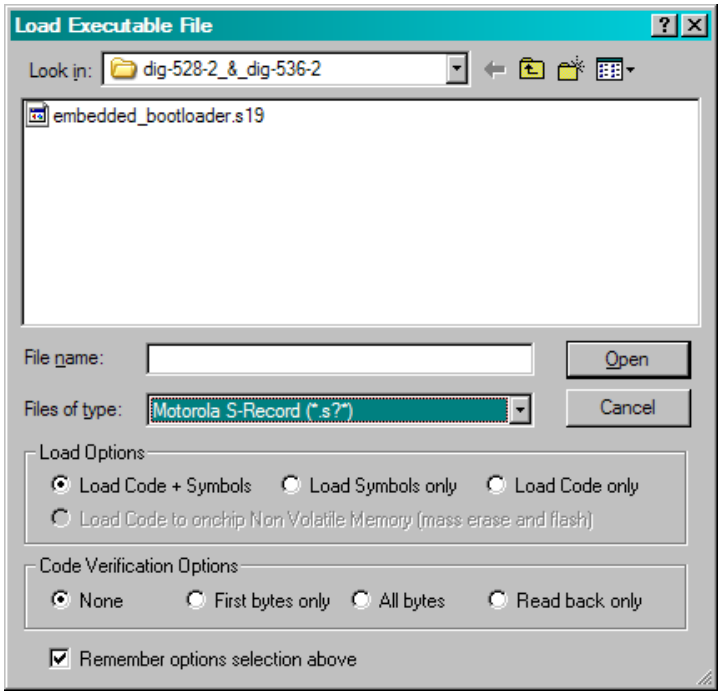

Figure 3-8. Load Executable Window

The Embedded Bootloader is now being programmed to the PCB as shown in Figure 3-9.

NOTE

In the event the status window does not appear as shown in Figure 3-9, select the PEDebug drop down menu, scroll down to Mode: Full Chip Simulation and then select In-Circuit Debug/Programming.
Repeat Step 3 if needed.

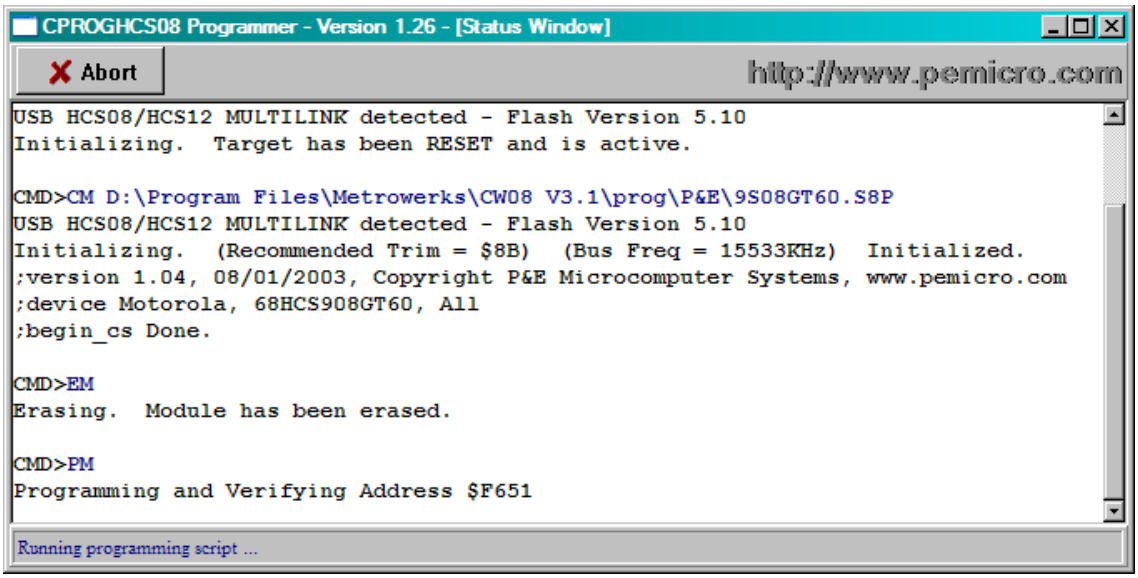

Figure 3-9. Status Window

6. Remove power and disconnect the BDM cable from the PCB. Next, power up the PCB. The PCB is now ready to upload an application. This is indicated by all four LEDs being on.

3.3.2 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 the chosen CodeWarrior installation directory. For example, `[installation directory] \CodeWarrior_CW08_Vx.x\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 3-10. In the Processor drop down menu, select HCS08. From the Target Interface drop down menu, select P&E Target Interface, then click the OK button.

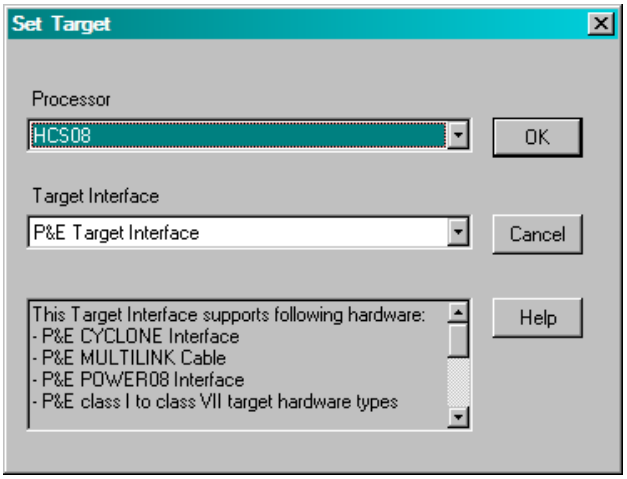

Figure 3-10. Set Target Window

3. When connecting for the first time, the Connection Assistant window appears prompting to select the debugger interface connection. As shown in Figure 3-11, a USB connection was chosen and the HCS08 was selected as the CPU type. Click the OK button.

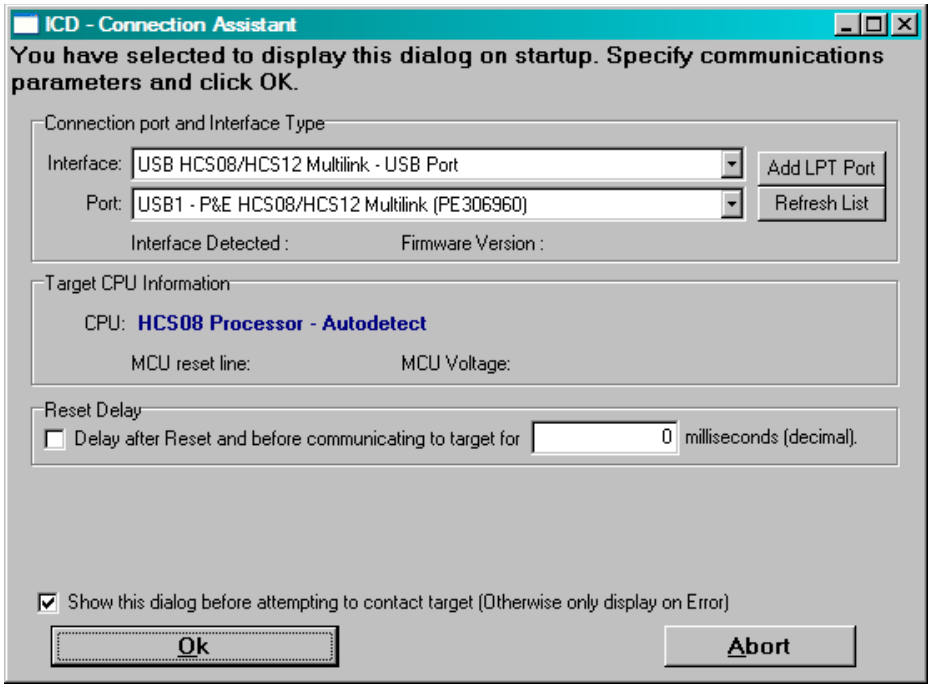

Figure 3-11. Connection Assistant Window

At this point, a copy of the NVM sector (both NVM0 and NVM1) with the production data must be made. The next few steps goes through the procedure manually by selecting a starting address and an ending address.

4. Select the PEDebug menu and then choose Start Expert Mode Programmer. The Programmer Expert window appears as shown in Figure 3-12.

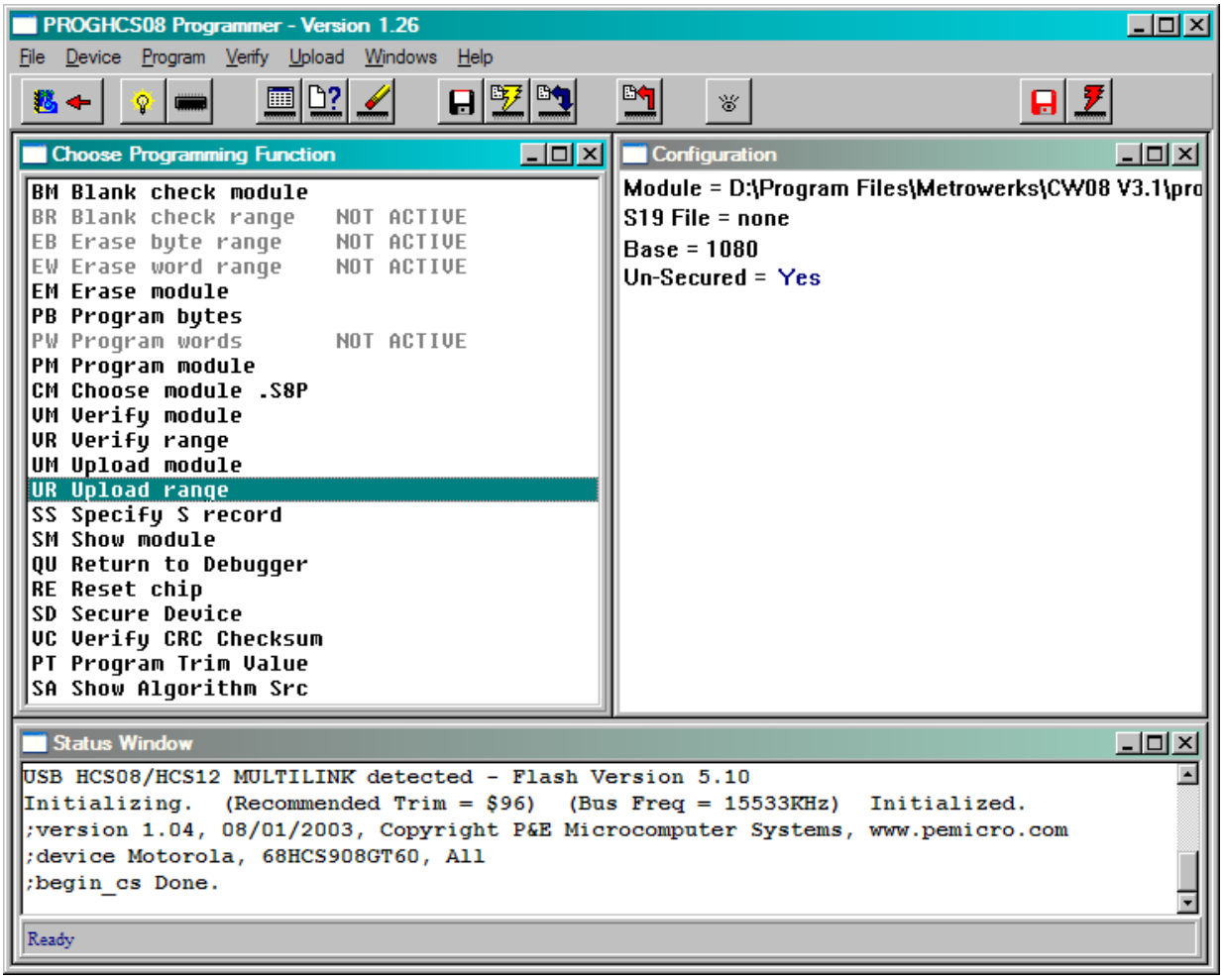

Figure 3-12. Programmer Expert Window

5. In the Programmer Expert window, double click on UR Upload Range. The Start Address window appears as shown in Figure 3-13. Specify the start address for the NVM section. Click the OK button. The following shows the start address for each NVM sector:
    - For NVM0, use start address 0x152F
    - For NVM1, use start address 0x172F

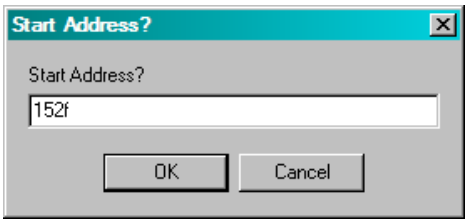

Figure 3-13. Start Address Window

6. In the End Address window, specify the end address for the NVM section and then click the OK button as shown in Figure 3-14. The following shows the end address for each NVM sector:
    - For NVM0, use end address 0x155B

- For NVM1, use end address 0x175B

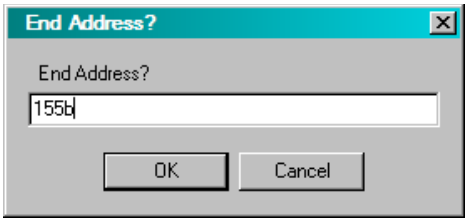

Figure 3-14. End Address Window

7. As shown in Figure 3-15, use the S19 window to specify which S19 file to store active NVM data to and then click the OK button. The following shows the S19 files for each NVM sector:
   - For NVM0, use `PD_NVM0.s19`
   - For NVM1, use `PD_NVM1.s19`

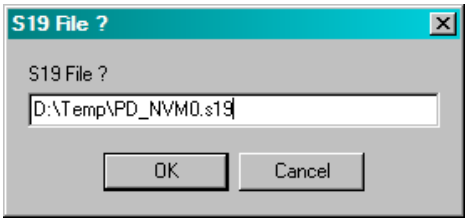

Figure 3-15. S19 File Window

NOTE

A copy of both NVM0 and NVM1 must be made as described above before executing the `Production_Data_Converter.exe` as described in Step 9.

8. Close the Programmer Expert window.

Use the PC tool `Production_Data_Converter.exe` to convert the production data in NVM to default NVM sector NVM0.

9. Copy the `Production_Data_Converter.exe` tool to the folder containing the `PD_NVM0.s19` and `PD_NVM1.s19` files. Execute the `Production_Data_Converter.exe` file. This can be done by either clicking on the `Production_Data_Converter.exe` or opening a Command Prompt window and running the executable at the command line. The output is a `PD_NVM.s19` file containing the production data from the active NVM sector. The command line version is shown in Figure 3-16.

NOTE

The `Production_Data_Converter.exe` tool can be found in the 13193EVK folder.

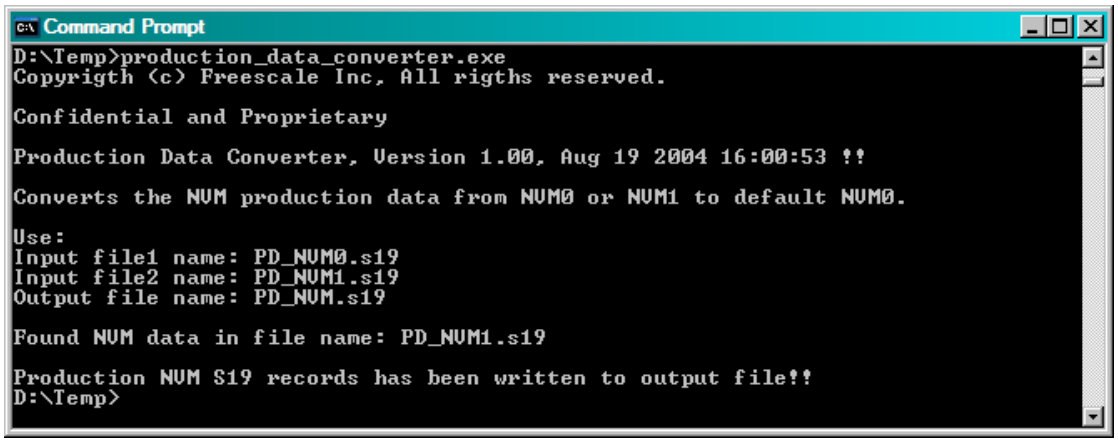

Figure 3-16. Command Window

10. Under the File menu, click on Load Application to open the Load Executable File window as shown in Figure 3-17. Select Freescale S-Record (`*.s19`) using the Files of type: drop down menu. Navigate to the folder where the `Embedded Bootloader.s19` file is located. Select the file and click the Open button.

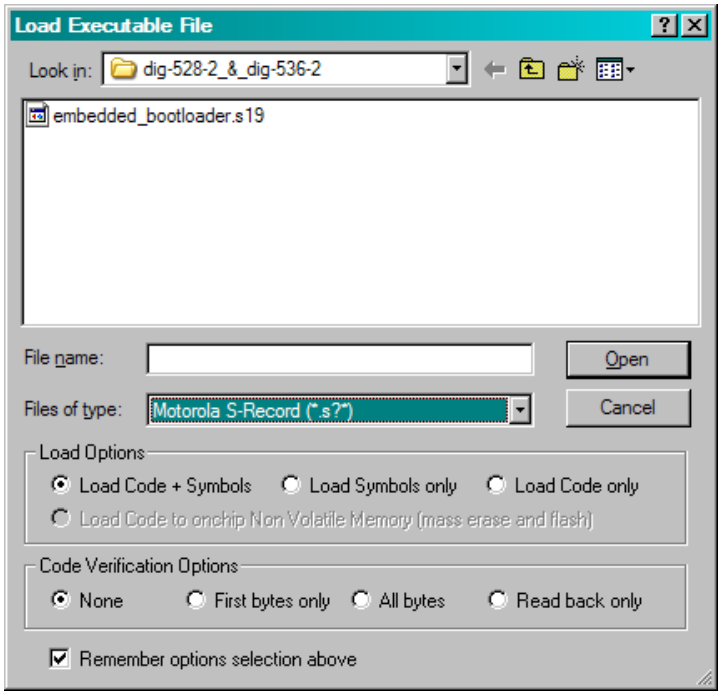

Figure 3-17. Load Executable File Window

The Embedded Bootloader is now programmed to the PCB as shown in Figure 3-18.

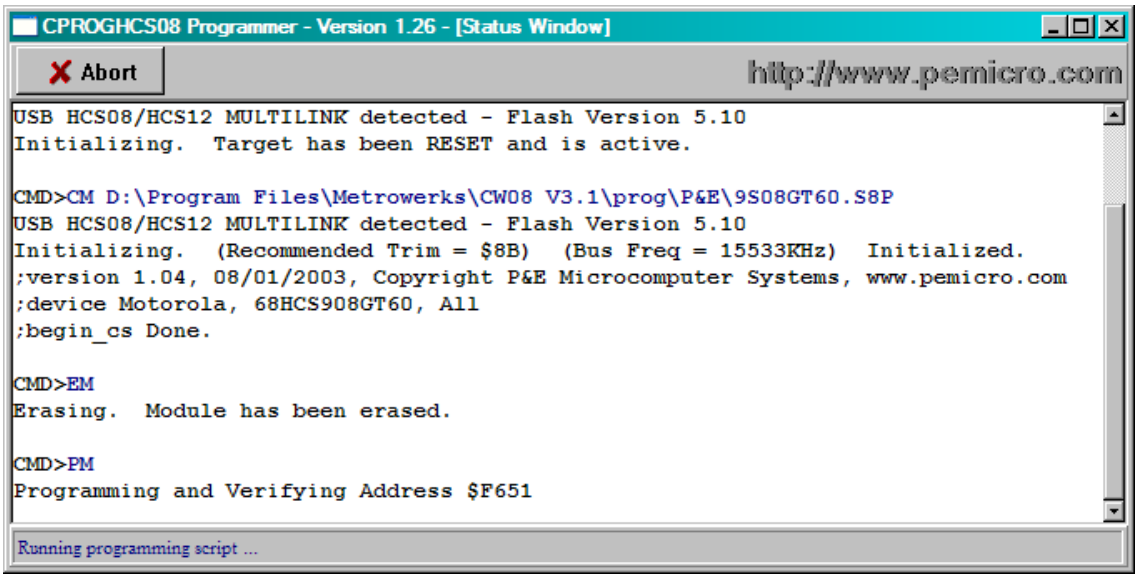

Figure 3-18. Status Window

11. Now, write the 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 9. Select the PM Program Module option and production data is written to flash.
12. Remove power and disconnect the BDM cable from the PCB. Next, power up the PCB. The PCB is now ready to upload an application. This is indicated by all four LEDs being on. 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.

For addition information, see the *802.15.4/ZigBee Embedded Bootloader Reference Manual* (802154EBRM) available from www.freescale.com/zigbee.

Chapter 4
Evaluation Kit Demonstration Applications

The sample applications for the 13192EVB are based on Freescale's Simple MAC (SMAC) and/or the 802.15.4 MAC software. For ZigBee stack application examples, see the appropriate Freescale BeeStack documentation.

The following applications are included on the BeeKit CD:

4.1 SMAC Applications

The following list highlights currently available SMAC applications. Refer to the *Simple Media Access Controller (SMAC) User's Guide* and AN3231 for more information.

- Basic Packet Error Rate (PER)
- Wireless UART
- Accelerometer
- Range
- Lighting
- Test Mode
- Repeater
- Simple Protocol Test Client
- Over the Air Programmer (OTAP)

4.2 802.15.4 MAC/PHY Applications

The following list highlights currently available 802.15.4 MAC/PHY applications. Refer to the *802.15.4 MAC/PHY Software Reference Manual* (802154MPSRM) and other appropriate Freescale documentation for more information.

- PTC Demonstration (AN2771)
- 802.15.4 MyStarNetwork Demo (802.15.4 MyStarNetwork User's Guide)
- 802.15.4 MyWirelessApp Demo (802.15.4 MyWirelessApp User's Guide)

4.3 Windows Based Application

The following list highlights currently available Windows based applications. Refer to the *Embedded Bootloader Reference Manual* (802154EBRM), the Freescale Test Tool Online Help, and other appropriate Freescale documentation for more information.

- Test Tool
- Command Console
- Script Server
- Embedded Bootloader
- Radio Test

Chapter 5
Solution Development

This chapter shows users how to begin development of an MC13192 system solution. Each section highlights the documentation users must read before they begin system development.

Unless specifically stated, all documents described in this chapter are available at: www.freescale.com\ZigBee

5.1 Hardware Design and Layout

Before users begin their hardware design and layout, Freescale provides and recommends reading the documents shown in Hardware Design and Layout Recommended Reading These documents contain reference design information and hardware design guidelines.

Table 5-1. Hardware Design and Layout Recommended Reading

Document Title	Part Number
Compact Integrated Antennas: Designs and Applications for the MC13191/92.	AN2731
Simple Media Access Controller (SMAC) User's Guide	SMACRM
13193 Evaluation Board Reference Manual	13192-EVBRM
MC13191 2.4 GHz, Low Power Transceiver Reference Manual	MC13191RM
MC13192/MC13193 2.4 GHz, Low Power Transceiver Reference Manual	MC13192RM
MC13191 2.4 GHz, Low Power Transceiver, Data Sheet	MC13191DS
MC13192/MC13193 2.4 GHz, Low Power Transceiver Data Sheet	MC13192DS

In addition to this, a complete reference design package can be provided upon request.

5.2 Software Applications Development

When building applications for the MC13192 transceiver, Freescale recommends using the Codewarrior Software Development Tools. A trial version is shipped on the BeeKit CD.

In addition, Freescale provides and recommends reading the relevant documents available from www.freescale.com\Zigbee. Most notably, Freescale recommends reading the documentation that describes the Embedded Bootloader implementation and the Non-volatile Memory (NVM) area used for storing information in the application.

Table 5-2. Software Applications Recommended Reading

Document Title	Part Number
Handling MAC Address Erasure, Recommendations for Restoration	AN2825
802.15.4/Zigbee Embedded Bootloader Reference Manual	802154EBRM
MC13191 2.4 GHz, Low Power Transceiver, Reference Manual	MC13191RM
MC13193/MC13193 2.4 GHz, Low Power Transceiver, Reference Manual	MC13193RM
HCS08 Flash Library Integration For Zigbee and 802.15.4 Applications	AN2770

5.2.1 Proprietary Applications (SMAC)

To begin development of a proprietary application, Freescale provides and recommends reading the documents shown in Table 5-3.

Table 5-3. Proprietary Applications Recommended Reading

Document Title	Part Number
Demonstration Operation: Running the Packet Error Rate, Wireless UART, Accelerometer, Range, and Lighting Demonstration Applications	AN3231
Simple Media Access Controller (SMAC) User's Guide	SMACRM

5.2.2 802.15.4 Specific Applications

Freescale provides and recommends reading the documents shown in 802.15.4 Specific Applications Recommended Reading. This documentation helps guide users through development of an application that sits on top of the 802.15.4 MAC.

Table 5-4. 802.15.4 Specific Applications Recommended Reading

Document Title	Part Number
802.15.4 MAC/PHY Software Reference Manual	802154MPSRM
Zigbee/802.15.4 PHY Protocol Test Client (PTC), Running the PTC Demonstration on the 13192-EVB (DIG-528 board)	AN2771
802.15.4 PHY (Physical Layer) Setup and Porting to Various Printed Circuit Boards (PCBs)	AN2769

5.2.3 ZigBee Applications

For development of ZigBee applications, refer to the appropriate Freescale BeeStack documentation.

Chapter 6
Test Tool Utility

This section introduces the Freescale Test Tool Utility's features, basic components, and setup configuration. The Freescale Test Tool is a Windows based graphical user interface that communicates via the PTC test interface to the Embedded Bootloader enabled applications that run on the 13192-EVBs. The Test Tool provides the following applets:

- Embedded Bootloader
- Command Console
- Script Server
- Radio Test

NOTE

The Command Console and Script Server require users to have knowledge of the 802.15.4 standard. See the 802.15.4 Standard from the IEEE group for detailed information about the 802.15.4 specification. Visit www.ieee.org for more information.

The following sections cover each of the Test Tool utilities in more detail.

6.1 13192-EVB Setup for USB Operation (Test Tool Utilities)

To setup the 13192-EVB for USB operation, perform the following steps.

1. Plug the 13192-EVB into a USB port of the PC with the supplied USB cable.
2. Switch the EVB power switch (S106) to USB.
3. Follow the Windows Hardware Manager default options during the driver install.
4. After the install is complete, reboot the system.

NOTE

In some cases it may be necessary to manually locate the drivers. To do so, perform the following steps.

5. Reinsert the Evaluation Kit CD.
6. If prompted for the `ftdibus.sys` driver, select Browse and change to the drivers directory on the BeeKit CD. Reinsert the BeeKit CD and click on the OK button.
7. If prompted for the `ftser2k.sys` driver, select Browse and change to the drivers directory on the BeeKit CD. Reinsert the BeeKit CD and click on the OK button.
8. After installation is complete, reboot the system.

6.2 Command Console

The Command Console allows users to interact with the hardware and send 802.15.4 commands directly to the 13192-EVBs. The interface is similar to that of an AT terminal application.

NOTE

The Command Console interface requires users to have a working knowledge of the 802.15.4 specification and command set.

The Command Console makes it possible to send commands from a computer to a device as well as receive responses from a device.

This section describes the following elements of the command console:

- Command Console Main Window Overview
- Common Function Overview

For additional details on the Command Console, refer to Command Console help by clicking on Start->Programs->Freescale Zigbee->Test Tool->Help.

Figure 6-1 shows the Command Console main window. The following describes the basic functionality.

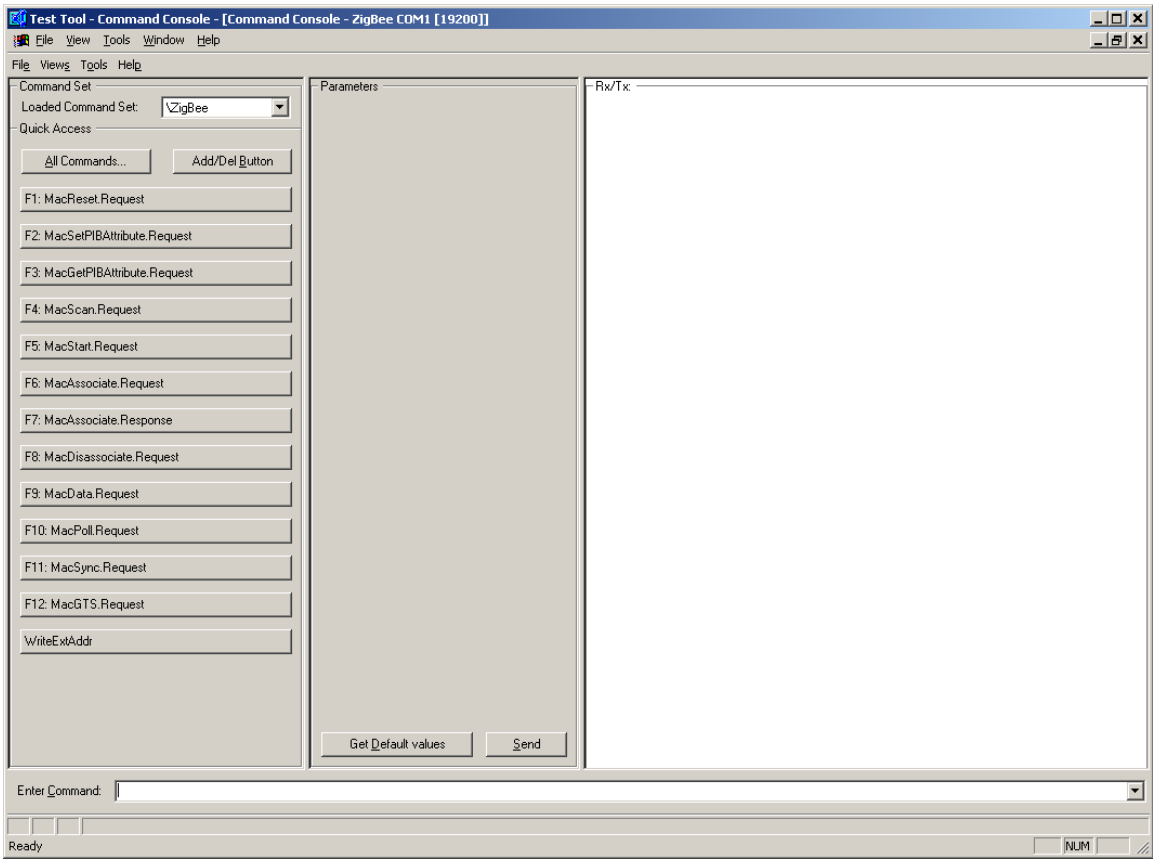

Figure 6-1. Command Console Main Window

6.2.1 Command Console Basic Functionality

This section provides step-by-step instructions for the Command Console. This will help users understand its basic functionality.

The PTC application is loaded by default on the 13192-EVBs. If the boards have been flashed with another application, run the Embedded Bootloader Utility and flash the board with the PTC Application. If the PTC application is running on the board, all four LEDs will light when the board is powered on.

If users have attached the 13192-EVB they will need to add the device to the Communication Setting option under the Tools menu. The USB driver for the 13192-EVB maps the board to a COM port. To determine the proper COM port for the USB driver, run the Windows Device Manager and check the COM ports to determine which port is mapped to the USB driver.

6.2.2 Running the Command Console

1. Start the Test Tool Application as previously described, then launch the Command Console application by clicking on View->Command Console as shown in Figure 6-2.

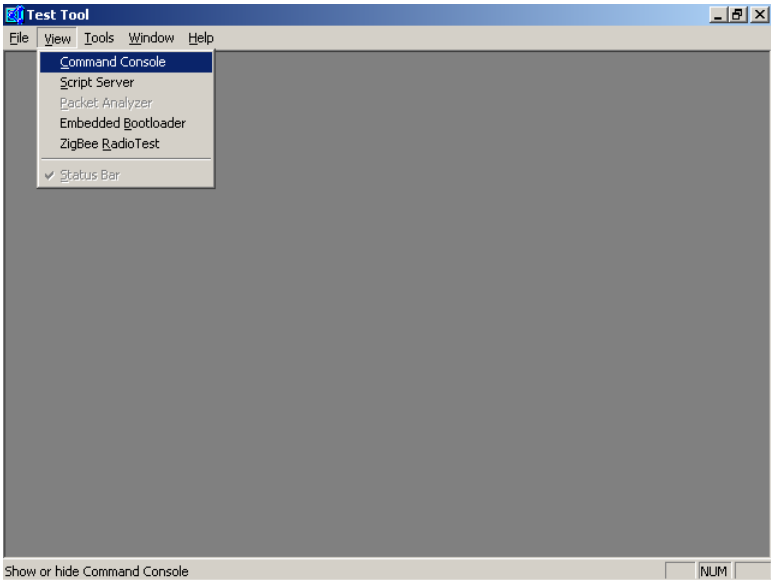

Figure 6-2. Test Tool Window (Command Console Select)

2. Select the device COM port and click the OK button as shown in Figure 6-3.

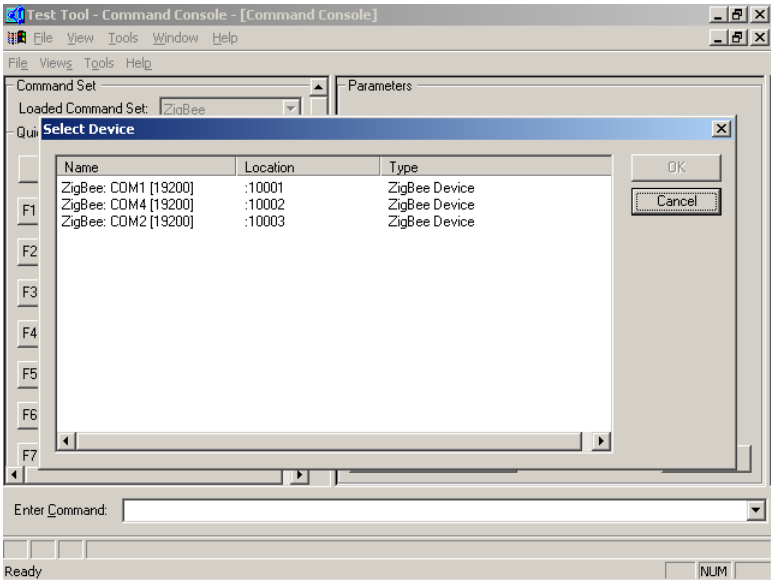

Figure 6-3. Test Tool Window (Command Console Device Select)

The Command Console window appears as shown in Figure 6-4.

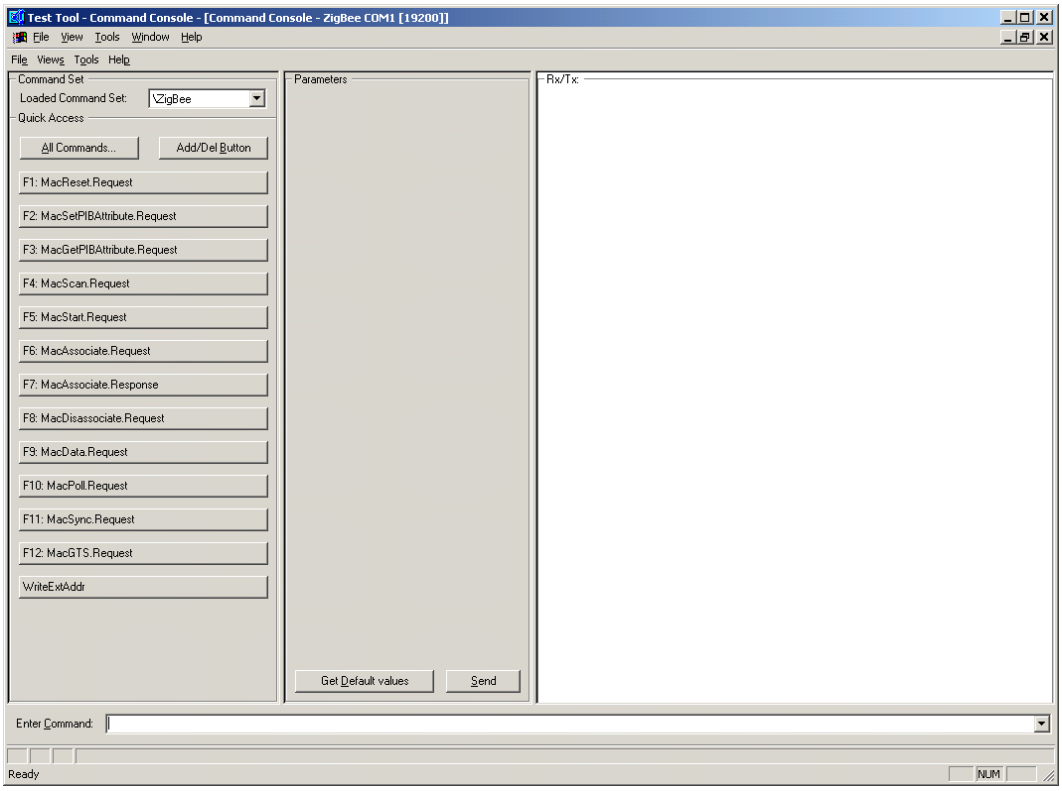

Figure 6-4. Command Console Window

3. In the Enter Command field, type MAC. This field is located at the bottom of the Command Console window.

The first field of the Status bar changes (The status field is below the Enter Command field). It now displays the first available command with the prefix MAC. The Command Console offers command completion. This means users do not have to enter the whole command name. To complete a command, press <Ctrl> + <Space>. Press <Ctrl> + <Space> again and a pop-up menu appears displaying all the commands available starting with the MAC prefix.

If an ambiguous command is entered, a pop-up menu appears showing all available commands beginning with the string present in the input field as shown in Figure 6-5.

4. From the pop-up menu in the Command Console window, click on the MacPurge.Request button.

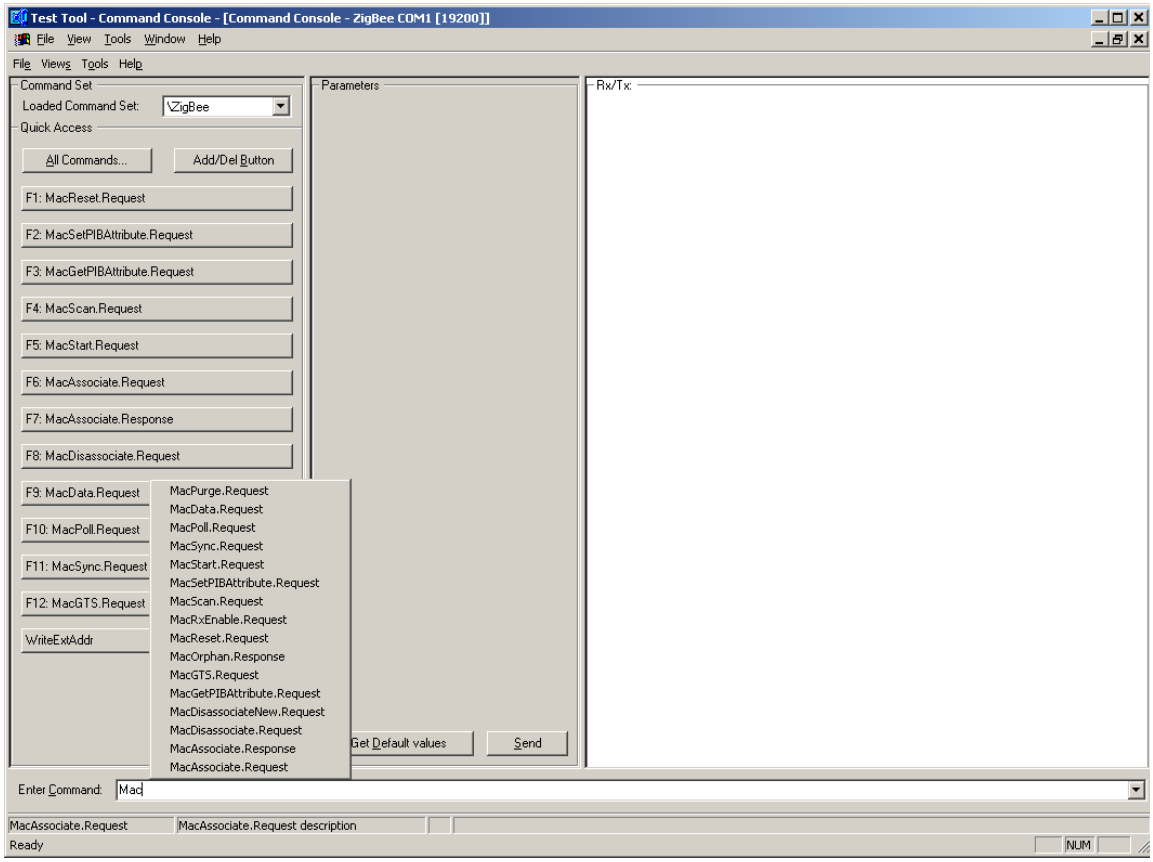

Figure 6-5. Command Console (MAC Command Entries)

As shown in Figure 6-6, sub-sequent fields of the Status bar now display the parameter selected in the current command. In this case, the command is MACPurge.Request and the parameter is msduHandle with a value of 0x55. The right-most status field provides a description of the command.

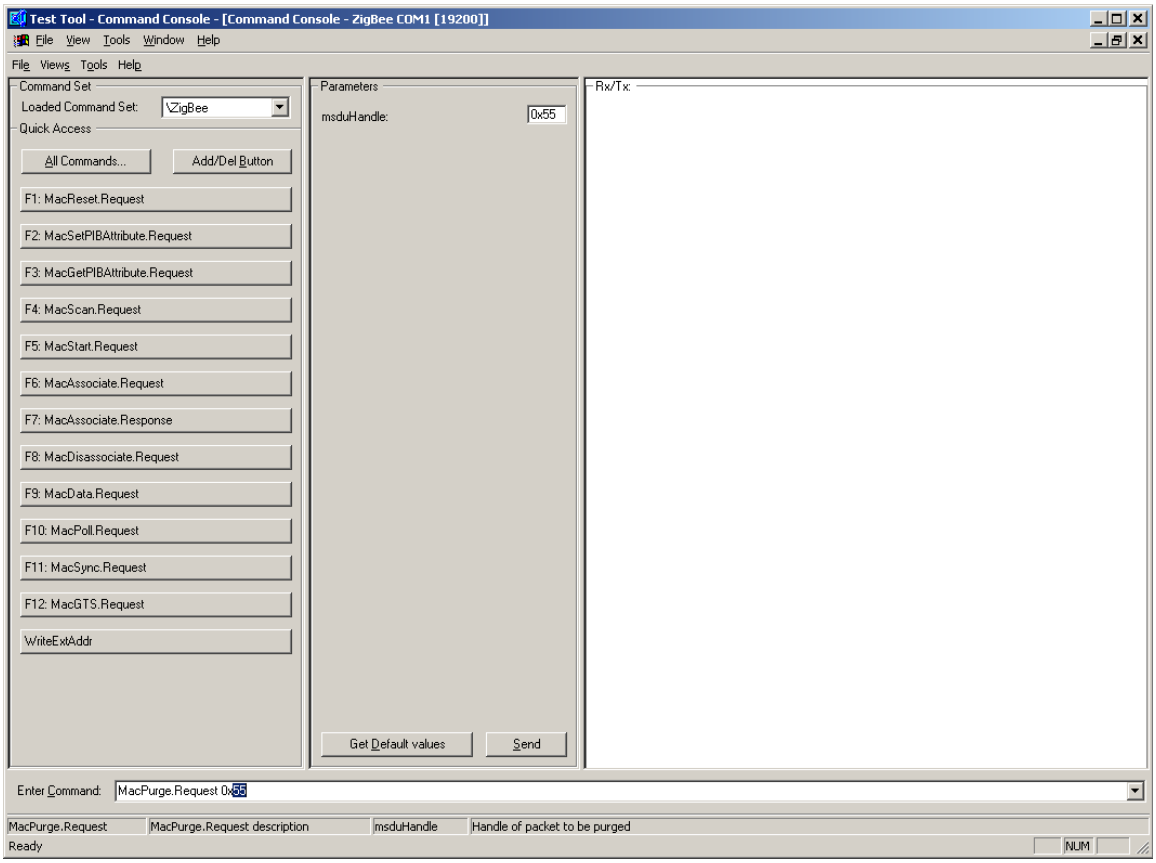

Figure 6-6. Command Console (MACPurge.Request Command)

5. Send the command by pressing the Enter key or clicking the Send button.

The Rx/Tx view is now updated with the command that was just transmitted (MacPurge.Request). The device promptly responds with an event. The most recent item is always placed at the bottom of the list. A more detailed view of each command or event can be seen by expanding the line by clicking on the [+] symbol. In this example, the MacPurge.Request is expanded by clicking on the [+] symbol in the display area. The information appears as shown in Figure 6-7.

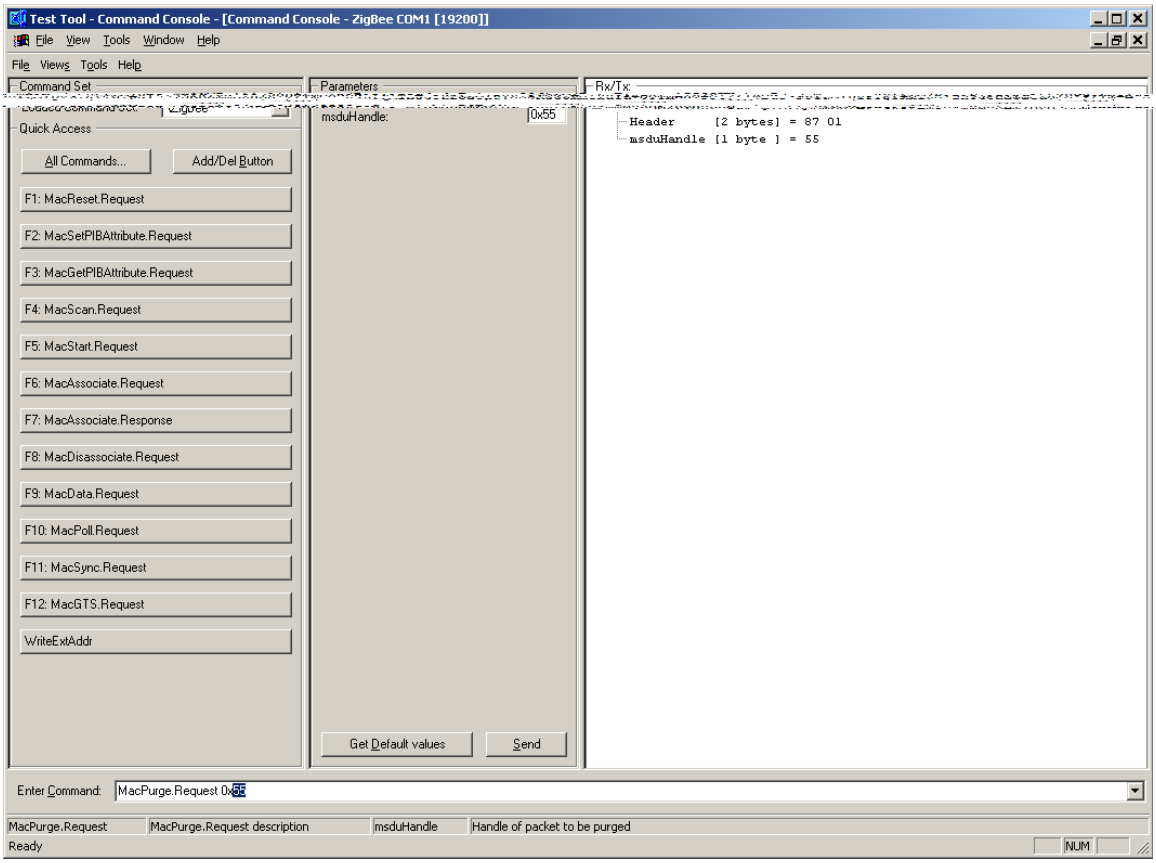

Figure 6-7. Command Console (Expanded Command View)

6.3 Script Server

The Script Server manages Scripts and Test Sets. The server is able to load and execute one or more Scripts and Test Sets. Output for the Scripts can be displayed. The Script execution progress and the test results are displayed in a separate view. The output and results can be stored in text files. One or more Scripts can be added to and saved as a Test Set. A Test Set can include other Test Sets. As an extended feature, the Test Results can be sent as an e-mail message.

NOTE

See the Script Server Guide by clicking on Start->Programs->Freescale Zigbee->Documentation->User Guide for more details.

The following steps describe how to get started with the Script Server.

1. Launch the Script Server application from the Test Tool main window toolbar by clicking on View->Script Server. The Script Server window appears as shown in Figure 6-8.

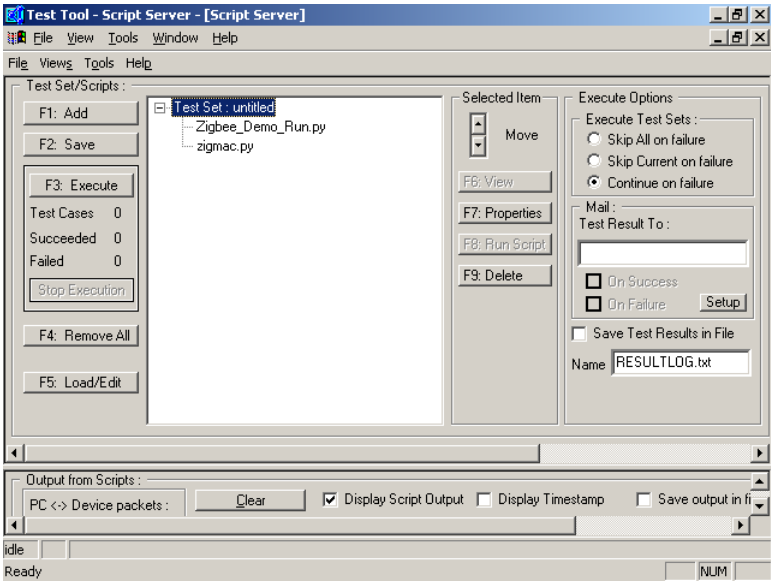

Figure 6-8. Script Server Window

2. Click on the F1:Add button or press F1 to search for Scripts and Test Sets. Perform a normal windows browse session to find the desired files. The demo scripts delivered for the Evaluation Kit are located in the following folder:

   `C:\Program Files\Freescale\Test Tool\Scripts\ZigBee\Demoscripts.`

The Scripts are executed by loading () and executing the following script:

`ZigBee_Demo_Run.py`

This file is located in the following folder:

`C:\Program Files\Freescale\Test Tool\Scripts`

The basic script functionality is as follows:

- ZigBee_Demo_Associate
  - — Uses two devices
  - — Coordinator starts PAN network
  - — Device associates to the Coordinator
- ZigBee_Demo_Data
  - — Uses two devices
  - — Coordinator starts PAN network
  - — Device associates to the Coordinator
  - — Device sends direct data
  - — Device receives indirect data from coordinator
- ZigBee_Demo_GetSet
  - — Uses one device
  - — Sets and gets all PIN attributes.
- ZigBee_Demo_Scan

  - Uses one devices
  - Performing active scan
  - Performing passive scan
  - Performing energy detection
  - Performing orphan scan
- ZigBee_Demo_Start
  - Uses two devices
  - Coordinator starts PAN network
  - Device performing scan

3. Select one or more Scripts (file extension is py) or Test Sets (file extension is tst) and click the Open button.

For example, as shown in Figure 6-9, the `RadioTest.py` file was selected from the RadioTest folder.

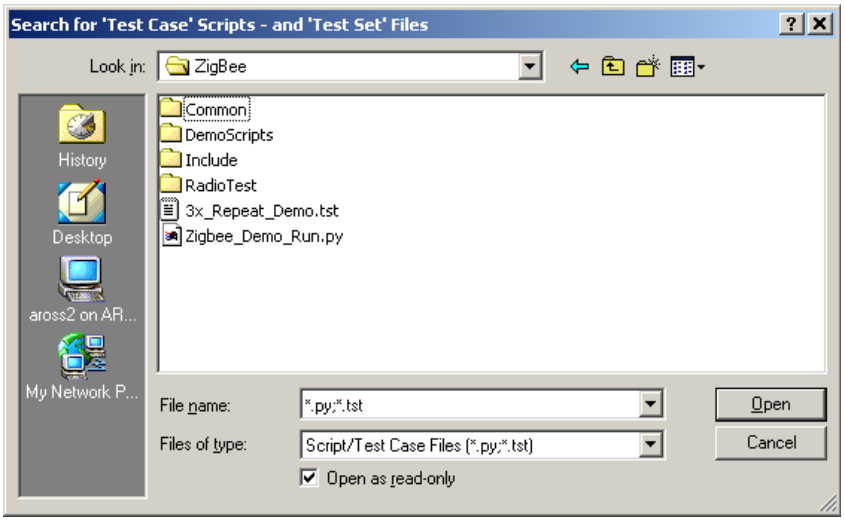

Figure 6-9. Test Case/Test Set Search Window

4. As shown in Figure 6-10, from the Script Server window, highlight the `RadioTest.py` file and click on the F3: Execute button to start the selected Scripts/Test Set.

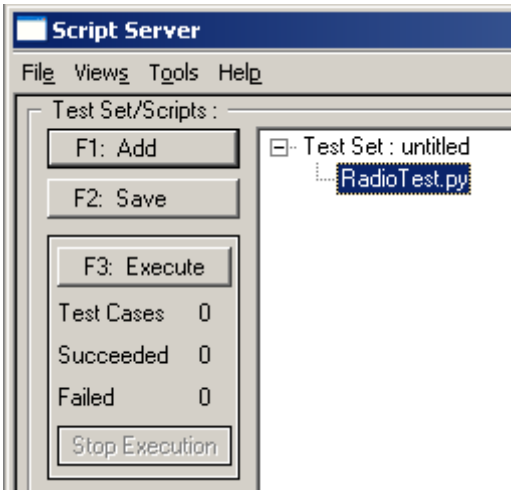

Figure 6-10. Script Server Window (Run Scripts/Test Sets)

The first two lines in the Script Output view are always as follows.

```
10:00:59 Default Pythin Script executed !
10:00:59 SearchPath included !
```

5. The Script can be terminated normally or can be stopped by clicking on the Stop Execution button in the Script Server window as shown in Figure 6-11.

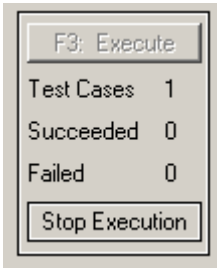

Figure 6-11. Script Server Window (Stop Execution)

The progress and result output are displayed in Test Results window as shown in Figure 6-12.

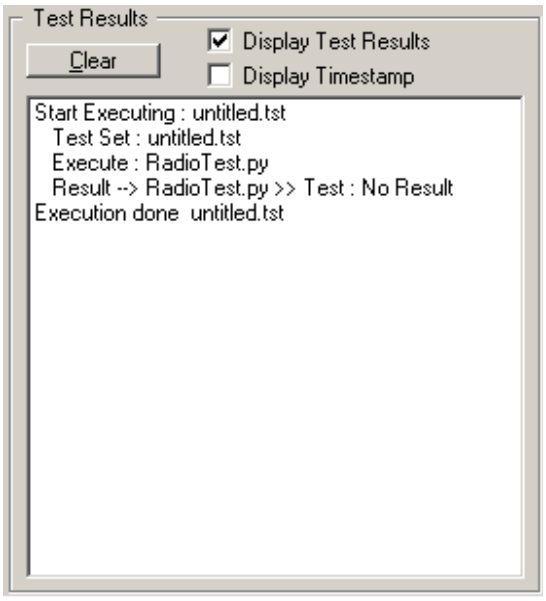

Figure 6-12. Test Results Window

6.4 Radio Test

The Radio Test window, as shown in Figure 6-13, runs the radio test script dialog using one board for radio testing or two boards for sending data between the boards. The application picks the first boards from the List of Devices. If the devices are not connected, then change the order in communication settings by using the Communication Settings option in the Tools menu. Highlight the device and use the Move Up or Move Down button to change the order.

The Radio Test Script has two parts:

1. Radio testing
2. Packet Error Rate (PER) estimation

The PER must be below 1% sending packets with 20 bytes payload to meet the 802.15.4 specification.

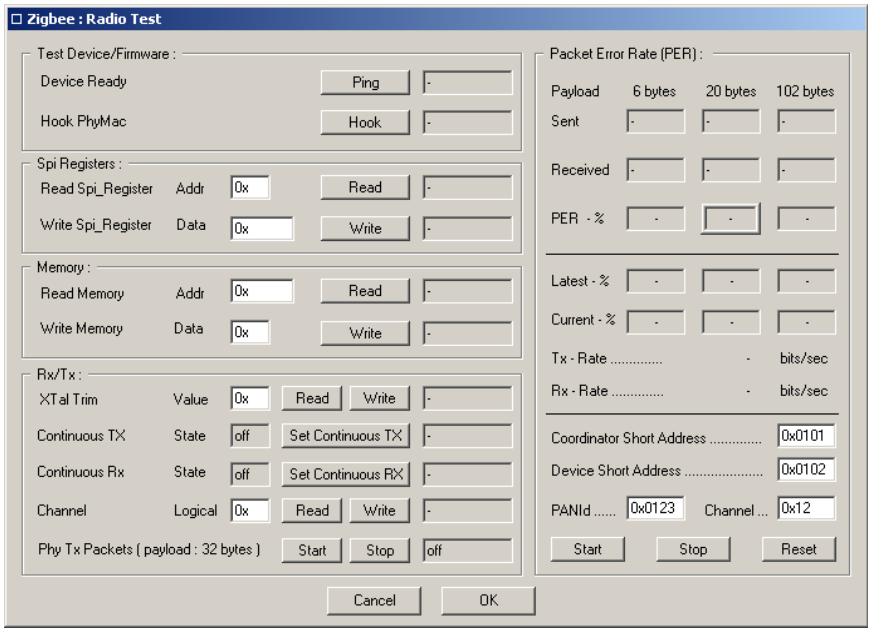

Figure 6-13. Radio Test Window

3. To launch the Radio Test script, from the Test Tool main window toolbar, click on View->ZigBee Radio Test as shown in Figure 6-14.

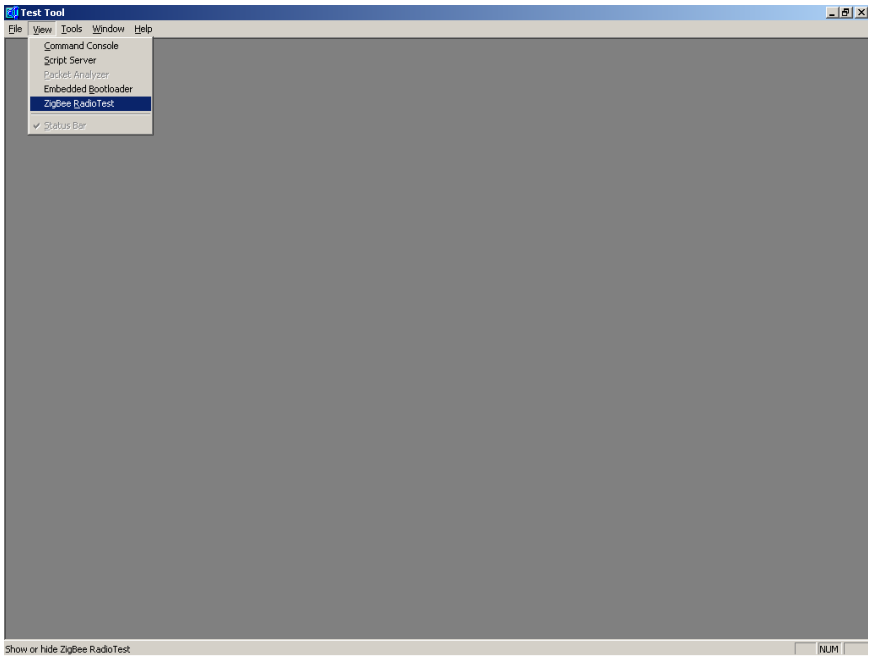

Figure 6-14. Test Tool Window (ZigBee Radio Test Selection)

NOTE

See the ZigBee Radio Test Guide located in windows by clicking on Start->Programs->Freescale Zigbee->Documentation->User Guides for more details.