13192 Evaluation Board Development Kit

(13192EVB) User's Guide

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About This Book

This guide provides a detailed description of how to use the Freescale IEEE® 13192 Evaluation Board Development Kit (13192EVB).

The 13192EVB contains two 13192-EVB evaluation boards, the Freescale BeeKit Wireless Connectivity Toolkit software CD, cables, power supplies, CodeWarrier™ and the Freescale BeeStack software. The 13192EVB 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.

For more information about the use of the Freescale Test Tool, including the Test Tool Embedded Bootloader application, see the Freescale *Test Tool User's Guide* (TTUG).

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 13192EVB.

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

Chapter 3 **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.

Revision History

The following table summarizes revisions to this document since the previous release (Rev 1.3).

Revision History

Location	Revision
Entire Document	Update for Test Tool release.

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
13192EVB	The 13192 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 13192EVB 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 13192EVB 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 13192EVB-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 13192EVB 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)[1]
- 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

1. The MCB13900 will be discontinued as of July 2007 and is not recommended for new designs. Freescale recommends the Infineon BFP420 and the NEC NE622M04.

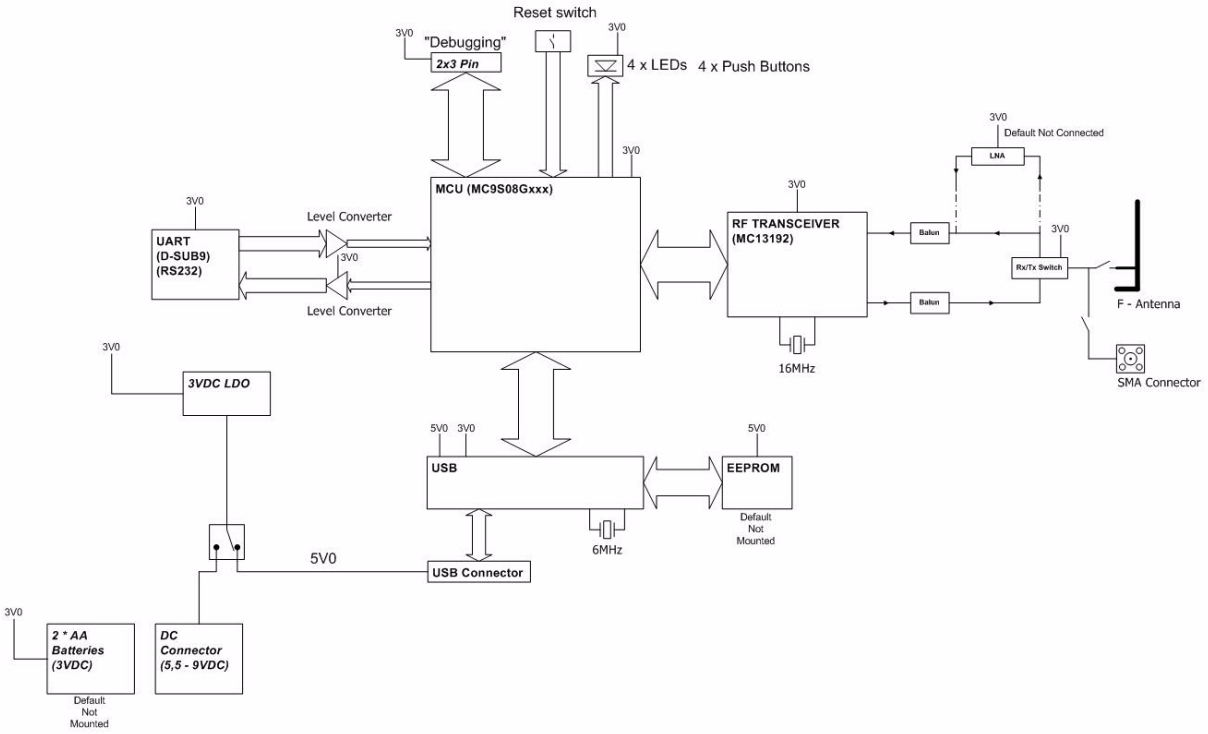

Figure 2-1. 13192-EVB Block Diagram

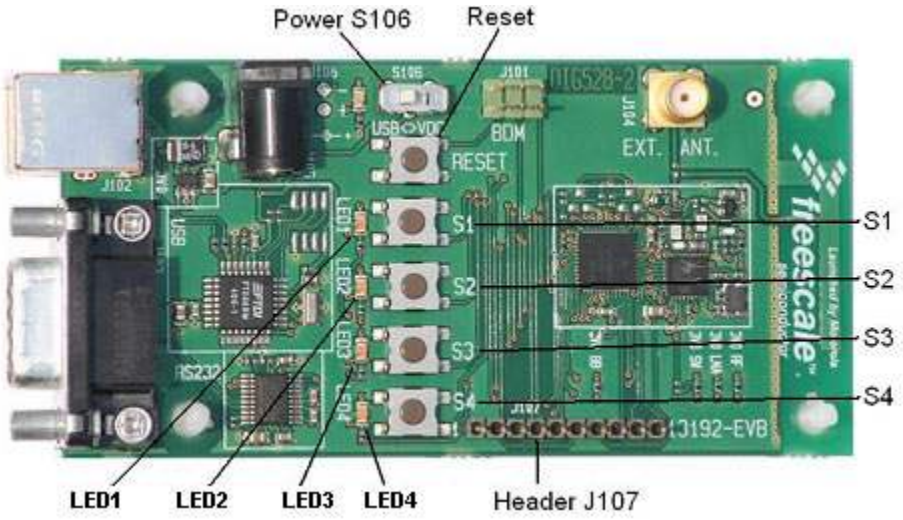

Figure 2-2. 13192-EVB Board Layout

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
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:

3.1 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)

3.2 802.15.4 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.

- 802.15.4 MyStarNetwork Demo (*802.15.4 MyStarNetwork User's Guide*)
- 802.15.4 MyWirelessApp Demo (*802.15.4 MyWirelessApp User's Guide*)

3.3 Windows Based Application

The following list highlights currently available Windows based applications. Refer to the *Test Tool User's Guide* (TTUG), the *BeeKit Wireless Connectivity Toolkit User's Guide* (BKWCTUG), and other appropriate Freescale documentation as needed for more information.

Chapter 4
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

4.1 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 4-1. 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
13192 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.

4.2 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 4-2. Software Applications Recommended Reading

Document Title	Part Number
Handling MAC Address Erasure, Recommendations for Restoration	AN2825
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

4.2.1 Proprietary Applications (SMAC)

To begin development of a proprietary application, Freescale provides and recommends reading the documents shown in Table 4-3.

Table 4-3. 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

4.2.2 802.15.4 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 4-4. 802.15.4 Specific Applications Recommended Reading

Document Title	Part Number
802.15.4 MAC/PHY Software Reference Manual	802154MPSRM
802.15.4 PHY (Physical Layer) Setup and Porting to Various Printed Circuit Boards (PCBs)	AN2769
Freescale Test Tool User's Guide	TTUG

4.2.3 ZigBee Applications

For development of ZigBee applications, refer to following Freescale BeeStack document which provides an overview of current Freescale BeeStack documentation:

- *Freescale BeeStack™ Documentation Overview* (BSDO)