



Quick Start Guide

# ZigBee™ Environment Demonstration (ZeD)

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# About This Guide

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This guide provides an introduction to the Freescale's ZigBee environment Demonstration (ZeD). This briefly guide describes what ZeD is, how to install it, launch it, and how to run a simple demonstration. This guide also shows how to download embedded files to the demonstration boards.

For more information on ZigBee, visit [www.freescale.com/802154](http://www.freescale.com/802154).

## Audience

This document is intended for ZigBee, IEEE<sup>®</sup> 802.15.4 MAC and SMAC custom software and application developers.

## Revision History

Current document revision number: 1.4

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

**Revision History**

Location	Revision
Entire document	Software updates and various screen shot updates.

## 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 abbreviations used in this document.

BDM	Background Debug Module
C	Coordinator
ED	End Device
EVB	MC13192 Evaluation Board with S08GT60 MCU
EVK	Evaluation Kit
GUI	Graphical User Interface
LED	Light Emitting Diode
MCU	MicroController Unit
NCB	MC1321x Network Controller Board with S08GT60 MCU
PC	Personal Computer
PCB	Printed Circuit Board
QE128-EVB	MC1320x Evaluation Board with S08QE128 MCU
R	Router
SARD	MC13192 Sensor Application Reference Design with S08QE128 MCU
SRB	MC1321x Sensor Reference Board with S08GT60 MCU
USB	Universal Serial Bus
ZeD	ZigBee environment Demonstration

# ZeD Introduction

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This guide shows how to install ZeD, program the boards using the embedded image files, how to use the ZeD Windows GUI to monitor and view the ZigBee network, and demonstrate the functionality of the ZigBee applications.

For a more information about ZeD, see the following documents:

- ZeD 1322xEVK Quick Start Guide
- ZeD 1321xEVK Quick Start Guide
- ZeD 13192EVK Quick Start Guide
- ZeD Software User's Guide
- ZeD Embedded Software Design User's Guide
- ZeD Smart Energy Quick Start Guide

## NOTE

13192 EVK Boards are no longer supported by the current BeeKit codebases but the boards can still be used with ZeD if customers still have older versions of the HCS08 BeeStack codebases.

## System Overview

The Freescale ZigBee environment Demonstration (ZeD) is a set of software components designed to visualize, monitor, and demonstrate how a ZigBee network functions. ZeD functions are closely tied to the capabilities of the Freescale BeeStack and the Freescale BeeKit Wireless Connectivity Toolkit to offer an intuitive view of how a ZigBee network is formed and how that network operates. ZeD also allows users to see how Home Automation Profile applications operate on the ZigBee layer while these applications perform various functions.

By demonstrating ZigBee network configurations and functionality, ZeD can be used as a first step in understanding what ZigBee can do and shows how to begin developing applications for it. ZeD also offers insight as to how an end-user might interface with a ZigBee network.

ZeD supports the ZigBee 2006 and ZigBee 2007 (ZigBee Feature Set - Stack Profile 1) standards as implemented in the Freescale BeeStack and the Home Automation Profile for ZigBee applications. ZigBee standards and the Home Automation Profile are defined by the ZigBee Alliance. See [www.zigbee.org](http://www.zigbee.org) for more details. As part of the BeeKit Wireless Connectivity Toolkit, ZeD operates with the other BeeKit components to offer a comprehensive and easy to use platform for ZigBee development.

## Hardware and Software Requirements

The following is a list of the minimum software and hardware requirements required by ZeD as shown in this guide:

- A PC running Microsoft Windows XP®, Microsoft Windows Vista® or Microsoft Windows 2000®
- BeeKit with ZeD installation package provided with a ZigBee EVK or downloaded from the Freescale web site at [www.freescale.com/zigbee](http://www.freescale.com/zigbee)
- The Freescale ZigBee evaluation boards that ship with the 13192-EVK, 1321x-EVK, or 1322x-EVK.
- 1 USB cable to connect the Combined Interface board to the PC.
- Twelve AA or four 9-Volt or twelve AA and four AAA batteries for the boards depending on the EVK type used.

# ZeD Installation

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ZeD is designed for use with the Freescale ZigBee evaluation boards shipped with the Freescale 13192-EVK (EVB and SARD), 1321x-EVK (NCB and SRB) and 1322x-EVK (Network Node (NN), Sensor Node (SN) and Low Power Node (LPN)).

## NOTE

If using the onboard AA battery pack to power the SRB and the temperature sensor is being used, the readings will not be accurate. To obtain more accurate readings, power the SRB through its on board DC power connector.

ZeD software consists of the following two components:

- Embedded software running on the physical evaluation boards. Each board runs a ZigBee Home Automation Application which runs on top of the Freescale BeeStack
- ZeD Windows GUI software running on a PC that allows users to see the state of the network and the functions performed by the embedded applications as these applications communicate over the air using ZigBee

When installing Freescale BeeKit with ZeD, both software components are deployed to the system. The ZeD embedded software consists of embedded image files used to program the boards. The embedded image files are located in the ZeD installation folder on the PC.

## Software Requirements

Before installing ZeD, ensure that the following items are in place. ZeD will not function if these requirements are not met.

- A PC running Microsoft Windows XP<sup>®</sup>, Microsoft Windows Vista<sup>®</sup> or Microsoft Windows 2000<sup>®</sup>.
- The Freescale ZigBee evaluation boards that come with the 13192-EVK, 1321x-EVK, 1322x-EVK. At a minimum, one of the boards must be configured as the ZigBee Coordinator running the Combined Interface application. The other boards are needed to demonstrate ZigBee networks and Home Automation “over the air” functionality.

The boards in the EVKs come pre-programmed with the ZigBee applications supported by ZeD. However, if the original software is overwritten, or users intend to try custom board configurations, the boards will have to be reprogrammed. See [Downloading an Embedded Image File \(HCS08\)](#), [Downloading an Embedded Image File \(ARM7\)](#) and the *ZeD Embedded Software User's Guide (ZEDESUG)* for more details on how to configure and program a board.

The following items are required to reprogram the boards using the ZeD embedded software image files for the HCS08 platforms (13192-EVK, 1321x-EVK):

- The BDM Support kit including the USB HCS08/HCS12 Multilink BDM from P&E Microcomputer Systems, Inc
- The BDM Software provided with the BeeKit Wireless Connectivity ToolKit

To reprogram the boards using the ZeD embedded software image files for the ARM7 platforms (1322x-EVK) one of the following items are required:

- J-Link JTAG Debugger and programming tools available in IAR Embedded Workbench IDE
- MC1322x Firmware Loader available in Freescale Test Tool 11.0.0 and later

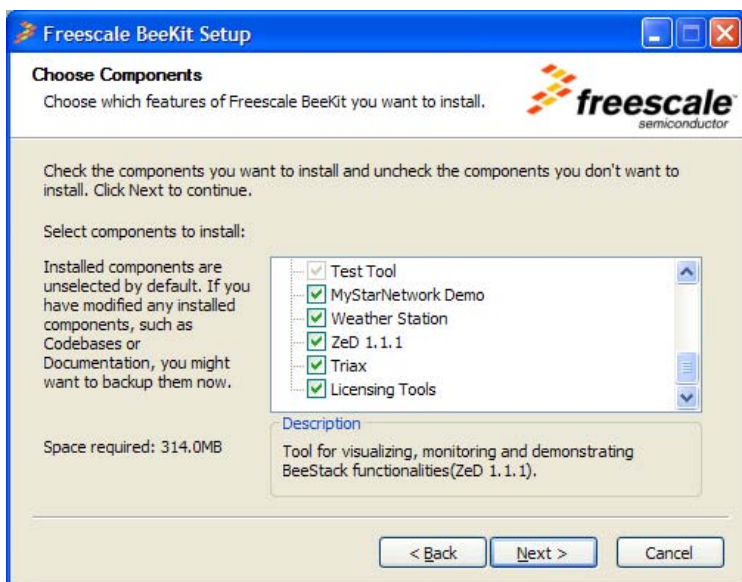
If users intend to customize the existing applications or develop their own ZigBee applications, they will also need the following items:



- The Freescale BeeKit Wireless Connectivity Toolkit with a license for Freescale BeeStack development. Refer to the *BeeKit Wireless Connectivity ToolKit User's Guide* for details on how to install and use BeeKit
- The Freescale CodeWarrior Development Studio for Freescale HC(S)08 Microcontrollers, Version 6.1 Special Edition (Full License) (Requires 60K upgrade for 802.15.4 and BeeStack) or later for the HCS08 platforms.
- IAR Embedded Workbench for ARM, Version 5.20 or later (Requires 256K Edition)

## Installing on the PC

ZeD is installed by default with the BeeKit Wireless Connectivity Toolkit software. To install ZeD, make sure that while installing BeeKit, the ZeD component check box is selected as shown in [Figure 1](#).



**Figure 1. Selecting ZeD to be Installed in the BeeKit Installer**

Refer to the *BeeKit Wireless Connectivity Toolkit Quick Start Guide* for details on how to use the BeeKit installer.

By default, the installation program copies the ZeD software to the PC hard drive in the following folder location:

Program Files\Freescale\ZeD v.v.v

The installation program also creates shortcuts to the ZeD PC GUI and the embedded image file folder in the following Windows Start Menu location:

Start -> Programs -> Freescale BeeKit -> ZeD v.v.v -> Freescale ZeD v.v.v

The installation program can also place a shortcut to the ZeD application on the PC desktop. In the above path examples, v.v.v designates a 3-digit version number, for example, 1.1.0.

# Forming a Network and Starting ZeD

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This section provides the steps required to form a ZigBee network using the evaluation boards running the Freescale BeeStack and the ZigBee Home Automation sample applications. This section also shows how to start ZeD to monitor and view network status.

## Forming the Network

To form the ZigBee network with the boards in the EVK follow the steps in only one of the following sections:

- If using the 1322x-EVK, see [Forming the Network Using 1322x-EVK Boards](#).
- If using the 1321x-EVK, see [Forming the Network Using 1321x-EVK Boards](#)
- If using the 13192-EVK, see [Forming the Network Using 13192-EVK Boards](#)

## Forming the Network Using 1322x-EVK Boards

For the 1322x-EVK, the Home Automation applications and the boards they are running on are:

- Combined Interface running on a MC1322x Sensor Node (SN)
- 1st On/Off Light running on a MC1322x Network Node (NN)
- 1st On/Off Switch running on a MC1322x Low Power Node (LPN)
- 2nd On/Off Light running on a SN
- 2nd On/Off Switch running on a LPN
- Dimmable Light running on a NN
- Dimmer Switch running on a SN
- Thermostat running on a NN
- Temperature Sensor running on a SN

To form a ZigBee network using the boards that come with the 1322x-EVK, perform the following steps:

1. Select the MC1322x Sensor Node board with the Combined Interface label from the EVK. This board serves as the ZigBee Coordinator.
2. Using a USB cable provided with the EVK, connect the Combined Interface SN to the computer that will be running ZeD.
3. Install the AA batteries on the rest of the SN and NN boards in the EVK and the AAA batteries on the LPN boards. The battery slots are located on the back of the boards.
4. Power ON the Combined Interface SN using the OFF/ON.
5. If the board drivers for the SN are not already installed, the Windows “Found New Hardware” wizard appears. Steer the system to the driver location (Freescale Drivers folder) which by default is at the following location:

`Program Files\Freescale\Drivers`

6. Power ON the other boards using the OFF/ON switch.
7. Users are now ready to form the ZigBee network. Press SW1 on the Combined Interface SN. Wait for LED1 and LED2 to be continuously on. The network is now formed.

8. Press SW1 on the “On/Off Light” NN. That board joins the network. When the board has joined, the Message “Running Device” appears on the board LCD screen.
9. Press SW1 on the “On/Off Switch” LPN. That board joins the network. When the board has joined, LED1 on the board turns continuously on.
10. Repeat Step 9 for the remaining boards in the EVK. Wait until each board joins before joining another one.
11. Users have now successfully formed a nine node, Home Automation ZigBee network.

## Forming the Network Using 1321x-EVK Boards

For the 1321x-EVK, the Home Automation applications and the boards they are running on are:

- Combined Interface running on a Network Controller Board (NCB)
- On/Off Light running on a Sensor Reference Board (SRB)
- On/Off Switch running on a SRB
- Dimmable Light running on a NCB
- Dimmer Switch running on a SRB
- Thermostat running on a NCB
- Temperature Sensor running on a SRB

To form a ZigBee network using the boards that come with the 1321x-EVK, perform the following steps:

1. Select the NCB board with the Combined Interface label from the EVK. This board serves as the ZigBee Coordinator.
2. Using a USB cable provided with the EVK, connect the Combined Interface NCB to the computer that will be running ZeD. For the board drivers to work correctly, ensure that the USB cable is connected directly to the PC and not to a USB external hub.
3. Install the AA batteries on the rest of the 6 (six) boards in the EVK. The battery slots are located on the back of the NCBs and SRBs.
4. Power ON the Combined Interface NCB using the OFF/ON switch and reset the board by pressing its Reset button.
5. If the board drivers for the NCB are not already installed, the Windows “Found New Hardware” wizard appears. Steer the system to the driver location (Freescale Drivers folder) which by default is at the following location:

`Program Files\Freescale\Drivers`

6. Power ON the other 6 (six) boards using the OFF/ON switch and then reset all of them by pressing their Reset buttons.
7. Users are now ready to form the ZigBee network. Press SW1 on the Combined Interface NCB. Wait for the “Running Device” message to appear on the NCB’s display. The network is now formed.

8. Press SW1 on the “On/Off Light” SRB. That board joins the network. When the board has joined, LED1 and LED2 on the board turn continuously on.
9. Press SW1 on the “On/Off Switch” SRB. That board joins the network. When the board has joined, LED1 on the board turns continuously on.
10. Repeat Step 9 for the other 4 (four) remaining boards in the EVK. Wait until each board joins before joining another one.
11. Users have now successfully formed a seven node, Home Automation ZigBee network.

## Forming the Network Using 13192-EVK Boards

For the 13192-EVK, the Home Automation applications and the boards they are running on are:

- Combined Interface running on a 13192-Evaluation Board (EVB)
- On/Off Light running on a Sensor Applications Reference Design (SARD) board
- On/Off Switch running on a EVB
- Dimmable Light running on a EVB
- Dimmer Switch running on a SARD board

To form a ZigBee network using the boards that come with the 13192-EVK, perform the following steps:

1. Select the EVB with the Combined Interface label from the EVK. This board serves as the ZigBee Coordinator.
2. Using a USB cable provided in the EVK, connect the Combined Interface EVB to the computer that will be running ZeD.
3. If the board drivers for the Combined Interface EVB are not already installed, the “Found New Hardware” wizard appears. Steer the system to the driver location (Freescale Drivers folder) which by default is at the following location:

`Program Files\Freescale\Drivers`

4. Power ON the Combined Interface EVB by moving switch S106 to the USB position. Reset the board by pressing its RESET button.
5. Attach the 9-Volt batteries to the other 4 (four) boards in the EVK.
6. Power ON the On/Off Switch EVB and the Thermostat EVB by turning the S106 switch on both boards to the VDC position. Reset both boards by pressing their RESET button.
7. Power ON the On/Off Light SARD and the Temperature Sensor SARD by changing S105 on both boards to the “Batt.” position. Reset both boards by pressing S105.
8. Users are now ready to form the ZigBee network. Press S1 on the Combined Interface EVB. Wait for LED1 and LED2 on the board to turn continuously on. The network is now formed.



9. Press S101 on the On/Off Light SARD. The board will join the network. When the board has joined, LED1 and LED2 on the board turn continuously on.
10. Press S1 on the On/Off Switch EVB. The board will join the network. When the board has joined, LED1 on the board turns continuously on.
11. Press S1 on the Dimmable Light EVB. The board will join the network. When the board has joined, LED1 on the board turns continuously on.
12. Press S101 on the Dimmer Switch SARD. The board will join the network. When the board has joined, LED1 on the board turns continuously on.
13. Users have now successfully formed a five node, Home Automation ZigBee network.

# Running ZeD

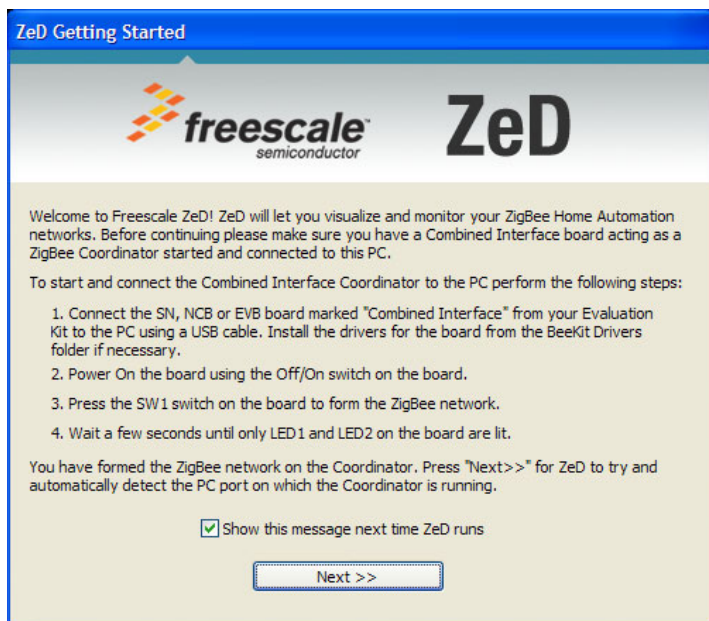
To run ZeD, perform the following tasks.

## 1. Start ZeD from the Windows Start Menu at:

Start-> Programs-> Freescale BeeKit-> ZeD v.v.v-> Freescale ZeD v.v.v

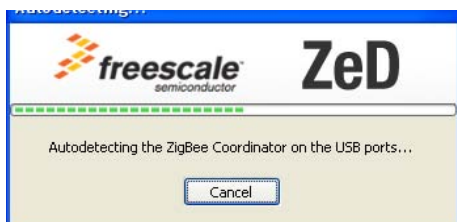
or by using the Freescale ZeD application shortcut on the Windows desktop.

## 2. If ZeD is started for the first time, it displays a short introduction message on how to connect the Combined Interface board (ZigBee Coordinator) to the PC as shown in [Figure 2](#).



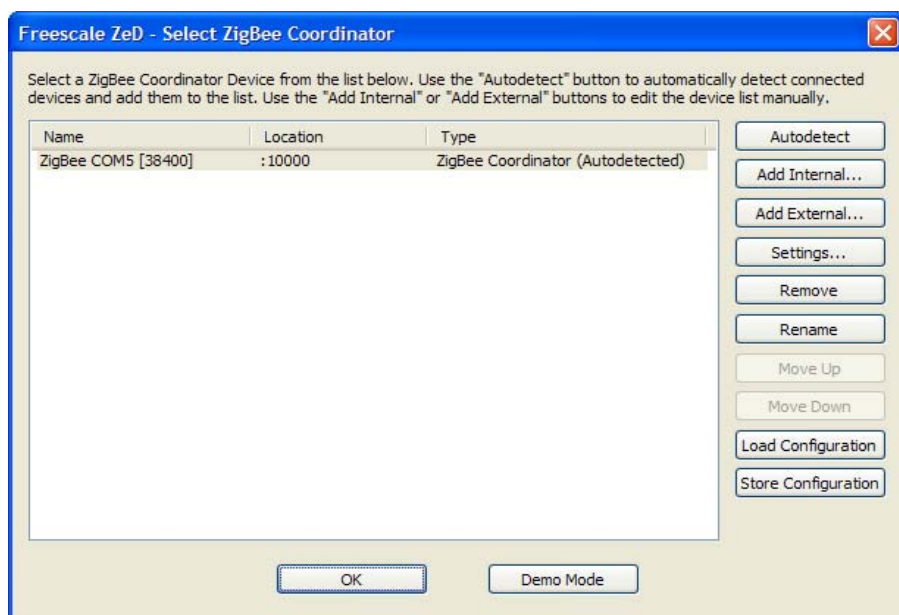
**Figure 2. ZeD Getting Started Message**

3. After pressing the Next>> button, ZeD tries to automatically detect the COM port that corresponds to the Combined Interface board serving as the ZigBee Coordinator. Figure 3 shows the ZeD window as it tries to autodetect the Combined Interface board.



**Figure 3. Automatic Detection of the ZigBee Coordinator Port**

4. If the Combined Interface board is detected, the board port is displayed in the list as having the type “ZigBee Coordinator (Autodetected)” as shown in the Coordinator Selection window (Figure 4).



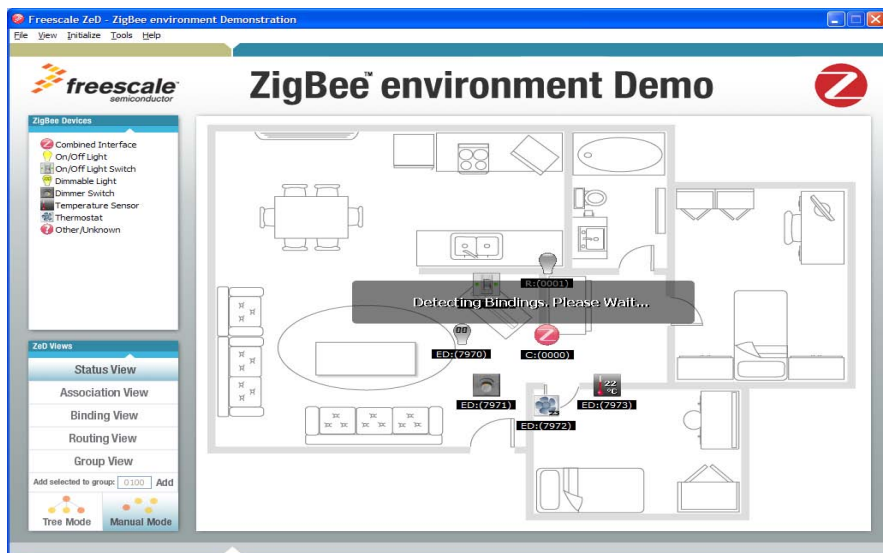
**Figure 4. ZigBee Coordinator Selection Dialog**

If no port appears in the list, or the first port in the list has the type “ZigBee Device” and not “ZigBee Coordinator (Autodetected)”, then ZeD has not been able to detect the coordinator board. If this occurs, check for the following:

- The board is properly connected via the USB cable to the PC and that the board drivers are correctly installed. See the *ZeD Software User's Guide* for a detailed description of virtual board ports and how they are assigned.
- The ZigBee network is formed on the Combined Interface coordinator board. LED1 and LED2 on the boards are on when the network is properly formed.
- There are no other instances of ZeD running on the PC.
- The port of the coordinator is not in use by other software such as Freescale Test Tool.

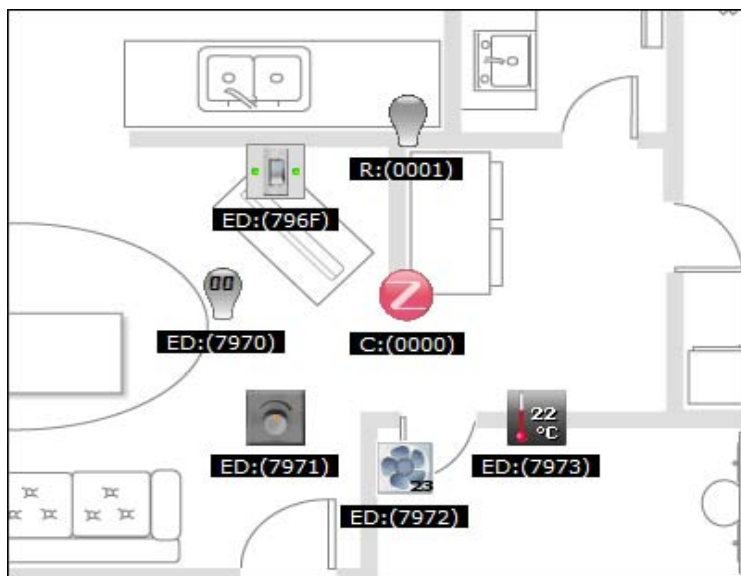
After checking these items, press the Autodetect button on the Coordinator Selection Window to repeat the Coordinator autodetection process.

5. Ensure that the COM port of the ZigBee Coordinator is highlighted and click the OK button. This launches the ZeD main window as shown in [Figure 5](#). ZeD connects to the ZigBee Coordinator and uses it as a gateway to find out information about the other nodes in the network. Users should wait until this network scan process is over and the “Detecting Bindings. Please Wait...” pop-up window disappears.



**Figure 5. ZigBee Main Window During Device Detection**

6. ZeD now displays the node ZigBee Home Automation endpoints as icons on the ZeD House Plan as shown in [Figure 6](#). The icons have the ZigBee Device Type (C for coordinator, R for router and ED for end device) and the network address of the node on the label.



**Figure 6. ZigBee Main Window Showing the ZigBee Nodes as Icons**

# ZeD Use Case

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This section describes how to use ZeD to initialize the Home Automation applications running on the boards in the EVK. This allows the boards to communicate and control each other over the ZigBee network and shows how the state change of the applications are reflected in the ZeD GUI.

## Use Case Requirements

Before running through the use case, follow the steps described in [Forming a Network and Starting ZeD](#), to first form either the nine, seven or five node networks and run the ZeD GUI. The boards also must be placed in Application Mode as described in the next section.

## Placing the Boards in Application Mode

This section describes how to place the boards in Application Mode so that the user interface on the boards can perform application specific functions. After being joined to a network, the boards are in Configuration Mode and the switches and LEDs on the boards have functions related to the network formation process. By placing the boards in Application Mode, the functions of the switches and LEDs change to application related functions.

For example, in Application Mode, LED2 on the On/Off Light board represents the actual on/off state of the light. Refer to the appropriate Freescale EVK documentation for more details on the user interface of the boards.

To switch between board modes, perform the following tasks:

1. Press and hold SW1 on each SN, NN, LPN, SRB and NCB board for about 2 seconds.
2. Press and hold S1 on each EVB board for about 2 seconds.
3. Press and hold S101 on each SARD board for about 2 seconds.

When the boards go from Configuration Mode to Application Mode, there should be a change in the state of the LEDs on the board. For the On/Off Light, On/Off Switch, Dimmable Light, and Dimmer Switch

boards, LED1 turns off. For the Thermostat and Temperature Sensor boards, the state of the LEDs is updated to match a binary representation of temperatures. For all the boards with a LCD display, the second line of the LCD displays “App” instead of “Cfg”.

Application mode is not available on the Combined Interface board.

## **ZeD Use Case Using EVK Boards**

This use case describes how to use ZeD for the boards that ship with the 1322x-EVK, 1321x-EVK and 13192-EVK. Where applicable, the steps are exactly the same with the following notable items.

- In the 1321x-EVK and 1322x-EVK, the SRB, NCB, SN, NN, and LPN switches are labelled SW1, SW2, SW3, SW4
- In the 13192-EVK, the EVB switches are labelled S1, S2, S3, S4 and the SARD switches are labelled S101, S102, S103, and S104
- The 13192-EVK boards do not have the Temperature Sensor and Thermostat functionality.
- The 1322x-EVK has two On/Off Light and On/Off Switch boards.

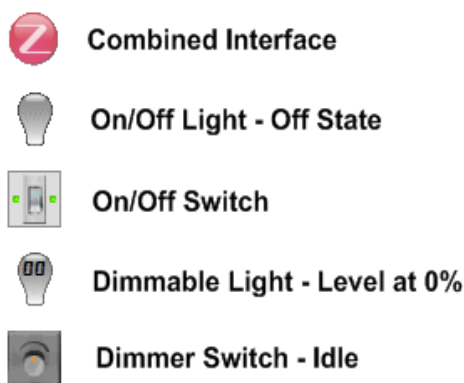
Follow this use case after ZeD finishes scanning the network and displays the nodes as icons on the ZeD main window house plan image as shown in the [Running ZeD](#) section.

Figure 7 shows the state of the icons on the screen for the 1321x-EVK and 1322x-EVK boards and how they reflect the state of the application. The temperature displayed by the Temperature Sensor will vary according to local room temperature.



**Figure 7. 1321x-EVK, 1322x-EVK Initial Boards States as Seen in ZeD**

Figure 8 shows the state of the icons on the screen for the 13192-EVK boards and how they reflect the state of the application.



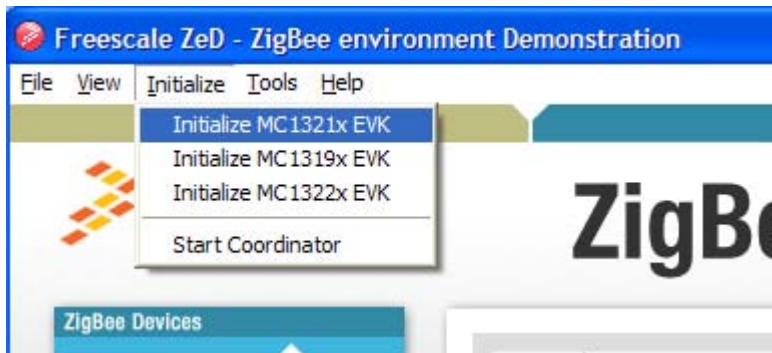
**Figure 8. 13192-EVK Initial Boards States as Seen in ZeD**



## Initializing the EVKs

This section performs network initialization so that devices that have matching functionality such as the On/Off Light and On/Off Switch can communicate with each other:

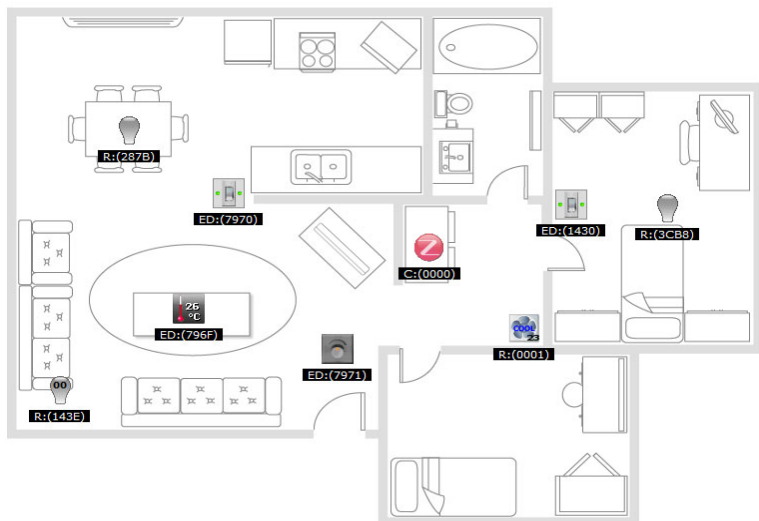
1. From the ZeD menu bar choose Initialize -> Initialize MC1321x EVK (or MC1319x EVK, MC1322x EVK) as shown in [Figure 9](#).



**Figure 9. Initializing the EVKs**

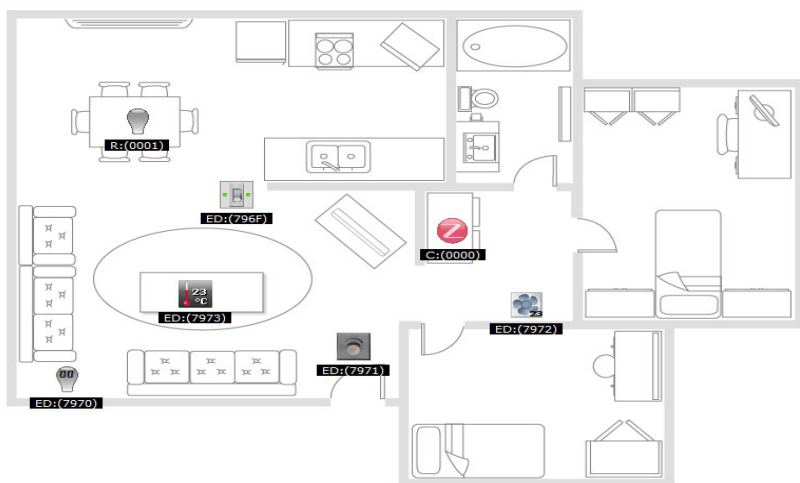
2. Wait until the initialization process completes and the pop-ups with the “Adding endpoints to groups. Please Wait...” message disappears.

The device icons moved to pre-defined positions on the house plan as shown in [Figure 11](#) for the 1322x-EVK.



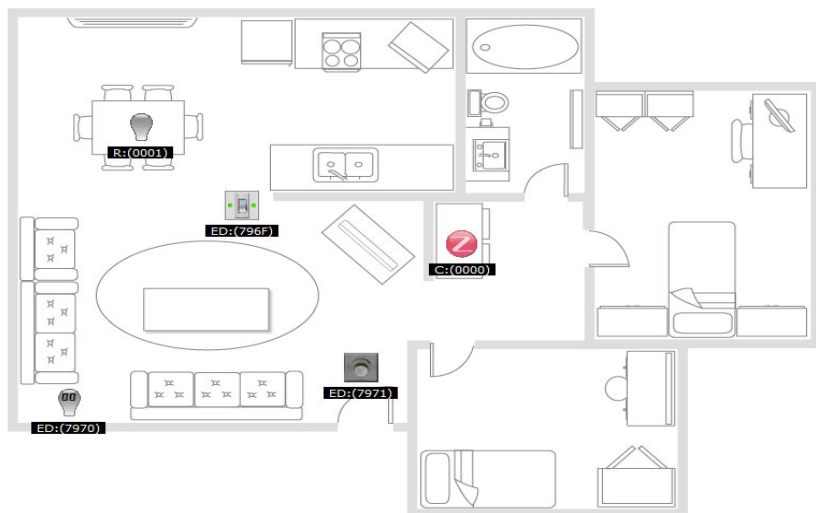
**Figure 10. Device Icons Moved to Pre-defined Positions at the End of Initialization (1322x-EVK)**

The device icons moved to pre-defined positions on the house plan as shown in [Figure 11](#) for the 1321x-EVK.



**Figure 11. Device Icons Moved to Pre-defined Positions at the End of Initialization (1321x-EVK)**

The device icons moved to pre-defined positions on the house plan as shown in [Figure 12](#) for the 13192-EVK.



**Figure 12. Device Icons Moved to Pre-defined Positions at the End of Initialization (13192-EVK)**

## NOTE

The 13192-EVK boards do not have the Temperature Sensor and Thermostat functionality.

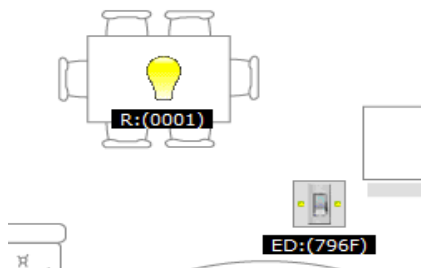
3. The initialization has made the following connections between devices using ZigBee groups:
  - The On/Off Switch(es) controls the On/Off Light(s)
  - The Dimmer Switch controls the Dimmable Light
  - The Temperature Sensor sends periodic temperature measurements to the Thermostat (1321x-EVK Only)

For more details about ZigBee groups, see the *ZeD Software User Guide*.

## Using the On/Off Switch and the On/Off Light (1322x-EVK, 1321x-EVK and 13192-EVK)

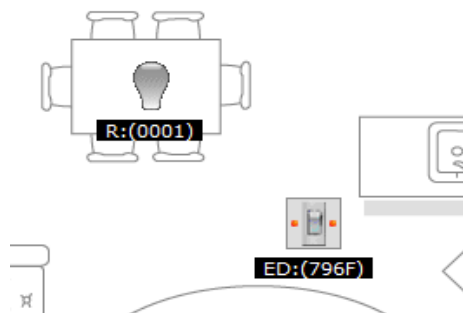
This section shows how the On/Off Switch can send commands over the ZigBee network to the On/Off Light and how the effect of the commands are reflected in the ZeD GUI.

1. Ensure that EVK initialization has been performed as described in [Initializing the EVKs](#) and that both On/Off Light and On/Off Switch boards are in Application Mode as described in [Placing the Boards in Application Mode](#).
2. Press SW1 on the On/Off Switch board. This sends the Toggle command to the light. Notice how LED2 on the On/Off Light board turns on and the On/Off Light icon on the ZeD GUI displays the light bulb on as shown in [Figure 13](#). The small LEDs on the On/Off Switch icon also turn yellow to indicate that the Combined Interface also received the Toggle command from the On/Off Switch and updated the icon.



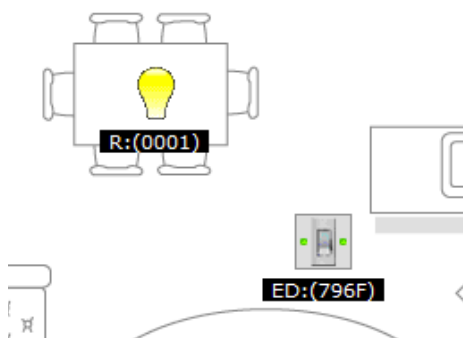
**Figure 13. The On/Off Switch Sending “Toggle” to the On/Off Light**

3. Only for the 1321x-EVK and 13192-EVK: Press and hold SW2 on the On/Off Switch board for about 2 seconds. This sends the Off command to the light. Notice how LED2 on the On/Off Light board turns off and the On/Off Light icon on the ZeD GUI changes the light bulb state to off as shown in [Figure 14](#). The small LEDs on the On/Off Switch icon also turn red, to indicate that the Combined Interface also received the Off command from the On/Off Switch and updated the icon.



**Figure 14. The On/Off Switch Sending “Off” to the On/Off Light**

4. Only for the 1321x-EVK and 13192-EVK: Press SW2 on the On/Off Switch board. This sends the On command to the light. Notice how LED2 on the On/Off Light board turns on and the On/Off Light icon on the ZeD GUI changes the light bulb state to on as shown in [Figure 15](#). The small LEDs on the On/Off Switch icon also turn green which means that the Combined Interface also received the On command from the On/Off Switch and updated the icon.



**Figure 15. The On/Off Switch Sending “On” to the On/Off Light**

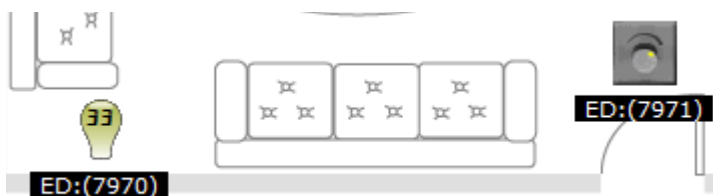
## NOTE

Steps 3 and 4 do not apply to the On/Off Switch running on the MC1322x-LPN board. When this board is running in low power mode, only SW1 is available. See ZigBee Application Users Guide for details.

## Using the Dimmer Switch and the Dimmable Light

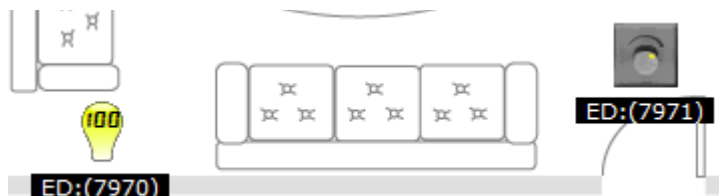
This section shows how the Dimmer Switch can send commands over the ZigBee network to the Dimmable Light and how the effect of the commands are reflected in the ZeD GUI.

1. Ensure that EVK initialization has been performed as described in [Initializing the EVKs](#) and that both Dimmer Switch and Dimmable Light boards are in Application Mode as described in [Placing the Boards in Application Mode](#)
2. Press SW2 on the Dimmer Switch board. This sends the “Step Up 33%” Command to the Dimmable Light. Notice how LED2 on the Dimmable Light boards turns on and LED3 and LED4 are off. The ZeD GUI shows the Dimmable Light bulb icon changing from the off state and the level (as a percentage) on the icon rises from 00 to 33 as shown in [Figure 16](#).



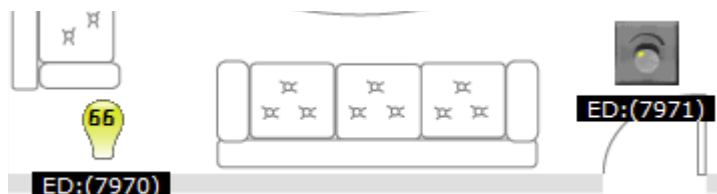
**Figure 16. The Dimmer Switch Sending “Step Up 33%” to the Dimmable Light**

3. Press SW2 on the Dimmer Switch board 2 (two) more times. Notice how LED3 and LED4 on the Dimmable Light turn on one at a time. The ZeD GUI shows the Dimmable Light bulb icon changing state (to maximum level), the percentage value on the bulb icon rises to 100 as shown in [Figure 17](#).



**Figure 17. The Dimmable Light Level Rising to 100%**

- Press SW1 on the Dimmer Switch board. This sends the “Step Down 33%” Command to the Dimmable Light. Notice how LED4 on the Dimmable Light boards turns off. The ZeD GUI shows the Dimmable Light bulb icon changing state and the percentage level on the icon lowers from 100 to 66 as shown in [Figure 18](#).



**Figure 18. The Dimmer Switch Sending “Step Down 33%” to the Dimmable Light**

## Using the Temperature Sensor and the Thermostat (1322x-EVK, 1321x-EVK Only)

The 13192-EVK boards do not have this functionality so these steps do not apply to the 13192-EVK boards.

This section shows how the Temperature Sensor board sends reports of the measured Local Temperature (LT) over the ZigBee network to the Thermostat which updates its state by entering heating or cooling modes according to the Desired Temperature (DT) it is set to maintain. The thermostat is set by default to maintain a Desired Temperature of 23°C (approximately 73°F).

- This use case shows temperatures in degrees Celsius. If users want to view the temperature in degrees Fahrenheit, they can select Tools->Options from the ZeD menu bar and then select the “Show Temperatures in Fahrenheit” radio button in the Options window.
- Performing the initialization as shown in [Initializing the EVKs](#) has configured the Temperature Sensor to report the measured room temperature to the Thermostat at 30 seconds intervals and also when the temperature actually changes. If the reported local room temperature is between 21°C and 25°C (Thermostat default Desired Temperature minus or plus 2°C), the thermostat stays in idle mode as indicated by a static, non-spinning Thermostat fan. However the Thermostat icon still displays the desired temperature in the bottom right corner of the Thermostat icon as shown in [Figure 19](#).



**Figure 19. Thermostat Remains Idle When Local Temperature is Close to Desired Temperature**

3. Ensure that the Thermostat board is placed in Application Mode as described in [Placing the Boards in Application Mode](#).
4. Press SW2 repeatedly on the Thermostat board to increase the Thermostat Desired Temperature to a value at least 3°C higher than the one reported by the Temperature Sensor, or place the Temperature Sensor in a location with a known lower temperature. Wait up to 30 seconds until the Sensor reports the temperature to the Thermostat. The Thermostat will enter the “Heating” mode. The fan in the Thermostat icon begins to spin and the “HEAT” indication appears on the icon as shown in [Figure 20](#).



**Figure 20. Thermostat In Heating Mode when Desired Temperature Higher than Local Temperature**

5. Press SW1 repeatedly on the Thermostat board to decrease the Thermostat Desired Temperature to a value at least 3°C lower than the one reported by the Temperature Sensor or place the Temperature Sensor SRB in a location with a known warmer temperature. Wait up to 30 seconds until the Sensor reports the temperature to the Thermostat. The Thermostat will enter the “Cooling” mode. The fan in the Thermostat icon will begin to spin and the “COOL” indication appears on the icon as shown in [Figure 21](#).



**Figure 21. Thermostat In Cooling Mode when Desired Temperature Lower than Local Temperature**



# Downloading Embedded Image Files

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The following sections show how to load an embedded image file to an HCS08 based EVK board and how to load an image file for the ARM7 based platforms.

## Downloading an Embedded Image File (HCS08)

This section shows how to load an embedded image file to an HCS08 based EVK board using the HiWave program included with the CodeWarrior IDE. This is necessary if users overwrite the original embedded images that work with ZeD on their EVK kit and need to revert to them later.

## System Requirements

The embedded image files are placed in the `Embedded` folder which is located in the ZeD installation folder. ZeD also comes with BeeKit solution files which can be used to customize the applications and generate user-defined applications. The *ZigBee Environment Demonstration (ZeD) Embedded Software Design User's Guide* describes how to obtain an output file (`.abs`) from a BeeKit solution file.

### NOTE

CodeWarrior IDE version 6.1 or later and a P&E HCS08/HCS12 Multilink Device (BDM) are needed to program an EVK board with an application.

## Connecting the BDM

Before downloading the code, connect the BDM to the board. Every board has a 6 pin BDM port, marked on the PCB. The BDM connector must be inserted into the BDM port. The red wire from the BDM connector must be on the same side as the number 1 pin of the BDM port. After powering on the board, the blue and the yellow LEDs on the BDM turn on. This means that the BDM is properly connected to the board. If the blue and the yellow LEDs are not on, check the connection and try again.

## Locating the HiWave Application

The HiWave application is located in the root folder of the CodeWarrior IDE binaries which by default installs in:

Program Files\Freescale\CW08 V5.0\prog\

for CodeWarrior 5.0 or in

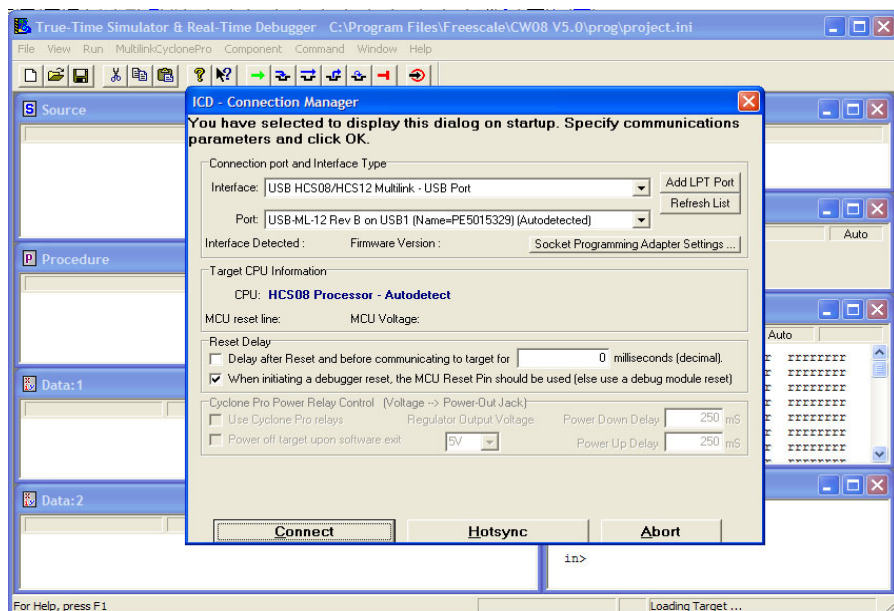
Program Files\Freescale\CodeWarrior for Microcontrollers V6.1\prog\

for CodeWarrior 6.1.

## Loading an Application

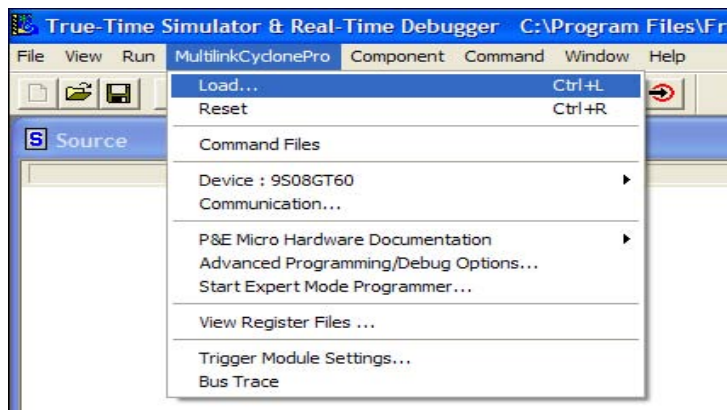
This example uses the On/Off Light application. To load the On/Off Light application image file on a SRB board using HiWave, perform the following steps:

1. Launch HiWave. The HiWave main window appears as shown in [Figure 22](#).
2. Click on the Connect button in the ICD Connection Manager window.



**Figure 22. Establishing Communication Between the BDM and the Board**

3. As shown in [Figure 23](#), from the menu bar of the HiWave main window choose MultilinkCyclonePro-> Load... (CTRL+L).



**Figure 23. Loading the .abs File**

4. Look in the following directory:

Program Files\Freescale\ZeD v.v.v\Embedded\MC1321xEVK

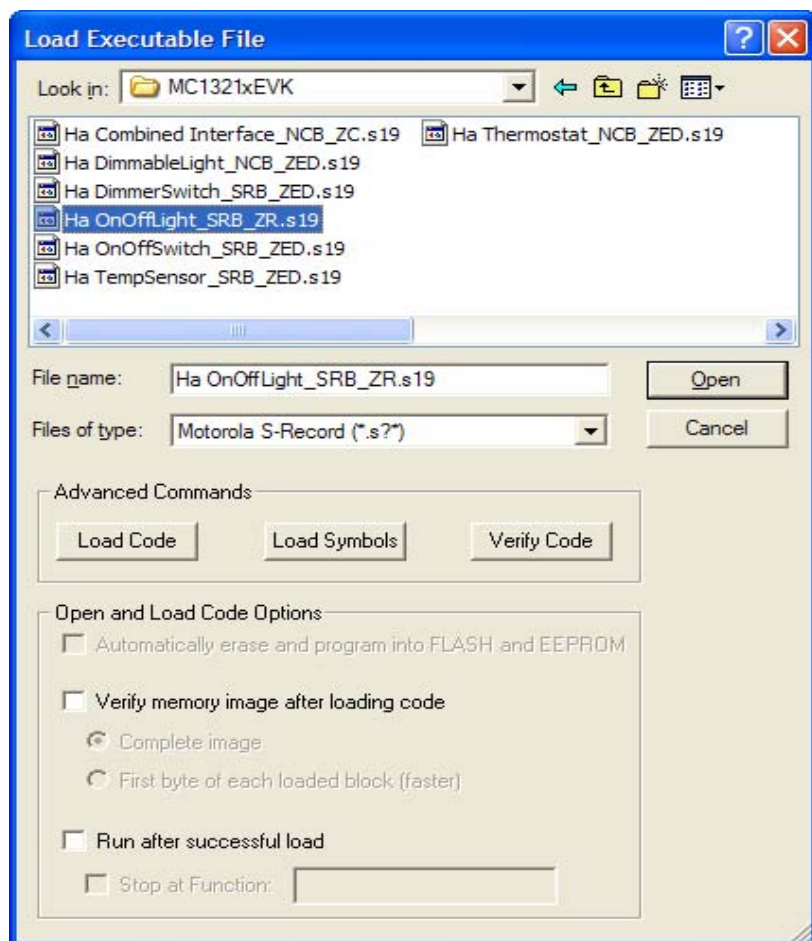
5. Ensure that the Files of type is search for executable files as follows:

Motorola S-Record (\*.s?\*)

6. Look for the following File name:

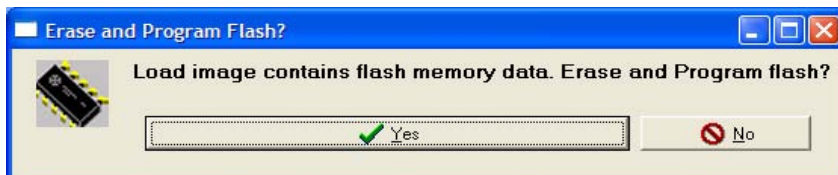
Ha OnOffLight\_SRB\_ZR.s19

7. As shown in [Figure 24](#), ensure that the Ha OnOffLight\_SRB\_ZR.s19 is highlighted and click on the Open button.



**Figure 24. Open \*.s19 file**

8. As shown in [Figure 25](#), click on the Yes button to erase and program the flash memory on the board.



**Figure 25. Erase and Program Flash memory**

9. Wait until programming is complete.
10. Close the HiWave application and reset the board.

## Downloading an Embedded Image File (ARM7)

To download an image for the ARM7 based platform (MC1322x-EVK), users have the following options.

- Use the MC1322x Firmware Loader feature of the Test Tool application as shown in the Freescale *Test Tool User Guide* (TTUG) to load the binary images available in the following folder:

Program Files\Freescale\ZeD v.v.v\Embedded\Mc1322xEVK

or

- Export the ZeD based solutions in BeeKit available in the ZigBeeHaApps\_Mc1322xEVK.bksln file which is located in the following directory:

Program Files\Freescale\ZeD v.v.v\BeeKitSolutionFiles\

and load the ZeD projects to the boards as shown in the *ZigBee Application User Guide* (ZAUGZB2007)

To find out more about how to generate a user specific image file using BeeKit and Freescale CodeWarrior or IAR Embedded Workbench, see the *ZigBee environment Demonstration (ZeD) Embedded Software Design User's Guide*, the *Freescale BeeStack Application Development Guide* and the *BeeKit Wireless Connectivity Toolkit User's Guide*.

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