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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China







Freescale Development Kits

# IEEE<sup>®</sup> 802.15.4

Wireless design made simple



## Our Wireless Portfolio

Our portfolio of 802.15.4 platforms lets the developer choose the best platform for their technical requirements and cost objectives. Whether they simply need to add a wireless transceiver to their existing design or create stand-alone wireless functionality, Freescale has the solution to meet their needs.

Freescale draws on extensive radio frequency (RF) and wireless experience from more than 50 years of radio product development. With our depth of experience in this area, we are qualified to offer comprehensive IEEE 802.15.4 standard-compliant and ZigBee®-compliant platform solutions. Freescale makes wireless simple by providing a one-stop shop for customers, complete with RF transceivers, MCUs, sensors, network protocol stacks, including 802.15.4 and ZigBee, reference designs and a flexible development tool suite. Virtually any low data rate, monitoring, control or automation application that requires long battery life and networking capability can benefit from the wireless connectivity solutions provided by the IEEE 802.15.4 standard and ZigBee technology.

### Software Development

While developers and users seek nirvana through a singular technology that solves all of their market needs, this rarely happens. Wireless sensing and control is no exception, however 802.15.4 is a solid foundation and Freescale has developed a number of protocol stacks based on it to meet specific application needs. Our 802.15.4 platform supports our simple media access controller (SMAC), IEEE 802.15.4 MAC, SynkroRF, BeeStack Consumer (ZigBee RF4CE) and BeeStack (ZigBee/ZigBee Pro) protocol stacks. These give developers the flexibility to build products optimized for different features, such as cost, performance, complexity and interoperability. Freescale solutions are delivered in conjunction with our BeeKit Wireless Connectivity Toolkit. The BeeKit provides a simple GUI approach to configure network settings, allowing the embedded designer to concentrate on building the application. BeeKit helps reduce development time for developers lacking extensive networking experience.

### BeeKit and BeeStack Solutions

IEEE 802.15.4 provides a solid foundation for wireless control and monitoring applications, enabling developers to take their applications to new levels of functionality. However, with this increased functionality comes increased complexity for the developer. Freescale steps in with an extensive portfolio of development kits based on our 802.15.4 platforms. Whether the customer is developing simple point-to-point applications or a complex mesh network using ZigBee technology, Freescale development kits provide the flexibility for whatever wireless application is needed. The development kits combine the hardware, software, tools and accessories needed to help streamline the development process.

#### BeeKit

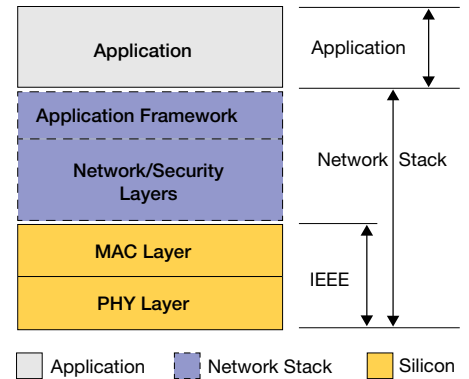
Freescale 802.15.4 protocol stacks allow application developers to enhance their product offerings and take their applications to new levels of functionality. However, with this increased functionality comes increased complexity as developers now have to concern themselves with issues such as network and protocol management options. Freescale stepped in to specifically develop the BeeKit Wireless Connectivity Toolkit to help minimize these issues. BeeKit provides a development environment where these design considerations can be managed in a straightforward, uncomplicated approach.

BeeKit offers a graphical user interface that includes codebases for our IEEE 802.15.4 MAC, SynkroRF, BeeStack Consumer (ZigBee RF4CE) and BeeStack (ZigBee/ZigBee Pro) protocol stacks. BeeKit comes in all Freescale development kits and may also be downloaded at [freescale.com](http://freescale.com). All protocol stacks are complimentary.

#### SMAC

SMAC is a simple and cost-effective start to wireless networking. Based on the 802.15.4 PHY, it provides commands to create simple point-to-point and star networks. The small 2.5–4 KB code size allows a low-cost platform for many applications requiring simple but effective wireless communication.

### Software Application Block Diagram



### SMAC Features

- Small memory footprint
- Supports point-to-point and star networks with repeaters
- Support for over the air programming

### IEEE 802.15.4 MAC

Our fully compliant IEEE 802.15.4 MAC provides a robust building block for point-to-point, star and mesh networks. While the MAC is part of the SynkroRF and BeeStack protocol stacks, it is often used as the foundation for proprietary stacks as well.

### IEEE 802.15.4 MAC Features

- Fully compliant IEEE 802.15.4 MAC
- Supports optional features, including beaconed networks and guaranteed time (GTS)
- Supports peer-to-peer, star and mesh networks

### SynkroRF

Synkro RF is optimized for very quick design cycles and an easy to follow design process. When SMAC is too simple and ZigBee is too complex, designers have the opportunity to utilize Synkro RF for proprietary 802.15.4 wireless monitoring and control. The network stack allows for application development with the API which uses the embedded processor running SynkroRF or the BlackBox which provides access to the complete API through a serial command set. Enhanced functionality includes features such as channel agility, larger data transfer with fragmentation, and low latency transmission. SynkroRF is the alternative when interoperability is not required.



### SynkroRF Features

- Easy-to-use IEEE 802.15.4 standards-based protocol
- Approximately 32 KB of memory
- For wireless monitoring and control, wire replacement
- API or BlackBox development options
- Enhanced interference avoidance with channel agility and low latency transmissions

### BeeStack Consumer (ZigBee RF4CE)

The BeeStack Consumer (ZigBee RF4CE) protocol is a lightweight networking stack built on top of the IEEE 802.15.4 standard and is fully compliant with the ZigBee RF4CE standard and supported application profiles.

The protocol was created to control, monitor and automate consumer electronics, including televisions, DVD players and recorders, set-top boxes, audio video receivers, remote controls and many others. RF4CE overcomes the growing technology challenges that today's consumer electronic products face with 30 year old infrared (IR) technology by removing the line of sight and field of vision issues while providing a fast bidirectional link to enhance the user experience. BeeStack Consumer starts with 802.15.4, but incorporates improvements in interference avoidance by adding channel agility and low latency transmissions to address the specific needs of consumer electronics.

### BeeStack Consumer (ZigBee RF4CE)

#### Features

- Lightweight networking stack built on the IEEE 802.15.4 standard
- Approximately 32 KB of memory
- For RF control, monitor and automation of consumer electronics products
- Optimized memory with standard command tables
- Two development options
  - Cost-effective API using embedded processor running
  - BlackBox with complete access to API through serial command set

- Improved interference avoidance capabilities with channel agility and low latency transmissions
- Supports ZigBee Remote Control Profile
- Supports ZigBee Input Device Profile

### BeeStack

ZigBee technology provides the ideal solution for larger, more complex networking, a robust and reliable option for self-forming and self-healing mesh networks. Since ZigBee is an open standard, it also allows for interoperability of products from different vendors. BeeStack is our ZigBee protocol stack that delivers a reliable and robust platform for ZigBee development.

### BeeStack Features

- Supports ZigBee 2007
- Supports ZigBee Pro
- Supports ZigBee Smart Energy Profile
- Supports ZigBee Health Care Profile
- Supports ZigBee Home Automation Protocol

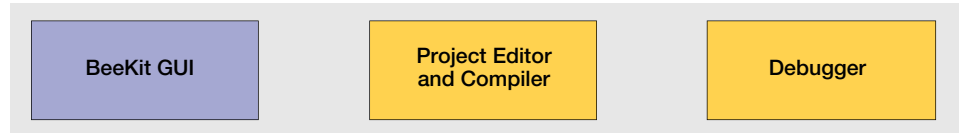
### Technical Features

- Operating system support
  - Windows® 2000
  - Windows XP
  - Windows 7
  - Windows Vista®

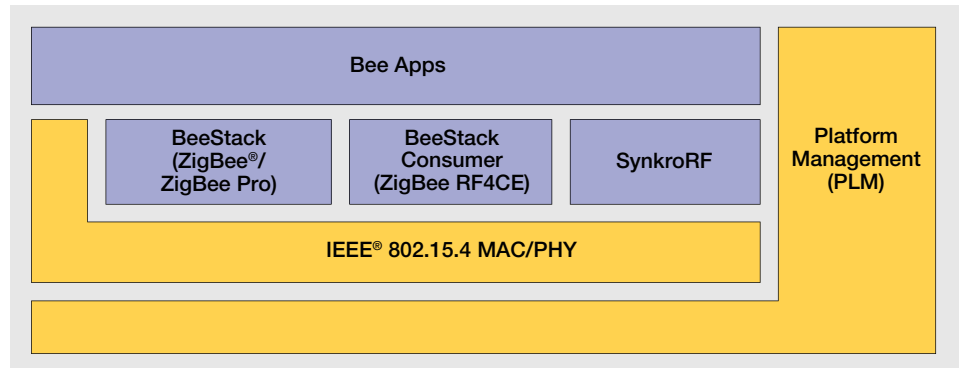
- Networking protocol code components and network application samples (code bases)
  - 802.15.4 MAC
  - SynkroRF
  - BeeStack Consumer (ZigBee RF4CE)
  - BeeStack (ZigBee/ZigBee Pro)
- Target families supported
  - MC1323x (HCS08)
  - MC1322x (ARM7™)
  - MC1321x (HCS08)
  - MC1320x (RF only)
- Development kits supported
  - 13234DSK/NSK
  - 13237ADC
  - TWR-13237
  - 1322XUSB/DSK/NSK/EVK
  - 13226PRO-DBG
  - 1321XCSK/DSK
  - 1320XRFC
- Integrated development environments (IDE)
  - CodeWarrior Development Studio for Microcontrollers
  - (CW-MICROCONTROLLERS) IAR EWARM for ARM

### BeeKit Block Diagram

#### Windows®-Based Components



#### Embedded SW Components (Codebase)



# MC1323X Development Kits

## Overview

Freescale offers a full set of hardware platforms for evaluation of the cost-effective MC1323X system-on-chip (SoC) solutions. Designers may choose the hardware and software platform that achieves their design goals. The newest SoC product family integrates the 2.4 GHz transceiver, HCS08 series MCU, memory and input/output (I/O) in a single package. The 8-bit integrated alternative allows easy implementation of cost-effective solutions for those familiar with the HCS08 family and for those just starting out with embedded wireless design.

MC1323X family development kits are built on three modular boards, each of which offer features and functions targeted at consumer electronics applications. The modular boards are assembled into specific configurations to allow straightforward system development. The modularity of the solutions offers designers the opportunity to select specific structures (using reference design materials and content) for direct implementation into their end systems, thereby reducing design time and associated costs.

## Modular Boards

### 1323X-MRB (Modular Reference Board)

The 1323X-MRB contains the MC13234CHT integrated circuit and all necessary input/output connections. It is a self contained module in a compact reference design.

### 1323X-MRB-ADC (ADC Modular Reference Board)

The 1323X-MRB-ADC contains the MC13237CHT integrated circuit and all necessary input/output connections including a 12-bit ADC which is unique to the MC13237CHT.

### 1323X-RCM (Remote Control Reference Motherboard)

The 1323X-RCM highlights the features of the MC1323X family for remote control design.

### 1323X-REM (Remote Extender Reference Motherboard)

The 1323X-REM is a remote extender and general application development board.

## Features

- MC1323x 802.15.4 2.4 GHz PiP
- LCD (RCM)
- Four LCD soft touch push buttons (RCM)
- 36 button keypad (RCM)
- Eight direction plus select joystick (RCM)
- IR transmitter (RCM)
- Buzzer (RCM)
- Digital accelerometer (RCM)
- Digital gyroscope (RCM)
- I/O header (REM)
- USB connection
- Power LED and six status LEDs (REM)
- Power LED and six status LEDs (RCM)
- Six push buttons (REM)
- IR receiver and transmitter (REM)
- Printed F antenna (REM)
- On/Off switch
- Battery connectors
- Test points



1323X Evaluation Kit

## MC13234CHT Development Tools Summary

Feature	MC13234CHT Developer Starter Kit	MC13234CHT Network Starter Kit
1323X-MRB	2	4
1323X-RCM	0	1
1323X-REM	2	3
USB Multilink	Yes	Yes
CodeWarrior IDE	CodeWarrior Special Edition	CodeWarrior Special Edition, CodeWarrior Standard Edition (13234NSK-SFTW only)
BeeKit	Yes	Yes
Freescale Network Analyzer	Yes	Yes
Out-of-Box Application	Range Demo	RF4CE Home Entertainment Control
RoHS Compliant	Yes	Yes
Price	\$279-13234DSK-BDM	\$529-13234NSK-BDM \$999-13234NSK-SFTW

## MC13237CHT Development Tools Summary

Feature	MC13237CHT Development Kit	MC13237CHT Tower Board	MC13237CHT Tower Kit
1323X-MRB-ADC	3	1	2
1323X-REM	3	0	0
TWR-RF-MRB	0	1	2
USB Multilink	Yes	No	No
CodeWarrior IDE	CodeWarrior Special Edition, CodeWarrior Standard Edition (13237ADC-SFTW only)	CodeWarrior Special Edition	CodeWarrior Special Edition
BeeKit	Yes	Yes	Yes
Freescale Network Analyzer	Yes	Yes	Yes
Out-of-Box Application	Battery Monitor	None	Range Demo
RoHS Compliant	Yes	Yes	Yes
Price	\$399-13237ADC-BDM \$899-13237ADC-SFTW	\$169-TWR-13237	\$269-TWR-13237-KIT

# MC1322X Development Kits

## Overview

Freescale has created the most complete set of hardware platforms for evaluating the MC1322X Platform in a Package (PiP) solution, allowing developers to select the hardware and software platform that best meets their needs. The unique PiP design integrates the 2.4 GHz transceiver, ARM7TDMI™ core, memory, I/O and RF matching components into a single package, significantly reducing the component cost and solution size. The MC1322X development kits are the ideal platforms for more complex 802.15.4 and ZigBee applications, providing plenty of memory and expansion capabilities. For designers who have ZigBee Pro applications to implement and prefer an ARM7 solution, the newest 13226PRO-DBG development kit is optimized for ZigBee Pro designs.

### 1322X-SRB (Sensor Reference Board)

The 1322X-SRB contains an MC13224 PiP, MMA7260Q three-axis acceleration sensor, MPXV5010G pressure sensor and a temperature sensor. The SRB provides a complete platform for evaluating the MC13224 PiP.

### 1322X-NCB (Network Coordinator Board)

The 1322X-NCB contains the MC13224 IC and a graphic LCD, creating the ideal demonstration platform for network coordinators. The LCD enables network monitoring by providing status messages.

### 1322X-LPB (Low Power Board)

The 1322X-LPB contains the MC13224 and is ideal for power measurements. The small form factor supports both AAA batteries and coin cell use and has the optional buck converter enabled to provide a low-power option.

### 1322X-USB

The 1322X-USB is programmed to function as an 802.15.4/ZigBee packet sniffer and can be used with the Daintree Sensor Network Analyzer software. The device can also be reprogrammed to support customer applications, providing a small form factor device for PC connectivity.

## Features

- MC1322X 802.15.4 2.4 GHz PiP
  - MC13224
  - MC13226 (ZigBee Pro)
- MMA7260Q three-axis acceleration sensor (1322X-SRB only)
- MPXV5010G pressure sensor (1322X-SRB only)
- Temperature sensor (1322X-SRB only)
- Printed F antenna
- SMA connector (1322X-NCB only)
- Color graphic LCD display (1322X-NCB only)
- Speaker
- Joystick, buttons and LEDs
- J-TAG interface for debug and programming
- Nexus debug interface (1322X-NCB only)
- Supports on-chip buck converter (1322X-LPB only)
- On-board expansion capabilities for external application-specific development
- LEDs and switches for demonstration monitoring and control
- Connections for battery or external power supply
- USB port to interface with PC
- Cables, batteries and power adapters
- Scalable software support for easy development of customer-specific network topologies



1322X Evaluation Kit

## MC1322X Development Kits

Feature	1322X USB Kit	1322X Developer Starter Kit	1322X Network Starter Kit	1322X ZigBee EVK	13226 ZigBee Pro Kit
1322X-SRB	N/A	1	1	4	2
1322X-NCB	N/A	1	1	3	2
1322X-LPB	N/A	N/A	1	2	1
1322X-USB	1	N/A	1	1	N/A
J-Link JTAG Debugger	No	Yes	Yes	Yes	Yes
IAR IDE	IAR 32K Edition	IAR 32K Edition	IAR 32K Edition, IAR 256K Edition with NSK-IAR	IAR 32K Edition, IAR 256K Edition with EVK-SFTW	IAR 32K Edition
BeeKit with BeeStack ZigBee® Protocol Stack	Included	Included	Included	Included	Included
Batteries, Cables and Power Adapters	Yes	Yes	Yes	Yes	Yes
Pre-Programmed Demonstration Application	None	Weather Station Demo, SynkroRF Demo	802.15.4 Network Demo	ZigBee Environment Demonstration	ZigBee Smart Energy Demo
RoHS Compliant	Yes	Yes	Yes	Yes	Yes
MSRP USD— Part #	\$79— 1322XUSB	\$379— 1322XDSK-DBG	\$579— 1322XNSK-DBG \$2599— 1322XNSK-IAR	\$1999— 1322XEVK \$3999— 1322XEVK-SFT	\$699— 13226PRO-DBG

# MC1321X Development Kits

## Overview

Freescale offers several different development kits for evaluating the MC1321X system in package (SiP), allowing developers to select the hardware and software platform that best meets their needs. The MC13213 device contains a 2.4 GHz RF transceiver and MC9S08GT60 MCU with 60 KB of flash and 4 KB of RAM in a 64-pin 9 x 9 mm LGA package. The development boards can be programmed with example demonstration applications or custom applications.

### 1321X-SRB

The 1321X-SRB contains an MC13213 IC, an MMA7260Q three-axis acceleration sensor and a temperature sensor. The SRB provides a complete platform for evaluating the MC13213 SiP.

### 1321X-NCB

The 1321X-NCB contains the MC13213 IC and an LCD, creating the ideal demonstration platform for network coordinators. The LCD enables network monitoring by providing status messages.

## Features

- MC13213 ZigBee-compliant 2.4 GHz SiP
- MMA7260Q three-axis acceleration sensor (1321X-SRB only)
- Temperature sensor (1321X-SRB only)
- Printed F antenna
- On-board expansion capabilities for external application-specific development
- Programmable 60 KB flash with 4 KB of RAM
- On-board BDM port for flash reprogramming and in-circuit hardware debugging
- LEDs and switches for demonstration monitoring and control
- LCD for demonstration messaging (1321X-NCB only)
- Connections for battery or external power supply
- RS232 and USB ports to interface with PC
- USB multilink BDM debugger/ programmer (BDM kits only)
- Cables, batteries and power adapters
- Scalable software support for easy development of customer-specific network topologies



1321X Evaluation Kit

## MC1321X Development Kits

Feature	1321X Consumer Starter Kit	1321X Developer's Starter Kit
1321X-SRB	1	2
1321X-NCB	1	N/A
CodeWarrior IDE	Special Edition	Special Edition
BeeKit with BeeStack ZigBee® Protocol Stack	Included	Included
ZigBee Packet Analyzer Hardware	No	No
Protocol Analyzer	No	No
Batteries, Cables and Power Adapters	Yes	Yes
Pre-Programmed Demonstration Application	RF4CE Virtual Remote Demo	Accelerometer Demo
RoHS Compliant	Yes	Yes
MSRP USD—Part #	\$399—1321XCSK-BDM	\$249—1321XDSDK \$349—1321XDSDK-BDM

For more information about 802.15.4/ZigBee products, please visit  
[freescale.com/802154](http://freescale.com/802154)

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