

# MC1321x 2.4 GHz “System in a Package”

## Overview

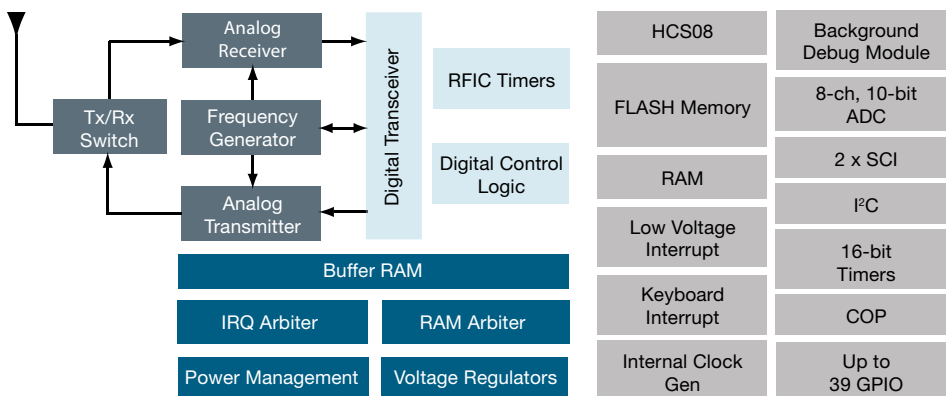
Freescale Semiconductor’s second-generation ZigBee® compliant platform combines an IEEE® 802.15.4-compliant radio and an 8-bit MCU into a 9 x 9 x 1 mm 64-pin LGA package, creating the first ZigBee compliant System in a Package (SiP). The MC1321x Family encompasses a series of devices that are memory scalable to fit the needs of the application. Each device includes a Freescale MC9S08GT-based MCU with up to 60 KB of Flash and 2.4 GHz 802.15.4 transceiver. Regardless of the application’s requirements, which may range from simple point-to-point connectivity to ZigBee mesh networks, the MC1321x devices scale to meet them. The most cost-effective device, the MC13211, contains 16 KB of Flash memory and is the ideal solution for proprietary networks that require simplicity and low cost. Freescale’s straightforward Simple MAC (SMAC) software layer, combined with the MC13211, provides a foundation for establishing robust,

proprietary wireless networks. The SMAC package is provided in American National Standards Institute (ANSI) C source code and includes a variety of software application examples that help users get started on adding wireless connectivity to their applications. For larger-scale networks, use the MC13212, which contains 32 KB Flash. This middle tiered solution offers the flexibility to support networks based on the SMAC, yet may also be used in more sophisticated 80.15.4 networks. The platform’s highest end device supports a fully compliant ZigBee platform. The MC13213 comes with 60 KB of Flash and 4 KB of RAM and supports Freescale’s BeeStack ZigBee protocol stack. This is an ideal platform for applications that require the benefits of mesh networking and interoperability offered by ZigBee technology. All devices in this SiP family are pin-compatible, enabling users to select the solution that best fits their application.

## Applications

- Home Automation
  - Smart Energy
  - Lighting control
  - Security
  - Heating, ventilation, and air conditioning (HVAC) control
- Commercial Building Automation
  - Lighting Control
  - Security
  - Access Control
  - HVAC control
  - Asset tracking
- Industrial Monitoring and Control
  - Process control
  - Factory automation
  - Environmental monitoring and control
  - Automated meter reading (AMR)
- Health Care
  - Patient monitoring
  - Fitness monitoring
- Consumer Electronics
  - RF remote control

## MC1321x Family



## Software Features

- 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 Features
  - Fully compliant IEEE 802.15.4 MAC
  - Supports optional features including beacons networks and Guaranteed Time Slots (GTS)
  - Supports peer-to-peer, star and mesh networks
- Synkro Features
  - RF remote control protocol stack
  - No line-of-sight restrictions
  - Supports 2-way device-to-device communication
- BeeStack Features
  - Supports ZigBee 2007 specification
  - Supports tree and mesh networks
  - Simplified network configuration through BeeKit Wireless Connectivity Toolkit

## Microcontroller Features

- 40 MHz HCS08 low-voltage, low-power core
- Up to 60 KB Flash and 4 KB RAM
  - MC13211: 16 KB Flash, 1 KB RAM
  - MC13212: 32 KB Flash, 2 KB RAM
  - MC13213: 60 KB Flash, 4 KB RAM
- Seven addressing modes for CPU
- Multiple 16-bit timers
- Operational in the 2.4 GHz worldwide unlicensed frequency band
- 2 V to 3.4 V operating voltage with on-chip voltage regulator
- -40° C to +85° C temperature range
- Low external component count
- Requires a single 16 MHz crystal
- Auto-trim feature for crystal accuracy
- Supports SMAC, IEEE 802.15.4 MAC and ZigBee software
  - 9 x 9 x 1 mm 64-pin LGA package
- 8-bit port keyboard interrupt (KBI)
- 8-channel, 10-bit analog-to-digital converter (ADC)
- Two independent serial communication interfaces (SCI) supporting up to 115.2 kBaud
- Inter-integrated circuit (I2C) with 100 kbps maximum bus loading
- Internal clock generator (ICG) at 100 kHz or 16 MHz (includes internal reference generator)
- Low-voltage detection
- In-circuit debug and Flash programming available via on-chip background debug module (BDM)
- Programmable low-voltage interrupt (LVI)
- Common on-chip processor (COP) watchdog timer

## RF Features

- Fully compliant IEEE 802.15.4 transceiver supports 250 kbps O-QPSK data in 5.0 MHz channels and full spread-spectrum encode and decode
- Operates on one of 16 selectable channels in the 2.4 GHz band
  - 0 dBm nominal output power, programmable from -27 dBm to +4 dBm
  - Receive sensitivity of < -92 dBm (typical) at 1 percent PER
  - Integrated transmit/receive switch
  - Has two PAs that can be programmed for single-ended or full differential operation
  - Supports external low-noise amplifier (LNA) and/or PA
  - Three low-power modes for increased battery life
  - Programmable frequency clock output for use by MCU
  - Onboard trim capability for 16 MHz crystal reference oscillator
    - Eliminates need for external variable capacitors
    - Allows for automated production frequency calibration
  - Four internal timer comparators available to supplement MCU timer resources
  - Supports streaming and post data processing modes
  - Seven general purpose input outputs (GPIOs) to supplement MCU GPIO

**Learn More:** For current information about Freescale products and documentation, please visit [www.freescale.com/zigbee](http://www.freescale.com/zigbee).