

# MC1323x 2.4 GHz IEEE® 802.15.4/ZigBee® System-on-Chip Solution

## Applications

### Consumer

- Television remote control
- Blu-ray remote control
- DVD remote control
- Set-top box remote control
- Amplifier remote control
- Surround sound remote control
- Automated service billing
- Invisible pet fences
- Electronic keys and locks
- Gaming peripherals
- Wireless gaming

### Healthcare

- Home healthcare
- Patient monitoring
- Fitness monitoring
- Institutional care
- Medication asset monitoring/billing
- Asset tracking

### Industrial

- Asset tracking and monitoring
- Electronic shelf labels
- Fire/security
- Door locks
- Retail pricing management
- Stock/pallet tracking
- Equipment locationing
- Liquid/gas flow detect/alarm
- Hazardous environment monitor
- Vibration alert
- Usage data collection

### Residential

- Access control
- Heating, ventilation and air conditioning (HVAC)
- Curtain/window blind control
- Lighting control
- Intruder alarms
- Water heater control
- Low-resolution video access control

## Overview

Our fourth-generation 2.4 GHz IEEE® 802.15.4/ZigBee® ready solution has been designed to serve the requirements of the consumer electronics market, yet offers a feature set and functionality combination that is well suited to many other general market applications. MC13234 and MC13237, collectively MC1323x, efficiently support low-power, battery-operated applications with optimized functionality and low cost objectives.

The CPU complex is based on the successful HCS08QE MCU. The CPU offers a 16-bit stack pointer, 16-bit index register and 8-bit accumulator. A range of functionality is supported with seven addressing modes and memory-to-memory data move instructions. Performance is enhanced with the fast 8-bit by 8-bit multiply and 16-bit by 8-bit divide instructions. Stop and Wait instructions offer power savings via these flexible operating modes.

The transceiver in the MC1323x system-on-chip (SoC) solution is a fully compliant IEEE 802.15.4 2.4 GHz transceiver. Offering 16 channels at 5 MHz spacing, the transceiver provides a data rate of 250 Kb/s. Output power is programmable from -30 dBm to +2 dBm (typical) with a receive sensitivity of -94 dBm. The integrated transmit and receive switch reduces overall component count.

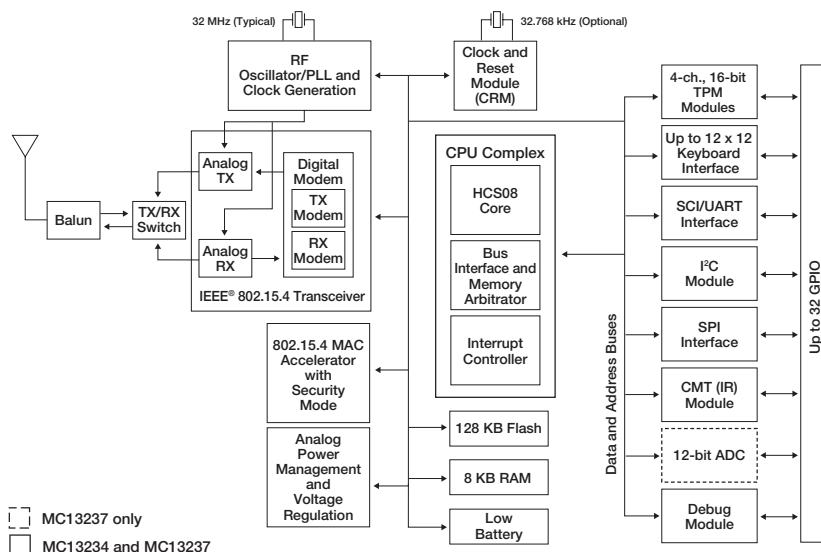
The 128 KB flash and 8 KB RAM solution provides memory features including single

power supply program and erase, an automated program and erase algorithm, and a burst program command for faster flash array program times. Our premiere flash memory offers up to 10,000 program/erase cycles at typical voltage and temperature and greater than 100 years' data retention under room temperature conditions.

Freescale has taken a platform approach that includes hardware, software, development tools and reference designs to help simplify development. Our BeeKit Wireless Toolkit provides an easy-to-use software environment to configure network parameters for our variety of platform alternatives: simple media access controller (SMAC), IEEE 802.15.4 MAC, SynkroRF™, BeeStack Consumer (ZigBee RF4CE™) and BeeStack (ZigBee/ZigBee Pro) protocol stacks. BeeKit is unique to Freescale, providing customers a GUI wizard and drop-down menus to help configure network parameters, vastly simplifying the network expertise needed and allowing designers to concentrate on their application. Finally, the MC1323x SoC simplifies wireless network design to enable embedded designers who may not have background or experience in RF solutions to ensure robust and optimized designs while incorporating wireless functionality into their end products.

We have made a proactive investment in RF engineering by providing a number of reference designs which include all of the details from IC to antenna.

## MC1323x Block Diagram



These include the design information for the development boards in each of the MC1323x development kits, as well as design alternatives that compare more in “form and factor” to real application solutions. Customers can take the bill of materials (BOM), gerbers and schematics, and simply copy the Freescale reference design or integrate that reference design into their project. The complete platform approach is offered to help designers reduce development time and speed time to market.

Freescale development kits provide the ideal development platform for a variety of applications, but are well suited to development of RF remote controls in particular. The MC1323x development kits specifically target fast, low-cost wireless network development, providing the necessary hardware, software, tools and demo applications to streamline the development process. These kits come with development boards programmed to allow developers to have the wireless network up and running in just 15 minutes.

The MC1323x SoC is a robust and flexible solution for wireless sensing and control applications and is optimized to support consumer electronics applications.

### Benefits

- IEEE 802.15.4-compliant transceiver provides a solid foundation for wireless networks
- High-performance 8-bit HCS08QE MCU offers a well-matched CPU to run target applications
- Low power consumption supports applications that require long battery life
- Multiple serial interfaces allow connections to a variety of devices
- Optimized flash and RAM provide a single device that runs the stack and application

### Software Features

#### SMAC

- Small footprint (<4 KB)
- Supports point-to-point and star networks with repeaters
- Support for over-the-air programming

#### 802.15.4-Compliant MAC

- Supports guaranteed time slots
- Supports beaconed and non-beaconed networks
- Supports peer-to-peer, star and cluster tree networks

### SynkroRF

- 802.15.4 based
- Complete network stack and API
- Channel agility

### BeeStack Consumer (ZigBee RF4CE)

- For RF remote control, monitoring and automation of consumer electronics
- Optimized with standard common tables
- Two development options
  - Cost-effective API with processor running protocol
  - BlackBox with complete access to API through serial command set
- Lightweight networking stack
- Channel agility
- Supports ZigBee Remote Control Profile
- Supports ZigBee Input Device Profile

### Features Summary

- IEEE 802.15.4 standard compliant on-chip transceiver/modem
  - 2.4 GHz ISM band operation
  - 16 selectable channels
  - Programmable transmitter output power (-30 dBm to +2 dBm typical)
  - -94 dBm typical receive sensitivity (<1% PER, 20-byte packets)
- Supports standard IEEE 802.15.4 signaling with 250 Kb/s data rate
- Hardware acceleration for IEEE 802.15.4 applications
  - MAC accelerator (sequencer and DMA interface)
  - Advanced encryption/decryption hardware engine (AES 128-bit and CCM)
- 8-bit HCS08QE CPU core with CPU clock up to 32 MHz and bus frequency up to 16 MHz
- Extensive onboard memory resources
  - 128 KB flash memory
  - 8 KB SRAM
- Power consumption
  - 34 mA typical current consumption in Rx mode with RF active
  - 27 mA typical current consumption in Tx mode at 0 dBm
- 22 mA typical current consumption in low power Rx (PPD) mode
- Power currents as low as 450 nA

- Extensive sleep mode control
  - Multiple low power modes and wake-up circuits
  - Clock management
  - Onboard 1 kHz oscillator for wake-up timer or optional 32.768 kHz crystal for accurate lower power timing
  - 32 MHz reference oscillator with on-board programmable capacitive loading
  - Wake up through programmable timer, external real-time interrupts or keyboard interface
- Extensive MCU peripherals
  - Powerful 12-bit ADC (MC13237 only)
  - UART module with full-duplex, standard non-return to zero format and programmable baud rates
  - SPI port with programmable master and slave operation
  - 8-pin KBI supports up to a 12 x 12 matrix capable of waking up device from low power modes
  - Timer modules configurable for buffered, center-aligned pulse width modulation on all channels
  - Inter-integrated circuit (I<sup>2</sup>C) interface
  - Carrier modulator timer IR remote carrier generator, modulator and transmitter
  - Up to 32 programmable input/outputs shared by peripherals and GPIO
- System protection features
  - Low battery detect
  - Watchdog timer (COP)
  - Sleep mode timers
- 1.8–3.6 V operating voltage with on-chip voltage regulators with low battery detect
- -40 °C to +85 °C temperature range
- RoHS-compliant 7 mm x 7 mm, 48-LGA package

### Orderable Parts

Part Number	Description
MC13234CHT	128 KB flash/8 KB RAM, 7 x 7 mm, 48-LGA, bulk 260/tray
MC13234CHTR2	128 KB flash/8 KB RAM, 7 x 7 mm, 48-LGA, tape and reel, 2000/reel
MC13237CHT	128 KB flash/8 KB RAM, 12-bit ADC, 7 x 7 mm, 48-LGA, bulk 260/tray
MC13237CHTR2	128 KB flash/8 KB RAM, 12-bit ADC, 7 x 7 mm, 48-LGA, tape and reel, 2000/reel

For more information, please visit [freescale.com/MC1323x](http://freescale.com/MC1323x)

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