BLE, Zigbee, Sub1G for IOT

SimpleLink wireless MCU ultra-low power platform

WCS - LPRF
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Gary Lin
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Low power, easily connected IoT applications
Agenda

Platform Overview
Key Features and Benefits
Kits and Tools
CC2640 Bluetooth Smart
CC2630 Zigbee / 6LoWPAN
CC1310 Sub-1GHz
The First Multi-standard Wireless MCU Platform for the IoT
Expanding the SimpleLink wireless connectivity portfolio with ultra-low power MCUs

<table>
<thead>
<tr>
<th>The lowest power</th>
<th>Industry’s only multi-standard platform</th>
<th>Easiest to design with</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Multi-year, always-on operation with a coin cell battery</td>
<td>• Code and pin compatibility across:</td>
<td>• Minimal RF experience required</td>
</tr>
<tr>
<td>• Go battery-less with energy harvesting</td>
<td>• Bluetooth® Smart</td>
<td>• Ready to use protocol stacks and TI-RTOS</td>
</tr>
<tr>
<td>• Integrated ultra-low power sensor controller</td>
<td>• 6LoWPAN</td>
<td>• Programmable ARM® Cortex®-M3 based MCU</td>
</tr>
<tr>
<td></td>
<td>• ZigBee®</td>
<td>• Simplest RF &amp; antenna design</td>
</tr>
<tr>
<td></td>
<td>• Sub-1 GHz</td>
<td>• Built-in robust security</td>
</tr>
<tr>
<td></td>
<td>• ZigBee RF4CE™</td>
<td>• Tools and reference designs</td>
</tr>
<tr>
<td></td>
<td>• Proprietary modes up to 5Mbps</td>
<td></td>
</tr>
</tbody>
</table>
CC26xx/CC13xx Ultra Low Power Wireless MCUs
Multiprotocol Platform

Improving the three key challenges:

<table>
<thead>
<tr>
<th>Easiest to design with</th>
<th>Lowest Power</th>
<th>Most Integrated</th>
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<tbody>
<tr>
<td>• Software Development Kits</td>
<td>• ~ 6mA Radio peaks and 1uA Sleep</td>
<td>• 4x4 QFN</td>
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<td>• Get-Started Documentation &amp; Wiki</td>
<td>• ~ 61µA/MHz ARM Cortex M3</td>
<td>• On-Chip Flash</td>
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<td>• Dynamic Design Kits</td>
<td>• &lt;10 uA avg. Current @ 1s BLE</td>
<td>• Single Ended Output</td>
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<td>• Low-cost Tools</td>
<td>• Sensor Controller Engine (SCE)</td>
<td>• Integrated DCDC</td>
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Comprehensive Design Support

Multi-year operation on a coin cell

Complete Bluetooth Smart system on a finger-tip size
MULTI-STANDARD:
Five technologies, one architecture

Application MCU
- Application
- Profiles / services
- TI RTOS
- Peripheral drivers and libraries
- Royalty free protocol stacks

Peripherals / modules
- DC/DC converter
- Temp/battery monitor
- AES
- GPIO
- Timers
- UART / SPI
- I2C / I2S
- DMA

ARM® Cortex®-M3

Radio
- Sensitivity -97dBm BLE
- Power output:
  - +5dBm @ 2.4 GHz
  - +15dBm @ Sub-1 GHz
- Integrated firmware
- LinkLayer in ROM

Sensor controller engine
- ADC and comparators
- Digital sensor readings
- Capacitive sensing

Memory
- 128 KB Flash
- 8 KB cache
- 20 KB SRAM

QFN package options:
4x4mm, 5x5mm, 7x7mm

Radio
- Sensitivity 97dBm BLE
- Power output:
  - +5dBm @ 2.4 GHz
  - +15dBm @ Sub-1 GHz
- Integrated firmware
- LinkLayer in ROM

Memory
- 128 KB Flash
- 8 KB cache
- 20 KB SRAM

Texas Instruments
SimpleLink CC26xx/CC13xx Architecture

**Quick Facts**

**Ultra-low Power Consumption**
- 61 µA/MHz ARM Cortex M3
- 8.2 µA/MHz Sensor Controller
- 1 µA sleep with retention and RTC
- 5.9 mA RX (single-ended)
- 6.1 mA TX (single-ended)
- <3µA while running 10 ADC samples/s

**SoCKey Features**
- Autonomous sensor controller engine
- 4x4, 5x5, and 7x7 mm QFN
- 1.7 - 1.95 V or 1.8 – 3.8 V supply range
- 128 KB Flash + 8 KB Cache
- 20 KB RAM

**RF Key Features**
- +5/+14 dBm output power (2.4GHz/Sub1GHz)
- -97/-120 dBm sensitivity (2.4GHz/Sub1GHz)
- Supports 2.4GHz and 915/868/433 MHz
- Pin compatible and SW compatible across protocols and frequency bands
SimpleLink™ Wireless MCU Platform

- Multi-standard
- Bluetooth Smart
- 6LoWPAN / ZigBee
CC2650 Wireless MCU *Multi-standard*

Future-proof:
Switch between multiple 2.4 GHz technologies with only one design

- Flexibility to develop solutions that support multiple technologies with the same architecture:
  - Bluetooth Smart, 6LoWPAN, ZigBee and RF4CE
- Go to production without locking in a selection and configure chosen technology at the time of installation in the field
CC2640 Wireless MCU *Bluetooth Smart*

- Lowest power Flash-based Bluetooth 4.1 solution with multi-year operation on smaller coin cells
- Finger-tip sized one-chip system integrating a Flash-based MCU and Bluetooth Smart radio
- Robust, royalty-free software stack with over-the-air update capability and comprehensive design support

**Easy multi-year support for IoT applications in a tiny package**
CC2630 Wireless MCU 6LoWPAN & ZigBee

Power a cloud-connected light switch for 10 years with a coin cell battery

- Enable battery-operated mesh networks or energy harvested nodes: Power a light switch for 10 years with a coin cell
- Connect 1,000’s of mesh network nodes in homes, buildings and cities with a portfolio of 802.15.4-based solutions
- Easily connect to the cloud and Internet through 6LoWPAN operation – each device includes an IPv6 address
Additional Wireless MCUs **Coming in 2015**

**CC1310 wireless MCU for Sub-1 GHz**
- Pin-to-pin compatible with CC26xx
- For long-range, city-wide low power networks
- Operation in 315 MHz, 433 MHz, 470 MHz, 868 MHz, 915 MHz and 920 MHz ISM bands

**CC2620 wireless MCU for ZigBee RF4CE**
- Low power, small & easy solution
- For advanced TV, set-top box and home entertainment remote controls
TI-RTOS *Flexible Software Solution*

- Real Time Operating System (RTOS)
  - Pre-emptive multi-threading
  - Deterministic scheduler
  - Tailored SYS/BIOS Kernel
- Zero-latency interrupts
  - Hardware: Timer functions
  - Software: Clock functions (Ex. One shot or periodic timer)
- Semaphores
  - Task Synchronization
- Peripheral Drivers
  - GPIO, I2C, SPI, UART, WATCHDOG, LCD
- Power policy manager
  - Handles power management

System analyzer

**Texas Instruments**
Sensor Controller Engine (*SCE*)

A proprietary low power CPU to offload the M3

**Key features**
- Handles sensor polling and performs simple processing
- Operates while the rest of the system is in powered down

Examples of sensors that will greatly benefit from using the Sensor Controller:
- PIR (motion detector)
- Capacitive touch keys
- Proximity sensors
- Accelerometers
- ADC measurements
- Pulse counting

- Use Sensor Controller Studio for configuration

---

**Data Sheet – Key Features**
- Autonomous 16-bit RISC CPU
- 2 KB SRAM (code + data)
- Clock Frequency:
  - 32kHz-24MHz
  - 8.2μA / MHz
Power Consumption

Low average power consumption

1. When in Standby (with RTC and RAM retention)
2. When processing with MCU
3. When radio is in Receive or Transmit
4. When peripheral is polled for data

1. **Standby Current**
   - 1 μA Standby with RTC and full retention
   - Less than 0.1 μA in Shutdown

2. **ARM Cortex M3**
   - Fast processing using less than 3 mA @ 48MHz
   - Less time used for stack and application processing and BLE connection events

3. **Radio**
   - ~6mA RX / TX current

4. **Sensor Controller Engine**
   - Sensor controller and its peripherals can be powered while rest of system is power off.
   - Run Sensor Reading with < 5 μA current consumption
Power Consumption Benchmark

Designed for low-power operation

- Multi-year on a coin cell
- Faster processing
- Optimized radio
- Ultra low sleep current
- Unique integrated Sensor Controller

### Ultra-low power

<table>
<thead>
<tr>
<th>When</th>
<th>Parameter @ 3V</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While processing</td>
<td>µA/MHz on ARM® Cortex®-M3</td>
<td>61 µA/MHz</td>
</tr>
<tr>
<td></td>
<td>Coremark / mA</td>
<td>48.5</td>
</tr>
<tr>
<td></td>
<td>Coremark @ 48MHz CPU</td>
<td>142</td>
</tr>
<tr>
<td>While communicating</td>
<td>Peak current RX</td>
<td>5.9 mA</td>
</tr>
<tr>
<td></td>
<td>Peak current TX</td>
<td>6.1 mA</td>
</tr>
<tr>
<td>While sleeping</td>
<td>µA/MHz on Sensor Controller</td>
<td>8.2 µA/MHz</td>
</tr>
<tr>
<td></td>
<td>Sleep mode with RTC and full memory retention</td>
<td>1 µA</td>
</tr>
</tbody>
</table>

Best-in-class ULPBench score of 140.2
Development Kits

CC2650DK $299

Full feature development kit with embedded TI XDS emulator for development and debugging.

C2650EMK $99

Powered by CR2032 Coin Cell Battery
Native sensor support for:
• 6-axis MEMS motion tracking (Invensense)
• Humidity (TI)
• IR temperature (TI)
• Light Sensor (TI)
• Buzzer (Changzhou Tianyin)
• Microphone (Knowles)
• Pressure (Bosch)
• Reed Relay (Meder)

Dev. Pack for custom functionality.
Supported by accompanying iOS/Android apps

CC2650STK $29

SmartRF06 Features:
• Dot matrix LCD
• 4 LEDs
• 5 buttons
• Accelerometer
• Ambient Light Sensor
• UART backchannel
• Micro SD card reader
• I/O breakout headers
SensorTag IoT Made Easy

• $29 Complete IoT development kit
• Access Sensor data in the cloud in 3 minutes
• 9 Low Power Sensors
  – 1 year battery life
• Expandable with DevPacks
  – Lowest cost $15 debugger
  – Watch/Display
  – LED/Audio
  – Interchangable between SensorTags
• Complete designs at www.ti.com/tidesign
  – Including 3D files
  – Print your own SensorTag
SensorTag Sensors

- 9 Low power sensors
- Humidity/Temperature
  - HDC1000
- Object Temperature
  - TMP007
- Ambient Light
  - OPT3001
- Pressure
- Accelerometer
- Gyro
- Magnetometer
- Digital Microphone
- Magnet sensor
SensorTag Versions

CC3200: WiFi

CC2650:
- Bluetooth Smart
- 6LoWPAN
- ZigBee

Easy migration between technologies
<table>
<thead>
<tr>
<th>Software</th>
<th>Support</th>
<th>And more...</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Common software</strong>&lt;br&gt;Across all SimpleLink ULP products:&lt;br&gt;• TI-RTOS operating system&lt;br&gt;• Code Composer Studio integrated development environment&lt;br&gt;• IAR Embedded Workbench</td>
<td><strong>Royalty-free network stacks</strong>&lt;br&gt;Robust, certified and proven stacks:&lt;br&gt;• BLE-Stack with OTA support&lt;br&gt;• Z-Stack™ supporting various ZigBee applications</td>
<td><strong>TI reference designs online</strong>&lt;br&gt;<strong>TI IoT cloud ecosystem</strong>&lt;br&gt;<strong>Silicon &amp; kit sales &amp; samples on TI Store</strong></td>
</tr>
<tr>
<td><strong>Comprehensive Development documentation, guides and wikis available online</strong></td>
<td><strong>E2E online support</strong>&lt;br&gt;TI E2E™ community – answers at your fingertips from engineers</td>
<td><strong>Training</strong>&lt;br&gt;Online videos and other resources to learn more about the parts and tools</td>
</tr>
<tr>
<td><strong>And more...</strong></td>
<td></td>
<td><strong>TI store 24/7</strong></td>
</tr>
</tbody>
</table>
CC2640

Bluetooth Smart

"CC2640 puts Smart in Bluetooth SMART"
CC2640
TI introduces the next generation platform

Improving the three key challenges for a Bluetooth low energy product:

**Easiest to design with**
- Qualified BT 4.1 Bluetooth Smart
- Get-Started Documentation & Wiki
- Dynamic Design Kits
- Low-cost Tools

**Lowest Power**
- ~ 6mA Radio peaks and 1µA Sleep
- ~ 61µA/MHz ARM Cortex M3
- <10 uA avg. Current @ 1s Conn. Int
- Sensor Controller Engine (SCE)

**Most Integrated**
- 4x4 QFN
- On-Chip Flash
- Single Ended Output
- Integrated DCDC

"CC2640 puts Smart in Bluetooth SMART"
Software Platform **CC2640**

Royalty free from TI, ready for application development

**Over-the-air download**
The FLASH can be partially updated over-the-air, which means that the application can be updated separately from the BLE stack.

**Source**

<table>
<thead>
<tr>
<th>IDE’s:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Composer Studio</td>
</tr>
</tbody>
</table>

**FLASH**

- TI RTOS
- Peripheral Drivers
- Application & Profiles (RTOS thread)
- Bluetooth low energy Protocol Stack (RTOS thread)

**ROM**

- Lower layers of RTOS kernel and BLE radio

**HW: CC26xx Evaluation & Development Boards**

**ROM code**
The RTOS kernel and parts of the BLE controller are stored in CC2640 ROM, so these components do not occupy FLASH space.

**IAR SYSTEMS**

**TI RTOS & Peripheral Drivers**

**Bluetooth low energy Protocol Stack (RTOS thread)**

**Application & Profiles (RTOS thread)**

**Source**

**Library**
Radio Frontend **Flexibility**

**Best Performance**
- Differential, external bias
- 5 dBm output power
- -97 dBm BLE sensitivity

**Smallest Footprint**
- Single ended, external bias
- 2 dBm output power
- -96 dBm BLE sensitivity

Other options are available. Internal biasing reduces BOM by one inductor at the cost of 1 dB sensitivity

---

**Evaluation Module**

<table>
<thead>
<tr>
<th></th>
<th>CC2650EM-4XD</th>
<th>CC2650EM-5XD</th>
<th>CC2650EM-7ID</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CC2650 Package Type</strong></td>
<td>4x4</td>
<td>5x5</td>
<td>7x7</td>
</tr>
<tr>
<td><strong>Pitch [mm]</strong></td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>GPIOs</strong></td>
<td>10</td>
<td>15</td>
<td>31</td>
</tr>
<tr>
<td><strong>RF Frontend Option</strong></td>
<td>Single Ended External Bias</td>
<td>Differential External Bias</td>
<td>Differential Internal Bias</td>
</tr>
<tr>
<td><strong>Area [cm²]</strong></td>
<td>1.3</td>
<td>1.5</td>
<td>2.3</td>
</tr>
</tbody>
</table>

**Illustration**

**Crystals**
- 2
- 2
- 2

**Capacitors**
- 14
- 17
- 18

**Inductors**
- 3
- 6
- 5

**Resistors**
- 1
- 1
- 1

**Total**
- 20
- 26
- 26

*NB! Differentiel External bias is not supported on 7x7*
Software Tools

BTool
Run and test all possible Bluetooth low energy functionality controlled from the PC tool.

BLE Device Monitor
Provides an intuitive and graphical way to explore Bluetooth low energy Services and Characteristics.

SmartRF™ Protocol Packet Sniffer
Capture Bluetooth low energy communication live with full overview.

SmartRF™ Flash Programmer
Program devices and Read/write IEEE addresses.
Bluetooth Smart Support

• **Unique Hardware and RF Support**
  – Schematic and Layout Review
  – Pre-compliance testing in RF Chamber
  – Perform Bluetooth pre-testing

• **Guides included in the BLE installer** ([www.ti.com/ble-stack](http://www.ti.com/ble-stack))
  – Software Developers Guide
  – Sample Applications Guide
  – Vendor Specific HCI Guide

• **Online documentation** ([www.ti.com/ble-wiki](http://www.ti.com/ble-wiki))
  – Code Examples
  – Training videos
  – Walkthrough Guides

• **Online E2E Support Community** ([www.ti.com/ble-forum](http://www.ti.com/ble-forum))
  – Supervised by TI Software and Hardware Experts
CC2630

ZigBee / 6LoWPAN
## Introducing CC2630

TI introduces the next generation platform for low power mesh networks and IoT applications

### Easiest cloud connectivity
- End to end solution from sensor to cloud
- Get-Started Documentation and reference design
- Integrated Design Kits
- Low-cost Tools

**Plug-in connectivity to the cloud in 10 minutes**

### Lowest Power
- ~6.1 mA Radio peaks and 1 µA Sleep
- 61 µA/MHz ARM Cortex M3
- <30 mAms avg. charge for polling operation
- Sensor Controller Engine (SCE)

**Average system current consumption 2x better than competition**

### Easiest mesh plug-in
- 4x4 QFN
- On-Chip Flash
- Network processor
- Integrated DCDC
- Cross-platform portable SW framework for IoT application

**Compact system design for bolted-on wireless connectivity**
Power Consumption – why lowest

• Average Power Consumption
  – Polling scenario runs at 30 mAms → **twice better than competition!!!!!**

<table>
<thead>
<tr>
<th>Segment</th>
<th>Unit operation description</th>
<th>Time (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wake up / ROM patch / Preprocessing</td>
<td>1.490</td>
</tr>
<tr>
<td>2</td>
<td>CSMA/CA</td>
<td>0.632</td>
</tr>
<tr>
<td>3</td>
<td>MAC Data Request TX (Poll)</td>
<td>0.750</td>
</tr>
<tr>
<td>4</td>
<td>MAC Ack RX</td>
<td>0.762</td>
</tr>
<tr>
<td>5</td>
<td>Postprocessing</td>
<td>0.882</td>
</tr>
</tbody>
</table>

• Faster Processing
  • With low power consumption (≤ 3.3 mA @ 48 MHz)
• Optimized Radio
  • With TX and RX around ~6 mA

• Ultra Low Sleep Current
  – 1 µA Sleep with RTC and full retention
  – Less than 0.15 µA in Shutdown

• Sensor Controller
  – Run Sensor Polling with < 5 µA
Software Platform **CC2630**
Royalty free from TI, ready for application development

Over-the-air download
The FLASH can be partially updated over-the-air, which means that the application can be updated separately from the stack.

**FLASH**
- TI RTOS & Peripheral Drivers
- Application & Profiles (RTOS thread)
- ZigBee certified stack (RTOS thread)

**ROM**
- RTOS kernel and core 802.15.4 MAC

**HW:** CC26xx Evaluation & Development Boards

**Source**
- ROM code
The RTOS kernel and the core 802.15.4 MAC are stored in CC2630 ROM, so these components do not occupy FLASH space.
ZigBee solution for Home Automation

- Mature, rich and complete end to end solution for IoT
  - Golden unit implementation for any Home Automation end nodes application
  - Certified ZigBee solution
  - Full implementation of an IoT Linux gateway solution with agent
  - ZigBee network processor host SW framework for any MCU: easy wireless add-on
  - Plus, tons of examples for ease of integration

<table>
<thead>
<tr>
<th>Example Application</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Door Lock</td>
<td>Implementation of a door lock sensor with remote pin code lock/unlock</td>
</tr>
<tr>
<td>Temperature sensor</td>
<td>Example of a certified temperature sensor application for periodic reporting</td>
</tr>
<tr>
<td>Thermostat</td>
<td>Temperature monitoring, set heat/cool mode and target points</td>
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<tr>
<td>HCU</td>
<td>Implements heating/cooling set commands. Reports status</td>
</tr>
<tr>
<td>Light</td>
<td>Implementation of a certified white dimmable light</td>
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<tr>
<td>Switch</td>
<td>Low power dimmer/toggle switch</td>
</tr>
<tr>
<td>Local gateway controller</td>
<td>Proxies all devices in the network, monitors and controls</td>
</tr>
<tr>
<td>Gateway IoT agent</td>
<td>MQTT gateway client for cloud connectivity</td>
</tr>
<tr>
<td>Command line interpreter</td>
<td>Explorer of all network processor interface</td>
</tr>
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# Hardware Design

**Small Form Factor**

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**Design Example**

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<th>Inductors</th>
<th>Resistors</th>
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<tr>
<td>2</td>
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<td>3</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>6</td>
<td>1</td>
<td>26</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>5</td>
<td>1</td>
<td>26</td>
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**Texas Instruments**
Software Tools

ZTool
Complete control of network processor via GUI. Scripting framework to automate operations.

PCT tool
Model battery life and current consumption according to use case and profile via an intuitive and flexible Web interface.

SmartRF™ Protocol Packet Sniffer
Capture 802.15.4 communication live with full overview.

SmartRF™ Flash Programmer
Program devices and Read/write IEEE addresses.
**ZigBee Support**

- **Unique Hardware and RF Support**
  - Schematic and Layout Review
  - Pre-compliance testing in RF Chamber

- **Guides included in the Z-Stack installer** ([www.ti.com/tool/z-stack](http://www.ti.com/tool/z-stack))
  - Home Automation Developers Guide
  - Sample Applications User Guide
  - ZigBee Developer Guide

- **Online collateral**
  - Application framework repository: [git tree repo](https://git-tree-repo)
  - Wiki: [ZigBee Home Automation wiki](https://zigbee-home-automation-wiki)
  - Additional collateral: [Link to App notes](https://link-to-app-notes)

- **Online E2E Support Community** ([www.ti.com/zigbee-forum](http://www.ti.com/zigbee-forum))
  - Supervised by TI Software and Hardware Experts
CC1310

Sub-1GHz wireless MCU
**CC1310**

TI introduces the next generation sub-1GHz family

Improving the three key challenges for a *Sub-1GHz Wireless MCU*:

<table>
<thead>
<tr>
<th>Longest Range</th>
<th>Lowest Power</th>
<th>Most Integrated</th>
</tr>
</thead>
</table>
| • High sensitivity  
  • -110dBm @ 50kBit  
  • -121dBm @2.4kBit  
  • Strong co-existence  
  • Up to 80dB blocking | • ~6mA Radio RX peak current  
  • 61μA/MHz ARM Cortex M3  
  • 700nA sleep current w/RTC + full retention  
  • Sensor Controller Engine (SCE) | • 4x4 QFN  
  • On-Chip Flash  
  • Single Ended Output  
  • Integrated DCDC  
  Complete 315 / 433 / 470 / 868 / 915 / 920MHz wireless MCU on a finger-tip size |

Full-building to city-wide RF coverage  
Up to 20 year battery life for flow meters and sensor nodes

«Exceptional combination of low power and high RF performance in a tiny package»
CC1310 Overview
One-chip Wireless MCU

- ARM Cortex M3 Application Processor
- ARM Cortex M0 Radio Processor
- Sensor Controller Engine (SCE)
- 128KB Flash / 20KB SRAM, 2KB SCE RAM

Application (M3)
- Application
- RTOS

Peripherals
- AES engine
- 4x 16bit timers
- UART / SPI / I2C
- I2S
- DMA

RF Core
- Sensitivity -121dBm @2.4kbps
- Pout +14Bm @868MHz

Radio (M0)
- Radio Firmware

Sensor Controller
- ADC readings
- Digital sensor readings

Integrated DC/DC
- Lower current consumption

QFN 4x4, 5x5, 7x7

Cortex M3
RF Core + Cortex M0
SCE
Peripherals

Texas Instruments
CC1310 Software
Royalty free from TI, ready for application development

IDE’s:
- Code Composer Studio
- (GCC coming in 2015)

FLASH
- Software Protocol Stack: SimpliciTI
  - Tbd wM-Bus (RTOS thread)
- Application (RTOS thread)
- TI RTOS & Peripheral Drivers

ROM
- RTOS kernel

CC13xx Evaluation & Development Boards

Source

ROM code
The RTOS kernel stored in CC1310 ROM, so these components do not occupy FLASH space. Only 6kB FLASH required.
TI RTOS on CC1310
Royalty free from TI, with RTOS kernel in CC1310 ROM

• Power policy manager
  – Simplifies power consumption optimization
  – Handles power management of the CC13xx
  – Always uses the most optimal power mode on the chip

• Peripheral Drivers (makes it easier to access the MCU peripherals.
  – Simplifies control of MCU peripherals
  – Open/read/write/close peripheral through API (GPIO, I2C, SPI, UART, WATCHDOG and others)

• Real Time Operating System (RTOS)
  – Separate OS thread for application
  – Deterministic pre-emptive scheduler
  – Small memory footprint (from 6kB depending on configuration. RTOS kernel in CC1310 ROM)
  – Common RTOS functions such as semaphores, events and clocks

• Tickless mode (clock tick suppression)
  – Reduces power consumption by only waking up system when necessary

• Open source
  – Source code freely available, but must be used on TI devices
Development Kit **CC1310**

**CC1310DK, $299**  
Coming soon!

*For complete system design and evaluation. 779 – 930MHz*

Full feature CC1310DK with embedded TI XDS emulator for development and debugging.

SmartRF06 Features:
- Dot matrix LCD, 4 LEDs, 5 buttons
- Accelerometer, Ambient Light Sensor,
- UART backchannel, Micro SD card reader, I/O breakout headers
SimpleLink™ Sub-1 GHz Support

Web Page:
http://www.ti.com/lsds/ti/wireless_connectivity/sub-1_ghz/overview.page
– Data Sheets
– Application Notes
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Engineer 2 Engineer Support Forum:
http://e2e.ti.com/support/wireless_connectivity/f/156.aspx (English language)
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Wiki:
http://processors.wiki.ti.com/index.php/Category:Sub-1GHz
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