

# Wireless Connectivity



RF ICs and proprietary protocols for the Sub-1 and 2.4 GHz frequency bands, ANT™, Bluetooth®, Bluetooth low energy, RFID/NFC, PurePath™ Wireless audio, ZigBee®, IEEE 802.15.4, ZigBee RF4CE, 6LoWPAN, Wi-Fi®, GPS



Now includes SimpleLink™ devices! See page 3 for details.



Wirelessly Connecting Everywhere

[www.ti.com/wirelessconnectivity](http://www.ti.com/wirelessconnectivity)

4Q 2012

# Wireless Connectivity Guide

## Table of Contents

With the industry's broadest wireless connectivity portfolio, TI offers cost-effective, low-power solutions for short-range, long-range, mesh and IP networks, as well as mobile handset connectivity and ISM band. TI has been in Wireless for more than 10 years and our solutions have been designed in a way that allows customers to get to market by faster. TI's wireless connectivity technologies include Wi-Fi®, Bluetooth®, Bluetooth low energy, ANT™, ZigBee®, IEEE 802.15.4, ZigBee RF4CE, NFC/RFID, 6LoWPAN and PurePath™ Wireless audio, GPS as well as a selection of RF ICs and proprietary protocols for the sub-1 and 2.4 GHz frequency bands. TI provides a large selection of support collateral such as development tools, technical documentation, reference designs, application expertise, customer support and third party and university programs.

### Wireless Connectivity and Application Areas

Introduction .....	3
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### Mesh & IP Networks

#### Wi-Fi®/ IEEE 802.11

Wi-Fi Overview .....	4
CC3000 .....	5
WL1271-TiWi.....	6
WL1271-TypeTN.....	7

#### ZigBee®/IEEE 802.15.4

ZigBee Overview. ....	8
ZigBee Light Link .....	9
CC2538 System-on-Chip.....	10
CC2520 Transceiver.....	11
CC2530 System-on-Chip.....	12
CC2530ZNP ZigBee Network Processor .....	13
CC2531 System-on-Chip with Integrated USB Controller.....	14
Z-Stack™ - ZigBee Protocol Stack.....	15
<b>6LoWPAN</b>	
6LoWPAN Overview .....	16
CC1180 .....	17

### Personal Area Networks

#### Bluetooth® technology

Bluetooth Overview .....	18
CC2560 QFN .....	19
CC2564 .....	20
<b>Bluetooth® low energy</b>	
Bluetooth low energy Overview.....	21
CC2540 System-on-Chip.....	22
CC2541 System-on-Chip.....	23
Bluetooth low energy Protocol Stack.....	24

#### ANT™

ANT Overview.....	25
CC2570/ CC2571 Network Processor .....	26

#### ZigBee® RF4CE

ZigBee RF4CE Overview .....	27
CC2533 System-on-Chip.....	28

#### PurePath™ Wireless Audio

PurePath Wireless Overview .....	29
CC8520 System-on-Chip.....	30

### Positioning

#### GPS

CC4000-TC6000GN .....	31
-----------------------	----

### Proprietary RF

#### Sub-1 GHz

CC430 Integrated MSP430 and CC1101 System-on-Chip .....	32
CC1100E Transceiver.....	33
CC1101 Transceiver .....	34
CC1101-Q1 Automotive-Qualified Transceiver .....	35
CC1110 System-on-Chip.....	36
CC1111 System-on-Chip with Integrated USB Controller.....	37
CC1131-Q1 Automotive-Qualified Receiver .....	38
CC1150 Transmitter .....	39
CC1151-Q1 Automotive-Qualified Transmitter .....	40
CC1190 RF Front End .....	41
CC1120, CC1121, CC1125, CC1175, CC1200 Tranceivers .....	42
CC110L Value Line Tranceiver.....	44

#### 2.4 GHz

CC2544 .....	45
CC2590, CC2591 RF Front End.....	46

### RFID/NFC

TMS37157 .....	47
TMS3705 .....	48
TRF796x, Reader/Writer Transceiver ICs .....	49
TRF7970A Transceiver .....	50

### Embedded Processors for Wireless Connectivity

Embedded Processors Overview .....	51
MSP430™ .....	52-54
Stellaris® .....	55
Sitara™ ARM® .....	56

### Resources

Development Tools .....	57-59
Development Tools FAQ .....	60
Software Overview .....	61-62
Developer Network .....	63
E2E Online Community .....	64
TI Connectivity Wiki .....	65
Product Comparison Guide .....	66-71
Selection Guides .....	72
TI Worldwide Technical Support .....	73

# Wireless Connectivity and Application Areas

## → Introduction

### The right wireless connectivity solution

Whatever type of wireless technology you need for your next designs, TI can help you find the right one for your application.

With the industry's broadest wireless connectivity portfolio, TI supports more than a dozen different wireless technologies for:

- 802.15.4 Standards based mesh and IP networks
- Personal area networks
- Proprietary RF sub-1 GHz
- Proprietary RF 2.4 GHz
- RFID/NFC
- GPS

### Main application areas

- Alarm, security and active/passive RFID/NFC
- Automotive
- Home automation and lighting
- Metering/smart energy
- Portable consumer
- Portable enterprise
- Consumer medical and health
- Remote controls
- Wireless audio

### Resources that make development easy

Our solutions are paired with resources that make development fast and easy and reduce time-to-market.

TI's out-of-the-box development tools will get you quickly started. Through TI you'll have access to a broad variety of cost-effective development tools, reference designs and supporting application and design notes.

Get answers to your design questions from the TI design experts through our interactive online E2E community.

If you need help to speed up your application development, TI has an extensive network of third parties to help accelerate your design. The network consists of recommended companies, RF consultants, and independent design houses that provide a series of hardware module products and design services.

### Wireless solutions optimized for TI's embedded processing portfolio

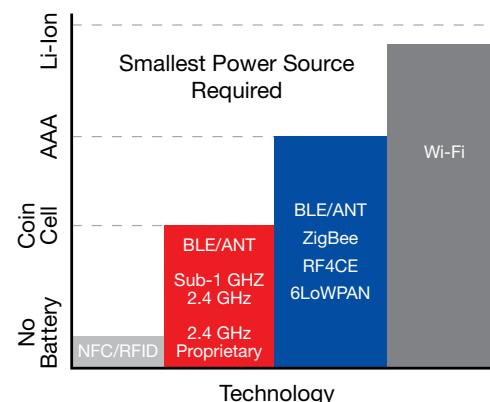
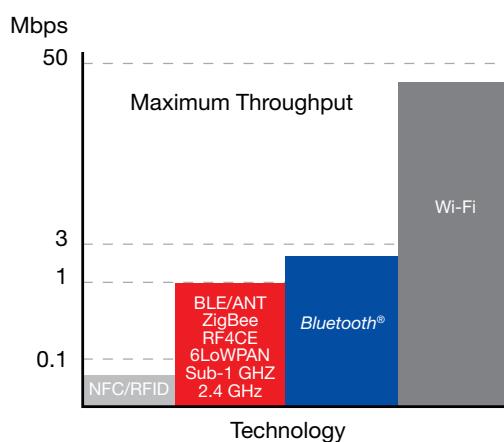
Decrease your development time with TI's wireless technologies pre-integration with TI Embedded Processing solutions.

Our connectivity solutions are designed for the industry's broadest embedded processing portfolio – from high-performance processors to low power MCUs.

### SimpleLink Makes Wireless Design Easier

SimpleLink™ self-contained solutions were designed to simplify wireless development and certification by minimizing the amount of RF expertise you need to wirelessly enable a wide range of applications. TI offers SimpleLink™ solutions for multiple wireless technologies including Wi-Fi®, ZigBee®, 6LoWPAN, ANT™ and GPS with an expanding portfolio to come.

A red corner on the page denotes a SimpleLink™ product.



## → Wi-Fi® Overview

### Wi-Fi IEEE 802.11 a/b/g/n

Wi-Fi continues to effectively penetrate the wireless market with an installed base of over 3.5B units with an annual shipment rate exceeding a billion units. nine out of ten Americans surveyed in a consumer poll said they would rather do without Starbucks for a year than give up their Wi-Fi connection!

### Application areas

- Medical devices and remote patient monitoring
- Consumer devices (tablets, e-books, media players), web browsing, internet connectivity, and streaming multimedia
- Industrial and home automation, remote monitoring, controlling, data-logging and diagnostics
- Smart machines
- Video conferencing
- Security and surveillance

### How does Wi-Fi technology work?

Wi-Fi networks use radio technologies based on the IEEE 802.11a, 802.11b, 802.11g and 802.11n to provide secure, reliable, fast wireless connectivity. Wi-Fi networks operate in the unlicensed 2.4 and/or 5 GHz radio bands at rates of 54 Mbps or greater. They can provide real-world performance similar to the basic 10BaseT wired Ethernet networks. For more information on Wi-Fi technology, visit [www.wi-fi.org](http://www.wi-fi.org).

(single-chip WLAN/Bluetooth® device) which further solve issues such as coexistence, antenna sharing in size-constrained devices, cost and power consumption.

Texas Instruments enables simple Wi-Fi connectivity with the self-contained SimpleLink™ CC3000, which allows very short design cycles by eliminating the need for extensive RF and Wi-Fi expertise.

### Why TI Wi-Fi?

Texas Instruments is the world's leading supplier of Wi-Fi products for portable, battery-powered products leveraging nearly a decade of experience and eight generations of products which are optimized for the needs of handheld products. TI is also the market leader in combined wireless products such as the WL1271



# Wi-Fi®/IEEE 802.11

## → CC3000

### SimpleLink™ Wi-Fi Module

#### CC3000, CC3000-TiWi-SL, CC3000-TypeVK

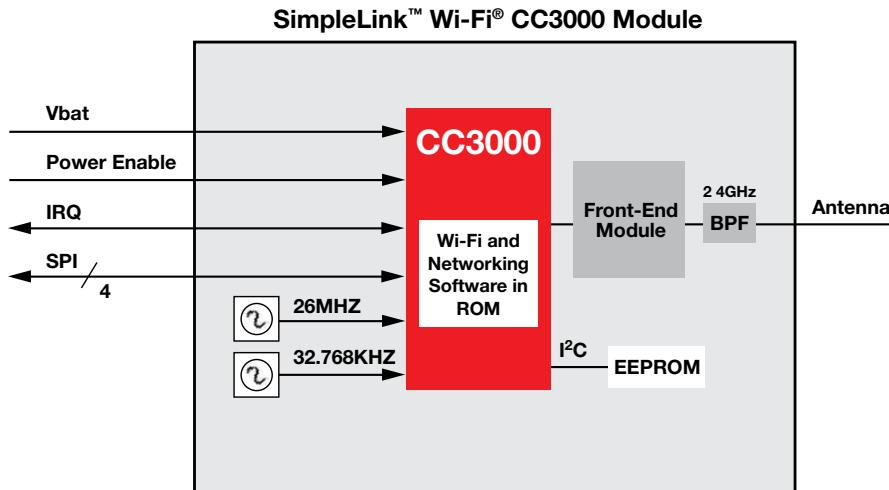
Learn more at: [www.ti.com/wifi](http://www.ti.com/wifi)

The CC3000 is a self-contained wireless solution that simplifies the process of implementing Internet connectivity. SimpleLink™ Wi-Fi minimizes host microcontroller (MCU) software requirements making it the ideal solution for embedded applications using any low-cost/low-power MCU.

The CC3000 is provided as a module by TI, LS Research and Murata to reduce development time, lower manufacturing costs, save board space, ease certification and minimize RF expertise required. Additionally, it is provided as a complete platform solution including software drivers, sample applications, API guide, user documentation and a world-class support community.

#### Key Features

- Embedded Wi-Fi and networking software including drivers, stack and supplicant
- Best-in-class link budget:
  - Typical WLAN transmit power (varies by module):
    - 18 to 19.5 dBm, 11 Mbps, CCK (b)
    - Typical WLAN sensitivity:
      - -85 to -89 dBm, 8% PER, 11 Mbps
- Compact code size (as low as 2KB flash and 250B RAM) required for host microcontroller
- FCC/IC and ETSI-tested, production ready module
- U.FL with dipole antenna or chip antenna FCC/IC certified, ETSI-tested reference designs available
- Assorted levels of integration including power management and clocking options
- Small form factor module
- Proven Wi-Fi interoperability
- Complete platform solution including API guide, sample applications, support community, user and porting guides are provided by TI



CC3000 Wi-Fi system diagram.

#### Benefits

- Embedded Wi-Fi software including all drivers, TCP/IP stack, and supplicant
- Credible, proven solution with best-in-class link budget
- Complete platform solution and certified modules

#### Applications

- Automation
- Home security/surveillance
- Network appliance
- Fitness/health/medical

#### Development Tools and Software

- EM board and Booster Pack for CC3000 TI module available 4Q12
- Integrated Development Kit – CC3000FRAMEMK-L and CC3000FRAMEMK-M available today with MSP-EXP430FR5739 included
- EM board only available through distribution such as Arrow, Avnet, Digikey and Mouser
- Sample applications available - [www.ti.com/tool/cc3000-platform](http://www.ti.com/tool/cc3000-platform)

#### Module Solutions

Partner	TI	LSR	Murata
Module part number	CC3000	CC3000-TiWi-SL	CC3000-TypeVK
Size	16.3mm x 13.5mm x 2mm	21mm x 14mm x 2.3mm	16.5mm x 11.5mm x 2.2mm
Temperature	-40° to 85°C	-40° to 85°C	-30° to 70°C

## → WL1271-TiWi

### WLAN 802.11 b/g/n and Bluetooth® v2.1 + EDR Module from LS Research

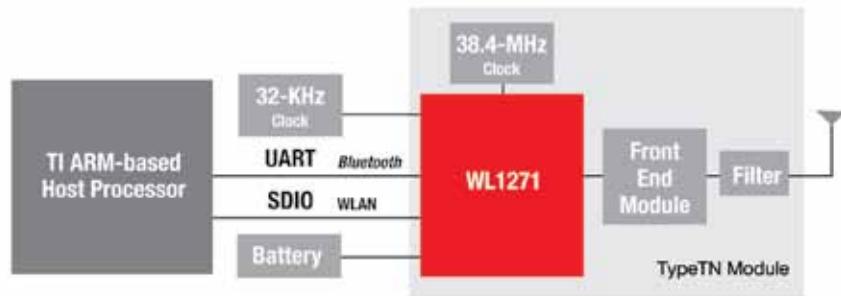
#### WL1271-TiWi

Learn more at: [www.ti.com/wl1271-tiwi](http://www.ti.com/wl1271-tiwi)

The WL1271-TiWi is a fully-integrated high performance module offered by LS Research utilizing TI's single-chip WL1271 2.4GHz IEEE 802.11 b/g/n and Bluetooth 2.1 + Enhanced Data Rate (EDR) Transceiver. Based on TI's 6<sup>th</sup> generation WLAN technology and 7<sup>th</sup> generation Bluetooth technology, the integrated solution provides best-in-class coexistence capabilities coupled with TI's Enhanced Low Power (ELP™) technology. The WL1271-TiWi is provided as a module to help customers reduce development time, lower manufacturing costs, save board space, ease certification, and minimize RF expertise required. For evaluation and development, various platforms are available which integrate WL1271-TiWi, Linux WLAN drivers, BlueZ Bluetooth stack, and sample source applications running on a TI host processor (AM/DM37x, AM18x, OMAP™4). A roadmap to other HLOS including WinCE and Android, as well as advanced features including ANT, Access Point and Wi-Fi Direct is planned.

#### Key Features

- IEEE 802.11 b/g/n compliant
- Typical WLAN transmit power:
  - +20 dBm, 11 Mbps, CCK (b)
  - +14.5dBm, 54 Mbps, OFDM (g)
  - +12.5 dBm, 65 Mbps, OFDM (n)
- Typical WLAN receiver sensitivity:
  - -89 dBm , 11 Mbps
  - -76 dBm , 54 Mbps
  - -73 dBm, 65 Mbps
- Bluetooth v2.1 + EDR
  - Increased Bluetooth transmit power: +9.5 dBm
  - -92 dBm receiver sensitivity
- Best-in-class coexistence technology on a single-chip
- ELP technology for extended battery life
- On board TCXO, power regulation, and U.FL antenna connector
- Hardware and software pre-integration with TI's AM/DM37x (ARM® Cortex™-A8), AM18xx (ARM9), and OMAP4 (ARM Cortex-A9) platforms
- Software upgradable for ANT and Bluetooth low energy
- FCC/IC/CE certified
- Dimensions: 13mm x 18mm x 1.9mm



WL1271-TypeTN WLAN and Bluetooth system diagram.

#### Benefits

- Secure, fast and reliable Wi-Fi and Bluetooth connectivity
- High throughput, robust connection with extended range
- Extended battery life and power efficiency
- Reduced development time and costs

#### Applications

- Mobile Consumer Devices
- Industrial and Home Automation, metering
- Portable data terminals
- Video Conferencing, Video Camera

#### Development Tools and Software

- AM/DM37x + WL1271 WLAN + Bluetooth development platform
- AM18x + WL1271 WLAN + Bluetooth development platform
- OMAP35xx + WL1271 WLAN + Bluetooth development platform
- Linux 2.6.x and 3.x WLAN drivers and BlueZ Open Source Bluetooth Stack included in SDK

#### General Characteristics

Parameter	Min	Unit
Frequency range	2.4	GHz
Data rate	65	Mbps
Operating voltage	3 to 4.8	V
I/O voltage	1.62 to 1.92	V
Operating temperature	-40 to 85	°C
IEEE 802.11	b, g, n, d, e, i	
Bluetooth specification	2.1 + EDR	
Transmit power IEEE802.11b (11 Mbps)	+20	dBm
Transmit power IEEE802.11g (54 Mbps)	+14.5	dBm
Transmit power IEEE802.11n (65 Mbps)	+12.5	dBm
Receiver sensitivity IEEE802.11b (11 Mbps)	-89	dBm
Receiver sensitivity IEEE802.11g (54 Mbps)	-76	dBm
Receiver sensitivity IEEE802.11n (65 Mbps)	-73	dBm
Current consumption IEEE802.11g	<1.2 (standby), 185 (Tx), 100 (Rx)	mA
Host interfaces	SDIO, UART	
Internal crystal frequency	38.4	MHz
I/O	3 x ADC, 1x DAC, 2 x GPIO	
Antenna	U.FL Connector or onboard antenna	
Size	13 x 18 x 1.9	mm <sup>3</sup>

## → WL1271-TypeTN

### WLAN 802.11 b/g/n and Bluetooth® v4.0 BLE Module from Murata

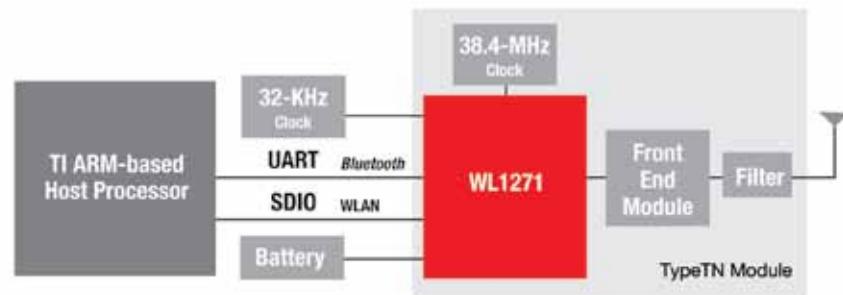
#### WL1271-TypeTN

Learn more at: [www.ti.com/product/wl1271-typetn](http://www.ti.com/product/wl1271-typetn)

The WL1271-TypeTN is a fully-integrated high performance module offered by Murata utilizing TI's single-chip WL1271 2.4GHz IEEE 802.11 b/g/n and v4.0 BLE Transceiver. Based on TI's 6th generation Wi-Fi technology and 7th generation technology, the solution provides best-in-class coexistence capabilities coupled with TI's Enhanced Low Power (ELP™) technology. The WL1271-TypeTN is provided as a module to help customers reduce development time, lower manufacturing costs, save board space, ease certification, and minimize RF expertise required. For evaluation and development, platforms are available which integrate the WL1271-TypeTN module, Linux Wi-Fi drivers, BlueZ Bluetooth stack, and sample source applications running on a TI host processor (AM335x).

#### Key Features

- IEEE 802.11 b/g/n Wi-Fi
- Typical WLAN transmit power:
  - +14.5dBm, 65Mbps (11n)
  - +20dBm, 11Mbps (11b)
- Typical WLAN receiver sensitivity:
  - -70dBm, 65Mbps
  - -88dBm, 11Mbps
- Bluetooth® v4.0 with Bluetooth low energy (BLE)
- Typical sensitivity:
  - -92dBm DH5
  - -85dBm EDR
- Bluetooth power class 1.5
  - +8dBm BDR (Typical)
- Best-in-class WLAN and coexistence technology on a single-chip
- Enhanced Low Power (ELP™) technology for extended battery life
- On module 38.4MHz reference oscillator, DC-DC voltage regulation, and U.FL Coaxial
- Hardware and software pre-integration With TI's AM335x (ARM® Cortex™-A8) platform
- Software Upgradable for ANT
- Dimensions:
  - 17 mm × 10 mm × 2.2 mm



WL1271-TypeTN WLAN and Bluetooth system diagram.

#### Benefits

- Secure, fast and reliable Wi-Fi and Bluetooth connectivity
- High throughput, robust connection with extended range
- Extended battery life and power efficiency
- Reduced development time and costs

#### Applications

- Mobile Consumer Devices
- Industrial and Home Automation, metering
- Portable data terminals
- Video Conferencing, Video Camera

#### Development Tools and Software

- AM335x + WL1271 + Bluetooth development platform
- DM814x + WL1271 + Bluetooth development platform
- Linux 2.6.x, 3.x WLAN drivers and BlueZ Open Source Bluetooth Stack included in SDK

#### General Characteristics

Parameter	Min	Unit
Frequency range	2.4	GHz
Data rate	65	Mbps
Operating voltage	2.7 to 4.8	V
I/O voltage	1.65 to 1.92	V
Operating temperature	-40 to 70	°C
IEEE 802.11	b, g, n	
Bluetooth specification	4.0 + EDR	
Transmit power IEEE802.11b (11 Mbps)	+20	dBm
Transmit power IEEE802.11g (54 Mbps)	+15	dBm
Transmit power IEEE802.11n (65 Mbps)	+14.5	dBm
Receiver sensitivity IEEE802.11b (11 Mbps)	-88	dBm
Receiver sensitivity IEEE802.11g (54 Mbps)	-73	dBm
Receiver sensitivity IEEE802.11n (65 Mbps)	-70	dBm
Current consumption IEEE802.11g	<0.1 (sleep), 175 (Tx), 90 (Rx)	mA
Host interfaces	SDIO, UART	
Internal crystal frequency	38.4	MHz
I/O	3 x ADC, 1x DAC, 2 x GPIO	
Antenna	U.FL Coaxial	
Size	17 x 10 x 2.2	mm^3

## → ZigBee Overview

### ZigBee/IEEE 802.15.4

ZigBee is a standards-based technology for remote monitoring, control and sensor network applications. The ZigBee standard was created to address the need for a cost-effective, standards-based wireless networking solution that supports low data-rates, low-power consumption, security, and reliability.

ZigBee supports self-healing mesh networking which is a decentralized network topology very similar to the Internet. It allows nodes to find new routes throughout the network if one route fails, making ZigBee a robust wireless solution.

### Application areas

ZigBee 802.15.4 can be used in any monitoring and control application that requires a wireless link:

- Consumer and Commercial lighting
- Home, building and industrial automation
- Energy harvesting
- Home control/security
- Medical/patient monitoring
- Logistics and asset tracking
- Sensor networks and active RFID
- Advanced metering/smart energy
- Commercial building automation

### Why TI ZigBee?

Texas Instruments is a founding member of the ZigBee Board of Directors. Unlike other hardware suppliers that outsource their ZigBee stack development, our software engineering team delivers golden unit certified platforms which are the benchmark for other developer companies to test against. TI is the lead technical editor for the next generation IP based protocol stack. TI's ZigBee solutions include:

- Cortex™ M3 based System-on-Chip (SoC) is targeted for dual stack SE and HA applications offering hardware security acceleration for fast commissioning.
- TI provides complete and free software solution on various platforms (8051 and Cortex M3 SoCs, ultra-low power MSP430™)
- TI provides extensive development tools, application support, reference designs
- TI is the ZigBee market leader and #1 in 802.15.4 and shipped the first 802.15.4 chip on the market (CC2420 )
- TI brings ZigBee technology to smartphones as mobile smart energy display

- TI had the first IEEE 802.15.4 radio and has a continued solid roadmap with focus on ZigBee

### Three paths to ZigBee

TI offers four ZigBee-compliant platforms, built on the second generation CC2538, CC2530 and CC2520 IEEE:

- The ZigBee second generation CC2530 SoC is a ZigBee “golden unit suite” that is targeted for low power applications and small form factor designs.
- The CC2530ZNP (ZigBee network processor) can be used for designs where the CC2530ZNP, containing the ZigBee Pro stack, communicates to the system’s main processor through the SPI, UART or USB UART interface. This partitioning option allows the designer to keep the ZigBee application profile and any other applications on the main processor.
- The second generation CC2520 802.15.4 transceiver can be used with the MSP430™ MCUs and Stellaris® suite of ARM® Cortex™ microcontrollers. It is recommended for designers who want additional flash and RAM, or other peripherals not supported in the SoC solutions.

		System-on-chip Small footprint High integration Low cost	Co-processor Flexible Easy to use Reduced time to market	Dual-chip Ultra low-power or High performance
Complete ZigBee® Solution	Application	 <b>CC2538</b> <b>CC2530/1</b>	Any Processor (e.g. MSP430 or Stellaris ARM)	MSP430 or Stellaris ARM
	Protocol stack		 <b>CC2530ZNP</b> based co-processor with embedded stack and uart/spi/usb interface	 <b>CC2520</b>
	Radio			
	RF front end (optional)	CC2590/CC2591/	CC2590/CC2591/	CC2590/CC2591/

TI's three paths to ZigBee.

[www.ti.com/zigbee](http://www.ti.com/zigbee)

## → Introducing ZigBee Light Link

### Overview

The world of wireless lighting control has seen a dramatic shift from custom or proprietary lighting solution as efficient and low cost solutions have been introduced to the general market. Consumers recognize the value of convenience, security, and comfort that wireless devices bring to the home or office. The barrier to these systems in the past has been that most product manufacturers do not provide a system that allows interoperability among different lighting control vendors.

Designers can create an easy to use lighting control solution using ZigBee light link (ZLL) profile on the Texas Instruments Z-stack Pro platform. ZLL is designed to run on the CC2530 product family. ZLL was created to save time, money and installation frustration by providing a simple easy to install network of lights, switches, occupancy sensors, daylight sensors that can be controlled by a mobile device such as an tablet and mobile phone as illustrated in Figure 1.

### TI ZigBee Light benefits

- Ease of set-up/installation
  - No tools required
  - No new wires to be installed, great for retrofit projects
  - No special devices needed

- Scalable over time to easily add your existing luminaries or new light points to the system
- System components in a reliable secure mesh network which allows communication to be safely relayed by multiple individual network nodes
- Flexibility of movement to allow you to change the positioning of your components wherever you want
- Control of lights from anywhere you like
- Enhanced selection of lighting levels (including on/off) and ambiances for a single or group of lights stored and recalled by the press of a button

### What makes ZigBee Light Link valuable?

Lighting control requires low cost technology, long battery life capability, reliable network performance and system security. This is why the ZigBee Light Link solution is based on ZigBee technology.

- This system does not require a coordinator node, or other special devices
- All components in the network are on a similar hierarchical level and can easily be added to or removed from the network without affecting system functionality or integrity



Figure 1 – Low Power RF lighting control



Courtesy of ZigBee Alliance

### How does TI ZigBee Light Link work?

With Light Link, adding or removing lamps is very easy and robust. Contrary to other networking solutions, it does not matter which lamp is installed first, or whether other lamps in the network are switched on or off. With ZigBee Light Link, adding a new lamp at a remote location is as easy as adding a lamp nearby in range. Figure 2 demonstrates the solution.

Only TI can provide you with one stop shopping for your wireless lighting projects. Smart phones, tablets and PCs via bridging devices can control lighting products based on TI. Wireless control is possible via direct control such as the key fob, remote control and wireless wall switch or occupancy sensor. ZigBee Light Link can also be controlled remotely using a tablet mobile app via a Wi-Fi to ZigBee gateway. Added digital functionality can add wake up features or time phased multi room on/off lighting for vacation mode security.

**TI gets you into the Smart Lighting market NOW!**

[ti.com/ZigBee](http://ti.com/ZigBee)

## → CC2538

### 2.4 GHz IEEE802.15.4 ZigBee System on Chip Solution

#### CC2538

Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/CC2538](http://www.ti.com/sc/device/CC2538)

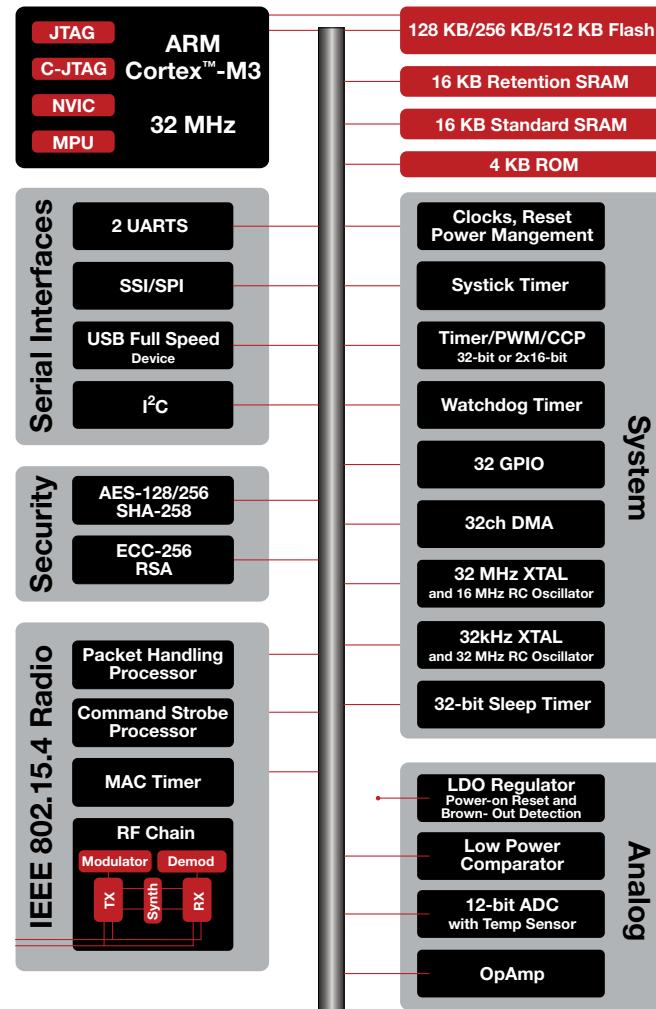
The CC2538 is a cost-effective, low power, and full System-on-Chip (SoC) solution specifically tailored to IEEE 802.15.4 point to point, star, and ZigBee PRO mesh network advanced applications as well as ZigBee IP Smart Energy2.0 applications and 6LoWPAN products.

The CC2538 combines a fully integrated high-performance RF transceiver with an industry-standard enhanced Cortex™ M3 MCU, Flash, RAM and other powerful supporting features and peripherals.

The CC2538 comes in multiple memory and feature options, among them 256KB/512KB Flash memory, 16KB/32KB RAM memory and multiple security features such as AES engine with 128,192,256 bit key support and Public Key Accelerator ECC and RSA-2048.

#### Key Features

- Future proof memory sizes
  - Up to 512 KB TSMC Flash to enable on-chip OTA
  - Up to 32 KB RAM (16 KB with retention) to comfortably implement ZigBee IP routers
- Lower Power IEEE 802.15.4 Radio
  - 19 mA in Rx
  - 22 mA in Tx @ 0 dBm
- Powerful MCU system
  - Low power ARM® CM3 from Stellaris®
  - 1.2  $\mu$ A sleep current with RTC with 120  $\mu$ s wakeup for long battery life
  - Robust and proven power management system
- Capable security core ready for ZigBee SE 2.0:
  - AES engine with 128,192,256 bit key support
- CCM, GCM, CTR, CBC-MAC, ECB modes of operation
- SHA-256 hash function
- Secure key storage memory
- High throughput
  - Public key accelerator
- ECC and RSA-2048
- Side channel attack protection against timing and power attacks



CC2538 system diagram.

#### Benefits

- Supports ZigBee PRO, ZigBee IP, advanced ZigBee profiles, ZigBee RF4CE, 6LoWPAN, and all 802.15.4-based solutions
- Excellent receiver sensitivity and programmable output power
- Very low current consumption in RX, TX, and multiple low-power modes ensure long battery lifetime
- Best-in-class selectivity and blocking performance, with lowest packet error rate. Suited for battery applications

#### Applications

- Meters and home area network - smart energy 1.x/smart energy 2.x
- Automated meter reading
- Lighting networks
- Remote controls
- Home/building automation
- Consumer products
- Industrial control and monitoring
- Low-power wireless sensor networks

## → CC2520

### RF Transceiver for IEEE 802.15.4/ZigBee

#### CC2520

Get samples, datasheets, evaluation modules and application notes at: [www.ti.com/sc/device/CC2520](http://www.ti.com/sc/device/CC2520)

The CC2520 is TI's second generation ZigBee/IEEE 802.15.4 RF transceiver for the 2.4-GHz unlicensed ISM band. This chip enables industrial-grade applications by offering state-of-the-art noise immunity, excellent link budget, operation up to 125°C and low-voltage operation.

In addition, the CC2520 provides extensive hardware support for packet handling, data buffering, burst transmissions, data encryption, data authentication, clear channel assessment, link quality indication and packet timing information. These features reduce the load on the host controller.

#### Key Features

- State-of-the-art noise immunity with minimum 48-dB adjacent channel rejection
- Excellent link budget (103 dB)
- Extended temp range (-40°C to +125°C)
- Extensive IEEE 802.15.4 MAC hardware support
- CC2420 interface compatibility mode
- AES-128 security module

#### Benefits

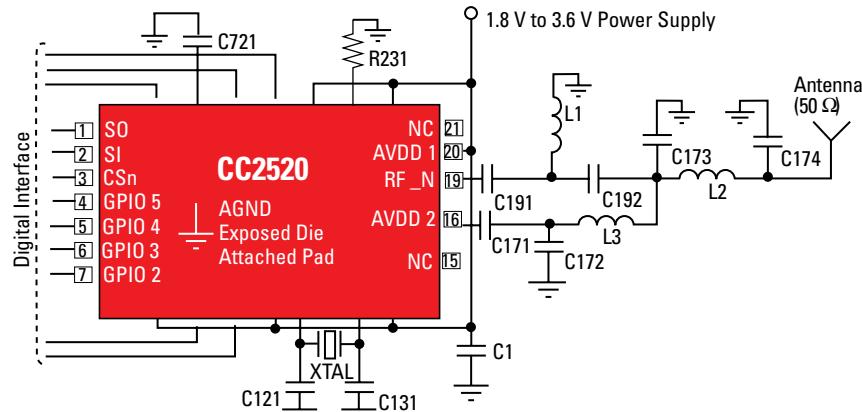
- Enables industrial applications in the 2.4-GHz ISM band
- Excellent coexistence with Bluetooth® and Wi-Fi®
- Hardware support to offload MCU

#### Applications

- Industrial monitoring and control
- Home and building automation
- Low-power wireless sensor networks
- Set-top boxes and remote controls

#### Development Tools and Software

- CC2520DK Development Kit
- Z-Stack™ software
- TIMAC
- SimpliciTI™ software protocol
- DK-EM2-2520Z - Stellaris® 2.4 GHz ZigBee wireless kit



CC2520 application circuit.

#### General Characteristics

Parameter	Min	Typ	Max	Unit
<b>Operating conditions</b>				
Frequency range	2394	—	2507	MHz
Data rate	—	250	—	kBaud
Operating voltage	1.8	—	3.6	V
Operating temperature	-40	—	125	°C
Output power	-18	—	5	dBm
<b>RX mode</b>				
Receiver sensitivity	—	-98	—	dBm
Adjacent channel rejection, +5 MHz	—	49	—	dB
Adjacent channel rejection, -5 MHz	—	49	—	dB
Adjacent channel rejection, +10 MHz	—	54	—	dB
Adjacent channel rejection, -10 MHz	—	54	—	dB
<b>Current consumption</b>				
Current consumption, RX	—	22	—	mA
Current consumption, TX, +5 dBm	—	33	—	mA
Current consumption, TX, 0 dBm	—	25	—	mA
Current consumption, power down	—	<1	—	µA

## → CC2530

### 2.4-GHz IEEE 802.15.4/ZigBee®/RF4CE System-on-Chip Solution

#### CC2530

Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/CC2530](http://www.ti.com/sc/device/CC2530)

The CC2530 is a cost-effective, low power, and true System-on-Chip (SoC) solution specifically tailored to IEEE 802.15.4 point to point and star or ZigBee PRO mesh network applications

The CC2530 comes in four different versions: CC2530-F32/64/128/256, with 32/64/128/256-KB flash memory respectively and combines a fully integrated high-performance RF transceiver with an industry-standard enhanced 8051 MCU, 8-KB RAM and other powerful supporting features and peripherals.

#### Key Features

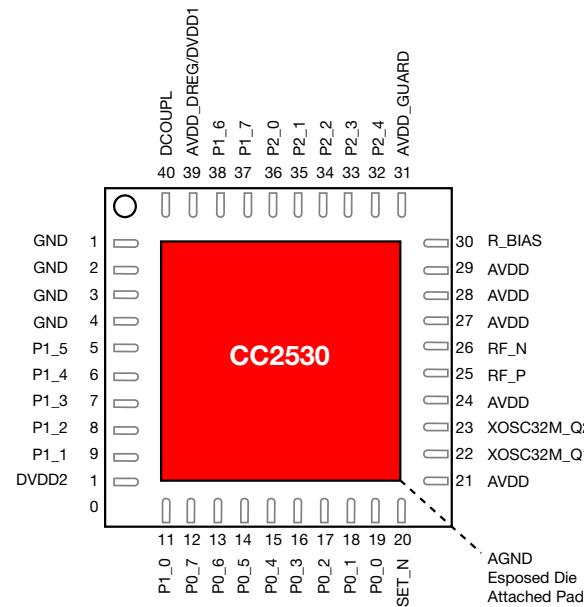
- Up to 256-kB flash with 20K erase cycles to support over-the-air updates, large applications
- 8-kB RAM for more complex applications and ZigBee profiles
- Programmable output power up to +4.5 dBm
- Less than 1- $\mu$ A current consumption in power down with sleep timer running
- Includes powerful address recognition and packet processing engine

#### Benefits

- Supports ZigBee/ZigBee PRO, ZigBee RF4CE, 6LoWPAN, and all 802.15.4-based solutions
- Excellent receiver sensitivity and programmable output power
- Very low current consumption in RX, TX, and multiple low-power modes ensure long battery lifetime
- Best-in-class selectivity and blocking performance, with lowest packet error rate. Suited for battery applications.

#### Applications

- Smart energy/automated meter reading
- Remote controls
- Home/building automation
- Consumer products
- Industrial control and monitoring
- Low-power wireless sensor networks



CC2530 package.

#### General Characteristics

Parameter	Min	Typ	Max	Unit
<b>Operating conditions</b>				
Frequency range	2400	—	2483.6	MHz
Operating temperature range	-40	—	125	°C
Operating supply voltage	2.0	—	3.6	V
Radio bit rate	—	250	—	kBaud
Receiver sensitivity	—	-97	—	dBm
Adjacent channel rejection	—	49/49	—	dB
Alternate channel rejection	—	57/57	—	dB
Blocking	—	57/57	—	dB
Nominal output power in TX mode	—	+4.5	—	dBm
<b>Current consumption</b>				
MCU active and RX mode	—	25	—	mA
MCU active and TX mode, +4 dBm	—	34	—	mA
Power mode 1	—	105	—	μA
Power mode 2	—	1	—	μA
Power mode 3	—	0.4	—	μA
<b>Wake-up and timing</b>				
From power mode 2 or 3 to active	—	120	—	μs
From active to RX or TX	—	192	—	μs

# ZigBee®/IEEE 802.15.4

## → CC2530ZNP

### ZigBee® Network Processor CC2530ZNP

Get samples, evaluation modules and application notes at: [www.ti.com/simplelink](http://www.ti.com/simplelink)

The CC2530ZNP (ZigBee Network Processor) is a low cost and effective way to design with the ZigBee protocol, without having to learn the complexities of the full ZigBee PRO stack and public application profiles. It is recommended for application developers that want to use their existing host processor, or prefer to use another processor to run other applications, while using the CC2530ZNP to communicate with other ZigBee devices. The ZNP is a CC2530 System-on-Chip (SoC) preloaded with the ZigBee PRO stack, without ZigBee Cluster Library. The CC2530ZNP communicates to the host processor via an SPI or UART command interface. The host processor communicates with the ZigBee processor using an easy to use protocol.

#### Key Features

- Easy to use ZigBee processor (8051 core)
- Integrated ZigBee Pro compliant stack
- Supports the TI Z-Stack™ software and Simple API
- Certified golden platform used in ZigBee interoperability test events
- Best in class selectivity, good coexistence with Wi-Fi® and Bluetooth® devices
- Low power consumption

#### Benefits

- Integrated HW design shortens time to market by 25%
- Embedded stack with simple sample applications reduce firmware development by up to 50%
- Compact radio reference design makes it ideal for small form factor end devices and sensors
- Low current consumption optimized for sleeping end nodes and battery operated devices

#### Applications

- Home and building automation
- Industrial monitoring and control
- Sensor networks
- Medical telehealth

#### Development Tools and Software

- CC2530ZNP-mini kit
- Simple ZigBee applications: Coordinator, router, end-device
- RF tester application: Eases FCC/ETSI testing



#### General Characteristics

Parameter	Min	Typ	Max	Unit
<b>Operating conditions</b>				
Frequency range	2400	—	2483.6	MHz
Operating temperature range	-40	—	125	°C
Operating supply voltage	2.0	—	3.6	V
Radio bit rate	—	250	—	kBaud
Receiver sensitivity	—	-97	—	dBm
Adjacent channel rejection	—	49/49	—	dB
Alternate channel rejection	—	57/57	—	dB
Blocking	—	57/57	—	dB
Nominal output power in TX mode	—	+4.5	—	dBm
<b>Current consumption</b>				
MCU active and RX mode	—	25	—	mA
MCU active and TX mode, +4 dBm	—	34	—	mA
Power mode 1	—	105	—	µA
Power mode 2	—	1	—	µA
Power mode 3	—	0.4	—	µA
<b>Wake-up and timing</b>				
From power mode 2 or 3 to active	—	120	—	µs
From active to RX or TX	—	192	—	µs

## → CC2531

### 2.4 GHz USB-enabled IEEE 802.15.4/ZigBee/RF4CE System-on-Chip Solution

#### CC2531

Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/CC2531](http://www.ti.com/sc/device/CC2531)

The CC2531 is a USB-enabled SoC solution for IEEE 802.15.4, ZigBee and RF4CE applications which enables USB dongles or USB upgradable network nodes to be built with low total bill-of-material costs. The CC2531 combines the performance of a leading RF transceiver with an industry-standard enhanced 8051 MCU, in-system programmable flash memory, 8-KB RAM, and many other powerful features. Combined with the golden-unit-status (ZigBee PRO) from TI, the CC2531 provides a robust and complete ZigBee PRO dongle for firmware upgradable network node.

#### Key Features

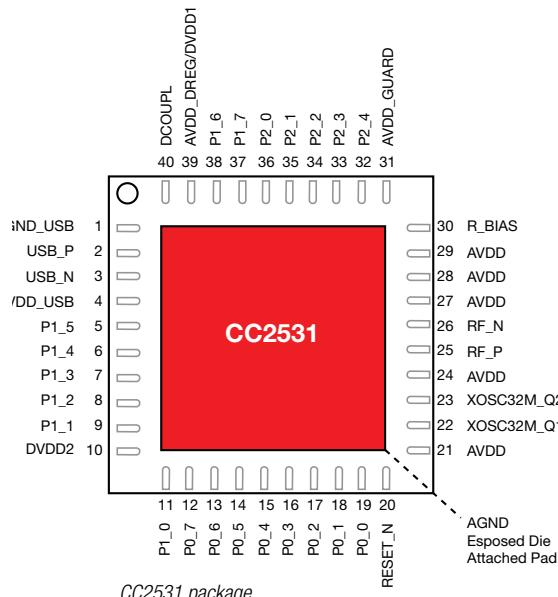
- Up to 256 KB Flash / 8-KB of RAM
- Excellent link budget (101.5 dB)
- 49dB adjacent channel rejection (best in class)
- Four flexible power modes
- Extended temperature range: -40 to +125°C
- AES-128 security module
- Fully compatible with the CC259x range extenders

#### USB

- USB 2.0 certified full speed device (12 Mbps)
- 5 highly flexible endpoints
- 1-KB dedicated FIFO
- No 48-MHz crystal required
- Certified CC2531 USB dongle reference design

#### Benefits

- 2X FLASH over closest competitor
- Supports ZigBee PRO, ZigBee RF4CE, and more
- 400m+ LOS range with CC2530EM dev boards
- 12dB better than closest competitor, filters interference from a jammer over 4x closer
- Lowest current consumption power down mode for long battery life low duty-cycle applications
- Widest temperature range for superior robustness
- Efficient security takes up little FLASH or MCU cycles
- Reduced part list and lower BOM cost



CC2531 package.

#### Benefits (continued)

- Ideal for gateway or bridge device
- Simple low-cost solution to 1000+ meter range
- Allows smaller PCB to help miniaturize product
- Provides legacy IR support with no added cost

#### Applications

- Home, building and industrial automation
- Energy harvesting
- Home control/security
- Medical/patient monitoring
- Logistics and asset tracking
- Sensor networks and active RFID
- Advanced metering/smart energy
- Commercial building automation

#### General Characteristics

Parameter	Min	Typ	Max	Unit
<b>Operating conditions</b>				
Frequency range	2400	—	2483.6	MHz
Operating temperature range	-40	—	125	°C
Operating supply voltage	2.0	—	3.6	V
Radio bit rate	—	250	—	kBaud
Receiver sensitivity	—	-97	—	dBm
Adjacent channel rejection	—	49/49	—	dB
Alternate channel rejection	—	57/57	—	dB
Blocking	—	57/57	—	dB
Nominal output power in TX mode	—	+4.5	—	dBm
<b>Current consumption</b>				
MCU active and RX mode	—	25	—	mA
MCU active and TX mode, +4 dBm	—	34	—	mA
Power mode 1	—	105	—	µA
Power mode 2	—	1	—	µA
Power mode 3	—	0.4	—	µA
<b>Wake-up and timing</b>				
From power mode 2 or 3 to active	—	120	—	µs
From active to RX or TX	—	192	—	µs

## → Z-Stack™ - ZigBee® Protocol Stack

### Z-Stack™ - TI's industry-leading ZigBee protocol stack

Z-Stack is TI's ZigBee-compliant protocol stack for a growing portfolio of IEEE 802.15.4 products and platforms. Z-stack is compliant with the ZigBee® specification, supporting both ZigBee and ZigBee PRO feature sets in the C2538 System-on -Chip (Soc), CC2530 SoC, MSP430+CC2520 transceiver and Stellaris® LM3S9B96+CC2520 transceiver. Z-stack supports the smart energy, home automation, building automation and health care public profiles. Z-Stack supports the Smart Energy and Home Automation profiles. The latest ZigBee PRO stack is downloadable from the TI web site without any royalty charge.

### Key features

- A fully compliant ZigBee PRO feature set on the CC2538, CC2530 and MSP430+CC2520 platforms

- A fully compliant ZigBee feature set on the CC2530 and CC2538 family of SoCs and an extensive family of MSP430 microcontrollers coupled with the latest best-in-class CC2520 transceiver
- A range of sample applications including support for the ZigBee Smart Energy and ZigBee Home Automation Profiles
- Over the Air Download support
- Incorporated support for the CC2591 ([www.ti.com/cc2591](http://www.ti.com/cc2591)) and the latest RF front end which supports regional requirements for +20dBm and +14dBm transmit power and improved receive sensitivity

### Benefits

- Compliant profile support for ZigBee Smart Energy 1.1 (ZSE), ZigBee Home Automation 1.1 (ZHA) and Health Care 1.0 (ZHC) profiles
- Golden Unit certified ZigBee PRO software stack: deployed in millions of systems worldwide today

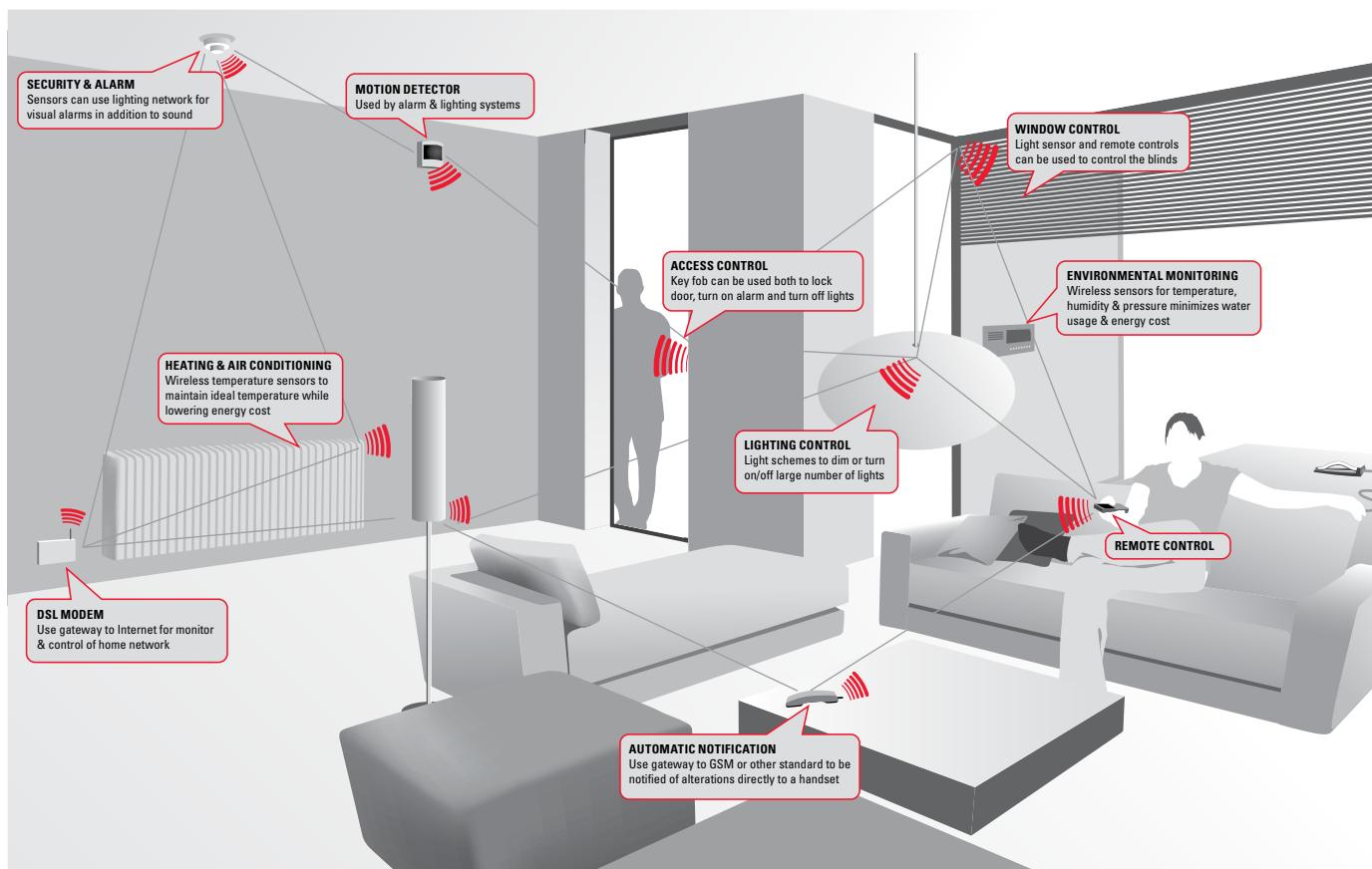
- Over the Air Download (OAD) support allows future updates for your deployed hardware (both ORTA clusters specified by the ZigBee Alliance and TI OAD mechanisms)
- Simple API to reduce development time
- A broad range of sample applications reduce your development costs

### Application areas

ZigBee 802.15.4 can be used in any monitoring and control application that requires a wireless link:

- Commercial and residential lighting
- Home, building and industrial automation
- Energy harvesting
- Home control/security
- Medical/patient monitoring
- Logistics and asset tracking
- Sensor networks and active RFID
- Advanced metering/smart energy
- Commercial building automation

[www.ti.com/z-stack](http://www.ti.com/z-stack)



## → 6LoWPAN Overview

### 6LoWPAN

6LoWPAN is an open standard defined by IETF (Internet Engineering Task Force) in RFC 4944. It defines IPv6 over low power, low cost RF networks. The 6LoWPAN technology natively supports IPv6 addresses on all nodes in a LoWPAN. 6LoWPAN uses mesh technique to support large scalable networks that require IP connectivity. In case one route fails, the technology allows nodes (routers) to find new routes throughout the network, making 6LoWPAN a robust wireless solution. Like in a Zigbee environment information is routed even if a node is out of order. 6LoWPAN makes the wireless embedded Internet possible! 6LoWPAN can be used with several different PHY layers, both sub-1 GHz and 2.4 GHz. It runs on top of IEEE 802.15.4 and enables end-to-end IPv6 addressing and IP context.

### Application areas

- Outdoor lighting systems
- The focus markets and applications are larger scale networks that require connection to an IP backbone network.
- The most relevant cases are, but not limited to:
  - Smart metering
  - Home, building and industrial automation
  - Industrial automation/monitoring/ process control
  - Logistics and asset tracking
  - Security large scale/commercial

### TI's 6LoWPAN solutions

TI's 6LoWPAN solutions are based on hardware from TI and software from its third party Sensinode Ltd. Sensinode Ltd. is a leading supplier of 6LoWPAN software components. TI's 6LoWPAN solutions include:

- Complete hardware and software 6LoWPAN platforms
- High-performance radio, based on the CC1101 radio design or CC1110 and CC430 System-on-Chip (SoC) solutions
- Application support
- Development kits and tools



### Application areas

TI offers two 6LoWPAN platforms, built on the CC1180 and CC430 radios. Both platforms are for sub-1 GHz operation.

- The CC430 SoC is a device that is targeted for low power applications and small form factor designs. The CC430 SoC runs both the 6LoWPAN stack and the customer application on networks up to 50 nodes
- The CC1180 can be used as a wireless network processor. Containing the 6LoWPAN stack, the CC1180 communicates to the system's main processor through the UART interface. This partitioning option allows the designer to keep the application on the main processor
- The CC1101/MSP430 platform is a two chip solution for larger node applications. The memory size of the MSP430F5XX family provides more partitioning for both the stack and application profile.

# Sub-1GHz 6LoWPAN Network Processor

## → CC1180

### Sub-1GHz 6LoWPAN Network Processor

#### CC1180RSPR/CC1180RSPT

Get samples, datasheets, evaluation modules and application notes at: [www.ti.com/sc/device/CC1180](http://www.ti.com/sc/device/CC1180)

The CC1180 is a cost effective, low power, sub- 1GHz network processor that provides wireless 6LoWPAN functionality for system designers that want to connect their end products to the internet using standards based IPv6 technology. The CC1180 is a preloaded version of the CC1110F32 SOC, where the TI third party Sensinode's 6LoWPAN stack. Nanostack 2.0 Light runs on the CC1180 Network processor. The application controlling the network processor runs on an external host microcontroller. The CC1180 network processor handles all the timing critical and processing intensive 6LoWPAN protocol tasks and leaves the application microcontroller free to handle.



#### Key Features

- Easy Integration of 6LoWPAN with mesh support into any design
- Compact stack ( around 20k ) optimized for sensor applications
- UART interface to almost any microcontroller running the application
- Standard IP socket programming: Supports updating of the NanoStack 2.0 Lite 6LOWPAN stack using Sensinode NanoBoot API

*CC-6LoWPAN-DK-868 Development Kit.*

#### Applications

- Home and building automation
- Industrial monitoring and control
- Sensor networks
- Medical telehealth

#### Development Tools and Software

- CC-6LOWPAN-DK-868
- RF tester application: Eases FCC/ETSI testing

#### General Characteristics

Parameter	Min	Typ	Max	Unit
Device type	SOC	—	—	—
Frequency ranges min	300	391	782	MHz
Frequency ranges max	348	464	928	MHz
Operating voltage	2.0	—	3.6	V
Operating temperature	-40	—	85	°C
Output power	-30	—	10	dBm
Receiver sensitivity	—	-98	-112	dBm
Standby Current	—	0.3	—	µA
Wakeup time (PD->RX/TX)	—	330	—	µS
Modulation techniques	—	GFSK	—	—

#### Benefits

- Integrated hardware design shortens time to market by 25%
- Embedded stack with simple sample applications reduce firmware development by up to 50%
- Compact radio reference design makes it ideal for small form factor end devices and sensors
- Low current consumption optimized for sleeping end nodes and battery operated devices

# Bluetooth® Technology

## → Bluetooth® Overview

### Bluetooth

Bluetooth wireless technology is one of the most prominent short-range communications technologies with an installed base of more than three billion units. *Bluetooth* is intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security, low power and low cost. A fundamental strength of *Bluetooth* is the ability to simultaneously handle data and voice transmissions. *Bluetooth* is designed to have very low power consumption by allowing radios to be powered down when inactive. The *Bluetooth* specification defines a uniform structure with global acceptance to ensure interoperability of any *Bluetooth* enabled device.

### Application areas

- Sports and Fitness
- Assisted Living
- Industrial Sensors
- Toys
- Entertainment Devices
- Mobile Accessories
- All Bluetooth Wireless Applications

### How does *Bluetooth* technology work?

*Bluetooth* technology operates in the unlicensed industrial, scientific and medical (ISM) band at 2.4 to 2.485 GHz, which is available and unlicensed in most countries. *Bluetooth* uses a spread spectrum, frequency hopping, full-duplex signal which was designed to reduce interference between wireless technologies sharing the 2.4 GHz spectrum. *Bluetooth* technology provides greater performance even when other technologies are being used along with *Bluetooth* technology. Information above cited from the *Bluetooth* SIG. For more information on *Bluetooth* technology, visit [www.Bluetooth.com](http://www.Bluetooth.com).

### Why TI *Bluetooth*?

TI is one of the leading semiconductor companies providing *Bluetooth* wireless technology for portable, battery-powered devices leveraging nearly a decade of experience and seven generations of products which are optimized for the needs of handheld products. TI is also the market leader in combined wireless products such as the WL1271 (singlechip WLAN/*Bluetooth* device),

CC2560 (*Bluetooth*), CC2564 (*Bluetooth/BLE*), which further solve issues such as coexistence, antenna sharing in size-constrained devices, cost and power consumption.

### Dual mode

Dual-mode *Bluetooth* low energy technology is available as a part of TI's proven WiLink™ and BlueLink™ connectivity combo solutions. These solutions support dual-mode operations by providing classic *Bluetooth* technology capability along with *Bluetooth* low energy technology. The WiLink and BlueLink solutions include on-chip coexistence, which yields size, cost, performance and power advantages that ease customer development cycles. WiLink brings connectivity features to mainstream products such as smart phones, mobile Internet devices (MIDs), portable media players (PMPs), gaming devices and personal navigation devices (PNDs).

To allow low-power sensors using *Bluetooth* low energy to connect to mobile phones and laptops, which typically use *Bluetooth*, a Dual Mode aggregator is required. Texas Instruments offers CC2564 that can act as a *Bluetooth/BLE* dual mode aggregator, or *Bluetooth* and ANT aggregator which allows *Bluetooth* and BLE technologies to interact.



## → CC2560

Bluetooth® v2.1 + EDR (Enhanced Data Rate)

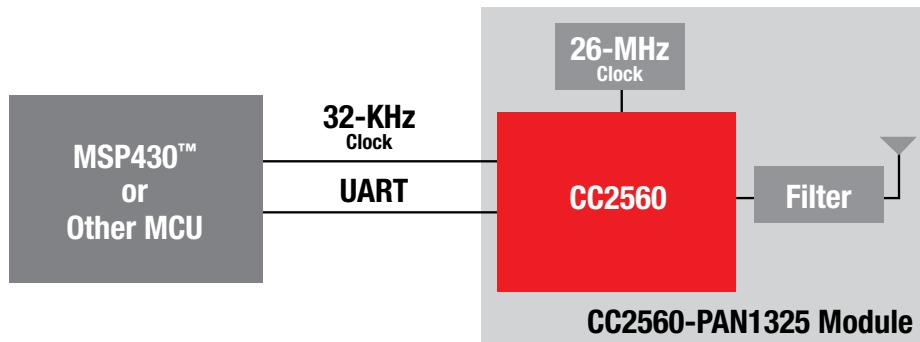
CC2560-PAN1325, CC2560 QFN, CC2560-PAN1315

Learn more at: [www.ti.com/bluetooth](http://www.ti.com/bluetooth)

The CC2560 is a highly-integrated class 2 HCI module with increased output power capabilities offered by Panasonic utilizing TI's CC2560 Bluetooth 2.1 + Enhanced Data Rate (EDR) Transceiver. Based on TI's 7th generation Bluetooth technology, the solution provides best-in-class Bluetooth RF performance of +10 dBm Tx power and -93 dBm receiver sensitivity. It is offered by TI in QFN package through standard TI distribution channels. The CC2560 is also provided as a module from partners like Panasonic, LSR and Murata to help customers reduce development time, lower manufacturing costs, ease certification, and minimize RF expertise required. For evaluation and development, various platforms are available which integrate the CC2560-PAN1325 module, Bluetooth stack, Profiles (SPP for MSP430™, SPP + A2DP for Stellaris®), and sample source applications running on a TI host controller (MSP430, Stellaris).

### Key Features

- Fully qualified Bluetooth v2.1 + EDR
- +10 dBm Tx power with transmit power control
- -93 dBm receiver sensitivity
- Support for Bluetooth power saving modes (sniff, hold)
- Hardware and software pre-integration with TI's MSP430 and Stellaris platforms
- FCC, CE, IC certified
- Also Dual mode solutions with BLE and ANT
- Operating temperature range is -20°C to +70°C or -40°C to +85°C



CC2560 block diagram.

### Benefits

- Supports replacement of serial cables for personal area networks
- High throughput, robust connection with extended range
- Extended battery life and power efficiency
- Reduced development time and costs

### Applications

- Cable replacement
- Wireless sensors
- Medical devices
- Computer peripherals
- Industrial control
- Consumer devices

### Development Tools and Software

- CC2560 Bluetooth Development Platform with PAN1323EMK+MSP430 Board
- Stellaris + CC2560 Bluetooth Development Platform-DK-EMZ-2560B
- EZ430-RF256x Bluetooth Evaluation Tool
- StoneStreet One Bluetopia Bluetooth Stack serial port profile

### TI CC2560 QFN Device

- Sold through TI and distribution channels
- 2-Layer reference design provided and supported by TI

### 3rd Party Module Solutions

Partner	Panasonic		Murata
Ref. Part	PAN1315A	PAN1325A	SN2100
TI Si	CC2560A	CC2560A	CC2564
Functions	BT	BT	BT, BLE or ANT
Size	6.5x9.0x1.7 mm	9.0x9.5x1.8 mm	17.5x16x2mm
TI EVM adaptor		EM Board	EM Board (Sep 2012)
Antenna on module	No	Yes	Yes
Radio Certification	FCC, IC, CE		FCC, IC
Comments	Available widely through distribution		Class 1 BT (+18 dBm)

# Bluetooth® Technology

## → CC2564

### Dual Mode Bluetooth® v4.0 Smart Ready

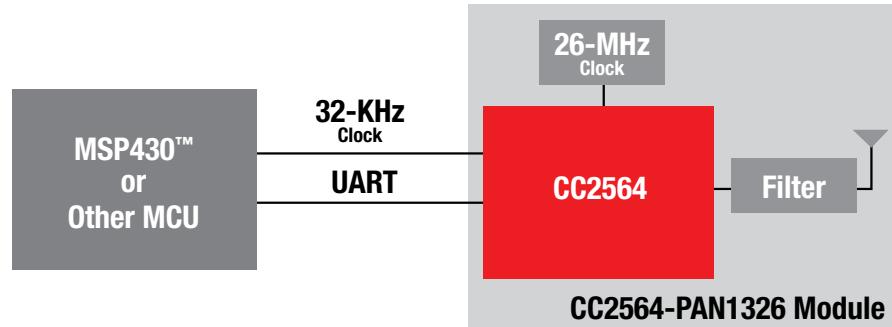
#### CC2564-PAN1326/16, CC2564 QFN

Learn more at: [www.ti.com/bluetooth](http://www.ti.com/bluetooth)

The CC2564 based solutions are a highly integrated class 2 HCI module is a highly-integrated class 2 HCI module with increased output power capabilities offered by Panasonic using TI's CC2564 Bluetooth v4.0 Transceiver. Based on TI's 7th generation Bluetooth technology, the solution provides best-in-class Bluetooth RF performance with an extended range +10dBm transmit power. This solution is provided as a module to help customers reduce development time, lower manufacturing costs, save board space, ease certification, and minimize RF expertise required. The device is made to communicate with other Bluetooth Smart Ready devices (single mode) and to communicate to classical Bluetooth through an aggregator. This solution can also be used for aggregation solutions with Bluetooth or ANT.

#### Key Features

- Communicates with Bluetooth low energy single mode devices
- Best-in-class Bluetooth RF performance (Tx, Rx sensitivity, blocking)
- Fully Qualified Bluetooth v4.0 EDR Certifications: Bluetooth, FCC , IC, and CE
- Operating Temperature Range: -20°C to +70°C or -400C to +850C
- Supply Voltage Range: 1.7 – 4.8V or 2.2 to 4.8
- Integrates with TI's ultra low-power MSP430 microprocessor
- Very fast algorithm for both ACL and eSCO
- Supports Extended Range Tx power with 10dBm typical output
- Low power scan method and inquiry scans at 1/3rd normal power
- UART Rates up to 4Mbps
- Receive sensitivity -93dBm



CC2564-PAN1326/16 WLAN and Bluetooth system diagram.

#### Benefits

- Best-in-class link budget extends application range
- Simplified hardware and software development
- Reduced development time and costs
- Enables simultaneous operations of Bluetooth with BLE

#### Applications

- Sport and Fitness
  - Heart Rate Monitor
  - Blood Pressure Sensor
  - Blood Glucose Meter
  - Thermometer
- Assisted Living
  - Flood Alarm
  - Heating Control
  - Automatic Key Control
- Industrial
  - Toys
  - Entertainment Devices
  - Mobile Accessories
  - All Bluetooth Wireless Application

#### Development Tools and Software

- CC256x BTBLE-KIT
- 1x MSP-EXP430F5438 Experimenter Board – sold separately
- 1x MSP-FET430UIF – sold separately
- StoneStreet One Bluetopia Bluetooth Stack and SDK:
  - Serial Port Profile (SPP)
  - Generic Attribute Profile (GATT)
  - Alert Notification Profile (ANP)
  - Alert Notification Service (ANS)
  - Device Information Service (DIS)
  - Health Thermometer Profile (HTP)
  - Health Thermometer Service (HTS)
  - Heart Rate Profile (HRP)
  - Heart Rate Service (HRS)

#### TI CC2564 QFN Device

- Sold through TI and distribution channels
- 2-Layer reference design provided and supported by TI

#### 3rd Party Module Solutions

Partner	Panasonic	LSR
Ref. Part	PAN1316	450-0104
TI Si	CC2564	CC2564
Functions	BT, BLE or ANT	BT, BLE or ANT
Size	6.5x9.0x1.7 mm	9.0x9.5x1.8 mm
TI EVM adaptor		EM Board
Antenna on module	No	Yes
Radio Certification	FCC, IC, CE	FCC, IC , CE
Comments	Available widely through distribution	

# Bluetooth® low energy Technology

## → Bluetooth low energy Overview

### Bluetooth® low energy technology

Bluetooth low energy technology offers ultra-low power, state-of-the-art communication capabilities for consumer medical, mobile accessories, sports and wellness applications. Compared to classic Bluetooth capabilities, Bluetooth low energy is a connectionless protocol, which significantly reduces the amount of time the radio must be on. Requiring only a fraction of the power consumption of traditional Bluetooth technology, Bluetooth low energy can enable target applications to operate on a coin cell for more than a year.

### Application areas

- Mobile accessories
- Consumer health/medical
- Sports/fitness
- Remote controls
- Wireless sensor systems

### TI's Bluetooth low energy solutions

#### – single mode and dual mode

TI provides Bluetooth low energy single-mode solutions for sensor applications and dual-mode solutions for mobile handheld devices. With both sides of the link, TI delivers a fully tested and robust Bluetooth low energy ecosystem. TI also offers Dual mode Smart Ready solutions based on CC2564. This dual mode solution allows customers to create solutions that talk with both classic Bluetooth devices and BLE devices. TI's BLE solutions include:

- TI provides both single mode and dual mode Bluetooth low energy solutions
- Both sides of the link to create a fully tested Bluetooth low energy ecosystem - from smart sensors to smart phones
- Leading RF performance up to -97dBm
- Excellent coexistence with other 2.4GHz devices
- CC2540 System on a chip integrated solution (host & controller) and certified modules available



### Single mode

TI's Bluetooth low energy solution for sensor applications includes the CC2540 2.4 GHz system-on-chip (SoC), TI protocol stack, profile software and application support. The CC2540 is an ultra-low power, true one-chip integrated solution with controller, host and application on one device. It is a flash based and flexible device, with ultra-low power consumption, leading RF performance and excellent coexistence with other 2.4 GHz devices. Combined with the Bluetooth low energy protocol stack, the CC2540 forms the market's most flexible and cost-effective single-mode Bluetooth low energy solution.

For more information see page 18.

[www.ti.com/bluetoothlowenergy](http://www.ti.com/bluetoothlowenergy)



"TI's profiles have been qualified and are ready to be built into products. It is great to see a company like TI investing this many development resources into helping low energy products come to market...I think we'll see a lot of products with low energy technology by the end of this year."

Mike Foley, Bluetooth SIG

# Low Energy



# Bluetooth® low energy Technology

## → CC2540

### Single-Mode Bluetooth® low energy System-on-Chip

#### CC2540

Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/CC2540](http://www.ti.com/sc/device/CC2540)

See also: [www.ti.com/product/tps62730](http://www.ti.com/product/tps62730)

The CC2540 is a cost-effective, low-power, true System-on-Chip (SoC) solution for single-mode Bluetooth low energy applications, including mobile accessories, sports and fitness, consumer health, sensors and actuators, remote controls, HID, proximity, and more. The CC2540 combines a 1 Mbps GFSK RF transceiver, offering superior range over the competition with a peripheral rich 8051 MCU core. This highly integrated and low cost SoC, coupled with TI's Bluetooth low energy stack, offers a true one-chip integrated solution.

#### Key Features

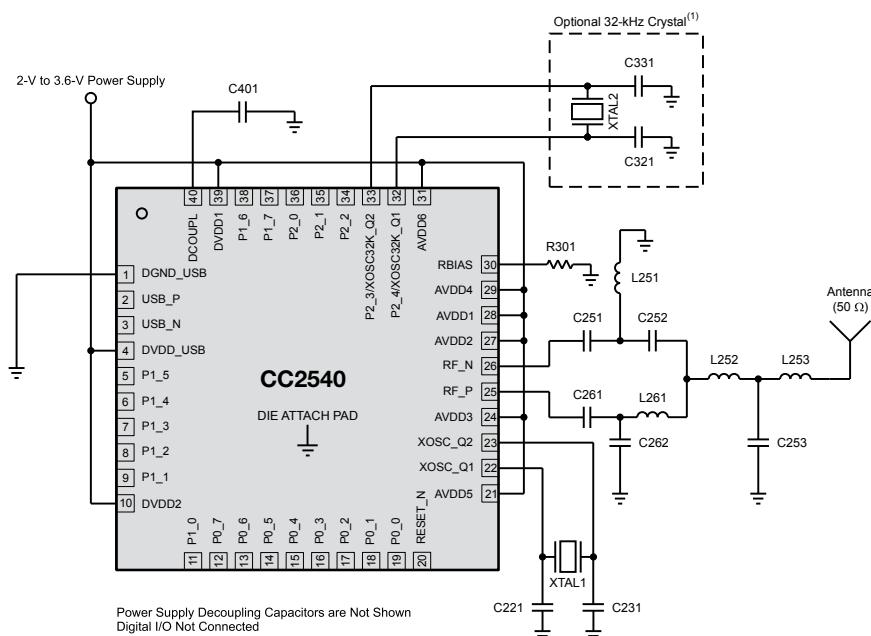
- True one-chip single mode Bluetooth low energy solution
- Optimized RF performance including Tx/Rx power and selectivity
- Extensive peripheral set including USB, DMA, GPIO, USARTs, ADC, timers
- Flexible low power modes to maximize system lifetime when battery powered

#### Benefits

- Versatile feature-rich device allows lowest cost system when integrating application and stack on single chip
- RF performance maximizes communication range while simultaneously minimizing the effect of interference sources
- Supports range of applications and reduces BOM cost through all-in-one SoC solution
- Ultra low average-power consumption in low-duty cycle systems

#### Applications

- Mobile/laptop accessories
- Sports and fitness
- Consumer health and medical
- Proximity



CC2540 application circuit.

#### Development Tools and Software

- Single mode Bluetooth low energy compliant software stack
- CC2540DK-MINI Development Kit for quick product development
- Bluetooth low energy packet sniffer
- Application profiles, sample applications, documentation and more

#### General Characteristics

Parameter	Min	Typ	Max	Unit
Frequency range	2402		2480	MHz
Data rate	—	1000	—	kBaud
Operating voltage	2	—	3.6	V
Operating temperature	-40	—	85	°C
Output power	-20	—	4	dBm
<b>RX mode</b>				
Receiver sensitivity	—	-93	—	dBm
Adjacent channel rejection, +1 MHz	—	5	—	dB
Adjacent channel rejection, -1 MHz	—	5	—	dB
Alternate channel rejection, +2 MHz	—	30	—	dB
Alternate channel rejection, -2 MHz	—	30	—	dB
<b>Current consumption</b>				
Current consumption, RX	—	19.6	—	mA
Current consumption, TX, +4 dBm	—	31.6	—	mA
Current consumption, TX, 0 dBm	—	27	—	mA
Current consumption, power down	—	0.4	—	µA

# Bluetooth® low energy Technology

## → CC2541

### Single-Mode Bluetooth® low energy System-on-Chip

#### CC2541

Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/CC2541](http://www.ti.com/sc/device/CC2541)

The CC2541 is a power-optimized true system-on-chip (SoC) solution for both low energy and proprietary 2.4-GHz applications. It enables robust network nodes to be built with low total bill-of-material costs. The CC2541 combines the excellent performance of a leading RF transceiver with an industry-standard enhanced 8051 MCU, in-system programmable flash memory, 8-KB RAM, and many other powerful supporting features and peripherals. The CC2541 is highly suited for systems where ultralow power consumption is required. This is specified by various operating modes. Short transition times between operating modes further enable low power consumption.

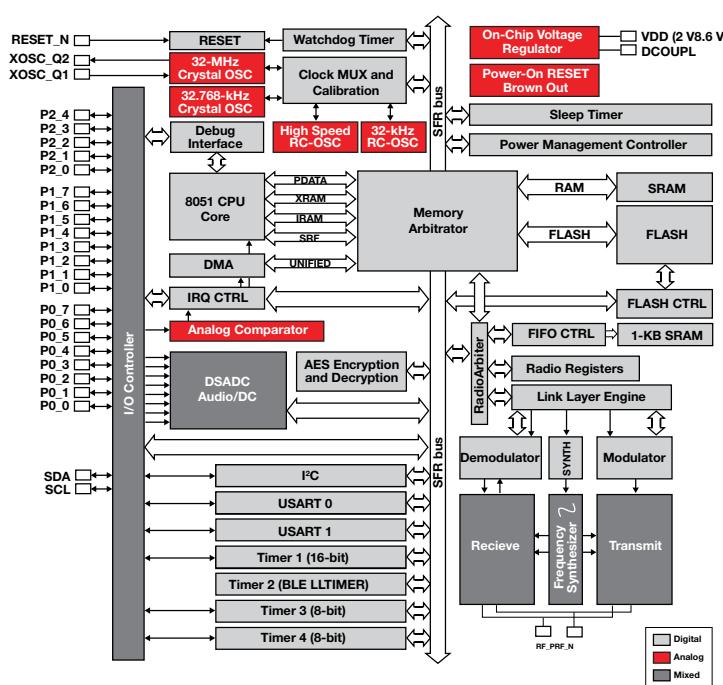
The CC2541 is pin-compatible with the CC2540 in the 6-mm × 6-mm QFN40 package, if the USB is not used on the CC2540 and the I<sup>2</sup>C/extra I/O is not used on the CC2541.

#### Key Features

- True one-chip single mode Bluetooth low energy solution
- Optimized RF performance including Tx/Rx power and selectivity
- Extensive peripheral set including I<sup>2</sup>C, DMA, GPIO, USARTs, ADC, timers
- Flexible low power modes to maximize system lifetime when battery powered

#### Benefits

- Versatile feature-rich device allows lowest cost system when integrating application and stack on single chip
- RF performance maximizes communication range while simultaneously minimizing the effect of interference sources
- Supports range of applications and reduces BOM cost through all-in-one SoC solution
- Ultra low average-power consumption in low-duty cycle systems



#### Applications

- Mobile/laptop accessories
- Sports and fitness
- Consumer health and medical
- Proximity

#### Development Tools and Software

- Single mode Bluetooth low energy compliant software stack
- CC2541EMK Evaluation Module Kit for quick product development
- CC2541DK-MINI Development Kit for quick product development
- CC2540DK Development Kit for advance prototyping
- Bluetooth low energy packet sniffer
- Application profiles, sample applications, documentation and more

#### General Characteristics

Parameter	Min	Typ	Max	Unit
Frequency range	2402		2480	MHz
Data rate	—	1000	—	kBaud
Operating voltage	2	—	3.6	V
Operating temperature	-40	—	85	°C
Output power	-20	—	0	dBm
<b>RX mode</b>				
Receiver sensitivity	—	-93	—	dBm
<b>Current consumption</b>				
Current consumption, RX	—	17.9	—	mA
Current consumption, TX, 0 dBm	—	18.2	—	mA
Current consumption, power down	—	0.4	—	µA

# Bluetooth® low energy Technology

## → BLEStack - Bluetooth low energy Protocol Stack and Tools

TI's Bluetooth® low energy (BLE) software development kit includes all necessary software to get started on the development of single-mode Bluetooth low energy applications using the CC2540/CC2541 system-on-chip. It includes object code with the BLE protocol stack, a sample project and applications with source code, and BTool, a Windows PC application for testing Bluetooth low energy applications. In addition to the software, the kit contains documentation, including a developer's guide and BLE API guide.

### Key Features

- Bluetooth specification version 4.0 compliant, single mode low energy host and controller sub-system. Stack certified as controller and host sub-systems.
- TI's Bluetooth low energy solution includes System-on-Chip (SoC), in-house developed protocol stack, profile software and application support
- Profile support planned based on specific profile specifications (attribute, PUID, proximity, remote

and more)

- Both master and slave role support, multi-role support
- Sample applications for profile and proprietary products
- Optimized specifically for CC2540/CC2541
- Available to all CC2540/CC2541 customers as object code (libraries)
- Royalty-free protocol stack
- Leverages TI's long experience in low-power radio protocol stacks for ZigBee, RF4CE and SimpliciTI

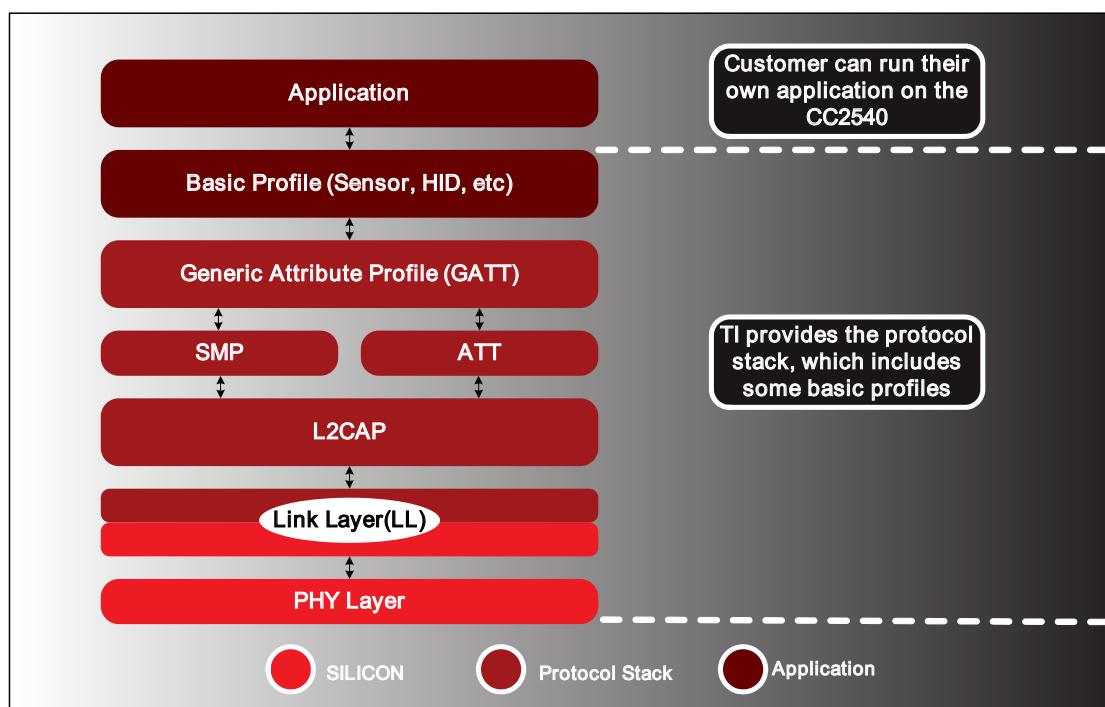
### Application areas

- Mobile phone accessories
- Sports/leisure/medical equipment
- Gaming/HID/remote controls
- Proximity applications - security or other spatially aware applications

[www.ti.com/blestack](http://www.ti.com/blestack)

### Benefits

- Easy development and certification of Bluetooth low energy end products
- Low power consumption
- Small stack footprint
- Robust and flexible stack implementation
- All aspects of Bluetooth low energy development provided by TI



## ANT™ Overview

## What is ANT™?

ANT provides a simple, low-cost and ultra-low power solution for short-range wireless communication in point-to-point and more complex network topologies. Suitable for various applications, ANT is today a proven and established technology for collection, automatic transfer and tracking of sensor data within sports, wellness management and home health monitoring applications.

## Application areas

- Sports/Fitness
  - Consumer health/medical
  - Mobile accessories
  - Wireless sensor systems

## TI's ANT solutions – from Smart Sensors to Smart Phones

TI's ANT products feature full system solutions for both sensor applications and mobile handheld devices. With both sides of the ANT link, TI delivers fully tested and robust ANT ecosystem solutions – from smart sensors to smart phones. TI's ANT solutions are developed in cooperation with Dynastream Innovations Inc, the company behind ANT. TI's ANT solutions include:

- Only TI offers single-mode (CC2570/71) and dual-mode solutions (CC2567, WiLink)
  - Fully tested TI ANT ecosystem solution – for both sensor and mobile handheld devices
  - Best in class RF performance
  - Excellent coexistence with other 2.4GHz devices

[www.thisisant.com](http://www.thisisant.com)



[www.ti.com/ant](http://www.ti.com/ant)

## CC257x ANT network processor + MSP430™ MCU

TI's ANT sensor device is a dual-chip solution, combining market leading RF technology and the MSP430™, the world's lowest power microcontroller. The CC257x network processors are 2.4 GHz devices tailored for ANT sensor applications. The ICs are easy to integrate, low cost, with ultra-low power consumption and superior RF performance, making them versatile enough to support a wide range of applications. In cooperation with Dynastream Innovations Inc, TI delivers a full turnkey ANT sensor solution, including software and application support.

For more information see page 26.

CC2564 dual mode ANT and *Bluetooth*

The CC2564 is the first dual-mode, ANT and *Bluetooth* solution in the market. This solution allows customers to connect to mobile phones and computers over *Bluetooth* from ANT+ enabled devices, and allows customers with *Bluetooth* solutions to add ultra low-power ANT+ connectivity.

The CC2567-PAN1327/17 is provided as a module to help customers reduce development time, lower manufacturing costs, save board space, ease certification, and minimize RF expertise required.

For more information see page 21.

## ANT+ Smartphone connectivity

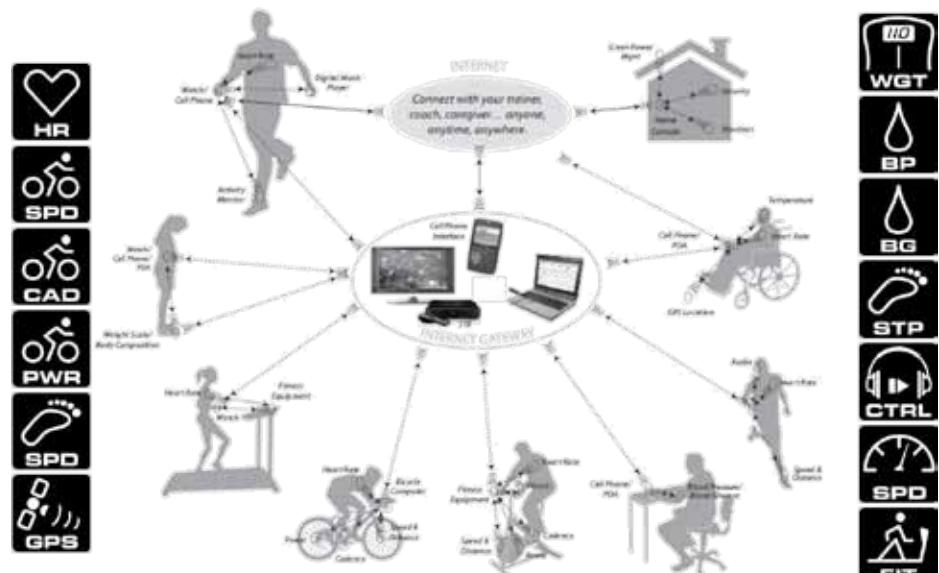
The functionality of ANT enables mobile handheld device manufacturers to deliver ANT+ interoperable sports, fitness and consumer health monitoring products. TI's WiLink™ family is the first to deliver ANT+ communication on a connectivity combo solution.

Leveraging TI's connectivity leadership in the Smartphone market, the ANT+ ecosystem is expanding its reach into the mobile handheld device market.

WiLink is the industry's first true single-chip mobile WLAN, GPS, *Bluetooth*<sup>®</sup>, *Bluetooth* low energy, ANT and FM transmit/receive solution. WiLink brings connectivity features to mainstream products such as Smartphones, mobile Internet devices (MIDs) and portable media players (PMPs). Existing devices based on both WiLink and BlueLink<sup>™</sup> solutions can enable ANT with a simple software upgrade, to connect to the many available ANT+ sensors today.

For more information visit

[www.ti.com/wilink](http://www.ti.com/wilink)



## → CC2570/CC2571

### ANT™ Network Processor CC2570/CC2571

Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/CC2570](http://www.ti.com/sc/device/CC2570)

The CC2570 and CC2571 are ANT RF network processors that implement the easy-to-use, power-efficient ANT protocol. The CC2570 supports 1 ANT channel, while the CC2571 supports 8 ANT channels. The CC2570/71 can be connected to a host MCU (such as an MSP430™) through a UART or SPI serial interface and accessed through a set of API calls. The majority of the ANT protocol is built into the CC2570/71, including the ANT-FS file system functionality; only the application and profile layers need to reside on the host MCU, thus keeping host MCU memory requirements to a minimum.

#### Key Features

- ANT compliant RF network processors
- UART/SPI serial interface to easy-to-use API command set
- Excellent RF performance (avg. power and boosted output power)
- Accurate full-range RSSI function suited for proximity
- ANT-FS support

#### Benefits

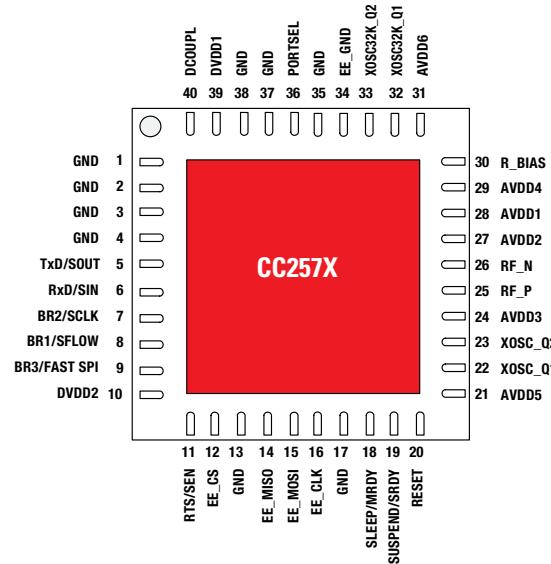
- Easy-to-integrate into ANT products
- Simple, accessible serial interface to ANT-enable your product
- Optimized low power for long device lifetime
- High resolution RSSI proximity pairing

#### Applications

- Sports and fitness equipment
- Health and medical equipment
- Consumer health devices
- Consumer electronics
- Wireless Sensor Networks

#### Development Tools and Software

- ANTC7EK1 CC257x Development Kit
- ANTware
- Integrated ANT-FS reference design
- ANT-FS PC host
- Embedded reference design



CC2570 package.

#### General Characteristics

Parameter	Min	Typ	Max	Unit
<b>Operating conditions</b>				
Frequency range	2400		2507	MHz
Data rate	—		—	kBaud
Operating voltage	2.0	—	3.6	V
Operating temperature	-40	—	85	°C
Output power	-20	—	4	dBm
<b>RX mode</b>				
Receiver sensitivity	—	-85.8	—	dBm
Adjacent channel rejection, +2 MHz	—	23	—	dB
Adjacent channel rejection, -2 MHz	—	23	—	dB
Alternate channel rejection, +4 MHz	—	39	—	dB
Alternate channel rejection, -4 MHz	—	39	—	dB
<b>Current consumption</b>				
Current consumption, RX	—	23.7	—	mA
Current consumption, TX, +4 dBm	—	34.3	—	mA
Current consumption, TX, 0 dBm	—	28.8	—	mA
Current consumption, power down	—	<1	—	µA

## → ZigBee® RF4CE Overview

With the use of ZigBee® RF4CE radio frequency (RF) technology, remote control applications can operate non-line-of-sight and provide more advanced features based on bi-directional communication.

ZigBee RF4CE advanced features for remote control applications:

- Non line-of-sight control
- Longer range
- Richer communication
- Increased reliability
- Enhanced features and flexibility
- Interoperability
- Longer battery life

### Application areas

- Remote controls
- Set-top boxes, TVs, Blu-Ray players
- 3D glasses

TI's RF4CE solutions include:

- Mature and Broad Portfolio (3rd generation 802.15.4 SoC, RF4CE golden platform)
- Market Leading Performance (best-in-class adjacent/alternate channel rejection, lowest system power consumption)
- System Expertise (HW, SW, tools experts, influential contributor to RF4CE standard)
- WWW support

RemoTI™ is a complete hardware and software solution for RF4CE remote control applications. TI has a mature and broad Portfolio (3rd generation 802.15.4 SoC and RF4CE golden platform):

- Software: The industry leading RF4CE-compliant stack feature the ZRC profile, a simple API, easy to understand sample application code and remote control reference design.
- Hardware: CC2533 System-on-Chip (SoC) optimized for IEEE 802.15.4 based remote-control applications. The CC2533 enables single-chip remote controls to be built with lower power, higher reliability and lower bill-of material cost than alternative devices.
- Extensive worldwide support and tools to ensure that development of ZigBee RF4CE-based products is simple, fast and can be completed at minimal cost.

### TI's industry-leading ZigBee RF4CE protocol stack

TI's ZigBee RF4CE-compliant protocol stack for remote control applications is built on TI's well proven IEEE 802.15.4 compliant TIMAC. It offers a simple, easy-to-use, intuitive software architectural framework and all of the

tools, documentation, and support needed to build an RF4CE compliant product.

The stack is compliant with the ZigBee RF4CE specification and supports the ZRC (ZigBee Remote Control) profile and will support the upcoming ZID (ZigBee Input Device) profile.

The latest RemoTI stack is downloadable from the TI web site without any royalty charge.

### Key features

- CC2530, CC2531 (USB), and CC2533 RF SoC and CC259x RF front-end support
- Remote control and proprietary profile support
- USB HID class support including keyboard and consumer controls pages
- Simple RemoTI API, or optional direct RF4CE interface
- Complete sample application code
- UART, SPI, keypad, LED and other driver support
- IR generation sample code for CC253x
- Easy-to-use development kits

[www.ti.com/rf4ce](http://www.ti.com/rf4ce)



## → CC2533

### ZigBee® RF4CE System-on-Chip CC2533

NEW

Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/CC2533](http://www.ti.com/sc/device/CC2533)

The CC2533 is a cost-effective, low power, and true System-on-Chip (SoC) solution specifically tailored to IEEE 802.15.4/RF4CE applications. The CC2533 comes in three different versions: CC2533-F32/64 with 32/64-KB Flash memory and 4-KB of RAM and the CC2533-F96 with 96KB Flash and 6-KB of RAM. The CC2533 combines a fully integrated high-performance RF transceiver with an industry-standard enhanced 8051 MCU and powerful supporting features and peripherals.

#### Key Features

- Up to 96-kB flash with 20K erase cycles to support over-the-air updates, large applications
- Up to 6-kB RAM for complex remote control applications
- Programmable output power up to +7 dBm
- Less than 1- $\mu$ A current consumption in power down with sleep timer running
- UART, I<sup>2</sup>C and SPI interfaces
- IR generation and modulation engine

#### Benefits

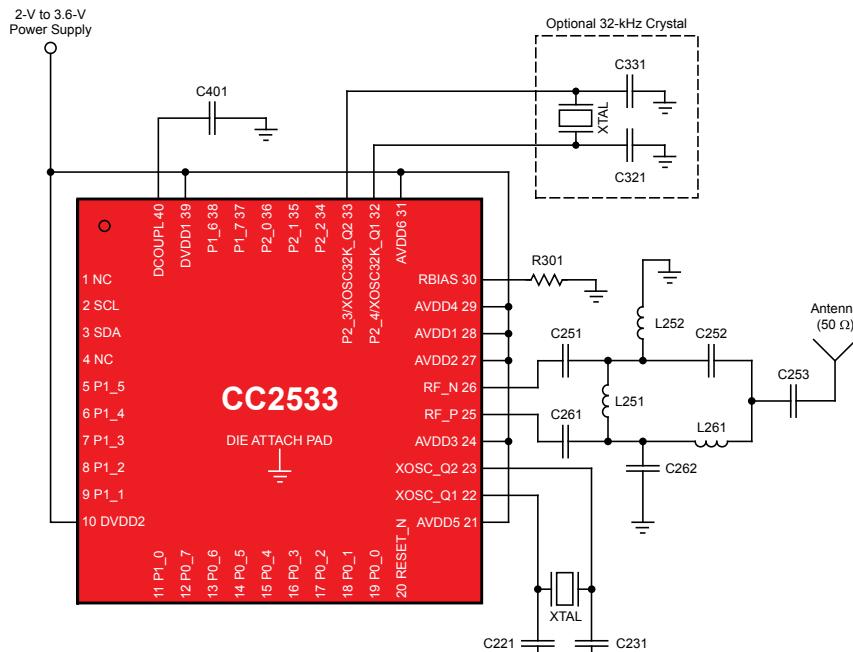
- Supports ZigBee RF4CE and 802.15.4-based solutions
- Excellent receiver sensitivity and programmable output power
- Very low current consumption in RX, TX, and multiple low-power modes ensure long battery lifetime
- Best-in-class selectivity and blocking performance (50-dB ACR)

#### Applications

- Remote controls
- Set-up boxes, TVs, Blu-Ray players
- 3D glasses
- Smart energy

#### Development Tools and Software

- REMOTI - RF4CE compliant protocol stack
- CC2533DK-RF4CE-BA - CC2533 RF4CE Development Kit
- CC2533DK - CC2533 Development Kit
- CC2533EMK - CC2533 Evaluation Module Kit



CC2533 application circuit.

#### General Characteristics

Parameter	Min	Typ	Max	Unit
<b>Operating conditions</b>				
Frequency range	2394	—	2507	MHz
Operating temperature range	-40	—	125	°C
Operating supply voltage	2.0	—	3.6	V
Radio bit rate	—	250	—	kBaud
Receiver sensitivity	—	-97	—	dBm
Adjacent channel rejection	—	49/49	—	dB
Alternate channel rejection	—	57/57	—	dB
Blocking	—	57/57	—	dB
Nominal output power in TX mode	—	+4.5	—	dBm
<b>Current consumption</b>				
MCU active and RX mode	—	25	—	mA
MCU active and TX mode, +4 dBm	—	34	—	mA
Power mode 1	—	200	—	μA
Power mode 2	—	1	—	μA
Power mode 3	—	0.5	—	μA
<b>Wake-up and timing</b>				
From power mode 2 or 3 to active	—	120	—	μs
From active to RX or TX	—	192	—	μs

## → PurePath™ Wireless Audio Overview

### PurePath™ Wireless Audio

By employing proprietary technology called PurePath Wireless, the CC85xx device family provides robust, high-quality, short-range 2.4 GHz wireless digital audio streaming in low-cost, single-chip solutions.

Two or more devices form a PurePath Wireless audio network. Great care has been taken to ensure that this audio network provides gap-less and robust audio streaming in varied environments and that it can coexist with existing wireless technologies in the crowded 2.4 GHz ISM band.

Most applications can be implemented without any software development and only require the CC85xx to be connected to an external audio source or sink (such as an audio codec, S/PDIF interface or class-D amplifier) and a few push buttons, switches or LED for human interaction. Advanced applications can interface a host processor or DSP directly to the CC85xx and directly stream audio and control most aspects of device and audio network operation.

The PurePath Wireless Configurator, a PC-based configuration tool, is used to set up the desired functionality and parameters of the target system and then produces firmware images that subsequently must be programmed into the embedded flash memory of each CC85xx.

All devices in the CC85xx family interface seamlessly with the CC2590 RF range extender device to allow for even wider RF coverage and improved robustness in difficult environments.

Built-in wireless audio protocol with excellent robustness and coexistence through multiple techniques:

- Adaptive Frequency Hopping
- Forward Error Correction
- Buffering and Retransmission
- Error Concealment
- Optional high quality audio compression

### Digital audio support

- CD-quality uncompressed audio (44.1/48 KHz, 16/24 bits)
- Digital I<sup>2</sup>S audio interface supports 1-2 audio channels (cc852x) or 3-4 audio channels (cc853x) at sample rates of 32, 40.275, 44.1 and 48 kHz/16 bit word-widths
- Audio latency less than 20 ms
- Data side-channel allows data to be sent alongside the audio between external host controllers

### Application areas

- Wireless headphones/headsets
- Wireless speaker systems
- Wireless signal cable replacement
- Wireless home theatre systems

### Wireless headphone/headset design



- Cost optimized design with 100% TI content
- 2x longer battery life than typical headphone (22hr on 465mah battery)
- Well suited for high quality headphones/headsets
- Design files available from TI

### Wireless 25W Li-ion powered speaker design



- Uses CC8520, TAS5727, BQ24610 (Li-Ion charger), LM2842Y (Step-down DC/DC)
- Targets ~20h playback (2 aHr @ CD quality)
- Well suited for PC/portable speakers
- iPhone RC application available (with Bluetooth low energy)

## → CC8520

### PurePath™ Wireless 2.4 GHz RF System-on-Chip for Wireless Digital Audio Streaming CC8520

Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/CC8520](http://www.ti.com/sc/device/CC8520)

The CC8520 is used to build a lossless wireless audio link. One CC8520 acts as audio source and the other as audio sink. I<sup>2</sup>S data is taken as input on the audio source side, audio data is transmitted without loss to the audio sink which then outputs the I<sup>2</sup>S audio data.

#### Key features

- Embedded audio network protocol with state-of-the-art error correction and concealment techniques
- Uncompressed wireless 44.1/48 kHz stereo audio
- Autonomous operation
- Free PurePath Wireless Configurator PC tool

#### Benefits

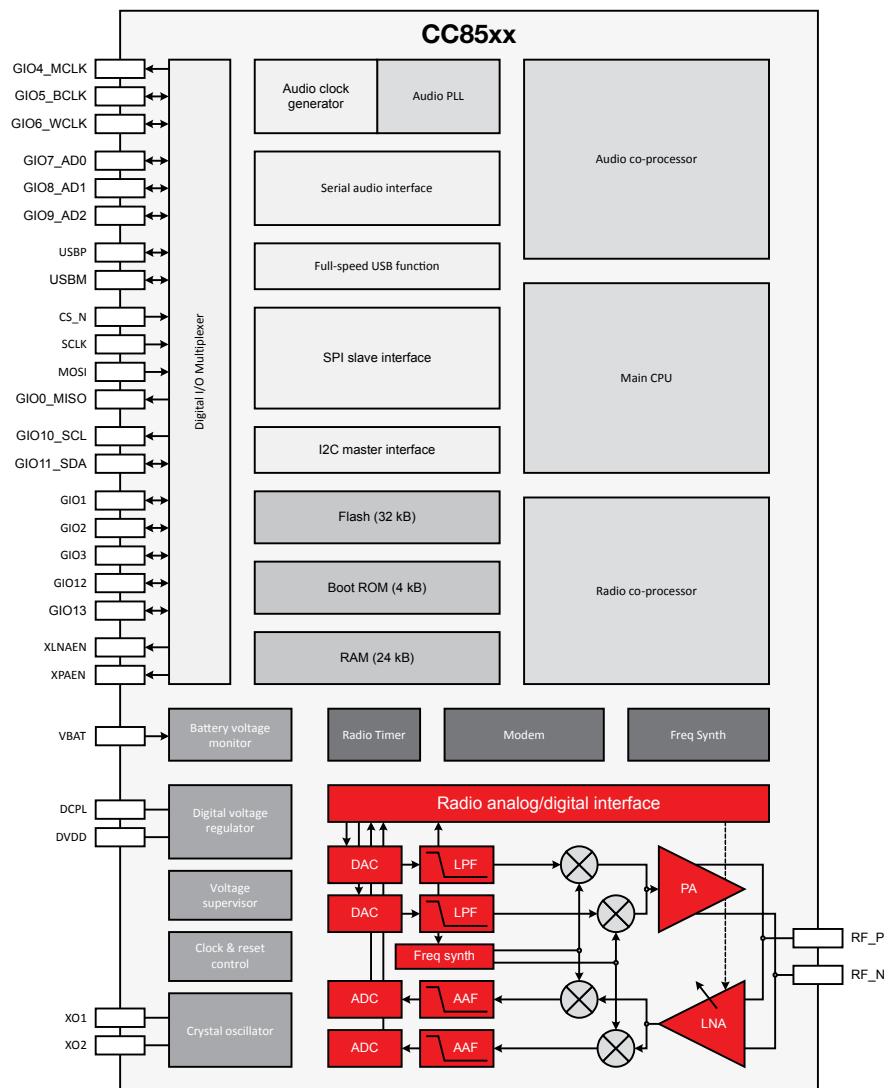
- No dropouts during audio playback
- Well suited for hi-fi audio systems
- No microcontroller or external memory needed
- Fast development time with no software development needed

#### Applications

- Wireless headphones/headsets
- Wireless speaker systems
- Wireless signal cable replacement
- Wireless home theatre systems

#### Development Tools and Software

- CC85XXDK Development Kit
- Purepath wireless configurator PC tool: [www.ti.com/ppwc](http://www.ti.com/ppwc)
- CC85XXDK-HEADSET and PurePath Wireless Commander [www.ti.com/tool/purepath-wl-cmd](http://www.ti.com/tool/purepath-wl-cmd)



CC8520 block diagram.

#### General Characteristics

	CC8520	CC8521	CC8530	CC8531
Number of wireless audio channels	2	2	4	4
Power consumption (RX) (mA)	25	25	25	25
Power consumption (TX) (mA)	29	29	29	29
Standby current (uA)	1	1	1	1
Data rate (max, Mbps)	5	5	5	5
Frequency range	2.4 GHz	2.4 GHz	2.4 GHz	2.4 GHz
Audio I/O	Digital I <sup>2</sup> S	USB Full Speed	Digital I <sup>2</sup> S	USB Full Speed

# GPS

## → CC4000-TC6000GN

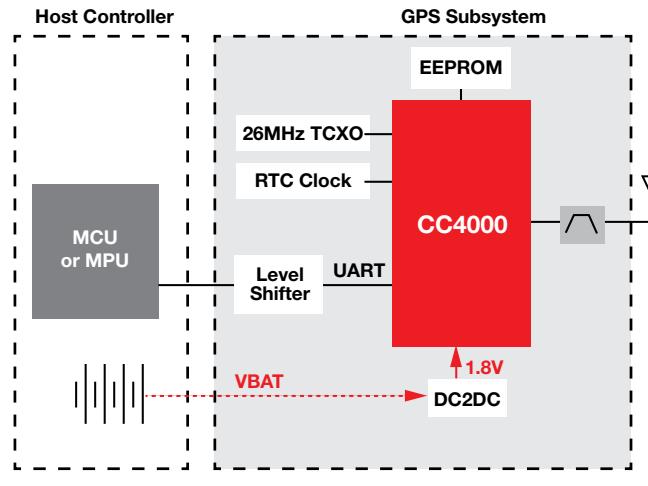
### SimpleLink™ GNS GPS Module CC4000-TC6000GN

Get samples, evaluation modules and application notes at: [www.ti.com/product/cc4000-tc6000gn](http://www.ti.com/product/cc4000-tc6000gn)

The following product brief applies to the TC6000GN – a highly-integrated GPS module offered by GNS using Texas Instruments' SimpleLink™ GPS CC4000. The GNS TC6000GN module enables applications benefitting from precise time, location, and/or velocity data. This solution provides industry standard NMEA protocol data for accurate time, position, latitude, longitude, satellite status, course and speed. This solution provides industry standard NMEA protocol data for accurate time, position, latitude, longitude, satellite status, course and speed. Autonomous warm start and hot start are enabled by on-board memory, improving start-up performance. A single GPIO is used to initiate a GPS fix (Push-to-fix), activating power management for active and deep sleep modes. Applications requiring high precision timing benefit from an independent programmable PPS generator. Further, the GPS driver and firmware is fully integrated into the module, greatly minimizing loading on the host CPU, and reducing system complexity. This allows GPS functionality to simply integrate with very small MCUs and MPUs. This solution is provided as a module to help customers reduce development time, lower manufacturing costs, save board space, and minimize RF and GPS expertise required.

#### Key features

- GPS driver and firmware fully integrated into module
- Industry standard NMEA 0183 interface protocol communication
- Protocol Communication NMEA provides
  - Time
  - Position
  - Speed
  - Satellite Status
  - Course
- Performance:
  - Autonomous cold start TTFF 35 seconds in open sky signal conditions
  - Autonomous hot start TTFF ~ 1 second in open sky signal conditions
  - Tracking accuracy better than 3 meters



CC4000-TC6000GN GPS system diagram.

- GPS tracking sensitivity of -162 dBm
- Push-to-fix: Single GPIO activates power management for active and deep sleep modes
- Pulse-per-second (PPS) generator: Independent output for high precision timing applications with accuracy <100ns (nominal)

#### Benefits

- Fully integrated GPS solution
- Standard NMEA protocol communication
- GPS tracking sensitivity -162dBm
- Very small package
- One single power supply
- Low power consumption
- Integrated LNA and TCXO

#### Applications

- Asset tracking
- Industrial M2M
- Portable navigation
- Fitness / health / medical
- Precision timing

#### Development Tools and Software

- CC4000GPSEM module and board
- Sample software for MSP-EXP430FR5529 Development Platform

[www.ti.com/tool/cc4000gpsem](http://www.ti.com/tool/cc4000gpsem)

#### General Characteristics

	CC4000	Unit
Receiver Frequency	1575.42	MHz
Operating voltage	1.7 to 1.95	V
I/O operating voltage	1.65 to 1.92	V
Operating temperature	-40°C to +85	°C
Sensitivity	-162 -147 (autonomous) -155 (assisted)	dBm
Current consumption	80µA (sleep), 68mA (acquisition)	
Interfaces	UART	
Internet crystal frequency	26	MHz
Size	10.0 x 9.3 x 2.3	mm <sup>3</sup>

## → CC430

### Integrated RF System-on-Chip Solution (MSP430™ microcontroller+ CC1101 radio)

#### CC430

Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/CC430](http://www.ti.com/sc/device/CC430)

See also: [www.ti.com/CC430](http://www.ti.com/CC430)

The CC430 family of ultra-low-power microcontroller System-on-Chip (SoC), with integrated CC1101 RF transceiver core, consists of several devices featuring different sets of peripherals, targeted for a wide range of applications. The architecture, combined with up to seven low-power modes, is optimized to achieve extended battery life in portable measurement applications. The device features the powerful MSP430™ 16-bit RISC CPU, 16-bit registers, and constant generators that contribute to maximum code efficiency. The CC430 family provides a tight integration between the microcontroller core, its peripherals, software, and the RF transceiver, making these true SoC solutions easy to use as well as improving performance.

#### Key Features

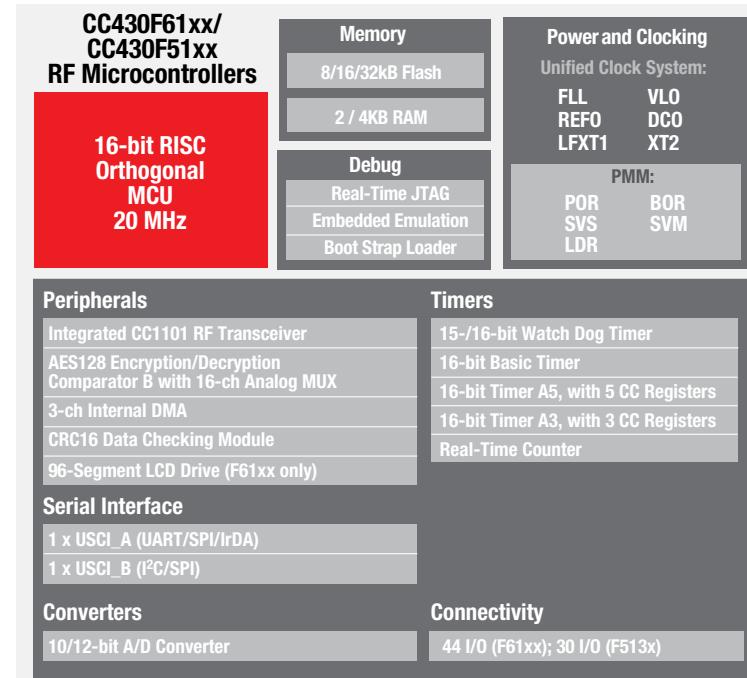
- Integrates MSP430 MCU and CC1101 RF transceiver
- As low as 1µA current consumption with state retention, 1.7 µA standby current with real time clock (RTC) and 180µA/MHz active current
- AES128 hardware module
- Code compatibility with existing MSP430 and free RF software available
- 10 and 12-bit A/D converter options

#### Benefits

- Save space and components in design
- Extended battery life in portable applications
- Secure RF transmissions
- Shorter design time with code re-use

#### Applications

- Low power RF sensors and energy harvesting monitors
- Home security and automation
- Sports and health monitoring
- Wireless networks targeting IEEE 802.15.4g standard



CC430 block diagram.

#### Development Tools and Software

- eZ430-Chronos wireless watch development tool
- CC430F5137 and CC430F6137 wireless development tools
- CC430F6147 wireless development tool (with DC-DC converter & LCD)

- Supported by Integrated Development Environments (IDEs) from TI and third parties including Code Composer Studio (CCS) and IAR Embedded Workbench for MSP430 from IAR Systems.

#### General Characteristics

	CC430F51xx	CC430F61xx
RF frequency bands	300-348MHz, 387-464MHz, 779-928MHz	300-348MHz, 387-464MHz, 779-928MHz
ADC	Optional 10-bit SAR, or 12-bit SAR	10-bit SAR, 12-bit SAR optional
RAM	2 - 4KB	2 - 4KB
Flash	8-32KB	8 -32 KB
Pin/package	48VQFN	64VQFN
GPIO	30	44
Peripherals	CC1101 RF Transceiver, 32-bit HW Multi, A/Sync Serial Comm USCI, AES-128 En/Decrypt, CRC16, DMA, RTC, Universal Clock	CC1101 RF Transceiver, 32-bit HW Multi, A/Sync Serial Comm USCI, AES-128 En/Decrypt, CRC16, DMA, RTC, Universal Clock
LCD segments	NA	96
Interface	1 USCI (UART/IrDA/SPI/I <sup>2</sup> C)	1 USCI (UART/IrDA/SPI/I <sup>2</sup> C)
Timers	1 16-bit (3CCR), 1 16-bit (5CCR), 1 Watchdog, 1 RTC	1 16-bit (3CCR), 1 16-bit (5CCR), 1 Watchdog, 1 RTC
Temp sensor	Yes	Yes
Brown out reset	Yes	Yes

## → CC1100E

### Integrated Multi-Channel RF Transceiver

#### CC1100E

Get samples, datasheets, evaluation modules and application notes at: [www.ti.com/sc/device/CC1100E](http://www.ti.com/sc/device/CC1100E)

#### Integrated solution provides low cost and high performance

The CC1100E is a highly integrated, multi-channel RF transceiver designed for low-power wireless applications in the 470-MHz and 950-MHz ISM bands.

#### Key Features

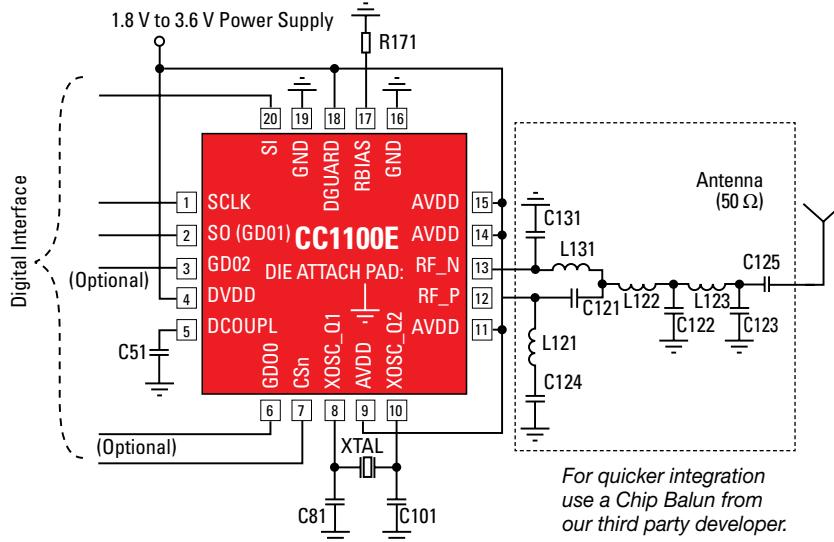
- Sub-1 GHz FSK/GFSK/MSK/ASK/OOK RF Transceiver
- 1.2 to 500-kBaud data rate
- Low-power, low system cost
- Sleep current: -200 nA
- 90- $\mu$ s PLL lock time: -240  $\mu$ s from sleep to RX/TX
- On-chip support for sync word detection, address check, flexible packet length and automatic CRC checking
- Separate 64-byte RX and TX data FIFOs (enable burst mode data transmission)
- Suitable for systems targeting Japanese ARIB STD-T96 and Chinese short range device regulations at 470-510 MHz

#### Benefits

- Fast development time and low system cost
- Flexible optimization of range power
- Enables use of inexpensive microcontroller
- Enables adaptive channel selection with increased robustness and coexistence of the wireless link
- Small size solution

#### Applications

- Automatic meter reading
- Active RFID



CC1100E application circuit.

#### General Characteristics

Parameter (433/868 MHz, 3.0 V, 25°C)	Min	Typ	Max	Unit	Condition
<b>Operating conditions:</b>					
Frequency range	470	—	510	MHz	
	950	—	960	MHz	
Operating temperature range	-40	—	+85	°C	
Operating supply voltage	1.8	—	3.6	V	
Data rate (programmable)	1.2	—	500	kBaud	
Output power (programmable)	-30	—	+12	dBm	
Receiver sensitivity, 1.2 kBaud	—	-112	—	dBm	1% packet error rate
<b>Power consumption</b>					
Current consumption RX	—	16	—	mA	Input well above sensitivity limit
Current consumption TX	—	15.0	—	mA	0 dBm
	—	30.0	—	mA	12 dBm
Current consumption, power down	—	<1	—	μA	

### Integrated Multi-Channel RF Transceiver

#### CC1101

Get samples, datasheets, evaluation modules and application notes at: [www.ti.com/sc/device/CC1101](http://www.ti.com/sc/device/CC1101)

See also: [www.ti.com/product/tps62730](http://www.ti.com/product/tps62730)

#### Integrated solution provides low cost and high performance

The CC1101 is a highly integrated, multi-channel RF transceiver designed for low-power wireless applications in the 315/433/868/915-MHz ISM bands. The CC1101 is an upgrade of the CC1100 transceiver with improvements for spurious response, close-in phase noise, input saturation level, output power ramping and extended frequency range.

#### Key Features

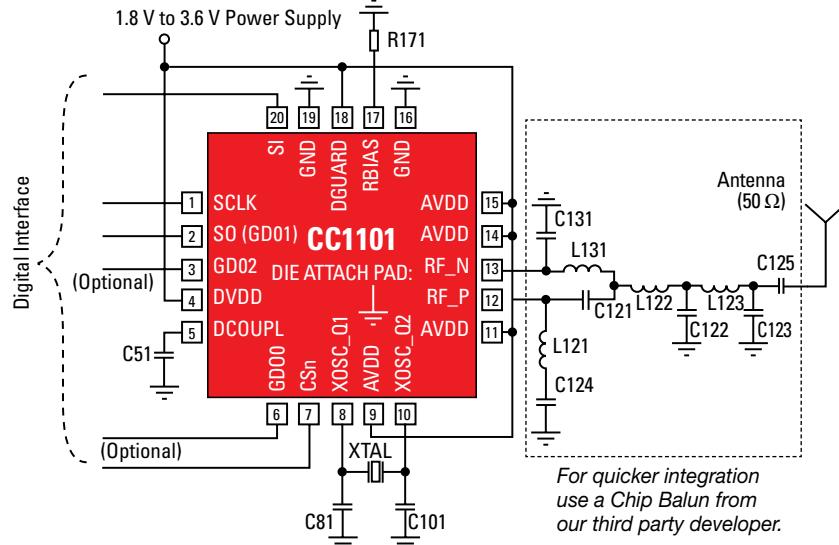
- Sub-1 GHz FSK/GFSK/MSK/ASK/OOK RF transceiver
- 1.2 to 500-kBaud data rate
- Low-power, low system cost
- Sleep current: 200 nA
- 90- $\mu$ s PLL lock time: 240  $\mu$ s from sleep to RX/TX
- On-chip support for sync word detection, address check, flexible packet length and automatic CRC checking
- Separate 64-byte RX and TX data FIFOs (enable burst mode data transmission)
- Suitable for systems targeting compliance with EN 300 200 (Europe) and FCC CFR Part 15 (U.S.)

#### Benefits

- Fast development time and low system cost
- Flexible optimization of range power
- Enables use of inexpensive microcontroller
- Enables adaptive channel selection with increased robustness and coexistence of the wireless link
- Small size solution

#### Applications

- Wireless alarm and security systems
- Automatic meter reading
- Industrial monitoring and control
- Home and building automation
- Wireless networks targeting IEEE 802.15.4g standard



The CC1101 is pin and register compatible with the 2.4-GHz CC2500 transceiver. Please see page 46.

#### Development Tools and Software

- |  |   |
|--|---|
| • CC1101DK-433 MHz Development Kit     | • CC1101EMK-433 MHz Evaluation Module Kit     |
| • CC1101DK-868/915 MHz Development Kit | • CC1101EMK-868/915 MHz Evaluation Module Kit |
|  | • SimpliciTI™ software protocol               |
|  | • Wireless M-Bus                              |

#### General Characteristics

Parameter	Min	Typ	Max	Unit	Condition
<b>(433/868 MHz, 3.0 V, 25°C)</b>					
Frequency range	300	—	348	MHz	
	387	—	464	MHz	
	779	—	928	MHz	
Operating temperature range	-40	—	+85	°C	
Operating supply voltage	1.8	—	3.6	V	
Data rate (programmable)	1.2	—	500	kBaud	
Output power (programmable)	-30	—	+12	dBm	
Receiver sensitivity, 1.2 kBaud	—	-113	—	dBm	1.2 kBaud, 868 MHz, 1% packet error rate
<b>Power consumption</b>					
Current consumption RX, 868 MHz	—	14.7	—	mA	Input well above sensitivity limit
Current consumption TX	—	15.0	—	mA	0 dBm
	—	30.0	—	mA	12 dBm
Current consumption, power down	—	<1	—	μA	

As part of the CC1101 family, the CC1101-Q1 (Transceiver), CC1131-Q1 (Receiver) and CC1151-Q1 (Transmitter) are available as automotive qualified versions in accordance to AEC-Q100 Grade 1. All three parts come in a pin-to-pin and software compatible 5x5mm QFN-32 package and offer an extended temperature range from -40 to +125°C, tighter specification values and guaranteed sensitivity values. See page 46 for more information.

## → CC1101-Q1

### Sub-1-GHz Automotive Qualified RF Transceiver

#### CC1101-Q1

Get samples, datasheets, evaluation modules and application notes at: [www.ti.com/sc/device/CC1101-q1](http://www.ti.com/sc/device/CC1101-q1)

Integrated solution provides high performance. The CC1101-Q1 is a highly integrated, multichannel RF transceiver designed for low-power wireless applications in the 315/433/868/915-MHz ISM bands. The CC1101-Q1 is the automotive derivate of the CC1101 transceiver qualified in accordance to AEC-Q100 with extended electrical specification and extended temperature range up to +125°C.

#### Key Features

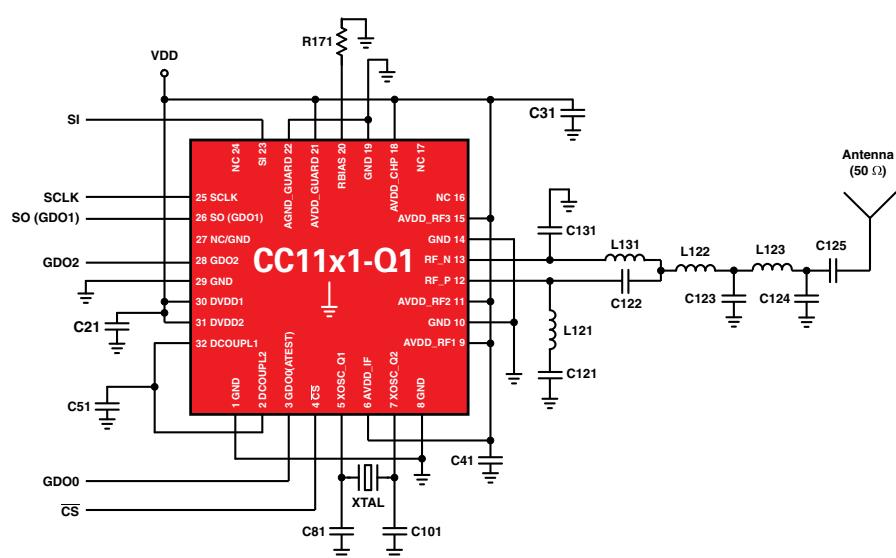
- Sub-1 GHz FSK/GFSK/MSK/ASK/OOK RF transceiver
- 1.2 to 250-kBaud data rate
- Low-power, low system cost
- Sleep current: 700 nA
- 90- $\mu$ s PLL lock time: 240  $\mu$ s from sleep to RX/TX
- On-chip support for sync word detection, address check, flexible packet length and automatic CRC checking
- Separate 64-byte RX and TX data FIFOs (enable burst mode data transmission)
- Suitable for systems targeting compliance with EN 300 200 (Europe) and FCC CFR Part 15 (U.S.)

#### Benefits

- Fast development time and low system cost
- Flexible optimization of range power
- Enables use of inexpensive microcontroller
- Enables adaptive channel selection with increased robustness and coexistence of the wireless link
- Easy system scaling from unidirectional to bidirectional systems through compatible device family

#### Applications

- Remote keyless entry
- Passive entry and passive start
- TPMS receiver
- Garage door opener
- High temperature sensors



The CC1101-Q1 is register compatible with the CC1101 transceiver.

#### Development Tools and Software

- CC1101DK-433 MHz Development Kit
- CC1101DK-868/915 MHz Development Kit
- SimpliciT™ software protocol

#### General Characteristics

Parameter (315, 433MHz, 3V, 25°C)	Min	Typ	Max	Unit
<b>Operating conditions:</b>				
Frequency range	310	—	348	MHz
	387	—	464	MHz
	779	—	928	MHz
Operating temperature	-40	—	125	°C
Operating voltage	1.8	—	3.6	V
Data rate (programmable)	1.2	—	250	kBaud
Output power (programmable)	-30	—	+12	dBm
Receiver sensitivity, 1.2 kBaud	—	-114	—	dBm
<b>Current consumption</b>				
Current consumption, RX	—	15.5	—	mA
Current consumption, TX, +10 dBm	—	29.5	—	mA
Current consumption, TX, 0 dBm	—	14.6	—	mA

## → CC1110

### RF System-on-Chip Solution

#### CC1110F8/F16/F32

Get samples, datasheets, evaluation modules and application notes at: [www.ti.com/product/cc1110f32](http://www.ti.com/product/cc1110f32)

See also: [www.ti.com/product/tps62730](http://www.ti.com/product/tps62730)

#### Radio, MCU and Flash

##### all-in-one chip

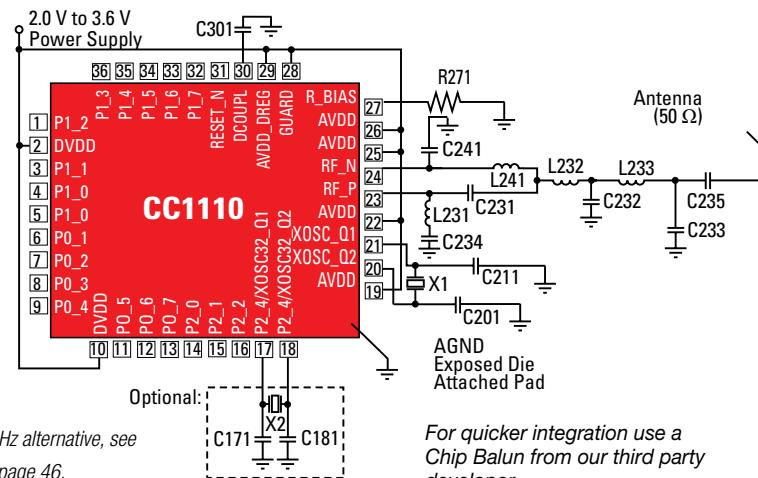
The CC1110Fx family consists of three Systems-on-Chip designed for low-power and low-voltage wireless communication applications. With a 315/433/868/915-MHz radio transceiver, a single-cycle 8051 MCU, 8/16/32-kB Flash memory and additional peripherals, these unique all-in-one devices make it easier than ever to finish your design faster while offering numerous application possibilities.

#### Key Features

- High-performance, low-power 8051 MCU core, typically with 8x the performance of a standard 8051
- Utilizes the high-performance CC1101 RF transceiver core
- 8/16/32-kB in-system programmable Flash
- 1/2/4-kB SRAM (with data retention in all power modes)
- 8- to 12-bit ADC, 21 general purpose I/O pins, on-chip timers
- Very few external components required
- Four flexible power modes for reduced power consumption
- Very fast transition times from sleep modes to active mode enables ultra-low average power consumption in low duty-cycle systems
- In deep-sleep modes the system can wake up on external interrupts or real-time counter events
- Low current consumption
- AES-128 encryption coprocessor
- Powerful DMA functionality
- Real-time clock with low-power 32.768-kHz crystal oscillator or internal 34-kHz RC Oscillator

#### Benefits

- Complete solution on one single chip
- Ideal for low-power, battery operated systems
- Robust and secure link with very good coexistence



For 2.4-GHz alternative, see  
CC2510, page 46.

For quicker integration use a  
Chip Balun from our third party  
developer.

#### Applications

- Alarm and security
- Automatic meter reader/ smart metering
- Consumer electronics
- Wireless networks targeting IEEE 802.15.4g standard

#### Development Tools and Software

- CC1110/CC1111DK Development Kit
- CC1110EMK-433 MHz Evaluation Module Kit
- CC1110EMK-868/915 MHz Evaluation Module Kit
- SimpliciT™ software protocol
- Wireless M-Bus
- CC1110DK-MINI

#### General Characteristics

Parameter	(433/868 MHz, 3.0 V, 25°C)	Min	Typ	Max	Unit	Condition
<b>Operating conditions</b>						
Frequency range	300	—	348	MHz		
	391	—	464	MHz		
	782	—	928	MHz		
Operating temperature range	-40	—	+85	°C		
Operating supply voltage	2.0	—	3.6	V		
Data rate (programmable)	1.2	—	500	kBaud		
Output power (programmable)	-30	—	10	dBm		
Receiver sensitivity	—	-111	—	dBm	1.2 kBaud, 868 MHz, 1% packet error rate	
<b>Current consumption</b>						
MCU active and RX mode	—	17	—	mA	System clock at 203 kHz	
MCU active and TX mode, 0 dBm	—	20/21	—	mA	MCU running at full speed (26 MHz), radio in TX mode, 0-dBm output power	
Power mode 2	—	0.5	—	µA	32 kHz RC-oscillator (or 32.768-kHz crystal oscillator) and sleep timer running	
Power mode 3	—	0.3	—	µA	No clocks running, power On Reset (POR) active, can wake up on external interrupt	
<b>Wake-up and timing</b>						
From power mode 2 or 3 to active	—	100	—	µs	Digital regulator and high-speed oscillators off, start-up of regulator and high-speed RC Oscillator	
From active to RX or TX	—	90	—	µs	Time from enabling 26-MHz crystal oscillator and the radio part until RX or TX starts	

## → CC1111

### RF System-on-Chip with Integrated Full-Speed USB Controller

#### CC1111F8/F16/F32

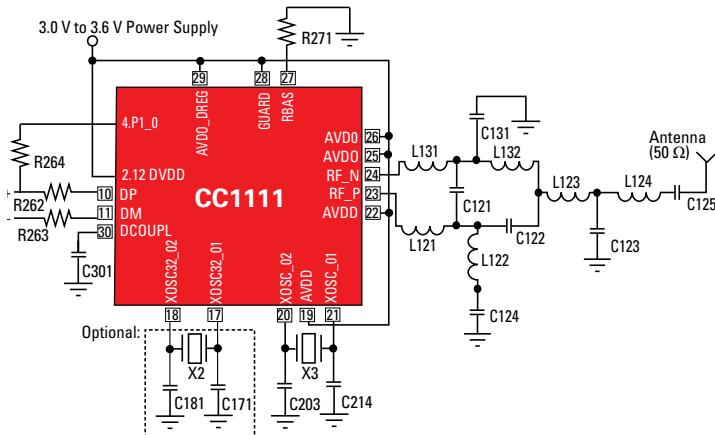
Get samples, datasheets, evaluation modules and application notes at: [www.ti.com/sc/device/CC1111F8](http://www.ti.com/sc/device/CC1111F8)

#### Radio, MCU, Flash and USB all-in-one chip

The CC1111 is a System-on-Chip (SoC) with USB controller for low-power wireless applications in the 315/433/868/915-MHz frequency bands. The CC1111 combines the excellent performance of the industry-leading CC1101 RF transceiver with an enhanced MCU, full-speed USB 2.0, 32-kByte Flash memory, 4-kBytes RAM, 128-bit AES hardware encryption and many other powerful features.

#### Key Features

- Full-speed USB 2.0 with 1-kB USB FIFO, 12-Mbps transfer rate, five bi-directional endpoints with support for bulk, interrupt and isochronous transfers
- Sub-1 GHz RF transceiver identical to the CC1101:
  - Highly configurable with support for 1.2 to 500kBaud data rate and FSK, MSK, GFSK and OOK/ASK modulation
- Very low current consumption:
  - 0.3  $\mu$ A in lowest power mode
- 8/16/32-kB in-system programmable flash
- 1/2/4-kB SRAM (with data retention in all power modes)
- Excellent receiver sensitivity and robustness
- 128-bit AES supported in hardware coprocessor
- 8-channel, 8- to 14-bit ADC with up to eight inputs
- Industry standard I<sup>2</sup>S interface for digital audio data, full duplex, mono and stereo support, configurable sample rate and sample size
- Direct memory access which reduces MCU load



CC1111 application circuit.

#### Benefits

- Complete solution on one single chip
- Ideal for low-power battery operated systems
- Robust and secure link with very good coexistence
- Powerful and flexible development tools and reference designs available

#### Applications

- Alarm and security applications
- Automatic meter reading
- Industrial monitoring and control
- Home and building automation

#### Development Tools and Software

- CC1110/CC1111DK Development Kit
- CC1111EMK-868/915 Evaluation Module Kit
- SimpliciTI software protocol

#### General Characteristics

Parameter	(433/868 MHz, 3.0 V, 25°C)	Min	Typ	Max	Unit	Condition
<b>Operating conditions</b>						
Frequency range	300	—	348	MHz		
	391	—	464	MHz		
	782	—	928	MHz		
Operating temperature range	0	—	85	°C		
Operating supply voltage	3.0	—	3.6	V		
Data rate (programmable)	1.2	—	500	kBaud		
Output power (programmable)	-30	—	10	dBm		
Receiver sensitivity	—	-110	—	dBm		1.2 kBaud, 1% packet error rate
<b>Current consumption</b>						
MCU active and RX mode	—	19	—	mA		
MCU active and TX mode, 0 dBm	—	20/21	—	mA		
Power mode 2	—	0.5	—	μA		
Power mode 3	—	0.3	—	μA		
<b>Wake-up and timing</b>						
From power mode 2 or 3 to active	—	100	—	μs		Digital regulator and high-speed oscillators off, start-up of regulator and high-speed RC oscillator
From active to RX or TX	—	90	—	μs		Time from enabling 26-MHz crystal oscillator and the radio part until RX or TX starts

## → CC1131-Q1

### Sub-1-GHz Automotive Qualified RF Receiver

#### CC1131-Q1

Get samples, datasheets, evaluation modules and application notes at: [www.ti.com/sc/device/CC1131-q1](http://www.ti.com/sc/device/CC1131-q1)

Integrated solution provides high performance. The CC1131-Q1 is a highly integrated, multichannel RF receiver designed for low-power wireless applications in the 315/433/868/915-MHz ISM bands. The CC1131-Q1 is the receiver only derivative of the CC1101-Q1 transceiver qualified in accordance to AEC-Q100 with extended electrical specification and extended temperature range up to +125°C

#### Key Features

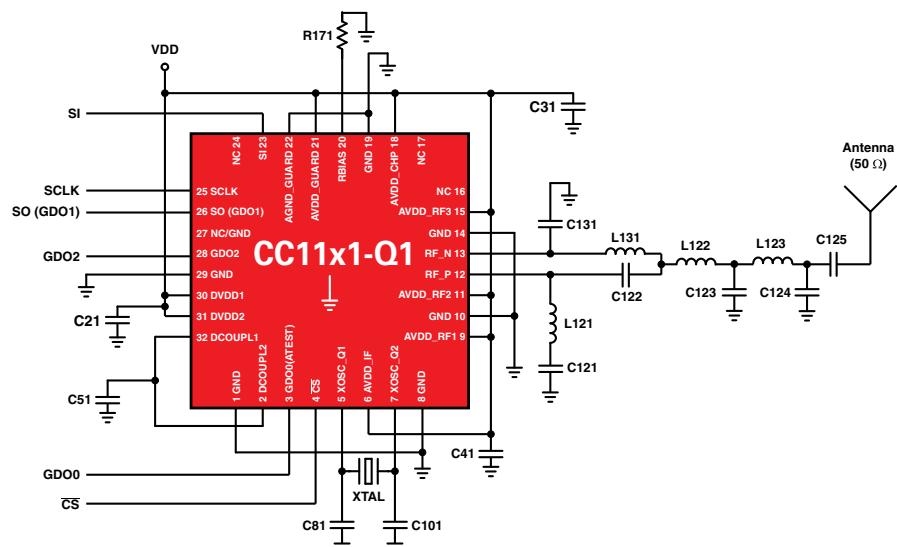
- Sub-1 GHz FSK/GFSK/MSK/ASK/OOK RF receiver
- 1.2 to 250-kBaud data rate
- Low-power, low system cost
- Sleep current: 700 nA
- 90-μs PLL lock time: 240 μs from sleep to RX
- On-chip support for sync word detection, address check, flexible packet length and automatic CRC checking
- 64-byte RX data FIFOs (enable burst mode data reception)
- Suitable for systems targeting compliance with EN 300 200 (Europe) and FCC CFR Part 15 (U.S.)

#### Benefits

- Fast development time and low system cost
- Flexible optimization of range power
- Enables use of inexpensive microcontroller
- Enables adaptive channel selection with increased robustness and coexistence of the wireless link
- Easy system scaling from unidirectional to bidirectional systems through compatible device family

#### Applications

- Remote keyless entry
- Passive entry and passive start
- TPMS receiver
- Garage door opener
- High temperature sensors



The CC1131-Q1 is register compatible with the CC1101-Q1 transceiver.

#### Development Tools and Software

- CC1101DK-433 MHz Development Kit
- CC1101DK-868/915 MHz Development Kit
- SimpliciT™ software protocol

#### General Characteristics

Parameter (315, 433MHz, 3V, 25°C)	Min	Typ	Max	Unit
<b>Operating conditions:</b>				
Frequency range	310	—	348	MHz
	387	—	464	MHz
	779	—	928	MHz
Operating temperature	-40	—	125	°C
Operating voltage	1.8	—	3.6	V
Data rate (programmable)	1.2	—	250	kBaud
Receiver sensitivity, 1.2kBaud	—	-114	—	dBm
<b>Current consumption</b>				
Current consumption, RX	—	15.5	—	mA

## → CC1150

### Multi-channel RF Transmitter

#### CC1150

Get samples, datasheets, evaluation modules and application notes at: [www.ti.com/sc/device/CC1150](http://www.ti.com/sc/device/CC1150)

#### Integrated solution provides low cost and high performance

The CC1150 is a highly integrated, multi-channel RF transmitter designed for low-power wireless applications in the 315/433/868/915-MHz ISM band.

#### Key Features

- Best-in-class price/performance ratio
- Many powerful digital features:
  - Full packet handling including preamble generation, sync word insertion, flexible packet length and automatic CRC generation
- Reference design with two-layer PCB with all components mounted on the same side
- Programmable high data rate from 1.2 to 500 kBaud
- Programmable output power up to +12 dBm
- Low-transmit current consumption
- Fast startup time (0.3 µs)
- Packaging: very small footprint 4x4 mm, 20-pin QLP package

#### Benefits

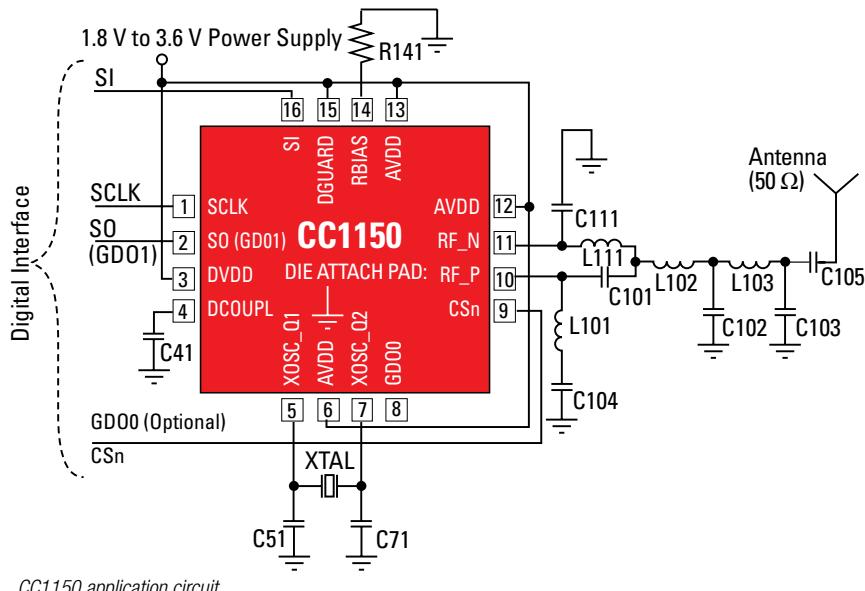
- Fast development time and low system cost
- Flexible optimization of range versus power
- Enables use of inexpensive microcontroller
- Small solution size

#### Applications

- Home and building automation
- Automatic meter reading
- Wireless alarm and security systems
- Industrial monitoring and control
- Wireless sensor networks
- Consumer electronics

#### Development Tools and Software

- CC1101DK-868/915 MHz Evaluation Module Kit
- CC1101DK-433 MHz Development Kit



CC1150 application circuit.

#### General Characteristics

Parameter	(433/868 MHz, 3.0 V, 25°C)	Min	Typ	Max	Unit
<b>Operating conditions</b>					
Frequency range	300	—	348	—	MHz
	400	—	464	—	MHz
	800	—	928	—	MHz
Output power (programmable)	-30	—	+10	—	dBm
Operating temperature range	-40	—	+85	—	°C
Operating supply voltage	1.8	—	3.6	—	V
Data rate (programmable)	1.2	—	500	—	kBaud
<b>Power consumption</b>					
Current consumption TX, (+10 dBm) 433 MHz	—	26.4	—	—	mA
Current consumption TX, (0 dBm) 433 MHz	—	14.9	—	—	mA
Current consumption, power down	—	<1	—	—	µA

## → CC1151-Q1

### Sub-1-GHz Automotive Qualified RF Transmitter

#### CC1151-Q1

Get samples, datasheets, evaluation modules and application notes at: [www.ti.com/sc/device/CC1151-q1](http://www.ti.com/sc/device/CC1151-q1)

Integrated solution provides high performance. The CC1151-Q1 is a highly integrated, multichannel RF transmitter designed for low-power wireless applications in the 315/433/868/915-MHz ISM bands. The CC1151-Q1 is the transmitter only derivative of the CC1101-Q1 transceiver qualified in accordance to AEC-Q100 with extended electrical specification and extended temperature range up to +125°C.

#### Key Features

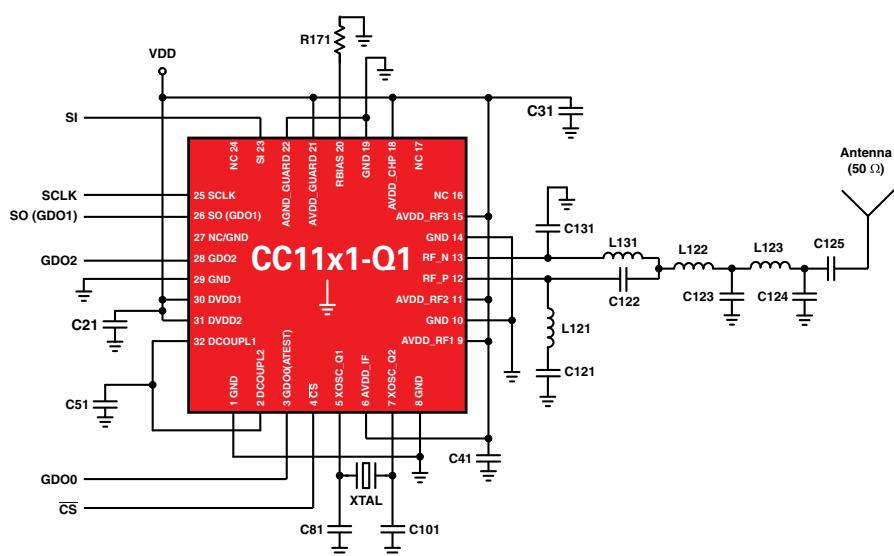
- Sub-1 GHz FSK/GFSK/MSK/ASK/OOK RF transmitter
- 1.2 to 250-kBaud data rate
- Low-power, low system cost
- Sleep current: 700 nA
- 90- $\mu$ s PLL lock time: 240  $\mu$ s from sleep to TX
- On-chip support for sync word insertion, address insertion, flexible packet length and automatic CRC insertion
- 64-byte TX data FIFOs (enable burst mode data transmission)
- Suitable for systems targeting compliance with EN 300 200 (Europe) and FCC CFR Part 15 (U.S.)

#### Benefits

- Fast development time and low system cost
- Flexible optimization of range power
- Enables use of inexpensive microcontroller
- Enables adaptive channel selection with increased robustness and coexistence of the wireless link
- Easy system scaling from unidirectional to bidirectional systems thru compatible device family

#### Applications

- Remote keyless entry
- Passive entry and passive start
- Garage door opener
- High temperature sensors



The CC1151-Q1 is register compatible with the CC1101-Q1 transceiver.

#### Development Tools and Software

- CC1101DK-433 MHz Development Kit
- CC1101DK-868/915 MHz Development K
- SimpliciT™ software protocol

#### General Characteristics

Parameter (315, 433MHz, 3V, 25°C)	Min	Typ	Max	Unit
<b>Operating conditions:</b>				
Frequency range	310	—	348	MHz
	387	—	464	MHz
	779	—	928	MHz
Operating temperature	-40	—	125	°C
Operating voltage	1.8	—	3.6	V
Data rate (programmable)	1.2	—	250	kBaud
Output power (programmable)	-30	—	+12	dBm
<b>Current consumption</b>				
Current consumption, TX, +10 dBm	—	29.5	—	mA
Current consumption, TX, 0 dBm	—	14.6	—	mA

# Sub-1 GHz

## → CC1190

### Sub-1 GHz Front End (850-950 MHz)

#### CC1190

Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/CC1190](http://www.ti.com/sc/device/CC1190)

The CC1190 is range extender for the sub-1GHz low-power RF transceivers and System-on-Chip (SoC) devices from Texas Instruments. The CC1190 integrates a power amplifier (PA), a low noise amplifier (LNA), switches, and RF matching for the design of high-performance wireless systems. The CC1190 increases the link budget by providing a power amplifier for increased output power, and an LNA with low noise figure for improved sensitivity. The CC1190 provides an efficient and easy-to-use range extender in a compact 4x4mm package.

#### Key Features

- Seamless Interface to Sub-1GHz low power RF devices from TI
- Up to 27 dBm (0.5 W) output power
- 2.9 dB LNA noise figure including switch and external antenna match
- Few external components: the integrated PA, LNA, Switches, matching network and inductors improve system performance over typical discrete front end solutions
- High transmit power efficiency PAE=50% at 26 dBm output power

#### Benefits

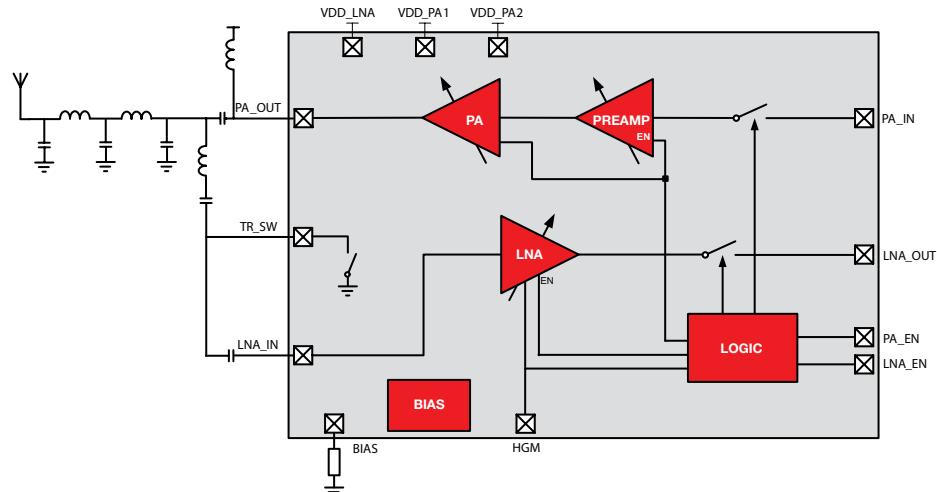
- An integrated front end reduces development time by up to 70%
- Using the CC1190 with even a small 6dB increase in link budget doubles the range, making the CC1190 a great choice for remote monitoring
- A compact reference design reduces the board space for a front end by up to 50%

#### Applications

- Wireless sensor networks
- Wireless metering infrastructure
- Wireless security systems
- Wireless long range remote monitoring

#### Development Tools and Software

- CC1101CC1190EMK915 Evaluation Module Kit



CC1190 block diagram.

#### General Characteristics

Parameter	Min	Typ	Max	Unit
Supply range	2.0	—	3.7	V
Frequency range	850	—	950	MHz
Ambient temperature range	-40	—	85	°C
Power down current	—	50	200	nA
RX mode				
Receive current, high gain mode	—	3	—	mA
Receive current, low gain mode	—	26	—	μA
Gain, high gain mode	—	11.6	—	dB
Gain, low gain mode	—	-6	—	dB
Input, 1-dB compression, high gain mode	—	-12.3	—	dB
Noise figure, high gain mode	—	2.9	—	dB
TX mode				
Transmit current, 26.5dBm output power	—	302	—	mA
Output power	—	26.5	—	dBm
Power added efficiency, PAE	—	48	—	%
Output 1-dB compression	—	24	—	dBm

## → CC1120, CC1121, CC1125, CC1175 and CC1200

### High Performance RF Transceiver for Narrowband Systems

CC1120, CC1121, CC1125, CC1175, CC1200

PREVIEW

Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/cc1120](http://www.ti.com/sc/device/cc1120)

See also: [www.ti.com/product/tps62730](http://www.ti.com/product/tps62730)

The RF Performance Line is a family of industry's highest performance RF parts, including RF transceivers and a transmitter. The parts operate in the 169/315/433/868/950MHz frequency bands. RF Performance Line offers a new level of RF selectivity and blocking. With 65dB adjacent channel rejection and 90dB blocking, robust applications can be built even without an external SAW filter.

The RF Performance Line devices are distinguished by supporting different RF channel bandwidths, data rates and RF regulations. See tables for RF regulations supported and featureset. Complete RF and MCU development is done with the RF Performance Line development kit. Out-of-the box, RF range and performance can be tested using the free SmartRF Studio and RF Packet Sniffer PC software. Code development can be done on the MSP430F5438A used in the development kit, which also includes peripherals like a dot matrix LCD display and various sensors.

#### Key Features

- Industry leading RF blocking and selectivity:
  - 65dB adjacent channel rejection at 12.5kHz offset
  - 90dB blocking
- High output power (up to +16dBm) and excellent sensitivity (Up to 145db link budget)
- WaveMatch; Advanced DSP sync detector with high sensitivity and strong noise and fast setting
- Advanced RX sniff mode with low power without sacrificing performance

#### Benefits

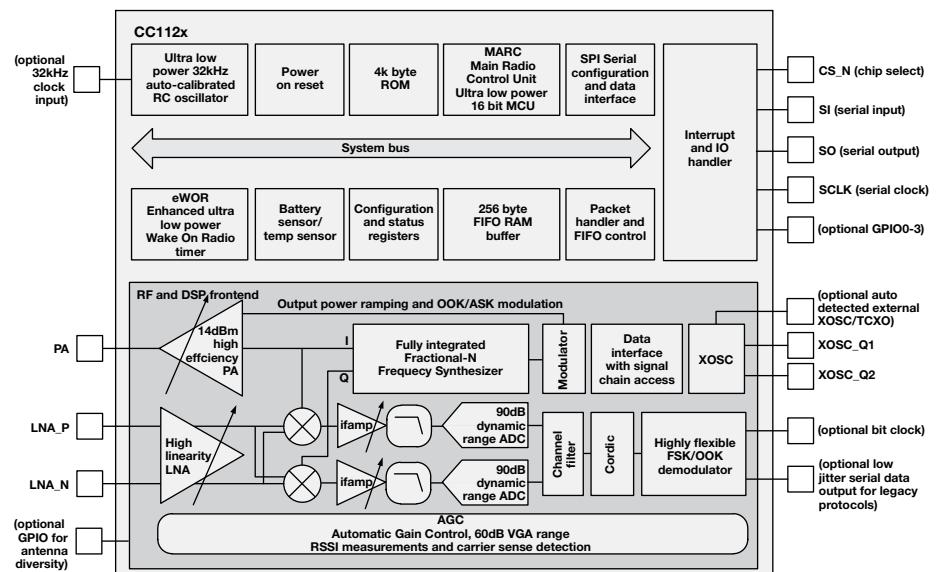
- First pass installation success. The RF chip market is growing 30% YoY, and robust RF is the key to communicate reliably in presence of interference => lower field install cost.
- The first fully integrated ETSI Category 1 radio on the market. Significant cost reduction compared to todays discrete solutions.
- Long range, 10's of kilometers out-of-the-box with the development kit.
- More reliable links, no false sync detects in noise.
- <3mA RX sniff mode current consumption. Extended battery life.

#### Applications

- Smart metering
- Alarm and security systems
- Industrial automation

#### Development Tools and Software

- RF Performance Line Development Kit
- SmartRF Studio



CC112x block diagram.

## → CC1120, CC1121, CC1125, CC1175 and CC1200 (continued)

PARAMETER	CC1175 (only TX)	CC1121	CC1120	CC1125	CC1200 (Q1 2013)
RCR 30	YES	NO	YES	YES	YES
ARIB T96, ARIB T108	YES	YES	YES	YES	YES
ETSI EN 300-220 Cat 1	YES	NO	Only 169MHz & 433MHz	YES	NO
ETSI EN 300-220 Cat 2	YES	YES	YES	YES	YES
FCC Part 15	YES	YES	YES	YES	YES
FCC Part 24	YES	NO	YES	YES	YES
FCC Part 90					
(Mask D, E, G, J)	YES	NO	YES	YES	YES
FCC Part 101	YES	NO	YES	YES	YES
ETSI EN 54-25	YES	YES	YES	YES	YES
ETSI 300-113 TN	YES	NO	NO	TX only	NO

### General Characteristics

	CC1120	CC1121	CC1175	CC1125	CC1200 (Q1 2013)
Device Type	Transceiver	Transceiver	Transmitter	Transceiver	Transceiver
Minimum RX Filter Bandwidth (kHz)	7.8	41.7	N/A	3.5	12.5
Frequency (Min)	164MHz, 410MHz, 820MHz	164MHz, 410MHz, 820MHz	164MHz, 410MHz, 820MHz	164MHz, 410MHz, 820MHz	410MHz, 820MHz
Frequency (Max)	192MHz, 480MHz, 960MHz	192MHz, 480MHz, 960MHz	192MHz, 480MHz, 960MHz	192MHz, 480MHz, 960MHz	480MHz, 960MHz
Data Rate (Max) (kbps)	200	200	200	200	1000
Phase noise @170MHz, 10kHz (dBc/Hz)	-111	-111	-115	-115	-110
Operating Voltage (Min) (V)	2.0	2.0	2.0	2.0	2.0
Operating Voltage (Max) (V)	3.8	3.8	3.8	3.8	3.8
RX Current (Lowest) (mA)	17	17	n/a	17	17
Standby Current (uA)	0.3	0.3	0.3	0.3	0.3
Modulation Techniques	2-FSK, 2-GFSK, 4-FSK, 4-GFSK, MSK, OOK	2-FSK, 2-GFSK, 4-FSK, 4-GFSK, MSK, OOK, extended support for 802.15.4g PHY FSK			
Sensitivity (Best) (dBm)	-123	-117	n/a	-127	-122
Adjacent Channel Selectivity (dB)	64	61	n/a	65	55
RF Blocking (+/- 10MHz) (dB)	90	86	n/a	104	90
TX Power (Max) (dBm)	16	16	16	16	16
AES128 Accelerator	NO	NO	NO	NO	YES

## → CC110L

### Value Line Tranceiver CC110L, CC113L, CC115L

Get samples, datasheets, evaluation modules and application notes at: [www.ti.com/sc/device/cc110L](http://www.ti.com/sc/device/cc110L)

The RF Value Line is a family of low cost RF parts, including a transceiver, a receiver and a transmitter. The parts are pin, register and code compatible, and they can be used to migrate between 1-way and 2-way RF solutions using the same PCB for both options. The parts operate in the 315/433/868/915MHz bands. The RF Value Line is based on TI's very popular CC1101 RF transceiver, and the devices have inherited the key benefits of this platform. This includes very flexible modulation formats and data rates to be compatible with almost any existing RF solution, advanced digital features and a vast pool of design resources with more than 50 application notes have been published on the platform.

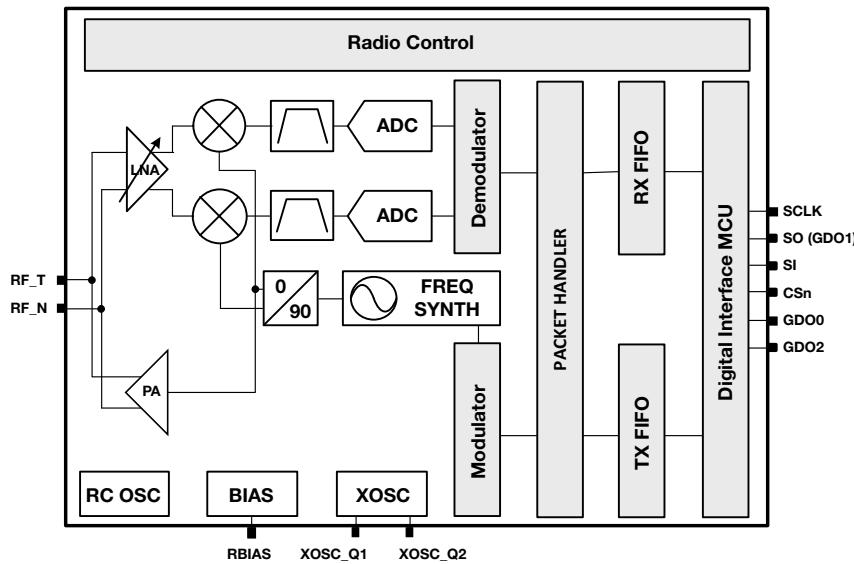
To make RF development easier and more accessible an RF Booster-Pack for the MSP430 LaunchPad is also available. The new 430BOOST-CC110L RF BoosterPack includes ETSI-compliant and FCC-certified modules to help speed development time, reduce certification costs and eliminate barriers associated with the RF hardware design process.

#### Key Features

- CC1101 RF performance
- Flexible RF modulation formats 2-FSK, 4-FSK, GFSK and OOK, data rates from 0.6 to 600kbps
- All Value Line devices are pin, register and code compatible
- \$1 price tag on transmitter + receiver bundle

#### Benefits

- Proven RF performance where millions of these devices are being used every day
- Backwards compatible with existing sub1-GHz systems
- Easy to switch between 1-way and 2-way solutions
- Complete 1-way RF link for \$1 in high volumes (100k+)



CC110L block diagram.

#### Applications

- Cost-sensitive 1-way and 2-way sub1-GHz RF applications
- Remote controls
- Toys
- Home and building automation
- Alarm and security systems

#### Development Tools and Software

- RF Value Line Development Kit
- SmartRF Studio PC software
- CC110L RF BoosterPack for MSP430 LaunchPad

#### General Characteristics

Device Type	CC110L	CC113L	CC115L
Frequency (Max)	300MHz, 387MHz, 779MHz	300MHz, 387MHz, 779MHz	300MHz, 387MHz, 779MHz
Data Rate (Max) (kbps)	348MHz, 464MHz, 928MHz	348MHz, 464MHz, 928MHz	348MHz, 464MHz, 928MHz
Operating Voltage (Min) (V)	600	600	600
Operating Voltage (Max) (V)	1.8	1.8	1.8
RX Current (Lowest) (mA)	3.6	3.6	3.6
Standby Current (µA)	14	14	na
Wakeup Time (PD-->RX/TX) (µS)	0.2	0.2	0.2
Modulation Techniques	240	240	240
Sensitivity (Best) (dBm)	2-FSK, 4-FSK, GFSK, OOK	2-FSK, 4-FSK, GFSK, OOK	2-FSK, 4-FSK, GFSK, OOK
TX Power (Max) (dBm)	-116	-116	na
Transmit current, 26.5dBm output power	12	na	12
Output power	—	26.5	—
Power added efficiency, PAE	—	48	—
Output 1-dB compression	—	24	—

## → CC2544

### 2.4GHz RF Value Line SoC with 32kB flash, 31 GPIO, I2C, SPI and UART

#### CC2543, CC2544 and CC2545

Get samples, evaluation modules and application notes at: [www.ti.com/product/CC2543](http://www.ti.com/product/CC2543)

CC2543/44/45 is a family of 2.4GHz RF Value Line System-on-Chip (SoC) with MCU, 32kB flash and 1/2kB RAM on a single die. They feature 2Mbps data rate, 102dB link budget and <1uA sleep current with sleep timer running. The family members are distinguished by different number of general I/O pins, and CC2544 has a USB interface.

The CC2543-CC2544 Development Kit provides a complete hardware performance test platform and generic software development environment for 2.4GHz RF proprietary applications. The kit includes two CC2543-based RF evaluation modules, one CC2544-based USB dongle, general purpose development boards (SmartRF05EB) for software and hardware prototyping, cables, antennas and documentation to get you up and running with the CC2543, CC2544, and CC2545 quickly and easily.

Complete RF and MCU development is done with the CC2543-CC2544 Development Kit. Out-of-the box, RF range and performance can be tested using the free SmartRF Studio. Code development can be done on embedded 8051 core used in the development kit, which also includes peripherals like a dot matrix LCD display and various other interfaces.

#### Key Features

##### Data throughput:

- 2Mbps radio
- Up to 256 byte packet length
- Quick RX/TX turnaround time

##### Link budget:

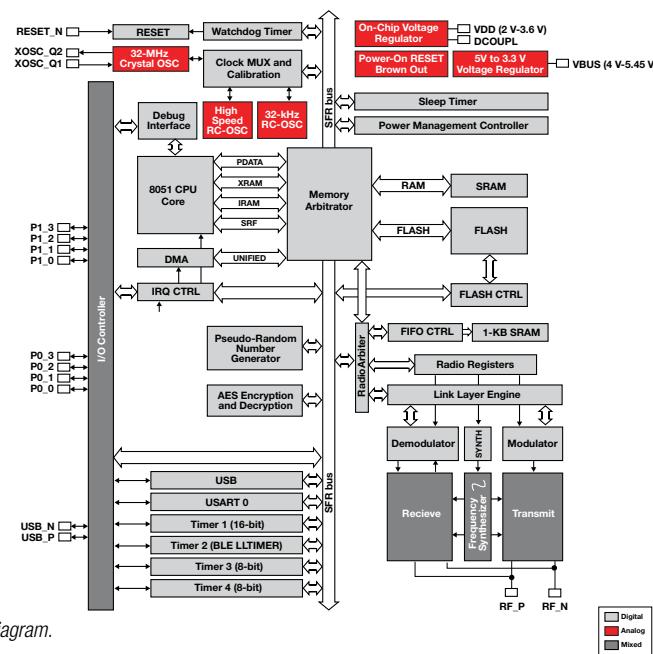
- +4dBm output power
- -98dBm sensitivity @ 250kbps
- -90dBm sensitivity @ 2Mbps

##### Power consumption:

- <1uA sleep current
- Quick transition between power modes

##### Low cost design:

- Integrated MCU, RF, memory and USB
- Ultra low-cost crystal, few external components, small PCB antennae



CC2544 block diagram.

#### Benefits

- High effective data rate, up to 1.6Mbps sustainable throughput
- Less time on-air and lower power consumption
- Up to 100dB link budget
- Long range with small antennas
- Several years of battery life on AA cells possible depending on application
- Perfect fit for wireless 2.4GHz consumer applications
- Good fit for PC keyboard and mouse

#### Applications

- Wireless mouse & keyboard
- Low-cost remote controls, toys
- Low-cost consumer applications

#### Development Tools and Software

- CC2543-CC2544 Development Kit
- CC2545 Evaluation Module Kit
- SmartRF Studio
- IAR Embedded Workbench

#### General Characteristics

	CC2543	CC2544	CC2545
Frequency (Min)	2379MHz	2380MHz	2379MHz
Frequency (Max)	2496MHz	2495MHz	2496MHz
Device Type	System-on-Chip	System-on-Chip	System-on-Chip
Flash size (KB)	32	32	32
RAM size (KB)	1	2	1
Data Rate (Max) (kbps)	2000	2000	2000
Operating Voltage (Min) (V)	2.0	2.0	2.0
Operating Voltage (Max) (V)	3.6	3.6	3.6
RX Current (Lowest) (mA)	21.2	22.5	20.8
Standby Current	0.9uA	1mA (USB suspend)	0.9uA
Modulation Techniques	GFSK, MSK	GFSK, MSK	GFSK, MSK
Sensitivity (Best) (dBm)	-98	-95	-98
TX Power (Max) (dBm)	4	4	4
Features	I2C, UART, SPI, 16 gpio	USB, UART, SPI, 8 gpio	I2C, UART, SPI, 31 gpio

## → CC2590, CC2591

### 2.4 GHz RF Front End

#### CC2590, CC2591

Get samples, datasheets, evaluation modules and application notes at: [www.ti.com/sc/device/CC2590](http://www.ti.com/sc/device/CC2590)  
and [www.ti.com/sc/device/CC2591](http://www.ti.com/sc/device/CC2591)

CC2590 and CC2591 are 2.4-GHz range extenders specially designed for all existing and future 2.4-GHz RF transceivers and System-on-Chip (SoC) solutions from TI. CC2590/CC2591 increase the link budget by providing a power amplifier for improved output power and an LNA with low noise figure for improved receiver sensitivity. They contain PA, LNA, switches, RF-matching, and balun for simple design of high-performance wireless applications.

#### Key Features

##### CC2590

- Up to +14-dBm output power
- 22-mA transmit current at 3 V at +12-dBm output power
- 4.6-dB LNA noise figure including RX/TX switch and antenna match

##### CC2591

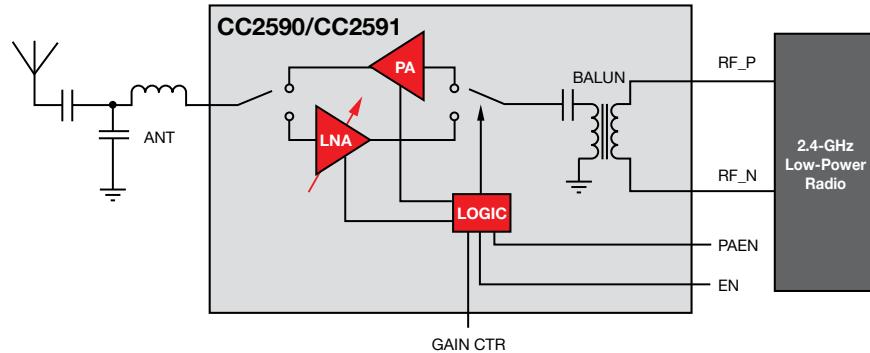
- Up to +22-dBm output power
- Up to +28-dB increased link budget
- 112-mA transmit current at 3 V at +20-dBm output power
- 4.8-dB LNA noise figure including RX/TX switch

##### CC2590/CC2591

- Seamless interface to TI's 2.4-GHz 802.15.4 low-power RF devices
- 6-dB typ improved sensitivity on CC24xx, CC2500, CC2510 and CC2511
- Very few external components: integrated PA, LNA, switches, inductors, balun and matching network
- Low receive current: 3.4 mA in HIGH gain mode, 1.7 mA in LOW gain mode
- 100 nA in power down
- Digital control of LNA gain by HGM pin
- Packaging: RoHS-compliant, 4x4 mm QFN-16

#### Development Tools

- CC2530-CC2591EMK Evaluation Module Kit
- CC2520-CC2591EMK Evaluation Module Kit



CC2590/CC2591 block diagram.

#### CC2590 General Characteristics

Parameter	Min	Typ	Max	Unit
Supply range	2.0	—	3.6	V
Frequency range	2400	—	2483.5	MHz
Ambient temperature range	-40	—	85	°C
Power down current	—	0.1	0.3	µA
<b>RX mode</b>				
Receive current, high gain mode	—	3.4	4	mA
Receive current, low gain mode	—	1.8	2	mA
Gain, high gain mode	—	11.4	—	dB
Gain, low gain mode	—	0	—	dB
Input, 1-dB compression, high gain mode	—	-21	—	dB
Noise figure, high gain mode	—	4.6	—	dB
<b>TX mode</b>				
Transmit current, 12-dBm output power	—	22	—	mA
Output power	—	12	—	dBm
Power added efficiency, PAE	—	23	—	%
Output 1-dB compression	—	10.4	—	dBm

#### CC2591 General Characteristics

Parameter	Min	Typ	Max	Unit
Supply range	2.0	—	3.6	V
Frequency range	2400	—	2483.5	MHz
Ambient temperature range	-40	—	85	°C
Power down current	—	0.1	0.3	µA
<b>RX mode</b>				
Receive current, high gain mode	—	3.4	4	mA
Receive current, low gain mode	—	1.7	2	mA
Gain, high gain mode	—	11	—	dB
Gain, low gain mode	—	1	—	dB
Noise figure, high gain mode	—	4.8	—	dB
Input, 1-dB compression, high gain mode	—	-17	—	dB
<b>TX mode</b>				
Transmit current, 20-dBm output power	—	100	—	mA
Output power	—	20	—	dBm
Power added efficiency, PAE	—	33	—	%
Output 1-dB compression	—	19	—	dBm

## PaLFI - Passive Low Frequency Interface Device

### TMS37157

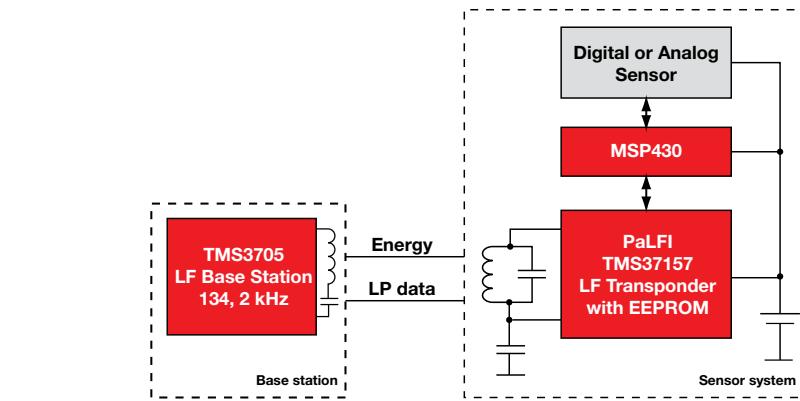
Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/TMS37157](http://www.ti.com/sc/device/TMS37157)

The PaLFI - Passive Low Frequency Interface TMS37157 enables short-range two way communication without the need of a battery by harvesting the RF energy transmitted from the base-station. It combines a Low Frequency RFID Transponder with EEPROM memory and an SPI Interface to connect to a microcontroller. The EEPROM memory is accessible via the LF- and SPI interface without battery support. It is ideal for data-logging applications (configuration or updating a device without the need of a battery), for medical applications (non-battery operated bio-sensors) and as a method for recharging batteries while enabling two way communications.

The TMS37157 can also be used in combination with active low power devices to wake up the active device in a defined read zone and thus conserve the battery life. Dependent on system parameters such as antenna sizes and base station power, the device wirelessly powers an MSP430 MCU at ranges up to 1.5 meter.

#### Key Features

- Low frequency half duplex (HDX) interface
  - Special selective addressing mode allows anti collision
  - Up to 8 kbit/s LF uplink data rate
- 3 wire SPI interface
- 1008 bit EEPROM:
  - 968 bit free available EEPROM user memory
  - 32 bit unique serial number
  - 8 bit selective address
  - Pages are irreversible lockable and protectable
- Power management for connected microcontroller



TMS37157 block diagram.

#### Benefits

- Batteryless operation of a microcontroller supplied by RF field
- EEPROM memory expansion for microcontroller
- Dedicated LF wake-up
- HDX transponder communication
- Battery check and battery charge function

#### Applications

- Wireless batteryless interface
  - Medical
  - Metering
- LF wake-up for container tracking
- Configuration memory (end of production line)

#### Development Tools and Software

- ez430-TMS37157 evaluation kit

#### PaLFI - Passive Low Frequency Interface

Part number	TMS37157
Communication interfaces	SPI, RFID, direct microcontroller access via RFID
Operating frequency	134.2kHz
Wired communication interface	3-wire SPI
Operating voltage	2V to 3.6VDC
Current consumption	Active mode max 150µA Power down mode 60nA
Battery charge current	max 2mA
Memory	32bit unique serial number 968 bit EEPROM user memory 8 bit selective address
Operating temperature	-40°C to +85°C
Storage temperature	-40°C to +125°C
Package	16 Pin VQFN, (4mm x 4mm)
Packing/delivery	Tape-on reel, 3000 per reel

## → TMS3705

### 134.2kHz Transceiver IC

#### TMS3705

Get samples, evaluation modules and application notes at: [www.ti.com/sc/device/TMS3705](http://www.ti.com/sc/device/TMS3705)

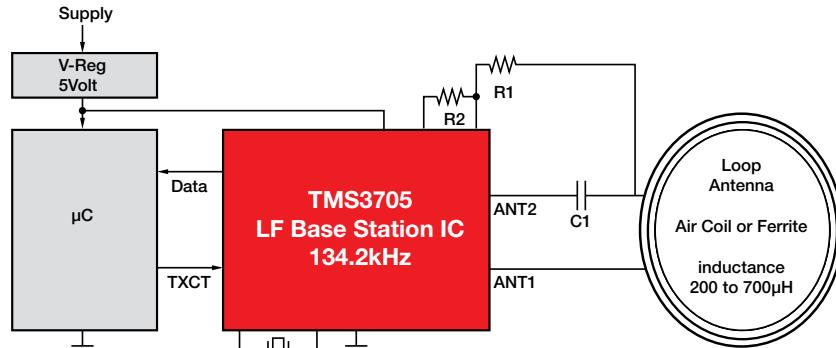
The TMS3705 is a highly integrated Transceiver IC to support all HDX Transponders and TI LF dual interface devices. This base station IC drives the antenna of a transponder system to send data modulated on the antenna signal, and to detect and demodulate the response from the transponder. It allows efficient development and enables minimizing the external component count for RFID reader systems.

#### Key Features

- Transceiver IC for 134.2 kHz Transponder and PaLFI – Passive Low Frequency Interface Device
- HDX transmission principle
- Digital FM/FSK demodulator
- Asynchronous or synchronous data interface to µC
- Automatic transponder frequency measurement and adaptation
- Integrated diagnosis functions
- Full bridge antenna driver
- Built in band-pass filter and limiter
- Short-circuit protection
- Power on reset
- PLL for internal clock generation
- Sleep-mode current consumption: typ. 15  $\mu$ A
- Designed for automotive requirements
- 16-Pin SOIC (D) package

#### Benefits

- 2-wire interface
- Low external component count
- Remote antenna principle (up to 10m)



*TMS3705 block diagram.*

#### Applications

- 134.2kHz Reader (HDX) for:
  - Automotive immobilizer
  - Animal ID
  - Access control
  - Industrial automation
  - Container tracking
  - Asset management

#### Development Tools and Software

- Included in ez430-TMS37157 Evaluation Kit

For more information on  
Transponders and Inlays please visit  
[www.ti.com/lf-transponders](http://www.ti.com/lf-transponders)

Part number	TMS3705
Operating frequency	134.2 kHz
Communication interface	SCI Asyn/Sync
Supply voltage	4.5 V to 5.5 VDC
Current consumption	RX 8 mA TX 220 mA peak Sleep Mode 15 $\mu$ A
Transmitter modulation	100% ASK
Demodulation format	FM/FSK
FSK datarate	8kbps
Transmission principle	HDX
Operating temperature	-40°C to +85°C
Storage temperature	-55°C to +150°C
Package	16-pin SOIC-D
Packing/delivery	Tape-on Reel, 2500 per reel

## → TRF796x

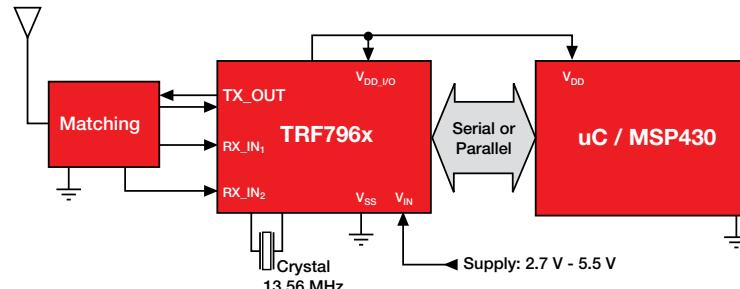
### 13.56MHz Reader/Writer Transceiver ICs TRF7960, TRF7960A, TRF7961, TRF7962A, TRF7963A, TRF7964A

Get samples, evaluation modules and application notes at: [www.ti.com/nfc](http://www.ti.com/nfc)

The TRF796x is a pin compatible, high performance 13.56MHz HF RFID Reader IC family comprising an integrated analog front end (AFE) and a built in data-framing system for ISO/IEC 15693, ISO/IEC 18000-3, ISO/IEC 14443A and B. This includes data rates up to 848kbits for ISO/IEC14443 with all framing and synchronization tasks on board. This architecture enables the customer to build a complete reader using only a low end micro-controller. Other standards and even custom protocols can be implemented by using the various Direct Modes of the device. The Direct Modes allow the user to get access to the Sub-Carrier Data or to the un-framed, however already ISO Formatted Data stream. A parallel or serial interface (SPI) can be used for the communication between the Microcontroller and the TRF796x. The transmitter has selectable output-power levels of 100mW (+20dBm) or 200mW (+23dBm) equivalent into a 50 Ohm load when using a 5V supply. The receiver system enables AM and PM demodulation using a dual-input architecture to minimize communication holes. The reader is configured by selecting the desired protocol in the control registers. Direct access to all control registers allows fine tuning of various reader parameters as needed.

#### Key Features

- ISO14443A/B, ISO15693 , Felica, Mifare
- Supply voltage range: 2.7 - 5.5 V
- Parallel data communication or serial 4-pin SPI interface
- Integrated data framing, CRC and/or parity checking
- Multiple sub-carrier receiving & decoding compatibility
- Data rates supported up to 848 kHz
- Integrated voltage regulators for MCU supply (20 mA)
- Clock output for MCU
- Selectable receive gain w/AGC
- Antenna driver using OOK or ASK modulation
- Programmable output power, 100 mW and 200 mW
- 7 user selectable power modes



TRF7960 block diagram.

#### Key benefits

- Easy to use with high flexibility
- Completely integrated protocol handling
- Auto-configured default modes for each supported ISO protocol
- Separate internal High-PSRR power supplies for analog, digital, and PA sections provide noise isolation for superior read range and reliability
- Dual receiver inputs with AM and PM demodulation to minimize communication holes
- Receiver AM and PM RSSI
- High integration reduces total BOM and board area
- Ultra-low-power modes
- Power down < 1 µA
- Standby 120 µA

#### Applications

- 13.56 MHz RFID reader
- Access control
- POS contactless payment
- Prepaid eMetering
- Medical equipment
- Product identification/authorization (consumables)

#### Development Tools and Software

- TRF7960AEVM – Evaluation Kit
- TRF7960ATB target board for MSP-EXP430F5438A board, ARM® Cortex™-M3 based DK-LM3S9BD96 board, or any other TI embedded microcontroller platform with the EM socket headers populated.

For more information on Transponders and Inlays please visit [www.ti.com/hf-transponders](http://www.ti.com/hf-transponders)

#### General Characteristics

Part Number	TRF7960	TRF7961	TRF7963A
TRF7960A	TRF7964A	TRF7962A	
Operating frequency	13.56 MHz		
Supported protocols	ISO/IEC 15693, ISO/IEC 18000-3 ISO/IEC 14443A ISO/IEC 14443B	ISO/IEC 15693, ISO/IEC 18000-3	ISO/IEC 14443A ISO/IEC 14443B
Operating voltage	2.7 to 5.5 VDC	Transmit: 200 mW at 120 mA, typ. 100 mW at 70 mA, typ. Active (RX only): 10 mA, typ. Stand-by: 120 µA Power down: <1 µA	Transmit: 200 mW at 120 mA, typ. 100 mW at 70 mA, typ. Active (RX only): 10 mA, typ. Stand-by: 120 µA Power down: <1 µA
Current consumption		Adjustable power, 100 mW or 200 mW at 5 VDC	ASK, adjustable 8% to 30% OOK Parallel 8-bit or 4-wire SPI
Transmitter power		-40°C to +110°C	-55°C to +150°C
Transmitter modulation		Storage temperature	32-pin QFN, (5 mm X 5 mm)
Communication interface		Packing/delivery	Tape-on Reel, 250 or 3000 per reel
Operating temperature			
Storage temperature			
Package			
Packing/delivery			

## → TRF7970A

### 13.56MHz NFC (Near Field Communication)/ RFID Transceiver IC

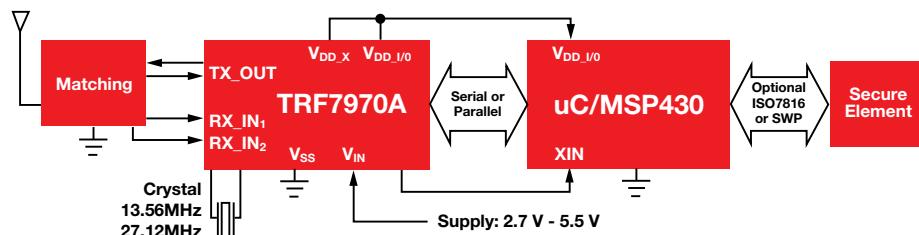
#### TRF7970A

Get samples, evaluation modules and application notes at: [www.ti.com/nfc](http://www.ti.com/nfc)

The TRF7970A is the newest addition to the TRF796x HF Transceiver IC Family. TRF7970A supports Near Field Communication (NFC) Standards NFCIP-1 (ISO/IEC 18092) and NFCIP-2 (ISO/IEC21481) which defines the selection of any of the four possible communication modes (NFC peer-to-peer, card emulation, proximity reader/writer – ISO14443A/B, Mifare or FeliCa and Vicinity reader/writer – ISO15693). Integrated encode, decode and data framing capability for data rates up to 848bps, wide supply voltage range support (2.7V – 5.5V), large FIFO buffer for RF communication, relevant NFC software stack libraries and an innovative RF field detector allow for easy development efforts and robust, cost effective designs. Finally, eight selectable power modes and ultra-low power operation enable the longest battery life in the industry. The devices also offer unparalleled flexibility via the various direct communication modes on the device to allow implementations of custom protocols as well as other 13.56 MHz standards. The receiver system enables AM and PM demodulation using a dual-input architecture to maximize communication robustness.

#### Key Features

- NFCIP-1, NFCIP-2
- Peer-to-peer, card emulation, reader/writer functionality
- ISO14443A, ISO14443B, FeliCa, ISO15693
- Supply voltage range: 2.7 – 5.5V
- Operating temperature: -40°C to +110°C
- Parallel or SPI interface
- Integrated data framing, CRC and/or parity checking
- Integrated voltage regulators for MCU supply (20mA)
- Clock output for MCU
- Selectable receive gain with AGC
- Antenna driver using OOK or ASK modulation
- Programmable output power, 100mW and 200mW
- RF field detector with programmable wake-up levels
- Eight user selectable power modes 100 mW and 200 mW
- 7 user selectable power modes



TRF7970A block diagram.

#### Benefits

- Easy to use with high flexibility
- Completely integrated protocol handling
- Auto-configured default modes for each supported ISO protocol
- Separate internal high-PSRR power supplies for analog, digital, and PA sections provide noise isolation for superior read range and reliability
- Dual receiver inputs with AM and PM demodulation to minimize communication holes
- Receiver AM and PM RSSI
- High integration reduces total BOM and board area
- Ultra-low-power modes
- Power down < 1 μA
- Standby 120 μA

#### Applications

Infrastructure devices which communicate to the NFC enabled smart phones and PDAs:

- Public transport/event ticketing
- Access control/digital door-lock
- POS contactless payment
- Medical equipment
- Product identification/authentication
- Sharing of electronic business cards
- Secure pairing
  - Bluetooth, wireless networks
- Short range wireless communication
- FW updates

#### Development Tools and Software

- TRF7970AEVM evaluation kit
- TRF7970ATB target board for MSP-EXP430F5529 board or any other TI embedded microcontroller platform with the EM socket headers populated

#### General Characteristics

Part Number	TRF7970A
Operating frequency	13.56 MHz
Reader/Writer	ISO/IEC 15693, ISO/IEC 18000-3 ISO/IEC 14443A ISO/IEC 14443B
Operating Modes	Peer-to-peer ISO18092 / NFCIP-1 Card Emulation ISO 14443A & B
Operating voltage	2.7 V to 5.5 VDC
Current consumption	Transmit: 200 mW at 120 mA, typ. 100 mW at 70 mA, typ. Power down: <1 μA
Transmitter power	Adjustable power, 100 mW or 200 mW at 5 VDC
Transmitter modulation	ASK, adjustable 8% to 30% OOK
Communication interface	Parallel 8-bit or 4-wire SPI
Operating temperature	-40°C to +110°C
Storage temperature	-55°C to +150°C
Package	32-pin QFN, (5 mm X 5 mm)
Packing/delivery	Tape-on Reel, 250 or 3000 per reel

# Embedded Processors for Wireless Connectivity

## → Embedded Processors

### TI Embedded Processors – A perfect companion to our radios in wireless systems

Microcontrollers are an integral part of all wireless connectivity systems, especially in low-power wireless solutions. From being the main applications and/or protocol processor to performing power management functions to coordinating communications, microcontrollers play a key role both in battery operated end nodes as well as host devices such as coordinators and routers. TI's broad industry leading portfolio of embedded processors, from the ultra-low power MSP430™ microcontrollers to the Stellaris® ARM® Cortex™-M family to our high performance Sitara™ ARM® portfolio and DSP products, ensures you have the choice of the right device for any wireless connectivity application.

TI recognizes the importance of embedded software in wireless connectivity solutions. Our embedded processors are supported by a wide variety of software stacks, including protocol and network solutions.

Finally we offer a comprehensive suite of development tools and online resources to make your wireless connectivity design robust, easy and fast.

### TI Embedded Processors

#### Microcontrollers (MCUs)

#### ARM®-based processors

#### Digital Signal Processors (DSPs)

Software and Dev. Tools						
16-bit ultra-low power MCUs	32-bit real-time MCUs	32-bit ARM MCUs	32-bit ARM MPUs	DSP DSP + ARM	Multicore DSPs	Ultra-low power DSPs
MSP430™  Up to 25MHz	C2000™ Delfino™ Piccolo™  40MHz to 300MHz	Stellaris ARM Cortex™-M  Up to 80MHz	Sitara ARM Cortex™-A8 & ARM9  Value line to 600MHz Perf. Line to 1.5GHz	C6000™ Integra™ DaVinci™ Video Processors  300MHz to >1.5GHz Floating point + Video Accelerators	C6000™  Up to 10GHz Multi-core, fixed/floating + Accelerators	C5000™  Up to 300MHz 16-bit fixed point + FFT Accelerator

# Embedded Processors for Wireless Connectivity

## → MSP430™ Microcontrollers

### The MSP430™ family of ultra-low-power microcontrollers

TI's MSP430 Microcontrollers (MCUs) are 16-bit, RISC-based, mixed-signal processors ideal for ultra-low-power (ULP) operation in conjunction with TI's broad radio portfolio. The diverse MSP430 MCU family portfolio offers the right mix of intelligent peripherals, ease of use, low cost and lowest power consumption enabling extended battery life and superior performance in wireless connectivity applications. High-performance peripheral integration includes 16-bit Sigma-Delta Analog-Digital Converters (ADCs), Digital-Analog Converters (DACs), Operational Amplifiers (Opamps), AES-128 security modules, RF Front ends, USB and LCD controllers allowing users a powerful suite of tools for their RF solutions. Visit [www.ti.com/msp430](http://www.ti.com/msp430) for a complete product portfolio and more information.

By making RF design easy, performance-rich and power-efficient, the MSP430 helps advance RF

### MSP430™ Embedded Software:

The MSP430 microcontroller supports several wireless connectivity protocol and networking software stacks with more options coming soon.

Stack	MSP430 device	Availability
SimpliciTI	MSP430F2xx, MPR430F5xx, MSP430F4xx, CC430Fxx, MSP430FR57xx	For more information, visit <a href="http://ti.com/embeddedrf">ti.com/embeddedrf</a>
TIMAC 802.15.4	MSP430F461x*, MSP430FR57xx	For more information, visit <a href="http://ti.com/embeddedrf">ti.com/embeddedrf</a>
ZigBee Coordinator	MSP430F227x*, MSP430F461x*, MSP430F54xxA*	For more information, visit <a href="http://ti.com/embeddedrf">ti.com/embeddedrf</a>
ZigBee End Device	MSP430F227x*, MSP430F461x*, MSP430F54xxA*, MSP430FR57xx	For more information, visit <a href="http://ti.com/embeddedrf">ti.com/embeddedrf</a>
Bluetooth v2.1 + EDR, SPP	MSP430BT5190*, MSP430F5529	For more information, visit <a href="http://ti.com/embeddedrf">ti.com/embeddedrf</a>
6LoWPAN	CC430Fxxx*, MSP430F5438A	For more information, visit <a href="http://ti.com/embeddedrf">ti.com/embeddedrf</a>
Dash7	CC430Fxxx*	For more information, visit <a href="http://ti.com/embeddedrf">ti.com/embeddedrf</a>

\*Can be ported to other MSP430 MCU devices (depending on memory requirements)

networking applications from RFID to Bluetooth®/Bluetooth low energy as well as proprietary protocols. These applications include, but are not limited to, industrial/building automation, asset tracking, industrial monitoring and tamper detection, alarm and security systems, sports/

body monitoring, wireless keyboard/mouse products, wireless gaming accessories and automatic metering infrastructure (AMI). The ultra-low power consumption of the MSP430 also enables energy harvesting applications with wireless systems. [www.ti.com/embeddedrf](http://www.ti.com/embeddedrf)

### MSP430 – your ultra-low power wireless connectivity microcontroller



#### Ultra-Low Power

##### World's Lowest Power MCU family

- Ultra-Low Power Active Mode
- 7 Low Power Modes
- Instant Wakeup
- All MSP430 devices are Ultra-Low Power



#### Integration

##### Intelligent Analog & Digital Peripherals

- Peripherals operate in low power modes
- Minimize physical footprint and Bill of Materials
- Featuring USB, RF, Capacitive Touch I/O, Metrology Engines, LCD, ADC, DAC & MORE



#### Extensive Portfolio, Low Cost Options

##### Find the right MCU for you

- 400+ devices
- Up 256kB Flash, 18kB RAM, 25+ package options
- Low cost devices available with Value Line
- Various levels of performance & integration



#### Easy to Get Started

##### Low cost and simple point of entry

- Complete kits starting @ \$4.30
- One tool for all MSP430 devices
- GUI-based coding & debugging tools available
- Code, documentation & other resources online

# Embedded Processors for Wireless Connectivity

## → MSP430™ Microcontrollers

### Tools

TI offers a broad range of hardware and software tools for the MP430 microcontroller family as well as comprehensive collateral such as reference designs, application notes and user guides. These combined with a vibrant, active community ecosystem make development fast and easy.

- **Embedded Emulation**

Enables powerful, low cost development tools

- **Real-Time, In-System Debug**

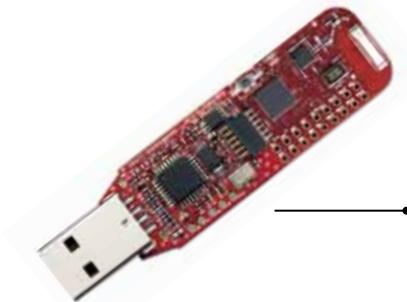
- No application resources
- Full speed execution
- H/W
- Single stepping
- Complex triggering
- Trace capability

- **Powerful, Easy to Use Tools**



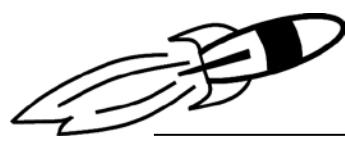
#### Development Software

- Free IDEs available
- CCS5 \$495 for MCU edition



#### eZ430 Development Tools

- Complete development tool
- USB stick form factor
- Real-time, in-system debug
- Removable target board
- Available for wireless development
- Starting at \$20



#### MSP430 LaunchPad

#### Meet the MSP430 LaunchPad

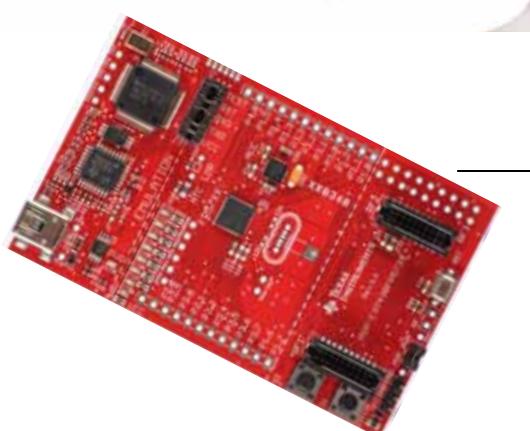
*Everything to Launch your applications!*

- Only \$4.30
- Embedded emulation w/mini USB cable
- 2 push buttons & 2 LEDs
- FREE software Compiler/Debugger
  - Code Composer Studio Ver 5
  - IAR Embedded Workbench



#### MSP430 Flash Emulation Tool

- 1 programming tool for all devices
- \$99 for USB FET
- \$49 target boards available for all devices



#### MSP430 Experimenter Boards

- Fully features prototyping system
- Available for FG4618, F5438 and FR5739
- Starting at \$49

# Embedded Processors for Wireless Connectivity

## → MSP430™ Microcontrollers

### Wireless Connectivity Hardware Tools from MSP430:

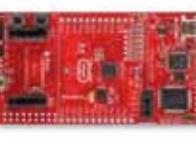
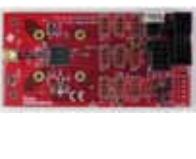
The MSP430 eZ430 development tools are the best way to get familiar with the MSP430 MCU and include all the software and hardware needed to develop a complete project and are available for as little as \$20. Most eZ430 tools include a programming interface that provides full debugging and programming capabilities for the detachable MSP430 target boards. For more information visit [www.ti.com/ez430](http://www.ti.com/ez430).

Part Number						
Key Feature	Full turn-key TI Wi-Fi evaluation and demonstration tool for the MSP430 FRAM MCUs and TI's SimpleLink™ Wi-Fi	Sub 1GHz wireless watch with integrated sensors	2.4GHz wireless connectivity development board	Solar Energy Harvester with 2.4 GHz connectivity	Passive low frequency RFID connectivity	Bluetooth® connectivity
Price	\$199	\$49	\$49	\$149	\$199	\$99

\*Can be ported to other MSP430 MCU devices (depending on memory requirements)

### Experimenter Board Kits:

These innovative kits feature select MSP430 devices and include additional hardware components to take advantage of the high level of analog integration available for easy system evaluation and prototyping. These kits are ideal for learning the MSP430 architecture, testing the capabilities of available peripherals and include integrated headers for plugging in low-power RF modules (CCxxxxEMK).

Part Number						
Key Features	MSP-EXP430F5438 Dot matrix grayscale display, microphone, audio output, RF expansion connector, USB connectivity, accelerometer, joystick	EM430F6137RF900 EM430F6137RF900	MSP-EXP430F5529 5-pad capacitive touch strip, microSD Card Slot with 1GB card, USB connectivity, supports	MSP-EXP430FR5739 Integrated MSP430FR5739 3 axis accelerometer NTC Thermister 8 Display LED's Footprint for additional through-hole LDR sensor 2 User input Switches	EM430F6147RF900 Sub 1GHz CC430 complete wireless development tool kit. Includes DC-DC converter option for lower power operation	MSP-SA430-SUB1GHZ Low cost sub GHz spectrum analyzer Supported Frequency Ranges: 300 – 348 MHz, 389 – 464 MHz, 779 – 928 MHz Open source QT-based Graphical User Interface
Supports	Any CCxxxxEMK module, PAN1323EMK, CC2567PAN1327ANTBT, CC3000	EM430F6137RF900	Most Wireless Daughter Cards (CCxxxx RF). CC1101EMK, CC2500EMK, CC2430EMK, CC2530EMK, CC4000GPSEM, CC3000	Connection to most Wireless Daughter Cards (CCxxxx RF), User Experience, Preloaded with out-of-box demo code, 4 Modes to test FRAM	CC430 SoCs	CC110x Transceivers, CC430 SoS, CC111x SoC
Price	\$149	\$149	\$149	\$49	\$149	\$249

\*Can be ported to other MSP430 MCU devices (depending on memory requirements)

# Embedded Processors for Wireless Connectivity



## Stellaris Microcontrollers for Connectivity and Networking

TI's Stellaris microcontrollers are 32-bit ARM® Cortex™-M3 and M4F based mixed-signal processors ideal for use in conjunction with TI's broad radio portfolio. The industry's broad 32-bit Cortex-M3 and M4F microcontroller portfolio offers the right mix of connectivity, software, and networked solutions to enable the quick and easy development of many wireless router, network coordinator, and wireless gateway applications. High-performance peripheral integration includes an integrated 10/100 Ethernet MAC and PHY, support for USB Device, Host and On the Go, and up to 3 CAN ports. Analog peripherals such as integrated op-amps, an integrated LDO, and 10-bit ADCs enable advanced mixed-signal solutions as well. Visit [www.ti.com/stellaris](http://www.ti.com/stellaris) for a complete product portfolio and more information.

## Stellaris Embedded Software

The Stellaris microcontrollers support several wireless connectivity protocols and networking software.

RF software design with Stellaris is made easy by the integration of RFID, ZigBee, *Bluetooth* and proprietary low-power radio protocols onto our DK-LM3S9D96 Development Kit and into StellarisWare®. When coupled with the DK-LM3S9D96 development

board, any wireless kit includes all of the hardware and software needed to jumpstart design, and the quickstart application included in each kit allows developers to evaluate working networks in 10 minutes or less.

[www.ti.com/stellariswireless](http://www.ti.com/stellariswireless)

### Performance

- **20-80 MHz ARM Cortex-M CPU**
- Optimized for single-cycle flash usage
- Thumb-2 ISA with high code density
- Single-cycle multiply and hardware divide
- Three power modes and battery-backed hibernation with non-volatile memory
- Integrated 32-ch DMA for ease of use & high data rate without CPU overhead

### Portfolio

- Largest ARM MCU portfolio in the world with over 160 devices
- 8KB-256KB Flash and 96KB RAM
- 10-bit, 8ch ADCs from 250ksps-1MSPS
- Up to 8 advanced PWM modules
- RTC, BOR, and integrated LDO
- Analog comparators and temp sensor
- 28 to 108 pin from SOIC to BGA

### Connectivity

- Ethernet MAC and PHY with 1588 PTP support
- USB Host, Device, or On-The-Go
- CAN 2.0 A/B with 32 mailboxes
- Integrated UART, I<sup>2</sup>C, SSI modules
- Integrated I<sup>2</sup>S master or slave
- External Peripheral Interface supporting SRAM, SDRAM, M2M, FPGA, CPLD

### Ease of Use

- IDE and compilers from industry leaders
- C-friendly development
- Low-cost development tools
- Application-specific and advanced development kits
- Production-ready application modules
- StellarisWare in ROM includes driver and peripheral libraries to ease development

Stack	Stellaris Device	Availability
SimpliciTI	Any Stellaris ≥ 16KB Flash	<a href="http://www.ti.com/simpliciti">www.ti.com/simpliciti</a>
TIMAC 802.15.4	Any Stellaris ≥ 32KB Flash	<a href="http://www.ti.com/timac">www.ti.com/timac</a>
ZigBee	Any Stellaris ≥ 128KB Flash	<a href="http://www.ti.com/z-stack">www.ti.com/z-stack</a>
Bluetooth	Any Stellaris ≥ 48KB Flash	<a href="http://www.ti.com/stonestreetone">www.ti.com/stonestreetone</a>

## Stellaris Kits

The Stellaris wireless development kits are the best way to get familiar with the Stellaris microcontroller and include all the hardware and software needed to develop a complete project. All kits include fully reprogrammable host and end-device processors for full flexibility in the wireless network configuration.

Part Number					
DK-LM3S9D96		DK-EM2-7960R	DK-EM2-2500S	DK-EM2-2520Z	DK-EM2-2560B
Key Feature	Stellaris LM3S9B96 Development Kit	13.56 MHZ RFID Kit	2.4 GHz SimpliciTI™ Kit	ZigBee Networking Kit	Stellaris 2.4GHz <i>Bluetooth</i> ® Wireless Kit
Price	\$425	\$99	\$125	\$249	\$199

# Embedded Processors for Wireless Connectivity



TI's Sitara™ ARM9™ and ARM® Cortex™-A8 processors in conjunction with TI's Wi-Fi/Bluetooth connectivity options provide the right combination of performance, power and peripherals to meet any wireless application need. Drive down system cost, simplify design and expand connectivity of your current design all while maintaining software compatibility across TI's ARM9™ and ARM® Cortex™-A8 processor portfolio.

## Key Features

- Multiple operating frequencies for optimizing power vs. performance
- 3D graphics acceleration, multiple packaging options and temperature ranges
- Pre-integrated TI connectivity solutions (Wi-Fi/Bluetooth)
- High-bandwidth connectivity peripherals such as Gigabit Ethernet, DDR2/DDR3 interfaces, CAN, PCI Express, SATA 2.0 and USB 2.0

## Applications

- Portable data terminals
- Point-of-sale
- Connected displays
- Consumer goods
- Industrial automation
- Portable navigation
- Medical
- Gaming equipment

## Development Tools

These full-featured development boards come complete with hardware, software and documentation and a wireless connectivity module to accelerate hardware/software development. Available from TI and distributors. Additional low-cost community-based boards can be obtained from numerous partners and distributors.

[www.ti.com/sitara](http://www.ti.com/sitara)

## Performance

- 200MHz ARM9 to 1.5GHz Cortex-A8
- Graphics acceleration up to 27M polygons per second
- High speed DDR2 and DDR3 memory performance

## Portfolio

- Leverage TI's extensive portfolio of embedded ARM devices to maximize your product's changing needs
- Reuse of both SW and HW design across portfolio
- Fully pin-for-pin and software compatible options across portfolio

## Performance

- Wi-Fi/Bluetooth
- Gigabit Ethernet
- SATA, CAN 2.0 and High speed USB interface
- Multiple serial ports
- Touch-screen LCD controllers
- Industrial peripheral support

## Ease of Use

- Free and easy access Linux and Android
- Application specific and advanced development kits
- Third-party RTOS ecosystem

Part Number				
AM335x – TMDXEV3358	AM37x – TMDSEVM3730	AM35x – TMDSEVM3517C	AM18x – TMDXEVWi-Fi1808L	
Description	Evaluate functionality of AM3352/3354/3356/3358 applications processor with WL1271 based Wi-Fi, 7" LCD touch screen, ENET PHY, USB connector, video connectors	Evaluate functionality of AM3703/AM3715 applications processor with WL1271 based Wi-Fi, 3.7" LCD resistive touch screen, ENET connector, USB connector, video connectors	Evaluate functionality of AM3505/3517 applications processor with WL1271 based Wi-Fi, LCD panel with resistive touch screen, hardware encryption, ENET connector, USB connector, video connectors	Evaluate functionality of AM1802/1806/1808 applications processor with WL1271 based Wi-Fi, a camera interface, touch screen LCD panel, ENET connector, video connectors, ADCs, DACs
Price	\$995	\$1495	\$999	\$1150

# Resources

## → Development Tools

TI provides development tools that enable both software and hardware designers to quickly get up and running with wireless connectivity products. The general purpose low-power RF development tools consist of three elements - the Evaluation Module, Evaluation Board and PC Tools:



### Evaluation Module (EM)

A small plug-in board with the complete reference design for the radio device, ensuring maximum performance.

### Evaluation Board (EB)

Contains sockets for the EM. Platform for testing the performance of the radio and for development of prototype software.

### PC Tools

Connect the EB to the PC and use available tools to test, configure and debug software running on the chip.

There are several types of hardware development tools.

### Development Kit (DK)

The DK contains all the hardware that is necessary to start development of an RF system. In most configurations, a development kit consists of two Evaluation Boards, two small RF modules, antennas and cables.

### Mini Development Kit (DK-MINI)

Mini Development Kits are low cost development kits that contain the basic hardware for prototyping and for developing simple demonstration applications. The kits can also be used for basic evaluation of the device.

### Evaluation Module Kit (EMK)

The EMK contains two RF modules (EM) and antennas. The EMK can be ordered separately and can be used as add-ons to existing kits, compatible motherboards or other boards with matching connectors.

### USB Dongles

Small form-factor dongles with the USB enabled System-on-Chip (SoC) and PCB antenna.

### ZigBee® and ZigBee RF4CE Development Kits

The ZigBee Development Kit (ZDK) has all the features of a development kit, but contains additional nodes for experimenting with the mesh capabilities of ZigBee. The kit is preprogrammed with a ZigBee demo application, giving you ZigBee directly out of the box.

A specific ZigBee Network Processor (ZNP) kit demonstrates the concept with a CC2530 running the Z-Stack and a small MSP430 running the application code.

To get quickly up and running with ZigBee RF4CE, there's a dedicated kit containing a fully functional remote controller, a receiver board with a multitude of connection options and a USB dongle for PC connectivity.

### Bluetooth low energy Development Kits

TI has made it easy for a fast and convenient development with Bluetooth Low Energy by the use of the CC2540DK-MINI. It contains a USB dongle and a Keyfob for rapid prototyping. Complete Evaluation Module Kits for CC2540 and CC2541 are also available.

# Resources

## → Development Tools

Device	Device Type	Development Kits	Evaluation Module Kits (Add-on boards)	Other compatible mother boards
CC1101	Transceiver sub-1 GHz	CC1101DK433 CC1101DK868-915	CC1101EMK433 CC1101EMK868-915	MSP430FG4618 Exp Board MSP430F5438 Exp Board
CC110L CC113L CC115L	Value Line Transceiver, Receiver and Transmitter	CC11xLDK868-915	CC11xLEMK-433	
CC1101-Q1 CC1131-Q1 CC1151-Q1	Automotive qualified transceiver Automotive qualified receiver Automotive qualified transmitter sub-1 GHz	CC1101DK-433 MHz CC1101DK-868/915 MHz		
CC1120	High Performance RF Transceiver for Narrowband Systems	CC1120DK	CC1120EMK169 CC1120EMK420-470 CC1120EMK868-915 CC1120EMK955	
CC1121	High Performance Low Power RF Transceiver		CC1121EMK868-915	
CC1175	High Performance RF Transmitter for Narrowband Systems		CC1175EMK868-915	
CC1110 CC1111	8051-based System on Chip sub-1 GHz	CC1110DK-MINI-868 CC1110-CC1111DK	CC1110EMK433 CC1110EMK868-915 CC1111EMK868-915 (USB dongle)	
CC430	Integrated MSP430 and CC1101 System-on-Chip	EZ430-Chronos Wireless Watch EM430F6137RF900 EM430F6147RF900 MSP-SA430-SUB1GHZ		
CC1190	PA and LNA frontend sub-1 GHz		CC1101CC1190EMK868 CC1101CC1190EMK915	
CC2500	Transceiver 2.4 GHz	CC2500-CC2550DK	CC2500EMK	MSP430FG4618 Exp Board MSP430F5438 Exp Board Stellaris DK-EM2-2500S
CC2510 CC2511	8051-based System on Chip 2.4 GHz	CC2510DK-MINI CC2510-CC2511DK	CC2510EMK CC2511EMK (USB dongle)	
CC3000-TypeVK CC3000-TiWi-SL CC3000-TypeVKEM	Wi-Fi module	CC3000FRAMEMK-M CC3000FRAMEMK-L CC3000-TIWI-SLEM	CC3000-TypeVK CC3000-TiWi-SL CC3300	MSP-EXP430F5529 MSP-EXP430F5438 MSP-EXP430FG4618 EK-LM4F232
CC4000	GPS Module	CC4000GPSEM	CC4000-TC6000GN	MSP-EXP430F5529
C2520	Transceiver IEEE 802.15.4, ZigBee PRO	CC2520DK	CC2520EMK	MSP430F5438 Exp Board Stellaris DK-EM2-2500Z
C2530	8051-based System on Chip	CC2530DK	CC2530EMK	
CC2531	IEEE 802.15.4, ZigBee PRO	Only for CC2530	CC2531EMK (USB Dongle)	
CC2533	8051-based System on Chip IEEE 802.15.4, ZigBee RF4CE	CC2533DK CC2533DK-RF4CE-BA	CC2533EMK	
CC2540 CC2541	8051-based System on Chip <i>Bluetooth®</i> low energy	CC2540DK-MINI CC2540DK	CC2540EMK CC2540EMK-USB (USB dongle), CC2541EMK	
CC2543/2544/2545	8051-based System-on-Chip	CC2543-CC2544DK	CC2545EMK	
CC2560	<i>Bluetooth v2.1 + EDR</i> module	PAN1323EMK	PAN1323EMK	MSP-EXP430F5438
CC2564	<i>Bluetooth v2.1 + EDR, Bluetooth v4.0</i> and ANT™ dual-mode	CC2567-PAN1327ANT-BTkit CC256x BTBLE-Kit		
CC257x	ANT™ network processor	ANTC7EK1 (CC257x)		
CC2590 CC2591	PA and LNA frontend 2.4 GHz		CC2520-CC2591EMK CC2530-CC2591EMK	
CC2595	PA Frontend 2.4 GHz		CC2595EMK	
CC85xx	PurePath™ Wireless Audio	CC85xxDK CC85xxDK-HEADSET		
TMS37157 TMS3705	Passive low frequency interface device 134.2kHz transceiver IC	ez430-TMS37157		
TRF796x	13.56 MHz transceiver IC	TRF796EVM	TRF7960ATB	
TRF7970A	13.56MHz NFC transceiver IC	TRF7970AEVM	TRF7970ATB	MSP-EXP430F5438, MSP-EXP430F5529
WL1271-TiWi		TMDXEV3358	TMDXWL1271COM6M	MSP-EXP430F5438, MSP-EXP430F5529
WL1271-TypeVK	Wi-Fi module	TMDSEVM3730 TMDXEVMWi-Fi1808L	TMDXWL1271LDCAM37X TMDXWL1271LDCAM18XL	

# Resources

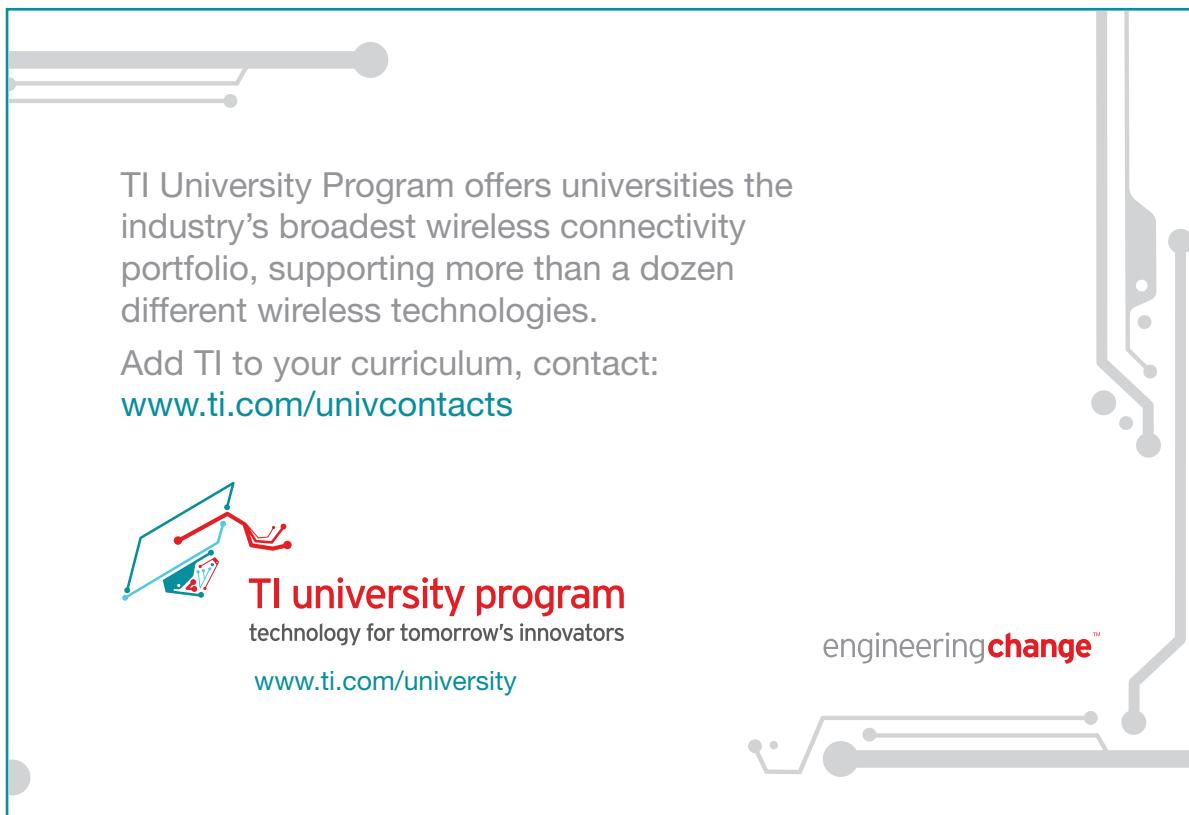
## → Development Tools

### Other Development Kits

Tool Name	Short Description
SOC-BB	General purpose battery board for LPRF EM modules. The board has EM connector sockets, break-out pins, battery holders for two AA batteries, a LED and a button.
CC-ANTENNA-DK	The Antenna Evaluation Kit can be used as a reference for various antenna designs and for testing the performance that can be achieved. This kit contains an A4 sized PCB panel with 16 different boards; 13 antenna designs and 3 boards for calibration purposes. The frequency range of the antennas is from 136 MHz to 2480 MHz.
CC-DEBUGGER	Low-cost debugger probe and programming tool for CCxxxx 8051-based System-on-Chip (SoC) and for programming of devices in the CC85XX family. Can be used together with SmartRF Studio, SmartRF Flash Programmer, PurePath Wireless Configurator and IAR Embedded Workbench for 8051.
eZ430-RF2560	Low-cost demonstration and evaluation tool with CC2560 and MSP430BT5190
AM37x / DM37x	WL1271-TiWi (WLAN/Bluetooth) connectivity card pre-integrated with AM/DM37x processor evaluation module
AM18x / OMAPL138	WL1271-TiWi (WLAN/Bluetooth) connectivity card pre-integrated with AM18x/OMAPL138 processor evaluation module
AM335x	WL1271-TypeTN (WLAN/Bluetooth) connectivity card pre-integrated with AM335x processor evaluation module
TMDXWL1271COM6M	WL1271-TypeTN (WLAN/Bluetooth) connectivity card available as aftermarket DM814x processor evaluation module
430BOOST - CC110L	CC110L BoosterPack for MSP430 LaunchPad
CC1180 - 6LoWPAN - DK868	Complete CC-6LOWPAN-DK-868 system development kit including IPv6 to 6LoWPAN gateway

### Related PC Tools

Tool Name	Short Description
SmartRF™ Studio	Application for controlling the RF ICs from the PC and to find appropriate register settings for the radio.
SmartRF™ Packet Sniffer	Simple packet sniffer application. Communicates with an evaluation board with a radio that captures packets on the specified channel. The sniffer GUI parses and displays the packets.
SmartRF™ Flash Programmer	Use this application to program hex files on the System on Chips or to update the firmware on the Evaluation Boards.
PurePath™ Wireless Configurator	Use this graphical PC tool for configuring and programming of CC85xx devices
PurePath™ Wireless Commander	Run tests for evaluating performances of CC85xx devices



## → Development Tools

### Frequently Asked Questions

#### What can I do with a DK?

In most configurations, a development kit consists of two Evaluation Boards, two small RF modules, antennas and cables. When the RF modules are connected to the Evaluation Board, it is possible to control the radio from the PC using SmartRF Studio. Most of the development kits also come preprogrammed with a Packet Error Rate test application, which makes it easy to perform practical range testing with the radios. In addition, the development kits are flexible platforms and it is easy to connect your own peripherals and controllers to break-out pins on the boards. The development kit would also serve as a known good platform during test and verification of your own system. For development kits with system-on-chips (SoC), the evaluation boards make it possible to debug and program the chip with no additional hardware. The kit also gives access to useful user interfaces for testing of the various peripherals and capabilities of the SoC. The hardware in the kit can also be used as a packet sniffer.

#### What is the purpose of the EMK?

The Evaluation Module (EM) is exactly the same piece of hardware that is being used in characterization of the radio, and you will get datasheet performance from these boards. The EMK can be ordered separately and can be used as add-ons to existing kits, compatible motherboards or other boards with matching connectors. The modules are equipped with two 2x10 sockets from Samtec (SFM-110-02-SM-D-A-K-TR) matched with headers from Samtec (TFM-110-02-SM-D-A-K-TR).

#### Why do I need the Evaluation Board?

The Evaluation Board (EB) is a flexible test and development platform. It makes it easy to perform basic functional RF tests.

For example:

- Connect the EB to your hardware to test your own RF design (running tests from SmartRF Studio)
- Use SmartRF Studio + EB + EM to send packets that are received by your own system
- Use your own system to send packets and receive the packets using SmartRF Studio + EB + EM

Thus, you can easily verify the behavior of either your own software or your own hardware, eliminating multiple error sources and reducing the time it takes to debug and test an RF system.

#### What is the MSP430 Experimenter's Board?

The MSP430 Experimenter's Boards are versatile development boards for MSP430 with a lot of external peripherals, making it easy to experiment and make prototypes to explore the many features of the MSP430 peripherals. These boards are also equipped with connectors for the RF Evaluation Modules. Note that due to the pin out of the connectors, only a subset of the Evaluation Modules can be used with the boards. You will find schematics, software examples and application notes for the experimenter's boards on the MSP430 development tools web pages.

#### Are the MSP430 Experimenter's Boards compatible with SmartRF Studio?

No

#### How do I adopt WLAN/Bluetooth®?

TI has created platforms which are pre-integrated, fully validated, and documented solutions to remove the obstacles of wireless design. Platforms provide complete system integration of all components including WLAN and Bluetooth hardware, firmware, low-level drivers, stacks, profiles, and sample source applications. Platforms have also been optimized for reduced system level power consumption and higher throughput. A full suite of detailed user guides, developer guides, datasheets, and extensive FAQs are included.

#### Where can I go to learn more about WLAN and Bluetooth tools?

[www.ti.com/connectivitywiki](http://www.ti.com/connectivitywiki)

#### Why modules?

Customers greatly benefit from validated RF modules which help reduce development time, lower manufacturing costs, improve PCB yield, decrease board space, ease certification, and minimize RF expertise required.

#### What is the difference between the DK-EM2-2500S and the DK-EM2-2520Z?

The DK-EM2-2500S is a kit tailored to work with the SimpliciTI software. It communicates using the CC2500EM but also comes with compatible software for the CC1101 as well as the CC2420. The DK-EM2-2500Z is a kit tailored to work with the ZigBee software. It uses the CC2520 to communicate with two re-programmable CC2530 battery boards.

## → Software

In addition to the comprehensive hardware portfolio, TI provides a wide range of supporting tools and software stacks:

### SimpliciTI™ Network Protocol [www.ti.com/simpliciti](http://www.ti.com/simpliciti)

SimpliciTI is a simple low-power RF network protocol aimed at small (<256 nodes) RF networks. Such networks typically contain battery operated devices, which require long battery life, low data rate and low duty cycle. They usually have a limited number of nodes talking directly to each other or through an access point or a range extender. Access points and range extenders are not required, but provide extra functionality such as storing and forwarding messages. With SimpliciTI the MCU resource requirements are minimal which results in a low system cost.

SimpliciTI was designed for easy implementation and out-of-the-box deployment on several TI RF platforms such as the MSP430™ family of low-power MCUs and the CC11xx/CC25xx transceivers and SoCs.

The latest update to SimpliciTI has extended the stack to include auto-acknowledgement, encryption, and dynamic network commissioning/decommissioning features. These additions increase the overall capabilities of SimpliciTI and broaden the scope of applications to which SimpliciTI can be applied. With the flexibility of SimpliciTI to ride on top of many forms of modulation, SimpliciTI is uniquely qualified to work as a basis for extending many existing proprietary formats.

SimpliciTI also supports the narrow band versions of TI's radios in the 2.4GHz and sub 1GHz bands.

### TIMAC – IEEE 802.15.4 medium access control software stack [www.ti.com/timac](http://www.ti.com/timac)

TIMAC is ideal when you need a wireless point-to-point or point-to-multipoint solution based on a standard (e.g. multiple sensors reporting directly to a master).

#### **TIMAC is:**

- A standardized wireless protocol for battery powered and/or mains powered nodes
- Support for acknowledgement and retransmission
- Suitable for applications with low data-rate requirements (about 100 kbps effective data rate)
- Support for IEEE 802.15.4-2003
- Support for IEEE 802.15.4-2006
- Multiple platforms
- Easy application development
- Easy porting

TIMAC is distributed as object code free of charge. There are no royalties for using TIMAC.

### RemoTI™ – ZigBee® RF4CE/EEE [www.ti.com/remoti](http://www.ti.com/remoti)

RemoTI is the industry leading RF4CE-compliant software architecture. Built on TI's well proven IEEE 802.15.4 compliant TIMAC, RemoTI offers a simple, easy-to-use, intuitive software architectural framework and all of the tools, documentation, and support needed to build an RF4CE compliant product. RemoTI allows you to reduce development time and cost, and enables a quick time to market. RemoTI supports the CC2530, CC2531 and CC2533 platforms.

### Z-Stack™ – ZigBee protocol stack [www.ti.com/z-stack](http://www.ti.com/z-stack)

Z-Stack is compliant with the ZigBee 2007 (ZigBee and ZigBee PRO) specification. It is the perfect way to bring the power of mesh network connectivity to any application. Z-Stack supports multiple platforms including the CC2530 System-on-Chip (SoC), CC2531 SoC, CC2520 + MSP430 platform and CC2520 + Stellaris® platform. They are all certified as ZigBee Compliant Platforms.

#### **Z-Stack is:**

- Robust and reliable (it was one of the first ZigBee stacks to be certified)
- Flexible (it offers APIs at different levels and enable several architectures, including network processor)
- Interoperable (it supports ZigBee Smart Energy and ZigBee Home Automation public profiles)

### BLEstack - Bluetooth® low energy protocol stack [www.ti.com/blestack](http://www.ti.com/blestack)

TI's *Bluetooth* low energy (BLE) solution includes all necessary software to get started on the development of single-mode *Bluetooth* low energy applications using the CC2540 system-on-chip. It includes object code with the BLE protocol stack, a sample project and applications with source code, and BTool, a Windows PC application for testing *Bluetooth* low energy applications. In addition to the software, the kit contains documentation, including a developer's guide and BLE API guide.

# Resources

## Software

### Protocol Stack

Name	Description	Web link
SimpliciTI™ Network Protocol	SimpliciTI is a simple low-power RF network protocol aimed at small RF networks	<a href="http://www.ti.com/simplicity">www.ti.com/simplicity</a>
TIMAC	IEEE 802.15.4 medium access control software stack	<a href="http://www.ti.com/timac">www.ti.com/timac</a>
Z-Stack™ Software	ZigBee® protocol stack	<a href="http://www.ti.com/z-stack">www.ti.com/z-stack</a>
RemoTI™ Software	ZigBee RF4CE protocol stack	<a href="http://www.ti.com/remoti">www.ti.com/remoti</a>
BLEstack	<i>Bluetooth</i> ® low energy protocol stack	<a href="http://www.ti.com/blestack">www.ti.com/blestack</a>
Bluetooth® Stack	Stonestreet One Bluetopia Bluetooth® Stack	<a href="http://www.ti.com/stonestreetone">www.ti.com/stonestreetone</a>
AM37x Linux SDK	Linux Open-Source Wi-Fi & BlueZ Bluetooth® Stack, Drivers & Demos	<a href="http://processors.wiki.ti.com/index.php/AM37x_release_download_page">processors.wiki.ti.com/index.php/AM37x_release_download_page</a>
DM37x Linux SDK	Linux Open-Source Wi-Fi & BlueZ Bluetooth® Stack, Drivers & Demos	TBD
AM18x Linux SDK	Linux Open-Source Wi-Fi & BlueZ Bluetooth® Stack, Drivers & Demos	<a href="http://processors.wiki.ti.com/index.php/AM18x_release_download_page">processors.wiki.ti.com/index.php/AM18x_release_download_page</a>
OMAPL138 Linux SDK	Linux Open-Source Wi-Fi Stack, Drivers & Demos	<a href="http://processors.wiki.ti.com/index.php/OMAPL138_DVSDK_download_page">processors.wiki.ti.com/index.php/OMAPL138_DVSDK_download_page</a>
AM335x Linux SDK	Linux Open-Source Wi-Fi & BlueZ Bluetooth® Stack, Drivers & Demos	<a href="http://processors.wiki.ti.com/index.php/AM335x_release_download_page">processors.wiki.ti.com/index.php/AM335x_release_download_page</a>
AM37x Android ADK	Wi-Fi & <i>Bluetooth</i> ® support integrated with Android Framework	<a href="http://processors.wiki.ti.com/index.php/AM37x_release_download_page">processors.wiki.ti.com/index.php/AM37x_release_download_page</a>
AM335x Android ADK	Wi-Fi & <i>Bluetooth</i> ® support integrated with Android Framework	<a href="http://processors.wiki.ti.com/index.php/AM335x_release_download_page">processors.wiki.ti.com/index.php/AM335x_release_download_page</a>

### Software Tools/Resources

Name	Description	Web link
SmartRF™ Studio	Applications for controlling the RF ICs from the PC and to find appropriate register settings for the radio	<a href="http://www.ti.com/smartrfstudio">www.ti.com/smartrfstudio</a>
SmartRF™ Packet Sniffer	Sample packet sniffer application. Communicates with an evaluation board with a radio that captures packets on the specified channel. The sniffer GUI parses and displays the packets.	<a href="http://www.ti.com/packetsniffer">www.ti.com/packetsniffer</a>
SmartRF™ Flash Programmer	Use this applications to program hex files on the System-on-Chip (SoC) or to update the firmware on the Evaluation Boards	See tool folder of your preferred SoC part
Example Libraries	The example libraries include the most basic functionality needed to establish a link between two devices	See tool folder of your preferred SoC part
USB Libraries	USB interface libraries for devices with built-in USB interface (CC2511, CC1111, CC2531)	See tool folder of your preferred SoC part
MSP430 Code Library for Low-Power RF	The code library provides functions to facilitate the interfacing of an MSP430 MCU to CC1100/2500 RF IC	<a href="http://www.ti.com/ccmsplib">www.ti.com/ccmsplib</a>
PurePath™ Wireless Configurator	Use this graphical PC tool for programming of CC85xx devices	<a href="http://www.ti.com/ppwc">www.ti.com/ppwc</a>
PurePath™ Wireless Commander	Run tests for evaluating performances of CC85xx devices	See tool folder of your preferred SoC part
SimpleLink™ CC4000 GPS Drivers	Firmware and demosoftware for out-of-the-box experience demo	<a href="http://www.ti.com/tool/cc4000gpsem">www.ti.com/tool/cc4000gpsem</a>
SimpleLink™ CC3000 Wi-Fi Sample Applications	Sample Applications drivers using TI's SimpleLink CC3000 Wi-Fi solution.	<a href="http://www.ti.com/tool/cc3000-platform">http://www.ti.com/tool/cc3000-platform</a>

### Low-Power RF Application Notes and Design Notes

Low-Power RF can provide you with more than 100 application notes and design notes. Find them on the Wireless Connectivity products webpages in the related litterature. You will then get device

specific documentation. To access any of the application notes and design notes, type the URL: [www.ti.com/wirelessconnectivity](http://www.ti.com/wirelessconnectivity) and then go to the documents tab and use the search engine to find the right information you need.

# Resources

## → Low-Power RF Developer Network

The TI Low-Power RF Developer Network is a worldwide community of respected, experienced, and well established companies servicing the low-power RF market in the sub-1 GHz and 2.4-GHz ISM frequency bands.

This network consists of recommended companies, RF consultants and independent design houses that provide scalable projects

from antenna circuit-board layout to turnkey system design and FCC or ETSI compliance testing.

### Benefits include:

- A faster design-to-production schedule and experience with the TI Low-power RF product portfolio
- RF circuit, low-power RF and ZigBee design services
- Low-Power RF and ZigBee module solutions
- Development tools for testing and troubleshooting RF systems

- RF certification services and RF circuit manufacturing
- Online search tool to determine suitable RF development partners

To find a suitable partner for your design and test project go to:

[www.ti.com/lprfnetwork](http://www.ti.com/lprfnetwork)

### Are you interested in becoming a TI development partner?

Send an email to [m.grazier@ti.com](mailto:m.grazier@ti.com) for more information.

## Featured third party developers

### Europe

#### Amber Europe:

Amber Wireless GmbH is a German electronics company specializing in the design, manufacturing and marketing of compact short range radio modules and modems for rapid implementation of cable-free data links and have become one of the leading suppliers for ISM/SRD radio modules and radio modems in Europe.

#### Wireless connectivity ICs:

CC430, CC1101, CC2520, CC2530

#### Contact details:

Contact: Wolfgang Esch  
Email: [wolfgang.esch@amber-wireless.de](mailto:wolfgang.esch@amber-wireless.de)  
Phone: 0049-2203-6991950  
URL: <http://www.amber-wireless.de/>

#### Radiocrafts:

Radiocrafts designs, manufactures and markets standard RF modules for operation in the license-free ISM bands at 315 / 433 / 429 / 868 / 915 MHz and 2.4 GHz.

#### Low-Power RF ICs:

CC2420, CC1020, CC2430, CC2431, CC2400, CC1000, CC2530

#### Contact details:

Contact: Peder Martin Ejven  
Email: [radiocrafts@radiocrafts.com](mailto:radiocrafts@radiocrafts.com)  
Phone: (+47) 4000 5195  
URL: <http://www.radiocrafts.com>

#### Sensinode 6LowPAN:

Sensinode is the pioneer IP-based wireless sensor network solution provider and offers seamless internet integration to embedded device and chip manufacturers through all industries on a worldwide level.

#### Wireless connectivity ICs:

CC2430, CC1100, CC1110

#### Contact details:

Phone: +358 10 387 8680  
URL: [www.sensinode.com](http://www.sensinode.com)

### United States

#### LS Research:

L.S. Research provides complete design services for product development including embedded firmware, RF design, antenna design, analog/digital design, PCB layout, and prototyping. L.S. Compliance provides FCC, CE, and ETSI testing services.

#### Wireless connectivity ICs

CC2530, CC2500, CC2550, CC2510, CC1100, CC1110, CC2511, CC256x, CC1020, CC2520/MSP430, WL1271-TiWi, CC3000-TiWi

#### Contact details:

Contact: Bill Steinike  
Email: [bsteinike@lsr.com](mailto:bsteinike@lsr.com)  
Phone: 262-375-4400 ext.103  
URL: <http://www.lsr.com/>

#### Anaren

Anaren (Nasdaq: ANEN) is a US-based global innovator of microwave/RF technology for the space, defense, wireless infrastructure, and consumer electronics sectors. As part of TI's Low-power RF network, the company offer its Anaren Integrated Radio (AIR) module family – compact, pre-certified, SMT radio modules eOEMs can quickly and cost-effectively implement without deep RF expertise and operate at 433MHz, 868MHz, 900MHz, and 2.5GHz. (AIR-equipped test boards available for use with TI EZ430 and DK tools.)

#### Wireless connectivity ICs:

CC1101, CC2500, CC8520 PurePath™ uncompressed wireless audio w/ CC2591 range extender; test boards

#### Contact details:

Contact: Mark Bowyer  
Email: [mbowyer@anaren.com](mailto:mbowyer@anaren.com) or [AIR@anaren.com](mailto:AIR@anaren.com)  
Phone: Toll free in US: 800.411.6596 or 44-2392-232392 (in Europe)  
URL: [www.anaren.com](http://www.anaren.com)

#### Awarepoint:

Awarepoint is providing its Real-Time Awareness Solutions® to healthcare clients that include prestigious teaching institutions, premiere independents, military facilities and members of major integrated delivery networks.

#### Wireless connectivity ICs:

CC2430, CC2431

#### Contact details:

Toll-Free: 1-888-860-FIND (888-860-3463)  
Phone: (858) 345-5000  
URL: [www.awarepoint.com](http://www.awarepoint.com)

#### Panasonic:

Panasonic Electronic Components provides powerful, highly flexible, cost effective RF modules for a wide variety of wireless Personal Area Network applications, while also specializing in contract manufacturing and design services.

#### Wireless connectivity ICs

CC2560-PAN1325/15, CC2564-PAN1326/16  
CC2567-PAN1327/17

#### Contact details:

URL: <http://www.panasonic.com/ti>

#### Pacific Design Engineering:

PDE provides complete product design services including; Wi-Fi applications development, Android and iOS development, RF design, antenna design, embedded firmware, microcontroller design, analog/digital design, mechanical and industrial design, PCB layout, and prototyping.

#### Wireless connectivity ICs:

SimpleLink Wi-Fi CC3000, CC2400, CC2500, CC2520/MSP430, CC2530, CC2540, CC2541, CC2591, CC8520 PurePath™ CC1100, CC1110, CC1111, CC1190, CC430

#### Contact details:

Contact: Derek Pyner  
Email: [pyner@pde.com](mailto:pyner@pde.com)  
Phone: (604) 421 1311 ext 20  
Toll Free (800) 561 3322  
URL: <http://www.pde.com>

#### Global Navigation systems GNS – GmbH:

GNS-GmbH is a German electronics company. GNS production complies with ISO 9001. GNS provides complete design services, software IP, RF design, PCB layout , prototyping, testing and manufacturing of GPS only and GPS combo modules. GNS also provides Software IP for GPS, BT, BLE, and FM / TMC based on different OS like Android, Linux, Windows, WIN CE

#### Wireless connectivity ICs:

CC4000, NL5500, NL5500L, MSP430

#### Contact details:

Contact: Werner Koch  
Email: [w.koch@gns-gmbh.com](mailto:w.koch@gns-gmbh.com)  
Phone: 0049-2405-4148-16  
URL: <http://www.gns-gmbh.com>

#### Murata:

Murata is a global leader in the manufacture of electronic components including wireless connectivity modules. Wireless modules are world class in terms of size, production capacity, and quality.

#### Wireless connectivity ICs

WL127x, WL128x, WL18xx, CC2560, CC3000

#### Contact details:

Email: [modules@murata.com](mailto:modules@murata.com)  
URL: [www.murata-ws.com](http://www.murata-ws.com)

# Resources

## → TI E2E™ Online Community

TI's Online Community has been created to provide you with technical support forums, videos and blogs, and the chance to openly and freely interact with fellow engineers.

**With the Online Community you can:**

- **Exchange** ideas, share knowledge and ask questions
- **View** our latest videos covering basic knowledge to deep technical content
- **Interact** with fellow engineers from all over the world

The screenshot shows the TI E2E Online Community homepage. At the top, there's a navigation bar with links for Products, Applications, Design Support, Sample & Buy, All Searches, Search by Keyword, and Search by Part Number. Below the navigation is a search bar and a sign-in link. The main content area is titled "TI E2E™ Community" and includes links for Support Forums, Videos, Blogs, and Groups. On the left, there's a sidebar with a "Support" section containing links for Amplifiers, Applications, ARM® & DSP Microprocessors, Clocks & Timers, Data Converters, Development Tools, DLP & MEMS (Micro-Electro-Mechanical Systems), Embedded Software, Interface, Logic, Low Power RF, Microcontrollers, Power Management, RF & Digital Radio, Other Analog, University Zone, E2E News and Site Support. Below that is a "News and Announcements" section with a message about the community moving to a new location. The right side features a "Community Activity" feed with posts from users like Stellaris, Geoff, Thomas, Bob, Martin, and others. It also includes a "Design Something.org" sidebar and a "Videos" section with a thumbnail for a video titled "eTech Day Dec. 8, 2010".

## Join the E2E Online Community

This is an advertisement for the TI E2E Online Community. It features a large call-to-action button with the text "Share, explore and solve challenges with fellow engineers and Tiers" and "Join the TI E2E™ Community". Below this is the website address "e2e.ti.com". To the right, there's a graphic of two people talking and a smaller image of a document with the text "TI E2E™ Community engineer.to.engineer, solving problems".

# Resources

## → TI Connectivity Wiki

[http://processors.wiki.ti.com/index.php/Wireless\\_Connectivity\\_Platforms](http://processors.wiki.ti.com/index.php/Wireless_Connectivity_Platforms)

TI's Wireless Connectivity Wiki provides the latest and most comprehensive technical information needed to begin developing a wireless application.

**With the Wireless Wiki you can:**

- ▶ **Discover** User guides, sample applications, software
- ▶ **Learn** about the diverse catalog of available platforms
- ▶ **Clarify** your understanding with support links for all wireless technologies

## Wireless Connectivity Platforms

[Wireless Connectivity Platforms](#)

Translate this page to [de - Deutsch](#)

Welcome to the  
Wireless

Connectivity

wiki! Here you can find information and materials on the wireless solutions that [Texas Instruments](#) has to offer. For information on specific wireless platforms visit their individual wikis by clicking the links below in the Platforms section. For further information and support be sure to visit TI's [E2E Community](#) forums.

### Contents [hide]

- [1 Overview](#)
- [2 Platforms](#)
  - [2.1 SimpleLink Wi-Fi](#)
  - [2.2 SimpleLink GPS](#)
  - [2.3 SimpleLink 6LoWPAN](#)
  - [2.4 Wi-Fi and Bluetooth](#)
  - [2.5 Bluetooth](#)
  - [2.6 ANT and Bluetooth](#)
  - [2.7 Zigbee](#)
  - [2.8 SimpliciTI](#)
- [3 Links](#)



All TI Wireless Connectivity  
Platforms carry FCC/C/CE  
certifications

## Overview

With the industry's broadest wireless connectivity portfolio, [Texas Instruments](#) offers cost-effective, low-power solutions for short range, long range, mesh and IP networks, personal area networks, locationing, as well as mobile handset connectivity and ISM band. TI's wireless connectivity technologies include [Wi-Fi®](#), [Bluetooth®](#) technology, [Bluetooth Low Energy](#) technology, [ANT™](#), and [Zigbee®](#). Paired with an extensive selection of support collateral such as development tools, technical documentation, reference designs, application expertise, and third party programs, TI's solutions simplify design and speed time to market.

# Resources

## Product Comparison Guide

	Wi-Fi®/IEEE 802.11				ZigBee®/IEEE 802.15.4			6LoWPAN	
Features/ Product	CC3000 TiWi-SL	CC3000 TypeVK	WL1271-TiWi	WL1271- TypeTN	CC2520	CC2538	CC2530/CC2531	CC1180RSPR	CC1180RSPT
Product type	WLAN transceiver module	WLAN transceiver module	WLAN/ Bluetooth transceiver module	WLAN transceiver module	Transceiver	SOC	SoC	Network Processor	Network Processor
Programmable frequency, MHz	2412 to 2472	2400 to 2483.5	2412 to 2472 (WLAN) 2402 to 2480 (Bluetooth)	2412 to 2472 (WLAN) 2402 to 2480 (Bluetooth)	2394 to 2507	2400 to 2483	2400 to 2483	300 to 348 MHz 391 to 464 MHz 782 to 928 MHz	300 to 348 MHz 391 to 464 MHz 782 to 928 MHz
Frequency resolution			5 MHz	5 MHz	1 MHz	1MHz	1 MHz		
Operating supply voltage	2.9V to 3.6V	2.7V to 3.6V	3 to 4.8 V	2.7 to 4.8V	1.8 to 3.8 V	2.0 to 3.6V	2.0 to 3.6 V	2.0 to 3.6	2.0 to 3.6
Current consumption (RX)	—	—	—	—	18.5 mA	19ma	24 mA		
Current consumption (TX, 0dBm)	—	—	—	—	25.8 mA	0dBm 24ma	29 mA		
Data rate (max)	54 Mbps	54 Mbps	65 Mbps	65 Mbps	250 kbps	250kbps	250 kbps	200kbs	200kbs
Receiver sensitivity	-85 dBm (802.11 b, 11Mbps) -75 dBm (802.11g, 54Mbps)	-88 dBm (802.11 b, 11Mbps) -74 dBm (802.11g, 54Mbps)	-89 dBm (802.11b, 11 Mbps), -73 dBm (802.11n, 65 Mbps)	-88 dBm (802.11 b, 11 Mbps), -70 dBm (802.11n, 65 Mbps)	-98 dBm	-97dBm at PER<1%	-97 dBm at PER <1%	-101dBm at 50kbps	-101dBm at 50kbps
Transmit power (up to)	+20 dBm (802.11 b, 11b)  +16.9 dBm (802.11g, 54g)	+19.5 dBm (802.11 b, 11b)  +15 dBm (802.11g)	+20 dBm (802.11b), +12.5 dBm (802.11n)	+20 dBm (802.11b), +14.5 dBm (802.11n)	+5 dBm	7.3dBm	+4.5 dBm	12dBm	12dBm
Multi-channel systems	OFDM and DSSS	OFDM and DSSS	OFDM and DSSS	OFDM and DSSS	DSSS	DSSS	DSSS		
RSSI output	—	—	—	—	Digital	Digital	Digital		
Integrated bit synchronizer	—	—	✓	✓	✓	✓	✓		
Integrated packet handling	—	—	✓	✓	✓	✓	✓		
Data buffering	✓	✓	✓	✓	128 bytes TX 128 bytes RX	128 TX 128 RX + DMA	128 TX 128 RX + DMA		
Internal RF switch/IF Filter	✓	✓	✓	✓	✓	✓	✓		
RF chip interface	—	—	—	—	Differential	Differential	Differential	Differential	Differential
Package type	21mm x 14 mm x 2.8mm	16.5 x 11.5 x 2.2 mm <sup>3</sup>	Surface mount: 13x18x1.9 mm <sup>3</sup>	17x10x2.2	QLP-48 7x7 mm	8x8 QFN56	QFN-40 6x6 mm	QFN-36, 6x6	QFN-36, 6x6
Integrated MCU	—	—	—	—	—	✓	✓	yes	yes
IEEE 802.15.4 compliant	—	—	—	—	✓	✓	✓	—	—
USB	—	—	—	—	—	—	—	no	no
AES encryption/authentication	✓	—	✓	✓	✓	✓	✓	yes	yes
Program memory	—	—	✓	✓	—	128/256/512K	32/64/128 256-kB Flash	—	—
Data memory	—	—	—	—	768 bytes	32k	8-kB SRAM	—	—

# Resources

## Product Comparison Guide

	Bluetooth®						ANT™	ZigBee® RFCE
Features/Product	CC2560	CC2564	CC2540	CC2541	CC2564-PAN1326	CC257x	CC2533	
Product type	Bluetooth transceiver	Bluetooth/BLE or Bluetooth/ANT transceiver	System-on-Chip	System-on-Chip	BT/BLE transceiver	Network Processor	SoC	
Programmable frequency, MHz	2402 to 2480	2402 to 2480	2400 to 2483 MHz	2379 to 2496 MHz	2402 to 2480	2400 to 2507	2400 to 2483	
Frequency resolution	1 MHz	1 MHz	2 MHz	1 MHz	1 MHz	1 MHz	1 MHz	
Operating supply voltage	1.7 to 4.8 V	1.7 to 4.8 V	2.0 to 3.6 V	2.0 to 3.6 V	1.7 to 4.8	2.0 to 3.6 V	2.0 to 3.6 V	
Current consumption (RX)	—	—	19.6mA	17.9 mA	—	22mA	25 mA	
Current consumption (TX, 0dBm)	—	—	27mA	18.2 mA @ 0dBm	—	26mA	29 mA	
Data rate (max)	2.1 Mbps	2.1 Mbps	1 Mbps	2 Mbps	1 Mbps	1 Mbps	250 kbps	
Receiver sensitivity	-91 dBm at PER <1%	-91 dBm at PER <1%	-93 dBm	-94 dBm@ 1Mbit	-93 dBm	-88 dBm	-97 dBm at PER <1%	
Transmit power (up to)	+10 dBm	+10 dBm	+4dBm	0dBm	+10 dBm	0dBm	+4.5dBm / +7dBm	
Multi-channel systems	FHSS	FHSS	FHSS	FHSS	FHSS	Frequency Agile	DSSS	
RSSI output	✓	✓	Digital	✓	✓	Digital	Digital	
Integrated bit synchronizer	✓	✓	✓	✓	✓	✓	✓	
Integrated packet handling	✓	✓	✓	✓	✓	✓	✓	
Data buffering	✓	✓	DMA	✓	✓	Yes	128 TX 128 RX + DMA	
Internal RF switch/IF Filter	✓	✓	✓	✓	✓	✓	✓	
RF chip interface	—	—	Differential	—	—	Differential	Differential	
Package type	QFN and surface mount modules	QFN and surface mount modules	QFN-40 6x6 mm	VQFN-40, 6x6	Surface mount module, integrated antenna: 9 x 9.5 x 1.8mm <sup>3</sup>	QFN-40 6x6 mm	QFN-40 6x6 mm	
Integrated MCU	—	—	✓	yes	—	✓	✓	
IEEE 802.15.4 compliant	—	—	—	—	—	—	✓	
USB	—	—	✓	no	—	—	—	
AES encryption/authentication	—	—	✓	yes	✓	✓	✓	
Data memory	✓	✓	128/256-kB Flash	8kB RAM	✓	—	32/64/96-kB Flash	
Program memory	—	—	8-kB SRAM	128/256kB FLASH	—	—	4/6-kB SRAM	

# Resources

## → Product Comparison Guide

	PurePath™ Wireless Audio	Proprietary RF Sub-1GHz						
Features/Product	CC8520/CC8530/ CC8521/CC8531	CC430	CC1100E	CC1101	CC1101-Q1	CC1110	CC1111	CC1131-Q1
Product type	Network Processor	SoC	Transceiver	Transceiver	UHF sub-1-GHz transceiver	SoC	SoC	UHF Sub-1-GHz receiver
Programmable frequency	2400 to 2483	300 to 348 MHz 387 to 464 MHz 779 to 928 MHz	470 to 510 MHz 950 to 960 MHz	300 to 348 MHz 387 to 464 MHz 779 to 928 MHz	310-348W 420-450 779-928	300 to 348 MHz 391 to 464 MHz 782 to 928 MHz	300 to 348 MHz 391 to 464 MHz 782 to 928 MHz	310-348 420-450 779-928
Frequency resolution	4 MHz	—	—	—	~400Hz	—	—	~400Hz
Supply voltage	2.0 to 3.6 V	1.8 to 3.6 V	1.8 to 3.6 V	1.8 to 3.6 V	1.8-3.6V	2.0 to 3.6 V	3.0 to 3.6 V	1.8-3.6V
Current consumption (RX)	25mA (receive stereo audio)	15 mA	15.5 mA	15.0 mA	15.5 mA in Receive Mode, 1.2 kBaud, 315 MHz	17 mA	17 mA	15.5 mA in Receive Mode, 1.2 kBaud, 315 MHz
Current consumption (TX, OdBm)	29mA (transmit stereo audio)	15 mA	16.6 mA	14.7 mA		20 mA	20 mA	
FSK data rate (max)	5Mbps	500 kbps	500 kbps	600 kbps	250kbaud	500 kbps	500 kbps	250kbaud
Modulation format	Shaped 8FSK, shaped 2FSK	FSK/GFSK/ MSK/OOK/ ASK	FSK/GFSK/ MSK/OOK/ASK	FSK/GFSK/ MSK/OOK/ASK	FSK/GFSK/ MSK/OOK/ ASK	FSK/GFSK/ MSK/OOK/ ASK	FSK/GFSK/ MSK/OOK/ ASK	FSK/GFSK/ MSK/OOK/ ASK
Receiver sensitivity (FSK)	-86dBm @ 2Mbps	-111	-112 dBm	-111 dBm	-114 dBm	-111 dBm	-111 dBm	-114 dBm
Transmit power (up to)	4dBm	+12 dBm	+11 dBm	+12 dBm	-30 to +12 dBm	+12 dBm	+12 dBm	—
Multi-channel systems/ frequency hopping protocols		✓	✓	✓	FHSS	✓	✓	FHSS
RSSI output		Digital	Digital	Digital	Digital	Digital	Digital	Digital
Integrated bit synchronizer		✓	✓	✓	✓	✓	✓	✓
Internal RF switch/IF filter		✓	✓	✓	✓	✓	✓	—
Antenna connection		Differential	Differential	Differential	Differential	Differential	Differential	Differential
Package type	QFN-40, 6x6	VQFN-48/ VQFN-64	QLP-20	QLP-20	QFN-32, 5x5 (RHB)	QLP-36	QLP-36	QFN-32, 5x5 (RHB)
Narrow band (12.5/25 kHz)	no	—	—	—	—	—	—	—
Integrated MCU	yes	✓	—	—	—	✓	✓	—
USB	CC8520/CC8530: no, CC8521/CC8531: yes	—	—	—	—	—	✓	—
AES encryption/ authentication	no	✓	✓	—	—	✓	✓	—
Program memory	24kB RAM	8/16/32-kB Flash	—	—	—	8/16/32-kB Flash	8/16/32-kB Flash	—
Data memory	32kB FLASH	2/4-kB SRAM	1/2/4-kB SRAM	—	—	1/2/4-kB SRAM	1/2/4-kB SRAM	—

# Resources

## Product Comparison Guide

Proprietary RF Sub-1GHZ									
Features/Product	CC1150	CC1151-Q1	CC1190	CC1120	CC1121	CC1125	CC1175	CC1200	CC115L
Product type	Transmitter	UHF Sub-1-GHz transmitter	Frontend	Transceiver	Transceiver	Transceiver	Transmitter	Transceiver	Transmitter
Programmable frequency	300 to 348 MHz 400 to 464 MHz 800 to 928 MHz	310-348 420-450 779-928	850 to 950 MHz	164 to 192 MHz 410 to 480 MHz 820 to 960 MHz	164 to 192 MHz 410 to 480 MHz 820 to 960 MHz	164 to 192 MHz 274 to 320 MHz 410 to 480 MHz 820 to 960 MHz	164 to 192 MHz 410 to 480 MHz 820 to 960 MHz	410 to 480 MHz 820 to 960 MHz	"300 to 348 MHz 387 to 464 MHz 779 to 928 MHz
Frequency resolution	—	~400Hz	—	6-30Hz	6-30Hz	6-30Hz	6-30Hz	—	397-412Hz
Supply voltage	1.8 to 3.6 V	1.8-3.6V	2.0 to 3.7 V	2.0 to 3.6	2.0 to 3.6	2.0 to 3.6	2.0 to 3.6	2.0 to 3.6	2.0 to 3.6
Current consumption (RX)	—	—	Adds 3.0 mA	17mA / 2mA sniff mode	17mA / 2mA sniff mode	17mA / 2mA sniff mode	17mA / 2mA sniff mode	17mA / 2mA sniff mode	na
Current consumption (TX, 0dBm)	14.5/15.9 mA	14.6 mA in transmit mode, 1.2 kBaud, 315 MHz	302 mA at +20dBm	45mA @ 12dBm	45mA @ 12dBm	45mA @ 12dBm	45mA @ 12dBm	45mA @ 12dBm	34.2mA @ 12dBm
FSK data rate (max)	500 kbps	250kBaud	—	200kbps	200kbps	200kbps	200kbps	1Mbps	600kbps
Modulation format	FSK/GFSK/MSK/00K/ASK	FSK/GFSK/MSK/00K/ASK	—	2-FSK, 2-GFSK, 4-FSK, 4-GFSK, MSK, ASK, 00K	2-FSK, 2-GFSK, 4-FSK, 4-GFSK, MSK, ASK, 00K	2-FSK, 2-GFSK, 4-FSK, 4-GFSK, MSK, ASK, 00K	2-FSK, 2-GFSK, 4-FSK, 4-GFSK, MSK, ASK, 00K	2-FSK, 2-GFSK, 4-FSK, 4-GFSK, MSK, ASK, 00K	2-FSK, 2-GFSK, 4-FSK, 4-GFSK, MSK, ASK, 00K
Receiver sensitivity (FSK)	—	—	6 dB improvement	-123	-117	-129	n/a	-123	n/a
Transmit power (up to)	+10 dBm	-30 to +12 dBm	+26 dBm	16dBm	16dBm	16dBm	16dBm	16dBm	12dBm
Multi-channel systems/ frequency hopping protocols	✓	FHSS	✓	—	—	—	—	—	—
RSSI output	—	—	—	—	—	—	—	—	—
Integrated bit synchronizer	—	—	—	—	—	—	—	—	—
Internal RF switch/ IF filter	—	—	—	—	—	—	—	—	—
Antenna connection	Differential	Differential	Differential	—	—	—	—	—	—
Package type	QLP-16	QFN-32, 5x5 (RHB)	QFN-16	QFN-32, 5x5	QFN-32, 5x5	QFN-32, 5x5	QFN-32, 5x5	QFN-32, 5x5	VQFN-20, 4x4
Narrow band (12.5/25 kHz)	—	—	✓	yes	no	yes	yes	yes	no
Integrated MCU	—	—	—	no	no	no	no	yes	no
USB	—	—	—	no	no	no	no	no	no
AES encryption/ authentication	—	—	—	no	no	no	no	yes	no
Program memory	—	—	—	—	—	—	—	—	—
Data memory	—	—	—	—	—	—	—	—	—

# Resources

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## → Product Comparison Guide

Proprietary RF - 2.4 GHz				
Features/ Product	CC2500	CC2510	CC2511	CC2591
Product type	Transceiver	SoC	SoC	RF front end
Programmable frequency, MHz	2400 to 2483	2400 to 2483	2400 to 2483	2400 to 2483.5
Frequency resolution	427 Hz	427 Hz	427 Hz	—
Operating supply voltage	1.8 to 3.6 V	2.0 to 3.6 V	3.0 to 3.6 V	2.0 to 3.6 V
Current consumption (RX)	12.8 mA	19.8 mA	22 mA	1.8 mA
Current consumption (TX, 0dBm)	21.6 mA	23 mA	23 mA	3.4 mA
Data rate (max)	500 kbps	500 kbps	500 kbps	—
Receiver sensitivity	–89 dBm at 250 kbps 1% PER –99 dBm at 10 kbps	–88 dBm at 250 kbps 1% PER –99 dBm at 10 kbps	–88 dBm at 250 kbps 1% PER –99 dBm at 10 kbps	—
Transmit power (up to)	+1 dBm	+1 dBm	+1 dBm	—
Multi-channel systems	FHSS	FHSS	FHSS	—
RSSI output	Digital	Digital	Digital	—
Integrated bit synchronizer	✓	✓	✓	—
Integrated packet handling	✓	✓	✓	—
Data buffering	64 bytes TX 64 bytes RX	128 bytes TX 128 bytes RX DMA	128 bytes TX 128 bytes RX DMA	—
Internal RF switch/IF Filter	✓	✓	✓	—
RF chip interface	Differential	Differential	Differential	—
Package type	QLP-20 4x4 mm	QLP-36 6x6 mm	QLP-36 6x6 mm	QFN-16 QFN-48
Integrated MCU	—	✓	✓	—
IEEE 802.15.4 compliant	—	—	—	—
USB	—	—	✓	—
AES encryption/authentication	—	✓	✓	—
Program memory	—	32-kB Flash	32-kB Flash	—
Data memory	—	4-kB SRAM	4-kB SRAM	—

# Resources

## Product Comparison Guide

Proprietary RF	RFID/NFC						
Features/Product	TMS37157 (PalFI)	TMS3705	TRF7960A	TRF7962A	TRF7963A	TRF7964A	TRF7970A
Product type	Transponder with SPI interface	RFID Reader	RFID Reader	RFID Reader	Contactless Reader	RFID Reader	NFC Transceiver
Programmable frequency, MHz	134.2 kHz downlink	134.2 kHz	13.56 MHz				
Frequency resolution	123kHz and 134.2 kHz	134.2 kHz -12 kHz	13.56 MHz ±7 kHz	13.56 MHz ±7 kHz	13.56 MHz ±7 kHz	13.56 MHz ±7 kHz	13.56 MHz ±7 kHz
Operating supply voltage	2 to 3.6 V	4.5 to 5.5 V	2.7 to 5.5 Vdc				
Current consumption (RX)	150 µA	8 mA	10 mA	10 mA	10 mA	10 mA	10 mA
Current consumption (TX, 0dBm)	150 µA	max Tx (dependent on antenna load), 220 mA	130 mA (+23 dBm)				
Data rate (max)	8 kbps	8 kbps	848 kbps max	26.48 kbps max	848 kbps max	848 kbps max	848 kbps max
Receiver sensitivity		Max. Gain of 5	1.4 mVpp @ fSUB-CARRIER 424 kHz 2.1 mVpp @ fSUB-CARRIER 848 kHz	1.4 mVpp @ fSUB-CARRIER 424 kHz 2.1 mVpp @ fSUB-CARRIER 848 kHz	1.4 mVpp @ fSUB-CARRIER 424 kHz 2.1 mVpp @ fSUB-CARRIER 848 kHz	1.4 mVpp @ fSUB-CARRIER 424 kHz 2.1 mVpp @ fSUB-CARRIER 848 kHz	1.4 mVpp @ fSUB-CARRIER 424 kHz 2.1 mVpp @ fSUB-CARRIER 848 kHz
"Transmit power (up to)	—	1.5mVpp	+23 dBm				
Multi-channel systems	—	—	Dual Rx				
RSSI output	—	—	Digital	Digital	Digital	Digital	Digital
Integrated bit synchronizer	—	—	—	—	—	—	—
Integrated packet handling	—	—	Yes	Yes	Yes	Yes	Yes
Data buffering			12 bytes FIFO (Tx/Rx)	12 bytes FIFO (Tx/Rx)	12 bytes FIFO (Tx/Rx)	128byte FIFO	128byte FIFO
Internal RF switch/IF Filter	3	3	Yes	Yes	Yes	Yes	Yes
RF chip interface	Differential	Differential	Single ended				
Package type	QFN-16	SOIC-16	QFN-32	QFN-32	QFN-32	QFN-32	QFN-32
Integrated MCU	—	—	—	—	—	—	—
IEEE 802.15.4 compliant	—	—	—	—	—	—	—
USB	—	—	—	—	—	—	—
AES encryption/authentication	—	—	—	—	—	—	—
Program memory	—	—	—	—	—	—	—
Data memory	121 bytes free available EEPROM user memory/ 32 Bit unique serial number	—	—	—	—	—	—

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