Wireless Connectivity

Texas Instruments

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

Wirelessly Connecting Everywhere

www.ti.com/wirelessconnectivity, www.ti.com/lprf

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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's wireless connectivity technologies include Wi-Fi®, *Bluetooth*®, *Bluetooth* low energy, ANT™, ZigBee®, IEEE 802.15.4, ZigBee RF4CE, RFID, 6LoWPAN and PurePath™ Wireless audio, 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. Additionally, TI E2E™ Online Community provides you with technical support forums, videos and blogs, and the chance to openly and freely interact with fellow engineers.

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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

- Mesh and IP networks
- Personal area networks
- Locationing
- Proprietary RF sub-1 GHz
- Proprietary RF 2.4 GHz
- RFID

Main application areas

- Alarm, security and active RFID
- 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.

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, starting at $49, 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.

Wi-Fi® Overview

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

Wi-Fi allows you to connect your computer, mobile phone or other mobile devices to each other, to the internet, and to wired networks - all without the expense of cumbersome cables. Connect easily, quickly, and securely without worrying about finding a wired network connection. Wi-Fi is the most prominent wireless connectivity technology for computers and internet, with several billion units deployed in the market today and approximately 1 billion units per year projected to ship beginning in 2011.

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
- Point of sale and point of purchase
- 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. Information above cited from the Wi-Fi Alliance. For more information on Wi-Fi technology, visit ***www.wi-fi.org.***

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

WL1271-TiWi

WLAN 802.11 b/g/n and *Bluetooth*® v2.1 + EDR Transceiver

WL1271-TiWi

Learn more at: **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 6th generation WLAN technology and 7th 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 WiFi Direct is planned.

WL1271-TiWi WLAN and Bluetooth system diagram.

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

Benefits

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

Applications

- Consumer devices
- Industrial and home automation
- Point of sale and point of purchase
- Video conferencing, video camera
- Medical devices
- Security and surveillance

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 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	ºC
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^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:

- 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

TI's ZigBee solutions

A long-standing member of the ZigBee alliance and with golden unit recognized ZigBee compliant platforms, TI is a leading supplier of ZigBee solutions. Unlike other hardware suppliers that outsource their ZigBee stack development, TI has a dedicated internal software engineering team that is working on the latest revisions of the ZigBee stack and application profile testing. TI's ZigBee solutions include:

- Complete hardware and software ZigBee-compliant platforms certified by a ZigBee Alliance approved test house.
- A free IEEE 802.15.4 MAC software and golden unit status Z-Stack™ protocol stack.
- High-performance radio featuring excellent coexistence with WLAN, *Bluetooth*® and other 2.4 GHz solutions.
- Application support.
- Development kits and tools.

Three paths to ZigBee

TI offers three ZigBee-compliant platforms, built on the second generation CC2530 and CC2520 IEEE 802.15.4 radios.

- The ZigBee second generation CC2530 system-on-chip (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 M3 technology. It is recommended for designers who want additional flash and RAM.

		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	CC2530/1	Any Processor (e.g. MSP430 or Stellaris ARM)	MSP430 or Stellaris™ ARM
	Protocol stack		CC2530ZNP based co-processor with embedded stack and uart/spi/usb interface	
	Radio			CC2520
	RF front end (optional)	CC2590 / CC2591	CC2590 / CC2591	CC2590 / CC2591

TI's three paths to ZigBee.

www.ti.com/zigbee

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**

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 (–40ºC to +125ºC)
- 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 functional block diagram.

General Characteristics

Parameter	Min	Typ	Max	Unit
Operating conditions				
Frequency range	2394	2483.5	2507	MHz
Data rate	—	250	—	kBaud
Operating voltage	1.8	—	3.6	V
Operating temperature	–40	—	125	ºC
Output power	–18	—	5	dBm
RX mode				
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
Current consumption				
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**

The CC2530 is a cost-effective, low power, and true system-on-chip 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-µA 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 block diagram.

General Characteristics

Parameter	Min	Typ	Max	Unit
Operating conditions				
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
Current consumption				
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
Wake-up and timing				
From power mode 2 or 3 to active	—	120	—	µs
From active to RX or TX	—	192	—	µs

CC2530ZNP

ZigBee® Network Processor
CC2530ZNP

NEW

Get samples, evaluation modules and application notes at: **www.ti.com/sc/device/CC2530ZNP**

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 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.

CC2530ZNP system block diagram.

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
Operating conditions				
Frequency range	2400	—	2483.6	MHz
Operating temperature range	–40	—	125	ºC
Operating supply voltage	2.0	—	3.6	V
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Receiver sensitivity	—	–97	—	dBm
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MCU active and RX mode	—	25	—	mA
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Power mode 2	—	1	—	µA
Power mode 3	—	0.4	—	µA
Wake-up and timing				
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**

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.

CC2531 block diagram.

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

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
Operating conditions				
Frequency range	2400	—	2483.6	MHz
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Power mode 3	—	0.4	—	µA
Wake-up and timing				
From power mode 2 or 3 to active	—	120	—	µs
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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. The Z-Stack is compliant with the ZigBee® 2007 (ZigBee and ZigBee PRO) specification, supporting both ZigBee and ZigBee PRO feature sets on the MSP430™+CC2520 and CC2530 System-on-Chip. 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 CC2530 and MSP430+CC2520 platforms
- A fully compliant ZigBee feature set on the CC2530 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), the latest RF Front end which support +20 dBm transmit power and improved receive sensitivity

Benefits

- Golden Unit certified ZigBee PRO software stack: deployed in systems worldwide today
- Over the Air Download (OAD) support allows future updates for your deployed hardware
- Support for ZigBee Smart Energy (ZSE) and ZigBee home automation (ZHA) Application Profiles
- Simple API to reduce development time
- Sample application code provided to reduce your development costs

Application areas

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

- 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

6LoWPAN Overview

PREVIEW*

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. 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

- 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
- Application support
- Development kits and tools

Application areas

TI offers two 6LoWPAN platforms, built on the CC1110 and CC430 radios. Both platforms are for sub-1 GHz operation.

- The CC430 System-on-Chip (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.
- The CC1110 can be used as a wireless network processor. Containing the 6LoWPAN stack, the CC1110 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.

**Expected release date 2H, 2011.*

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

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

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. For users of *Bluetooth* technology this hopping 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.*

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 (single-chip WLAN/*Bluetooth* device) and CC2567 (*Bluetooth*/ANT) which further solve issues such as coexistence, antenna sharing in size-constrained devices, cost and power consumption.

CC2560-PAN1325

Bluetooth® v2.1 + EDR (Enhanced Data Rate) Transceiver
CC2560-PAN1325

Learn more at: **www.ti.com/sc/device/cc2560-pan1325**

The CC2560-PAN1325 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. The CC2560-PAN1325 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 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
- *Bluetooth*, FCC, CE, IC certified
- Dimensions: 9mm x 9.5mm x 1.8 mm (CC2560-PAN1325, integrated antenna); 6.5mm x 9.5mm x 1.8mm (CC2560-PAN1315, without antenna)
- *Bluetooth* + ANT footprint compatible modules are available (CC2567-PAN1327/17), and *Bluetooth* + *Bluetooth* low energy footprint compatible modules available in 2H11

CC2560-PAN1325 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

- MSP430BT5190 + CC2560 *Bluetooth* Development Platform with PAN1315EMK
- Stellaris + CC2560 *Bluetooth* Development Platform
- EZ430-RF2560 *Bluetooth* Evaluation Tool
- MindTree Ethermind *Bluetooth* Stack and SDK including Serial Port Profile (SPP) for MSP430
- StoneStreet One Bluetopia *Bluetooth* Stack and SDK with Serial Port Profile (SPP) + Advanced Audio Distribution Profile (A2DP) for Stellaris

General Characteristics

Parameter	Min	Unit
Frequency range	2.4	GHz
Data rate	2.1	Mbps
Operating voltage	1.7 to 1.98 or 2.2 to 4.8	V
I/O voltage	1.62 to 1.92	V
Operating temperature	–20 to 70	ºC
Bluetooth specification	2.1 + EDR	
Transmit/Output power (typical)	+10	dBm
Receiver sensitivity (typical)	-93	dBm
Current consumption	135µA (sleep), 40mA (Tx,EDR)	
Host Interfaces	GPIO, PCM, UART	
Internal Crystal Frequency	26	MHz
I/O	3xADC, 1xDAC, 2xGPIO	
Antenna	Integrated	
Size	9.5 x 9.0 x 1.8	mm^3

CC2567-PAN1327

ANT™ + *Bluetooth*® Dual-Mode, Single Chip Module
CC2567-PAN1327

Learn more at: **www.ti.com/cc2567-pan1327**

The CC2567-PAN1327 is the first single chip, dual-mode ANT + *Bluetooth* solution in the market. This solution is a highly-integrated class 2 HCI module with increased output power capabilities created by Panasonic utilizing TI's CC2567 *Bluetooth* 2.1 + Enhanced Data Rate (EDR) and ANT+ dual-mode 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. This module 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 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, a platform is available that integrates the CC2567-PAN1327 module, *Bluetooth* stack, Profiles (SPP for MSP430), ANT+ solution and sample source applications running on a TI host controller (MSP430™, others to follow).

Key Features

- Fully qualified *Bluetooth* v2.1 + EDR
- ANT+ *Bluetooth* smart priority mechanism allows flexible coexistence and simultaneous operation
- +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 Platforms
- *Bluetooth*, FCC, CE, IC certified
- Dimensions: 9 mm x 9.5 mm x 1.8 mm (CC2567-PAN1327, integrated antenna); 6.5 mm x 9.5 mm x 1.8 mm (CC2567-PAN1317, without antenna)

CC2567-PAN1327 block diagram.

Benefits

- *Bluetooth* provides a high throughput, robust connection with extended range to over 3 billion *Bluetooth* devices
- ANT+ ultra low power (ULP) for both master and slave devices provides extended battery life
- Ease of integration and low system cost allows fast time to market
- 2.4GHz allows for global deployment
- Established ANT+ interoperable ecosystem, with installed base of over 13 million devices (December 2010)

Applications

- ANT+ and *Bluetooth* Aggregators
- Sports and Fitness Devices
- Wellness and Health Devices
- Ability to add ultra-low power ANT+ technology to existing *Bluetooth* solutions
- Connect current ANT+ applications to mobile phones and computers via *Bluetooth*

Development Tools and Software

- CC2567-PAN1327 based ANT plus *Bluetooth* Health and Fitness Aggregator kit (CC2567-PAN1327ANT-BTKIT)
- MindTree Ethermind *Bluetooth* Stack and SDK including Serial Port Profile (SPP) and ANT+solution for MSP430

General Characteristics

Parameter	Min	Unit
Frequency range	2.4	GHz
Data rate	2.1	Mbps
Operating voltage	1.7 to 1.98 or 2.2 to 4.8	V
I/O voltage	1.62 to 1.92	V
Operating temperature	–20 to 70	ºC
Bluetooth specification	2.1 + EDR	
Transmit/output power (typical)	+10	dBm
Receiver sensitivity (typical)	-93	dBm
Current consumption	135µA (sleep), 40mA (Tx,EDR)	
Host Interfaces	GPIO, PCM, UART	
Internal crystal frequency	26	MHz
I/O	3xADC, 1xDAC, 2xGPIO	
Antenna	Integrated	
Size	9.5 x 9.0 x 1.8	mm^3

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.

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 17.

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 is the industry's first true single-chip mobile WLAN, GPS, *Bluetooth*, *Bluetooth* low energy, ANT™ and FM transmit/receive solution. 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).

Dual-mode BLE solutions will be available in 2H11. The WL1271-TiWi (p.5), CC2560-PAN1325 (p.14) and CC2567-PAN1327 (p. 15) will all be software-upgradeable to BLE in 2H'2011.

www.ti.com/bluetoothlowenergy

CC2540

Single-Mode *Bluetooth*® low energy System-on-Chip
CC2540

Get samples, evaluation modules and application notes at: **www.ti.com/sc/device/CC2540**

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

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

CC2540 application circuit.

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	ºC
Output power	-20	—	4	dBm
RX mode				
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
Current consumption				
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

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 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, 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
- Available to all CC2540 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

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

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

Bluetooth® Innovation World Cup 2011

With the *Bluetooth* Innovation World Cup, the *Bluetooth* SIG is looking for new applications and products using *Bluetooth* low energy technology primarily in the fields of sports and fitness, health care and home automation. The ideas make use of the unique characteristics of *Bluetooth* low energy technology, such as very low power consumption and the market potential that opens up through this major standardized wireless connection opportunity.

The Innovator of the Year 2011 will be awarded

- A prize of $5,000 USD and a *Bluetooth* Qualification Program (QDID) voucher worth $5,000-10,000 USD.
- Promotion of your idea or product and extensive press work throughout the competition using the marketing channels of the *Bluetooth* SIG, WFSGI, CES, Continua Health Alliance and ispo.
- Participation at the *Bluetooth* Innovation World Cup presentation at CES 2012.
- Participation at ispo, the world's leading sporting goods trade show.

Are you the next Innovation World Cup winner?

www.innovation-worldcup.com

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.
www.thisisant.com

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 21.

CC2567 dual mode ANT and *Bluetooth*

The CC2567-PAN1327/17 is the first dual-mode, ANT and *Bluetooth* solution in the market. The CC2567-PAN1327/17 module 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 15.

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*®, *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™ 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

www.ti.com/ant

CC2570/CC2571

ANT™ Network Processor
CC2570/CC2571

Get samples, evaluation modules and application notes at: **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 block diagram.

General Characteristics

Parameter	Min	Typ	Max	Unit
Operating conditions				
Frequency range	2400		2507	MHz
Data rate	—		—	kBaud
Operating voltage	2.0	—	3.6	V
Operating temperature	–40	—	85	ºC
Output power	–20	—	4	dBm
RX mode				
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
Current consumption				
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

RemoTI™ is a complete hardware and software solution for RF4CE remote control applications.

- 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 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

CC2533

ZigBee® RF4CE System-on-Chip
CC2533

NEW

Get samples, evaluation modules and application notes at: **www.ti.com/sc/device/CC2533**

The CC2533 is a cost-effective, low power, and true System-on-Chip 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-µA current consumption in power down with sleep timer running
- UART, I^2C 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 basic RF4CE development kit
- CC2533DK - CC2533 development kit
- CC2533EMK - CC2533 evaluation module kit

CC2533 application circuit.

General Characteristics

Parameter	Min	Typ	Max	Unit
Operating conditions				
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
Current consumption				
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
Wake-up and timing				
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

External system

- Seamless connection and control of selected TI audio codecs, DACs/ADCs and digital audio amplifiers using I^2S and I^2C
- HID functions like power control, binding, volume control, audio channel selection can be mapped to I/Os
- RoHS compliant 6mm x 6mm QFN-40 package

RF section

- 5 Mbps over-the-air data rate
- Bandwidth-efficient modulation format
- Excellent link budget with programmable output power up to +4 dBm and -83 dBm sensitivity
- Seamless support for CC2590 range extender
- Suited for systems targeting compliance with worldwide radio frequency regulations: ETSI EN 300 328 and EN 300 440 class 2 (Europe), FCC CFR47 Part 15 (US) and ARIB STD-T66 (Japan)

Digital audio support

- CD-quality uncompressed audio (44.1/48 KHz, 16/24 bits)
- Digital I^2S 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

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**

The CC8520 is used to build a lossless wireless audio link. One CC8520 acts as audio source and the other as audio sink. I²S data is taken as input on the audio source side, audio data is transmitted without loss to the audio sink which then outputs the I²S 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***

CC8520 block diagram.

General Characteristics

	CC8520	CC8530 (preview)*
Number of wireless audio channels	1-2	3-4
Number of audio slaves per master	4	4
Standby current (uA)	1	1
Power consumption (RX) (mA)	25	25
Power consumption (TX) (mA)	29	29
Data rate (Max) (Mbps)	5	5
Frequency range	2.4 GHz	2.4 GHz
TX power with/without CC2590 (dBm)	+10/+4 dBm	+10/+4 dBm

**CC8530 - expected release date Q2, 2011*

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**

The CC430 family of ultra-low-power microcontroller system-on-chip, 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 five 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 system-on-chip solutions easy to use as well as improving performance.

CC430 block diagram.

Key Features

- Integrates MSP430 MCU and CC1101 RF transceiver
- 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
- 16-ch, 12-bit A/D converter

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

Development Tools and Software

- eZ430-Chronos Wireless Watch Development Tool
- CC430F5137 Wireless Development Tool
- CC430F6137 Wireless Development Tool (with 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	12-bit SAR	Optional 12-bit SAR
RAM	2 - 4KB	2 - 4KB
Flash	8-32KB	16-32KB
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^2C)	1 USCI (UART/IrDA/SPI/I^2C)
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

CC1020/CC1021

Narrowband RF Transceiver
CC1020/CC1021

Get samples, datasheets, evaluation modules and application notes at: **www.ti.com/sc/device/CC1020** and **www.ti.com/sc/device/CC1021**

A true single-chip, narrowband UHF transceiver
The CC1020/CC1021 is a true single-chip FSK/GFSK and OOK RF transceiver that meets the stringent requirements of multi-channel narrowband applications in the 402 to 470-MHz and 804 to 940-MHz frequency bands. The CC1020 is designed to comply with the EN 300 220, ARIB STD-T67 standards and FCC CFR47 part 15. The CC1021 is identical to the CC1020 except that it can be used with minimum 50-kHz channel spacing.

CC1020 functional block diagram.

Key Features
- Channel spacing down to 12.5 kHz
- Blocking performance (71 dB at ±2 MHz)
- High receiver sensitivity (up to –118 dBm for 12.5-kHz channel spacing)
- Programmable output power up to +10 dBm
- Low receive and transmit current consumption
- Programmable carrier sense indicator and digital RSSI output
- Programmable frequency in <300-Hz steps

Benefits
- Ideal for narrowband applications
- Perfect for battery-operated industrial systems requiring long range and good noise immunity
- Suitable for listen-before-talk systems
- Suitable for frequency hopping systems

Applications
- Narrowband applications in the 426/429/433/868/915/950-MHz ISM/SRD band
- Automatic meter reading
- Wireless alarm and security systems
- Home automation
- Low-power telemetry
- Remote keyless entry

Development Tools and Software
- CC1020/CC1070DK-433 MHz development kit
- CC1020/CC1070DK-868 MHz development kit
- CC1020EMK-433 MHz evaluation module kit
- CC1020EMK-868 MHz evaluation module kit

General Characteristics

Parameter (433/868 MHz, 3.0 V, 25°C)	Min	Typ	Max	Unit	Condition
Operating conditions					
Frequency range	402	—	470	MHz	Programmable in less than 300-Hz steps
	804	—	960	MHz	Programmable in less than 600-Hz steps
Data rate	0.45	—	153.6	kBaud	
Operating voltage	2.3	3.0	3.6	V	
TX mode					
Output power 433/868	–20	—	+10/+5	dBm	
FSK separation	0	—	108/216	kHz	
*ACP, 12.5/25 kHz	—	–46 –49	—	dBc	
OBW, 99.9%, 12.5/25 kHz	—	7.5 9.6	—	kHz	12.5-kHz spacing: 2.4 kBaud, ± 2.025 kHz 25-kHz spacing: 4.8 kBaud ± 2.475 kHz
RX mode					
Sensitivity OOK, 2, 4/4, 8 kBaud	—	–116/–107	—	dBm	Manchester coded data
Sensitivity FSK, 2.4 kBaud*	—	–118	—	dBm	12.5-kHz spacing: 12.288-kHz receiver filter bandwidth, jammer at ±12.5/±25-kHz offset
Image channel rejection, calibrated	—	49/52	—	dB	
Blocking, ±2 MHz	—	64/71	—	dB	
Blocking, ±10 MHz	—	75/78	—	dB	
Power consumption					
Current consumption, RX	—	19.9	—	mA	
Current consumption, TX 433/868	—	16.2/20.5	—	mA	0-dBm output power
Current consumption, power down	—	0.2	1.8	µA	

** The CC1021 is identical to the CC1020 except that it can be used with minimum 50-kHz channel spacing.*

CC1100E

Integrated Multi-Channel RF Transceiver
CC1100E

Get samples, datasheets, evaluation modules and application notes at: **www.ti.com/sc/device/CC1100E**

Integrated solution provides low cost and high performance

The CC1101E 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-µs PLL lock time: –240 µs 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 functional block diagram.

General Characteristics

Parameter (433/868 MHz, 3.0 V, 25°C)	Min	Typ	Max	Unit	Condition
Operating conditions:					
Frequency range	470 950 470	— — —	510 960 510	MHz MHz 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
Power consumption					
Current consumption RX	—	16	—	mA	Input well above sensitivity limit
Current consumption TX	— —	15.0 30.0	— —	mA mA	0 dBm 12 dBm
Current consumption, power down	—	<1	—	µA	

CC1101

Integrated Multi-Channel RF Transceiver
CC1101

Get samples, datasheets, evaluation modules and application notes at: **www.ti.com/sc/device/CC1101**

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-µs PLL lock time: 240 µs 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 37.

Development Tools and Software

- CC1101DK-433 MHz development kit
- CC1101DK-868/915 MHz development kit
- CC1101EMK-433 MHz evaluation module kit
- CC1101EMK-868/915 MHz evaluation module kit
- SimpliciTI™ software protocol
- Wireless M-Bus

General Characteristics

Parameter (433/868 MHz, 3.0 V, 25°C)	Min	Typ	Max	Unit	Condition
Operating conditions:					
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
Power consumption					
Current consumption RX, 868 MHz	—	14.7	—	mA	Input well above sensitivity limit
Current consumption TX	— —	15.0 30.0	— —	mA mA	0 dBm 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 pages 30, 33 and 35 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**

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.

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

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-µs PLL lock time: 240 µs 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

Development Tools and Software

- CC1101Q1EMK433 MHz evaluation module kit
- CC1101Q1EMK868-915 MHz evaluation module kit
- CC1101DK-433 MHz development kit
- CC1101DK-868/915 MHz development kit
- SimpliciTI™ software protocol

General Characteristics

Parameter (315, 433MHz, 3V, 25ºC)	Min	Typ	Max	Unit
Operating conditions:				
Frequency range	310	—	348	MHz
	387	—	464	MHz
	779	—	928	MHz
Operating temperature	–40	—	125	ºC
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
Current consumption				
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/sc/device/CC1110F8**

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.

For 2.4-GHz alternative, see CC2510, page 38.

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

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

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
- SimpliciTI™ software protocol
- Wireless M-Bus
- CC1110DK-MINI

General Characteristics

Parameter					
(433/868 MHz, 3.0 V, 25°C)	Min	Typ	Max	Unit	Condition
Operating conditions					
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
Current consumption					
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
Wake-up and timing					
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**

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

The CC1111 is a System-on-Chip 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 µA 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^2S interface for digital audio data, full duplex, mono and stereo support, configurable sample rate and sample size
- Direct memory access which reduces MCU load

Benefits

- Complete solution on one single chip
- Ideal for low-power battery operated systems

CC1111 functional block diagram.

- 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
Operating conditions					
Frequency range	300	—	348	—	
	391	—	464	—	
	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
Current consumption					
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	
Wake-up and timing					
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**

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 derivate 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
- CC1101Q1EMK433 MHz evaluation module kit
- CC1101Q1EMK868-915 MHz evaluation module kit
- CC1101DK-433 MHz development kit
- CC1101DK-868/915 MHz development kit
- SimpliciTI™ software protocol

General Characteristics

Parameter (315, 433MHz, 3V, 25ºC)	Min	Typ	Max	Unit
Operating conditions:				
Frequency range	310	—	348	MHz
	387	—	464	MHz
	779	—	928	MHz
Operating temperature	–40	—	125	ºC
Operating voltage	1.8	—	3.6	V
Data rate (programmable)	1.2	—	250	kBaud
Receiver sensitivity, 1.2kBaud	—	–114	—	dBm
Current consumption				
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**

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

- CC1150EMK-433 MHz evaluation module kit
- CC1150EMK-868/915 MHz evaluation module kit
- CC1101DK-433 MHz development kit

CC1150 functional block diagram.

General Characteristics

Parameter (433/868 MHz, 3.0 V, 25°C)	Min	Typ	Max	Unit
Operating conditions				
Frequency range	300	—	348	MHz
	400	—	464	MHz
	800	—	928	MHz
Output power (programmable)w	–30	—	+10	dBm
Operating temperature range	–40	—	+85	°C
Operating supply voltage	1.8	—	3.6	V
Data rate (programmable)	1.2	—	500	kBaud
Power consumption				
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**

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 derivate 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-µs PLL lock time: 240 µs 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
- CC1101Q1EMK433 MHz evaluation module kit
- CC1101Q1EMK868-915 MHz evaluation module kit
- CC1101DK-433 MHz development kit
- CC1101DK-868/915 MHz development kit
- SimpliciTI™ software protocol

General Characteristics

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

CC1190

Sub-1 GHz Front End (850-950 MHz)
CC1190

Get samples, evaluation modules and application notes at: **www.ti.com/sc/device/CC1190**

The CC1190 is range extender for the sub-1GHz low-power RF transceivers and system-on-chip 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.

CC1190 block diagram.

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

- CC1190EMK-915 Evaluation Module Kit

General Characteristics

Parameter	Min	Typ	Max	Unit
Supply range	c	—	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	—	uA
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

CC2500

Low-Power, Highly Integrated RF Transceiver
CC2500

Get samples, datasheets, evaluation modules and application notes at: **www.ti.com/sc/device/CC2500**

The CC2500 is a highly integrated, multi-channel RF transceiver designed for low-power wireless applications in the 2.4-GHz ISM band.

Key Features

- Excellent selectivity and out-of-band blocking performance
- Many powerful digital features:
  - Full packet handling including preamble generation, sync word insertion/detection, address check, flexible packet length and automatic CRC
- Programmable carrier sense indicator, digital RSSI output
- Very few low-cost external components required
- Reference design with two-layer PCB with all components mounted on the same side
- 2-FSK, GFSK, MSK, OOK

Benefits

- Fast development time and low system cost
- Enables use of inexpensive microcontroller
- Adaptive channel selection with increased robustness and coexistence of the wireless link
- Robust and secure link with very good coexistence with *Bluetooth*® and WiFi

Applications

- Wireless game controllers
- Wireless keyboard/mouse
- Consumer electronics
- Wireless voice audio
- Sports and leisure equipment
- RF-enabled remote controls

Development Tools and Software

- CC2500/CC2550DK development kit
- CC2500EMK evaluation module kit
- eZ430-RF2500 MSP430 Wireless Development Tool
- SimpliciTI™ Software Protocol

The CC2500 is pin and register compatible with the sub-1 GHz CC1101 transceiver, please see page 29.

General Characteristics

Parameter (433/868 MHz, 3.0 V, 25°C)	Min	Typ	Max	Unit	Condition
Operating conditions					
Frequency range	2400	—	2483.5	MHz	
Data rate (programmable)	1.2	—	500	kBaud	
Sensitivity, 2.4 kBaud	—	–104	—	dBm	Optimized sensitivity
Sensitivity, 250 kBaud	—	–89	—	dBm	Optimized sensitivity
Output power (programmable)	–30	—	1	dBm	
Operating supply voltage	1.8	—	3.6	V	
Current consumption					
RX input signal at the sensitivity limit, 2.4 kBaud	—	17.0	—	mA	
RX input well above sensitivity limit, 2.4 kBaud	—	14.5	—	mA	
RX input signal at the sensitivity limit, 250 kBaud	—	16.6	—	mA	Current optimized
RX input well above sensitivity limit, 250 kBaud	—	13.3	—	mA	Current optimized
Current consumption, TX, 0 dBm	—	21.2	—	mA	
Current consumption, TX, –12 dBm	—	11.1	—	mA	
Current consumption, power down	—	<1	—	µA	

CC2510

System-on-Chip RF Solution
CC2510F8/F16/F32

Get samples, datasheets, evaluation modules and application notes at: **www.ti.com/sc/device/CC2510F8**

The CC2510Fx is a true System-on-Chip device designed for low-power and low-voltage wireless communication applications. The CC2510Fx combines the excellent performance of the CC2500 RF transceiver with an industry-standard enhanced 8051 MCU, 8/16/32 kB of in-system programmable Flash memory, 1/2/4 kB of RAM and many other powerful peripherals.

Key Features

- High-performance, low-power 8051 MCU core with in-system programmable Flash and SRAM
- Four flexible power modes for reduced power consumption and very fast transition times from sleep modes to active mode
- Excellent selectivity and out-of-band blocking performance, and AES-128 encryption coprocessor
- 2-FSK, GFSK, MSK, OOK

Benefits

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

Applications

- Consumer electronics
- Wireless keyboard/mouse
- Wireless gaming accessories
- Wireless voice audio
- Sports and leisure equipment
- Remote controls

Development Tools and Software

- CC2510/CC2511DK development kit
- CC2510EMK evaluation module kit
- SimpliciTI™ Software Protocol
- CC2510DK-MINI

For sub-1 GHz alternative, see CC1110 page 31.

General Characteristics

Parameter	Min	Typ	Max	Unit	Condition
Operating conditions					
Frequency range	2400	—	2483.5	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	—	1	dBm	
Receiver sensitivity, 2.4 kBaud	—	–103	—	dBm	2-FSK, 203-kHz RX filter bandwidth, 1% PER
Receiver sensitivity, 250 kBaud	—	–90	—	dBm	2-FSK, 540-kHz RX filter bandwidth, 1% PER
Current consumption					
MCU active and RX mode	—	17.4	—	mA	MCU running at full speed (26 MHz), radio in RX mode 2.4 kBaud
MCU active and TX mode, 0 dBm	—	26	—	mA	MCU running at full speed (26 MHz), radio in TX mode, 0-dBm output power
Power mode 2	—	0.5	1	µA	32-kHz RC oscillator (or 32.768-kHz crystal oscillator), sleep timer running and digital regulator off
Power mode 3	—	0.3	1	µA	No clocks running, digital regulator off
Wake-up and timing					
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 power mode 1 to active	—	4	—	µs	Digital regulator on and high-speed oscillator off 32-kHz RC oscillator (or 32.768-kHz crystal oscillator) running

CC2511

System-on-Chip with Integrated Full-Speed USB-Certified Controller
CC2511F8/F16/F32

Get samples, datasheets, evaluation modules and application notes at: **www.ti.com/sc/device/CC2511F8**

The CC2511Fx is a powerful 2.4-GHz System-on-Chip that includes a full-speed USB controller. These unique ICs shorten time to market and allow designers to build tiny USB devices that communicate wirelessly with PC peripherals.

Key Features

- Full-speed USB with 1-kB USB FIFO, 12 Mbps transfer rate, 5 bidirectional endpoints with support for bulk, interrupt and isochonous transfers
- High-performance, low-power 8051 MCU core with in-system programmable Flash, SRAM and full-speed USB controller
- Four flexible power modes for reduced power consumption and very fast transition times from sleep modes to active mode
- Excellent selectivity and out-of-band blocking performance, and AES-128 encryption coprocessor
- 2-FSK, GFSK, MSK, OOK

Benefits

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

Applications

- Consumer electronics
- Wireless keyboard/mouse
- Wireless gaming accessories
- Wireless voice audio
- Sports and leisure equipment
- RF-enabled remote controls

Development Tools and Software

- CC2510/CC2511DK development kit
- CC2511EMK evaluation module kit
- SimpliciTI™ Software Protocol

For sub-1 GHz alternative, see CC1111 on page 32.

General Characteristics

Parameter	Min	Typ	Max	Unit	Condition
Operating conditions					
Frequency range	2400	—	2483.5	MHz	
Operating temperature range	0	—	+85	°C	
Operating supply voltage	3.0	—	3.6	V	
Data rate (programmable)	1.2	—	500	kbps	
Output power (programmable)	–30	—	1	dBm	
Receiver sensitivity, 2.4 kBaud	—	–103	—	dBm	2-FSK, 203-kHz RX filter bandwidth, 1% PER
Receiver sensitivity, 250 kBaud	—	–90	—	dBm	2-FSK, 540-kHz RX filter bandwidth, 1% PER
Current consumption					
MCU active and RX mode	—	17.4	—	mA	MCU running at full speed (26 MHz), radio in RX mode 2.4 kBaud
MCU active and TX mode, 0 dBm	—	26	—	mA	MCU running at full speed (2 MHz), radio in TX mode, 0-dBm output power
Power mode 2	—	0.5	1	µA	32-kHz RC oscillator (or 32.768-kHz crystal oscillator), sleep timer running and digital regulator off
Power mode 3	—	0.3	1	µA	No clocks running, digital regulator off
Wake-up and timing					
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	—	4	—	µs	Digital regulator on and high-speed oscillator off, 32-kHz RC oscillator (or 32.768-kHz crystal oscillator) running

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** and **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 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.

CC2590/CC2591 block diagram.

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

- CC2590EMK evaluation module kit
- CC2430-CC2590EMK evaluation module kit
- CC2591EMK evaluation module kit

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
RX mode				
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
TX mode				
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
RX mode				
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
TX mode				
Transmit current, 20-dBm output power	—	100	—	mA
Output power	—	20	—	dBm
Power added efficiency, PAE	—	33	—	%
Output 1-dB compression	—	19	—	dBm

CC2595

2.4 GHz RF Front End PA
CC2595

Get samples, evaluation modules and application notes at: **www.ti.com/sc/device/CC2595**

CC2595 is a 2.4-GHz power amplifier (PA) / transmit range extender specially designed for all existing and future 2.4-GHz RF transceivers and System-on-Chip solutions from TI and other transceiver vendors. CC2595 increases the link budget by providing a power amplifier for improved output power. Its simple single-ended input/output design makes it suitable for all TI 2.4GHz transceivers as well as those from other vendors.

Key Features

- Up to +22.5 dBm output power
- Up to +22.5 dB increased link budget
- 80 mA transmit current at 3 V at +20-dBm output power (40% power added efficiency [PAE])
- Very few external components: integrated PA has input and interstage matching networks on-chip
- 100 nA in power down
- Packaging:
  - 3x3 mm QFN-16
  - Packaging: RoHS-compliant

Benefits

- Unconditionally stable and rugged to at least 10:1 VSWR all phases
- Ultra-high power added efficiency
- Ultra-low cost
- Small size solution
- Compatible with multiple transceivers

Development Tools

- CC2595EMK evaluation module kit

CC2595 block diagram.

General Characteristics

RF CHARACTERISTICS TJ = 25°C, VCC = 3 V (unless otherwise specified)						
Parameter		**Test Condition**	**Min**	**Typ**	**Max**	**Unit**
F	Frequency range of operation		2400		2483.5	MHz
POUT PAE	Output power Power added efficiency	V_{CC}=3V, PIN = 0 dBm	+20	+20.7 40		dBm %
POUTHI PAEHI	Output power (high) Power added efficiency (high)	V_{CC} = 3.3 V, PIN = +3 dBm	+22	+22.5 45		dBm %
P1dB	Output 1-dB compression point			+17		dBm
IRL	Input return loss		10	15		dB
ORL	Output return loss		8	10		dB
	Output power variation over frequency	2400 MHz to 2483.5 MHz			0.5	dB
	Output power variation over supply voltage	2 V to 3.6 V			4	dB
	Output power variation over temperature	–40°C to 85°C			1	dB
	Harmonics		Compliant with international regulatory standards			
K	Stability		Unconditionally stable			
Load mismatch			No damage up to 10:1 VSWR condition, all phases			

TMS37157

PaLFI - Passive Low Frequency Interface Device
TMS37157

Get samples, evaluation modules and application notes at: **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.

TMS37157 block diagram.

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

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 eeel, 3000 per reel

TMS3705

134.2kHz Transceiver IC
TMS3705

Get samples, evaluation modules and application notes at: **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.

TMS3705 block diagram.

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 µA
- Designed for automotive requirements
- 16-Pin SOIC (D) package

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

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

Development Tools and Software
- Included in ez430-TMS37157 Evaluation Kit

For more information on Transponders and Inlays please visit *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 uA
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

TRF7960, TRF7961

13.56MHz Transceiver IC
TRF7960, TRF7961

Get samples, evaluation modules and application notes at: **www.ti.com/sc/device/TRF7960 and sww.ti.com/sc/device/TRF7961**

The TRF796x is a high performance 13.56MHz HF RFID Reader IC 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

- ISO-14443A/B, ISO-15693
- 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

- TRF7960 EVM evaluation kit
- TRF7960TB target board for MSP-EXP430F5438 board, ARM Cortex-M3 based DK-LM3S9B96 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*

General Characteristics

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

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™-M3 family to our 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)

Texas Instruments Developer Network — **Software and Dev. Tools** — Texas Instruments expressDSP™

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™-M3 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 Accelorators	C6000™ Up to 10GHz Multi-core, fixed/floating + Accelerators	C5000™ Up to 300MHz 16-bit fixed point + FFT Accelerator

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* for a complete product portfolio and more information.
By making RF design easy, performance-rich and power-efficient, the MSP430 helps advance RF 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

MSP430 – your ultra-low power wireless connectivity microcontroller

Ultra-Low Power + Performance

World's Lowest Power MCU Family
- Optimized low power modes & instand wake-up
- 230µA/MIPA I 0.7 µA RTC I 0.1 µA RAM

Do More with MSP430
- Industry leading code density
- Increase speed and flexibility with advanced clocking, hardware acceleration, and up to 25 MIPS

System Integration

Intelligent Analog & Digital Peripherals
- 16-bit ADCs, DACs, DMA, MPY, comparators, LCD, USB, RF, high-res timers, power management, AES-128, Op Amps, Capacitive touch I/Os

Embedded Software
- Broad portfolio of embedded software stacks for wireless applications (protocol, network)

Extensive Portfolio

Find the right MCU for you
- 200+ devices with one consistent architecture
  Flash: 0.5 - 256 kB Pins: 14 - 113
  RAM: 128 B - 16 B

NEW - MSP430 Value Line
- Don't Settle I 16-bit performance, 8-bit price
- Starting at $0.25 USD

Easy to Get Started

Consistent Development Environment
- One development tool for all MSP430 devices
- Code compatibility throughout portfolio

Get Started Now!
- Complete dev kits at $20 USD
- eZ430-Chronos development watch, $49 USD
- Free code-limited IDEs

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	http://www.ti.com/simpliciti
TIMAC 802.15.4	MSP430F461x*	http://www.ti.com/timac
ZigBee Coordinator	MSP430F227x*, MSP430F461x*, MSP430F54xxA*	http://www.ti.com/z-stack
ZigBee End Device	MSP430F227x*, MSP430F461x*, MSP430F54xxA*	http://www.ti.com/z-stack
Bluetooth v2.1 + EDR, SPP	MSP430BT5190*	http://focus.ti.com/docs/toolsw/folders/print/mt-bt-sdk.html
6LoWPAN	CC430Fxxx*	Coming 2H 2011
Dash7	CC430Fxxx*	Coming 1H 2011

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

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
- CCS4 $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 4
  - IAR Embedded Workbench

MSP430 Flash Emulation Tool
- 1 programmaging 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
- Starting at $99

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.*

Part Number					
	eZ430-Chronos	eZ430-RF2500	eZ430-RF2500-SHE	eZ430-TMS37157	eZ430-RF2560
Key Feature	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	$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			
	MSP-EXP430F5438	PAN1315EMK	EM430F5137RF900/ EM430F6137RF900
Key Feature	Dot matrix grayscale display, microphone, audio output, RF expansion connector (for use with any CCxxxxEMK module), USB connectivity, accelerometer, joystick	*Bluetooth*® module to plug into and use with the MSP-EXP430F5438 experimeter board for software and hardware prototyping of *Bluetooth* applications. The MSP430+CC2560 Software Development Kit includes a *Bluetooth* stack, serial port profile (SPP) and embedded sample applications running on FreeRTOS	Sub 1GHz CC430 complete wireless development tool kit
Price	$149	$99	$149

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

Stellaris®

Stellaris Microcontrollers for Connectivity and Networking

TI's Stellaris microcontrollers are 32-bit ARM® Cortex™-M3 based, mixed-signal processors ideal for use in conjunction with TI's broad radio portfolio. The industry's broadest 32-bit Cortex-M3 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 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, and proprietary low-power radio protocols onto our DK-LM3S9B96 development kit and into StellarisWare®. When coupled with the DK-LM3S9B96 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

Performance

- **20-80 MHz ARM Cortex-M3 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 wiutout 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^2C, SSI modules
- Integrated I^2S 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	www.ti.com/simpliciti
TIMAC 802.15.4	Any Stellaris ≥ 32KB Flash	www.ti.com/timac
ZigBee	Any Stellaris ≥ 128KB Flash	www.ti.com/z-stack

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-LM3S9B96	DK-EM2-7960R	DK-EM2-2500S	DK-EM2-2520Z
Key Feature	Stellaris LM3S9B96 Development Kit	13.56 MHZ RFID Kit	2.4 GHz SimpliciTI™ Kit	ZigBee Networking Kit
Price	$425	$99	$125	$249

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 TI 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 protoype 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-chips 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

Development Tools

Device	Device Type	Development Kits	Evaluation Module Kits (Add-on boards)	Other compatible mother boards
CC1020	Transceiver Sub-1 GHz, narrowband	CC1020-CC1070DK433 CC1020-CC1070DK868	CC1020EMK-433 CC1020EMK-868	
CC1101	Transceiver sub-1 GHz	CC1101DK433 CC1101DK868-915	CC1101EMK433 CC1101EMK868-915	MSP430FG4618 Exp Board MSP430F5438 Exp Board
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	CC1101Q1EMK433 MHz CC1101Q1EMK868-915 MHz	
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 CC430F5137		
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)	
CC2520	Transceiver IEEE 802.15.4, ZigBee PRO	CC2520DK	CC2520EMK	MSP430F5438 Exp Board Stellaris DK-EM2-2500Z
CC2530	8051-based System on Chip	CC2530DK	CC2530EMK	
CC2531	IEEE 802.15.4, ZigBee PRO	CC2530ZDK CC2530ZDK-ZNP-MINI	CC2531EMK (USB Dongle)	
CC2533	8051-based System on Chip IEEE 802.15.4, ZigBee RF4CE	CC2533DK CC2533DK-RF4CE-BA	CC2533EMK	
CC2540	8051-based System on Chip *Bluetooth*® low energy	CC2540DK-MINI	CC2540EMK CC2540EMK-USB (USB dongle)	
CC2560-PAN1325	*Bluetooth* v2.1 + EDR Transceiver		PAN1315EMK	MSP-EXP430F5438
CC2567-PAN1327	*Bluetooth* v2.1 + EDR and ANT™ dual-mode transceiver	CC2567-PAN1327ANT-BTkit		
CC257x	ANT™ network processor	ANTC7EK1 (CC257x)		
CC2590	PA and LNA frontend		CC2590EMK	
CC2591	2.4 GHz		CC2591EMK CC2520-CC2591EMK CC2530-CC2591EMK	
CC2595	PA Frontend 2.4 GHz		CC2595EMK	
CC85xx	PurePath™ Wireless Audio	CC85xxDK CC85xxDK-MINI		
TMS37157 TMS3705	Passive low frequency interface device 134.2kHz transceiver IC	ez430-TMS37157		
TRF796x	13.56 MHz transceiver IC	TRF7960EVM	TRF7960TB	

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-Chips 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

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 programming 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

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

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

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 / IEEE *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

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, CC2531 System-on-Chip, 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

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.

Software

Protocol Stack

Name	Description	Web link
SimpliciTI™ Network Protocol	SimpliciTI is a simple low-power RF network protocol aimed at small RF networks	www.ti.com/simpliciti
TIMAC	IEEE 802.15.4 medium access control software stack	www.ti.com/timac
Z-Stack™ Software	ZigBee® protocol stack	www.ti.com/z-stack
RemoTI™ Software	ZigBee RF4CE protocol stack	www.ti.com/remoti
BLEstack	*Bluetooth®* low energy ptotocol stack	www.ti.com/blestack

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	www.ti.com/smartrfstudio
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.	www.ti.com/packetsniffer
SmartRF Flash Programmer	Use this applications to program hex files on the system-on-chips 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	www.ti.com/ccmsplib
PurePath™ Wireless Configurator	Use this graphical PC tool for programming of CC85xx devices	www.ti.com/ppwc

Low-Power RF Application Notes

To access any of the following application notes, type the URL: ***www.ti.com/lit/litnumber*** and replace the lit number with the number in the lit number column below.

Application Notes Title	Literature Number
AN014 — Frequency Hopping Systems	swra077
AN015 — RF Modem Reference Design	swra076
AN021 — Voltage Level Conversion	swra071
AN022 — CC1020 Crystal Frequency Selection	swra070
AN023 — CC1020 MCU Interfacing	swra069
AN024 — Frequency Hopping Protocol	swra068
AN025 — CC1020 RF MODEM	swra067
AN026 — Wireless Audio	swra066
AN027 — Temperature Compensation	swra065
AN028 — LC Filter with Improved High-Frequency Attenuation	swra064
AN029 — CC1020/CC1021 Automatic Frequency Control (AFC)	swra063
AN030 — CC1020/1021 Received Signal Strength Indicator	swra062
AN031 — Mono Audio Link	swra061
AN032 — 2.4 GHz Regulations	swra060
AN033 — Porting of RF Blinking LED Software Example to CC2420 - MSP430	swra059a
AN036 — CC1020 1021 Spurious Emission	swra057
AN039 — Using CC1100/CC1150 in European 433/868 MHz bands	swra054
AN043 — Small Size 2.4 GHz PCB Antenna	swra117d
AN045 — Z-Tool	swra119
AN047 — CC1100/CC2500 Wake on Radio	swra126b
AN048 — 2.4 GHz Chip Antenna	swra092b
AN049 — Software for CC1100/CC2500 and MSP430 – Examples and Function Library	swra141
AN050 — Using the CC1101 in the European 868MHz SRD band	swra146b
AN056 — Gang-Pro CC and Production Programming of the CC2430	swra157
AN057 — Measuring Power Consumption on eZ430-RF2480	swra177
AN058 — Antenna Selection Guide	swra161b
AN060 — Security on TI IEEE 802.15.4 Compliant RF Devices	swra209a
AN061 — Optimizing power consumption with the CC2520DK	swra210
AN062 — TI-MAC and Z-Stack modifications for using CC2591 RF Front End w/CC2430	swra208a
AN063 — Using CC2591 RF Front End with CC2430	swra212
AN064 — Two Way Audio Communications Using the CC2510	swra225b
AN065: Using CC2591 RF Front End with CC2520	swra229a
AN066 — TI-MAC modifications for using CC2591 PA/LNA with MSP430F2618+CC2520	swra230a
AN067 — Wireless MBUS Implementation with cc1101 and MSP430	swra234a
AN068 — Design Steps and Results for Changing PCB Layer Thickness	swra236a

Application Notes Title	Literature Number
AN069 — Low Cost Long Range One Way Audio Communications at 900 MHz	swra237b
AN070 — CC1020 Automatic Power-Up Sequencing	swra279
AN071 — CC2430 to CC2530 Migration Guide	swra287
AN072 — Using the TAI-SAW TA0801A SAW Filter and External PA	swra296a
AN074 — RemoTI Coexistence Testing	swra285
AN078 — TIMAC and Z-Stack Modifications for using CC2591 RF Front End with CC2	swra290
AN080 — LED Lighting with Remote Control using CC2510 and CC1110	swra305
AN081 — Johanson Technology balun optimized for CC2530	swra297a
AN082 — One Way and Two-Way Audio Communications using the CC1110 or CC2	swra295a
AN084 — RemoTI SimpleConsole Application	swra304a
AN086 — Using CC2591 Front End with CC2530 and CC2531	swra308a
AN089 — Real World Range Testing Using CC85xx	swra320
AN092 — Measuring *Bluetooth* low energy Power Consumption	swra347
AN093 — Modifying Radio Register Parameters for SimpliciTI Applications	swra352
Implementing 'Diversity' Using Low Power Radios	swra317
Ultra-Low-Power 27-MHz Wireless Mouse Reference Design	slaa302
Using the CC2430 & TIMAC with low-power wireless sensors: A power-consumption st	slyt295
CC430 Wake on Radio functionality	slaa459
Using the USCI I^2C master (on the CC430)	slaa382

Low-Power RF Design Notes

To access any of the following design notes, type the URL: ***www.ti.com/lit/litnumber*** and replace the lit number with the number in the lit number column below.

Design Notes Title	Literature Number
DN000 — Design Note Overview	swra120r
DN002 — Practical Sensitivity Testing	swra097
DN004 — Folded Dipole Antenna for CCC25xx	swra118
DN005 — CC11xx Sensitivity versus Frequency Offset and Crystal Accuracy	swra122c
DN006 — CC11xx Settings for FCC15.247 Solutions	swra123b
DN009 — Upgrading from CC1100 to CC1101	swra145a
DN010 — Close-in Reception with CC1101	swra147b
DN011 — RF Module Testing using SmartRF Studio	swra149a
DN012 — Programming Output Powers on CC1100 and CC1150	swra150a
DN013 — Programming Output Powers on CC1101	swra151a
DN014 — Programming Output Powers on CC2500 and CC2550	swra152
DN015 — Permanent Frequency Offset Compensation	swra159a
DN016 — Compact Antenna Solution for 868/915 MHz	swra160b
DN017 — CC11xx 868/915 MHz RF Matching	swra168a
DN018 — Range Measurements in an Open Field Environment	swra169a
DN019 — Powering Low-Power RF Products	swra173b
DN020 — Programming Output Power on CC2430	swra171
DN021 — CC2500 and CC2510 Sensitivity versus Frequency Offset and Crystal Accura	swra181
DN022 — CC11xx OOK/ASK Register Settings	swra215b
DN023 — 868 MHz, 915 MHz and 955 MHz Inverted F Antenna	swra228b
DN024 — 868 MHz, 915 MHz and 955 MHz Monopole PCB Antenna	swra227d
DN025 — Johanson Technology Matched Balun Filter optimized for CC1101 868/915MH	swra250
DN028 — CC2510 Quarter Wave	swra253
DN029 — CC2510 Half Wave	swra254
DN030 — ACR Measurements on IEEE 802.15.4 Systems	swra255
DN031 — CC-Antenna-DK Documentation and Antenna Measurements Summary	swra328
DN032 — Options for Cost Optimized CC11xx Matching	swra346
DN033 — Mitsubishi Ceramic Antenna for 868 MHz, 915 MHz & 955	swra307a
DN034 — YAGI 2.4 GHz PCB Antenna	swra350
DN035 — Antenna Quick Guide	swra351
DN101 — Using the ADC to Measure Supply Voltage	swra100a
DN102 — SoC Temperature Sensor	swra101a
DN105 — Upgrade from CC2510/11 Preview to Released Part	swra153
DN106 — Power Modes in CC111xFx, CC243xFx, and CC251xFx	swra162b
DN107 — DMA and Radio Configuration	swra164a

Design Notes Title	Literature Number
DN108 — Using AES Encryption in CC111xFx CC243xFx and CC251xFx	swra172b
DN109 — Using I2S in CC111xFx and CC251xFx	swra183
DN110 — Main Radio Control State Transition Times	swra191
DN111 — Current Consumption for a Polling Receiver	swra207a
DN112 — Using UART in CC111xFx CC243x CC251xFx and CC253xFx	swra222b
DN113 — CC111xFx CC243xFx CC251xFx CC253xFx SPI Interface	swra223a
DN114 — Test_Signals_for_Debug_Purpose in CC111xFx, CC251xFx, and CC243x	swra241a
DN115 — Using PWM for Dimmer Function in LED Lighting	swru227
DN116 — Clearing Module Interrupt Flags in LPW SoC Devices (PDF 211 KB)	swra303
DN117 — SimpliciTI-compatible UART Driver	swra306
DN118 — Porting SimpliciTI to the SmartRF CCxx10 Target Board	swra311
DN119 — Asynchronous Serial Mode for CC111xFx and CC251xFx	swra316
DN200 — Using Constants in Code With Z-Stack	swra104
DN201 — Using the Direct Join Request Feature in Z-Stack	swru124a
DN300 — SmartRF04EB Troubleshooting	swra105b
DN301 — Code Export From SmartRF Studio	swra106
DN302 — Register View in SmartRF Studio	swra107a
DN400 — Interfacing CC1100 - CC2500 with MSP430	swra116a
DN401 — Interfacing CC1020/1 with MSP430	swra115
DN402 — Simple Audio Loopback Using CC251X	swra138
DN500 — Packet Transmission Basics	swra109c
DN501 — PATABLE Access	swra110b
DN502 — CRC Implementation	swra111d
DN503 — SPI Access	swra112b
DN504 — FEC Implementation	swra113a
DN505 — RSSI interpretation and timing	swra114d
DN506 — GDO Pin Usage	swra121a
DN507 — FEC Decoding	swra313
DN508 — Frequency Scanning using CC430Fx, CC110x, and CC111xFx	swra315
DN509 — Data Whitening and Random TX Mode	swra322

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Wireless connectivity ICs:
CC430, CC1101, CC2520, CC2530

Contact details:
Contact: Wolfgang Esch
Email: wolfgang.esch@amber-wireless.de
Phone: 0049-2203-6991950
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Contact details:
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Phone: (+47) 4000 5195
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Wireless connectivity ICs
CC2530, CC2500, CC2550, CC2510, CC1100, CC1110, CC2511, CC256x, CC1020, CC2520/MSP430, WL1271-TiWi

Contact details:
Contact: Bill Steinike
Email: bsteinike@lsr.com
Phone: 262-375-4400 ext.103
URL: http://www.lsr.com/

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CC2430, CC2431

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Product Comparison Guide Sub-1 GHz

Features/Product	TMS37157PaIFI	TMS3705	TRF7960	TRF7961	CC1020	CC1021
Product type	Transponder with SPI Interface	RFID Reader	RFID Reader	RFID Reader	Transceiver	Transceiver
Programmable frequency	134.2 kHz	134.2 kHz	13.56 MHz	13.56 MHz	402 to 470 MHz	402 to 470 MHz
					804 to 960 MHz	804 to 960 MHz
Frequency resolution	134.2 kHz -12 kHz	134.2 kHz -12 kHz	13.56 MHz ±7 kHz	13.56 MHz ±7 kHz	—	—
Supply voltage	2 to 3.6 V	4.5 to 5.5 V	2.7 to 5.5 Vdc	2.7 to 5.5 Vdc	2.3 to 3.6 V	2.1 to 3.6 V
Current consumption (RX)	150 µA	8 mA	10 mA	10 mA	19.9/19.9 mA	19.9/19.9 mA
Current consumption (TX, 0dBm)	150 µA	max Tx (dependent on antenna load), 220 mA	120 mA (23 dBm)	120 mA (23 dBm)	16.2/20.5 mA	16.2/20.5 mA
FSK data rate (max)	8 kbps	8 kbps	848 kbps	26.48 kbps	153.6 kbps	153.6 kbps
Modulation format	ASK/FSK	ASK/FSK	ASK/PPM/FSK	ASK/PPM/FSK	FSK/OOK/GFSK	FSK/GFSK/OOK
Receiver sensitivity (FSK)	—	1.5mVpp	fSUB-CARRIER = 424 kHz, 2.5mVpp fSUB-CARRIER = 848 kHz, 3mVpp	fSUB-CARRIER = 424 kHz, 2.5mVpp	–118 dBm	–109 dBm
Transmit power (up to)	—	—	+23 dBm	+23 dBm	+10 dBm	+10 dBm
Multi-channel systems/frequency hopping protocols	—	—	—	—	✓	✓
RSSI output	—	—	Digital	Digital	Digital	Digital
Integrated bit synchronizer	—	—	—	—	✓	✓
Internal RF switch/IF filter	✓	✓	✓	✓	✓	✓
Antenna connection	Differential	Differential	Single ended	Single ended	Single ended	Single ended
Package type	QFN-16	SOIC-16	QFN-32	QFN-32	QFN-32	QFN-32
Narrow band (12.5/25 kHz)	—	—	—	—	✓	—
Integrated MCU	—	—	—	—	—	—
USB	—	—	—	—	—	—
AES encryption/authentication	—	—	—	—	—	—
Program memory	—	—	—	—	—	—
Data memory	121 bytes free available EEPROM user memory/ 32 Bit unique serial number	—	—	—	—	—

Product Comparison Guide Sub-1 GHz (continued)

Features/Product	CC1101	CC1100E	CC1150	CC1101-Q1	CC1131-Q1	CC1151-Q1	CC1110	CC1111	CC430	CC1190
Product type	Transceiver	Transceiver	Transmitter	UHF sub-1-GHz transceiver	UHF Sub-1-GHz receiver	UHF Sub-1-GHz transmitter	SoC	SoC	SoC	Frontend
Programmable frequency	300 to 348 MHz 387 to 464 MHz 779 to 928 MHz	470 to 510 MHz 950 to 960 MHz	300 to 348 MHz 400 to 464 MHz 800 to 928 MHz	310-348w 420-450 779-928	310-348 420-450 779-928	310-348 420-450 779-928	300 to 348 MHz 391 to 464 MHz 782 to 928 MHz	300 to 348 MHz 391 to 464 MHz 782 to 928 MHz	300 to 348 MHz 387 to 464 MHz 779 to 928 MHz	850 to 950 MHz
Frequency resolution	—	—	—	~400Hz	~400Hz	~400Hz	—	—	—	—
Supply voltage	1.8 to 3.6 V	1.8 to 3.6 V	1.8 to 3.6 V	1.8-3.6V	1.8-3.6V	1.8-3.6V	2.0 to 3.6 V	3.0 to 3.6 V	1.8 to 3.6 V	2.0 to 3.7 V
Current consumption (RX)	15.0 mA	15.5 mA	—	15.5 mA in Receive Mode, 1.2 kBaud, 315 MHz	15.5 mA in Receive Mode, 1.2 kBaud, 315 MHz		17 mA	17 mA	15 mA	Adds 3.0 mA
Current consumption (TX, 0dBm)	14.7 mA	16.6 mA	14.5/15.9 mA			14.6 mA in transmit mode, 1.2 kBaud, 315 MHz	20 mA	20 mA	15 mA	302 mA at +26dBm
FSK data rate (max)	600 kbps	500 kbps	500 kbps	250kBaud	250kBaud	250kBaud	500 kbps	500 kbps	500 kbps	—
Modulation format	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	FSK/GFSK/ MSK/OOK/ASK	FSK/GFSK/ MSK/OOK/ ASK	—
Receiver sensitivity (FSK)	–111 dBm	–112 dBm	—	–114 dBm	–114 dBm	—	–111 dBm	–111 dBm	–111	6 dB improvement
Transmit power (up to)	+12 dBm	+11 dBm	+10 dBm	–30 to +12 dBm	—	–30 to +12 dBm	+12 dBm	+12 dBm	+12 dBm	+26 dBm
Multi-channel systems/ frequency hopping protocols	✓	✓	✓	FHSS	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	Differential	Differential	Differential
Package type	QLP-20	QLP-20	QLP-16	QFN-32, 5x5 (RHB)	QFN-32, 5x5 (RHB)	QFN-32, 5x5 (RHB)	QLP-36	QLP-36	VQFN-48/ VQFN-64	QFN-16
Narrow band (12.5/25 kHz)	—	—	—	—	—	—	—	—	—	✓
Integrated MCU	—	✓	—	—	—	—	✓	✓	✓	—
USB	—	✓	—	—	—	—	—	✓	—	—
AES encryption/ authentication	—	✓	—	—	—	—	✓	✓	✓	—
Program memory	—	8/16/32-kB Flash	—	—	—	—	8/16/32-kB Flash	8/16/32-kB Flash	8/16/32-kB Flash	—
Data memory	—	1/2/4-kB SRAM	—	—	—	—	1/2/4-kB SRAM	1/2/4-kB SRAM	2/4-kB SRAM	—

Product Comparison Guide 2.4 GHz

Features/Product	CC2500	CC2510	CC2511	CC2520	CC2530	CC2531	CC2533	CC2540	CC2550
Product type	Transceiver	SoC	SoC	Transceiver	SoC	SoC	SoC	SoC	Transmitter
Programmable frequency, MHz	2400 to 2483	2400 to 2483	2400 to 2483	2394 to 2507	2400 to 2483	2400 to 2483	2400 to 2483	2400 to 2483	2400 to 2483
Frequency resolution	427 Hz	427 Hz	427 Hz	1 MHz	1 MHz	1 MHz	1 MHz	2 MHz	427 Hz
Operating supply voltage	1.8 to 3.6 V	2.0 to 3.6 V	3.0 to 3.6 V	1.8 to 3.8 V	2.0 to 3.6 V	2.0 to 3.6 V	2.0 to 3.6 V	2.0 to 3.6 V	1.8 to 3.6 V
Current consumption (RX)	12.8 mA	19.8 mA	22 mA	18.5 mA	24 mA	24 mA	25 mA	19.6mA	—
Current consumption (TX, 0dBm)	21.6 mA	23 mA	23 mA	25.8 mA	29 mA	29 mA	29 mA	27mA	22.8 mA
Data rate (max)	500 kbps	500 kbps	500 kbps	250 kbps	250 kbps	250 kbps	250 kbps	1 Mbps	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	–98 dBm	–97 dBm at PER <1%	–97 dBm at PER <1%	–97 dBm at PER <1%	–93 dBm	—
Transmit power (up to)	+1 dBm	+1 dBm	+1 dBm	+5 dBm	+4.5 dBm	+4.5 dBm	+4.5dBm / +7dBm	+4dBm	+1 dBm
Multi-channel systems	FHSS	FHSS	FHSS	DSSS	DSSS	DSSS	DSSS	FHSS	FHSS
RSSI output	Digital	Digital	Digital	Digital	Digital	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	128 bytes TX 128 bytes RX	128 TX 128 RX + DMA	128 TX 128 RX + DMA	128 TX 128 RX + DMA	DMA	64 bytes
Internal RF switch/IF Filter	✓	✓	✓	✓	✓	✓	✓	✓	—
RF chip interface	Differential	Differential	Differential	Differential	Differential	Differential	Differential	Differential	Differential
Package type	QLP-20 4x4 mm	QLP-36 6x6 mm	QLP-36 6x6 mm	QLP-48 7x7 mm	QFN-40 6x6 mm	QFN-40 6x6 mm	QFN-40 6x6 mm	QFN-40 6x6 mm	QLP-16 4x4 mm
Integrated MCU	—	✓	✓	—	✓	✓	✓	✓	—
IEEE 802.15.4 compliant	—	—	—	✓	✓	✓	✓	—	—
USB	—	—	✓	—	—	✓	—	✓	—
AES encryption/authentication	—	✓	✓	✓	✓	✓	✓	✓	—
Program memory	—	32-kB Flash	32-kB Flash	—	32/64/128 256-kB Flash	128/256-kB Flash	32/64/96-kB Flash	128/256-kB Flash	—
Data memory	—	4-kB SRAM	4-kB SRAM	768 bytes	8-kB SRAM	8-kB SRAM	4/6-kB SRAM	8-kB SRAM	—

Product Comparison Guide 2.4 GHz (continued)

Features/Product	CC2560-PAN1325	CC2560-PAN1315	CC2567-PAN1327	CC2567-PAN1317	WL1271-TiWi	CC257x	CC2591	CC2595	CC8520
Product type	*Bluetooth* transceiver	*Bluetooth* transceiver	*Bluetooth*/ ANT transceiver	*Bluetooth*/ ANT transceiver	WLAN/ *Bluetooth* transceiver	Network Processor	RF front end	RF Front End	Network Processor
Programmable frequency, MHz	2402 to 2480	2402 to 2480	2402 to 2480	2402 to 2480	2412 to 2472 (WLAN) 2402 to 2480 (*Bluetooth*)	2400 to 2507	2400 to 2483.5	2400 to 2483.5	2400 to 2483
Frequency resolution	1 MHz	1 MHz	1 MHz	1 MHz	5 MHz	1 MHz	—	—	4 MHz
Operating supply voltage	1.7 to 4.6 V	1.7 to 4.6 V	1.7 to 4.6 V	1.7 to 4.6 V	3 to 4.8 V	2.0 to 3.6 V	2.0 to 3.6 V	2.0 to 3.6 V	2.0 to 3.6 V
Current consumption (RX)	—	—	—	—	—	22mA	1.8 mA	80mA	25 mA
Current consumption (TX, 0dBm)	—	—	—	—	—	26mA	3.4 mA	—	29 mA at +4 dBm
Data rate (max)	2.1 Mbps	2.1 Mbps	2.1 Mbps	2.1 Mbps	65 Mbps	1 Mbps	—	—	5 Mbps
Receiver sensitivity	–91 dBm at PER <1%	–93 dBm at PER <1%	–91 dBm at PER <1%	–93 dBm at PER <1%	-89 dBm (802.11b, 11 Mbps), -76 dBm (802.11g, 54 Mbps), -73 dBm (802.11n, 65 Mbps)	-88dBm	—	—	-83dBm
Transmit power (up to)	+10 dBm	+10 dBm	+10 dBm	+10 dBm	+20 dBm (802.11b), +14.5 dBm (802.11g), +12.5 dBm (802.11n)	0dBm	—	—	+4dBm
Multi-channel systems	FHSS	FHSS	FHSS	FHSS	OFDM and DSSS	Frequency Agile	—	—	FHSS
RSSI output	—	—	—	—	—	Digital	—	—	—
Integrated bit synchronizer	✓	✓	✓	✓	✓	✓	—	—	✓
Integrated packet handling	✓	✓	✓	✓	✓	✓	—	—	✓
Data buffering	✓	✓	✓	✓	✓	Yes	—	—	Yes
Internal RF switch/IF Filter	✓	✓	✓	✓	✓	✓	—	—	✓
RF chip interface	—	—	—	—	—	Differential	—	—	Differential
Package type	Surface mount module, integrated antenna: 9 x 9.5 x 1.8 mm^3	Surface mount module, no antenna: 6.5 x 9.5 x 1.8 mm^3	Surface mount module, integrated antenna: 9 x 9.5 x 1.8 mm^3	Surface mount module, no antenna: 6.5 x 9.5 x 1.8 mm^3	Surface mount: 13x18x1.9 mm3	QFN-40 6x6 mm	QFN-16 QFN-48	QFN-16 3mm x 3mm	QFN-40 6x6 mm
Integrated MCU	—	—	—	—	—	✓	—	—	✓
IEEE 802.15.4 compliant	—	—	—	—	—	—	—	—	—
USB	—	—	—	—	—	—	—	—	—
AES encryption/ authentication	—	—	—	—	✓	✓	—	—	—
Program memory	✓	✓	✓	✓	✓	—	—	—	Yes
Data memory	—	—	—	—	—	—	—	—	Yes

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