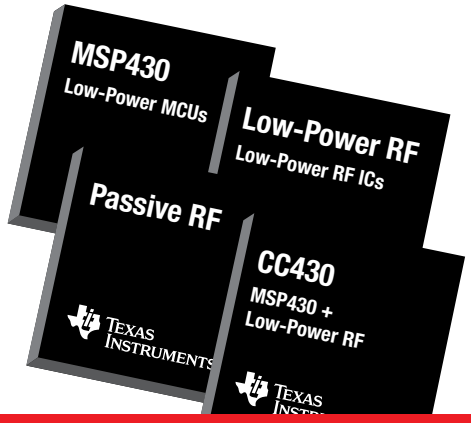
MSP430™ MCUs, Passive RF and Low-Power RF Solutions Guide



The Texas Instruments (TI) portfolio of MSP430™ microcontrollers and Low-Power RF devices are an ideal fit for low-power wireless networks, including standard-based IEEE 802.15.4 and ZigBee® or other proprietary networks. The MSP430 product line offers the unique combination of ultra-low power consumption with a high-performance 16-bit CPU and integrated analog. Together, MSP430 and TI's Low-Power RF devices help wireless designers achieve low power, long range and reliably performing designs at a competitive price. TI also offers the CC430 family of sub 1 GHz system-on-chip monolithic devices that integrate the MSP4305xx microcontroller with a flexible Low-Power RF transceiver, offering you more performance in less space.

Supported Standard-Based Networks

- IEEE 802.15.4 – A wireless radio frequency standard for low-power and short-range applications. This standard is ideal for point-to-point or point-to-multipoint networks. Systems that start with an 802.15.4-based proprietary network can later be upgraded with new software and evolve to a ZigBee-compliant system. TIMAC software and packet sniffer are included for free with the protocol.

- ZigBee PRO – A low-power wireless network standard that offers mesh networking as well as interoperability between different vendors' products. ZigBee is a network layer on top of the IEEE 802.15.4 standard (PHY and MAC layers). The new Advanced Metering Infrastructure (AMI) profile and the Home Automation profile are a perfect fit for a powerful combination of smart metering and home automation services – based on a worldwide standard. Z-Stack™ software and packet sniffer come bundled for free.

Proprietary Networks

- SimpliciTI™ Network Protocol – This free software code and packet sniffer, an excellent start for building a network, is battery operated and was designed to be used with TI Low-Power RF system-on-chips or the MSP430 and an RF transceiver. SimpliciTI network protocol is a simple and versatile solution, combining MSP430+CC1101/2500, CC1110/2510 and CC2520 DSSS parts, and offering applications such as alarm systems, smoke detectors and active RF-ID applications.

Passive Standard-Based Networks

- ISO 18000-2 – This Passive RF air-interface protocol enables short-range two way communication without the need of a battery by scavenging the RF energy transmitted from a base-station. It is ideal for data-logging applications (configuring 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.

Standalone MCU and Low-Power RF Selection Table

Standard-Based Network			Proprietary Network		Passive Standard-Based Network
IEEE 802.15.4	ZigBee®	ZigBee PRO	SimpliciTI™		ISO 18000-2
CC2520	CC2520 with TIMAC	CC2520 with TIMAC and Z-Stack™ software	Sub-1 GHz CC1101/CC1150, CC102x/ CC1070	2.4 GHz CC2500/CC2550/CC2520	134.2KHz TMS37157
MSP430F261x MSP430F543x	MSP430F261x MSP430F543x	MSP430F261x MSP430F543x	MSP430 device with >6-KB Flash and 1-KB RAM	MSP430 device with >6-KB Flash and 1-KB RAM	MSP430F22xx

These are recommended devices. Any MSP430 device can be used depending on Flash/RAM requirements of the software solution.

System-on-Chip Solutions

The CC430 is the industry's highest performance, single-chip, low-power RF solution. It is based on the new 5xx generation of ultra-low-power MSP430 microcontrollers, with a high level of peripheral integration, outstanding analog performance and ease of use. The 5xx core is paired with the flexible CC1101 sub-1GHz transceiver to deliver the sensitivity and blocking performance required to achieve a robust communication link in any RF environment. The CC430 enables the user to minimize RF power, size, and cost requirements while still maintaining superior application performance. TI also offers 8051-based System-on-Chip solutions. For IEEE 802.15.4 and ZigBee networks, use CC2530.

Application-Specific Product Recommendations

Application	MCU and RF Solution		System-on-Chip
Alarm and Security (Smoke, Motion, Glass Break Detector)	MSP430F20xx, MSP430F22xx, TMS37157	CC1101/CC1150, CC1020/CC1070,	CC1110/CC1111, CC251x, CC2530, CC430
Automated Meter Reading (AMR) for Utility Meters, Advanced Meter Infrastructure (AMI)	MSP430FE42x, MSP430FW42x, MSP430F41x, MSP430F2618, TMS37157	CC1101/CC1150, CC1020/CC1070, CC2530ZNP, CC2520	CC1110/CC1111, CC251x, CC2530, CC430
Wireless Sensor Networks (Monitoring, Asset Tracking)	MSP430F20xx, MSP430F41x, TMS37157	CC1101/CC1150, CC2500/CC2550, CC2530ZNP	CC1110/CC1111, CC251x, CC2530, CC2520, CC430
Building Automation (Light, Temperature, Process Control)	MSP430F20x1, MSP430F21x1, MSP430F41x, MSP430 F2618, TMS37157	CC1101/CC1150, CC2500/CC2550, CC2520, CC2530ZNP	CC1110/CC1111, CC251x, CC2530, CC430
PC Peripherals	MSP430F22x2, MSP430F21x1	CC2500/CC2550, CC2520	CC2430, CC251x, CC430
Home and Leisure Equipment (Remote Controls, Gaming, Toys, Home Electronics)	MSP430F20xx, MSP430F23/24x, MSP430F41x, MSP430F43x	CC1101/CC1150, CC2500/CC2550	CC1110/CC1111, CC251x, CC430
Medical	MSP430FG4xxx, MSP430F41x TMS37157	CC1101/CC1150, CC2500/CC2550, CC2530ZNP, CC2520	CC1110/CC1111, CC2530, CC251x, CC430

Getting Started with MSP430 and Low-Power RF Devices

Low-Power RF devices receive and transmit data via the SPI protocol. The MSP430 Code Library for TI RF devices makes communicating to an RF device simple through a MSP430 SPI, USART, USI, USCI or even "bit-banged" I/O port.

For the CC430, standalone MSP430 and Low-Power RF devices, we recommend the following set-up:

- Two MSP-EXP430FG4618 experimenter boards (standalone MSP430 and Low-Power RF devices) or 1 FET430F6137RF900 EVM kit (CC430)
- One CC1101 or CC2500 EMK (includes two boards) – for standalone MSP430 and Low-Power RF devices only
- IDE (IAR Workbench or Code Composer™ studio V4 have limited versions for free download)
- MSP-FET430UIF or equivalent MSP430 programming and debugging interface
- MSP430 Code Library for CC430, Low-Power RF devices and other software resources
- SmartRF Studio

Hardware and Software Resources

Part Number	Description	Web Link
MSP-EXP430FG4618	The MSP430FG4618/F2013 Experimenter Board, together with low-power RF EMKs, are an ideal platform for beginning development with these devices. The Experimenter Board features selected MSP430 devices, plug-in header for low-power RF evaluation modules and additional hardware components for easy system evaluation and prototyping	**www.ti.com/msp430wireless**
Low-Power RF EMKs	Low-Power RF EMKs are designed to enable the easy evaluation of products, allowing for RF measurements and the development of a prototype.	**www.ti.com/lprf**
MSP430 Code Library for Low-Power RF Devices	Code Library provides functions to facilitate the interfacing of an MSP430 device to CC1100/CC2500 devices.	FREE DOWNLOAD: **www.ti.com/ccmsplib**
SimpliciTI™ Network Protocol	A Low-Power RF network protocol perfect for small RF networks.	FREE DOWNLOAD: **www.ti.com/simpliciti**
TIMAC IEEE 802.15.4 MAC Software	IEEE 802.15.4 medium access control (MAC) software stack for CC2520 and MSP430.	FREE DOWNLOAD: **www.ti.com/timac**
Z-Stack™ Software ZigBee® Protocol Stack	Z-Stack software is compliant with the ZigBee PRO and earlier versions (ZigBee 2006 and ZigBee 2007). It supports multiple platforms including the CC2520 and MSP430 platform and CC2430 System-on-Chip. The Z-Stack protocol stack has been awarded the ZigBee Alliance's golden unit status by the ZigBee test house TÜV Rheinland.	FREE DOWNLOAD: **www.ti.com/z-stack**
Passive RF EmKs	The kit comes with an eZ430 MSP430F1612 USB development stick, and an MSP430 MCU target board including an MSP430F2274 plus the TMS37157 PaLFI. A battery board for active operation in addition to an RFID Base station reader/writer provide the infrastructure for various evaluation set ups.	**www.ti.com/ez430_tms37157**

In addition, TI has partnered with various companies offering a variety of hardware and software tools for developing RF solutions with the MSP430 and Low-Power RF devices. Please visit ***www.ti.com/lprfnetwork*** *for a complete listing.*

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DSP	dsp.ti.com	Computers and Peripherals	www.ti.com/computers
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Interface	interface.ti.com	Energy	www.ti.com/energy
Logic	logic.ti.com	Industrial	www.ti.com/industrial
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Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
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