TI CC430 超低功耗 MCU 射频应用方案

TI 公司的 CC430 系列是集成了 RF 收发器的超低功耗 MCU 系统级芯片(SoC),器件具有功能强大的 MSP430™ 16 位 RISC CPU,16 位居寄存器,以及常数发生器,以得到最高的代码效率.工作电压 1.8V-3.6V,CPU 工作时的功耗 160 μA/MHz,主要用在建筑物自动化,测试测量和财产跟踪.本文介绍 CC430 主要特性, CC430F613x 和 CC430F513x 的功能方框图, 小于 1GHz 无线电方框图,以及 CC430F61xx 和 CC430F51xx 的典型应用电路图与材料清单.

The Texas Instruments CC430 family of ultralow-power microcontroller system-on-chip with integrated RF transceiver cores 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 主要特性:

True System-on-Chip (SoC) for Low-Power Wireless Communication Applications

Wide Supply Voltage Range: 1.8 V to 3.6 V

Ultralow Power Consumption:

CPU Active Mode (AM): 160 μA/MHz

Standby Mode (LPM3 RTC Mode):2.0 μA

Off Mode (LPM4 RAM Retention): 1.0 μA

Radio in RX: 15 mA, 250 kbps, 915 MHz

MSP430 System and Peripherals

16-Bit RISC Architecture, Extended Memory, 50-ns Instruction Cycle Time

Wake-Up From Standby Mode in Less Than 6 μs

Flexible Power Management System with SVS and Brownout

Unified Clock System with FLL

16-Bit Timer TA0, Timer_A with Five Capture/Compare Registers

16-Bit Timer TA1, Timer_A with Three Capture/Compare Registers

Hardware Real-Time Clock

Two Universal Serial Communication Interfaces

USCI_A0 supporting UART, IrDA, SPI

USCI_B0 supporting I^2C, SPI

12-Bit A/D Converter With Internal Reference, Sample-and-Hold, and Autoscan Features (Only CC430F613x and CC430F513x) Comparator

The CC430 has one active mode and five software selectable low-power modes of operation. An interrupt event can wake up the device from any of the low-power modes, service the request, and restore back to the low-power mode on return from the interrupt program.

The following six operating modes can be configured by software:

• Active mode (AM)

– All clocks are active

• Low-power mode 0 (LPM0)

– CPU is disabled

– ACLK and SMCLK remain active, MCLK is disabled

– FLL loop control remains active

• Low-power mode 1 (LPM1)

– CPU is disabled

– FLL loop control is disabled

– ACLK and SMCLK remain active, MCLK is disabled

• Low-power mode 2 (LPM2)

– CPU is disabled

– MCLK and FLL loop control and DCOCLK are disabled

– DCO's dc-generator remains enabled

– ACLK remains active

• Low-power mode 3 (LPM3)

– CPU is disabled

– MCLK, FLL loop control, and DCOCLK are disabled

– DCO's dc-generator is disabled

– ACLK remains active

• Low-power mode 4 (LPM4)

– CPU is disabled

– ACLK is disabled

– MCLK, FLL loop control, and DCOCLK are disabled

– DCO's dc-generator is disabled

– Crystal oscillator is stopped
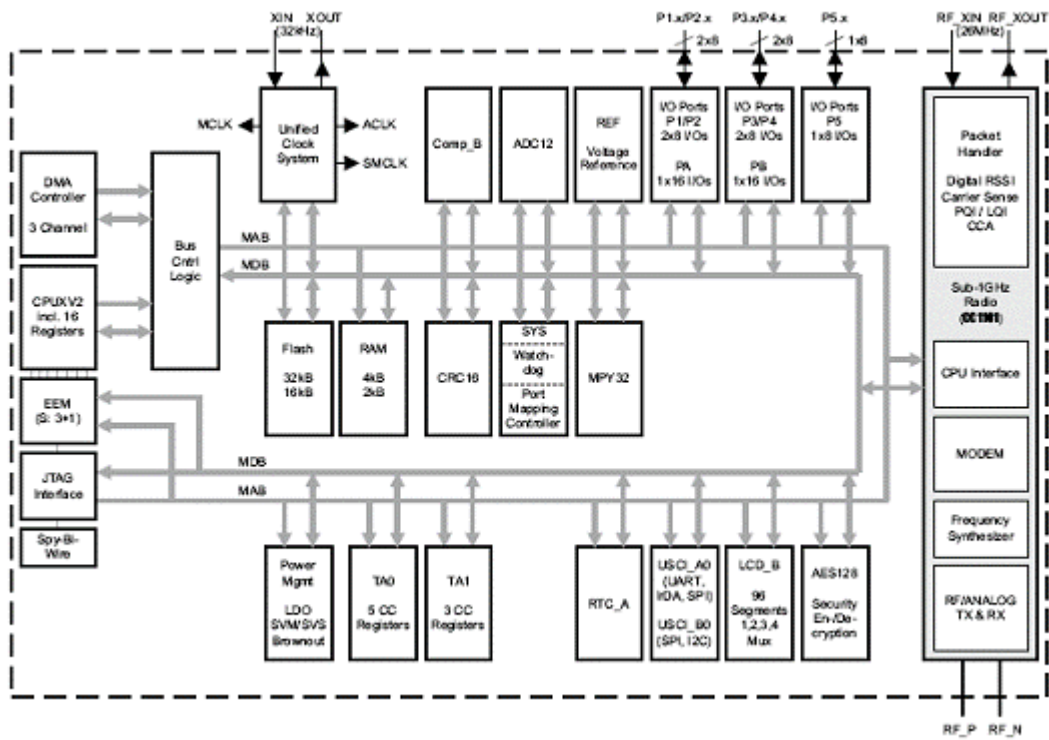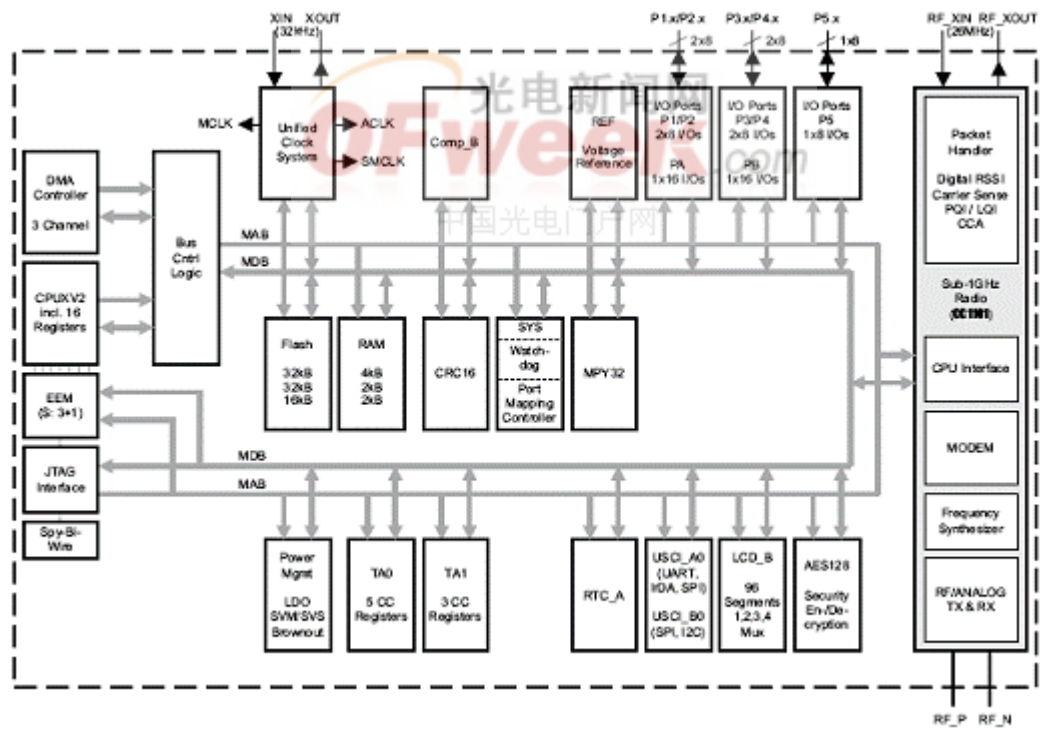
– Complete data retention
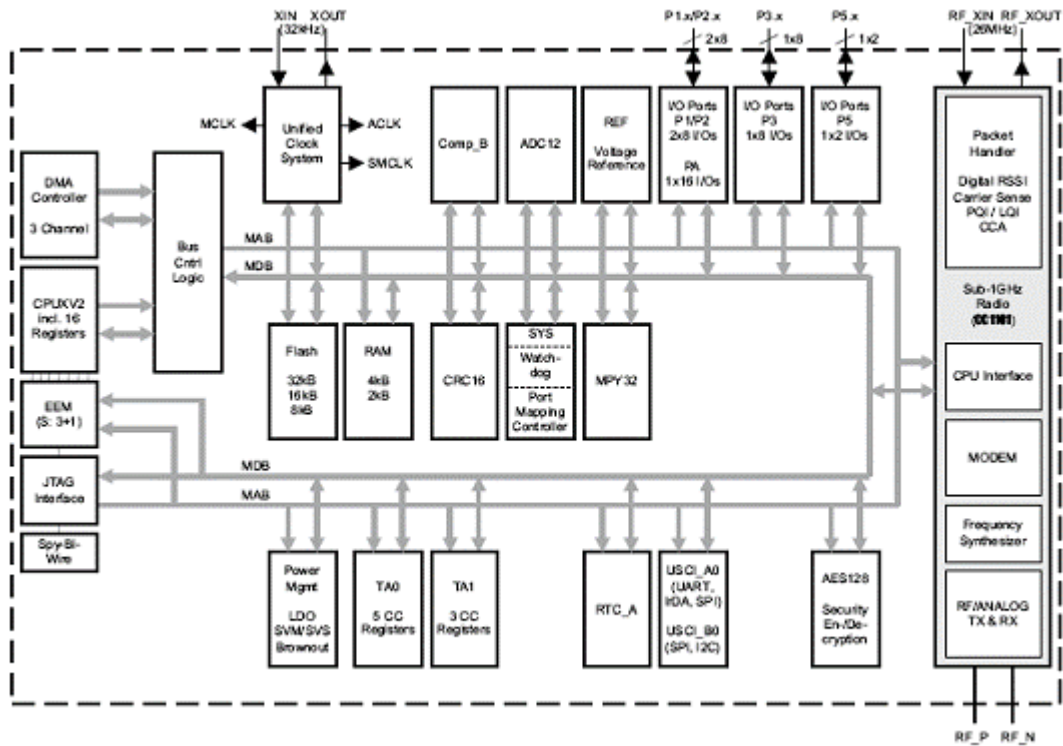
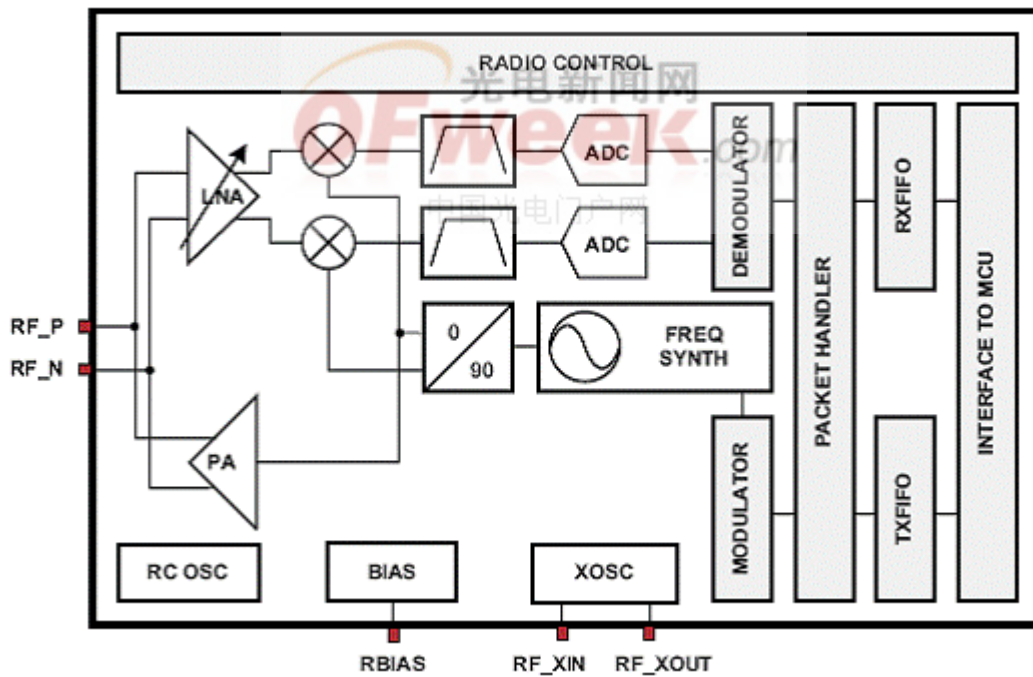图 1.CC430F613x 功能方框图

图 2. CC430F612x 功能方框图

图 3. CC430F513x 功能方框图

图 4. 小于 1GHz 无线电方框图

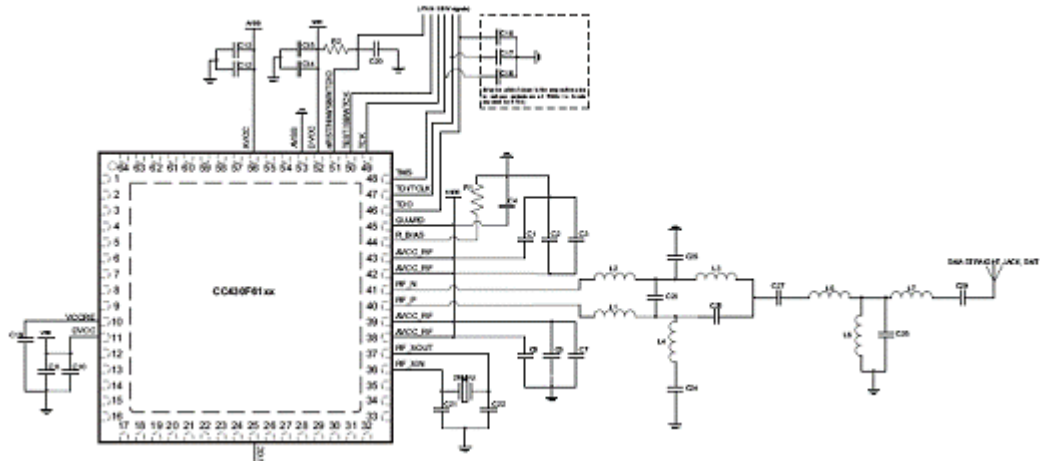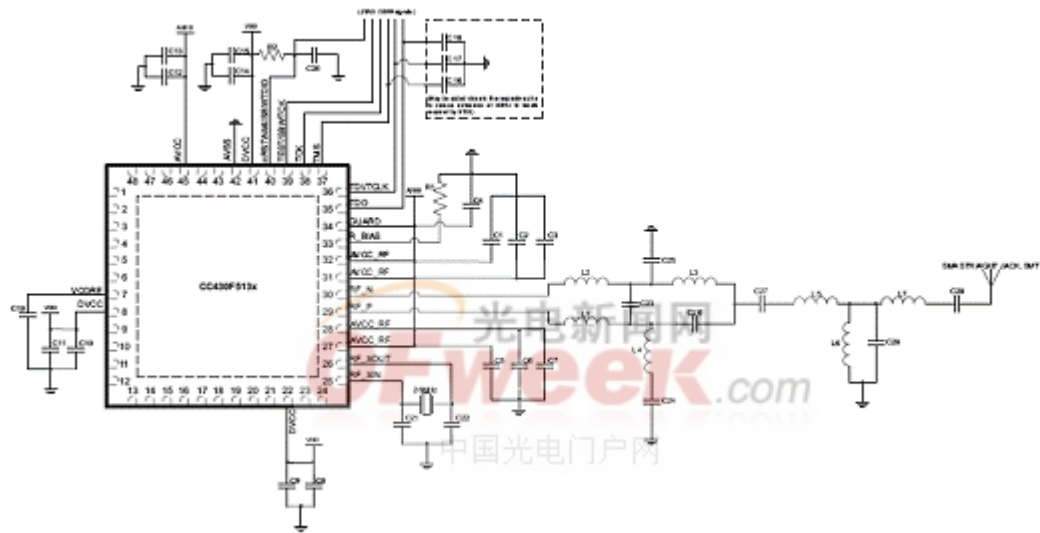图 5. CC430F61xx 典型应用电路图

图 6. CC430F51xx 典型应用电路图

应用电路图材料清单:

Component(s)	for 315MHz	for 433MHz	for 868/915MHz	Comment
C1,3,4,5,7,9,11,13,15	100nF			Decoupling capacitors
C8,10,12,14	10µF			Decoupling capacitors
C2,6,16,17,18	2pF			Decoupling capacitors
C19	470nF			V_{CORE} capacitor
C20	2.2nF			$\overline{RST}$ decoupling cap (optimized for SBW)
C21,22	27pF			Load capacitors for 26-MHz crystal[1]
R1	56kΩ			R_BIAS (±1% required)
R2	47kΩ			$\overline{RST}$ pullup
L1,2	Capacitors: 220pF	0.016µH	0.012µH	
L3,4	0.033µH	0.027µH	0.018µH	
L5	0.033µH	0.047µH	0.015µH	
L6	dnp[2]	dnp[2]	0.0022µH	
L7	0.033µH	0.051µH	0.015µH	
C23	dnp[2]	2.7pF	1pF	
C24	220pF	220pF	100pF	
C25	6.8pF	3.9pF	1.5pF	
C26	6.8pF	3.9pF	1.5pF	
C27	220pF	220pF	1.5pF	
C28	10pF	4.7pF	8.2pF	
C29	220pF	220pF	1.5pF	

(1) The load capacitance C_L seen by the crystal is $C_L = 1/((1/C21)+(1/C22)) + C_{parasitic}$. The parasitic capacitance $C_{parasitic}$ includes pin capacitance and PCB stray capacitance. It can be typically estimated to be around 2.5pF.
(2) dnp: do not populate.