CC2430DB
Demonstration Board
User Manual

Table of content

1 Introduction

This manual contains reference information for the CC2430 DB hardware. The following tools, which can be used with the kit, have their own user manual that can be downloaded from the TI website:

- SmartRF® Studio
- Chipcon general packet sniffer
- IAR EW8051 C-compiler and C-Spy debugger (www.IAR.se)

The CC2430DB demonstration board includes a number of functions and applications that allows quick testing of the RF interface and peripherals of the CC2430. It can for example be used for:

- Evaluation of SmartRF®04 products.
- Measurement of current consumption. The kit is designed for low power operation, and with an ampere meter the current consumption can be measured for all operating modes.
- Prototype development. The CC2430DB includes a USB interface that can be used as emulator interface for the CC2430. Additionally, all I/O ports are available on pin connector on the board to allow easy access for external applications.

2 Definitions

CC2430DB	CC2430 Demonstration Board; described in this user manual
USB MCU	The Silicon Labs C8051F320 MCU used to provide a USB interface on the CC2430DB
Factory firmware	The firmware that is supplied programmed into the USB MCU from the factory. This firmware supports SmartRF® Studio operation.
SoC	System on a Chip. A collective term used to refer to Chipcon ICs with on-chip MCU and RF transceiver
ICE	In Circuit Emulator

3 Kit content

3.1 Hardware

The CC2430DB kit contains the following:

- 1 CC2430DB demonstration board
- 1 USB cable
- Quick start guide
- This document

4 Getting started

Make sure to install SmartRF® Studio **before** connecting the CC2430DB to a PC, as it installs the required hardware drivers on the PC. SmartRF® Studio can be downloaded from the TI web pages:
http://focus.ti.com/docs/toolsw/folders/print/smartrftm-studio.html

5 Hardware description CC2430DB

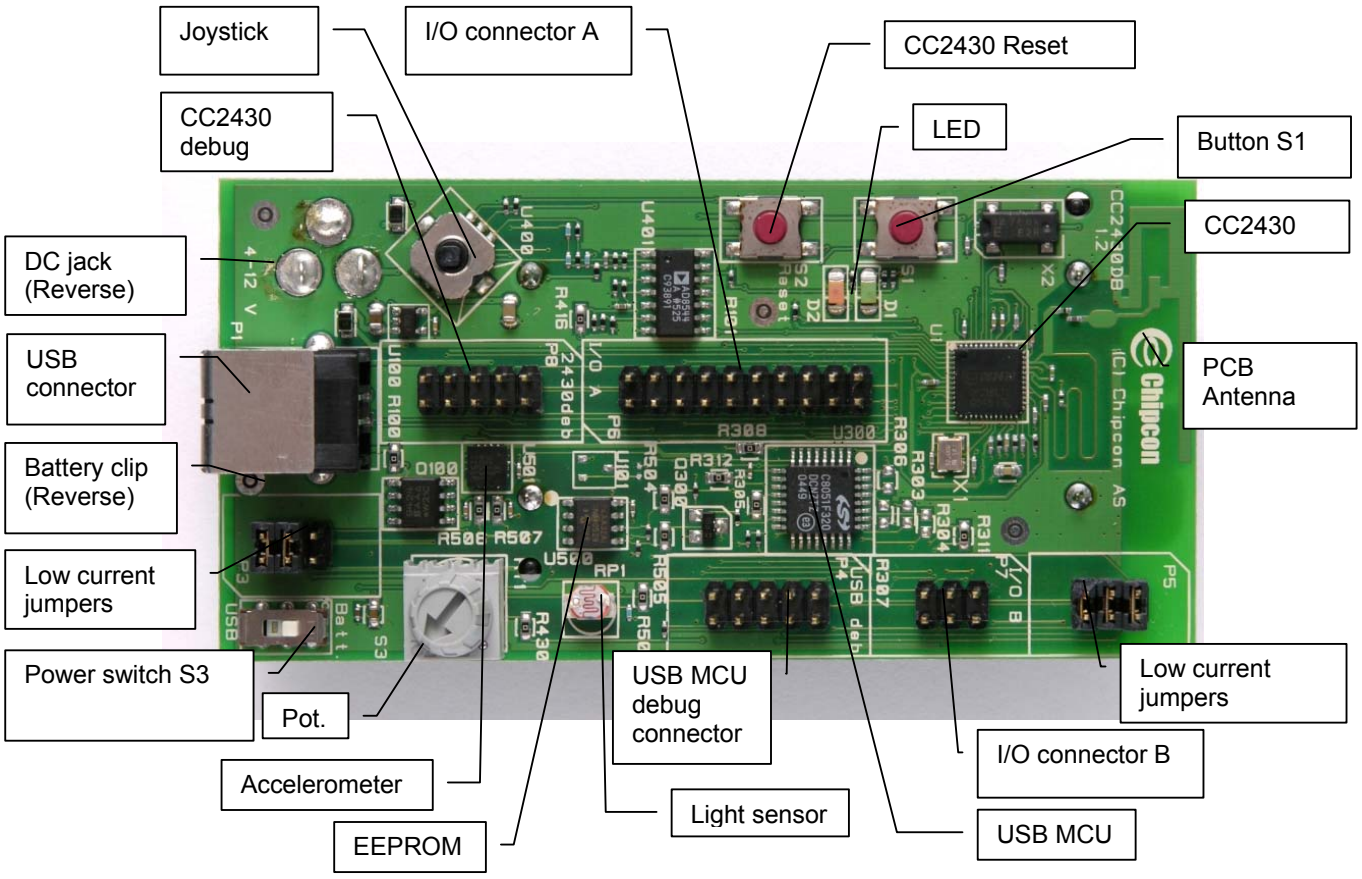

Figure 1: CC2430DB overview

5.1 Powering CC2430DB

The CC2430DB can be powered in three different ways:

- 2.5 mm DC jack connector. This connector is placed under the board. The centre pin is used for the positive voltage. A 4-10V DC power supply should be used. The onboard voltage regulator supplies 3.3V to the board.
- USB power. If the CC2430DB is connected to a USB socket on a PC, it will draw power from the USB bus. The onboard voltage regulator supplies 3.3V to the board.
- Battery power. The CC2430DB includes a battery clip for two AA type batteries

If several power sources are connected, the CC2430DB will be powered from the supply that supplies the highest voltage. The USB MCU is only powered when USB or DC jack power is used.

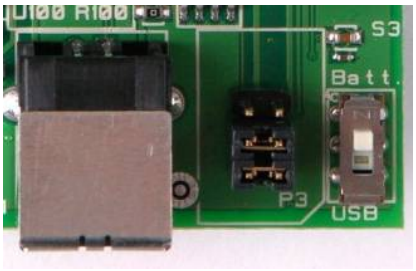

Figure 2: Power switch setting

The Power Switch S3 must be set according to what power source is used. If DC jack or USB power is applied, the switch should be set to the USB position. If the board is powered from batteries, the switch should be set to the BATT position as shown in Figure 2. When either DC power or batteries are used to power the board, the switch can be used as an on/off switch.

When powering the CC2430DB from batteries, the CC2430 will work down to 1.8V. Please note that when using USB, the voltage range is limited to 3.0V – 3.6V. The CC2430DB has been designed for a temperature range of –40° C to +85° C.

5.2 USB Interface

The USB interface is used to interface to a PC to run the In-Circuit Emulator in the IAR Embedded Workbench (IAR EW) and using SmartRF® Studio. The IAR EW can also be used to reprogram the CC2430DB (see the IAR EW manual for more details).
Furthermore, it is also possible to reprogram the CC2430DB via the USB interface with the Chipcon programming software, or to use the board for the Chipcon packet sniffer.

When connected to the USB port the CC2430DB is powered from the USB and no other voltage supplies are required.

Please refer to the Chipcon Flash Programmer User Manual installed with SmartRF® Studio for a detailed description of how to reprogram the CC2430DB.

5.3 User interface

The CC2430DB includes a joystick and a push button as user input devices, and two LEDs as user output devices.

5.4 EEPROM

A 32Kbit EEPROM is included for non volatile storage of data that is frequently updated. The EEPROM has 1 Million guaranteed write cycles.

5.5 Accelerometer

The accelerometer can be used to measure movements in 2 axes. It can also be used for tilt measurements by measuring the earth's gravitation. The accelerometer has a 20 ms start-up time after power on. See the Analog Devices ADXL321 datasheet for details about the accelerometer.

5.6 Potentiometer

The potentiometer controls the voltage on the analog input pin P0_7 of the CC2430. The voltage, and thus the potentiometer position, can be measured with the CC2430 A/D converter.

5.7 Light sensor

A light dependent resistor (LDR) measures light level and gives an analog signal that is measured by the CC2430 A/D converter. The light sensor resistance ranges from 5KΩ (light) to 20MΩ (dark).

5.8 I/O connectors

The I/O connectors bring out all the signals from CC2430. These connectors allow easy access to all CC2430 I/O pins. External circuitry can be connected to these connectors for prototyping.

Pin	Function
1	VDD
2	VDD_SW_CONTROLLED[1]
3	P0_0/LDR
4	RESET_N
5	P0_1/BUTTON PUSH
6	P1_7/SO/MISO/UART_RD
7	P0_2/EE_SDA
8	P1_6/SI/MOSI/UART_TD
9	P0_3/EE_SCL
10	P1_5/SCLK/RTS
11	P2_1/DD
12	P1_4/CSN/SS/CTS
13	P2_2/DC
14	P2_0/JOY PUSH
15	P0_6/JOY
16	P1_2/VDD_SW_CTRL
17	P0_7/POT
18	P1_1/LED2
19	P1_0/LED1
20	GND

Table 1: I/O connector A (P6) pin-out

Pin	Function
1	P1_3/GPIO
2	DC_JACK_PWR
3	P0_4/ACC_X
4	VDD
5	P0_5/ACC_Y
6	GND

Table 2: I/O connector B (P7) pin-out

[1] VDD_SW_CONTROLLED is controlled by the signal named VDD_SW_CTRL

5.9 Jumper settings

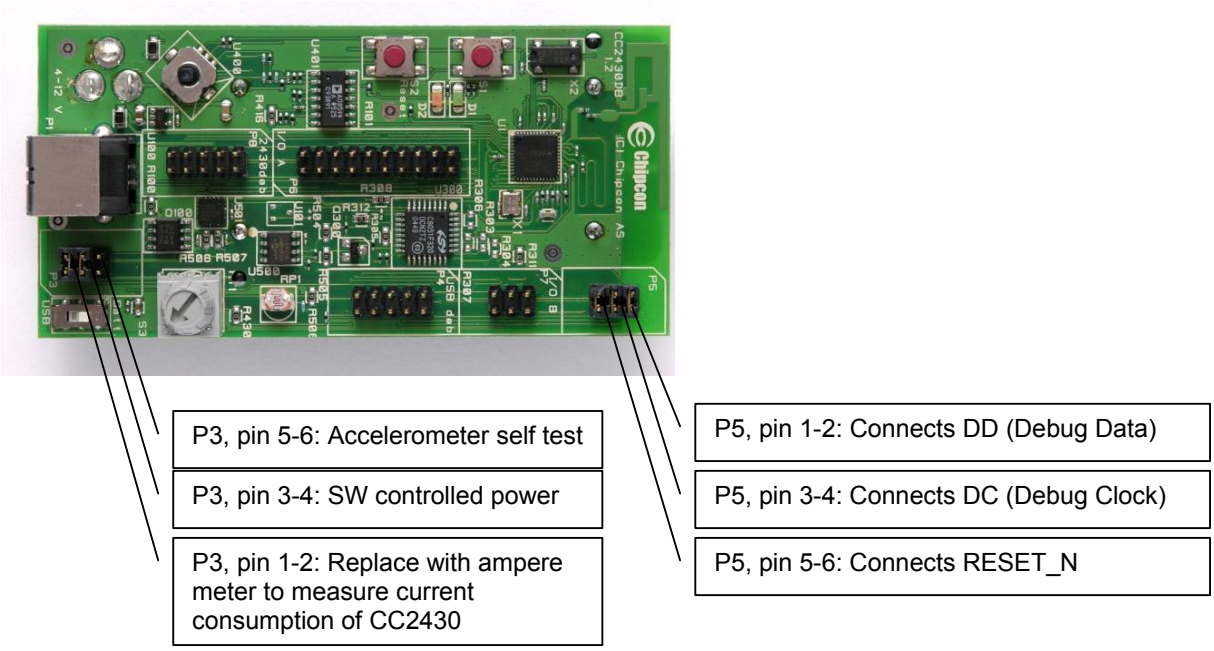

Figure 3: CC2430DB Jumper settings

Header	Pin	Description	Default setting
P3	1-2	Replace with ampere meter to measure current consumption of CC2430	Mounted
P3	3-4	SW controlled power. Can be removed when performing current measurement to reduce leakage current	Mounted
P3	5-6	Accelerometer self test. Mount to perform accelerometer self test function. See also section 5.9.1.	Not mounted
P4	7-9	Manual reset of USB MCU	Not mounted
P4	9-10	Mount during power on to force USB MCU into boot loader	Not mounted
P5	1-2	Connects DD (Debug Data) between USB MCU and CC2430. Should be removed when connecting ICE to P8 “2430deb“ connector	Mounted
P5	3-4	Connects DC (Debug Clock) between USB MCU and CC2430. Should be removed when connecting ICE to P8 “2430deb” connector	Mounted
P5	5-6	Connects RESET_N signal between USB MCU and CC2430. Can be removed when performing current measurement to reduce leakage current	Mounted

Table 3: Jumper settings summary

5.9.1 P3 Jumpers

The jumper between pin 1-2 on P3 can be replaced with an ampere meter to measure current consumption of CC2430. The jumper must be mounted for normal operation.

The jumper between pin 3-4 can be removed when performing current measurement to reduce leakage current of the peripheral devices connected to the CC2430. The jumper must be mounted for normal operation

The jumper between pin 5-6 can be mounted to perform accelerometer self test function. By mounting this jumper, a voltage is applied to the accelerometer outputs. See the Analog Devices ADXL321 datasheet for details about the accelerometer self test. The jumper must be removed for normal operation.

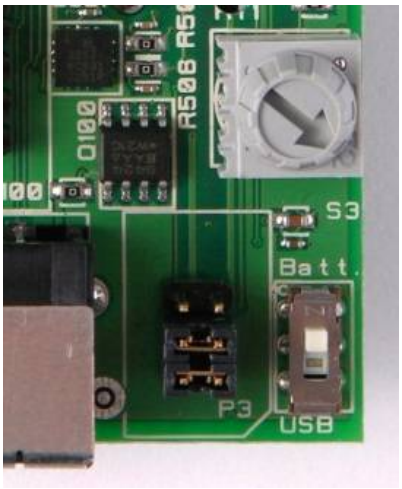

Figure 4: Default P3 jumper settings

5.9.2 P5 Jumpers

All jumpers on header P5 must be mounted for normal operation.

The jumper between pin 1-2 on P5 connects DD (Debug Data) between USB MCU and CC2430.

The jumper between pin 3-4 on P5 connects DC (Debug Clock) between USB MCU and CC2430DB.

When the CC2430DB is used with emulator connected to the USB port, both the DD and DC jumpers must be mounted. They should only be removed if an external emulator is used. Chapter 6.2 gives instructions on how to connect the external emulator to the CC2430DB.

The jumper between pin 5-6 on P5 connects RESET_N signal between USB MCU and CC2430. The jumper can be removed when performing current measurement to reduce leakage current for the circuits connected to the RESET pin. The jumper must be mounted for normal operation.

Figure 5: P5 default jumper settings

5.10 Signal flow

The signal lines from the I/O connectors and the CC2430 run via 0Ω resistors to the various peripherals on the CC2430DB. The peripherals can be disconnected from the CC2430 signal pins by removing the 0Ω resistors. Please refer to Table 6 for a list of what resistors correspond to which signals.

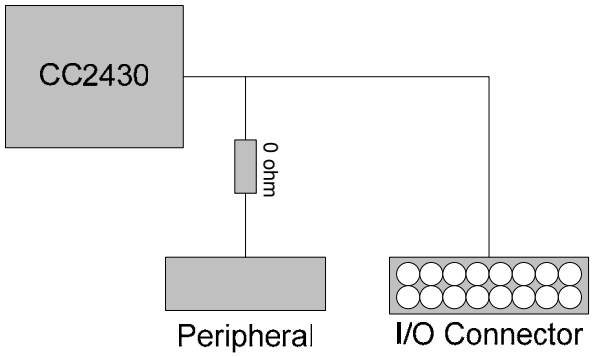

Figure 6: CC2430DB Signal flow

6 Using CC2430DB for prototyping

The CC2430DB can be used for prototyping by programming the CC2430 with custom applications. All I/O ports on the CC2430 are available on pin row header at the edge of the board, and the USB interface can be used as In Circuit Emulator (ICE) interface allowing real time in circuit emulation of the CC2430.

Table 6 on page 13 shows what pins on the MCU are used for various functions.

P6 and P7 pin-row connectors can be used to connect the CC2430DB to other PCB or prototyping boards. See page 6 for the pin-out of these connectors.

0Ω resistors are included to isolate the CC2430 from the external components on the CC2430DB. By removing these resistors, signals can be accessed on the pin headers. Refer to section 5.10 and Table 6 for information about which pin corresponds to which resistor.

6.1 Debugging using the USB interface

The most common way to use the CC2430DB for development is to use the USB interface to control the CC2430 on-chip In-Circuit Emulator. The USB interface supplies power to the board, so there is no need for additional DC power or batteries. The USB interface can also be used to program the CC2430 in circuit using the Chipcon programming software.

6.2 Debugging CC2430DB with the CC2430 debug connector

The CC2430DB can be used with the Chipcon packet sniffer or other applications that require USB interface for communication with PC and debugging with an emulator simultaneously. In these cases the SoC debug connector can be used for connecting the ICE. The SmartRF04EB can be used as emulator interface with a cable from P14 “SoC debug/flash” on SmartRF04EB to P8 “2430deb” on CC2430DB. See Figure 7 below. The jumpers between pin 1-2, 3-4 and 4-5 on header P5 must be removed.

CC2430DB must be powered from battery, USB or DC jack when debugged from SmartRF04EB.

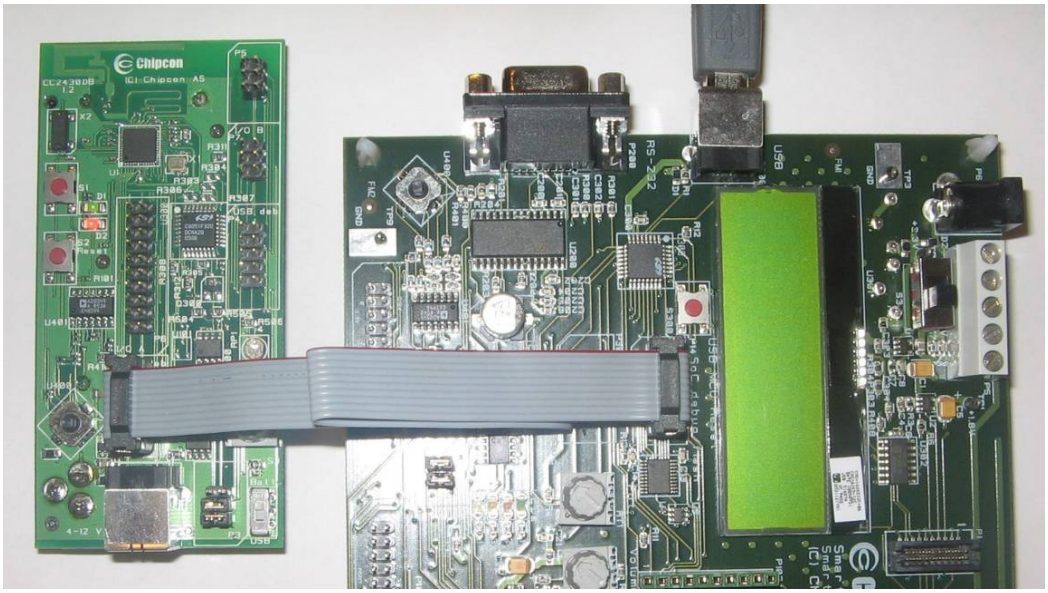

Figure 7: CC2430 Debug Connector

6.3 Low power operation

CC2430DB is designed for low power operation when running from batteries. Only the CC2430 is powered in this mode, the USB MCU is not powered. The voltage to the peripheral functions connected to the CC2430 is controlled by an I/O pin P1.2 (VDD_SW_CTRL) on the CC2430. Table 4 lists the current consumption for each of the peripherals.

To obtain minimum current consumption with the CC2430DB, the VDD_SW_CTRL (P1.2) output must be configured as output.

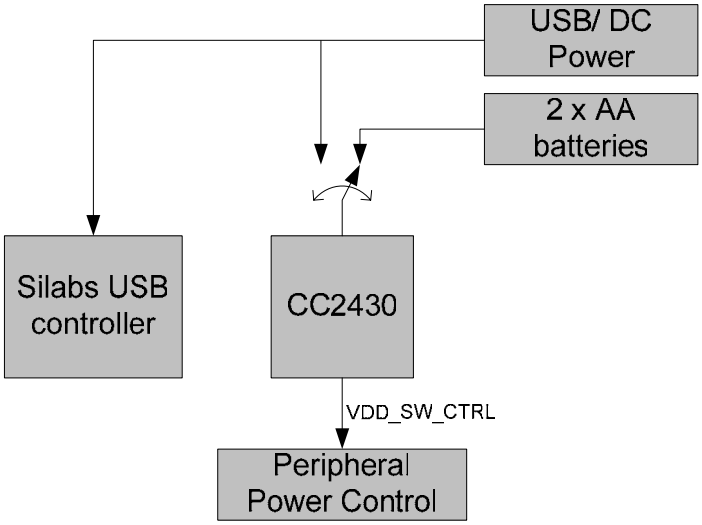

Figure 8: Voltage supply distribution

Table 4 below shows the current consumption for all modules and operation modes with 3.3V supply voltage

Device	Active mode (mA)		Power down mode (µA)	
	Typical	Max	32KHz	Sleep
CC2430	7,2	27	1µA	0.3µA
EEPROM	1	3	0	
Accelerometer	0,49		0	
Potentiometer	0,33		0	
Light sensor	0,001	0.015	0	
LEDs		24	0	
Total	**9mA**	**54mA**	**1µA**	

Table 4: Current consumption summary

To accurately measure the current consumption of the chip the jumpers listed in Table 5 should be removed.

Header	Pin	Description	Low power setting
P3	1-2	Replace with ampere meter to measure current consumption of CC2430	Mounted, or connect ampere meter
P3	3-4	SW controlled power. Can be removed when performing current measurement to reduce leakage current	Not mounted
P5	5-6	Connects RESET_N signal between USB MCU and CC2430. Can be removed when performing current measurement to reduce leakage current	Not mounted

Table 5: Jumper setting for low power measurements

In order to achieve lowest possible current consumption, the I/O ports of the CC2430 should be configured as listed in Power down state in Table 6 below.

2430 pin	Name	Schematic Name	Description	Active state[2]	Power down state	0Ω ohm resistor
11	P0_0	P0_0/LDR	Light dependent resistor analog input	IN ANALOG	OUT LOW	R506
12	P0_1	P0_1/BUTTON PUSH	Push button interrupt active low	IN PULL-UP	IN	
13	P0_2	P0_2/EE_SDA	EEPROM SDA	OUT HIGH	OUT LOW	R505
14	P0_3	P0_3/EE_SCL	EEPROM SCL	OUT HIGH	OUT LOW	R504
15	P0_4	P0_4/ACC_X	Accelerometer x-axis	IN ANALOG	OUT LOW	R507
16	P0_5	P0_5/ACC_Y	Accelerometer y-axis	IN ANALOG	OUT LOW	R508
17	P0_6	P0_6/JOY	Joystick analog signal	IN ANALOG	OUT LOW	R416
18	P0_7	P0_7/POT	Potentiometer analog input	IN ANALOG	OUT LOW	R430
9	P1_0	P1_0/LED1	Green LED	OUT HIGH	OUT HIGH	
8	P1_1	P1_1/LED2	Red LED	OUT HIGH	OUT HIGH	

[2]Active state means that Software controlled VDD is on, this should only be enabled when required by an I/O module

6	P1_2	P1_2/VDD_SW_CTRL	Voltage control for I/O modules	OUT HIGH	OUT LOW	
5	P1_3	P1_3/GPIO	Free I/O for controlling external signal	OUT LOW	OUT LOW	
4	P1_4	P1_4/CSn/SS/CTS		OUT LOW	OUT LOW	R305
3	P1.5	P1_5/SCLK/RTS		OUT LOW	OUT LOW	R308
2	P1_6	P1_6/SI/MOSI/UART_TD		OUT LOW	OUT LOW	R306
1	P1_7	P1_7/SO/MISO/UART_RD		OUT LOW	OUT LOW	R307
48	P2_0	P2_0/Joy_push	Joystick push interrupt active high	IN	IN	
46	P2_1	P2_1/DD	Debug Data	IN		Jumper P5
45	P2_2	P2_2/DC	Debug Clock	IN		Jumper P5
10	RESET	RESET_N	Reset			Jumper P5

Table 6: Pinout CC2430

The joystick output is coded as an analog voltage. This has been done in order to save the number of pins required on the MCU to interface with the joystick. The push function of the joystick is connected to a digital input pin.

6.4 Using the UART interface on the CC2430DB

The CC2430 UART interface port is accessible on the header connectors as 3.3V signals. An RS232 driver circuit is required to connect the UART interface on CC2430DB to a serial port on a PC. The RS232 port on a SmartRF04EB can be connected to the CC2430DB to allow applications to interface to a PC serial port.

Table 7 shows the connection between the CC2430DB and the SmartRF04EB. Both the P8 (10-pin) connector and the P6 (20-pin) connector on the CC2430DB can be used, but only one of them should be connected at the same time.

Signal Name	SmartRF04EB P10	CC2430DB P8, ”2430deb”	CC2430DB P6, ”I/O A”
RD	9	10	6
TD	11	8	8
RTS	13	6	10
CTS	15	5	12
GND	20	1	20

Table 7: CC2430ZDK to SmartRF04EB serial port connections

A jumper must be placed between pin 7 and pin 9 on the USB MCU debug connector P301 on the SmartRF04EB board. This will ensure that the Silabs USB controller does not force any pins to erroneous levels.

To use the serial port on CC2430DB USART1 must be used on alternative location 2 in the CC2430. Please see the CC2430 datasheet for instructions how to select serial port and location. Using the SmartRF04EB will only work if the Silabs USB controller on the CC2430DB is powered, i.e. the CC2430DB must be powered from a USB or DC jack.

7 Programming CC2430 with a HEX file

The CC2430 can be programmed from the USB interface using the Chipcon programming software. Figure 9 shows the flash programming interface. For additional information regarding Chipcon Flash Programmer please refer to Chipcon Flash Programmer User Manual.

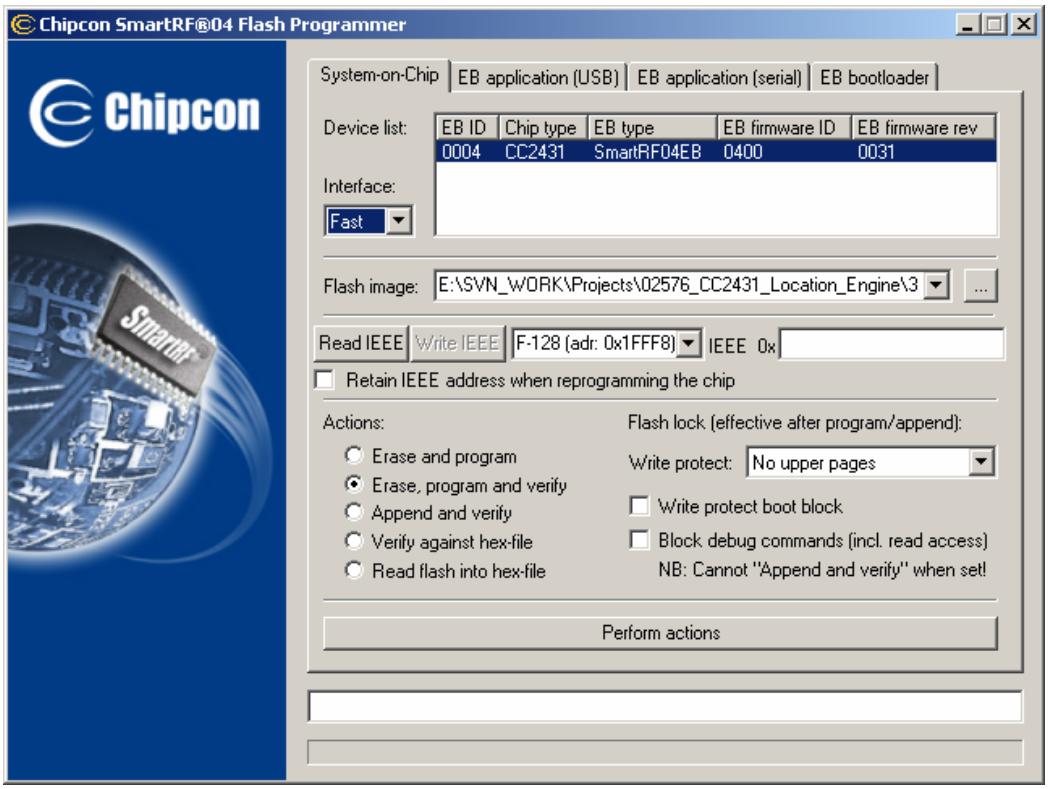

Figure 9: Chipcon Flash programmer software

8 Schematics

See the CC2430DB Reference Design for CC2430DB schematics. The CC2430DB reference design can be downloaded from the product page for CC2430DB on TI's websites.

9 Bill of Materials (BOM)

Ref.	Part name	Pcs/ unit	Description	Manufacturer	Part number
B1-2	1XAA_1_5V	2	Mounting clip for one AA battery cell	Keystone	
U500	24AA32A/SN	1	4 KB I2C EEPROM	Microchip	24AA32A/SN
U401	AD8544	1	Rail-to-rail quad opamp	Analog Devices	AD8544AR
U501	ADXL321	1	18 g peak X,Y accelerometer	Analog Devices	ADXL321
D100-101	BAT254	2	Diode, Si, Schottkey	Philips	BAT254
Q300	BC846	1	BJT, Si, NPN, small-signal	Philips	BC846B
U300	C8051F320	1	Silicon Labs 8051 USB Microcontroller	Silicon Labs	C8051F320
U1	CC2430	1	Single-chip transceiver and microcontroller	Chipcon	CC2430
C71	C_1U_0402_ X5R_K_6P3	1	Capacitor 1uF, 0402, X5R,10%, 6.3V	Murata	GRM155R60 J105KE19D
C207;C281;C300; C400;C471;C500; C503	C_100N_0402 _X5R_K_10	7	Capacitor, 100n, 0402, X5R, 10%, 10V		
C401	C_100P_0402 _NP0_J_50	1	Capacitor, 100p, 0402, NP0, 5% 50V		
C101;C351; C501-502	C_10N_0402 _X7R_K_25	4	Capacitor, 10n, 0402, X7R, 10%, 25V		
C102	C_10U_0805 _X5R_L_25	1	Capacitor, 10u, 0805, XR5, 15% 25V	murata	GRM21BR61A106K
C431;C441	C_15P_0402 _NP0_J_50	2	Capacitor, 15p, 0402, NP0, 5%, 50V		
C231;C411;C421	C_220N_0402 _X5R_K_10	3	Capacitor, 220n, 0402, X5R, 10%, 10V		
C241	C_220N_0603 _X7R_K_50	1	Capacitor, 220n, 0603, X7R, 10%, 50V		
C191;C211	C_33P_0402 _NP0_J_50	2	Capacitor, 33p, 0402, NP0, 5%, 50V		
C103	C_2U2_0603 _X5R_K_10	1	Capacitor, 2u2, 0603, X5R, 10%, 10V		
C104	C_33N_0402 _X7R_K_25	1	Capacitor, 33n, 0402, X7R, 10%, 25V		
C100	C_4U7_0805 _X5R_K_6	1	Capacitor, 4U7, 0802, X5R, 10%, 6.3V	Murata	GRM21
C341	C_5P6_0402 _NP0_J_50	1	Capacitor, 5p6, 0402, NP0, 5%, 50V		
C251;C271;C381	C_68P_0402 _NP0_J_50	3	Capacitor, 68p, 0402, NP0, 5% 50V		
P2	DC_JACK_2.5	1	DC jack, 2.5mm center pin		
U101	EM6353_1_8V	1	brown-out detector, 200ms delay, SOT23-3 "beta" pinout, 1.8V	EM Microelectronic	EM6353
D1	LED_CL150GCD	1	LED, green, 1206	Citizen	CL150GCD
D2	LED_CL150URCD	1	LED, red, 1206	Citizen	CL150URCD
U100	LP2985-3.3V	1	Voltage regulator, low noise, 3.3 V	National Semiconductor	LP2985AIM5-3.3
L341	L_1N8_0402_S	1	Inductor, 1n8, 0402, Monolithic type, +/-0.3 nH	Murata	LQG15-series
L331	L_22N_0402_J	1	Inductor, 22n, 0402, 5%	Murata	LQG15-series
L321	L_6N8_0402_J	1	Inductor, 6n8, 0402, Monolithic type, +/-5%	Murata	LQG15-series
RP1	NSL_19M51	1	Silonix CdS photoconductive cell 5 kOhm (light) to 20 M Ohm (dark)	Silonix	NSL-19M51
P6	PINROW_2X10	1	2x10 pinrow, 2.54mm pitch, through-hole	AMP	5-0826632-0

P3;P5;P7	PINROW_2X3	3	2x3 pinrow, 2.54mm pitch, through-hole	AMP	0-0826632-3
P4;P8	PINROW_2X5	2	2x5 pinrow, 2.54mm pitch, through-hole	AMP	0-0826632-5
S1-2	PUSH_BUTTON	2	Momentary push-button, SMD	Alps	SKHUAF
RT1	R_0-10K_TRIM	1	10k trimming pot with knob	BI Technologies	72PTR10K
R303-304; R311-312 R100;R305;R306-307; R308;R416;R430; R504-508	R_0603	4	Resistor, general, 0603; Do not mount		
	R_0_0603	12	Resistor, 0 ohms, 0603	Koa	
R405;R410-412	R_100K_0402_F	4	Resistor, 100k, 0402, 1%	Koa	
R413-415	R_10K_0402_F	3	Resistor, 10k, 0402, 1%	Koa	
R300-302	R_1K0_0402_J	3	Resistor, 1k, 0402, 5%	Koa	
R403-404;R407; R501	R_200K_0402_F	4	Resistor, 200k, 0402, 1%	Koa	
R409	R_220K_0402_F	1	Resistor, 220k, 0402, 1%	Koa	
R400;R440-441	R_270_0402_F	3	Resistor, 270 ohm, 0402, 1%	Koa	
R502-503	R_2K2_0402_G	2	Resistor, 2k2, 0402, 2%	Koa	
R241	R_2_0402_F	1	Resistor, 2 ohm, 0402, 1%	Koa	
R406	R_330K_0402_F	1	Resistor, 330k, 0402, 1%	Koa	
R101;R261;R310; R401;R420	R_43K_0402_F	5	Resistor, 43K, 0402, 1%	Koa	
R402	R_470K_0402_F	1	Resistor, 470k, 0402, 1%	Koa	
R102;R309;R509	R_4K7_0402_G	3	Resistor, 4.7k, 0402, 2%	Koa	
R221	R_56K_0402_F	1	Resistor, 56K, 0402, 1%	Koa	
Q100	SI9424DY	1	MOS-FET, p-channel	Siliconix	SI9424DY
S3	SWITCH_6PIN	1	Double switch, ALPS SSSS222700	ALPS	SSSS222700
P1	USB_B	1	USB B-style PCB-mount socket	AMP	787780-1
X1	X_32.000/ 10/15/30/16	1	Crystal, 32.000MHz,NX3225DA, 10/15ppm, 16 pF ! Temp range -30 - +85 deg C !	NDK	NX3225DA
X2	X_32.768/ 20/50/40/12	1	Crystal, 32.768 kHz, 12.5pF, 20/50 ppm,SMD package	Epson	MC-306
U400	skrhab_e010	1	4-directional switch with a centre push	Alps	skrhab_e010

10 Document History

Revision	Date	Description/Changes
1.0	2007-04-16	Initial release

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