Chipcon

– Connecting Smarter

SmartRF®03 – Product line

User Manual

Rev. 1.0

SmartRF ® CC2420 ZigBee DK Development Kit

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Introduction

The CC2420 is a single-chip, IEEE 802.15.4 compliant and ZigBee™ ready RF transceiver. It provides a highly integrated, flexible low-cost solution for applications using the world wide unlicensed 2.4 GHz frequency band. The CC2420 ZigBee DK Development Kit is a natural supplement to the already established Chipcon CC2420 kits, i.e. the CC2420DK Development Kit and the CC2420DBK Demonstration Board Kit. The hardware is representative of an actual application, and is well suited as a prototyping, evaluation and demonstration platform targeting various ZigBee applications. With this kit a ZigBee Logical device type mapped to the IEEE 802.15.4 Full Function and Reduced Function Devices (FFD and RFD) using the CC2420 can be demonstrated. An FFD can take the role of a ZigBee Coordinator, Router, or End Device depending on the ZigBee logical device type configuration. An RFD can act as ZigBee End Device and cannot serve as a ZigBee Coordinator or ZigBee Router.

The CC2420 ZigBee DK has the capability to demonstrate ZigBee low power capabilities. The CC2420 ZigBee DK is bundled with the Figure 8 Wireless ZigBee stack for evaluation, demonstration, prototyping and developing purposes of the Z-Stack features. The hardware platform is based on the CC2420DB Demonstration Board. The hardware contains an integrated PCB antenna, the IEEE 802.15.4 compliant RF transceiver CC2420 with necessary support components, an Atmel Atmega128L AVR microcontroller, 32 kB external RAM, and, as well as a joystick, buttons and LED's that can be used to demonstrate the current ZigBee Home Lightning Profile. Please note that CC2420DB includes this memory because it can be used for debugging purposes, to buffer and store data if desired. The 32kB external RAM size is not a requirement nor necessary for a low cost ZigBee logical device.

The CC2420DB is also furnished with connectors where the internal signals on the PCB are available for further sensor daughter boards addition to easy add additional profile hardware when desired. The details of the CC2420DB features are described in the CC2420DBK User Manual. Please refer to the references section of this document.

The CC2420 ZigBee DK provides, in addition to five CC2420DB's, a CC2400EB that together with CC2420EM can utilize the capability of running Chipcon's Packet Sniffer with the new ZigBee packet parser addition.

This User Manual describes how to use the CC2420 ZigBee DK Development Kit. The Figure 8 Wireless Z-Stack, tools and documentation will be provided as a distribution package available for download from the Chipcon ZigBee Developer Site after the purchase of this kit. When purchased, customers will be provided with a user name and password to access this site to download the Z-Stack End Customer distribution package. The Chipcon ZigBee Developer site will be available in the beginning of October.

Please refer to the reference section of this document for links to Atmel's documentation on how to use their tools.

Your CC2420 ZigBee DK Development Kit should contain the following items:

Kit contents	
Item	*Number of articles*
Demonstration Board (CC2420DB)	5
Evaluation Board (CC2400EB)	1
Evaluation Module (CC2420EM)	1
CC2420 sample kit	1
Quick Start instructions	1
CC2420DB Important Notice	1
User name and password for Chipcon ZigBee Developer Site	1
Atmel JTAG ICE mkII	1
Power Supplies (global AC-to-DC adapter)	6
Battery clip/adapter	5
RS-232 cable	3
USB cable	1
2.4 GHz Antenna	1

Important:

Contact your local telecommunication authorities before transmitting an RF signal to ensure that there are no local restrictions on the use of the 2.400 –2483.5 MHz ISM band. The CC2420 operates in the 2.4 GHz frequency band. Although this frequency band is usually described as "world-wide", some countries do not allow unlicensed operation in this band.

CC2420 ZigBee DK Hardware Components

Table 1 below contains a description of the hardware components included in the CC2420 ZigBee DK Development Kit.

Hardware Component	Number of pcs.	Description
CC2420DB	5	Each CC2420DB demonstration board contains a CC2420 with necessary support components to develop a full functional IEEE 802.15.4 or ZigBee™ device. The boards contain an Atmel ATMega128L AVR microcontroller, external RAM, a PCB antenna, as well as a RS-232 serial port, joystick, potentiometer, temperature sensor, buttons and LED's that can be used to implement a user interface for applications.
RS-232 Cable	3	RS-232 cable for connection of the CC2420DB boards to a PC.
CC2400EB	1	CC2420 transceiver motherboard. Connects to a PC to run the Chipcon Packet Sniffer software. RF Performance evaluation is also possible.
CC2420EM	1	CC2420 transceiver daughter board, connects to the CC2400EB board.
USB Cable	1	For connection of the CC2400EB / CC2420EM to a PC.
Antenna	1	50Ω quarter-wave monopole, SMA male connector for use with CC2420EM
Power supply	3	DC Power supply (with global connectors) for use with the CC2420DB / CC2400EB.
Atmel JTAGICE mkII	1	Atmel JTAG based debug / programming tool. Connects to PC through USB or serial port. USB and RS-232 Cables for use with the JTAG ICE are included.
Battery Clip	5	Use to connect 3 x 1.5 AA batteries to demonstrate low power capabilities

Table 1: CC2420 ZigBee DK Hardware Components

CC2420 ZigBee DK Software Components

The table below contains a description of the software components included in the CC2420 ZigBee DK. The software components also include software, which has been licensed from Figure 8 Wireless (www.figure8wireless.com).

Software component	Description
Chipcon Packet Sniffer	IEEE 802.15.4 / ZigBee packet sniffer. Downloadable from the Chicpon web site. Runs on the CC2400EB / CC2420EM hardware platform, and connects to a PC through a USB connector.
Chipcon MAC Layer Object Code	Object code for Atmel AVR. Included in library form with Z-Stack.
GCC Tool	See download instructions in Figure 8 Wireless Z-Stack User's Guide for the CC2420DB
Atmel AVR Studio	See download instructions in Figure 8 Wireless Z-Stack User's Guide for the CC2420DB
Programmer's Notepad	See download instructions in Figure 8 Wireless Z-Stack User's Guide for the CC2420DB
Figure 8 Wireless ZigBee Stack ("Z-Stack")	Mix of Source and Object code for Atmel AVR. Complete implementation of the ZigBee Alliance specification. Compliant with the ZigBee specification v 0.92, and updated upon ZigBee specification changes. Full ZigBee security functionality will be available by v1.00 release. Included Documentation: • User's Guide (including instructions on how to obtain Atmel and GCC tool sets free of additional charges) • API descriptions for each ZigBee layer • Programmers Guides for each sample application (see below) • Serial Port Interface Documentation • OS Abstraction Layer ("OSAL") Documentation • ZigBee Implementer's Guide (packaged in upcoming releases)
Figure 8 Wireless Sample Applications	Sample application source code for Home Control – Lighting ZigBee Profile, including • Switch Remote Control • Switch Load Controller • Light Sensor Monochromatic • Dimmer Remote Control • Dimmer Load Controller • Occupancy Sensor Sample application source code for customer specified Profiles and applications, including • Generic Application • Serial Application

Software component	Description
Figure 8 Wireless Z-Configurator	Z-Configurator (Executable): The Z-Stack Configurator is a Windows application which enables automated customization of ZigBee enabled applications. Configurator features include: • Selection of the ZigBee logical target device mapped to a RFD or FFD. • Selection of resources to support Association Tables, Routing Tables, Binding Tables. In later releases, interactive entry/feedback to permit iterative changes for application optimal setting will be provided. • Selection of Profiles and assignment to Endpoints. • Selection of Device Profile network configuration elements (beacon order, etc.). • Automated extraction of appropriate source code and libraries into build directory to permit creation of device according to selections. • End customer can further optimize resulting application.
Figure 8 Wireless Z-Profile Builder	Z-Profile Builder (Executable): The Z-Stack ZigBee Profile Builder is a Windows application, which enables users to create their own profiles. The application allows the customer to generate profiles, which can be ported into the Z-Stack Configurator for creation of a customer specified profile assigned to a device endpoint. Profile Builder will enable the end customer to do the following: • Create a new profile based on a ZigBee Alliance assigned Profile ID. • Define proprietary Devices based on the customer-defined Profile. • Define Clusters and Attributes which will form the basis of messaging between the customer's devices. • Advertise Clusters on Endpoints to enable standard ZigBee Service Discovery and Binding operations to work using the customers proprietary Profile, Devices and Clusters. • Permit the customer to incorporate and utilize standard ZigBee profiles, advertising these on a specific interface, to permit a controlled level of interoperability (if desired) with other standard ZigBee devices while still enabling operation as a proprietary device.

Software component	Description
Figure 8 Wireless Z-Trace	Z-Trace ZigBee Protocol Stack Trace Tool (Executable): The Z-Trace is a Windows application running on Windows 2000 Pro or Windows XP Pro. The Z-Trace is designed to fulfill test and debug functions, and operates the attached ZigBee/IEEE 802.15.4 CC2420DB through a serial cable connection. • Permit viewing of trace and debug information from a target unit under test The Z-Trace consists of the following components: • Windows executable • Z-Trace User's Manual and Release Notes

Table 2: CC2420 ZigBee DK Software Components

Optional software components

Table 3 below contains a description of the optional software components available separately for the CC2420 ZigBee DK Development Kit.

Software component	Description
Figure 8 Wireless ZigBee Stack	Source code. Compliant with the ZigBee specification v 0.92, and updated upon ZigBee specification changes. Contact your local Chipcon sales office for further information.
Chipcon MAC layer source code	Source code for the Chipcon MAC Sublayer. Available free of charge, through the MAC software license agreement. Contact your local Chipcon sales office for further information.

Table 3: CC2420 ZigBee DK Optional Software Components

CC2420DB PCB

The PCB picture provides an overview of the CC2420DB with description of the various components embedded on the PCB.

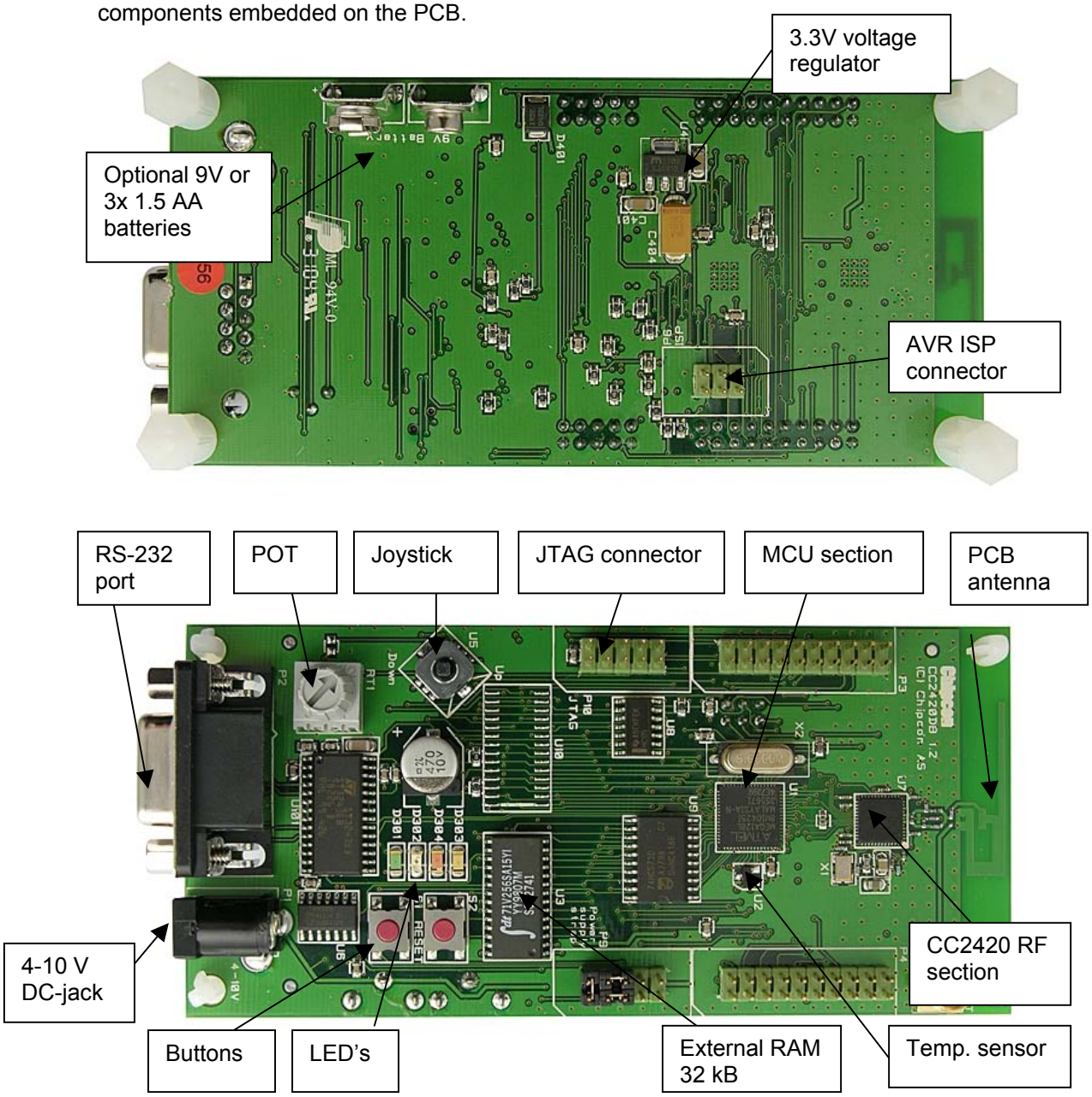

Figure 1: CC2420DB overview

Hardware Overview

The hardware platform of CC2420 ZigBee DK is based on already established Chipcon CC2420 kits. Detailed information about the hardware and software included in this kit can be downloaded from the Chipcon CC2420 product site.

http://www.chipcon.com/index.cfm?kat_id=2&subkat_id=12&dok_id=115

Power Supply Section

The power supply section contains two voltage regulators. One is an external 3.3 V regulator for use by the microcontroller and the I/O pins of the CC2420. The second is an internal regulator of CC2420 used to generate the 1.8 V supply applied for powering of the CC2420 core.

A diode prevents permanent damage if wrong polarity is applied to the board. There are two power connectors; a 2.5mm DC jack-type connector allows you to connect an unregulated battery eliminator easily (the positive supply is on the center pin), and a connector for a 9V battery on the bottoms side of the PCB. We recommend that 3 or 4 AA or AAA alkaline cells are used to power the CC2420DB if a suitable battery pack is used.

RS-232 Interface

A serial port is included on the CC2420DB. This port can be used with the Figure 8 Wireless Z-Trace. The port includes support for RTS/CTS-type hardware flow control (handshaking). This port is per default always enabled by a jumper. See the jumper settings for demonstration board control.

Microcontroller and User Interface

The microcontroller used is an AVR ATmega128L from Atmel. This controller has 128 kB of Flash program memory, 4 kB of SRAM data memory and 4 kB of non-volatile EEPROM data memory. The controller is interfaced to the CC2420 via its built-in SPI interface as well as few general-purpose I/O pins.

The MCU is also connected to four LEDs, a joystick and an extra button for user interface purposes. The different examples use these peripherals differently. An analogue temperature sensor, a potentiometer and 32 kB of external RAM are also included.

An ISP and a JTAG ICE connector are provided for programming the AVR without using the serial port. In this case an Atmel AVR JTAG or ISP programmer should be connected to their respective connectors.

All of the I/O pins are connected to footprints for 2 x 10 pin-row connectors, P3 and P4. These connectors are compatible with Agilent logic analyzer probes, and can be used either for testing or for prototyping. For instance, it is possible to add a daughter board containing additional circuitry using these connectors.

Connector P3 pinout			
Pin number	**Signal name in schematic**	**Pin usage**	**AVR pin**
1	Not Connected (NC)	Not Applicable (N/A)	N/A
2		Unregulated supply voltage (Insert R101 to connect)	N/A
3	FORCE_ON	RS-232 Force On	N/A

4	PE4	Yellow LED / RS-232 Force On control	06 PE4
5	PE2	Joystick centre push button	04 PE2
6	PE0	ISP MOSI / Joystick up	02 PE0
7	PG3	External 32 kHz crystal / General purpose I/O	18 PG3
8	PE1	ISP MISO / Joystick right	03 PE1
9	PG4	External 32 kHz crystal / General purpose I/O	19 PG4
10	PE5	Push button S2	07 PE5
11	PE3	Red LED	05 PE3
12	PE6	Joystick interrupt	08 PE6
13	RTS	RS-232 handshaking	30 PD5
14	PE7	External interrupt / General purpose I/O	09 PE7
15	RXD1	RS-232 data from PC	27 PD2
16	PB7	Green LED	17 PB7
17	CTS	RS-232 handshaking	32 PD7
18	PB4	Orange LED	14 PB4
19	TXD1	RS-232 data to PC	28 PD3
20	GND	Ground	N/A

Table 4: P3 pinout

Connector P4 pinout				
Pin number	**Signal name in schematic**	**Pin usage**	**CC2420 pin**	**AVR pin**
1	NC	N/A	N/A	N/A
2	AREF	Voltage reference for A/D Converter.	N/A	62
3	RESET	Reset	N/A	20
4	SCLK	CC2420 SPI clock, AVR ISP	32 (SCLK)	11
5	PF1	Joystick left	N/A	60
6	SO	CC2420 SPI out	34 (SO)	13
7	PF2	Joystick	N/A	59
8	SI	CC2420 SPI in	33 (SI)	12
9	PF3	Temperature sensor	N/A	58
10	VREG_EN	CC2420 voltage regulator enable	41 (VREG_EN)	15

11	PF0	Potentiometer	N/A	61
12	FIFO	CC2420 FIFO	30 (FIFO)	26
13	CSn	CC2420 SPI chip select	31 (CSn)	10
14	FIFOP	CC2420 FIFOP	29 (FIFOP)	25
15	3.3V	3.3V Regulated supply	N/A	N/A
16	RESETn	CC2420 Reset	21 (RESETn)	16
17	N.C.	N/A	N/A	N/A
18	CCA	CC2420 Clear Channel Assessment	28 (CCA)	31
19	SFD	CC2420 Start of Frame Delimiter	27 (SFD)	29
20	GND	Ground	N/A	N/A

Table 5: P4 pinout

External RAM

The lower 4 kB of the external RAM is remapping of the Atmega128L internal register and RAM. CC2420DB includes this memory because it can be used for debugging purposes, to buffer and store data if desired. The 32 kB RAM size is not a requirement nor necessary for a low cost ZigBee logical device mapped to a Full Functional Device (FFD) or Reduced Functional Device (RFD).

RAM requirements for a ZigBee application:

- End Devices: minimum 1.5 kB
- Coordinator or Router: minimum 2.5 kB

These numbers are highly dependent on how the end user configures their solution.

Important notice:

The CC2420DB, which is incorporated in the CC2420 ZigBee DK, is mounted with one 32kB external SRAM. Please note that when measuring the current consumption of one of the ZigBee device in the sample application, the RAM will contribute with 2mA in any power down mode applied, since it is not possible to shut down the power supply.

Memory Requirements

The Z-Stack is running on the CC2420DB Demonstration Board, which contains the AVR-ATmega128L microcontroller. The overall Z-Stack memory requirement will depend upon compiler, code optimization level, application specific code including application profiles, microcontroller platform, and additional features, e.g. security.

If you want to use a different microcontroller platform it will be important to keep in mind when the Z-Stack is ported the memory requirement will depend on the items described above.

The complete Figure 8 Wireless ZigBee stack (Z-Stack) will have a memory requirement in the range of 60kB for a ZigBee Coordinator. Additional flash size must be available for the application. Keep in mind that these numbers are preliminary and are microcontroller dependant.

Unfortunately, it is very difficult to say anything exact with respect to code and RAM size requirements for ZigBee. Different ZigBee applications and configurations will also have different memory requirements. You should also consider the ZigBee stack profiles which defines how many other routers / end devices must be handled by a router / coordinator. This will mostly affect the RAM requirements, and will e.g. be different in a home application from

an industrial application. The application will of course also need a certain amount of resources, which is very difficult to estimate at this stage.

CC2420DB Low Power Mode Support

To apply certain low power modes with CC2420DB for application development, it will be necessary to apply an additional clock source together with the 8 MHz crystal oscillator. The Atmega128L provides the Timer/Counter oscillator pins (TOSC1 and TOSC2), and these pins are available on the CC2420DB connector P3. The oscillator is optimized for use with a 32.768 kHz crystal. This clock source can be connected the following ways.

1. A crystal can be connected directly between the pins.
2. An external clock source can be applied to the TOSC1 pin. Atmel does not recommend this method.

The timer 0 will be clocked by the 32.768 kHz crystal oscillator and then the overflow or compare match timer interrupt is applied to wake up ATmega128L from power save mode. Please refer to the ATmega128L data sheet for more details on the various power down modes of the microcontroller.

Pin Name	Connector P3	Atmega128 L
TOSC1 (PG4)	Pin 9	Pin 19
TOSC2 (PG3)	Pin 7	Pin 18

Table 6: Low power mode signal

To demonstrate an application using the power down mode:

1. Apply 3x 1.5 AA batteries with the battery clip included in the kit.
2. The library macros will be made available on how to set the ATmega128L into the various power mode that can apply to minimize the current draw on CC2420DB.
3. Apply the joystick switch as the external interrupt to wake up the ATmega128L to idle mode and run an application.

CC2420DB Temperature Range

The CC2420DB can support a temperature range of -30˚ C to +85˚ C.

Jumper Settings for CC2420DB Control

The CC2420DB has three default jumper settings for proper operation. Figure 2 depicts the placement of the three jumpers J1, J2 and J3. They are mounted on connector P9. Please refer to CC2420DBK User Manual schematics page 1 for more details.

Jumper	Purpose	Comments
J1	To apply power of 3.3V to the circuitry on the PCB board	An option can be to remove the jumper and connect an ampere meter in series to measure current consumption
J2	To apply power of 3.3V to the potentiometer and temperature sensor on the PCB board	Can be removed to disconnect the devices if not used, to decrease current consumption
J3	To always have the RS-232 driver enabled, hence the driver is forced on	This jumper can be disconnected and controlled by software instead if desired

Table 7 Jumper explanation

The J3 jumper can permanently disable the RS-232 port by grounding the control signal when moving the jumper to connect pin 6 and 8 together on connector P9.

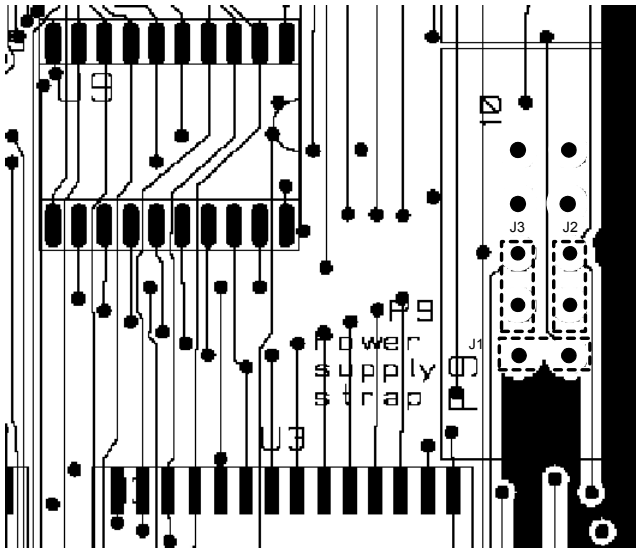

Figure 2 Jumpers

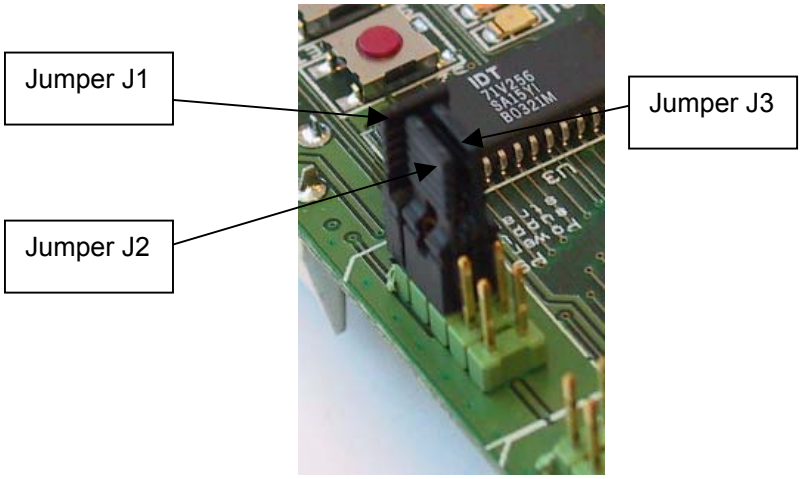

Figure 3 Jumpers on CC2420DB

To enable software control of the RS-232 driver U101, the jumper J3 can be moved.

Step-By-Step procedure:

1. Move RS-232 jumper J3 from P9 to P3 between pin 3 and 4
2. It will share the same port pin PE4 as the yellow LED, so when RS-232 is on the LED will be set.

CC2420DB Current Measurement and Consumption

It is fully possible to measure the actual current consumption with CC2420DB. To measure the current jumper J1 must be removed and an ampere meter connected in series. The current measurement is performed for the current total draw of the CC2420DB.

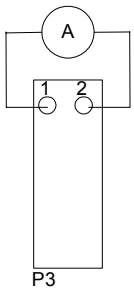

Figure 4: Connector P3 with ampere meter attached

To help minimize the current consumption of the CC2420DB for a specific ZigBee device the default jumper J3 can be moved to enable software control of the RS-232 driver.

The external RAM will always draw 2mA in any power down mode since its power supply cannot be disabled. Hence, if the external RAM (U3) is removed the current consumption will decrease with 2mA.

The jumper J2 is controlling the power for the potentiometer (RT1) and temperature sensor (U2), which will also contribute to the total current consumption in any power down mode.

Using the CC2400EB and CC2420EM for ZigBee Packet Sniffing

The capability to sniff ZigBee network traffic is provided using the CC2400EB and CC2420EM along with Chipcon's Packet Sniffer software. This software can be used as an IEEE 802.15.4 compliant packet parser as well.

Figure 5: CC2400EB + CC2420EM

Step-by-Step procedure for use of the Packet Sniffer:

1. Install the Packet Sniffer software
   http://www.chipcon.com/index.cfm?kat_id=2&subkat_id=12&dok_id=115
2. Plug in the USB cable between the PC and CC2400EB
3. Plug in power supply
4. Restart your computer so Windows can detect the board.
5. Reset CC2400EB with the reset button (Optional).
6. After about 5 seconds the LED's start to blink as a binary counter.
7. Start the Packet Sniffer (The LEDs will continue to blinking)
   a. The CC2400EB will be detected in the selection window. See figure 6
8. Select an IEEE 802.15.4 channel.
9. Press the "Capture" button on the menu bar to start the sniffer (LED's will be cleared)
   a. When the Packet Sniffer is running, the LEDs will blink when packets are received. See figure 7

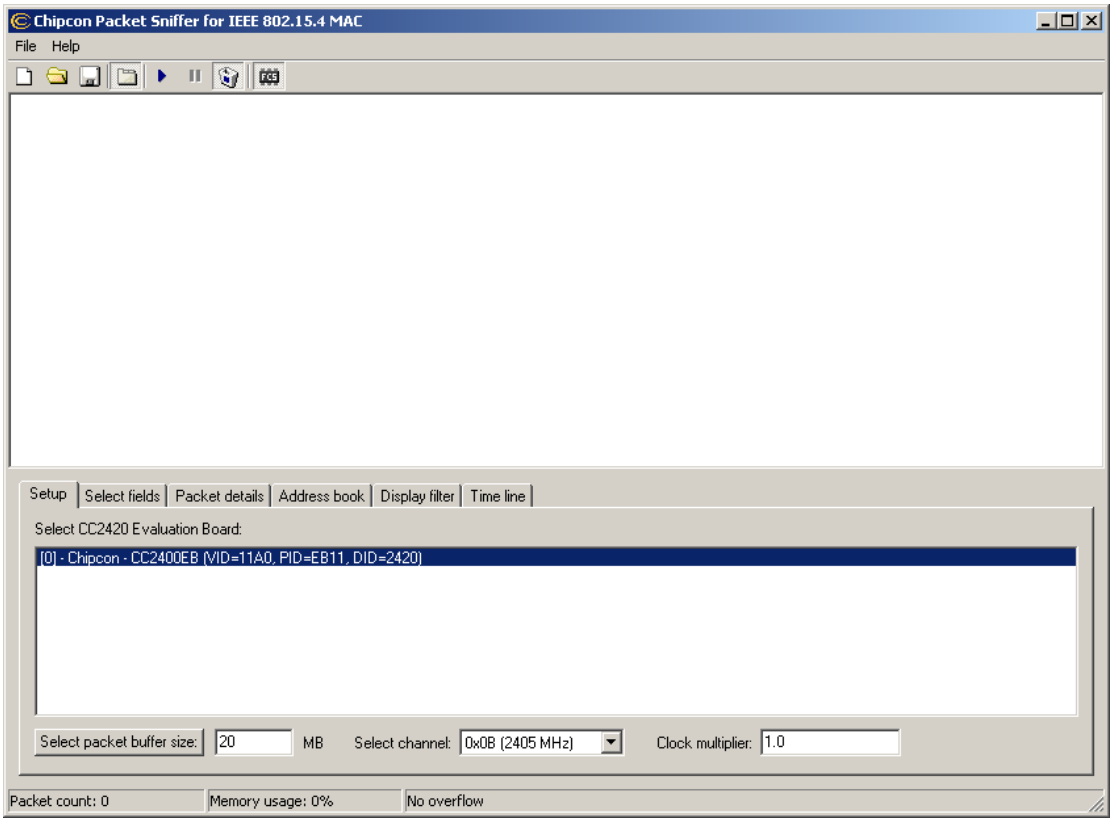

Figure 6: Packet Sniffer

In order to do ZigBee network layer (NWK) or Application Support Sub layer decodes, go to the "Select Fields" section of the sniffer. Use the "MAC Fields", "NWK Fields" and "APS Fields" at the bottom to switch between the different levels of decoding. See figure 7 for an example.

- Decoding of NWK layer command frames is implemented
- Decoding of APS layer command frames. They should appear with the undecoded APS payload.
- There is no decoding of ZigBee Device Objects (ZDO) / Profile information. I.e., the APS payload is shown directly.

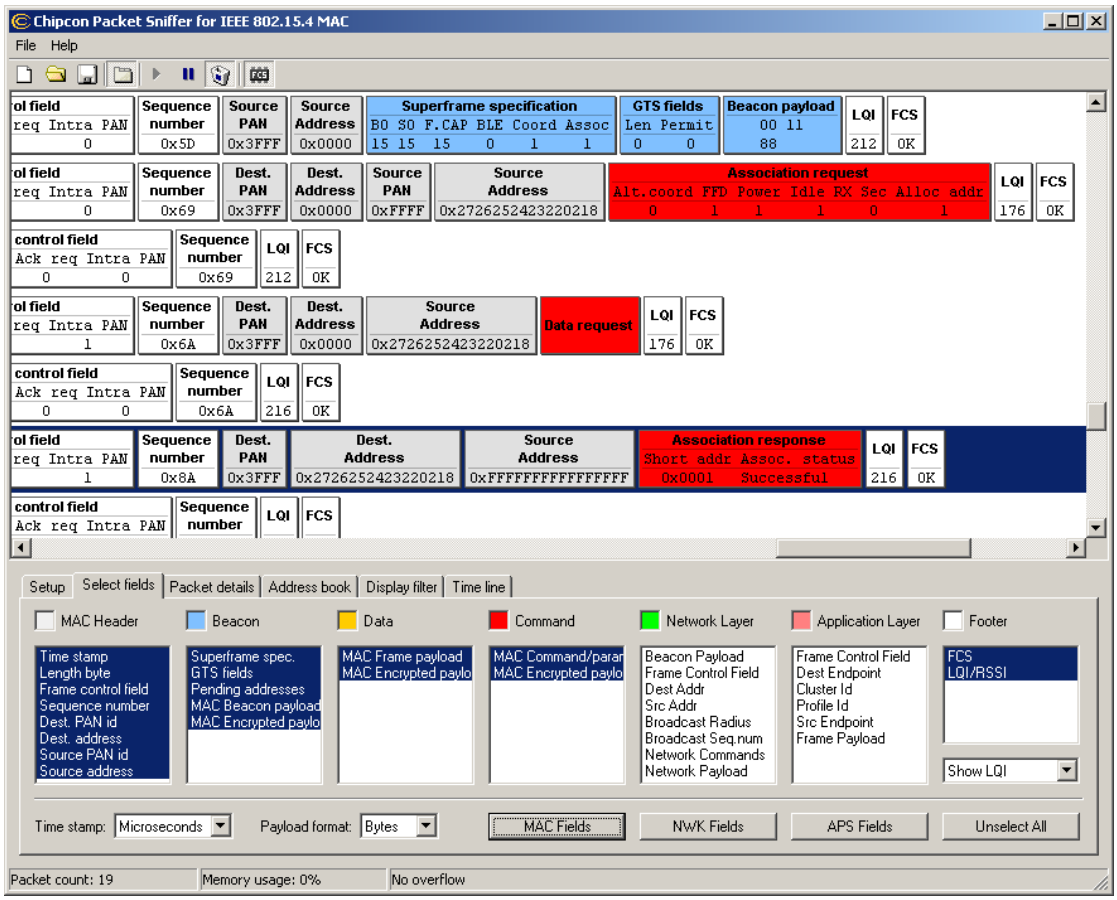

Figure 7: Packet Sniffer Capture Window

Using the CC2420DB Demonstration Board with the Z-Stack

The CC2420DB is designed for quick prototyping, and also for quick practical evaluation such as range testing with the Z-Stack for sample ZigBee logical devices.

Software can be programmed into the Atmega128L microcontroller using an external programmer such as the AVR JTAG ICE mkII provided with the kit. Alternatively, the AVR ISP programmer can also be used.

No CC2420DB in the CC2420 ZigBee DK is preprogrammed with a ZigBee Home Control Lighting Profile device.

IEEE 64- bits Extended Address

Each CC2420DB is preprogrammed with an IEEE extended address in the ATmega128L microcontroller EEPROM. The IEEE address is stored at EEPROM location 0x0000.

CC2420DB Z-Stack Download and Debugging Using AVR Studio 4

Use a serial cable to connect the serial interface of the CC2420DB to the serial port of a PC running AVR Studio and Z-Trace for debugging information from the Figure 8 Wireless Z-Stack. When the CC2420DB RS-232 port is connected the Z-Trace can display debugging information if the compile switch in the make file is set. Please refer to the Z-Stack Compile Options used with CC2420 and figure 9 for hardware setup.

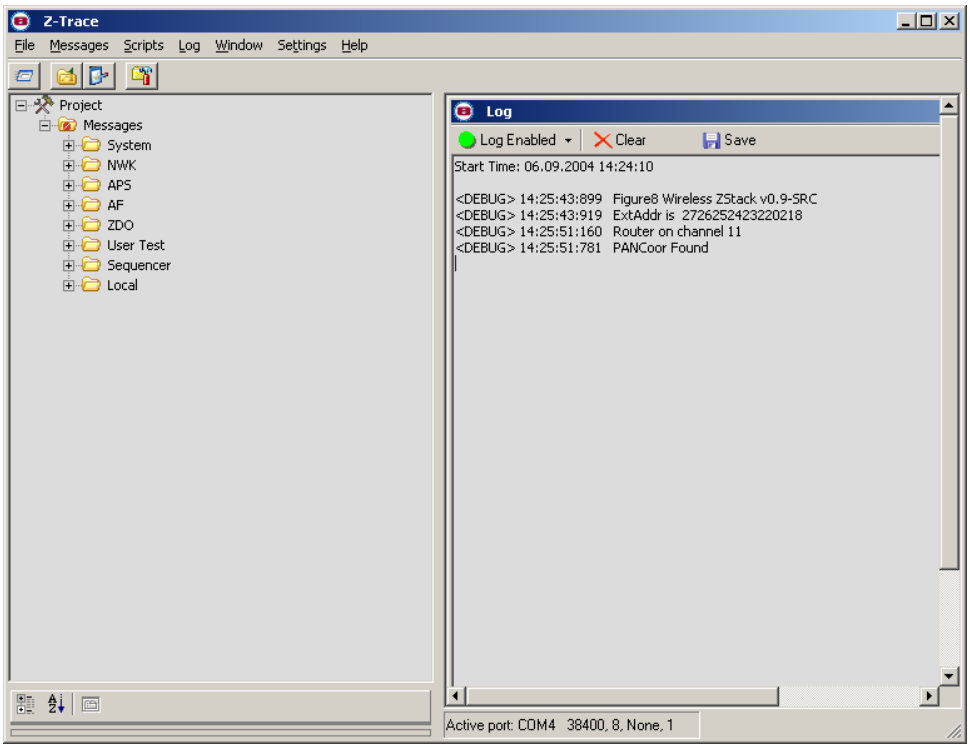

Figure 8: Z-Trace view

Note:

Chipcon's SmartRF® Studio cannot communicate with the CC2420DB, but can be used to find optimum register values for the CC2420.

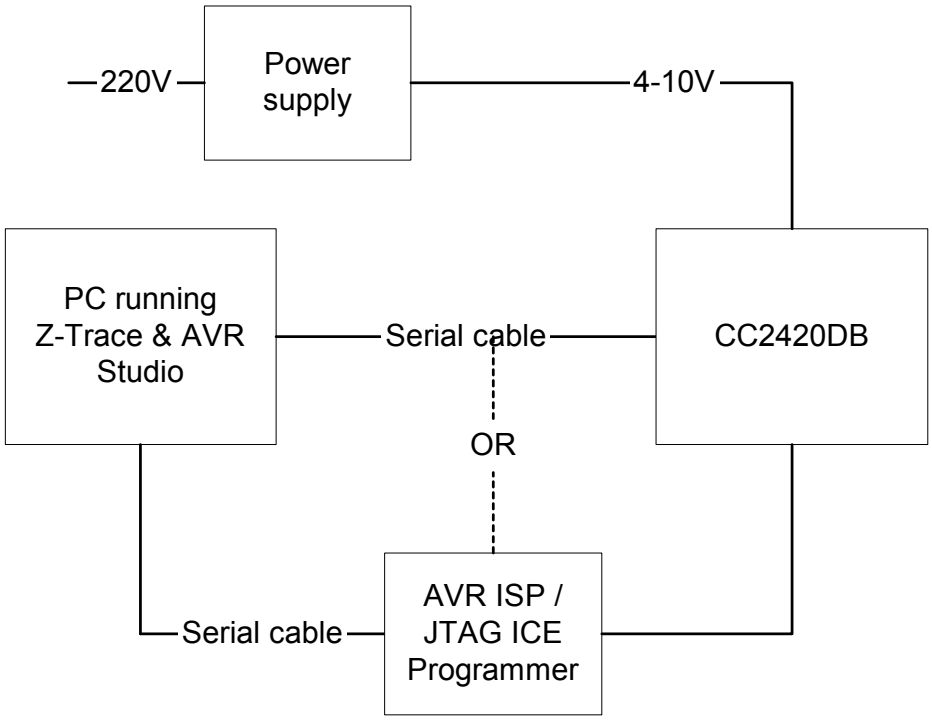

Figure 9: Software download using AVR Studio 4

Preprogrammed Fuses

The configuration of the processor fuses can be performed through the SPI interface with the AVR ISP programmer or the JTAG ICE programmer and AVR Studio 4. The JTAG ICE fuse window is depicted in figure 10. The CC2420DB is configured with the following fuses enabled:

1. On Chip Debug Enabled
2. JTAG Interface Enabled
3. Serial program downloading (SPI) enabled
4. Preserve EEPROM memory through the Chip Erase Cycle
5. Boot Flash section size = 512 Boot start address
6. Brown-out detection level at VCC=2.7 V
7. Brown-out detection enabled
8. Ext.Crystal/Resonator High Freq.; Start Up time: 1CK + 4 ms [CKSEL=1111 SUT=11]

Note:

When using the JTAG ICE or the AVR ISP programmer the boot vector fuse must be disabled. The CC2420DB for the CC2420 ZigBee DK will not be programmed with a bootloader.

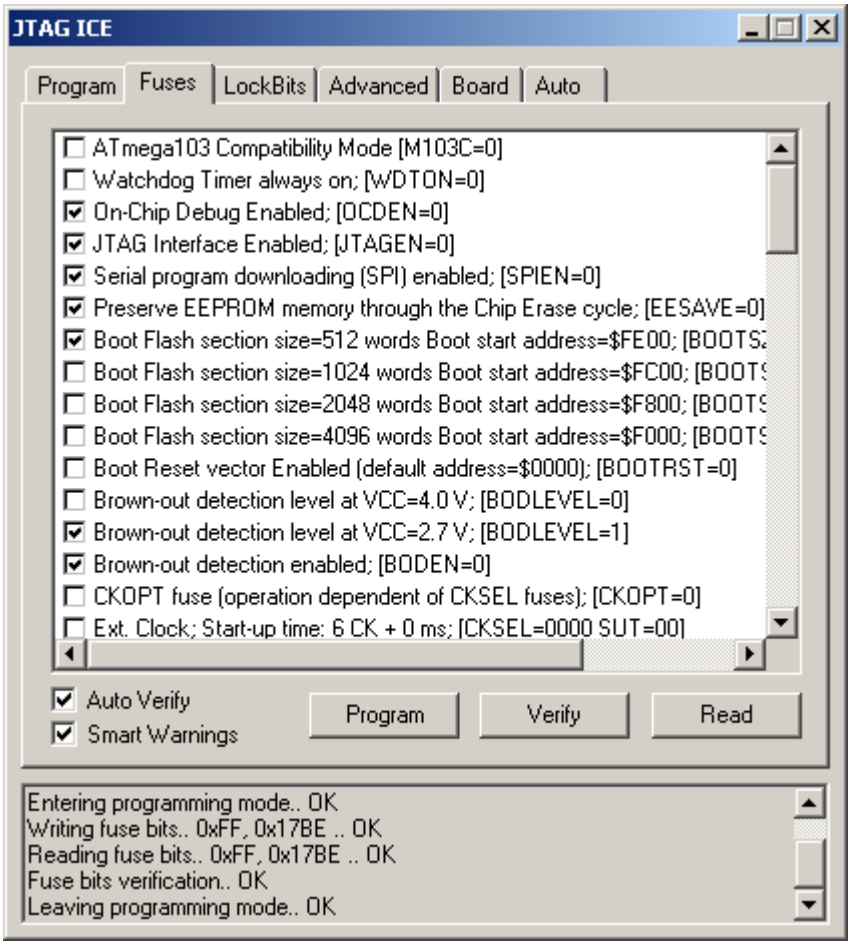

Figure 10: AVR Studio Fuses Window

CC2420DB Development Environment for ZigBee Applications

The CC2420DB Development Environment required for the development of software applications based on the CC2420 and Figure 8 Wireless Z-Stack software tools is a combination of three tools; a text editor of choice (e.g. UltraEdit-32), a GNU AVR GCC compiler/assembler/linker and Windows application for downloading and debugging provided by the microcontroller manufacturer. A basic overview for the CC2420DB Development Environment is as follows:

Text Editor:

A text editor such as Programmer's Notepad or Ultra Edit with syntax highlighting is used for source code writing. This editor is configured to run the make files, by use of macros linked to the make files for AVR GCC.

AVR GCC:

The free GNU AVR GCC cross development tools are used to generate the image for the CC2420DB running on the Atmega128L microcontroller. Please see the related documentation in order to obtain detailed insight on compiler options, make files etc.

AVR Studio:

The AVR Studio is only used with the AVR ISP programmer or AVR JTAG ICE mkII to configure the microcontroller switches, downloading code and debugging. The CC2420DB used in the CC2420 ZigBee DK is not programmed with the bootloader. If you are interested in using the bootloader it can be downloaded from Chipcon's web site.

The bootloader is used with AVR studio and the serial port. Please refer to CC2420DBK User Manual (http://www.chipcon.com/index.cfm?kat_id=2&subkat_id=12&dok_id=115) for details.

In general Chipcon's tools for the demonstration board kit is free of charge to enable our customers to start their development right away, without having to buy an expensive compiler or an Integrated Development Environment. However, these tools for the CC2420DB are not integrated, but rather a custom mixture of three separate tools from various providers.

JTAG ICE

The CC2420DB provides a connector for the JTAG ICE programmer to communicate with AVR Studio. The JTAG ICE mkII connector is P10.

The JTAG interface is used to debug or download source code using the Z-Stack (.cof) or (.hex) files built with the make file provided for a sample ZigBee device. Please refer to the Figure 8 Wireless Z-Stack User's Guide for CC2420DB for details on how to use the JTAG feature.

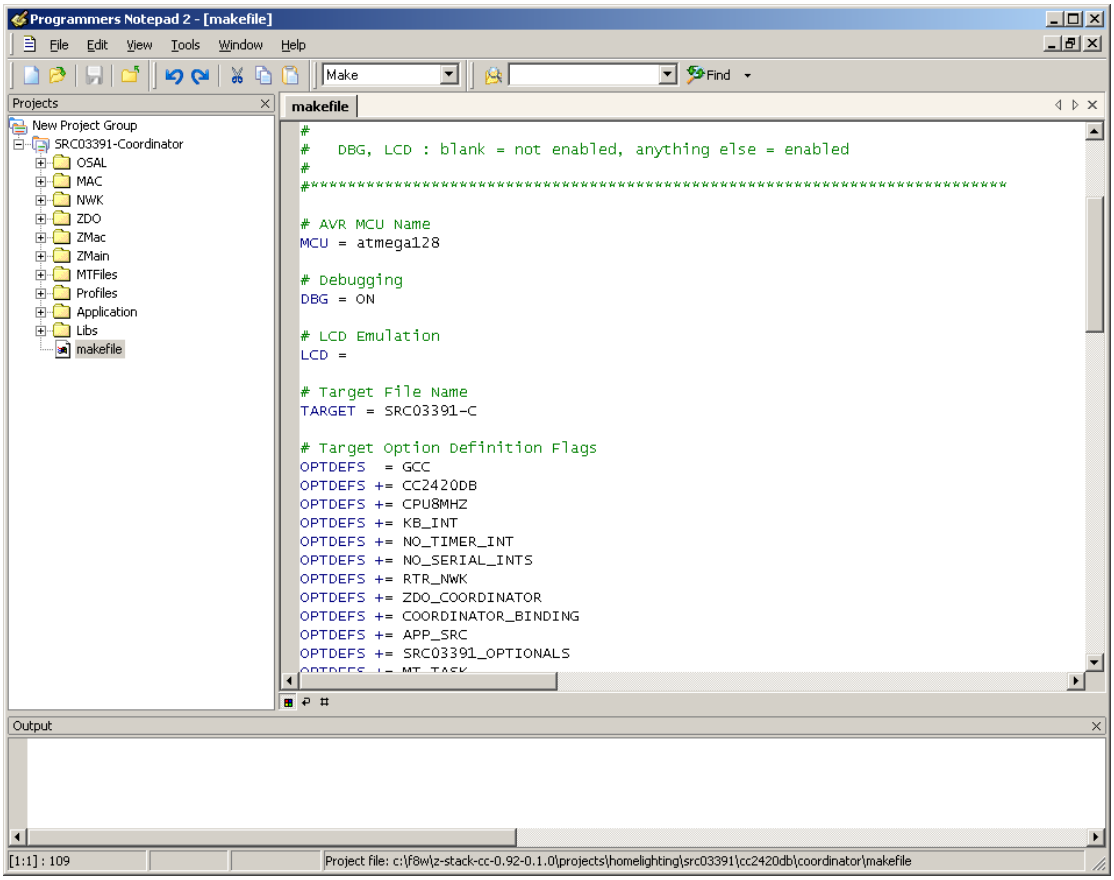

Figure 11: Programmer's Notepad for a sample ZigBee device project

See the make file enclosed with the Z-Stack software sample device examples for details.

Step-by-Step procedure:

1. Connect JTAG ICE to connector P10 on CC2420DB
2. Connect external power supply to CC2420DB
3. Start AVR Studio
4. Load the selected .cof file, built using the make file option extcoff
    a. Please refer to the Figure 8 Wireless Z-Stack User's Guide for the CC2420DB for details on how to build a sample device
5. Download the built .cof or .hex file (See figure 12)
6. Start and run the sample ZigBee device application on CC2420DB
7. Use the Packet Sniffer to monitor the network traffic

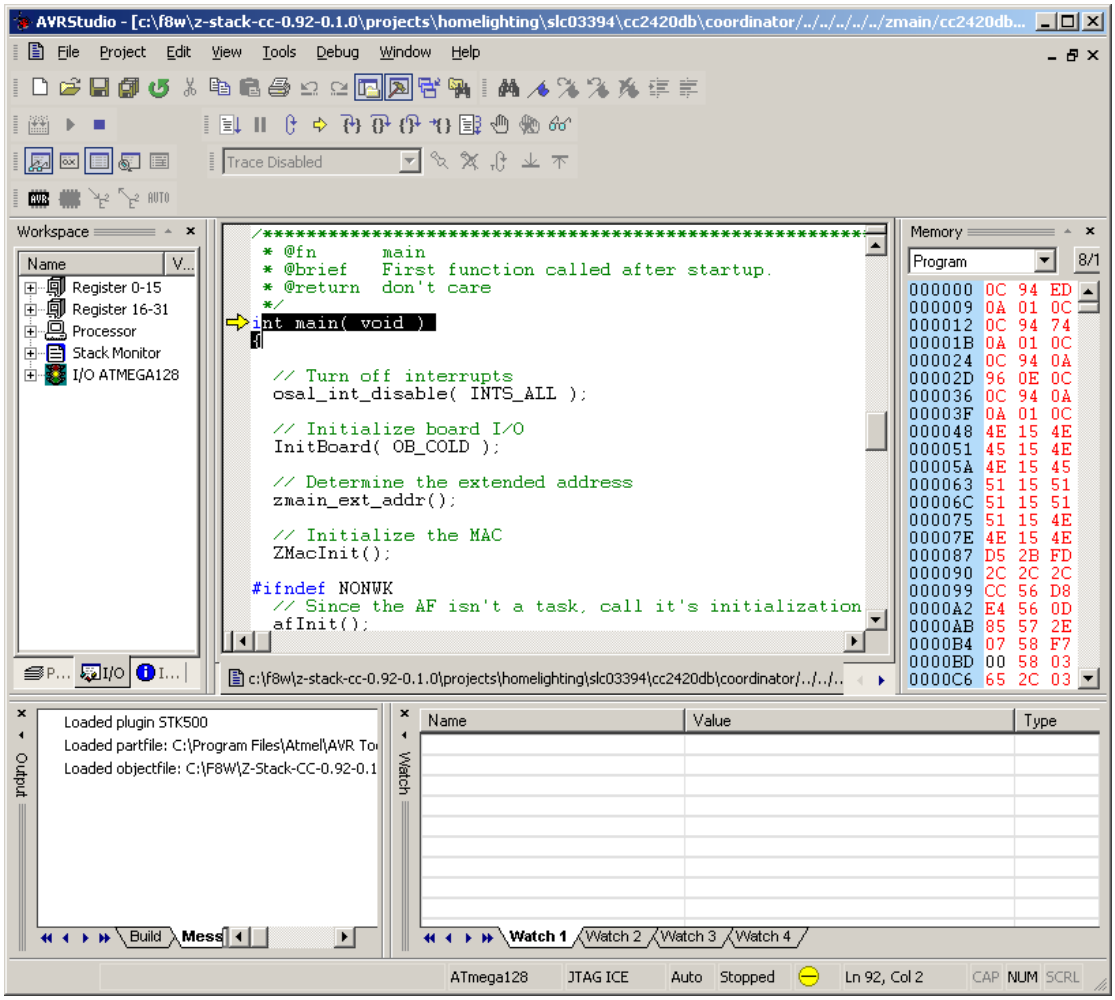

Figure 12: AVR Studio debugging window

In System Programming

Using the AVRISP in-circuit programmer or similar devices, the microcontroller can be reprogrammed. Both the program code memory (flash) and the EEPROM can be reprogrammed.

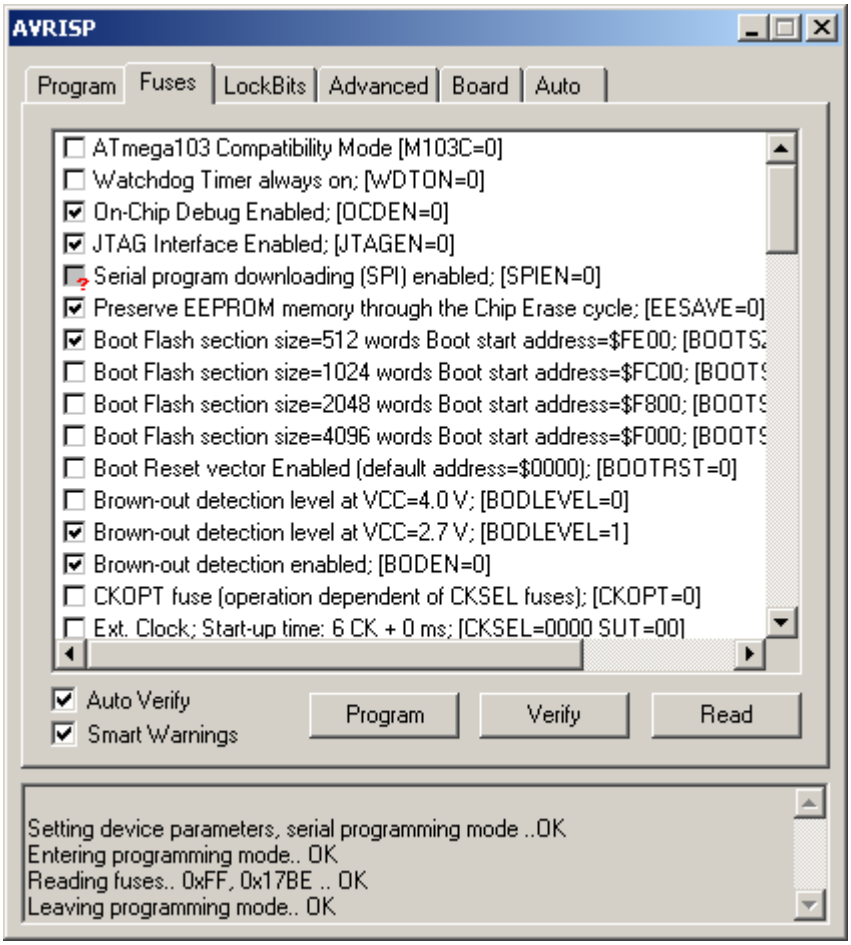

Figure 13: AVRISP Program Window used to program flash or EEPROM

The device used for programming must be connected to the CC2420DB programming ISP header connector. The programming interface uses 4 signal lines. These four lines can be accessed at the 6-pin connector, P6. The pin-out and description are listed in the table below.

Signal/pin	AVR programming socket, pin
MISO	1
SCK	3
MOSI	4
RESET	5
VCC	2
GND	6

Table 8: ISP header connector

Troubleshooting

It does not work

- Make sure that the power supply of CC2420DB is connected to the correct pins on the power connector.
- Is the supply voltage correctly polarized? If not, the protection diode will prevent any current from flowing. + and – are indicated on the PCB. On the DC jack, the tip is + and the ring is –.
- If you get the following error message in AVR Studio:
    - The OCD JTAG adapter was detected but there is no target power. Apply power to the target application or target device and click retry, to abort click cancel

  Please check that the JTAG ICE mkII or CC2420DB have the power applied
- If you get the following error message in AVR Studio:
    - OCD JTAG adapter was detected, but the target device did not return a valid JTAG ID, This could caused by no target device; the JTAGEN Fuse of the target device is not program, thus disabling the JTAG interface; existing application code programmed into the target device disable the JTAG interface thus requiring external reset pin to be activated upon connect see the JTAG ICE user manual for more information

  Please try to update the JTAG ICE mkII firmware using AVR Studio or check that the JTAG fuse has not been erased, [Tools] -> [STK500/AVRISP/JTAGICE]

References

CC2420 Datasheet:

http://www.chipcon.com/index.cfm?kat_id=2&subkat_id=12&dok_id=115

CC2420DK User Manual:

http://www.chipcon.com/index.cfm?kat_id=2&subkat_id=12&dok_id=115

CC2420DBK User Manual:

http://www.chipcon.com/index.cfm?kat_id=2&subkat_id=12&dok_id=115

Packet Sniffer User Manual:

http://www.chipcon.com/index.cfm?kat_id=2&subkat_id=12&dok_id=115

Atmel ATmega 128L data sheet:

http://www.atmel.com/dyn/resources/prod_documents/doc2467.pdf

AVR Studio:

http://www.avrfreaks.net/Home/News/article.php?NewsID=457

Or

http://www.atmel.com/dyn/products/tools.asp?family_id=607

WinAVR / AVR GCC:

http://www.avrfreaks.net/AVRGCC/index.php

Or

http://winavr.sourceforge.net/

Programmer's Notepad:

http://www.pnotepad.org/

IEEE 802.15.4:

http://www.ieee802.org/15/pub/TG4.html

Or

http://standards.ieee.org/getieee802/download/802.15.4-2003.pdf

ZigBee:

www.zigbee.org

Figure 8 Wireless:

www.figure8wireless.com

Document History

Revision	Date	Description/Changes
1.0	13.09.2004	Initial release.

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