

# **ATAB542x-x-WB User Guide**

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## **ATMEL “Wireless BlackBird” Transceiver Demonstration Kit**



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# Section 1

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## Introduction

Congratulations on your purchase of the ATMEL ATAB542x “Wireless BlackBird” Transceiver Demonstration Kit. This kit is built around the ATA542x RF transceiver IC and the ATmega3290 AVR<sup>®</sup> micro-controller.

This User Guide describes the Demonstration Kit features and provides two versions of the menu system in the demo software – (1) an abridged version which gives the top two tiers of the menu, and (2) an exhaustive version which gives the menu in full detail, including the resulting action from all possible joystick movements at each point in the menu.

For the most rapid path to executing a working demo with the transceiver pair, see the Quick Start Card included in the package. It shows how to execute the Link Quality demo – a demo in which each transceiver in the pair measures and displays the relative signal strength of the other transceiver’s RF transmission.

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### 1.1 Purpose

The Wireless BlackBird kit, consisting of a pair of transceivers, was designed with a positive out-of-the-box experience in mind. Using the Quick Start Card included in the package, an end-user can, within a matter of minutes, have a demonstration running. This User’s Guide outlines the demo-software menu, providing a complete, single document which the end-user can reference while becoming intimately familiar with the many features of the demo.

Equally so, this kit is suitable for a developer who wishes to explore the full capabilities of the ATA542x radio and the AVR micro-controller. Through the ISP, UART, or JTAG interface, the developer has complete control.

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### 1.2 Description

The ATMEL Wireless BlackBird is a 2" x 3.5" PC-board transceiver using the ATA542x UHF transceiver IC and the ATmega3290 AVR micro-controller, as shown in Figure 1-1. It is offered in five frequencies: 315, 345, 434, 868, and 915 MHz. The BlackBird is UART-, ISP-, and JTAG- ready. It has a custom LCD display, a 4-way joystick, and is powered by 2 AAA batteries.

The UART, ISP, and JTAG I/Os allow end-users to load software into the AVR and to interface with the ATA542x radio. With the joystick, the end-user can navigate through menus and select functions to execute. The LCD displays the menus, as well as showing transceiver activity during each of the various demo functions.

The BlackBird is capable of up to 20Kbit/s Manchester FSK modulation, or 10Kbit/s ASK. Its fractional-N frequency synthesizer gives a nice 800Hz RF resolution. An internal TX/RX switch controls the single-ended RF I/O which is capable of up to 10dBm (adjustable) output.

The ATMEL part numbers for the different frequency versions are:

ATAB5423-3-WB	for 315 MHz
ATAB5425-3-WB	for 345 MHz
ATAB5428-4-WB	for 434 MHz
ATAB5428-8-WB	for 868 MHz
ATAB5429-9-WB	for 915 MHz

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### 1.3 Performance Characteristics

Some typical characteristics for the ATA542x BlackBird transceiver board are:

Sensitivity: approximately -102 dBm FSK and -105 dBm ASK

Data Rate: up to 20 Kbit/s FSK and 10 Kbit/s ASK

Frequency/Channels: Multi-channel operation over +/- 2.5 MHz with 800 Hz resolution

Temperature Range: -40C to 85C

Power Output: ~ 0 to ~ 10 dBm (switchable)

Supply Current:

OFF mode: <1 uA

RX mode: 12 mA

TX mode @ ~0 dBm: 12 mA

TX mode @ ~ 8 dBm: 21 mA

Voltage Requirement : 3 or 6 VDC

Range : ≥ 1000 feet

The specifications for the ATA542x transceiver IC are included in its Data Sheet on the accompanying CD.

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### 1.4 Kit Contents

The ATAB542x kit contains two ATAB542x transceivers (with batteries), as determined by the ATMEL part number ordered, a Quick Start Card, and a CD. The kit is complete, the software is preloaded, and it is ready for immediate use. Figure 1-2 shows the kit contents.

Included on the accompanying CD are:

1. User Guide
2. Bills of Material
3. Data Sheets
4. schematic and layout files
5. IAR® and WinAVR source code
6. a \*.hex file for the Demo software
7. a Quick Start Guide

Figure 1-1. Wireless BlackBird Transceiver

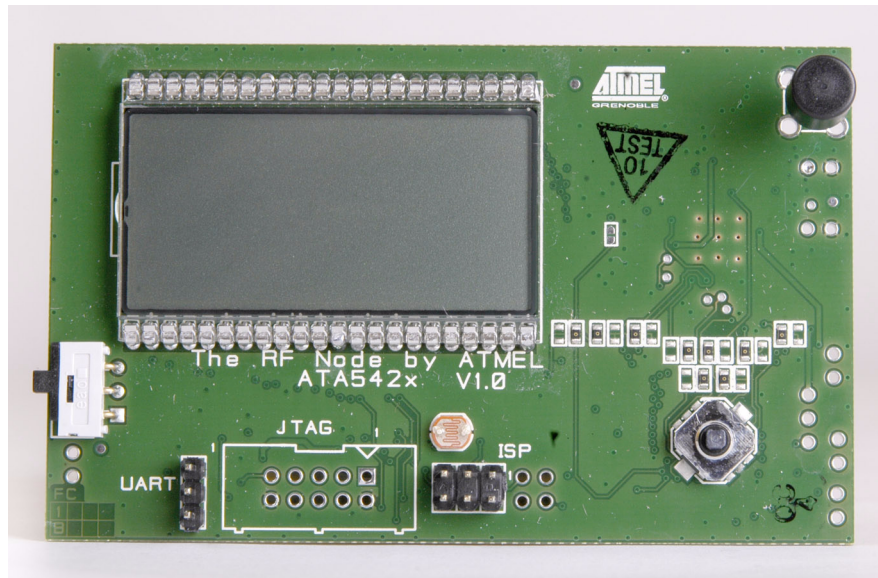


Figure 1-2. Wireless BlackBird Demonstration Kit





## Section 2

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# Operating the Transceivers

This section contains remarks about how the Menu Guides, both abridged and exhaustive, are set-up and how to use them. Then, both versions of the Menu Guide, respectively, are given.

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### 2.1 Menu Guide Description

These menu guides are intended to provide the user with two views of the demo-software menu. First, the abridged version shows a top-level view of only the first two tiers of the menu system. At a glance, the user can see what features are demonstrated in the pre-loaded software. Second, in the exhaustive version, the user has a simple-to-navigate outline with complete details about each feature in the software. Additionally, in the exhaustive version, short instructions are given for the demonstrations whose execution is not intuitively clear from simply the outline material alone.

The following are comments important to understanding these guides and navigating the Demo software menu:

1. anything that appears on the LCD display is highlighted in the outline with bold text. This helps the user to more quickly spot the place in this outline that corresponds to the current position in the menu system while using the Wireless BlackBird.
2. there are 5 possible movement of the joystick:
  - P - press
  - L - move left
  - R - move right
  - U - move up
  - D - move downthat result in some action. Each is described in the exhaustive version.
3. where reasonable, a few sentences of explanation either complement or replace the abbreviated descriptions of the joystick movements.
4. unless otherwise stated, these actions apply to each menu item:
  - L - backs out of the menu item
  - P - starts/ends/selects the menu itemSo, a very important action that the user **MUST** remember is:  
**only by pressing (P) the joystick will a selected menu item be stored in memory!**

5. the letters "X" or "x" are used in this outline to indicate display of a number that has a variable value.

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## 2.2 The Abridged Menu Guide

There are 6 main menus:

**DIAGNOSTICS**  
**LINK QUALITY**  
**TEMPERATURE SENSOR**  
**LIGHT SENSOR**  
**FREQ HOPPER**  
**SYSTEM SETUP**

They are accessible by moving the joystick downward (not to be confused with pressing it) or upward after power-up. At each main menu which has sub-menus, these sub-menus can be accessed by pressing the joystick. Moving the joystick leftward backs out of the currently-selected sub-menu.

These 6 main menus and each one's sub-menu are described here:

**DIAGNOSTICS** - provides transmit and receive functions for testing and evaluation. The sub-menus are:

**MARK** - transmits a continuous logic "1" (the upper FSK frequency)

**SPACE** - transmits a continuous logic "0" (the lower FSK frequency)

**TOGGLE** - generates a continuous square wave by toggling between MARK and SPACE (FSK mode)

**RSSI** - indicates received signal strength

**PKT TX** - transmits packet data

**PKT RX** - receives packet data

**S LINK** - serial link mode; permits two PCs to communicate over an RF link

**LINK QUALITY** - two transceivers exchange data packets with one-another. Each transceiver displays the relative strength of the signal it receives.

**TEMPERATURE SENSOR** - two transceivers exchange with one-another the temperature measurement made by each's on-board sensor. The temperature measured by a transceiver's own sensor, as well as that reported by the other transceiver, is displayed.

**LIGHT SENSOR** - two or more transceivers exchange with one-another the light intensity measurement made by each's on-board sensor. This is a multi-transceiver demonstration with a single MASTER and one or more REMOTES. The intensity measured by a transceiver's own sensor, as well as that reported by the other transceiver, is displayed. NOTE: the REMOTES communicate only with the MASTER – not with other REMOTES.

**FREQ HOPPER** - two transceivers exchange data packets, in either single or continuous mode, as they hop among pre-set channels.

**SYSTEM SETUP** - various functions

- PWR DWN** - puts the transceiver in one of two different sleep modes
- CHANNEL ADJUST** - adjusts/trims the frequency of the selected channel
- UNIT ID ADR** - assigns a unit ID to the transceiver
- SET DATE/TIME** - sets the date and time of the internal clock
- PWR LVL** - sets the power output (LO ~ 0dBm, HI ~ 8dBm)
- LCD SEG ON** - displays all segments on the LCD
- A/D TST** - shows that the A/D converter works
- CLK OUT** - outputs a square wave at the RC oscillator frequency
- TIME** - displays day/date/time information
- RF MODULE SELECT** - loads pre-set register data for each RF frequency

**2.3 The Exhaustive Menu Guide**

To power-up the transceiver, slide the white-and-black switch downward. The text **ATMEL WIRELESS BLACKBIRD** scrolls across the screen. The **AVR** logo and the device part number (**542x**) are also displayed. At this point:

- P - displays **VERSION X.XX**, the current version of the demo software
- P,L,R,U,D - goes to power-up display (ATMEL SMARTRF...)
- U,D - scrolls through the main menu (DIAGNOSTICS, LINK QUALITY, ...)
- P - selects desired menu item

**2.3.1 DIAGNOSTICS**

**Contains seven transmit/receive functions**

sub-menus: MARK, SPACE, TOGGLE, RSSI, PKT TX, PKT RX, S LINK

- P - accesses sub-menus
- L - goes to power-up display (ATMEL SMARTRF...)
- U,D - scrolls through main menu (DIAGNOSTICS, LINK QUALITY, ...)

**2.3.1.1 MARK**

**Transmits a continuous logic "1" (the upper FSK frequency)**

- P - accesses menu items
  - L - goes to DIAGNOSTICS
  - U,D - scrolls thru menu (MARK, SPACE, ...)
  - CH x** - sets radio channel (0 to 9)
    - P - sets channel and goes to PWR LVL
    - L - goes to PWR LVL
    - U - increments channel
    - D - decrements channel
  - PWR LVL** - sets TX power level
    - P - sets selected power level (LO/HI) and goes to MARK
    - L - goes to MARK
    - U - selects HI power
    - D - selects LO power
- MARK (blinking), channel number, AVR logo, antenna icon, and P LO (or, P HI)**





radio is transmitting, indicated by AVR logo and antenna icon

P,L,R,U,D - goes to START and stops transmitting

**START** - exits or re-starts TX mode

P - re-starts TX mode

L - goes to MARK (main menu)

U,D - goes to EXIT

**EXIT** - exits TX mode

P,L - goes to MARK (main menu)

U,D - goes to START

### 2.3.1.2 SPACE

Same as the MARK menu, except it transmits a continuous logic "0"  
(the lower FSK frequency)

### 2.3.1.3 TOGGLE

Generates a continuous square wave by toggling between MARK and SPACE  
(FSK mode)

P - accesses menu items

L - goes to DIAGNOSTICS

U,D - scrolls thru menu (MARK, SPACE, ...)

**CH x** - sets radio channel (0 to 9)

P - sets channel and goes to FSK

L - goes to FSK

U - increments channel

D - decrements channel

**FSK** - sets transmitter to ASK or FSK

P - sets mode and goes to x KBPS

U,D - toggles between ASK and FSK

**x KBPS** - sets data rate, dependent on modulation chosen

P - goes to TOGGLE

U,D - changes data rate (1,5,10 kbps for ASK; 1,5,10,20,40 kbps for FSK)

**TOGGLE, AVR logo, antenna icon, and CH x** - radio is transmitting, indicated by AVR logo and antenna icon

P,L,R,U,D - goes to START and stops transmitting

**START** - exits or re-starts TX mode

P - re-starts TX mode

L - goes to TOGGLE (main menu)

U,D - goes to EXIT

**EXIT** - exits TX mode

P,L - goes to TOGGLE (main menu)

U,D - goes to START

## 2.3.1.4 RSSI

**Indicates received signal strength**

*Note:* a 2nd transceiver must be put into one of the above transmit modes (MARK, SPACE, or TOGGLE) in order to see a received signal strength indication

P - accesses menu items

L - goes to DIAGNOSTICS

U,D - scrolls thru menu (MARK, SPACE, ...)

**CH x** - sets radio channel (0 to 9)

P - sets channel and goes to FSK

L - goes to FSK

U - increments channel

D - decrements channel

**FSK** - sets transmitter to ASK or FSK

P - sets mode and goes to x KBPS

L - goes to x KBPS

U,D - toggles between ASK and FSK

**x KBPS** - sets data rate, dependent on modulation chosen

P - sets data rate and goes to RSSI

L - goes to RSSI

U,D - changes data rate (1,5,10 kbps for ASK; 1,5,10,20,40 kbps for FSK)

**RSSI, number, vertical bar-graph** - shows a number and bar-graph to indicate relative signal strength

P,L,R,U,D - goes to RSSI (main menu)

## 2.3.1.5 PKT TX

**Transmits packet data**

*Note:* a 2nd transceiver must be put into the PKT RX mode in order to see this demonstration

P - accesses menu items

L - goes to DIAGNOSTICS

U,D - scrolls thru menu (MARK, SPACE, ...)

**CH x** - sets radio channel (0 to 9)

P - sets channel and goes to FSK

L - goes to FSK

U - increments channel

D - decrements channel

**FSK** - sets transmitter to ASK or FSK

P - sets mode and goes to x KBPS

L - goes to x KBPS

U,D - toggles between ASK and FSK

**x KBPS** - sets data rate, dependent on modulation chosen

P - sets data rate and goes to PKT TX

L - goes to PKT TX

U,D - changes data rate (1,5,10 kbps for ASK; 1,5,10,20,40 kbps for FSK)

**PKT TX (blinking), number** - transmits a packet

P, R - transmits packet and increments counter

L - goes to PKT TX (main menu)

U - resets counter to 0000

**HOW TO EXECUTE THE “PKT TX” FEATURE:** When ready to transmit, the blinking text **PKT TX** and **0000** is displayed. On the RX, a portion of the data packet (for example, **0D5500**) and a **4-digit number** is displayed. This number is the packet number sent by the TX. Transmission is indicated on the LCD of the TX by an **AVR logo (blinking)** and an **antenna icon**. When a packet is sent, the **4-digit number** on the TX display is incremented. At the RX, the **4-digit number** is set to the packet number sent by the TX.

### 2.3.1.6 PKT RX

#### Receives packet data

*Note:* a 2nd transceiver must be put into the PKT TX mode in order to see this demonstration

P - accesses menu items

L - goes to DIAGNOSTICS

U,D - scrolls thru menu (MARK, SPACE, ...)

**CH x** - sets radio channel (0 to 9)

P - sets channel and goes to FSK

L - goes to FSK

U - increments channel

D - decrements channel

**FSK** - sets transmitter to ASK or FSK

P - sets mode and goes to x KBPS

L - goes to x KBPS

U,D - toggles between ASK and FSK

**x KBPS** - sets data rate, dependent on modulation chosen

P - sets data rate and goes to PKT RX

L - goes to PKT RX

U,D - changes data rate (1,5,10 kbps for ASK; 1,5,10,20,40 kbps for FSK)

**PKT RX, (data & 4-digit number after packet received)** - displays received packet info from a transceiver in PKT TX mode

L - goes to PKT RX (main menu)

U,D - scrolls to show the entire contents of the packet received

**HOW TO EXECUTE THE “PKT RX” FEATURE:** see the description under **PKT TX**

### 2.3.1.7 S LINK

#### Serial link mode for connecting to a PC

*Note:* this demonstration requires 2 transceivers

*Note:* this mode can also be used as an "RF sniffer"

P - accesses menu items

L - goes to DIAGNOSTICS

U,D - scrolls thru menu (MARK, SPACE, ...)

**CH x** - sets radio channel (0 to 9)

P - sets channel and goes to FSK



- L - goes to FSK
- U - increments channel
- D - decrements channel
- FSK** - sets transmitter for ASK or FSK
  - P - sets mode and goes to x KBPS
  - L - goes to x KBPS
  - U,D - toggles between ASK and FSK
- x KBPS** - sets data rate, dependent on modulation chosen
  - P - sets data rate and goes to ASCII
  - L - goes to ASCII
  - U,D - changes data rate (1,5,10 kbps for ASK; 1,5,10,20,40 kbps for FSK)
- ASCII** - transmits in serial-link ASCII mode for communication between two PCs
  - P, L - turns on serial link transmission (SL ON, antenna icon (blinking))
  - U, D - change between ASCII and HEX mode
  - SL ON - serial-link mode activated
    - P, L - turns serial-link mode off (SL OFF) and returns to S LINK after momentary pause
- HEX** - transmits in serial-link HEX mode for communication between two PCs
  - Note: Use HEX mode or "RF sniffer" applications*
  - P, L - turns on serial link transmission (SL ON, antenna icon (blinking))
  - U, D - change between ASCII and HEX mode
  - SL ON - serial-link mode activated
    - P, L - turns serial-link mode off (SL OFF) and returns to S LINK after momentary pause

**HOW TO EXECUTE THE "S LINK" FEATURE:** Connect the BlackBird's 3-pin UART header to a PC with a suitably-modified serial RS232 cable. (NOTE: For "RF sniffer" applications, only one such set-up is required. To communicate between two PCs via an RF link, do two set-ups.). Using the Terminal Emulator included on the CD (or, another suitable one), configure the serial port for 38.4k, N, 8, 1. In the **S LINK** menu, select the desired **CH x**, **ASK** or **FSK**, **x KBPS**, and **ASCII** mode for one of the transceivers. When the LCD displays SL ON with a blinking antenna icon in the lower left-hand corner, the device is ready for communication. Repeat this with the 2nd transceiver. Now, type on one PC and observe the packet data displayed on the other PC. NOTE: in order to command the transceiver to transmit the message, one must hit <ENTER> on the keyboard.

## 2.3.2 LINK QUALITY

### Exchanges and displays measured signal strengths

*Note: this demonstration requires 2 transceivers*

- P - accesses menu items
- L - goes to power-up display (ATMEL SMARTRF...)
- U,D - scrolls through menu (DIAGNOSTICS, LINK QUALITY, ...)
- CH x** - sets radio channel (0 to 9)
  - P - sets channel and goes to FSK
  - L - goes to FSK

- U - increments channel
  - D - decrements channel
  - FSK** - sets transmitter to ASK or FSK
  - P - sets mode and goes to x KBPS
  - L - goes to x KBPS
  - U,D - toggles between ASK and FSK
  - x KBPS** - sets data rate
  - P - sets data rate and goes to \*WAIT\*
  - L - goes to \*WAIT\*
  - U,D - changes data rate (1,5,10 kbps for ASK; 1,5,10,20 kbps for FSK)
  - \*WAIT\*, antenna icon (blinking)** - transceiver is in REMOTE mode
  - L - goes to LINK QUALITY
- Note: One transceiver should be left as a REMOTE at the \*WAIT\*, antenna icon (blinking) display. Proceed with the other transceiver through the remaining menus to establish it as the MASTER.*
- R - puts transceiver into MASTER mode
  - MLINKxx, XXXX** - transmits to a REMOTE receiver
  - L - goes to LINK QUALITY
  - R + momentary hold - changes display information (Mxx, Rxx, etc.)
  - Mxx, Rxx, counter, AVR and antenna icon (blinking)** - Mxx displays signal strength received from REMOTE's transmitter; Rxx displays signal strength received from the MASTER's transmitter, as reported from the REMOTE.
  - L - goes to LINK QUALITY
  - R + momentary hold - changes display information (MLINKxx, XXXX, etc.)
  - U - resets counter to 0000

**HOW TO EXECUTE THE “LINK QUALITY” FEATURE:** One transceiver should be left as a REMOTE at the **\*WAIT\*, antenna icon (blinking)** display. When the other transceiver is put into MASTER mode, it starts sending packets and establishes communication with the REMOTE. **MLINKxx, xxxx**, and an **antenna icon (blinking)** show on the display. **MLINKxx** displays the relative signal strength of the signal received from the REMOTE link's transmitter (00 to 99). **xxxx** increments to show what packet number has been successfully sent and acknowledged. The REMOTE displays the same, except **RLINK** instead of **MLINK**.

### 2.3.3 TEMPERATURE SENSOR

#### Exchanges and displays measured temperatures

*Note: this demonstration requires 2 transceivers*

- P - accesses menu items
- L - goes to power-up display (ATMEL SMARTRF...)
- U,D - scrolls through menu (DIAGNOSTICS, LINK QUALITY, ...)
- CH x** - sets radio channel (0 - 9)
- P - sets channel and goes to FSK
- L - goes to FSK
- U - increments channel
- D - decrements channel

**FSK** - sets transmitter for ASK or FSK

P - sets mode and goes to x KBPS

L - goes to x KBPS

U,D - toggles between ASK and FSK

**x KBPS** - sets data rate

P - sets data rate and goes to \*WAIT\*, antenna icon (blinking)

L - goes to \*WAIT\*, antenna icon (blinking)

U,D - changes data rate (1,5,10 kbps for ASK; 1,5,10,20 kbps for FSK)

**\*WAIT\*, antenna icon (blinking)** - transceiver is in REMOTE mode

*Note: One transceiver should be left as a REMOTE at the \*WAIT\*, antenna icon (blinking) display. Set the other transceiver to MASTER (R joystick motion).*

L - goes to TEMPERATURE SENSOR

R - puts transceiver into MASTER mode

**HOW TO EXECUTE THE “TEMPERATURE SENSOR” FEATURE:** One transceiver should be left as a REMOTE at the **\*WAIT\*, antenna icon (blinking) display**. When the other transceiver is put into MASTER mode, it starts sending packets and establishes communication with the REMOTE. The MASTER cycles through 3 screens: (1) **M TEMP**, with **AVR logo** and **antenna icon (blinking)**, and a **thermometer icon**, (2) **LOCAL**, the measured **temperature** at the MASTER, and the **thermometer icon**, (3) **REMOTE**, the reported measured **temperature** at the REMOTE, and the **thermometer icon**. The REMOTE will cycle through the same 3 screens as the master, displaying **R TEMP** instead of **M TEMP**.

During any of these 3 screens, on either the MASTER or SLAVE:

L - returns TEMPERATURE SENSOR

U - toggles the displayed temperature between F and C

#### 2.3.4 LIGHT SENSOR

**Exchanges and displays measured light intensities**

*Note: this demonstration requires 1 or more REMOTE transceivers*

*Note: in the SYSTEM SETUP menu, under UNIT ID ADR utility, the REMOTE IDs can be set manually to any value 0 to 255*

P - accesses menu items

L - goes to power-up display (ATMEL SMARTRF...)

U,D - scrolls through menu (DIAGNOSTICS, LINK QUALITY, ...)

**CH x** - sets radio channel (0 - 9)

P - sets channel and goes to FSK

L - goes to FSK

U - increments channel

D - decrements channel

**FSK** - sets transmitter for ASK or FSK

P - sets mode and goes to x KBPS

L - goes to x KBPS

U,D - toggles between ASK and FSK

**x KBPS** - sets data rate

P - sets data rate and goes to \*WAIT\*, antenna blinking

L - goes to \*WAIT\*, antenna blinking

U,D - changes data rate (1,5,10 kbps for ASK; 1,5,10,20 kbps for FSK)

**\*WAIT\*, blinking antenna** - transceiver is in REMOTE mode

*Note: All transceivers except ONE (regardless of a single- or multi-sensor demo) should be left as a REMOTE at the \*WAIT\*, blinking antenna display. Proceed with ONLY ONE transceiver through the remaining menus.*

R - goes to SINGLE SENSOR

L - goes to LIGHT SENSOR

**SINGLE SENSOR** - sets single-sensor mode

P - sets sensor mode and goes to S ADDR x

L - goes to S ADDR x

U,D - toggles between SINGLE SENSOR and MULTI SENSOR

**S ADDR x** - sets the address of the REMOTE sensors to poll

*Note: this should be set to 1 if only one sensor is polled*

P - sets number and puts radio into MASTER mode

L - puts radio into MASTER mode

U,D - changes number of sensors to poll (1 - 254)

**MULTI SENSOR** - sets multi-sensor mode

P - sets sensor mode and goes to S ADDR x

L - goes to S ADDR x

U,D - toggles between SINGLE SENSOR and MULTI SENSOR

**S ADDR x** - sets the number of REMOTE sensors to poll

P - sets number and puts radio into MASTER mode

L - puts radio into MASTER mode

U,D - changes number of sensors to poll (1 - 254)

**HOW TO EXECUTE THE “LIGHT SENSOR” FEATURE:**

**SINGLE-SENSOR mode:** After one transceiver is put into MASTER mode, the MASTER polls the REMOTE with ID #1. The MASTER starts sending packets and establishes communication with the REMOTE. The MASTER cycles through 3 screens: (1) **M LIGHT**, with **AVR logo** and **antenna icon (blinking)**, and a **4-digit number**, (2) **LOCAL** and a **4-digit number**, (3) **REMOTE** and a **4-digit number**. The REMOTE cycles through the same 3 screens as the master, displaying **R LIGHT** instead of **M LIGHT** and no **4-digit number**.

**MULTI SENSOR mode:** This mode is similar to the SINGLE SENSOR mode except that each successive transmission addresses the next incremental REMOTE ID, up to the largest ID # set in the MULTI SENSOR menu. In order to do this mode successfully, a specific power-up sequence is required. For example, if the largest ID # is set to 3, the MASTER will poll REMOTE 1, then REMOTE 2, then REMOTE 3, and the repeat continually until the demo is terminated.

The 4-digit number is a relative intensity indicator. 1024 represents the brightest light the sensor can measure; 0000, the dimmest.

### 2.3.5    **FREQ HOPPER**

#### **hops among preset channels**

*Note:    this demonstration requires 2 transceivers*

P - accesses menu items

L - goes to power-up display (ATMEL SMARTRF...)

U,D - scrolls through menu (DIAGNOSTICS, LINK QUALITY, ...)

**\*WAIT\*** - ready to begin demo

    L - goes to FREQ HOPPER

    R - goes to M HOP

**M HOP** - sets single-event or continuous mode

    P - transmits in single-event mode

    L - returns to FREQ HOPPER menu

    U - transmits in continuous mode

#### **HOW TO EXECUTE THE “FREQ HOPPER” FEATURE:**

**SINGLE-EVENT mode** - at the **M HOP** screen, pressing the joystick sends a packet on 3 of the 5 pseudo-randomly-selected pre-set channels. The display shows **M HOP**, **AVR logo**, and **CH-x**. **CH-x** displays the channels on which it received a valid return packet from the REMOTE. Conversely, "----" indicates the data on that channel was not valid. During this mode, the REMOTE displays a **4-digit number** if it receives at least one good packet of the three.

**CONTINUOUS mode** - at the **M HOP** screen, moving the joystick up (until the **snowflake** is visible) continuously sends packets as the MASTER hops among the 5 pre-set channels. The display shows **M HOP**, **AVR logo**, **snowflake**, and **CH-x**. During this mode, the REMOTE displays a 4-digit number if it receives at least one good packet of the three.

In this demo, the REMOTE scans the 5 pre-set hop channels, goes to sleep, then repeats. These pre-set hop channels are not to be confused with the channel numbering in other user-selectable menus.

### 2.3.6    **SYSTEM SETUP**

#### **contains ten “house-keeping” functions**

sub-menus: PWR DWN, CHANNEL ADJUST, UNIT ID ADR, SET DATE/TIME, PWR LVL, LCD SEG ON, A/D TST, CLK OUT, TIME, REMOVE SELECT

P - accesses sub-menus

L - goes to power-up display (ATMEL SMARTRF...)

U,D - scrolls through menu (DIAGNOSTICS, LINK QUALITY, ...)

#### 2.3.6.1    **PWR DWN**

#### **Puts transceiver in two different sleep modes**



P - accesses menu items  
L - goes to SYSTEM SET-UP  
U,D - scrolls through menu (PWR DWN, CHANNEL ADJUST...)

**PWR OFF** - sets transceiver power-down mode

P - sets power-down mode  
L - goes to SYSTEM SETUP  
U,D - toggles between PWR OFF and PWR SAVE

**PWR SAVE** - display and radio are off; 32kHz oscillator and real-time clock are on

P - wakes-up part at power-up display (ATMEL SMARTRF...)

**PWR OFF** - turns display and radio off; uC is asleep; max draw <1uA

P - wakes-up part at SYSTEM SETUP

### 2.3.6.2 CHANNEL ADJUST **Adjusts/trims the frequency of the selected channel**

P - accesses menu items  
L - goes to SYSTEM SET-UP  
U,D - scrolls through menu (PWR DWN, CHANNEL ADJUST...)

**CH x** - sets radio to channel 0 thru 9

P - sets channel and goes to CH x, AVR logo, antenna, and 4-digit number

L - goes to SYSTEM SET-UP

U,D - changes channel number

**CH x, AVR logo, antenna, and 4-digit number** - initiates transmitting

P - toggles between transmitting and not transmitting

U,D - changes 4-digit number

**HOW TO EXECUTE THE “CHANNEL ADJUST” FEATURE:** when the transceiver is transmitting, change the **4-digit number** with the joystick movement until the desired operational frequency is reached. Each increment in the hexadecimal number trims the transmit frequency about 1kHz.

### 2.3.6.3 UNIT ID ADR **Assigns a unit ID to the transceiver**

*Note: for REMOTEs only -- the MASTER is always assigned ID #0*

*Note: this utility can be used to manually set the REMOTE IDs for the LIGHT SENSOR demonstration*

P - accesses menu items  
L -goes to SYSTEM SET-UP  
U,D - scrolls through menu (PWR DWN, CHANNEL ADJUST...)

**ADDRESS xxx** - ID assigned to this unit

- P - sets selected address number and goes to SYSTEM SET-UP
- L - goes to SYSTEM
- U,D - changes address to 0 thru 255

#### 2.3.6.4 SET DATE/TIME

##### Sets date and time of internal clock

- P - accesses menu items
- L - goes to SYSTEM SET-UP
- U,D - scrolls through menu (PWR DWN, CHANNEL ADJUST...)

##### **MONTH** - sets month

- P - sets selected value and goes to DAY
- L - goes to DAY
- U,D - select month (1 thru 12)

##### **DAY** - sets day number

- P - sets selected value and goes to YEAR
- L - goes to YEAR
- U,D - select day number (1 thru 31)

##### **YEAR** - sets year

- P - sets selected value and goes to DAYOFWK
- L - goes to DAYOFWK
- U,D - select year

##### **DAYOFWK** - sets day of week

- P - sets selected value and goes to HOUR
- L - goes to HOUR
- U,D - select day (1 thru 7, 1 = Monday)

##### **HOUR** - sets hour

- P - sets selected value and goes to MINUTES
- L - goes to MINUTES
- U,D - select hour (0 thru 23)

##### **MINUTES** - set minutes

- P - sets selected value and goes to SECONDS
- L - goes to SECONDS
- U,D - select minutes (0 thru 59)

##### **SECONDS** - set seconds

- P - sets selected value and displays day, date, and time
- L - goes to day,date and time
- U,D - select seconds (0 thru 59)

**day, date, and time** displayed

P (again) - goes to SYSTEM

### 2.3.6.5 PWR LVL

**Sets power output LO ~ 0dBm, HI ~ 8dBm)**

P - accesses menu items

L - goes to SYSTEM SET-UP

U,D - scrolls through menu (PWR DWN, CHANNEL ADJUST...)

**P LO** - sets power output

P - sets value and goes to SYSTEM SET-UP

U - selects P HI

D - selects P LO

### 2.3.6.6 LCD SEG ON

**Displays all segments in LCD**

P - accesses menu items

L - goes to SYSTEM SET-UP

U,D - scrolls through menu (PWR DWN, CHANNEL ADJUST...)

P - turns all segments on simultaneously, then erases the LCD and turns all segments on sequentially

P (again),L,R,U,D - goes to SYSTEM SET-UP

### 2.3.6.7 A/D TST

**Shows that the A/D converter works**

P - accesses menu items

L - goes to SYSTEM SET-UP

U,D - scrolls through menu (PWR DWN, CHANNEL ADJUST...)

**RSSI 0** - the RSSI output is on A/D channel 0

P - displays the hex value out of the A/D converter

L,R,U,D - goes to SYSTEM SET-UP

L - goes to SYSTEM SETUP

U,D - scrolls through menus (TEMP 1, LGHT 2, VCC 3)

P (again) - goes to RSSI 0

**TEMP 1** - the temperature sensor output is on A/D channel 1

P - displays the hex value out of the A/D converter

L,R,U,D - goes to SYSTEM SET-UP

L,R,U,D - goes to SYSTEM SETUP

P (again) - goes to TEMP 1

**LGHT 2** - the light sensor output is on A/D channel 2

P - displays the hex value out of the A/D converter

L,R,U,D - goes to SYSTEM SET-UP



L,R,U,D - goes to SYSTEM SETUP

P (again) - goes to LGHT 2

**VCC 3** - the voltage source output is on A/D channel 3

P - displays the hex value out of the A/D converter

L,R,U,D - goes to SYSTEM SET-UP

L,R,U,D - goes to SYSTEM SETUP

P (again) - goes to VCC 3

### 2.3.6.8 CLK OUT

**Outputs a square wave on JTAG-header pin #5**

P - activates output

L - goes to SYSTEM SET-UP

U,D - scrolls through menu (PWR DWN, CHANNEL ADJUST...)

*Note: this square wave is 10 CPU-cycles high, then 10 CPU-cycles low, repeating.*

**CLK OUT** and **AVR** logo - indicates output is activated

P,L,R,U,D - deactivates clock output and goes to SYSTEM SETUP

### 2.3.6.9 TIME

**Displays day/date/time information**

P - displays information

L - goes to SYSTEM SET-UP

U,D - scrolls through menu (PWR DWN, CHANNEL ADJUST...)

P,L,R,U,D - goes to SYSTEM SETUP

### 2.3.6.10 RF MODULE SELECT

**Loads pre-set register data for each RF frequency**

P -accesses menu items

L - goes to SYSTEM SET-UP

U,D - scrolls through menu (PWR DWN, CHANNEL ADJUST...)

**5429 – 915MHZ** - selects pre-set data for 915MHz

P - selects 915MHz data is loaded, and then goes to SYSTEM SET-UP

L - goes to SYSTEM SET-UP

U,D - scrolls through menu (5423 – 315MHZ, 5425 – 345MHZ,...)

**5423 – 315MHZ** - selects pre-set data for 315MHz

P - selects 315MHz data is loaded, and then goes to SYSTEM SET-UP

L - goes to SYSTEM SET-UP

U,D - scrolls through menu (5423 – 315MHZ, 5425 – 345MHZ,...)

**5425 – 345MHZ** - selects pre-set data for 345MHz

P - selects 345MHz data is loaded, and then goes to SYSTEM SET-UP

L - goes to SYSTEM SET-UP



U,D - scrolls through menu (5423 – 315MHZ, 5425 – 345MHZ,...)

**5428 – 433MHZ** - selects pre-set data for 433MHz

P - selects 433MHz data is loaded, and then goes to SYSTEM SET-UP

L - goes to SYSTEM SET-UP

U,D - scrolls through menu (5423 – 315MHZ, 5425 – 345MHZ,...)

**5428 – 868MHZ** – selects pre-set data for 868MHz

P - selects 868MHz data is loaded, and then goes to SYSTEM SET-UP

L - goes to SYSTEM SET-UP

U,D - scrolls through menu (5423 – 315MHZ, 5425 – 345MHZ,...)



## Section 3

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# Appendix

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### 3.1 Miscellaneous Information

- 3.1.1 Software re-load and FUSE settings** If at any time the software for the BlackBird needs to be re-loaded, please use the file:

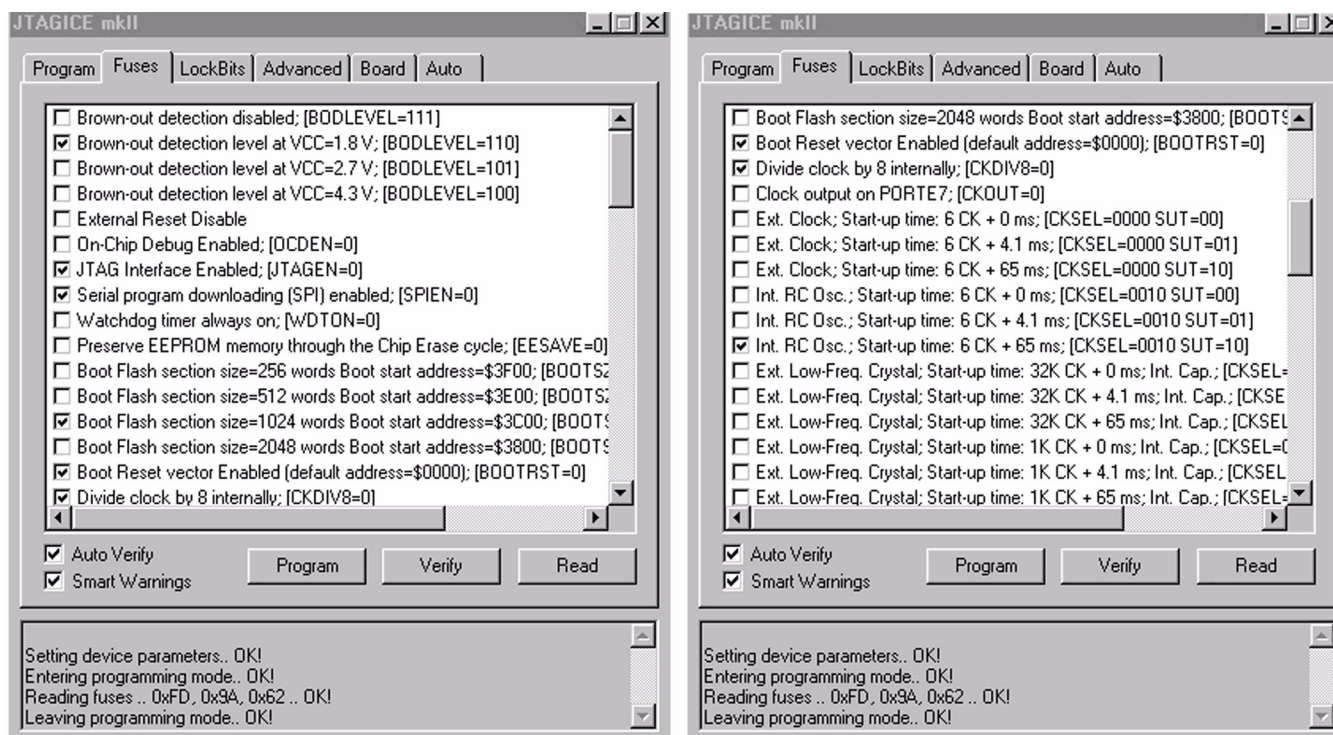
CD:\software\IARSRF\_B100.hex

In addition to programming the BlackBird with the executable software, the FUSEs must be correctly set. Here are the FUSEs which need to be checked, in text and with snapshots of the pop-up from AVR Studio.

- brown-out detection @ 1.8v
- JTAG interface enabled (optional)
- SPI enabled (may be ghosted – that's OK)
- boot reset vector enabled
- divide clock by 8 internally
- boot flash section size = 2048
- int RC oscillator: 6CK + 65ms

Note: if minimum current-consumption is desired, uncheck "brown-out detection @ 1.8v" and "JTAG interface enabled".

Figure 3-1.



### 3.1.2 Software documentation

To facilitate understanding the source code, it is recommended that DOXYGEN software (<http://www.doxygen.com>) be used to generate documentation. A file called "Doxyfile" is on the CD in the software directory. This file will be helpful when generating documentation with DOXYGEN.



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[www.atmel.com/literature](http://www.atmel.com/literature)

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