APPLICATION NOTE

Atmel AVR10002: ATmega256RFR2 Evaluation Kit – User Guide

8-bit Atmel Microcontroller

Features

- Evaluation platform for the Atmel® ATmega256RFR2 using programmed performance test measurement application consisting of simple range measurement and packet error rate measurement
- Test various IEEE® 802.15.4 hardware embedded features
- Experiment with the enhanced feature set of ATmega256RFR2
- Use serial boot loader functionality to flash new application software image into the MCU's program memory
- Enabled for demo/evaluation of remote control applications like ZigBee® Remote Control and ZigBee Light Link
- Extendable to any IEEE 802.15.4-based wireless application development such as ZigBee, 6LowPAN, ISA100, or any other proprietary network protocol

Introduction

The Atmel ATmega256RFR2-EK is an evaluation kit that allows the setup and the operation of a simple wireless network based on the ATmega256RFR2. With this kit the user can verify the performance of the chip and evaluate complete wireless system solutions including wireless stacks such as IPv6/6LoWPAN, ZigBee RF4CE and ZigBee PRO. Also the kit is an ideal platform for evaluation and development of various proprietary sytems using low level drivers or the new Atmel Lightweight Mesh Stack.

Figure 1. ATmega256RFR2-EK hardware.

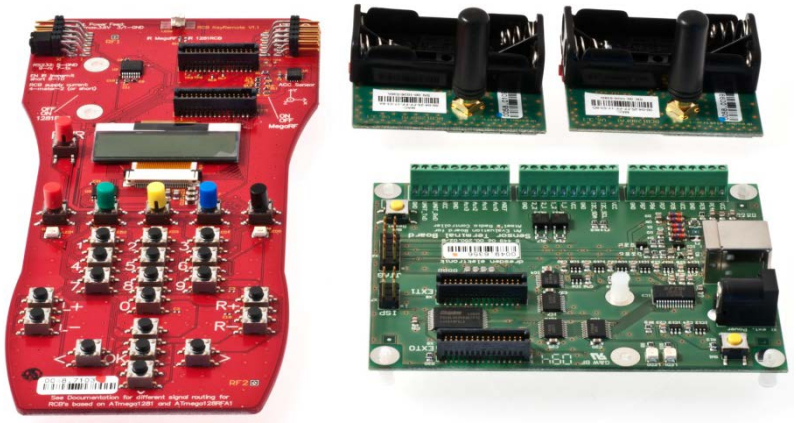


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1. Disclaimer

Typical values contained in this application note are based on simulations and testing of individual examples.

Any information about third-party materials or parts was included in this document for convenience. The vendor may have changed the information that has been published. Check the individual vendor information for the latest changes.

2. Overview

First in this document the complete hardware contents of the kit are explained in Chapter 3.

Then it describes how to set up and run the pre-flashed Performance Test application included with the Atmel ATmega256RFR2 Evaluation Kit. This initial test application is described in Chapter 4.

The Performance Test application includes a dedicated serial boot loader firmware which allows easy firmware update of the IEEE 802.15.4 compliant Atmel ATmega256RFR2 SoC [1]. The use of this serial boot loader is covered in Chapter 5.

The document also explains how to setup and program RCB firmware using the JTAG interface. See Chapter 6 for details.

3. Hardware Description

3.1 Kit contents

2 x RCB256RFR2 Radio Controller Board (RCB)

1 x RCB Sensor Terminal Board (STB)

1 x RCB Key Remote Control board (KEY_RC)

1 x RCB-BB RS232 cable

1 x USB cable

2 x 2.4GHz antenna

4 x AAA battery

3.1.1 The RCB256RFR2

The RCB256RFR2 is a small, battery-powered reference board that carries one Atmel ATmega256RFR2 System on Chip. It represents a system hardware reference for this microcontroller and contains a battery holder, SMA antenna connector and a 2x30 pin connector that allows the use of this board together with several different base boards to support various kinds of RF applications.

In this Atmel ATmega256RFR2-EK it serves the purpose of the RF communication interface module. With different applications loaded the board can be either used on the controller side as well as on the target side of a wireless network. The board can be also used to act as a simple RF performance evaluation module.

A detailed hardware description of this board can be found in Appendix A.

3.1.2 The RCB Key Remote Control board

The RCB Key Remote Control board is a remote control type base board that offers a typical remote control user interface like buttons, but also contains elements of more advanced remote controls like a display and LEDs as event indicators.

It provides the standard 2x30 pin connector that is used on the Radio Controller Board platform and allows the connection of different types of RCBs to demonstrate different RF remote control applications and features.

This board has also external connectors for serial interface as well as a JTAG connector and can be used as development and programming base board for updating the firmware on the RCB's microcontroller.

A full description of the board is found in [8].

3.1.3 The Sensor Terminal board

The Sensor Terminal board is an interface board for the small form factor Radio Controller boards. It supports the 2x30 pin connector of the RCB platforms and provides several additional external interfaces like USB or GPIOs. It also provides a JTAG connector and therefore also allows the firmware update of RCB's plugged into the 2x30 pin connector.

It is used as interface board for enabling a user controllable target application and for PC-based RF performance measurements with the RCB platforms.

A detailed hardware description of the Sensor Terminal Board is found in [10].

4. Performance Test Measurement Firmware Package

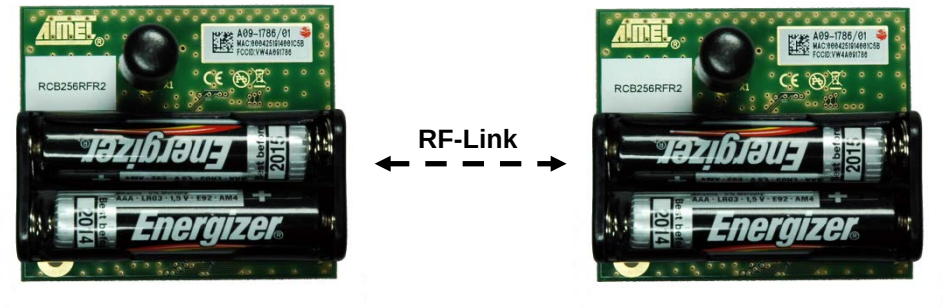
The main purpose of the Performance Test application is to offer a generic and simple to use tool to verify the RF performance of the Atmel ATmega256RFR2. This performance measurement firmware package is preprogrammed into every RCB256RFR2 contained in this kit. It can be operated in two different scenarios:

1. Simple Range Measurement – OP Mode 1
   This mode is used to test simple transceiver performance when using only two RCB256RFR2. Each board is individually powered by batteries. The range measurement can be performed by simply setting both RCBs as communication peers and exchanging test frame data.
2. Packet Error Rate Measurement – OP Mode 2
   This mode is used to perform more extensive transceiver tests. In this mode one RCB is operated stationary and it is connected to the host PC while the other is a mobile stand-alone RCB capable of performing basic range and terrain/environment survey measurements.

4.1 Simple Range Application

The RCB256RFR2 preprogrammed Performance Test Measurement application features an operation mode that is called Simple Range Measurement. After power up a RCB is in receive mode and ready to receive transmitted data packets from a transmitting node. One of the RCBs can be put into transmit mode to start the test. A successful transmit and receive operation is indicated by blinking LEDs as the frames are transmitted and received by each board. This visual indication can be used for easy RF range measurements between two RCB256RFR2.

Figure 1-1. Simple range measurement hardware setup.



4.1.1 Application setup

Insert two AAA batteries into each of the RCB256RFR2, connect the SMA stub antennas to the SMA connector of the board and apply power to both RCBs by turning on the power switch located on the top side of the board. The RCBs run a power-on check and indicate the successful completion by switching on LED D2.

4.1.2 Operational description

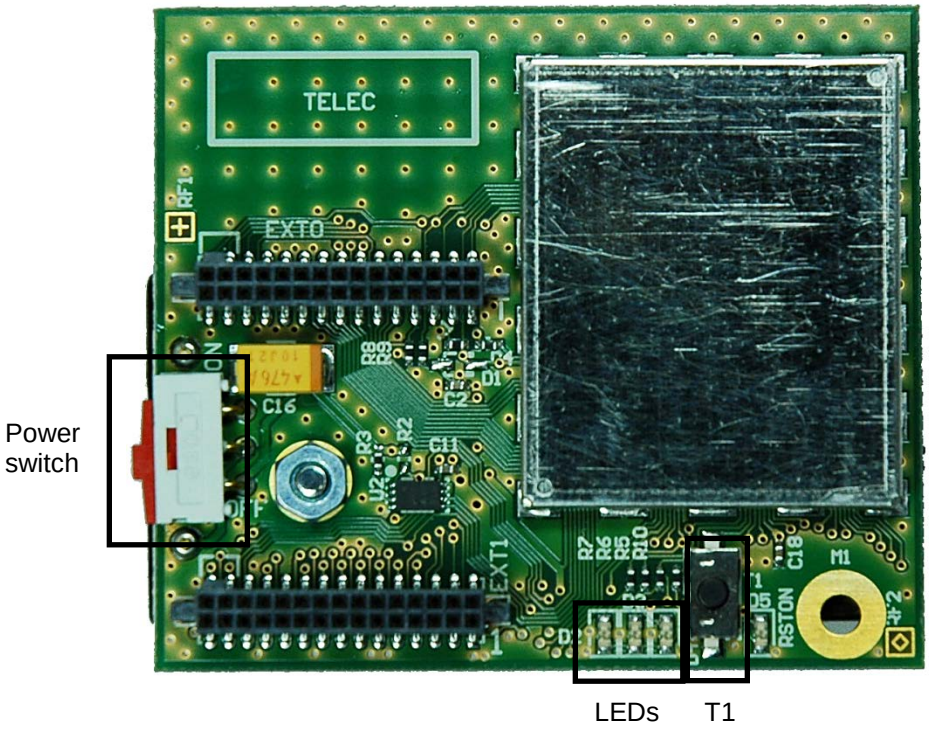
Pressing the T1 button on one RCB starts the Simple Range Measurement application. The application will then establish a dedicated RF link to the second RCB and after this first configuration phase it will automatically start the continuous transmission of data packets:

1. The RCB initiates a configuration procedure by broadcasting frames on a predefined RF channel and is waiting for response from its peer RCB.
2. After a successful configuration, the initiating node is set as a transmitter node and its companion RCB as a receiver node.
3. Once the RF data link is established the transmitter node sends data frames to its communication peer.

Each frame transmission is indicated by toggling of a LED on the transmitting node. A successful frame reception is indicated by toggling a LED on the receiver node. The LED on the receiver node stops toggling if no or no valid frames are received. This is an indication that the RF link between the two nodes is no longer operational. The frame transmission can be stopped at any time by pressing T1 button for a second time on the transmitter node.

Note: The node configuration (peer-to-peer configuration) gets lost when the power to an RCB is switched off or the board gets a reset. To restart the Simple Range Measurement both RCBs need to be reset or power cycled and button T1 must be pressed on that RCB that should operate as the transmitter node to restart data communication between the nodes.

Figure 4-2. Power switch, D2 LED and T1 button on RCB.



4.1.3 Purpose of the Simple Range Measurement Test

The Simple Range Measurement test is meant to be used to test basic RF link quality and range possibilities between two RF units when out in the field in a given environment.

To get an indication about the transmission range a user can start the transmission by pressing button T1 on the RCB that should operate as transmitter and use the second node as mobile receiver. Good RF link quality is indicated by continuously toggling a LED of the receiver node. As soon as the receiving node is moved too far away from the transmitting RCB or due to high attenuation structures between transmitter and receiver node, the LED stops toggling.

The LED on the transmitter RCB toggles always on successful data transmission and gives the user the visual indication that still data packets are transmitted. The nodes can be put in different places in order to get a fast indication whether a RF transmission is possible between these two locations. A typical scenario is that the transmitting RCB is placed on a fixed location while the receiving RCB is used to walk around and verify the RF range by observing the toggling LEDs.

4.2 Packet Error Rate Measurement (PER)

The second operation mode of the Performance Test Measurement application is the Packet Error Rate measurement test. The test and its basic parameters are defined in the IEEE 802.15.4 standard [2]. The test can be easily performed by simply connecting one of the RCB nodes via the STB to the Host-PC running a Terminal application, i.e. HyperTerminal. This provides the user with a simple configuration interface to control the test parameters. Individual performance tests can be configured and executed by menu options in the Terminal window.

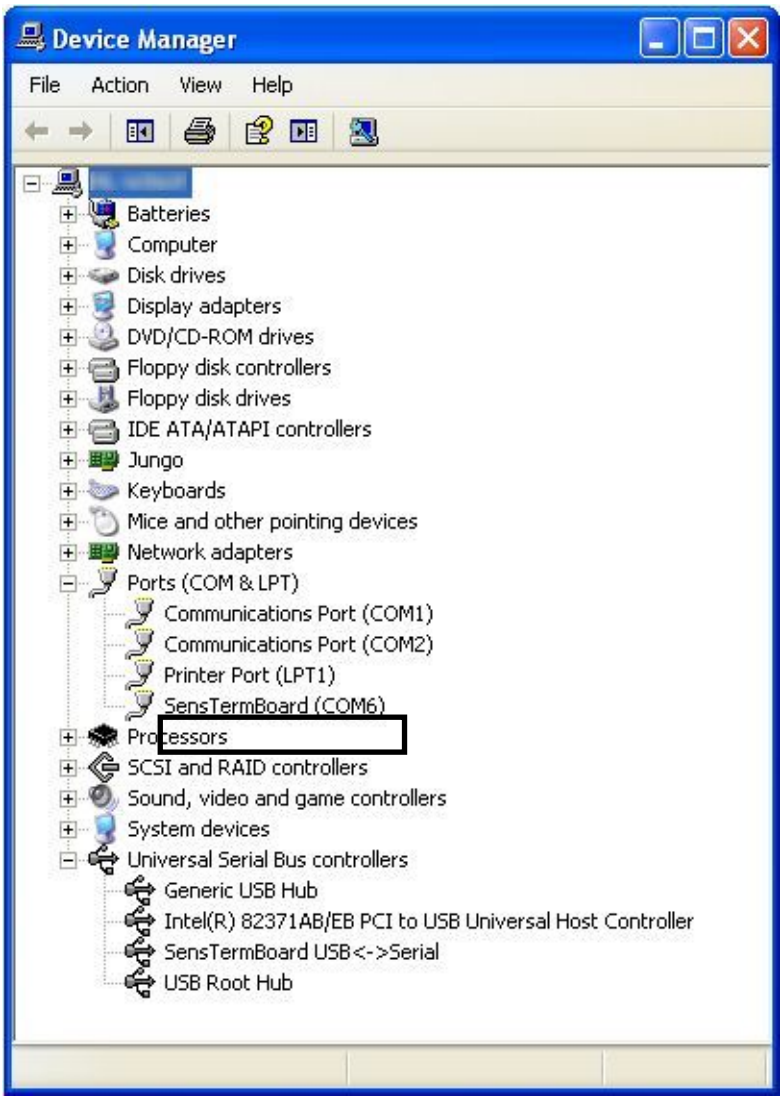
4.2.1 Setting and configuring kit hardware

1. Insert two AAA batteries into a stand-alone RCB256RFR2. This RCB makes one peer node also referred to as a receiver node.
2. Mount the second RCB without batteries on top of STB by plugging it onto the EXT0 and EXT1 connectors. This RCB and STB board assembly makes a transmitter node. This node is used as stationary node and must be connected with the USB cable to the host PC running a Windows® XP or later operating system.
3. Download and install a USB driver for the STB as described in [10].
4. Once the driver is downloaded unpack the driver archive to a folder on the host PC's hard-disk.
5. Connect USB cable to the STB. The New Hardware Installation Wizard will recognize the new board and will guide through the USB driver installation. When the Wizard is asking for the driver to install, navigate to the directory where the driver archive has been unpacked to.

Note: A successful installation and USB enumeration with the PC is indicated by the power status LED (LED 2) on the STB.

6. Identify the new hardware in the Windows Device Manager. The assigned COM-port number is needed when configuring the Terminal application later. See Figure 4-3 for an example COM port assignment for the STB.

Figure 4-3. Windows Device Manager.



Once the Terminal application is launched it needs to be configured to communicate with the STB hardware via the corresponding COM port.

7. The Terminal program running on the Host-PC is used to control the application running on Atmel ATmega256RFR2 device of the STB-RCB board assembly.

Set up the Terminal program parameters as below:

BAUD RATE:	115200
PARITY:	None
DATA BITS:	8
STOP BITS:	1
FLOW CONTROL:	Off

Once the USB driver software is installed and the Terminal window is set up, a user can display the application menu by typing any character on the Host-PC's keyboard. The device firmware starts looking for a peer device which is indicated by means of a growing dotted line.

8. Switch on the second RCB to allow initial peer configuration.

Figure 4-4. Searching for peer device.

```
Character received on UART: PER Measurement mode
Press ENTER to Abort Search for Peer Device and to start single node operation m
ode
Search for Peer device initiated.....................
```

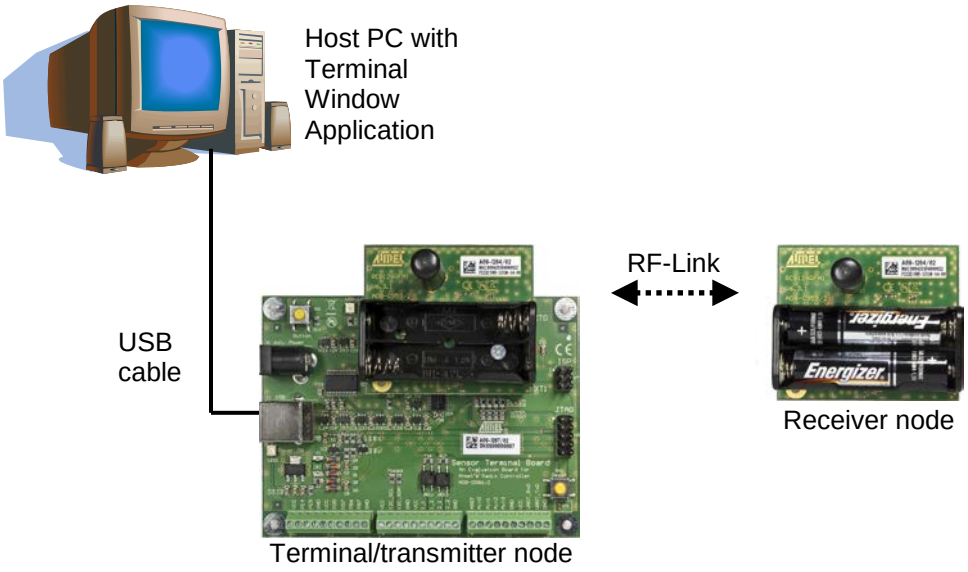
Once the second RCB is powered up the first node will recognize this and will establish a preconfigured link between those two nodes. The application will assign the device roles – the stationary STB-RCB setup will operate as the transmitter while the mobile node will act as a receiver node. After this step the command menu is displayed.

Figure 4-5. Successful configuration and command menu.

```
Search for Peer device initiated.....................................
.....................
Peer device found
 Starting PER Measurement mode as Transmitter
*****************************************************
Software Version:4.0
Performance test application (ATmega256RFR2)
Main menu:
(1) Transceiver Configuration
(2) Transceiver State Selection
(3) PER-Test Configuration
(4) Service Functions
(5) Start_test
>_
```

The complete setup will look like shown below.

Figure 4-6. Complete setup.



4.2.2 Packet Error Rate Measurement Menu

The packet error rate measurement can be controlled using the menu options displayed in the Terminal window, see Figure 4-7. The first four main menu entries will led to sub-menus if selected. Configuration changes, single side tests and packet error rate measurements can be done by pressing the corresponding command key sequences. Pressing ‘5’ will start the test with the selected parameters.

Figure 4-7. Performance test application main menu.

```
*******************************************************
Software Version:4.0
Performance test application (ATmega256RFR2)
Main menu:
(1) Transceiver Configuration
(2) Transceiver State Selection
(3) PER-Test Configuration
(4) Service Functions
(5) Start_test
>
```

4.2.3 Configuration parameters

The first and the third entry in the Performance test application main menu are about basic parameters that can be modified to perform the PER test under different conditions. Sub-menu (1) leds to the transceiver configuration which i.e. allows for selecting a different channel number or the transmission power (see Figure 4-8. Sub-menu (3) enables configuration of the Packet Error Test parameters like different number or length of data packets (see Figure 4-9). Both include all kinds of basic parameters required for basic RF performance tests.

The list of all possible configuration parameters is found in Appendix, Table A-1.

Figure 4-8. Transceiver configuration sub-menu.

```
*******************************************************
Software Version:4.0
Performance test application (ATmega256RFR2)
Main and Sub-menu:
(1) Transceiver Configuration
    (C) : Channel = 21
    (P) : Channel page = 0
    (X) : Receiver Desensitization = disabled
    (W) : Tx power = 4 dBm  (TX_PWR=0x0)
    (A) : ACK request = true
    (F) : Frame retry enabled = false
    (M) : CSMA enabled = true
    (0) : Leave sub-menu
(5) Start_test
>
```

Figure 4-9. PER-Test configuration sub-menu.

```
*******************************************************
Software Version:4.0
Performance test application (ATmega256RFR2)
Main and Sub-menu:
(3) PER-Test Configuration
    (N) : Number of test frames = 100
    (L) : Frame length (PSDU) = 20
    (Z) : CRC settings on remote node
    (0) : Leave sub-menu
(5) Start_test
>_
```

4.2.4 Single side tests

Some of the command keys can initiate single side tests that are only using the stationary STB-RCB assembly. This includes Energy scan, Sleep mode or Continuous wave transmission tests. These tests do even work without having performed an initial pairing sequence, either by cancelling the search for a peer by a second key press or letting the pairing procedure run into a timeout.

4.2.5 Start Test (Option 5)

The main menu option (5) starts a frame transmission to its peer device. Once this command key is used a basic PER test is performed with the configured test parameters as frame length, ACK request, retry setting, selected channel, and transmit output power. An example PER test sequence is described in Section 4.2.6.

4.2.6 A typical PER test sequence

Once the hardware is properly connected, the initial peer configuration sequence has been passed successfully and the Performance Test application menu is visible in the Terminal software the steps to initiate a basic PER test with a generic parameter set are as follows:

Parameter settings (parameters not listed here are left with their reset values):

1. Enter the Transceiver Configuration submenu: 1.
2. Select channel number: C.
   Enter channel number, for example: 11.
3. Select acknowledge (ACK) request option (enable/disable): A.
   For the basic PER the acknowledgement should be disabled.
4. Select frame retry option (enable/disable): F.
   For the basic PER the frame retries should be disabled.
5. Select CSMA option: M.
   For the basic PER the CSMA should be disabled
6. Return to the main menu: 0.
7. Enter the PER-Test Configuration submenu: 3.
8. Select number of test frames: N.
   Enter number of packets for this test, for example: 1000.
9. Select frame length: L.
   Set frame length to 20 bytes as this is the value defined by the IEEE 802.15.4 for a basic PER: 20.
10. Return to the main menu: 0.

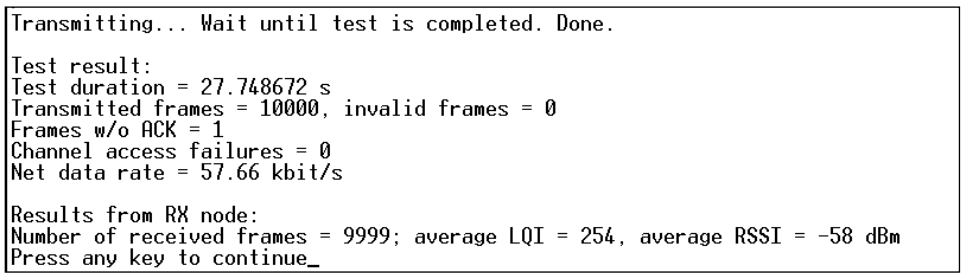
The second mobile receiving node should now be moved to a location where a regular packet error rate measurement should give more exact indication about the RF link quality between the stationary STB-RCB assembly and this second mobile node. Once this node is placed the test can be started.

11. Start test: S.
    This starts the PER test.

During the test the text: “Transmitting … wait until test is completed.” is displayed in the Terminal window.

After the test has been completed the test results are displayed in the Terminal window. The test result contains information like test duration, number of successfully transmitted frames, effective data rate, number of successfully received frames and average link quality for all data frames. An example test results is shown in Figure 4-10.

Figure 4-10. Packet error rate.



The PER test provides a statistical indication about the reliability of an RF link. For increased statistical significance it is recommended to use a higher number of packets (>10000) for this test and to repeat the test for one dedicated RF link between two points for more than one time.

5. Uploading Firmware Using On-Chip Boot Loader Program

The Atmel AT256RFR2-EK development kit devices are preprogrammed with a serial boot loader program that allows the update of the firmware in the RCBs via the serial interface of the Atmel ATmega256RFR2. The Atmel AVR® microcontroller has a separate boot loader program memory section where this serial boot loader firmware is located.

5.1 Functionality overview

The boot loader firmware is capable of reprogramming (flashing) the device program memory with a new program application image. Due to that the application firmware can be easily upgraded without a separate programmer (for example, Atmel AVR JTAGICE mkII).

The RCBs must be mounted either on top of the STB board which is connected with a USB cable to a host PC or on top of the RCB Key Remote Control board connected to the host PC via the UART interface. For both cases, required interface cables are contained within the kit. A boot loader PC application is executed on the host. It establishes a serial connection link with the base board and is used to upload a new application memory binary file into the device program application memory. Firmware images must be in SREC file format

The boot loader firmware occupies 2048 words in the upper address space of the AVR microcontroller. The boot loader firmware is executed upon power up or device reset. The program execution starts in the boot loader memory section and initiates a handshaking procedure with the boot loader PC host application before it can begin with a new program upload.

ATmega256RFR2 program memory layout including its application and boot loader sections is shown in Figure 5-1.

After uploading a new device firmware into the application program memory the boot loader remains in its original program space location. If desired, it can be used again to update the existing application program anytime again.

If the PC boot loader application is not responding to this handshaking procedure the boot loader hands over the program execution after a timeout of ~500milisecond to the application that is actually loaded into the regular program memory.

Figure 5-1. Atmel ATmega256RFR2 program memory partitioning.

Address		**0 15**
0x0000 0x1EFFF	0 129023	Application Space (129024 words)
0x1F800 0x1FFFF	129024 131071	Boot loader (2048 words)

5.2 Flashing a firmware image using the serial boot loader

The steps to use the boot loader firmware to update the software in the application space of the ATmega256RFR2 are as follows.

1. Install the boot loader GUI application on your host-PC. The boot loader GUI application is found on the atmel.com website under the Atmel AVR2054 application note [14].

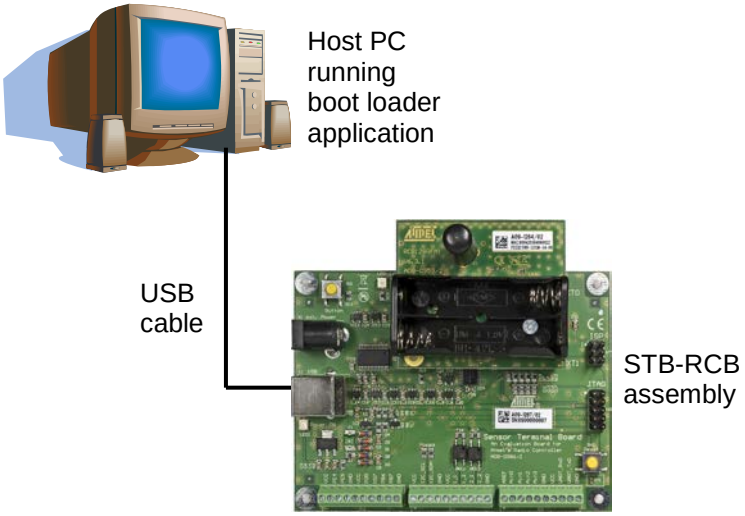
2. Connect one RCB that should get a new application firmware to the STB.
3. Connect the STB-RCB board assembly to the host PC using the USB cable.

If the STB board has never been connected to the host PC a USB software driver must be downloaded and installed for the STB [10]. The STB will get a COM port assigned by the operating system.

It is also possible to use UART pins of the ATmega256RFR2 which are accessible on the RCB Key Remote Control board to use this serial boot loader update method. For this purpose the kit contains a special serial cable that can be connected to a host PC's standard RS232 connector and connects on the other side to the exposed UART pins of the RCB256RFR2 which are accessible via connector EXT on the RCB Key Remote Control.

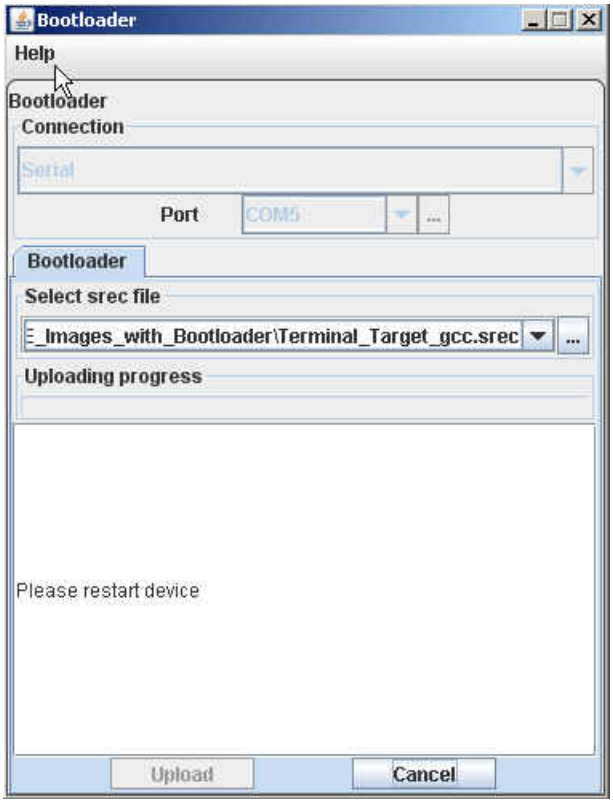
Throughout this document the boot loader operation based on the RCB-STB and the USB interface is the primary used firmware update method.

Figure 5-2. Application software upgrade with a boot loader hardware setup.



4. Launch the serial boot loader PC software application on the host PC.
5. Select the source file to be uploaded (file_name.srec) using the PC boot loader application by either typing the source file path name or navigating to it using the navigation action button.
6. Once the source filename has been entered push the 'Upload' button to enter the source file name and begin uploading procedure.

Figure 5-3. Boot loader PC application GUI window.



7. When the message ‘Please restart device’ appears push the reset button on the STB. Now the boot loader firmware in the Atmel ATmega256RFR2 will initiate the handshake procedure and the new image upload begins. The progress indicator gives visual feedback about this upload procedure.
8. Upon upload completion the RCB is ready to execute the updated application.

Device fuses are not changed during the firmware upgrade using the serial boot loader.

9. When the firmware update for one RCB has been finished the board can be removed from the STB and the second RCB can be updated with a different application firmware.

For further details about the usage of the serial boot loader and the boot loader PC GUI refer to [13].

6. Programming RCB Using Atmel AVR JTAGICE mkII

Atmel ATmega256RFR2 device program (Flash) and data (EE) memories as well as the fuse configuration can be programmed and updated using a JTAG interface programmer (for example, AVR JTAGICE mkII [11]). The RCB device programming is possible when the RCB is mounted on top of KEY_RC board to make a KEY_RC-RCB board assembly or when mounted on top of STB to make an STB-RCB board assembly.

6.1 Prerequisites for JTAG programming

In order to use the JTAG programming and debugging capabilities of the Atmel AT256RFR2-EK the following prerequisites have to be met:

1. A JTAG capable hardware like the KEY-RC-RCB or the STB-RCB setup.
2. A JTAG programmer (like the AVR JTAGICE mkII).
3. JTAG programming software (like the Atmel Studio IDE).

The Atmel Studio package can be downloaded from the atmel.com website:

http://www.atmel.com/tools/atmelstudio.aspx

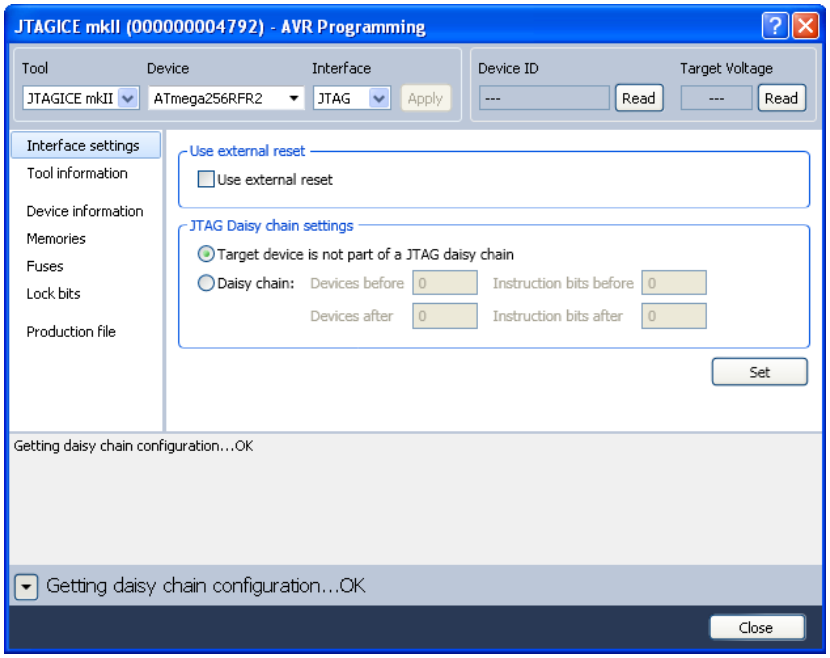
Once the Atmel Studio is installed it allows the use of the AVR JTAGICE mkII to reprogram the RCB.

6.2 Programming the RCB in the KEY-RC setup

Follow the steps below:

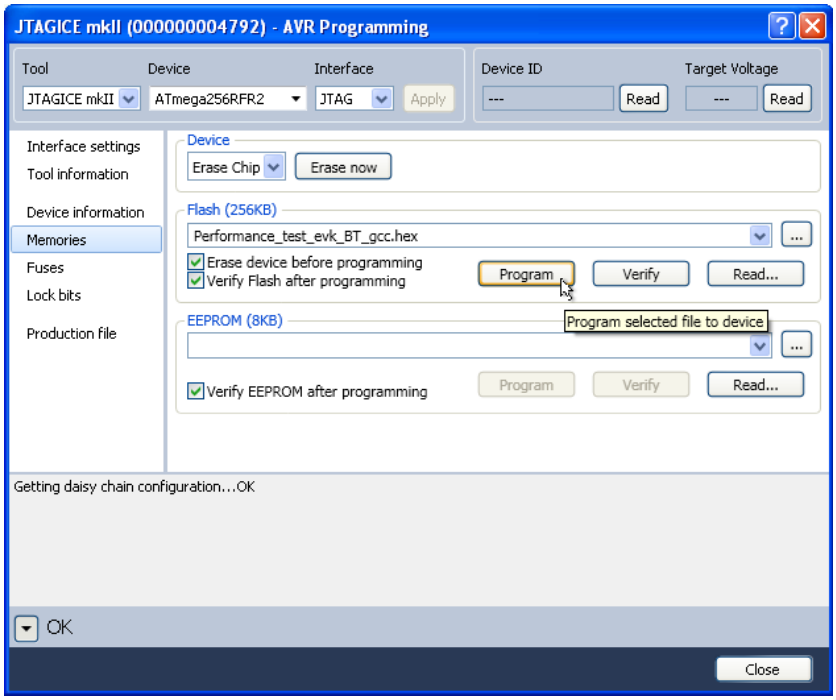
1. Assemble KEY_RC-RCB (Controller) node.
2. Insert batteries into the controller nodes RCB256RFR2.
3. Connect the AVR JTAGICE mkII JTAG cable to the JTAG connector on the top of the RCB Key Remote Control board.
4. Switch the power supply on: (1) on the RCB and (2) on the AVR JTAGICE mkII programmer.
5. Launch Atmel Studio IDE.
6. Navigate to the ‘Tools’ menu bar, click on ‘AVR Programming’
7. Select your programmer (‘JTAGICE mkII’), the device type (‘ATmega256RFR2’), the interface used (‘JTAG), and click ‘Apply’ to perform the device identification. See Figure 6-1 as reference.

Figure 6-1. Atmel Studio AVR Programming dialog.



8. Select Memories from the left tab and pick a HEX file in the Flash section. Click ‘Program’. The device is programmed with a new application program image. See Figure 6-2 as reference.

Figure 6-2. Atmel Studio AVR Programming dialog (2).



9. In the Fuses tab select the fuse configuration (see Appendix A) depending on the application.

6.3 Programming the RCB in the STB setup

Follow steps below:

1. Assemble STB-RCB (Terminal Target).
2. Connect USB cable to a free USB port of a PC or any other USB equipped host. This supplies power to the node (STB-RCB board assembly).
3. Connect the Atmel AVR JTAGICE mkII programmer cable to the JTAG connector on the STB.
4. Launch Atmel Studio IDE.
5. Go on as described in Section 6.2.

Appendix A. Performance Test Measurement Application

A.1 ATmega256RFR2 fuses – boot loader configuration

Performance Application with boot loader ATmega256RFR2 fuses settings:

```
Fuse      Description
-----------------------------------------------------
BODLEVEL  Brown-out detection at VCC=1.8V
OCDEN     disabled
JTAGEN    enabled
SPIEN     enabled
WDTON     disabled
EESAVE    enabled
BOOTSZ    Boot flash=2048W
BOOTRST   enabled
CKDIV8    enabled
CKOUT     disabled
SUT_CKSEL Int. RC Osc. 6CK + 0ms
FUSES OVERVIEW (with boot loader):
EXTENDED  0xFE
HIGH      0x92
LOW       0x42
```

A.2 List of user interface commands and options

Once the devices have finished the initial peer configuration phase the user interface on the transmitter side allows performing several tests. These can be configured and initiated by pressing the corresponding command key in the Terminal program.

Note: Commands are listed in order of the appearance in the user interface and not in alphabetical order.

Note: In unpaired state, not all menu entries are available.

Table A-1. User interface commands (main menu).

Command key	Parameter and possible options
1	Transceiver Configuration
2	Transceiver State Selection
3	PER-Test Configuration
4	Service Functions
5	Start test

Table A-2. User interface commands (transceiver configuration sub-menu).

Command key	Parameter and possible options
C	Channel [11 … 26]
P	Channel page: 0 – 250 kbps, OQPSK Modulation (IEEE 802.15.4) 2 – 500 kbps, OQPSK Modulation (proprietary) 16 – 1000 kbps, OQPSK Modulation (proprietary) 17 – 2000 kbps, OQPSK Modulation (proprietary)
X	Enable/Disable Receiver Desensitization
W	Transmit Power [-17dBm … +4dBm] A – Absolute value in dBm R – TX_PWR register value
A	Enable/Disable ACK request
F	Enable/Disable Frame retry
M	Enable/Disable CSMA
0	Leave sub-menu

Table A-3. User interface commands (transceiver state selection sub-menu).

Command key	Parameter and possible options
X	Enable/Disable Receiver Desensitization
S	Reset Transceiver
T	Sleep transceiver T – Wake up Transceiver
G	switch transceiver off
J	switch transceiver PLL on
K	switch transceiver to RX mode
U	Continuous transmission on current channel C – Continuous Wave mode P – Pseudo Random Binary Sequence mode
0	Leave sub-menu

Table A-4. User interface commands (PER-Test configuration sub-menu).

Command key	Parameter and possible options
N	Number of test frames [1 … 2^32-1]
L	Frame length (PSDU) [11 … 127]
Z	CRC setting on remote node
0	Leave sub-menu

Table A-5. User interface commands (Service Functions sub-menu).

Command key	Parameter and possible options
I	Identify peer device by blinking
E	Energy scan on all channels N – duration [0 ... 14]
U	Continuous transmission on current channel C – Continuous Wave mode P – Pseudo Random Binary Sequence mode
D	Transmit a continuous wave pulse on current channel
V	Get sensor data, i.e. supply voltage and temperature
H	Read - Write Transceiver Registers R - to Read Reg W - to Write Reg D - to get register Dump
0	Leave sub-menu

Appendix B. References

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Appendix D. Revision History ATmega256RFR2 PCBA

Version	Description
A09- 1785/01	Initial revision

Appendix E. Revision History

Doc. Rev.	Date	Comments
42082A	03/2013	Initial document release



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