RCB Certification Firmware Manual

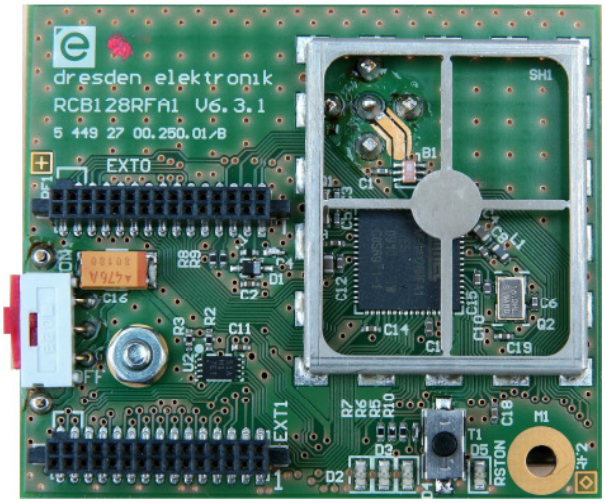
Features

- **User Manual for RCB Certification Firmware**

1 Introduction

The manual describes the usage of RCB (DUT) firmware for certification purposes. Figure 1-1 as an example shows one target board demonstrating the 8 bit AVR microcontroller with integrated low power 2.4 GHz transceiver [1].

Figure 1-1. RCB128RFA1 – Single-Chip Radio Controller Board



Other DUTs may look different with a slightly different user interface, for details refer to section 2.

AVR® E·LINK™

RCB Certification Firmware Manual

Rev. 0001B-AVR-10/09

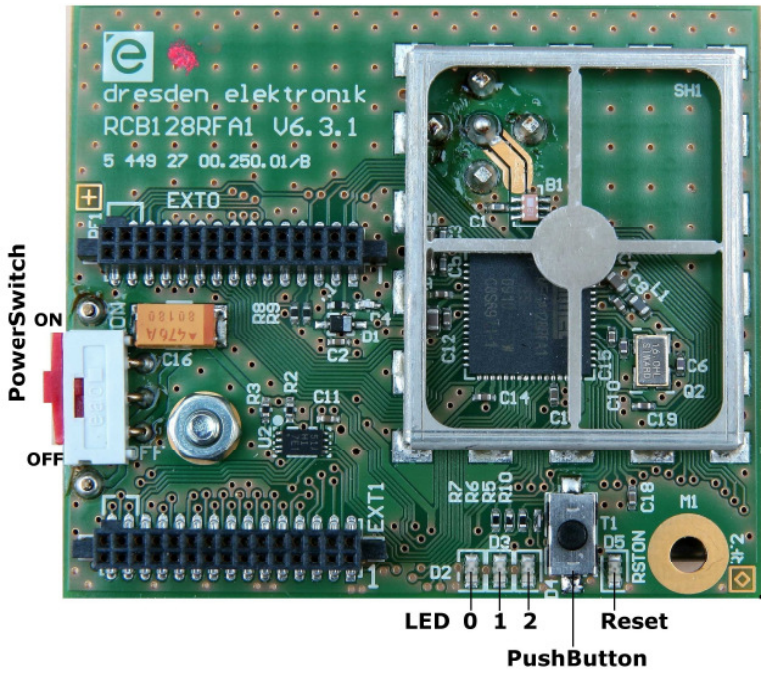
2 Hardware Description

2.1 RCB128RFA1 v6.3.1

The RCB features the following user interface:

- (3) STATUS LED's (*LED_0 … LED_2*)
- (1) RESET LED (*LED_R*)
- (1) Push Button (*Button*)
- (1) Power Switch (*Sw*)

Figure 2-1. RCB128RFA1 v6.3.1 – User Interface



Main components:

- 8 bit AVR microcontroller with integrated low power 2.4 GHz transceiver [1]
- AT25010A, EEPROM
- Antenna, Mobile Mark PSTG0-2400HS

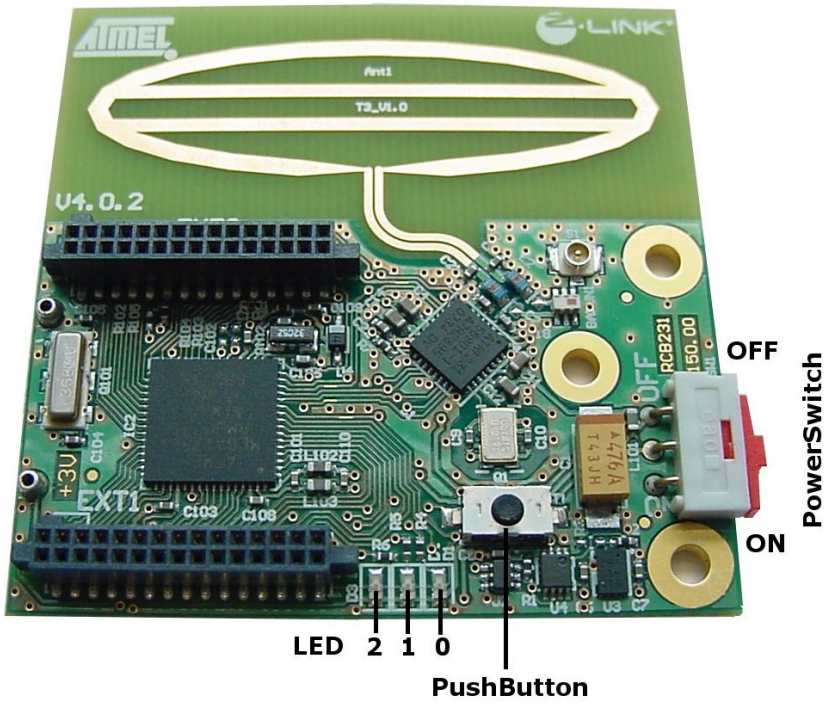
Figure 1-1 shows the RCB without shielding cover in an active state, the microcontroller part is running and the radio transceiver part is in TRX_OFF state (IDLE / Standby). For details refer to the next sections. The RCB is manufactured, tested and shipped with shielding cover attached to the frame.

2.2 RCB231 v4.0.2

The RCB features the following user interface:

- (3) STATUS LED's (*LED_0 … LED_2*)
- (1) Push Button (*Button*)
- (1) Power Switch (*Sw*)

Figure 2-2. RCB231 v4.0.2 – User Interface



Main components:

- AT86RF231, 2.4 GHz low power radio transceiver [2]
- ATmega1281, 8 bit AVR microcontroller
- AT25010A, EEPROM
- Antenna, on board or antenna connector

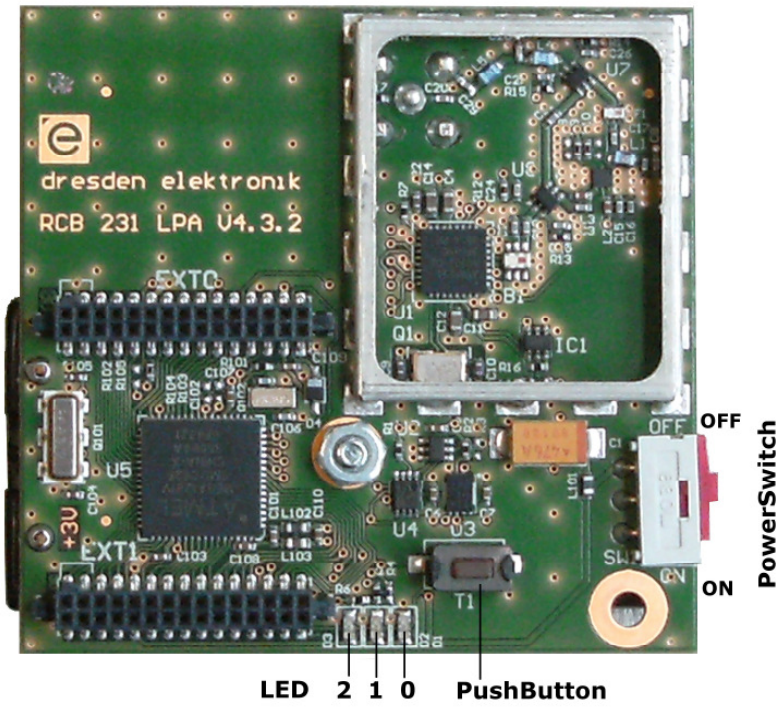
The picture shows the RCB in an active state, the microcontroller part is running and the radio transceiver part is in TRX_OFF state (IDLE / Standby). For details refer to the next sections. Note the different order or weighting of the LED's compared to the RCB shown in 2.1.

2.3 RCB231LPA v4.3.2

The RCB features the following user interface:

- (3) STATUS LED's (*LED_0 … LED_2*)
- (1) Push Button (*Button*)
- (1) Power Switch (*Sw*)

Figure 2-3. RCB231LPA v4.3.2 – User Interface



Main components:

- AT86RF231, 2.4 GHz low power radio transceiver [2]
- uPG2314T5N, Power Amplifier
- ATmega1281, 8 bit AVR microcontroller
- AT25010A, EEPROM
- Antenna, Mobile Mark PSTG0-2400HS

The picture shows the RCB in OFF state. Note the different order or weighting of the LED's compared to the RCB shown in 2.1.

Figure 2-3 shows the RCB for illustration without shielding cover. However, the board is manufactured, tested and shipped with shielding attached to the frame.

2.4 RCB212SMA v5.3.2

To be defined, no firmware support yet.

3 Firmware Description

3.1 Prerequisites

Before power-on the DUT by moving (*Sw*) to (*ON*) position, ensure the DUT is equipped with two AAA batteries. These batteries are to be placed at the back side of the DUT in the battery holder. Pay attention to the correct polarity of the batteries.

3.2 Power-On and Configuration

There are two possibilities to power-on the DUT:

1. Without DUT configuration update,
2. Configuration mode (press (*Button*) during power-on).

The next sections describe different ways to power-on a DUT in detail.

3.2.1 Without DUT Configuration Update

The first choice is the standard selection to power-on the DUT.

To select operation without radio transceiver configuration update, power-on the DUT by switching (*Sw*) to (*ON*) position. Do not press the (*Button*).

There are two possible system configurations:

- The very first power-on cycle (factory reset) enables operation at maximum TX output power and standard PSDU data rate. The DUT starts at test mode state "***0***", refer to section 3.3.
- All other power-on cycles remember the last radio transceiver configuration and test mode selection before last power-off cycle.

If available, the LED indicating the reset state (*LED_R*) is on for a short time. Once this LED is off again, the microcontroller is waiting for a new (*Button*) command.

3.2.2 Configuration Mode

Power-on the DUT in configuration mode allows either:

- Reset to factory configuration, and, if required
- Selection of TX output power and/or PSDU data rate, see references [1…2].

To do this, press and hold the (*Button*) before power-up the DUT. Once the DUT is powered on, the three state LED's (*LED_0* … *LED_2*) are switched on. Further handling of the (*Button*) determines the next configuration options.

3.2.2.1 Factory Reset

If the (*Button*) is pressed during power-on and immediately released afterwards, factory reset configuration is loaded.

If TX output power has to be switched to the minimum value do not release the (*Button*) within two seconds, for details refer to 3.2.2.2.

If no further (*Button*) activity is recognized, all three state LED's are switched off 5 sec later. Continue to select the test mode as described in section 3.3.

3.2.2.2 Transmitter Output Power Selection

If the (*Button*) is not released for about two seconds after power-on, the TX output power is set to the minimum possible value. This is indicated by switching off the three state LED's (*LED_0* … *LED_2*), and immediately after switching on state LED (*LED_2*). Now the (*Button*) has to be released to continue with PSDU data rate selection, or wait to leave the radio transceiver configuration menu 5 sec later.

PSDU Data Rate Selection

Release the (*Button*) either immediately or after TX output power selection, to enable the PSDU rate selection. This is possible independently on a previous TX output configuration. Each new (*Button*) press toggles the status LED's similar to a binary counter between 1 through 4. Note, a new (*Button*) press event to select the PSDU data rate has to be performed within 5 sec after power-on or TX output power selection. Otherwise the configuration menu is left towards the ***Test Mode Selection***, see section 3.3.

The PSDU data rate is coded as follow:

Table 3-1. Configuration Settings for 2.4 GHz Radio Transceiver

State	LED_0	LED_1	LED_2	Description
0	ON	ON	ON	Factory reset value PSDU data rate = 250 kb/s
1	ON	off	off	PSDU data rate = 250 kb/s
2	off	ON	off	PSDU data rate = 500 kb/s
3	ON	ON	off	PSDU data rate = 1000 kb/s
4	off	off	ON	PSDU data rate = 2000 kb/s
	other			other configurations are not available yet

Once state 4 is reached, a new (*Button*) press starts at state 1.

If, after power-on, perhaps TX output power selection and the first (*Button*) release, the (*Button*) is not pressed, as well as after each new (*Button*) press event to toggle the PSDU data rate, a 5 sec timer is started to automatically leave the radio transceiver configuration. Each new (*Button*) press resets the timer.

Leaving the radio transceiver configuration is done automatically after about 5 sec and indicated by switching all state LED's off.

Note, the configuration menu is only accessible after power-on. Each new TX output power or PSDU data rate configuration requires a power cycle of the DUT.

3.3 Test Mode Selection

After power-on, and optionally DUT configuration, the DUT is waiting for user input, in detail a (*Button*) press event. As long as no (*Button*) press occurs, the system remains in the state after power-on, see table below.

Each new (*Button*) press event switches to the next state, for example after the initial state 0 (TRX_OFF) a (*Button*) press selects state 1, the radio transceiver starts to transmit a continuous wave carrier at channel 11. The TX output power used is according to the initial configuration.

Table 3-2. Test Mode Selection Table

State	LED[1]	Channel	Blink Period	RX/TX	Modulation	Burst	Comment
	0 1 2		[sec]				
0		n/a					TRX_OFF
1	B[2]	11[3]	2	TX	no	CW	
2	B	18[3]	2	TX	no	CW	
3	B	26[3]	2	TX	no	CW	
4	B	11	1	TX	yes[4]	CW	
5	B	18	1	TX	yes[4]	CW	
6	B	26	1	TX	yes[4]	CW	
7	B	11	0.5	TX	yes[4]	burst	100 ms
8	B	18	0.5	TX	yes[4]	burst	100 ms
9	B	26	0.5	TX	yes[4]	burst	100 ms
10	B	11	0.2	RX	n/a	n/a	
11	B	18	0.2	RX	n/a	n/a	
12	B	26	0.2	RX	n/a	n/a	

Notes:

(1) Note the individual LED order for each RCB type.

(2) B indicates LED is blinking, all other LED's are off

(3) Due to the radio transceiver architecture the unmodulated, CW TX RF frequency is at $f_{TX,CW,noMod} = f_{channel} - 0.5$ MHz. But still within the modulation bandwidth of a modulated TX output signal.

(4) These states using the PSDU data rate setting as configured after power-on, refer to 3.2.

The selected channel is indicated by the corresponding LED, whereas the blinking period indicates the operating mode.

A new (*Button*) press selects the next state. Once state 12 is reached, the next (*Button*) press switches to state 0, and therefore sets the radio transceiver part back into TRX_OFF (IDLE / Standby) state.

It is not possible to change the PSDU data rate within this operating mode. Doing this requires a DUT power cycle as described in section 3.2.

3.4 Error Handling

In test scenarios where external interferers or events are applied to check the robustness of the DUT, the device may not be able to continue with normal operation.

Normal operation according to 3.3 is always indicated with one out of three LED's blinking, whereas an error condition is visualized by all three state LED's (*LED_0* … *LED_2*) on.

If a malfunction is indicated and the DUT is not damaged, it returns to normal operation after two seconds. The same holds for unexpected resets of the whole system, for instance during an ESD stress test. Such an event may cause an internal reset and the DUT immediately continues with normal operation according to the mode selected before.

Furthermore, any behavior of the state LED's different to 3.3 indicates a malfunction of either the microcontroller or radio transceiver part.

4 Abbreviations

DUT	-	Device Under Test
LED	-	Light Emitting Diode
PHY	-	Physical Layer
PSDU	-	PHY Service Data Unit
RCB	-	Radio Controller Board
RX	-	Receiver
TX	-	Transmitter

5 EVALUATION BOARD/KIT IMPORTANT NOTICE

This evaluation board/kit is intended for use for **FURTHER ENGINEERING, DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY.** It is not a finished product and may not (yet) comply with some or any technical or legal requirements that are applicable to finished products, including, without limitation, directives regarding electromagnetic compatibility, recycling (WEEE), FCC, CE or UL (except as may be otherwise noted on the board/kit). Atmel supplied this board/kit "AS IS," without any warranties, with all faults, at the buyer's and further users' sole risk. The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies Atmel from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge and any other technical or legal concerns.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER USER NOR ATMEL SHALL BE LIABLE TO EACH OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

No license is granted under any patent right or other intellectual property right of Atmel covering or relating to any machine, process, or combination in which such Atmel products or services might be or are used.

Mailing Address: Atmel Corporation, 2325 Orchard Parkway, San Jose, CA 95131

References

[1] ATmega128RFA1; 8 bit AVR microcontroller with Low Power 2.4 GHz transceiver for ZigBee and IEEE802.15.4; Datasheet; Rev. AVR-15/June/2009; Atmel Corporation

[2] AT86RF231; Low Power, 2.4 GHz Transceiver for ZigBee, IEEE 802.15.4, 6LoWPAN, RF4CE, SP100, WirelessHART and ISM Applications; Datasheet; Rev. 8111C-MCU Wireless-10/09; Atmel Corporation

[3] AT86RF212; Low Power 700/800/900 MHz Transceiver for IEEE 802.15.4, P802.15.4c Draft Amendment, Zigbee, 6LoWPAN, and ISM Applications; Datasheet; Rev. 8186B-MCU Wireless-02/09; Atmel Corporation

[4] ATmega1281/V; 8-bit Microcontroller with 128K Bytes In-System Programmable Flash; Datasheet; Rev. 2549L–AVR–08/07; Atmel Corporation

History

Rev. 0001A-AVR-10/09

- Initial Release

Rev. 0001B-AVR-10/09

- Firmware modification
    - Recovery of DUT operation mode after power-cycle
    - Possibility to reset to factory settings
    - Error handling during DUT stress events (e.g. ESD)

Headquarters

Atmel Corporation
2325 Orchard Parkway
San Jose, CA 95131
USA
Tel: 1(408) 441-0311
Fax: 1(408) 487-2600

International

Atmel Asia
Unit 1-5 & 16, 19/F
BEA Tower, Millennium City 5
418 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
Tel: (852) 2245-6100
Fax: (852) 2722-1369

Atmel Europe
Le Krebs
8, Rue Jean-Pierre Timbaud
BP 309
78054 Saint-Quentin-en-
Yvelines Cedex
France
Tel: (33) 1-30-60-70-00
Fax: (33) 1-30-60-71-11

Atmel Japan
9F, Tonetsu Shinkawa Bldg.
1-24-8 Shinkawa
Chuo-ku, Tokyo 104-0033
Japan
Tel: (81) 3-3523-3551
Fax: (81) 3-3523-7581

Product Contact

Web Site
www.atmel.com

Technical Support
avr@atmel.com

Sales Contact
www.atmel.com/contacts

Literature Request
www.atmel.com/literature

0001B-AVR-10/09