AVR600: RZ600 HW Manual

Features

- **Contains the full selection of AT86RF family radio transceivers.**
- **Covers the 2.4GHz ISM band and 700, 800 and 900MHz frequency bands.**
- **In total 3 pair of radio transceivers are available – one pair per radio transceiver.**
- **Two ATUC3A3256 based USB host boards are included**
  - **Based on Atmel® AVR® UC core**
  - **80 Dhrystone MIPS and Draws Only 40 mA at 66 MHz**
  - **Low, full and high speed USB compliant**
  - **Ideal for PC to RF gateways, packet sniffers and network commissioning tools**
- **On board ID chip for easy IEEE MAC address**
- **Stub antennas for all frequency bands**

1 Introduction

The RZ600 kit is an evaluation kit for the Atmel AT86RF family of radio frequency devices. The family contains the two 2.4GHz device AT86RF230 and AT86RF231. These are highly acclaimed networking devices within low power personal area networks. In addition to this the world's first IEEE 802.15.4 enabled sub gigahertz radio is provided – the AT86RF212. With the kit you also receive two AVR UC3 based host nodes that can be used to evaluate a point to point network connection. That being said; the RZ600 radio boards sport an Atmel standardized 10-pin connector that will enable the RF boards to be connected to any AVR microcontroller. A wide range of the standard Atmel AVR design tools have the host end of the standardized 10-pin connector – so as a customer you will be able to evaluate Atmel radio transceivers in virtually any application segment.

The RZ600 kit enables RF4CE, IEEE 802.15.4, ZigBee® and 6lowPAN network technologies to run on the full Atmel portfolio of low power AVR microcontrollers.

Figure 1-1. RZ600 HW Overview



8-bit AVR® Microcontrollers

Application Note

Rev. 8293A-AVR-03/10

2 Related Items

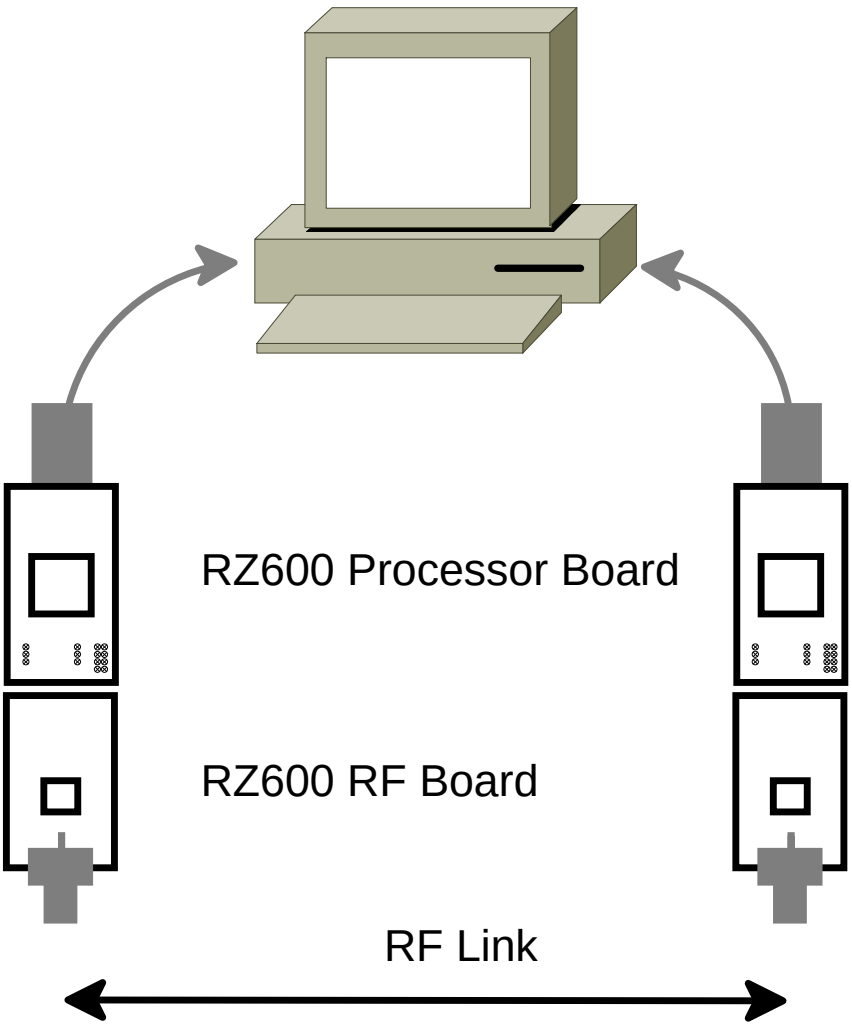
AVR32 Studio (Atmel's free IDE)
http://www.atmel.com/dyn/products/tools_card.asp?tool_id=4116
AVR32 GNU Toolchain (Atmel's free Compiler and Utilities)
http://www.atmel.com/dyn/products/tools_card.asp?tool_id=4118
JTAGICE mkII (On-chip programming and debugging tool)
http://www.atmel.com/dyn/products/tools_card.asp?tool_id=3353
AVR ONE! (On-chip programming and debugging tool)
http://www.atmel.com/dyn/products/tools_card.asp?tool_id=4279

3 Overview

This section gives an overview of the RZ600 kit from a system perspective as well as what the kit contains and its minimum requirements. A set of condensed instructions are then given on how to get the evaluation application for the kit up and running in the shortest time possible.

Figure 3-1 shows how the two processor boards paired with the radio frequency boards also available in the kit can form a wireless peer to peer data connection over USB. The application that is pre programmed by Atmel on the AT32UC3A3256 is indeed such a USB to RF gateway.

Figure 3-1 RZ600 used in conjuntion with PC



3.1 Kit Contents

The RZ600 kit contains the following pieces of hardware:

- 2 pcs. AT86RF230 radio cards: miniature carrier board with the AT86RF230 radio transceiver mounted, SMA antenna connector, one wire ID chip and Atmel standard 10-pin connector.
- 2 pcs. AT86RF231 radio cards: miniature carrier board with the AT86RF231 radio transceiver mounted, SMA antenna connector, one wire ID chip and Atmel standard 10-pin connector.
- 2 pcs. AT86RF212 radio cards: miniature carrier board with the AT86RF212 radio transceiver mounted, SMA antenna connector, one wire ID chip and Atmel standard 10-pin connector.
- 2 pcs. AVR UC3 based processor cards: usb dongle form factor board with AT32UC3A3256 processor mounted, LEDs, UART connection and host side Atmel standard 10-pin connector.
- 2 pcs. 2.4GHz SMA stub antenna. These are shared between the AT86RF230 and AT86RF231 radio transceivers.

- 2 pcs. Sub gigahertz SMA stub antenna. Used with the AT86RF212 radio transceiver.
- 2 pcs. Bag with wires and squid cable: The squid cable fits the radio frequency boards and will enable wiring to a hardware that does not contain the standard Atmel 10-pin accessory header.
- 1 pcs. Technical Library CD

3.2 System Requirements

Table 3-1 contains the minimum system requirements for the RZ600 kit when connected to a PC for application development on the AT32UC3A3256 microcontroller.

Table 3-1. Minimum System Requirements

Parameter	Value	Comment
Hardware		
PC/CPU	Intel Pentium III or better, 800 MHz	
PC/RAM	128 MBytes	
PC/Video	1024x768, SVGA	
PC/ Hard disk free space	200 Mbytes	
On-Chip Debugger and programmer	AVR JTAGICE mkII or AVRONE!	The AVR JTAGICE mkII or AVRONE! is needed if the user wishes to debug and do custom application development.
Software		
Operating System	Windows2000/XP/Vista	
IDE	AVR32 Studio or IAR Embedded Workbench	AVR32 Studio with compiler utilities is required for reprogramming the processor board and for application development.

3.3 Quick Start Guide

To following sequence is suggested when testing the evaluation application the RZ600 kit:

1. Unpack the kit and verify contents
2. Identify the processor boards and select two radio frequency boards with the same radio transceiver mounted. It is suggested to do this even though there are two different radio transceivers for the 2.4GHz band that are fully compatible with each other: AT86RF230 vs. AT86RF231.
3. Mount a radio frequency board to each of the processor boards
4. Insert the assembly into a free USB port on the computer.
5. Let the devices enumerate – they should become available as two CDC virtual COM ports.
6. Open two terminal windows and start typing. Verify that the text in the two terminals are the same.

4 Hardware Description

This chapter walks through the different pieces of hardware that you will find in the RZ600 kit in greater detail.

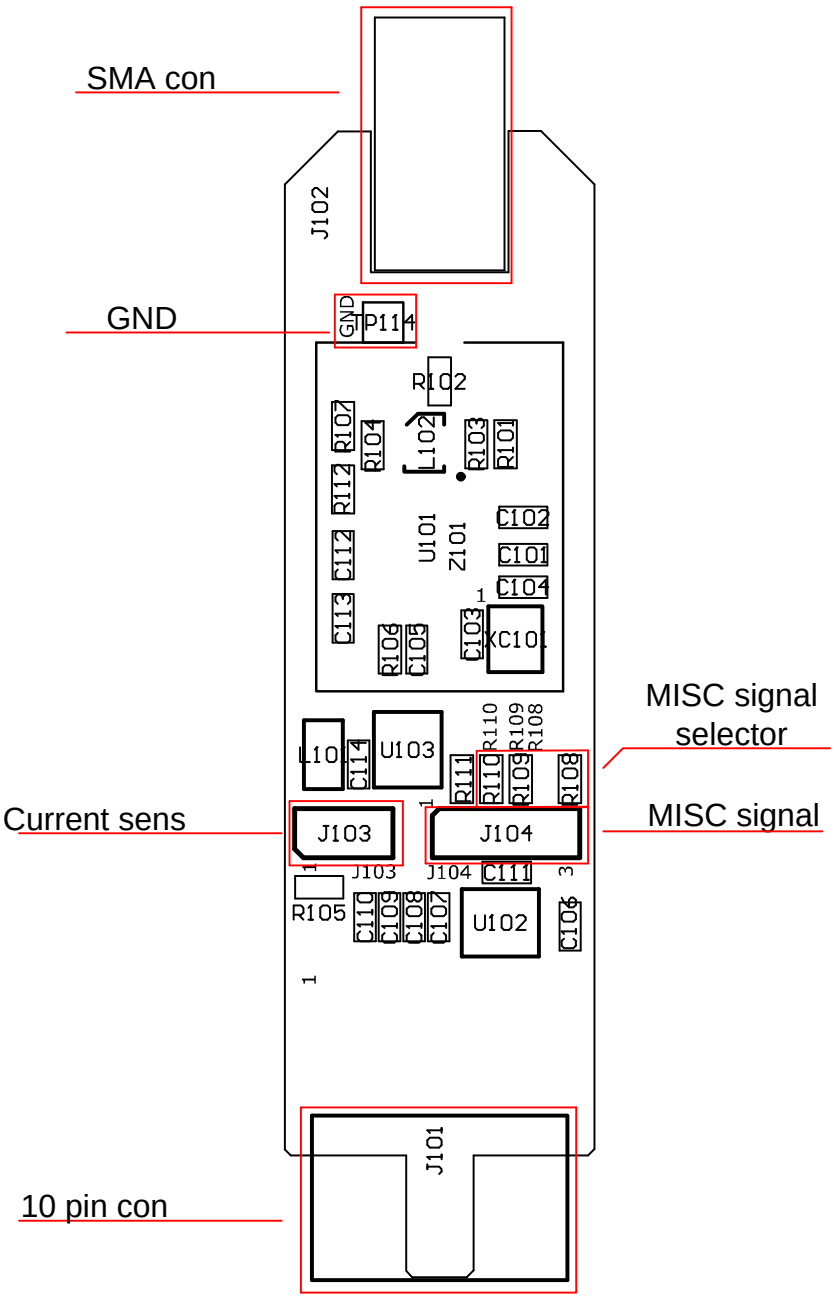
4.1 Radio Frequency Board

A total of six radio frequency boards included in the kit, two boards per radio transceiver:

- **AT86RF230:** First generation 2.4GHz ISM band radio transceiver from Atmel.
- **AT86RF231:** Second generation 2.4GHz ISM band radio transceiver with front ends for antenna diversity and external power amplifier and encryption accelerators.
- **AT86RF212:** 868/915MHz ISM band long range radio transceiver with front end for external power amplifier and encryption accelerators.

The radio transceiver share the same printed circuit board with slightly different component values mounted for each of them. See Figure 4-2 for full schematics of the radio frequency board.

Figure 4-1 Radio Frequency Board Overview



4.1.1 Connectors

There are two main connectors on the board; one is the female SMA antenna connector and in the opposite direction of the board is a 10-pin dual row header. See Table 4-1 for pinout of this header.

Table 4-1. Radio Frequency 10-pin header

Pin	Name	Name	Pin
1	Reset	Misc	2
3	Interrupt	Sleep Transmit	4
5	Chip Select	MOSI	6
7	MISO	SCK	8
9	GND	VCC (1.8 – 3.6V)	10

There are also two single row headers on the board:

- **J103 (Not mounted):** Two pin header that can be soldered in to do current measurement with an ampere meter. R105 must be unsoldered to enable this feature.
- **J104 (Not mounted):** Three pin header that can be soldered in to access the auxiliary (Miscellaneous) signals from the radio transceiver.

4.1.2 Crystal

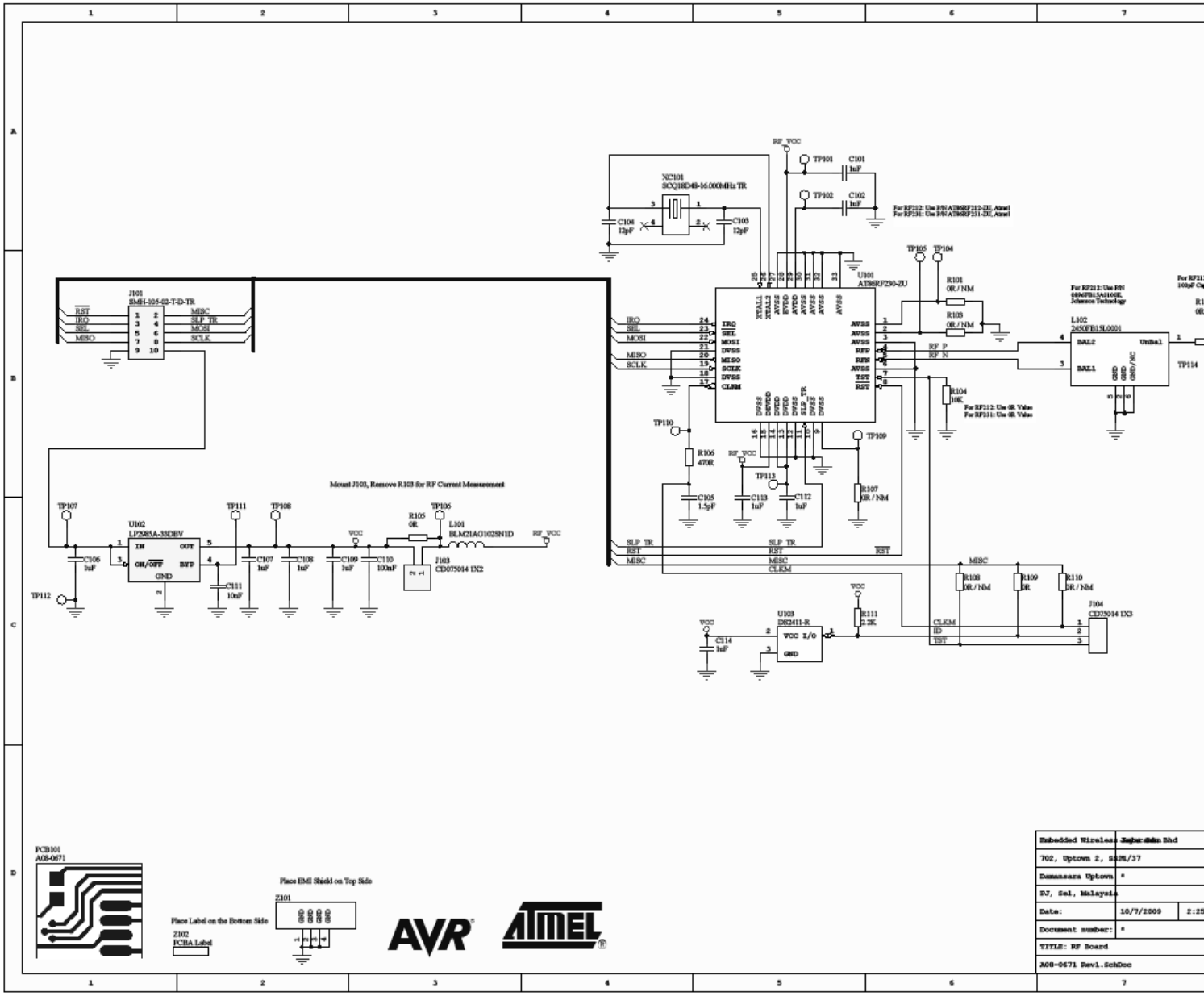
A high accuracy 16MHz crystal is mounted and used by the radio transceiver for carrier frequency generation.

4.1.3 RF Front End

Since the output from the radio transceiver itself is a balanced signal pair, a balun is needed to transform into a 50Ohm single ended signal fed to the SMA connector. Johanson Technology provides two pin compatible baluns for the AT86RF230, AT86RF231 and AT86RF212:

- **2450FB15L0001:** 2.45 GHz filter balun optimized for AT86RF230 and AT86RF231.
- **0896FB15A0100:** Sub gigahertz filter balun combination optimized for AT86RF212.

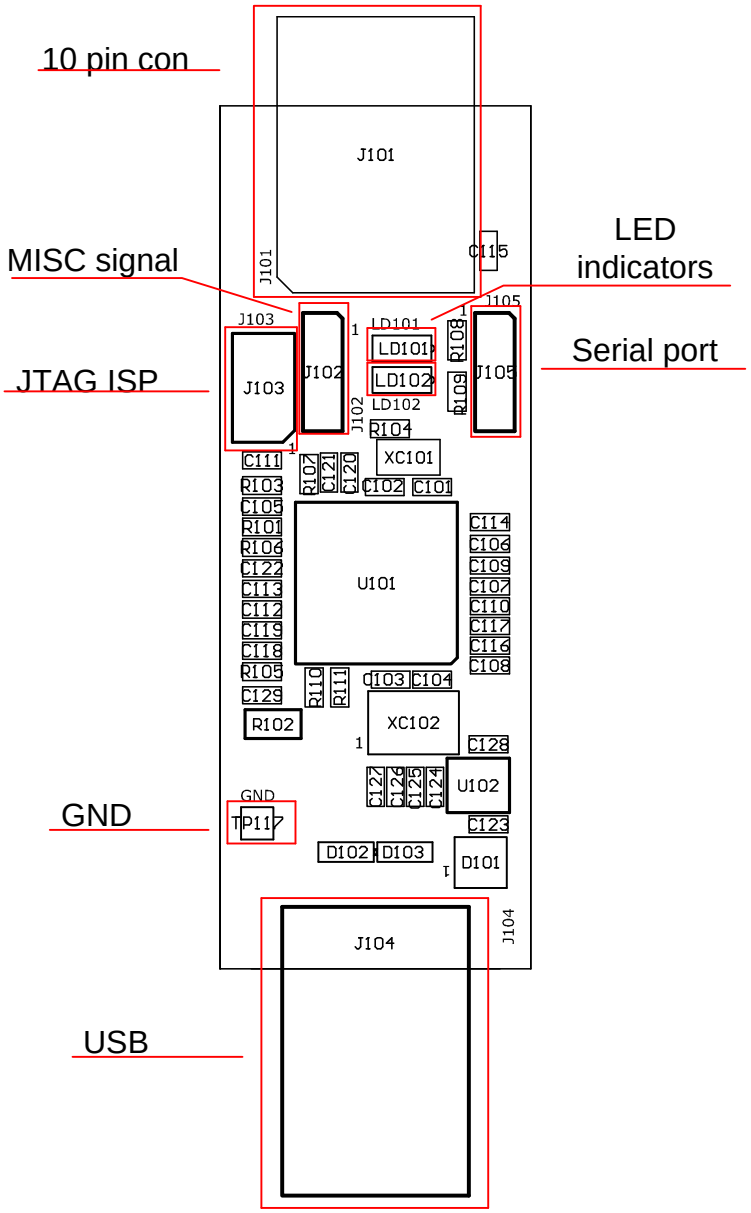
Figure 4-2 Radio Frequency Board



4.2 ATAVR32UC3 Processor Board

There are two AT32UC3A3256 based processor board in the kit. They run the protocol stack to control the radio transceiver as well as providing USB full and high speed USB connection (up to 480Mbps). Figure 4-3 shows an overview of some of the main components and their placement.

Figure 4-3 Processor Board Overview



4.2.1 Processor

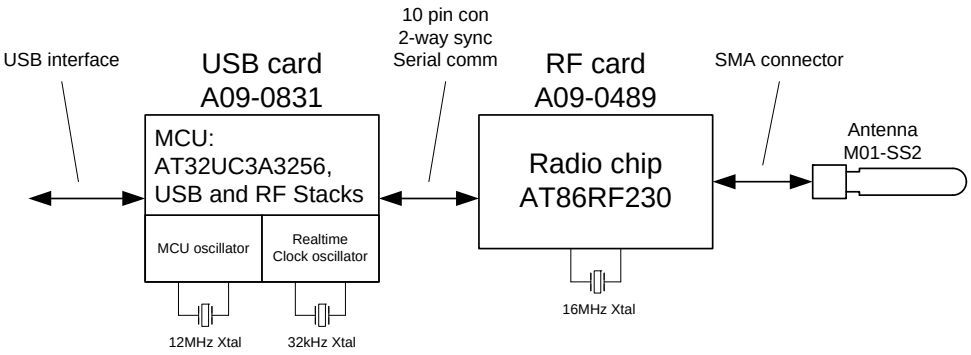
The AT32UC3A3256 flash microcontroller is designed for exceptionally high data throughput with Hi-Speed USB OTG, SD/ SDIO card, Multi-Level-Cell (MLC) NAND flash with ECC and SDRAM interfaces. Designed with the multi-layered 32-bit AVR databus, 128 KB on-chip SRAM with triple high speed interfaces, and multi-channel Peripheral and memory to memory DMA controller, the AT32UC3A3256 offers outstanding data throughput. The device is reprogrammable through the 10 pin JTAG connector on the board.

4.2.2 Clocks

There are two clocks available on the processor board:

- **12MHz:** The crystal is required as input to the internal PLL of the AT32UC3A3256 to generate the base frequency for the full and high speed USB mode.
- **32kHz:** Used as input source for the real time clock.

Figure 4-4 Clock Locations



4.2.3 LEDs

Two LEDs are available connected to the AT32UC3A3256's pins PX22 and PX41. These are turned on by sinking current through the pin – logic low while acting as an input.

4.2.4 Headers

Four headers are available on the processor board:

- **10-pin header (J101):** Interface for the radio frequency board.
- **Three pin header RF (J102 – not mounted):** Auxiliary signals that can be patched in from the same three pin header on the radio frequency board. See Table 4-2 for pinout.
- **JTAG Interface (J103 – not mounted):** Standard Atmel JTAG header.
- **Three pin header UART (J105 – not mounted):** See Table 4-3 for pinout.

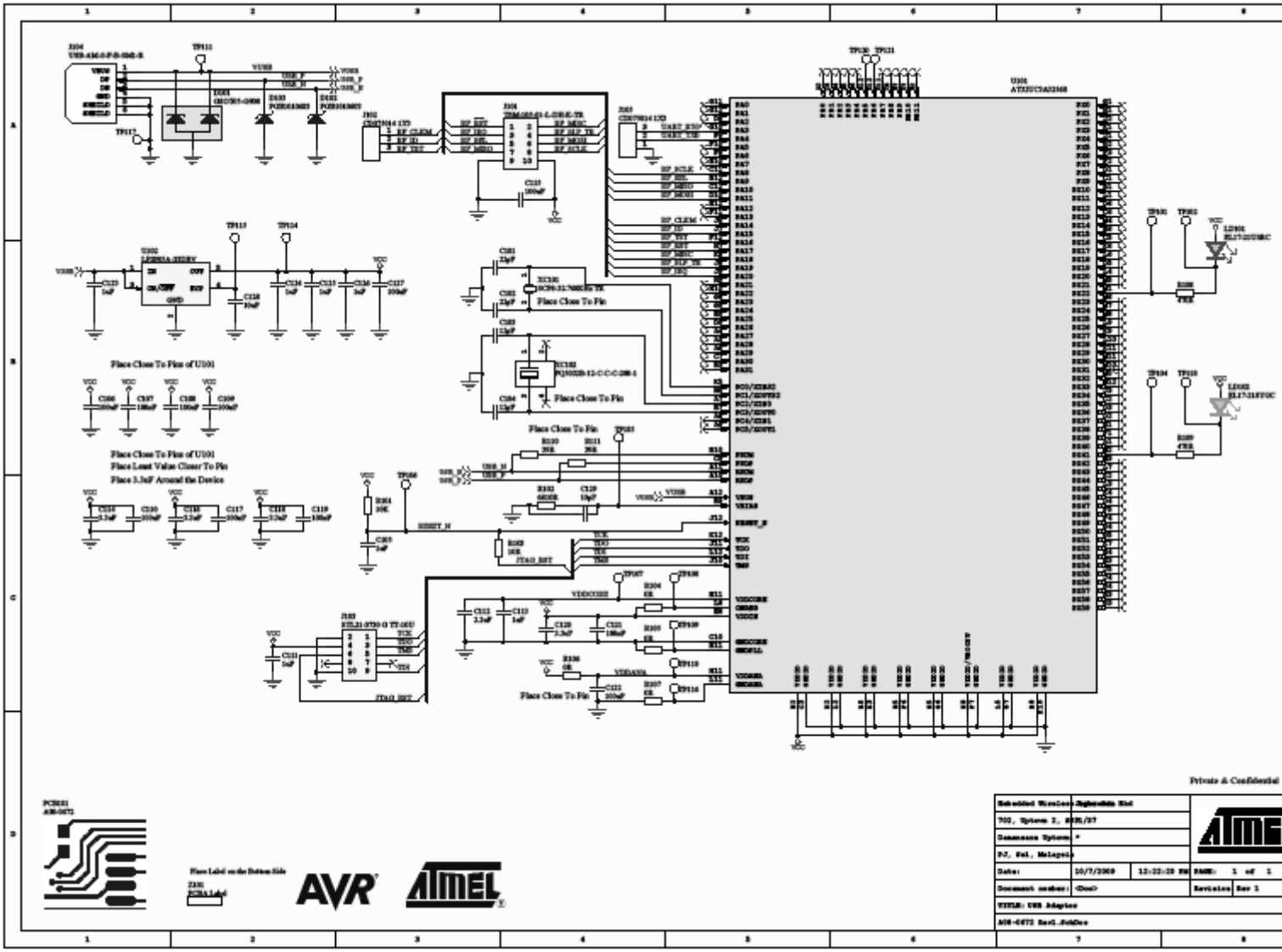
Table 4-2. J102 3-pin RF Auxiliary header

Pin	Name
J102-1	Clock Output
J102-2	ID Chip
J102-3	Test pin – AT86RF230

Table 4-3. J105 3-pin UART header

Pin	Name
J105-1	GND
J105-2	UART TX
J105-3	UART RX

Figure 4-5 Processor Board



4.3 Antennas

There are two different antennas (SMA stub type) available in the RZ600 kit

- **Long Type:** This is used only in conjunction with the AT86RF212 radio transceiver.
- **Short Type:** This antenna is made for the 2.4GHz frequency band and can be used either on the AT86RF230 or AT86RF231 radio transceiver.

The antennas should be screwed onto the respective radio frequency board and gently tightened.

4.4 Cables

There are two different cable types available in the RZ600 kit

- Squid Cable:
- Single Wire:

5 Connecting Radio Frequency Board to a Custom Board

The radio frequency boards found as part of this kit can be used stand alone as well as in conjunction with the processor board. Table 4-1 shows the pinout of the standardized 10-pin bus that is defined between the two unit. However, it is possible to add the radio frequency board to any routing as long as the required signals are available. This is possible due to the radio frequency board being able to be mounted on the squid cable included in this kit. With this squid cable it is possible to route all 10 signals down onto a custom hardware. The reminder of this chapter shows a few examples on how to wire these signals.

5.1 Default Supported Kits

Besides from being used on the processor boards the radio frequency board can be attached to wide range of Atmel evaluation and starter kits. The following kits are supported directly. If you do not find your preferred kit here, please take a look at section 5.2.

Table 5-1. Plug and Play Kits

Kit Name	Comment
STK600	
- Any ATxmega device	Any of the digital ports can be used.
- ATmega164/324/644/1284P	
STK500	
- ATmega164/324/644/1284P	
XPLAIN	Any of the digital ports can be used.
EVK1104	Squid Cable.
EVK1105	Squid Cable.

5.2 Squid Cable

There are two squid cables (10pin male header to single wires) included in the kit. The intended use of this special cable assembly is to plug the radio frequency board onto it, and connect the ten single wires to any hardware platform that does not have the standard auxiliary connector available.

Table 5-2. Squid Cable Pinout

PIN	PIN
Pin 1 (Brown): Reset	**Pin 2 (Red):** Miscellaneous

PIN	PIN
Pin 3 (Orange): Interrupt	**Pin 4 (Yellow):** Sleep Transmit
Pin 5 (Green): Chip Select	**Pin 6 (Blue):** Master Out Slave In
Pin 7 (Purple): Master In Slave Out	**Pin 8 (Grey):** SPI Clock
Pin 9 (White): Ground	**Pin 10 (Black):** Vcc

5.3 Example AVR32: EVK1100

Intentionally left blank.

5.4 Example ARM7: AT91SAM7X-EK

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6 Firmware

Table 6-1. Firmware Layout

Path	File	Comment
/Applications		Parent folder for kit appl
/Applications/TAL_Examples/Wireless_UART		Parent folder for wireles application
/Applications/TAL_Examples/Wireless_UART/Src		Source Folder
/PAL		Processor Abstraction L
/PAL/AVR32		Parent folder for AVR32 processor specific code
/PAL/AVR32/Generic/Inc		Generic include files sha AVR32 devices.
/PAL/AVR32/Generic/Src		Generic source code sh all AVR32 devices.
/PAL/AVR32/UC3A3256		Parent folder for all AT32UC3A3256 specific
/PAL/AVR32/UC3A3256/Boards/RZ600		Board specific code for t kit
/PAL/AVR32/UC3A3256/Inc		Include files for the proc code
/PAL/AVR32/UC3A3256/Src		Source files for the proc specific code
/TAL		Transceiver Abstraction
/TAL/AT86RF212/Inc		Include files specific to t AT86RF212 radio transc
/TAL/AT86RF212/Src		Source files specific to t AT86RF212 radio transc
/TAL/AT86RF230B/Inc		Include files specific to t AT86RF230 radio transc

Path	File	Comment
/TAL/AT86RF230B/Src		Source files specific to t AT86RF230 radio transc
/TAL/AT86RF231/Inc		Include files specific to t AT86RF231 radio transc
/TAL/AT86RF231/Src		Source files specific to t AT86RF231 radio transc
/Resources		Common resources use layers
/Resources/Buffer_Management/Inc		
/Resources/Buffer_Management/Src		
/Resources/Queue_Management/Inc		
/Resources/Queue_Management/Src		

7 Getting Started

This chapter describes how to get started with the RZ600 kit and run the demo application in the most efficient way. Read section for section sequentially and follow the directions carefully. The quick start guide assumes that the requirements in section 3.2 are fulfilled.

7.1 Kit Unpacking

1. Open the box and verify that all items are present as outlined in section 3.1.
2. Locate the two processor boards and select a pair of radio transceivers to test – they should be of the same type.
3. Mount the radio frequency board onto the processor boards 10-pin connector. Make sure that pin 1 on both boards aligns.
4. Attach any of the auxiliary signals between the two units using the single wires.

7.2 USB Enumeration

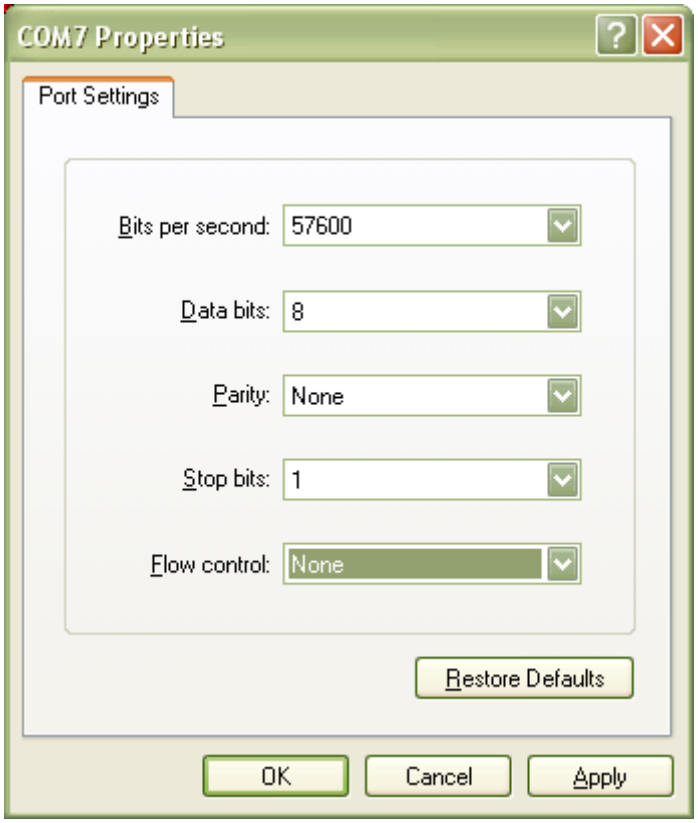
1. Connect one of the board assemblies to you PC and let it start USB enumeration process.
2. The first time this is done, the CDC driver will have to be installed. A “Found new hardware wizard” will pop up. Select “No, not this time” and next.
3. Select “Install from a list or specific location (Advanced). Click next. Select “Include this location in the search:”. Select the following folder: /PAL/AVR32/UC3A3256/Boards
4. Click finish.
5. Verify what COM port that was assigned to the USB device. This can be done from the Control Panel under the start menu. Select Administrative Tools from the menu and then click the Computer Management. Now click on the Computer Management item – and look under the Ports (COM & LPT) from the list. A new COM port should be available
6. Repeat step 1 to 5 for the second board assembly.

7.3 Run the Example Application

Any terminal application can be used to connect to the COM ports, this section shows how to do this with HyperTerminal.

1. From the start menu select All Programs, Accessories, Communications and finally HyperTerminal.
2. Type in a name for the connection
3. A “Connect To” dialog will appear. Make sure to select the correct COM port.
4. Press the Configure button and use the setting shown in Figure 7-1. Click the OK button twice.
5. You now have a terminal window ready to use
6. Repeat steps 1 to 5 for the second board assembly.
7. Type characters in one of the terminals and verify that they are conveyed over to the second terminal.

Figure 7-1 COM Port Settings



7.4 Install Software and Test

This step is only required for doing application development on the RZ600 kit.

1. Install AVR32 GNU Toolschain – see section 2.
2. Install AVR32 Studio – see section 2.

7.5 Programming the Example Application

This step is only required for doing application development on the RZ600 kit.

1. Connect either a JTAG ICE mkII or AVRONE! to your compter.
2. Go through the driver installation. Let the PC select the best USB driver for the attached debugger. The AVR USB program takes care of this in the background.
3. Solder the 50 mil 10-pin connector to one of the processor board.
4. Mount a 100mil to 50mil adapter to the debugger and connect the probe to the freshly soldered connector.
5. Use AVR32 Studio or IAR Embedded Workbench to develop and debug programs.

8 Appendix

8.1 FCC Statements

8.1.1 Equipment usage

This equipment is for use by developers for evaluation purposes only and must not be incorporated into any other device or system.

8.1.2 Compliance Statement (Part 15.19)

These devices comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. These devices may not cause harmful interference, and
2. These devices must accept any interference received, including interference that may cause undesired operation.

8.1.3 Warning (Part 15.21)

Changes or modifications not expressly approved by Atmel Norway could void the user's authority to operate the equipment.

8.1.4 Compliance Statement (Part 15.105(b))

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/TV technician for help.

8.1.5 FCC IDs

- A09-0489 AT86RF230 **VW4A09-0489**
- A09-0490 AT86RF 231 **VW4A09-0490**
- A09-0491 AT86RF 212 **VW4A09-0491**

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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.

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