AVRXXXX: RZ600-232 HW Manual

Features

Contains the Reference design for AT86RF232 Transceiver

- Option of ordering Single Transceiver board, over ordering the entire set found in the main RZ600 Kit.
- Order as many of RZ600-232 Board alone as required.
- Stub antenna included
- AT32UC3A3256 based USB host boards orderable separately as AVRRZ600-USB
- Ideal for PC to RF gateways, packet sniffers and network commissioning tools
- On board ID chip for easy IEEE MAC address

1 Introduction

The AVRRZ600-232 Subkit is an evaluation kit for the Atmel AT86RF232 radio frequency device. The box contains one Single RF232 2.4GHz board with the required accessories (connectors and Antenna). These are highly acclaimed networking devices within low power personal area networks. That being said; this RZ600-232 radio board also sports 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 of Atmel, you are empowered to evaluate Atmel radio transceivers in virtually any application segment. The RZ600-232 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

AVRRZ600-232

AVRRZ600-232 Hardware User Manual

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

FLIP 3.4.2(Flexible In System Programmer)
http://www.atmel.com/dyn/products/tools_card.asp?tool_id=3886

3 Overview

This section gives an overview of the RZ600-232 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 (AVRRZ600-USB) paired with the radio frequency boards (AVRRZ600-232) 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 conjunction with PC
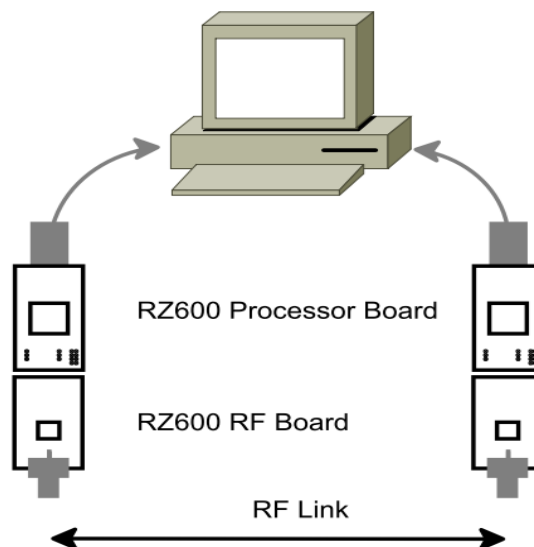
3.1 Kit contents

The RZ600-232 kit contains the following pieces of hardware:
- 1 unit AT86RF232 radio board: miniature carrier board with the AT86RF232 radio transceiver mounted, SMA antenna connector, one wire ID chip and Atmel standard 10-pin connector.
- 1 pc. 2.4GHz SMA stub antenna
- 1 pc. 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.

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	1024×768,SVGA	
PC/Hard disk free space	200 Mbytes	
On-Chip Debugger & Programmer	AVR JTAG ICE mkII or AVR ONE!	AVR JTAG ICE mkII or AVR ONE! is required if the user wishes to debug and do custom application development.
Software		
Operating System	Windows 2000/XP/Vista/7	
IDE	AVR 32 Studio or IAR Embedded Workbench for Atmel AVR32	AVR 32 Studio with compiler utilities or IAR EWB is required for application development
Programmer	FLIP 3.4.2	Batch ISP command line tool with FLIP 3.4.2 can be used for reprogramming the processor board controller

3.3 Quick Start Guide

RZ600 processor board – RZ600-USB is programmed for AT86RF231 radio boards in the factory. For using the AT86RF232 transceiver boards, processor board needs to be reprogrammed. Refer section "7.5.2 Bootloader Programming using BatchISP" and "Table 6-1 Firmware layout" table for programming the processor board using preprogrammed boot loader available on the processor board controller. The following sequence is suggested when testing the evaluation application on the RZ600-232 kit:

1. Unpack the kit and verify contents
2. Connect 2 RZ600-232 boards each to 2 RZ600-USB boards.

3. Connect the RF Board to the appropriate antenna. Refer Section 4.3 for selecting proper antenna for the radio transceiver.
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 is 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

AT86RF232: Third generation 2.4GHz ISM band radio transceiver with front ends for antenna diversity and external power amplifier and encryption accelerators.

This board and the RZ600-230, 231, 212 radio transceivers 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
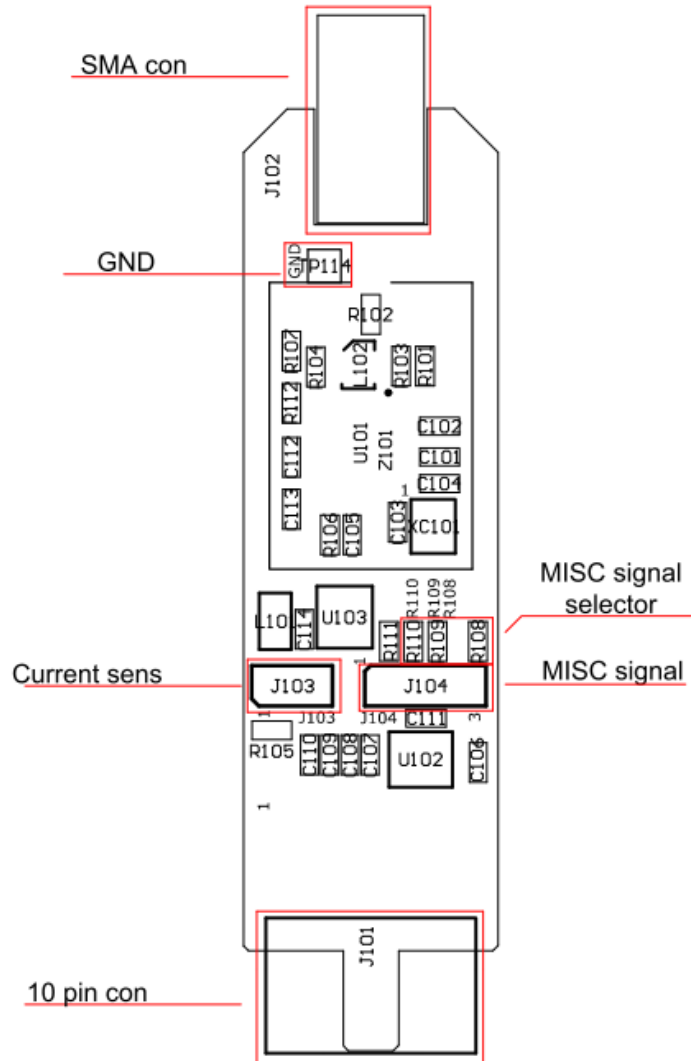
4.2 Connectors

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 pin out 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.

4.3 Crystal

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

4.4 RF Front End

RZ600 radio boards shares a common layout across all the three transceivers AT86RF212, AT86RF230, AT86RF231. For the schematic given in Figure 4-2 differences in bill of Material are as given in the Table 4-2.

Table 4-2 BoM Variants

| Part | BoM Variants | | | |
	RF232	RF231	RF230	RF212
U101	AT86RF232	AT86RF231	AT86RF230	AT86RF212
R101	0 ohm	DNI	0 ohm	DNI
R103	0 ohm	DNI	0 ohm	DNI
R107	DNI	DNI	0 ohm	DNI
R112	DNI	DNI	0 ohm	DNI
L102	2450FB15L0001	2450FB15L0001	2450FB15L0001	0896FB15A0100E
R102	0 ohm	0 ohm	0 ohm	100pF
R104	0 ohm	0 ohm	10k	0 ohm
*DNI -Do not Install Component				

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.

The Johanson Technology recommends 2450FB15L0001 Balun which is optimized for AT86RF232 for radio designs using this Transceiver.

Figure 4-2 Radio Frequency Board

AVRRZ600-232

4.5 Cables

There are two different cable types available in the RZ600 kit
• Squid Cable:
• Single Wire:

5 Connecting Radio Board to 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

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

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

6 Firmware

Table 6-1. Firmware Layout

Path	Comment
/Applications	Parent Folder for kit applications
/Applications/TINY_TAL_Examples	Parent for Tiny TAL Example Applications
/Applications/TINY_TAL_Examples/Wireless_UART	Parent Folder for Wireless UART application for different RF Transceivers
/Applications/TINY_TAL_Examples/Wireless_UART/ AT86RF232_AT32UC3A3256S_RZ600/IAR_Library	IAR EWB Project files for AT86RF232 Transceiver. Also contains Batch file to download the ELF File for AT86RF232 Transceiver.
/Applications/TINY_TAL_Examples/Wireless_UART/ AT86RF232_AT32UC3A3256S_RZ600/IAR_Library/ Release/Exe	ELF File that can be downloaded to AT32UC3A3256S for AT86RF232 Transceiver.
/Applications/TINY_TAL_Examples/Wireless_UART/ Inc	Configuration File specific to Wireless UART application & ISP
/Applications/TINY_TAL_Examples/Wireless_UART/ Src	Source folder containing main file & trampoline assembler file.
/Build	Parent folder for Windows Batch Files used to build the application
/Build/Build_RZ600_Wireless_Uart_lib	Folder containing Batch File for Wireless UART application
/Build/Build_RZ600_Wireless_Uart_lib/IAR/AVR32	Batch file for building Wireless UART application developed in IAR EWB.
/Doc	Folder containing Reference Manual & Release Notes
/Doc/Reference_Manual/TINY_TAL_AT86RF2XX_ RZ600/html	Reference Manual for Tiny TAL & PAL specific APIs for RZ600 in html format
/Doc/Reference_Manual/graphics	Folder containing graphics used in the reference manual

/Include	Header Files for application & all layers of stack
/PAL	Platform Abstraction Layer
/PAL/AVR32	Parent Folder for AVR32 specific Header files
/PAL/AVR32/AT32UC3A3256	Parent Folder for AT32UC3A3256 specific Header Files
/PAL/AVR32/AT32UC3A3256/Boards/RZ600_232	RZ600 Board specific PAL configuration file for AT86RF232 Transceiver
/PAL/AVR32/AT32UC3A3256/Inc	Include files for the AT32UC3A3256 processor codes
/PAL/AVR32/Generic/Inc	Generic Include Files shared by all AVR32 devices
/PAL/Inc	PAL API Prototypes & PAL Types Header Files. Includes Type definitions for multi compiler support.
/TAL	Transceiver Abstraction Layer
/TAL/AT86RF232/Inc	Include files specific to the AT86RF232 RF Transceiver
/TAL/Inc	Folder contains TAL API function declarations & TAL types header files
/TINY_TAL	Tiny Transceiver Abstraction Layer
/TINY_TAL/AT86RF232/Inc	Include files specific to the AT86RF232 RF Transceiver
/TINY_TAL/Inc	Folder contains TINY TAL API function declarations & TAL types header files
/UTILS	Directory contains Linker script files
/UTILS/LINKER_SCRIPTS	Linker scripts for each microcontroller & compiler
/UTILS/LINKER_SCRIPTS/AT32UC3A3/256S/IAR	Linker script file for IAR compiler and AT32UC3A3256S microcontroller
/Driver	USB CDC Driver for AT32UC3A3256S Microcontroller

7 Getting Started

This chapter describes how to get started with the RZ600-232 kit and run the demo application in the most efficient way. Read section by 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. Take two AVRRZ600-USB boards and select a pair of AVRRZ600-232 radio transceivers to test.
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.
5. Connect the RF Board to the antenna.

7.2 USB Enumeration for Windows XP

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 in the RZ600 firmware: /Driver

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>Device Manager 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 USB Enumeration for Windows 7

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. Windows 7 does not launch the "Found new hardware wizard" automatically.

3. Go to "Control Panel>System and Security" and click "Device Manager" under the heading "System".

4. Right Click on "Unknown device" under the heading "Other devices". Select "Update Driver Software"
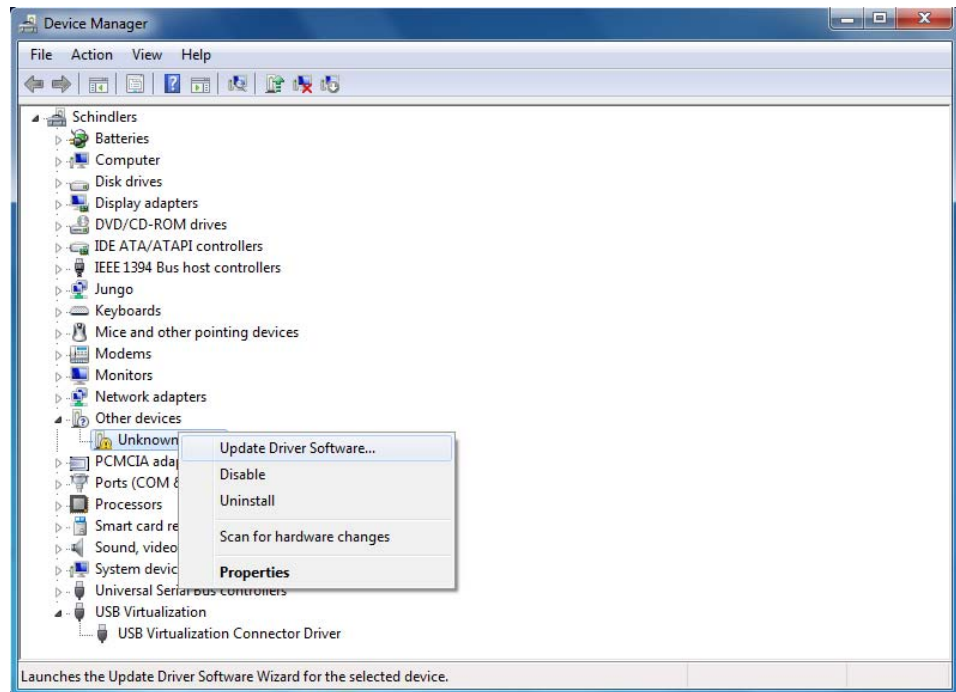
5. Click "Browse my computer for driver software" and give the following folder in the RZ600 firmware as search location: /Driver.

6. Click Next. Select "Install this driver software anyway".

7. Verify what COM port was assigned to USB device in the Device Manager under Ports (COM&LPT).

8. Repeat steps 1 to 7 for the second board assembly.

7.4 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 OK button and use the setting shown in Figure 7-1. Click the OK button again.
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

7.5 Install Software and test

This step is only required for doing application development on the RZ600 kit.
1. Install AVR32 GNU Toolchain – see section 2.
2. Install AVR32 Studio – see section 2.
3. Install Flip 3.4.2 if bootloader programming is required. Refer section "7.5.2 Bootloader Programming using BatchISP"
4. IAR Embedded Workbench: IAR EWB workspace files given with the example application is compatible with IAR Embedded Workbench for Atmel AVR32 3.31.1

7.6 Programming Example application with JTAGICE MKII or AVRONE

This step is only required for doing application development on the RZ600 kit.
1. Connect either a JTAG ICE mkII or AVRONE! to your computer.
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. Mount a 100mil to 50mil adapter to the debugger and connect the probe to J103,JTAG header on the processor board.
4. Use AVR32 Studio or IAR Embedded Workbench to develop and debug programs.

7.7 Bootloader Programming using Batch ISP

AT32UC3A3256S on RZ600 Processor boards are shipped with preprogrammed bootloader along with the example application using AT86RF231 transceiver. The following sequence is suggested for loading AT32UC3A3256S with any other output elf file. Refer the "Table 6-1 Firmware layout" to find the path for the elf release file of example application for all the transceivers.

BatchISP programming is supported on AVR32 target by the Trampoline section placed at the reset vector (80000000h). For more details about Trampoline section for AVR32, refer BatchISP application note 7745C, http://www.atmel.com/dyn/resources/prod_documents/doc7745.pdf

1. Short the pin 1(GND) & pin 2(USART TX) of J105, 3-pin UART Header before connecting the RZ600 USB Stick to the PC.
2. Connect the device to the USB port of computer. This will activate the ISP and open a New Hardware Installation Window the first time this is done.
3. Choose not to connect to Windows Update for this installation and click 'Next'.

4. On the next screen, select "Install from a list or specific location (Advanced)" and click 'Next'

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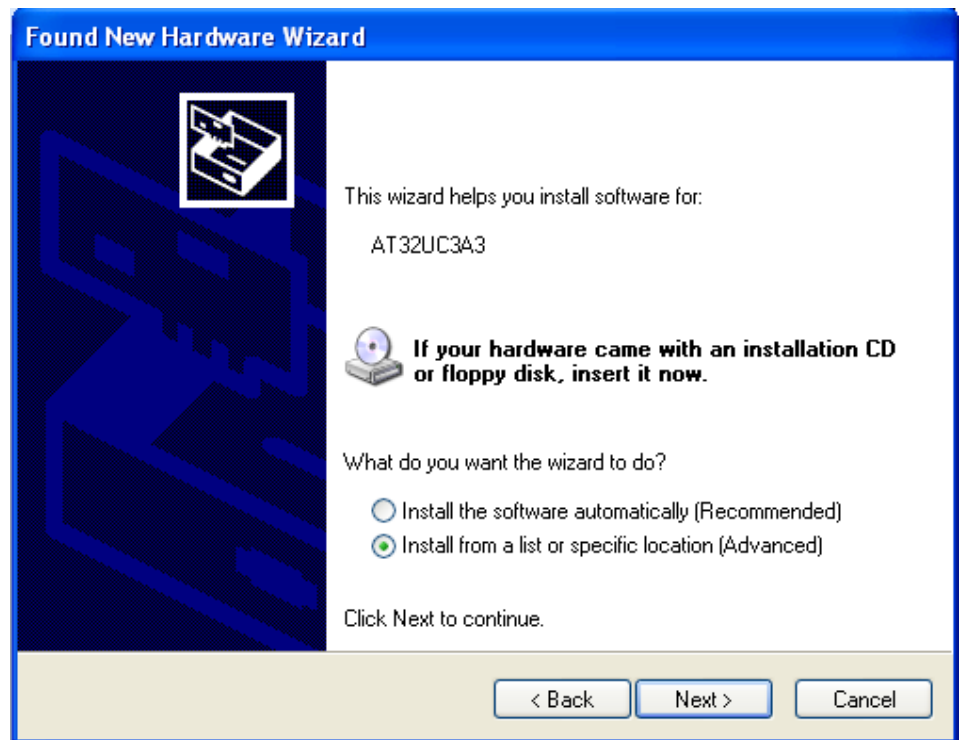
5. Then request to search in the usb folder of the FLIP installation directory and Click Next.
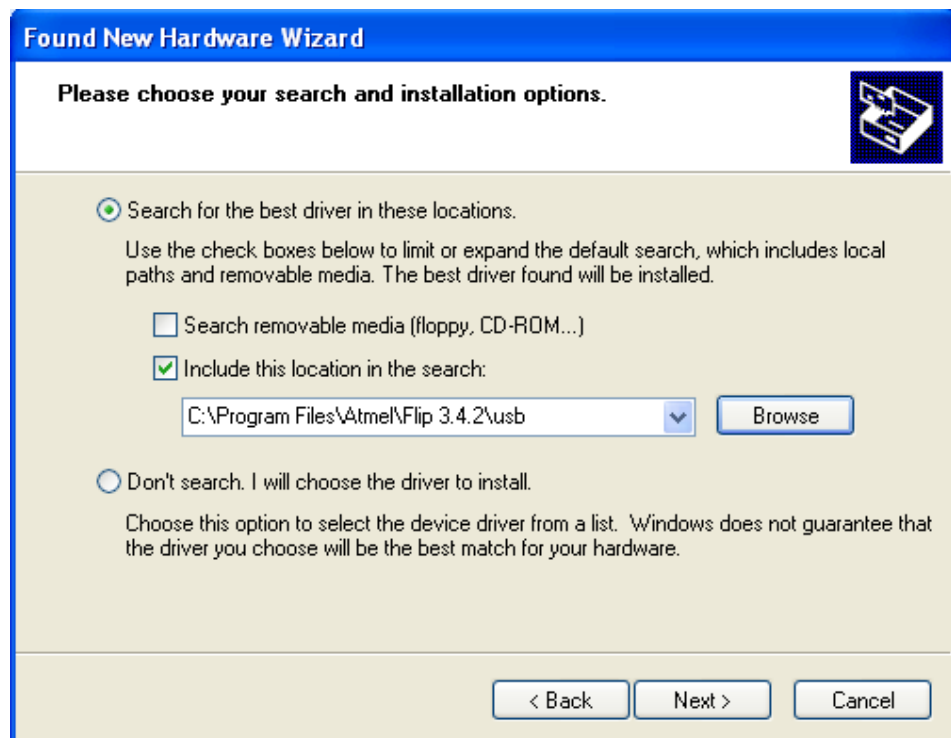
6. After the completion of driver installation click Finish.
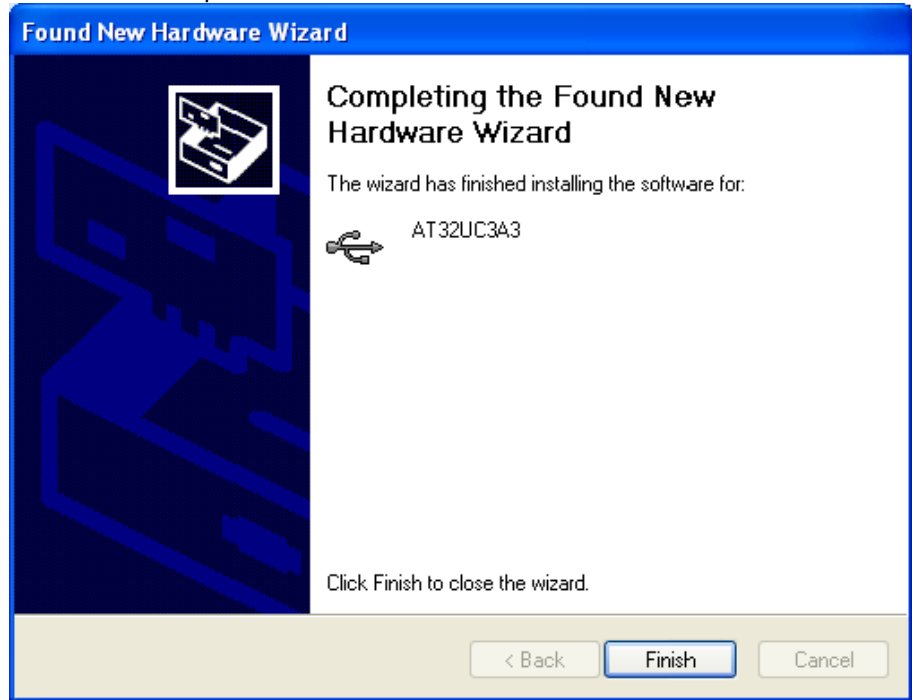
7. Next navigate to the location where IAR EWB project files for the selected transceiver are located in the RZ600 firmware. Refer "Table 6-1 Firmware layout" for the location.
8. Execute the Batch File to load the firmware into the processor board and launch the application using BatchISP.
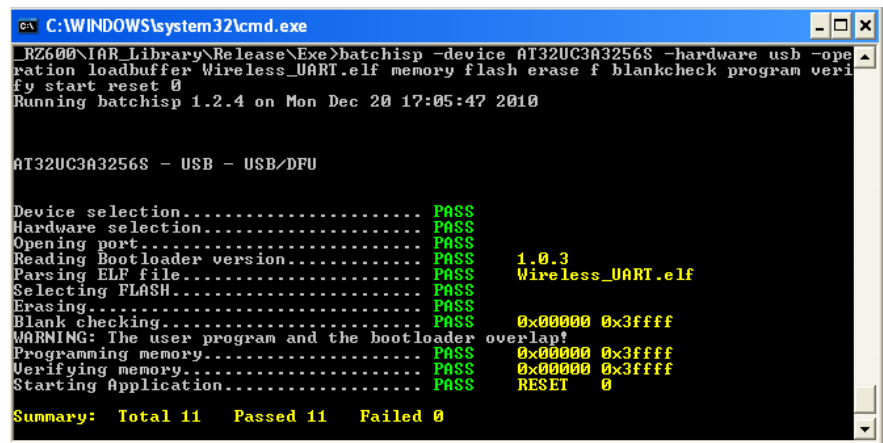
9. Repeat the above steps for the second processor board also. Device driver need not be   installed the second time.
10. Follow the steps given in Section 7.3 to run the example application.

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7.8 Programming the Bootloader

This steps needs to be followed only if the preprogrammed bootloader on RZ600 Processor board is erased.

1. Connect a JTAG ICE mkII to your computer
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. Be sure to use the correct orientation of 10 pin header when connecting the JTAG ICE mkII to the target application PCB
5. Use AVR32 Studio to program the bootloader as explained in the following steps.
6. In the AVR32 Studio Targets pane select JTAG ICE mkII and press Enter to open the Properties View.
7. In the Properties View select the Device as UC3A3256S and board as Unspecified.
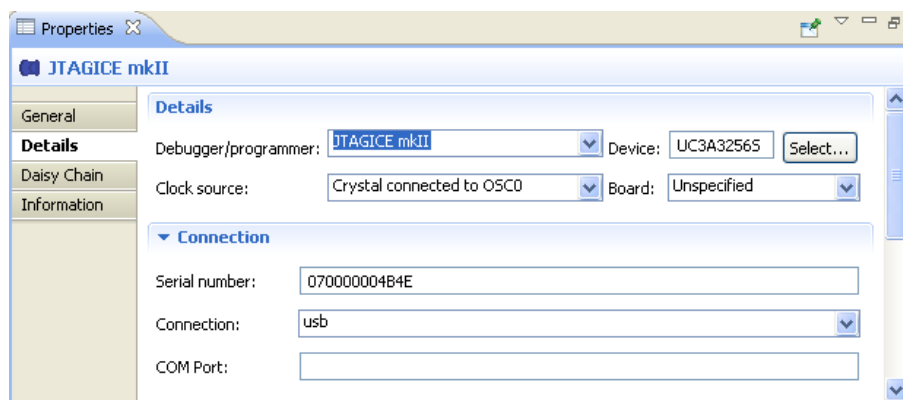
8. Select "Program Bootloader" in the Target Context Menu.
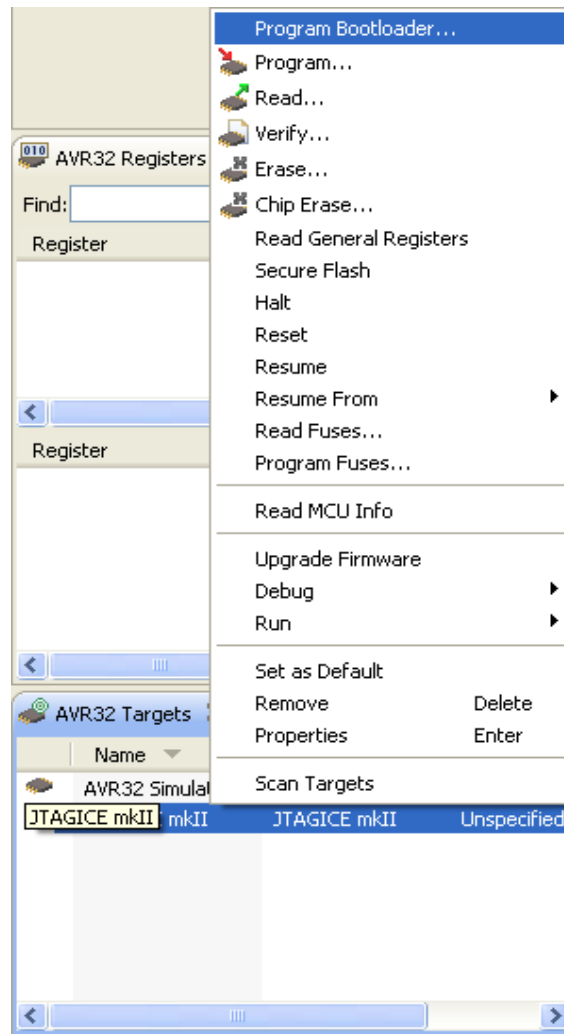
9. In the AT32UC3 Bootloader Wizard select Type: USB DFU & Version 1.0.3.Press Next Button.
10. Set up the User page configuration Word as 0x929E0454 with ISP_IO_COND_PIN=4 & Fuse bit Configuration value as 0xFFF7FFFF which is the default value.

NNNNN
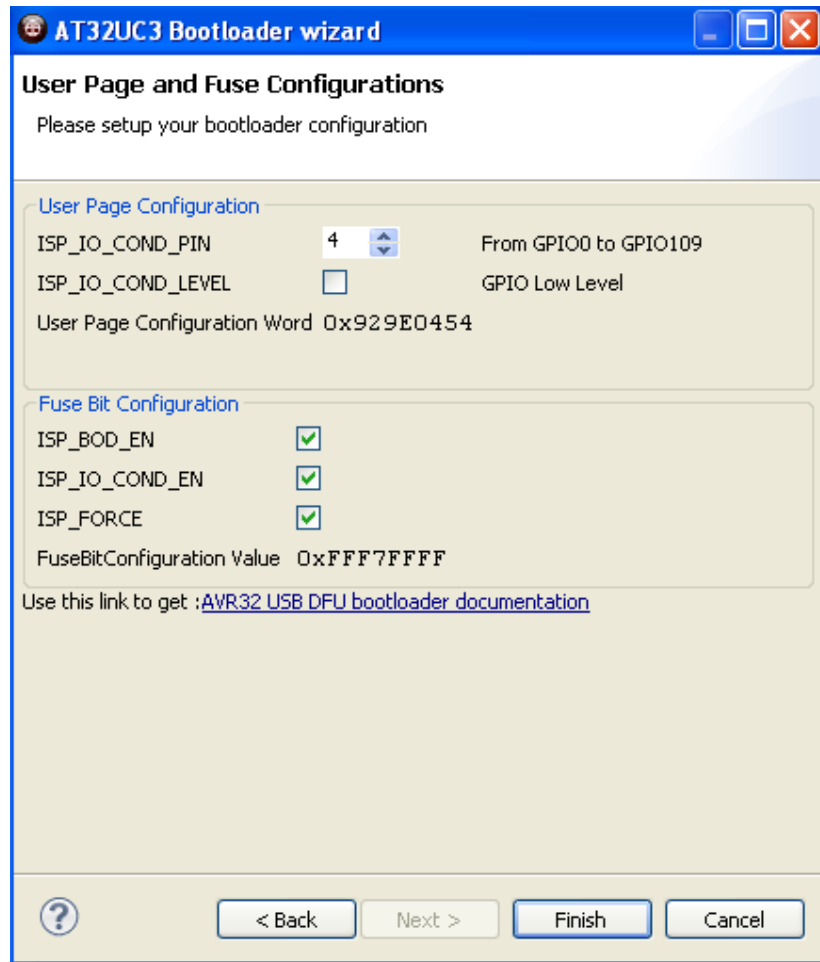
11. Press the Finish Button.

8 Appendix - FCC Statements

8.1 Equipment Usage

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

8.2 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.

8.3 Warning – Part 15.21

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

8.4 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 engineer for help.

8.5 FCC ID

PCBA Number : A09-1078
Transceiver   :AT86RF232
FCC ID   :VW4A091078

This device is only allowed to be connected to MCU units made by ATMEL and specifically designated for use with this Module FCC ID VW4A091078 The use of all other host systems need to be re-certified by the FCC (through a new certification or a Class 2 Permissive Change procedure)

9 Appendix – European Union – ETSI Statements

The AVRRZ600-232 kit has been certified for use in European Union countries. If this product is incorporated into a product, the manufacturer must ensure compliance of the final product to the European harmonized EMC and low-voltage/safety standards. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Annex II of the R&TTE Directive.

Furthermore, the manufacturer must maintain a copy of the modules' documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. If any of these specifications are exceeded in the final product, a submission must be made to a notified body for compliance testing to all required standards.

IMPORTANT: The 'CE' marking must be affixed to a visible location on the OEM product.

The CE marking must have a height of at least 5mm except where this is not possible on account of the nature of the apparatus.

The CE marking must be affixed visibly, legibly, and indelibly.

More detailed information about CE marking requirements you can find at "DIRECTIVE 1999/5/EC OF THE EUROPEAN PARLIAMENT
AND OF THE COUNCIL" on 9 March 1999 at section 12.