# AVR296: AVRUSBRF01 USB/RF Dongle

## 1. Introduction

Congratulations on acquiring the AVR® AVRUSBRF01. This kit is a USB dongle designed to enhance and demonstrate wireless communications features in addition to the AT90USB162 8 bit AVR USB microcontroller.

### 1.1 Overview

This document describes the AVRUSBRF01 dongle, powered by an AT90USB162 microcontroller. This board is designed to allow an easy evaluation of USB and wireless transmissions using the provided demonstration software.

This user guide acts as a general getting started guide as well as a complete technical reference for advanced users.

**Figure 1-1.** AT90USB162 RF Dongle

## 1.2 AT90USB162 USB/RF Dongle Features

The AVRUSBRF01 provides the following features:

- AT90USB162 running at 16 MHz (16 Mips).
- Transmission using an nrf24L01 from Nordic Semiconductor™
- USB Full speed device
- Reset (RST) and bootloader (HWB) buttons
- LED signalling for Transmit/Receive operations
- Power supply: USB Bus powered (5V)
- 6 Pin ISP/Debug Header
- Upgrade through the USB interface

# 2. Using the AVRUSBRF01

This chapter describes the board and all its features.

## 2.1 Getting started

The AVRUSBRF01 reference design allows the user to build an RF application in a short time and reduce time to market.

This kit contains two dongles. These dongles are factory programmed with a CDC_RF application. Driver installation and demo startup are explained in the following document: AVR487: AVRUSBRF01 Quick Start (8136 document).

Please refer to the web page www.atmel.com/avrusbrf01 for further information and product updates.

Two demonstration firmwares are available for the AVRUSBRF01 dongle:

- AT90USB162-AT90USB162-usbdevice_cdc_rf
- AT90USB162-AT90USB162-usbdevice_cdc_rf_fap (this version implements the frequency agility protocol library from Nordic Semiconductor™).

These firmwares can be compiled using:

- IAR Embedded Workbench® for Atmel AVR
- AVR GCC (AVR Studio® 4)

For more information about firmwares source code, please refer to the HTML Help, available in the sources directory.

After compilation of a demo firmware, you can download it to the dongle microcontroller using FLIP or AVR Studio (using the JTAG header).

## 2.2    nrf24L01

The AVRUSBRF01 allows wireless communications with the help of the Nordic Semiconductors™ nrf24L01 module.
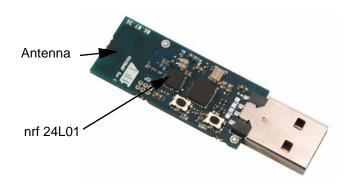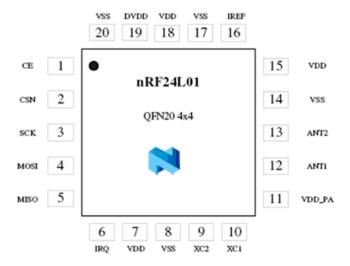
**Figure 2-1.**    Location of nrf module:



**Figure 2-2.**    nrf 24L01 module pinout:



This low power Transceiver module uses the 2.4 GHz ISM frequency Band, in 123 possible frequency channels. The transmission uses GPSK (Gaussian Phase Shift Keying) modulation. This module can transmit at a datarate up to 2 Mbit/s with a power from -18 to 0 dB (-18, -12, -6, 0).

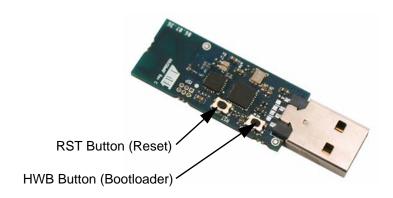For more information about this module, please visit Nordic Semiconductor Website.

## 2.3 Buttons

Two Push buttons are available on the AVRUSBRF01 board:

- **RST**: Reset button. Resets the microcontroller when pressed.
- **HWB**: Bootloader Button. If maintained pressed while resetting the dongle (with RST Button), this button forces the microcontroller to enter into DFU mode (Device Firmware Upgrade). While the dongle is running the firmware, this button can be used as a standard input button.
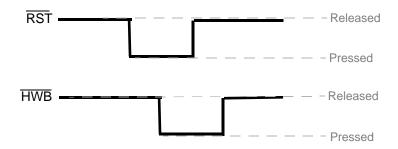
**Figure 2-3.** On Board Push Buttons:



RST Button (Reset)

HWB Button (Bootloader)

To force the execution the on-chip DFU bootloader, execute the following procedure:

- Push both HWB and RST buttons
- Release RST button first
- Release HWH button

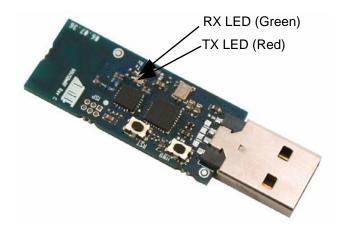**Figure 2-4.** Entering DFU Mode (Bootloader):



When in bootloader mode, one can program/update the on-chip code with the help of FLIP software that can be downloaded from the Atmel web site (www.atmel.com).

## 2.4 LEDs

Two LEDs are on the AVRUSBRF01 board:

- **TX**: red LED connected to PORTD1, may be driven by software to indicate whenever the dongle is transmitting data.
- **RX**: green LED connected to PORTD0, may be driven by software to indicate whenever the dongle is receiving data.

**Figure 2-5.** On-board signalling LEDs:



## 2.5 ISP / Debug header

The AVRUSBRF01 dongle can be programmed using FLIP and the Bootloader. The dongle can also be programmed via an ISP header (located close to the ATMEL logo on the board). The ISP / debug header allows serial programming (using a programmer, like a JTAG ICE MKII) and debugging while using the Reset pin in DebugWire function.
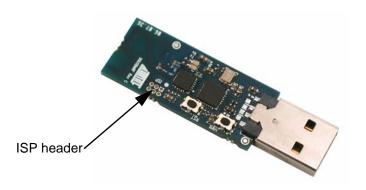
**Figure 2-6.** 6-pin ISP / Debug header:

**Figure 2-7.** ISP / Debug header pinout:

ISP / Debug header

SPI_MISO (PD0)    1    VCC
SPI_SCK (SCK)    SPI_MOSI (PD1)
RESET ($\overline{\text{RST}}$)    GND

Note: The ISP / Debug header is not mounted by default, you need to solder a 1.27 pitch header on the board to be able to debug your firmware.

## 3. Troubleshooting Guide

Please refer to this guide before sending a request to AVR Technical Support. Main problems should be solved here. This guide assumes that the board driver file provided by Atmel is used.

**Figure 3-1.** Troubleshooting Guide

| Problem | Reason or Condition | Problem / Solution |
| --- | --- | --- |
| AVRUSBRF01 does not work | Bad power supply | Check the power supply source level (5V) on VCC testpoint (ISP header). |
| AVRUSBRF01 does not enumerates | No firmware programmed | Program a demo software, using FLIP or AVR Studio 4. |
| AVRUSBRF01 starts bootloader instead of firmware | Boot Reset enabled | SET the BOOTRST Fuse bit. |
| The Reset Button Does not work | DebugWire function enabled | CLEAR the DWEN Fuse bit. |
| AVRUSBRF01 does not enter DFU Mode | No bootloader programmed | Program the bootloader using ISP header. |
| | DebugWire function enabled | CLEAR the DWEN Fuse bit. |
| | HWB is disabled | CLEAR the HWBE Fuse bit. |
| AVRUSBRF01 does not communicates when running fap demo firmware | Not synchronized | Press HWB button on each dongle before first communication. Both two dongles must be running a fap* firmware |

Note: *fap: Frequency Agility Protocol, for more information, please refers to the cdc_rf_fap firmware manual.

## 4. Technical Specifications

- System Unit
    - Physical DimensionsL=138 x W=16 mm

- Operating Conditions
    - Voltage Supply 5V (USB) (<100mA)

- Features
    - AT90USB162 running at 16 MHz (16 Mips).
    - USB Full speed device
    - nrf24L01 based radio transmissions at 2.4 GHz (ISM frequency band). GPSK.
    - Embedded signalling LEDs.
    - Reset (RST) and bootloader (HWB) buttons
    - On chip bootloader for easy firmware upgrade.

## 5. Technical Support

For Technical support, please contact avr@atmel.com. When requesting technical support, please include the following information:

- Which target AVR device is used (complete part number)
- Target voltage and speed
- Clock source and fuse setting of the AVR
- Programming method (ISP, Parallel or specific Boot-Loader)
- Hardware revisions of the AVR tools, found on the PCB
- Version number of AVR Studio. This can be found in the AVR Studio help menu.
- PC operating system and version/build
- PC processor type and speed
- A detailed description of the problem

## 6. Complete Schematics

On the next pages, the following documents of AVRUSBRF01 are shown:

- Complete schematics
- Assembly drawing
- Board layout
- Bill of materials

Figure 6-1. Schematics, 1 of 1

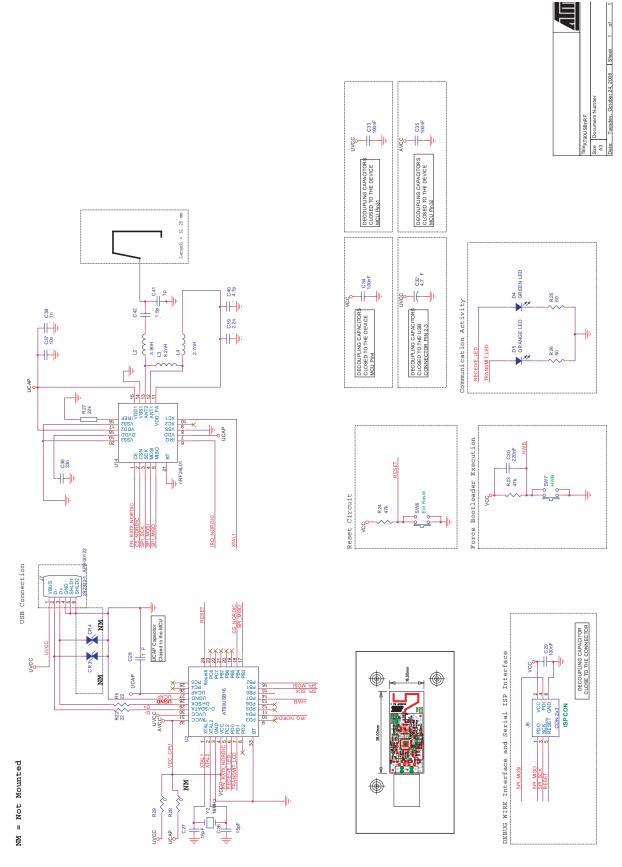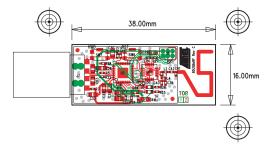**Figure 6-2.** Assembly Drawing, 1 of 1(component side view)
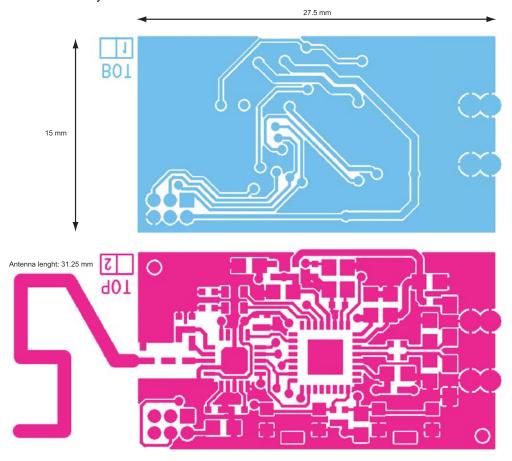


**Figure 6-3.** Board Layout



**Table 6-1.** Bill of Materials

| Qtty | Schematic Reference | Value | Tech. Characteristics | Package |
|------|---------------------|-------|-----------------------|---------|
| Inductor | | | | |
| 1 | L2 | 3.9 nH | LQP15 serie0402 (Murata) | 0402 |
| 1 | L3 | 8.2 nH | LQP15 serie0402 (Murata) | 0402 |
| 1 | L4 | 2.7nH | LQP15 serie0402 (Murata) | 0402 |
| Capacitors | | | | |
| 2 | C26 C27 | 15 pF | Max 5V | 0402 |

**Table 6-1.** Bill of Materials

| Qtty | Schematic Reference | Value | Tech. Characteristics | Package |
|------|---------------------|-------|-----------------------|---------|
| 1 | C28 | 1 µF | Max 5V | 0603 |
| 3 | C29 C34 C35 | 100 nF | Max 5V | 0603 |
| 1 | C33 | 100 nF | Max 6V | 0604 |
| 1 | C30 | 220 nF | Max 5V | 0603 |
| 1 | C32 | 4.7 µF | Max 6V | 0603 |
| 1 | C36 | 33 nF | Max 5V | 0402 |
| 1 | C37 | 10 nF | Max 5V | 0402 |
| 1 | C38 | 1 nF | Max 5V | 0402 |
| 1 | C39 | 2.2 nF | Max 5V | 0402 |
| 1 | C40 | 4.7 pF | Max 5V | 0402 |
| 1 | C41 | 1 pF | Max 5V | 0402 |
| 1 | C42 | 1.5 pF | Max 5V | 0402 |
| 1 | C44 | 10 µF | Max 5V | 0603 |
| **Diodes** | | | | |
| 1 | D4 | Green | SMD Led 0603 Green | 0603 |
| 1 | D5 | Red | SMD Led 0603 Red | 0603 |
| 2 | CR3 CR4 | | USB ESD suppressor | 0603 |
| **Resistors** | | | | |
| 2 | R5 R22 | 22 | | 0402 |
| 2 | R23 R24 | 47 k | | 0402 |
| 2 | R25 R26 | 47 | | 0402 |
| 1 | R27 | 22 k | 1% | 0402 |
| 1 | R28 | 0 | | 0402 |
| 1 | R29 | 0 | | 0402 |
| 2 | R7 R8 | 15 or 10 | | 0402 |
| **Crystals** | | | | |
| 1 | Y2 | 16 MHz | 16 MHz SMD crystal <= 60ppm (FA-20H, Epson Toyocom) | |
| **Integrated Circuits** | | | | |
| 1 | U14 | | Nordic nrf24L01 | |
| 1 | U2 | | AT90USB16 | QFN32 5x5 |
| | | | | |
| | | | | |
| **Connectors** | | | | |
| 1 | J7 | | USB Connector A-Type(WERI 6900411) | |
| 1 | J6 | | ISP Connector (Header 6pts 3x2.54mm) | |
| **Switches** | | | | |
| 2 | SW7 SW6 | | KMR (ITT CANNON, ref Farnell: 4156560)) | |

Note: The rows with grey background color specify that the corresponding component is not mounted by default (Optional).