



nRF51 Dongle

Developing with the MDK-ARM Microcontroller Development Kit

User Guide v1.0

1 Introduction

The nRF51 Dongle combined with the nRF51 SDK forms a complete solution for product development based on nRF51 series chips.

The nRF51 Dongle is fitted with the nRF51422 chip, which is a powerful, highly flexible multi-protocol System on Chip (SoC) ideally suited for ANT™/ANT+, *Bluetooth*® low energy (BLE), and 2.4 GHz proprietary ultra-low power wireless applications.

And, if you are not using the ANT protocol, you can use the nRF51822 chip in your end product - without any changes needed to your code.

1.1 Key features

The nRF51 Dongle has the following key features:

- nRF51422 flash based ANT/ANT+, *Bluetooth* low energy SoC solution
- 2.4 GHz compatible with nRF24L devices
- RGB LED
- 6 GPIOs for connecting external hardware
- SEGGER J-Link OB Debugger
- Virtual COM port interface through UART
- Drag and drop Mass Storage Device (MSD) programming
- mbed enabled

1.2 Required tools

Below is a list of hardware and software tools that is required if you plan to explore all the features on the nRF51 Dongle. All the tools may not be required for all use cases.

Nordic Tools	Description
nRFgo Studio	<p>nRFgo Studio is our tool to program and configure devices. It supports the programming of nRF51 SoftDevices, applications, and bootloaders. The different programming modes are available on individual tabs in the nRF51 programming module. Studio is used for the following:</p> <ul style="list-style-type: none"> • <i>Bluetooth</i> Direct Test Mode (DTM) testing • Erasing flash memory • Programming a SoftDevice • Programming an application • Programming the bootloader <p>nRFgo Studio supports programming of SEGGER J-Link based nRF51 devices. For more information, see the help in nRFgo Studio.</p>
nRF51 Tools	<p>nRF51 Tools is a package that contains JLinkARM, JLink CDC, nRFjprog, and mergehex. The nRFjprog is a command line tool for programming nRF51 series chips. It is also useful in a production setup. nRF51 Tools will be installed together with nRFgo Studio.</p>
nRF51 SDK	<p>The nRF51 Software Development Kit (SDK) provides source code of examples and libraries forming the base of your application development. The nRF51 SDK includes:</p> <ul style="list-style-type: none"> • Example code • ANT profile examples • <i>Bluetooth</i> profile examples • Drivers • Libraries <p>For more information, see the documentation packaged with the nRF51 SDK.</p>
Master Control Panel	<p>The Master Control Panel is the software tool that is used with the nRF51 Dongle (PCA10031) to act as a <i>Bluetooth</i> low energy peer device. You can test your application's wireless connection with this tool. The Master Control Panel supports programming of SEGGER J-Link based nRF51 devices. For more information, see the help files in the Master Control Panel.</p>
nRF Master Control Panel for Android 4.3	<p>nRF Master Control Panel for Android 4.3 is a powerful generic tool that allows you to scan and explore your <i>Bluetooth</i> Smart devices and communicate with them on an Android phone. MCP supports a number of <i>Bluetooth</i> SIG adopted profiles including the Device Firmware Update (DFU) profile from Nordic Semiconductor.</p>
S110 SoftDevice	<p><i>Bluetooth</i> low energy Peripheral/Broadcaster protocol stack. For more information, see the <i>S110 nRF51822 SoftDevice Specification</i> and the nRF51 SDK documentation.</p>
S120 SoftDevice	<p><i>Bluetooth</i> low energy Central protocol stack solution supporting up to eight simultaneous Central role connections. For more information, see the <i>S120 nRF51822 SoftDevice Specification</i> and the nRF51 SDK documentation.</p>
S130 SoftDevice	<p><i>Bluetooth</i> Smart concurrent multi-link protocol stack solution supporting simultaneous Central/Peripheral/Broadcaster/Observer role connections. For more information, see the <i>S130 nRF51822 SoftDevice Specification</i> and the nRF51 SDK documentation.</p>
S210 SoftDevice	<p>ANT protocol stack. For more information, see the <i>S210 nRF51422 SoftDevice Specification</i> and the nRF51 SDK documentation.</p>
S310 SoftDevice	<p>ANT and <i>Bluetooth</i> low energy Peripheral controller and host multiprotocol stack. For more information, see the <i>S310 nRF51422 SoftDevice Specification</i> and the nRF51 SDK documentation.</p>

Third party tools	Description
Keil MDK-ARM Development Kit	Keil MDK-ARM Development Kit is a development environment specifically designed for microcontroller applications that lets you develop using the nRF51 SDK application and example files.
SEGGER J-Link Software	The J-Link software is required to debug using the J-Link hardware that is mounted on the nRF51 Dongle.
ANTware II	ANTware is an application used for the control of ANT wireless devices. It is an excellent tool for first time ANT developers to explore the capabilities of ANT as a low power wireless solution, and for experienced users to easily setup and monitor advanced ANT networks. ANTware II improves upon past versions with a slick new interface, streamlined functions, and a variety of new features.

1.3 Documentation

Below is a list of the core documentation for the nRF51 Series and the nRF51x22 chip.

Note: See our website for additional documentation such as Application Notes and White Papers.

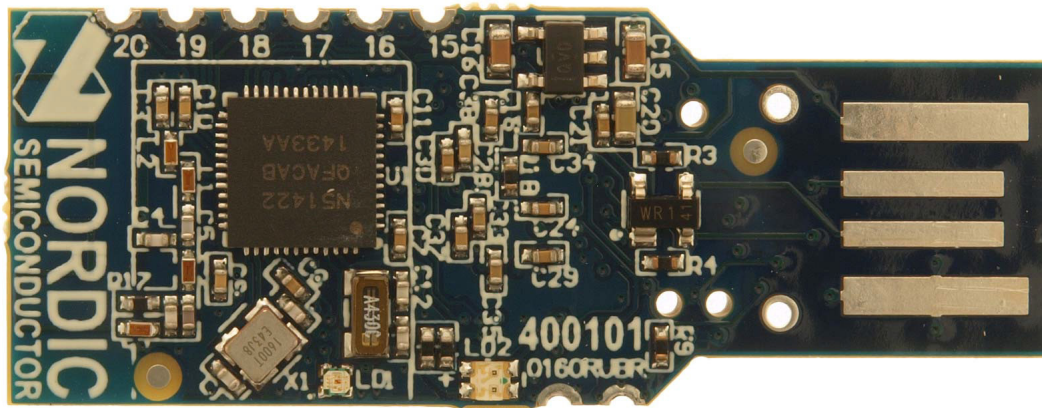
Document	Description
<i>nRF51 Series Reference Manual</i>	The <i>nRF51 Series Reference Manual</i> is a functional description of all the modules and peripherals supported by the nRF51 series.
<i>nRF51x22 Product Specification</i>	The <i>nRF51x22 Product Specification</i> contains all specifications specific to the chip.
<i>S110 nRF51822 SoftDevice Specification</i>	The <i>S110 nRF51822 SoftDevice Specification</i> contains information about the SoftDevice features and performance.
<i>S120 nRF51822 SoftDevice Specification</i>	The <i>S120 nRF51822 SoftDevice Specification</i> contains information about the SoftDevice features and performance.
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<i>S210 nRF51422 SoftDevice Specification</i>	The <i>S210 nRF51422 SoftDevice Specification</i> contains information about the SoftDevice features and performance.
<i>S310 nRF51422 SoftDevice Specification</i>	The <i>S310 nRF51422 SoftDevice Specification</i> contains information about the SoftDevice features and performance.
<i>nRF51 SDK Documentation</i>	The nRF51 SDK documentation includes user guides, descriptions, and reference material to help you understand the protocols, examples, and other components of the SDK.
<i>nRF51x22 Product Anomaly Notification</i>	The <i>nRF51x22 Product Anomaly Notification</i> - list of anomalies relevant for the chip.
<i>ANT Message Protocol and Usage</i>	The <i>ANT Message Protocol and Usage</i> document describes the ANT protocol in detail and contains the fundamental knowledge you need in order to develop successfully with ANT.
nRF51 Dongle Hardware Files	<p>The nRF51 Dongle includes firmware source code, documentation, hardware schematics, and layout files. Included are the following files:</p> <ul style="list-style-type: none"> • Altium Designer files • Schematics • PCB layout files • Production files <ul style="list-style-type: none"> • Assembly drawings • Drill files • Gerber files • Pick and Place files • Bill of Materials

1.4 nRF51 Dongle release notes

Date	Kit version	Description
October 2014	1.0	<ul style="list-style-type: none">• First release.

2 Kit content

In addition to hardware, the nRF51 Dongle consists of firmware source code, documentation, hardware schematics, and layout files which are available from www.nordicsemi.com.



1 x nRF51 Dongle (PCA10031)

Figure 1 nRF51 Dongle content

3 Getting started

This section shows you how to get access to the tools, libraries, and documentation.

Connect your nRF51 Dongle to a computer.

1. Connect your nRF51 Dongle to a computer.
2. The status light (**LD2**) will come on, indicating it has power.
3. After a few seconds, the computer will recognize the nRF51 Dongle as a standard USB drive.

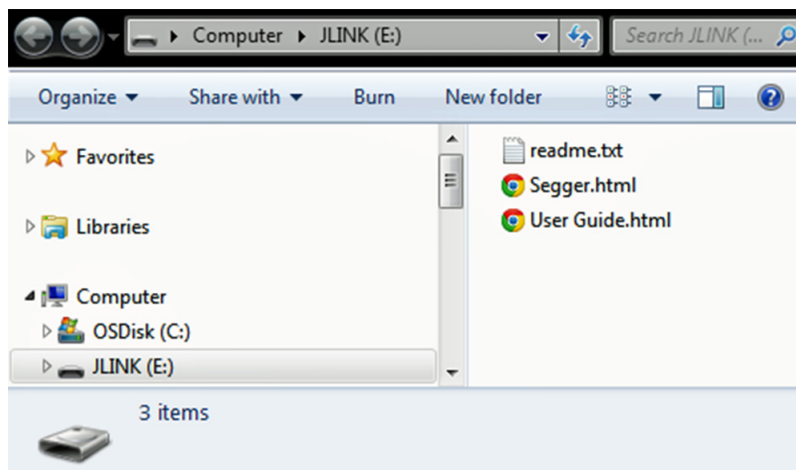


Figure 2 Windows example

Get started with the toolchain and examples.

1. Download and install nRFgo Studio (which includes the nRF Tools package; JLinkARM, JLink CDC, nRFjprog, and mergehex) from www.nordicsemi.com.
2. Download and install the latest Keil MDK-ARM from www.keil.com/arm.
3. Download and install the latest nRF51 SDK found on <http://developer.nordicsemi.com>.
4. Read the information in the Readme.txt file that is installed together with the SDK.

After the installation, the SDK documentation is found here:

Online: http://developer.nordicsemi.com/nRF51_SDK/doc/index.html.

Offline: <keil_location>/ARM/Pack/NordicSemiconductor/nRF_Examples/<version>/documentation

4 Interface MCU

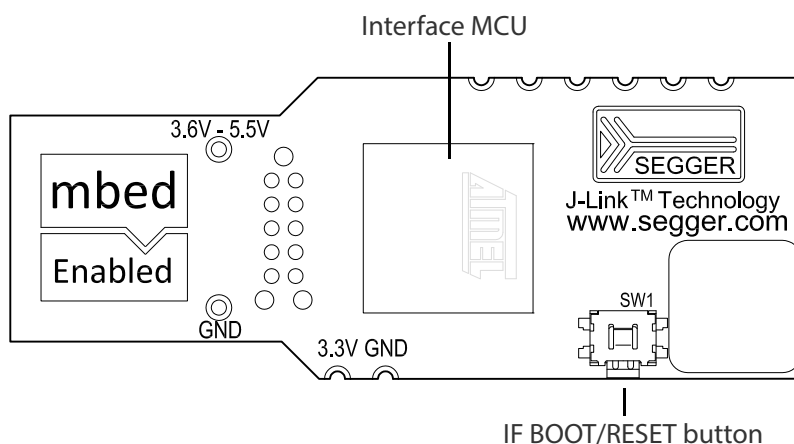


Figure 3 Interface MCU

4.1 IF Boot/Reset button

The nRF51 Dongle is equipped with a boot/reset button (**SW1**). This button is connected to the interface MCU on the board and have two functions:

- Reset button for the nRF device.
- Enter boot loader mode of the interface MCU.

During normal operation the button will function as a reset button for the nRF device. To enter boot loader mode of the interface MCU, the button must be pressed while the board is powered. This is done by unplugging and reconnecting the dongle.

4.2 Virtual COM port

The on-board Interface MCU features a Virtual COM port via UART.

- Flexible baudrate setting up to 1 Mbps
- Dynamic HWFC handling
- Tri-stated UART lines while no terminal is connected

Table 1 shows an overview of the UART connections on nRF51422 and the interface MCU.

nRF51422		Interface MCU
Default GPIO	UART	UART
P0.08	RTS	CTS
P0.09	TXD	RXD
P0.10	CTS	RTS
P0.11	RXD	TXD

Table 1 Relationship of UART connections on nRF51422 and Interface MCU

The UART signals are routed directly to the interface MCU. The UART pins connected to the Interface MCU is tri-stated when no terminal is connected to the Virtual COM port on the computer.

Note: The terminal used must send a DTR signal in order to configure the UART Interface MCU pins.

The P0.08 (RTS) and P0.10 (CTS) can be used freely when HWFC is disabled on the nRF51422.

4.3 Interface MCU Firmware

The on board Interface MCU is factory programmed with an mbed compliant bootloader, this feature enables the ability to swap interface FW between the factory preloaded SEGGER J-Link OB and the nRF51 mbed interface FW, see **section 4.1 “IF Boot/Reset button”** on page 8 on how to enter the bootloader.

To swap Interface MCU FW, simply drag the Interface image (.bin) into the mounted bootloader drive on the connected computer and power cycle the board.

Both the nRF51 mbed interface FW and the J-Link OB image can be downloaded from www.nordicsemi.com.

Note: If you have swapped to the mbed image and want to revert back to the J-Link image, download the latest SEGGER J-Link software from www.segger.com and open a debug session to update to the latest J-Link OB firmware version.

Note: The J-Link serial number is linked to the Interface MCU and will not change even when swapping the Interface MCU FW, so it can be useful to write the serial number on a sticker on the board.

5 Hardware description

This chapter describes the nRF51 Dongle (PCA10031) hardware.

The nRF51 Dongle can be used as a development platform for the nRF51 device. It features an on-board programming and debugging solution. In addition to radio communication, the nRF51 device can communicate with a computer through a virtual COM port provided by the interface MCU. The nRF51 Dongle can be loaded with Master Emulator firmware, that when combined with the Master Control Panel, gives you a peer device for nRF51 that you can use to test the wireless connection.

5.1 Hardware drawings

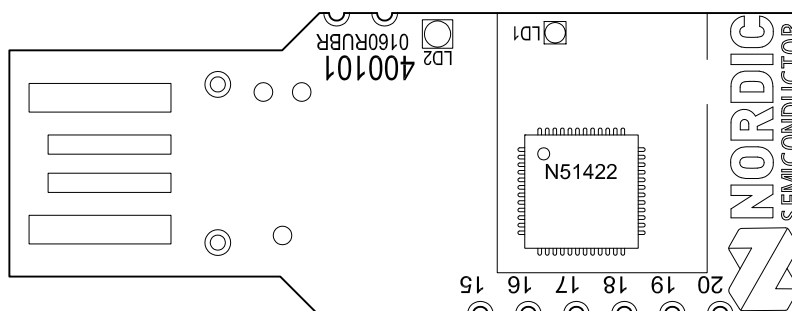


Figure 4 nRF51 Dongle top

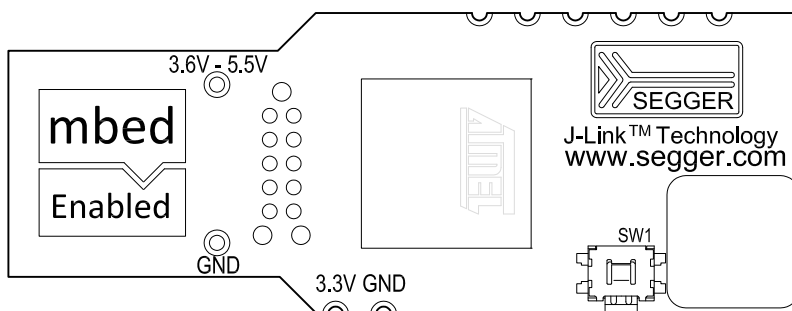


Figure 5 nRF51 Dongle bottom

5.2 Block diagram

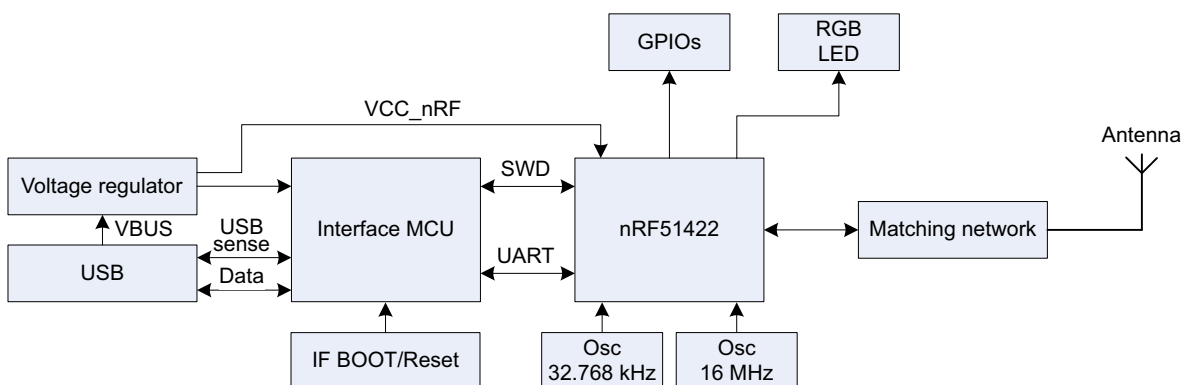


Figure 6 nRF51 Dongle block diagram

5.3 Multicolor LED

The nRF51 Dongle is equipped with a multicolor RGB LED (**LD1**). The LED is connected to dedicated I/Os on the nRF51422 chip. The connections are shown in **Table 2**.

Color	GPIO
Red	P0.21
Green	P0.22
Blue	P0.23

Table 2 LED connection

The LEDs are active low, meaning that writing a logical zero '0' to the output pin will illuminate the LED.

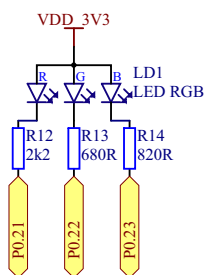


Figure 7 LED configuration

5.4 External connections

The nRF51 Dongle has 6 GPIOs available as well as ground and power connections. The available GPIOs are P0.15 - P0.20, See **Figure 8** for location of the GPIOs and power connectors.

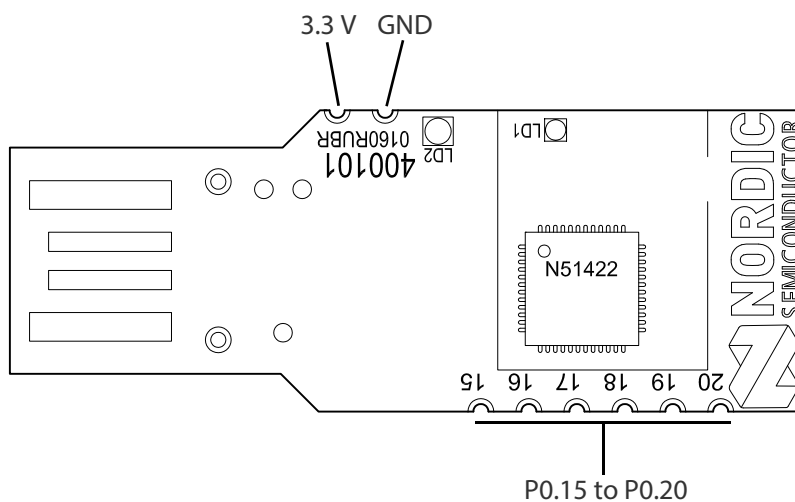


Figure 8 GPIOs and power connectors

Note: No reverse voltage protection on the power connections.

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Revision history

Date	Version	Description
October 2014	1.0	• First release.

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