# nRFready™ Desktop 2 Reference Design Kit

nRF6928

## User Guide v3.0

# 1 Introduction

The nRFready™ Desktop 2 reference design is the latest generation desktop reference design from Nordic Semiconductor. It provides an ideal starting point for developing your next generation wireless keyboard and mouse designs, independent of technology trends and choices.

Based on the nRF51822 chip, which allows for the implementation of the multiprotocol wireless keyboard and mouse, this reference design provides a jump start for your *Bluetooth*® low energy and/or 2.4 GHz Gazell computer peripheral development.

With the Desktop 2 reference design you can:

- Make *Bluetooth* Smart peripherals that have significantly reduced power consumption compared to traditional *Bluetooth* peripherals.
- Combine *Bluetooth* low energy with Gazell into one solution to make hybrid products that automatically choose which protocol stack to use depending on the capabilities of the host system. This enables you to design products that can work both with *Bluetooth* 4.0 enabled computers as well as older systems that does not support *Bluetooth* low energy.

## 1.1 Minimum requirements

Below are listed the minimum requirements a computer must have for developing with Desktop 2 on each protocol.

- *Bluetooth* low energy:
  - Windows 8
  - *Bluetooth* 4.0 hardware or an available USB port
- Gazell/2.4 GHz:
  - Windows XP or later
  - Available USB port

# 2 Kit content

The Desktop 2 Reference Design Kit consists of hardware, hardware design files (available from the Infocenter), and firmware (available from your My Page account at www.nordicsemi.com).

## 2.1 Desktop 2 Reference Design Kit hardware content


***Figure 1*** *Desktop 2 Reference Design Kit hardware content*

## 2.2 Downloadable content

The Desktop 2 Reference Design Kit includes firmware source code, documentation, hardware schematics, and layout files. The documentation, hardware schematics and layout files are available from the Infocenter. To access the firmware, log in to your My Page account, enter the Desktop 2 product key (found on the Desktop 2 Reference Design Kit box label), and download the firmware and hardware files.

### nRF6928-FW Desktop 2 Firmware files

- Firmware for Desktop 2 Mouse
  - Precompiled HEX files
  - Source code
  - Keil ARM® project files
- Firmware for Desktop 2 Keyboard
  - Precompiled HEX files
  - Source code
  - Keil ARM project files
  - Firmware documentation help file
- S110 SoftDevice

### nRF6928-HW Desktop 2 Hardware files

The ZIP file and its subdirectories contain the hardware design files for the Desktop 2 Reference Design Kit.

- Altium Designer files
- PCB layout files
- Production files
  - Assembly drawings
  - Drill files
  - Gerber files
  - Pick and Place files
  - Bill of Materials
- Schematics

### Other relevant nRF51822 documentation

- *nRF51 Series Reference Manual*
- *nRF51822 Product Specification*
- *S110 SoftDevice Specification*
- *nRF51822 Product Anomaly Notification*

# 3 Quick start

This chapter describes how to set up the Desktop 2 Reference Design Kit.

## 3.1 Insert batteries and turn on the keyboard and mouse

1. Insert the batteries (2 x AAA) into the battery holder on the keyboard.
2. Turn on the keyboard with the power switch, as shown in ***Figure 2***. The keyboard is now ready for pairing.

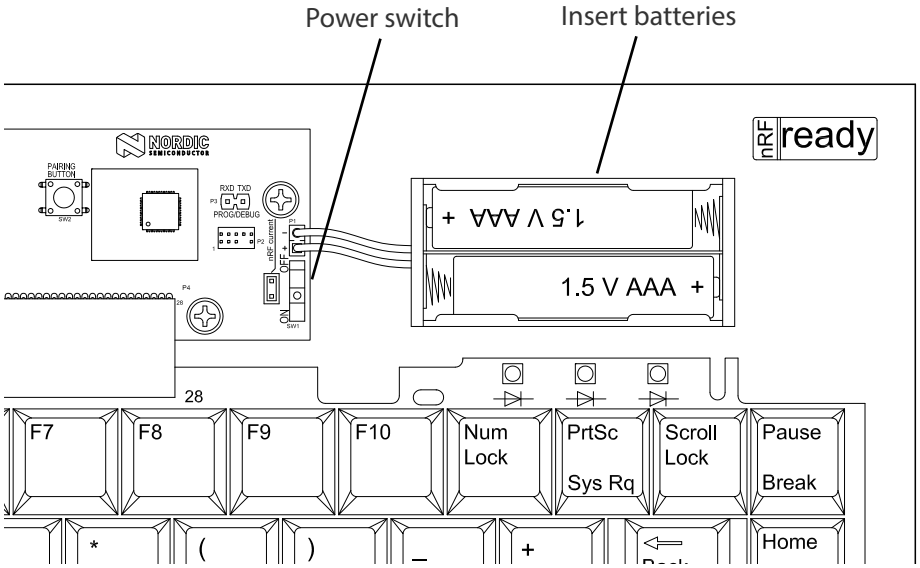



***Figure 2*** *Insert the batteries and turn on the keyboard and mouse*

3. Slide off the top cover of the mouse by pressing it down and simultaneously pushing it backwards.

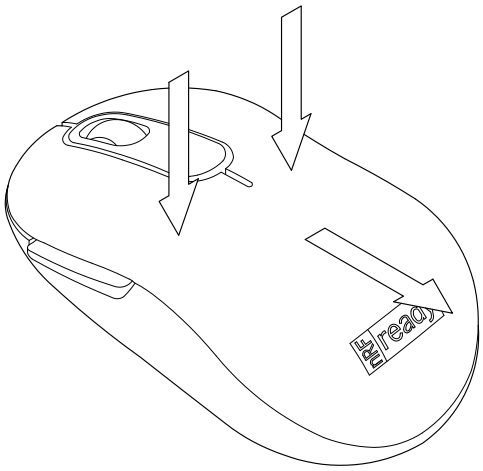



***Figure 3*** *Slide off the top cover*

4. Insert the batteries (2 x AAA) into the mouse as shown in ***Figure 4***. Put the top cover back on. The mouse is now ready for pairing.

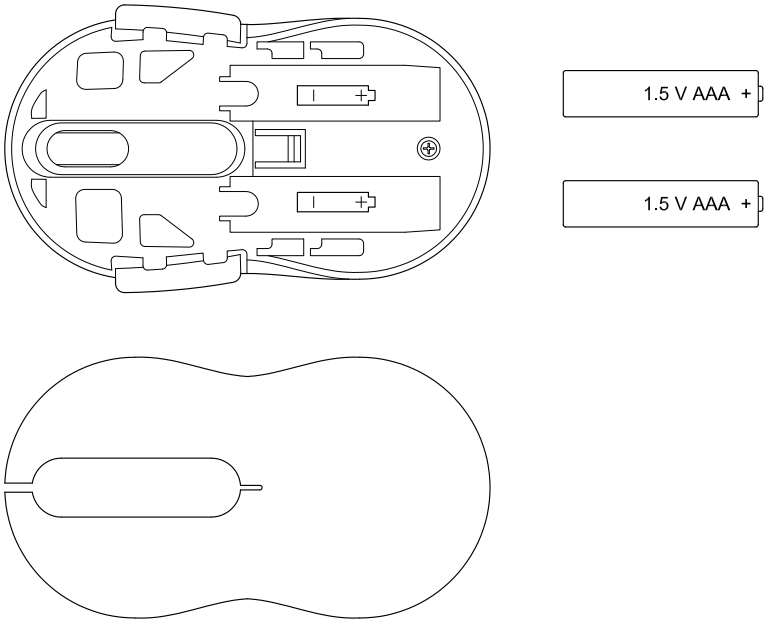



***Figure 4*** *Insert the batteries*

## 3.2 Pairing procedure

The mouse can connect with a host system using one of the following:

- *Bluetooth*® 4.0 and Windows 8
- 2.4 GHz/Gazell and Windows XP or later

The keyboard can connect with a host system using one of the following:

- *Bluetooth* 4.0 and Windows 8
- 2.4 GHz/Gazell and Windows XP or later

### 3.2.1 Pair the keyboard and mouse to a Windows 8 system using *Bluetooth* 4.0

If your computer is not enabled for *Bluetooth* 4.0, insert the *Bluetooth* dongle into the computer, and wait for the dongle to be recognized and the drivers to install.

1. Press the pairing button on the keyboard, see ***Figure 5***.

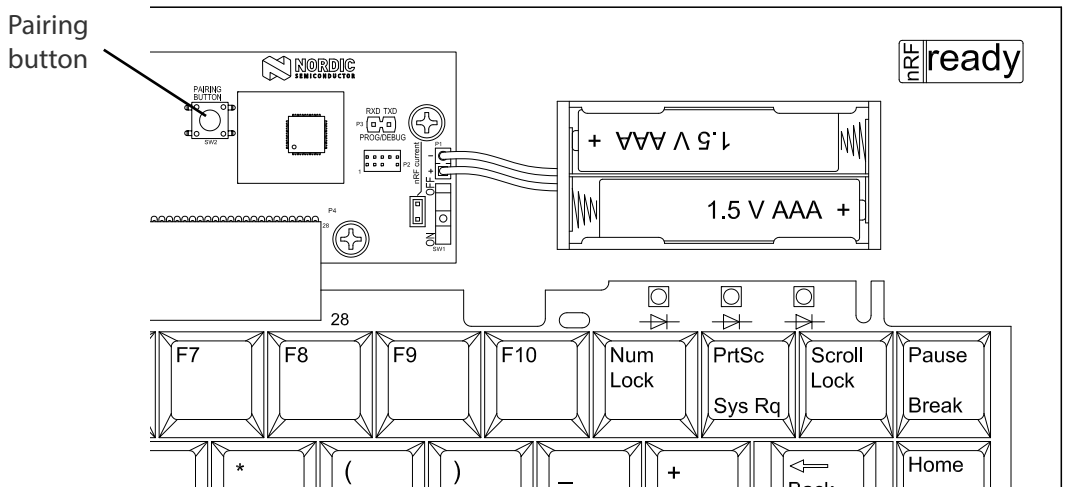



***Figure 5*** *Press the pairing button*

2. Press the left, right, and the scroll wheel buttons on the mouse at the same time.

3. On your computer, navigate to the *Bluetooth* settings menu (press Windows key + W, then type '*Bluetooth* settings' in the search box).

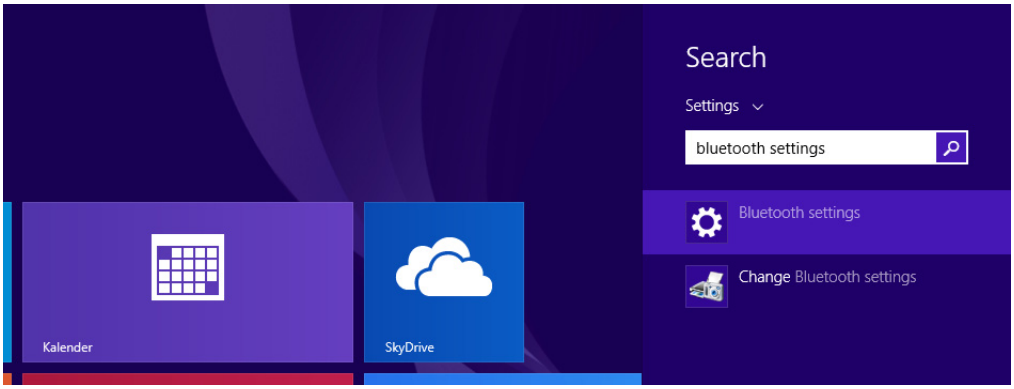



***Figure 6*** *Enter the Bluetooth settings menu*

4. When discovered, the keyboard will be listed as **Desktop 2 Keyboard**. Select it from the list and click **Pair**.

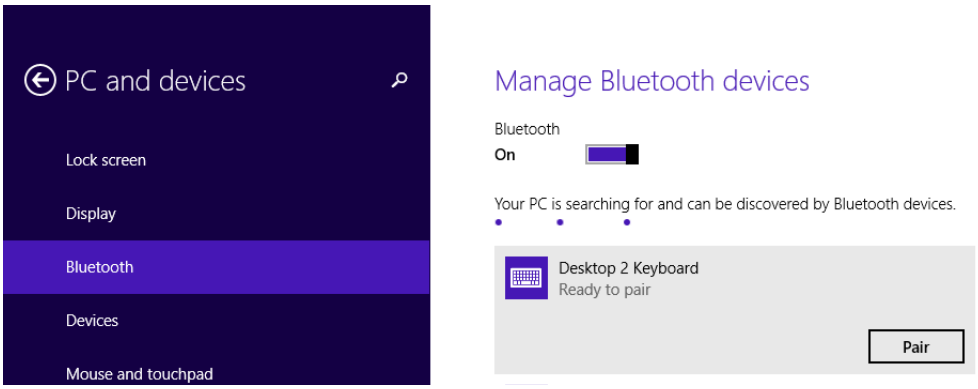



***Figure 7*** *Select and pair with the keyboard*

5. When prompted, enter the six digit code on the Desktop 2 Keyboard.

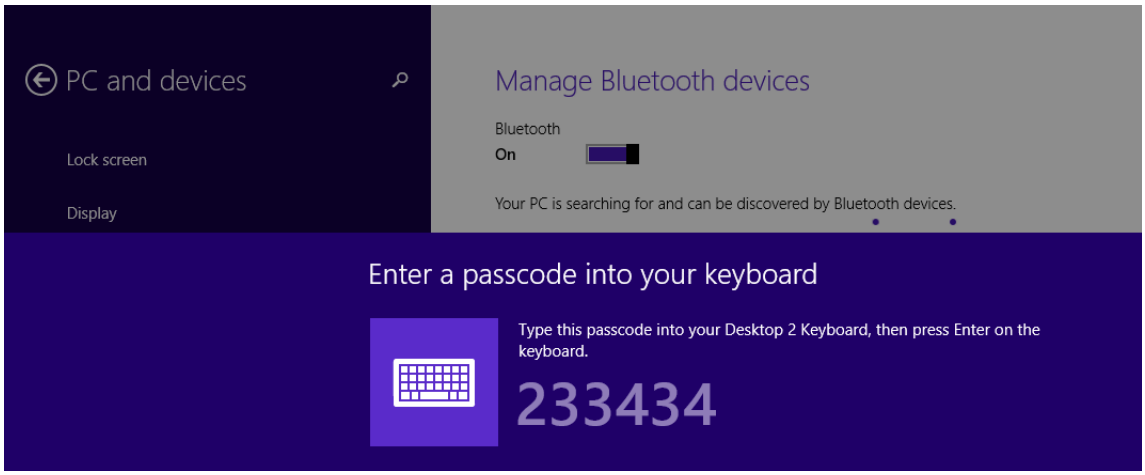



***Figure 8*** *Enter the six digit code*

6. When discovered, the mouse will be listed as **Desktop 2 Mouse**. Select it from the list and click **Pair**.

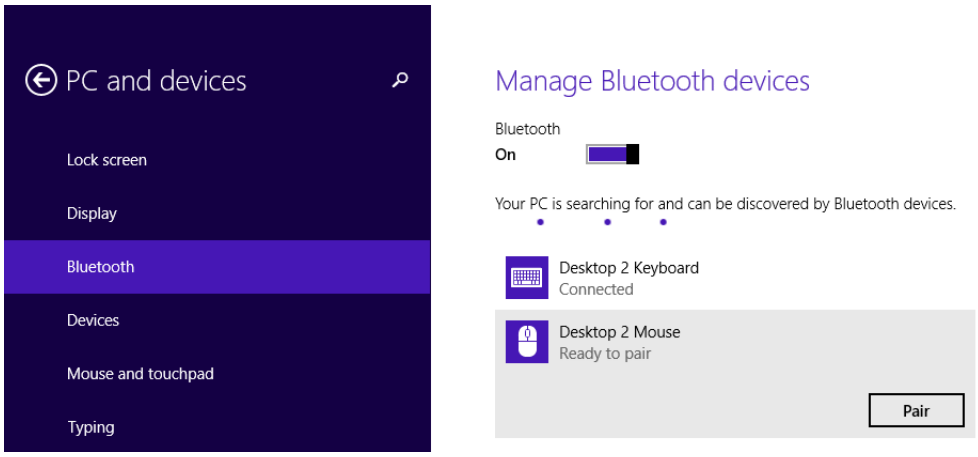



***Figure 9*** *Select and pair with the mouse*

7. After successfully pairing, the devices will show up as connected devices.

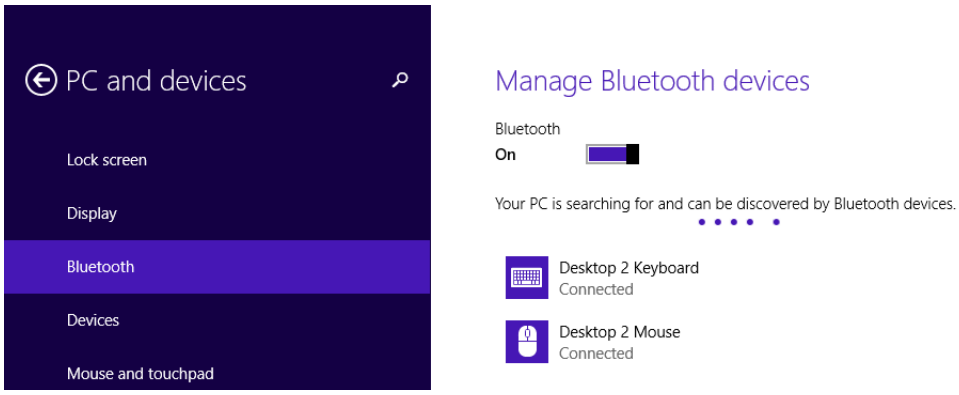



***Figure 10*** *Connected devices*

### 3.2.2 Pair the keyboard and mouse to a Windows 7 or 8 system using Gazell/2.4 GHz

1. Insert the Gazell dongle into the USB port.
2. Place the keyboard close to the dongle (within10 cm) and press the pairing button.
3. Place the mouse close to the dongle (within 10 cm) and press the left, right, and the scroll wheel buttons at the same time.

When pairing is completed you will be able to type on your keyboard and move the cursor with the mouse.

# 4 System overview

This chapter describes how the Desktop 2 Reference Design Kit functions and how it can be used for development purposes. The Desktop 2 Mouse (nRF6926) and Desktop 2 Keyboard (nRF6927) are fully functional ultra-low power computer peripherals that are capable of connecting to a computer using both *Bluetooth*® 4.0 or Nordic Semiconductor's proprietary ultra-low power 2.4 GHz protocol, Gazell.

For both the keyboard and mouse, the user experience will be similar to what you would expect from common USB HID based peripherals regardless of which protocol is in use.

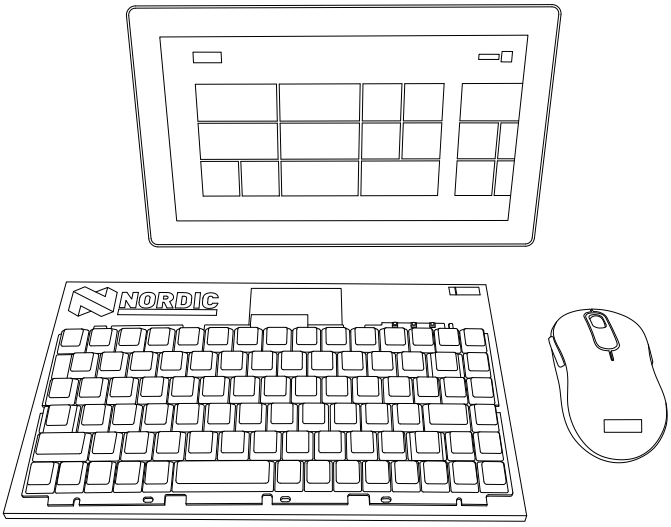



***Figure 11*** *System overview*

## 4.1 Operation modes explained

When there is no pairing information available to the keyboard and mouse, or they are actively put into pairing mode, they will search for both Gazell and *Bluetooth* 4.0 enabled devices in order to establish a new connection.

### 4.1.1 Proprietary 2.4 GHz Gazell mode

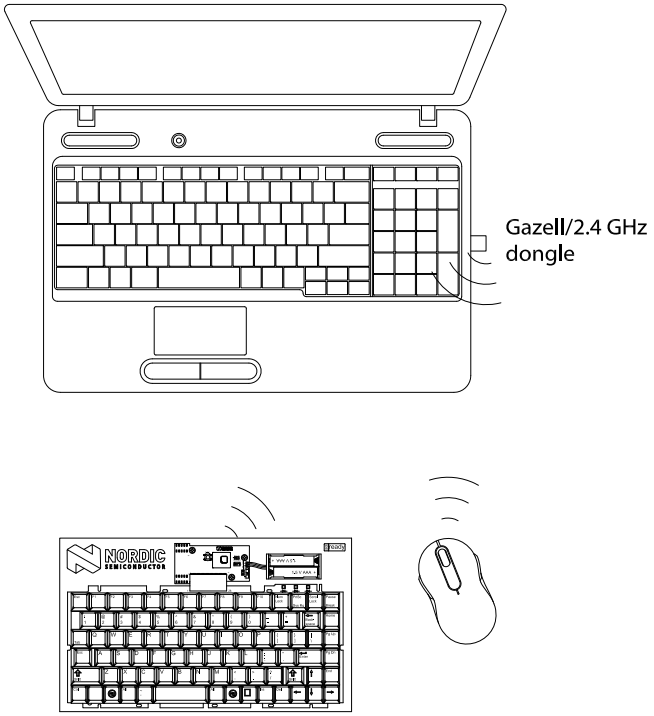



***Figure 12*** *Proprietary 2.4 GHz Gazell mode*

Gazell is a proprietary low power protocol stack that even when used in the most challenging of environments (where there is interference from other radio sources) gives a reliable wireless link. Details on Gazell can be found in the nRF51 SDK documentation.

The operating system interacts with the Gazell USB dongle as if it were a wired USB HID mouse and keyboard. The keyboard and mouse send their data as USB HID reports to the Gazell USB dongle. The Gazell USB dongle then forwards these data reports to the operating system.

### 4.1.2 *Bluetooth* 4.0 mode

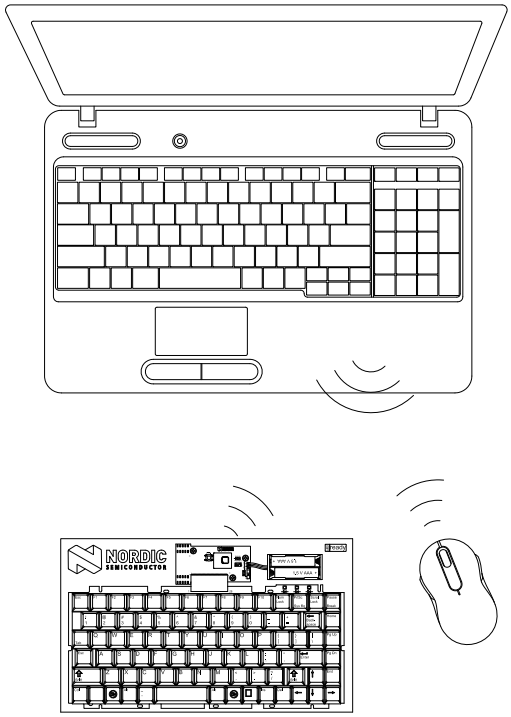


***Figure 13*** *Bluetooth 4.0 mode*

*Bluetooth* 4.0 includes a low energy feature that is the basis for all *Bluetooth* Smart devices. This technology makes it possible to create a new generation of *Bluetooth* compatible peripherals that can combine both low cost and ultra-low power wireless connectivity even with low latency devices like a wireless mouse.

*Bluetooth* 4.0 includes the HID over GATT profile. This profile defines how a device with *Bluetooth* low energy wireless communications can support HID services over the *Bluetooth* low energy protocol stack using the Generic Attribute Profile (GATT). The HID over GATT profile is a direct mapping of the USB HID standard to the Generic Attribute Profile.

Desktop 2 features the HID over GATT profile which means it can connect to any *Bluetooth* 4.0/*Bluetooth* Smart Ready host system supporting the HID over GATT profile. In addition to controlling how the HID data is transferred, the profile requires the use of *Bluetooth* device security. On the keyboard and mouse security and data encryption are handled by the *Bluetooth* Security Manager, which is a *Bluetooth* Protocol Layer managed by the S110 SoftDevice on the nRF51822 chip. On a computer or tablet, the Security Manager is handled in the *Bluetooth* driver stack.

When the mouse or keyboard is in *Bluetooth* pairing mode it begins advertising to pair with *Bluetooth* Smart Ready devices. To connect and pair, the computer or tablet needs to be enabled to scan for new devices.

The main steps of the pairing process performed by the computer or tablet are:

1. Scan for peripheral devices.
2. Connect to a peripheral device.
3. Bond/pair with the peripheral device.

**Note:** The keyboard has extra security and will only bond when a six digit key code generated by the host is typed in.

Read more about *Bluetooth* 4.0 and HID over GATT at http://developer.bluetooth.org.

Most new computers and tablets have built in *Bluetooth* 4.0 transceivers, eliminating the need for an external USB dongle to provide *Bluetooth* 4.0 connectivity. An external *Bluetooth* 4.0 USB dongle is provided in this reference design in case you don't have a *Bluetooth* Smart or *Bluetooth* Smart Ready host to work on.

When using built in *Bluetooth* 4.0, the operating system will manage all the wireless links in the host (*Bluetooth* BR/EDR/low energy as well as Wi-Fi) and ensure co-existence between them. By using an external *Bluetooth* 4.0 dongle you will lose this benefit and co-existence might be reduced. Therefore, if you want to release a product with a USB dongle to be compatible with older computers, using the proprietary Gazell USB dongle will be a better solution both in terms of co-existence, cost, and power efficiency.

## 4.2 Enabling remote wake up functionality in Windows 8 when using *Bluetooth* 4.0

Remote wake up functionality from *Bluetooth* 4.0 devices will in many cases not be enabled by default on Windows 8 systems. See the "How do I enable remote wake in Windows?" section in Microsoft *Bluetooth* Wireless Technology FAQ. In Windows 8.1, or later the Remote wake up functionality is enabled by default.

**Note:** Some computers power down the USB ports during standby. If you encounter problems, consider testing the USB wake up functionality with a standard wired HID mouse or keyboard to ensure that the USB ports are functional in standby. This behavior can be altered by settings in the BIOS on most systems.

## 4.3 Firmware upgrading

The mouse and keyboard firmware can be freely modified and updated by using a 1.8 V compatible SWD-programmer like the SEGGER J-Link (not included with this kit).
***Section Appendix A: "Installing drivers and configuring KEIL projects for the SEGGER debugger"*** on page 33 describes how to upgrade the firmware. The Desktop 2 is also shipped with a device firmware upgrade (DFU) compatible bootloader installed, making it possible to upgrade the firmware over the air. This is described in the firmware help files.

## 4.4 Supported operating systems

In *Bluetooth* 4.0 HID over GATT mode:

- Implementation follows the *Bluetooth* 4.0 HID over GATT profile and will be compatible with all host systems which incorporate this profile.

In proprietary 2.4 GHz Gazell mode:

- All compatible systems capable of using USB HID devices.

# 5 Hardware description

This chapter describes the Desktop 2 Reference Design Kit modules.

## 5.1 nRF6926 Desktop 2 Mouse

The Desktop 2 Mouse is a complete reference design for a dual protocol mouse. It can use *Bluetooth*® low energy and Gazell/2.4 GHz protocols. By using a highly efficient DC/DC converter and a low power optical sensor, the Desktop 2 Mouse provides a highly integrated and high performance desktop peripheral.


***Figure 14*** *Desktop 2 Mouse*

### 5.1.1 Key features

The Desktop 2 Mouse has the following key features:

- ADNS-3000 low power optical sensor
- 5 buttons
- Mechanical Z axis scroll wheel
- Dual protocol, *Bluetooth* low energy and Gazell/2.4 GHz
- nRF51822 SoC
- High efficiency DC/DC boost converter
- Connectors for ISP, debugging, and current measurements
- Powered by one or two AAA batteries in parallel

### 5.1.2 Headers and connectors

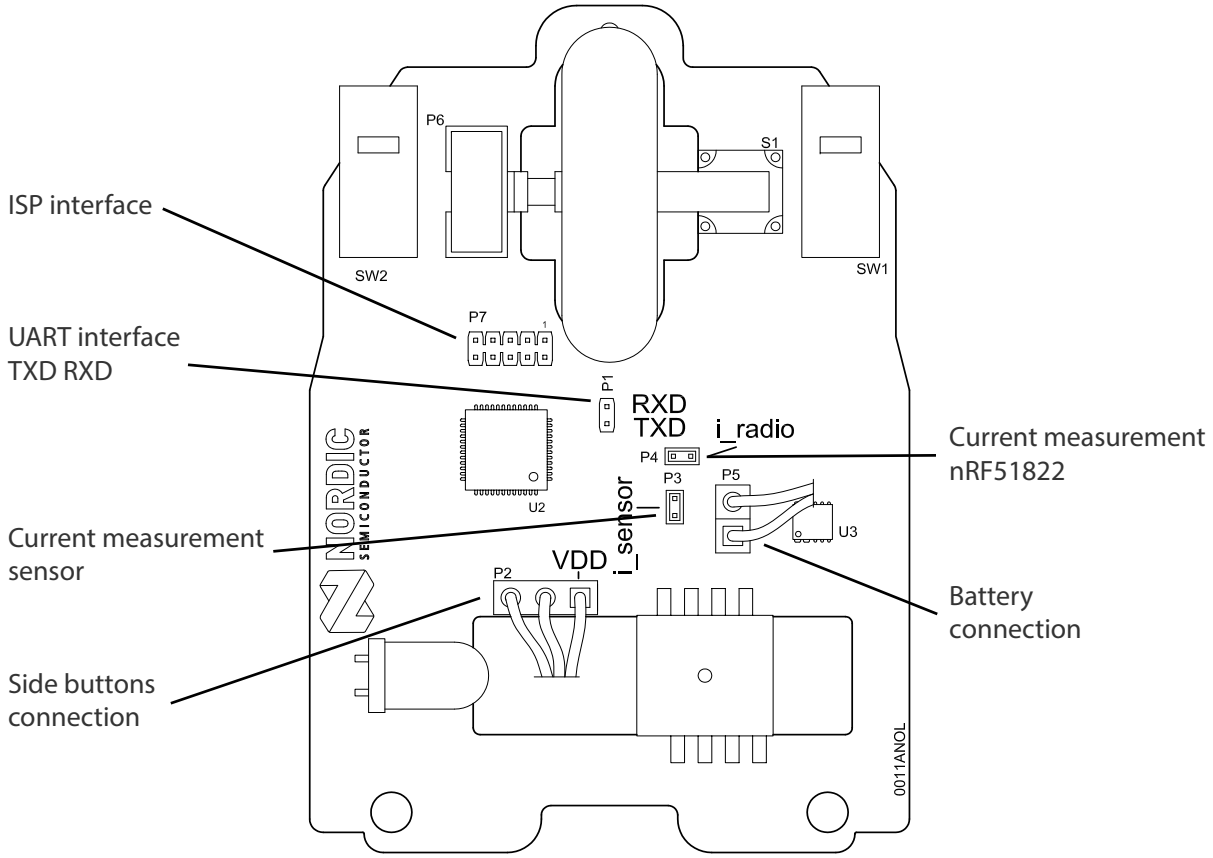



***Figure 15*** *Headers and connectors - mouse (PCA20009)*

#### 5.1.2.1 Current measurement headers

Header **P3** and **P4** (see ***Figure 15***) must be shorted for the mouse to function properly. Replacing the short with a small (<10 Ω) shunt resistor will enable current drain measurements on each VDD rail. **P3** is i_Sensor (ADNS-3000) and **P4** is i_radio (nRF51822).

#### 5.1.2.2 DTM UART header

Header **P1** is a separate serial interface (UART) that gives you access to the *Bluetooth* low energy Direct Test Mode (DTM) in nRF51822. This interface is used to control the *Bluetooth* low energy radio (RF PHY) and is supported by commercially available *Bluetooth* test equipment used for *Bluetooth* qualification. This serial interface also enables you to test radio performance and to optimize your antenna.

The UART can also be used as a general purpose UART for features like code tracing.

#### 5.1.2.3 ISP and debug interface

Programming of nRF51822 as well as debugging can be done through a standard ARM® SWD interface available on **P7**. See ***Figure 15*** on page 16 for the location on the PCB.

More information about the ISP interface can be found in the *J-Link/J-Trace User Guide* and at www.segger.com. Our pin configuration is described in ***Figure 16*** and in ***Table 1***.

For further information about programming and debugging, see ***Section Appendix A: "Installing drivers and configuring KEIL projects for the SEGGER debugger"*** on page 33**.**

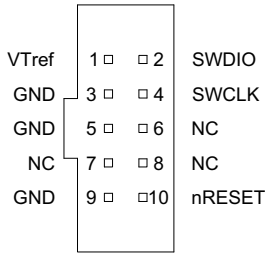



***Figure 16*** *ISP interface pinout*

| Pin | Signal | Type | Description |
|---|---|---|---|
| 1 | VTref | Input | This is the target reference voltage. It is used to check if the target has power, to create the logic-level reference for the input comparators, and to control the output logic levels to the target. It is normally fed from VDD of the target board and must not have a series resistor. |
| 2 | SWDIO/TMS | I/O/output | JTAG mode set input of target CPU. This pin should be pulled up on the target. Typically connected to TMS of the target CPU. When using SWD, this pin is used as Serial Wire Output trace port. (Optional, not required for SWD communication). |
| 3 | GND | GND | Ground |
| 4 | SWCLK/TCK | Output | JTAG clock signal to target CPU. It is recommended that this pin is pulled to a defined state of the target board. Typically connected to TCK of the target CPU. |
| 5 | GND | GND | Ground |
| 6 | NC | NC | Not connected |
| 7 | NC | NC | Not connected |
| 8 | NC | NC | Not connected |
| 9 | GND | GND | Ground |
| 10 | nRESET | | nRESET |

***Table 1*** *ISP interface pin description*

### 5.1.3 Design description

The Desktop 2 Mouse consists of three main functional parts:

- Power supply
- RF and microcontroller
- Sensor interface

### 5.1.4 Block diagram

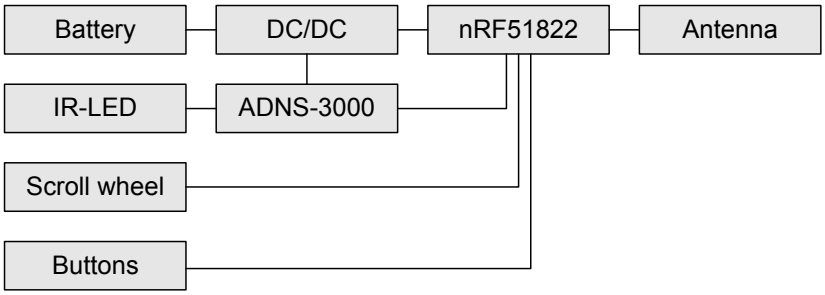



***Figure 17*** *Desktop 2 Mouse block diagram*

The following sections describe the most important details of each of these functional parts.

Extracts from the hardware design files, available for download, are used in this section to describe the design. See ***Section "nRF6928-HW Desktop 2 Hardware files"*** on page 4 for a list of the downloadable hardware design files.

#### 5.1.4.1 Power supply

The Desktop 2 Mouse is powered by one or two AAA 1.5V batteries (in parallel). The nRF51822 chip and the sensor front end are powered at 1.9 V by a DC/DC step up. The mouse can operate with a battery voltage between 0.65 V and 1.5 V thereby utilizing the entire capacity of the battery.

The system DC/DC is always enabled by connecting EN to Vin.

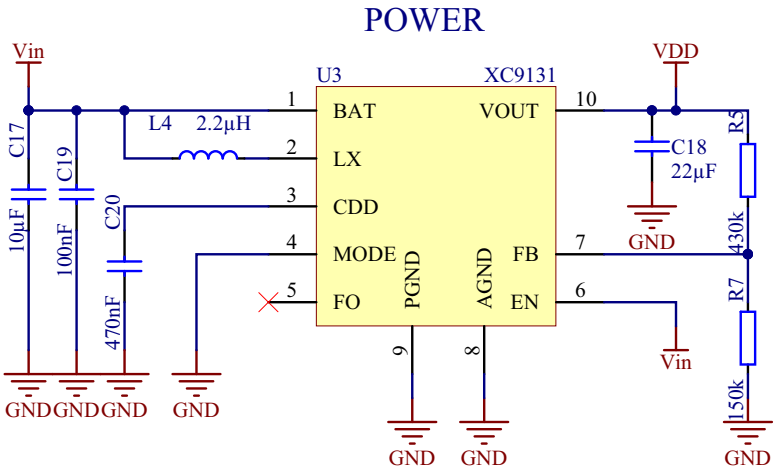



***Figure 18*** *DC/DC converter schematics*

#### 5.1.4.2 Sensor interface

The navigation engine in this design forms a compact mouse tracking system and is composed of:

- ADNS-3000
- ADNS-5110-001 lens
- HSDL-4261 IR LED

The ADNS-3000 is connected to one of the SPI masters in nRF51822 with the SDIO, MISO, MSCK, and MOSI signals. The serial port is used to set and read parameters in the ADNS-3000, and to read the motion information.

The MOTION detect pin is a level-sensitive output that signals the microcontroller when motion has occurred. See the ADNS-3000 data sheet for more information.

#### 5.1.4.3 Antenna interface

The antenna connection on the radio chip is differential with an impedance different from 50 Ω. The components between the radio and the antenna are called the matching network and consist of the components shown in ***Figure 19***.

The matching network has four main tasks:

- Transform the balanced output of the radio to an unbalanced connection to the antenna (balun).
- Transform the output impedance of the radio to a 50 Ω antenna.
- Suppress harmonics to a level below the regulations level in TX mode.
- Suppress the LO leakage in RX mode.

The function of Capacitor C2 is to tune the antenna to 50 Ω. On this specific board the capacitor value 1.0 pF achieves this, but with another antenna arrangement a different value could be required.

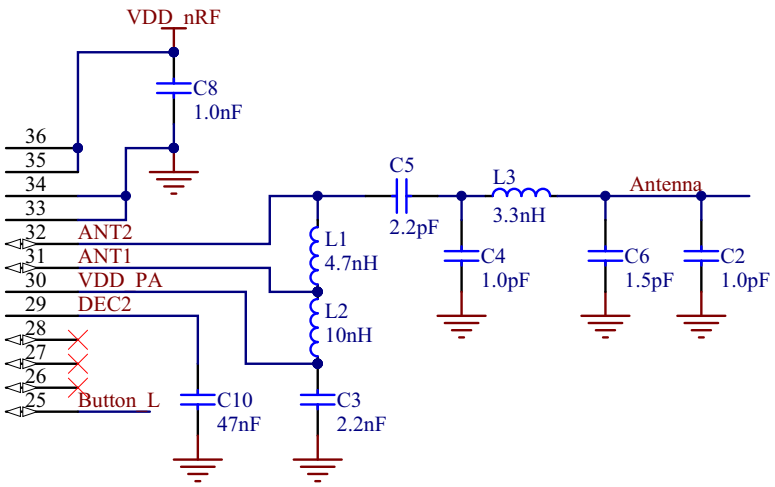



***Figure 19*** *Matching network schematics*

#### 5.1.4.4 Battery level monitoring

The battery voltage is fed through a 1 kΩ resistor (R4) to an ADC input on the nRF51822 chip. The resistor is used to limit the current and to protect the circuit during power up (before the DC/DC has reached VCC).

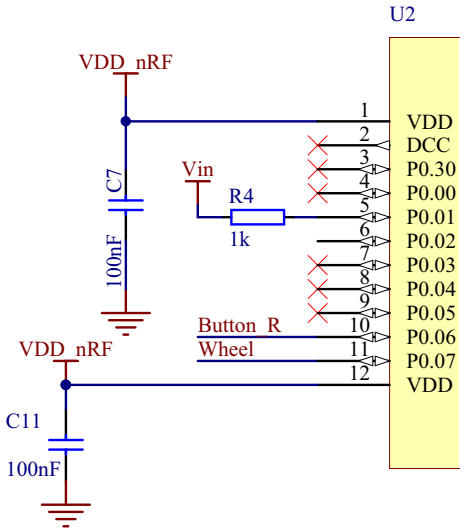



***Figure 20*** *Battery level monitoring schematic*

## 5.2 nRF6927 Desktop 2 Keyboard

The Desktop 2 Keyboard is a complete reference design for a dual protocol keyboard. It can use *Bluetooth* low energy and Gazell/2.4 GHz protocols. The keyboard consist of an 86 button keyboard matrix together with the nRF51822 radio module.

### 5.2.1 Key features

The Desktop 2 Keyboard has the following key features:

- 86 button keyboard matrix
- Dual protocol (*Bluetooth* low energy and 2.4 GHz propriety) radio module with a PCB antenna
- Supplied from 2x AAA batteries
- nRF51822 SoC

### 5.2.2 Keyboard hardware

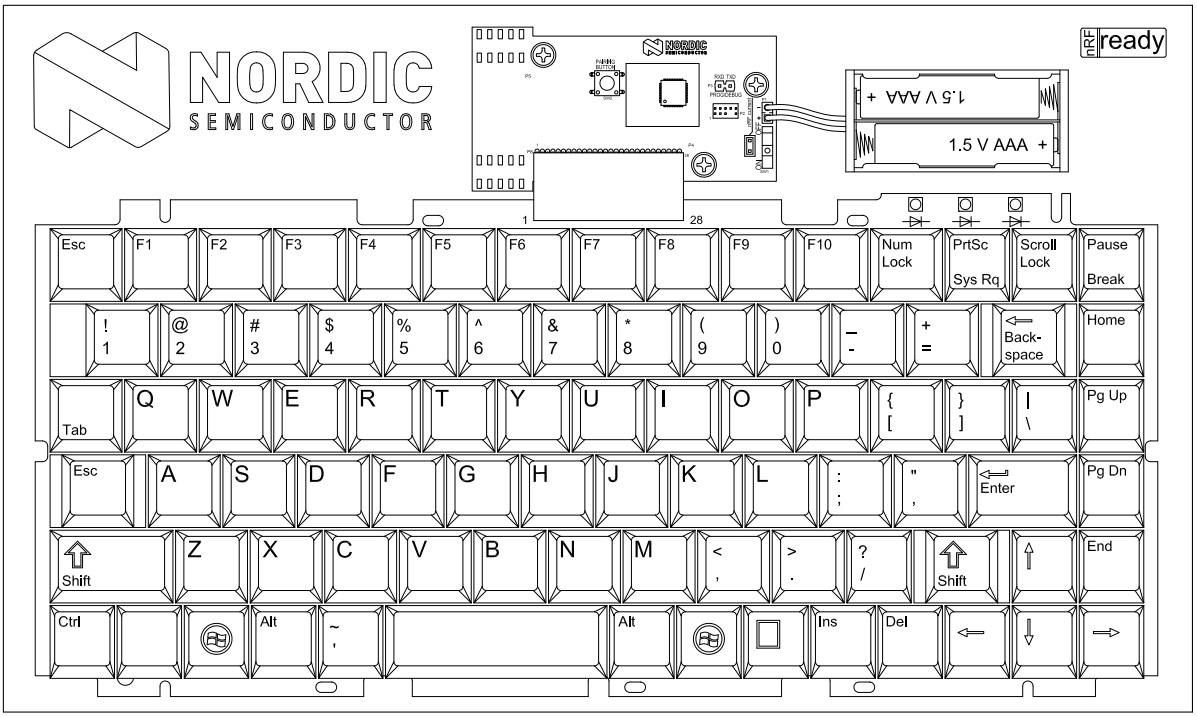



***Figure 21*** *Desktop 2 Keyboard*

### 5.2.3 Headers and connectors

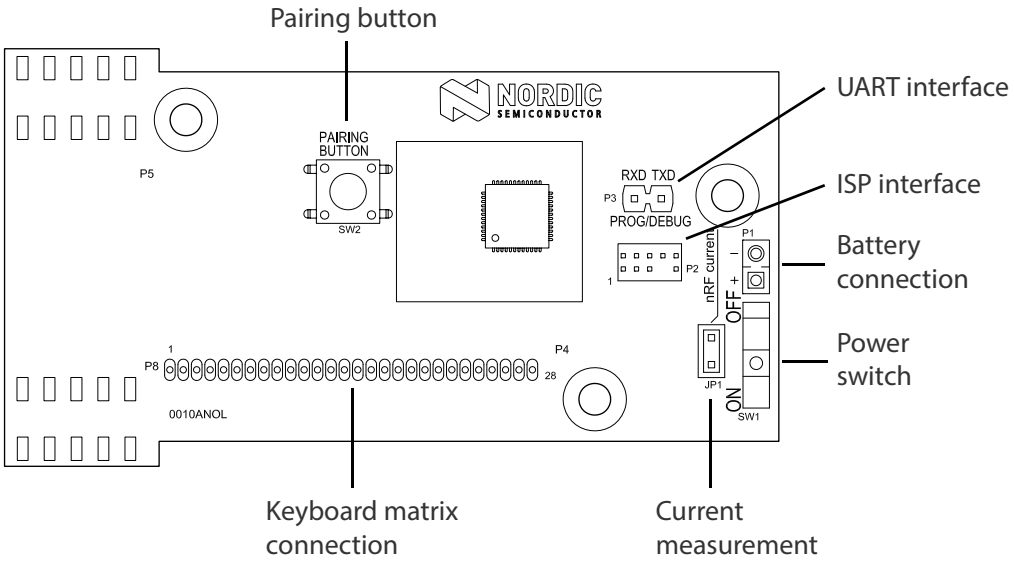



***Figure 22*** *Keyboard PCB (PCA400085)*

#### 5.2.3.1 Battery voltage header

Header **P1** is the battery voltage (1.8 - 3.0 V) connector.

#### 5.2.3.2 Current measurement header

Header **JP1** is used for current measurement and must be shorted during normal operation.

#### 5.2.3.3 ISP and debug interface

Programming and debugging of the nRF51822 chip is available through a standard ARM SWD interface available on **P2**. See ***Figure 22*** on page 23 for location on the PCB.

More information about the ISP interface can be found in the *J-Link/J-Trace User Guide* and at www.segger.com. Our pin configuration is described in ***Figure 23*** and ***Table 2***.

For further information about programming and debugging, see ***Appendix A: on page 33.***

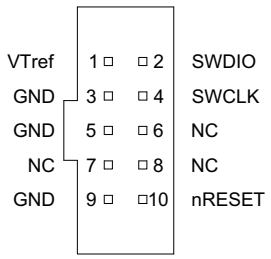



***Figure 23*** *ISP interface pinout*

| Pin | Signal | Type | Description |
|---|---|---|---|
| 1 | VTref | Input | This is the target reference voltage. It is used to check if the target has power, to create the logic-level reference for the input comparators, and to control the output logic levels to the target. It is normally fed from VDD of the target board and must not have a series resistor. |
| 2 | SWDIO/TMS | I/O/output | JTAG mode set input of target CPU. This pin should be pulled up on the target. Typically connected to TMS of the target CPU. When using SWD, this pin is used as Serial Wire Output trace port. (Optional, not required for SWD communication). |
| 3 | GND | GND | Ground |
| 4 | SWCLK/TCK | Output | JTAG clock signal to target CPU. It is recommended that this pin is pulled to a defined state of the target board. Typically connected to TCK of the target CPU. |
| 5 | GND | GND | Ground |
| 6 | NC | NC | Not connected |
| 7 | NC | NC | Not connected |
| 8 | NC | NC | Not connected |
| 9 | GND | GND | Ground |
| 10 | nRESET | | nRESET |

***Table 2*** *ISP interface pin description*

#### 5.2.3.4 UART interface

A serial interface (UART) gives you access to the *Bluetooth* low energy Direct Test Mode (DTM) on nRF51822. This interface is used to control the *Bluetooth* low energy radio (RF PHY) and is supported by commercially available *Bluetooth* test equipment used for *Bluetooth* test and qualification. This serial interface also enables you to test radio performance and to optimize your antenna. The UART can also be used as a general purpose UART and is accessible on header **P3**.

### 5.2.4 Design description

The Desktop 2 Keyboard consists of three main functional parts:

- Power supply
- RF and microcontroller
- Keyboard button matrix interface

### 5.2.5 Block diagram

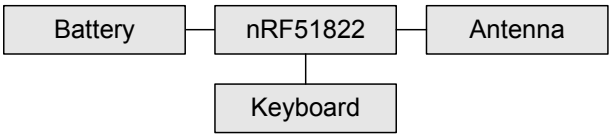


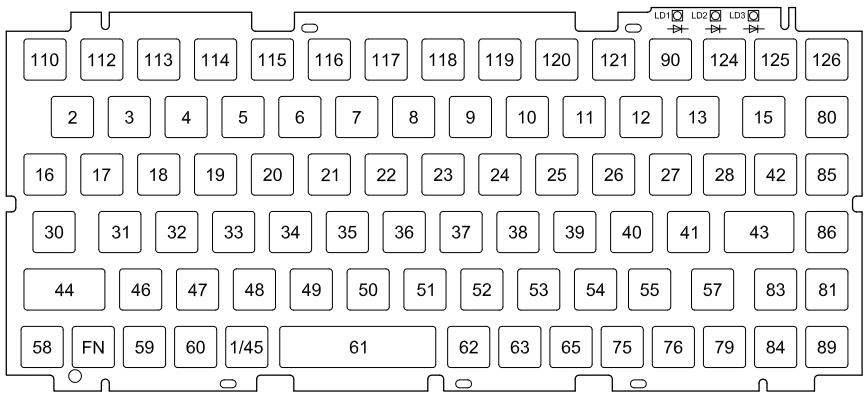

***Figure 24*** *Desktop 2 Keyboard block diagram*

The following sections describe these functional modules.

Extracts from the hardware design files, available for download, are used in this section to describe the design. See ***Section "nRF6928-HW Desktop 2 Hardware files"*** on page 4 for a list of the downloadable hardware design files.

#### 5.2.5.1 Keyboard matrix

The Desktop 2 Keyboard uses an 86 button matrix from Cherry GmbH.



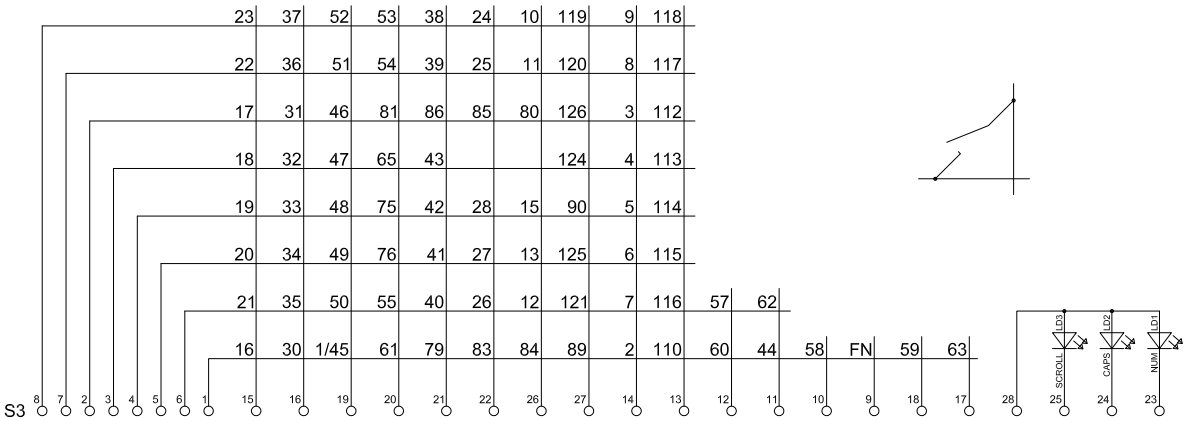




***Figure 25*** *Keyboard matrix schematic*

The matrix has 8 rows and 16 columns, using 24 I/Os on the nRF51822 chip. The I/Os are organized as shown in ***Table 3 on page 27.***

| nRF51822 I/O | Connector no. | Keyboard matrix |
|---|---|---|
| P0.21 | 1 | Row1 |
| P0.22 | 2 | Row6 |
| P0.23 | 3 | Row5 |
| P0.24 | 4 | Row4 |
| P0.25 | 5 | Row3 |
| P0.28 | 6 | Row2 |
| P0.06 | 7 | Row7 |
| P0.13 | 8 | Row8 |
| P0.02 | 9 | Col3 |
| P0.01 | 10 | Col4 |
| P0.00 | 11 | Col5 |
| P0.30 | 12 | Col6 |
| P0.29 | 13 | Col7 |
| P0.08 | 14 | Col8 |
| P0.07 | 15 | Col16 |
| P0.05 | 16 | Col15 |
| P0.04 | 17 | Col1 |
| P0.03 | 18 | Col2 |
| P0.09 | 19 | Col14 |
| P0.10 | 20 | Col13 |
| P0.11 | 21 | Col12 |
| P0.12 | 22 | Col11 |
| | 23 | NUM LED |
| P0.15 | 24 | CAPS LED |
| | 25 | SCROLL LED |
| P0.16 | 26 | Col10 |
| P0.17 | 27 | Col9 |
| VCC_nRF | 28 | |

***Table 3*** *nRF51822 I/O used on keyboard matrix*

#### 5.2.5.2 Radio interface

'The antenna connection on the radio chip is differential with an impedance different from 50 Ω. The components between the radio and the antenna are called the matching network and consist of the components shown in ***Figure 26***.

The matching network has four main tasks:

- Transform the balanced output of the radio to an unbalanced connection to the antenna (balun).
- Transform the output impedance of the radio to a 50 Ω antenna.
- Suppress harmonics to a level below the regulations level in TX mode.
- Suppress the LO leakage in RX mode.

The function of Capacitor C1 is to tune the antenna to 50 Ohms. On this specific board the capacitor value 1.8 pF achieves this, but with another antenna arrangement a different value could be required.

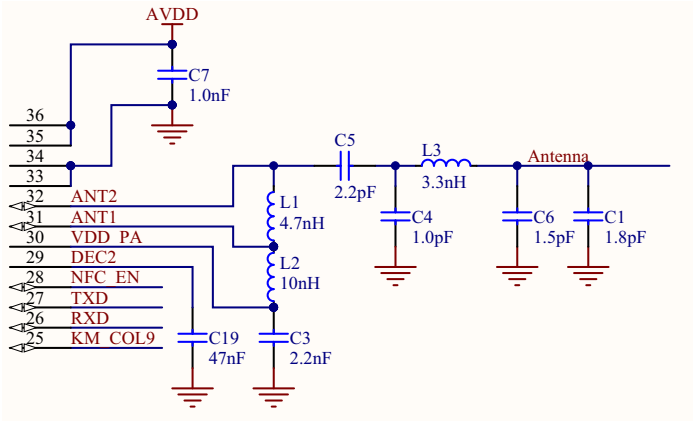



***Figure 26*** *Radio interface*

## 5.3 nRF2728 USB dongle hardware description

The nRF2728 USB dongle is a receiver with a USB interface. This single-chip USB dongle uses the nRF24LU1+ SoC solution from Nordic Semiconductor.

### 5.3.1 Key features

The nRF2728 USB dongle has the following key features:

- Compact form factor
  - 12 x 23 mm without USB connector
  - 12 x 32 mm with USB connector
- Meander type antenna
- USB v2.0 compatible
- ETSI 300-440, FCC CFR 47 paragraph 15.247 and Industry Canada RSS-210 Issue 7 precompliance test reports
- Supports firmware development directly on the dongle
- nRF device: nRF24LU1P-F32Q32

### 5.3.2 Hardware figures

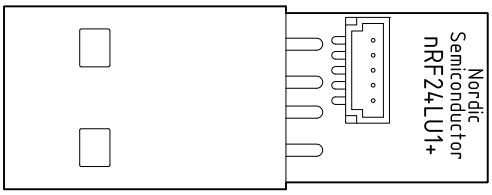



***Figure 27*** *nRF2728 top view*

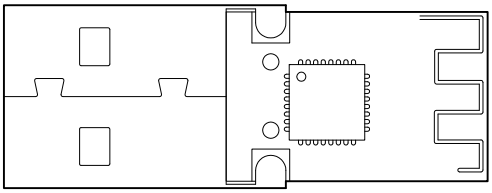


***Figure 28*** *nRF2728 bottom view*

### 5.3.3 Block diagram

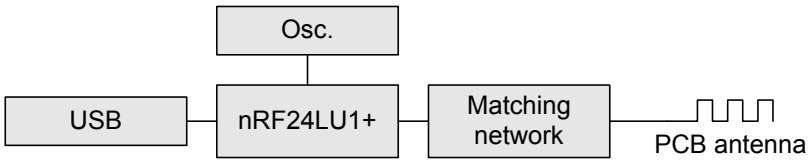



***Figure 29*** *nRF2728 nRF24LU1+ USB dongle functional block diagram*

### 5.3.4 Design description

The nRF24LU1+ USB dongle consists of one printed circuit board, the nRF2728.

#### 5.3.4.1 nRF ISP interface - firmware upgrade

A connector for the nRF24LU1+ ISP interface is included on the USB dongle for easy firmware upgrade purposes. The interface is found on connector **J2**. The USB dongle can be programmed using the nRFgo™ nRF24LU1+ Development Kit together with an nRFgo Starter Kit. For further information, please see the *nRFgo nRF24LU1+ Development Kit User Guide*.

#### 5.3.4.2 Power supply

The nRF24LU1+ is connected to the USB 5 V supply through a 10 Ω resistor (R6). An internal voltage regulator enables the chip to be powered directly from the USB bus; it does not require an external voltage regulator. The VDD pins are only for internal decoupling. They are connected together and decoupling capacitors are placed close to the VDD pins, as recommended in the *nRF24LU1+ Product Specification*.

#### 5.3.4.3 Matching network

To make the USB dongle as small as possible, the layout of the matching network is changed from the reference layout in the *nRF24LU1+ Product Specification*. The component values are different in order to compensate for the changed layout. As the component values in this design are very sensitive to layout changes, it must be stressed that if the layout is changed, the matching network and the antenna must be retuned for optimum performance by using a vector network analyzer.

#### 5.3.4.4 Antenna

The antenna is a quarter wavelength meander type antenna printed on the PCB. The antenna is tuned to be resonant at 2.44 GHz, and the impedance is matched to the 50 Ω output of the matching network with the use of **L4** and **C13**. When the USB dongle is connected to a computer, the computer adds a significant ground plane to the USB dongle. This means that any antenna measurements must be done with the dongle connected to the computer. The antenna is tuned for this layout only. If the layout is changed and/or a plastic housing is added, the antenna should be tested and possibly retuned. The antenna can be retuned by changing its length and/or changing the values of **L4** and **C13**. The exact length of the antenna and the values of **L4** and **C13** must be determined by doing measurements with a vector network analyzer.

### 5.3.5 Regulatory pre-compliance testing results

The nRF2728 nRF24LU1+ USB dongle has been tested in a certified lab on key RF parameters for the purpose of demonstrating compliance with ETSI 300-440, FCC CFR 47 paragraph 15.247 and Industry Canada RSS-210 Issue 7.

The test reports can be downloaded together with the hardware design files.

The file names are:

- nRF2728 - ETSI 300 440 Test report.pdf
- nRF2728 - FCC part 15 Test report.pdf

# 6 Troubleshooting

**I can't pair my device when using the Gazell USB dongle.**

- Ensure that the batteries are placed in right direction.
- On the keyboard the power switch must be to the "on" position.
- Try holding the device closer to the USB dongle while initiating the pairing.
- Ensure that the USB dongle is properly enumerated. You can find it in the "Devices and Printers" in Windows as "Nordic Semiconductor nRFready Desktop Solution".

**I can't find the device in the device list when searching for new *Bluetooth*® devices in Windows 8.**

- Ensure that the batteries are placed in right direction.
- On the keyboard the power switch must be to the "on" position.
- Unplug all Gazell USB dongles in close proximity to ensure that your device doesn't pair with the wrong protocol.
- Ensure that no previous paired hosts are still connecting to the device. Turn them off or remove the bond.
- Try moving the mouse when searching.
- Ensure that your computer actually has *Bluetooth* 4.0 low energy support.
    - Find the *Bluetooth* adapter in the device manager and see that "Microsoft *Bluetooth* LE Enumerator" is present. If this is missing you must upgrade the drivers for the *Bluetooth* adapter if possible.

**I can find the device in the device list when *Bluetooth* bonding in Windows 8, but the bonding fails.**

- Try to move around the mouse or push some keys on the keyboard when bonding. In some scenarios the device can stop advertising before the bond was completed.
- Try restarting the *Bluetooth* adapter or the computer.

# Appendix A: Installing drivers and configuring KEIL projects for the SEGGER debugger

## Prerequisites

- Keil µVision™ with ARM®-MDK that is tested and working with MDK version 4.54.
- nRF51 SDK
- SEGGER J-Link
- 20 to 10 pin JTAG cable adapter

## Download and install SEGGER drivers

1. Download the latest SEGGER J-Link software and documentation pack.
2. Download and run the J-Link Software (version 4.52b or later) and documentation pack for Windows. The serial number from your SEGGER J-Link hardware is needed. It is printed on the bottom side of the J-Link, see ***Figure 30***.

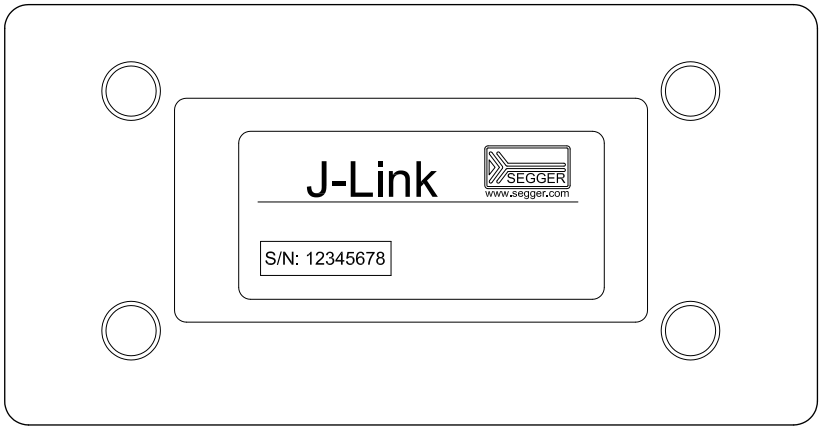



***Figure 30*** *J-Link serial number location*

3. During installation you will be prompted to select the IDE that should be updated with the latest SEGGER DLLs. Check the box for **Keil MDK** and any other IDEs you want to use with SEGGER.

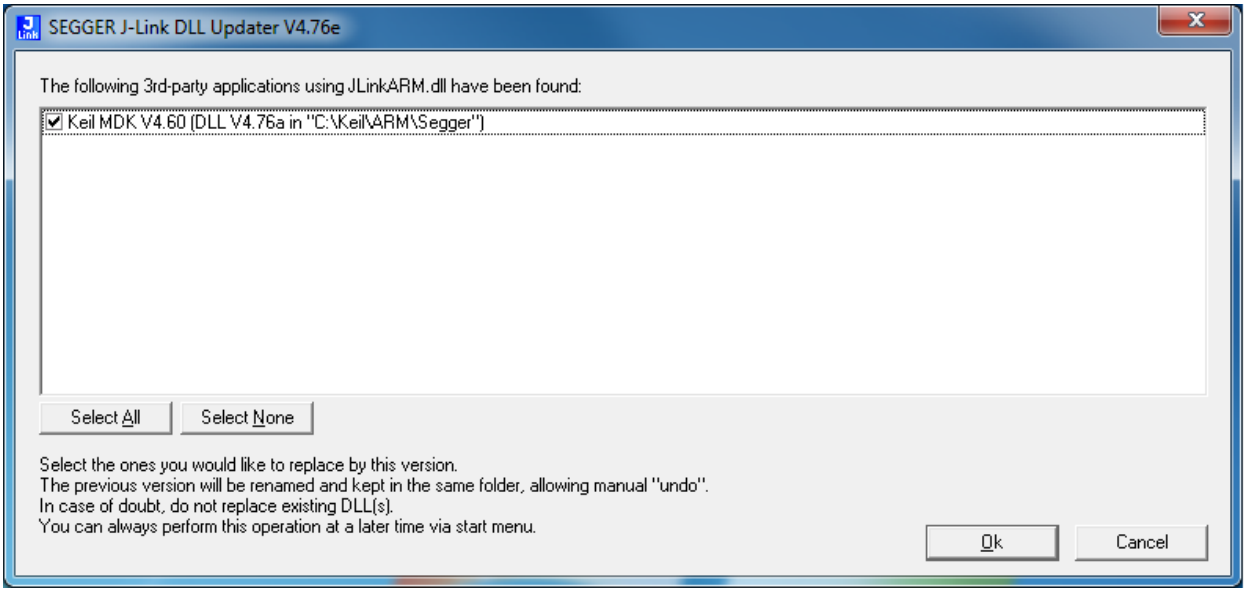



***Figure 31*** *Select which IDE to update with SEGGER*

4. Go to Known problems for MDK v4.54. Download JL2CM3 and copy it to **<keil>/ARM/Segger**. This patch is necessary for the SEGGER debugger to work.
5. Connect the J-Link to the computer with a USB cable. Wait for drivers to install.

## Connecting the SEGGER J-Link to the Desktop 2 hardware

1. Connect the SEGGER J-Link to the Desktop 2 Mouse, see ***Figure 32***, or to the Keyboard, see ***Figure 33***.
2. Power on the mouse or keyboard

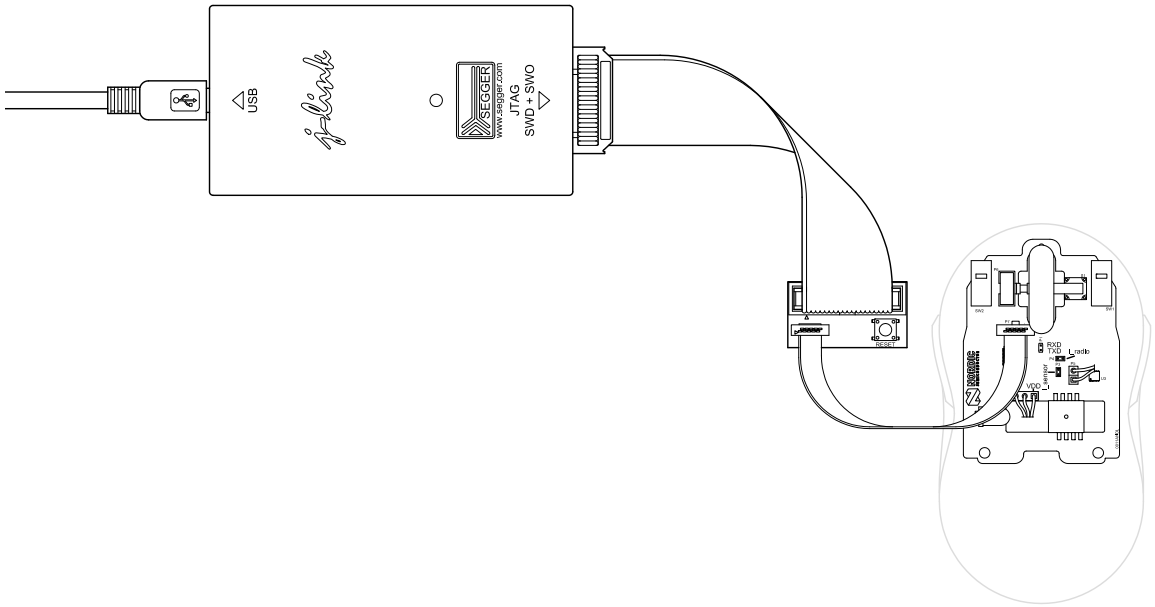



***Figure 32*** *Connecting the SEGGER J-Link to the mouse*

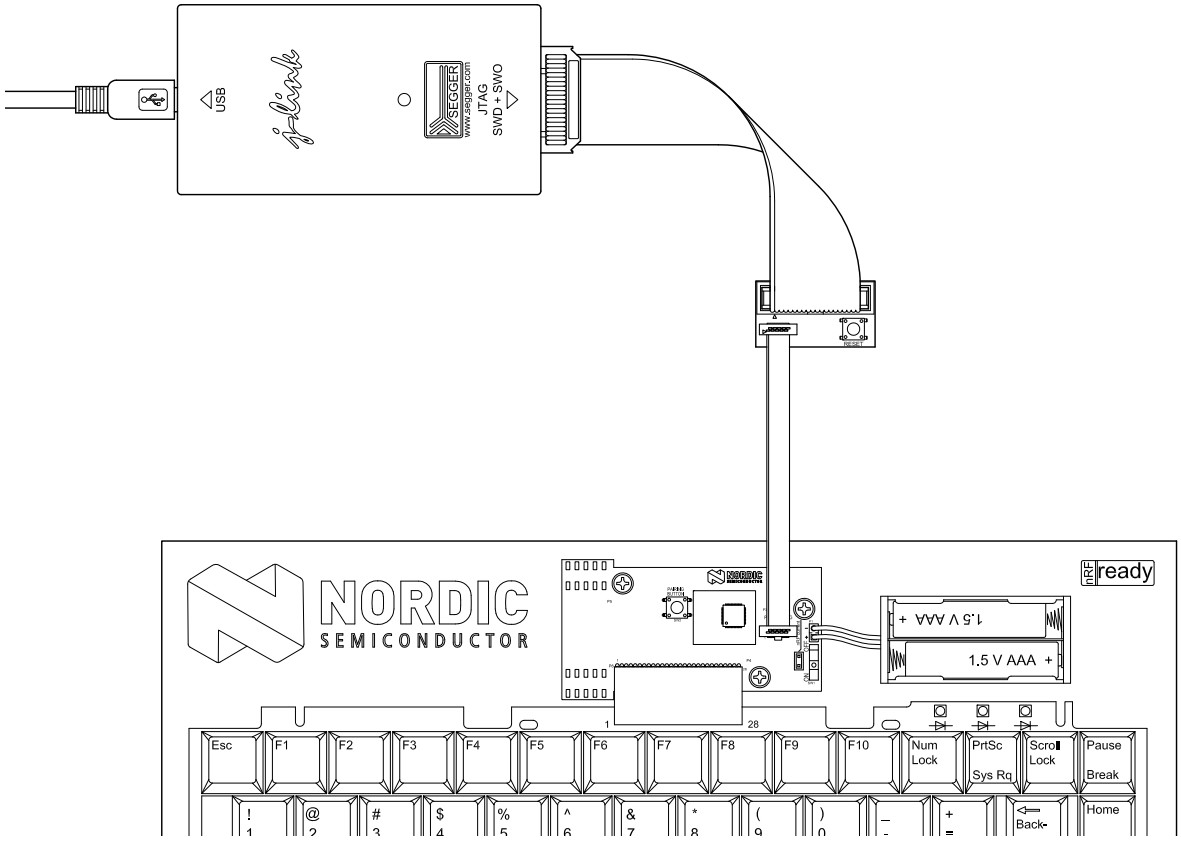



***Figure 33*** *Connecting the SEGGER J-Link to the keyboard*

## Configuring KEIL projects for SEGGER debugger for first time use

1. Open Keil µVision IDE by double-clicking a project file. The Target Options window will open.
2. Click the **Target Options** button on the toolbar or click **Project** menu and select **Options for Target**.

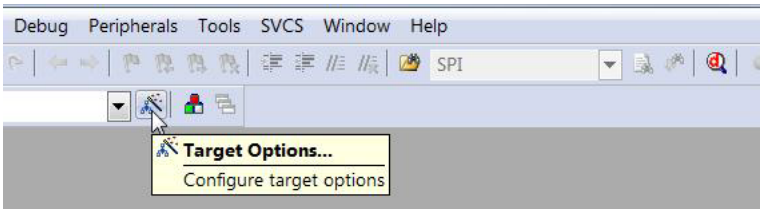



***Figure 34*** *Keil Target configuration*

3. Under the **Debug** tab in the Use list, select **J-LINK / J-Trace Cortex** option as shown in ***Figure 35***.

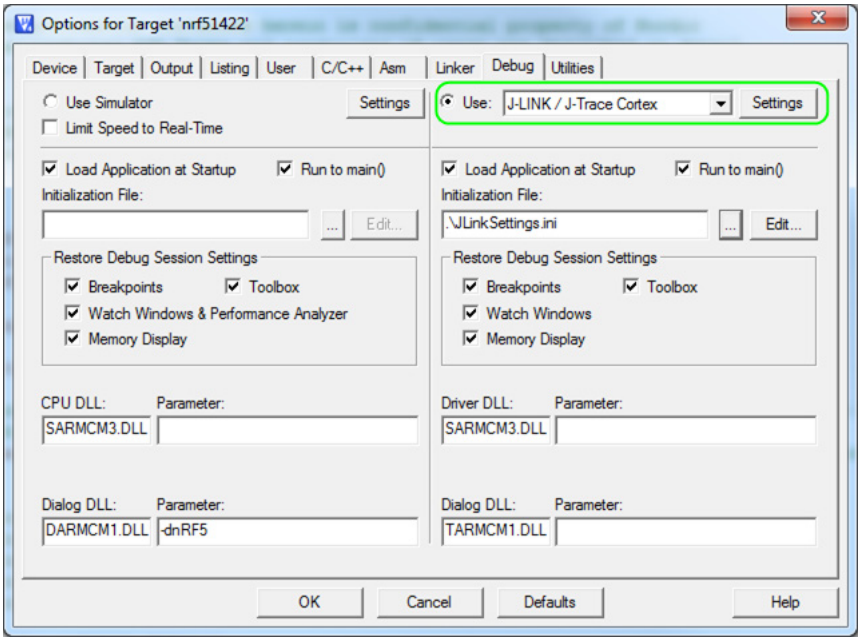



***Figure 35*** *Selecting JLink debugger in Keil*

4. Click the **Settings** button shown in ***Figure 35.*** Both the SEGGER Control Panel and the Keil Target Driver Setup will open.

**Note:** If the SEGGER J-Link firmware requires an update, before the SEGGER Control Panel or Keil target Driver Setup open, you will be prompted with the message "A new firmware version is available for the connected emulator". In this case, click **OK**.

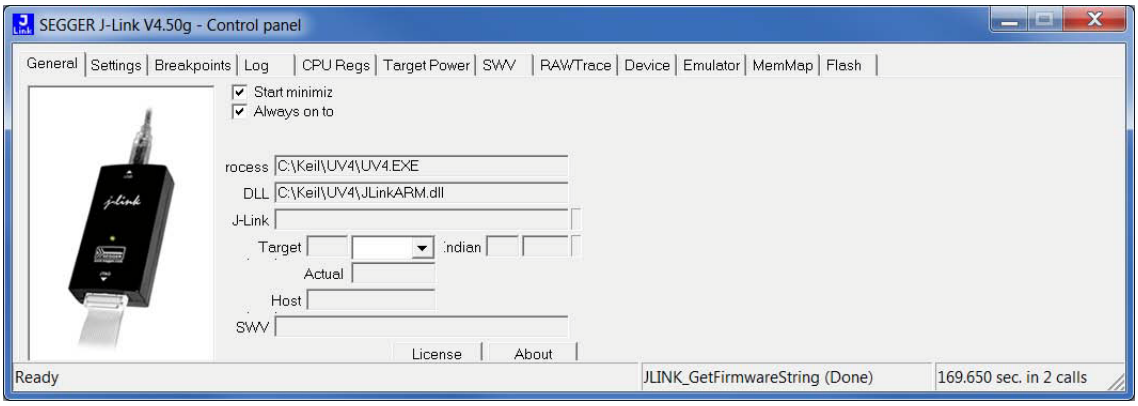



***Figure 36*** *SEGGER control panel*

5. Click the **Debug** tab shown in the figure. Set Port to **SW** and Max Clock to **1 MHz**, as shown in ***Figure 37***. Make sure that SN and IDCODE are populated properly and click **OK**.

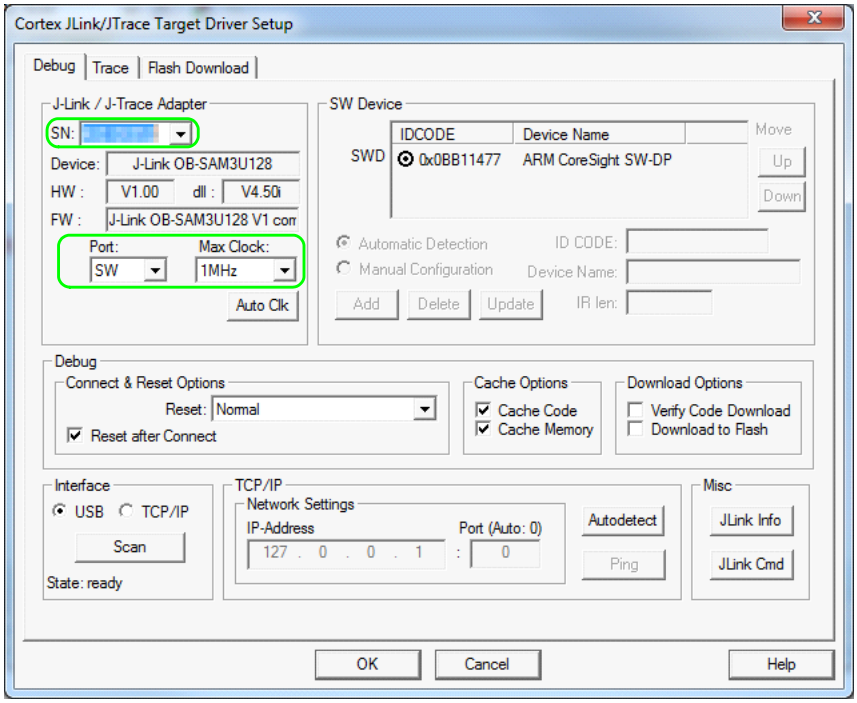



***Figure 37*** *Debug settings*

6. Click the **Flash Download** tab shown in the figure below. Make sure **Erase Sectors** is selected, and that **Program** and **Verify** are checked. Furthermore, add the appropriate Programming Algorithm as shown in the figure.

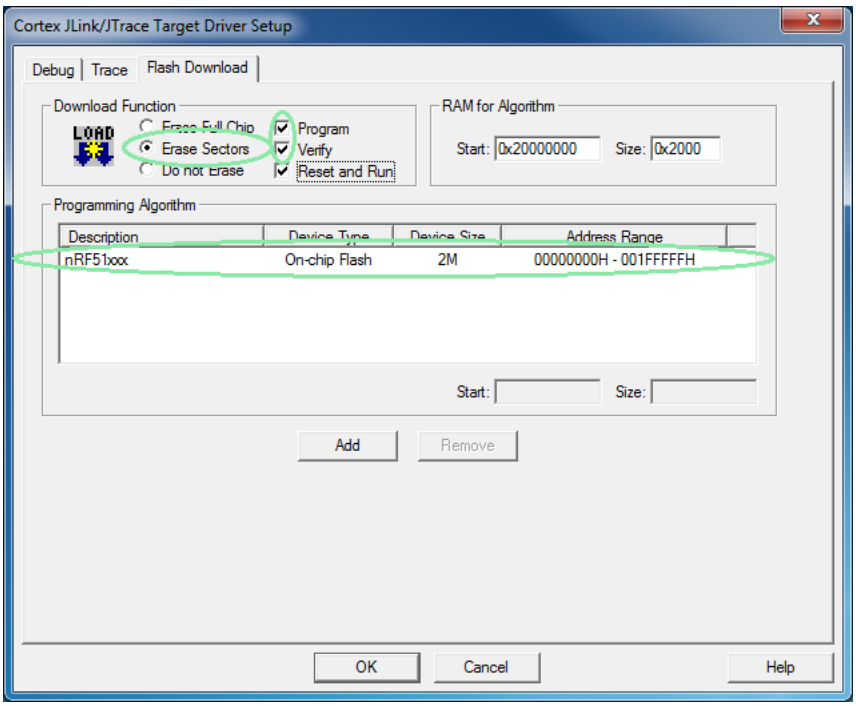



***Figure 38*** *Flash settings*

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## Revision history

| Date | Version | Description |
|---|---|---|
| October 2015 | 3.0 | Updated to match hardware rev. 3.0, where the NFC module is removed. |
| March 2014 | 2.0 | Updated to match hardware rev. 2.0. |
| December 2012 | 1.1 | Updated brand names to reflect their respective branding guidelines. |
| December 2012 | 1.0 | First release. |

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