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# nRF52840 Preview Development Kit v0.11.x

**User Guide**

v1.2

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# Revision history

Date	Version	Description
January 2018	1.2	Updated to match PDK v0.11.x
February 2017	1.1	Updated: <ul style="list-style-type: none"><li>• <a href="#">Swapping interface MCU firmware</a> on page 14</li><li>• <a href="#">MSD</a> on page 15</li></ul>
December 2016	1.0	First release

# 1 Introduction

The nRF52840 Preview Development Kit (DK) includes hardware, firmware source code, documentation, hardware schematics, and layout files.

## nRF52840 Preview Development Kit Product Brief

The key features of the development kit are:

- nRF52840 flash-based ANT™/ANT+™, Bluetooth® Low Energy SoC solution
- Buttons and LEDs for user interaction
- I/O interface for Arduino form factor plug-in modules
- SEGGER J-Link OB Debugger with debug out functionality
- UART interface through virtual COM port
- USB
- Flash memory
- Drag-and-drop mass storage device (MSD) programming
- Supporting NFC-A listen mode
- Mbed Enabled

For access to firmware source code, hardware schematics, and layout files, see [www.nordicsemi.com](http://www.nordicsemi.com).



### Environmental Protection

Waste electrical products should not be disposed of with household waste.

Please recycle where facilities exist. Check with your local authority or retailer for recycling advice.

# 2 Minimum requirements

Before you start, check that you have the required hardware and software.

## Hardware requirements

- Personal computer (PC) or Mac
- Micro-USB 2.0 cable

## Software requirements

- Operating system: Windows 7, Windows 8, Windows 10, MacOS, or Linux
- SEGGER J-Link Software



# 3 Kit content

The nRF52840 Preview DK consists of hardware, access to software components, reference design files, and documentation.

## 3.1 Hardware content

The nRF52840 Preview Development Kit (DK) contains the development kit board PCA10056 and an NFC antenna.

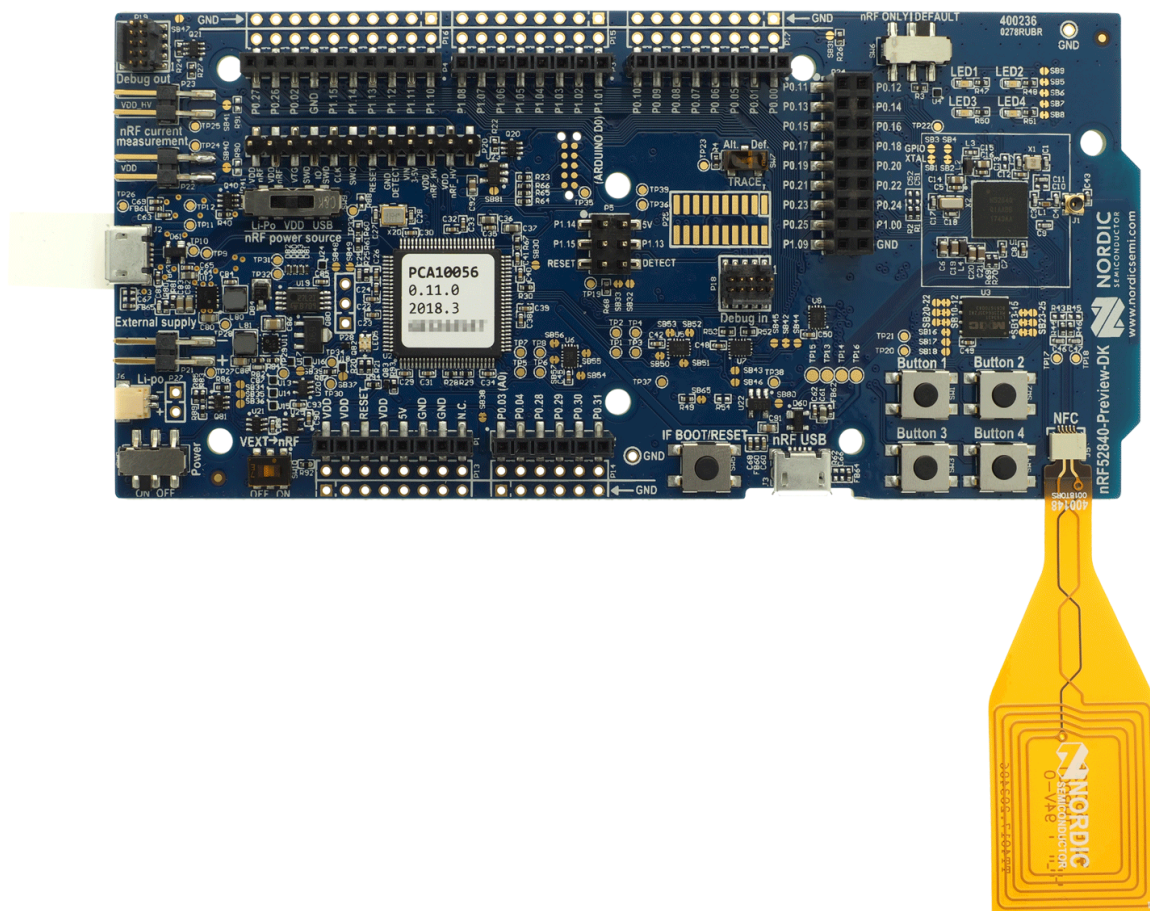


Figure 1: nRF52840 Preview DK board (PCA10056) and NFC antenna

## 3.2 Downloadable content

The nRF52840 Preview DK downloadable content includes the hardware files.

- In the [nRF5 SDK](#), you can find precompiled application firmware examples.

### Hardware files

Schematics, layout, bill of materials, and Gerber files for nRF52840 Preview DK are included in a zip file.

- [nRF52840 Preview DK hardware files](#)



## 3.3 Related documentation

In addition to the information in this document, you may need to consult other documents.

### **Nordic documentation**

- [nRF52840 Objective Product Specification](#)
- [nRF52840 Compatibility Matrix](#)
- [nRF52840 Errata](#)

# 4 Getting started

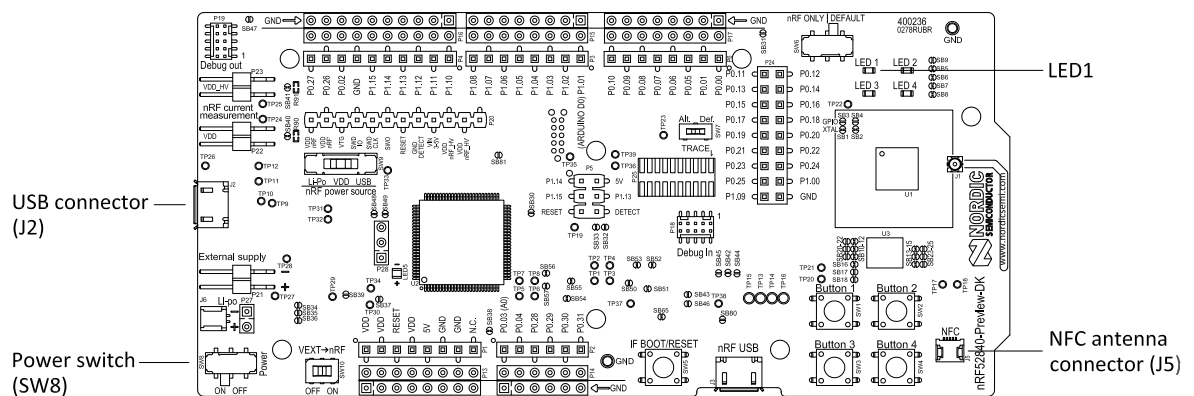
Before you start developing, complete a few steps to set up the hardware and download the required software.

Before you start:

- Unpack the kit.
- Check [Minimum requirements](#) on page 6.

Follow the steps below to set up your kit:

1. Connect the NFC antenna to the connector marked **NFC**.



2. To power up the board:
  - a) Connect a micro-USB 2.0 cable to the USB connector **J2** on the nRF52840 Preview DK and the other end to one of your PC's USB host port.  
In addition to providing power to the board, the USB connection supports target programming.
  - b) Slide the power switch **SW8** to the ON position.

A pop-up may appear. You can ignore it.

Check that **LED1** has started pulsating. For more information, see [Buttons and LEDs](#) on page 28.

Open Windows Explorer to check that the nRF52840 Preview DK has appeared as a removable drive named "JLINK".

This allows you to program the chip on the board.

3. Set up the software following the instructions in [Nordic tools and downloads](#) in nRF5 Getting Started. The actual software required depends on your OS and development IDE.
4. To set up a connection between your smart phone and the PDK, enable NFC on your smart phone and bring your phone close to the PDK.

Your phone will prompt you to open [Getting started with the nRF52840 Development Kit](#). This page contains a link that makes it easy to install the nRF Toolbox mobile app.

# 5 Nordic tools and downloads

Once you have your kit set up you can start developing. Our software tools help you develop and test your device through all the steps in the software development cycle.

## Development IDE

Pick one of the IDEs with a compiler supported by Nordic:

IDE	Windows	Linux	OSX
<a href="#">MDK-ARM Keil <math>\mu</math>Vision</a>	Yes	No	No
<a href="#">GNU/GCC</a>	Yes	Yes	Yes
<a href="#">IAR</a>	Yes	No	No
<a href="#">SEGGER Embedded Studio (SES)</a>	Yes	Yes	Yes

## Essential tools

To program our devices you need to download these Nordic tools.

Tool	Description	Download	Documentat	Protocol
SDK - Software Development Kit	Application examples, source files, SoftDevices	<a href="#">Windows/Linux</a>	<a href="#">nRF5 SDK</a>	BLE/ANT
nRF5x Command Line Tools	Collection of command line tools, like nrfjprog, mergehex	<a href="#">nRF5x Tools Windows32</a> <a href="#">nRF5x Tools Linux32</a> <a href="#">nRF5x Tools Linux64</a> <a href="#">nRF5x Tools OSX</a>	<a href="#">nRF5x Command Line Tools</a>	BLE/ANT

## Optional tools

These tools are not essential, but we recommend that you use them.

Tool	Description	Download	Documentation	Protocol
<a href="#">nRFG Studio</a>	Programming and erasing chips	<a href="#">Windows32</a> <a href="#">Windows64</a>	Help file	BLE/ANT
SoftDevice	Wireless protocol stack library	Click the Download tab on: <a href="#">nRF52840 Product page</a> <a href="#">nRF52832 Product page</a> <a href="#">nRF51822 Product page</a> <a href="#">nRF51422 Product page</a>	<a href="#">nRF52 Series SDS</a> <a href="#">nRF51 Series SDS</a>	BLE/ANT
Master Control Panel	Peer device emulator for computers	<a href="#">Windows32</a> <a href="#">Windows64</a>	Help file	BLE
<a href="#">nRF Connect for desktop</a>	Peer device emulator for computers	<a href="#">nRF Connect for OS-X</a> <a href="#">nRF Connect for Ubuntu Linux</a> <a href="#">nRF Connect for Windows</a>	<a href="#">nRF Connect Bluetooth Low Energy</a>	BLE
<a href="#">nRF Connect for mobile</a>	Peer device emulator app for smartphones	<a href="#">Android v4.3 or later</a> <a href="#">IOS v8 or later</a>		BLE
<a href="#">Nordic nRF Toolbox app</a>	App that contains all the Nordic apps	<a href="#">Android v4.3 or later</a> <a href="#">IOS v8 or later</a> <a href="#">Windows Phone v8.1 or later</a>		BLE
nRF5x pynrfjprog	A simple Python interface for the nrfjprog DLL	<a href="#">nRF5x pynrfjprog</a>	<a href="#">nRF5x pynrfjprog</a>	BLE/ANT
ANTware II	Peer device emulator for the ANT protocol running on computers	<a href="#">ANTware II</a>	<a href="#">ANTware II</a>	ANT
<a href="#">nRF Sniffer</a>	Monitors on-air traffic	<a href="#">nRF Sniffer download</a>	<a href="#">nRF Sniffer</a>	BLE

See also [Nordic mobile apps](#) for a list of available *Bluetooth* Low Energy mobile apps for iOS, Android and Windows Phones.

# 6 Start developing

After you have set up the development kit and installed the toolchain, it is time to start developing.

There are several ways to continue from here. For more information, see the following nRF5 SDK instructions :

- [Running precompiled examples](#)

See how you can quickly test a precompiled example without having to use the full toolchain, it is a matter of copying and pasting a precompiled HEX file onto your development kit board.

- [Compiling and running a first example](#)

Test that you have set up your toolchain correctly by compiling, programming and running a very simple example.

- [Running examples that use a SoftDevice](#)

Before you can run more advanced examples that use *Bluetooth* or ANT, you must first program the SoftDevice on the board.

# 7 Interface MCU

The interface MCU on the nRF52840 Preview Development Kit (DK) board can run either SEGGER J-Link OB or mbed OB interface firmware and is used to program and debug the firmware of the nRF52840 SoC.

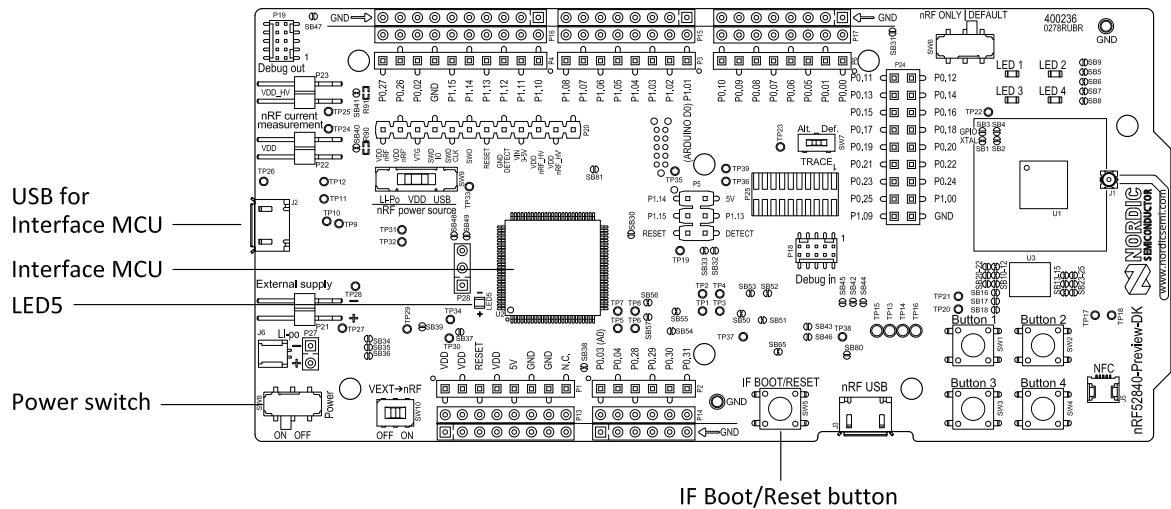


Figure 2: Interface MCU

## 7.1 IF Boot/Reset button

The nRF52840 Preview DK board is equipped with an IF Boot/Reset button (**SW5**).

This button is connected to the interface MCU on the board and has two functions:

- Resetting the nRF52840 SoC.
- Entering bootloader mode of the interface MCU.

During normal operation the button will function as a reset button for the nRF52840 SoC. For this to work, pin reset on **P0.18** needs to be enabled in the SoC.

The button is also used to enter the bootloader mode of the interface MCU. To enter the bootloader mode, keep the reset button pressed while powering up the board until **LED5** starts to blink. You can power up the board either by disconnecting and reconnecting the USB cable or by toggling the power switch (**SW8**).

**Note:** Pin reset can be enabled by defining the `CONFIG_GPIO_AS_PINRESET` variable in the project settings. This can be done, for example, by defining the preprocessor symbol in Keil. Go to **Project > Options for Target > C/C++ > Preprocessor Symbols > Define** and add the `CONFIG_GPIO_AS_PINRESET` variable after `NRF52840_XXAA`.

This functionality can be removed by using `nrfjprog.exe` with arguments `--recover -f NRF52`.

## 7.2 Virtual COM port

The onboard interface MCU features a UART interface through a virtual COM port.

The virtual COM port has the following features:



- Flexible baud rate setting up to 1 Mbps.<sup>1</sup>
- Dynamic hardware flow control (HWFC) handling.
- Tri-stated UART lines when no terminal is connected.

The table below shows an overview of the UART connections on nRF52840 and the interface MCU.

GPIO nRF52840	nRF52840 UART
P0.05	RTS
P0.06	TXD
P0.07	CTS
P0.08	RXD

Table 1: Relationship of UART connections on nRF52840 and interface MCU

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

**Note:** The terminal software used must send a DTR signal to configure the UART interface MCU pins.

The **P0.05** (RTS) and **P0.07** (CTS) can be used freely when HWFC is disabled on the SoC.

**Note:** The mbed OB interface does not support HWFC through the virtual COM port.

### 7.2.1 Dynamic HWFC handling

When the interface MCU receives a DTR signal from a terminal, it performs automatic hardware flow control (HWFC) detection.

Automatic HWFC detection is done by driving **P0.07** (CTS) from the interface MCU and evaluating the state of **P0.05** (RTS) when the first data is sent or received. If the state of **P0.05** (RTS) is high, HWFC is assumed not to be used. If HWFC is not detected, both CTS and RTS can be used freely by the nRF application.

After a power-on reset of the interface MCU, all UART lines are tri-stated when no terminal is connected to the virtual COM port. Due to the dynamic HWFC handling, if HWFC has been used and detected, **P0.07** (CTS) will be driven by the interface MCU until a power-on reset has been performed or until a new DTR signal is received and the detection is redone.

To ensure that the UART lines are not affected by the interface MCU, the solder bridges for these signals can be cut and later resoldered if needed. This might be necessary if UART without HWFC is needed while **P0.05** (RTS) and **P0.07** (CTS) are used for other purposes.

## 7.3 Swapping interface MCU firmware

The onboard interface MCU is factory-programmed with an mbed-compliant bootloader. This feature makes it possible to swap the interface firmware between the factory-preloaded SEGGER J-Link OB and the mbed interface firmware.

1. Download the mbed interface firmware and the J-Link OB image from [www.nordicsemi.com](http://www.nordicsemi.com).
2. Enter the bootloader.

<sup>1</sup> Baud rate 921 600 is not supported through the virtual COM port.

See section [IF Boot/Reset button](#) on page 13 on how to enter the bootloader.

3. To swap the interface MCU firmware, drag the interface image (.bin) into the mounted bootloader drive on the connected computer.
4. Power cycle the board.

**Note:**

- The J-Link serial number is linked to the interface MCU and will not change even when swapping the interface MCU firmware.
- When in bootloader mode, do not drag and drop any files except those downloaded from [www.nordicsemi.com](http://www.nordicsemi.com) for use with the interface MCU. If a wrong file is used, it can overwrite the bootloader and ruin the interface MCU firmware without the possibility of recovery.

## 7.4 MSD

The interface MCU features a mass storage device (MSD). This makes the development kit appear as an external drive on your computer.

This drive can be used for drag-and-drop programming. However, files cannot be stored on this drive. By copying a HEX file to the drive, the interface MCU will program the file to the device.

**Note:**

- Windows might try to defragment the MSD part of the interface MCU. If this happens, the interface MCU will disconnect and be unresponsive. To return to normal operation, the development kit must be power cycled.
- Your antivirus software might try to scan the MSD part of the interface MCU. Some antivirus programs trigger a false positive alert in one of the files and quarantine the unit. If this happens, the interface MCU will become unresponsive.
- If the computer is set up to boot from USB, it can try to boot from the development kit if the development kit is connected during boot. This can be avoided by unplugging the development kit before a computer restart, or changing the boot sequence of the computer.

You can also disable the MSD of the kit by using the **msddisable** command in J-Link Commander. To enable, use the **msdenable** command. These commands take effect after a power cycle of the development kit and stay this way until changed again.

# 8 Hardware description

The nRF52840 Preview Development Kit (DK) board PCA10056 can be used as a development platform for the nRF52840 SoC. It features an onboard programming and debugging solution.

In addition to radio communication, the nRF52840 SoC can communicate with a computer through USB and a virtual COM port provided by the interface MCU.

## 8.1 Hardware drawings

nRF52840 Preview DK hardware drawings show both sides of the PCA10056 board.

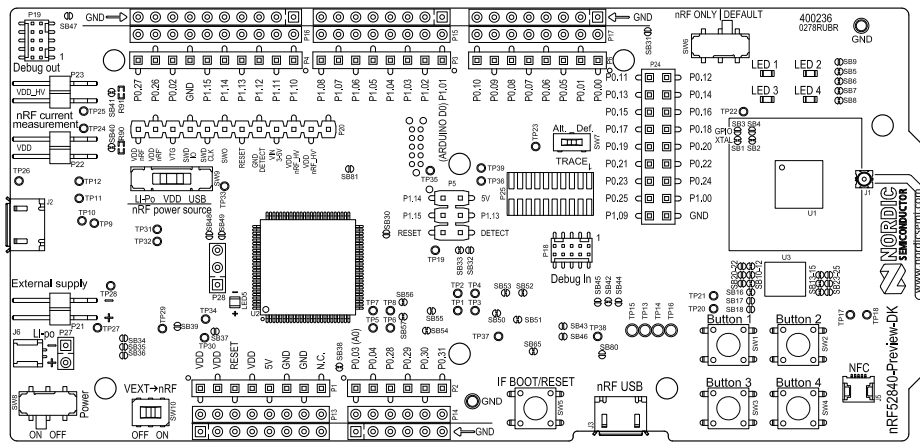


Figure 3: nRF52840 Preview DK board front view

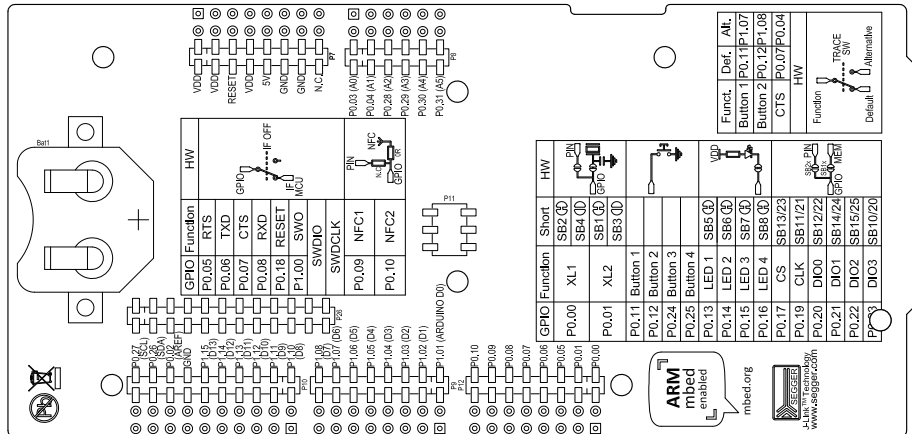


Figure 4: nRF52840 Preview DK board back view

## 8.2 Block diagram

The nRF52840 Preview DK block diagram shows the connections between the different blocks.

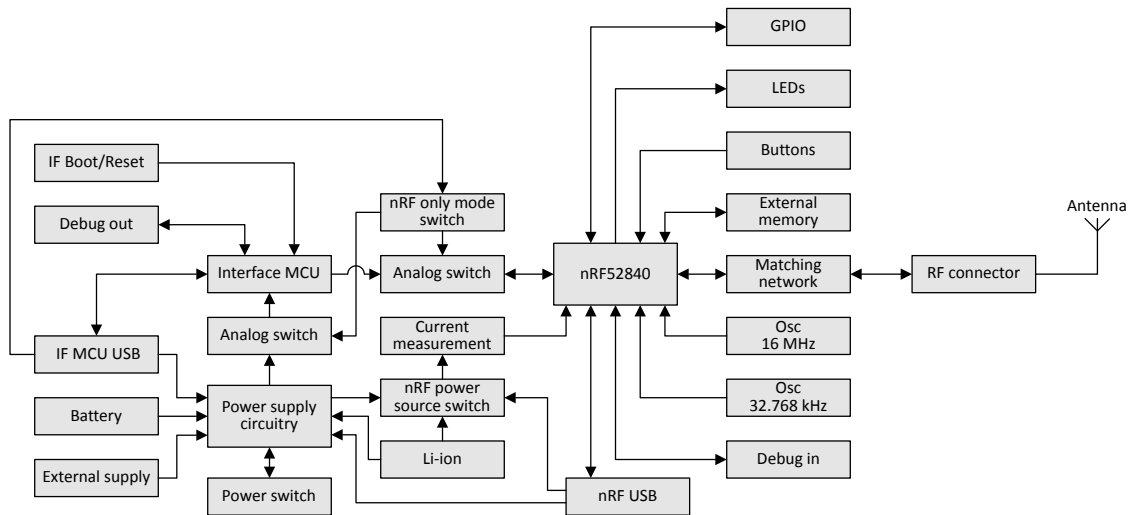


Figure 5: nRF52840 Preview DK block diagram

### 8.3 Power supply

The nRF52840 Preview DK board has multiple power options.

The power options are:

- USB connector **J2** for the interface MCU (5 V)
- USB connector **J3** for the nRF52840 (5 V)
- Lithium polymer (Li-Po) battery connectors **J6** or **P27** (2.5–5.0 V)
- VIN 3–5 pin on **P20** (3.0–5.0 V)
- External supply on **P21** (1.7–3.6 V)
- Coin cell battery

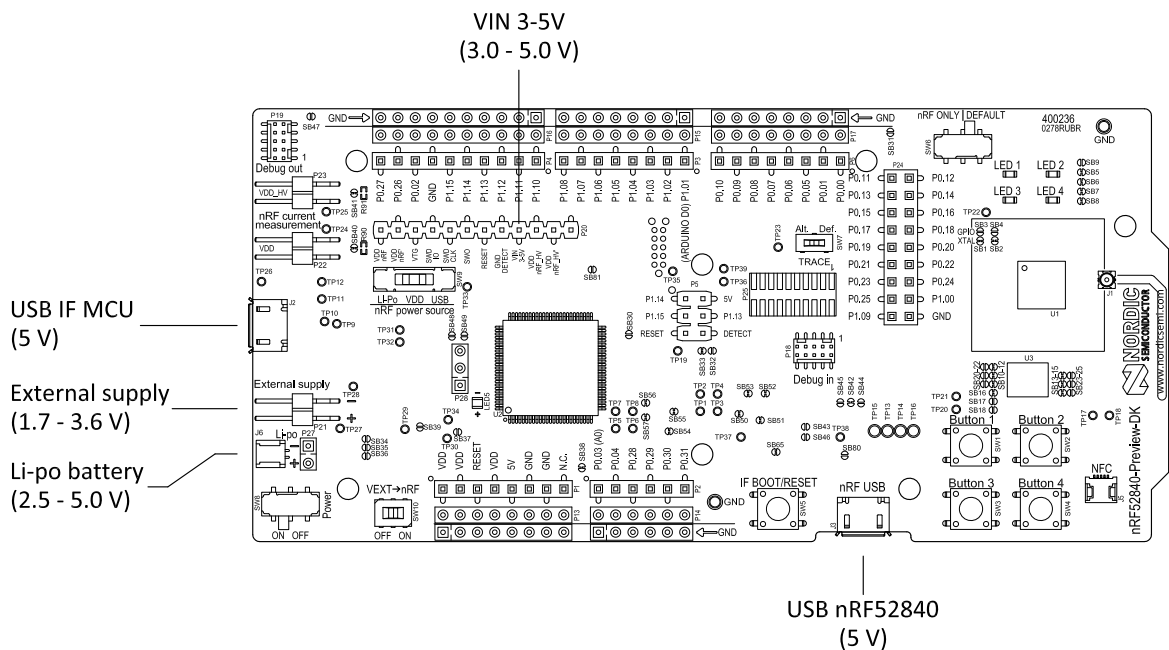


Figure 6: Power supply options (board front)

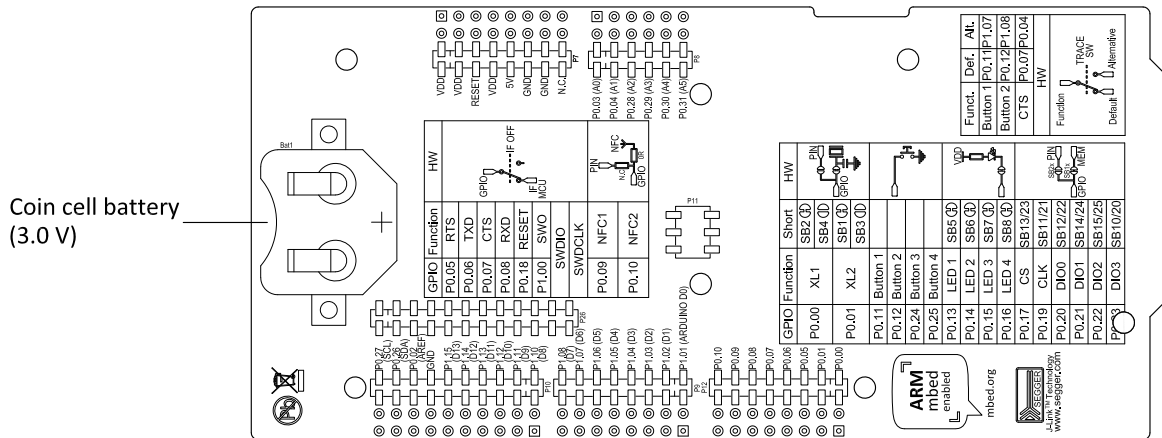


Figure 7: Power supply options (board back)

### 8.3.1 5 V power sources

The nRF52840 Preview DK board has a 5 V boost regulator.

It gives a stable 5 V output from four possible sources:

- USB connector **J2** for the interface MCU
- USB connector **J3** for the nRF52840
- Li-Po polymer battery connectors (**J6** or **P27**)
- VIN 3–5 V pin on **P20**

Each of these sources has a reverse protection diode to prevent current flowing in the wrong direction if multiple sources are connected at the same time.

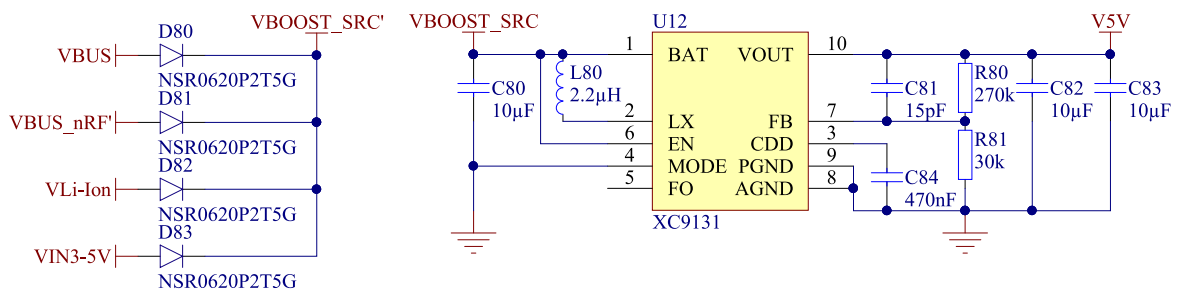


Figure 8: 5 V regulator and protecting diodes

### 8.3.2 VDD power sources

The main board supply (VDD) can be sourced from the 5 V domain, external power supply, and coin cell battery.

For the 5 V domain, there are two regulators, one fixed 3 V buck regulator and one voltage follower regulator that follows the VDD\_nRF voltage. The coin cell battery and external power supply are not regulated.

- 5 V domain:
  - Fixed 3 V buck regulator
  - VDD\_nRF voltage follower
- External power supply
- Coin cell battery

For more information about power sources, see section [nRF52840 power source](#) on page 21.

The power sources are routed through a set of load switches, which is controlled by logic to give the correct priority of the power sources.

If the high voltage regulator of the nRF52840 is used, the board will be supplied from the VDD\_nRF voltage follower regardless of the state of the other power sources.

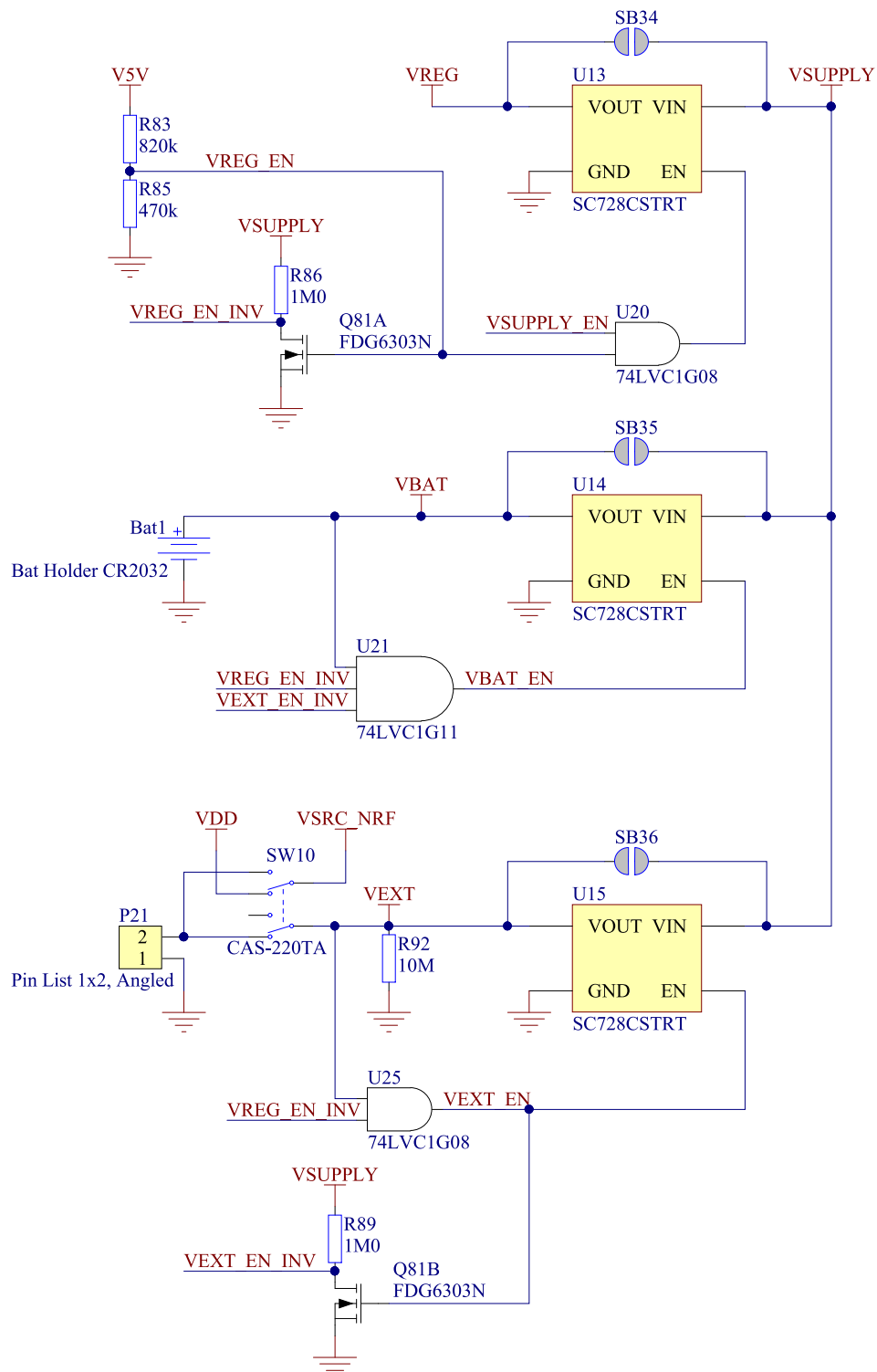


Figure 9: Power supply circuitry

The power switches work in the way that the body diode of the internal transistor powers the VSUPPLY net, which supplies the gates controlling the enable signal of the switches. If 5 V is present, the switches



for external supply and battery are disabled. If external supply is present, the switch for the battery is disabled.

The power switches can be bypassed by shorting one or more solder bridges.

Power source	Power switch bypass	Voltage level
Regulator	SB34	3.0 V
Coin cell battery	SB35	Battery
External supply	SB36	1.7 V–3.6 V

Table 2: Power switch bypass solder bridges

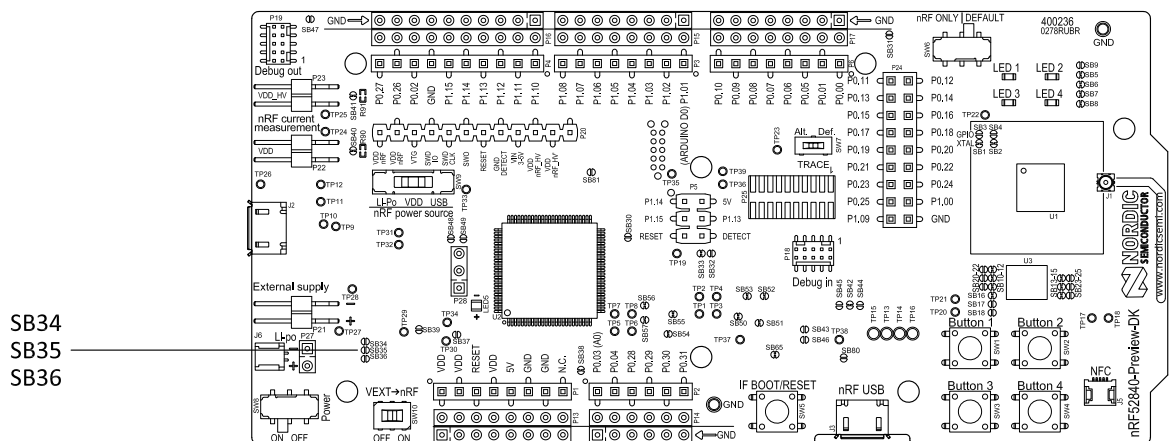


Figure 10: Power switch bypass solder bridges

**Note:** Connect only one power source at a time. Shorting the solder bridges removes the reverse voltage protection.

### 8.3.3 Interface MCU power

The power for the interface MCU is routed through two load switches, one for the VDD supply and one for the USB supply. This makes it possible to disconnect the interface MCU from the power domain when not in use.

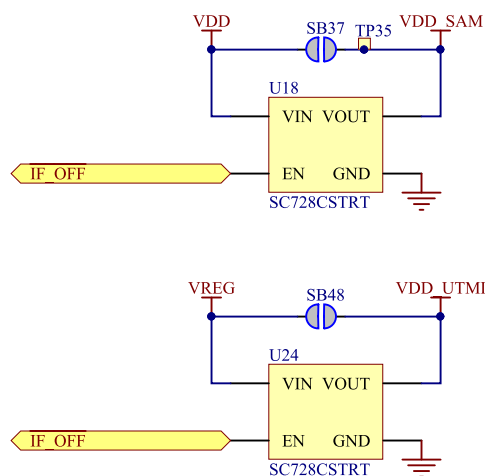


Figure 11: Interface MCU power switch

These switches are controlled by the presence of a USB connected to the interface MCU USB connector (**J2**), and the state of the nRF only switch (**SW6**). See section [Operating modes](#) on page 22 for more information.

### 8.3.4 nRF52840 power source

The nRF52840 Preview DK board has a power source switch (**SW9**) for selecting between three power sources for the nRF52840 SoC.

The three positions of the switch are:

- VDD (default)
- Li-Po
- USB

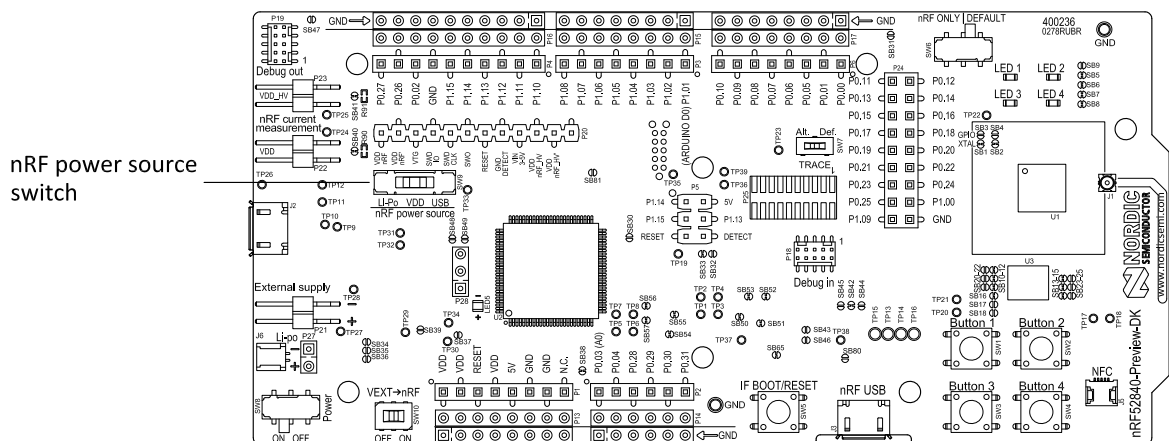


Figure 12: nRF52840 power source switch

The nRF52840 SoC has a high voltage buck regulator that can support up to 5 V input. In the VDD position, the SoC is powered either from the on-board buck regulator, coin cell battery, or external supply (**P21**). In the Li-Po position, the high voltage regulator of the SoC is supplied directly from the Li-Po battery connectors (**J6** or **P27**). In the USB position, the USB high voltage regulator gets power from the nRF52840 USB connector (**J3**).

When the high voltage regulator is used, the VDD\_nRF voltage can be set by the firmware of the SoC. To make sure the rest of the board has the same voltage level, the VDD of the board is sourced by a regulator following the VDD\_nRF voltage when the high voltage regulator is used.

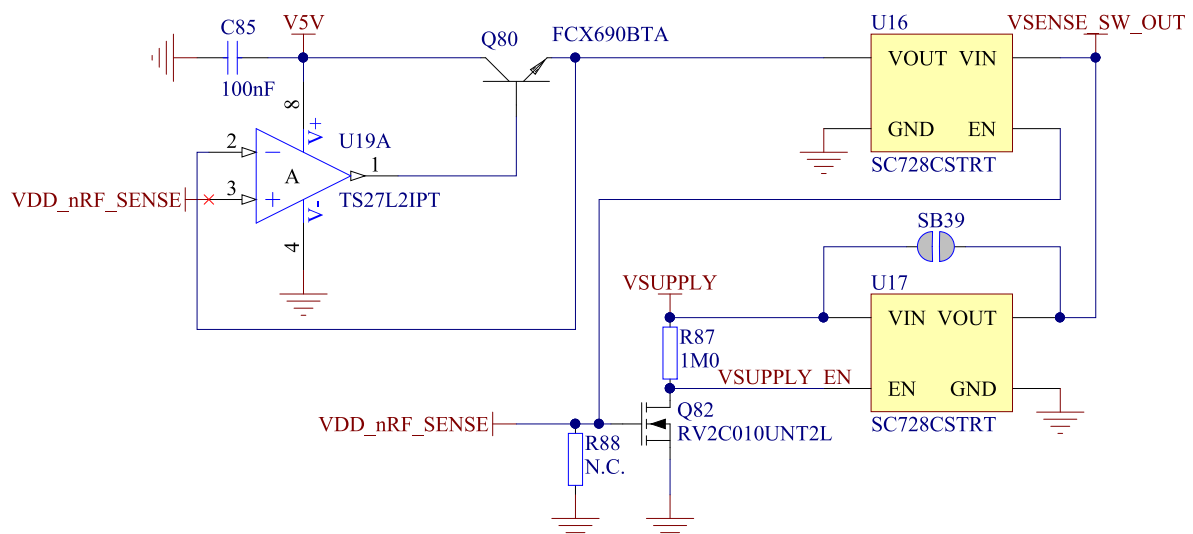


Figure 13: VDD\_nRF voltage follower and switch

To make sure that the nRF52840 is not powered when the nRF power switch (**SW8**) is OFF, two load switches are used, one for the high voltage regulator (**U23**) and one for the USB supply (**U22**). These switches are controlled by VDD.

### 8.3.5 nRF52840 direct supply

It is possible to power the SoC directly from a source without powering the rest of the board from the same source.

The external source can be connected to the external supply connector (**P21**) and the VEXT->nRF switch (**SW10**) put in the ON position. The nRF power source switch (**SW9**) must be in the VDD position, and the allowed voltage range is 1.7–3.6 V.

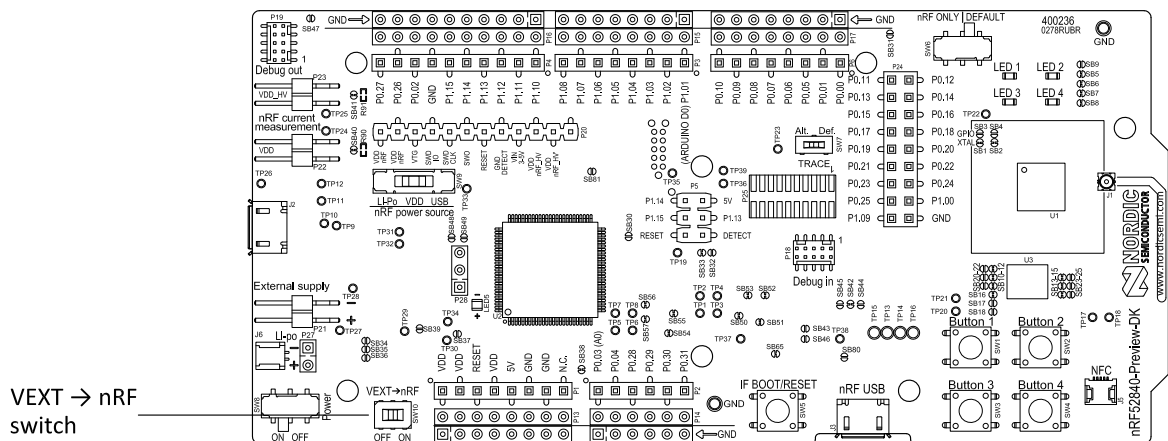


Figure 14: VEXT->nRF switch (SW10)

Since it is only the nRF52840 SoC that is supplied from this source, it is recommended to supply the VDD domain from a different source (coin cell battery or USB) to prevent the pins of the SoC to be connected to unpowered devices. To prevent leakage due to voltage differences, the board should be set in the nRF only mode, see section [Operating modes](#) on page 22.

**Note:** To reduce trace length and parasitic components, the external memory is connected to the SoC directly instead of using analog switches. It is recommended to cut solder bridges to avoid leakage, see section [External memory](#) on page 25.

## 8.4 Operating modes

The nRF52840 Preview DK board has various modes of operation.

### 8.4.1 USB detect

To detect when USB for the interface MCU is connected, there is a circuit sensing the VBUS of USB connector **J2**.

When the USB cable is connected, the VDD is propagated to the USB\_DETECT signal.

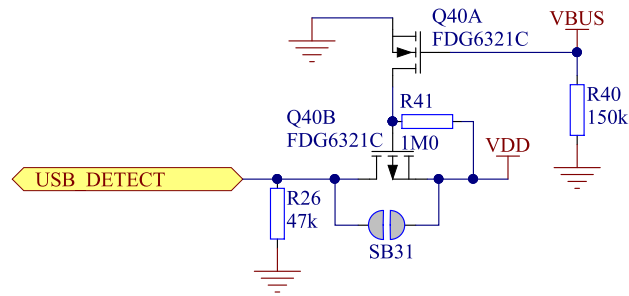


Figure 15: USB detect

### 8.4.2 nRF only mode

The nRF only mode disconnects the interface MCU and LEDs from the SoC using analog switches.

This is done to isolate the chip on the board as much as possible, and can be of use when measuring currents on low-power applications.

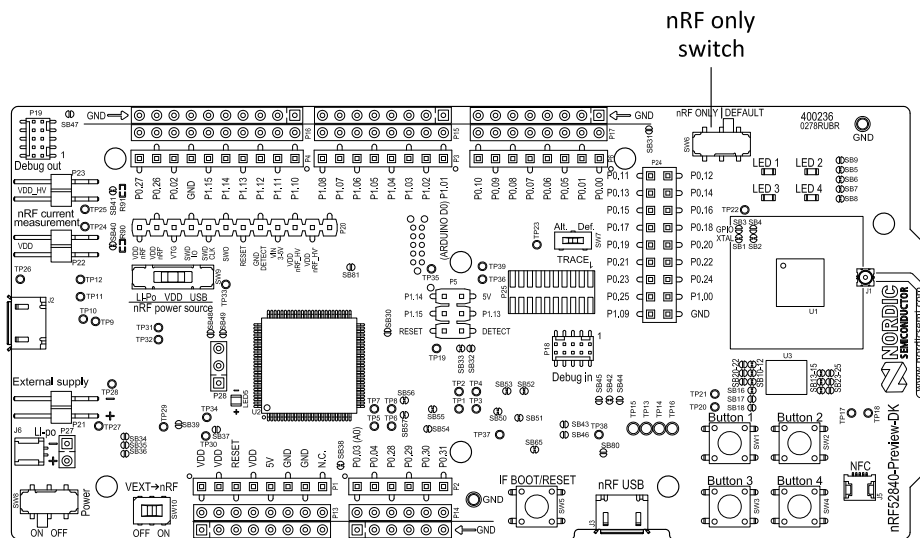


Figure 16: nRF only switch (SW6)

### 8.4.3 Signal switches

On the nRF52840 Preview DK board, there are multiple analog switches that are used to connect and disconnect signals based on different scenarios.

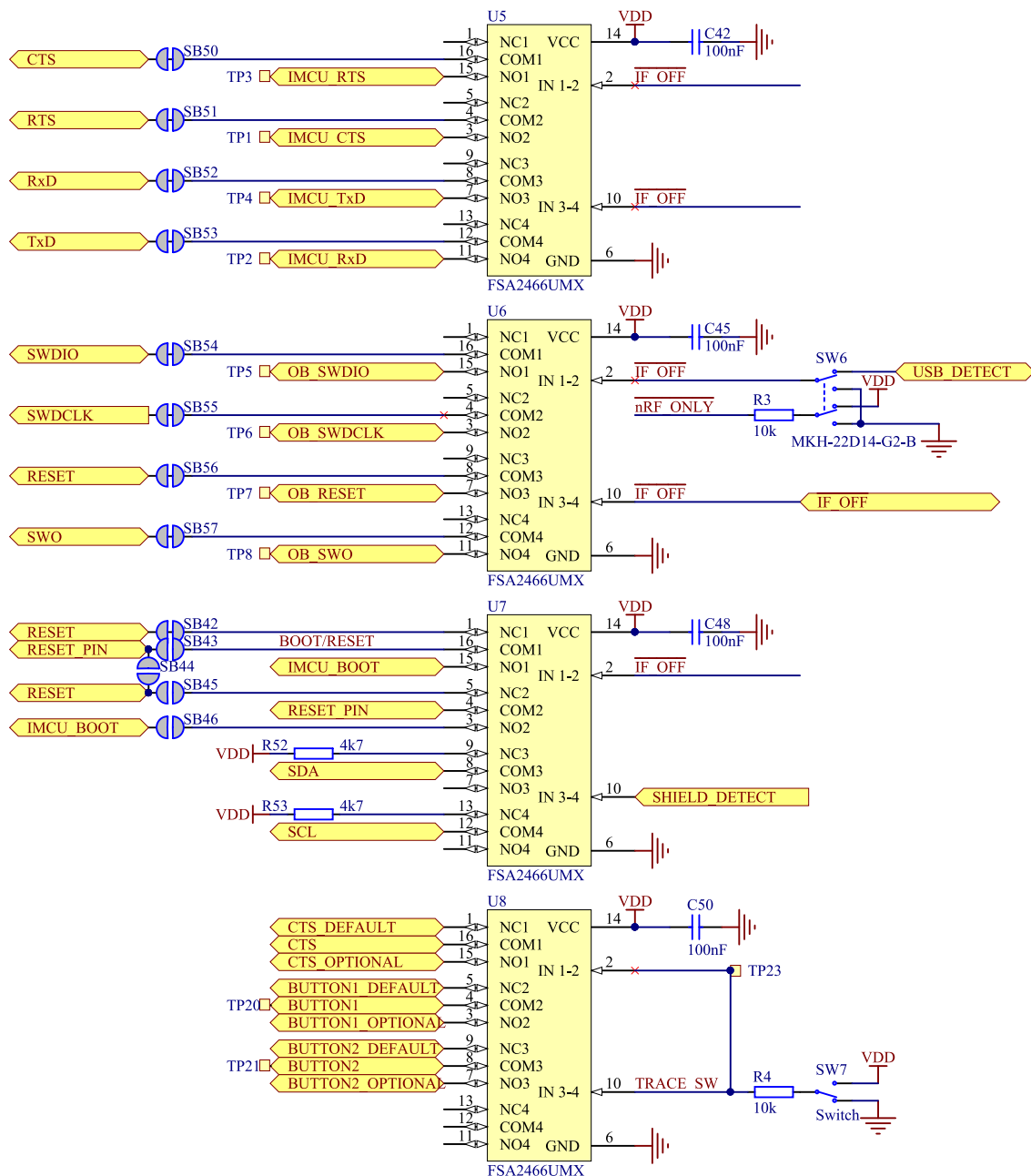


Figure 17: Signal switches

The USB and **SW6** control the signal switches by using USB\_DETECT as an input to **SW6**. Therefore, the interface MCU can be disconnected either by unplugging the USB cable in **J2** or by toggling **SW6**.

The signal controls a set of switches (**U5**, **U6**, **U7**) that break the connection between the nRF52840 and the interface MCU, and control the power for the interface MCU. For more information, see section [Interface MCU power](#) on page 20.

Switches **U5** and **U6** break the connection of the UART lines and SWD/RESET lines. In addition, the signal controls the routing of the RESET signal depending on user preference when the interface MCU is connected/disconnected.

- When the interface MCU is disconnected, cutting **SB42** will disconnect the IF Boot/Reset button from the reset pin (**P0.18**) of nRF52840.
- When the interface MCU is disconnected, shorting **SB45** will connect the RESET pin in the Arduino interface to the reset pin (**P0.18**) of nRF52840.

- When the interface MCU is connected, shorting **SB46** will connect the RESET pin in the Arduino interface to the BOOT input of the interface MCU.
- Shorting **SB43** will connect the RESET pin in the Arduino interface to the IF Boot/Reset button.
- Shorting **SB44** will connect the RESET pin in the Arduino interface to the reset pin (**P0.18**) of nRF52840.

When a shield is connected, there are two analog switches connecting the pull-up resistors to the I2C bus lines (SDA and SCL). This function is using one ground pin on the Arduino shield to control the switch. This feature can be disabled by cutting **SB33**. To permanently enable pull-up resistors, short **SB32**.

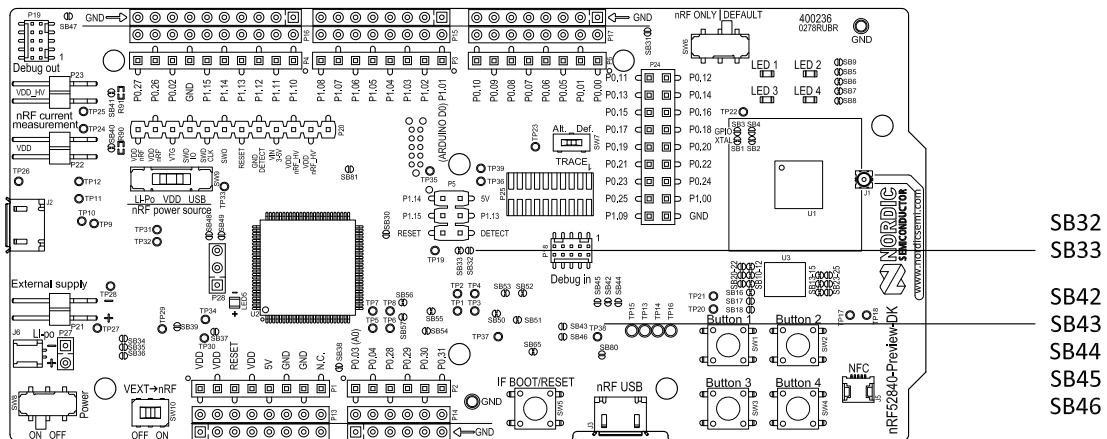


Figure 18: Solder bridges: Shield detect and reset behavior

The last switch (**U8**) controls which GPIOs certain signals are routed to. This is due to some features using the same GPIOs as the Trace output by default. These analog switches are controlled by **SW7**. See chapter [Debug input and trace](#) on page 34 for more information.

## 8.5 External memory

The nRF52840 Preview DK board has a 64 Mb external flash memory. The memory is a multi-I/O memory supporting both regular SPI and Quad SPI.

The memory is connected to the chip using the following GPIOs:

GPIO	Flash memory pin	Solder bridge for memory use (default: shorted)	Solder bridge for GPIO use (default: open)
P0.17	CS	SB13	SB23
P0.19	SCLK	SB11	SB21
P0.20	SIO_0/SI	SB12	SB22
P0.21	SIO_1/SO	SB14	SB24
P0.22	SIO_2/WP	SB15	SB25
P0.23	SIO_3/HOLD	SB10	SB20

Table 3: Flash memory GPIO usage and connecting solder bridges

To use the GPIOs for a purpose other than the onboard external memory and have them available on the **P24** connector, six solder bridges (**SB10–SB15**) must be cut and six solder bridges (**SB20–SB25**) must be shorted. See [Figure 19: Configuring GPIOs for external memory](#) on page 26 for details.