

# nRF5340 DK Hardware v1.0.0

User Guide



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# Revision history

Date	Description
2020-12-03	First release

# 1 Introduction

The nRF5340 DK is a hardware development platform used to design and develop application firmware on the nRF5340 *System on Chip (SoC)*.

The key features of the *Development Kit (DK)* are:

- nRF5340 *SoC*
- Support for the following wireless protocols:
  - Bluetooth® Low Energy
  - NFC
  - 802.15.4
  - Thread
  - Zigbee
  - ANT™
  - 2.4 GHz proprietary
- Arduino Rev3 compatibility
- 2.4 GHz and NFC antennas
- SWF RF connector for direct RF measurements
- User-programmable LEDs (4) and buttons (4)
- SEGGER J-Link OB programmer/debugger
- Pins for measuring power consumption
- Drag-and-drop *Mass Storage Device (MSD)* programming
- 1.7-5.0 V power supply from USB, external Li-Po battery, or CR2032 coin cell battery

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

**Note:** The nRF5340 DK shall be powered by a PS1 class power supply (maximum power less than 15 W).



## 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.

The nRF5340 DK is intended for use only by skilled persons.

Skilled person: Person with relevant education or experience to enable him or her to identify hazards and to take appropriate actions to reduce the risks of injury to themselves and others.



# 2 Kit content

The nRF5340 DK includes hardware, preprogrammed firmware, documentation, hardware schematics, and layout files.

The nRF5340 DK (PCA10095) comes with a *Near Field Communication (NFC)* antenna.

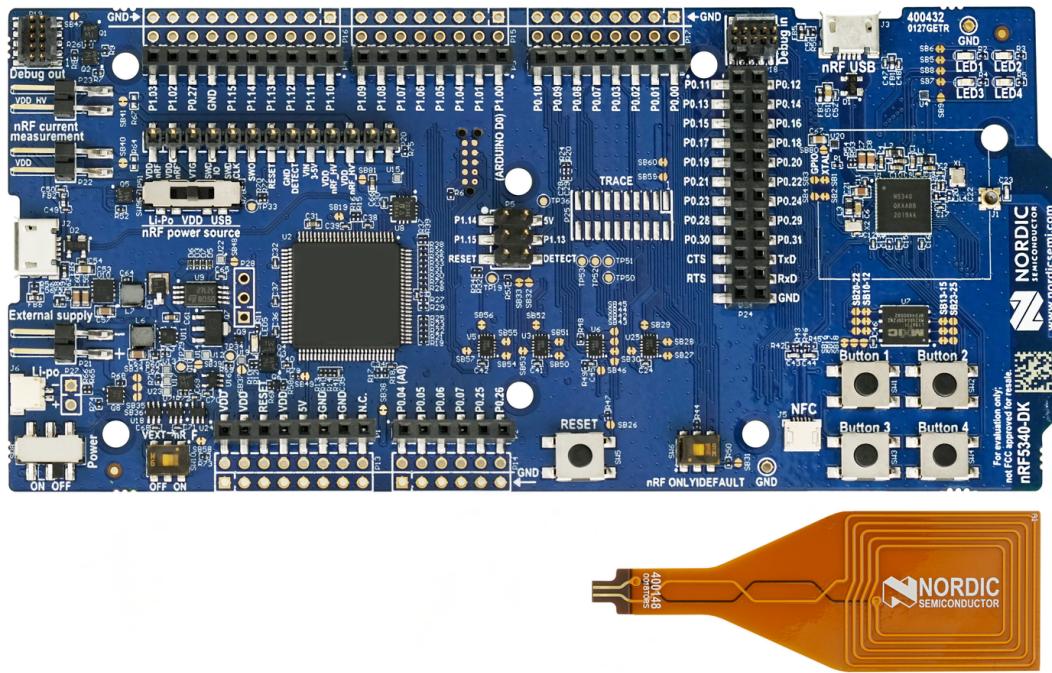


Figure 1: nRF5340 DK (PCA10095) and NFC antenna

## Hardware files

The hardware design files including schematics, PCB layout files, bill of materials, and Gerber files for the nRF5340 DK are available on the [nRF5340 product page](#).

# 3 Interface MCU

The interface MCU on the nRF5340 DK runs SEGGER J-Link OB interface firmware and is used to program and debug the firmware of the nRF5340 SoC.

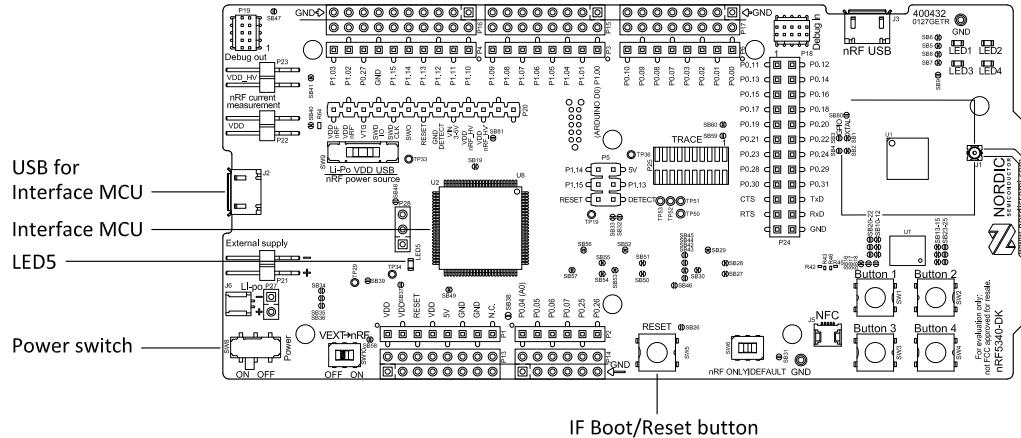


Figure 2: Interface MCU

## 3.1 IF Boot/Reset button

The nRF5340 DK is equipped with an IF Boot/Reset button (**SW5**).

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

- Resetting the nRF5340 SoC.
- Entering bootloader mode of the interface MCU.

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 *DK* until **LED5** starts to blink. You can power up the *DK* either by disconnecting and reconnecting the USB cable or by toggling the power switch (**SW8**).

## 3.2 Virtual COM port

The onboard interface MCU features a *Universal Asynchronous Receiver/Transmitter (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 following table shows an overview of the *UART* connections on nRF5340 SoC and the interface MCU.

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

GPIO nRF5340	nRF5340 UART
P0.19	RTS
P0.20	TXD
P0.21	CTS
P0.22	RXD

Table 1: Relationship of UART connections on nRF5340 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 *Data Terminal Ready (DTR)* signal to configure the *UART* interface MCU pins.

The **P0.19 (Request to Send (RTS))** and **P0.21 (Clear to Send (CTS))** can be used freely when *HWFC* is disabled on the *SoC*.

### 3.2.1 Dynamic HWFC handling

When the interface MCU receives a *DTR* signal from a terminal, it performs automatic *HWFC* detection.

Automatic *HWFC* detection is done by driving **P0.21 (CTS)** from the interface MCU and evaluating the state of **P0.19 (RTS)** when the first data is sent or received. If the state of **P0.19 (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, **P0.21 (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 **P0.19 (RTS)** and **P0.21 (CTS)** are used for other purposes.

## 3.3 MSD

The interface MCU features an *MSD*. This makes the *DK* 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 *DK* 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 *DK* if the *DK* is connected during boot. This can be avoided by unplugging the *DK* 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 *DK* and stay this way until changed again.

# 4 Hardware description

The nRF5340 DK (PCA10095) features an onboard programming and debugging solution.

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

## 4.1 Hardware drawings

nRF5340 DK hardware drawings show both sides of the PCA10095.

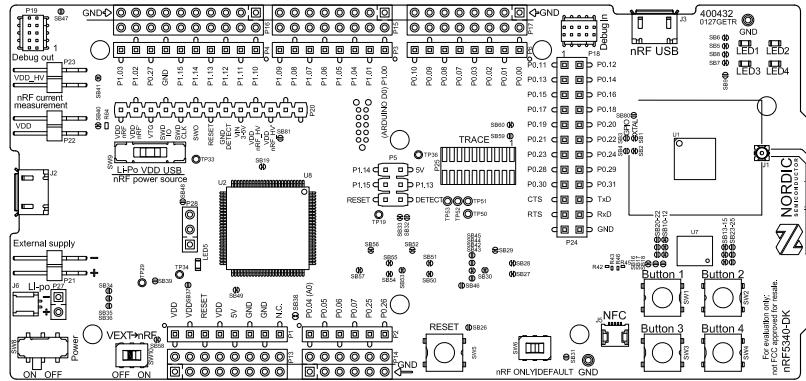


Figure 3: nRF5340 DK (PCA10095) front view

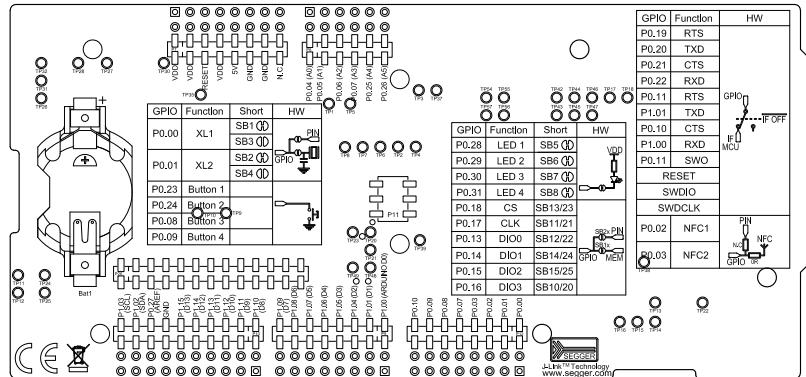


Figure 4: nRF5340 DK (PCA10095) back view

## 4.2 Block diagram

The nRF5340 DK block diagram shows the connections between the different blocks.

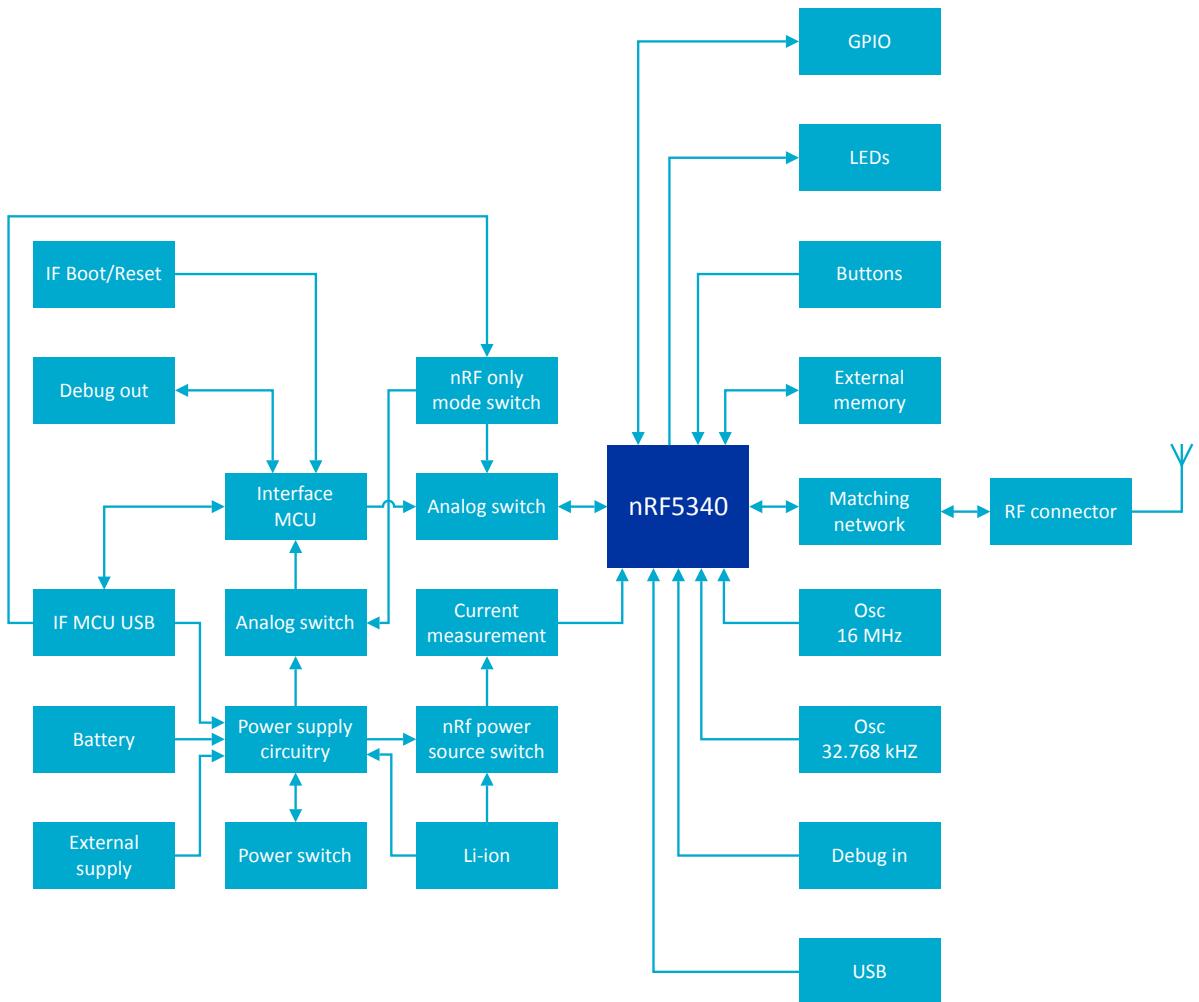


Figure 5: Block diagram

## 4.3 Power supply

The nRF5340 DK has multiple power options.

The power options are the following:

- USB connector **J2** for the interface MCU (5 V)
- USB connector **J3** for the nRF5340 SoC (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

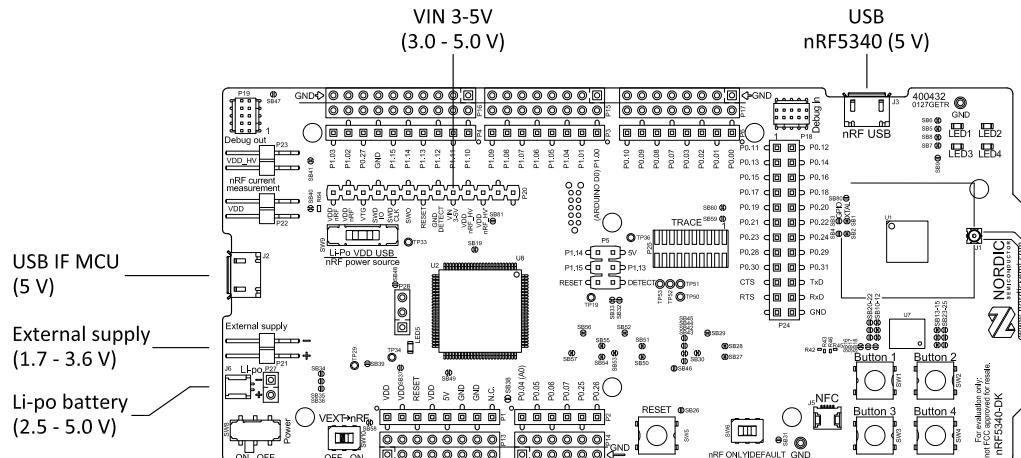


Figure 6: Power supply options (front)

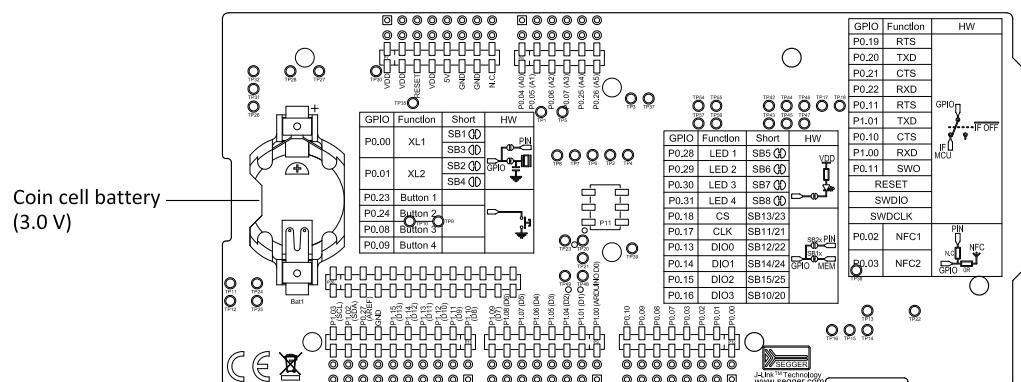


Figure 7: Power supply options (back)

### 4.3.1 5 V power sources

The nRF5340 DK has a 5 V boost regulator.

It gives a stable 5 V output from the following sources:

- USB connector **J2** for the interface MCU
- USB connector **J3** for the nRF5340 SoC
- Li-Po polymer battery connectors (**J6** or **P27**)
- VIN 3-5 V pin on **P20**

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

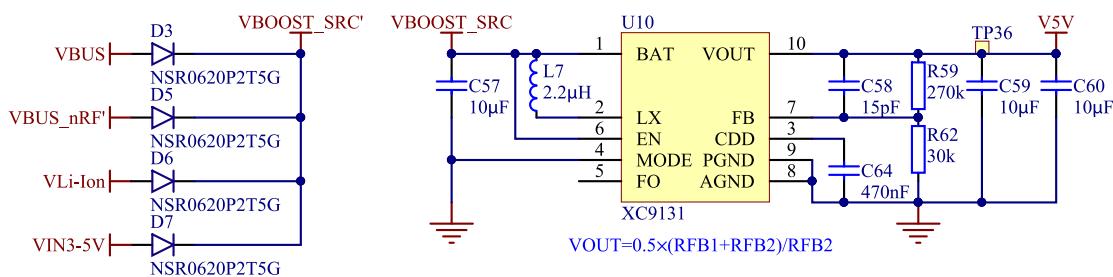


Figure 8: 5 V regulator and protecting diodes

### 4.3.2 VDD power sources

The main 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 [nRF5340 power source](#) on page 15.

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

If the high voltage regulator of the nRF5340 is used, the *DK* will be supplied from the VDD\_nRF voltage follower regardless of the state of the other power sources.

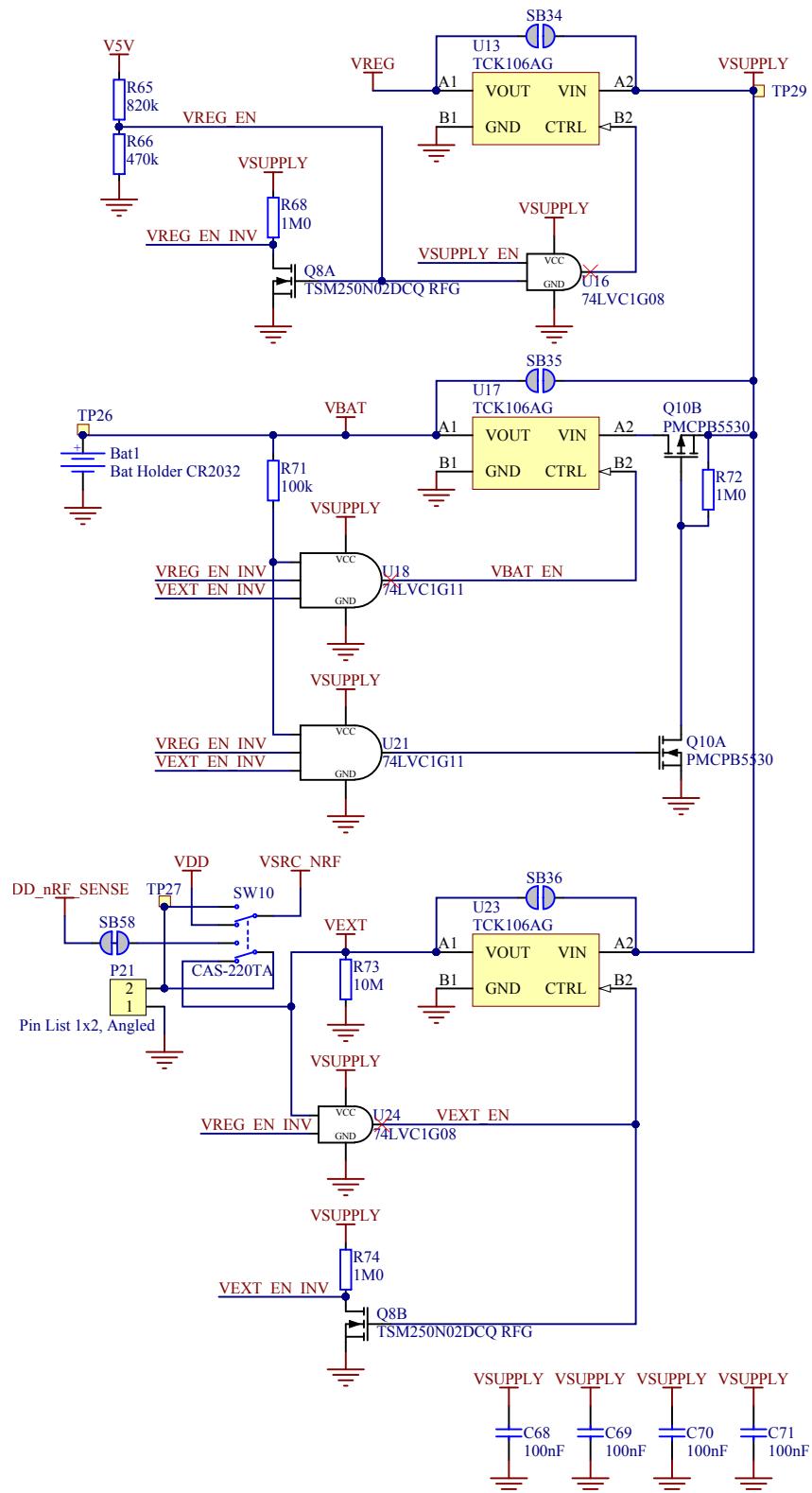


Figure 9: Power supply circuitry

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

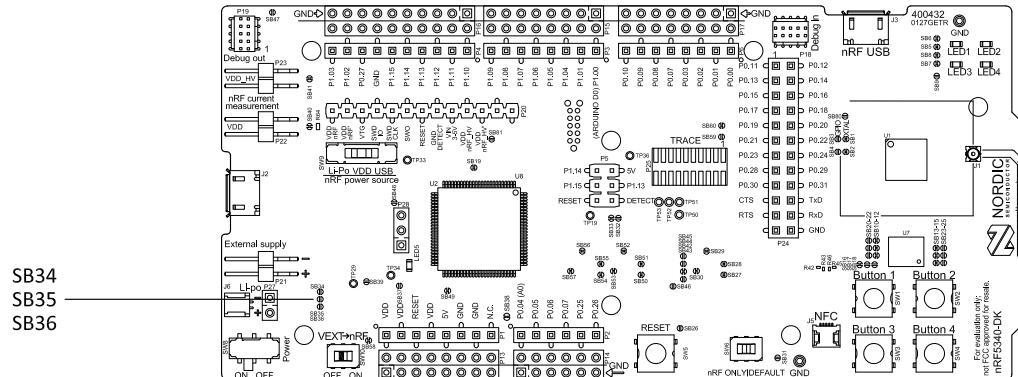


Figure 10: Power switch bypass solder bridges

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

### 4.3.3 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.

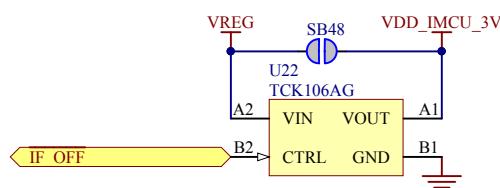
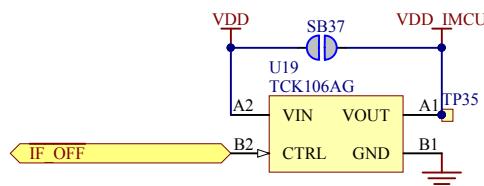


Figure 11: Interface MCU power switch

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 [Operating modes](#) on page 17 for more information.

### 4.3.4 nRF5340 power source

The nRF5340 DK has a power source switch (**SW9**) for selecting between three power sources for the nRF5340 SoC.

The three positions of the switch are the following:

- VDD (default)
- Li-Po
- USB

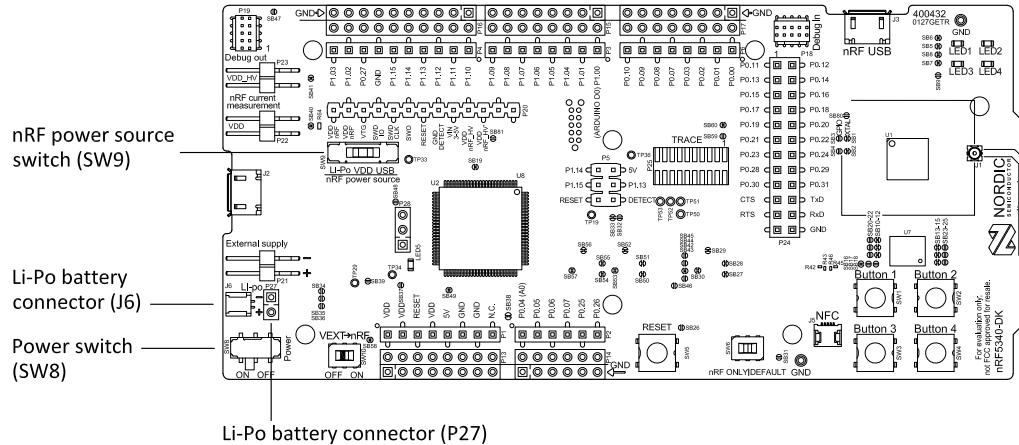


Figure 12: nRF5340 DK power source switch

The nRF5340 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 onboard 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 nRF5340 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 DK has the same voltage level, the VDD of the DK is sourced by a regulator following the VDD\_nRF voltage when the high voltage regulator is used.

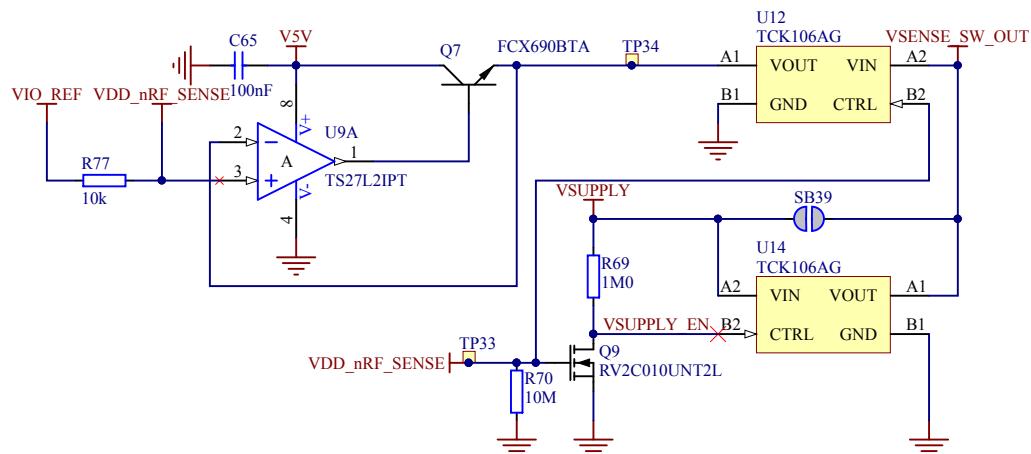


Figure 13: VDD\_nRF voltage follower and switch

To make sure that the nRF5340 SoC is not powered when the nRF power switch (**SW8**) is OFF, two load switches are used, one for the high voltage regulator (**U15**) and one for the USB supply (**U20**). These switches are controlled by VDD.

### 4.3.5 nRF5340 SoC direct supply

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

This is done by connecting the external source to the external supply connector (**P21**) and sliding the **VEXT->nRF** switch (**SW10**) to 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.

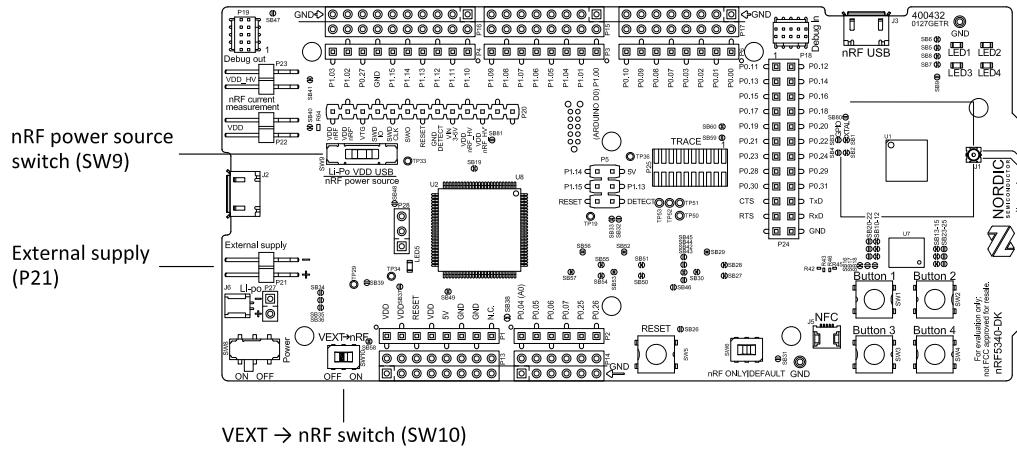


Figure 14: VEXT->nRF switch (SW10)

Since it is only the nRF5340 SoC that is supplied from this source, it is recommended that the VDD domain is supplied from a different source to prevent the pins of the SoC to be connected to unpowered devices.

To avoid voltage differences on the *DK*, the External supply is also connected to the input of the voltage follower when the **VEXT->nRF** switch (**SW10**) is in the ON position. The voltage follower circuit requires 5 V to be present on the *DK*, see [5 V power sources](#) on page 12.

The voltage follower can be disconnected from the External supply by cutting **SB58**. To prevent leakage due to voltage differences, the *DK* should be set in the nRF only mode, see [nRF only mode](#) on page 18.

**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 [External memory](#) on page 20.

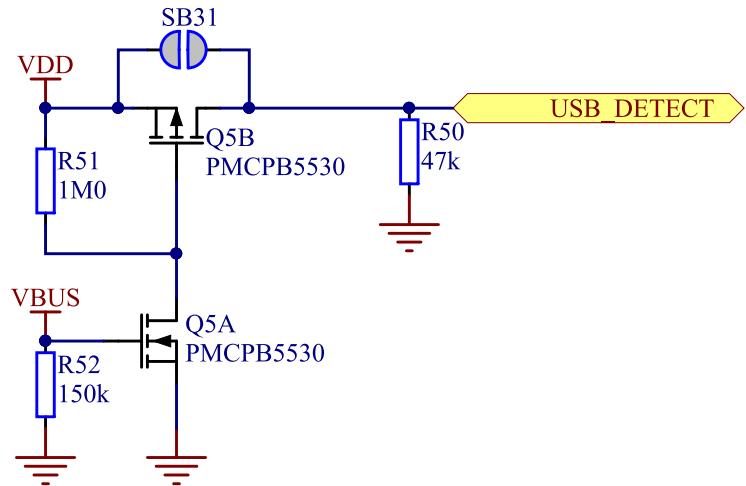
## 4.4 Operating modes

The nRF5340 DK has various modes of operation.

### 4.4.1 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.



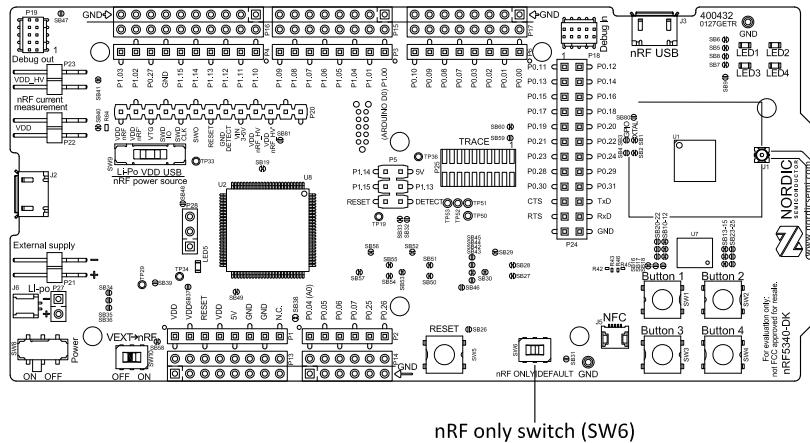
*Figure 15: USB detect*

#### 4.4.2 nRF only mode

The nRF only mode disconnects the power supply, external memory, and LEDs of the interface MCU. It also disconnects the signal lines between the nRF5340 SoC and the interface MCU using analog switches.

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

The power supply of the external memory can be changed to maintain operation in the nRF only mode. See [External memory](#) on page 20.



*Figure 16: nRF ONLY switch (SW6)*

### 4.4.3 Signal switches

On the nRF5340 DK, there are multiple analog switches that are used to connect and disconnect signals based on different scenarios.

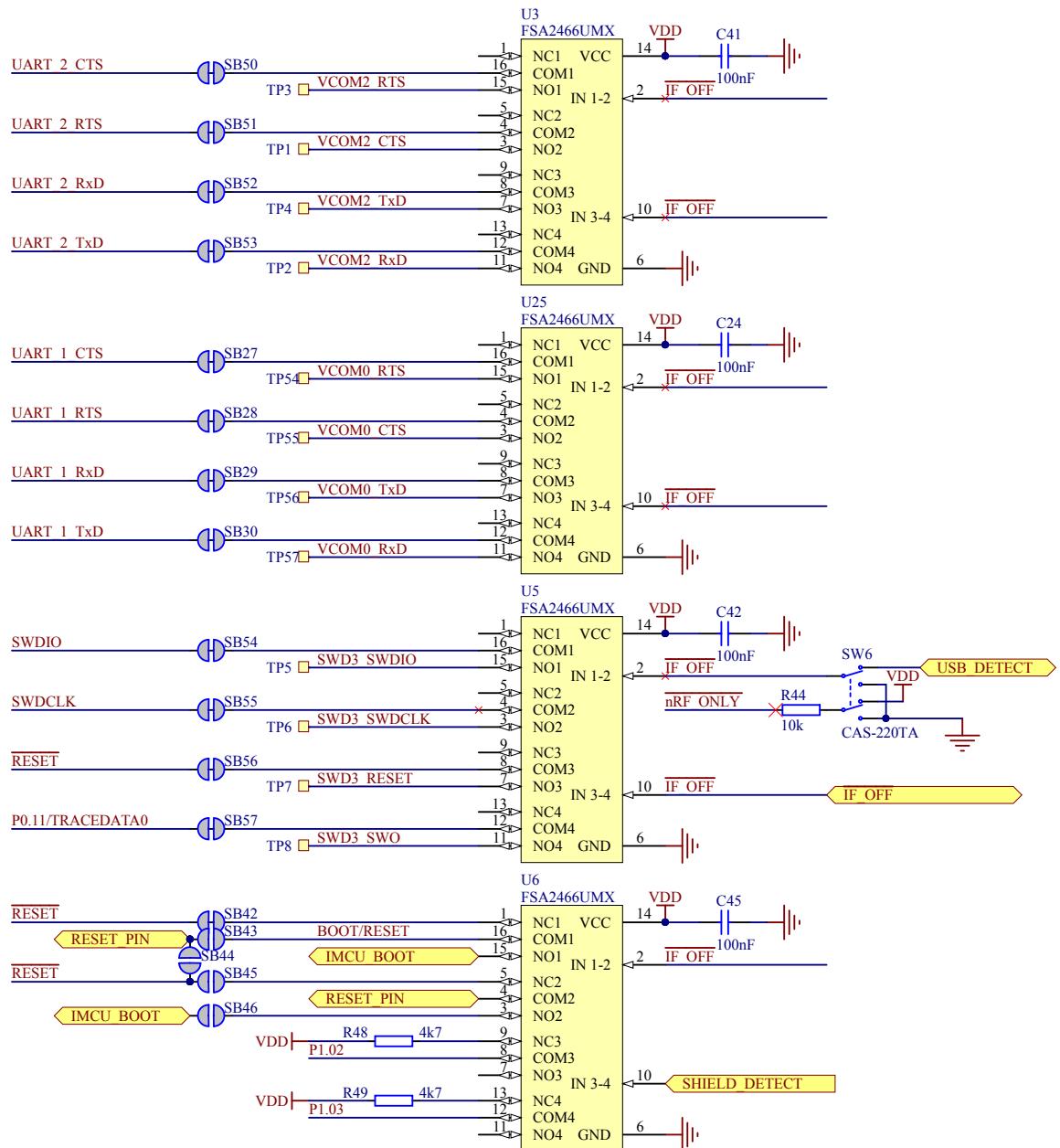


Figure 17: Signal switches

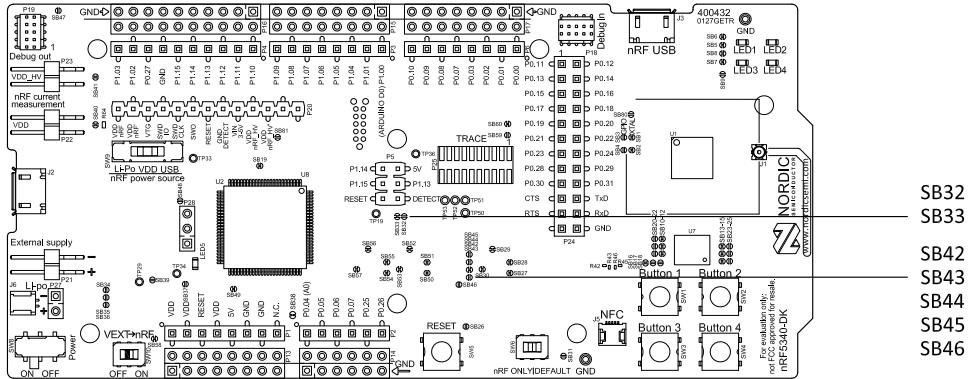
The USB and **SW6** control the signal switches by using **USB\_DETECT** as an input to **SW6**. Therefore, the interface MCU can be disconnected either by unplugging the USB cable from **J2** or by toggling the **nRF ONLY** switch **SW6**.

The signal controls a set of switches (**U3**, **U5**, **U6**) that break the connection between the nRF5340 and the interface MCU, and control the power for the interface MCU. For more information, see [Interface MCU power](#) on page 15.

Switches **U3** and **U5** 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 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.

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*

## 4.5 External memory

The nRF5340 DK 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)
P0.18	CS	SB13	SB23
P0.17	SCLK	SB11	SB21
P0.13	SIO_0/SI	SB12	SB22
P0.14	SIO_1/SO	SB14	SB24
P0.15	SIO_2/WP	SB15	SB25
P0.16	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 the following figure for details.

**Note:** If debugging the QSPI communication is needed, the **SB20–SB25** can be shorted without cutting **SB10–SB15**, but the pins should not be driven externally.

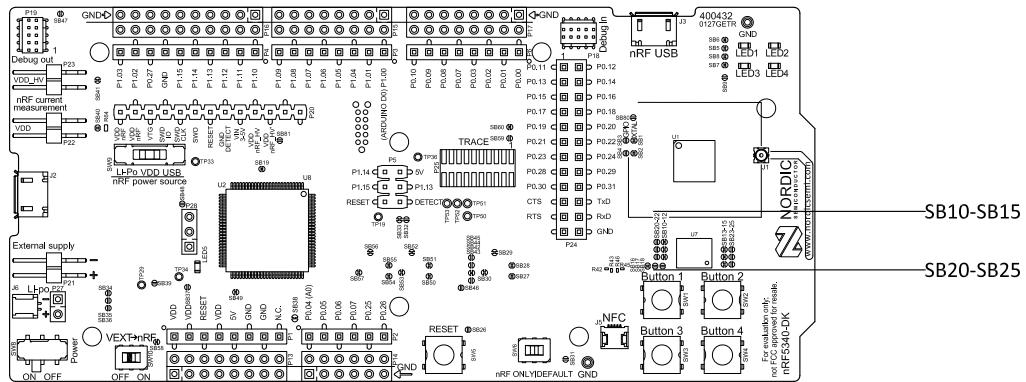


Figure 19: Configuring GPIOs for external memory

By default, the power supply of the external memory is coming from the VDD domain and it is controlled by the nRF only switch (**SW6**). In the nRF only mode, there are two optional power sources for keeping the external memory powered, VDD and VDD\_nRF. If VDD\_nRF is selected, the power consumption of the external memory will be added to the nRF5340 current measured on **P22** or **P23**. See the following table for configuration:

Power source	Solder bridge	Default state
VDD_PER	SB16	Shorted
VDD	SB17	Open
VDD_nRF	SB18	Open

Table 4: Flash memory power source configuration

## 4.6 Connector interface

Access to the nRF5340 GPIOs is available from connectors **P2**, **P3**, **P4**, **P5**, **P6**, and **P24**.

The **P1** connector provides access to ground and power on the nRF5340 DK.

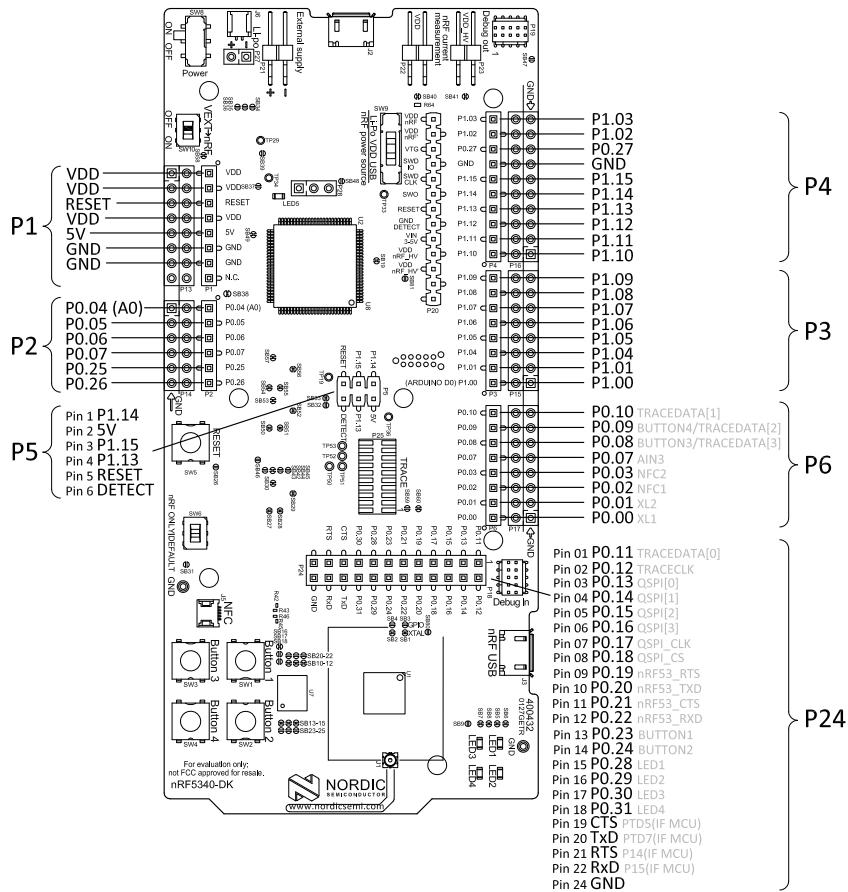


Figure 20: nRF5340 DK connectors

Some of the signals are also available on connectors **P7**, **P8**, **P9**, **P10**, **P11**, and **P12**, which are on the bottom side of the *DK*. By mounting pin lists on the connector footprints, the nRF5340 DK can be used as a shield for Arduino motherboards<sup>2</sup> or other boards that follow the Arduino standard.

For easy access to GPIO, power, and ground, the signals can also be found on the through-hole connectors **P13–P17**.

#### Note:

Some pins have default settings:

- **P0.00** and **P0.01** are used for the 32.768 kHz crystal and are not available on the connectors. For more information, see [32.768 kHz crystal](#) on page 24.
- **P0.19**, **P0.20**, **P0.21**, and **P0.22** are used by the UART connected to the interface MCU. For more information, see [Virtual COM port](#) on page 7.
- **P0.02** and **P0.03** are by default used by NFC1 and NFC2. For more information, see [NFC antenna interface](#) on page 27.
- **P0.08–P0.09** and **P0.23–P0.24** are by default connected to the buttons and **P0.28–P0.31** are connected to the LEDs. For more information, see [Buttons and LEDs](#) on page 23.
- **P0.13–P0.18** are by default connected to the external memory. For more information, see [External memory](#) on page 20.

When the nRF5340 DK is used as a shield together with an Arduino standard motherboard, the Arduino signals are routed as shown in the following figure.

<sup>2</sup> Only 3.3 V Arduino boards.

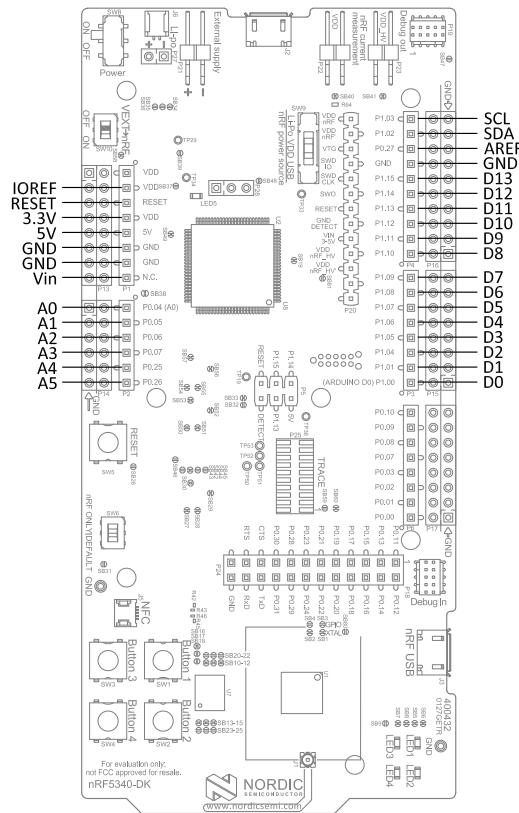


Figure 21: Arduino signals routing on the nRF5340 DK

#### 4.6.1 Mapping of analog pins

The table shows the mapping between GPIO pins, analog inputs, and the corresponding Arduino analog input naming.

GPIO	Analog input	Arduino naming
P0.04	AIN0	A0
P0.05	AIN1	A1
P0.06	AIN2	A2
P0.07	AIN3	A3
P0.25	AIN4	A4
P0.26	AIN5	A5

Table 5: Mapping of analog pins

## 4.7 Buttons and LEDs

The four buttons and four LEDs on the nRF5340 DK are connected to dedicated GPIOs on the nRF5340 SoC.

Part	GPIO	Solder bridge
Button 1	P0.23	-
Button 2	P0.24	-
Button 3	P0.08	-
Button 4	P0.09	-
LED 1	P0.28	SB5
LED 2	P0.29	SB6
LED 3	P0.30	SB7
LED 4	P0.31	SB8

Table 6: Button and LED connection

If P0.28–P0.31 are needed elsewhere, the LEDs can be disconnected by cutting the short on SB5–SB8. See Figure 22: Disconnecting the LEDs on page 24 for more information.

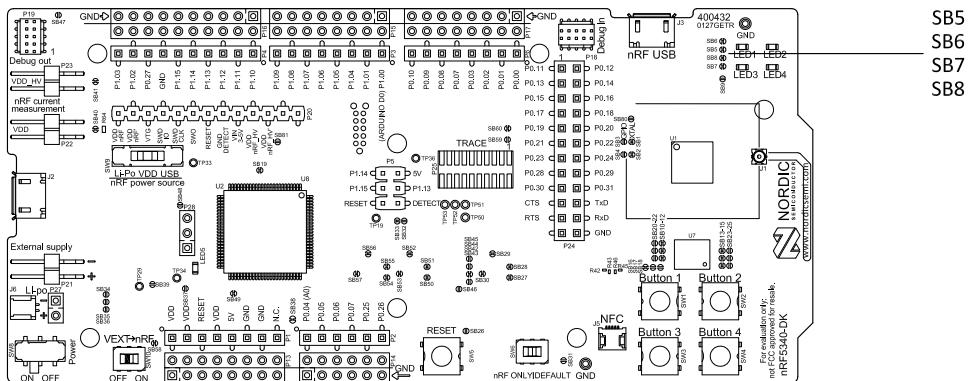


Figure 22: Disconnecting the LEDs

The buttons are active low, meaning that the input will be connected to ground when the button is activated. The buttons have no external pull-up resistor, and therefore, to use the buttons, the P0.08, P0.09, P0.23, P0.24 pins must be configured as input with an internal pull-up resistor.

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

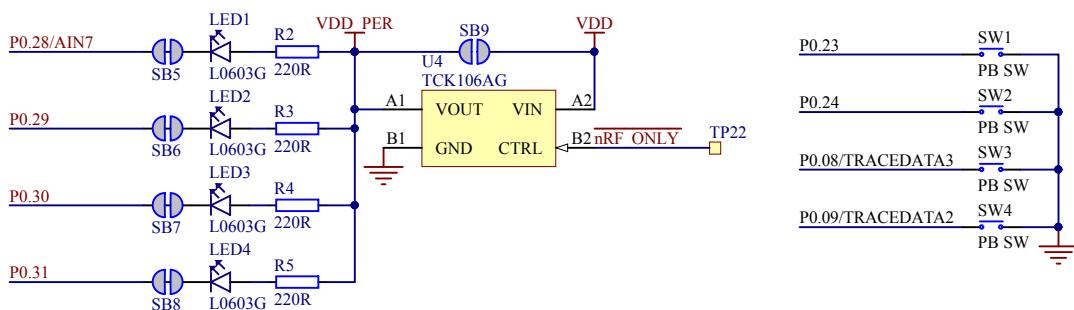


Figure 23: Button and LED configuration

## 4.8 32.768 kHz crystal

The nRF5340 SoC can use an optional 32.768 kHz crystal (X2) for higher accuracy and lower average power consumption.

On the nRF5340 DK, **P0.00** and **P0.01** are used for the 32.768 kHz crystal by default and are not available as GPIO on the connectors.

**Note:** When using ANT/ANT+™, the 32.768 kHz crystal (**X2**) is required for correct operation.

If **P0.00** and **P0.01** are needed as normal I/Os, the 32.768 kHz crystal can be disconnected and the GPIO routed to the connectors. Cut the shorting track on **SB1** and **SB2**, and solder **SB3** and **SB4**. See the following figure for reference.

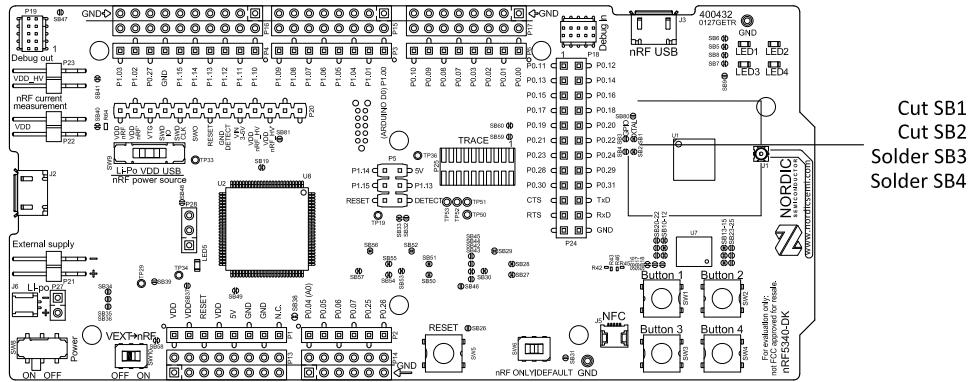


Figure 24: Configuring P0.00 and P0.01

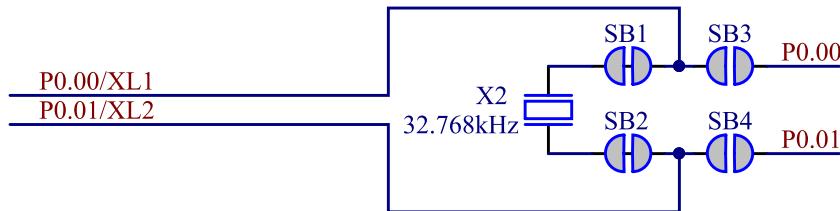


Figure 25: 32.768 kHz crystal and SB1–SB4

## 4.9 Debug input and trace

The Debug in connector (**P18**) makes it possible to connect external debuggers for debugging when the interface MCU USB cable is not connected or the *DK* is in nRF only mode.

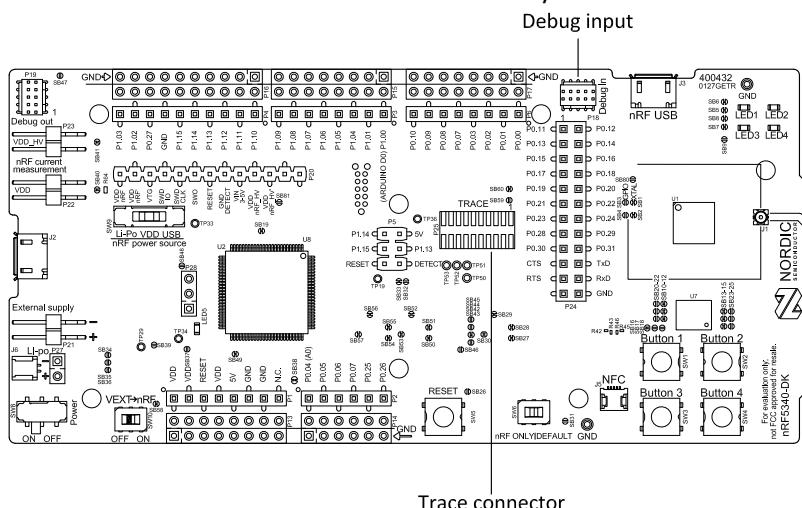


Figure 26: Debug input and trace connectors

For trace, a footprint for a 20-pin connector is available (**P25**). If trace functionality is required, it is possible to mount a 2×10 pin 1.27 mm pitch surface-mount pin header.

GPIO	Trace	Default use
P0.12	TRACECLK	
P0.11	TRACEDATA[0]	
P0.10	TRACEDATA[1]	
P0.09	TRACEDATA[2]	Button 4
P0.08	TRACEDATA[3]	Button 3

Table 7: Default and Trace GPIOs

The reference voltage for the debug input and trace is by default connected to VDD\_nRF'. This can be connected to the VDD by cutting **SB60** and soldering **SB59**.

## 4.10 Debug output

The nRF5340 DK supports programming and debugging external boards with nRF51 Series , nRF52 Series, or nRF53 Series SoCs. To debug an external board with SEGGER J-Link OB IF, connect to the Debug out connector (**P19**) with a 10-pin cable.

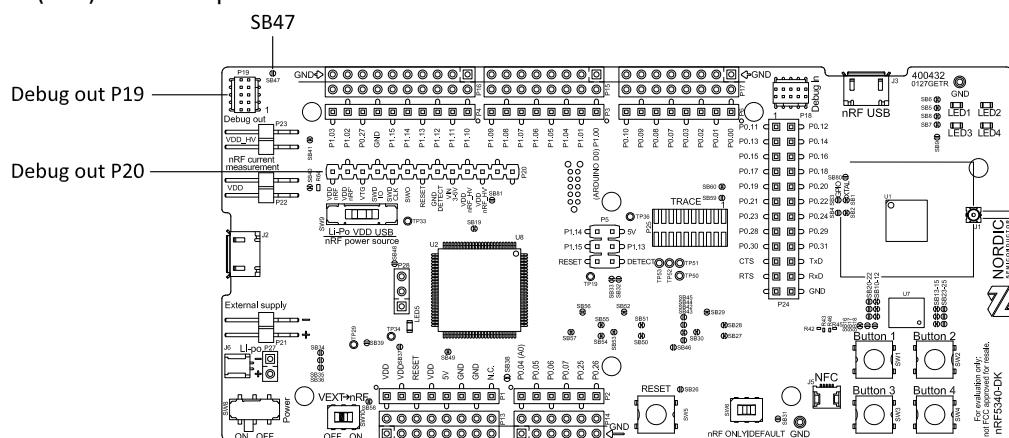


Figure 27: Debug output connector

When the external board is powered, the interface MCU will detect the supply voltage of the board and program/debug the target chip on the external board instead of the onboard nRF5340 SoC.

**Note:** The voltage supported by external debugging/programming is VDD voltage. Normally, this is 3 V when running from USB, but if the onboard nRF5340 SoC is supplied from either USB or Li-Ion, the nRF power source switch (**SW9**) is in either Li-Po or USB position, and VDD can be set by the nRF5340 firmware. Make sure the voltage level of the external board matches the VDD of the nRF5340 DK.

You can also use **P20** as a debug out connection to program shield-mounted targets. For both **P19** and **P20**, the interface MCU will detect the supply voltage on the mounted shield and program/debug the target.

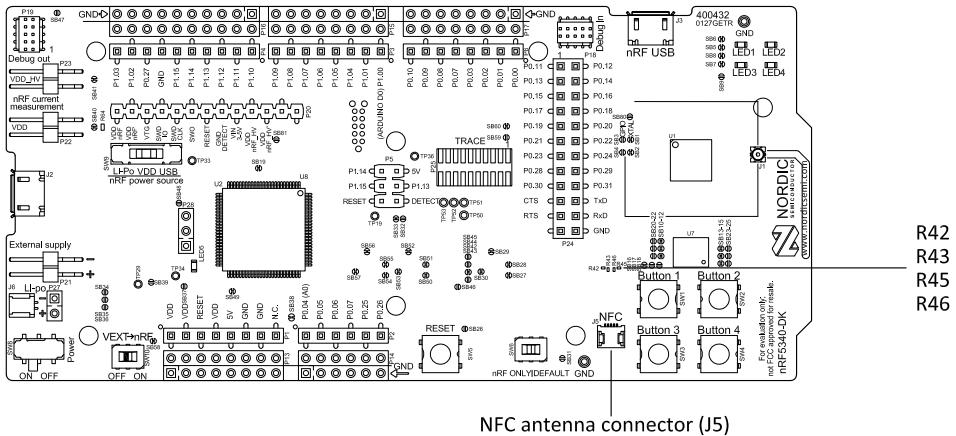
If the interface MCU detects target power on both **P19** and **P20**, it will by default program/debug the target connected to **P19**.

If it is inconvenient to have a separate power supply on the external board, the nRF5340 DK can supply power through the Debug out connector (**P19**). To enable this, short solder bridge **SB47**. While **SB47** is shorted, it is not possible to program the onboard nRF5340 SoC even if the external board is unplugged.

## 4.11 NFC antenna interface

The nRF5340 DK supports an *NFC* tag.

NFC-A listen mode operation is supported on the nRF5340 SoC. The NFC antenna input is available on connector **J5** on the nRF5340 DK.

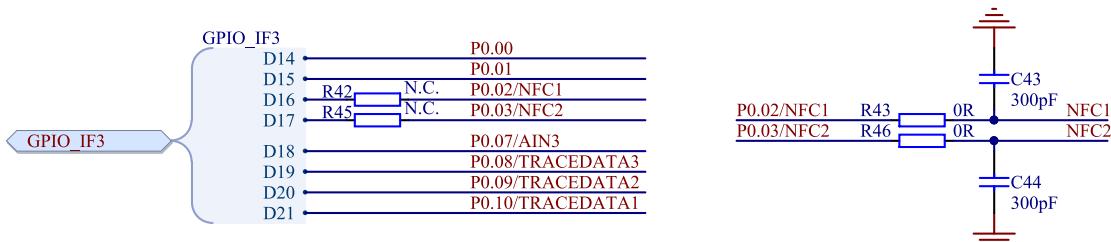


*Figure 28: NFC antenna connector*

*NFC* uses two pins, **W1** (*NFC1*) and **AA1** (*NFC2*), to connect the antenna. These pins are shared with GPIOs (**P0.02** and **P0.03**) and the PROTECT field in the NFCPINS register in UICR defines the usage of these pins and their protection level against abnormal voltages. The content of the NFCPINS register is reloaded at every reset.

**Note:** The NFC pins are enabled by default. NFC can be disabled and GPIOs enabled by setting the CONFIG\_NFCT\_PINS\_AS\_GPIOS to y. See [Configuring your application](#) for instructions.

Pins **W1** and **AA1** are by default configured to use the **NFC** antenna, but if they are needed as normal GPIOs, **R43** and **R46** must be NC and **R42** and **R45** must be shorted by **OR**.



*Figure 29: NFC input*

## 4.12 Extra op-amp

The voltage follower for the power supply uses a dual package op-amp.

The extra op-amp has been routed out to a connector (**P28**, not mounted) so that it is accessible for the user.

For more information on the power supply, see [Power supply](#) on page 11.

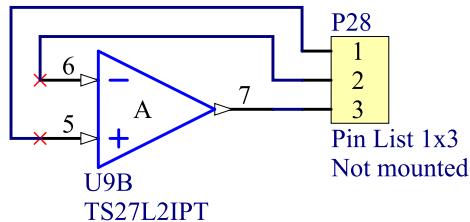


Figure 30: Extra op-amp

## 4.13 Solder bridge configuration

The nRF5340 DK has a range of solder bridges for enabling or disabling functionality on the DK. Changes to these are not needed for normal use of the DK.

The following table is a complete overview of the solder bridges on the nRF5340 DK.

Solderbridge	Default	Function
SB1	Closed	Cut to disconnect the 32.768 kHz on P0.01
SB2	Closed	Cut to disconnect the 32.768 kHz on P0.00
SB3	Open	Short to enable P0.01 as normal GPIO
SB4	Open	Short to enable P0.00 as normal GPIO
SB5	Closed	Cut to disconnect LED1
SB6	Closed	Cut to disconnect LED2
SB7	Closed	Cut to disconnect LED3
SB8	Closed	Cut to disconnect LED4
SB9	Open	Short to bypass peripheral power switch
SB10	Closed	Cut to disconnect the QSPI memory from P0.16
SB11	Closed	Cut to disconnect the QSPI memory from P0.17
SB12	Closed	Cut to disconnect the QSPI memory from P0.13
SB13	Closed	Cut to disconnect the QSPI memory from P0.18
SB14	Closed	Cut to disconnect the QSPI memory from P0.14
SB15	Closed	Cut to disconnect the QSPI memory from P0.15
SB16	Closed	Cut to disconnect QSPI memory power supply from VDD_PER
SB17	Open	Short to connect QSPI memory power supply to VDD
SB18	Open	Short to connect QSPI memory power supply to VDD_nRF
SB20	Open	Short to enable P0.16 as a normal GPIO
SB21	Open	Short to enable P0.17 as a normal GPIO
SB22	Open	Short to enable P0.13 as a normal GPIO
SB23	Open	Short to enable P0.18 as a normal GPIO
SB24	Open	Short to enable P0.14 as a normal GPIO

Solderbridge	Default	Function
SB25	Open	Short to enable P0.15 as a normal GPIO
SB26	Closed	Cut to disable the rgw pull-up resistor of the BOOT/RESET line
SB31	Open	Short to bypass the USB detect switch
SB32	Open	Short to permanently enable the I <sup>2</sup> C pull-up resistors
SB33	Closed	Cut to permanently disable the I <sup>2</sup> C pull-up resistors
SB34	Open	Short to bypass the power switch on the USB power
SB35	Open	Short to bypass the power switch on the coin cell battery power
SB36	Open	Short to bypass the power switch on the external supply power
SB37	Open	Short to bypass the interface MCU power switch
SB38	Closed	Cut to disable VDD power to the Arduino interface
SB39	Open	Short to bypass the power switch for regulator, coin cell, or external supply
SB40	Closed	Cut for current measurements of the VDD_nRF
SB41	Closed	Cut for current measurements of the VDD_nRF_HV
SB42	Closed	Cut to disconnect IF Boot/Reset button from nRF5340 reset pin when the interface MCU is disconnected
SB43	Open	Short to connect IF Boot/Reset button to RESET pin on the Arduino interface
SB44	Open	Short to connect the RESET pin on the Arduino interface to the nRF5340 reset pin
SB45	Open	Short to connect the RESET pin on the Arduino interface to the interface nRF5340 reset pin when the interface MCU is disconnected
SB46	Open	Short to connect the RESET pin on the Arduino interface to the interface MCU Boot when the interface MCU is disconnected
SB47	Open	Short to enable power supply of the external device when using the debug out connector
SB48	Open	Short to bypass the interface MCU USB power switch
SB50	Closed	Cut to disconnect the nRF5340 CTS line from the signal switch and interface MCU
SB51	Closed	Cut to disconnect the nRF5340 RTS line from the signal switch and interface MCU
SB52	Closed	Cut to disconnect the nRF5340 RxD line from the signal switch and the interface MCU
SB53	Closed	Cut to disconnect the nRF5340 TxD line from the signal switch and interface MCU
SB54	Closed	Cut to disconnect the nRF5340 SWDIO line from the signal switch and interface MCU
SB55	Closed	Cut to disconnect the nRF5340 SWDCLK line from the signal switch and interface MCU

Solderbridge	Default	Function
SB56	Closed	Cut to disconnect the nRF5340 RESET line from the signal switch and interface MCU
SB57	Closed	Cut to disconnect the nRF5340 SWO line from the signal switch and the interface MCU
SB58	Closed	Cut to disconnect voltage follower from external supply when SW10 is in ON position
SB59	Open	Solder to connect debug in and trace reference voltage to VDD
SB60	Closed	Cut to disconnect debug in and trace reference voltage from VDD_nRF'
SB80	Open	Short to bypass the power switch for the VBUS of nRF5340
SB81	Open	Short to bypass the power switch for VDD_HV of nRF5340

Table 8: Solder bridge configuration

# 5 Measuring current

The current drawn by the nRF5340 *SoC* can be monitored on the nRF5340 DK.

Current can be measured using various test instruments. Examples of test equipment are the following:

- Power analyzer
- Oscilloscope
- Ampere meter
- Power Profiler Kit

Power analyzer and Power Profiler Kit measurements are not described in this document. For more information on Power Profiler Kit, see [Power Profiler Kit User Guide](#).

For measuring instructions, see [Using an oscilloscope for current profile measurement](#) on page 32 and [Using an ampere meter for current measurement](#) on page 33.

The nRF5340 *SoC* has two possible power supplies, VDD (1.7–3.6 V) and VDDH (2.5–5.5 V). The nRF5340 DK is prepared for measuring current on both domains. Only the VDD domain current measurement is described here, but the approach is the same with the VDDH supply. See the following table for the corresponding components.

Component	VDD	VDDH
Measurement connector	P22	P23
Solder bridge	SB40	SB41
Series resistor	R64	R67

*Table 9: Components for current measurement on VDD and VDDH*

**Note:** When measuring the current consumption:

- It is not recommended to use a USB connector to power the *DK* during current measurements due to potential noise from the USB power supply. However, when measuring current on an application using the USB interface of the nRF5340 *SoC*, the USB must be connected. It is recommended to power the *DK* from a coin cell battery, external power supply on connector **P21** (1.7–3.6 V), or through the Li-Po connector **J6** or **P27** (2.5–5.0 V).
- The current measurements will become unreliable when a serial terminal is connected to the virtual COM port.
- After programming the nRF5340 *SoC*, the USB for the interface MCU must be disconnected.

For more information on current measurement, see the tutorial [Current measurement guide: Introduction](#).

## 5.1 Preparing the DK

To measure current, you must first prepare the *DK*.

The suggested configurations actually split the power domains for the nRF5340 *SoC* and the rest of the *DK*.

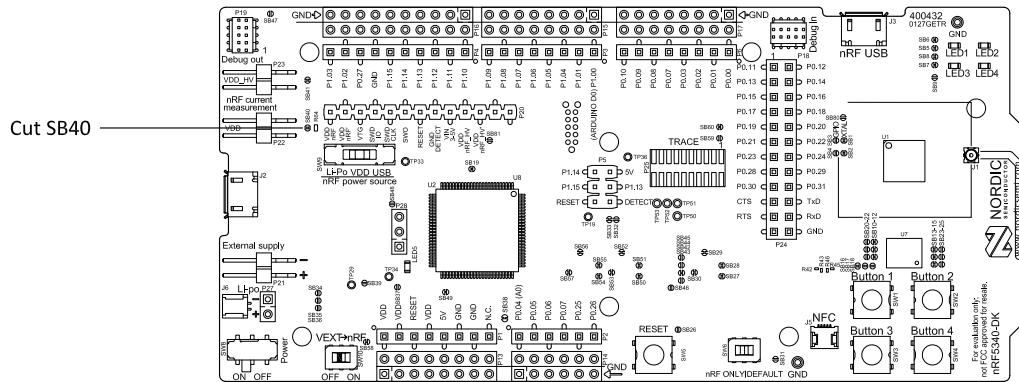


Figure 31: Preparing the DK for current measurements

- To put **P22** in series with the load, cut the PCB track shorting solder bridge **SB40**.
- To restore normal kit function after measurement, solder **SB40** or apply a jumper on **P22**.
- To reprogram the nRF5340 SoC while the **DK** is prepared for current measurements, remove measurement devices from **P22**, and then connect the USB cable.

## 5.2 Using an oscilloscope for current profile measurement

An oscilloscope can be used to measure both the average current over a given time interval and capture the current profile.

Make sure you have prepared the **DK** as described in section [Preparing the DK on page 31](#).

1. Mount a  $10\ \Omega$  resistor on the footprint for **R64**.
2. Connect an oscilloscope in differential mode or similar with two probes on the pins of the **P22** connector as shown in the following figure.
3. Calculate or plot the instantaneous current from the voltage drop across the  $10\ \Omega$  resistor by taking the difference of the voltages measured on the two probes. The voltage drop will be proportional to the current. The  $10\ \Omega$  resistor will cause a  $10\text{ mV}$  drop for each  $1\text{ mA}$  drawn by the circuit being measured.

The plotted voltage drop can be used to calculate the current at a given point in time. The current can then be averaged or integrated to analyze current and energy consumption over a period.

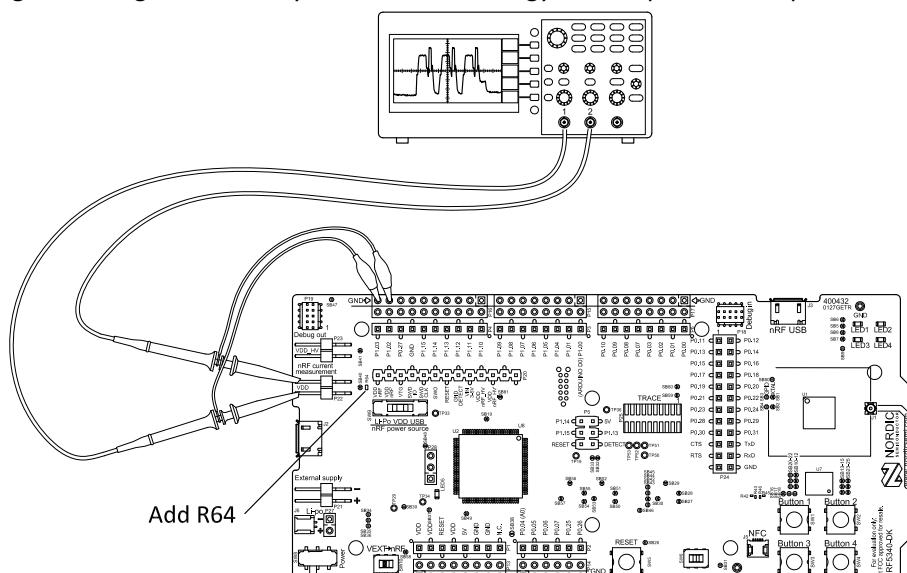


Figure 32: Current measurement with an oscilloscope

Some tips to reduce noise:

- Use probes with  $1\times$  attenuation
- Enable averaging mode to reduce random noise
- Enable high resolution function if available

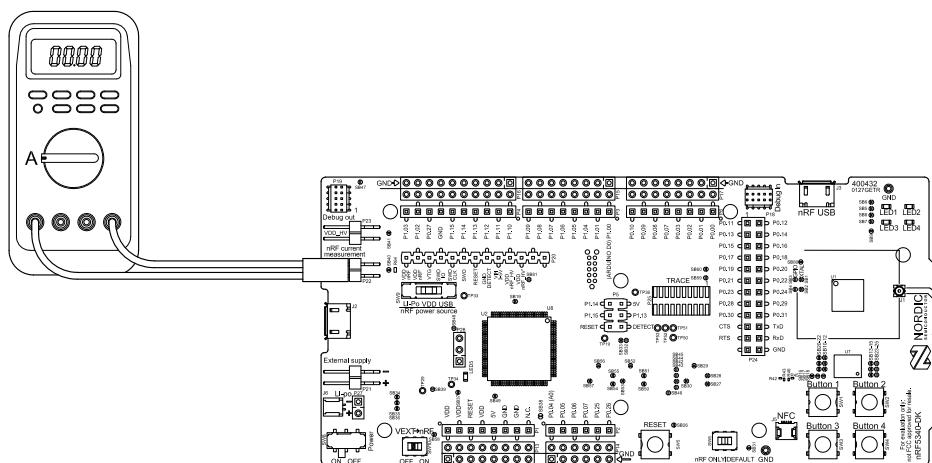
Use a minimum of 200 kSa/s (one sample every 5  $\mu$ s) to get the correct average current measurement.

## 5.3 Using an ampere meter for current measurement

The average current drawn by the nRF5340 SoC can be measured using an ampere meter. This method monitors the current in series with the nRF device.

Make sure you have prepared the DK as described in section [Preparing the DK on page 31](#).

Connect an ampere meter between the pins of connector **P22** as shown in the following figure.



*Figure 33: Current measurement with an ampere meter*

**Note:** An ampere meter will measure the average current drawn by the nRF5340 SoC if:

- The SoC is in a state where it draws a constant current, or, the activity on the device changing load current, like BLE connection events, is repeated continuously and has a short cycle time (less than 100 ms) so that the ampere meter will average whole load cycles and not parts of the cycle.
- The dynamic range of the ampere meter is wide enough to give accurate measurements from 1  $\mu$ A to 15 mA.

We recommend that you use a true RMS ampere meter.

# 6 RF measurements

The nRF5340 DK is equipped with a small coaxial connector (**J1**) for conducting measurements of the RF signal using a spectrum analyzer.

The connector is of SWF type (Murata part no. MM8130-2600) with an internal switch. By default, when no cable is attached, the RF signal is routed to the onboard trace antenna.

A test probe is available (Murata part no. MXHS83QE3000) with a standard SMA connection on the other end for connecting instruments (the test probe is not included with the kit). When connecting the test probe, the internal switch in the SWF connector will disconnect the onboard antenna and connect the RF signal from the nRF5340 SoC to the test probe.

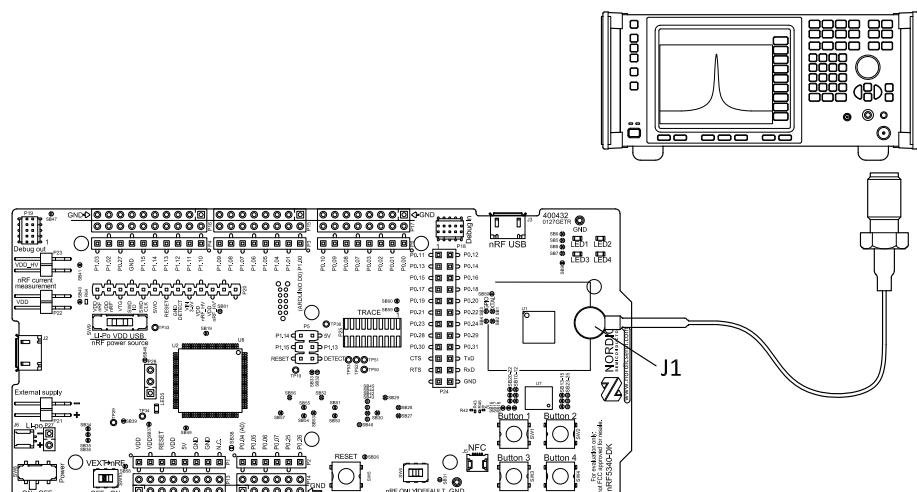


Figure 34: Connecting a spectrum analyzer

The connector and test probe will add loss to the RF signal, which should be taken into account when measuring. See the following table for more information.

Frequency (MHz)	Loss (dB)
2440	1.0
4880	1.7
7320	2.6

Table 10: Typical loss in connector and test probe

# Glossary

## **Clear to Send (CTS)**

In flow control, the receiving end is ready and telling the far end to start sending.

## **Data Terminal Ready (DTR)**

A control signal in RS-232 serial communications transmitted from data terminal equipment, such as a computer, to data communications equipment.

## **Development Kit (DK)**

A development platform used for application development.

## **Hardware Flow Control (HWFC)**

A handshaking mechanism used to prevent an overflow of bytes in modems. It is utilizing two dedicated pins on the RS-232 connector, Request to Send and Clear to Send.

## **Integrated Development Environment (IDE)**

A software application that provides facilities for software development.

## **Mass Storage Device (MSD)**

Any storage device that makes it possible to store and port large amounts of data in a permanent and machine-readable fashion.

## **Near Field Communication (NFC)**

A standards-based short-range wireless connectivity technology that enables two electronic devices to establish communication by bringing them close to each other.

## **NFC-A Listen Mode**

Initial mode of an NFC Forum Device when it does not generate a carrier. The device listens for the remote field of another device. See [Near Field Communication \(NFC\)](#) on page 35.

## **Operational Amplifier (op-amp)**

A high-gain voltage amplifier that has a differential input and, usually, a single output.

## **Receive Data (RXD)**

A signal line in a serial interface that receives data from another device.

## **Request to Send (RTS)**

In flow control, the transmitting end is ready and requesting the far end for a permission to transfer data.

## **Root Mean Square (RMS)**

An RMS meter calculates the equivalent direct current (DC) value of an alternating current (AC) waveform. A true-RMS meter can accurately measure both pure waves and the more complex nonsinusoidal waves.

## **SubMiniature Version A (SMA) Connector**

A semi-precision coaxial RF connector for coaxial cables with a screw-type coupling mechanism.

**System on Chip (SoC)**

A microchip that integrates all the necessary electronic circuits and components of a computer or other electronic systems on a single integrated circuit.

**Transmit Data (TXD)**

A signal line in a serial interface that transmits data to another device.

**Universal Asynchronous Receiver/Transmitter (UART)**

A hardware device for asynchronous serial communication between devices.

# Acronyms and abbreviations

These acronyms and abbreviations are used in this document.

**CTS**

Clear to Send

**DK**

Development Kit

**DTR**

Data Terminal Ready

**HWFC**

Hardware Flow Control

**IDE**

Integrated Development Environment

**MSD**

Mass Storage Device

**NFC**

Near Field Communication

**op-amp**

Operational Amplifier

**RMS**

Root Mean Square

**RTS**

Request to Send

**RXD**

Receive Data

**SMA**

SubMiniature version A

**SoC**

System on Chip

**TXD**

Transmit Data

**UART**

Universal Asynchronous Receiver/Transmitter

# Recommended reading

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

## Nordic documentation

- [nRF5340 Product Specification](#)
- [nRF5340 Compatibility Matrix](#)
- [nRF5340 Errata](#)
- [nRF Connect SDK](#)

# FCC regulatory notice

The following regulatory notices apply to the nRF5340 DK.

This kit has not been authorized under the rules of the FCC and is designed to allow:

- Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product.
- Software developers to write software applications for use with the end product.

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