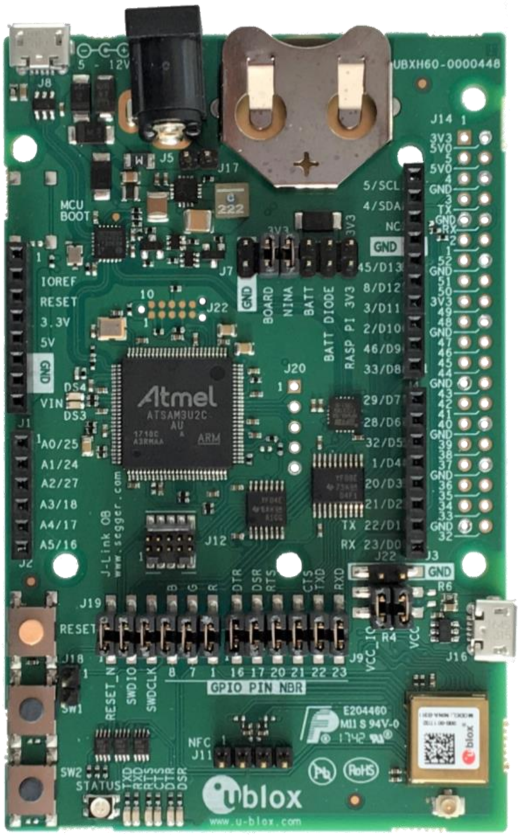
S

EVK-NINA-B3

Evaluation kit for NINA-B3 modules

User guide



Abstract

This document describes how to set up the EVK-NINA-B3 evaluation kit to evaluate NINA-B3 series standalone Bluetooth® 5 low energy modules. It also describes the different options for debugging and the development capabilities included in the evaluation board.

UBX-17056481 - R08

C1-Public

Document information

Title	**EVK-NINA-B3**
Subtitle	Evaluation kit for NINA-B3 modules
Document type	User guide
Document number	UBX-17056481
Revision and date	R08 16-May-2023
Disclosure restriction	C1-Public

This document applies to the following products:

Product name	Type number	Software support	PCN reference
EVK-NINA-B301	EVK-NINA-B301-00	Open CPU	-
EVK-NINA-B311	EVK-NINA-B311-01	u-connectXpress	-
EVK-NINA-B302	EVK-NINA-B302-00	Open CPU	-
EVK-NINA-B312	EVK-NINA-B312-01	u-connectXpress	-
EVK-NINA-B306	EVK-NINA-B306-00	Open CPU	-
EVK-NINA-B316	EVK-NINA-B316-01	u-connectXpress	-

Contents

1 Quick start guide

EVK-NINA-B3 software and documentation is available at www.u-blox.com/evk-search.

1.1 Installing s-center evaluation software

s-center is a powerful and easy-to-use tool for evaluating, configuring, and testing u-blox short range modules. Running on Windows 10 operating systems, the software allows end users to assess and configure u-blox short range modules using the EVK.

Follow the procedure outlined below to download and install the s-center software and documentation. The software can be downloaded from the u-blox s-center product page and is available free of charge.

1. Download the latest s-center software to your computer.
2. Open the s-center setup installer to install the software.
3. Select Launch button in the installer or open the application from the Windows Start button.

1.2 Installing J-Link drivers

Follow the procedure outlined below to install the J-Link drivers needed for programming the module.

1. Connect the EVK-NINA-B3 board to your PC using the USB cable provided with the product.
2. Verify that the USB drivers are installed successfully. If the drivers do not install automatically, see also Evaluation board setup.
3. Once the drivers are installed, a COM port is enabled in Windows. Use the Windows Device Manager to view the COM port number for the USB serial port.
4. Start s-center to communicate with the module.

1.3 Installing serial port drivers

EVK-ANNA-B4 EVKs include a mounted FTDI chip to provide serial port connectivity. Normally the driver for the UART is installed automatically when the board is connected. If the driver fails to install, the driver files can be retrieved form the manufacturers website [9]

2 Product description

2.1 Overview

The EVK-NINA-B3 evaluation kit is a versatile development platform that allows quick prototyping of a variety of extreme low-power Internet of Things (IoT) applications, using full Bluetooth 5, NFC, and IEEE 802.15.4.

EVK-NINA-B3 boards are available in several variants:

- EVK-NINA-B301 including the NINA-B301 Open CPU module with an antenna connector for connecting to external antennas.
- EVK-NINA-B311 including the NINA-B311 module with pre-flashed u-connectXpress software and an antenna connector for connecting to external antennas.
- EVK-NINA-B302 including the NINA-B302 Open CPU module with a unique (2.4 GHz metal sheet) internal antenna soldered onto the device.
- EVK-NINA-B312 including the NINA-B312 module with pre-flashed u-connectXpress software and a unique (2.4 GHz metal sheet) internal antenna soldered onto the device.
- EVK-NINA-B306 including the NINA-B306 Open CPU module with an internal PCB trace antenna.
- EVK-NINA-B316 including the NINA-B316 module with pre-flashed u-connectXpress software and internal PCB trace antenna.

☞ The debug chip “Atmel” is not mounted on NINA-B31x u-connectXpress secure-boot EVKs as it serves no useful purpose on secure modules.

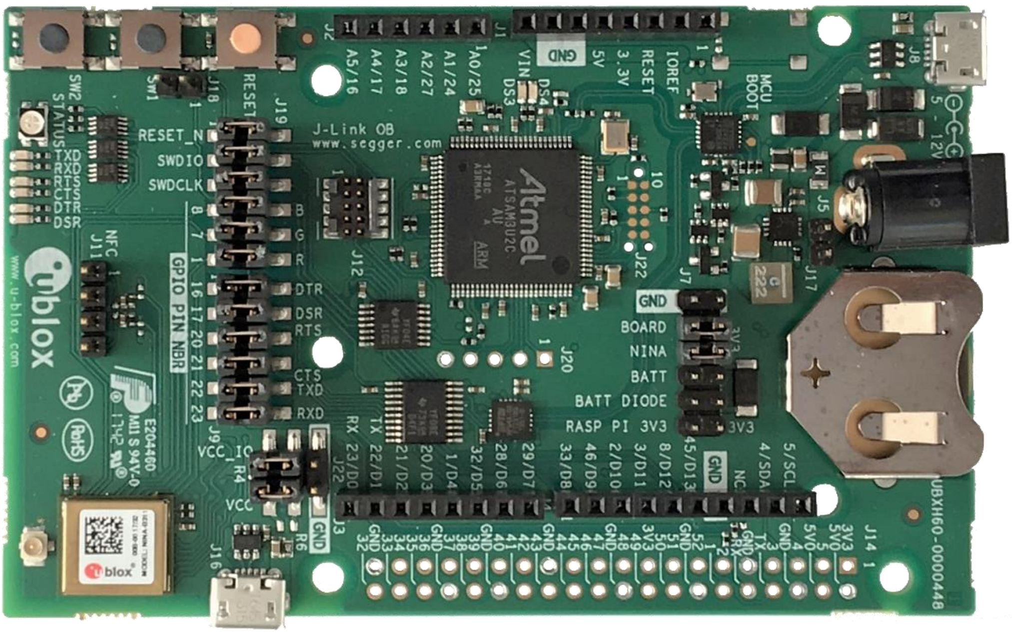


Figure 1: EVK-NINA-B301/-B311 evaluation board

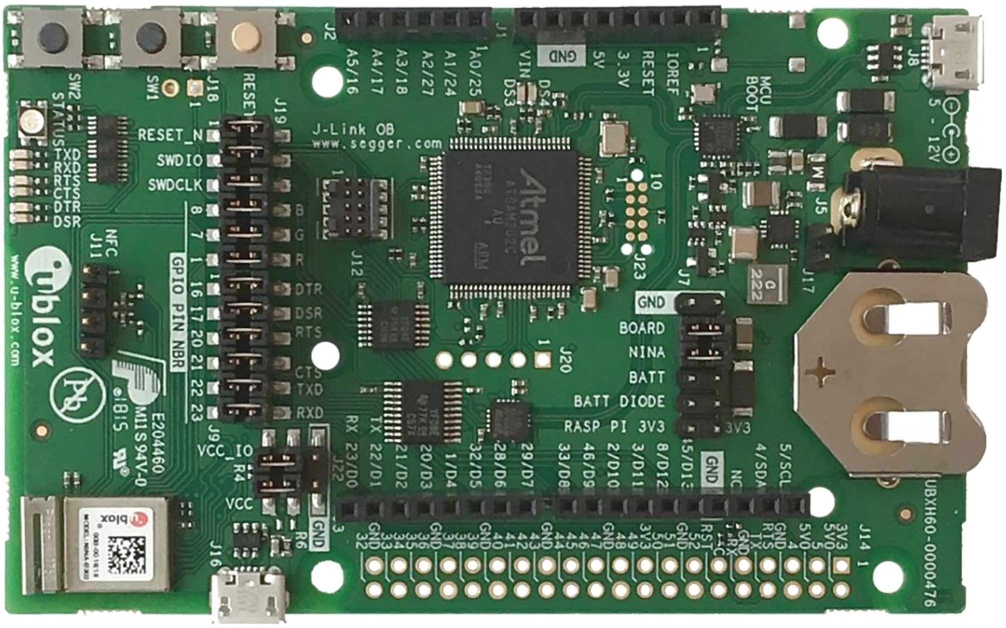


Figure 2: EVK-NINA-B302/-B312 evaluation board

⚠ Take care when handling the EVK-NINA-B302 or EVK-NINA-B312. Applying force to the NINA module might damage the internal antenna.

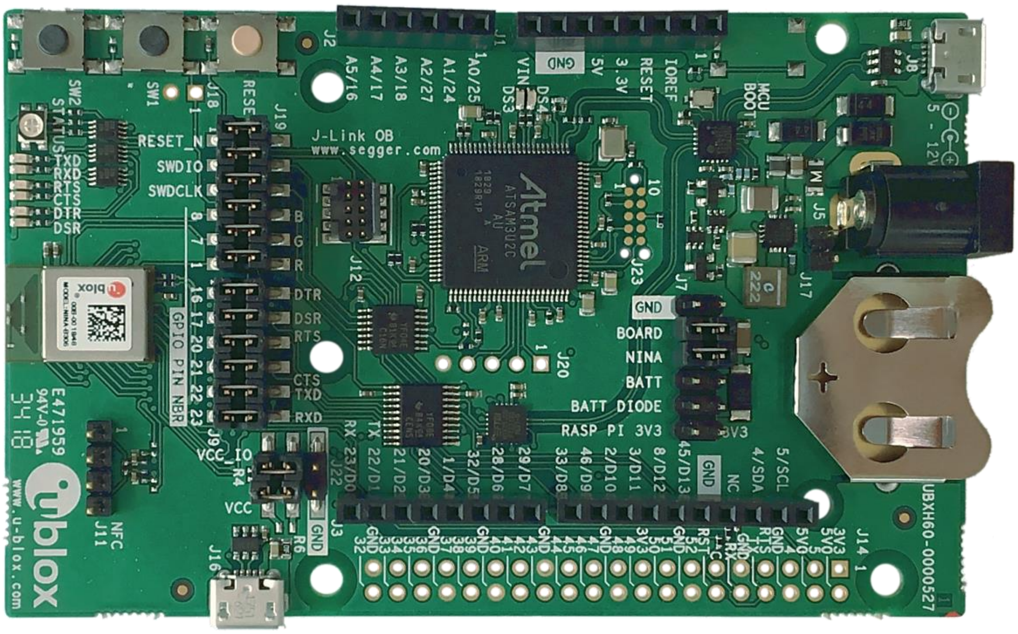


Figure 3: EVK-NINA-B306/-B316 evaluation board

The evaluation boards provide access to all the 38 GPIO pins and interfaces available on the NINA-B3 modules through a variety of connectors and interfaces including Arduino™ Uno R3 [1] and Raspberry Pi [2] header connectors.

The stand-alone NINA-B3 modules include an Arm® Cortex®-M4F microcontroller with 1 MB internal flash and 256 kB RAM, running at a system clock of 64 MHz. This has been integrated inside the Nordic Semiconductor nRF52840 chip that the modules are based on. The evaulation board provides simple USB drag-n-drop programming and a SEGGER J-Link debug interface that can be used with the Open CPU variants of the EVK. Nordic Semiconductors, the manufacturer of the nRF52840 chip that the NINA-B3 series are based on, provides a free Software Development Kit (SDK) with a broad selection of drivers, libraries, and example applications that can be used for rapid prototyping.

2.2 Kit includes

The EVK-NINA-B3 evaluation kit includes the following:

- NINA-B3 evaluation board
- 2.4 GHz antenna with U.FL connector (only in EVK-NINA-B301 and EVK-NINA-B311)
- NFC antenna
- USB cable
- Quick start card

2.3 Key features

- u-blox NINA-B3 Bluetooth low energy module based on the Nordic nRF52840 chipset
    - Full Bluetooth 5 support
    - NFC tag functionality
    - 802.15.4 PHY
    - Integrated Arm Cortex-M4 microcontroller with 1 MB flash, 256 kB RAM, and 64 MHz system clock
    - USB 2.0
    - Wide 1.7-3.6 V supply range
- The NINA-B3 module supports different interfaces that can be configured to any of the 38 available GPIO pin(s):
    - 8 analog capable inputs
    - 12 PWM capable outputs
    - 3x SPI
    - 2x UART with HW flow control
    - 2x I2C
    - 1x I2S
    - 1x PDM input
    - 1x Quadrature decoder
- EVK-NINA-B31x support for u-connectXpress software
- EVK-NINA-B30x support for developing your own software on the Open CPU NINA-B3 module
- Full UART to USB converter with a Virtual COM port, allowing control of the extended UART features of u-blox u-connectXpress software
- On-board J-Link debugger/programmer
    - Mass Storage Device interface to PC for drag-n-drop programming
    - Debug port
    - An additional Virtual COM port that, for example, may be connected to add-on boards or to a debug UART on the NINA-B3
- Dedicated USB connector for the NINA-B3 USB interface
- Additional flash memory can be added to the board for use by the NINA-B3 module
- RGB LED and push buttons
- Arduino UNO R3 and Raspberry Pi compatible pin header interfaces
- Jumper headers and level shifters allow for flexible powering options of the NINA-B3 module, even with full board support. They isolate the module entirely and control each power net separately in order to precisely measure low power applications or disconnect only unused parts of the board to save battery life.
- Multiple board power supply options
    - 5-12 V power plug
    - 5 V USB supply
    - 5-12 V Arduino VIN input
- Battery holder supporting CR2032 coin cell batteries

2.4 EVK-NINA-B3 block diagram

The block diagram in Figure 4 shows the major interfaces and internal connections of the EVK-NINA-B3. The following sections describe in detail how the different interfaces are connected and may be used, as well as how the evaluation board may be configured to suit the needs of the user.

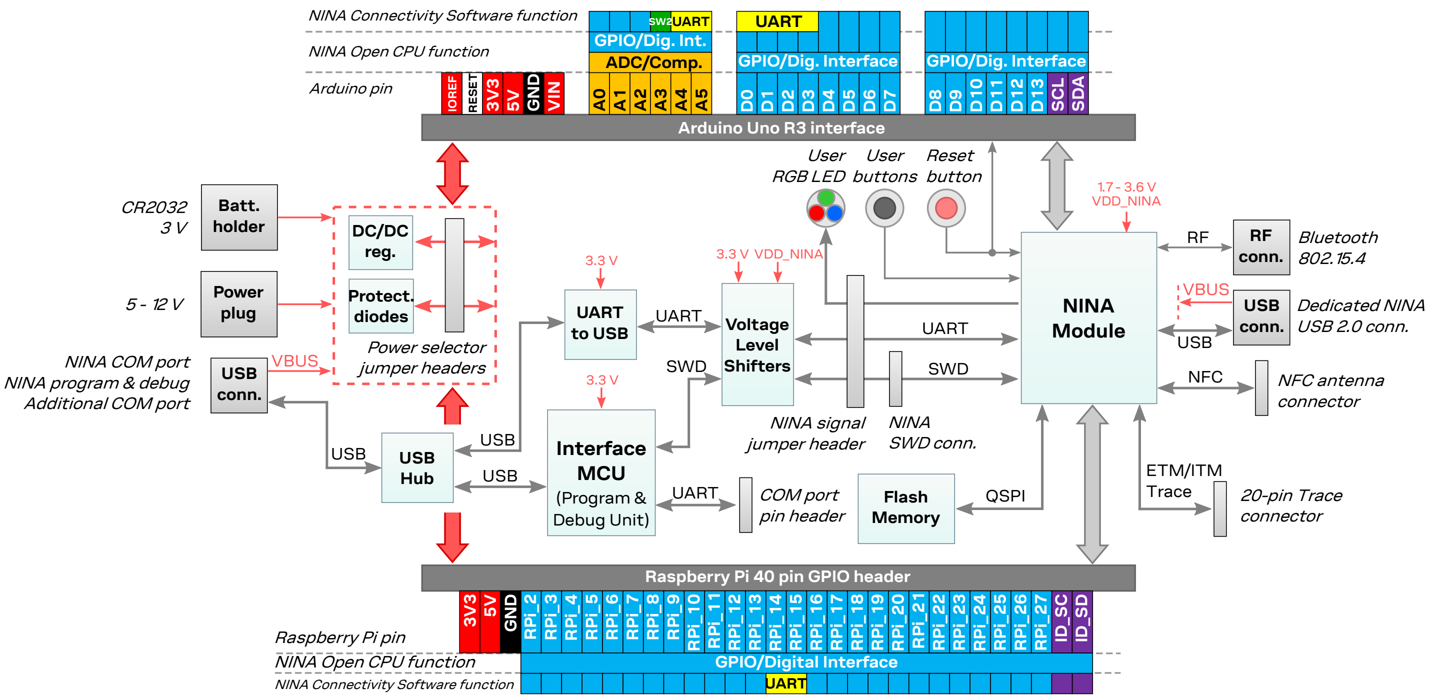


Figure 4: EVK-NINA-B3 block diagram

2.5 Connectors

Figure 5 shows the available connectors of the EVK-NINA-B3 and their layout. Table 1 describes the connectors and their uses in detail.

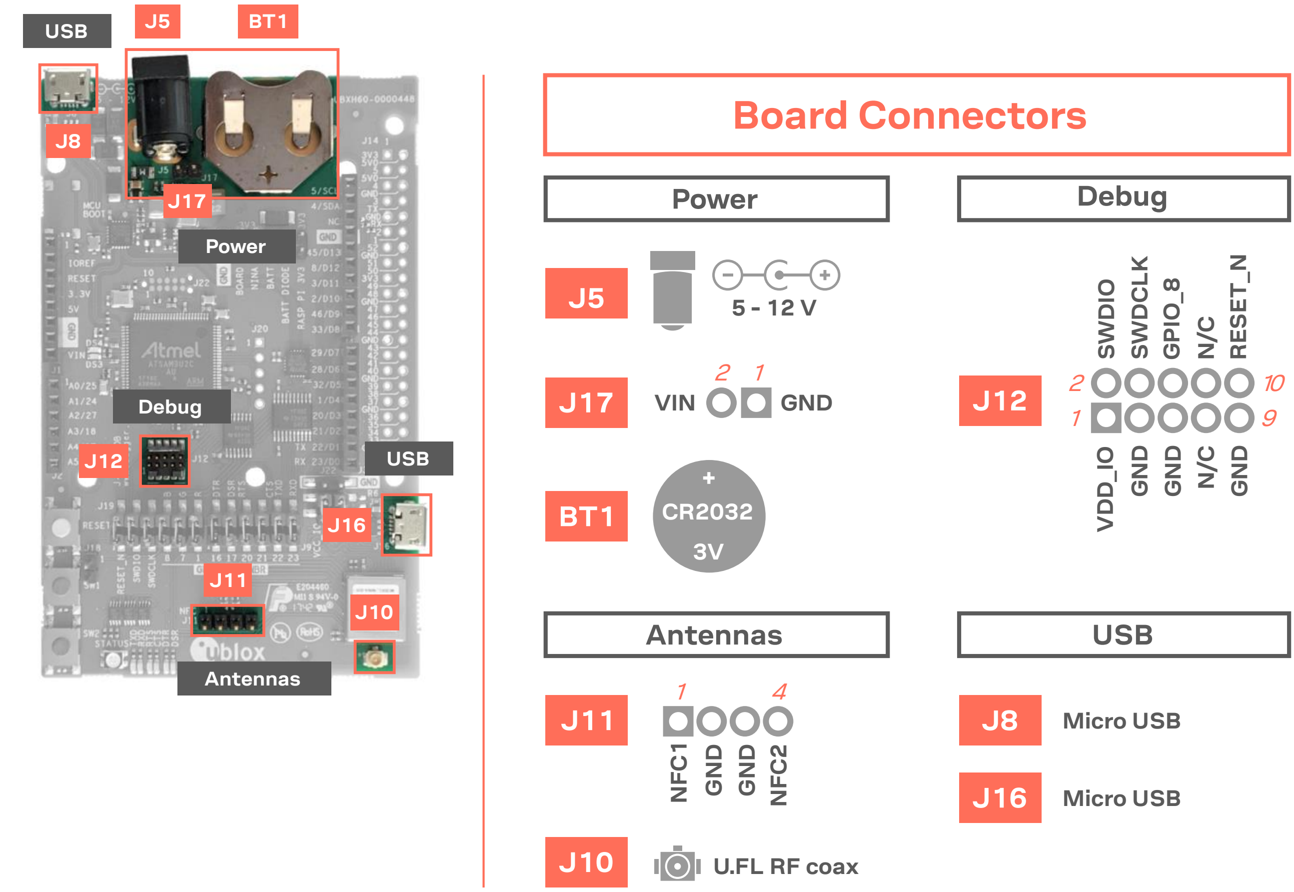


Figure 5: Available connectors and their pinout

Connector annotation	Function	Description
J5	Power supply	2.1 mm power jack, the center pin is the positive terminal. 5 – 12 V input.
J17	Power supply	Pin header that can be used to connect external power supplies. 5 – 12 V input.
BT1	Battery holder	CR2032 coin cell battery holder. CR2032 usually has a 3 V potential when fully charged.
J11	NFC antenna connector	Pin header that connects to the u-blox NFC antenna included in the kit. The antenna can be mounted in either direction.
J10	2.4 GHz RF antenna connector	U.FL coaxial connector that can be used to connect antennas or RF equipment. This connector is only included in the EVK-NINA-B301/EVK-NINA-B311.
J12	Cortex Debug connector	10-pin, 50 mil pitch connector that can be used to connect external debuggers to the NINA-B3 module. The NINA-B3 modules support Serial Wire debug (SWD) and Serial Wire Viewer, but not JTAG debug.
J8	Power supply, COM port and debug USB	The main USB connector that is used to program, debug, and communicate with the NINA module. It can also be used to power the entire board.
J16	Power supply and NINA USB port	Additional USB connector directly connected to the NINA-B3 USB interface. Can also be used to power the entire board.

Table 1: EVK-NINA-B3 connector description

3 Setting up the evaluation board

This chapter describes the procedures for starting up the EVK and includes guidelines for measuring the current consumption of the module.

☞ To accommodate alternative antenna and software solutions, several EVK-NINA-B3 variants are available. The procedures for setting up each of the board variants subsequently differ. See also Overview.

3.1 Software and hardware preparation

Complete the prerequisites described in this section before Starting up the EVK.

3.1.1 Installing software

- **EVK-NINA-B30x evaluation boards only**

  J-Link drivers are needed for programming the open CPU NINA-B30 modules. J-Link drivers are usually automatically installed on a PC correctly when the evaluation boards are plugged in. If the drivers are not installed automatically, download the J-Link driver included in the Nordic nRF Command Line Tools and follow the Installing J-Link drivers procedure to install the J-Link drivers needed for programming the open CPU NINA-B30 modules. The drivers need only be installed once when you connect the EVK to a new computer.

- **EVK-NINA-B31x evaluation boards only**

  EVK-NINA-B31x evaluation boards are pre-flashed with u-connectXpress software, which enables users to configure the module using AT commands with u-blox s-center evaluation software. To install the evaluation software, see s-center evaluation software.

3.1.2 Connecting external antennas

3.1.2.1 2.4 GHz antenna

To evaluate the 2.4 GHz radio on the EVK boards utilizing external antennas connect a 2.4 GHz antenna to the U.FL connector (J10) on the board.

The board variants that include modules with internal antennas do not need an external antenna.

3.1.2.2 NFC antenna

To use any of the board variants as an NFC tag, an NFC antenna can be connected to the NFC antenna connector (J11).

3.1.3 Power on evaluation board

Before powering on the evaluation boards, make sure that the power configuration jumpers are connected according to your use cases, as described in Powering options. The default configuration described in Selecting the power configuration jumpers works for most use cases.
Check the polarity of the EVK connector before connecting an external power supply to the evaluation board. Center conductor is positive (+) and the ring is negative (-).

Plug the external power supply to the power jack connector (J5) or connect a USB host to the USB connector (J8) with a USB cable. Alternatively, you can power on a EVK-NINA-B3 evaluation board with a CR2032 coin cell battery. See also Powering options for more details.

3.1.4 COM ports

Open the Windows Device Manager to view the two COM ports automatically assigned to the device.

- "USB Serial Port" is used to communicate with the UART interface of the module.
- "JLink CDC UART Port" can be used as an extra USB to the UART interface. See also Extra USB to UART interface.

3.2 Starting up the EVK

3.2.1 EVK-NINA-B31x

3.2.1.1 u-connectXpress software

EVK-NINA-B31 is delivered with u-connectXpress software that supports secure boot functionality that only allows signed u-blox software to boot.

☞ Go to the u-blox support webpage to get the latest available firmware. Instructions for reflashing the EVK-NINA-B3 can be found in the Software section of the NINA-B3 system integration manual [4].

3.2.1.2 s-center evaluation software

To enable communication with the module:

1. Start the u-blox s-center evaluation software.
2. Use the default baudrate 115200, 8N1 with flow control.

For a list of available AT commands, see the u-connect AT commands manual [5].

To get started with the basic use case set up of the EVK-NINA-B31, see the u-connectXpress user guide [7].

3.2.2 EVK-NINA-B30x

3.2.2.1 Nordic Semiconductor SDK

The EVK-NINA-B30x is delivered without any SW preflashed,

If you want to use the EVK-NINA-B30x together with Nordic Semiconductor SDK, refer to the Software section of the NINA-B3 System integration manual [4] that describes how to:

- Create your own board file
- Adapt the examples in the Nordic Semiconductor SDK to use this board file

See also the u-blox short range open CPU GitHub repository [8].

3.2.2.2 Software debug options

You can debug the software using the following two options in EVK-NINA-B30x:

- Onboard debug solution available on the USB connector
- Using an external debugger connected to J12 connector

An external debugger connected to the J12 connector is useful when powering the evaluation board with a CR2032 coin cell battery, or through the J5 external power supply connector. It could also be useful in a scenario where the debug MCU interface has been disconnected from the NINA-B3 module using the jumpers on the J19 header.

SEGGER J-Link software [6] is required in order to debug using the onboard J-Link hardware on the EVK-NINA-B30x.

3.3 Measuring current consumption

☞ Before starting the current consumption measurement, go through the Board configuration to determine which power configuration you need and what NINA signals must be isolated. The jumper connecting J22 pins 1 and 3 must be removed to measure the current consumption.

Figure 6 shows some suggestions for measuring the current consumption of the NINA-B3 module describes how to connect the various instruments.

3.3.1 Using an amperemeter

An amperemeter should be connected in series with the power source regardless of what is being measured. In this way, the current can be measured when the NINA module is supplied from either the onboard 3.3 V regulator or an external supply.

3.3.2 Using a voltmeter

The EVK board must be modified before module current can be measured with a voltmeter.

To modify the board, solder a low resistance, high-tolerance, 0402 sized resistor to the footprint labeled R6. This resistor replaces the jumper normally positioned between J22 pins - 1 and 3 so that any current running through it produces a voltage across its terminals. Measure this voltage with the voltmeter and calculate the current using Ohm's law.

3.3.3 Using an external power supply or power analyzer

To measure the power consumption of the NINA modules, connect the instrument terminals to the J22 pins, as shown in Figure 6. Since the external voltage of any connected instrument can never perfectly match the 3.3 V generated by the EVK, some small current leakage is apparent whenever the signal from the ANNA module is connected to an EVK peripheral. The leakage is typically in the order of one to several hundred nano amps.

To reduce leakage current, use a second external power channel to supply the EVK peripherals. This second channel must also be used to enable PC communication when using any NINA supply voltages other than 3.3 V.

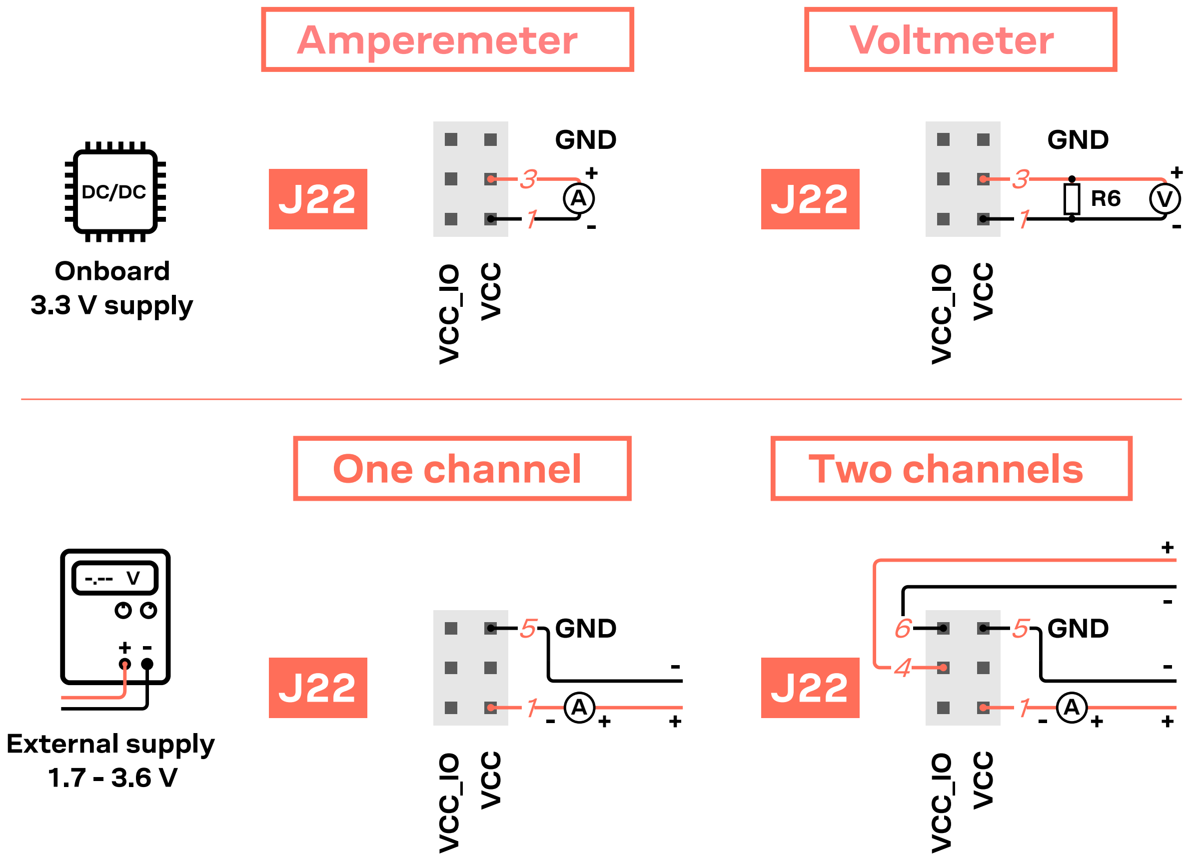


Figure 6: Current consumption measuring options

4 Board configuration

4.1 Powering options

Power can be supplied to the board in any of the following ways:

- Via any of the USB connectors, J8 or J16
- Using the power jack, J5
- Using the Arduino interface VIN or 5V pin, J1.8 or J1.5
- Using the Raspberry Pi interface 5V pins, J14.2 or J14.4
- Using the pin header J17
- Plugging in a battery to the battery holder BT1

These power supply sources are distributed to the rest of the board as shown in Figure 7.

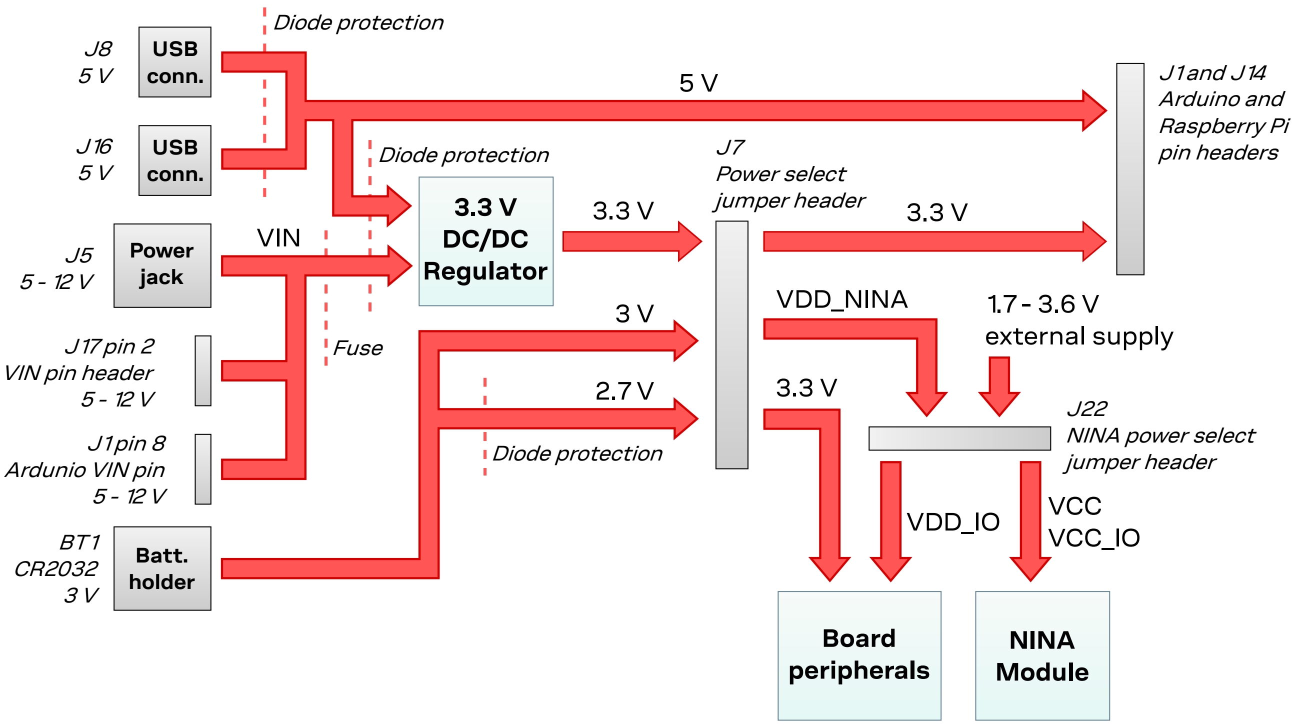


Figure 7: Block diagram of the power net distribution

4.1.1 Selecting the power configuration jumpers

The EVK-NINA-B3 offers flexible powering options for the NINA-B3 module and the board itself. To configure this, jumpers are added or removed to pin headers, shorting two of the pins together and connecting or disconnecting different power nets on the evaluation board.

Figure 8 provides an overview of the available EVK power sources and shows the schematic net names to which they are connected.

⚠ Check the jumper positions carefully; if a jumper is connected in a wrong way, it can permanently damage the components that are ON or connected to the board. Also note that some jumpers should not be mounted simultaneously.

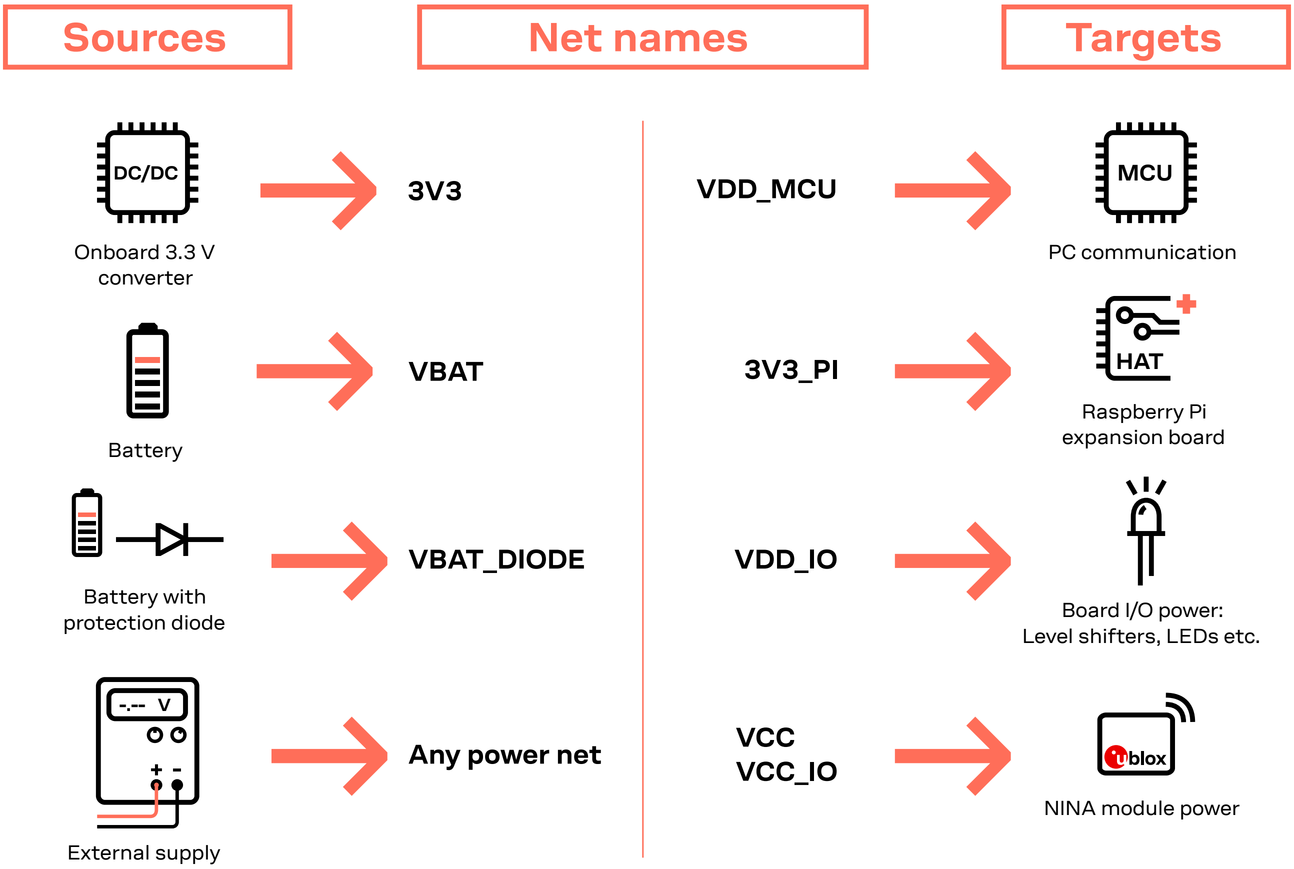


Figure 8: Available EVK power sources and targets

Figure 9 shows the pinout location of power configuration jumper headers J7 and J22.

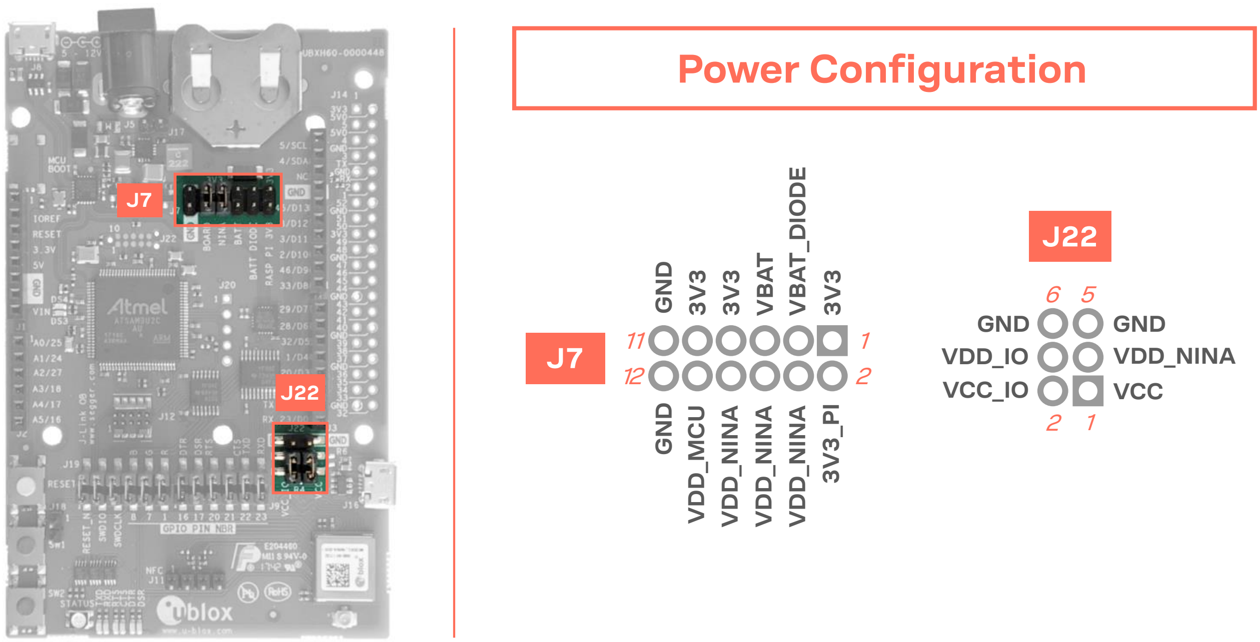


Figure 9: Jumper headers J7 and J22

Table 2 describes the pinout of jumper headers J7 and J22 used to configure the board power nets.

Connector annotation	Pin number	Schematic net name	Description
J7	1	3V3	Regulated 3.3 V net. This net is supplied by the board and will always be powered as long as a power source is connected.
	2	3V3_PI	Connects to the Raspberry Pi header's (J14) 3V3 pins. If a Raspberry Pi is connected, this net must be unconnected to prevent back currents. If a HAT is connected, this net can be shorted to the EVK 3.3 V supply to power the HAT.
	3	VBAT_DIODE	To protect the battery from current back surges, connect the battery to the NINA module via a protection diode using this pin.
	4	VDD_NINA	Connects to J22 pin 3, from where it can be connected to the module supply pin or somewhere else.
	5	VBAT	Battery + terminal
	6	VDD_NINA	Connects to J22 pin 3, from where it can be connected to the module supply pin or somewhere else.
	7	3V3	Regulated 3.3 V net. This net is supplied by the board and will always be powered as long as a power source is connected.
	8	VDD_NINA	Connects to J22 pin 3, from where it can be connected to the module supply pin or somewhere else.
	9	3V3	Regulated 3.3 V net. This net is supplied by the board and will always be powered as long as a power source is connected.
	10	VDD_MCU	Supply net for the board functions not directly connected to the NINA module; Interface MCU, USB hub, UART to USB converter etc.
	11	GND	Ground net.
	12	GND	Ground net.
J22	1	VCC	NINA module voltage supply that connects to the module VCC pin. Shorted to the VCC_IO net via 0 Ω resistor R4 by default.
	2	VCC_IO	Connects to the NINA module VCC_IO pin. Shorted to the VCC net via 0 Ω resistor R4 by default.
	3	VDD_NINA	Connects to J7 pins 4, 6 and 8. Short J22 pins 1 and 3 allow the EVK to power the NINA module.
	4	VDD_IO	Supply net for level shifters, LEDs and peripherals connected directly to the NINA module. Short J22 pins 2 and 4 use the NINA module I/O voltage as supply.
	5	GND	Ground net.
	6	GND	Ground net.

Table 2: J7 and J22 pin out

4.1.2 Default power configuration, 3.3 V

This is the default power configuration for the evaluation board, and the jumpers are installed out of the box with this power configuration. All board peripherals are powered up, the NINA module is directly supplied by the board and everything is running at 3.3 V.

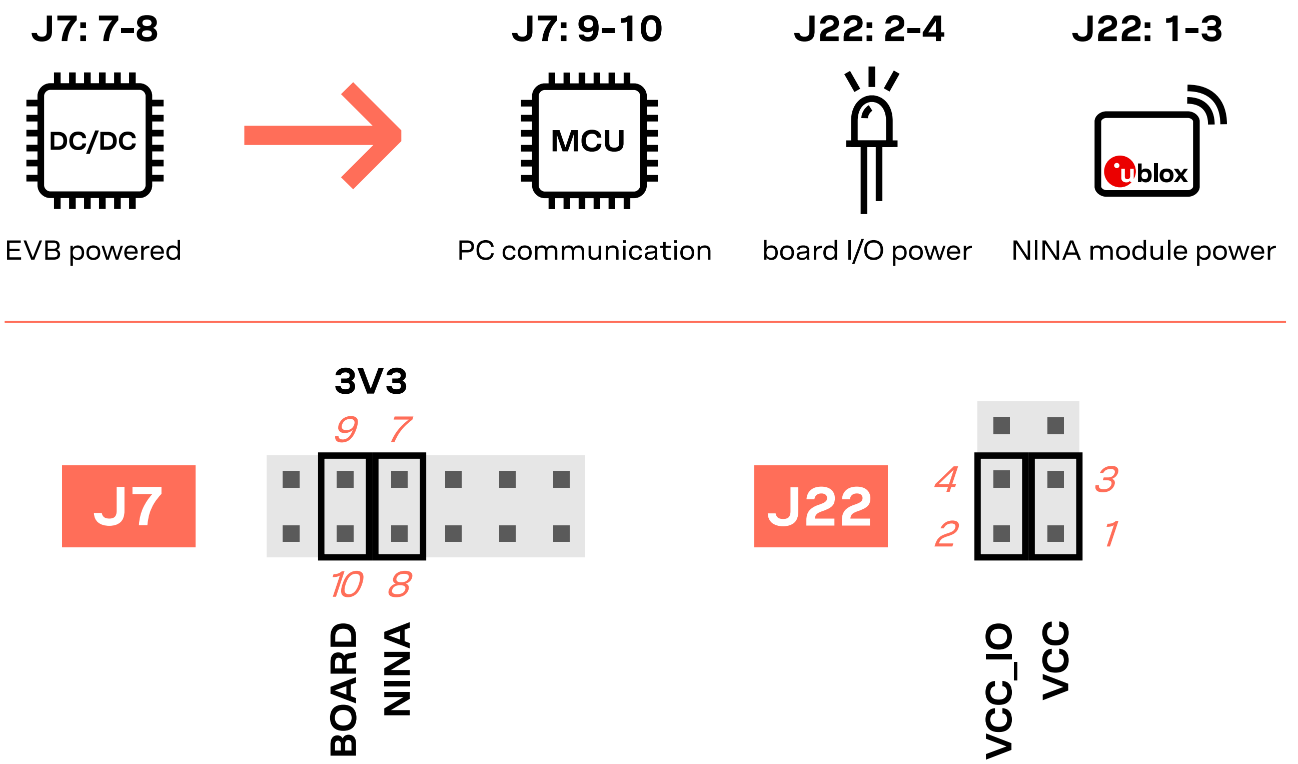


Figure 10: Jumper positions for default power configuration

Connector annotation	Add jumper to pins	Description
J7	7, 8	Selects the board regulated 3.3 V net as source for the VDD_NINA net.
	9, 10	Powers up the Interface MCU, USB hub, and UART to USB converter with 3.3 V.
J22	1, 3	Powers up the NINA module. The NINA VCC and VCC_IO pins are connected to the selected source for the VDD_NINA net.
	2, 4	Powers up the peripherals directly connected to NINA such as LEDs and external memory with the NINA supply voltage.

Table 3: Jumper positions for default power configuration

4.1.3 Battery powered, 3 – 1.7 V

Figure 11 shows the default configuration for battery-powered operation, where the jumpers highlighted with dashed lines are optional.

The battery voltage is connected to **VDD_NINA**, which in turn, is connected to the NINA-B3 **VCC** supply. If needed, a jumper can be added to J22 pins - 2 and 4 to supply LEDs and other peripherals with power – as long as this does not exceed the maximum current rating of the battery. If the NINA module has to be configured, the **VDD_MCU** net can be connected to enable PC communications by adding a jumper to the J7 pins 9 and 10.

☞ Jumpers must be connected to both J7: 9-10 and J22: 2-4 to be able to communicate with the NINA module from a PC. If possible, the EVB power configuration should be switched to the default 3.3 V configuration, as connecting an extra board peripheral might deplete the battery.

⚠ Do not connect jumpers J7: 5-6 and J7: 7-8 at the same time while a battery is connected! This might cause damage to the battery.

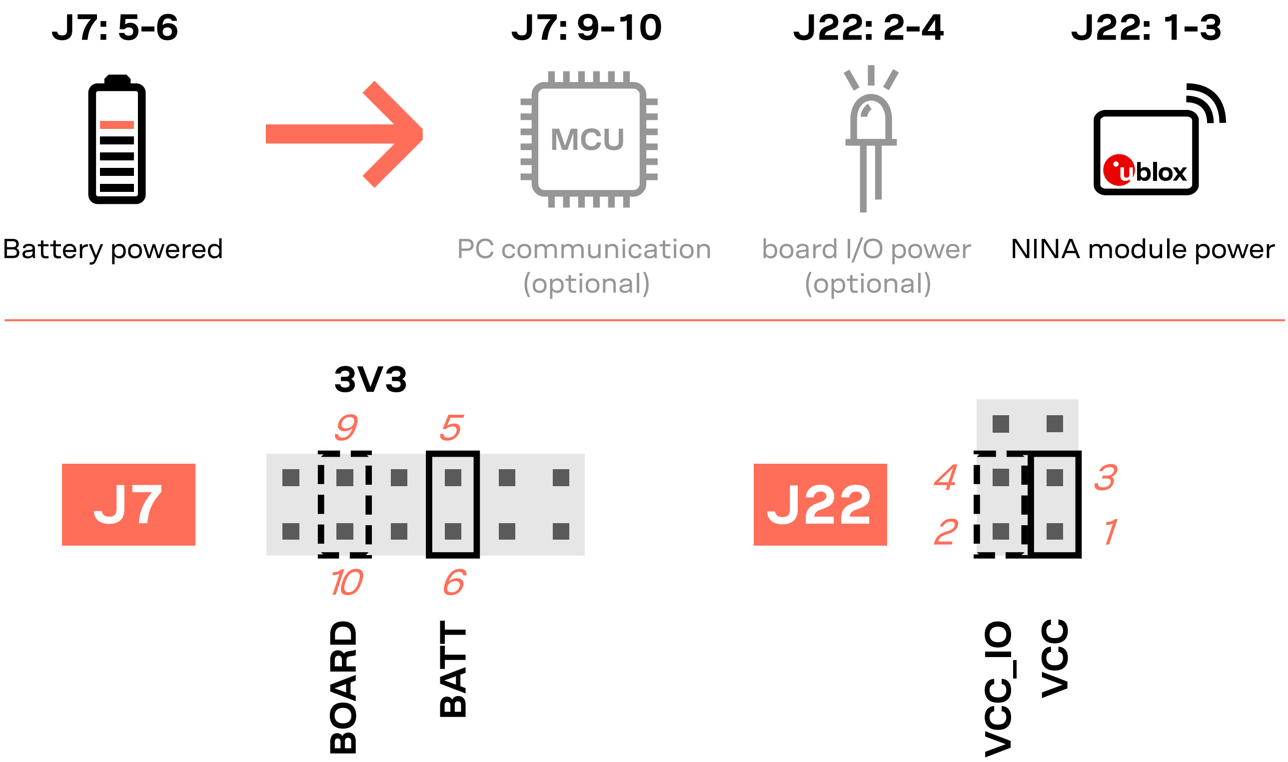


Figure 11: Jumper positions for battery powered operation (jumpers shown with dashed lines are optional)

Connector annotation	Add jumper to pins	Description
J7	5, 6	Selects the battery connected to the battery holder as source for the VDD_NINA net.
	9, 10	(Optional) Powers up the Interface MCU, USB hub, and UART to USB converter with 3.3 V.
J22	1, 3	Powers up the NINA module. The NINA VCC and VCC_IO pins are connected to the selected source for the VDD_NINA net.
	2, 4	(Optional) Powers up the peripherals directly connected to NINA such as LEDs and external memory with the NINA supply voltage.

Table 4: Jumper positions for battery powered operation (two optional jumpers)

4.1.4 Battery powered with protection diode, 2.7 – 1.7 V

This use case is meant to protect the battery from current back surges. When using the NFC interface, there is a risk that the applied electromagnetic field can cause back surges on the module power supply lines that typically damage a non-chargeable battery. To prevent this potential damage, a schottky diode is added in series with the battery to block any back current surges.

Figure 12 shows the jumper configuration for connecting the diode for battery-powered operation, where the jumper is added to J7 pins 3 and 4 instead of pins 5 and 6. The jumpers shown in dashed lines are optional.

☞ The diode will lower the voltage level of the battery by about 0.3 V.

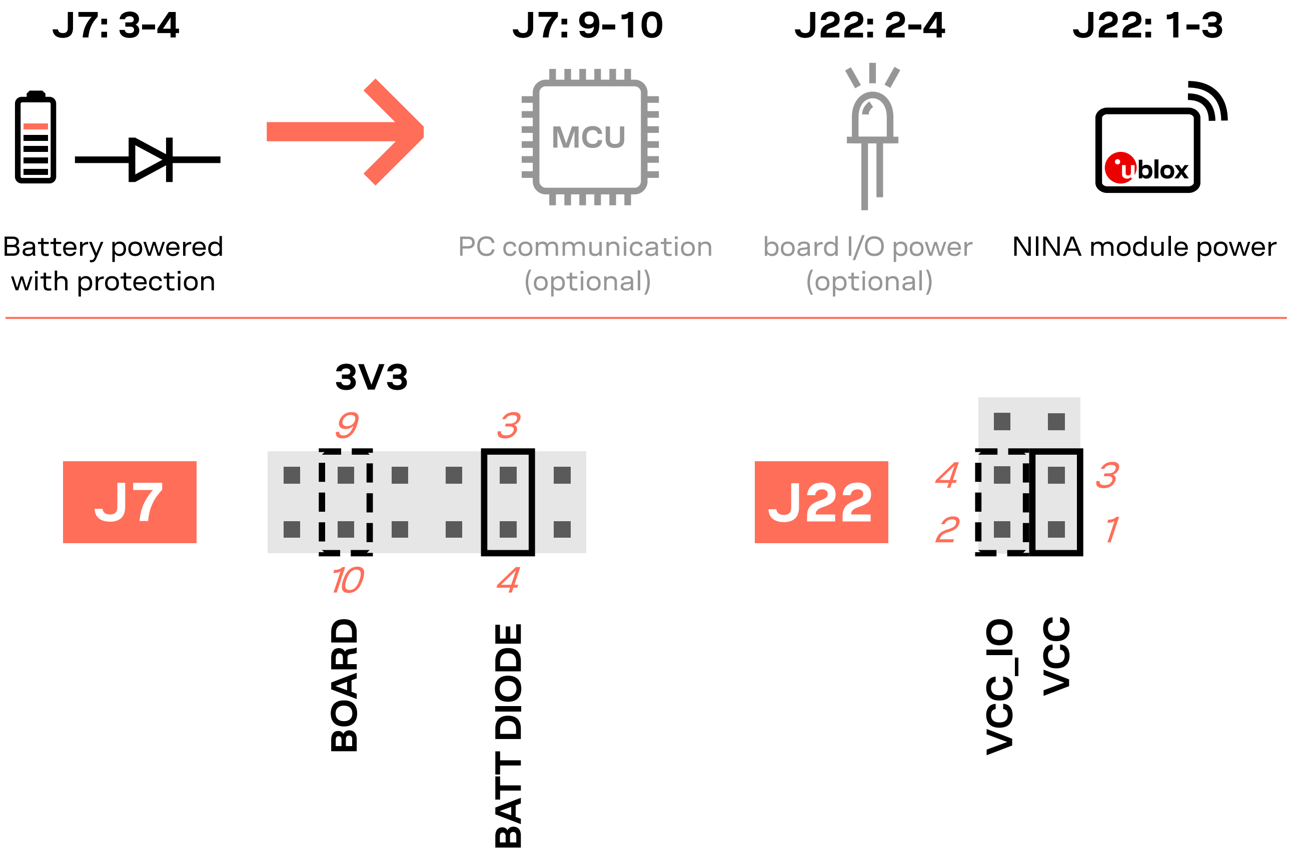


Figure 12: Jumper positions for battery powered operation using the protection diode

Connector annotation	Add jumper to pins	Description
J7	3, 4	Selects the diode protected battery as a source for the VDD_NINA net.
	9, 10	(Optional) Powers up the Interface MCU, USB hub, and UART to USB converter with 3.3 V.
J22	1, 3	Powers up the NINA module. The NINA VCC and VCC_IO pins are connected to the selected source for the VDD_NINA net.
	2, 4	(Optional) Powers up the peripherals directly connected to NINA such as LEDs and external memory with the NINA supply voltage.

Table 5: Jumper positions for battery powered operation with a protection diode (two optional jumpers)

4.1.5 External supply, 3.6 – 1.7 V

When measuring current consumption or performing other NINA-B3 module characterization measurements, it can be useful to power the module with an external source such as a lab power supply. In such a case, all jumpers can be removed and the required supply nets can be fed externally by connecting to the pin headers. For example, the NINA-B3 module can be powered by connecting an external supply directly to the J22 pin 1 and GND. For more information on how to connect external power supplies, see Measuring current consumption.

☞ Make sure that unpowered parts of the board are properly isolated from the NINA module. If a voltage is applied to the signal of an unpowered device/component, current might leak through various protection circuits of this device. This might give false readings when measuring current consumption etc. Isolation can be achieved by removing NINA signal jumpers. For example, see Disconnecting NINA signals from board peripherals.

Figure 13 below shows a few optional jumper connections that can be helpful when supplying the module with an external supply.

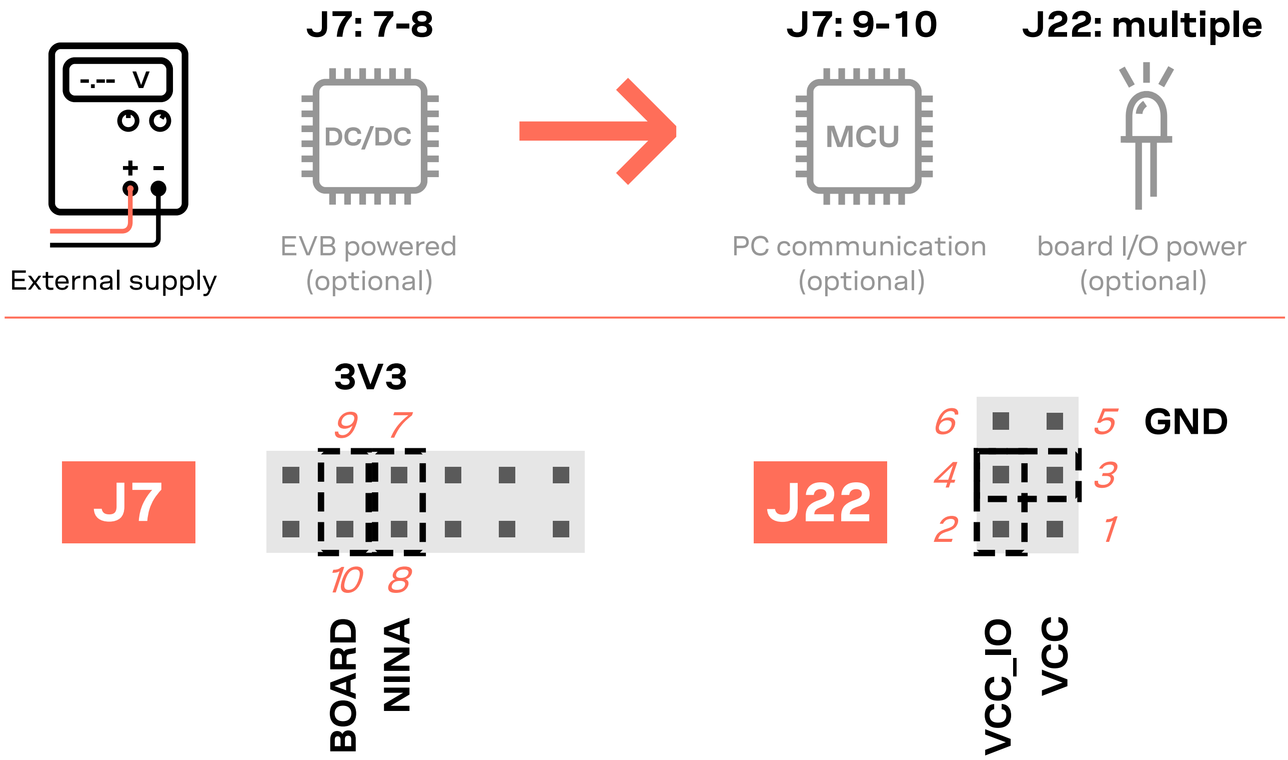


Figure 13: Optional jumper positons while using an external power supply

Table 6 shows the optional jumper positions for configuring the power up behavior of the board when using an external supply.

Connector annotation	Add jumper to pins	Description
J7	7, 8	(Optional) Selects the board-regulated 3.3 V net as a source for the VDD_NINA net.
	9, 10	(Optional) Powers up the Interface MCU, USB hub, and UART to USB converter with 3.3 V.
J22	3, 4	(Optional) Powers up the peripherals directly connected to NINA such as LEDs and external memory with the selected source for the VDD_NINA net.

Table 6: Optional jumper positions for use with an external supply

4.1.6 Raspberry Pi HAT

Use the jumper configurations shown in Figure 14 to connect a HAT to the Raspberry Pi interface. Depending on how the NINA module should communicate with a test PC over USB or with the HAT, the **VDD_MCU** net could be left unpowered. The jumpers shown in dashed lines are optional.

⚠ The **3V3_PI** supply net must only be powered when connecting to a Raspberry Pi expansion board (HAT). The jumper (J7: 1-2) must be disconnected if you are connecting to a Raspberry Pi board.

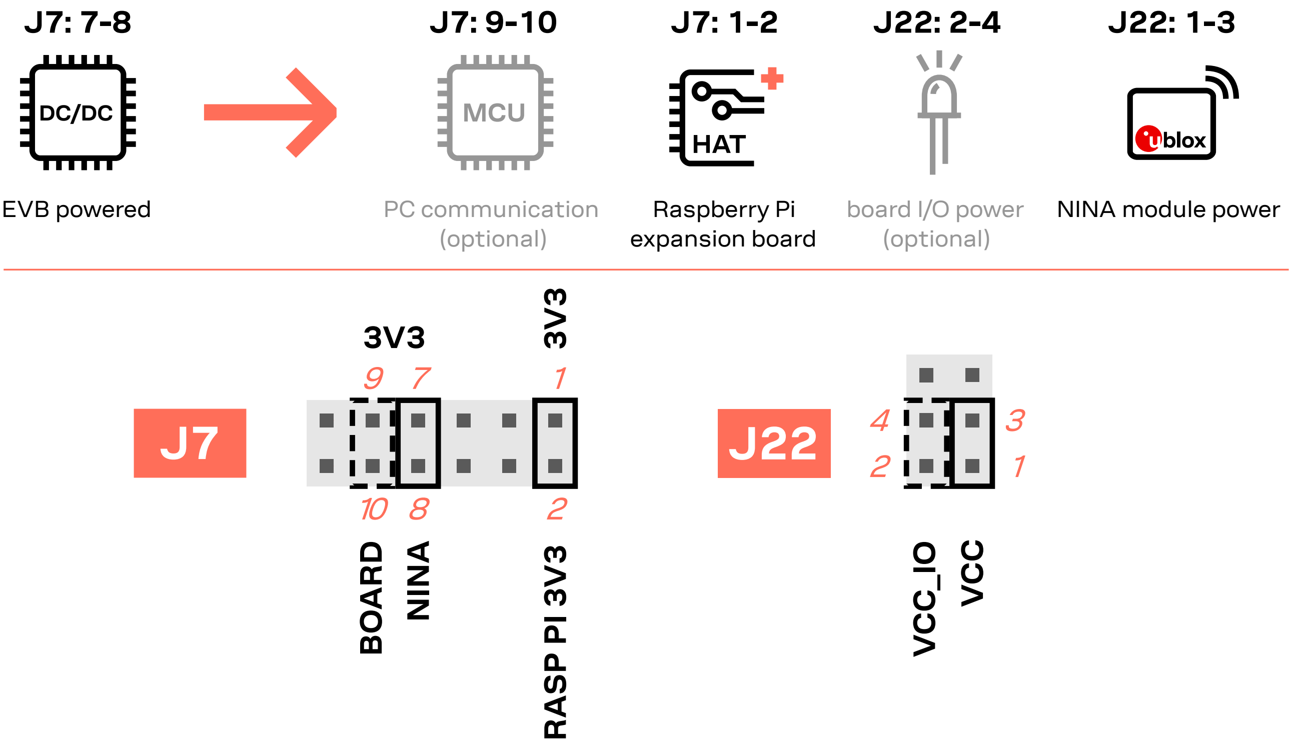


Figure 14: Configuration for Raspberry Pi HAT connection (optional jumpers shown with dashed lines)

Connector annotation	Add jumper to pins	Description
J7	1,2	Connects the 3V3_PI net to the regulated 3.3 V supply.
	7, 8	Selects the board regulated 3.3 V net as a source for the VDD_NINA net.
	9, 10	(Optional) Powers up the Interface MCU, USB hub, and UART to USB converter with 3.3 V.
J22	1, 3	Powers up the NINA module. The NINA VCC and VCC_IO pins are connected to the selected source for the VDD_NINA net.
	2, 4	(Optional) Powers up the peripherals directly connected to NINA such as LEDs and external memory with the NINA supply voltage.

Table 7: Jumper configuration when connected to a Raspberry Pi HAT

4.2 Disconnecting NINA signals from board peripherals

All evaluation board peripherals, such as level shifters, LEDs, and the interface MCU are connected to the NINA-B3 module by default. This might not suit all evaluation scenarios.

All peripherals can be switched off by disconnecting their power supplies (see also Powering options), but if only specific signals have to be isolated, it will require finer control. All the NINA module signals that are connected to board peripherals have thus been routed via jumper headers, so that jumpers can be pulled or added as needed by the evaluation board user, isolating, or connecting specific signals. Figure 15 shows the physical layout of these jumper headers.

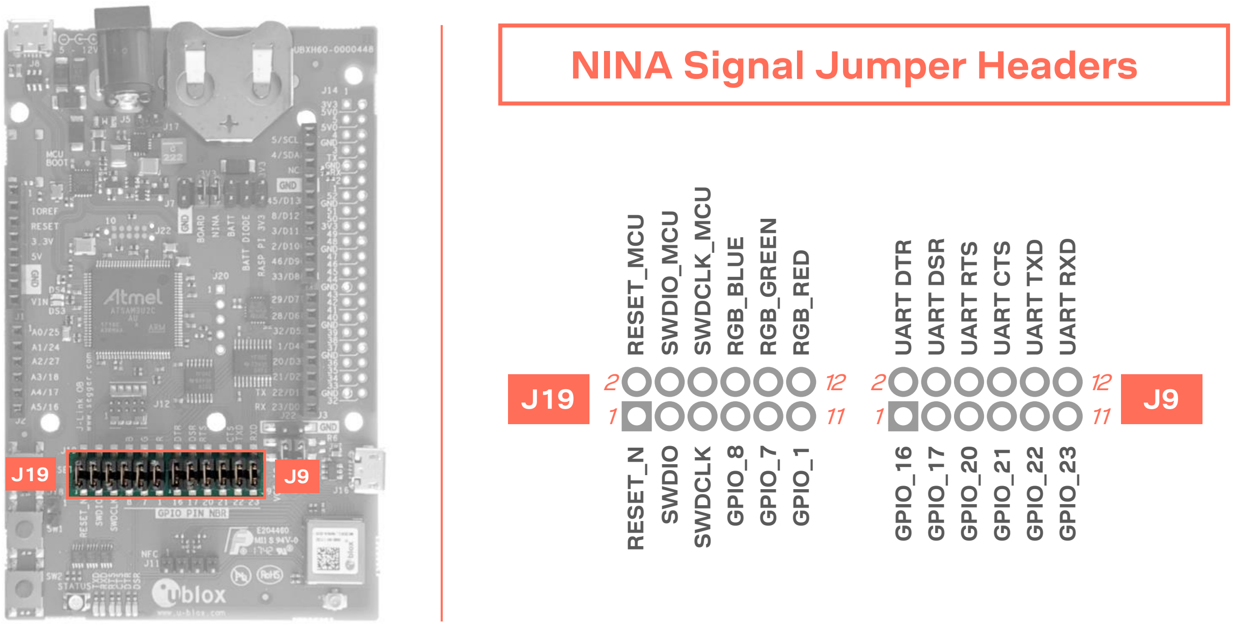


Figure 15: Jumper headers J19 and J9 used to isolate specific NINA signals

Table 8 describes the pinout for the jumper headers, J19 and J9, used for isolating or connecting specific evaluation board peripherals that are connected to the NINA-B3 module by default.

Connector annotation	Pin number	Schematic net name	Description
J19	1	RESET_N	NINA reset signal, active low
	2	RESET_N_I	Connects to the Interface MCU's reset line
	3	SWDIO	SWD data signal
	4	SWDIO_I	Interface MCU SWD data signal, used to program/debug the NINA module
	5	SWDCLK	SWD clock signal
	6	SWDCLK_I	Interface MCU SWD data signal, used to program/debug the NINA module
	7	GPIO_8	NINA-B30: GPIO or TRACE NINA-B31: BLUE signal
	8	BLUE	RGB diode blue signal, active low
	9	GPIO_7/ SWITCH_1	NINA-B30: GPIO, can be used as either user LED output or push-button input NINA-B31: SWITCH_1 and GREEN signal
	10	GREEN	RGB diode green signal, active low
	11	GPIO_1	NINA-B30: GPIO, can be used as user LED output NINA-B31: RED signal
	12	RED	RGB diode red signal, active low
J9	1	GPIO_16/ UART_DTR	NINA-B30: analog capable GPIO signal NINA-B31: UART DTR output
	2	UART_DTR_I	UART to USB DTR signal
	3	GPIO_17/ UART_DSR	NINA-B30: analog capable GPIO signal NINA-B31: UART DSR input
	4	UART_DSR_I	UART to USB DSR signal
	5	GPIO_20/ UART_RTS	NINA-B30: analog capable GPIO signal NINA-B31: UART RTS output

Connector annotation	Pin number	Schematic net name	Description
	6	UART_RTS_I	UART to USB RTS signal
	7	GPIO_21/ UART_CTS	NINA-B30: GPIO signal NINA-B31: UART CTS input
	8	UART_CTS_I	UART to USB CTS signal
	9	GPIO_22/ UART_TXD	NINA-B30: GPIO signal NINA-B31: UART TXD output
	10	UART_TXD_I	UART to USB TXD signal
	11	GPIO_23/ UART_RXD	NINA-B30: analog capable GPIO signal NINA-B31: UART RXD input
	12	UART_RXD_I	UART to USB RXD signal

Table 8: Pinout of the jumper headers - J19 and J9

5 Interfaces and peripherals

5.1 Buttons and LEDs

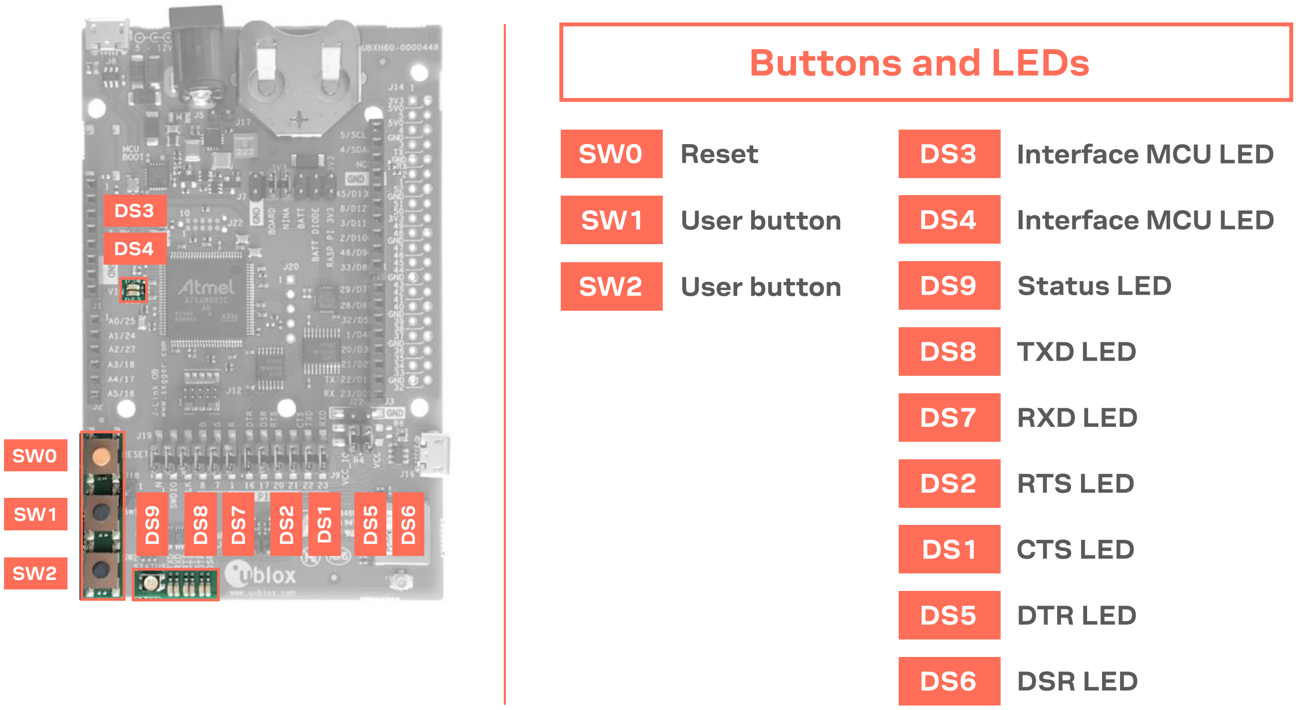


Figure 16: Position of the push buttons and LEDs on the evaluation board

Annotation	Function	Description
SW0	Reset button	Connected directly to the NINA RESET_N pin.
SW1	User button	Push button for application use. Connected directly to the NINA SWITCH_1 (GPIO_7) pin
SW2	User button	Push button for application use. Connected directly to the NINA SWITCH_2 (GPIO_18) pin.

Table 9: EVK-NINA-B3 buttons

Annotation	Function	Description	Color
DS1	UART CTS LED	Connected to the NINA UART_CTS (GPIO_21) pin via jumper header J9	Green
DS2	UART RTS LED	Connected to the NINA UART_RTS (GPIO_20) pin via jumper header J9	Orange
DS3	Interface MCU LED	Blinks on USB enumeration and activity, lit when the Interface MCU is connected via USB	Green
DS4	Interface MCU LED	Error LED	Orange
DS5	UART DTR LED	Connected to the NINA UART_DTR (GPIO_16) pin via jumper header J9	Orange
DS6	UART DSR LED	Connected to the NINA UART_DSR (GPIO_17) pin via jumper header J9	Green
DS7	UART TXD LED	Connected to the NINA UART_TXD (GPIO_22) pin via jumper header J9	Orange
DS8	UART RXD LED	Connected to the NINA UART_RXD (GPIO_23) pin via jumper header J9	Green
DS9	RGB LED	Connected to the NINA RED (GPIO_1), GREEN (GPIO_7) and BLUE (GPIO_8) pins via jumper header J19. The RGB LED shows the status for the u-connect applications. ☞ See the NINA-B3 data sheet [3] for additional information.	RGB

Table 10: EVK-NINA-B3 LED indicators

5.2 Arduino interface

The EVK-NINA-B3 includes a set of pin headers and mounting holes that are compatible with certain Arduino or Arduino inspired shields. Figure 17 shows the layout of the Arduino interface and Table 11 explains the pinout in more detail. For information about the specifications that must be met for a shield to be compatible with the EVK-NINA-B3, see Arduino shield compatibility.

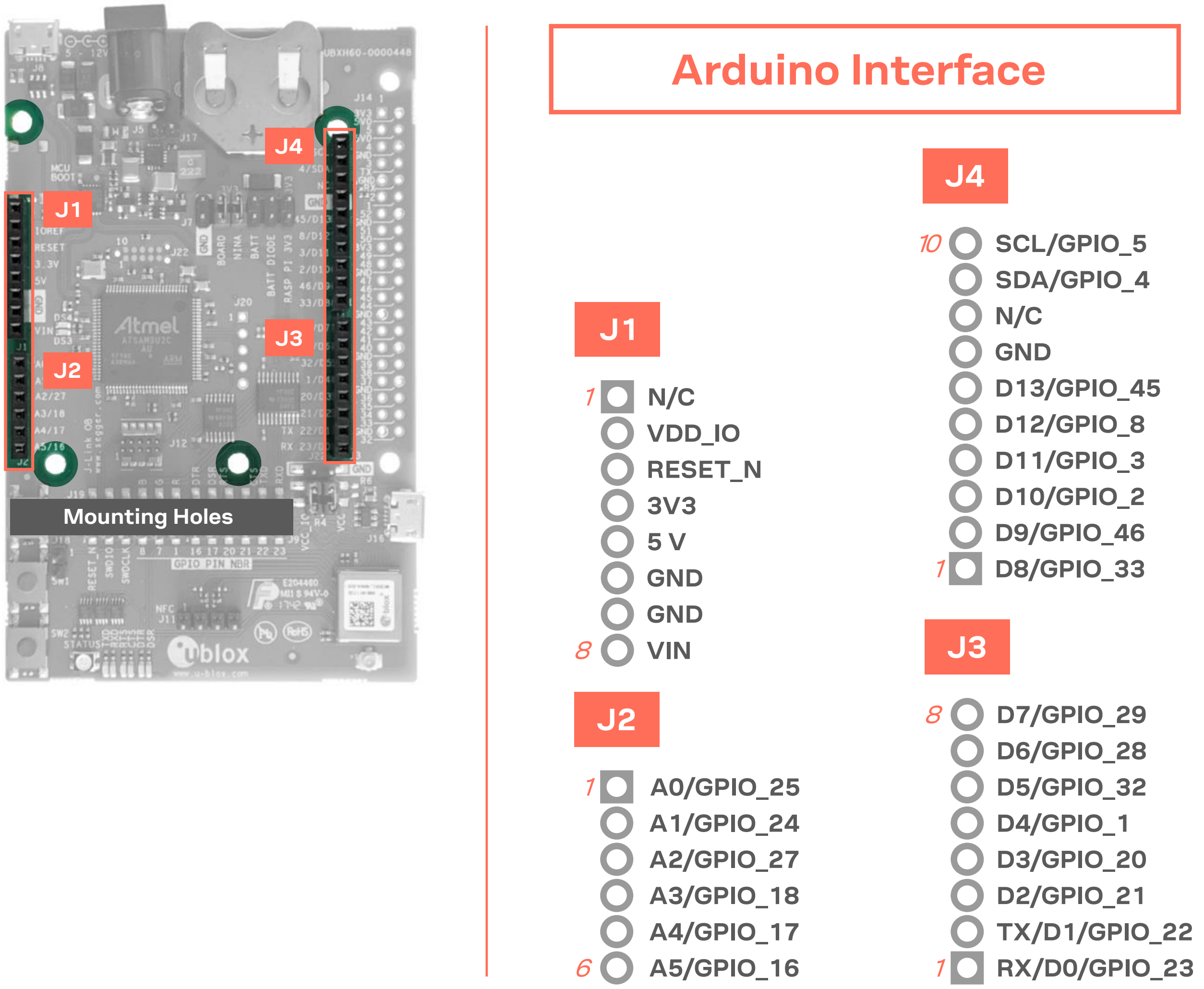


Figure 17: Pin headers that are compatible with some Arduino shields

Conn.	Pin No.	Arduino pin	Description	Schematic net name	nRF52 pin	Alternate functions and notes
J1	1	N/C	Not Connected	-	-	Not connected
	2	IOREF	I/O reference voltage level. Selectable by user to 1.7 – 3.6 V	VDD_IO	-	See section 4.1
	3	RESET	NINA reset signal input. Active low logic	RESET_N	P0.18	
	4	3.3V	3.3 V DC regulated supply output	3V3	-	
	5	5V	5 V regulated supply output	5V	-	Cannot be used as supply input, use VIN instead. Only supplied by USB VBUS.
	6	GND	Ground	GND	GND	
	7	GND	Ground	GND	GND	
	8	VIN	External DC supply input, 5 – 12 VDC	VIN	-	
J2	1	A0	Analog input	GPIO_25	P0.04	Analog function capable GPIO

Conn.	Pin No.	Arduino pin	Description	Schematic net name	nRF52 pin	Alternate functions and notes
	2	A1	Analog input	GPIO_24	P0.30	Analog function capable GPIO
	3	A2	Analog input	GPIO_27	P0.05	Analog function capable GPIO
	4	A3	Analog input	SWITCH_2/ GPIO_18	P0.02	Analog function capable GPIO, SWITCH_2 on NINA-B31. This signal is pulled low when the button SW2 is pressed.
	5	A4	Analog input	UART_DSR/ GPIO_17	P0.28	Analog function capable GPIO, UART_DSR signal on NINA-B31
	6	A5	Analog input	UART_DTR/ GPIO_16	P0.03	Analog function capable GPIO, UART_DTR signal on NINA-B31
J3	1	D0/RX	Digital I/O, UART RX	UART_RXD/ GPIO_23	P0.29	UART_RXD signal on NINA-B31
	2	D1/TX	Digital I/O, UART TX	UART_TXD/ GPIO_22	P1.13	UART_TXD signal on NINA-B31
	3	D2	Digital I/O	UART_CTS/ GPIO_21	P1.12	UART_CTS signal on NINA-B31
	4	D3	Digital I/O	UART_RTS/ GPIO_20	P0.31	UART_RTS signal on NINA-B31
	5	D4	Digital I/O	GPIO_1	P0.13	
	6	D5	Digital I/O	GPIO_32	P0.11	
	7	D6	Digital I/O	GPIO_28	P0.09	Signal not connected by default. Configured for NFC use.
	8	D7	Digital I/O	GPIO_29	P0.10	Signal not connected by default. Configured for NFC use.
J4	1	D8	Digital I/O	GPIO_33	P1.09	
	2	D9	Digital I/O	GPIO_46	P0.12	
	3	D10	Digital I/O	GPIO_2	P0.14	
	4	D11	Digital I/O	GPIO_3	P0.15	
	5	D12	Digital I/O	GPIO_8	P1.00	
	6	D13	Digital I/O	GPIO_45	P0.07	
	7	GND	Ground	GND		
	8	AREF	Analog reference voltage level	-	-	Not connected
	9	SDA	I2C data signal	GPIO_4	P0.16	
	10	SCL	I2C clock signal	GPIO_5	P0.24	

Table 11: Pinout of the Arduino UNO R3 compatible interface

5.2.1 Arduino shield compatibility

☞ The EVK-NINA-B3 has an I/O voltage range of 1.7–3.6 V. It can therefore be used only with shields that also support an I/O voltage within this range.

The EVK-NINA-B3 has a pinout that is compatible with some Arduino, or Arduino inspired, shields. This section describes the features of certain EVK pins that a shield must comply with:

- **IOREF**: The I/O voltage level of the NINA-B3 module is 3.3 V by default, but the EVK can be modified to allow other voltages (1.7-3.6 V).
- **RESET**: Is connected to the RESET button (SW0).
- **3V3**: A regulated 3.3 V output. Should not be used as a voltage supply input, use the VIN pin instead.

- **5V**: Is only a 5 V supply output if the EVK is being powered by USB. If any other power configuration is used, this pin will be unconnected (floating). It is safe to connect an external 5 V supply to this pin even when a USB cable is connected. This pin may be used to power the board.
- **VIN**: May be used as a 5 -12 V supply input to power the EVK-NINA-B3.
- Pin 0 (**RX**): Is connected to the NINA-B3 UART RX pin (NINA pin 23).
- Pin 1 (**TX**): Is connected to the NINA-B3 UART TX pin (NINA pin 22).

Note on SCL/SDA: On some Arduino boards, the I2C signals, SCL, and SDA are connected to the pins A4 and A5 and to the SCL and SDA pins in the top right-hand corner. Since these pins will be shorted together it might cause problems when connected to the EVK-NINA-B3, which has not shorted these pins together.

Note on digital I/O pins: Some of the digital I/O pins can be connected to the on-board debug MCU, thus allowing serial communication and flashing/debugging over USB. This can cause interference on the signals that are also used by an Arduino shield. For information about how to disconnect these signals from the debug MCU, see also Disconnecting NINA signals from board peripherals.

5.3 Raspberry Pi compatible interface

The EVK-NINA-B3 includes a 40-pin GPIO header that can be used to interface with either a Raspberry Pi computer board or with a Raspberry Pi expansion board (HAT). The EVK-NINA-B3 uses different hardware and software configurations depending on if it is connected to a Pi or a HAT; the differences are covered in this section. The default configuration is to connect to a Pi.

Not all the Raspberry Pi versions and HATs are supported, since it requires the 40-pin GPIO header, which older versions did not have. Table 12 lists the compatible Raspberry Pi versions.

Compatible Raspberry Pi boards
Raspberry Pi 1 Model A+
Raspberry Pi 1 Model B+
Raspberry Pi 2 Model B
Raspberry Pi 3 Model B
Raspberry Pi Zero
Raspberry Pi Zero W

Table 12: Compatible Raspberry Pi boards

Figure 18 shows the layout of the Raspberry Pi interface and Table 13 explains the pinout in detail. There are three mounting holes that can be used for increased mechanical stability. The two holes on either side of connector J14 are common to all Raspberry Pi boards, but the third one is only compatible with the Pi Zero boards.

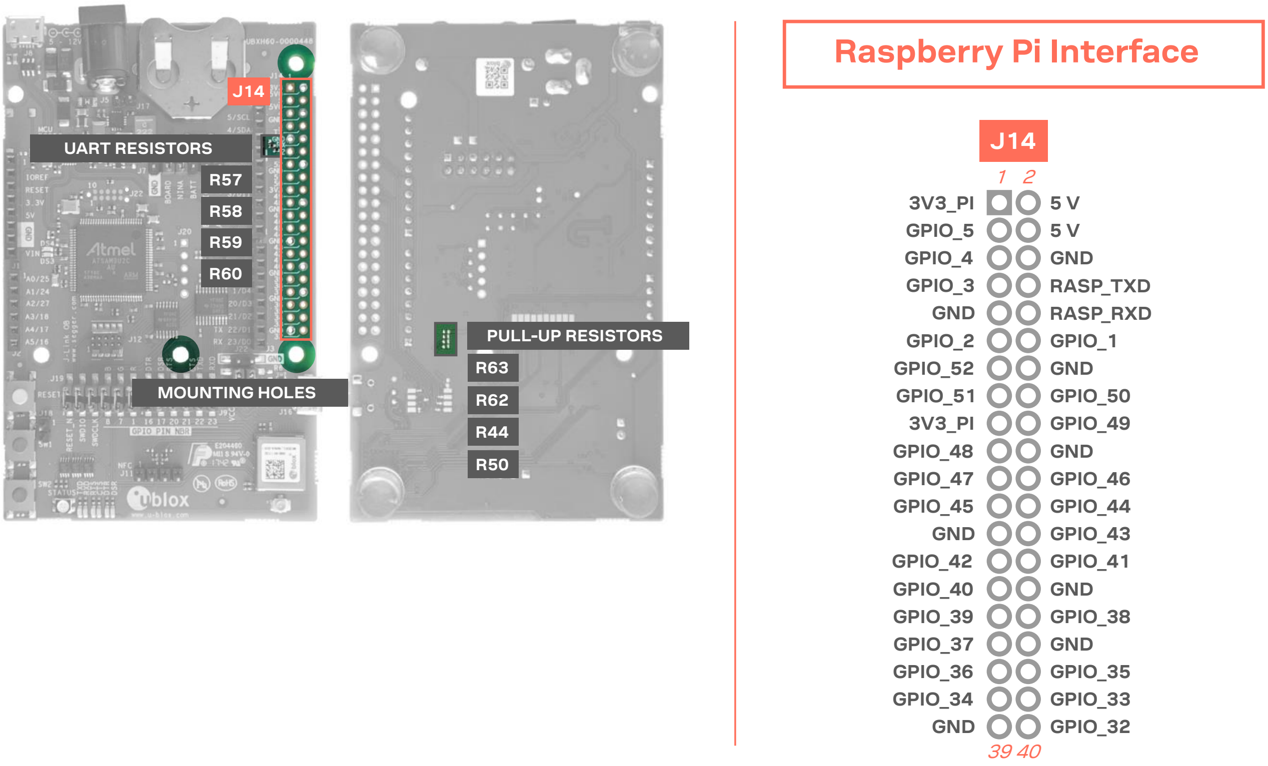


Figure 18: Pin header J14 that is compatible with the Raspberry Pi GPIO connectors

Conn.	Pin No.	Raspberry Pi pin	Description	Schematic net name	nRF52 pin	Alternate functions and notes
J14	1	3.3 V	3.3 V supply pin	3V3_PI	-	Not connected by default. See section 4.1.
	2	5 V	5 V supply pin	5V	-	Cannot be used as supply input. Supplied by USB VBUS and protected from back powering.
	3	GPIO02	Digital I/O	GPIO_5	P0.24	
	4	5 V	5 V supply pin	5V	-	Cannot be used as supply input. Supplied by USB VBUS and protected from back powering.
	5	GPIO03	Digital I/O	GPIO_4	P0.16	
	6	GND	Ground	GND	GND	
	7	GPIO04	Digital I/O	GPIO_3	P0.15	
	8	GPIO14	Digital I/O, UART TX/RX	RASP_TXD	P0.29	Connected to NINA UART_RXD pin by default. See UART.
	9	GND	Ground	GND	GND	
	10	GPIO15	Digital I/O, UART RX/TX	RASP_RXD	P1.13	Connected to NINA UART_TXD pin by default. See UART.
	11	GPIO17	Digital I/O	GPIO_2	P0.14	
	12	GPIO18	Digital I/O	GPIO_1	P0.13	
	13	GPIO27	Digital I/O	GPIO_52	P0.19	Connected to NINA through a solder bridge. If the solder bridge is cut this pin is left floating.
	14	GND	Ground	GND	GND	
	15	GPIO22	Digital I/O	GPIO_51	P0.17	Connected to NINA through a solder bridge. If the solder bridge is cut this pin is left floating.

Conn.	Pin No.	Raspberry Pi pin	Description	Schematic net name	nRF52 pin	Alternate functions and notes
	16	GPIO23	Digital I/O	GPIO_50	P0.20	Connected to NINA through a solder bridge. If the solder bridge is cut this pin is left floating.
	17	3.3 V	3.3 V supply pin	3V3_PI	-	Not connected by default. See Powering options.
	18	GPIO24	Digital I/O	GPIO_49	P0.22	Connected to NINA through a solder bridge. If the solder bridge is cut this pin is left floating.
	19	GPIO10	Digital I/O	GPIO_48	P0.21	Connected to NINA through a solder bridge. If the solder bridge is cut this pin is left floating.
	20	GND	Ground	GND	GND	
	21	GPIO09	Digital I/O	GPIO_47	P0.23	Connected to NINA through a solder bridge. If the solder bridge is cut this pin is left floating.
	22	GPIO25	Digital I/O	GPIO_46	P0.12	
	23	GPIO11	Digital I/O	GPIO_45	P0.07	
	24	GPIO08	Digital I/O	GPIO_44	P0.27	
	25	GND	Ground	GND	GND	
	26	GPIO07	Digital I/O	GPIO_43	P0.06	
	27	ID_SD	EEPROM config I2C data signal	GPIO_42	P0.26	Should only be used to read or simulate HAT EEPROMs. See EEPROM support.
	28	ID_SC	EEPROM config I2C clock signal	GPIO_41	P1.14	Should only be used to read or simulate HAT EEPROMs. See EEPROM support.
	29	GPIO05	Digital I/O	GPIO_40	P1.15	
	30	GND	Ground	GND	GND	
	31	GPIO06	Digital I/O	GPIO_39	P1.11	
	32	GPIO12	Digital I/O	GPIO_38	P1.10	
	33	GPIO13	Digital I/O	GPIO_37	P1.03	
	34	GND	Ground	GND	GND	
	35	GPIO19	Digital I/O	GPIO_36	P1.02	
	36	GPIO16	Digital I/O	GPIO_35	P1.01	
	37	GPIO26	Digital I/O	GPIO_34	P1.08	
	38	GPIO20	Digital I/O	GPIO_33	P1.09	
	39	GND	Ground	GND	GND	
	40	GPIO21	Digital I/O	GPIO_32	P0.11	

Table 13: Pinout of the Raspberry Pi compatible interface

5.3.1 Powering considerations

There are two voltage nets used in the Raspberry Pi interface - **3V3_PI** and **5V**. Both the **3V3_PI** and **5V** nets can be used to power HATs, but should not be used when connecting to a Raspberry Pi. For more information, see Raspberry Pi HAT.

⚠ The **3V3_PI** power net must not be connected to the 3.3 V supply when connected to a Raspberry Pi board. It could damage both the boards.

5.3.2 UART

The Raspberry Pi interface provides two pins that can be used for UART communications **GPIO14** and **GPIO15**. In UART communications, signals are always connected RX <-> TX and vice versa. This means that on a Raspberry Pi board **GPIO14** will be TX and on a HAT it will be RX. To support talking to both HATs and Pi boards, the zero Ω resistors - R57, R58, R59 and R60 can be used to toggle the NINA TX and RX pins between **GPIO14** and **GPIO15**. If a NINA-B30 is used, this switch can also be made in the software. By default, the EVK-NINA-B3 will be configured to simulate a HAT, and **GPIO14** is connected to the NINA **UART_RXD** pin and **GPIO15** is connected to the NINA **UART_TXD** pin.

5.3.3 EEPROM support

The Raspberry Pi interface supports a unique EEPROM solution to store the HAT specific GPIO configurations on the HAT board, to be read by the Raspberry Pi before configuring its GPIOs. The two pins used for this - **ID_SD** and **ID_SC**, are connected to the NINA-B3 module. The NINA module can thus either read the GPIO configuration from a HAT or simulate an EEPROM and send configurations to a connected Pi. This requires a NINA-B30 module and a custom-built application.

It is not mandatory to use this EEPROM solution; if not used, the two NINA pins **GPIO_42** and **GPIO_41** should be left unconfigured.

Two pull-up resistors - R44 and R50, can be added to the I^{2}C lines if needed. They are not mounted on the evaluation board by default.

Visit https://github.com/raspberrypi/hats/blob/master/designguide.md for more information on the ID EEPROM specification.

5.4 Additional Interfaces

In addition to the normal interfaces most commonly used, there are a few expansion options available for the user. These extra interfaces require some modifications of the EVB before they can be used. Figure 19 shows the additional interfaces – that require some soldering before use.

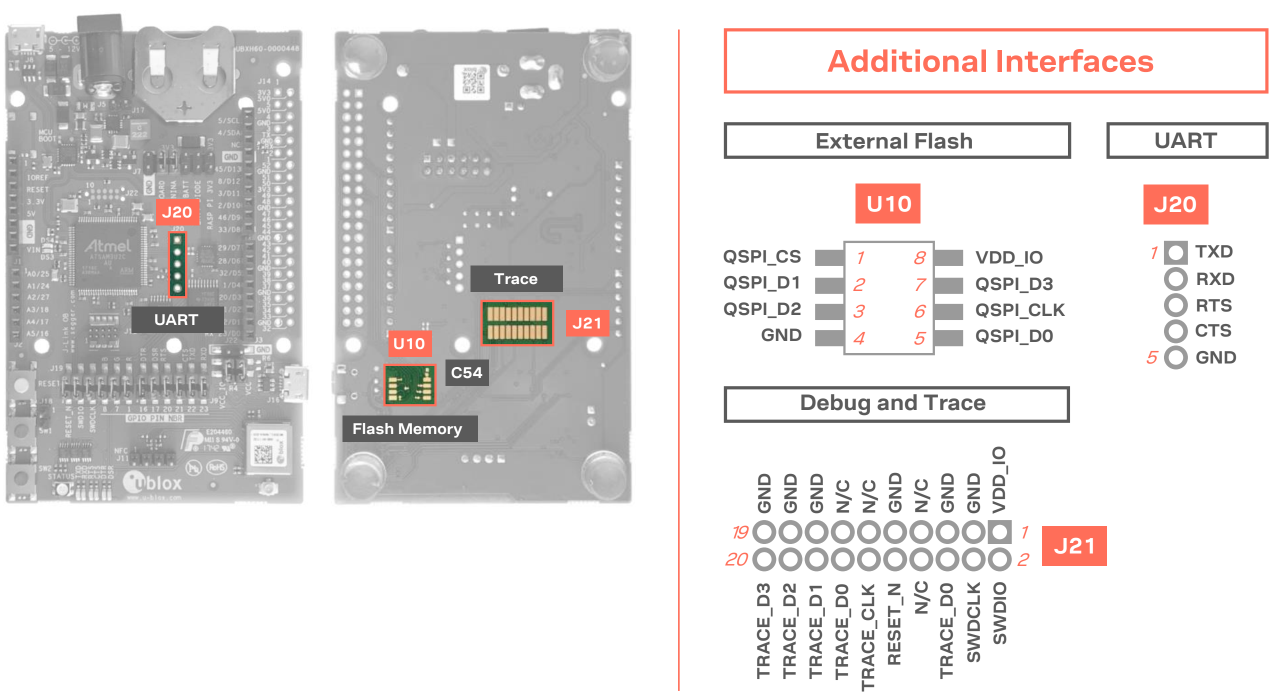


Figure 19: Additional interfaces and expansion options

Connector annotation	Pin number	Schematic net name	nRF52 pin	Description
U10	1	QSPI_CS/GPIO_51	P0.17	Chip select input signal, active low
	2	QSPI_D1/GPIO_48	P0.21	MISO in single SPI mode, or data I/O signal in dual/quad mode
	3	QSPI_D2/GPIO_49	P0.22	Data I/O signal in quad mode (optional)
	4	GND	GND	Ground
	5	QSPI_D0/GPIO_50	P0.20	MOSI in single SPI mode, or data I/O signal in dual/quad mode
	6	QSPI_CLK/GPIO_52	P0.19	Chip clock input signal, up to 32 MHz supported
	7	QSPI_D3/GPIO_47	P0.23	Data I/O signal in quad mode (optional)
	8	VDD_IO	-	Supply net for LEDs and peripherals connected directly to the NINA module. Supply for the external memory chip.
J20	1	MCU_TXD	-	Interface MCU data output signal
	2	MCU_RXD	-	Interface MCU data input signal
	3	MCU_RTS	-	Interface MCU flow control output signal
	4	MCU_CTS	-	Interface MCU flow control input signal
	5	GND	GND	Ground
J21	1	VDD_IO	-	Supply net for LEDs and peripherals connected directly to the NINA module. Supply for the external memory chip.
	2	SWDIO	SWDIO	Serial Wire Debug data I/O signal
	3	GND	GND	Ground
	4	SWDCLK	SWDCLK	Serial Wire Debug clock signal
	5	GND	GND	Ground
	6	TRACE_D0/SWO/ GPIO_8	P1.00	Serial trace data signal / Parallell trace data signal
	7	N/C	-	Not connected
	8	N/C	-	Not connected
	9	GND	GND	Ground
	10	RESET_N	P0.18	NINA reset signal, active low
	11	N/C	-	Not connected
	12	TRACE_CLK/GPIO_45	P0.07	Parallell trace clock signal
	13	N/C	-	Not connected
	14	TRACE_D0/SWO/ GPIO_8	P1.00	Serial trace data signal / Parallell trace data signal
	15	GND	GND	Ground
	16	TRACE_D1/GPIO_46	P0.12	Parallell trace data signal
	17	GND	GND	Ground
	18	TRACE_D2/GPIO_32	P0.22	Parallell trace data signal
	19	GND	GND	Ground
	20	TRACE_D3/GPIO_33	P0.23	Parallell trace data signal

Table 14: Pinout of the additional interfaces

5.4.1 Extra memory – external Flash

The NINA-B3 series module supports adding extra memory outside of the module. This memory space can be used to store data and/or expand the application code size. QSPI and Quad Serial Peripheral Interface is used by the NINA-B3 module to communicate with the external flash memory. Information about the QSPI interface, the supported modes and supported clock frequencies can be found in the NINA-B3 series data sheet [1].

The signals used in the QSPI interface are shared with other interfaces and GPIO functions. These have been routed both to the flash memory footprint on the bottom side of the evaluation board and to the GPIO pin header J14 (Raspberry Pi interface). To reduce the risk of interference on the QSPI interface, solder bridges have been added to the signal lines. The bridges should be cut to isolate the copper traces routed to J14 before soldering the flash memory to the board. Figure 20 shows where to cut the solder bridges.

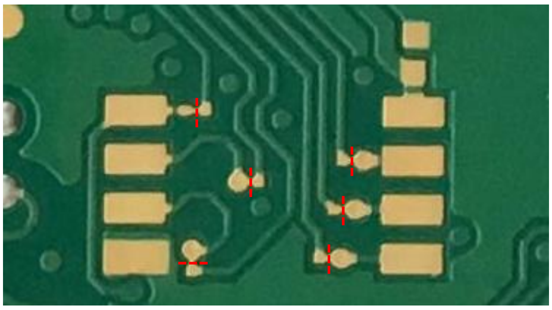


Figure 20: Cut these solder bridges before soldering the external memory

The PCB footprint has been designed for SOIC-8 packages with 5.3 mm body width. A 0402 size decoupling capacitor footprint has also been added (labeled C54 in the schematics), typically 100 nF should be used.

5.4.2 Extra USB to UART interface

If the evaluation board is connected to a PC using the USB connector J8, two serial COM ports will be available. The COM port labeled "JLink CDC UART" (on a Windows PC) is not normally connected to anything but is routed as a 4-pin UART interface to the pin header J20. This interface could be connected to a secondary UART interface on the NINA-B3 module, or to a UART interface on an Arduino shield etc.

A secondary UART can, as of NINA-B31-SW3.0.0, be configured using the u-connectXpress `AT+UMRSCFG` command, see the u-connectXpress AT commands manual [5].

5.4.3 CPU trace interface

The Arm Cortex-M4Fprocessor of the NINA-B3 modules supports tracing of CPU instructions via Cortex Debug+ETM connector 20-pin, 50 mil pitch connector. This extended connector has the same features as J12, but also allows for instruction trace operations via the Embedded Trace Macrocell (ETM) of the Cortex-M4 microcontroller inside the NINA-B3 module. This requires a special external debugger. Note that the 50 mil pitch pin header is not soldered onto the evaluation board by default.

Figure 21: Pin assignment

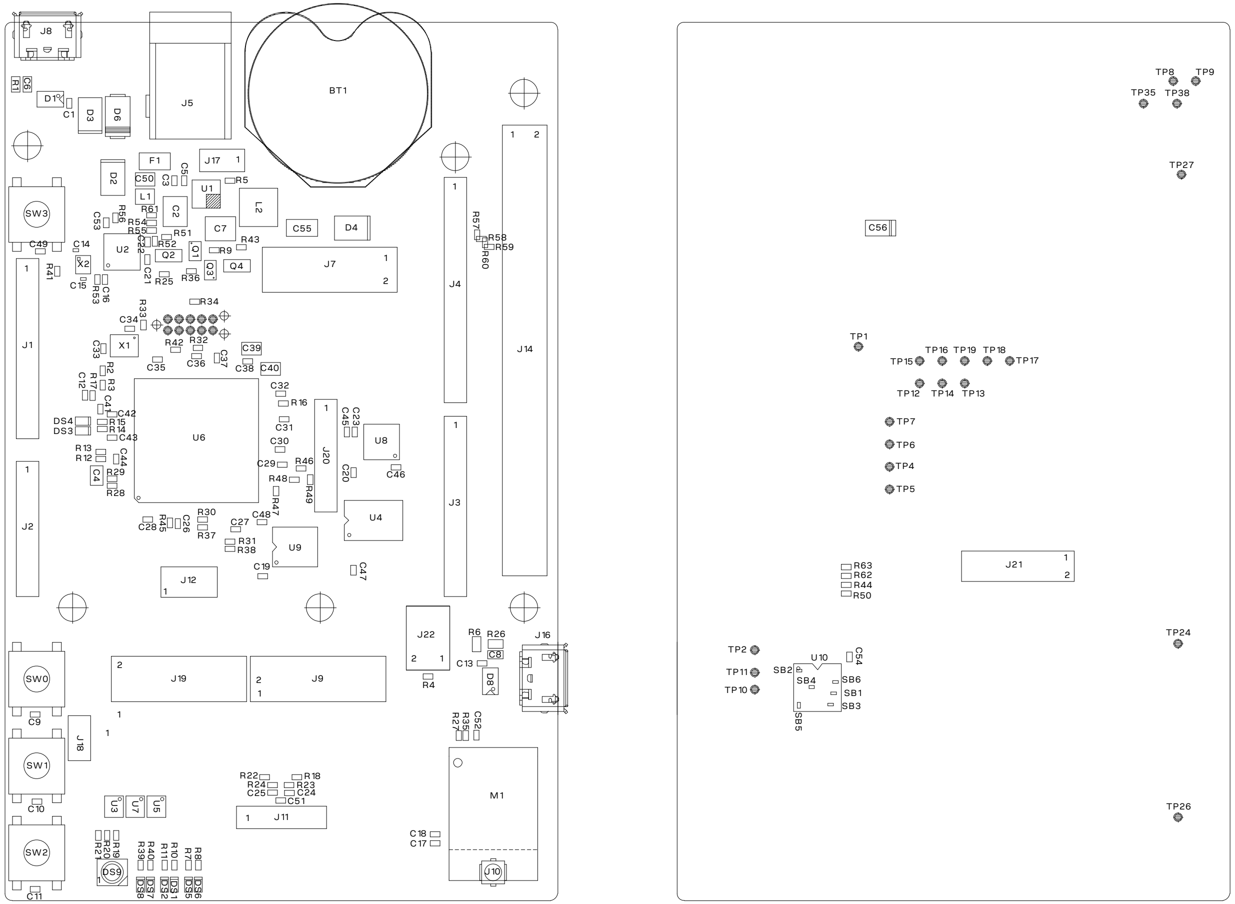
No.	Name	I/O[1]	Description
1	Reserved	I	Reserved
2	D_SEL	I	Interface select
3	TIMEPULSE	O	Time pulse (1PPS)
4	EXTINT	I	External interrupt pin
5	USB_DM	I/O	USB data
12	V_ANT Reserved		MAX-M8W: Active Antenna Supply Voltage MAX-M8C/Q : Reserved

Table 15: Pinout table

[1] I/O notations: I=Input, O=Output, I/O=Input or Output, PU=Pull Up, PD=Pull Down, D=Default, PP=Push-Pull, OD=Open Drain, AI/AO=Analog Input/Output, NC=Not Connected

Appendix

A Schematics



Top view

Bottom view (mirrored)

Figure 22: Component layout

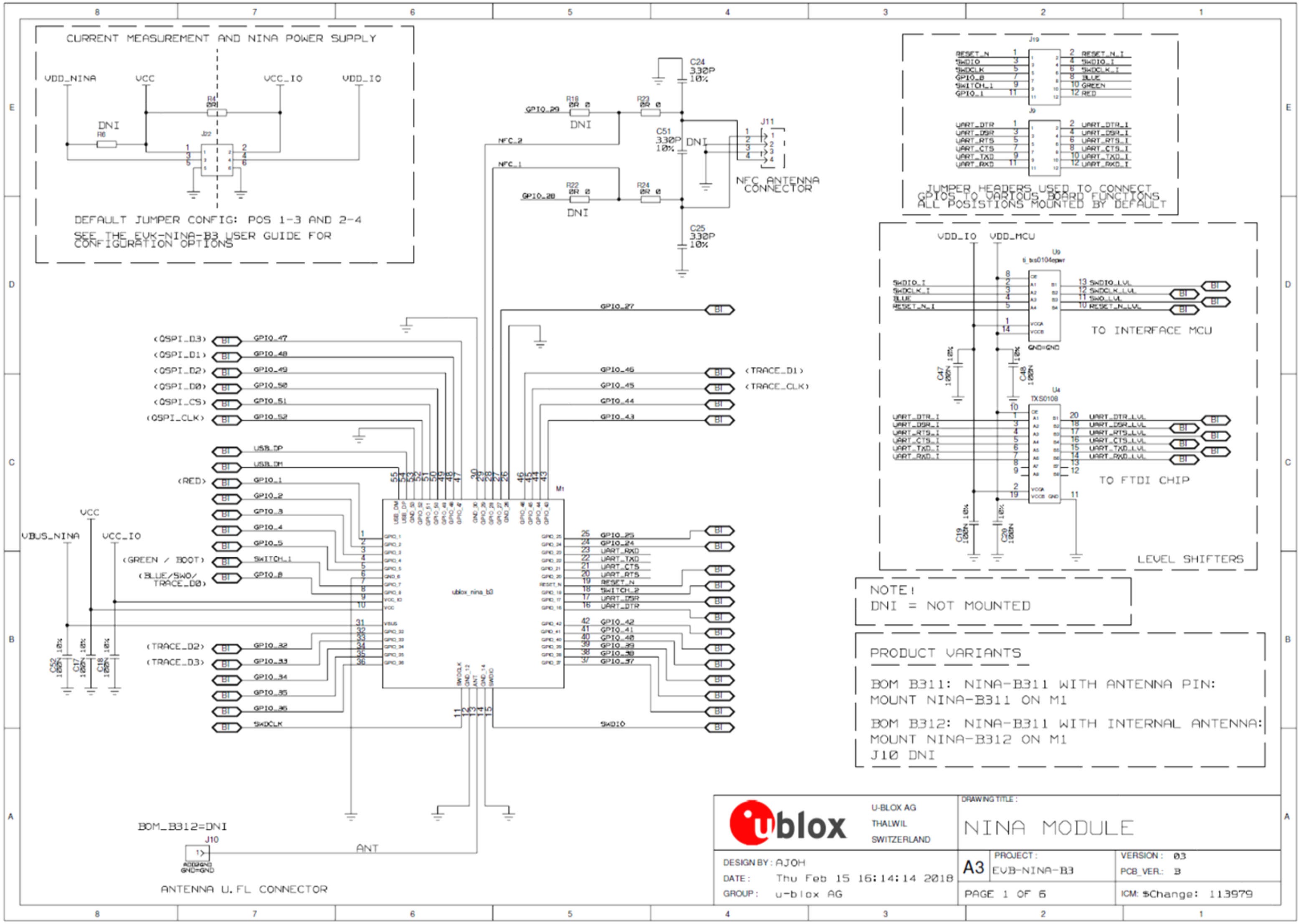


Figure 23: NINA module schematic

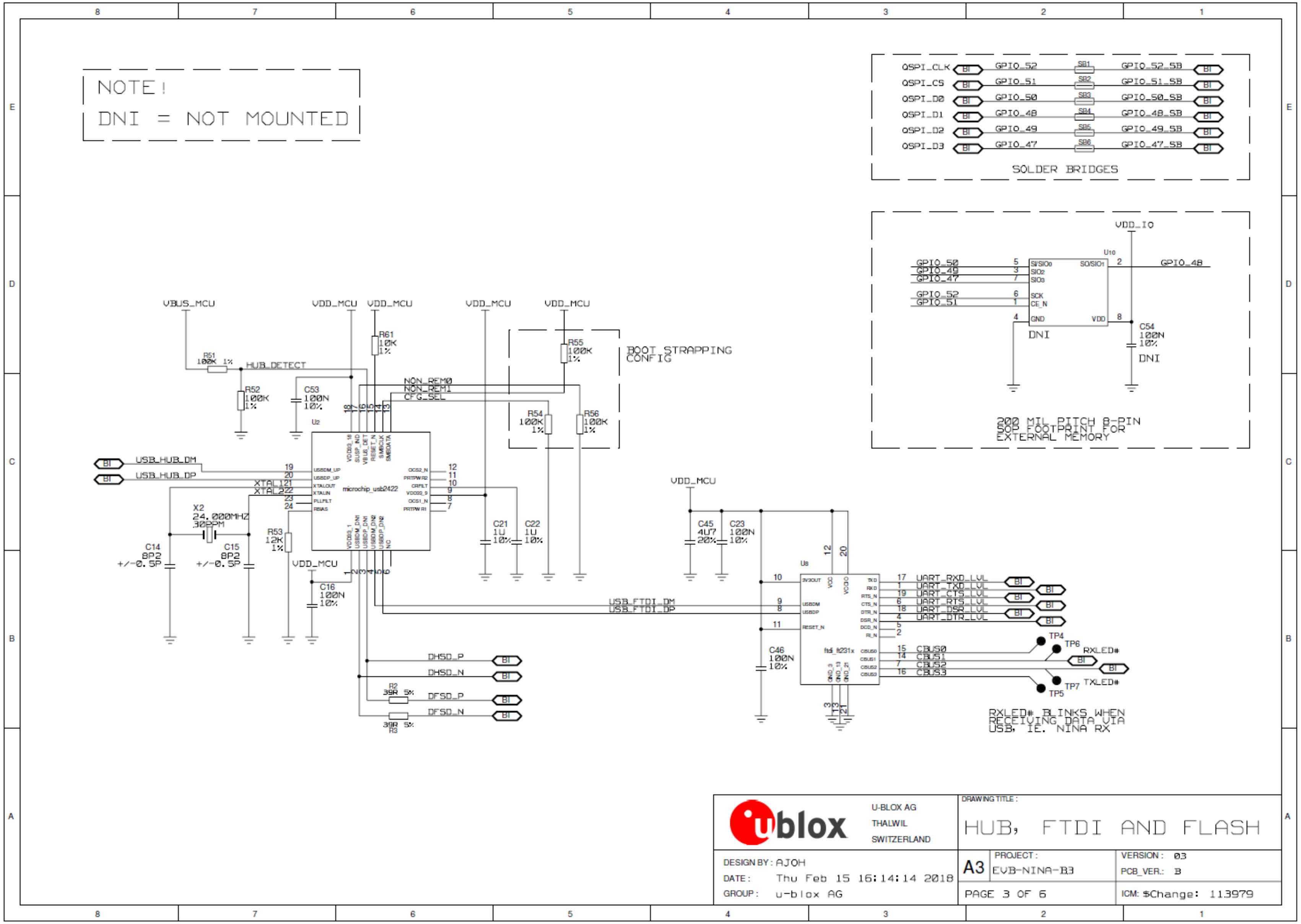


Figure 24: Hub, FTDI, and flash schematic

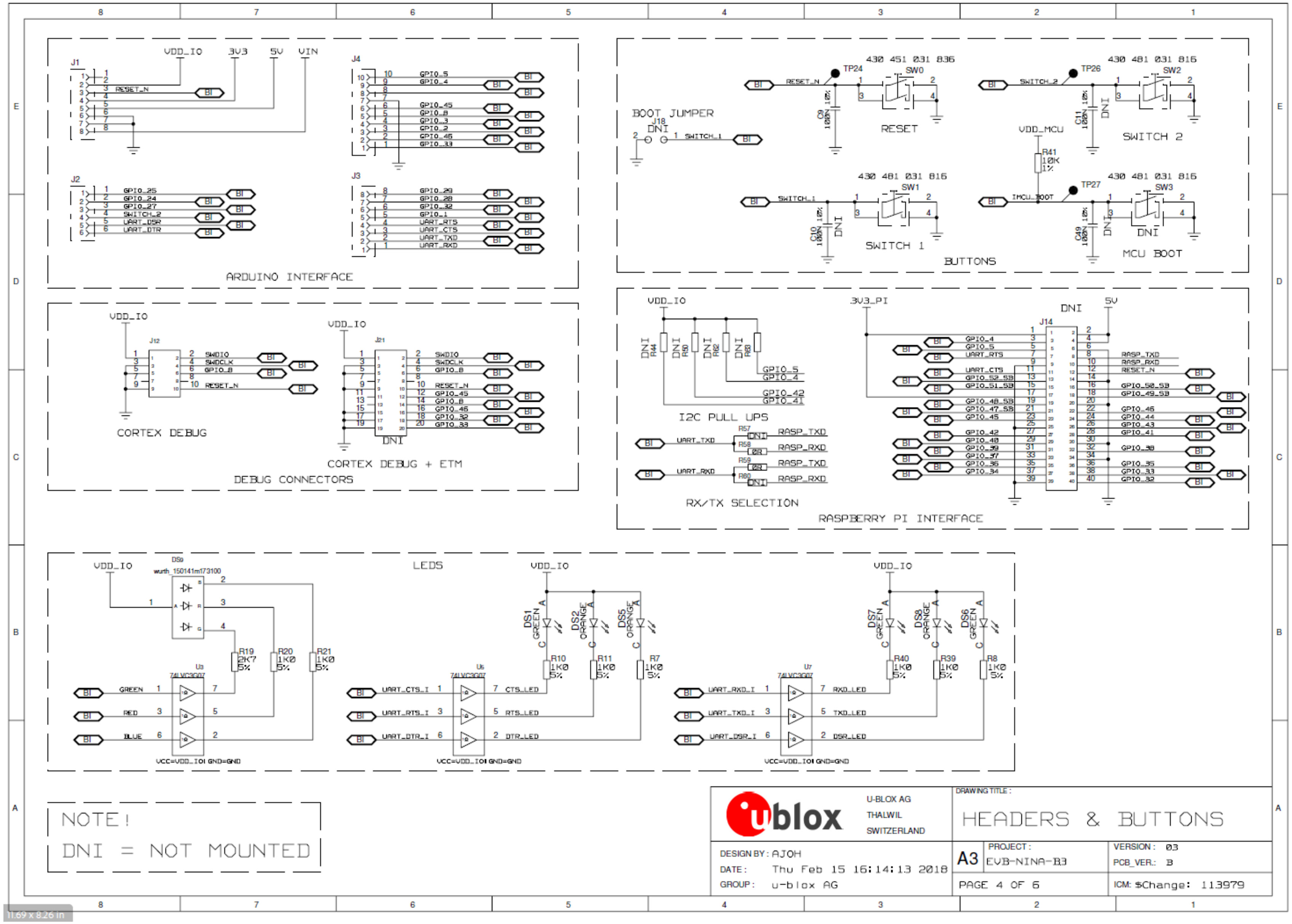


Figure 25: Headers and buttons schematic

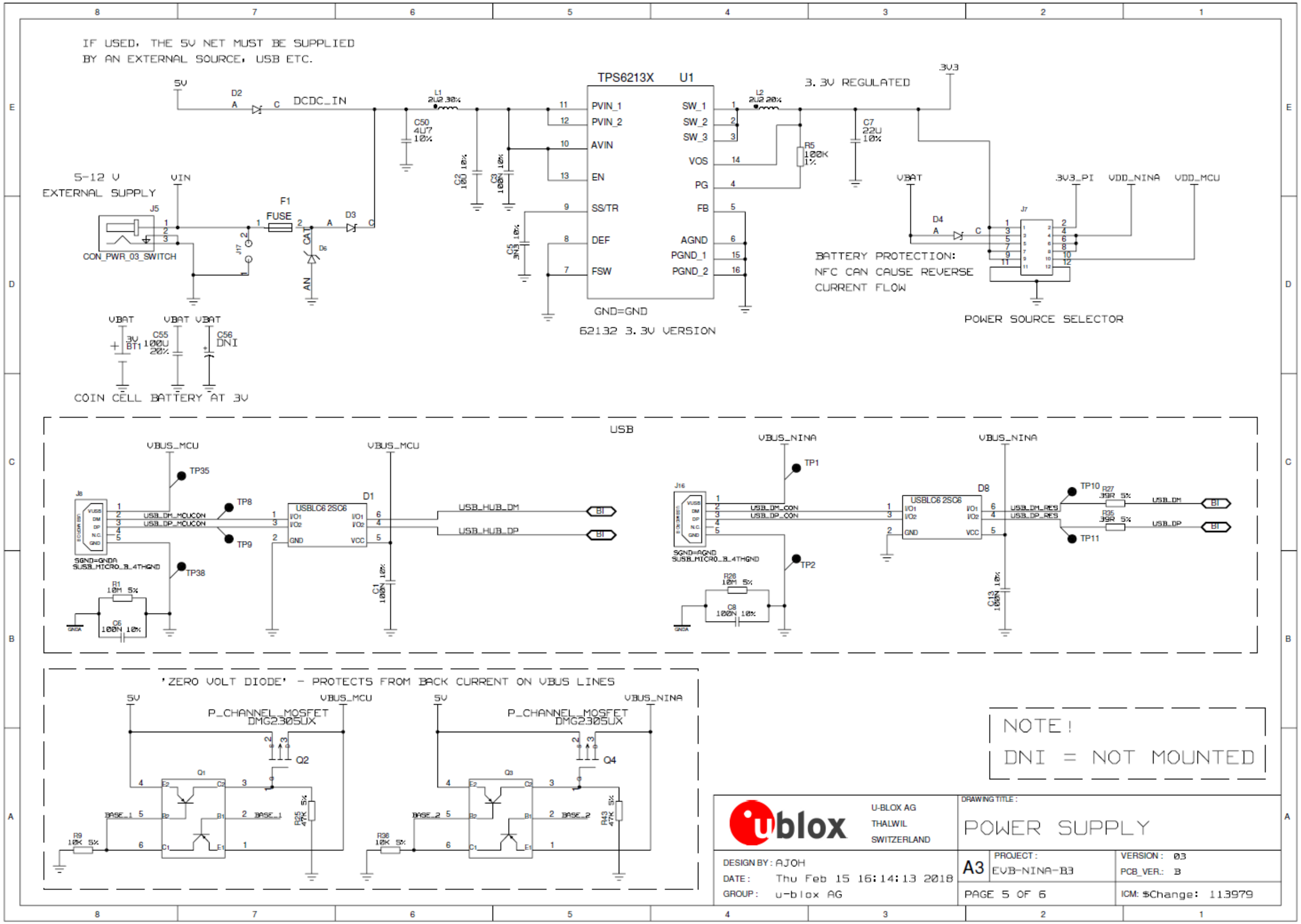


Figure 26: Power supply schematics

B Glossary

Abbreviation	Definition
API	Application programming interface
CTS	Clear To send
EVK	Evaluation kit
GND	Ground
GPIO	General-Purpose Input/Output
LED	Light-Emitting Diode
MCU	Micro controller unit
MSD	Mass storage device
NFC	Near Field Communication
U.FL	Coaxial RF connector
USB	Universal serial bus
RTS	Request To send
SDK	Software development kit
SPA	Serial port application
UART	Universal Asynchronous Receiver/Transmitter

Table 16: Explanation of the abbreviations and terms used

Related documents

[1] Arduino website
[2] Raspberry Pi website
[3] NINA-B3 data sheet, UBX-17052099
[4] NINA-B3 series system integration manual, UBX-17056748
[5] u-connect AT commands manual, UBX-14044127
[6] SEGGER J-Link software
[7] u-connectXpress user guide, UBX-16024251
[8] GitHub repository for u-blox Open CPU modules
[9] FTDI Chip home page: https://ftdichip.com/

☞ For product change notifications and regular updates of u-blox documentation, register on our website, www.u-blox.com.

Revision history

Revision	Date	Name	Comments
R01	07-Feb-2018	cmag, ajoh, kgom	Initial release.
R02	6-Jul-2018	kgom	Included reference to NINA-B31 Getting Started guide in section 2.2.1.
R03	13-Sep-2018	mape	Added information about open CPU devices and how to use them on Windows 10 host.
R04	16-Apr-2019	ajoh, fbro	Included information about the EVK-NINA-B3x6 variant. Improved the quality of most pictures, changed the structure of this document. Updated section 3.2. Added information about debugging options (section 3.2.2.2), measuring current consumption (section 3.3) and additional interfaces (section 5.4).
R05	23-Sep-2019	flun	Clarified information about RGB LED status in Table 10 (section 5.1).
R06	7-Jul-2020	mape	Removed references to u-connectScript. Improved EVK-NINA-B30x setup instructions in chapter 3.2.2. Added information about how to use secondary UART in u-connectXpress (5.4.2).
R07	3-Dec-2020	mape	Corrected formatting in Table 10, revised number of supported variants in section 2.1, and included other editorial updates.
R08	16-May-2023	mape	Added note about FTDI driver install in Evaluation board setup. Added note in Overview to clarify that the Atmel chip is not mounted on u-connectXpress EVKs. Updated Setting up the evaluation board. Revised Setting up the evaluation board.

Contact

u-blox AG

Address: Zürcherstrasse 68
8800 Thalwil
Switzerland

For further support and contact information, visit us at www.u-blox.com/support.