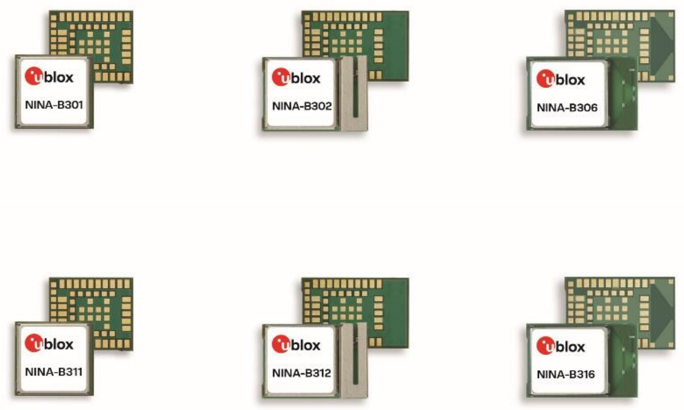
S

NINA-B3 series

Stand-alone Bluetooth 5 low energy modules

System integration manual



Abstract

This document describes the system integration of the NINA-B3 series stand-alone Bluetooth 5 low energy modules.

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C1-Public

Document information

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Document status descriptions	
Draft	For functional testing. Revised and supplementary data will be published later.
Objective specification	Target values. Revised and supplementary data will be published later.
Advance information	Data based on early testing. Revised and supplementary data will be published later.
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Production information	Document contains the final product specification.

This document applies to the following products:

Open CPU:

Product name	Document status	Comment
NINA-B301	Early Production Information	
NINA-B302	Early Production Information	
NINA-B306	Early Production Information	NINA-B306-01B is without external LFXO.

u-connectXpress:

Product name	Document status	Comment
NINA-B311	Early Production Information	
NINA-B312	Early Production Information	
NINA-B316	Early Production Information	

☞ For information about the related hardware, software, and status of listed product types, see the respective data sheets.

Contents

1 System description

1.1 Overview and applications

NINA-B3 series modules are small stand-alone Bluetooth 5 low energy microcontroller units (MCU) that feature full Bluetooth 5, a powerful Arm® Cortex®-M4 with FPU, and state-of-the-art power performance. The embedded low power crystal in the NINA-B3 series improves power consumption by enabling optimal power save modes.

NINA-B3x2 comes with an internal antenna, while the NINA-B3x1 has a pin for use with an external antenna. The internal PIFA antenna is specifically designed for the small NINA form factor and provides an extensive range. The NINA-B3 series is globally certified for use with the internal antenna or a range of external antennas. This greatly reduces time, cost, and effort for customers integrating the NINA-B3 in their designs.

The NINA-B3 series includes the following two sub-series as listed in the table below:

Model	**Description**
NINA-B30 series	Bluetooth 5 module with a powerful Arm Cortex-M4 with FPU, and state-of-the-art power performance. Both the variants of NINA-B30 are open CPU modules that enable customer applications to run on the built-in Arm Cortex-M4 with FPU. With 1 MB flash and 256 kB RAM, they offer the best-in-class capacity for customer applications on top of the Bluetooth low energy stack. NINA-B301 has a pin for use with an external antenna, NINA-B302 comes with an internal PIFA antenna, and NINA-B306 has an internal PCB antenna integrated in the module PCB. The internal antennas are specifically designed for the small NINA form factor and provides an extensive range. The NINA-B306-01B module variant comes without the LFXO (Low frequency crystal oscillator) mounted.
NINA-B31 series	Bluetooth 5 module with a powerful Arm Cortex-M4 with FPU and u-connectXpress software pre-flashed. The software in NINA-B31 modules provides support for u-blox Bluetooth low energy Serial Port Service, GATT client and server, beacons, NFC™, and simultaneous peripheral and central roles – all configurable from a host using AT commands. The NINA-B31x modules provide top grade security, thanks to secure boot, which ensures the module only boots up with original u-blox software. NINA-B311 has a pin for use with an external antenna, NINA-B312 comes with an internal PIFA antenna, and NINA-B316 has an internal PCB antenna integrated in the module PCB. The internal antennas are specifically designed for the small NINA form factor and provides an extensive range.

	NINA-B311	NINA-B312	NINA-B316
Grade			
Automotive			
Professional	•	•	•
Standard			
Radio			
Chip inside		nRF52840	
Bluetooth qualification	v5.0	v5.0	v5.0
Bluetooth low energy	•	•	•
Bluetooth output power EIRP [dBm]	10	10	10
Max range [meters]	1400	1400	1400
NFC	•	•	•
Antenna type (see footnotes)	pin	metal	pcb
Application software			
u-connectXpress	•	•	•
Interfaces			
UART	2	2	2
GPIO pins	28	28	28
Features			
AT command interface	•	•	•
Simultaneous GATT server and client	•	•	•
Low Energy Serial Port Service	•	•	•
Throughput [Mbit/s]	0.8	0.8	0.8
Maximum Bluetooth connections	8	8	8
Secure boot	•	•	•
Bluetooth mesh	•	•	•

pin = Antenna pin
metal = Internal metal PIFA antenna
pcb = Internal PCB antenna

Table 1: NINA-B30 series main features summary

⚠ Regulations in the European market require the maximum output power of the radio to be limited. See also ETSI – European market.

1.2 Architecture

1.2.1 Block diagrams

Figure 1 shows the block diagram of the NINA-B3 series. The 32.768 kHz crystal not part of NINA-B306-01B.

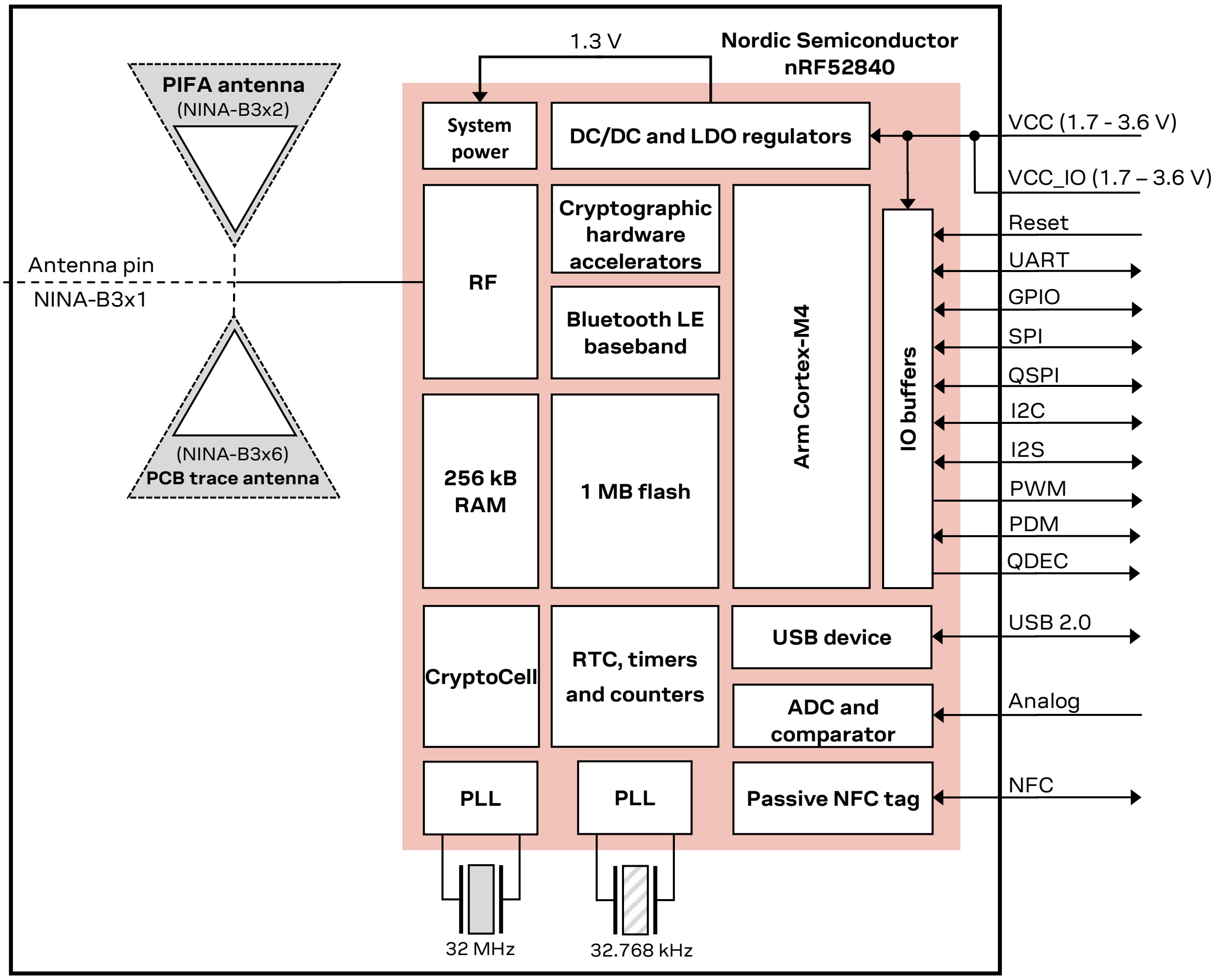


Figure 1: Block diagram of the NINA-B3 series

1.2.2 Hardware options

NINA-B3 series modules use an identical hardware configuration except for the different PCB sizes and antenna solutions. An on-board 32.768 kHz low power crystal is included in all variants except the NINA-B306-01B. An integrated DC/DC converter for higher efficiency under heavy load situations is also included.

1.2.3 Software options

NINA-B3 can be used either together with the pre-flashed u-connectXpress software or as an open CPU module where you can run your own application developed with the Nordic SDK development environment inside the NINA-B3 module. For further information about the various software options, see Software.

The u-connectXpress software also, from SW 3.0.0, contains Bluetooth mesh functionality.

1.3 Pin configuration and function

See the NINA-B3 series data sheet [2] for information about pin configuration and function.

1.4 Supply interfaces

1.4.1 Main supply input

The NINA-B3 series uses an integrated DC/DC converter to transform the supply voltage presented at the **VCC** pin into a stable system core voltage. Because of this, the NINA-B3 modules are compatible for use in battery powered designs.

When using the NINA-B3 with a battery, it is important that the battery type can handle the peak power of the module. For the battery supply, consider adding extra capacitance on the supply line to avoid capacity degradation. See the NINA-B3 series data sheet [2] for information about voltage supply requirements and current consumption.

Rail	Voltage requirement	Current requirement (peak)
VCC	1.7 V – 3.6 V	20 mA
VCC_IO	Tied to VCC	

Table 2: Summary of voltage supply requirements

☞ The current requirement in Table 2 considers using the u-connectXpress software with UART communications. But it does not include any additional I/O current. Any use of external push buttons, LEDs, or other interfaces will add to the total current consumption of the NINA-B3 module. The peak current consumption of the entire design will need to be taken into account when considering a battery powered solution.

1.4.2 Digital I/O interfaces reference voltage (VCC_IO)

On NINA-B3 series modules, the I/O voltage level is the same as the supply voltage and **VCC_IO** is internally connected to the supply input **VCC**.

When using NINA-B3 with a battery, the I/O voltage level will vary with the battery output voltage, depending on the charge of the battery. Level shifters might be needed depending on the I/O voltage of the host system.

1.4.3 VCC application circuits

The power for NINA-B3 series modules is provided through the VCC pins, which can be one of the following:

- Switching Mode Power Supply (SMPS)
- Low Drop Out (LDO) regulator
- Battery

The SMPS is the ideal choice when the available primary supply source has a higher value than the operating supply voltage of the NINA-B3 series modules. The use of SMPS provides the best power efficiency for the overall application and minimizes the current drawn from the main supply source.

⚠ While selecting SMPS, ensure that the AC voltage ripple at the switching frequency is kept as low as possible. Layout shall be implemented to minimize impact of high frequency ringing.

The use of an LDO linear regulator is convenient for a primary supply with a relatively low voltage where the typical 85-90% efficiency of the switching regulator leads to minimal current saving. Linear regulators are not recommended for high voltage step-down, as these dissipate a considerable amount of energy.

DC/DC efficiency should be evaluated as a tradeoff between active and idle duty cycles of the specific application. Although some DC/DC can achieve high efficiency at extremely light loads, a typical DC/DC efficiency quickly degrades as idle current drops below a few mA, greatly reducing the battery life.

Due to the low current consumption and wide voltage range of the NINA-B3 series module, a battery can be used as a main supply. The capacity of the battery should be selected to match the application. Care should be taken so that the battery can deliver the peak current required by the module. See the NINA-B3 series data sheet [2] for the electrical specifications.

It is best practice to include decoupling capacitors on the supply rails close to the NINA-B3 series module. But depending on the design of the power routing on the host system, capacitance might not be needed.

1.5 System function interfaces

1.5.1 Module reset

You can reset NINA-B3 modules by applying a low level on the **RESET_N** input pin, which is normally set high with an internal pull-up. This causes an "external" or "hardware" reset of the module. The current parameter settings are not saved in the non-volatile memory of the module and a proper network detach is not performed.

1.5.2 Internal temperature sensor

The radio chip in NINA-B3 contains a temperature sensor used for over temperature and under temperature shutdown.

⚠ The temperature sensor is located inside the radio chip and should not be used if an accurate temperature reading of the surrounding environment is required.

1.6 Debug – Serial Wire Debug (SWD)

The primary interface for debugging is the SWD interface. NINA-B30 series modules provide an SWD interface for flashing and debugging. The two pins **SWDIO** and **SWDCLK** should be made accessible on header or test points.

The SWD interface is disabled on the NINA-B31 series modules.

1.7 Serial interfaces

⚠ As NINA B3 can be used with both the u-connectXpress and open CPU based applications, based on the Nordic SDK, the available interfaces and the pin mapping may vary. For detailed pin information, see Pin configuration and function.

1.7.1 Universal Asynchronous Serial Interface (UART)

NINA B3 provides a Universal Asynchronous Serial Interface (UART) for data communication.

The following UART signals are available:

- Data lines (RXD as input, TXD as output)
- Hardware flow control lines (CTS as input, RTS as output)
- DSR and DTS are used to set and indicate system modes

The UART can be used as both a 4-wire UART with hardware flow control and a 2-wire UART with only **TXD** and **RXD**. If using the UART in 2-wire mode, **CTS** should be connected to GND on the NINA-B3 module.

Depending on the bootloader used, the UART interface can also be used for software upgrades. See also Software.

The u-connectXpress software adds the **DSR** and **DTR** pins to the UART interface. These pins are not used as originally intended, but to control the state of the NINA-B3 module. Depending on the current configuration, the **DSR** can be used to:

- Enter command mode
- Disconnect and/or toggle connectable status
- Enable/disable the rest of the UART interface
- Enter/wake up from the sleep mode

See the NINA-B3 series data sheet [2] for characteristics information about the UART interface.

Interface	Default configuration
COM port	115200 baud, 8 data bits, no parity, 1 stop bit, hardware flow control

Table 3: Default settings for the COM port while using the u-connectXpress software

It is recommended to make the UART available either as test points or connected to a header for a software upgrade.

The I/O level of the UART will follow the VCC voltage and it can thus be in the range of 1.8 V and 3.6 V. If you are connecting the NINA-B3 module to a host with a different voltage on the UART interface, a level shifter should be used.

1.7.2 Serial Peripheral Interface (SPI)

NINA-B3 supports up to three serial peripheral interfaces that can operate in both master and slave modes with a maximum serial clock frequency of 8 MHz in both these modes. The SPI interfaces use the following signals:

- SCLK
- MOSI
- MISO
- CS
- **DCX** (Data/Command signal). This signal is optional but is sometimes used by the SPI slaves to distinguish between SPI commands and data.

When using the SPI interface in master mode, it is possible to use GPIOs as additional Chip Select (CS) signals to allow addressing of multiple slaves.

1.7.3 Quad serial peripheral interface (QSPI)

The Quad Serial Peripheral Interface enables connection of external memory to the NINA-B3 module in order to increase the application program size. The QSPI uses the following signals:

- CLK, serial clock output, up to 32 MHz
- CS, Chip/Slave select output, active low, selects which slave on the bus to talk to
- D0, MOSI serial output data in single mode, data I/O signal in dual/quad mode
- D1, MISO serial input data in single mode, data I/O signal in dual/quad mode
- D2, data I/O signal in quad mode (optional)
- D3, data I/O signal in quad mode (optional)

1.7.4 I2C interface

The Inter-Integrated Circuit (I2C) interfaces can be used to transfer or receive data on a 2-wire bus network. NINA-B3 can operate as both Central and Peripheral on the I2C bus using both standard (100 kbps) and fast (400 kbps) transmission speeds. The interface uses the **SCL** signal to clock instructions and data on the **SDA** signal.

External pull-up resistors are required for the I2C interface. The value of the pull-up resistor should be selected depending on the speed and capacitance of the bus. See Electrical specifications in the NINA-B3 series data sheet [2] for recommended resistor values.

1.7.5 USB 2.0 interface

The NINA-B3 series modules include a full speed Universal Serial Bus (USB) device interface compliant with version 2.0 of the USB specification. The pin configuration of the USB interface is provided below:

- VBUS, 5 V supply input, required in order to use the interface
- USB_DP, USB_DM, differential data pair

The USB interface has a dedicated power supply that requires a 5 V supply voltage for the **VBUS** pin. This allows the USB interface to be used even though the rest of the module might be battery powered or supplied by a 1.8 V supply, etc.

1.8 GPIO pins

In an un-configured state, NINA-B3 modules have 38 GPIO pins and no analog or digital interfaces. All interfaces or functions must be allocated to a GPIO pin before use. Eight of the 38 GPIO pins are analog enabled, meaning that they can have an analog function allocated to them. In addition to the serial interfaces, Table 5 shows the digital and analog functions that can be assigned to a GPIO pin.

Function	Description	Default NINA-B3 pin	Configurable GPIOs
General purpose input	Digital input with configurable pull-up, pull-down, edge detection and interrupt generation		Any
General purpose output	Digital output with configurable drive strength, push-pull, open collector, or open emitter output		Any
Pin disabled	Pin is disconnected from the input and output buffers.	All*	Any
Timer/ counter	High precision time measurement between two pulses/ Pulse counting with interrupt/event generation		Any
Interrupt/ Event trigger	Interrupt/event trigger to software application/ Wake-up event		Any
HIGH/LOW/Toggle on event	Programmable digital level triggered by internal or external events without CPU involvement		Any
ADC input	8/10/12/14-bit analog to digital converter		Any analog
Analog comparator input	Compare two voltages, capable of generating wake-up events and interrupts		Any analog
PWM output	Output simple or complex pulse width modulation waveforms		Any
Connection status indicator	Indicates if a BLE connection is maintained	BLUE**	Any

* = If left unconfigured ** = If using u-connectXpress software

Table 4: GPIO custom functions configuration

1.8.1 Analog interfaces

Eight out of the 38 digital GPIOs can be multiplexed to analog functions. The following analog functions are available for use:

- 1x 8-channel ADC
- 1x Analog comparator*
- 1x Low-power analog comparator*

*Only one of the comparators can be used simultaneously.

1.8.1.1 ADC

The Analog to Digital Converter (ADC) can sample up to 200 kHz using different inputs as sample triggers. Both one-shot conversion and continuous sampling are supported. Table 5 shows the sample speed in correlation to the maximum source impedance. It supports 8/10/12-bit resolution. The ADC includes 14-bit resolution if oversampling is used. Any of the 8 analog inputs can be used both as single-ended inputs and as differential pairs for measuring the voltage across them.

The ADC supports the full 0 V to VCC input range. If the sampled signal level is much lower than **VCC**, it is possible to lower the input range of the ADC to encompass the desired signal and obtain a higher effective resolution. Continuous sampling can be configured to sample at a configurable time interval, or at different internal or external events, without CPU involvement.

ACQ [us]	Maximum source resistance [kΩ]
3	10
5	40
10	100
15	200
20	400
40	800

Table 5: Acquisition vs. source impedance

1.8.1.2 Comparator

The comparator compares voltages from any analog pin with different references as shown in Table 6. It supports the full 0 V to VCC input range and can generate different software events to the rest of the system. The comparator can operate in the one of the following two modes as explained below - Single-ended or Differential:

- Single-ended Mode: A single reference level or an upper and lower hysteresis selectable from a 64-level reference ladder with a range from 0 V to VREF as described in Table 6.
- Differential Mode: Two analog pin voltage levels are compared, optionally with a 50 mV hysteresis

1.8.1.3 Low power comparator

The low-power comparator operates in the same way as the normal comparator, with reduced functionality. It can be used during system OFF modes as a wake-up source.

1.8.1.4 Analog pin options

Table 6 shows the supported connections of the analog functions.

☞ An analog pin may not be simultaneously connected to multiple functions.

Symbol	Analog function	Connects to
ADCP	ADC single-ended or differential positive input	Any analog pin or VCC
ADCN	ADC differential negative input	Any analog pin or VCC
VIN+	Comparator input	Any analog pin
VREF	Comparator single-ended mode reference ladder input	Any analog pin, VCC, 1.2 V, 1.8V or 2.4V
VIN-	Comparator differential mode negative input	Any analog pin
LP_VIN+	Low-power comparator IN+	Any analog pin
LP_VIN-	Low-power comparator IN-	GPIO_16 or GPIO_18, 1/16 to 15/16 VCC in steps of 1/16 VCC

Table 6: Possible uses of the analog pin

1.9 Antenna interfaces

☞ The antenna interface is different for each module variant in the NINA-B3 series.

1.9.1 Antenna pin – NINA-B3x1

NINA-B3x1 is equipped with an RF pin. The RF pin has a nominal characteristic impedance of 50 Ω and must be connected to the antenna through a 50 Ω transmission line to allow reception of radio frequency (RF) signals in the 2.4 GHz frequency band.

Choose an antenna with optimal radiating characteristics for the best electrical performance and overall module functionality. An internal antenna integrated on the application board or an external antenna that is connected to the application board through a proper 50 Ω connector can be used.

While using an external antenna, the PCB-to-RF-cable transition must be implemented using either a suitable 50 Ω connector, or an RF-signal solder pad (including GND) that is optimized for 50 Ω characteristic impedance.

1.9.1.1 Antenna matching

For optimal performance, the antenna return loss should be as good as possible across the entire band when the system is operational. The enclosure, shields, other components and surrounding environment will impact the return loss seen at the antenna port. Matching components are often required to re-tune the antenna to bring the return loss within an acceptable range.

It is difficult to predict the actual matching values for the antenna in the final form factor. Therefore, it is a good practice to have a placeholder in the circuit with a “pi” network, with two shunt components and a series component in the middle, to allow maximum flexibility while tuning the matching to the antenna feed.

1.9.1.2 Approved antenna designs

NINA-B3 modules come with a pre-certified design that can be used to save costs and time during the certification process. To take advantage of this service, the customer is required to implement an antenna layout according to the u-blox Antenna reference designs.

The designer integrating a u-blox reference design into an end-product is solely responsible for the unintentional emission levels produced by the end product.

The module may be integrated with other antennas. In this case, the OEM installer must certify his design with the respective regulatory agencies.

1.9.2 Integrated antenna – NINA-B3x2/B3x6

NINA-B3x2 and NINA-B3x6 modules are equipped with an integrated antenna on the module. This simplifies the integration, as there is no need to do an RF trace design on the host PCB. By using NINA-B3x2 or NINA-B3x6, the certification of NINA-B3 series modules can be reused, thus minimizing the effort needed in the test lab. NINA-B3x2 modules use an internal metal sheet PIFA antenna, while the NINA-B3x6 modules have a PCB trace antenna that uses antenna technology licensed from Proant AB.

1.9.3 NFC antenna

NINA-B3 series modules include a Near Field Communication interface, capable of operating as a 13.56 MHz NFC tag at a bit rate of 106 kbps. As an NFC tag, data can be read from or written to the NINA-B3 modules using an NFC reader; however, the NINA-B3 modules are not capable of reading other tags or initiating NFC communications. Two pins are available for connecting to an external NFC antenna: **NFC1** and **NFC2**.

1.10 Reserved pins (RSVD)

Do not connect the reserved (**RSVD**) pin. The reserved pins are allocated for future interfaces and functionality.

1.11 GND pins

Good connection of the module's GND pins with a solid ground layer of the host application board is required for correct RF performance. It significantly reduces EMC issues and provides a thermal heat sink for the module.

For information about ground design, see also Module footprint and paste mask and Thermal guidelines.

2 Software

NINA-B3 series modules can be used either with the pre-flashed u-connectXpress software, or as an open CPU module in which you can run your own application developed with the Nordic SDK development environment inside the NINA-B3 module.

The software on the NINA-B3 module contains the following parts:

- SoftDevice S140 is a Bluetooth® Low Energy (LE) central and peripheral protocol stack solution
- Optional bootloader
- Application

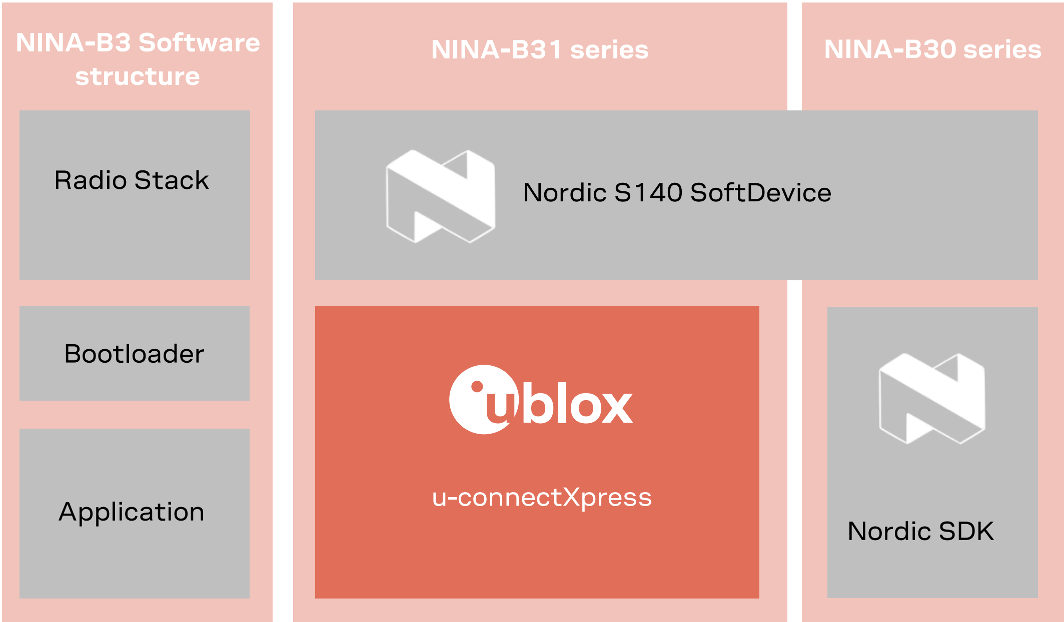


Figure 2: NINA-B3 software structure and available software options

2.1 u-connectXpress software

NINA-B31 series modules are delivered with the u-blox secure boot loader and pre-flashed u-connectXpress software.

The u-connectXpress software enables use of the Bluetooth Low Energy functions, controlled by AT commands over the UART interface. Some of the supported features include the u-blox Low Energy Serial Port Service, GATT server and client, central and peripheral roles, and multidrop connections.

For information about the features, capabilities, and use of u-connectXpress software, see the u-connectXpress user guide [16] and u-connectXpress AT commands manual [4].

The u-connectXpress software on NINA-B3 is also (as of version 3.0.0) Bluetooth-mesh enabled. For more information about the mesh software, see the Implementing Bluetooth mesh with u-connectXpress software application note [24].

2.2 Open CPU

2.2.1 Nordic nRF5 SDK

The Nordic nRF5 SDK includes a broad selection of drivers and libraries and provides a rich development environment for various devices and applications. The SDK is delivered as a plain zip archive, which makes it easy to install. The SDK comes with support for the SEGGER Embedded Studio, Keil and IAR IDEs, as well as the GCC compiler, which offers the freedom to choose the IDE and compiler.

2.2.1.1 Getting started on the Nordic nRF5 SDK

When working with the Nordic SDK on the NINA-B3 series module, follow the steps below to get started with the Nordic Semiconductor toolchain and examples:

1. Download and install the nRF Connect application and install the Programmer app, which allows programming over SWD, from www.nordicsemi.com.
2. Download and install the latest SEGGER Embedded Studio from www.segger.com.
3. Download and extract the latest nRF5 SDK found on http://www.nordicsemi.com/eng/Products/Bluetooth-low-energy/nRF5-SDK to the directory that you want to use to work with the nRF5 SDK.
4. Read the information in the SDK Release Notes and check the nRF5 software development kit documentation available at the Nordic Semiconductor Infocenter [14].

The easiest way to get started with the Nordic SDK is to copy one of the examples in the SDK. Choose an example that best matches your needs and use the board definition that is most like your board. If you are building for NINA-B3 the closest board definition is the *pca10056.*

2.2.1.2 Create a custom board for Nordic SDK

The predefined hardware boards included in the Nordic SDK are Nordic development boards only. To add support for a custom board, create a custom board support file called `custom_board.h`. This file is normally located in the folder `…\components\boards\` or included together with the `sdk_config.h` file in the `config` folder of the example.

The custom board can then be selected by adding the define statement `#define BOARD_CUSTOM`.

☞ The referenced file location is in accordance with Nordic nRF5 SDK version 17.0.

Figure 3shows an example of how the custom board support file might look like for EVK-NINA-B3.

```
#ifndef CUSTOM_BOARD_H
#define CUSTOM_BOARD_H

#ifdef __cplusplus
extern "C" {
#endif

#include "nrf_gpio.h"
// In this file PIN 25 is used as button SWITCH_1, if the GREEN led
// should be used it is possible to defined that one instead.
#define LEDS_NUMBER    2

#define LED_1          NRF_GPIO_PIN_MAP(0,13)  // RED
#define LED_2          NRF_GPIO_PIN_MAP(1,00)  // BLUE
// #define LED_3       NRF_GPIO_PIN_MAP(0,25)  // GREEN

#define LEDS_ACTIVE_STATE 0
```

```
#define LEDS_LIST { LED_1, LED_2 }

#define LEDS_INV_MASK  LEDS_MASK

#define BSP_LED_0      LED_1
#define BSP_LED_1      LED_2
// #define BSP_LED_2   LED_3

#define BUTTONS_NUMBER 2

#define BUTTON_1       25  // SWITCH_1
#define BUTTON_2       2   // SWITCH_2
#define BUTTON_PULL    NRF_GPIO_PIN_PULLUP

#define BUTTONS_ACTIVE_STATE 0

#define BUTTONS_LIST { BUTTON_1, BUTTON_2 }

#define BSP_BUTTON_0   BUTTON_1
#define BSP_BUTTON_1   BUTTON_2

#define RX_PIN_NUMBER  NRF_GPIO_PIN_MAP(0,29)
#define TX_PIN_NUMBER  NRF_GPIO_PIN_MAP(1,13)
#define CTS_PIN_NUMBER NRF_GPIO_PIN_MAP(1,12)
#define RTS_PIN_NUMBER NRF_GPIO_PIN_MAP(0,31)
#define HWFC           true

#define BSP_QSPI_SCK_PIN   19
#define BSP_QSPI_CSN_PIN   17
#define BSP_QSPI_IO0_PIN   20
#define BSP_QSPI_IO1_PIN   21
#define BSP_QSPI_IO2_PIN   22
#define BSP_QSPI_IO3_PIN   23

// Arduino board mappings
#define ARDUINO_SCL_PIN             24  // SCL signal pin
#define ARDUINO_SDA_PIN             16  // SDA signal pin

#define ARDUINO_13_PIN              NRF_GPIO_PIN_MAP(0, 7)
#define ARDUINO_12_PIN              NRF_GPIO_PIN_MAP(0, 2)
#define ARDUINO_11_PIN              NRF_GPIO_PIN_MAP(0, 15)
#define ARDUINO_10_PIN              NRF_GPIO_PIN_MAP(0, 14)
#define ARDUINO_9_PIN               NRF_GPIO_PIN_MAP(0, 12)
#define ARDUINO_8_PIN               NRF_GPIO_PIN_MAP(1, 9)
#define ARDUINO_7_PIN               NRF_GPIO_PIN_MAP(0, 10)
#define ARDUINO_6_PIN               NRF_GPIO_PIN_MAP(0, 9)
#define ARDUINO_5_PIN               NRF_GPIO_PIN_MAP(0, 11)
#define ARDUINO_4_PIN               NRF_GPIO_PIN_MAP(0, 13)
#define ARDUINO_3_PIN               NRF_GPIO_PIN_MAP(0, 31)
#define ARDUINO_2_PIN               NRF_GPIO_PIN_MAP(1, 12)
#define ARDUINO_1_PIN               NRF_GPIO_PIN_MAP(1, 13
#define ARDUINO_0_PIN               NRF_GPIO_PIN_MAP(0, 29)

#define ARDUINO_A0_PIN              NRF_GPIO_PIN_MAP(0, 4)
#define ARDUINO_A1_PIN              NRF_GPIO_PIN_MAP(0, 30)
#define ARDUINO_A2_PIN              NRF_GPIO_PIN_MAP(0, 5)
#define ARDUINO_A3_PIN              NRF_GPIO_PIN_MAP(0, 2)
#define ARDUINO_A4_PIN              NRF_GPIO_PIN_MAP(0, 28)
#define ARDUINO_A5_PIN              NRF_GPIO_PIN_MAP(0, 3)

#define RASPBERRY_PI_3_PIN          NRF_GPIO_PIN_MAP(0, 24)
#define RASPBERRY_PI_5_PIN          NRF_GPIO_PIN_MAP(0, 16)
#define RASPBERRY_PI_7_PIN          NRF_GPIO_PIN_MAP(0, 15)
#define RASPBERRY_PI_11_PIN         NRF_GPIO_PIN_MAP(0, 14)
#define RASPBERRY_PI_13_PIN         NRF_GPIO_PIN_MAP(0, 19)
```

```
#define RASPBERRY_PI_15_PIN         NRF_GPIO_PIN_MAP(0, 17)
#define RASPBERRY_PI_19_PIN         NRF_GPIO_PIN_MAP(0, 21)
#define RASPBERRY_PI_21_PIN         NRF_GPIO_PIN_MAP(0, 23)
#define RASPBERRY_PI_23_PIN         NRF_GPIO_PIN_MAP(0, 7)
#define RASPBERRY_PI_27_PIN         NRF_GPIO_PIN_MAP(0, 26)
#define RASPBERRY_PI_29_PIN         NRF_GPIO_PIN_MAP(1, 15)
#define RASPBERRY_PI_31_PIN         NRF_GPIO_PIN_MAP(1, 11)
#define RASPBERRY_PI_33_PIN         NRF_GPIO_PIN_MAP(1, 3)
#define RASPBERRY_PI_35_PIN         NRF_GPIO_PIN_MAP(1, 2)
#define RASPBERRY_PI_37_PIN         NRF_GPIO_PIN_MAP(1, 8)

#define RASPBERRY_PI_8_PIN          RX_PIN_NUMBER
#define RASPBERRY_PI_10_PIN         TX_PIN_NUMBER
#define RASPBERRY_PI_12_PIN         NRF_GPIO_PIN_MAP(0, 13)
#define RASPBERRY_PI_16_PIN         NRF_GPIO_PIN_MAP(0, 20)
#define RASPBERRY_PI_18_PIN         NRF_GPIO_PIN_MAP(0, 22)
#define RASPBERRY_PI_22_PIN         NRF_GPIO_PIN_MAP(0, 12)
#define RASPBERRY_PI_24_PIN         NRF_GPIO_PIN_MAP(0, 27)
#define RASPBERRY_PI_26_PIN         NRF_GPIO_PIN_MAP(0, 6)
#define RASPBERRY_PI_28_PIN         NRF_GPIO_PIN_MAP(1, 14)
#define RASPBERRY_PI_32_PIN         NRF_GPIO_PIN_MAP(1, 10)
#define RASPBERRY_PI_36_PIN         NRF_GPIO_PIN_MAP(1, 1)
#define RASPBERRY_PI_38_PIN         NRF_GPIO_PIN_MAP(1, 9)
#define RASPBERRY_PI_40_PIN         NRF_GPIO_PIN_MAP(0, 11)

#ifdef __cplusplus
}
#endif

#endif // CUSTOM_BOARD_H
```

Figure 3: Example of EVK-NINA-B3 custom board support file

The board file can also be downloaded from the u-blox shortrange open CPU github repository [20].

To make the build system use your custom board file define the build variable `BOARD_CUSTOM` in the build configuration. If you build on an existing example, undefine the default `BOARD_PCA10056`.

2.2.1.3 Adding a board configuration to your project

A flexible way of adding a board to your project is to add a new build configuration to your Segger Studio project and then use this configuration to select the correct board file for your build. By adding several configurations, you can build for several targets from the same Segger Studio project.

You can use the following procedure to build from both your custom board and u-blox EVK to test your code on different platforms:

1. Add a build configuration in the Segger Studio project.

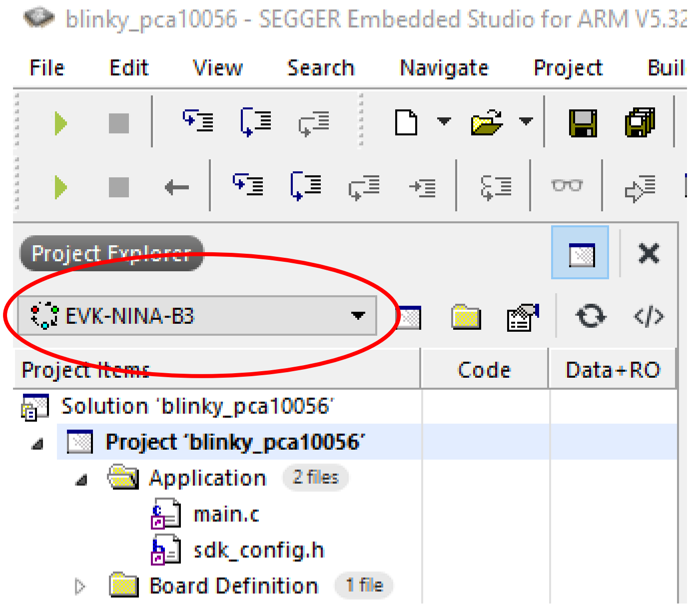


Figure 4 Add a build configuration to Segger Studio

2. Configure the build configuration to use your board definition. Assuming that you are basing your project on an example from the Nordic nRF5 SDK, remember to undefine the configuration for the original board.

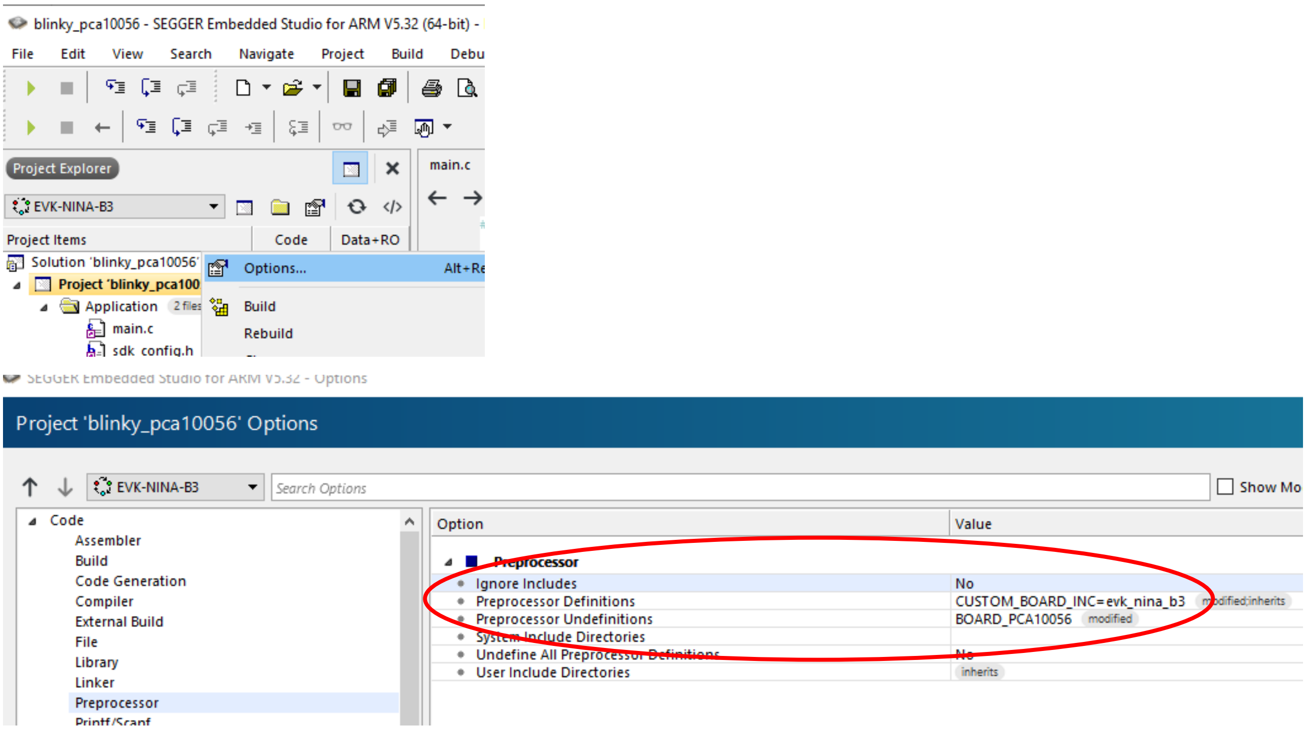


Figure 5 Setting up board configuration to use evk_nina_b3.h board file

The build for your configuration now uses your custom board file.

2.2.1.4 clock source configuration

To configure your application for use with an internal RC oscillator or external LFXO in the Nordic SDK, see reference [18].

2.2.2 Zephyr

Zephyr [19] is a widely adopted open-source Real Time Operating System (RTOS) that is supported on a multitude of chipsets, including the nRF52840 chip in the NINA-B3 module. The Zephyr project is supported by the Linux Foundation.

Nordic Semiconductor provides the nRF Connect SDK for development using the Zephyr OS, but it is also possible to use a command-line environment for example.

2.2.2.1 Getting started with Zephyr on the NINA-B3 module

Follow the procedure below to get started with Zephyr:

1. Install the Toolchain Manager from the *nRF Connect for Desktop* application and from there install the nRF Connect SDK. For more information, see reference [23].
2. If a command line environment is preferred, see the Getting Started section on the Zephyr website [19].

2.2.2.2 Defining a board configuration in Zephyr

The Zephyr OS is in many aspects similar to Linux and uses a similar structure of `make` files and config files as the Linux kernel. It also uses a device tree file to set up the pin mapping for your board.

Although an example configuration for EVK-NINA-B3 is not yet included in the Zephyr distribution, the configuration can be downloaded from the u-blox shortrange open CPU github repository [20].

Copy the configuration to the `<install directory>/zephyr/boards/arm` folder and the build the project from your preferred environment.

2.2.2.3 Building for the NINA-B3 EVK using nRF Connect SDK

To build the blinky sample using the nRF Connect SDK open the sample as shown in Figure 6. You can then build and flash from within Segger Studio.

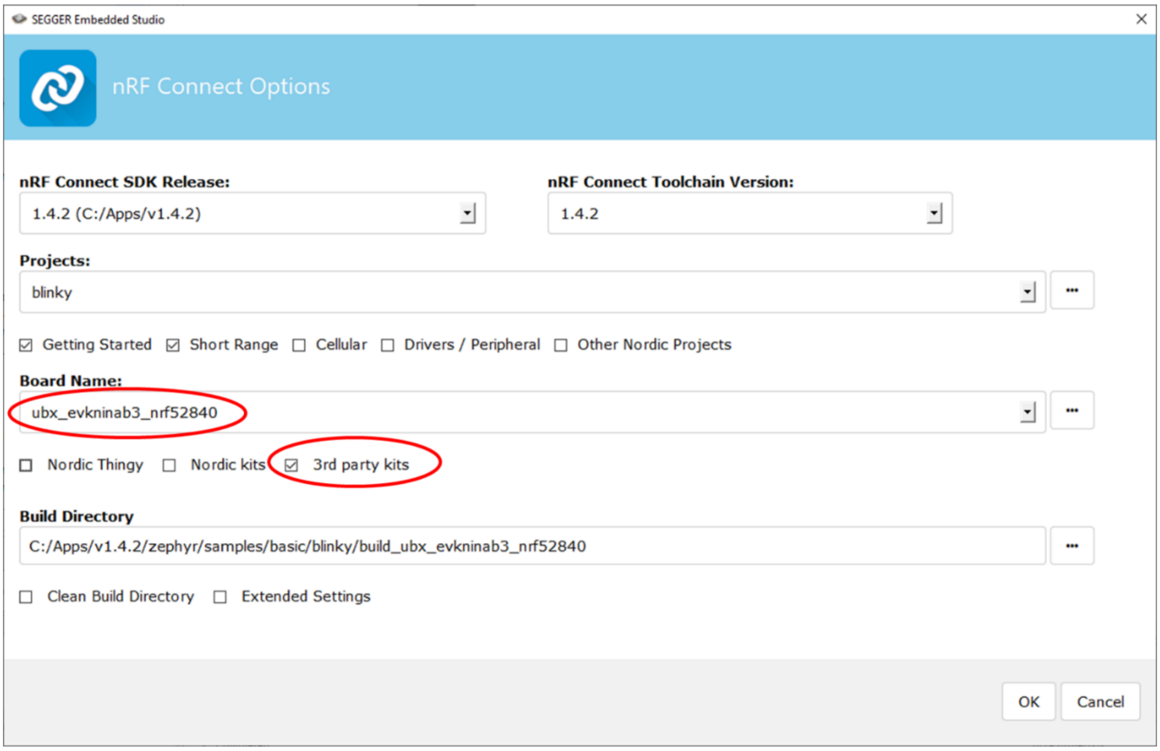


Figure 6 Opening blinky sample for the NINA-B3 EVK

2.2.2.4 Building for NINA-B3 EVK using the Zephyr command-line environment

To build and flash the Zephyr "blinky" example for the NINA-B3 EVK, move to the zephyr folder in your installation on the shell prompt and enter:

```
~/zephyrproject/zephyr$ west build -b ubx_evkninab3_nrf52840 samples/basic/blinky
~/zephyrproject/zephyr$ west flash
```

The example board configuration also contains several documentation files that can be included in your local documentation. The files are in reStructuredText (RST) format. To generate HTML or PDF output from these files, refer to the Zephyr Project documentation [21].

2.2.3 Saving Bluetooth MAC address and other production data

Open CPU (B30x) variants of the NINA-B3 module come with a pre-programmed Bluetooth MAC address. If needed, this address can be used by the customer application.

The MAC address is programmed into the CUSTOMER[0] and CUSTOMER[1] User Information Configuration Register (UICR) of the nRF52840 chip. The address can be read and written from the registers using Segger J-Link utilities or the nrfjprog utility from Nordic.

```
$ nrfjprog.exe --memrd 0x10001080 --n 8
```

The memory area can be saved and, if the flash is erased, written back later using the `savebin` and `loadbin` utilities in the Segger J-link tool suite.

The UICR memory area also holds the serial number and other information that can be saved for later configuration purposes. Use the following commands to save the whole memory area:

```
$ nrfjprog.exe --readuicr uicr.hex
...
$ nrfjprog.exe --program uicr.hex
```

For additional information about saving and using the public Bluetooth device address, see the Using the public IEEE address from UICR application note [17].

2.2.4 Support – Nordic development forum

For support related to the Nordic nRF5 SDK or nRF Connect SDK, refer to the Nordic development zone website at: https://devzone.nordicsemi.com/.

2.3 Updating NINA-B31 software

New versions of NINA-B31 u-connectXpress software can be flashed to the module over the UART interface. See also Updating software with -center and Updating software with AT commands.

The following pins should be made available as either headers or test points to flash the module:

- **UART** (RX, TX)
- **RESET_N**
- **SWITCH_1** and **SWITCH_2**

2.3.1 Updating over UART

NINA-B3 u-connectXpress software includes the bootloader for flashing NINA-B3 over the UART interface. The software is available for download at www.u-blox.com.

Distributed in a single ZIP container, the software includes two separate binary files and one JSON file that includes the software label, software description, file name, version, flash address, image size, image id, file permissions, and signature file reference for the SoftDevice and ConnectivitySoftware applications:

- Java Script Object Notation: `NINA-B31X-CF-<version>.json`. For example: `NINA-B31X-CF-1.0.json`
- ConnectivitySoftware: `NINA-B31X-SW-x.y.z-<build>.bin`. For example: `NINA-B31X-SW-3.0.0-005.bin`
- SoftDevice: `NINA-S140-SD-a.b.c.bin`. For example, `NINA-S140-SD-6.1.1.bin`

Signature files (`NINA-B31X-SI-x.x.x-xxx.txt` and `NINA-S140-SI-x.x.x-xxx.txt`) for each of the binaries are also included in the container.

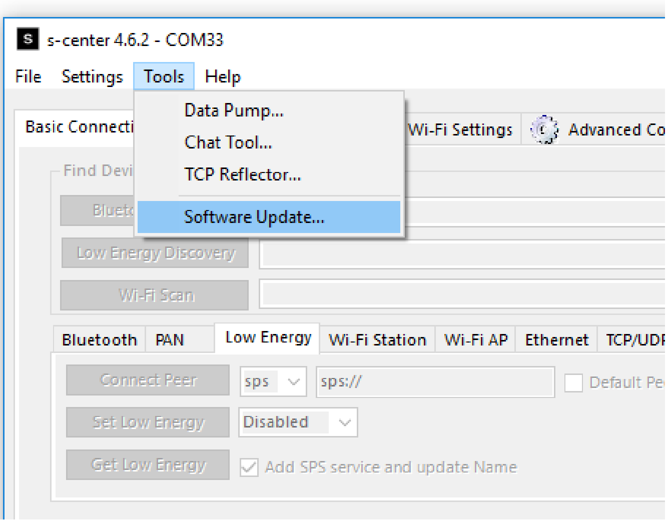
2.3.1.1 Updating software with s-center

⚠ To update NINA-B3 u-connectXpress requires s-center software version 4.6.2 or later. See also the s-center user guide [6].

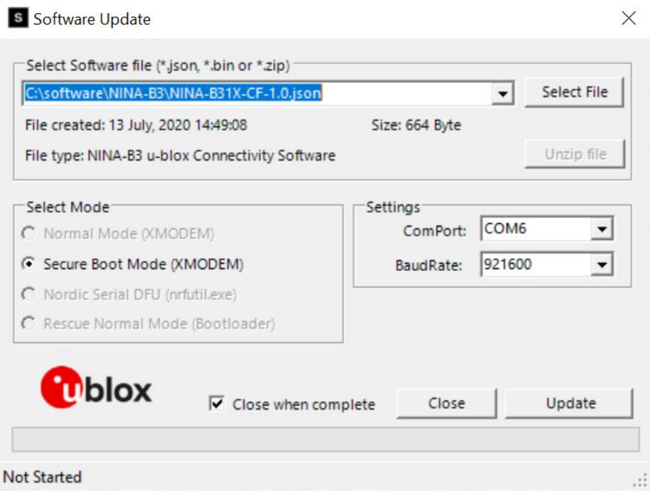
Procedure

1. Connect the supplied serial cable from the J8 connector on EVK-NINA-B3 to the USB port your computer. For further information about setting up EVK-NINA-B3, see also EVK-NINA-B3 user guide [3].
2. Download and the latest version of the s-center and u-connectXpress software from u-blox Product Resources. See also EVK-NINA-B3 user guide [3] and s-center user guide [6].
3. Start s-center and choose "USB Serial Port (COMx)" in the drop-down “COM Port” menu. All other dialog settings are set to default.
4. Select **Open Port**. A series of AT commands and response are shown in the “Console Window”.

5. Select **Tools** > **Software Update**.



6. Check that the correct COM port is shown in "Settings". **Select File** and choose the `NINA-B31X-CF-<version>.json` file from the unzipped u-connectXpress container.



7. Select **Update**. The module then reboots using the secure bootloader and flashing of both the SoftDevice and application starts automatically.

2.3.1.2 Updating software with AT commands

☞ You can send AT commands to NINA-B3 to execute certain tasks over the serial interface, using open-source terminal emulator software that supports XMODEM, like TeraTerm or ExtraPuTTy. Alternatively, you can send all AT commands described in this section using the s-center software in AT mode. The examples given in this procedure have been created and tested on EVK-NINA-B31 using TeraTerm. See also the u-connectXpress AT command manual [4] and Bootloader protocol specification [5].

The bootloader must be running when the software is "sent" to the module. You start the bootloader using either:

- AT commands
- Pressing the SW1 and SW2 buttons simultaneously during a module reset (initiated by setting **RESET_N** low). The bootloader prompt ">" is seen when the boot loader mode has started. See also Module reset.

☞ In contrast to the s-center configuration, UART hardware flow is not used for updating software using AT commands. The file download uses standard XMODEM-CRC16 protocol and 128 byte packets.

Prerequisites

As a prerequisite to updating software using AT commands, you must open the JSON file included in the download container and make note of the defined values to be parsed with the update command. You also need to copy the signatures given in the related txt files, as shown in Figure 8. This information is needed during the install. The defined values to include in the command, together with the signature file (`NINA-B31X-SI-x.x.x-xxx.txt`), are shown in Figure 5.


```
[
  {
    "Label": "ConnectivitySoftware",
    "Description": "NINA-B31X u-blox connectivity software",
    "File": "NINA-B31X-SW-3.0.0-005.bin",
    "Version": "NINA-B31X-SW-3.0.0-005",
    "Address": "0x26000",
    "Size": "0x4C95C",
    "Id": "0x0",
    "Permissions": "rwx",
    "SignatureFile": "NINA-B31X-SI-3.0.0-005.txt"
  },
  {
    "Label": "SoftDevice",
    "Description": "S140 softdevice from Nordic for NINA-NRF",
    "File": "NINA-S140-SD-6.1.1.bin",
    "Version": "NINA-S140-SD-6.1.1",
    "Address": "0x0",
    "Size": "0x25DE8",
    "Id": "0x1",
    "Permissions": "rw",
    "SignatureFile": "NINA-S140-SI-6.1.1.txt"
  }
]
```


Figure 7: Defined values for ConnectivitySoftware and SoftDevice as shown in the JSON file


```
N04lae2U7ztBojLvyBmHJKvuQmyioscrE3kdQviDcqSwST59Dg8WZbcN5C6xwZtA3vE/A0M2h3JulhVv49UIIjzh
TZwYLLrnWGNWgu4cAPkmMHkZa5MZl/QSb/GeT8naXe7oVTS2S2NzXX83N+ovmTVBMpkfQiEoNJw5u5+agXq3J4kz
9g1LylUNtHbucAJR5cs1hsrOC+UZSULY2+4jNqxdN3m6BlvQyycxJCJ2J49cnB85RdY4bfJlPGTwcqtGp2Z014Y/
Z7PjeNOMoTFUKZDWN6e+U8a8e6pULCBLqBH5gC/UU/aSLJLsLL64VEKt2NJB5lZ2fqgzZr82Dqmrpw==
```


Figure 8: Typical ConnectivitySoftware and SoftDevice signature file

Command syntax

You use the software update command `AT+UFWUPD` with following syntax to update both the u-connectXpress and SoftDevice software.

```
AT+UFWUPD=<mode>,<baud_rate>[,<id>,<size>,<signature>,<name>,<flags>]
```

The defined values for each parameter are shown in Table 7.

Parameter	Type	Description
<mode>	Enumerator	Download mode: 0: Update mode for the ConnectivitySoftware through the serial port 1: Bootloader mode for update of the SoftDevice through the serial port.
<baud rate>	Enumerator	Baud rate in bits per second: 115200 (default), 230400, 460800, or 921600
<id>	Integer	ID number of the software image.
<size>	Integer	Size of the firmware image. Enter the size integer for the respective software as defined in the `NINA-B31X-SI-x.x.x-xxx.txt` file. Shown in hex format in the JSON file but must entered as bytes in decimal notation in the command.
<signature>	String	RSA signature of the firmware image as base64-encoded string. Enter the 344-character text string defined in the `NINA-B31X-SI-x.x.x-xxx.txt` file.
<name>	String	The name of the firmware. Maximum string length is 22.
<flags>	String	Permissions for using the firmware image. Permission flags are marked in UNIX style: "`rwx`" is the default flag for the u-connectXpress software. "`rw`" is the default flag for other binary images.

Table 7: Defined values for update parameters

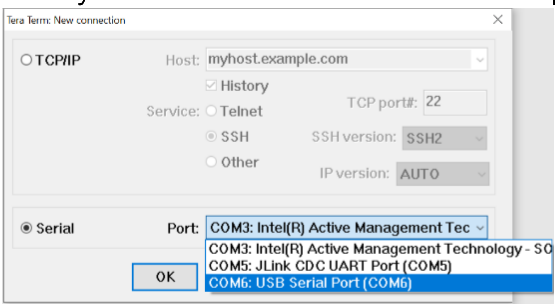
2.3.1.2.1 Setting up the serial port

☞ You can send AT text commands to NINA-B3 to execute tasks using open-source terminal emulator software that supports XMODEM like TeraTerm or ExtraPuTTy. Alternatively, you can send all AT commands described in this section using the s-center software in AT mode. See also the s-center user guide [6].

Procedure

The examples in this procedure have been created and tested on EVK-NINA-B31 using TeraTerm.

1. Connect the supplied serial cable from the J8 connector on EVK-NINA-B3 to the USB port your computer. For further information about setting up EVK-NINA-B3, see also EVK-NINA-B3 user guide [3].
2. Download and unzip the latest u-connectXpress software from u-blox Product Resources.
3. Discover the COM port number for the USB Serial Port on your computer (MS Windows: **Start>Device Manager>Ports**). See also “Setting up the evaluation board” in the EVK-NINA-B3 user guide [3].
4. Start your chosen terminal emulator and open the connection to the USB serial port (COMx).



5. Setup the serial port and connection. Set “Speed” to 115200 with all other parameters set to default. Select **New setting**.

2.3.1.2.2 Updating u-connectXpress connectivity software only

☞ You can send AT text commands to NINA-B3 to execute tasks using open-source terminal emulator software that supports XMODEM, like TeraTerm or ExtraPuTTy. Alternatively, you can send all AT commands described in this section using the s-center software in AT mode. See also the s-center user guide [6].

Procedure

The examples in this procedure have been created and tested on EVK-NINA-B31 using TeraTerm.

1. Setup the serial port connection. See also Setting up the serial port.
2. Enter Software version identification `AT+GMR` command to find out the current version of your u-connectXpress software.

```
AT+GMR
"2.0.0-025"
OK
```

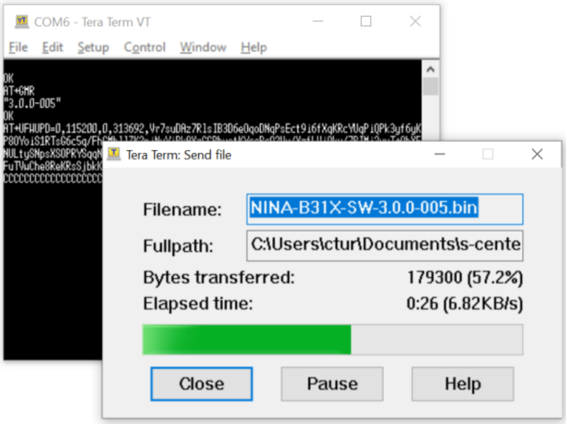
3. Prepare the module to accept a binary file for download and start the bootloader at the appropriate baud rate. Enter the Update software `AT+UFWUPD` command together with the ConnectivitySoftware values defined in the `NINA-B31X-CF-<version>.json` file and the signature in the `NINA-B31X-SI-x.x.x-xxx.txt` file. The bootloader must be running when the software is “sent” to the module in the next step. Note particularly that `<mode>=0`, `<name>=ConnectivitySoftware`, and `<flags>=rwx`. See also Prerequisites and Command syntax.

```
AT+UFWUPD=0,115200,0,313692,Vr7suDAz7RlsIB3D6eOqoDNqPsEct9i6fXqKRcYUqPiQPk3yf6yKP8OY
oiS1RTsG6c5q/FhGMhllZK2niNuYiPkAXrCGBhwstKYccRcO2Vx/XzfLWiOkv/7PIMi2uyT+9hXFNULtySNp
sXSOPRYSqqNhYC9Numhwe0y5Fgi6SB90jiElDZRTaMZog34jfJCPdy2+U6M2w12Zss1sS16FFuTVwChe8ReK
RsSjbkKmT3Ft34TJrrLvcwJKxlcWx1DV1pm2NY6fGNfKo1b9FG9z+3Iq/GstvkEXa9uS0fdWDM5Vd6BNT7fV
ubi2JLvc5k+QCJotbYyGChmjfHhx16o2BA==,ConnectivitySoftware,rwx
```

NINA-B3 returns a series of “C” characters for as long as the bootloader is running.

```
CCCCCCCCCCCCCCCCCCC
```

4. While the bootloader is running, send the u-connectXpress `NINA-B31X-SW-3.0.0-0.005.bin` file to NINA-B3. The file is sent using XMODEM protocol.



5. Once the binary file has been sent, NINA-B3 displays the greeting text `+STARTUP`. Enter the Software version identification `AT+GMR` command again to make sure that the latest software version is now installed.

```
+STARTUP
AT+GMR
"3.0.0-005"
OK
```

2.3.1.2.3 Updating both the SoftDevice and u-connectXpress connectivity software

The SoftDevice is updated with AT commands using dual-banked approach, and as a SoftDevice update overwrites the application currently flashed in the module it is also necessary to flash the ConnectivitySoftware application after the SoftDevice update.

☞ You can send AT text commands to NINA-B3 to execute tasks using open-source terminal emulator software that supports XMODEM, like TeraTerm or ExtraPuTTy. Alternatively, you can send all AT commands described in this section using the s-center software in AT mode. See also the s-center user guide [6].

Procedure

The examples in this procedure have been created and tested on EVK-NINA-B31 using TeraTerm.

1. Setup the serial port connection. See also Setting up the serial port.
2. Prepare NINA-B3 to accept the SoftDevice binary file for download at the defined baud rate. Enter the Update software `AT+UFWUPD` command together with the SoftDevice values `<mode>` and `<baudrate>` defined in the `NINA-B31X-CF-<version>.json` file. Note particularly that `<mode>=1`. See also Prerequisites and Command syntax.

```
AT+UFWUPD=1,115200
>
```

3. Enter the configuration action command "`l`" to list all firmware images and check the current version of your SoftDevice.

```
> l
image_id                00
image_name              ConnectivitySoftware
image_addr              00026000
size                    0004C95C
permissions             rwx-----
```

```
signature
Vr7suDAz7RlsI...
...a9uS0fdWDM5Vd6BNT7fVubi2JLvc5k+QCJotbYyGChmjfHhx16o2BA==

image_id                01
image_name              NINA-S140-SD-6.1.1
image_addr              00000000
size                    00025DE8
permissions             rw------
signature
KHIsyhdHDIwzWf9...
...WGhe4vy6jj3kUnSosh6rrcIxqfcUDVQ4T1NwIy3wsR7SDWzE8ZmOHiU0/IEFHKY

OK
>
```

4. Store the SoftDevice signature. Enter the configuration action command s together with the SoftDevice values for <imageid> <signature> defined in the NINA-B31X-CF-<version>.json file and NINA B31X-SI-x.x.x-xxx.txt signature file. Note particularly that the <image id> of the SoftDevice is 1. See also Prerequisites and Command syntax.

```
> s 1
MT9MR1FCE6IY1qaPse1FatzN1Cjuea0/sVpgv670y8FwH8LYFANspk5Yl+DfOXwFcgqWKcHmN0lcKAt4b2ug
u+BItwsoQpbzwDnWLUwDJBIa6ZgsdLx/kTUNW3hWdGvQuFIfwXk4NhvX/3RlIOmPqM/shkN7tF4kaSeS/aUp
Ub81edKC57kQa8L0uWXVhRyI3OwoGkvXBMKoKVIphFgP6WwKdwanrI6TWID5Ii6P16XU2s2XdG8LVooVqnID
O5iD4RbHMv9b5FwcyDVNrJiT8Ky7ybV/AwCh+LM8TDoHsmhvuuHICSzeQ6vdTMXXYELNXuhjsThtEbMLiA9/
NtMwlw==

OK
>
```

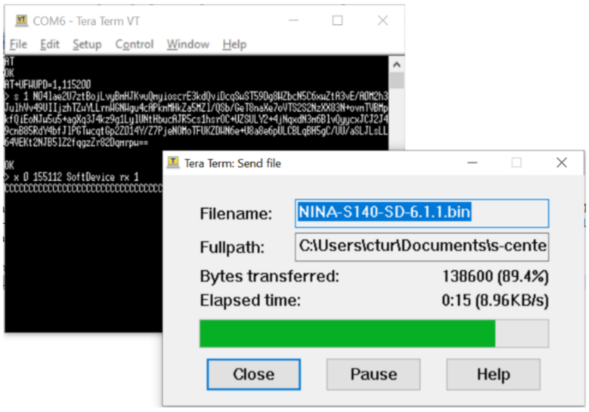
5. Prepare the bootloader to accept a file transfer using XMODEM protocol. Enter the configuration action command "x" together with the SoftDevice values <imageaddress>, <imagesize> <imagename>, <permissions> and <imageid> defined in the NINA-B31X-CF-<version>.json file.

```
> x 0 155260 SoftDevice rw 1
```

NINA-B3 returns a series of 'C' characters for as long as the bootloader is running.

```
CCCCCCCCCCCCCCCCCCCCCCCCCC
```

6. While the bootloader is running, send the SoftDevice NINA-S140-SD-x.x.bin file to NINA-B3. The file is sent using XMODEM protocol.



NINA-B3 displays the greeting text +STARTUP once the binary file has been sent.

7. Having flashed the SoftDevice, you now flash the connectivity software in the same way. To initially store the signature of the connectivity software, enter the configuration action command "s" together with the ConnectivitySoftware values `<imageid> <signature>` defined in the `NINA-B31X-CF-<version>.json file` and signature in the `NINA B31X-SI-x.x.x-xxx.txt` file.

```
> s 0
ff52l1nTW2lNFI72umSFCZ3mPDloaKDDf686J50KkLmKk01xycoOHNQuuAijTEgZU9aT49g78kcz+Rs/ZC0j
TDBUCT+opw3QahEqnobuWGogKwZL2XAGHhKTYogUrvvzWGXS9hBDCov/e1F5S2T3DRixLRXBec6rc92LLibw
8dxEqNWXL+RBd9ckuJ9K4Z0yqisUGrbGe+0Pv8JR75UUV9un6DF9ECTN4HQoVco3F53DWbDc6FBYkeJHQzbg
DL/AXi3GXgJ3tZ2xaXUWpodFT6Dsk/hTKjq8aosz7ImN+71SCHDACv+TVaEBMQfiXIfrFZm9V/mti7/kAGVb
POw1Hg==

OK
>
```

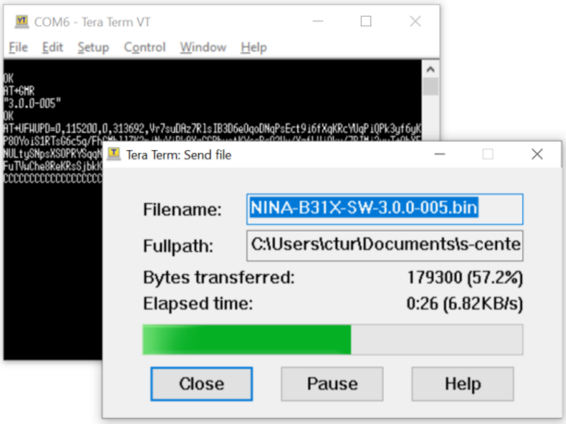
8. Prepare the bootloader to accept a file transfer using XMODEM protocol. Enter the configuration action command "x" with the ConnectivitySoftware values `<imageaddress>, <imagesize>, <imagename> <permissions>`, and `<imageid>` defined in the `NINA-B31X-CF-<version>.json` file.

```
> x 0x26000 0x4C95C ConnectivitySoftware rwx 0
```

NINA-B3 returns a series of 'C' characters for as long as the bootloader is running.

```
CCCCCCCCCCCCCCCCCCCCCCCCCC
```

9. While the bootloader is running, send the u-connectXpress `NINA-B31X-SW-3.0.0-0.005.bin` file to NINA-B3. The file is sent using XMODEM protocol.



10. Set the connectivity software as the startup image. Once the binary file has been sent, enter the configuration action command "f" with the ConnectivitySoftware value `<imageid>` defined in the `NINA-B31X-CF-<version>.json` file.

```
> f 0
OK
>
```

11. Enter the configuration action command "q" to reset and start the module with the newly flashed software.

```
> q
+STARTUP
```

For further information about bootloader commands and their parameter syntax, see the u-connectXpress bootloader protocol specification [5] and u-connectXpress AT commands manual [4].

2.4 Flashing NINA-B30 open CPU software

The NINA-B30 open CPU module can be flashed over the SWD interface.

2.4.1 Flashing over the SWD interface

For SWD flashing, an external debugger must be connected to the SWD interface of the NINA-B30 module. A third-party tool such as the J-flash or the nRF Connect Programmer from Nordic Semiconductor is used to flash the SW via the external debugger.

☞ The external debugger SEGGER J-Link BASE works with the NINA-B30 modules.

☞ The EVK-NINA-B30 evaluation kit incorporates an onboard debugger and can therefore be flashed without any external debugger. See also the EVK-NINA-B3 user guide [3].

2.4.1.1 Flashing the software

⚠ As flashing the software erases the Bluetooth device address, it must be manually rewritten to the module after flashing. Ensure that you make a note of your Bluetooth device address before continuing with the flashing procedure. See also Bluetooth MAC address and other production data.

In the nRF Connect Programmer, drag-and-drop the hex files you want to program in the GUI, as shown in Figure 9.

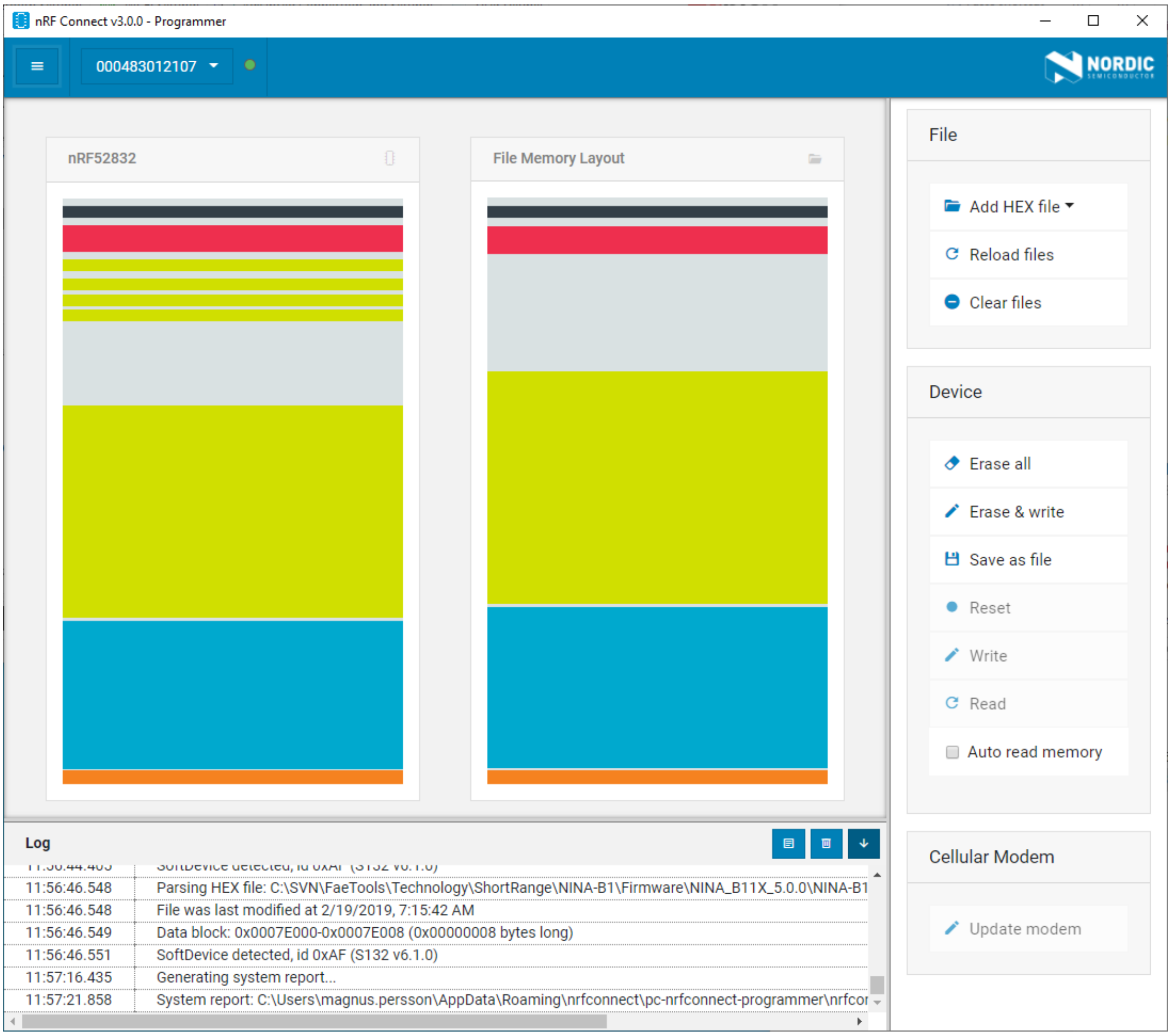


Figure 9: Nordic nRF Connect Programmer

3 Design-in

3.1 Overview

For an optimal integration of NINA-B3 series modules in the final application board, it is recommended to follow the design guidelines described in this chapter. Every application circuit must be properly designed to ensure that the related interface functions correctly, but a number of specific points require special attention during the design of the application device.

The following list provides some important points sorted by rank of criticality in the application design, starting from the highest relevance:

1. Module antenna connection: **Ant** pad.

The antenna circuit affects the RF compliance of the device integrating the NINA-B3 modules with the applicable certification schemes. Follow the Design for NINA family recommendations.

2. Module supply: **VCC**, **VCC_IO**, and **GND** pins.

The supply circuit affects the performance of the device integrating the NINA-B3 series module. Follow the NINA-B3x6 – PCB trace antenna schematic and layout design recommendations.

3. Analog signals: GPIO

Analog signals are sensitive to noise and should be routed away from high frequency signals.

4. High speed interfaces: **UART, SPI** and **SWD** pins.

High speed interfaces can be a source of radiated noise and can affect compliance with regulatory standards for radiated emissions. Follow the NINA-B3x6 – PCB trace antenna and Asynchronous serial interface (UART) design guidelines.

5. System functions: **RESET_N**, **I2C**, **GPIO** and other System input and output pins.

Accurate design is required to ensure that the voltage level is well defined during module boot.

6. Other pins:

Accurate design is required to ensure proper functionality.

3.2 Design for NINA family

NINA-B3 is based on the Nordic nRF52840 chip that has larger dimensions when compared to the nRF52832 that is used in NINA-B1. Because of this and to enable more GPIO pins underneath the module, the size of the NINA-B3 series needs to be increased. For instance, the module size of the NINA B3x2 is 10 x 15.0 mm as compared to the NINA-B112, which is 10 x 14.0 mm.

Pinouts for both the NINA-B1 and W1 are supported so that all modules in the NINA series can be placed interchangeably on a common footprint. However, to accommodate the larger dimension of the NINA-B3, a keep-out area of 1 mm should be reserved during design. Otherwise, the mechanical design of the NINA-B3 is identical to the NINA-B1 and W1 modules.

3.3 Antenna interface

As the unit cannot be mounted arbitrarily, the placement should be chosen with consideration so that it does not interfere with radio communications. The NINA-B3x2 variant that includes an internal surface mounted antenna cannot be mounted inside a metal enclosure. No metal casing or plastics using metal flakes should be used. Avoid metallic based paint or lacquer as well. NINA-B3x1 offers more design freedom, as an external antenna can be mounted further away from the module.

⚠ According to FCC regulations, the transmission line from the module antenna pin to the antenna or antenna connector on the host PCB is considered part of the approved antenna design. Therefore, module integrators must either follow exactly one of the antenna reference designs used for the FCC type approval of the module or certify their own designs.

3.3.1 RF transmission line design (NINA-B3x1 only)

RF transmission lines, such as the ones from the **ANT** pad up to the related antenna connector or up to the related internal antenna pad, must be designed so that the characteristic impedance is as close as possible to 50 Ω. Figure 10 shows the design options and the main parameters to be taken into account when implementing a transmission line on a PCB:

- Microstrip: track coupled to a single ground plane, separated by dielectric material.
- Coplanar microstrip: track coupled to ground plane and side conductors, separated by dielectric materials).
- Strip: track sandwiched between two parallel ground planes and separated by dielectric materials.

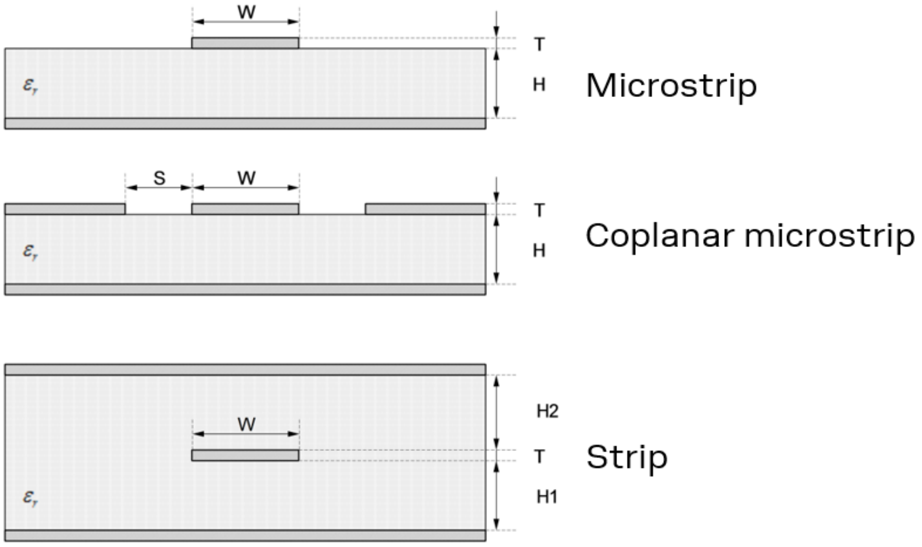


Figure 10: Transmission line trace design

To properly design a 50 Ω transmission line, the following remarks should be taken into account:

- The designer should provide enough clearance from surrounding traces and ground in the same layer; in general, a trace to ground clearance of at least two times the trace width should be considered, and the transmission line should be 'guarded' by ground plane area on each side.
- The characteristic impedance can be calculated as a first iteration by using tools provided by the layout software. It is advisable to ask the PCB manufacturer to provide the final values that are usually calculated using dedicated software and available stack-ups from production. It could also be possible to request an impedance coupon on the side of the panel so that the real impedance of the traces can be measured.
- FR-4 dielectric material, despite its inherent high losses at high frequencies, can be considered in RF designs providing that:

- RF trace length must be minimized to reduce dielectric losses.
- If traces longer than a few centimeters are needed, it is recommended to use a coaxial connector and cable to reduce losses.
- Stack-up should allow for thick 50 Ω traces and at least 200 µm of trace width is recommended to ensure good impedance control over the PCB manufacturing process.
- FR-4 material exhibits poor thickness stability and thus less control of impedance over the trace length. Contact the PCB manufacturer to find out the specific tolerance of controlled impedance traces.

- The transmission lines width and spacing to GND must be uniform and routed as smoothly as possible: route RF lines in 45° angle or in arcs.
- Add GND stitching vias around transmission lines.
- Ensure solid metal connection of the adjacent metal layer on the PCB stack-up to the main ground layer, providing enough vias on the adjacent metal layer.
- Route RF transmission lines far from any noise source (as switching supplies and digital lines) and from any sensitive circuit to avoid crosstalk between RF traces and Hi-impedance or analog signals.
- Avoid stubs on the transmission lines; any component on the transmission line should be placed with the connected pad over the trace. Also avoid any unnecessary component on RF traces.

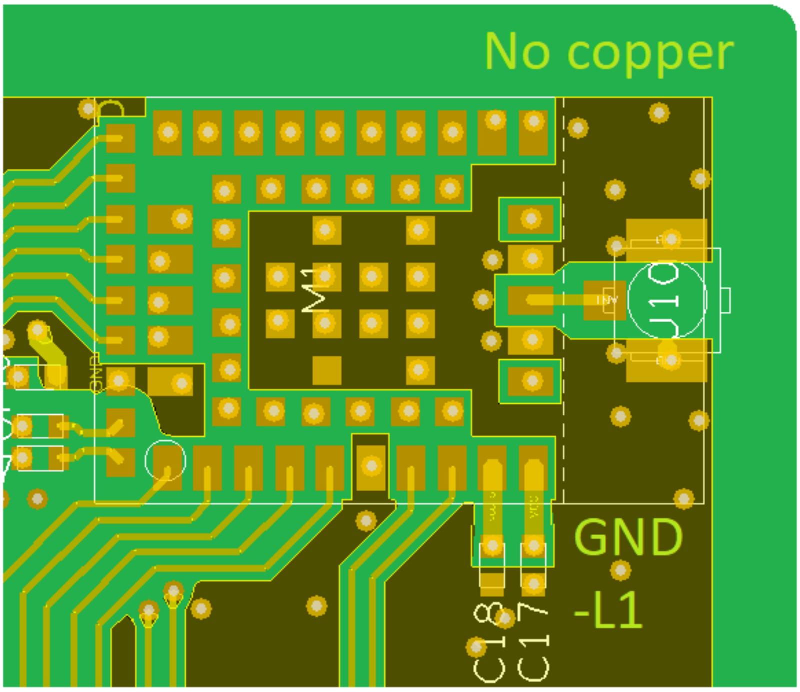


Figure 11: Example of RF trace and ground plane design from NINA-B3 Evaluation Kit (EVK)

3.3.2 Antenna design (NINA-B3x1 only)

NINA-B301 and NINA-B311 are suitable for designs where an external antenna is needed for the mechanical integration or placement of the module.

Designers must take care of the antennas from all perspectives at the beginning of the design phase when the physical dimensions of the application board are under analysis/decision. This is important because the RF compliance of the device integrating the NINA-B3 module, together with all the applicable required certification schemes, heavily depends on the radiating performance of the antennas.

The designer is encouraged to consider one of the u-blox suggested Pre-approved antennas and observe the following layout requirements.

- External antennas, such as a linear monopole:
  - External antennas basically do not impose any physical restrictions on the design of the PCB where the module is mounted.
  - The radiation performance mainly depends on the antennas. It is required to select antennas with optimal radiating performance in the operating bands.
  - RF cables should be carefully selected with minimum insertion losses. Additional insertion loss will be introduced by low quality or long cables. Large insertion loss reduces radiation performance.
  - A high quality 50 Ω coaxial connector provides proper PCB-to-RF-cable transition.
- Integrated antennas such as patch-like antennas:
  - Internal integrated antennas impose physical restrictions on the PCB design:

    An integrated antenna excites RF currents on its counterpoise, typically the PCB ground plane of the device that becomes part of the antenna; its dimension defines the minimum frequency that can be radiated. As the orientation of the ground plane related to the antenna element must be considered, the ground plane can be reduced to a minimum size that is similar to the quarter of the wavelength of the minimum frequency that needs to be radiated.

    The RF isolation between antennas in the system must be as high as possible and the correlation between the 3D radiation patterns of the two antennas must be as low as possible. In general, an RF separation of at least a quarter wavelength between the two antennas is required to achieve a maximum isolation and low pattern correlation; increased separation should be considered (if possible) to maximize the performance and fulfill the requirements in Table 8.

    As a numerical example, the physical restriction to the PCB design can be considered as shown below:

    Frequency = 2.4 GHz → Wavelength = 12.5 cm → Quarter wavelength = 3.125 cm[1]
  - Radiation performance depends on the entire product and antenna system design, including product mechanical design and usage. Antennas should be selected with optimal radiating performance in the operating bands according to the mechanical specifications of the PCB and the entire product.

Table 8 summarizes the requirements for the antenna RF interface.

Item	Requirements	Remarks
Impedance	50 Ω nominal characteristic impedance	The impedance of the antenna RF connection must match the 50 Ω impedance of the **ANT** pin.
Frequency Range	2400 - 2500 MHz	Bluetooth low energy.
Return Loss	S_{11} < -10 dB (VSWR < 2:1) recommended S_{11} < -6 dB (VSWR < 3:1) acceptable	The Return loss or the S_{11}, as the VSWR, refers to the amount of reflected power, measuring how well the primary antenna RF connection matches the 50 Ω characteristic impedance of the **ANT** pin. The impedance of the antenna termination must match as much as possible the 50 Ω nominal impedance of the **ANT** pin over the operating frequency range, thus maximizing the amount of the power transferred to the antenna.
Efficiency	> -1.5 dB (> 70%) recommended > -3.0 dB (> 50%) acceptable	The radiation efficiency is the ratio of the radiated power to the power delivered to the antenna input; the efficiency is a measure of how well an antenna receives or transmits.
Maximum Gain	+3 dBi	Higher gain antennas can be used, but these must be evaluated and/or certified. See also Regulatory information and requirements.

Table 8: Summary of antenna interface (ANT) requirements for NINA-B3

[1] Wavelength referred to a signal propagating over the air

While selecting external or internal antennas, the following recommendations should be observed:

- Select antennas that provide optimal return loss (or VSWR) figure over all the operating frequencies.
- Select antennas that provide optimal efficiency figure over all the operating frequencies.
- Select antennas that provide an appropriate gain figure (based on the combined antenna directivity and efficiency figure), so that the electromagnetic field radiation intensity does not exceed the regulatory limits specified in some countries (for example, by the FCC in the United States).

3.3.2.1 RF Connector Design

If an external antenna is required, the designer should consider using a proper RF connector. It is the responsibility of the designer to verify the compatibility between plugs and receptacles used in the design.

Table 9 suggests some RF connector plugs that can be used by the designers to connect RF coaxial cables based on the declaration of the respective manufacturers. The Hirose U.FL-R-SMT RF receptacles (or similar parts) require a suitable mated RF plug from the same connector series. Due to wide usage of this connector, several manufacturers offer compatible equivalents.

Manufacturer	Series	Remarks
Hirose	U.FL® Ultra Small Surface Mount Coaxial Connector	Recommended
I-PEX	MHF® Micro Coaxial Connector	
Tyco	UMCC® Ultra-Miniature Coax Connector	
Amphenol RF	AMC® Amphenol Micro Coaxial	
Lighthorse Technologies, Inc.	IPX ultra micro-miniature RF connector	

Table 9: U.FL compatible plug connector

Typically, the RF plug is available as a cable assembly. Different types of cable assembly are available; the user should select the cable assembly best suited to the application. The key characteristics are:

- RF plug type: select U.FL or equivalent
- Nominal impedance: 50 Ω
- Cable thickness: Typically from 0.8 mm to 1.37 mm. Select thicker cables to minimize insertion loss.
- Cable length: Standard length is typically 100 mm or 200 mm; custom lengths may be available on request. Select shorter cables to minimize insertion loss.
- RF connector on the other side of the cable: for example another U.FL (for board-to-board connection) or SMA (for panel mounting)

Consider that SMT connectors are typically rated for a limited number of insertion cycles. In addition, the RF coaxial cable may be relatively fragile compared to other types of cables. To increase application ruggedness, connect the U.FL connector to a more robust connector such as SMA fixed on panel.

☞ A de-facto standard for SMA connectors implies the usage of reverse polarity connectors (RP-SMA) on Wi-Fi and Bluetooth end products to increase the difficulty for the end user to replace the antenna with higher gain versions and exceed the regulatory limits.

The following recommendations apply for proper layout of the connector:

- Strictly follow the connector manufacturer's recommended layout:
  - SMA Pin-Through-Hole connectors require GND keep-out (clearance or void area) on all the layers around the central pin up to annular pads of the four GND posts.
  - UFL surface mounted connectors require no conductive traces (that is, clearance, a void area) in the area below the connector between the GND land pads.
- If the RF pad size of the connector is wider than the microstrip, remove the GND layer beneath the RF connector to minimize the stray capacitance thus keeping the RF line 50 Ω. For example, the active pad of the UF.L connector must have a GND keep-out (clearance or void area) – at least on the first inner layer to reduce parasitic capacitance to ground.

3.3.2.2 Integrated antenna design

If integrated antennas are used, the transmission line is terminated by the integrated antennas themselves. The following guidelines should be followed:

- The antenna design process should begin at the start of the whole product design process. Self-made PCBs and antenna assembly are useful in estimating overall efficiency and the radiation path of the intended design.
- Use antennas designed by an antenna manufacturer providing the best possible return loss (or VSWR).
- Provide a ground plane large enough according to the related integrated antenna requirements. The ground plane of the application PCB may be reduced to a minimum size that is similar to one quarter of wavelength of the minimum frequency that needs to be radiated. The overall antenna efficiency may benefit from larger ground planes.
- Proper placement of the antenna and its surroundings is also critical for antenna performance. Avoid placing the antenna close to conductive or RF-absorbing parts such as metal objects, ferrite sheets and so on as they may absorb part of the radiated power or shift the resonant frequency of the antenna or affect the antenna radiation pattern.
- It is highly recommended to strictly follow the detailed and specific guidelines provided by the antenna manufacturer regarding correct installation and deployment of the antenna system, including the PCB layout and matching circuitry.
- Further to the custom PCB and product restrictions, antennas may require tuning/matching to comply with all the applicable required certification schemes. It is recommended to consult the antenna manufacturer for the design-in guidelines and plan the validation activities on the final prototypes like tuning/matching and performance measures. See also Table 8.
- The RF functional section may be affected by noise sources like hi-speed digital buses. Avoid placing the antenna close to buses such as DDR or consider taking specific countermeasures like metal shields or ferrite sheets to reduce the interference.

⚠ Take care of interaction between co-located RF systems like LTE sidebands on 2.4 GHz band. Transmitted power may interact or disturb the performance of NINA-B3 modules.

3.3.3 On-board antenna

If a plastic enclosure is used, it is possible to use NINA-B3 with the embedded antenna. In order to reach an optimum operating performance, follow the instructions for each variant, NINA-B3x2 and NINA-B3x6 – PCB trace antenna.

3.3.3.1 NINA-B3x2

- The module shall be placed in the corner of the host PCB with the antennas feed point in the corner (pins 15 and 16), as shown in Figure 12. Other edge placements positions, with the antenna closest to the edge, are also possible. These will however give moderate reduced antenna performance compared to the corner placement.

- A large ground plane on the host PCB is a prerequisite for good antenna performance.
- The host PCB shall include a full GND plane underneath the entire module, including the antenna section. This facilitates efficient grounding of the module.
- High / large parts including metal shall not be placed closer than 10 mm to the module antenna.
- At least 5 mm clearance between the antenna and the casing is needed. If the clearance is less than 5 mm, the antenna performance will be affected. PC and ABS gives less impact and POS type plastic gives more.
- The module shall be placed such that the antenna faces outwards from the product and is not obstructed by any external items in close vicinity of the products intended use case.

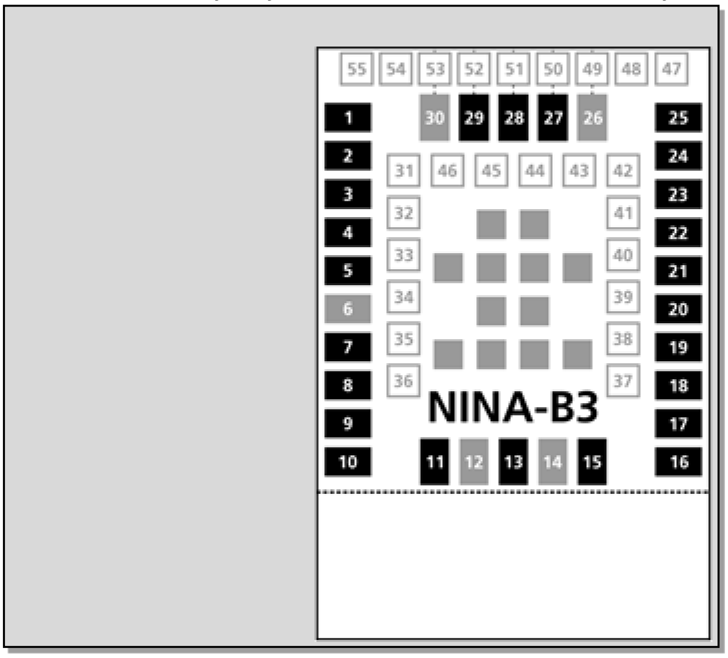


Figure 12: NINA-B3x2 with internal antenna

⚠ Take care when handling the NINA-B3x2. Applying force to the NINA-B3x2 module might damage the internal antenna.

⚠ Make sure that the end product design is done in such a way that the antenna is not subject to physical force.

3.3.3.2 NINA-B3x6 – PCB trace antenna

- The module shall be placed in the center of an edge of the host PCB.
- A large ground plane on the host PCB is a prerequisite for good antenna performance. It is recommended to have the ground plane extending at least 10 mm on both sides of the module. See Figure 13.
- The host PCB shall include a full GND plane underneath the entire module, with a ground cut out under the antenna according to the description in Figure 14.
- The NINA-B3x6 has 4 extra GND pads under the antenna that need to be connected for a good antenna performance. Detailed measurements of the footprint including this extra GND pads can be found in the NINA-B3 series data sheet [2].
- High / large parts including metal shall not be placed closer than 10 mm to the module's antenna.
- At least 10 mm clearance between the antenna and the casing is needed. If the clearance is less than 10 mm, the antenna performance will be affected. PC and ABS gives less impact and POS type plastic gives more.
- The module shall be placed such that the antenna faces outwards from the product and is not obstructed by any external items in close vicinity of the products intended use case.

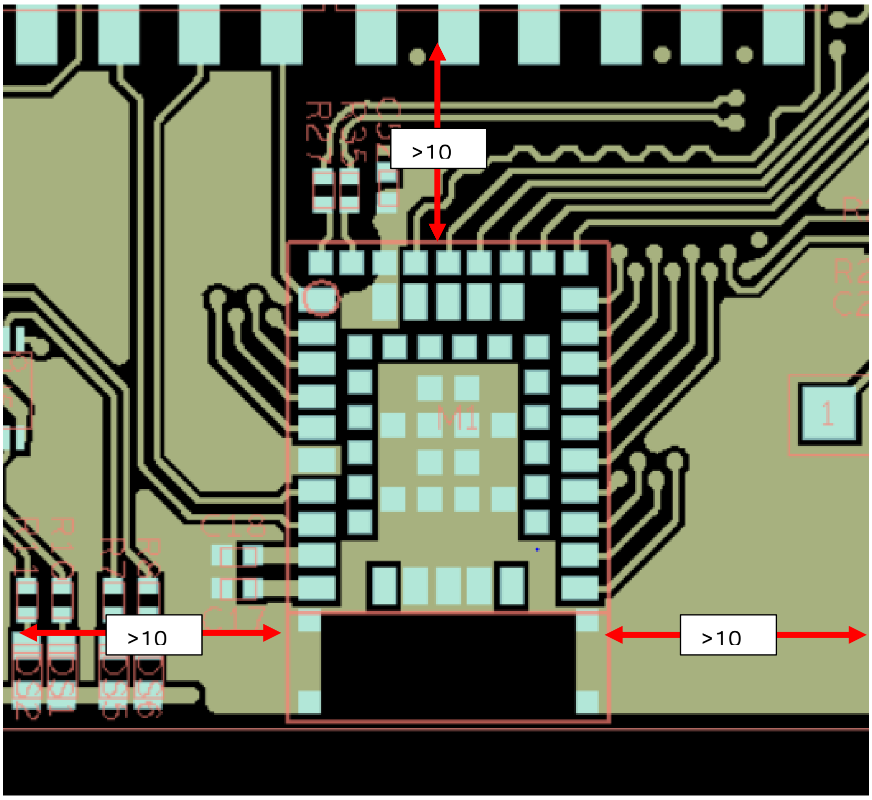


Figure 13: Extend GND plane outside the NINA-B3x6 module

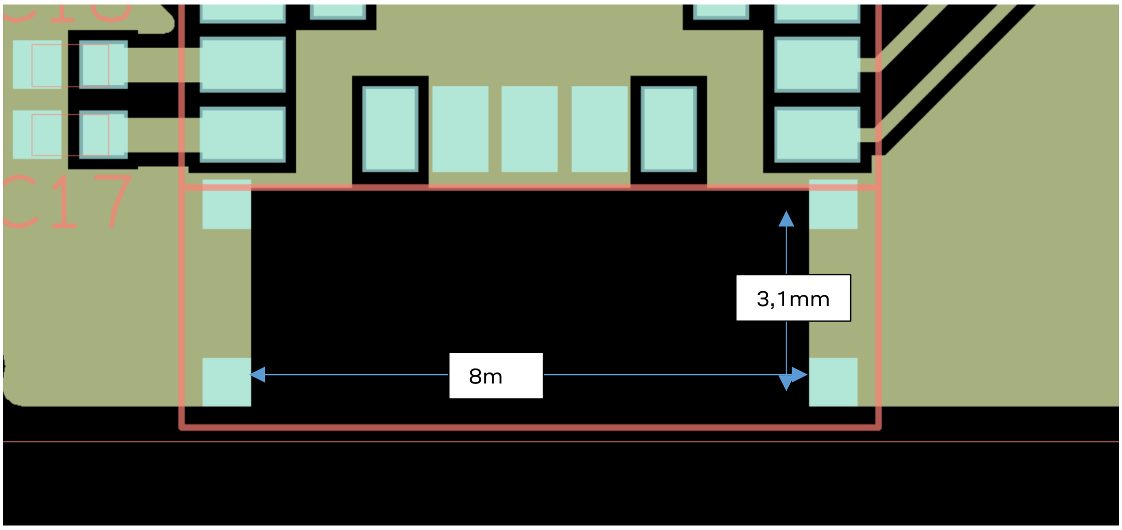


Figure 14: Size of the GND cut out for the NINA-B3x6 module

3.4 Supply interfaces

3.4.1 Module supply design

For correct RF performance, a good connection of the module **VCC** pin with DC supply source is necessary. Guidelines for the supply design are summarized below:

- The VCC connection must be as wide and short as possible.
- The VCC connection must be routed through a PCB area separated from sensitive analog signals and sensitive functional units. It is a good practice to interpose at least one layer of PCB ground between the VCC track and other signal routing.

There is no strict requirement for adding bypass capacitance to the supply net close to the module. But depending on the layout of the supply net and other consumers on the same net, bypass capacitors might still be beneficial. Though the GND pins are internally connected, connect all the available pins to solid ground on the application board, as a good (low impedance) connection to an external ground can minimize power loss and improve RF and thermal performance.

3.5 Serial interfaces

3.5.1 Asynchronous serial interface (UART) design

The layout of the UART bus should be made so that noise injection and cross talk are avoided.

It is recommended to use the hardware flow control with RTS/CTS to prevent temporary UART buffer overrun.

The flow control signals RTS/CTS are active low thus a 0 (ON state =low level) will allow the UART to transmit.

- CTS is an input to the NINA-B3 module. If the host applies a 0 (ON state = low level) the module is allowed to transmit.
- RTS is an output off the NINA-B3 module. The module applies a 0 (ON state = low level) when it is ready to receive transmission.

3.5.2 Serial peripheral interface (SPI)

The layout of the SPI bus should be made so that noise injection and cross talk are avoided.

3.5.3 I2C interface

The layout of the I2C bus should be made so that noise injection and cross talk are avoided.

3.5.4 QSPI interface

The layout of the QSPI bus should be made so that noise injection and cross talk are avoided.

3.5.5 USB interface

The layout of the USB bus should be made so that noise injection and cross talk are avoided.

3.6 NFC interface

⚠ The pins for the NFC interface can also be used as normal GPIOs. In NINA-B30 series modules, ensure that the NFC pins are configured correctly in software. Connecting an NFC antenna to the pins configured as GPIO will damage the module. In NINA-B31 series modules, the NFC pins will always be set to "NFC mode".

The NFC antenna coil must be connected differentially between the **NFC1** and **NFC2** pins of the device.

Two external capacitors should be used to tune the resonance of the antenna circuit to 13.56 MHz.

The required tuning capacitor value is given by the below equations: an antenna inductance of L_{ANT} = 2 µH will give tuning capacitors in the range of 130 pF on each pin. For good performance, match the total capacitance on NFC1 and NFC2.

NINA-B3 modules have been tested with a 3 x 3 cm PCB trace antenna, so it is recommended to keep an antenna design close to these measurements. You can still use a smaller or larger antenna as long as it is tuned to resonate at 13.56 MHz. To comply with European regulatory demands, the NFC antenna must be placed in such a way that the space between the NINA-B3 module and the remote NFC transmitter is always within 3 meters during transmission.

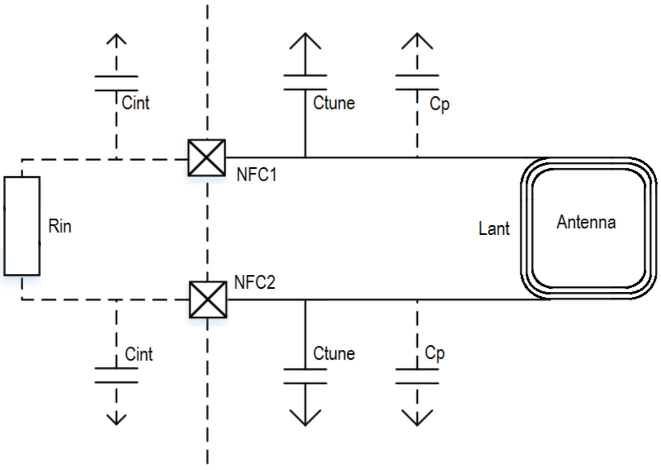


Figure 15: NFC antenna design

$$C'_{tune} = \frac{1}{(2\pi \times 13.56\,MHz)^2 L_{ant}} \quad were\ C'_{tune} = \frac{1}{2} \times \left(C_p + C_{int} + C_{tune}\right)$$

$$C_{tune} = \frac{2}{(2\pi \times 13.56\,MHz)^2 L_{ant}} - C_p - C_{int}$$

3.6.1 Battery protection

If the antenna is exposed to a strong NFC field, current may flow in the opposite direction on the supply because of parasitic diodes and ESD structures.

If the battery used does not tolerate a return current, a series diode must be placed between the battery and the device in order to protect the battery.

3.7 General High Speed layout guidelines

These general design guidelines are considered as best practices and are valid for any bus present in NINA-B3 series modules; the designer should prioritize the layout of higher speed buses. Low frequency signals are generally not critical for layout.

⚠ One exception is represented by High Impedance traces (such as signals driven by weak pull resistors) that may be affected by crosstalk. For those traces, a supplementary isolation of 4w from other buses is recommended.

3.7.1 General considerations for schematic design and PCB floor-planning

- Verify which signal bus requires termination and add series resistor terminations to the schematics.
- Carefully consider the placement of the module with respect to antenna position and host processor.
- Verify with PCB manufacturer allowable stack-ups and controlled impedance dimensioning.
- Verify that the power supply design and power sequence are compliant with NINA-B3 series supply interface specifications.

3.7.2 Module placement

- Accessory parts like bypass capacitors should be placed as close as possible to the module to improve filtering capability, prioritizing the placement of the smallest size capacitor close to module pads.

⚠ Particular care should be taken not to place components close to the antenna area. The designer should carefully follow the recommendations from the antenna manufacturer about the distance of the antenna vs. other parts of the system. The designer should also maximize the distance of the antenna to Hi-frequency buses like DDRs and related components or consider an optional metal shield to reduce interferences that could be picked up by the antenna thus reducing the module's sensitivity.

- An optimized module placement allows better RF performance. For more information on antenna considerations and module placement, see also Antenna interface.

3.7.3 Layout and manufacturing

- Avoid stubs on high-speed signals. Even through-hole vias may have an impact on signal quality.
- Verify the recommended maximum signal skew for differential pairs and length matching of buses.
- Minimize the routing length; longer traces will degrade signal performance. Ensure that the maximum allowable length for high-speed buses is not exceeded.
- Ensure that you track your impedance matched traces. Consult with your PCB manufacturer early in the project for proper stack-up definition.
- RF and digital sections should be clearly separated on the board.
- Ground splitting is not allowed below the module.
- Minimize the bus length to reduce potential EMI issues from digital buses.
- All traces (including low speed or DC traces) must couple with a reference plane (GND or power); Hi-speed buses should be referenced to the ground plane. In this case, if the designer needs to change the ground reference, an adequate number of GND vias must be added in the area of transition to provide a low impedance path between the two GND layers for the return current.
- Hi-Speed buses are not allowed to change reference plane. If a reference plane change is unavoidable, some capacitors should be added in the area to provide a low impedance return path through the different reference planes.
- Trace routing should keep a distance greater than 3w from the ground plane routing edge.
- Power planes should keep a distance from the PCB edge sufficient to route a ground ring around the PCB, and the ground ring must then be connected to other layers through vias.

3.8 Module footprint and paste mask

The mechanical outline of the NINA-B3 series module can be found in the NINA-B3 series data sheet [2]. The proposed land pattern layout reflects the pad's layout of the module.

The Non Solder Mask Defined (NSMD) pad type is recommended over the Solder Mask Defined (SMD) pad type, which implements the solder mask opening 50 µm larger per side than the corresponding copper pad.

The suggested paste mask layout for the NINA-B3 series modules is to follow the copper mask layout as described in the NINA-B3 series data sheet [2].

⚠ These are recommendations only and not specifications. The exact mask geometries, distances, and stencil thicknesses must be adapted to the specific production processes of the customer.

3.9 Thermal guidelines

NINA-B3 series modules have been successfully tested from -40 °C to +85 °C. NINA-B3 series modules are low power devices that generate only a small amount of heat during operation. A good grounding should still be observed for temperature relief during high ambient temperatures.

3.10 ESD guidelines

The immunity of devices integrating NINA-B3 modules to Electrostatic Discharge (ESD) is part of the Electromagnetic Compatibility (EMC) conformity, which is required for products bearing the CE marking, compliant with the R&TTE Directive (99/5/EC), the EMC Directive (89/336/EEC) and the Low Voltage Directive (73/23/EEC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European Norms for device ESD immunity: ESD testing standard *CENELEC EN 61000-4-2* and the radio equipment standards *ETSI EN 301 489-1*, *ETSI EN 301 489-7*, *ETSI EN 301 489-24*, the requirements of which are summarized in Table 10.

The ESD immunity test is performed at the enclosure port, defined by *ETSI EN 301 489-1* as the physical boundary through which the electromagnetic field radiates. If the device implements an integral antenna, the enclosure port is seen as all insulating and conductive surfaces housing the device. If the device implements a removable antenna, the antenna port can be separated from the enclosure port. The antenna port includes the antenna element and its interconnecting cable surfaces.

The applicability of ESD immunity test to the whole device depends on the device classification as defined by *ETSI EN 301 489-1*. Applicability of the ESD immunity test to the related device ports or the related interconnecting cables to auxiliary equipment depends on device accessible interfaces and manufacturer requirements, as defined by *ETSI EN 301 489-1*.

Contact discharges are performed at conductive surfaces, while air discharges are performed at insulating surfaces. Indirect contact discharges are performed on the measurement setup horizontal and vertical coupling planes as defined in *CENELEC EN 61000-4-2*.

☞ For the definition of integral antenna, removable antenna, antenna port, and the device classification, refer to the *ETSI EN 301 489-1*. For the contact and air discharges definitions, refer to *CENELEC EN 61000-4-2*.

Application	Category	Immunity level
All exposed surfaces of the radio equipment and ancillary equipment in a representative configuration	Indirect Contact Discharge	±8 kV

Table 10: Electromagnetic Compatibility ESD immunity requirements as defined by CENELEC EN 61000-4-2, ETSI EN 301 489-1, ETSI EN 301 489-7, ETSI EN 301 489-24

NINA-B3 is manufactured taking into account specific standards to minimize the occurrence of ESD events; the highly automated process complies with IEC61340-5-1 (STM5.2-1999 Class M1 devices) standard, and therefore the designer should implement proper measures to protect any pin that may be exposed to the end user from ESD events.

Compliance with the standard protection level specified in EN61000-4-2 can be achieved by including ESD protections in parallel to the line, close to areas accessible by the end user.

4 Handling and soldering

⚠ NINA-B3 series modules are Electrostatic Sensitive Devices that demand the observance of special handling precautions against electrostatic damage. Failure to observe these precautions can result in severe damage to the product.

4.1 ESD handling precautions

⚠ As the risk of electrostatic discharge in the RF transceivers and patch antennas of the module is of particular concern, standard ESD safety practices are prerequisite. See also Figure 16.

Consider also:

- When connecting test equipment or any other electronics to the module (as a standalone or PCB-mounted device), the first point of contact must always be to local GND.
- Before mounting an antenna patch, connect the device to ground.
- When handling the RF pin, do not touch any charged capacitors. Be especially careful when handling materials like patch antennas (~10 pF), coaxial cables (~50-80 pF/m), soldering irons, or any other materials that can develop charges.
- To prevent electrostatic discharge through the RF input, do not touch any exposed antenna area. If there is any risk of an exposed antenna being touched in an unprotected ESD work area, be sure to implement proper ESD protection measures in the design.
- When soldering RF connectors and patch antennas to the RF pin on the receiver, be sure to use an ESD-safe soldering iron (tip).

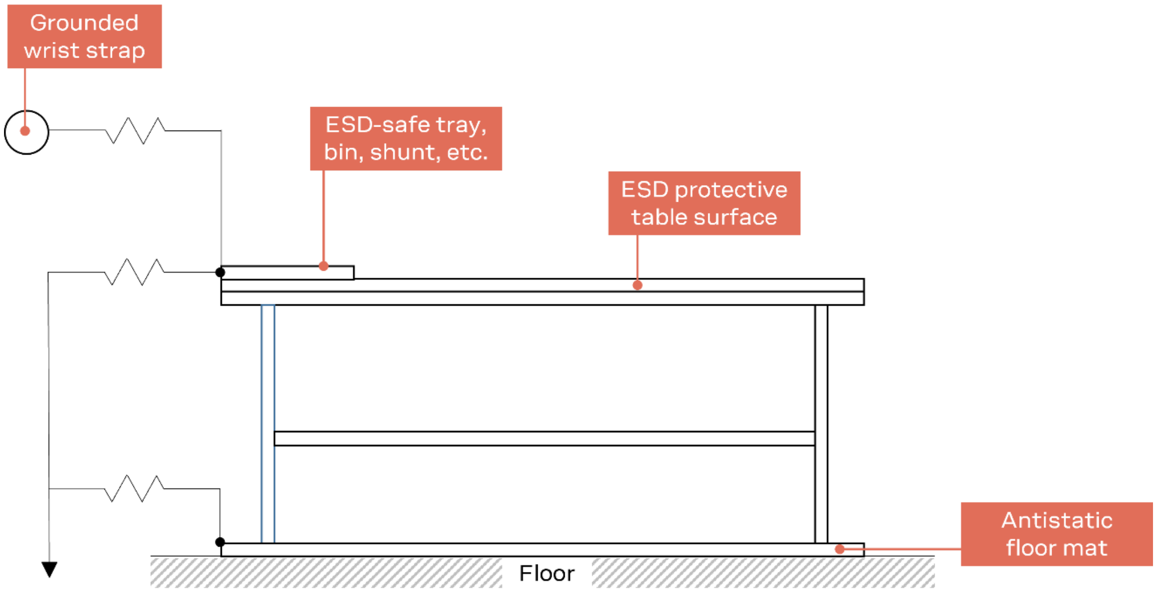


Figure 16: Standard workstation setup for safe handling of ESD-sensitive devices

4.2 Packaging, shipping, storage, and moisture preconditioning

For information pertaining to reels, tapes or trays, moisture sensitivity levels (MSL), shipment and storage, as well as drying for preconditioning, refer to the respective NINA-B3 data sheet [2] and Packaging information reference guide [1].

4.3 Soldering

☞ No natural rubbers, hygroscopic materials or materials containing asbestos are employed.

4.3.1 Reflow soldering process

NINA-B3 series modules are surface mounted devices supplied on a FR4-type PCB with gold-plated connection pads. The modules are manufactured in a lead-free process with lead-free soldering paste. The bow and twist of the PCB is maximum 0.75% according to IPC-A-610E.

The thickness of solder resist between the host PCB top side and the bottom side of the NINA-B3 series module must be considered for the soldering process.

NINA-B3 modules are compatible with the industrial reflow profile for common SAC type RoHS solders. No-clean soldering paste is strongly recommended.

The reflow profile is dependent on the thermal mass of the entire populated PCB, the heat transfer efficiency of the oven, and the type of solder paste that is used. The optimal soldering profile that is used must be trimmed for each case depending on the specific soldering process and PCB layout.

The target parameter values shown in Table 11are only general guidelines for a Pb-free process. The given values are tentative and subject to change. For further information, see also the JEDEC J-STD-020C standard [5].

Process parameter		Unit	Target
Pre-heat	Ramp up rate to T_{SMIN}	K/s	3
	T_{SMIN}	°C	150
	T_{SMAX}	°C	200
	t_S (from +25 °C)	s	150
	t_S (Pre-heat)	s	60 to 120
Peak	T_L	°C	217
	t_L (time above T_L)	s	40 to 60
	T_P (absolute max)	°C	245
Cooling	Ramp-down from T_L	K/s	4
	Allowed soldering cycles	-	1

Table 11: Recommended reflow profile

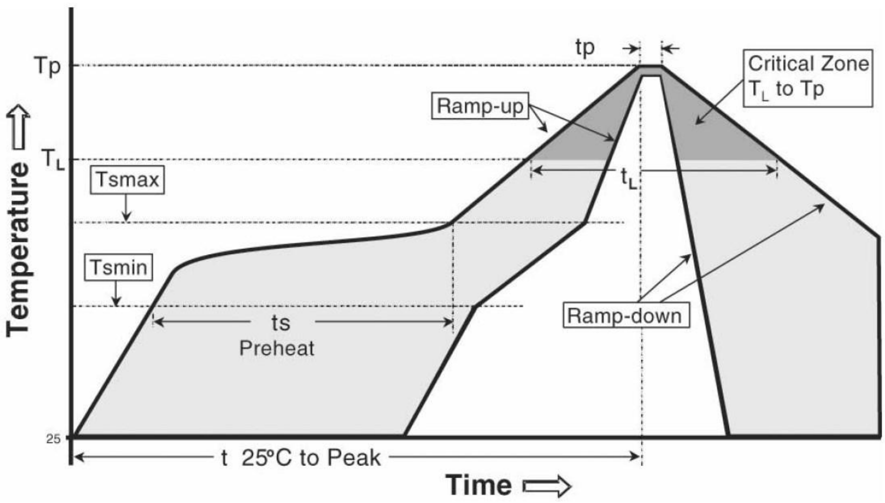


Figure 17: Reflow profile

☞ Lower value of T_P and slower ramp down rate (2 – 3 °C/sec) is preferred.

☞ After reflow soldering, optical inspection of the modules is recommended to verify proper alignment.

4.3.2 Cleaning

Cleaning the modules is not recommended. Residues underneath the modules cannot be easily removed with a washing process.

- Cleaning with water will lead to capillary effects where water is absorbed in the gap between the baseboard and the module. The combination of residues of soldering flux and encapsulated water leads to short circuits or resistor-like interconnections between neighboring pads. Water will also damage the sticker and the ink-jet printed text.
- Cleaning with alcohol or other organic solvents can result in soldering flux residues flooding into the housings that are not accessible for post-wash inspections. The solvent will also damage the sticker and the ink-jet printed text.
- Ultrasonic cleaning will permanently damage the module and the crystal oscillators in particular. For best results, use a "no clean" soldering paste and eliminate the need for a cleaning stage after the soldering process.

4.3.3 Other remarks

- Only a single reflow soldering process is allowed for boards with a module populated on them.
- Boards with combined through-hole (THT) components and surface-mounted (SMT) devices may require wave soldering. Only a single-wave soldering process is allowed for boards populated with the modules. Miniature Wave Selective Solder processes are preferred over the traditional wave soldering processes.
- Hand soldering is not recommended.
- Rework is not recommended.
- Conformal coating can affect the performance of the module, so it is important to prevent the liquid from flowing into the module. The RF shields do not provide protection for the module from coating liquids with low viscosity, and so care is required in applying the coating. Conformal coating of the module will void the module warranty.
- Grounding metal covers: Attempts to improve grounding by soldering ground cables, wick or other forms of metal strips directly onto the EMI covers are made at the customer's own risk and will void the module’s warranty. The numerous ground pins included in the module design are adequate to provide optimal immunity to interferences.
- The module contains components that are sensitive to ultrasonic waves. Use of any ultrasonic processes, such as cleaning, welding, and so on, can damage the module. Use of ultrasonic processes on an end product integrating this module will void the warranty.

5 Regulatory information and requirements

NINA-B3 series modules are certified for use in different regions and countries such as Europe, USA and Canada. See the NINA-B3 series data sheet [2] for a list of approved countries/regions where NINA-B3 modules are approved for use. Each market has its own regulatory requirements that must be fulfilled, and the NINA-B3 series modules comply with the requirements for a radio transmitter in each of the listed markets.

In some cases, limitations must be placed on the end product that integrates a NINA-B3 module to comply with the regulatory requirements. This chapter lists the limitations and requirements that a module integrator must take into consideration. It is divided into different subsections for each market.

The Integration checklist at the end of this chapter provides a summary of the requirements for each market.

⚠ This section reflects u-blox' interpretation of different regulatory requirements of a radio device in each country/region. It does not cover all the requirements placed on an end product that uses the radio module of u-blox or any other manufacturer.

5.1 ETSI – European market

5.1.1 Compliance statement

Detailed information about European Union regulatory compliance for the NINA-B3 series modules is available in the NINA-B3 Declaration of Conformity [15].

⚠ Module integrators are required to make their own "Declaration of Conformity", in which test standards and directives that are tested and fulfilled by the end product are listed.

5.1.2 NINA-B3 Software security considerations

⚠ An end user cannot be allowed to change the software on the NINA-B3 module to any unauthorized software or modify the existing software in an unauthorized way. A module integrator must consider this in the end product design. Typically, the SWD interface (the **SWDCLK** and **SWDIO** pins) must not be accessible by the end user.

5.1.3 Output power limitation

The Radio Equipment Directive requires radio transmitters that have an Effective Isotropic Radiated Power (EIRP) of 10 dBm or more, to either implement an adaptivity feature or reduce its medium utilization.

NINA-B3 series modules are based on the Nordic Semiconductor nRF52840 chip, which supports multiple radio protocols such as Bluetooth low energy, IEEE 802.15.4 with thread, etc.

Since Bluetooth low energy does not support either adaptivity or reduced medium utilization, a NINA-B3 Bluetooth LE implementation on the European market must have an EIRP of less than 10 dBm.

⚠ In the European market, it is the end product manufacturer that holds the responsibility that these limitations are followed. If the u-blox module integrator is not the end product manufacturer, the module integrator should make sure that this information is shared with the end product manufacturer.

☞ Radio protocols based on 802.15.4, which supports adaptivity is allowed an EIRP of 10 dBm or higher.

EIRP is calculated as:

$$EIRP(dBm) = P_{TX}(dBm) – L(dB) + G_{TX}(dBi)$$

where, P_{TX} is the output power of the transmitter, L is the path loss of the transmission line between the transmitter and antenna, and G_{TX} is the maximum gain of the transmit antenna. Consider the following for each of these components:

- Output power:
  - The output power setting of the NINA-B3 module. An end product user must not be able to increase the setting above the 10 dBm EIRP limit, by sending configuration commands etc.
  - The operating temperature of the end product. The output power of a transmitter is typically increased as the ambient temperature is lowered. The operating temperature range of NINA-B3 is -40 to +85 °C, and across this range the output power can typically vary by 1 dB. The output power at the lowest operating temperature (yielding the highest output power) must be considered for the EIRP calculation.
- Path loss – Long antenna cables or PCB traces, RF switches, etc. will attenuate the power reaching the antenna. This path loss should be measured and taken into consideration for the EIRP calculation.
- Antenna gain - The maximum gain of the transmit antenna must be considered for the EIRP calculation.

5.1.3.1 Implementation in the NINA-B31 series

In the u-connectXpress software, output power can be configured by using the Bluetooth configuration AT command.

```
AT+UBTCFG=4,<output power>
```

The default output power setting (6), which typically corresponds to +6 dBm output power at room temperature. This setting is based on the following assumptions:

- -40 °C is the lowest operating temperature of the end product
- The path loss is negligible
- The maximum antenna gain of the end-product antenna is +3 dBi.

With these assumptions, the EIRP will be just below the 10 dBm limit. If, for instance the antenna gain is instead +2 dBi and an antenna cable with 1 dB path loss is used, a higher output power setting could be used.

☞ The maximum output power setting (8) typically corresponds to +8 dBm output power, though the output power setting does not match the actual output power 1:1. Use a power meter or spectrum analyzer to measure the actual output power before committing to a power setting.

5.1.3.2 Implementation in the NINA-B30 series

An integrator of the open CPU variant of the NINA-B3 series on the European market must make sure that an end user cannot in any way configure the output power of the radio to 10 dBm EIRP or above.

5.1.4 Safety Compliance

⚠ In order to fulfill the EN 60950-1 safety standard, the NINA-B3 series modules must be supplied with a Class-2 Limited Power Source.

5.2 FCC/ISED – US/Canadian markets

5.2.1 Compliance statements

The NINA-B3 series modules comply with Part 15 of the FCC Rules and with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that the interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to correct the interference using either one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

⚠ Since u-blox cannot control how integrators of NINA-B30 will operate the module, an extra precaution is required by the FCC/ISED. NINA-B30 customers are required to undergo a 'Change in ID' process. See also Change in ID/Multiple Listing process..

⚠ The NINA-B3 modules are for OEM integrations only. The end product has to be professionally installed in such a manner that only the authorized antennas can be used. See also Antenna selection.

⚠ Any changes to hardware, hosts or co-location configuration may require new radiated emission and SAR evaluation and/or testing. Any changes or modifications NOT explicitly APPROVED by u-blox may cause the NINA-B3 module to cease to comply with the FCC rules part 15 thus void the user's authority to operate the equipment on the US market.

Model	FCC ID	ISED certification number
NINA-B301	XPYNINAB30	8595A-NINAB30
NINA-B302	XPYNINAB30	8595A-NINAB30
NINA-B306	XPYNINAB30	8595A-N INAB30
NINA-B311	XPYNINAB31	8595A-NINAB31
NINA-B312	XPYNINAB31	8595A-NINAB31
NINA-B316	XPYNINAB31	8595A-NINAB31

Table 12: FCC IDs and ISED certification numbers for the NINA-B3 series modules

5.2.2 RF Exposure

NINA-B3 series modules comply with the FCC radiation exposure limits and the requirements of IC RSS-102 issue 5 radiation exposure limits set forth for an uncontrolled environment.

☞ Having a separation distance of minimum 10 mm between the user and/or bystander and the antenna and /or radiating element ensures that the maximum output power of NINA-B3 is below the SAR test exclusion limits presented in KDB 447498 D01v06 (US market limits).

☞ Having a separation distance of minimum 15 mm between the user and/or bystander and the antenna and /or radiating element ensures that the output power (e.i.r.p.) of NINA-B3 is below the SAR evaluation Exemption limits defined in RSS-102 issue 5 (Canadian market limits).

5.2.3 Antenna selection

⚠ For NINA-B301 and NINA-B311, the Reference design for external antennas (U.FL connector) must be followed to comply with the NINA-B30/NINA-B31 FCC/IC modular approval. Use only those antennas that have been authorized for use with NINA-B3. See also Pre-approved antennas.

☞ u-blox has provided these pre-approved antennas and reference design to enable quick time to market, but it is possible and encouraged for customers to add their own antennas and connector designs. These must be approved by u-blox and in some cases tested. Contact your nearest u-blox support for more information about this process.

5.2.4 IEEE 802.15.4 channel map limitation

The 2.4 GHz band used by 802.15.4 communications is segmented into 16 channels, ranging from channel 11 at 2405 MHz to channel 26 at 2480 MHz, with 5 MHz channel spacing. Due to the wide spectral properties of the 802.15.4 signal, the use of channel 26 results in too much power being transmitted in the FCC restricted band starting at 2483.5 MHz. As a result, channel 26 must not be used on the US/Canadian market.

5.2.4.1 Implementation in NINA-B31 series

IEEE 802.15.4 is currently not supported in the u-connectXpress software. No additional effort is needed.

5.2.4.2 Implementation in NINA-B30 series

Integrators of the open CPU variant of the NINA-B3 series will have to make a “change in FCC ID” filing to inherit the test results of the u-blox FCC compliance tests. In this filing process it must be made clear that the software application has been limited to not use channel 26, and that it cannot be ‘unlocked’ by an end user. It should not be possible for an end user to change the software on the module to any unauthorized or modified software that allows the use of 802.15.4 channel 26. Typically, the SWD interface on the NINA-B30 module, which allows full access to all registers and code space, must be made unavailable to end users.

5.2.5 Change in ID/Multiple Listing process

☞ A Change in ID can be done only for the NINA-B30 series.

The open CPU feature of the NINA-B30 series allows customers to create their own software applications using the NINA-B3 hardware. This software will have full control of radio parameters, and it is possible to configure the radio in a way that it will be non-compliant with the FCC regulatory requirements.

For any product including an FCC/ISED approved radio device, it will be the sole responsibility of the FCC/ISED ID holder, in this case u-blox, to ensure that the product complies with the FCC radio regulations. Since the software applications created by integrators of the NINA-B30 series cannot be controlled by u-blox, the module integrator will have to take over this responsibility. This process is known as a “change in ID” in the US and “multiple listing” in Canada.

Most FCC accredited test houses can provide the service to make a change in ID. Module integrators can also make an application themselves to a Telecommunication Certification Body (TCB). Typically, the following documentation has to be submitted:

- A permission letter, signed by u-blox, that allows the module integrator (or test house) to make the change in ID.
- An application letter stating that there is no change in the design, circuitry, or construction of the NINA-B30 module, and that the original NINA-B30 test results are still representative of the new product. Minor cosmetic differences are allowed but must be described.
- Photos of the product showing the nameplate or label containing the new FCC ID.
- The user manual for the product.
- (Optional) Short- and long-term confidentiality requests. The FCC typically makes all submitted photos and documentation publicly available on their website. Applicants can request that certain sensitive information is published later or not at all.

5.2.6 End product verification requirements

⚠ The modular transmitter approval of NINA-B3, or any other radio module, does not exempt the end product from being evaluated against applicable regulatory demands.

The evaluation of the end product shall be performed with the NINA-B3 module installed and operating in a way that reflects the intended end product use case. The upper frequency measurement range of the end product evaluation is the 5th harmonic of 2.4 GHz as declared in 47 CFR Part 15.33 (b)(1).

The following requirements apply to all products that integrate a radio module:

- Subpart B - UNINTENTIONAL RADIATORS
  To verify that the composite device of host and module comply with the requirements of FCC part 15B, the integrator shall perform sufficient measurements using ANSI 63.4-2014.
- Subpart C - INTENTIONAL RADIATORS
  It is required that the integrator carries out sufficient verification measurements using ANSI 63.10-2013 to validate that the fundamental and out of band emissions of the transmitter part of the composite device complies with the requirements of FCC part 15C.

When the items listed above are fulfilled, the end product manufacturer can use the authorization procedures as mentioned in Table 1 of 47 CFR Part 15.101, before marketing the end product. This means the customer has to either market the end product under a Suppliers Declaration of Conformity (SDoC) or to certify the product using an accredited test lab.

5.2.7 End product labelling requirements

5.2.7.1 US market

An end product using the NINA-B3 series modules must have a label containing, at least, the information shown in Figure 18 or Figure 19. The label must be affixed on an exterior surface of the end product such that it will be visible upon inspection in compliance with the modular approval guidelines developed by the FCC. In accordance with 47 CFR § 15.19, the end product shall bear the following statement in a conspicuous location on the device:

“This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.”

☞ When the device is so small or for such use that it is not practicable to place the statement above on it, the information shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed.

In case, where the final product will be installed in locations where the end user is unable to see the FCC ID and/or this statement, the FCC ID and the statement shall also be included in the end product manual.

5.2.7.2 Canadian market

The host product shall be properly labelled to identify the modules within the host product.

The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labelled to display the Innovation, Science and Economic Development Canada certification number for the module, preceded by the word "Contains" or similar wording expressing the same meaning, as shown in Figure 18 or Figure 19.

Le produit hôte devra être correctement étiqueté, de façon à permettre l'identification des modules qui s'y trouvent.

L'étiquette d'homologation d'un module d'Innovation, Sciences et Développement économique Canada devra être posée sur le produit hôte à un endroit bien en vue, en tout temps. En l'absence d'étiquette, le produit hôte doit porter une étiquette sur laquelle figure le numéro d'homologation du module d'Innovation, Sciences et Développement économique Canada, précédé du mot « contient », ou d'une formulation similaire allant dans le même sens et qui va comme suit:

This device contains FCC ID: XPYNINAB30 IC: 8595A-NINAB30

Figure 18: Example of an end product label that includes a NINA-B30 series module

This device contains FCC ID: XPYNINAB31 IC: 8595A-NINAB31

Figure 19: Example of an end product label that includes a NINA-B31 series module

5.2.8 End product user manual requirements

5.2.8.1 US market

As stated in the US market labelling requirements, the following statement shall be placed in a prominent section of the instruction manual, when it cannot feasibly be placed on the physical device:

"This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation."

The statement "this device contains" along with the FCC ID of NINA-B30 or NINA-B31, as shown in Figure 18 or Figure 19 shall also be placed in the instruction manual when it cannot be placed on the physical device.

5.2.8.2 Canadian market

User manuals for license-exempt radio apparatus shall contain the following text, or an equivalent notice that shall be displayed in a conspicuous location, either in the user manual or on the device, or both:

"This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation."

Under Industry Canada regulations, this radio transmitter can only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be chosen in such a way that the equivalent isotropically radiated power (e.i.r.p.) is not more than that is necessary for successful communication.

Le manuel d'utilisation des appareils radio exempts de licence doit contenir l'énoncé qui suit, ou l'équivalent, à un endroit bien en vue dans le manuel d'utilisation ou sur l'appareil, ou encore aux deux endroits.

"Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage;
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

Conformément aux réglementations d'Industry Canada, cet émetteur radio ne peut fonctionner qu'à l'aide d'une antenne dont le type et le gain maximal (ou minimal) ont été approuvés pour cet émetteur par Industry Canada. Pour réduire le 25ecess d'interférences avec d'autres utilisateurs, il faut choisir le type d'antenne et son gain de telle sorte que la puissance isotrope rayonnée équivalente (p.i.r.e) ne soit pas supérieure à celle requise pour obtenir une communication satisfaisante.

5.3 MIC - Japanese market

5.3.1 Compliance statement

The NINA-B3 series modules comply with the Japanese Technical Regulation Conformity Certification of Specified Radio Equipment (ordinance of MPT N°. 37, 1981), Article 2, Paragraph 1:

- Item 19 "2.4 GHz band wide band low power data communication system".

5.3.2 48-bit address requirement

Radio devices on the Japanese market, which can be connected directly or indirectly to a public network, must have an at least 48-bit (12 hex) long ID code. In practice this means that the device addresses used in the radio communication protocol (Bluetooth, Thread, ZigBee, Gazell etc.) must be at least 48 bits.

☞ Note that this requirement is not applicable to devices only intended for use in private or personal networks.

5.3.2.1 Implementation in the NINA-B30 series

The requirements on a NINA-B30 design depend on the used radio protocol(s):

- The Bluetooth protocol uses 48-bit addressing, no additional effort is needed.
- IEEE 802.15.4 based protocols, such as Thread and ZigBee, use (at the MAC layer) a combination of 16- and 64-bit addresses. The 16-bit ('short') address can be used to reduce overhead in communications. However, each device must have a 64-bit ('extended') address, and can always be accessed using this address. Because of this no additional effort is needed when using an 802.15.4 based protocol.
- Protocols based on the 2.4 GHz proprietary mode do not necessarily follow any standards, so there is no guarantee that the 48-bit addressing requirement will be fulfilled. If the end product can be connected to, or accessed through, a public network using a proprietary protocol, it is the end product manufacturer's responsibility to make sure that the protocol uses at least 48-bit addressing.

⚠ Failure to comply with these requirements will void the NINA-B3 Japan certification, and it will be illegal to place the end product on the Japanese market.

5.3.2.2 Implementation in the NINA-B31 series

All the radio communication protocols supported in the NINA-B31 series use at least 48 bit long addressing. No further actions are required by the module integrator.

5.3.3 End product labelling requirement

When a product integrating a NINA-B3 series module is placed on the Japanese market the product must be affixed with a label with the "Giteki" marking as shown in Figure 20. The marking must be visible for inspection.

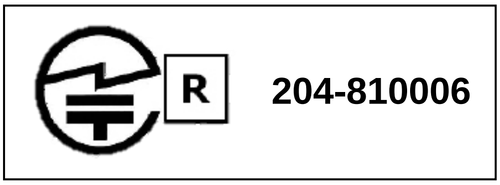


Figure 20: Giteki mark, R and the NINA-B3 MIC certification number

☞ The required minimum size of the Giteki mark is Ø3.0 mm.

5.3.4 End product user manual requirement

As the MIC ID is not included on the NINA-B3 series label, the end product manufacturer must include a copy of the NINA-B3 Japan Radio Certificate to the end product technical documentation.

☞ Contact the u-blox support team in your area to obtain a copy of the NINA-B3 Japan Radio Certificate.

5.4 NCC – Taiwanese market

5.4.1 Compliance statements

- 經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、 加大功率或變更原設計之特性及功能。
- 低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前項合法通信，指依電信法規定作業之無線電通信。低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

Statement translation:

- Without permission granted by the NCC, any company, enterprise, or user is not allowed to change frequency, enhance transmitting power or alter original characteristic as well as performance to an approved low power radio-frequency devices.
- The low power radio-frequency devices shall not influence aircraft security and interfere legal communications; If found, the user shall cease operating immediately until no interference is achieved. The said legal communications means radio communications is operated in compliance with the Telecommunications Act. The low power radio-frequency devices must be susceptible with the interference from legal communications or ISM radio wave radiated devices.

5.4.2 End product labelling requirement

When a product integrating a NINA-B3 series module is placed on the Taiwanese market, the product must be affixed with a label or marking containing at least the following information:

5.4.2.1 NINA-B301 Label

Contains Transmitter Module

內含發射器模組: CCAI18LP1970T4

Figure 21: Example of an end product label that includes a NINA-B301 module

5.4.2.2 NINA-B302 Label

Contains Transmitter Module

內含發射器模組: CCAI18LP197AT6

Figure 22: Example of an end product label that includes a NINA-B302 module

5.4.2.3 NINA-B306 Label

Contains Transmitter Module

內含發射器模組: CCAI19LP1670T0

Figure 23: Example of an end product label that includes a NINA-B306 module

5.4.2.4 NINA-B311 Label

Contains Transmitter Module

內含發射器模組: CCAI18LP197BT8

Figure 24: Example of an end product label that includes a NINA-B311 module

5.4.2.5 NINA-B312 Label

Contains Transmitter Module

內含發射器模組: CCAI18LP197CT0

Figure 25: Example of an end product label that includes a NINA-B312 module

5.4.2.6 NINA-B316 Label

Contains Transmitter Module

內含發射器模組: CCAI19LP1680T3

Figure 26: Example of an end product label that includes a NINA-B316 module

Any similar wording that expresses the same meaning may be used. The marking must be visible for inspection.

☞ Note that each NINA-B3 module variant has its own certification number.

Module variant	NCC ID
NINA-B301	CCAI18LP1970T4
NINA-B302	CCAI18LP197AT6
NINA-B306	CCAI19LP1670T0
NINA-B311	CCAI18LP197BT8
NINA-B312	CCAI18LP197CT0
NINA-B316	CCAI19LP1680T3

Table 13: NINA-B3 series NCC ID certification numbers

5.5 KCC – South Korean market

5.5.1 Compliance statement

The NINA-B3 series modules are certified by the Korea Communications Commission (KCC).

5.5.2 End product labeling requirements

When a product containing a NINA-B3 series module is placed on the South Korean market, the product must be affixed with a label or marking containing the KCC logo and certification number as shown in the following figures:

R-C-ULX-NINA-B30

Figure 27: Sample label of an end product that includes a NINA-B30 series module

R-C-ULX-NINA-B31

Figure 28: Sample label of an end product that includes a NINA-B31 series module

5.5.3 End product user manual requirements

The KCC logo and NINA-B3 certification numbers described in the KCC end-product labeling requirements must also be included in the end products user manual.

5.6 Anatel Brazil compliance

When a product containing a NINA-B3 module is placed on the Brazilian market, the product must be affixed with a label or marking containing the Anatel logo, NINA-B3 Homologation number: 03851-19-05903 and a statement claiming that the device may not cause harmful interference but must accept it (Resolution No 506).

ANATEL
03851-19-05903

"Este equipamento opera em caráter secundário, isto é, não tem direito a proteção contra interferência prejudicial, mesmo de estações do mesmo tipo, e não pode causar interferência a sistemas operando em caráter primário."

Statement translation:

"This equipment operates on a secondary basis and, consequently, must accept harmful interference, including from stations of the same kind, and may not cause harmful interference to systems operating on a primary basis."

When the device is so small or for such use that it is not practicable to place the statement above on it, the information shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed.

In case, where the final product will be installed in locations where the end-user is not able to see the Anatel logo, NINA-B3 Homologation number and/or this statement, the Anatel logo, NINA-B3 Homologation number and the statement shall also be included in the end-product manual.

5.7 Australia and New Zealand regulatory compliance

The NINA-B3 modules are compliant with AS/NZS 4268:2012/AMDT 1:2013 standard – Radio equipment and systems – Short range devices – Limits and methods of standard measurement made by the Australian Communications and Media Authority (ACMA).

The NINA-B3 module test reports can be used as part of evidence in obtaining permission the Regulatory Compliance Mark (RCM). To meet overall Australian and/or New Zealand compliance on the end product, the integrator must create a compliance folder containing all the relevant compliance test reports.

More information on registration as a Responsible Integrator and labeling requirements will be found at the following websites:

Australian Communications and Media Authority web site http://www.acma.gov.au/.

New Zealand Radio Spectrum Management Group web site www.rsm.govt.nz.

5.8 South Africa regulatory compliance

The NINA-B3 modules are compliant and certified by the Independent Communications Authority of South Africa (ICASA). End products that are made available for sale or lease or is supplied in any other manner in South Africa shall have a legible label permanently affixed to its exterior surface. The label shall have the ICASA logo and the ICASA issued license number as shown in the figure below. The minimum width and height of the ICASA logo shall be 3 mm. The approval labels must be purchased by the customer's local representative directly from the approval authority ICASA. A sample of a NINA-B3 ICASA label is included below:

More information on registration as a Responsible Integrator and labeling requirements will be found at the following website:

Independent Communications Authority of South Africa (ICASA) web site - https://www.icasa.org.za

5.9 Integration checklist

The following checklist can be used to get an overview of the requirements of each market. It is in no way a complete list of all actions required but should cover the essentials of integrating a NINA-B3 radio module.

General requirements

☐ The SWD interface cannot be accessed by an end product user.

Specific to the European market

☐ The E.I.R.P of the end product is measured to be within the applicable limit.

☐ A Class-2 limited power source is used to supply the module.

☐ A Declaration of Conformity has been created.

Specific to the US and Canadian markets

☐ (NINA-B30) A Change in ID/Multiple Listing has been performed.

☐ (NINA-B3x1) The antenna connector reference design has been followed and a pre-approved antenna is used with the end product. If not, then u-blox has been contacted to get approval to make changes and/or add a new antenna.

☐ (NINA-B30) If 802.15.4 is used, the radio channel 26 has been disabled and end product users' cannot enable it.

☐ The fundamental and out of band emissions of the end product has been measured and complies with the applicable limits.

☐ An SDoC has been created, or an accredited test lab has been used to certify the end product.

☐ The end product labelling requirements are fulfilled.

- ☐ The end product documentation requirements are fulfilled. The necessary legal statements are included at a prominent location in the user guide.

Specific to the Japanese market

- ☐ (NINA-B30) If applicable, the product fulfills the 48-bit addressing requirements.
- ☐ The end product labelling requirements are fulfilled.
- ☐ A copy of the NINA-B3 Japan Radio Certificate has been included in the end product technical documentation

Specific to the Taiwanese market

- ☐ The end product labelling requirements are fulfilled.

Specific to the South Korean market

- ☐ The end product labelling requirements are fulfilled.
- ☐ The end product user manual requirements are fulfilled.

Specific to the Brazilian market

- ☐ The end product labelling requirements are fulfilled.
- ☐ The end product user manual requirements are fulfilled.

Specific to the Australian and/or New Zealand markets

- ☐ The end product labelling requirements are fulfilled.
- ☐ A compliance folder containing all the relevant compliance test reports is created and available.

Specific to the South African market

- ☐ The end product labelling requirements are fulfilled.

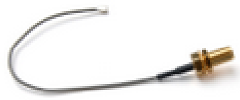
5.10 Pre-approved antennas list

This section lists the different external antennas that are pre-approved for use with NINA-B3 series modules.

☞ Note that not all antennas are approved for use in all markets/regions.

5.10.1 Antenna accessories

Name	U.FL to SMA adapter cable
Connector	U.FL and SMA jack (outer thread and pin receptacle)
Impedance	50 Ω
Minimum cable loss	0.5 dB, The cable loss must be above the minimum cable loss to meet the regulatory requirements. Minimum cable length 100 mm.
Comment	The SMA connector can be mounted in a panel. For information about integrating the U.FL connector, see also the Reference design for external antennas (U.FL connector).
Approval	RED, MIC, NCC, KCC, ANATEL, ACMA and ICASA



Name	U.FL to Reverse Polarity SMA adapter cable
Connector	U.FL and Reverse Polarity SMA jack (outer thread and pin)
Impedance	50 Ω
Minimum cable loss	0.5 dB, The cable loss must be above the minimum cable loss to meet the regulatory requirements. Minimum cable length 100 mm.
Comment	The Reverse Polarity SMA connector can be mounted in a panel. For information about integrating the U.FL connector, see also the Reference design for external antennas (U.FL connector). It is necessary to follow this reference design to comply with the NINA-W1 FCC/IC modular approvals.
Approval	FCC, IC, RED, MIC, NCC, KCC, ANATEL, ACMA and ICASA

5.10.2 Single band antennas

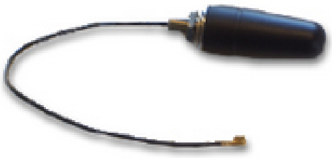
NINA-B302 and NINA-B312 (u-blox LILY antenna)	
Manufacturer	ProAnt
Gain	+3 dBi
Impedance	N/A
Size (HxWxL)	3.0 x 3.8 x 9.9 mm
Type	PIFA
Comment	SMD PIFA antenna on NINA-B302 and NINA-B312. Should not be mounted inside a metal enclosure.
Approval	FCC, IC, RED, MIC, NCC, KCC, ANATEL, ACMA and ICASA

NINA-B306 and NINA-B316	
Manufacturer	ProAnt
Gain	+3 dBi
Impedance	N/A
Size (HxWxL)	1.1 x 3.4 x 10 mm
Type	PCB trace
Comment	PCB antenna on NINA-B306 and NINA-B316. Should not be mounted inside a metal enclosure.
Approval	FCC, IC, RED, MIC, NCC, KCC, ANATEL, ACMA and ICASA

GW.26.0111	
Manufacturer	Taoglas
Polarization	Vertical
Gain	+2.0 dBi
Impedance	50 Ω
Size	Ø 7.9 x 30.0 mm
Type	Monopole
Connector	SMA (M) .
Comment	To be mounted with the U.FL to SMA adapter cable.
Approval	RED, MIC, NCC, KCC, ANATEL, ACMA and ICASA

Ex-It 2400 28 RP-SMA	
Manufacturer	ProAnt
Polarization	Vertical
Gain	+3.0 dBi
Impedance	50 Ω
Size	Ø 12.0 x 28.0 mm
Type	Monopole
Connector	Reverse Polarity SMA plug (inner thread and pin receptacle).
Comment	This antenna requires to be mounted on a metal ground plane for best performance. To be mounted with the U.FL to Reverse Polarity SMA adapter cable. An SMA version antenna is also available but not recommended for use (Ex-IT 2400 SMA 28-001).
Approval	FCC, IC, RED, MIC, NCC, KCC, ANATEL, ACMA and ICASA Original part number at certification: Ex-IT 2400 RP-SMA 28-001

Ex-It 2400 28 U.FL-100	
Manufacturer	ProAnt
Polarization	Vertical
Gain	+2.0 dBi
Impedance	50 Ω
Size	Ø 12.0 x 28.0 mm
Type	Monopole
Cable length	100 mm
Connector	U.FL. connector
Comment	This antenna requires to be mounted on a metal ground plane for best performance. To be mounted with a U.FL connector. For information about integrating the U.FL connector, see also the Reference design for external antennas (U.FL connector). It is necessary to follow this reference design to comply with the NINA-B3 FCC/IC modular approvals.
Approval	FCC, IC, RED, MIC, NCC, KCC, ANATEL, ACMA and ICASA Original part number at certification: Ex-IT 2400 MHF 28



Ex-It 2400 Foldable RP-SMA	
Manufacturer	ProAnt
Polarization	Vertical
Gain	+3.0 dBi
Impedance	50 Ω
Size	Ø 10 x 83 mm
Type	Monopole
Connector	Reverse Polarity SMA plug (inner thread and pin receptacle)
Comment	To be mounted with the U.FL to Reverse Polarity SMA adapter cable. An SMA version antenna is also available but not recommended for use (Ex-IT 2400 SMA 70-002).
Approval	FCC, IC, RED, MIC, NCC, KCC, ANATEL, ACMA and ICASA Original part number at certification: Ex-IT 2400 RP-SMA 70-002

InSide™-2400	
Manufacturer	ProAnt
Gain	+3.0 dBi
Impedance	50 Ω
Size	27 x 12 mm (triangular)
Type	Patch
Cable length	100 mm
Connector	U.FL. connector
Comment	Should be attached to a plastic enclosure or part for best performance. To be mounted with a U.FL connector. For information about integrating the U.FL connector, see also the Reference design for external antennas (U.FL connector). It is necessary to follow this reference design to comply with the NINA-W1 FCC/IC modular approvals.
Approval	FCC, IC, RED, MIC, NCC, KCC, ANATEL, ACMA and ICASA

FlatWhip™-2400	
Manufacturer	ProAnt
Gain	+3.0 dBi
Impedance	50 Ω
Size	Ø 50.0 x 30.0 mm
Type	Monopole
Connector	SMA plug (inner thread and pin)
Comment	To be mounted with the U.FL to SMA adapter cable. EOL. Use only for legacy products.
Approval	RED, MIC, NCC, KCC, ANATEL, ACMA and ICASA

6 Product testing

6.1 u-blox in-line production testing

As part of our focus on high quality products, u-blox maintain stringent quality controls throughout the production process. This means that all units in our manufacturing facilities are fully tested and that any identified defects are carefully analyzed to improve future production quality.

The Automatic test equipment (ATE) deployed in u-blox production lines logs all production and measurement data – from which a detailed test report for each unit can be generated. Figure 29 shows the ATE typically used during u-blox production.

u-blox in-line production testing includes:

- Digital self-tests (firmware download, MAC address programming)
- Measurement of voltages and currents
- Functional tests (host interface communication)
- Digital I/O tests
- Measurement and calibration of RF characteristics in all supported bands, including RSSI calibration, frequency tuning of reference clock, calibration of transmitter power levels, etc.
- Verification of Wi-Fi and Bluetooth RF characteristics after calibration, like modulation accuracy, power levels, and spectrum, are checked to ensure that all characteristics are within tolerance when the calibration parameters are applied.

Figure 29: Automatic test equipment for module test

6.2 OEM manufacturer production test

As all u-blox products undergo thorough in-series production testing prior to delivery, OEM manufacturers do not need to repeat any firmware tests or measurements that might otherwise be necessary to confirm RF performance. Testing over analog and digital interfaces is also unnecessary during an OEM production test.

OEM manufacturer testing should ideally focus on:

- Module assembly on the device; it should be verified that:
  - Soldering and handling process did not damage the module components
  - All module pins are well soldered on application board
  - There are no short circuits between pins
- Component assembly on the device; it should be verified that:
  - Communication with host controller can be established
  - The interfaces between module and device are working
  - Overall RF performance test of the device including antenna

In addition to this testing, OEMs can also perform other dedicated tests to check the device. For example, the measurement of module current consumption in a specified operating state can identify a short circuit if the test result deviates that from that taken against a “Golden Device”.

The standard operational module firmware and test software on the host can be used to perform functional tests (communication with the host controller, check interfaces) and perform basic RF performance testing. Special manufacturing firmware can also be used to perform more advanced RF performance tests.

6.2.1 “Go/No go” tests for integrated devices

A “Go/No go” test compares the signal quality with a “Golden Device” in a location with known signal quality. This test can be performed after establishing a connection with an external device.
A very simple test can be performed by just scanning for a known Bluetooth low energy device and checking the signal level.
These kinds of test may be useful as a “go/no go” test but not for RF performance measurements.
This test is suitable to check the functionality of the communication with the host controller and the power supply. It is also a means to verify if the components are well soldered.
A basic RF functional test of the device including the antenna can be performed with standard Bluetooth low energy devices as remote stations. The device containing the NINA-B3 series module and the antennas should be arranged in a fixed position inside an RF shield box to prevent interferences from other possible radio devices to get stable test results.

Appendix

A Glossary

Abbreviation	Definition
ADC	Analog to digital converter
ATE	Automatic test equipment
BLE	Bluetooth low energy
CTS	Clear To send
DCX	Data/Command signal
DDR	Dual-Data rate
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
ESD	Electro static discharge
FCC	Federal Communications Commission
GATT	Generic ATTribute profile
GND	Ground
GPIO	General Purpose Input/Output
I^2C	Inter-Integrated Circuit
LDO	Low drop out
LED	Light-Emitting Diode
LFXO	Low Frequency Crystal Oscillator
MAC	Media access control
MISO	Master input, slave output
MOSI	Master output, slave input
MSL	Moisture sensitivity level
NFC	Near Field Communication
NSMD	Non solder mask defined
PCB	Printed circuit board
PIFA	Planar inverted-F antenna
QDEC	Quadrature DECoder
QSPI	Quad serial peripheral interface
RF	Radio frequency
RoHS	Restriction of hazardous substances
RSSI	Received signal strength indicator
RST	reStructuredText (RST, ReST, or reST)
RTS	Request to send
RXD	Receive data
SCL	Signal clock
SDL	Specification and description language
SMA	SubMiniature version A
SMD	Solder mask defined
SMPS	Switching mode power supply
SMT	Surface-Mount technology
SPI	Serial peripheral interface
SWD	Serial wire debug

Abbreviation	Definition
Thread	Networking protocol for Internet of Things (IoT) "smart" home automation devices to communicate on a local wireless mesh network
THT	Through-Hole Technology
TXD	Transmit data
UART	Universal asynchronous receiver/transmitter
UICR	User information configuration registers
USB	Universal serial bus
VCC	IC power-supply pin
VSWR	Voltage standing wave ratio

Table 14: Explanation of the abbreviations and terms used

B Antenna reference designs

Designers can take full advantage of NINA-B3's Single-Modular Transmitter certification approval by integrating the u-blox reference design into their products. This approach requires compliance with the following rules:

- Only listed antennas can be used. Refer to NINA-B3 series data sheet [2] for the listed antennas.
- Schematics and parts used in the design must be identical to the reference design. Use only parts validated by u-blox for antenna matching.
- PCB layout must be identical to the one provided by u-blox. Implement one of the reference designs described in this section or contact u-blox.
- The designer must use the PCB stack-up provided by u-blox. RF traces on the carrier PCB are part of the certified design.

The available designs are presented in this section.

B.1 Reference design for external antennas (U.FL connector)

When using the NINA-B301/B311 together with this antenna reference design, the circuit trace layout must be made in strict compliance with the instructions below.
Components connected to the RF trace must be kept as indicated in the reference design. The reference design uses a U.FL micro coaxial connector to connect the external antenna via a 50 Ω coaxial cable.

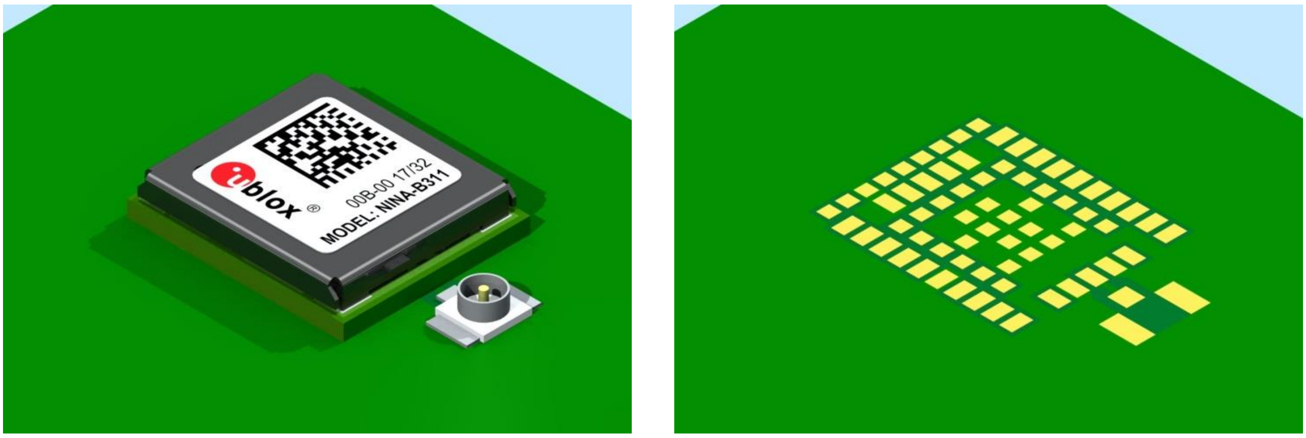


Figure 30: Antenna reference design

B.1.1 Floor plan

This section describes where the critical components and copper traces are positioned on the reference design.

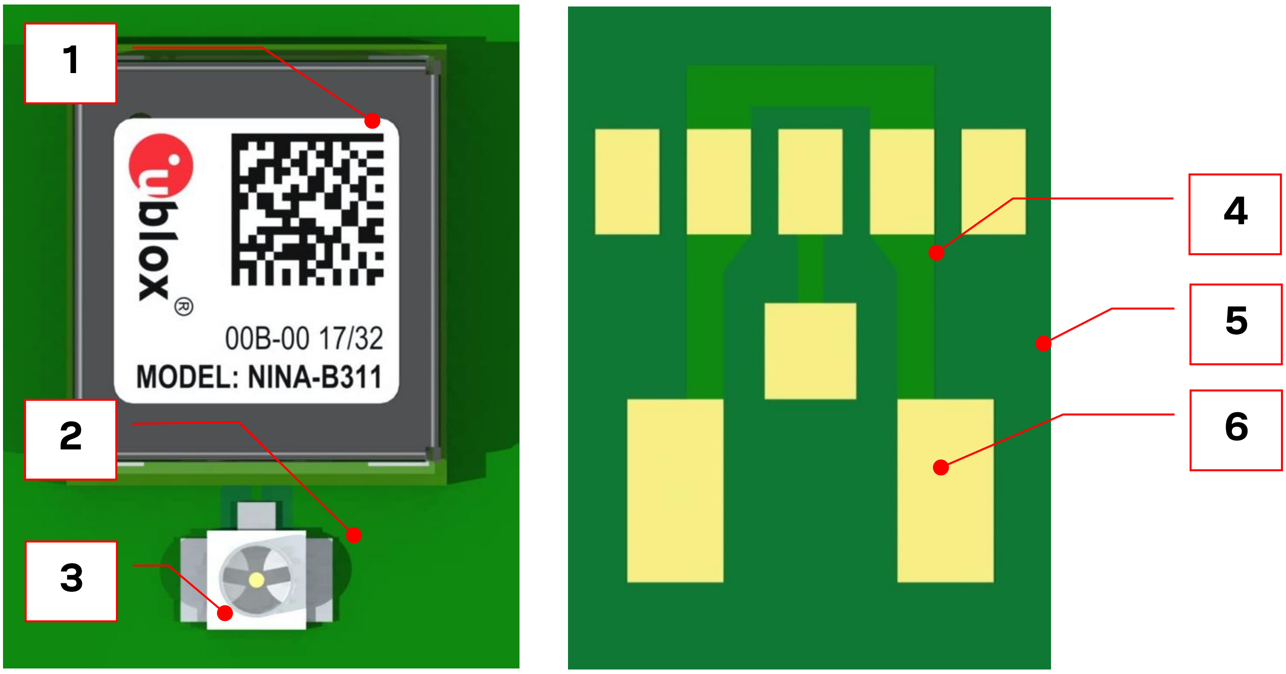


Figure 31: NINA-B301/B311 antenna reference design

Reference	Part	Manufacturer	Description
1	NINA-B301/B311	u-blox	NINA-B3 module with antenna pin
2	U.FL-R-SMT-1(10)	Hirose	Coaxial connector, 0 – 6 GHz, for external antenna
3	Carrier PCB		Should have a solid GND inner layer underneath and around the RF components (vias and small openings are allowed)
4	RF trace		Antenna coplanar microstrip, matched to 50 Ω
5	GND trace		Minimum required top layer GND-trace. See also Figure 33.
6	Copper keep-out		Keep this area free from any copper on the top layer

Table 15: Included parts in the antenna connector design

B.1.2 RF trace specification

The 50 Ω coplanar micro-strip dimensions used in the reference design are shown in Figure 32 and Table 16. GND stitching vias should be used around the RF trace to ensure a proper GND connection. No other components are allowed within this area.

The solid GND layer beneath the 'top layer' shall surround at least the entire RF trace and connector. No signal traces are allowed to be routed on the GND layer within this area but vias and small openings are allowed.

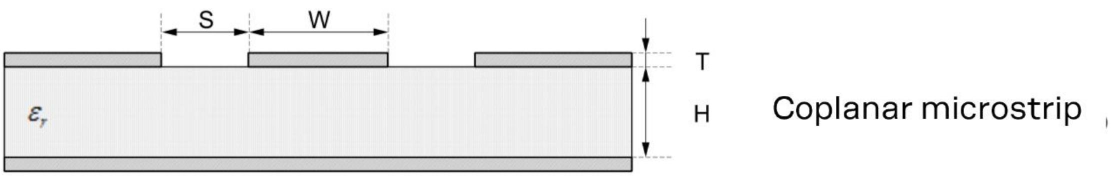


Figure 32: Coplanar micro-strip dimension specification

Reference	Item	Value
S	Spacing	200 +/- 50 µm
W	Conductor width	300 +/- 30 µm (match as close to 50 Ω as possible)
T	Copper and plating/surface coating thickness	35 +/- 15 µm
H	Conductor height	150 +/- 20 µm
ε_r	Dielectric constant (relative permittivity)	3.77 +/- 0.5 @ 2 GHz

Table 16: Coplanar micro-strip specification

☞ The GND spacing requirements of the NINA ANT and U.FL connector RF pins are greater than the spacing requirement of a 50 Ω coplanar micro-strip. However, at the conductor width and height specified in Table 16 the increased spacing to GND does not affect the trace impedance significantly for short trace lengths. Therefore, the impedance will still be close to 50 Ω.

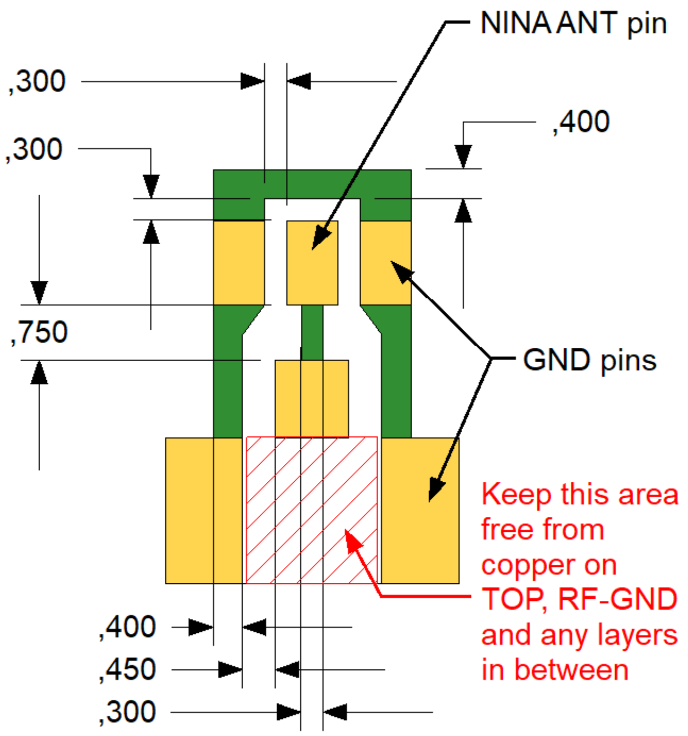


Figure 33: RF trace and minimum required GND trace of the U.FL antenna connector reference design. Dimensions are shown in mm.

Related documents

[1] u-blox package information guide, UBX-14001652
[2] NINA-B3 series data sheet, UBX-17052099
[3] EVK-NINA-B3 user guide, UBX-17056481
[4] u-connectXpress AT commands manual, UBX-14044127
[5] u-connectXpress bootloader protocol specification, UBX-17065404
[6] s-center user guide, UBX-16012261
[7] JEDEC J-STD-020C - Moisture/Reflow Sensitivity Classification for Non Hermetic Solid State Surface Mount Devices.
[8] IEC EN 61000-4-2 - Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test
[9] ETSI EN 301 489-1 - Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements
[10] IEC61340-5-1 - Protection of electronic devices from electrostatic phenomena – General requirements
[11] ETSI EN 60950-1:2006 - Information technology equipment – Safety – Part 1: General requirements
[12] FCC Regulatory Information, Title 47 – Telecommunication
[13] JESD51 – Overview of methodology for thermal testing of single semiconductor devices
[14] Nordic Semiconductor InfoCenter - https://infocenter.nordicsemi.com/index.jsp
[15] NINA-B3 declaration of conformity, UBX-18053818
[16] u-connectXpress User Guide, UBX-16024251
[17] Using the public IEEE address from UICR, UBX-19055303
[18] RC oscillator configuration for nRF5 open CPU modules, UBX-20009242
[19] fZephyr Project, https://www.zephyrproject.org/
[20] u-blox shortrange open CPU github repository, https://github.com/u-blox/u-blox-sho-OpenCPU
[21] Zephyr Project Documentation, https://docs.zephyrproject.org
[22] https://devzone.nordicsemi.com/nordic/short-range-guides/b/getting-started/posts/adjustment-of-ram-and-flash-memory
[23] nRF Connect SDK page at Nordic Semiconductor, https://www.nordicsemi.com/Software-and-tools/Software/nRF-Connect-SDK
[24] Implementing Bluetooth mesh with u-connectXpress software, UBX-19025268

☞ 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	16-Nov-2017	apet, ajoh, ajah, kgom	Initial release.
R02	22-Mar-2018	apet	Removed references to application development using Arm Mbed for NINA-B30x open CPU modules.
R03	8-Jun-2018	apet, kgom	Updated Nordic SDK section to SDKv15 (section 2.2.1). Updated flashing instructions in Flashing the NINA-B31 u-blox connectivity software (section 2.3).
R04	13-Sep-2018	ajoh, kgom	Changed the product status to Initial Production. Updated regulatory information section with instructions on how to comply with regulatory restrictions for different global markets (section 5). Added information about an FCC approved antenna connector reference design in Appendix B.
R05	14-Feb-2019	ajoh, fbro, mper	Added instructions for using s-center to flash NINA-B31 (section 2.3.1.1). Added instructions on how to put an end product on the Japanese and Taiwanese markets (section 5). Added the software version for java script. Added the new antenna type NINA-B3x6.
R06	16-Apr-2019	ajoh, fbro	Changed the product status to Initial Production. Updated Section 5 to reflect the change with respect to SWD interface access, which applies for all NINA-B3 variants. Also added regulatory guidelines for the South Korean market. Updated some values in recommended reflow profile.
R07	10-May-2019	fbro	Updated u-connectScript version to 1.0.1 and modified the product status for NINA-B31x-20B to Initial Production. Included information about Bluetooth MAC address (section 2.2.3). Corrected information about UART flow control (section 3.5.1). Updated Single band antennas (section 5.10.2).
R08	23-Sep-2019	mape	Updated some links to Nordic InfoCenter (section 2.2.1.1). Removed nRF Go Studio and replaced with nRF Connect Programmer (section 2.4.1).
R09	20-Dec-2019	mwej	Added instructions on how to put an end product on the Brazilian, Australian, New Zealand and South Africa markets (section 5).
R10	20-Apr-2020	mape	Removed all u-connectScript references. Included small correction in the chapter Flashing the NINA-B31 u-blox software , section 2.3.1.2.2.
R11	8-Dec-2020	mape	Added information about NINA-B306-01B variant.
R12	30-Apr-2021	mape	Added signals for flashing in section 2.3. Added information about how to use build configurations for nRF5 SDK for open CPU in section 2.4. Included information about Zephyr configurations in section 2.2.2. Added information about mesh software in section 2.1. Revised information describing the update of NINA-B3 software in section 2.1, and removed inappropriate low frequency clock section.
R13	14-Jan-2022	hekf, mape	Updated names for ProAnt Ex-It series antennas and FlatWhip EOL in the Pre-approved antennas list. Included minor correction to UART flashing example in Updating both the SoftDevice and u-connectXpress connectivity software. Revised Product testing and Handling and soldering information. Revised maximum ESD sensitivity in ESD guidelines.

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