FCC Modular Integration Instructions

List of applicable FCC rules

Listed below are the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. C*ompliance to unintentional-radiator rules (Part 15 Subpart B) are unlisted since that is not a condition of a module grant that is extended to a host manufacturer.*

FCC Rule	Bluetooth
15.247	x
15.212	x
15.203	x
15.5	x
15.15	x
15.29	x

Table 1

Summarize the specific operational use conditions

Intended use is as follows:

- Industrial automation
- Smart buildings and cities
- Low power sensors
- Wireless-connected and configurable equipment
- Point-of-sales
- Health devices (residential home healthcare and hospital healthcare)

	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 2 – NINA-B3 series main features summary

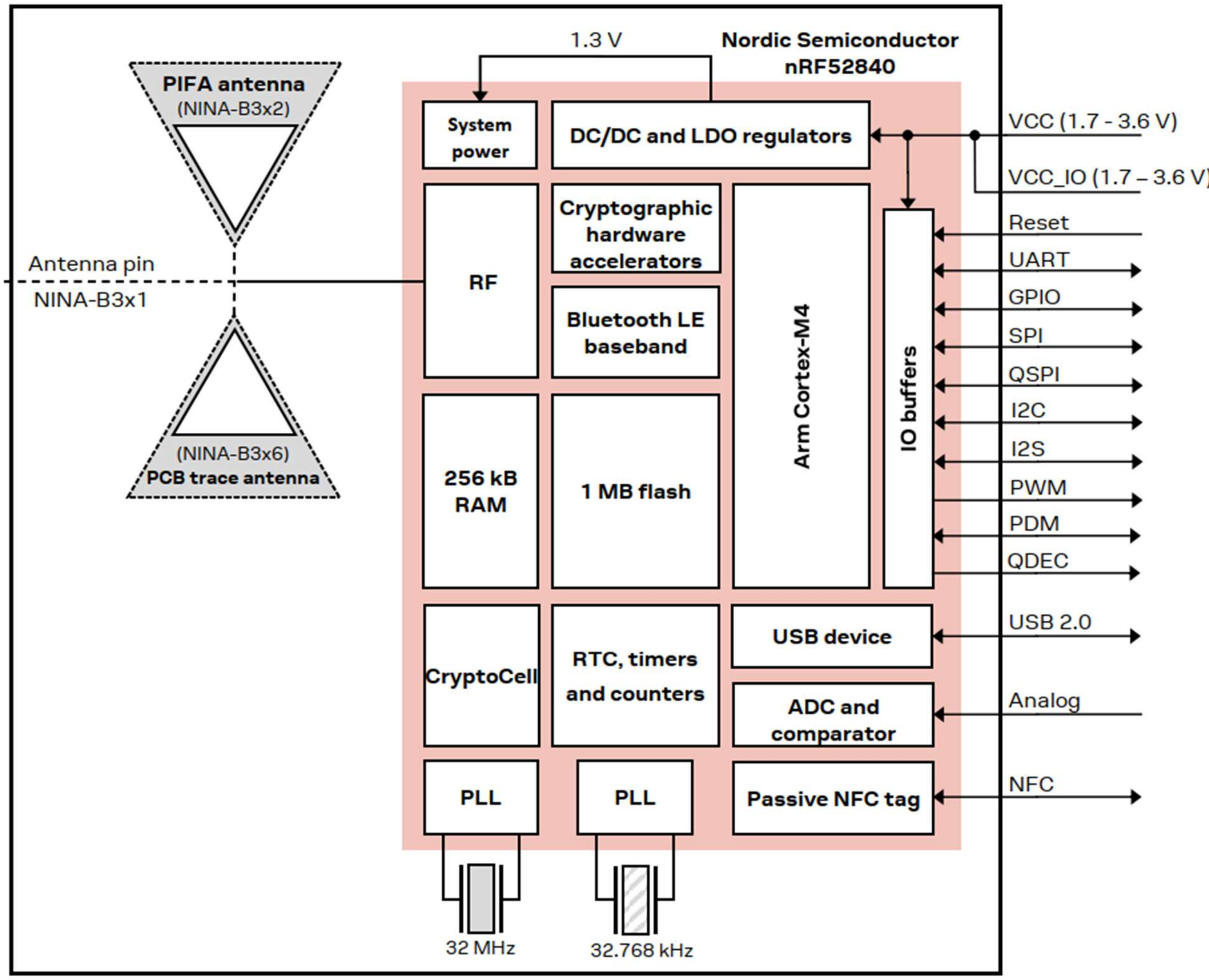

Figure 1 – Block Diagram of the NINA-B3 series

See Table 3: Summary of antenna interface (ANT) requirements for NINA-B3 for more information.

Limited module procedures

The NINA-B3 series has a maximum radiated Bluetooth output power EIRP of 10 dBm.

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

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

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.

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

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.

- NINA-B3x1
  - The NINA-B3x1 modules do not include an internal antenna, and thus the PCB has been trimmed to allow for a smaller module (10.0 x 11.6 mm). Instead of an internal antenna, the RF signal is available at a module pin (ANT) with a nominal characteristic impedance of 50 Ω for routing to an external antenna or antenna connector using a controlled impedance trace.
- NINA-B3x2
  - NINA-B3x2 modules include an integrated internal metal sheet PIFA antenna mounted on the PCB (10.0 x 15.0 mm). The RF signal pin (ANT) is not connected to any external signal path. The antenna is a metal sheet PIFA antenna that makes the module insensitive to placement on the carrier board or the size of the carrier board, when compared to other integrated antenna solutions.
- NINA-B3x6
  - NINA-B3x6 modules include an internal PCB antenna integrated in the module PCB, using antenna technology from Proant AB. The module PCB is 10.0 x 15.0 mm. The RF signal pin (ANT) is not connected to any external signal path.

Trace antenna designs

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. 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 ⍰ 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.

RF exposure considerations

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.

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

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 5 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).

The SAR Test Exclusion Threshold is summarized in the following table(s):

Radio	Transmit Frequency (MHz)	Conducted Output Power	Power Tolerance (dB)	Duty Cycle	Minimum Separation Distance (mm)	Exclusion Threshold	Limit	Compliant
Bluetooth Low Energy	2402	8 dBm	1.5	100.0%	5	2.8	3.0	Yes

The integrator may also use a suitable separation distance between the user and/or bystander and the antenna and /or radiating element to ensure 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).

Test reports for the original NINA-B3 series grant:

- NINAB31 Wireless Communication System Module Test Report   Propriatary u-blox AG
- NINAB31 Wireless Communication System Module Test Report 802.15.4 u-blox AG
- NINAB31 Wireless Communication System Module Test Report BLE u-blox AG
- NINAB31 Wireless Communication System Module Test Report F1900149E3 u-blox AG

Antennas

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.

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 3.

- As a numerical example, the physical restriction to the PCB design can be considered as follows: Frequency = 2.4 GHz → Wavelength = 12.5 cm → Quarter wavelength = 3.125 cm
- 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.

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	S11 < -10 dB (VSWR < 2:1) recommended S11 < -6 dB (VSWR < 3:1) acceptable	The Return loss or the S11, 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.

Table 3: Summary of antenna interface (ANT) requirements for NINA-B3

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).

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 3.
- 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.

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). 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 give 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.

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.

- The host PCB shall include a full GND plane underneath the entire module, with a ground cut out under the antenna.
- 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. 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.

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.

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

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

RF Connectors

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 4 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 4

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.

Label and compliance information

The host integrator must comply with all of the following labeling requirements.

An end product using the NINA-B3 series modules must have a label containing, at least, the information shown in Figure 2. 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.

This device contains
FCC ID: 2A3O3NINAB31

Figure 2 - Example of an end product label

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."

For devices approved under Part 15, the user's manual or instruction manual for an intentional or unintentional radiator shall caution the user about changes or modifications to the device (Section 15.21).

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, user manual, or pamphlet supplied to the user or placed on the container or packaging in which the device is marketed.

Host product manufacturers are advised to provide a physical or e-label stating "Contains FCC ID" with their finished product. The information must be provided in a form that an end-user can reasonably be expected to have the capability to access, such as the instruction manual, a separate product insert, computer disk, web page, or the device's own electronic screen. Compliance information may be provided electronically as permitted in Section 2.935.

A compliance information statement that includes the following items (Section 2.1077(a)) must be supplied with the product at the time of marketing or importation:

- Identification of the product, e.g., trade name, model, etc.
- Identification of the authorized modular components used in the assembly. Authorized modular components shall be identified as specified in Section 2.1077(a) for SDoC procedures or Section 2.925 for certification.
- A statement that the product complies with the rules, as applicable; and
- The name and address, and telephone number, or internet contact information of the responsible party's (as defined in Section 2.909(b)) contact located in the United States.

Devices displaying their FCC ID, warning statements, or other information electronically must also be labeled, either on the device or its packaging, with the FCC ID and other information (such as a model number) that permits the devices to be identified at the time of importation, marketing, and sales as complying with the FCC's equipment authorization requirements. This requirement is in addition to the electronic labeling of the device. Devices can be labeled with a stick-on label, printing on the packaging, a label on a protective bag, or by similar means. Any removable label shall be of a type intended to survive normal shipping and handling, and must only be removed by the customer after purchase.

Information on test modes and additional testing 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.

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. 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.

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

Additional testing, Part 15 Subpart B disclaimer

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 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.

References

1. u-blox System Integration Manual, UBX-17056748
2. u-blox package information guide, UBX-14001652
3. NINA-B3 series data sheet, UBX-17052099
4. NINA-B3 declaration of conformity, UBX-18053818