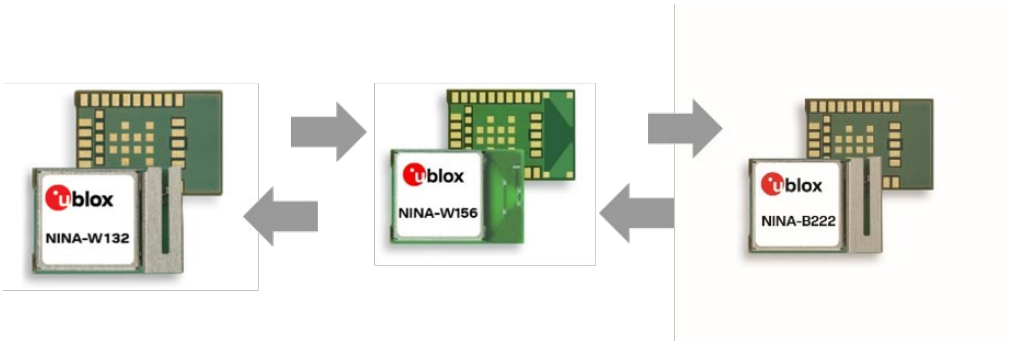
NINA module family

Nested design and migration

Application note



Abstract

This application note describes design guidelines for NINA-B1, NINA-B2, NINA-W1, NINA-B3, and NINA-B4 short range modules. The guidelines can be used for designing a common PCB that allows assembly of different generations of NINA modules.

UBX-17065600 - R03
C1-Public

Document Information

Title	**NINA module family**	
Subtitle	Nested design and migration	
Document type	Application note	
Document number	UBX-17065600	
Revision and date	R03	30-Mar-2021
Disclosure Restriction	C1-Public	

This document applies to the following products:

Product name	Type number	Software version	PCN reference
NINA-B111	All	All	N/A
NINA-B112	All	All	N/A
NINA-W101	All	All	N/A
NINA-W102	All	All	N/A
NINA-W106	All	All	N/A
NINA-W131	All	All	N/A
NINA-W132	All	All	N/A
NINA-W151	All	All	N/A
NINA-W152	All	All	N/A
NINA-W156	All	All	N/A
NINA-B221	All	All	N/A
NINA-B222	All	All	N/A
NINA-B301	All	All	N/A
NINA-B302	All	All	N/A
NINA-B306	All	All	N/A
NINA-B311	All	All	N/A
NINA-B312	All	All	N/A
NINA-B316	All	All	N/A
NINA-B400	All	All	N/A
NINA-B401	All	All	N/A
NINA-B406	All	All	N/A
NINA-B410	All	All	N/A
NINA-B411	All	All	N/A
NINA-B416	All	All	N/A

Contents

1 Overview

u-blox adheres to a core "nested design" philosophy that allows customers to maintain form factor, mechanical compatibility, and software continuity. This design approach means that application designs can be easily upgraded with future (or previous) generations of most suitable NINA modules – without any necessary change in the PCB layout. With a common pinout and footprint, NINA modules offer a flexible migration path for futureproof applications.

This document highlights the physical differences between NINA module generations and contains the necessary hardware guidelines for designing generic host PCBs that integrate NINA modules.

☞ Use this application note together with the relevant system integration manual [1][5][7][9][11] and datasheet [4][6][8][10][12] when designing your nested application design or planning for migration to a new module platform.

2 Migration options

Product feature adaption and cost reduction are the main objectives for migration. The inclusion or removal of Bluetooth BR/EDR, Bluetooth Low Energy (LE) and Wi-Fi standards, as well the opportunity to reduce costs by descaling to NINA modules with lesser functionality, drive the need to migrate between the various modules in the NINA family.

2.1 Migration rationales

Figure 1 shows the migration options for u-connectXpress module variants.

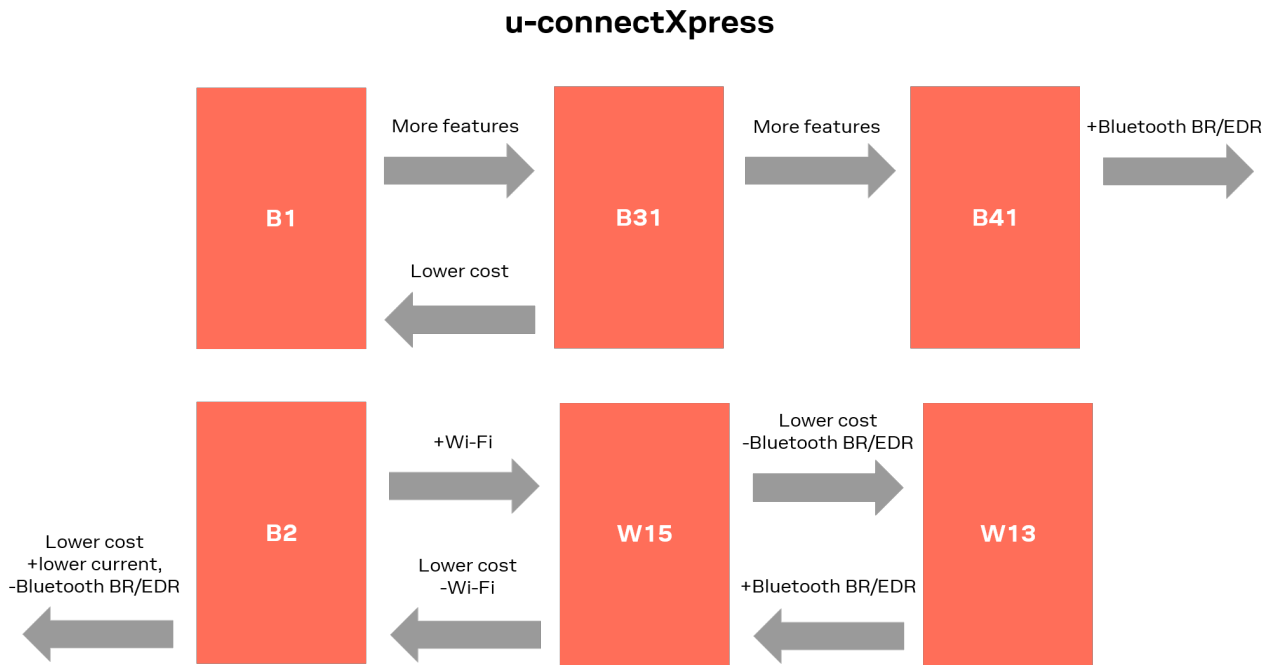


Figure 1. Possible migration rationales for u-connectXpress variants

Figure 2 shows the migration options for Open CPU module variants.

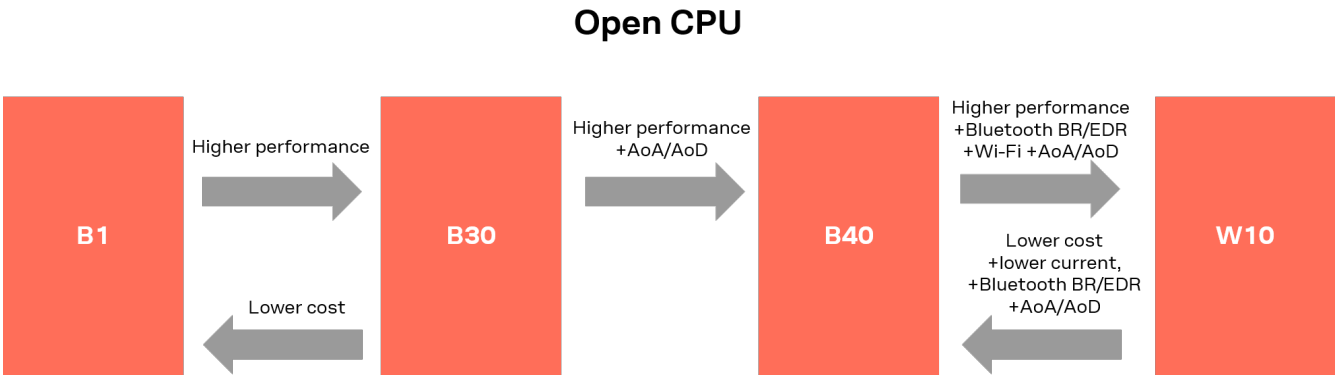


Figure 2. Possible migration rationales for Open CPU variants

2.2 Processor migration paths

NINA module variants comprise either Nordic nRF52 or Espressif ESP32 chipset. These two chip alternatives offer separately exclusive migration paths – although migration between Nordic and Espressif is possible when developing Bluetooth BR/EDR or WiFi solutions.

NINA modules come with either u-blox u-connectXpress software or Open CPU structures that allow custom applications to leverage the full hardware capabilities of the embedded chip.

☞ To learn about the available features of each module, see u-blox short range line card [13].

Expressif migration u-connectXpress	Chip	Bluetooth BR/EDR	Bluetooth LE	WiFi	GPIO
NINA-B2	ESP32	4.2	Yes	No	16
NINA-W15	ESP32	4.2	Yes	2.4G b/g/n	16
NINA-W132	ESP32	4.2	Yes	2.4G b/g/n	16

Table 1: Espressif u-connectXpress

Expressif migration	Chip	Bluetooth BR/EDR	Bluetooth LE	Wi-Fi	MCU	RAM	Flash	GPIO
NINA-W10	ESP32	4.2	Yes	2.4G b/g/n	LX6	520kB	2048/4096 kB	24

Table 2: Espressif Open CPU

Nordic migration	Chip	Bluetooth BR/EDR	Bluetooth LE	WiFi	GPIO
NINA-B11	nRF52832	v5.0	Yes	No	19
NINA-B31	nRF52840	v5.0	Yes	No	24
NINA-B41	nRF52833	v5.1	Yes	No	28

Table 3. Nordic u-connectXpress

Nordic migration	Chip	Bluetooth BR/EDR	Bluetooth LE	WiFi	MCU	RAM	Flash	GPIO
NINA-B30	nRF52840	v5.0	Yes	No	M4F	256kB	1024kB	24
NINA-B40	nRF52833	v5.1	Yes	No	M4F	128kB	512kB	28

Table 4. Nordic Open CPU

☞ The available memory capacity offered by each chip supplier is another important consideration as this determines the complexity and scope of features that can be supported in the application product.

3 NINA family design

The physical size, footprint, pinout, electrical characteristics, mechanical outline, and antenna options supported by each NINA variant influence the migration path that is best suited for any design application.

To fully appreciate the limitations and possibilities for nested designs and product migration, the most prominent physical differences are described in this chapter.

3.1 Physical size and pad placement

Table 1 describes the size and number of pads for each NINA variant.

	NINA-B1	NINA-B2	NINA-W1	NINA-B3	NINA-B4
Number of pads	30	36	36	55	55
Size (mm)	10x14	10x14	10x14	10x15	10x15

Table 5: NINA number of pads and physical dimensions

Despite the difference in the module size and number of pads, the geometric size and placement of common pads in each NINA variant is the same. This means the different NINA modules can be mounted and assembled in the same application hardware.

The essential interfaces, such as the UART, VCC, GND, switches and LEDs, are positioned on the same pins in all NINA modules. The additional pins of the more complex NINA variants are commonly general purpose I/Os that can be used to connect peripheral components. In Open CPU modules, the pins can be configured as additional interfaces in the software.

When planning to migrate to the slightly larger NINA-B3 and NINA-B4 variants, an additional 1 mm keep-out area must be implemented in the design. See also section 2.3.

3.2 Antenna options

Each of the three different available antenna technologies must be handled separately. All requiring unique and incompatible design of the host PCB GND artwork. This limits the migration possibilities to modules having the same antenna technology. This is generally not an issue since all antenna variants are available for most modules.

NINA variant	Antenna technology
NINA-BXX1	Antenna pin to connect an external antenna
NINA-BXX2 NINA-WXX2	Embedded PIFA antenna
NINA-BXX6 NINA-WXX6	Embedded Niche antenna

Table 6: NINA antenna technology

3.3 Footprint and pinout

NINA-B3 and NINA-B4 series modules are slightly larger than other modules in the NINA family, but their pinout and footprint is nonetheless compatible and interchangeable in nested application designs. See also section 3.1.

Since the mechanical outline of the NINA-B3 and NINA-B4 series module is larger and includes the full complement of pads, these variants provide an ideal footprint for developing nested application designs. All modules in the NINA family can be accommodated in this PCB footprint.

As the pad placement and dimensions are identical, any NINA variant can be assembled on the footprint of another – even if it contains just a subset of pads supported in the original.

☞ Although all NINA module variants can (with adherence to the guidelines in this document) be mounted arbitrarily on their potentially differing footprints, it is advisable to upgrade application PCBs to include the correct footprint of the assembled module.

Figure 1 shows the pinout and size variations between the various NINA modules. The featured modules are from left to right: NINA-B1, NINA-W132/NINA-B2, and NINA-B3/NINA-B4. Additional pads are highlighted in red.

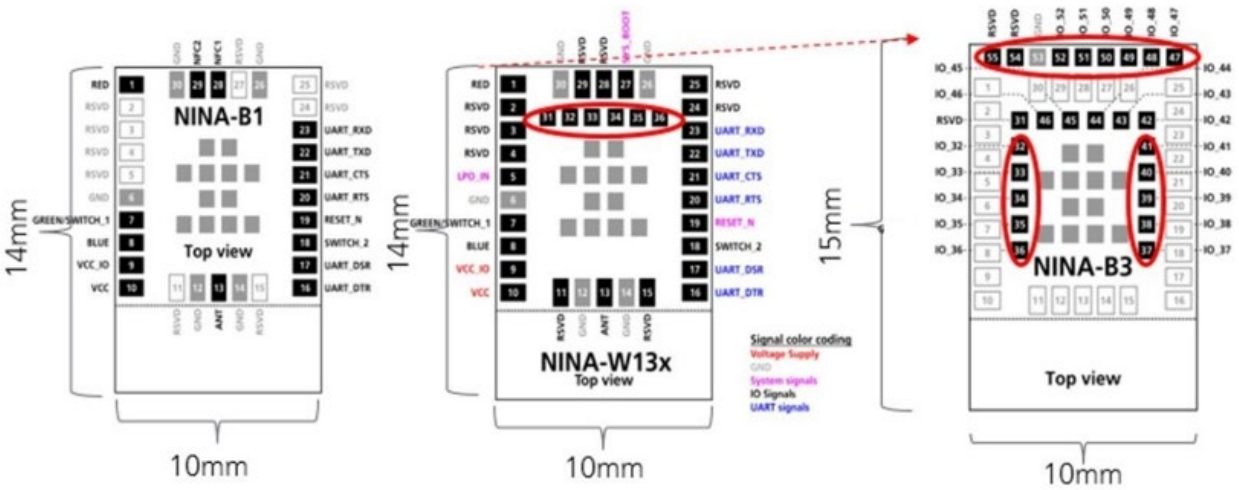


Figure 1: NINA modules pin-out and dimensions

3.4 Electrical characteristics

When designing for migration it is important to make sure that the chosen power supply complies with the specified voltage tolerances and noise characteristics. It must also be able to source the specified peak current. Detailed power management information is available in the respective module datasheet [4][6][8][10][12].

Moreover, it is important to make sure that the interface voltage complies with the interfacing components. This is generally not a concern If migrating to a module that comprises a chip of the same chip manufacturer, but before migrating between Nordic and Espressif processors it is important to study the module specifications given in the respective datasheet [4][6][8][10][12].

As Wi-Fi applications normally consume more power, it is especially important to study the performance capabilities of the power management before migrating to modules that support Wi-Fi.

Table 1 summarizes the pin out of NINA family modules and highlights the key electrical differences.

Pin	NINA-B1: Pin 1–30	NINA-W1/B2: Pin 1–36	NINA-B3/B41: Pin 1–55	Comment one
1	Red	Red	Red	
2	IO_2	GPI_2	IO_2	NINA-B4 supports external LPO on this pin
3	IO_3	GPI_3	IO_3	NINA-B4 supports external LPO on this pin
4	IO_4	GPI_4	IO_4	
5	IO_5	LPO_IN	IO_5	NINA-W1: In LPO_IN mode, the signal needs to be 0/0.7 V; e.g., via an external voltage divider
6	GND	GND	GND	
7	Green/Switch_1	Green/Switch_1	Green/Switch_1	
8	Blue SWO/GPIO_8)*	Blue	Blue (SWO/TRACE_D0/GPIO_8)*	*Trace-Serial wire output available on the NINA-B1 and NINA-B3 open CPU variants
9	VCC_IO	VCC_IO	VCC_IO	
10	VCC	VCC	VCC	NINA-W1 needs 300 mA
11	RSVD (SWDCLK)*	RSVD	RSVD (SWDCLK)*	*SWD interface for NINA-B1, NINA-B30X and NINA-40X
12	GND	GND	GND	
13	Ant	Ant	Ant	For external antenna version only
14	GND	GND	GND	
15	RSVD (SWDIO)*	RSVD	RSVD (SWDIO)*	*SWD interface for NINA-B1, NINA-B30X and NINA-40X
16	UART_DTR	UART_DTR	UART_DTR	
17	UART_DSR	UART_DSR	UART_DSR	
18	Switch_2	Switch_2	Switch_2	
19	Reset_N	Reset_N	Reset_N	
20	UART_RTS	UART_RTS	UART_RTS	
21	UART_CTS	UART_CTS	UART_CTS	
22	UART_TXD	UART_TXD	UART_TXD	
23	UART_RXD	UART_RXD	UART_RXD	
24	IO_24	GPIO_24	IO_24	
25	IO_25	GPIO_25	IO_25	Bootstrap pin for NINA-W1 Pull-up, Pull-down
26	GND	GND	GND	
27	IO_27	Sys_Boot	IO_27	Bootstrap pin for NINA-W1 Pull-up, Pull-down
28	NFC1	GPIO_28	NFC1	
29	NFC2	GPIO_29	NFC2	
30	GND	GND	GND	
31		GPIO_31	RSVD	
32		GPIO_32	IO_32	Boot strap pin for NINA-W1, Pull up
33		RSVD	IO_33	
34		GPI_34	IO_34	
35		GPIO_35	IO_35	
36		GPIO_36	IO_36	Boot strap pin for NINA-W1, 10k pull-up
37			IO_37	
38			IO_38	

Pin	NINA-B1: Pin 1–30	NINA-W1/B2: Pin 1–36	NINA-B3/B41: Pin 1–55	Comment one
39			IO_39	
40			IO_40	
41			IO_41	
42			IO_42	
43			IO_43	
44			IO_44	
45			IO_45	
46			IO_46	
47			IO_47	
48			IO_48	
49			IO_49	
50			IO_50	
51			IO_51	
52			IO_52	
53			GND	
54			RSVD	
55			RSVD	

Table 7: Summary of pin differences and compatibility levels between different NINA modules

3.5 Mechanical outline

In this section NINA-B302 is shown as an example of a module that includes the full set of pads. NINA-B306 is shown as an example of a module that includes the additional GND pads required for the Niche antenna.

The mechanical outline of all NINA modules is found in the corresponding datasheet [4][6][8][10][12].

3.5.1 NINA-B3x2

Figure 3 shows the common footprint shared between the NINA-B312 and NINA-B412 modules. It represents the largest and most extensive complement of pads. The footprint of all other NINA modules is a derivative of this one.

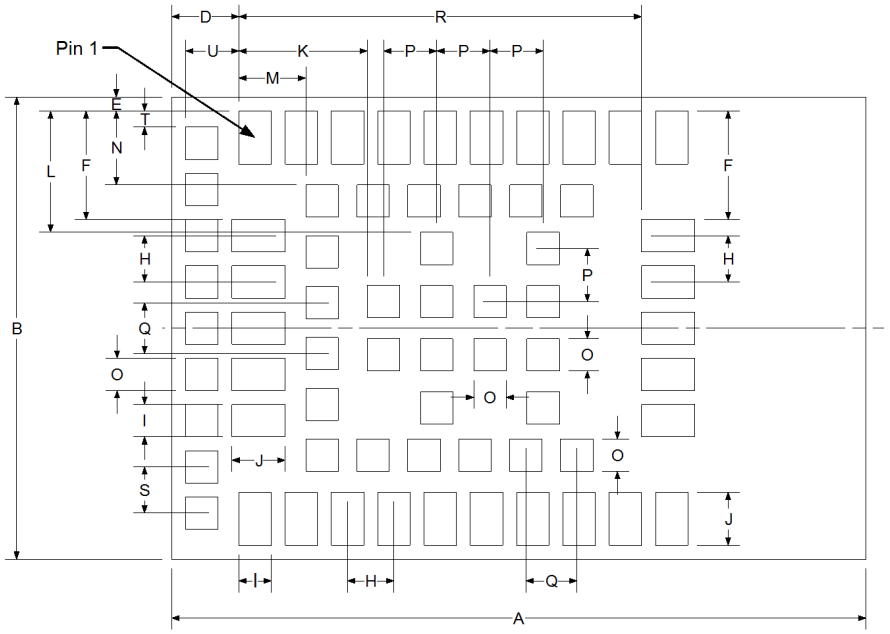


Figure 3: NINA-B3x2 mechanical outline

Parameter	Description	Typical [mm]	[mil]	Tolerance [mm]	[mil]
A	Module PCB length	15.0			
B	Module PCB width	10.0			
C	Module thickness	3.87			
ccc	Seating plane coplanarity	0.10			
D	Horizontal edge to lateral pin 1 edge	1.45			
E	Vertical edge to lateral pin 1 edge	0.30			
F	Vertical pin 1 edge to lateral pin edge	2.35			
G	Depanelizing residual	0.10			
H	Lateral and antenna row pin to pin pitch	1.00			
I	Lateral, antenna row and outer pin width	0.70			
J	Lateral and antenna row pin length	1.15			
K	Horizontal pin 1 edge to central pin edge	2.775			
L	Vertical pin 1 edge to central pin edge	2.625			
M	Horizontal pin 1 Edge to inner row pin edge [mm]	1.45			
N	Vertical pin no.1 edge to inner row pin edge [mm]	1.6			
O	Central, inner and outer row pin width and length	0.70			
P	Central pin to central pin pitch	1.15			
Q	Inner row pin to pin pitch	1.1			
R	Horizontal pin 1 edge to antenna row pin edge	8.7			
S	Outer row pin to pin pitch	1.0			
T	Vertical pin 1 edge to outer row pin edge	0.35			
U	Horizontal pin 1 edge to outer row pin edge	1.15			
V	PCB and shielding cover thickness	2.27			
W	Module antenna width	3.8			
X	Antenna overhang outside module outline on any side	0.0		+0.60	
	Module weight [g]	<1.0			

Table 8: NINA-B3x2 mechanical outline data

3.5.2 NINA-B316

Modules that support Niche PCB antennas have additional GND pads, which are shown in red in Figure 4. The extra pads, combined with the unique GND artwork requirements of the main PCB, make these variants incompatible with NINA modules that support other antenna technologies. Details about main PCB layout requirements are described in the respective System integration manual [1][5][7][9][11].

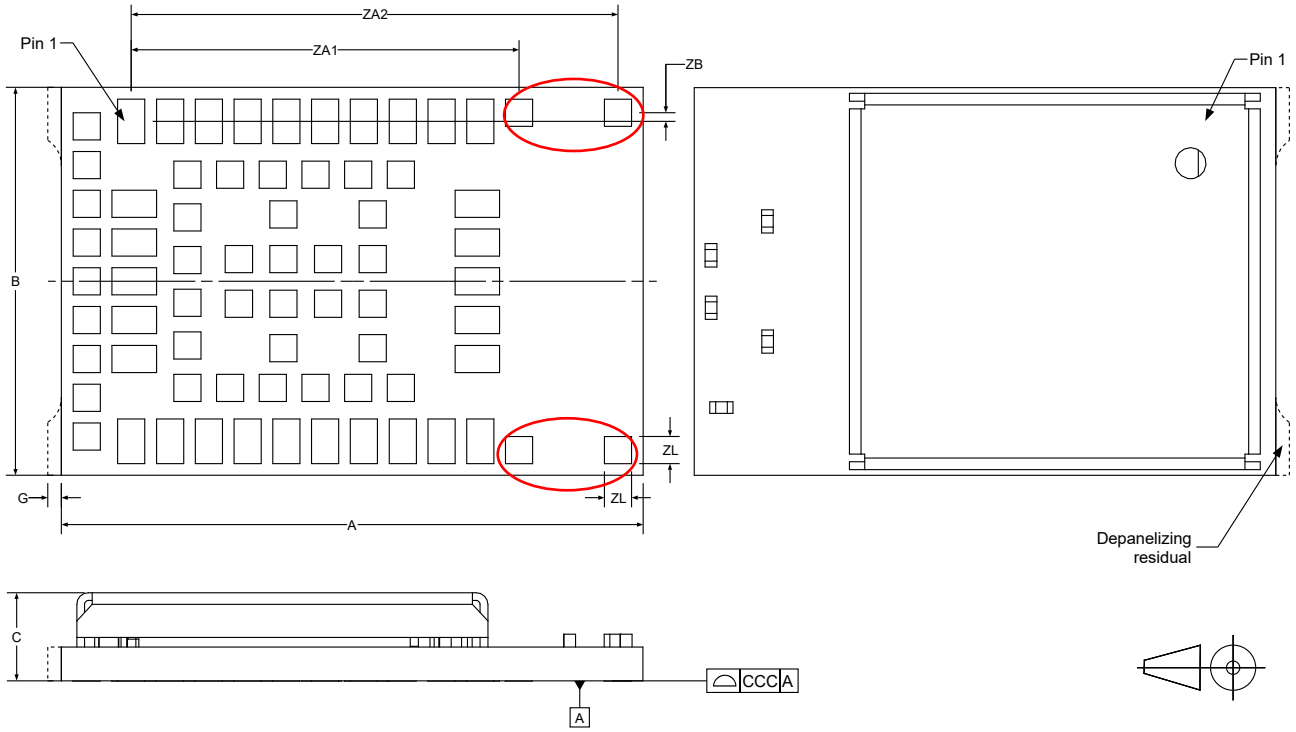


Figure 4: NINA-B316 and NINA-B416 mechanical outline with additional GND pads shown in red

Parameter	Description	Typical [mm]	[mil]	Tolerance [mm]	[mil]
A	Module PCB length	15.0	590.6	+0.20/-0.10	+7.9/-3.9
B	Module PCB width	10.0	393.7	+0.20/-0.10	+7.9/-3.9
C	Module thickness	2.23	87.8	+0.40/-0.20	+15.8/-7.9
ccc	Seating plane coplanarity	0.10	3.9	+0.02/-0.10	+0.8/-3.9
D	Horizontal edge to pin 1 center	1.80	70.9	+/-0.10	+/-3.9
E	Vertical edge to pin 1 center	0.875	34.4	+/-0.10	+/-3.9
F	Vertical pin 1 center to lateral pin center	2.125	83.7	+/-0.05	+/-2.0
G	Depanelizing residual	0.10	3.9	+0.25/-0.1	+9.8/-3.9
H	Lateral and antenna row pin to pin pitch	1.00	39.4	+/-0.05	+/-2.0
I	Lateral, antenna row and outer pin width	0.70	27.6	+/-0.05	+/-2.0
J	Lateral and antenna row pin length	1.15	45.3	+/-0.05	+/-2.0
K	Horizontal pin 1 center to central pin center	6.225	245.1	+/-0.05	+/-2.0
L	Vertical pin 1 center to central pin center	2.40	94.5	+/-0.05	+/-2.0
M	Horizontal pin 1 center to inner row pin center	1.45	57.1	+/-0.05	+/-2.0
N	Vertical pin 1 center to inner row pin center	1.375	54.1	+/-0.05	+/-2.0
O	Central, inner, and outer row pin width and length	0.70	27.6	+/-0.05	+/-2.0
P	Central pin to central pin pitch	1.15	45.3	+/-0.05	+/-2.0
Q	Inner row pin to pin pitch	1.10	43.3	+/-0.05	+/-2.0
R	Horizontal pin 1 center to antenna row pin center	8.925	351.4	+/-0.05	+/-2.0
S	Outer row pin to pin pitch	1.00	39.4	+/-0.05	+/-2.0
T	Vertical pin 1 center to outer row pin center	0.125	4.9	+/-0.05	+/-2.0
U	Horizontal pin 1 center to outer row pin center	1.15	45.3	+/-0.05	+/-2.0
Y	Horizontal pin 1 center to lateral pin center	0.075	3.0	+/-0.05	+/-2.0
ZA1	Horizontal pin 1 center to first set of antenna GND pins pin center	10.0	393.7	+/-0.05	+/-2.0
ZA2	Horizontal pin 1 center to second set of antenna GND pins pin center	12.55	494.1	+/-0.05	+/-2.0
ZB	Vertical pin no.1 center to antenna GND pin center	0.225	8.9	+/-0.05	+/-2.0
ZL	Antenna GND pin width and length	0.70	27.6	+/-0.05	+/-2.0
	Module weight [g]	<1.0			

Table 9: NINA-B316 and NINA-B416 mechanical dimensions

4 Design considerations

4.1 Migration strategy summary

- As antenna technology puts incompatible requirements on the main PCB GND artwork, migration is only possible between modules that support the same antenna technology.
- The footprint of the NINA-B3 and NINA-B4 series module contains the full set of pads, whereas other NINA modules only contain a sub-set.
- The dimensions and placement of common pads is identical between the different generations of NINA modules. This means that, with adherence to the guidelines included in this document, different NINA modules can be mounted and assembled in the same application hardware
- Power management requirements can differ between modules and must be considered when preparing for migration.
- It is important to check that peripheral components are compatible with the NINA modules chosen for the application.
- An appropriate footprint for chosen modules should be implemented on the PCB. Otherwise, the paste mask must be designed for the specific NINA module that is chosen. Make sure that soldering paste is not, accidentally or otherwise, applied on unused pins.

4.2 Paste mask

The proposed land pattern layout reflects the pad layout of the module.

As Non Solder Mask Defined (NSMD) pads have a solder mask opening that is 50 µm larger per side than the corresponding copper pad, NSMD pad types are preferred over Solder Mask Defined (SMD) types.

The suggested paste mask layout for NINA modules must follow the copper mask layout, as described in the corresponding data sheet [4][6][8][10][12].

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

Appendix

A Glossary

Abbreviation	Definition
BOM	Bill Of Materials
GPIO	General Purpose Input Output
LED	Light Emitting Diode
NSMD	Non Solder Mask Defined
PCB	Printed Circuit Board
SMD	Solder Mask Defined
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus

Table 10: Explanation of the abbreviations and terms used

Related documents

[1] NINA-B1 series system integration manual, UBX-15026175
[2] NINA-B1 getting started guide, UBX-16009942
[3] u-connectXpress AT commands manual, UBX-14044127
[4] NINA-B1 series data sheet, UBX-15019243
[5] NINA-W1 series system integration manual, UBX-17005730
[6] NINA-W13 series data sheet, UBX-17006694
[7] NINA-B3 series system integration manual, UBX-17056748
[8] NINA-B3 series data sheet, UBX-17052099
[9] NINA-B2 series system integration manual, UBX-18011096
[10] NINA-B2 series data sheet, UBX-18006649
[11] NINA-B4 series system integration manual, UBX-19052230
[12] NINA-B41 series data sheet, UBX-20035327
[13] Short range line card, UBX-1400345

☞ 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	15-May-2018	fbro	Initial release
R02	21- Sep-2018	fbro	Changed the subtitle
R03	30-Mar-2021	lber	Restructured content and added NINA-B41 to the scope of the document

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