SHORT RANGE

Blueprint B201

Location device powered by a solar panel

Application Note

Abstract

This application note describes the features and design of B201. This design is available to u-blox customers as a blueprint, including the schematics, bill of materials, layout, Gerber data and firmware source files.

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UBX-17064653 - R02

Document Information		
Title	**Blueprint B201**	
Subtitle	Location device powered by a solar panel	
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This document applies to the following products:

Product name	Type number	Firmware version	PCN reference
B201	-	-	-

Contents

1 Overview

B201 is a location device that integrates the u-blox' NINA-B1 and EVA-M8 series modules, thus making use of both the positioning and short range radio technologies. The hardware has been designed to optimize power consumption and it includes a solar panel solution and a rechargeable battery.

This application note provides information about the hardware solutions implemented in B201.

2 Product description

B201 includes a NINA-B1 Bluetooth Low Energy module, an EVA-M8 GNSS module, two LEDs, three buttons, a USB connector, a solar panel and a coin cell battery connector. Figure 1 illustrates the placement of components.

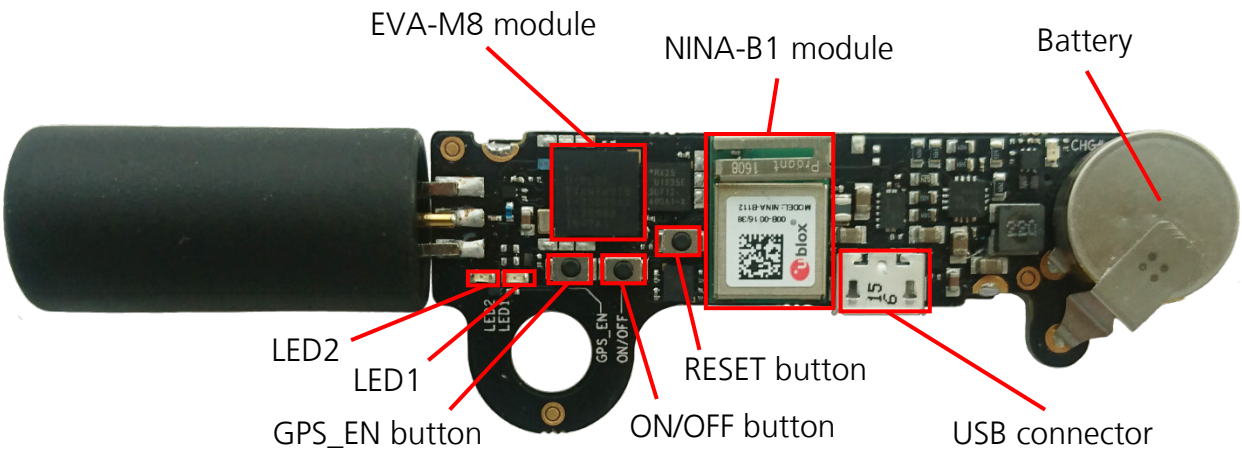


Figure 1: Description of components on B201 (top side)

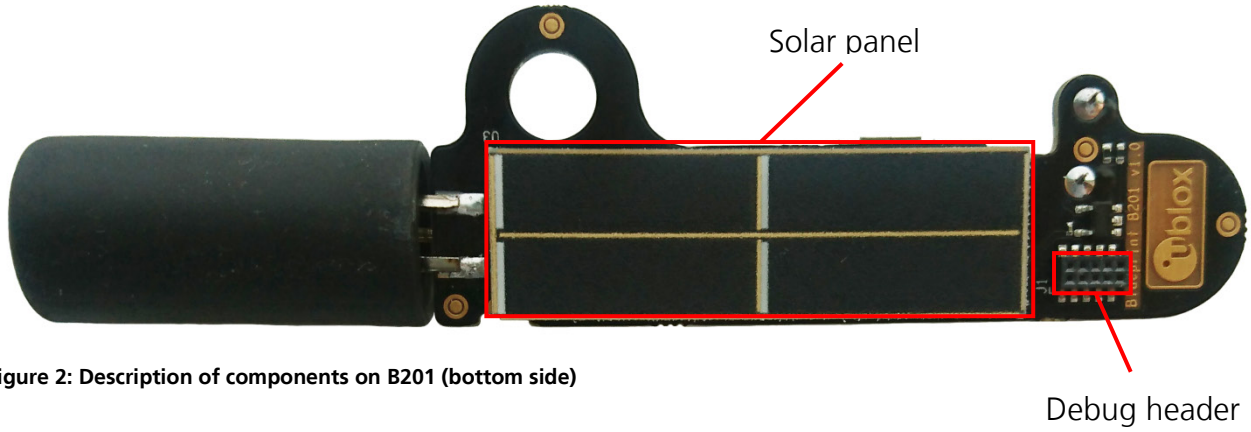


Figure 2: Description of components on B201 (bottom side)

2.1 Block diagram

Figure 3 shows the block diagram of B201.

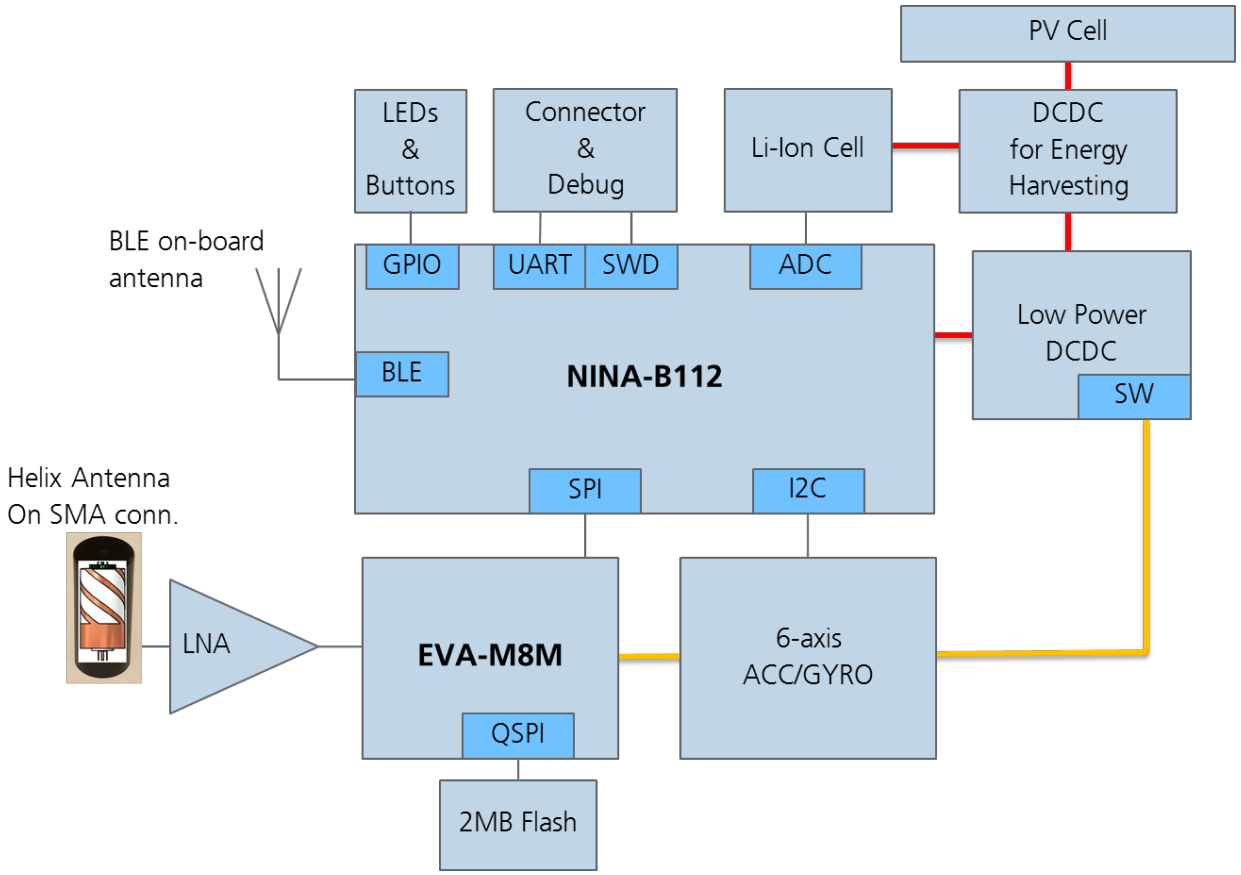


Figure 3: Block diagram of B201

2.2 Mechanical dimensions and PCB information

The dimension of B201 is 6.7 mm x 2.6 mm (excluding the GNSS antenna). The PCB has a 4-layer stack-up as shown in Figure 4. Thickness is 1.63 mm.

Build Up	Description	Material	Thickness [µm]	Remarks
	Pastemask on top layer			
	Sikscreen on top layer			Color: white
	Soldermask on top layer		20	+/- 10 µm, all via holes must be covered with soldermask
	Top CU surface coating	chemical Ni/Au	35	+/-15 µm, Finished thickness
	Top layer	CU		
Drilled via	Dielectric	PP IT-180A 7628x3	575	+/-20 µm (2x1080 prepreg)
Drilled via	Plating		35	+/-15 µm, Finished thickness
Drilled via	**Layer 2**	CU		
Drilled via	Dielectric	Core IT-180A 0,3	300	+/-20 µm
Drilled via	**Layer 3**	CU		
Drilled via	Plating		35	+/-15 µm, Finished thickness
Drilled via	Dielectric	PP IT-180A 7628x3	575	+/-20 µm (2x1080 prepreg)
	Bottom layer	CU		
	Bottom CU surface coating	chemical Ni/Au	35	+/-15 µm, Finished thickness
	Soldermask on bottom layer		20	+/- 10 µm, all via holes must be covered with soldermask
	Silkscreen on bottom layer			Color: white
	Pastemask on bottom layer			None
Total Thickness:			**1630**	+/-100 µm

Figure 4: Description of the PCB layers

2.3 Power supply

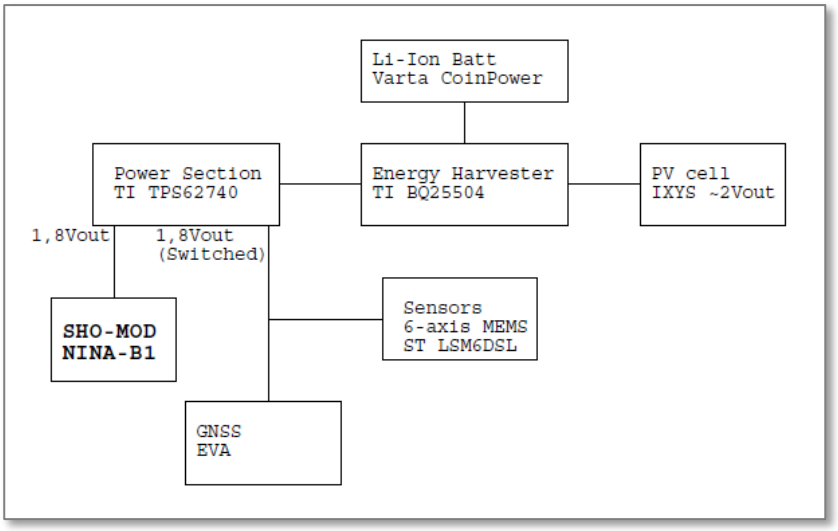


Figure 5: Block diagram that shows the power supply in B201

The power for the Blueprint B201 is supplied by the rechargeable coin cell battery. The coin cell battery is charged by the solar panel and/or power supplied to the USB connector. The rechargeable battery has a capacity of 85 mAh.

The power to the auxiliary components such as the position module and the accelerometer/gyroscope can be controlled by a GPIO from NINA-B1.

2.4 Data interfaces

2.4.1 NINA-B1 UART interface

The NINA-B1 UART interface is available on the debug header as shown in Figure 6.

☞ The UART pins are configured by the NINA-B1 software.

In Figure 6, the UART pins are configured as shown in Table 1.

Debug header pin	Function	NINA-B1 pin
4	UART_RX	23
5	UART_TX	22
6	UART_CTS	21
7	UART_RTS	20

Table 1: UART pin mapping

2.4.2 NINA-B1 SWD interface

The NINA-B1 SWD interface is available on the debug header as shown in Figure 6.

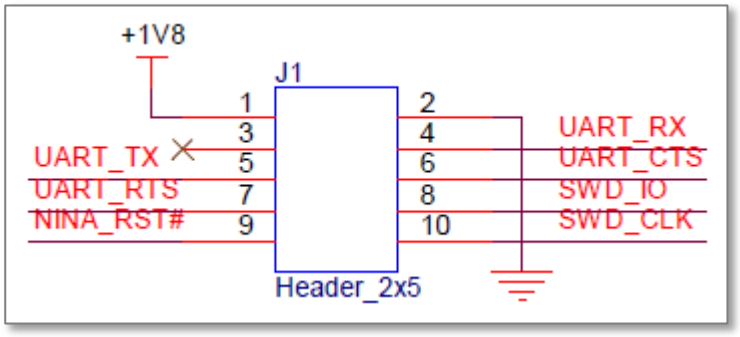


Figure 6: B201 debug header

2.5 Buttons and LEDs

Three buttons and two LEDs are provided on the blueprint B201 for indications and manual operation of the unit as described in Table 2.

Name	Element	Description	NINA-B1 pin
ON/OFF	Button	General function button	18
GPS_EN	Button	General function button	7
RESET	Button	Reset button	19
LED1	Green LED	General function LED	1
LED2	Green LED	General function LED	8

Table 2: Description of LEDs and buttons available on B201

2.6 Antenna interface

2.6.1 NINA-B1 antenna

B201 uses the internal antenna mounted on the NINA-B112 module.

The module placement is not optimal for the internal antenna.

2.6.2 EVA-M8 antenna

B201 uses a Helix antenna type for the EVA-M8 module. In this example, the antenna used is the MWSL-1203D from MARUWA. The MWSL-1203D acts as its own filter, attenuating signals from common cellular and ISM frequency bands.

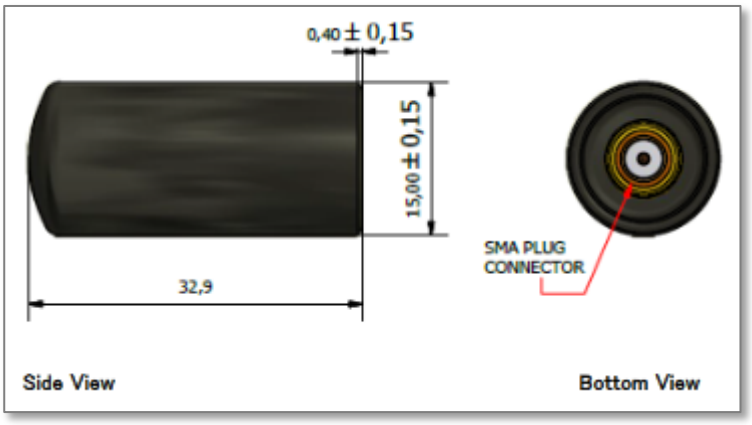


Figure 7: Helix antenna dimensions

The ANT_OFF pin logic must be inverted. The function of the ANT_OFF pin can be inverted by sending the following sequence once to the GNSS module using the UART or the SPI interface:

B5 62 06 41 0C 00 00 00 03 1F 90 47 4F B1 FF FF EA FF 33 98

Applying this sequence results in a permanent change and cannot be reversed. An unstable supply voltage at the VCC_IO pin while applying this sequence can damage the receiver.

3 Design solutions

3.1 Power supply

A direct battery connection or an LDO power supply is not used because:

- Direct battery connection uses a higher voltage to supply, increasing the current used by the digital logic (even if the microcontroller core is powered by a dedicated DC/DC inside the module).
- The LDOs can overcome this problem but the efficiency is limited to V_out/V_in −(I_q) ; the quiescent current has a big impact during sleep modes while the LDO approach limits the efficiency during active mode.

Some DC/DCs are available in the market with high efficiency in the micro-ampere range and with a quiescent current as low as 300 nA.

- Those parts enable additional use cases where the product can be deployed in situations where the battery space and duration are a premium.
- Some examples: Texas Instr. TI TPS62740 (Step-Down), Maxim MAX1722x (Step-Up).

A power switch makes it possible to save some of the micro-amps used by the peripherals that are not used during sleep mode and provide an easy and clean shutdown option.

Some energy harvesting solutions are available on the market that offer the possibility to collect energy from 10 µW up to hundreds of mW depending on the technology used and the cell size.

NINA-B1 consumes 300 nA in sleep mode, thus enabling the possibility to slowly recharge a battery or capacitor and communicate when ready.

In B201, a rechargeable Li-Ion battery was chosen due to the extra power required by the GNSS chipset and to provide an energy pool for the step-down converter.

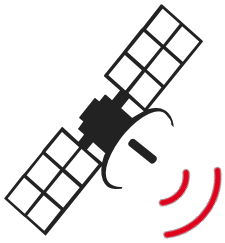
4 Software

The NINA-B1 demo software available in the *Delivered package* is based on the Nordic SDK v12.2.0. A precompiled firmware file is provided and can be used with B201.

The demo software demonstrates the usage of the GNSS module, the BLE module, and the SPI interface with which these modules are connected.

The software has the following functionalities:

- Position (latitude and longitude), GNSS fix status, UTC time and Data valid status are decoded from the NMEA message $xxRMC received via the SPI interface.
- If the fix status is OK and the Data is valid, the Position and UTC time are presented in the standardized GATT Service "Location and Navigation".
- If a remote device subscribes to the GATT notifications of the Location and Speed characteristic, a notification will be sent for every valid $xxRMC message that NINA-B1 receives from the GNSS module.
- When switching off the B201 device with the ON/OFF button, NINA-B1 will switch off the power to the GNSS module before entering sleep mode.
- The B201 device will automatically switch off when inactive for more than 3 minutes.
- LED1 indicates that the B201 device is on by 0.2 s ON / 1.8 s OFF and an active BLE connection by 0.4 s ON / 4.0 s OFF.



(GATT Loc & Nav Service)

5 Delivered package

The Blueprint B201 delivery package includes the following:

- Schematic files
- BOM files
- Gerber files
- Pick and Place file
- Assembly files
- Board Stack-up
- Firmware file
- Firmware source code

Appendix

A Glossary

Name	Definition
BOM	Bill Of Materials
GATT	Generic Attribute Profile
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input Output
LDO	Low Drop-out
LED	Light Emitting Diode
PCB	Printed Circuit Board
SDK	Software Development Kit
SWD	Serial Wire Debug
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus
UTC	Coordinated Universal Time

Table 3: Explanation of abbreviations used

Related documents

[1] NINA-B1 Series System Integration Manual, document number UBX-15026175

[2] NINA-B1 Getting Started guide, document number UBX-16009942

[3] u-blox Short Range Modules AT Commands Manual, document number UBX-14044127

[4] NINA-B1 series Data sheet, document number UBX-15019243

☞ For regular updates to u-blox documentation and to receive product change notifications, register on our homepage (http://www.u-blox.com).

Revision history

Revision	Date	Name	Comments
R01	15-Dec-2017	apet	Initial release.
R02	11-Apr-2018	apet, mhan	Updated the product name.

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