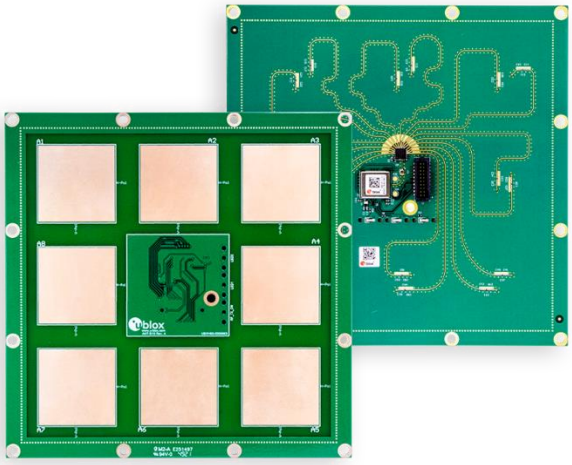
ANT-B10

ANT-B10 Bluetooth LE 5.1 direction finding antenna board

Data sheet



Abstract

The ANT-B10 Bluetooth Low Energy 5.1 antenna board is designed for use in direction finding and indoor positioning applications. Fully compliant with the Bluetooth 5.1 standard, the board hosts the NINA-B411 standalone Bluetooth module running the u-connectLocate software that supports the u-blox angle-of-arrival (AoA) algorithm. This technical datasheet provides an overview and full functional description of the antenna board, including a detailed pin list, block diagram, mechanical and electrical specifications, approvals summary, and ordering information. Aimed towards developers and other technical staff, this document provides the critical information necessary for the design of customer applications based on the board.

Document information

Title	**ANT-B10**	
Subtitle	ANT-B10 Bluetooth LE 5.1 direction finding antenna board	
Document type	Data sheet	
Document number	UBX-22008373	
Revision and date	R03	10-Feb-2023
Disclosure restriction	C2-Restricted	

Product status	**Corresponding content status**	
Functional sample	Draft	For functional testing. Revised and supplementary data will be published later.
In development / Prototype	Objective specification	Target values. Revised and supplementary data will be published later.
Engineering sample	Advance information	Data based on early testing. Revised and supplementary data will be published later.
Initial production	Early production information	Data from product verification. Revised and supplementary data may be published later.
Mass production / End of life	Production information	Document contains the final product specification.

This document applies to the following products:

Product name	**Type number**	**IN/PCN reference**	**Product status**
ANT-B10	ANT-B10-00C-00	N/A	In Development
ANT-B10	ANT-B10-10C	N/A	In Development

Contents

1 Functional description

1.1 Overview

The ANT-B10 is a compact antenna board designed specifically for Bluetooth angle of arrival (AoA) direction finding systems. Featuring eight patch-antenna elements in an arrangement that offers optimal performance in the presence of multipath effects, ANT-B10 measures the angle of arrival for an incoming Bluetooth Low Energy (LE) radio signal with high accuracy. In conjunction with at least two more ANT-B10 boards and positioning engine software, it determines the precise position of a Bluetooth LE device in an indoor environment. The board features the NINA-B411 Bluetooth LE 5.1 standalone module, which is programmed with u-connectLocate software that implements a unique u-blox direction-finding algorithm.

1.2 Product features

As the ANT-B10 board supports all of the features supported in the integrated NINA-B411 module, this document aims to describe the features of the ANT-B10 board specifically. For more information about the NINA-B411 module, see the NINA-B41 series data sheet [1].

Table 1 describes the key features of the ANT-B10 board.

Item	ANT-B10	
Manufacturer	u-blox AG	
Type	2-port patch antenna	
Bluetooth version	5.1	
Band support	2.402 GHz – 2.480 GHz	
Typical, module, conducted output power	+8 dBm at pin	
ANT-B10 maximum patch antenna gain[1]	Vertical Polarization	Horizontal Polarization
	-14.6 dBi @ 2402 MHz	-14.4 dBi @ 2402 MHz
	-13.9 dBi @ 2440 MHz	-14.3 dBi @ 2440 MHz
	-14.8 dBi @ 2480 MHz	-15.0 dBi @ 2480 MHZ
Module RX sensitivity (conducted)	-95 dBm	
Module RX sensitivity, long range mode (conducted)	-102 dBm	
Supported 2.4 GHz radio modes	Bluetooth Low Energy	
Supported Bluetooth LE data rates	1 Mbps 2 Mbps	
Native USB	12 Mbit/s	
4 – wire UART	1 Mbit/s	
4 – wire SPI	8 MHz	
GPIOs	3	
Status LEDs	3	
RF Calibration in OTP	Yes	
Maximum number of tags[2]	20	
Board Size	126.09 x 126.09 x 9.851 mm	

[1]RF switch and path losses are included as part of the antenna

[2]Maximum number of tags depends on u-connectLocate version

Table 1: Key features of the ANT-B10 Bluetooth LE 5.1 antenna board

1.3 Product description

Product name	Description
ANT-B10	Bluetooth 5.1 direction-finding antenna board with NINA-B411 standalone Bluetooth module and eight-element antenna array

Table 2: Product description

1.4 Block diagram

Figure 1 shows a block diagram of the ANT-B10 Bluetooth LE 5.1 antenna board. Including a 20-pin header connector that provides the physical interface for any external device, the board also features several status LEDs to indicate the state of the power supply, bootloader, and RF power. See also LEDs and system control signals.

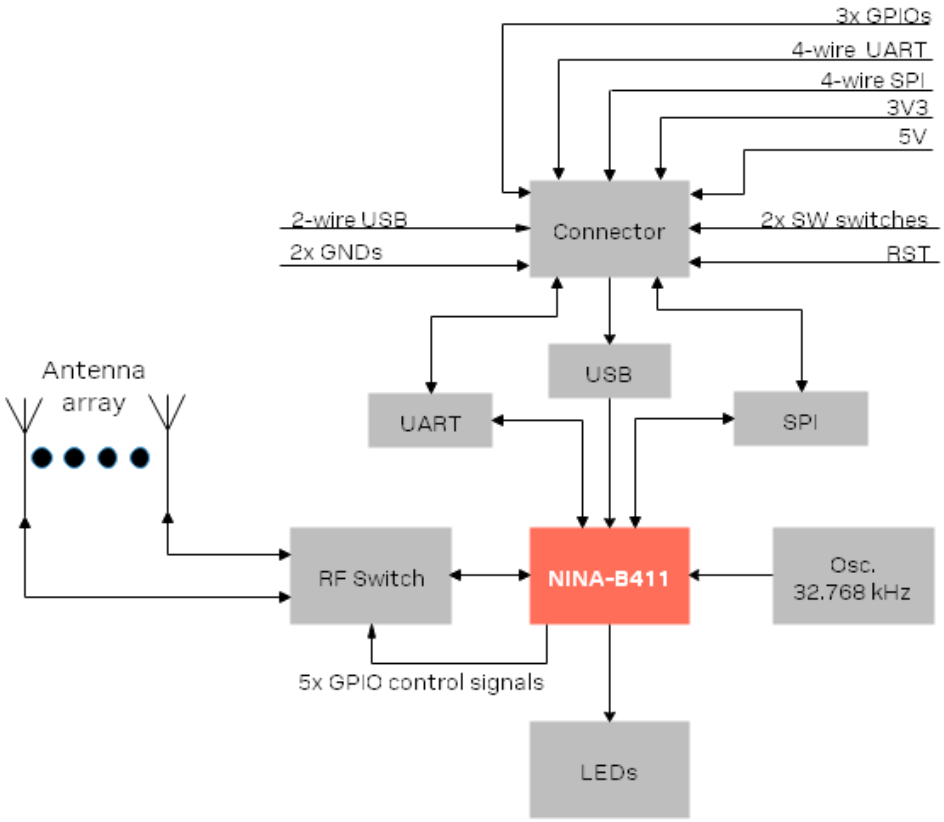


Figure 1: ANT-B10 block diagram

2 Interfaces and IOs

The ANT-B10 Bluetooth LE 5.1 antenna board supports several interfaces and IOs that are accessible through the 20-pin header.

2.1 Connectivity to host interfaces

ANT-B10 connects to a host in one of the following ways:

- Native USB (not currently supported)
- 4- wire UART
- 4- wire SPI (not currently supported)

2.1.1 Native USB

Native USB is a full-speed Universal Serial Bus (USB) interface that is compliant to USB 2.0 and supports transfer speeds up to 12 Mbit/s.

☞ Native USB is planned for future release but is not currently supported.

2.1.2 UART

ANT-B10 includes a 4-wire UART high-speed interface that supports hardware flow control with baud rates up to 1 Mbps. The UART interface can be used to connect to other external devices, such an application board, Arduino open-source platform, Raspberry Pi single-board computers, and so on.

The characteristics of the UART interface include:

- Pin configuration:
  - **TXD**, data output pin
  - **RXD**, data input pin
  - **RTS**, Request To Send, flow control output pin (optional)
  - **CTS**, Clear To Send, flow control input pin (optional)
- Hardware flow control or no flow control is supported.
- Programmable baud rate generator allows most industry standard rates up to 1 Mbps.
- Default frame configuration (not changeable):
  - 8 data bits
  - No parity bit
  - 1 stop bit

Frames are transmitted in such a way that the least significant bit (LSB) is transmitted first.

2.1.3 SPI

ANT-B10 supports a Serial Peripheral Interface with serial clock frequencies up to 8 MHz. The interface is accessible through the 20-pin header connector.

The characteristics of the SPI interface include:

- Pin configuration in master mode:
  - **SCLK**, Serial clock output
  - **MOSI**, Master Output Slave Input data line
  - **MISO**, Master Input Slave Output data line
  - **CS**, Chip/Slave select output, active low, selects which slave on the bus to talk to. Only one select line is enabled by default but more can be added by customizing a GPIO pin.
  - **DCX**, Data/Command signal, this signal is optional but is sometimes used by the SPI slaves to distinguish between SPI commands and data
- Pin configuration in slave mode:
  - **SCLK**, Serial clock input
  - **MOSI**, Master Output Slave Input data line
  - **MISO**, Master Input Slave Output data line
  - **CS**, Chip/Slave select input, active low, connects/disconnects the slave interface from the bus.
- Both master and slave modes are supported.
- The serial clock supports both normal and inverted clock polarity (CPOL) and data should be captured on rising or falling clock edge (CPHA).

☞ SPI is planned for future release but is not currently supported.

2.2 GPIOs

ANT-B10 supports three GPIOs that can connect to any external host device.

3 LEDs and system control signals

ANT-B10 supports status LEDs and system control signals used specifically for programming.

3.1 LEDs

The **antenna board is equipped with the following status LEDs:**

- Power good indicator LED (green)
- Bootloader mode [not currently supported]. TBD.
- RF Tx On: indicates whether the device is transmitting RF power during Angle of Delivery (AoD) calculations [not currently supported] TBD.

3.2 Control signals

ANT-B10 uses the following control signals for programming/updating through the UART interface.

- **SWITCH_1** and **SWITCH_2** input control signals
- Bootloader mode: To enter bootloader mode, **SWITCH_2** must be driven low during startup.
- Factory reset: To restore all settings to their factory default, **SWITCH_1** must be driven low during start up and then held low for 10 seconds.

☞ **SWITCH_1,** and **SWITCH_2** are controlled by the software.

Table 3 describes the pin definitions and system control signals used by NINA-411 and ANT-B10.

ANT-B10 header pin	Description
3	SWITCH_1
11	SWITCH_2
13	RST (RESET)

Table 3 ANT-B10 system control signals

4 Pin definition

The ANT-B10 board implements a PTSHSM-510-D-06-T-C, 20-pin header connector from Major League Electronics that provides the physical interface for all ANT-B10 signals. See also Pin header dimensions.

4.1 Pin assignment

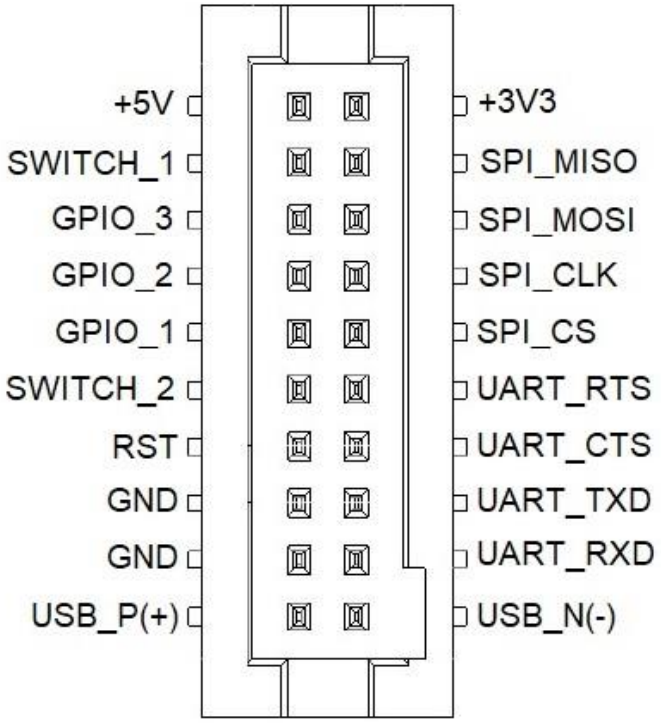


Figure 2: ANT-B10 Bluetooth LE 5.1 board pin assignment

4.2 Pin description

Table 4 describes the ANT-B10 pins located on the bottom side of board.

Pin#	Description	Pin#	Description
1	+5V (USB)	2	+3V3
3	SWITCH_1	4	SPI_MISO
5	GPIO_3	6	SPI_MOSI
7	GPIO_2	8	SPI_CLK
9	GPIO_1	10	SPI_CS
11	SWITCH_2	12	UART_RTS
13	RST	14	UART_CTS
15	GND	16	UART_TXD
17	GND	18	UART_RXD
19	USB_P(+)	20	USB_N(-)

Table 4: ANT-B10 pinout

5 Electrical specifications

⚠ Stressing the device above one or more of the Absolute maximum ratings can cause permanent damage. These are stress ratings only. Operating the module at these or at any conditions other than those specified in the Operating conditions should be avoided. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

☞ All given application information is only advisory and does not form part of the specification.

5.1 Absolute maximum ratings

Symbol	Description	Condition	Min	Max	Unit
VCC	Module supply voltage	Input DC voltage at VCC pin	–0.3	3.9	V
V_DIO	Digital pin voltage	Input DC voltage at any digital I/O pin, VCC ≤3.6 V	-0.3	VCC + 0.3	V
		Input DC voltage at any digital I/O pin, VCC > 3.6 V	-0.3	3.9	V
P_ANT	Maximum power at receiver	Input RF Power at antenna pin		+10	dBm

Table 5: Absolute maximum ratings

⚠ ANT-B10 board is not protected against overvoltage or reversed voltages. Voltage spikes exceeding the power supply voltage parameters shown in Table 5 must be kept within the specified limits using appropriate protection devices.

5.2 Maximum ESD ratings

Parameter	Min	Typical	Max	Unit	Remarks
ESD indirect contact discharge			Pending	kV	According to EN 301 489-1

Table 6: Maximum ESD ratings

ANT-B10 board host Electrostatic Sensitive Devices and require special precautions to be taken during handling. See also ESD precautions

5.3 Operating conditions

Unless otherwise specified, all operating condition specifications are given for an ambient temperature of 25 °C and a supply voltage of 3.3 V and +5V (for USB pin).

Operation beyond the specified operating conditions is not recommended and extended exposure beyond these parameters may affect device reliability.

5.3.1 Operating temperature range

Parameter	Min	Max	Unit
Storage temperature	–40	+105	°C
Operating temperature	–40	+85	°C

Table 7: Temperature range

5.3.2 Supply/Power pins

Symbol	Parameter	Min	Typ	Max	Unit
VCC	Input supply voltage	3.0	3.3	3.6	V
VBUS	USB input supply voltage	-	5.0	-	V
t_RVCC	Supply voltage rise time			60	ms
VCC_IO	I/O reference voltage		VCC		V

Table 8: Input characteristics of voltage supply pins

5.3.3 Current consumption

Table 9 shows the current consumption of ANT-B10 during several typical use cases using the u-connectLocate software.

		3.3 V VCC	
Mode	**Condition**	**Average**	**Peak**
Active	Receiver on		
		11 mA	30 mA
Standby	Receiver off		
		4.2 mA	30mA

Table 9: Current consumption during typical use cases

5.4 Antenna Radiation Pattern

Radiation patterns are measured in a far-field anechoic chamber with a measurement distance of 3 m. The device under test (DUT) is positioned using a 2-axis positioning system, allowing rotation along azimuth (phi φ) and elevation (theta θ). Azimuth is the angle from the x-axis toward the y-axis. Elevation is the angle down from the z-axis. The intensity of the received (*r*) signal is plotted as the distance from the origin at the azimuth and elevation angles. See Figure 3.

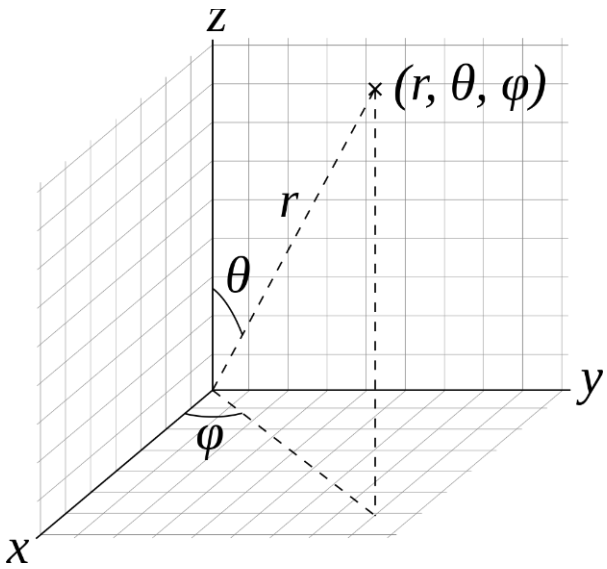


Figure 3: Spherical coordinate system

Figure 4 shows the antenna orientation in X-Y-Z cartesian coordinate system.

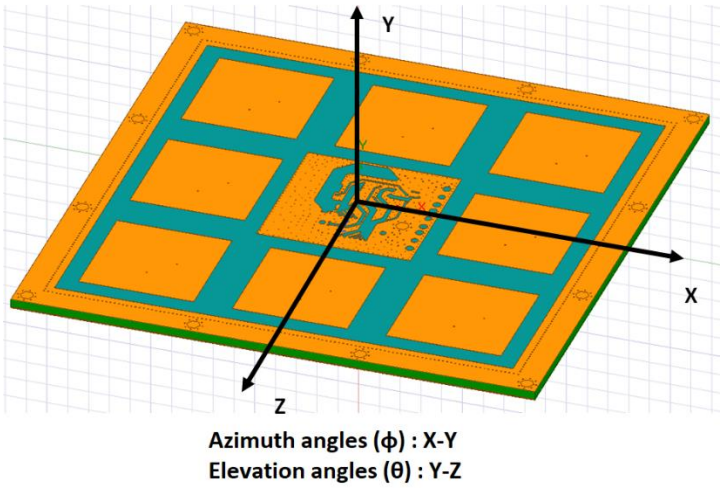


Figure 4: ANT-B10 patch antenna – 3D representation

Figure 5 shows the 2D, X-Z plain horizontal polarization antenna gain plot as a function of direction.

Figure 5: ANT-B10 patch antenna board – 2D X-Z plain horizontal polarization radiation pattern

Figure 6 shows the 2D, X-Z plain vertical polarization antenna gain plot as a function of direction.

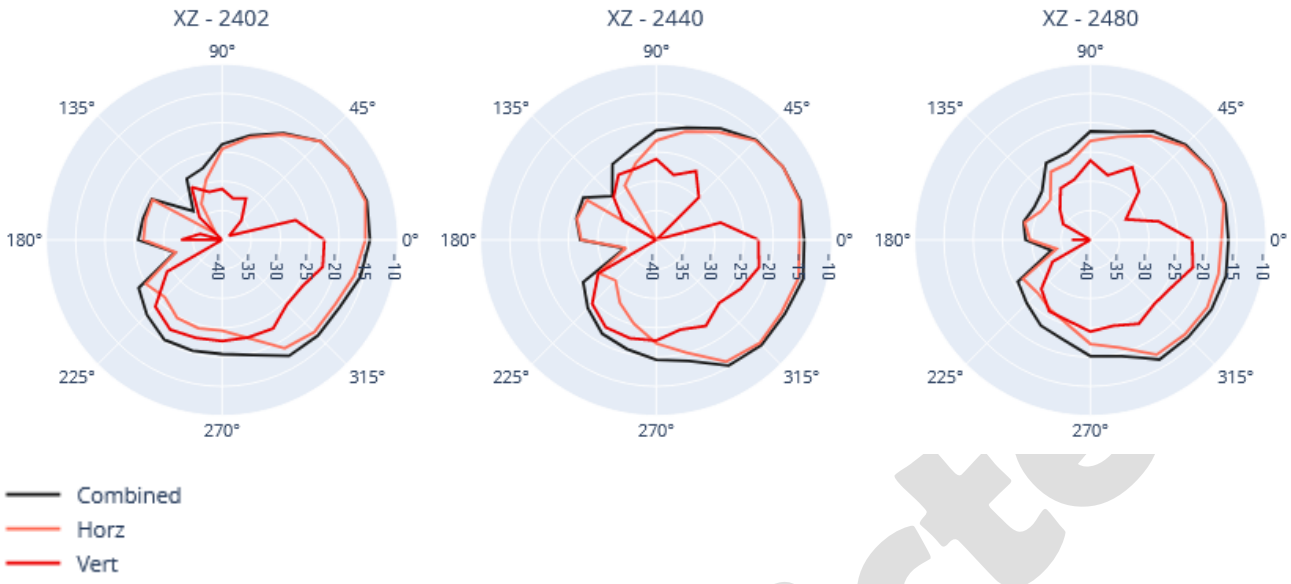


Figure 6: ANT-B10 patch antenna board – 2D X-Z plain vertical polarization radiation pattern

Figure 7 shows the 2D, Y-Z plain horizontal polarization antenna gain plot as a function of direction.

Figure 7: ANT-B10 patch antenna board – 2D Y-Z plain horizontal polarization radiation pattern

Figure 8 shows the 2D, Y-Z plain vertical polarization antenna gain plot as a function of direction.

Figure 8: ANT-B10 patch antenna board – 2D Y-Z plain vertical polarization radiation pattern

Figure 9 shows the 2D, X-Y plain horizontal polarization antenna gain plot as a function of direction.

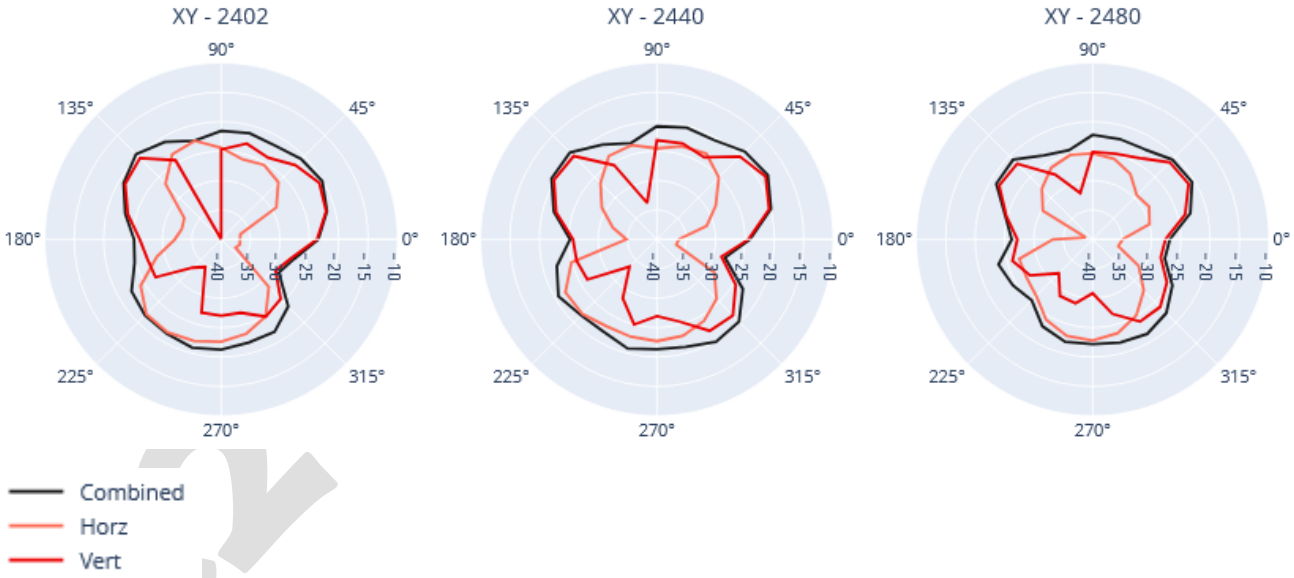


Figure 9: ANT-B10 patch antenna board – 2D X-Y plain horizontal polarization radiation pattern

Figure 10 shows the 2D, X-Y plain vertical polarization antenna gain plot as a function of direction.

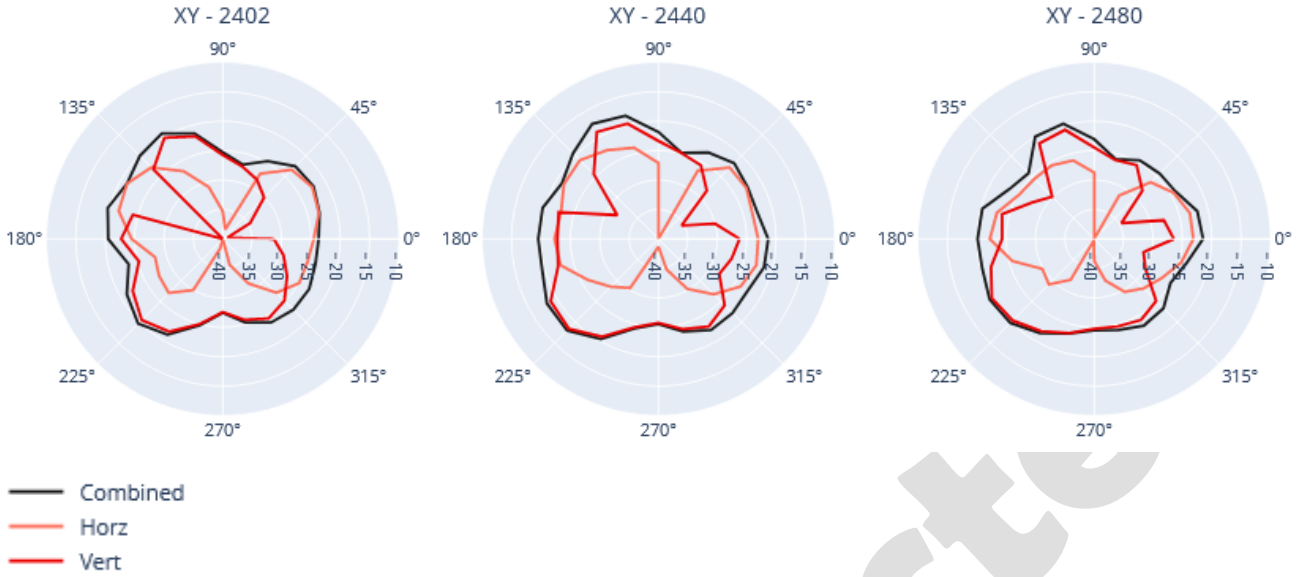


Figure 10: ANT-B10 patch antenna board – 2D X-Y plain vertical polarization radiation pattern

6 Mechanical specification

For more information about mounting the ANT-B10 and enclosures please see the ANT-B10 System Integration Manual [4].

6.1 Physical dimensions

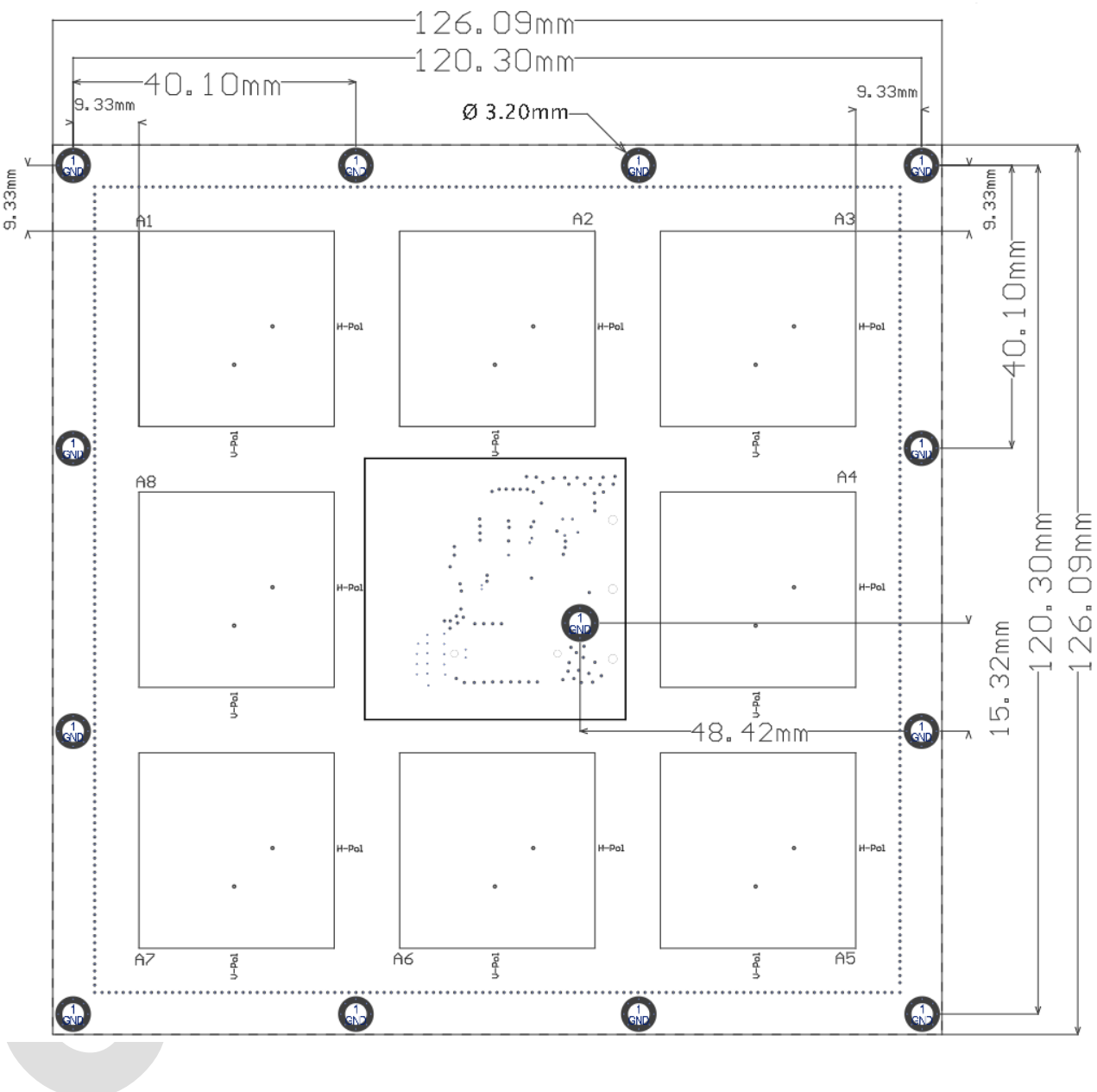


Figure 11: Physical dimensions of the ANT-B10 board

6.2 Pin header dimensions

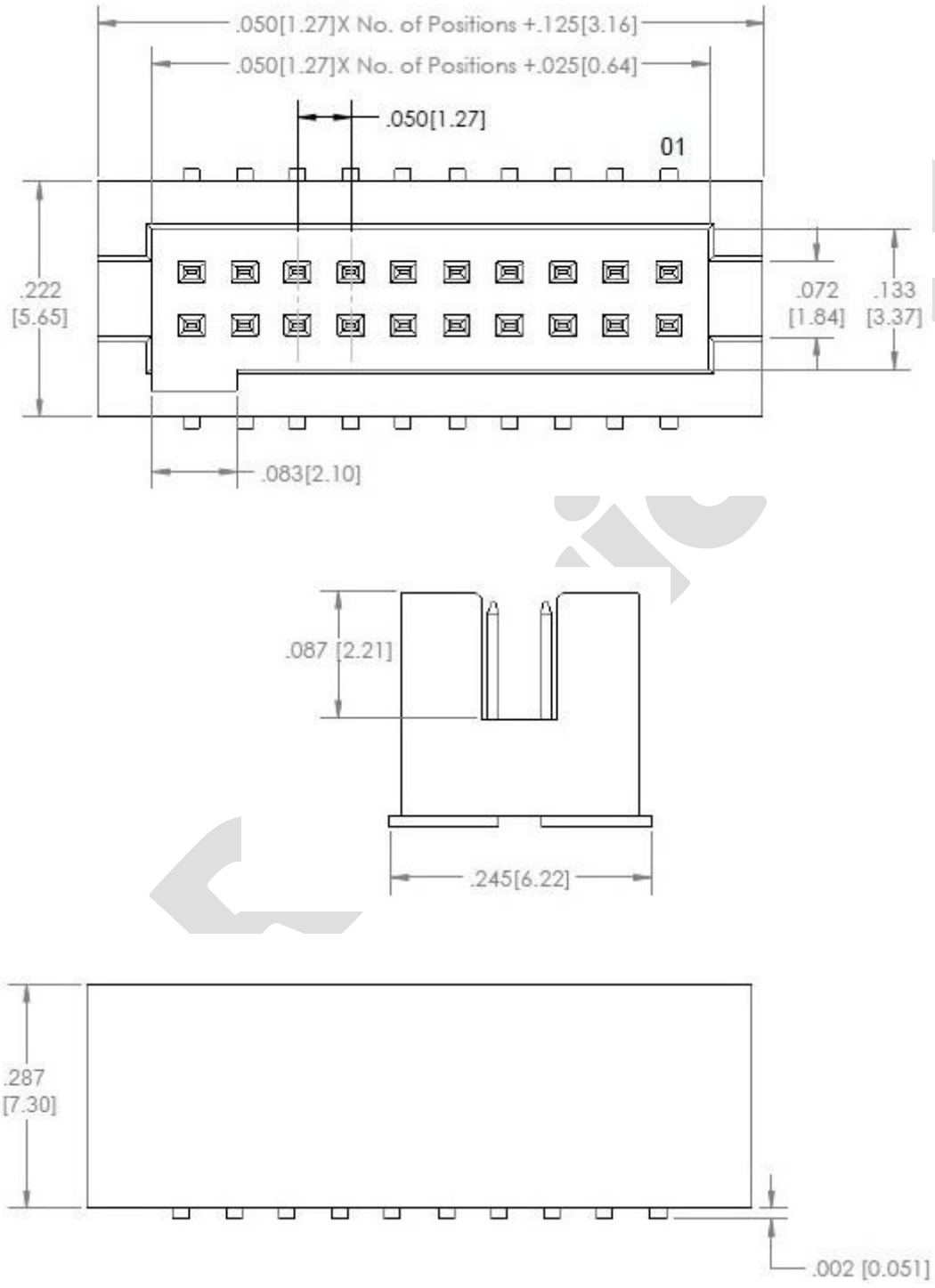


Figure 12 Pin header physical dimensions (dimensions are in inches)

7 Approvals

⚠ Approval for ANT-B10 is pending.

The ANT-B10 antenna board will be certified for use with the NINA-B4 module. For more information see the NINA-B41 series data sheet [1].

☞ For detailed information about the regulatory requirements that must be met when using NINA-B4 modules in an end product, see the NINA-B4 series certification application note [3].

8 Product handling

8.1 Packaging

Packaged and shipped in trays containing multiple ANT-B10 boards.

8.2 Shipment, storage, and handling

For more information regarding shipment, storage and handling, see the u-blox package information guide [2].

8.3 ESD precautions

⚠ ANT-B10 antenna boards are Electrostatic Sensitive Devices that demand the observance of special handling precautions against static damage. Failure to observe these precautions can result in severe damage to the product. See also Maximum ESD ratings.

Proper ESD handling and packaging procedures must be applied throughout the processing, handling, and operation of any application that incorporates ANT-B10.

9 Labeling and ordering

The labels displayed on all u-blox products include important product information.

Figure 13 shows the label applied to ANT-B10 antenna boards, which include the model name, revision, production date, and data matrix that bears a unique serial number and the u-blox logo.

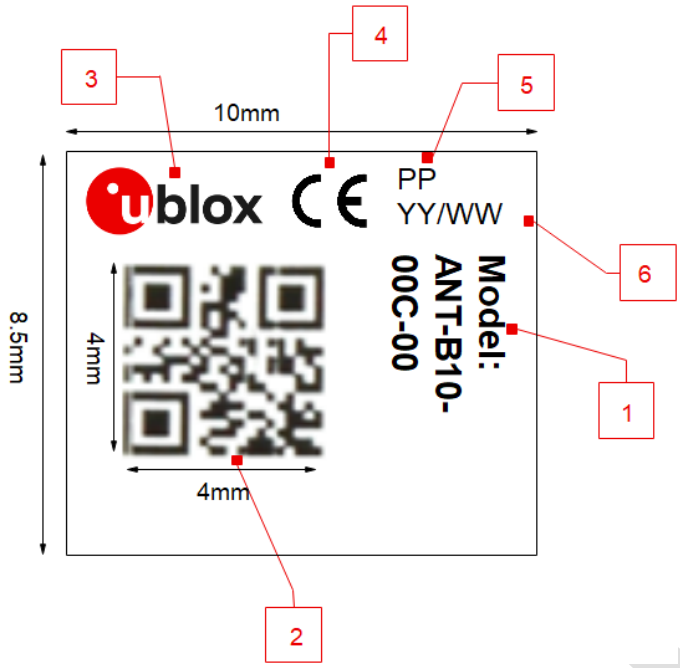


Figure 13: Product label format with dimensions for ANT-B10

Reference	Description	Source	Type
1	Type number (format ANT-TGVV-MMQ-XX), e.g. ANT-B10-00C-00	PSP	
	"Model:" ANT-B10-00C-00		Font type: Arial Narrow Font style: Bold Font size: 3pt
2	Data matrix (product identifier, serial number, datacode) • Product identifier: 3 digits defined by EMS • Serial number Datacode: 4 digits, defined in the PSP	EMS flow and PSP	DataMatrix
3	Company logo and trademark	Preprinted on label	
4	Placeholder for CE marking (when certified)	EMS flow	
5	Panel position number	EMS flow	Font type: Arial Narrow Font style: Regular Font size: 3pt
6	Production date YY/WW (year/week)	EMS flow	Font type: Arial Narrow Font style: Regular Font size: 3pt

Table 10: Label references

9.1 Ordering codes

Ordering Code	Product name	Product
ANT-B10-00C	ANT-B10	Bluetooth 5.1 direction-finding antenna board with NINA-B411 standalone Bluetooth module and eight-element antenna array. Packaged in trays containing multiple antenna boards
ANT-B10-10C	ANT-B10	Bluetooth 5.1 direction-finding antenna board with NINA-B411 standalone Bluetooth module and eight-element antenna array. Packaged in carton box containing a single antenna board

Table 11: Product ordering codes

Product changes affecting form, fit, or function are documented by u-blox. For a list of Product Change Notifications (PCNs), visit www.u-blox.com.

Appendix

A Glossary

Abbreviation	Definition
BR/EDR	Bluetooth Basic Rate / Enhanced Data Rate
BT	Bluetooth
DNI	Do Not Insert
I2S	Inter-IC-Sound
IC	Integrated Circuit
PCM	Pulse Code Modulation
SDIO	Secure Digital Input Output
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus
VIO	Input /Output Voltage
SPI	Serial Peripheral Interface

Table 12: Explanation of the abbreviations and terms used

Related documentation

[1] NINA-B41 series data sheet, UBX-20035327
[2] u-blox package information guide, UBX-14001652
[3] NINA-B4 series certification, application note, UBX-20037320
[4] ANT-B10 System Integration Manual, UBX-22025788

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	03-May-2022	iban	Initial release
R02	16-Dec-2022	iban	Added ANT-B10 patch antenna gain to Product features. Updated block diagram, revised part number of header connector in Pin definition. Added antenna radiation patterns and Ordering codes.
R03	10-Feb-2023	iban, mape	Minor additions in Product features.

Contact

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