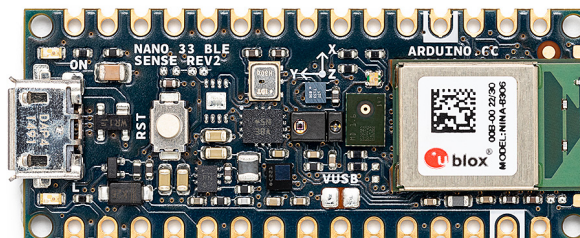




User Manual  
SKU: ABX00069



## Description

The Arduino® Nano 33 BLE Sense Rev2 is a miniature sized module containing a NINA B306 module, based on Nordic nRF52480 and containing an Arm® Cortex®-M4F. The BMI270 and BMM150 jointly provide a 9 axis IMU. The module can either be mounted as a DIP component (when mounting pin headers), or as a SMT component, directly soldering it via the castellated pads.

The Nano 33 BLE Sense Rev2 is available in two variants: without headers (SKU: ABX00069) and with headers (SKU: ABX00070).

## Target areas:

Environmental sensing, Machine Learning

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## 1 Application Examples

**Onboard Sensors for Rapid Prototyping:** Equipped with a wide range of built-in sensors (IMU, microphone, temperature, humidity, pressure, color, and gesture), it lets you test multiple applications without additional hardware.

**AI at the Edge:** Run TinyML models directly on the board to perform tasks such as speech recognition, anomaly detection, or gesture classification locally, without needing cloud connectivity.

**Wireless Communication:** With integrated Bluetooth® Low Energy (BLE), you can seamlessly connect your projects to smartphones, wearables, or other BLE devices for IoT applications.

**Scalable Development:** Start small with sensor demos and grow into complex IoT systems. The familiar Nano form factor ensures compatibility with a wide ecosystem of accessories and community resources.

**Cross-platform Integration:** Its BLE capabilities and sensor suite make it ideal for integrating with mobile apps, cloud dashboards, or wearable devices, enabling quick end-to-end solution development.

## 2 Features

### 2.1 General Specifications Overview

The Nano 33 BLE Sense Rev2 is an evolution of its predecessor, the Nano 33 BLE and Nano 33 BLE Sense. Where Nano 33 BLE Sense Rev2 continues the legacy.

The board features the standard 14x digital I/O ports, 8x analog channels, dedicated pins for I2C, SPI and UART connections.

Feature	Description
Microcontroller	nRF52480 32-bit Arm® Cortex®-M4
Frequency	64 MHz
Internal Memory	256 kB RAM / 1MB flash
USB Connectivity	Micro USB port for power and data
Power	Input voltage (VIN): 5-18 V / Power via USB at 5 V
Digital Inputs	GPIO (21x - All exposed I/O can be used as digital), PWM (5x)
Analog Inputs	12-bit ADC (8x)
Communication	UART (1x), I2C (1x), SPI (1x)
Dimensions	18 mm x 45 mm
Operating Temperature	-40 °C to +85 °C



## 2.2 Microcontroller

The Nano 33 BLE Sense Rev2 is based on the 32-bit **nRF52480** series microcontroller, from Nordic Semiconductor, which uses a 64 MHz Arm® Cortex®-M4 microprocessor.

On the Nano 33 BLE Sense Rev2, the operating voltage is fixed at 3.3 V being compatible with shields, accessories and circuits originally designed for older Nano boards that works with the same operating voltage.

Component	Details
nRF52480 Processor	Arm® Cortex®-M4 core at up to 64 MHz
Flash Memory	1 MB of Flash Memory
Programming Memory	256 kB of RAM
ADC	Yes (12-bit)
DAC	Yes (12-bit)

For more technical details on this microcontroller, visit [Nordic - nRF52480 series official documentation](#).

Most of its pins are connected to the external headers, however some are reserved for internal communication with the wireless module and the on-board internal I<sup>2</sup>C peripherals (IMU and Crypto).

**NOTE:** As opposed to other Arduino Nano boards, pins A4 and A5 have an internal pull up and default to be used as an I<sup>2</sup>C Bus so usage as analog inputs is not recommended.

## 2.3 Full speed USB Connector

The Nano 33 BLE Sense Rev2 has one micro USB 2.0 full speed port up to 12 Mbps, used to power and program your board as well as send and receive serial communication.

Pin	Function	Type	Description
1	VUSB	Power	Power Supply Input. If board is powered via VUSB from header this is an Output <b>(1)</b>
2	D-	Differential	USB differential data -
3	D+	Differential	USB differential data +
4	ID	Analog	Selects Host/Device functionality
5	GND	Power	Power Ground



## 2.4 Digital Analog Converter (DAC)

The Nano 33 BLE Sense Rev2 has a DAC with up to 12-bit resolution attached to the A0 analog pin. A DAC is used to convert a digital signal to an analog signal.

## 2.5 Board Actuators

The Nano R4 features an RGB LED and single color built-in LED, both can be controlled through the Nano 33 BLE Sense Rev2 GPIOs. See the pinout section for a detailed overview.

## 2.6 Related Products

- Arduino Screw Terminal Adapter (ASX00037)
- Arduino Connector Carrier (ASX00061)

# 3 Ratings

### 3.0.1 Recommended Operating Conditions

The table below provides a guideline for the optimal use of the Nano 33 BLE Sense Rev2 board, outlining typical operating conditions and design limits. The operating conditions of the Nano 33 BLE Sense Rev2 are largely a function based on its component's specifications.

Symbol	Description	Min	Typ	Max	Unit
$V_{IN}$	Input voltage (VIN pin)	5.0	7.0	18.0	VDC
$V_{USB}$	Input voltage (USB connector)	4.8	5.0	5.5	VDC
$T_{OP}$	Operating temperature	-40	25	85	°C

**Note:**  $V_{DD}$  Nano 33 BLE Sense Rev2 only supports 3.3V I/Os and is **\*\*NOT\*\*** 5V tolerant so please make sure you are not directly connecting 5V signals to this board or it will be damaged. Also, as opposed to Arduino Nano boards that support 5V operation, the 5V pin does NOT supply voltage but is rather connected, through a jumper, to the USB power input.



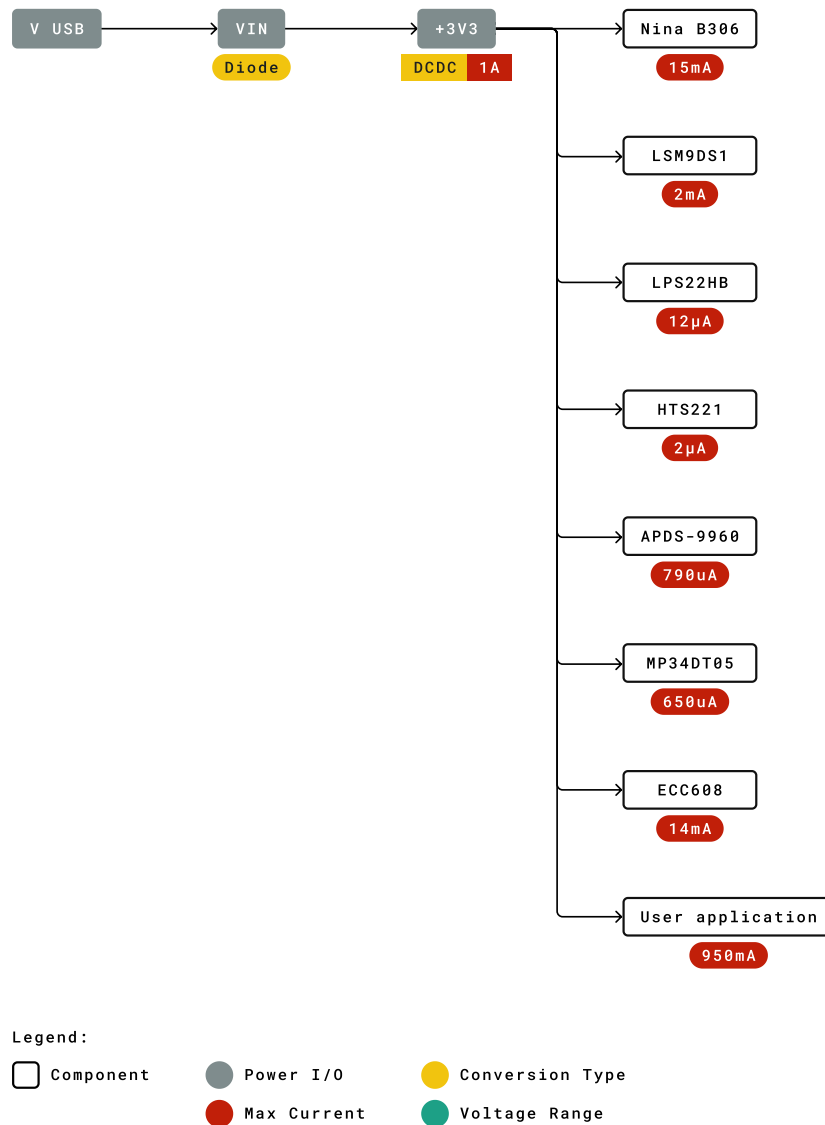
### 3.1 Power Options

Power can either be supplied via the VIN pin, or via the micro USB connector. If power is supplied via VIN, the MP2322GQH buck converter steps the voltage down to 3.3 V.

When using the 3V3 pin to power external peripherals, notice that above 150 mA the board may become very hot due to LDO regulator functioning basis.

### 3.1.1 Power Tree

The board can be powered via USB connector,  $V_{IN}$  or  $V_{USB}$  pins on headers. The following diagram illustrates the Nano 33 BLE Sense Rev2 main system power architecture.



Power tree

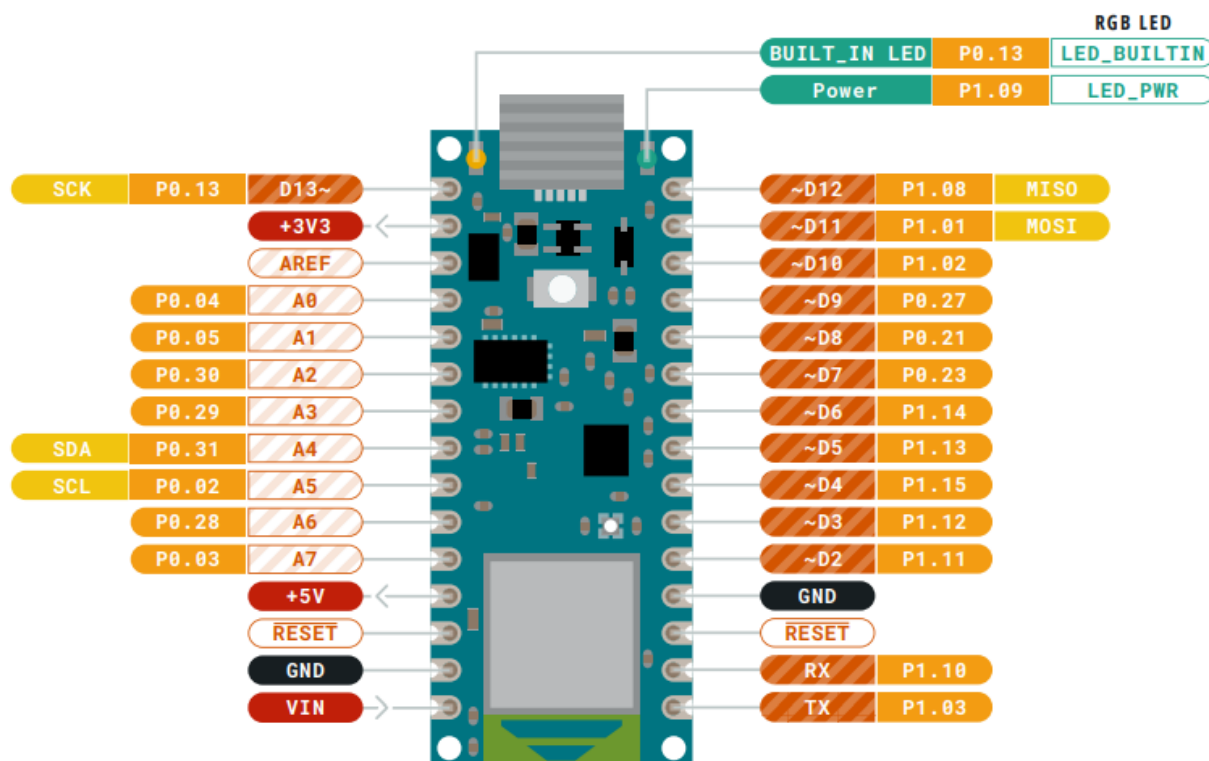
**NOTE:** Since  $V_{USB}$  feeds  $V_{IN}$  via a Schottky diode and a DC-DC regulator specified minimum input voltage is 4.5V the minimum supply voltage from USB has to be increased to a voltage in the range between 4.8V to 4.96V depending on the current being drawn.



## 4 Functional Overview

### 4.1 Pinout

The Nano breakout connectors pinout is shown in the following figure.



Pinout for Nano R4

#### 4.1.1 Headers

The board exposes two 15 pin connectors which can either be assembled with pin headers or soldered through castellated vias.

Pin	Function	Type	Description
1	D13	Digital	GPIO
2	+3V3	Power Out	Internally generated power output to external devices
3	AREF	Analog	Analog Reference; can be used as GPIO
4	A0/DAC0	Analog	ADC in/DAC out; can be used as GPIO
5	A1	Analog	ADC in; can be used as GPIO
6	A2	Analog	ADC in; can be used as GPIO
7	A3	Analog	ADC in; can be used as GPIO
8	A4/SDA	Analog	ADC in; I2C SDA; Can be used as GPIO <b>(1)</b>
9	A5/SCL	Analog	ADC in; I2C SCL; Can be used as GPIO <b>(1)</b>
10	A6	Analog	ADC in; can be used as GPIO
11	A7	Analog	ADC in; can be used as GPIO



Pin	Function	Type	Description
12	VUSB	Power In/Out	Normally NC; can be connected to VUSB pin of the USB connector by shorting a jumper
13	RST	Digital In	Active low reset input (duplicate of pin 18)
14	GND	Power	Power Ground
15	VIN	Power In	Vin Power input
16	TX	Digital	USART TX; can be used as GPIO
17	RX	Digital	USART RX; can be used as GPIO
18	RST	Digital	Active low reset input (duplicate of pin 13)
19	GND	Power	Power Ground
20	D2	Digital	GPIO
21	D3/PWM	Digital	GPIO; can be used as PWM
22	D4	Digital	GPIO
23	D5/PWM	Digital	GPIO; can be used as PWM
24	D6/PWM	Digital	GPIO, can be used as PWM
25	D7	Digital	GPIO
26	D8	Digital	GPIO
27	D9/PWM	Digital	GPIO; can be used as PWM
28	D10/PWM	Digital	GPIO; can be used as PWM
29	D11/MOSI	Digital	SPI MOSI; can be used as GPIO
30	D12/MISO	Digital	SPI MISO; can be used as GPIO

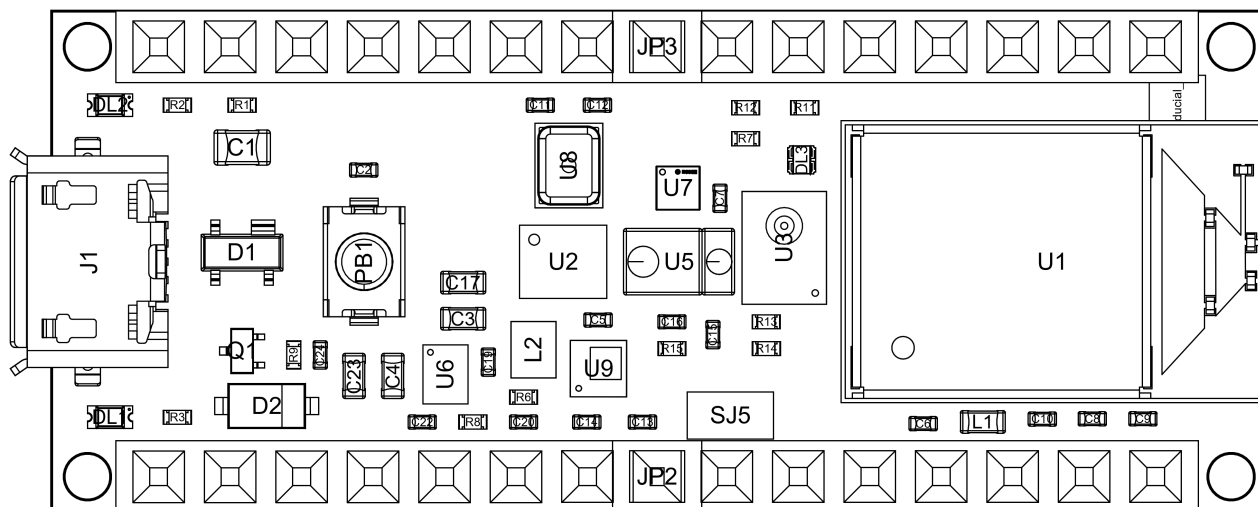
#### 4.1.2 Debug

On the bottom side of the board, under the communication module, debug signals are arranged as 3x2 test pads with 100 mil pitch with pin 4 removed. Pin 1 is depicted in Figure 3 – Connector Positions

Pin	Function	Type	Description
1	+3V3	Power Out	Internally generated power output to be used as voltage reference
2	SWD	Digital	nRF52480 Single Wire Debug Data
3	SWCLK	Digital In	nRF52480 Single Wire Debug Clock
5	GND	Power	Power Ground
6	RST	Digital In	Active low reset input

## 4.2 Board Topology

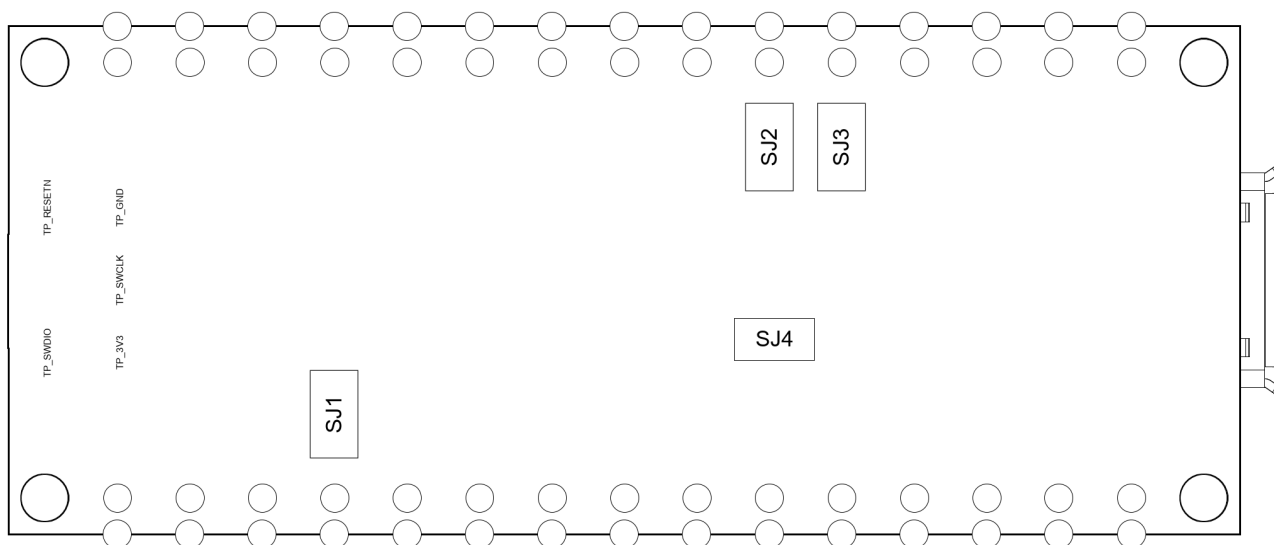
Top:



Board topology top

Ref.	Description	Ref.	Description
U1	NINA-B306 Module Bluetooth® Low Energy 5.0 Module	U6	MP2322GQH Step Down Converter
U2	BMI270 Sensor IMU	PB1	IT-1185AP1C-160G-GTR Push button
U3	MP34DT06JTR MEMS Microphone	U8	HS3003 Humidity Sensor
U7	BMM150 Magnetometer IC	DL1	Led L
U5	APDS-9660 Ambient Module	DL2	Led Power
U9	LPS22HBTR Pressure Sensor IC		

Bottom:



Board topology bot

Ref.	Description	Ref.	Description
SJ1	VUSB Jumper	SJ2	D7 Jumper
SJ3	3v3 Jumper	SJ4	D8 Jumper

## 4.3 IMU

The Nano 33 BLE Sense Rev2 provides IMU capabilities with 9-axis, by combination of the BMI270 and BMM150 ICs. The BMI270 includes both a three axis gyroscope as well as an three axis accelerometer, while the BMM150 is capable of sensing magnetic field variations in all three dimensions. The information obtained can be used for measuring raw movement parameters as well as for machine learning.

## 4.4 LPS22HB (U9) Barometer and Temperature Sensor

The LPS22HB pressure sensor IC (U9) includes both a piezoresistive absolute pressure sensor together with a temperature sensor integrated into a small chip. The pressure sensor (U9) interfaces with the main microcontroller (U1) via an I2C interface. The sensing element is composed of a micromachined suspended membrane for measuring absolute pressure, and includes a Wheatstone bridge internally for measuring the the piezoresistive elements. The temperature perturbations are compensated via an included temperature sensor on-chip. The absolute pressure can range from 260 to 1260 hPa. Pressure data can be polled via I2C at up to 24-bits, while temperature data can be polled at up to 16-bits.

The Arduino\_LPS22HB library provides a ready to use implementation of the I2C protocol with this chip.

## 4.5 HS3003 (U8) Relative Humidity and Temperature Sensor

The HS3003 (U8) is a MEMS sensors, designed to provide accurate readings of relative humidity and temperature in a small package. Temperature-compensation and calibration is performed on-chip, without requiring external circuitry. The HS3003 can measure the relative humidity from 0% to 100%RH with fast response times (under 4 seconds). The included on-chip temperature sensor (used for compensation) is has a temperature accuracy of  $\pm 0.1$  °C.

U8 communicates via the main microcontroller via an I2C bus.

### 4.5.1 Gesture Detection

Gesture detection utilizes four directional photodiodes to sense reflected IR energy (sourced by the integrated LED) to convert physical motion information (i.e. velocity, direction and distance) to a digital information. The architecture of the gesture engine features automatic activation (based on Proximity engine results), ambient light subtraction, cross-talk cancellation, dual 8-bit data converters, power saving inter-conversion delay, 32-dataset FIFO, and interrupt driven I2C communication. The gesture engine accommodates a wide range of mobile device gesturing requirements: simple UP-DOWN-RIGHT-LEFT gestures or more complex gestures can be accurately sensed. Power consumption and noise are minimized with adjustable IR LED timing.

### 4.5.2 Proximity Detection

The Proximity detection feature provides distance measurement (E.g. mobile device screen to user's ear) by photodiode detection of reflected IR energy (sourced by the integrated LED). Detect/release events are interrupt driven, and occur whenever proximity result crosses upper and/ or lower threshold settings. The proximity engine features offset adjustment registers to compensate for system offset caused by unwanted IR energy reflections appearing at the sensor. The IR LED intensity is factory trimmed to eliminate the need for end-equipment calibration due to component variations. Proximity results are further improved by automatic ambient light subtraction.

### 4.5.3 Color and ALS Detection

The Color and ALS detection feature provides red, green, blue and clear light intensity data. Each of the R, G, B, C channels have a UV and IR blocking filter and a dedicated data converter producing 16-bit data simultaneously. This architecture allows applications to accurately measure ambient light and sense color which enables devices to calculate color temperature and control display backlight.



## 4.6 Digital Microphone

The MP34DT06JTR is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated to produce audio sensors

# 5 Device Operation

## 5.1 Getting Started - IDE

If you want to program your Nano 33 BLE Sense Rev2 while offline you need to install the Arduino Desktop IDE [1] To connect the Nano 33 BLE Sense Rev2 to your computer, you'll need a Micro-B USB cable. This also provides power to the board, as indicated by the LED.

## 5.2 Getting Started - Arduino Cloud Editor

All Arduino boards, including this one, work out-of-the-box on the Arduino Cloud Editor [2], by just installing a simple plugin.

The Arduino Cloud Editor is hosted online, therefore it will always be up-to-date with the latest features and support for all boards. Follow [3] to start coding on the browser and upload your sketches onto your board.

## 5.3 Getting Started - Arduino Cloud

All Arduino IoT enabled products are supported on Arduino Cloud which allows you to Log, graph and analyze sensor data, trigger events, and automate your home or business.

## 5.4 Sample Sketches

Sample sketches for the Nano 33 BLE Sense Rev2 can be found either in the "Examples" menu in the Arduino IDE or in the "Documentation" section of the Arduino Docs website.

## 5.5 Online Resources

Now that you have gone through the basics of what you can do with the board you can explore the endless possibilities it provides by checking exciting projects on Arduino Project Hub [4], the Arduino Library Reference [5] and the on line store where you will be able to complement your board with sensors, actuators and more.

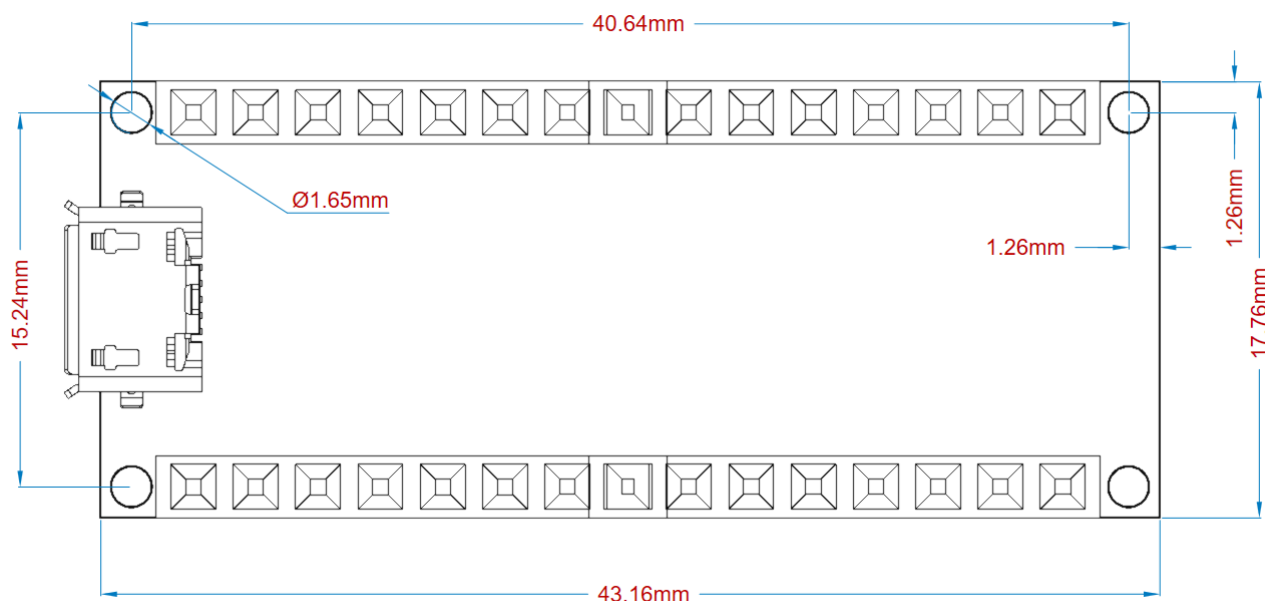
## 5.6 Board Recovery

All Arduino boards have a built-in bootloader which allows flashing the board via USB. In case a sketch locks up the processor and the board is not reachable anymore via USB it is possible to enter bootloader mode by double-tapping the reset button right after power up.

# 6 Mechanical Information

## 6.1 Board Outline and Mounting Holes

The board measures are mixed between metric and imperial. Imperial measures are used to maintain 100 mil pitch grid between pin rows to allow them to fit a breadboard whereas board length is Metric



Board layout



## 7 Certifications

### 7.1 Declaration of Conformity CE DoC (EU)

We declare under our sole responsibility that the products above are in conformity with the essential requirements of the following EU Directives and therefore qualify for free movement within markets comprising the European Union (EU) and European Economic Area (EEA).

### 7.2 Declaration of Conformity to EU RoHS & REACH 211 01/19/2021

Arduino boards are in compliance with RoHS 2 Directive 2011/65/EU of the European Parliament and RoHS 3 Directive 2015/863/EU of the Council of 4 June 2015 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Substance	Maximum limit (ppm)
Lead (Pb)	1000
Cadmium (Cd)	100
Mercury (Hg)	1000
Hexavalent Chromium (Cr6+)	1000
Poly Brominated Biphenyls (PBB)	1000
Poly Brominated Diphenyl ethers (PBDE)	1000
Bis(2-Ethylhexyl} phthalate (DEHP)	1000
Benzyl butyl phthalate (BBP)	1000
Dibutyl phthalate (DBP)	1000
Diisobutyl phthalate (DIBP)	1000

Exemptions : No exemptions are claimed.

Arduino Boards are fully compliant with the related requirements of European Union Regulation (EC) 1907 /2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH). We declare none of the SVHCs (<https://echa.europa.eu/web/guest/candidate-list-table>), the Candidate List of Substances of Very High Concern for authorization currently released by ECHA, is present in all products (and also package) in quantities totaling in a concentration equal or above 0.1%. To the best of our knowledge, we also declare that our products do not contain any of the substances listed on the "Authorization List" (Annex XIV of the REACH regulations) and Substances of Very High Concern (SVHC) in any significant amounts as specified by the Annex XVII of Candidate list published by ECHA (European Chemical Agency) 1907 /2006/EC.



### 7.3 Conflict Minerals Declaration

As a global supplier of electronic and electrical components, Arduino is aware of our obligations with regards to laws and regulations regarding Conflict Minerals, specifically the Dodd-Frank Wall Street Reform and Consumer Protection Act, Section 1502. Arduino does not directly source or process conflict minerals such as Tin, Tantalum, Tungsten, or Gold. Conflict minerals are contained in our products in the form of solder, or as a component in metal alloys. As part of our reasonable due diligence Arduino has contacted component suppliers within our supply chain to verify their continued compliance with the regulations. Based on the information received thus far we declare that our products contain Conflict Minerals sourced from conflict-free areas.

## 8 FCC Caution

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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
- (2) this device must accept any interference received, including interference that may cause undesired operation.

#### **FCC RF Radiation Exposure Statement:**

1. This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
2. This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment.
3. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

English: User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both. This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

- (1) this device may not cause interference
- (2) this device must accept any interference, including interference that may cause undesired operation of the device.

French: 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.

#### **IC SAR Warning:**

English This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.



French: Lors de l'installation et de l'exploitation de ce dispositif, la distance entre le radiateur et le corps est d'au moins 20 cm.

**Important:** The operating temperature of the EUT can't exceed 85°C and shouldn't be lower than -40°C.

Hereby, Arduino S.r.l. declares that this product is in compliance with essential requirements and other relevant provisions of Directive 2014/53/EU. This product is allowed to be used in all EU member states.

Frequency bands	Maximum output power (ERP)
863-870Mhz	TBD

## 9 Company Information

Company name	Arduino S.r.l
Company Address	Via Andrea Appiani 25 20900 MONZA Italy

## 10 Reference Documentation

Reference	Link
Arduino IDE (Desktop)	<a href="https://www.arduino.cc/en/software">https://www.arduino.cc/en/software</a>
Arduino Cloud Editor	<a href="https://create.arduino.cc/editor">https://create.arduino.cc/editor</a>
Arduino Cloud Editor - Getting Started	<a href="https://docs.arduino.cc/arduino-cloud/guides/editor/">https://docs.arduino.cc/arduino-cloud/guides/editor/</a>
Arduino Project Hub	<a href="https://create.arduino.cc/projecthub?by=part&amp;part_id=11332&amp;sort=trending">https://create.arduino.cc/projecthub?by=part&amp;part_id=11332&amp;sort=trending</a>
Library Reference	<a href="https://www.arduino.cc/reference/en/">https://www.arduino.cc/reference/en/</a>
Forum	<a href="https://create.arduino.cc/projecthub/Arduino_Genuino/getting-started-with-arduino-web-editor-4b3e4a">https://create.arduino.cc/projecthub/Arduino_Genuino/getting-started-with-arduino-web-editor-4b3e4a</a>
Nina B306	<a href="https://content.u-blox.com/sites/default/files/NINA-B3_DataSheet_UBX-17052099.pdf">https://content.u-blox.com/sites/default/files/NINA-B3_DataSheet_UBX-17052099.pdf</a>
Arduino_LPS22HB Library	<a href="https://github.com/arduino-libraries/Arduino_LPS22HB">https://github.com/arduino-libraries/Arduino_LPS22HB</a>
Arduino_APDS9960 Library	<a href="https://github.com/arduino-libraries/Arduino_APDS9960">https://github.com/arduino-libraries/Arduino_APDS9960</a>



## 11 Revision History

Date	Revision	Changes
25/04/2024	5	Updated link to new Cloud Editor
03/05/2023	4	Add SKU for version with headers
10/11/2022	3	Updated to account for Rev2 changes: LSM9DS1 -> BMI270+Bmm150, HTS221 -> HS3003, MPM3610 -> MP2322, PCB modification
03/08/2022	2	Reference documentation links updates
27/04/2021	1	General datasheet updates