Description

The **Arduino® Nicla Sense ME** is our smallest form factor yet, with a range of industrial grade sensors packed into a tiny footprint. Measure process parameters such as temperature, humidity and movement. Dive into edge computing with powerful data fusion capabilities. Make your own industrial grade wireless sensing network with the onboard BHI260AP, BMP390, BMM150 and BME688 Bosch sensors.

Target areas:

wireless sensor networks, data fusion, artificial intelligence, gas detection

Features

- **ANNA-B112** Bluetooth® Module

  - **nRF52832** System-on-chip

    - 64 MHz ARM® Cortex-M4F microcontroller
    - 64 KB SRAM
    - 512 KB Flash
    - RAM mapped FIFOs using EasyDMA
    - 2x SPI (one is accessible via pin header)
    - 2x I2C (one is accessible via pin header)
    - 12-bit/200 ksps ADC
    - 2.400 - 2.4835 GHz Bluetooth® (5.0 via cordio stack, 4.2 via ArduinoBLE)

  - Internal antenna
  - Internal 32 MHz oscillator
  - 1.8V Operating Voltage

- **Bosch BHI260AP** - AI smart sensor hub with integrated IMU

  - Fuser 2 CPU Core

    - 32 Bit Synopsys DesignWare ARC™ EM4™ CPU
    - floating point RISC Processor
    - 4-channel micro DMA controller/ 2-way associative cache controller

  - 6-axis IMU

    - 16-bit 3-axis accelerometer
    - 16-bit 3-axis gyroscope

  - Pro Features

    - Self-learning AI software for fitness tracking
    - Swim analytics
    - Pedestrian dead reckoning
    - Relative and absolute orientation

  - External 2MB FLASH connected via QSPI

- **Bosch BMP390** High-performance pressure sensor

  - Operation range: 300-1250 hPa
  - Absolute accuracy pressure (typ.): ± 0.5 hPa
  - Relative accuracy pressure (typ.): ± 3.33 hPa (equivalent to ±25 cm)
  - RMS noise in pressure @ highest resolution: 0.02 Pa
  - Temperature coefficient offset: ± 0.6 Pa/K
  - Long-term stability (12 months): ± 0.016 hPa
  - Max sampling rate: 200 Hz
  - Integrated 512 byte FIFO buffer

- **Bosch BMM150** 3-axis Magnetometer

    - Magnetic range typ.

        - X,Y axis: ±1300µT
        - Z axis: ±2500µT

    - Resolution: 0.3µT
    - Non-linearity: <1% FS

- **Bosch BME688** Environmental sensing with Artificial Intelligence

    - Operating range

        - Pressure: 300-1100 hPa
        - Humidity: 0-100%
        - Temperature: -40 - +85°C

    - eNose Gas sensor

        - Sensor-to-sensor deviation (IAQ): ± 15% ± 15 IAQ
        - Standard scan speed: 10.8 s/scan
        - Electric charge for standard scan: 0.18 mAh (5 scans - 1 min)
        - Major Sensor outputs

            - Index for air quality (IAQ)
            - bVOC- & CO2-equivalents (ppm)
            - Gas scan result (%)
            - Intensity level

- **ATSAMD11D14A-MUT** Microcontroller

    - Serial to USB Bridge
    - Debugger interface

Contents

1 The Board

1.1 Application Examples

The Arduino® Nicla Sense ME is your gateway to develop wireless networking solutions with rapid development and high robustness. Get real-time insight into the operational characteristics of your processes. Take advantage of the high quality sensors and networking capabilities to evaluate novel WSN architectures. Ultra low power consumption and integrated battery management allows for deployment in various capabilities. WebBLE allows for easy OTA update of the firmware as well as remote monitoring.

- **Warehouse & Inventory Management**: The environmental sensor of the Arduino® Nicla Sense ME is able to detect the ripening state of fruits, vegetable and meat allowing for intelligent management of perishable assets alongside the Arduino Cloud.

- **Distributed Industrial Sensing**: Identify operating conditions within your machine, factory or greenhouse remotely and even in hard to access or hazardous areas. Detect natural gas, toxic gases or other hazardous fumes using the AI capabilities on the **Arduino® Nicla Sense ME**. Improve safety levels with remote analysis. Mesh capabilities allow for simple deployment of WSN with minimal infrastructure requirements.

- **Wireless Sensor Network Reference Design**: The Nicla form factor has been specifically developed at Arduino® as a standard for wireless sensor network which can be adapted by partners to develop custom-designed industrial solutions. Get a head start by developing custom end-user solutions including Cloud connected smart wearables and autonomous robotics. Researchers and educators can use this platform to work on an industrially-recognized standard for wireless sensor research and development that can shorten the time from concept to market.
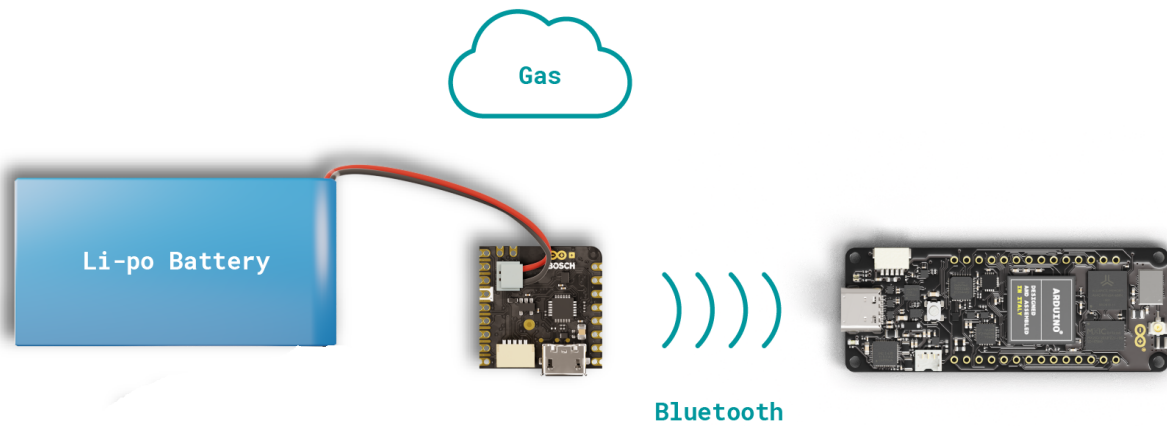
1.2 Accessories (Not Included)

- Single cell Li-ion/Li-Po battery

1.3 Related Products

- ESLOV connector
- Arduino® Portenta H7 (SKU: ABX00042)

1.4 Assembly Overview

Example of a typical solution for remote environmental sensing including an Arduino® Nicla Sense ME, Arduino® Portenta H7 and LiPo battery.

2 Ratings

2.1 Recommended Operating Conditions

Symbol	Description	Min	Typ	Max	Unit
V_{IN}	Input voltage from VIN pad	3.5	5.0	5.5	V
V_{USB}	Input voltage from USB connector	4.8	5.0	5.5	V
V_{DDIO_EXT}	Level Translator Voltage	1.8	3.3	3.3	V
V_{IH}	Input high-level voltage	$0.7V_{DDIO\_EXT}$[1]		V_{DDIO_EXT}	V
V_{IL}	Input low-level voltage	0		$0.3V_{DDIO\_EXT}$[2]	V
T_{OP}	Operating Temperature	-40	25	85	°C

Note : V_{DDIO_EXT} is software programmable. While the ADC inputs can accept up to 3.3V, the maximum value is at the ANNA B112 operating voltage.
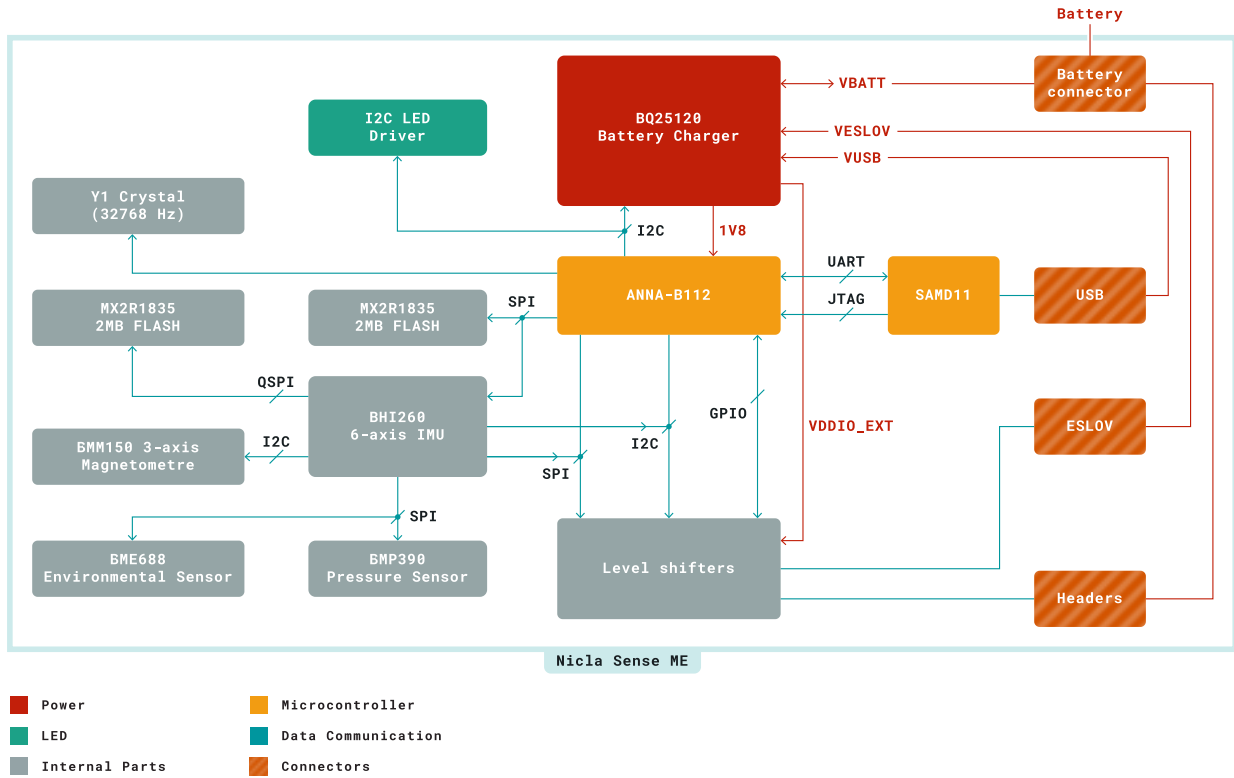
1 : All I/O pins operate at V_{DDIO_EXT} apart from the following:

- ADC1 and ADC2 - 1V8
- JTAG_SAMD11 - 3V3
- JTAG_ANNA - 1V8
- JTAG_BHI - 1V8

2 : If the internal V_{DDIO_EXT} is disabled, it is possible to supply it externally.
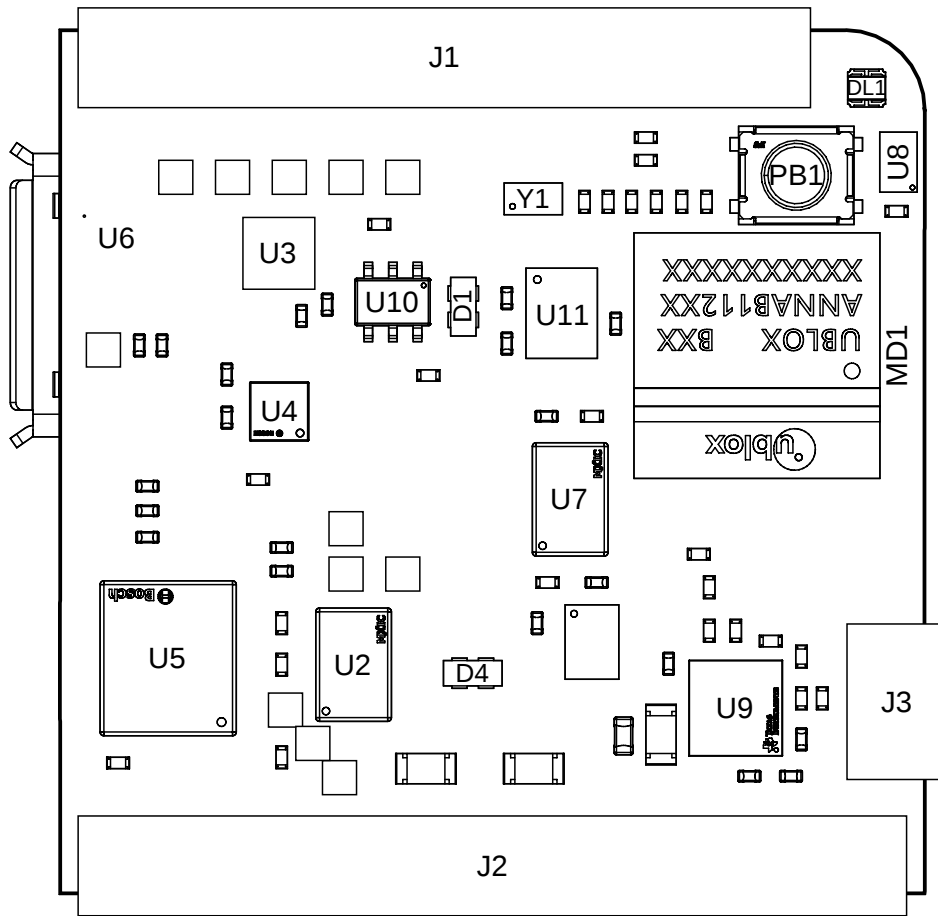
3 Functional Overview

3.1 Block Diagram

Nicla Sense ME Block Diagram

3.2 Board Topology

Top View

Nicla Sense ME Top View

Ref.	Description	Ref.	Description
MD1	ANNA B112 Bluetooth® Module	U2, U7	MX25R1635FZUIH0 2 MB FLASH IC
U3	BMP390 Pressure Sensor IC	U4	BMM150 3-axis Magnetic Sensor IC
U5	BHI260AP 6 axis IMU and AI core IC	U6	BME688 Environmental Sensor IC
U8	IS31FL3194-CLS2-TR 3-channel LED IC	U9	BQ25120AYFPR Battery Charger IC
U10	SN74LVC1T45 1Channel voltage level translator IC	U11	TXB0108YZPR Bidirectional IC
U12	NTS0304EUKZ 4-bit translating transceiver	J1	ADC, SPI and LPIO Pin headers
J2	I2C, JTAG, Power and LPIO pin headers	J3	Battery pin headers
Y1	SIT1532AI-J4-DCC MEMS 32.7680 kHz Oscillator	DL1	SMLP34RGB2W3 RGB SMD LED
PB1	Reset button		

Back View
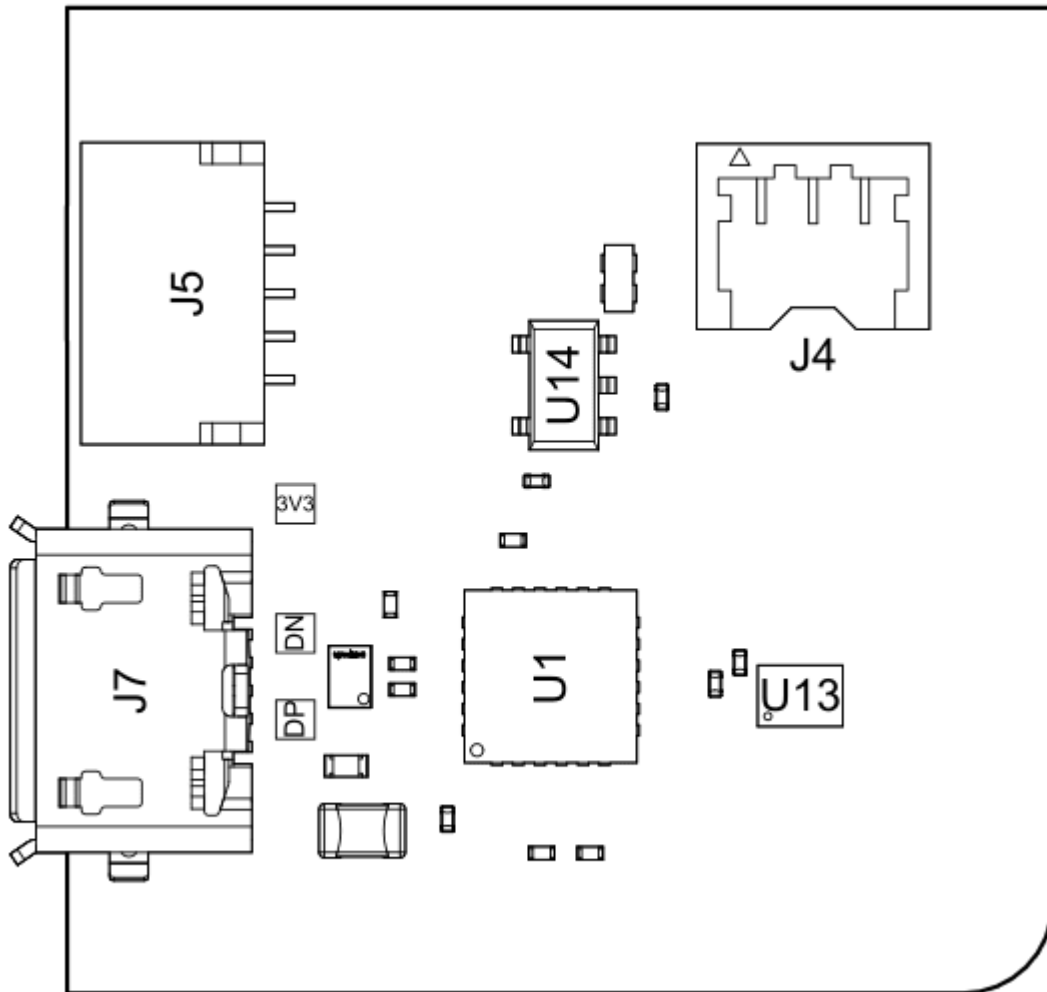
Nicla Sense ME Back View

Ref.	Description	Ref.	Description
U1	ATSAMD11D14A-MUT USB Bridge	U13	NTS0304EUKZ 4-bit translating transceiver IC
U14	AP2112K-3.3TRG1 0.6 A 3.3 V LDO IC	J4	3-pin 1.2mm ACH Battery Connector (BM03B-ACHSS-GAN-TF)
J5	SM05B-SRSS-TB(LF)(SN) 5-pin Eslov connector	J7	microUSB connector

3.3 Microcontroller

The Arduino® Nicla Sense ME is powered by a nRF52832 SoC within the ANNA-B112 module (MD1). The nRF52832 SoC is built around an ARM® Cortex-M4 microcontroller with floating point unit running at 64 MHz. Sketches are stored inside the nRF52832 internal 512 KB FLASH which is shared with the bootloader. 64 KB SRAM is available to the user. The ANNA-B112 acts as SPI host for the data logging 2MB flash (U7) and the BHI260 6-axis IMU (U5). It is also the secondary for the BHI260 (U5) I2C and SPI connection. While the module itself runs at 1.8V, a level shifter can adjust the logic level between 1.8V and 3.3V depending on the LDO set in BQ25120 (U9). An external oscillator (Y1) provides a 32 KHz signal.

3.4 Bosch BHI260 Smart Sensor System with Built-in 6-Axis IMU

The Bosch BHI260 is a ultra low power programmable sensor, combining a Fuser2 core processor, 6-axis IMU (gyroscope and accelerometer) together with a sensor fusion software framework. The BHI260 is a smart sensor core (hosting a programmable recognition system), that handles communication with other sensors on the **Arduino Nicla Sense ME** via I2C and SPI connections. There is also a dedicated 2MB Flash (U2) used to store execute in place (XiP) code as well as data storage, such as Bosch sensor fusion algorithm (BSX) calibration data. The BHI 260 is capable of loading custom algorithms that can be trained on a PC. The generated smart algorithm then operates on this chip.

3.5 Bosch BME688 Environmental Sensor

The **Arduino Nicla Sense ME** is able to perform environmental monitoring via the Bosch BME688 sensor (U6). This provides capabilities for pressure, humidity, temperature as well as Volatile Organic Compound (VOC) detection. The Bosch BME688 performs gas detection via an eNose metal oxide semiconductor array with a typical gas scan cycle of 10.8 seconds.

3.6 Bosch BMP390 Pressure Sensor

Industrial grade accuracy and stability in pressure measurements is provided by the BMP390 (U3) designed for prolonged use, with a relative accuracy of ±0.03 hPa and an RMS of 0.02 Pa in high resolution mode. The Bosch BMP390 is suitable for rapid measurements with a sampling rate of 200 Hz, or for low power use with a sampling rate of 1 Hz, consuming less than 3.2 μA. U3 is controlled via a SPI interface to the BHI260 (U2), on the same bus as the BME688 (U6).

3.7 Bosch BMM150 3-Axis Magnetometer

The Bosch BMM150 (U4) provides accurate 3-axis measurements of magnetic field with compass-level accuracy. Combined with the BHI260 IMU (U2), Bosch sensor fusion can be used to obtain high accuracy spatial orientation and motion vectors for detection of heading in autonomous robots as well as predictive maintenance. There is a dedicated I2C connection to the BHI260 (U2), acting as the host.

3.8 RGB LED

An I2C LED driver (U8) drives the RGB LED (DL1), and is capable of a maximum output of 40 mA. It is driven by the ANN-B112 (U5) microcontroller.

3.9 USB Bridge

The SAMD11 microcontroller (U1) is dedicated to act as both the USB bridge as well as the JTAG controller for the ANNA-B112. A logic level translator (U13) acts as an in between to translate 3.3V logic to 1.8V for the ANNA-B112. The 3.3V voltage is generated from the USB voltage by a LDO (U14).
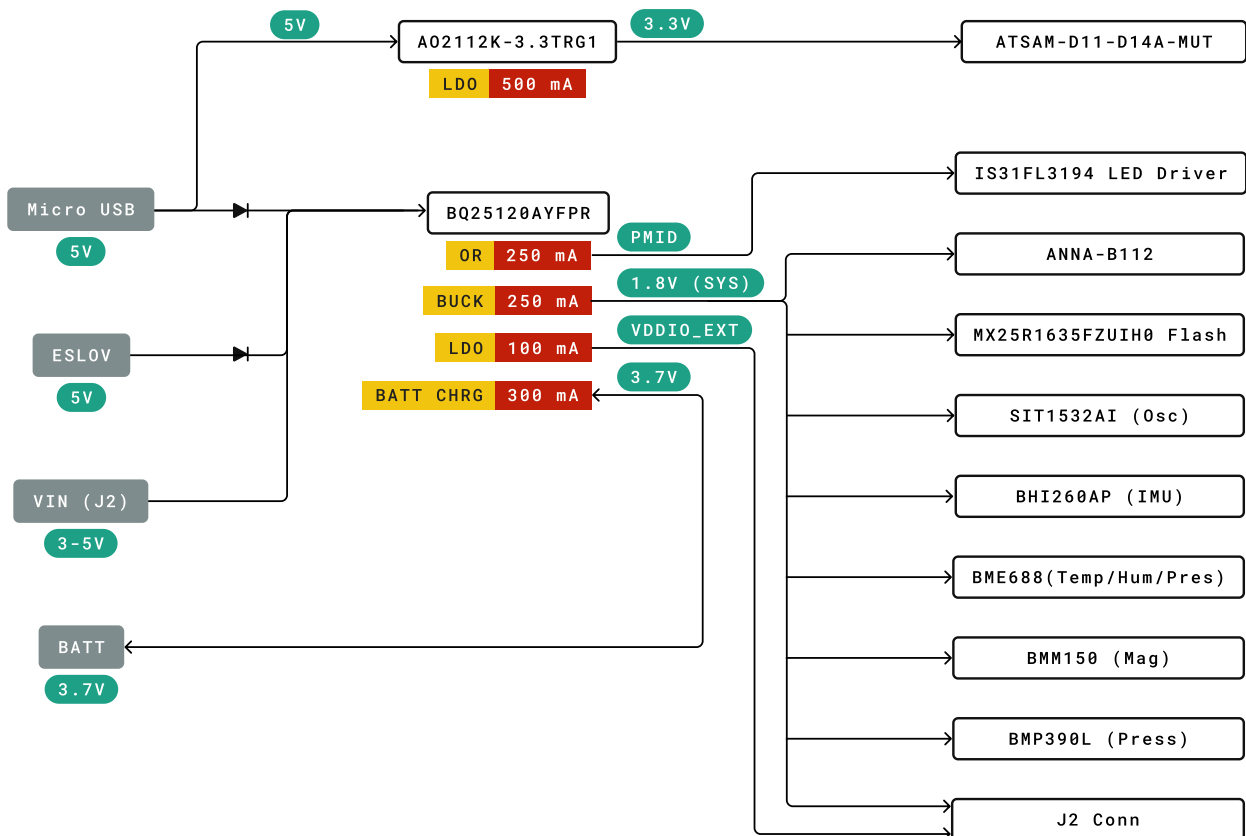
3.10 Power Tree

Nicla Sense ME Back View

The **Arduino Nicla Sense ME** can be powered via micro USB (J7), ESLOV (J5) or VIN. This is converted into the relevant voltages via the BQ2512BAYFPR IC (U9). A Schottky diode provides reverse polarity protection to the USB and ESLOV voltages. When voltage is supplied via the microUSB, a linear 3.3V regulator also provides power to the SAMD11 microcontroller used for programming the board as well as for JTAG and SWD. The LED driver (U8) and RGB Leds (DL1) are driven by a boost voltage of 5V. All other components operate off the 1.8V rail regulated by a buck converter. PMID acts as an OR switch between VIN and BATT and operates the LED driver. All I/O broken out to the pins are fed through a bi-direction voltage translator running at V_{DDIO_EXT}.

Additionally, the BQ25120AYFPR (U9) also provides support for a single cell 3.7V LiPo/Li-ion battery pack connected to J4, allowing use of the board as a wireless sensor network.

4 Board Operation

4.1 Getting Started - IDE

If you want to program your Arduino® Nicla Sense ME while offline you need to install the Arduino® Desktop IDE **[1]** To connect the Arduino® Nicla Sense ME to your computer, you'll need a micro USB cable. This also provides power to the board, as indicated by the LED. The Arduino core is operated on the ANNA-B112 while the Bosch Smart Sensor framework operates on the BHI260.

4.2 Getting Started - Arduino Web Editor

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

The Arduino® Web 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.

4.3 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.

4.4 Getting Started - WebBLE

The Arduino Nicla Sense ME provides capability for OTA updates to the NINA-B112 and BHI260 firmware using WebBLE.

4.5 Getting Started - ESLOV

This board can act as a secondary to a ESLOV controller and have the firmware updated through this method.

4.6 Sample Sketches

Sample sketches for the Arduino® Nicla Sense ME can be found either in the "Examples" menu in the Arduino® IDE or in the "Documentation" section of the Arduino® Pro website **[4]**

4.7 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 ProjectHub **[5]**, the Arduino® Library Reference **[6]** and the online store **[7]** where you will be able to complement your board with sensors, actuators and more.

4.8 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.

5 Connector Pinouts

Note: All the pins on J1 and J2 (excluding fins) are referenced to the V_{DDIO_EXT} voltage which can be generated internally or supplied externally.

5.1 J1 Pin Connector

Pin	Function	Type	Description
1	LPIO0_EXT	Digital	Low Power IO Pin 0
2	NC	N/A	N/A
3	CS	Digital	SPI Cable Select
4	COPI	Digital	SPI Controller Out / Peripheral In
5	CIPO	Digital	SPI Controller In / Peripheral Out
6	SCLK	Digital	SPI Clock
7	ADC2	Analog	Analog Input 2
8	ADC1	Analog	Analog Input 1

5.2 J2 Pin Header

| Pin	Function	Type	Description
1	SDA	Digital	I2C Data Line
2	SCL	Digital	I2C Clock
3	LPIO1_EXT	Digital	Low Power IO Pin 1
4	LPIO2_EXT	Digital	Low Power IO Pin 2
5	LPIO3_EXT	Digital	Low Power IO Pin 3
6	GND	Power	Ground
7	VDDIO_EXT	Digital	Logic Level Reference
8	N/C	N/A	N/A
9	VIN	Digital	Input Voltage

Note: For further information on how Low Power I/Os work, check Nicla Family Form Factor documentation.

5.3 J3 Fins

Pin	Function	Type	Description
P1	BHI_SWDIO	Digital	BHI260 JTAG Serial Wire Debug Data
P2	BHI_SWDCLK	Digital	BHI260 JTAG Serial Wire Debug Clock
P3	ANNA_SWDIO	Digital	ANNA JTAG Serial Wire Debug Data
P4	ANNA_SWDCLK	Digital	ANNA JTAG Serial Wire Debug Clock
P5	RESET	Digital	Reset Pin
P6	SAMD11_SWDIO	Digital	SAMD11 JTAG Serial Wire Debug Data
P7	+1V8	Power	+1.8V Voltage Rail
P8	SAMD11_SWDCLK	Digital	SAMD11 JTAG Serial Wire Debug Clock

Note: These test points can easily be accessed by inserting the board in a double row 1.27 mm/50 mil pitch male header. **Note 2:** All JTAG logic levels operate at 1.8V apart from the SAMD11 pins (P6 and P8) which are 3.3V. All these JTAG pins are 1.8V only and don't scale with VDDIO.

6 Mechanical Information
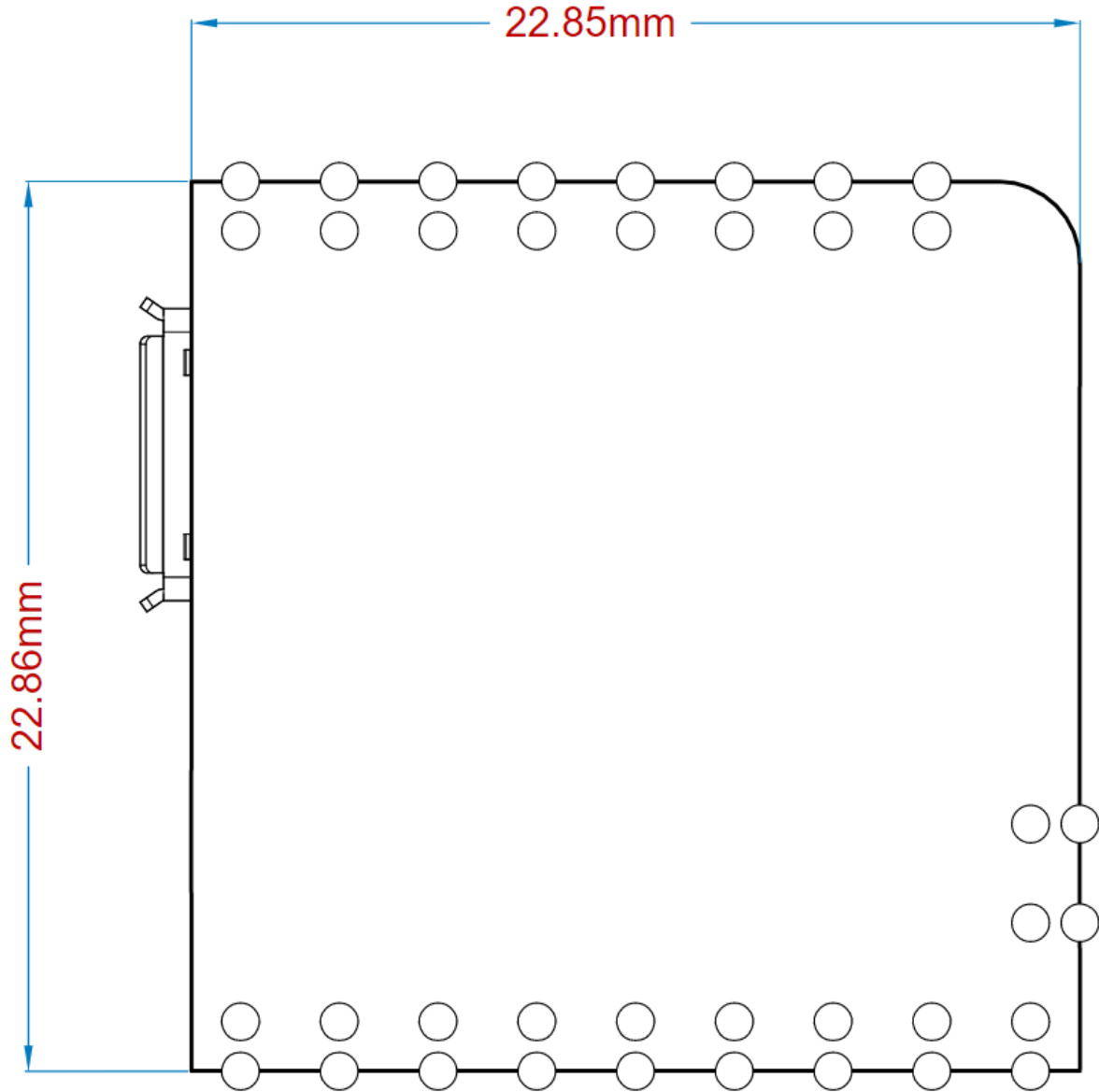
6.1 Power Consumption

Description	Min	Typ	Max	Unit
Power consumption in standby		460		uA
Power consumption with blink sketch		960		uA
Power consumption advertising with sensor polling at 1Hz		2.5		mA
Power consumption advertising with sensor polling once per hour		1.15		mA

Note: The measurements have been performed by activating temperature sensor, accelerometer and gyroscope, which have been configured with 1Hz sample rate and 1ms latency.

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 nedoit 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℃ and shouldn't be lower than -40℃.

Hereby, Arduino S.r.l. declares that this product is in compliance with essential requirements and other relevant provisions of Directive 201453/EU. This product is allowed to be used in all EU member states.

Frequency bands	Typical Output Power
2.4 GHz, 40 channels	+6dBm

9 Company Information

Company name	Arduino SRL
Company Address	Via Andrea Appiani 25, 20900 Monza MB, Italy

10 Reference Documentation

Ref	Link
Arduino® IDE (Desktop)	https://www.arduino.cc/en/Main/Software
Arduino® IDE (Cloud)	https://create.arduino.cc/editor
Arduino® Cloud IDE Getting Started	https://create.arduino.cc/projecthub/Arduino_Genuino/getting-started-with-arduino-web-editor-4b3e4a
Arduino® Pro Website	https://www.arduino.cc/pro
Project Hub	https://create.arduino.cc/projecthub?by=part&part_id=11332&sort=trending
Library Reference	https://github.com/bcmi-labs/Arduino_EdgeControl/tree/4dad0d95e93327841046c1ef80bd8b882614eac8
Online Store	https://store.arduino.cc/

11 Revision History

Date	Revision	Changes
27-05-2021	01	Initial Version
20-07-2021	02	Technical Revisions

12 Product Warnings and Disclaimers

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BEFORE INSTALLING THE PRODUCTS, ENSURE THAT ITS FIRMWARE IS UPGRADED TO THE LATEST VERSION, AVAILABLE FOR DOWNLOAD FROM OUR WEBSITE. DURING THE LIFESPAN OF PRODUCTS, IT IS IMPORTANT TO CHECK ABOUT THE APPLICABILITY OF FIRMWARE UPDATES.

USERS SHOULD, WHERE APPLICABLE, CHANGE PASSWORDS FREQUENTLY AND ENSURE A HIGH-QUALITY PASSWORD (PASSWORDS SHOULD BE LONG AND COMPLEX ENOUGH, NEVER SHARED, AND ALWAYS UNIQUE). FURTHERMORE, IT IS THE USERS' RESPONSIBILITY TO KEEP ITS ANTI-VIRUS SYSTEM UP TO DATE.

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CERTAIN SENSORS, DEVICES AND OTHER PANEL ACCESSORIES MAY BE PROGRAMMED INTO PANEL AS "SUPERVISORY" SO THAT THE PANEL WILL INDICATE IF IT DOES NOT RECEIVE A REGULAR SIGNAL FROM THE DEVICE

WITHIN A CERTAIN PERIOD OF TIME. CERTAIN DEVICES CANNOT BE PROGRAMMED AS SUPERVISORY. DEVICES CAPABLE OF BEING PROGRAMMED AS SUPERVISORY MAY NOT BE PROPERLY PROGRAMMED AT INSTALLATION, RESULTING IN A FAILURE TO REPORT TROUBLE WHICH COULD RESULT IN DEATH, SERIOUS INJURY AND/OR PROPERTY DAMAGE.

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