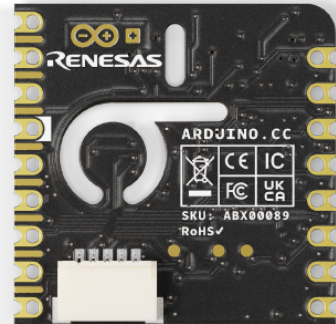


Product Reference Manual
SKU: ABX00089



Description

Start sensing the world around you with Nicla Sense Env. The board combines three state-of-the-art sensors from Renesas® with the simplicity of integration and scalability of the Arduino ecosystem. Expand your Portenta, MKR, or Nano projects by adding a Nicla Sense Env. In addition to its ultra-low power temperature and humidity sensor, it integrates two state-of-the-art, industrial-grade gas sensors, able to evaluate air quality in indoor and outdoor environments.

Target Areas:

Industrial automation, building automation, prototyping

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1 Application Examples

The Arduino Nicla Sense Env, when combined with Portenta, MKR, or Nano family boards, provides a versatile solution for various sectors. Below are some application examples that demonstrate its transformative potential:

- **Industrial automation:** The Nicla Sense Env enhances industrial automation by providing precise monitoring and control capabilities, ensuring safety, efficiency, and environmental compliance in various processes.
 - **Heat pump machines:** When combined with a Portenta family board, the Nicla Sense Env can be easily installed into any heat pump to properly monitor air quality, temperature, and humidity, both indoors and outdoors. This allows users to adjust the thermostat, set temperature schedules, and review energy consumption and air quality at any time.
 - **Industrial processes toxic substances detection:** The Nicla Sense Env can be easily implemented in multiple industrial processes to detect the presence of poisonous substances or gas leakages, such as volatile organic compounds (VOCs), hydrocarbons, CO₂, and hydrogen. The data can then be transmitted to the connected Portenta, MKR, or Nano family board to provide real-time alarms.
- **Prototyping:** The Nicla Sense Env offers a ready-to-use solution for developers working on prototypes, integrating various environmental sensors to expedite development.
 - **Ready-to-use environmental monitoring prototyping solution:** The Nicla Sense Env is a valuable tool for Portenta, MKR, and Nano family board developers working on prototypes, integrating ready-to-use sensors such as temperature, humidity, and gas sensors.
- **Building automation:** In building automation, the Nicla Sense Env facilitates the creation of intelligent systems that improve comfort, safety, and energy efficiency.
 - **Climate control systems:** Integrate a Nicla Sense Env into your HVAC, air conditioning, or ventilation system to accurately measure air quality, humidity, and temperature. This ensures compliance with environmental regulations inside your smart building and increases tenant comfort.
 - **Automated air purifier:** With its embedded sensing capabilities, the Nicla Sense Env provides a comprehensive solution for air purifier systems in smart buildings and offices, saving energy and helping to maintain user health and wellness.
 - **Fumes and fire detection:** The effects of fire, smoke, and fumes can be catastrophic in various environments. By incorporating intelligent gas sensors with onboard Artificial Intelligence (AI), the Nicla Sense Env can detect the presence of indoor and outdoor carbon dioxide, notifying authorities for timely intervention.

2 Features

2.1 General Specifications Overview

The Nicla Sense Env is a compact, powerful board for environmental sensing applications. It integrates two advanced state-of-the-art, industrial-grade gas sensors, and the Renesas R7FA2E1A92DNH microcontroller, making it ideal for monitoring air quality, temperature, and humidity in various environments.

The main features are highlighted in the table shown below.

| **Feature** | **Description** |

Feature	Description
Microcontroller	48 MHz, Arm® Cortex® M23 (not accessible or programmable by the user)
Internal Memory	128 kB Flash and 16 kB SRAM
Power Supply	Various options for easily powering the board: Using the power supply of the connected Portenta, MKR, or Nano board and using an external power supply connected through the board's header connector pins (VCC pin)
Analog Peripherals	12-bit ADC (x2)
Digital Peripherals	UART (x1), I2C (x1), SPI (x1)
Onboard Humidity and Temperature Sensor	Renesas HS4001
Onboard Indoor Air Quality Sensor	Renesas ZMOD4410AI1V (total volatile organic compounds, CO ₂ , and indoor air quality)
Onboard Outdoor Air Quality Sensor	Renesas ZMOD4510AI1V (nitrogen dioxide, ozone, and outdoor air quality)
Dimensions	22.86 mm x 22.86 mm
Weight	2 g
Pinout features	Castellated pins allow the board to be SMD soldered on a custom board or carrier

2.2 Included Accessories

- ESLOV cable

2.3 Related Products

- Arduino Portenta H7 (SKU: ABX00042)
- Arduino Portenta H7 Lite (SKU: ABX00045)
- Arduino Portenta H7 Lite Connected (SKU: ABX00046)
- Arduino Portenta C33 (SKU: ABX00074)
- Arduino MKR WiFi 1010 (SKU: ABX00023)
- Arduino MKR WAN 1310 (SKU: MKRWAN1310WANT)
- Arduino MKR ZERO (SKU: ABX00012)
- Arduino MKR NB 1500 (SKU: MKRNB1500WANT)

3 Ratings

3.1 Recommended Operating Conditions

The table below provides a comprehensive guideline for the optimal use of the Nicla Sense Env, outlining typical operating conditions and design limits. The operating conditions of the Nicla Sense Env are largely based on the specifications of its components.

Parameter	Symbol	Min	Typ	Max	Unit
Supply Input Voltage ¹	V_{IN}	-	3.3	-	V
ESLOV Input Voltage	VESLOV	-	5.0	-	V
Operating Temperature	T_{OP}	-40	-	85	°C

¹ Nicla Sense Env powered through the VCC pin (+3.3 VDC).

3.2 Power Consumption

The table below summarizes the power consumption of the Nicla Sense Env in different test cases. Notice that the board's operating current will depend greatly on the application.

Parameter	Symbol	Min	Typ	Max	Unit
Typical Mode Current Consumption ²	I_{NM}	-	TBD	-	mA
Low Power Mode Current Consumption ³	I_{LP}	-	TBD	-	mA
Deep Sleep Mode Current Consumption ⁴	I_{DS}	-	TBD	-	mA

² Nicla Sense Env powered through the power supply (+3.3 VDC) of a Portenta C33 board.

³ Nicla Sense Env powered through the power supply (+3.3 VDC) of a Portenta C33 board.

⁴ Nicla Sense Env powered through the power supply (+3.3 VDC) of a Portenta C33 board.

To put the Nicla Sense Env in **deep sleep mode**, use the API provided by the **Nicla Sense Env Arduino library**.

4 Functional Overview

The core of the Nicla Sense Env is the R7FA2E1A92DNH microcontroller from Renesas. The board also contains several sensors and user-programmable LEDs connected to its microcontroller, such as a relative humidity and temperature sensor, indoor and outdoor air quality sensors, and two LEDs, one orange and one RGB LED, available for the user.

4.1 Pinout

The Nicla Sense Env connectors pinout is shown in the figure below.

TBD

4.2 Block Diagram

An overview of the high-level architecture of the Nicla Sense Env is illustrated in the figure below.

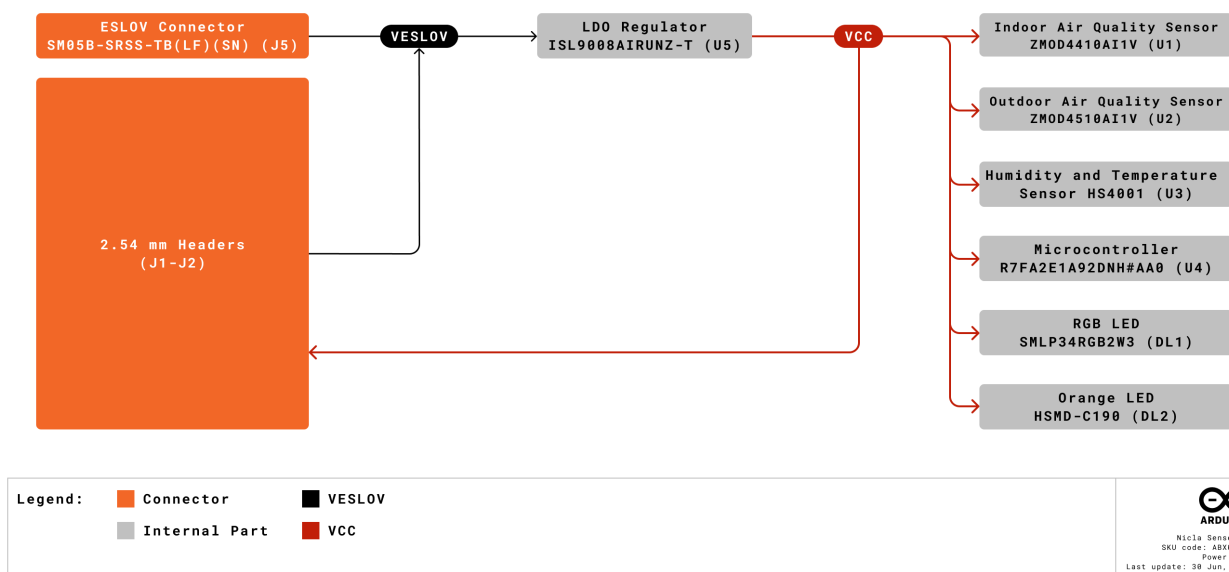
TBD

4.3 Power Supply

The Nicla Sense Env can be powered through one of the following interfaces:

- **ESLOV connector:** The Nicla Sense Env can be powered through the power supply of a connected Portenta or MKR family board by using the ESLOV connector.
- **External +3.3 VDC power supply:** This can be connected to the VCC pin of the board's header connector.

A detailed figure below illustrates the power options available on the Nicla Sense Env and the main system power architecture.



Low-Power Tip: Use the API provided by the **Nicla Sense Env Arduino library** to put the board into low-power and deep sleep mode.

Safety Note: If you power your Nicla Sense Env board through its VCC pin, notice that the **only** operating input voltage is +3.3 VDC; any other voltage will permanently damage the board.

5 Device Operation

5.1 Getting Started - IDE

If you want to program your Nicla Sense Env offline with a Portenta, MKR, or Nano family board, install the Arduino Desktop IDE **[1]**. You will need a USB cable to connect the Portenta, MKR, or Nano board to your computer.

5.2 Getting Started - Arduino Web Editor

All Arduino devices work out of the box on the Arduino CCloud Editor **[2]** by installing a simple plugin. The Arduino Cloud Editor is hosted online. Therefore, it will always be up-to-date with all the latest features and support for all boards and devices. Follow **[3]** to start coding on the browser and upload your sketches onto your device.

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. Take a look at the official documentation to know more.

5.4 Sample Sketches

Sample sketches for the Nicla Sense Env can be found either in the “Examples” menu in the Arduino IDE or the “Nicla Sense Env Documentation” section of Arduino documentation **[4]**.

5.5 Online Resources

Now that you have gone through the basics of what you can do with the device, you can explore the endless possibilities it provides by checking exciting projects on Arduino Project Hub **[5]**, the Arduino Library Reference **[6]**, and the online store **[7]** where you will be able to complement your Nicla Sense Env board with additional extensions, sensors, and actuators.

6 Mechanical Information

The Nicla Sense Env is a double-sided 28.86 mm x 28.86 mm board with an ESLOV connector overhanging the bottom edge and dual castellated/through-hole pins around two of the four edges of the board.

6.1 Board Dimensions

The Nicla Sense Env board outline is shown in the figure below; all the dimensions are in mm.

The Nicla Sense Env does not have mounting holes for mechanical fixing. The slots found in the board were placed because of the board's sensor requirements and specifications.

6.2 Board Connectors

The ESLOV connector of the Nicla Sense Env is placed on the bottom side of the board; its placement is shown in the figure below; all the dimensions are in mm.

The Nicla Sense Env was designed to be usable as a surface-mount module and presents a dual inline package (DIP) format with the MKR-styled header connectors on a 2.54 mm pitch grid with 1 mm holes.

6.3 Board Peripherals and Actuators

The Nano Matter has one reset button and two LEDs, an orange and an RGB LED, available for the user; the reset button and the orange and RGB LED are placed on the top side of the board. Their placement is shown in the figure below; all the dimensions are in mm.

7 Product Compliance

7.1 Product Compliance Summary

Product Compliance
CE (European Union)
RoHS
REACH
WEEE
FCC (USA)
IC (Canada)
UKCA (UK)
Matter®
Bluetooth®

7.2 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).

7.3 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.

7.4 Conflict Minerals Declaration

As a global supplier of electronic and electrical components, Arduino is aware of our obligations concerning 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 a minimum distance of 20 cm between the radiator and your body.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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 a minimum distance of 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.

9 Company Information

Company name	Arduino S.r.l.
Company address	Via Andrea Appiani, 25 - 20900 MONZA (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 - Getting started	https://docs.arduino.cc/arduino-cloud/getting-started/iot-cloud-getting-started
Nano Matter Documentation	https://docs.arduino.cc/hardware/nicla-sense-env
Project Hub	https://create.arduino.cc/projecthub?by=part&part_id=11332&sort=trending
Library Reference	https://www.arduino.cc/reference/en/
Online Store	https://store.arduino.cc/

11 Document Revision History

Date	Revision	Changes
02/07/2024	1	First release