

Description

The Arduino GIGA R1 WiFi brings the power of the STM32H7 to the Mega form factor, being the first Mega board to include onboard Wi-Fi® and Bluetooth® connectivity. The board provides 76 digital inputs/outputs (13 with PWM capability), 14 analog inputs and 2 analog outputs (DAC) all easily accessible via pin headers. The STM32 microprocessor with dual-core Cortex® M7 and Cortex® M4, together with onboard memory and audio jack enables you to perform machine learning and signal processing on the edge.

Target Areas

3D printing, Signal Processing, Maker, Robotics



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1 Application Examples

The GIGA R1 WiFi combines the best of the Portenta H7 and the Mega 2560. A generous amount of I/O easily accessible via pins allows for easy and fast testing of new ideas and solutions. The STM32H7 has ample power to handle machine-learning tasks. Your IoT projects can even benefit from the Arduino Cloud with the help of the onboard secure element and its wireless connectivity.

- **3D Printing:** The Mega form factor has been very popular for creating 3D printers. Connect sensors to the high-resolution ADC interfaces for high-performance sensing of the 3D printing process. Together with the dual-core computing power, controls the printing process like never before. Monitor filament usage and print status locally over Bluetooth® or from anywhere in the world with the Arduino Cloud, or any other third-party service, and its Wi-Fi® features.
- **Audio Processing:** The GIGA R1 WiFi provides a 3.5 mm audio input/output to easily interact with audio signals in the environment. Analyse and create audio signals directly on the board. Connect a microphone and control a wide range of digital and analog devices. Create your own musical instrument and change the note through the various inputs. Create an online concert with the Arduino Cloud or any other third-party service and connect with people all over the world.
- **Data acquisition device:** Thanks to the numerous analog inputs, including the jack connector (J15) and the two DAC outputs with a resolution of up to 12 bits, you can create your own data acquisition device. Make your own multimeter or even an oscilloscope and create an online dashboard with the Arduino Cloud or any other third-party service. Design your own electrochemical experiments, apply custom current/voltage waveforms and check the status of your experiment from the comfort of your home.

2 Features

2.1 General Specifications Overview

The Portenta C33 is a powerful microcontroller board designed for low-cost IoT applications. Based on the high-performance R7FA6M5BH2CBG microcontroller from Renesas®, it offers a range of key features and a low-power design that make it well-suited for a variety of applications. The board has been designed with the same form factor as the Portenta H7 and is backward compatible, making it fully compatible with all Portenta family shields and carriers through its MKR-styled and high-density connectors. The following table summarizes the board's main features.

Feature	Description
Microcontroller	Dual-core STM32H747XIH6 32-bit Arm® Cortex®-M7 and 32-bit Arm® 32-bit Cortex®-M4
Memory	STM32H747XI 2 MB Flash / 1 MB RAM
Digital Inputs	Digital Inputs 5 V compatible (x76)
Analog Inputs	Analog inputs with a voltage range of 3,3.8 V (x12)
PWM Pins	PWM Pins with 8 bits resolution (x13)
Secure Element	ATECC608A-MAHDA-T Module (x1)
Communication	UART (x4), I2C (x3), SPI (x2), CAN (external transceiver required) (x1)



Feature	Description
Camera	20 pin Arducam camera connector
Display	D1N, D0N, D1P, D0P, CKN, CKP, D68-D75
Audio	3-pins Audio Jack Connector
Power	Input voltage (VIN): 6-24 V / DC Current per I/O Pin: 8 mA
Dimensions	114 mm x 86.5 mm
Weight	67 g
Operating Temperature	-40 °C to +85 °C
Certifications	CE, FCC, IC, RoHS, REACH, UKCA, WEEE, Japan (No Radio)

2.2 Microcontroller

Component	Details
ST STM32H747XI Processor	Dual-core Arm® Cortex®-M7 core at up to 480 MHz + Arm® 32-bit Cortex®-M4 core at up to 240 MHz
Flash Memory	2 MB of Flash Memory with read-while-write support
Programming Memory	1 MB of RAM

2.3 Inputs

Characteristics	Details
Number of inputs	8x Analog/Digital inputs
Inputs overvoltage protection	yes
Antipolarity protection	yes
Input impedance	8.9 kΩ

2.4 Outputs

Characteristics	Details
Number of outputs	4x relays (NO)
Max current per relay	10 A
Max peak current per relay	15 A
Continuous current per terminal	10 A
Short-circuit protection	No, external fuse required
Relay rated voltage	250 VAC
Relay Max voltage	400 VAC
Rated load AC1	2500 VA
Rated load AC15 (230 VAC)	500 VA
Breaking capacity DC1: 24/30/110/220V	10/4/0.3/0.12 A
Minimum switching load	300 mW (5 V/5 mA)
Max output line length (unshielded)	100 m
Relay response time from state 0 to 1	6 ms for relay output
Relay response time from state 1 to 0	4 ms for relay output
Bounce time NO	3 ms
Bounce time NC	6 ms



Characteristics	Details
Relay mechanical durability	10 million cycles
Relay electrical durability	10 thousand cycles with a resistive load of 10 A

2.5 Communication

Interfaces	Type	Protocols/Technologies supported
Ethernet	10/100BASE-T Port	TCP/IP, MODBUS TCP
RS-485	Half-duplex without termination resistance	MODBUS RTU, Custom serial communication
Wireless connectivity	Wi-Fi®	2.4 GHz
Wireless connectivity	Bluetooth® Low Energy	4.2 supported by firmware, 5.1 supported by hardware

2.6 Security

Component	Details
ATECC608B Crypto Microchip®	Cryptographic co-processor with secure hardware-based key storage
	Protected storage for up to 16 Keys, certificates, or data
	Networking key management support
	Secure boot support
	Guaranteed unique 72-bit serial number

3 Accessories (<included / not included>)

- Micro UFL antenna (Included)
- USB-C® cable (Not included)
- USB 2.0 Type-A cable (Not included)



4 Related Products

- Arduino Mega Proto Shield Rev3 (A000080)
- Arduino 4 Relays Shield (A000110)
- Arduino Motor Shield Rev3 (A000079)

5 Rating

5.1 Recommended Operating Conditions

Description	Value
Temperature Operating Range	-20...50 °C
Protection degree rating	IP20
Pollution degree	2 conforming to IEC 61010

Note: V_{DD} controls the logic level and is connected to the 3.3V power rail. V_{AREF} is for the analog logic.

5.2 Power Specification

Property	Min	Typ	Max	Unit
Supply voltage	12	-	24	V
Permissible range	10.2	-	27.6	V
Power consumption (12V)	0.6	-	2	W
Power consumption (24V)	0.6	-	2.2	W

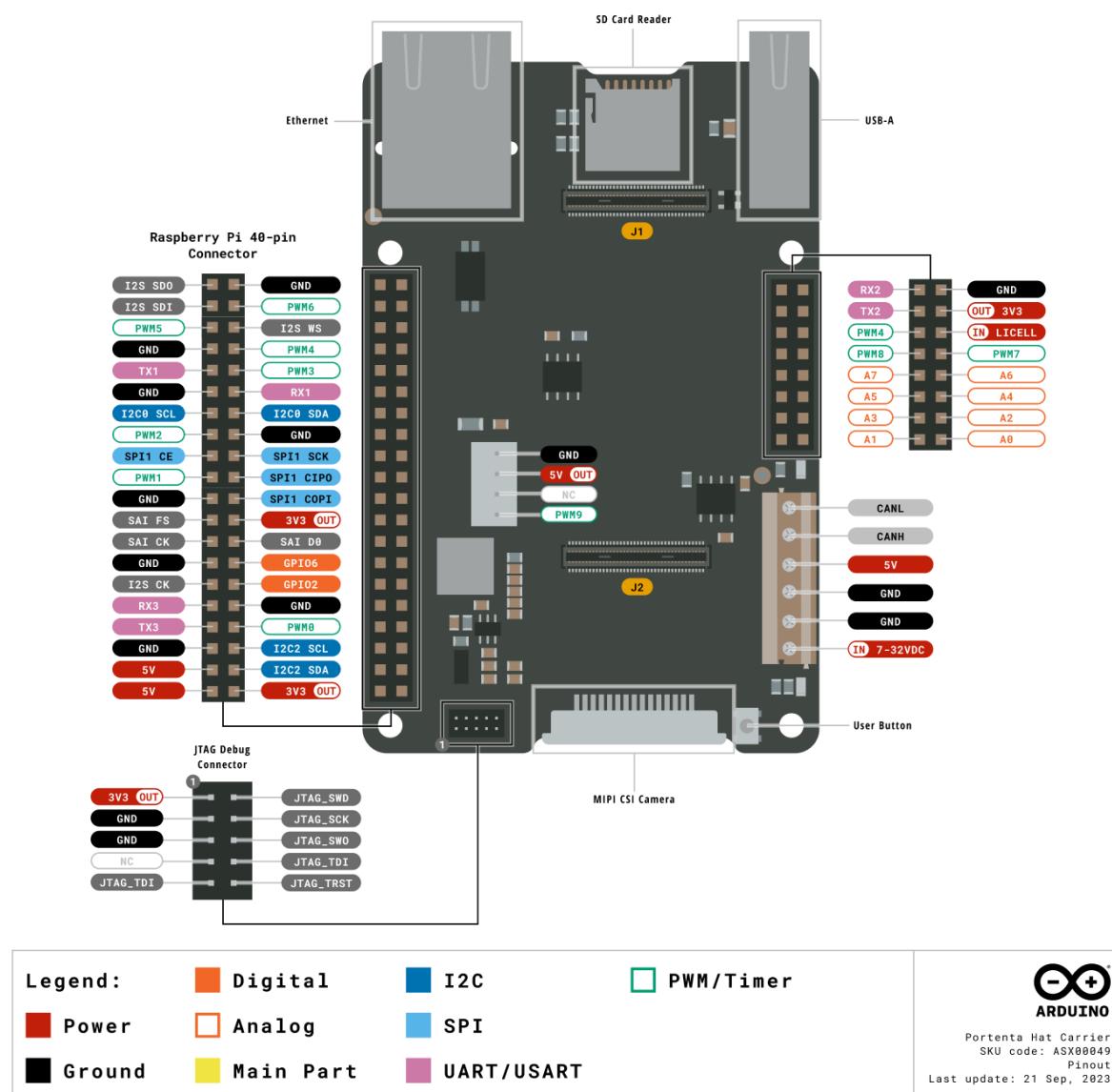
5.3 Current Consumption

Parameter	Symbol	Min	Typ	Max	Unit
Deep Sleep Mode Current Consumption ¹	I _{DS}	-	86	-	µA
Normal Mode Current Consumption ²	I _{NM}	-	180	-	mA

6 Functional Overview

6.1 Pinout

The Portenta Hat Carrier pinout is shown in the following figure.



Portenta Hat Carrier pinout

Safety Note: Disconnect power before board modifications. Avoid short-circuiting. Refer to the full guide for more safety tips.



6.2 Full Pinout Table

The full pinout of the Portenta Hat Carrier is available in the following tables sorted by element/connector.

6.2.1 16-Pin Header (J6)

Pin number	Silkscreen	Power Net	Portenta HD Standard Pin	High-Density Pin	Interface
1	A0		ANALOG_A0	J2-73	
2	A1		ANALOG_A1	J2-75	
3	A2		ANALOG_A2	J2-77	
4	A3		ANALOG_A3	J2-79	
5	A4		ANALOG_A4	J2-74	
6	A5		ANALOG_A5	J2-76	
7	A6		ANALOG_A6	J2-78	
8	A7		ANALOG_A7	J2-80	
9	PWM7		PWM_7	J2-64	
10	PWM8		PWM_8	J2-66	
11	LICELL		LICELL	J2-7	RTC Power Source
12	PWM4		GPIO_0	J2-46	
13	3V3	+3V3_PORTENTA	VCC	J2-23, J2-34, J2-43, J2-69	
14	TX2		SERIAL2_TX	J2-26	UART 2 TX
15	GND	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
16	RX2		SERIAL2_RX	J2-28	UART 2 RX

Table 6: 16-Pin Header (J6) pinout



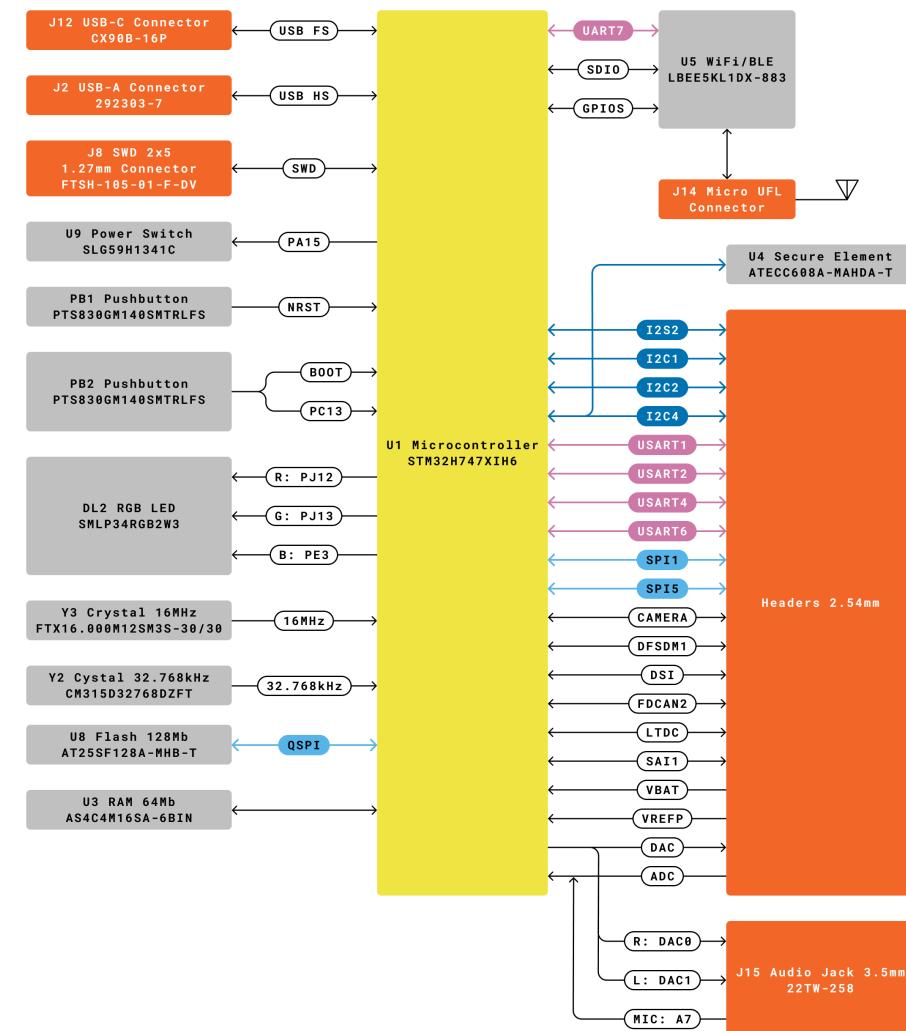
6.2.2 Power Block CAN Bus (J9)

Pin number	Silkscreen	Power Net	Portenta HD Standard Pin	High-Density Pin	Interface
1	VIN 7-32VDC	INPUT_7V-32V			
2	GND	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
3	GND	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
4	5V	+5V	VIN	J1-21, J1-24, J1-32, J1-41, J1-48	
5	CANH			J1-49 (Through U1)	CAN BUS - CANH
6	CANL			J1-51 (Through U1)	CAN BUS - CANL

Table 7: Power Block CAN Bus (J9) pinout

6.3 Block Diagram

The block diagram with the main parts of the product can be checked in the following image:



Legend:	Connector	I2C/I2S	Other SERIAL
Main Part		SPI	
Internal Part			UART/USART

GIGA R1 WiFi
 SKU code: ABX00053
 Block Diagram
 Last update: 3 Nov, 2022

Arduino GIGA R1 WiFi Block Diagram

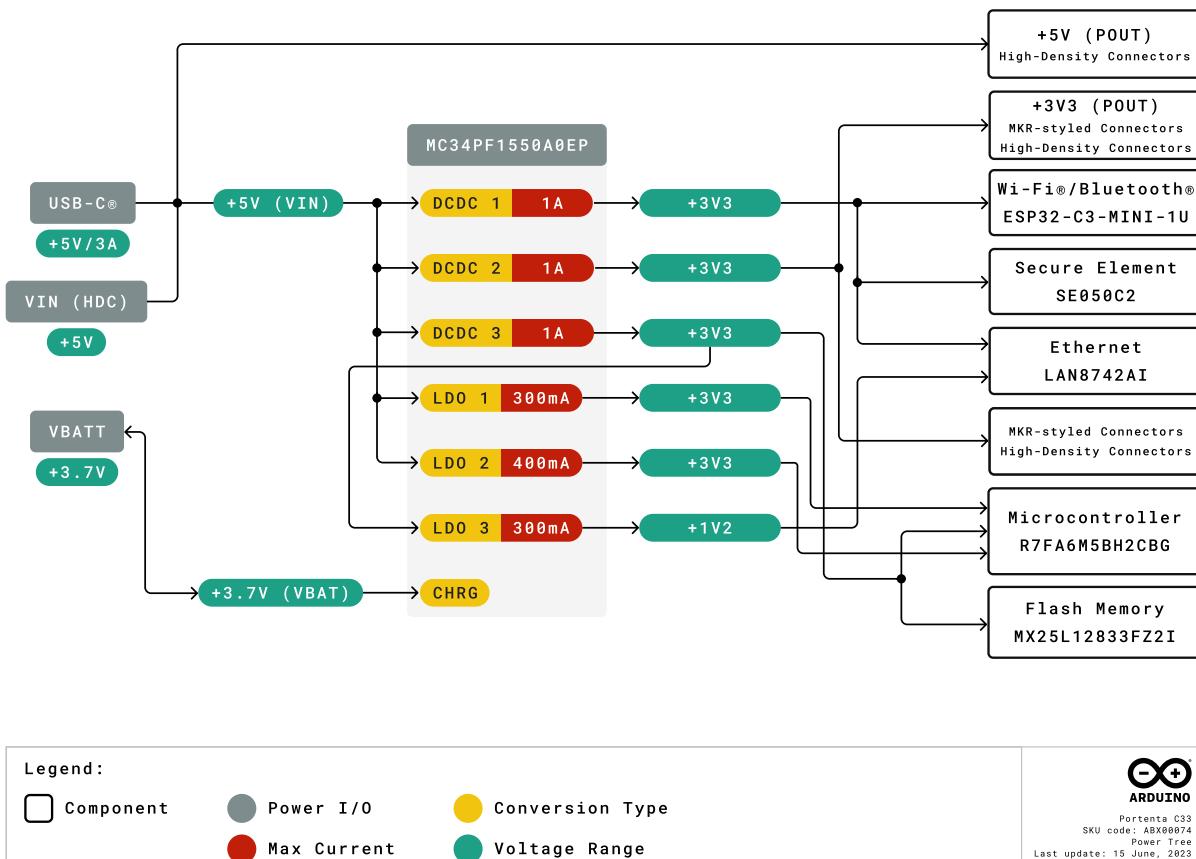
6.4 Power Supply

The Portenta C33 can be powered through one of these interfaces:

- USB-C® port
- 3.7 V single-cell lithium-ion/lithium-polymer battery, connected through the onboard battery connector
- External 5 V power supply connected through the MKR-styled pins

The recommended minimum battery capacity is 700 mAh. The battery is connected to the board via a disconnectable crimp-style connector as shown in Figure 3. The battery connector part number is BM03B-ACHSS-GAN-TF(LF)(SN).

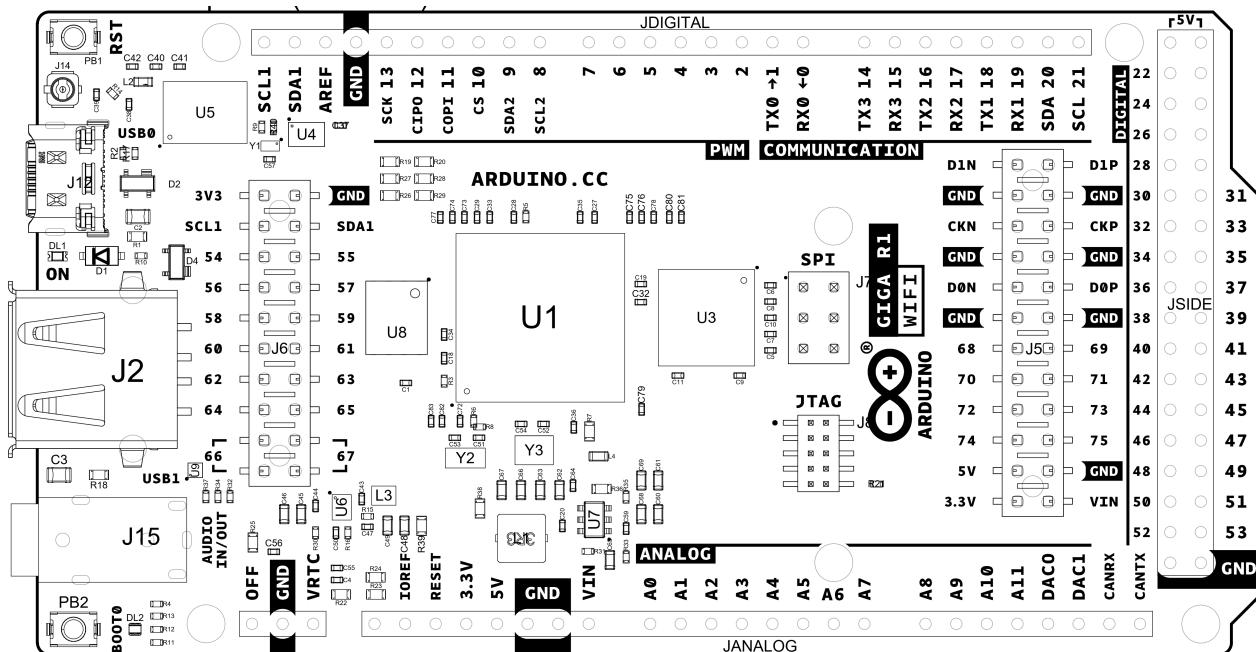
The following diagram shows the power options available on the Portenta C33 and illustrates the main system power architecture.



Power architecture of the Portenta C33



6.5 Product Topology

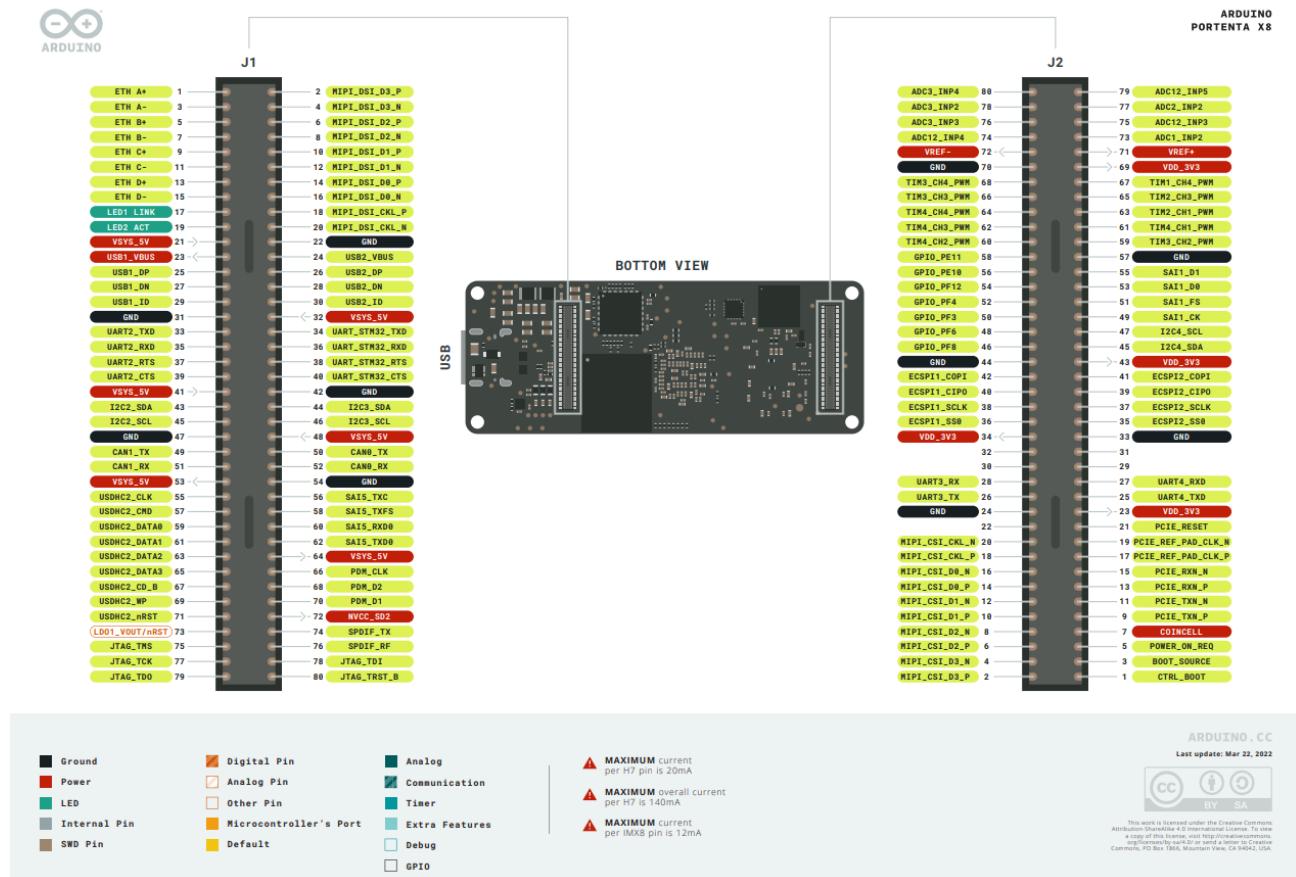


Top View of Arduino GIGA R1 WiFi

Ref.	Description	Ref.	Description
U1	STM32H7 Dual Core Microcontroller IC	U8	AT25SF128A-MHB-T 16 MB Flash IC
U3	AS4C4M16SA 8MB SDRAM IC	U4	ATECC608A-MAHDA-T Secure Element IC
U5	LBEE5KL1DX-883 Wi-Fi®/Bluetooth® Module	U6	MP2322GQH Buck Converter 3.3V IC
U7	MP2269GD-Z Buck Converter 5V IC	JANALOG	Analog input/output headers
JDIGITAL	Digital input/output headers	JSIDE	Digital input/output headers
SPI	SPI headers	JTAG	JTAG Headers
J2	USB 2.0 A Host	J15	3.5 mm audio in/out
PB1	RESET Button	PB2	BOOT0 button
J14	Micro UFL connector	J5	Camera
J6	Camera	DL1	Power LED
DL2	RGB SMLP34RGB2W3 Common anode LED	J12	CX90B-16P USB-C® connector

6.5.1 High-Density Connectors (J1-J2)

The High-Density connectors (J1-J2) provide connectivity with the Portenta family boards. For detailed information, refer to the Portenta Hat Carrier pinout and the respective documentation for the Portenta family boards. In the following image, the Portenta X8 board High-Density connectors pinout is shown as an example.



Portenta X8 High-Density connectors pinout

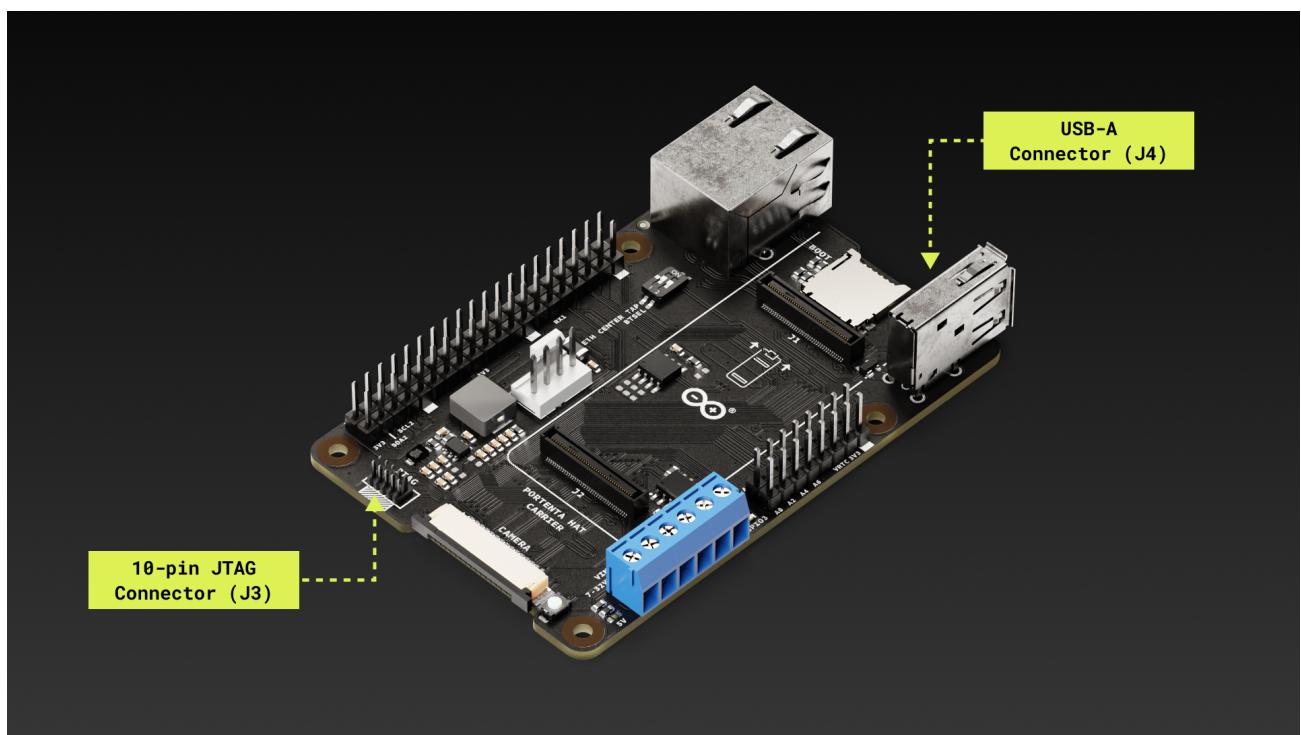
6.5.2 JTAG Connector (J3)

Debugging capabilities are integrated directly into the Portenta Hat Carrier and are accessible via the 10-pin JTAG connector (J3) shown in Figure 7.

6.5.3 USB-A (J4)

The onboard USB-A connector (female), shown in Figure 7, is integrated into the Portenta Hat Carrier for multiple purposes, including:

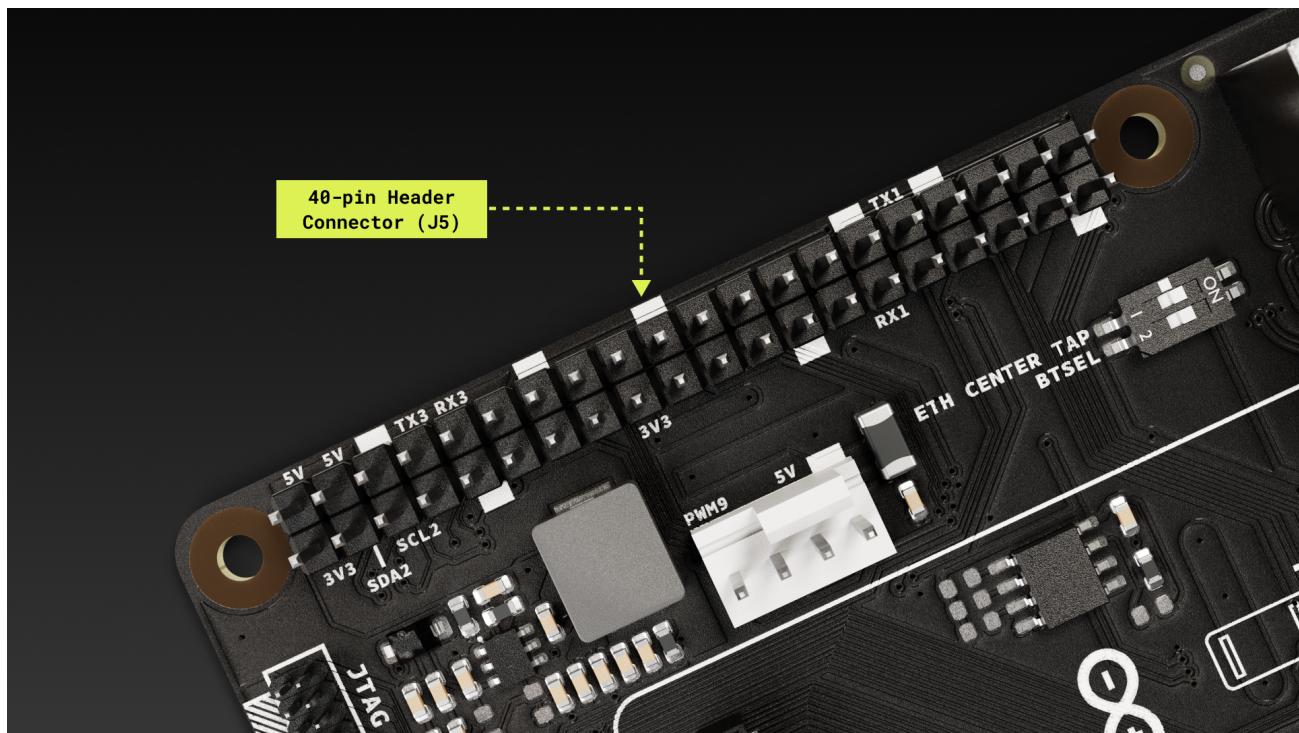
- Connecting external peripherals such as mouse devices, keyboards, USB cameras, hubs, and hard drives.
- Data logging using a USB memory stick.



JTAG and USB-A connectors of the Portenta Hat Carrier

6.5.4 40-Pin Header Connector (J5)

The Portenta Hat Carrier features a 40-pin header connector as shown in Figure 8, making it compatible with most of the Raspberry Pi® Hats available on the market.



Raspberry Pi®-compatible 40-pin header connector

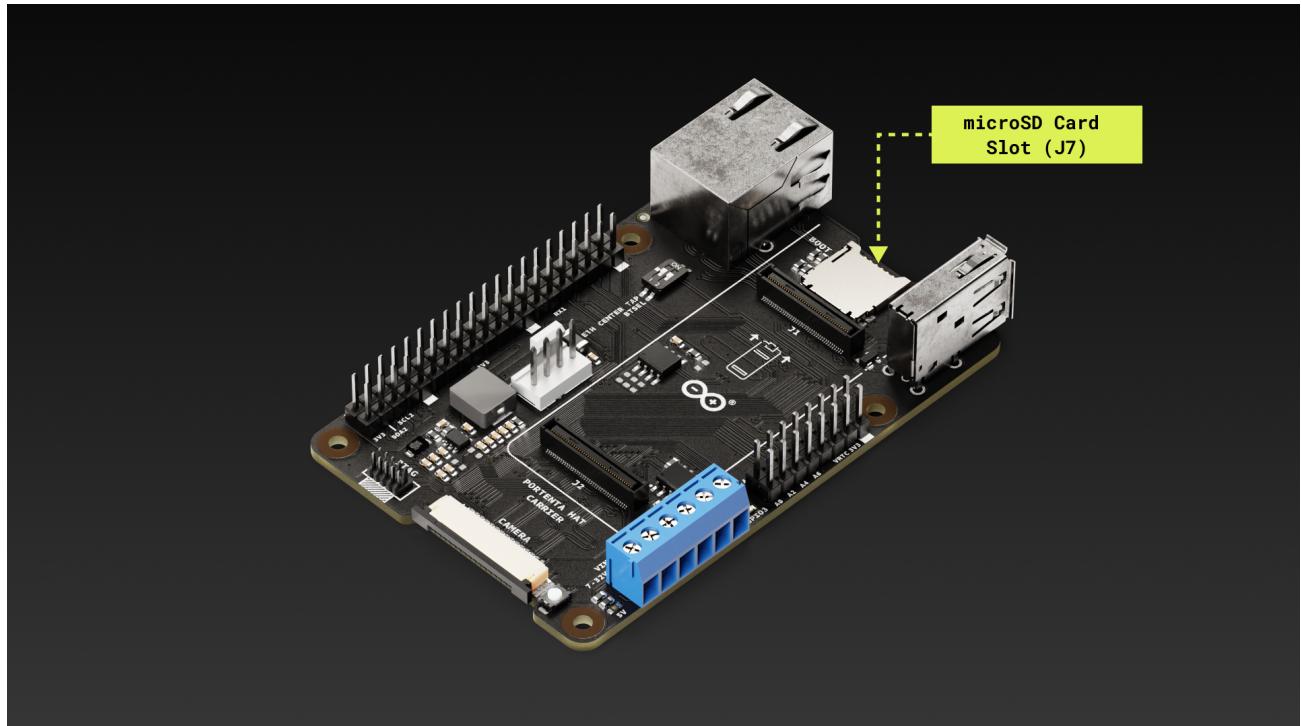
The main interfaces and general-purpose pins available through this connector include:

- SPI (x1)
- I2S (x1)
- SAI (x1)
- 5 VDC (x2)
- 3.3 VDC (x2)
- I2C (x2)
- UART (without flow control) (x2)
- PWM (x7)
- GND (x8)
- GPIO (x26)

6.5.5 MicroSD Card Slot (J7)

The onboard microSD card slot can be used for:

- Data logging operations
- Media purposes



MicroSD card slot of the Portenta HAT Carrier



7 Device Operation

7.1 Getting Started – IDE

If you want to program your while offline you need to install the Arduino® Desktop IDE [1]. To connect the to your computer, you will need a cable, which can also provide power to the board, as indicated by the LED (DL1).

7.2 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.

7.3 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.

7.4 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 [4], the Arduino Library Reference [5], and the online store [6]; where you will be able to complement your board with sensors, actuators and more.

7.5 Board Recovery

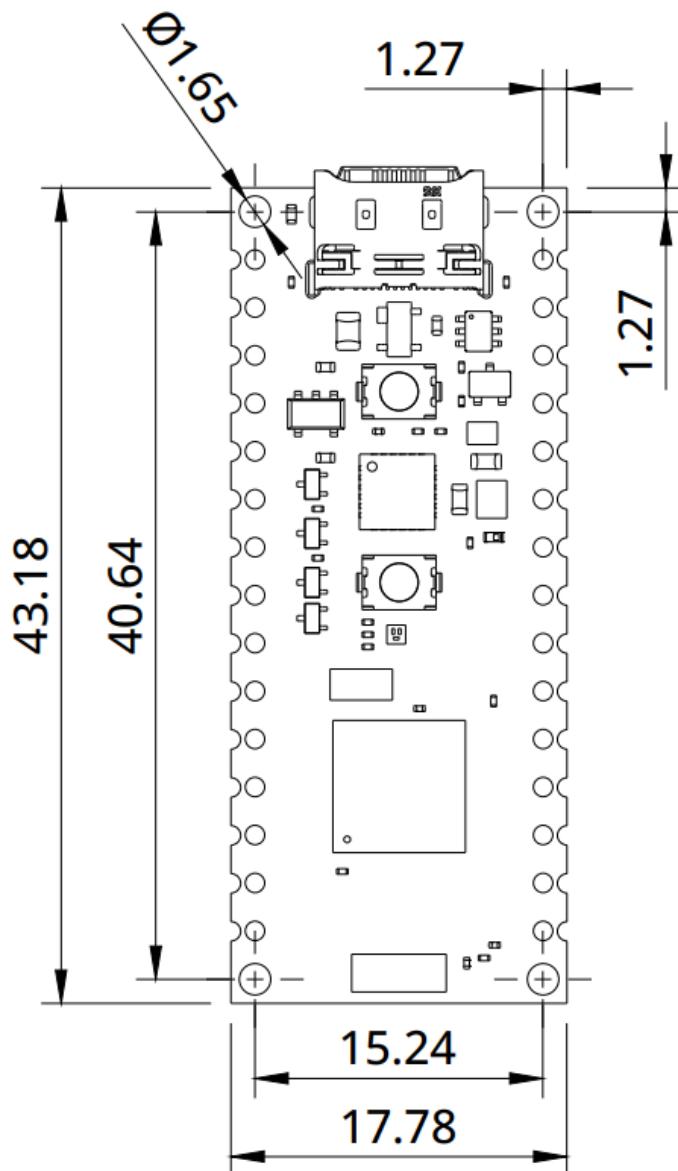
All Arduino boards have a built-in bootloader which allows flashing the board via USB. In case a sketch locks up the processor and the board is not reachable anymore via USB, it is possible to enter bootloader mode by double-tapping the reset button right after the power-up.

8 Mechanical Information

The Nano Matter is a double-sided 18 mm x 45 mm board with a USB-C® port overhanging the top edge and dual castellated/through-hole pins around the two long edges; the onboard wireless antenna is located in the center of the bottom edge of the board.

8.1 Board Dimensions

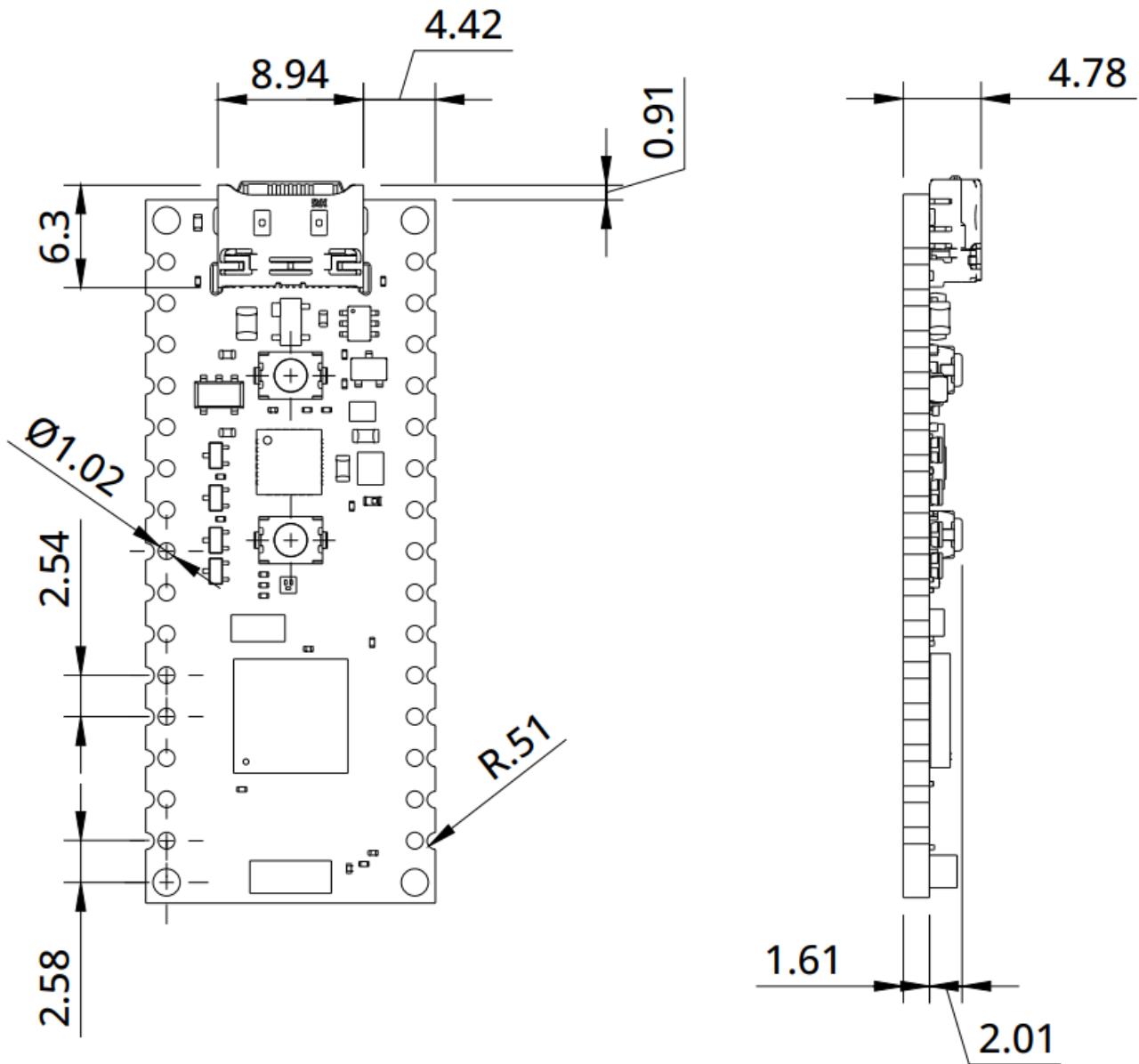
The Nano Matter board outline and mounting holes dimensions are shown in the figure below; all the dimensions are in mm.



The Nano Matter has four 1.65 mm drilled mounting holes for mechanical fixing.

8.2 Board Connectors

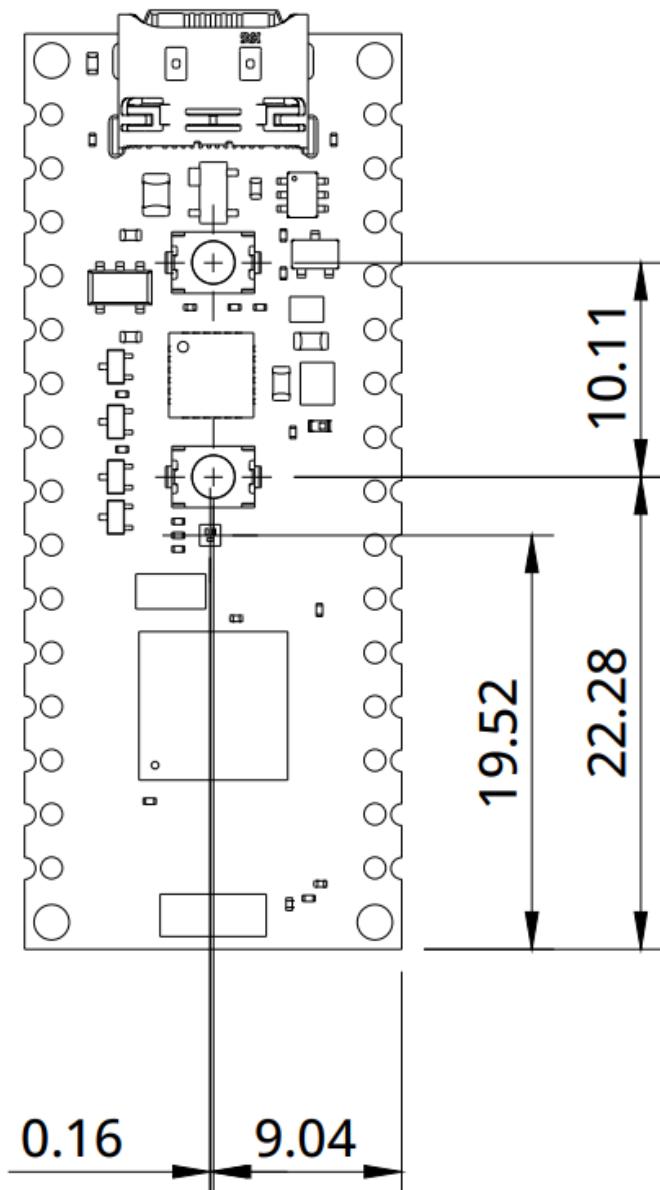
Connectors of the Nano Matter are placed on the top side of the board; their placement is shown in the figure below; all the dimensions are in mm.



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

8.3 Board Peripherals and Actuators

The Nano Matter has one push button and one RGB LED available for the user; both the push button and the 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.



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



9 Certifications

9.1 Certifications Summary

Certification	Status
CE/RED (Europe)	Yes
UKCA (UK)	Yes
FCC (USA)	Yes
IC (Canada)	Yes
MIC/Telec (Japan)	Yes
RCM (Australia)	Yes
RoHS	Yes
REACH	Yes
WEEE	Yes

9.2 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).

9.3 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
-----	-----
02/11/2023	2
25/10/2023	1
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.

9.4 Conflict Minerals Declaration

As a global supplier of electronic and electrical components, Arduino is aware of our obligations with regard 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.

9.5 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 & 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 n'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.

Company Information

Company name	Arduino SRL
Company Address	Via Andrea Appiani, 25 - 20900 MONZA (Italy)

Reference Documentation

Ref	Link
Arduino IDE (Desktop)	https://www.arduino.cc/en/Main/Software
Arduino IDE (Cloud)	https://create.arduino.cc/editor
Cloud IDE Getting Started	https://docs.arduino.cc/cloud/web-editor/tutorials/getting-started/getting-started-web-editor
Project Hub	https://create.arduino.cc/projecthub?by=part&part_id=11332&sort=trending
Library Reference	https://github.com/arduino-libraries/
Online Store	https://store.arduino.cc/



10 Revision History

Date	Revision	Changes
23/01/2024	7	Updated Interfaces section
14/12/2023	6	Updated Related Product section
14/11/2023	5	FCC and Block Diagram Updates
30/10/2023	4	I2C ports information section added
20/06/2023	3	Power tree added, related products information updated
09/06/2023	2	Board's power consumption information added
14/03/2023	1	First release