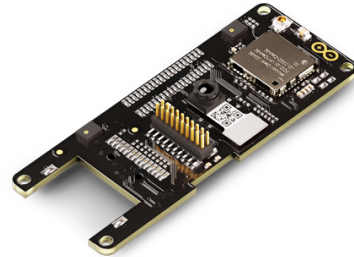Product Reference Manual
SKU: ASX00021-ASX00026

Description

The Arduino Portenta Vision Shield is an add-on board providing machine vision capabilities and additional connectivity to the Portenta family of Arduino boards, designed to meet the needs of industrial automation. The Portenta Vision Shield connects via a high-density connector to the Portenta boards with minimal hardware and software setup.

Target Areas

Industry, Surveillance

Features

Note: This board needs the Arduino Portenta H7 or Portenta C33 to function.

- **Himax HM-01B0 camera module**

    - Ultra-Low-Power Image Sensor designed for always-on vision devices and applications

    - High-sensitivity 3.6 μ BrightSenseTM pixel technology

    - Window, vertical flip and horizontal mirror readout

    - Programmable black level calibration target, frame size, frame rate, exposure, analog gain (up to 8x) and digital gain (up to 4x)

    - Automatic exposure and gain control loop with support for 50 Hz / 60 Hz flicker avoidance

    - Motion Detection circuit with programmable ROI and detection threshold with digital output to serve as an interrupt

    - **Supported resolutions**

        - QQVGA (160x120) at 15, 30, 60 and 120 FPS
        - QVGA (320x240) at 15, 30 and 60 FPS

    - **Power**

        - < 1.1 mW QQVGA resolution at 30 FPS,
        - < 2 mW QVGA resolution at 30 FPS

- **2x MP34DT06JTR MEMS PDM Digital Microphone**

    - AOP = 122.5 dB SPL
    - 64 dB signal-to-noise ratio
    - Omnidirectional sensitivity
    - –26 dBFS ± 1 dB sensitivity

- **MIPI 20-pin compatible JTAG Connector**

- **Memory**

    - Micro SD Card Slot

Contents

1 The Board

The included HM-01B0 camera module has been pre-configured to work with the OpenMV libraries provided by Arduino. Based on the specific application requirements, the Portenta Vision Shield is available in two configurations with either Ethernet or LoRa® connectivity. Ethernet is designed for integration of the Portenta into wired networks and providing high bandwidth. In situations requiring long-range operation at low bandwidth, LoRa® connectivity is the way to go. The multi-core processor of the Portenta H7 makes embedded vision possible by minimizing the data bandwidth required.

1.1 Product Variants

The Portenta Vision Shield is available in two variants:

- Ethernet variant (ASX00021)
- LoRa® variant (ASX00026)

1.2 Application Examples

Thanks to the low power consumption of the Portenta Vision Shield, it is well suited for bringing machine learning to a wide range of Industry 4.0 and IoT applications.

- **Industrial production:** The included HM-01B0 camera along with the OpenMV libraries allows for quality control of items within a manufacturing or packaging plant. The small footprint, low power consumption and LoRa®/Ethernet connectivity allow for the module to be deployed essentially anywhere so that defects are identified quickly and removed from the production environment.

- **Predictive maintenance:** The combination of machine vision and machine learning capabilities of the Portenta Vision Shield and the Portenta H7 opens up possibilities for predictive maintenance based on subtle differences in the visual representation of machinery. These capabilities are further enhanced with the two MP34DT05 MEMS microphones included in the Portenta Vision Shield.

- **Surveillance:** The Portenta Vision Shield is able to provide surveillance capabilities in areas with low Wi-Fi® penetration (e.g. warehouses) and large areas (e.g. shopping centers). The OpenMV libraries enable the Portenta Vision Shield to identify objects and alert the operator via LoRa® while saving a snapshot on the microSD storage slot.

1.3 Related Products

The Portenta Vision Shield is developed as an add-on shield compatible with the following Portenta boards:

- Portenta H7 (ABX00042)
- Portenta H7 Lite (ABX00045)
- Portenta H7 Lite Connected (ABX00046)
- Portenta C33 (ABX00074). **Only connectivity. Not compatible with the Portenta Vision Shield camera**

2 Ratings

2.1 Absolute Maximum

Symbol	Description	Min	Typ	Max	Unit
VINMax	Input voltage from HD Connectors	-0.3	-	3.3	V

2.2 Thermal

Symbol	Description	Min	Typ	Max	Unit
TST	Storage Temperature	-30		85	°C
TOP	Operating Temperature	-40		85	°C

3 Functional Overview

3.1 Board Topology
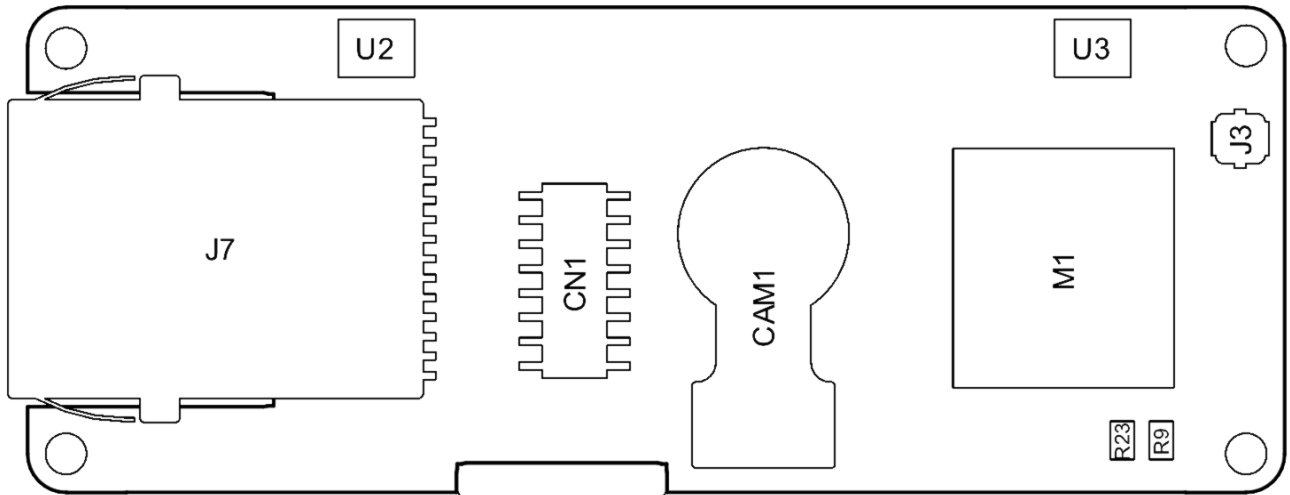
Top view
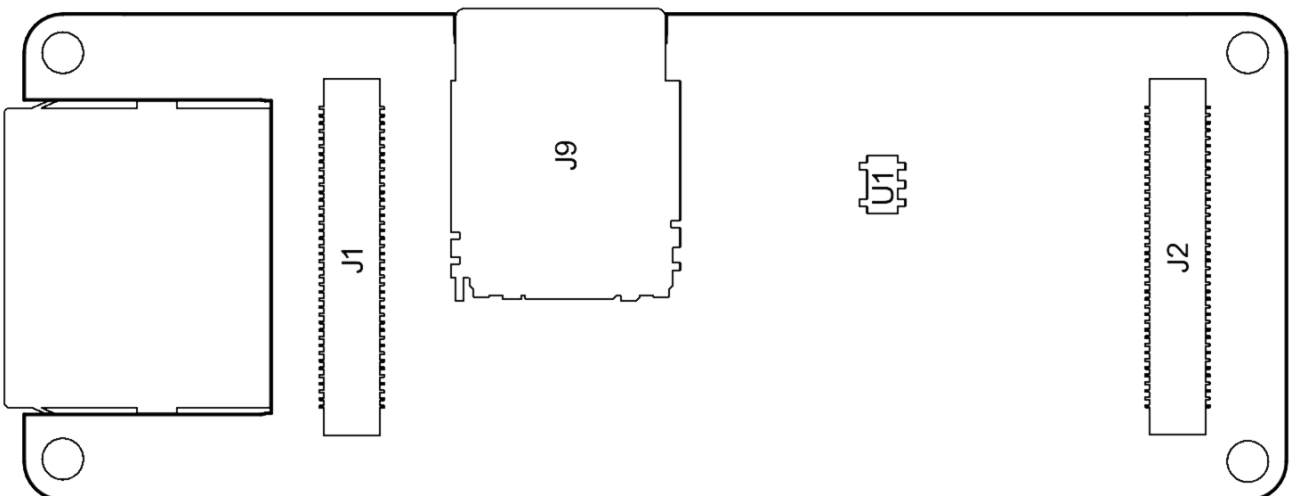
Bottom view

Ref.	Description	Ref.	Description
U1	Voltage Regulator	J3	LoRa® Radio Antenna U.FL Connector (ASX00026 Only)
U2,U3	ST MP34DT06JTR Digital Microphones	J7	Ethernet Connector (ASX00021 Only)
M1	Murata CMWX1ZZABZ LoRa® Module (ASX00026 Only)	J9	Micro SD Card Connector
J1, J2	High-Density Connectors	CN1	JTAG Connector
CAM1	Camera Module Himax HM-01B0		

3.2 Power

The Portenta H7/C33 supplies 3.3 V power to the LoRa® module (ASX00026 only), Ethernet communication (ASX00021 only), Micro SD slot and dual microphones via the 3.3 V output of the high-density connectors. An onboard LDO regulator supplies a 2.8 V output (300 mA) for the camera module.

3.3 Camera Module

The Himax HM-01B0 Module is a very low-power camera with 324x324 resolution and a maximum of 60 FPS depending on the operating mode. Video data is transferred over a configurable 8-bit interconnect with support for frame and line synchronization. The module delivered with the Portenta Vision Shield is the monochrome version. Configuration is achieved via an I2C connection with the compatible Portenta boards microcontrollers.

HM-01B0 offers very low-power image acquisition and provides the possibility to perform motion detection without main processor interaction. The "Always-on" operation provides the ability to turn on the main processor when movement is detected with minimal power consumption.

Note: The Portenta C33 is not compatible with the camera of the Portenta Vision Shield

3.4 Digital Microphones

The dual MP34DT05 digital MEMS microphones are omnidirectional and operate via a capacitive sensing element with a high (64 dB) signal-to-noise ratio. The microphones have been configured to provide separate left and right audio over a single PDM stream.

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

3.5 Micro SD Card Slot

A Micro SD card slot is available under the Portenta Vision Shield board. Available libraries allow reading and writing to FAT16/32 formatted cards.

3.6 Ethernet (ASX00021 Only)

Ethernet connector allows connecting to 10/100 Base TX networks using the Ethernet PHY available on the Portenta board.

3.7 LoRa® Module (ASX00026 Only)

LoRa® connectivity is provided by the Murata CMWX1ZZABZ module. This module contains an STM32L0 processor along with a Semtech SX1276 Radio. The processor is running on Arduino open-source firmware based on Semtech code.

4 Board Operation

4.1 Getting Started — OpenMV

The Portenta Vision Shield and Portenta H7 are supported under OpenMV. In order to easily use OpenMV download the latest OpenMV IDE **[1]** and follow the Portenta Vision Shield official documentation **[2]** to learn how to create OpenMV vision applications.

4.2 Getting Started — IDE

If you want to program your Arduino board while offline you need to install the Arduino Desktop IDE **[3]**. To connect the board to your computer, you will need a USB cable. This also provides power to the board, as indicated by the LED.

4.3 Getting Started — Arduino Cloud Editor (Create)

All Arduino and Genuino boards, including this one, work out-of-the-box on the Arduino Cloud Editor **[4]** 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 **[5]** to start coding on the browser and upload your sketches onto your board.

4.4 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.

4.5 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 ProjectHub **[6]**, the Arduino Library Reference **[7]** and the online store **[8]** where you will be able to complement your board with sensors, actuators and more.

4.6 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 the power-up.

5 Connector Pinouts

5.1 JTAG

Pin	Function	Type	Description
1	VDDIO	Power	Positive Reference voltage for debug interface
2	SWD	I/O	Single Wire Debug Data
3,5,9	GND	Power	Negative reference voltage for debug interface
4	SCK	Output	Single Wire Debug Clock
6	SWO	I/O	Single Wire Debug Trace
10	RESET	Input	CPU Reset
7,11,12,13,14,15,17,18,19,20	NC	Not Connected	

5.2 High-Density Connector

BOTTOM

J1-Female   J2-Female

SWO	79		80		CAM D7	2	1	FORCE_BOOTLOADER
SWCK	77		78		CAM D6	4	3	BOOT_SOURCE
SWDIO	75		76		CAM D5	6	5	POWER_ON_REQ
RESET	73		74		CAM D4	8	7	COINCELL
	71		72	V-SDCARD	CAM D3	10	9	
	69		70		CAM D2	12	11	
	67		68	DMIC D0	CAM D1	14	13	
SDC D3	65		66	DMIC CK	CAM D0	16	15	
SDC D2	63		64	VSYS	CAM VS	18	17	
SDC D1	61		62	I2S D0	CAM CLK	20	19	
SDC D0	59		60	I2S DI	CAM HS	22	21	
SDC CMD	57		58	I2S WS	GND	24	23	VCC/+3V3
SDC CLK	55		56	I2S MCK	UART2 TX	26	25	UART3 TX
VSYS	53		54	GND	UART2 RX	28	27	UART3 RX
CAN1 RX	51		52			30	29	
CAN1 TX	49		50			32	31	
GND	47		48	VIN	VCC	34	33	GND
I2C1 SD6	45		46	I2C0 SCL	SPI1 CS	36	35	
I2C1 SDA	43		44	I2C0 SDA	SPI1 CK	38	37	
VIN	41		42	GND	SPI1 MISO	40	39	
UART1 CTS	39		40	UART0 CTS	SPI1 MOSI	42	41	
UART1 RTS	37		38	UART0 RTS	GND	44	43	VCC/+3V3
UART1 RX	35		36	UART0 RX	GPIO 0	46	45	I2C2 SDA
UART1 TX	33		34	UART0 TX	GPIO 1	48	47	I2C2 SCL
GND	31		32	VIN	GPIO 2	50	49	SAI CK
USB1 ID	29		30		GPIO 3	52	51	SAI FS
USB1 D-	27		28	USB0 D-	GPIO 4	54	53	SAI D0
USB1 D+	25		26	USB0 D+	GPIO 5	56	55	
USB1 VBUS	23		24		GPIO 6	58	57	GND
VIN	21		22	GND	PWM 6	60	59	PWM 1
ETH L2	19		20	DSI CK-	PWM 7	62	61	PWM 2
ETH L1	17		18	DSI CK+	PWM 8	64	63	PWM 3
	15		16	DSI D0-	PWM 9	66	65	PWM 4
	13		14	DSI D0+	PWM 10	68	67	PWM 5
	11		12	DSI D1-	GND	70	69	VCC/+3V3
	9		10	DSI D1+	ADC VREF-	72	71	ADC VREF+
ETH B-	7		8		ADC A4	74	73	ADC A0
ETH B+	5		6		ADC A5	76	75	ADC A1
ETH A-	3		4		ADC A6	78	77	ADC A2
ETH A+	1		2		ADC A7	80	79	ADC A3

■ Ground	■ Internal Pin	▨ Digital Pin	■ Microcontroller's Port
■ Power	■ SWD Pin	▧ Analog Pin	■ High Density Connector
■ LED	□ Other Pin	■ Default	

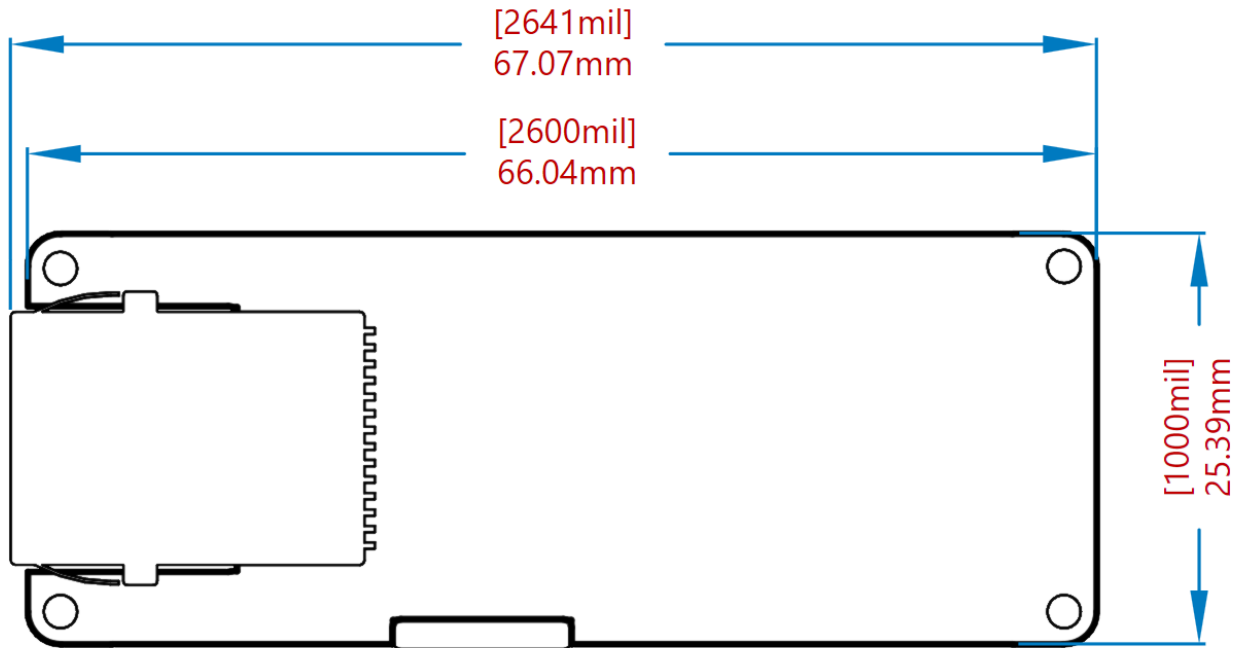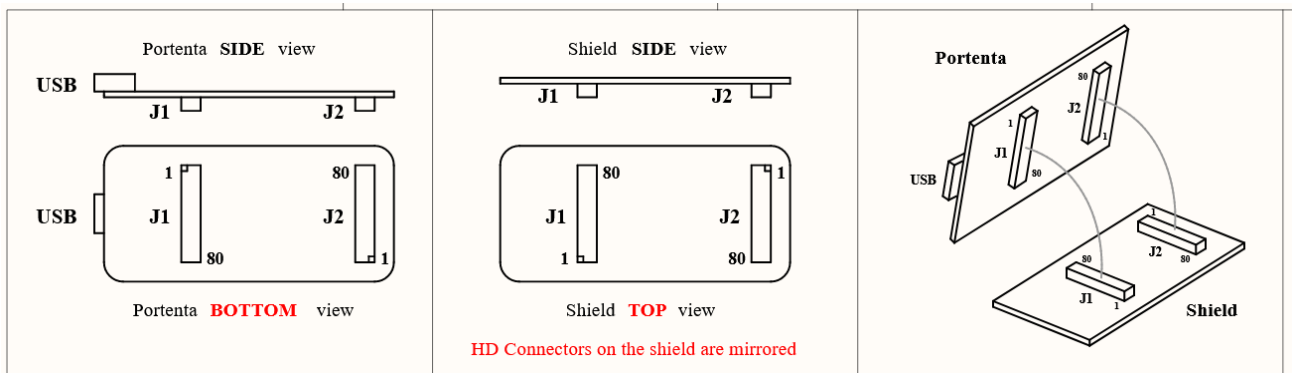*High-density connector pinout*

6 Mechanical Information

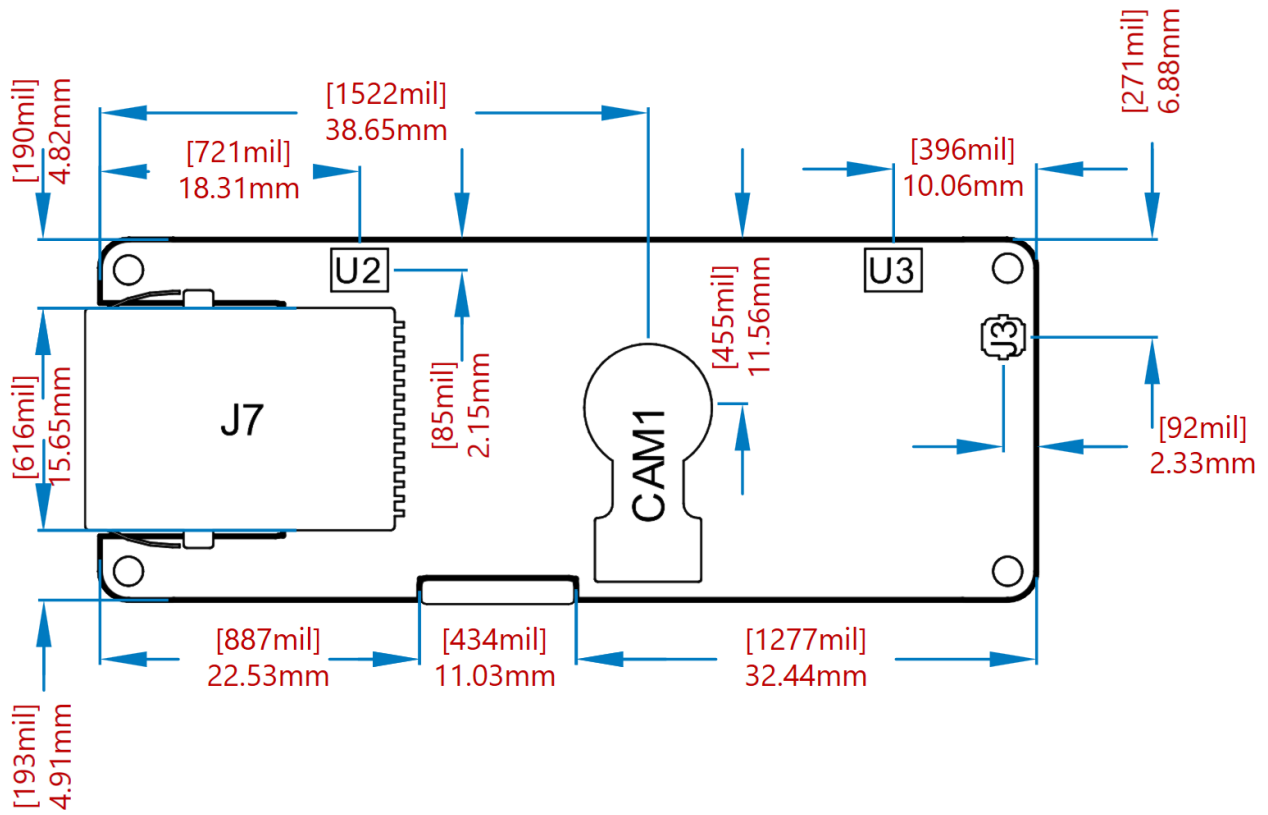## 6.1 Board Outline

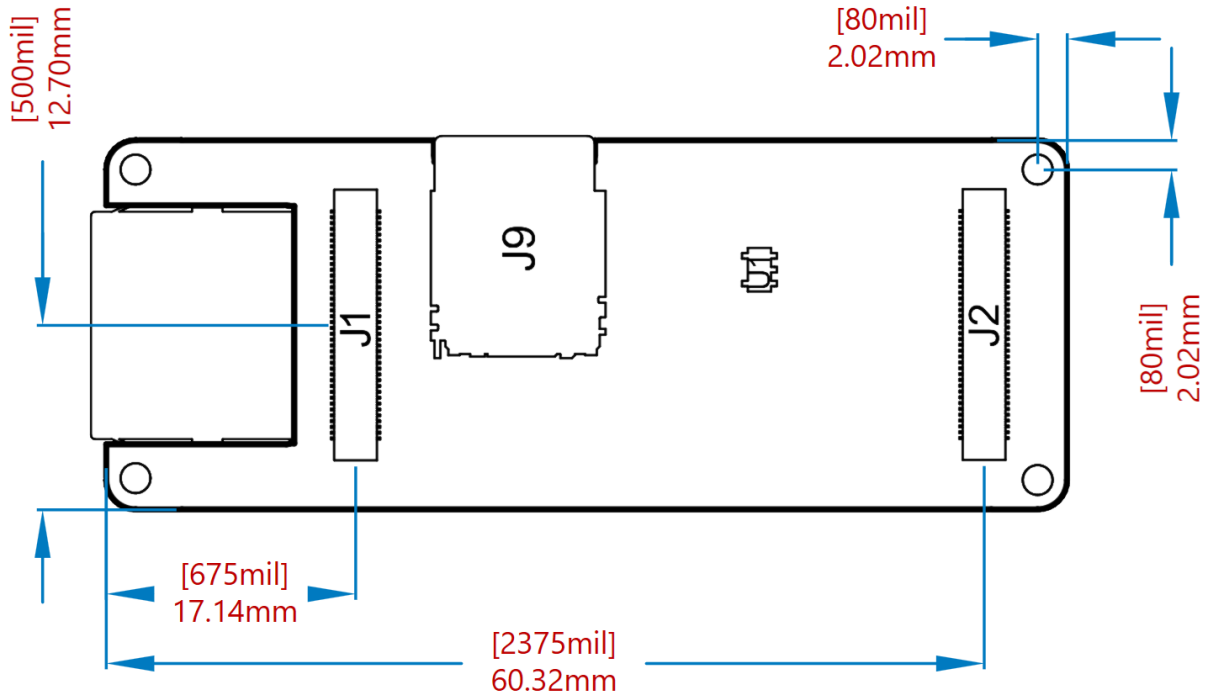*Board dimensions*

6.2 Mounting Instructions

Mounting details

6.3 Connector and Component Positions

Connectors positions TOP

Connectors positions BOTTOM

7 Certifications

7.1 Declaration of Conformity CE/RED 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 191 11/26/2018

Arduino boards are in compliance with Directive 2011/65/EU of the European Parliament and 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, and (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 20 cm between the radiator& your body.

Antenna manufacturer:	Dynaflex
Antenna Model:	2G-3G-4G ADHESIVE MOUNT ANTENNA DIPOLE
Antenna type:	External omnidirectional dipole antenna
Antenna gain:	-1 dBi

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	Maximum Output Power (ERP)
863-870 MHz	0.73 dBm

9 Company Information

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

10 Reference Documentation

Ref	Link
OpenMV IDE	https://openmv.io/pages/download
Portenta Vision Shield Documentation	https://docs.arduino.cc/hardware/portenta-vision-shield
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/arduino-cloud/guides/overview
ProjectHub	https://create.arduino.cc/projecthub?by=part&part_id=11332&sort=trending
Library Reference	https://www.arduino.cc/reference/en/
Arduino Store	https://store.arduino.cc/

11 Change Log

Date	Revision	Changes
03/09/2024	5	Cloud Editor updated from Web Editor
20/11/2023	4	Structure Updates. FCC Caution Updated
15/11/2023	3	Updates as a Collective Datasheet
13/01/2022	2	Information update
03/03/2021	1	First Release