Description

The Arduino Portenta Vision Shield is an addon 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 H7 with minimal hardware and software setup.

Target Areas

Industry, surveillance

Features

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

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

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

  - High sensitivity 3.6µ 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 50Hz / 60Hz 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**

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

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

  - AOP = 122.5 dBSPL
  - 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.

Note: The Portenta Vision Shield is available in two SKU, Ethernet (ASX00021) and LoRa® (ASX00026)

1.1 Application Examples

Thanks to the low power consumption of the 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 allows 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 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 Vision Shield.

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

1.2 Related Products

The Vision Shield is developed as an add-on shield that requires the Portenta H7.

2 Ratings

2.1 Absolute Maximum

Symbol	Description	Min	Typ	Max	Unit
VINMax	Input voltage from HD Connectors	-0.3	-	3.3	V
PMax	Maximum Power Consumption	-	-	TBC	mW

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
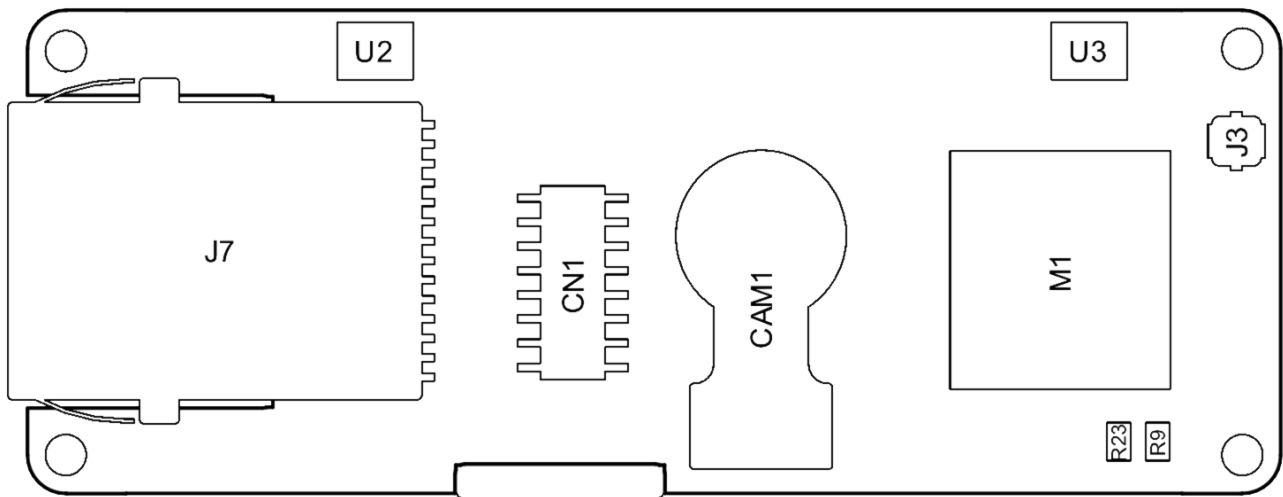
Top view
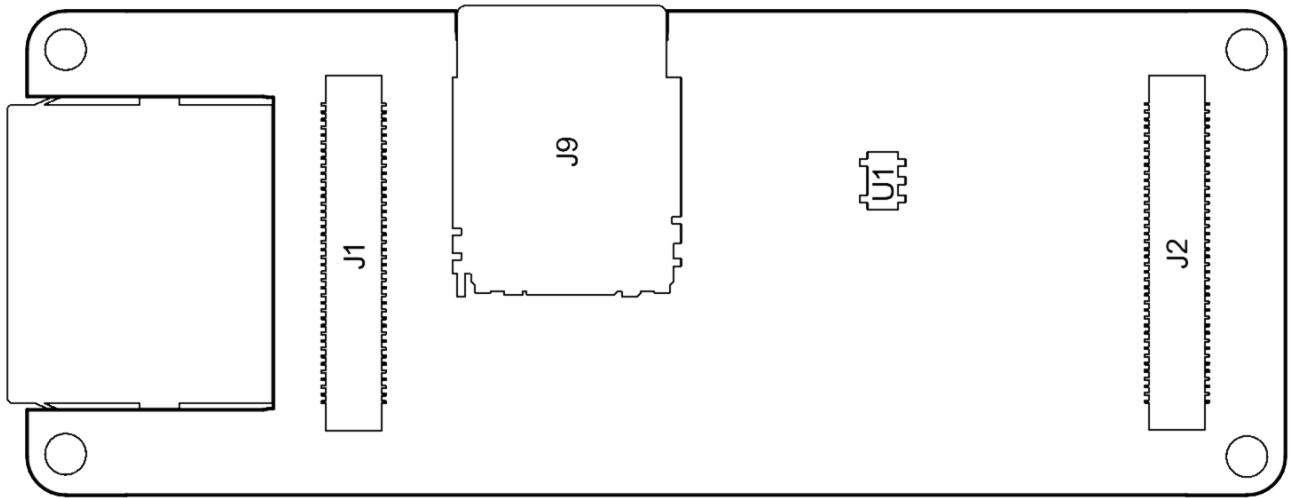
Bottom view

Ref.	Description	Ref.	Description
U1	Voltage Regulator	J3	LoRa® Radio Antenna U.FL Connector (ASX00026 Only)
U2,U3	ST MP34DT06JTR Digital Microphone	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

3.2 Camera Module

The Himax HM-01B0 Module is a very low power camera with 324x324 resolution and a maximum of 60FPS 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 Vision Shield is the monochrome version. Configuration is achieved via a I2C connection with the Portenta H7.

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

3.3 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

3.4 Micro SD Card Slot

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

3.5 Ethernet (ASX00021 Only)

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

3.6 LoRa® Module (ASX00026 Only)

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

3.7 Power

The Portenta H7 supplies 3.3V power to the LoRa® module (ASX00026 only), microSD slot and dual microphones via the 3.3V output via the high density connector. An onboard LDO regulator supplies a 2.8V output (300mA) for the camera module.

4 Board Operation

4.1 Getting Started — IDE

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

4.2 Getting Started — Arduino Web Editor (Create)

All Arduino and Genuino 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 IoT Cloud

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

4.4 Getting Started — OpenMV

**NOTE!
** It is highly recommended that you ensure you have the latest bootloader on your Portenta H7 before loading OpenMV firmware.

Arduino Vision Shield and Portenta H7 are supported under OpenMV. In order to easily use OpenMV download the latest OpenMV IDE **[5] **set up Portenta H7 in boot mode by double tapping reset and connect via the connection button.

OpenMV connection status

Once connected you will receive a message like the following:
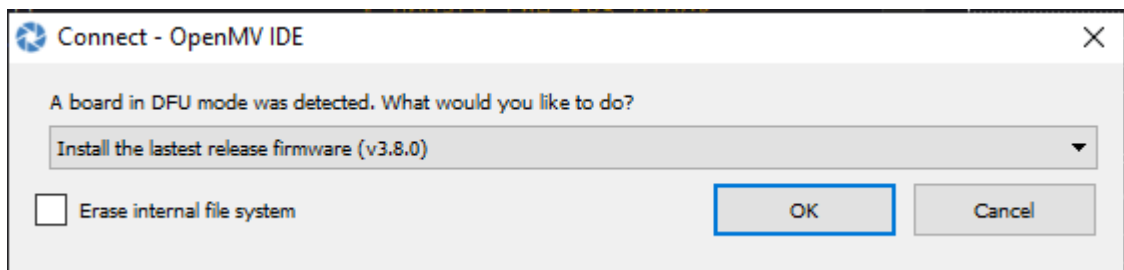
OpenMV connect window

Click on "OK" and the latest OpenMV firmware will be automatically loaded. To open the "Hello World" example, under the **File** menu select **Examples **-> **Arduino **->_ Basics _and click on **helloworld.py**.
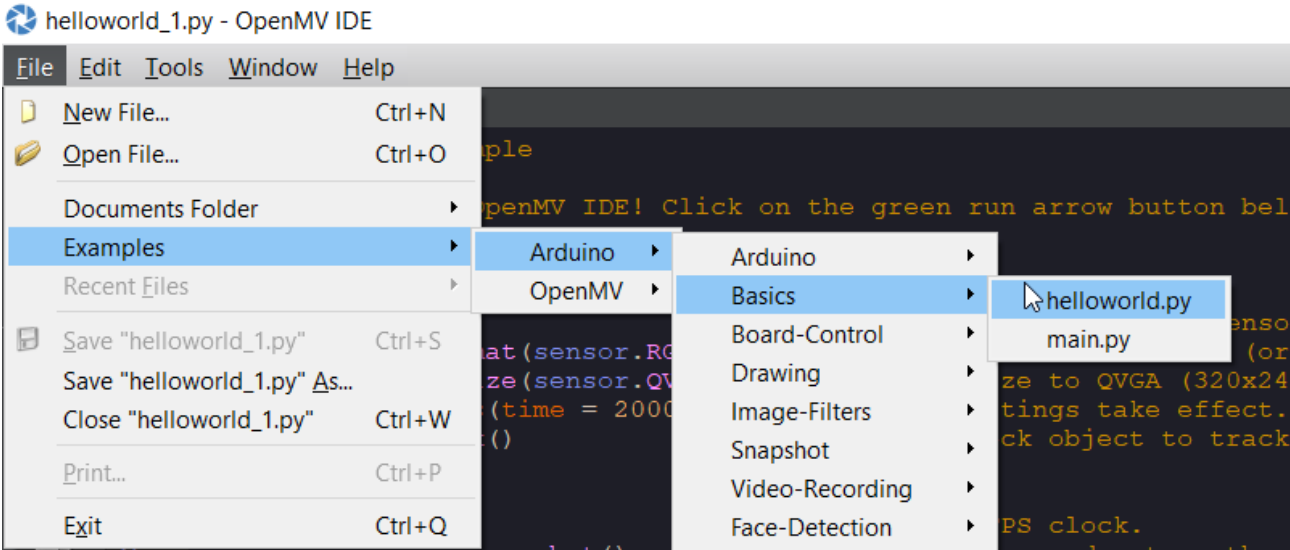
OpenMV IDE loading "hello world!" example

Click on the green square underneath the connection button to run.

OpenMV Run button

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 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

SWO	79	80	
SWCK	77	78	
SWDIO	75	76	
RESET	73	74	
	71	72	V-SDCARD
	69	70	
	67	68	DMIC D0
SDC D3	65	66	DMIC CK
SDC D2	63	64	VSYS
SDC D1	61	62	I2S D0
SDC D0	59	60	I2S DI
SDC CMD	57	58	I2S WS
SDC CLK	55	56	I2S MCK
VSYS	53	54	GND
CAN1 RX	51	52	
CAN1 TX	49	50	
GND	47	48	VIN
I2C1 SD6	45	46	I2C0 SCL
I2C1 SDA	43	44	I2C0 SDA
VIN	41	42	GND
UART1 CTS	39	40	UART0 CTS
UART1 RTS	37	38	UART0 RTS
UART1 RX	35	36	UART0 RX
UART1 TX	33	34	UART0 TX
GND	31	32	VIN
USB1 ID	29	30	
USB1 D-	27	28	USB0 D-
USB1 D+	25	26	USB0 D+
USB1 VBUS	23	24	
VIN	21	22	GND
ETH L2	19	20	DSI CK-
ETH L1	17	18	DSI CK+
	15	16	DSI D0-
	13	14	DSI D0+
	11	12	DSI D1-
	9	10	DSI D1+
ETH B-	7	8	
ETH B+	5	6	
ETH A-	3	4	
ETH A+	1	2	

J2-Female

CAM D7	2	1	FORCE_BOOTLOADER
CAM D6	4	3	BOOT_SOURCE
CAM D5	6	5	POWER_ON_REQ
CAM D4	8	7	COINCELL
CAM D3	10	9	
CAM D2	12	11	
CAM D1	14	13	
CAM D0	16	15	
CAM VS	18	17	
CAM CLK	20	19	
CAM HS	22	21	
GND	24	23	VCC/+3V3
UART2 TX	26	25	UART3 TX
UART2 RX	28	27	UART3 RX
	30	29	
	32	31	
VCC	34	33	GND
SPI1 CS	36	35	
SPI1 CK	38	37	
SPI1 MISO	40	39	
SPI1 MOSI	42	41	
GND	44	43	VCC/+3V3
GPIO 0	46	45	I2C2 SDA
GPIO 1	48	47	I2C2 SCL
GPIO 2	50	49	SAI CK
GPIO 3	52	51	SAI FS
GPIO 4	54	53	SAI D0
GPIO 5	56	55	
GPIO 6	58	57	GND
PWM 6	60	59	PWM 1
PWM 7	62	61	PWM 2
PWM 8	64	63	PWM 3
PWM 9	66	65	PWM 4
PWM 10	68	67	PWM 5
GND	70	69	VCC/+3V3
ADC VREF-	72	71	ADC VREF+
ADC A4	74	73	ADC A0
ADC A5	76	75	ADC A1
ADC A6	78	77	ADC A2
ADC A7	80	79	ADC A3

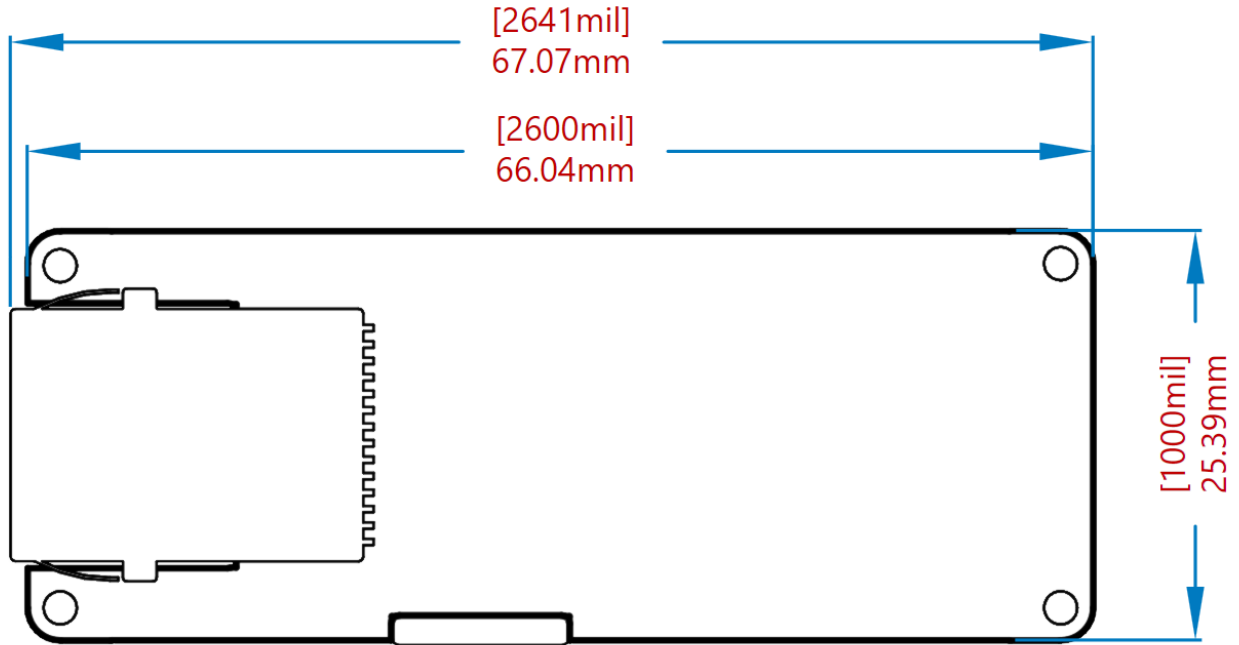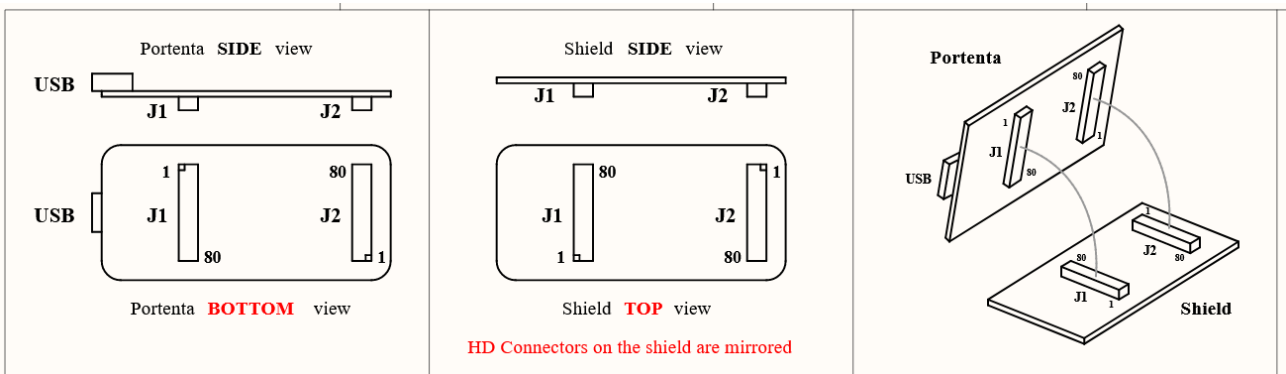|		
■ Ground	■ Internal Pin	▨ Digital Pin	■ Microcontroller's Port
■ Power	■ SWD Pin	▨ Analog Pin	■ High Density Connector
■ LED	□ Other Pin	■ Default	

High density connector pinout

6 Mechanical Information
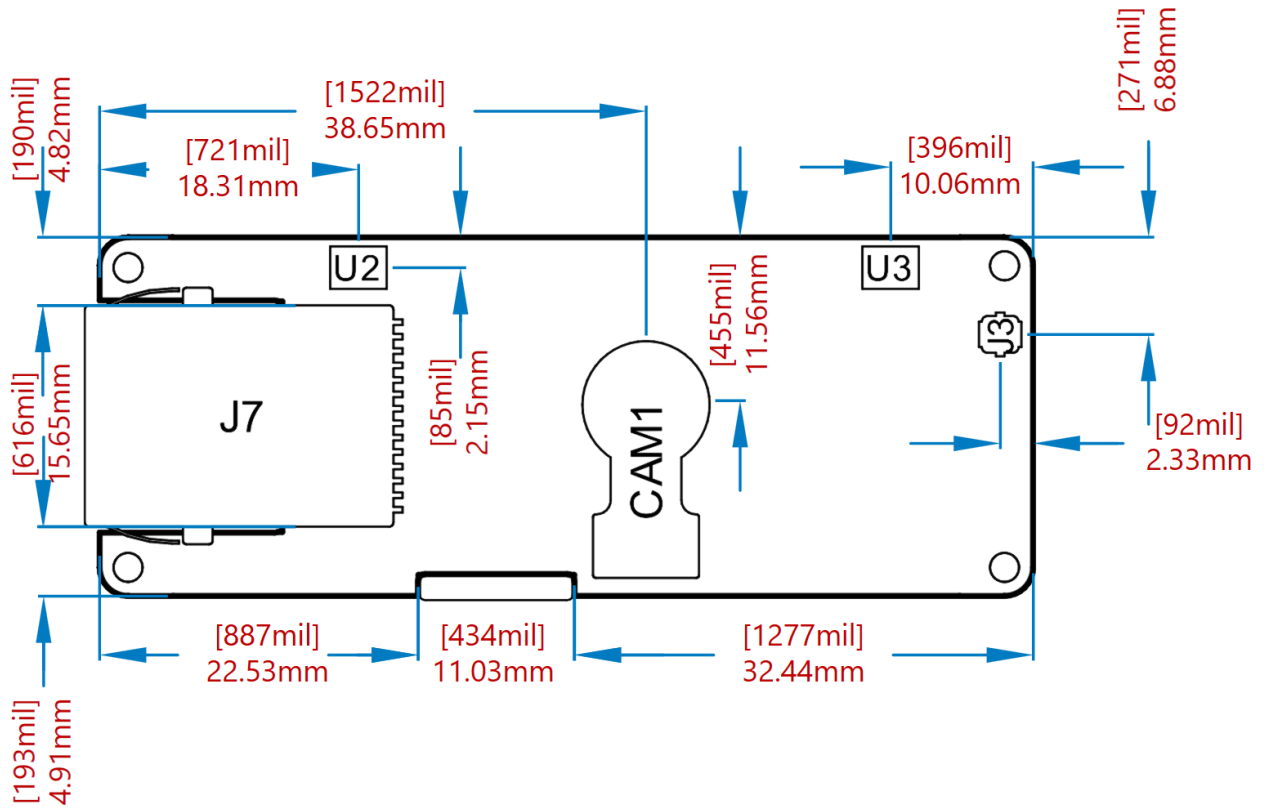
6.1 Board Outline
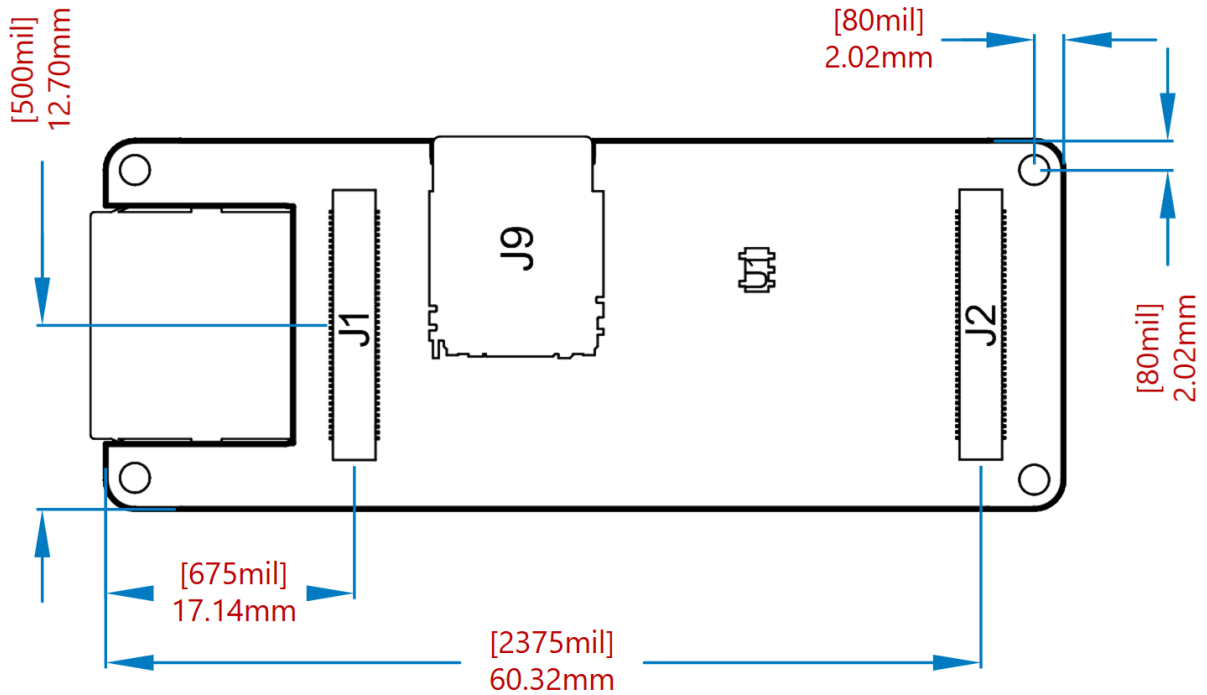

Board dimensions

6.2 Mounting Holes

Mounting holes overview

6.3 Connector and Component Positions
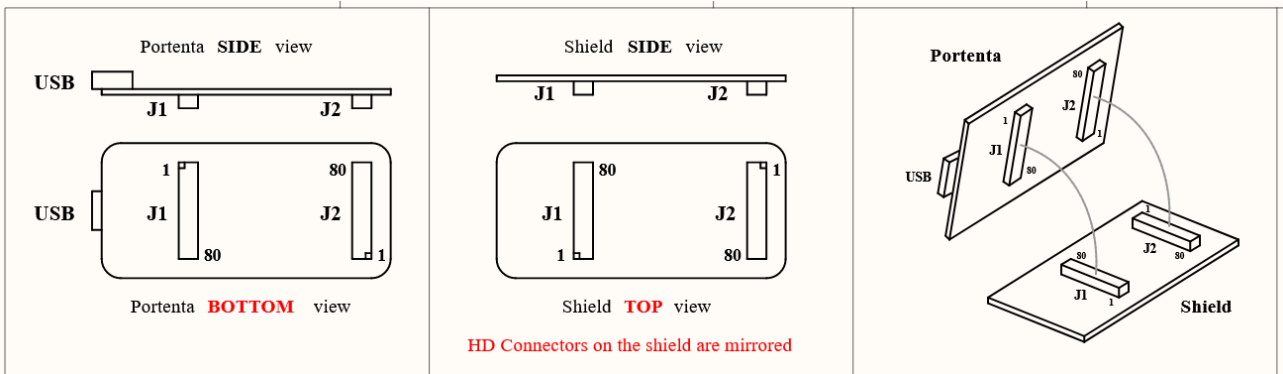

Connectors positions TOP

Connectors positions BOTTOM

6.4 Mounting Instructions

Mounting details

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 minimum distance 20cm 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)
863-870MHz	0.73dBm

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
Cloud IDE Getting Started	https://create.arduino.cc/projecthub/Arduino_Genuino/getting-started-with-arduino-web-editor-4b3e4a
Forum	http://forum.arduino.cc/
OpenMV IDE	https://openmv.io/pages/download
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
03/03/2021	1	First Release
13/01/2022	1	Information update