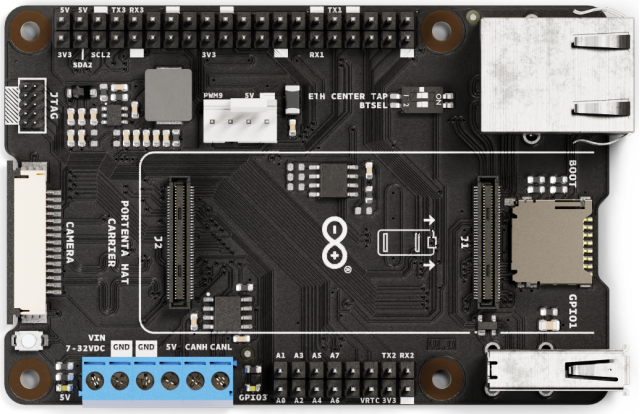
Product Reference Manual
SKU: ASX00049



Description

The Portenta Hat Carrier is an innovative solution enabling multiple robotics, industrial, and building automation projects. Combined with the Portenta X8, H7, or C33 boards, it evolves into a powerful industrial platform, further complemented by its compatibility with Raspberry Pi® Hats. The carrier grants easy access to an array of peripherals, such as CAN, Ethernet, microSD, USB, camera, and analog input and output ports. Its design is further enhanced with dedicated pins for efficient debugging and PWM fan connector.

Target Areas:

Industrial automation, building automation, robotics, prototyping

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Latest information:

The most recent datasheet version of this product is always available at:

https://docs.arduino.cc/resources/datasheets/ASX00049-datasheet.pdf

CONTENTS

1 Application Examples **4**

2 Accessories (Not Included) **4**

3 Related Products **5**

4 Solution Overview **5**

5 Features **6**

5.1 General Specifications Overview 6

5.2 Communication Interfaces 6

5.3 Other Features 7

6 Ratings **8**

6.1 Recommended Operating Conditions 8

7 Functional Overview **9**

7.1 Pinout 9

7.2 Full Pinout Table 10

7.2.1 Raspberry Pi® 40-Pins Connector (J5) 10

7.2.2 16-Pin Header (J6) 11

7.2.3 Power Block CAN Bus (J9) 12

7.2.4 FAN PWM Header (J11) 12

7.2.5 JTAG Header (J3) 13

7.2.6 MIPI Camera (J10) 13

7.2.7 USB-A (J4) 14

7.2.8 Ethernet (J8) 14

7.2.9 MicroSD Card Slot (J7) 15

7.3 Block Diagram 16

7.4 Power Tree 17

7.5 Product Topology 18

7.5.1 High-Density Connectors (J1-J2) 19

7.5.2 JTAG Connector (J3) 20

7.5.3 USB-A (J4) 20

7.5.4 40-Pin Header Connector (J5) 21

7.5.5 16-Pin Header Connector (J6) 22

7.5.6 MicroSD Card Slot (J7) 23

7.5.7 RJ45 Connector For Ethernet (J8) 24

7.5.8 Screw Terminal Block (J9) 25

7.5.9 Camera Connector (J10) 26
7.5.10 PWM Header Connector (J11) 27
7.5.11 DIP Switch Positions (SW2) 27
7.5.12 User-Programmable Push Button (PB1) 28
8 Device Operation 28
8.1 Getting Started - IDE 29
8.2 Getting Started - Arduino Web Editor 29
8.3 Getting Started - Arduino Cloud 29
8.4 Getting Started - Portenta Hat Carrier with Portenta X8 - Linux 29
8.5 Online Resources 29
8.6 Board Recovery 29
9 Mechanical Information 30
9.1 Product Outline 30
10 Certifications 31
10.1 Certifications Summary 31
10.2 Declaration of Conformity CE DoC (EU) 31
10.3 Declaration of Conformity to EU RoHS & REACH 211 01/19/2021 31
10.4 Conflict Minerals Declaration 32
11 FCC Caution 32
12 Company Information 33
13 Reference Documentation 33
14 Revision History 34

1 Application Examples

The Portenta Hat Carrier is designed to complement the Portenta family. It provides direct access to the Portentas' peripheral interfaces, enabling connections to USB and MIPI cameras. Furthermore, it improves the prototyping potential through straightforward compatibility with a broad spectrum of Raspberry Pi® Hats.

- **Motion Controller**: With the Portenta Hat Carrier, the Portenta X8 becomes an optimal motion controller for advanced industrial machinery, including industrial robots. Its integrated CAN interface (hardware level) and a Robot Operating System (ROS) container (software level) empower the Portenta X8 to manage robotic arm trajectories, while concurrently communicating with all associated electronics, such as motors and sensors.
- **Audio Quality Test Bench**: Use the Portenta Hat Carrier with the appropriate Raspberry Pi® Hat to assess the audio quality of speakers and musical instruments. This duo facilitates ambient sound monitoring across diverse settings, including bustling production facilities or public infrastructure.
- **Smart Building Security**: Enhance your building's security with the combined strength of the Portenta X8 and the Portenta Hat Carrier. Receive real-time notifications in instances of security breaches, establish an intelligent video surveillance system to spot unauthorized activities, or amplify your access control by integrating a high-resolution camera with the Portenta Hat Carrier.
- **Prototyping With Raspberry Pi® Hats**: Expand the capabilities of your Portenta lineup with the Portenta Hat Carrier. Ready for action, it is designed to be paired with an extensive range of Raspberry Pi® Hats, catering to diverse requirements, from embedded sensing to direct actuation.

2 Accessories (Not Included)

- MicroSD card (x1)
- MIPI camera (x1)
- Compatible Raspberry Pi® Hats
- PWM fan

Note: The Portenta Hat Carrier is a carrier that requires a compatible System-On-Module board to operate, e.g. the Portenta X8, Portenta H7 or Portenta C33.

3 Related Products

- Arduino Portenta X8 (SKU: ABX00049)
- Arduino Portenta H7 (SKU: ABX00042)
- Arduino Portenta H7 Lite (SKU: ABX00045)
- Arduino Portenta H7 Lite Connected (SKU: ABX00046)
- Arduino Portenta C33 (SKU: ABX00074)

4 Solution Overview

The Portenta Hat Carrier works alongside the Portenta family boards. The connection between the Portenta Hat Carrier and the Portenta family boards is fast and easy thanks to the High-Density connectors (J1 and J2) found in the Portenta Hat Carrier.

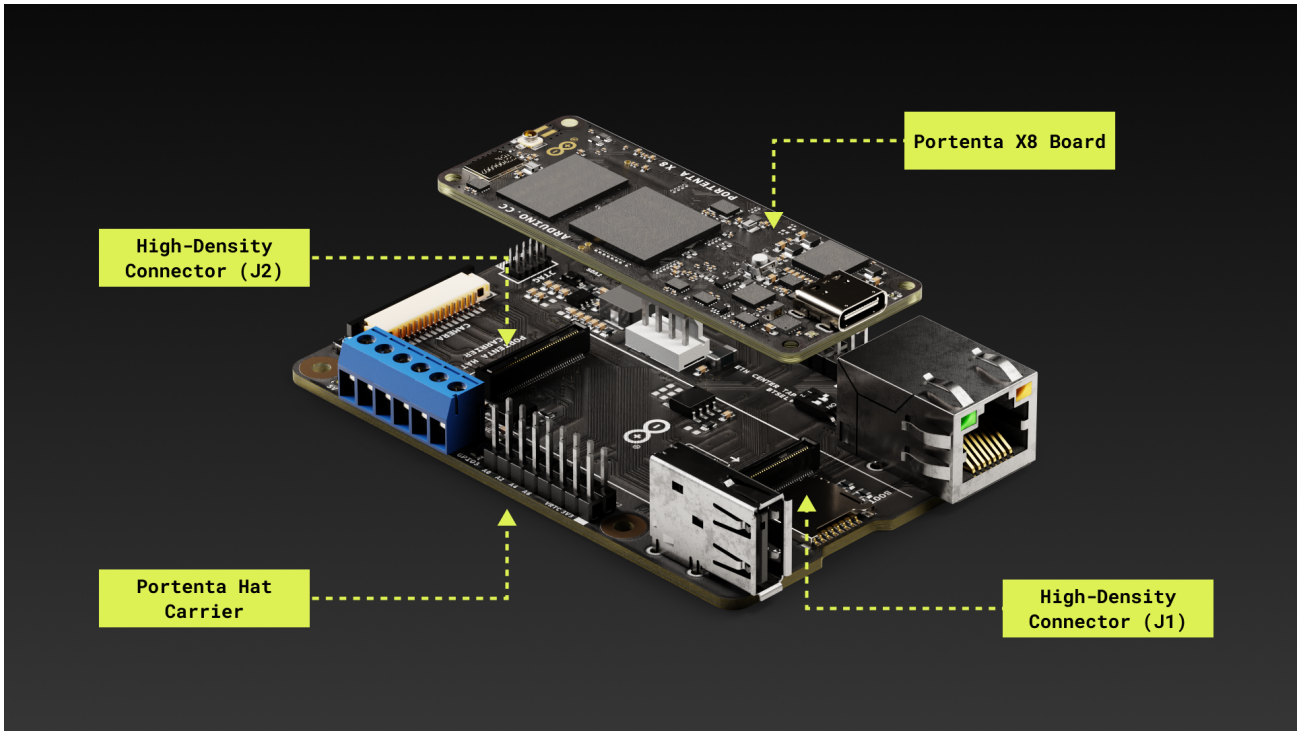


Figure 1. Portenta Hat Carrier and Portenta family boards connection

5 Features

5.1 General Specifications Overview

Characteristics	Details

Supply voltage	▪ From the onboard screw terminal block (J9):
	  ▪ +7-32 VDC to power both the carrier and the connected Portenta family board
	  ▪ +5 VDC power supply
	▪ +5 VDC from the USB-C® connector of the connected Portenta family board
	▪ From the onboard 40-pin header connector (J5):
	  ▪ +5 VDC power supply

Carrier maximum current	1.5 A
USB connectivity	USB-A for data logging and external peripherals (x1)
Communication interfaces	▪ Ethernet (x1) ▪ SPI (x1) ▪ I2S (x1) ▪ I2C (x3) ▪ UART (without flow control) (x3)
Certifications	CE/RED, FCC, UKCA, IC, RoHS, REACH and WEEE

Table 1: General specification overview of the Portenta Hat Carrier

5.2 Communication Interfaces

Interfaces	Connector
Ethernet (x1)	RJ45 connector (J8)
SPI (x1)	40-pin header connector (J5)
I2S (x1)	40-pin header connector (J5)
I2C (x3)	▪ I2C0: 40-pin header connector (J5) ▪ I2C1: High-Density connector (J1)* ▪ I2C2: 40-pin header connector (J5)
CAN FD (x1)	CAN1: Screw terminal block (J9)
UART (without flow control) (x3)	▪ UART1: 40-pin header connector (J5) ▪ UART2: 16-pin header connector (J6) ▪ UART3: 40-pin header connector (J5)

Table 2: Communication interfaces of the Portenta Hat Carrier

Note: I2C1 is shared also with the onboard EEPROM memory and the MIPI connector.

5.3 Other Features

Feature	Description
Additional onboard storage	MicroSD card slot for data logging and media purposes (J7) (x1)
USB	USB-A 2.0 connector for data logging and external peripherals (J4) (x1)
Video support	Only with the Portenta X8 board through its onboard USB-C®
Camera support	Only with the Portenta X8 board through the onboard MIPI camera connector of the carrier (J10)
CAN bus support	Onboard transceiver (J9) (x1)
Ethernet	RJ45 connector (J8) (x1)
Push button	▪ Push button (x1) used as a user-programmable button connected to GPIO1
LEDs	▪ Power LED (x1) ▪ User-programmable LED (x1) connected to the GPIO3 pin of the onboard High-Density connectors
DIP switch (with two sliders)	▪ ETH CENTER TAP: Enable/Disable Ethernet (OFF position to enable for Portenta X8, ON position to enable for Portenta H7/C33) ▪ BTSEL: Portenta X8 Flashing mode (ON position)

Table 3: Other important features of the Portenta Hat Carrier

6 Ratings

6.1 Recommended Operating Conditions

Table 4 provides a comprehensive guideline for the optimal use of the Portenta Hat Carrier, outlining typical operating conditions and design limits.

Parameter	Symbol	Min	Typ	Max	Unit
VIN from onboard screw terminal[1] (J9) of the carrier	$VIN_{TERMINAL}$	7.0	-	32.0	V
+5 VDC from onboard screw terminal (J9) of the carrier	$V5_{TERMINAL}$	-	5.0	-	V
USB-C® from the connected Portenta family board	$V5_{USBC}$	-	5.0	-	V
Current delivered by the carrier	$I_{CARRIER}$	-	-	1.5	A
+5 VDC from the 40-pin header connector of the carrier	$V5_{HEADER}$	-	5.0	-	V
Operating ambient temperature	T_{OP}	-40	-	85	°C

Table 4: Recommended operating conditions of the Portenta Hat Carrier

[1]The power supply connected to the onboard screw terminal block powers the carrier, the connected Portenta family board, and compatible Raspberry Pi® Hats. The onboard screw terminal connector has an integrated reverse polarity protection.

7 Functional Overview

7.1 Pinout

The Portent Hat Carrier pinout is shown in Figure 2.

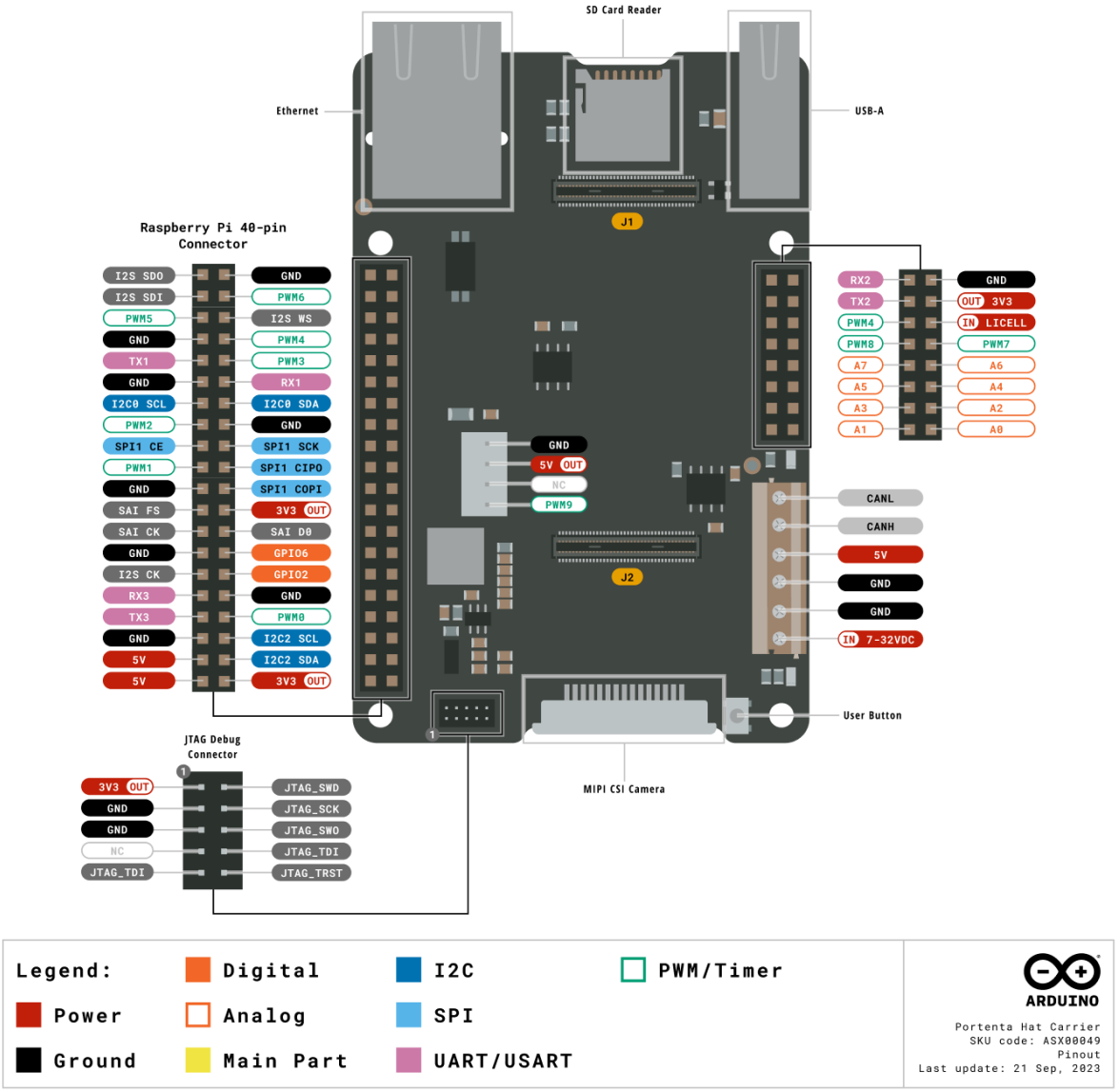


Figure 2. Portenta Hat Carrier pinout

7.2 Full Pinout Table

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

7.2.1 Raspberry Pi® 40-Pins Connector (J5)

Pin number	Silkscreen	Power Net	Portenta HD Standard Pin	High-Density Pin	Interface
1	3V3	+3V3_PORTENTA	VCC	J2-23, J2-34, J2-43, J2-69	
2	5V	+5V	VIN	J1-21, J1-24, J1-32, J1-41, J1-48	
3	I2C2 SDA			J2-45	I2C 2 SDA
4	5V	+5V	VIN	J1-21, J1-24, J1-32, J1-41, J1-48	
5	I2C2 SCL		I2C2_SCL	J2-47	I2C 2 SCL
6	GND	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
7	PWM0		PWM_0	J2-59	
8	TX3		SERIAL3_TX	J2-25	UART 3 TX
9	GND	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
10	RX3		SERIAL3_RX	J2-27	UART 3 RX
11	GPIO2		GPIO2	J2-50	
12	I2S CK		I2S_CK	J1-56	I2S CK
13	GPIO6		GPIO_6	J2-58	
14	GND	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
15	SAI D0		SAI_D0	J2-53	SAI D0
16	SAI CK		SAI_CK	J2-49	SAI CK
17	3V3	+3V3_PORTENTA	VCC	J2-23, J2-34, J2-43, J2-69	
18	SAI FS		SAI_FS	J2-51	SAI FS
19	SPI1 COPI		SPI1_MOSI	J2-42	SPI 1 MOSI
20	GND	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
21	SPI1 CIPO		SPI1_MISO	J2-40	SPI 1 MISO
22	PWM1		PWM_1	J2-61	
23	SPI1 SCK		SPI1_CK	J2-38	SPI 1 CK
24	SPI1 CE		SPI1_CS	J2-36	SPI 1 CS
25	GND	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
26	PWM2		PWM_2	J2-63	
27	I2C0 SDA		I2C0_SDA	J1-44	I2C 0 SDA
28	I2C0 SCL		I2C0_SCL	J1-46	I2C 0 SCL
29	RX1		SERIAL1_RX	J1-35	UART 1 RX
30	GND	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	

Pin number	Silkscreen	Power Net	Portenta HD Standard Pin	High-Density Pin	Interface
31	PWM3		PWM_3	J2-65	
32	TX1		SERIAL1_TX	J1-33	UART 1 TX
33	PWM4		PWM_4	J2-67	
34	GND	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
35	I2S WS		I2S_WS	J1-58	I2S WS
36	PWM5		PWM_5	J2-60	
37	PWM6		PWM_6	J2-62	
38	I2S SDI		I2S_SDI	J1-60	I2S SDI
39	GND	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
40	I2S SDO		I2S_SDO	J1-62	I2S SDO

Table 5: Raspberry Pi® 40-Pins Connector (J5) pinout

7.2.2 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

7.2.3 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

7.2.4 FAN PWM Header (J11)

Pin number	Silkscreen	Power Net	Portenta HD Standard Pin	High-Density Pin	Interface
1	PWM9		PWM_9	J2-68	
2	N/A				
3	5V	+5V	VIN	J1-21, J1-24, J1-32, J1-41, J1-48	
4	GND	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	

Table 8: FAN PWM Header (J11) pinout

7.2.5 JTAG Header (J3)

Pin number	Silkscreen	Power Net	Portenta HD Standard Pin	High-Density Pin	Interface
1	N/A	+3V3_PORTENTA	VCC	J2-23, J2-34, J2-43, J2-69	
2	N/A		JTAG_SWD	J1-75	JTAG SWD
3	N/A	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
4	N/A		JTAG_SCK	J1-77	JTAG SCK
5	N/A	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
6	N/A		JTAG_SWO	J1-79	JTAG SWO
7	N/A		NC	NC	
8	N/A		JTAG_TDI	J1-78	JTAG TDI
9	N/A		JTAG_TRST	J1-80	JTAG TRST
10	N/A		JTAG_RST	J1-73	JTAG RST

Table 9: JTAG Header (J3) pinout

7.2.6 MIPI Camera (J10)

Pin number	Silkscreen	Power Net	Portenta HD Standard Pin	High-Density Pin	Interface
1	N/A	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54	
2	N/A		CAM_D0_D0_N	J2-16, J2-24, J2-33, J2-44, J2-57, J2-70	
3	N/A		CAM_D1_D0_P	J2-14	
4	N/A	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
5	N/A		CAM_D2_D1_N	J2-12	
6	N/A		CAM_D3_D1_P	J2-10	
7	N/A	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
8	N/A		CAM_CK_CK_N	J2-20	
9	N/A		CAM_VS_CK_P	J2-18	
10	N/A	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
11	N/A		GPIO_5	J2-56	
12	N/A		NC	NC	
13	N/A		I2C1_SCL	J1-45	I2C 1 SCL
14	N/A		I2C1_SDA	J1-43	I2C 1 SDA
15	N/A	+3V3_PORTENTA	VCC	J2-23, J2-34, J2-43, J2-69	

Table 10: JTAG Header (J3) pinout

7.2.7 USB-A (J4)

Pin number	Silkscreen	Power Net	Portenta HD Standard Pin	High-Density Pin	Interface
1	N/A	+5V	VIN / USB0_VBUS	J1-21, J1-24, J1-32, J1-41, J1-48	
2	N/A		USB0_D_N	J1-28	USB D-
3	N/A		USB0_D_P	J1-26	USB D+
4	N/A	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	

Table 11: USB-A (J4) pinout

7.2.8 Ethernet (J8)

Pin number	Silkscreen	Power Net	Portenta HD Standard Pin	High-Density Pin	Interface
1	N/A	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
2	ETH CENTER TAP				
3	N/A		ETH_D_P	J1-13	
4	N/A		ETH_D_N	J1-15	
5	N/A		ETH_C_P	J1-9	
6	N/A		ETH_C_N	J1-11	
7	N/A		ETH_B_P	J1-5	
8	N/A		ETH_B_N	J1-7	
9	N/A		ETH_A_P	J1-1	
10	N/A		ETH_A_N	J1-3	
11	N/A		ETH_LED2	J1-19	
12	N/A	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
13	N/A		N/A		
14	N/A		ETH_LED1	J1-17	

Table 12: Ethernet (J8) pinout

7.2.9 MicroSD Card Slot (J7)

Pin number	Silkscreen	Power Net	Portenta HD Standard Pin	High-Density Pin	Interface
1	N/A		SDC_D2	J1-63	
2	N/A		SDC_D3	J1-65	
3	N/A		SDC_CMD	J1-57	
4	N/A	VDD_SDCARD	VSD	J1-72	
5	N/A		SDC_CLK	J1-55	
6	N/A	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	
7	N/A		SDC_D0	J1-59	
8	N/A		SDC_D1	J1-61	
CD1	N/A		SDC_CD	J1-67	
CD2	N/A	GND	GND	J1-22, J1-31, J1-42, J1-47, J1-54, J2-24, J2-33, J2-44, J2-57, J2-70	

Table 13: MicroSD Card Slot (J7) pinout

7.3 Block Diagram

An overview of the Portenta Hat Carrier high-level architecture is illustrated in Figure 3.

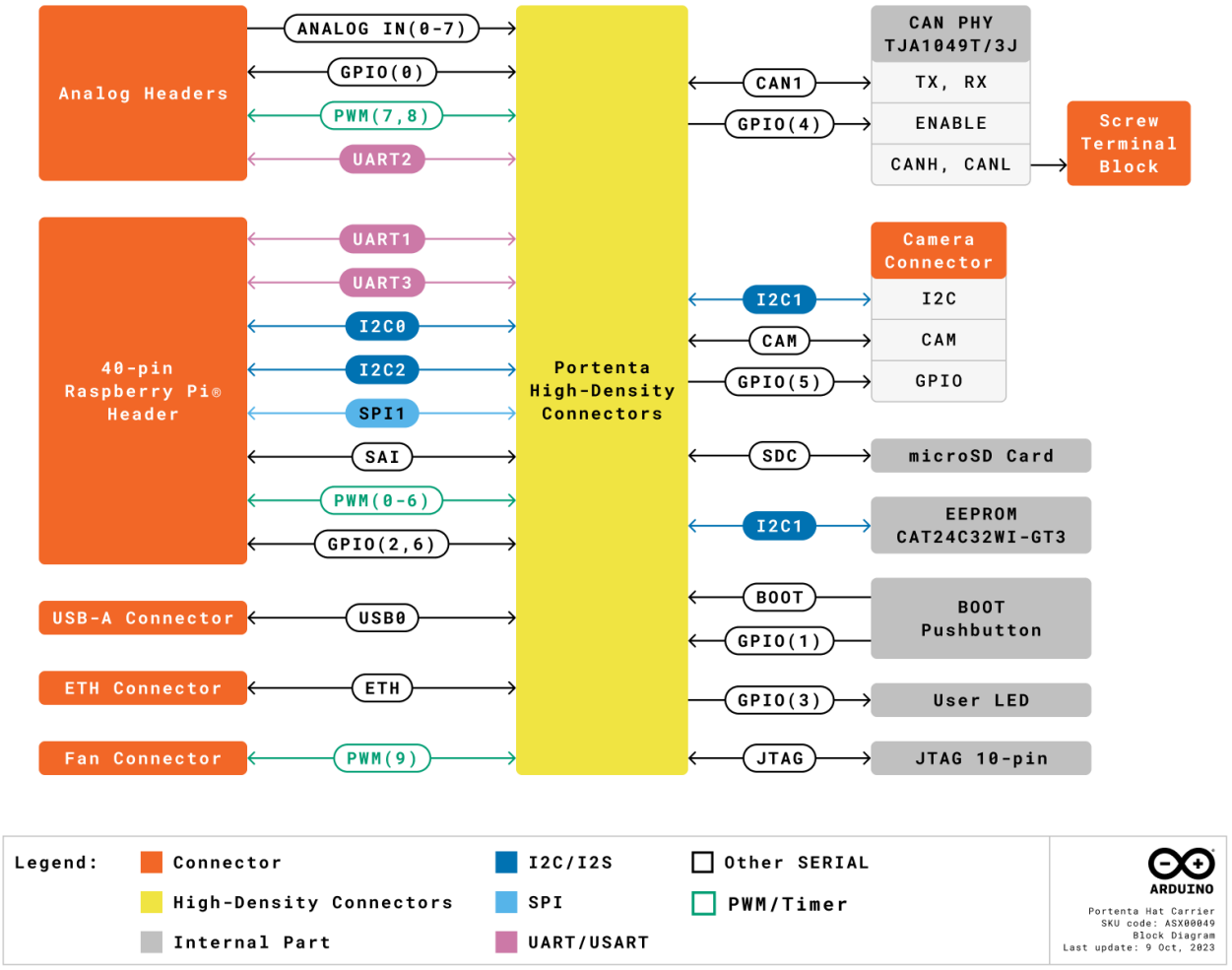


Figure 3. Portenta Hat Carrier block diagram

7.4 Power Tree

Figure 4 shows the power options available on the Portenta Hat Carrier and illustrates the main system power architecture.

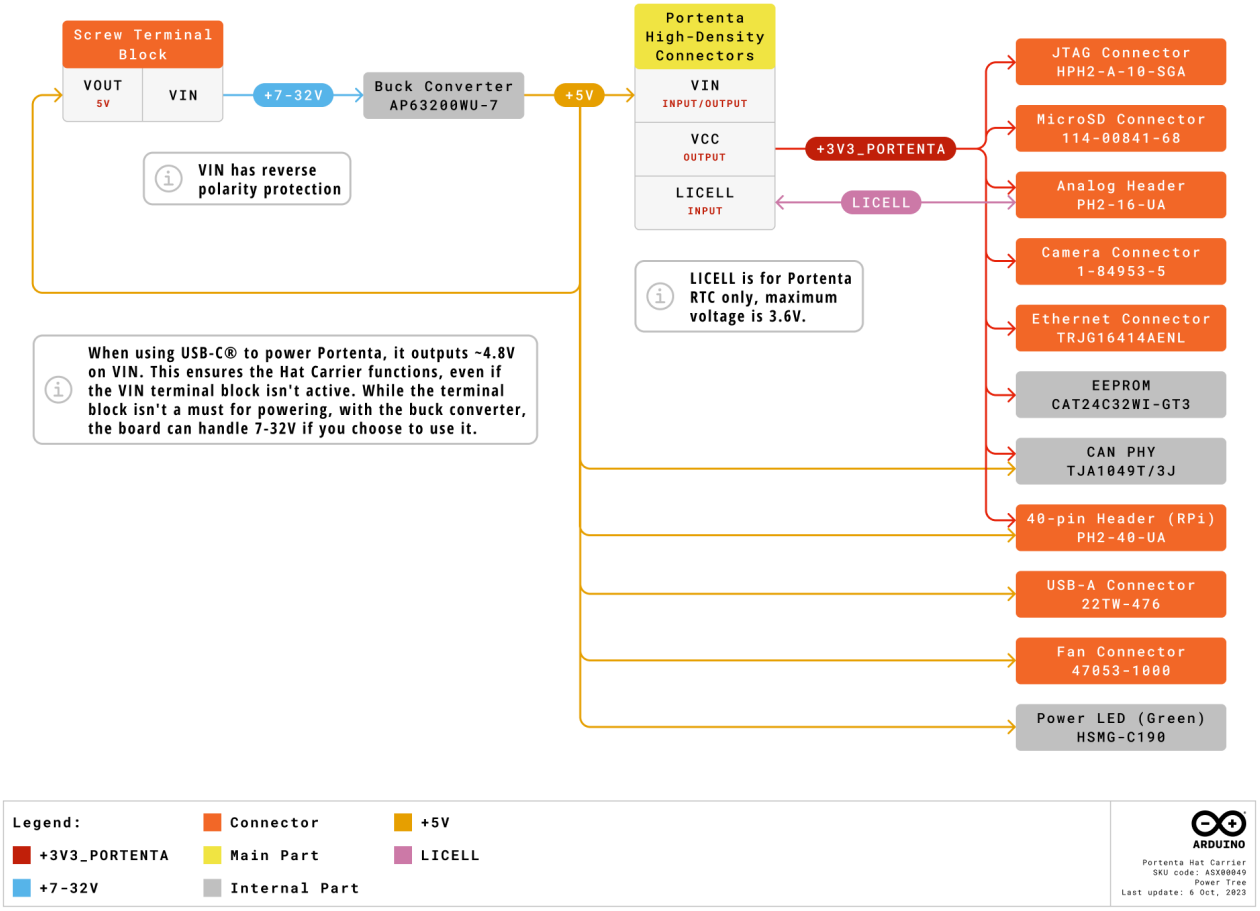


Figure 4. Portenta Hat Carrier power tree

As shown in Figure 4, the Portenta Hat Carrier can be powered in multiple ways:

- **Through the screw terminal block connector (J9)**: Accepting a voltage range between +7 to +32 VDC. An AP63200WU-7 buck converter (U7) then steps down the +7 to +32 VDC VDC input to +5 VDC for the carrier and any connected Portenta family board. It is also possible to power the system with a fixed +5 VDC using the "5V" pin present in this block connector.
- **Via the connected Portenta family board's USB-C® connector**: It provides a stable +5 VDC to the carrier and the connected Portenta Family board.
- **From a Raspberry like Hat using the 40-pin header connector**: It provides a stable +5 VDC to the carrier and the connected Portenta Family board.

7.5 Product Topology

An overview of the Portenta Hat Carrier topology is illustrated in Figure 5.

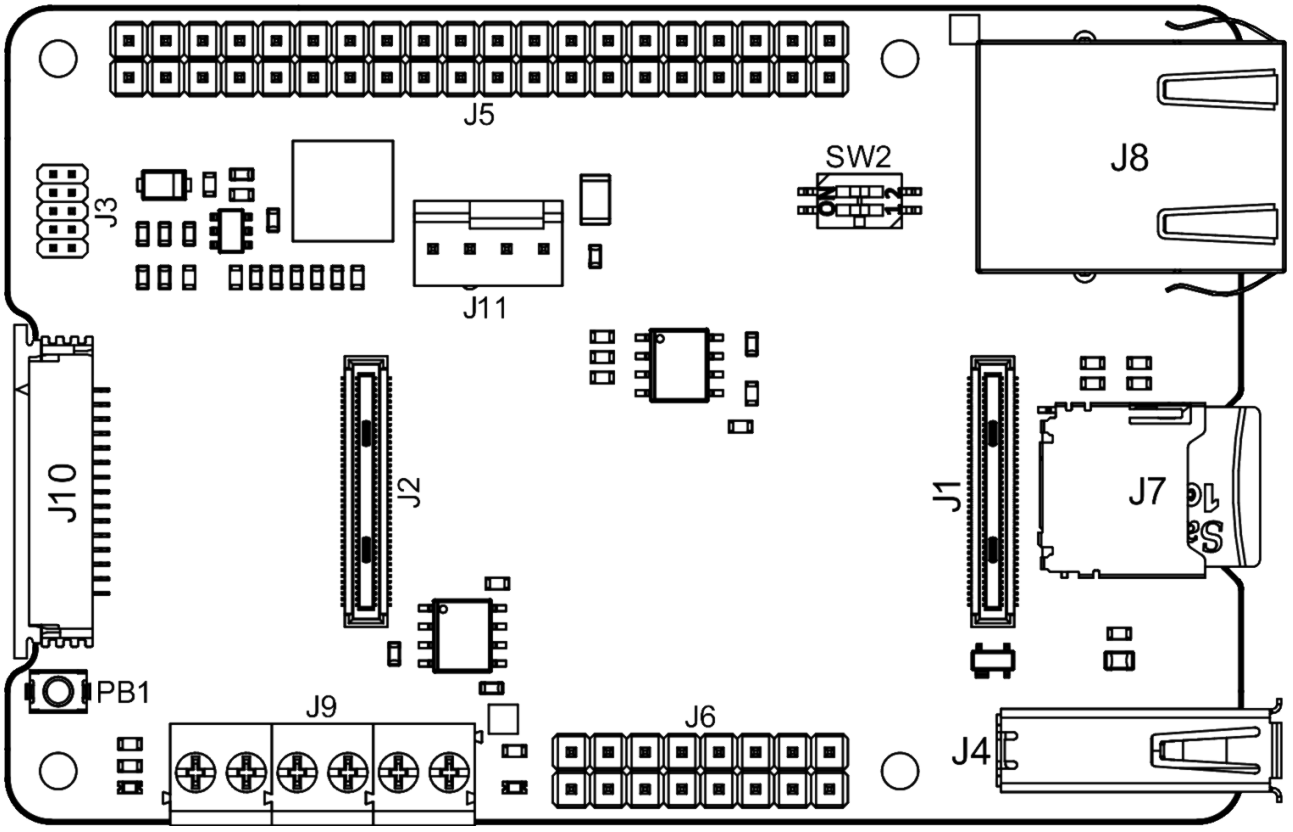


Figure 5. Portenta Hat Carrier topology

Item	Feature	Item	Feature
J1, J2	High-Density connectors for Portenta boards	J8	RJ45 connector for Ethernet
J3	JTAG male connector for debugging	J9	Screw terminal for power supply and CAN bus
J4	USB-A female connector for data logging and external devices	J10	MIPI camera connector (only for Portenta X8 board)
J5	40-pin male header compatible with Raspberry Pi® Hats	J11	Male header for external fan
J6	16-pin male header for analog and digital pins	SW2	DIP switch (2 positions): ▪ Ethernet mode ▪ Portenta X8 Flashing mode (ON position)
J7	MicroSD slot for data logging and media purposes	PB1	▪ User programmable button

Table 14: Product Topology Description

7.5.1 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 Figure 6, the Portenta X8 board High-Density connectors pinout is shown as an example.

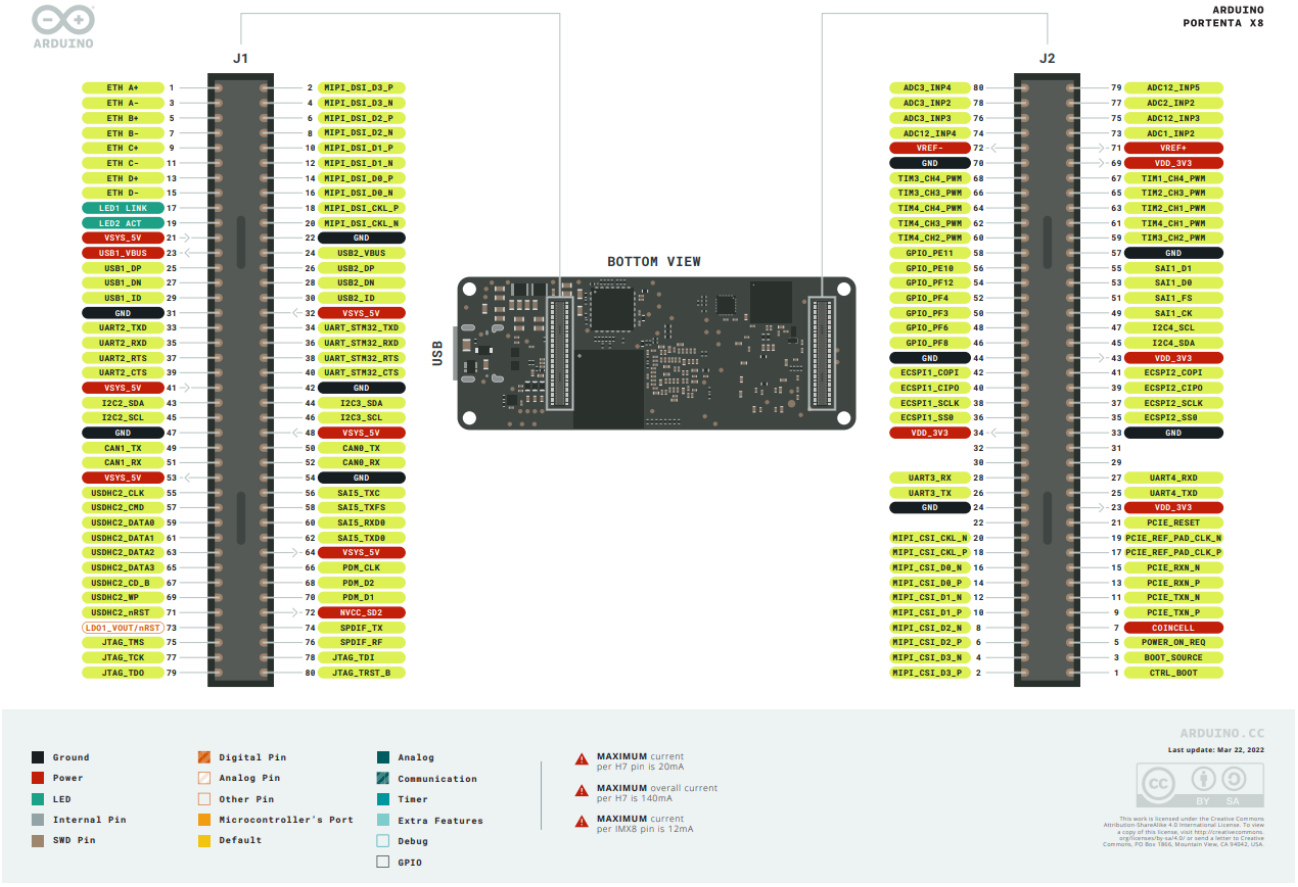


Figure 6. Portenta X8 High-Density connectors pinout

7.5.2 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.

7.5.3 USB-A (J4)

The onboard USB-A connector (female), shown in Figure 7, is integrated in 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.

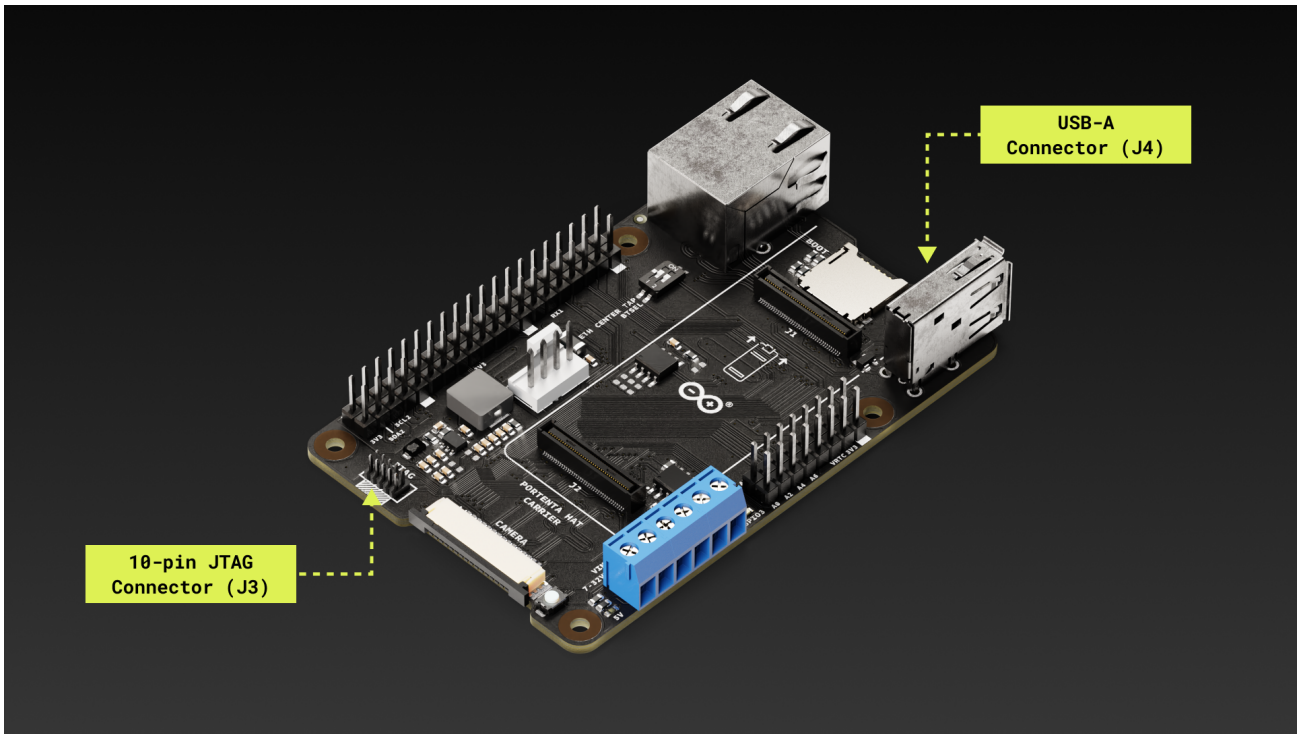


Figure 7. JTAG and USB-A connectors of the Portenta Hat Carrier

7.5.4 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.

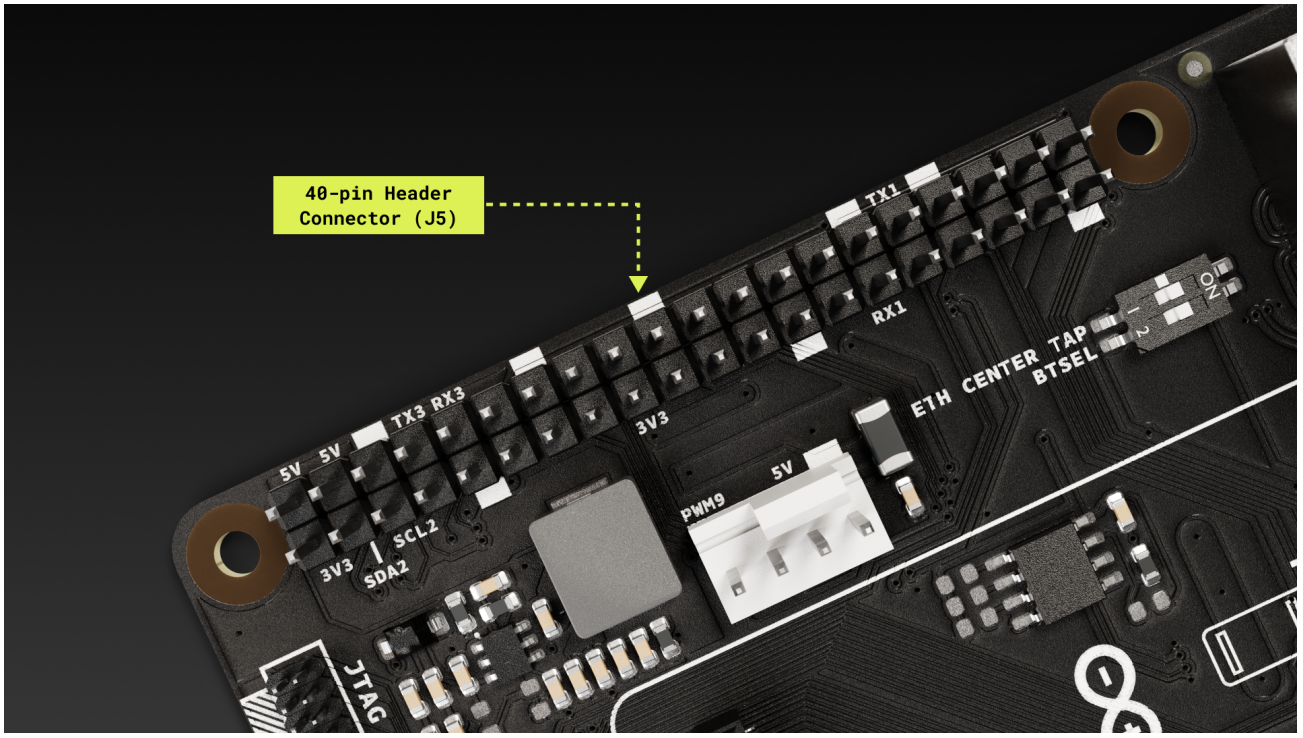


Figure 8. Raspberry Pi®-compatible 40-pin header connector

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)

7.5.5 16-Pin Header Connector (J6)

The Portenta Hat Carrier has a 16-pin connector as shown in Figure 9 to access multiple analog, PWM, serial ports, and power-related pins.

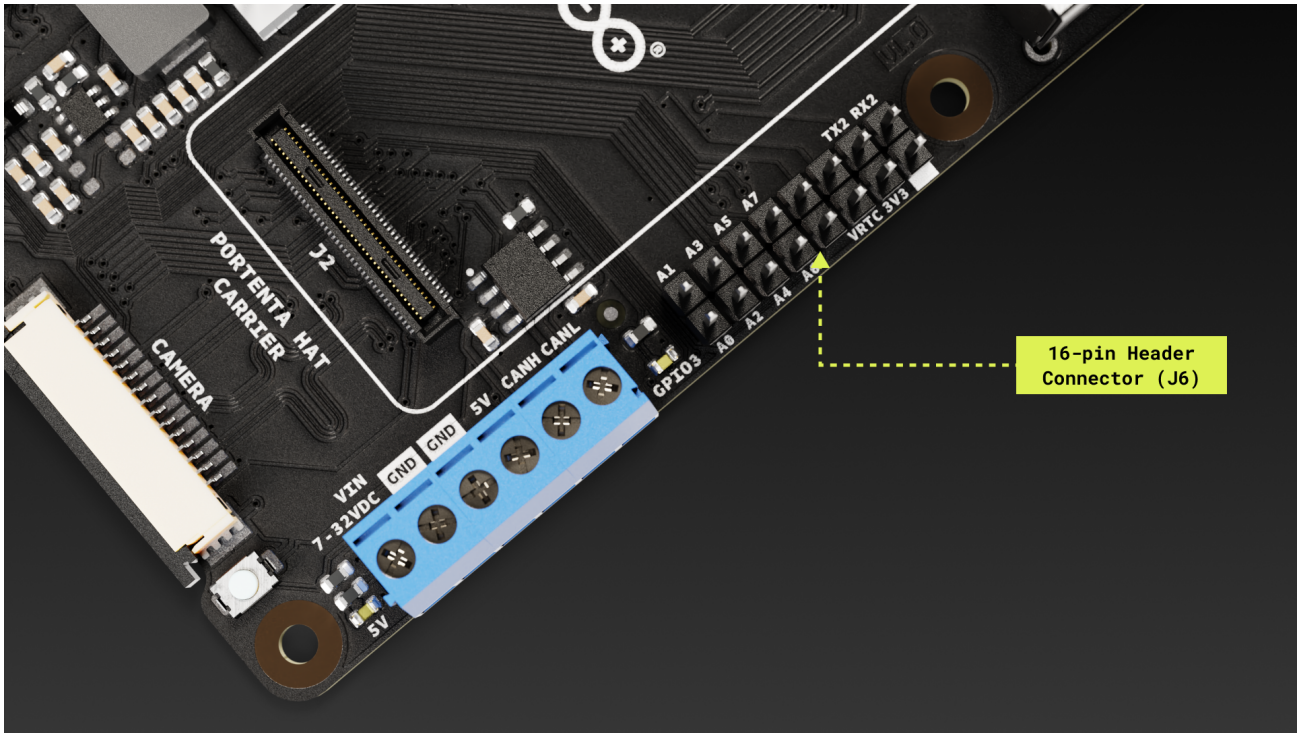


Figure 9. 16-pin header connector

The main interfaces and general-purpose pins that can be accessed via this connector are:

- Analog I/O (x8)
- PWM (x2)
- 1x LiCell pin for Portenta's RTC power (x1)
- GPIO (x1)
- 3.3 VDC (x1)
- GND (x1)
- UART (without flow control) (x1)

7.5.6 MicroSD Card Slot (J7)

The onboard microSD card slot can be used for:

- Data logging operations
- Media purposes

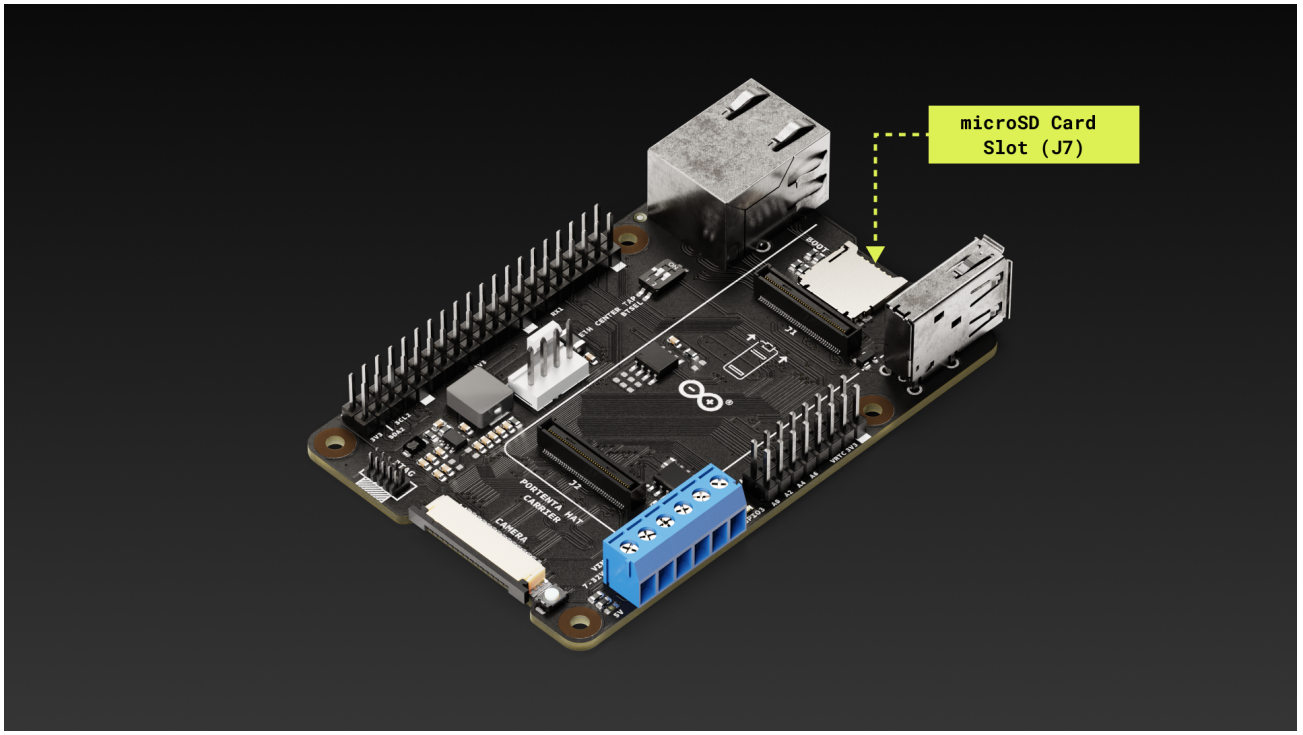


Figure 10. microSD card slot of the Portenta Hat Carrier

7.5.7 RJ45 Connector For Ethernet (J8)

The RJ45 connector, directly linked to the high-density connector on the Portenta board, facilitates an Ethernet cable connection to your network. It integrates magnetics for electrical isolation, and features LED indications for activity (orange) and speed (green).

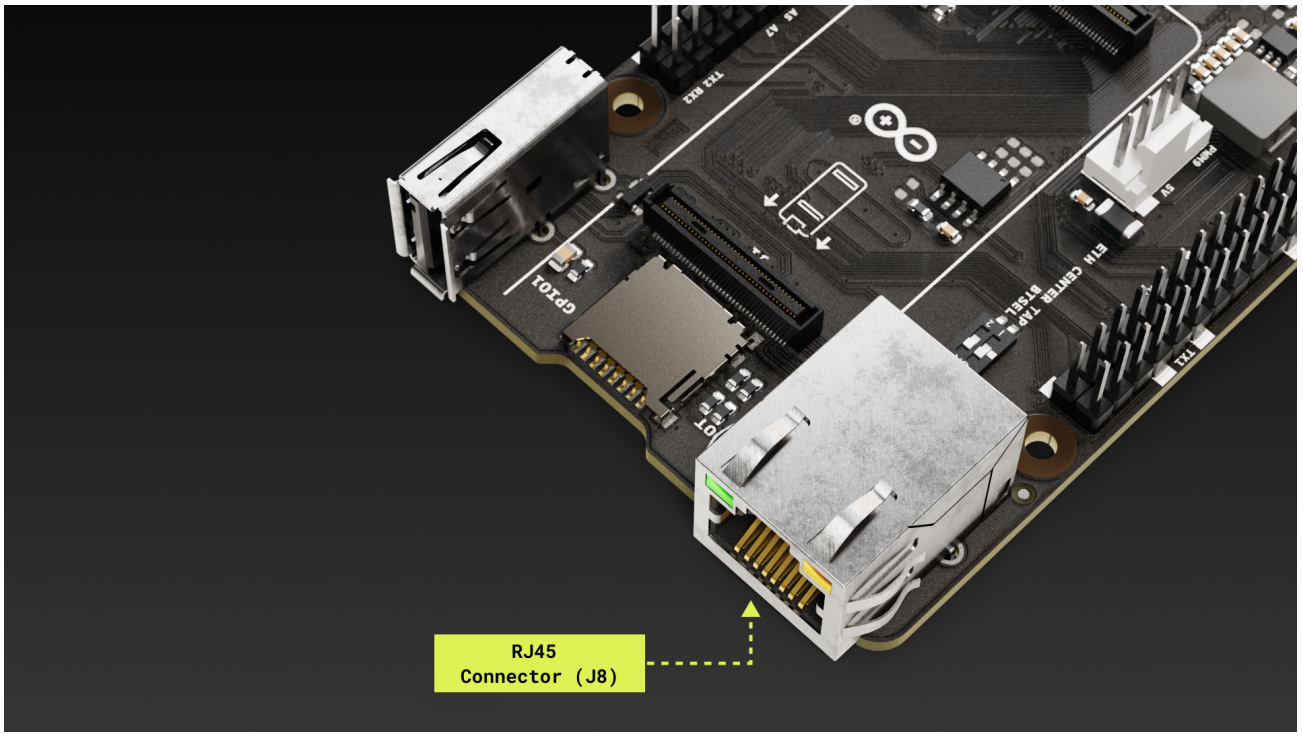


Figure 11. RJ45 connector of the Portenta Hat Carrier

Depending of the Portenta family board attached to the Portenta Hat Carrier, the DIP switch (SW2) must be in a specific position to ensure the correct functioning of the ethernet interface:

- For the Portenta X8, be sure that the ETH CENTER TAP on the DIP switch (SW2) is on the default position OFF.
- For the Portenta X7 or Portenta C33, set the ETH CENTER TAP on the DIP switch (SW2) to ON.

7.5.8 Screw Terminal Block (J9)

The screw terminal block connector shown in Figure 12 contains the power supply and CAN bus communication pins.

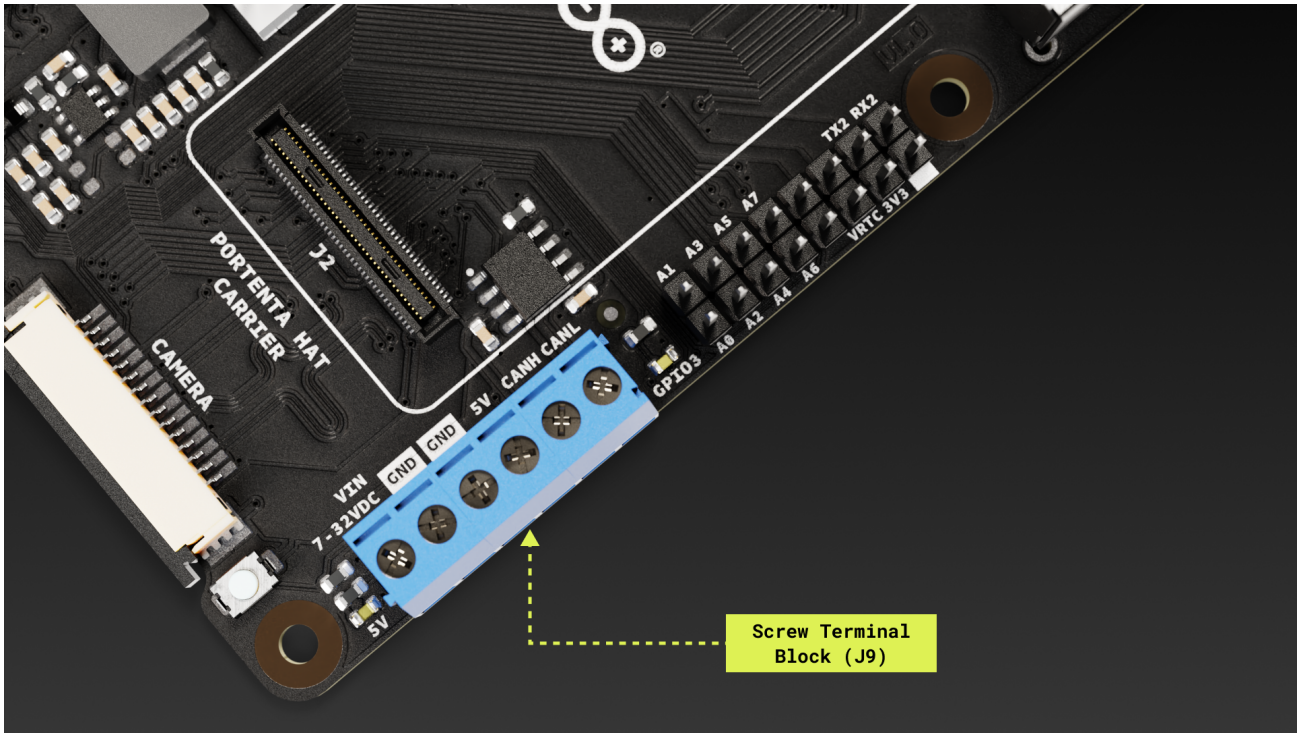


Figure 12. Screw terminal block connector of the Portenta Hat Carrier

Power Pins

The Portenta Hat Carrier and any connected board to it can be powered using the power terminals located on the screw terminal block (J9):

- **VIN 7-32VDC and GND terminals**: Supply the board using a voltage range of +7-32 VDC. This method is particularly convenient when powering the board with batteries.
- **5V and GND terminals**: Power the board with a fixed voltage of +5 VDC. Additionally, these pins can power external peripherals operating at +5 VDC. An AP63200WU-7 buck converter (U7) steps down the input voltage from +7-32 VDC to the +5 VDC used by the carrier and the connected board to it.

CAN Bus Pins

- **CANH and CANL terminals**: The Portenta Hat Carrier has a high-speed CAN transceiver based on the TJA1049T/3J IC. These terminals enable reliable CAN bus communication. The 120 ohms termination resistor is not included in the device so make sure to add it in your final deployment to meet the bus requirements and obtain the ideal performance.

7.5.9 Camera Connector (J10)

The Portenta Hat Carrier, when combined with a Portenta X8, supports MIPI cameras. The latter can be plugged into the onboard camera connector shown in Figure 13 via a flexible flat cable.

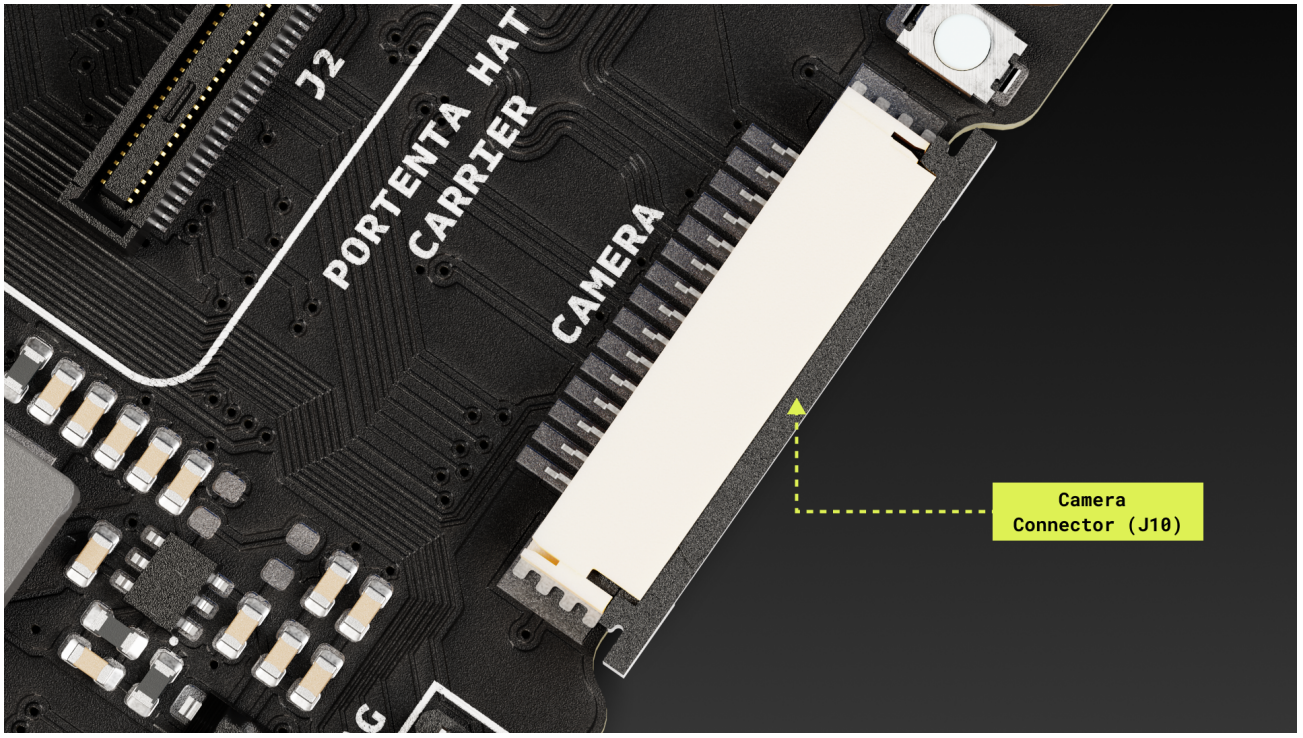


Figure 13. Camera connector of the Portenta Hat Carrier

Some of the potential compatible devices are the following:

- OmniVision® OV5645 sensor, like the one used in the Raspberry Pi® Camera Module 1.
- Sony® IMX219 sensor, like the one used in the Raspberry Pi® Camera Module 2.

7.5.10 PWM Header Connector (J11)

The PWM header connector controls an optional fan's speed, perfect for heat dissipation in closed cases and heavy CPU-demanding applications.

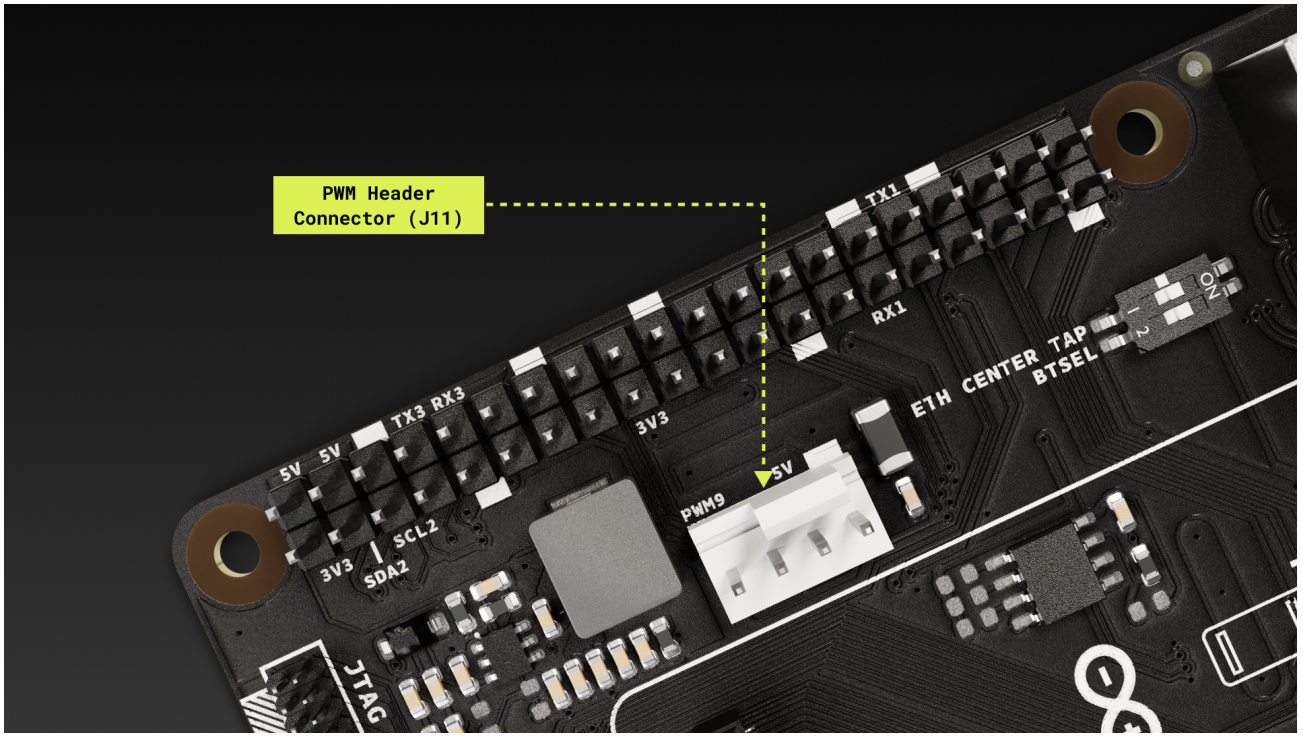


Figure 14. PWM connector of the Portenta Hat Carrier

7.5.11 DIP Switch Positions (SW2)

The Portenta Hat Carrier has a DIP switch with two different functions depending on the Portenta family board connected to it:

Portenta X8:

Switch	Position	Meaning
ETH CENTER TAP	ON	Ethernet **disabled**
	OFF	Ethernet **enabled**
BTSEL	ON	Flashing Mode (ON)
	OFF	Reserved for future applications

Upon positioning the *BTSEL* switch to the *ON* state, the Portenta X8 is configured to enter *Flashing Mode*.

Portenta H7 and Portenta C33:

Switch	Position	Meaning
ETH CENTER TAP	ON	Ethernet **enabled**
	OFF	Ethernet **disabled**
BTSEL	ON	Not used
	OFF	Not used

7.5.12 User-Programmable Push Button (PB1)

You can program the multifunctional push button on the Portenta Hat Carrier for diverse implementations with a single press or initiate specific events, switch between states, and execute actions as required by the application.

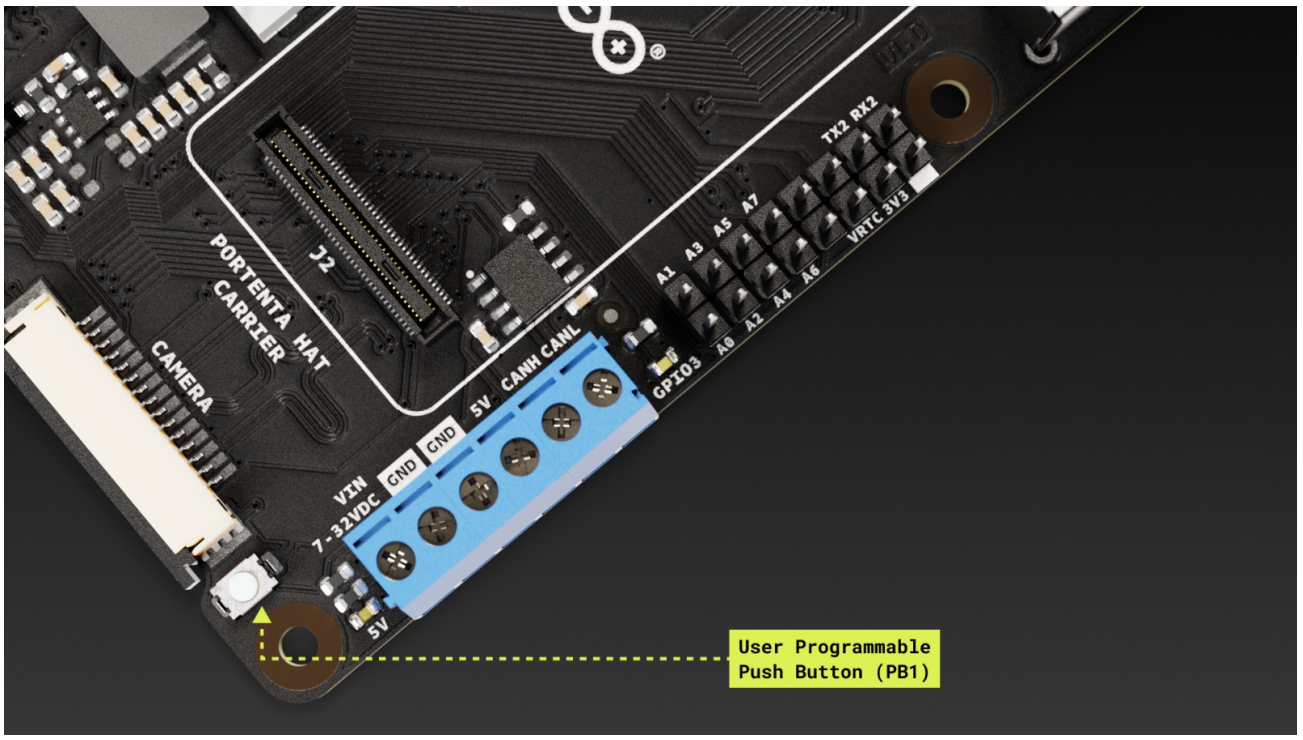


Figure 15. User-programmable push button of the Portenta Hat Carrier

8 Device Operation

The carrier is designed to function in conjunction with the Portenta family boards (refer to the Solution Overview section for more details). For further information, consult the datasheets for Portenta X8, Portenta H7, or Portenta C33 boards.

8.1 Getting Started - IDE

If you want to program your Portenta Hat Carrier offline, you'll need to install the Arduino Desktop IDE [1]. To connect your Portenta family board with the Portenta Hat Carrier to your computer, a USB-C® cable is required.

8.2 Getting Started - Arduino Web Editor

All Arduino devices work out-of-the-box with the Arduino Web Editor [2] after installing a straightforward plugin.

Being hosted online ensures that the Arduino Web Editor remains up-to-date, boasting the latest features and comprehensive support for all boards and devices. To begin coding in the browser and uploading your sketches to your device, follow the instructions here [3].

8.3 Getting Started - Arduino Cloud

The Arduino Cloud supports all Arduino IoT-enabled products, enabling you to log, visualize, and analyze sensor data, initiate events, and automate either your home or business.

8.4 Getting Started - Portenta Hat Carrier with Portenta X8 - Linux

The Portenta Hat Carrier with a Portenta X8 is a powerful system that runs Linux in its main core and Arduino in its secondary core. In case you want to know more about how to use Linux with your Portenta X8 and your Portenta Hat Carrier, you can check the official documentation for the Portenta Hat Carrier [4] and the Portenta X8 [5].

8.5 Online Resources

Having acquainted yourself with the device's basic functionalities, delve into its limitless potentials. Engage with inspiring projects on Arduino Project Hub [6], explore the Arduino Library Reference [7], and visit the online store [8] to augment your Portenta Hat Carrier with supplemental extensions, sensors, and actuators.

8.6 Board Recovery

- **Portenta C33 or Portenta H7**: In case a sketch locks up the processor and the board is not reachable anymore via USB, bootloader mode can be accessed by double-tapping the reset button right after powering up.
- **Portenta X8**: If your Linux system become unresponsive, press the reset button to reboot. If the system remains unresponsive post-reboot, re-flashing the board might be necessary. Consult the official Portenta Hat Carrier [4] and the Portenta X8 [5] documentation for further guidance.

9 Mechanical Information

9.1 Product Outline

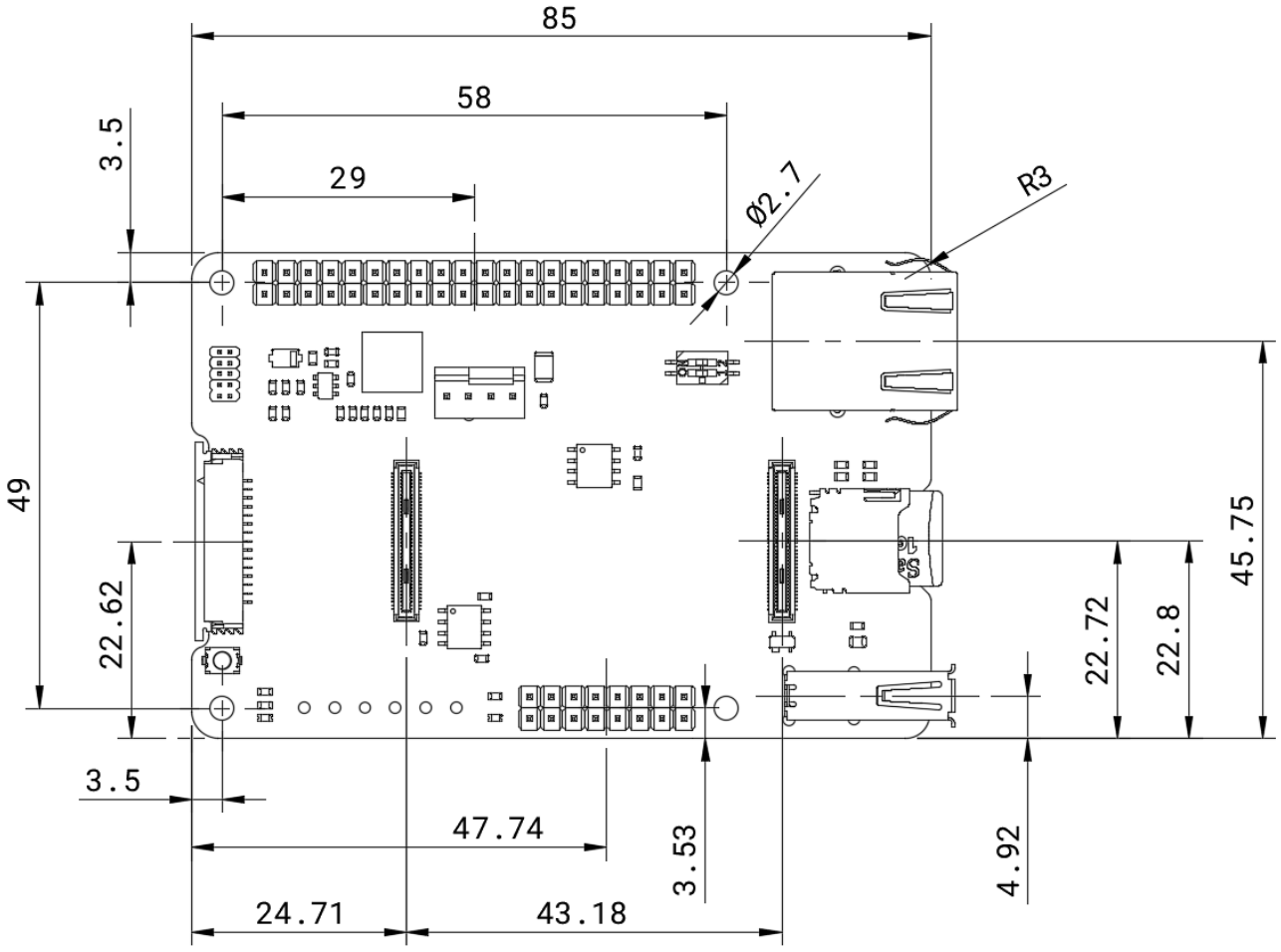


Figure 16. Portenta Hat Carrier board dimensions (in mm)

10 Certifications

10.1 Certifications Summary

Certification	Status
CE/RED (Europe)	Yes
UKCA (UK)	Yes
FCC (USA)	Yes
IC (Canada)	Yes
RoHS	Yes
REACH	Yes
WEEE	Yes

10.2 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).

10.3 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.

10.4 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.

11 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 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 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℃ 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 2014/53/EU. This product is allowed to be used in all EU member states.

12 Company Information

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

13 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
Arduino Portenta Hat Carrier Documentation	https://docs.arduino.cc/hardware/portenta-hat-carrier
Arduino Portenta X8 Documentation	https://docs.arduino.cc/hardware/portenta-x8
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/

14 Revision History

Date	Revision	Changes
02/11/2023	2	Flashing Mode Description
25/10/2023	1	First Release