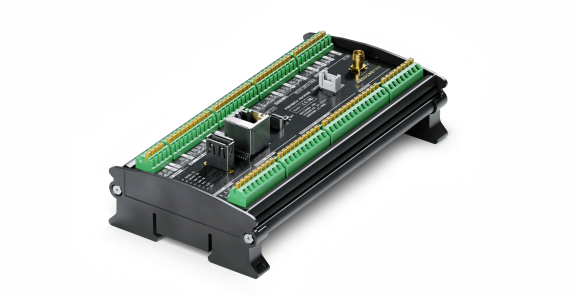
User Manual
SKU: AKX00032



Description

The Arduino® Portenta Machine Control is powered with a 24V DC power supply and provides several input/output digital and analog pins. This makes the board capable of driving high-power relays, sampling analog signals and measuring temperature with different probes.

Target Areas

Industry 4.0, system integrators

Features

- **STM32H747XI dual Cortex® Microcontroller**
  - Arm® Cortex®-M7 core at up to 480 MHz + Arm® 32-bit Cortex®-M4 core at up to 240 MHz
  - 2 MB of Flash Memory with read-while-write support
  - 1 MB of RAM
- **On-board memory**
  - 8 MB SDRAM
  - 16 MB Flash QSPI
- **NXP SE0502 secure element**
- **Power**
  - Input voltage: 24V DC +/- 20%
  - Output voltage: 24V DC
  - Reverse polarity protection
- **8x digital input channels**
  - 0-24V DC input
- **8x Digital output channels**
  - Non-galvanic isolated 24V power input
  - 8x High-side switches with current limit and inductive load kick-back protection
- **3x Analog input channels**

  Each channel is software configurable to be:
  - 0-10V input
  - 4-20mA input
  - NTC input with 3V voltage reference **REF3330AIRSER**
- **4x Analog output channels**
  - DC Voltage output software configurable: 0-10V DC
  - Max 20mA per channel
  - Analog Out Channel 2 with maximum period of ~1.3 ms (Recommended for high-frequency PWM signals)
  - Analog Out Channels 0, 1, 3 with standard timers
- **12x Digital programmable channels**
  - Non-galvanic isolated 24V power input
  - 12x High-side switches with current limit and inductive load kick-back protection
  - 12x Digital inputs

- **3x Temperature channels**

  Each channel is software configurable to measure:

  - Thermocouple K, non-grounded, front-end **MAX31855KASA+T**
  - Thermocouple J, non-grounded, front-end **MAX31855KASA+T** with software multiplication coefficient
  - PT100, front-end **MAX31865ATP+T**

- **2x Encoder channels ABZ**

  - 0-24V DC input

- **High-speed CAN**

  - **TJA1049T/3J** able to work at 12V/24V DC
  - On-board termination resistors

- **RS-232/RS-422/RS-485 software configurable**

  - **SP335ECR1-L** with onboard termination resistors. RS-485 is configurable to be half duplex or full duplex

- **I2C**

  - Grove connector
  - 10 kΩ pull-ups on board

- **Ethernet**

  - On-board LAN transformer

- **Full-speed USB-A connector**

- **Half-speed micro-USB Type B connector**

- **RTC**

  - At least 48 hours of memory retention

- **Wi-Fi®/Bluetooth® Low Energy**

  - SMA connector 50 Ω

Note: ESD protection on all inputs/outputs

Contents

1 The Board **6**
1.1 Application Examples 6
1.2 Related Products 6
1.3 Solution Overview 7
2 Ratings **7**
2.1 Recommended Operating Conditions 7
2.2 Absolute Maximum Ratings 8
3 Functional Overview **9**
3.1 Block Diagram 9
3.2 Board Topology 10
3.3 Digital Inputs 11
3.4 Digital Outputs 11
3.5 Programmable Digital I/O 11
3.5.1 Current Limit 11
3.5.2 Kick-Back Protection 12
3.6 Analog Input 12
3.7 Analog Output 12
3.8 Temperature Measurements 13
3.9 Front-Ends 13
3.10 Connecting Thermocouples 13
3.11 Connecting Two Wires RTDs (PT100) 14
3.12 Connecting Three Wires RTDs (PT100) 14
3.13 Encoders 14
3.14 CAN 14
3.15 RS-232/RS-422/RS-485 15
3.16 I2C 15
3.17 Ethernet 15
3.18 USB-A Connector 15
3.19 Micro-USB Connector 15
3.20 RTC 16
3.21 Power Tree 16
4 Board Operation **16**
4.1 Getting Started - IDE 16

4.2 Getting Started - Arduino Cloud Editor 17
4.3 Getting Started - Arduino Cloud 17
4.4 Online Resources 17
5 Connector Pinouts 17
5.1 Power Supply (J4) 17
5.2 HMI - Communication Protocols (J5) 17
5.3 Temperature Probes (J7) 18
5.4 Analog in (J9) 18
5.5 Analog Out (J11) 19
5.6 Digital Inputs (J3) 19
5.7 Digital Outputs (J6) 19
5.8 Programmable Digital I/O (J8) 20
5.9 Encoders (J10) 20
5.10 USB A (J15) 21
5.11 USB Micro (J16) 21
6 Mean Time Between Failure (MTBF) 21
7 Mechanical Information 22
7.1 Board Outline 22
8 Certifications 22
8.1 Declaration of Conformity CE DoC (EU) 22
8.2 Declaration of Conformity to EU RoHS & REACH 211 01/19/2021 23
8.3 Conflict Minerals Declaration 23
9 FCC Caution 24
10 Company Information 25
11 Reference Documentation 25
12 Revision History 25

1 The Board

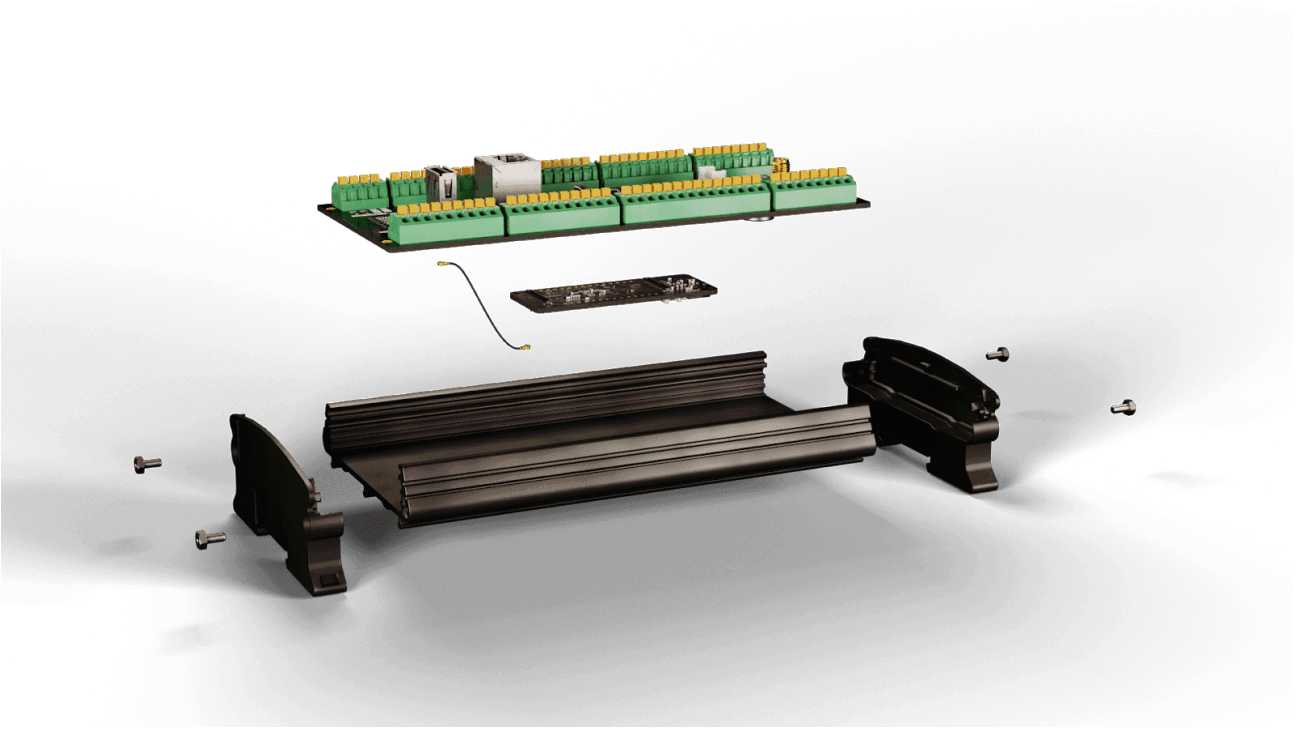
1.1 Application Examples

- **Food processing:** The Portenta Machine Control is the perfect solution to meet your food processing needs by providing control to your lab and industrial operation's demands across the beverage, drying, and fermentation fields. Access professional support from Arduino or take advantage of the community support to reduce your time-to-market. With the Portenta Machine Control, you will have real-time information about the status of your process being able to improve the yield and minimize waste by adjusting the food processing parameters using edge computing.
- **Glass bottle manufacturing:** Make use of the fast-edge computing capabilities of the Portenta range for minimal latency control of industrial components used in glass bottle manufacturing. Ensure the consistency of glass bottles created while simultaneously increasing the overall equipment effectiveness and increasing the generated revenue. Make use of custom thermal control algorithms to ensure optimum annealing processes with minimal resource consumption. All while increasing the bottles per minute ratio (BPM).
- **Packaging:** Develop and control machines that fill, freeze, wrap, seal, label, and much more to ensure that your product is safely packaged to reach your consumer. Interconnect different processes of your manufacturing line with Arduino's advanced technologies such as the Arduino Cloud infrastructure. Reduce labor costs and achieve a fully automated line with minimal human interaction to meet the strongest hygiene and quality standards.

1.2 Related Products

- Portenta H7

1.3 Solution Overview



The Portenta Machine control exploded view

2 Ratings

2.1 Recommended Operating Conditions

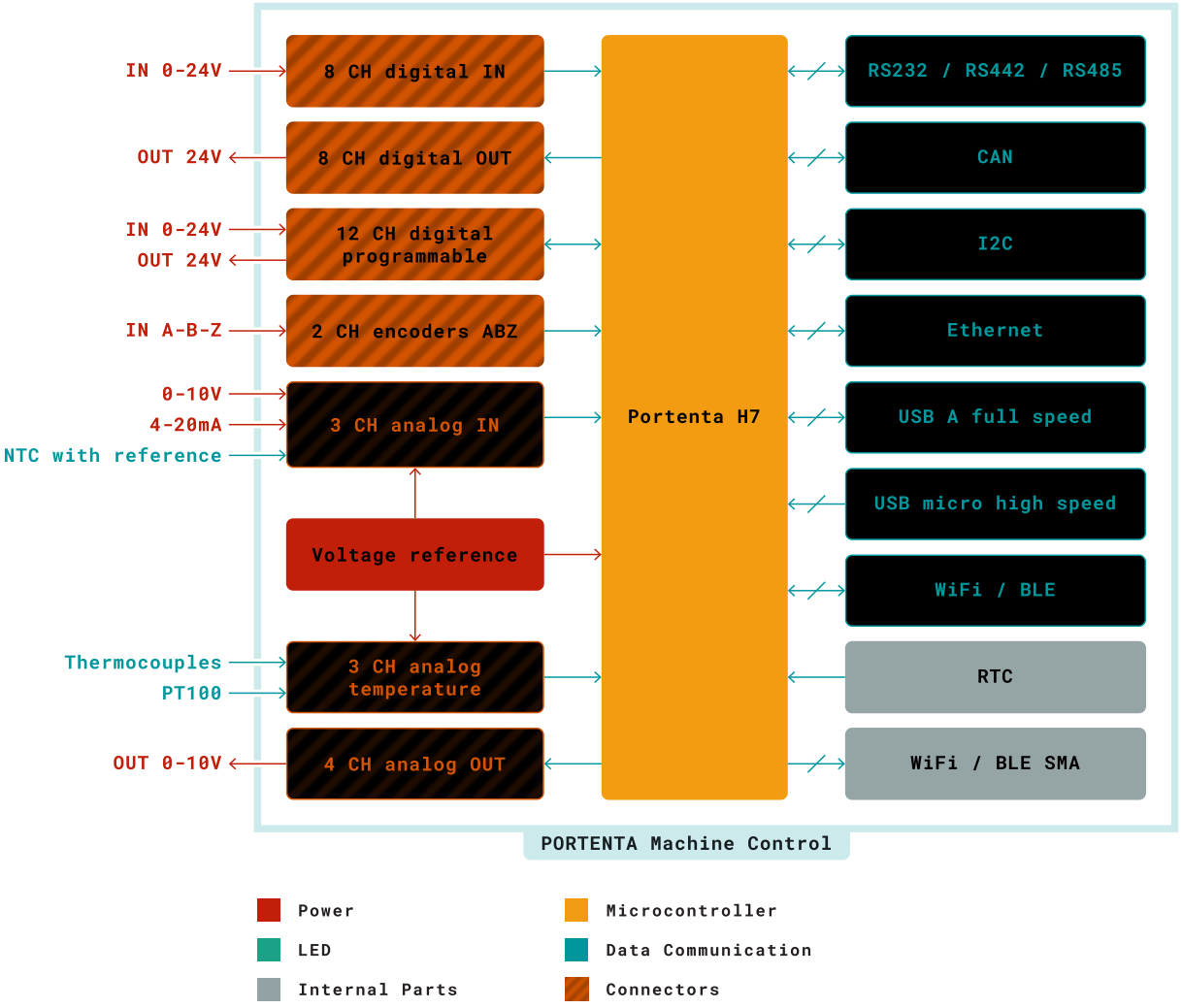
Symbol	Description	Min	Max
T_{Max}	Conservative thermal limits for the whole board:	-40 °C (-40°F)	85 °C (185 °F)

2.2 Absolute Maximum Ratings

Symbol	Description	Min	Typ	Max	Unit
V_{INMax}	Input voltage on PWR SUPPLY connector 24V IN pin	0	-	35	V
$V_{A_IN_0\text{-}10V}$	Input voltage on analog IN pins in 0-10V mode	0	-	13	V
$I_{A_IN_4\text{-}20mA}$	Input current on analog IN pins in 4-20mA mode	0	-	30	mA
$V_{A_IN_NTC}$	Input voltage on analog IN pins in NTC mode	0	-	3.5	V
V_{I2C}	I2C connector voltage	0	-	3.4	V
V_{D_IN}	Input voltage on DIGITAL IN connector channels. Exceeding 25V will trigger the ESD protection diodes.	0	-	25	V
V_{D_OUT}	Output voltage on DIGITAL OUT connector channels. It is the same as DIGITAL OUT connector pin 24V IN since it must be provided externally. Exceeding 25V will trigger the ESD protection diodes.	0	-	25	V
$V_{D_PROG_OUT}$	Output voltage on DIGITAL PROGRAMMABLE connector channels. It is the same as DIGITAL PROGRAMMABLE connector pin 24V IN since it must be provided externally. Exceeding 25V will trigger the ESD protection diodes.	0	-	25	V
I_{OUT_24V}	Maximum output current from any 24V OUT pin	0	-	500	mA
I_{OUT_ENC}	Maximum output current from any ENCODERS pin	0	-	2	mA

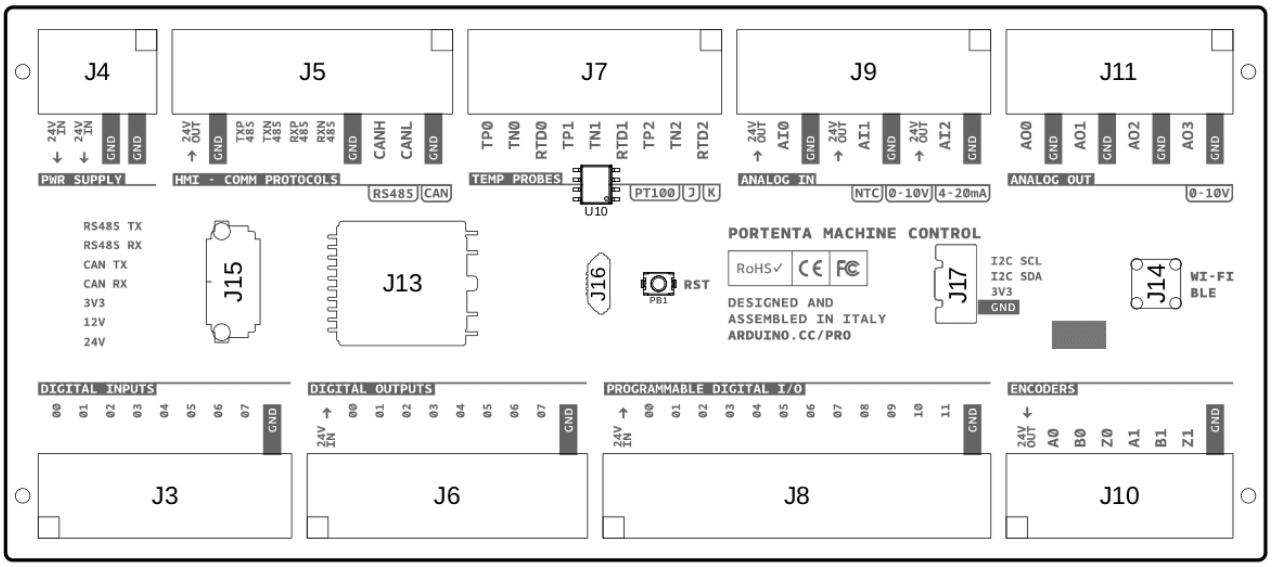
3 Functional Overview

3.1 Block Diagram



Block Diagram of Portenta Machine Control

3.2 Board Topology



Portenta Machine Control topology

Ref.	Description	Ref.	Description
J3	Digital inputs	J10	Encoders
J4	Power supply 24V	J11	Analog out
J5	HMI - Comm protocols (RS-232, RS-422, RS-485, CAN)	J13	Ethernet
J6	Digital outputs	J14	Wi-Fi® / Bluetooth® Low Energy SMA
J7	Temperature probes	J15	USB A
J8	Digital programmable	J16	USB micro
J9	Analog in	J17	Grove I2C
PB1	RESET Push Button	U10	MAX31855KASA+T Thermocouple converter

3.3 Digital Inputs

The digital inputs connector has 8x channels, each is a 680 kΩ and 100 kΩ resistor divider: a 0-24V input is scaled down to 0-3V.

3.4 Digital Outputs

The Portenta Machine Control has the following outputs specifications:

- 8x high side switches (2x **TPS4H160AQPWPRQ1**), one for each channel.
- The current limit nominal value is 0.6A per channel. Due to internal **TPS4H160AQPWPRQ1** circuit tolerances, the real value can be higher, up to 0.9A.

The digital output connector (J6) has a 24V IN pin which must be supplied with 24V DC. The 24V IN pin is not galvanically isolated: the input voltage must be referred to the same GND of the board.

The supply voltage can be the same 24V which is powering the board.

3.5 Programmable Digital I/O

The **programmable digital I/O** connector has a 24V IN pin which must be supplied with 24V DC.

The 24V IN pin is not galvanically isolated: the input voltage must be referred to the same GND of the board.

The supply voltage can be the same 24V which is powering the board. There are 3x **TPS4H160AQPWPRQ1** chipsets, one for each channel, having a total of 12x high-side switches.

3.5.1 Current Limit

- The nominal value is 0.6A per channel, however, due to the internal **TPS4H160AQPWPRQ1** circuit tolerances the real value can be reach up to 0.9A.
- It is possible to change the behavior of the 12 channels when the current limit is reached:
  - **Latch**: when the current limit is reached the channel is shut down and the co-respective channel *enable* pin must be toggled to activate the channel again.
  - **Retry**: when the current limit is reached the channel is shut down and re-connected after a short period of time.

3.5.2 Kick-Back Protection

There is an internal inductive loads kick-back protection with an additional external protection of a 60V, 2A Schottky diode **PMEG6020ER**:

- 12x digital input channels, each is a 680 kΩ and 100 kΩ resistor divider: a 0-24V input is scaled down to 0-3V. Although the high-side switches are independent of the digital input channels, it is possible to read the status of the high-side switches through the digital input channels.

3.6 Analog Input

The internal A/D converter of the microcontroller has a range resolution of 12-16 bits, delivering decimal values from 0 to a maximum of 65535 and being configurable by the user via software.

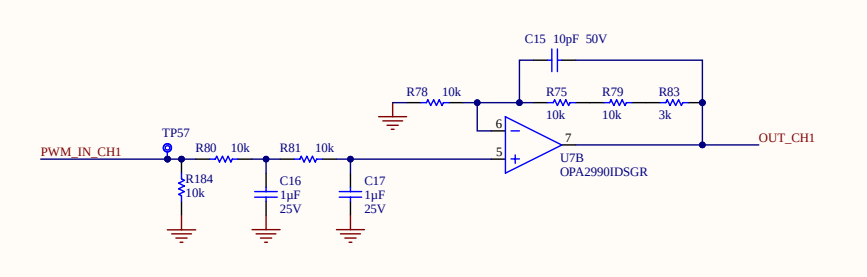
There are three independent analog input channels available. Each of them has an analog switch **TS12A44514PWR** which is switching between three modes:

- **0-10V**: The input is connected to a 100 kΩ and 39 kΩ resistor divider. A 0-10V input is scaled down to 0-2.8V. The input impedance is approximately 28 kΩ.
- **4-20mA**: The input is connected to a 120Ω resistor. Having 4-20mA current input for a 0.48V-2.4V voltage.
- **NTC**: The input is connected to a 3V voltage reference (**REF3330AIRSER**) with a 100 kΩ resistor in series, becoming part of a resistor divider powered by the voltage reference.

An output pin provides 24V to power sensors. A 500mA PTC resettable fuse protects the 24V output pin.

3.7 Analog Output

Four independent analog output channels are available. Each of them has a double low-pass filter and a high-current op-amp arranged in a non-inverting topology with a gain of 3.3.



Analog Output Circuit

At each input of each channel, a PWM from the Portenta board is provided and filtered by a double low-pass filter, obtaining a DC output with a small AC ripple. The signal is then fed to the channel non-inverting amplifier which amplifies it by 3.3.

The output signal is a DC whose amplitude is a function of the PWM duty cycle.

The maximum output current is 20mA per channel.

Analog Out Channel 2 (AO2) is connected to pin PG7 on the Portenta H7 and features an HRTIM (High-Resolution Timer) function. The HRTIM configuration includes a frequency of 200 MHz (tick time = 5 ns), a clock prescaler of 4, and a maximum period of 65533 ticks (1.31 ms). This results in a maximum period of ~1.3 ms, making AO2 suitable mainly for high-frequency PWM signals.

For applications requiring periods longer than 1.3 ms, consider using Analog Out Channels 0, 1, or 3, which use standard timers.

3.8 Temperature Measurements

Three independent temperature measurement channels are available.

Each channel can measure non-grounded thermocouples or PT100 sensors, but not both at the same time.

NOTE: **Do not connect both a thermocouple and a PT100 to one channel**. Only a single channel at a time is available to be read, according to the analog switch's position.

3.9 Front-Ends

There are two front ends on the board:

- MAX31855KASA+T dedicated to thermocouples.
- MAX31865ATP+T dedicated to PT100.

The front ends are multiplexed to the three channels via:

- A single low-ohmic single-pole double-throw analog switch **NX3L4053HR,115** which is switching between one front end or the other.
- Three quadruple single pole single throw analog switches **TMUX1511RSVR** which are switching the active channel between the three available.

3.10 Connecting Thermocouples

WARNING: Connect only **non-grounded** thermocouples. Do not connect a thermocouple and a PT100 to the same channel.

Connect a **thermocouple** to a channel CH (0-2):

- Connect the thermocouple positive pin to **TP**CH.
- Connect the thermocouple negative pin to **TN**CH.

NOTE: Depending on the region and normative, thermocouples can have different cables color codes. Please check the meaning of each cable code before connecting them do the device. Do not connect the thermocouple negative pin to GND.

3.11 Connecting Two Wires RTDs (PT100)

Connect a **two-wire RTD** to a channel CH (0-2):

- Connect one RTD pin to **TP**CH.
- Connect the other RTD pin to **TN**CH.
- Connect a jumper between TP0 and **RTD**CH.

NOTE: Depending on the region and normative, RTD sensors like the PT100 can have different cables color codes. Please check the meaning of each cable code before connecting them do the device. Do not connect the RTD negative pin to GND.

3.12 Connecting Three Wires RTDs (PT100)

Connect a **three-wire RTD** to a channel CH (0-2):

- Connect one RTD pin to **TP**CH.
- Connect a second RTD pin to **TN**CH. **Do not connect this pin to GND**.
- Connect the third RTD pin to **RTD**CH.

NOTE: Depending on the region and normative, RTD sensors like the PT100 can have different cables color codes. Please check the meaning of each cable code before connecting them do the device. Do not connect the RTD negative pin to GND.

3.13 Encoders

- Two independent ABZ encoder channels are available.
- Each channel is pulled-up to the board 24V supply with a 10 kΩ pull-up resistor.

3.14 CAN

The on-board transceiver is the **TJA1049T/3J** and implements the CAN physical layer as defined in *ISO 11898-2:2016* and *SAE J2284-1* to *SAE J2284-5*. It is compatible with a 12V or 24V bus:

- **Nominal** maximum data rate: 5 Mbit/s.
- Integrated ESD protection.
- 60 Ω termination resistors are on board, with 4.7 nF to GND.

A 500mA PTC resettable fuse protects the 24V OUT pin.

3.15 RS-232/RS-422/RS-485

The on-board transceiver is the **TJA1049T/3J**, which can be SW configured for RS-232, RS-442 or RS-485 half/full duplex:

- **Nominal** data rates are: 20 Mbps for the RS-485 and 1 Mbps for the RS-232.
- Selectable 250 kbps Slew Limiting.
- Integrated RS-485 120 Ω differential cable termination, inactive for RS-232.
- Integrated ESD protection.
- A 500mA PTC resettable fuse protects the 24V output pin.

3.16 I2C

- Grove connector.
- 10 kΩ pull-ups on board.

3.17 Ethernet

- On-board transformer.
- The 10/100 Ethernet physical interface is directly connected to the internal Ethernet MAC and provides full duplex communication with automatic *MDIX* support.

3.18 USB-A Connector

- Transfer rates of up to 480 Mbps.
- It can be used both as a host and as a device.
- ESD protection.

3.19 Micro-USB Connector

The Half-Speed USB interface of the Portenta board is connected to the micro-USB connector of the Portenta Machine Control.

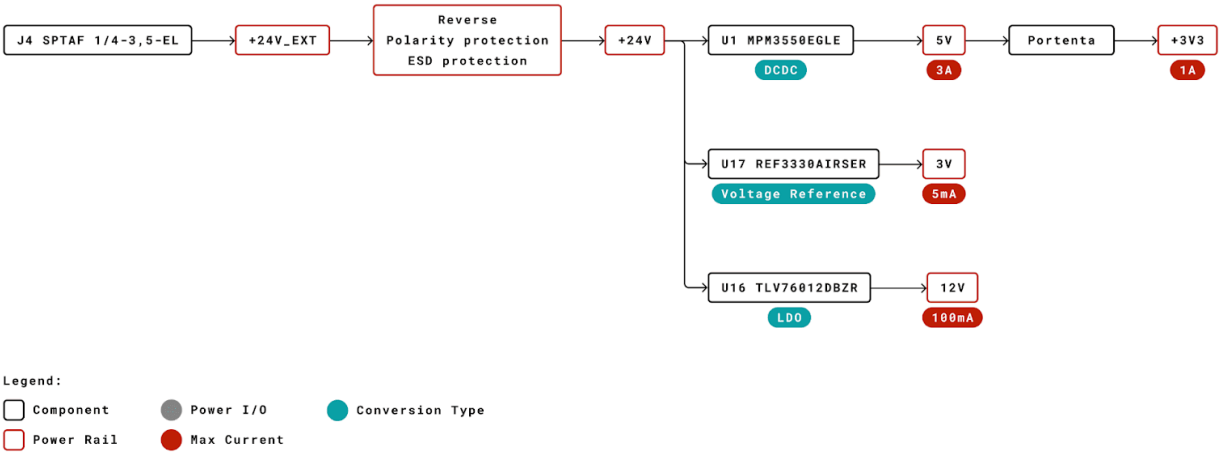
- It can be used to program the Portenta board via a micro-USB cable.
- It can be used to power the Portenta board while the 24V power supply is off.
- ESD protection.

3.20 RTC

The on-board real-time clock/calendar is the **PCF8563T/F4** which clock is provided by a dedicated external crystal oscillator:

- A 100 mF supercapacitor (**FC0V104ZFTBR24**) provides power to the **PCF8563T/F4** when the board power supply is disconnected. The RTC chipset will be powered by the supercapacitor for at least 48 hours.
- 32,768 kHz crystal clock (**Q13FC1350000400**).

3.21 Power Tree



Portenta Machine Control Power Tree

4 Board Operation

4.1 Getting Started - IDE

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

4.2 Getting Started - Arduino Cloud Editor

All Arduino boards, including this one, work out-of-the-box on the Arduino Cloud Editor [2], 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 [3] to start coding on the browser and upload your sketches onto your board.

4.3 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.

4.4 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.

5 Connector Pinouts

5.1 Power Supply (J4)

Pin	Type	Description
1	24V IN	Board input voltage, reverse polarity protected.
2	24V IN	Board input voltage, reverse polarity protected.
3	GND	GND
4	GND	GND

5.2 HMI - Communication Protocols (J5)

Pin	Type	RS-232	RS-485 Full Duplex/RS-422	RS-485 Half Duplex	CAN
1	24V OUT				
2	GND				
3	TXP 485		TX+	Data+	
4	TXN 485	TXD	TX-	Data-	
5	RXP 485	RXD	RX+		
6	RXN 485		RX-		
7	GND	Ground	Ground	Ground	
8	CANH/CAN TX				CAN_H
9	CANL/CAN RX				CAN_L
10	GND				Ground

5.3 Temperature Probes (J7)

NOTE: RTD (**R**esistance **T**emperature **D**etector) is a PT100 sensor.

Pin	Type	Channel	Description
1	TP0	00	Thermocouples P RTD P
2	TN0	00	Thermocouples N RTD N **NOTE:** DO NOT CONNECT THIS PIN TO GND
3	RTD0	00	RTD P third wire
4	TP1	01	Thermocouples P RTD P
5	TN1	01	Thermocouples N RTD N **NOTE:** DO NOT CONNECT THIS PIN TO GND
6	RTD1	01	RTD P third wire
7	TP2	02	Thermocouples P RTD P
8	TN2	02	Thermocouples N RTD N **NOTE:** DO NOT CONNECT THIS PIN TO GND
9	RTD2	02	RTD P third wire

5.4 Analog in (J9)

Pin	Type	Channel	Description
1	24V OUT	-	Output voltage connected to the board input voltage. A single PTC protects pins 1, 4, 7. PTC nominal value 0.5A
2	AI0	00	Analog input
3	GND	-	GND
4	24V OUT	-	Output voltage connected to the board input voltage. A single PTC protects pins 1, 4, 7. PTC nominal value 0.5A
5	AI1	01	Analog input
6	GND	-	GND
7	24V OUT	-	Output voltage connected to the board input voltage. A single PTC protects pins 1, 4, 7. PTC nominal value 0.5A
8	AI2	02	Analog input
9	GND	-	GND

5.5 Analog Out (J11)

Pin	Type	Channel	Description
1	AO0	00	Analog output
2	GND	-	GND
3	AO1	01	Analog output
4	GND	-	GND
5	AO2	02	Analog output
6	GND	-	GND
7	AO3	03	Analog output
8	GND	-	GND

5.6 Digital Inputs (J3)

Pin	Type	Channel	Description
1	00	00	Digital input
2	01	01	Digital input
3	02	02	Digital input
4	03	03	Digital input
5	04	04	Digital input
6	05	05	Digital input
7	06	06	Digital input
8	07	07	Digital input
9	GND	-	GND

5.7 Digital Outputs (J6)

Pin	Type	Channel	Description
1	24V IN	-	Input voltage: this voltage is (non galvanically) isolated with respect to the board input voltage.
2	00	00	Digital output
3	01	01	Digital output
4	02	02	Digital output
5	03	03	Digital output
6	04	04	Digital output
7	05	05	Digital output
8	06	06	Digital output
9	07	07	Digital output
10	GND	-	GND

5.8 Programmable Digital I/O (J8)

Pin	Type	Channel	Description
1	24V IN	-	Input voltage: this voltage is (non galvanically) isolated with respect to the board input voltage.
2	00	00	Digital programmable Input/Output
3	01	01	Digital programmable Input/Output
4	02	02	Digital programmable Input/Output
5	03	03	Digital programmable Input/Output
6	04	04	Digital programmable Input/Output
7	05	05	Digital programmable Input/Output
8	06	06	Digital programmable Input/Output
9	07	07	Digital programmable Input/Output
10	08	08	Digital programmable Input/Output
11	09	09	Digital programmable Input/Output
12	10	10	Digital programmable Input/Output
13	11	11	Digital programmable Input/Output
14	GND	-	GND

5.9 Encoders (J10)

Pin	Type	Channel	Description
1	24V OUT	-	Output voltage connected to the board input voltage. PTC protected with nominal value 0.5A
2	A0	00	Encoder A input
3	B0	00	Encoder B input
4	Z0	00	Encoder Z input
5	A1	01	Encoder A input
6	B1	01	Encoder B input
7	Z1	01	Encoder Z input
8	GND	-	GND

5.10 USB A (J15)

Pin	Description
1	VBUS
2	DN
3	DP
4	GND

5.11 USB Micro (J16)

Pin	Description
1	VBUS
2	DN
3	DP
4	ID
5	GND

6 Mean Time Between Failure (MTBF)

MTBF, which stands for Mean Time Between Failure, is calculated according to statistical device failures and indicates the reliability of a device.

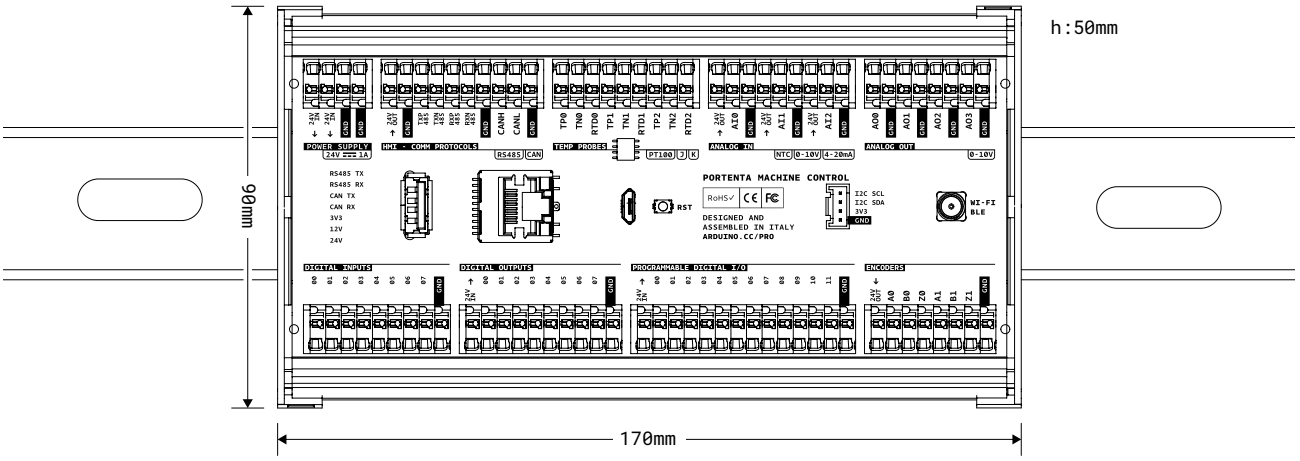
The MTBF figure (in hours/years) for the Portenta Machine Control can be found in the table below. The MTBF figure was calculated according to the MIL-HDBK-217F part count method.

Standard	Portenta Machine Control	Environmental Conditions
MIL-HDBK-217F	513550 h/58 years	25 °C

Important note: MTBF is the statistical representation of the likelihood of a unit failing and *does not necessarily represent a product's life*.

7 Mechanical Information

7.1 Board Outline



Portenta Machine Control Outline

8 Certifications

8.1 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).

ROHS 2 Directive 2011/65/EU Conforms to: EN50581:2012

Directive 2014/35/EU. (LVD) Conforms to: EN 60950-1:2006/A11:2009/A1:2010/A12:2011/AC:2011

Directive 2004/40/EC & 2008/46/EC & 2013/35/EU, EMF Conforms to: EN 62311:2008

8.2 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.

8.3 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.

9 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 minimum distance 20cm between the radiator & your body.

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 minimum distance 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.

10 Company Information

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

11 Reference Documentation

Reference	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
Arduino Pro Website	https://www.arduino.cc/pro
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/

12 Revision History

Date	Revision	Changes
19/11/2024	9	Updated analog output channel details
03/09/2024	8	Cloud Editor updated from Web Editor
06/02/2024	7	MTBF information
08/05/2023	6	RTD and thermocouples new information
11/04//2023	5	Updates and table improvements
13/10/2022	4	Big improvements and fixes
26/09/2022	3	Fix features indentation, update analog output diagram, fix format issues and update images reflecting the location change of the MAX31855KASA+T converter (top side)
09/05/2022	2	Remove PT1000, not compatible
13/04/2021	1	First release