

DESCRIPTION

Panda EDU Dock Rev.1 is an educational board designed to be used with the METE HOCA **Akana R1**, aiming to provide an experience of basic electronic components considered essential for starting STEM education and producing codes through hands-on experimentation.

The dock features **8 red 5mm LEDs** and an **RGB LED** that can mix three primary colors to achieve the desired hue. This allows users to create light games and learn the intricacies of coding flow.

The board includes **two potentiometers** that enable input of analog values to the Akana R1 and an **LDR** light sensor that measures ambient light levels. This allows users to experience utilizing analog inputs and create projects based on environmental light conditions.

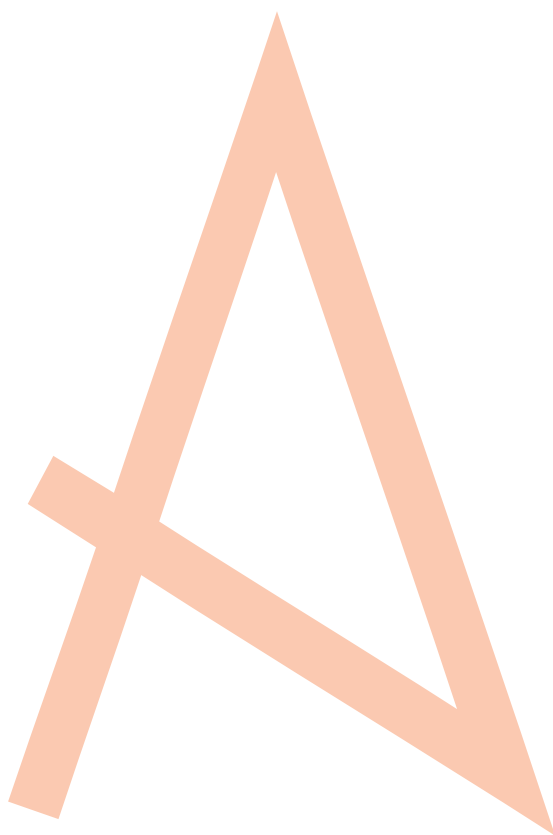
Additionally, the dock is equipped with a **PCT2075** high-precision **I2C temperature sensor** and a **piezo buzzer** capable of producing sound at desired frequencies. This makes it possible to develop temperature-sensitive projects and generate alert sounds when necessary.

In addition to the components on the Panda EDU Dock Rev.1, there are two **micro servo** connections and an **8-pin expansion connection** for additional components. The expansion connection has all the necessary pins for connecting external sensors and modules.

All components on the dock are compatible with the **RP2040** microcontroller on which the Akana R1 is based, and they operate at a 3.3 Volt logic level.

FEATURES

1. STEM-Specific PCB Design
 - a. Educational-friendly white color selection
 - b. Practical component layout
 - c. GPIO and name information under each component
2. 8 Red 5mm LEDs
 - a. 8-bit sequential positioning
 - b. Each connected to a separate GPIO pin
 - c. Current limiting resistors
 - d. LED name and GPIO label under each LED
3. 2 Potentiometers
 - a. Space-saving radio-type potentiometers
 - b. Voltage selection between 0-3.3V
 - c. Upward increasing design selection
 - d. Filter capacitor for stable selections
 - e. Connected to the analog pins of Akana R1
 - f. Potentiometer name and GPIO label beside each
4. RGB LED
 - a. Common 5050 model
 - b. Each color connected to a separate GPIO pin
 - c. Current limiting resistors
 - d. Circuit for equalizing brightness levels of different colors
 - e. GPIO label beside each color
5. LDR Light Sensor
 - a. Commonly used package
 - b. Increasing value design as darkness increases
 - c. Connected to the analog pin of Akana R1
 - d. GPIO label
6. PCT2075 Temperature Sensor
 - a. High-precision sensor selection
 - b. Easy usage with I2C data communication connection
 - c. Fixed I2C address (0x4A)
 - d. PCB design that reduces environmental effects
7. Piezo Buzzer
 - a. Passive buzzer capable of producing sound at desired frequencies
 - b. MOSFET circuit that does not load Akana R1
 - c. GPIO label
8. 2 Micro Servo Connections
 - a. Usage of SG90/SG92 type micro servos
 - b. Color-coded connections under the socket
9. Expansion Header
 - a. 3.3 Volt, 5 Volt, VIN, and GND power connections
 - b. SDA/SCL connections from the selected I2C channel of Akana R1
 - c. GP24 digital GPIO
 - d. GP29 analog/digital GPIO



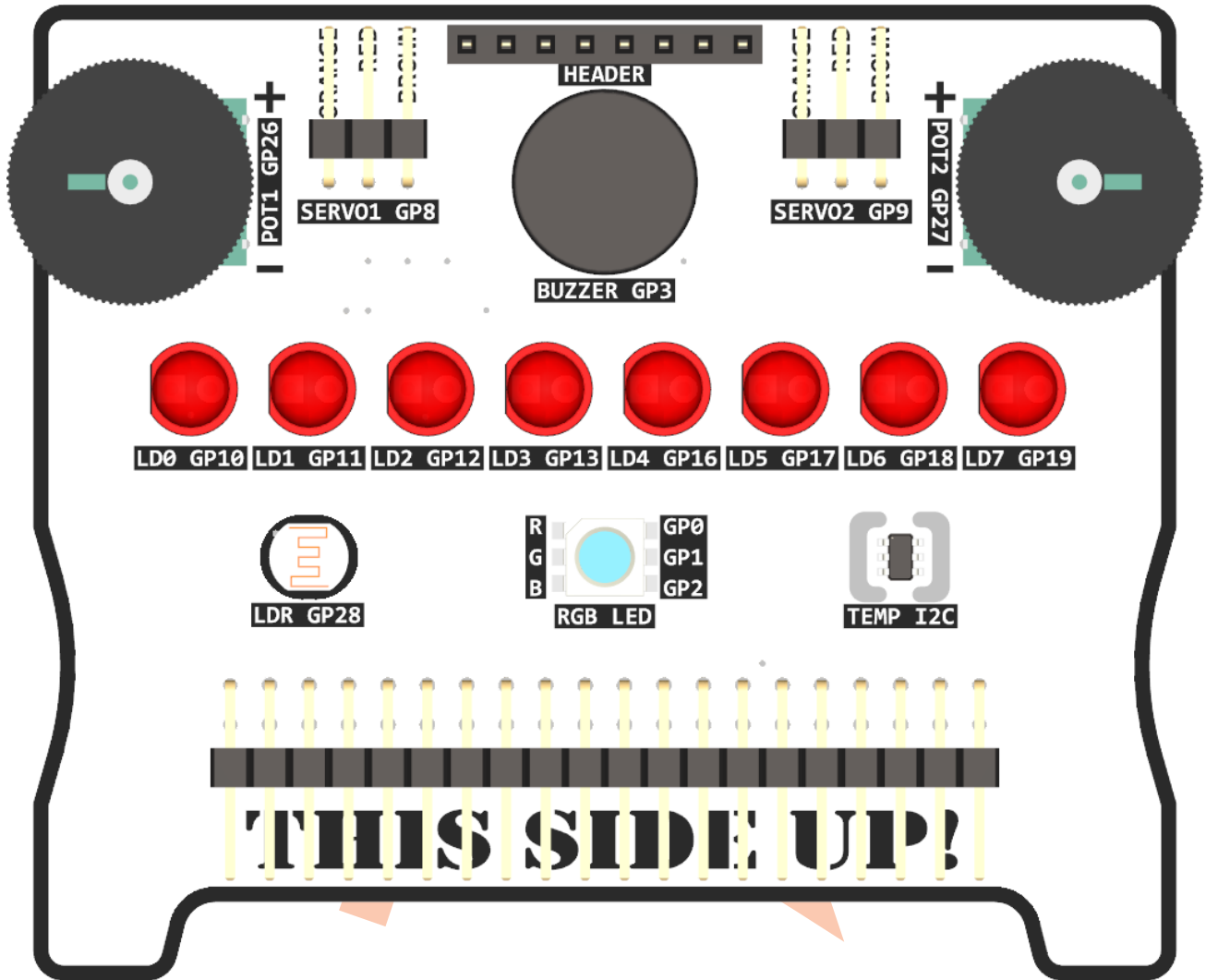
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USAGE GUIDELINES

Panda EDU Dock Rev.1 is sensitive to short circuits like any electronic device and can be damaged if placed on a conductive surface, if conductive objects fall on it, or in case of liquid contact.

Like all electronic boards, the Panda EDU Dock Rev.1 should never be used on metal surfaces, and no conductive objects should be allowed to touch it.



When the dock is not in use, it should be removed from the Akana R1 and stored in its package to avoid damage. Leaving cables connected to the expansion connector on the dock may cause the header socket to loosen over time and create connection issues.

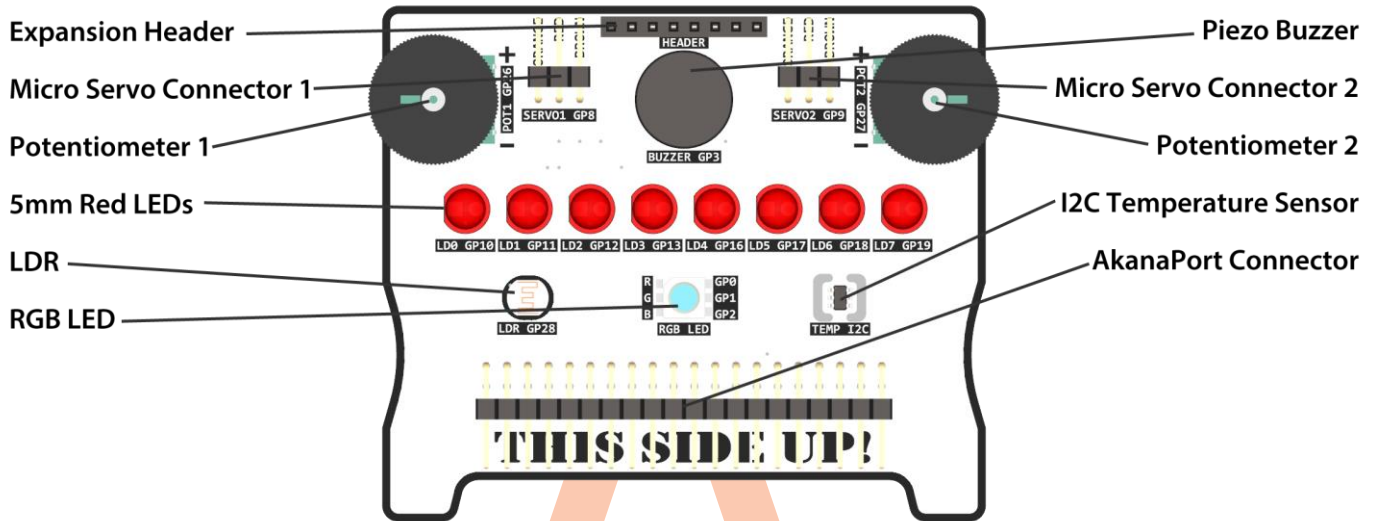
The maximum voltage that can be supplied through the VIN input on the dock is 14 volts. Supplying higher voltage may cause the voltage regulator on the Akana R1 to overheat and fail.

The maximum voltage that can be supplied through the 5V input on the dock is 5.5 volts. When powered through the 5V pin on the dock and Akana R1, it should not be connected to a computer via USB.

The maximum voltage that can be supplied through the 3V3 input on the dock is 3.5 volts. Supplying higher voltage can cause damage to the components on both the Panda EDU Dock and the Akana R1.

GETTING TO KNOW PANDA EDU DOCK REV.1

Below is the front view of the **Panda EDU Dock Rev.1**. The board connected to **AkanaPort**, the expansion slot of the **Akana R1** is built on the premise of connecting a component to each GPIO pin. All the basic electronic components, which are the first step in **STEM education**, are included on the board and can be used easily without the need for any wiring.



The first stage of microcontroller training is successfully turning an **LED** on and off. This is immediately followed by using a **button** to light the LED. The next step involves creating animations using multiple LEDs.

The buttons on the Akana R1 and the internal **GP25 LED** cover the first two stages of STEM education. For more advanced topics, a series of LEDs, the use of analog inputs, a **piezo buzzer**, and an **LDR light sensor** are included.

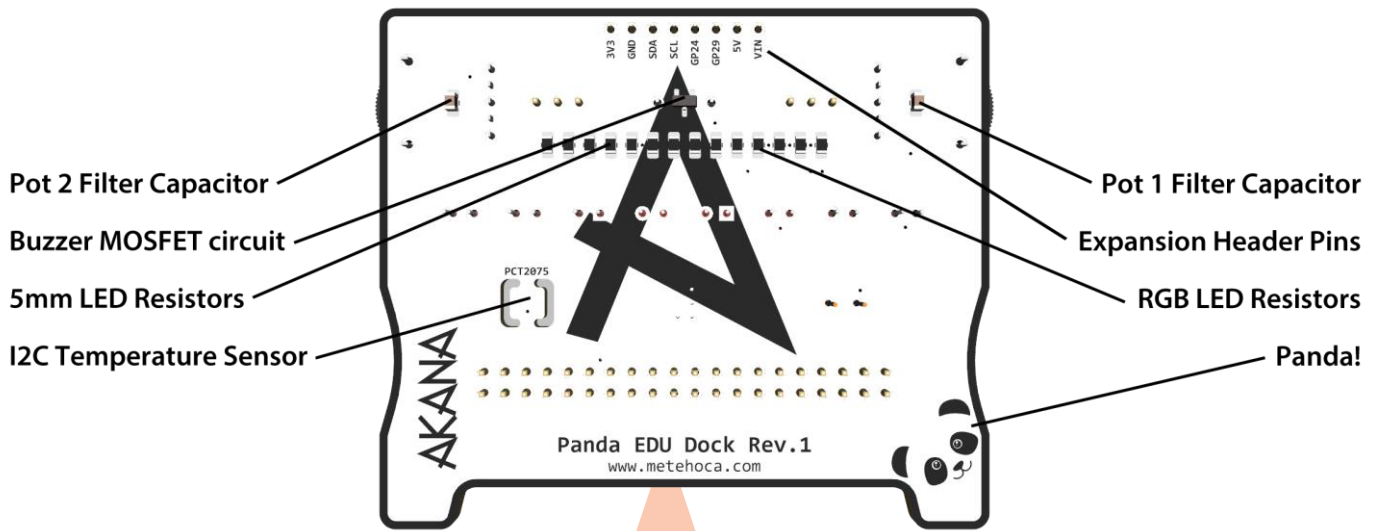
All the necessary components are carefully positioned on the Panda EDU Dock Rev.1. The high-precision **I2C temperature sensor** is also placed on the PCB in a way that is unaffected by environmental factors to experience temperature changes.

There are two connection points for connecting **micro servos**, which are part of the later stages of STEM education, and wire colors are indicated under the pins to help users connect the servos accurately.

To incorporate external sensors not included on the board into the system, an **expansion header** containing the necessary power, data lines, analog, and digital GPIO pins has been placed at the top and made user-friendly with colored labels.

The 8 pieces of 5mm red LEDs on the Panda EDU Dock Rev.1 have been selected with current-limiting resistors to ensure they do not glare and can be looked at for extended periods. This allows for longer work sessions and easy video recording of the projects.

The potentiometers on the board have been selected as easily adjustable radio-type models and send voltage selections between 0-3.3V to the analog inputs of the Akana R1. The two potentiometers on the sides are designed to increase the voltage when turned upward with a finger. Although the rotation directions are opposite, this method was preferred for its memorability in radio-type usage. Additionally, each potentiometer has a filter capacitor for accurate readings.



Above is the back view of the Panda EDU Dock Rev.1. The **filter and current-limiting components** of the devices on the dock are placed on the back to avoid distraction. Each component was positioned with the idea of ensuring an uninterrupted and seamless experience.

The **LDR light sensor** connected to the analog pin of the Akana R1 is designed to show higher values as the ambient darkness increases. This facilitates the writing of codes that will activate as **darkness rises**. To enhance the LDR's sensitivity to incoming light, its lower part has been prepared in black, allowing it to receive light from all directions.

Each color of the **RGB LED** on the dock is connected to a separate GPIO pin, and the pins to which the colors are connected are indicated next to the LED. Additionally, properly selected current-limiting resistors prevent the colors from illuminating at different brightness levels when the same values are sent. The RGB LED can be lit in a way that produces the desired color by sending different **PWM** signals to each color.

The **piezo buzzer** on the Panda EDU Dock Rev.1 allows sounds to be generated at the desired frequency. The piezo buzzer has a **MOSFET**-based driver circuit to ensure it can produce adequate sound levels without placing a load on the GPIO pin of the Akana R1.

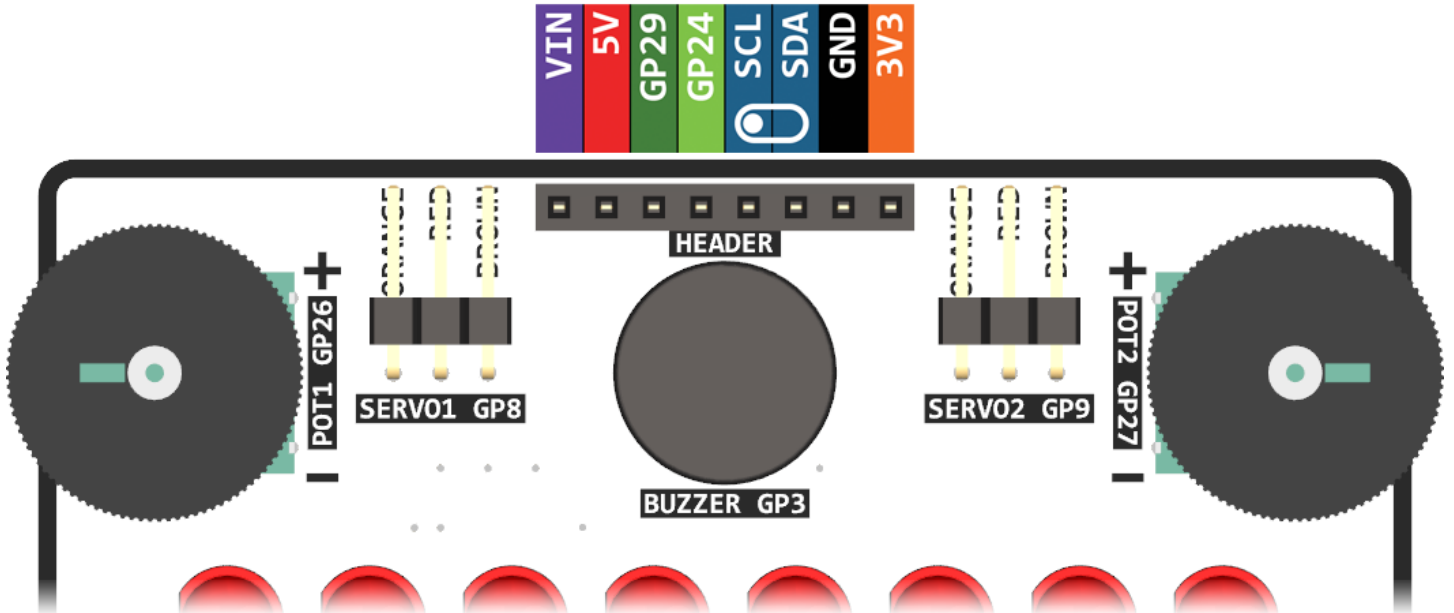
The **NXP**-produced PCT2075, which can measure with high precision, was chosen as the **I2C temperature sensor** on the board. Thanks to the internal ADC's Sigma-Delta conversion, the sensor can measure with an error margin of $\pm 1^\circ\text{C}$. Its measurement step is also a very precise value of 0.125°C .

To prevent the I2C temperature sensor from being affected by environmental factors on the PCB, it has been placed on an island created on the Panda EDU Dock Rev.1 PCB. This allows it to respond much more quickly to temperature changes in the environment. No copper fill was used in the area where the sensor is soldered, and the solder pads and traces have been kept as small as possible.

EXPANSION HEADER

Panda EDU Dock Rev.1 features an expansion connection called HEADER, which allows external sensors and modules to be connected.

This expansion connection consists of **8 female pins** and includes all necessary outputs to power components that can be connected externally, as well as essential GPIO connections for transferring data to be read or sent.



Above, the pin functions of the HEADER connection on the Panda EDU Dock Rev.1 are shown. A single HEADER connection includes power lines, analog and digital GPIO pins, and an I2C channel.

The VIN, 5V, 3V3, and GND lines are the power channels of the expansion connection. Up to 14 volts can be supplied from the **VIN** input to power the **Akana R1**, and when this is done, power can also be obtained from the **5V and 3V3** channels. Alternatively, when the Akana R1 is powered via USB, external components can be powered using the voltage obtained from the 5V and 3V3 channels.

The **SDA** and **SCL** pins of the selected **I2C** channel, according to the I2C channel selection switch on the Akana R1, are also present on the connection. This makes it possible to operate external I2C components alongside the I2C OLED display on the Akana R1 and the I2C temperature sensor on the Panda EDU Dock Rev.1.

Care should be taken to ensure that the Akana R1 operates at a **3.3 Volt logic level**. To prevent damage to the Akana R1 and Panda EDU Dock Rev.1, components used on the **I2C channel and other GPIO pins** must also operate at a 3.3 Volt logic level.

The **GP24** and **GP29** GPIO pins of the Akana R1 are also present on the HEADER. GP24 is a general-purpose **digital I/O** pin, while GP29 can be used as both a digital I/O and an **analog input**. Thus, it is possible to use digital or analog connections outside of the dock with the dock and the Akana R1.

It should be remembered that these GPIO pins, like the others, also operate at a 3.3 Volt logic level.

PANDA EDU DOCK REV.1 FUNCTION TABLE

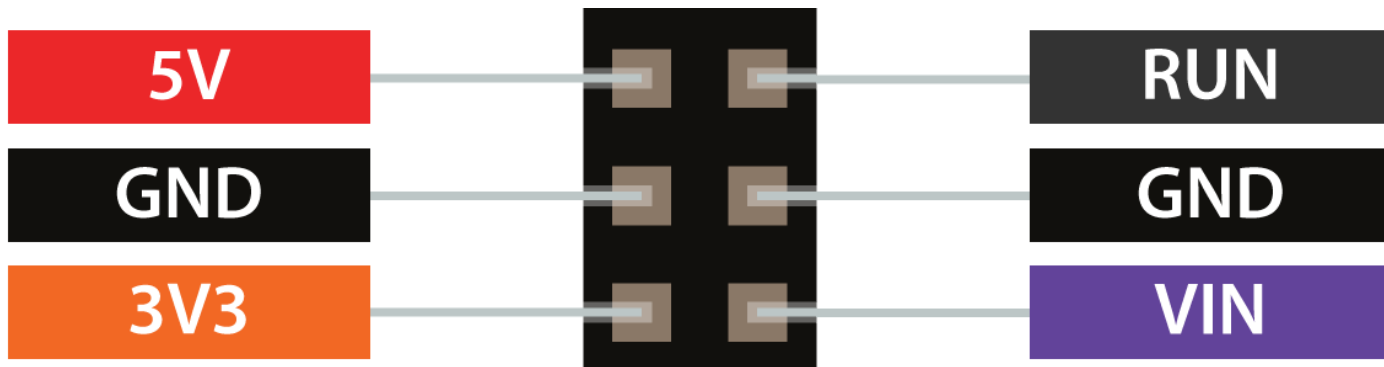
Pin	Type	Function	Description
GP0	Output	RGB-RED	Red color of the RGB LED; can be used with PWM
GP1	Output	RGB-GREEN	Green color of the RGB LED; can be used with PWM
GP2	Output	RGB-BLUE	Blue color of the RGB LED; can be used with PWM
GP3	-	-	Not used on the dock
GP4	I2C0	I2C0 SDA	Default I2C0 SDA pin; Should be reserved for I2C devices
GP5	I2C0	I2C0 SCL	Default I2C0 SCL pin; Should be reserved for I2C devices
GP6	I2C1	I2C1 SDA	Default I2C1 SDA pin; Should be reserved for I2C devices
GP7	I2C1	I2C1 SCL	Default I2C1 SCL pin; Should be reserved for I2C devices
GP8	Output	SERVO 1	Signal connection of SERVO 1
GP9	Output	SERVO 2	Signal connection of SERVO 2
GND	Power	HEADER	Ground connection
GP26	Analog Input	POT 1	Left potentiometer pin; can read analog values
GP27	Analog Input	POT 2	Right potentiometer pin; can read analog values
GP28	Analog Input	LDR	LDR light sensor pin; can read analog values
GP29	Analog Input	HEADER	Analog GPIO pin on the Expansion Header
SDA		I2C SDA	SDA pin of the I2C channel selected by the I2C selector
SCL		I2C SCL	SCL pin of the I2C channel selected by the I2C selector
5V	Power	HEADER	5V regulated from the USB or received from the VIN input
GND	Power	HEADER	Ground connection
3V3	Power	HEADER	3.3 Volt regulator output; the main power line of the Akana R1

Pin	Type	Function	Description
GP10	Output	LD0	5mm Red LED; can be used either digitally or with PWM
GP11	Output	LD1	5mm Red LED; can be used either digitally or with PWM
GP12	Output	LD2	5mm Red LED; can be used either digitally or with PWM
GP13	Output	LD3	5mm Red LED; can be used either digitally or with PWM
GP14	Digital I/O	BTN_ENTER	ENTER button pin; should be avoided
GP15	Digital I/O	BTN_BACK	BACK button pin; should be avoided
GP16	Output	LD4	5mm Red LED; can be used either digitally or with PWM
GP17	Output	LD5	5mm Red LED; can be used either digitally or with PWM
GP18	Output	LD6	5mm Red LED; can be used either digitally or with PWM
GP19	Output	LD7	5mm Red LED; can be used either digitally or with PWM
GND	Power	HEADER	Ground connection
GP20	Digital I/O	BTN_LEFT	LEFT button pin; should be avoided
GP21	Digital I/O	BTN_RIGHT	RIGHT button pin; should be avoided
GP22	Digital I/O	BTN_UP	UP button pin; should be avoided
GP23	Digital I/O	BTN_DOWN	DOWN button pin; should be avoided
GP24	Digital I/O	HEADER	Digital GPIO pin on the Expansion Header
GP25	Digital I/O	LED	Onboard user LED
RUN	System	RESET	RP2040 reset pin
GND	Power	HEADER	Ground connection
VIN	Power	HEADER	Maximum power input of up to 14 volts

ELECTRICAL CHARACTERISTICS AND LIMITS

Panda EDU Dock Rev.1, shares the same electrical limitations as the **Akana R1**, with which it is used.

The RP2040 microcontroller on the Akana R1 operates at a **3.3 Volt logic level**. Therefore, any sensors, modules, or other electronic circuits used with the Akana R1 should be selected to operate at 3.3 Volts.



The entire design of the Akana R1 is based on a **3.3 Volt** foundation, and every component on the board operates at this voltage. The **3.3 Volt regulator** (AP2112K-3.3TRG1) on the board uses the voltage supplied through the 5 Volt regulator connected to the USB or VIN input to power all components that operate at 3.3 Volts, primarily the RP2040 microcontroller and the OLED screen.

To enable the use of components that require 5 Volts, such as **WS2812** series addressable LEDs or **micro servo** motors, the Akana R1 also features a 5 Volt output. This 5 Volt output is provided by the **5 Volt regulator** (AMS1117-5.0) connected either through the USB line or the VIN input on the AkanaPort.

The electrical values of the power components and the power pins on the AkanaPort are as follows:

- **RP2040 GPIO voltage:** Maximum 3.5 Volts
- **Onboard OLED display:** Maximum 3.5 Volts
- **AkanaPort 5V supply:** Maximum 5.5 Volts
- **AkanaPort 3.3V supply:** Maximum 3.5 Volts
- **AkanaPort VIN supply:** Maximum 14 Volts

To power the Akana R1 with a single-cell Li-Ion or Li-Po battery, the **5V** supply input should be used. These types of batteries provide a voltage between 3.7 and 4.2 volts when fully charged, which is sufficient for the onboard 3.3V regulator to produce the required voltage. For operating the Akana R1 with a two or more cell battery, the **VIN** (Voltage In) pin should be used.

The VIN input on AkanaPort is protected against reverse polarity with a **Schottky diode**. However, there is no such protection on the 5V and 3.3V lines, so it is crucial to be very careful when powering the board through these lines.



VERSIONS

METE HOCA Panda EDU Dock Rev.1 Versions

Date	Changes
19 May 2024	First version; Rev.1

Document Versions

Date	Changes
19 May 2024	Initial release

