OPERATING INSTRUCTIONS

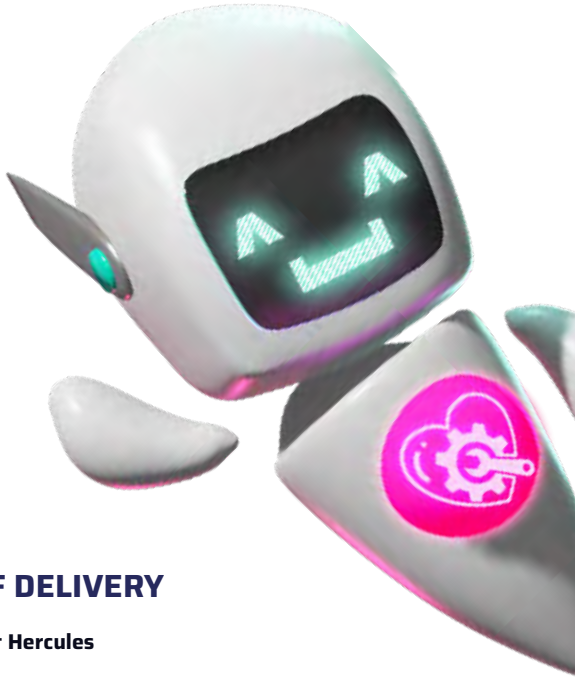
ROBOHEART HERCULES
REV. 1.0
OPERATING INSTRUCTIONS

Thank you for choosing the RoboHeart Hercules to give your projects a heart!

The RoboHeart was developed by makers for makers. As passionate makers, we were looking for the ideal board to control our self-built robots but couldn't find what we were seeking. Therefore, we decided to get active ourselves and create a board that meets our needs and ideas.

This board, designed based on the needs we encountered in our own projects, addresses the requirements and challenges we face as makers worldwide. That is why RoboHeart brings together a range of essential functions in one board, setting the stage for successful projects.

The RoboHeart is more than just a technical tool - it's the heart that brings your projects to life. It's a board that we like to use for our own projects, and we hope you'll enjoy it as much as we do!



SCOPE OF DELIVERY

- **RoboHeart Hercules**
- **Operating instructions**

Before you can get started with RoboHeart, there are a few points to consider.

Please read the operating instructions before using the RoboHeart!

For reasons of better readability alone, the simultaneous use of male, female and other personal designations is dispensed with. All personal designations apply to all gender forms. This in no way implies discrimination against the other gender, but is to be understood as gender-neutral.

TABLE OF CONTENTS

OVERVIEW

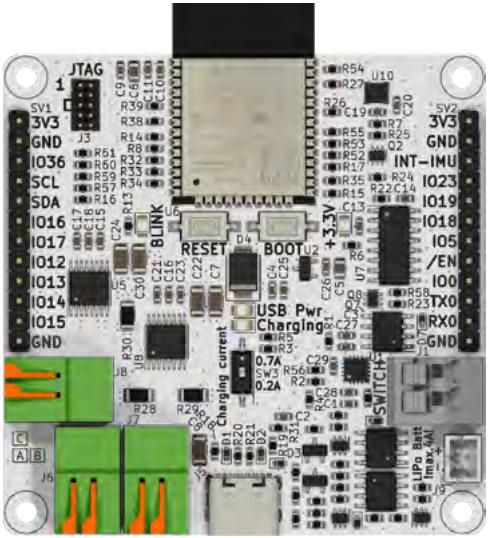


Figure 1: RoboHeart Hercules – top view

The RoboHeart Hercules from Augmented Robotics is a microcontroller board based on the ESP32 from Espressif. The microcontroller can communicate with other devices via 2.4 GHz Wi-Fi, Bluetooth and Bluetooth Low Energy via an on-board antenna. It is possible to set up your own Wi-Fi access point with RoboHeart. A dedicated app for Bluetooth communication with a smartphone (iOS and Android) is provided by Augmented Robotics.

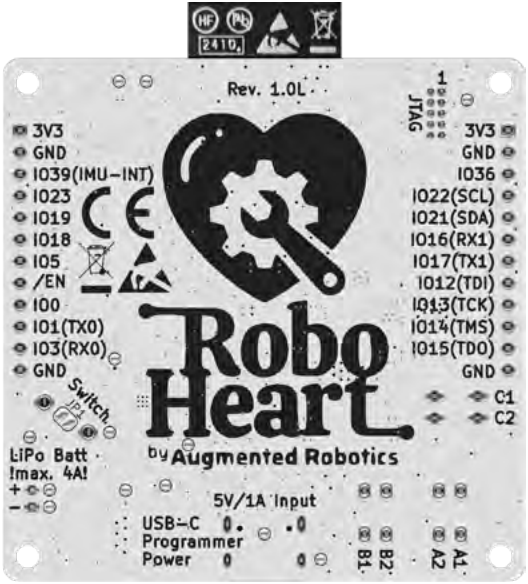


Figure 2: RoboHeart Hercules – bottom view

RoboHeart has 8 digital input/output pins and 6 digital/analog input/output pins.

SUMMARY

Microcontroller module	**ESP32-WROOM-32E**
Processor	Xtensa dual-core 32-bit LX6
Processor frequency	up to 240 MHz
Memory	448 KB ROM, 520 KB SRAM, 8 MB Flash
Serial interfaces	UART, SPI, I2C, LED PWM, motor PWM, JTAG
Wireless connectivity	Wi-Fi 802.11b/g/n, Bluetooth® V4.2, Bluetooth® Low Energy
IMU	**LSM6DS3TR-C**
Digital acceleration sensor	3-axis, ±2 g, ±4 g, ±8 g, ±16 g
Digital gyroscope	3-axis, ±125 dps, ±250 dps, ±500 dps, ±1000 dps, ±2000 dps
Resolution	16-bit
Built-in features	Free-fall detection, wake-up function, orientation in 6 degrees of freedom
Motor connections	
Motor driver	2 x DRV8833PWPR
Maximum voltage A/B/C	max. 4.5 V (depending on the battery voltage)
Maximum peak output current at the motor block A	1 A
Maximum peak output current at the motor block B	1 A
Maximum peak output current at the motor block C	2 A

USB	
USB connection	USB-C 2.0
USB input voltage	5 V
USB input current	max. 1 A
USB charging current	Switchable between 0.2 A and 0.7 A
More	
JTAG connection	2x5 pins, 1.27 mm spacing
Compatible battery type	LiPo: 1 cell (1S, rated voltage 3.7 V)
Battery connection	JST-PH 2.0 mm
Maximum discharge current	4 A
Dimensions	61 x 61 mm (without antenna)
Size of the mounting holes	M2.5
Weight	25 g
Maximum current on 3V3 pin	100 mA
Operating temperature	0 °C to 45 °C

SAFETY INSTRUCTIONS

1. Safety and operation

- The RoboHeart is not a toy! Keep it away from children.
- The product may only be set up, operated or stored in a place that is inaccessible to children. The same applies to rechargeable batteries.
- Never operate a visibly damaged RoboHeart.
- Do not modify RoboHeart by replacing or repairing components unless this is expressly recommended in the user manual or on the official RoboHeart website. Improper modifications may render the RoboHeart unusable or dangerous to use.

2. General safety precautions

- Handling packaging materials: Avoid packaging materials being accessible to children to prevent the risk of suffocation.
- Replacement and repair: Ensure that all repairs and component replacements are carried out by qualified personnel or the manufacturer's service department to ensure safety.

3. Electrical safety

- Do not connect the RoboHeart to a power source until you have connected all peripheral components (such as DC motors, switches, sensors, etc.). No „hot plugging" of peripheral components as long as the RoboHeart is switched on.
- Make sure that the USB cable is connected to the RoboHeart, and the battery cables are not crushed or damaged by sharp edges. Do not place any objects on the cables.
- Pay attention to the maximum voltages and never exceed them.
- The RoboHeart can be operated via a single-cell LiPo battery

(not included) with a nominal voltage of 3.7 V and a maximum current of 4 A or via a USB-C cable with a nominal voltage of 5.0 V and a maximum current of 1 A.

- Avoid touching the RoboHeart if you are electrostatically charged, as it is susceptible to electrostatic discharge (ESD).

4. Handling the RoboHeart

- Handle the product with care; bumps, knocks or a fall can damage it.

- Keep the RoboHeart away from dust and dirt as well as flammable or highly flammable materials (e.g. paper).

- Make sure that the RoboHeart can radiate the heat generated during operation and that there is enough space for it to dissipate heat through passive convection cooling, especially under high loads.

- Avoid operating the RoboHeart in the immediate vicinity of strong magnetic or electromagnetic fields, transmitting antennas or RF generators, as these can affect the components on the board.

5. Ambient conditions

- Do not operate the RoboHeart in rooms or in adverse ambient conditions where flammable gases, vapors or dusts are present or may be present. There is a risk of explosion.

- Never use the RoboHeart at temperatures below 0 °C or above 45 °C.

- Do not use the RoboHeart inside vehicles and only operate it in temperate climates, never in tropical climates.

- Make sure that no containers filled with liquid, vases or plants are placed on or next to the RoboHeart to avoid contact with moisture and wetness.

6. Emergency measures

- Safety shutdown: Make sure that there is a way to quickly disconnect the RoboHeart from the power source in the event of an emergency.

7. Storage and disposal

- Store the RoboHeart in a dark, dry and ESD-protected place. Protect it from direct sunlight.

- Do not place the RoboHeart on valuable furniture surfaces without suitable protection to avoid scratches, pressure marks or discoloration. The same applies to the battery.

- Never use the RoboHeart immediately after it has been moved from a cold room to a warm room. The resulting condensation can lead to malfunctions or damage.

- If it can be assumed that safe operation is no longer possible, take the RoboHeart out of operation and secure it against unintentional operation. Disconnect it from the power supply and take it to a specialist workshop or dispose of it in an environmentally friendly manner.

8. Further information

- If you are unsure about the correct operation or if you have any questions that are not answered in the operating instructions, please contact us or another specialist.

⚠ SAFETY INSTRUCTIONS FOR RECHARGEABLE BATTERIES

Although the use of rechargeable batteries is now a matter of course in everyday life, they pose numerous dangers and problems. Although no rechargeable battery is included in the scope of delivery, safety is our top priority, and we want to inform users about precautionary measures when handling rechargeable batteries. Especially with LiPo batteries, which have a higher energy density than conventional NiCd or NiMH batteries, various safety measures must be observed, otherwise there is a risk of explosion and fire. It is therefore essential to observe the following information and safety instructions. If additional information is provided by the battery manufacturer, read and follow it carefully!

1. General safety

- Batteries are not toys. Keep them out of the reach of children.
- Do not leave batteries lying around as they could be swallowed by children or pets. If this happens, consult a doctor immediately.
- Improper use of batteries or failure to observe the battery manufacturer's safety recommendations in connection with the RoboHeart can result in a short circuit or overload of the battery, which can lead to a fire or explosion. There is danger to life!
- Never charge damaged, leaking or deformed batteries. Dispose of them in an environmentally friendly manner.

2. Handling and storage

- Store batteries in a suitable place and install a smoke detector in the room. The risk of fire or toxic smoke cannot be ruled out.
- Fire protection: Store LiPo batteries in fireproof containers or special LiPo bags.
- Temperature monitoring: Store batteries at room temperature

and avoid extreme temperatures. The optimum storage temperature is between 15 °C and 25 °C.

- Never damage the outer casing of a battery. There is a risk of fire and explosion.
- Do not charge batteries that are still hot. Let them cool down to room temperature before charging them.
- Recharge batteries approximately every 3 months to avoid deep discharge.
- Never store damaged or inflated lithium batteries in an apartment, house or garage.

3. Transportation of batteries

- Transport containers: Use fireproof containers or special LiPo battery bags for transportation.
- Charge level: Transport LiPo batteries in a partially charged state (approx. 30-50 %) to minimize the risk of damage and fires.

4. Charging and discharging

- The RoboHeart is suitable for charging a single LiPo battery with one cell (nominal voltage 3.7 V). Never charge other battery types or non-rechargeable batteries.
- Never charge batteries unattended. Despite the extensive protective circuits on the RoboHeart, malfunctions or problems when charging and discharging a battery cannot be ruled out.
- Place RoboHeart and the battery on a non-flammable, heat-resistant surface and keep it away from flammable objects. Do not cover the RoboHeart and the battery when charging.
- The charging current can be set between 0.2 A and 0.7 A using a switch. Never operate the switch during the charging process. Always observe the maximum charging current of the battery specified by the battery manufacturer. At 0.7 A, the

battery charges quickly, but if it is not designed for this by the manufacturer, there is a risk of fire or explosion!

- When charging: Place the RoboHeart and the battery on a non-flammable, heat-resistant surface. Keep sufficient distance from flammable objects. Leave sufficient distance between RoboHeart and battery, do not place the battery on the RoboHeart.

- Make sure that the RoboHeart and the battery are sufficiently ventilated during the charging and discharging process.

5. Operation and use

- Observe the polarity of the battery when connecting (plus sign and minus sign), otherwise there is a risk of fire and explosion. The RoboHeart has a protection circuit against incorrect polarity. Nevertheless, incorrect polarity can lead to damage in certain situations.

- Avoid using bent, burnt or otherwise damaged batteries.

- Pay attention to the C-rate of the battery, which indicates the maximum discharge current. Only use batteries that can deliver a discharge current of 5 A or more.

- Disconnect the battery from RoboHeart if it is not going to be used for a longer period of time.

6. Precautionary measures

- Batteries must never be short-circuited, dismantled or thrown into a fire. There is a risk of fire and explosion.

- Ensure that the lithium battery is not over-discharged. Deep discharging leads to permanent damage to the battery.

- Avoid mechanical stress on the battery and never pull on the connection cables.

- Ensure that the battery does not overheat during operation, charging or discharging, transportation and storage. Do not

place the battery next to heat sources and keep it away from direct sunlight.

7. **Emergency measures**

- If the battery is damaged or the outer casing is inflated, stop using the battery. Do not charge it and dispose of it in an environmentally friendly manner. Use protective gloves when handling damaged batteries.

PINOUT

Your RoboHeart has many connection options, which are explained below.

Here you can see them all at a glance:

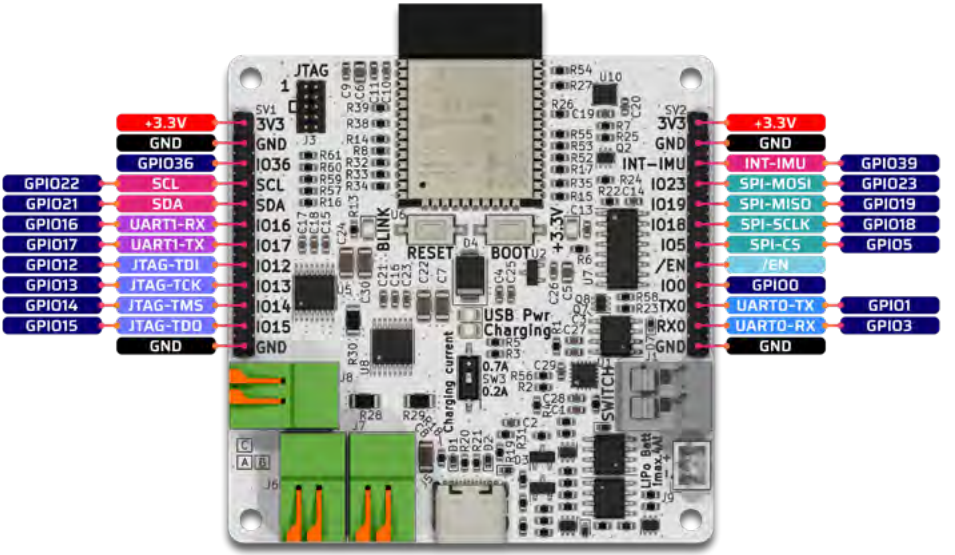


Figure 3: RoboHeart Hercules all pins – top view

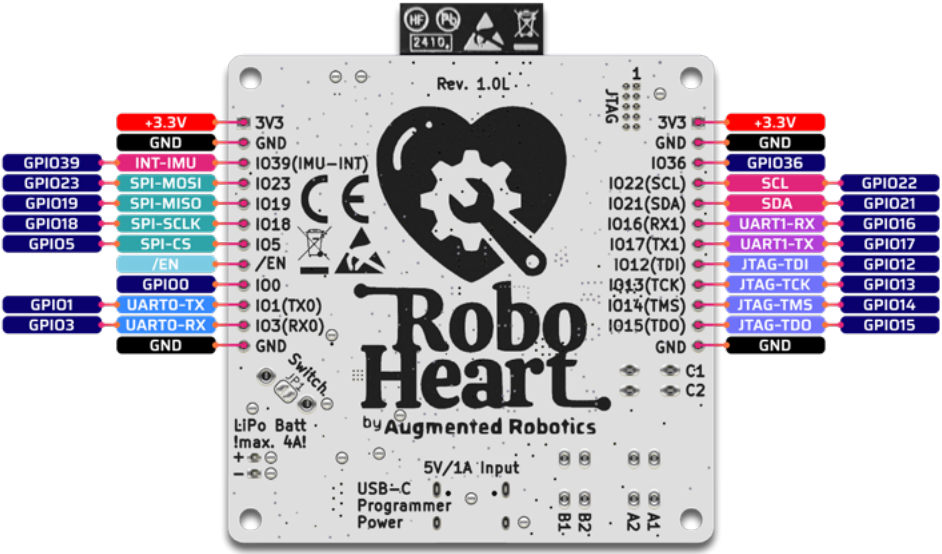


Figure 4: RoboHeart Hercules all pins - bottom view

SWITCHES

The RoboHeart has a connector to which you can connect your own external switch (not included). The connector is marked *SWITCH* or *J1* on the board.

You have three options for using the connector:

SWITCH - Option 1: External switch

As shown in the following *Figure 5*, this switch is capable of disconnecting the main power supply. This is useful if you want to install the RoboHeart in your own housing, so you can attach a separate switch to the outside of the housing and switch off the RoboHeart without having to cut any cables or unscrew the housing.

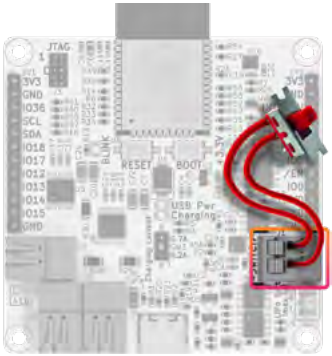


Figure 5: RoboHeart with external switch

When RoboHeart is switched off via this switch, the remaining leakage current is approx. 200 µA. Please note that the battery can also be charged when the RoboHeart is switched off via this switch.

⚠ **Attention!** The switch you use should be designed for a **direct current** of at least 4.5 A or more!

SWITCH - Option 2: Cable bridge

If you want to use your RoboHeart unchanged, please leave the supplied cable plugged into the connector (see *Figure 6*). This cable closes the power circuit and allows you to operate the RoboHeart with a LiPo cell and/or via a USB connection.

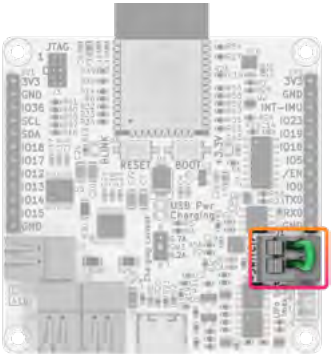


Figure 6: RoboHeart unchanged with closed power circuit

Please make sure that you use the correct connector marked *SWITCH* or *J1*.

⚠ **Attention!** If you want to use your own cable, please make sure that the cable is as short and as thick as possible (AWG 20 or thicker).

To insert and remove cables from the connector, press the lever down briefly to open the terminal. Then insert the stripped end of the cable and release the lever to fix the cable in place. To remove the cable, press the lever and pull the cable out.

SWITCH - Option 3: Solder bridge

If you don't like the first two options, you can close the power circuit forever with a solder jumper. The solder jumper is labeled *SWITCH* or *JP1* on the back of RoboHeart, see *Figure 7*.

Figure 7: RoboHeart position of the SWITCH solder bridge

You can connect the two contacts of JP1 with a soldering iron and some solder. Never solder a powered RoboHeart or a RoboHeart with a connected battery!

⚠ **Attention!** Make sure that you do not connect any other pads to *JP1*! Once established, the connection is permanent, which means that an external switch (*SWITCH - Option 1: External switch*) or a cable (*SWITCH - Option 2: Cable bridge*) will no longer work!

USB OPERATION

Power supply via USB

The RoboHeart can be supplied with power via the built-in USB-C port.

⚠ **Attention!** Only use certified USB-C cables that allow a rated current of 1.2 A at 5 V.

If you connect a USB-C cable to RoboHeart and the other end of the cable to your computer or another power/voltage source such as a USB power adapter, the *USB Pwr* LED will light up green. This means that your RoboHeart is receiving power and voltage from the USB source. Please make sure that the supply circuit is closed via the *SWITCH connector* (see chapter *Switches*).

The RoboHeart always acts as a consumer via USB-C, it cannot supply any connected devices with power/voltage via the USB port.

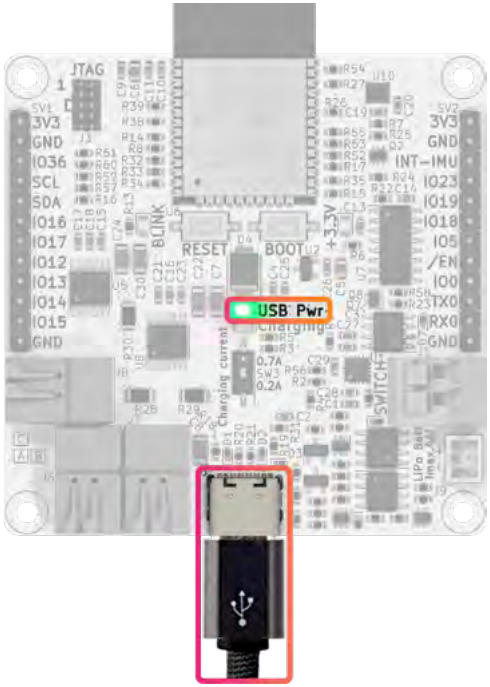


Figure 8: RoboHeart is powered via the USB-C port

Programming via USB

The RoboHeart can also be programmed via the USB-C connection. The RoboHeart is compatible with the Arduino development environment (IDE). You can find our RoboHeart library in the library manager of the Arduino IDE. As both the Arduino IDE and compatibility with the ESP32 are constantly changing, we keep the information on programming the RoboHeart up to date on our website.

You can access the website using the following QR code:

or via: https://augmented-robotics.com/roboheart/

On our website you will find information about RoboHeart and many other useful links such as tutorials, our forum, project ideas and links to our official libraries and examples, which are completely **open source**!

If you are familiar with programming ESP32 modules, you will notice that we have included the *RESET* and *BOOT* buttons (see *Figure 9*). These do not need to be pressed when programming via USB-C, as the RoboHeart has an automatic upload mode. This means that if your Arduino IDE is correctly set to RoboHeart, you can simply click on *Upload* in the Arduino IDE and your sketch will be conveniently uploaded to the RoboHeart.

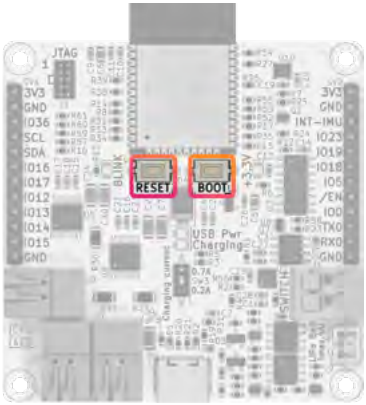


Figure 9: Position of the BOOT and RESET buttons

Programming without USB

In the chapter *Programming via USB* you read that you can easily load your Arduino sketch onto your RoboHeart via USB-C, automatically and without pressing any buttons.

Experienced makers also have the option of programming the ESP32 on the RoboHeart with an external USB-UART converter via the *TX0* and *RX0* pins. To do this, you must connect the pins of your external converter as follows:

RoboHeart	<->	External converter
TX0	**<->**	**RX**
RX0	**<->**	**TX**
GND	**<->**	**GND**

In this case, you must put the ESP32 into boot mode by holding down the *BOOT* button and briefly pressing and releasing the *RESET* button. Continue to hold the BOOT button until the code upload begins. You can then release the *BOOT* button. After the compiled code has been uploaded, briefly press the *RESET* button to restart the ESP32.

BATTERY OPERATION

A single-cell (1S) LiPo battery with a nominal voltage of 3.7 V can be connected to RoboHeart to supply RoboHeart with power. The connector is a JST-PH 2.0 mm connector, which is used in many drones and other models. So, if you have working batteries from drones with you, you may be able to use them with your RoboHeart.

Make sure that you carefully read and follow the manufacturer's instructions for the batteries. These contain important information on safety, charging, discharging and maintenance of the batteries.

Note that the voltage of a LiPo battery follows a discharge curve in normal operation and the voltage can vary between 4.2 V and 2.7 V depending on the charge status of the LiPo.

⚠ **Attention!** Please observe the battery safety instructions in this manual when using rechargeable batteries!

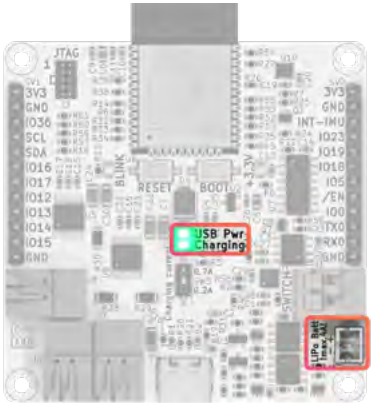


Figure 10: Battery connection and charging LED

When you connect the battery to RoboHeart, RoboHeart is automatically supplied with power/voltage.

If you connect a USB current/voltage source and the battery voltage is between 2.7 V and 4.1 V and the total current consumption is below 1 A, the battery is automatically charged, and the *Charging* LED lights up. There is a seamless transition to charging (without resetting the ESP32), while the rest of the board and the connected peripherals continue to operate with the provided current/voltage.

We have eliminated the annoying switching between charging and discharging known from other boards and made using RoboHeart with the battery as easy as using a smartphone. There is another practical supply function that is also known from smartphones, which we will discuss in the chapter *Dual-Power*.

There are a few things to keep in mind when RoboHeart is powered by a battery.

⚠ **Attention!** Use batteries with power cables that are as short and thick as possible.

The RoboHeart starts to charge a connected battery very slowly from 2.7 V with 20 mA (if the *Charging current* switch is set to *0.7A*, the pre-charge current is 70 mA).

⚠ **Attention!** Please observe the battery manufacturer's instructions as to whether the battery can be charged at such a low voltage!

From 3.0 V, the charging current circuit switches to fast charging mode. The *charging current* switch (see *Figure 11*) gives you information about the charging current in fast charging mode. If the switch is in the *0.2A* position, the battery is charged from 3.0 V with 0.2 A. If the switch is in the *0.7A* position, the battery is charged at 0.7 A from 3.0 V.

⚠ **Attention!** Do not use the *0.7A* lightly! The RoboHeart cannot recognize whether your battery is suitable for such a high charging current. Always check the battery manufacturer's instructions regarding the charging current. Otherwise, there is a risk of fire and explosion!

If the *charging* LED starts flashing, then something is wrong with the battery. You must remove the battery immediately if the *charging* LED flashes twice per second.

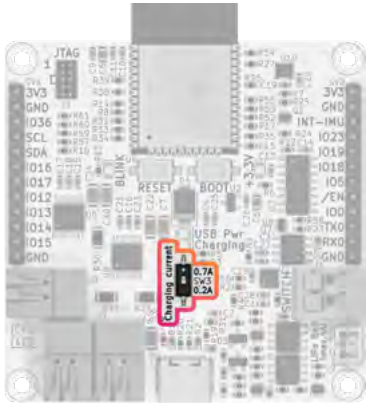


Figure 11: Charging current switch

The RoboHeart continuously monitors the battery voltage. When the battery reaches a voltage of approx. 4.2 V, fast charging stops. The RoboHeart then continues to monitor the voltage and starts charging again as soon as the voltage has dropped by around 100 mV to keep the battery voltage constant. During this monitoring phase, the *charging* LED does not light up, as this process is no longer regarded as an active charging process.

If the RoboHeart is operated via a rechargeable battery, the battery is discharged to a voltage of 3.0 V. Below this voltage, RoboHeart automatically switches off the battery to prevent deep discharge and permanent damage to the battery. Nevertheless, it is advisable to either charge discharged batteries immediately or at least disconnect them from RoboHeart.

Avoid connecting an overcharged battery with a voltage of more than 4.4 V, otherwise your RoboHeart may be damaged.

Dual-Power

What does dual power mean with RoboHeart?

As a maker, you always need the output on the serial monitor. Be it to debug or to observe the status of your RoboHeart through serial print outputs. But what happens if you have connected loads to the RoboHeart that draw a lot of current, such as motors?

With other boards, we were often faced with the problem that there was simply not enough current to control motors and read the print output on the serial monitor at the same time. As other boards often only have one power input and the USB port of a PC usually only supplies 0.5 A, it is hardly possible to supply motors with them.

RoboHeart is different! As soon as the power via the USB port is insufficient, RoboHeart switches seamlessly (without resetting the microcontroller) to dual-power mode, i.e. it draws the required power from the battery. RoboHeart is therefore supplied with power via USB and the battery at the same time in the event of a high load. The connected peripheral loads receive sufficient power, and you can still observe the output on the serial monitor.

ROBOHEART SUBSYSTEMS

Motor connections

In *Figure 12* you can see where the motor connections are located. A total of three brushed direct current (DC) motors can be connected to these (not included). The connections are labeled A, B and C.

The motors are controlled via two DRV8833PWPR motor drivers from Texas Instruments. All drivers can be switched off by pulling IO2 to LOW (can only be controlled via software).

The two connections (A and B below) have a maximum output of 1 A each. Connection C has a maximum output of 2 A. The connec-

tions are protected against overcurrent.

The maximum output voltage of all motor connections corresponds to the battery voltage + 225 mV.

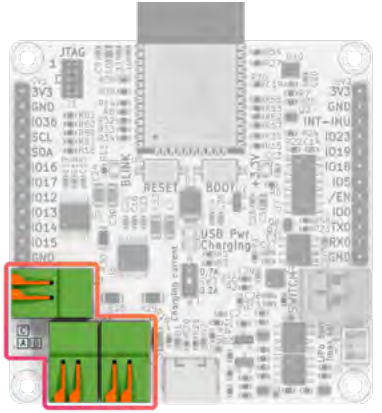


Figure 12: Motor connections

To connect a motor cable to this connector, lift the lever to open the terminal. Then insert the stripped end of the cable and release the lever until it clicks back into place to secure the cable. To remove the cable, lift the lever again and pull the cable out.

Motor output A is controlled with PWM via IO25 and IO26.

Motor output B is controlled with PWM via IO27 and IO32.

Motor output C is controlled with PWM via IO33 and IO4.

The PWM frequencies are adjustable between 0 and 100 kHz.

In the event of a fault in output A and/or B, IO34 is pulled LOW (in the event of overheating and/or overload).

In the event of a fault in output C, IO35 is pulled LOW (in the event of overheating and/or overload).

You can test the motors with our programming examples in the RoboHeart Arduino library without having to program a single line of code.

If you want to operate precise stepper motors, the RoboHeart is also suitable for this. You can find a programming example for this in our library.

You can also find Bluetooth control in our library that is compatible with our free Bluetooth app for Android and iOS.

Acceleration sensor and gyroscope (IMU)

The RoboHearts' IMU (inertial measurement unit), an LSM6DS3TR-C from STMicroelectronics, combines a 3D acceleration sensor and a 3D gyroscope. These sensors provide continuous and energy-efficient motion and orientation detection. The 3D accelerometer measures acceleration in all three directions (X, Y, Z) with selectable ranges from ±2 g to ±16 g, while the 3D gyroscope measures angular velocity in three axes with ranges from ±125 dps to ±2000 dps.

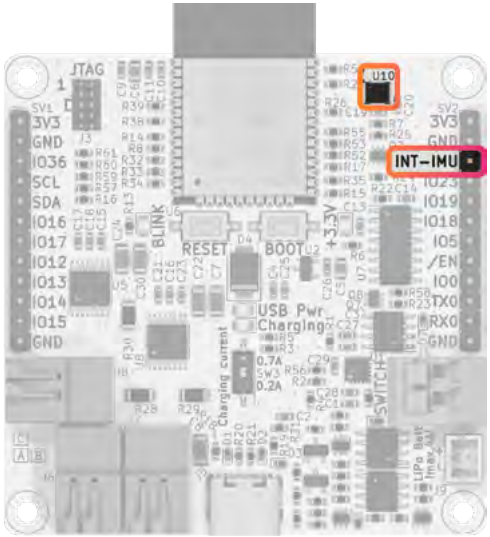


Figure 13: Position of the IMU and the IMU interrupt pin

The IMU offers various predefined interrupts that are activated when certain events occur, such as the free-fall interrupt, which detects free fall, or the wake-up interrupt, which reacts to movements. In addition, specific movement patterns and events can be configured, which are reported to the *INT-IMU* pin.

With the interrupt function of the IMU you can program very interesting projects, e.g. you can put the RoboHeart into a „sleep mode“ to save energy and only when someone nudges it, the *INT-IMU* pin is automatically pulled high by the IMU and wakes up the RoboHeart (puts it into active mode). You can even go one step further and connect an external board to the *INT-IMU* pin and use the wake-up signal for the external board.

Note that the *IMU-INT* pin is connected internally on the RoboHeart to GPIO39 of the ESP32 if you want to use this pin.

With our example sketches in the Arduino-compatible library, you can display the measurement data of the IMU without having to write a single line of code.

CONTROL WITH THE ROBOHEART CONTROL APP

Your project is finished, but you still need a Bluetooth smartphone control?

No problem! On our website you will always find links to our free control apps for iOS and Android. These apps are compatible with the examples you can find in our Arduino library. You don't need to worry about the Bluetooth setup, we have already pre-programmed everything for you.

SERIAL COMMUNICATION

I2C – bus

In the pinout in *Figure 3* you can see the *SCL* and *SDA* pins, which are the pins for the I2C bus (Inter-Integrated Circuit). The I2C bus enables communication between the RoboHeart Hercules and various peripheral devices such as sensors and displays (not included). The bus has internal pull-up resistors. You can communicate with the built-in IMU on the RoboHeart via this bus. The I2C address of the IMU is 0x6A.

Internally on RoboHeart the *SCL* and *SDA* pins are connected to the following GPIOs of the ESP32:

SCL	**–**	**GPIO 22**
SDA	**–**	**GPIO 21**

UART

The UART (Universal Asynchronous Receiver-Transmitter) is a serial communication interface that can be used on the RoboHeart Hercules to communicate with other devices such as computers, microcontrollers and sensors. You can see on the pinout in *Figure 3* the pins *IO16* and *IO17*, which are marked *RX1* and *TX1* on the back.

Please note: As these pins are intended for the UART, the respective lines on the RoboHeart have serial protective resistors.

To establish UART communication between the RoboHeart Hercules and another device, connect the *TXD1* and *RXD1* pins of the RoboHeart to the corresponding RXD and TXD pins of the other device.

RoboHeart	**<->**	**external board**
TXD1	**<->**	**RX**
RXD1	**<->**	**TX**
GND	**<->**	**GND**

You can also use the *TXD0* and *RXD0* pins for UART communication as well as all other digital pins of the ESP32 if you configure them accordingly in your Arduino sketch.

JTAG

For experienced makers, we have a very special treat on the RoboHeart - the JTAG connection (see *Figure 14*). With this connection you can program the ESP32 via an external JTAG controller (not included). The special feature here is that you can even change variables during program runtime, which is no longer possible with the conventional Arduino development environment. This can also be harmful to your program, so you need to know exactly what you are doing when working with JTAG!

With a pin spacing of 1.27 mm and 10 pins, the JTAG connection is compatible with standard mini JTAG cables. The JTAG lines on the RoboHeart are equipped with serial protective resistors.

On the back of your RoboHeart you can see that the respective JTAG GPIOs from the ESP32 are also routed to the pin headers on the side: *IO12(TDI)*, *IO13(TCK)*, *IO14(TMS)*, *IO15(TDO)*. These pins have no serial protective resistors.

In *Figure 15* you can see the JTAG pin assignment.

⚠ **Attention!** The high logic level for all GPIOs and serial interfaces is 3.3 V.

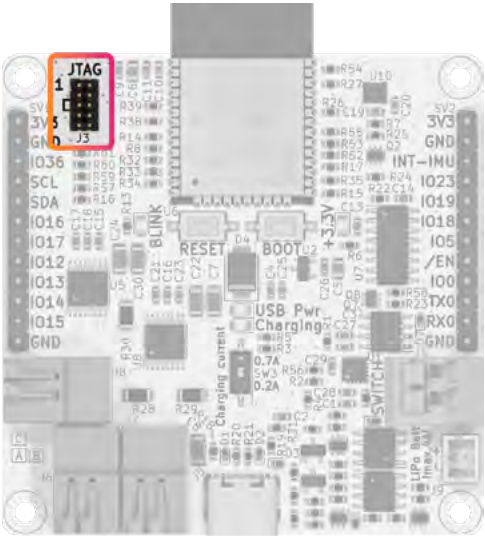


Figure 14: Position of the JTAG connector on the RoboHeart

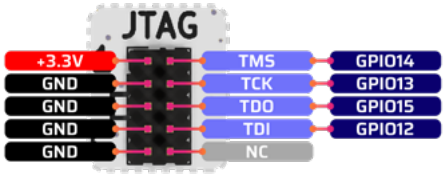


Figure 15: JTAG pinout

SPECIAL PINS AND BUTTONS

3V3 pins

On RoboHeart you will certainly have noticed the two pins labeled *3V3* (see *Figure 16*). There are a total of three different voltage buses on the board.

1. **5V bus:** which is fed from the USB-C port, and which is immediately converted by our power circuit into the output of the battery bus.

2. **Battery bus:** Battery voltage + 225 mV depending on whether a battery is connected and what charge level it has. If no battery is connected, but only USB, this bus has a voltage between 3.3 V and 3.5 V.

3. **3V3 bus**: a regulated voltage bus that supplies a constant 3.3 V (unless the battery voltage is lower, and no USB source is connected).

The digital part of RoboHeart, such as the ESP32, the IMU or the USB-UART converter, is supplied via the 3V3 bus. The *+3.3V* LED (see *Figure 16*) tells you whether the 3V3 bus is supplied with voltage.

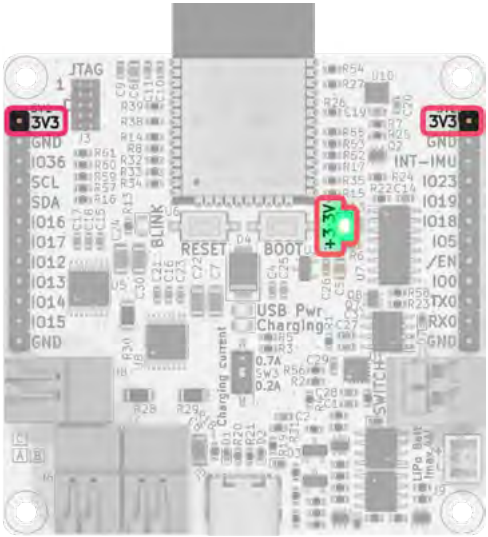


Figure 16: Position of the 3V3 LED and the 3V3 pins

You can use the *3V3* pins to supply external components if you want to connect an ultrasonic sensor (not included), for example. Make sure that your external components do not draw more than 100 mA per *3V3* pin, as this bus is not protected against overcurrent.

You also have enough *GND* pins to connect many external components without the need for additional connecting elements, breadboards or similar or soldering.

Blink LED

The classic for every maker! Before the actual project starts, everyone begins with a „Blink LED“ program. This is the „Hello World“ of the Maker.

This LED should not be missing on the RoboHeart either, you will find its position in *Figure 17*. You can also find a simple blink LED program in our Arduino library. You can use this LED for any purpose in your project and configure it via your Arduino sketch.

Please note that the blink LED is connected internally on the RoboHeart to *GPIO13*, you can also control this pin externally. In addition, this line leads to TCK on the JTAG connector. This means that when you use JTAG, this LED will start blinking, which is completely normal.

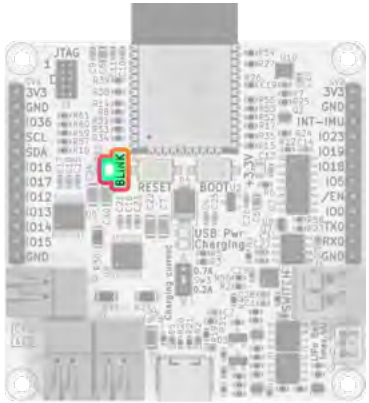


Figure 17: Position of the Blink LED

BOOT and RESET buttons

To reboot the ESP32, you do not need to disconnect the RoboHeart from the USB source or the battery. You can simply press the *RESET* button briefly (see *Figure 9*). A reboot may sometimes be necessary if the ESP32 hangs for any reason or if you have loaded a new program onto the ESP32.

The *RESET* button internally pulls the EN pin of the ESP32 to LOW. An internal delay element is also connected in between.

If you want to put your ESP32 into boot mode, you can do this with the *BOOT* button. This button internally pulls the IO0 pin of the ESP32 to LOW. A serial protective resistor is connected in between.

Unlike other boards, you don't need these buttons on the RoboHeart to upload your Arduino sketch. The RoboHeart has an internal circuit that enables an automated upload via the USB-C port without the need to press any buttons.

MOUNTING THE ROBOHEART IN YOUR PROJECT

If you want to mount your RoboHeart in a moving project, such as your own remote-controlled car (with our Bluetooth app, see *Control with the RoboHeart Control app*) or your own robot, then your RoboHeart must be securely attached. We have provided a hole in each corner of the RoboHeart for this purpose. These are the mounting holes that you can use in your project (in *Figure 18* marked). The mounting holes are compatible with M2.5 screws/ spacers. The screw heads also have space (according to DIN 85). The area around the drill holes is protected so that the screw heads cannot damage any components on the RoboHeart, and no voltage potential can be transferred to the screws or your housing.

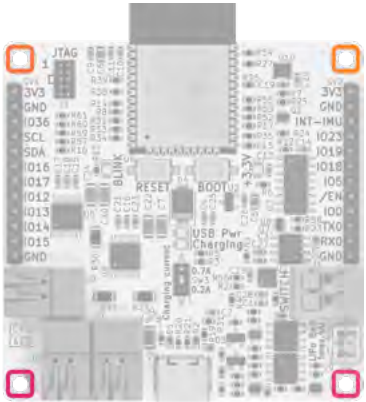


Figure 18: RoboHeart position mounting holes

Dedicated housing for the RoboHeart

Although the RoboHeart itself can make a stylish impression in the Maker workshop, it is still sometimes practical to protect the RoboHeart from the outside world. A beautiful housing for your own circuit board makes every maker's heart beat faster!

We offer you exactly what you need. You can print your RoboHeart housing yourself if you have a 3D printer at home. We provide you with our 3D models for this!

Visit our website, where you will find a link to our 3D models for the RoboHeart housing. The models are also open source. They are optimized for FDM printing and do not require any support structures.

*Figure 19: RoboHeart housing**

* Illustrations similar. Errors and omissions excepted.

WASTE DISPOSAL

Electronic devices are recyclable materials and should not be disposed of with household waste. Dispose of the product at the end of its service life in accordance with the applicable legal regulations.

CONTACT US

If you have any questions, please contact:

Augmented Robotics s.r.o.
Na Bráne 8665/4
010 01 Žilina
Žilinský kraj
SLOWAKEI

E-Mail: roboheart.queries@augmented-robotics.com

CREATIVE COMMONS ATTRIBUTION OF THE AUTHORS

RoboHeart Hercules was designed in KiCad in true Maker style. This project would not have been possible without the KiCad community!

This product uses libraries from KiCad, which are licensed under the Creative Commons Attribution 4.0 International License (CC BY 4.0). You can find more information about the license at the following link: https://creativecommons.org/licenses/by/4.0/

The authors of the respective libraries are named below:

File name	Main authors	File author
C_0603_1608Metric.step	Maurice easyw & Frank Shack	KiCad StepUp, ksu, FreeCAD
C_0805_2012Metric.step	Maurice easyw & Frank Shack	KiCad StepUp, ksu, FreeCAD
C_1206_3216Metric.step	Maurice easyw & Frank Shack	KiCad StepUp, ksu, FreeCAD
D_SOD-523.step	Frank Shackmeister and Maurice easyw	KiCad StepUp, ksu, FreeCAD
D_SMB.step	Frank Shackmeister and Maurice easyw	KiCad StepUp, ksu, FreeCAD
PinHeader_2x05_P1.27mm_Vertical.step	Frank/Shack & Maurice/EasyW	KiCad StepUp, ksu, FreeCAD
USB_C_Receptacle_GCT_USB4105-xx-A_16P_TopMnt_Horizontal.step	Joan Obijuan, Rene Poeschl and Frank Shackmeister	KiCad StepUp, ksu, MCAD
JST_PH_B2B-PH-K_1x02_P2.00mm_Vertical.step	poeschlr using CadQuery, maurice, hyOzd	Rene Poeschl
LED_0805_2012Metric.step	Frank Severinsen	KiCad StepUp, ksu, FreeCAD
SO-8_3.9x4.9mm_P1.27mm.step	Maurice easyw	KiCad, OCCT
SOT-363_SC-70-6.step	Frank Shackmeister, Maurice easyw	KiCad StepUp, ksu, FreeCAD

R_0603_1608Metric.step	Frank Shackmeister, Maurice easyw	KiCad StepUp, ksu, FreeCAD
R_1206_3216Metric.step	Frank Shackmeister, Maurice easyw	KiCad StepUp, ksu, FreeCAD
PinHeader_1x12_P2.54mm_Vertical.step	Frank/Shack & Maurice/EasyW	KiCad StepUp, ksu, FreeCAD
SW_SPST_CK_RS-282G05A3.step	Stefan Olsson	-
SW_DIP_SPSTx01_Slide_Copal_CHS-01B_W7.62mm_P1.27mm.step	Stefan Olsson	Terje Io
SOT-23-3.step	Frank Shackmeister and Maurice easyw	KiCad, OCCT
SOIC-16_3.9x9.9mm_P1.27mm.step	Maurice easyw	KiCad StepUp, ksu, FreeCAD
LGA-14_3x2.5mm_P0.5mm_LayoutBorder3x4y.step	-	KiCad StepUp, ksu, FreeCAD
QFN-16-1EP_3x3mm_P0.5mm_EP1.8x1.8mm.step	Maurice easyw	KiCad StepUp, ksu, FreeCAD
ESP32-WROOM-32.step	Stefan Olsson	-
TSSOP-16_4.4x5mm_P0.65mm.step	Maurice easyw	KiCad StepUp, ksu, FreeCAD

This product also uses SnapMagic libraries licensed under the same license.

File name	Main authors	File author
1-2834011-2.stp	TraceParts	SnapMagic
1-2834016-2.stp	TraceParts	SnapMagic

NOTES

MADE WITH LOVE
FOR MAKERS BY MAKERS

AUGMENTED ROBOTICS

RoboHeart_Hercules_Operating_Instructions_EN_v1-1