

RBQ Manual

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1.1 RBQ Introduction



[RBQ]

RBQ is a quadrupedal robot platform developed by **Rainbow Robotics**, designed to be easy for many users to adopt. With onboard sensors and interfaces, RBQ uses strong mobility to support surveillance, reconnaissance, inspection, and related missions.

As a development platform, RBQ provides rich interfaces and an SDK so you can build, integrate, and test your own robot applications.

Key Features

- **Durability** With an IP54 rating and a highly durable mechanical structure, RBQ can operate reliably in harsh environments for extended periods.
- **Expandability** The robot supports additional equipment and sensors through built-in expansion interfaces and power outputs. It also provides a developer-friendly software environment for fast prototyping and integration.

- **Mobility RBQ** can be transported in its dedicated case using an ordinary vehicle. It is designed so one person can handle carrying, setup, and operation.

General Specification

Parameter	Specification
Dimensions (L × W × H)	98 × 43 × 62 cm
Weight (with battery)	42 kg
Walking Speed	9 km/h (up to 14 km/h in running mode)
Max Payload	15 kg
Walking Capability	<ul style="list-style-type: none"> • Longitudinal slope: 45% • Lateral slope: 20% • Stairs & steps: up to 25 cm
Operating Time	2 hours (up to 4 hours max)
IP Rating	IP54
Battery	Swappable / Separate charging / Auto charging supported
Built-in Sensors	<ul style="list-style-type: none"> • IMU • (RGB + Depth) ×2 • Depth ×4 • 3D LiDAR (optional)
Communication	Wi-Fi / LTE (optional)
External Interfaces	54 V, 12 V, CAN (1 ch), Gigabit LAN ×3
Optional Surveillance Sensors	4K PTZ camera & thermal camera

2.1 Common Guide

If this is your first time running the robot, this is a quick start guide.

Must-read



First, review **General safety guidelines** and all **Safety & Precautions**. After understanding what each symbol means, read the relevant manuals before using RBQ.

1) Operation sequence

Sequence

1. Set the initial pose and turn on power.
2. Connect RBQGUI and the robot on the Steam Deck.
3. Operate in the GUI in the **Stance → Walk** order.
4. Check battery and connection status in state monitoring.
5. At the end, follow the charging/packing flow (or, if necessary, the emergency stop & recovery flow).

Detailed procedures

Follow the documents below in **1 → 5 order**, and confirm each step.

1. Set the initial pose and turn on power
2. Connect RBQGUI and the robot
3. Operate **Stance → Walk** (basic motion)
4. State monitoring
5. End of use: charging · packing · emergency recovery

2) Additional development

- If you need joint-level development (e.g., joints, sensors, etc.): see the [Level 0 guide](#).
 - If you need to use motion APIs: see the [Level 1 guide](#).
-

Only key links

- Safety: [Safety section](#)
- Operation: [Operation guide start](#)
- GUI: [GUI introduction](#)
- Development: [Level 0 guide](#), [Level 1 guide](#)

2.2 Level 0 Developer Guide (Low-Level Control · LVO SDK)

This page matches the software doc [Concept - Low-Level Access / LVO SDK](#).

It is the doc map for **low-level control** close to **joints and sensors**. There is no prerequisite order vs the **Level 1 (high-level) guide** - pick the track that fits your goal.

What LVO SDK covers (summary)

Per Concept:

- Read sensor data (IMU, joint encoders, etc.)
- **Joint-level** commands: position, velocity, torque
- **Typical uses**: custom controllers, low-latency real-time experiments, locomotion research

If you only need predefined gaits and motions, use the [Level 1 Developer Guide](#) and [High Level / LV1 SDK](#) in [Concept](#).

Who this is for

- Developers who command **torque, gains, and setpoints per joint**
- Research / control work that needs deep **real-time state** (joints, feet, IMU, etc.)

For joystick-only field use, [Common Guide](#) and the [GUI introduction](#) may be enough.

Prerequisites

Item	Details
OS	Ubuntu 22.04 (x86_64) recommended - Developers guide system requirements
Network	When using the real robot, follow the same network setup as Controller & Wi-Fi.
Multi-process	API: <code>process ID</code> , <code>setMotionOwner()</code> - required before joint commands

Suggested reading order (low-level)

1. Common guide (read it first)
2. Level 1 Developer Guide together
3. API: high-level structure and required APIs (e.g., `process ID`, `setMotionOwner()` in C++)
4. ROS2: low-level topics (joint state, foot state, robot state, etc.) and test with examples first
5. Sim / training: RBQ GYM, RBQ Lab, Simple-RL
6. Updates & contact: How to update GUI software, How to update robot software, Error reporting

Safety & responsibility

Direct low-level joint control extends beyond typical intended use. Read the user responsibility disclaimer and API; validate in **simulation**, **low speed**, and a **clear area** before hardware trials.

Changing control loops or torque increases **fall**, **joint limit**, and **collision** risk. Operators must be able to intervene with **RBQGUI** - GUI introduction, Basic motion commands. Operators should also know the Emergency stop and recovery procedures flow.

GUI and field operation

Emergency flow (**EMERGENCY** → **Stance**, etc.) follows the Developers guide GUI section and GUI introduction. For live debugging, state monitoring is also useful.

Doc index

- [Concept](#)
- [Developers guide](#)
- [API](#)
- [ROS2](#)
- [RBQ GYM](#) · [RBQ Lab](#) · [Simple-RL](#)
- [How to update GUI software](#)
- [How to update robot software](#)
- [Error reporting](#)

2.3 Level 1 Developer Guide (High-Level Commands · LV1 SDK)

This page matches the software doc Concept - High-Level Command Interface / LV1 SDK.

It is the **high-level** path: **predefined actions and commands** without managing low-level joint details. **There is no prerequisite order vs the Level 0 (low-level) guide** - start here if you integrate apps, ROS 2, or motions without per-joint torque programming.

What LV1 SDK covers (summary)

Per Concept:

- Run common motions and gaits with a **single command**
- Smooth fit with the **RBQ APP** command set
- APIs: C/C++, Python, **ROS 2**
- **Typical uses:** application developers, system integration, rapid prototyping with minimal setup

For **direct** sensor and actuator access, use the Level 0 Developer Guide and Low Level / LV0 SDK in Concept.

Who this is for

- Developers attaching **gait modes and high-level motion** via ROS 2 or the API
- Teams starting from Simple-Motion / Simple-Command style examples
- Workflows with a **development PC** - Connect to the RBQ development PC

Prerequisites

Item	Details
OS / build	Developers guide - shared sim / hardware setup
Concepts	Concept - High Level / LV1 SDK
Network	With the real robot, follow the same connectivity guidance as Controller & Wi-Fi.

Suggested reading order (high-level)

1. Common guide
2. Developers guide
3. API: required high-level motion APIs (e.g., `motionStaticReady()`, `motionDynamicWalk()`, etc.)
4. ROS2: high-level command / navigation topics and gait mapping
5. Examples: Simple-Motion, Simple-Command
6. Updates & contact: How to update GUI software, How to update robot software, Error reporting

GUI and operation docs

High-level commands may run alongside **RBQGUI** in the field. Design so you do not fight **Sit / Stance / EMERGENCY** - GUI introduction, Basic motion commands.

Gait / sensor quality: Calibration & tuning, state monitoring. Versions: Robot software update.

Notes

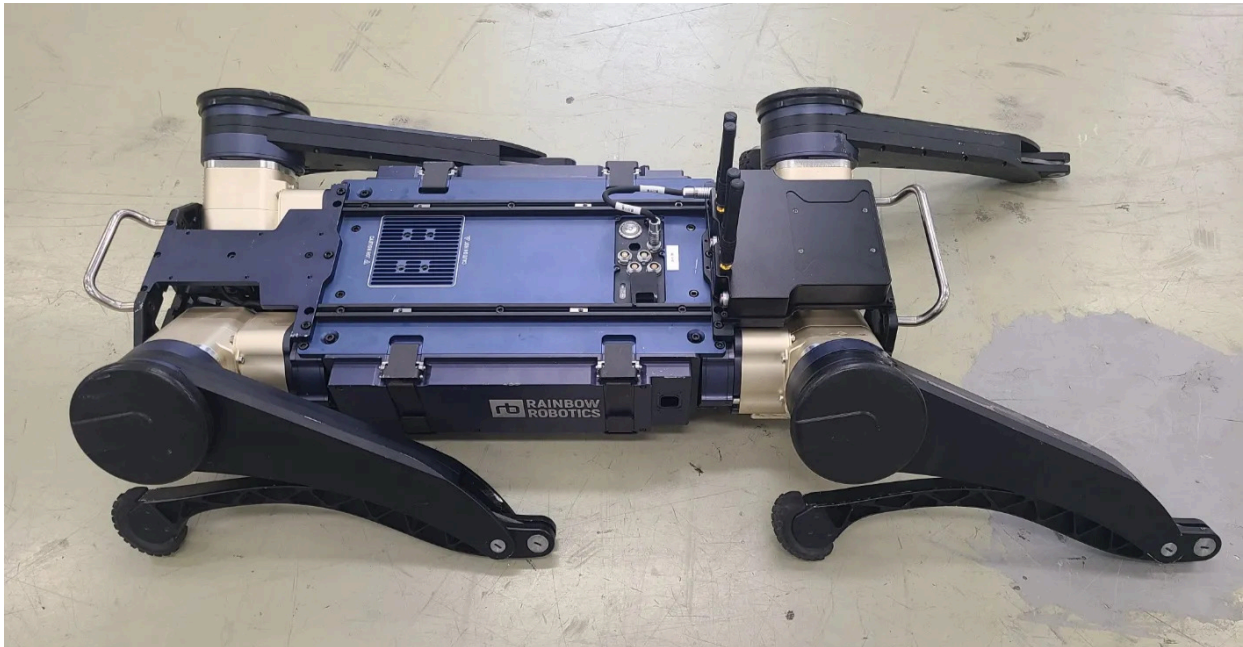
RL and custom gaits still carry **fall and collision** risk. Validate in simulation and a safe clearance; keep **GUI** intervention possible. **Direct joint** low-level work belongs under the Level 0 guide and **safety / disclaimer**.

Doc index

- Concept
- Developers guide
- API · ROS2
- Simple-Motion · Simple-Command
- How to connect to the RBQ development PC
- Error reporting

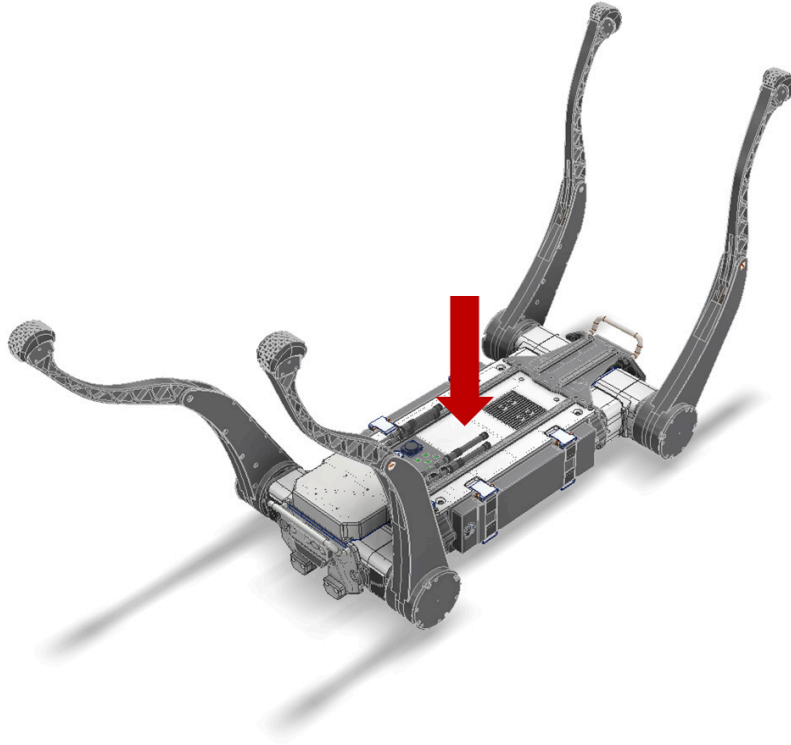
3.1 Robot Initial Pose Setting

Place the robot on a flat floor so that all feet and knees contact the ground. Refer to the robot posture in the image below.

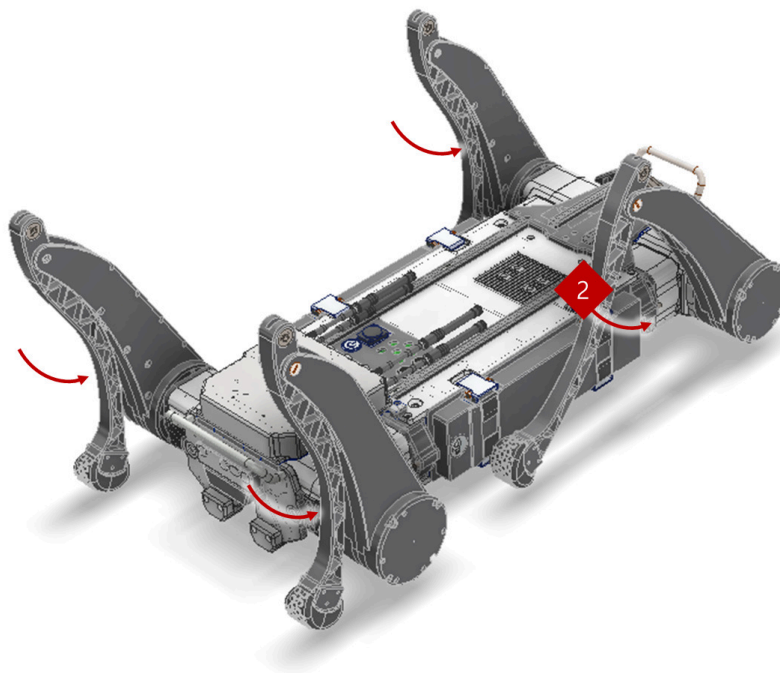


[RBQ10 Initial Pose]

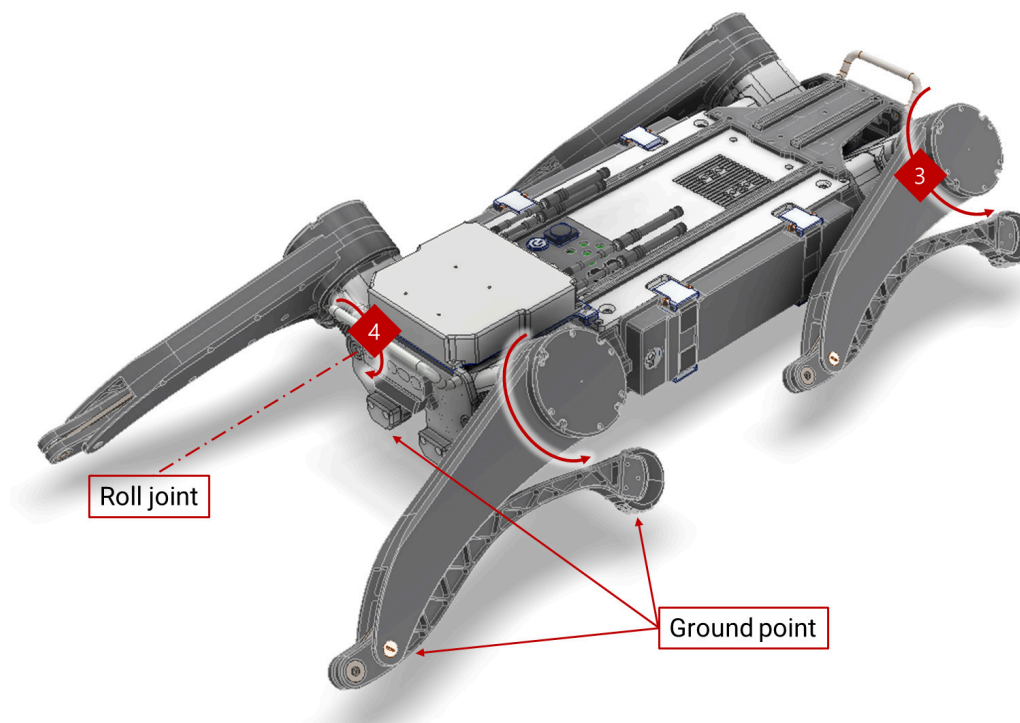
Step 1. A flat surface is required.



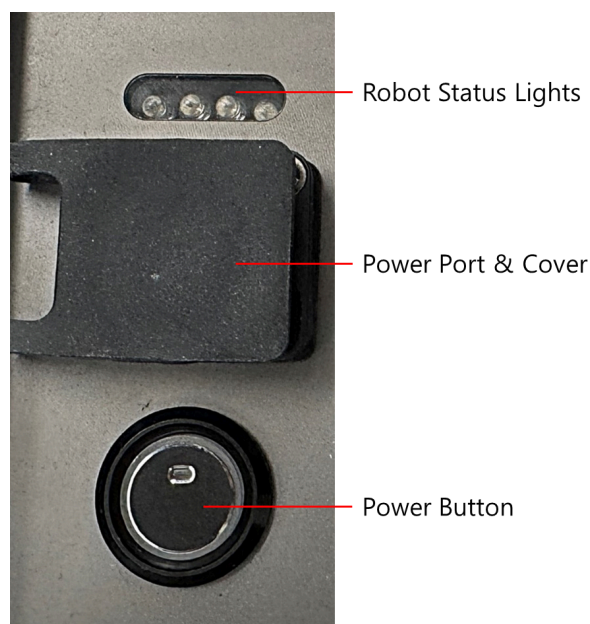
Step 2. Fully fold the knee joint.



Step 3. Rotate the hip pitch and roll joints so that the “feet” and “knee” joints touch the ground. There are three ground points. (Body Bumper, Knee Joint, Foot)



Turn On the Robot



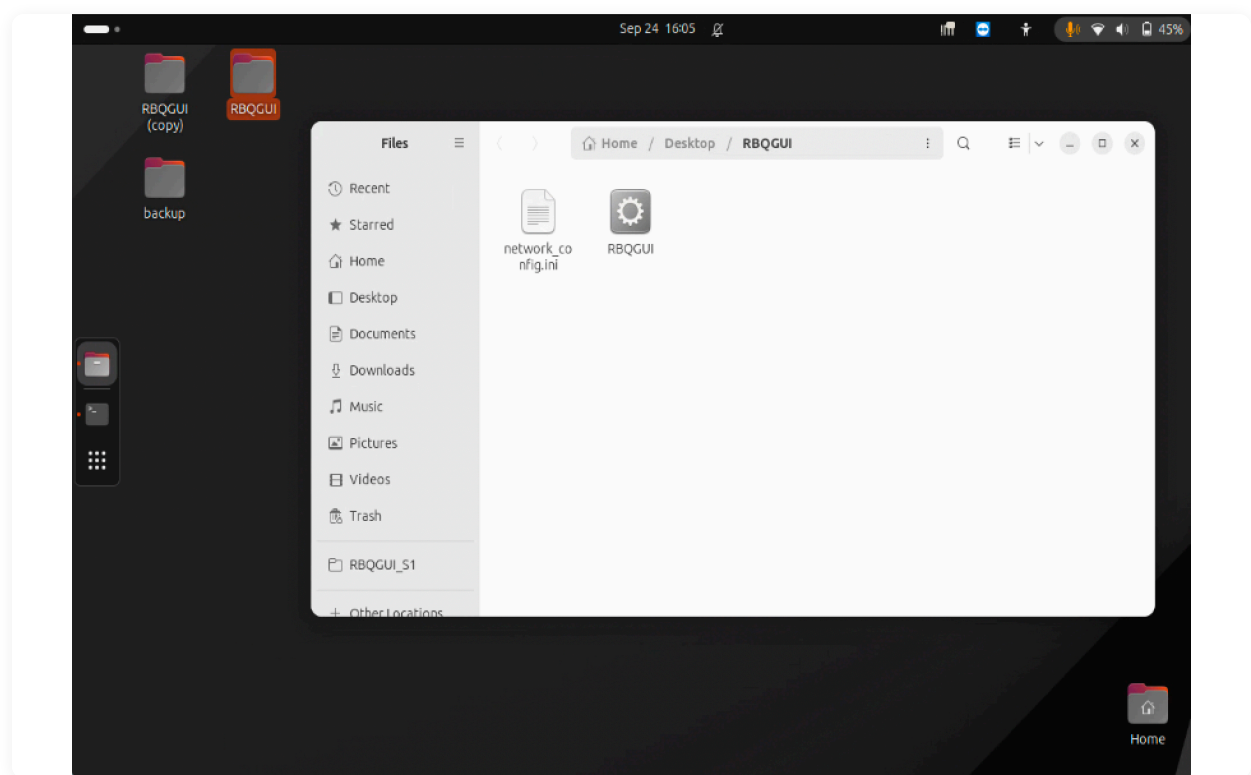
- Press **Power Button** and check the red light on the button
- Check for **double-beep sound**

3.2 Controller (Steam Deck) and Wi-Fi Connection

This page describes how to connect the STEAM DECK to the robot Wi-Fi, communicate with the robot in RBQGUI, and proceed through auto start. Complete Robot Initial Pose Setting (initial pose and power on) first.

Step 1: Open RBQGUI app

Run the **RBQGUI** app from the STEAM DECK desktop.



[RBQGUI app]

Step 2: Wi-Fi connection

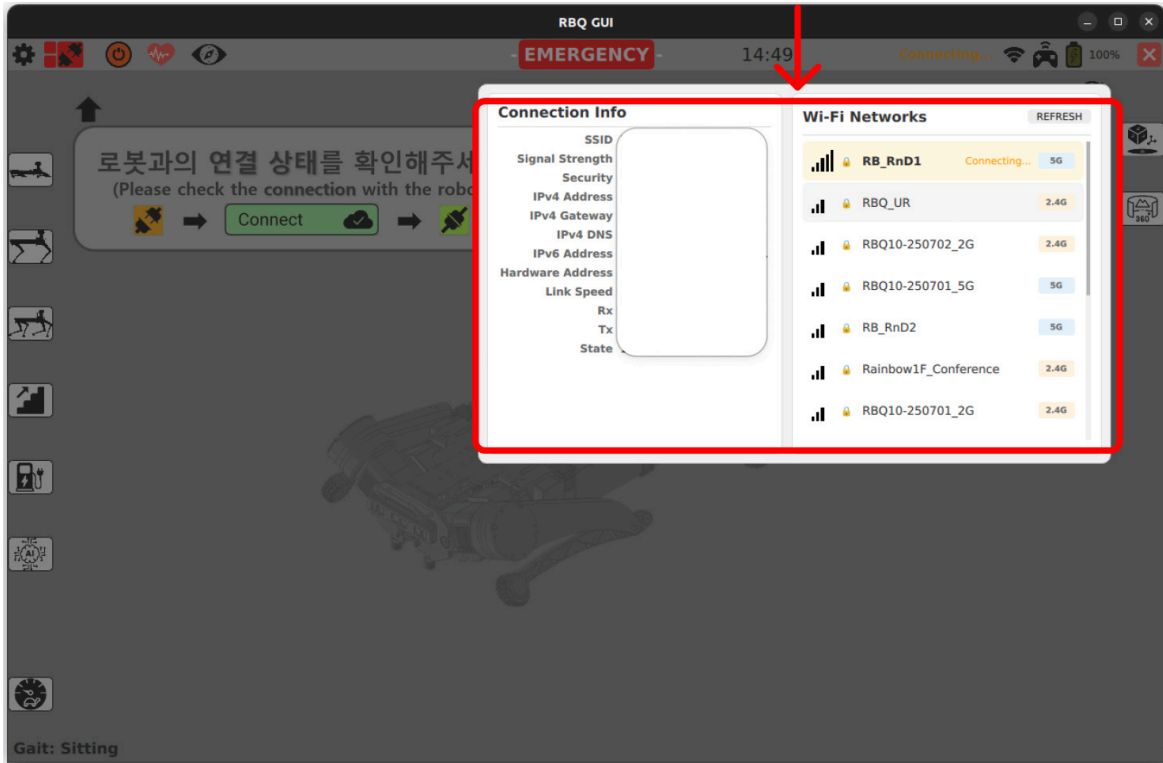
The robot provides a Wi-Fi access point named `RBQ_{XX}` (XX differs by unit).
Connect the STEAM DECK to that network.

1. **Check Wi-Fi** - After connecting the Steam Deck to the robot AP (`RBQ_{XX}`), confirm the **top-right** of RBQGUI shows the network name and signal icon.



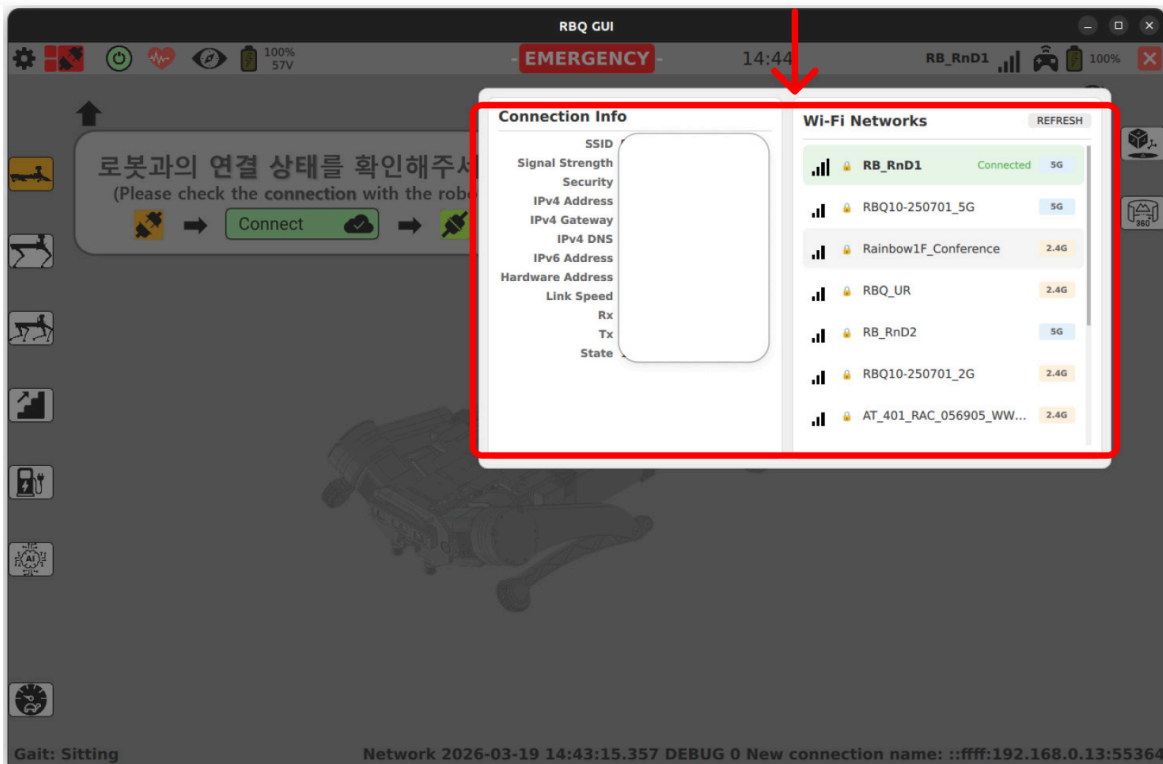
[Wi-Fi menu]

2. **Select the robot network** - Choose `RBQ_{XX}` in the list. (If it does not appear, check robot power and Wi-Fi operation.)



[Select RBQ_{XX}]

3. Verify connection - Confirm the deck shows **Connected** to **RBQ_{XX}** .



[Wi-Fi connected]

Step 3: Connect STEAM DECK and robot

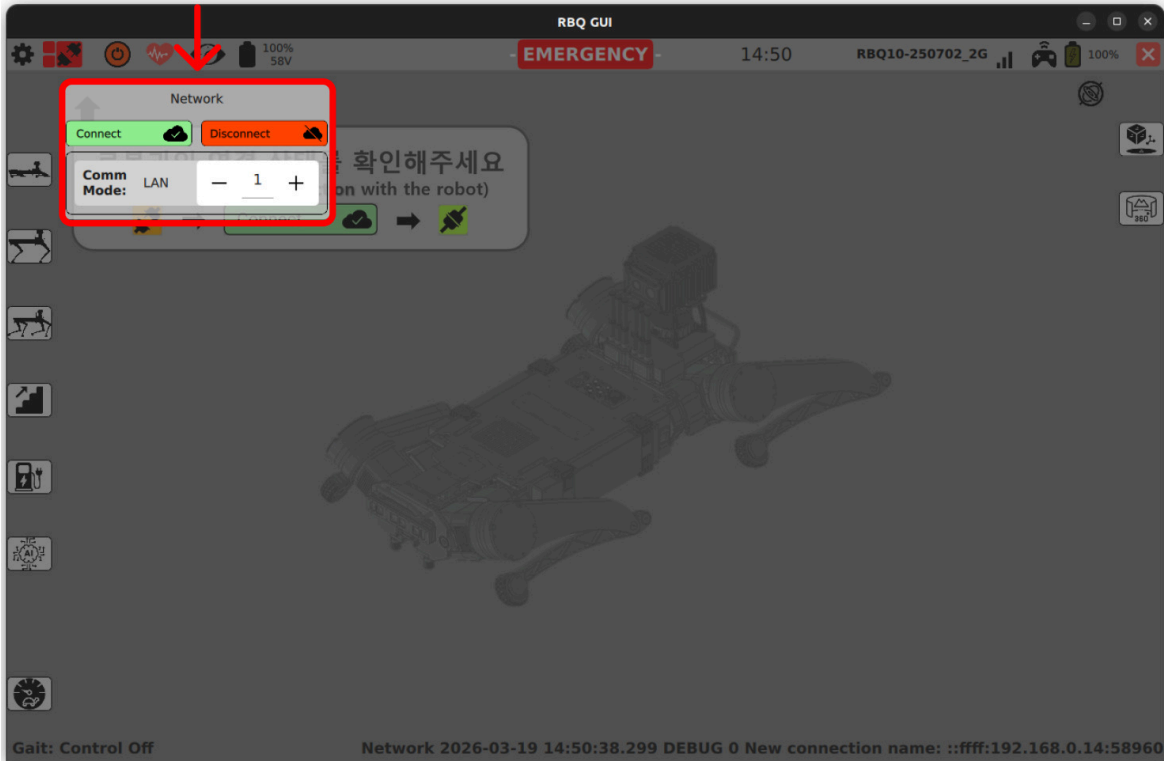
For RBQGUI to talk to the robot, you must also establish remote controller-robot communication inside the app.

1. **Open the connection dialog** - Press **Remote Controller-Robot Communication Connection** (orange) on the left of the top bar. A connection pop-up appears.



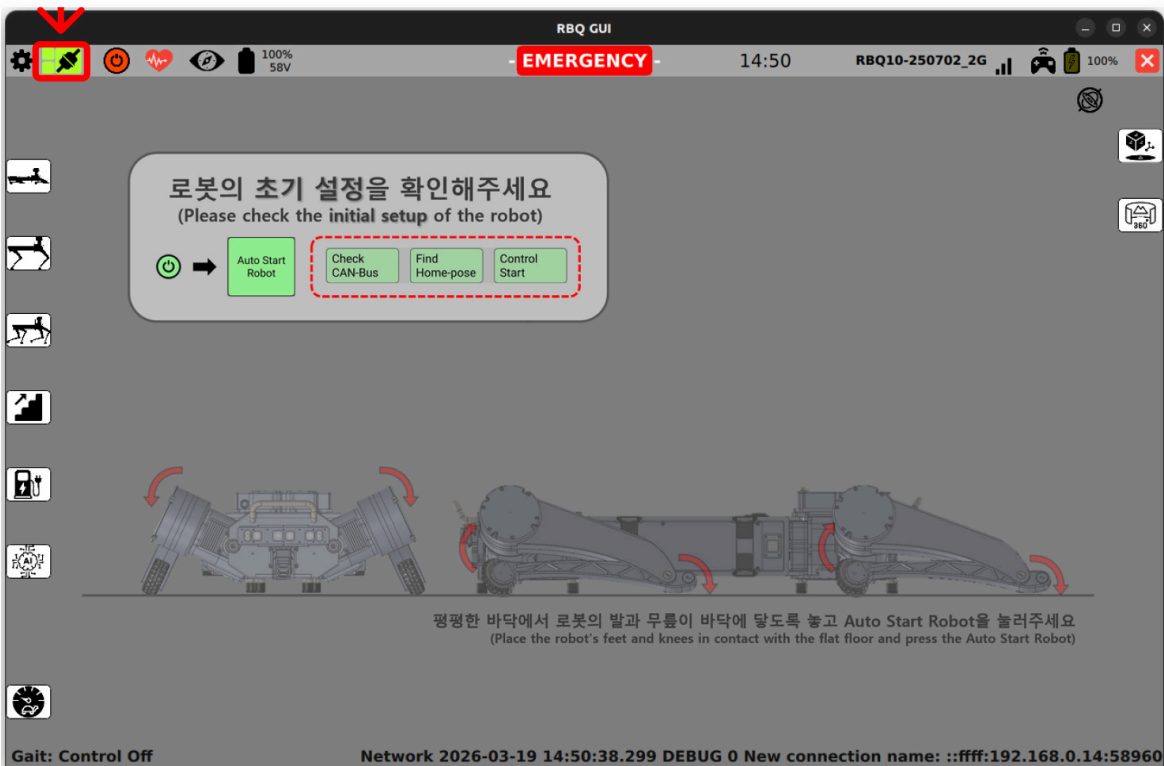
[Communication connection button and pop-up]

2. **Connect** - In the pop-up, press **Connect** to attempt communication with the robot.



[Connect]

3. **Confirm result** - When connected, **Remote Controller-Robot Communication Connection** at the same position turns **green**, and the pop-up shows a connected state.

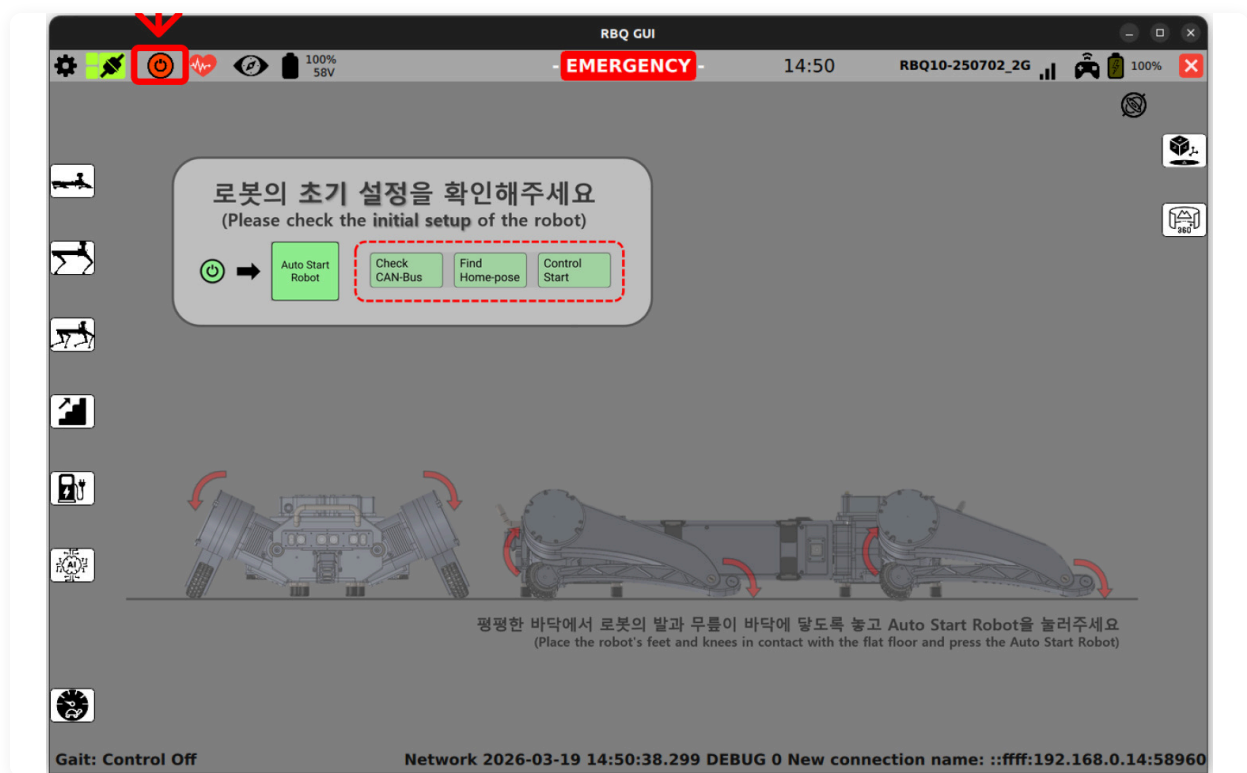


[Connected (button green)]

Step 4: Auto start

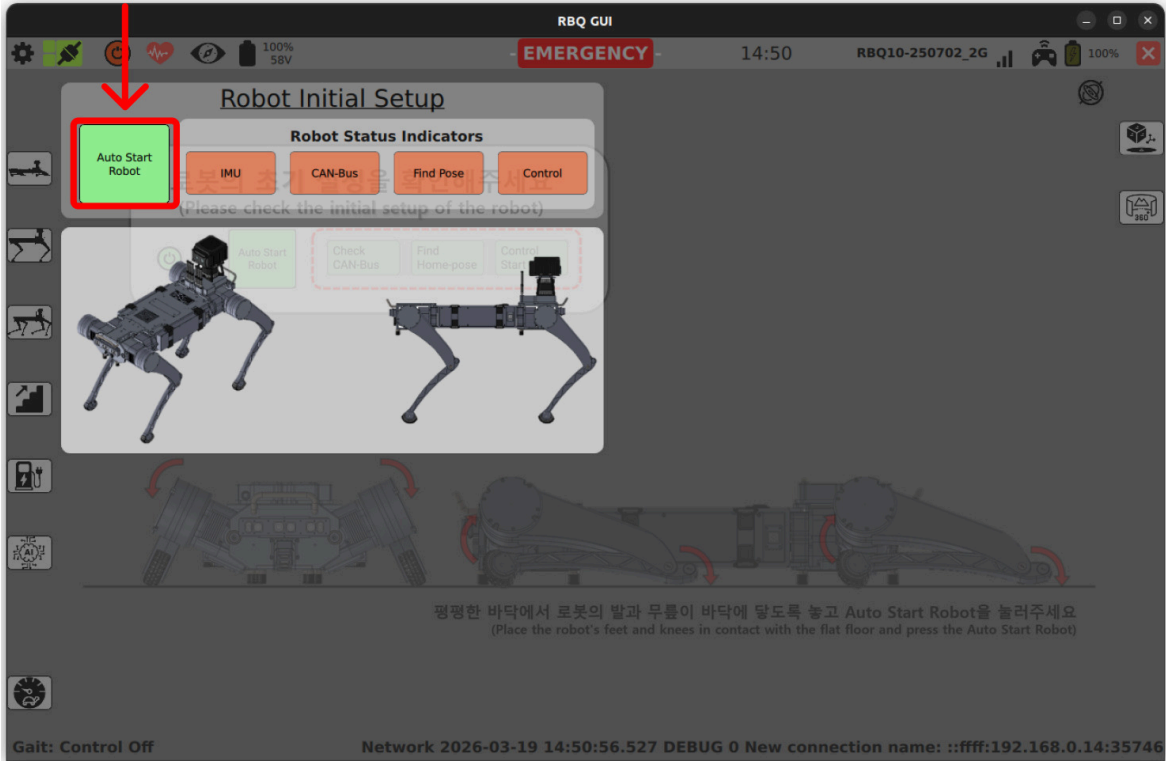
To bring up robot software and state in one flow, use the auto start procedure.

1. Open initial setup - Press **Robot Initial Setup** (red) on the left of the top bar.



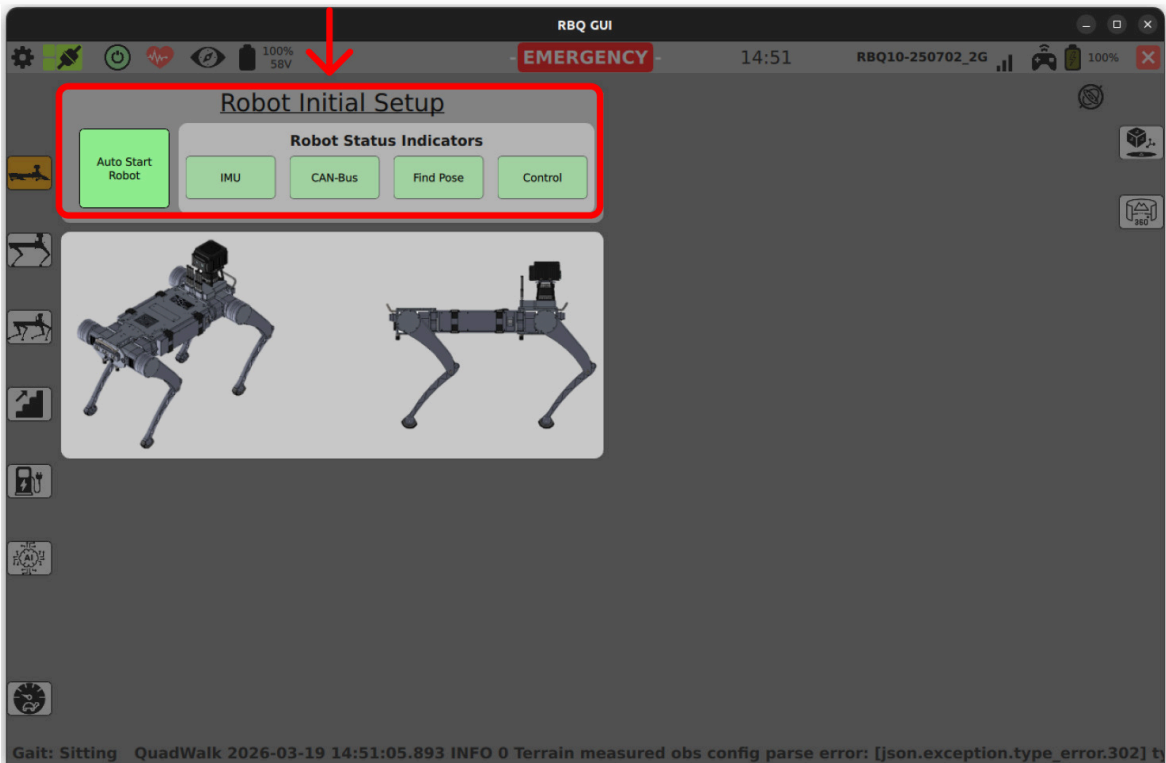
[Robot Initial Setup button]

2. Run auto start - In the pop-up, press **Auto Start Robot** . After a short wait, progress appears on screen.



[Auto Start Robot]

3. Check progress - Confirm each item such as **Manual Setup** updates. (Some items may show green before others for a while.)



[Auto start in progress]

4. **Confirm completion** - When **all** setup items shown on screen are **green**, auto start has completed successfully.



[Auto start complete (all green)]

Caution

If, after auto start, not all setup items turn green or an error is shown, confirm no people are nearby, review the emergency stop procedures, then follow the steps below. Before operation, always comply with the general safety guidelines.



1. If **Check CAN-Bus** fails: power off the robot safely, then restart.
2. If **Find Home-pose** fails: on a flat, stable surface per maintenance safety, check leg pose, then restart.

If the problem persists, contact Rainbow Robotics via error reporting.

3.3 Charging

The RBQ10 can be charged with a charger or a docking station. The charger uses the charging port on the top of the robot; the docking station can charge through the port on the bottom. You can also connect a charging cable to the docking station and plug it into the top charging port on the robot.

! Charge the robot only with the supplied RBQ10 charger or RBQ10 docking station.

Charging with the external charging cable

Connect the external charging cable directly to the charging terminals on the top of the robot.

- Charging with the RBQ10 power supply



You can check charging status using the indicator LEDs on the charger.



Color of LED	Status
Green	Charged
RED	Charging

- Charging via the RBQ10 docking station external charging port

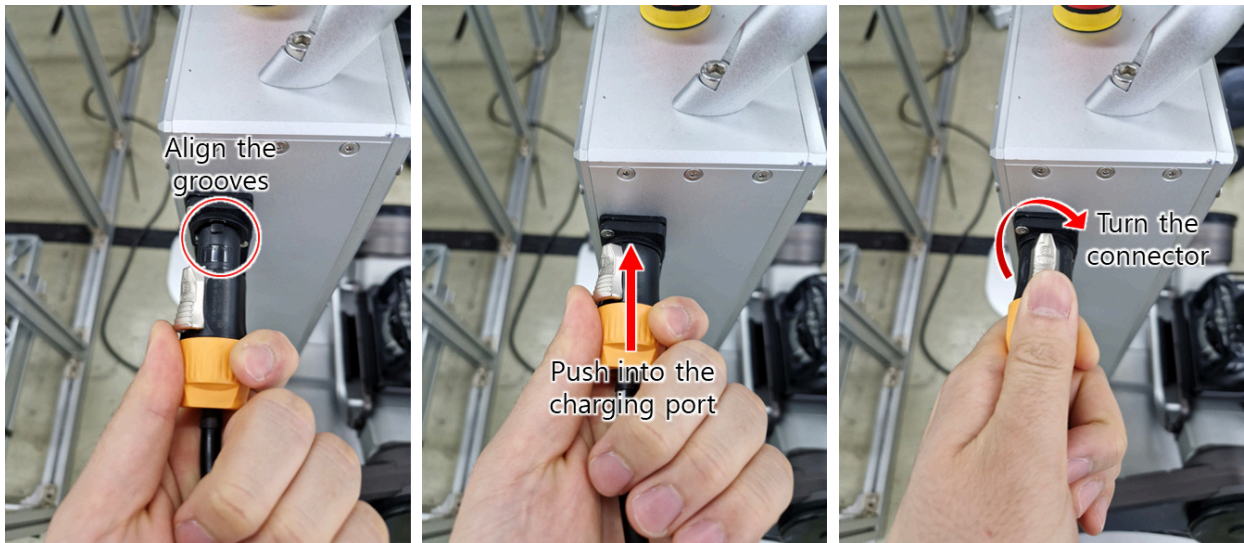


[External charging port]



[External charging cable]

Step 1. Connect the external charging cable to the RBQ10 docking station external charging port.



Step 2. Connect the external charging cable to the RBQ10 charging port.



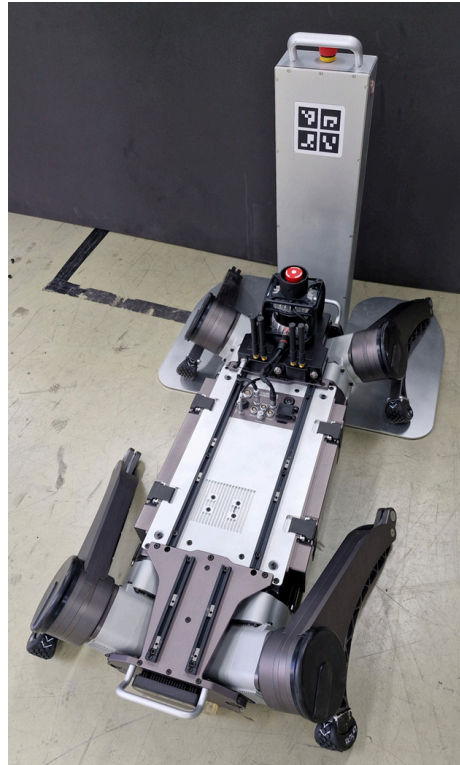
Step 3. Charge the RBQ10 using the docking station external charging cable.



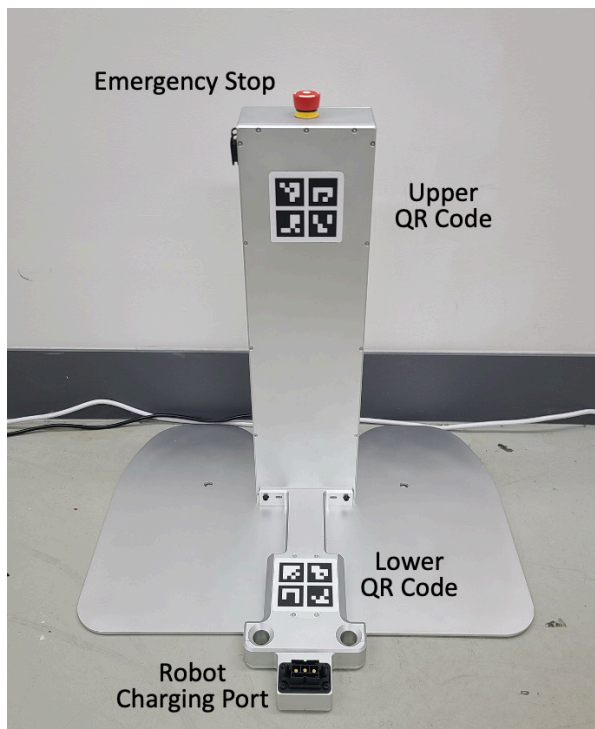
⚠️ If the robot is fully discharged and will not power on, it cannot be charged from the docking station.

💡 When the robot is charged and operates normally, it can be charged through the docking station.

Charging with the docking station





Description



[Docking station parts]


Status description



Color of LED	Status
Green 	Charged
RED 	Charging

Manual docking

Step 1: Position the robot so its rear camera faces the docking station.

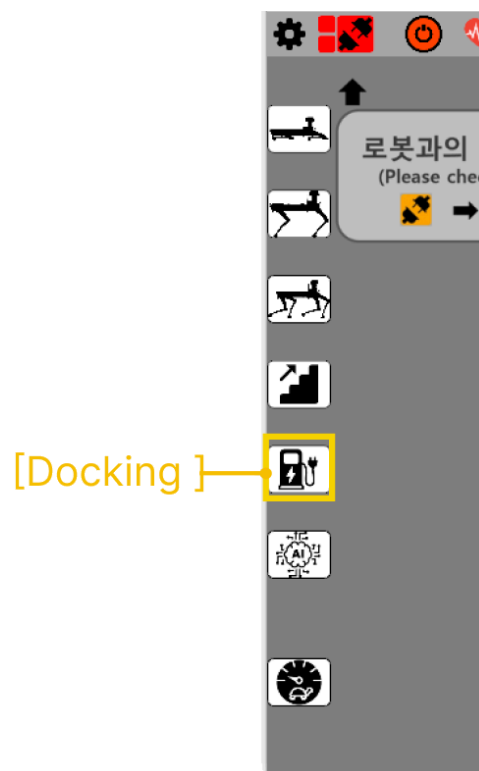
 Confirm the distance between the docking station and the robot is within 1-3 meters.



[Manual docking step 1]

Step 2: Press the **Docking** button.

💡 When the robot recognizes the QR code, docking starts automatically.



[Docking]

[Docking button]

Docking station installation guide

The charging station is water-resistant, but if water gets on the charging terminals, charging problems may occur.

Therefore, avoid installing it where water splashes.

The power cable is treated for water exposure, but when connecting to an external outlet, prevent water from entering the plug connection.

Prolonged direct sunlight can cause overheating; installing in a shaded location is recommended.

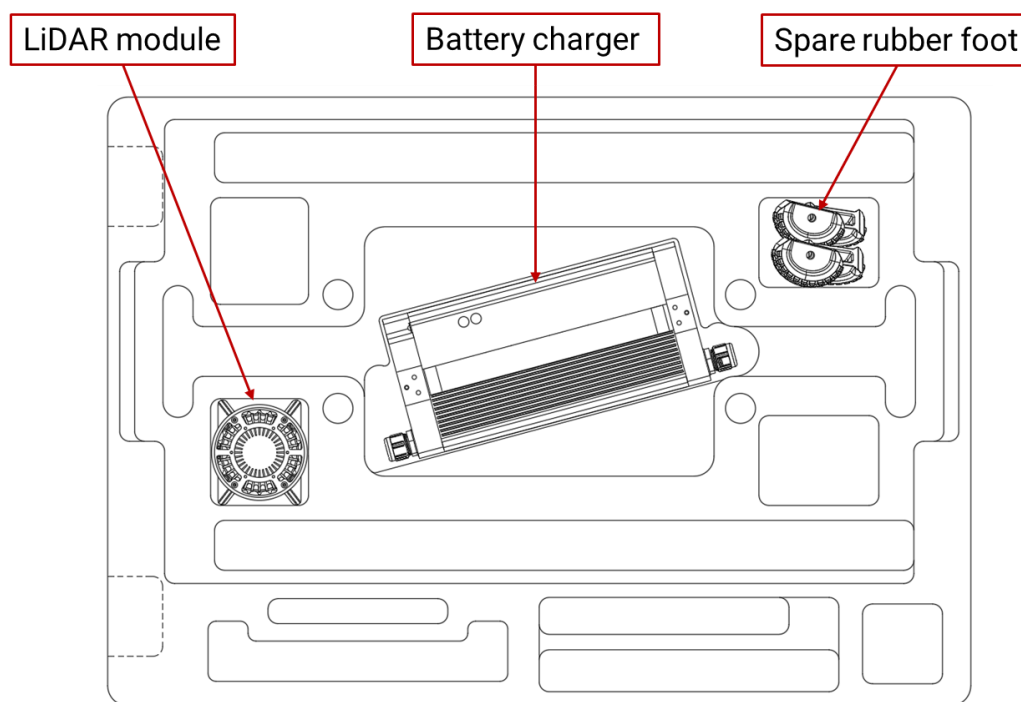
Secure the charging station to the floor using the fixing holes.

3.4 Packing

The RBQ10 is primarily stored and transported using a Pelican case. The model of the Pelican case used is the 1730 Protector Case. Please refer to the images below and store the RBQ10 along with other items accordingly.

Robot packing and unpacking

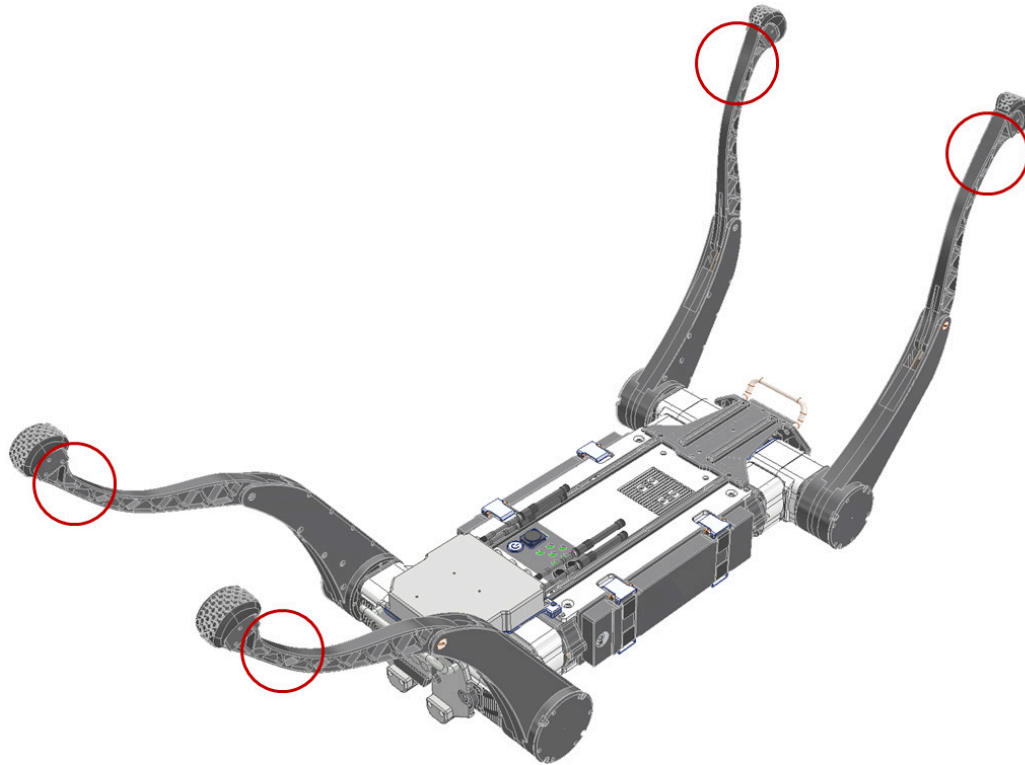
The Pelican case has two layers. The lower layer holds the charger, spare rubber feet, and LiDAR; the RBQ10 is placed on top of them.



-Bottom layer of Pelican 1730-

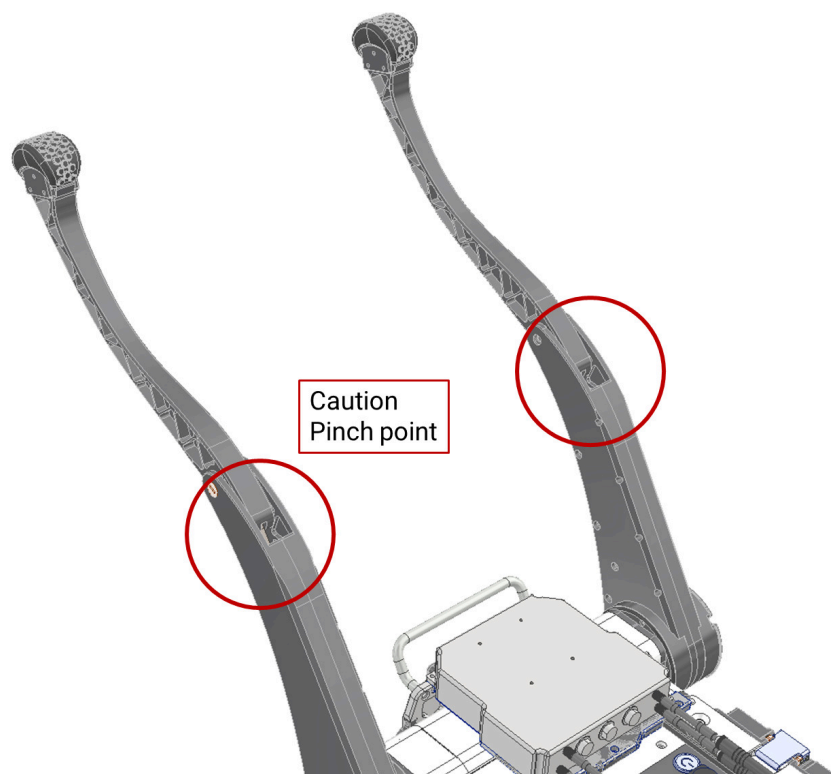
After arranging items in the lower layer, carry the robot as shown in the figure and place it in the case.

- ⚠ The robot must be carried by two people working together.
- ⚠ Before transporting the robot, remove any additional equipment attached to it and turn off the power.

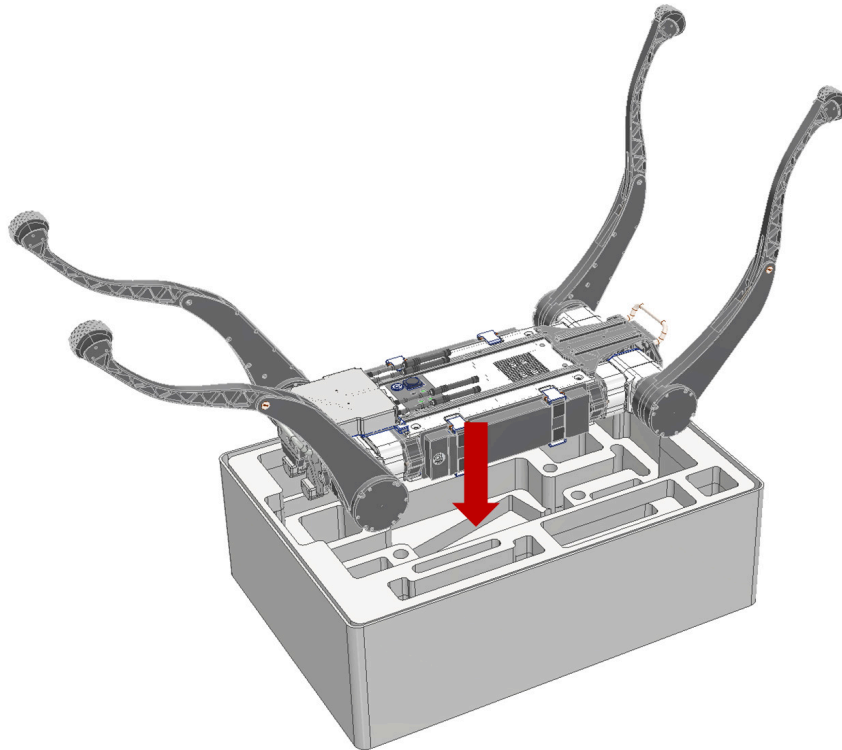


After setting the RBQ10 on the floor, extend the legs as shown in the figure.

Two people should carry the robot, each holding one of the leg areas marked in red.



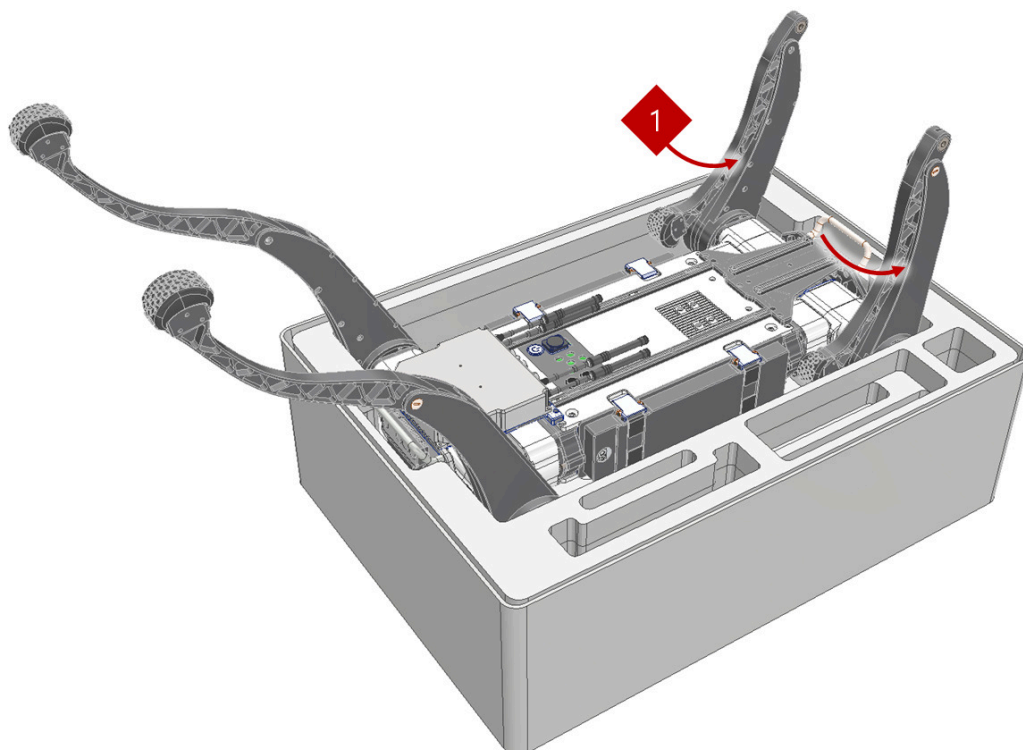
! Be careful not to let any foreign objects get into the knee joint rotation area, and ensure fingers do not get pinched!



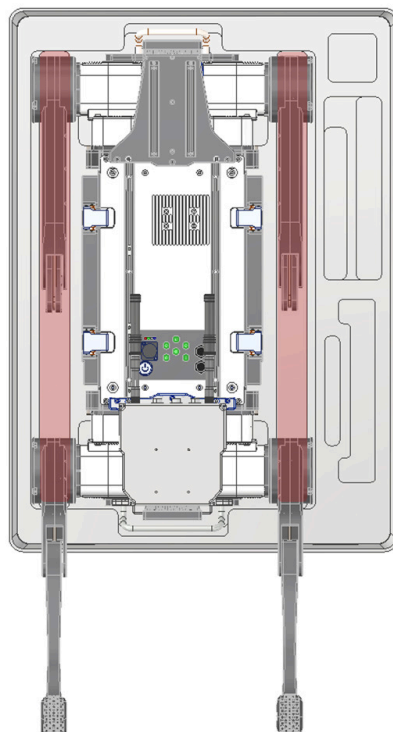
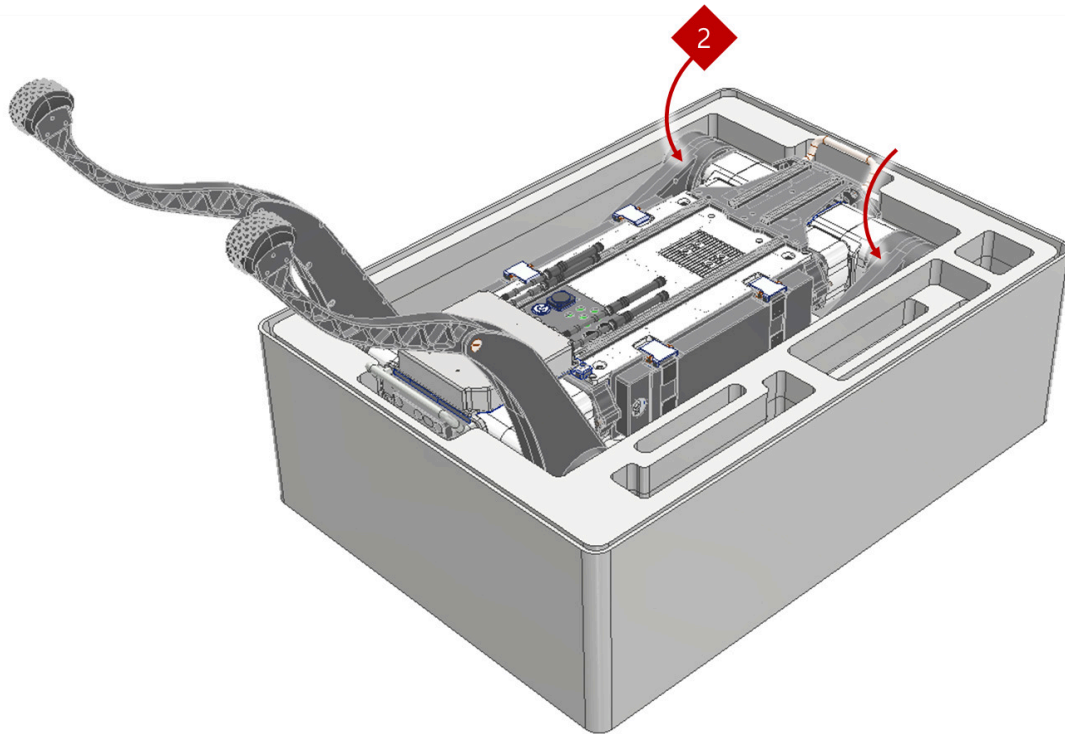
Place the robot in the Pelican 1730 case to match the case shape.

After the body is in the case, fold the legs in this order:

Step 1: Fold the front legs' knee joints fully

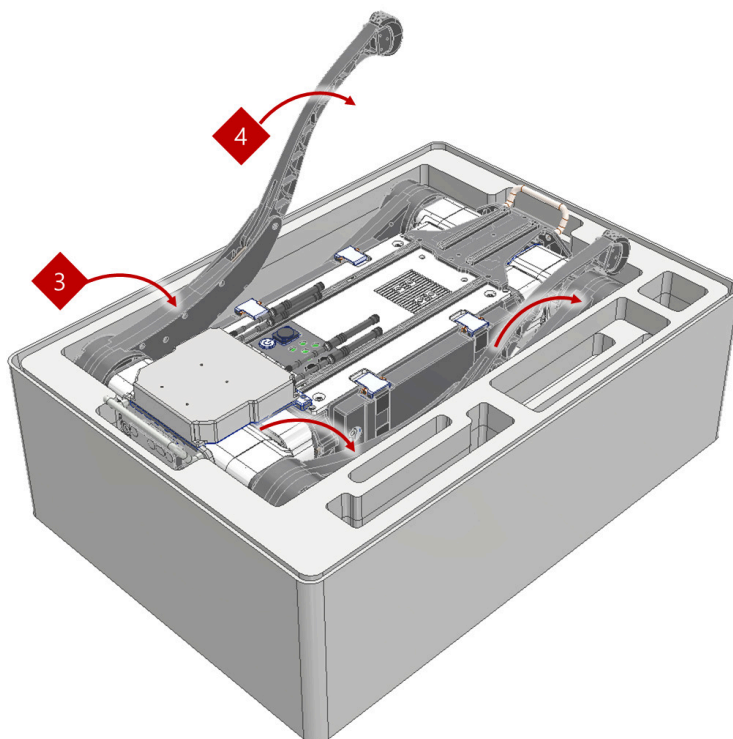


Step 2: Rotate the front legs' hip pitch joints and place the legs into the case recesses



Step 3: Rotate the rear legs' hip pitch joints so the legs go over the front thighs

Step 4: Fully extend the rear shins



Place the remote controller in the side storage next to the robot. Remaining empty space can be used as needed.

Close the lid to finish packing.

Unpacking is the reverse of the above steps.

Packing Dimension

Packing Dimension

Case Type	External Dimensions	Weight (Empty)
Pelican 1730 Protector Case	37.50 × 27.13 × 14.37" (inch) 86.3 × 60.9 × 31.7 (cm)	44 lbs / 20 kg

Packing List

Packing List

The components may vary depending on the optional items.

Category	Items
Standard	RBQ10 × 1 unit Battery charger x 1 unit Spare rubber foot x 4 ea Spare body bumper Remote controller x 1 unit Basic tools (wrench) x 1 set
Navigation Pack	Standard list are included LiDAR module x 1 unit

3.5 Emergency Stop and Recovery Procedures

Emergency stop using the button



[Emergency stop push button on the rear of the robot]

When the robot's **emergency stop button** is pressed, all joints switch to **High Damping**. In this state, the robot's legs resist external motion but **do not** accept torque or position commands. This is a safety mode to protect the user and the robot in an emergency or unintended motion.

💡 During emergency stop, control is disabled and the robot may lose posture and settle to the ground under gravity.

To recover from emergency stop:

1. Rotate the emergency stop button clockwise and return it to its original position.
2. Press the "Stance" button in the GUI, or perform **Robot Initial Pose Setting**.
3. Follow the initialization steps to return the robot to a ready state.

This reinitializes joint control and robot posture correctly.

4.1 RBQGUI

Downloads

- Download RBQGUI.Applmage
 - Download RBQGUI.apk
-

Introduction

RBQGUI is the dedicated application to remotely control and monitor the RBQ quadruped from a PC or handheld controller. After connecting to the robot, you can change posture (sit, stand, walk, etc.) and inspect the environment using the 3D virtual view or camera video.

- **Connection:** Communicates with the robot on the same network.
- **Control:** Select gait modes, stair, docking, etc., and drive motion with the joystick.
- **Monitoring:** View battery and connection status on screen.

Below is a representative screen after launching RBQGUI.



<RBQGUI main screen>

Button reference (1-9)

No.	Function
1	Sit mode: keep the robot in a sitting pose
2	Stance mode: stand up to the default pose
3	walk mode: walk (forward/back, strafe, turn)
4	Stair mode: gait suited for stairs
5	Docking mode: align to the charging dock
6	RL (Vision Trot) mode: vision-based RL walking
7	walking Parameter Setting mode: tune speed, body height, foot lift, etc.
8	3D Virtual View mode: switch to the 3D virtual view
9	Camera View mode: switch to the live camera view

💡 When posture or the app view changes, the corresponding button turns orange.

4.2 Basic Motion Command

Sit Mode

The robot will maintain the sit posture. Any joystick operation will not be working.

[**► Open on YouTube \(click\)**](#)

Sit mode

Stance Mode

- currently Sitting → stand up
- currently Walking or Stair mode → stop & stand in place

[**► Open on YouTube \(click\)**](#)

Stance mode

Joystick Operation

 Joystick	Command	Robot Action
L Stick	Forward / Backward	Nose up / down
L Stick	Left / Right	Roll Left / Right
R Stick	Forward / Backward	Height up / down
R Stick	Left / Right	Turn Left / Right

Walk Mode

[!\[\]\(0dc690309bcc577bffe1c73810af57c4_img.jpg\) Open on YouTube \(click\)](#)


Walk mode

Joystick Operation

 Joystick	Command	Robot Action
L Stick	Forward / Backward	Go Forward / Backward
L Stick	Left / Right	Go Left / Right
R Stick	Forward / Backward	Pitch Forward / Backward
R Stick	Left / Right	Turn Left / Right

Stair Mode

In stair mode, the robot adjusts the walking speed and leans the body according to the slope of the stairs.

 When the robot is in stair mode,
R Stick - Forward / Backward control keys are not used.

[!\[\]\(2027f710942186bc2d02193053a49d40_img.jpg\) Open on YouTube \(click\)](#)



Stair mode

Joystick Operation

 Joystick	Command	Robot Action
L Stick	Forward / Backward	Go Forward / Backward
L Stick	Left / Right	Go Left / Right
R Stick	Forward / Backward	
R Stick	Left / Right	Turn Left / Right

Docking Mode

In this mode, the robot autonomously aligns itself with the charging station.

-  The robot will stop any locomotion and begin charging once docked.
-  Do not manually move the robot while in docking mode.
- Ensure the docking station is properly positioned and powered.

RL (Vision Trot) Mode

In this mode, the robot uses a vision-based Reinforcement Learning policy to walk. It is trained to respond dynamically to terrain using onboard camera input.

- Ideal for uneven terrain or dynamic obstacles.
- May have different responsiveness compared to manually programmed gait modes.

[!\[\]\(3f41268aaa93dab4a01c59fb2f124f87_img.jpg\) Open on YouTube \(click\)](#)

RL (Vision Trot) mode

Joystick Operation

 Joystick	Command	Robot Action
L Stick	Forward / Backward	Go Forward / Backward
L Stick	Left / Right	Go Left / Right
R Stick	Forward / Backward	
R Stick	Left / Right	Turn Left / Right

Walking Parameter Setting

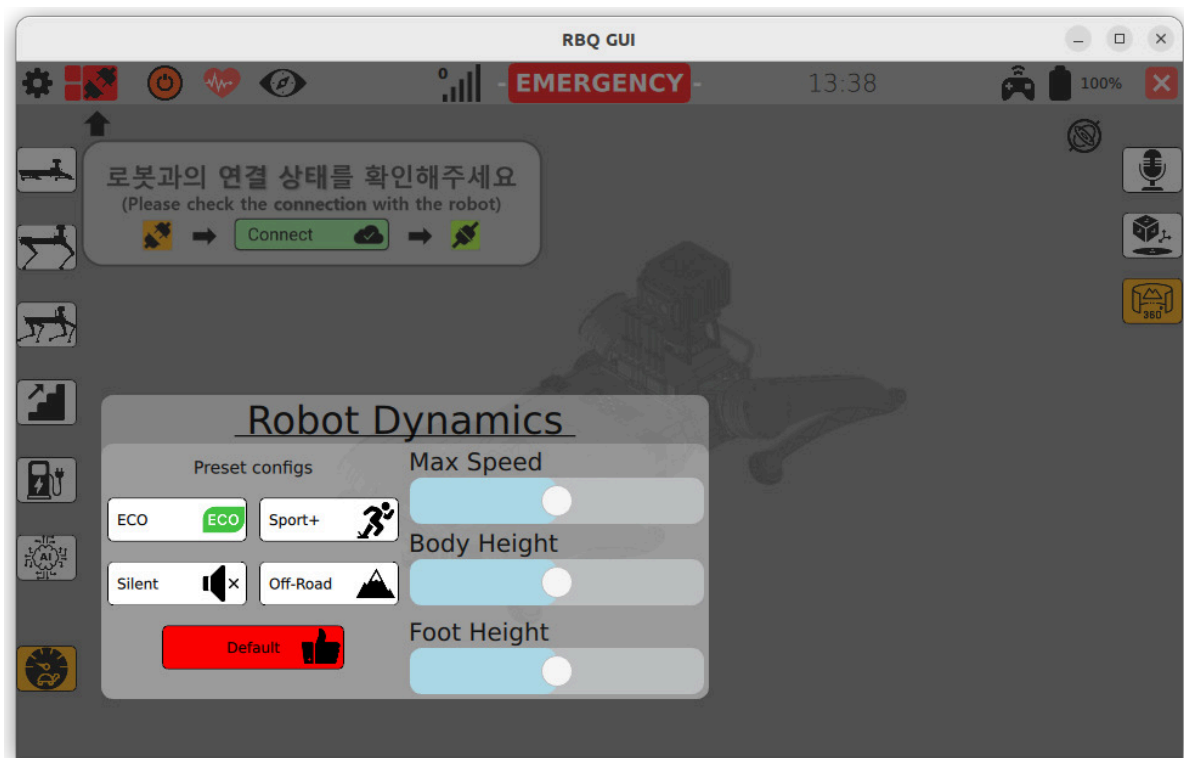
Customize Your Robot's Gait in Real Time

[!\[\]\(d7afaf512ee054276d9d45e534143c76_img.jpg\) Open on YouTube \(click\)](#)

Walking parameter setting

You can fine-tune the walking behavior via the GUI:

- **Max Command Speed** - Limits how fast the robot walks
- **Body Height** - Adjust vertical posture for clearance
- **Foot Height** - Controls how high the feet lift during swing phase

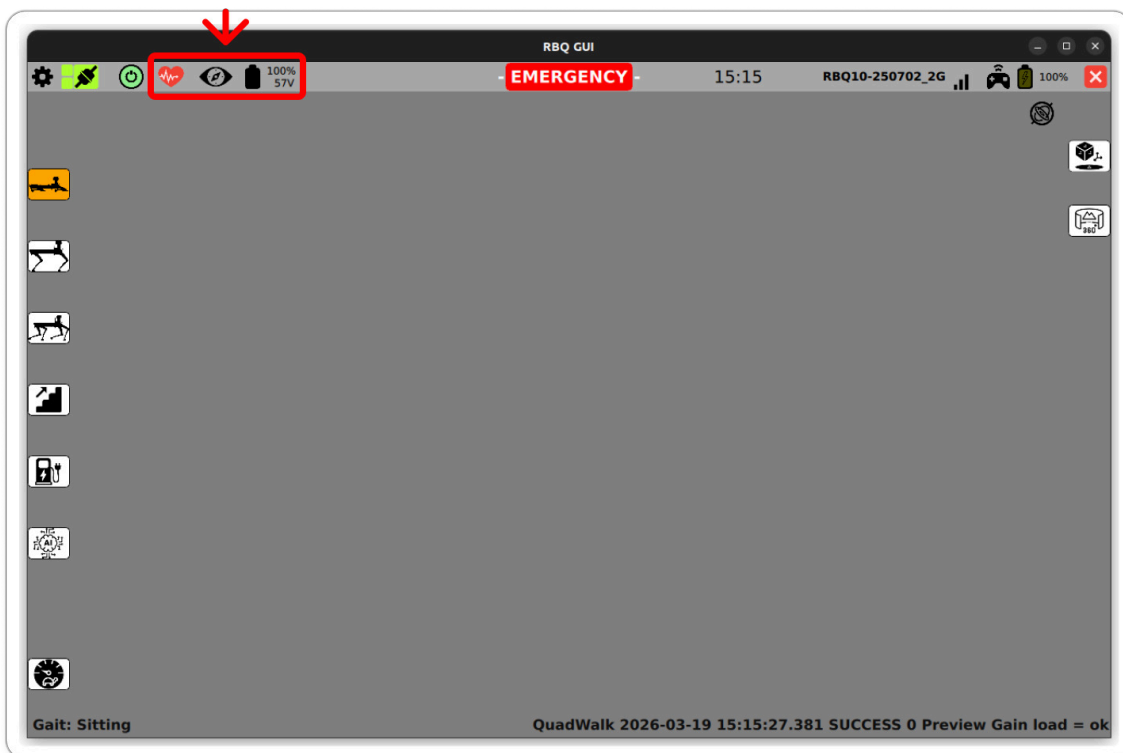


4.3 State Monitoring

In RBQGUI, you can check the robot's current status (emergency/power/sensors/perception modules) in real time.

1) Top Status Area

As shown in `state_monitoring1.png`, the top area displays **EMERGENCY** status and various system status icons (battery/connection/power, etc.).

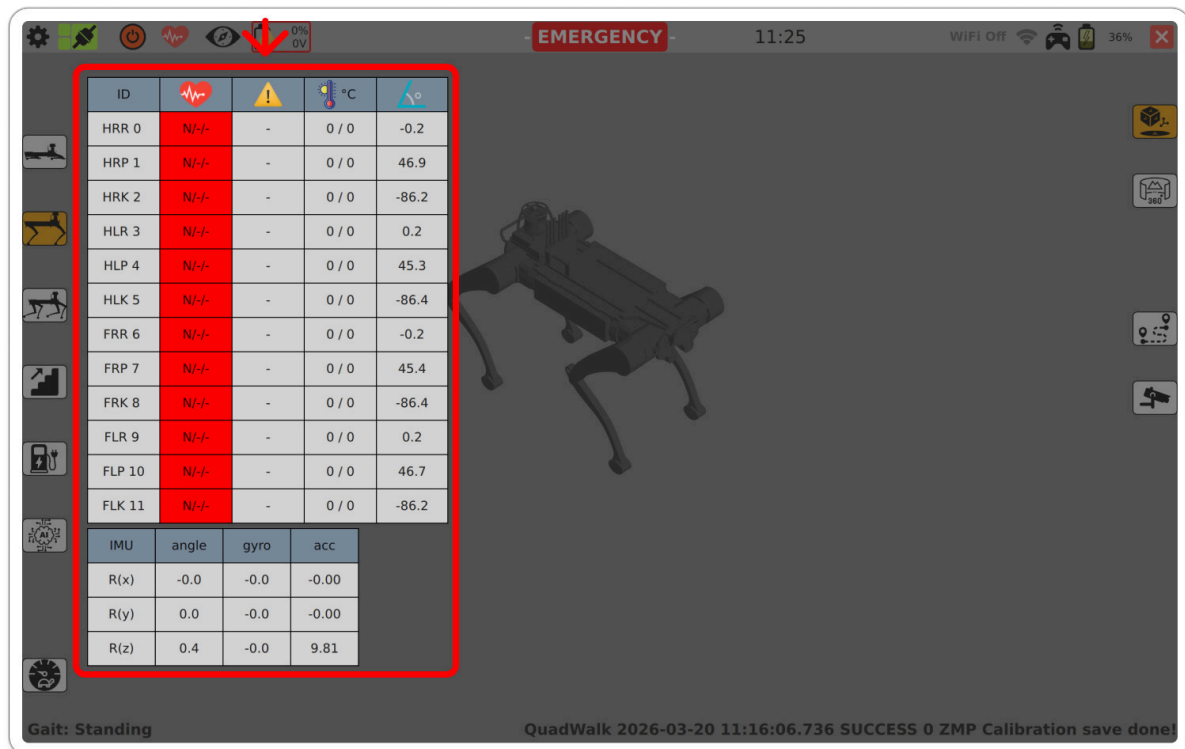


Top status area

2) Diagnostic Table (Motors/IMU, etc.)

In `state_monitoring2.png`, you can review diagnostic values per leg/joint (e.g., HRR/HRP/...) along with readings such as temperature, gyro, and acceleration (ACC)

in a table.



Joint/Sensor diagnostic table

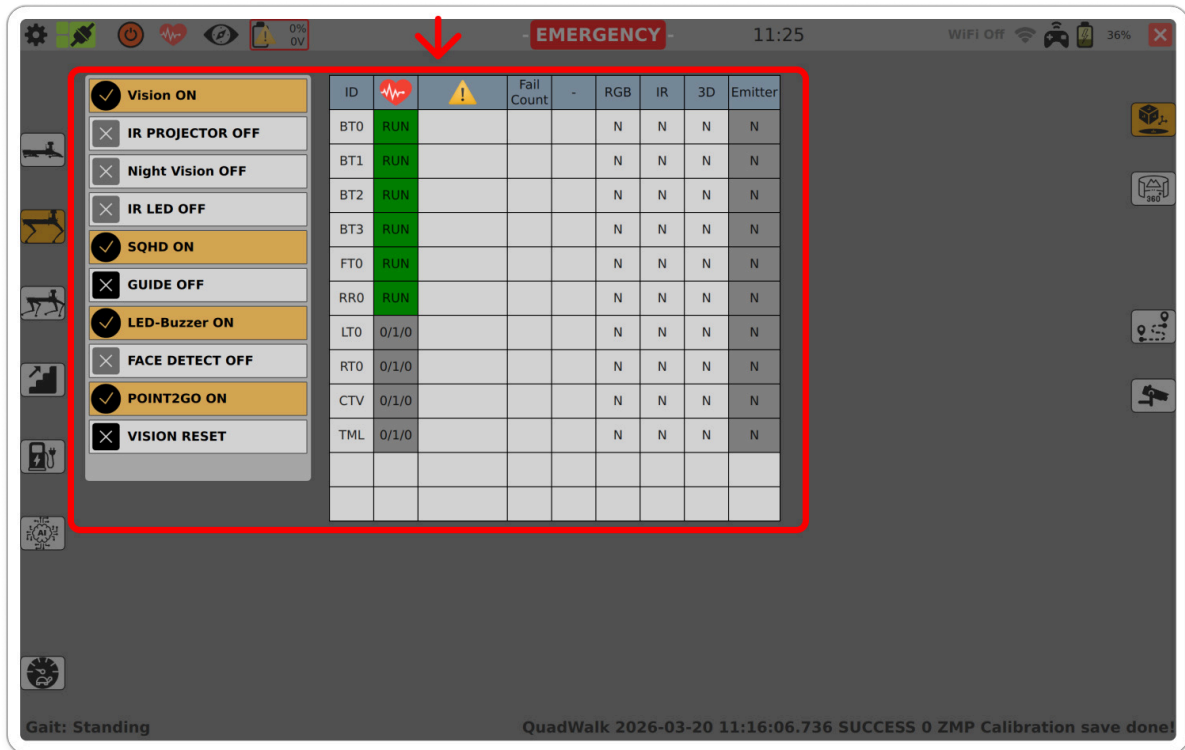
Joint Naming

Joint IDs in the diagnostic table use the following abbreviations:

- **HRR** : Hind Right Roll, **HRP** : Hind Right Pitch, **HRK** : Hind Right Knee
- **HLR** : Hind Left Roll, **HLP** : Hind Left Pitch, **HLK** : Hind Left Knee
- **FRR** : Front Right Roll, **FRP** : Front Right Pitch, **FRK** : Front Right Knee
- **FLR** : Front Left Roll, **FLP** : Front Left Pitch, **FLK** : Front Left Knee

3) Perception Status

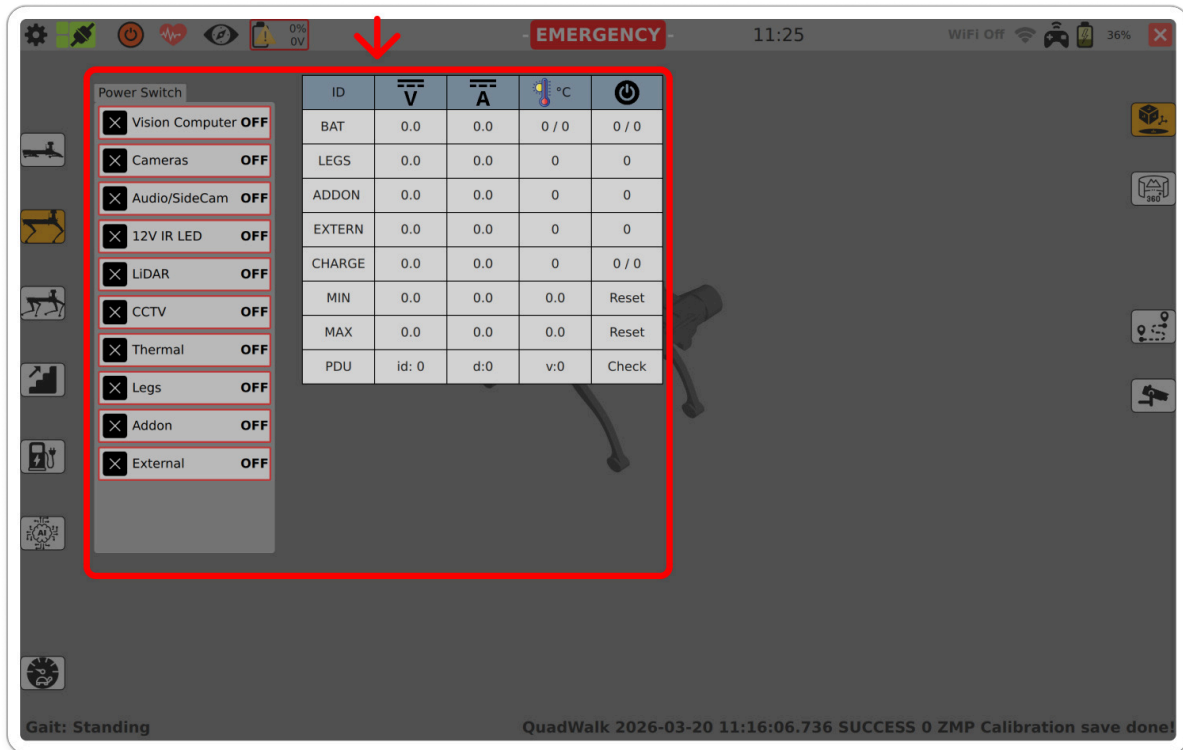
As shown in `state_monitoring3.png`, you can toggle perception-related modules (e.g., IR projector, night vision, LED buzzer, etc.), and check module operation/error/count values (Fail/Count).



Perception module status

4) Power Switch & Module Check

In `state_monitoring4.png`, you can check power switch states (Vision Computer/Cameras/sensors such as LiDAR) and also review major power/load status like BAT/LEGS/ADDON/EXTERN/CHARGE. Use `Reset` and `Check` to refresh the status.



Power switch & module check

Notes / Warnings

- If **EMERGENCY** or an abnormal state is shown, secure safety first and then check the cause (sensor/power/perception module operation, etc.).
- If perception/sensor modules are OFF, the corresponding features (e.g., vision-based walking) may be limited.

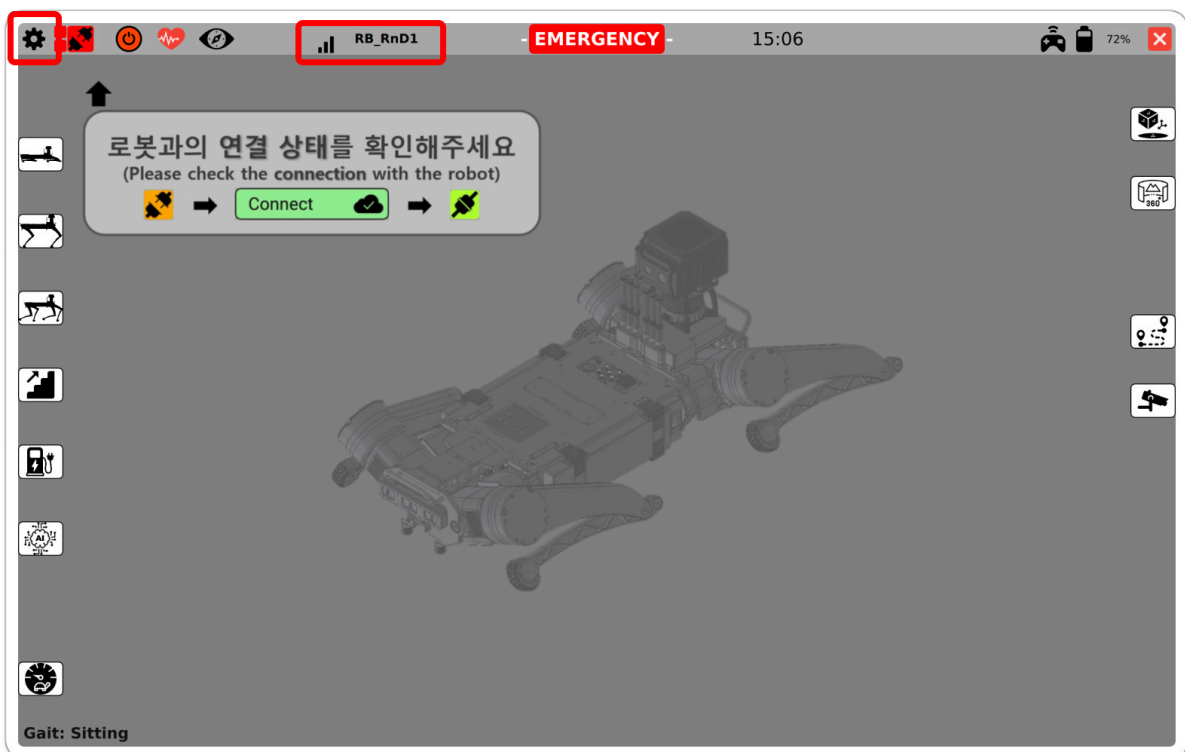
4.4 GUI Software Update

This page explains how to update the GUI software from RBQGUI.

1. Make sure the internet connection is working.

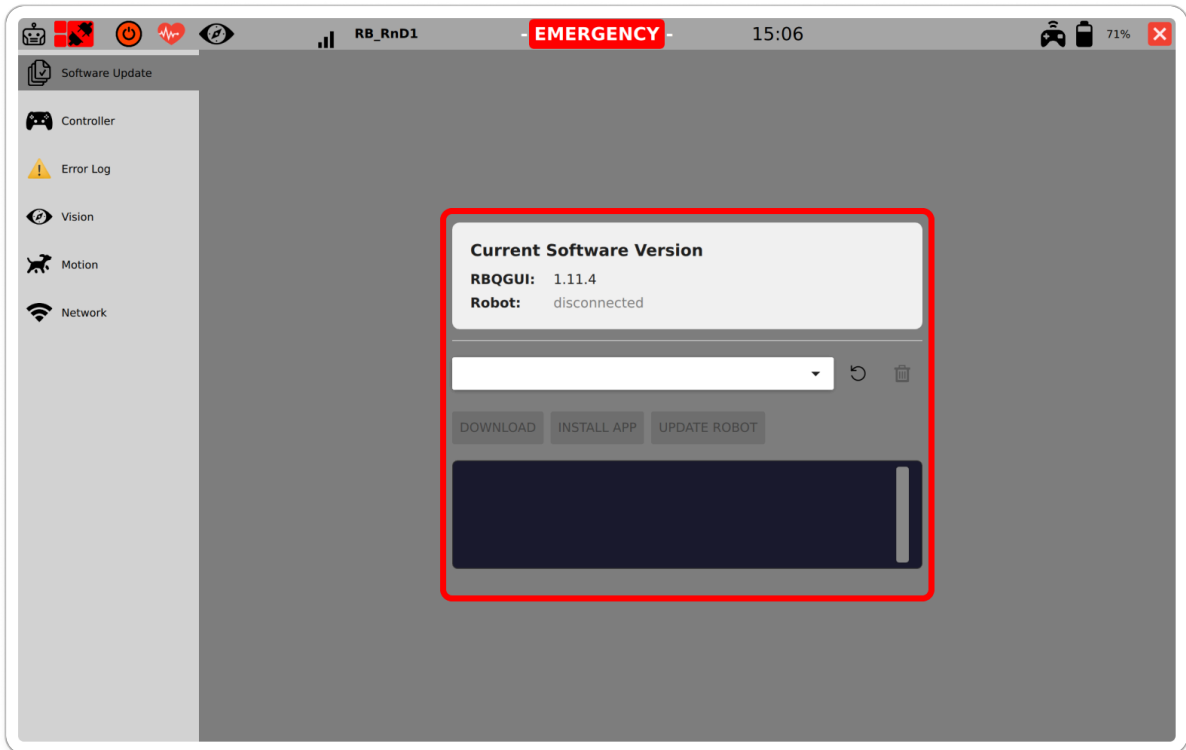
(You must connect to a Wi-Fi network with internet access, not the robot network.)

Press the Settings button in the top-left to open the settings screen.



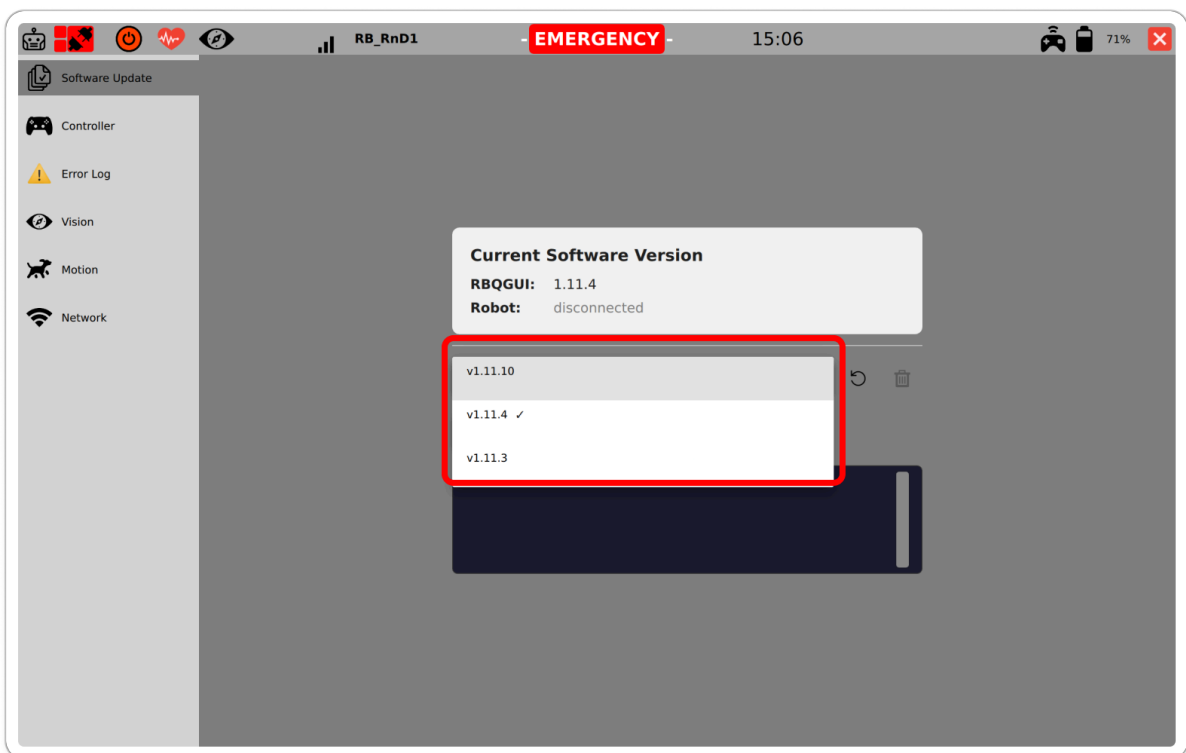
Check internet connection

2. On the **Software Update** screen, check the current GUI version (RBQGUI) and the available target versions.

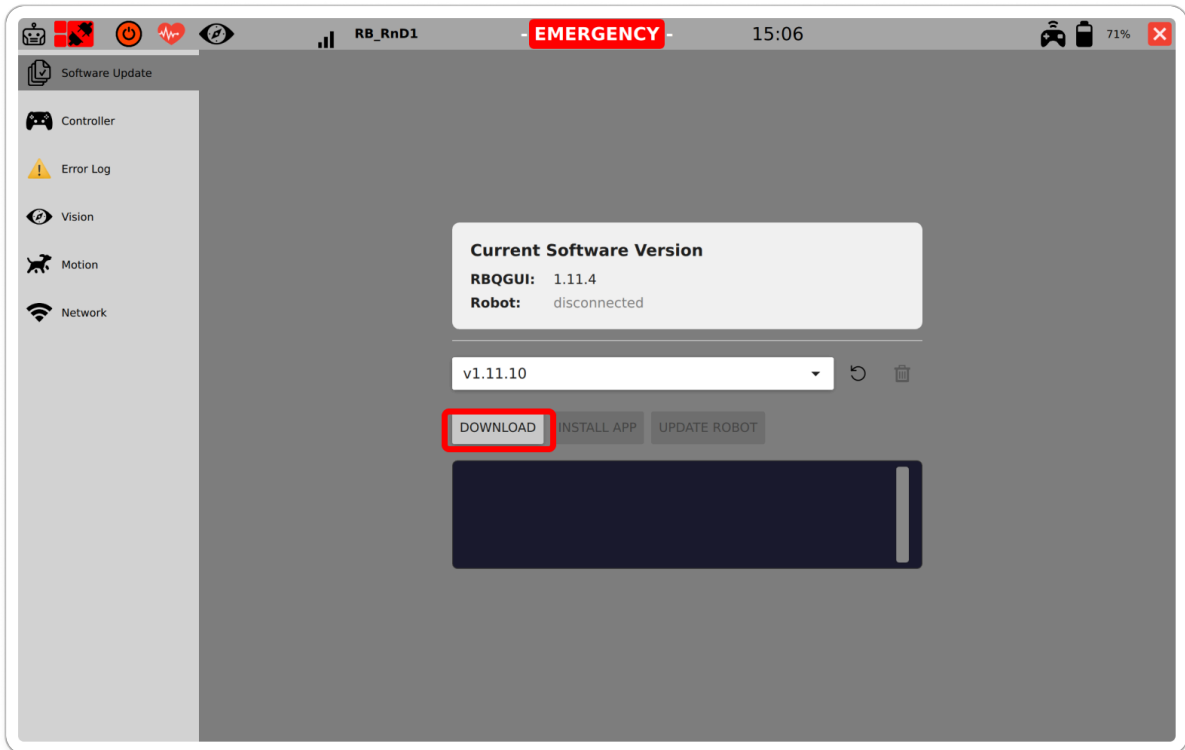


Current GUI / Target version

3. Select the desired version from the dropdown and click **DOWNLOAD**.
(Versions marked with a check mark are already downloaded.)

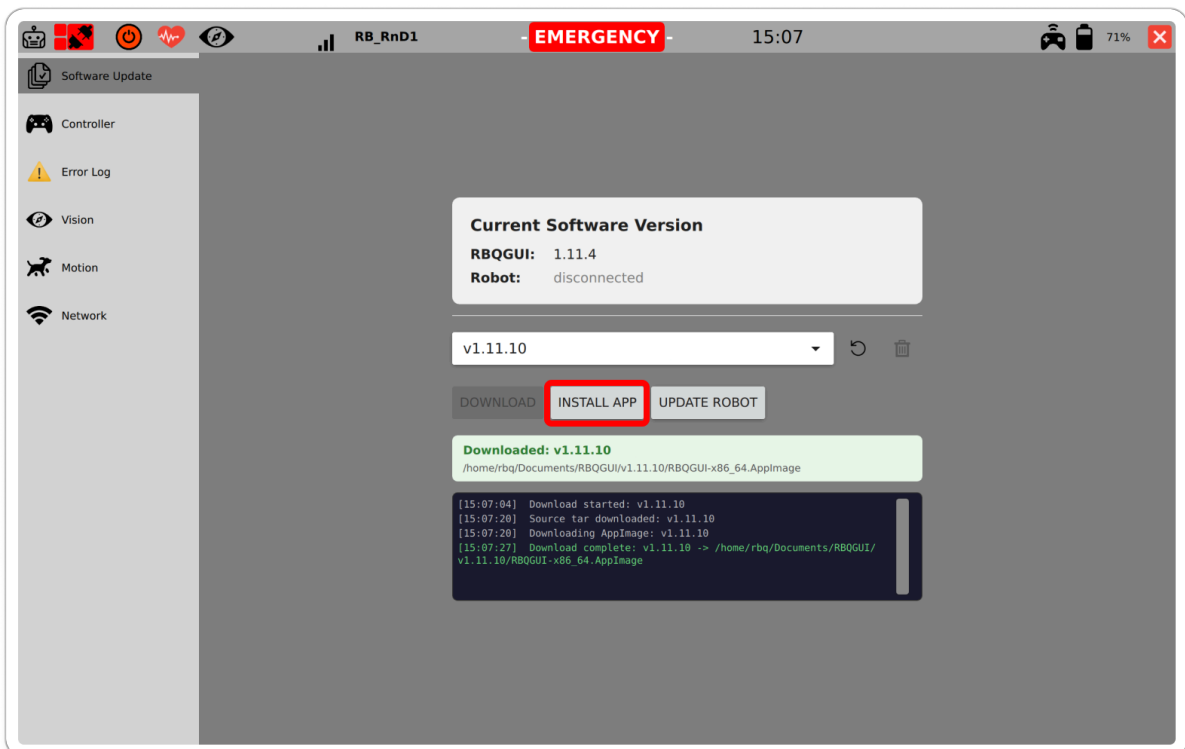


Select version



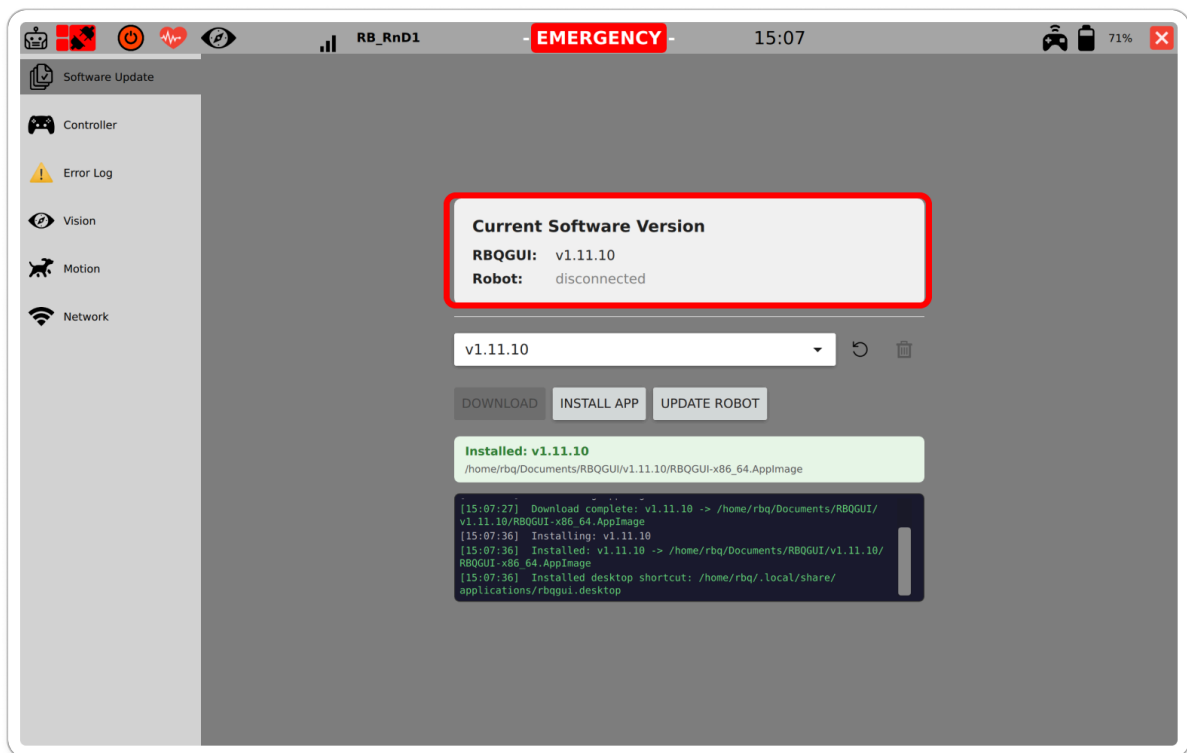
DOWNLOAD

4. After downloading, click **INSTALL APP**.



INSTALL APP

5. After installation completes, the installation log is displayed.
Check the updated RBQGUI version on the screen.



Installation complete

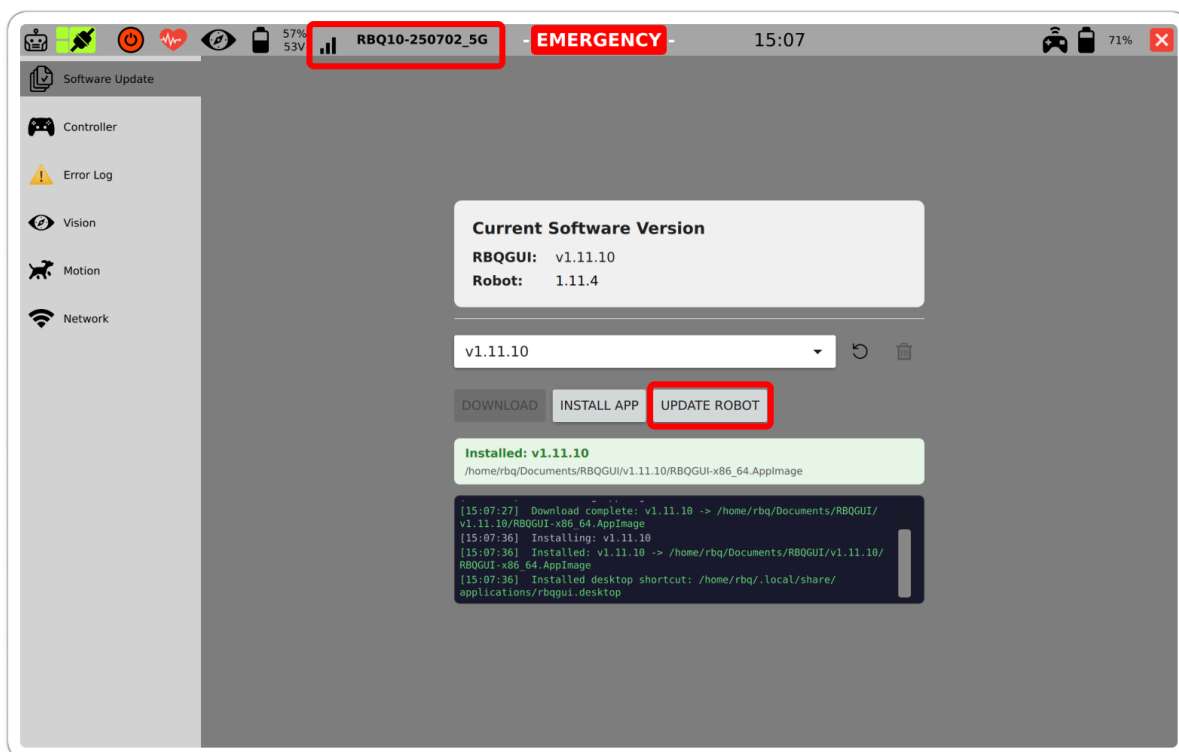
Notes / Warnings

- Check safety if **EMERGENCY** is shown.
- Updates can take time depending on the network condition.

4.5 Robot Software Update

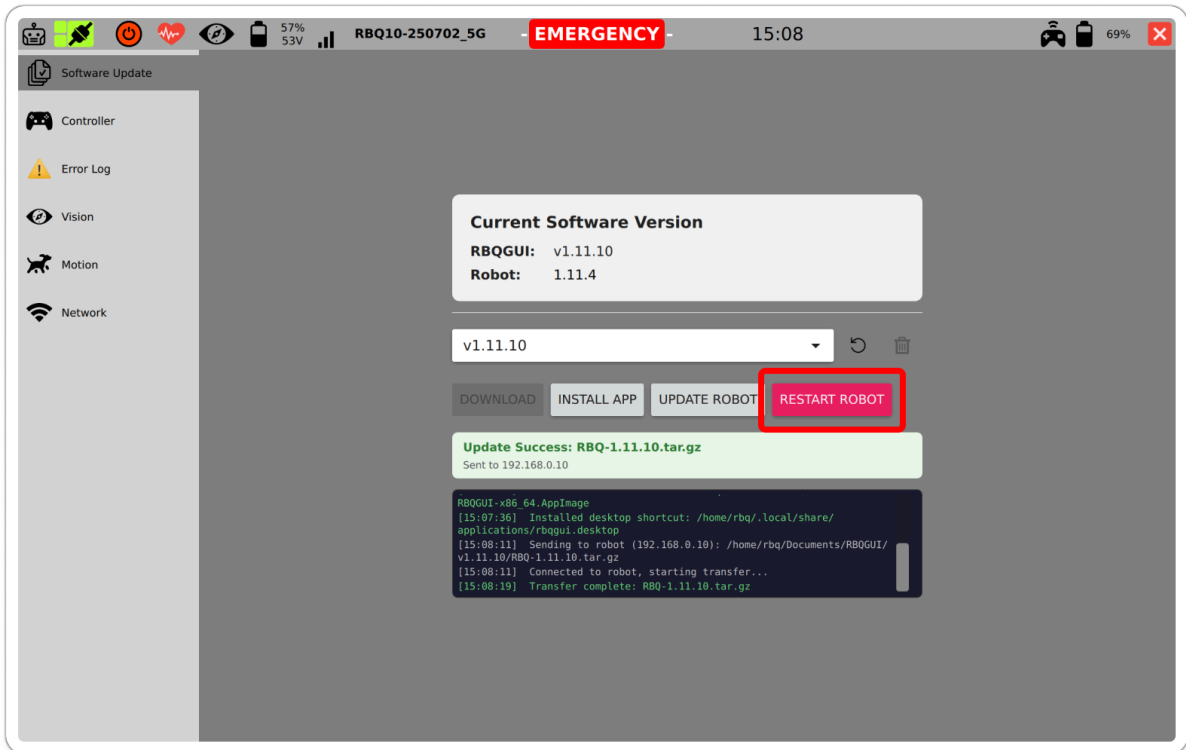
This page explains how to update robot software from RBQGUI.

1. On the **Software Update** screen, check the current robot version and whether **UPDATE ROBOT** is enabled. Make sure Wi-Fi is connected between the robot and RBQGUI.



UPDATE ROBOT

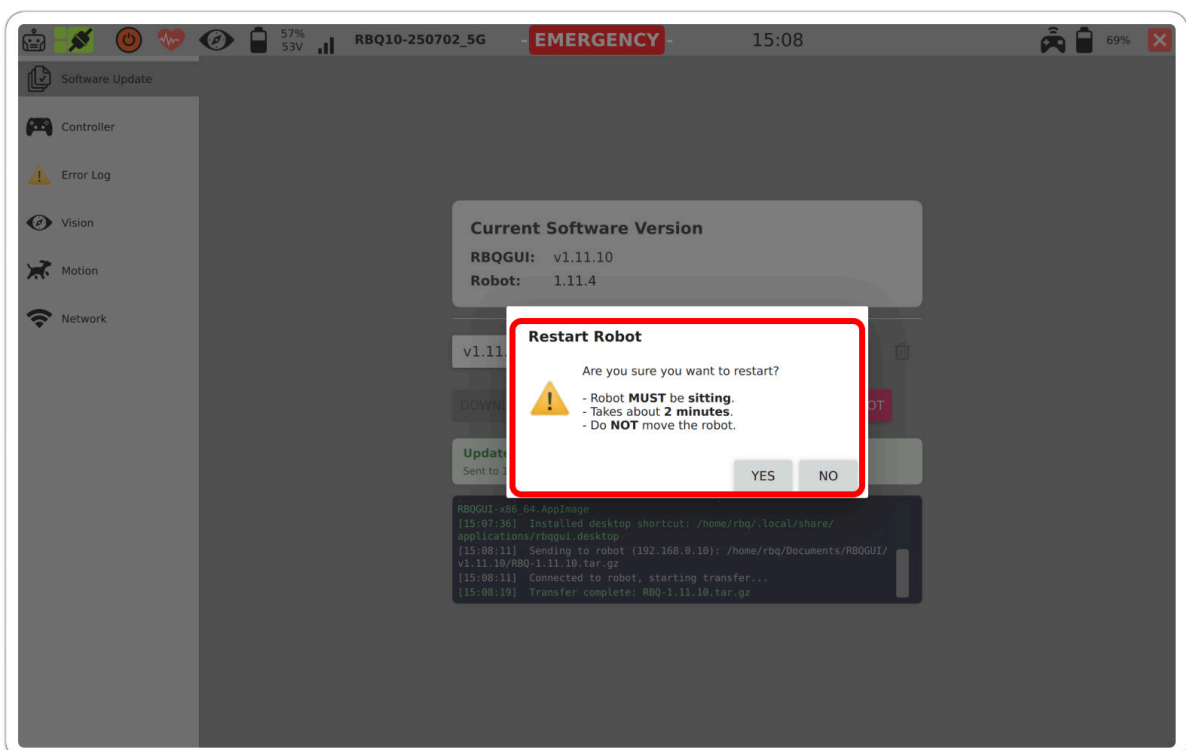
2. Transfer/install runs, and when finished, a success message and logs are shown.



Update complete / logs

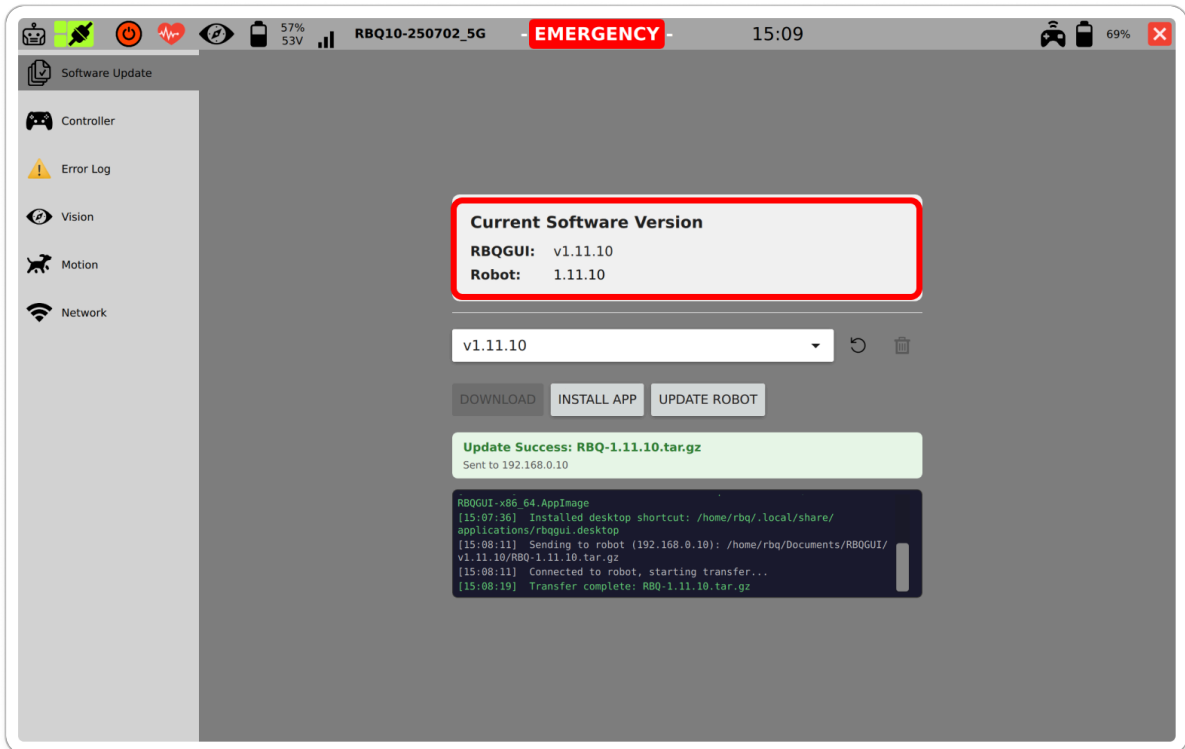
3. A restart confirmation dialog will be shown.

The robot must be in **sitting** state, and you should not move the robot before restarting.



Restart Robot (YES/NO)

4. After restart, the Robot version is displayed as the updated value.



Update complete confirmation

Notes / Warnings

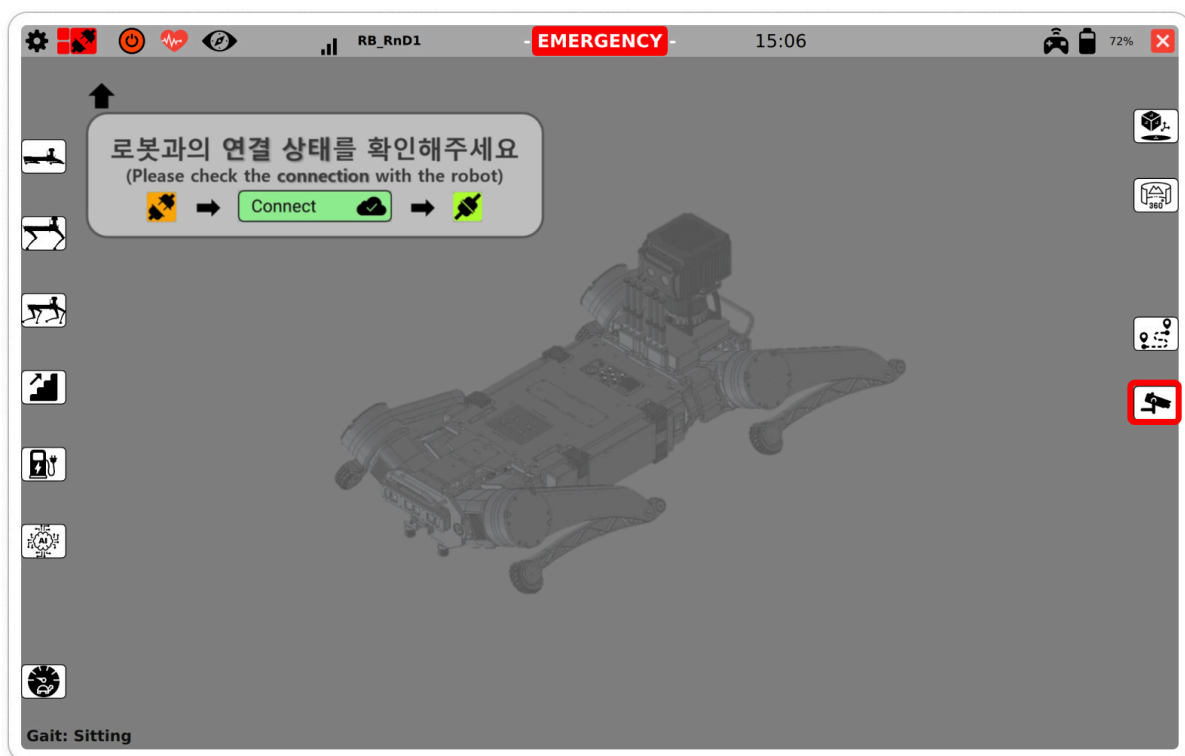
- Check safety if **EMERGENCY** is shown.
- Updates can take time depending on the network condition.

4.6 PTZ GUI

If a PTZ camera (optional) is installed, you can control the camera direction (Pan/Tilt), zoom, and video mode (Thermal/Color) from RBQGUI.

1) Screen entry

1. Run RBQGUI and connect to the robot.
2. Move to the camera screen, then open the PTZ control screen.
3. When the PTZ is connected normally, you can use the control area at the bottom.



PTZ GUI main screen

2) Basic operation (Pan/Tilt)

- Drag the PTZ control area (virtual joystick) on the screen to move the camera left/right (Pan) and up/down (Tilt).

- When you release your hand, input stops. If needed, drag again for fine adjustments.
- For more accurate positioning, move slowly using smaller inputs instead of fast movements.

3) Zoom control

Use the bottom **Zoom** buttons to change the optical zoom immediately.

- **1x** , **3x** , **8x** , **16x** , **32x** : fixed zoom selection
- **Center** : return the camera direction to the default center position



Zoom buttons and switch area

4) Video mode & joystick

On the bottom-right, you can control the **Thermal/Color** switch and the virtual joystick display.

- **Thermal / Color:** switch between thermal (**Thermal**) and color (**Color**) video
 - **Joystick icon** (center of the right side of the screen): tap to show/hide the virtual joystick panel
-

5) Exit

Press the **Exit** button at the top-right to close the PTZ screen and return to the basic GUI screen.

Demo video

[**▶ Open on YouTube \(click\)**](#)

PTZ basic operation

5.1 Specification

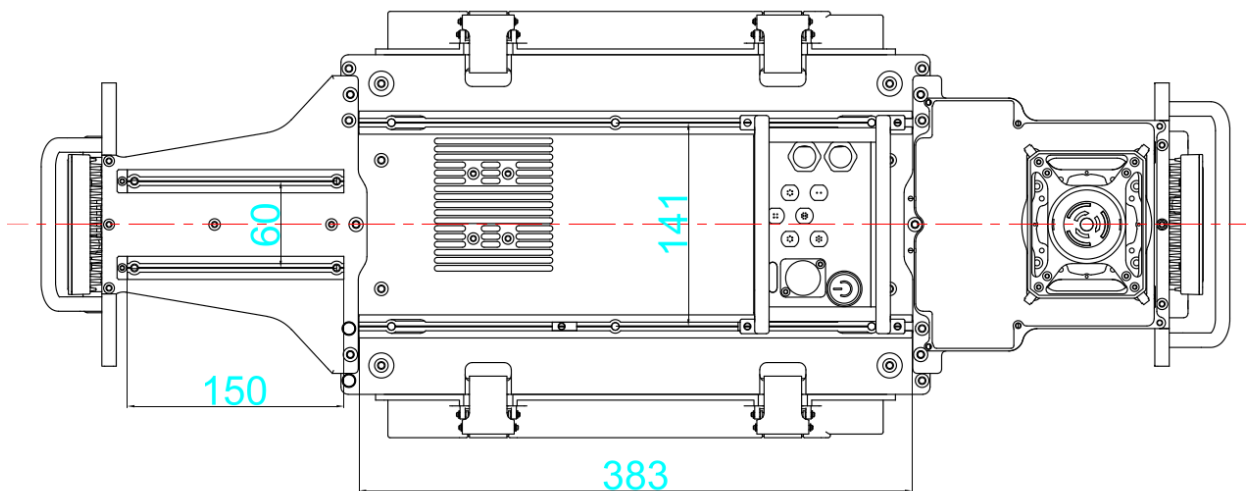
URDF

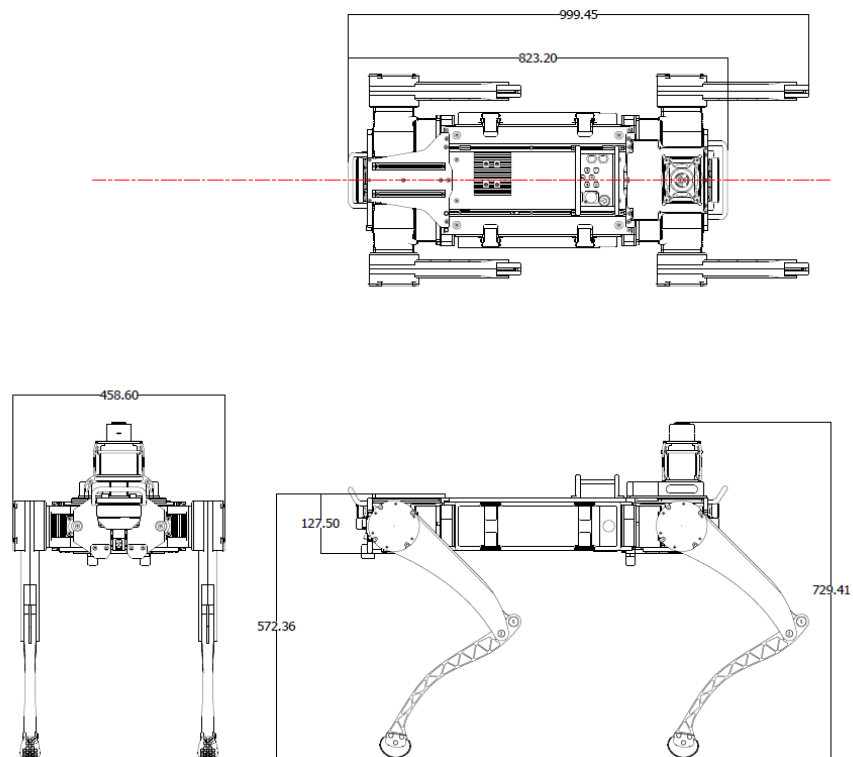
- [Download RBQ URDF.zip](#)
-

CAD

- [Download RBQ CAD.zip](#)
-

Robot Dimension





Joint Specification

Joint Specification

Category	Hip Roll Joint	Hip Pitch Joint	Knee Joint
Max Angular Vel	14.4 rad/s	14.4 rad/s	11.15 rad/s
Nominal Torque	40 Nm	40 Nm	50 Nm
Max Torque	104 Nm	104 Nm	140 Nm
Rotor Inertia	0.014058265	0.014058265	0.0214816
Joint Range	Left: $-30^{\circ} \sim 43^{\circ}$ Right: $-43^{\circ} \sim 30^{\circ}$	No limit	$-158.1^{\circ} \sim -19.3^{\circ}$

IMU Sensor Specification

Parameter	Specification
Gyroscope In-Run Bias	5 °/hr

Gyroscope Range	$\pm 2,000$ °/sec
Accelerometer Range	± 16 g
Accelerometer In-Run Bias	< 0.04 mg
IMU Data Update Rate	800 Hz
Extended Kalman Filter Update Rate	400 Hz

- IMU Offset
 - Robot body Center to IMU Center (x,y,z) : (0.00665, 0, -0.0404)

5.2 Physical Parameter

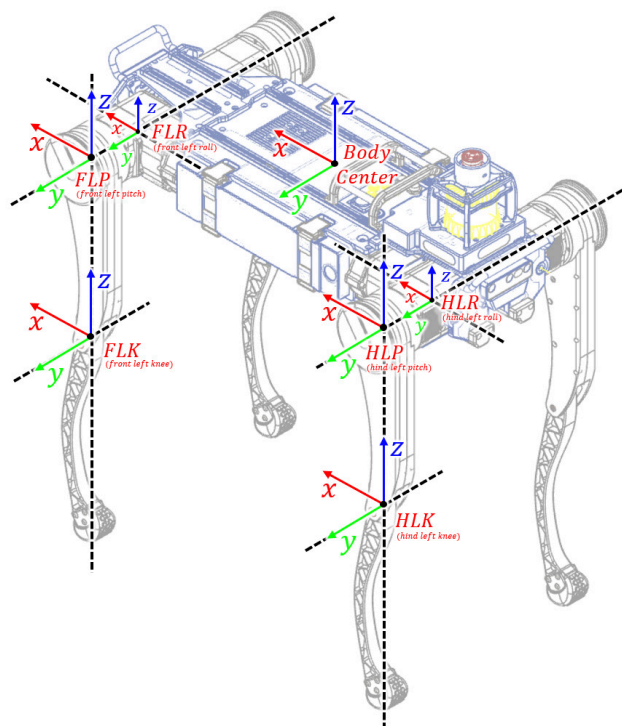
URDF

- Download RBQ URDF.zip
-

CAD

- Download RBQ CAD.zip
-

Joint Coordinates & Offset



Joint Structure

#	Joint	Parent Link	Child Link	Rev Axis	TF (x, y, z)
0	HRR	body link	HR_hip link	(1, 0, 0)	(-0.31218, -0.09, 0)
1	HRP	HR_hip link	HR_thigh link	(0, 1, 0)	(0, -0.10285, 0)
2	HRK	HR_thigh link	HR_calf link	(0, 1, 0)	(0, 0, -0.33)
	HRF	HR_calf link	HR_foot link	fixed	(0, 0, -0.33)
3	HLR	body link	HL_hip link	(1, 0, 0)	(-0.31218, 0.09, 0)
4	HLP	HL_hip link	HL_thigh link	(0, 1, 0)	(0, 0.10285, 0)
5	HLK	HL_thigh link	HL_calf link	(0, 1, 0)	(0, 0, -0.33)
	HLF	HL_calf link	HL_foot link	fixed	(0, 0, -0.33)
6	FRR	body link	FR_hip link	(1, 0, 0)	(0.31218, -0.09, 0)
7	FRP	FR_hip link	FR_thigh link	(0, 1, 0)	(0, -0.10285, 0)
8	FRK	FR_thigh link	FR_calf link	(0, 1, 0)	(0, 0, -0.33)
	FRF	FR_calf link	FR_foot link	fixed	(0, 0, -0.33)
9	FLR	body link	FL_hip link	(1, 0, 0)	(0.31218, 0.09, 0)
10	FLP	FL_hip link	FL_thigh link	(0, 1, 0)	(0, 0.10285, 0)
11	FLK	FL_thigh link	FL_calf link	(0, 1, 0)	(0, 0, -0.33)
	FLF	FL_calf link	FL_foot link	fixed	(0, 0, -0.33)



Joint Naming

HRR : Hind Right Roll, **HRP** : Hind Right Pitch, **HRK** : Hind Right Knee

HLR : Hind Left Roll, **HLP** : Hind Left Pitch, **HLK** : Hind Left Knee

FRR : Front Right Roll, **FRP** : Front Right Pitch, **FRK** : Front Right Knee

FLR : Front Left Roll, **FLP** : Front Left Pitch, **FLK** : Front Left Knee

Link Mass & Inertia Parameter

Link Inertia Information

Link Name	Mass (kg)	CoM (m)	Inertia Tensor (kg·m ²)
body link	16.758	x : -0.013265 y : 0.0	ixx="0.163831629266" ixy="-0.000271071491" iyy="0.590891341306"

		z : 0.011765	ixz="0.040352639311" iyz="0.000216428332" izz="0.678714788268"
HR_hip link	3.6693 44	x : 0.027522 y : -0.01681 z : -0.00187	ixx="0.006957590282" ixy="-0.0017011378" iyy="0.00993982268" ixz="-0.000029676183" iyz="0.000087952172" izz="0.012145140245"
HR_thigh link	1.80014	x : -0.00476 5 y : -0.00441 z : -0.06311	ixx="0.018990787558" ixy="0.000045769435" iyy="0.019770882672" ixz="-0.001024809563" iyz="0.000510504233" izz="0.001828257915"
HR_calf link	0.4520	x : 0.008988 y : 0.000072 z : -0.14911	ixx="0.00214256" ixy="0.000000075939" iyy="0.00216568" ixz="0.0000230368745" iyz="0.000009344688" izz="0.0000616440919"
HR_foot	0.06	0,0,0	ixx="9.6e-06" ixy="0.0" ixz="0.0" iyy="9.6e-06" iyz="0.0" izz="9.6e-06"
HL_hip link	3.6693 44	x : 0.027522 y : 0.01681 z : -0.00187	ixx="0.006957590282" ixy="0.0017011378" iyy="0.00993982268" ixz="-0.000029676183" iyz="-0.000087952172" izz="0.012145140245"
HL_thigh link	1.80014	x : -0.00476 5 y : 0.00441 z : -0.06311	ixx="0.018990787558" ixy="-0.000045769435" iyy="0.019770882672" ixz="-0.001024809563" iyz="-0.000510504233" izz="0.001828257915"
HL_calf link	0.4520	x : 0.008988 y :	ixx="0.00214256" ixy="-0.000000075939" iyy="0.00216568"

		-0.00007 2 z : -0.14911	ixz="0.0000230368745" iyz="-0.000009344688" izz="0.0000616440919"
HL_foot	0.06	0,0,0	ixx="9.6e-06" ixy="0.0" ixz="0.0" iyy="9.6e-06" iyz="0.0" izz="9.6e-06"
FR_hip link	3.6693 44	x : -0.027522 y : -0.01681 z : -0.00187	ixx="0.006957590282" ixy="0.0017011378" iyy="0.00993982268" ixz="0.000029676183" iyz="0.000087952172" izz="0.012145140245"
FR_thigh link	1.80014	x : -0.00476 5 y : -0.00441 z : -0.06311	ixx="0.018990787558" ixy="0.000045769435" iyy="0.019770882672" ixz="-0.001024809563" iyz="0.000510504233" izz="0.001828257915"
FR_calf link	0.4520	x : 0.008988 y : 0.000072 z : -0.14911	ixx="0.00214256" ixy="0.000000075939" iyy="0.00216568" ixz="0.0000230368745" iyz="0.000009344688" izz="0.0000616440919"
FR_foot	0.06	0,0,0	ixx="9.6e-06" ixy="0.0" ixz="0.0" iyy="9.6e-06" iyz="0.0" izz="9.6e-06"
FL_hip link	3.6693 44	x : -0.027522 y : 0.01681 z : -0.00187	ixx="0.006957590282" ixy="-0.0017011378" iyy="0.00993982268" ixz="0.000029676183" iyz="-0.000087952172" izz="0.012145140245"
FL_thigh link	1.80014	x : -0.00476 5 y :	ixx="0.018990787558" ixy="-0.000045769435" iyy="0.019770882672" ixz="-0.001024809563"

		0.00441 z : -0.06311	iyz=" -0.000510504233" izz="0.001828257915"
FL_calf link	0.4520	x : 0.008988 y : -0.00007 2 z : -0.14911	ixx="0.00214256" ixy=" -0.000000075939" iyy="0.00216568" ixz="0.0000230368745" iyz=" -0.000009344688" izz="0.0000616440919"
FL_foot	0.06	0,0,0	ixx="9.6e-06" ixy="0.0" ixz="0.0" iyy="9.6e-06" iyz="0.0" izz="9.6e-06"

5.3 Rail & spring nut

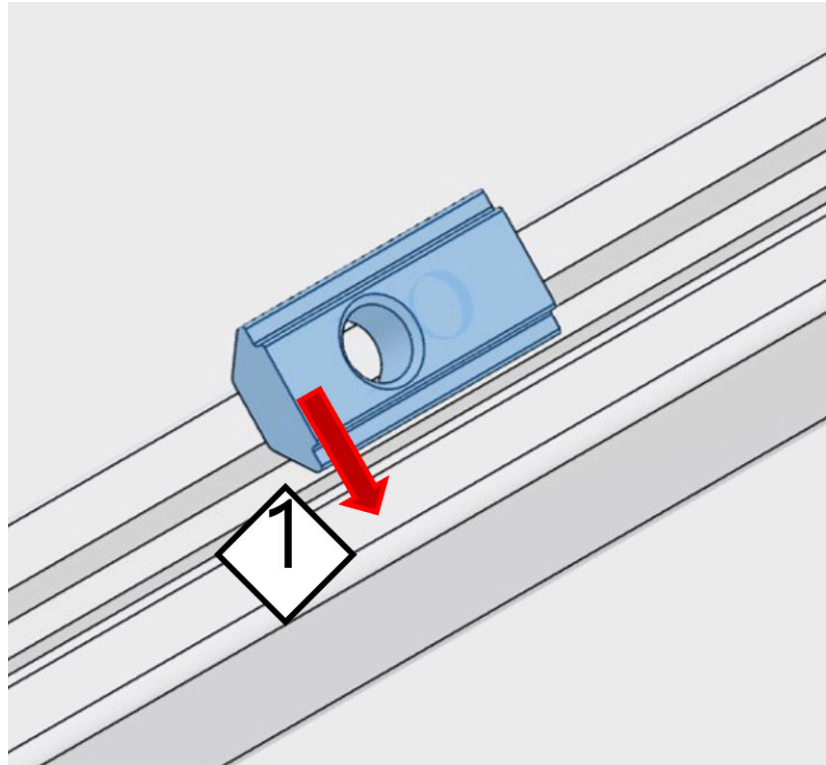
The robot uses **rails** for mounting optional hardware such as **PTZ cameras**, **LiDAR** units, and related brackets. **Spring nuts** inserted into the rail slot provide threaded anchor points for bolts.

Purchase links

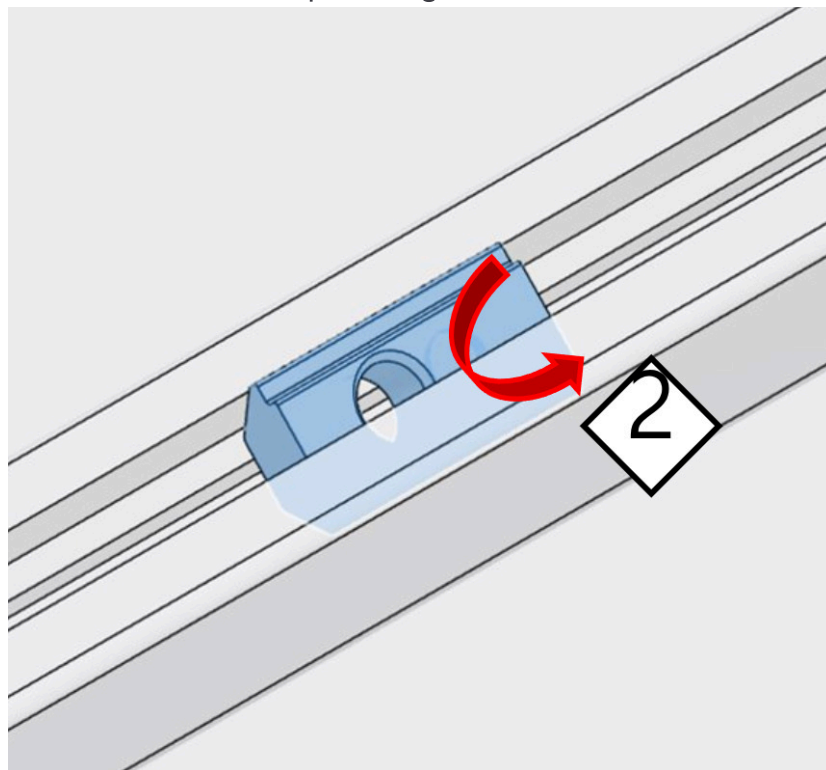
Region	MISUMI product page
South Korea	SHNTP5-5 (kr.misumi-ec.com)
United States	SHNTP5-5 (us.misumi-ec.com)

Inserting a spring nut

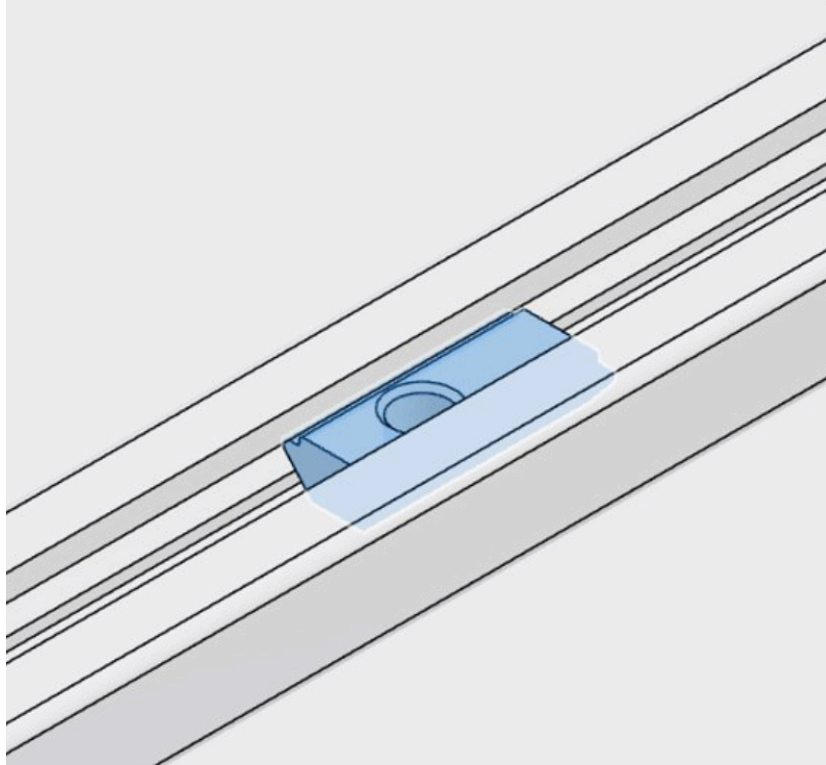
1. **Insert at an angle.** Slide the spring nut **diagonally** into the rail slot so it enters the internal channel.
2. **Press the part that sticks out.** A portion of the nut may sit **proud of the slot**; press it so the nut seats fully in the channel.
3. **Align with the rail.** Adjust the nut so it is **aligned with the slot** and can slide along the rail as needed.



Step 1 - diagonal insert



Step 2 - press the protruding section



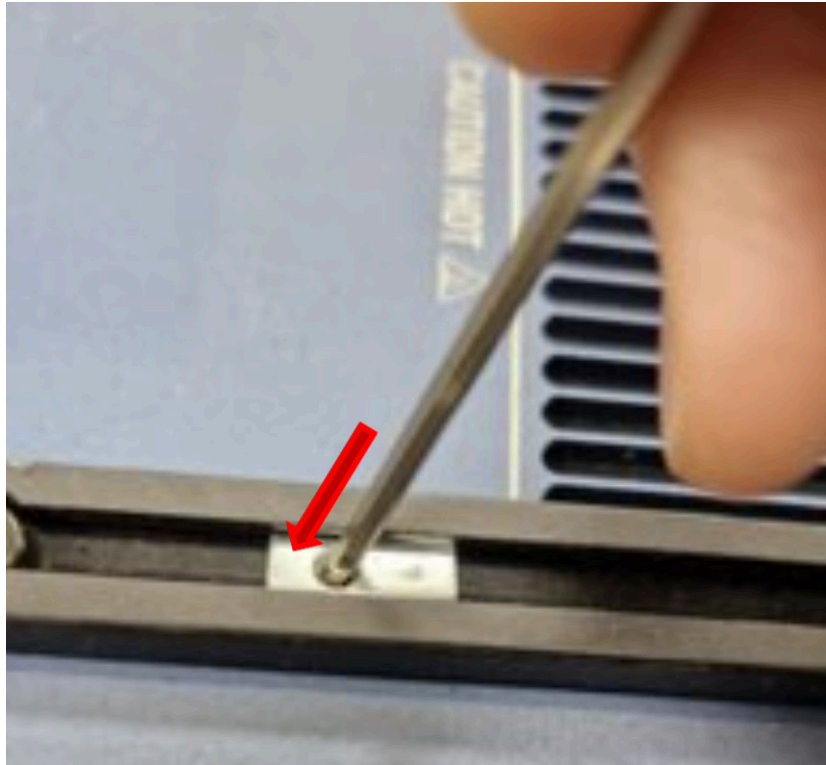
Step 3 - align with the slot

Removing a spring nut

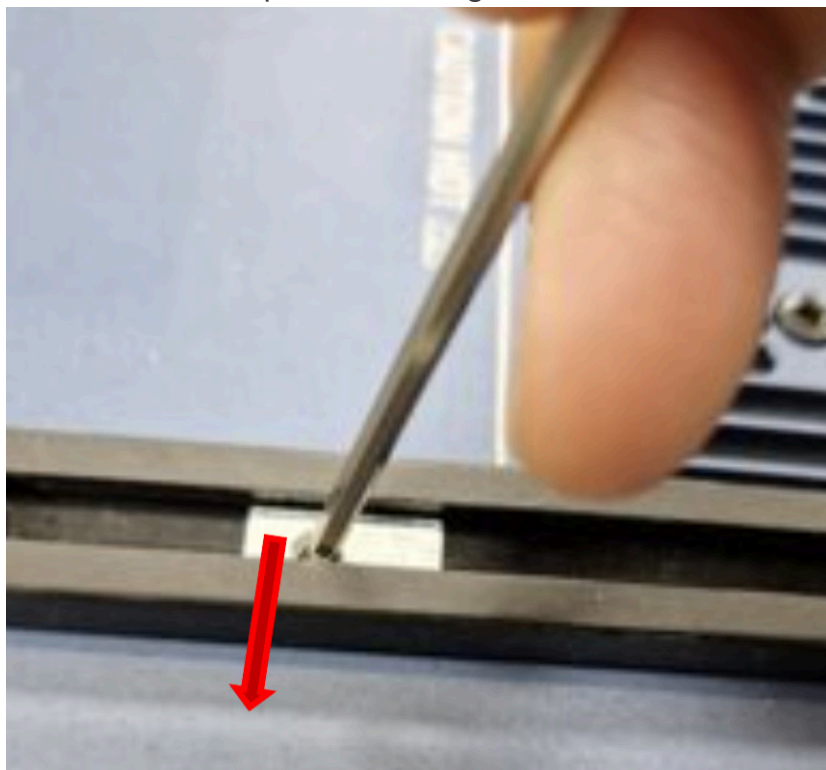
Tool diameter

Use a rigid rod **no larger than 4 mm** in diameter. A thicker tool can damage the nut or mar the rail slot.

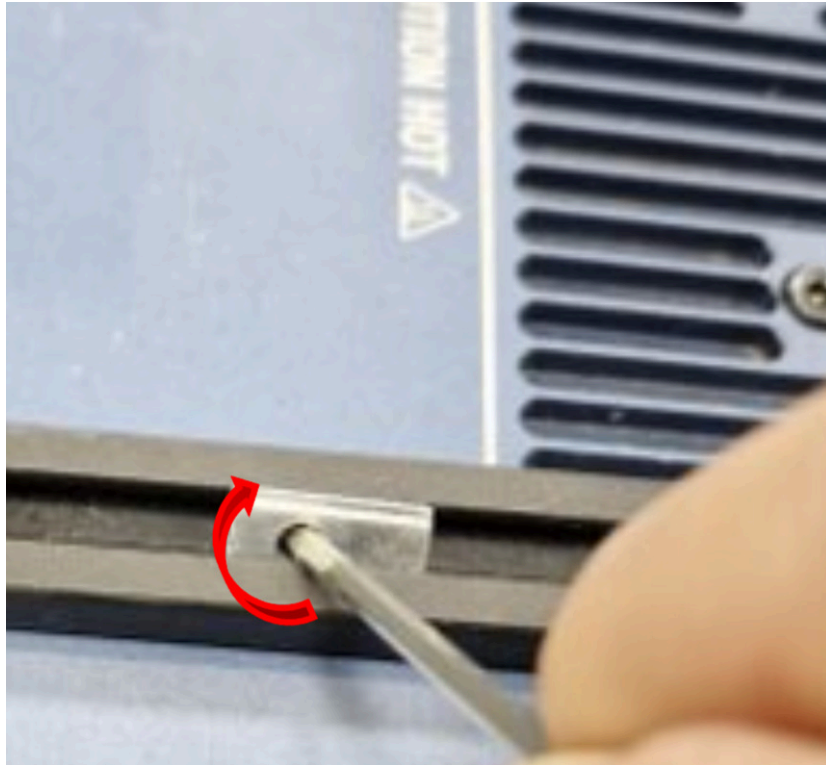
1. **Insert a rod into the nut.** Pass a **rigid rod** (≤ 4 mm diameter) through the hole in the spring nut.
2. **Push to one wall.** Push the nut **against one inner wall** of the rail slot.
3. **Twist and lift.** While holding it against that wall, **twist and lift** the nut toward the **opposite** side of the slot so it can clear the profile and release from the rail.
4. **Remove.** Withdraw the nut from the slot.



Step 1 - rod through the hole



Step 2 - push to one wall



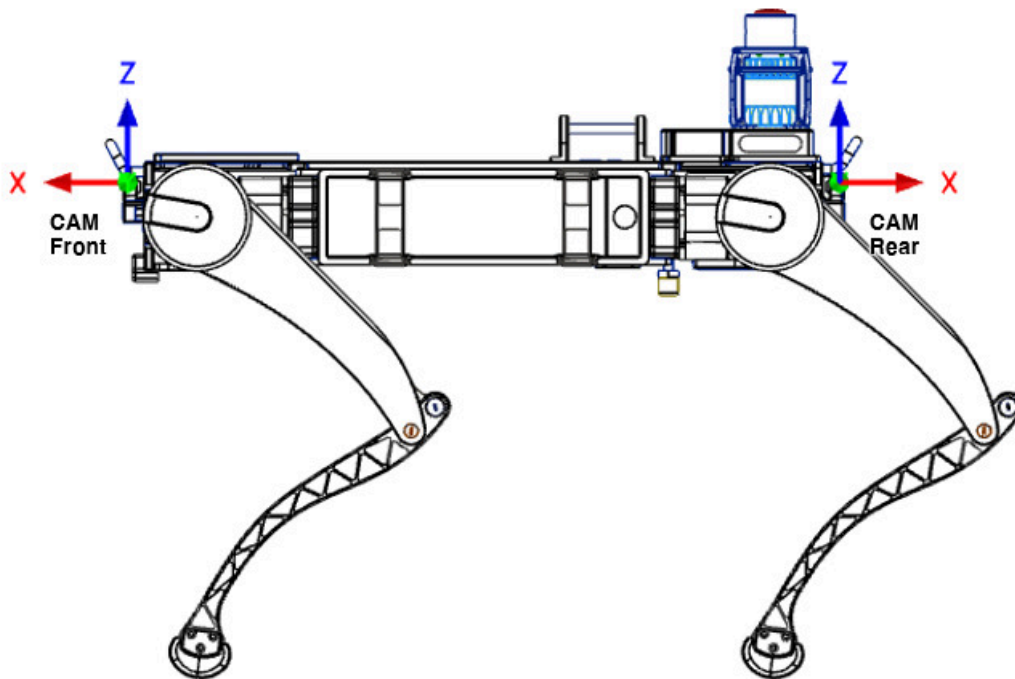
Step 3 - twist and lift



Step 4 - remove

5.4 Front & Rear Cameras (OAK-D Pro Wide)

Overview



Front & rear cameras overview

Model & references

- **Model:** OAK-D Pro Wide
- **Product:** Luxonis OAK-D Pro Wide
- **Intrinsics / extrinsics:** Luxonis calibration docs

Field of view (FOV)

- **Stereo (depth):** 150° / 127° / 79.5° (DFOV / HFOV / VFOV)
- **RGB (IMX378):** 120° / 95° / 93° (DFOV / HFOV / VFOV)

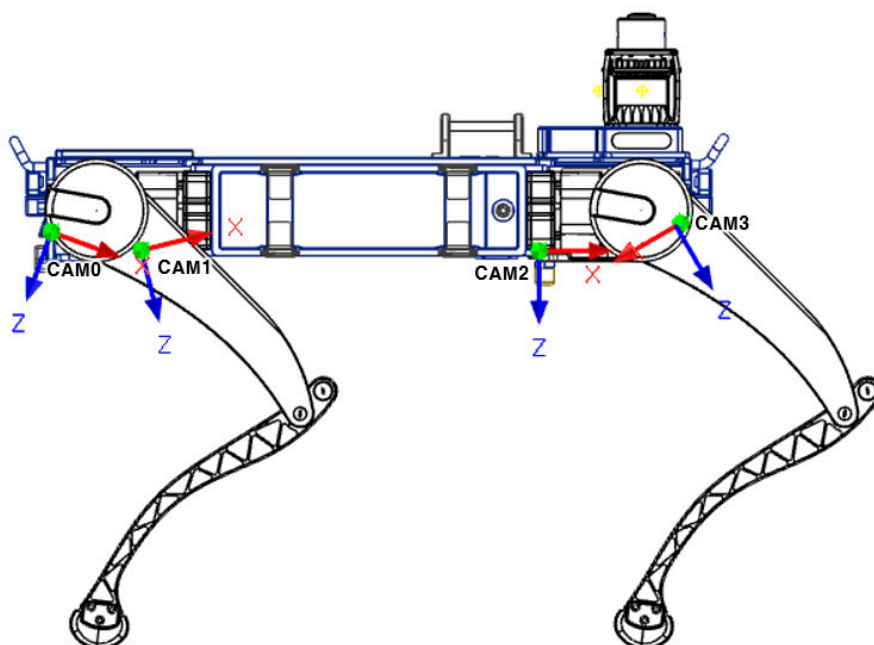
- RGB (OV9782): 150° / 127° / 79.5° (DFOV / HFOV / VFOV)

Base-to-camera transform matrices (TF)

Camera	RGB TF	Depth TF
Front Camera	$\begin{bmatrix} 0.0000 & 0.0000 & 1.0000 \\ 0.388031 & & \\ -1.0000 & 0.0000 & 0.0000 \\ 0.000000 & & \\ 0.0000 & -1.0000 & 0.0000 \\ 0.037764 & & \\ 0.0000 & 0.0000 & 0.0000 \\ 1.000000 & & \end{bmatrix}$	$\begin{bmatrix} 0.0000 & -1.0000 & 0.0000 \\ 0.388031 & & \\ 0.0000 & 0.0000 & -1.0000 \\ -0.037500 & & \\ 1.0000 & 0.0000 & 0.0000 \\ 0.037764 & & \\ 0.0000 & 0.0000 & 0.0000 \\ 1.000000 & & \end{bmatrix}$
Rear Camera	$\begin{bmatrix} 0.0000 & 0.0000 & -1.0000 \\ -0.388031 & & \\ 1.0000 & 0.0000 & 0.0000 \\ 0.000000 & & \\ 0.0000 & -1.0000 & 0.0000 \\ 0.037764 & & \\ 0.0000 & 0.0000 & 0.0000 \\ 1.000000 & & \end{bmatrix}$	$\begin{bmatrix} 0.0000 & 0.0000 & -1.0000 \\ -0.388031 & & \\ 1.0000 & 0.0000 & 0.0000 \\ 0.037500 & & \\ 0.0000 & -1.0000 & 0.0000 \\ 0.037764 & & \\ 0.0000 & 0.0000 & 0.0000 \\ 1.000000 & & \end{bmatrix}$

5.5 Ground-view Camera (Intel RealSense D430)

Overview



Ground-view camera overview

Model & references

- **Model:** Intel RealSense D430
- **Specifications:** Intel D430 product page

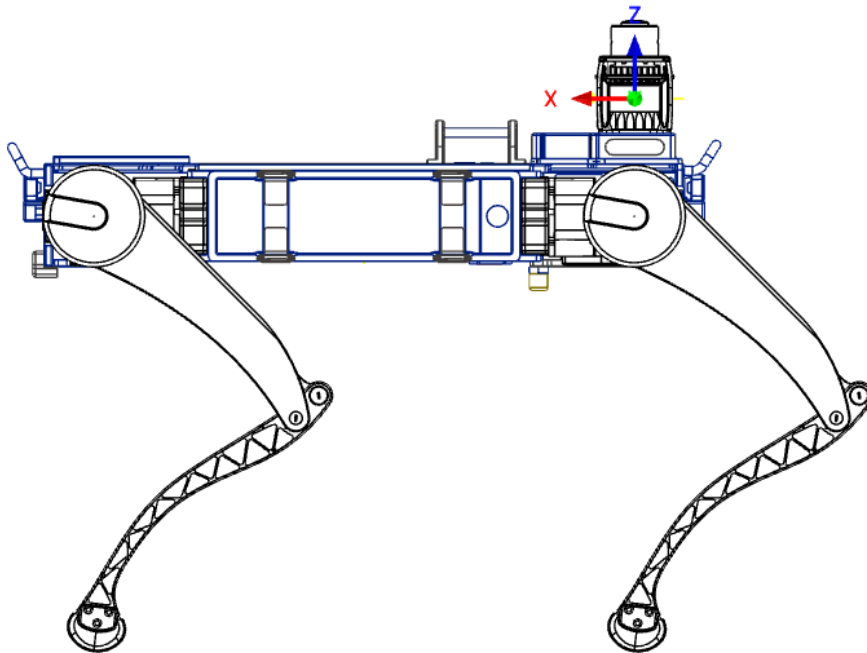
Base-to-camera transform matrices (TF)

Camera	Depth TF
--------	----------

Camera 0	[-0.939693 0.000000 0.342020 0.364620] [0.000000 1.000000 0.000000 0.000000] [-0.342020 0.000000 -0.939693 -0.026630] [0.000000 0.000000 0.000000 1.000000]
Camera 1	[-0.970296 0.000000 -0.241922 0.260530] [0.000000 1.000000 0.000000 0.000000] [0.241922 0.000000 -0.970296 -0.047590] [0.000000 0.000000 0.000000 1.000000]
Camera 2	[-1.000000 0.000000 0.000000 -0.195150] [0.000000 1.000000 0.000000 0.006500] [0.000000 0.000000 -1.000000 -0.048320] [0.000000 0.000000 0.000000 1.000000]
Camera 3	[0.861341 -0.0909518 -0.499820000 -0.352993] [-0.105042 -0.9944680 -5.69736e-05 -1.1e-050] [-0.497050 0.0525513 -0.866129000 -0.020514] [0.000000 0.0000000 0.000000000 1.000000]

5.6 LiDAR (OS1-32)

Overview



OS1-32 LiDAR overview

Model & references

- Product: Ouster OS1

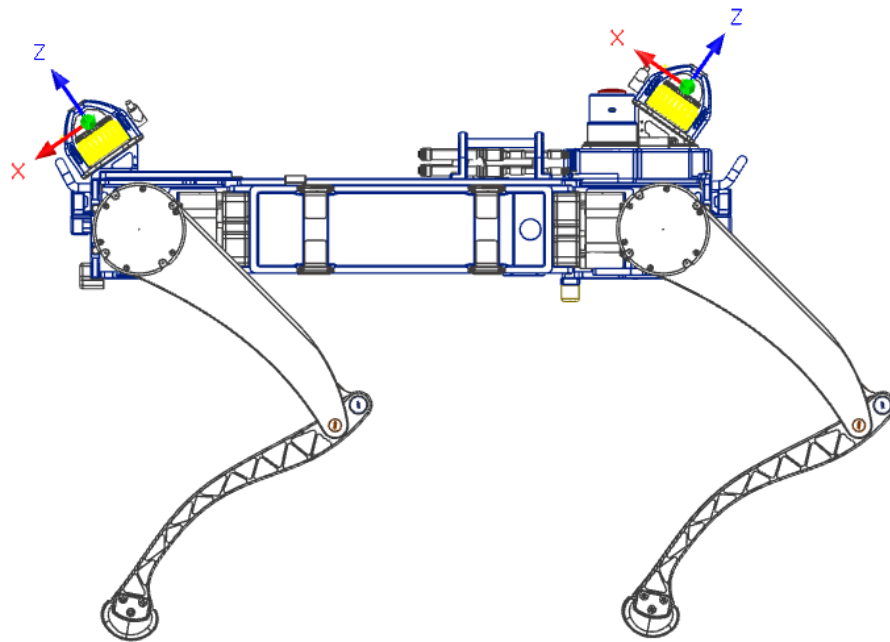
Base-to-LiDAR transform matrices (TF)

	Base to LiDAR TF
LiDAR	$\begin{bmatrix} 0.000000 & 0.000000 & 0.000000 & -0.312600 \\ 0.000000 & 1.000000 & 0.000000 & -0.000033 \end{bmatrix}$

```
[ 0.000000  0.000000  1.000000 -0.136850 ]  
[ 0.000000  0.000000  0.000000  1.000000 ]
```

5.7 LiDAR (MID-360)

Overview



MID-360 LiDAR overview

Model & references

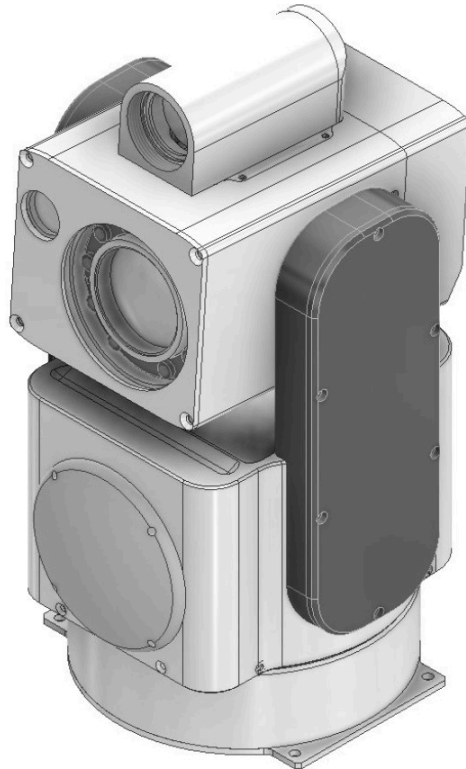
- Product: Livox MID-360

Base-to-LiDAR transform matrices (TF)

	Base to LiDAR TF
LiDAR-Front	$\begin{bmatrix} 0.81920 & 0.00000 & 0.57358 & 0.37282 \\ 0.00000 & 1.00000 & 0.00000 & 0.00000 \end{bmatrix}$

	[-0.57358 0.00000 0.81915 0.12777]
	[0.00000 0.00000 0.00000 1.00000]
LiDAR-Rear	[0.81920 0.00000 -0.57358 -0.34100]
	[0.00000 1.00000 0.00000 0.00000]
	[0.57358 0.00000 0.81915 0.16963]
	[0.00000 0.00000 0.00000 1.00000]

5.8 PTZ Camera (Option)



PTZ Camera

PTZ Camera Specs

Zoom Camera

Item	Spec
Resolution	Up to 1920×1080
Frame Rate	Up to 30 FPS (varies by resolution)
Optical Zoom	32×
Angle of View	H: 64.66° (wide) ~ 2.29° (tele) / V: 38.08° (wide) ~ 1.30° (tele)

Thermal Camera

Item	Spec
Resolution	Up to 640×512

Item	Spec
Angle of View	48.7° × 38.6°
Measurement Temperature Range	-20°C ~ +550°C

Motion Control

Item	Range
Pan	±165°
Tilt	-12° ~ +90°

Speaker

Item	Spec
Output	Up to 25 W
Frequency Response	100-20000 Hz

Microphone

3.5 mm external jack provided

Weight

4.5 kg

Size

160 × 160 × 320 mm

5.9 Docking Station

This page lists **hardware specifications and reference figures** for the RBQ10 **docking station** accessory.

Operation & charging

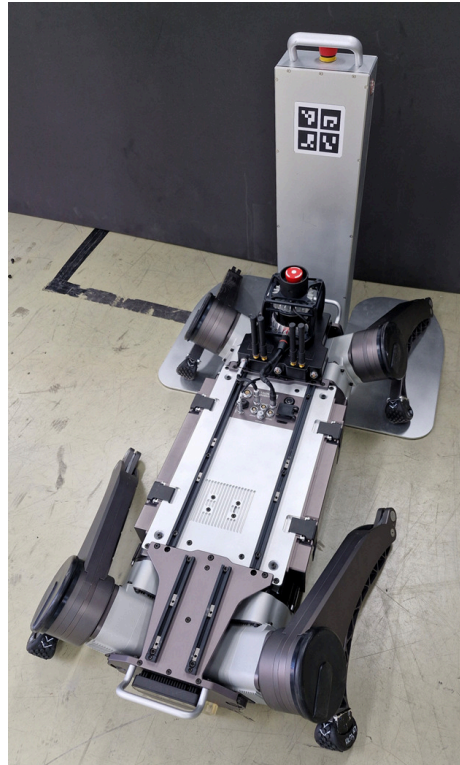
How to connect cables, dock manually, and charge the robot is described in **Charging** (operation guide), not here.

General specifications

Item	Specification
Product	RBQ10 Docking Station (supplied accessory)
Function	Docking alignment and charging via the robot's bottom charging interface
External charging port	For optional charging path using the station's power (see Charging)

Add or update **dimensions, weight, input voltage, current, and environmental ratings** from the product nameplate or datasheet when available.

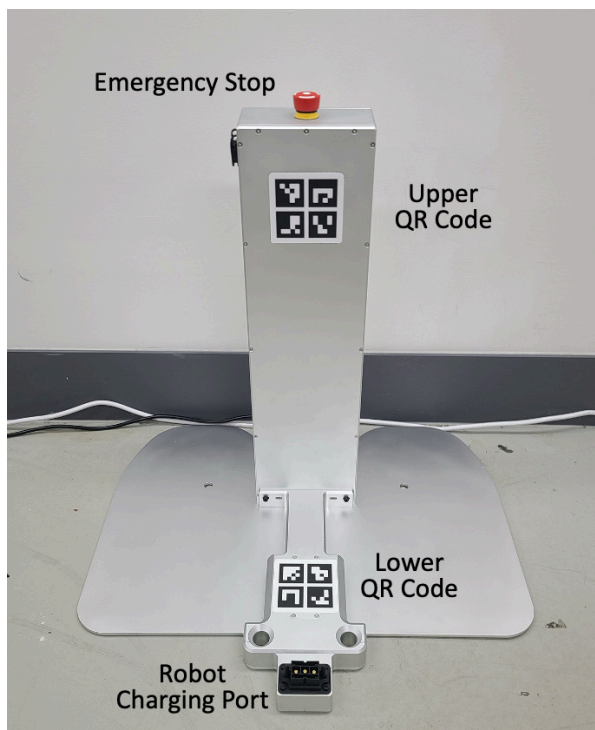
Product overview



[Product appearance (reference)]

Parts reference



Use the diagram below to identify main parts. Callouts match the supplied illustration.



Status indicators

Indicator meanings are summarized below. For behavior during use, see **Charging**.



Color of LED	Status
Green 	Charged
RED 	Charging

[Status / LED reference]

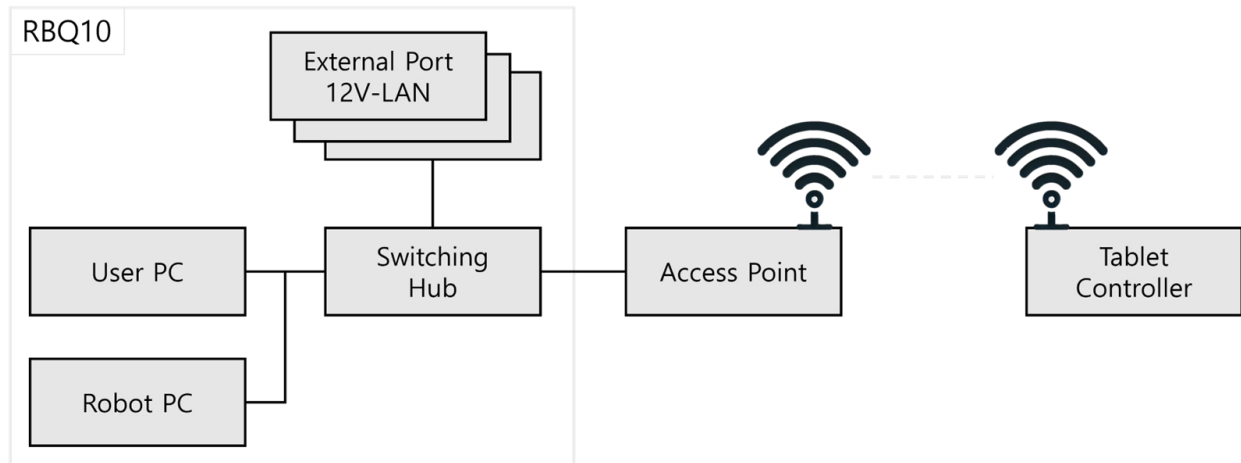
5.10 Battery



Battery Specification

Parameter	Specification
Battery Weight	6.2kg (3.1kg x2)
Battery Capacity	18Ah (9Ah x2) / 907Wh
Standard Voltage	50.4V
Charging Voltage	58.8V
Charging Current	10.5A
Operating Time	2h
Charging Time	1h 20m (20 to 80%)

6.1 Network Configuration Diagram



[Network Configuration Diagram]

- Wi-Fi : 2.4Ghz and 5Ghz
- Network Switch Speeds : Fast Ethernet(100Mbps)
- Access Point ip : 192.168.0.1
- Robot PC ip : 192.168.0.10
- User PC : 192.168.0.12

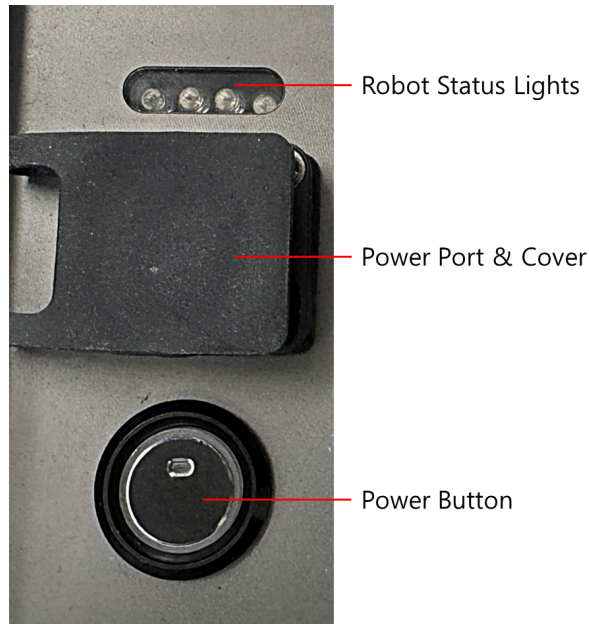
6.2 External Port Information

Overall External Port Panel



[Overall External Port Panel]

Charging & Power Switch


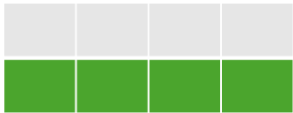



[Charging & Power Switch]


- Robot Battery Lights

Robot Lights	Battery
	~25%
	25%~50%
	50%~75%
	75%~

- Robot Status Lights (blinking)

Robot Lights	Status
	Off: Robot power off
	Blink Green: Robot power on, ready to connect
	Green: Robot connecting the controller

- Power Button Status

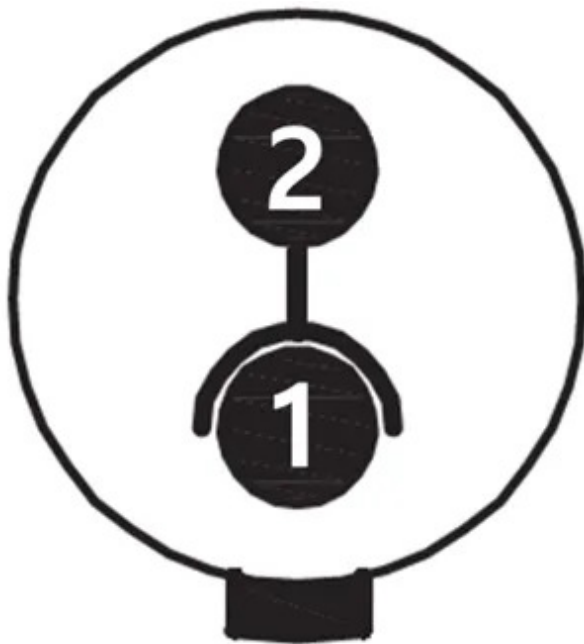
Power Button	Robot Status
	No Lights: Robot and motors off
	Red Lights: Computers on

User Port Pin Map



[User Port]

POWER



Pin	Function	Color
1	VCC	Red
2	GND	Black

- VCC: 42.0 ~ 58.4V (Battery Power)
- Max. Current: 5A

PWR-CAN



Pin	Function	Color
1	VCC	Red
2	GND	Black
3	CAN High	White
4	CAN Low	Blue

- VCC: 42.0 ~ 58.4V (Battery Power)
- Max. Current: 10A
- *Can Communication is Connected to the Robot PC*

12V-LAN



Pin	Function	Color
1	VCC	Red
2	GND	Black
3	LAN TX+	White/Green
4	LAN TX-	Green
5	LAN RX+	White/Orange
6	LAN RX-	Orange

- VCC: 12V
- Max. Current: 2A
- Network Switch Speeds: Fast Ethernet (100Mbps)
- *Lan Communication is Connected to the switching hub

LiDAR



Pin	Function	Color
1	VCC	Red
2	GND	Black
3	LAN TX+	White/Green
4	LAN TX-	Green
5	LAN RX+	White/Orange
6	LAN RX-	Orange

- VCC: 12V
- Max. Current: 2A
- Network Switch Speeds: Fast Ethernet (100Mbps)
- *Lan Communication is Connected to the User PC

Direct PC Port



- Vision
 - Connected to the User PC
- Motion
 - Connected to the Robot PC

7.1 Battery Replacement

How to detach batteries

DANGER - Shock / short circuit



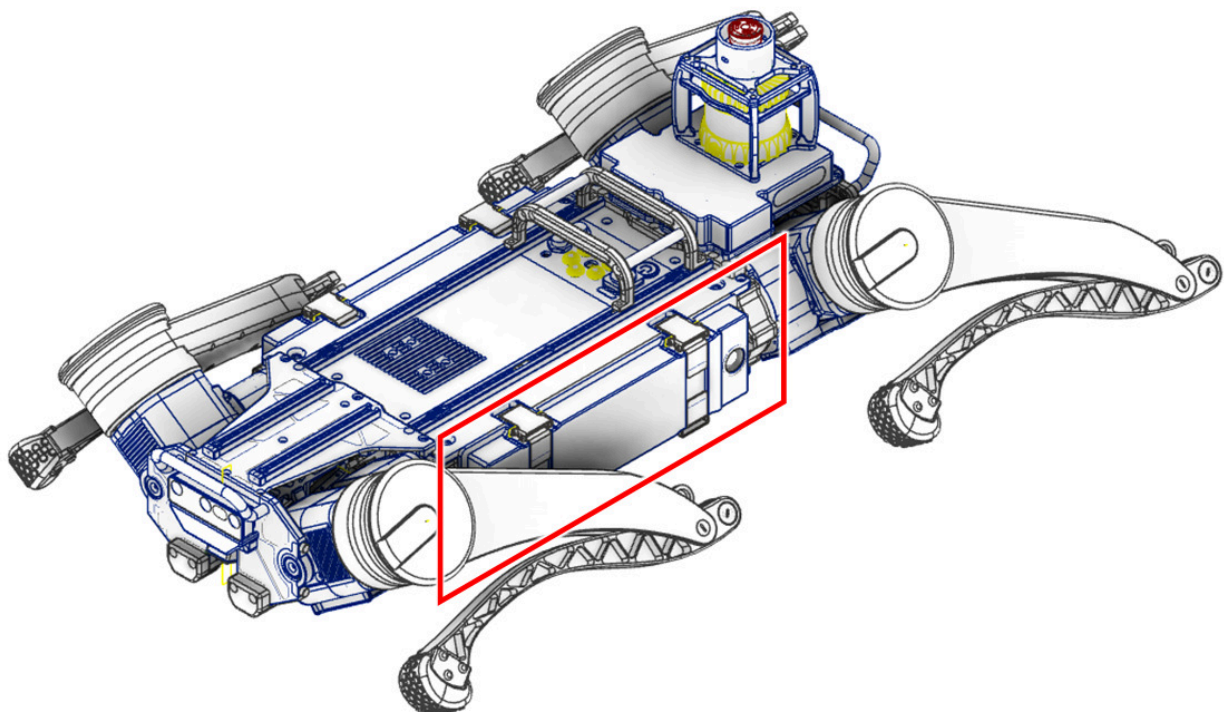
Bare-hand contact with battery terminals or connectors can cause shock, short circuit, burns, or fire. Always wear **insulating gloves** when detaching or attaching. Confirm power is fully off.

WARNING



Before detaching, confirm the RBQ10 is **sitting down** and **powered off**. Otherwise the robot may move or fall, which can escalate to a more severe incident.

The batteries are located on the sides of the RBQ10.

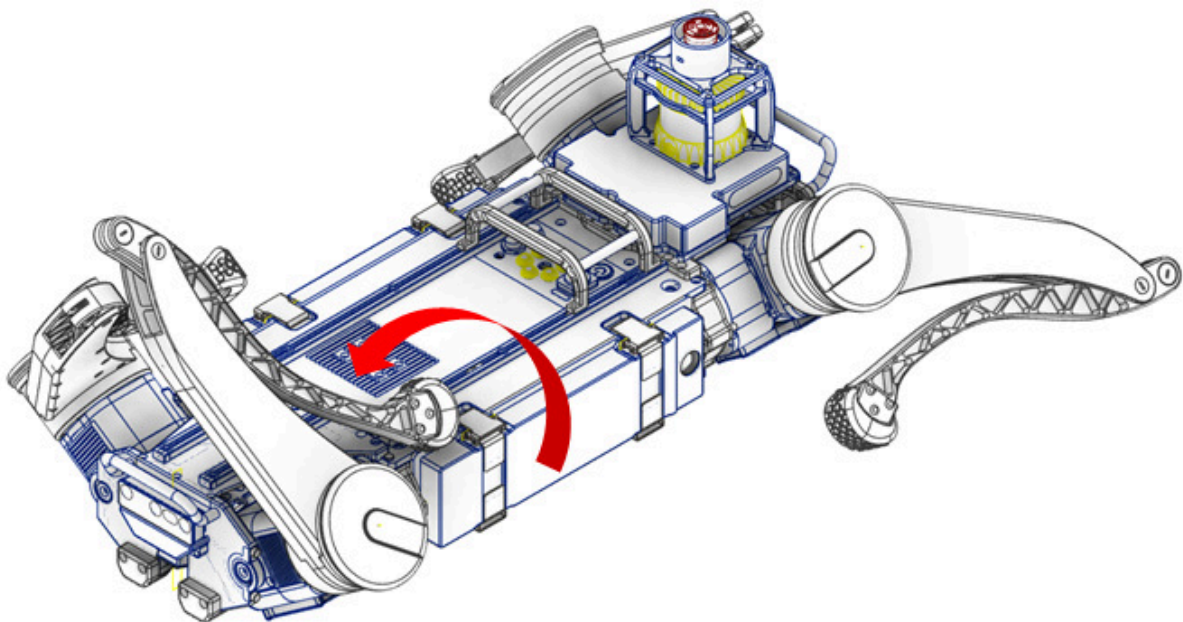


Before opening the latches of the RBQ10, the front legs must be lifted up for clearance.

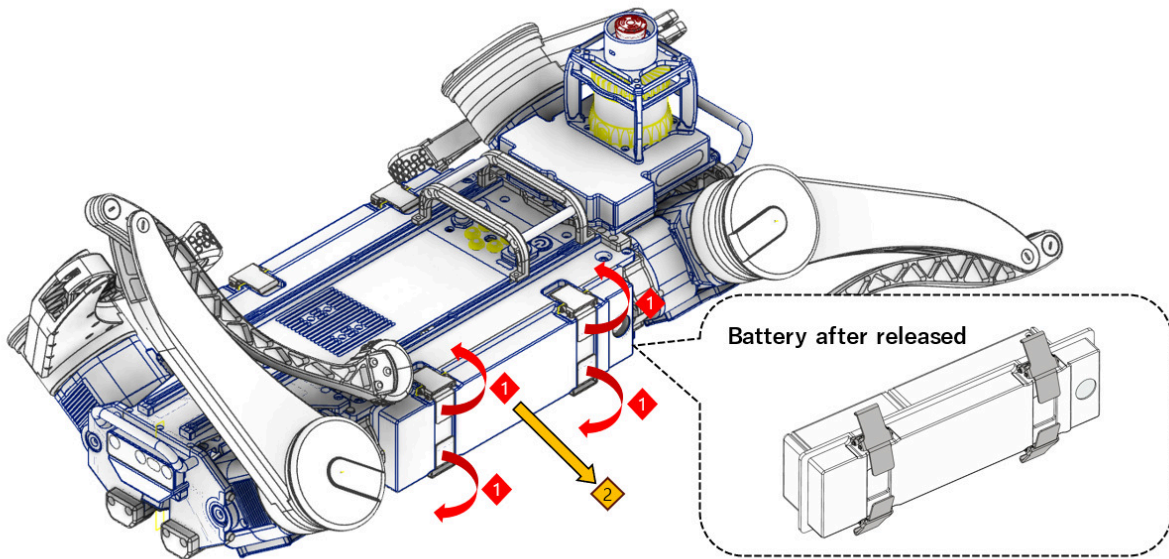
CAUTION - Pinch hazard



When lifting the legs or operating the latches and battery cover, keep **fingers and hands clear of gaps** between legs, body, and cover. Pulling or pushing a lever while your hand is in the gap can cause injury. **Support or hold** the part with one hand and operate levers and covers with the other only.

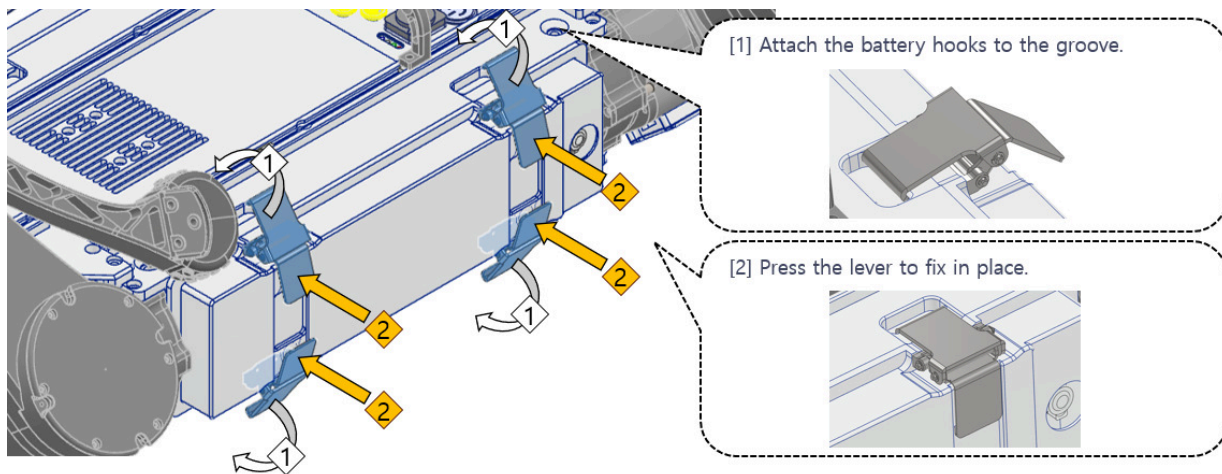


The levers are on the sides of the battery latches and pulling all four of them releases the battery from the body. After releasing the latches, pull the battery cover to detach the battery.



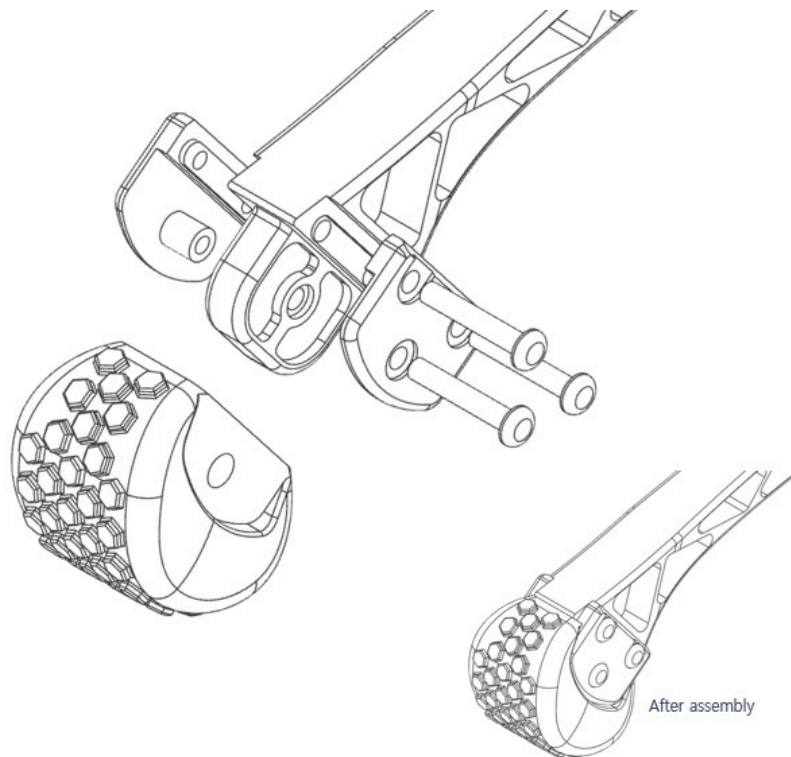
How to attach batteries

To attach the batteries, push the battery into the robot body and place the hook into the groove. Then, firmly press the levers to fix the battery.



7.2 Foot Replacement

The rubber feet of the RBQ10 wear down with use. If the feet are significantly worn, they need to be replaced. The replacement process is as follows.



Step 1. Unscrew the bolt using a 4mm hex wrench.

Step 2. Remove the foot covers and pull the rubber foot.

Step 3. Replace the foot with a new component.

Step 4. Fasten the bolts to the cover. (Apply Loctite 243 before fastening)

7.3 Connector Attachment/Detachment

The RBQ10 interface connector uses MOCO's F-series waterproof connector. Once the connector is engaged, it cannot be disconnected by vibration or pulling the wire. To remove the connector, you need to hold the handle and pull it to safely detach it without damage.

Step 1. Grab the handle.

⚠ Applying force to the wires outside the handle area may caouse damage.



Warning!
Applying force to the wires
outside the handle area
may cause damage!

Step 2. Align the red dots and press the connector handle until it clicks.



Step 3. Check connection.

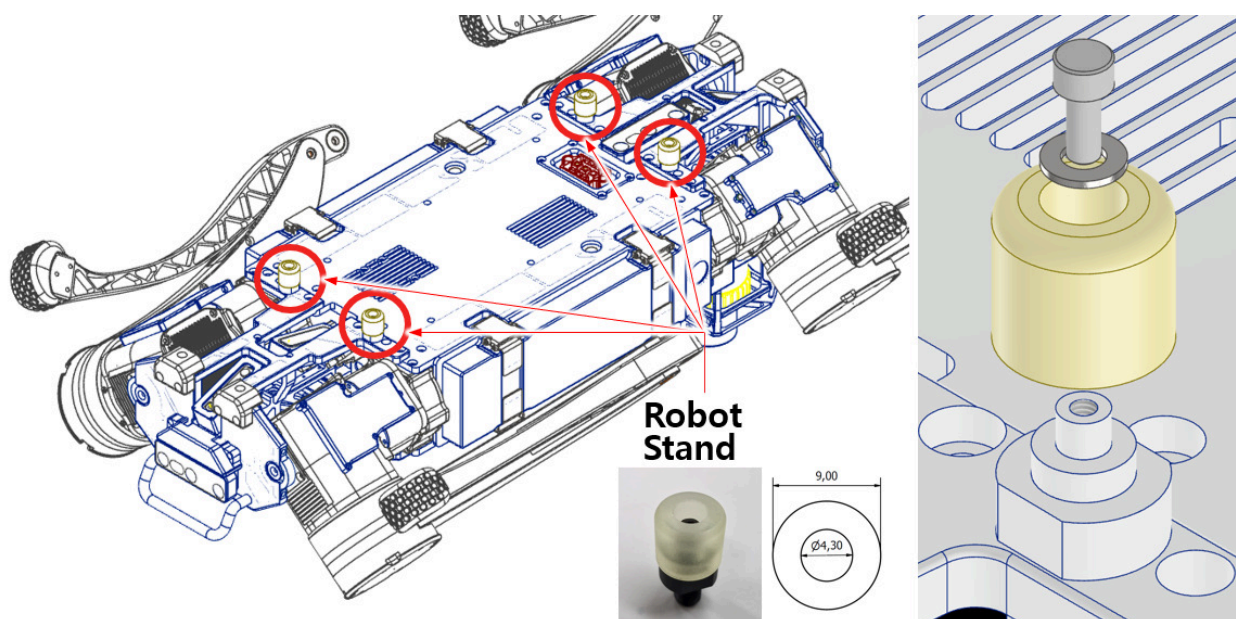


7.4 Stand & Bumper Replacement

The stand that supports the body of the RBQ10 when it is in a standby sitting position, and the front and rear bumpers that absorb impact when the robot falls, wear out with use and need to be replaced. The replacement method is as follows, so please refer to it if necessary.

Stand replacement

The stand of the RBQ10 consists of M4×10mm hex-wrench bolts and M4 flat washers. If any parts are lost during disassembly, you can purchase replacements of the same specifications.

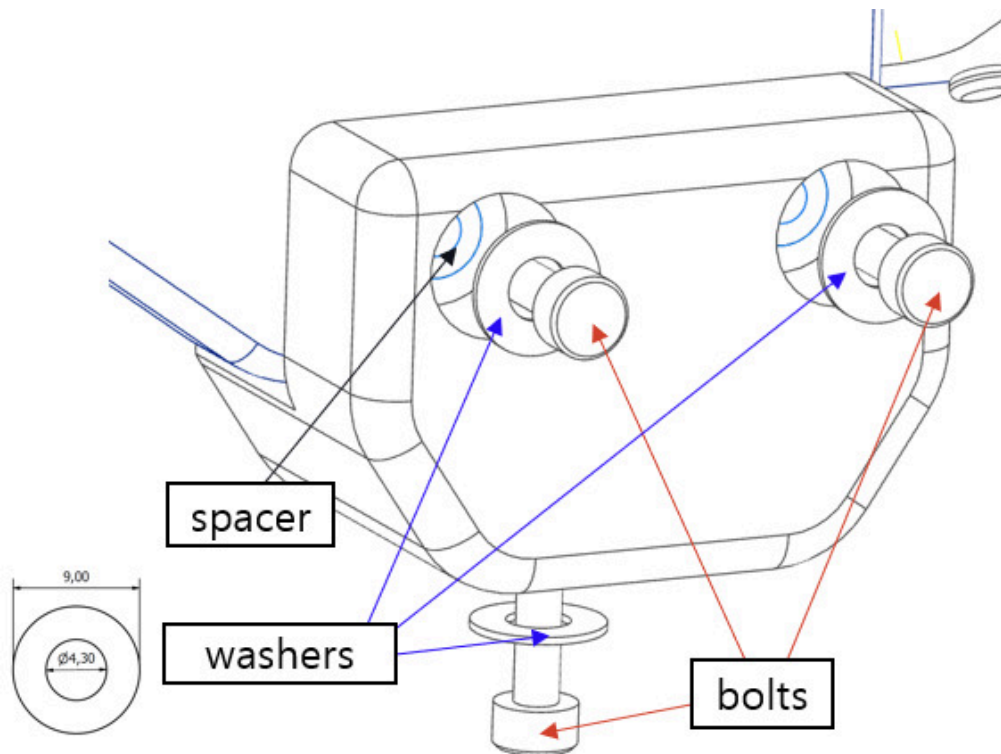


Step 1. Unscrew the bolt using a 3mm hex wrench.

Step 2. Pull out the urethane stand and replace it with a new component.

Step 3. Fasten the bolt. (Apply Loctite 243 to the bolt thread)

Front & rear bumpers



3 sets of M3×10mm bolts and M4 flat washers attach the bumper to the robot.

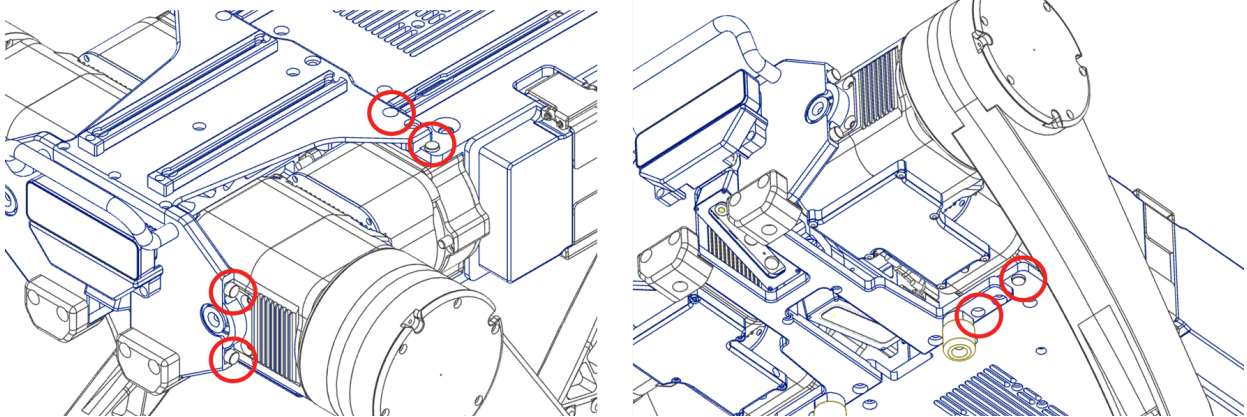
Use a 2.5mm hexagonal wrench to untighten the bolts.

7.5 Leg module Attachment/Detachment

This manual explains the disassembly and assembly sequence of the RBQ10 leg module. The instructions are based on the front left leg, and since the other legs have a symmetrical structure, the same method should be used for the disassembly and assembly process. Please note that the spring washer for the bolts securing the leg is crucial for proper fastening, so be careful not to forget it during assembly.

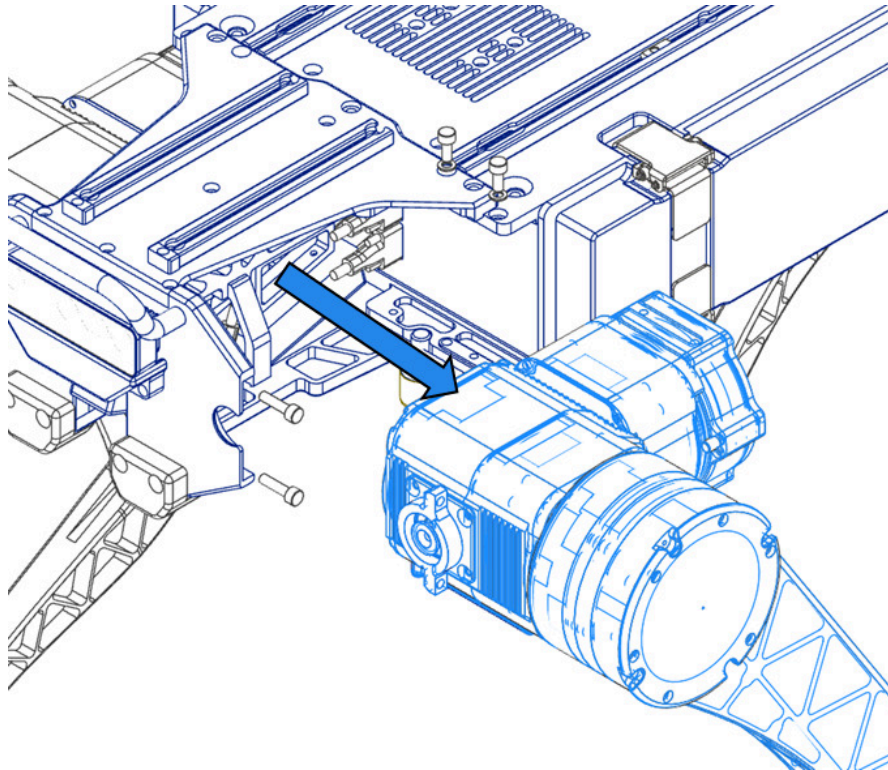
Leg module disassembly

The bolts fastening the leg module are placed as shown below.



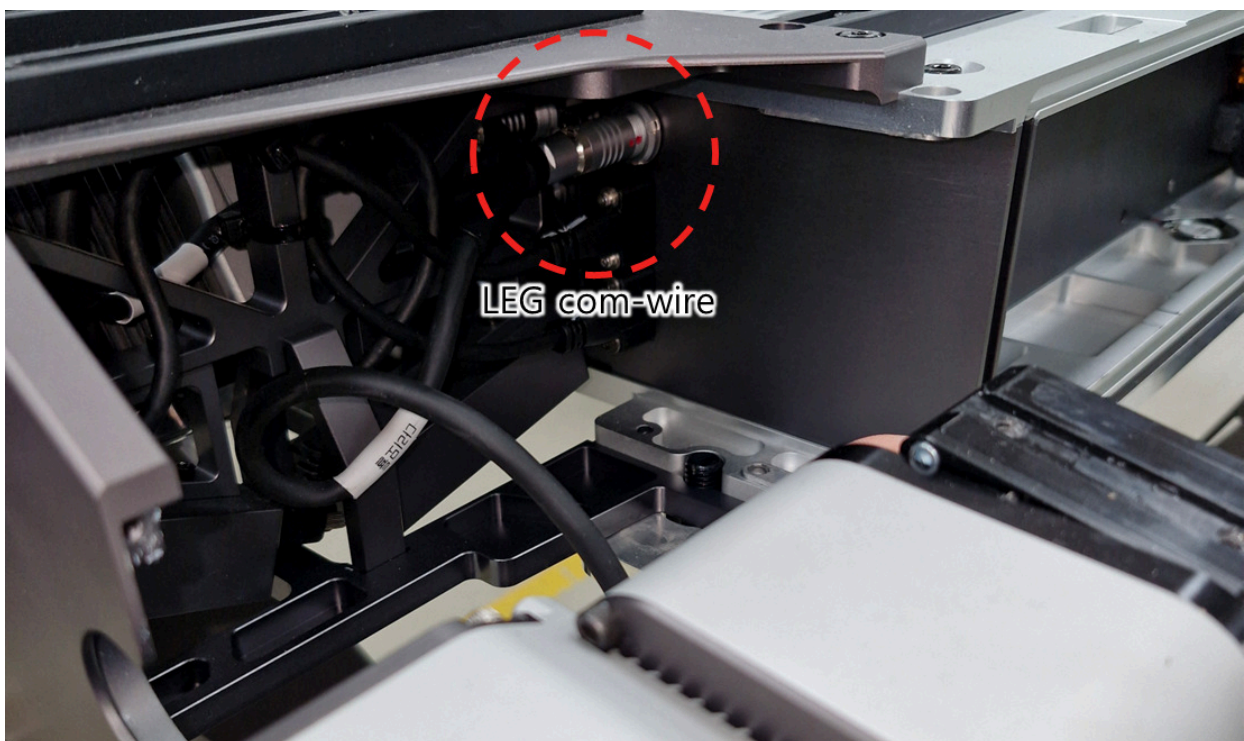
Step 1. Unscrew the bolts fastening the leg module. There are 6 bolts in total, use a 4mm hex wrench. Dispose of the used M5 spring washers.

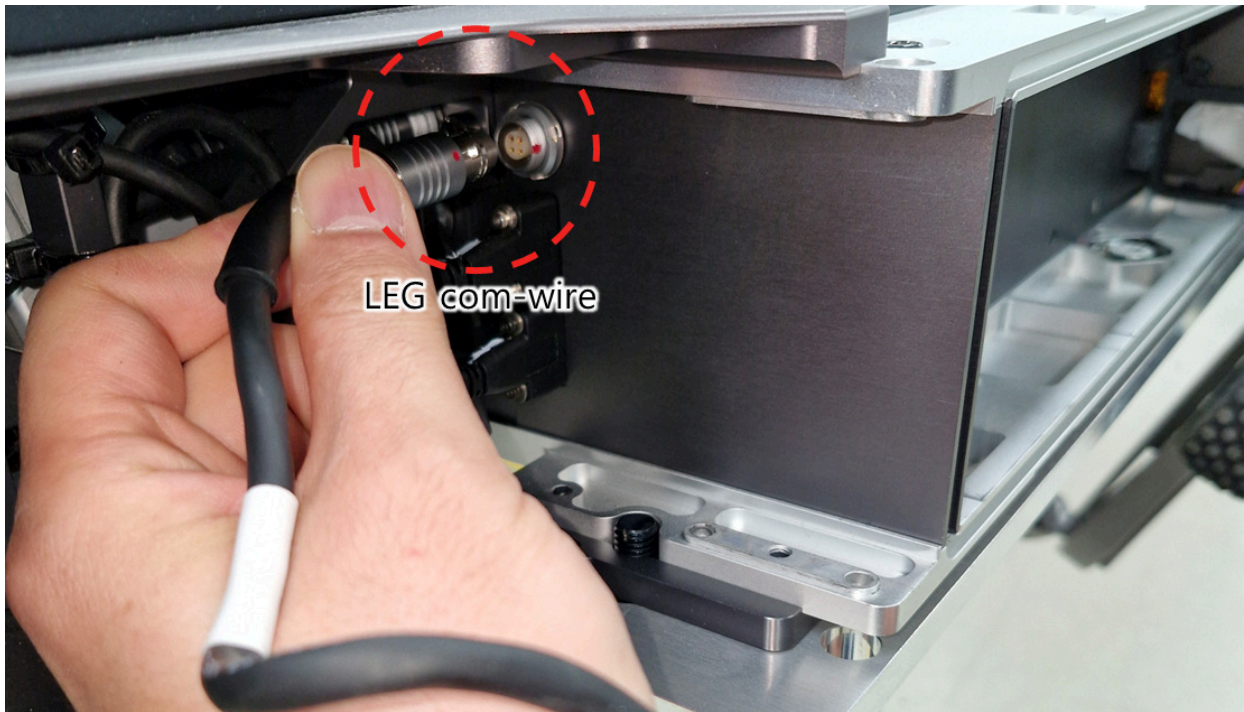
Step 2. Pull the leg module outward after the bolts are unscrewed. Be careful not to damage the com-wire by pulling it too far.



Step 3. After removing the leg module, pull the connector handle to release the com-wire.

⚠ Pulling the wire may cause disconnection. Make sure to pull the handle.

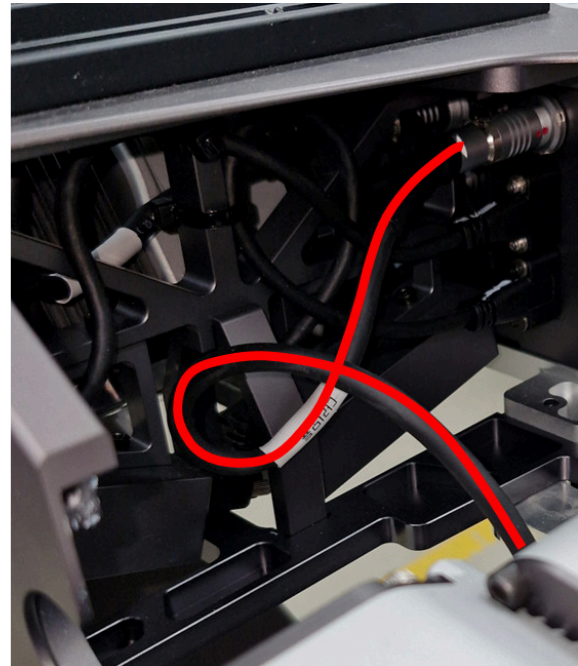




Leg module assembly

The leg com-cable must be rolled once before assembly. If it is assembled without rotation, the com-cable may get pinched and damaged between the leg and the upper and lower plates.

Step 1. Roll the com-cables as shown in the picture below.

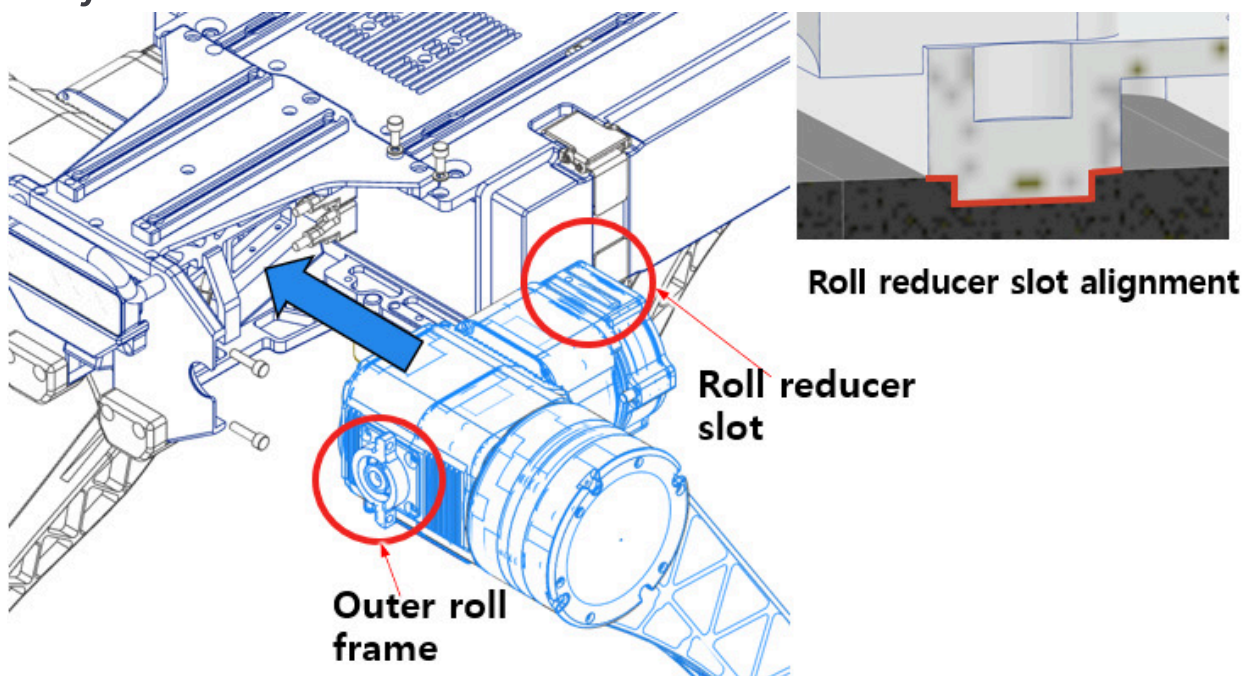


Step 2. Align the red dots of the connector and press firmly to connect the cable.

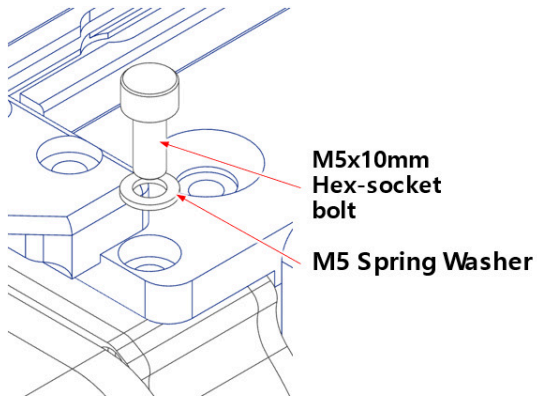
⚠ Pushing the cable may cause disconnection! Make sure to press the handle.



Step 3. Insert the outer roll frame and the roll reducer slot into the body frame.



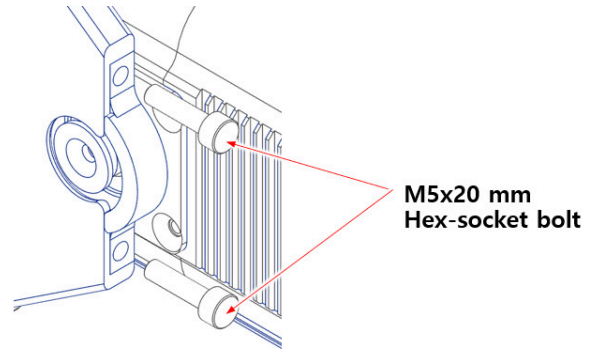
Step 4. Screw the bolts fixing the leg module. There are 6 bolts in total, use a 4mm hex wrench. Make sure to insert the M5 spring washers.



**M5x10mm
Hex-socket
bolt**

M5 Spring Washer

Unscrew the upper & lower bolts.
(4 sets of M5x10mm hex-socket bolt
& M5 spring-washer)

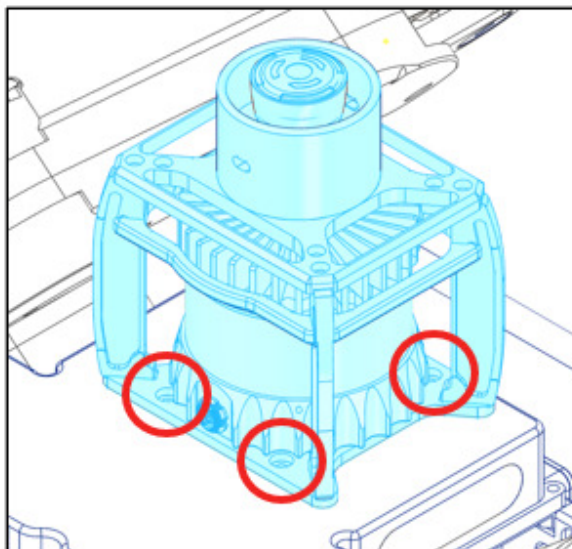
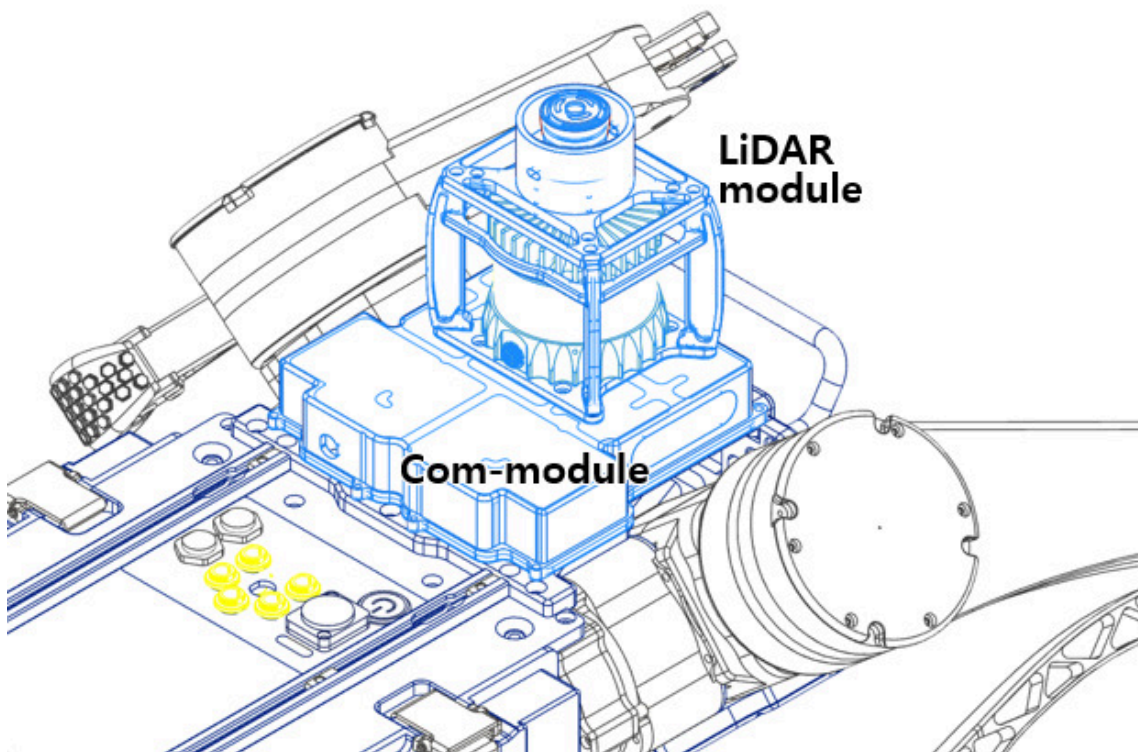


**M5x20 mm
Hex-socket bolt**

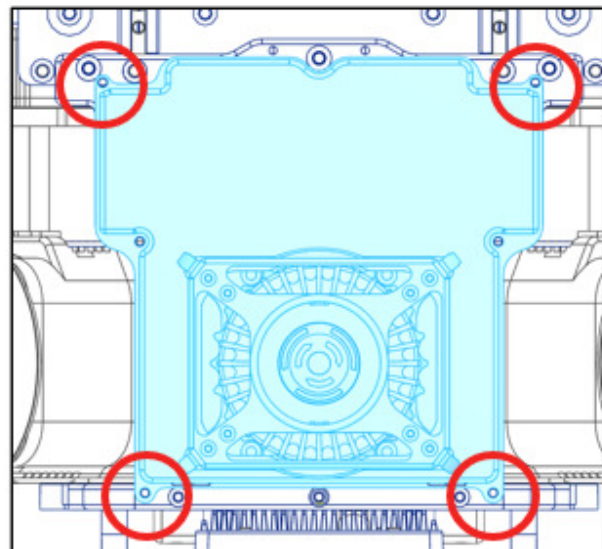
Unscrew the front bolts.
(Two M5x20mm hex-socket bolts)

7.6 Comm & Lidar module Attachment/Detachment

The communication module and LiDAR module of the RBQ10 can be removed if needed. Detachment is possible by removing the bolts that secure these modules. When detaching the modules, the robot's power must always be turned off. The locations and specifications of these bolts are as follows.



LiDAR module bolts



Com-module bolts

LiDAR module specification

Parameter	Specification
Bolts	M4 × 5mm hex-bolts
Hex wrench	3mm
Q'ty	4 on each edge

Communication Module Specification

Parameter	Specification
Bolts	M4 × 10mm hex-bolts
Hex wrench	3mm
Q'ty	4 on each edge

7.7 Calibration & Tuning

You can perform **ZMP calibration** and **various tuning** in the app to improve the robot's walking stability and performance.

ZMP Calibration

ZMP (Zero Moment Point) calibration aligns the center of ground reaction force while the robot is standing, so the robot can maintain balance during walking.

Preparation

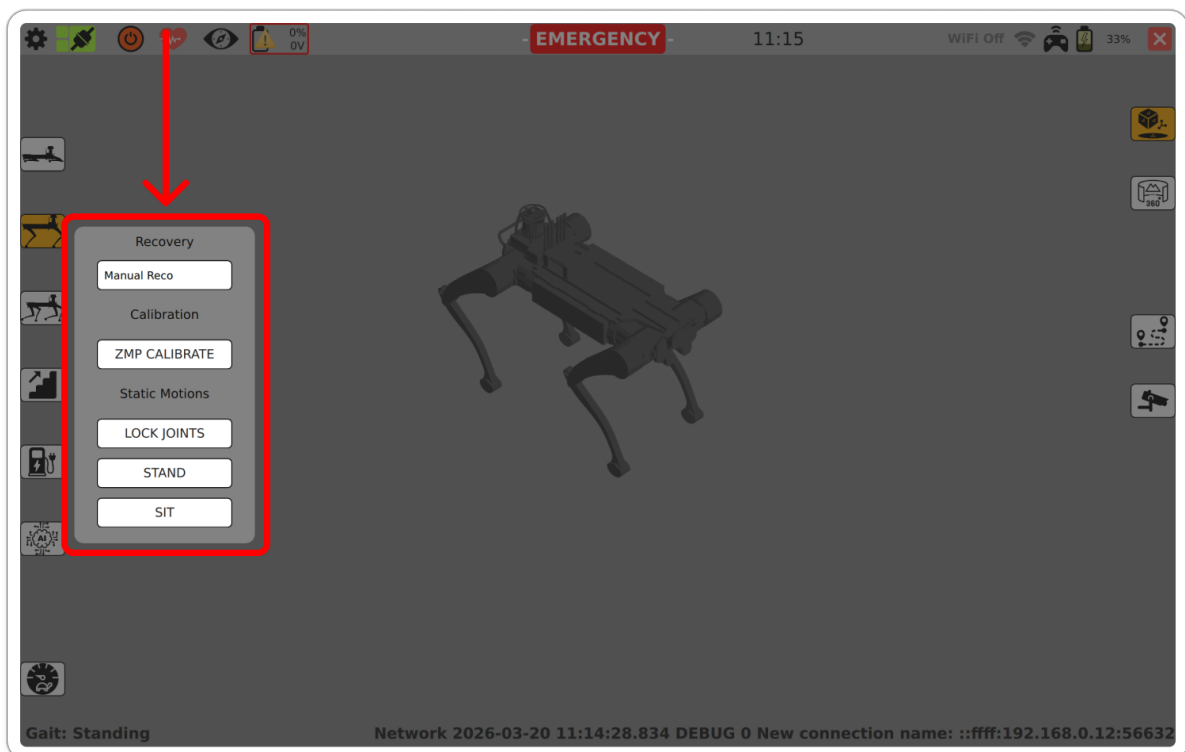
- Place the robot on a **flat, solid surface**.
- Ensure there are no obstacles around the robot.
- The RBQGUI app must be connected to the robot.

Procedure

1. Launch the **RBQGUI** app and connect to the robot.
2. Set the robot to **Stance** (standing) mode.
3. Press and hold the **Sit** button.

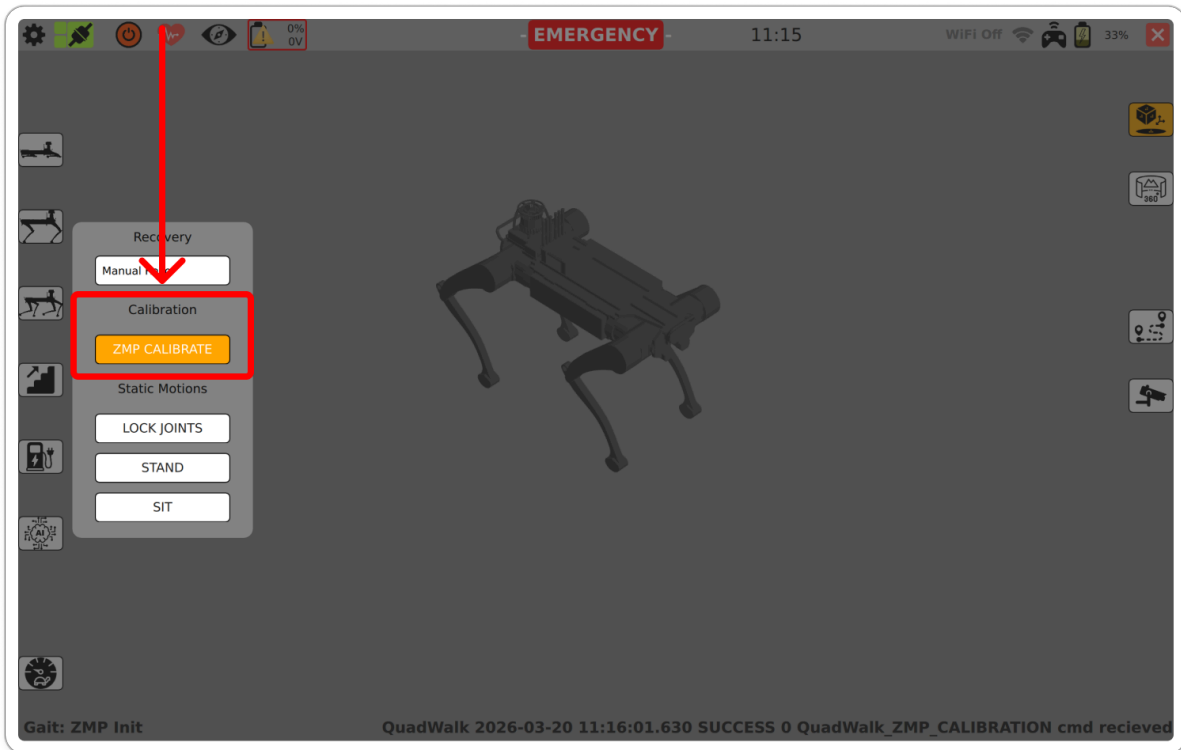


4. In the menu, select the **ZMP CALIBRATE** button.



5. When the button turns **orange**, calibration is in progress.

6. Do not touch the robot until calibration is complete.



7. When the button returns to **white** (default) and the display shows **Gait: Stance**, calibration is complete.
8. Move the robot and verify that the operation is normal.

CAUTION



Do not place objects on the robot or push the robot during calibration. If calibration fails, you may need to run it again.

8.1 Safety Indications

This manual uses the following safety and information labels. Learn what each symbol means, then read the relevant manual before using the RBQ.

Label meanings



DANGER

Immediate risk of death or serious injury. Follow instructions; only trained personnel may perform the operation.



CAUTION

Risk of serious injury or equipment damage. Do not skip steps or mishandle.



WARNING

Minor or moderate injury, or damage to the product or surroundings, may occur if instructions are ignored.



NOTE

Not directly safety-critical, but important for use, installation, or maintenance.

MUST READ



You must read the user manual or safety section before performing the procedure. May include legal and safety responsibilities.

8.2 General Safety Guidelines

General safety rules you must follow when using the RBQ safely. For the meaning of warning symbols, see [Safety Indications](#).

General principles

- The RBQ **can carry payloads** and **supply power to** attachments. Attachments affect stability and energy use depending on weight and shape.
- The RBQ is a **dynamic machine**; **unexpected motion** can occur depending on terrain, floor, and obstacles. If anything seems wrong, stop immediately and check the cause.

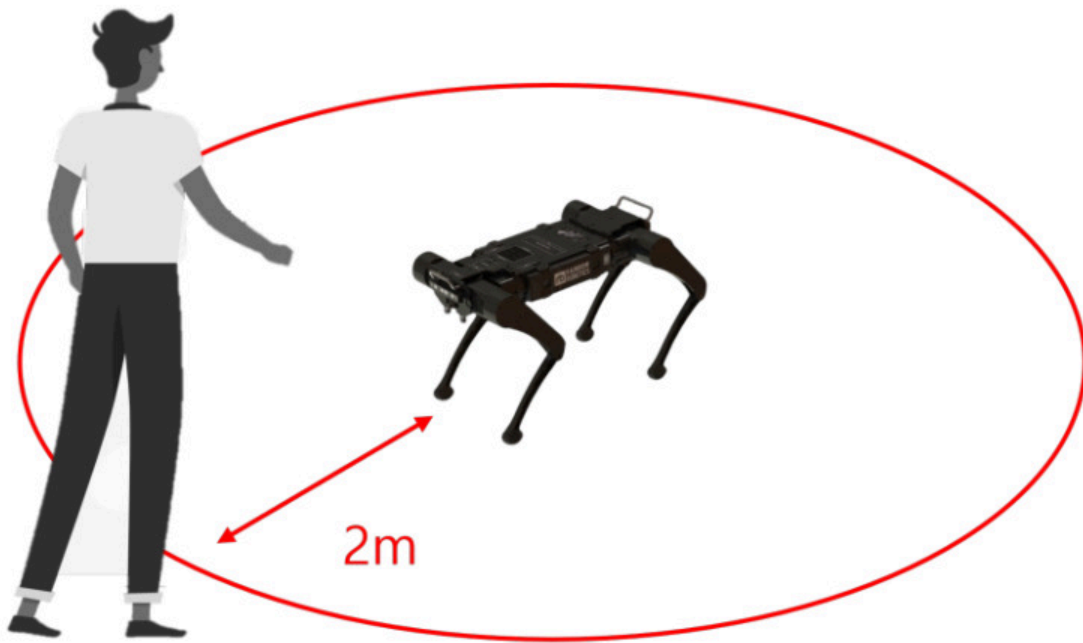
WARNING



RBQ motion is dynamic; unexpected behavior can occur depending on terrain, floor condition, and obstacles. If anything seems wrong, trigger emergency stop immediately and find the cause.

Before operation

- **Trained operators only:** The robot must be operated only by personnel who have read this manual and completed safety training. Read the manual and complete operation and safety training before use.
- **Work area:** Provide **enough clear space** for movement, posture correction, and recovery from falls. Do not leave hazards nearby. In tight or cluttered spaces, correction motions may move the robot in unexpected directions; consider guarding if needed.



[Provide sufficient work space; install guarding if necessary.]

During operation

DANGER



While the robot is operating, no people, animals (including pets), or other living beings may enter within 2 m of the robot. Keep that zone clear while the robot is moving and do not touch the robot.

- **Emergency stop:** See Emergency Stop Procedures.
- **No entry:** People and animals (including dogs/pets) must not enter within 2 m of the robot. Do not enter the motion envelope or touch the robot while it is moving.
- **Settings:** Periodically verify installation angle, tool settings, and safety settings.

Equipment and modifications

- **Safety I/O only:** Connect safety-related equipment only to dedicated safety I/O ports. Do not connect them to general-purpose I/O.

- **No unauthorized modifications:** Do not modify the robot without Rainbow Robotics support. Damage from unauthorized modification is the user's responsibility.
-

Heat and electricity

- **Heat:** The robot and controller can get hot after long use. Touch only after they have cooled.
 - **Electrical safety:** See Electrical Safety.
-

General warnings

- **Payloads:** Payloads affect stability and energy use. Assess risk by weight and shape before attaching.
- **Obstacles:** Sudden obstacles can cause avoidance or correction that **accelerates in an unexpected direction**. Keep clear space around the robot.
- **Stairs and uneven surfaces:** The robot may change posture abruptly on stairs or uneven floors. Limit speed and approach in those areas.
- **Past performance:** Safe operation in the past does not guarantee the same under the same conditions later. Check the environment and settings regularly.

8.3 Emergency Stop Procedures

How to stop the robot immediately in an emergency and how to recover. Routine emergency stop and recovery are also on Emergency Stop and Recovery.

Automatic stop and safety-related behavior

The robot may stop automatically or cut motor power in the following cases:

- **Fall detected**
- **Low battery**
- **Controller (app) stop command** received
- **Interrupt** signal during an automatic mission

The RBQ has **emergency stop (E-Stop)**, **remote stop**, **speed limit**, **posture stabilization**, and other safety-related features. On flat ground, assume a **stopping distance of up to about 1 m** for safety-related stops; on slopes or uneven floors it can be longer.

Using the emergency stop button



[Emergency stop push button on the rear of the robot]

Pressing the **emergency stop push button** on the rear puts all joints into **High Damping**. In this state the robot resists external forces but does not accept torque or position commands-control is disabled and the robot may settle to the floor.

CAUTION



Emergency stop protects people and the robot. Press the button immediately if there is abnormal motion, collision risk, shock, or pinch risk. **It is for real emergencies-not for everyday stopping.** Repeated unnecessary use can add risk by losing controlled stability.

Recovery after emergency stop

1. **Release the button:** Turn the emergency stop button clockwise back to its normal position.
2. **Restore posture:** Press "Stance" in the GUI or set initial posture per Robot Initial Pose Setting.

3. Find the **cause**: Remove or fix the cause of the stop (obstacle, error, wrong settings) before operating again.

Stop from the app (GUI)



[Emergency button at top center of RBQ GUI]



WARNING

Pressing **Emergency** cuts power to all motors. Use only in critical situations.

Residual motion after power off

WARNING



After power is off, RBQ legs **do not auto-lock**. On slopes, stairs, or slippery floors the robot can still slide, roll, or move by inertia-power off does not immediately mean fully safe.

On slopes, stairs, or slippery floors after power off you may still get:

- **Sliding**
- **Rolling or falling**
- **Continued motion from inertia**

Before approaching, check floor condition and posture; approach only from a safe direction.

8.4 Operating Environment Requirements

The RBQ is a quadruped robot used in **various environments**-indoors, general workshops, hazardous sites, military use, patrol/inspection, etc.

- **Below:** Recommended conditions for general use and specification limits.
- **Special environments** (hazardous workplaces, military, unmanned patrol, etc.) may require separate risk assessments and additional measures.

Recommended environment (general use)

The following are recommended for normal operation and service life. Performance and warranty apply when these are met.

Temperature and humidity

- **Use and storage temperature:** Stay within the operating and storage ranges stated in the manual or specifications. Outside those ranges you may get reduced performance, failure, or shorter battery life.
- **Humidity:** In very damp or condensing environments, sensors and electrical parts can be affected-use and store within the specified humidity range when possible.

Floor and space

- **Flatness:** The robot is most stable on flat, solid floors within the specified limits. On steep slopes, rough terrain, or slippery surfaces it may fall or become unstable.
- **Space:** Provide enough room for movement, posture correction, and recovery from falls. **While operating, no people or animals (including pets) may enter within 2 m of the robot.** Keep safe clearance from obstacles as well.

Electromagnetic and physical environment

- **Magnetic fields:** Strong fields can affect sensors and control-avoid use when possible.

- **Vibration and shock:** Excessive vibration or shock can cause failure or bad measurements—damp or isolate, or limit use.

Hazardous environments

WARNING



Do not use in explosive atmospheres, flammable gas, or heavy dust. If no IP rating is stated, **do not use** outdoors, in rain, or near water features (use is prohibited).

Use in special or marginal environments

In hazardous workplaces, military use, unmanned patrol, disaster sites, or hard-to-access inspections, **temperature, humidity, floor, and space** may not meet specification, and unpredictable hazards may exist.

If you use the RBQ for such purposes, perform a **risk assessment before use** and apply **additional safety devices, procedures, and PPE** as needed. Warranty may not apply to failures or damage from use outside the specified environment.

Contact Rainbow Robotics if needed. See [Contact / Error Reporting](#).

8.5 Maintenance Safety

Safety rules for maintenance such as battery replacement, foot/bumper/leg module replacement, and calibration.

Before work

CAUTION



- 1) Before maintenance, turn robot power off and disconnect the battery if needed.
- 2) Touch parts only after the robot has fully stopped. Confirm joints are in a safe state.
- 3) Use only specified tools and procedures. Disassembly or assembly not in the manual can cause damage or injury.

Battery and electrical

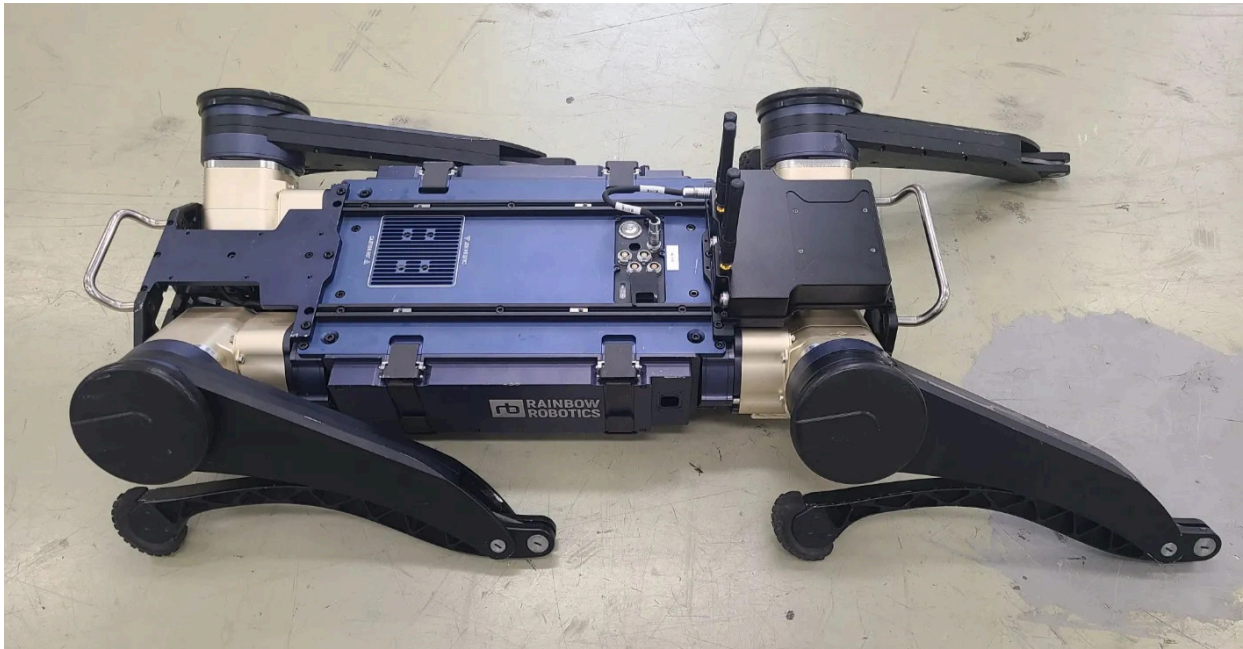
- **Battery replacement:** Follow Battery Handling Precautions and Battery Replacement.
 - **Cables and connectors:** When detaching connectors, do not pull on cables-use the specified method.
-

Mechanical parts

- **Legs, feet, bumper:** When replacing feet, leg modules, or stand and bumper, confirm screws and fasteners are tight-loose parts can come off during operation.
- **Calibration:** Perform calibration and tuning per the manual and GUI only when the robot is stable.

Work environment

- **Flat surface:** Work on a level, stable surface-the robot can fall on a slope.
- **Solo heavy lifting:** When lifting heavy parts alone, get help or use equipment to avoid injury.



[Perform maintenance on a level, stable surface.]

If unsure or something is wrong, contact Rainbow Robotics. See [Contact / Error Reporting](#).

8.6 Handling and Transportation

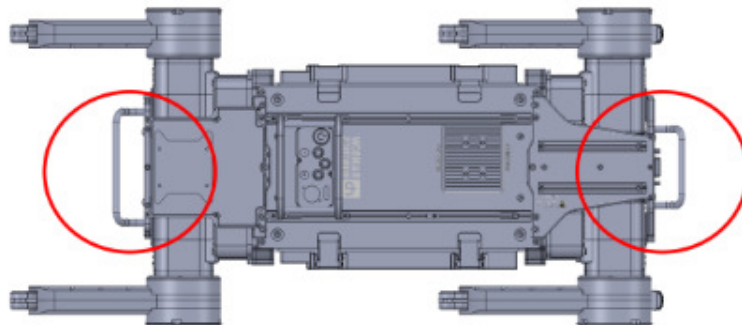
Safe handling when moving, packing, and shipping the RBQ. Packing and unpacking steps are also on the Packing page.

General precautions when moving

- **Power off:** Always turn power off before lifting or moving. If power is on, legs can move and cause injury.
- The robot is heavy and joints can move-support it so it cannot fall, or use designated carriers/moving methods.

Pinch hazard and handles

- Keep **fingers, clothing, long hair, and jewelry** out of handle and joint areas. Grip handles with a **closed fist**; do not insert fingers where they can be pinched.

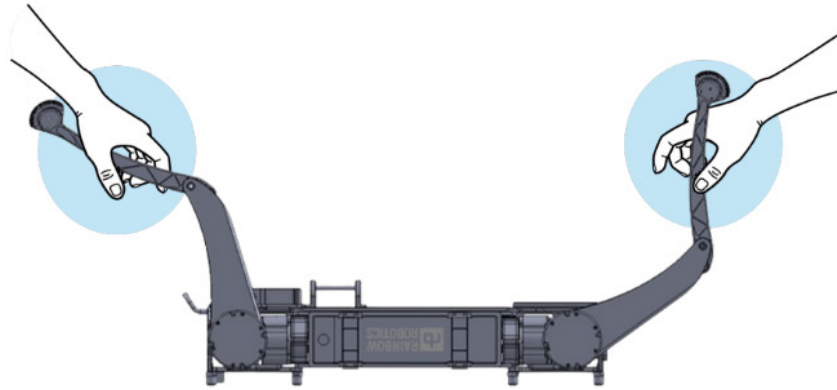


[Grip handles with a closed fist so fingers cannot be pinched.]

Lifting

- **Two people required:** Always lift with **two people** front and back. **With one hand support the left/right legs (or body side); with the other hand grip the handle in a fist.** Lift using the handle so the whole robot stays level and stable. Lifting from one side only or twisting can drop legs or shift the center of mass.

- The RBQ is **modular**. Unlike a single-piece body, **parts can separate and fall** more easily. Avoid shock and twisting when lifting; do not drop-coordinate and move slowly.



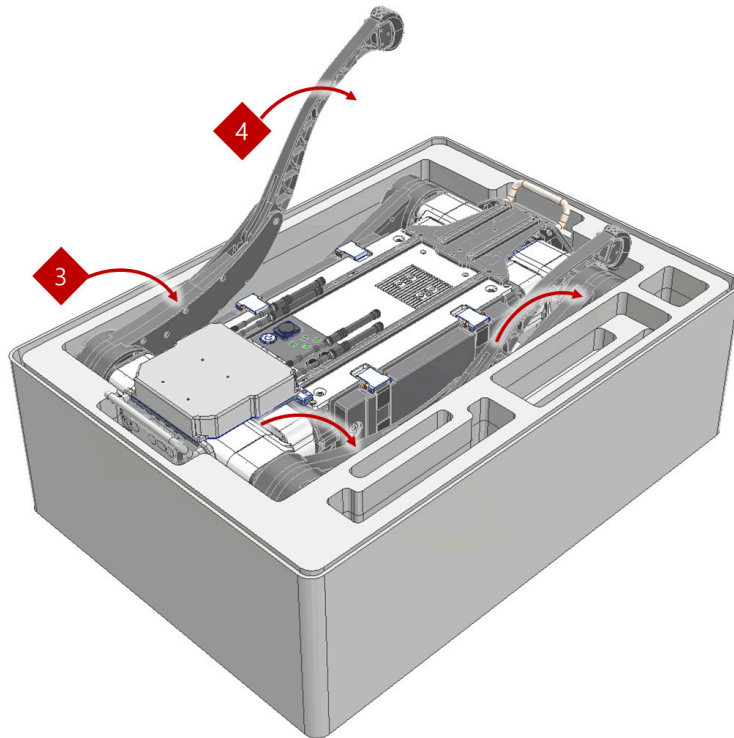
[One hand supports left/right legs; the other grips the handle-lift by the handle and move the whole robot steadily.]

CAUTION



Do not force-lift or drag while power is on. Turn power off and secure a stable posture first. Modular construction is more vulnerable to separation and drops than a one-piece design-take extra care against shock and drops.

Packing and shipping



[Ship in original packaging and secure so nothing moves inside the box.]

- **Original packaging:** Use the factory packaging when possible—shock and vibration can damage internal parts.
- **Securing:** Cushion and secure so the robot cannot move inside the box.
- **Labeling:** Mark handling (orientation, fragile, etc.) and avoid excessive stacking or throwing.

Battery

NOTE



For air or sea shipment with the battery installed, check applicable rules (e.g. UN dangerous goods, airline rules). If required, remove the battery and ship separately—confirm in the manual or with Rainbow Robotics.

Docking station and charger

- **Charger and docking station:** Pack and ship without shock; avoid tangling or crushing cables.
-

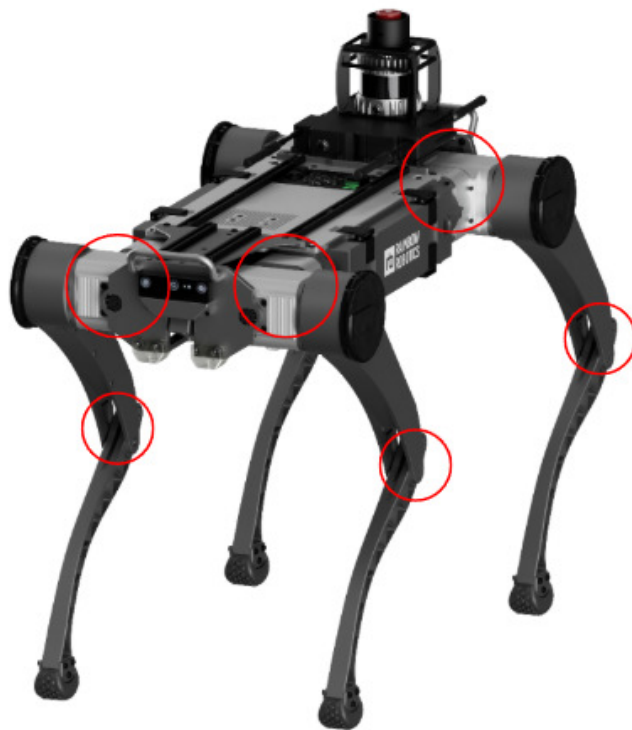
Storage

- **When not in use:** Store in the **dedicated case** or **docking station** when possible. Case size and weight are in the product documentation.
- **Environment:** Follow **storage temperature and humidity** in Operating Environment Requirements. For the battery, follow Battery Handling Precautions.

8.7 Mechanical Safety

Measures to prevent injury or damage from joints, legs, and drive components.

Motion envelope and access



[During motion, keep hands, clothing, and cables clear of joints and legs.]

Red circles in the figure mark **hazard zones** with pinch and collision risk (around hip and leg joints). During handling, transport, and inspection, do not put fingers, clothing, cables, long hair, or jewelry into these zones.

CAUTION



- 1) Do not enter the motion envelope or put hands or body on the robot body or legs while it is moving-risk of pinch and collision.
- 2) If the robot falls or corrects posture, people or objects nearby can be struck-maintain sufficient clear space.

Locomotion and speed

- **Walking:** The RBQ moves on four legs. Observe **speed, acceleration, and load limits** in the manual and GUI. Speed changes take effect immediately; actual speed depends on floor friction, commands, balance correction, and faults.
- **Stay within limits:** Overload or excessive speed can cause failure or unstable motion. Collisions with objects can release large kinetic energy-apply safety settings suited to the environment.

Joints, legs, and pinch risk

- **Pinch points:** Mainly around **hip and leg joints**. During normal driving, hands usually cannot reach them, but during **handling, transport, and inspection**, keep fingers, clothing, cables, hair, and jewelry clear.
- **If something is wrong:** Stop immediately, trigger emergency stop, find the cause, then continue.

Stairs, slopes, and uneven floors

WARNING



On stairs or uneven surfaces the robot will try to adjust posture; you cannot eliminate all errors. Do **not** use sudden manual intervention or force the robot to stop. Limit approach distance and speed on stairs and slopes; keep about 2 m clearance if needed.

Installation and movement

- **Flat floor:** Use the robot on a flat, stable floor per specifications. It can fall on slopes or slippery surfaces.

- **Handling and transport:** Follow the procedures for moving, packing, and shipping. See Handling and Transportation.

8.8 Electrical Safety

Safety rules when working with **electrical equipment** such as the RBQ, chargers, and docking stations.

- **When it applies:** During charging, inspection, and repair; whenever you handle electrical equipment directly.
- **Field use:** In hazardous environments, military use, patrol, etc., ideal electrical conditions may be hard to maintain. Perform charging, internal inspection, and wiring work in a dry, safe place whenever possible.

High-voltage areas, wet parts, and damaged cables or connectors pose shock risk. Even if they look intact, **high voltage or strong EMI** can cause latent damage—stop use and inspect if anything seems wrong.

General precautions



DANGER

Post clear warning signs near electrical equipment where shock is possible.



CAUTION

- 1) Do not tear, damage, or remove covers. Be careful when handling labeled parts and nearby components.
- 2) Do not touch internal electrical parts to avoid shock.
- 3) When charging, inspecting, or repairing, do not touch power cables, charging ports, or the controller with wet hands.

Charging and power

- **Designated charger only:** Charge the RBQ10 only with the supplied RBQ10 dedicated charger or docking station. Other chargers risk damage, fire, or shock.
- **Cable check:** Ensure charging and power cables are not tangled or damaged; do not use if damaged.
- **Grounding:** Where you charge or inspect, ensure the controller and docking station are properly grounded per regulations. In field or mobile use, charge in as safe a location as possible.

Repair and disassembly

CAUTION



For internal inspection, part replacement, or cable work, **turn power off** and disconnect the battery if needed.

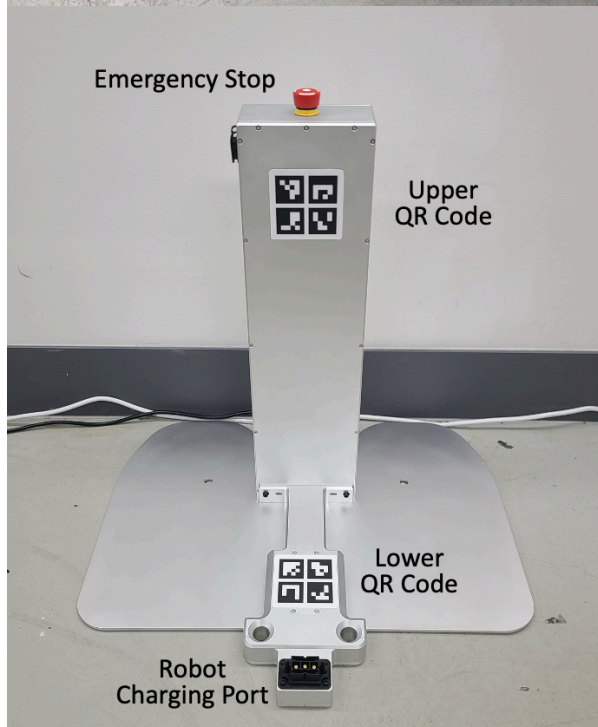
- **No unauthorized modifications:** Do not alter electrical circuits or wiring yourself.

If you have a problem, contact Rainbow Robotics. See [Contact / Error Reporting](#).

8.9 Battery Handling Precautions

Safe handling, charging, and storage of the RBQ's on-board battery. For replacement steps, see Battery Replacement.

Charging



[Use only the designated charger and docking station.]

CAUTION



- 1) Charge only with the RBQ10 dedicated charger or RBQ10 docking station. Other chargers can cause overcharge, overheating, or fire.
- 2) While charging, keep the robot and charger away from flammables and heat sources.
- 3) Do not use damaged chargers or cables.

Charging steps are described on the [Charging](#) page.

- **Fully discharged:** If the robot is fully discharged and will not power on, the docking station may not charge it. In that case, connect the supplied external charger directly to the charging port.

Handling and storage

- **Impact and penetration:** Do not drop the battery, puncture it, or submerge it. Do not use a damaged battery; contact Rainbow Robotics.
- **Temperature:** Stay within the specified storage and use temperature range. Do not expose to high heat, direct sunlight, or heaters.
- **Storage:** Do not store the battery upside down. If unused for a long time, check its condition periodically.

DANGER



Battery removal when not in use: When not in use, **remove the battery** for storage. Leaving the battery installed in a powered-off robot for **more than 24 hours** can cause **irreversible damage**.

8.10 Fire and Heat Precautions

Measures to prevent fire, burns, and overheating when using the RBQ, charger, and battery.

Heat and contact

CAUTION



- 1) The robot body and controller get hot after long use. Do not touch during operation or immediately after. Allow at least about 1 hour to cool, check UI temperature, or power off and let it cool.
- 2) Batteries, chargers, and docking stations can also get hot-do not place flammable material near them while charging.

- **Ventilation:** Place the controller and charger in a well-ventilated area; do not cover with cloths or covers. Overheating can cause failure or fire.
-

Fire prevention

- **Flammables:** Do not place paper, cloth, solvents, or other flammables near the robot or charger.
 - **Battery:** Do not expose the battery to fire, crush it, or puncture it. Do not use a damaged battery; dispose of it safely.
 - **Charging:** Use only the designated charger; do not use damaged cables or chargers. See also [Battery Handling Precautions](#).
-

If something goes wrong

- **Smoke or odor:** Turn power off immediately, unplug, and **move to a safe distance**.

DANGER



If a **fire starts** on the RBQ, charger, or battery, **do not attempt to extinguish it yourself**. Prioritize life safety: **evacuate**, then call the fire service. Lithium batteries are hard to fully extinguish with water or ordinary extinguishers and may worsen the situation-use extinguishers suitable for electrical fires (gas, powder, etc.) as recommended.

- **Overheat alarm:** If the product or GUI shows an overheat warning, stop use, let it cool, then consult the manual or Rainbow Robotics.

8.11 User Responsibility Disclaimer

Scope of responsibility and limitations when using the RBQ and related manuals and software.

MUST READ



You must read the user manual and safety-related documentation. Review these documents in advance for legal and safety responsibility.

Intended use and prohibited use

Intended use

- The RBQ is a quadruped robot intended for **transport and movement in industrial sites, restricted areas, and supervised environments**.
- Use is assumed in **designated or marked areas**. See Operating Environment Requirements and Specifications for motion and environment limits.
- You may mount **non-contact sensing and monitoring payloads**; power can be supplied to such payloads.

Unsuitable use

- The RBQ is **not suitable for collaborative work** where people and the robot share the same space continuously.
- Use outside the intended scope without a risk assessment is prohibited.

Explicit prohibitions

The following uses are prohibited (examples only; not exhaustive):

- **No riding**: Carrying or transporting people or animals

- Underwater or airborne use; weapon or medical device use; home use; transport of hazardous materials; intentional harm; illegal purposes; climbing assistance; tampering that impairs sensors or function, etc.

Low-level API control of joints is outside the intended use described in this document. If you use it that way, you need a **separate risk assessment**. See the Developer Guide and API documentation.

Lawful use

- The user is responsible for complying with all applicable laws and regulations.
 - The product must be used only within the purposes, environments, and limits specified in the manual and by Rainbow Robotics. Rainbow Robotics is not liable for damage from use outside those limits.
-

Safety and risk

- **Risk assessment:** The user or system integrator must perform a risk assessment for the actual environment (workplace, coexistence with people and equipment, etc.). Configure guards, devices, and procedures accordingly.
 - **Training:** Anyone who operates, inspects, or maintains the system must complete the relevant manual and safety training before use.
-

Modifications and unauthorized repair

- If you modify the product or change parts or software without Rainbow Robotics approval, Rainbow Robotics is not liable for failures, accidents, or damage that result.
- Repair and inspection should be within what the manual allows the user to do, or contact Rainbow Robotics. See [Contact / Error Reporting](#).

Improper use

- Improper use (explosive atmospheres, medical/life-related uses, transport of people or animals, no risk assessment, use beyond specifications, etc.) is prohibited. Rainbow Robotics is not liable for direct or indirect damage from such use.

For legal or safety questions about product use, contact Rainbow Robotics. See [Contact / Error Reporting](#).

9.1 Error Reporting

We are continuously working to gather and address various runtime errors and issues experienced by users. If you encounter any problems, we highly encourage you to report them through the following channels:

- **Email:** If you have questions, feel free to reach out directly via email at rbq.support@rainbow-robotics.com