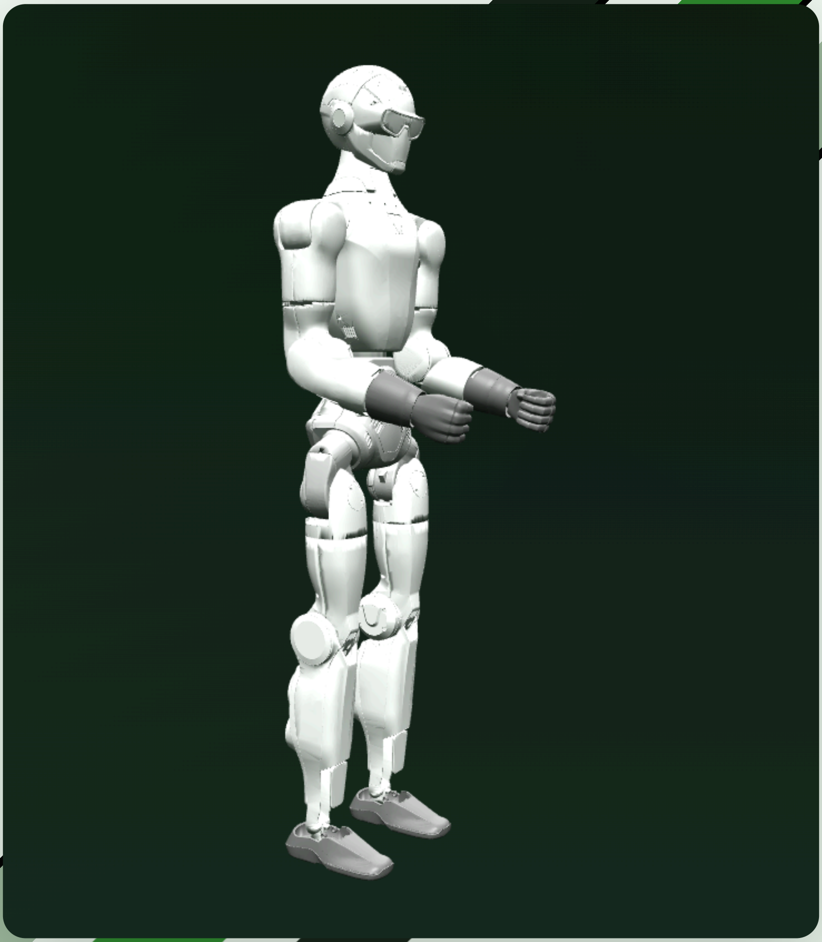
MYBOTSHOP

QUADRUPED ROBOTICS

Unitree R1

User Manual



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Contents

1 Attention

Attention: Read this document carefully. In case of doubt, it is essential to consult specialists, experts, or the manufacturer (Unitree Robotics) or distributor (MYBOTSHOP / QUADRUPED Robotics) of the assemblies used. The robot must not be put into operation before clarification. Contact information is available in Chapter 7, Getting Help & RMA.

Do not allow persons who are not familiar with the robotics or these instructions to operate the robot. Robots are dangerous in the hands of untrained users.

Do not operate the robot if you are intoxicated, under the influence of drugs, or unable to concentrate. Maintain adequate safety clearance from the robot during operation, and familiarize yourself with the emergency stop procedure (L2+B, held for more than 5 seconds) before switching the robot on.

Caution: The R1 cannot actively maintain its own balance while transitioning into a standing posture — an operator must firmly support the robot at the rear shoulder handle throughout every startup sequence until operation control mode (R2+A) is confirmed. Never release the robot before that point.

2 Disclaimer

The Unitree R1 documented here is sold and supported by *MYBOTSHOP / QUADRUPED Robotics* as the German distributor for Unitree Robotics. The R1 is controlled through Unitree's CycloneDDS-based `unitree_sdk2` / `unitree_sdk2_python` / `unitree_ros2` stack, which operates with or without ROS 2 — basic familiarity with DDS-based robot control is assumed for the SDK chapter of this manual.

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This product is intended for civilian use only. Users should avoid making dangerous modifications or using the robot in hazardous ways. Some features described in this manual may still be under active development or testing and will be released to users in subsequent updates — the global humanoid robotics sector is still in early-stage development, and users are encouraged to understand the current limitations of the platform before purchase. Final product appearance may differ from images shown in this manual. For terms, policies and compliance with local laws and regulations, refer to the Unitree Robotics website and the RMA/support process in Chapter 7.

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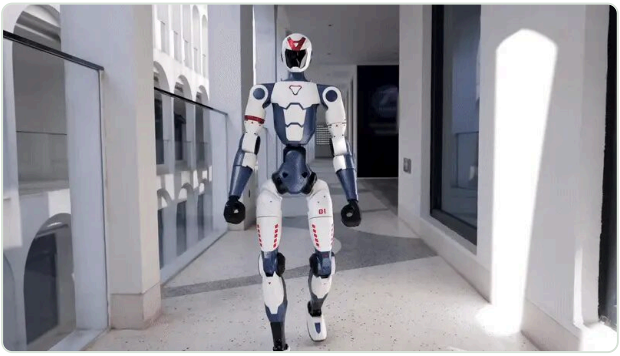
3 About the R1

Unitree R1



H1 Robot

The Unitree R1 is an ultra-lightweight, fully customizable humanoid robot designed to accelerate the adoption of humanoid robots in real-world applications. With agile mobility, open control interfaces, and seamless integration with large multimodal models, the R1 serves as an ideal platform for research, development, education, and experimentation. Its compact form factor, high responsiveness, and modular design make it suitable for both algorithm development and embodied AI exploration.

Agile Mobility and High Degrees of Freedom

The Unitree R1 features a flexible mechanical structure with 20 to 26+ degrees of freedom, enabling agile and expressive movement across a wide range of scenarios. Each leg is equipped with 6 degrees of freedom, ensuring stable locomotion and adaptability on complex terrain. The inclusion of a 2-DOF waist and 2-DOF head (on supported models) enhances balance, motion coordination, and environmental perception.

This kinematic design allows the R1 to prioritize movement as the foundation for task execution, supporting both dynamic locomotion and upper-body manipulation.

H1 Robot

Multimodal Intelligence and Perception

The R1 is integrated with a large multimodal model , enabling combined understanding of voice, audio, and visual input . Equipped with binocular or monocular cameras (model-dependent), a 4-microphone array , and stereo speakers, the robot is capable of natural interaction, perception-driven decision-making, and immersive human–robot communication.

The 2-DOF head further improves situational awareness by allowing active visual exploration of the environment.

Open Control and Developer-Friendly Design

Designed as an intelligent pioneer platform, the Unitree R1 provides fully open control interfaces for joints and sensors. It supports mainstream simulation environments, enabling algorithms developed in simulation to transition seamlessly into real-world deployment.

This openness makes the R1 particularly suitable for:

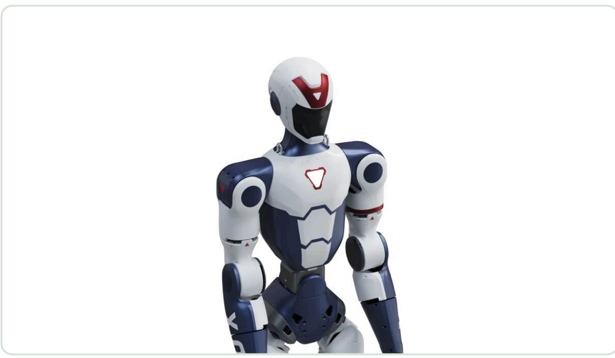
- Robotics research and education
- Embodied AI and reinforcement learning
- Motion control and whole-body coordination
- Human–robot interaction experiments

Customization and Expandability

The R1 supports user-customizable exterior finishes and modular hardware expansion. Selected models can be equipped with high-performance computing modules, including NVIDIA Jetson Orin , delivering up to 100 TOPS of AI computing power.

Quick-release smart batteries, OTA upgrades, and optional dexterous hands further enhance flexibility and long-term usability.

Model Variants & Specs



Unitree R1 Humanoid Robot - Next Generation Robotics

The Unitree R1 represents a breakthrough in humanoid robotics, combining cutting-edge AI capabilities with robust mechanical engineering. Available in three distinct configurations, the R1 series caters to diverse use cases—from consumer applications to advanced research and development.

Model Lineup

R1 Internal Hardware Architecture

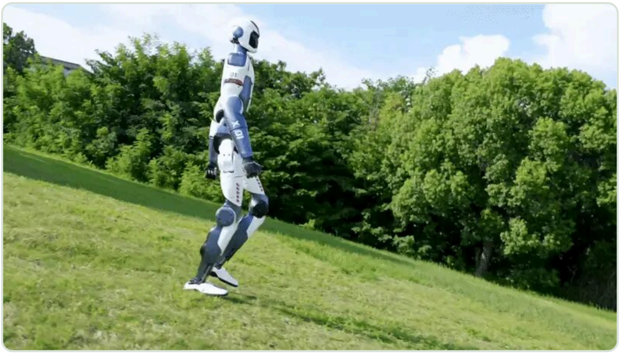
Mechanical Dimensions

Parameter	R1 AIR	R1	R1 EDU
Height x Width x Depth (Standing)	1230 x 357 x 190 mm	1230 x 357 x 190 mm	1230 x 357 x 190 mm
Total Weight (Incl. Battery)	~25 kg	~29 kg	~29 kg
Total Degrees of Freedom	20	26	26–40
Single Leg DOF	6	6	6
Single Arm DOF	4	5	5
Waist DOF	—	2	2
Head DOF	—	2	2
Dexterous Hand	—	—	Optional
Joint Output Bearing	Crossed Roller Bearings, Double Hook Ball Bearings	Crossed Roller Bearings, Double Hook Ball Bearings	Crossed Roller Bearings, Double Hook Ball Bearings
Joint Motor	**Low-inertia, high-speed internal rotor PMSM with permanent magnet synchronous motor; optimized for rapid response and thermal dissipation**		
Maximum Arm Payload [1]	~2 kg	~2 kg	~2 kg
Calf + Thigh Length	600 mm	600 mm	600 mm
Forearm + Upper Arm Length	420 mm	420 mm	420 mm

Joint Articulation Range

Joint Movement Space	R1 AIR	R1	R1 EDU

Knee Joint	-10° ~ +139°	-10° ~ +139°	-10° ~ +139°
Hip Joint: Yaw (Y)	±157°	±157°	±157°
Hip Joint: Pitch (P)	-168° ~ +146°	-168° ~ +146°	-168° ~ +146°
Hip Joint: Roll (R)	-60° ~ +100°	-60° ~ +100°	-60° ~ +100°
Waist Joint: Yaw (Y)	—	±150°	±150°
Waist Joint: Roll (R)	—	±30°	±30°



R1 Traversing Inclined Terrain

Electrical Characteristics

Parameter	R1 AIR	R1	R1 EDU
Electrical Routing	Hollow + Internal Routing	Hollow + Internal Routing	Hollow + Internal Routing
Joint Encoder	Dual + Single Encoder	Dual + Single Encoder	Dual + Single Encoder
Thermal Management	Localized Air Cooling	Localized Air Cooling	Localized Air Cooling
Power Supply	Lithium Battery	Lithium Battery	Lithium Battery
Base Computing Unit	**8-Core High-Performance CPU**		
Microphone Array	4-Mic Array	4-Mic Array	4-Mic Array
Integrated Speaker	Yes	Yes	Yes
Wireless Connectivity	**WiFi 6 + Bluetooth 5.2**		
Vision System	Monocular Camera	Binocular Camera	Binocular Camera

R1 Fall Recovery

Accessories & Expansion

Component	R1 AIR	R1	R1 EDU
High-Power Computing Module	/	/	NVIDIA Jetson Orin (40–100 TOPS) [2]
Smart Battery (Quick Release)	Yes	Yes	Yes
Charger Included	Yes	Yes	Yes
Manual Controller	Yes	Yes	Yes

Performance & Support

Parameter	R1 AIR	R1	R1 EDU
Battery Runtime	~1 hour	~1 hour	~1 hour
Intelligent OTA Upgrade	Yes	Yes	Yes
Secondary Development [2]	/	/	Yes

[1] Arm Payload Variability: The maximum load capacity of the manipulator arm varies significantly depending on the arm's extension posture and configuration.

[2] Development Documentation: For comprehensive secondary development guidelines, please consult the official SDK and development manual.

Warning: Safety Notice: The humanoid robot features a sophisticated mechanical structure with substantial power output. Operators must maintain adequate safety clearance from the robot during operation. Exercise appropriate caution at all times. Civilian Use Only: This product is designed exclusively for civilian applications. Users are strictly prohibited from implementing hazardous modifications or deploying the robot in dangerous operational contexts.

Note: Product Appearance: Final product appearance may differ from images shown. Please reference the actual delivered product. Feature Availability: Certain capabilities demonstrated on this page remain under active development and testing. These features will be released to users in subsequent updates. Industry Context: The global humanoid robotics sector is currently in early-stage development. Individual consumers are strongly encouraged to thoroughly understand the current limitations of humanoid robots prior to purchase.

R1 Precision Motion Control

4 Quick Start – Startup & Shutdown Procedure

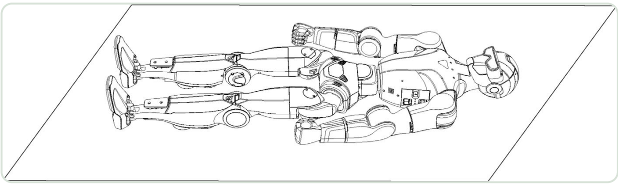
Quick Start

Startup Procedure

Startup from Supine Position

Step 1: Pre-start Checks

Before powering on, place the R1 flat on the ground with its front side facing upward . Ensure the surrounding area is clear of people and obstacles. Arrange the robot's arms and legs in a natural, relaxed posture as illustrated in the reference figure.

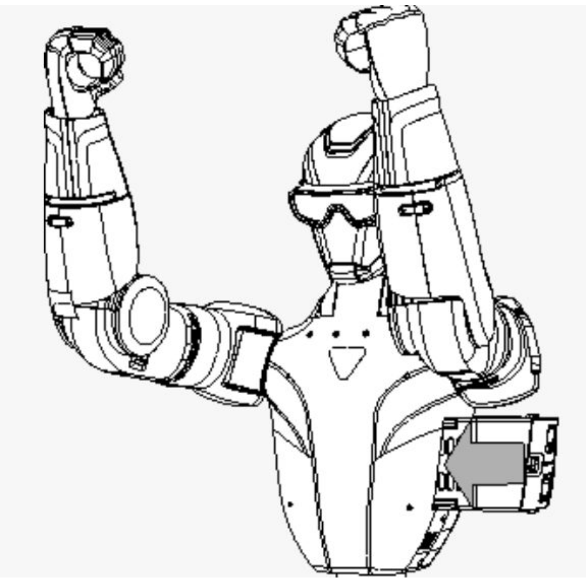


R1 Startup

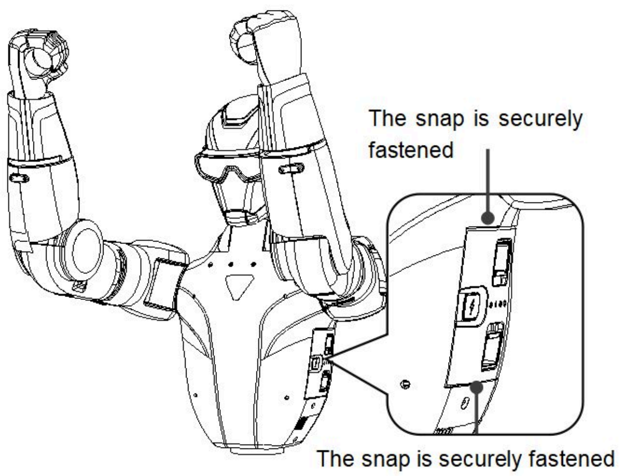
Step 2: Install the Battery Pack

Insert the battery pack into the battery compartment from the side of the robot . Ensure the power switch is facing toward the front of the R1.

If the battery does not slide in smoothly, remove it and adjust the orientation. Do not apply force , as this may damage the battery connector or locking mechanism. A clear click sound indicates successful installation. Confirm that the latch is fully secured.



Inserting Battery

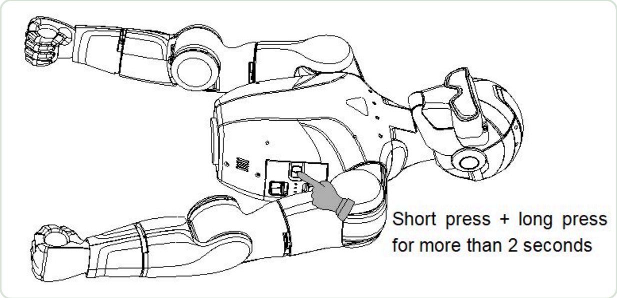


Powering On

Step 3: Power On

After confirming that the robot is correctly positioned and the area is clear, power on the battery using the following sequence:

1. Briefly press the battery power button once.
2. Press and hold the button for more than 2 seconds to turn on the battery.

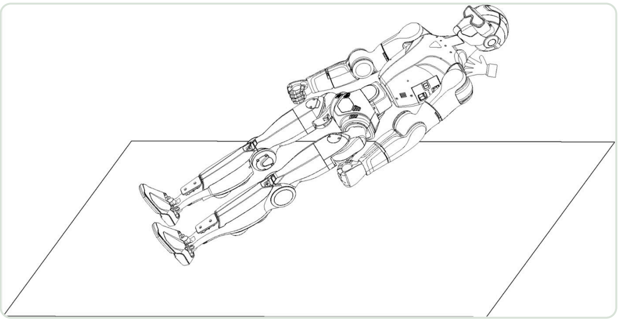


R1 Startup

Step 4: Start the Robot

After the power-on sequence, wait approximately 1 minute until the R1 enters the zero-torque state . Make sure the environment remains unobstructed during this process.

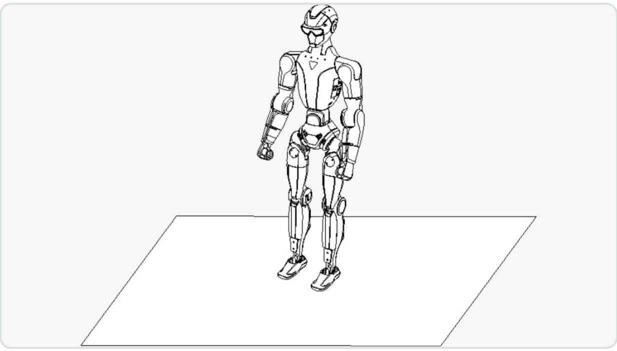
Press L2 + UP to switch the robot into the standing preparation posture. Firmly hold the handle located at the back of the R1's shoulders and assist the robot as it rises to a standing position.



R1 Startup

> **Warning:** Do not release the robot at this stage. The R1 cannot actively maintain balance while entering the standing posture.

Once the robot is fully upright, press R2 + A to enter the walking/running motion control mode. At this point, the robot can actively balance itself and you may safely let go.



R1 Startup

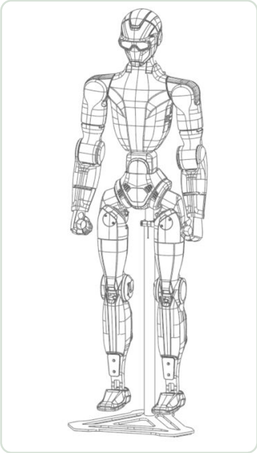
Emergency Stop

If the R1 enters an abnormal or unsafe state, press and hold L2 + B for more than 5 seconds . The robot will switch to a damping mode and gradually lower itself to the ground.

Startup from Standing Position

Step 1: Pre-start Checks

Before powering on, suspend the R1 using a suitable support frame , with the robot's front facing forward. Verify that the surrounding area is clear of people and obstacles. Arrange the arms and legs in a natural resting posture as illustrated in the reference figure.

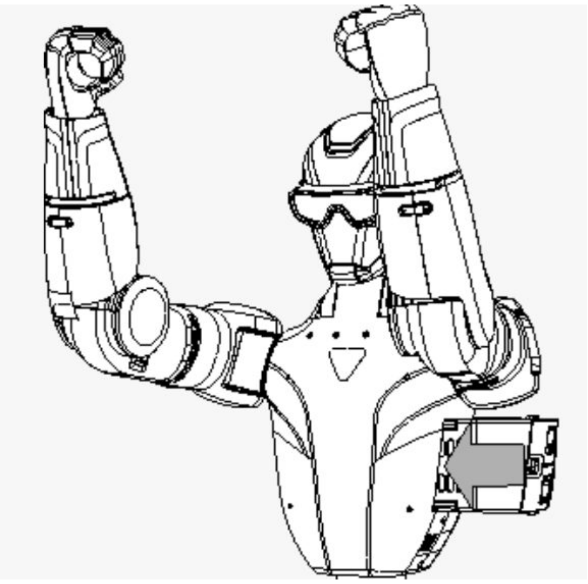
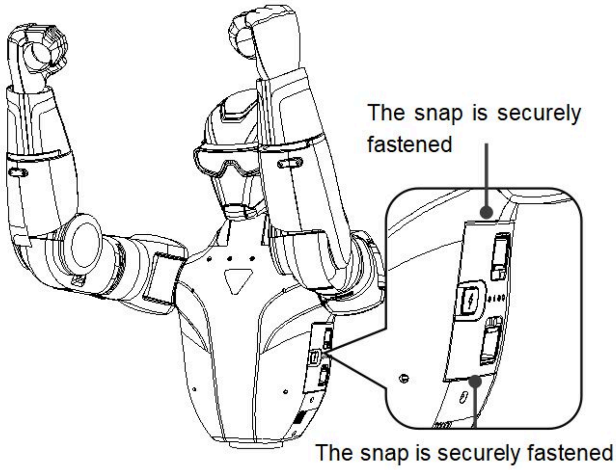


R1 Startup

Step 2: Install the Battery Pack

Insert the battery pack into the battery compartment from the side of the robot . Ensure the power switch is oriented toward the front of the R1.

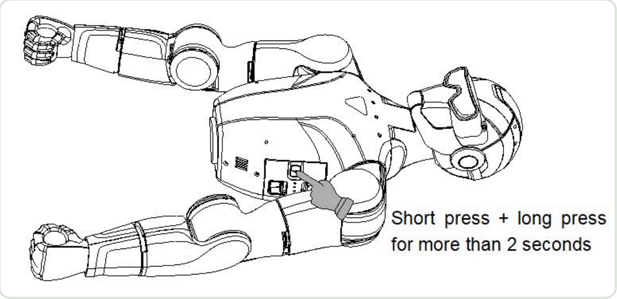
If the battery does not insert smoothly, remove it and adjust the orientation. Do not force the battery , as this may damage the connector or locking mechanism. A distinct click confirms successful installation. Verify that the latch is fully engaged.

 Inserting Battery	 Powering On

Step 3: Power On

After completing the pre-start checks and confirming that the area around the robot is clear, power on the battery using the following sequence:

1. Briefly press the battery power button once.
2. Press and hold the button for more than 2 seconds to turn on the battery.

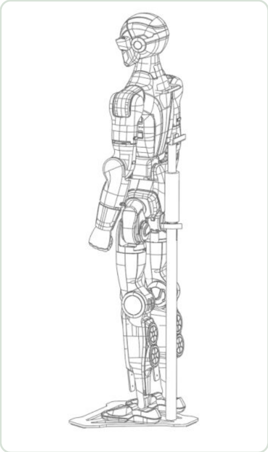


R1 Startup

Step 4: Start the Robot

After the short press followed by the long press, wait approximately 1 minute until the R1 enters the zero-torque state . Ensure the surroundings remain unobstructed during this time.

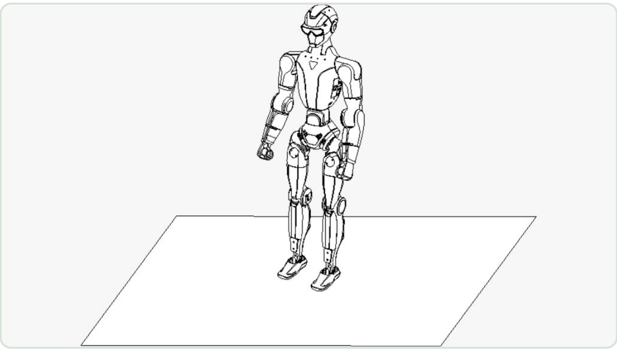
Press L2 + UP to enter the standing preparation posture. Firmly hold the handle at the back of the R1's shoulders, then release the quick-release clamp on the support frame. Gradually lower the support bracket to allow the robot's feet to make contact with the ground, assisting the robot as it transitions to a standing position.



R1 Startup

> **Warning:** Do not release the robot during this step. The R1 is not yet capable of actively maintaining balance.

Once the robot is upright and stable, press R2 + A to enter the walking/running motion control mode. At this point, the robot can actively balance itself and you may safely let go.



R1 Startup

Emergency Stop

If the R1 enters an abnormal or unsafe condition, press and hold L2 + B for more than 5 seconds . The robot will switch to a damping mode and gradually lower itself to the ground.

Shutdown Procedure

Powering Down the R1

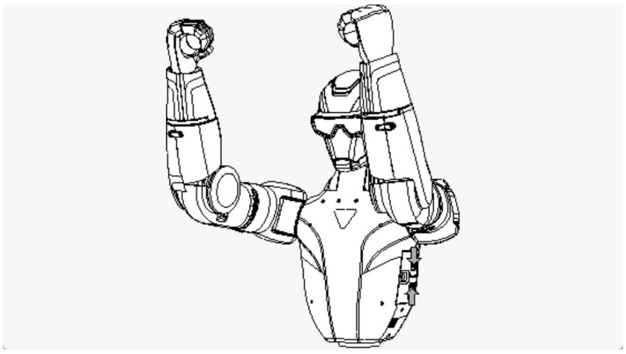
Before shutting down the R1, move the robot to an open area, ensuring there is enough space behind it. Grasp the rear handle and press L2 + UP to bring the R1 into its standing preparation posture. Do not release the handle at this stage , as the robot cannot maintain balance on its own.

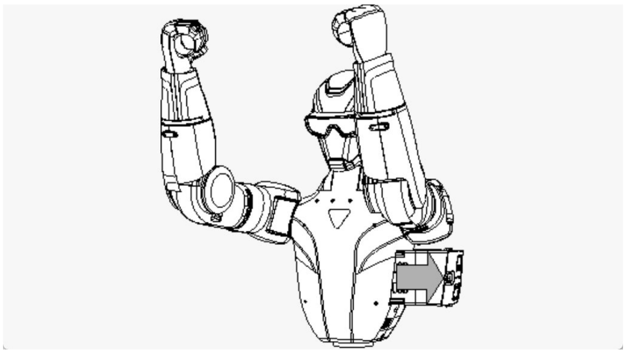
Steps to shutdown:

1. Gently lay the R1 on its back on a flat surface.
2. Press L2 + Y to activate zero-torque mode.

3. Briefly press the battery power switch, then press and hold it for more than 2 seconds to turn off the robot.

After powering down, adjust the robot's arm and leg joints according to the required body positioning for the next startup.





Important: If the R1 will remain unused for a long period, remove the battery pack immediately. Press the battery latch with both hands to safely detach the battery.

Exercise caution around moving joints to avoid pinching your hands.

5 SDK Development & Network Setup

SDK Development

This section summarises how to set up and develop applications for the Unitree R1 using the official SDKs. It is based on Unitree's R1 Developer Guide and the public Unitree repositories. Always treat the official guide as the authoritative reference for your firmware version.

Overview

The R1 is controlled through Unitree's CycloneDDS-based communication stack, which operates with or without ROS 2 while remaining ROS 2 compatible. Three primary SDKs are available:

- unitree_sdk2 — the C++ SDK for high- and low-level control, state subscription, and sensor access. Repository: unitree_sdk2 .
- unitree_sdk2_python — the Python interface (pybind11 wrapper) for rapid prototyping. Repository: unitree_sdk2_python .
- unitree_ros2 — ROS 2 packages that bridge the same DDS interface into ROS 2 topics and messages. Repository: unitree_ros2 .

All Unitree open-source SDKs are published under the Unitree Robotics GitHub organisation .

Requirements

Item	Requirement
Operating System	Ubuntu 20.04 LTS
Compiler	GCC 9.4.0 (C++17)
Build System	CMake 3.10+
Architecture	x86_64 or aarch64
Transport	DDS (CycloneDDS)
Python (optional)	Python 3.8+

Installing Dependencies

Install the build toolchain and required libraries:

```
sudo apt update
sudo apt install -y cmake g++ build-essential \
    libyaml-cpp-dev libeigen3-dev libboost-all-dev \
    libspdlog-dev libfmt-dev
```

Building and Installing unitree_sdk2

Clone and build the C++ SDK:

```
git clone https://github.com/unitreerobotics/unitree_sdk2.git
cd unitree_sdk2
mkdir build && cd build
cmake ..
make
```

To install the SDK system-wide (recommended for use in your own CMake projects):

```
cd unitree_sdk2/build
cmake .. -DCMAKE_INSTALL_PREFIX=/opt/unitree_robotics
sudo make install
```

Installing the Python Interface

For Python development, install unitree_sdk2_python :

```
git clone https://github.com/unitreerobotics/unitree_sdk2_python.git
cd unitree_sdk2_python
pip3 install -e .
```

Network Configuration

The R1 communicates with a development PC over Gigabit Ethernet using CycloneDDS. Connect the robot and your computer with an Ethernet cable, then identify the interface that links to the robot:

```
# List network interfaces and find the one connected to the R1
ifconfig
```

Unitree robots use the 192.168.123.x subnet by convention. Ensure your development machine is on the same subnet as the robot's onboard computer. The R1-EDU development computing unit is preconfigured at 192.168.123.164 (default login unitree / 123 — change after first access). Configure your PC's wired interface to a static address on the same subnet:

```
# Example: set a static IP on the wired interface (replace eth0 with your NIC)
sudo ip addr add 192.168.123.222/24 dev eth0
sudo ip link set eth0 up

# Confirm the robot is reachable
ping 192.168.123.164
```

Important: The exact network setup and any robot-specific addresses are documented in the official

R1 Developer Guide . Confirm the values for your unit before configuring your PC.

Specifying the Network Interface

unitree_sdk2 examples and applications must be told which network interface is connected to the robot. The interface name (for example eth0) is passed as a command-line argument when launching an example:

```
# Run a built example, passing the network interface name
./example_program eth0
```

In C++, the interface is supplied when initialising the DDS channel factory:

```
#include <unitree/robot/channel/channel_factory.hpp>

int main(int argc, char** argv)
{
    // argv[1] is the network interface connected to the R1 (e.g. "eth0")
    unitree::robot::ChannelFactory::Instance()->Init(0, argv[1]);
    // ... create publishers / subscribers and control the robot ...
    return 0;
}
```

The equivalent in Python:

```
import sys
from unitree_sdk2py.core.channel import ChannelFactoryInitialize

# sys.argv[1] is the network interface connected to the R1 (e.g. "eth0")
ChannelFactoryInitialize(0, sys.argv[1])
# ... create publishers / subscribers and control the robot ...
```

Control Interfaces

The SDK exposes both high-level and low-level control:

- High-level control issues task-space commands (locomotion modes, posture, velocity) and is the safe default for most applications.
- Low-level control commands individual joint targets (position, velocity, torque, stiffness, and damping). Low-level commands bypass built-in balancing safeguards and must remain within the documented joint limits.

The R1 joint indices, names, and motion limits used by the low-level interface are listed in the About R1 page under Joint Motors → Joint Indexing and Motion Limits . Always validate commanded joint motions against those limits before sending them.

Warning: Custom low-level control code can command the robot into unsafe states. Test new control software with the R1 safely supported or in a clear, open area, keep the emergency stop within reach, and validate joint commands against the documented limits before deployment.

Further Resources

- R1 Developer Guide (official)
- unitree_sdk2 (C++ SDK)
- unitree_sdk2_python (Python interface)
- unitree_ros2 (ROS 2 packages)
- Unitree Robotics on GitHub
- Unitree Document Center

6 Hardware Overview & Specification

About R1

Unitree R1 Humanoid Robot

Component Overview

The Unitree R1 humanoid robot is composed of an upper body and a lower body, featuring a modular mechanical structure with multiple degrees of freedom (DOF) to support precise motion and posture control. Depending on the selected model, the R1 offers different joint configurations to balance weight, flexibility, and functionality.

Each leg is designed with six degrees of freedom , incorporating the hip, thigh, knee, and ankle joints to ensure stable locomotion and adaptable movement. The arms are available in two configurations, providing either four or five degrees of freedom , including the shoulder, upper arm, and elbow joints. The Air variant features a simplified arm design with a reduced elbow configuration.

The waist module is offered in two versions: a fixed configuration with no degrees of freedom, and an articulated configuration with two degrees of freedom , corresponding to the lumbar joint. Similarly, the head module is available in either a fixed (0-DOF) configuration or a 2-DOF articulated neck , enhancing environmental perception and sensor orientation. The Air variant does not include waist or head articulation.

Based on these configurations, the R1 series is divided into the R1 Air , R1 Basic , and R1 EDU models. These variants provide a total of 20 or 26 degrees of freedom , enabling accurate whole-body motion control and flexible posture adjustment across a wide range of applications.

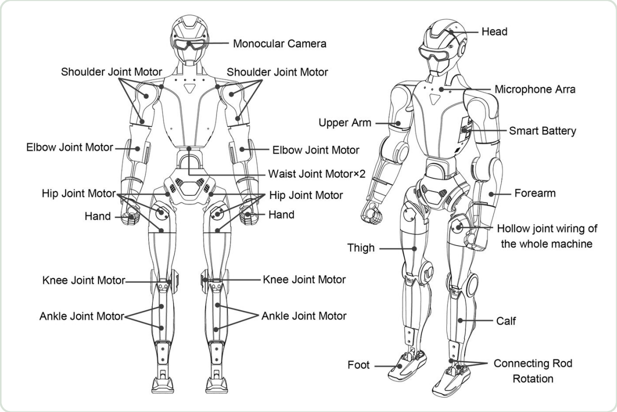
Degrees of Freedom by Model

Category	R1 Air	R1 Basic / R1 EDU
Total DOF	20	26
Single Leg DOF	6	6
Waist DOF	0	2

Single Arm DOF	4	5
Head DOF	0	2

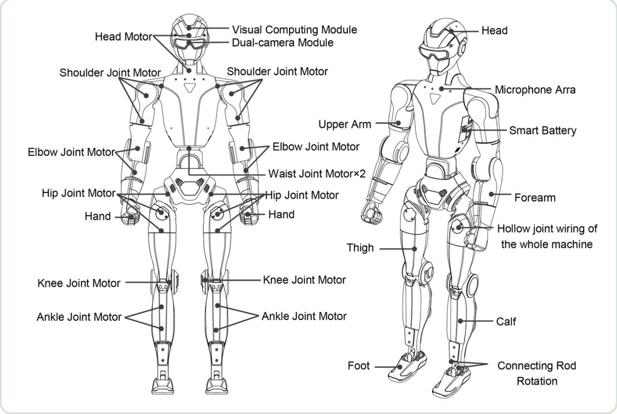
Component Description

R1 Air



Unitree R1 Humanoid Robot

R1 Basic / R1 EDU



Unitree R1 Humanoid Robot

Dexterous Hand (Dex3-1)

Overview

The Dex3-1 dexterous hand is a compact, force-capable end-effector designed for precise manipulation tasks in humanoid robot applications. Featuring a three-finger configuration and multiple sensing elements, the Dex3-1 enables fine-grained object interaction while maintaining a lightweight and robust design.

Electrical Parameters

Parameter	Specification
Operating Voltage	12–58 V
Sensing Range	10 g – 2500 g
Total Degrees of Freedom	7
Array Sensors	9

Degrees of Freedom Configuration

The Dex3-1 hand provides a total of seven active degrees of freedom , distributed as follows:

- Thumb: 3 active degrees of freedom
- Index Finger: 2 active degrees of freedom
- Middle Finger: 2 active degrees of freedom

This configuration enables both power grasping and delicate manipulation, supporting a wide range of interaction scenarios.

Joint Motion Ranges

The allowable joint angle ranges for each finger are defined below:

- Thumb: - 0° to +100° - −35° to +60° - −60° to +60°
- Index and Middle Fingers: - 0° to +90° - 0° to +100°

These ranges provide sufficient flexibility for stable grasping, finger coordination, and controlled contact with objects.

Usage Guidelines

When operating the Dex3-1 dexterous hand, users should ensure that the robot's motion planning prevents unintended contact between the hand and the robot body. If necessary, increasing the outward offset of selected shoulder joints can help reduce the risk of self-collision.

During development and testing, it is recommended to avoid highly dynamic or strenuous behaviors—such as running or balance stress tests—while the dexterous hand is active. This helps protect the mechanical structure and ensures reliable operation during manipulation-focused tasks.

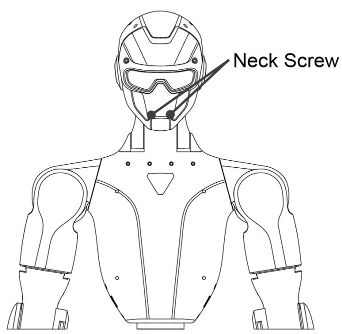
Mounting Hole Positions

Front Chest Mounting Holes

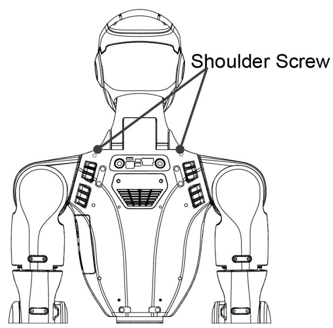
The Unitree R1 provides mounting points on the front chest area for installing external components or accessories. If access to these mounting holes is required, follow the procedure below carefully.

Mounting Preparation Procedure

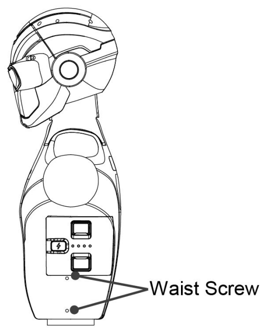
1. Remove fixing screws Detach the following screws as indicated in the reference diagram: Two neck fixing screws from the front Two shoulder fixing screws from the rear Four waist fixing screws from both sides
2. Drill front panel holes From the inside of the front panel, use a 3.3 mm drill bit to carefully drill through the existing front panel screw holes.
3. Tap mounting threads From the inside of the front panel, use an M4 tap to create threads along the existing M4 threaded paths. Take care to align the tap correctly and avoid damaging the internal threads.



Front



Back

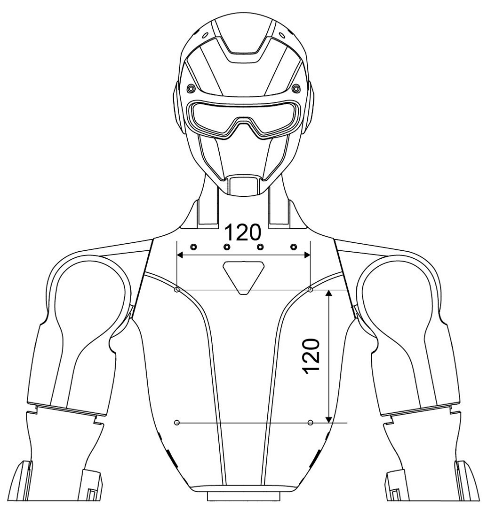


Side

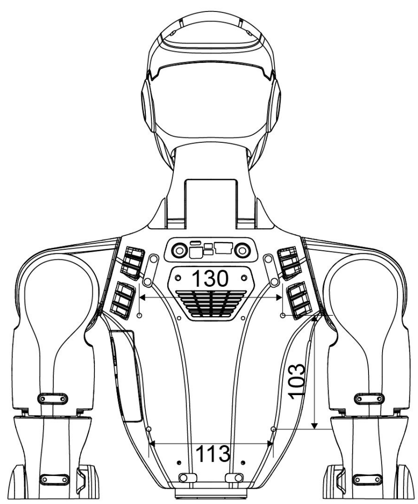
Mounting Hole Specifications

- Thread Type: M4 threaded hole
- Units: millimeters (mm)

Refer to the R1 Mounting Hole Dimension Diagram below for detailed hole positions and spacing before installation.



Front

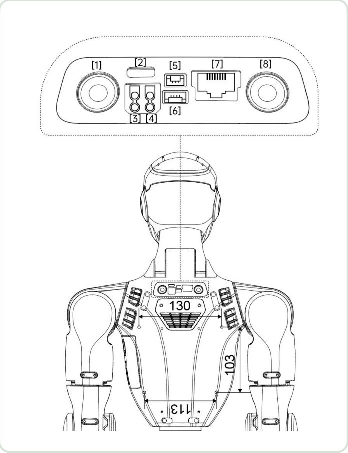


Back

Important: Ensure all drilling and tapping operations are performed with the robot powered off and the battery removed. Improper handling may damage internal structures or compromise mechanical integrity.

Electrical Interfaces

The upper section of the Unitree R1 is equipped with multiple electrical interfaces used to connect joint motors, sensor peripherals, networking equipment, and external control devices. This interface layout is designed to support convenient system debugging, fault diagnosis, and secondary development activities.



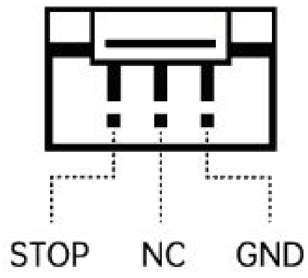
Unitree R1 Humanoid Robot

Interface List

No.	Interface Type	Abbreviation	Description
1	Reserved Button	Reserved Button	Not connected (NC)
2	Type-C	Type-C	Supports USB 3.0 devices; used on EDU version to connect to the rear computing module
3	XT30UPB-F	24V	24 V / 3 A power output
4	XT30UPB-F	36V	36 V / 5 A power output
5	GH1.25	Emergency Stop Interface	External emergency stop interface
6	GH1.25	Reserved Socket	Not connected (NC)
7	RJ45	1000 BASE-T	Gigabit Ethernet interface
8	Button	STOP	Integrated emergency stop button

External Emergency Stop Interface

The external emergency stop interface uses a GH1.25 connector. Pin assignments are defined from left to right as shown below.



Unitree R1 Humanoid Robot

Pin Number	Signal
1	STOP
2	NC
3	GND

Important: When connecting external power or emergency stop devices, ensure correct voltage levels and pin alignment. Improper connections may result in system malfunction or hardware damage.

Onboard Computer

Overview

The R1-EDU Professional Edition is equipped with a dedicated Development Computing Unit , designed specifically to support secondary development, algorithm deployment, and advanced perception or control workloads. This onboard computer provides sufficient computing performance for real-time processing, AI inference, and system integration tasks.

Development Computing Unit Specifications

Parameter	Specification
Model	NVIDIA Jetson Orin NX
CPU Architecture	Arm® Cortex®-A78AE

CPU Core Count	8
Thread Count	8
Max Turbo Frequency	Up to 2.0 GHz
GPU	1024-core NVIDIA Ampere GPU with 32 Tensor Cores
Max GPU Frequency (Dynamic)	918 MHz
Video Memory	16 GB
System RAM	16 GB
Cache	2 MB L2 + 4 MB L3
Storage	2 TB
Instruction Set	64-bit
OpenGL Support	Version 4.6
OpenCL Support	Version 3.0
DirectX Support	Version 12.1

Network Configuration

- Default IP Address: 192.168.123.164

This address is preconfigured for communication and development access within the robot's internal network.

Usage Notes

- The Development Computing Unit is intended exclusively for secondary development purposes .
- Default login credentials are provided for initial access: Username: unitree Password: 123
- The computing module shipped with the robot may be replaced with a newer or higher-performance version , provided that its performance is not lower than the specifications listed above.

Important: For security reasons, users are strongly advised to change the default login credentials after first access. Ensure proper shutdown procedures are followed before performing any hardware or software modifications.

Camera Field of View (FOV)

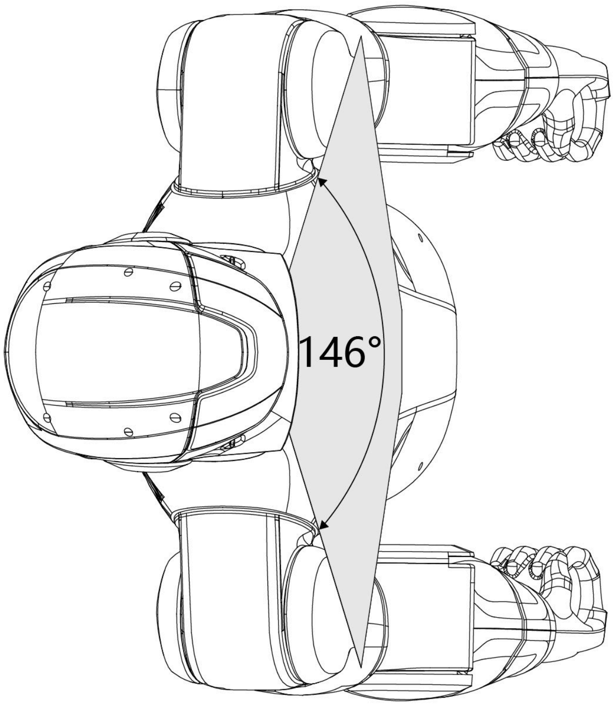
The Unitree R1 is equipped with wide-angle vision systems designed to provide strong visual perception and spatial awareness. Depending on the model variant, the robot uses either a monocular or binocular camera configuration to support perception, navigation, and interaction tasks across diverse environments.

Camera Configurations by Model

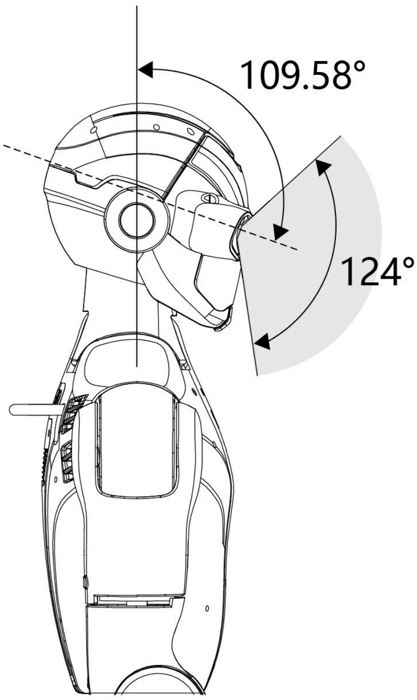
- R1 AIR The R1 AIR head integrates a monocular camera with a horizontal field of view of up to 146° and a maximum vertical field of view of 110° . This configuration provides broad visual coverage while maintaining a lightweight design.
- R1 Basic / R1-EDU The R1 Basic and R1-EDU models are equipped with a binocular depth camera module , offering a horizontal field of view of up to 150° and a maximum vertical field of view of 124° . This setup enables depth perception and enhanced spatial understanding.

Vertical Field of View Example

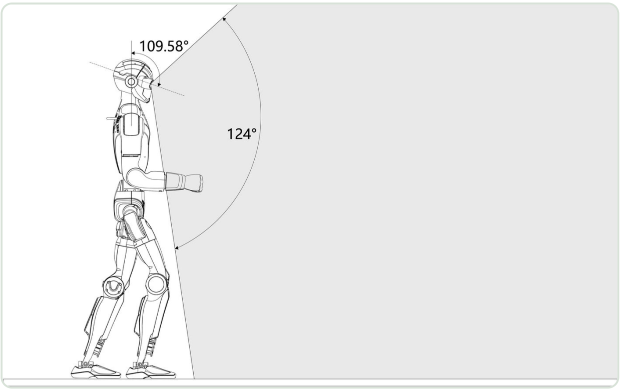
When using the binocular camera module, the effective vertical field of view is influenced by the head's pitch motion range. For example, a vertical FOV of approximately 109.58° corresponds to the available head pitch movement range, allowing the robot to actively scan its surroundings.



Horizontal FOV



Vertical FOV



Unitree R1 Humanoid Robot

Perception Capabilities

The R1's wide field of view significantly enhances visual perception, enabling accurate environmental understanding, reliable obstacle detection, and high-precision spatial awareness. These capabilities allow the robot to respond intelligently and adapt flexibly to a wide range of real-world scenarios, including navigation, interaction, and perception-driven tasks.

Single Camera Technical Parameters

Category	Specification
RGB Full Resolution	1280 × 1088
Depth Resolution	544 × 448
Depth Frame Rate	10 Hz
RGB Frame Rate	30 Hz
Sensor Resolution	13 Megapixels
Shutter Type	Global shutter
Dynamic Range	66 dB (Normal mode) / >100 dB (HDR mode)
Infrared Enhancement	850 nm / 940 nm near-infrared support
Gain Control	15.5× analog gain, 16× digital gain
Exposure Control	Auto exposure and gain control; supports exposure < 1 line
Advanced Features	HDR output, high photosensitivity, high SNR, LED strobe, external exposure control, multi-sensor synchronization, horizontal/vertical window adjustment, interface register programming

Note: Actual field of view and perception performance may vary depending on configuration, lighting conditions, and operational posture of the robot.

Joint Motors

The Unitree R1 is equipped with self-developed joint motors engineered for high performance, compact integration, and precise motion control. Each motor features a hollow-shaft design , reducing overall weight while enabling efficient internal routing of cables and mechanical components.

To support accurate control and state estimation, the joint motors are fitted with dual encoders , providing high-resolution feedback for both position and velocity. This design meets the requirements of high-precision control, dynamic motion execution, and stable whole-body coordination.



Joint Indexing and Motion Limits

The table below lists the joint sequence numbers , joint names , and corresponding motion limits (in radians). Entries marked as EMPTY indicate reserved or unused joint indices.

Joint No.	Joint Name	Limit (rad)
0	L_LEG_HIP_PITCH	−2.9322 ~ 2.5482
1	L_LEG_HIP_ROLL	−1.0472 ~ 1.7453
2	L_LEG_HIP_YAW	−2.7402 ~ 2.7402
3	L_LEG_KNEE	−0.1745 ~ 2.4260
4	L_LEG_ANKLE_PITCH	−0.8727 ~ 0.5760
5	L_LEG_ANKLE_ROLL	−0.2618 ~ 0.2618
6	R_LEG_HIP_PITCH	−2.9322 ~ 2.5482
7	R_LEG_HIP_ROLL	−1.0472 ~ 1.7453
8	R_LEG_HIP_YAW	−2.7402 ~ 2.7402
9	R_LEG_KNEE	−0.1745 ~ 2.4260
10	R_LEG_ANKLE_PITCH	−0.8727 ~ 0.5760
11	R_LEG_ANKLE_ROLL	−0.2618 ~ 0.2618
12	WAIST_YAW	−2.6180 ~ 2.6180
13	WAIST_ROLL	−0.5236 ~ 0.5236

14	EMPTY	EMPTY
15	L_SHOULDER_PITCH	−3.1416 ~ 2.0944
16	L_SHOULDER_ROLL	−2.4784 ~ 0.2269
17	L_SHOULDER_YAW	−1.9199 ~ 1.9199
18	L_ELBOW	−0.9757 ~ 2.1850
19	L_WRIST_ROLL	−1.9199 ~ 1.9199
20	EMPTY	EMPTY
21	EMPTY	EMPTY
22	R_SHOULDER_PITCH	−3.1416 ~ 2.0944
23	R_SHOULDER_ROLL	−2.4784 ~ 0.2269
24	R_SHOULDER_YAW	−1.9199 ~ 1.9199
25	R_ELBOW	−0.9757 ~ 2.1850
26	R_WRIST_ROLL	−1.9199 ~ 1.9199
27	EMPTY	EMPTY
28	EMPTY	EMPTY
29	HEAD_PITCH	−0.6283 ~ 0.6283
30	HEAD_YAW	−1.8326 ~ 1.8326

Note: Joint limits are defined in radians and may vary depending on hardware configuration, firmware version, and operational conditions. Always ensure commanded joint motions remain within the specified limits.

7 Getting Help & RMA

RMA / Support

How to Raise a Return Merchandise Authorization (RMA) Case

At QUADRUPED Robotics, we are committed to providing excellent support to ensure your issues are resolved promptly. If you encounter any problems with our products, please follow the steps below to raise a Return Merchandise Authorization (RMA) case:

Step 1: Open a Topic in Our Forum

1. Visit MYBOTSHOP Forum .
2. Open a new topic describing your issue in detail. Our support team and community members will attempt to assist you in resolving the problem remotely.

Step 2: Contact Support for RMA Number

If the issue cannot be resolved remotely through our forum:

1. Email us at support @ quadruped . de .
2. Provide a detailed description of the issue and include any troubleshooting steps already taken.
3. Our support team will evaluate your case and, if necessary, issue a RMA number along with a return address or a shipping label.

Important Shipping Information

Note: Please note: All goods must be sent back to the following address: QUADRUPED Robotics GmbH c / o MYBOTSHOP GmbH Willy - Messerschmitt - Strasse 12 50126 Bergheim Germany Do not ship goods without obtaining a RMA number. Parcels sent without a RMA number will be declined and returned to the sender. Do not ship goods to QUADRUPED Robotics GmbH Office in Leverkusen!

Help Resources

In case of any issues, help can be taken from any of the following forums/resources:

1. MYBOTSHOP Forum : The forum is actively monitored by support teams at MYBOTSHOP GmbH .
2. Github Issues : Issues can be reported in the repository.
3. Online QA Sites: Questions can be asked on any of the QA sites like StackOverflow and Answers ROS .

8 Getting Involved

Getting Involved

The software provided are Opensource, so contributions from community are welcome on our Github repository

9 FAQ

Frequently Asked Questions

(Coming Soon)