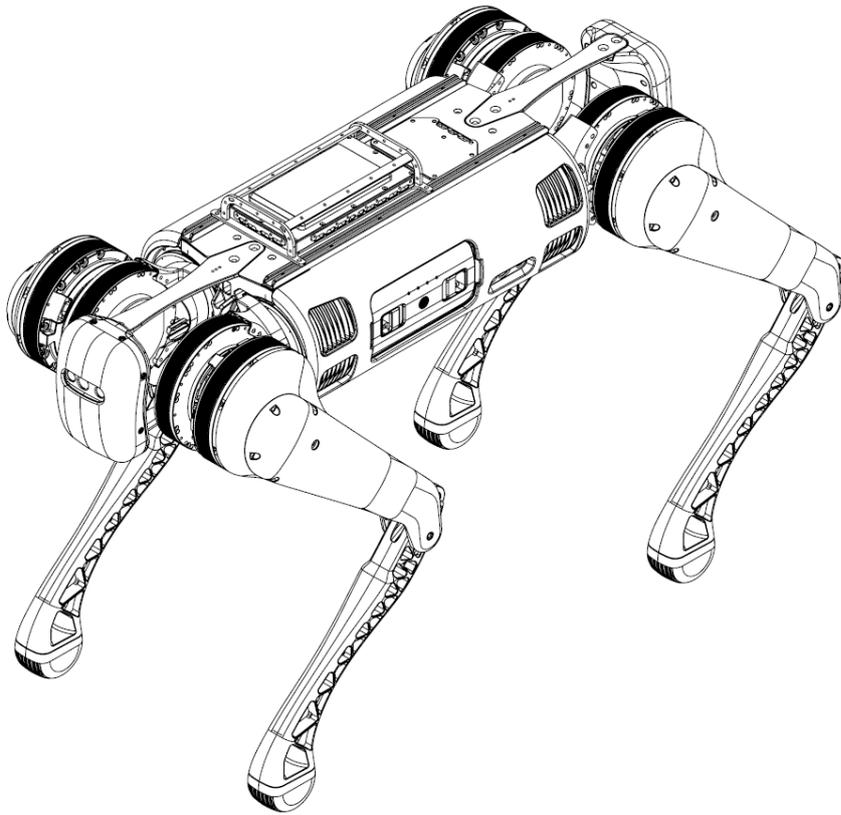


B1

User Manual V1.0.1



**Unitree**

[www.unitree.cc/cn](http://www.unitree.cc/cn)

## Declarations and Warnings

1. This product is not a toy and is not intended for use by persons under the age of 18. Keep out of reach of children and be careful when operating in the presence of children.
2. Please be sure to read this article carefully before using the product, understand how to use the product correctly and your legitimate rights, responsibilities, and safety instructions. Otherwise, it may bring property damage, safety accidents and personal safety hazards. Once used this product, you are deemed to have carefully read, understood, recognized, and accepted all the terms and contents of this article. Users undertake to be responsible for their actions and all consequences therefrom. Users undertake to use this product only for legitimate purposes and agree with these terms and any relevant policies or guidelines that United may establish.
3. To the fullest extent permitted by law, in no event does Unitree provide any express or implied commercial or technical warranties not covered herein, that the products/services provided are completely defect-free, that they are fully compliant with customer requirements, that there will be no problems or interruptions in the use of the products/services, and that Unitree will be able to completely repair these defects. In any case, Unitree shall not be liable for direct or indirect economic losses of the customer because of this service manual, and the maximum compensation of Unitree for the losses of the customer caused by its own product liability shall not be higher than the amount paid by the customer for the purchase of the product/service.
4. The laws of some countries may prohibit the exemption of guarantee clauses, so your relevant rights may vary in different countries.
5. Subject to legal compliance, Unitree reserves the right of final interpretation of the above terms. Unitree has the right to update, amend or terminate this term without prior notice.
6. When using, please control the robot within sight, keep a certain safe distance from the robot, and do not touch the robot with your hands after the robot is powered on.
7. Before long term standby, please operate the robot dog to the lying down posture (press button L2 twice + A button and make the robot lie down or press the L2+B button to enter the damping state) to avoid damage caused by automatically shutting down and falling down.
8. When the battery power is only one block left, please stop and turn off the robot dog in time, take out the battery to charge to avoid the damage of falling when the battery is low.

# Catalogue

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Unitree Robotics

## Product Overview

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This chapter mainly introduces the functional characteristics of the product

Unitree Robotics

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## Product Overview

### Introduction

The B1 industrial protection level quadruped robot consists of B1 itself and remote control. The robot has 12 degrees of freedom (12 high-performing joint units), 3 degrees of freedom for a single leg. The force control technology is used to control the force and position of each joint, so that it makes user achieve the force control of the machine and obtain excellent movement performance. It has multi-road condition adaptability, strong obstacle crossing ability, can easily climb stairs and cross rugged terrain, can adapt to ruins, railway tracks and many other complex terrains. We provide detailed users instructions, software development manuals, etc., and also provide high-level control function of secondary development documents and routines (for example walking), provide low-level control function of secondary development documents and routines (such as motor position, speed and torque), and multiple expansion ports are equipped with to meet different expansion functions.

### Function Highlights

- **Super large load capacity, universal helper**

The B1 has a very large load capacity, with a maximum standing load of 80kg and a continuous load of 20kg. It can meet various load demands in special and complex operations and become a universal and powerful helper for operators in emergencies.

- **Multi-road Condition adaptability, great ability to cross obstacles**

With its swift posture and self-developed and continuously optimized movement control algorithm, B1 has super obstacle-crossing ability, can easily climb stairs and traverse rough terrain, can adapt to different weather and many complex terrains, such as ruins and railway tracks, has high mobility and flexibility, and able to replace humans in many special or high-risk environments to complete work.

- **Highest IP68 waterproof, strong protection function**

The B1 robot structure has a protection level of not less than IP67 (has passed the protection level certification) during operation, and the standard protection level is IP67 (optional IP68). It can not only adapt to outdoor rainy weather and various harsh environments, but also work under 1.2 meters of water.

- **Equipped with other peripherals to improve operation accuracy**

The B1 can also be equipped with various peripherals, which can perfectly cooperate with Unitree's self-developed Z1 robotic arm to complete complex tasks and explore various application scenarios. Users can also adapt to various peripherals, such as gas sensing, temperature sensing, 5G networking, infrared pan-tilt, industrial cameras, 3D radar, etc, to improve the accuracy of operations.

- **Self-charging, all-weather operation (optional)**

The B1 is equipped with a contact charging board, which can complete self-charging, greatly improve operation time and efficiency, and provide a strong guarantee for all-weather operations.



- If you want to choose IP68 protection level and self-charging function, please contact with relevant personnel of Unitree!
- For use in special environments, including scenarios such as ultra-high load, high temperature, underwater, corrosion, etc. please contact with relevant personnel of Unitree!

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## Body B1

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This chapter introduces the Body B1 and its functions

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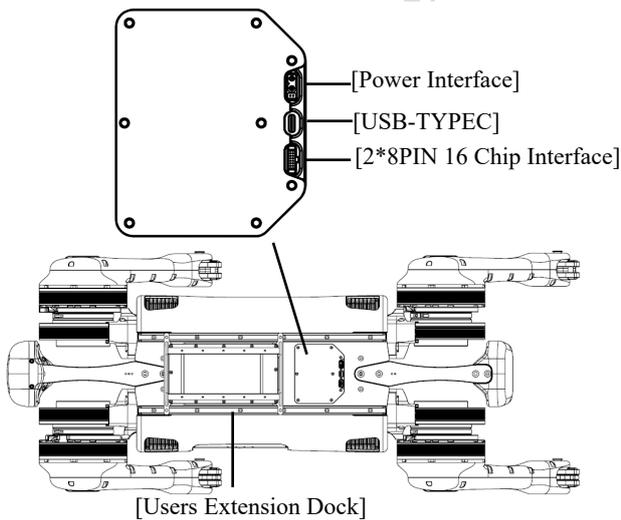
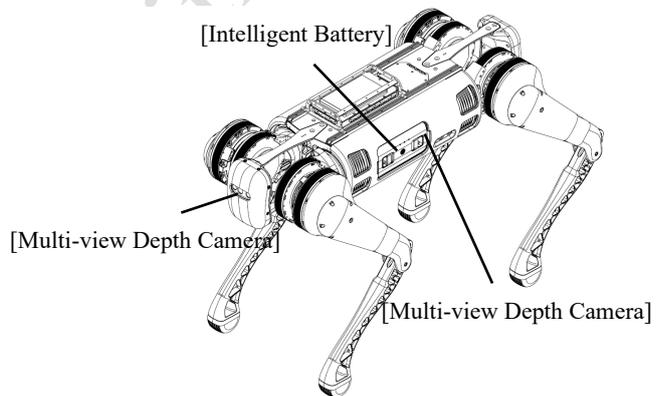
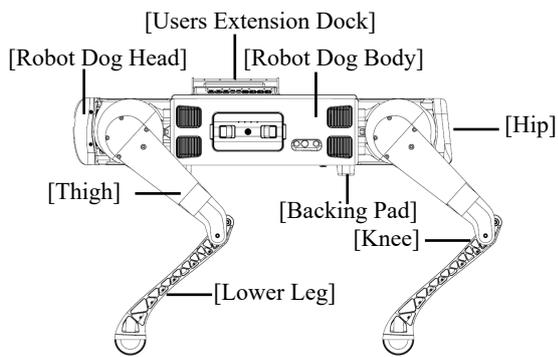
Unitree Robotics

# Body B1

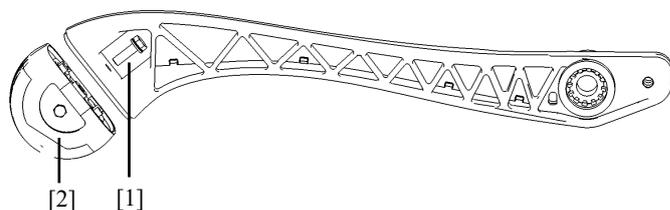
## Introduction

The B1 quadruped robot with industrial protection level has installed 5 sets of Intel D430 depth cameras, which can sense the surrounding environment and terrain; It equipped with 3 NVIDIA NX computing power cards to provide super AI computing power; It equipped with x86 architecture movement control processor with powerful computing power. The body B1 and battery adopt a split design, which supports quick battery replacement without tools. All connecting materials and structures are made of 6061-T6 aluminum alloy, and individual key components are 7075-T6, which can withstand the impact of falling. All the shell parts of the legs (thigh rod, motor shell) are made of aluminum alloy, which has a good heat dissipation effect.

## B1 Parts Name



## Foot End Components Description



- [1] Tightening screw at the end of foot
- [2] Rubber Foot Pad

The foot component adopts a new design: the foot of the quadruped robot is the first to contact the physical world, which greatly affects the movement performance and reliability of the robot. The B1 foot pad is made of high molecular weight elastic rubber material, which can not only buffer the impact when the foot is in contact with the ground, but also ensure a long life when used on rough ground. In the event of severe abrasion or damage, it can be quickly replaced.



- The foot component is a consumable, and its life span is usually 2-6 months (depending on the frequency, duration and working condition). Abrasion will be more serious, especially when it runs on the rough ground. If it is found that the foot pads are obviously worn out or damaged, or the impact noise of the robot on the ground is significantly increased when walking, please replace the foot end components in time to avoid damage to the foot end and cause the robot to move abnormally.

## Load Function Description

The B1 has a very large load capacity, with a maximum standing load of 80kg and a continuously working load of 20kg. When the robot load is relatively large, the height of the robot's standing and walking will become shorter, which will adversely affect the heating of the knee motor. At present, the height of the robot should be raised, which can be realized by "up" and "down" buttons on the remote control. At the same time, the footholds of the legs also need to make adjustment by pressing R2+A/B to switch between two different footholds. When the load is relatively large, it should be switched to the foothold state as shown in Figure 2, which will sacrifice some extreme movement performance to reduce the heat of the motor on the robot.

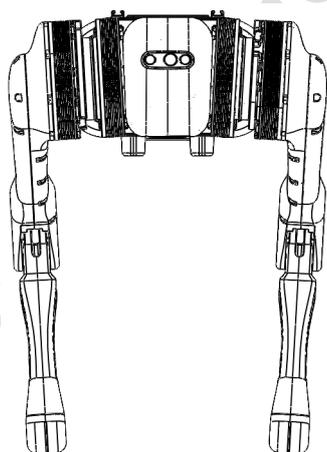


Figure 1

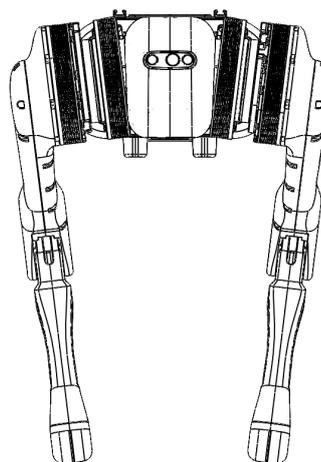


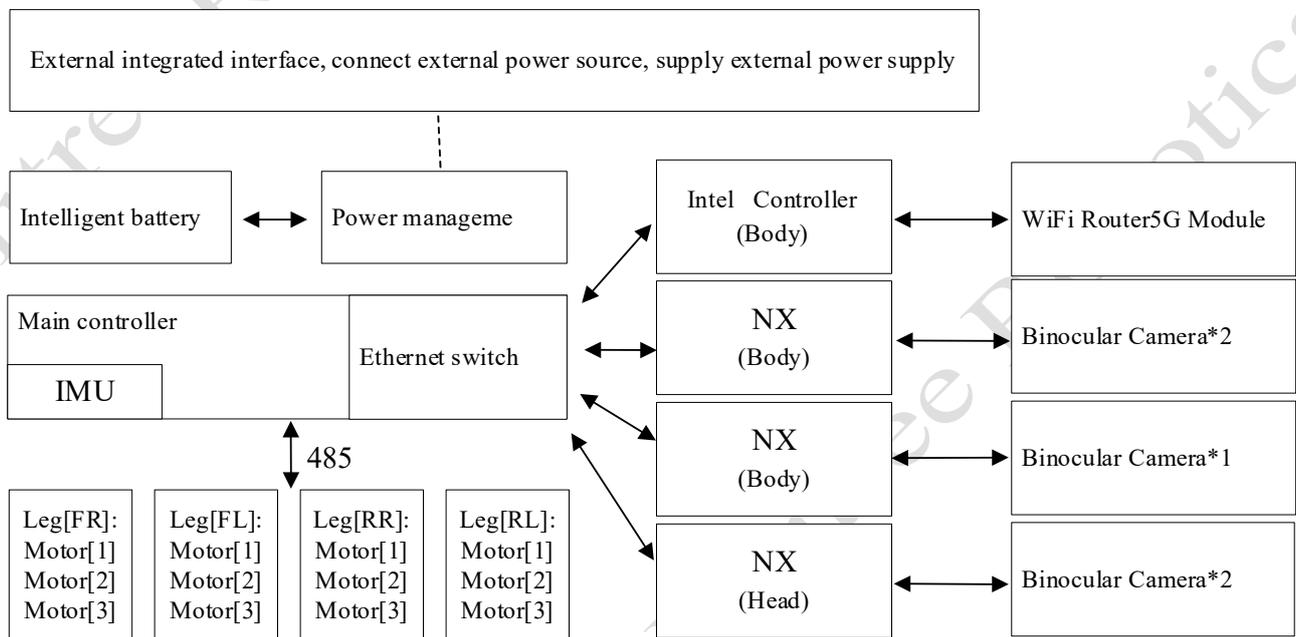
Figure 2



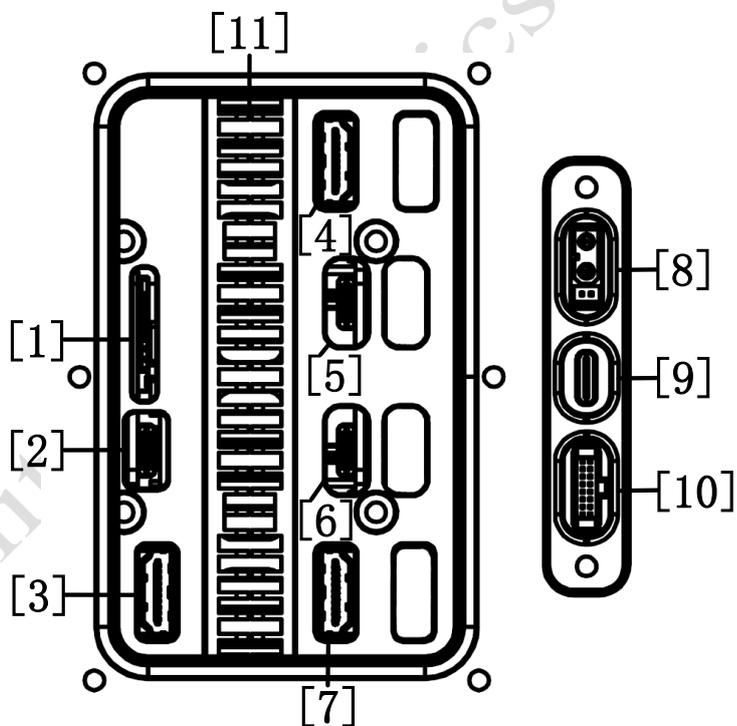
- please reduce the speed appropriately and run carefully!
- In the process of carrying the load, it is recommended that the weight be controlled within 20kg.

## System Architecture Description

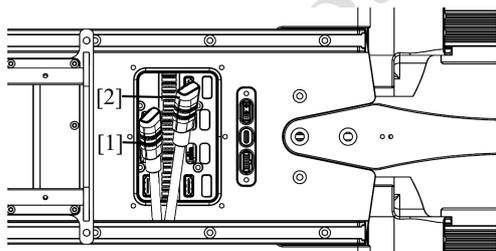
**Hardware Architecture:** The B1 adopts a new brand hardware structure and control system. The control system is as follows:



**Hardware interface:** Interface is provided in the back cover of B1 for users, through which developers can directly access to Mini PC and NX controller. The hardware interface is shown in the figure, in which the head NX controller does not open the Type-C and HDMI interface.



- [1] Sim Card Slot
- [2] Mini PC Type-C Interface
- [3] Mini PC HDMI Interface
- [4] NX Controller 1 HDMI Interface
- [5] NX Controller 1 Type-C Interface
- [6] NX Controller 2 Type-C Interface
- [7] NX Controller 2 HDMI Interface
- [8] XT30 (2+2) Power Interface
- [9] TYPE-C USB 2.0 Interface
- [10] 2×8PIN Ethernet Interface
- [11] Cooling Fin

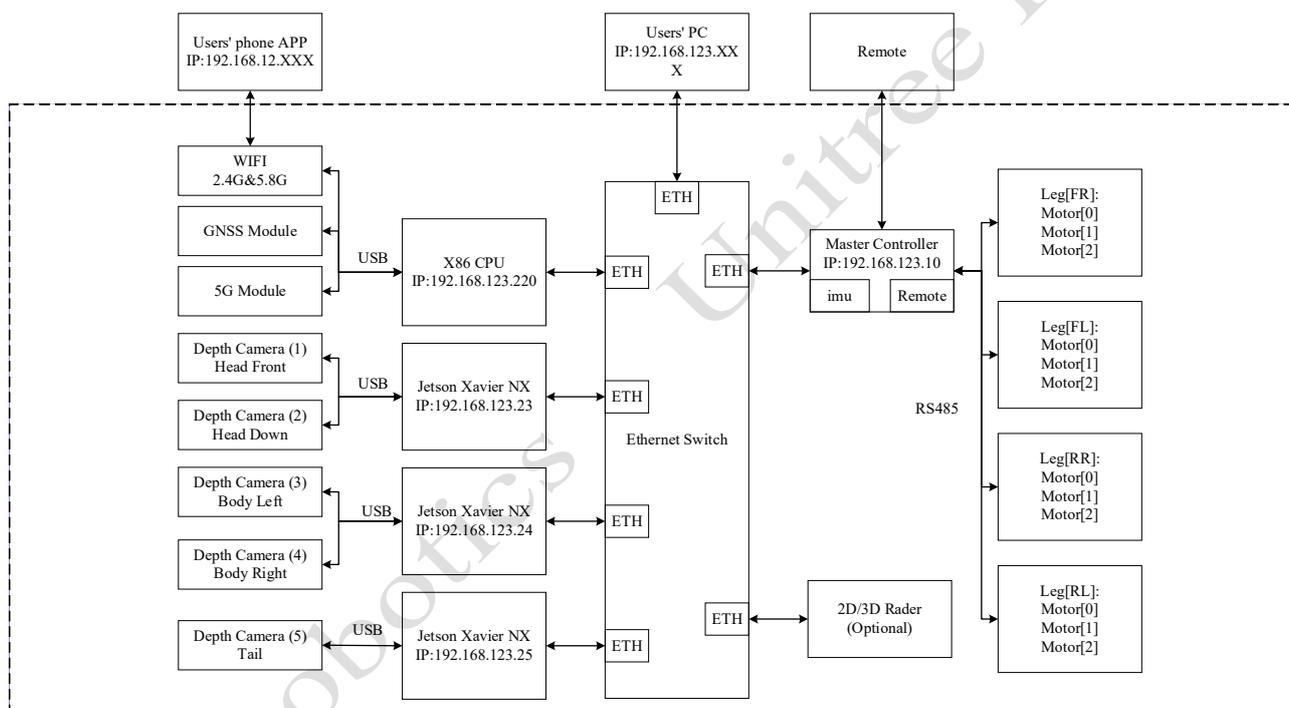


- [1] Coprocessor Interface (Type-C)
- [2] Main Processor Interface (Type-C)

The back cover of B1 also provides two interfaces, namely the main processor Type-C interface and the coprocessor Type-C interface. The PC can be directly connected to the B1 core controller through these two interfaces. The main processor interface and coprocessor interface are used for:

- Firmware upgrade.
- Real-time broadcast of hardware status information.
- Troubleshooting. When B1 fails, users can check the status of B1 through these two interfaces and conduct preliminary fault analysis and diagnosis.

**Network architecture:** The operating system of Mini PC is a real-time Linux (Ubuntu) operating system. The system architecture diagram is shown in the figure:



1) The user's PC can directly connect the robot's built-in movement controller, perception controller and underlying controller with Ethernet.

2) The users' PC can communicate with the underlying controller of the robot and the robot self-loading controller freely, which facilitate real-time transmission of visual perception data to each other.

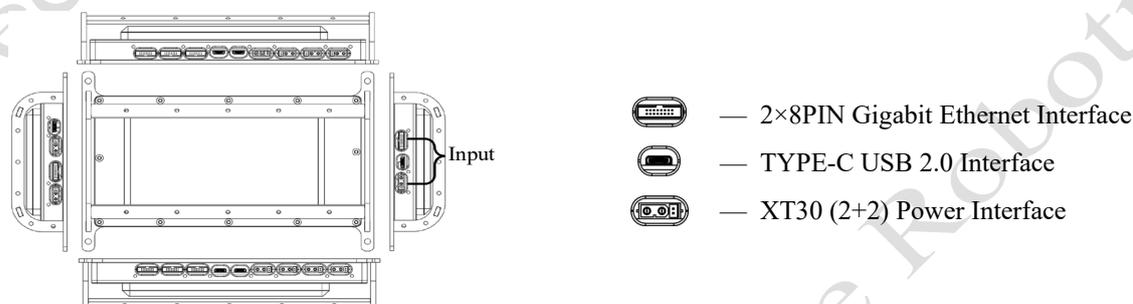
3) The self-loading sensors of the robot are fully open and available for secondary development.

4) Develop low-level control: All motors and sensors of the robot can be read and controlled in real time, which is convenient for directly using open-source robot algorithms

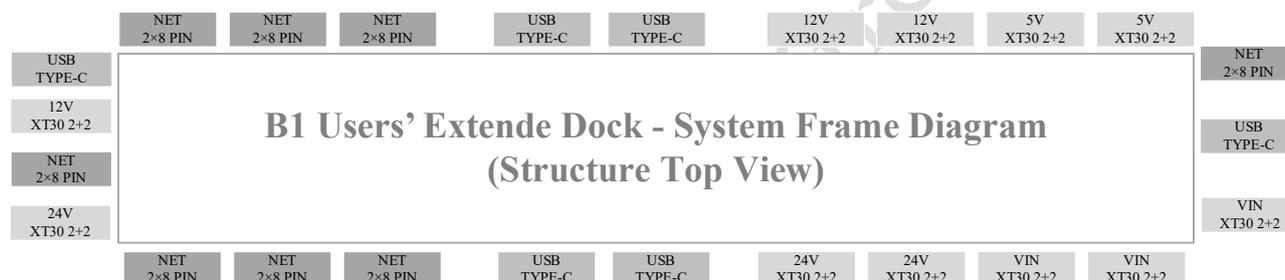
5) Develop high-level control: Users can directly send high-level movement commands to the robots, such as front, back, left and right.

## Extended Interface Description

The back of the B1 provides sdk expansion interfaces to develop more extended functions for users. It includes 3 input interfaces (Gigabit Ethernet interface, Type-C interface, power interface), 7 Gigabit Ethernet extension interfaces, 5 Type-C extension interfaces, and 10 power extension interfaces. The sdk expansion interfaces are as shown in the figure below.



B1 Users' Extende Dock - System Frame Diagram (Structure Top View) is shown in the figure:



### ● 2×8PIN Gigabit Ethernet Interface+12V Power Supply+485/CAN (Pass-through) Interface:

- 1) Total number of Interfaces: 8 interfaces (2×8PIN waterproof interfaces)
- 2) Gigabit Ethernet: 1 channel is connected to the robot dog Mini PC, 7 channels are connected to external
- 3) Power Output: 12V × 7 channels, 10A electric current in total (same path as external power supply)
- 4) 485/CAN (Pass-through): 3-Interface CHA channel 485/CAN, 3-interface CHB channel 485/CAN

### ● Type-C USB2.0 Interface:

- 1) Total number of interfaces: 6 interfaces (Type-C waterproof interface)
- 2) 7-channel USB-HUB: The generatrix is connected to the robot dog MINIPC. 5 channels are connected to the external; 2 channels are connected to 2 groups of USB, and then transfer to 485 (or CAN) Pass-through modules: CHA/CHB
- 3) Power output: 5V/1A×5 channels (USB power supply is independent of external power supply)

### ● XT30(2+2) power supply +485/CAN (Pass-through) interface:

- 1) 36-58V input/output: 3 channels 10A electric current in total, CHA channel 2 interfaces 485/CAN + CHB channel 1 interface CAN/485
- 2) 24V output: 3 channels 10A electric current in total, CHA channel 2 interfaces 485/CAN + CHB channel 1 interface CAN/485
- 3) 12V output: 3 channels 10A electric current in total, CHB channel 2 interfaces 485/CAN + CHA channel 1 interface CAN/485
- 4) 5V output: 2 channels 5A electric current in total, CHB channel 1 interface 485/CAN + CHA channel 1 interface CAN/485

## Operating Mode Description

The Operating Mode and Walking Mode supported by B1 are as follows:

### 1) Static Standing

Static standing state means that the robot fuselage position is at the initial height after boot and stand, the fuselage is horizontal, and the 3-axis attitude and 3-axis position control can be completed by the joystick. In the static standing state, the walking mode can be switched by the remote control button START, and the walking mode can be switched back to the static standing state by the remote control button SELECT.

### 2) Walking Mode, which can be divided into ordinary walking mode and obstacle walking mode.

**Ordinary Walking Mode:** The robot completes the actions of forward and backward, left, and right sideways, and turning in place by controlling the remote control.

**Obstacle Walking Mode:** The robot completes the actions of forward and backward, left and right side shift, in-place turn, crossing obstacles, climbing stairs, and slopes by controlling the remote control.

## Protection Level Description

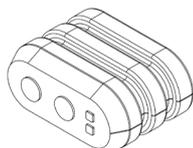
The B1 quadruped robot with industrial protection level is used with B1 special battery pack, and the protection level is not less than IP67. The degree of protection is not permanent and may be degraded by long term use. Please make sure that the interface of the battery, interface of battery compartment, surface of battery, and surface of battery compartment are dry and free of water, and then install the battery pack into the robot.

After use in harsh environments (rainy days, sand dust, wetlands), please clean the surface of the robot itself to ensure that there are no water droplets before putting it in the package. The following situations do not have IP67 protection level:

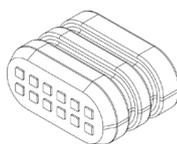
- 1) The waterproof plug is loose, the sealing ring is aging, etc.
- 2) Other damage occurs in the robot itself, such as cracking of the shell.
- 3) Batteries are not installed as required.
- 4) Interface protective cover is not installed in place.

### ● The use of waterproof plug

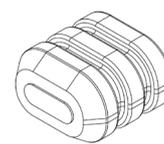
The B1 quadruped robot is equipped with XT30(2+2) waterproof plug, 16-core waterproof plug, USB-C waterproof plug and matched sealing ring. Before the users make it start, put the sealing ring on the waterproof plug, and then insert it into the interface to complete the installation. Make sure to check that the waterproof plug is installed correctly!



XT30(2+2) Plug



16-core Plug



USB-C Plug



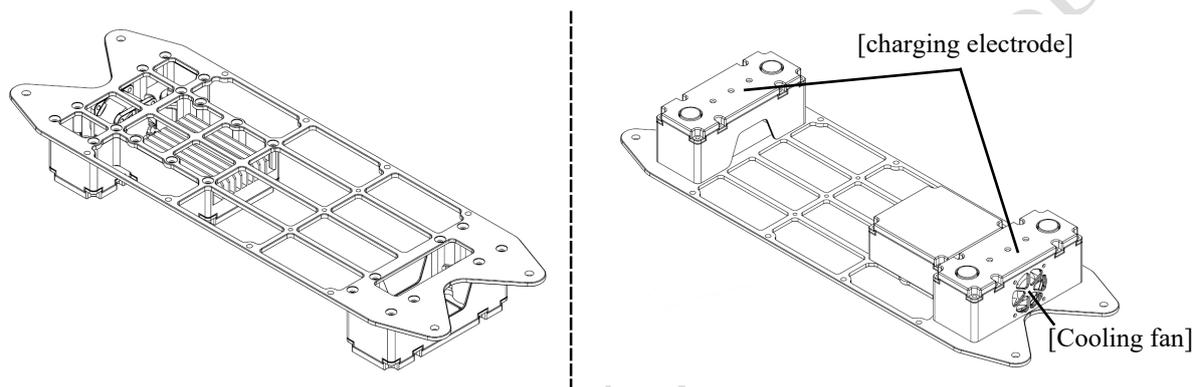
- install waterproof plug correctly when it is used. Improper installation will cause water to enter the robot itself and damage the robot!

## Autonomous Charging Description(optional)

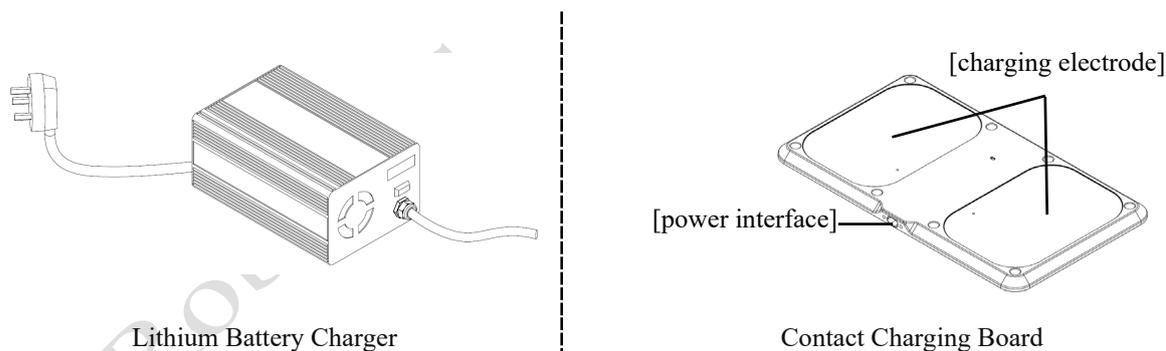
B1 can be optionally equipped with autonomous charging function, which can be combined with visual recognition, three-dimensional construction, and other technologies to independently plan charging routes and it can complete charging independently, greatly improve working time and efficiency, and provide a strong guarantee for all-weather operation.

The Self-charging Version of B1 (optional) is equipped with two charging electrodes at the bottom of the fuselage and is used with the B1-contact charger.

### B1 fuselage bottom parts names:



**B1-Contact Charger parts list:** The B1-Contact Charger consists of a lithium battery charger and a contact charging plate.



### ● Technical Specifications:

| Parameters           | Specifications                            | Note                       |
|----------------------|---|----------------------------|
| Model                | B1  |                            |
| Charging Board       | 507mm×290mm×19.5mm                        |                            |
| Charging Voltage     | 58.8V                                     |                            |
| Charging Current     | 10A (slow charging) / 15A (fast charging) |                            |
| Working Temperature  | 5°C-40°C                                  | Ideal Charging Temperature |
| Protection Level     | IP67                                      | No less than IP67          |
| Storage Temperature  | 22°C-28°C                                 | Ideal Storage Temperature  |
| Relative Humidity    | ≤95%                                      |                            |
| Atmospheric Pressure | 70~106Kpa                                 |                            |
| Cooling Method       | Self-cooling + Air-cooling                |                            |

### ● Contact Charging Board Functions:

1) Model identification: The charging pile can identify the robot model, avoid the robot of different battery models (voltage) to incorrectly connect the charging pile, and avoid the charging pile from supplying power to the unknown model of the robot/battery/load.

2) Reverse plate protection: The charging plate does not distinguish between polarity, and the robot is compatible with front and back recumbent.

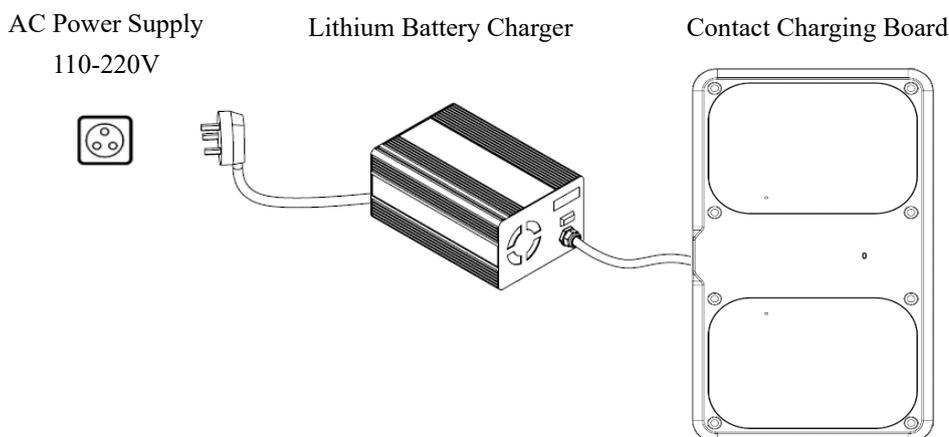
3) Plate short-circuit protection: Triggered when the charging plate is short-circuited, the protection will cut off the connection between the short-circuit plate and the charger/battery, and the charging will be automatically restored after the short-circuit point is disconnected.

4) Plate jitter protection: When the charging plate is unreliable contact, the protection will cut off the connection between the charger and the battery, avoid the plate ignition phenomenon caused by contact, and the robot can automatically resume charging after getting up and lying down again.

5) Full charge circuit break protection: When the charging current  $< 1A$ , the charger is automatically disconnected from the battery.

### ● B1-Contact Charger Instruction:

1) Preparation before charging: Place the B1-contact charger in the open room, first connect the lithium battery charger to the input AC power supply, and then connect the contact charging board power interface, as shown in the following figure.



2) Charging: When using the contact charger to charge, first use the remote control to control the robot to lie down, so that the bottom 2 charging electrodes of the B1 robot are in contact with the charging plate 2 charging electrodes to achieve charging, and the button on the lithium battery charger can switch between fast charging and slow charging. When the charge is full, the charger is automatically disconnected from the battery.

### ● Notes:

1) It is strictly forbidden to use a charger that is not provided by Unitree official for charging.

2) The ideal working environment temperature of B1-contact charger is  $5^{\circ}\text{C}$ - $40^{\circ}\text{C}$ , relative humidity  $\leq 95\%$ , and atmospheric pressure  $70\sim 106\text{Kpa}$ .

3) When using, please ensure that there are no water droplets on the surface and interface of the charger, and the surrounding area is empty and barrier-free.

4) When using, moving, or charging, please be careful to charge the plug to avoid damage by external forces.

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## **B1 Battery Pack**

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This chapter describes the Unitree B1 battery pack and the use of it.

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## B1 Battery Pack

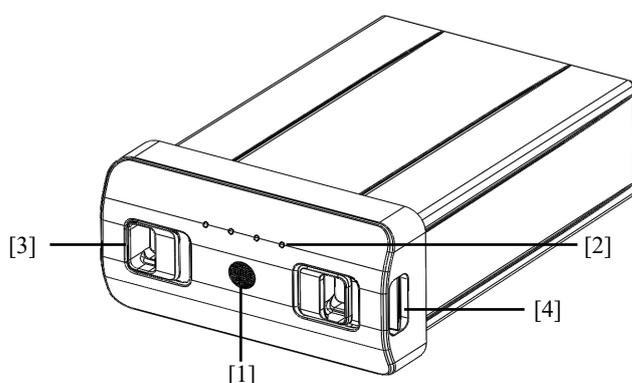
### Description

The battery pack is specially designed for B1 industrial protection level quadruped robot with capacity of 18000mAh, nominal voltage of 58.8V, and charge and discharge management function. The battery pack uses high-performance battery cells and advanced battery management system independently developed by Unitree Robotics to provide sufficient power for B1 quadruped robot. Battery packs must be charged by using a special charger provided by Unitree Robotics.

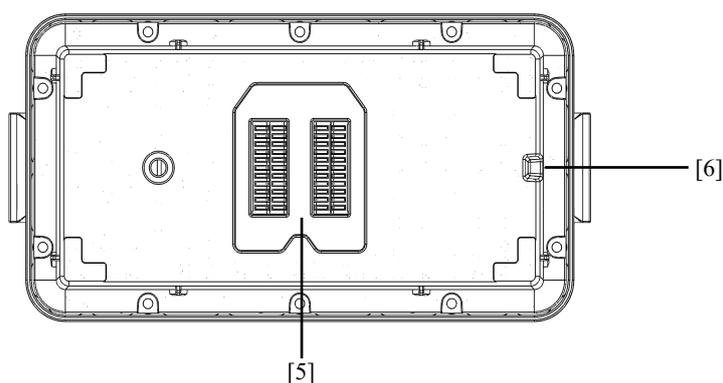


- Before using the battery pack for the first time, make sure that the battery packs are fully charged before using at the first time!

### Parts Name



- [1] Power Switch
- [2] LED Light
- [3] Fastener
- [4] Tab
- [5] Charger Interface
- [6] Foolproof Interface



## Technical Specifications

| Parameter                             | Specifications   | Remarks               |
|---------------------------------------|------------------|-----------------------|
| Rated Voltage (Power Supply)          | 51.8V            |                       |
| Rated Electric Current (Power Supply) | None             | Electric current jump |
| Rated Voltage (Power Supply)          | 58.8V            |                       |
| Rated Electric Current (Power Supply) | 15A              |                       |
| Rated Capacity                        | 18000mAh,932.4Wh |                       |
| Run Times                             | About 2.5-3h     |                       |

## Battery Pack Function

1) **Power display:** The battery has its own power indicator, which can display the current battery power.

2) **Battery storage self-discharge protection:** The battery will start self-discharge to 65% power to protect the battery when the battery power is higher than 65% without any operation and stored for 10 days. Each self-discharge process lasts about 1 hour. There is no LED light indication during the discharge period. It is a normal phenomenon and that there may be a slight heat.

3) **Balance charging protection:** Automatically balance the voltage of the internal cells of the battery to protect the battery.

4) **Overcharge protection:** Overcharging will seriously damage the battery, and it will automatically stop charging when the battery is fully charged.

5) **Charging temperature protection:** Charging will damage the battery when the battery temperature is below  $-5^{\circ}\text{C}$  or above  $55^{\circ}\text{C}$ , and the battery will lead to abnormal charging.

6) **Charging electric current protection:** High electric current charging will seriously damage the battery. When the charging current is more than 15A, the battery will stop charging.

7) **Over-discharge protection:** Over-discharge will seriously damage the battery. When the battery is discharged to 40.6V, the battery will cut off the output.

8) **Short circuit protection:** In the event of a short circuit detected by the battery, the output will be cut off to protect the battery.

9) **Battery load detection protection:** When the battery is on, if there is no electrical equipment is connected, the battery will automatically shut down after 3 seconds.

10) **Waterproof and dustproof function:** The protection level is not less than IP67 after installing the battery pack to B1 correctly.

11) **Abnormal charging display:** The battery pack LED light can display relevant information about battery protection triggered by abnormal charging.



- Before using the battery pack, please read and strictly abide by requirements made by Unitree Robotics in the manual, the disclaimer, the sticker on the surface of the battery pack and the surface of the special charger. The consequences of not using it as required shall be borne by the users.

## Battery Indicator

When the battery pack is off, the users can check the current battery by shortly pressing the battery switch once.



Be used to display the battery power during the charging and discharging process of the battery pack.

The indicator is defined as follows.



that the LED light is constant on



Indicates that the LED light is flashing



Indicates that the LED light is off

### Battery Indicator Light

| LED1 | LED2 | LED3 | LED4 | Current Battery |
|------|------|------|------|-----------------|
|      |      |      |      | 87.5%-100%      |
|      |      |      |      | 75%-87.5%       |
|      |      |      |      | 62.5%-75%       |
|      |      |      |      | 50%-62.5%       |
|      |      |      |      | 37.5%-50%       |
|      |      |      |      | 25%-37.5%       |
|      |      |      |      | 12.5%-25%       |
|      |      |      |      | 0%-12.5%        |
|      |      |      |      | =0%             |

## Battery Pack Turn on/ Turnoff

● **Turn on a battery pack:** In the off state, the users can press the power switch briefly once, and then press the power switch for more than 4 seconds. Turn on the battery after flowing water light glides. When the battery is on, the power indicator is constant green, and the battery indicator shows the current battery power.

● **Turn off the battery pack:** In the on state, the users can press the power switch briefly once, and then press the power switch for more than 4 seconds to turn off the battery. After the battery is turned off, the indicator lights are off.

## Battery Pack Charging

1) Connect the charger to an AC power source (100-240V, 50/60Hz). It must be ensured that the external power supply voltage matches the rated input voltage of the charger before connecting. Otherwise, the charger will be damaged (the rated input voltage of the charger is marked on the nameplate of the charger).

2) Plug in the input AC power first before charging the battery, then connect the charger to the battery.

3) Before charging the battery, ensure that the battery pack is switched off. Otherwise, the battery and charger may be damaged.

4) The users need to remove the battery pack from the robot itself when charging the battery pack.

5) In the charging state, the battery indicator of battery pack will flash at a frequency of 1Hz (1 second/time) and indicate the current battery.

6) If the battery indicator is off, the battery pack is fully charged. Please remove the battery pack and charger to finish charging.

7) The temperature of the battery pack may be high after running, t, and the battery pack must be charged after the temperature of the battery pack has dropped to room temperature.

**Charging battery indicator:** The battery pack LED light shows the current battery while charging.

| Charging Indicator Light |      |      |      |                 |
|--------------------------|------|------|------|-----------------|
| LED1                     | LED2 | LED3 | LED4 | Current Battery |
|                          |      |      |      | 0%-25%          |
|                          |      |      |      | 25%-50%         |
|                          |      |      |      | 50%-75%         |
|                          |      |      |      | 75%-100%        |
|                          |      |      |      | Full-Charged    |

**Charging protection indication:** The battery pack LED light can display battery protection information triggered by abnormal charging.

| Charging Protection Indicator Light |      |      |      |                  |   |
|-------------------------------------|------|------|------|------------------|---|
| LED1                                | LED2 | LED3 | LED4 | Indication       | Protection Item   |
|                                     |      |      |      | LED2 2 times/sec | Excessive Electric Current Charging                     |
|                                     |      |      |      | LED2 3 times/sec | Short Circuit Charging                                  |
|                                     |      |      |      | LED3 2 times/sec | Excessively high battery voltage caused by overcharging |
|                                     |      |      |      | LED3 3 times/sec | Excessively High Charging Voltage                       |
|                                     |      |      |      | LED4 2 times/sec | Excessively Low Charging Temperature                    |
|                                     |      |      |      | LED4 3 times/sec | Excessively High Charging Temperature                   |

In the event of a fault (excessive charging electric current, short-circuiting of charging, excessively high battery voltage caused by overcharging, and excessively high charging voltage), the users need to unplug the charger first to eliminate the fault before plugging the charger again to resume charging. For example, if the charging temperature is abnormal, unplug the charger first, and after the charging temperature returns to normal, plug the charger again to recharge.



● reasons, the battery needs to be discharged during transportation. The discharge method is divided into active discharge and passive discharge.

- 1) Active discharge: Install the battery pack into the robot and run to a lower battery (for exam around 65%).
- 2) Passive discharge: Battery storage self-discharge protection, please refer to "[Battery Pack Function](#)" for detailed description.

## Precautions for Use

1) The battery pack should be used at an ambient temperature of -5°C to 55°C. If the temperature is too high (above 60°C), the battery pack may catch fire or even explode. If the temperature is too low (below -10°C), the life span of the battery pack will be seriously compromised.

2) It is forbidden to use the battery pack in a strong magnetic field or static electricity environment. Otherwise, the battery pack protection board will fail, which will lead to the malfunction of the battery pack and the robot.

3) Stop using the robot as soon as possible and replace the battery pack with a new one or charge the battery pack when only one bar of battery flashes.

4) Before installing or removing the battery pack in the B1 battery compartment, please make sure that the battery pack is closed, otherwise the battery pack or the robot will be damaged.



● Charging or storage of battery packs may result in fire or property damage and personal injury by improperly use.

For more detailed descriptions, please refer to the "[Battery Pack Safe Operation Guide](#)".

Unitree Robotics

Unitree Robotics

## Remote Control

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This chapter introduces the Unitree Robotics remote control and its use.

Unitree Robotics

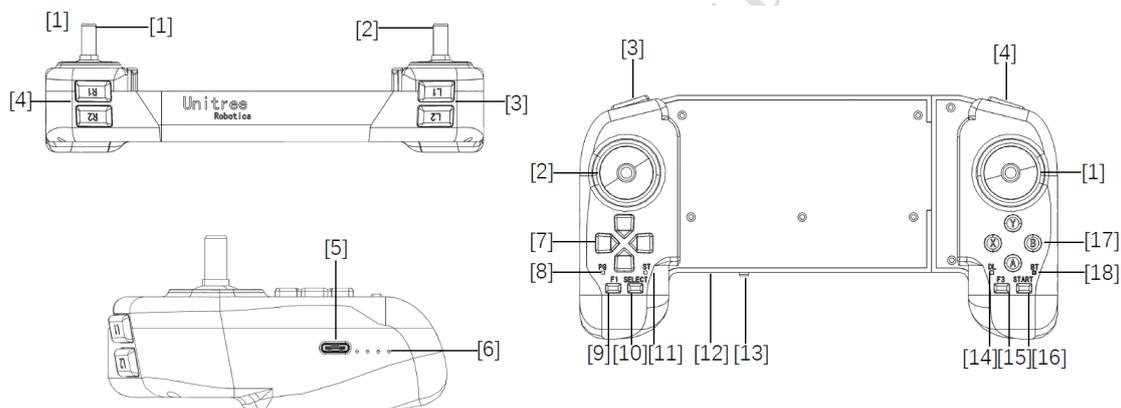
Unitree Robotics

## Remote Control

### Introduction

The remote control is part of the B1 remote control module, and the remote control handle has a installed digital transmission module and a bluetooth module. The robot dog communicates with the remote control through the data transmission module to achieve one-to-one correspondence, and remote control can be connected when the robot is on. The robot dog can be manipulated to achieve stable and full control of 3-axis posture and 3-axis position when standing. The users can manipulate the robot to move forward and backward, move left and right, spin turn and walk under certain rules (straight line, circle, rectangle), etc. on flat ground, and can even climb or walk downstairs and slopes. The remote control handle adopts a easy holding design, which makes the structure conform with ergonomic and feels more comfortable.

### Parts Name



- [1]Right Rocker [2] Left Rocker [3] Key L1/L2 [4] Key R1/R2 [5] Type C Charging Interface Type C  
 [6] Data Transmission Signal Light [7] Left Key [8]Power Connect Indicator  
 [9]F1 Left Rocker Calibration Key [10]SELECT [11]Charging Status Indicator [12]Power Indicator Light  
 [13] Power Button [14] Data Transmission Indicator Light [15] F3 Right Rocker Calibration Key  
 [16] START [17] Right Key [18] Bluetooth Signal Indicator Light

### Technical Specifications

| Parameter                | Specification                       | Remarks          |
|--------------------------|-------------------------------------|------------------|
| Charging Voltage         | 5.0V                                |                  |
| Charging Current         | 2A                                  |                  |
| Lithium Battery Capacity | 2500mAh                             |                  |
| Communication Mode       | Data Transmission Module, Bluetooth |                  |
| Running Time             | 4.5h                                |                  |
| Remote Control Distance  | Above 100m                          | Open Environment |

## Remote Control Handle Rocker Calibration

Hold the remote control without touching the rocker, press the upper buttons F1 and F3 on the remote control and release them at the same time. At this time, the remote control will emit a continuous "beep~beep~" sound (1 time/sec) to indicate that it has entered the calibration mode. After entering the calibration mode, the users need to turn the left and right rockers to full rudder and rotate several times until the sound of "beep~beep~" stops, and the calibration is ready. Press F3 once to make the calibration take effect and complete the calibration.



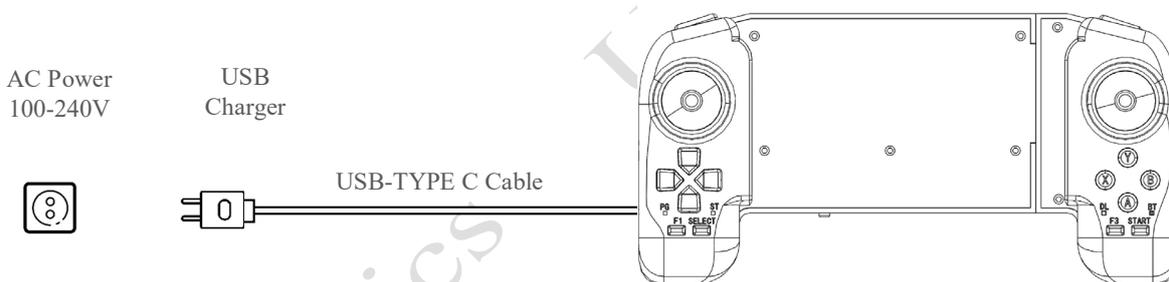
● Attention! When calibrating the remote rod, please do not touch the rocker before calibration. The rocker can only be moved after entering the calibration mode.

## Remote Control Turnon/Turnoff

- **Turn on the remote control:** Shortly press the power button once, then long press the power button for more than 2 seconds, and hear a "beep", which means the remote control is turned on.
- **Turn off the remote control:** Shortly press the power button once, then long press the power button for more than 2 seconds, and hear three "beeps", which means the remote control is turned off.

## Remote Control Charging

When the handle battery indicator shows low power (same state as the low battery indicator), the handle should be connected to the charger, as shown in the figure below:



- 1) Please use an official USB charger. If you do not use an official charger, it is recommended to use a 5V/2A USB charger that meets the FCC/CE standard.
- 2) Make sure the remote control is turned off before charging the remote control.
- 3) In the charging state, the battery indicator will flash at a frequency of 1Hz (1 second/time) and indicate the current battery.
- 4) When the battery indicator lights are all off, it means that the battery pack is fully charged, please remove the charger to complete the charging.

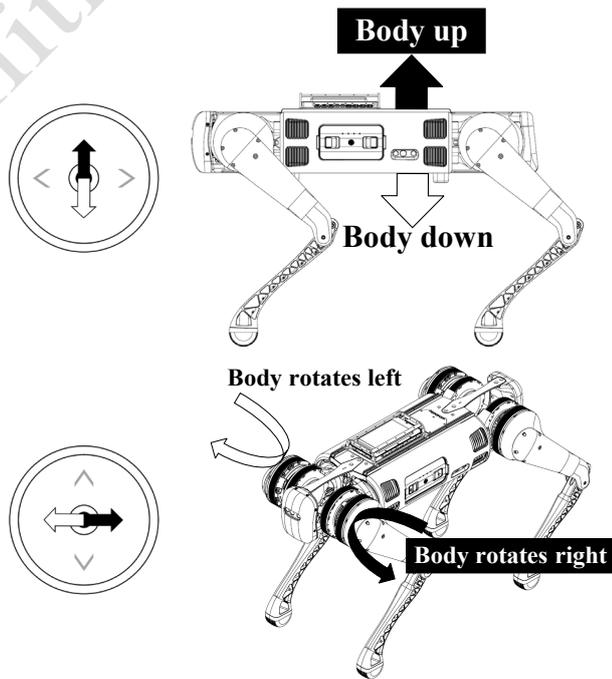
| Charging Indicator Light |      |      |      |                 |
|--------------------------|------|------|------|-----------------|
| LED1                     | LED2 | LED3 | LED4 | Current Battery |
| ☀                        | ○    | ○    | ○    | 0%-25%          |
| ☀                        | ☀    | ○    | ○    | 25%-50%         |
| ☀                        | ☀    | ☀    | ○    | 50%-75%         |
| ☀                        | ☀    | ☀    | ☀    | 75%-100%        |
|                          |      |      |      | Full Charged    |

## Remote Control Basic Operation

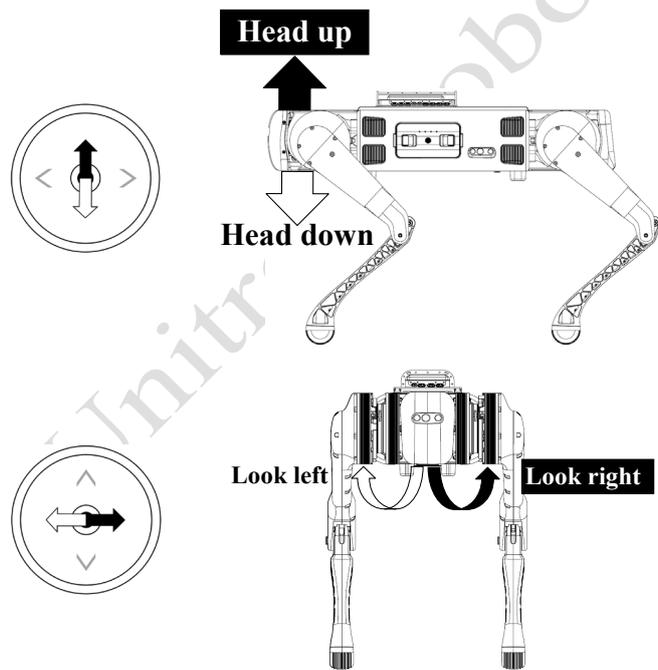
After the remote control is turned on, the data transmission light on the left side is on, which means that the remote control has related to the B1 data transmission module, and B1 can be controlled by the remote control at this time. When the rocker of the remote control is used to control B1, the control mode of the rocker is divided into standing control and walking control.

### Standing control

Left rocker

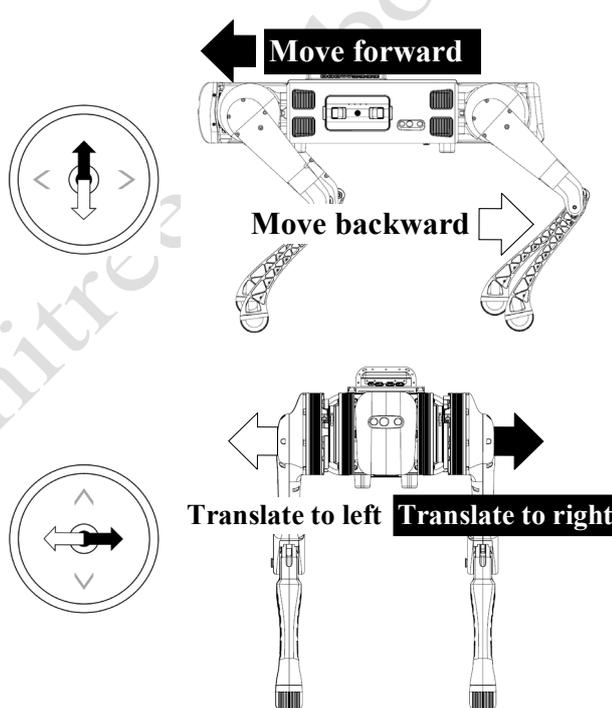


Right rocker

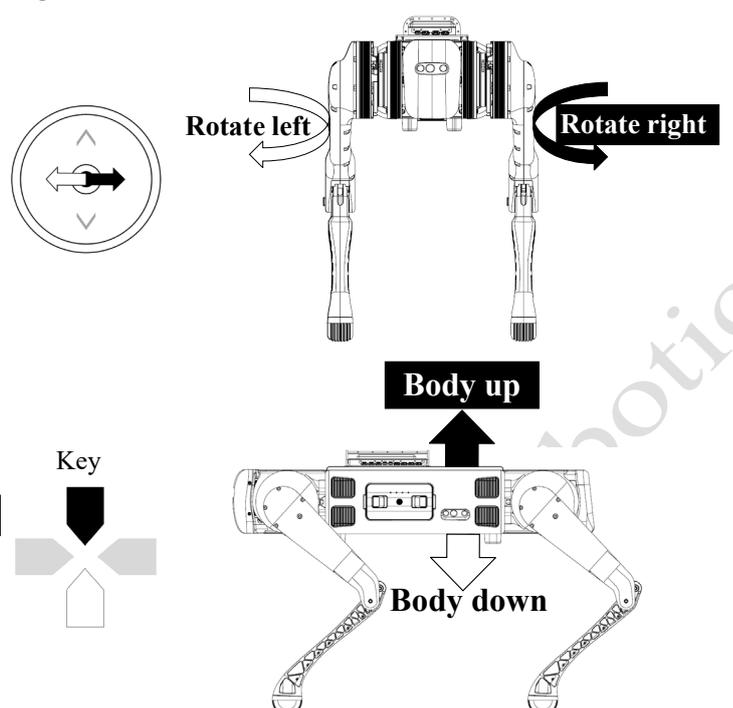


### Walking control

Left rocker



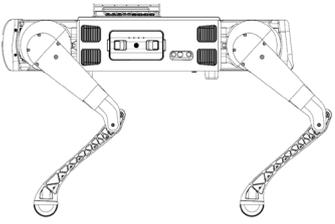
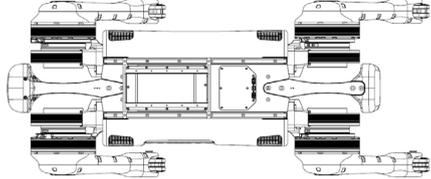
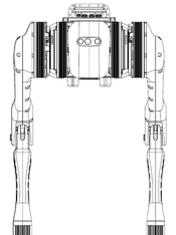
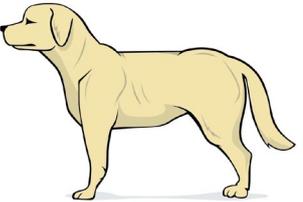
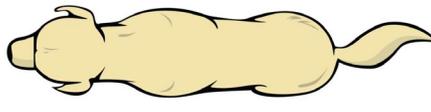
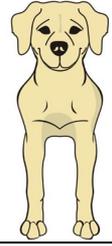
Right rocker





- Rocker back to center/neutral position: The rocker of the handle is in the middle position.
- Rocker amount: The deviation of the remote control rocker from the center of the rocker.
- Walls, doors, and other obstacles greatly weaken the signal between the robot and the remote control module. Please be sure to operate the robot in an open space.

### Robot and robot diagram:

|               | Side view   | Top view   | Front view  |
|---------------|---|--|---|
| Robot         |  |  |  |
| Robot diagram |  |  |  |

### Remote control command:

| Key   |   | Effect   |
|---|---|--|
| Left Rocker   | Push forward/backward                         | Move back or forth/Prone position  |
|   | Push left/right                               | Sideways movement/Twist  |
| Right Rocker  | Push forward/backward                         | Head up or down/Pitch  |
|   | Push left/right                               | Left or right turn/ Shake head   |
| START   |   | Walking Mode   |
| SELECT  |   | Static Standing Mode   |
| <b>Position switch</b>  |   |  |
| L2+A  | Lock the joints and get into a prone position |  |
|   | Return to standing position (locked joints)   |  |
| L2+B  | Damping state                                 |  |
| L2+START  | Walking mode (Mode 2)                         |  |
|   | Obstacle-crossing walking mode (Mode 3)       |  |
| <b>Foothold distance switch</b>   |   |  |
| R2+A  | Large load space                              |  |
| R2+B  | Normal space                                  |  |
| <b>Three movement states</b>  |   |  |
| Mode 1: Static Standing State   |   | Normal standing, the users can push the rocker to twist the body instead of moving.                              |
| Mode 2: Ordinary Walking Mode   |   | The joystick can be pushed to move, the robot can be stopped to stop moving, and the pusher can be moved again.  |
| Mode 3: Obstacle Walking Mode   |   | The obstacle can be moved by the joystick, stop pushing the robot to stop moving, and the pusher can move again. |
| <ul style="list-style-type: none"> <li>● Mode 1 press START to enter Mode 2, Mode 2/Mode 3 press SELECT to enter Mode 1.</li> <li>● Mode 2, in static state, press L2+START to switch to Mode 3</li> <li>● Mode 3, in stop state, press L2+START to enter Mode 1</li> </ul> |   |  |

Unitree Robotics

Unitree Robotics

## **Running**

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This chapter introduces how to run the B1 robot and related precautions.

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## Running

### Note before Review

The operation instructions in this chapter correspond to the robot movements when the users use the official control program of Unitree Robotics.

When the users run the program developed by themselves in the developer mode: The remote control commands are still valid when the high-level (application layer) is developed. At this time, if the high-level API commands and the remote control commands are sent to the robot, both commands will be executed by the robot. It may cause the robot to become unstable. Please be sure to judge whether the users need to use the remote control according to the running state of the robot. Remote control commands fail during low-level development.

This chapter is an introductory chapter for new users to manipulate robots. New users can quickly master how to use the handle to control the robot to show excellent movement performance by reading this section. This chapter is also a chapter that old users often need to refer to. Old users can read this chapter repeatedly to grasp the essentials of operating the robot, and then they can draw inferences from case, and know what kind of movements are not recommended.

### Operation Environment Requirement

1) Run the robot in  $-5^{\circ}\text{C}$  -  $55^{\circ}\text{C}$  with good weather condition. Do not operate in bad weather, such as lightning and tornado weather. When operating in water, the users need to be sure to comply with the requirements described in the IP67 Protection level instructions.

2) Please keep it under control in the users' view when using the robot and keep the robot maintain a safe distance of at least 2 meters from obstacles, complex ground, crowds, water, and other objects.

3) Please do not run the robot in an electromagnetic interference environment. Sources of electromagnetic interference include but are not limited to: high-voltage power lines, high-voltage transmission stations, mobile phone base stations, and television broadcast towers.

4) Please do not run the robot in the WiFi signal interference environment. WiFi signal interference is usually caused by co-channel interference. In case of interference, be sure to turn off some or all WiFi signal sources of other wireless devices before using the remote control to operate the robot.

5) Due to the different level of control proficiency of the actual users, for the sake of reliability and safety, please use it in an open, unobstructed, and flat ground environment. When operating the robot, it should be noted that the steps should be less than 20cm and the slope should be less than  $30^{\circ}$ . Failure to meet these conditions may cause the robot fall. When the robot is walking on complex ground or terrain with certain undulations and slopes, the users should reduce the walking speed of the robot and operate it carefully to prevent the robot from tripping over obstacles.

6) The legged robot has certain requirements for the ground on which it walks. Do not use the robot on very low friction ground, such as ice. Do not use the robot on soft ground, such as thick spongy ground. If the robot is used on smooth ground, such as glass and ceramic tile, the users need to control the robot for movement carefully and smoothly, avoid violent movement, and reduce the walking speed of the robot to prevent the robot foot from slipping and falling.

## Check before Power on

- 1) Only Use Unitree Robotics authentic parts and ensure that all parts are in good working condition.
- 2) Ensure that the firmware has been updated to the latest version.
- 3) The users ensures that he or she is not operating the robot while intoxicated, under the influence of drugs, and unable to concentrate
- 4) Be familiar with the characteristics of each gait mode. Be familiar with the emergency braking method of the robot in case of instability / loss of control.
- 5) Ensure that there are no foreign matters (such as water, oil, sand, soil, etc.) inside the robot and its components.
- 6) Ensure that the remote control module and battery pack are fully charged.
- 7) If the expansion interface is used, check whether the cable connection is correct.
- 8) Check whether the waterproof plug is installed correctly.

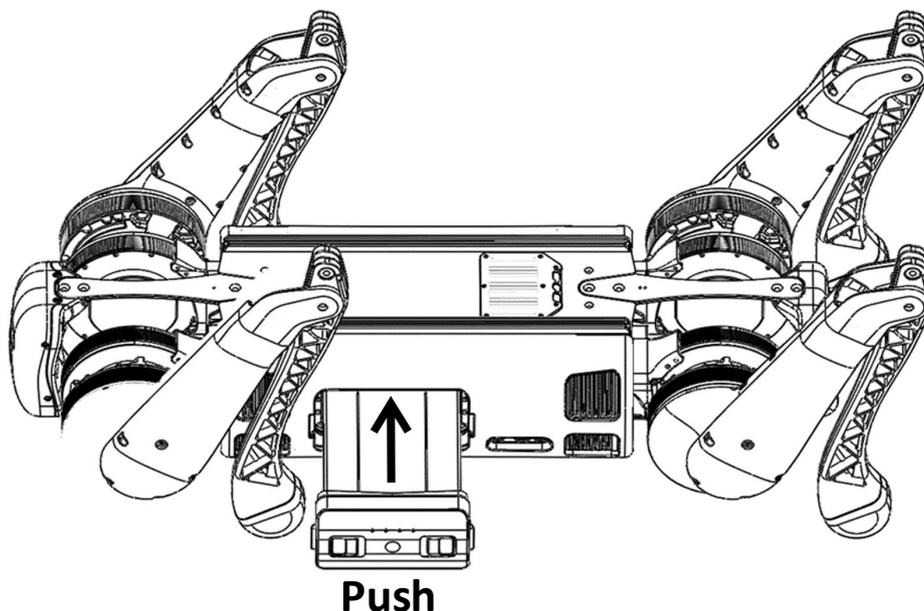


● For more detailed descriptions, please refer to "Daily Maintenance" - "[Inspection and Maintenance](#)".

## Preparation before Power on

### 1) Installing Battery Packs

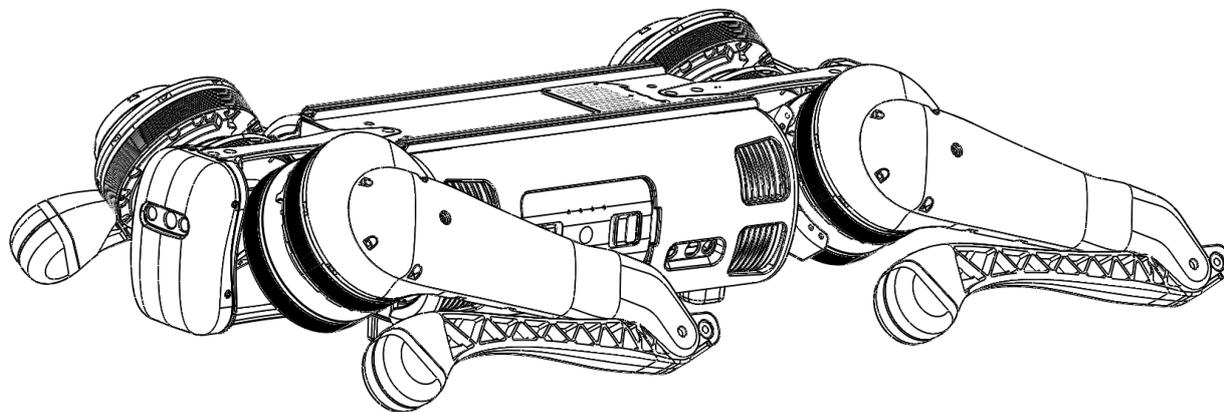
Put the B1 on the flat ground and install the battery pack into the battery slot from the side of the robot dog. Pay attention to the installation direction. If the battery pack cannot be fully inserted, please adjust the direction of the battery packs and do not press forcibly to avoid damage to the battery interface and buckle. Please make sure that the buckle is in place!



● It is recommended that the battery is fully charged.

## 2) Body Placement

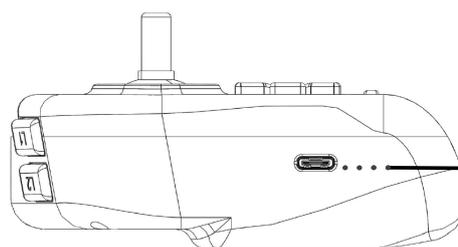
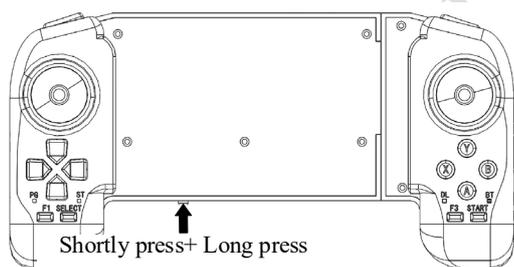
Horizontal type startup: please make sure that the robot dog is placed on a flat ground before startup and operation. The belly support pad of the robot dog should be flat against the ground. The machine body should lie on the ground horizontally without tilting. The legs of the robot dog should be fully retracted (as shown in the figure below). The four knee joints and foot ends should be flat on the ground to ensure that neither the thighs nor the legs of the robot dog are pressed by the machine body.



- If the starting up fails, please check the placement of the body!
- The thigh and the lower legs protruding outward or the lower legs being pressed inward may cause the robot dog to fail to start up!
- Be careful with your hands at the movement joints, be careful!

## 3) Connect the Remote Control Module

First, briefly press the power switch of the remote control once, and then long press the power switch for more than 2 seconds. The users can turn on the remote control when they hear "tick" ~". The remote control corresponds to the data transmission module of the robot dog one-to-one, and it can be connected automatically when it is turned on. All the data transmission signal lights on the left side of the handle indicate that the connection is successful, and the remote control can control the robot dog, as shown in the following figure:



**Automatic connection:** Both the remote control and the robot are in the power-on state and the left digital signal light is all on, which indicating that the connection is successful.

## Power on/Remote Control

After the robot completes the pre-boot inspection, and the pre-boot preparation requirements are placed, follow the following steps to boot the machine: first press the power switch once, and then press the power switch for more than 4 seconds, you can turn on the battery (when the battery is on, the indicator light is green, and the indicator light shows the current battery level). After the battery starts, wait for 2 minutes, the robot stands, the fuselage height is about 63cm, parallel to the ground, that is, the robot is power on successfully.

1) After powering on, the robot directly enters the ordinary walking mode, at this time you can push the joystick to control the robot forward and backward, shift side to side, in-place turning, etc., if you do not push the joystick, it will stop moving.

2) When the walking mode is stationary, press SELECT-> to enter a static standing state, at which point you can control the position through the joystick.

3) In static standing state, press START-> into walking mode.

4) In ordinary walking state, press L2+START-> to switch obstacle mode. At this point, the joystick can be pushed to control the robot to walk over obstacles and climb stairs, and if the joystick is not pushed, it will stop moving. Crossing the obstacle walking mode by pressing L2+START can switch back to the normal walking mode.

5) In walking state, press R2+A-> switch to large load spacing to move. In this case, some extreme sports performance will be sacrificed to reduce the heat generation of the fuselage motor, so that the load operation can be more stable and reliable.

6) With large load spacing movement, press R2+B-> switch to normal spacing movement.

7) In any state, press L2+A-> to lock the robot and press START to unlock the robot.

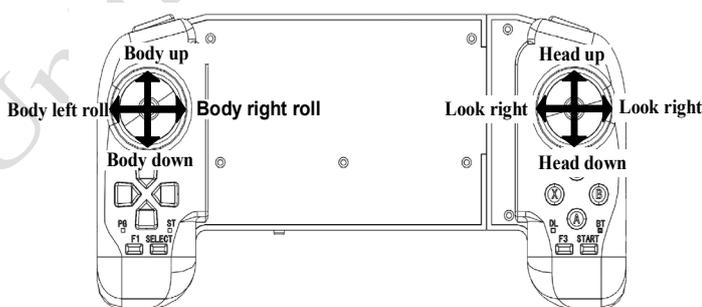
8) After the robot locks, press L2+A The robot is in a lying state. (i.e., press L2+A 2 times, and the robot completes locking - lying down)

9) Press L2+A to stand up in the lying state, currently the robot is in a locked state, press START to unlock the robot. (That is, press L2+A 3 times, and the robot completes the locking-lying down-standing in turn)

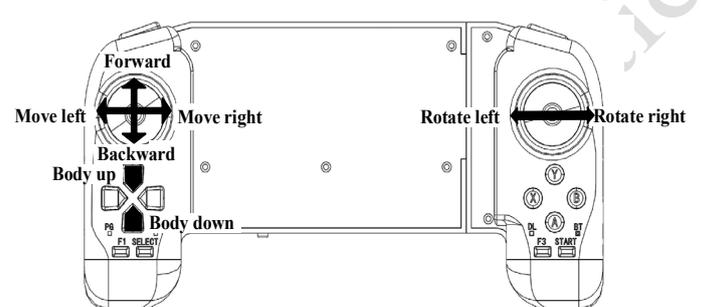
10) In any state, L2+B-> damping state/low-power state, in which the robot will lie down and need to press L2+A to make him stand up.

11) L1+L2: Lock the B1 remote control, in which case the remote control will not be able to control B1. Press L1+L2 to control B1 again. This button requires B1 to be used with the Z1 robotic arm, and the remote control can be switched to the control robotic arm.

Standing posture control



Movement state gesture control





- Do not press the push remote control stick during the boot of the robot.
- When using the remote control to control the robot to move, gently push the rocker, and slowly increase the speed after familiarizing with the operation.
- For the description and operation of the remote control, please refer to the chapter of "[Remote Control Basic Operation](#)".



- Do not touch the robot dog during exercise!



- Please keep the robot under control in the users' view and keep a safe distance of at least 2 meters from the robot while using.
- For the sake of reliability, please use it in an open and flat ground environment. When the robot walks on the terrain with certain undulations or slopes, the users should reduce the walking speed of the robot and manipulate it carefully to avoid tripping over obstacles.
- The legged robots have certain requirements on the ground they walk on. Do not use the robot on surfaces with very little friction, such as ice. Do not use the robot on soft ground, such as thick sponge ground. If it is used on a smooth ground, such as glass, tiles, etc., please control the robot carefully and flexibly to avoid strenuous movements and reduce the walking speed of the robot to prevent the robot from slipping and falling.
- For other precautions, please be sure to read "[Precautions for Operation](#)" and "[Safe Operation Guide](#)".

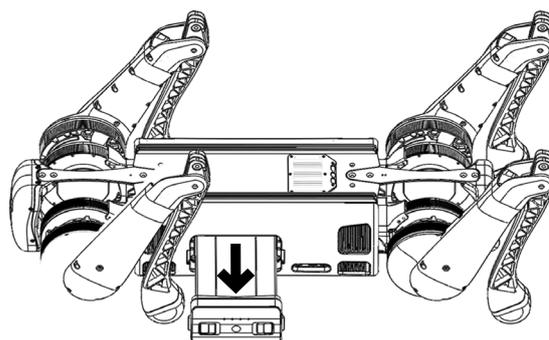
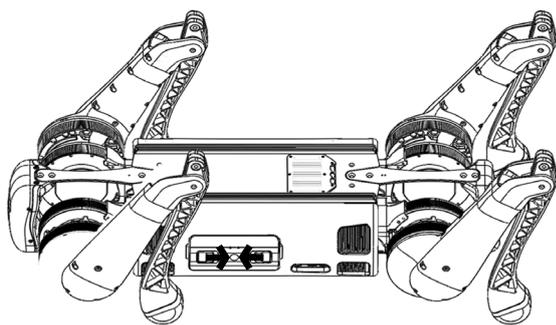
## Power off

Please make sure that the robot dog stands on a flat ground and the robot is in a static standing state before turning it down, (the position of the robot body is in the initial state after startup and standing, the body is horizontal, the handle is not operated, and the robot is in a static standing state).

- Press the buttons L2+A twice, and the robot completes the joint locking and lying down actions in turn.
- After the robot enters the lying state, press the power button briefly and then press the power button for 4 seconds to shut down.

After shutdown, please place the positions of the thigh and lower legs and hip joints of the robot according to the requirements of the chapter "[Preparation before Power on](#)" to prepare for the next startup.

Take out the battery pack: press and hold the two buckles of the battery packs with hands and push it inward to pop up the battery packs.



- Please make sure that the robot turned off in a damping state, otherwise the robot will fall heavily on the ground after it is turned down and powered off, which may cause damage to the robot body and certain potential hidden dangers!
- Be careful to pinch your hands at the movement joints, please be careful!

## Precautions for Operation

### 1) Standing state

In standing state, when the ground friction is insufficient or the robot's feet are not reliably supported, do not violently control the robot to adjust its posture (including pitch, yaw, height adjustment, etc.), otherwise it may cause the robot to lose stability and fall.

### 2) Walking status

Please control the robot walk under flat terrains. When walking on the ground with low friction, do not violently control the robot to complete the movement, otherwise it may cause the foot end of the robot to slip and fall.

### 3) About cruising ability

The rated endurance of the robot is about 2-4h for the alternating operation of no-load static standing and upright walking. The endurance time will be reduced according to the actual operating conditions of the robot, such as a long time of fast walking, a long time of drastic adjustment of the body posture when the robot stands, a robot leg bending standing, running with a load, walking at a lower height of the body, and terrain with appropriate fluctuations and slopes. (When the height of the body is low and the bend of knee joint is relatively large, the burden of the motor is large, the power consumption will increase significantly earlier, and accompanied by the motor heating).

### 4) About steps and undulating roads:

Considering that the robot does not use the visual perception system, and the users have different proficiency levels, for the sake of reliability and stability, it is currently recommended that the users control the robot walk on steps no more than 20cm, otherwise it may stumble due to improper operation. When encountering undulating ground, the users should also be careful and slow down the robot.

### 5) About climbing

Rated forward climbing angle is less than or equal to  $30^\circ$ . When the robot does not use the visual perception system, the robot body is likely to drift laterally when the climbing angle is large (about equal to or greater than  $30^\circ$ ). Since the visual perception system is not used, the robot is likely to be unstable if the users control the robot make a turn directly on the slope. When climbing the slope, please reduce the walking speed and properly control the robot.

### 6) About speed

The maximum walking speed is 1.2m/s under the stable control of flat terrain.

### 7) About foot end components

The robot foot end components are consumables, and we will give spare foot end components with the robot. The abrasion will be serious, especially running on rough ground. If it is found that the foot pad is worn out or damaged obviously, or the impact noise on the ground is significantly increased when the robot is walking, please replace the foot end components in time to prevent the robot from moving abnormally or falling due to the damage of the foot end components.

### 8) About IP67/IP68 protection

Please make sure that the battery interface, battery compartment interface, battery surface and battery compartment surface are dry before operation, and then install the battery to the robot body. Please clean the surface of the robot after operation in rainy weather.

### 9) Do not touch the robot dog during exercise! Carefully pinch hands at joints, such as knee joints.

## Robot Abnormal Condition Description

Unitree Robotics adopts a simplified mechanical structure to reduce the difficulty of manufacturing and improve the reliability of the machine. The robots have achieved the leading level at home and abroad in terms of structure, dynamic performance, motion performance and cost. The quadruped robot developed and produced by us is reliable in quality and cost-effective. It is very suitable as a new quadruped mobile platform for the exploration of scientific research and industrial applications. But the robots will have some abnormal conditions when the external environment does not meet the requirements of robot operation or the users do not use it properly.



- caused by improper operation by the users is not covered by the warranty. Please use it in strict accordance with the operating instructions.

## Common Problems and Solutions

When using the B1 quadruped robot, the robot may be abnormal. Most abnormal situations are controllable (there are solutions). The users should not panic when encountering these problems. Read the following contents in detail and solve the problems step by step.

If you have any questions, please contact Unitree Robotics official technical support: support@unitree.cc.

### ● Self-testing fails after startup

When the robot lies on the ground and starts the machine, if the robot dog does not stand up after 2 minutes, and the robot dog does not stand up after pressing the remote control L1+START, it means that the self-test has failed, and the robot dog cannot stand up. In this case, it is necessary to re-check the robot body and try again according to the steps of the two chapters "[Check before Power on](#)" and "[Preparation before Power on](#)".

### ● Self-protection after falling down

In the use of Unitree Robotics official movement control program (control the robot move by using the remote control), the robot will switch to self-protection status as a result of falling down caused by the external environment reasons (lack of friction, etc.) on the surface or improper operation, the motor of the robot will automatically switch to the braking state to protect the various parts.

### ● How to turn off the robot when the remote control module fails

When encountering the failure of the remote control module (such as the handle battery exhaustion, etc.), the remote control buttons cannot be used to make the robot lie on the ground and standby. The only way to forced shutdown is to press the battery supply button.

Forced shutdown: Keep the robot at least 2 meters away from obstacles, complex ground, crowd, water, and other objects. Hold the head and tail of the robot, short press the power switch once, and then lonely press the power switch for more than 4 seconds to turn off. Move it to the ground slowly after powering off.

### ● The robot is easy to fall down and cannot stand when powered on

The correct starting posture is not used, which resulting in the wrong angle of the motor. Restart the robot after using the correct starting posture.

### ● How to stand by for a long time

If you need to stand by for a long time, please control the robot to the lying position and press (press L2 + B keys to enter the damping mode) to avoid the robot from falling down and falling when the power is low!



- Notice! When moving the robot, do not place your hands on joints, such as the hip joints, be careful to pinch your hands! If the robot is standing and forced to shut down without protection measures, it will shoot flat on the ground after power off.

**Common posture and leg lifting suggestions in use**

| <b>Posture</b> | <b>Body height</b> | <b>Suggested leg lifting</b> |
|----------------|--------------------|------------------------------|
|----------------|--------------------|------------------------------|

|                       |  |  |
|-----------------------|--|--|
| Static standing state |  |  |
|-----------------------|--|--|

|          |  |  |
|----------|--|--|
| Lie down |  |  |
|----------|--|--|

|                             |  |  |
|-----------------------------|--|--|
| Large load spacing movement |  |  |
|-----------------------------|--|--|

|                                  |  |  |
|----------------------------------|--|--|
| Obstacle-crossing walking status |  |  |
|----------------------------------|--|--|

|                      |  |  |
|----------------------|--|--|
| Normal walking state |  |  |
|----------------------|--|--|

|               |  |  |
|---------------|--|--|
| Damping state |  |  |
|---------------|--|--|

Unitree Robotics

## Safe Operation Guide

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# Safe Operation Guide

## Battery Pack Safe Operation Guide

Improper use, charging or storage of battery packs may result in fire or property and personal injury. Be sure to use the battery pack in accordance with the safety instructions below.

### ● Use

- 1) Make sure the battery pack has enough battery before each use.
- 2) When using, moving or charging, please be careful with the battery and charging plug to avoid being damaged by external force.
- 3) When the power of the battery pack is lower than two bars, stop using the robot as soon as possible, replace the battery pack with a new one or charge the battery pack.
- 4) It is normal for a battery that has just been used or charged to generate heat.
- 5) It is forbidden to contact the battery pack with any liquid. Do not immerse the battery pack in the liquid or wet it. Short circuit and decomposition reactions may occur when the inside of the battery pack meets water, which may lead to spontaneous combustion of the battery pack or even explosion.
- 6) It is forbidden to use battery packs not officially provided by Unitree Robotics. If the users need to replace it, please go to the official website of Unitree Robotics for relevant purchase information. Unitree Robotics is not responsible for battery pack accidents, operation failures and machine damage caused using battery packs not officially provided by Unitree Robotics.
- 7) It is forbidden to use battery packs with damaged packages and shells.
- 8) Before installing or unplugging the battery pack from the robot, please keep the power of the battery pack off. Do not plug and unplug the battery pack when the power supply of the battery pack is turned on, otherwise the power supply or the robot may be damaged.
- 9) The battery packs should be used at an ambient temperature of  $-5^{\circ}\text{C}$ - $55^{\circ}\text{C}$ . If the temperature is too high (higher than  $60^{\circ}\text{C}$ ), the battery packs may catch fire or even explode. If the temperature is too low (lower than  $-10^{\circ}\text{C}$ ), the life span of the battery pack will be seriously damaged.
- 10) It is forbidden to use the battery pack in strong magnetic field or electrostatic environment. Otherwise, the battery packs protection board will fail, resulting in the failure of the battery packs and the robot.
- 11) It is forbidden to disassemble or puncture the battery pack in any way.
- 12) If the battery pack is seriously impacted by external forces, it cannot be used again until it is delivered to Unitree Technology for official inspection.
- 13) If the battery pack is on fire, use solid fire extinguishers. It is recommended to use fire extinguishers in the following order: sand, fire blanket, dry powder, and carbon dioxide extinguishers.
- 14) Do not place the battery pack in the pressure cooker or microwave oven.
- 15) Do not place the battery pack on the conductor plane.
- 16) Do not use any conductive material (such as wire or other metal objects) to short the positive and negative terminals of the battery pack.
- 17) Do not hit the battery pack. Do not place heavy objects on the battery pack or charger.

18) If there is dirt on the battery pack interface, please use a clean and dry brush, toothpick, or dry cloth to clean it. Otherwise, poor contact may be caused, resulting in energy loss or failure to charge.

#### ● Charge

1) The battery pack will automatically stop charging when fully charged. It is recommended to disconnect the charger after the battery pack is fully charged.

2) Please make sure that the battery is turned off before plugging in the charger.

3) When charging the battery, please ensure that the battery is charged within sight to prevent unpredictable accidents.

4) When charging, please pay attention to ensure that the environment around the battery has good heat dissipation, and there are no flammable and explosive items such as sundries.

5) Please keep the intelligent battery pack closed when charging.

6) The intelligent battery pack must be charged with a special charger officially provided by Unitree Robotics. Unitree Robotics will not be responsible for all the consequences caused by using a charger not officially provided by Unitree Robotics.

7) When charging, please place the battery pack and charger on the cement floor and other surrounding areas without flammable and combustible materials. Please pay attention to the charging process to prevent accidents.

8) It is forbidden to charge the battery pack immediately after the robot runs. At this time, the battery pack is in a high temperature state, and forced charging will seriously damage the life of the battery pack. It is recommended to wait for the battery pack to cool to room temperature before charging. The ideal charging ambient temperature (5°C -40°C) can greatly prolong the service life span of the battery pack.

9) After charging, please disconnect the charger from the battery pack. Regularly check and maintain the charger, and regularly check the appearance of the battery pack and other components. Never use alcohol or other combustible agents to clean the charger. Do not use a damaged charger.

#### ● Storage and transportation

1) When the battery pack is not in use, please remove the battery pack from the robot and store it out of the reach of children.

2) It is forbidden to place the battery pack near a heat source, such as a car in direct sunlight or hot weather, a fire source, or a heating furnace. The ideal storage temperature of the battery pack is 22°C -28°C.

3) During storage, please pay attention to ensure that the surrounding environment of the battery has good heat dissipation and is free of sundries and other inflammables and explosives.

4) The environment where the battery pack is stored shall be kept dry. Do not place the battery pack in water or where water may leak.

5) It is forbidden to mechanically impact, crush or pierce the battery pack. It is forbidden to drop or artificially short circuit the battery pack.

6) It is forbidden to store or transport the battery pack together with glasses, watches, metal necklaces, hairpins, or other metal objects.

7) Do not transport damaged battery packs. Once the battery pack needs to be transported, be sure to discharge the battery pack to about 65% charge.

8) Do not store the battery pack for a long time after it is completely discharged to avoid the battery pack entering the state of over-discharge, which may cause damage to the battery cell and cannot be restored to use.

- **Abandonment**

Damaged batteries such as bulging, falling, water ingress and breakage shall be scrapped and shall not be used again to avoid safety risks. Be sure to completely discharge the battery pack before placing it in the specified battery pack recycling box. Battery packs are hazardous chemicals, which are forbidden to be discarded in ordinary garbage cans. For details, please follow local laws and regulations on battery pack recycling and disposal.

Unitree Robotics

Daily Maintenance

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## Daily Maintenance

### Whole Machine Clean

#### ● Clean

When the B1 is used in harsh environments (rainy, dusty, wet), please clean the surface of the robot body in time.

Before cleaning the robot body, please turn off the power, use a clean, soft cloth to wipe the body, especially pay attention to whether the multi-view depth camera is wiped clean. It is strictly forbidden to use metal brushes, sandpaper, etc. to clean to avoid scratching the surface of the parts. After cleaning, dry the body with a soft cloth. After drying, use a fan or air gun to dry the accumulated water on the surface of the robot and the joint gap to avoid leaving water marks.



● Be careful! The whole B1 robot (including battery pack) has IP67 waterproof. (IP68 is optional.) Do not remove the battery pack when cleaning!

#### ● Storage

The B1 should be stored in a dry and cool room and away from the sun and rain to avoid the corrosion of parts and shorten the service life span. Take out the battery pack when storing for a long time.

### Inspection and Maintenance

Carrying out routine inspection before and after operation can greatly improve the reliable performance of products, reduce potential safety hazards and extend the service life span.

#### Uncharged checklist

| Type                          | Main points  |
|-------------------------------|--|
| Appearance of the whole robot | 1) Whether the appearance of the body is clean and free of damage or deformation marks.<br>2) Whether the lens on the camera surface has foreign matters.  |
| Structure                     | 1) Visually and touch to check whether the body, joints, connections, and foot end parts are in good condition. If there are cracks or damages, replace them in time and contact Unitree Robotics after-sales service.<br>2) Ensure that the screws of all connecting parts are locked, especially the screws of joint connectors and battery locking knobs.<br>3) Whether the waterproof plug and the sealing ring are in good condition, if they are aged or not installed and the body enters the water, it will cause a short circuit.<br>4) Whether the inlet and outlet of heat sink are blocked by foreign matters. |
| Foot end parts                | Check whether there is obvious foot pad damage. If there is damage, please replace it in time.   |
| Battery packs                 | 1) Check the battery pack interface of the body for foreign matters and deformation.<br>2) Whether the battery pack is installed reliably to ensure that it will not loosen during operation.<br>3) Check whether the battery pack shell is obviously damaged. The battery pack with obvious damage is forbidden to be used.   |
| Remote Control                | 1) Whether the remote control rocker is in the middle position and whether the rocker enters sand and other foreign matters.<br>2) Check whether each key of the remote control is lagged.   |

**Charged checklist**

| Type           | Main points  |
|----------------|--|
| Remote control | 1) Confirm whether the basic operation function of the rocker is normal.<br>2) Confirm whether the current power is sufficient |
| Battery        | Confirm whether the current power is sufficient.   |
| Cooling fan    | Listen carefully with ears to confirm that the cooling fan works normally and there is no sound such as scratching.            |



- It is recommended to do the above inspection before each use!
- If any parts are damaged and need to be replaced, please contact Unitree Robotics after-sales service in time!

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After-sales Service and Policy

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## After-sales Service and Policy

### Warranty Period Description

- 1) After the users purchase the whole B1 robot and other related products, the whole robot is guaranteed for one year, and the warranty period starts from the day the users receive the goods.
- 2) If the Unitree Robotics product the users purchased has exceeded the warranty period, they can also extend the original maintenance period by purchasing services.
- 3) During the maintenance period of one year, the customers have the right to obtain corresponding services from Unitree Robotics.
- 4) During the warranty period, without the permission of Unitree Robotics, unauthorized modification, disassembly, opening of the shell, etc. occurs, the warranty period will be invalid directly.
- 5) Repair or replacement parts will be delivered within 20 days after receiving the customers' bad parts.



- For specific products that can be purchased, please consult local service sales agency!

### Service Scope

According to the specific situation, we will carry out corresponding maintenance or parts replacement for the Unitree Robotics products the users purchased.

● **Services may not be provided as required due to the following circumstances:**

- 1) Unexpected situations caused by force majeure (such as: fire, flood, earthquake, lightning strike, etc.).
- 2) Deterioration of service conditions caused by social problems (such as turmoil, war, strike, government regulation, etc.).
- 3) The service cannot be implemented due to interruption of energy supply (such as electricity, water supply, oil, etc.).

● **Damage to production equipment of Unitree Robotics caused by the following reasons does not belong to the scope of service commitment:**

- 1) The equipment produced by Unitree Robotics is damaged due to force majeure events (natural disasters, fires, wars, etc.).
- 2) Equipment damage caused by natural loss and abrasion.
- 3) Direct damage is caused because the onsite operating environment (such as humidity) or external factors (such as external electromagnetic interference and internal interconnection device fault) cannot meet the environmental requirements as prompted.
- 4) Large-scale hardware or data damage to production equipment of due to intentional or negligence, improper use or deliberate sabotage.
- 5) Damage caused by failure to operate the production equipment of Unitree Robotics according to the operation manual of the equipment.

6) Damage to the system caused by the customers or third parties, including unauthorized relocation and installation of the system without complying with the requirements of Unitree Robotics; Damage caused by unauthorized adjustment, modification, or deletion of identification marks without following the requirements of Unitree.

7) Altered or marked the product equipment itself without permission according to the requirements of Unitree Robotics.

8) System damage caused by the customers' own infrastructure.

9) Equipment whose hardware or software has been modified without authorization of Unitree Robotics.

## Disclaimer

1) Unitree Robotics does not provide any explicit or implied commercial and technical guarantees not involved in this article.

2) Unitree Robotics does not guarantee that the products / services provided are completely free from defects and fully meet the customer's requirements. It also does not guarantee that Unitree Robotics can completely repair these defects.

3) In any case, Unitree Robotics shall not bear legal liability for direct or indirect economic losses to the customers due to this service specification, and the maximum compensation amount of Unitree Robotics for losses to the customers caused by its own product liability shall not be higher than the amount paid by the customers for the products/services.

4) The purchased parts are not within the scope of services included in this service specification.

5) No on-site services are provided for terminal products and accessories.

6) The maintenance service provided by Unitree Robotics for more than one year is an optional service. The customers can choose whether to purchase related services and choose when to terminate them. If the customers choose to purchase related services, it means that the customer allows Unitree Robotics to access, collect and process information related to faults, detection, positioning and debugging when providing services. Unitree Robotics will access and process relevant information in accordance with the customers' request under the premise of the customers' consent, and the information will only be used to provide maintenance services. Since the users are the controller of such information, Unitree Robotics cannot confirm whether such information contains customers' confidential information or personal data, and the customers shall guarantee that it will obtain or retain all necessary consents, licenses, authorizations ("Agree") is used to allow Unitree Robotics to provide this service, so that Unitree Robotics will not violate applicable legal requirements, the customers' privacy policy, or the agreement between the customer and the user when providing related services. Unitree will take reasonable measures to ensure the security of such users information, but Unitree Robotics is not responsible for direct or indirect responsibility for the act of obtaining and processing such information in the process of providing services.

## Other Detailed Rules

1) When you send the product to Unitree, you need to bear the mailing fee in advance.

2) After receiving the defective products, you need to guarantee, Unitree Robotics will test the products to determine the problems and responsibilities. If it is a quality defect of the product itself, Unitree Robotics will be responsible for the cost of testing, materials, labor, and express delivery.

3) If the tested products do not meet the conditions of free maintenance, you can choose to pay for maintenance or send back the original robot, the original robot sent back the express fee will be borne by you.

4) If the problem of the product exceeds the warranty scope, we will charge the corresponding testing fee, replacement parts fee, test fee, labor cost and transportation cost according to the specific problem.

5) Product maintenance may cause data loss. Please back up your data first.

6) Please do not return severely damaged battery packs; If you have sent it back, Unitree Robotics will scrap the battery pack and not return it.

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## Appendix

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## Appendix

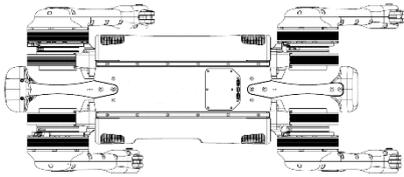
### Packing Lis

The B1 quadruped robot is equipped with the following parts, including a list of items and gifts, please check that they are all complete!

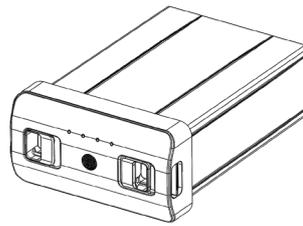


● The following pictures are for reference only. If the pictures are different from the actual objects, please refer to the actual objects.

#### Item list

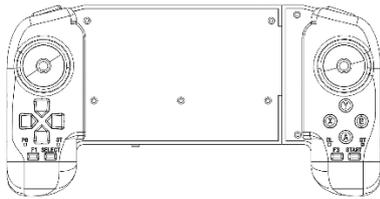


The whole B1 robot (without battery)

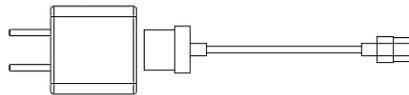


The B1 battery

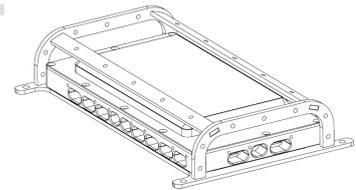
The B1 battery charger



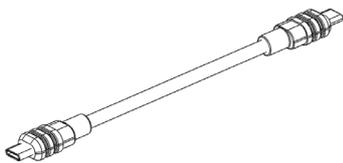
Remote control



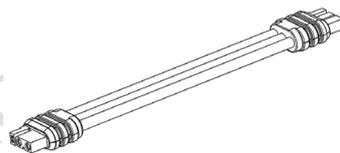
Remote charger & Type-C cable (1m)



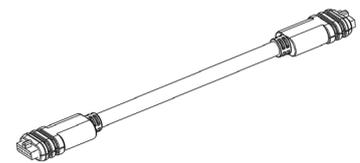
User extension dock



User extension dock USB cable  
(15cm)

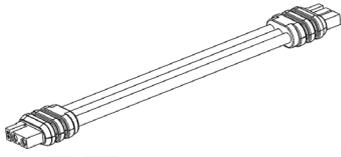
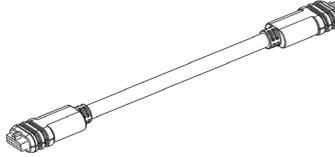
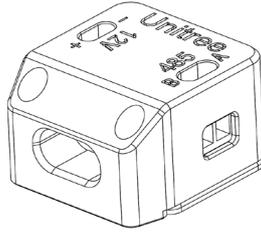
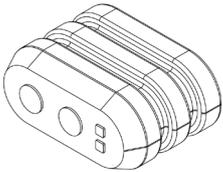
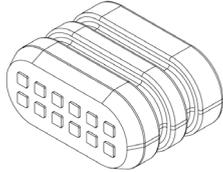
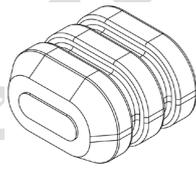
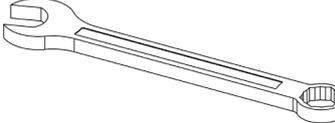


User extension dock power cable  
(10cm)



User extension dock 16 core  
cable (15cm)

Gifts list

|   |  |   |
|---|--|---|
|  <p>XT30 (2 + 2) cable (100cm) × 2</p>   |  <p>16 core cable (100cm) × 2</p>   |  <p>16 core convert to RJ45 / power / 485 junction box</p> |
|  <p>XT30 (2 + 2) waterproof plug × 3</p> |  <p>16 core waterproof plug × 3</p> |  <p>USB-C waterproof plug × 3</p>                          |
|  <p>Foot end component x 4</p>          |  <p>Foot removal wrench</p>        |  <p>Fixing screw removal wrench for debug Interface</p>   |
| <p><b>External air cooling module</b></p>   |  |   |

 Please carefully check whether the items in the box are complete and intact. If there is any problem such as missing or damaged, please contact the Unitree Robotics official after-sales service in time.

## Product Parameter Information

|                                    |   |  |
|------------------------------------|---|--|
| Product size                       | Length, width and height (standing)   | 1126mm*467mm*636mm   |
|                                    | Length, width and height (folded)   | 1202mm*467mm*297mm   |
| Product weight                     | Body weight   | 50kg   |
|                                    | Battery weight  | 5kg  |
| Load capacity                      | Continuous walking load   | 20kg   |
|                                    | Maximum standing load   | 80kg   |
| Cruising ability                   | Standing endurance  | 2.5h   |
|                                    | Empty load continuous endurance   | 2h   |
| Movement ability                   | Maximum climbing angle  | 30°  |
|                                    | Maximum step height   | 20cm   |
|                                    | Maximum movement speed  | 1.2m/s   |
| Dustproof and waterproof capacity  | Protection class  | IP67   |
| Control & perception configuration | Control system  | Intel Mini-PC×1  |
|                                    | Perceptual controller   | Jetson Xavier NX×3   |
|                                    | Depth camera  | 5 pairs  |
| Product configuration              | Maximum momentary torque of knee joint  | 210N.m   |
|                                    | Standard output   | Power/USB 2.0/ETH  |
|                                    | External interface  | Equipped with optional (gigabit network port×7, RS485×4, USBx5, CANx4) |
| Features and equipment             | 5G wireless network communication, GNSS acquisition (GPS, BeiDou, etc.), over the horizon remote control and image transmission | Standard configuration   |
|                                    | Smart robotic arm, autonomous charging, PTZ camera, 3D radar, radar-based SLAM algorithm, visual recognition algorithm          | Optional   |

More information: For details, please refer to the Unitree Robotics official website

Chinese:<http://www.unitree.cc/cn/>

English:<http://www.unitree.cc/>

## Remote Quick Lookup Table

| Key   |                       | Effect   |
|---|-----------------------|--|
| Left Rocker   | Push forward/backward | Move back or forth/Prone position  |
|   | Push left/right       | Sideways movement/Twist  |
| Right Rocker  | Push forward/backward | Head up or down/Pitch  |
|   | Push left/right       | Left or right turn/ Shake head   |
| START   |                       | Walking Mode   |
| SELECT  |                       | Static Standing Mode   |
| <b>Position switch</b>  |                       |  |
| L2+A  |                       | Lock the joints and get into a prone position  |
|   |                       | Return to standing position (locked joints)  |
| L2+B  |                       | Damping state  |
| L2+START  |                       | Walking mode (Mode 2)  |
|   |                       | Obstacle-crossing walking mode (Mode 3)  |
| <b>Foothold distance switch</b>   |                       |  |
| R2+A  |                       | Large load space   |
| R2+B  |                       | Normal space   |
| <b>Three movement states</b>  |                       |  |
| Mode 1: Static Standing State   |                       | Normal standing, the users can push the rocker to twist the body instead of moving.                              |
| Mode 2: Ordinary Walking Mode   |                       | The joystick can be pushed to move, the robot can be stopped to stop moving, and the pusher can be moved again.  |
| Mode 3: Obstacle Walking Mode   |                       | The obstacle can be moved by the joystick, stop pushing the robot to stop moving, and the pusher can move again. |
| <ul style="list-style-type: none"> <li>● Mode 1 press START to enter Mode 2, Mode 2/Mode 3 press SELECT to enter Mode 1.</li> <li>● Mode 2, in static state, press L2+START to switch to Mode 3</li> <li>● Mode 3, in stop state, press L2+START to enter Mode 1</li> </ul> |                       |  |