

Unmanned Vehicle Product User Manual

Chapter 1 Important Statement

1.1 Disclaimer

Unmanned Vehicle is a ROS intelligent unmanned vehicle platform for **scientific research/teaching/R&D purposes**, mainly used for experimental applications such as autonomous driving, robot control, and artificial intelligence algorithm verification.

Before using this product, please be sure to carefully read this instruction manual and strictly follow all safety operating procedures. **Improper operation may result in equipment damage, personal injury, or property loss, and the manufacturer shall not be held jointly liable.**

During the use of the product, the following situations are not within the scope of the manufacturer's liability:

- Collisions or loss of control caused by incorrect configuration of autonomous driving algorithms or improper parameter settings
- Damage caused by users' unauthorized modification, disassembly of the control board (breaking the anti-disassembly label is deemed as automatically waiving the warranty), PCB soldering, flying wire, or probe testing
- Losses caused by violating the operating procedures of this manual
- Failures caused by use in non-designated environments (such as outdoor rain and snow, humidity, dust, strong magnetic fields, etc.)
- Failures caused by using non-original or non-compliant batteries and chargers
- Damage caused by overvoltage, reverse connection, short circuit, battery overcharge or overdischarge
- Damage caused by collision, drop, or water immersion
- Overheating damage caused by long-term high-load operation

This product is not suitable for passenger transportation. The operation of the equipment involves experimental operations such as verification of autonomous driving algorithms, and its behavior is uncertain. The risks shall be borne by the user.

1.2 Symbol Explanation

Symbol	Meaning
 Warning	Operating instructions that may cause personal injury or serious damage to equipment must be strictly followed
 Attention	Operation instructions that may lead to equipment failure or performance degradation
 Prohibited	Absolutely prohibited operations, violation of which may lead to equipment damage, personal injury, or warranty invalidation
 Tips	Important information and best practices to help use this device correctly

Chapter 2 Safety Precautions

Important: Before using the Unmanned vehicle, all operators must read and fully understand the content of this chapter. Violating safety operating procedures may result in equipment damage, personal injury, and may lead to warranty invalidation.

2.1 General Safety

- Operators should have basic experience in operating robots or electronic devices;
- When the driverless vehicle is in operation, ensure that surrounding personnel maintain a safe distance (recommended to be no less than 1 meter);
- It is prohibited to touch moving parts (tires, steering gears, encoders, transmission mechanisms, etc.) while the driverless vehicle is in operation;
- Before use, check the appearance of the device. If any abnormalities (such as a damaged housing, loose screws, damaged cables, etc.) are found, immediately stop using it;
- It is prohibited to use this equipment for passenger transportation;
- After the device has been dropped or subjected to a severe impact, it must undergo a comprehensive inspection of its mechanical structure and electrical connections before it can be used again;
- Children should operate this device under adult supervision.

2.2 Electrical Safety

- Only use the original power adapter and battery, and it is prohibited to use power sources with mismatched specifications;
- Before powering on, confirm that all wiring is secure and undamaged; check whether the power cord has any cuts, crush injuries, or exposed copper wires;
- **Do not plug or unplug any connector while energized** , and ensure that the power switch is in the off state before powering on;
- If you detect an unusual odor, smoke, or abnormal heating, immediately cut off the power supply and disconnect the battery;
- Do not use or charge during thunderstorms;
- Do not insert metal objects into any interface;
- Ensure that all components such as Jetson controllers, STM32/ESP32 control boards, and sensors are well grounded.

2.3 Battery Safety

Battery Specification: XT60 Plug; 5200 mAh 3S (11.1 V) 35C Lithium Battery

Charging Safety

- A matching balance charger (30 W, 1-4 S, AC 100-240 V) must be used;
- The charging environment must be well-ventilated, fireproof, and away from flammable materials;
- Someone must be on duty during charging, **long-term charging without supervision is strictly prohibited** ;
- Charge with the lowest current when the battery is low.

Discharge and Use

- Battery level should not be lower than **20%** , over-discharge can cause irreversible damage to the battery;
- If a rapid voltage drop or severe overheating is detected during operation, the operation shall be stopped immediately;
- Ensure that the battery is firmly fixed to prevent loose connections caused by severe vibrations.

Storage

- Maintain the battery level during long-term storage at **40% - 60%** (storage voltage approximately 3.7 - 3.85 V/cell);
- Store in a dry and cool place, avoiding direct sunlight and high temperatures;

- Avoid long-term storage (more than 1 month) in a fully charged or empty state.

Daily Inspection

- Regularly check whether the battery case is swollen, cracked, or leaking. If any abnormalities are found, stop using it immediately;
- Check whether the battery connector and power cord are securely connected before each operation;
- Do not short-circuit, immerse, or expose the battery to open flames.

Emergency Response

- If the battery bulges, smokes, or emits an unusual odor, immediately disconnect the battery from the power management module and transfer the battery to a safe and well-ventilated area;
- It is recommended to equip the laboratory with sandboxes, fire blankets, or Class D dry powder fire extinguishers to handle battery fires.

2.4 Mechanical Safety

- Regularly inspect the chassis structural components to ensure there are no looseness, deformation, or cracks;
- Check whether the tire is firmly fixed, the tire wear condition, and replace it if necessary;
- During operation, it is prohibited to insert hands or other objects into the moving mechanism;
- Check the fixation of components such as steering gears, motors, and encoders;
- 3D printed parts are structural consumables, and any obvious manufacturing defects (such as delamination, severe cracks, etc.) must be reported **within 7 days** of arrival; damage during normal use is not covered by the warranty;
- After the equipment has been subjected to a collision, it is necessary to check whether the aluminum alloy base plate, shock absorption system, etc. are normal.

2.5 Environmental Limitations for Use

Parameter	Range
Operating Temperature	0 °C ~ 40 °C
Storage Temperature	-10 °C ~ 55 °C

Operating Humidity	Not greater than 80% RH, no condensation
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- It is prohibited to use in rain, snow, dust (such as sandstorms), or humid environments;
- Do not use in a strong magnetic field environment;
- Suitable for indoor flat ground or dedicated experimental sites;
- Avoid using in areas with strong electromagnetic interference to prevent affecting the normal operation of sensors and controllers.

2.6 Emergency Response

Situation	Processing Method
Device out of control	Set the CH7 channel of the remote control to the middle position (RC mode), switch to manual control, and cut off the control signal from the host computer
Battery Abnormality (Bulging/Smoking/Odor)	Immediately disconnect the XT60 connection between the battery and the power management module, and transfer the battery to a safe and ventilated area
Odor / Smoke (Other Components)	Cut off all power sources, transfer the equipment to a safe and well-ventilated area, and do not continue to operate it
Collision or Drop	Cut off the power supply, conduct a comprehensive inspection of the mechanical structure and electrical connections (including cables, interfaces, and fixing screws), and only continue to use it after confirming that there are no abnormalities.
Sensor malfunction	Switch to manual remote control mode (middle position of CH7), stop automatic operation, and gradually troubleshoot sensor connections

Chapter 3 Product Overview

3.1 Product Introduction

The Unmanned Vehicle is a **fully open-source Ackermann architecture simulation vehicle platform** that caters to education, research, and competition scenarios, providing a complete Development Environment from hardware to software.

OSRACER integrates NVIDIA Jetson series controllers as the core computing unit, combines with embedded microcontrollers to complete real-time control of the chassis, motors, and sensors, fully supports the ROS1/ROS2 ecosystem, and can seamlessly integrate with existing robot algorithms and toolchains.

3.2 Product Use

The OSRACER driverless vehicle is suitable for the following scenarios:

- **Higher Education** : As an experimental teaching platform, it helps students gain in-depth understanding of the architecture, perception, and planning algorithms of autonomous driving systems
- **Scientific Research Experiment** : Verification of cutting-edge algorithms such as SLAM, path planning, swarm intelligence, and multi-sensor fusion
- **Competition Platform**: A basic platform for experimental vehicles in autonomous driving and robotics challenges
- **Industrial Application Verification**: Assist partners in the automotive industry and the field of autonomous driving to quickly build a ROS-based R&D and testing platform

3.3 Product Features

- Open-source control programs and Development Documents, facilitating learning and secondary development
- Support **typical autonomous driving functions such as mapping (SLAM), path planning, and autonomous navigation**
- Integrate **the ROS1/ROS2 ecosystem** , enabling seamless integration with existing robot algorithms and toolchains
- Compatible **NVIDIA ISAAC simulation environment** , supporting teaching and research that combines virtual and real
- Provide sample programs and extension interfaces to facilitate algorithm verification and function expansion
- Modularization Sensor Support: Compatible with various sensors such as cameras, lidars, IMUs, etc.

3.4 Inapplicable Scenarios

- It is strictly prohibited to use for carrying people or transporting personnel
- It is strictly prohibited to use on public transportation roads such as highways

and railways

- It is strictly prohibited to operate for a long time in complex outdoor terrain without safety protection
- It is strictly prohibited to use in continuous automated operations in industrial production

Chapter 4 Product Composition

4.1 Packing List

After unpacking, please confirm whether the following components are complete. If any are found missing or damaged, please contact the supplier promptly:

Serial Number	Item Name	Quantity	Remarks
1	Unmanned Vehicle Complete Machine	1	Includes Jetson controller and control board
2	Power Lithium Battery	1	XT60 Plug, 5200mAh 3S
3	Balance Charger	1	30W, 1-4S
4	Remote control and receiver	1	FOSS I6S
5	Data Cable	Several	USB-A to USB-C 等
6	Power adapter and cable	1 set	—
7	Product User Manual	1	This document
8	Supporting Materials U Disk/Card	1	Including mirroring download addresses, etc.

4.2 Component Name

[Image: Rendering of the entire vehicle, including pull-line text labels - host computer, slave computer, ESC, encoder, servo, battery compartment, power management, power switch, LDS LiDAR, RGB camera]

The vehicle is divided into **chassis module** and **platform module** two parts:

Chassis Module:

[Image: Chassis Rendering]

- Chassis Structure: All-Terrain Tires, Differential, Shock Absorption System, Anti-Collision Sponge, Aluminum Alloy Base Plate
- Power system: Brushed motor + Magnetic encoder + Servo
- Control System: Controller (STM32/ESP32) + Controller Expansion Board + Remote Control Receiver

Platform Module:

[Image: Rendering of the upper board]

- Aluminum alloy upper panel: Electronic adjustment + Power management module + Battery level display module
- Sensors: LiDAR (LDS) + Industrial Camera (RGB)
- Computing platform: NVIDIA Jetson Orin Nano Super

4.3 Vehicle Structure Description

[Image: Chassis rendering - Top-down view, with key component positions labeled]

[Image: Hardware Block Diagram — Showing the Electrical Connection Relationships between Modules]

The vehicle hardware connection relationships are as follows:

1. **Host computer power supply line:** Jetson Orin Nano Super is connected to the DC output port of the power management board via a DC5525 power cable.
2. **Host computer signal line:** Jetson USB3.2 connects to a USB2.0 HUB, which branches out USB2.0 ports to connect to the LDS LiDAR, RGB camera, and lower-level controller.
3. **Power supply circuit for the lower computer:** The embedded controller draws power from the power supply interface on the side of the power management module via an XT30 to XT30 cable.
4. **Lower computer signal line:** The lower computer connects to peripherals such as ESC electronic speed controllers, SERVO steering gears, ENC encoders, and 2.4G RF receivers through I/O interfaces.
5. **Device power supply circuit:** The power battery (XT60 plug) is connected to the power management module to supply power to the entire device.

Chapter 5 Technical Specifications

Explanation: The parameters in this chapter are sourced from the hardware

parameter table and the main text content in the reference document. Items marked with "to be determined" indicate that there is no clear data in the reference document, and shall be subject to the physical nameplate or supplementary materials provided by the manufacturer.

5.1 Overall Machine Parameters

Parameter Name	Parameter Value	Remarks
Product Model	OSRACER	
Overall dimensions (length × width × height)	380 × 300 × 220 mm	
Vehicle weight	4 kg (including battery)	
Maximum Load Capacity	It is not recommended to increase the load	
Rated Load	It is not recommended to increase the load	
Maximum driving speed	4 m/s	
Maximum steering angle	30°	
Minimum turning radius	0.5m	
Endurance Time	2h	
Charging Time	50min	

5.2 Main Component Parameters

Host computer

Parameter Name	Parameter Value	Remarks
Controller Model	Jetson Orin Nano 8GB	
CPU	6-core Arm® Cortex®-A78AE v8.2 64-bit CPU 1.5MB L2 + 4MB L3	
GPU	1024-core NVIDIA Ampere architecture GPU with 32 Tensor Cores	
Memory	8GB 128-bit LPDDR5 68 GB/s	
Storage	128GB NVMe SSD	
Operating System	Ubuntu 22.04 + ROS HUMBLE	

lower computer

Parameter Name	Parameter Value	Remarks
Controller Model	osrcore v20260511 (integrated 9-axis sensor)	核心 ESP32-S3-WROOM-1U N8R16
Motor Type	Brushed DC motor + Electronic Speed Controller (ESC)	
Encoder	Magnetic encoder, 1024 lines	
Steering Gear	20KG DC 8.4V	
Communication Interface	Micro USB, serial port, baud rate 115200 - 460800	
Remote	2.4 GHz RC Model Remote	

Control Reception	Controller	
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sensor

sensor	Model/ Specification	Parameter	Remarks
LiDAR	LakiBeam 1L (Single-line LiDAR)	Sampling rate is 43.2kHz, angular resolution reaches 0.1°/0.25, and ranging range $\geq 40\text{m}$ (at 70% reflectivity)	
Camera	USB camera	1080p 120hz / Field of View (FOV) 120°)	
IMU	QMI8658 + QMC6309	Onboard nine-axis sensor	

Battery

Parameter Name	Parameter Value	Remarks
Battery Type	Power Lithium Polymer Battery (LiPo)	3S
Battery Capacity	5200 mAh	
Nominal Voltage	11.1 V (3S)	
Discharge Capacity	35 C	
Output Terminal	XT60 Plug	
Charger Specifications	30 W, 1-4 S, balanced charger	Parameters of the matching charger

5.3 Operating Environment Parameters

Parameter Name	Parameter Value	Remarks
Operating Temperature	0 °C ~ 40 °C	Reference value
Operating Humidity	Not greater than 80% RH, no condensation	Reference Value
Protection Class	Not waterproof or dustproof	

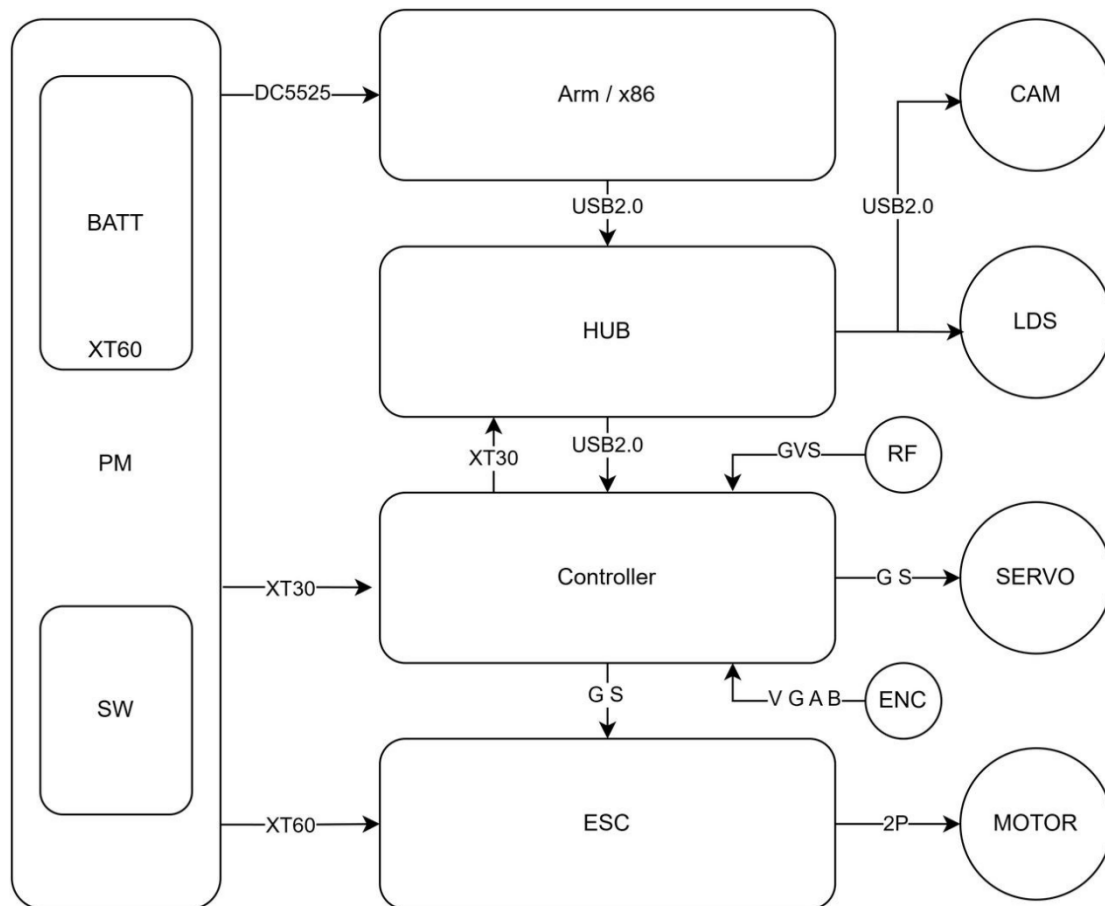
5.4 Storage and Transportation Parameters

Parameter Name	Parameter Value	Remarks
Storage Temperature	-10 °C ~ 55 °C	Reference Value
Storage Humidity	Not greater than 85% RH, no condensation	Reference Value
Stored Electricity	40% ~ 60% (long-term storage)	

Chapter 6 Electrical Instructions

6.1 Overview of Electrical System

The OSRACER driverless vehicle adopts a hierarchical power supply architecture, with power centrally supplied by the power lithium battery and distributed to each functional unit via the power management module.



- **Power Source:** Power lithium battery (XT60 plug, 5200mAh 3S 11.1V 35C), which provides the main energy for the entire vehicle
- **Power Management Module:** Distributes battery power to the host computer (Jetson), lower computer (controller), sensors, and other peripherals, while providing overcurrent and overvoltage protection
- **Host computer (Jetson Orin Nano Super):** Powered by DC5525 power cable, with a rated input of 19V (adapted and output by the DC port of the power management board)
- **Lower computer (controller):** Powered by the XT30 cable from the XT30 port on the side of the power management module, outputting 5V
- **Sensor :** Distributes power supply and signals through USB2.0 HUB, connects LDS lidar, RGB camera, and lower-level controller
- **Remote control receiver:** The 2.4G RF receiver is powered by the lower computer's I/O interface

6.2 Power Supply Connection

Power Management Module Interface Description

Interface	Type	Usage	Remarks
XT60 (Main Input)	Power Inlet	Connect the power battery	Main power supply inlet, correctly connected with the right polarity
DC Output Port	Power outlet	Connect to Jetson Orin Nano Super	DC5525 Interface Specification
XT30 (Side Output)	Power outlet	Connect to the lower-level controller	5V/12V Distributed Output
USB HUB Power Supply	Power outlet	Sensor Power Supply Bus	5V USB power supply output

Connection Steps

⚠ Ensure the power switch is off before connecting. Plugging or unplugging while the device is powered on may cause damage to the device.

1. Securely insert the XT60 plug of the power battery into the main input interface of the power management module, ensuring that the polarity is correct (red for positive, black for negative);
2. Connect the DC5525 power cable to the DC output port of the power management board, and connect the other end to the DC input port of Jetson Orin Nano Super;
3. Connect the XT30 power supply cable to the XT30 output port on the side of the power management module, and connect the other end to the XT30 power input port of the lower-level controller;
4. Use a USB-A to USB-C cable to connect the USB 3.2 downstream port of Jetson Orin Nano Super to a USB 2.0 HUB device;
5. Connect the USB 2.0 ports split from the USB HUB to the data interfaces of the LDS lidar, RGB camera, and lower-level controller respectively;
6. Check again that all interface connections are secure and free of looseness.

6.3 Line Connection Instructions

[Image: Schematic Diagram of the Overall Circuit Connection of the OSRACER Driverless Vehicle]

Host computer signal line

Jetson Orin Nano Super connects to a USB2.0 HUB device via the USB3.2 downstream port, and the USB2.0 ports split from the HUB are respectively connected to:

- **LDS LiDAR:** Provides environmental perception data
- **RGB Camera:** Provides visual perception data
- **Lower-level controller (Controller):** Provides vehicle body control command issuance and status postback

Lower computer signal line

The lower computer controller is connected to the following peripheral devices through the I/O interface:

Device	Interface	Function
ESC Electronic Speed Controller	I/O (PWM Output)	Motor Drive and Speed Control
SERVO Steering Gear	I/O (PWM Output)	Steering Angle Control
ENC Encoder	I/O (Pulse Input)	Motor Speed and Mileage Data Acquisition
2.4G RF Remote Control Receiver	I/O (PPM Signal)	Receive remote control commands (RC mode)

6.4 Pre-power-on Inspection

 **Before connecting the battery, be sure to complete all of the following inspection items. Powering on without performing the required inspections may result in equipment damage or personal injury.**

Battery Inspection

- Short press the power indicator to confirm that the power display is not less than 3 bars; direct power-on operation is prohibited when the power is less than 3 bars
- Check that the battery case is free from swelling, cracking, or leakage; if any abnormalities are found, immediately stop using it and contact after-sales service
- Confirm that the XT60 plug of the battery is free from charring, deformation, or looseness, and that the metal pins are free from oxidation

Power cord inspection

- Check that all power cables are in good appearance, without damage, crush injury, aging, or exposed copper wires
- Confirm that all interfaces are firmly connected without loose connections; there are no obvious signs of overheating at the interfaces
- Ensure that the battery is securely fixed to prevent cable loosening caused by vibrations during operation
- Measure the output voltage of the power management module (DC port 5V/12V output) and confirm it is within the normal range

Equipment Appearance Inspection

- Jetson Orin Nano Super Controller indicator lights are normal (power indicator light is constantly green)
- STM32/ESP32 control board has no abnormal heating and no odor
- Sensors (lidar, camera) are securely installed, and USB/ Ethernet interfaces are not bent
- The remote control receiver antenna is undamaged and oriented correctly

Safety Environment Inspection

- Ensure there are no obstacles around the vehicle to prevent collisions caused by accidental startup after power-on
- The power switch is in the off state
- The remote control battery is fully charged, and the remote control and receiver have been paired

6.5 Power-on Sequence

 **Power on strictly in the following order, and it is prohibited to plug or unplug any interface while the power is on.**

1. **Inspection** - Confirm that all circuit connections are correct and secure, and complete all inspection items in Section 6.4
2. **Turn on the main switch** — Turn on the main switch of the power management module
3. **Observation Indicator** - Wait for the system self-check, and confirm that the Jetson Orin Nano Super power indicator lights up (the lower computer indicator lights up synchronously)
4. **Wait for the system to start** — Wait for the Jetson system to fully start (about 30-60 seconds)
5. **Start the device driver** — Start the OSRACER device driver in the Jetson

terminal:

```
ros2 launch osracer_bringup bringup.launch.py
```

1. **Power-on completed** — After the driver is successfully loaded, the system enters standby mode and can be controlled via the remote control or ROS commands

Caution: After the first power-on or battery replacement, it is recommended not to start the driver immediately. Instead, only observe the indicator lights and device startup logs, and continue only after confirming that there are no abnormalities.

6.6 Power-off Sequence

 **Power off strictly in the following order; incorrect power-off operations may cause data loss or equipment damage.**

1. **Stop Operation** — Ensure the driverless vehicle is in a stationary state with no ongoing tasks
2. **Switch to remote control mode** — Set the CH7 channel of the remote control to the middle position (RC mode) to cut off the automatic control of the host computer
3. **Close the host computer application** - Close host computer programs such as RViz, navigation application, SLAM, etc.
4. **Close the device driver** — Press **Ctrl+C** in the Jetson terminal to normally terminate the roslaunch process
5. **Shut down the Jetson system** — Execute the normal shutdown command:

```
sudo shutdown -h now
```

1. **Cut off the main power supply** — After waiting for Jetson to fully shut down (indicator light goes out), turn off the main switch of the power management module
2. **Disconnect the battery** - Unplug the battery XT60 plug
3. **Power-off completed** — Wait 30 seconds before moving, inspecting, or storing

Warning: Abnormal power outage (such as directly turning off the main switch without completing the above process) may cause damage to Jetson system files, data loss of ROS nodes, or sudden locking of ESC/servos.

6.7 Electrical Parameters

Parameter Name	Parameter Value	Remarks
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Nominal voltage of power battery	11.1V (3S Li-ion Battery)	Each cell is 3.7V
Power battery capacity	5200mAh	5200mAh-3S-35C
Specifications for XT60 Plug of Power Battery	XT60 (Male-Female Pair)	Positive foolproof design
Power supply voltage of the host computer	DC 5V / 19V (via DC5525)	Power Management Board Output Adaptation
Power supply voltage of the lower computer	DC 5V (via XT30)	Power Management Board Output
Sensor Supply Voltage	DC 5V (via USB HUB)	USB Standard Power Supply
Power supply for remote control receiver	DC 5V (via I/O 接口)	Power supply for the lower-level controller
Typical operating current	Refer to the overall machine power consumption	Depending on the load
Maximum operating current	Refer to motor specifications	35C continuous discharge

Chapter 7 Installation and Use

7.1 Battery Installation

 **Before installation, it is necessary to confirm that the battery has been unplugged from the charger or power management board.**

Installation Steps

1. Untie the magic cable tie to expose the battery compartment
2. Correctly place the power lithium battery into the battery compartment
3. Securely insert the XT60 plug of the battery into the XT60 interface of the power management module, ensuring that the locking buckle is tightly fastened

4. Re-secure the magic cable tie to ensure the battery does not shake
5. Organize cables to avoid squeezing or excessive bending of battery wires

Disassembly Steps

1. Untie the magic cable tie
2. Disconnect the battery XT60 plug
3. Remove the battery from the battery compartment

 **Excessive bending of battery wires is prohibited. Wire damage is not covered by the warranty.**

7.2 Inspection Before Use

Before each use, please check item by item according to the following list:

Serial Number	Inspection Items	Acceptance Criteria
1	Power Check	The battery indicator shows no less than 3 bars
2	Battery Appearance	No expansion, no rupture, no leakage
3	Battery Connection	The XT60 plug is secure and without looseness
4	Sensor Installation	LiDAR and camera are firmly fixed
5	Remote control battery level	The remote control battery is fully charged
6	Remote Control Connection	Receiver indicator is normal
7	Surrounding Environment	No obstacles, flat ground

[Image: Schematic of pre-use checklist]

7.3 Basic Usage Process

Step 1: Battery Check

Press and hold the battery indicator button briefly to check the current battery level.
The device can only be used when the battery level is at least 3 bars.

[Image: Location and Display Status of Battery Indicator]

Step 2: Turn on the device

- 1. Short press the power switch
- 2. Press and hold the power switch until you hear a "beep".
- 3. Release, device power-on completed

[Image: Power Switch Location and Operation Instructions]

Step 3: Remote Control Mode Switching

The supporting remote control is **Fusi I6S** . For the functions of the remote control, please refer to the remote control manual.

Mode	Switching Mode	Usage
Remote Control Mode (RC)	Channel CH7 is adjusted to the middle position	Manually control the vehicle
Automatic Mode (ROS)	Channel CH7 adjusted to the upper gear	Upper computer control, vehicle autonomous navigation

 **When using for the first time, it is recommended to first switch to RC mode (middle position of CH7), and then switch to automatic mode after getting familiar with manual control.**

Step 4: Configure the host computer network (if necessary)

Configure WiFi by connecting to a PC via USB:

- 1. Connect the PC and Jetson (Port 4) using a USB-A to USB-C cable
- 2. On the PC, find the USB Ethernet device in the network settings
- 3. Connect to 192.168.55.1 using RustDesk Remote Desktop, Password: nvidia
- 4. Login user nvidia, password: nvidia
- 5. Open the WiFi network configuration in the upper right corner and connect to the target WiFi (e.g., OSRBOT_AP-5G, password 12345678)
- 6. After successful connection, use ifconfig to view and record the IP Address

of Jetson

[Image: RustDesk Connection Interface]

[Image: WiFi Network Configuration Interface]

Step 5: Connect to the host computer

Recommended Method: RustDesk Remote Desktop (with Desktop)

1. Ensure that the PC and Jetson are on the same network
2. Open RustDesk on the PC, and enter the IP Address of Jetson (e.g., 192.168.25.163)
3. Enter Password: `nvidia`
4. Login user `nvidia`, password: `nvidia`

Backup Method: SSH (No Desktop Environment)

```
ssh nvidia@<IP 地址>
# 输入 yes 确认连接
# 输入密码: nvidia
```

Step 6: Start the device driver

Start the unmanned vehicle driver in the Jetson terminal:

```
ros2 launch osracer_bringup bringup.launch.py
```

After hearing the drive startup prompt, the vehicle enters standby mode.

Step 7: View Sensor Data

View odometry data:

```
ros2 topic echo /osracer/odometry/filtered
```

View LiDAR data (RVIZ):

```
ros2 launch osracer_rviz view_lidar.launch.py
```

View camera data (RVIZ):

```
ros2 launch osracer_rviz view_image.launch.py
```

7.4 Use Post-Processing

After each use, please follow the steps below for proper handling:

1. Stop all ROS programs

Press **Ctrl+C** in each terminal window to terminate the running launch process, and wait for the nodes to fully exit.

2. Shut down Jetson normally

```
sudo shutdown -h now
```

Wait for the system to prompt for shutdown before proceeding to the next step.

1. Turn off the power

Refer to the steps in Chapter 6 "Power-off Sequence" to disconnect the power of each device in sequence.

2. Disconnect the battery

Unplug the battery XT60 connector and separate the battery from the vehicle.

3. Cleaning and Inspection

- Clean the dust and debris adhering to the wheels and chassis
- Check tire wear and replace if necessary
- Check if each connector is loose, and tighten it promptly
- Check the cable appearance for any cuts or crush injuries

4. Properly store

- Store the vehicle in a dry and well-ventilated area, avoiding moisture and direct sunlight
- Avoid heavy pressure or stacking on other items
- If the remote control batteries are not used for a long time (more than 2 weeks), please remove them
- If the lithium battery is to be stored for a long time, please charge it to 40%-60% of its capacity.

Chapter 8 Maintenance and Upkeep

8.1 Daily Maintenance

Mechanical Part

Inspection	Inspection	Inspection Method	Exception Handling
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Items	Cycle		
Tire Wear	Before each use	Visually inspect the tire tread depth and surface condition	Replace the tire promptly when the tread pattern is severely worn or cracks appear on the tread
Tire Fixation	Before each use	Gently push the tire by hand to confirm that there is no looseness or obvious shaking	Tighten the tire mounting screws
Screw Tightening	Weekly	Check if the chassis screws are loose	Tighten with an Allen wrench
Battery Fixation	Before each use	Confirm that the magic cable tie is firmly fixed without displacement	Re-tighten or replace the cable tie
Cable Management	Weekly	Check if the cable is over-bent or exposed	Reorganize and secure with cable ties
Chassis anti-collision sponge	Monthly	Check if the sponge is damaged or detached	Re-paste or Replace

Electrical Part

Inspection Items	Inspection Cycle	Inspection Method	Exception Handling
Battery level	Before each use	Short press the battery indicator light, and a reading of no less than 3 bars is considered qualified	Charge using the included charger
Battery Appearance	Weekly	Visually inspect for swelling, rupture, or leakage	Immediately stop using and contact after-sales service

Interface Connection	Before each use	Ensure that each XT60/XT30 interface is securely plugged in place	Reinsert tightly. If the interface heats up, it needs maintenance.
Cable Appearance	Weekly	Check if the power cord is damaged, crushed, or has exposed copper wires	Contact after-sales service to replace the cable
Jetson Indicator Light	Before each use	Confirm that the start indicator light is lit normally	Check the power supply or contact after-sales service
Controller overheating	Observation during operation	After the device has been powered off for 30 minutes, touch the controller housing to check the temperature	Normal temperature is normal; if the outer shell is obviously hot to the touch (greater than 50°C), immediately stop the machine and contact after-sales service

Sensor Section

Inspection Items	Inspection Cycle	Inspection Method	Exception Handling
LiDAR Cleaning	Weekly	Gently wipe the lidar lens with a soft cloth	Avoid using alcohol or organic solvents
Camera Cleaning	Weekly	Gently wipe the lens with a glasses cloth	Avoid pressing the lens forcefully
Sensor Installation	Before each use	Confirm that the sensor bracket is securely fixed without looseness	Tighten the mounting screws
Sensor Data	Before each use	Check if the data is output normally after startup	Contact Technical Support

[Image: Flowchart of Daily Maintenance Inspection]

8.2 Battery Maintenance

Charging Specification

- **Charger Requirements** : A balance charger (specifications: 30W, 1-4S, display screen, AC 100-240V, XT60 plug) that comes with this product must be used. The use of inferior or incompatible chargers is prohibited.
- **Charging Environment** : Well-ventilated, away from flammable materials, and long-term charging without supervision is strictly prohibited
- **Charging Method** : When the battery level is below 3 bars, use the lowest current (approximately 0.5A~1A) for slow charging
- **Charging completed** : After the charger indicator turns green, promptly cut off the power to avoid overcharging

Usage Specification

- Battery level should not be lower than 20%, as over-discharge can cause irreversible damage to the battery
- If a rapid voltage drop or severe overheating is detected during operation, immediately stop the operation and cut off the power
- Avoid using the battery under extreme temperatures (below 0°C or above 40°C)
- The battery must be firmly fixed to prevent the outer casing from being damaged due to severe collisions or vibrations

Storage Specification

- **Long-term storage**: Charge the battery to 40%—60% (approximately 3.7 - 3.85V/cell)
- **Storage Environment**: Dry, cool, avoid direct sunlight and high temperatures (above 55°C)
- **Regular Inspection**: Check the battery level every 2 to 3 months, and recharge it to around 50% when the battery level drops below 40%
- **Prohibited Actions** : Prohibited from long-term storage at full charge (100%) or empty charge (0%)

[Image: Schematic Diagram of Battery Maintenance Precautions]

8.3 Storage Requirements

Storage Item	Requirements
Stored Electricity	40%~60% (long-term storage)
Storage	-10°C ~ 55°C

Temperature	
Storage Humidity	Not greater than 85% RH, no condensation
Storage Method	Store in a powered-off state, and store the battery separately
Environmental Requirements	dry, ventilated, and free of corrosive gases
Regular inspection	Check the battery level and appearance every 2 to 3 months

Steps for Vehicle Storage

1. Disconnect the battery from the power management module (XT60 plug)
2. Remove the battery and store it separately according to the battery storage specification (40% - 60% charge)
3. Clean the dust, debris, and oil stains adhering to the chassis
4. Organize and secure all cables to avoid long-term bending
5. Cover the entire vehicle with a dust cover to avoid direct sunlight
6. Store in a stable, dry place out of reach of children

[Image: Schematic Diagram of Vehicle Storage]

8.4 Transportation Requirements

Transportation Project	Requirements
Battery Handling	Discharge to 40% - 60%, then disassemble and transport separately
Packaging Requirements	Use the original packaging or a shipping box with shock-absorbing filling materials
Cable Fixing	Organize and secure all cables to prevent pulling during transportation
Sensor Protection	LiDAR and cameras need to be protected with anti-vibration packaging

Transportation Restrictions

Comply with local regulations related to lithium battery transportation (such as UN3481)

 **Warning:** Do not drop, squeeze, or subject the device to severe vibrations during transportation. Lithium battery transportation must comply with local laws and regulations.

Chapter 9 Troubleshooting

 **Emergency Stop:** If the vehicle experiences abnormal deviation or loss of control in automatic mode, immediately move the CH7 channel of the remote control to **the middle position (RC mode)** to cut off automatic control and restore manual control.

9.1 Power-on Abnormality

9.1.1 The device does not respond after the power switch is turned on

Possible Causes	Troubleshooting Steps	Solution
Battery depleted	Check if the power indicator light is on	Charge using the included balance charger, and after charging is complete, the battery level should be no less than 3 bars before use
Battery not connected	Check if the XT60 plug at the battery end is firmly inserted into the power management board	Reinsert the XT60 battery plug firmly until you hear a "click" sound, indicating it is in place
Power switch failure	Observe whether the indicator light turns on after the switch is pressed	Contact after-sales service to replace the power management module
Power management	Use a multimeter to measure whether each output port has a	Contact after-sales service for maintenance, and do not

module failure	normal voltage output	disassemble the PCB by yourself
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9.1.2 Jetson fails to start

Possible Causes	Troubleshooting Steps	Solution
Jetson has insufficient power supply	Use a multimeter to measure whether the output voltage of the DC5525 cable is $5V \pm 5\%$	Replace the power management module or DC5525 cable
Jetson system failure	Observe the Jetson indicator light (green blinking = normal startup in progress, constantly off = abnormal)	Re-flash the system mirroring, refer to the factory mirroring download address
USB HUB connection is loose	Check if the connection cable between the USB HUB and Jetson is secure	Reinsert the connection cable firmly

9.1.3 roslaunch driver failed to start

Possible Causes	Troubleshooting Steps	Solution
ROS environment not loaded	Confirm whether the terminal has executed <code>source ~/osracer_ws/devel/setup.bash</code>	Execute the above command in a new terminal, or add the command to <code>~/.bashrc</code>
Missing dependency package	Read the error message from the terminal and locate the name of the missing ROS package	运行 <code>rosdep install --from-paths src --ignore-src -r -y</code>
Port or process is occupied	Check if the launch process has been repeatedly started	<code>pkill -f osracer_bringup</code> Terminate existing processes and then relaunch

Diagnostic command:

```
# 检查 ROS 节点运行状态
```

```

ros2 node list

# 检查话题发布情况
ros2 topic list

# 查看驱动 launch 详细输出日志
ros2 launch osracer_bringup bringup.launch.py

# 若 launch 卡住，按 Ctrl+C 中断，查看最后 10 行报错

```

9.2 Operational Exception

9.2.1

The remote control cannot control the vehicle

Possible Causes	Troubleshooting Steps	Solution
Remote control battery is low	Check the battery indicator on the remote control (red light = low battery)	Replace the remote control battery (alkaline batteries are recommended)
The receiver is not connected or not powered	Check if the receiver indicator light is on (steady on = normal)	Reconnect the receiver cable to the lower computer control board
The remote control and receiver are not paired	Confirm that the remote control and receiver models are paired, and try to re-pair the codes	Perform the code pairing operation according to the remote control manual
RC/ROS Mode Error	Confirm that the CH7 channel is set to the middle position (RC mode)	Set CH7 to the middle position, and it will default to RC mode after power-on
Communication anomaly of the lower computer	Check if the USB cable connecting the USB HUB to the lower computer is securely connected	Reconnect or replace the USB cable

9.2.2 Abnormal Vehicle Driving Direction

Possible Causes	Troubleshooting Steps	Solution
Incorrect wiring for forward and reverse rotation of the motor	Switch between forward and reverse gears, and observe whether the actual driving direction is consistent with the gear position	Adjust the motor wiring sequence (arbitrarily swap two motor wires)
Steering Gear Neutral Offset	Push the direction joystick in RC mode and observe whether the steering angles of the front wheels are symmetrical	Recalibrate the neutral position using the remote control's travel fine-tuning function or the ESC's built-in menu
Encoder data anomaly	Observe whether there is a jump in the odometer data after driving a certain distance	Reinsert the encoder cable securely and check that the cable is not bent or broken

9.2.3 Irregular vehicle deviation or fishtailing

Possible Causes	Troubleshooting Steps	Solution
Uneven tire wear	Check if the tread wear of the four tires is consistent	Replace worn tires, it is recommended to replace them simultaneously on the same axle
Tire fixing is loose	Check whether the tire mounting bolts and wheel hubs are tightened securely	Use tools to tighten the tire mounting screws
Abnormal damping system	Lift the vehicle off the ground and push the tire to check the vibration amplitude	Check the shock absorber spring and shock absorber rubber sleeve, and contact after-sales service for repair
Encoder data jump	Use <code>ros2 topic echo /odom</code> to check if the odometry data frames are continuous	Reinsert the encoder cable securely to ensure it does not interfere with the tire

9.3 Steering Abnormality

9.3.1 Steering is insensitive or unable to turn

Possible Causes	Troubleshooting Steps	Solution
Steering gear failure	After powering on, observe whether the steering gear has abnormal noise or jamming, and manually turn the front wheel to judge the resistance	Replace the servo (specification: standard PWM servo, voltage range matching the device)
Abnormal power supply to the steering gear	Gently push the direction joystick in RC mode, and use a multimeter to measure whether the power supply voltage of the servo is between 4.8 - 6V	Check the servo output port of the power management module and replace the module if necessary
Front wheel mechanical jamming	Turn off the power, manually turn the front wheel left and right, and check for any foreign objects blocking or bearing damage	Remove foreign objects or contact after-sales service to replace the bearing
Steering mechanism loose	Check whether the ball joints at both ends of the steering linkage are detached or loose	Reinstall and tighten all steering mechanism connectors

9.3.2 Jitter in Place

Possible Causes	Troubleshooting Steps	Solution
The steering gear responds too quickly	Slightly move the directional joystick in RC mode and observe whether high-frequency jitter occurs	Reduce the servo PWM signal frequency, or enable servo soft start in the ESC parameters
Excessive friction between the	Place the vehicle on a flat and smooth surface (such as tile or acrylic board) and test again	Improve the operating environment and avoid long-term operation on rough gravel

tire and the ground		ground
Excessive clearance in steering mechanism	Check the wear of steering linkages and ball joints	Contact after-sales service to replace worn parts

9.4 Sensor Abnormality

9.4.1 LiDAR has no data output

Possible Causes	Troubleshooting Steps	Solution
USB connection is loose	Check the USB cable connection between the USB HUB and the lidar	Reinsert the USB cable securely to ensure the interface latch is properly locked
LiDAR is not powered	Observe whether the radar indicator light is on (it should remain constantly on or rotate for scanning after power-on)	Check if the USB HUB power supply is normal, and use an external USB power cable if necessary
LiDAR failure	Approach the light exit of the radar, observe whether there is a faint red light flashing; listen for normal operating sounds	Contact after-sales service to replace the lidar module
Radar lens contamination	Check whether there is dust, water mist, or obstructions on the laser emission/reception window	Use a clean, soft cloth to gently wipe the lens. Do not use alcohol or organic solvents.

Diagnostic Command:

```
# 检查雷达话题是否发布
ros2 topic list | grep scan

# 查看雷达原始数据
ros2 topic echo /scan

# 查看雷达设备节点
```

```
ls -l /dev/serial/by-id/
```

9.4.2 Camera has no image

Possible Causes	Troubleshooting Steps	Solution
USB connection is loose	Check the USB cable connection between the USB HUB and the camera	Reinsert the USB cable securely
Camera driver is abnormal	Execute <code>ls /dev/video*</code> to check if the device node exists	Reinstall the camera driver or change the USB port
Camera hardware failure	Connect the camera to other USB devices for testing	Contact after-sales service to replace the camera module

Diagnostic Command:

```
# 检查摄像头设备节点
ls /dev/video*

# 查看摄像头话题
ros2 topic list | grep image

# 检查摄像头话题发布情况
ros2 topic echo /camera/color/image_raw
```

9.4.3 IMU Data Anomaly

Possible Causes	Troubleshooting Steps	Solution
IMU connection loose	Check if the connection wires between the IMU module and the lower computer/carrier board are secure	Reinsert the connection cable securely and ensure the wire sequence is correct
IMU data drift	Observe whether the triaxial acceleration and angular velocity data are within a reasonable	Perform IMU calibration (refer to the factory calibration process),

	range under static conditions	or contact after-sales service
IMU hardware failure	Under static conditions, the three-axis data simultaneously deviate significantly from the normal values	Contact after-sales service to replace the IMU module

Diagnostic command:

```
# 查看 IMU 话题
ros2 topic list | grep imu

# 查看 IMU 原始数据
ros2 topic echo /imu/data
```

9.5 Abnormal heating or odor

 **Safety First** : When any of the following situations occur, you should **immediately stop operation** , cut off the power supply (preferably disconnect the battery XT60 connection), and conduct troubleshooting after the device has completely cooled down. Do not continue operation in an abnormal state.

9.5.1 Abnormal Phenomenon Identification and Emergency Response

Abnormal Phenomenon	Possible Causes	Emergency Response Procedures
The motor housing is abnormally hot to the touch (a touch feels burning pain at temperatures above 60 degrees Celsius)	Motor overload, coil short circuit, or long-term locked rotor	Immediately stop the machine, disconnect the battery; after cooling, check for mechanical jamming and motor coil resistance
The control panel/PCB is overheating severely (a burning smell can be detected)	Power management module overloaded, short-circuited, or component damaged	Immediately cut off all power sources, do not reconnect power, and contact after-sales service
The battery is	Overcharge (charger	Immediately disconnect

overheating, swelling, or deformed	failure), overdischarge, internal short circuit	the battery XT60 plug, move the battery to an outdoor open area free of flammable materials, place it in a sand bucket or fireproof container, and do not use it again
Obvious odor (burnt smell, plastic melting smell)	Cable insulation damage short circuit, solder joint cold solder, device breakdown	Cut off all power sources, check cables and solder joints, and do not continue to supply power

9.5.2 Preventive Measures

- **Before operation:** Check that the cables are free of damage, excessive bending, and squeezing, and the battery case is free of swelling
- **During operation :** Avoid long-term locked rotor (motor not rotating but still energized), and avoid continuous operation in high-temperature environments (above 40 degrees Celsius)
- **When charging :** Someone must be on duty, place it in a fireproof environment, and disconnect the charger promptly after it is fully charged
- **During storage :** Check the battery level monthly, and maintain the battery level between 40% and 60% when not in use for an extended period

 **When contacting after-sales service, please provide:** Serial Number, description of the fault phenomenon, operating steps and environmental conditions at the time of the fault occurrence, relevant photos or videos.

Chapter 10 Certification and Compliance Information

10.1 Product Certification Information

 **The specific certification status of this product shall be subject to the marking on the nameplate, and the following is typical information.**

Certification Project	Status	Remarks
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China 3C Certification	To be confirmed	Subject to the product nameplate marking
CE Declaration of Conformity	To be confirmed	Subject to the product nameplate marking
RoHS Environmental Protection Statement	To be confirmed	Subject to the product nameplate marking
FCC Certification (if applicable)	To be confirmed	Subject to the product nameplate marking

10.2 Lithium Battery Transportation Compliance

The lithium batteries contained in this product are subject to the following regulations:

- **UN38.3:** Lithium Battery Transportation Safety Test Certification
- **IATA DGR:** International Air Transport Association Dangerous Goods Regulations
- **GB/T 36053-2018:** Safety Requirements for Lithium Battery Transportation (Chinese Standard)

 **When carrying or transporting lithium batteries, please comply with the requirements of airlines and local regulations. It is recommended to contact the carrier in advance to confirm the lithium battery transportation requirements.**

10.3 RoHS / Environmental Declaration

This product (Unmanned Vehicle) is committed to reducing the use of hazardous substances and complies with the requirements of the following environmental protection directives (specifically subject to the product certification certificate):

- **EU RoHS Directive** (2011/65/EU and its amending directives): Restricts the use of specific hazardous substances in electrical and electronic equipment
- **China RoHS** (Administrative Measures for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products): Same as above

10.4 Disposal Instructions

Waste Type	Processing Method
Lithium Battery	Hand over to qualified waste battery recycling agencies for

	disposal, and it is strictly prohibited to discard them casually
Electronic components	Handled by electronic waste recycling points
Metal structural parts	can be recycled as metal scrap
3D printed part	Handle as ordinary plastic waste
Packaging Materials	Classify and recycle according to local regulations

 It is strictly prohibited to dispose of lithium batteries in regular trash or incinerate them, as this may lead to fires or environmental pollution.

Chapter 11 Nameplate Information

[Image: Example image of product nameplate style]

The product nameplate shall include the following information (subject to the actual product):

Information Item	Description
Product Name	OSRACER Driverless Vehicle
Product Model	Subject to the physical nameplate
Power Supply Specification	DC 11.1V (3S Lithium Battery)
Input Power	Subject to the physical nameplate
Serial Number (SN)	Factory-unique serial number, used for warranty traceability
Production Date	YYYY-MM-DD format
Manufacturer	Subject to the physical nameplate

Production Address	Subject to the physical nameplate
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⚠ Please keep the nameplate information properly. When applying for after-sales service, you need to provide the serial number, which is usually located at the bottom of the vehicle body or near the control module.

Chapter 12 After-sales and Technical Support

12.1 Warranty Instructions

Component Category	Warranty Period	Warranty Scope
Core Hardware	12 months	Chassis metal structural components, controller main board (ESP32), power management and distribution module (PCB), Jetson carrier board (original factory unmodified), lidar (original factory installed), camera (original factory installed), IMU sensor (original factory installed), original factory wiring harness, original factory remote control and receiver
Mechanical and Electrical Components	6 months	Brushed DC motor, encoder (factory-installed and undismantled), steering servo, electronic speed controller (ESC)
3D Printed Part	DOA Guarantee Only	Report obvious manufacturing defects (delamination, severe cracks, breakage upon assembly) within 7 days of arrival
Wire Connector	DOA/30 Days	Damage upon arrival or functional failure within 30 days (such as poor crimping, missing pins, etc.)

The following situations are not covered by any warranty:

- Damage caused by incorrect ROS parameter configuration, improper PID/MPC/reinforcement learning parameters
- Collision or loss of control caused by the failure of autonomous driving

algorithms

- Damage caused by using non-recommended batteries or chargers
- Electrical operation errors such as overvoltage, reverse connection, short circuit, etc.
- Battery overcharge, over-discharge, and swelling
- Physical damage such as collision, drop, water immersion, dust, mud, etc.
- Unauthorized disassembly of motors, encoders, ESCs, PCB soldering, flying wires, and probe testing
- Structural punching, cutting
- Anti-tamper label damaged (damage is considered as automatic waiver of warranty)
- Force majeure factors (lightning strikes, earthquakes, floods, etc.)

12.2 After-sales Service Process (RMA)

If you need to apply for after-sales service, please follow the steps below:

1. Prepare materials

- Serial Number (visible on the nameplate)
- Purchase Certificate (Invoice or Contract)
- Fault Description (Describe in detail the fault phenomenon and the process of occurrence)
- Fault Photo or Video
- Usage Environment and Operating Instructions

2. Contact Customer Service

- Contact Information: See the after-sales service card inside the package
- Customer service hours: 9:00-18:00 on working days (subject to actual situation)

3. Wait for evaluation

- The manufacturer will complete the evaluation within 3-5 working days after receiving the complete materials.

4. Repair or Replacement

- If it is evaluated to be within the warranty scope, repair or replacement will be arranged.
- For items not covered by warranty, a paid repair quote will be provided

12.3 Technical Support

Supported Types	Content	Acquisition Method
Document Support	Product User Manual, ROS Development Document, Quick Start Guide	Materials inside the package or download from the official website
Software Support	Driver Update, Firmware Upgrade, Example Program	GitHub open source repository or technical support channel
Online Support	FAQ, Technical Forum	Official Website or Technical Forum

Technical Support Resources:

- Official Documentation: See the information card inside the package
- ROS Open Source Repository: See the information card inside the package
- Contact Technical Support: Refer to the After-Sales Service Card inside the package

12.4 Special Instructions for Engineering Prototypes and Customized Versions

Engineering prototypes, test prototypes, and customer customized versions:

- Provide in accordance with the **"AS IS"** principle
- Only for R&D and functional verification
- Does not guarantee final performance indicators
- Does not apply to the standard consumer-grade complete machine warranty policy

FCC Warning:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: Any changes or modifications to this device not explicitly approved by manufacturer could void your authority to operate this equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.