

TRON 2 Tri-Form Set User Manual

生成时间：2026-09-14

Version History

Vers ion	Revisio n Date	Modifie d By	Change Description
v1.0	20260518	damon	Initial draft of the first shipment prepared.
v1.1	20260717	damon	Updates for Main Controller V2.1.24 Upgrade and Corrections of Previous Errors
v1.2	20260810	damon	Information updates for the main controller V2.2.11 upgrade - Added section 6.3: Robot connection to external internet - In section 7.1 (robot body firmware upgrade), added more detailed instructions regarding the motor driver firmware - In section 5.3.3 (starting the teleoperation applet within the VR device), changed the logic of the teleoperation program's interactive interface - In section 5.4 (during teleoperation), changed the home key combination to X+A - In sections 3.2 (mode descriptions and usage flow diagrams) and 3.5 (meaning of indicator lights), added descriptions related to demo mode - In section 3.2, added a manual takeover function during inference on the actual robot - In Section 1.2 Product Specifications, the CPU of the Development Expansion Module has been changed to Intel Core Ultra.
v1.4	20260912	damon	Add a section on remote controller firmware upgrade

Safety Notice

To ensure the safety of both users and the robot, please read the following precautions carefully before use:

1. Professional Use Only: This product is intended for professional use. Individuals under 18 are not advised to operate the device. The operation should only be performed by persons with relevant technical knowledge or under the supervision of qualified personnel.
2. Keep Out of Reach of Children: Prevent children from approaching or interacting with the robot. In environments where children are present, take extra precautions and ensure the robot operates only in safe and supervised conditions.

3. Idle Protection: Do not leave the robot powered on and unattended. Activate mechanical or software-based suspension protection to prevent unintended movement.
4. Safe Operating Environment: Keep the operating area clear of obstacles at all times. Use safety restraints or tethers when necessary to prevent accidental movement, tipping, or injury.
5. Maintain a Safe Distance: Always keep the robot within your line of sight. Maintain a minimum distance of 1 meter (3 feet) from the robot during operation.
6. Handling Precautions: Do not touch the robot's joints or actuating components immediately after power-on or during transportation, as unexpected movement may cause pinching or impact injuries.
7. Low Battery Warning: When a low battery warning is displayed, power off the robot and recharge the battery immediately to prevent unexpected shutdown, system malfunction, or damage.

Safety Warnings

	■ General Safety Warning: This product must be operated in accordance with the instructions in the user manual. Incorrect usage may result in injury, damage, or malfunction. Always ensure that the robot operates in a safe environment.
	■ Battery Safety Warning: This robot is powered by a rechargeable battery. Use only the recommended battery type and follow the correct installation procedures. Improper handling or installation of the battery may result in fire, explosion, or leakage. Dispose of used batteries according to local regulations.
	■ Environmental Conditions Warning: Avoid exposing the robot to excessive moisture, extreme temperatures, or hazardous environments. Operating in wet or freezing conditions can damage internal components and compromise safety.
	■ High-Impact and Collision Risk: This robot may perform high-impact movements, particularly in dynamic environments. Ensure that people and animals are kept at a safe distance to avoid injury from collisions or sudden movements.
	■ Adaptation to Different Environments: This robot is designed to operate in various environments. Ensure the terrain is stable and clear of obstacles before use. Use on uneven surfaces, inclines, or rough terrain may affect stability and performance, potentially causing tipping or loss of balance.
	■ Maintenance Warning: Always turn off and disconnect the power supply before performing any maintenance or repairs. Regular inspection and maintenance are required to ensure safe operation and to prevent malfunctions.
	■ Hand or Body Part Entrapment Risk: Keep hands, feet, and other body parts clear of moving parts during operation to prevent injury or entrapment. This robot contains actuators that may cause injury if body parts come into contact with them while moving.

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To avoid illegal acts, possible injury, and losses, please strictly observe the following requirements:

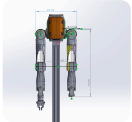
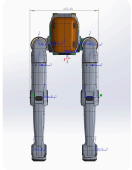
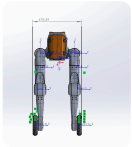
1. For safety precautions, refer to the Safety Notice. Before using this product, carefully read this document and the Safety Notice to understand your rights, responsibilities, and legal terms. Failure to comply may result in property loss or safety hazards. By using this product, you indicate that you fully understand and accept all terms in this document. Operate strictly according to the instructions and take full responsibility for your actions and any related consequences. LimX Dynamics assumes no responsibility for injury or loss caused to relevant personnel due to improper operation.
2. Unauthorized disassembly, modification, or non-standard repair of the product is strictly prohibited. LimX Dynamics is not responsible for equipment faults or damage caused by such actions.
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8. You must comply with the export-control laws and regulations applicable in your region.
9. You must undertake to use this product for legitimate purposes and agree to accept all terms in this document.
10. LimX Dynamics reserves the right of final interpretation of this agreement and may update or adjust it as needed.

1 Product Overview

1.1 Introduction

TRON 2 is a modular, composable, multi-scenario embodied-robotics research platform designed for research users. It enables users to freely implement ideas across different robot configurations. By providing open low-level interfaces and Python/C++ development compatibility, it significantly lowers the research barrier in embodied intelligence. As an ideal platform for university research and teaching as well as secondary development by industry enterprises, TRON 2 is dedicated to advancing robotics from the laboratory toward industrialization.

1.2 Product Specifications

Parameter Category	Parameter Item	TRON 2 EDU Version	TRON 2 Standard Version	Notes
"—" = Not available, "o" = Optional, "✓" = Standard Version				
Mechanical Parameters	Material	Aluminum alloy, plastic	Aluminum alloy, plastic	
	Degrees of Freedom	Single arm: 7 DOF; single leg: 5 DOF; head: 2 DOF	Single arm: 7 DOF; single leg: 5 DOF; head: 2 DOF	
Dimensions	Dual-Arms	- Shoulder width: 447 mm - Arm length: 730 mm (without gripper)	- Shoulder width: 447 mm - Arm length: 730 mm (without gripper)	
	Sole	- Overall width: 453 mm - Standing height: 987 mm	- Overall width: 453 mm - Standing height: 987 mm	
	Wheeled-legs	- Overall width: 478 mm - Standing height: 1015 mm	- Overall width: 478 mm - Standing height: 1015 mm	
	Top Expansion Area	Width: 146 mm; depth: 170 mm	Width: 146 mm; depth: 170 mm	

Functions	Secondary Development	√	—	
	Sole/Wheeled Control Functions	Four-directional Movement, Turning, Static Standing, Squatting Down In-place, Robot Height Adjustment, Stand Up After a Fall, and Ground Clearance Detection	Four-direction movement, turning, static standing, height adjustment (squat/stand), fall recovery, off-ground detection	
	Dual-Arm Teleoperation Method	VR device (PICO 4 Ultra)	—	
	Data Collection and Local Storage	√	—	
	Dual-Arm Safety Boundary Protection	√	—	

Dual-Arm Configuration	Maximum End Effector Load	Maximum: 5kg per arm; Extended: 3kg per arm	Maximum: 5kg per arm; Extended: 3kg per arm	
	Maximum End-Effector Speed	5m/s	5m/s	
	Maximum End-Effector Acceleration	36m/s ²	36m/s ²	
	Repeat Positioning Accuracy	± 0.5mm	± 0.5mm	
	Teleoperation Delay	100ms	100ms	
	End-Effector Type	Gripper \ Dexterous hand	Gripper \ Dexterous hand	
	Gripper Performance	Gripping Force: 20N Maximum; Gripping Width: 85mm	Gripping Force: 20N Maximum; Gripping Width: 85mm	

Sole/Wheeled Configuration	Maximum Movement Speed	Sole: 2-3 m/s; wheeled: 3-5 m/s	Sole: 2-3 m/s; wheeled: 3-5 m/s	
	Maximum Climbing Slope	Sole: 15°; wheeled: 30°	Sole: 15°; wheeled: 30°	
	Maximum Step Height	20cm	20cm	
	Maximum Load Capacity	30kg for flat ground walking; 20kg for stair climbing	30kg for flat ground walking; 20kg for stair climbing	

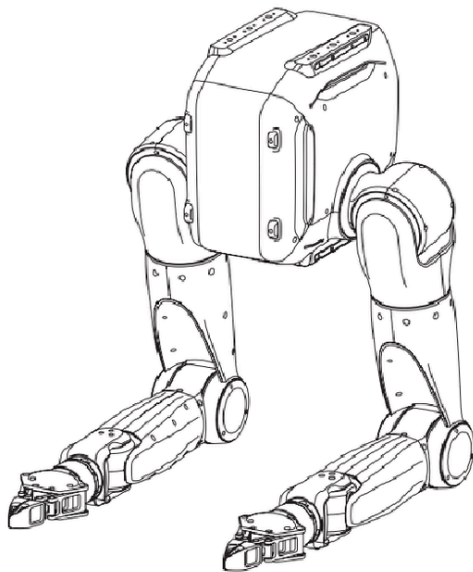
Electrical Parameter s	Battery Output Voltage	46.8V	46.8V	
	Maximum Battery Power	2800W	2800W	
	Support for Battery Replace ment	√	√	
	Battery Type	Ternary lithium battery	Ternary lithium battery	
	Battery Capacity	9Ah	9Ah	
	Charging Power	542W	542W	
	Charging Input Voltage/C urrent	100~240V/8A	100~240V/8A	
	Charging Output Voltage/C urrent	54.275V/10A	54.275V/10A	
	Charging Time	20-80% Charge: 30min ; 20-100% Charge: 54min	20-80% Charge: 30min ; 20-100% Charge: 54min	

Sensor Configuration	Waist RGBD Camera	√	√	
	IMU(Inertial Measurement Unit)	√	√	
	Head RGBD Camera	√ (only for Dual-Arms / Mobile Dual-Arms)	—	
	Wrist RGBD Camera	√ (only for Dual-Arms / Mobile Dual-Arms)	—	
Communication Interfaces	Ethernet Port	√ (1 port)	√ (1 port)	
	USB 3.0 Port	√ (1 port)	√ (1 port)	
	EtherCAT Port	√ (2 port)	√ (2 port)	
	RS485 Port	√ (1 port)	√ (1 port)	
Peripheral Charging Interfaces	24 V Power Output Port	√ (2 port)	√ (2 port)	
	48 V Power Output Port	√ (1 port)	√ (1 port)	
Power Supply Port	External Power Supply Port	√ (1 port)	√ (1 port)	

Developer Expansion Module	CPU	Intel Core Ultra	—	
	Storage Capacity	2TB	—	
	Interfaces	3 x ETH ports, 3 x USB 3.0, 1 x 24 V input power, 1 x 12 V output power	—	
Software Compatibility and Developer Tools	SDK	√	—	
	Robot Management Platform	√	√	
	Data Platform	√	—	
	Simulation Platform	√	—	
	Software Compatibility	Compatible with Python, C++ development environments; Supports ROS1/ROS2 systems	—	

1.3 Packing List

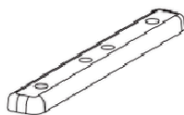
- Flight Case



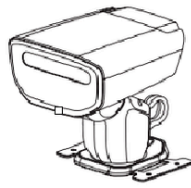
**body
x1**



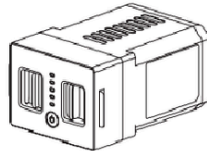
Developer expansion module x1
(EDU version only)



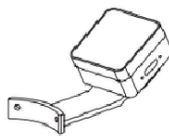
**Body foot pad
x1**



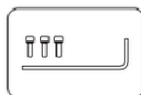
Head camera x1



**Battery
x1**



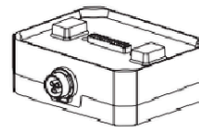
**Wrist cameras and
brackets
x2**



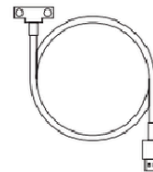
Tool kit x1



VR device x1



**Battery charging
dock x1**



**Wrist cameras
Data Cable x2**



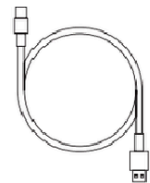
**User manual
x1**



**Remote
controller
x1**



**Power adapter
x1**



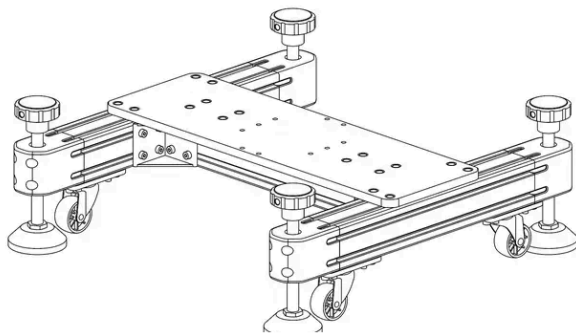
**Remote Controller
Charging Cable x1**



Certificate x1

Carton

Carton



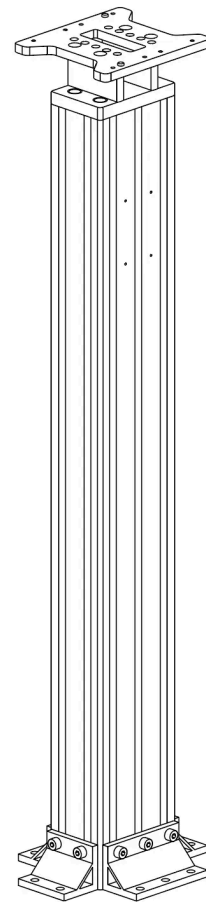
Fixed base x1



Fixed-stand bracket for
developer expansion
module x1

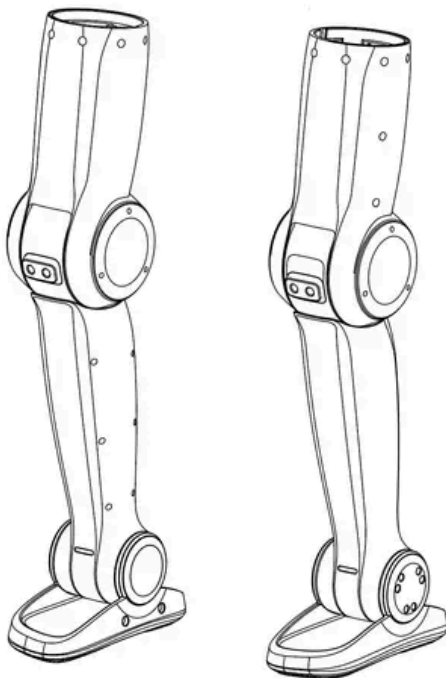


Tool kit x1

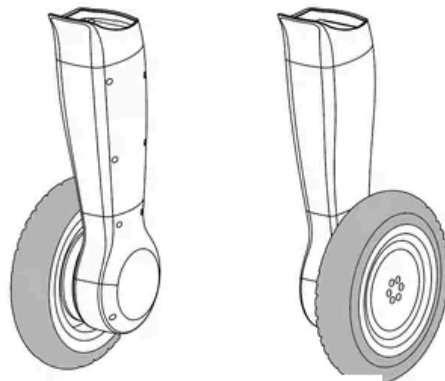


Fixed stand
x1

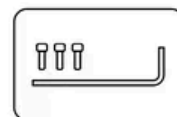
- Carton



Thigh and sole lower legs x2

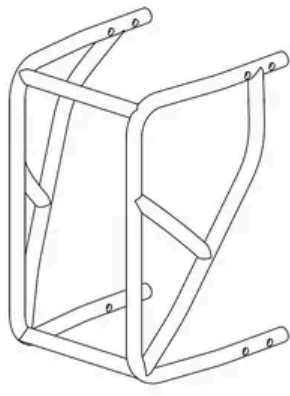


Wheeled lower legs
x2

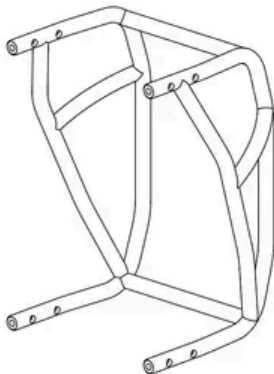


Tool kit x1

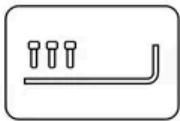
• Carton



Front roll-cage
frame x1

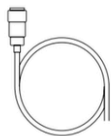


Rear roll-cage
frame x1

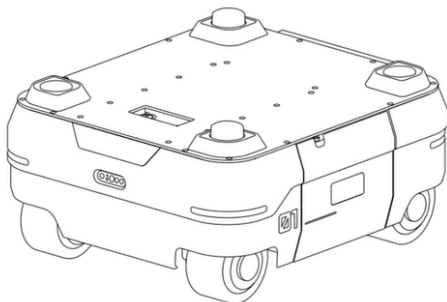


Tool kit x1

Wooden Crate (Equipped on mobile dual-arms version only)



Male Aviation Plug x 1
(4-Pin)



Mobile Base x1



Tool Kit x 1

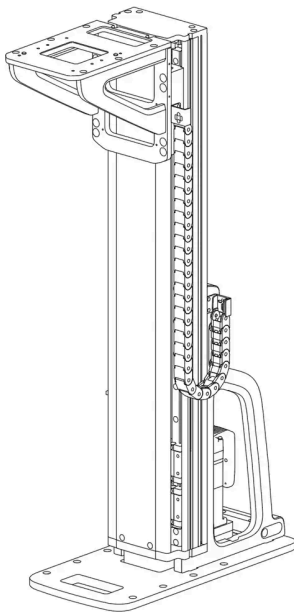


Certificate of
Conformity x1



Power Charger x 1
(AC 220V)

Carton (Equipped on mobile dual-arms version only)



Mobile stand
x1



Tool kit x1

1.4 Body Components and Ports

Body Components

Component/ Ports	Function Description	Component/ Ports	Function Description
Status Indicator	Displays overall robot status, including mode status, fault status, low-battery reminders, etc.	Peripheral Expansion Platform	Includes peripheral expansion platforms at the top, front, and bottom. All threaded holes are M4 and are used to mount external expansion devices.

Robot Body Receptacle Interfaces

Component/ Ports	Function Description	Component/ Ports	Function Description
Power Button	Used to power the robot on/off	Battery Level Indicator	Displays the current robot battery level
External Power Ports	Used to connect an external power adapter	Emergency Stop Button	In an emergency, press this button to enter torque-off mode, cutting motor power
24 V Power Output Ports	LCB female connector, stable 24 V DC output, rated output 5 A, maximum output 20 A	48 V Power Output Port	LCB female connector, stable 48 V DC output, rated output 10 A, maximum output 20 A
USB 3.0 Ports	USB-A 3.0, available for external device expansion	Ethernet Ports	Gigabit Ethernet port for connecting a computer, router, or other communication module
RS485 Ports	Used to expand external devices	EtherCAT Ports	Used to expand external devices

Developer Expansion Module Ports

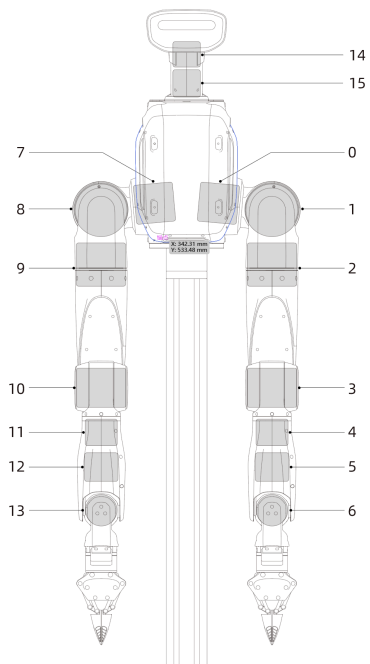
Component/Interface	Function Description	Component/ Ports	Function Description
12 V Power Output Port	LCB female connector, stable 12 V DC output, maximum output current 5 A	Ethernet Interface	Gigabit Ethernet port

1.5 Coordinate Frames and Joint Limits

Dual-Arms Configuration

When all joints are at zero degrees, their joint coordinate frames are shown below. Red indicates the x-axis, green indicates the y-axis, and blue indicates the z-axis.

Joint numbers and limits are shown below.

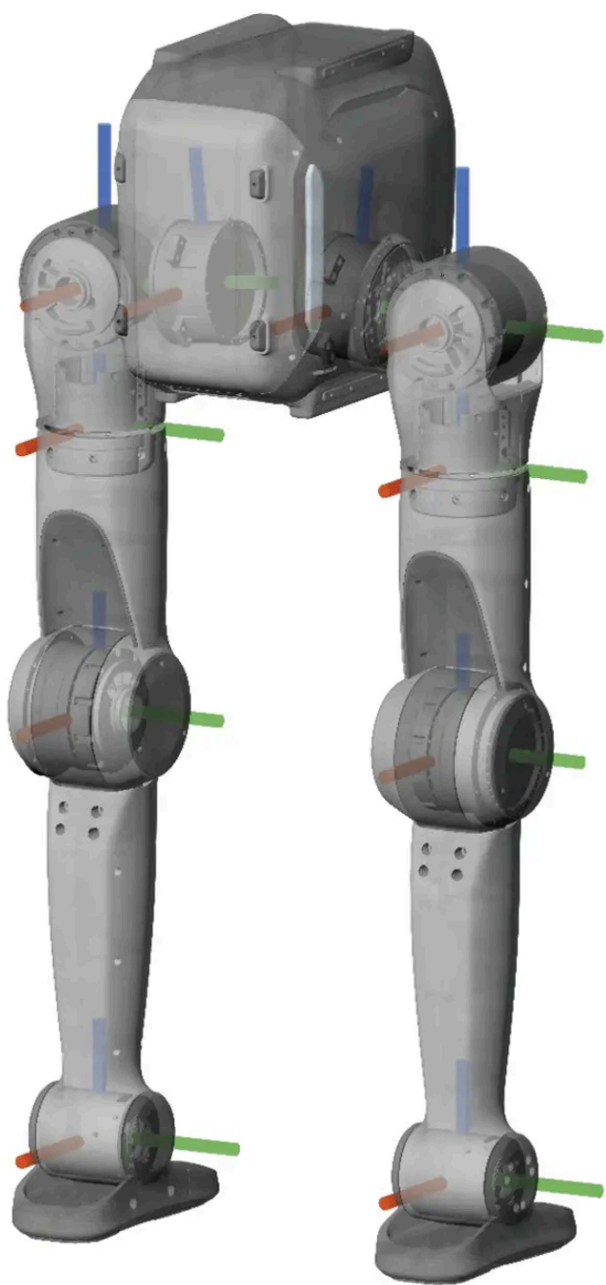


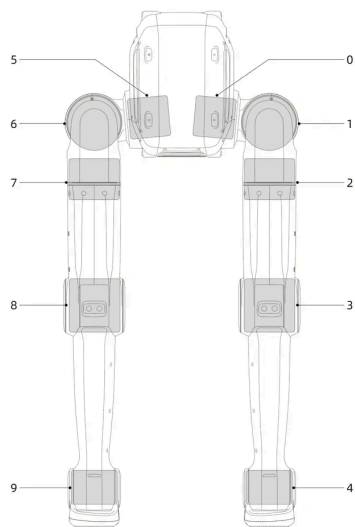
Joint No.	English Joint Name	Limits (deg)		Limits (rad)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
0	proximal_pitch_L_Joint	-180	149	-3.14	2.60
1	proximal_roll_L_Joint	-15	183	-0.26	3.22
2	proximal_yaw_L_Joint	-210	85	-3.66	1.48
3	elbow_L_Joint	-150	15	-2.61	0.26
4	wrist_yaw_L_Joint	-100	80	-1.74	1.39
5	wrist_pitch_L_Joint	-45	45	-0.78	0.78
6	wrist_roll_L_Joint	-90	90	-1.57	1.57
7	proximal_pitch_R_Joint	-180	149	-3.14	2.60
8	proximal_roll_R_Joint	-183	15	-3.22	0.26
9	proximal_yaw_R_Joint	-85	210	-1.48	3.66
10	elbow_R_Joint	-150	15	-2.61	0.26
11	wrist_yaw_R_Joint	-80	100	-1.39	1.74
12	wrist_pitch_R_Joint	-45	45	-0.78	0.78

Joint No.	English Joint Name	Limits (deg)		Limits (rad)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
13	wrist_roll_Right_Joint	-90	90	-1.57	1.57
14	head_pitch_Joint	-45	60	-0.78	1.04
15	head_yaw_Joint	-90	90	-1.57	1.57

Sole/Wheeled Configuration

When all joints are at zero degrees, their joint coordinate frames are shown below. Red indicates the x-axis, green indicates the y-axis, and blue indicates the z-axis.





Joint No.	English Joint Name	Limits (deg)		Limits (rad)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
0	proximal_pitch_L_Joint	-180	149	-3.14	2.60
1	proximal_roll_L_Joint	-15	183	-0.26	3.19
2	proximal_yaw_L_Joint	-210	85	-3.66	1.48
3	knee_L_Joint	-150	15	-2.61	0.26
4	ankle_pitch_L_Joint	-97	97	-1.69	1.69
	wheel_L_Joint	∞	∞	∞	∞
5	proximal_pitch_R_Joint	-180	149	-3.14	2.60
6	proximal_roll_R_Joint	-183	15	-3.19	0.26
7	proximal_yaw_R_Joint	-85	210	-1.48	3.66
8	knee_R_Joint	-150	15	-2.61	0.26
9	ankle_pitch_R_Joint	-97	97	-1.69	1.69
	wheel_R_Joint	∞	∞	∞	∞

1.6 Installation Guide

1.6.1 Installation Video Guide

Item No.	Video Title	Video Links
1	Unboxing	https://oss.limxdynamics.com/uploads/video/2026/09/14/1789355702850_1_unboxing_EN.mp4
2	Dual-Arm Installation	https://oss.limxdynamics.com/uploads/video/2026/09/14/1789355830898_2_dual_arm_installation_EN.mp4
3	Wheeled-Foot Installation	https://oss.limxdynamics.com/uploads/video/2026/09/14/1789355919536_3_wheeled_foot_installation_EN.mp4
4	Wheeled-Foot Sole Switching	https://oss.limxdynamics.com/uploads/video/2026/09/14/1789356075749_4_wheeled_foot_sole_switching_EN.mp4
5	Anti-Roll Bar Installation	https://oss.limxdynamics.com/uploads/video/2026/09/14/1789356161975_5_anti_roll_bar_installation_EN.mp4
6	Remote Controller Pairing	https://oss.limxdynamics.com/uploads/video/2026/09/14/1789356247700_6_remote_controller_pairing_EN.mp4
7	Packing	https://oss.limxdynamics.com/uploads/video/2026/09/14/1789356371536_7_packing_EN.mp4
8	Dual-Arm Remote Control	https://oss.limxdynamics.com/uploads/video/2026/09/14/1789356411220_8_remote_controller_arm_EN.mp4
9	Wheeled-Foot Remote Control	https://oss.limxdynamics.com/uploads/video/2026/09/14/1789356489931_9_remote_controller_wheeled_foot_EN.mp4
10	Dual-Arm Teleoperation	https://oss.limxdynamics.com/uploads/video/2026/09/14/1789356585575_10_dual_arm_teleoperation_EN.mp4
11	Network Setup	https://oss.limxdynamics.com/uploads/video/2026/09/14/1789356666294_11_network_setup_EN.mp4
12	Zero Calibration	https://oss.limxdynamics.com/uploads/video/2026/09/14/1789356776087_12_zero_calibration_EN.mp4

1.6.2 Pre-Power-On Wiring Check

DANGER

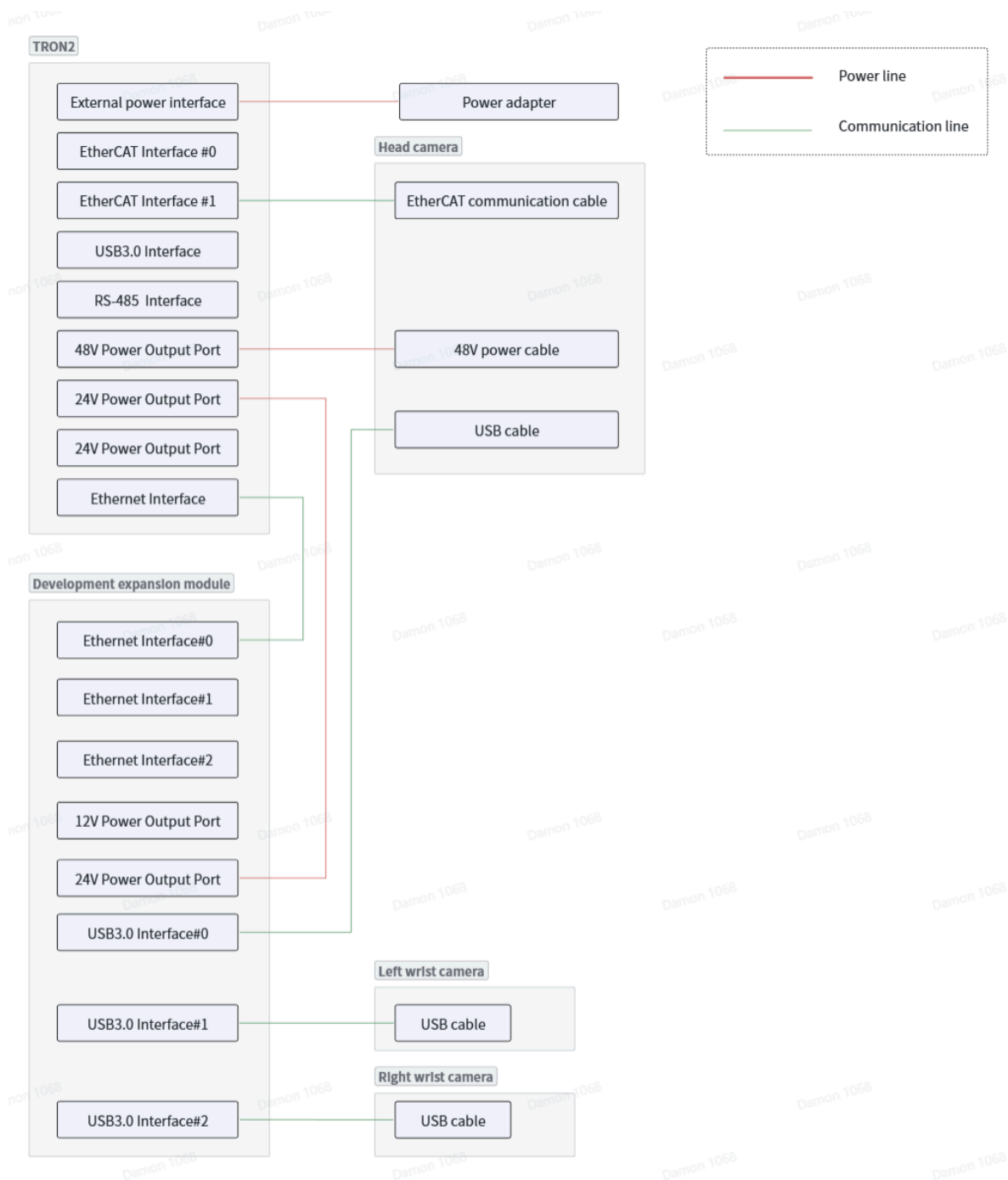
Incorrectly connecting a power cable may immediately damage the robot hardware.

Mandatory Checks Before Power-On

1. Verify that the robot, power adapter, and Mobile Base are all powered off.
2. Check each cable label against its port label as shown in the wiring diagrams. Pay particular attention to the power cable connections.
3. Verify the connector orientation. Never force a connector into a port.
4. Verify that every connector is fully seated and locked, with no looseness, misalignment, or exposed metal contacts.
5. Inspect the cables and connectors for damage, deformation, signs of burning, or unusual odors.
6. If you cannot confirm that the wiring is correct, do not power on the robot. Contact LimX Dynamics Technical Support.

Dual-Arm Robot Wiring

Before power-on, check the Dual-Arm Robot wiring against the diagram below.

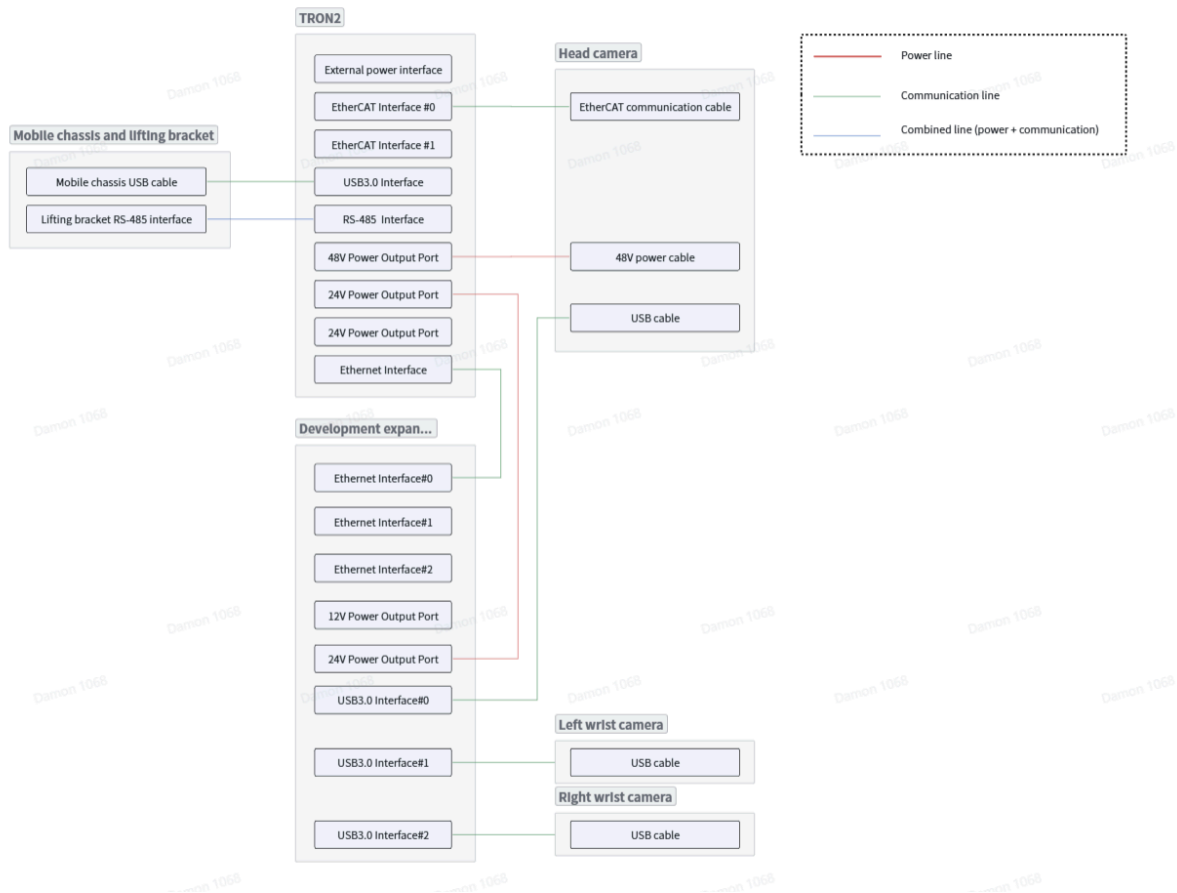


Tip

The robot can be converted from the Dual-Arm Configuration to either the Sole or Wheeled-legs Configuration. The robot-body wiring remains the same. Check the wiring against the Dual-Arm Robot wiring diagram.

Mobile Base Wiring

This wiring diagram applies only to the Mobile Dual-Arms Robot. Before power-on, check the wiring of both the Dual-Arm Robot and the Mobile Base.



2 Battery Level Check and Charging Instructions

2.1 Robot Battery Level Check and Charging

Checking the Robot Battery Level

Short-press the power button once to check the battery level.

Charging the Robot Battery

1. Connect the battery charging dock and power adapter, align the aviation connector with the keyed position, and insert it.
2. Insert the battery into the charging dock, press it down to ensure it is fully seated, and plug the power adapter into a power outlet (220 V AC).
3. If the battery indicator flashes and the power adapter indicator is steady blue, charging has started. When the battery indicator and the power adapter indicator are both steady green, the battery is fully charged.

Battery and Adapter Indicator Lights

	Not Charging	Charging	Charging Complete	Charging Fault
Battery	No light	Green flashing	Green steady	
Power Adapter	Green steady	Blue steady	Green steady	Red flashing

Tip:

- If the device will not be used for an extended period, charge the battery once every three months to avoid battery damage.
- Long-term charging is not recommended. Remove the power adapter promptly after the battery is fully charged.

2.2 Remote Controller Battery Level Check and Charging

Checking the Remote Controller Battery Level

After long-pressing the Power button below the remote controller screen to turn it on, check the battery icon at the upper right of the screen.

Charging the Remote Controller

1. Connect the Type-C end of the remote controller charging cable to the remote controller and connect the other end to a 5 V/1 A power supply.
2. A steady green remote controller indicator means charging has started successfully.

Remote Controller Charging Indicator

	Not Charging	Charging / Charging Complete
Remote Controller Indicator	No light	Green steady

2.3 Mobile Bases Battery Level Check and Charging (Mobile Dual-Arms Version Only)

Checking the Mobile Bases Battery Level

The normal battery voltage range is 24-29.4 V. If the chassis LED flashes red, the battery voltage is too low. Charge it promptly.

Charging the Mobile Bases

Use the 10A charger provided with the product. Insert the charger plug into the charging port on the rear of the mobile base, then connect the charger to a power source. The robot will begin charging.

3 Using Your TRON 2

3.1 Operating Environment Requirements

- Electromagnetic interference: Avoid operating near interference sources such as high-voltage power lines and mobile base stations.
- Wi-Fi signal interference: Avoid co-channel interference. If interference occurs, turn off other nearby wireless signal sources.
- Line-of-sight control: Keep the robot within visual range at all times and maintain a safety distance of at least 1 m from obstacles, crowds, water surfaces, etc.
- Temperature range: -5°C to 40°C. Outdoor use is prohibited in severe weather such as heavy fog, rain, snow, or thunderstorms.
- Water and dust protection: The robot is not waterproof or dustproof. Avoid humid, sandy, or dusty environments.
- Ground requirements: Use on flat ground with high friction. Operate cautiously if the robot must be used on smooth surfaces.
- Safety assistance: In Sole/wheeled configurations, use a tether to avoid falls during remote control and early development testing.

3.2 Mode Descriptions and Usage Flow

Configurati on	Mode	Mode Description
Dual-Arms Configurati on	Show Mode	Provides Preset Motion Demo, Drag-to-Record Trajectory, and Playback of Recorded Trajectory.
	VR Teleoperation Mode	In this mode, a VR device is used to remotely operate the robot, mainly for teleoperation, data collection, etc.
	High-Level Development Mode (EDU version only)	Allows calls to high-level application development interfaces to control robot motion based on built-in motion-control algorithms, such as moveJ and servoP.
	Low-Level Development Mode (EDU version only)	Allows calls to low-level development interfaces to directly control joints.

5. Observe the status indicator. During startup, it flashes white. After about 20 s, it changes to steady Blue/Cyan/Green, indicating startup is complete.
6. Check the signal indicator on the remote controller display. If a signal is shown, pairing has succeeded and startup is complete.

Tip:

The robot can start normally only after the head is installed and the head joint power cable and joint communication cable are connected.

Power-Off Procedure

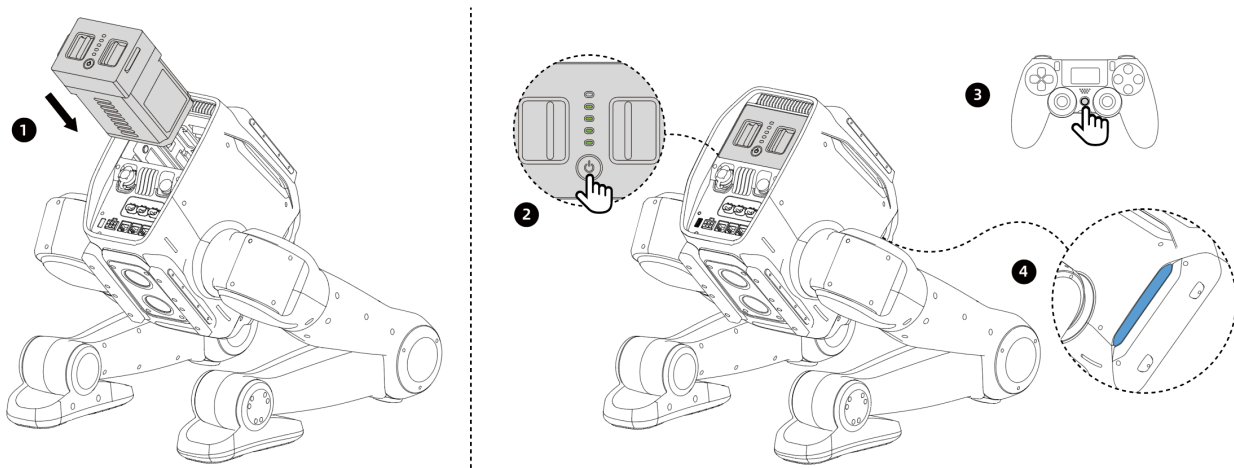
1. To stop robot motion, press L1+X simultaneously in remote-control mode to enter idle state. All joint motors enter torque-damping state and will slowly move downward.
2. For the fixed-base version, unplug the external power interface. For the mobile base version, turn off the power switch at the rear of the base.
3. Short-press for 0.5 s, then long-press the robot Power button for 3 s to power off. The battery level indicator and status light will turn off.
4. Long-press the remote controller power-off button for 3 s to power off. The display will turn off.

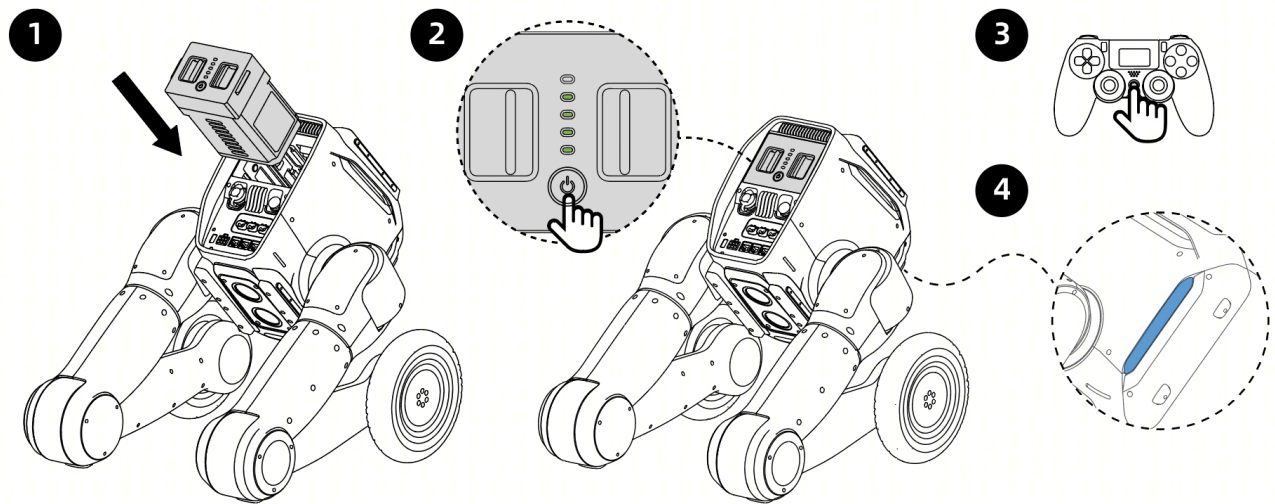
Tip:

Note: Enter idle state first and allow the joint motors to return slowly. If the power-off button is pressed directly, the joints will drop immediately and may damage the robot.

3.4 Sole/Wheeled Robot Power-On/Off Procedure

Power-On Procedure





1. Before powering on, place the robot in the position shown and keep it self-balanced.
2. Insert a fully charged battery into the battery compartment and press until the latch locks.
3. Short-press for 0.5 s, then long-press the robot Power button for 3 s to start the robot. The battery level indicator will turn on.
4. Long-press the remote controller power button for 2 s to turn it on. The display will light up and show information.
5. Observe the status indicator. It flashes white during startup, and steady blue indicates startup is complete.
6. About 20 s after startup, the body status indicator changes from white to steady Blue/Cyan/Green. Check the signal indicator on the remote controller display. If a signal is shown, pairing has succeeded and startup is complete.

Power-Off Procedure

1. To stop robot motion, press L1+X simultaneously in remote-control mode to enter squat state and let the device land stably.
2. Long-press the robot power-off button for 3 s to power off. The battery level indicator and status light will turn off.
3. Long-press the remote controller power-off button for 2 s to power off. The display will turn off.
4. After all indicators turn off, remove the battery.

3.5 Robot Light Indicator Meanings

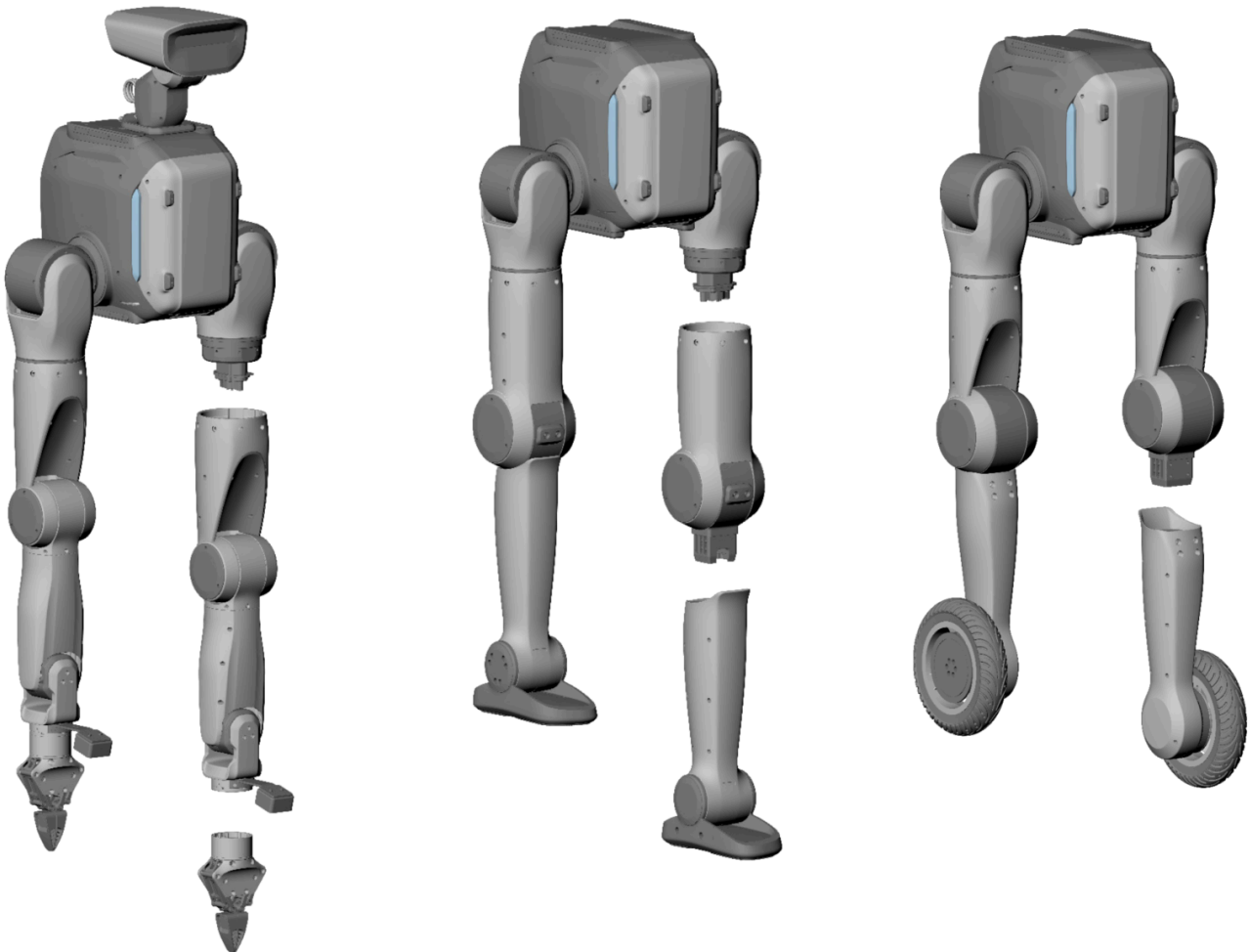
Event/Status	Indicator Color	Indicator Description	Frequency (seconds/time)
TRON2 Robot Body			

Starting Up	White slow flashing	Startup self-test in progress	1
Fault Warning	Red steady	Robot fault detected	/
Low Battery Warning	Red flashing	Robot battery low (below 20%)	2
Critically Low Battery Warning	Red fast flashing	Robot battery low (below 5%)	0.5
Emergency Stop State	Yellow flashing	Body emergency stop button triggered	2
Show Mode	Blue-Violet	After startup or mode switching, the current mode status will be shown.	/
Remote-Control Mode (for Sole/wheeled)	Steady blue	After startup or mode switching, the current mode status will be shown.	/
VR Teleoperation Mode (for dual-arms configuration)	Steady blue	After startup or mode switching, the current mode status will be shown.	/
High-Level Developer Mode	Steady cyan	After startup or mode switching, the current mode status will be shown.	/
Low-Level Developer Mode	Steady green	After startup or mode switching, the current mode status will be shown.	/
Stair Mode (only for wheeled)	Purple dynamic	Robot is in stair mode	2
Fall (for Sole/wheeled)	Steady yellow	Robot fall detected	/
Off-Ground Detection (for Sole/wheeled)	Yellow breathing	Robot is in off-ground detection state	2
Mobile Chassis (mobile dual-arm version only)			
Error	Red steady	Error occurred	/
Low Battery Warning	Red flashing	Battery level below 15% warning	1

Charging	Green slow flashing	Charging current greater than 1 A	2
Parking	Yellow steady	Four wheels locked in an X configuration	/
Normal Motion Mode	Blue steady	Standby state or straight-line motion	/

3.6 Robot Configuration Switching

- Automatic recognition is supported between configurations; manual configuration is not required.
- The leg and arm configurations share the same first three joints. To replace an arm or leg, detach it below the hip (for legs) or shoulder (for arms) joint. This can be done by one person using the supplied toolkit.
- Switching between bipedal and wheeled-biped configurations can be completed quickly. The mounting structure includes poka-yoke design to prevent the feet from being installed front/back reversed or the wheeled legs from being installed inside/out reversed.

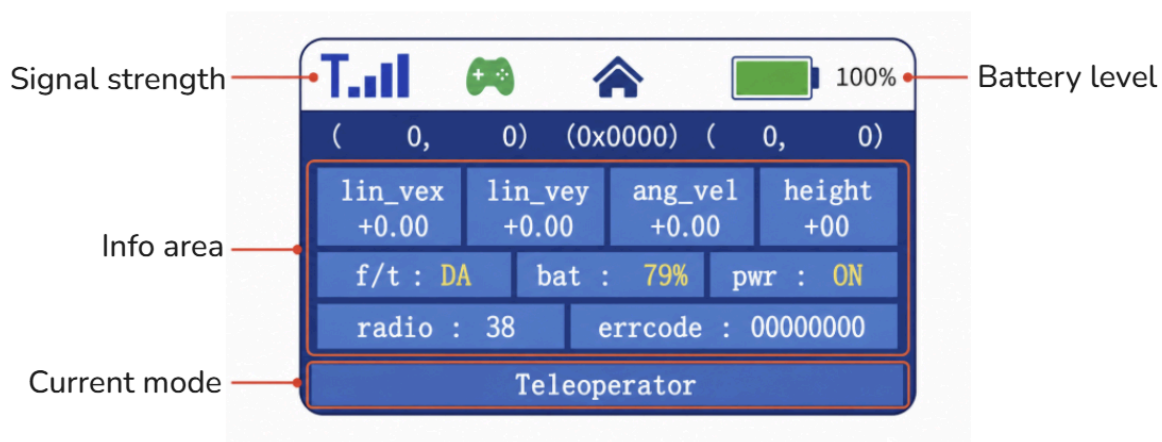


4 Remote Controller Instructions

4.1 Remote Controller Power On/Off

- Turn on the remote controller: Press and hold the Power button for more than 2 s. When you hear a beep, the remote controller has turned on successfully and enters the default interface.
- Turn off the remote controller: Press and hold the Power button for more than 2 s. When you hear a beep, the remote controller turns off and the display goes dark.

4.2 Screen Information



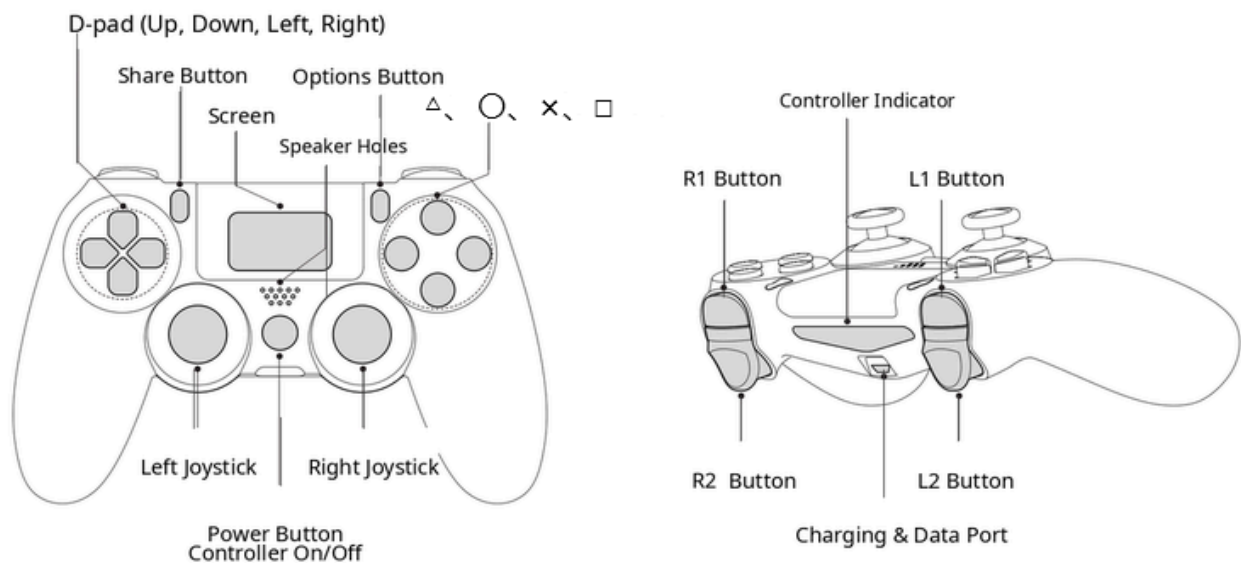
Signal Strength: When the remote controller is not connected to the robot, no signal icon is shown. After connection, blue signal bars are displayed. More lit bars indicate stronger signal.

Battery Level: Indicates the remote controller battery level

Information Area: Returns the robot's current mode, battery level, whether the robot is powered on, etc.

Current Mode/Status: High-Level Development(High-Level Developer Mode)/Low-Level Development(Low-Level Developer Mode)/Teleoperator(Remote-Control Mode)/show Mode/Idle(idle state in different modes)

4.3 Remote Controller Buttons



4.4 Dual-Arms/Mobile Dual-Arms Robot Remote-Control Commands

Concept	Command Description	Prerequisite	Button	Notes
Mode Switching	Cycles through modes in the dual-arm configuration	Idle state	R1 + Right button	After startup, the robot remains in the mode used before shutdown by default
Return Action	- In dual-arms mode, the homing action consists of the arms swinging outward and then hanging down naturally (if the safety protection function is enabled, this triggers the arm's table-avoidance action). - After completing the homing action, the robot automatically enters the idle state (the joint motors are in torque damping mode).	Effective only in Remote-Control Mode and High-Level Developer Mode	L1+X	
Enters the idle state directly	Does not execute the return action. All joint motors enter torque-damping state and slowly move downward.	Global	L1+ □	Use only in emergencies when the return action fails

Concept	Command Description	Prerequisite	Button	Notes
Emergency Stop Button	All motor drives are immediately powered off, but battery power and indicator lights remain on. The whole robot will drop.	Global	Press the left joystick + right joystick	Triggering emergency stop in any mode or state immediately cuts power to all motors
Emergency Stop Release	Motors power on again	Emergency Stop State	Press the Right joystick button	Single-clicking has no effect in other states. After release, the robot enters damping state.
Zero Calibration	Used to recalibrate joint zero positions	Idle state	L1+R1	Zero calibration is required only after the main controller has been upgraded or after severe impact causes zero-position loss or position drift.

4.5 Sole/Wheeled Robot Remote-Control Commands

Command	Command Description	Prerequisite	Button	Notes
Mode Switching	Cycles through modes in the two-leg configuration	Idle state	R1 + Right button	After startup, the robot remains in the mode used before shutdown by default
Enter prapered State	Performs ground-contact/head-lift action	Idle state	L1+ ○	
Enters the idle state directly	Does not execute the return action. All joint motors enter torque-damping state and slowly move downward.	Global	L1+ □	Use only in emergencies when the return action fails
Stand Up in Place	The robot stands up from ready state	Ready state	L1+ △	

Command	Command Description	Prerequisite	Button	Notes
Return Action	- In the sole/wheeled configuration, the return action is squat-and-fold. - After the return action is complete, the robot automatically enters idle state (joint motors are in torque-damping state).	Effective only in Remote-Control Mode and High-Level Developer Mode	L1+X	
Forward/Backward Movement	The robot moves forward/backward according to remote-control commands	Standing state	Left joystick up/down	
Left/Right Movement (sole only)	The robot moves left/right according to remote-control commands	Standing state	Left joystick left/right	
Turn in Place	The robot rotates clockwise/counterclockwise according to remote-control commands	Standing state	Right joystick left/right	
Height Adjustment	The user can adjust body height within the allowed range using the remote controller	Standing state	Hold R1 + Up/Down buttons. The robot descends/ascends at constant speed and stops when released.	After power cycling, the robot returns to the default position and does not remember the previous height setting
Flat-Ground/Stair Mode Switching (wheeled-biped only)	Switches between stair mode and flat-ground mode	Standing state	Press the Share button for 2 s	
Fall Recovery	Restores the robot to standing after an accidental fall	Fall detected	L2+ △	This key combination has no effect when the robot is in normal state

Command	Command Description	Prerequisite	Button	Notes
Emergency Stop Button	All motor drives are immediately powered off, but battery power and indicator lights remain on. The whole robot will drop.	Global	Press the left joystick + right joystick	Triggering emergency stop in any mode or state immediately cuts power to all motors
Emergency Stop Release	Motors power on again	Emergency Stop State	Press the Right joystick button	Single-clicking has no effect in other states. After release, the robot enters damping state.
Zero Calibration	Used to recalibrate joint zero positions	Idle state	L1+R1	Zero calibration is required only after the main controller has been upgraded or after severe impact causes zero-position loss or position drift.

Tip:

After emergency stop is triggered, power to all motors is immediately cut off (confirm the emergency stop state before startup).

a.Body emergency stop: The robot is in emergency stop state when the emergency stop button is pressed, and not in emergency stop state when it is released. After emergency stop is released, the robot must be powered on again to restore its state.

b.Remote controller emergency stop: Pressing the left and right joysticks simultaneously enters emergency stop state. Press the right joystick button to exit emergency stop state, and the robot state will automatically recover after a few seconds.

5 VR Device and Dual-Arms Teleoperation Instructions

5.1 VR controller Buttons

5.2 VR controller Commands

Dual-Arms

Concept	Command Description	Prerequisite	Button
Start VR Teleoperation	Enters the initial zero position for VR teleoperation from the idle-state posture; the grippers also perform zero calibration.	Robot is in VR Teleoperation Mode	Long-press X+A buttons simultaneously (>1 s)
Return to Initial Teleoperation Zero Position	During teleoperation, use the VR controllers to return the arms to the initial zero position (elbows folded forward 90°).	VR teleoperation working state	Long-press X+A buttons simultaneously (>1 s)
End-Effector Following	Hold the VR controllers; the robotic arm end effectors follow.	VR teleoperation working state	None
End-Effector Lock	During VR teleoperation, the arms can be paused.	VR teleoperation initial zero state / VR teleoperation working state	- During teleoperation, click the left controller X button to pause the left arm; click again to resume. - During teleoperation, click the right controller A button to pause the right arm; click again to resume. - In zero-return locked state, click the left controller X button and right controller A button simultaneously.
Gripper control	Remotely closes and opens the grippers.	VR teleoperation initial zero state / VR teleoperation working state	short-press Left/right trigger button
Start Data Collection	Starts collecting teleoperation data. When the VR device receives the robot's data-collection start signal, the VR controllers vibrate for feedback and the data platform status is updated synchronously.	VR teleoperation working state	Right controller B button

Stop Data Collection	Stops collecting teleoperation data. When the VR device receives the robot's data-collection stop signal, the VR controllers vibrate for feedback and the data platform status is updated synchronously.	VR teleoperation working state	Left controller Y button
Mobile base			
Concept	State Description	Prerequisite	Button
Chassis Mode Selection	Selects Ackermann Mode or Diagonal Movement Mode for the chassis	VR teleoperation working state	The default out-of-box mode is Ackermann Mode. Long-press the right joystick for 1 s to switch to Diagonal Movement Mode. Long-press the left joystick for 1 s to switch to Ackermann Mode.
Forward Movement	Robot moves forward	VR teleoperation working state	Push left joystick forward
Backward Movement	Robot moves backward	VR teleoperation working state	Push left joystick backward
Ackermann Rotation	In Ackermann Mode, the drive wheels rotate to turn the chassis	VR teleoperation working state	In Ackermann Mode, push the right joystick left/right
Diagonal Movement	In Diagonal Movement Mode, the chassis does not rotate; the drive wheels turn and the chassis moves diagonally left/right	VR teleoperation working state	In Diagonal Movement Mode, push the right joystick left/right
Speed Adjustment	Mobile chassis speed can be adjusted with the joystick	VR teleoperation working state	The farther the left joystick is pushed forward/backward, the higher the speed. Stroke 0 means speed 0; maximum stroke means maximum speed.

Parking State	When the robot needs to remain stopped at a fixed position for a long time, such as parking or performing fixed-table tasks, switch the chassis to Parking State. The four wheels lock in an X-shaped four-wheel steering configuration.	VR teleoperation working state	Long-press the left controller Grip button and right controller joystick simultaneously for 1 s
Emergency Stop	For the TRON2 dual-arm configuration with mobile chassis, the mobile chassis also stops immediately when emergency stop is triggered.	VR teleoperation working state	VR controllers: press the VR left and right joysticks simultaneously. Remote Controller: press the left and right joysticks simultaneously.
Lift Stand			
Concept	State Description	Prerequisite	Button
Raise	Controls the stand to raise the robot height	VR teleoperation working state	Hold the right controller Grip button and push the left joystick forward
Lower	Controls the stand to lower the robot height	VR teleoperation working state	Hold the right controller Grip button and push the left joystick backward
Return to Zero	Sends a command to return the stand to zero position (zero position is the top end of the stand, making battery removal easier).	VR teleoperation working state	Long-press the right controller Grip button and left controller joystick simultaneously for 1 s

5.3 Teleoperation Preparation

5.3.1 Dual-Arms Zero Calibration

Tip:

- Zero calibration is required only after the main controller has been upgraded or after severe impact causes zero-position loss or position drift.
- In the mobile chassis configuration, raise the robot to the highest point before performing zero calibration.
- After zero calibration is complete, wait about 5 seconds while the robot refreshes the new zero-position information before performing other operations.

1. Press **L1+X** to ensure the dual arms are in idle state and hanging naturally;

2. Press `L1+R1` on the remote controller to start automatic zero calibration. After calibration ends, the dual arms should hang naturally;
3. If the indicator turns red during the process, zero calibration has failed. Try calibrating again.

5.3.2 Switching the TRON2 Robot to Teleoperation Mode

Press `R1+Right button` on the remote controller to switch to Teleoperation Mode.

5.3.3 Starting the Teleoperation App on the VR Device

Note: Do not remove the protective sticker covering the detection sensor before teleoperation use (otherwise the headset may frequently enter sleep mode).

1. Turn on the VR device and connect to the TRON2 robot Wi-Fi `"TRON2A_XXX_2.4G"` or `"TRON2A_XXX_5G"`. The password is `12345678`.
-

1. In the Resource Library, click the installed teleoperation mini-program `Limx_teleop` to launch it.
 2. Select "tron2-offline" in the configuration options. For the robot IP, enter `10.192.1.2`. Keep the tracking settings at their defaults (check "Head", "Controller", and "Hands"). Click Connect to enter the TRON2 teleoperation working state. The default view is the see-through interface shown below.
-

Note: If prompted whether to enable body following during the process, select No.

1. Hang the VR headset horizontally around your neck, as shown below. Hold the VR controllers in your hands, ready for teleoperation.

5.4 Using Teleoperation

5.4.1 Starting Teleoperation and Entering Ready State

Long-press `left X button + right A button` simultaneously for 1.0 s to start zero return. After zero return ends, the dual arms should be in teleoperation ready state, with the forearms extended forward at a 90° angle.

5.4.2 Entering Teleoperation Working State

Hold the controllers with both hands, align the user's arms close to the robot arms' posture, keep the controllers level and forward, then short-press **X+A** simultaneously for about 0.2 s to unlock and enter teleoperation working state.

5.4.3 Returning Dual Arms to Ready State

This function returns the dual arms to the initial forward-extended ready state. Long-press **X+A** simultaneously for 1.0 s to trigger it.

5.4.4 Unlocking Dual-Arm Motion

After zero return is triggered, the dual arms enter locked state by default. Short-press **X+A** for about 0.2 seconds to unlock. The robotic arm end effectors will then start moving by following the positions of the user's controllers.

5.4.5 Single-Arm Pause/Resume

This function pauses a specified arm and is used for correction when the user's arm posture differs greatly from the robotic arm posture. Short-press **X** (left arm) or short-press **A** (right arm) once to pause. Short-press **X** (left arm) or short-press **A** (right arm) again to resume motion. When resumed, motion continues from the paused position.

5.4.6 Gripper Grasping

Press **left trigger button/right trigger button** to open the left/right gripper; press again to close it.

5.4.7 Mobile base and Lift Stand Control

At this point, the mobile chassis and lift stand can be controlled normally according to the VR device commands.

6 Robot Network Connection

6.1 PC to dual-arm – Wired

1. Use an Ethernet cable to connect the Gigabit Ethernet port on the robot's rear side to the PC Ethernet port.
 2. Modify the IP address of the personal computer to the same network segment as the robot to access the system. The robot IP address is 10.192.1.2. For example, set the PC address to 10.192.1.120.
-

6.2 PC to dual-arm – Wireless

1. After the robot startup is complete, use a personal computer to connect to the robot Wi-Fi. The name format is usually "TRON2A_XXX_2.4G" or "TRON2A_XXX_5G".
2. Enter the Wi-Fi password: 12345678 .

6.3 dual-arm to an External Network

1. After the PC is connected to the dual-arm, open a browser and access the dual-arm management page at <http://10.192.1.2:8080> .
2. Click the Wi-Fi icon on the right, and enter the Wi-Fi information required for the dual-arm to connect, including Wi-Fi Band, Wi-Fi SSID, Wi-Fi Password, and Router Admin Password.

7 Robot Software Upgrade

7.1 Robot Body Firmware Upgrade

Use a browser to enter the robot management page and select the robot software version downloaded locally in advance for upgrade. The steps are as follows:

1. Connection and IP settings:
 - a. Connect a personal computer to the robot.
 - b. Use the Shell command `ping 10.192.1.2` to ensure the connection is normal.
2. Access the management page: enter the following in the browser address bar:<http://10.192.1.2:8080> to enter the robot management page.
3. Select and upgrade software:
 - a. Go to the LimX Dynamics official website → Downloads , at <https://www.limxdynamics.com/en/downloads>. Select the product model **TRON2**, choose the firmware type and version you need, and download the firmware package to your local computer.
 - b. On the robot management page, go to the **Version Management** section. Select the firmware type you wish to upgrade, click **Choose File** to upload the firmware package, then click the **Upgrade** button after the upload is complete. Wait patiently for the upgrade to finish.
 - c. Note: Upgrading the motor driver firmware must be done in two steps (this applies to both the dual-arm configuration and the bipedal/wheeled-leg configuration). First, select all motors, choose the downloaded "**TRON2 – Motor Driver Firmware**", and click **Upgrade**. Then, select all motors again, choose the downloaded "**TRON2 – Motor Driver Firmware Supplementary Package**", and click **Upgrade**.
 - d. Note: The robot will automatically restart after certain firmware upgrades are completed.

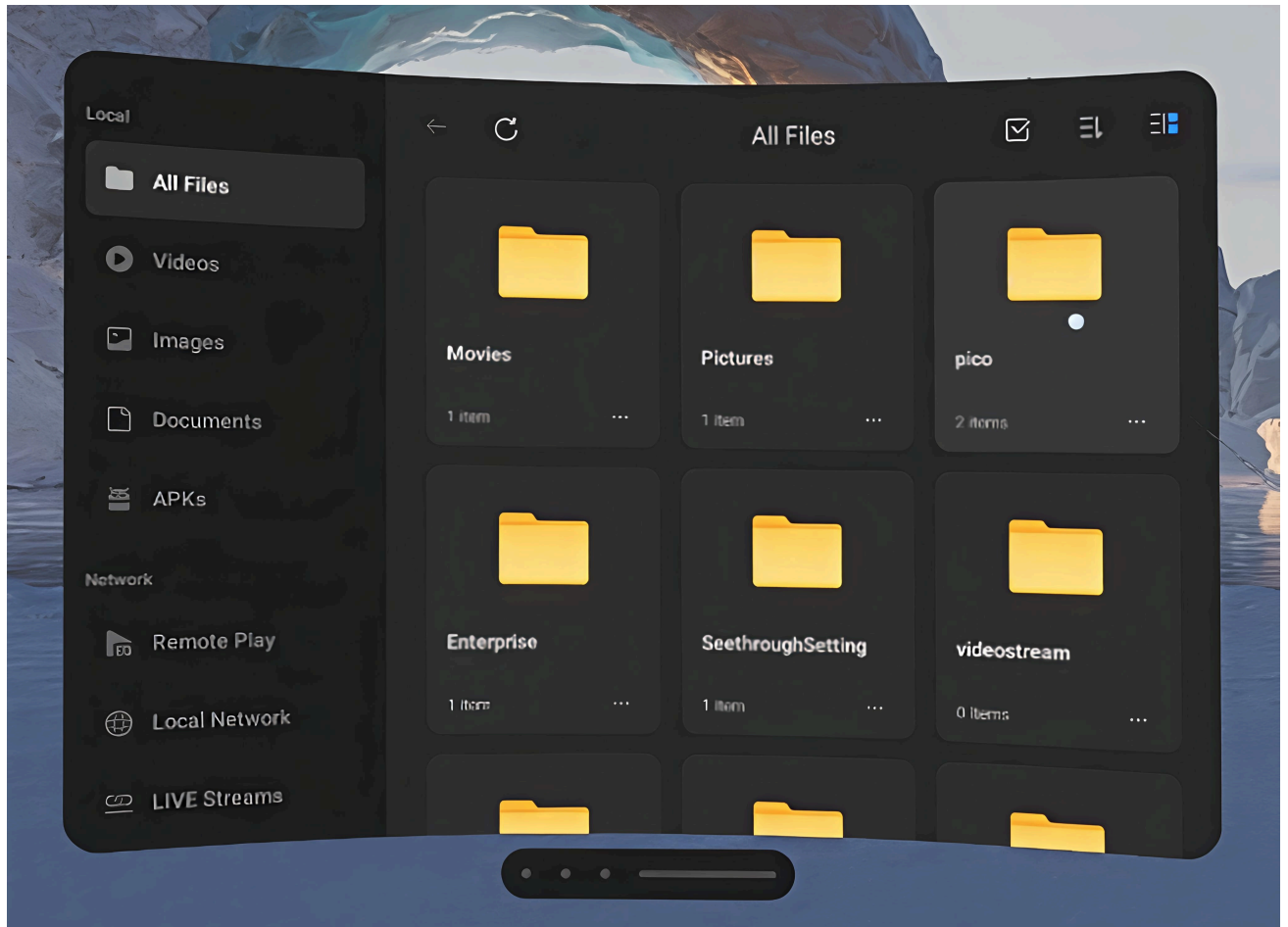
7.2 Upgrading the VR Device App

1. Before upgrading, first delete the existing program.

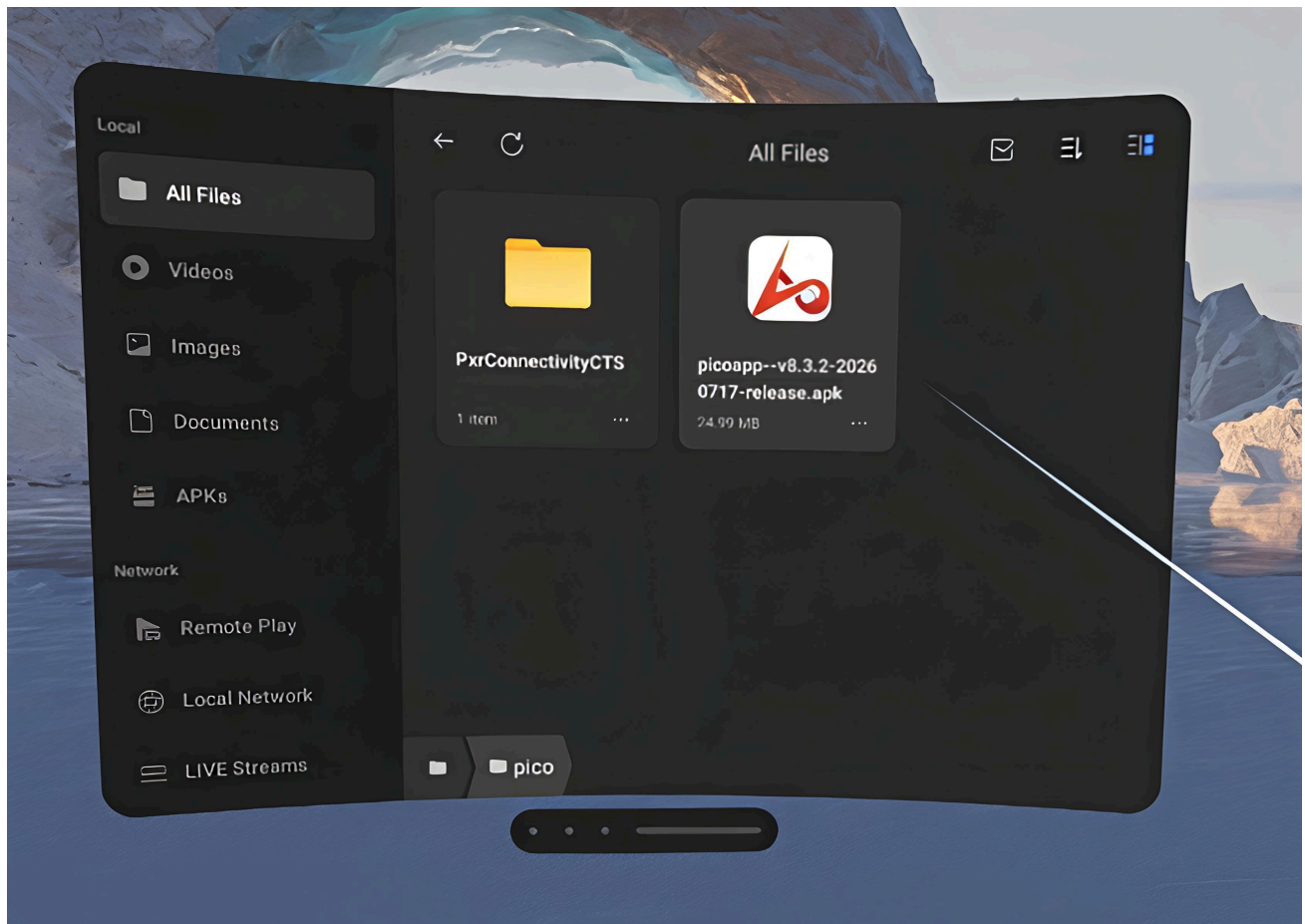


1. Use a Type-C cable to connect the Pico to your computer. Drag the downloaded Pico update package into the **pico** folder located in the internal shared storage of the Pico4 Ultra.

2. Using the VR controller, click the **pico** folder.



3. Using the VR controller, click the software package you want to install.

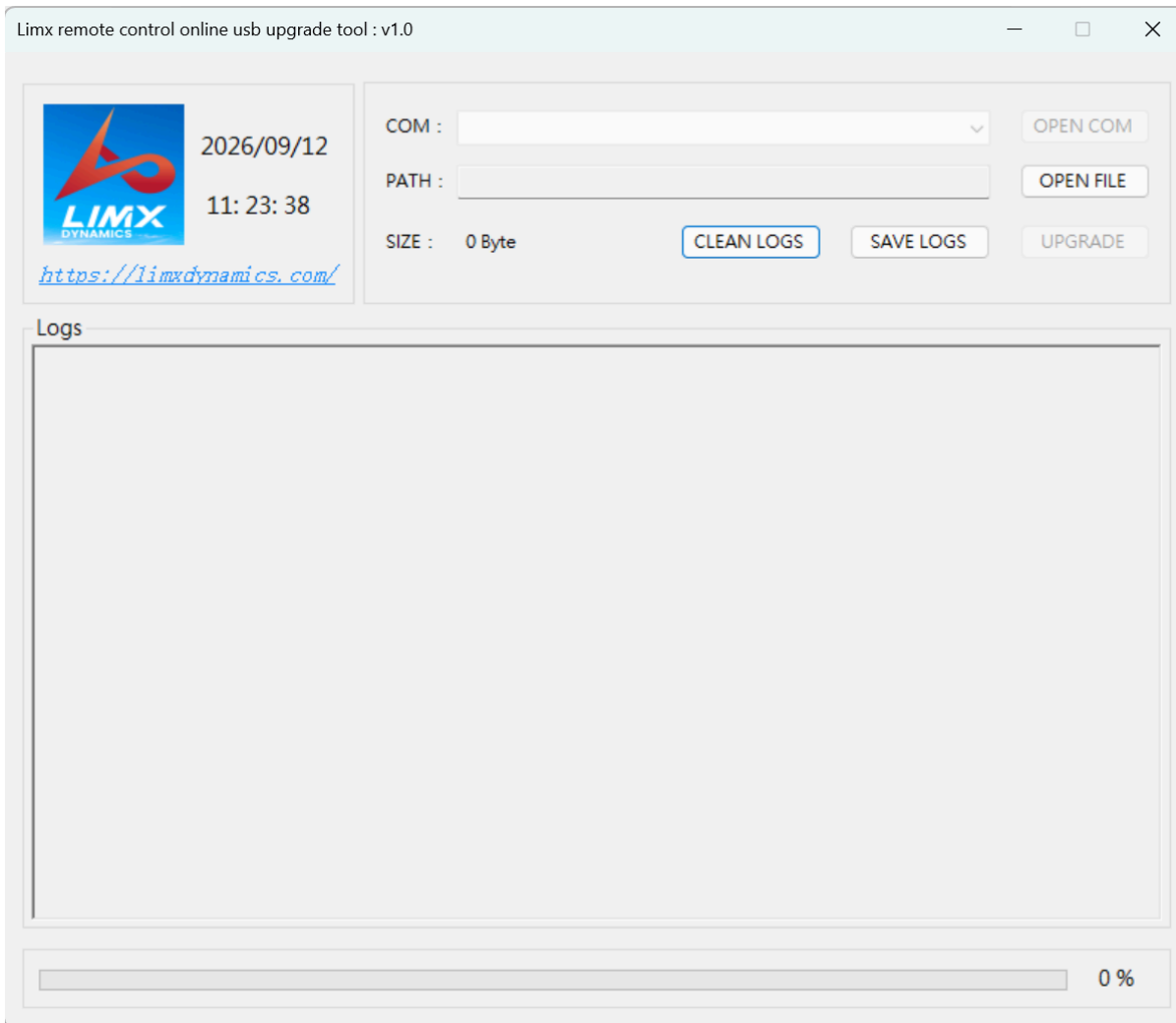


4. Click **Install**.

7.3 The remote controller firmware upgrade

The remote controller firmware upgrade tool runs on Windows only

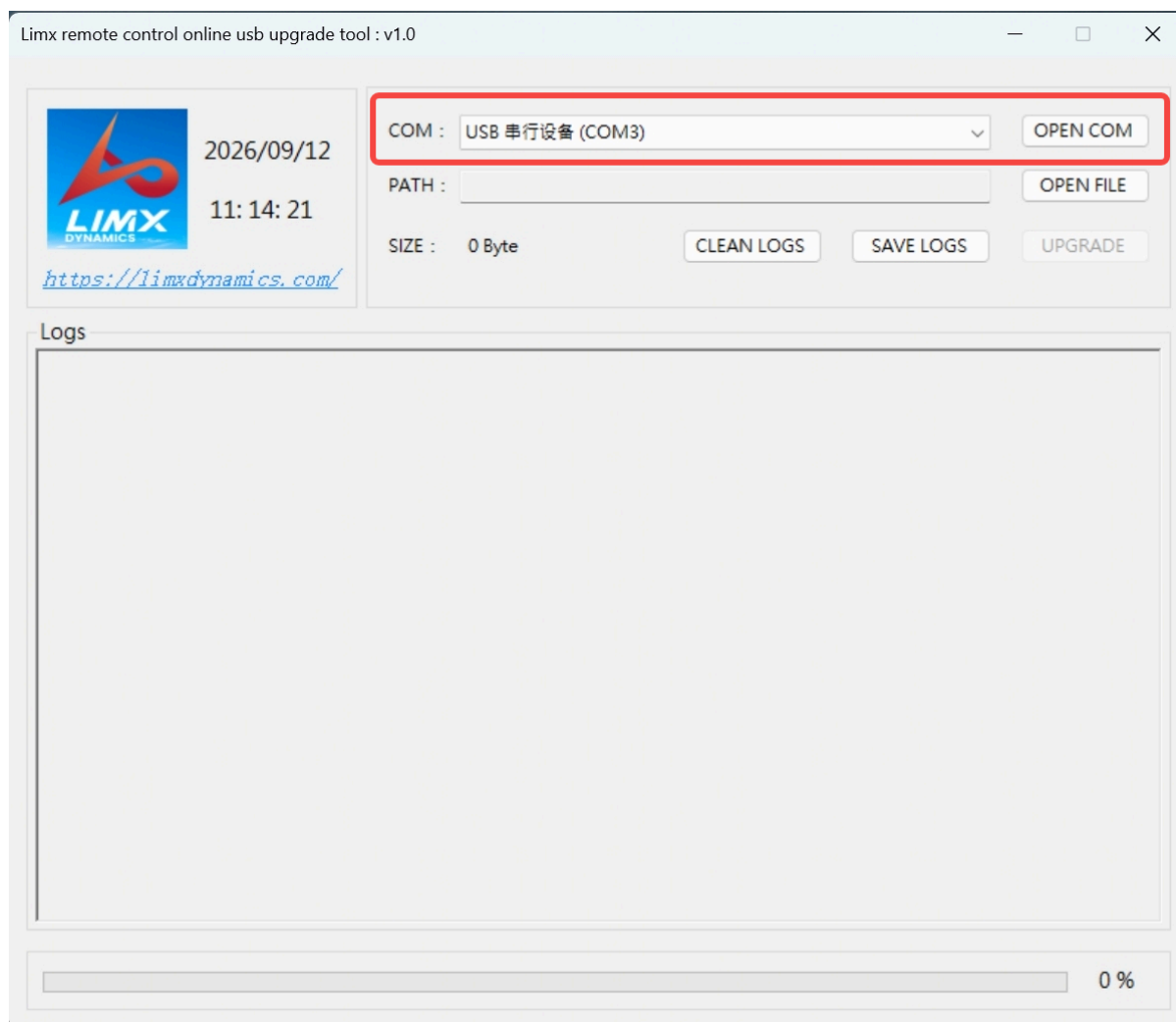
Download the remote controller firmware upgrade tool from the official website. The interface after opening the software is shown in the figure.



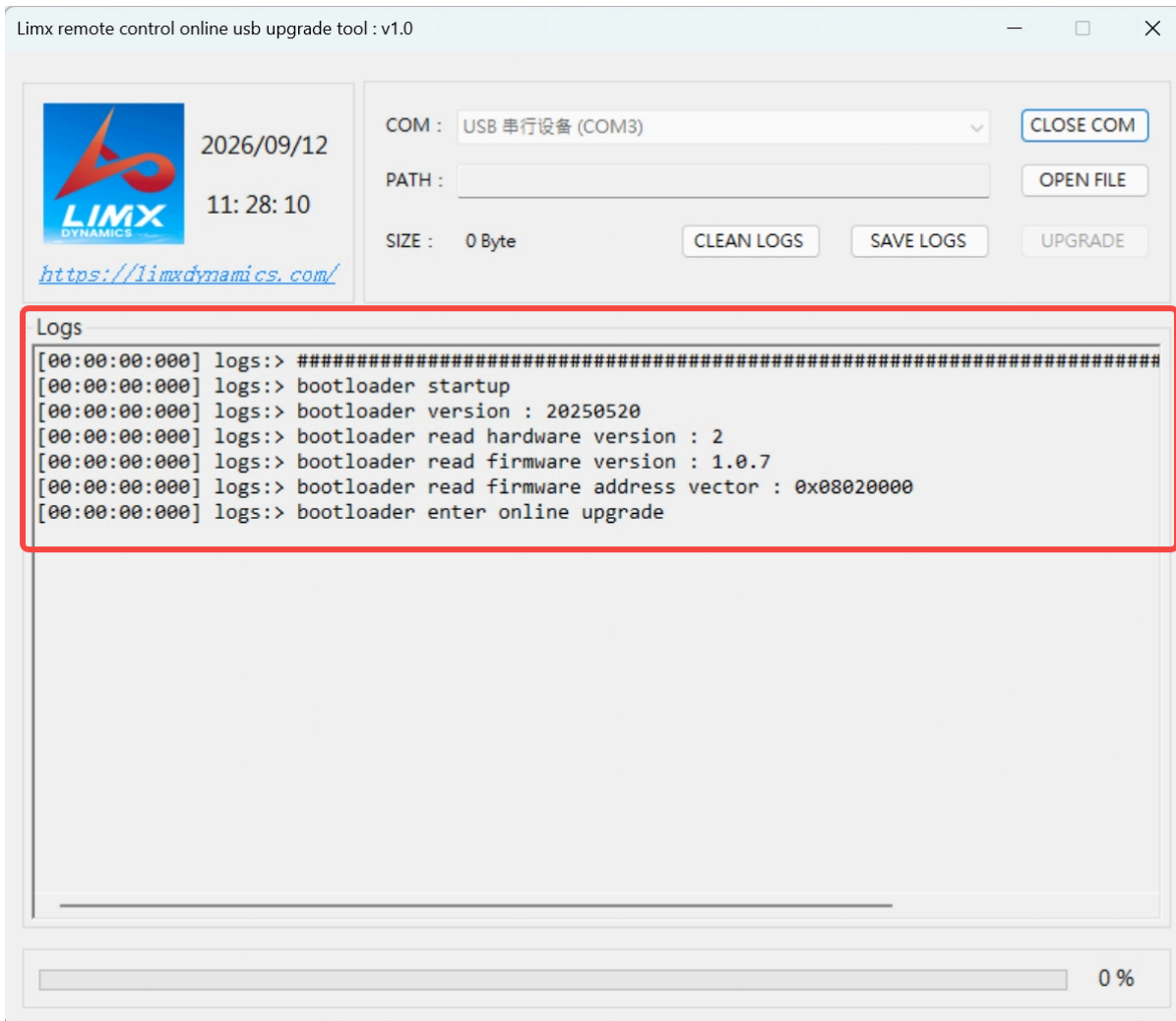
Take out the remote controller charging cable and connect the remote controller to be upgraded to a Windows PC. With the remote controller powered off, press and hold the Left Joystick + Power button. The remote controller will enter Boot state.



In the "COM" field, select the device number of the remote controller, then click "OPEN COM" to open the remote controller serial port.



After opening the serial port, the remote controller log information will be displayed, and the status shown on the remote controller screen will also switch to BootUSB.



Download the latest remote controller firmware from the official website and save it locally. Then click OPEN FILE and select the downloaded new firmware.



2026/09/12

11: 30: 23

<https://limxdynamics.com/>

COM : USB 串行设备 (COM3)

CLOSE COM

PATH : C:\Users\dagua\Downloads\RCGen2_T2_V1.0.7_20260630.bin

OPEN FILE

SIZE : 0 Byte

CLEAN LOGS

SAVE LOGS

UPGRADE

Logs

```
[00:00:00:000] logs:> #####  
[00:00:00:000] logs:> bootloader startup  
[00:00:00:000] logs:> bootloader version : 20250520  
[00:00:00:000] logs:> bootloader read hardware version : 2  
[00:00:00:000] logs:> bootloader read firmware version : 1.0.7  
[00:00:00:000] logs:> bootloader read firmware address vector : 0x08020000  
[00:00:00:000] logs:> bootloader enter online upgrade
```

0 %

Click UPGRADING to start the firmware upgrade.



2026/09/12

11: 30: 54

<https://limxdynamics.com/>

COM : USB 串行设备 (COM3)

CLOSE COM

PATH : C:\Users\dagua\Downloads\RCGen2_T2_V1.0.7_20260630.bin

OPEN FILE

SIZE : 242034 Byte

CLEAN LOGS

SAVE LOGS

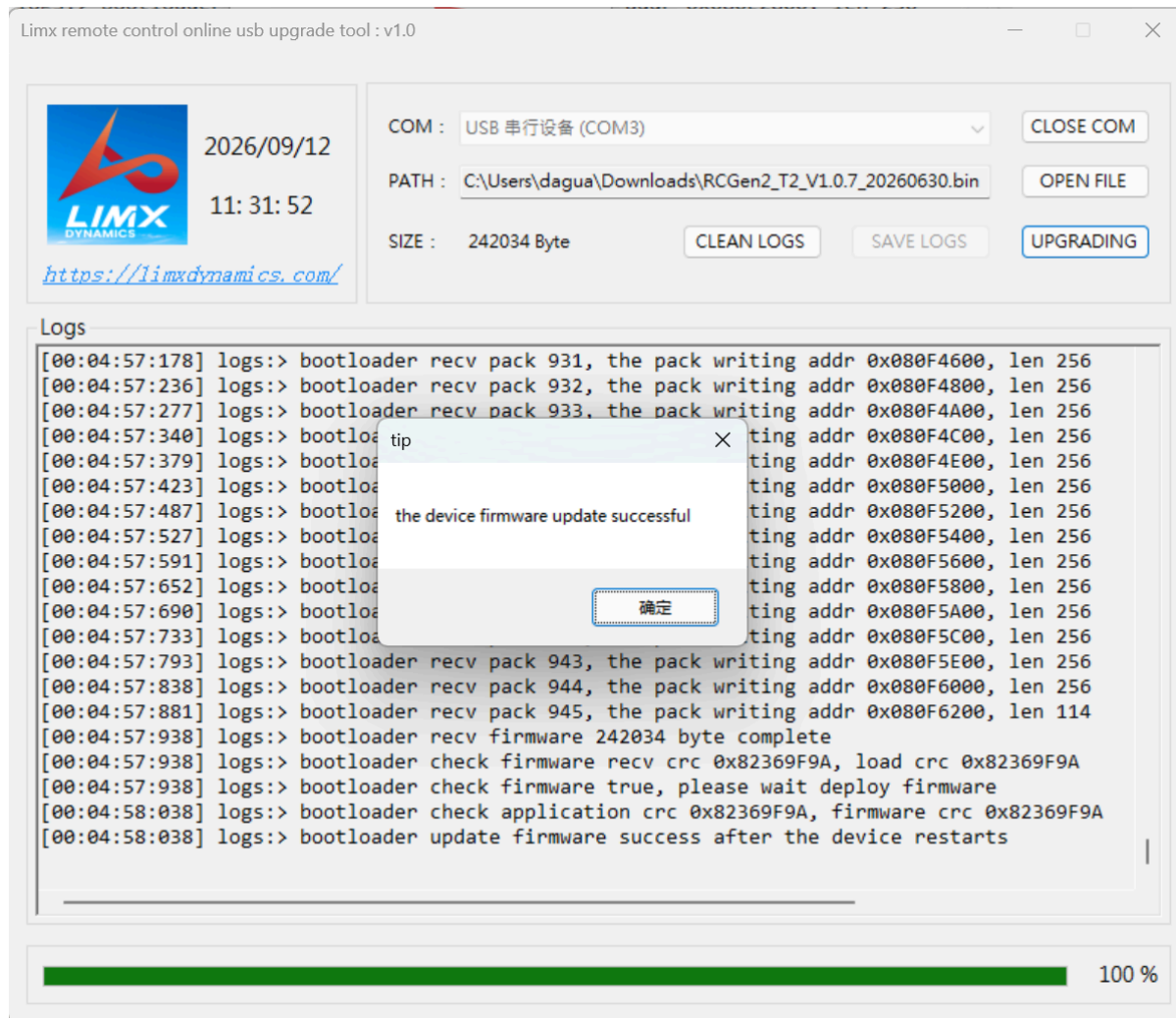
UPGRADING

Logs

```
[00:04:19:626] logs:> bootloader recv pack 124, the pack writing addr 0x0808F800, len 256
[00:04:19:669] logs:> bootloader recv pack 125, the pack writing addr 0x0808FA00, len 256
[00:04:19:714] logs:> bootloader recv pack 126, the pack writing addr 0x0808FC00, len 256
[00:04:19:757] logs:> bootloader recv pack 127, the pack writing addr 0x0808FE00, len 256
[00:04:19:801] logs:> bootloader recv pack 128, the pack writing addr 0x08090000, len 256
[00:04:19:843] logs:> bootloader recv pack 129, the pack writing addr 0x08090200, len 256
[00:04:19:888] logs:> bootloader recv pack 130, the pack writing addr 0x08090400, len 256
[00:04:19:931] logs:> bootloader recv pack 131, the pack writing addr 0x08090600, len 256
[00:04:19:976] logs:> bootloader recv pack 132, the pack writing addr 0x08090800, len 256
[00:04:20:020] logs:> bootloader recv pack 133, the pack writing addr 0x08090A00, len 256
[00:04:20:063] logs:> bootloader recv pack 134, the pack writing addr 0x08090C00, len 256
[00:04:20:106] logs:> bootloader recv pack 135, the pack writing addr 0x08090E00, len 256
[00:04:20:151] logs:> bootloader recv pack 136, the pack writing addr 0x08091000, len 256
[00:04:20:194] logs:> bootloader recv pack 137, the pack writing addr 0x08091200, len 256
[00:04:20:238] logs:> bootloader recv pack 138, the pack writing addr 0x08091400, len 256
[00:04:20:282] logs:> bootloader recv pack 139, the pack writing addr 0x08091600, len 256
[00:04:20:326] logs:> bootloader recv pack 140, the pack writing addr 0x08091800, len 256
[00:04:20:371] logs:> bootloader recv pack 141, the pack writing addr 0x08091A00, len 256
[00:04:20:414] logs:> bootloader recv pack 142, the pack writing addr 0x08091C00, len 256
[00:04:20:458] logs:> bootloader recv pack 143, the pack writing addr 0x08091E00, len 256
```

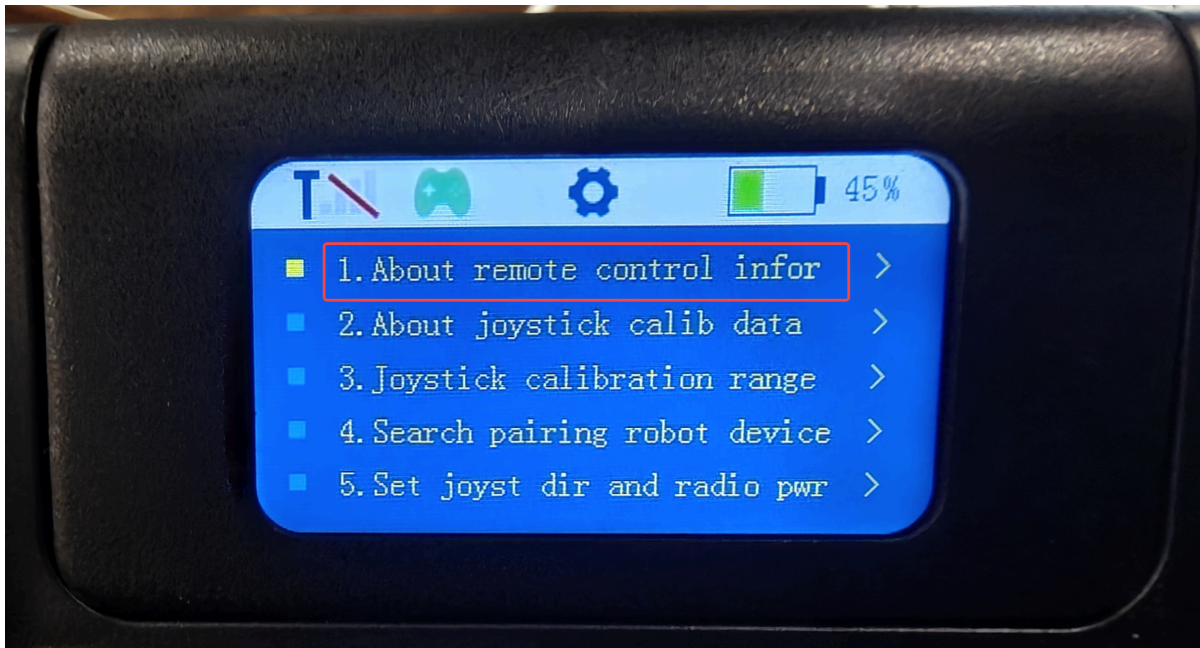
15 %

A prompt will pop up after the upgrade is successful.

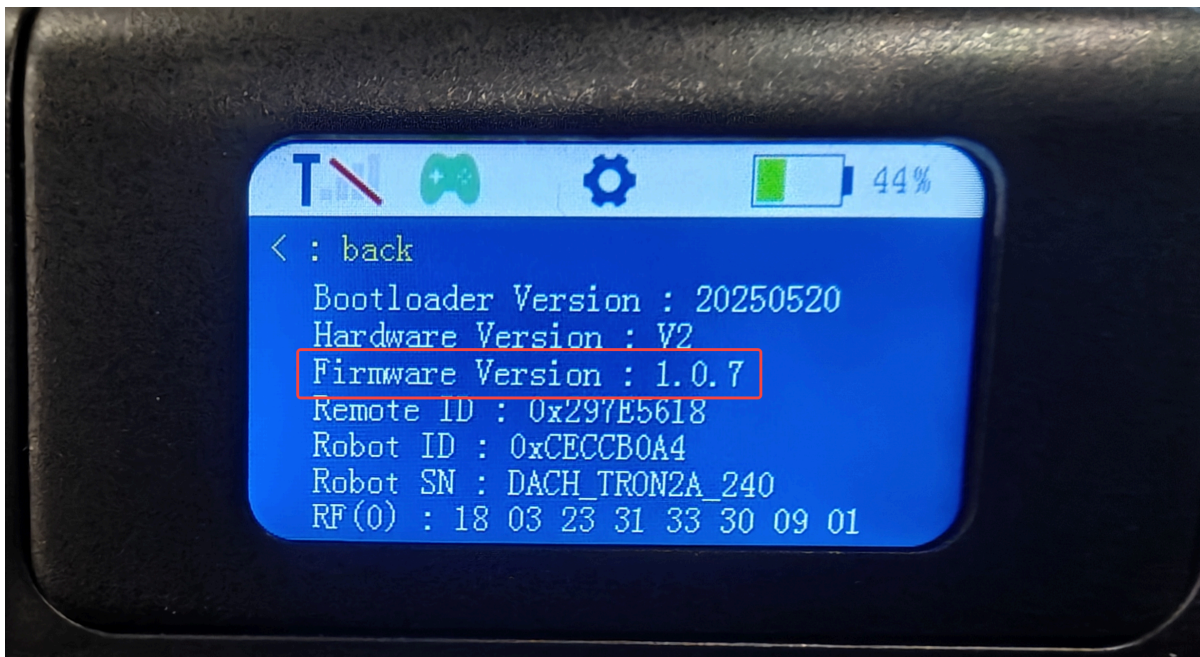


At this point, long press the power button to turn off the remote controller. After restarting, you can verify the upgraded remote controller firmware version again. To do so, double-click the Power button on the remote controller to enter the settings page, and use the Up/Down buttons to adjust the options and select the first

item.



Press the Right button to enter, and the remote controller information will be displayed. The Firmware Version shown is the current firmware version of the remote controller.



8 Log Export

1. Connect to the robot Wi-Fi. Password: 12345678 .
2. Enter the following in the browser address bar: <http://10.192.1.2:8090> to enter the log management interface.
3. Export the log files and bag files from the time when the issue occurred.

9 Routine Care and Maintenance

9.1 Cleaning and Storage

- Clean the surface regularly or after operation in dusty environments using a clean microfiber cloth.
- Use the transport case designed specifically for the TRON 2 robot for storage and transport to prevent impact and vibration.

9.2 Inspection and Maintenance

- Exterior maintenance: Clean dust from joint areas and check whether screws are loose.
- Software updates: Upgrade official firmware in a timely manner to fix potential system vulnerabilities and optimize motion algorithms.
- Battery pack: Charge to 50%-60% before storage (avoid full charge or deep discharge), and recharge to the same range every 3 months.
- Remote controller: Keep interfaces clean, ensure the joysticks are not subjected to external force during storage, and regularly check anti-interference performance.