TRON 2 User Manual

生成时间：2026-11-12

Version History

Update Date	Change Description
2026-11-05 Latest	🚀 **Updated for Main Controller V2.7** New Section 4.6: Web-Based Robot Control New Drag teaching: Added the Hand Guide state in Motion mode (section 4.2.2) and drag teaching on the robot management page (section 4.6.3) Updated Section 5.2: Teleoperation Commands

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 toprevent 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.
3. Do not use this product in extreme environments, such as high temperature, low temperature, or corrosive chemical environments. LimX Dynamics is not responsible for equipment issues caused by such conditions.
4. Under normal use conditions, issues caused by natural component wear or battery aging are not considered product quality issues, and LimX Dynamics assumes no responsibility for them.
5. This product must not be used for any activity that endangers national security, including but not limited to support for terrorism, nuclear facilities, biochemical weapon development, or the design and use of weapons of mass destruction.
6. Please confirm that you are not subject to any trade restrictions or sanctions; otherwise, you may not be able to use LimX Dynamics products and services normally.
7. LimX Dynamics is committed to ensuring product compliance worldwide. Please comply with the laws and regulations of your region and pay attention to relevant compliance requirements.
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.
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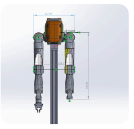
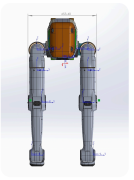
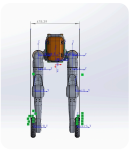
1 Product Overview

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/s²	36m/s²	
	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	

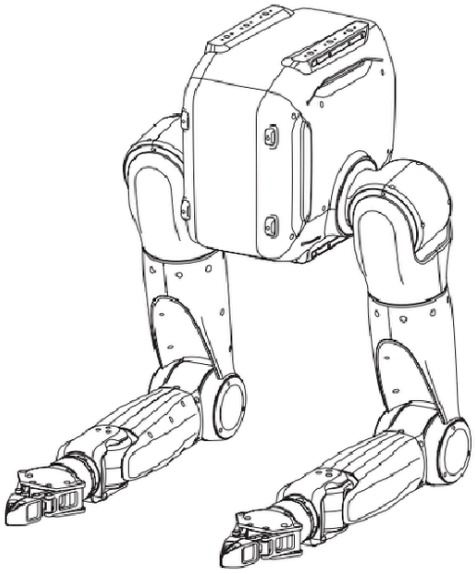
Electrical Parameters	Battery Output Voltage	46.8V	46.8V	
	Maximum Battery Power	2800W	2800W	
	Support for Battery Replacement	√	√	
	Battery Type	Ternary lithium battery	Ternary lithium battery	
	Battery Capacity	9Ah	9Ah	
	Charging Power	542W	542W	
	Charging Input Voltage/Current	100~240V/8A	100~240V/8A	
	Charging Output Voltage/Current	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



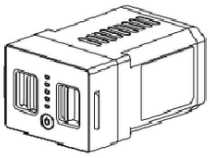
Head camera x1



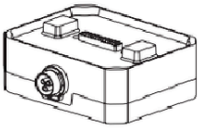
VR device x1



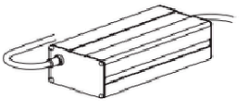
Remote controller x1



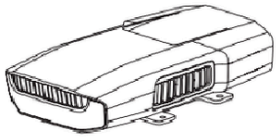
Battery
x1



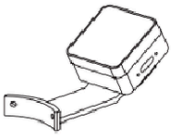
Battery charging dock x1



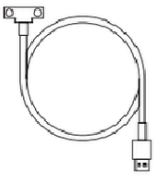
Power adapter x1



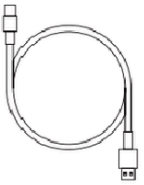
Developer expansion module x1
(EDU version only)



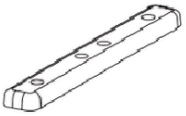
Wrist cameras and brackets
x2



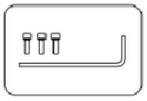
Wrist cameras Data Cable x2



Remote Controller Charging Cable x1



Body foot pad
x1



Tool kit x1

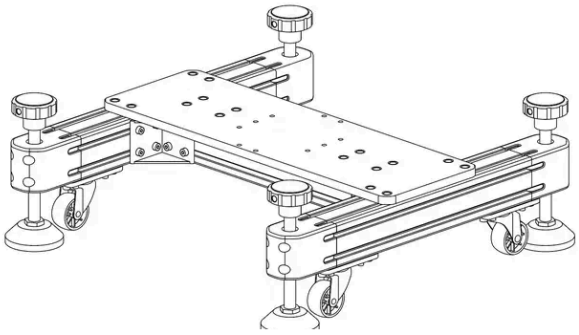


User manual
x1



Certificate x1

Carton	Carton



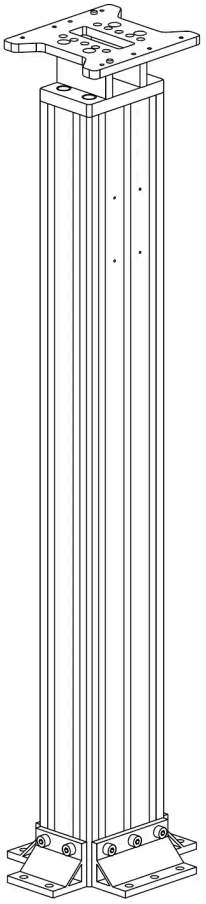
Fixed base x1



Fixed-stand bracket for developer expansion module x1

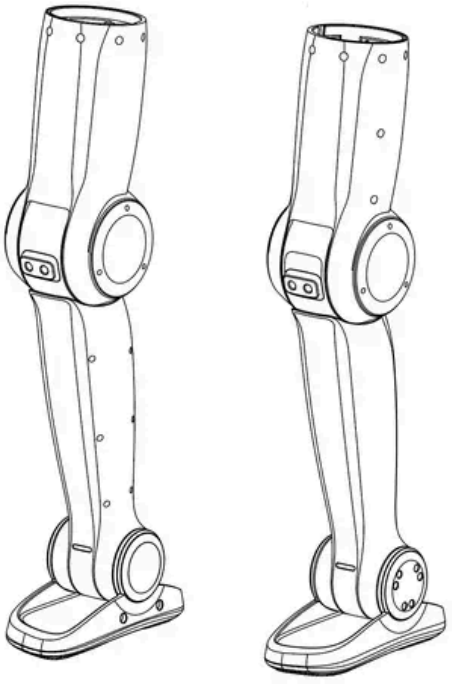


Tool kit x1

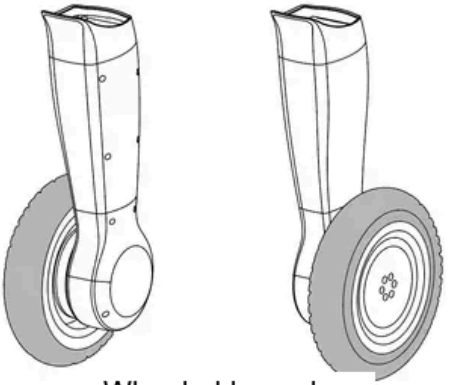


Fixed stand x1

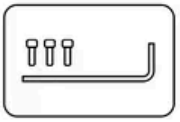
- **Carton**



Thigh and sole lower legs x2



Wheeled lower legs x2

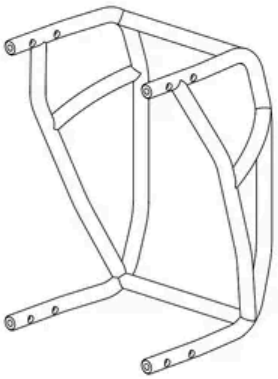


Tool kit x1

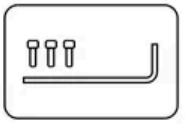
- **Carton**



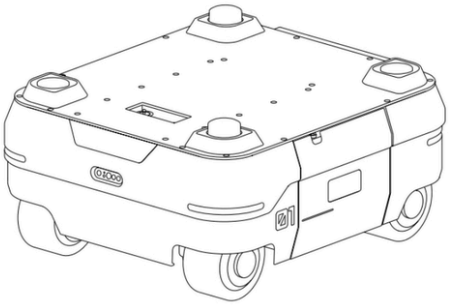
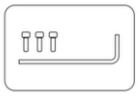
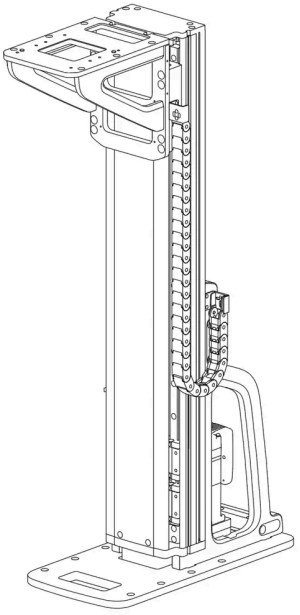
Front roll-cage frame x1



Rear roll-cage frame x1



Tool kit x1

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

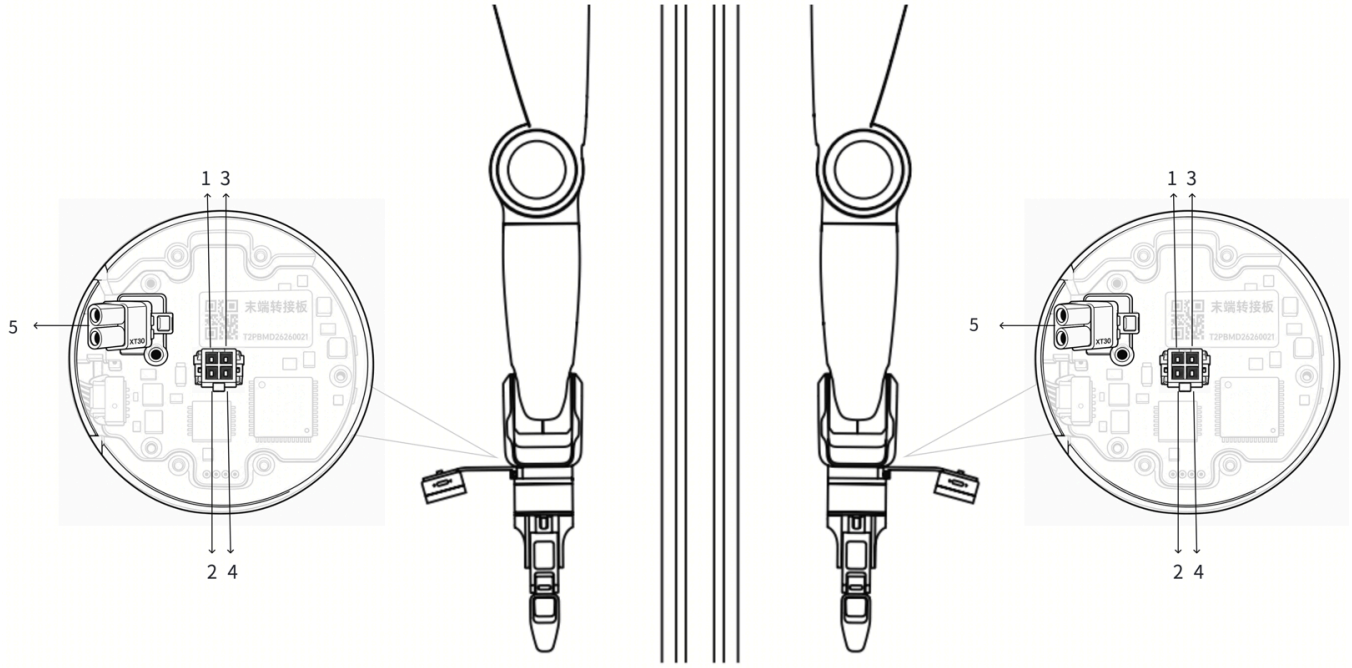
Component /Ports	Function Description	Component/Ports	Function Description
Power Button	Used to power the robot on/off	**Battery Level Indicator**	Displays the current robot battery level
External Power Ports	Used to connect an external power adapter	**Emergency Stop Button**	In an emergency, press this 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

Arm-End Adapter Board Pinout

The figure below shows the connector locations and pin numbers on the arm-end adapter board. Pin assignments are listed in the table.



Pin	Connector Type	Description
1	MX3.0	Power supply positive, 24 V
2	MX3.0	Power supply negative, GND
3	MX3.0	Gripper control signal (positive logic)
4	MX3.0	Gripper control signal (negative logic)
5	XT30	48 V power supply

> 📐 **Wrist Adapter Flange Specification**
> The wrist adapter flange interface specification is **DIN ISO 9409-1-A50**. View detailed interface dimensions.When selecting a gripper, dexterous hand, or other accessory, check that the mounting dimensions, fasteners, and electrical interfaces are compatible.

Gripper Dimensions

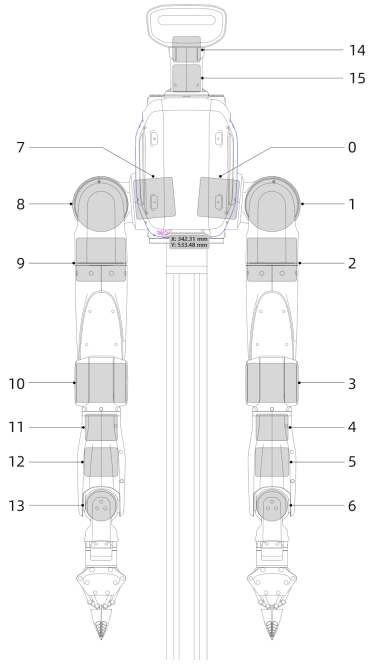
The figure below shows the gripper dimensions in the **closed** and **open** positions.

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.

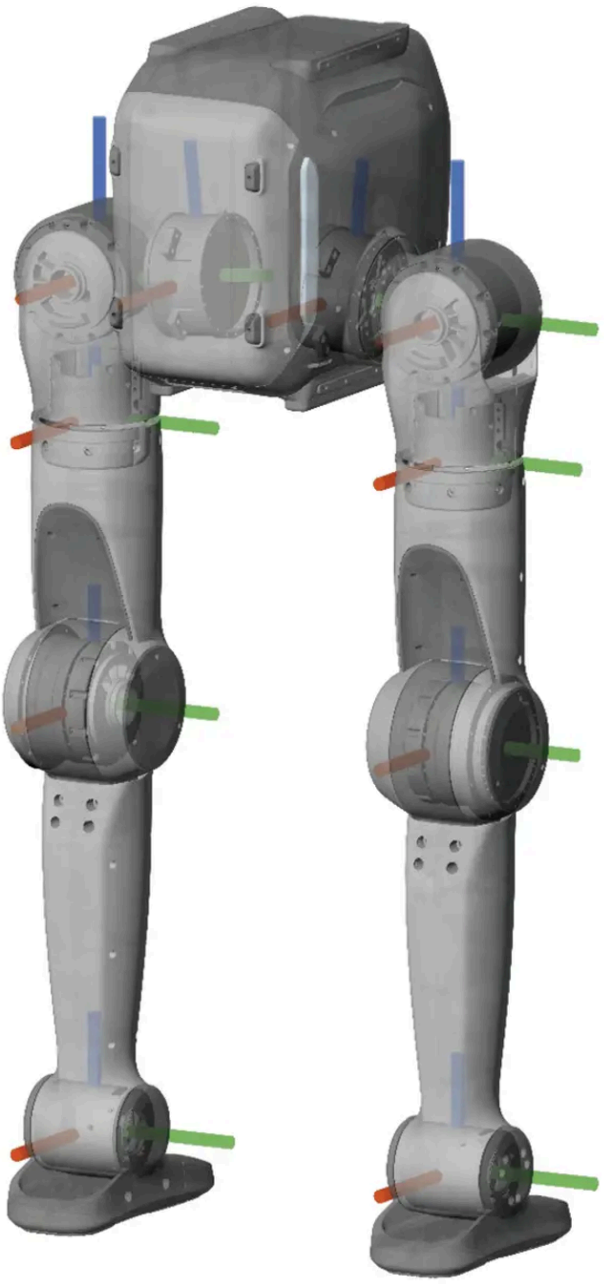


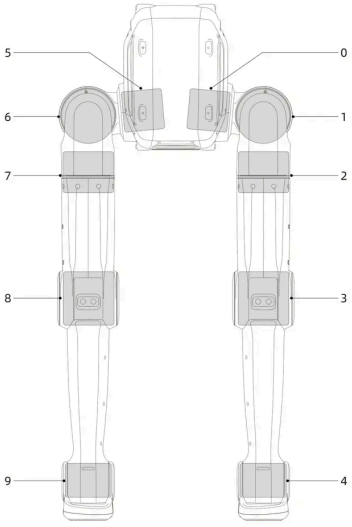
Joint No.	English Joint Name	Limits (deg)		Limits (rad)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
0	proximal_pitch_L_Joint	-180	149	-3.141	2.600
1	proximal_roll_L_Joint	-15	170	-0.261	2.967
2	proximal_yaw_L_Joint	-210	85	-3.665	1.483
3	elbow_L_Joint	-150	30	-2.617	0.523
4	wrist_yaw_L_Joint	-100	80	-1.745	1.396
5	wrist_pitch_L_Joint	-43	43	-0.750	0.750
6	wrist_roll_L_Joint	-43	43	-0.750	0.750
7	proximal_pitch_R_Joint	-180	149	-3.141	2.600
8	proximal_roll_R_Joint	-170	15	-2.967	0.261
9	proximal_yaw_R_Joint	-85	210	-1.483	3.665
10	elbow_R_Joint	-150	30	-2.617	0.523
11	wrist_yaw_R_Joint	-80	100	-1.396	1.745
12	wrist_pitch_R_Joint	-43	43	-0.750	0.750

Joint No.	English Joint Name	Limits (deg)		Limits (rad)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
13	wrist_roll_R_Joint	-43	43	-0.750	0.750
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/material/默认/TRON 2/video/1_unboxing_EN_output.mp4
2	Dual-Arm Installation	https://oss.limxdynamics.com/uploads/material/默认/TRON 2/video/dual_arm_installation2_EN.mp4
3	Wheeled-Foot Installation	https://oss.limxdynamics.com/uploads/material/默认/TRON 2/video/3_wheeled_foot_installation_EN_output.mp4
4	Wheeled-Foot Sole Switching	https://oss.limxdynamics.com/uploads/material/默认/TRON 2/video/4_wheeled_foot_sole_switching_EN_output.mp4
5	Anti-Roll Bar Installation	https://oss.limxdynamics.com/uploads/material/默认/TRON 2/video/5_anti_roll_bar_installation_EN_output.mp4
6	Remote Controller Pairing	https://oss.limxdynamics.com/uploads/material/默认/TRON 2/video/6_remote_controller_pairing_EN_output.mp4
7	Packing	https://oss.limxdynamics.com/uploads/material/默认/TRON 2/video/7_packing_EN_output.mp4
8	Dual-Arm Remote Control	https://oss.limxdynamics.com/uploads/material/默认/TRON 2/video/8_remote_controller_arm_EN_output.mp4
9	Wheeled-Foot Remote Control	https://oss.limxdynamics.com/uploads/material/默认/TRON 2/video/9_remote_controller_wheeled_foot_EN_output.mp4
10	Dual-Arm Teleoperation	https://oss.limxdynamics.com/uploads/material/默认/TRON 2/video/10_dual_arm_teleoperation_EN_output.mp4
11	Network Setup	https://oss.limxdynamics.com/uploads/material/默认/TRON 2/video/11_network_setup_EN_output.mp4
12	Zero Calibration	https://oss.limxdynamics.com/uploads/material/默认/TRON 2/video/12_zero_calibration_EN_output.mp4

1.6.2 Pre-Power-On Wiring Check

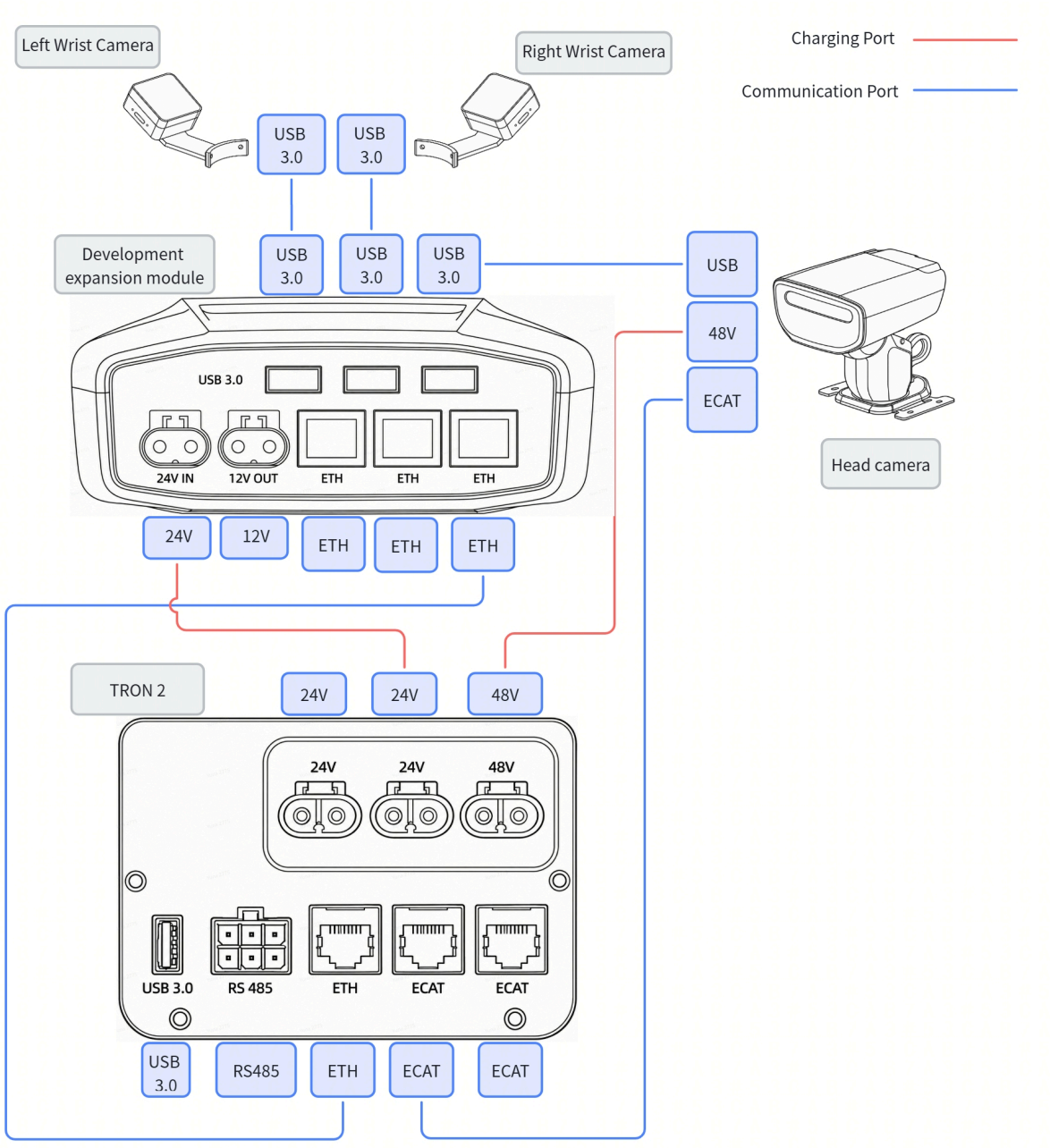
> 🚫 **DANGER**
> Never connect a 24 V power cable to a 48 V port. Connecting a power cable incorrectly may damage the robot hardware.

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.



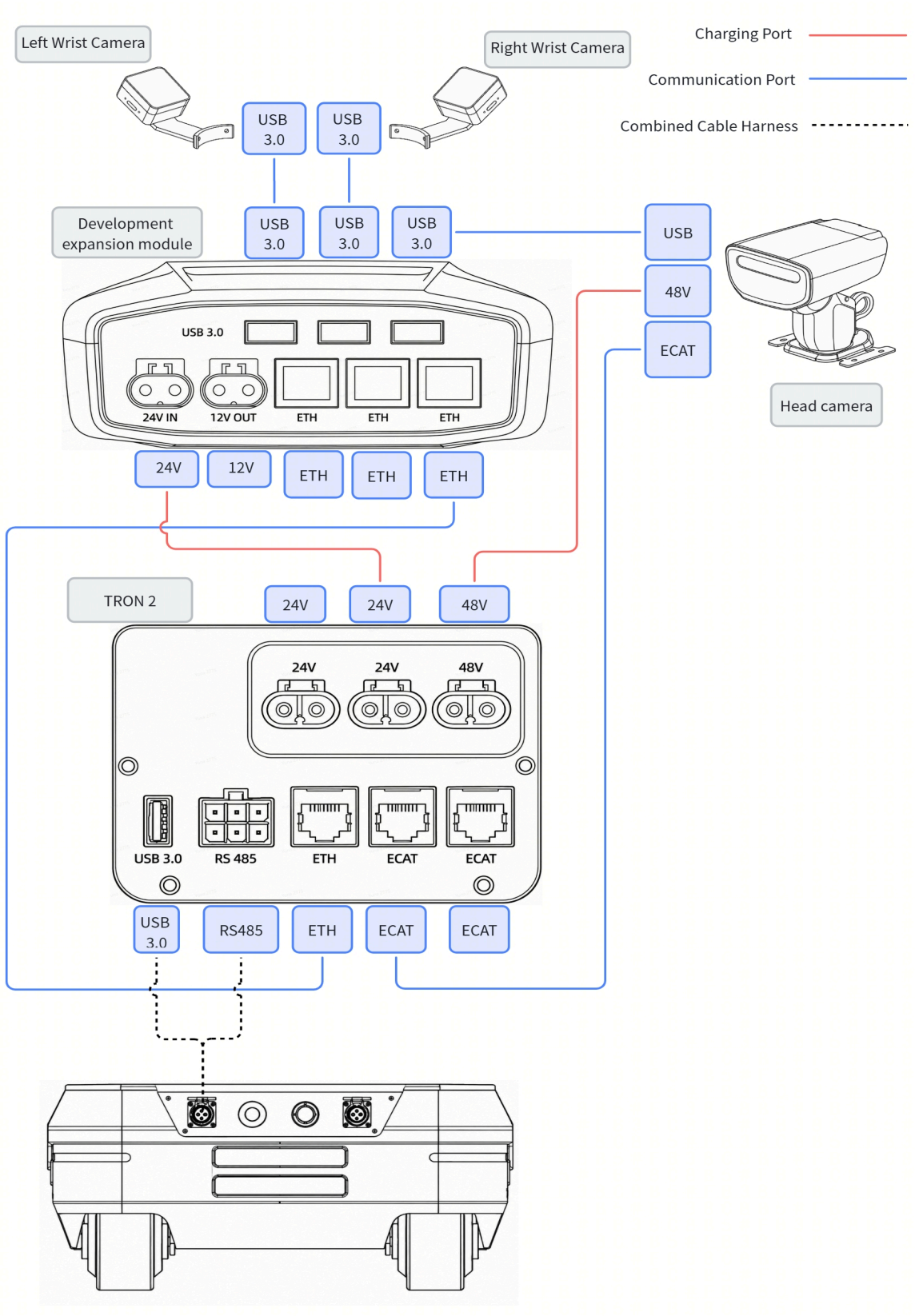
> 💡 **Tip**
>
> The robot can be converted from the Dual-Arm Configuration to either the Sole or Wheeled-legs Configuration. The robot-body wiring remains the same. Check the wiring against the Dual-Arm Robot wiring diagram.

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.

> 💡 **Wiring Tip**

- The communication harness that connects to the Mobile Base includes cables with USB 3.0 and RS485 interfaces. Route the harness out through the rail drag chain, then connect it to the communication interface on the Mobile Base with the aviation connector.
- Connect the charging cable to the charging interface on 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.

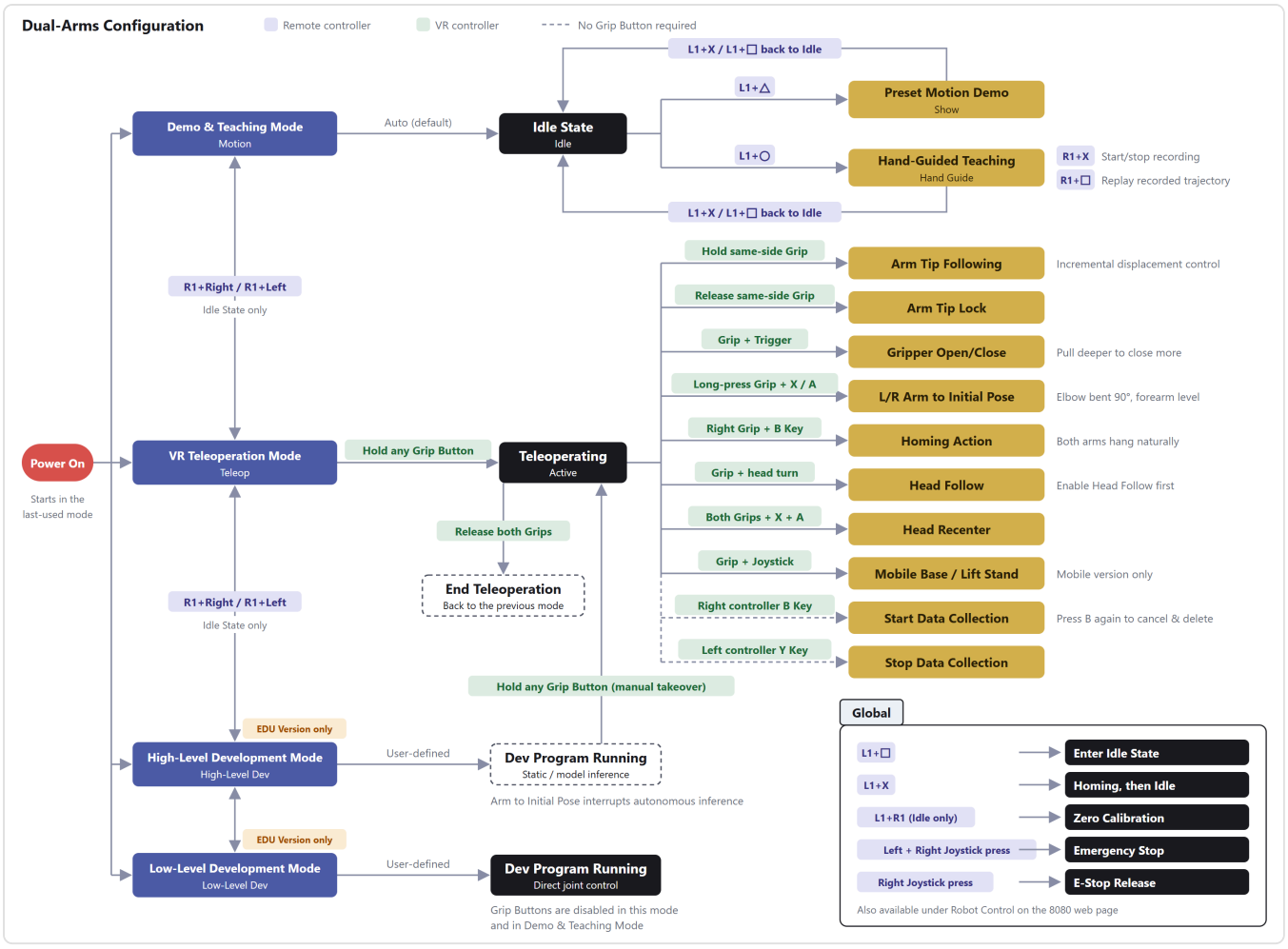
3 Using Your TRON 2

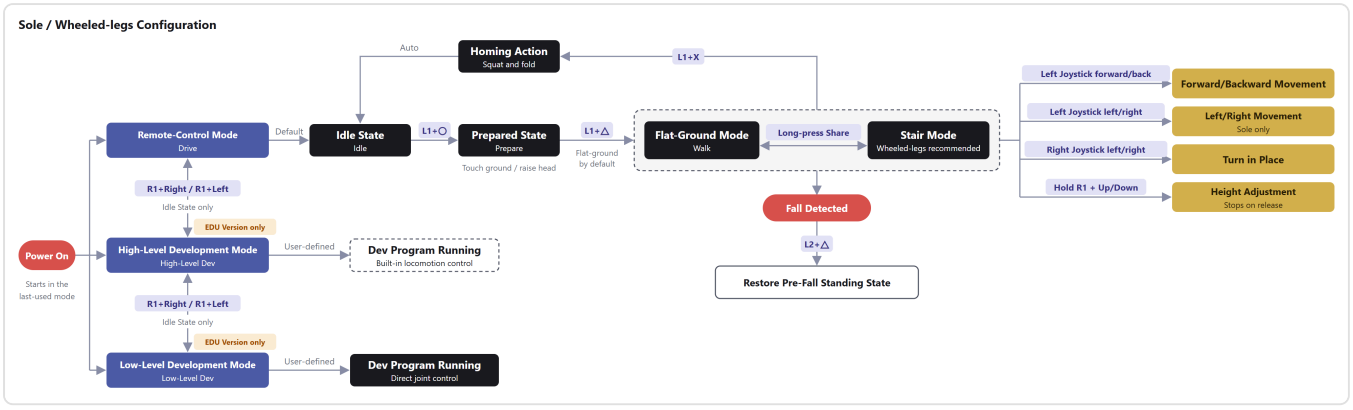
3.1 Operating Environment Requirements

- 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

Configuration	Mode	Mode Description
Dual-Arms Configuration	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.
Sole/Wheeled Configuration	Remote-Control Mode	The user controls robot motion with the remote controller, including forward/backward/left/right movement, turning, height adjustment, etc.
	High-Level Development Mode (EDU version only)	Calls high-level application development interfaces to control robot motion based on built-in motion-control algorithms, including forward/backward/left/right movement, turning, height adjustment, etc.
	Low-Level Development Mode (EDU version only)	Calls low-level motion-control interfaces outside the built-in motion-control algorithms to directly control joints.





3.3 Dual-Arms/Mobile Dual-Arms Robot Power-On/Off Procedure

Power-On Procedure

1. Complete robot installation according to the installation procedure and wait for startup.
2. Insert a fully charged battery into the battery compartment and press until the latch locks. For the fixed-stand version, connect the power adapter to the external power interface and to 220 V power before startup. For the mobile base version, turn on 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 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. 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.

> ⚠️ **NOTICE**
> Install the robot head and connect the head joint power cable and joint communication cable before powering on. Otherwise, the robot cannot start.

> 💡 **Tip**
> If you are not using the remote controller, skip steps 4 and 6 and control the robot from the 8080 web page. See 4.6.

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. Alternatively, click **Home** on the **Robot Control** page of the 8080 web page.
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.

> ⚠️ **NOTICE**
> Put the robot into the idle state first so that the joint motors return slowly. If you press the power button directly, the joints drop immediately and the robot may be damaged.

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.	/

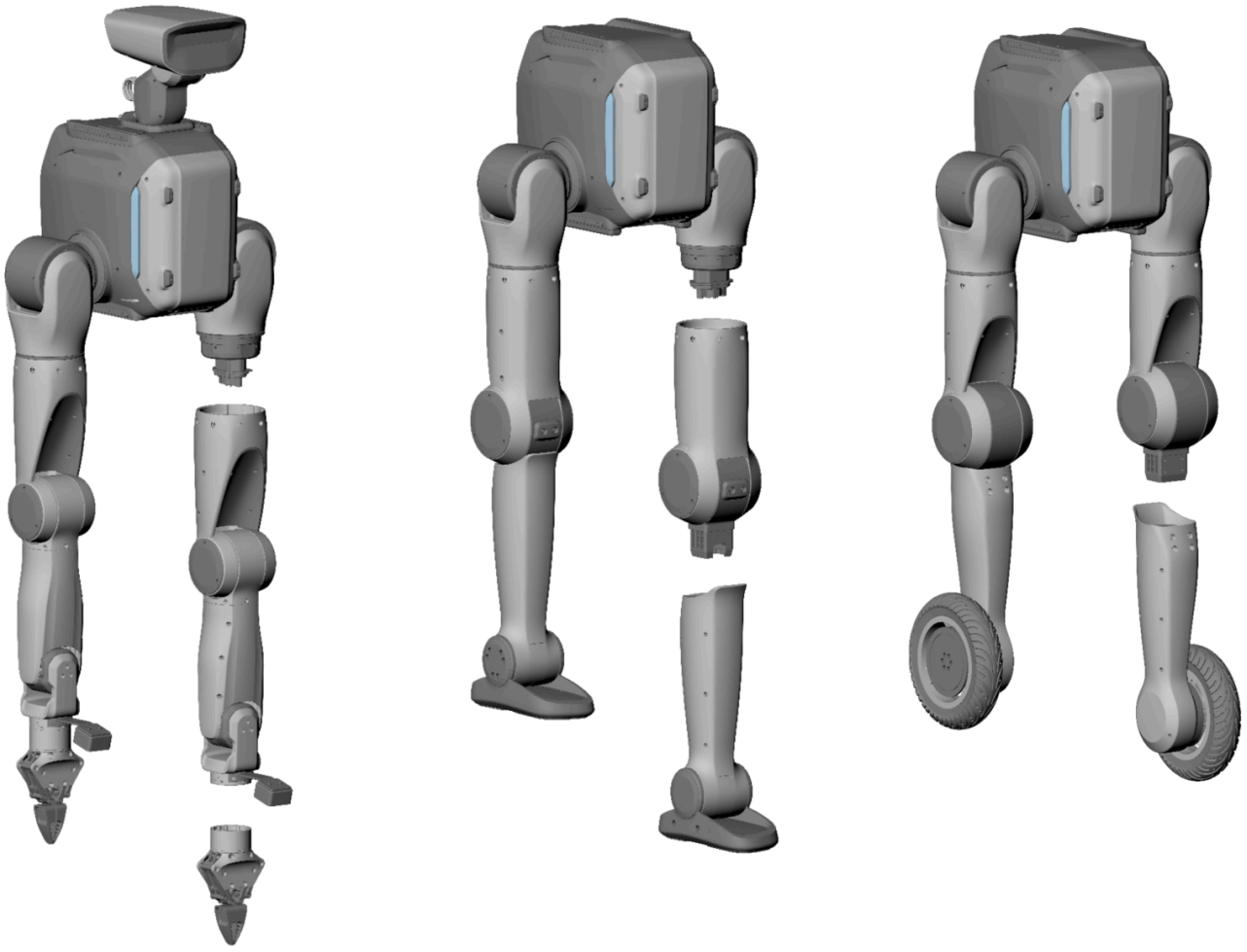
Event/Status	Indicator Color	Indicator Description	Frequency (seconds/time)
Remote-Control Mode (for Sole/wheeled)	Steady blue	After startup or mode switching, the current mode status will be shown.	/
VR Teleoperation Mode (for dual-arms configuration)	Steady blue	After startup or mode switching, the 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

3.6 Robot Configuration Switching

- The robot automatically recognizes each configuration. No manual setup is required.
- ① **Hip/shoulder interface:** The leg and arm configurations share the same first three joints. Replace a whole arm or leg at this interface. One person can do this with the supplied toolkit.
- ② **Knee interface:** Swap the lower leg to switch quickly between the Sole and Wheeled-legs configurations. The mounting structure has a poka-yoke design that prevents the foot from being

installed front-to-back or the wheel from being installed inside-out.



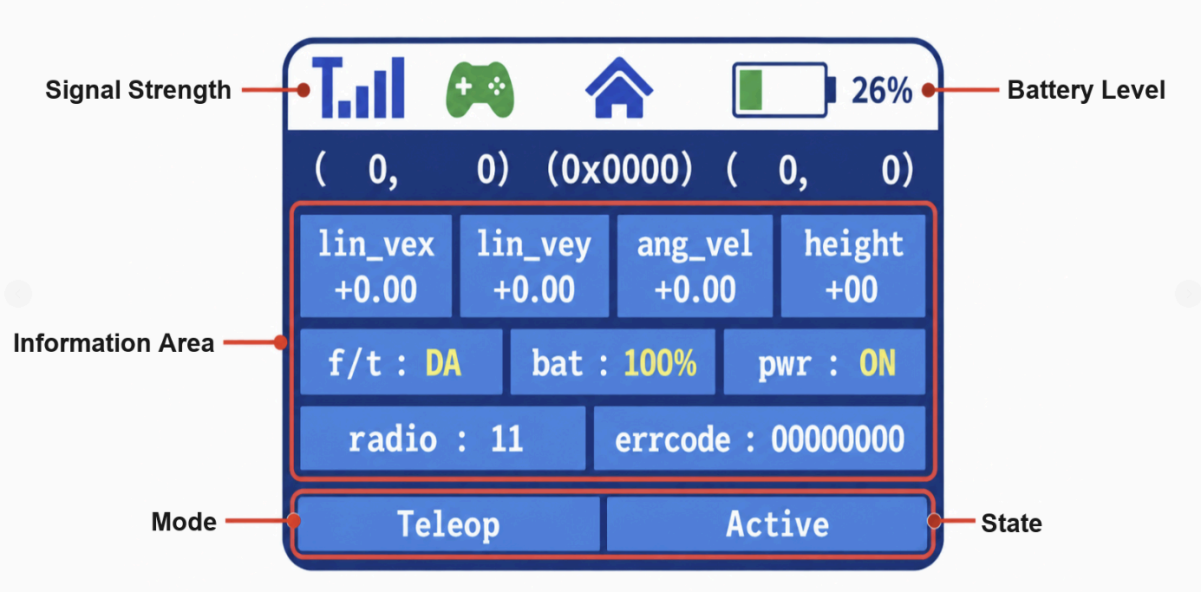
> ⚠️ **NOTICE: Interface ① (Hip/Shoulder)**
>
> - Power off the robot before removing or installing an arm or leg. Use the 3.0 mm L-shaped hex key from the supplied toolkit. Fully seat the connector before tightening the M4 screws one by one.
> - Replace a screw after it has been removed and installed 3 times. Loose screws can cause the robot to drift while walking or lose communication.
> - If you buy replacement screws, use M4×8 socket head cap screws.

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



4.2.1 Screen Layout

Screen Area	Description
Signal Strength	No signal icon appears until the remote controller connects to the robot. Once connected, blue signal bars appear. More bars indicate a stronger signal.
Battery Level (top right)	Shows the battery level of the remote controller. This is not the robot battery level.
Information Area	Shows feedback from the robot, including motion values, body height, battery level, power status, and error codes. `bat` is the robot battery level, `pwr` is the robot power status, and `errcode` is the current error code. Field names appear exactly as shown on the screen.
Mode (bottom left)	Shows the current mode. In the example, `Teleop` indicates VR Teleoperation Mode.
State (bottom right)	Shows the current state within that mode. In the example, `Active` indicates that the robot is ready to be controlled with the VR device.

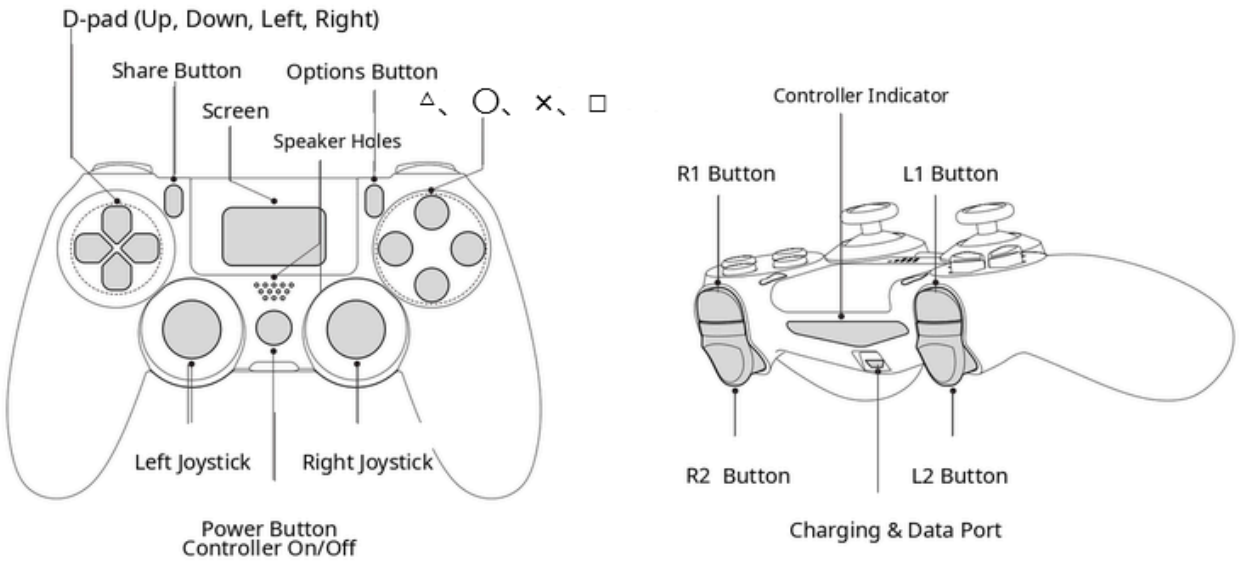
4.2.2 Remote Controller Modes and States

Screen Mode	Mode Description	Screen State	State Description
Motion	Show Mode (demo and teaching)	Show	Demo motion state. To prevent accidental activation, enter it only from the `Idle` state of `Motion` mode by pressing `L1+△`. It cannot be entered with `R1+Right` or `R1+Left`.
		Hand Guide	Drag-to-record (hand-guiding) state. Enter it only from the `Idle` state of `Motion` mode by pressing `L1+○`. In this state, you can move the robotic arms by hand to record and replay motion trajectories: • Record (Rec): Press `R1+X` to start recording, move the arms by hand to demonstrate the motion, then press `R1+X` again to stop recording. • Replay: Press `R1+□` to replay the most recently recorded motion.
		Idle	Idle state.
Drive	Remote-Control Mode (Sole/Wheeled Configuration)	Prepare	The robot is in the ready posture.
		Walk	The robot is standing or walking.
		Docking	The robot has started auto-recharge and is moving onto the charging dock.
		Charging	The robot is seated on the charging dock and is charging or fully charged.
		Undocking	The robot is leaving the charging dock.
		Idle	Idle state.
Teleop	VR Teleoperation Mode (Dual-Arms Configuration)	Active	Teleoperation is active. Control the robot directly with the VR device.
		Idle	Idle state.

Screen Mode	Mode Description	Screen State	State Description
High-Level Dev	High-Level Development Mode	Active	Running.
		Idle	Idle state.
Low-Level Dev	Low-Level Development Mode	Active	Running.
		Idle	Idle state.

> ⚠ **CAUTION**
> Before entering the `Show` state in `Motion` mode, clear all objects within at least 1 m of the robot. The demo motions can strike nearby objects.

4.3 Remote Controller Buttons



> ⇄ **How to Switch Modes**
>
> - Press `L1+□` to enter the idle state of the current mode. Before you press it, make sure the robot is properly supported.
> - Check that the current state at the bottom right of the screen shows `Idle`.
> - Press `R1+Right` to cycle forward through the modes, or `R1+Left` to cycle backward. Each press switches to the next mode.
> - Check the mode name at the bottom left of the screen to confirm that the robot is in the required mode.
> - You can switch modes only in the idle state. If the current state is not `Idle`, `R1+Right` and `R1+Left` do not switch modes. To enter a state within a mode, use the command for that state.

- In the dual-arms configuration, the forward order of the modes is: `Motion` → `Teleop` → `High-Level Dev` → `Low-Level Dev`.

> 💡 **Tip**
> If the screen already shows `Idle` but the mode does not change, press `L1+□` once more, then press `R1+Right` or `R1+Left`.

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

Concept	Command Description	Prerequisite	Button	Notes
Mode Switching	Forward order: Show Mode → VR Teleoperation Mode → High-Level Development Mode → Low-Level Development Mode	Idle state	`R1 + Right`: Cycle forward through the modes `R1 + Left`: Cycle backward through the modes	At startup, the robot returns to the mode it was in before shutdown. In Motion mode, press `L1+△` in the Idle state to enter the Show state.
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+ □`	
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 the dual-arm modes. Forward order: Show Mode → VR Teleoperation Mode → High-Level Development Mode → Low-Level Development Mode	Idle state	`R1 + Right`: Cycle forward through the modes `R1 + Left`: Cycle backward through the modes	After startup, the robot remains in the mode used before shutdown by default

Enter Prepared 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+ □`	
Stand Up in Place	The robot stands up from ready state	Ready state	`L1+ △`	
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-Legs recommended)	Switches between stair mode and flat-ground mode	Standing state	Press the `Share Button` for 2 s	Wheeled-Legs Configuration is recommended for stairs. Sole Configuration requires specific step height, tread depth, and friction, with a high risk of tipping over. Avoid use unless necessary, and always use fall protection when testing.
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
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.

> 🔋 **Auto-Recharge**
> The TRON 2 Wheeled-Legs Configuration supports auto-recharge. For usage instructions, see the TRON 2 Auto-Recharge Base User Manual in the Documentation Center.

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

4.6 Web-Based Robot Control

In addition to the remote controller, you can use **Robot Control** on the robot management page (port 8080) to switch modes, home the arms, enter the idle state, and perform zero calibration. When you use this page together with the VR controllers, the remote controller is not required.

4.6.1 Robot Control Page

1. Connect your computer to the robot and make sure it can reach the robot IP address `10.192.1.2`. For connection methods, see 6.1 or 6.2.
2. Enter http://10.192.1.2:8080 in the browser address bar to open the robot management page.
3. Click **Robot Control** in the left menu. The top of the page shows the connection status, current state, and current mode.

Page Controls

Page Area	Button	Function
Working Mode	VR Teleoperation / Developer / Low-level Developer / Demo & Teaching Mode	Switches directly to the selected mode. Modes can be switched only in the idle state.
Basic Control	Home	Both arms perform the homing action, hang down naturally, and then enter the idle state.
	Idle Mode	Enters the idle state directly without the homing action. The joint motors enter the torque-damping state and slowly move downward. Use this if homing fails.
	Zero Calibration	Recalibrates the joint zero positions.
Top-right corner of the page	Emergency Stop	Immediately cuts power to all motors.

4.6.2 Switching Modes from the Web Page

1. Check the current state and mode at the top of the page. If the robot is already in the required mode, you do not need to switch.
2. If the robot is not in the idle state, click **Home** or **Idle Mode** under **Basic Control** first. Before clicking, make sure the robot is safely supported and keep clear of the arms.
3. After the current state shows the idle state (`ST_IDLE`), click the required mode under **Working Mode**.
4. Confirm that the current mode at the top of the page and the robot status indicator have changed to the required mode.

4.6.3 Demo and Teaching

In Demo & Teaching Mode, you can use the web page to run the preset motion demo, or move the robotic arms by hand to record a trajectory and play it back.

> ⚠ **CAUTION**
> Before you run a demo or play back a trajectory, clear all objects within at least 1 m of the robot. The robot can strike nearby objects while it moves. To stop the motion, click **Home** under **Basic Control**. In an emergency, click **Emergency Stop** in the top-right corner of the page.

Before you start, switch the robot to Demo & Teaching Mode as described in 4.6.2.

- **Motion Demo**

Click **Motion Demo** in the lower-right area of the page. The robot performs the preset demo motions.

- **Drag Teaching**

Click **Drag Teaching** to enter the drag teaching state. The page appears as shown below: the **Saved trajectories** list is on the left, and the control panel is on the right.

---

1. **Record a trajectory:** Click **Start recording**, then move the robotic arms by hand to demonstrate the motion. When you finish, click the button again to stop recording. The trajectory is saved automatically to the list on the left.
2. **Rename a trajectory:** Select the trajectory in the list, enter a new name in the box above the list, and click **Rename**.
3. **Play back a trajectory:** Select the trajectory in the list and click **Replay**. The robot repeats the recorded trajectory once.
4. **Delete a trajectory:** Click the delete icon to the right of the trajectory.

5 VR Device and Dual-Arms Teleoperation Instructions

5.1 VR controller Buttons

5.2 VR controller Commands

Global Commands			
Concept	**Button**	**Prerequisite**	**State Description**
Start Teleoperation	Hold the Grip Button on either controller	VR Teleoperation Mode, or High-Level Development Mode (stationary or during model inference)	The robot starts responding to the VR controllers. In High-Level Development Mode, holding a Grip Button switches the robot directly to VR Teleoperation Mode. Holding a Grip Button in Show Mode or Low-Level Development Mode does not enter VR Teleoperation Mode.
End Teleoperation	Release the Grip Buttons on both controllers	VR Teleoperation Mode	Exits VR Teleoperation Mode and returns to the mode used before teleoperation.

Global Commands			
Start Data Collection	B button on the right controller	VR Teleoperation Mode or during model inference	Starts collecting teleoperation data. The Grip Button does not need to be held.
Stop Data Collection	Y button on the left controller	Any mode	Stops collecting teleoperation data. The Grip Button does not need to be held.
Cancel Data Collection	Press the B button on the right controller again	Data collection in progress	Cancels the current data collection and deletes the data package just recorded. The Grip Button does not need to be held.
Emergency Stop	Press the left and right joystick buttons simultaneously	Any mode	Power to all motor drivers is cut immediately; battery power and indicator lights remain on. On robots with a Mobile Base, the Mobile Base also stops immediately.
Emergency Stop Release	Click the right joystick button	Emergency Stop State	The motors are powered on again, and the robot enters the damping state. Clicking has no effect in other states.
Head			
Concept	**Button**	**Prerequisite**	**State Description**
Head Down/Up	Hold the Grip Button on at least one controller	VR Teleoperation Mode, with Head Follow enabled in the VR app	When the operator wearing the VR headset looks down/up, the robot head follows.
Head Turn Left/Right	Hold the Grip Button on at least one controller	VR Teleoperation Mode, with Head Follow enabled in the VR app	When the operator wearing the VR headset turns their head left/right, the robot head turns with it.
Head Recenter	Hold the Grip Buttons on both controllers + X button + A button	VR Teleoperation Mode, with Head Follow enabled in the VR app	The robot head returns to its initial upright, forward-facing posture.
Dual-Arms (single-arm robots default to the right arm and use only the right controller)			

Global Commands			
Concept	**Button**	**Prerequisite**	**State Description**
End-Effector Following	Hold the Grip Button on the left/right controller	VR Teleoperation Mode	Hold the left Grip Button to make the left arm end effector follow the left controller; hold the right Grip Button to make the right arm end effector follow the right controller. Uses incremental displacement control.
End-Effector Lock	Release the Grip Button on the left/right controller	VR Teleoperation Mode	Releasing a controller's Grip Button pauses the corresponding arm end effector. Typical use: hold one arm still during one-handed operation.
Gripper Grasping	Hold the Grip Button + pull the Trigger Button on the same side	VR Teleoperation Mode	**Adjust opening:** Hold the Grip Button, then pull the trigger. The farther you pull it, the more the gripper closes; release the trigger to open the gripper. **Hold opening:** While pulling the trigger, release the Grip Button. The gripper keeps its current opening, and the arm on the same side locks in place.
Left Arm to Initial Pose	Long-press the left Grip Button + X button	VR Teleoperation Mode	Keep holding both buttons until the left arm returns to the initial teleoperation pose (left elbow bent 90°, forearm horizontal). Hold the buttons until the arm reaches the pose. If you release them midway, the arm stops immediately at its current position. During homing, the left arm does not follow the controller.
Right Arm to Initial Pose	Long-press the right Grip Button + A button	VR Teleoperation Mode	Keep holding both buttons until the right arm returns to the initial teleoperation pose (right elbow bent 90°, forearm horizontal). Hold the buttons until the arm reaches the pose. If you release them midway, the arm stops immediately at its current position. During homing, the right arm does not follow the controller.
Mobile Base			

Global Commands			
Concept	**Button**	**Prerequisite**	**State Description**
Forward/Backward Movement	Hold the left Grip Button + push the left joystick forward/backward	VR Teleoperation Mode	The robot moves forward/backward. The farther you push the joystick, the faster it moves.
Left/Right Translation	Hold the left Grip Button + push the left joystick left/right	VR Teleoperation Mode	The robot moves left/right without changing its heading. The farther you push the joystick, the faster it moves.
Diagonal Movement	Hold the left Grip Button + push the left joystick diagonally	VR Teleoperation Mode	The robot moves in the joystick direction without changing its heading. The farther you push the joystick, the faster it moves.
In-Place Rotation	Hold the right Grip Button + push the right joystick left/right	VR Teleoperation Mode	The robot rotates left/right in place. The farther you push the joystick, the faster it rotates.
Parking State	Long-press the right joystick button for 1 s	VR Teleoperation Mode	Use this when the robot must remain at a fixed position for a long time (for example, when parked or performing fixed-table tasks). The four wheels lock in an X-shaped four-wheel steering configuration. Mobile Dual-Arms robots only.
Lift Stand			
Concept	**Button**	**Prerequisite**	**State Description**
Raise/Lower	Hold the right Grip Button + push the right joystick forward/backward	VR Teleoperation Mode	Raises/lowers the robot torso. The farther you push the joystick, the faster it moves. The travel range is limited by the robot's configured upper and lower limits.

> 💡 **Tip**

- VR teleoperation works the same way for local network teleoperation, remote internet teleoperation, and manual takeover during autonomous inference.
- The Grip Button is the master enable for its controller. All VR controls require at least one Grip Button to be held, except the data collection buttons.
- The left and right joysticks and buttons work independently and can be used at the same time. For example, move forward while rotating to turn as you move.
- Arm homing interrupts autonomous inference and switches the robot to VR Teleoperation Mode.

5.3 Teleoperation Preparation

5.3.1 Dual-Arms Zero Calibration

> ⚠️ **NOTICE**
>
> - 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` on the remote controller (or click **Home** on the **Robot Control** page of the 8080 web page) to make sure both arms are in the idle state and hanging naturally.
2. Press `L1+R1` on the remote controller (or click **Zero Calibration** on the 8080 web page) to start automatic zero calibration. After calibration ends, both 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

Use either of the following methods to switch to VR Teleoperation Mode:

- Method 1 – **Remote controller:** Press `L1+□`. After the screen shows `Idle`, press `R1+Right` or `R1+Left` to cycle through the modes until the bottom bar shows `Teleop` and `Active`.
- Method 2 – **8080 web page:** On the **Robot Control** page, click **Idle Mode**. After the current state shows `ST_IDLE`, click **VR Teleoperation** under **Working Mode**. For details, see 4.6.

After switching, start the teleoperation app on the VR device and complete the preparation steps in the following sections.

> 💡 **Tip**
> If you are using the remote controller and the screen shows `Idle` but the mode does not change, press `L1+□` once more and try again. Before doing so, make sure the robot is safely supported.

5.3.3 Starting the Teleoperation App on the VR Device

> ⚠️ **NOTICE**
> Do not remove the protective sticker covering the detection sensor before teleoperation use (otherwise the headset may frequently enter sleep mode).

- When connecting the VR device to the robot for the first time, **wear the VR Headset** and complete the following settings in the VR interface.
- Tip: Point with the right-hand controller. Short-press the Trigger Button on the right-hand controller to select or confirm.

Step	Operation	Illustration
1. Power on the VR device	Press and hold the Power Button on the right side of the Headset for approximately 3 seconds to power on, then **put on the Headset** to enter the system home screen	
2. Connect to the robot Wi-Fi	In the quick panel / Settings, connect to `TRON2A_XXX_2.4G` or `TRON2A_XXX_5G` with password `12345678`	
3. Start the teleoperation app	Library > Unknown Sources > `Limx_teleop`	

Step	Operation	Illustration
4. Configure and connect	Select `Tron2`, enter `10.192.1.2` as the IP, and click **Connect**	

NOTICE: For local teleoperation, we recommend disconnecting the robot from external Wi-Fi networks. Keep only the robot's 5 GHz Wi-Fi network enabled for the VR device.

> ⚠️ **NOTICE**
> If the VR device is connected to the robot's 5 GHz Wi-Fi network while the robot is also connected to an external 5 GHz Wi-Fi network, the two networks may interfere with each other. This can cause video latency, sluggish controls, or jitter. If the robot needs to connect to an external network, use a 2.4 GHz Wi-Fi network and keep the VR device connected to the robot's 5 GHz Wi-Fi network.

- **Full walkthrough:** The following video shows the complete process: opening Limx_teleop, connecting to the robot's network, selecting PICO Controllers, enabling Head Follow (the robot's head camera follows the VR headset), and turning on the left and right wrist camera feeds.

> 💡 **Tip**
> If you are prompted to enable body following, 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

> 💡 **Starting Teleoperation**
> Make sure the robot is in VR Teleoperation Mode (see 5.3.2). Hold the controllers with both hands and match your arm posture to the robot's arms before you begin.

> ⚠️ **CAUTION**
> - When operating for the first time, use small, slow movements. Avoid sudden large controller movements, which can cause the robotic arms to swing rapidly or strike nearby objects. The

teleoperation link has a latency of about 100 ms, so anticipate your movements.

- Release the Grip Buttons before you walk. Otherwise, both arms will move with your body.

5.4.1 Dual-Arm Zero Return

To return the left arm, long-press `left Grip Button + X button`. To return the right arm, long-press `right Grip Button + A button`. The corresponding arm returns to the initial teleoperation pose (elbow bent 90°, forearm horizontal).

Keep holding the buttons until the arm reaches the pose. If you release them midway, the arm stops immediately at its current position; long-press again to continue. During zero return, the arm does not follow the controller.

5.4.2 Arm Following and Unlocking

- **Unlock and follow:** Hold the Grip Button on the left/right controller to unlock the corresponding arm. Its end effector then follows the controller, moving from its current position by the same direction and distance as the controller (incremental displacement control).
- **Lock:** Release the Grip Button to lock the corresponding arm at its current position immediately. During one-handed operation, release the Grip Button on the other controller to hold that arm still.
- **Move in segments:** When you hold the Grip Button again after releasing it, the arm does not jump to the controller's position. It continues following from its current position. To move the arm a long distance, release the Grip Button, bring the controller back, and then hold the Grip Button again to continue.

5.4.3 Gripper Grasping

After you hold the Grip Button on the same side to start teleoperation, release the trigger once, then pull the `left/right Trigger Button` to control the left/right gripper. Gripper closure is proportional to trigger travel: the farther you pull the trigger, the more the gripper closes. Release the trigger to open the gripper.

5.4.4 Mobile Base and Lift Stand Control

At this point, the Mobile Base and Lift Stand can be controlled normally according to the VR controller comm ands.

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.

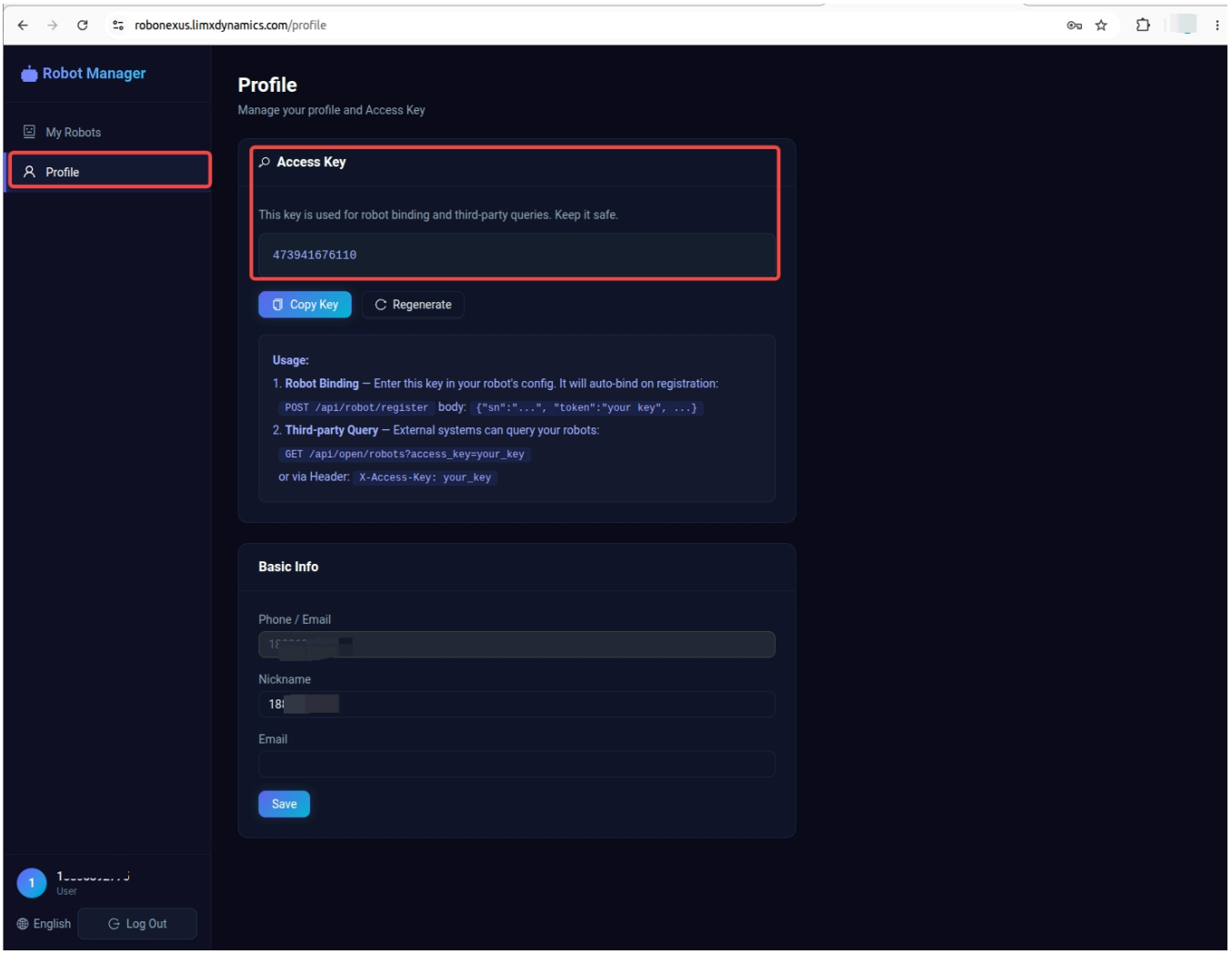
6.4 Remote Teleoperation Configuration

After completing the following settings, you can use a VR device to teleoperate a bound robot over an external network.

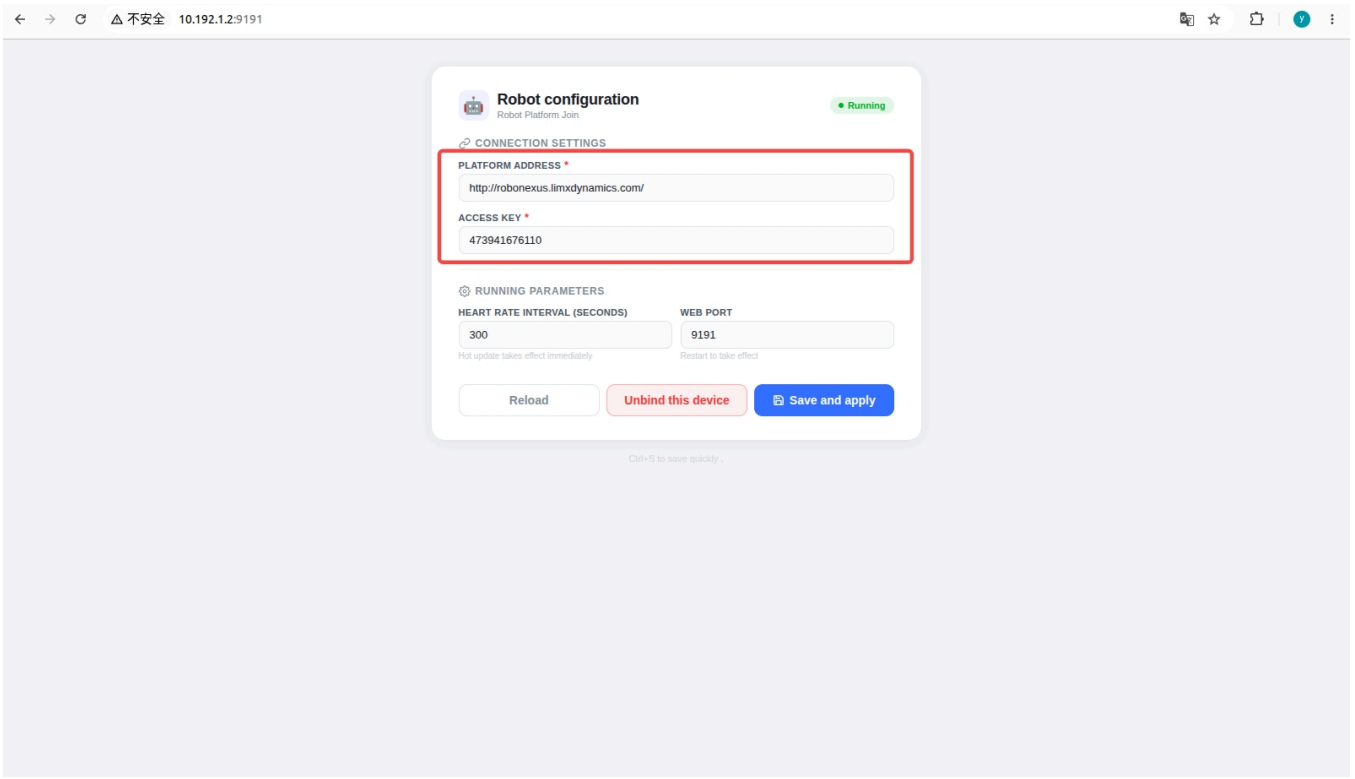
> 💡 **Tip**
> Before proceeding, complete the settings in 6.3 dual-arm to an External Network, and make sure both the robot and the VR device are connected to an external network.

6.4.1 Binding the Robot

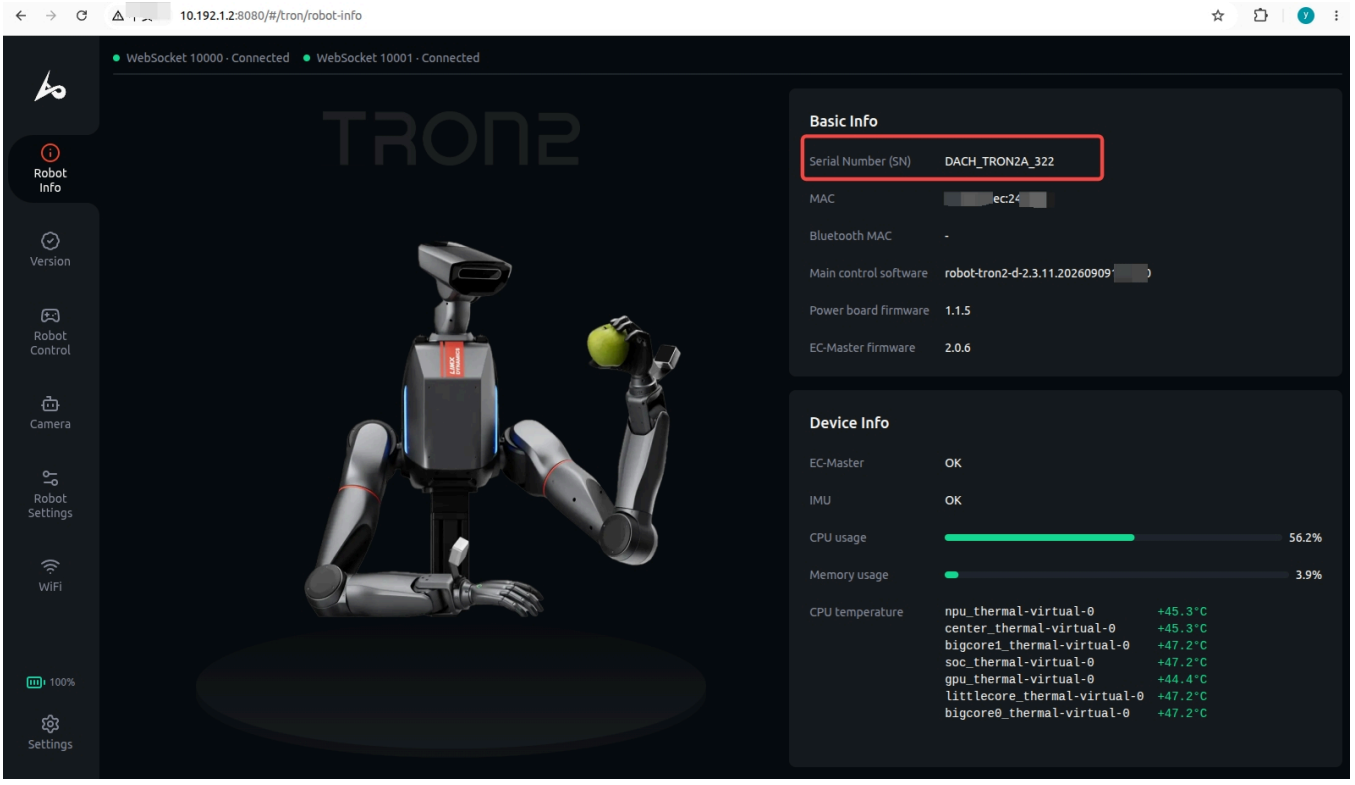
1.Access the Robot Management Platform at http://robonexus.limxdynamics.com/ over the external network. Register and log in to your account, then obtain the Access Key on the personal information page.



2.Connect to the robot via Wi-Fi or the Ethernet port, then access the Remote Teleoperation Configuration page at http://10.192.1.2:9191 in a browser. Enter the platform address `http://robonexus.limxdynamics.com/` and your account's Access Key, then save and apply the configuration.

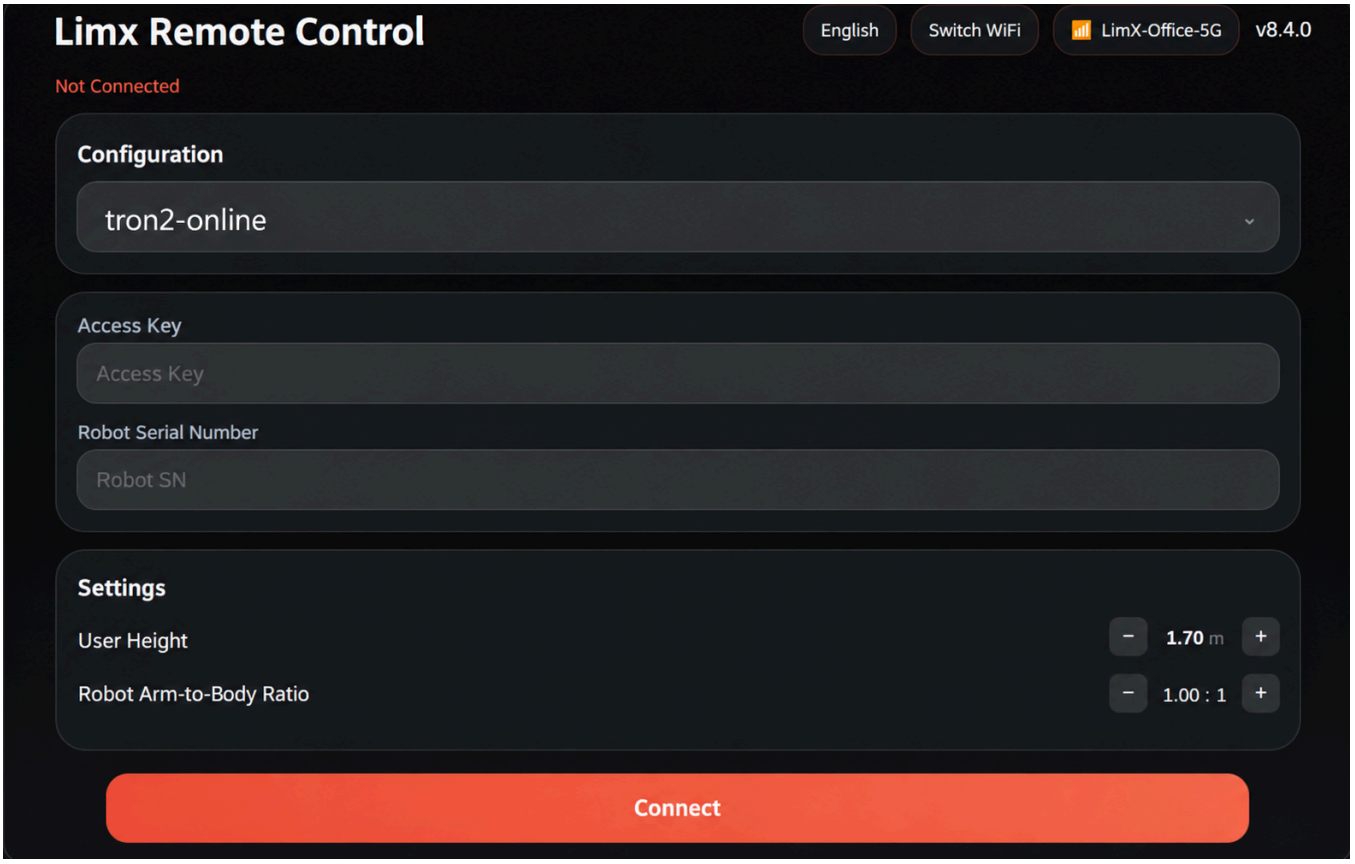


3.Access the robot management page at http://10.192.1.2:8080, and record the robot's Serial Number (SN) under "Robot Information".

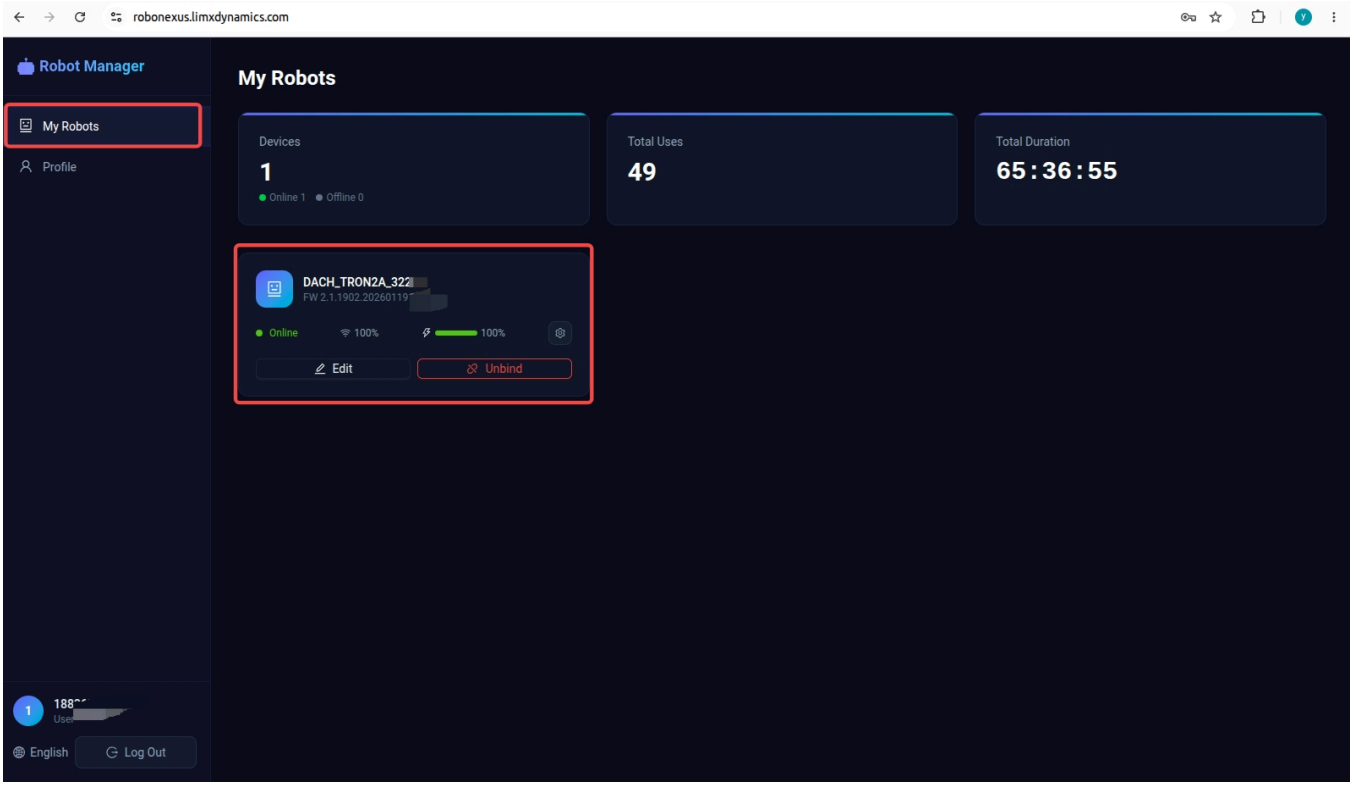


6.4.2 Connecting the VR Device

1. Open the teleoperation app on the VR device and select connection via an external network.
2. Select `tron2-online` as the configuration, enter your account's Access Key and the robot's serial number, then click "Connect".



3.After the connection succeeds, the Robot Management Platform displays the robots currently available for remote teleoperation.

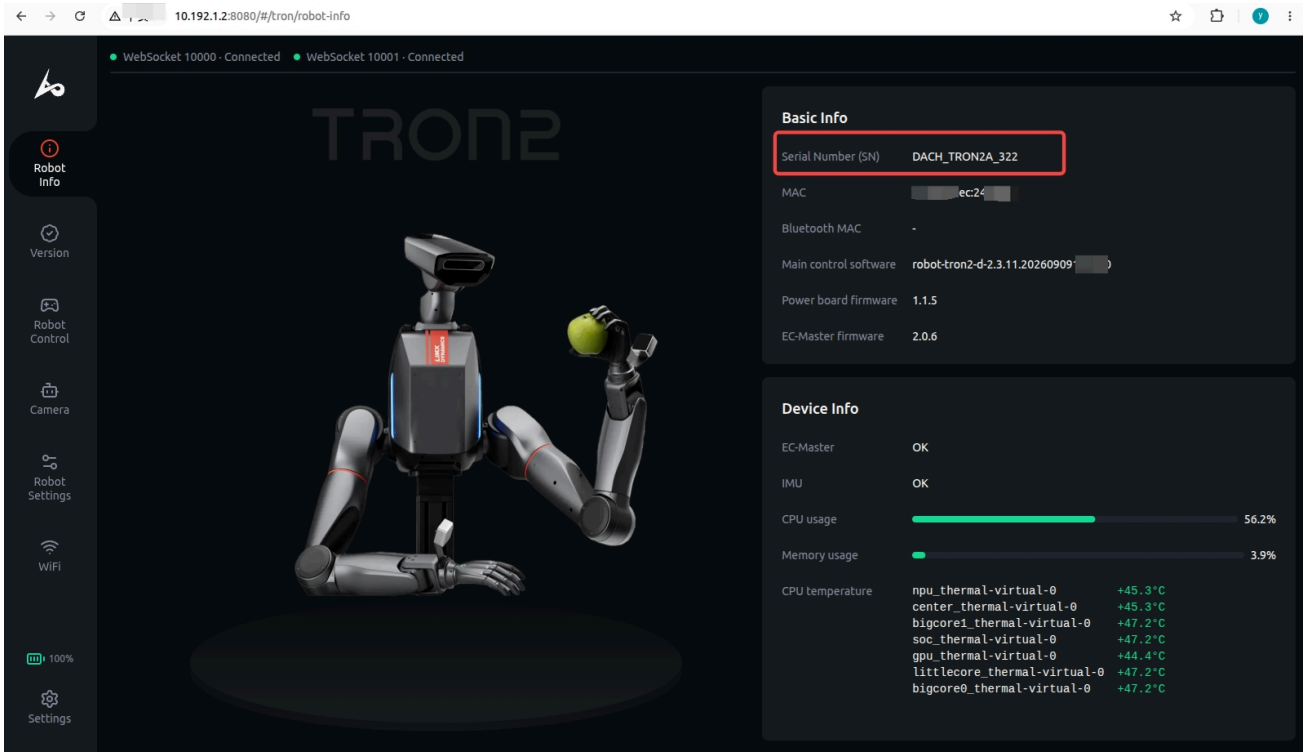


7 Robot Software Upgrade

7.1 Robot Body Firmware Upgrade

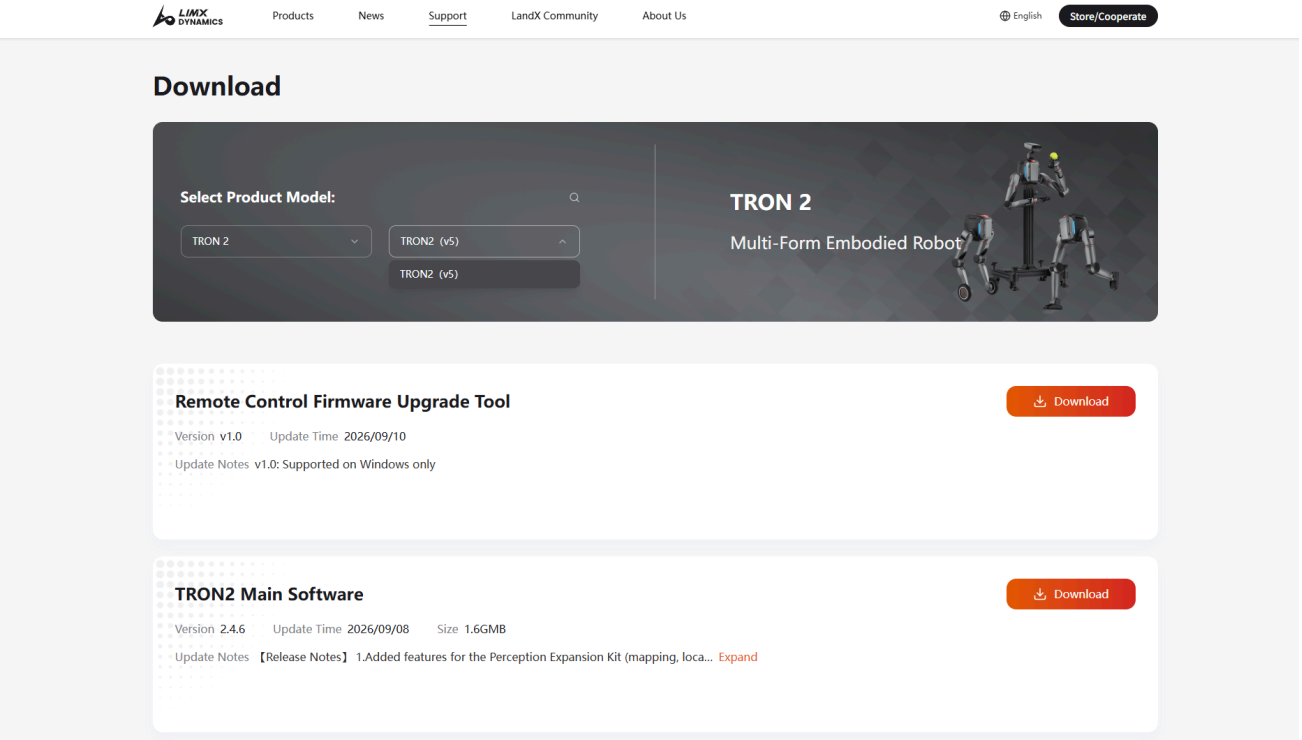
Use a browser to enter the robot management page and select the robot software version downloaded locally in advance for upgrade. The steps are as follows:

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.

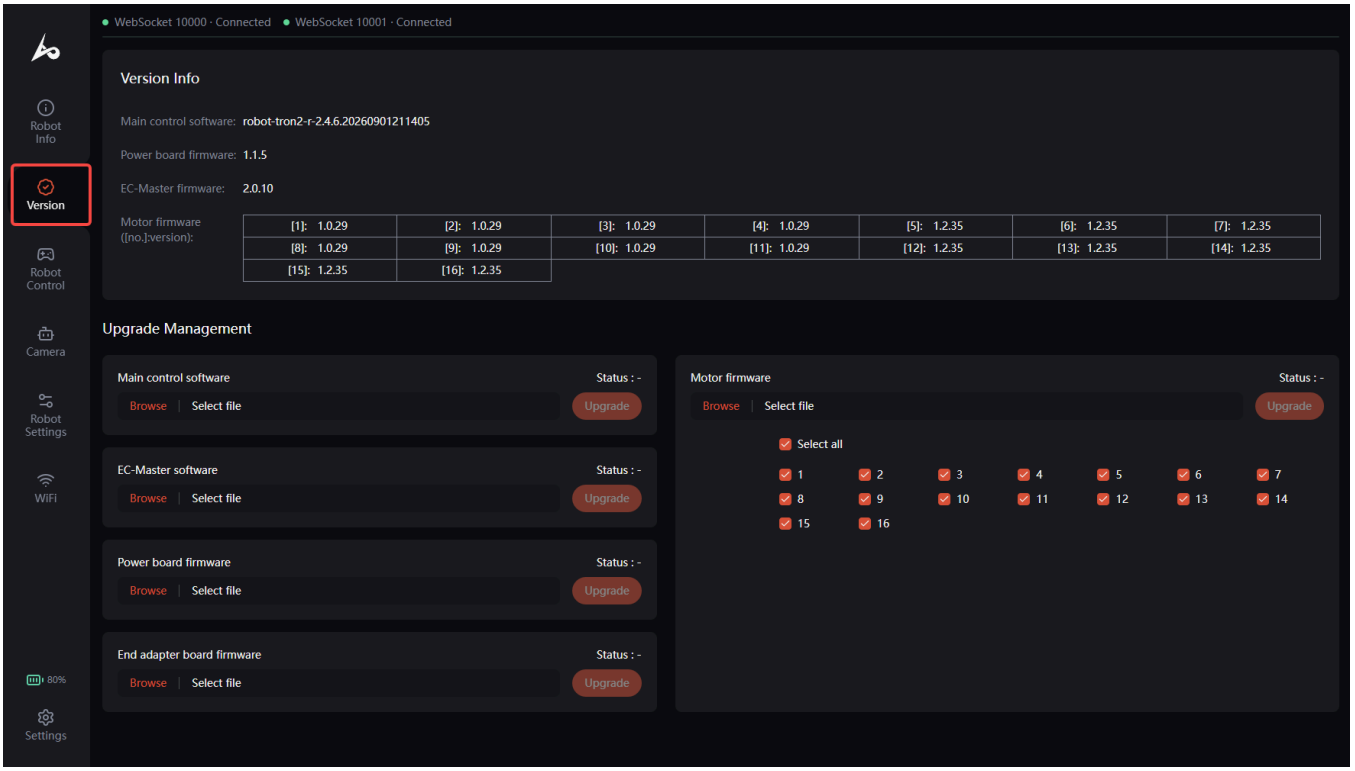


3. Select and upgrade software:
   a. Go to the LimX Dynamics official website → Downloads ，at https://www.limxdynamics.com/en/downloads. Select the product model **TRON2**, choose the firmware type and version you need, and download

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 **Select 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 Online

Before proceeding, make sure the VR device is connected to an external network.

1. Open the Library from the bottom menu of the VR device and find the teleoperation app. Press and hold the Grip Button on the controller, then select "Uninstall" in the pop-up window.
2. Open the browser on the VR device, search for "LimX Dynamics", and go to the LimX Dynamics official website.
3. Go to "Support > Downloads", select `TRON 2`, and download the latest VR device app.
4. When the download is complete, select "Install app" in the pop-up installation prompt and wait for the installation to finish.
5. After installation, you can find the teleoperation app in the Library.

Operation Video

7.3 The remote controller firmware upgrade

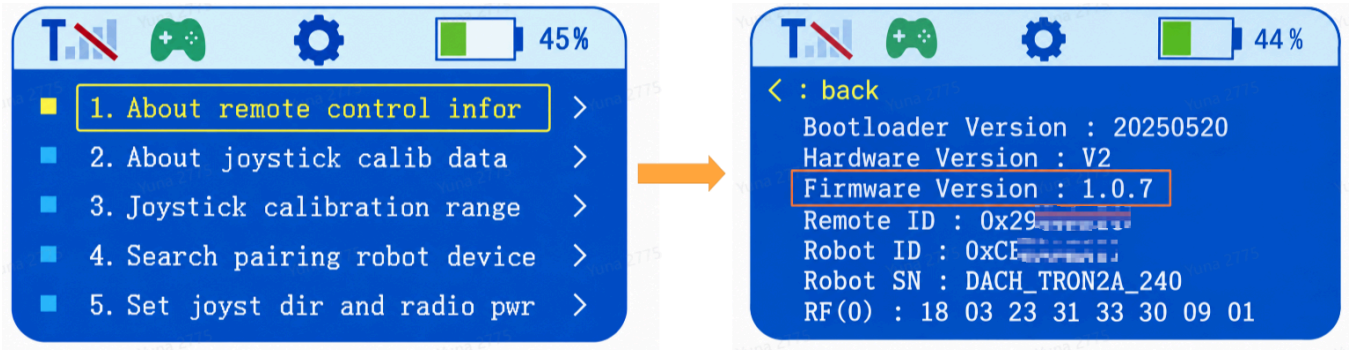
> 💡 **Tip**
> The remote controller firmware upgrade tool runs on Windows only.

1. Download the remote controller firmware upgrade tool from the official website, unzip it, and open the software.
2. Take out the remote controller charging cable and connect the remote controller to be upgraded to a Windows PC.
3. With the remote controller powered off, press and hold the Left Joystick + Power button. The remote controller will enter Boot state.
4. In the "COM" field, select the device number of the remote controller, then click "OPEN COM" to open the remote controller serial port.
5. After the serial port is opened, the remote controller log information will be displayed, and the status shown on the remote controller screen will switch to "BootUSB".
6. Download the latest remote controller firmware from the official website and save it locally. Click "OPEN FILE" and select the downloaded new firmware.
7. Click "UPGRADING" to start the firmware upgrade. A prompt will pop up after the upgrade is successful.

Operation Video

Long press the power button to turn off the remote controller. After restarting, you can verify the upgraded firmware version: double-click the Power button to enter the settings page, use the Up/Down buttons to

select the first item, then press the Right button to enter. The remote controller information will be displayed, where "Firmware Version" is the current firmware version.



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.