MARK1

SERIES

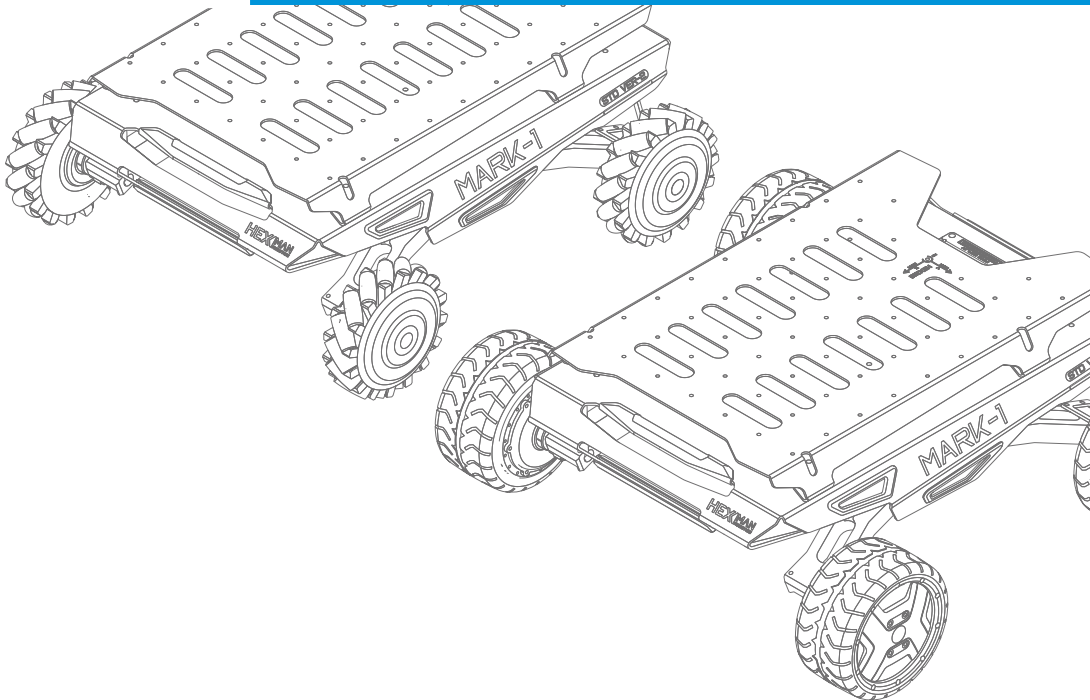### Customizable Mobile Chassis

Product Manual

V1.0.4

Important safety information

▪ Please confirm the operating voltage, power, installation and other parameters of the equipment before use. Any issues caused by exceeding these parameters are not covered by the warranty.

▪ Please evaluate the IP level, temperature, and equipment suitability requirements of the usage environment. Problems caused by harsh environments are not covered by the warranty.

▪ This device does not provide stable safety features such as collision prevention, drop prevention, and biological proximity warning. Please conduct a safety assessment of the integrated product and comply with corresponding regulations and certifications to ensure that the developed product does not have significant safety hazards.

▪ Please read the relevant maintenance requirements to prevent irreversible damage caused by incorrect operation, such as excessive battery discharge, low tire pressure, low pressure causing wheel hub damage, lack of lubrication causing shaft wear, etc.

▪ For the first time using, please place the device in a safe and open environment without any load. Follow the operating instructions to start and test all related functions. If you have any questions, please contact the purchasing channel service personnel.

▪ When there is an abnormality or accident in the equipment, please immediately use an emergency stop or turn off the power to avoid secondary damage, and contact relevant technical personnel. Do not disassemble on your own.

⚠ Note: Any damage caused by force majeure such as disassembly, modification, abnormal use, or natural disasters by the user will not be covered by the warranty.

This product does not assume any corresponding responsibility for safety accidents caused by the user's integrated equipment. Users are requested to evaluate the risks and conduct reliability tests on their own, and hereby declare.

Version update information

V1.0.0: Starting version

V1.0.1: Modify parameters, add remote control fine-tuning method, modify ROS package usage method

V1.0.2: CAN protocol added free mode and updated manual layout

V1.0.3: Modifying remote control instructions and system support instructions

V1.0.4: Add buzzer, line offset, and wire control step instructions

CATALOG

1.1 Product Introduction

MARK1 is a mobile chassis module with strong scalability, high throughput, and excellent cost-effectiveness. This module adopts a left and right swing arm suspension system design, which can use Mecanum wheels and differential systems, is universal indoors and outdoors, and can pass through most obstacle scenarios. As a highly customized product, MARK1 can accept special modifications from users and supports direct use of underlying drivers, making it particularly suitable for teaching robot principles and competition scenarios with hardware hands-on needs.

Figure 1.1 Chassis Appearance

1.2 Product List

Item	Number
Robot chassis	X1
Battery charger	X1
Aviation plug adapter cable (4pin)	X1
Toolbox (optional)	X1
Wireless remote control (optional)	X1
Packaging paper box	X1

1.3 Performance Parameter

Item	MARK-DIFF	MARK-MCNM
Size	584x617x233MM	584*532*231MM
Radius of rotation	415MM	378MM
Ground clearance	132MM	132MM
Unloaded mass	22KG	22KG
Rated load	asphalt pavement 25KG	25KG
Maximum speed	2.0M/S	3.0M/S
Maximum climbing angle	full load 15° no load 40°	10°
Obstacle crossing	no load 90MM	no load 30MM
Sports mode	Four wheel differential system	Mecanum wheel
Braking mode	Electronic brake	Electronic brake
Working hours[1]	3-5H	3-5H
Motor power	4*250W	4*90W
Encoders conflg	Analog 4096p	1024p
Battery parameters	24V/12.5AH	24V/12.5AH
Charging time	6H	5H
Power output	24V (29.4Vmax)	24V (29.4Vmax)
Interface	ROS	ROS
	（CAN bus optional）	（CAN bus optional）
IP level	IP22	IP22
Operation temperature	0-40℃	0-40℃

[1]Note: The working time is the average 1A current measured data
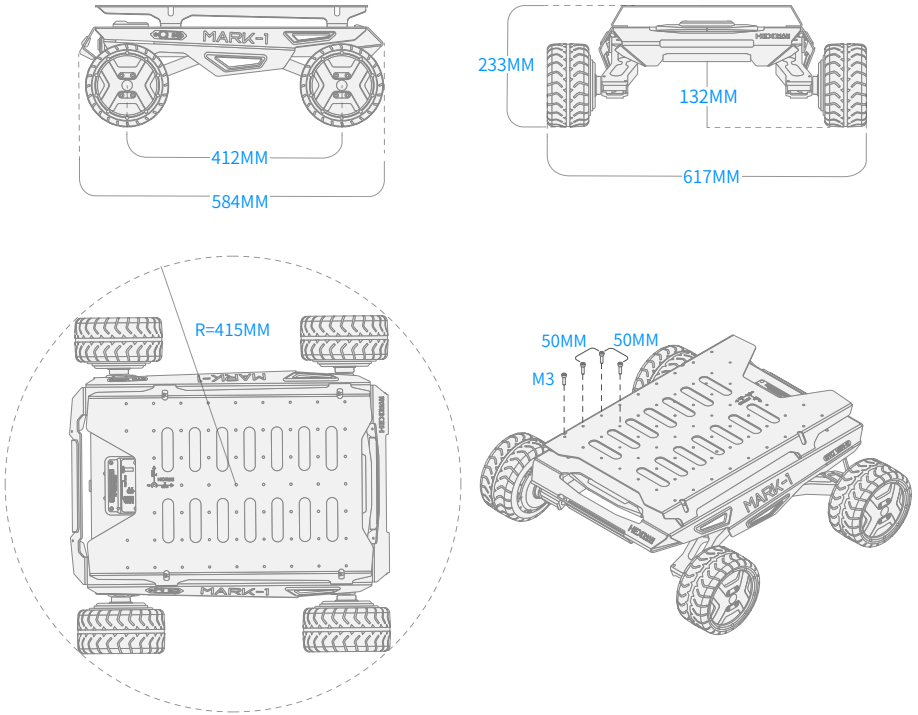
1.4 Size Parameter
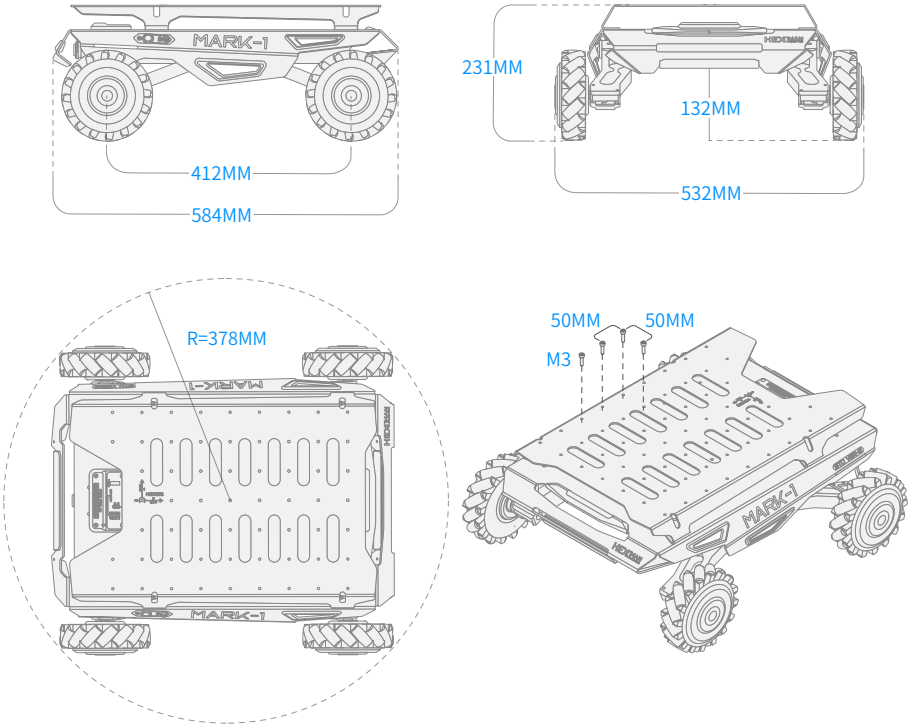

Figure 1.2 MARK1-DIFF Dimensional Drawing

Figure 1.3 MARK1-MCNM Dimensional Drawing

2.1 Architecture Introduce

This section will provide a basic introduction to the chassis, facilitating users and developers to have a basic understanding of the chassis. As shown in Figure 2.1, it is an overview view of the entire mobile robot chassis.
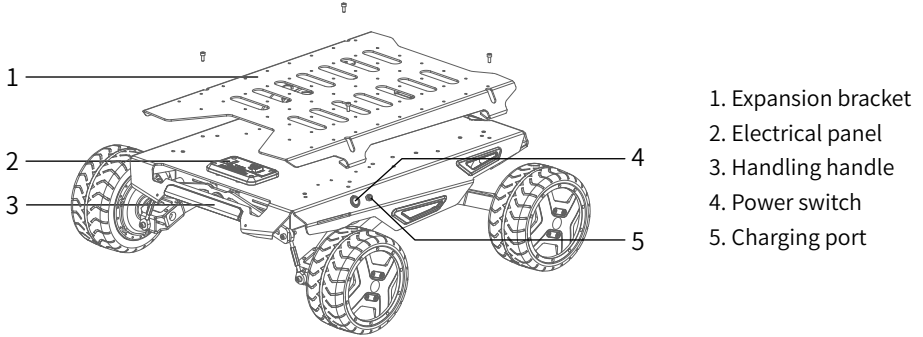

1. Expansion bracket
2. Electrical panel
3. Handling handle
4. Power switch
5. Charging port

Figure 2.1 Overview View

2.2 Electrical Interface Description

The rear electrical interface is shown in Figure 2.2. Among them, 1 is the power display; 2 is the CAN communication and 24V power expansion port; 3 is the power output port; 4 is the fuse.

1. Power display LED
2. 4PIN extension interface
3. XT30 power output interface
4. Fuse
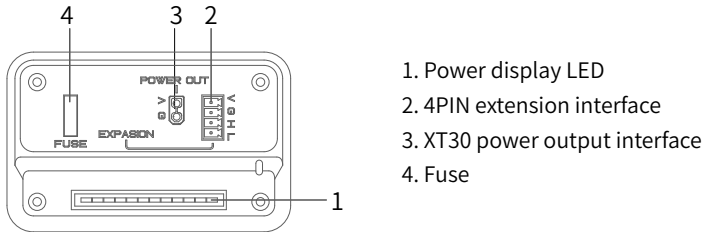
Figure 2.2 Electrical Panel View
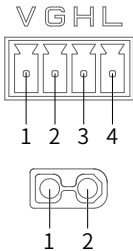
Pin number	Types	Function	Notes
1	Power	VCC	Positive (22V~29.4V) 5A MAX
2	Power	GND	Negative pole
3	CAN	CAN-H	CAN HIGH
4	CAN	CAN-L	CAN LOW

Figure 2.3 External Interface Pin Diagram

2.3 Remote Control Description

The remote control is an optional accessory that can easily control the chassis. In this product, we adopt a design of left hand forward and backward with left and right translation, and right hand clockwise and counterclockwise rotation.The function definition is as follows：

SWA: Working mode; Upper: Free mode, motor power off; Middle: Remote control mode; Lower: CAN control mode.

SWC: Brake control; Up: Hold the brake, down: Release the brake.

SWD: Speed mode; Upper: 25% speed, middle: 50% speed; Bottom: Full speed.

S1: Throttle rocker; controls linear motion.

S2: Spin rocker; Control rotational motion.

POWER: Power button, short press to turn on, long press to turn off.

ADJUST: Rocker fine adjustment button, only used on time during calibration.

The remote control has the highest priority. When the remote control is turned on, the chassis prioritizes using the control mode selected by SWA, ignoring the mode setting of CAN commands.
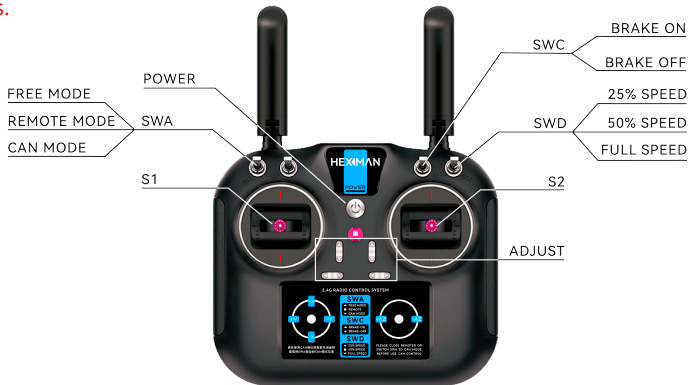
Figure 2.4 Remote Control Function Diagram

2.4 Data cable description

The chassis uses a four core plug for external communication. Be sure to connect the equipment before connecting it to prevent a short circuit in the power supply. (Misoperation damage to the machine is not covered by the warranty)

Color	Function	Notes
Red	VCC	MAX 5A
Black	GND	
Yellow	CAN_H	
Green/Blue	CAN_L	

3.1 Operating instructions

3.1.1 Detection before power on

1) Check the chassis status. If there are any abnormalities, please contact after-sales service。 (Suggested chassis ground clearance test for first use.)

3.1.2 Power on and start up

1) Press the power switch button (see 4 in Figure 2.1), the power button lights up, and the electrical panel bar light displays the power (the battery is not fully charged at the factory).

2) The chassis enters the self inspection program, and after 3 seconds, the buzzer sounds three times, the motor is enabled, and the robot starts.

3.1.3 Wireless remote control

1) Push the SWA paddle to the top position. Press and hold the POWER button (see Figure 2.4), the remote control buzzer will sound, and the remote control will turn on.

2) Move the SWA paddle to the middle position to enter remote control mode.

3) If there are brakes, please shift the SWC to the lower position to release the brakes.

4) Move the joystick S1 up and down to move forward and backward, left and right to shift (unique to the Mecanum wheel), and S2 to rotate left and right.

5) If there are no issues with the test, you can switch the SWD to full speed mode by moving it to the lower position. Please continue using it in an open environment.

6) Move the SWA lever to the top position, hold down the POWER key for a long time, and the remote control will shut down.

7) If there is a remote control deviation (The rocker was not pushed but the chassis moved) ,please use ADJUST to adjust the zero point of the joystick, and press and hold the fine adjustment button to continuously increase the adjustment amount.

3.1.4 Power off and shutdown

1) Press the switch button (see Figure 2.1, 4), light goes out, and the motor is released.

3.1.5 Charge

1) Ensure that the chassis is in a shutdown and power off state.Insert the charger plug into position 5 on the side of the vehicle (see Figure 2.1, 5).

Note: The battery takes 4 hours and the light changes from red to green to fully charge.

Working mode	Equipment performance
Standby mode	Motor starts servo, unable to control
Free mode	Motor off servo, can be pushed freely, cannot be controlled
Remote control mode	Motor start servo, remote control
CAN mode	Motor start servo, CAN/ROS command control

3.1.7 Buzzer

The car mounted buzzer is used for device alarms and special function reminders, and can be automatically or manually activated. Based on the beeping situation, chassis issues can be quickly identified, as shown in the table below.

Function	Startup	Low battery reminder	Low battery error	Manual/special functions	System error
Cycle	Disposable	5s	1s	2s	2s
Step1	2KHz/100ms	4KHz/100ms	4KHz/100ms	2KHz/100ms	4KHz/100ms
Step2	3KHz/100ms	2KHz/100ms	2KHz/100ms	4KHz/100ms	number of cycles[note]
Step3	4KHz/100ms	Silent until the end of the cycle			

Note: The number of system error single cycle beeps corresponds to the order of the byte where the error code is located, such as 4 beeps when the drive is disconnected.

3.1.8 Line offset

The straight-line deviation of the chassis is influenced by many factors, and is generally controlled within a deviation of 50cm within 10m. If the deviation is too large, the following measures can be taken:

1) Check if the ground is level, potholes and slopes can cause deviations

2) Check if the tire cover is normal, severe wear and foreign objects can cause diameter changes.

3) Is the speed too fast or the acceleration and deceleration too large during the test? Please test at a low and constant speed.

4) Is there any uneven load, which can lead to varying degrees of shock absorption compression, and the load test can be removed.

3.1.9 Wired control steps

If using CAN to control the chassis, the following steps or commands are required.

1) Wait for the chassis to start and sound the start buzzer before proceeding to the next step.

2) Ensure that the remote control is turned off or switched to CAN mode.

3) Enabling device (general setting instruction).

4) Switch to CAN mode (chassis status setting command).

5) Start motion (chassis motion control command).

If using ROS/Serial port to control the chassis, In addition to the above operations, it is also necessary to connect the device first.

1) Correctly connect the chassis to the CAN-COM HUB, please refer to Figure 3.2 (Example of HUB connection).

3.2 CAN bus communication protocol

The CAN communication in the product adopts CAN2.0B (extended frame), with a communication baud rate of 500K. CAN bus is an optional solution, Please contact the staff for instructions and usage cases.

3.3 Serial communication protocol

The serial communication protocol is a packaging and encapsulation of the CAN protocol, adding frame header, frame length, frame ID, and checksum. Please contact the staff for instructions and usage cases.

3.4 XROS development package

XROS is an open-source development package based on ROS, which helps users quickly use our various devices and products on the ROS platform, reducing the amount of large-scale development. This code package supports the full set of XSTD protocol standards. Please contact customer service to obtain the development package and instructions for use. Before use, you need to install the ubuntu operating system and ROS robot operating system yourself. This ROS package is compatible with ROS and ROS2 versions as follows. Please refer to the XROS user manual for usage instructions.

Note: To use XROS, CAN-COM HUB is required as a conversion device.

Ubuntu 18
Ubuntu 20

:::ROS
Melodic
Noetic

:::ROS2
Galactic
Foxy

XSTD
SUPPORT DEVICES

python™

GAZEBO

3.5 CAN-COM HUB introduce

CAN-COM HUB is a protocol conversion device. It is a device that must be equipped for communication using the XROS development package and USB serial port. This device is not included in the default configuration. If necessary, please contact customer service.

Figure 3.1 CAN-COM HUB

3.5.1 HUB Connection Diagram
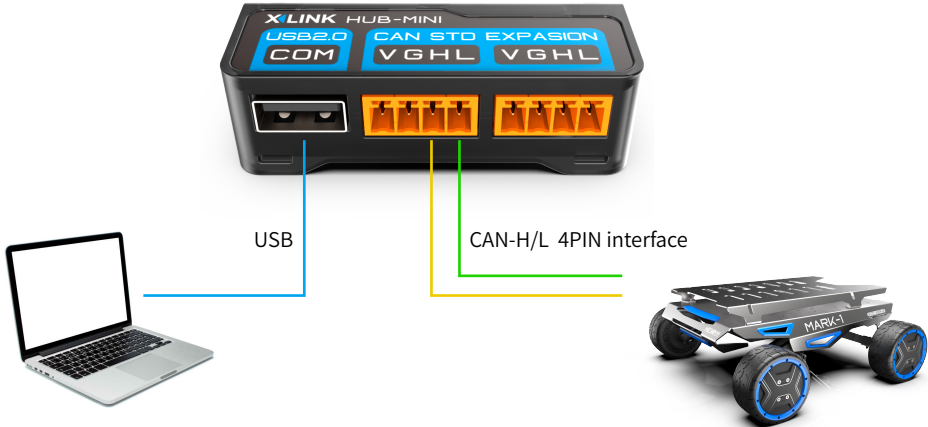

USB   CAN-H/L 4PIN interface

Figure 3.2 Example of HUB connection

3.6 ROS Package Usage

The robot chassis provides an ROS interface, allowing developers to obtain chassis information and control the chassis through the ROS package. Before use, you need to install the ubuntu operating system and ROS robot operating system yourself. This ROS package is compatible with Melodc under ubuntu18.04 and Noetic under ubuntu20.04.

Please first create a workspace for ROS, copy the contents of the src folder in XROS to the src folder in the workspace, compile the workspace, and add environment variables.

After completion, follow the following steps:

1: Run sh script for serial port
Open the terminal in path：ros_ws/src/BASE/xpkg_comm/scripts, and enter :sh script_init.sh to run. Alternatively, copy file:CAN2COM_HUB.rules to folder:/etc/udev/rules.d.

2: Restart the system.

3: Connect the HUB, power on the chassis, and ensure that it is not squeezed against the collision edge, keeping the power wheel suspended.

4: Run launch file.
To directly use the node, please open the terminal in directory: workspace/src/B-RINGUP/xpkg_bringup/launch and enter : roslaunch bringup_key_ctrl.launch to run.
If you need to use a keyboard for testing, please open the terminal in directory: workspace/src/BRINGUP/xpkg_bringup/launch, enter : roslaunch bringup_key_ctrl.launch to run, and use the keyboard direction keys to operate the chassis. The usage is the same as turtle_teleop_key.

3.6.1 ROS Topics and Messages

After successfully launching the ROS package, you can view ROS topics through the rostopic list. /tf and /odom are topics published by chassis nodes,/cmd_ Vel is a topic subscribed to by chassis nodes.

The chassis node sends a message type of nav_ msgs/Odometry to the topic /odom. This message represents the chassis odometer information, including the current posture information of the chassis and the linear velocity angular velocity information.

Chassis node sends a message type tf2_ msgs/TFMessage to topic/tf, containing chassis tf transformation information.

Chassis subscribes messages from topics /cmd_vel. Message type is geometry_msgs/Twist. After receiving this message, the chassis moves, where linear. x is the linear velocity, linear. y is the linear speed of left and right translation (only applicable to Mecanum wheel models) and angular. z is the rotational angular velocity.

Please review the parameter settings and legends of other ROS nodes in the readme and node_map files of the ROS package.

Note: If using the feature pack separately, the communication node must be enabled first, located at base/xpkg_ comm.

3.7 XVIEW Chassis testing system

This system is a human-computer interaction software designed for debugging and development, which can test the chassis motion ability online and provide real-time feedback on robot data, monitor remote controllers, drivers, and other devices. Need to be used in conjunction with CAN-COM HUB.

1: Download driver package: CP210x_Universal_Windows_Driver。

https://www.silabs.com/documents/public/software/CP210x_Universal_Windows_Driver.zip

2: Connect the equipment through the HUB module (as shown in Figure 3.2), the HUB module buzzer sounds three times, and the HUB module starts.

3: The chassis is powered on and turned on. The XVIEW interface switches to the chassis window, selects the COM port, clicks Connect, and the Enable Device button is highlighted. Click Enable Device to communicate with the chassis.

For detailed instructions on using XVIEW, please click on the instruction button above in the software to view it.

Figure 4.1 Explanation interface

Figure 4.2 Concise Overview

Figure 4.3 Detailed Data

Figure 4.4 Chart Monitoring

3.8 Instructions for using the charger

Lithium battery chargers provide different charging voltages based on the number of battery strings, with commonly used specifications of 7 strings (29V) and 6 strings (25V). Please choose the correct charger to charge, and it is recommended to use the device's built-in charger. If you have any questions, please contact customer service.

Work indicator light:

🟩   Not charging or charging completed

🟥   Charging

note:

1. Please make sure to check if the charging voltage is correct, The charging voltage of the device will be marked on the device nameplate.

2. Please make sure to charge in an occupied environment and cut off the power when leaving.

3. Please start charging after the device is aligned, and do not use the device during charging.

4. Chargers and equipment should be kept away from the bedroom, with no combustible materials around and kept dry.

5. The charger uses a 220V AC input power supply, please ensure that the input voltage is stable.

6. The single continuous charging time should not exceed 8 hours. If the charger overheats, the charging should be stopped immediately.

⚠ Using the wrong charger can cause irreparable damage to the battery. Please confirm the charging voltage on the device nameplate before using it.

This product does not assume any responsibility for the consequences caused by the user's incorrect use of the charger or unsupervised long-term charging. Users are requested to evaluate the risks and conduct reliability testing on their own. This statement is hereby made.

HEX MAN
ROBOTICS

启原机器人(东莞)有限公司