

Autonomous Mobile Robot

User Manual



Zhejiang HuaRay Technology Co., Ltd.
1-401, No. 590 Changhe Road, Binjiang, Hangzhou, Zhejiang, P.R. China
Model: RTA-C060-LQ/RTA-C060-Q/RTA-C100-LQ/RTA-C100-Q

V1.2.1

Translation Version

EC Declaration of Conformity

We, Zhejiang HuaRay Technology Co., Ltd.
Room 401, Floor 4, Building 1, No.590, Changhe Road, Changhe Street, Binjiang
District, Hangzhou City, Zhejiang Province, China

Declare that the product described is in conformity with
The Machinery Directive: 2006/42/EC
The Electromagnetic compatibility Directive: 2014/30/EU

Applicable Harmonized standards:

EN ISO 12100:2010
EN ISO 3691-4:2023
EN 1175:2020
EN ISO 13849-1:2023

Product Name: Automated Guided Vehicle
Product Model: RTA-C060-LQ, RTA-C100-LQ, RTA-C060-Q, RTA-C100-Q.
Trade Mark: 

Person / Company authorised to compile the technical file
established in the EU Community:

Name:

Address:

Responsible for making this declaration is the

Manufacturer: Zhejiang HuaRay Technology Co., Ltd.

Authorized representative established within the EU



2023-03-17
Hangzhou, China

Issue date and place

Manager
XXXXXXXXXXXX

Name and position

Signature and
company stamp

Preface

This document describes in detail the installation, functions, and configuration of the product. Read this document carefully before using the product, and keep it properly for future reference.

Symbol Conventions

The following categorized signal words with defined meanings might appear in the manual.

Identification	Description
 WARNING	Indicates a medium or low potential hazard which, if not avoided, could result in minor or moderate injury.
 CAUTION	Indicates a potential risk which, if ignored, could result in equipment damage, data loss, reduced equipment performance, or unpredictable results.
 TIPS	Provides methods to help you solve a problem or save time.
 DESCRIPTION	Provides additional information as a supplement and emphasis to the text.

Revision History

Version	Revision Content	Release Time
V1.2.0	Added product model, using environment, transportation and storage method, product parameter	March 2023
V1.1.0	Added functional descriptions of front and rear TOF cameras and rear laser module and changed the product appearance picture and product name.	April 2022
V1.0.0	First release.	October 2020

Important Safeguards and Warnings

The following sections describe the proper use of this product. In order to prevent hazards and property loss, please read the User Manual carefully before using the product and strictly observe the instructions therein.

Transport Requirements



CAUTION

- Use the original package or equivalent and packaging method for packaging during transportation.
- Prevent heavy load, violent vibration, or soaking that may damage the equipment during transportation.
- Transport the equipment within the permitted temperature and humidity range. For details about the requirements on transport temperature and humidity, refer to the technical specifications of the corresponding model.

Storage Requirements



CAUTION

- Store the equipment within the permitted temperature and humidity range. For details about the requirements on storage temperature and humidity, refer to the technical specifications of the corresponding model.
- Prevent heavy load, violent vibration, or soaking that may damage the equipment during storage.

Installation Requirements



DANGER

- Always cut off the power supply before connection or disassembly; hot-line work is strictly prohibited.
- For the equipment with protective earthing, ensure that the equipment is properly grounded to avoid damage by static electricity or induced voltage and to avoid electric shock.
- Install and use the equipment strictly in accordance with national and local electrical safety regulations.
- Please use accessories or attachments specified by the manufacturer, and refer all installations to qualified service personnel.
- Please install the equipment in a well-ventilated place and do not block the vent hole thereof.
- Do not expose the equipment to a heat source or direct sunlight, such as a radiator, heater, stove, or other heat generation device, to avoid a fire hazard.
- Do not expose the equipment to an explosive, moist, dusty, extremely hot or extremely cold, or corrosive gas environment with strong electromagnetic radiation or unstable lighting conditions.
- Prevent heavy load, violent vibration, or soaking that may damage the equipment during installation.



WARNING

A safe and stable power supply is the prerequisite for the normal operation of the equipment.

- Ensure that the supply voltage is stable in the operating environment and meets the power supply requirement for the equipment.
- Protect the power cord from being walked on or pinched, particularly at plugs, convenience receptacles, and the point where they exit from the equipment.
- If more than one power supply mode is supported, do not supply the equipment with two or more power modes that may result in damage to the equipment.
- For the power supply requirement for single equipment, refer to the corresponding User Manual.



CAUTION

It is recommended to use the equipment with a lightning arrester to obtain a better lightning protection effect.

Operation Requirements



CAUTION

A proper operating environment guarantees the normal operation of the equipment. Check that the following conditions are met before using the equipment.

- Use the equipment within the permitted temperature and humidity range. For details about the requirements on operation temperature and humidity, refer to the technical specifications of the corresponding model.
- Use the equipment under stable working conditions.
- Do not allow any liquid to flow into the equipment. Otherwise, internal parts may be damaged. If this occurs, cut off the power supply, stop using the equipment, remove all connected cables, and contact after-sales service.
- Do not plug or unplug interfaces such as RS-232 and RS-485 with power on. Otherwise, these interfaces may be easily damaged.
- Back up data during deployment and operation to avoid data loss in the event of abnormal operation. The company assumes no responsibility for data security.
- The company assumes no responsibility for equipment damage or any product problem due to unintended use or misoperation.

Maintenance and Repair Requirements



WARNING

- Please refer system inspection and maintenance operations to qualified service personnel on a regular basis. Do not disassemble the equipment without authorization.
- Please use accessories or attachments specified by the manufacturer, and refer all servicing operations to qualified personnel.

Table of Contents

Preface	II
Important Safeguards and Warnings.....	III
Chapter 1 Product Safety Instructions	7
1.1 Disclaimer.....	7
1.2 Reading Tips	7
1.3 Foreseeable Misuse	8
1.4 Operation Security	9
1.4.1 Operation Environment Security	9
1.4.2 Operational Check	9
1.4.3 Parking Security	10
1.4.4 Battery Safety. Precautions for Battery Use	11
Chapter 2 Product Overview.....	13
2.1 About This Product.....	13
2.2 Function Features.....	13
2.3 Appearance.....	14
2.4 Product Structure	15
2.4.1 Dimensions	15
2.4.2 Front Panel	15
2.4.3 Rear Panel.....	16
2.5 Product Model.....	17
2.6 Using environment.....	17
Chapter 3 Out of Box Audit	18
Chapter 4 Installation Requirements	19
4.1 Installation Site Requirements.....	19
4.2 Shelf Requirements	19
4.3 Signal Requirements.....	20
4.4 Navigation Requirements.....	20
4.5 Charging Pole Requirements	21
Chapter 5 Display Screen Operation Instructions.....	24
5.4.1 Main Interface Information	24
5.4.2 Real-time information	25
5.4.3 Manipulation and Control.....	28
5.4.4 System Information	31
5.4.5 QR Code Camera Streaming	32
5.5 Implementation	33
5.6 Charging.....	33
5.6.1 Manual charging.....	33
5.6.2 Automatic charging	34
Chapter 6 Alarm Descriptions	35
Chapter 7 Inspection and Maintenance	38
7.1 Safety Instructions	38
7.2 Safety Check.....	38
7.3 Daily Check.....	38
7.4 Monthly Check.....	39
7.5 Half-yearly Check.....	39
7.6 Yearly Check.....	40
Chapter 8 Transportation and storage.....	42
8.1 Handling precautions.....	42
8.2 Handling Method	42
8.3 Storage precaution	42
Appendix 1 Instruction to power off the lithium battery	43
Appendix 2 Obstacle Avoidance Description	44
Safety Laser Scanner	44

General Laser Scanner 44

TOF Camera 45

Appendix 3 Waste disposal..... 46

Appendix 4 Legal Information 47

Appendix 5 Cybersecurity Recommendations 49

Appendix 6 Braking distance test.....51

Chapter 1 Product Safety Instructions

1.1 Disclaimer

- The user is responsible for any losses caused by unreasonable use, and Hua Rui Technology is not liable.
- However, even if all operations are carried out in accordance with safety guidelines, there is no guarantee that the machine will not cause personal injury or property loss.
- Hua Rui Technology is not responsible for personal injury or property loss caused by substitute parts or modified parts.

1.2 Reading Tips

- Please read carefully before using the robot.
- AMR must not be disassembled or assembled without authorization.
- Please pay attention to the safety warnings mentioned in the User Guide.
- If the robot has any abnormal problems, please contact the dealer in time.
- If you smell any unusual odor while using the robot, please stop the machine immediately.
- The User Guide is not a substitute for the Technical Agreement.

1.3 Foreseeable Misuse

Any use that deviates from the intended purpose of AMR is considered misuse.

Including but not limited to:

- Carrying or transporting people.
- Use in outdoor environments.
- Use in environments with strong interference to navigation equipment.
- Use in dusty, powdery and other explosive environments.
- Use in environments with high salt content (maritime climate).
- Use in extremely harsh environments (extreme climate, frozen warehouses, strong magnetic fields, etc.).
- Carrying flammable and explosive items.
- Carrying liquid items.
- Running over uneven surfaces, obstacles or steps.
- Use the robot on slopes.
- Total robot payload exceeded.
- Use the emergency stop button for any operation other than emergency stop.
- Change the configuration related to equipment safety obstacle avoidance.

1. 4 Operation Security

1. 4. 1 Operation Environment Security

- The ground should be flat, without grooves, damage, hollows, oil, glue and other pollutants.
- There should be no screws, rags, gloves, wires, cables or other foreign objects on the ground that could easily get stuck or entangled in the wheels.
- Do not operate in overly open areas (larger than the laser sensing distance), such as long corridors.
- A fully loaded and low-speed robot can only cross steps no higher than 10mm.
- When passing through narrow passages, the robot needs to maintain a 100mm gap between both sides of the passage.
- The sections of the working area should be protected or marked with warning signs to remind other personnel of the robots' entry and exit.

1. 4. 2 Operational Check

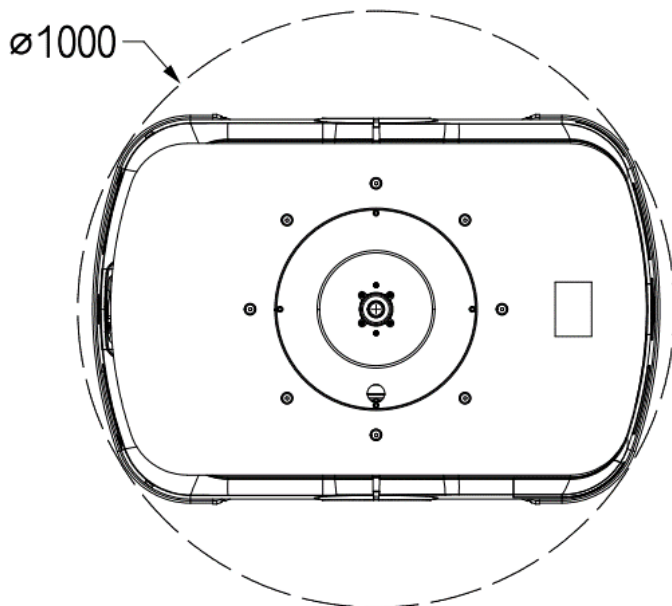
The condition of the robot should be checked before activation to ensure safe use. Things to check include:

- Whether the wheel fasteners are tightened.
- Whether the power system is normal.
- Whether the emergency stop function is normal.
- Whether the lifting and carrying equipment is damaged (such as bent, cracked, or worn).
- Whether the warning device is normal.
- Whether the outline marker light is normal.
- Whether the laser sensor functions normally.
- The battery should be fully charged at least once a month.
- Whether the battery power is normal.
- Whether the charging function is normal.

1. 4. 3 Parking Security

When the robot stops running, it should be turned off and the power supply should be cut off.

- Do not park on ramps.
- Do not park near heat or fire sources.
- Do not park in open pits, underpasses, elevator shafts or other similar areas.
- It is not allowed to park in the fire passage, stairway entrance and areas that block the passage of fire-fighting equipment.
- In special cases, safety measures should be taken for the robot, such as using wedges.
- The maximum turning diameter of the no-load safe avoidance range is 1000mm, please be careful to avoid it.



1. 4. 4 Battery Safety. Precautions for Battery Use



WARNING

The battery pack has the risk of fire and explosion. Do not explode, crush, incinerate, heat or throw the battery pack into fire.

- The scrapped battery pack should be disposed of promptly according to local recycling or waste regulations.
- The battery pack must be charged at a temperature of $0^{\circ}\text{C} \sim 45^{\circ}\text{C}$. Charging in an environment outside this range will cause the battery pack's performance to decline and its life span to be shortened.
- The low voltage state must be charged in time, otherwise it is easy to cause the battery group to be seriously over-discharged and unable to recover.
- During the consumption process, the battery pack should be prevented from overcharging and over-discharging to ensure the lifespan of the storage battery pack. The battery pack should be strictly prohibited from reverse connection and short circuit to prevent loss of the battery pack. If over-discharging occurs, consumption should be stopped and charging should be done as fast as possible.
- Battery packs should be kept away from high humidity and high temperature environments. Half-charged battery packs should be stored in a dry, ventilated, clean warehouse. Room temperature should not exceed 40°C , Relative Humidity (RH) should not be greater than 80%, and suitable storage temperature range is $-10^{\circ}\text{C} \sim 25^{\circ}\text{C}$.
- The Battery group in Consume should undergo at least one standard charge and discharge cycle every three months (one cycle at a standard charge and discharge current of 0.2C), which is beneficial to the maintenance of the Battery life and capacity.
- For half-charged battery packs in stock, the battery packs should be charged and discharged at least once every 6 months (charge and discharge for one cycle at a standard charge and discharge current of 0.2C), and then continue to be stored in a half-charged state.
- If the Battery emits Release odor, excessive heat generation, or strange smell during consumption, charging, or storage, you should immediately stop consumption, cut off the charger or device power, and contact the manufacturer in a timely manner.
- After the battery reaches the end of its life, please do not discard it at will to avoid polluting the environment.
- The battery group should be consumed according to the technical indicators specified in the technical protocol or specification book.

- For Battery groups that exceed the Lifespan, Consume should be stopped and a new Battery group should be replaced.
- It must be charged with a dedicated charger. If it is charged with a non-dedicated charger, it may cause corruption to the battery pack or even be dangerous. Before charging the battery pack, please pay attention to whether it is compatible with the charger. You should read the charger's consumer manual in detail and operate it strictly according to its consumer requirements.
- It is strictly forbidden to discharge while charging, or to charge while discharging, otherwise it will cause battery corrupt or even dangerous.
- When the Battery Pack is charging, personnel should be arranged to supervise in order to promptly detect dangers caused by improper operation such as improper setting of Charging Voltage, misuse of the Electrical Port for charging, etc.
- The battery group should be protected from strong impacts such as dropping and collision when being consumed. It is strictly forbidden to consume sharp objects that pierce the battery group.
- It is strictly forbidden to disassemble or modify the Battery unit without permission, as this may cause damage to the Battery unit or even danger.
- It is strictly forbidden to consume or place the battery pack in an extremely hot environment or a sparking environment. It is strictly forbidden to put the battery pack in a heater, microwave oven, washing machine or high-pressure container. Do not put it in liquid or allow it to absorb moisture.
- If the Battery Group leaks, do not come into direct contact with the leaked liquid. If it sticks to your skin or clothes, rinse immediately with plenty of water.
- It is strictly forbidden to place the Battery Group in an electrostatic environment.

Chapter 2 Product Overview

2.1 About This Product

The robot of underride automated guided vehicle (AMR) is mainly intended for solving the problems of high labor cost, low management efficiency, and high order error rate in traditional warehousing operations and production line logistics operations. It is an important part of high-efficiency intelligent logistics and intelligent factory solutions, and one of the three core modules among AMR robots, robots control system (RCS), and warehouse management system (WMS). The AMR is applicable for e-commerce distribution centers, 3C manufacture, traditional manufacture, healthcare industry, food industry, and car manufacturing.



The product suitable for handling cargo, prohibiting people from riding or transporting/transferring people

2.2 Function Features

- Turning diameter: 1000 mm, passage width: 650 mm, height: 300 mm, competitive when compared with similar products in the market.
- Unloaded kinematic velocity: 1.5 m/s, acceleration: 1.0 m/s², loaded lifting/stop accuracy/kinematic accuracy: ± 10 mm, docking accuracy: up to 5 mm under some conditions.
- Supports laser/QR code/contour-based navigation and hybrid navigation.
- Under the specific condition, the AMR can avoid obstacles from all angles. Visual obstacle avoidance is available.
- The front and rear TOF cameras provide 3D obstacle avoidance with horizontal and vertical fields of view being 72° and 50° respectively.
- Possesses data obstacle avoidance technology, which allows the AMR to smoothly decelerate and stop when meeting obstacles.
- Automatic charge and manual battery change (takes 90 seconds) make charging quick and easy.
- To ensure running stability, we provide various accessories (square pallet, round pallet, pallet latch, limit anchor, etc.) based on customer requests and site conditions.

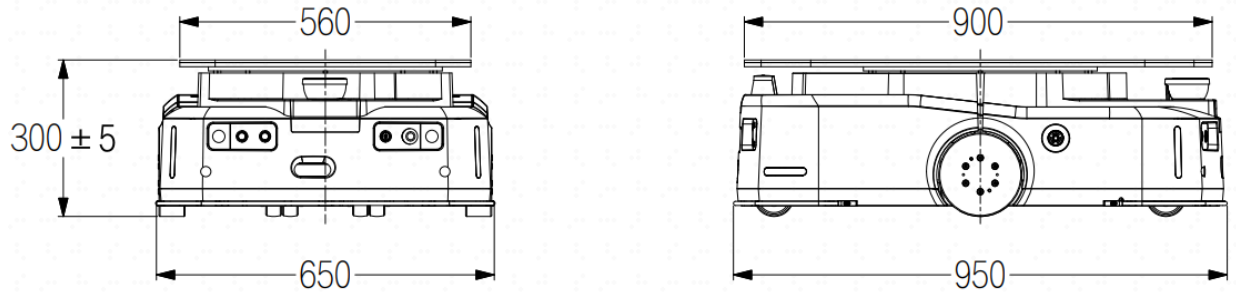
2.3 Appearance



2.4 Product Structure

2.4.1 Dimensions

Figure 1-1 Outline dimensions (unit: mm [inch])



2.4.2 Front Panel

Figure 1-2 Front panel

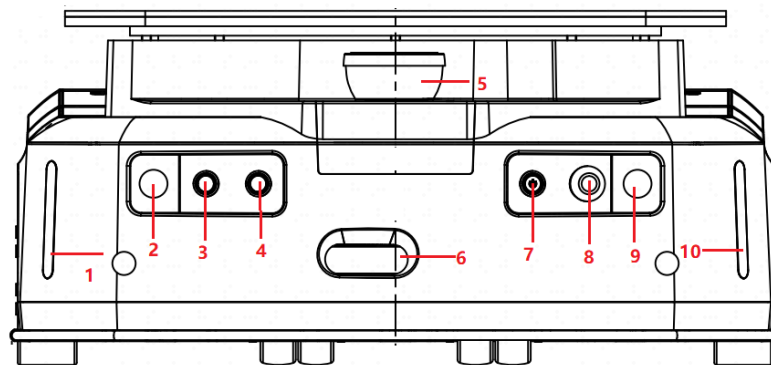


Table 1-1 Description of the front panel

No.	Name	Description
1, 10	Indicator light bar	- Yellow: Standby. - Green: In task or charging. - Red light flashes (1 s interval): Error or obstacle alert. - Red light flashes (3 s interval): Low battery capacity.  Description The error indicator light takes priority.
2, 9	-	-
3	Confirm	Press this button to confirm manual intervention.

No.	Name	Description
4	Maintain/Auto	Switch the AMR to maintain/auto mode. - Press this button to switch to maintenance mode. When the motor clamp is released, the motor is disabled and you can manually drive the AMR. - When you release the button, the indicator goes off, and the AMR enters task mode. You cannot drive the AMR when the motor is enabled.
5	Safety Laser	Safety Laser Scanner.
6	TOF cameras	Provide 3D obstacle avoidance for the robot.
7	Key switch	Turn the key switch, to turn on and off the robot.
8	Stop	- Press this button to stop the AMR. - Rotate the button out to get the AMR to self-check and run again.

2.4.3 Rear Panel

Figure 1-3 Rear panel

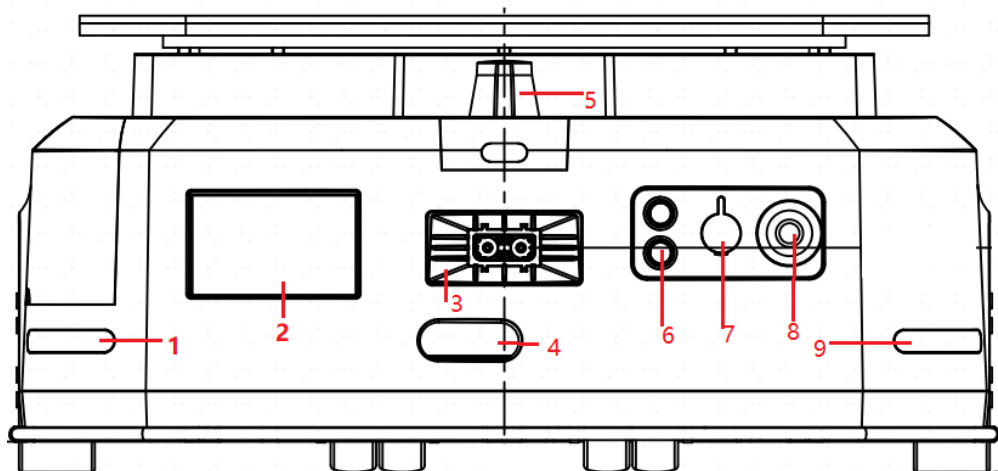


Table 1-2 Description of rear panel

No.	Name	Description
1, 9	Indicator light bar	- Yellow: Standby. - Green: In task or charging. - Red light flashes (1 s interval): Error or obstacle alert. - Red light flashes (3 s interval): Low battery capacity.  Description The error indicator light takes priority.

No.	Name	Description
2	Display screen	Displays the operating status, exception/failure information, and lift control of the equipment in real-time.
3	Back charging port	Used for automatic charge connection.
4	TOF cameras	Provide 3D obstacle avoidance for the robot.
5	Laser	General Laser Scanner.
6	Confirm	Press this button to confirm manual intervention.
7	Debugging port	Used for connecting the debugging cable (unavailable for users).
8	Stop	● Press this button to stop the AMR. ● Rotate the button out to get the AMR to self-check and run again.

2.5 Product Model

RTA-C060-LQ
RTA-C060-Q
RTA-C100-LQ
RTA-C100-Q

2.6 Using environment

Scenario: Indoor.

Altitude: Less than 2000 m.

Temperature: $0^{\circ}\text{C} \sim 40^{\circ}\text{C}$.

Humidity: 10%~90%, no condensation.

Air: No dust, flammable, explosive and corrosive gases.

Static electric: In order to easily discharge static electricity, the floor material should use a substance that is easy to discharge.

In environments prone to interference such as electromagnetic waves, scattered light, ultrasonic waves and static electricity, users and manufacturers need to check in advance whether the normal operation of AMRs is affected.

Chapter 3 Out of Box Audit

When receiving your AMRs from transportation company, please unpack and inspect the packing box against the following checklist. If you have any questions, please immediately contact after-sales service.

Table 2-1 Unpacking checklist

Check Sequence	Check Item		Check Content
1	Whole package	Appearance	Check for damage.
		Packing	Check for deformation.
		Accessories (list of accessories on the warranty card)	Check for completeness.
2	Front and rear panel	The model on the rear panel	Check for consistency with the order contract.
		The label on the rear panel	Check for tearing.  Description Do not tear up or throw away the labels or tags; otherwise, the warranty will be invalidated. Usually, we need you to show the serial number when we provide the service after sales.
3	Casing	Appearance	Check for damage.

Chapter 4 Installation Requirements

4.1 Installation Site Requirements

Floor Gradient

The AMR can normally run on a floor with a gradient not greater than 5% under control at rated speed. The gradient must be not greater than 1% for accurate positioning of the parking spot. When the AMR runs on an uneven floor, the gradient shall not be greater than 1.5%, and the transition range shall not be shorter than the vehicle length.

Floor Bearing

The load per unit area of the floor shall be greater than that per unit area in the horizontal projected area of the AMR, and the floor shall be kept intact and protected from destructive damage. The pressure on the floor generated when the AMR runs shall be effectively transmitted to the cement-bearing layer. A composite floor is preferred. The load resulting from the wheel pressure concentrating into a small area is mainly taken into account in the floor bearing requirements.

Electrical Features

In order to avoid accumulating static electricity in the AMR (when used in an electrostatic-sensitive environment), the electrical impedance of the floor surface on which the AMR runs shall be maintained at $10^6 \Omega$ to $10^9 \Omega$ (refer to DIN51953).

Coefficient of Friction

The coefficient of sliding friction on the floor, for example, for rubber tires, shall be higher than 0.5. The coefficient of friction is very important for maintaining safe braking distance and accurate handling positioning and can be easily affected by dirt, cleaning operation, or the use of a cleaning agent.

4.2 Shelf Requirements

- Maintain the minimum width and minimum height under the shelf for the AMR to pass through safely. If the AMR may rotate under the shelf, keep the space under the shelf at least 10 cm greater than the diagonal length of the AMR.
- Attach an up-looking camera on the bottom of the shelf to recognize the QR code and reflective film.
- Camera recognition distance: The on-shelf camera operates effectively within 99 mm to 141

mm, which is the vertical distance between the camera lens and the QR code under the shelf.

4.3 Signal Requirements

AP: Connect terminals in the wireless network together and then connect the wireless network to the Ethernet. The layout of APs is as below:

- APs are mounted to the ceiling of the workshop.
- Use the 2.4 GHz band for wireless APs, set channels to 1, 6, and 11 respectively, and arrange channels in a cellular fashion to prevent co-channel interference between adjoining APs.
- APs (coverage 20 m, installation height 4 m) shall be 7-9° tilt during installation.
- Because of the high attenuation of wireless signal through walls, you need to fully consider physical obstacles like a wall when distributing APs.



Description

The omnidirectional type or directional type will determine the coverage range and installation method of APs.

4.4 Navigation Requirements

Laser-based Navigation

- Site: There shall not be dense moving objects. The proportion of moving objects in the field of view of the laser module is not greater than 70%, the environment is evenly distributed with structured buildings, and it is not rain, snow, or sand-dust weather.
- Mapping: Remotely control the AMR to walk around the site by following the scheduled path, if possible, at a speed not higher than 0.5 m/s. The map shall be a closed path. It is better to erase objects that are obviously moving.

QR Code-based Navigation

Measure the site dimensions and make a CAD drawing indicating obstacles such as columns, distribution boxes, and fire hydrants. The measurement error must be controlled within ± 10 mm. Properly set the AMR path and related points based on the drawing.

Requirements on floor code:

- Use a carpenter's ink marker to draw a line and mark points according to the map.
- The floor code is printed on sticky label paper using a Zebra printer.
- Align the floor code label paper with the line with an accuracy of ± 1 mm.
- Attach the floor code label paper and cover it with a protection film to ensure that the film is smooth and clean without bubbles.
- Re-attach the floor code label paper if it is damaged or contaminated.

Combined Laser-based and QR Code-based Navigation

Switchover between laser-based and QR code-based navigation: The laser-based navigation mode applies where the environmental change is kept to a minimum level, for example, stationary walls or objects. Or, you can install reflectors for easier recognition on the site.

Contour-based Navigation

Site requirements:

- The floor is irregularly textured, for example, an emery floor.
- The floor is not prone to be stained or damaged.
- The floor is not prone to be attached with a QR code label.
- The surrounding is complex and ever-changing, so laser scanning and positioning are difficult.

Requirements on floor code: Suitable for collecting a texture code template in large areas such as long passageways.

1. Set guide lines with a width of not more than 5 mm.
2. Make the AMR autonomously run along guide lines to collect the texture image at a speed of 1 m/s with a camera frame rate not less than 25 fps.
3. Run the AMR along each guide line three times by making the equipment position right above the guide line, at 5 cm to the left of the guide line, and at 5 cm to the right of the guide line.
4. Output the collected image to the processor for post-processing and generate a texture code template by image stitching.

Combined Laser-based and Contour-based Navigation

- Switchover between laser-based and contour-based navigation: The laser-based navigation mode applies where the environmental change is kept to a minimum level, for example, stationary walls or objects.
- Or, you can install reflectors for easier recognition on the site.
- The contour-based navigation applies to the high-precision docking part, and the floor can be covered with textured floor stickers.

4.5 Charging Pole Requirements

Installation Requirements:

- Install a charging pole on flat ground.
- Secure the charging pole to the ground with four M8 anchor bolts, with expansion bolts flush with the ground. Cut off the excess portion of bolts or cover them with rubber caps to prevent safety hazards.
- Maintain 30 cm of space or more on the rear side of the charging pole.
- Keep the charging contact in the same line as the center of the code.

Operating conditions:

- Ambient temperature: 0 °C to 40 °C.
- Max. relative humidity: not higher than 90%, good ventilation.
- The operation area is free of conductive or explosive dust, corrosive metal, gas or steam that damages insulation, or strong electromagnetic interference.
- The installation base is free of violent vibration or impact, and the vertical inclination is not more than 1°.

Safety requirements:

A dry chemical extinguisher or sandbox is equipped for a single charging pole within 5 m².

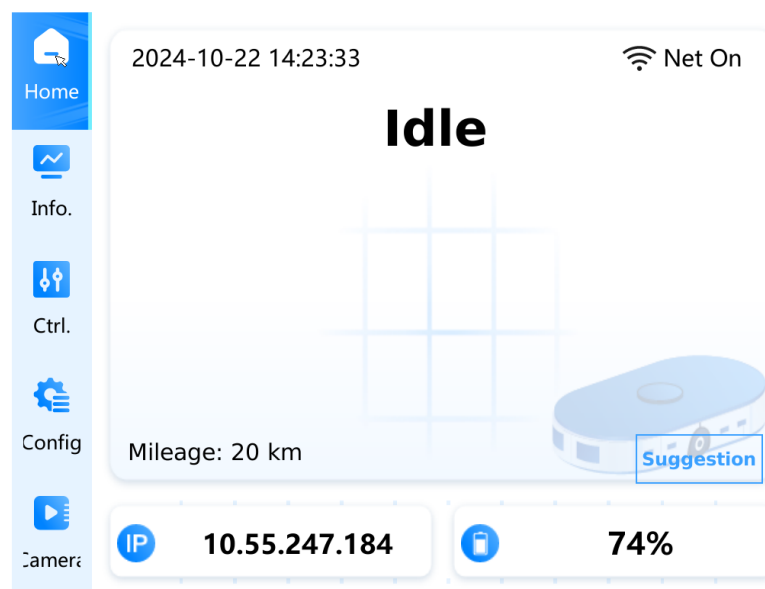
Chapter 5 Display Screen Operation Instructions

5.4.1 Main Interface Information

The real-time task information on the main interface contains three parts:

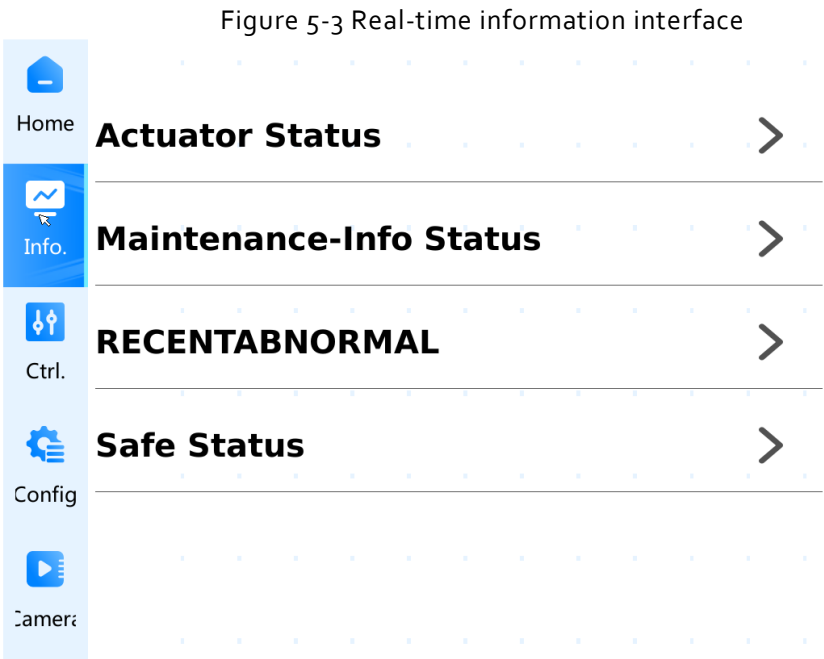
- Status bar: home page, real-time information, operation control, system information, QR code camera streaming;
- Upper part: time, signal strength, battery power, manual and automatic status, operating status, network status;
- Bottom part: device address, real-time battery power;

Figure 5-2 Home page interface

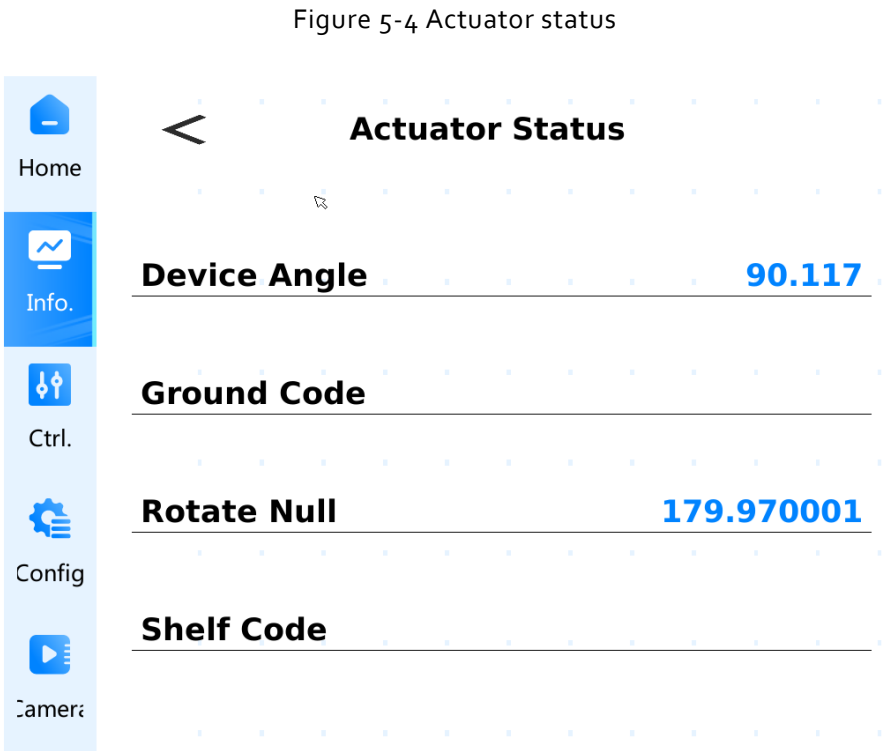


5. 4. 2 Real-time information

You can check the current system information, platform tasks and status, etc. ,including actuator status, maintenance information status, platform business alarms, recent abnormality displays, and security status.

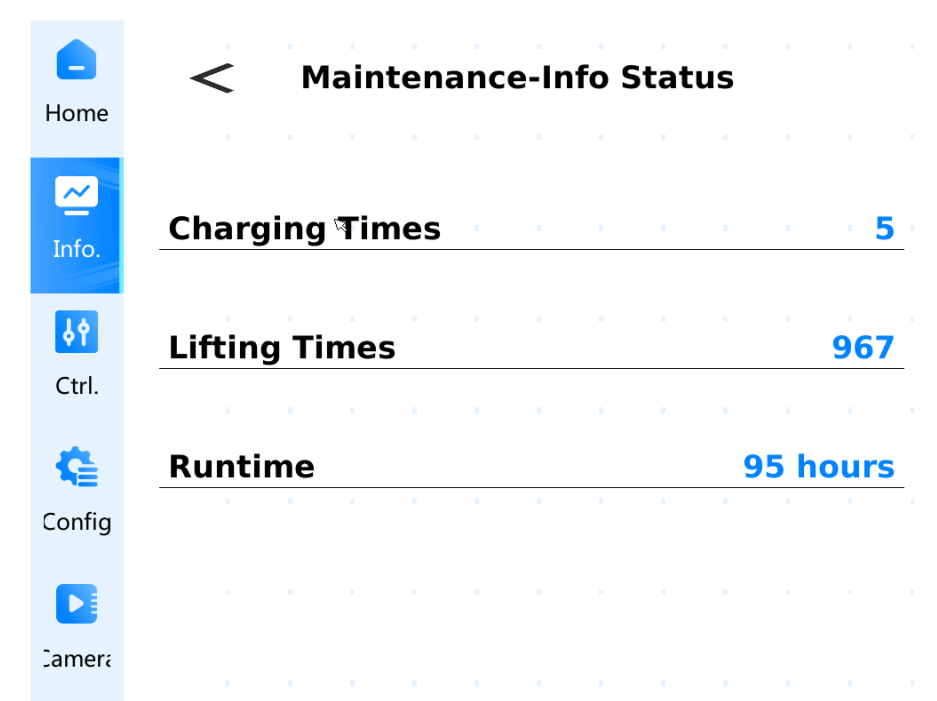


The actuator status includes the equipment operating angle, ground QR code, shelf code information, and rotation zero angle value.



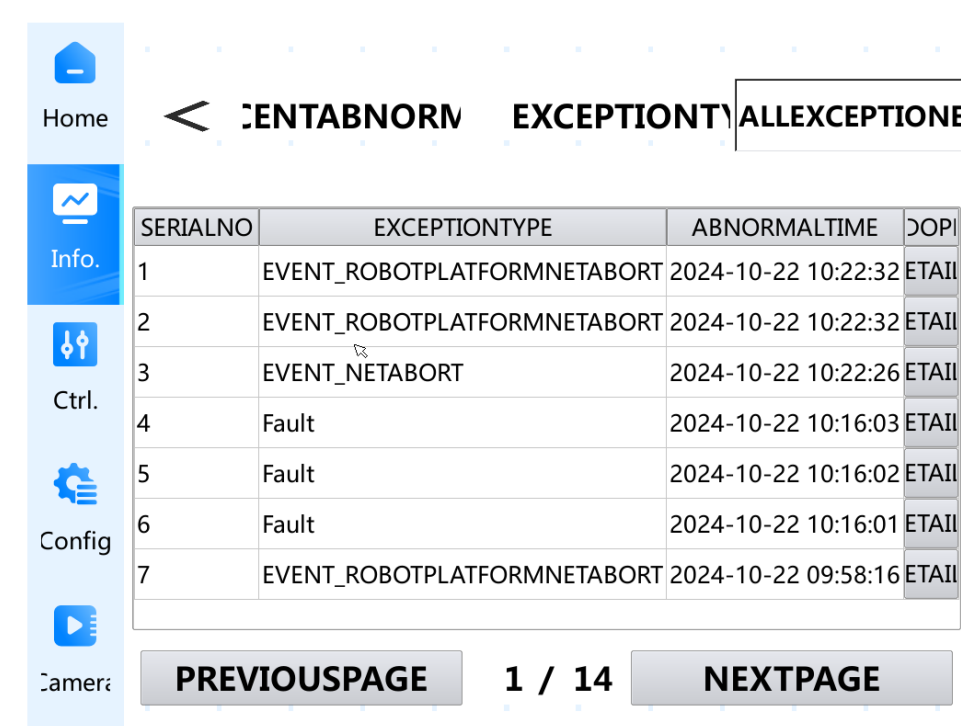
Maintenance information includes the number of times the equipment has been charged, the total number of lifts, and the total operating time.

Figure 5-5 Maintenance information status



Recent abnormality display: You can view abnormal alarm information and details within 24 hours.

Figure 5-6 Device abnormality display



5. 4. 3 Manipulation and Control

Enter the manipulation control interface to control the current device to lift, lower, rotate, and adjust the volume.

Figure 5-7 Manipulation and control

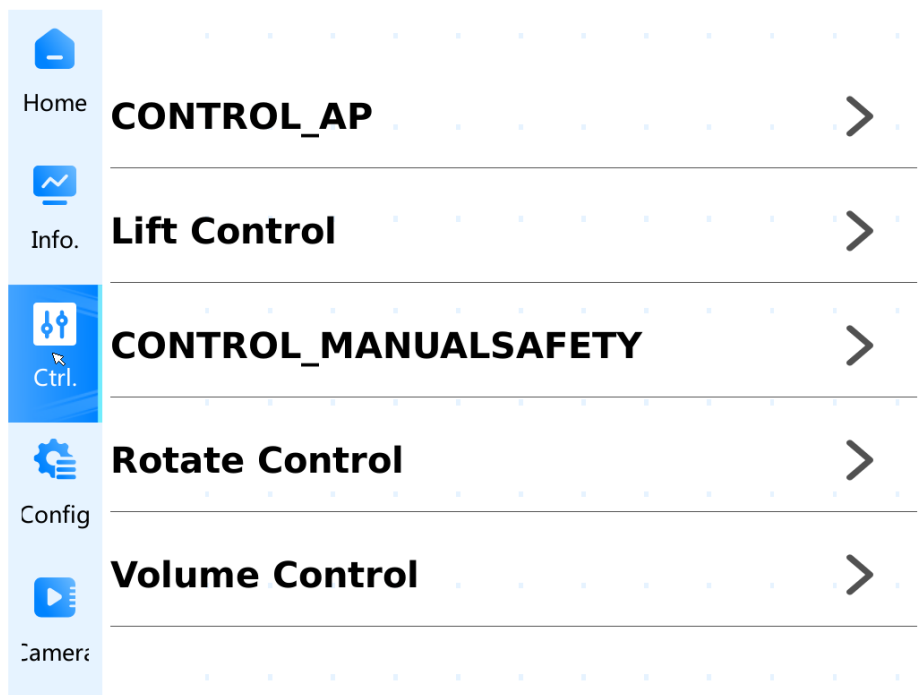


Figure 5-8 Vehicle AP configuration

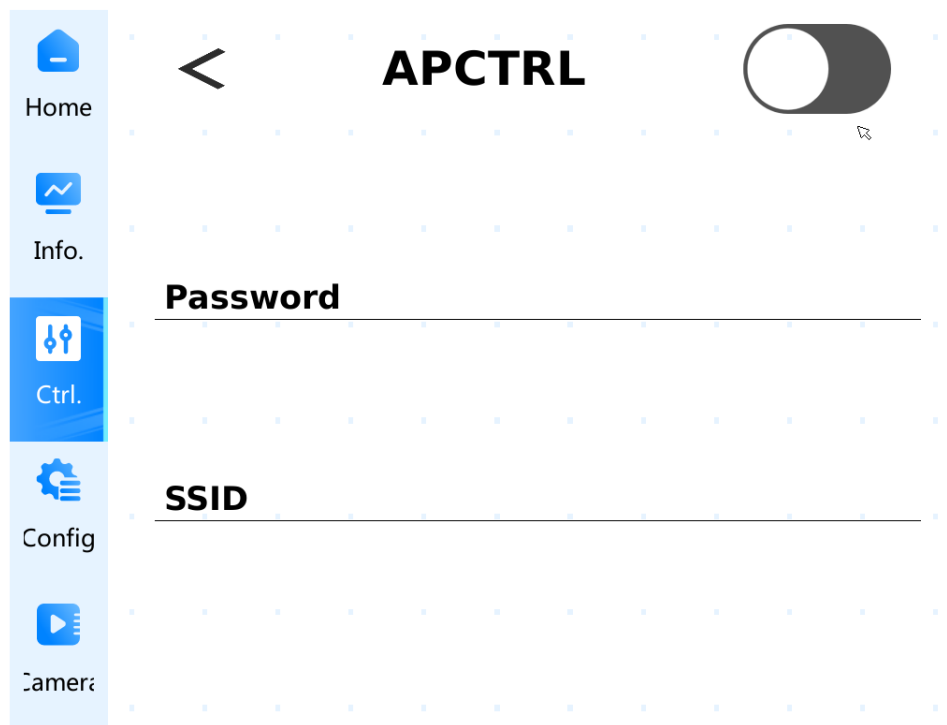


Figure 5-9 Pallet lifting control

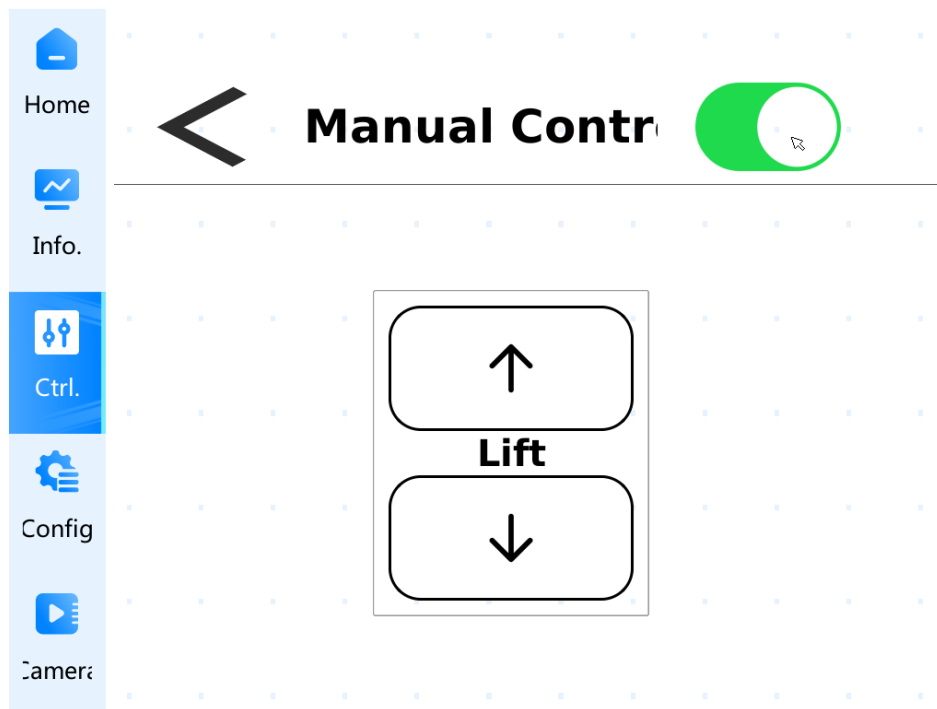


Figure 5-10 Pallet rotation control

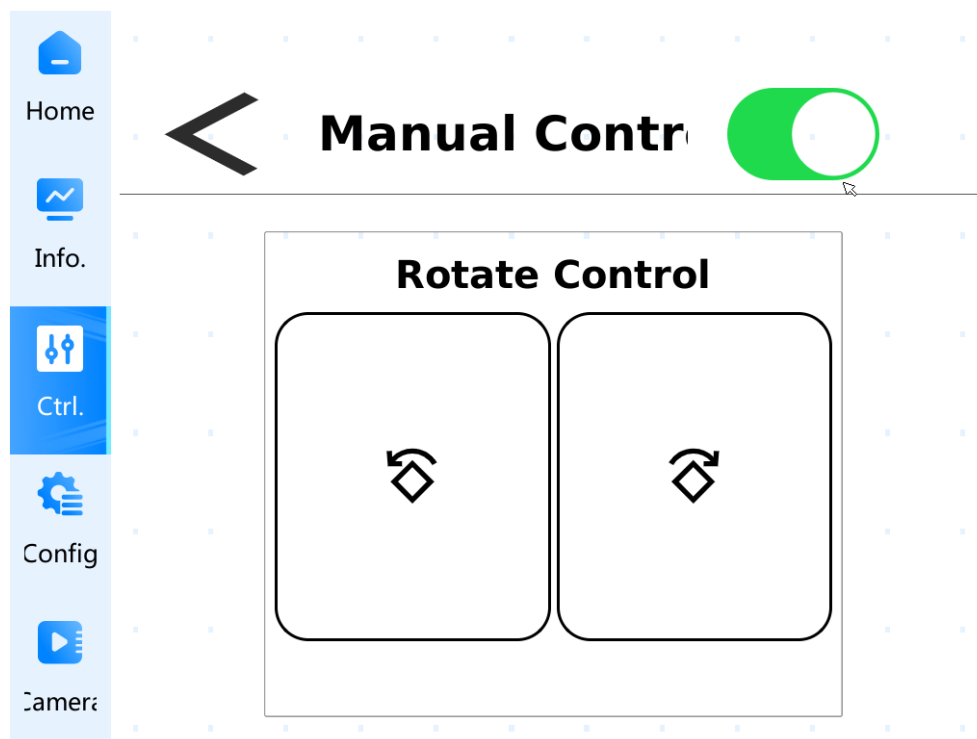


Figure 5-11 Volume control

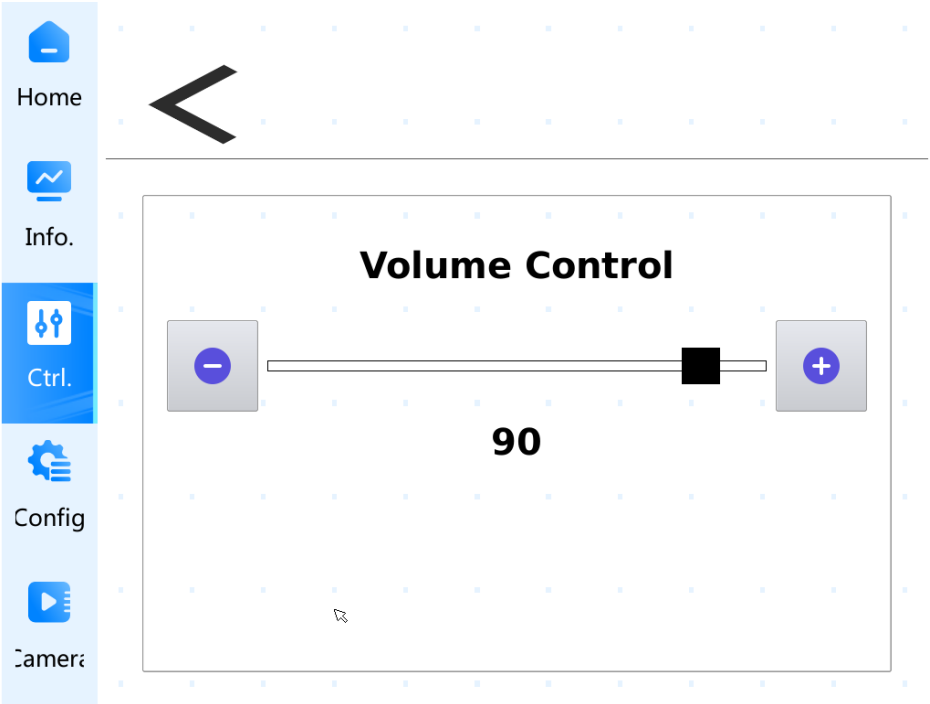
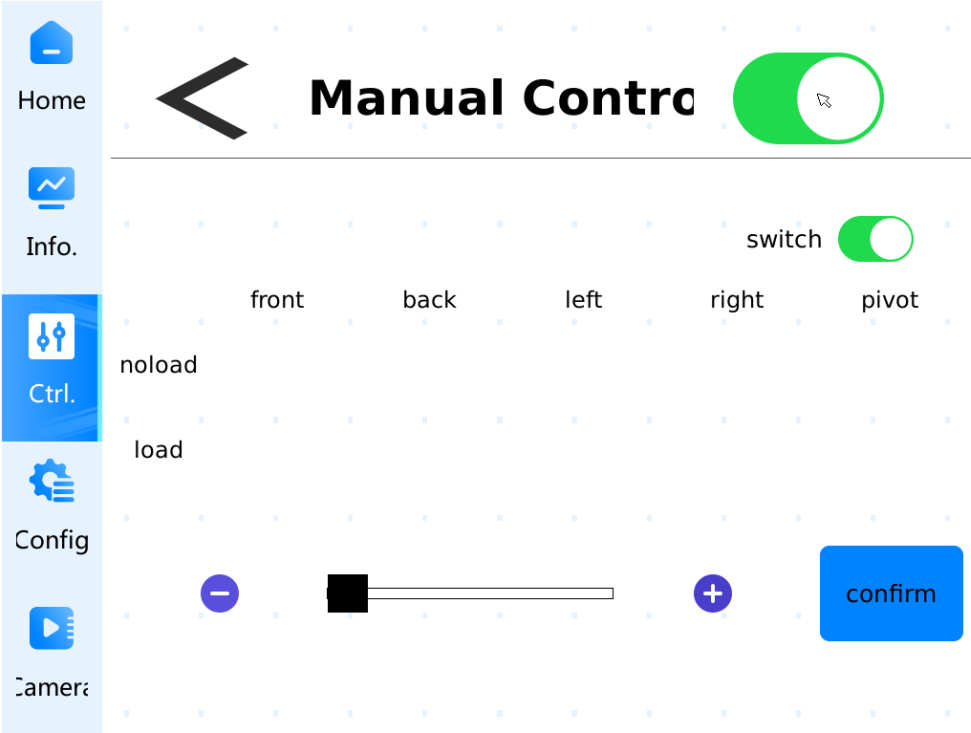


Figure 5-12 Obstacle avoidance distance setting



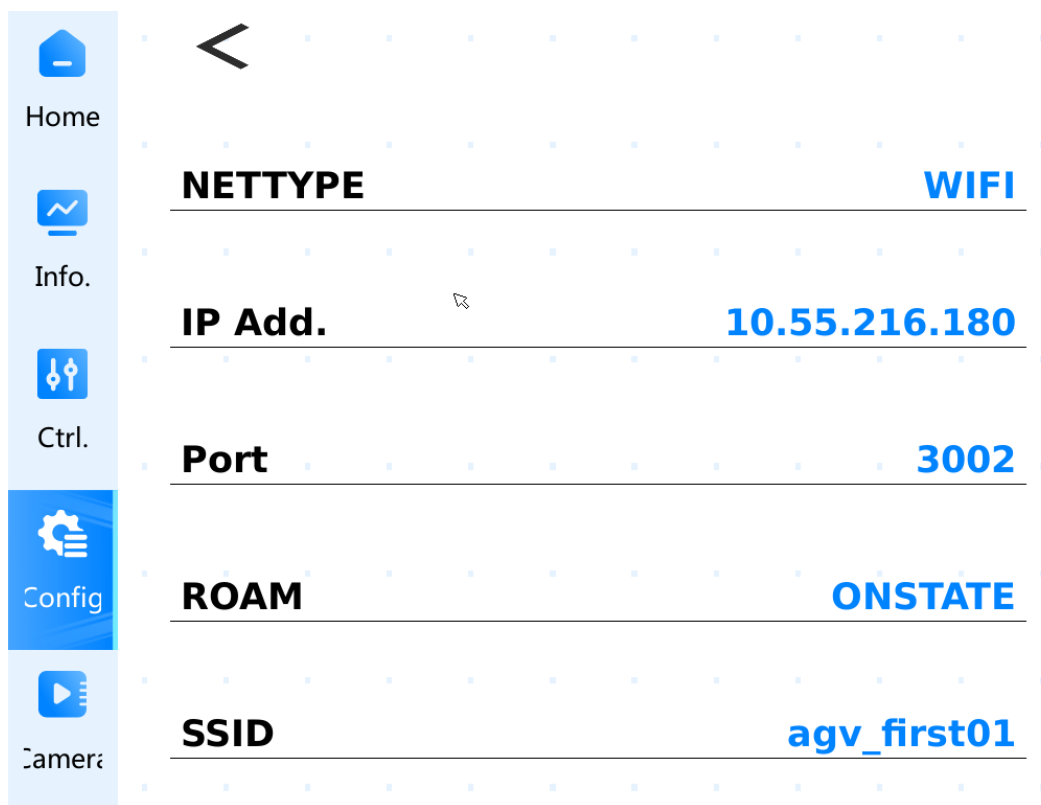
5. 4. 4 System Information

Enter the system information interface to query various software version information and device models.

Figure 5-12 Version information



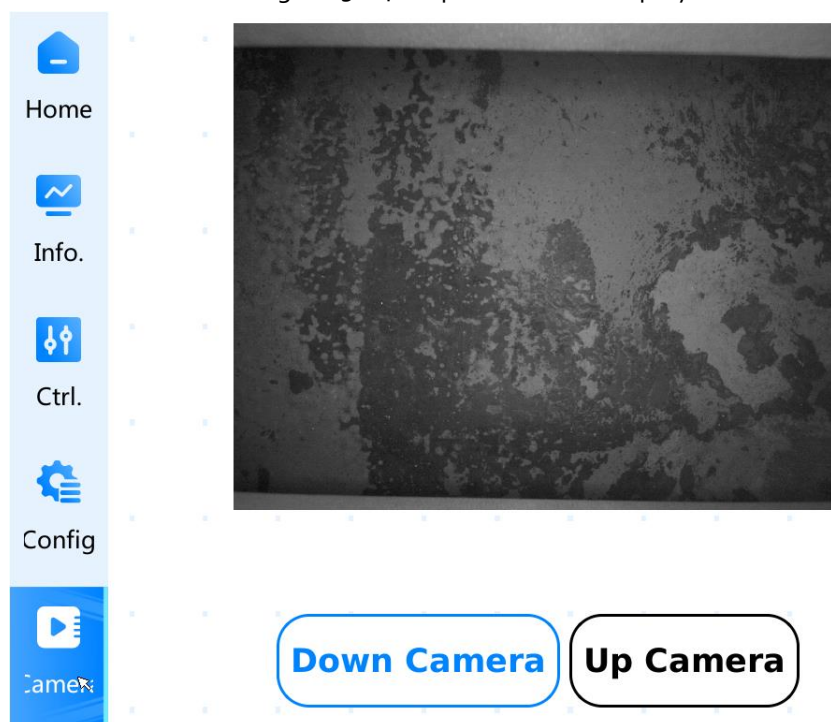
Figure 5-13 WIFI information



5. 4. 5 QR Code Camera Streaming

The QR Code information can be viewed through the camera's Acquire Stream Interface, and Acquire Stream can be used to determine whether the camera is in error.

Figure 5-14 Acquire Stream Display



5.5 Implementation

Before AMR runs automatically, operations such as map creation, route editing, and business configuration are required. For specific operation steps, please refer to the training course and training material "Implementation Operation Manual".

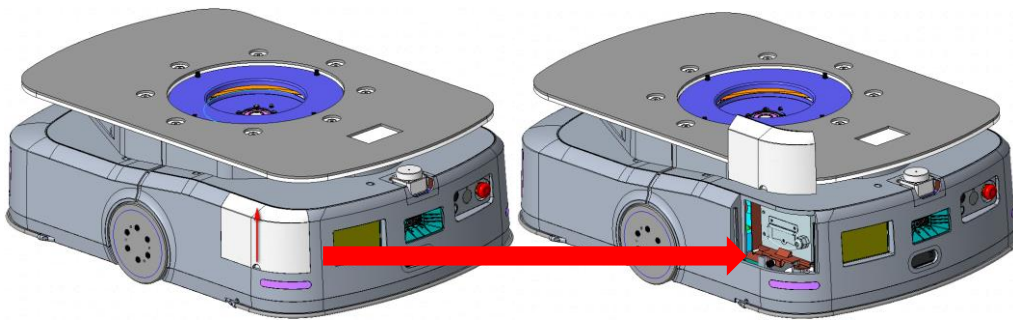
5.6 Charging

AMR supports manual and automatic charging.

5.6.1 Manual charging

Open the battery cover, disconnect the battery from the device wiring, and connect the charger interface.

Figure 5-6-1 Manual charging electrical port



Manual charging requires a Hua rui dedicated charger.

Charging Voltage: 57.6V MAX

Charging Current: 15A MAX

5.6.2 Automatic charging

Automatic charging is a unified RCS charging schedule without manual intervention. For specific configuration, please refer to the "Implementation Manual".

Automatic charging connectors include tail charging, side charging, and bottom charging.

The charging contacts are located near the tail of the robot, as shown in the figure below.

Applicable Model: RTA-C060-LQ、RTA-C100-LQ、RTA-C060-Q、RTA-C100-Q

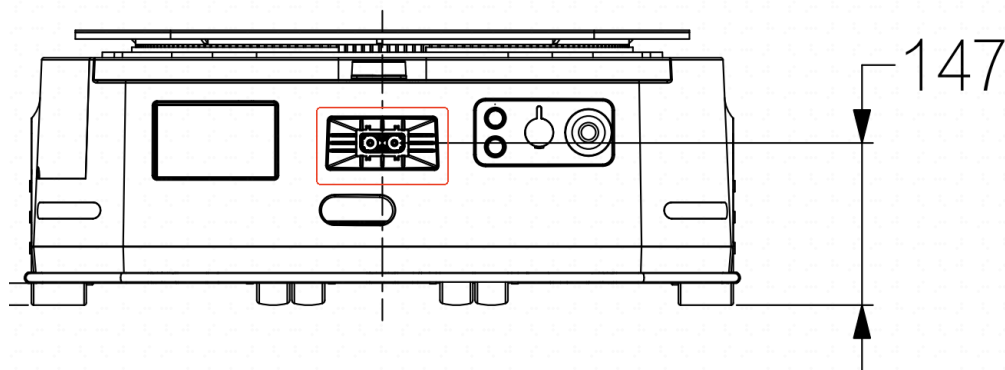
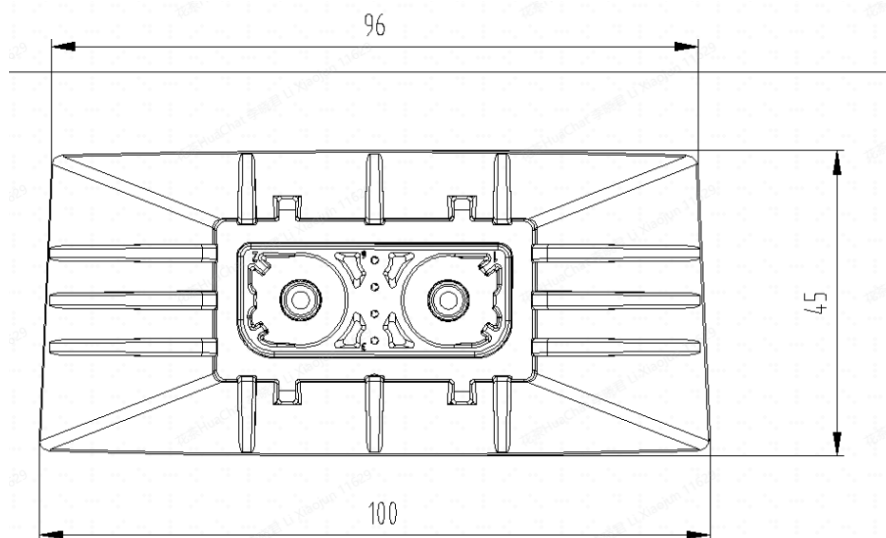


Figure 5-6-2 Rear electrical charging port (Dimension in mm)



Automatic charging requires a Hua rui dedicated charger.

Charging Voltage: 57.6V MAX

Charging Current: 18A MAX

Whether the robot is charged manually or automatically, it needs a charger configured by Consume Hua rui. Chargers from other manufacturers may cause fires, burn nearby people, and corrupt the robot and device.

Chapter 6 Alarm Descriptions

The following table shows alarms/faults and solutions.

Table 4-1 Alarm descriptions

Alarm/Fault		Reason for Exception	Solution
The floor code cannot be recognized.		Non-critical QR code is not recognized in a motion task.	For reference only. You can replace the QR code.
AMR collision		The AMR collision bumper is impacted.	Manually eliminate the collision problem.
Abnormal QR code (floor code)		- The QR code is not attached at the correct angle. - The QR code is illegible and cannot be properly recognized.	Replace the QR code.
Obstacle alert		An obstacle is detected within the obstacle avoidance area.	Move the obstacle away.
AMR exception	Motor fault	- Moving parts including the left wheel, right wheel, lifting part, and rotating part, may be faulty during the self-test. - It takes more than 5 minutes before the driver operates stably during the self-test, or the control link is abnormal when the driver operates normally.	- Restart the equipment - Replace faulty parts if necessary
	LIDAR fault	- The point cloud data of laser navigation is not reported. - The laser navigation network is disconnected. - The laser navigation driver is faulty.	- Restart the equipment - Program the laser navigation module - Check the network connection - Replace faulty parts if necessary
	CAN fault	-	- Restart the equipment - Check parts
	MCU fault	- The information on the MCU cannot be obtained. - The version of the MCU is o.	- Upgrade the MCU - Disassemble the AMR and check the connection

Alarm/Fault		Reason for Exception	Solution
	DMCAMERA fault	• The camera cannot be connected. • The camera is not streaming. • Failed to authorize the software-based encryption for the camera. • The camera is in frame loss mode. • The camera is uncalibrated. • The camera cannot be called out.	• Check the network connection. • Authorize encryption • Turn off the frame loss mode • Camera calibration
AMR IMU fault		-	Replace faulty parts if necessary
Sudden stop		The AMR suddenly stops when detecting an obstacle in the sudden stop zone.	Move the obstacle away.
Emergency stop button pressed		The emergency stop button is pressed.	Release the emergency stop button
AMR derailment		• The critical QR code cannot be recognized. • The AMR runs with a deviation greater than 10 cm or 10°.	• Replace the QR code. • Check the site condition
Update failed		• Failed to download updates. • Failed to verify downloaded updates.	• Replace the update package • Perform update again
Navigation laser stained		The navigation laser is stained.	Clean the navigation laser
AMR slipping		The AMR slips when moving.	Check whether the coefficient of friction for the ground meets the requirement.
AMR failed to stay on the path		The AMR stays off the path and cannot freely move onto the path in an unsafe environment.	Move the AMR to another location and try again.
AMR camera exception		-	-
Shelf exception		The shelf QR code cannot be recognized, or the AMR deviates from the shelf.	• Check whether the shelf QR code is properly attached. • Check whether the shelf QR code is covered with a reflective film. • Check whether the shelf QR code is properly spaced from the camera.



Description

- Upon completion of manual intervention, press the Confirm button to end your operation.
- Upon completion of manual intervention, ensure that the AMR stops on the QR code when pressing the Confirm button. Otherwise, manual intervention cannot be ended.

Chapter 7 Inspection and Maintenance

The safe and durable operation of AMRs depends on careful maintenance, which, if neglected, may endanger the personal safety and damage property. Regularly inspect the equipment to eliminate exceptions. Do not use faulty AMRs to ensure the safe and durable operation of AMRs. The normal AMR sound in motion is about 66dB. If the sound is abnormal, please check and maintain the AMR.



Description

Only trained personnel can check and maintain the AMR.

7.1 Safety Instructions

- Keep the work zone clean. Oil, grease, and water reduce the safety, accuracy, and performance of the AMR.
- Take off all metal accessories such as rings, watches, and others. Short circuits or fires may happen if metal objects contact the conductive parts.
- Remove all obstacles which may affect the AMR operation before starting.
- Check whether there is no abnormal sound when the AMR is running. If there is, you need to fix it to avoid damaging the AMR. Do not try to fix the issue before turning off the power.
- Turn off the power when not using the AMR for a long time.

7.2 Safety Check

When the system is shut down and restarted again, the following safety checklist should be regularly inspected (at least once every 24 hours for systems that are continuously operating).

- Check the status and function of all buttons on the AMR.
- Check the status and functions of all obstacle avoidance sensors on the AMR.
- Press around the bumper to check its status and functions.
- When testing the safety device, check the status and functions of the indicator and signal horn.
- Check whether the motor brake is normal by moving the AMR without lifting the brake when it is powered off. If the AMR cannot be moved, the driving motor brake is working properly.
- Check whether the lifting unit structure is steady and running properly.



Description

Make sure that the AMR stops running when checking.

7.3 Daily Check

Maintain the AMRs:

- The surface of the AMRs is clean without stains, the lens cover is intact without obvious

- scratches, and the upper and lower cameras work normally.
- The lights on the AMRs display normally, and the operation board works properly.
- The stop button and power button work properly.
- The laser and obstacle avoidance sensor work properly.
- The sound alarm system works properly.

7.4 Monthly Check

Maintain the AMRs:

- The lifting unit works properly, and there is no situation like failure to lift or lower to specific positions.
- The AMR runs normally with no deviation.
- The joints of the AMR parts and cable connection are not loosened.
- The battery, switch, stop, and bumper work properly.
- No charging exception occurs.

Table 5-1 Hydraulic lifting parameters

Check Part	Check Item	Check Method and Troubleshooting
Lifting structure	Rotation gap of the lifting tray	Manually rotate the lifting tray until you feel resistance, and then calculate the lifting tray gap. If the gap exceeds 2°, contact after-sale service for replacement.
	Anti-skid gasket of the lifting tray	Check whether the anti-skid gasket is broken or loose. You need to replace it if it affects the shelf's anti-skid performance.
	Belt (screw lifting)	Check whether the belt is loose or broken. You may need to tighten or replace the belt when necessary.
Pump (hydraulic lifting)	Check the height of the hydraulic fluid.	The hydraulic fluid level should not be lower than 1/2 of the tank capacity. Refill if necessary.
	Check the hydraulic system for fluid leakage.	Check the pump and around the fluid pipes. • When observing that the hydraulic fluid is not in mist status, check the screws on the fluid pipe and the push pole of the hydraulic cylinder to locate the fluid leakage. • Replace the hydraulic cylinder if it leaks fluid. • Replace the fluid pipe or seal ring, or tighten the fluid pipe screws when the fluid cylinder leaks.

7.5 Half-yearly Check

Maintain the AMRs:

- Check the lubrication status of the damping part of the driving wheel and the rotation bearing.
- Check whether the joints of the AMR are tight. If not, use the torque wrench to tighten them to

specifications.

- Check whether the casters rotate freely and check the wear of the wheels. Replace if necessary.
- Check whether the connector of the charging pole is complete without deformation and whether there is displacement, damage, or deformation on the charging pole base. If any, you need to fix them in time.
- Lubricate rotary gear, slewing bearing, and internal screw or bearing. If the bearing or gear is seriously worn, replace it if necessary.

Table 5-2 Hydraulic lifting parameters

Check Part	Check Item	Check Method and Troubleshooting
Slewing bearing and lifting	Surface of the gear	Check whether the surface of the gear is worn, and use a feeler gauge to check whether the gap between the slewing bearing and the gear gets larger. Theoretically, the gap should be no larger than 0.2 mm.
	Tightening	Check the tightness of the screws on the slewing bearing.
	Seal bar	Check whether the seal bar is broken.
	Cleaning	Clean the surface of the gear to make it free from abrasive powder or debris.
	Screw (screw lifting)	Fill in lubricant oil.
	Bearing (screw lifting)	
Pump (hydraulic lifting)	Check the height of the hydraulic fluid.	The hydraulic fluid level should not be lower than 1/2 of the tank capacity. Refill if necessary.
	Check the hydraulic system for fluid leakage.	Check the pump and around the fluid pipes. • When observing that the hydraulic fluid is not in mist status, check the screws on the fluid pipe and the push pole of the hydraulic cylinder to locate the fluid leakage. • Replace the hydraulic cylinder if it leaks fluid. • Replace the fluid pipe or seal ring, or tighten the fluid pipe screws when the fluid cylinder leaks.
	Check the quality of the hydraulic fluid.	Take a drop of the hydraulic fluid and rub it between your fingers to check whether you can clearly feel grains. You can also check whether you can see grains in the hydraulic fluid by dripping it on paper. Replace the hydraulic fluid if necessary.

7.6 Yearly Check

Maintain the AMRs:

- Maintain the wearing status of the driving wheel and casters. Replace if necessary.
- Inspect and maintain the relative moving parts for lubrication conditions. Lubricate if

- necessary. Check the bearing and screw for wearing or loosening. Replace if necessary.
- Check the tightness, cleanliness, and effectiveness of the internal parts of the charging pole. Replace if necessary.

Table 5-3 Hydraulic lifting parameters

Check Part	Check Item	Check Method and Troubleshooting
Pump	Hydraulic fluid	Change the hydraulic fluid.
	Fluid pipe	Check whether the fluid pipe is aged and hardened. Replace if necessary.
Pump motor	Connector	Check whether it is aged.
	Fastening bolt	Check the tightness.
	Cable	Check whether it is aged or worn.
Rotation motor	Connector	Check whether it is aged.
	Cable	Check whether it is aged or worn.
	Fastening bolt	Check the tightness.

Chapter 8 Transportation and storage

8.1 Handling precautions

- The AMR is packed in a wooden crate on a pallet, and is not allowed to be turned over, inverted or watered during transport. When lifting and loading, do not allow collision and do not damage the exterior surface of the AMR when unpacking.
- The charging pile is packed in a wooden crate and is not to be turned over, inverted or watered during transport. When lifting and loading, do not allow collision and do not damage the exterior surface of the vehicle when unpacking.
- All lifting positions must be used during transportation and disassembly, and ensure that the lifting device has sufficient load capacity.

8.2 Handling Method

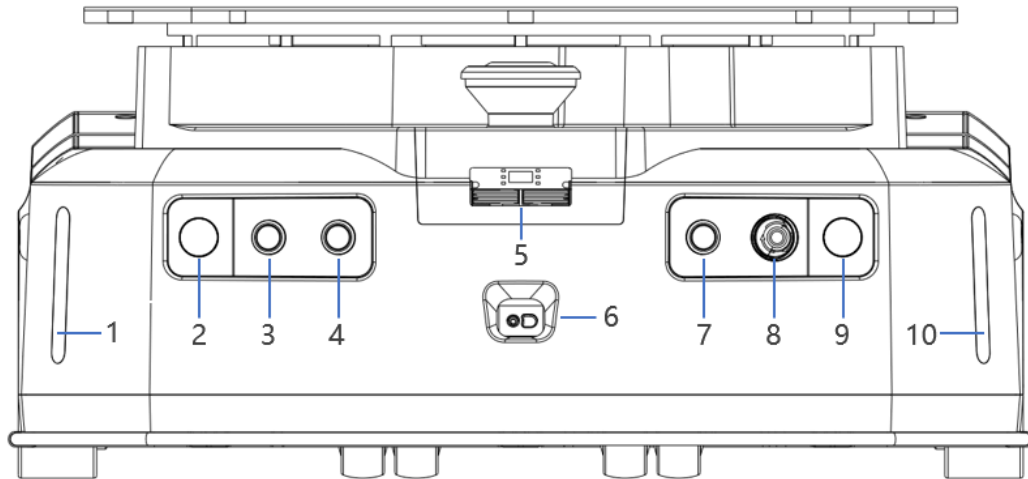
The AMR is packed in a wooden crate on a pallet, and is not allowed to be turned over, inverted during transport. When lifting and loading, do not allow collision and do not damage the exterior surface of the AMR when unpacking.

8.3 Storage precaution

If the AMR is out of use for more than 2 months, park the AMR in a well-ventilated, frost-free, clean and dry room and take the following measures.

1. Clean the vehicle thoroughly inside and out, and dustproof it.
2. Fully lift the lifting platform several times to check that it is working properly; afterwards lower the lifting platform to its lowest level.
3. Raise the vehicle on squared timbers so that the drive wheels are off the ground.
4. Apply a thin layer of oil or grease to all exposed mechanical surfaces.
5. Fully charge the battery and recharge it every 2 or 3 months.
6. Spray all electrical contacts with a suitable contact spray.

Appendix 1 Instruction to power off the lithium battery



Turn the key switch shown in 8, to power off the lithium battery.

Appendix 2 Obstacle Avoidance Description

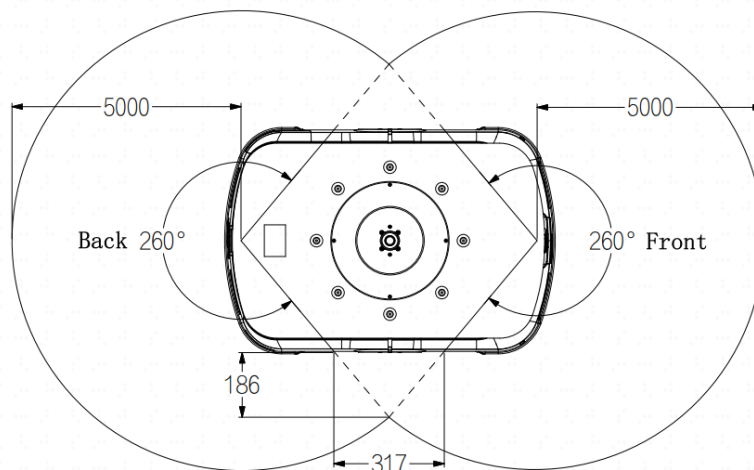
AMR continuously detects obstacles during operation, reducing the chance of the robot colliding with obstacles during operation.

Three types of sensors are responsible for detecting obstacles:

- Safety Laser Scanner
- General Laser Scanner
- TOF Camera

Safety Laser Scanner

A safety laser scanner with a 260° field of view is configured in front of the AMR. When the AMR is running, the safety laser continuously scans the surrounding environment to detect objects.



Safety laser scanners have the following limitations:

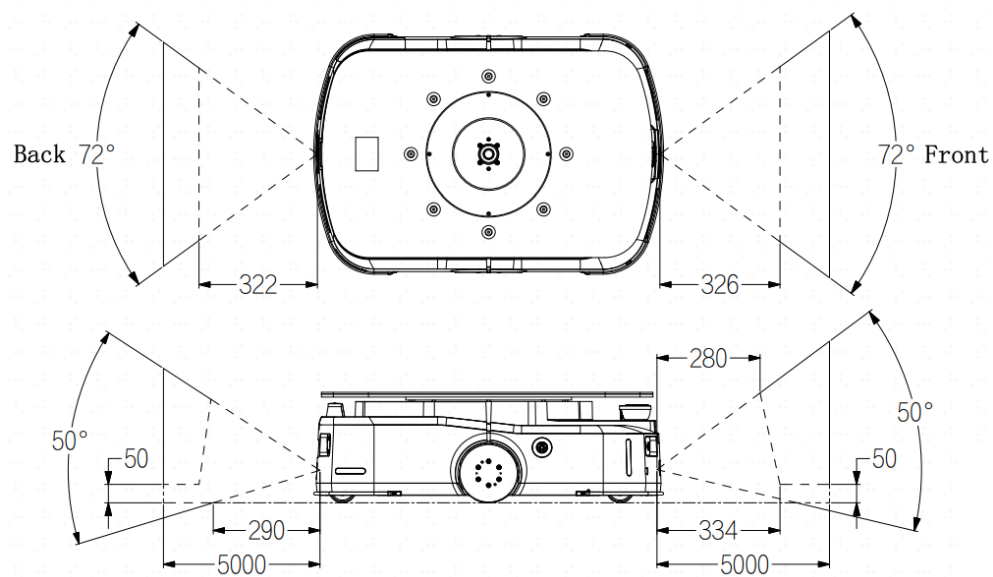
- Only objects intersecting a plane 200mm above the floor can be detected.
- Transparent obstacles are not detected well.
- When reflective obstacles are detected, the scanner data may be inaccurate.

General Laser Scanner

A general laser scanner with a 260° field of view is configured at the back of the AMR. When the AMR is running, the safety laser continuously scans the surrounding environment to detect objects.

TOF Camera

ARM has a TOF camera on the front and back to detect objects in front or behind. The TOF camera detects a distance of 300mm to 3m, with a vertical angle of 50° and a horizontal angle of 70° .



Although the 3D camera and rear obstacle avoidance laser have the function of detecting obstacles, they cannot be used as a means to reduce safety risks and cannot be used for the safety function of personnel detection. If the robot only relies on 3D cameras and rear obstacle avoidance lasers to detect personnel, the robot may collide with personnel and cause personal injury.

Appendix 3 Waste disposal

- If material inside the cell leaks, the operator should immediately evacuate the incident area until the fumes have dissipated. Turn the ventilation on to blow out the hazardous gases. Wipe the test area with a rag, remove any spillage and place the leaking battery in a plastic bag and then in a steel container. Avoid skin and eye contact or inhalation of hazardous gases.
- It is forbidden to open, destroy or incinerate the battery as there is a risk of explosion, rupture or leakage during these handling processes.
- Do not short-circuit, overcharge, forcibly discharge or throw the battery into a fire. It is forbidden to squeeze and puncture the battery or to immerse it in a solution.
- It is recommended that the battery be completely discharged, that the lithium metal cells are depleted of the lithium metal inside the battery, and that they be disposed of by a professional organization.

Appendix 4 Legal Information

Declaration of Trademark

- VGA is the trademark of IBM.
- Windows mark and Windows are trademarks or registered trademarks of Microsoft.
- Other trademarks or company names that may be referred to in this document are properties of their respective owners.

Disclaimer

- Within the scope permitted by applicable laws, this company will make no compensations for any exceptional, affiliated, indirect, or secondary losses due to the content of this manual or the product described herein, and will not compensate for any losses of profits, data, goodwill, documents, or for anticipated savings.
- The product described in this manual is provided “as is.” Unless required by applicable laws, this company provides no express or implied guarantee of any of this manual’s contents, including but not limited to marketability, satisfaction with quality, suitability for specific purposes, and non-infringement upon third-party rights.

Privacy Protection Notice

As the device user or data controller, you might collect personal data of others such as the face, fingerprints, and car plate number. You need to be in compliance with the local privacy protection laws and regulations to protect the legitimate rights and interests of other people by implementing measures including but not limited to: providing clear and visible identification to inform data subjects of the existence of surveillance area and providing related contact.

About this Manual

- The Manual is for reference only. If there is an inconsistency between the Manual and the actual product, the actual product shall prevail.
- We are not liable for any loss caused by the operations that do not comply with the Manual.
- The Manual would be updated according to the latest laws and regulations of related regions. For detailed information, see the paper manual, CD-ROM, QR code, or our official website. If there is an inconsistency between the paper manual and the electronic version, the electronic version shall prevail.
- We reserve the right to change any information contained in the document at any time, which will be then included in a new version, without prior notice.
- The User Manual may contain technical errors, non-conformities with functionalities or operations of the product, or typographic errors; the ultimate power of interpretation is vested with the company.

- Upgrade the reader software or try other mainstream reader software if the Manual (in PDF format) cannot be opened.

Appendix 5 Cybersecurity Recommendations

Essential measures for ensuring basic network security for the device:

1. Use A Strong Password

Refer to the following recommendations for setting up the password:

- The length should not be less than 8 characters.
- A strong password is comprised of at least two of these three character types: letters in upper and lower cases, numbers, and special characters.
- Do not contain the username in its forward or reverse sequence.
- Do not use continuous characters, such as 123 and abc.
- Do not use repeated characters, such as 111 and aaa.

2. Timely Update Firmware and Client Software

- As is standard procedure in the tech industry, the firmware of devices (NVRs, DVRs, IP cameras, etc.) should be timely updated to the latest version to ensure the equipment is current with the latest security patches and fixes. With the device connected to the Internet, it is recommended to turn on automatic online update detection to timely get firmware updates launched by providers.
- It is recommended to download and use the latest client software.

Recommended measures to enhance cybersecurity:

1. Physical Protection

Physical protection is recommended for devices (especially storage devices), such as placing them in a special room, or special cabinet, and well conduct access control and key control to prevent damages to hardware and external devices (USB flash drive, serial ports) by unauthorized persons through physical contact.

2. Changing Passwords Regularly

Regularly change the passwords to your devices to help ensure that only authorized users are able to access the system.

3. Timely Set up and Update Password Reset

This device supports password reset. To reduce the risk of this function being attacked by hackers, it is recommended to timely setup password reset, including reserved phone number/email, and security questions. If any of such information changes, update the password reset in time. When setting up security questions, set up an answer that is difficult for someone to guess their way into your system.

4. Enable Account Lock-Down

Account lock-down is enabled by default. To keep your Account safe, it is recommended to keep this setting. After hackers fail multiple attempts to hack passwords, the corresponding Account and source IPs are locked.

5. Change HTTP and Other Default Service Ports

These ports can be changed to any set of numbers between 1024–65535. Avoiding the default ports reduces the risk of hackers being able to guess which ports you are using.

6. Enable HTTPS

Enable HTTPS to access Web services through safe channels.

7. **Bind MAC Address**

Bind the IP and MAC address of the gateway device to reduce the risk of ARP deception.

8. **Reasonably Allocate Account and Permission**

Add users properly according to business and management needs, and allocate minimum sets of permissions to them.

9. **Turn off Unnecessary Services and Use Safe Modes**

- If not needed, SNMP, SMTP and UPnP can be turned off to reduce the risks for the device.
- If necessary, it is strongly recommended to use safe modes, including but not limited to:
 - ◇ SNMP: Select SNMP v3 and set a stronger encryption password and authentication password.
 - ◇ SMTP: Select TLS to access the mailbox server.
 - ◇ FTP: Select SFTP and set a complex password.
 - ◇ AP hotspot: Select WPA2-PSK encryption mode and set a complex password.

10. **Audio/Video Encryption Transmission**

If your audio/video data includes important or sensitive contents, use the encrypted transmission to make it more difficult for someone to steal your data.

11. **Security Audit**

- Review online users: Do this from time to time to find out illegal login, if any.
- Review device log: This gives you the IP data of a device trying to log in and the critical operation information of users already in the login status.

12. **Network Log**

The limited storage capacity of the device cannot store many logs for a long time. If you need to save logs for a long, enable online log to ensure key logs are synced to the online log server for easy backtracking.

13. **Building Safe Network Environment**

To keep the device safer and reduce network risks, we recommend you to:

- Turn off the port mapping of the router to prevent external networks from directly accessing the services of router intranet devices.
- Partition and isolate the network according to the actual network needs. If there is no communication demand between the two subnets, it is recommended to use a VLAN, gatekeeper, etc., to partition the network for network isolation.
- Build up the 802.1x access authentication to reduce the risk of illegal terminals connecting with your private networks.
- Enable device IP/MAC address filtering to limit the hosts that can access the device.

Appendix 6 Braking distance test

The robot's braking capabilities must be fully tested before consuming.

The robot's braking distance depends on the following three factors:

- The robots running speed
- Valid load of robot
- The road surface on which the robot travels, including but not limited to road flatness, slope, Friction Coefficient, etc.

Therefore, the exact braking distance of the robot cannot be determined in advance. The exact distance must be determined in the environment and driving conditions in which the robot operates. The goal of the braking test is to ensure that the robot brakes in time to avoid collisions with people or objects when driving with maximum Valid load, in different field settings at different speeds and on the steepest support slope. If the measured braking distance is too long, the Obstacle Avoidance distance of the robot should be set larger to ensure Security Guard safety. This can happen if the road surface has low Friction, such as high-gloss floors, etc. The Obstacle Avoidance distance should always be at least slightly larger than the braking distance at all speeds.

