

C040 Latent Lifting AMR

User Manual



V1.0.0

Preface

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About this manual

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Symbol Convention

The following symbols may appear in this document:

Table 1 Symbol Meanings	
Symbols	Instruction
 DANGER	Indicates a high potential danger that may cause severe injury or death.
 WARNING	Indicates a moderate or low potential hazard, which may cause moderate injury.
 CAUTION	Indicates potential risks that may damage equipment or data
 TIPS	Indicates helpful content to resolve issues or save time.
 NOTE	Indicates supplementary information or emphasis on the main text.

Safety Guidelines

The following guidelines are essential for the correct use of the product. To prevent hazards and property damage, read carefully and strictly adhere to these instructions before and during use.

Transportation Requirements



- Packaging: Use the original factory packaging or materials of equivalent quality during transportation.
- Transportation: Avoid heavy pressure, severe vibration, or immersion that may damage the device.
- Environment: Transport the device within the allowable temperature and humidity ranges specified in the technical parameters for the corresponding model.

Storage Requirements



- Environment: Store the device within the allowable temperature and humidity ranges specified in the technical parameters for the corresponding model.
- Transportation: Prevent damage from heavy pressure, severe vibration, or immersion during storage.

Installation Requirements



- Power Safety: Always disconnect the power supply before wiring, disassembly, or installation.
- Grounding: Ensure proper grounding for devices with grounding terminals to avoid damage from static electricity or induced voltage and to prevent electric shock.
- Regulations: Strictly comply with national and local electrical safety codes during installation.
- Accessories: Use only manufacturer-specified components, and have installation

performed by certified professionals.

- Ventilation: Do not block the device's ventilation openings. Install in a well-ventilated area.
- Location:
 - Avoid installing near heat sources, direct sunlight (e.g., radiators, heaters, stoves), or flammable environments to prevent fire hazards.
 - Do not place the device in explosive, humid, dusty, extremely hot/cold, corrosive, or electromagnetically noisy environments.
 - Handling: Protect the device from heavy pressure, vibration, or immersion during installation.



WARNING

Power Supply Precautions

- Stability: Ensure stable voltage that meets the device's power requirements.
- Cable Protection: Prevent power cables from being trampled or tightly pressed, especially at plugs, sockets, and connection points.
- Multi-Power Devices: Do not connect devices supporting multiple power sources to two or more supplies simultaneously.
- Specifications: Refer to the device-specific manual for power requirements.

Operational Requirements



CAUTION

Work Environment

- Conditions:
 - Operate within the allowable temperature and humidity ranges specified in the technical parameters.
 - Use the device on stable, flat surfaces.
- Liquid Exposure:
 - Prevent liquids from entering the device. If liquid ingress occurs, immediately disconnect power, stop use, unplug all cables, and contact after-sales.
 - Port Safety: Do not hot-swap RS-232, RS-485, or other interfaces to avoid port damage.
 - Data Security: Regularly back up data to prevent loss due to operational errors.

The company is not liable for data security issues.

- Misuse Liability: The company is not responsible for damage caused by over-specification use or improper operation.



WARNING

Robot-Specific Safety

- Software Compliance: Ensure the robot operates with correct software, including maps and task configurations. Incorrect software may cause injuries or equipment damage.
- Hazard Areas: Keep all personnel away from operational danger areas.
- Foot Safety: Operators must wear safety shoes to prevent injuries from the robot passing over feet.
- Restricted Areas: Install barriers or set no-go areas on maps near ladders, scaffolds, etc., to prevent falls or collisions.
- Load Security: Properly secure loads to avoid tipping or falling, which may cause injuries or equipment damage.



WARNING

Maintenance

- Professional Service: Schedule regular inspections and maintenance by certified technicians. Unauthorized disassembly is prohibited.
- Genuine Parts: Use only manufacturer-approved components for repairs.

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Chapter One Safety Overview

HuaRay Technology has designed multi-layer safety mechanisms for the robot, including deceleration or stopping to avoid collisions. However, accidents may still occur due to operator negligence or failure to follow safety guidelines. Most incidents during operation, maintenance, or repair stem from non-compliance with safety protocols. By analyzing potential hazards and implementing appropriate safeguards before each operation, most accidents can be prevented.

This document aims to ensure the safety of personnel and equipment during robot operation. All operators and personnel entering the robot's operational area must read this manual thoroughly.

Improper operation, maintenance, or repair is extremely hazardous and may result in injury or death. Do not operate, maintain, or repair the device until you have fully read and understood this manual.

1.1 Disclaimer

- **User Liability:** HuaRay Technology assumes no responsibility for losses caused by improper use.
- **Inherent Risks:** Even with strict adherence to safety guidelines, the robot may still cause personal injury or property damage.
- **Unauthorized Modifications:** HuaRay Technology is not liable for harm caused by replacement or modified components.

1.2 Reading Guidelines

- Read this manual thoroughly before operating the robot.
- Unauthorized disassembly or assembly of the AMR is prohibited.
- Observe all safety warnings in the user guide.
- Contact the distributor immediately if abnormalities occur.
- Stop and power off the robot immediately if unusual odors are detected.
- This manual does not replace technical agreements.

1.3 Usage Prohibitions

- **Environment Restrictions:**

- Outdoor use.
- Environments with strong navigation interference (e.g., electromagnetic noise).
- Explosive, dusty, or high-salt environments (e.g., marine climates).
- Extreme conditions (freezers, strong magnetic fields).
- Operational Restrictions:
 - Transporting flammable, explosive, or liquid items.
 - Operating on uneven surfaces, stairs, or slopes.
 - Carrying passengers or overloading the chassis.
 - Spinning on slopes.

1.4 Safety Precautions

(See detailed sections below.)

1.5 Operational Safety

1.5.1 Operating Environment Safety

- Ground Requirements:
 - Flat, free of grooves, cracks, oil, or adhesives.
 - No loose screws, cables, or debris that could jam wheels.
- Navigation Limits:
 - Avoid overly void areas (e.g., long corridors) exceeding laser perception range.
 - Maximum step height: 10 mm for loaded robots at low speed.
 - Maintain 100 mm clearance on both sides in narrow passages.
 - Hazard Sign: Mark robot pathways with barriers or warning signs.

1.5.2 Pre-Operation Checks

Inspect the following before use:

- Wheel fasteners are tightened.
- Power system functions normally.
- Emergency stop mechanism is operational.
- Lifting mechanism shows no damage (bending, cracks, or wear).
- Warning lights and sensors (laser, TOF) are functional.
- Battery is fully charged monthly and meets voltage requirements.

- Charging system operates correctly.

1.5.3 Parking Safety

- Power Off: Shut down and disconnect power when not in use.
- Prohibited Areas: Slopes, heat sources, fire hazards, pits, underground passages, elevator shafts, fire exits, or stairways.
- Safety Measures: Use wheel chocks if necessary.
- Clearance: Maintain space based on the robot's maximum rotation diameter (loaded/unloaded).

1.5.4 Battery Safety

WARNING: Batteries pose fire/explosion risks. Do not disassemble, crush, incinerate, heat, or expose to open flames.

- **Charging:**
 - Charge within 0°C–40°C. Out-of-range charging degrades performance and lifespan.
 - Use only manufacturer-approved chargers.
 - DO NOT charge via discharge ports or discharge via charging ports.
- **Storage:**
 - Store partially charged batteries in dry, ventilated areas ($\leq 40^{\circ}\text{C}$, $\leq 80\%$ humidity).
 - Ideal storage temperature: -10°C – 25°C .
- **Maintenance:**
 - Perform a full 0.2C charge/discharge cycle every 3 months for in-use batteries.
 - For stored batteries, perform maintenance cycles every 6 months.
- **Disposal:**
 - Follow local regulations for end-of-life batteries.
 - Never discard expired batteries improperly.
- **Emergency Response:**
 - Stop use immediately if leaks, overheating, or odors occur.
 - Rinse skin/clothing with water if exposed to battery fluid.
- **Prohibited Actions:**
 - Exposing batteries to extreme heat, liquids, or static electricity.
 - Modifying or piercing battery casings.

Chapter Two Product Overview



NOTE

The product figures in this chapter are for illustrative purposes. In case of discrepancies between the images and the actual product, the physical product shall prevail.

2.1 Product Introduction

This product is a Latent Lifting AMR (Autonomous Mobile Robot), designed to address challenges in traditional warehousing and production line logistics, such as high labor costs, low management efficiency, and order inaccuracies. It is a core component of intelligent logistics and smart factory solutions, integrating three key modules: AMR, RCS (Robot Control System), and WMS (Warehouse Management System).

Applications: Photovoltaic/lithium battery industries, e-commerce sorting centers, 3C manufacturing, traditional manufacturing, healthcare, food processing, and automotive industries.

2.2 Functional Features

- Dimensions:
 - Rotation diameter: 810 mm (industry-leading).
 - Width at rack interface: 540 mm, height: 250mm.
- Performance:
 - Unloaded speed: 2.0 m/s; acceleration: 1.0 m/s².
 - Positioning accuracy: ± 10 mm (unloaded/loaded), 5 mm docking precision in specific scenarios (varies by model).
- Navigation:
 - Supports laser, DM code, texture navigation, and hybrid navigation.
- Obstacle Avoidance:
 - 360° omnidirectional avoidance (expandable to visual avoidance).
 - Front/rear TOF cameras for 3D avoidance (field of view: horizontal 72°, vertical 50°; varies by model).
 - Data-driven avoidance technology for smooth deceleration and stopping.
- Battery: Supports automatic charging and manual battery replacement (90-second swap).

- Customization:
 - Optional accessories: square/round pallets, pallet pins, and leveling feet for enhanced stability.

2.3 Product Parameter

●Standard ○Optional -None

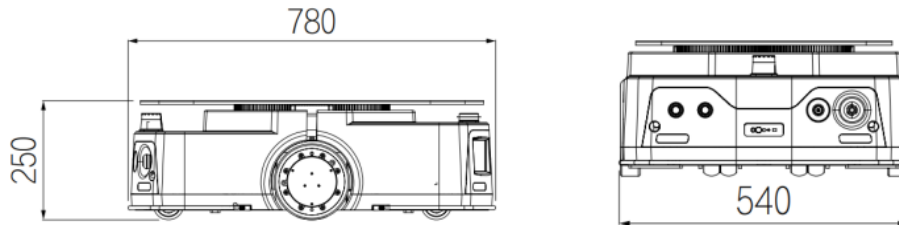
Table 2-1 Product Parameters

Product Model		C040
Navigation Method	DM Code	●
	Texture	●
	Laser SLAM	●
Basic Parameter	Dimensions (L×W×H, mm)	780*540*250
	Rated load (kg)	400
	Rotation Diameter (mm)	810
	Lift Height (mm)	60
	Lift Plate Size (mm)	728*480
Safety	Laser Obstacle Avoidance (Front)	●
	Laser Obstacle Avoidance (Rear)	○
	TOF Obstacle Avoidance (Front)	○
	TOF Obstacle Avoidance (Rear)	○
	Bumper	Front/Rear
	Emergency Stop Button	Front/Rear
	Sound and Light Alarm	●
Motion	Max Unloaded Speed (m/s)	2.0
	Rated Load Speed (m/s)	1.5
Battery	Rated Operating Time (h)	6
	Charging Time (h)	1.3

2.4 Product Structure

2.4.1 Product Dimensions

Figure 2-1 Dimensioned Drawing of the Device (Unit: mm)



2.4.2 Front Panel

Figure 2-2 Front Panel

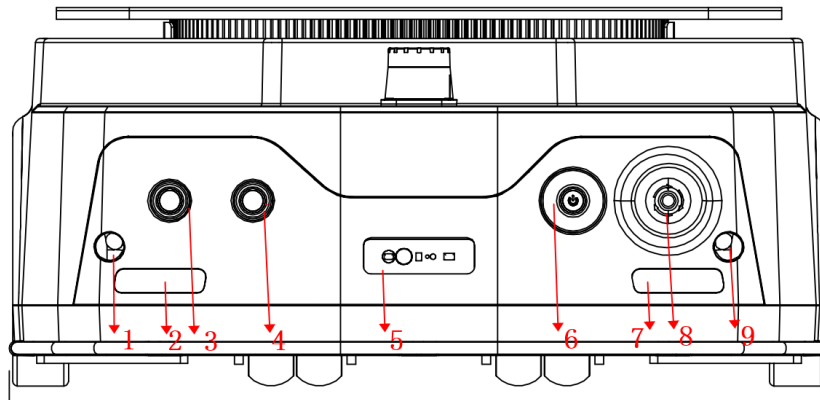


Table 2-2 Front Panel Description

No.	Components	Instructions
1、9	Outline Lights	Indicates operational safety width.
2、7	LED Strip	● Yellow: Standby; ● Green: Active/Charging; ● Red (1s blink): Obstacle/Error; ● Red (3s blink): Low battery.  NOTE Faults take priority.
3	Confirm Button	For manual intervention confirmation.
4	Maintenance/Auto	Used to switch the device maintenance/automatic mode. ● Pressed: Maintenance mode; ● Released: Auto mode (light off).
5	TOF Camera	Provides 360° omnidirectional avoidance for the robot.
6	Power Button	Press to power on/off.
8	Emergency Stop Button	● Press to halt operations; ● Rotate to reset and self-check.

2.4.3 Rear Panel

Figure 2-3 Rear Panel

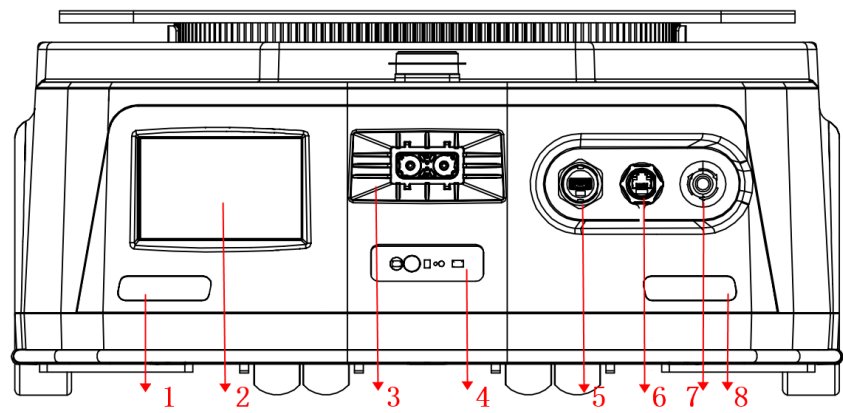


Table 2-3 Rear Panel Description

No.	Components	Instructions
1、 8	LED Strip	● Yellow: Standby; ● Green: Active/Charging; ● Red (1s blink): Obstacle/Error; ● Red (3s blink): Low battery.  NOTE Faults take priority.
2	Display Screen	Shows real-time status, errors, and lift controls.
3	Rear charging port	Used for autonomous charging docking.
4	TOF camera	Provides 360° omnidirectional avoidance for the robot.
5	USB port	● Firmware updates: For internal device programming (non-user function). ● Optional handheld controller: Requires additional hardware.
6	Debug Port	For debugging (non-user function).
7	Emergency Stop Button	● Press to halt operations; ● Rotate to reset and self-check.

Chapter Three Unboxing Checklist

When the transportation company delivers the required latent lift-type AMR to you, please refer to the table below for unboxing inspection. If there are any issues, please contact the company's after-sales service personnel in a timely manner.

Table 3-1 Unboxing Checklist

Step	Check Item		Details
1	Overall Packaging	Exterior	Check for visible damage.
		Packaging	Inspect for signs of impact.
		Accessories (Manifest on the Warranty Card)	Verify completeness against the warranty card checklist.
2	Front/Rear Panels	Model Label (on the back panel film)	Confirm consistency with the purchase contract.
		Nameplate	Ensure it is intact. DO NOT remove or discard.  NOTE Do Not tear or discard it. The serial number on the nameplate is required for warranty claims.
3	Chassis	Exterior	Check for visible damage.

Chapter Four Installation Requirements

4.1 Site Requirements

Slope

- AMR can operate on slopes $\leq 5\%$ at rated speed. For precise parking, slopes must $\leq 1\%$.
- On uneven terrain, slopes $\leq 1.5\%$ with transition distances longer than the vehicle length.

Ground Load Capacity

- Floor load capacity must exceed the AMR's pressure per unit area.
- Concrete or composite floors are recommended to distribute wheel pressure effectively.

Electrical Properties

Floor resistivity: 10^6 – $10^9 \Omega$ (per German DIN51953) to prevent static buildup in sensitive environments.

Friction Coefficient

- Minimum sliding friction coefficient: 0.5 (for rubber tires).
- Ensure floors are clean; contaminants or cleaning agents may reduce friction.

4.2 Racks Requirements

- Clearance: Minimum width/height under racks must allow AMR passage. For rotations, add 10cm beyond the diagonal length.
- Markings: Attach DM codes and reflective films under racks.
- Camera Range: DM code recognition distance: 99–141 mm (vertical from camera lens).

4.3 Signal Requirements

AP: Connect multiple wireless network terminal devices together and then connect the wireless network to Ethernet.

Wireless AP Layout

- Mounting: Ceiling-mounted APs at 4 m height, tilted 7° – 9° .

- Channels:
 - 2.4 GHz: Use channels 1, 6, 11.
 - 5 GHz: Use channels 149, 153, 157, 161, 165 (cellular arrangement to avoid interference).
- Coverage: 12 m radius per AP. Avoid walls or physical barriers.



NOTE

The difference between omnidirectional and directional coverage direction of AP will determine its coverage and installation method.

4.4 Network Configuration Requirements

Avoid IP ranges: 192.168.23.x and 192.168.24.x (reserved for internal modules), which will lead to functional abnormality in:

- 3D TOF
- Laser
- Upper and lower cameras, etc.

4.5 Navigation Requirements

Laser Navigation

- Environment: Minimal moving objects (<70% of laser field). Avoid using in severe weather, such as rain, snow, or dust.
- Mapping: Manually drive AMR at ≤ 0.5 m/s to create a closed-loop map. Remove movable objects.

DM Code Navigation

Site Preparation: Measure site dimensions and create a CAD layout (± 10 mm accuracy), including obstacles (columns, electrical boxes, fire hydrants). Plan AMR routes and DM code placements based on the CAD drawing.

DM Code Installation:

- Use an ink line marker to align placement positions.
- Print codes on adhesive labels using a Zebra printer.
- Align codes with ink lines (± 1 mm precision).

- Cover codes with protective film (smooth, clean, bubble-free).
- Replace damaged or soiled codes immediately.

Laser + DM Code Hybrid Navigation

Transition Points:

- Select areas with minimal laser environment changes (e.g., fixed walls).
- Use reflective markers if the environment is unstable.

Texture Navigation

Site Requirements:

- Irregular textured floors (e.g., diamond-polished concrete).
- Resistant to stains.
- Unsuitable for DM code placement.
- Complex environments challenging for laser mapping.

Ground code requirements: Suitable for capturing texture code templates in large areas such as long corridors.

Texture Template Creation:

1. Lay guide lines ≤ 5 mm wide.
2. Capture texture images via autonomous line-following at 0.5 m/s (camera ≥ 15 fps).
3. Perform three runs per line: centered, 5 cm left, and 5 cm right.
4. Process images via algorithms to generate texture templates through stitching.

Laser + Texture Hybrid Navigation

- Transition Points: Stable laser environments (e.g., fixed walls).
- Use reflective markers if needed.
- Apply textured floor stickers for high-precision docking.

4.6 Charging Pile Requirements



NOTE

Different models of charging piles are compatible with different models of AMRs. The specific charging pile model to be used should correspond to the actual model of the AMR.

Direct/Side Charging Pile Installation Requirements

- Install the AMR charging pile on a flat and level ground surface.
- Secure it to the ground using four sets of M8 anchor bolts. The expansion sleeves must not protrude above the ground surface during installation. To prevent safety hazards, any excess bolt length should be cut off or covered with rubber caps.
- Ensure a clearance of at least 30cm behind the charging pile for door access.
- During installation, align the charging contacts and the DM code center in a straight line.

Operating Conditions:

- Ambient temperature: $0^{\circ}\text{C} < \text{temperature} < 40^{\circ}\text{C}$.
- Maximum relative humidity: $\leq 90\%$, with good air circulation.
- No conductive or explosive dust, no corrosive gases or vapors that damage metal or insulation, and no strong electromagnetic interference at the operating site.
- The installation base must not experience severe vibration or impact, with a vertical tilt angle not exceeding 1° .

Safety Requirements:

- A dry powder fire extinguisher or sandbox must be available within a 5 m² radius of each charging pile.

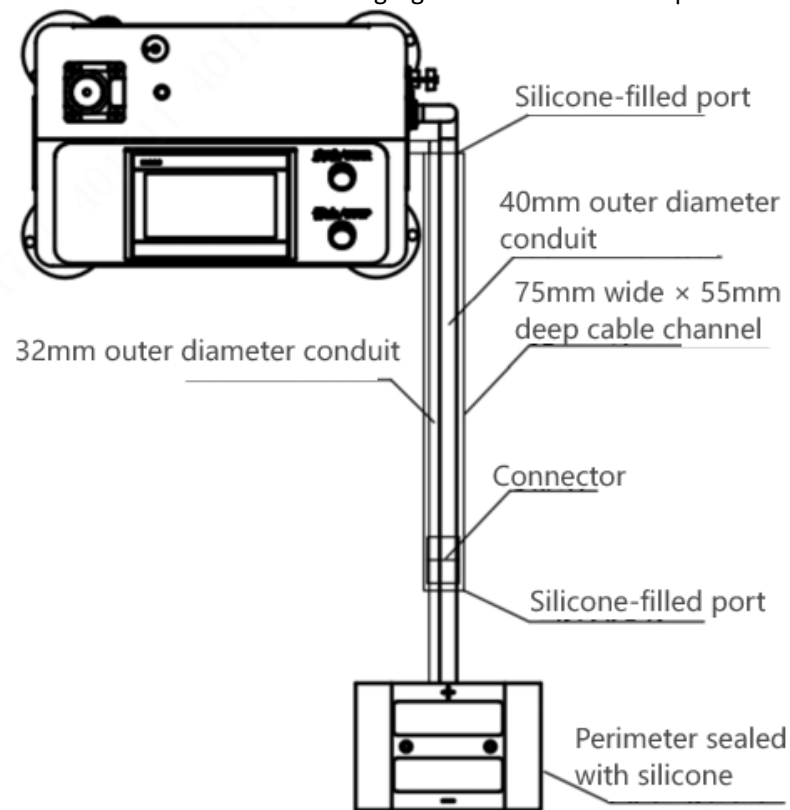
Ground-Mounted Charging Pile Installation Requirements

- At the designated brush plate location, create a wiring hole measuring 80 × 50 mm with a depth of 55 mm, and route the brush plate leads from the main unit direction.
- Between the main unit and the brush plate, cut a wiring channel 75 mm wide and 55 mm deep.
- Thread the cables through conduits with outer diameters of 40 mm and 32 mm, respectively. Ensure a secure connection between the main unit cables and the brush plate

cables using connectors, with the connector section enclosed within the conduit.

- Seal both ends of the conduit with silicone to fully plug the openings.
- Firmly fix the brush plate to the ground using screws.
- Backfill with cement and seal the perimeter of the brush plate with silicone.

Figure 4-1 Ground-Mounted Charging Pile Installation Requirements



Chapter Five Usage Instruction

The operation of the robot is divided into Deployment and Operation & Maintenance. This section describes the basic operational steps for both phases. After the robot arrives on-site, professional personnel are required for deployment. Once deployment is complete, the robot can operate according to predefined workflows.

5.1 Device Startup

Before using the robot, ensure that daily inspections have been performed.



DANGER

- Release the Emergency Stop Button and press the Power Button. Wait for full startup before operating.
- After startup, operators should leave the robot's working area to avoid interference with obstacle detection sensors, which may cause abnormal behavior.
- Clear obstacles from the operating area to ensure an unobstructed path for the robot.



CAUTION

When paused, the robot will not accept tasks from the control system.

Pause methods:

- Press the Emergency Stop Button
- Press the Maintenance Button.
- Log In to the monitoring Client and pause the robot.

Device shutdown: Press the Power Button to turn it off.

5.2 APP Operation

Connect to the robot via its IP address to perform forward/backward movement, left/right rotation, and lifting operations.

Operating Steps

Step 1: Power on the device and establish an IP connection.

Figure 5-1: Device Connection

设备连接

V1.0.9 R20231127

用户名

robot

密码

●●●●●●●●

设备IP

请填写设备IP

连接

Step 2: Use the control panel to operate the robot.

Figure 5-2 Control Panel

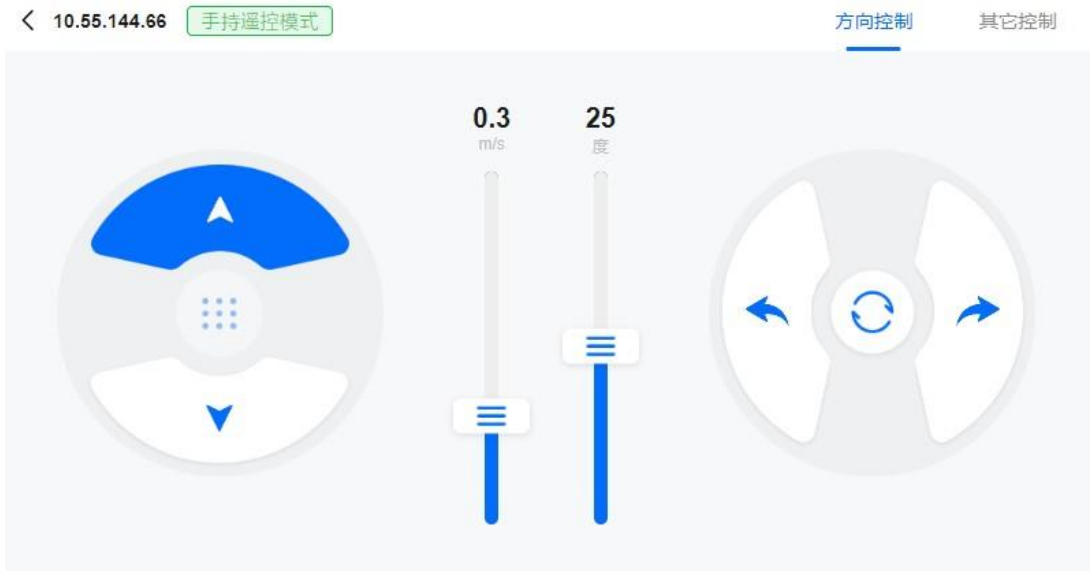


Table 5-1 Control Panel Functions

Button	Function	Button	Function
	Move forward		Move backward
	Rotate left (Hold “Forward” + “Left” for a left-turning arc)		Rotate right (Hold “Forward” + “Right” for a right- turning arc)
	Adjust speed/angular velocity		Pause robot

5.3 Touchscreen Operations

The touchscreen displays the robot’s real-time status, task details, alarms, obstacle avoidance data, and map configurations.

5.3.1 Main Interface

The main interface includes three sections:

- Status Bar: Access to Home, Real-time Data, Controls, System Info, and DM Code Camera Stream.
- Top Panel: Time, Wi-Fi signal strength, battery level, Manual/Auto mode, operational status, network status.
- Bottom Panel: Device address and real-time battery level.

Figure 5-3 Idle State



Figure 5-4 Obstacle Encounter Status



Figure 5-5 Device Collision



Real-Time Data: View system status, tasks, including the status of executing agencies, maintenance information status, platform business alarms, recent anomalies display, and security status.

Figure 5-6 Real-time Information Interface



The status of the executing agency include: Running angle, ground/rack DM codes, rotation zero-point.

Figure 5-7 Actuator Status



Maintenance information include: Charge cycles, lift counts, total runtime.

Figure 5-8 Maintenance Status



Platform Alarms: When anomalies occur, check platform alerts to diagnose issues caused by device operations and address them accordingly.

Figure 5-9 Platform Alarm Information

首页

实时信息

操作控制

系统信息

相机拉流

<

平台报警信息

RCS任务单号:

起始点:

起始点名称:

目标点:

目标点名称:

子任务信息:

任务模板名称:

[设备段路径状态:-; 算法状态:空闲可用; 设备状态:状态正常; 规划状态:为可规划状态;][充电状态:电量正常无需充电][休息状态:已经在等待点88000028]

第三方任务单号:

alarmFlag:0

alarmMsg:状态正常

advice:状态正常

Recent Alarms: View detailed alerts and errors from the past 24 hours.

Figure 5-10 Equipment Abnormality Display

首页

实时信息

操作控制

系统信息

相机拉流

<

近期异常显示

异常类型

全部异常

序号	异常类型	异常时间	详情描述
1	急刹	2024-01-12 15:06:32	详情
2	设备遇障	2024-01-12 15:06:32	详情
3	人工干预	2024-01-12 14:42:33	详情
4	碰撞	2024-01-12 14:42:31	详情
5	人工干预	2024-01-12 14:42:08	详情
6	碰撞	2024-01-12 14:42:06	详情
7	设备遇障	2024-01-12 14:41:48	详情

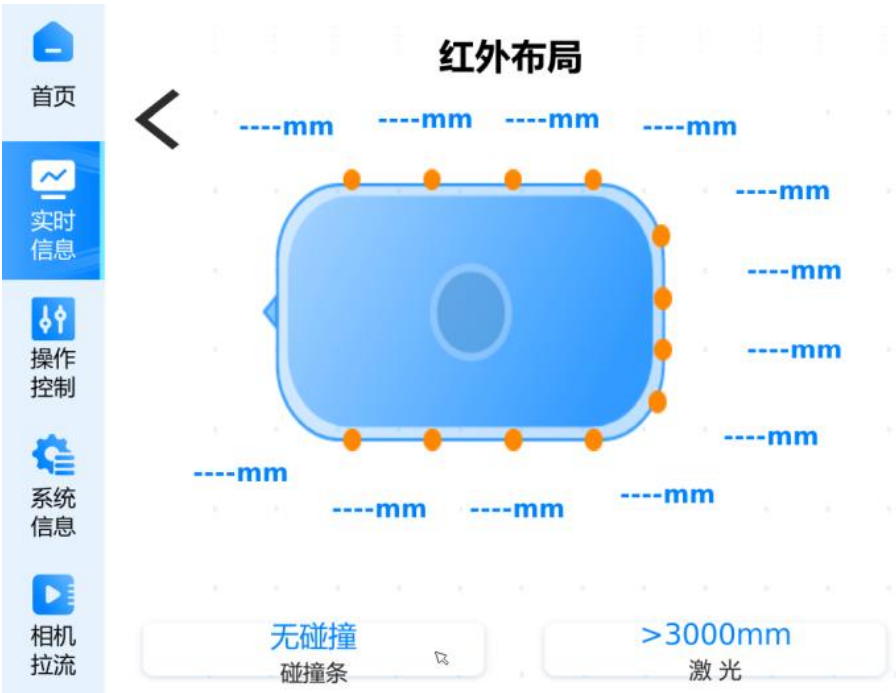
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Safety Status: Monitor recent device anomalies and safety-related events.

Figure 5-11 Sensor Obstacle Encounter Interface



5.3.2 Screen Control

Access the Control Interface to adjust lifting, lowering, rotation, and volume settings.

Figure 5-12 Operation Control



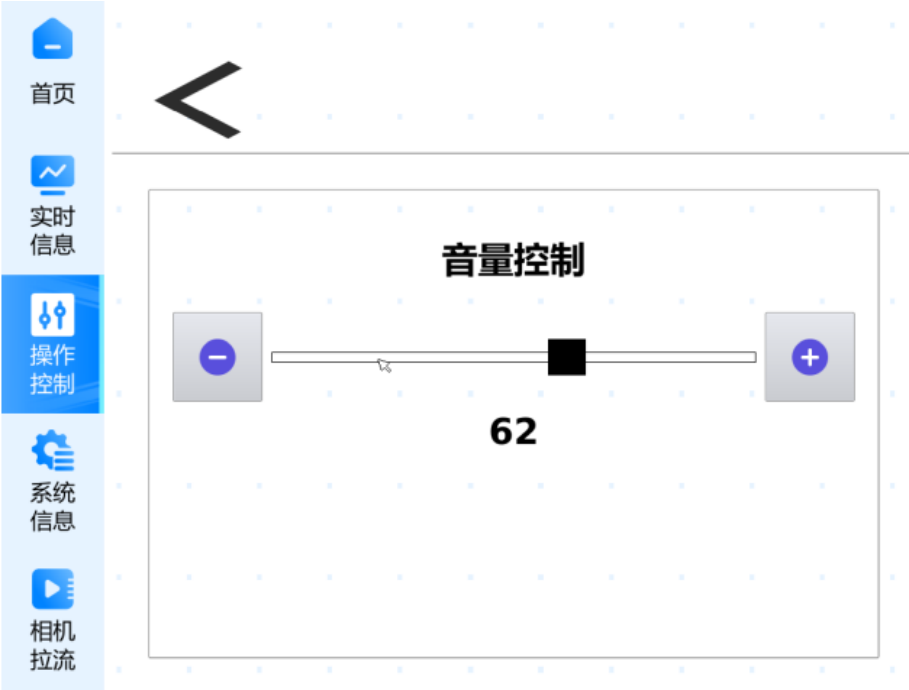
Figure 5-13 Pallet Lifting Up and Down Control



Figure 5-14 Pallet Rotation Control



Figure 5-15 Volume Control



5.3.3 System Information

Navigate to the System Info interface to view software versions and device models.

Figure 5-16 Version Information



首页	
实时信息	平台IP地址10.55.216.180
操作控制	端口号3002
系统信息	本地IP
相机拉流	

首页	
实时信息	
操作控制	
系统信息	
相机拉流	

<

网络类型

WIFI

平台IP地址

10.55.216.180

端口号

3002

漫游状态

打开

无线SSID

agv_first01

Use the camera stream interface to monitor DM code recognition and diagnose camera malfunctions.

Figure 5-19 Camera Stream Interface



5.4 Implementation Operations

Before autonomous operation, the AMR requires map creation, path editing, and task configuration. Refer to training lessons/materials for detailed steps.

5.5 Charging Operation

The charging station supports manual & automatic charging.

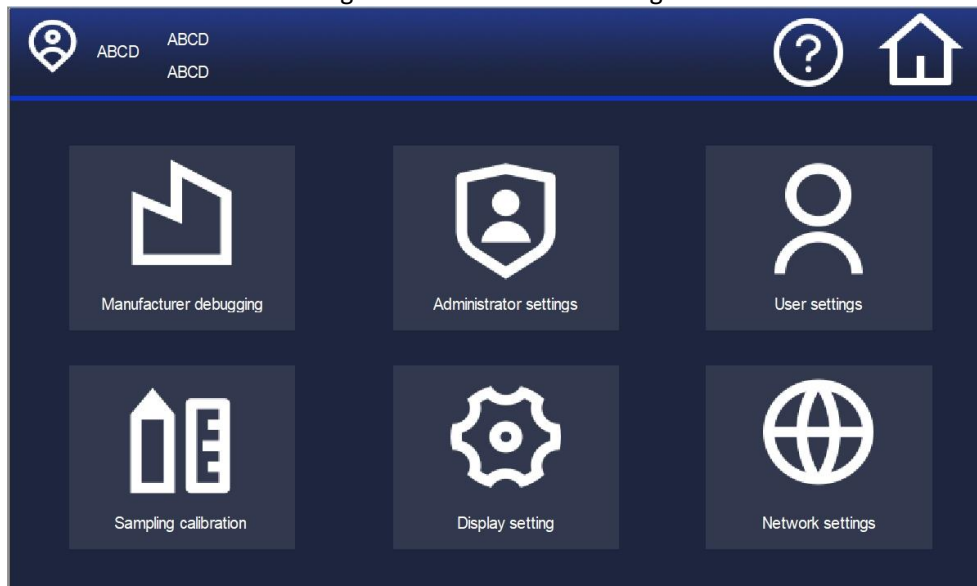
- Manual charging: Manually align the robot with the charging contacts and press the charging button.
- Automatic charging: Managed by the RCS (Robot Control System) without manual intervention.

Charging Station Configuration Steps:

(Note: Interface examples are for reference only; actual settings depend on the charging station model.)

1. Enter the settings page → Select “Network Settings.”

Figure 5-20 Network Settings



2. View communication status:

- Charger ↔ Platform
- Charger ↔ Wi-Fi module

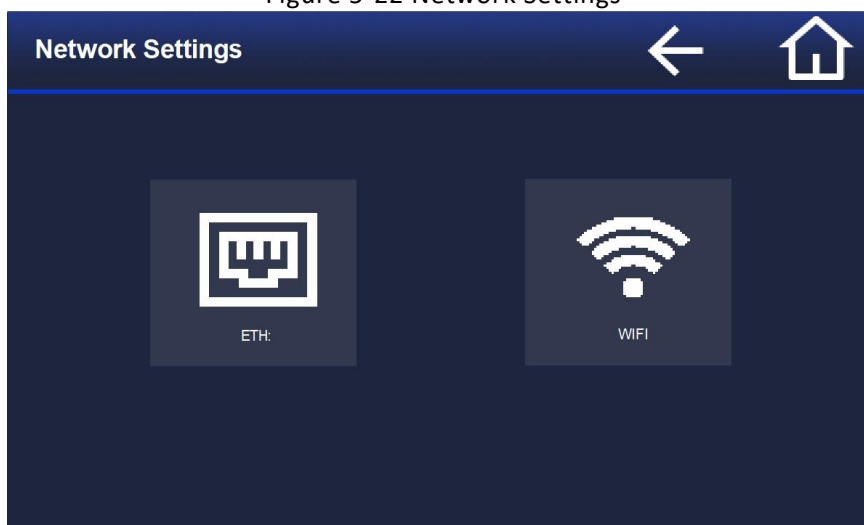
Figure 5-21 Network Settings



- a. Interface Settings: Configure wired (Ethernet) or Wi-Fi connection.
- b. Protocol Settings: Choose between two protocols & set server IP/port.
- c. Other Settings: Enable Wi-Fi logs/SSH access.
- d. LED Indicators:
 - Red: Off/Inactive/Disconnected
 - Green: On/Active/Connected
- e. Normal Operation: Module heartbeat, control board communication, and module time should show continuous increments.

3. Select Wired (Ethernet) or Wi-Fi Connection.

Figure 5-22 Network Settings



4. Wired (Ethernet) settings: the left side displays the current port information, while the right side is the editable configuration area.

Figure 5-23 Ethernet Settings



- a. To connect the charger via Ethernet:
 - Configure the IP address, gateway, and subnet mask for the Ethernet port.
 - Click "Set"; the button will turn blue. Wait until it turns gray to confirm success.
 - Verify that the Ethernet information on the left matches your configured settings.
 - b. If DHCP is enabled, the local IP/gateway/mask on the left may differ from the settings on the right.
 - c. Network Configuration Warning: Incorrect subnet mask, gateway or local IP settings will cause network connection failure
5. In the Wi-Fi settings interface, the left panel displays current Wi-Fi status while the right panel contains editable configuration fields.

Figure 5-24 Wi-Fi Setting

a. To configure Wi-Fi connection:

- Enter SSID, password, local IP, gateway and subnet mask
- Click “Set” (button turns blue during processing)
- Wait until button turns gray indicating successful configuration
- Verify configured parameters match displayed information in left panel

b. DHCP Note: When DHCP is enabled, actual local IP/gateway/subnet mask (left panel) may differ from manually configured values (right panel)

c. Network Configuration Warning: Incorrect subnet mask, gateway or local IP settings will cause network connection failure

d. Frequency Band Setting:

- 5GHz-only
- 2.4GHz-only
- A specific frequency band

If the connected band (left) differs from the configured band (right): Restart the charger to force a re-scan for the specified band.



NOTE

If the selected band is unavailable in the current environment, the charger may not connect using the configured band.

6. Protocol Configuration: Configure remote server IP and protocol mode (2 protocol options available)

Figure 5-25 Service Settings

Service settings

1234 - 1234 - 1234 1234 : 1234 : 1234

Server information:

TCP status: NULL

TYPE: RTP- 1234- 1234- 1234

Remote IP: 1234 1234 1234 1234 Remote Port: 1234

Protocol: DH

Local Port: 1234

Platform connection:

Send Registration 1st login 2nd login

Heartbeat Notify

Reported Count: 123457 Heartbeat packet co: 123457

setup:

Remote IP: 172 18 101 21

Remote Port: 3002

Protocol: DH

(You need to restart after modifying the protocol Settings)

Reconnect set up

a. Interface Layout:

- Left panel: Current server information
- Right panel: Editable parameter fields

b. Configuration Steps:

- Enter remote IP and port
- Click "Set" (button turns blue during processing)
- Wait for button to turn gray indicating success
- Verify server information in left panel

c. TCP Connection Troubleshooting: If TCP connection fails persistently, check Wi-Fi setting for errors

d. Protocol Mode Change:

- After switching protocol mode and clicking "Set":
- Charger restart required for changes to take effect

Chapter Six Alarm Description

The specific alarm errors and proposals are shown in the table below.

Table 6-1 Alarm Description

Alarm/Fault		Root Cause	Solution
DM Code Unrecognized (Ground)		Non-critical DM code points not detected during movement.	Replace the DM code (treated as a warning only).
Collision Detected		Device bumper triggered.	Manual intervention to resolve the collision.
DM Code Anomaly (Ground)		- DM code angle incorrect. - DM code blurry (low recognition confidence).	Replace the DM code manually.
AMR System Fault	Obstacle Detected	Obstacle detected in the obstacle avoidance area.	Remove obstacles
	Motor Fault	- Self-test failure (left/right wheels, lifting, rotation). - Drive status timeout (5+ mins) or control link failure.	- Restart the AMR. - Replace faulty components.
	LIDAR Fault	- No navigation LIDAR point cloud data. - LIDAR network disconnected. - LIDAR driver error.	- Restart the AMR. - Reflash LIDAR firmware. - Check network cables. - Replace components.
	CAN Fault	-	- Restart the AMR. - Inspect components.
	MCU Fault	- No data from microcontroller. - Microcontroller version reported as "0".	- Update microcontroller firmware. - Inspect wiring connections.
	DMCAMERA Fault	- Camera disconnected. - No video bit stream. - Encryption/license error. - Frame loss mode active. - Uncalibrated camera.	- Check network. - Renew license. - Disable frame loss mode. - Recalibrate camera.
AMR IMU Failure		-	Replace the IMU.
Emergency Brake		Obstacle detected in the emergency stop area.	Remove obstacles
Emergency Stop Activated		Emergency stop button pressed.	Release the emergency stop button.
Device derailment		- Critical DM code unrecognized. - Position deviation >10 cm or 10°.	- Replace DM Code - Check construction alignment.
Upgrade failed		- Update file download failed. - File verification failed.	- Replace Update Package - Retry the update.

Alarm/Fault		Root Cause	Solution
LIDAR Contamination		Dirty LIDAR surface.	Clean the LIDAR surface.
AMR Slippage		Slippage detected during movement.	Check ground friction coefficient (ensure compliance with specifications).
AMR Track Entry Fault		AMR not at a valid position or unsafe environment.	Move the AMR to another valid position.
AMR Camera Fault		-	-
Rack Anomaly		• Rack DM code unrecognized. • Rack misaligned.	• Check DM code placement. • Remove reflective film. • Adjust rack-camera distance.



NOTE

- After manual intervention, press the “Confirm Button” to finalize the operation.
- Ensure the AMR is stationary on a DM code when confirming, or the intervention cannot be completed.

Chapter Seven Inspection and Maintenance

The safe and long-term use of AMR device depends on meticulous maintenance. Neglecting maintenance may endanger personnel and damage property. Always perform routine checks, address anomalies promptly, and avoid using faulty AMRs to ensure safety and extend service life.



NOTE

Only trained personnel should perform inspections and maintenance.

7.1 Safety Guidelines for Maintenance

- Keep the work area clean. Oil, grease, or water can compromise safety, accuracy, and performance.
- Remove jewelry (rings, watches, etc.) to prevent short circuits or burns.
- Clear obstacles before startup to avoid collisions.
- Listen for unusual noises during operation. Address issues immediately; never ignore warnings while the AMR is running.
- Power off the AMR when not in use for extended periods.
- Recharge if the battery is depleted due to prolonged inactivity.

7.2 Safety Inspection

Perform these checks after system restarts or at least every 24 hours for continuous operation:

- Inspect emergency stop buttons for functionality.
- Test obstacle avoidance sensors and safety edges.
- Verify the condition and functionality of bumpers by pressing each of the four contact points (front, rear, left, and right).
- Verify warning lights/indicators and alarm sounds.
- Confirm motor brake functionality (AMR should not move when powered off).
- Check lifting unit stability and operation.



NOTE

Perform functional checks only when the AMR is stationary.

7.3 Daily Inspection

General Maintenance:

- Clean the AMR surface; ensure camera lenses are scratch-free and code-reading functions work.
- Verify indicator lights, control panel, and emergency stop/power buttons.
- Test LIDAR, obstacle sensors, and audible alarms.

7.4 Monthly Inspection

General Maintenance:

- Ensure lifting mechanism operates smoothly (no misalignment or incomplete movements).
- Check for hydraulic oil leaks; replace oil if contaminated.
- Inspect walking alignment (no deviation).
- Tighten loose fasteners and connectors.
- Verify all safety components (E-stop, bumpers) operational.
- Test battery, charging, and wheels/casters for wear (replace when needed).

Table 7-1 Lifting Parameters

Component	Inspection items	Procedure & Troubleshooting
Lifting Structure	Lifting Platform Rotational Backlash	Manually rotate the lifting platform until resistance is felt, then measure the rotational backlash. If the backlash exceeds 2°, contact warranty support for replacement.
	Anti-slip pads	Replace if worn or detached.
	Upper/lower limit sensors	Verify sensor functionality.

7.5 Semi-Annual Maintenance

General Maintenance:

- Lubrication Check: Inspect shock absorbers on drive wheels and linear bearings.
- Fastener Tightness: Verify all fasteners are secure and calibrate with a torque wrench as required.
- Drive Wheel Inspection:
 - Ensure wheels rotate smoothly.
 - Check for wear; replace if necessary.
- Charging Dock Check:

- Inspect charging connectors for damage or deformation.
- Ensure the dock base is stable and undamaged.

Table 7-2 Semi-annual Inspection

Component	Inspection items	Procedure & Troubleshooting
Slewing Bearing and Lifting Mechanism	Gear Surface	Inspect gear surfaces for wear. Use a feeler gauge to measure clearance between the slewing bearing and gears. Theoretical clearance must not exceed 0.2 mm.
	Bolt pre-tightening force	Verify the pre-tightening force of slewing bearing bolts.
	Sealing Strips	Inspect sealing strips for damage or degradation.
	Cleaning	Thoroughly clean gear surfaces to eliminate wear debris, foreign particles, and residue.

7.6 Annual Maintenance

General Maintenance:

- Wear Inspection: Check drive wheels and casters; replace if worn.
- Lubrication: Reapply grease to drive components.
- Motor Checks:
 - Inspect pre-tightening force of fasteners.
 - Check connectors and cables for aging.
 - Charging Dock: Clean internal components; replace loose or faulty parts.

Table 7-3 Annual Inspection

Component	Inspection items	Procedure & Troubleshooting
Walking, lifting, rotating motor	Connector	Check for aging
	Wire	Check for aging and wear.
	Bolt pre-tightening force	Check the bolt pre-tightening force

Chapter Eight Transportation and Storage

8.1 Transportation Precautions

- AMR Packaging: Packed in palletized wooden crates and cartons.
- During transportation:
 - Do not tilt, invert, or expose to water.
 - Avoid collisions during lifting/loading.
 - Protect the exterior during unpacking.
- Charging Dock Packaging:
 - Packed in wooden crates and cartons.
 - Follow the same precautions as AMR transportation.
- General Guidelines: Use all designated lifting points.
- Ensure lifting equipment has sufficient load capacity.

8.2 Transportation Methods

The AMR is shipped in palletized wooden crates and cartons. During transportation:

- Do not tilt, invert, or expose to water.
- Avoid collisions during lifting/loading.
- Protect the exterior during unpacking.

8.3 Storage Guidelines

If the AMR is idle for over 2 months, store it in a dry, frost-free, ventilated, and dust-free area.

Follow these steps:

1. Clean Thoroughly: Remove dust and debris from all surfaces.
2. Test Lifting Mechanism:
 - Fully raise and lower the platform multiple times to ensure functionality.
 - Leave the platform in the lowest position.
3. Elevate Drive Wheels: Use wooden blocks to lift the AMR, ensuring drive wheels are off the ground.
4. Anti-Corrosion Protection: Apply a thin layer of oil or grease to exposed mechanical parts.
5. Battery Maintenance:

- Fully charge the battery before storage.
 - Recharge every 2–3 months to prevent depletion.
6. Electrical Contact Care: Spray all electrical contacts with a suitable anti-corrosion agent.

Appendix One Obstacle Avoidance Instructions

The robot's laser obstacle avoidance sensors detect obstacles within 400cm. Obstacle avoidance areas can be configured as deceleration zones and emergency stop zones:

- Deceleration Area (default: 180cm): The AMR slows down when obstacles enter this range.
- Emergency Stop Area (default: 50cm): The AMR stops immediately if obstacles enter this range.

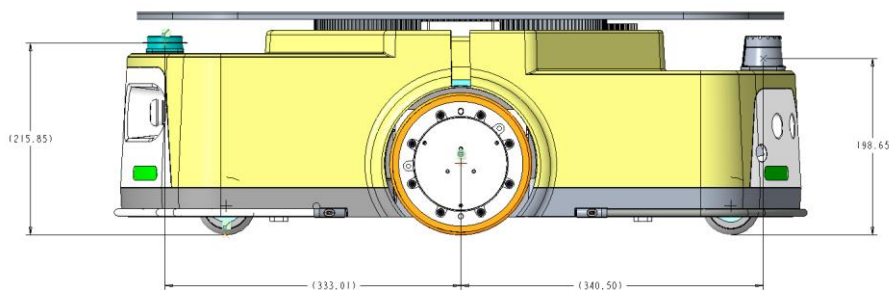
The TOF camera detects obstacles within 30 cm to 400cm, covering a 72° horizontal and 50° vertical field of view. It follows the same deceleration and emergency stop area (default: 50cm) logic as the laser sensors.



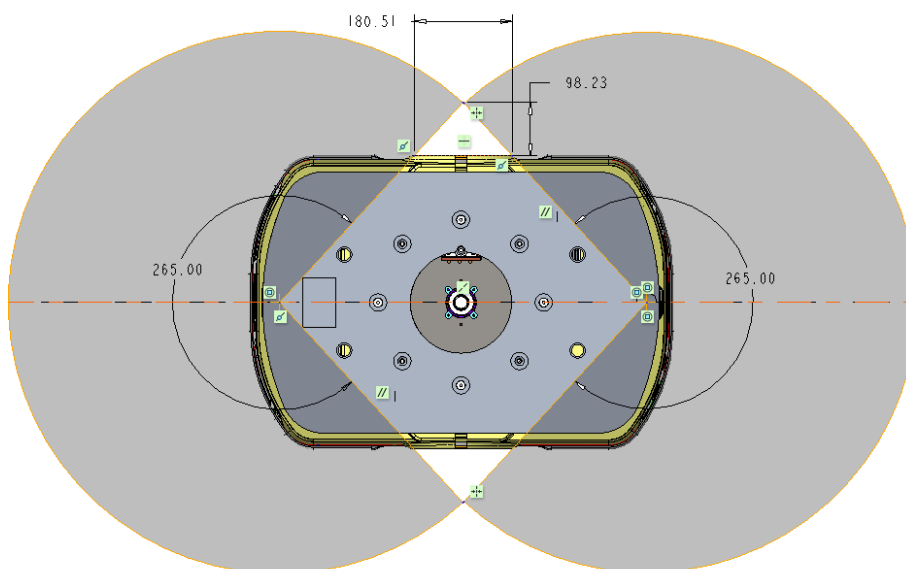
NOTE

- Adjust obstacle avoidance areas based on the actual operating environment.
- Sensor configurations vary by AMR model.
- Strictly prohibit obstacle avoidance testing on AMRs with incomplete or unverified configurations.

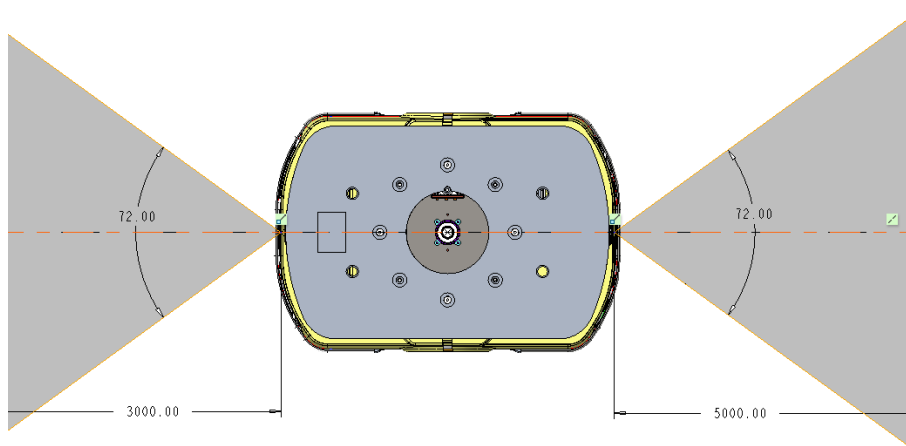
Appendix Figure 1-1 Obstacle Avoidance Diagram



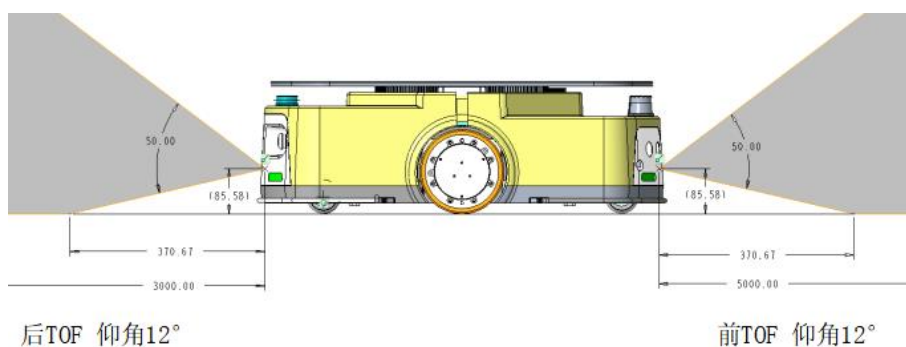
Appendix Figure 1-2 Obstacle Avoidance Diagram



Appendix Figure 1-3 Obstacle Avoidance Diagram



Appendix Figure 1-4 Obstacle Avoidance Diagram



Appendix Two Waste Disposal Guidelines

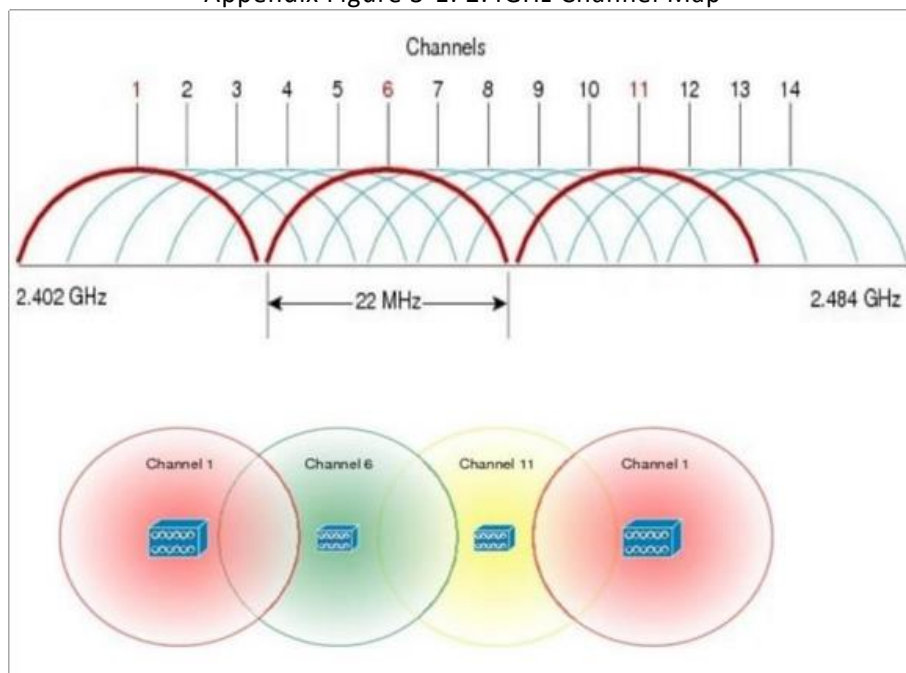
- **Battery Leakage:**
 - If battery materials leak, evacuate the area immediately until fumes dissipate.
 - Ventilate the space to disperse hazardous gases.
 - Clean the spill with absorbent material, collect the leaked residue in a sealed plastic bag, and place it in a steel container.
 - Avoid skin/eye contact and inhalation of fumes.
- **Prohibited Actions:**
 - Open, damage, or incinerate batteries (risk of explosion, rupture, or leakage).
 - Short-circuit, overcharge, force-discharge, or expose batteries to fire.
 - Crush, puncture, or immerse batteries in liquids.
- **Safe Disposal:**
 - Fully discharge lithium-metal batteries to neutralize internal lithium content.
 - Transfer all batteries to certified recycling facilities for professional handling.

Appendix Three Wireless Network Requirements

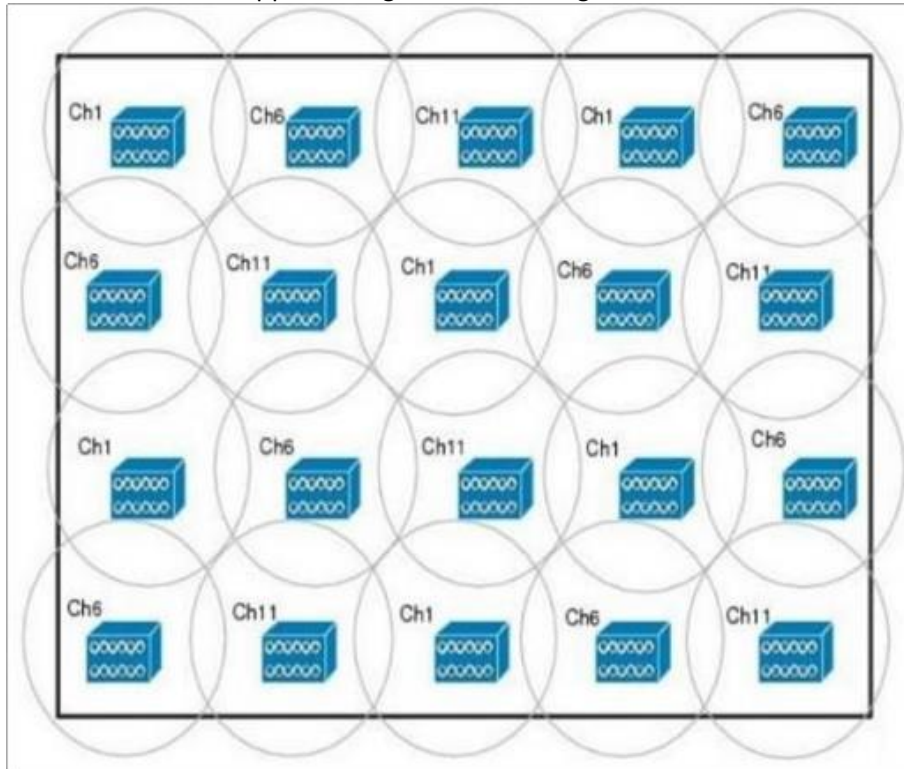
Appendix 3.1 Wireless AP Placement Guidelines

- Installation: Mount APs ceiling-mounted or wall-mounted (tilted 7–9° for wall mounting, height 3–5 meters).
- AP Quantity:
 - Avoid over-deployment (causes interference).
 - Coverage Reference:
 - ◆ Metal rack environments: 15m radius per AP (20dBm transmit power).
 - ◆ Non-rack environments: 20m radius per AP.
- AP Types: Select omnidirectional or directional APs based on coverage needs.
- Channel Configuration:
 - 2.4GHz: Use channels 1, 6, 11.
 - 5.8GHz: Use channels 149, 153, 157, 161, 165.
 - Ensure adjacent APs use non-overlapping channels.

Appendix Figure 3-1: 2.4GHz Channel Map

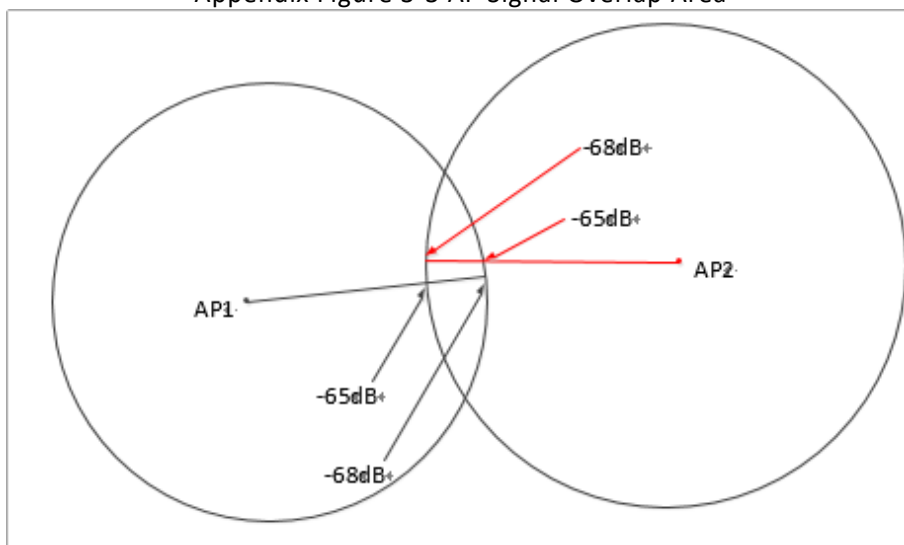


Appendix Figure 3-2 Coverage Areas



- Signal Penetration:
 - Wireless signals degrade through walls.
 - Deploy additional APs near firewalls or thick barriers (e.g., near firewall doors).
- AP Overlap Area:
 - Ensure -65dB signal overlap between adjacent APs for seamless roaming.
 - Key factors: STA roaming strategy, AP-STA matching thresholds, STA speed, and AP/AC handoff time.

Appendix Figure 3-3 AP Signal Overlap Area



Appendix 3.2 Wireless Network Configuration

- Dedicated Band:
 - Assign robots exclusive 2.4GHz or 5.8GHz bands for industrial use.
 - Use MAC address binding to ensure IP uniqueness and prevent unauthorized access.
- AP Settings:
 - Disable smart antennas and auto-adjust features.
 - Fix transmit power and channels for predictable signal distribution.
- Channel Bandwidth: Configure 20MHz bandwidth for both 2.4GHz and 5.8GHz bands.

Appendix 3.3 Network Signal Strength Requirements

- Core Areas (e.g., loading areas, queues): Signal $\geq -55\text{dB}$, ping 1500-byte packets with latency $<100\text{ms}$.
- Non-Core Areas (e.g., warehouse edges): Signal between -68dB and -65dB , ping latency $<200\text{ms}$.
- Edge Areas: Signal $\geq -65\text{dB}$, ping 1500Byte packets latency $<200\text{ms}$.



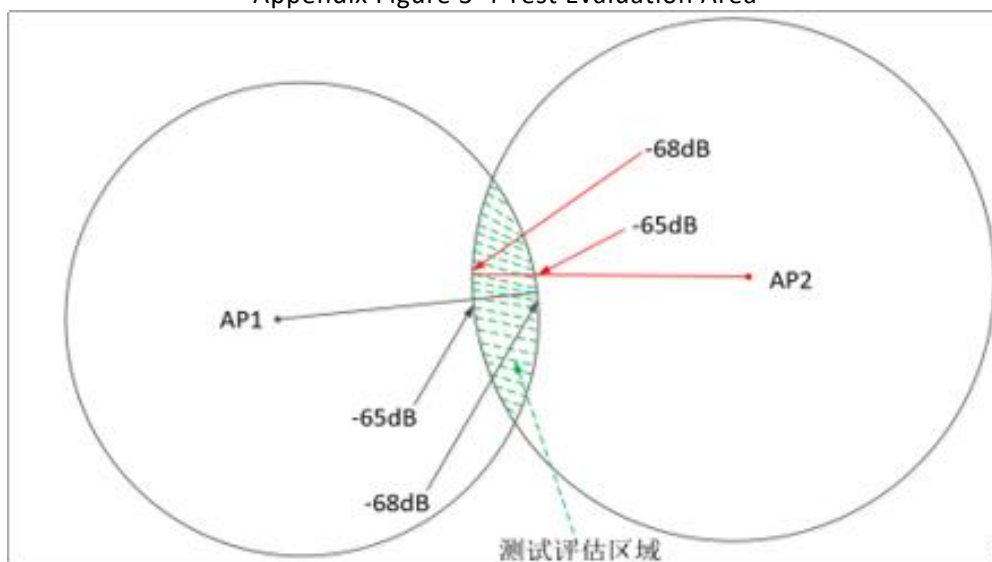
NOTE

Testing Protocol: Signal strength shall be verified through actual testing using the robot's onboard Wi-Fi module.

Roaming Test:

- At -65dB signal strength, move the robot at 800 mm/s .
- Ping 1500-byte packets: latency $<200\text{ms}$, uplink/downlink $\geq 2\text{Mbps}$.
- Handoff Requirements:
 - Packet loss <2 packets per roam.
 - Switch time $<100\text{ms}$.
- Recommended: Dual-AC redundancy for network stability.

Appendix Figure 3-4 Test Evaluation Area



Appendix Four Safety Commitments and Recommendations

The product adheres to the principles of minimal necessary data acquisition and minimal service, strictly prohibits the implantation of backdoors, removes unnecessary and insecure services (such as Telnet), and continuously introduces innovative security technologies to enhance and improve the product's security capabilities.

The security of software platforms requires not only the continuous attention and efforts of manufacturers during the research, development, production, and delivery phases, but also the active participation of users. Users should consistently focus on and improve the consumption environment and methods of the platform to better ensure the secure operation of the software platform after it is put into use. Therefore, it is recommended that users consume the software platform securely, including but not limited to:

Account Management

- The length must be no less than 8 characters.
- At least two types of characters must be included, with character types comprising uppercase and lowercase letters, numbers, and symbols.
- Does not include the account name or the reverse order of the account name.
- Do not use consecutive characters, such as 123, abc, etc.
- Do not use overlapping characters, such as 111, aaa, etc.

1. Regularly modify the password.

It is recommended that you regularly modify your account password to reduce the risk of it being guessed or cracked.

2. Reasonably allocate accounts and permissions.

According to business and management needs, reasonably add new accounts and allocate the minimum permission set for them.

3. Enable Account Lockout

The factory default setting enables the account lockout feature. It is recommended to keep this feature activated to ensure account security. After multiple failed attempts for password by an attacker, the corresponding account and source IP will be locked out.

4. Timely set and update password reset information.

The software platform supports the password reset feature. To mitigate the risk of this feature being exploited by attackers, please promptly set the relevant information for password reset. If there are any changes to the information, please modify it in a timely manner. When setting security questions, it is not advisable to use easily guessable answers, and to provide different

answers for different security questions.

5. Enable account binding IP/MAC

To further enhance security, it is recommended that you bind your account to the IP/MAC of the terminal of the commonly used client side.

Service Configuration

1. Enable HTTPS

It is recommended that you enable HTTPS for secure access to the Channel Access WEB service.

2. Shut down non-essential services, enable a secure mode.

If not needed, it is recommended to shut down functions such as SSH and SMTP to reduce the attack risks. If necessary, it is strongly advised to adopt a secure mode, including but not limited to:

- SMTP: Choose the TLS method to connect to the email server.
- FTP: Select SFTP and set a complex password.

Network Configuration

1. Configure the firewall white-list.

It is recommended that you configure the firewall white-list feature to only permit access from the IP addresses listed in the white-list. Therefore, please ensure that both your computer's IP address and the corresponding software platform's IP address are included in the list.

2. Network segmentation/Isolation

It is recommended that you separate the video surveillance network and the office network into different Virtual Local Area Networks (VLANs) on the Switch and Router, achieving the goal of isolating the two networks to prevent attackers from using the office network as a springboard to attack the video surveillance network.

Security Audit

1. View online user

It is recommended that you periodically check the online user to identify if there are any unauthorized users.

2. Check the platform logs.

By examining the logs, you can obtain the IP information of the attempts to log into the software platform, as well as the operational details of the logged-in users.

Physical Protection

It is recommended that you implement physical protection for the software platform, such as placing it in a dedicated server room or cabinet, and ensuring proper access control and key

management to prevent unauthorized personnel from engaging in destructive physical interactions with the hardware.

Boundary Security Configuration

It is recommended that you deploy security protection at the boundaries of the software platform, implementing necessary measures such as authorized access, access control, and intrusion prevention to ensure the internal security of the software platform.

Appendix 5 Revision Records

Appendix Table 5-1 Revision Record

Version Number	Revised Content	Publication Date
V1.0.0	First Publication	2024.11