

400KG Latent Lifting AMR-CE

User Manual



Company: Zhejiang HuaRay Technology Co., Ltd.

Address: 1-401, No. 590 Changhe Road, Binjiang, Hangzhou, Zhejiang, P.R. China

Model: RTA-C040-LQ-2L2T-EC

original version V1.0.0

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 1175:2020
EN ISO 3691-4:2023
EN ISO 13849-4:2023

Product name: Automated Guided Vehicle

Product model: RTA-C040-LQ-2L2T-EC

Serial number:

Trade mark: **iRAYPLE**

Name and address of the person authorized to compile the technical file:

Name: Dahua Technology Netherlands B.V.

Address: Louis Braillelaan 80, 2719 EK Zoetermeer The Netherlands

Responsible for making this declaration is the

Manufacturer



Authorized representative established within the EU



2025-01-14

Hangzhou,
China

Product Director

Yinchunhui
Liuxin

Issue date and
place

Name and
position

Signature and
company
stamp

EU Conformity Statement



This product is marked with "CE" and comply therefore with the applicable harmonized

European standards listed under the Radio Equipment Directive 2014/53/EU.

RF Exposure Information

This device has been tested and meets applicable limits for Radio Frequency (RF) exposure.

Preface

This document provides a detailed description of the product's installation, functions, and configuration. Please read it carefully before consuming the product, and after reading, please save the document properly for future reference.

Symbol Convention

The following symbols may appear in this document:

Table 1 Symbol Instructions

Symbols	Instructions
 DANGER	Indicates a high potential hazard. Failure to avoid may result in severe injury or death.
 CAUTION	Indicates potential risks. Ignoring these instructions may lead to equipment damage, data loss, performance degradation, or unexpected results.
 TIPS	Indicates helpful content to resolve issues or save time.
 NOTE	Indicates supplementary information or emphasis on the main text.

Revision Record

Table 2 Revision Record

Version Number	Revised Content	Publication Date
V1.0.0	Initial release.	2025.5

Safety Instructions

To prevent hazards and property damage, please read and strictly adhere to the following guidelines when using the product.

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.
- Only trained or experienced personnel should perform operations.



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.



Recommendation: Use with a surge protector for enhanced lightning protection.

Operational Requirements



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.

Maintenance Requirements



WARNING

- 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 Product Safety Notice

1.1 Disclaimer

- HuaRay Technology shall not be held liable for any losses resulting from improper use. Users bear full responsibility.
- Even when all operations strictly follow safety guidelines, there is no guarantee the machine will not cause personal injury or property damage.
- HuaRay Technology assumes no responsibility for personal injury or property damage caused by substitute or modified components.

1.2 Reading Guidelines

- Read this manual thoroughly before operating the AMR.
- Unauthorized disassembly or reassembly of the AMR is prohibited.
- Heed all safety warnings in this user guide.
- Contact your distributor immediately if the AMR malfunctions.
- Stop and power off the AMR immediately if you detect unusual odors during operation.
- This user manual does not replace technical agreements.

警告 WARNING

Potential hazard that may cause death or severe injury. Read the following carefully to prevent fatal or serious harm.

注意安全 CAUTION

Potential situation that may cause minor or moderate injury. Alerts against unsafe practices. Read the following to prevent injury.

通知 NOTICE

Critical information, including scenarios that may damage equipment or property.

1.3 Foreseeable Misuse

警告 WARNING

Any use deviating from the AMR's intended purpose is considered misuse, including but not limited to:

- Transporting personnel or allowing riders.
- Outdoor operation.
- Use in environments with strong interference to navigation devices (e.g., electromagnetic fields).
- Operation in explosive environments (dust, flammable particles).
- Use in high-salt environments (marine climates).
- Deployment in extreme conditions (freezing warehouses, strong magnetic fields).
- Transporting flammable, explosive, or liquid items.
- Operation on uneven, obstructed, or stair-covered surfaces.
- Use on slopes.
- Exceeding the AMR's maximum payload capacity.
- Using the emergency stop button for non-emergency purposes.
- Modifying safety obstacle-avoidance configurations.

1.4 General Safety Precautions

警告 WARNING

Ensure the robot runs correct software (maps, tasks). Incorrect software may cause collisions with personnel/equipment.

警告 WARNING

Restrict access to hazardous operational areas.

 警告 WARNING

Wear safety shoes; the robot chassis (under 40mm clearance) may drive over feet.

 警告 WARNING

- Isolate areas where ladders/scaffolding are used; robots may collide, causing falls or damage.
- Mark restricted areas on maps (e.g., near stairs, floor openings) to prevent falls or damage.
- Keep updating maps.

 警告 WARNING

- The robot may drive into stairwells or floor openings, causing severe injuries or damage.
- Mark restricted areas on the map and keep it updated.

 警告 WARNING

Improperly secured or unbalanced loads may fall or tip the robot, injuring nearby personnel or damaging equipment.

 警告 WARNING

Unauthorized modifications may introduce unanticipated hazards, invalidating the original risk assessment.

 警告 WARNING

Robots may emit non-ionizing radiation, which could potentially harm certain special individuals, particularly those with implanted active or inactive medical devices.

 警告 WARNING

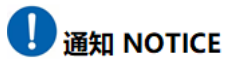
When operating in enclosed spaces, ensure all personnel stay clear of the robot's path.

 注意安全 CAUTION

The robot's noise level during normal operation is below 75DB. Wear noise-canceling earplugs if discomfort occurs.

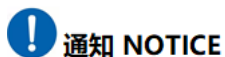
1.5 Operational Safety

1.5.1 Operating Environment Safety



- The ground must be flat, free of grooves, cracks, hollows, oil, adhesives, or other contaminants.
- Remove screws, rags, cables, or other debris that may entangle the wheels.
- Avoid excessively open areas (e.g., long corridors) beyond the robot's laser detection range.
- A fully loaded robot at low speed can only cross steps $\leq 10\text{mm}$ high.
- Maintain at least 100mm clearance on both sides when passing through narrow passages.
- Mark hazardous areas with warning signs to alert others of robot movement.

1.5.2 Pre-Operation Checks

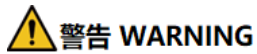


Before use, inspect the robot to ensure safety:

- Wheel fasteners are tightened.
- Power system is functional.
- Emergency stop works properly.
- Lifting mechanism is undamaged (no bends, cracks, or wear).
- Warning devices and contour lights are operational.
- Laser sensors function correctly.

- Battery is fully charged at least once per month.
- Battery level and charging function are normal.

1.5.3 Parking Safety



When stopping the robot:

- Power off and disconnect the battery.
- Do not park on slopes, near heat/flame sources, or in open pits, underground passages, elevator shafts, fire exits, or stairwells.
- In special cases, secure the robot with wedges or other measures.
- The maximum turning diameter for obstacle avoidance is 810mm—maintain clearance.

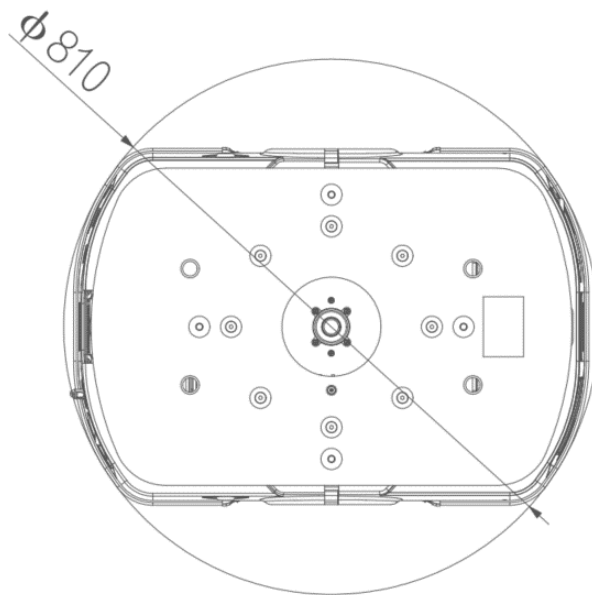
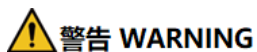


Figure 1-1

1.5.4 Battery Safety



Battery packs pose fire/explosion risks. Do not disassemble, crush, incinerate, heat, or expose to fire.

- Dispose of end-of-life batteries per local regulations.

- Charge batteries at 0°C–45°C. Extreme temperatures degrade performance.
- Avoid deep discharge; recharge promptly to prevent irreversible damage.
- Prevent overcharging, over-discharging, reverse polarity, or short circuits.
- Store batteries in dry, ventilated areas at $\leq 40^{\circ}\text{C}$ and $\leq 80\%$ humidity (ideal: $-10^{\circ}\text{C} - 25^{\circ}\text{C}$).
- Perform a full charge-discharge cycle every 3 months for maintenance (0.2C per cycle).
- For stored batteries, recharge every 6 months at 50% capacity (0.2C per cycle).
- Stop use if the battery emits odor, overheats, or leaks. Contact the manufacturer.
- Do not discard expired batteries—recycle properly.
- The battery pack should be used according to the technical specifications specified in the technical agreement or specification sheet.
- Use only approved chargers. Mismatched chargers may cause damage or hazards.
- Never charge via the discharge port or discharge via the charge port.
- Supervise charging to detect voltage errors or misuse.
- Avoid drops, impacts, or piercing the battery.
- Do not disassemble or modify the battery.
- Keep away from heat, sparks, liquids, or high humidity.
- If leakage occurs, avoid contact; rinse skin/clothing with water

immediately.

- Avoid electrostatic environments.

1.6 Warning Labels

The AMR has multiple warning labels prohibiting riding or inserting hands into lifting mechanisms.



Figure 1-2 Mind Your Hands



Figure 1-3 Do Not Step



Figure 1-4 RIDING ON THIS TRUCK IS PROHIBITED

1.7 Residual Risk

Despite inherent safety designs and protective measures, residual risks remain. Users must be informed and take precautions:

- Standing in the robot's path or moving toward it risks being run over, trapped, or struck.
- Touching a moving robot may result in crushing, entrapment, or collision.
- Localization errors may cause the robot to place loads outside designated areas, risking crushing or trapping.

Chapter Two Product Introduction

2.1 Product Overview

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 high order error rates. It is a key component of intelligent logistics and smart factory solutions, integrating with AMR, RCS (Robot Control System), and WMS (Warehouse Management System). It is widely applicable in industries including e-commerce sorting centers, 3C manufacturing, traditional manufacturing, healthcare, food, and automotive production. Applicable industries include e-commerce sorting centers, 3C manufacturing, traditional manufacturing, healthcare, food, and automotive manufacturing.

2.2 Key Features

- Compact design: Rotation diameter: 810mm; fits racks with width $\geq$ 540mm, height $\geq$ 250mm (industry-leading).
- High precision: Unloaded speed: 1.5m/s; acceleration: 0.7m/s²; lifting load positioning accuracy: $\pm$ 10mm (static/motion); achieves 5mm docking precision in specific scenarios (speed varies by model).
- Flexible navigation: Supports laser/DM code/texture navigation and hybrid navigation.
- 360° omnidirectional obstacle avoidance in designated scenarios.
- Front TOF camera for 3D obstacle avoidance (FOV: 72° horizontal, 50° vertical; specifications vary by model).
- Data-based obstacle avoidance: Smooth deceleration and stopping upon detecting obstacles.
- Autonomous charging.
- Customizable accessories: Square pallets, round pallets, pallet pins, and limit feet enhance stability during operation.

2.3 Product Dimension and Appearance

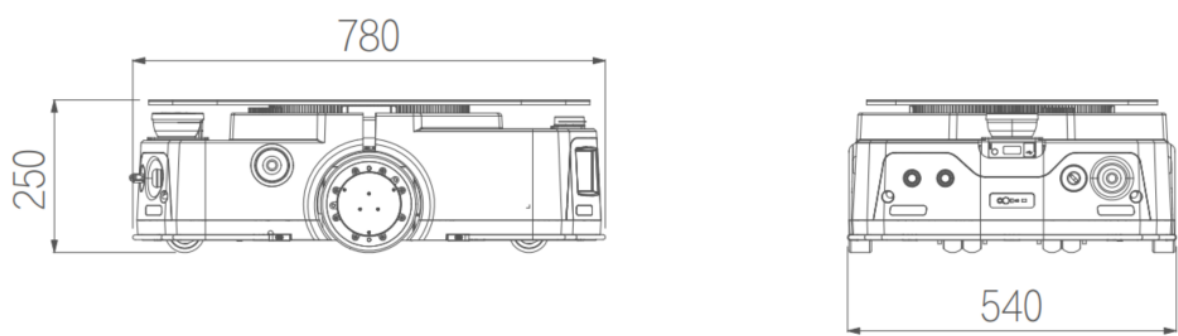


Figure 2-1 Device Dimensioned Drawing (Unit: mm)



Figure 2-2 Product Appearance

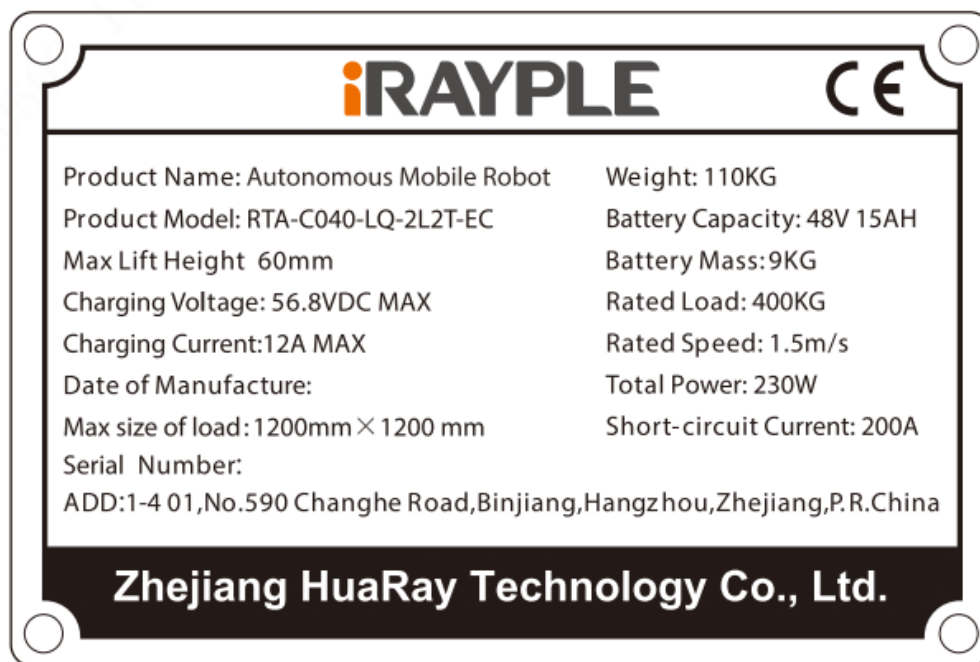


Figure 2-3 Product Nameplate

2.4 Control Panel

Figure 2-3 Front Control Panel Diagram

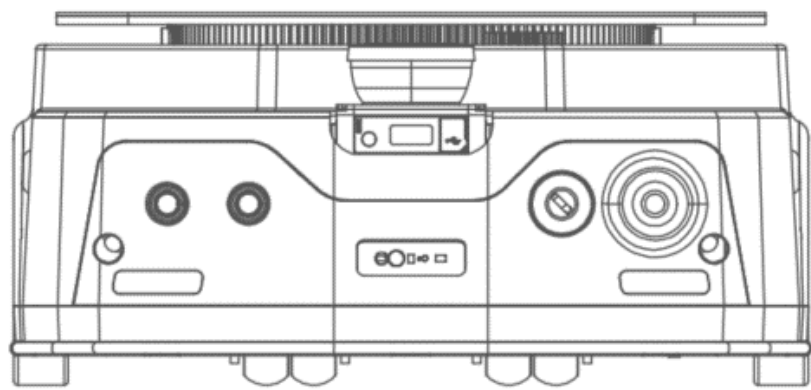
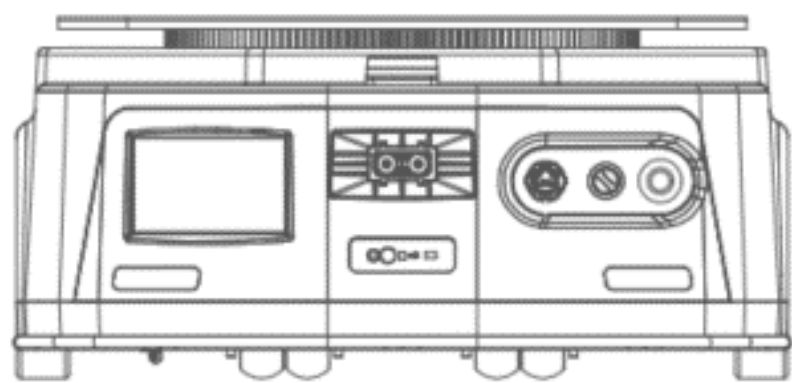


Figure 2-4 Rear Control Panel Diagram



EMERGENCY STOP:

- Five emergency stop buttons located around the robot (front, rear, left, right).
- Pressing any button cuts motor power via internal safety contactors and activates brakes.
- Status: **Red indicator lights** when stopped. Robot cannot move until resumed.
- Recovery: Release the button, then press RESUME to restore operation (**green lights**).



注意安全 CAUTION

Do not use frequently. Overuse may cause failure during emergencies, risking injury.

POWER:

- ON: Powers up the robot. Voice prompt: "Press RESUME to enter automatic task mode."
- OFF: Shuts down.
- Idle status: Without pressing RESUME, the robot remains in protective stop.



通知 NOTICE

Remove and store the key when not in use.

RESUME Button

Required to resume operation after:

- Initial power-on/reboot

- Emergency stop release
- Manual/auto mode switch
- Safety laser-triggered stop

AUTO/MANUAL Switch

- AUTO: Automatic task mode.
- MANUAL:
- Front panel: Manually push the robot.
- Rear panel: Control via APP or remote.



注意安全 CAUTION

In manual mode, the robot stops only near obstacles. Operate carefully to avoid collisions.

- OFF BRAKE: Releases the motor brake using an external 24V DC power supply when the robot cannot power on.
- USB/LAN: Debugging interface.
- CHARGING Port: For manual charging (use manufacturer-provided charger only).



注意安全 CAUTION

Only use original HuaRay chargers for automatic/manual charging. Non-compliant chargers may cause fires, injury, or damage.

2.5 Status Indicator Lights

LED strips indicate robot status:

Color	Status
Green	Executing tasks
Red	Emergency stop/Bumper triggered/Error
Blue	Updating/Protective stop
Yellow	Idle/Waiting for tasks

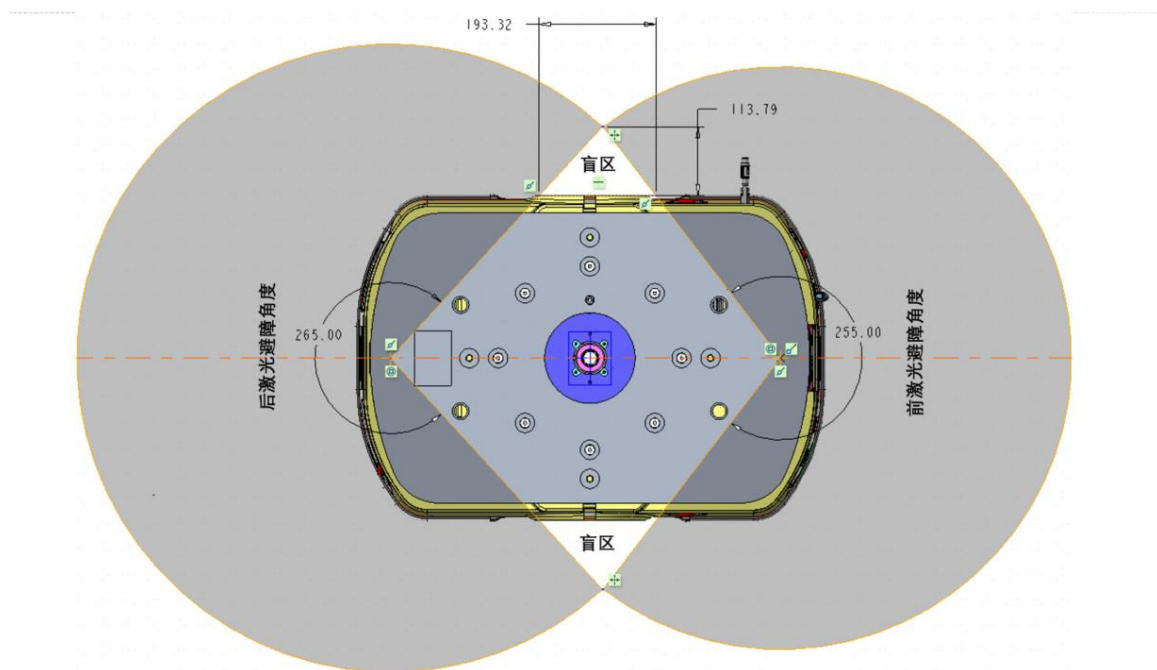
2.6 Obstacle Detection

AMRs continuously detect obstacles using three sensors:

- Safety Laser Scanner
- Standard Laser Scanner
- TOF Camera

2.6.1 Safety Laser Scanner

- Front-mounted;
- 270° FOV;
- Continuously monitors the surroundings to detect objects.



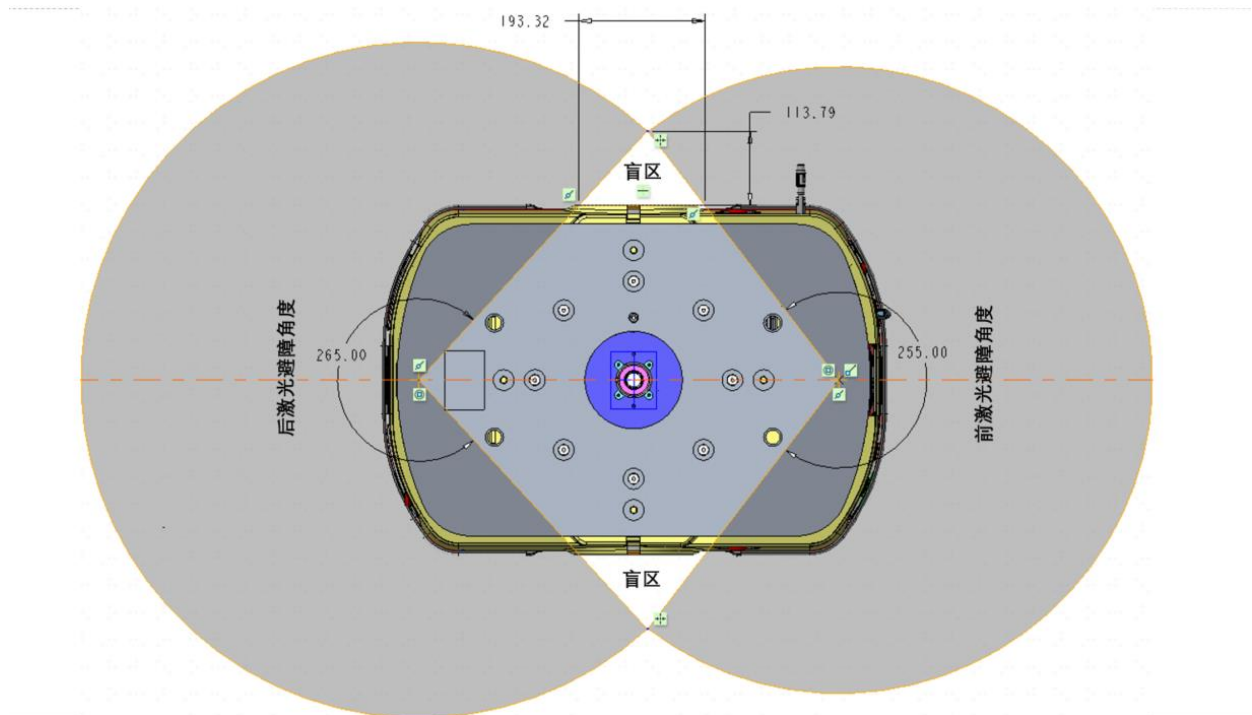
! 通知 NOTICE

Limitations:

- Detects only objects intersecting a 200mm-high plane above the floor.
- Struggles with transparent obstacles.
- Inaccurate data on reflective surfaces.

2.6.2 Standard Laser Scanner

- Rear-mounted;
- 240° FOV;
- Continuously monitors the surroundings to detect objects.

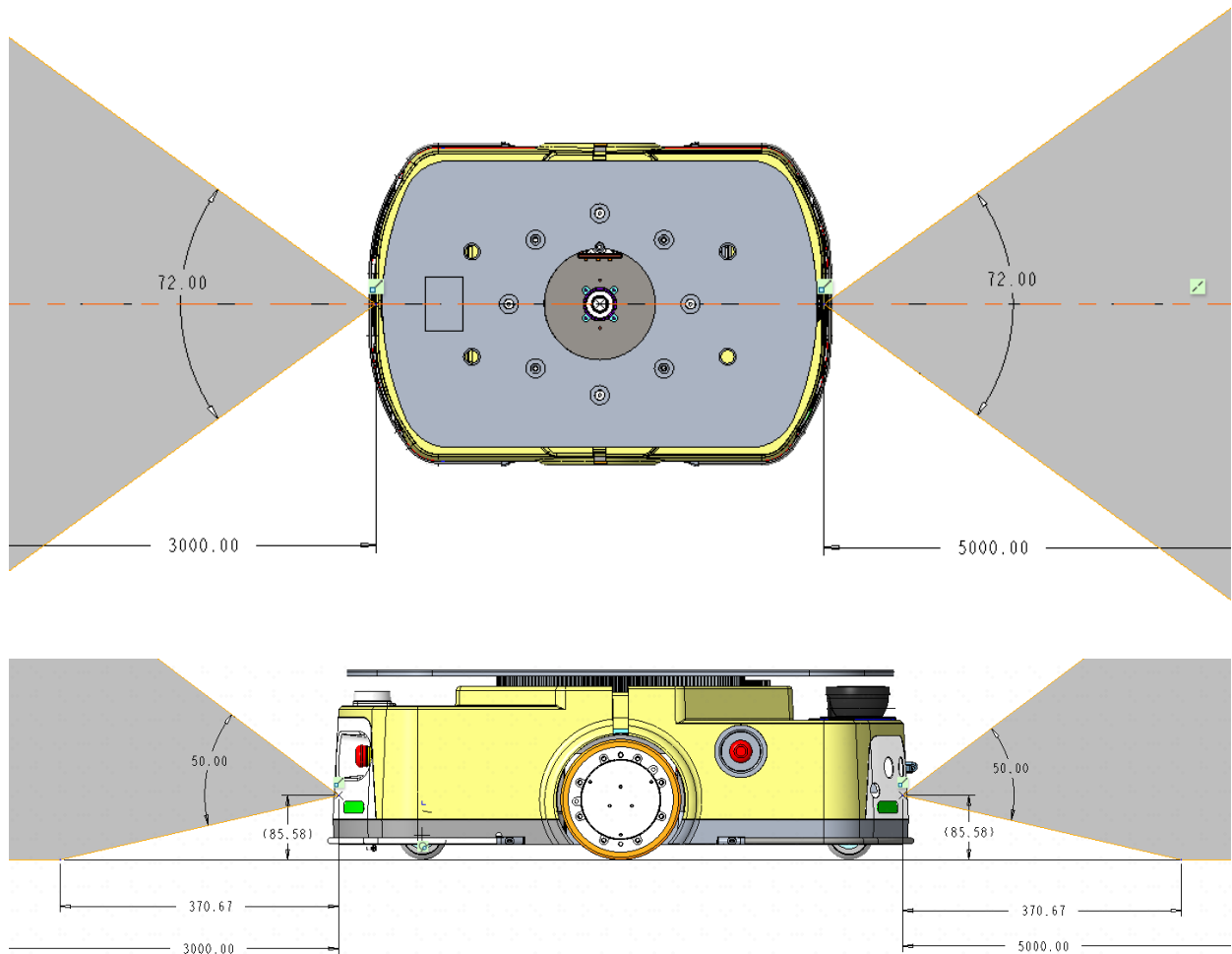


! 警告 WARNING

- Not for safety-critical personnel detection. Reliance on 3D camera and rear-obstacle avoidance laser may cause collisions.

2.6.3 TOF Camera

Front/rear cameras detect objects within 300mm–3m range (50° vertical, 70° horizontal FOV).



警告 WARNING

- **Not for safety-critical personnel detection. Reliance on 3D camera and rear-obstacle avoidance laser may cause collisions.**

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

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 m^2 radius of each charging pile.

 警告 WARNING

- Obstacle Detection Limitations

Although the 3D cameras and rear obstacle-avoidance laser can detect obstacles, they must not be relied upon for safety-critical functions or personnel detection. Relying solely on these sensors may result in collisions with personnel, causing injury.

- Charging Area Hazards
- During the final docking phase (within 1 meter of the charging station), the robot moves backward at speeds $< 0.3\text{ m/s}$.
- Personnel must keep clear during docking.

- Approaching the robot in this phase risks collision and injury.
 - Charging Area Requirements
- The robot charging area must be designated a restricted access area. At all times, maintain:
- Escape routes ≥ 0.5 meters wide and ≥ 2.1 meters high on all sides of the robot.

Chapter Five Touchscreen Operation Manual

The touchscreen displays real-time robot status, task information, alerts, obstacle avoidance data, and map configuration.

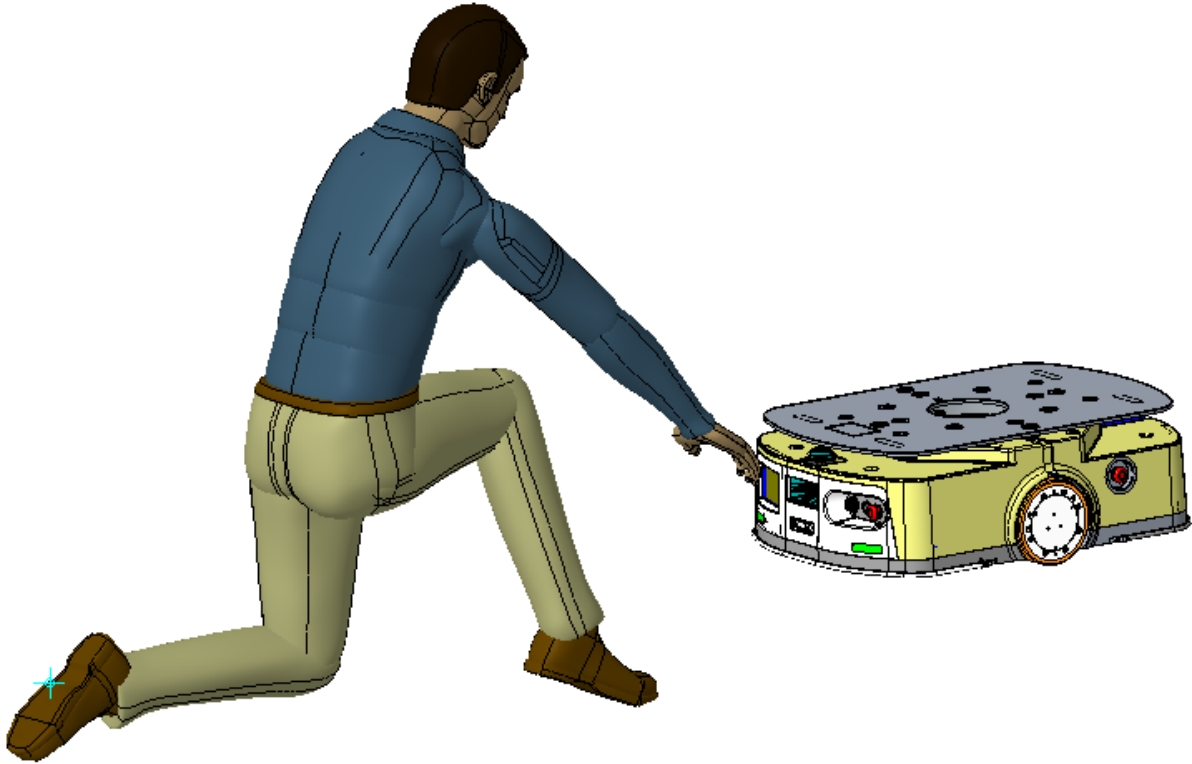


Figure 5-1 Screen Location

5.1 Touchscreen

5.1.1 Home Screen

The home interface shows real-time task information in three sections:

- Status Bar: Home, Real-time Info, Operation Control, System Info, DM Code Camera Streaming.
- Top Bar: Time, Signal Strength, Battery Level, Manual/Auto Mode, Operation Status, Network Status.
- Bottom Bar: Device Address, Real-time Battery Level.

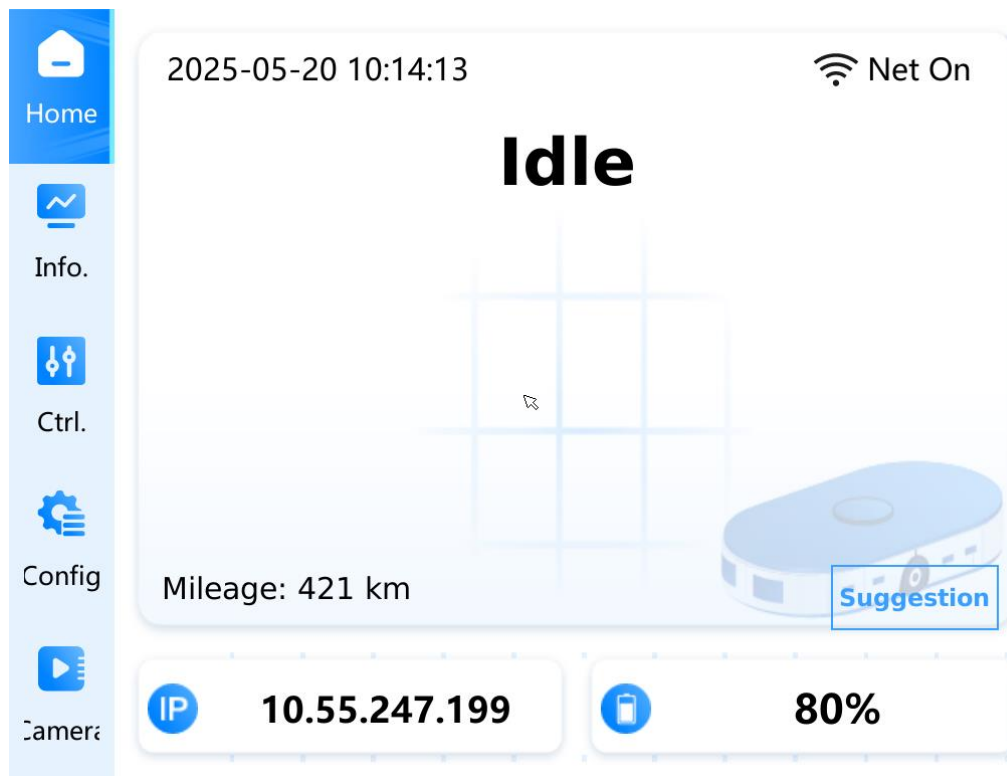


Figure 5-2 Home Interface

5.1.2 Real-time Information

View system status, platform tasks, and alerts, including:

- **Actuator Status**
- **Maintenance-Info Status**
- **Platform Alarm**
- **Recent Exception Display**
- **Safe Status**

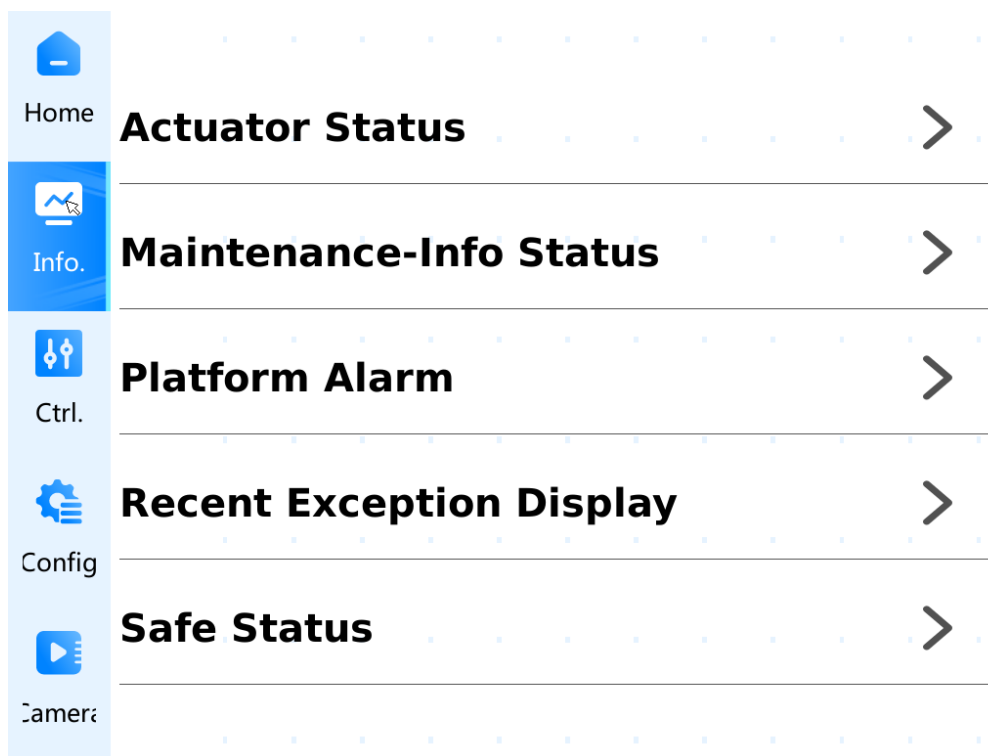


Figure 5-3 Real-time Info Interface

Actuator Status: Device Angle, Ground Code, Shelf Code, Rotate Null.

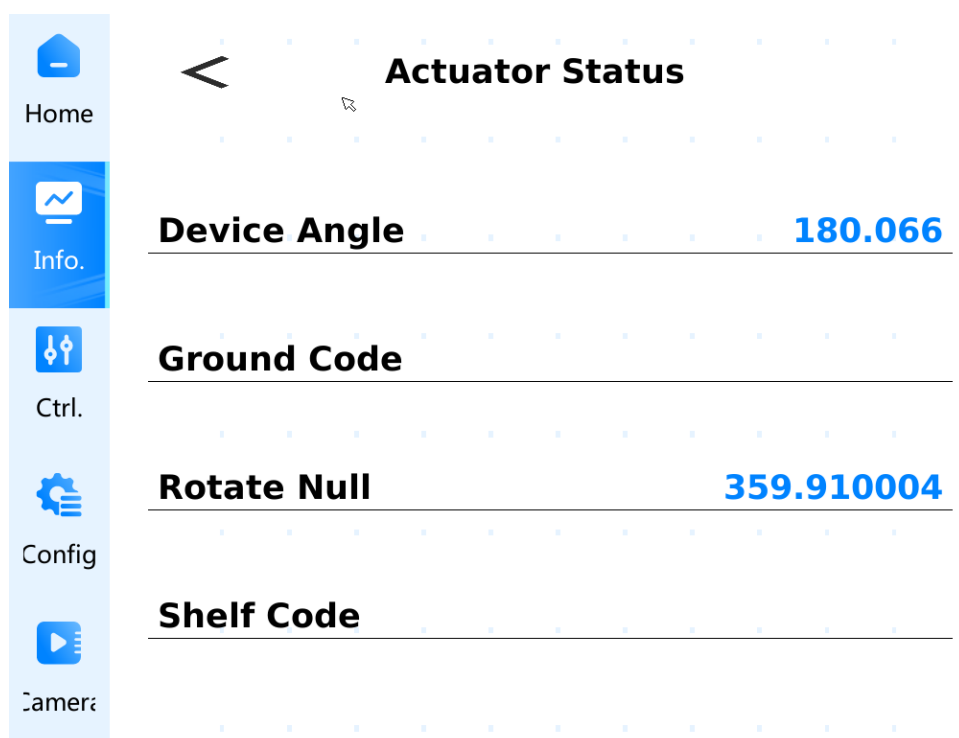


Figure 5-4 Actuator Status

Maintenance-Info Status: Charging Times, Lifting Times, Runtime.

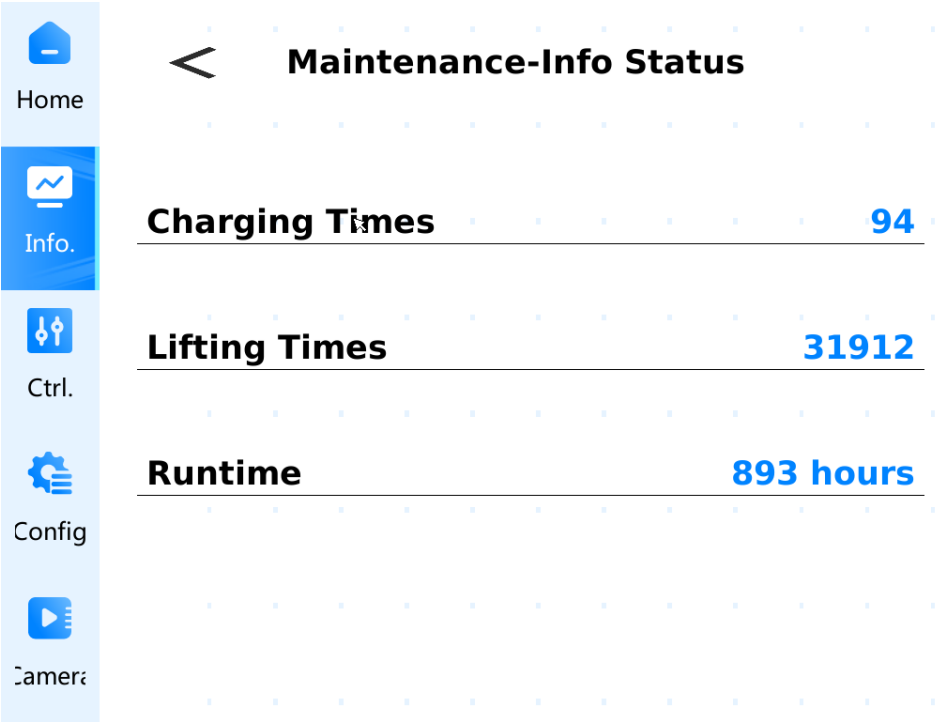


Figure 5-5 Maintenance Status

Recent Exception Display: View alerts and details within the last 24 hours.

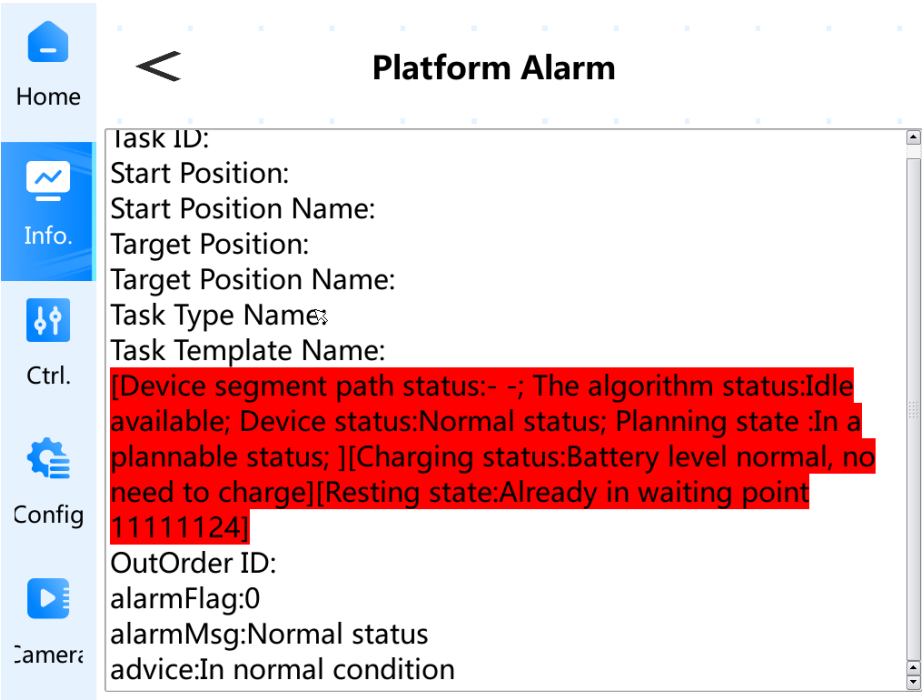


Figure 5-6-1 Platform Alarm

Home

Info.

Ctrl.

Config

Camera

<

t Exception D

Exception Typ

All abnormalities

Serial number	Exception Types	Exception time	ed descr
1	Disconnected from Platform	2025-05-19 19:35:11	Details
2	Disconnected from Platform	2025-05-19 19:35:11	Details
3	Network failure	2025-05-19 19:34:55	Details
4	Disconnected from Platform	2025-05-19 19:27:58	Details
5	Disconnected from Platform	2025-05-19 19:27:58	Details
6	Network failure	2025-05-19 19:27:41	Details
7	Disconnected from Platform	2025-05-19 18:50:12	Details

Previous page

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Figure 5-6-2 Device Alarm

5.1.3 Operation Control

Adjust lifting, lowering, rotation, and volume settings.

Home	Control AP	>
Info.	Lift Control	>
Ctrl.	Rotate Control	>
Config	Volume Control	>
Camera	Virtual Key	>

Figure 5-7 Operation Control

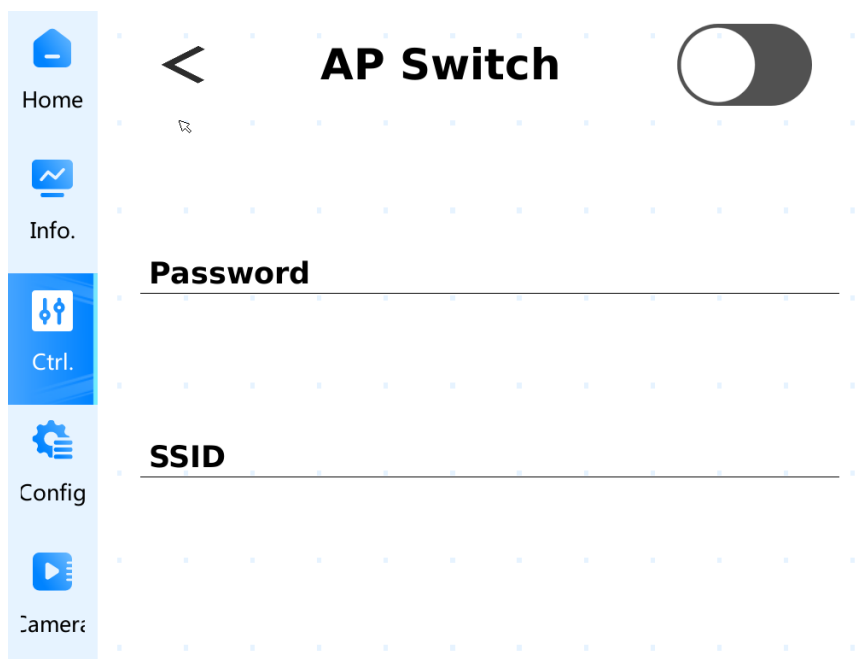


Figure 5-8 Chassis AP Configuration

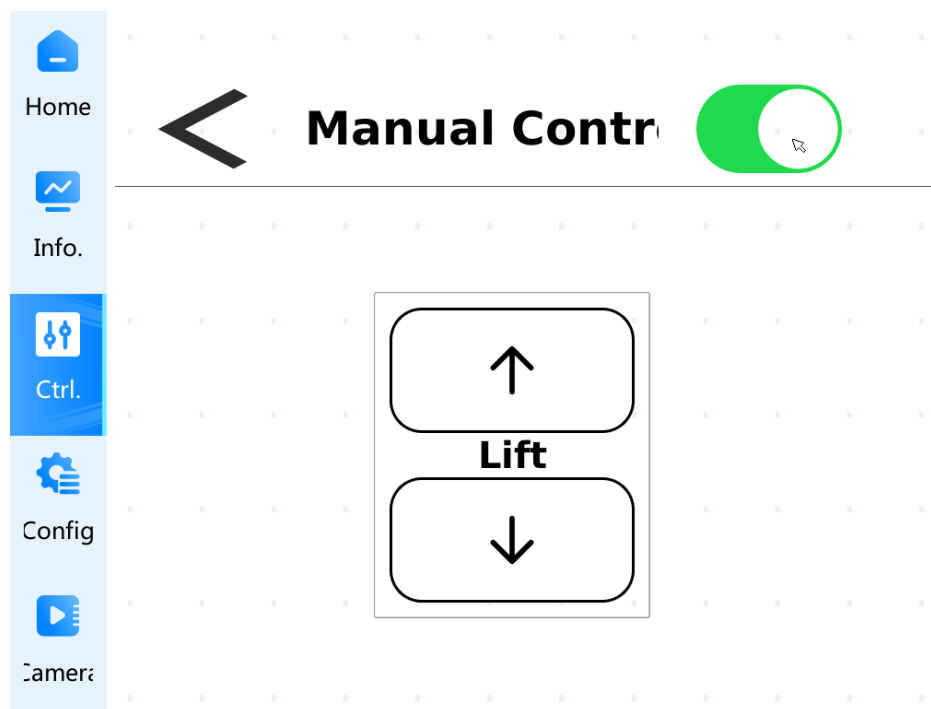


Figure 5-9 Pallet Lifting Control

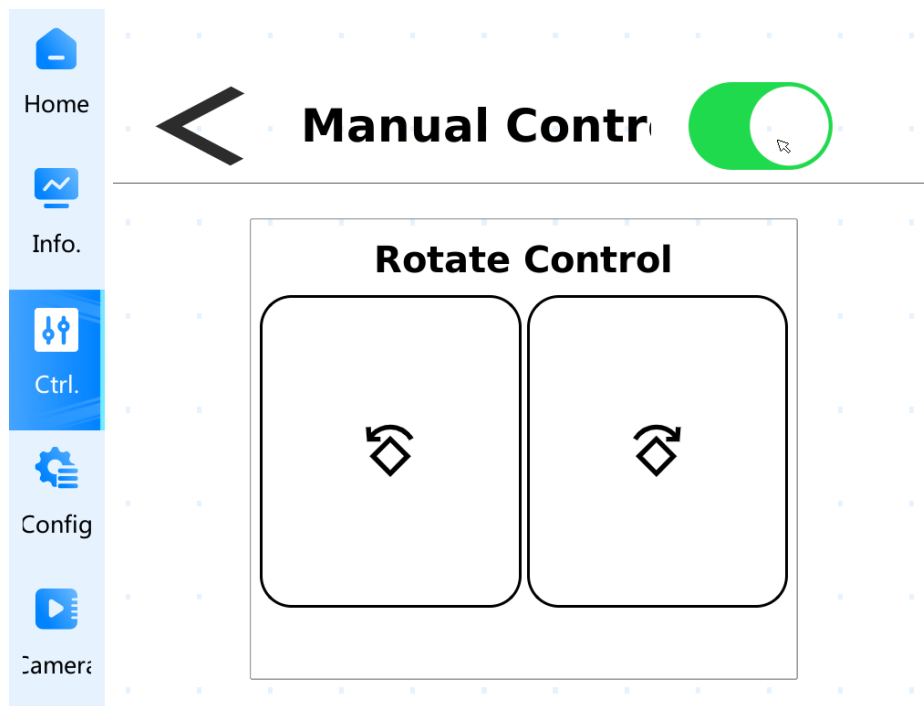


Figure 5-10 Pallet Rotation Control

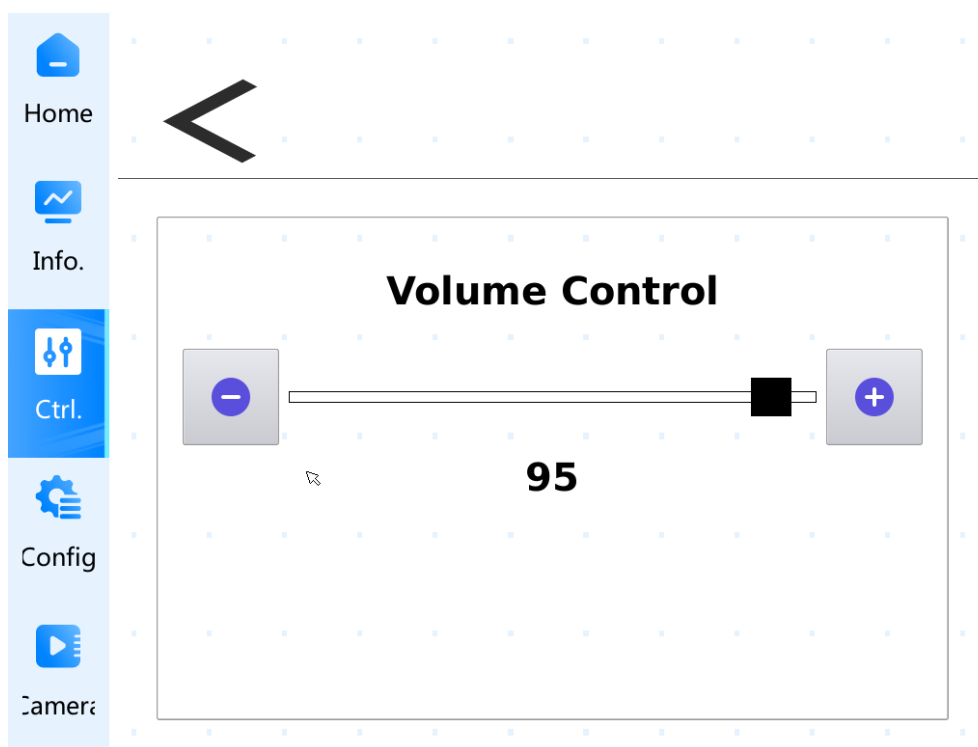


Figure 5-11 Volume Control

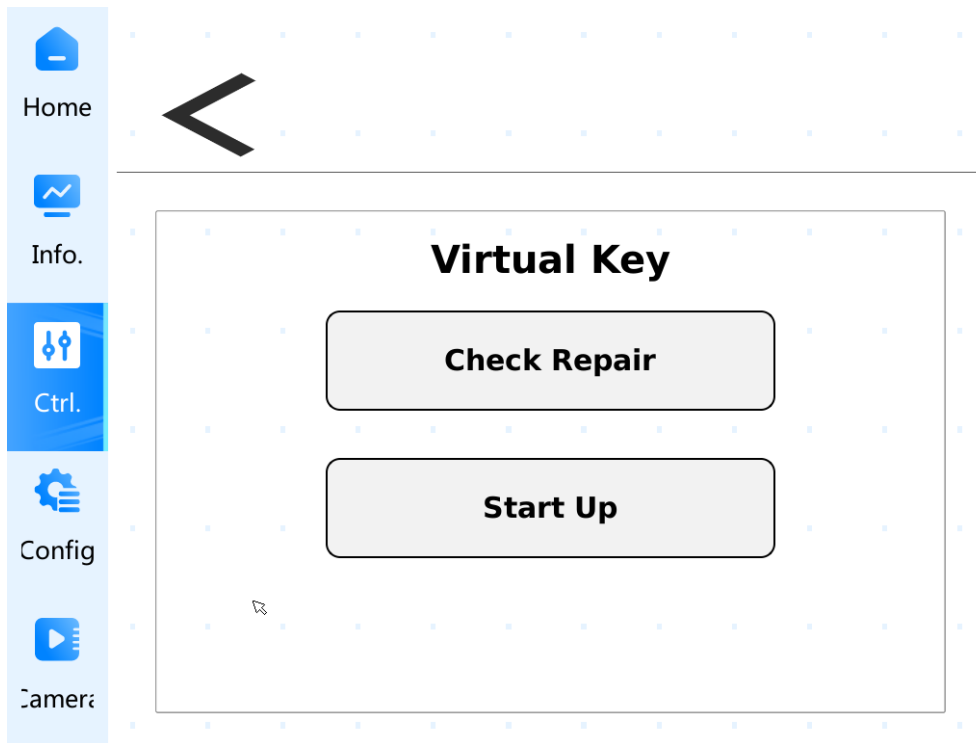


Figure 5-12 Virtual Key

5.1.4 System Information

Check software versions and device models.

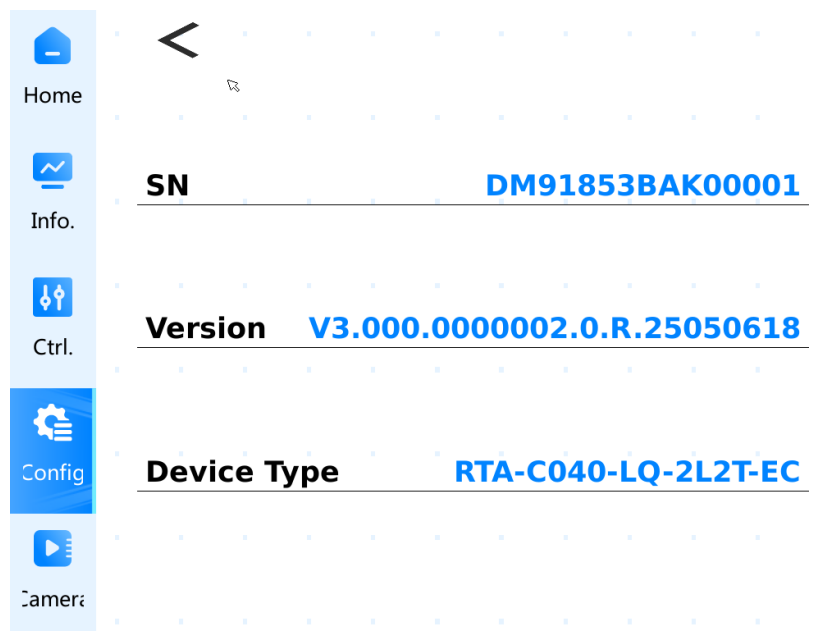


Figure 5-13 Version Info

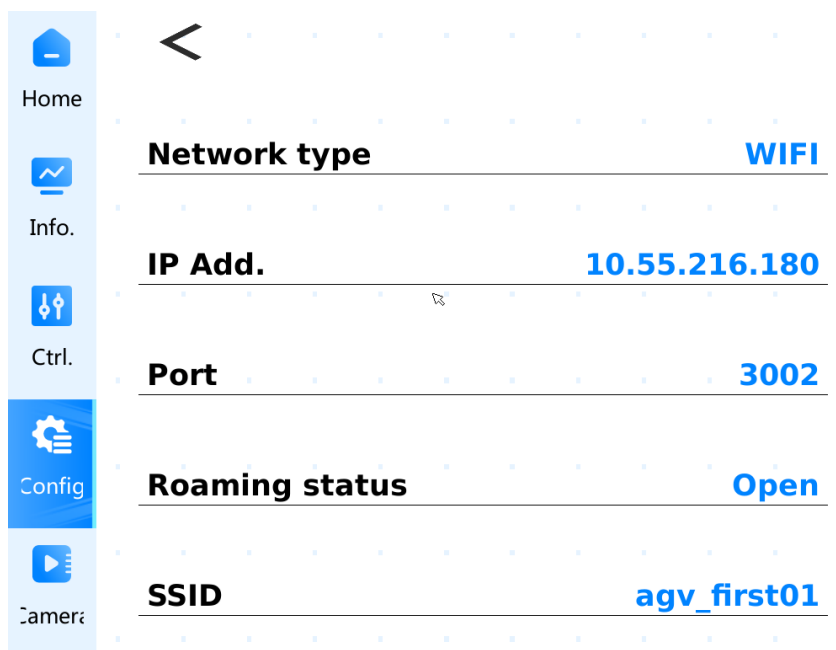


Figure 5-14 WiFi Info

5.1.5 DM Code Camera Streaming

Monitor DM code data streams and diagnose camera faults.

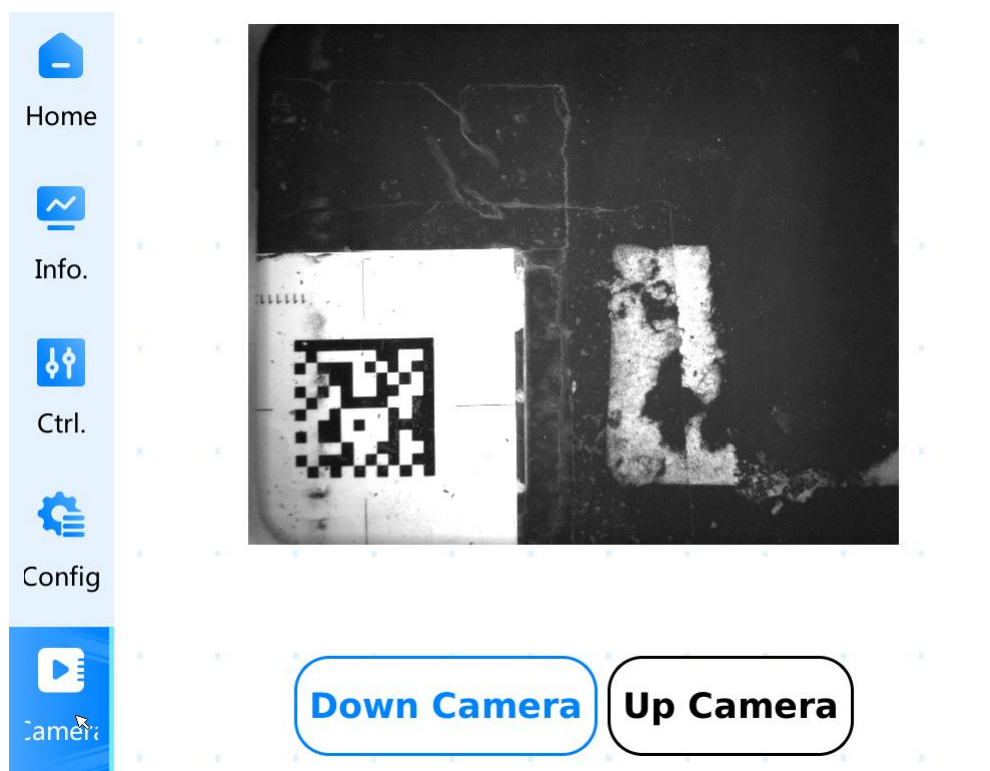


Figure 5-15-1 Streaming Display

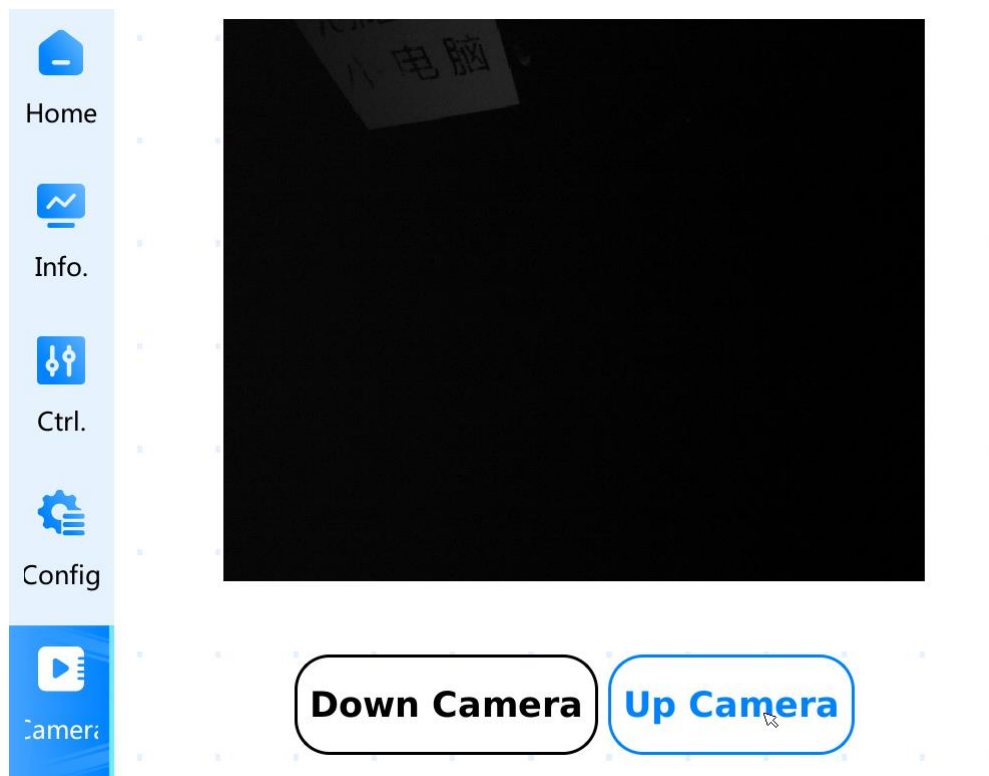


Figure 5-15-2 Streaming Display

5.2 Operational Setup

Before AMR operation, complete:

- Map creation
- Path editing
- Task configuration
- Refer to the "Operations Manual" in training materials for detailed steps.

5.3 Charging Operation

Automatic Charging

- Managed by RCS;
- No manual intervention.
- Refer to the "Operations Manual" in training materials for detailed steps.

Charging Interfaces:

- Rear charging port
- Side charging port

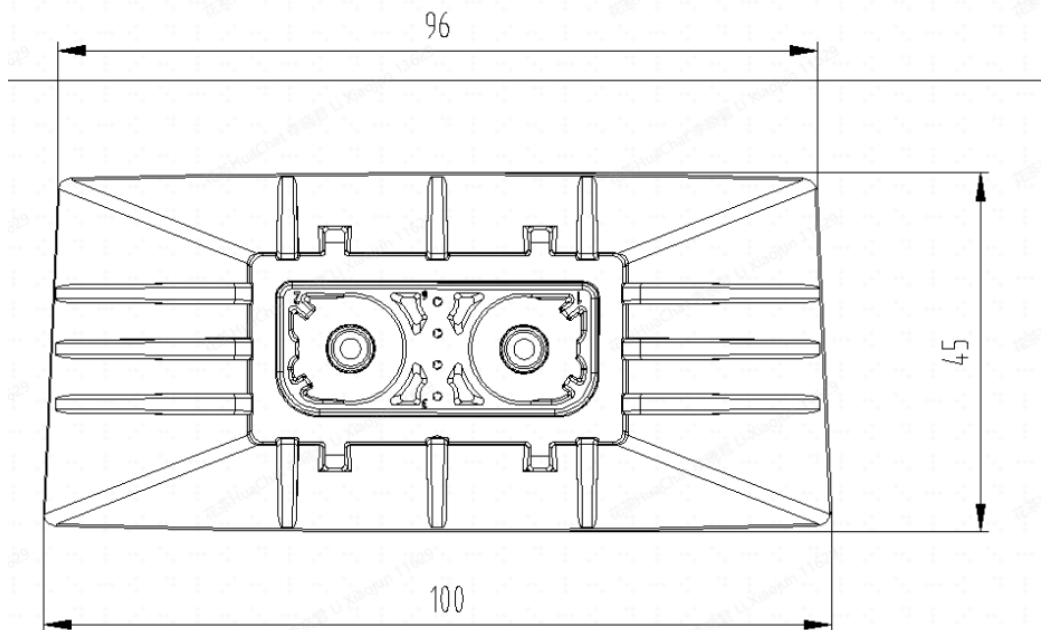


Figure 5-16: Rear Charging Port (Dimensions in mm)

Exclusive Charger: Use only HuaRay-manufactured chargers for automatic charging.

Specifications:

- Voltage: 57.6V MAX
- Current: 30A MAX

 **警告 WARNING**

Non-compliant chargers may cause fires, injury, or equipment damage.

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.
Obstacle Detected		Obstacle detected in the obstacle avoidance area.	Remove obstacles
AMR System Fault	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 MCU. - MCU version reported as "0".	- Update MCU firmware. - Inspect wiring connections.

Alarm/Fault		Root Cause	Solution
	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.
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		-	-

Alarm/Fault		Root Cause	Solution
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, **and do so in accordance with the requirements of this manual.**

During AMR inspection and maintenance, please turn the POWER key switch on the robot's front panel to **OFF** and remove the key.

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. And the power supply should be shut down.

7.3 Regular 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.
- Confirm audible alarm system functions correctly.

Inspection Item	Method	Maintenance Cycle
Upper Camera	Dust particles may settle on optical glass. Remove with non-woven anti-static cloth to maintain decoding accuracy. Check for scratches/cracks.	Weekly / Replace as needed
Laser Scanner	Static charge attracts dust. Clean with SICK Anti-Static Plastic Cleaner (P/N: 5600006) and SICK Lens Cloth (P/N: 4003353). Check for scratches/cracks.	Weekly / Replace as needed

Drive Wheels (×2)	Clean dirt with damp cloth; ensure no entanglement. Check for tears.	Weekly / Replace as needed
Caster Wheels (×4)	Clean dirt with damp cloth; ensure no entanglement. Check for tears.	Weekly / Replace as needed
LED Strips	Verify strips are intact and display colors correctly.	Monthly / Replace as needed
Speaker	Confirm speaker function normally.	Monthly / Replace as needed
TOF Camera	Inspect optical glass for scratches/cracks.	Weekly / Replace as needed
Buttons	Test all buttons for responsiveness.	Monthly / Replace as needed
Emergency Stop	Verify emergency stop functionality.	Monthly / Replace as needed
Safety Labels & Nameplates	Ensure labels/identification plates are legible and undamaged.	Monthly / Replace as needed

7.4 Monthly Inspection

General Maintenance:

- **Ensure lifting mechanism operates smoothly (no misalignment or incomplete movements).**
- **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).**
- **Check whether the casters rotate smoothly and inspect the wheels for wear and tear. Replace them if necessary.**

Component	Inspection items	Procedure & Troubleshooting
Lifting Structure	Lifting Disk Rotation Clearance	Manually rotate the lifting disk until resistance is felt, then calculate the clearance. If the clearance exceeds 2 ° , request warranty 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, linear bearings and lifting screw inside.**
- **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.**
- **Lubrication Maintenance for Lift-and-Rotation Gears and Slewing Ring Internals.**

Table 7-2 Semi-Annual Maintenance

Check Part	Inspection items	Inspection methods and Exception handling
Lifting screw	Gear Tooth Surface	Check gear teeth for wear. Use a feeler gauge to measure clearance between slewing ring and gears. Theoretical clearance should not exceed 0.20mm.
	Fastening	Check pre-tightening force of slewing ring bolts.
	Sealing Strip	Inspect sealing strips for damage.

Check Part	Inspection items	Inspection methods and Exception handling
	Cleaning	Remove wear debris and contaminants from gear tooth surfaces.

7.6 Annual Maintenance

General Maintenance:

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

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

警告 WARNING

- **Impact or collision may cause structural damage to the robot, posing risks of malfunction and personal injury.**
- **If any damage is suspected, conduct a thorough inspection to ensure structural integrity and strength are uncompromised.**

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.
- When transporting AMRs, please use the original packaging materials.

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

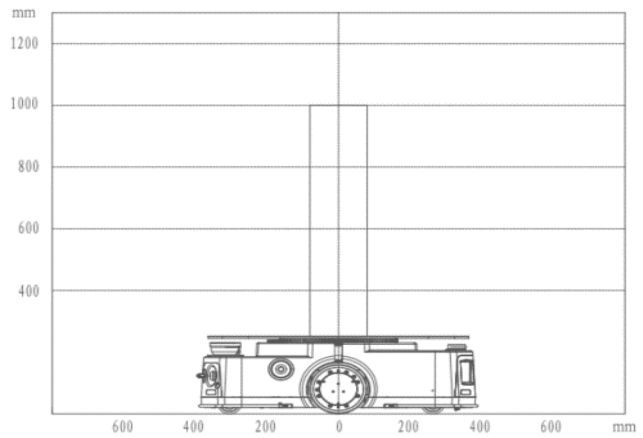
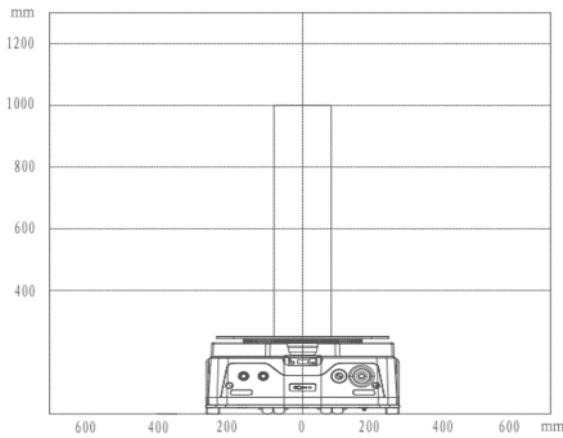
If the AMR is idle for over 2 months, store it in a dry, frost-free, ventilated, and dust-

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.**

Chapter Nine Payload

This specification applies to total payloads not exceeding 400 kg.



警告 WARNING

Load Securement & Distribution

Improperly secured or eccentrically loaded payloads may result in falling objects or robot tipping, potentially causing personal injury to nearby personnel or equipment damage.

注意安全 CAUTION

Travel Surface Requirements

Maintain flat travel surfaces free of protrusions and depressions. Impacts or jolts may cause payloads to shift or fall from the robot, leading to equipment damage and personal injury.

注意安全 CAUTION

Slippery Surface Hazard

Operating with payloads on wet/slippery surfaces may cause instability, resulting in equipment damage and personal injury.

Critical Operational Parameter:

The coefficient of friction between the driving surface and robot's drive wheels must range between 0.60 and 0.80 for payload specifications to remain valid. If outside this range, implement additional safety measures to ensure secure operation.

Appendix One 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 Two Legal Declaration

Trademark Declaration

- VGA® is a trademark of IBM Corporation.
- Windows® and the Windows logo are registered trademarks of Microsoft Corporation.
- All other trademarks or company names mentioned herein are properties of their respective owners.

Responsibility Declaration

- To the extent permitted by law, under no circumstances shall the company be liable for any special, incidental, indirect, or consequential damages arising from the use of products or content described in this document, including but not limited to loss of profits, data, goodwill, documents, or anticipated savings.
- Products are provided "as-is" without warranties of any kind, whether express or implied, including merchantability, fitness for a particular purpose, or non-infringement, unless required by applicable law.

Privacy Compliance

This product may collect personal data (e.g., biometrics, license plates, emails, phone numbers, GPS). Users must comply with regional/national privacy laws, such as posting visible signage in monitored areas and providing contact information for data subjects.

Documentation Notes

- This manual applies to multiple product models. Actual product appearance and functionality may vary.
- Users assume full responsibility for losses caused by non-compliance with this manual.
- Updates to this document will be released via physical copies, electronic media, QR codes, or our official website. In case of discrepancies, the

electronic version prevails.

- The company reserves the right to modify this document without prior notice.
- Technical inaccuracies or typographical errors are subject to the company's final interpretation.
- Use the latest PDF reader if the document fails to open.

Appendix Three Cybersecurity Recommendations

Essential Measures for Basic Cybersecurity:

1. Use Strong Passwords

Follow these guidelines for password creation:

- Minimum 8 characters.
- Include at least two character-types (uppercase, lowercase, numbers, symbols).
- Avoid using account names or their reversed forms.
- Avoid sequential characters (e.g., 123, abc).
- Avoid repetitive characters (e.g., 111, aaa).

2. Update Firmware and Client Software

- Regularly update firmware to the latest version to ensure security and functionality. Enable auto-update detection for internet-connected devices.
- Always use the latest version of client software.

Enhanced Cybersecurity Recommendations

3. Physical Security

- Store devices (especially storage equipment) in secure locations (e.g., locked server rooms or cabinets).
- Restrict physical access to prevent unauthorized hardware tampering or peripheral connections (e.g., USB drives, serial ports).

4. Regular Password Changes

- Change passwords periodically to mitigate guessing or cracking risks.

5. Configure Password Reset Information

- Set up and update password reset details (e.g., registered phone/email, security questions). Avoid easily guessable answers.

6. Enable Account Lockout

- Keep the default account lockout feature enabled. Failed login attempts will lock the account and source IP.

7. Change Default Service Ports

- Modify default HTTP and other service ports to values between 1024–65535 to reduce port-scanning risks.

8. Enable HTTPS

- Use HTTPS for secure web service access.

9. MAC Address Binding

- Bind gateway IP addresses to MAC addresses to prevent ARP spoofing.

10. Role-Based Access Control

- Create users with least-privilege permissions based on operational needs.

11. Disable Non-Essential Services

- Turn off unused services (e.g., SNMP, SMTP, UPnP). If required, use secure modes:
 - ✧ **SNMP**: Use v3 with complex encryption/authentication passwords.
 - ✧ **SMTP**: Enable TLS for email server connections.
 - ✧ **FTP**: Use SFTP with strong passwords.
 - ✧ **AP Hotspot**: Enable WPA2-PSK encryption.

12. Encrypt Audio/Video Transmissions

- Enable encryption for sensitive audio/video data to prevent interception.

13. Security Auditing

- Monitor active users to detect unauthorized access.
- Review device logs to track login attempts and critical user actions.

14. Network Logging

- Enable network logging to synchronize critical logs to a remote server for long-term retention and troubleshooting.

15. Secure Network Architecture

- Disable router port forwarding to block external access to internal devices.
- Isolate subnets using VLANs or firewalls if no communication is required.
- Implement 802.1x authentication to prevent unauthorized network access.
- Enable IP/MAC address filtering to restrict device access.

Appendix Four Brake Distance Testing

The robot's braking capability must be thoroughly tested prior to operation.

The braking distance depends on three factors:

- **Robot operating speed**
- **Robot payload**
- **Travel surface conditions (including but not limited to flatness, incline gradient, and coefficient of friction)**

Therefore, the exact braking distance cannot be predetermined. The precise distance must be determined within the robot's operating environment and driving conditions.

Test Objective:

Verify that the robot stops timely to avoid collisions with humans or objects when operating under:

- **Maximum payload**
- **Variable speeds across different site configurations**
- **Steepest supported incline**

Critical Parameters:

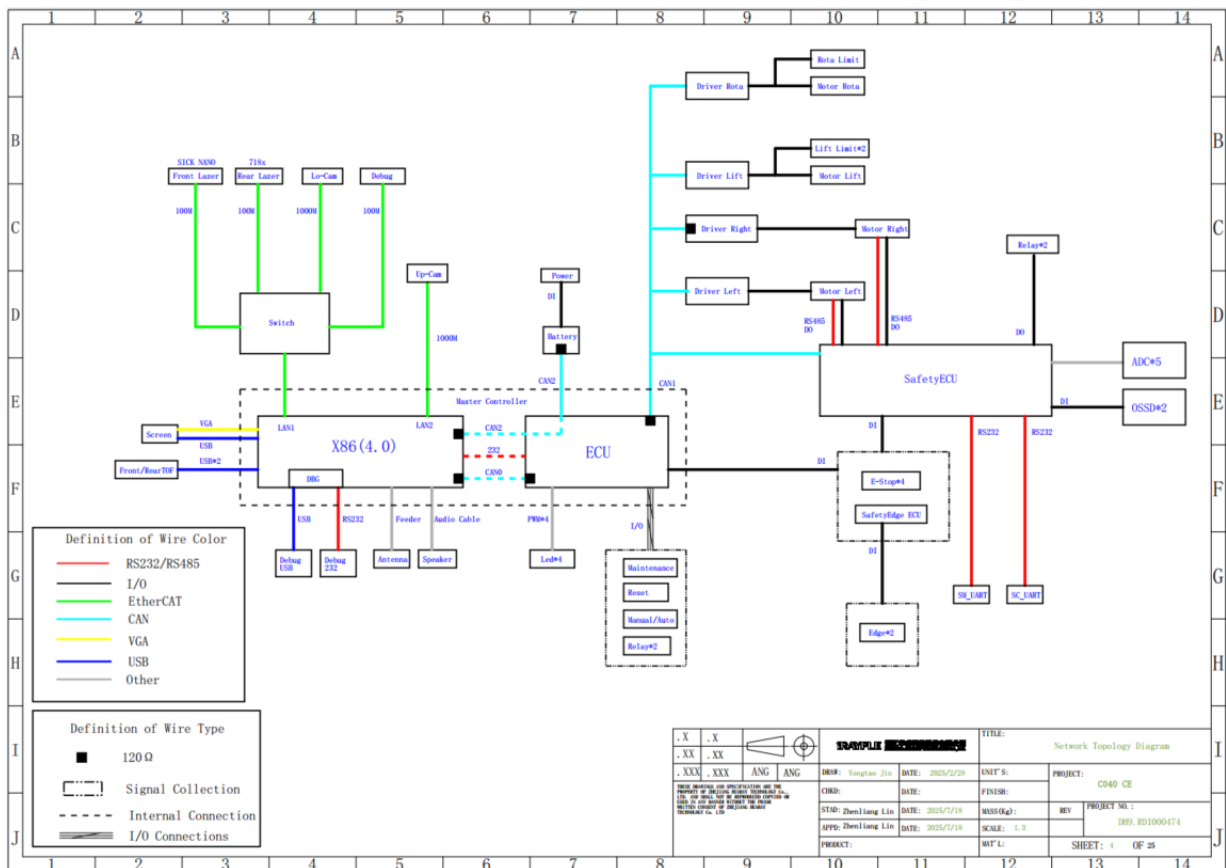
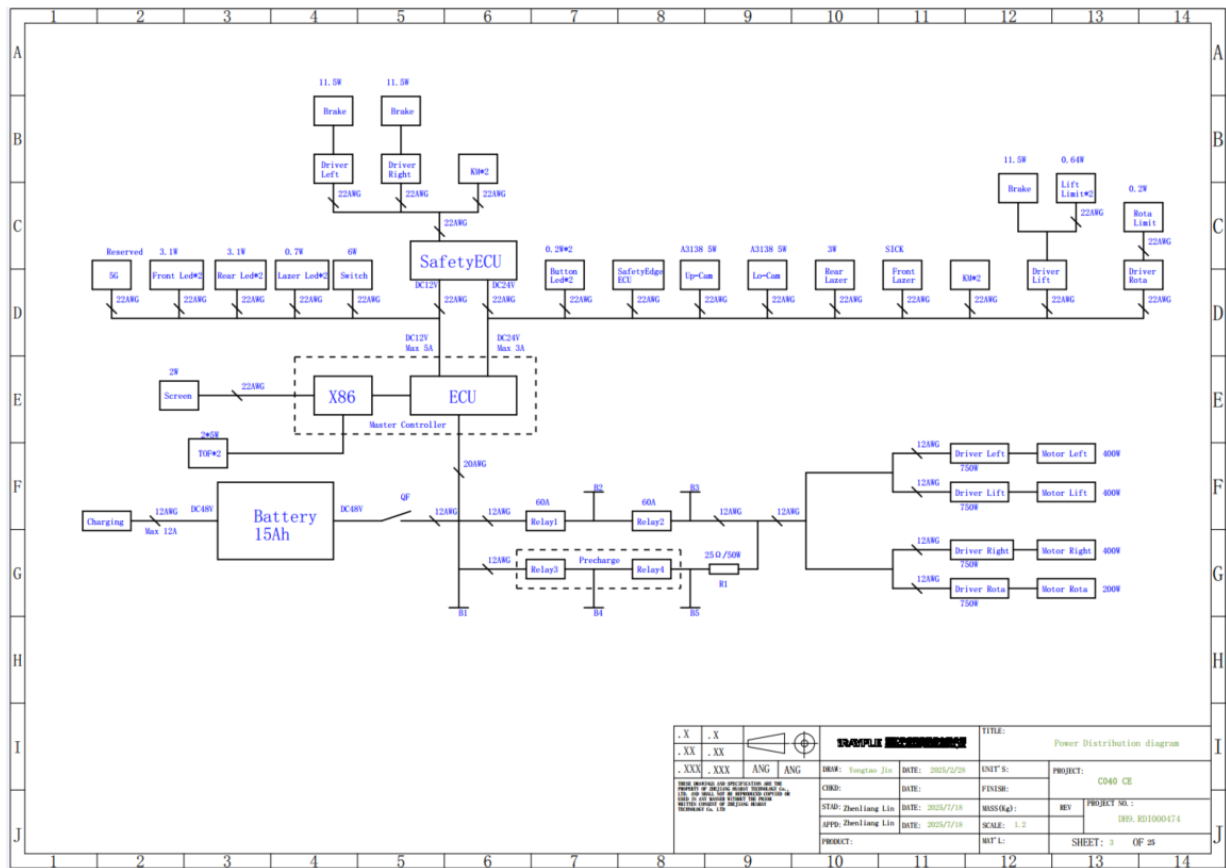
If measured braking distance exceeds specifications → Increase obstacle avoidance distance to ensure safety.

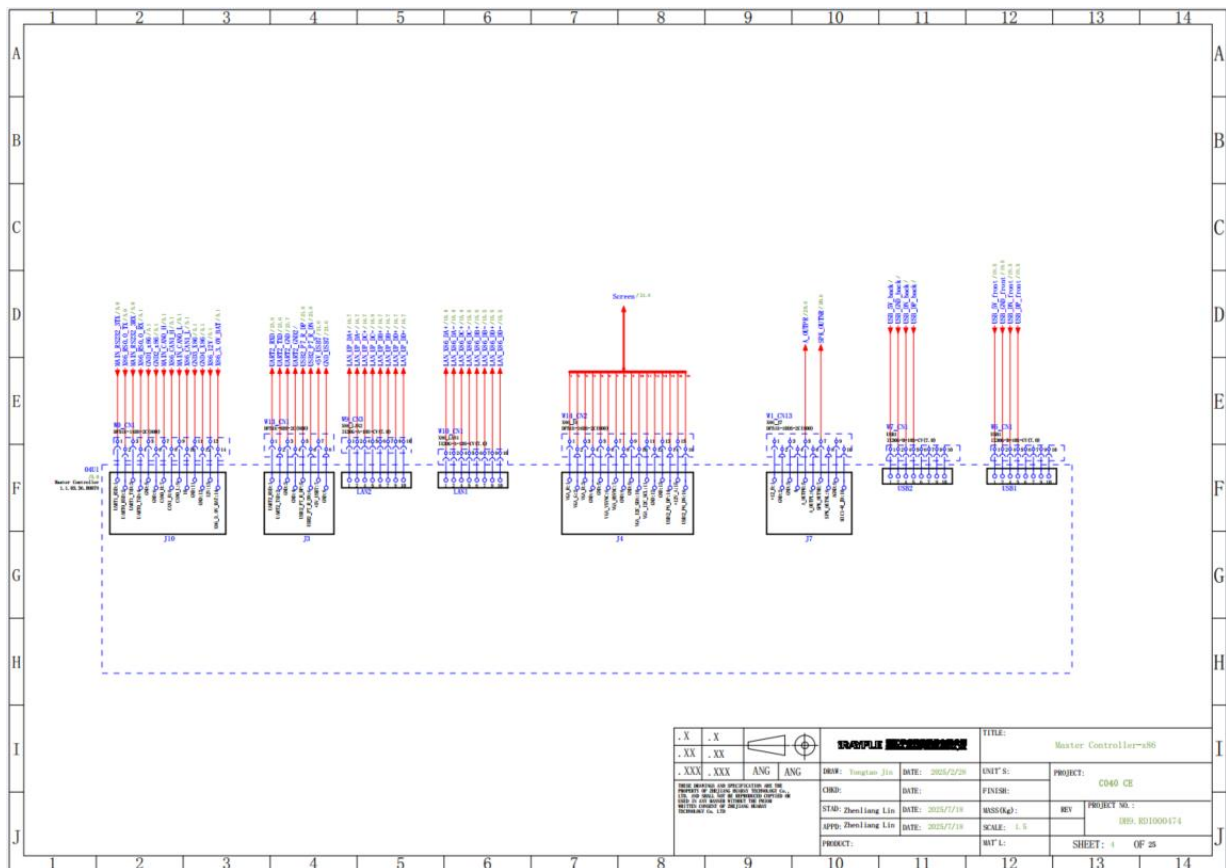
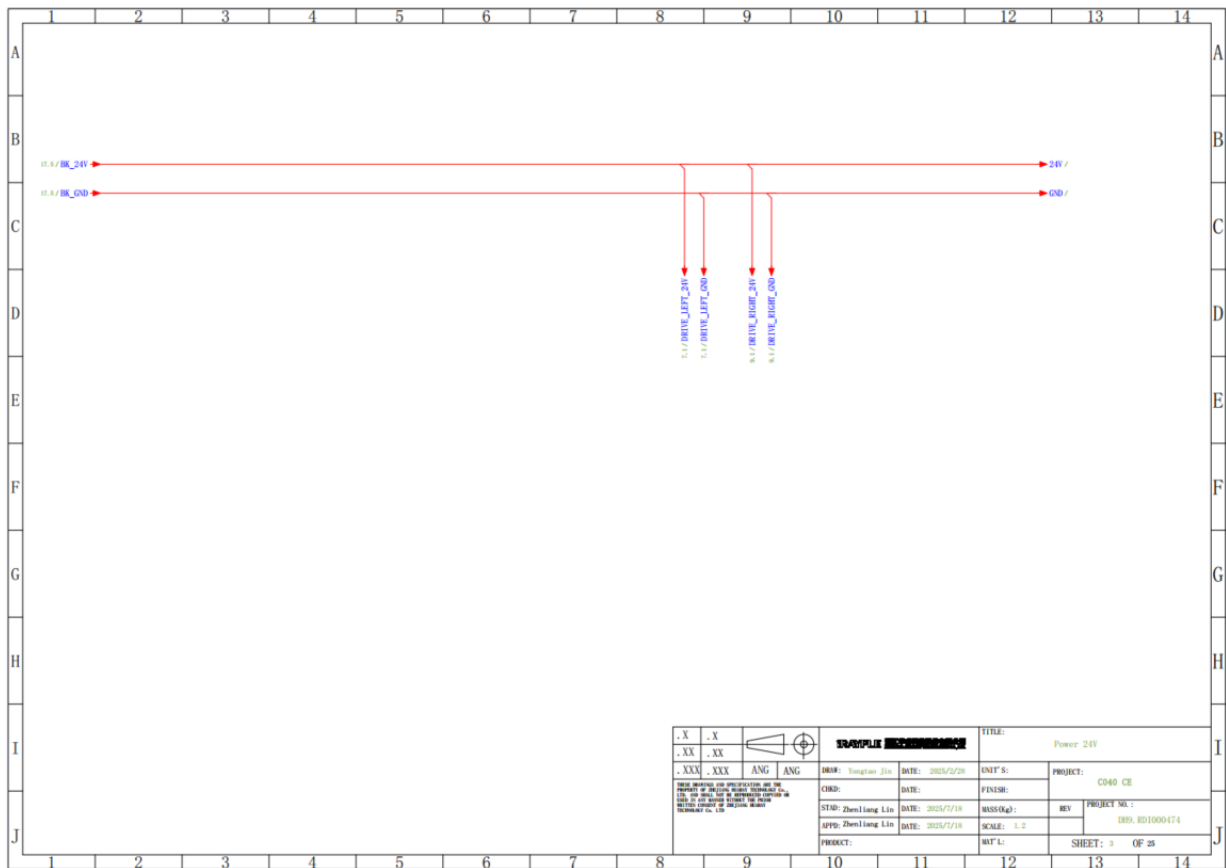
Common trigger: Low-friction surfaces (e.g., high-gloss flooring)

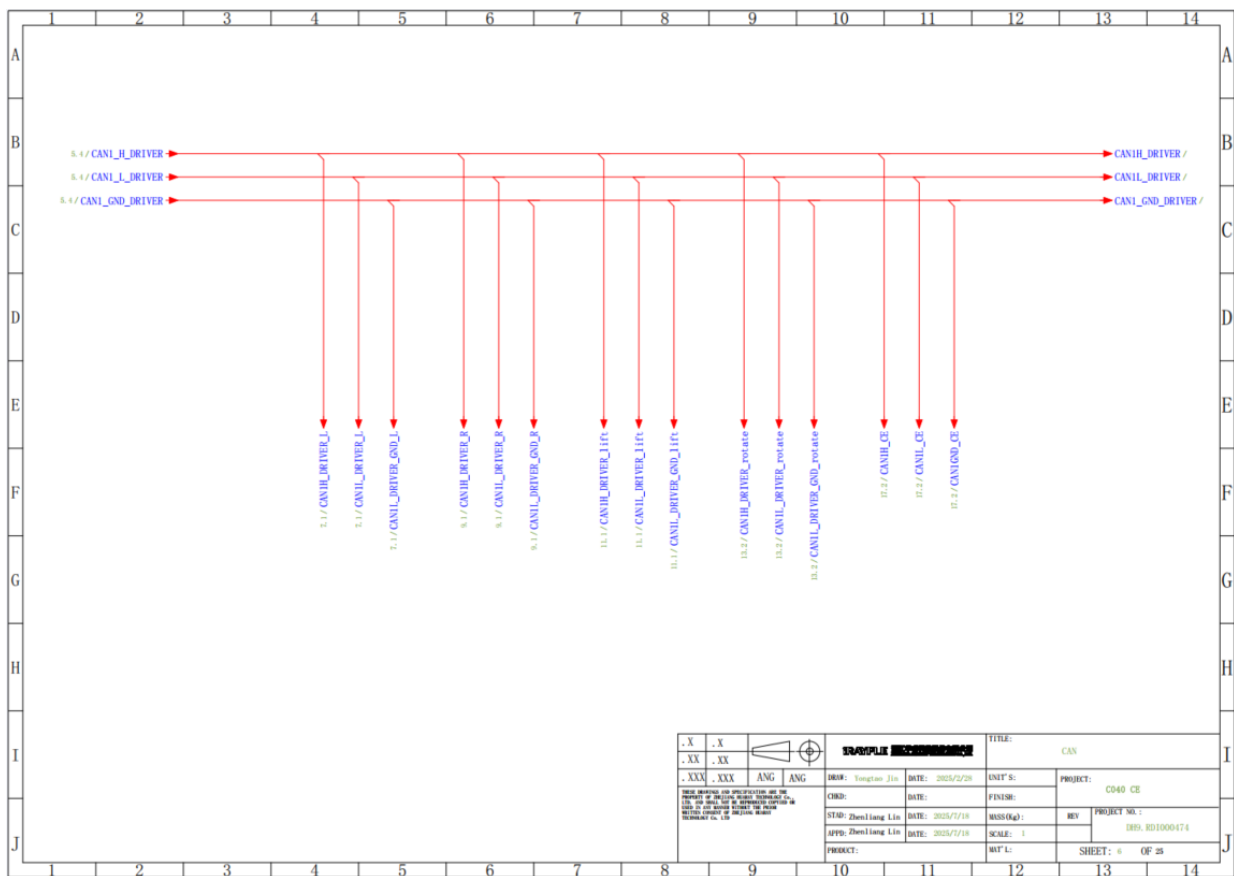
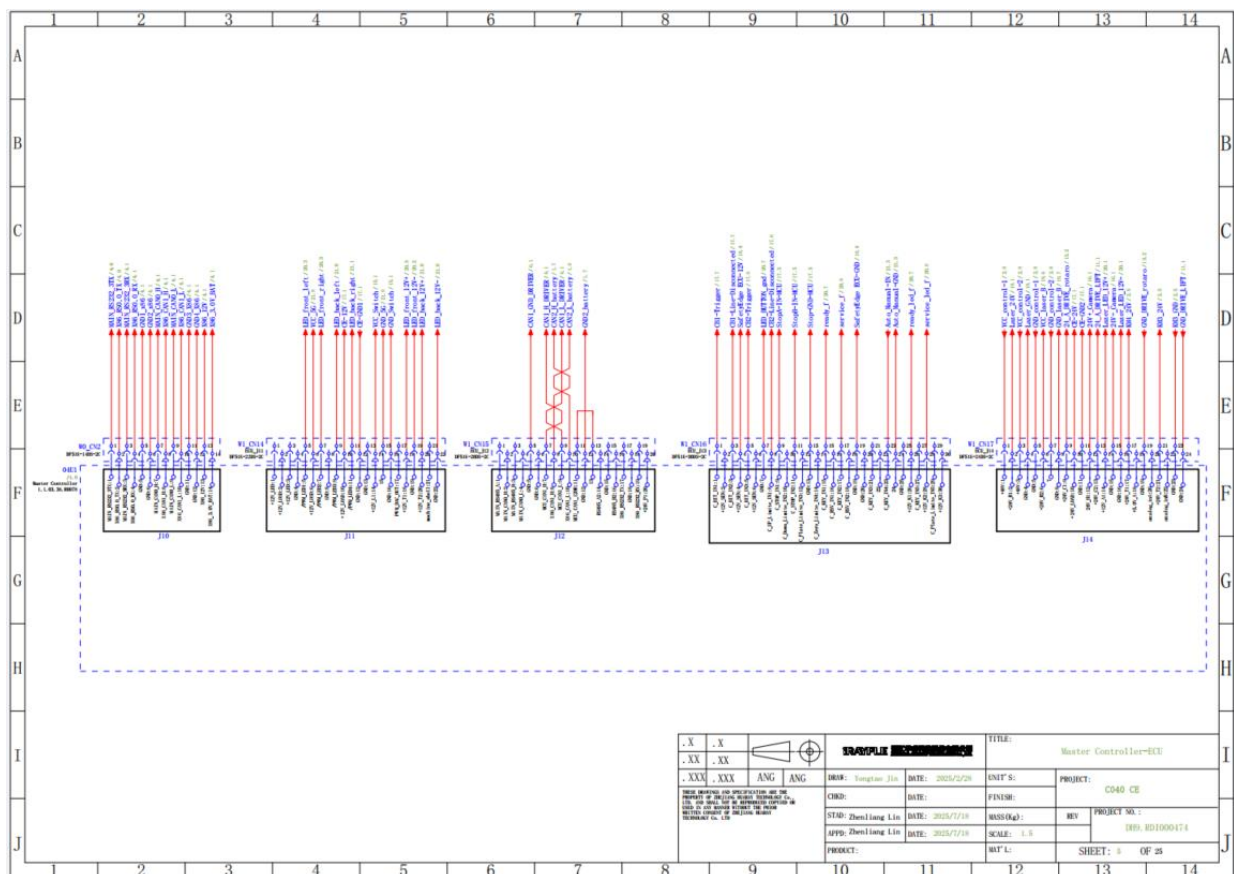
Fundamental Rule:

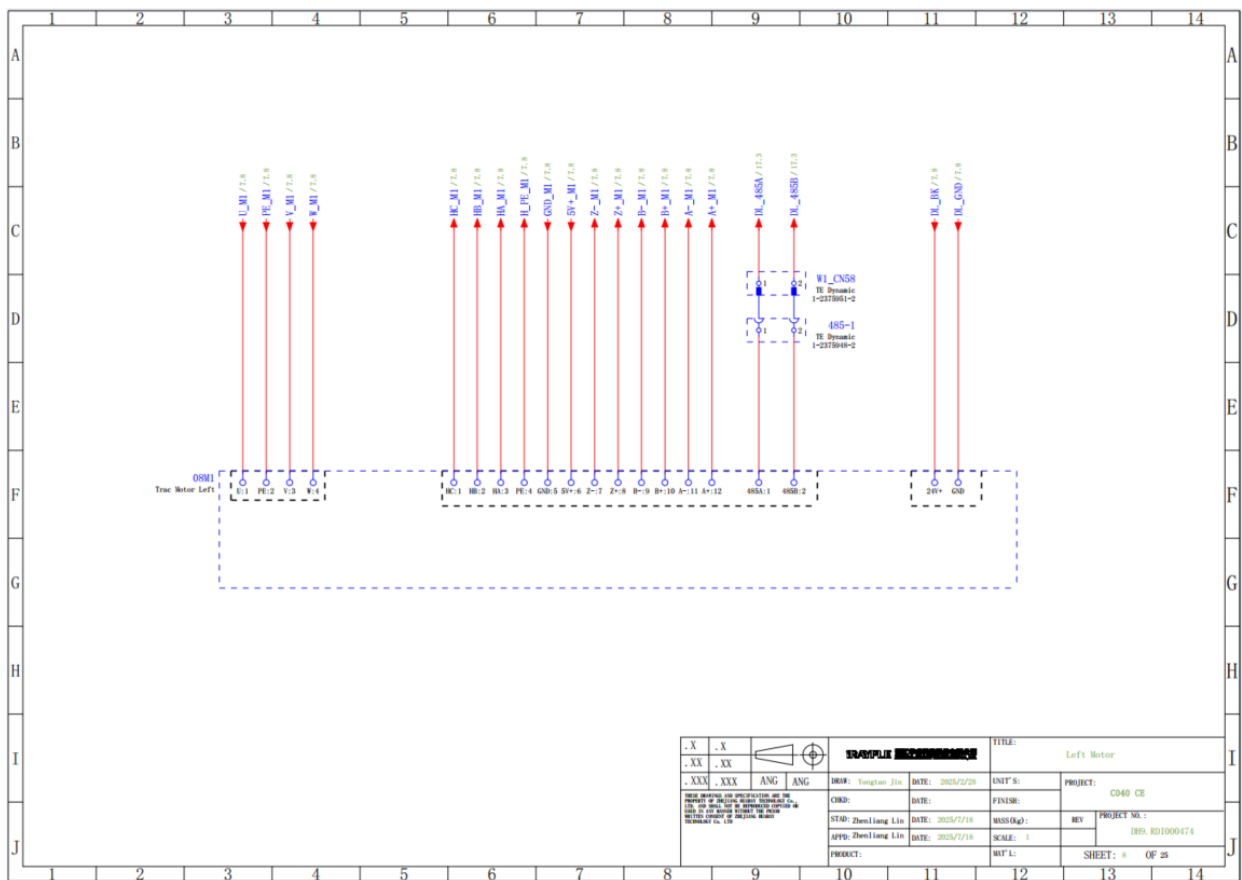
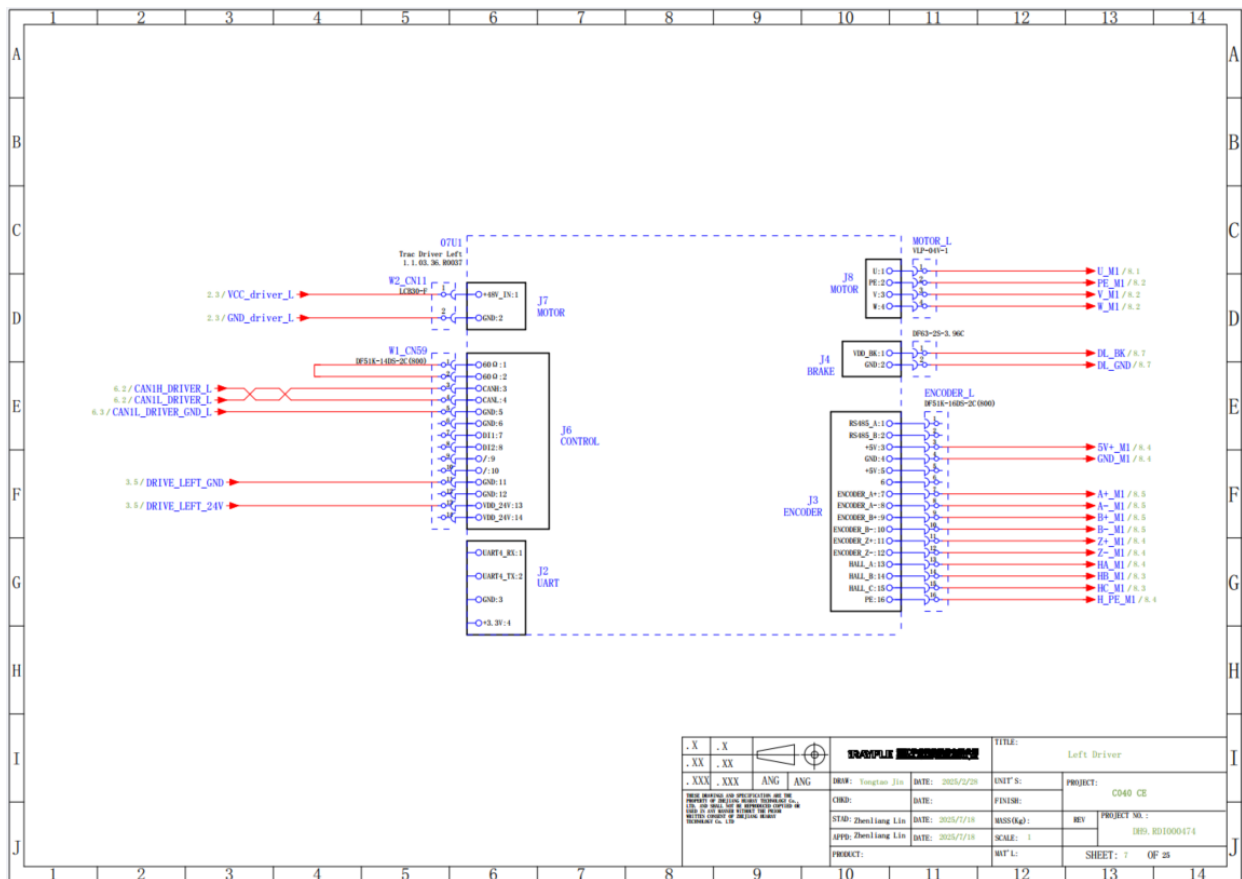
Obstacle avoidance distance must always exceed braking distance by a safety margin at all speeds.

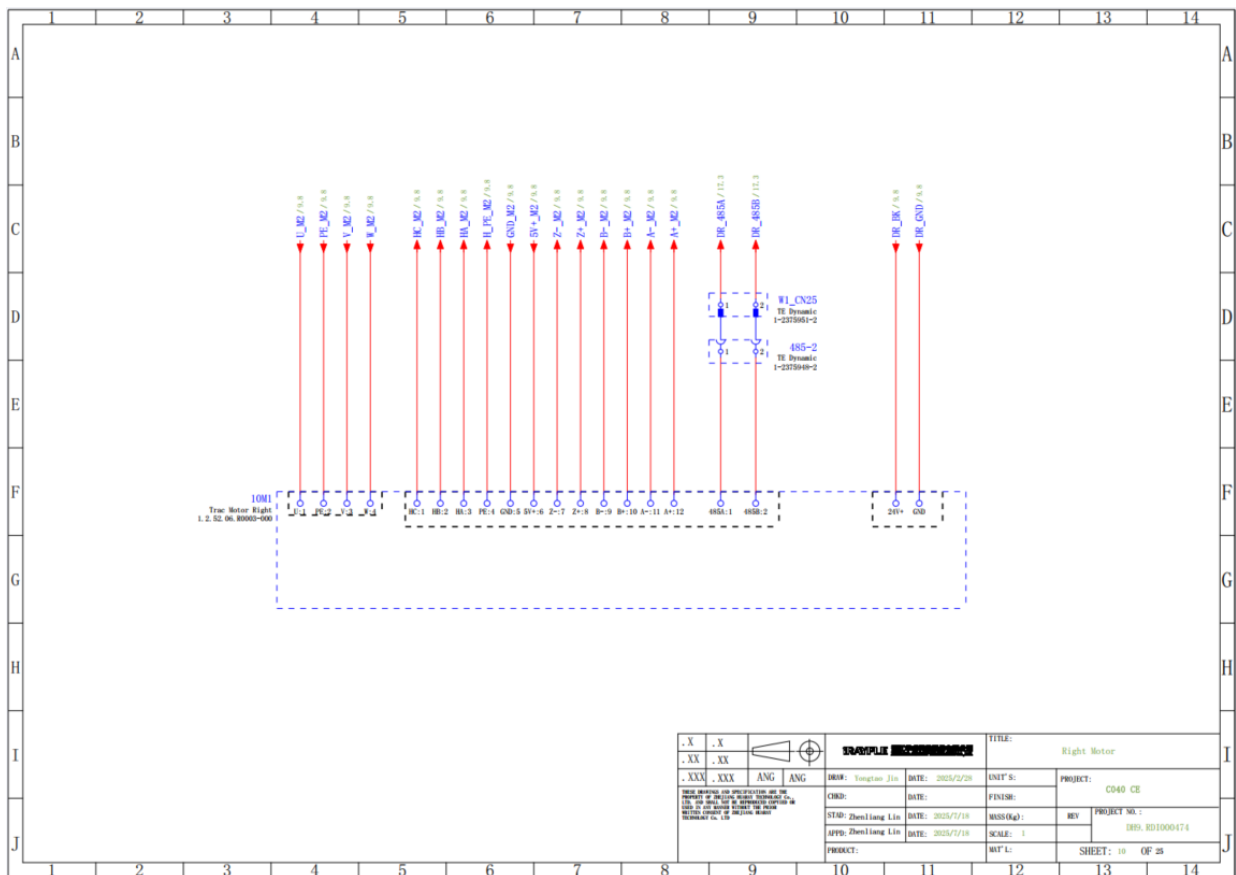
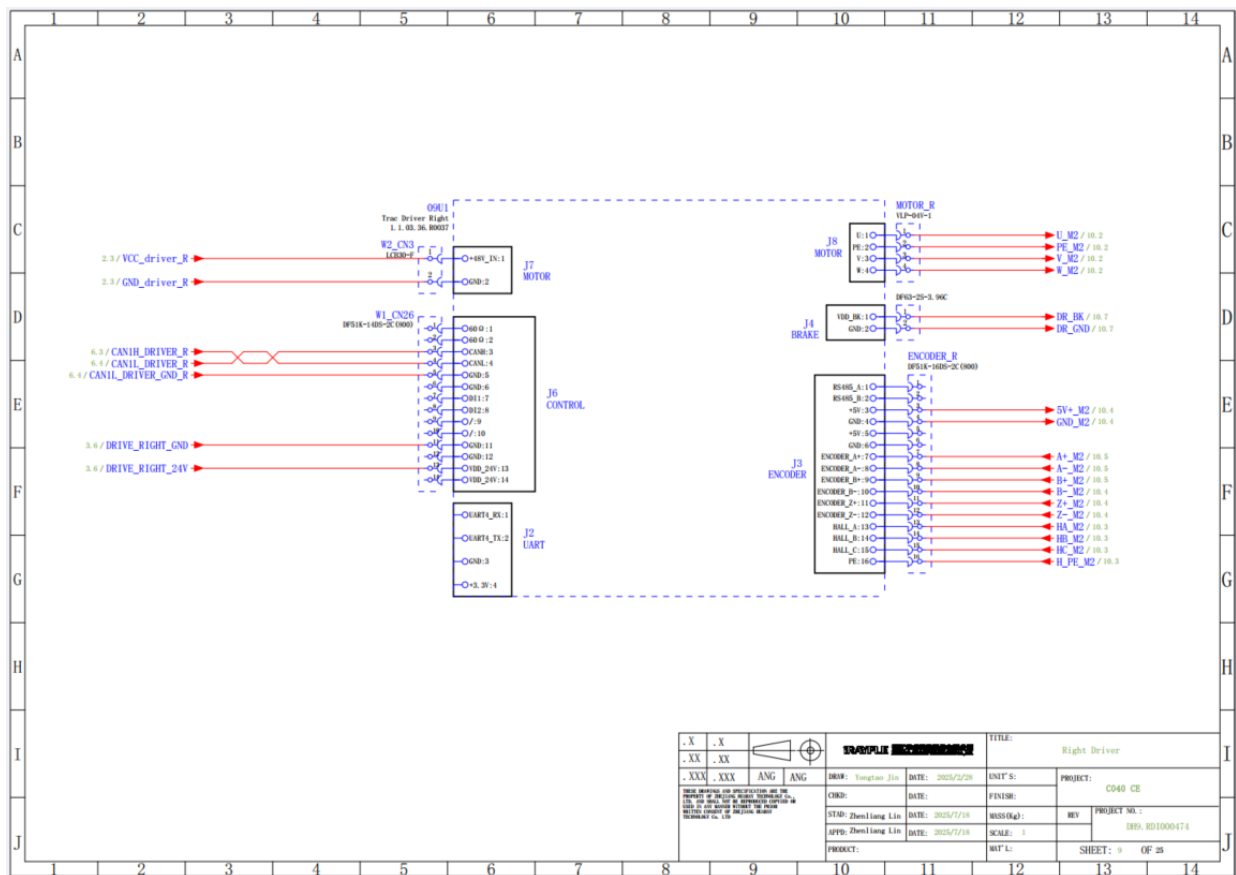
Appendix Five Electrical Schematic Diagram

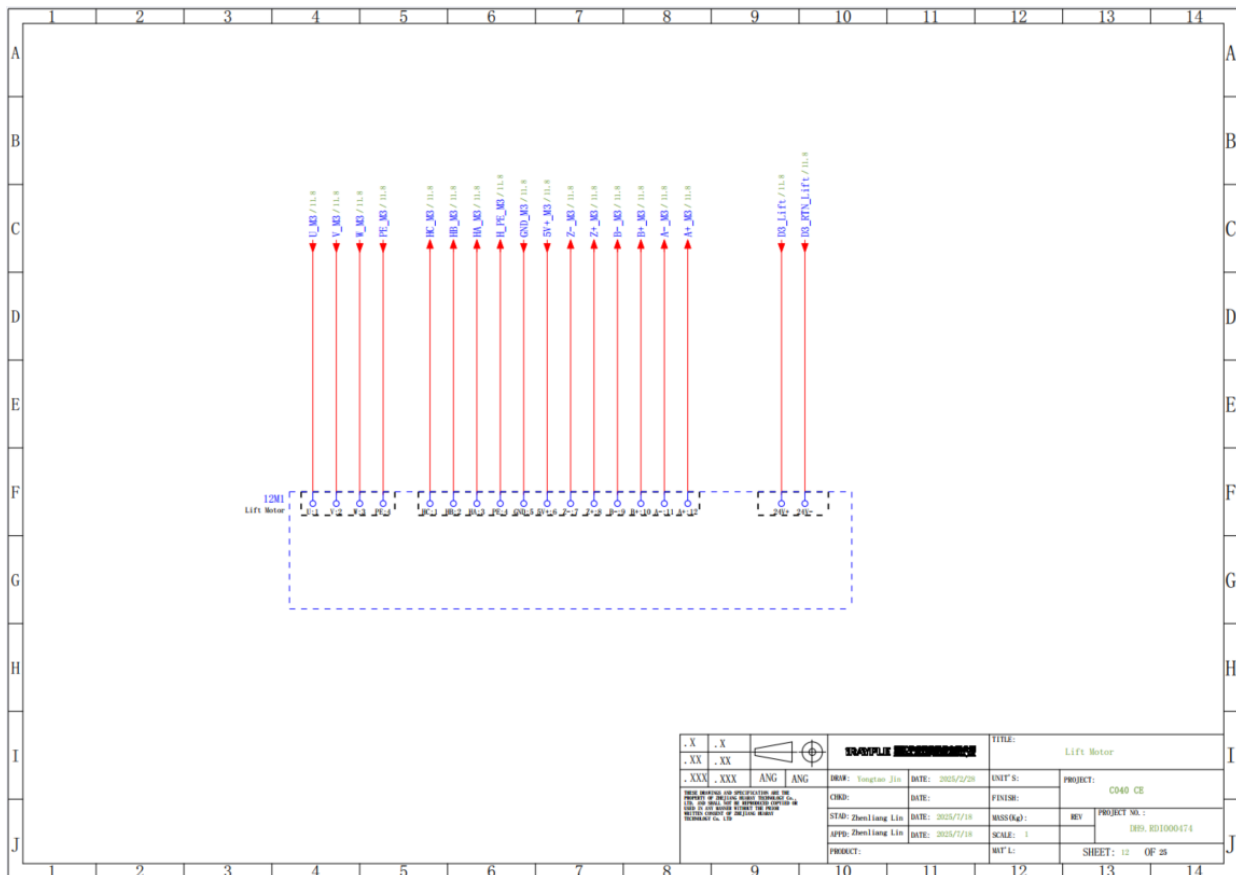
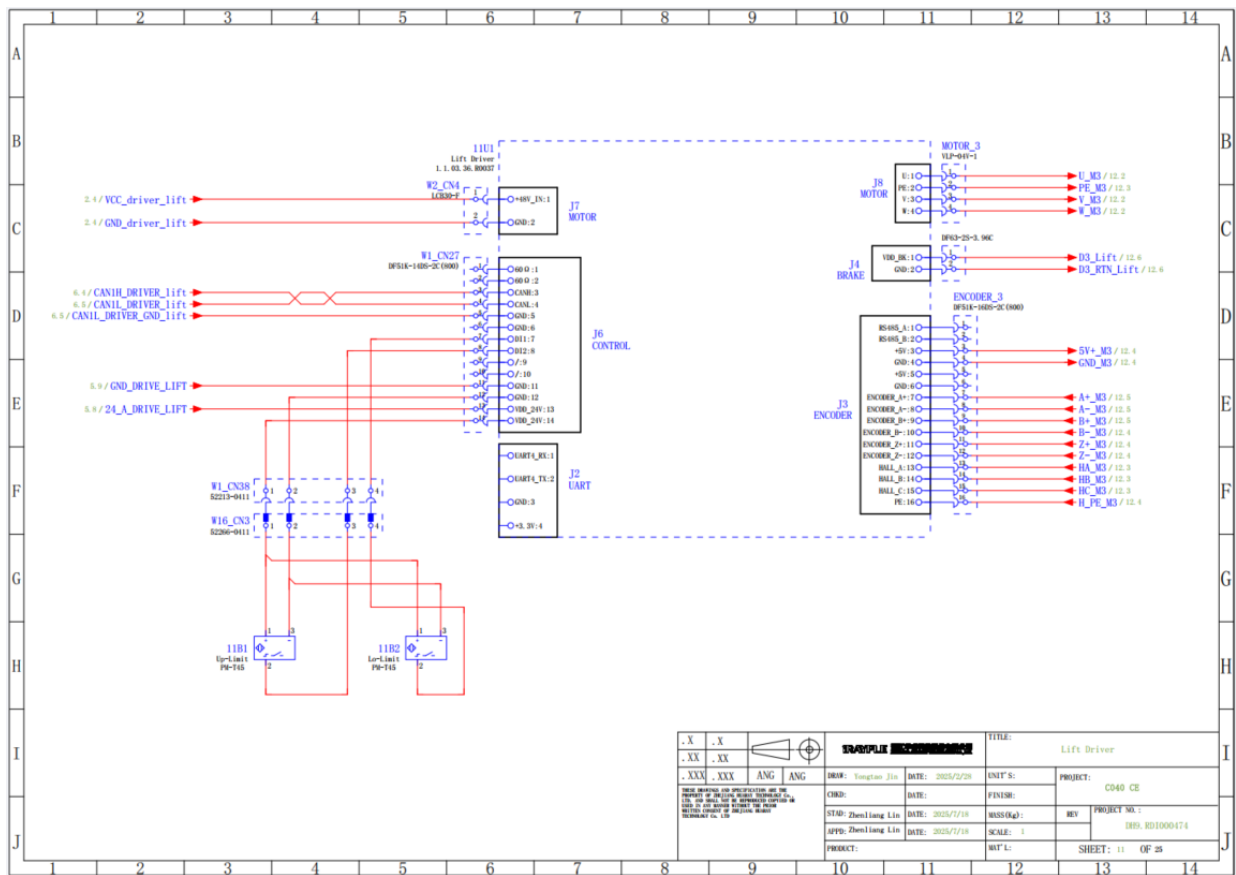


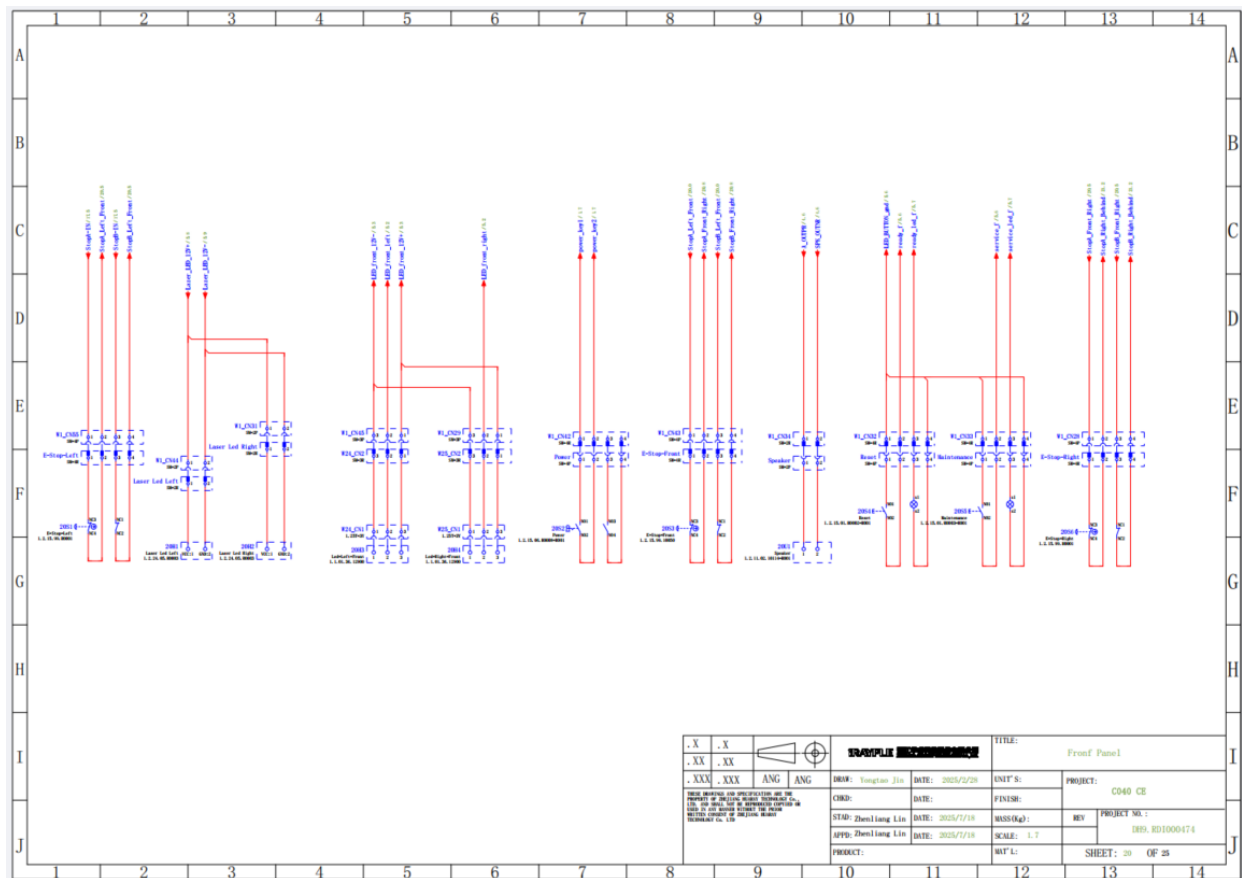
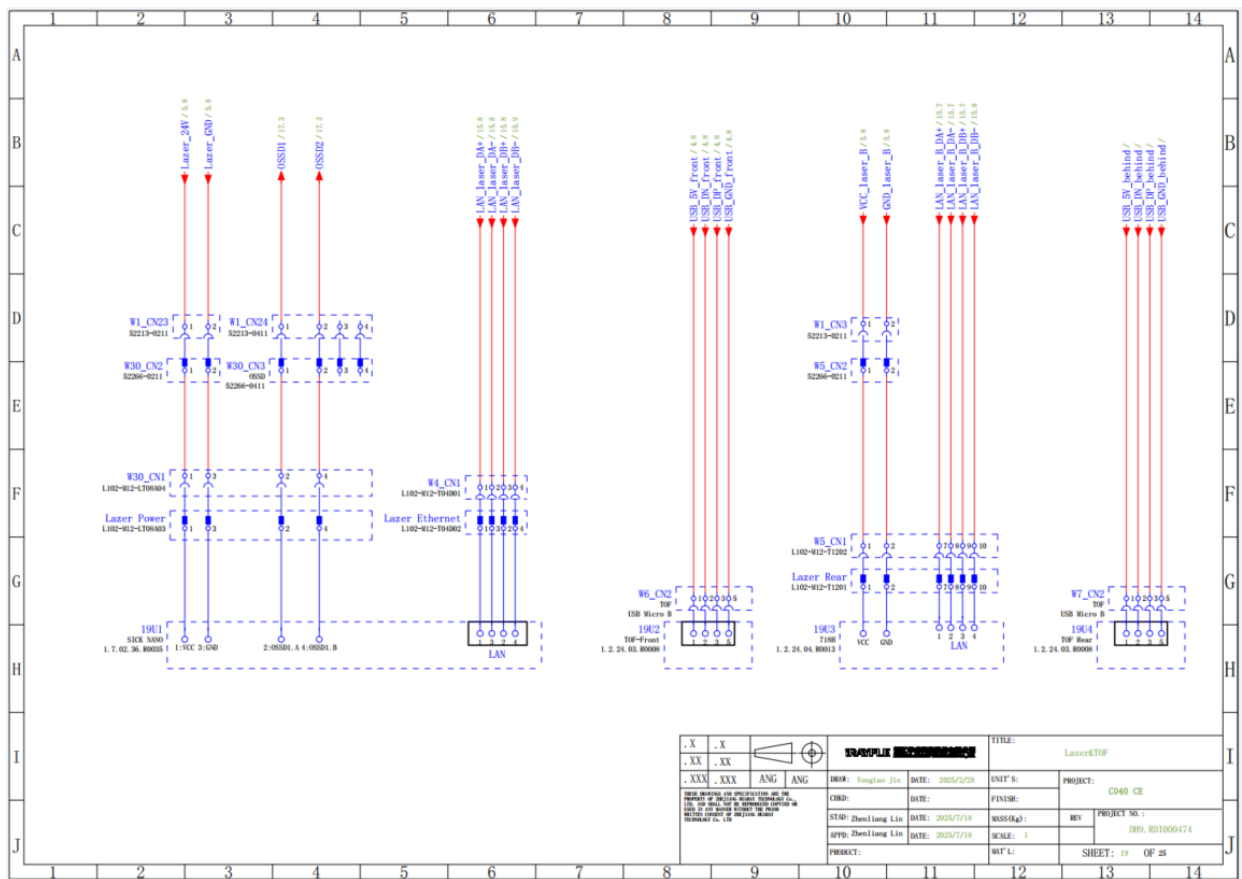


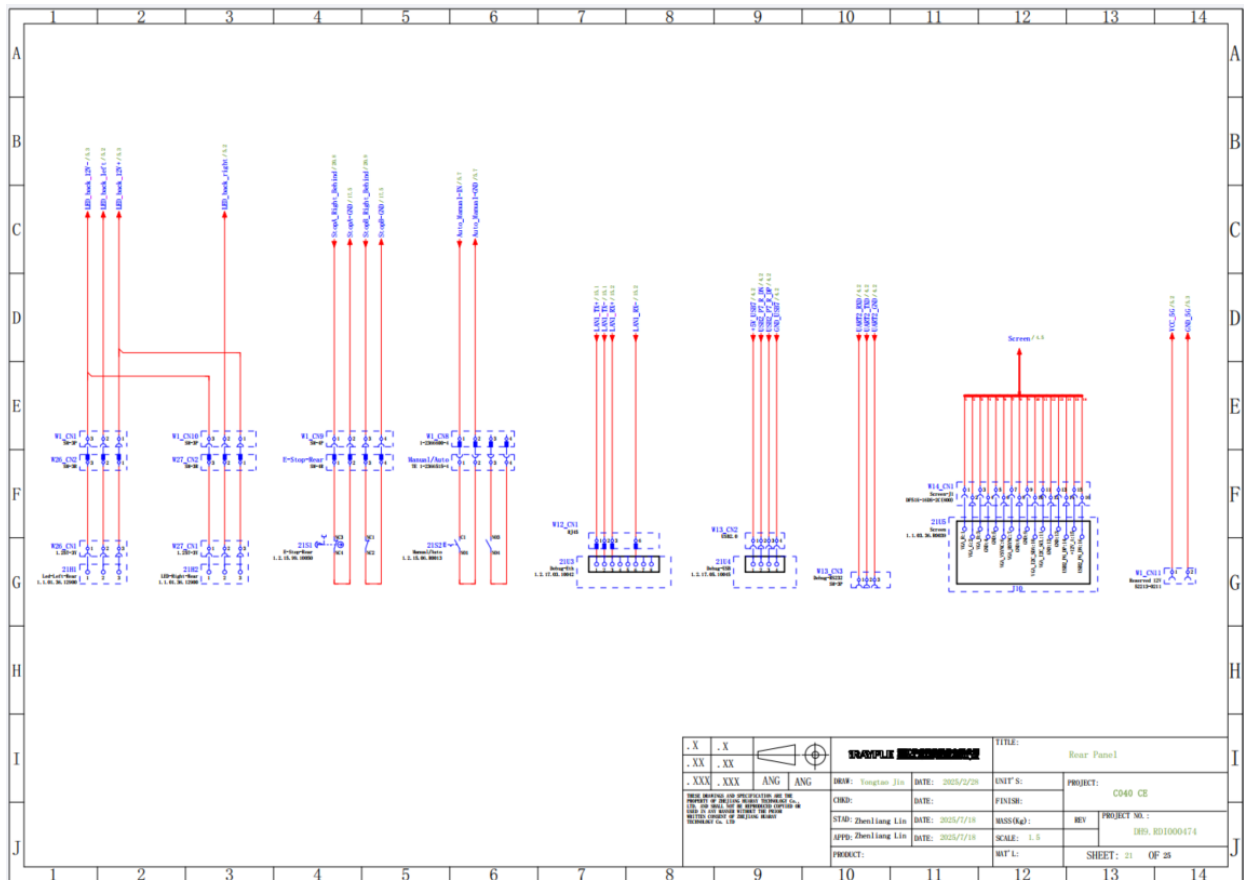




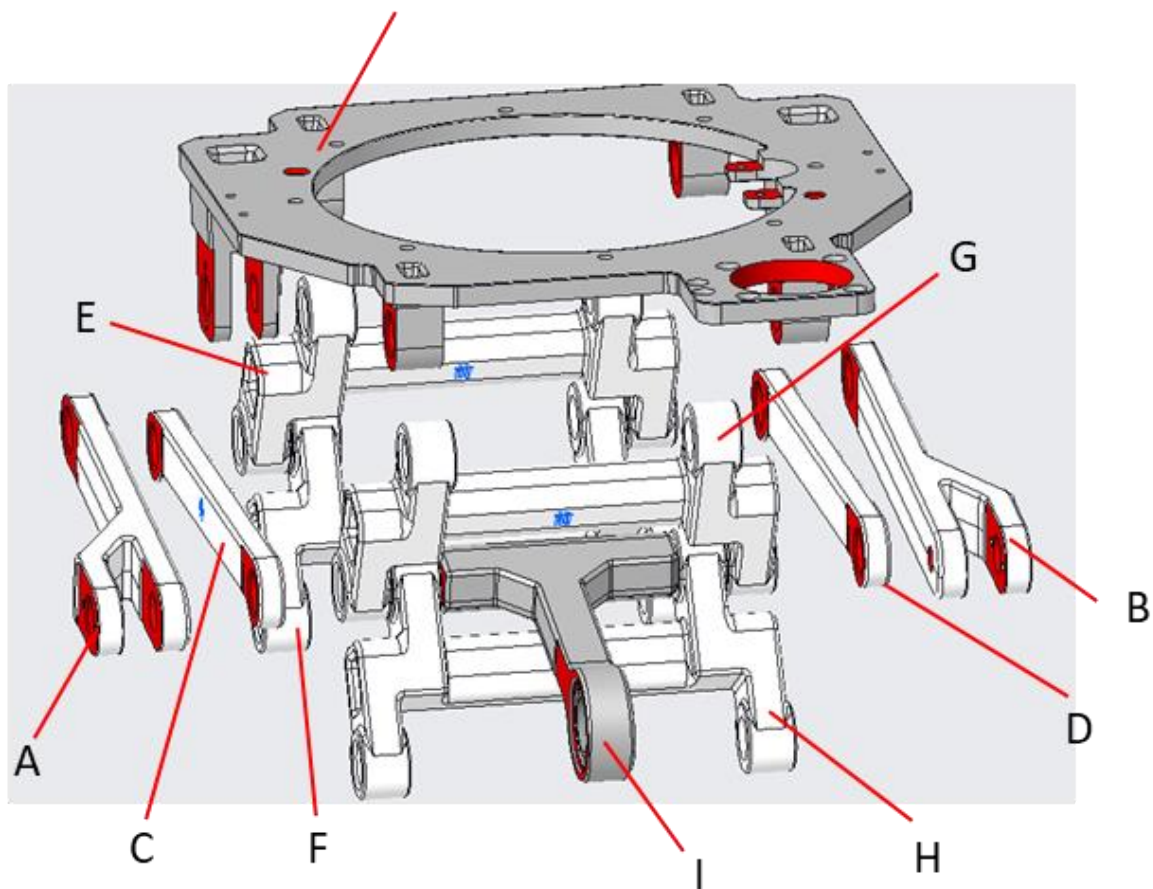








Appendix Six Schematic diagram of mechanism



C o d e	Name	Materi al	Maxim um compr essive stress	Maxi mu m tensi le stres s	Maxi mu m princ ipal stres s	Targ et
A	Link_bal ance_L	A380 Y.S=1 60 (Line ar calcul	45.74 6	3.05	27.3 78	Maxi mu m princ ipal stres
B	Link_bal ance_R		22.88 2	1.34	13.7 11	
C	Link_FR _L		49.88 5	7.78	35.5 69	

D	Link_FR _R	ation)	47.05 1	15.2 98	30.5 38	s <13 6
E	V_R_upr		36.35 5	5.54 28	8.08 16	
F	V_R_lwr		31.31 4	4.43 86	8.35 2	
G	V_F_upr		33.50 9	4.76 3	8.59 83	
H	V_F_lwr		55.50 9	8.51 74	13.2 54	
I	Top platform		9.789 5	0.57 95	8.37 44	
J	Link_mot or	45# Y.S=6 00	61.58	3.17 61	67.4 67	Maxi mu m tensi le stres s <60 0

Appendix Seven Radio Parameters

Radio 1	
Technology	2.4G WIFI
Transmitter / Receiver /Transceiver	Transceiver
Frequency Band	2.412 to 2.472GHz
Transmitter Power	12dBm-19dBm

Radio 2	
Technology	5G WIFI
Transmitter / Receiver /Transceiver	Transceiver
Frequency Band	5.15 to 5.875GHz
Transmitter Power	12dBm-16dBm