

C060D&C100D Latent AGV Maintenance Manual



Zhejiang HuaRay Technology Co., Ltd.

Preface

Automated Guided Vehicles (hereafter referred to as AMR or AGV) are specifically designed for indoor material transportation. Before operating or performing maintenance on the AGV, thoroughly read this manual. You must be fully familiar with the AGV's operation and understand its operational and maintenance instructions; otherwise, serious accidents may occur. After reading, store this manual in a safe, dry location for future reference.

This manual details the AGV's performance specifications, operating procedures, and maintenance precautions. Ensure the device model matches the description herein during use or repair.

This AGV is classified as an industrial handling vehicle and complies with:

- EN ISO 3691-1 (Industrial trucks – Safety requirements and verification – Part 1)
- EN 1295 (Industrial trucks – Electromagnetic compatibility)
- EN 12053 (Safety of industrial trucks – Test methods for measuring noise emissions)
- EN 1175-1 (Safety of industrial trucks – Electrical requirements)
- GB/T 30029-2013 (General Rules for Design of Automated Guided Vehicles)
- ISO 13849-1:2015 Cat. 1 (Safety of machinery – Safety-related parts of control systems)

The AGV must only be used for its intended purpose within specified operational limits.

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Chapter One Safety Instructions

1.1 On-Site Supervision

- Familiarize yourself with all operational guidelines.
- Train operators on AGV usage, safety, and maintenance.
- Ensure operators comply with safety regulations and maintenance protocols.

1.2 Occupational Safety

- Maintain AGV cleanliness and functionality. Perform daily/weekly inspections per maintenance schedules.
- Stop the AGV immediately if defects affecting safety are detected.
- In case of malfunction: Power off and notify supervisors.
- Do not repair components without authorization.
- Operators are responsible for personal and environmental safety.
- Report accidents immediately; leave the AGV undisturbed at the scene.

1.3 Operator Requirements

- Age $\geq$ 18 years.
- Physically and mentally fit (e.g., normal vision/hearing).
- Trained in operation, safety, and maintenance.
- Authorized by on-site supervisors.
- Understand AGV operational characteristics.
- Recommended: Wear safety shoes at all times.

1.4 Emergency Procedures

For malfunctions: Stop operation, power off. Do not use until repaired by authorized personnel.

1.5 Safety Instructions

Trained personnel must oversee AGV safety during all shifts.

- Do not linger or play in the AGV's operating path.
- Do not transport unstable, unbalanced, or unsecured loads with a high center of gravity.
- Do not stand, sit, or walk on loads being handled by the AGV.
- Do not clean the AGV directly with liquids.

- Do not park, operate, adjust, or perform maintenance on slopes.
- Keep clear of the load-handling area.
- Keep clear of load-handling machinery.
- Before performing any maintenance, ensure the power is turned off.
- Before manually pushing the vehicle, release the drive motor brake.
- Use dedicated lifting tools for handling, and avoid applying force to weak areas such as the top cover or bumper sensors.
- Never transport loads exceeding the AGV's rated capacity.
- Never use the AGV to lift personnel.
- Never carry passengers.
- Never touch any moving parts.
- Never insert limbs into gaps in the AGV's chassis or lifting mechanisms.
- Never operate a malfunctioning unit. Immediately repair it or use manual controls to remove it from the system.
- Never modify program parameters (including control and scheduling programs) while the AGV is running.

1.6 Manual Operation

- Use only for fault recovery or maintenance.
- Operate with extreme caution, especially with loads.
- Continuously monitor surroundings.

- Ensure the path is clear of obstacles and personnel before manual movement.
- Ensure the load-handling area is unoccupied before manually operating the AGV.
- Verify AGV positioning during load handling.

1.7 Daily Safety Inspection

The following safety inspections must be performed regularly after system restart (at least once every 24 hours for continuously operating systems):

- **Emergency stop buttons:** Check condition and functionality. The AGV must stop when activated.
- **Obstacle avoidance sensors:** Verify operation. The AGV must stop when an obstacle enters the safety area.
- **Bumper sensors:** Test functionality by pressing each side (front, rear, left, right). The AGV must stop upon contact.
- **Warning devices:** Inspect status lights, indicators, and alarm horns during safety tests.
- **Drive motor brake:** Ensure proper function. The AGV should not be movable when powered off with the brake engaged.

1.8 Comprehensive Safety Inspection

Maintain a log documenting inspections, including date, time, inspector name, and remarks.

Warning: The AGV is a heavy-duty machine. Malfunctioning safety systems can cause severe damage. Report faults discovered by operators

to maintenance personnel immediately.

1.9 Noise

The average operator noise exposure level (LpA) complies with **EN 12053:2001** and **EN ISO 4871** (values listed in the manual).

Note: Higher sound pressure levels may occur due to operational methods, environmental factors, or external noise sources.

1.10 Use in Hazardous Environments

Standard AGVs are prohibited in explosive atmospheres. For AGVs specifically designed for hazardous conditions, please contact your dealer.

1.11 Maintenance and Structural Modifications

Do not modify the AGV without the manufacturer's written approval.

Prohibited actions: Adding/removing parts, welding, or bending components.

Unauthorized modifications will:

- Void the warranty.
- Allow the manufacturer to deny future maintenance.

Exceptions: Modifications are only permitted with the manufacturer's written consent, provided the user:

- Engages qualified safety engineers to design, test, and implement changes.
- Maintains permanent records of modification plans, tests, and execution.
- Updates load labels, stickers, manuals, and other documentation.
- Affixes a permanent, legible label on the AGV detailing:
 - Modification type/date.
 - Name/address of the modifying entity.

Chapter Two Operating Environment

2.1 System Composition

An AGV is a transport vehicle that operates autonomously within a defined area, performing material handling and assembly tasks using a specific navigation method. Typically, AGVs function as part of a larger intralogistics system, such as warehouses, semi-finished goods storage, or integrated manufacturing processes.

Each AGV is equipped with a manual control handle for temporary manual operation in special circumstances.

A single AGV is part of an integrated system that includes:

- Warehouse Management System (WMS)
- AGV Control System
- One or more AGVs
- Charging stations

2.2 Operating Conditions

- **Temperature range:**

- Continuous operation: +5°C to +35°C
- Short-term operation: 0°C to +40°C
- For extreme temperatures (freezing or high-heat environments), consult the manufacturer for specialized AGV models.
- **Recommended humidity:** 40%–80% (non-condensing).
- **Floor requirements:**
 - Load-bearing capacity: Must support AGV + payload weight.
 - Surface friction coefficient: ≥ 0.5 (optimal surfaces: hard concrete or epoxy resin).
- **Flatness:** Must be level (see the manual for specific obstacle clearance details).

2.3 Restrictions

Do NOT operate the AGV in the following conditions:

- Transporting or lifting people.
- Explosive atmospheres.
- Floors with insufficient load capacity.
- If the AGV is damaged or malfunctioning.

2.4 Clearance Requirements

- Ensure adequate overhead clearance for the AGV and its load.
- Verify sufficient space when passing through doorways or narrow passages.

2.5 Floor Load Capacity

The **combined weight of the AGV and its payload** must never exceed the floor's **maximum load capacity**.

2.6 Lift Use

- Transporting AGVs between floors via lift requires supervisor approval.
- Ensure the total weight (AGV + payload) does not exceed the lift's rated capacity.

WARNING: No personnel should enter the lift while the AGV is moving in or out.

Chapter Three Operation Manual

3.1 Vehicle Overview

Figure 3-1 Front Panel

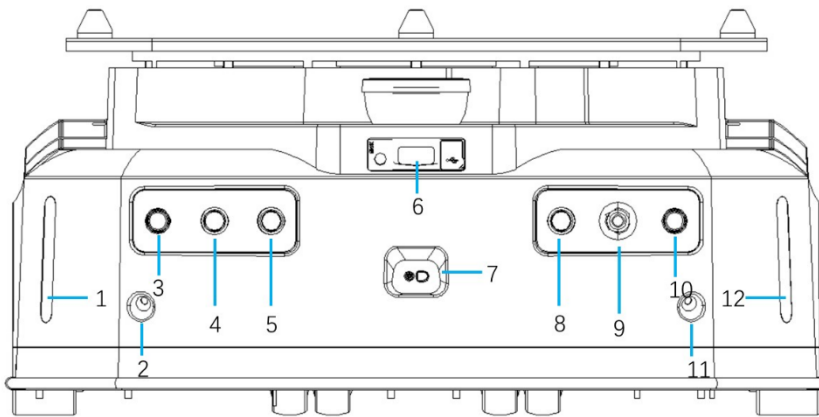


Table 3-1 Front Panel Instruction

No.	Components	Instructions
1、12	LED Strip	● Yellow: Standby; ● Green: Active/Charging; ● Red (1s blink): Obstacle/Error; ● Red (3s blink): Low battery.  NOTE Faults take priority.
2、11	Blocked Orifice	N/A
4	Confirmation Button	For manual intervention confirmation.
5	Maintenance/Auto	Used to switch the device maintenance/automatic mode. ● Pressed: Maintenance mode; motor disabled, AMR can be pushed manually. ● Released: Auto mode (light off). Motor enabled, AMR cannot be pushed.
6	Laser Display Window	Displays the working status and fault codes of the laser.
7	TOF camera	3D obstacle detection
8	Power Button	Press to power on/off.
9	Emergency Stop Button	● Press to halt operations; ● Rotate to reset and self-check.

Figure 3-2 Rear Panel

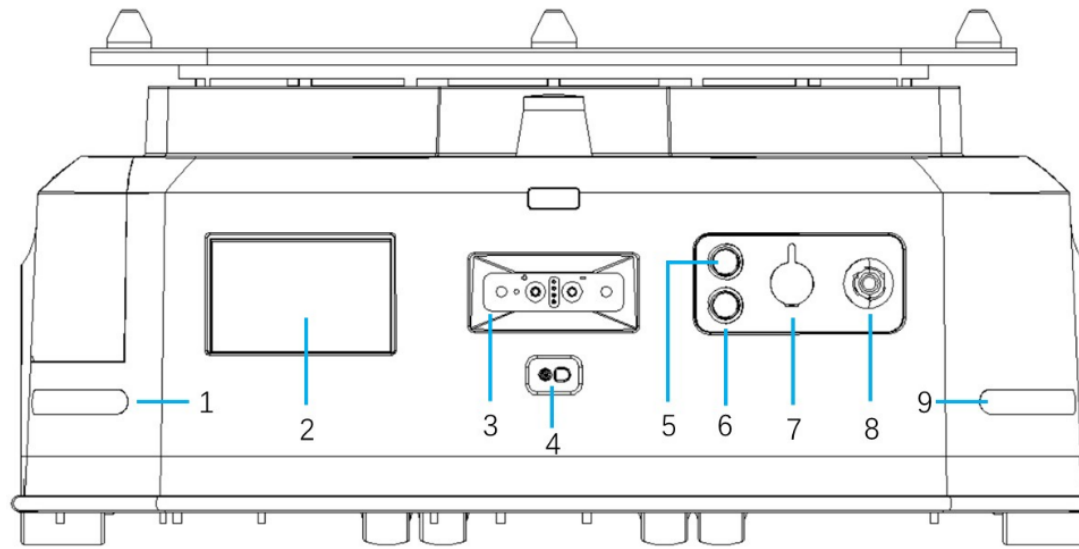


Table 3-2 Rear Panel Instruction

No.	Components	Instructions
1、9	LED Strip	● Yellow: Standby; ● Green: Active/Charging; ● Red (1s blink): Obstacle/Error; ● Red (3s blink): Low battery.  NOTE Faults take priority.
2	Display screen	Displays device real-time running status, faulty/error message and lifting control.
3	Rear Charging Port	Used for auto charging.
4	TOF camera	3D obstacle detection
5	Maintenance/Auto	Used to switch the device maintenance/automatic mode. ● Pressed: Maintenance mode; motor disabled, AMR can be pushed manually. ● Released: Auto mode (light off). Motor enabled, AMR cannot be pushed.
6	Confirm Button	For manual intervention confirmation.
7	Debug Port	For debugging (non-user function).
8	Emergency Stop Button	● Press to halt operations; ● Rotate to reset and self-check.

3.2 Safety Device

Figure 3-3 Safety Device

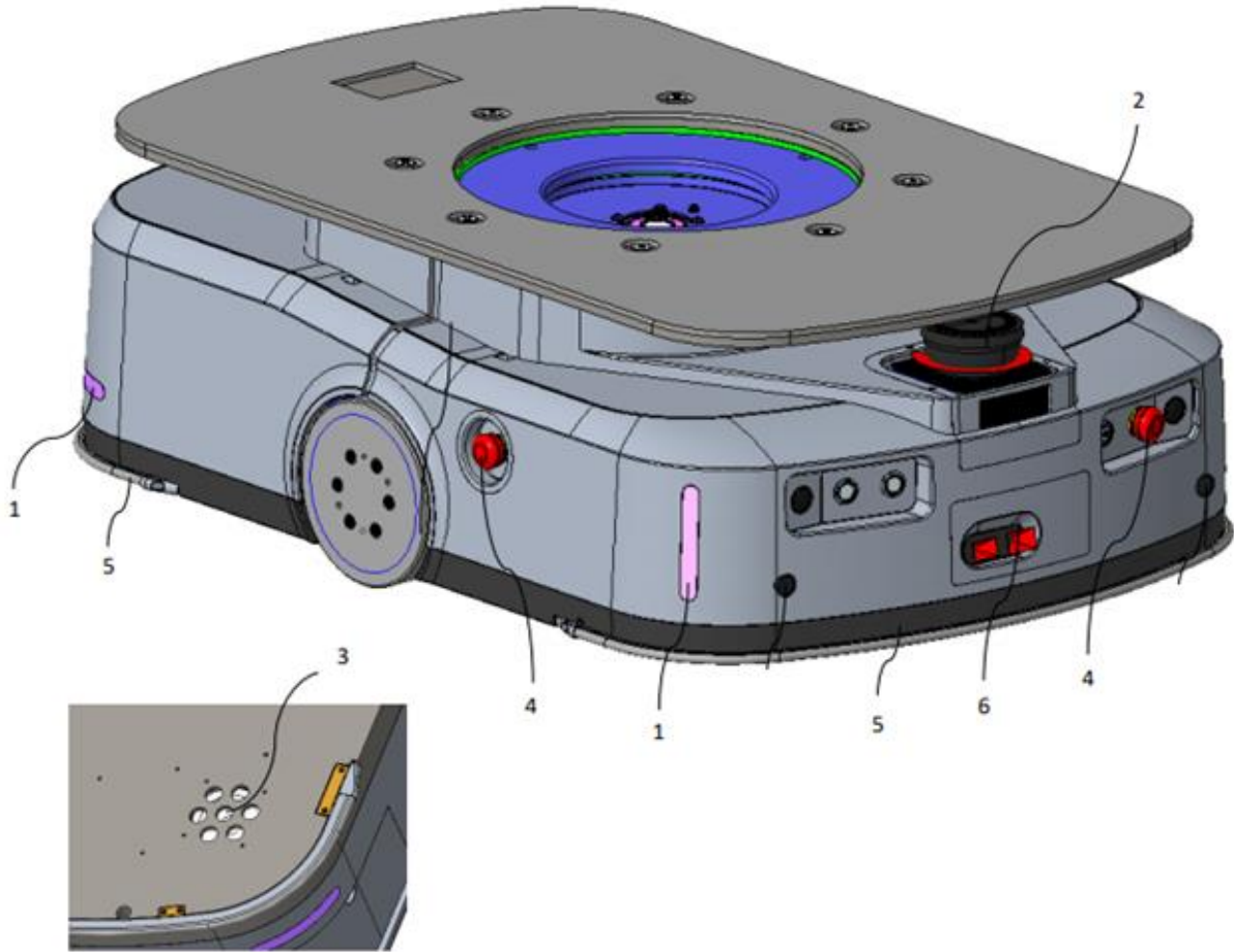


Table 3-3 Safety Device Instruction

No.	Components	Instructions
1	Tri-Color Light	An indicator light for the device's operational status. ● Green Light: ✧ During operation, indicates the device is functioning normally. ✧ During charging, indicates the battery level (represented by segments). ● Yellow Light: ✧ Flashing, indicates the device is in sleep mode. ✧ Steady on, indicates the device is in idle mode. ● Red Light: Indicates a device abnormality, such as network signal issues, device malfunction, low battery, the device already being in a low-battery sleep state, or the device encountering an obstacle.  Flashing red indicates low-battery charging.
2	Laser Scanner	Located at the front (used for obstacle avoidance or navigation), it detects obstacles (people or objects) on the ground or is used for navigation. The obstacle avoidance laser features two safety areas: Safety Area: If an obstacle is detected within this area, a safety stop command is generated, and an audible alarm sounds. Warning Area: If an obstacle is detected within this area, the vehicle will decelerate, and an audible alarm sounds. The warning area is larger than the safety area.
3	Audible Alarms	Located under the vehicle. It plays music during normal operation and emits a warning sound during obstacle avoidance or when a fault occurs.

No.	Components	Instructions
4	Emergency Stop Button	● Pressing this button causes the device's mechanical systems to stop running. ● Rotating and releasing (popping out) this button restores the device to normal operation.
5	Bumper	One located at the front and one at the rear. The AGV stops running upon collision.
6	TOF	One located at the front and one at the rear. 3D obstacle detection



NOTE

Emergency Stop button use only in emergencies. Frequent activation may damage drive motors. Release by rotating clockwise.

Chapter Four Maintenance

Regular inspections by qualified personnel are mandatory to ensure operational integrity. Only trained personnel may perform inspection and repairs.

4.1 Safety Instructions for Maintenance

- Maintain clean work areas (oil/water degrades performance)
- Remove metallic jewelry to prevent short circuits
- Verify clear operational paths before powering on
- Investigate abnormal sounds immediately (do not inspect device before shut down).
- Power down during extended inactivity

4.2 Safety Inspection

The following safety inspections must be performed regularly after system restart (at least once every 24 hours for continuously operating systems):

- **Emergency stop buttons:** Check condition and functionality. The AGV must stop when buttons activated.
- **Obstacle avoidance sensors:** Verify operation. The AGV must stop when an obstacle enters the safety area.
- **Bumpers:** Test functionality by pressing each side (front, rear, left, right). The AGV must stop upon contact.

- **Warning devices:** Inspect status lights, indicators, and alarm horns during safety tests.
- **Drive motor brake:** Ensure proper function. The AGV should not be movable when powered off with the brake engaged.

Weekly Safety Inspection

Perform the following inspections once per week:

- **Roller unit:** Inspect structural integrity and operational stability.

4.3 Daily Inspection

Component	Inspection items	Method & Corrective Action
Laser Safety Scanner	Scratches/Damage	If found, identify the cause and replace (see Section 5.2.1).
	Dust/Obstruction	Clean gently with an alcohol-dampened soft cloth.
	Loose Connection	Check for looseness; if found, re-tighten (see Section 5.2.1).
Bumper	Rubber Strip Detachment	If detached from the frame, investigate and reattach. Replace if irreparable.
	Frame Connection	Check for looseness; tighten if necessary (see Section 5.2.2).
	Surface Damage	If damaged, replace (see Section 5.2.2).
Vehicle body	Coating/Scratches	Inspect for scratches; investigate causes if found.
Battery	Charge Level	Ensure sufficient charge. If not, troubleshoot charging issues.
Indicator	Functionality	Replace if malfunctioning (see Section 5.2.3).

4.4 Monthly Inspection

Component	Inspection items	Method & Corrective Action
Driving Wheel	Wear/Cracks/Delamination	Replace if cracks, delamination, or >2mm wear (see Section 5.4).
	Loose Screws	Re-tighten if necessary (see Sections 5.4 & 5.6).
	Foreign Objects	Remove any entangled debris (see Section 5.4).
Chain	Extension, Wear, Tension	If the chain is worn, too tight, or too loose, lubricant should be applied or the chain should be replaced (See Section 5.6).

4.5 Semi-Annual Maintenance

Component	Inspection items	Method & Corrective Action
Battery	Voltage	Fully charged voltage must be $\geq 50V$.
Vehicle Interior	Dust Accumulation	Blow out dust with compressed air (remove top cover; see Section 5.1).
Omnidirectional wheels	Cracks/Delamination	Replace if damaged (see Section 5.4.1).
	Nut Preload	Re-tighten (see Sections 5.4.1 & 5.6).
Electric Roller	Abnormal Noise	Listen from a distance of 50cm near the roller structure to check for any clicking or sharp abnormal noise during operation.
Driving Wheel	Wear/Cracks/Delamination	Replace if cracks, delamination, or >2mm wear (see Section 5.4.2).
	Loose Screws	Re-tighten if necessary
Chain	Extension, Wear, Tension	If the chain is worn, too tight, or too loose, lubricant should be applied or the chain should be replaced (See Section 5.6).

4.6 Annual Maintenance

Component	Inspection items	Method & Corrective Action
Drive Reducer	Mounting Bolts	Inspect the preload of the reducer mounting screws and the screws on the reducer-motor mounting clamp.
Drive Motor	Connector Aging	Replace if degraded (see Section 5.1).
	Bolt Preload	Re-tighten (see Sections 5.3).
	Cable Wear	Replace if damaged (see Section 5.1).
Power System Inspection	Drive Unit	Check for any abnormal noise from the drive module during robot operation.
Critical Fasteners	Re-torquing	Re-torque the drive wheel mounting screws and caster mounting screws according to the standard screw torque specifications.
Exterior	Robot Casing	Check the robot casing for any cracks or damage.
Laser Safety Scanner	Loose Mounting Screws	Check for looseness. If loose, re-tighten. Refer to Section 5.2 Laser Safety Scanner for the procedure.

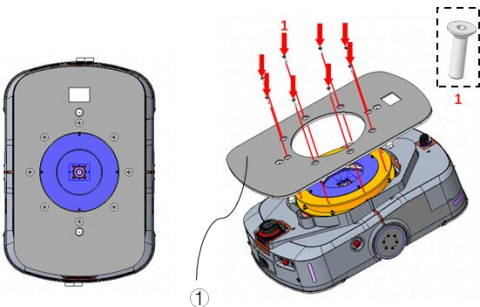
Chapter Five Maintenance

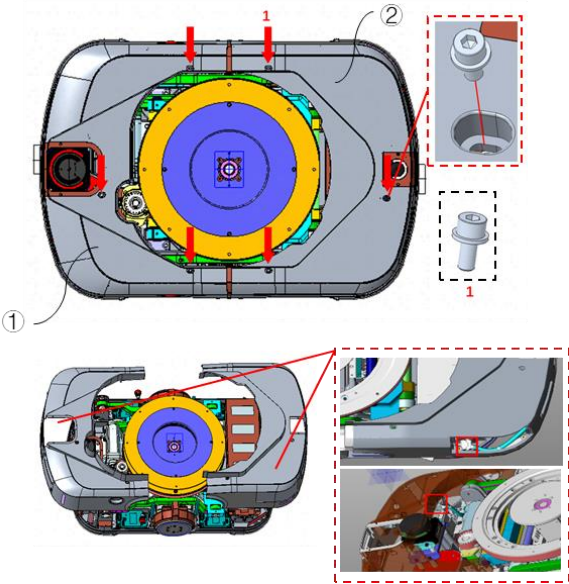
Warning: Only trained personnel may perform repairs. All spares must be original components.

Remarks: Apply threadlocker (243) to all M5+ screws upon reassembly.

5.1 Body Casing

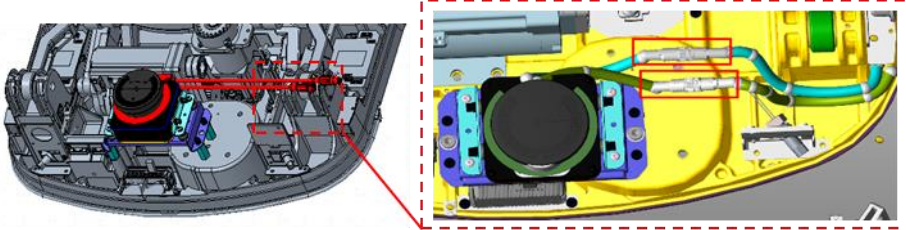
5.1.1 Lifting Deck Assembly and Casing

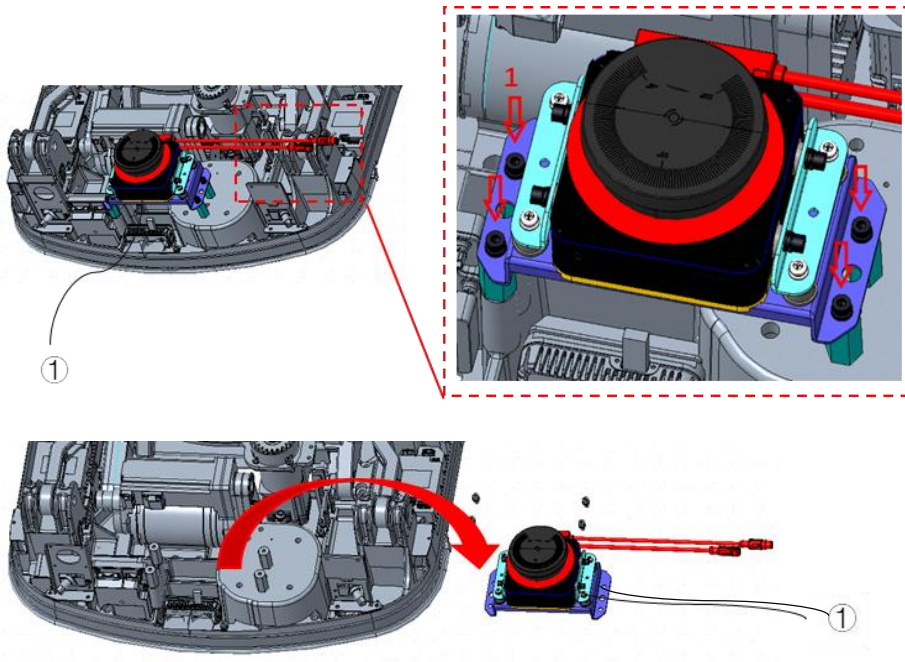
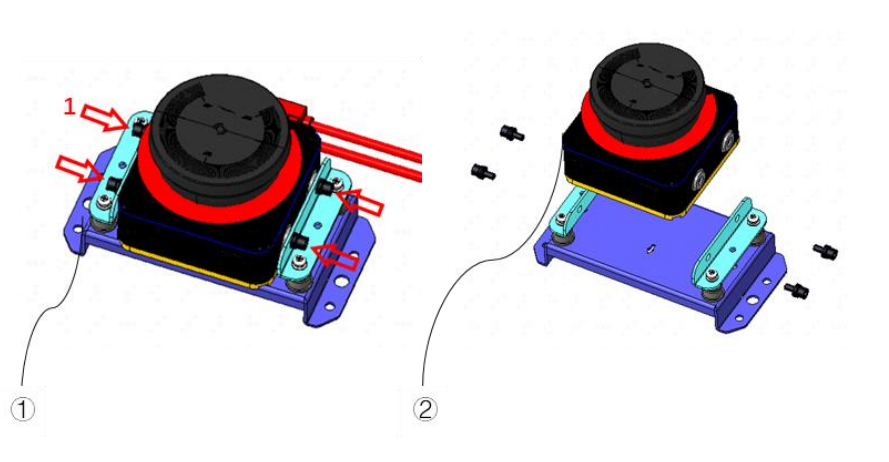
5.1.1 Instructions for Removing the Lifting Deck		
Purpose: To inspect internal components or disconnect/reconnect internal electronic connectors.		
Components Involved: Lifting deck assembly, Vehicle cover assembly		
Tools & Materials: Hex key		
Step	Illustration	Instructions
1. Remove the lifting deck		1. Using a 6mm hex key, gradually loosen and remove the eight M8x30 flat head socket cap screws from the lifting deck assembly (①). After removal, clean the threads and holes to ensure no residue or damage remains.
		2. With two people working together, steadily lift the pallet and carefully place it horizontally in the designated location. Ensure the surrounding area is clean and free of obstacles.
		3. Inspect the pallet and fixed components for any damage or wear. Clean or replace them as needed.
		Precautions
		1. Lifting deck is heavy: Recommend 2-person handling.

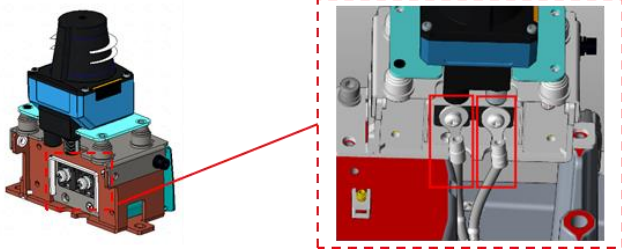
		2. Ensure the pallet is stable and securely gripped to prevent accidents caused by slipping. Both individuals should coordinate when lifting and lowering to avoid pinching fingers.
2. Removing the front and rear covers		1. Using a 4mm hex key, gradually loosen and remove the seven M5x10 socket head cap screws from the front shell assembly (①) and rear shell assembly (②). After removal, clean the threads and holes to ensure no residue or damage remains. 2. Gently wiggle the front shell until loose, then slowly lift it upward. Be careful not to scratch the laser! Avoid pulling on the chassis connectors! If the front shell needs to be completely removed, disconnect the connectors first. 3. Gently wiggle the rear shell until loose, then slowly lift it upward. Be careful not to scratch the laser! Avoid pulling on the chassis connectors! If the rear shell needs to be completely removed, disconnect the connectors first. 4. Place the shells in the designated area. Ensure the placement area is stable and free of obstacles. Handle them gently to avoid damaging or tilting the shells and internal electrical components. Precautions During the front shell disassembly/assembly process, lift it upward carefully. Avoid scratching the laser and pulling on the connecting cables to the chassis! During the rear shell disassembly/assembly process, lift it upward carefully. Avoid scratching the laser and pulling on the connecting cables to the chassis!

5.2 Safety Device

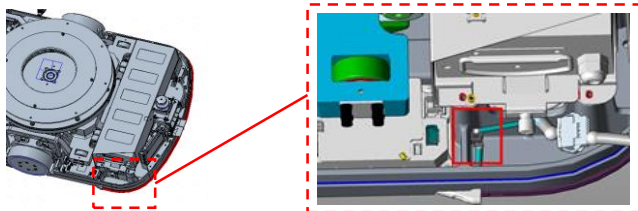
5.2.1 Front/Rear Laser Scanner

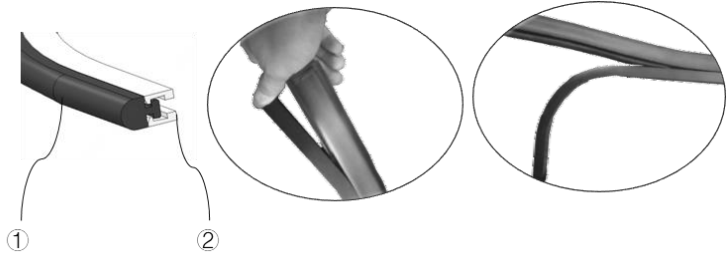
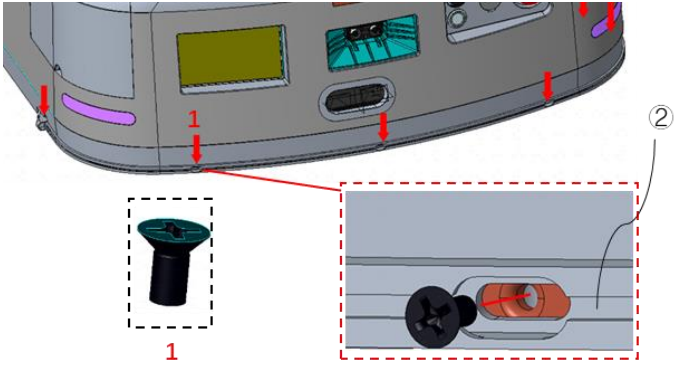
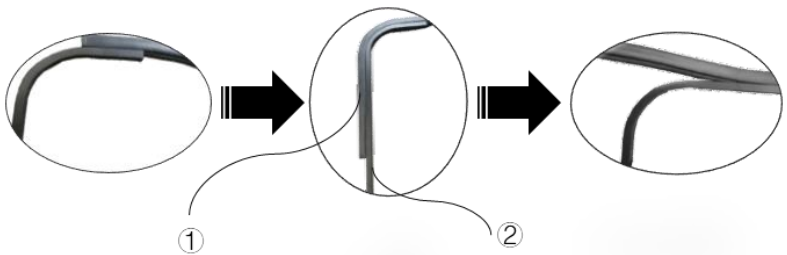
5.2.1 Instructions for Replacing the Laser Scanner		
Purpose: Replacement required due to laser safety scanner failure.		
Components Involved: Vehicle casing assembly, Laser mounting plate, Laser safety scanner		
Tools & Materials: Phillips screwdriver, Hex key, Threadlocker 243		
Step	Step	Step
1. Disassemble Lifting Deck and Casing	Refer to 5.1.1 Illustration for Disassembling the Lifting deck Assembly and Casing	Refer to the detailed process in 5.1.1 Disassembling the Lifting deck Assembly and Casing (When replacing the front laser assembly, only the front casing needs to be disassembled; the same applies for the rear laser).
2. Disconnect Connectors		Disconnect the connectors.
3. Disassemble Laser Bracket		Using a 4mm hex key, gradually loosen and remove the four M5x12 socket head cap screws from the bracket plate of the front laser assembly (①). After removal, clean the threads and holes to ensure no residue or damage.

(Using Front Laser Assembly as an Example)		Pull out the front laser assembly (①) together with its bracket and place it securely. Notes: The laser cable length is limited; do not pull forcefully. There are multiple interfaces for screws and wiring harnesses; it is recommended to mark positions or take photos for reference to ensure correct reassembly.
4. Disassemble Laser Safety Scanner		Using a 4mm hex key, gradually loosen and remove the four M5x12 socket head cap screws from the bracket plate of the front laser assembly (①). After removal, clean the threads and holes to ensure no residue or damage. Carefully remove the laser safety scanner (②), avoiding collision with the installation sheet metal on both sides during removal. Install the new laser by reversing the steps. Replacement is complete. Notes: The laser is a valuable item; handle it gently and avoid touching the lens surface.

5. Reassembly	Refer to respective disassembly steps.	Reassemble in the reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener..
6. Note		Steps for disassembling the rear laser safety scanner are the same as above. When disconnecting connectors in step 2, pay special attention to also remove the charging base connectors.

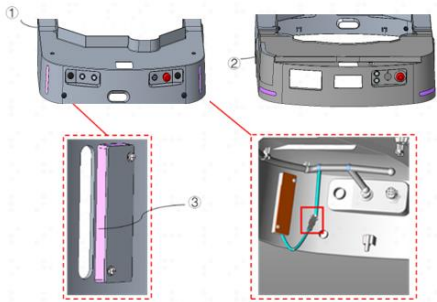
5.2.2 Bumper

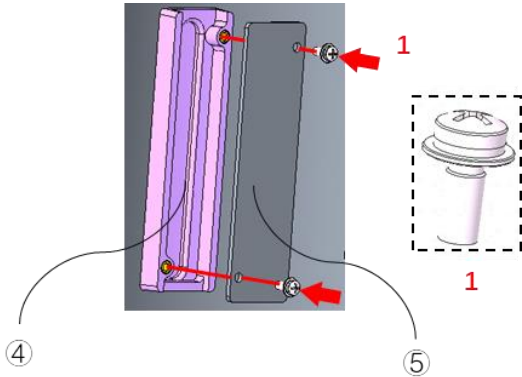
5.2.2 Bumper Removal Guide		
Purpose: Replace bumper.		
Components Involved: Bumper sensor (rubber strip part), Bumper frame, Lifting deck assembly and casing.		
Tools & Materials: Phillips screwdriver, Soapy water (optional), Threadlocker 243		
Step	Illustration	Instructions
1. Removing the top cover	Refer to 5.1.1 Illustration for Disassembling the Lifting deck Assembly and Casing.	Refer to detailed process in 5.1.1 Disassembling the Lifting deck Assembly and Casing.
2. Unplugging		Unplug connectors used for connecting the bumper to other cables.

3. Removing the bumper rubber strip		1. Starting from the end without wiring, pinch the contact rubber strip (①) and pull it upward at an angle to separate it from the aluminum channel frame (②). Continue this method sequentially towards the end with wiring until the entire strip is removed. Precautions 1. Starting from the unwired end makes removal easier. 2. The illustration does not show the full vehicle; the frame is actually fixed to the vehicle.
4. Remove & Secure Aluminum Channel Frame (Skip to Step 6 if not needed)		Steps Using a PH1 Phillips screwdriver, gradually loosen and remove the twelve M3x6 flat head Phillips screws (six front, six rear) from the aluminum channel frame (②). After removal, clean the threads and holes. 2. Replace and fix the aluminum channel framework.
5. Installing the rubber strip		Steps 1. Apply soapy water to the aluminum channel where the contact rubber strip (①) will be fixed. 2. Insert the unwired end of the contact rubber strip into one end of the aluminum channel frame (②). 3. Push the strip along the channel until one end aligns with the channel.

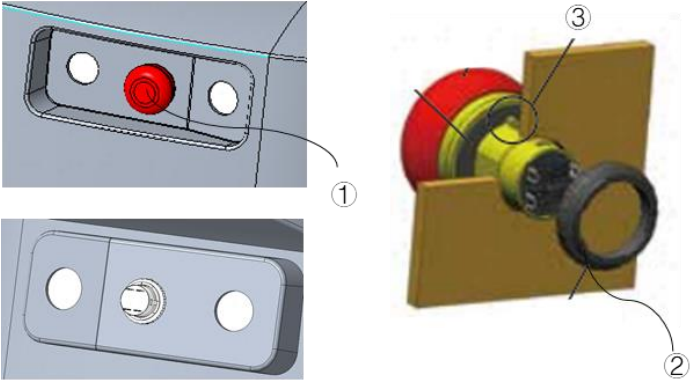
		4. Press the last end into the channel to complete installation.
		Precautions
		1. The soapy water is used for reducing the friction coefficient between the rubber strip and channel.
6. Reassembling	See the disassembly steps of the parts.	Stuff the cables inside the vehicle body and connect them. Reassemble other parts in reverse order of disassembly.

5.2.3 Indicator

5.2.3 Indicator Replacement Guide		
Purpose: Replacement required due to indicator failure.		
Components Involved: Lifting deck, Front casing, Light strip mounting plate, Indicator light		
Tools & Materials: Phillips screwdriver, Hex key, Threadlocker 243		
Step	Illustration	Instructions
1. Removing the top cover	Refer to 5.1.1 Illustration for Disassembling the Lifting deck Assembly and Casing.	Refer to detailed process in 5.1.1 Disassembling the Lifting deck Assembly and Casing.
2. Disassemble Light Strip Assembly (Example: Front Casing Light Strip)		1. The light strip assembly (③) is adhesively bonded to the casing (①). During disassembly, gently pry the gap at the joint using an appropriate tool until loose.
		2. Disconnect the connectors.
		3. Remove the light strip assembly (③) for the next step.
		Precautions
		1. Do not forcibly pull the light strip before the connectors are fully disconnected to avoid damaging them.

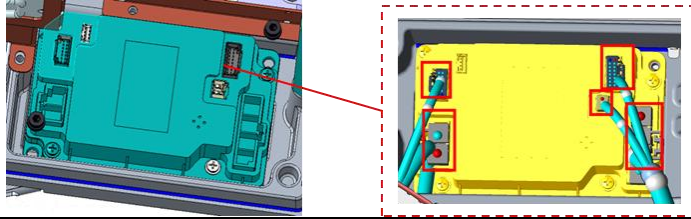
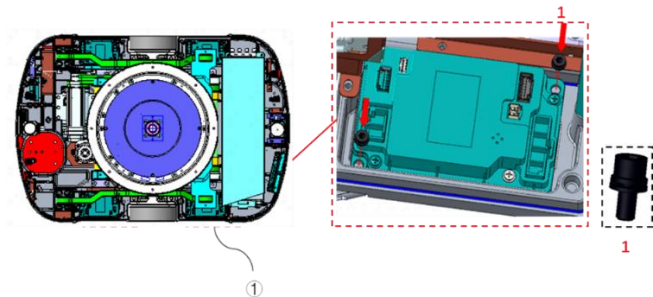
		2. Apply even force when prying the adhesive part to avoid scratching the casing surface. 3. When replacing the indicator light on the other side, disassemble the corresponding fasteners.
3. Replacing the light strip		1. Using a PH1 Phillips screwdriver, gradually loosen and remove the four M3x6 flat head Phillips screws (two on each side) from the light strip assembly (③). After removal, clean the threads and holes. 2. Separate the light strip (④) from the light strip mounting plate (⑤). After replacing with a new light strip, reinstall the screws. Peel off the backing adhesive on the new strip, align it with the holes on the casing, and reinstall to complete the replacement.
4. Reassembling	See the disassembly steps of the parts.	Reassemble in reverse order of disassembly.

5.2.4 Emergency Stop Button

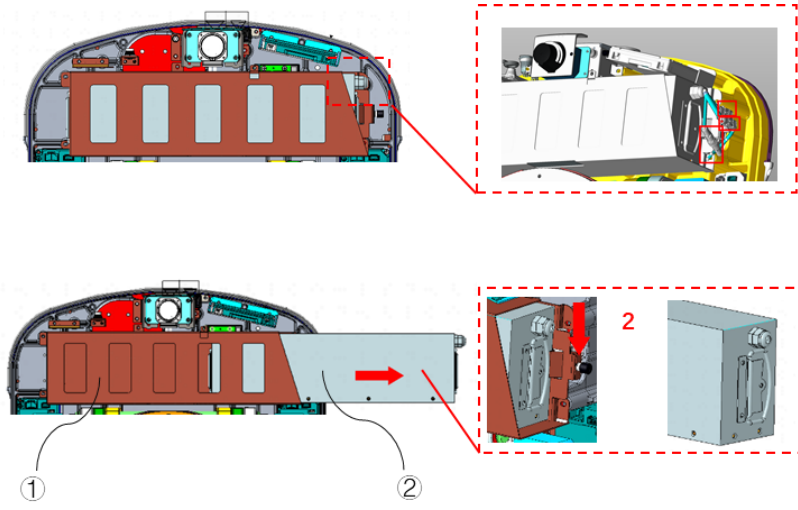
5.2.4 Emergency Stop Button Replacement Guide		
Purpose: Replacement required due to Emergency Stop Button failure.		
Components Involved: Plastic front/rear casing, Emergency Stop Button		
Tools & Materials: Special lock ring wrench (Model: MT-001).		
Step	Illustration	Instructions
1. Removing the front and rear covers	See 5.1.1	See 5.1.1
2. Removing the emergency stop button		1. Using the special lock ring wrench (Model: MT-001), unscrew the plastic nut (②) on the switch counterclockwise to complete switch removal.
		Precautions 1. Disassembly of other button switches is similar to the front emergency stop switch: loosen the nut, disconnect the connector, then pull out.
		2. Do not use pliers or similar tools to tighten the lock ring, and avoid over-tightening to prevent damage.
4. Reassembling	See the disassembly steps of the parts.	1. Reassemble in reverse order: Insert the operation unit from the front through the mounting hole, position the anti-rotation lug (③) facing directly upward, then use the special lock ring wrench (Model MT-001) to tighten the lock ring to the recommended torque of 0.88 N·m.

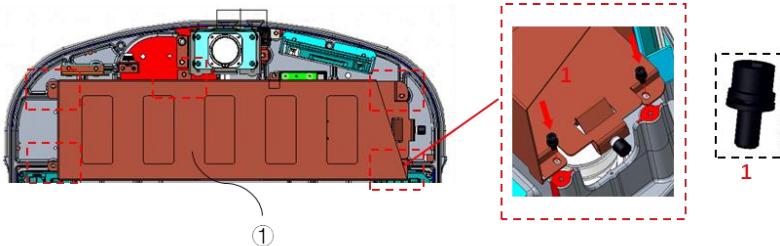
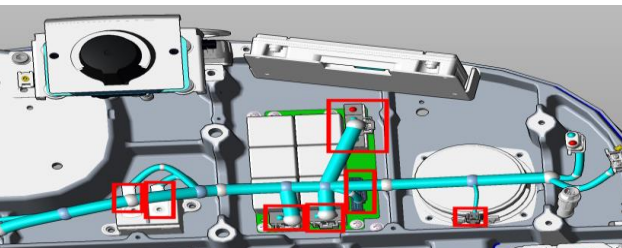
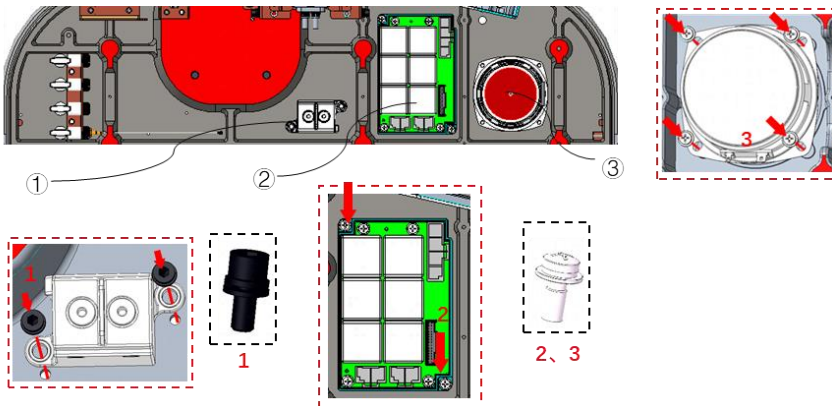
5.3 Chassis Module

5.3.1 Motor Drive Removal

5.3.1 Motor Drive Replacement Guide		
Reason for Operation: Replacement of Motor Drive		
Components Involved in the Operation: Front/Rear casings, lifting deck.		
Tools & Materials: Hex key set		
Step	Illustration	Instructions
1. Removing the lifting deck and casing	Refer to 5.1.1 Illustration for Disassembling the Lifting deck Assembly and Casing.	Refer to detailed process in 5.1.1 Disassembling the Lifting deck Assembly and Casing.
2. Disconnect Connectors		1. Press the connector lock and gently pull to disconnect.
3. Disassemble Motor Drive		1. Using a 4mm hex key, gradually loosen and remove the two M5x12 socket head cap screws located diagonally on the motor drive (①). After removal, clean the threads and holes. 2. Gently pry the drive unit away from the thermal pad using the side of a hex key. Maintain gentle, even force to avoid damaging the drive.
4. Reassembling	See the disassembly steps of the parts.	Reassemble in the reverse order of disassembly.

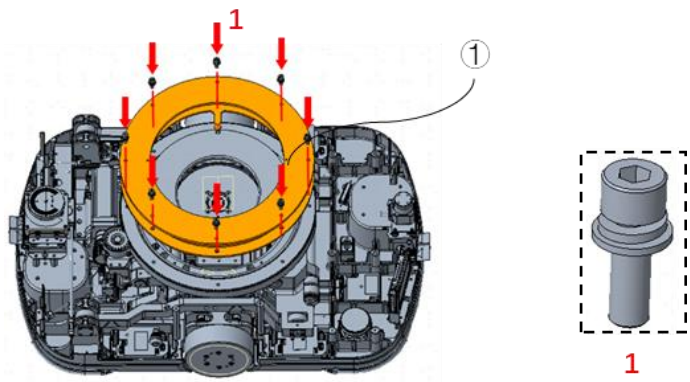
5.3.2 Speaker, I/O Box, Relay

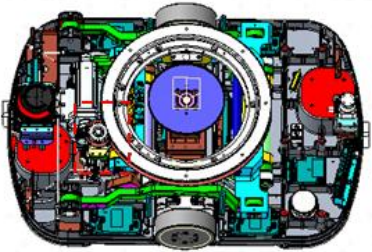
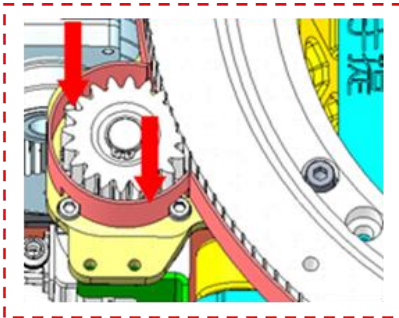
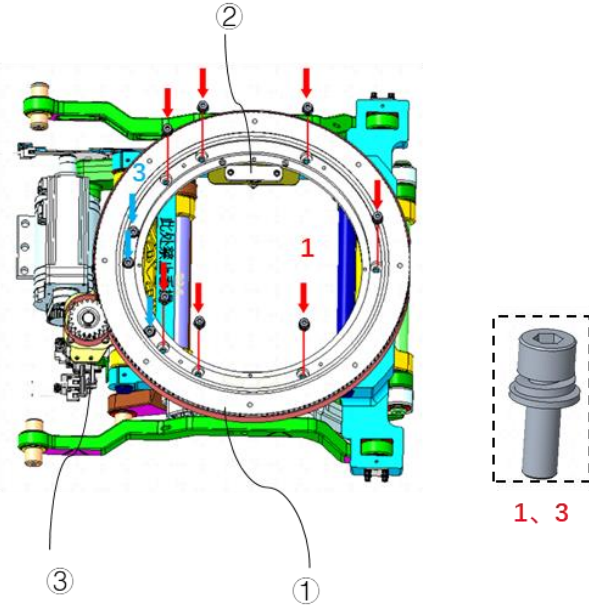
5.3.2 Speaker, Relay Board, Relay Replacement Guide		
Purpose: Replace speaker, relay board, relay.		
Components Involved: Rear casing, lifting deck, battery compartment.		
Tools & Materials: Phillips screwdriver, Hex key		
Step	Step	Step
1. Disassemble Lifting deck and Casing	Refer to 5.1.1 Illustration for Disassembling the Lifting deck Assembly and Casing.	Refer to detailed process in 5.1.1 Disassembling the Lifting deck Assembly and Casing.
2. Remove Battery		1. Press connector locks and gently pull to disconnect. For the aviation plug, rotate counterclockwise to disconnect. 2. Rotate the PEM captive screws counterclockwise, applying even force until the limit part loosens. 3. Grasp the handle on the battery (②), gently lift it, and slowly remove it from the battery compartment (①). Avoid pulling on the connecting cables during the process. Place the battery in a safe, stable location. Ensure all procedures follow relevant safety regulations to prevent accidents.
		1. Using a 4mm hex key, gradually loosen and remove the five M5x12 socket head cap screws from the battery

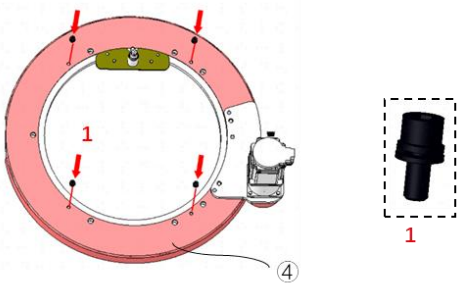
3. Remove Battery Compartment		compartment (①). After removal, clean the threads and holes. 2. Place the battery compartment in the designated area, ensuring it is stable and obstacle-free. Handle gently to avoid damage or tilting.
4. Disconnect Connectors		1. Press connector locks and gently pull to disconnect. For terminals on the relay, unscrew the nuts counterclockwise.
5. Replace Speaker, Relay Board, Relay		1. Replace Relay: Using a 4mm hex key, gradually loosen and remove the <u>two M5x12 socket head cap screws</u> located diagonally on the relay (①). After removal, clean the threads and holes, and disconnect the connectors. 2. Replace I/O Box: Using a PH2 Phillips screwdriver, gradually loosen and remove the two M4x10 Phillips flat head machine screws from the I/O box (②). After removal, clean the threads and holes, and disconnect the connectors. 3. Replace Speaker: Using a PH2 Phillips screwdriver, gradually loosen and remove the four M4x10 Phillips flat head machine screws from the speaker (③). After removal, clean the threads and holes, and disconnect the connectors.

6. Reassembly	Refer to respective disassembly steps.	1. Reassemble in the reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener .
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5.3.3 Slewing Support

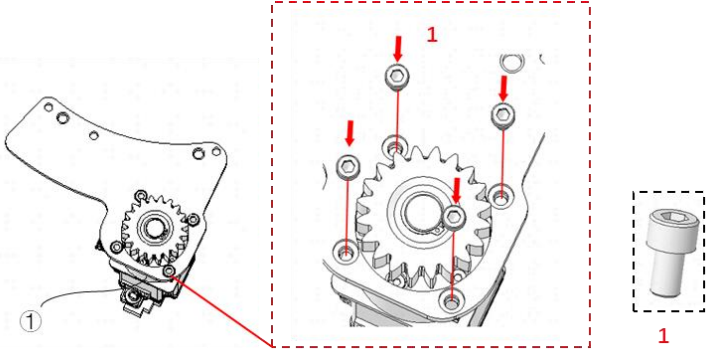
5.3.3 Slewing Supports Replacement/Maintenance Guide		
Purpose: Slewing Supports Replacement/Maintenance (greasing)		
Components Involved: Front/Rear casings, Lifting deck, Slewing supports		
Tools & Materials: Phillips screwdriver, 5mm/6mmHex key, Threadlocker 243, Grease gun (for maintenance), Changcheng lubricant 7014-1 (for maintenance)		
Step	Illustration	Instructions
1. Remove the lifting deck and casing	Refer to 5.1.1 Illustration for Disassembling the Lifting Deck Assembly and Casing	Refer to detailed process in 5.1.1 Disassembling the Lifting Deck Assembly and Casing.
2. Disassemble Spacer Block		1. Use a 6mm hex key to gradually loosen and remove the eight M5x12 hex socket head cap combo screws on the Spacer Block-①. After removal, clean the threads and screw holes to ensure no residue or damage. 2. Place the spacer block in a designated area. Ensure the area is level and unobstructed. Handle with care to avoid damage or tilting. Precautions 1. The hex key must be inserted from the corresponding hole above the screw.

3. Slewing Ring Gear Lubrication (Skip to next step if replacing)	 	1. Use a grease gun to inject Grease 7014-1 between the gears of the slewing ring. Rotate the outer ring during greasing to ensure even distribution of the grease. 2. Disconnect the wiring between the rotating motor (③) and the homing sensor (②).
4. Disassemble Slewing Support		1. Use a 6mm hex key to gradually loosen and remove the seven M8x20 hex socket head cap combo screws on the slewing support-①. After removal, clean the threads and screw holes. 2. Disconnect the wiring between the Rotation Motor-③ and the Homing Sensor-②. 3. Remove the slewing support-① from the machine. Use a 6mm hex key to loosen and remove the three M8x20 hex socket head cap combo screws on the rotation motor mounting plate. After removal, clean the threads and screw holes. Separate the rotation motor from the slewing ring. Precautions: 1. Do not damage the connectors when disconnecting the wiring for the rotation motor and homing sensor. 1. Install new bearing, then reverse disassembly steps.

5. Disassemble Oil Sump		1. Use a 4mm hex key to gradually loosen and remove the four M5x12 hex socket head cap combo screws on the Oil Sump-④. After removal, clean the threads and screw holes.
6. Replacement & Reassembly	Refer to respective disassembly steps.	1. Reassemble in reverse order of disassembly. Apply torque to all fasteners according to the requirements specified in section 5.6 Fastener. Note: When installing the slewing ring, ensure the mounting surface is clean and free of debris, impurities, etc.

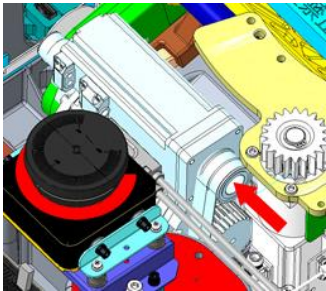
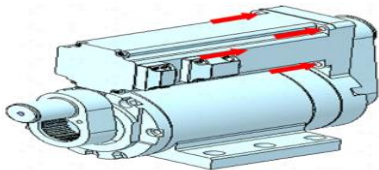
5.3.4 Rotating Motor

5.3.4 Rotating Motor Replacement Work Instructions		
Purpose: Replacement of Rotating Motor		
Components Involved: Top cover, Lifting deck, Gears, Rotating motor		
Tools & Materials: Hex key set, diagonal cutters, threadlocker 243, cable ties.		
Step	Illustration	Instructions
1. Disassemble Lifting Deck and Casing	Refer to 5.1.1 Illustration for Disassembling the Lifting Deck Assembly and Casing.	Refer to detailed process in 5.1.1 Disassembling the Lifting Deck Assembly and Casing

2. Remove Slewing support	Refer to 5.3.3 related illustration.	Refer to detailed process in 5.3.3 Removing the Slewing Support.
3.Remove Rotating Motor		Using a 5mm hex key, gradually loosen and remove the four M6x10 socket head cap screws from the rotation motor (①). After removal, clean the threads and holes, then replace the motor.
4. Reassembly	See the respective disassembly steps.	- Reassemble in reverse order of disassembly. - Test motor operation before full reassembly to avoid rework. - Replace any cut cable ties.

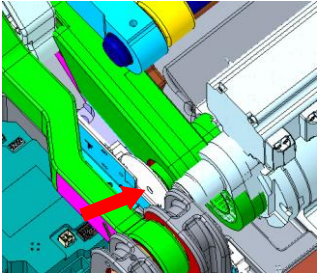
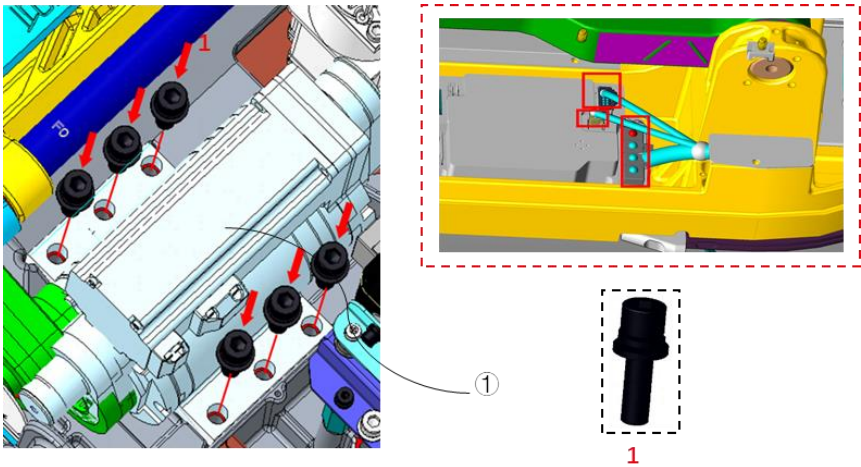
5.3.5 Lifting Synchronization Belt/Motor

5.3.5 Lifting Motor/Synchronization Belt Replacement Work Instruction		
Purpose: Replacement of Lifting Motor/Synchronization Belt		
Components Involved: Front Cover, Lifting Deck, Slewing Support, Lifting Motor		
Tools & Materials: Hex key set, Cable Ties, Threadlocker 243		
Step	Illustration	Instructions
1. Disassemble Lifting Deck and Casing	Refer to 5.1.1 Illustration for Disassembling the Lifting Deck Assembly and Casing.	Refer to detailed process in 5.1.1 Disassembling the Lifting Deck Assembly and Casing.
2. Remove Slewing Support	Refer to 5.3.3 related illustration	Refer to detailed process in 5.3.3 Removing the Slewing Support

3. Replace Synchronization Belt		1. Using a 4mm hex key, gradually loosen and remove the four M5 screws from the timing pulley. After removal, clean the threads and holes. Remove the timing pulley and belt for replacement.
4. Replace Lifting Motor		1. Using a 4mm hex key, gradually loosen and remove the four M5x20 screws from the lifting motor. After removal, clean the threads and holes.
		Precaution
		1. It is easier to remove the two lower screws first, then the two upper ones.
5. Reassembly	See the respective disassembly steps.	1. Reassemble in reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener .

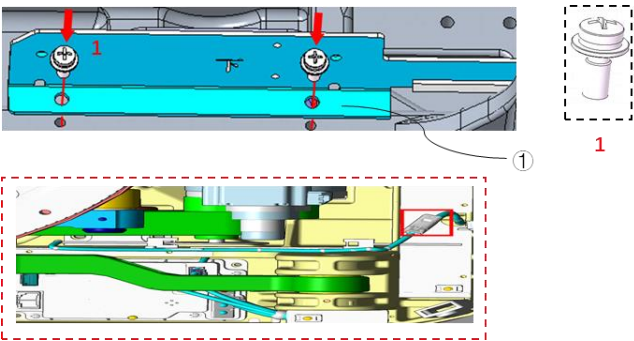
5.3.6 Lifting Reducer

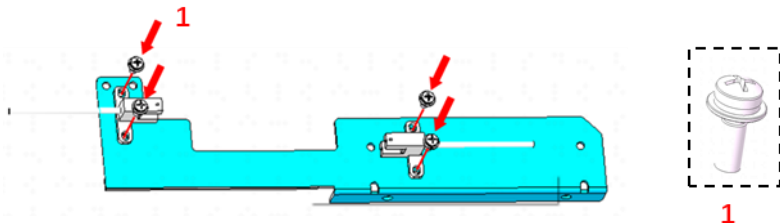
5.3.6 Lifting Reducer Replacement Guide		
Purpose: Replacement of the lifting reducer.		
Components Involved: Front and Rear Covers, Lifting Deck, Slewing Support, Lifting Reducer		
Tools & Materials: Hex key set, diagonal cutters, cable ties, threadlocker 243		
Step	Illustration	Instructions

1. Lifting	N/A	Operate the touch screen to manually raise the lifting mechanism to its highest position.
2. Disassemble Lifting Deck and Casing	Refer to 5.1.1 Illustration for Disassembling the Lifting deck Assembly and Casing.	Refer to detailed process in 5.1.1 Disassembling the Lifting deck Assembly and Casing
3. Remove Slewing Support	Refer to 5.3.3 related illustration.	Refer to detailed process in 5.3.3 Removing the Slewing Support.
4. Remove Limit Trigger Plate		Using a 5mm hex key, gradually loosen and remove the M6 flat head screw from the lifting limit trigger plate. After removal, clean the threads and hole, then remove the trigger plate.
5. Replace Lifting Reducer		- Using an 8mm hex key, gradually loosen and remove the six M10x35 socket head flat head machine screws from the lifting reducer (①). After removal, clean the threads and holes. - Disconnect the lifting motor connector, then remove and replace the lifting reducer. Note: - When removing the reducer, another person should hold and secure the lifting mechanism (or use a screwdriver inserted through the positioning holes of the inner and outer links to fix it) to prevent it from dropping rapidly.

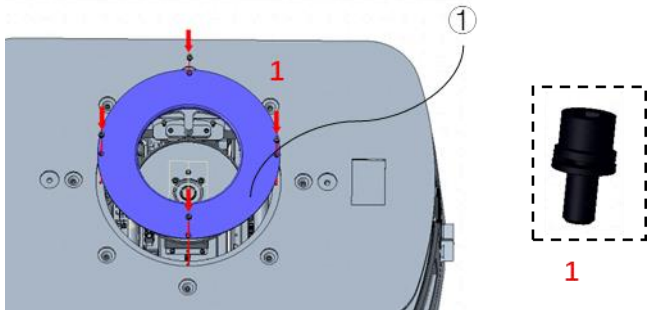
6. Reassembly	Reassemble in reverse order of disassembly.	1. Reassemble in reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener .
		2. Note: If a screwdriver is used to secure the lifting mechanism, it must be removed before the self-check to avoid overcurrent and corrupt the mechanism.

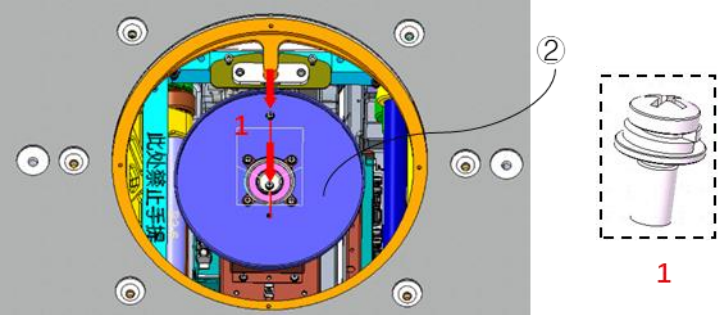
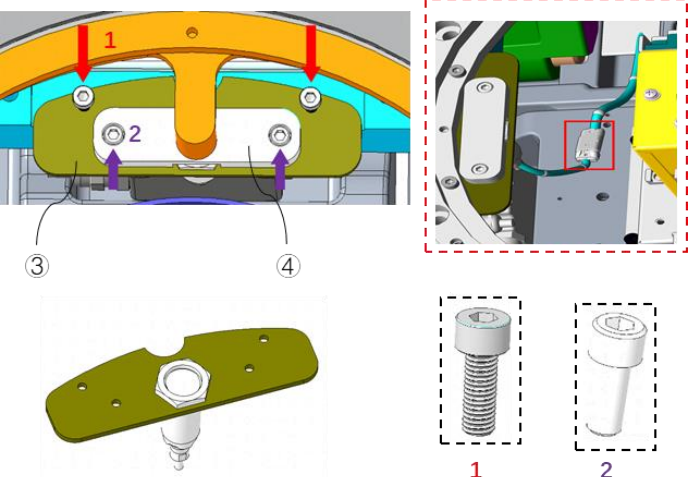
5.3.7 Lifting Proximity Switch

5.3.7 Lifting Proximity Switch Replacement Guide		
Purpose: Inspect internal vehicle components or disconnect/connect electronic component connectors inside the vehicle.		
Components Involved: Lifting Deck, front/rear housing, lifting proximity sensor.		
Tools & Materials: Long-handle Phillips screwdriver, 5mm hex key, 6mm hex key.		
Step	Illustration	Instructions
1. Lower	N/A	Operate the touchscreen to manually lower the lifting mechanism to the lowest position; if it is already at the lowest position, skip this step.
2. Remove Lifting deck and Casing	Refer to 5.1.1 Illustration for Disassembling the Lifting deck Assembly and Casing.	Refer to detailed process in 5.1.1 Disassembling the Lifting deck Assembly and Casing.
3. Remove Proximity Sensor Mounting Plate		1. Using a PH2 Phillips screwdriver, gradually loosen and remove the two M4x10 Phillips flat head machine screws from the proximity sensor mounting plate (①). After removal, clean the threads and holes.
		2. Disconnect the proximity sensor connector (press the lock and gently pull), then remove the mounting plate

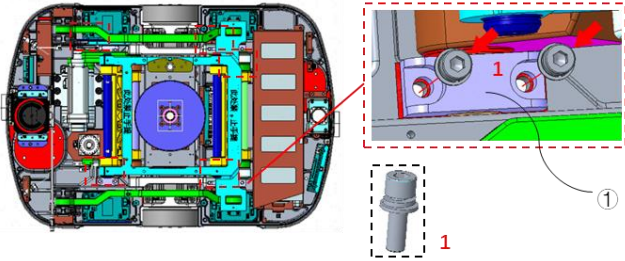
4. Replace Lifting Proximity Sensor		1. Using a PH1 Phillips screwdriver, gradually loosen and remove the four M3x8 Phillips flat head machine screws from the proximity sensor mounting plate (①). After removal, clean the threads and holes, then replace the sensor.
5. Reassembly	See the respective disassembly steps.	Reassemble in reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener .

5.3.8 Rotating Proximity Switch

5.3.8 Rotating Proximity Switch Replacement Guide		
Purpose: Replace the rotating homing proximity sensor.		
Components Involved: Cover plate, upper camera pallet, rotating proximity sensor.		
Tools & Materials: Phillips screwdriver, hex key set, adjustable wrench.		
Step	Illustration	Instructions
1. Replace the cover plate		1. Using a 4mm hex key, gradually loosen and remove the four M5x12 socket head cap screws from the cover plate (①). After removal, clean the threads and holes, then remove the panel.

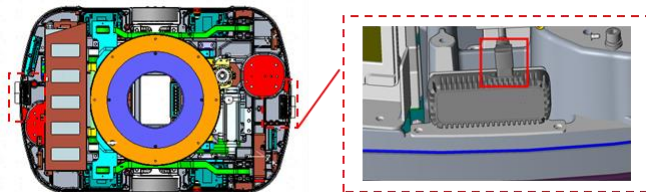
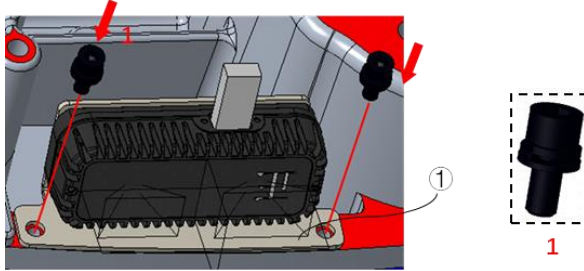
2. Remove Upper Camera Pallet		1. Using a PH2 Phillips screwdriver, gradually loosen and remove the two M4x10 Phillips flat head machine screws from the upper camera pallet (②). After removal, clean the threads and holes, then remove the pallet.
3. Remove Rotating Sensor		1. Using a 4mm hex key, gradually loosen and remove the two M5x14 socket head cap screws from the rotating homing sensor mounting plate (③). After removal, clean the threads and holes, then remove the mounting plate. 2. Using a 4mm hex key, gradually loosen and remove the two M5x12 socket head cap screws from the photoelectric sensor mounting limit piece (④). After removal, clean the threads and holes. 3. Use an adjustable wrench to loosen the sensor's securing nut, disconnect its connector, and replace the rotating sensor. Precaution The M5x14 screws have strict length requirements here; they cannot be replaced with other screws.
4. Reassembly	See the respective disassembly steps.	Reassemble in reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener.

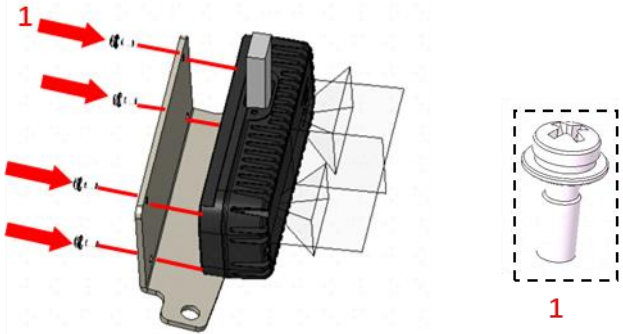
5.3.9 Lifting Mechanism

5.3.9 Lifting Mechanism Replacement Guide		
Purpose: Replacement required due to lifting mechanism failure.		
Components Involved: Lifting Deck, front/rear casing, lifting proximity sensor, lifting mechanism		
Tools & Materials: Long-handle Phillips screwdriver, hex key set, 5mm Torx wrench		
Step	Illustration	Instructions
1. Lower	N/A	Operate the touch screen to manually lower the lifting mechanism to its lowest position. Skip this step if already at the lowest position.
2. Disassemble Lifting deck and Casing	Refer to 5.1.1 Illustration for Disassembling the Lifting deck Assembly and Casing.	Refer to detailed process in 5.1.1 Disassembling the Lifting deck Assembly and Casing.
3. Remove Lifting Proximity Sensor Mounting Plate	Refer to 5.3.7 Lifting Proximity Switch Replacement Work Instructions.	Refer to detailed process in 5.3.7 Lifting Proximity Switch Replacement.
4. Remove Lifting Mechanism		1. Using a 6mm hex key, gradually loosen and remove the eight M8x25 socket head cap screws from the lifting fixed block (①). After removal, clean the threads and holes, then remove the fixed block.
		2. Using a 5mm Torx wrench, loosen the two securing screws (M6 flat head Torx screws) for the lifting mechanism's short shafts. Remove the smooth shaft first, then remove the entire mechanism.
		Precaution When handling the lifting mechanism, be careful to avoid pinching fingers. Hold the left and right links of the mechanism;

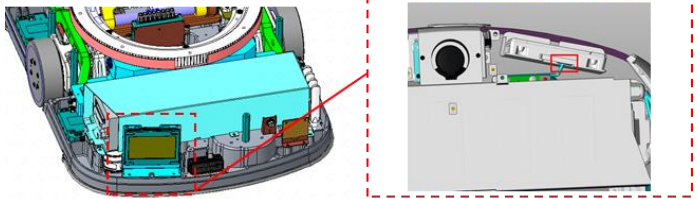
		do not hold the front/rear links or the smooth shaft (as shown in the diagram).
5. Reassembly	See the respective disassembly steps.	Reassemble in reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener .

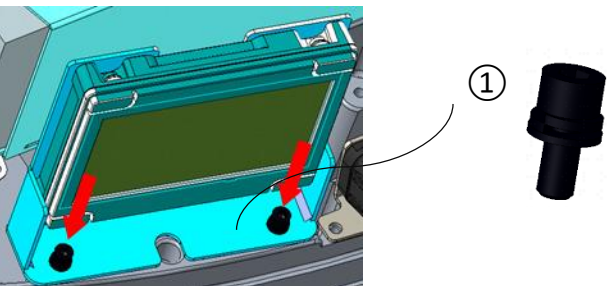
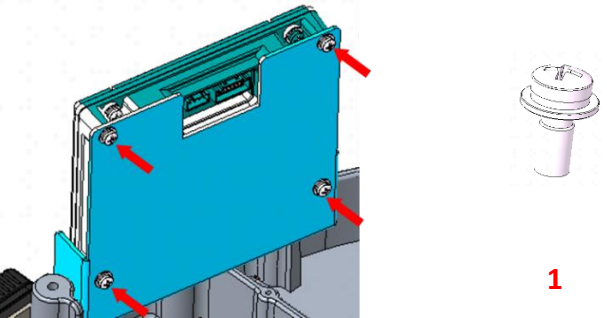
5.3.10 TOF

5.3.10 TOF Assembly Replacement		
Purpose: TOF assembly damage requires replacement.		
Components Involved: Lifting deck, front/rear casings, TOF assembly.		
Tools & Materials: Long-handle Phillips screwdriver, hex key set.		
Step	Illustration	Instructions
1. Disassemble Lifting deck and Casing	Refer to 5.1.1 Illustration for Disassembling the Lifting deck Assembly and Casing.	Refer to detailed process in 5.1.1 Disassembling the Lifting deck Assembly and Casing.
2. Disconnect Connectors		1. Disconnect the connectors.
3. Remove TOF Mounting Plate		1. Using a 4mm hex key, gradually loosen and remove the two M5x12 socket head cap screws from the TOF mounting plate (①). After removal, clean the threads and holes, then remove this assembly.

4. Remove and Replace TOF Sensor		1. Using a PH0 Phillips screwdriver, gradually loosen and remove the four M2x6 Phillips pan head machine screws from the TOF mounting plate (①). After removal, clean the threads and holes, then remove and replace the TOF sensor.
5. Reassembly	See the respective disassembly steps.	Reassemble in reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener .

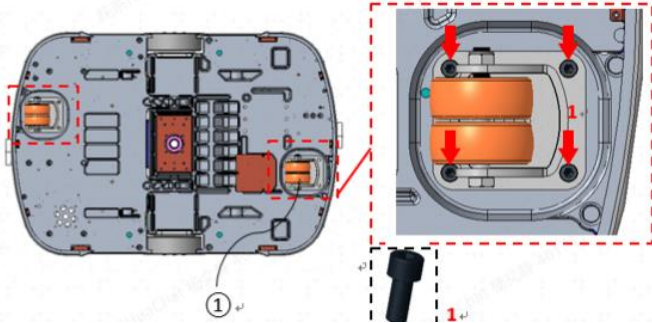
5.3.11 Screen

5.3.11 Screen Assembly Replacement		
Purpose: Screen damage requires replacement.		
Components Involved: Lifting deck, front/rear casings, TOF assembly.		
Tools & Materials: Long-handle Phillips screwdriver, hex key set.		
Step	Illustration	Instructions
1. Disassemble Lifting Deck and Casing	Refer to 5.1.1 Illustration for Disassembling the Lifting deck Assembly and Casing.	Refer to detailed process in 5.1.1 Disassembling the Lifting deck Assembly and Casing.
2. Disconnect Connectors		1. Disconnect the corresponding connectors.

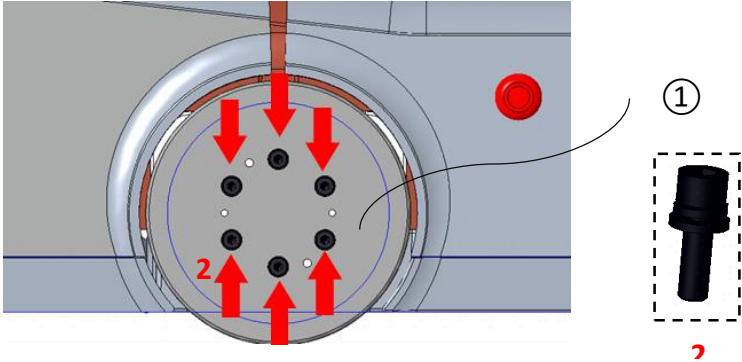
3. Remove TOF Mounting Plate		1. Using a 4mm hex key, gradually loosen and remove the two M5x12 socket head cap screws from the screen mounting plate (①). After removal, clean the threads and holes, then remove the screen assembly.
4. Remove and Replace TOF Sensor		1. Using a PH2 Phillips screwdriver, gradually loosen and remove the four M4x10 Phillips pan head machine screws from the TOF mounting plate (①). After removal, clean the threads and holes, then remove and replace the TOF sensor.
5. Reassembly	See the respective disassembly steps.	Reassemble in reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener.

5.4 Drive Unit

5.4.1 Caster Wheel

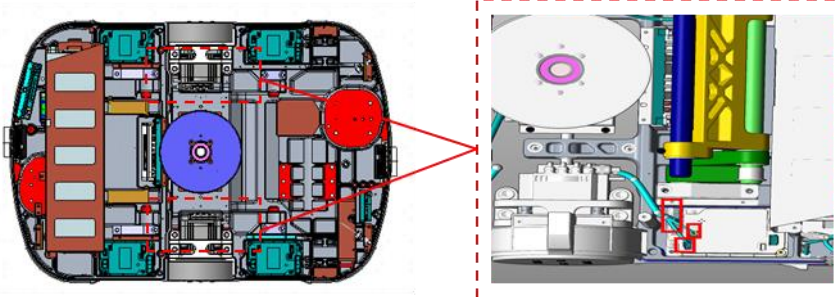
5.4.1 Caster Wheels Replacement Guide		
Purpose: Caster Wheels Replacement		
Components Involved: Caster Wheels		
Tools & Materials: Hex socket, ratchet wrench, 243 threadlocker		
Step	Illustration	Instructions
1. Remove the Caster Wheel		1. Using appropriate lifting equipment, evenly position slings on the designated lifting points of the AGV. Slowly and steadily lift the AGV, ensuring it is secure and does not sway.
		2. Using a 6mm hex socket and ratchet wrench, remove the four M8x18 hex socket head cap screws from the caster wheel ((1)).
		3. When removing the last screw/nut, support the caster wheel with your hand. After removal, set the wheel aside and replace it with a new one.
2. Reassembly	See the respective disassembly steps.	Reassemble in reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener .

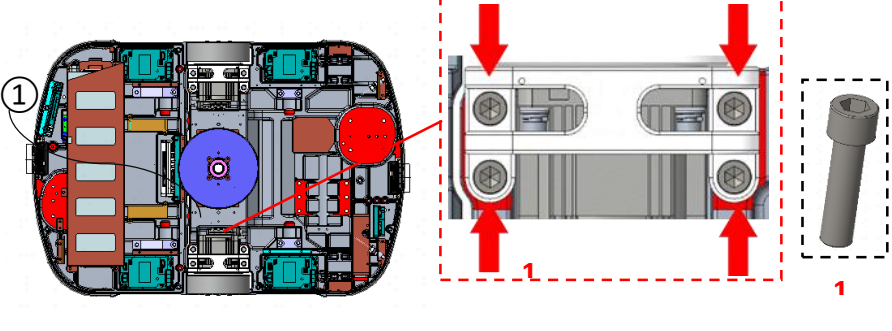
5.4.2 Drive Wheel

5.4.2 Drive Wheel Replacement Guide		
Purpose: Drive Wheel Replacement		
Components Involved: Top plate, rear casing, drive wheel.		
Tools & Materials: Phillips screwdriver, hex key, two M6x25 hex screws (for auxiliary disassembly).		
Step	Illustration	Instructions
1. Disassemble Lifting Deck and Casing	Refer to 5.1.1 Illustration for Disassembling the Lifting deck Assembly and Casing.	Refer to detailed process in 5.1.1 Disassembling the Lifting deck Assembly and Casing.
2. Remove Drive Wheel		1. Using appropriate lifting equipment, evenly position slings on the designated lifting points of the AGV. Slowly and steadily lift the AGV, ensuring it is secure and does not sway. Use wooden blocks or other supports to raise the entire vehicle until the drive wheel is off the ground.
		2. Using a 5mm hex key, remove the six M6x20 hex socket head cap screws from the drive wheel (①).
		3. Use the two M6x25 hex screws, screwing them into the threaded holes on both sides, to push the wheel out.
		Precaution 1. Ensure the lifting tools are safe and reliable.

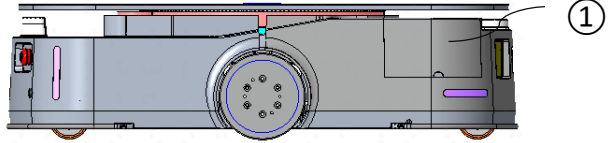
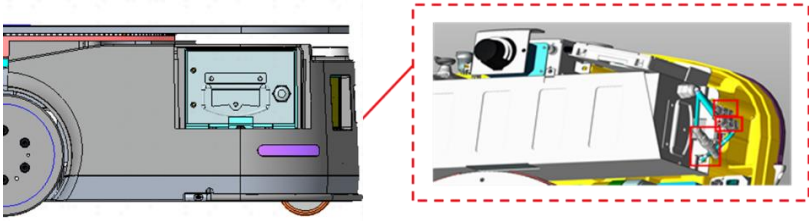
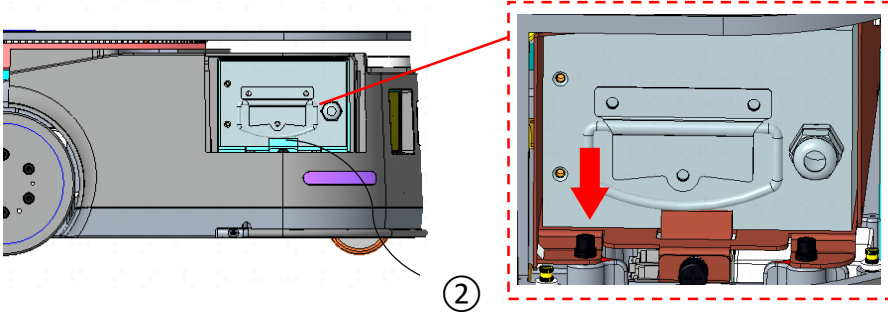
		2. The two pushing screws must be screwed in evenly. A large difference in depth may cause jamming.
2. Reassembly	See the respective disassembly steps.	Reassemble in the reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener . Gently tap the drive wheel into place, aligning the threaded holes, then secure the screws.

5.4.3 Disassembling the Drive Unit

5.4.3 Shock Absorber Unit Disassembly Guide		
Purpose: Replace components on the shock absorber unit.		
Components Involved: Top plate, front/rear casings, shock absorber unit.		
Tools & Materials: Phillips screwdriver, hex key set.		
Step	Illustration	Instructions
1. Remove Top Cover	See 5.1.1	See 5.1.1
2. Disconnect Motor Wiring		1. Press the connector lock and gently pull to disconnect.

3. Remove Drive Unit Screws		1. Using a 10mm hex key, gradually loosen and remove the four M12x45 hex socket head cap screws from the drive unit (①). After removal, clean the threads and holes.
4. Reassembly	Refer to respective disassembly sections.	2. Use two Phillips screwdrivers to simultaneously pry the drive unit upward, separating the drive unit pins from the chassis, allowing the entire unit to be removed. Reassemble in the reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener.

5.5 Battery

5.5 Battery Replacement Guide		
Purpose: Replace battery.		
Components Involved: Rear casing battery door, battery securing clamp, battery.		
Tools & Materials: Phillips screwdriver		
Step	Illustration	Instructions
1. Open Battery Door		1. Pry open the battery door upward by hand.
2. Disconnect Connector		1. Disconnect the connector on the battery.
3. Remove Battery		1. Using a Phillips screwdriver, loosen the PEM captive screws on the battery clamp.
		2. Grasp the handle on the battery and pull it out horizontally.
		Precaution
		1. Do not use open flames near the battery; risk of explosion. 2. Do not short-circuit the battery; risk of explosion.

		3. Do not smoke while handling the battery.
4. Reassembly	Refer to respective disassembly steps.	Reassemble in the reverse order of disassembly. Apply torque to all fasteners as specified in 5.6 Fastener .

5.6 Fastener

Thread Diameter	Pitch	Fastening Torque Tf, N·m									
		Performance Level 4.8		Performance Level 5.8		Performance Level 8.8		Performance Level 10.9		Performance Level 12.9	
		Standard Value	Torque Range	Standard Value	Torque Range	Standard Value	Torque Range	Standard Value	Torque Range	Standard Value	Torque Range
M3	0.5	0.6	0.5-0.7	0.8	0.7-0.9	1.2	1.1-1.5	1.6	1.2-1.9	2.0	1.6-2.3
M4	0.7	1.5	1.2-1.7	2	1.6-2.2	2.5	2.2-3.5	3.5	3.0-4.5	4.8	3.8-5.7
M5	0.8	3.0	2.5-3.5	3.5	3.2-4.4	5.0	4.5-6.7	7.0	5.8-8.8	9.3	7.4-11.2
M6	1	5.5	4.4-6.6	6.4	5.3-7.4	8	7.4-11.2	12	9.6-14.4	16	15-20
M8	1.25	13.5	10.3-14.4	15	12-18	20	16-26	32	26-36	42	35-53
	1	13.5	11.0-15.4	15	14-19	20	17-28	32	31-44	48	38-58
M10	1.5	24	20-28	30	25-35	40	36-52	65	51-69	80	74-88
	1.25	24	21-30	30	26-38	40	38-55	65	60-76	92	74-110
M12	1.75	42	35-50	54	44-62	75	61-94	110	90-130	140	128-170
	1.25	42	37-52	54	46-65	75	68-102	120	105-145	160	140-185
M14	2	60	56-80	70	54-94	120	97-150	160	140-180	230	204-273
	1.5	70	61-86	80	74-108	140	120-185	180	170-210	250	225-290