OMRON

AMR (Autonomous Mobile Robot)

OL-series

User's Manual

OL-450S2
OL-450S3



M109-E-01

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Introduction

Thank you for purchasing the OL-series Autonomous Mobile Robot (referred to as AMR in this document).
This manual is OMRON's original instructions describing the setup, operation, and user maintenance of the product.
This document describes AMR functionality supported with FLOW v5.3.
This manual does not describe all configuration steps that you perform using the software supplied with an AMR. The *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* describes configuration and use of the AMR.
Please read this manual and make sure you understand the functionality and performance of the AMR before attempting to use it.
Keep this manual in a safe place where it will be available for reference during operation.
To download a digital copy of this manual, use the following QR code or visit the website listed below.

https://robotics.omron.com/browse-documents/?dir_id=37207

Intended Audience

This manual is intended for the following personnel, who must also have knowledge of factory automation (FA) systems and robotic control methods.

- Personnel in charge of introducing FA systems.
- Personnel in charge of designing FA systems.
- Personnel in charge of installing and maintaining FA systems.
- Personnel in charge of managing FA systems and facilities.

It is the end-user’s responsibility to ensure that all personnel who will work with or around AMRs have attended an appropriate training and have a working knowledge of the system. The user must provide the necessary additional training for all personnel who will be working with the system.
As described in this document, you should allow only skilled persons or instructed persons to do certain procedures. Skilled persons have technical knowledge or sufficient experience to enable them to avoid either electrical or mechanical dangers. Instructed persons are adequately advised or supervised by skilled persons to enable them to avoid either electrical or mechanical dangers.
All personnel must observe industry-prescribed safety practices during the installation, operation, and testing of all electrically-powered equipment.
Before working with the AMR, every person must confirm that they:

- Have the necessary qualifications and training for normal, abnormal, and emergency situations.
- Have access to this document and other safety documentation.
- Have read and understand the related documentation.
- Have agreed work in the manner specified by the documentation.

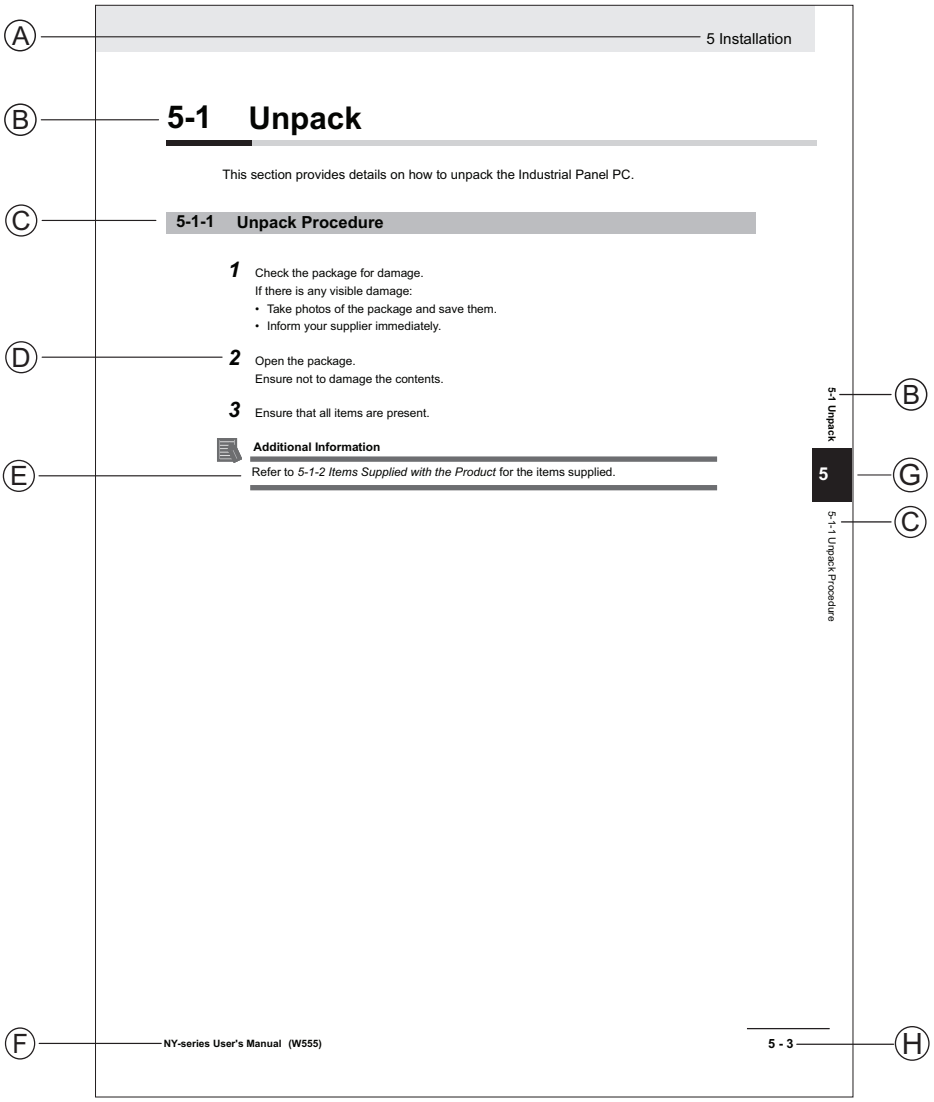
Units

All units are metric unless otherwise noted.
Distances are provided in mm unless otherwise noted.

Manual Information

Page Structure

The following page structure is used in this manual.



Note: This illustration is provided as a sample. It will not literally appear in this manual.

Item	Explanation	Item	Explanation
A	Level 1 heading	E	Special Information
B	Level 2 heading	F	Manual name
C	Level 3 heading	G	Page tab with the number of the main section
D	Step in a procedure	H	Page number

Special Information

Special information in this manual is classified as follows:



Precautions for Safe Use

Precautions on what to do and what not to do to ensure safe usage of the product.



Precautions for Correct Use

Precautions on what to do and what not to do to ensure proper operation and performance.



Additional Information

Additional information to read as required.
This information is provided to increase understanding or make operation easier.



Version Information

Information on differences in specifications and functionality between different versions.

Sections in this Manual

1 Overview
2 Specifications
3 Installation
4 Operation
5 Troubleshooting
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Terms and Conditions Agreement

Warranty and Limitations of Liability

Warranty

- **Exclusive Warranty**

  Omron's exclusive warranty is that the Products will be free from defects in materials and workmanship for a period of twelve months from the date of sale by Omron (or such other period expressed in writing by Omron). Omron disclaims all other warranties, expressed or implied.

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  OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, ABOUT NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THE PRODUCTS. BUYER ACKNOWLEDGES THAT IT ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE.
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NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT(S) IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Programmable Products

- Omron Companies shall not be responsible for the user's programming of a programmable Product, or any consequence thereof.
- Omron Companies shall not be responsible for the operation of the user accessible operating system (e.g. Windows, Linux), or any consequence thereof.

Disclaimers

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Change in Specifications

Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the Product may be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.

Errors and Omissions

Information presented by Omron Companies has been checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.

Safety Precautions

Definition of Precautionary Information

The following notation is used in this manual to provide precautions required to ensure safe usage of the AMR. The safety precautions that are provided are extremely important to safety.
Always read and heed the information provided in all safety precautions.
The following notation is used.

⚠ **DANGER**	Identifies an imminently hazardous situation which, if not avoided, is likely to result in serious injury, and might result in fatality or severe property damage.
⚠ **WARNING**	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage.
⚠ **CAUTION**	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

Symbols

	The circle and slash symbol indicates operations that you must not do. The specific operation is shown in the circle and explained in text. This example indicates prohibiting disassembly.
	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a precaution for electric shock.
	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a general precaution.
	The filled circle symbol indicates operations that you must do. The specific operation is shown in the circle and explained in text. This example shows a general precaution for something that you must do.
	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a precaution for high temperatures.
	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a precaution for laser radiation.

Dangers

⚠ DANGER

There is risk of serious injury by crushing if the AMR tips over as a result of improper operation on inclines that do not comply with the operating specifications.



The end-user of the AMR must perform a risk assessment to identify and mitigate any additional personal and property damage hazards caused by the payload.



No modification is allowed that may affect functionality unless a complete risk assessment is performed. Any modifications made to the AMR can lead to loss of safety or functionality of the AMR. Therefore it is the end-user's responsibility to perform a complete risk assessment after making any modifications to the AMR, and to confirm that all safety features of the AMR are fully functional.



Operators must read this manual and operate the AMR and Charging Station within the defined specifications.



Only qualified personnel who have read and understood this manual should manually move, operate the AMR, or install accessories.



Toxic, explosive gases can be released when using a CO2 fire extinguisher or water in combination with lithium.



Do not charge a battery that has not been approved for the OL-series AMR. There is a risk of explosion when charging an incorrect battery. Failure to comply with the above mentioned instruction could result in damage to the Charging Station, battery, and AMR.



Warnings

⚠ WARNING

General

It is the end-user's responsibility to perform a task-based risk assessment and to implement appropriate safety measures at the point of use of the AMR in accordance with local regulations.



It is the end-user's responsibility to make sure that the AMR design and implementation complies with all local standards and legal requirements.



Do not allow the AMR to operate in areas that are used for emergency personnel evacuation.



Do not operate the AMR in hazardous environments where there is explosive gas, an oil mist, or a corrosive atmosphere.



Use only the specified tools, equipment, cleaners, and OMRON-supplied spare parts to service and maintain the AMR and Charging Station according to the specified service interval. Failure to do so could result in an unsafe operating state than might result in injury to person or damage to property.	
Do not use organic solvents to clean any part of the AMR unless directed in the cleaning instructions. Organic solvents might damage electronics resulting in an unsafe operating state that could cause injury or damage to equipment. OMRON recommends using the Maintenance kit for cleaning supplies from the manufacturer.	
When lifting the AMR, take care to lift it from safe lifting points and secure it with safety straps for even weight distribution and to ensure that the AMR is level and stable when lifted. OMRON recommends using a mechanical lift.	
Follow all unpacking safety instructions and use appropriate tools and equipment. Failure to do so could result in personal injury or property damage.	
While conducting any work on the AMR, make sure it is located on a flat, level surface with wheels chocked and emergency stop active to prevent unexpected movement.	
It is the user's responsibility to train operators and all other personnel on proper use of the AMR and AMR safety.	
Do not walk, run, or suddenly throw objects in the travel path of the AMR or directly toward the AMR.	
Personnel who work with or around the AMR should not stand close to the AMR when it is rotating with no forward motion.	
Equipment used to lift the AMR must be adequately rated. It is the end user's responsibility to review lifting equipment and apply appropriate safety factors before lifting.	
Immobilization might cause motors in the AMR to overheat, resulting in a fire.	
The Manual Mover must be used only to transport an OL-series AMR. Do not use the Manual Mover for any other purpose.	
Inspect the Manual Mover for damage, deformation and cracks before each use and do not lift a weight greater than the safe permissible working load indicated on the Manual Mover	
Do not operate the Manual Mover on sloping surfaces. The weight of the AMR can cause you to loose control on a sloping surface.	
After transporting the AMR using the Manual Mover to a new location, ensure the workspace floor on which the AMR is deposited is clear and flat.	
Ensure the Work Bench is securely fixed on the floor before mounting the AMR on it.	
The Work Bench must be used only for performing maintenance tasks on the AMR.	

The Service Charger is not a user-serviceable device.	

Battery and Charging Station

Do not damage the battery by subjecting it to impacts or shocks. Using a damaged battery can result in fire or other dangerous conditions.	
Do not dispose of the battery in a waste stream that might result in incineration or crushing. Safely dispose of the battery through a designated facility according to all local and national environmental regulations regarding lithium battery disposal.	
(Battery) Risk of Fire - No User Serviceable Parts AVERTISSEMENT: Risque d'incendie - Aucune des pièces ne peut être.	
There are no serviceable parts in battery. Only licensed / certified personal can replace the battery and it can only be with an OMRON factory-supplied battery intended for use in the AMR.	
The following actions are strictly prohibited and could result in injury or damage to the equipment. • Persons with cardiac pacemakers in the AMR charging zone • Persons with metal implants in the AMR charging zone • Holding, placing, or allowing objects between the charging coils	
If the Charging Station power cords are installed on the floor, you must make sure that they are highly visible to prevent tripping hazards and are protected from physical damage with barriers or covers.	
Due to hazardous electrical voltage / residual voltage, wait for at least two minutes before carrying out any maintenance on the AMR or Charging Station.	
If any safety or warning symbols in the charging zone are damaged or illegible, replace them with new ones.	
The Charging Station transfers high electric power, and contains hazardous voltage. The user must take necessary precautions when working near the Charging Station, and follow appropriate Lock-Out, Tag-Out (LOTO) instructions prior to any maintenance work done on the Charging Station.	
Do not allow liquids of any kind to come in contact with the Stationary or Mobile Coil.	

Payload

The user is responsible for the safety of the AMR, which includes confirming that the system is stable with any payload, payload structure, or other attachments while functioning in the specified operating environment.	
The payload must be placed away from AMR sensors. If the payload or associated structure blocks any of the AMR's sensors, the AMR cannot function correctly.	

The payload or payload structure shall not be positioned in such a way that would put the operator in danger while trying to reach an emergency stop button.	
If the AMR transports containers of liquid or other non-solid material, consider the effect on the AMR's stability if their contents can shift. It is the end user's responsibility to ensure that the payload is properly secured to the AMR, and that payload shifting does not create AMR instability.	
Do not exceed the maximum size and weight of the payload carrier to be transported on the AMR defined in the Specifications in this manual.	

Operating Environment

Do not operate the AMR in hazardous environments where there is explosive gas, an oil mist, or a corrosive atmosphere.	
Objects in the environment protruding out, above, or below the AMR lasers' scanning planes shall be configured as Forbidden Areas during workspace map creation. This will minimize possible collision risk during operation.	
While it is possible to generally reduce AMR deceleration settings for normal operation, the maximum deceleration used in the case of emergency stops, or stops due to Front Safety Scanner intrusions cannot be lowered below 2000 mm/s2. It is your responsibility to ensure that the AMR and its load will remain stable in your operating environment at all times, including during an emergency stop.	
Do not operate the AMR on steps, in slopes, or in floor conditions other than those listed in the Specifications.	
A physical barrier must be easily detectable by the AMR and also strong enough to stop a fully-loaded AMR traveling at its maximum speed.	
Personnel must stay clear of the AMR while it is in motion or when the Lifting Plate is engaged. The Lifting Plate can cause crushing injury or damage when personnel are working near the it.	

Cybersecurity

To maintain the security and reliability of the system, a robust cybersecurity defense program should be implemented, which may include some or all of the following:

Anti-virus protection

- Install the latest commercial-quality anti-virus software on the computer connected to the control system and keep the software and virus definitions up-to-date.
- Scan USB drives or other external storage devices before connecting them to control systems and equipment.

Security measures to prevent unauthorized network access

- Install physical controls so that only authorized personnel can access control systems and equipment.
- Reduce connections to control systems and equipment via networks to prevent access from untrusted devices.
- Install firewalls to block unused communications ports and limit communication between systems. Limit access between control systems and systems from the IT network.
- Control remote access and adopt multifactor authentication to devices with remote access to control systems and equipment.
- Set strong password policies and monitor for compliance frequently.

Data input and output protection

- Backup data and keep the data up-to-date periodically to prepare for data loss.
- Validate backups and retention policies to cope with unintentional modification of input/output data to control systems and equipment.
- Validate the scope of data protection regularly to accommodate changes.
- Check validity of backups by scheduling test restores to ensure successful recovery from incidents.
- Safety design, such as emergency shutdown and fail-soft operations in case of data tampering and incidents.

Additional recommendations

- When using an external network environment to connect to an unauthorized terminal such as a SCADA, HMI or to an unauthorized server may result in network security issues such as spoofing and tampering.
- You must take sufficient measures such as restricting access to the terminal, using a terminal equipped with a secure function, and locking the installation area by yourself.
- When constructing network infrastructure, communication failure may occur due to cable disconnection or the influence of unauthorized network equipment.
- Take adequate measures, such as restricting physical access to network devices, by means such as locking the installation area.
- When using devices equipped with an SD Memory Card, there is a security risk that a third party may acquire, alter, or replace the files and data in the removable media by removing or unmounting the media.
- Please take sufficient measures, such as restricting physical access to the Controller or taking appropriate management measures for removable media, by means of locking and controlling access to the installation area.
- Educate employees to help them identify phishing scams received via email on systems that will connect to the control network.

Cautions

⚠ CAUTION

Do not operate the AMR without shielding the Scissor Lift.	
Riding on the AMR is strictly prohibited and could result in injury or damage to the equipment.	
Lasers cannot reliably detect glass, mirrors, and other highly-reflective objects. Use caution when operating the AMR in areas that have these types of objects. If the AMR will need to drive close to these objects, we recommend that you use a combination of markings on the objects (e.g., tape or painted strips), and also use Forbidden Areas in the map, so that the AMR can plan paths safely around these objects.	
The Manual Mover should be used to move the AMR when needed. Avoid pushing the AMR.	
Never connect electric loads directly to the battery bypassing protective circuits.	
Do not allow any foreign metal objects to be near the AMR or the charging coils.	
When placing the AMR back on the floor after lifting, you must make sure that all safety precautions have been taken to prevent personal injury or property damage.	
Beware of entrapment danger when the AMR moves backwards during docking. Entrapment danger exists between the payload carrier and the AMR.	
Changing warning buzzer parameter values might make the AMR unsafe and affect its compliance to safety standards. Refer to the applicable safety standards for your locale before you change any parameter values.	
During pick up and drop off operations, ensure the Lifting Plate of the AMR is clear of all obstructions.	
Ensure there is adequate clearance for the height of the AMR in the workspace. Install physical barriers and create Forbidden Areas to prevent the AMR from entering a hazardous workspace.	
Before removing a Forbidden Zone map feature from an AMR map, ensure that same area in the AMR workspace is clear of all hazards.	
Service charger cables pose a tripping hazard. Place cables in a manner that prevents tripping or isolate the area to prevent people from interacting with cables.	
Do not push or lean against the AMR at any time as the wheels of the AMR can still be moved after engaging the E-STOP button or if the AMR loses power.	
If the AMR is stopped using the E-STOP button during a lifting motion, the AMR will resume the motion after it is reset.	
If the AMR is powered-OFF during a lifting motion, the AMR's Lifting Plate will return to its lowest position when the AMR's power is restored.	

Although the AMR's software provides the option of using the map features to keep the AMR within its designated workspace, poor or improper localization may result in incorrect path planning. To ensure safety, you must always install physical barriers where there is a risk of property damage or personal hazard.	
OMRON is not responsible for any risks incurred by modifying safety zone sizes or other Front Safety Scanner settings.	
It is the end user's responsibility to make sure that the speed is appropriate for the payload that the AMR carries, and that the AMR movement does not cause payload instability or loss of AMR control.	

Precautions for Safe Use

- You must comply with the latest version of the applicable laser safety regulations.
- Although the lasers used are Class 1/1M (eye-safe), OMRON recommends that you not look into the laser light. The maximum permissible exposure cannot be exceeded when viewing lasers with the naked eye.
- It is the end user's responsibility to ensure that the payload does not attenuate the wireless antennas' signal.
- Check and conform to the maximum weight of payload (including the payload carrier), the maximum dimensions of the payload carrier, and the CoG as specified in this manual.
- Remove the AMR from a Charging Station when conducting any installation or maintenance actions.
- The Stationary Coil must be properly installed and secured to the Charging Ramp prior to the operation of the Charging Station.
- The Charging Ramp must be placed flush with the floor.
- Before you configure wireless Ethernet on your AMR, contact your network administrator to confirm the IP, radio, security settings, and for authorization.
- During pick-up and drop-off activities the AMR’s safety detection fields are muted. Keep clear of the AMR during these activities.
- Do not operate the AMR without all skins fastened correctly. Moving parts are exposed when the AMR is in motion.
- Bright, direct, or high-intensity light can interfere with the AMR's laser operation. Do not operate the AMR in areas where it may be exposed to these conditions.
- Always wear safety shoes when operating in the same environment as the AMR.
- You must have floor markings at Charging Stations and pickup / dropoff locations with adequate clearance to prevent people from entering these hazard zones.
- You cannot use the same marker tape configuration for different AMRs in hybrid fleets because of their different sizes and turn radiuses. To determine the distance between the AMR and its final alignment goal (such as a machine with which it interfaces), refer to the AMR User's Manual to obtain the exact dimensions.
- The AMR must be powered ON in order to charge the battery while at the Charging Station.
- In case of fire, use a type ABC or type BC dry chemical fire extinguisher.
- Ensure the AMR is OFF when manually moving or conducting any maintenance on the AMR.
- The AMR's internal clock must be set correctly to ensure that accurate timestamps are present in the Debug Info File.
- Do not allow the battery to remain discharged for an extended period of time.
- Laser lenses can easily get scratched and damaged. Care must be taken to prevent scratching the laser lens during any maintenance or installation procedures.
- Follow proper maintenance schedules to ensure best performance of the AMR.
- Do not attempt to lift the AMR from the bottom with a forklift or similar devices. Doing so could damage the AMR.
- The frequency of cleaning intervals depends on your particular system, its operating environment, and the amount of use. Cleaning intervals may need to be shortened for certain environments.
- The operation of the lasers may be affected by substances in the AMR operating environment, such as fog, smoke, steam, and other small particulates. You must clean the lenses of all lasers periodically and as guided in this document to avoid operational failures.

- Never remove the battery while the AMR is powered ON. Always turn the AMR OFF before attempting to remove a battery.
- Make sure the AMR is switched OFF before it is stored.
- Carefully tilt the mast over so that the cables on the inside are not trapped.
- Do not use the Manual Mover to transport people.
- Do not perform maintenance tasks on the AMR when it is suspended in the Manual Mover.
- Ensure the AMR is properly attached to the Manual Mover before transporting the AMR.
- Always remove the payload or payload carrier from the AMR before attaching the AMR to the Manual Mover and operating the Manual Mover.
- The Field of view of the AMR is limited in the vertical plane. Operators must consider height restrictions in the AMR's operating environment.
- The cleaning fluid in the Maintenance Kit should be kept away from oxidizing agents and strongly acidic or alkaline materials. Chemical reactions may occur if mixed.
- For more information about each optional accessory for the AMR, refer to its original manufacturer's documentation.
- Do not leave the Manual Mover unattended and always engage the brake to keep the device stationary.
- Ensure there is enough clearance for the movement of the AMRs Lifting Plate when using the Lift Bridge.
- To avoid a potential short circuit, do not press the button on the Lift Bridge unless the Lift Bridge is connected to the AMR.
- You can contribute to resource conservation and protecting the environment by the proper disposal of Waste Electronics and Electrical Equipment (WEEE). All electrical and electronic products should be disposed of separately from the municipal waste system according to local ordinances using designated collection facilities.



- Do not touch the AMR charging coils. Coils get very hot during and after charging.
- Intentional movement of the payload carrier (such as conveyor or arm) during the AMR movement is prohibited.
- Always follow proper electrical safety practices and review electrical equipment information labels.
- At least two people are needed to elevate the Work Bench while installing the foot pads.
- Use a pallet jack, forklift, or dolly to move the Work Bench after unpacking.
- At least two people are needed to roll out the Manual Mover from the wooden box after unpacking.
- Keep fingers clear of mast joints when raising or lowering the mast.

Precautions for Correct Use

- The Scissor Lift Shield may be removed only for maintenance purposes after ensuring the AMR is powered OFF.
- Use only OMRON supplied Service Charger when the AMR state of charge is too low to allow docking. Follow provided Service Charger instructions.
- When using the Manual Mover to move the AMR, the AMR must be turned OFF.
- For the Charging Station components replacement, use only the supplied Wiferion replacement parts and follow replacement instructions.
- The Lifting Rings and Slings must be removed before operating the AMR.
- The Lifting Plate must be placed at the lowest position before lifting the AMR.
- The Main Disconnect Switch should not be used as a frequent means of turning OFF the AMR.
- Prior to using the cleaning fluid, test its compatibility to the laser lens by first applying a small quantity of cleaner to an inconspicuous spot.
- Do not apply a bending stress to the surface of the laser lens when cleaning.
- It is the end-user's responsibility to a perform risk assessment before implementing any optional accessory for the AMR to ensure its compatibility with the work environment.
- During pickup and drop off activities, ensure the AMR's Lifting Plate has no obstructions.
- Ensure the AMR does not obstruct emergency evacuation routes, or areas designated for fire extinguishers and fire alarms.
- All areas in a workspace which do not allow for a minimum of 500 mm clearance on either side of the AMR and in the direction of travel of the AMR, must have physical barriers installed.
- IATA regulations (UN 3480, PI 965) require that air freight shipped lithium ion batteries not installed in the AMR must be transported at a state of charge not exceeding 30%. To avoid total discharge, fully charge the battery immediately upon receipt. The battery might arrive fully charged if it is not shipped by air freight.
- Implementing methods to circumvent the need for a person to enable the AMR's motor power at start-up is prohibited.
- The Charging Station shall only be used to charge an OL-series AMR battery.
- Select the right sensors to detect that the payload is in the right position.
- Always lift the battery using the two handles on top of the battery enclosure.
- Clean accumulated dust on AMR internal components during regular maintenance.

Regulations and Standards

Directives

The AMR system complies with the following Directives.

- 2006/42/EC
  Machinery Directive
- 2023/1542/EU
  EU Battery Regulation

Standards

The AMR system conforms to the following Standards.

AMR Standards

- EN ISO 12100
  Safety of Machinery - General Principles for Design - Risk Assessment and Reduction.
- EN ISO 13849-1
  Safety of Machinery - Safety Related Parts of Control Systems SRP/CS – Part 1, General Principles for Design.
- EN/IEC 60204-1
  Safety of Machinery - Electrical equipment of machines, Part 1 General Requirements.
- EN ISO 3691-4 (except clause 4.12)
  Industrial Trucks - Safety Requirements And Verification - Part 4: Driverless industrial trucks and their systems.
- EN 61000-6-2
  EMC, Part 6-2: Immunity Standard for Industrial Environments.
- EN 61000-6-4
  EMC, Part 6-4: Emissions Standard for Industrial Environments.
- KS C 9610-6-2
  EMC Immunity Testing of Industrial Environments.
- KS C 9610-6-4
  EMC Emission Testing of Industrial Environments.

Charging Station Standards

- EN 60335-2-29
  Household and similar electrical appliances - Safety - Part 2-29: Particular requirements for battery chargers.
- EN 62311
  Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz to 300 GHz).
- UL 1564
  Standard for Industrial Battery Chargers.

- EN 55011
  Industrial, scientific, and medical equipment standard - Assessment of radio frequency disturbance characteristics, limits and methods of measurement.
- EN 61000-6-2
  Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments.

Battery Standards

- UN 38.3
  Standard for transportation of lithium batteries.

Regulatory Markings

The following regulatory markings appear on the AMR.

- KC
- CE

The following regulatory markings appear on the Stationary Electronics and Stationary Coil.

- CE
- cMETus

The following regulatory marking appears on the battery.

- CE

Conformance to KC Certification

When you use this product in South Korea, observe the following precautions.

사 용 자 안 내 문
이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

This product meets the electromagnetic compatibility requirements for business use.

Related Manuals

Use the following related manuals for reference.

Manual Title	Description
Advanced Robotics Command Language Enterprise Manager Integration Guide (Cat. No. I618)	Describes how to use the Advanced Robotics Command Language (ARCL) a text-based, command line operating language Use ARCL to integrate a fleet of AMRs with an external automation system.
Fleet Operations Workspace Core User's Manual (Cat. No. I635)	Describes Fleet management, MobilePlanner software, the SetNetGo OS, and most of the configuration procedures for an AMR.
MobilePlanner Integrated Help	A repository of Help topics available in the MobilePlanner application. Help topics describe MobilePlanner software, the SetNetGo OS, and most of the configuration procedures for an AMR.
Fleet Operation Workspace Core Integration Toolkit User’s Manual (Cat. No. I637)	Contains information that is necessary to use the Integration Toolkit facilitating integration between the AMR, the Fleet Manager and the end user's client application.
Fleet Operations Workspace Core Integration Toolkit MQTT API User's Manual (Cat. No. M107)	Contains information that is necessary to use the Integration Toolkit MQTT API facilitating integration between the AMR, the Fleet Manager and the end user's client application.
Fleet Operations Workspace iQ User's Manual (Cat. No. I665)	Describes functionality and operation of the Fleet Operations Workspace iQ application.
AMR (Autonomous Mobile Robot) OL-series Safety, Unpacking, and Assembly Guide (Cat. No. M110)	Describes safety, unpacking, and assembly of the OL-series AMR.
AMR (Autonomous Mobile Robot) OL-series Charging Station Safety, Unpacking , and Installation Guide (Cat. No. M111)	Describes safety, unpacking, and installation of the OL-series AMR Charging Station.
AMR (Autonomous Mobile Robot) OL-series Battery Safety, Unpacking, and Installation Guide (Cat. No. M112)	Describes safety, unpacking, and installation of the OL-series AMR Battery.
Mobile I/O Box User's Manual (Cat. No. I677)	Contains information for setting up and using a Mobile I/O box with the AMR.

Glossary

Term / Abbreviation	Description
Ambient Operating Temperature	The temperature range of the AMR's environment in which continued operation is possible.
AMR	This term is used to refer to the OL-series autonomous mobile robot.
ARAM	Advanced Robotics Automation Management software that performs all of the high-level, autonomous robotics functions, including obstacle avoidance, path planning, localization, and navigation.
ARAMCentral	The software running on the Fleet Manager appliance. This manages the AMRs' map, configuration, and traffic control including multi-AMR avoidance, destination, standby, and docking.
ARCL	Advanced Robotics Command Language that provides a simple, text-based, command-and-response operating language. Used with the optional Fleet Manager, ARCL can help manage a fleet of mobile robots.
Balance	The charging operation that equalizes each cell in the battery to maintain consistent runtime and performance.
CAN bus	Controller Area Network that provides a serial communications protocol allowing electronic control units and devices to communicate with each other.
CAT5	Twisted pair Ethernet cable that supports 100 MHz frequency.
Center of Gravity	The average location of weight for an object.
Center of Rotation	The midpoint of a line between the center of the drive wheel hubs about which the AMR will rotate.
Charging Station	System that is used to charge an AMR battery that is comprised of the Stationary Electronics (power supply box), the Stationary Coil, the Charging Ramp (charging platform) and the cable between these items.
Coordinate System	The X, Y, Z, and theta reference system relating the AMR to its environment and to the relative position of other devices.
Debug Info File	A zip file downloaded from SetNetGo that contains detailed information about the status of the system used by OMRON engineers for troubleshooting.
Dropoff	A Job segment typically used where the payload is transferred from the AMR to the Goal.
E-STOP button	Emergency stop button.
Emergency stop	A function that overrides an AMR's controls and brings it to a rapid stop for safety purposes.
Encoder	A sensor on each drive motor of the AMR that is used to collect and transmit information about distance traveled and direction.
Ethernet	A type of network used in local area networks that typically uses a twisted pair cable and supports data speeds up to 100 Mbps.
FA	Factory Automation
Fleet	Two or more AMRs operating in the same workspace controlled by a single Fleet Manager.
Fleet Manager	The operational mode of the computing appliance that runs the FLOW Core software to control a fleet of AMRs.
Fleet Operations Workspace (FLOW)	A computing system that consists of software and hardware packages and is used to set up, integrate, and manage a fleet of AMRs within a factory environment.
Goal	A map-defined virtual destination for mobile robots (e.g., pickup or dropoff points).

Term / Abbreviation	Description
I/O	Input and output signals that are transmitted to and from a device.
Immobilization	An AMR state where it cannot physically move due to circumstances related to physical, electrical, and other limiting factors.
Instructed persons	Persons that are adequately advised or supervised by skilled persons to enable them to avoid electrical and mechanical dangers.
IP	Internet protocol that provides a set of communication standards for transmitting data between networked devices. An IP address is used as a device's unique network identifier.
IPXX	Ingress protection rating designated for devices to describe the level of protection provided against the intrusion of solid objects, dust, and water.
Job	An activity typically consisting of one or two segments that instruct the AMR to drive to a Goal for material pickup or dropoff.
LED	A light emitting diode that illuminates to provide a visual indication of some operation.
Light strip	The linear lights on the front and rear of the AMR that indicate motion, turns, and AMR states.
Localization	The process by which an AMR determines its location within the operating environment.
Lock-out Tag-out	A procedure to ensure equipment is properly turned OFF so that hazardous energy sources are isolated and rendered inoperative during tasks such as maintenance, installation, or other actions that require access to electrical components.
Macro	In MobilePlanner, a virtual container with a series or sequence of nested Tasks and / or Goals typically used to perform the same sequence of discrete functions in different tasks.
Map	A representation of the AMR's environment within MobilePlanner that it uses for navigation.
MobilePlanner	The primary software application for programming AMR actions. It provides the tools for all major AMR activities, such as observing a fleet of AMRs, commanding individual AMRs to drive, creating and editing map files, Goals, and Tasks, and modifying AMR configurations.
Motion Controller	The AMR's Motion Controller is an industrial computer that has been ruggedized and adapted for the control of the drive motors and inertial sensors.
NUC	Next Unit of Computing (NUC) is a small-form-factor computer. The AMR's PC is an NUC.
Path	The line on an AMR's map between its current position and its destination that provides an indication of the AMR's intended motion.
Payload	Any item(s) that are placed on the AMR for the purposes of securing, transporting, and transferring some object.
Pickup	A Job segment where an AMR typically acquires a payload.
Polo	The AMR firmware that controls motors and also computes the AMR's heading readings and other low-level operating conditions to ARAM.
Safety commissioning	Testing and commissioning for verification of proper function the AMR's onboard safety systems using a software wizard.
Safety Controller	A device installed in the AMR that provides all safety functions and operations.
SetNetGo (SNG)	The software operating system that resides on the AMR and the optional Fleet Manager. It is used to configure the AMR's communication parameters,gather Debug Info Files, and upgrade the software.

Term / Abbreviation	Description
Skilled persons	Persons that have the technical knowledge or sufficient experience to enable them to avoid electrical or mechanical dangers.
Shut-down	The process of powering OFF in a controlled manner to allow for correct operation at the next start-up request.
Start-up	The process of booting and enabling all systems after being powered OFF to reach an operational state.
Stationary Coil	A fixed coil that is connected to the Stationary Electronics that the AMR (Mobile Coil) docks to, that is used for autonomous charging.
Stationary Electronics	Unit that receives AC power from the facility and supplies power to the Stationary Coil for charging purposes.
Swing radius	The distance from the AMR center of rotation to the furthest point on its perimeter when it rotates in place.
Tasks	Instructions for the AMR to perform certain actions like reading inputs, setting outputs, movement commands, talking, waiting and other functions.
Troubleshooting	Efforts such as information collection, diagnostics, and error recovery to resume normal operation.
Turn radius	The radius of the circle that the AMR will travel when turning while moving forward.
Wizard	A guide within a software user interface that assists the user in performing an operation or function.
Workspace	The intended operating area of the AMR.

Revision History

A manual revision code appears as a suffix to the catalog number on the front and back covers of the manual.



Revision code	Date	Revised content
01	March 2025	Original production

1

Overview

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1-1 Intended Use

The AMR is designed to work in an indoor, industrial environment, and in the presence of trained personnel. This includes structured or semi-structured workplaces such as warehouses, distribution, and logistics facilities where general public access is restricted. You must deploy it only in applications where you anticipate and mitigate potential risks to personnel and equipment.

The AMR is not intended to be used in the following environments.

- Outdoor or uncontrolled areas without risk analysis.
- Areas with general public access.
- Areas with life-support systems.
- Residential areas.

Although the AMR is equipped with highly advanced safety systems, it must be deployed in a manner that takes into account potential risks to personnel and equipment.

The AMR shall be commissioned as instructed in this manual.

⚠ DANGER

- The end-user of the AMR must perform a risk assessment to identify and mitigate any additional personal and property damage hazards caused by the payload.
- No modification is allowed that may affect functionality unless a complete risk assessment is performed. Any modifications made to the AMR can lead to loss of safety or functionality of the AMR. Therefore it is the end-user's responsibility to perform a complete risk assessment after making any modifications to the AMR, and to confirm that all safety features of the AMR are fully functional.
- Operators must read this manual and operate the AMR and Charging Station within the defined specifications.
- Only qualified personnel who have read and understood this manual should manually move, operate the AMR, or install accessories.



⚠ DANGER

There is risk of serious injury by crushing if the AMR tips over as a result of improper operation on inclines that do not comply with the operating specifications.



⚠ WARNING

- It is the end-user's responsibility to perform a task-based risk assessment and to implement appropriate safety measures at the point of use of the AMR in accordance with local regulations.
- It is the end-user's responsibility to make sure that the AMR design and implementation complies with all local standards and legal requirements.
- Personnel who work with or around the AMR should not stand close to the AMR when it is rotating with no forward motion.
- Do not operate the AMR in slopes or in floor conditions other than those listed in the Specifications.
- Do not allow the AMR to operate in areas that are used for emergency personnel evacuation.
- Do not operate the AMR in hazardous environments where there is explosive gas, an oil mist, or a corrosive atmosphere.
- Do not walk, run, or suddenly throw objects in the travel path of the AMR or directly toward the AMR.
- It is the user's responsibility to train operators and all other personnel on proper use of the AMR and AMR safety.
- AMR shall not be used in towing or tugging applications.
- Personnel must stay clear of the AMR while it is in motion or when the Lifting Plate is engaged. The Lifting Plate can cause crushing injury or damage when personnel are working near it.



⚠ CAUTION

- Do not operate the AMR without shielding the Scissor Lift.
- Do not push or lean against the AMR at any time as the wheels of the AMR can still be moved after engaging the E-STOP button or if the AMR loses power.



⚠ CAUTION

Riding on the AMR is strictly prohibited and could result in injury or damage to the equipment.





Precautions for Safe Use

Always follow proper electrical safety practices and review electrical equipment information labels.



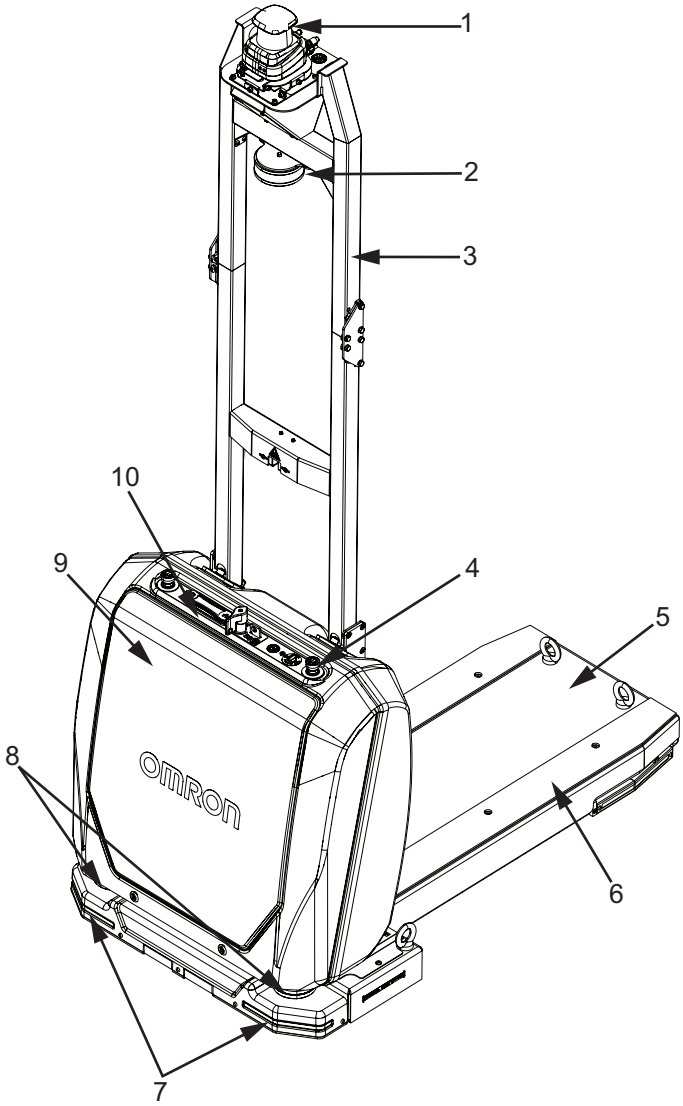
Precautions for Correct Use

The Scissor Lift Shield may be removed only for maintenance purposes after ensuring the AMR is powered OFF.

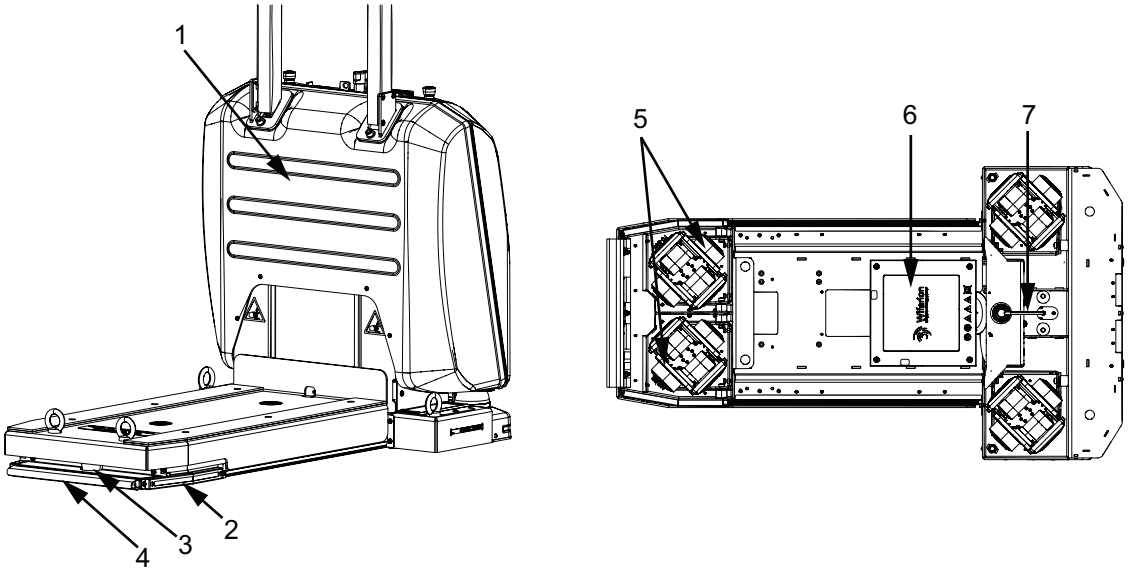
1-2 Features and Components

The Omnidirectional Lift (OL) is an intelligent AMR with a low profile lifting platform. The AMR is designed to transport payload carriers such as roll cages, pick carts, pallets, and trolleys autonomously throughout a facility.

This section provides an overview of the basic features and components of the AMR.



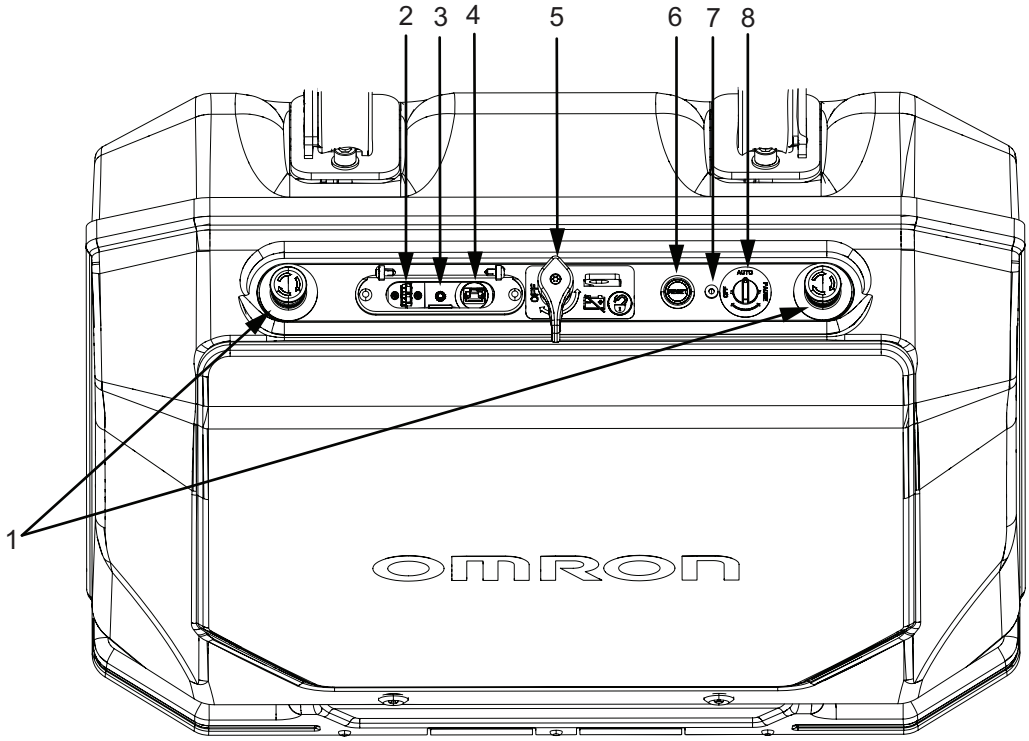
Item	Description	Item	Description
1	360-degree Scanner	2	LED Signal Lamp
3	Mast	4	Emergency Stop (E-STOP) Button
5	Lifting Plate	6	Rubber Strip
7	Front Light Strips	8	Front Safety Scanners
9	Front Skin	10	Control Strip



Item	Description	Item	Description
1	Rear Skin	2	Rear Light Strips
3	Rear Scanner	4	Rear Bumper
5	Wheel Sets	6	Mobile Coil
7	Grounding Chain		

1-2-1 Control Strip

The Control Strip features are described below.



Item	Description	Item	Description
1	Emergency Stop (E-STOP) buttons	2	Service Charger Connector
3	Manual Lift Control Connector	4	Maintenance Ethernet Port

Item	Description	Item	Description
5	Main Disconnect Switch	6	Reset Button
7	Power LED	8	Selection Switch

Emergency Stop Button

The AMR is equipped with two E-STOP buttons on either side of the Control Strip. Pressing the E-STOP button activates the emergency stop circuit and the AMR comes to a stop immediately.

Additional Information

Refer to *4-16-1 Emergency Stop Recovery Procedure* on page 4-41 for more information about restarting the AMR after an emergency stop.

Service Charger Connector

Use this port for connecting the optional Service Charger when charging the AMR manually.

Manual Lift Control Connector

This port is used for connecting an optional Lift Bridge device to lower the Lifting Plate manually in the event that the AMR runs out of power.

Maintenance Ethernet Port

Use the Maintenance Ethernet port to connect a PC directly to the AMR with a pass-through or cross-over CAT5 (or better) Ethernet cable for configuration or troubleshooting.

Main Disconnect Switch

Use the Main Disconnect Switch to remove all battery power from the AMR for maintenance, transport, or other abnormal situations. A locking tab is provided to secure the switch to the tab with a padlock.

Reset Button

The reset button returns the AMR to an operational state after an interruption during normal operation.

Power LED

The Power LED provides a visual indication of the AMR's operating state.

Selection Switch

Use the three-way Selection Switch to set the AMR's operational state to AUTO, PAUSE, or OFF.

1-2-2 Lasers

Several laser sensors are provided on the AMR for navigation and safety as described below.

⚠ CAUTION

Lasers cannot reliably detect glass, mirrors, and other highly-reflective objects. Use caution when operating the AMR in areas that have these types of objects. If the AMR will need to drive close to these objects, we recommend that you use a combination of markings on the objects (e.g., tape or painted strips), and also use Forbidden Areas in the map, so that the AMR can plan paths safely around these objects.



Precautions for Safe Use

- You must comply with the latest version of the applicable laser safety regulations.
- Although the lasers used are Class 1/1M (eye-safe), OMRON recommends that you not look into the laser light. The maximum permissible exposure cannot be exceeded when viewing lasers with the naked eye.

360-degree Scanner

The 360-degree Lidar scanner is positioned on top of the mast. Its 360-degree scanning plane aids in location determination. The 360-degree Scanner operates in a single plane positioned at 2200 mm above the floor to a range of 30 m.

Front Safety Scanners and Rear Scanner

Two safety scanners are mounted on either side of the front bottom of the AMR and one scanner is mounted on the rear bottom of the AMR. The Front Safety Scanners detect obstacles at the scanning plane of 105 mm above the floor to a range of 40 m. The Rear Scanner detects objects that are at least 40 mm tall and to a range of 10 m.
If an object is detected by the scanner, the AMR will come to a stop. When the object is removed, the AMR will automatically resume driving.
The scanners also detect obstacles that might be significantly wider near the floor, such as a column base, while the 360-degree Scanner might detect only the upper, narrow portion of the column.

⚠ WARNING

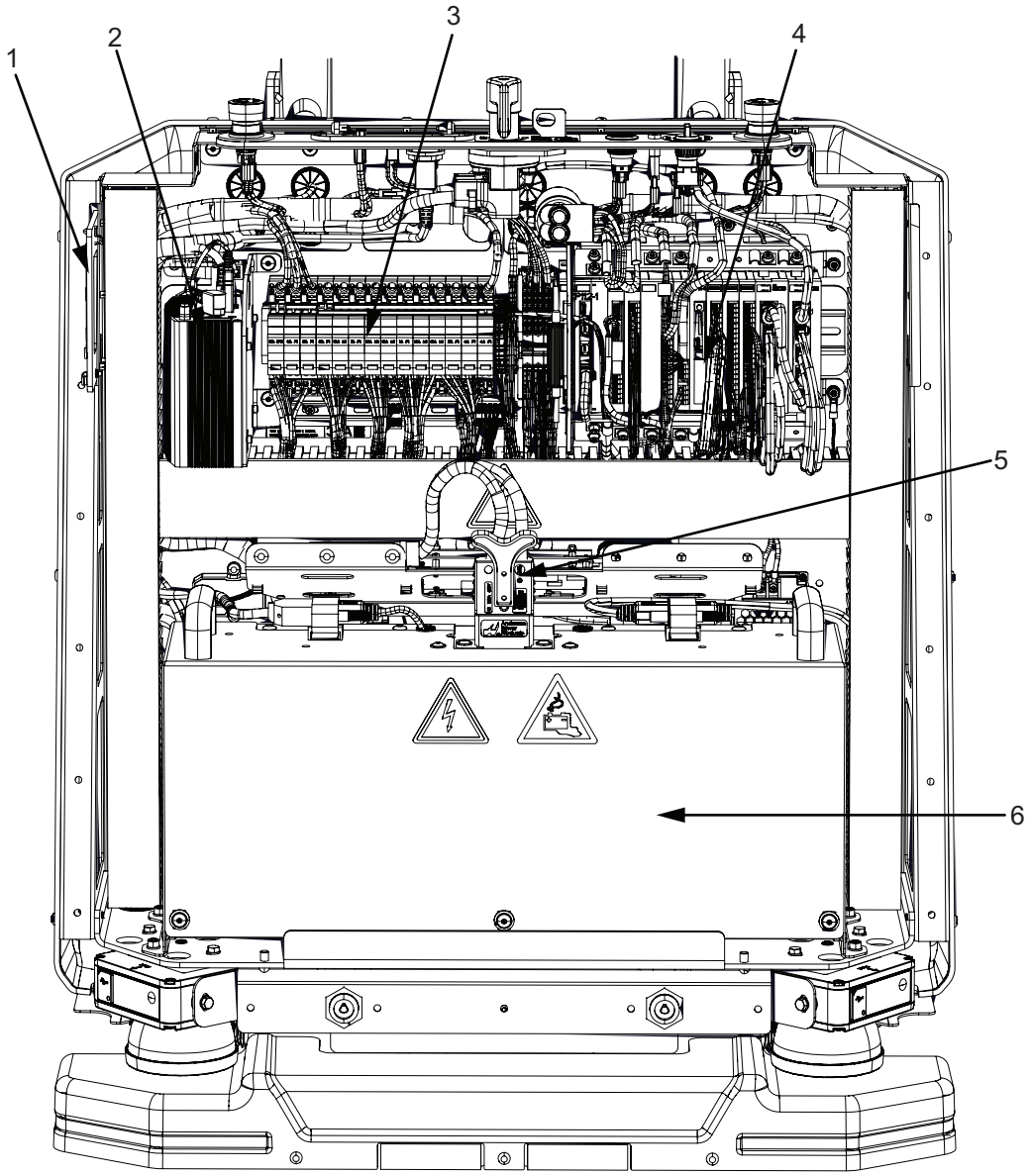
Objects in the environment protruding out, above, or below the AMR lasers' scanning planes shall be configured as Forbidden Areas during workspace map creation. This will minimize possible collision risk during operation.

1-2-3 Skins

Skins are removable covers on the front and back of the AMR. They are secured to the AMR with machine locks. Refer to *6-9-1 Removing and Replacing Skins* on page 6-23 for more information.

Components under Front Skin

Removal of the front skin provides access to the following items.



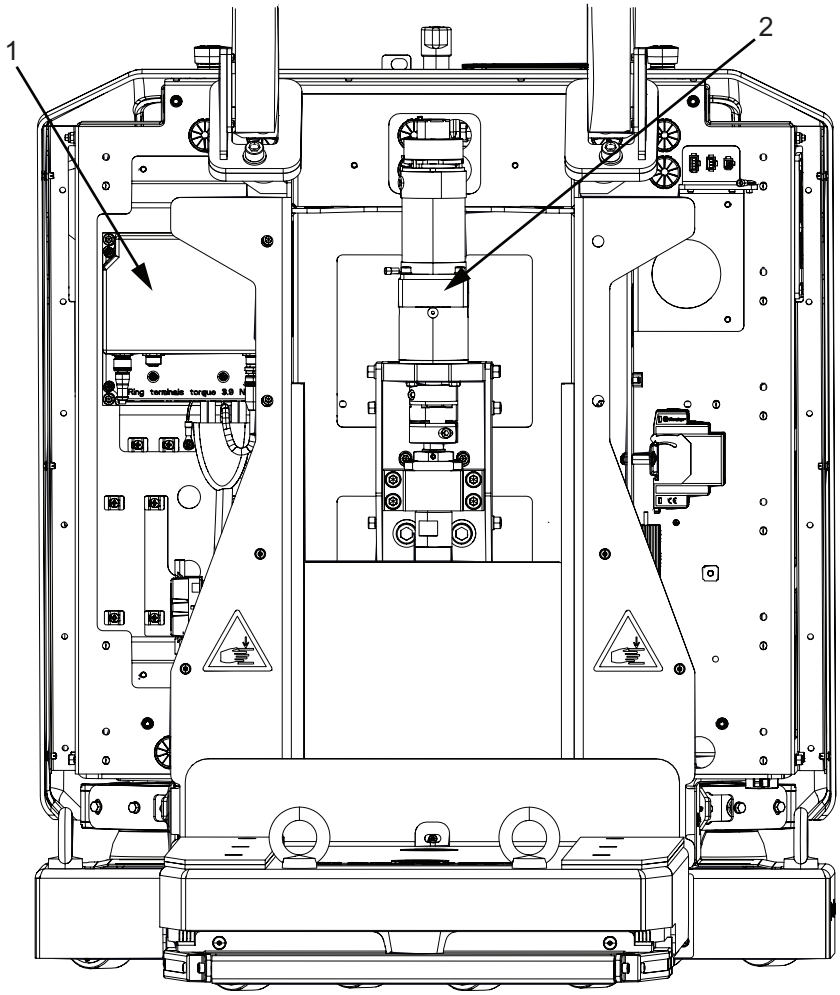
Item	Description	Item	Description
1	Wireless Antenna (2x)	2	PC
3	Circuit Breaker Panel	4	Motion Controller
5	AMR battery power connector	6	Battery

Components under Rear Skin

Removal of the Rear skin provides access to the following items.

Additional Information

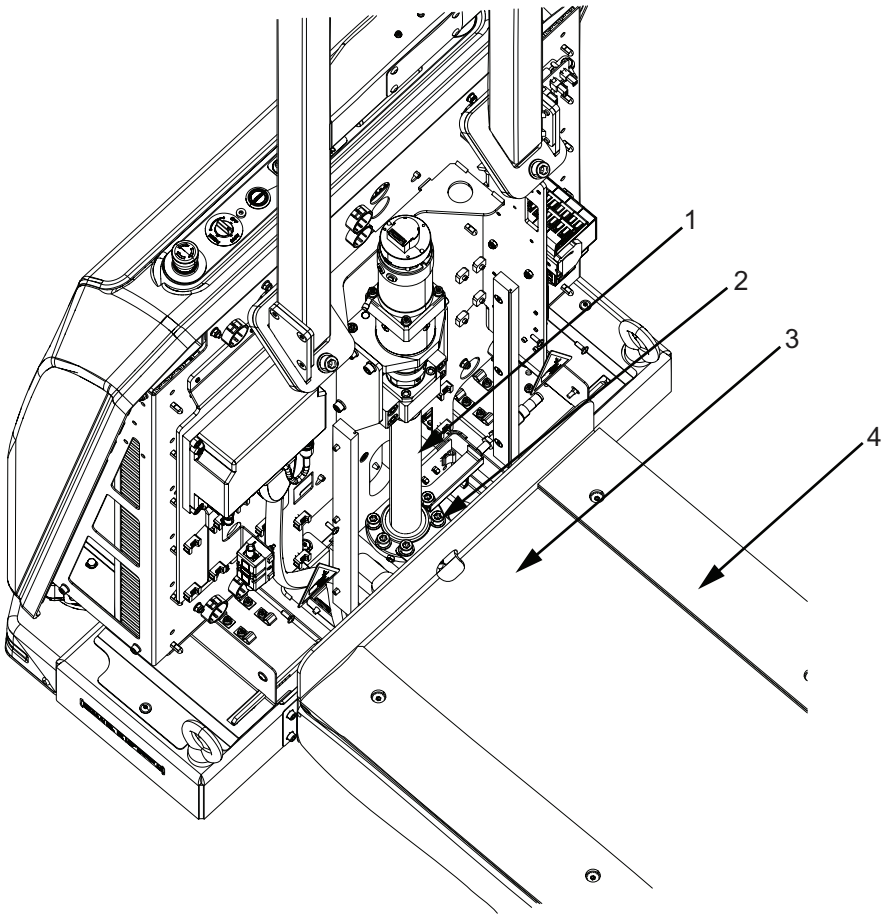
The Rear Skin is not a user-replaceable part. To remove or replace the Rear Skin, contact your local OMRON service representative.

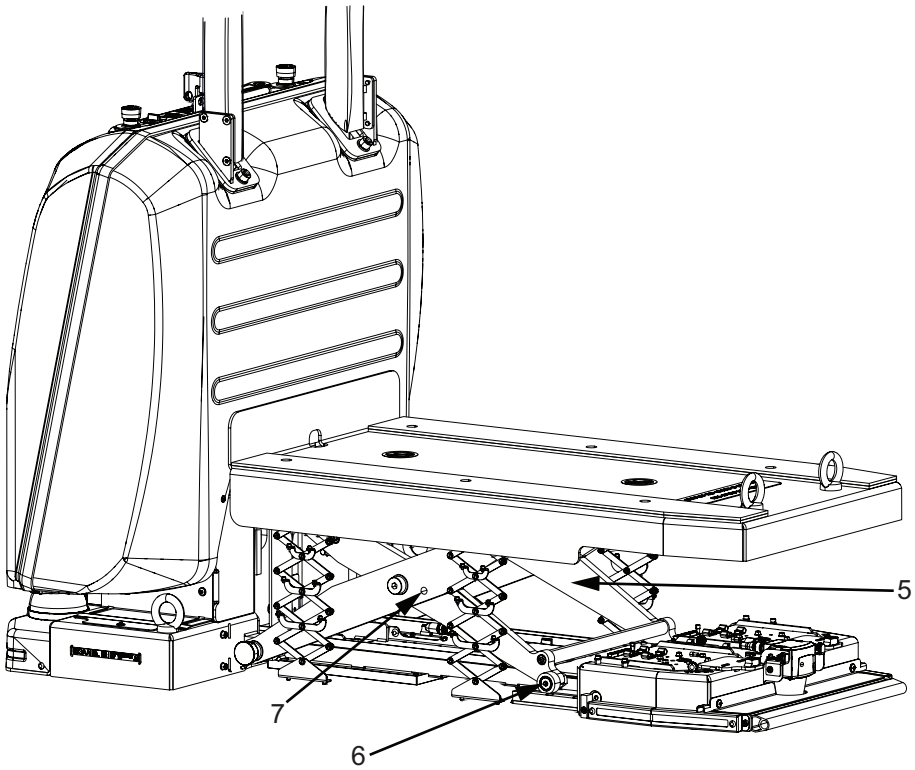


Item	Description
1	Mobile Electronics
2	Lifting System

● Lifting System Components

The Lifting System components are shown below.





Item	Description	Item	Description
1	Spindle Shaft	2	Spindle Nut
3	Lifting Plate	4	Rubber Strip

Item	Description	Item	Description
5	Scissor Lift	6	Track Rollers (4x)
7	Locking Hole (2x)		

The Scissor Lift Shield consists of slats attached to the Scissors on either side of the AMR, shielding them at each lift position.
The image above shows the AMR without the Scissor Lift Shield.

⚠ CAUTION

Do not operate the AMR without shielding the Scissor Lift.



1-2-4 Rear Bumper

An emergency stop bumper is mounted on the rear of the AMR. If the Rear Bumper is depressed as a result of collision with an object, the emergency stop circuit is activated and the AMR comes to a stop immediately.

1-2-5 Light Strips and Signal Lamp

Four LED Light Strips on the four corners of the AMR and a Signal Lamp on the mast provide visual indication about the AMR's status and its pending movement.

1-2-6 Drive Train and Suspension

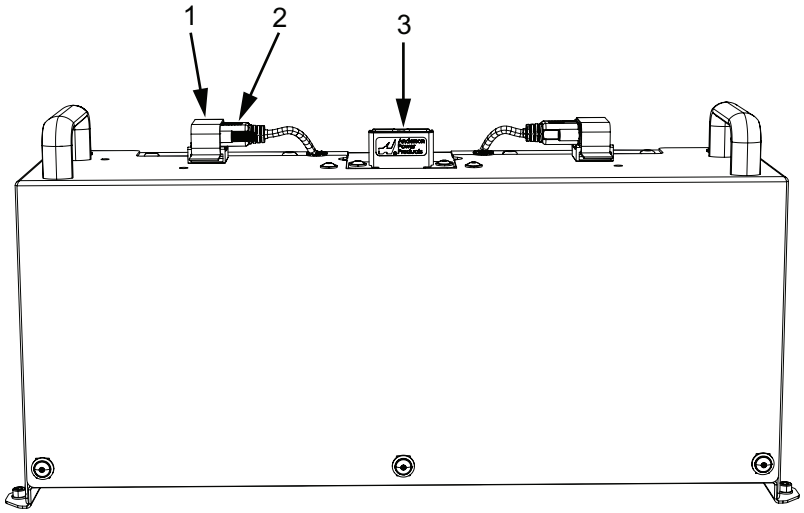
The AMR utilizes an omnidirectional-type drive train with four sets of drive wheels. This drive train style makes the AMR highly maneuverable and allows it to navigate forward, backward, sideways, and rotate in place. The drive wheels have solid polyurethane treads for traction and durability. This arrangement allows the AMR to maintain contact with the floor over uneven areas or bumps.

1-2-7 Computing System

The AMR's PC and the Motion Controller together form its main computing system, providing all navigational controls, application interfaces, and low level motor control. The PC is a compact computing device known as an NUC.
The PC runs the SetNetGo (SNG) operating system and the Advanced Robotics Automation Management (ARAM) software, while the Motion Controller controls the inertial sensors and the drive motors.

1-2-8 Battery

A rechargeable lithium-ion battery provides power to the entire AMR and any accessories.
The battery must be automatically recharged while in the AMR.



Item	Description	Item	Description
1	Velcro strap (2x)	2	Battery CAN connector (2x)
3	Anderson Powerpole socket		

Additional Information

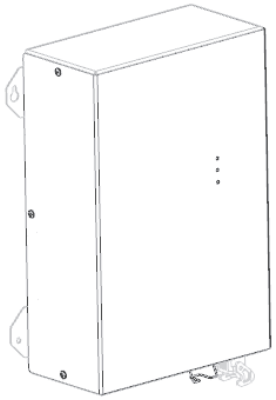
The battery is shipped separately from the AMR to comply with dangerous goods shipping regulations.

1-2-9 Charging Station

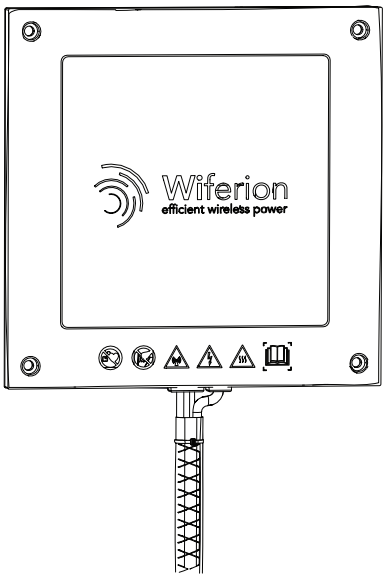
The Charging Station enables the AMR to charge autonomously. The Charging Station is equipped with infrared communication sensors that detect the presence of the AMR and provide communications between the battery and the Charging Station.

The Charging Station consists of the following main components:

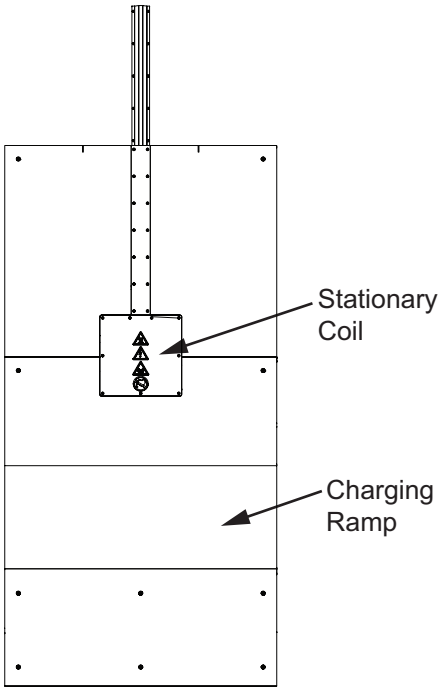
- The Stationary Electronics is the power supply box.



- The Stationary Coil is the fixed charging coil that is connected to the Stationary Electronics. The AMR docks itself over the Stationary Coil to align the Mobile Coil with the Stationary Coil. This initiates autonomous wireless charging.



- The Charging Ramp is the charging platform on which the Stationary Coil is mounted.



Additional Information

If you have more than one AMR that use a single Charging Station, make sure that your map contains features such as parking spaces or queuing lanes to accommodate AMRs that are approaching and leaving the charging area.

1-2-10 Wireless Antennas

Two wireless antennas are factory-installed on either side of the AMR to provide optimal range.

Precautions for Safe Use

It is the end user's responsibility to ensure that the payload does not attenuate the wireless antennas' signal.

1-2-11 Localization

Localization is the process by which the AMR determines its location within its work environment. Though any two AMR lasers can be configured at a time for localization, the AMR's primary method of localization utilizes the Front Safety Scanners to scan and detect features in its environment.
Each drive wheel is equipped with an encoder that sends information to the navigation system about the distance traveled and direction. The AMR's Motion Controller has gyroscopic inertial sensing to track the AMR's rotation.

1-3 Autonomous Navigation

The AMR combines hardware and mobile-robotics software to provide an adaptive lifting platform to transport a payload. It is equipped with an autonomous navigation system which enables the AMR to navigate and perform its basic functions independently and without the need for facility modification. After it scans the physical features in its environment, the AMR navigates safely and autonomously to any accessible destination. It can move continuously and without human intervention, autonomously recharging itself as necessary.

Navigation paths are updated many times per second to maintain a smooth trajectory and to avoid obstacles detected by the on-board sensors. An AMR reacts to obstacles in its path by slowing and if necessary, stopping safely. It then either plans a new path around the obstacle or, if the obstacle has moved, resumes its original path. If no such path is available, the AMR fails the current Job. Path planning parameters, together with constraints specified in the AMR's workspace map, define the path that the AMR will plan and follow through its environment. Use the MobilePlanner software to modify the AMR's path planning parameters as required for your environment.

The AMR can operate independently, without a wireless connection in areas where no other AMRs are present. In this mode, the AMR uses a map that is stored internally for all navigation and pre-configured tasks. When an AMR operates in an area with other AMRs, wireless connectivity to a Fleet Manager is required. Refer to *1-6-5 Fleet Manager* on page 1-22 for more information.

Navigational parameters are stored on the AMR's Computing System and can be viewed and modified using the MobilePlanner software.

⚠ CAUTION

Although the AMR's software provides the option of using the map features to keep the AMR within its designated workspace, poor or improper localization may result in incorrect path planning. To ensure safety, you must always install physical barriers where there is a risk of property damage or personal hazard.

The MobilePlanner software configures the many high-level operating characteristics of the AMR and typically communicates with the AMR over a wireless network. A direct connection through the Maintenance Ethernet Port on the AMR is also possible.

The AMR uses range data from the four laser scanners as its primary means of detecting obstacles and of maintaining an accurate understanding of its location in the environment. Additionally, it uses data from the following sensors:

- Encoders (one on each drive motor) provide information on the distance traveled by each drive wheel and direction of travel.
- Gyroscopic inertial sensors to track the AMR's rotation.

Before an AMR enters a high-traffic area, you must take appropriate precautions to alert people working in those areas. The AMR features a programmable warning buzzer.

If high-traffic areas include other moving vehicles such as fork-lift trucks or autonomous moving machines, consider adjusting the AMR's operating parameters to reduce the risk of a collision.You can do this with one of the following methods.

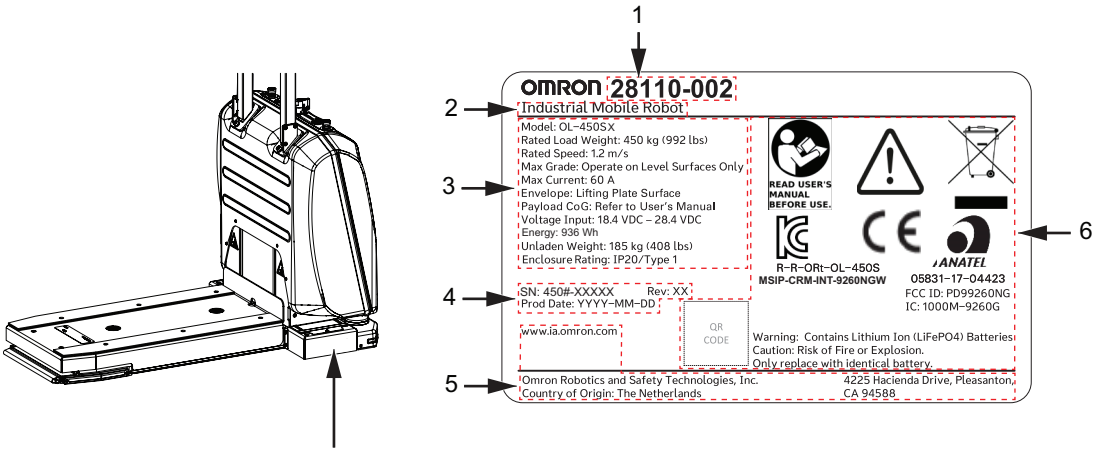
- Editing the workspace map to include features that restrict the AMR's operation in specific areas, such as preferred lines, resisted areas, and movement parameter sectors to reduce speed.
- Editing the AMR's configuration to affect its behavior in all locations, such as restricting its maximum speed.

1-4 Labels

Labels provide important information about the AMR and Charging Station components. Use the following information to understand label details and placement locations.

1-4-1 AMR Information Label

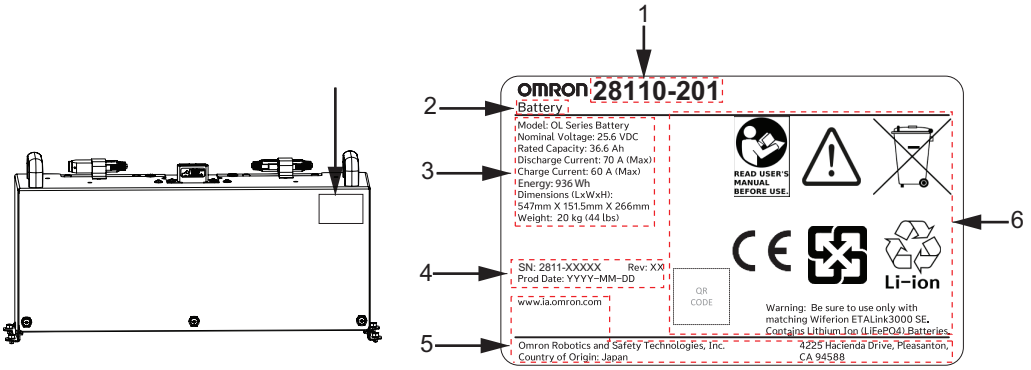
The AMR information label is described below. The following example may differ slightly from your product's label.



Item	Name	Description
1	Part Number	The AMR part number is provided.
2	Product Type	The product type is provided.
3	AMR Information	General information about the AMR is provided.
4	Production Information	The following information is provided. • SN indicates the serial number. • Product manufacture date is provided in YYYY-MM-DD format.
5	Product Origin Information	Product origin information is provided.
6	Alerts and Compliance	General alerts and compliance information is provided.

1-4-2 Battery Information Label

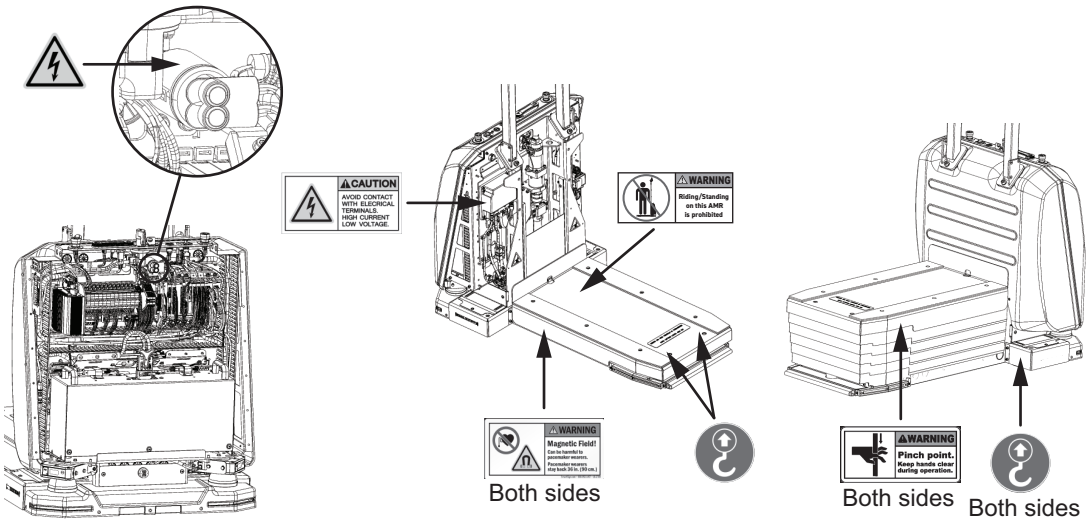
The battery information label is described below. The following example may differ slightly from your product's label.



Item	Name	Description
1	Part Number	The Battery part number is provided.
2	Product Type	The product type is provided.
3	Battery Information	Details about the Battery are provided.
4	Production Information	The following information is provided. • SN indicates the serial number. • Product manufacture date is provided in YYYY-MM-DD format.
5	Product Origin Information	Product origin information is provided.
6	Alerts, Compliance, and Designation	General alerts, compliance, and battery designation information is provided.

1-4-3 AMR Safety and Warning Label Locations

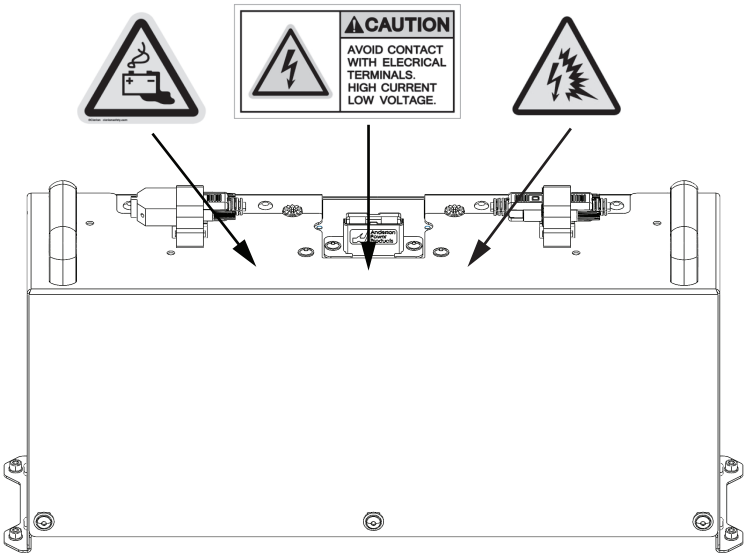
Use the following information to understand all safety and warning label locations on the AMR.



Symbol	Meaning
	Designated lift point
	Electric shock hazard
	Strong magnetic field hazard - pacemaker warning
	Strong magnetic field hazard
	Pinch point hazard

1-4-4 Battery Safety and Warning Label Location

Use the following information to understand all safety and warning label locations on the AMR.



Symbol	Meaning
	Battery leak hazard
	Electric shock hazard
	Arc flash hazard

1-5 Part Numbers

The AMR and battery part numbers are provided in the table below.

Refer to *A-1 Parts List* on page A-2 for accessories and user-replaceable spare parts.

Item	Part Number
OL-450 S2 AMR	28110-002
OL-450 S3 AMR	28110-003
Battery	28110-201



Additional Information

Before ordering lithium-ion batteries, please verify local shipping regulations to ensure compliance with applicable laws and restrictions. The battery is shipped separately from the AMR, to comply with dangerous goods shipping regulations.

1-6 Accessories

Information about the accessories for the AMR is provided in this section.

Precautions for Safe Use

For more information about each accessory for the AMR, refer to its original manufacturer's documentation.

Precautions for Correct Use

It is the end-user's responsibility to perform a risk assessment before implementing any accessory to ensure its compatibility with the work environment.

1-6-1 Stationary Electronics

The Stationary Electronics is the power supply box that provides power to the Stationary Coil. The Stationary Electronics (part number 28110-101) is a required accessory for charging the AMR.

Additional Information

The part number 28110-101 is a bundle that includes both the Stationary Electronics and the Stationary Coil.

1-6-2 Stationary Coil

The Stationary Coil is the fixed charging coil that is connected to the Stationary Electronics. The Stationary Coil is installed on the Charging Ramp. The AMR drives up the Charging Ramp and docks itself over the Stationary Coil to align the Mobile Coil with the Stationary Coil.
The Stationary Coil (part number 28110-101) is a required accessory for charging the AMR.

Additional Information

The part number 28110-101 is a bundle that includes both the Stationary Electronics and the Stationary Coil.

1-6-3 Battery

The battery provides power to the AMR. The battery (part number 28110-020) is a required accessory for charging the AMR.

1-6-4 Charging Ramp

The Charging Ramp (part number 28110-102) is a convenient platform secured to the floor, over which the Stationary Coil is installed. The AMR drives up the Charging Ramp and docks itself over the Stationary Coil to initiate autonomous charging.

1-6-5 Fleet Manager

To manage and administer multiple AMRs in the same workspace, you must use a Fleet Manager running the Fleet Operations Workspace (FLOW) software. The Fleet Manager is a computing device with a processor capable of running the Fleet Operations Workspace Core suite.
For a fleet of AMRs, the Fleet Operations Workspace Core (FLOW Core) software running on a Fleet Manager shares the map between all AMRs in the fleet. This provides a common frame of reference for navigation and localization, preventing contention between AMRs while managing traffic flow and ensuring Job completion. Refer to *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for more information.
When two or more AMRs operate in the same workspace, they may not be able to accurately detect each other or to precisely determine each other's dimensions without a Fleet Manager. This occurs because the laser scanners are positioned in recessed channels inside the footprint of the AMR. When two AMRs approach each other, their laser scanners will detect the inner surface of that channel and not the outer perimeter of the other AMR. When in close proximity, each AMR will plan its motion more accurately with information from the Fleet Manager about the position of the other AMR.
The Fleet Manager controls AMRs over a wireless network to share information between all AMRs in the fleet and improve efficiency through the following methods:

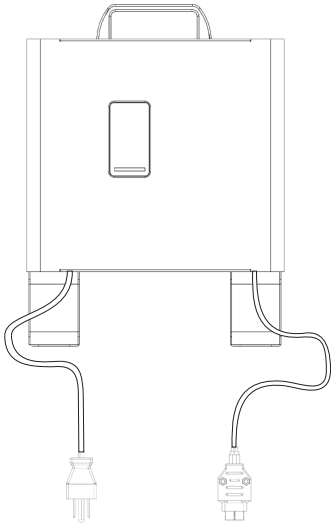
- Dynamic position and heading of the AMR (velocity and direction of travel).
- AMR size including payload structure consideration.
- Path planning information for the individual AMR's intended route.

Additional Information

- The AMR requires wireless communications when operating within a fleet. Refer to *3-5-3 Wireless Connection* on page 3-19 for more information.
- Details for the use and configuration of the functions are covered in the *Fleet Operations Workspace Core User's Manual (Cat. No. I635)*.

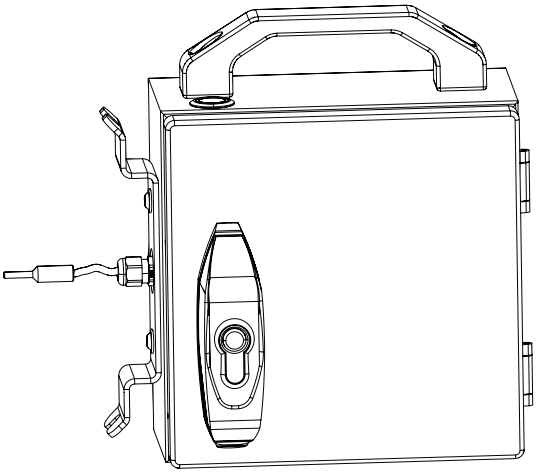
1-6-6 Service Charger

In the event the AMR cannot be charged at the Charging Station, an optional portable Service Charger (part number 28110-103) is available to charge the battery.



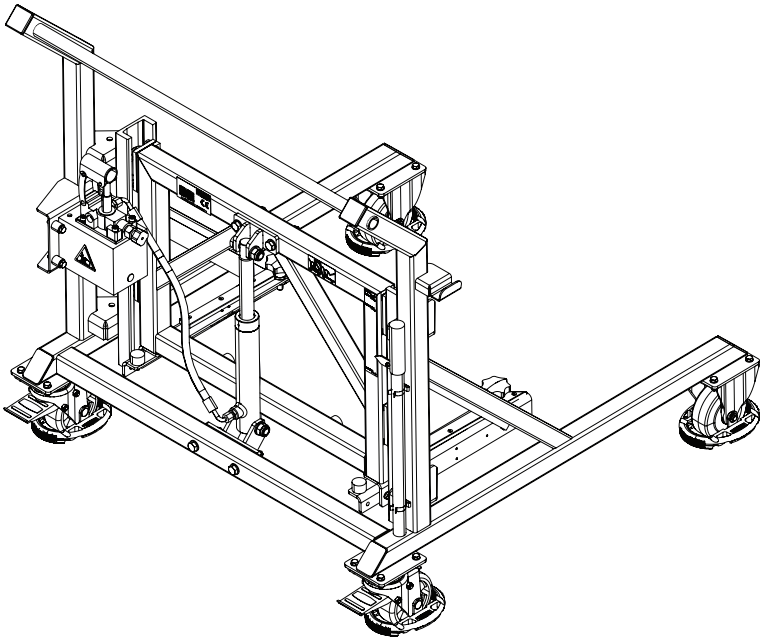
1-6-7 Lift Bridge

If the AMR loses power when the Lifting Plate is in the raised position (with or without a payload carrier resting on it), you can lower the Lifting Plate using the optional portable Lift Bridge (part number 28110-503).
A charger for charging the Lift Bridge battery is available (part number 28110-508). The charger is rated for 220 - 240 V at 50 Hz (Europe only). For other regions, OMRON recommends locally sourced Makita DC18RC Fast Charger.



1-6-8 Manual Mover

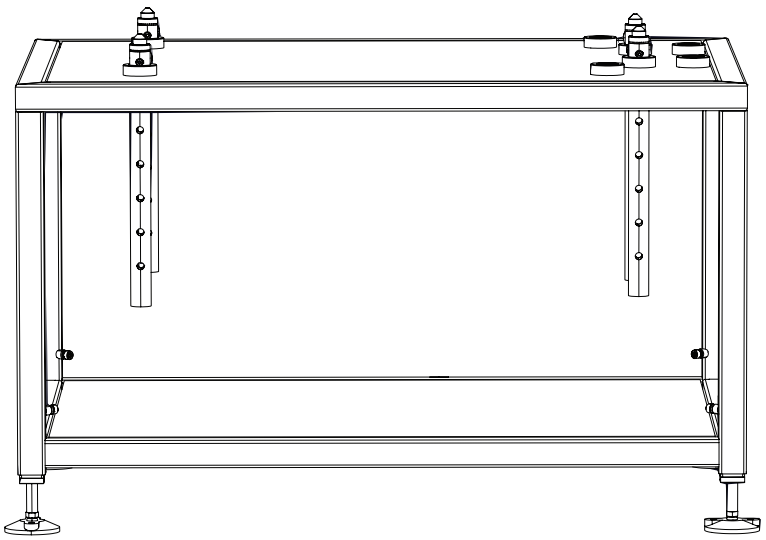
If the AMR needs to be moved over a short distance when it has no power, the optional Manual Mover (part number 28110-501) can be used to transport it.



1-6-9 Work Bench

The Work Bench (part number 28110-504) is a sturdy table with adjustable height used for performing maintenance tasks for the AMR. Lifting and placing the AMR on the Work Bench provides easy access

to all parts of the AMR (including the underside) at a convenient height for completing maintenance procedures.



1-6-10 Mobile I/O Box

The Mobile I/O box is a small external unit that interfaces with an AMR or fleet of AMRs wirelessly. It can be used to:

1. Summon an AMR to a Goal with the Call Function.
2. Use External Digital I/O for control of connected devices. These can be associated with AMR related actions like opening a door for an AMR.

The Mobile I/O Box (part number 23419-802) is intended to be part of an environment with AMRs controlled by a Fleet Manager.
Refer to *Mobile I/O Box User's Manual (Cat. No. I677)* for more information.

1-6-11 Cell Alignment Positioning System

The Cell Alignment Positioning System (CAPS) is an optional software feature that provides higher repeatability for AMR positioning. CAPS technology uses the AMR's sensors to detect a user-defined target shape and position itself in relation to the target with high repeatability. It does not require additional sensors or magnetic tape to be applied to the floor.
Flexible navigation allows the AMR to approach a station or cart from any angle so that docking can be achieved from any direction.
This feature also enables smoother and quicker loading and unloading of material, contributing to a shorter cycle time.
The CAPS license part number is 20271-805.

Additional Information

Refer to the *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for more information about standard target dimensions.

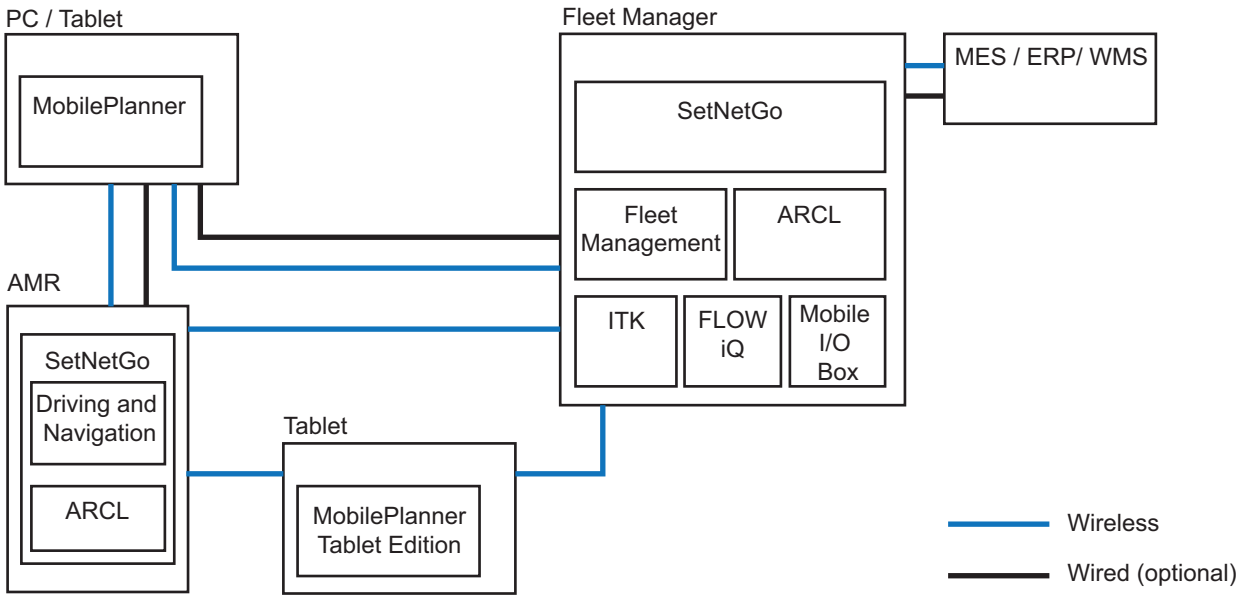
1-6-12 Cycle Time Optimization

Cycle Time Optimization is an optional software feature that promotes higher efficiency by eliminating delays. Included in the license is Seamless Motion, a feature that allows the AMR to complete a job and accept the next without stopping. Also included are path caching algorithms that maintain and re-use the most efficient routes for additional time savings.
The Cycle Time Optimization license part number is 20271-905.

1-7 FLOW Core Software

The FLOW (Fleet Operations Workspace) Core software package consists of different software components that provide specific functionality during AMR configuration and operation. The information in this section provides an overview of the different FLOW Core software components, their functions, and interactions within the AMR system.

- MobilePlanner (PC / Tablet)
- Fleet Management
- SetNetGo
- Mobile I/O Box
- Integration Toolkit (ITK)
- FLOW iQ
- Driving and Navigation



Additional Information

Refer to the *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for more information.

1-7-1 MobilePlanner Software

MobilePlanner is part of the Fleet Operations Workspace software and runs on the user's PC, or as a portable tablet version on Android® and iOS® devices. It provides a tabbed graphical user interface on the PC and a touchscreen interface on tablets.

MobilePlanner software typically communicates with the AMR securely over a wireless network during normal operation.

This software provides the following general functionality:

- Map creation and editing with Forbidden Areas, charging locations, Goals, and other workspace features.
- Creation and editing of Macros, Tasks, and Routes.
- Configure parameters that control the AMR's operation in the mapped workspace.

- Monitor the location and behavior of a single AMR or a fleet of AMRs.
- Accelerated installation of new fleets with configuration inheritance.
- Quick access buttons for fleet observability, map editing, configuration management, system management and data analytics.
- Providing operator inputs for the AMR.
- Scheduling autonomous operations.
- Administrator accounts for full feature access or operator accounts for restricted access to features and functions.
- Supported languages of English, Japanese, German, French, Italian, Korean, Spanish, Polish, Simplified Chinese, and traditional Chinese.

System Requirements

MobilePlanner system requirement information is provided below for PC and Tablet Edition software.

Software Type		Requirements
PC		• Operating System: Windows 11 and Windows 10 (64 bit) • CPU: 1.5 GHz dual-core CPU recommended • Main Memory: 1.5 GB minimum (4 GB minimum recommended) • Hard Disk: minimum of 400 MB of available space • Video Memory: 256 MB minimum • Display: XGA 1024 × 768, 16 million colors minimum
Tablet Edition	Android®	Android® version 9 or newer with a minimum 2GB of RAM
	iOS®	iOS® version 10 or newer

Tablet Edition

The MobilePlanner tablet edition is an easy-to-use interface designed to monitor and control AMRs with a tablet. This software has a limited set of features and functions as described below.

- Localize AMRs.
- Initiate the map creation process.
- Monitor individual AMRs or a fleet of AMRs for Job counts, current Job queue, locations, battery level, and travel speed.
- Send AMRs to perform up to 6 predefined jobs with a single button press.
- Send AMRs to charging locations or other map objects.
- View alerts from AMRs.

1-7-2 Fleet Management Software

Fleet Management software runs on the Fleet Manager hardware. It provides the following general functionality for a fleet of OMRON AMRs.

- Intelligent Job assignment
  Reduces wasted time and movement by continuously looking ahead to anticipate which AMRs will be best positioned for upcoming Tasks.
- Managed motion
  Ensures smooth operations in busy environments by coordinating traffic flows and efficiently sequencing pick-up and drop-off at target locations.
- Traffic control

Notifies converging AMRs of their predicted paths, allowing them to re-calculate and avoid collision in the most efficient way.

- Map updates
  Distributes map updates automatically across the entire Fleet.
- Charge management
  Tracks battery power of the entire Fleet, directing AMRs to their nearest available or preferred charging station on a schedule that ensures continuous Fleet operation.
- Skill administration
  Considers the capabilities of individual AMRs in the Fleet and ensures the correct AMR is assigned to the correct Job.

1-7-3 SetNetGo Software

The SetNetGo software runs on the AMR and the Fleet Manager. This software is a proprietary, immutable operating system developed by OMRON.
SetNetGo is used for configuration and setup, software upgrades, diagnostics, and retrieving log files for troubleshooting purposes. The SetNetGo interface is viewable from within MobilePlanner or with a web browser when a connection to the AMR or Fleet Manager has been established (wired or wireless).



Additional Information

Refer to the *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* and *MobilePlanner Integrated Help* for more information.

Mobile I/O Box Package

The Mobile I/O Box package is a component in SetNetGo that communicates with the Mobile I/O Box. This package manages updates for Mobile I/O Box devices in the system.



Additional Information

Refer to the *Mobile I/O Box User's Manual (Cat. No. I677)* for more information.

Integration Toolkit (ITK)

The Integration Toolkit is OMRON’s interface application that enables integration between the Fleet Manager and the end user’s client application, manufacturing execution system (MES), or warehouse management system (WMS).
This integration layer facilitates autonomous control for a fleet of AMRs using standard communication methods including MQTT, REST, and SQL. The Integration Toolkit facilitates queuing and monitoring of all AMR Job types such as pickup, drop-off, and multi-segment.



Additional Information

Refer to the *Fleet Operation Workspace Core Integration Toolkit User’s Manual (Cat. No. I637)* and *Fleet Operation Workspace Core Integration Toolkit - MQTT API User's Manual (Cat. No. M107)* for more information.

● ARCL Programming Language

The Advanced Robotics Command Language (ARCL) is a programming language integrated into the AMR control system. Its operating format is a text-based command and response server. Use ARCL to integrate one or more AMRs into an external automation system. You do not need access to MobilePlanner to use ARCL.

Typical uses of ARCL are:

- Operating and monitoring the AMR.
- Operating accessories and peripherals.



Additional Information

Refer to the *Advanced Robotics Command Language AMR Reference Guide (Cat. No. I617)* for more information.

FLOW iQ Package

The FLOW iQ package provides visualization tools to generate graphics on the fly such as heat maps, robot path map, robot utilization, and more to track and optimize the AMR application. This package runs exclusively on a Fleet Manager device.

The FLOW iQ package is a licensed component in SetNetGo that enables the functionality described above.



Additional Information

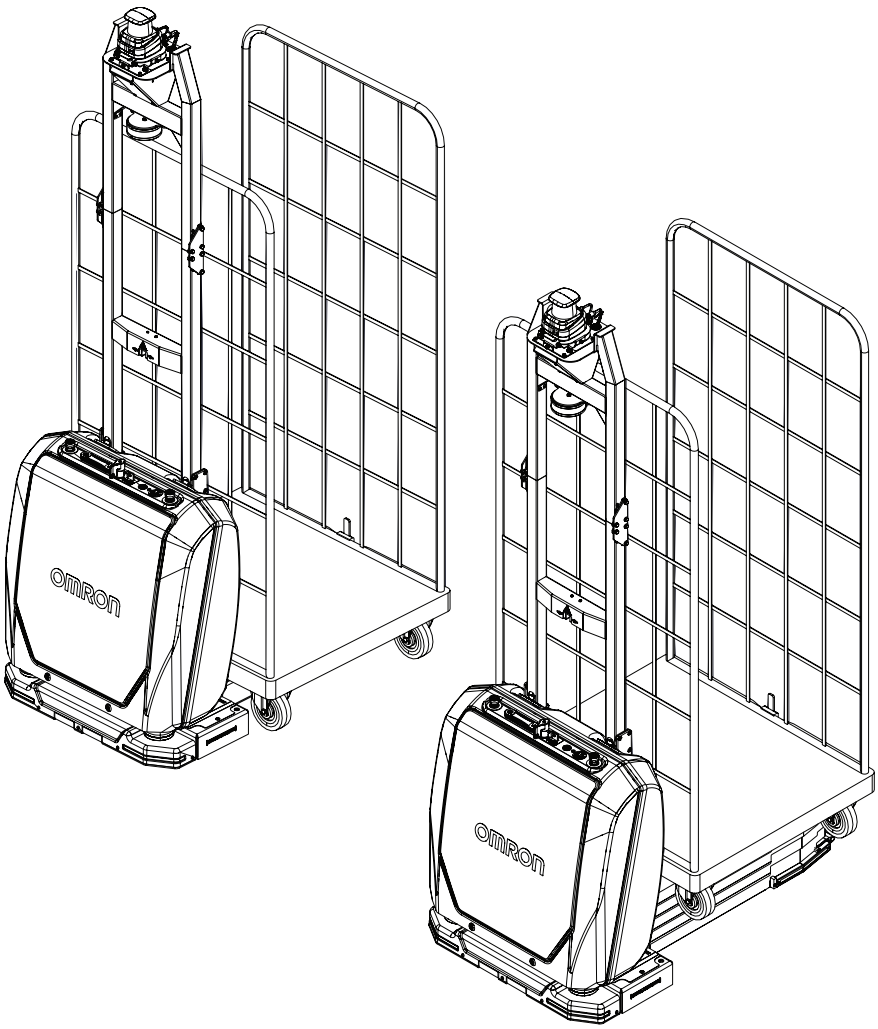
Refer to the *Fleet Operations Workspace iQ User's Manual (Cat. No. I665)* for more information.

1-7-4 Driving and Navigation Software

Driving and Navigation software runs on the AMR within SetNetGo. This software provides all essential AMR functionality using various subsystems such as ARAM and MARCOS.

1-8 Payload Considerations

This section describes considerations and requirements for AMR payloads.
A payload is considered as any item(s) that are placed on the AMR for the purposes of securing, transporting, and transferring. A payload carrier is required to secure an object during transport. The payload carrier can be a cart, trolley, cage, pallet, or a pick-up and drop-off (P&D) stand. The end user or an integrator is responsible for designing and implementing a payload carrier. Refer to *Payload Carrier Dimensions* on page 2-9 for more information.
The AMR drives under a payload carrier and lifts it up on the Lifting Plate. A typical AMR application would involve picking up, transporting, and delivering the payload carrier containing the payload. The payload carrier can be with or without wheels.



Make the following considerations for the payload carrier.

- The payload should be placed stably on the payload carrier with heavy items placed on the bottom and lighter items placed on the top.
- The center of gravity (COG) must be at the middle of the payload carrier. Refer to *2-3-2 Payload Center of Gravity* on page 2-10 for more information.
- The maximum weight of the payload and the payload carrier together must not exceed 450 Kg.
- The payload must be placed and remain within the dimensions of the payload carrier.
- The payload carrier must remain stable on the Lifting Plate of the AMR. Refer to *Payload Carrier Dimensions* on page 2-9 for more information.

- All wheels that may be present on a payload carrier must be the same size.
- Ensure the payload carrier is in good condition and free of defects.
- Ensure there is no debris or dirt on the underside and wheels of the payload carrier.

Careful considerations for the center of gravity and moment of inertia of the payload carrier must be made. Refer to *2-3-2 Payload Center of Gravity* on page 2-10 for more information.

⚠ DANGER

The end-user of the AMR must perform a risk assessment to identify and mitigate any additional personal and property damage hazards caused by the payload.



⚠ WARNING

- The payload must be placed away from the AMR sensors. If the payload or associated structure blocks any of the AMR's sensors, the AMR cannot function correctly.
- The user is responsible for the safety of the AMR, which includes confirming that the system is stable with any payload, payload structure, or other attachments while functioning in the specified operating environment.
- If the AMR transports containers of liquid or other non-solid material, consider the effect on the AMR's stability if their contents can shift. It is the end user's responsibility to ensure that the payload is properly secured to the AMR, and that payload shifting does not create AMR instability.
- The payload or payload structure shall not be positioned in such a way that would put the operator in danger while trying to reach an emergency stop button.
- Do not exceed the maximum size and weight of the payload carrier to be transported on the AMR defined in the Specifications in this manual.



⚠ CAUTION

It is the end user's responsibility to make sure that the speed is appropriate for the payload that the AMR carries, and that the AMR movement does not cause payload instability or loss of AMR control.



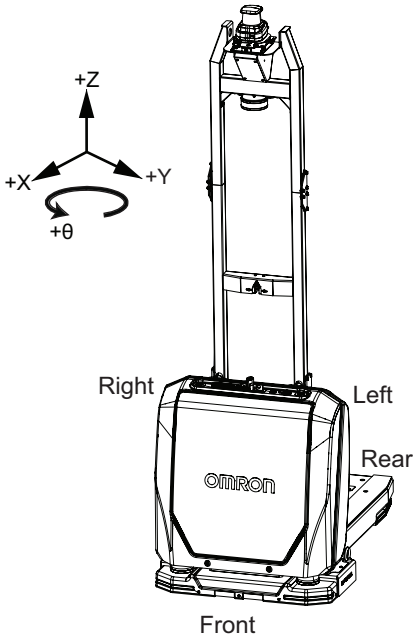


Precautions for Safe Use

Check and conform to the maximum weight of the payload (including the payload carrier), the maximum dimensions of the payload carrier, and the CoG as specified in this manual.

1-9 Coordinate System

AMRs use the X, Y, Z, and Theta coordinate system displayed in the figure below. This information is relevant for identifying which is the left or right side of the AMR. For example, the +X direction is the direction of AMR forward travel.
The origin of the coordinate system is the AMR's center of rotation at floor height.
Coordinates are required for understanding the center of gravity envelope and for procedures such as installing and configuring user supplied additional scanners. The AMR's coordinates are also associated with the map coordinates.
The rotation value Theta specifies the AMR's angle of rotation, which determines its heading or direction of travel.
The origin of the vertical coordinate Z is set at ground level (Z=0). The value of Z is required when you calculate the mount position of items such as additional scanners. Positions of additional items like this are set in MobilePlanner.



2

Specifications

This section provides specifications of the AMR and other associated items.

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2-1 Performance Specifications

Performance specifications for the AMR are provided below.

Item	Specification	
	OL-450S2	OL-450S3
Maximum payload capacity	450 kg	
Run time	Full payload: approximately 7 hours No payload: approximately 11 hours	
Swing radius	685 mm	
Turn radius	750 mm	
Maximum translational speed (forward and sideways)	1200 mm/s	
Maximum translational speed (reverse)	300 mm/s	
Maximum translational acceleration	750 mm/s^2	
Maximum translational deceleration	1000 mm/s^2	
Maximum rotational speed*1	65 degrees/s	35 degrees/s
Maximum rotational acceleration / deceleration	165 $degrees/s^2$	85 $degrees/s^2$
Lifting speed	40 mm/s	
Maximum moment of inertia	100 $kg\text{-}m^2$	
Stop position repeatability (single AMR)*2	• To a position: ±160 mm ± 7° • With CAPS: ±6 mm, ±0.6°	
Stop position repeatability (fleet)*2	• To a position: ±160 mm, ± 7° • With CAPS: ±10 mm, ±0.8°	

*1. The maximum rotational speed is reduced to 17 degrees/s when the AMR is traveling at speeds over 20 mm/s.

*2. Stop position repeatability values were obtained using default AMR parameters and a map created by the OL-series AMR.

2-2 Lifting Specifications

The AMR lift mechanism specifications are provided below.

Item	Specification	
	OL-450S2	OL-450S3
Maximum Lifting Height	308 mm	
Lifting Speed	40 mm/s	
Height of Lifting Plate	108 mm	
Length of Lifting Plate	771 mm	851 mm
Width of Lifting Plate	446 mm	

2-3 Physical Specifications

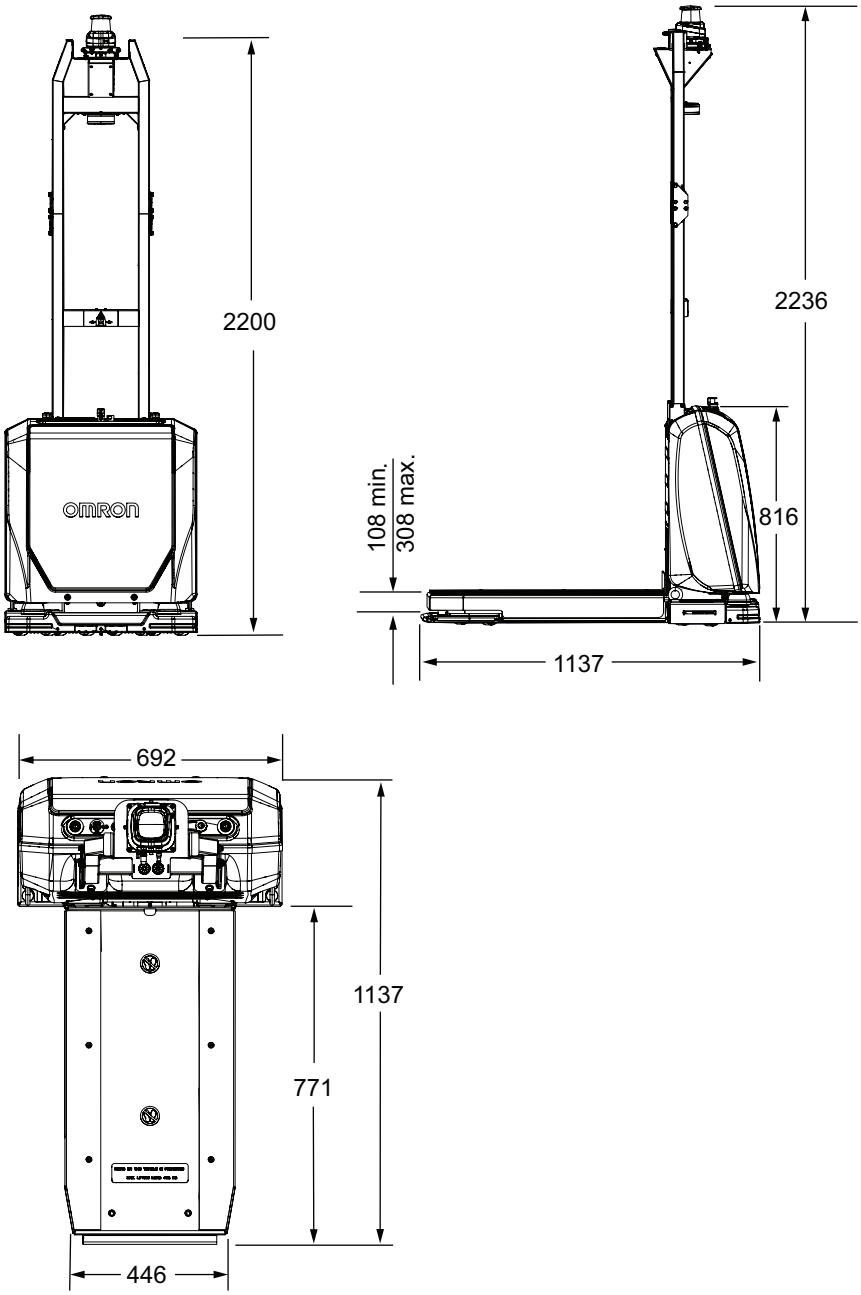
Physical specification of the AMR and other items are provided below.

2-3-1 Dimensions

Dimensional specifications are provided in the following sections.

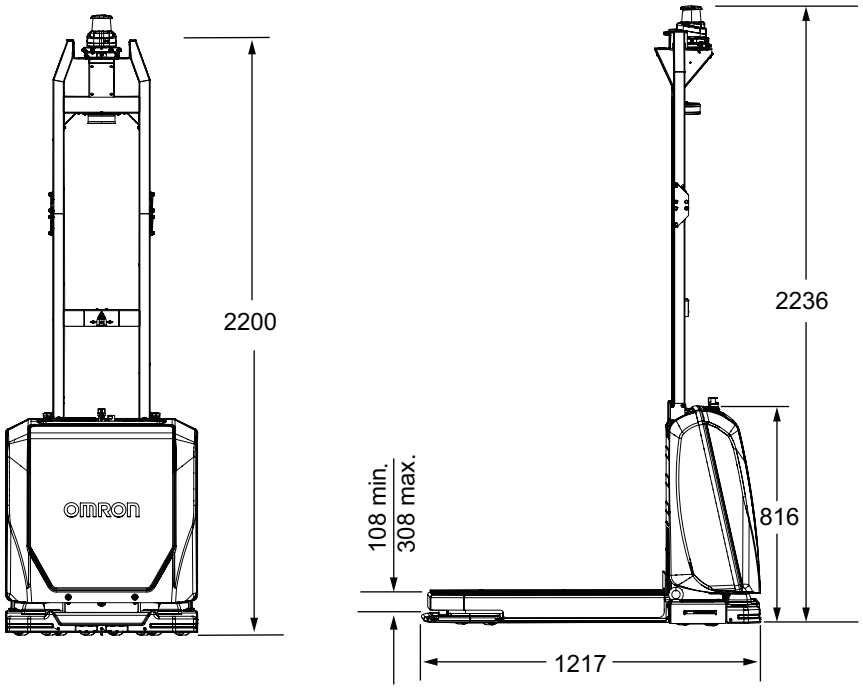
Overall AMR S2 Dimensions

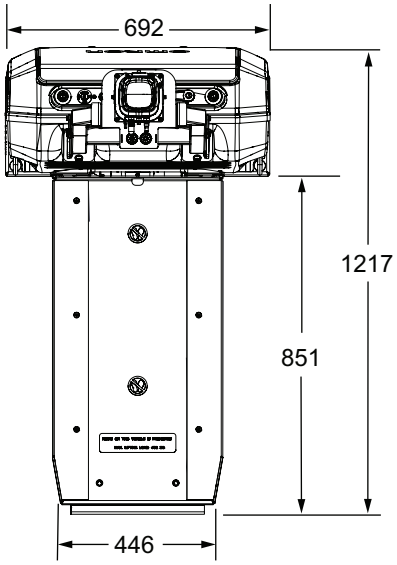
The overall dimensions of the AMR model S2 are provided below.



Overall AMR S3 Dimensions

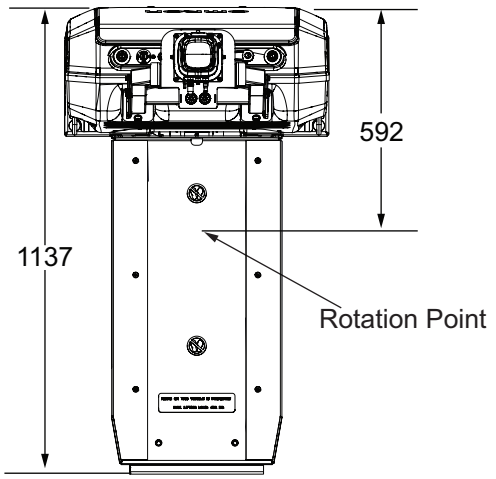
The overall dimensions of the AMR model S3 are provided below.



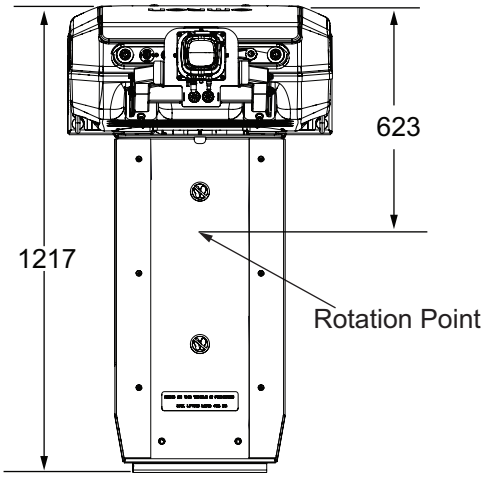


Center of Rotation

The dimensions of the AMR center of rotation is provided below.



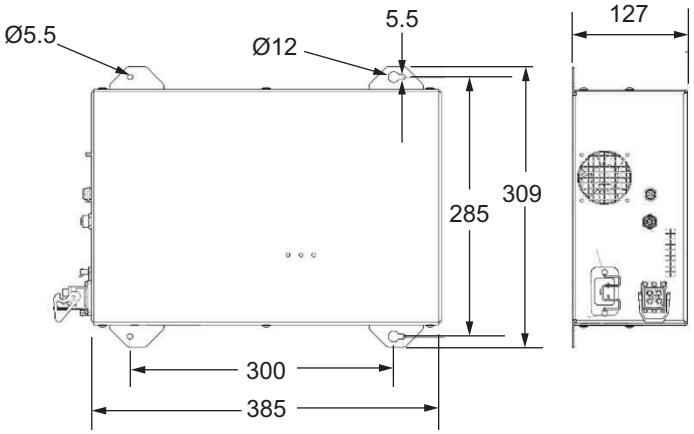
AMR Model S2



AMR Model S3

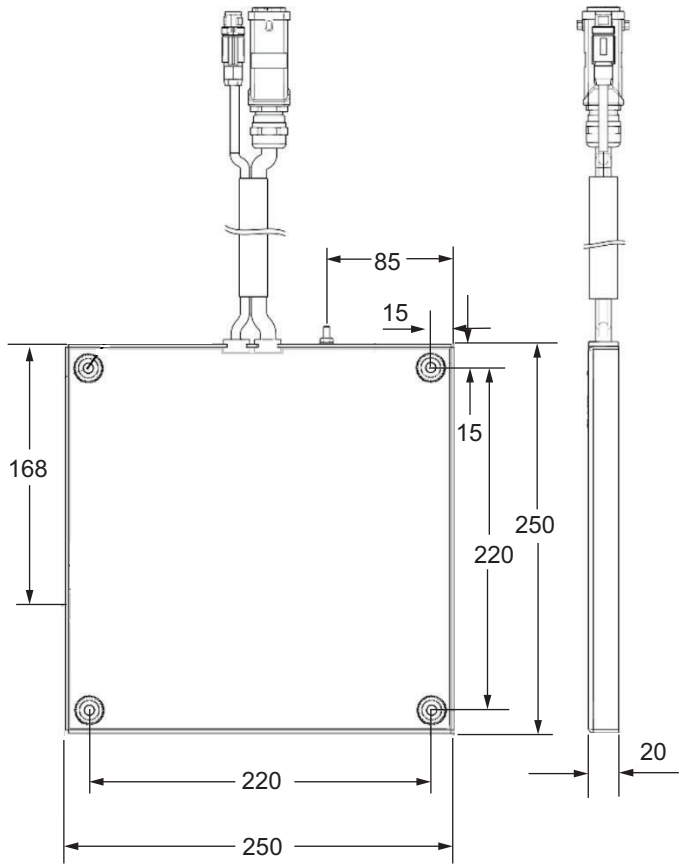
Stationary Electronics Dimensions

Physical dimensions of the Stationary Electronics are provided below.



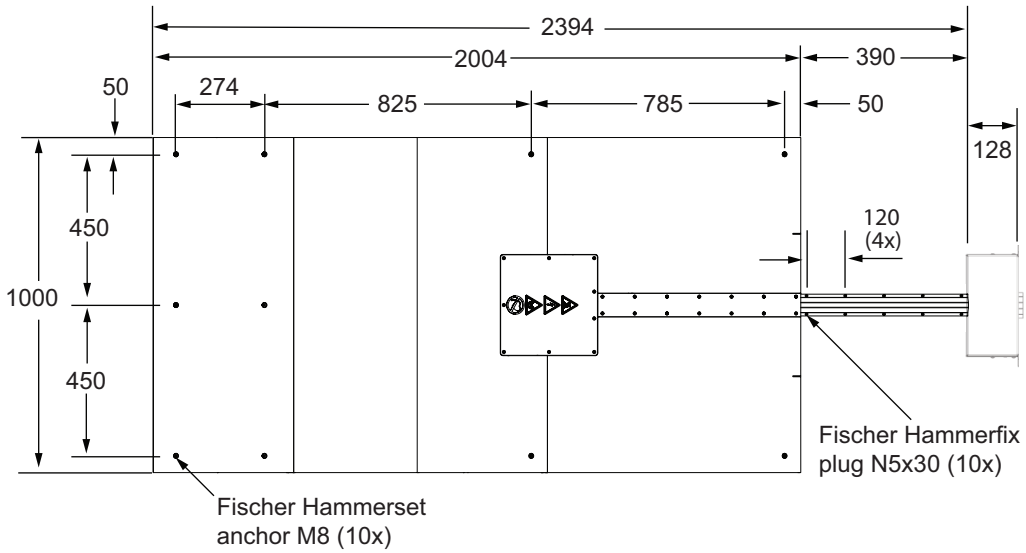
Stationary Coil Dimensions

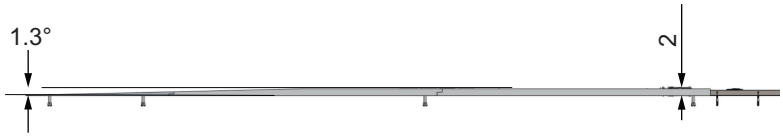
Physical dimensions of the Stationary Coil are provided below.



Charging Ramp Dimensions

Physical dimensions of the Ramp are provided below.



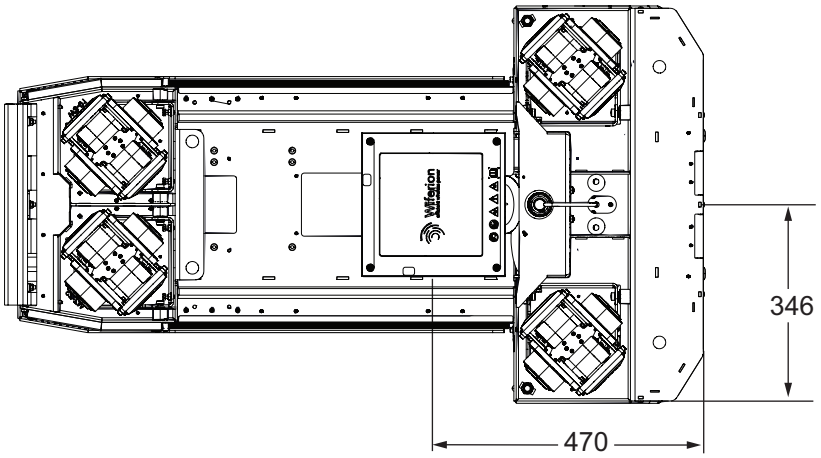


Distance to Center of Coil Dimensions

The following sections provide the dimensions for the distance to the center of the Mobile and Stationary Coils.

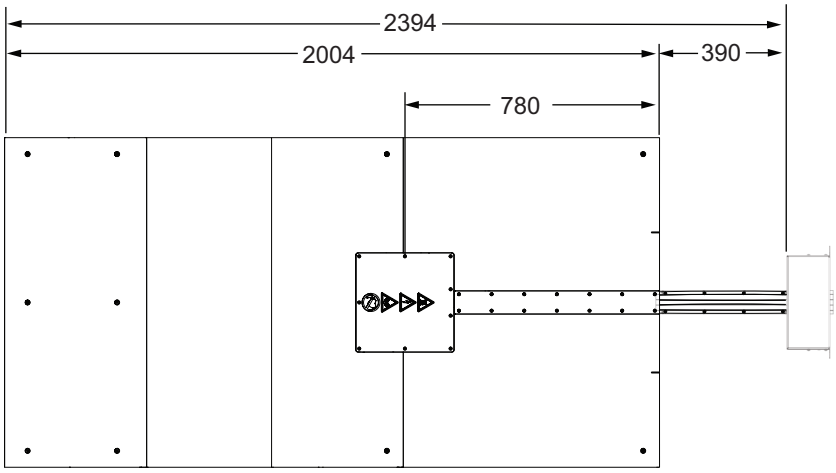
● Distance to Center of Mobile Coil

The dimensions for the distance to the center of the Mobile Coil (AMR) in the charging position are provided below.



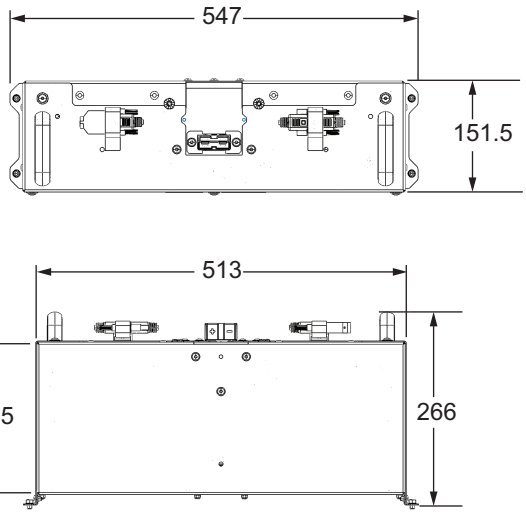
● Distance to Center of Stationary Coil

The dimensions for the distance to the center of the Stationary Coil on the Charging Ramp are provided below.



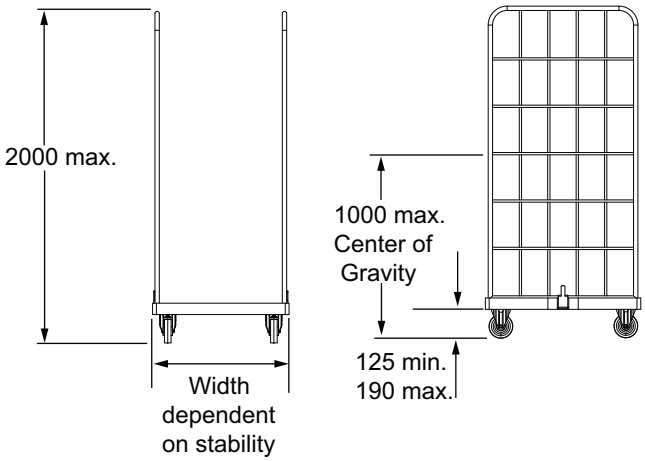
Battery Dimensions

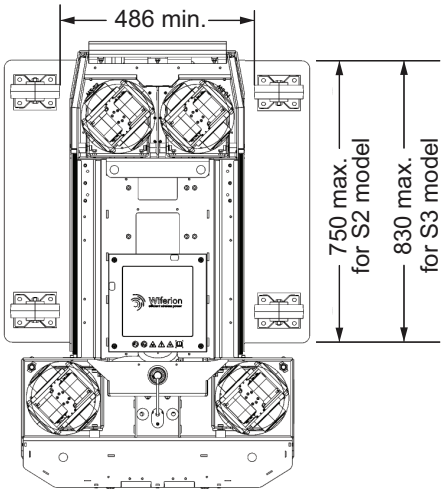
Physical dimensions of the battery are provided below.



Payload Carrier Dimensions

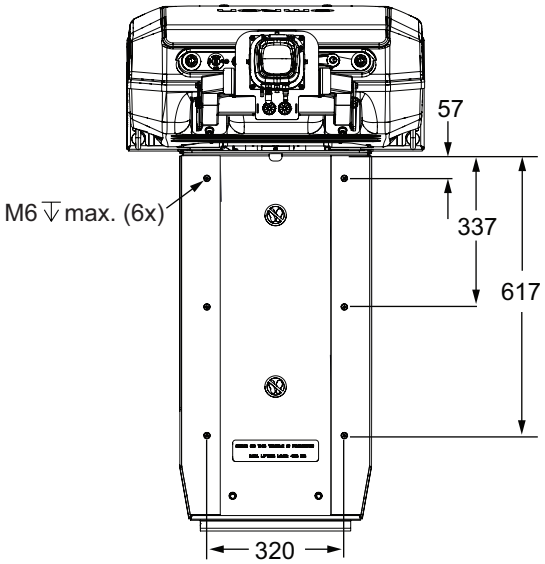
Physical dimensions of the payload carrier are provided below.



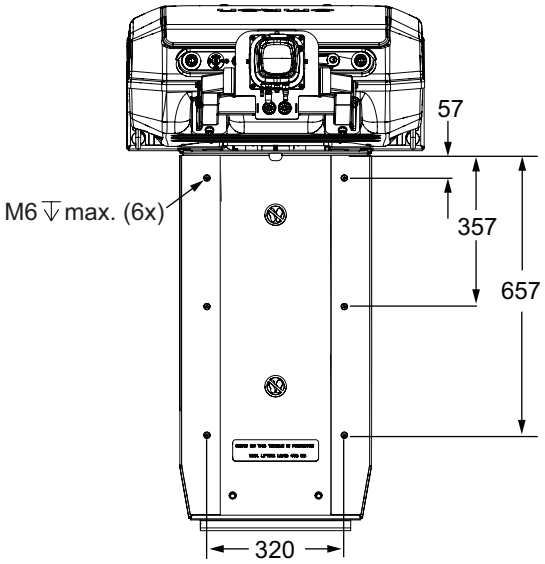


Positioning Pin Mounting Hole Dimensions

Positioning Pin mounting hole dimensions are provided below.
Refer to the image below for the AMR S2 model mounting hole dimensions.



Refer to the image below for the AMR S3 model mounting hole dimensions.



2-3-2 Payload Center of Gravity

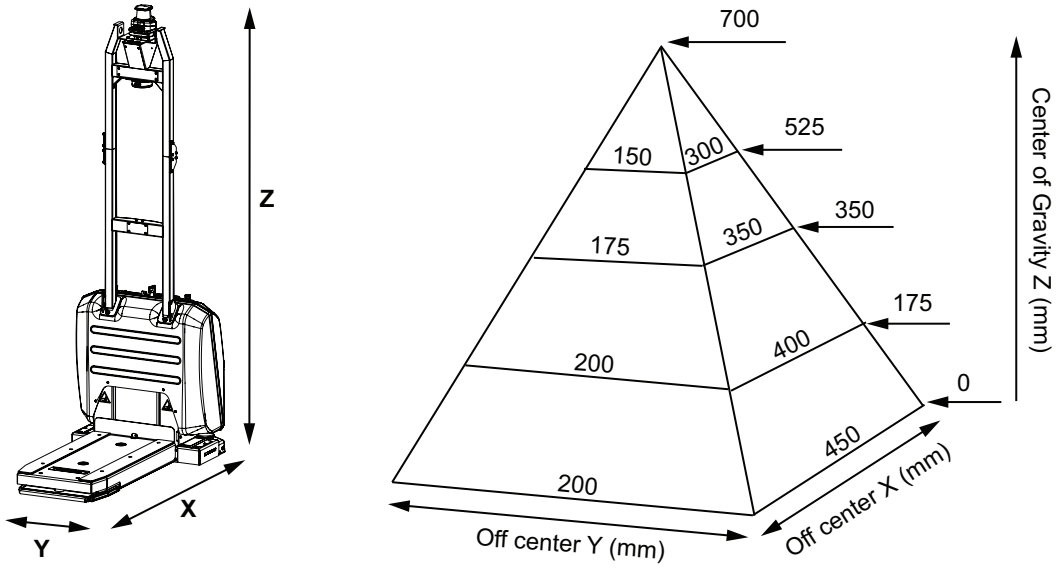
CoG is a critical factor when placing items on the AMR for transport. Keep the payload carrier's CoG centered over the Lifting Plate and as low as possible. This provides optimum stability, particularly when the AMR traverses irregularities in the floor or stops suddenly.
The AMR has a maximum payload of 450 kg. This includes the payload carrier and any load carried by it. The CoG of the combined mass of the payload carrier, including the payload being transported, must be within the specified limits. These limits must be observed to ensure stability while the AMR is in motion and also while loading and un-loading the payload carrier.
Make the following payload considerations when implementing your payload.

- If the payload or payload carrier can shift during AMR movement, consider its effect on the AMR's center of gravity.

- If the payload is tall and also has substantial weight, consider the effect on the AMR's center of gravity.
- Tipping hazards are more likely if the payload center of gravity is outside the recommended specifications.

The following figure provides information about the payload's center of gravity allowable limits.
The figure assumes the following conditions.

- The payload is securely attached to the AMR and it does not shift due to the AMR's motion.
- The AMR does not exceed its specified default limits for acceleration, deceleration, linear velocity, angular velocity.
- The floor coefficient of friction is within the required specifications.
- The AMR is operating on a flat, level surface and not on an inclined surface.



2-3-3 Weights

Weights are provided in the table below.

Item	Weight	
	OL-450S2	OL-450S3
AMR (no battery or accessories)	165 kg	170 kg
Battery	20 kg	
Stationary Electronics	5.9 kg	
Stationary Coil	2.8 kg	

2-4 Environmental Specifications

Environmental specifications are provided in the following sections.

2-4-1 AMR Environmental Specifications

Environmental specifications for the AMR are provided below.

Item		Specification
Ambient operating temperature		5 to 40°C
Storage temperature		-20 to 60°C
Operating / storage humidity		5% to 95%, non-condensing
Altitude		2000 m maximum
Pollution degree		2
Ingress Protection class*1		IP20
Enclosure rating		NEMA Type 2
Atmospheric		Non-hazardous environments (no explosive gas and oil mist).
Radiation		No environments with ionizing radiation.
Wavelength		Avoid infrared devices in and near the range of 845 nm.
Electromagnetic field limits		10 V/m at 80-1000 MHz, 3 V/m at 1400-6000 MHz
Dust Tolerance		Maximum allowed: Floor accumulation: < 11.7 mL / m2 with a particle size < 40 µm.
Dust and smoke		Avoid dusty and smoky areas. It may degrade the efficiency of Front Safety Scanners and result in unexpected halt of the AMR operation.
Floor condition	Maximum gap traversal*2	10 mm
	Maximum step traversal	No step traversal permitted
	Maximum slope	Flat surfaces only
	Flatness	NEN 2747-2001 / flatness category 5 DIN 18202 Group 3
	Levelness	F_L25 (per ACI 117 standard)
	Minimum floor compressive strength	9.9 MPa, NEN-EN 206-1: 2014 / strength category C25 / 30
	Coefficient of friction	Static coefficient of friction µs ≥ 0.6 Dynamic coefficient of friction µd ≥ 0.4
	Floor covering (drains, flooring)	None
	Maximum floor resistance	1 G-ohm
	Abrasion resistance	NEN 2743-1999 / Abrasion resistance 1 (to reduce dust formation)

*1. If covers or other items are removed from the AMR (Skins, Scissor Lift Shield slats etc.), the IP rating will be compromised. Take measures to ensure all openings are properly covered to maintain the desired IP rating of the system.

*2. Frequent driving over gaps will shorten the lifespan of the drivetrain components.

2-4-2 Charging Station Environmental Specifications

Environmental specifications for the Stationary Electronics are provided below.

Item		Specification
Ambient operating temperature		-10 to 40°C
Storage temperature		-20 to 55°C
Relative humidity		0 to 95%, non-condensing
Altitude		2000 m maximum
Pollution degree		1
Noise		55 dB(A)
Ingress protection	Stationary Electronics	IP20
	Stationary Coil	IP68

2-4-3 Battery Environmental Specifications

Environmental specifications for the battery are provided below.

Item	Specification
Ambient charging temperature	10 to 40°C
Discharging temperature	0 to 50°C
Storage temperature*1	-20 to 60°C
Humidity (operating and storage)	10 to 90%, non-condensing
Ingress protection class	IP54

*1. Refer to *4-10-5 Storing Batteries* on page 4-26 for more information.

2-5 Other Specifications

Other specifications are provided in the following sections.

2-5-1 Laser Specifications

Specifications for the lasers are provided below.

Item	Scanning Plane	Scanning Class
Front Safety Scanners	Horizontal plane 105 mm from floor surface to a range of 40 m.	Class 1M in accordance with the following standards: • IEC 60825-1 • 21 CFR 1040.10 and 1040.11
Rear Scanner	Horizontal plane 40 mm from floor surface to a range of 10 m.	Class 1 in accordance with the following standards: • IEC 60825-1 • 21 CFR 1040.10 and 1040.11
360-degree Scanner	Horizontal plane 2200 mm from floor surface to a range of 30 m.	

2-5-2 Battery Specifications

Battery specifications are provided below.

Item	Specification
Type	Lithium-ion (LifePO4)
Nominal voltage	25.6 VDC
Nominal capacity	42 Ah
Nominal energy	1074 Wh
Recharge time	45 minutes (for five hours of operation)*1
Duty cycle (depth of discharge)	80 %
Life span	Approximately 6000 cycles*2*3

*1. Charging time can vary based on battery cell temperature and state of charge to prolong battery life.

*2. Approximately 80% of nominal battery capacity will be available after using the battery at 100% depth of discharge.

*3. Under the following conditions:
- Temperature: 15 to 30°C
- Relative humidity: 25% to 85%

2-5-3 Charging Station Specifications

Electrical specifications for the Stationary Electronics are provided below. Depending on the installation location and method, as well as the ambient temperature, deviations from the values given below are possible.

Item	Specification
Input voltage	200-240 VAC +/- 10%; single phase
Input frequency	50-60 Hz
Input power	3.3 kW
Current consumption	16 A

Item	Specification
Output voltage	28 VDC (nominal)
	60 VDC (maximum)
	15 VDC (minimum)
Maximum output power	3 kW
Maximum output current	60 A
Charging time	45 minutes (approx.)

Electrical interface specifications for the Stationary Electronics are provided below.

Item	Specification
CAN	5-pole M12 connector
IrDA (internal communication)	8-pole M12 connector
AC Main connection	C20 IEC socket connector



Additional Information

The length of the cable connection between the Stationary Electronics and the Stationary Coil is 3 m.

2-5-4 Drive Train

Drive train specifications are provided below.

Description	Specification
Drive wheels	Steel wheels with Vulkollan tread
Wheel hardness	90 +/- 5 Shore A
Drive wheel dimensions	75 mm diameter x 28 mm width
Drive wheel motor (x 8)	300 W PMS servo motor
Brakes	Dynamic braking
Steering	Omnidirectional

2-5-5 Safety Function Performance Levels

The Performance Level (PL) calculation for safety functions of the AMR is based on the ISO 13849-1: 2023 standard. PL evaluation has been performed for the AMR.
The PL achieved and the Probability of Dangerous Failure per Hour (PFHd) are calculated per ISO 13849-1: 2023 for the following safety functions.

Safety Function	Safety Stop Type	Reset Type	Description	PL	Category	PFHd
E-STOP Buttons on the Control Strip of AMR	Emergency Stop	Manual Reset	Pressing the E-STOP button results in an emergency stop (controlled stop). In this case, the power to the AMR motors remains ON in order to achieve a controlled stop. Once the controlled stop is achieved, the power to the motors is disconnected.	e	3	5.9×10^{-8}

Safety Function	Safety Stop Type	Reset Type	Description	PL	Category	PFHd
Front Safety Scanner Detection	Protective Stop	Automatic Reset	If an obstacle intrudes into the safety zones, the Front Safety Scanner (s) will trigger a protective stop (category 1 stop). Since this is also a controlled stop, the power to the AMR motors remains ON in order to achieve a controlled stop. Once the controlled stop is achieved, the power to the motors is disconnected. If the safety zone intrusion is cleared of the obstacle, the AMR will automatically restart and resume operation.	d	3	1.00×10^{-7}
Rear Bumper Detection	Emergency Stop	Manual Reset	An emergency stop bumper is placed at the rear of the AMR. If the AMR's rear end collides with an object, the Rear Bumper is depressed and the emergency stop circuit takes effect and stops the AMR immediately. To start the AMR, it must first be reset.	d	3	3.4×10^{-7}
Overspeed Protection	Emergency Stop	Manual Reset	The safety control system detects overspeed. To start the AMR, it must first be reset.	d	3	2.5×10^{-7}
Speed Control (Adapting to the Size of ESPE)	Emergency Stop	Manual Reset	This function is for adapting to the ESPE size.	d	3	1.00×10^{-7}
Braking System (Controlled Deceleration)	Emergency Stop	Manual Reset	Controlled Deceleration	d	3	1.00×10^{-7}
Warnings (LEDs)	N/A	N/A	This function is for the visual warning system.	a	B	2.5×10^{-5}
Warnings (buzzer)	N/A	N/A	This function is for the auditory warning system.	a	B	9.9×10^{-6}
Load Handling	N/A	N/A	This function is to ensure the Lifting Platform stays up and does not fall down.	b	B	8.60×10^{-6}
Load Handling	N/A	N/A	This function is to ensure the load is in the correct position on the Lifting Plate.	b (when implemented)	B	9.9×10^{-6}

2-5-6 Stopping Distance and Time

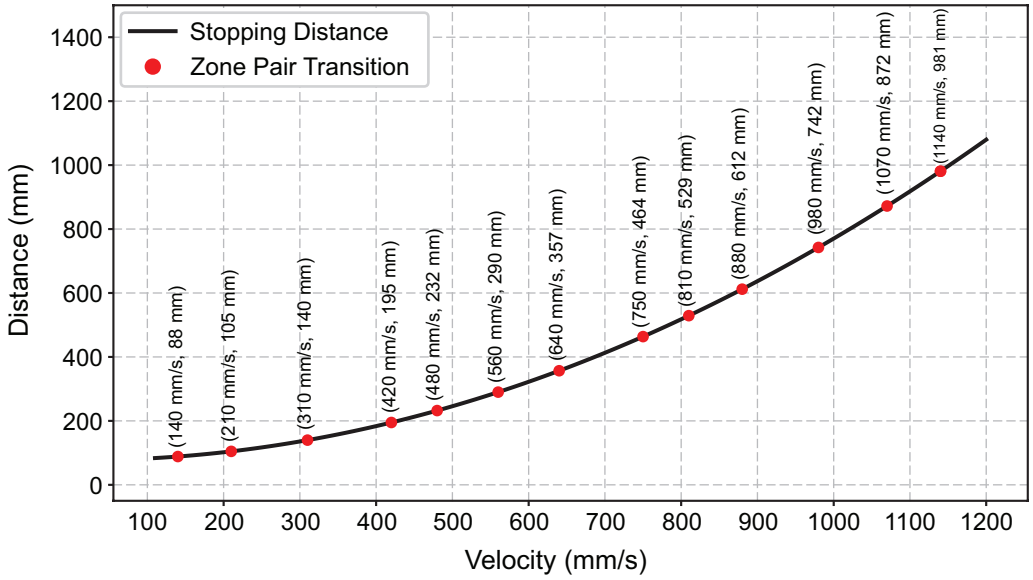
The Stopping Distance and Time test has been performed for the AMR. For this evaluation, the AMR drove towards an obstacle with the path planning and obstacle avoidance features disabled. The AMR navigated to a stop using only the safety system. For the duration of this test, the AMR was monitored by a motion capture system that measured the time elapsed and distance traveled as the AMR came to a stop. The AMR traveled in straight line trajectories over the full range of translational velocities for both forward and lateral motion.

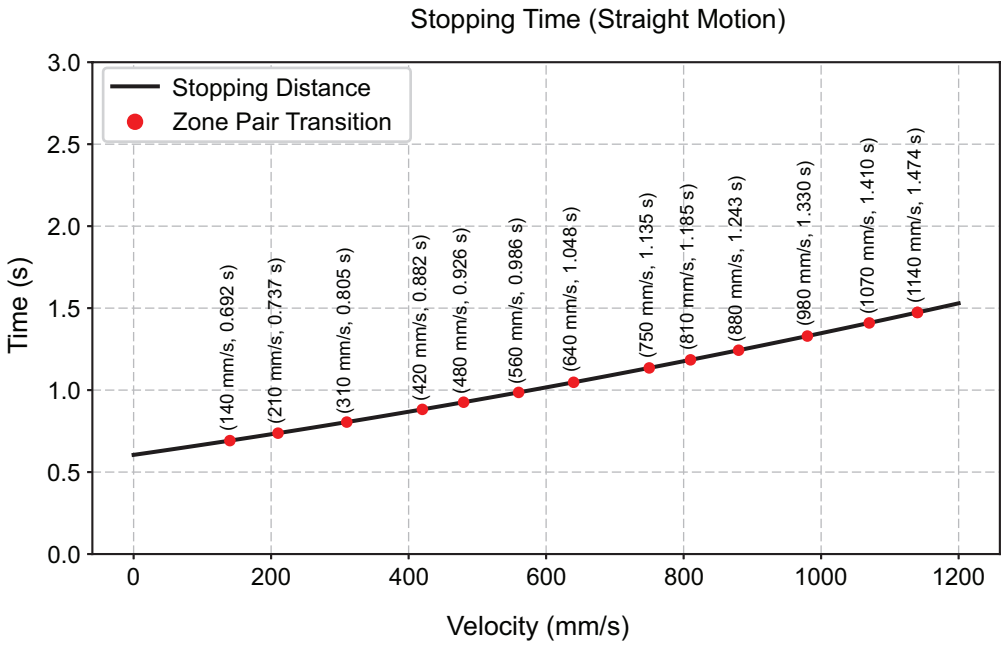
Test Assumptions:

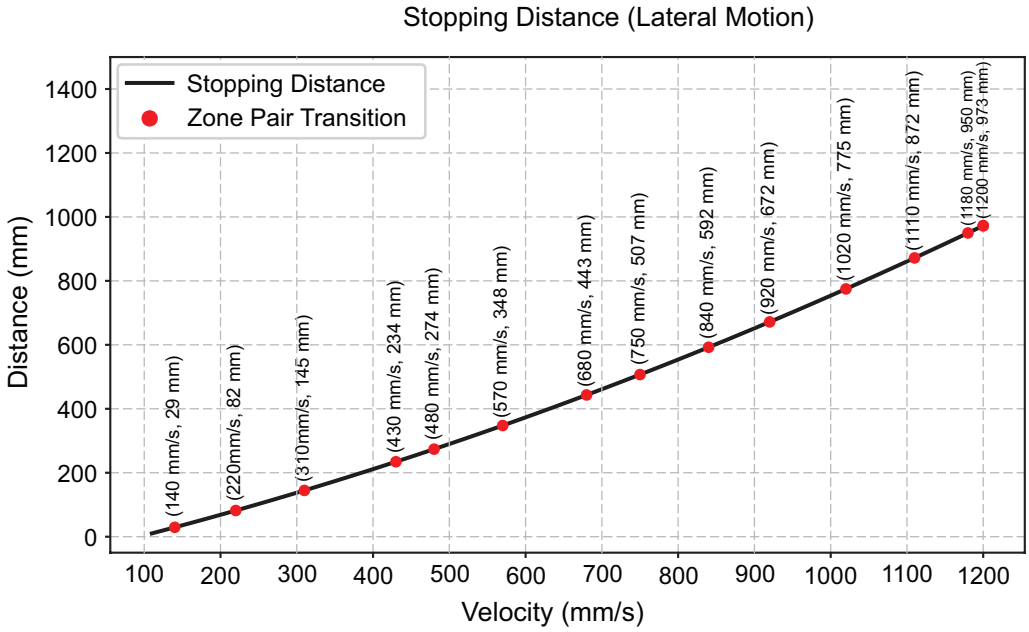
- Robot payload: 450 kg
- Velocities tested (AMR maximum): Straight -100 to 1200 mm/s, Lateral -100 to 1200 mm/s
- Floor friction: 0.63 dynamic and 0.76 static coefficient of friction
- Specified Overall Floor Flatness (SOFF): 25 (Moderately Flat)
- Specified Overall Floor Levelness (SOFL): 15 (Conventional)

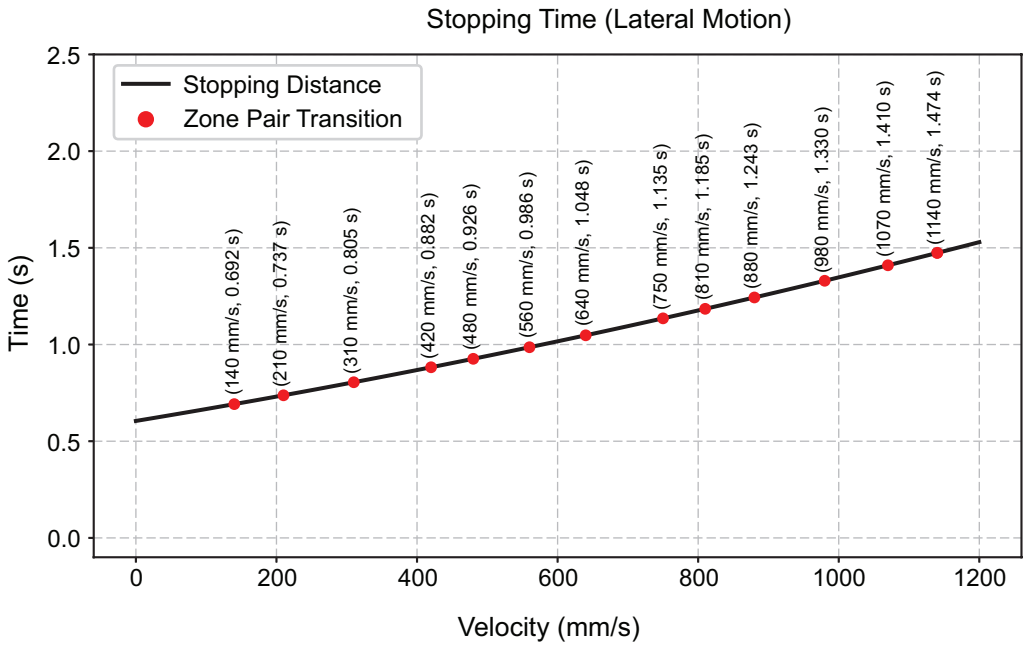
Stopping distance and time for the AMR are provided below. This information applies to all allowable payloads.

Stopping Distance (Straight Motion)




Stopping Time (Straight Motion)
Stopping Distance
Zone Pair Transition
Time (s)
Velocity (mm/s)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
200
400
600
800
1000
1200
(140 mm/s, 0.692 s)
(210 mm/s, 0.737 s)
(310 mm/s, 0.805 s)
(420 mm/s, 0.882 s)
(480 mm/s, 0.926 s)
(560 mm/s, 0.986 s)
(640 mm/s, 1.048 s)
(750 mm/s, 1.135 s)
(810 mm/s, 1.185 s)
(880 mm/s, 1.243 s)
(980 mm/s, 1.330 s)
(1070 mm/s, 1.410 s)
(1140 mm/s, 1.474 s)


Stopping Distance (Lateral Motion)
Stopping Distance
Zone Pair Transition
Distance (mm)
Velocity (mm/s)
1400
1200
1000
800
600
400
200
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
(140 mm/s, 29 mm)
(220mm/s, 82 mm)
(310mm/s, 145 mm)
(430 mm/s, 234 mm)
(480 mm/s, 274 mm)
(570 mm/s, 348 mm)
(680 mm/s, 443 mm)
(750 mm/s, 507 mm)
(840 mm/s, 592 mm)
(920 mm/s, 672 mm)
(1020 mm/s, 775 mm)
(1110 mm/s, 872 mm)
(1180 mm/s, 950 mm)
(1200 mm/s, 973 mm)



2-5-7 Wireless Specifications

Wireless network specifications for the AMR are provided below.

Item	Description
Signal Strength	The minimum required signal strength is -60 dBm.
Channel Interference	No more than two detectable access points at a level of -85 dBm at any given location. No more than one access point at a signal strength higher than -85 dBm at any given location.
Latency	Maximum recommended latency for round trip communication is 10 ms.
Standard	IEEE 802.11 a/b/g
Security	Authentication: WPA-PSK, WPA2-PSK, PEAP-MSCHAPv2, EAP-TLS Encryption: TKIP/RC4/CCMP/AES

2-5-8 Path Planning Specifications

Specifications for obstacle detection in path planning are provided below.

Item	Specification
Maximum sensing range for detection of obstacles	40 m
Minimum obstacle height for detection	100 mm (front), 50 mm (rear) (at 3 m distance)
Maximum obstacle height above ground for detection	110 mm
Minimum obstacle width for detection at maximum (3 m) safety range	70 mm
Minimum obstacle avoidance reaction time	250 ms

2-5-9 Service Charger Specifications

Specifications for the Service Charger are provided below.

Item	Specification
Input Voltage	220 to 240 VAC, 50 to 60 Hz

Item	Specification
Maximum Input Current	2.2 A at 230 VAC
Output Voltage	24 VDC
Output Current	15 A (fused to 20 A)
Ambient Operating Temperature	0° to 35°C
Ingress Protection	IP21
Weight	3.5 kg

3

Installation

This section describes how to install and configure the AMR for operation.

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3-2 Charging Station Installation 3-4

3-2-1 Floor Conditions 3-5
3-2-2 Mount the Stationary Electronics 3-5
3-2-3 Install the Charging Ramp 3-5
3-2-4 Install Stationary Coil on Charging Ramp 3-8
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3-9 Map Creation Overview 3-25

3-9-1 Basic Mapping Tasks 3-26

3-1 Installation Introduction

The general AMR installation steps are provided below.

⚠ WARNING

- Follow all unpacking safety instructions and use appropriate tools and equipment. Failure to do so could result in personal injury or property damage.
- When lifting the AMR, take care to lift it from safe lifting points and secure it with safety straps for even weight distribution and to ensure that the AMR is level and stable when lifted. OMRON recommends using a mechanical lift.



⚠ WARNING

Equipment used to lift the AMR must be adequately rated. It is the end user's responsibility to review lifting equipment and apply appropriate safety factors before lifting.



⚠ CAUTION

The Manual Mover should be used to move the AMR when needed. Avoid pushing the AMR.





Precautions for Safe Use

Remove the AMR from a Charging Station when conducting any installation or maintenance actions.



Additional Information

Unpack all equipment before beginning the AMR configuration procedure.
Refer to the following documents for more information.

- *AMR (Autonomous Mobile Robot) OL-series Charging Station Safety, Unpacking , and Installation Guide (Cat. No. M111)*.
- *AMR (Autonomous Mobile Robot) OL-series Safety, Unpacking, and Assembly Guide (Cat. No. M110)*.
- *AMR (Autonomous Mobile Robot) OL-series Battery Safety, Unpacking, and Installation Guide (Cat. No. M112) for more information*.

1 Install the Charging Station.
Refer to *3-2 Charging Station Installation* on page 3-4 for more information.

2 Assemble the AMR and install the battery.
Refer to *AMR (Autonomous Mobile Robot) OL-series Safety, Unpacking, and Assembly Guide (Cat. No. M110)*, and *AMR (Autonomous Mobile Robot) OL-series Battery Safety, Unpacking, and Installation Guide (Cat. No. M112) for more information*.

3 Charge the battery.
Refer to *4-10-2 Charging Battery for the First Time* on page 4-22 for more information.

4 Configure the network connections.
Refer to *3-5 Network Connections* on page 3-18 for more information.

5 Install any optional items.
Refer to *1-6 Accessories* on page 1-21 for more information.

6 Generate a map for the AMR.
Refer to *3-9 Map Creation Overview* on page 3-25 for more information.

3-2 Charging Station Installation

Make the following considerations before installing the Charging Station.

- The charging zone must be clearly marked with floor/ground markings.
- Mount the Stationary Electronics in a safe, dry place and out of direct sunlight.
- Refer to *3-2-1 Floor Conditions* on page 3-5 for floor condition requirements before installing the Charging Station.
- Mount the Stationary Electronics vertically and leave at least 100 mm of clear space around the unit for ventilation purposes.
- The minimum installation height of the Stationary Electronics is 0.6 m.
- The Stationary Electronics needs access to the facility AC power.
- Install the Charging Station away from forklift traffic or high traffic areas. This will prevent collisions between the docked AMRs and other operating vehicles in the area.
- The Stationary Electronics must be installed with its own circuit breaker and its own residual-current device (RCD) in accordance with the applicable standards for low voltage installations. This also applies to the cabling.
- Use earthed sockets, placed at a maximum distance of 1 m from the Stationary Electronics.
- Do not place any extension cords between the Stationary Electronics and the Stationary Coil.
- Do not place any extension cords between the facility AC power supply and the Stationary Electronics.
- The Stationary Electronics must be installed in an orientation and location so that the LED indicators are always visible to the operator.
- Keep 2.5 m around the Charging Station clear of any flammable materials.
- Keep the charging area floor clean and clear of any conducting objects (metals, carbon, etc.) to prevent them from coming between the Stationary and Mobile coils.
- Strong magnetic fields form between the coils while charging. Personnel with pacemakers or metal implants should not enter the charging zone. Refer to *Coil Hazard Zone* on page 3-11 for more information.

⚠ WARNING

If the Charging Station power cords are installed on the floor, you must make sure that they are highly visible to prevent tripping hazards and are protected from physical damage with barriers or covers.



Precautions for Safe Use

The Stationary Coil must be properly installed and secured to the Charging Ramp prior to the operation of the Charging Station.



Additional Information

The length of the cable connection between the Stationary Electronics and the Stationary Coil is 3 m.

The following sections give details of the installation procedures.

3-2-1 Floor Conditions

The floor on which the Charging Ramp (with the Stationary Coil) is mounted must be flat, stable, clean, and dry.
Avoid liquids (water) on the floor where the Stationary Coil and cables are located as this may damage the coil.

⚠ WARNING

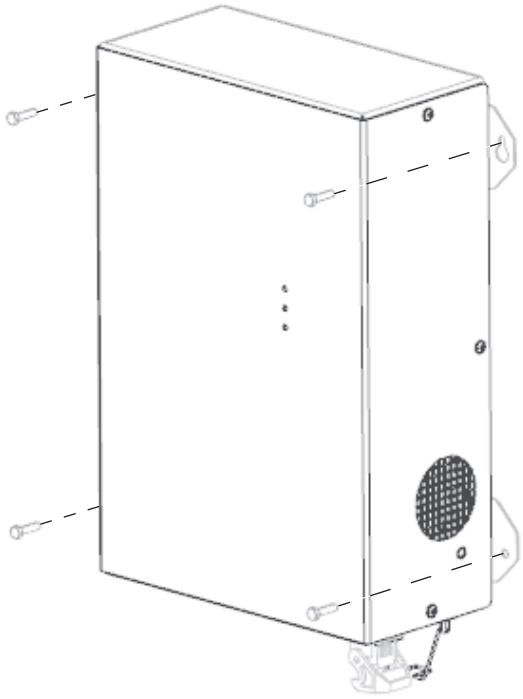
Do not allow liquids of any kind to come in contact with the Stationary or Mobile Coil.

3-2-2 Mount the Stationary Electronics

The Stationary Electronics unit must be mounted on a wall or a vertical stand attached to the floor. Drill four holes on the wall and install the Stationary Electronics. Refer to *Stationary Electronics Dimensions* on page 2-6 for more information about mounting hole dimensions.

Additional Information

The screws for mounting the Stationary Electronics must be supplied by the user.



3-2-3 Install the Charging Ramp

The following sections describe the installation of the Charging Ramp.
Required items and considerations before installing the Charging Ramp:

- Refer to *3-2-1 Floor Conditions* on page 3-5 before installing the Charging Ramp on the floor.

- The Charging Ramp consists of three plates which need to be assembled first and then installed on the floor.
- The screws to secure the Charging Ramp to the floor must be provided by the user. OMRON recommends using anchors for the screws. Refer to *Charging Ramp Dimensions* on page 2-7 for more information about the Charging Ramp dimensions and hole specifications.
- The Charging Ramp must be securely installed on the floor before installing the Stationary Coil on it.

Installation Procedure

Follow the procedure below to assemble and install the Charging Ramp. Two people may be required to complete this procedure.

Precautions for Safe Use

The Charging Ramp must be placed flush with the floor.

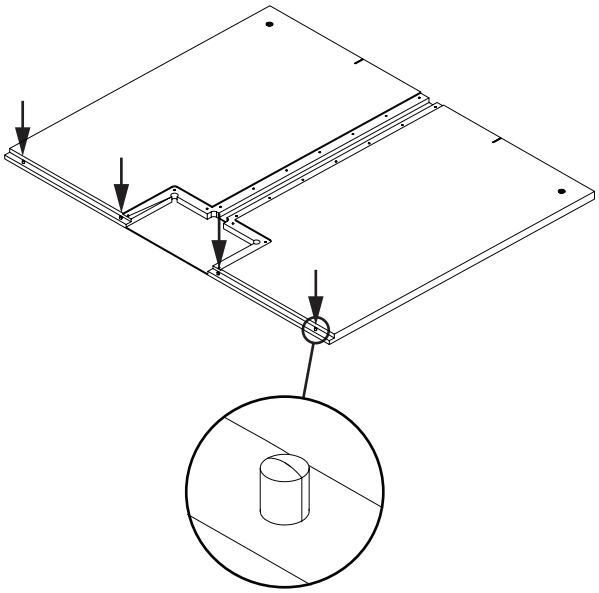
The following items are required for this procedure:

- Charging Ramp (part number 28110-102)
- Dowel pins for assembling the Charging Ramp (included)
- Screws and anchors for installing the Charging Ramp on the floor (user-supplied)

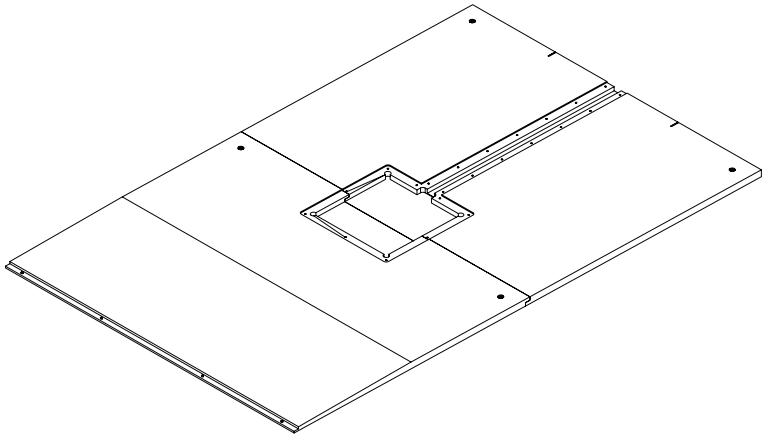
1 Designate a floor area for installing the Charging Ramp.
Refer to *Charging Ramp Dimensions* on page 2-7 for more information about the Charging Ramp dimensions.

2 Place plate 1 of the Ramp on the floor.
Plate 1 has the long channel for the cable and partial channel for the Stationary Coil.
Plate 2 has the other partial channel for the Stationary Coil.
Plate 3 is the metal transition.

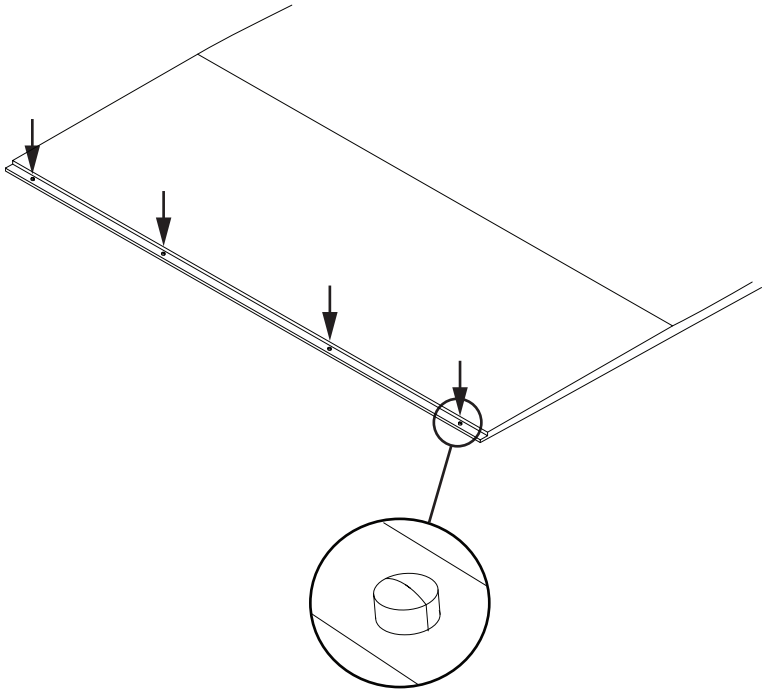
3 Place the four long dowel pins on the holes and press down as shown in the figure below.



4 Align and place plate 2 over the dowel pins on plate 1 and press down.



5 Place the four short dowels on the holes and press down.

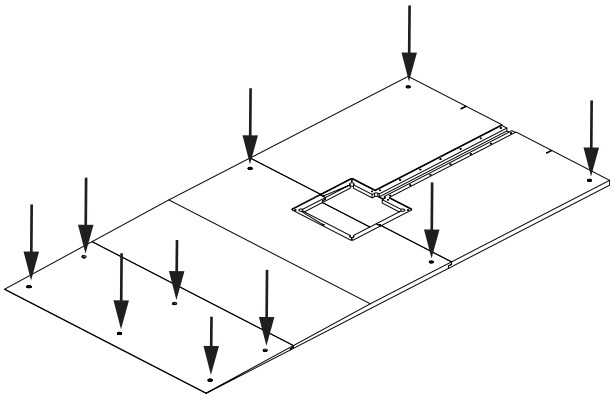


6 Align and place plate 3 over the dowel pins on plate 2 and press down.
The Charging Ramp is now assembled.

7 Use the assembled Charging Ramp as a template and mark the holes on the floor for installation.
Refer to *Charging Ramp Dimensions* on page 2-7 for more information about hole specifications.

8 Drill four holes on the floor for plates 1 and 2 and six holes for plate 3.

9 Install anchors into the holes.



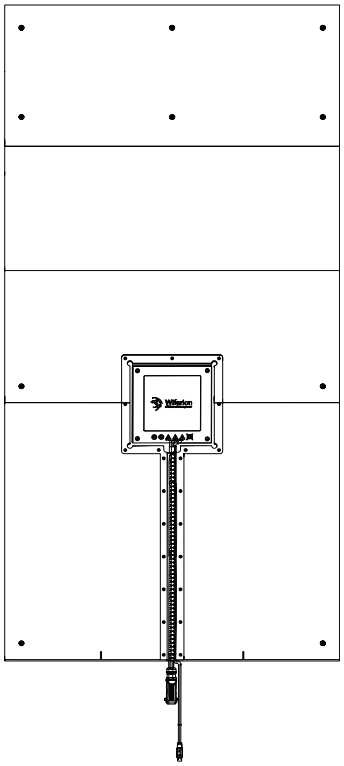
10 Position the Charging Ramp on the floor by aligning all ten holes on the Charging Ramp with the holes on the floor.

11 Insert and tighten all ten screws to secure the Charging Ramp to the floor.
This concludes the procedure.

3-2-4 Install Stationary Coil on Charging Ramp

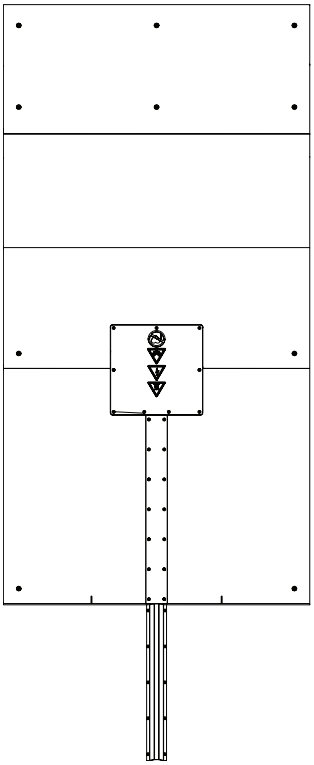
Follow the procedure below to install the Stationary Coil on the Charging Ramp.
Screws for securing the Stationary Coil cover and the cable cover are included.

1 Place the Stationary Coil on the Charging Ramp and the cable inside the channel as shown in the figure below. Ensure that the Wiferion logo is facing up.



2 Cover the Stationary Coil and the cable with the provided covers.

3 Insert the screws and tighten to secure the covers for the Stationary Coil and the cable to the Charging Ramp.



This completes the procedure.

3-2-5 Electrical Connections

Make the following considerations before connecting the Stationary Electronics to facility AC power and to the Stationary Coil.

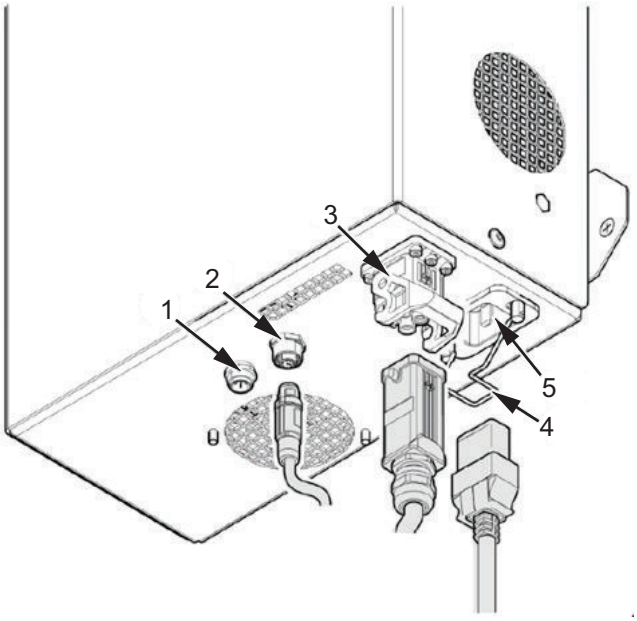
- The Stationary Electronics is not fitted with its own power disconnect switch allowing a connection or disconnection to and from the facility AC power supply. Make sure that the system can be externally disconnected from it.
- The Stationary Electronics must be installed with its own circuit breaker and residual-current device (RCD) in accordance with the applicable standards for low voltage installations. This also applies to the cabling. The circuit breaker must be easily accessible.
- Before connecting the Stationary Electronics to the facility AC power supply, make sure that the electrical connection complies with the regulations and is equipped for 230 V AC at 50/60 Hz with protective earth conductor, an emergency OFF switch, a 16 A fuse, and an RCD. The Stationary Electronics may be connected only to sockets with an earthing contact. Refer to *2-5-3 Charging Station Specifications* on page 2-14 for more information.

Additional Information

The cable to connect the Stationary Electronics to the facility AC power supply is not included. Only the connector (IEC 60320 C19) is provided. You must supply the cable and attach the connector.

Connection Procedure

Follow the procedure below to connect the Stationary Electronics to facility AC power and to the Stationary Coil.



Callout	Connector
1	CAN socket
2	IrDa socket
3	Coil connection
4	Retaining bracket
5	AC input socket

1 Connect the square plug from the Stationary Coil to the coil connection socket (3) on the Stationary Electronics.

2 Connect the rounded plug from the Stationary Coil to the IrDA M12 socket (2).

3 When routing the cables, ensure that their insulation is not damaged by sharp edged or moving parts.

4 Connect the facility AC power supply cable to the AC input socket (5) on the Stationary Electronics.

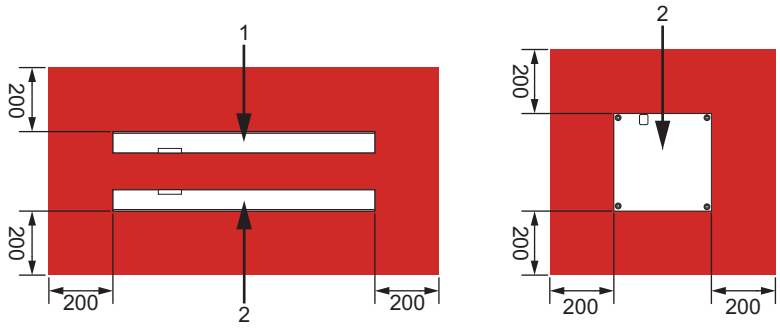
5 Secure the plug to the AC input socket (5) with the retaining bracket (4) to complete this procedure.
The Stationary Coil and the Stationary Electronics are now connected.

3-2-6 Charging Zone Safety

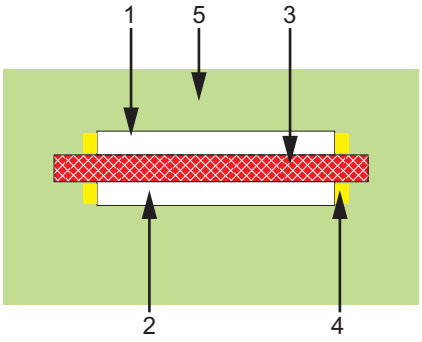
The following sections describe the coil hazard zone and floor markings required around the charging zone.

Coil Hazard Zone

Strong magnetic fields occur around the coils while charging. These magnetic fields can pose a health hazard to personnel. Do not allow personnel to enter this zone while charging is in progress.



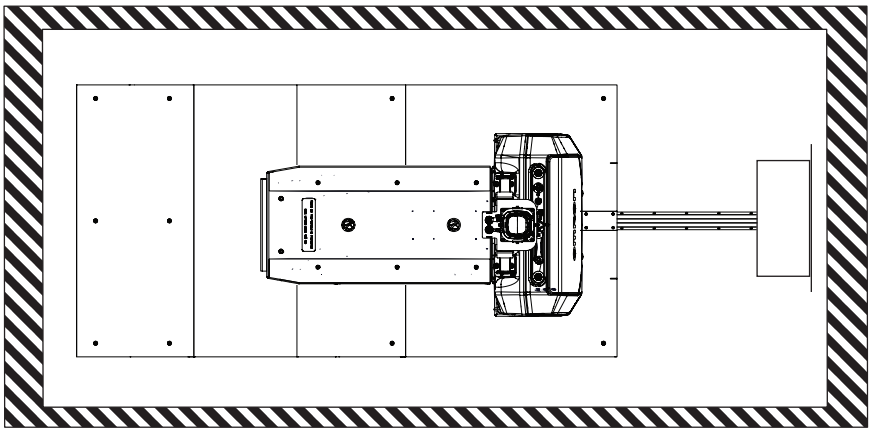
Keep the charging area floor clean and clear of any conducting objects (metals, carbon, etc.) to prevent them from coming between the Stationary and Mobile Coils. A minimum of 75 mm of area around the two Coils in the charging position must be kept clear of any conducting objects.



Item	Detail
1	Mobile Coil
2	Stationary Coil
3	Hazard zone; keep this zone free from any conducting objects.
4	Edges of the coils; avoid conducting objects (particularly metal) around the edges.
5	No special measures.

Charging Zone Floor Marking

Make the AMR charging area visually distinct by adding floor markings as shown in the figure below.



3-2-7 Charging Station Commissioning

Make the following considerations before commissioning the Charging Station.

- Ensure all the precautions and procedural steps listed in *3-2-5 Electrical Connections* on page 3-9 are followed.
- Ensure the facility AC power cable is connected to the Stationary Electronics.
- Ensure the two cables between the Stationary Electronics and the Stationary Coil are connected properly.

Commissioning Procedure

Use the following procedure to commission the Stationary Electronics.

1. Enable the facility AC power to energize the Stationary Electronics.
2. Confirm that the green (steady) LED on the Stationary Electronics turns ON to complete this procedure.
   The Stationary Coil is now ready for charging the AMR battery.

3-3 Battery Installation

Installation or removal of the battery must be performed by persons who have read and understood this manual.

Before you begin, turn the AMR OFF: place the Selection Switch and the Main Disconnect Switch in the OFF position.

⚠ WARNING

Do not damage the battery by subjecting it to impacts or shocks. Using a damaged battery can result in fire or other dangerous conditions.





Additional Information

Inspect the empty battery compartment and remove any foreign objects before attempting to install a battery.



Precautions for Correct Use

Always lift the battery using the two handles on top of the battery enclosure.

3-3-1 Battery Installation and Connection Procedure

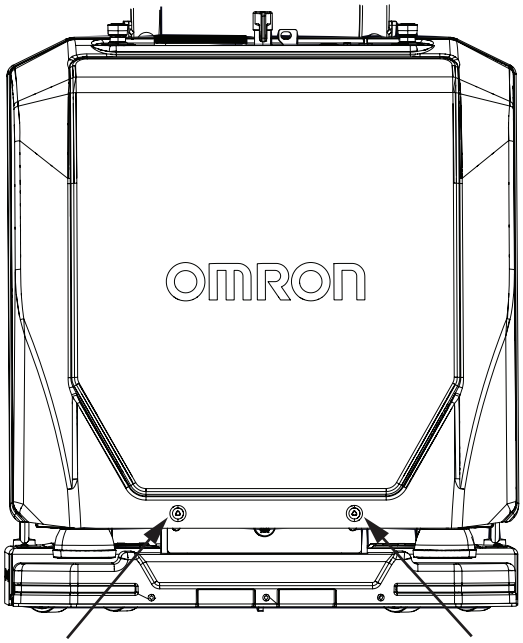
Use the following procedure to install the battery and connect it to the AMR.

The following items are required for this procedure.

- The battery assembly (part number 28110-020)
- Triangle spanner key (included)
- Four bolts to attach the battery (included)
- 3 mm hex bit

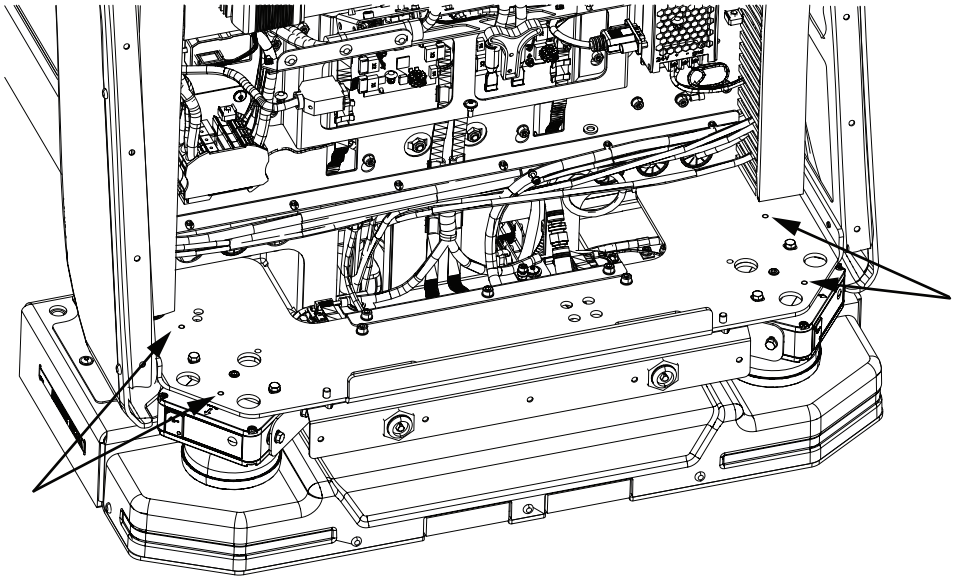
1 Turn the AMR OFF. Refer to *4-4 AMR Shut-down Procedure* on page 4-8 for more information.

2 Remove the Front Skin by loosening the two machine locks with the triangle spanner key.

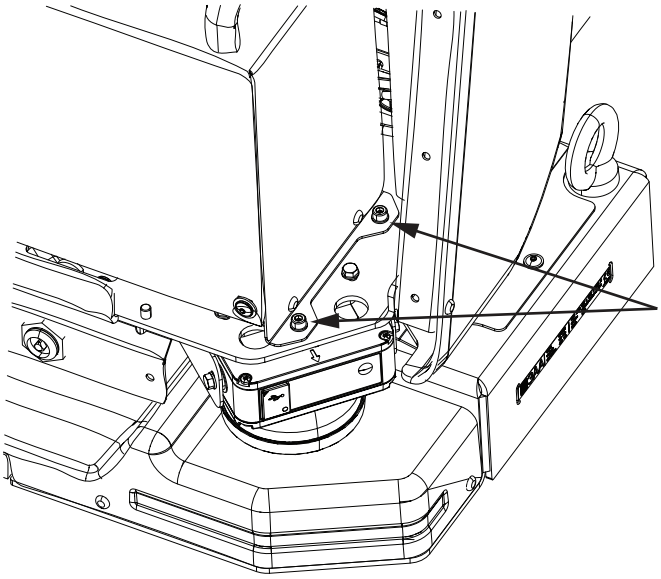


Refer to *6-9-1 Removing and Replacing Skins* on page 6-23 for more information.

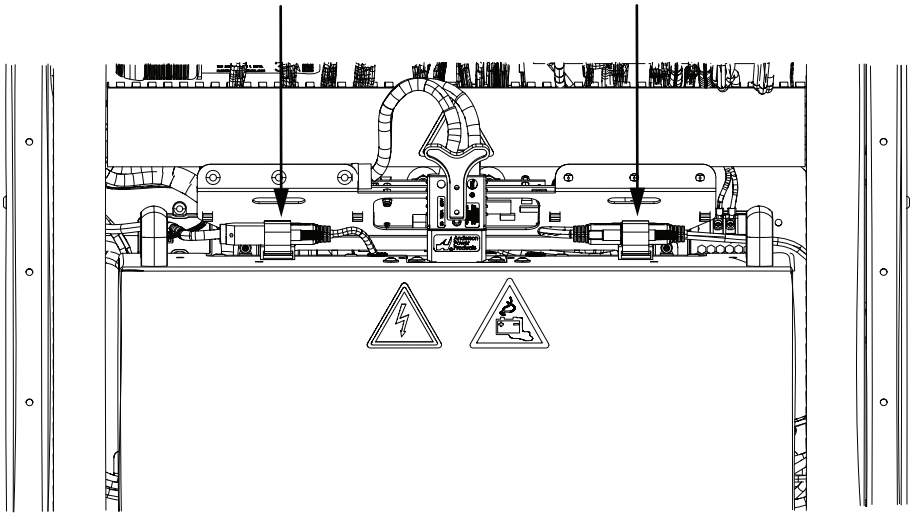
3 Carefully place the battery on the base plate of the AMR by aligning the holes on the battery over the four holes on the base plate.



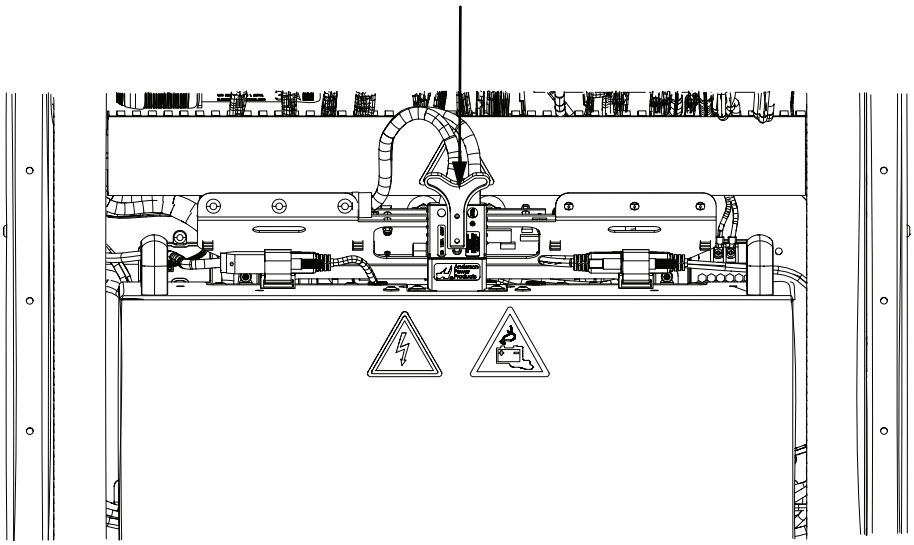
4 Insert the four bolts (two on each side) and tighten to a torque of 7 N-m to secure the battery to the base plate.



5 Connect the two CAN connectors of the battery with the DB9 connectors of the AMR and tighten the straps.



6 Insert the battery power connector of the AMR into the Anderson Powerpole socket in the battery.



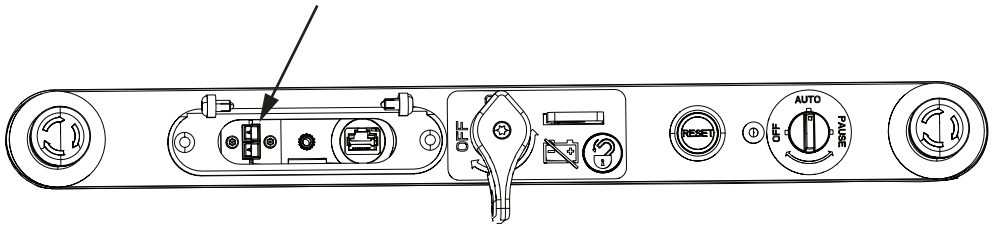
7 Replace the Front Skin and tighten the two machine locks to complete this procedure.

3-4 Control Strip Connections

The following information describes the connectors and port in the Control Strip of the AMR. These items are typically used when performing configuration or maintenance procedures.

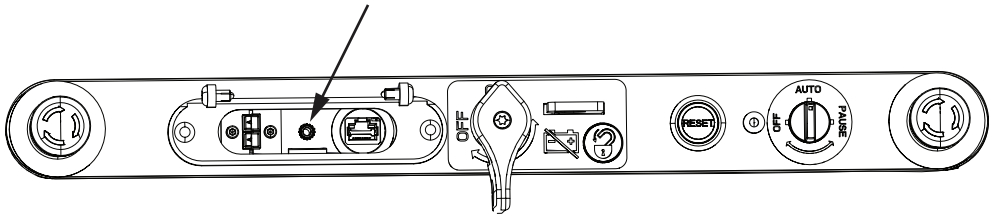
3-4-1 Service Charger Connection

The Anderson Powerpole 2-pole (small PP15/30/45) panel connector is typically used for connecting the Service Charger.



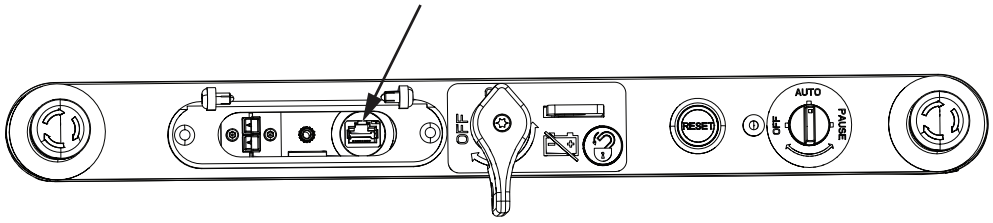
3-4-2 Manual Lift Control Connection

The Manual Lift Control Connector is a 3.5 mm Jack Plug socket for connecting the Lift Bridge device.



3-4-3 Maintenance Ethernet Connection

The Maintenance Ethernet port is a standard RJ-45 port. It is available for configuration and trouble-shooting with a PC that is directly connected with a pass-through or cross-over CAT5 (or better) Ethernet cable.



3-5 Network Connections

Wireless and wired networks are available on the AMR. The wired network is typically used for initial configuration and troubleshooting. The wireless network is typically used during normal operation and can also be used for maintenance and troubleshooting. Use the information in this section to configure the network settings of the AMR.

3-5-1 Default Network Settings

The default network settings and functions associated with the Maintenance Ethernet Port are described in this section.

Precautions for Correct Use

Consult your network systems administrator before using SetNetGo to change any default settings. Refer to the *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for information about modifying network settings.

Additional Information

Access to the SetNetGo Web Interface is always enabled and accessible with the Maintenance Ethernet Port.

The AMR's network has the following default configuration. Your network administrator should review this information for compatibility with your existing network.

Item	Setting
Network Class	Class C
Netmask for all ports	255.255.255.0
Permanent Maintenance Ethernet Port IP address	10.39.46.1
Ethernet negotiation method	Auto-MDIX
Network method	Access Point (AP)
Identifier (SSID)	Wireless Network
Security method	Unsecured

3-5-2 Wired Connection Procedure

Use the following procedure to establish a wired connection to the AMR.
Make the following considerations before beginning this procedure.

- A Cat-5 Ethernet cable is required.
- A PC with an available RJ45 Ethernet port is required.
- Sysmac Studio must be installed on the PC if connecting to the NX102.

1 Connect the Ethernet cable from the PC to the AMR Maintenance Ethernet Port.

2 Verify the PC network settings by accessing the network adapter properties on your PC for the network that will be used as the AMR connection.

DHCP is used by default. If a static IP is preferred, set the range between 10.39.46.100 and 10.39.46.149.

3 Verify the settings by opening a browser window and accessing https://10.39.46.1. If the settings are correct, this will display the SetNetGo web interface and complete this procedure.

3-5-3 Wireless Connection

OMRON recommends wireless connectivity for a single AMR operating in a workspace, though it can operate temporarily without a wireless network. A wireless connection is required when the AMR is operating in a workspace with other AMRs. You must use a wired connection to access SetNetGo for the initial wireless connection configuration. Refer to *3-5-2 Wired Connection Procedure* on page 3-18 for more information. The wireless configuration of the Omni Lift is set using SetNetGo with one of the following methods.

Precautions for Safe Use

Before you configure wireless Ethernet on your AMR, contact your network administrator to confirm the IP, radio, security settings, and for authorization.

- Use the SetNetGo tab in the MobilePlanner software.
- Open a Web browser on your PC and enter the URL: https://10.39.46.1 to connect directly to the SetNetGo Web Interface on the AMR.

Additional Information

A workspace with a single AMR can operate without a wireless network.

After accessing the SetNetGo interface, access the *Management Interface* area in the *Network* tab to enter the wireless connection network data.
Use the following table as a worksheet to collect all necessary information before configuring the wireless settings.

Item	Details
Static IP Address for the AMR	
Netmask	
Gateway	
DNS Server(s)	
SSID for the AMR Network	
Mode for the network	Infrastructure
Radio Mode	Auto (802.11a/b/g Only)
	802.11 a
	802.11 b/g
Channel Set	
Wireless Watchdog IP Address	

Item	Details	
Security Encryption	Disabled	
	TKIP/RC4	
	CCMP/AES	
	TKIP/CCMP/AES	
Authentication Method	OPEN (not recommended)	
	WPA2-PSK	Key is either: Passphrase (8-63 ASCII only) Raw Hex (64 Hex-only)
	WPA-PSK	Key is either: Passphrase (8-63 ASCII only) Raw Hex (64 Hex-only)
	PEAP-MSCHAPv2	• Username: • Password: • Private key: • Download or Create New • Private key length: 1024 or 2048 bit Hostname: • Upload certificate: • Certificate password (if needed): • Validate Server Certificate:
	EAP-TLS	• Username: • Password: • Private key: • Download or Create New • Private key length: 1024 or 2048 bit Hostname: • Upload certificate: • Certificate password (if needed): • Validate Server Certificate:

After entering the wireless settings information, you can view the status of the wireless connection in the *Network* tab.



3-5-4 Wireless Considerations

It is recommended to use wireless network industry best practices. Always conduct a comprehensive workspace survey and test your wireless service before AMR configuration and operation begins. Make the following considerations when the AMR is communicating with a wireless network. Refer to *2-5-7 Wireless Specifications* on page 2-19 for more information.

Signal Availability and Type

The wireless network should provide constant service throughout the workspace. Make the following considerations when choosing a wireless network type and ensuring signal availability.

- If you have an AMR fleet, constant access is an operational requirement. For a single or segregated AMRs, partial signal coverage might be acceptable in workspace areas where you do not need to send commands or receive status from the AMR.

- A signal strength of > -40 dBm is the ideal wireless signal strength. A signal strength of -60 dBm is the recommended minimum.
- Do not obstruct the wireless antenna areas with metal or other objects that can degrade the signal. Refer to *1-2 Features and Components* on page 1-5 for more information about the location of wireless antennas.
- Choosing a 2.4 GHz network versus a 5 GHz network will depend on workspace survey and analysis results to account for factors such as existing frequencies, interference, or other objects that can reduce signal strength and coverage.

A low quality wireless connection can cause problematic AMR behavior, such as:

- Unintended behavior may occur if Fleet Manager parameter edits are made while an AMR is not connected.
- Increased network traffic due to packet retransmission.
- Frequent disconnections may lead to an AMR failing to reconnect, requiring user intervention.
- Network packet loss leading to unexpected behavior, such as failure to perform Jobs or failure to move to a Goal.
- AMRs may collide when they are operating in close proximity.

Bandwidth

All devices that access a Wireless network consume its bandwidth. The greater the number of AMRs in your fleet, the more wireless resources they consume.

Additional Information

- Refer to *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for more information about wireless resources.
- The bandwidth usage varies by application. Payload accessories might affect your bandwidth requirements if they stream data through the AMR's wireless interface.

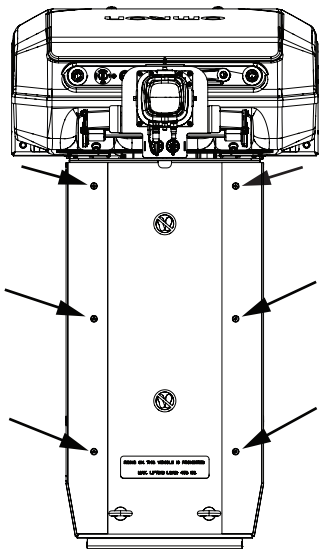
Use a dedicated network to restrict wireless network access to AMRs and use security to prevent other devices from accessing the network.

Typical bandwidth consumption for a fleet is an average 50 Kbps per AMR. This increases when you connect multiple AMRs to a Fleet Manager and actively manage them with MobilePlanner. Bandwidth consumption might increase or decrease depending on the types of commands and debugging tools that you enable in MobilePlanner. Downloading Debug Info Files and viewing log files on SetNetGo are other examples of functions that may increase bandwidth usage.

The bandwidth consumption is unlikely to exceed 500 Kbps per AMR. A value of 500 Kbps per AMR is within the capabilities of most wireless access points (>=54 Mbps). If you have multiple access points with overlapping coverage, this number is less of a concern.

3-6 Payload Carrier Mounting Points

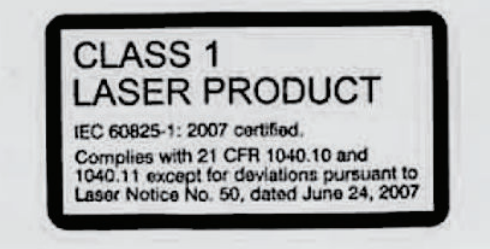
Six payload carrier mounting points are provided on the Lifting Plate of the AMR. Positioning pins can be installed on the mounting holes of the AMR. Alignment hardware can be added to these positioning pins to ensure the correct positioning of the payload carrier.



Refer to *Positioning Pin Mounting Hole Dimensions* on page 2-10 for more information.

3-7 Attaching Warning Labels

A laser warning label is provided with the AMR. The label should be placed where the operators will see it and must be visible from at least two opposing sides of the AMR. All other warning labels are attached at the factory.



⚠ WARNING

If any safety or warning label is damaged or illegible, replace it immediately with a new label.

3-8 AMR Commissioning

Although the AMR is commissioned at the factory, the user must perform commissioning as part of the initial setup upon receipt. The AMR must be commissioned before it can operate autonomously. Commissioning is used to confirm the correct operation of the following equipment and functions:

- Internal health check
- E-STOP buttons on the Control Strip

Additional Information

- You must repeat the commissioning procedure after regular preventative maintenance procedures.
- The AMR has a linear speed limit of 300 mm/s and a rotational speed limit of 18 degrees/s when it is in a decommissioned state.

The commissioning procedure is executed within MobilePlanner. Refer to *MobilePlanner Integrated Help* for more information about commissioning the AMR.

3-8-1 Commissioning Procedure

Use the following procedure to execute commissioning. Refer to *MobilePlanner Integrated Help* for more information.

Additional Information

Ensure that there are no E-STOP buttons depressed before beginning this procedure.

1. Start the MobilePlanner software and connect to the AMR.
2. Access the *Main Menu* > *Robot* > *Commissioning* area.
3. Follow the on-screen instructions to complete the test.
   You can print a certificate after successful completion of the commissioning.

3-9 Map Creation Overview

A map is a scanned representation of the floor plan in the AMR's operating space. Maps contain the static features in the AMR's environment, such as walls, doors, permanent shelving, etc. They also contain user-definable sectors, lines, and areas that help the AMR perform its Job. Maps also contain a variety of Goals, Routes, and Tasks that comprise the destinations and activities of the AMR in the workspace.

Before you can use your AMR, you must create a digitized map of its designated workspace. The map records the shape and location of permanent physical features in the workspace. These features are walls, corners, doors, columns and large immovable fixtures such as machines or fixed industrial shelving.

For optimal performance of an OL-series AMR in a fleet, use a map created by an OL-series AMR for the area in which it operates.

⚠ WARNING

Objects in the environment protruding out, above, or below the AMR lasers' scanning planes shall be configured as Forbidden Areas during workspace map creation. This will minimize possible collision risk during operation.



A single AMR laser scanner or a combination of the laser scanners can be configured to scan the workspace to create a map. For optimal coverage of the workspace, use all three laser scanners to create the map. Since the Front Safety Scanner scans only a narrow horizontal plane, parallel to the floor at a height of 105 mm from the floor to a range of 40 m, the laser cannot detect physical features above or below this plane, or features that are out of operating range and resolution. This means that some features are not recorded on the map such as overhanging objects like shelves or tables with narrow supporting legs. Other features that are below the scanning plane may not be recorded, such as low lying objects like a column base or a pallet that contains no cargo. The 360-degree Scanner on the other hand, scans the workspace in a single plane at a height of 2200 mm from the floor to a range of 30 m and the Rear Scanner detects objects that are at least 40 mm tall and to a range of 10 m.

Moving objects such as fork-lift trucks and carts, or transient objects such as pallets loaded with finished goods do not provide useful mapping data. Erase such objects from the map after you create it.

If the workspace has open stairwells, docks, ledges or other vertical drops, make sure that you surround such areas with physical barriers. Barriers must be detectable by the Front Safety Scanner's scanning plane, which are at a height of 105 mm from the floor. Install the barriers before mapping a workspace.

To ensure the map is accurate, drive the AMR under the following conditions.

- Drive in a way that the laser scanners of the AMR are exposed to the objects in the workspace while considering that each laser scanner has a limited field of view. This ensures that the laser scanners detect the objects completely and objects are mapped accurately.
- Minimal or no payload.
- Drive at low rotational speed and acceleration.

Use the MobilePlanner software to create and then edit your workspace map. You can add virtual elements to the map that modify the behavior of an AMR. Examples of virtual elements include the following items.

- Forbidden Lines and Areas: areas in the workspace where an AMR cannot enter or move across.
- Movement parameters sectors: areas where an AMR must travel within a specified speed range.

- Preferred lines: paths that you specify on the map which the AMR must consider when planning the most efficient path to follow autonomously to its Goal.
- Preferred-direction zones: areas where the AMR will prefer to travel in a specified direction. In a typical preferred direction zone (such as a narrow hallway), there is an opposite direction that you want the AMR to avoid. Use a preferred-direction zone to keep the AMR to the preferred side of a hallway. The AMR is able to travel on the alternate side of the zone if the preferred side is blocked.

Regardless of the constraint specified by any virtual element on the map, the AMR always operates according to its safety protocols. For example, when the AMR is following a preferred line it will still respond to and avoid dynamic obstacles.

In a mixed fleet, sharing a common map may not always be optimal because the Front Safety Scanners in the OL-series AMR are mounted significantly closer to the floor and the 360-degree Scanner is mounted much higher. If workspace map features at a height between 120 mm and 200 mm remain consistent in the environment, then using a common map in a mixed fleet will have little to no impact on the performance of the AMRs. To maintain optimal performance of all AMRs in a mixed fleet, generate a map using the OL-series AMR and merge it with an existing map created by another OMRON AMR in the fleet.



Additional Information

Refer to *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for complete details about workspace map creation.

3-9-1 Basic Mapping Tasks

The basic mapping tasks are provided below. Refer to *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for complete details about mapping tasks and functions.

- Install the Charging Station before you create a map file.
- Drive the AMR to make a floor plan scan. It is recommended that you drive the AMR near the Charging Ramp or the Stationary Coil so the Stationary Coil can be placed in the correct location of the map.
- Drive the AMR around the workspace multiple times, and from various directions. Also, begin and end your mapping process at the same location for the most accurate results.
- Load the scan into the MobilePlanner software on your PC to create and edit a digitized map.
- Add Job-related features such as Routes, Goals, and Docks (targets) to your map.
- Transfer the working map to the Fleet Manager when multiple AMRs are present, or back to the AMR if you have only one in operation. The Fleet Manager automatically uploads the new map to each AMR in your fleet as soon as the AMR becomes idle.
- Save map collections and deploy your AMR in any of your workspaces by selecting the appropriate map file.

4

Operation

This section provides information about the operation of the AMR.

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4-1 Payload Movement and Transfer

A typical AMR application involves transporting a payload carrier from one point to another within a facility. For example, the AMR drives under a cart and carries the cart with payload from one area of a factory and then deposits the cart in another area and drives away from it.

⚠ WARNING

If the AMR transports containers of liquid or other non-solid material, consider the effect on the AMR's stability if their contents can shift. It is the end user's responsibility to ensure that the payload is properly secured to the AMR, and that payload shifting does not create AMR instability.

⚠ CAUTION

- During pick-up and drop-off operations, ensure the Lifting Plate of the AMR is clear of all obstructions.
- It is the end user's responsibility to make sure that the speed is appropriate for the payload that the AMR carries, and that the AMR movement does not cause payload instability or loss of AMR control.

Precautions for Safe Use

- During pick-up and drop-off activities the AMR’s safety detection fields are muted. Keep clear of the AMR during these activities.
- Intentional movement of the payload carrier (such as conveyor or arm) during the AMR movement is prohibited.

Precautions for Correct Use

During pick-up and drop-off activities, ensure the AMR's Lifting Plate has no obstructions.

4-1-1 Payload Detection and Monitoring

To comply with ISO 3691-4:2023 requirements, the AMR's laser scanners must be configured to detect and monitor the payload or payload carrier and its positioning on the AMR during loading and unloading.

For payload detection and monitoring during transit, additional user-supplied laser scanners will need to be installed. It is the user's responsibility to procure additional laser scanner(s) and determine an appropriate mounting location and method.

The following is a list of OMRON recommended laser scanners for payload detection and monitoring.

- Hokuyo UST
- TiM 551 / 561
- OS32C-DM
- Nanoscan3
- Microscan3
- MultiScan100

Refer to *MobilePlanner Integrated Help* for more information about the SensorCheckPolygon task for payload detection.

Precautions for Correct Use

Select the right sensors to detect that the payload is in the right position.

4-2 Overhanging Payloads

OMRON recommends that you use payload carriers that conform to the size restrictions specified in this manual. Refer to *Payload Carrier Dimensions* on page 2-9 for more information. If your payload carrier is wider than 800 mm, you will need to increase the dimensions of the AMR's safety zones. Contact your local OMRON representative for more information about modifying the safety zones.

⚠ CAUTION

OMRON is not responsible for any risks incurred by modifying safety zone sizes or other Front Safety Scanner settings.



4-3 AMR Start-up

This section provides details about AMR start-up procedure.
Ensure the following conditions are met before attempting to start-up the AMR.

- The battery is sufficiently charged. Refer to *4-10 Charging AMR Battery* on page 4-20 for more information.
- Ensure the Front and Rear Skins are closed.
- Check the workspace of the AMR for improper objects and remove them.
- Ensure the Front Safety Scanners, the Rear Scanner and the 360-degree Scanner are clean and functional.
- Keep the Lifting Plate clean and free of conductive objects such as metals, carbon etc.

Precautions for Safe Use

Do not operate the AMR without all skins fastened correctly. Moving parts are exposed when the AMR is in motion.

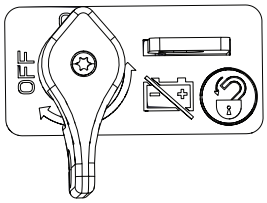
Precautions for Correct Use

Implementing methods to circumvent the need for a person to enable the AMR's motor power at start-up is prohibited.

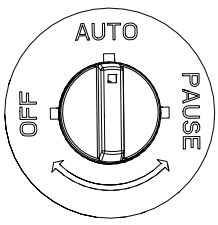
4-3-1 AMR Start-up Procedure

At start-up, the AMR powers all of its systems, including all factory and user configurations. It then automatically runs its on-board software and customer integrated processes to provide an application-ready AMR. If a map has been created and stored, and the AMR is localized, the AMR will be capable of operating autonomously. Refer to *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for information on map creation and localization.

1 Turn the Main Disconnect Switch to the ON position.



2 Turn the Selection Switch to the AUTO position to complete the procedure.



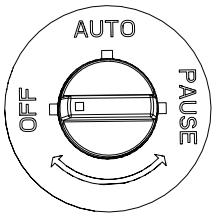
The Power LED lights up and the LED Signal Lamp, Front and Rear Light Strips turn ON.

It takes about one minute for all the systems to start-up and make their various interconnections. The AMR's Computing System and navigation lasers automatically start when the AMR turns ON.

4-4 AMR Shut-down Procedure

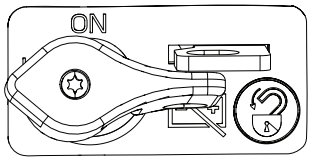
Follow the procedure below to shut down the AMR in a controlled manner. The system will save the AMR's last known location so it can automatically localize when it is powered ON later.

1 Turn the Selection Switch to the OFF position.



The Power LED, the Front and Rear Light Strips, and the LED Signal Lamp turn OFF.

2 Turn the Main Disconnect Switch to the OFF position.



This completes the procedure.

4-5 Workspace

The workspace is considered to be any area where the AMR will travel. It must be carefully evaluated and prepared before the AMR is placed into operation. Use the information below to adapt your workspace for optimal AMR performance.

The workspace must be flat, level floor with no steps or inclined surfaces, free of clutter and debris, and have adequately wide doorways and corridors to allow navigation by an AMR.

⚠ WARNING

- Do not operate the AMR on steps, in slopes, or in floor conditions other than those listed in the Specifications.
- Do not allow the AMR to operate in areas that are used for emergency personnel evacuation.

⚠ CAUTION

Ensure there is adequate clearance for the height of the AMR in the workspace. Install physical barriers and create Forbidden Areas to prevent the AMR from entering a hazardous workspace.

Precautions for Safe Use

- Bright, direct, or high-intensity light can interfere with the AMR's laser operation. Do not operate the AMR in areas where it may be exposed to these conditions.
- Always wear safety shoes when operating in the same environment as the AMR.
- You must have floor markings at Charging Stations and pickup / dropoff locations with adequate clearance to prevent people from entering these hazard zones.
- You cannot use the same marker tape configuration for different AMRs in hybrid fleets because of their different sizes and turn radiuses. To determine the distance between the AMR and its final alignment goal (such as a machine with which it interfaces), refer to the AMR User's Manual to obtain the exact dimensions.
- The Field of view of the AMR is limited in the vertical plane. Operators must consider height restrictions in the AMR's operating environment.

Precautions for Correct Use

- Ensure the AMR does not obstruct emergency evacuation routes, or areas designated for fire extinguishers and fire alarms.
- All areas in a workspace which do not allow for a minimum of 500 mm clearance on either side of the AMR and in the direction of travel of the AMR, must have physical barriers installed.

Floors must provide good traction, typical of good walking conditions. Rough or uneven floors can affect safety of the AMR's operation as the lasers' sensing plane is not always parallel to the floor.

If operation is required in areas where an approaching AMR's visibility is obstructed, such as blind corners and doorways, perform a risk assessment and apply appropriate mitigation techniques according to applicable standards.

Take measures to keep problematic objects away from the AMR's path and operating area. Some examples of problematic objects are:

- Transparent doors, walls, or barriers.
- Floors with access panels removed.

- Cables, hoses, etc.
- Highly reflective objects.
- Chain-link fences.
- Overhanging objects.
- Objects that are supported by posts or legs (chairs, desks, ladders).

Obstacle detection tests were conducted for the AMR using the following human analog test pieces:

- A horizontally placed cylinder with a diameter of 200 mm and a length of 600 mm.
- A vertically placed cylinder with a diameter of 70 mm and a length of 400 mm.

Surface reflectance of the cylinders was between 2 and 6 % and optical density was 1.22 (black).

If an obstacle has protrusions outside the plane of the AMR's Front Safety Scanners, or indents in this plane, then the AMR will underestimate the obstacle's size. This will reduce the effectiveness of the AMR's protective clearances, or in extreme cases, lead to collisions. Additional user-supplied scanners may be required to detect obstacles with these features.

Make the following considerations when traversing gaps.

- A maximum speed of 750 mm/s must be used.
- Observe the maximum gap traversal details provided in this manual. Refer to *2-4-1 AMR Environmental Specifications* on page 2-12 for more information.
- Frequent driving over gaps will shorten the lifespan of the drivetrain components. OMRON recommends rectifying floor gaps.

Regularly maintain the workspace as follows:

- Immediately remove any material on the workspace floor, such as dust, dirt, grease, ice, or pooled liquid. Objects on the floor might interfere with safe driving and accurate navigation. Any material that affects the drive wheel traction impairs the AMR’s ability to drive, stop, turn, and navigate. Pay particular attention to Goal locations and commonly traveled paths.
- Keep the AMR workspace clean and free of movable transient objects such as pallets, carts and furniture. Any objects that block the mapped permanent features of the workspace (such as walls, columns and doors) can interfere with navigation, causing the AMR to be less efficient.
- Keep the floor of the workspace free of dust, debris, grease, or liquids. A floor that is not clean can impact AMR traction and cause dust accumulation on laser lenses which may lead to AMR operation disruption.
- If you make a permanent change to the workspace, such as by installing a large fixed machine, consider re-mapping the impacted area to incorporate the change, particularly if the change blocks the AMR's ability to scan original workspace features.

4-5-1 Operating Zone

For a safe operating zone of the AMR, a clearance of at least 500 mm in width and 2300 mm in height must be maintained on both sides of the AMR. There must be 500 mm clearance in front of the AMR in the direction of travel at all times. Within this operating zone, the maximum forward and lateral speed of the AMR is 1200 mm/s and maximum reverse speed is 300 mm/s.

4-5-2 Operating Hazard Zones

Operating hazard zones are areas between the AMR and an obstacle that would not leave sufficient room for a person to escape and avoid getting crushed. These are areas of inadequate clearance less than 500 mm between the sides or front / rear of the AMR and an obstacle. It can also be an area which cannot be protected by the AMR's detection devices.

You must make these areas visually distinct. Personnel that will work near these zones must be trained and informed about your chosen method used to make hazard zones visually distinct.

4-5-3 Restricted Zones

Restricted zones are areas of inadequate clearance which cannot be protected by the AMR detection devices.
You may need to provide physical barriers that the AMR can detect accurately with its Front Safety Scanners so that it does not attempt to drive near these areas.
Only authorized persons are permitted to enter restricted zones.
You may need to implement map features such as Forbidden Areas to keep AMRs within their designated area of operation. Refer to the *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for information about adding restricted zones to your workspace map.

⚠ CAUTION

Before removing a Forbidden Zone map feature from an AMR map, ensure that same area in the AMR workspace is clear of all hazards.



4-5-4 Physical Barriers

Use physical barriers together with logical barriers (map restrictions) to prevent the AMR from approaching any fall hazards or other critical locations that are within its operating area.

⚠ WARNING

A physical barrier must be easily detectable by the AMR and also strong enough to stop a fully-loaded AMR traveling at its maximum speed.



Such areas may include:

- The edge of a loading dock or ramp.
- Entrance to downward stairs.
- Any other vertical drop that exceeds the AMR's maximum step height.
- Fire doors, firefighting equipment, access to stairways and exits, and all emergency shutdown switches in the facility.

Required characteristics of physical barriers are listed below.

- The barrier must be attached to a solid wall or floor and should be strong enough to stop a fully-laden AMR traveling at maximum speed.
- The barrier must extend around the hazard completely.
- Mark all physical barriers to make sure that the AMR's Front Safety Scanners can detect them easily.
- Barriers must extend above and below the laser's sensing plane, particularly if the floor is not flat.
- Barriers should be flat and perpendicular to the Front Safety Scanner sensing plane.
- The minimum detectable size of a barrier is 300 mm x 300 mm and must be mounted no higher than 100 mm from the floor.

4-5-5 Logical Barriers

In addition to physical barriers, use MobilePlanner to create Forbidden Areas or Lines as logical barriers on the workspace map to prevent AMRs from closely approaching a fall hazard. These map features assume proper AMR localization. These restrictions must be continuous so that the AMR cannot plan a path around the logical barrier. If the AMR is not able to properly localize its current position, it may enter the Forbidden Areas. You must always install physical barriers where there is a risk of property damage or safety hazard.

4-5-6 Obstacles

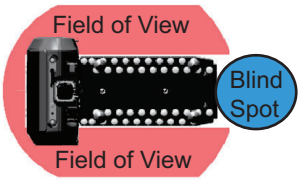
If the AMR will be entering high-traffic areas, take appropriate precautions to alert people in those areas that an AMR might enter. If the traffic consists of other machines, adjust the AMR and the other machines' parameters to reduce the risk of a collision.

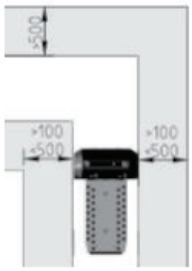
4-5-7 Payload Transfer Stations

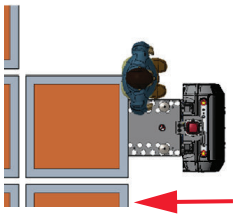
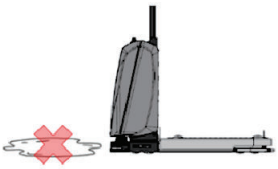
Payload transfer stations are designated areas where the payload is transferred to or from the AMR. When the payload transfer stations are outside the restricted zones, these stations shall be designed to prevent personal injury by the rigid parts of the AMR or its payload. These payload transfer stations shall be designated as operating hazard zones as defined in this section of the manual.

4-5-8 Risk Mitigation

Use the following table to understand risks and mitigating actions when operating the AMR.

Situation	Risk	Mitigation	Image
Personnel step into safety zone of the AMR when the AMR drives forwards, backwards or laterally.	Omni Lift does not stop in time.	• Personnel should be trained on proper use of the AMR and AMR safety. • Personnel should wear safety shoes to reduce impact.	
The AMR rotates.	The AMR's blind spot behind the Rear Bumper is the area that falls outside the filed of view of the Front Safety Scanners.	Personnel should be trained on the AMR's blind spot.	

Situation	Risk	Mitigation	Image
AMR drives in the operating hazard zone where there is less than 500 mm between the side of the AMR and an obstacle, for example doors that open into the zone or pillars in the zone.	Risk of entrapment.	• Personnel should avoid this zone as much as possible. • Mark the floor in these zones with clear symbols. • Personnel should be trained on proper use of the AMR and AMR safety.	
Objects in front of and beside the AMR at a height of less than 105 mm from the floor or behind the AMR at a height of less than 40 mm from the floor such as shelves, cords, forklift forks on the ground, uneven floor, etc. are not detected by the AMR.	The AMR collides with the obstacle.	Remove flat obstacles from the floor.	
Objects at a height of more than 105 mm from the floor, such as bridges, forklift blades, wall-hanging objects, etc. are not detected by the AMR.		Ensure no obstacles are 'floating' above the ground.	
Translucent objects, such as glass doors, facades, etc. are not detected by the AMR.		Use tape on transparent objects so the AMR detects them.	
Personnel standing on a ladder in AMR workspace.	AMR does not detect the person.	Cordon off the work area with cones.	

Situation	Risk	Mitigation	Image
The AMR sets down or picks up a payload.	The AMR's safety system is disabled (during loading, unloading, and docking), which may result in a risk of entrapment. The load may be placed on the feet of personnel or person may be trapped between the AMR and the load.	• Personnel should be trained on proper use of the AMR and AMR safety. • Personnel should wear safety shoes to reduce impact.	 
Liquids or dirt on floor in AMR's path.	Dirt or liquids on the path may negatively affect the AMR's braking distance.	Keep the workspace floor clean and dry.	
Payload carrier is incorrectly loaded.	Unstable payload carrier.	• Ensure the load is placed stably on the payload carrier. • Take into account the CoG of the payload carrier. Refer to *2-3-2 Payload Center of Gravity* on page 2-10 for more information.	
Objects protrude out of the payload carrier.	Damage to surroundings or injury to personnel.	Ensure payload is within the dimensions of the payload carrier.	

4-6 Clearances

The AMR must operate in an environment that is generally flat, with no doors or other restricted areas that are too narrow for the AMR to pass through. The AMR is designed to operate in environments that contain doors, passageways, or other constrained areas that are wide enough for it to traverse. You must ensure that adequate clearance is maintained on each side of the AMR, so that a person cannot get trapped between the AMR and a wall or other fixed object. The AMR must not navigate through doorways or pathways that are intended for personnel unless there is adequate room for both to pass without risk, and without interfering with travel paths per applicable standards.
Refer to *4-5-1 Operating Zone* on page 4-10 and *4-5-2 Operating Hazard Zones* on page 4-10 for more information.
An AMR must often maneuver close to machinery, conveyors, or other fixed objects. In such cases, operating standards typically allow an exception to side clearance requirements.
An exception to side clearance requirements may apply at pickup and dropoff locations, where the AMR must get close to conveyors or other fixed objects.

Precautions for Safe Use

You must have floor markings at Charging Stations and pickup / dropoff locations with adequate clearance to prevent people from entering these hazard zones.

Additional Information

Refer to *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for information about software parameters that you can use to control the AMRs front and side clearance zones. These settings can help to prevent the AMR from closely approaching obstacles.

4-6-1 Rotational Clearances

The AMR travels in forward, lateral, and backward directions and can rotate on its center of rotation (turns in place). When the AMR is rotating in place, adequate clearance must be provided.

⚠ WARNING

Personnel who work with or around the AMR should not stand close to the AMR when it is rotating with no forward motion.

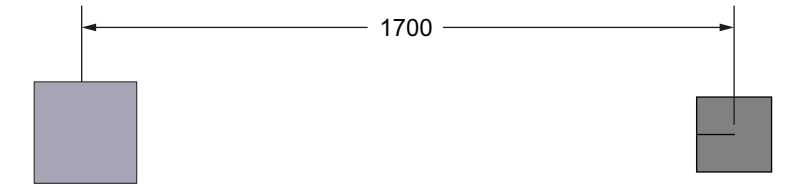


Additional Information

The AMR's Light Strips and LED Signal Lamp display a distinct turn signal pattern when it rotates. Refer to *4-18 Light Strips and Signal Lamp States* on page 4-43 for more information.

4-6-2 Docking Clearances

Set a 1700 mm distance between the Docking Target Goal (defined in the map) and the center of the Stationary Coil using MobilePlanner. This distance provides sufficient room for the AMR's Mobile Coil to align with the Stationary Coil during the docking operation. This distance is measured from the Docking Target Goal to the center of the AMR.



Operating areas where the clearance between the AMR and its surroundings is 500 mm or less are considered hazard zones. You must make these areas visually distinct. Personnel that will work near these zones must be trained and informed about your chosen method used to make docking area hazard zones visually distinct. Use floor markings to draw attention to the docking area hazard zones.

4-7 Narrow Passageway Behavior (Linear)

The AMR can operate at its maximum speed (1200 mm) through a 2000 mm wide passageway. It will travel at a slower speed when traversing through a passageway less than 2000 mm wide.
The practical minimum width for a passageway is 1300 mm. The most narrow passageway it can traverse is 1200 mm wide. In order for the AMR to pass through these narrow spaces, you may need to use specific map features or change the AMR's configuration to reduce the speed. These widths are practical for linear speeds of less than 300 mm/s.

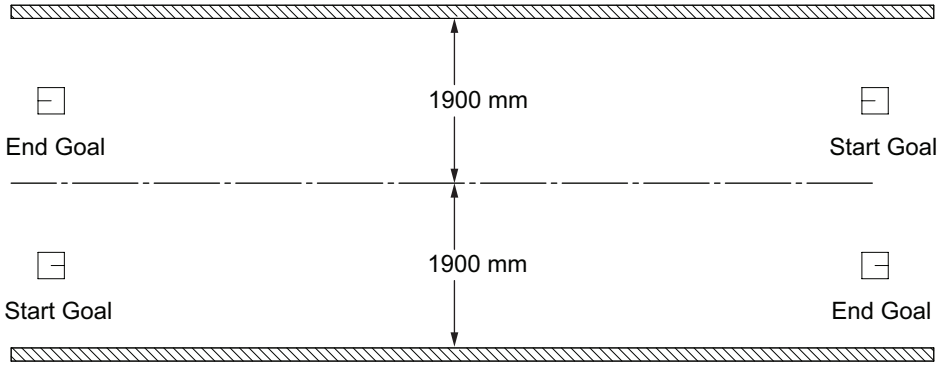


Additional Information

Use the Door Goals feature on the map for pre-alignment when the AMR travels through narrow passageways.

4-8 Minimum Lane Width

When an OL-series AMR operates in a corridor with another moving OL-series AMR, it must have a minimum lane width of 1900 mm in order to travel at its maximum speed.
For example, corridors that have two OL-series AMRs traveling through it at once must be at least 3800 mm wide for operation at full speed. Corridors that are below 3800 mm wide may cause the OL-series AMRs to slow down when traveling in the area in close proximity to one another. The minimum lane width requirement will increase if the AMRs are transporting extra-wide payload carriers or if an OL-series AMR is operating with another OMRON AMR such as an MD-series or HD AMR.



4-9 Immobilization

In rare circumstances, it is possible for the AMR to become physically immobilized in a position from which it cannot move without operator assistance. Immobilization may also occur from a low battery or AMR error.

⚠ WARNING

Immobilization might cause motors in the AMR to overheat, resulting in a fire.



Refer to the following sections for information about recovering from immobilization.

- *6-4 Lifting the AMR* on page 6-5.
- *4-14 Manually Moving the AMR* on page 4-31.
- *5-3-1 Low Battery Recovery* on page 5-5.

4-10 Charging AMR Battery

The AMR features a coil (Mobile Coil) under the unit for wireless charging. When the AMR positions itself over the the Stationary Coil, current in the Stationary Coil generates a magnetic field between the two coils. This induces a current in the Mobile Coil and the battery charges wirelessly. This process is called induction charging.
The Charging Station is equipped with infrared communication for detection of the AMR at the charging position and communication between the Stationary Electronics and the Mobile Electronics in the AMR. When the Stationary and Mobile coils are aligned correctly, the system switches to charging mode and battery charging is initialized. When the Mobile Coil in the AMR moves away from the Stationary Coil, the connection is interrupted and the charging process stops automatically.
The AMR battery supplies adequate power for the motors, electronics, and accessories.
Typical runtime with no load is approximately 11 hours and typical fully loaded runtime is approximately 7 hours. The primary factors that affect runtime are AMR speed, acceleration, idle time at Goal locations, payload amount, and power consumed by accessories.
Check the battery's state-of-charge (SOC) percentage (%) using MobilePlanner.

⚠ DANGER

Do not charge a battery that has not been approved for the OL-series AMR. There is a risk of explosion when charging an incorrect battery. Failure to comply with the above mentioned instruction could result in damage to the Charging Station, battery, and AMR.

⚠ WARNING

The following actions are strictly prohibited and could result in injury or damage to the equipment.
- Persons with cardiac pacemakers in the AMR charging zone.
- Persons with metal implants in the AMR charging zone.
- Holding, placing, or allowing objects between the charging coils.

⚠ CAUTION

Never connect electric loads directly to the battery bypassing protective circuits.

Precautions for Safe Use

- The AMR must be powered ON in order to charge the battery while at the Charging Station.
- Do not touch the AMR charging coils. Coils get very hot during and after charging.

4-10-1 Charging Station

The Charging Station provides an automated method of recharging the AMR's battery.
A 3 m power cable connects the Stationary Electronics to the Stationary Coil.
The Stationary Coil outputs a maximum of 3 kW of power and can charge a depleted battery in approximately 45 minutes.

⚠ WARNING

Do not allow liquids of any kind to come in contact with the Stationary or Mobile Coil.

⚠ WARNING

The Charging Station transfers high electric power, and contains hazardous voltage. The user must take necessary precautions when working near the Charging Station, and follow appropriate Lock-Out, Tag-Out (LOTO) instructions prior to any maintenance work done on the Charging Station.

⚠ CAUTION

Do not allow any foreign metal objects to be near the AMR or the charging coils.

Precautions for Safe Use

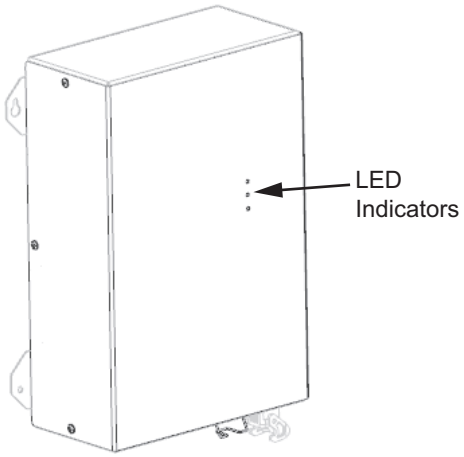
In case of fire, use a type ABC or type BC dry chemical fire extinguisher.

Precautions for Correct Use

The Charging Station shall only be used to charge an OL-series AMR battery.

Stationary Electronics LEDs

The Stationary Electronics has LED indicators to display the status of the unit as described below.



When the Stationary Electronics is supplied with facility AC power, the unit powers ON and illuminates all LEDs on the front panel briefly. Use the LEDs to determine the operational status of the Stationary Electronics.

Upon initial power-up, all LEDs will turn ON briefly to confirm they are not faulty.
The following table provides detailed description of each LED state.

Green LED	Yellow LED	Red LED	State
ON steady	OFF	OFF	Battery charging
Flashing slowly	OFF	OFF	Stationary Electronics in standby mode. Power is supplied and AMR is not detected.
Flashing rapidly	OFF	OFF	Battery full. Charging complete.
ON steady	Flashing slowly	OFF	Battery is charging at a reduced rate because of coil misalignment.
Flashing rapidly		ON steady	Battery is not charging. There is no power transfer because of coil misalignment.
Flashing slowly	Flashing rapidly	OFF	Stationary Electronics fan faulty.
Flashing rapidly	Flashing rapidly	OFF	Facility AC power / voltage derating
ON steady	Flashing rapidly	OFF	Battery is charging at a reduced rate because either the temperature of the Stationary Coil or the Mobile Coil is too high.
ON steady	ON steady	OFF	Mobile Electronics fan faulty. MOSFET temperature difference.
Flashing rapidly	Flashing slowly	ON steady	• Defective coil (s) (no resonance detected). • Grounding fault at Stationary side.
Flashing rapidly	Flashing rapidly	ON steady	Stationary Electronics has turned OFF due to high temperature.
Flashing rapidly	ON steady	ON steady	Mobile Coil or Mobile Electronics faulty.
Flashing slowly		ON steady	Grid fault (overvoltage or undervoltage DC bus).
Flashing slowly	Flashing slowly	ON steady	CAN communication error on Stationary side.
Flashing slowly	Flashing rapidly	ON steady	CAN communication error on Mobile side.
Flashing slowly	ON steady	ON steady	Stationary Electronics fault.
OFF	Flashing slowly	Flashing slowly	Stationary Electronics in bootloader state
OFF	ON steady	ON steady	Software updating

4-10-2 Charging Battery for the First Time

OMRON recommends that you charge the battery immediately after unpacking and installing the battery in the AMR for the first time. The battery is shipped with 30% state of charge (SOC) and discharging may have occurred during transport.

Precautions for Correct Use

IATA regulations (UN 3480, PI 965) require that air freight shipped lithium ion batteries not installed in the AMR must be transported at a state of charge not exceeding 30%. To avoid total discharge, fully charge the battery immediately upon receipt. The battery might arrive fully charged if it is not shipped by air freight.

There are two ways to charge the battery for the first time before a map of the workspace has been created for the AMR.

- Charge the battery using the Service Charger.
- Drive the AMR in Automatic Drive mode to the Charging Station for charging the battery.

Depending on the distance of the Charging Station set up in your facility, choose one of the two methods above to charge the battery.

Charge Using Service Charger

Follow the steps below to charge the battery using the Service Charger. The Service Charger can be used to charge the AMR battery for the first time or when the battery SOC is too low to drive the AMR to the Charging Station.

The Service Charger is rated to operate within a voltage range of 220 to 240 VAC at 50 to 60 Hz. Refer to *2-5-9 Service Charger Specifications* on page 2-19 for more information.

If the Service Charger is supplied with power outside the rated voltage range, use a step-up transformer rated for a minimum of 750 W. OMRON recommends the Bronson++ WTI-4000 Voltage Converter.

⚠ CAUTION

The Service Charger cables pose a tripping hazard. Place cables in a manner that prevents tripping or isolate the area to prevent people from interacting with cables.

Precautions for Correct Use

Use only OMRON supplied Service Charger when the AMR state of charge is too low to allow docking.

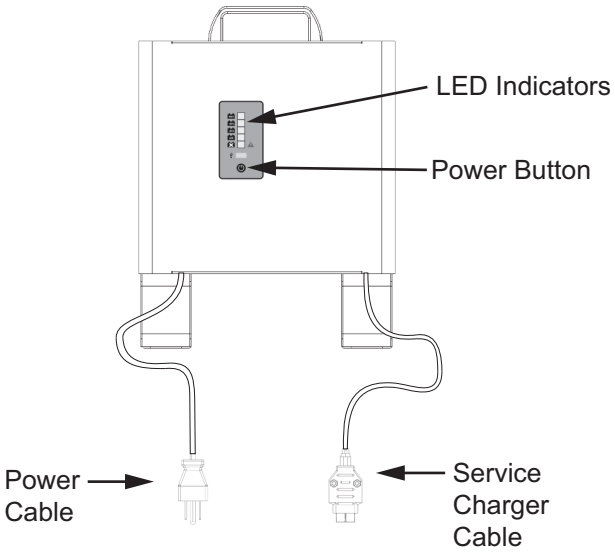
Additional Information

After charging is complete, disconnect the Service Charger from the AMR and do not leave it connected to the AMR. The Service Charger will stop delivering current after the battery is fully charged.

1 Turn the Main Disconnect Switch to the ON position.
The AMR should remain powered ON during charging.

2 Set the Selection Switch to PAUSE to prevent any automatic or manual control of the AMR.

3 Connect the Service Charger cable to the Service Charger connector on the Control Strip of the AMR.



4 Connect the power cable of the Service Charger to a wall socket.

5 Press the Power button on the Service Charger.
The AMR battery begins charging.
The LED indicators on the Service Charger show the battery SOC.
The charging process takes approximately 2.5 hours to complete.

Automatic Drive Mode Charging

For initial charging before a workspace map has been created for the AMR, you can drive the AMR in Automatic Drive mode through MobilePlanner to the Charging Station for charging the battery. Refer to

- *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for more information about installing and accessing MobilePlanner.
- *MobilePlanner Integrated Help* for more information about driving the AMR on Automatic Drive mode.

4-10-3 Autonomous Charging

During normal operation, the AMR charges its battery autonomously by driving to the Charging Station under configurable conditions (battery level and opportunities). The AMR drives to the location of the Charging Station based on the map loaded onto the AMR and it uses this information to autonomously recharge as configured.
The AMR arrives at the Charging Station and moves up the Charging Ramp to position itself over the Stationary Coil. After the two coils detect each other, charging begins. The Stationary Electronics LED light turns a steady green to indicate that charging is initialized. The AMR's Light Strips and Signal Lamp display the charging status of the AMR. Refer to *Stationary Electronics LEDs* on page 4-21 and *4-18 Light Strips and Signal Lamp States* on page 4-43 for more information.

⚠ CAUTION

Beware of entrapment danger when the AMR moves backwards during docking. Entrapment danger exists between the payload carrier and the AMR.



Ensure the battery SOC does not fall below 10%. If the battery level becomes too low or absolutely depleted, the AMR is immobilized and autonomous charging will not be possible. If this occurs, user interaction is required. The AMR can be physically moved to the Charging Station or charged with the Service Charger. The AMR must be able to power ON to resume charging once at the Charging Station. Refer to *5-3-1 Low Battery Recovery* on page 5-5 and *4-14 Manually Moving the AMR* on page 4-31 for more information.

If you move the AMR during the charging process, the charging will stop and re-docking is required to resume.

Autonomous Charging Considerations

Make the following considerations when establishing your AMR charging strategy.

- The operating software monitors battery level and sends the AMR to a Charging Station if the state of charge is 10% or less.
- If one or more individual battery cells is discharged excessively, autonomous charging cannot start. Refer to *5-3 Battery Problems* on page 5-5 and *4-10-4 Balancing the Battery* on page 4-25 for more information.
- If the battery level becomes too low, the AMR is immobilized and autonomous charging will not be possible. User intervention will be required to recover. Refer to *4-9 Immobilization* on page 4-19 for more information.
- If an AMR is OFF or in an emergency stop state while docked, a Fleet Manager will consider that Charging Station as available and may send other AMRs to that Charging Station to charge.
- An AMR may occupy a Charging Station indefinitely after it is fully charged until it is commanded to another location.
- A Charging Station that has lost power is still considered available by the Fleet Manager until an AMR attempts to charge at that location. Use the *FailedDriveInAttemptsBeforeIgnore* parameter to determine when to ignore that Charging Station if charging attempts fail.
- By default, the AMR will automatically disengage from a Charging Station and then attempt to re-dock if Charging Station power is lost. This will only occur when the AMR is actively charging or attempting to charge.
- The AMR must be powered-ON for charging to occur.

4-10-4 Balancing the Battery

The AMR's battery is composed of multiple cells which must stay balanced to maintain maximum runtime.

The battery balancing process occurs after the battery is fully charged while still connected wirelessly to the Charging Station.

The time interval between battery balancing is related to the length of time required to balance a battery. A battery that is significantly out of balance can take 48 hours or longer to balance after charging.

To balance the battery at every charge while the AMR is engaged with the Charging Station:

Set the AMR's *DockUntilDoneCharging* parameter to True to balance the battery every time the AMR engages the Docking Target. In this mode, the battery will typically take about 15 additional minutes to balance after charging.



Additional Information

If the AMR's *DockUntilDoneCharging* parameter is set to False while the *StateOfChargeTo-ChargeTo* and *MinutesToChargeFor* parameters are both set to a default value of 0, the AMR will never leave the Charging Station. Do not use this combination of parameter settings.

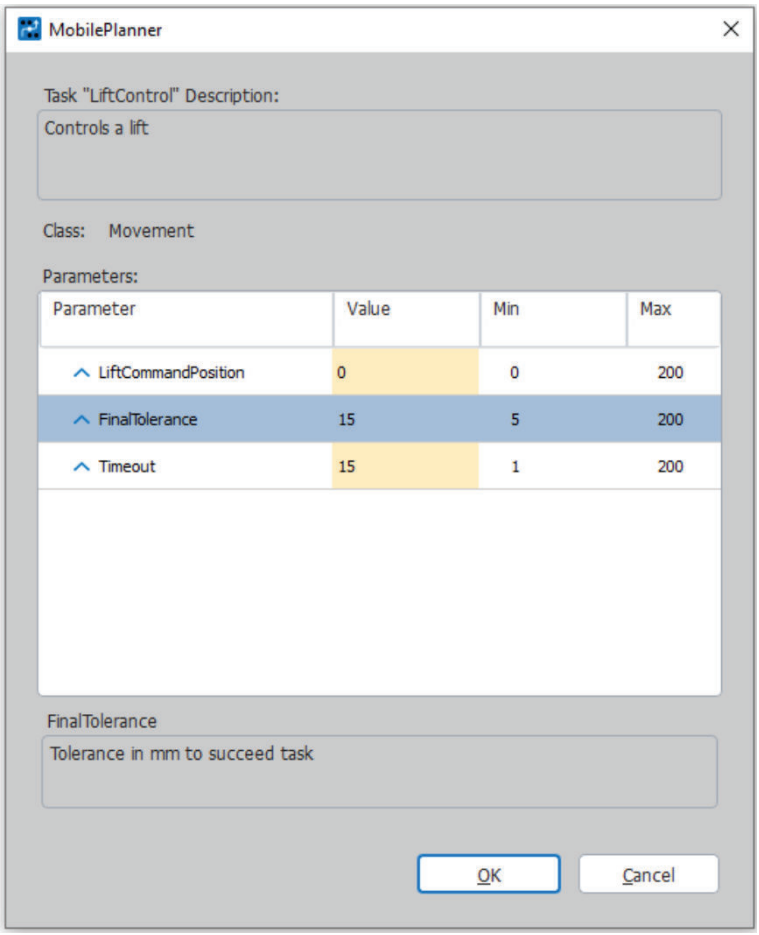
4-10-5 Storing Batteries

If the AMR will not be used for an extended period, the battery should be removed and stored.
Make the following considerations when storing batteries.

- Lithium batteries must be stored in accordance with local regulations and ordinances.
- Always charge the battery to at least 50% capacity before long-term storage.
- The batteries must be stored in the upright position. Do not place the batteries on the side, top, or end when storing.
- Stored batteries should be fully balanced and charged every 6 months to prevent significant deterioration. Failure to re-charge a stored battery periodically can damage it.
- Batteries stored at temperatures greater than 35°C or less than -20°C must stabilize for 4 to 8 hours until within the nominal operating temperature, with no condensation before use.
- Store the batteries on a flat surface in an area free of vibration.
- Do not place anything on top of the batteries.
- Never expose the battery to water or other liquids.
- Do not store in direct sunlight or near other heat sources.
- Do not store the batteries in a flammable environment.

4-11 Lift Mechanism

The AMR's lifting mechanism is designed to raise and lower a payload carrier during pick-up and drop-off operations.
The Lifting Plate (or deck) height can be controlled with Tasks and Macros configured in MobilePlanner. Refer to *MobilePlanner Integrated Help* for more information.
You can control the AMR's Lifting Plate using the *LiftControl* Task in MobilePlanner. The *LiftCommandPosition* parameter allows you to specify the deck height in mm. The maximum height to which the Lifting Plate can be raised is 200 mm and the starting point (lowest) is 0 mm. The Lifting Plate set point of 0 mm corresponds to the lowest position at 108 mm (Lifting Plate height) from the floor surface. Refer to *2-2 Lifting Specifications* on page 2-3 for more information.



You can also configure macros in MobilePlanner for lifting heights as shown below.

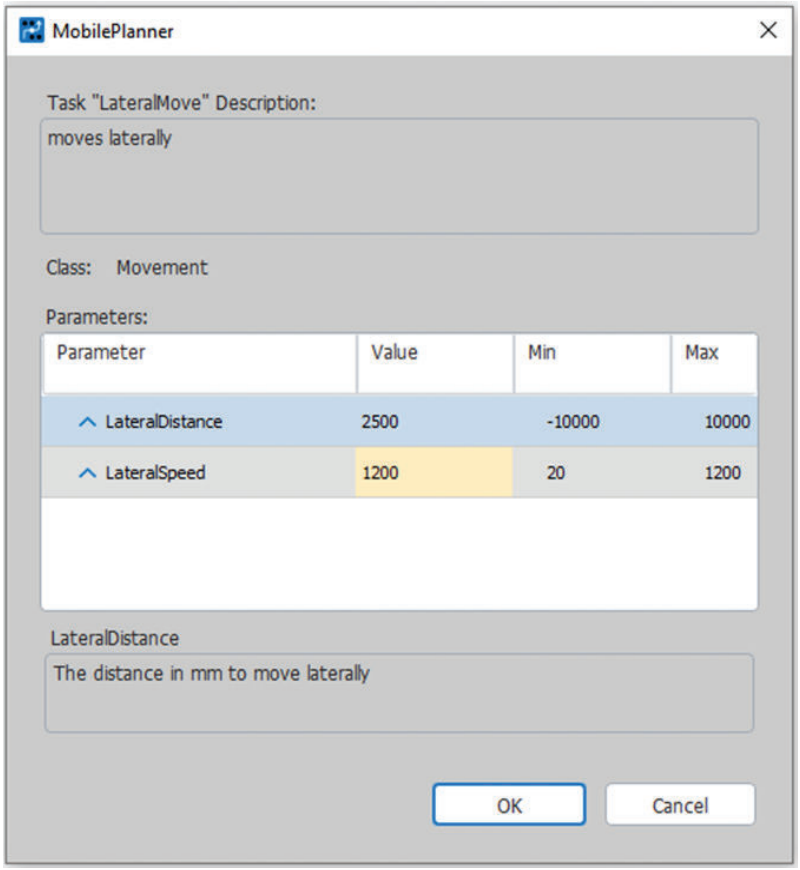
1. In MobilePlanner, configure a Macro ("Raise Lift" or "Lower Lift") to raise or lower the Lifting Plate to a height between 0 and 200 mm. Refer to the *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for more information.
2. In the Macros list, right-click the **Raise lift** or **Lower Lift** macro you created and choose **Execute**.

⚠ CAUTION

- If the AMR is stopped using the E-STOP button during a lifting motion, the AMR will resume the motion after it is reset.
- If the AMR is powered-OFF during a lifting motion, the AMR's Lifting Plate will return to its lowest position when the AMR's power is restored.

4-12 Lateral Motion

The AMR is capable of moving laterally (sideways) to transport the load. You can control the AMR's lateral motion using the *LateralMove*task in MobilePlanner. For the lateral distance traversed by the AMR, use the *LateralDistance* parameter. Specifying positive values will move the AMR to the left while negative values will move it to the right. Use the *LateralSpeed* parameter to control the speed with which the AMR will travel laterally to execute the task.



Refer to *1-9 Coordinate System* on page 1-32 for more information about the left and right sides of the AMR.

4-13 Control Strip

The following sections describe the functions of the Maintenance Ethernet Port, Main Disconnect Switch and Mode Selection Switch in operating the AMR.

4-13-1 Maintenance Ethernet Port

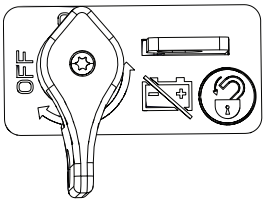
Use the maintenance Ethernet port to connect a PC directly to the AMR when using software for configuration or troubleshooting. This port should only be used as a single connection point. Do not connect the maintenance port directly to your LAN.
This port automatically assigns the IP address 10.39.46.1 to the connecting PC.
Access to the SetNetGo web interface is always available at this port.

Additional Information

Refer to *3-5 Network Connections* on page 3-18 for more information.

4-13-2 Main Disconnect Switch

Turning the Main Disconnect Switch to the OFF position disconnects all power completely from the AMR. Turning it ON establishes connection between the internal battery and all AMR systems.



When the Main Disconnect Switch is in the ON position, the AMR Skins cannot be removed.

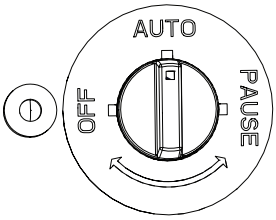
Precautions for Correct Use

The Main Disconnect Switch should not be used as a frequent means of turning OFF the AMR.

To power OFF the AMR in a controlled manner, turn off the AMR through MobilePlanner and then set the Selection Switch to OFF.

4-13-3 Selection Switch

The following table describes the three operational states of the AMR set using the Selection Switch.



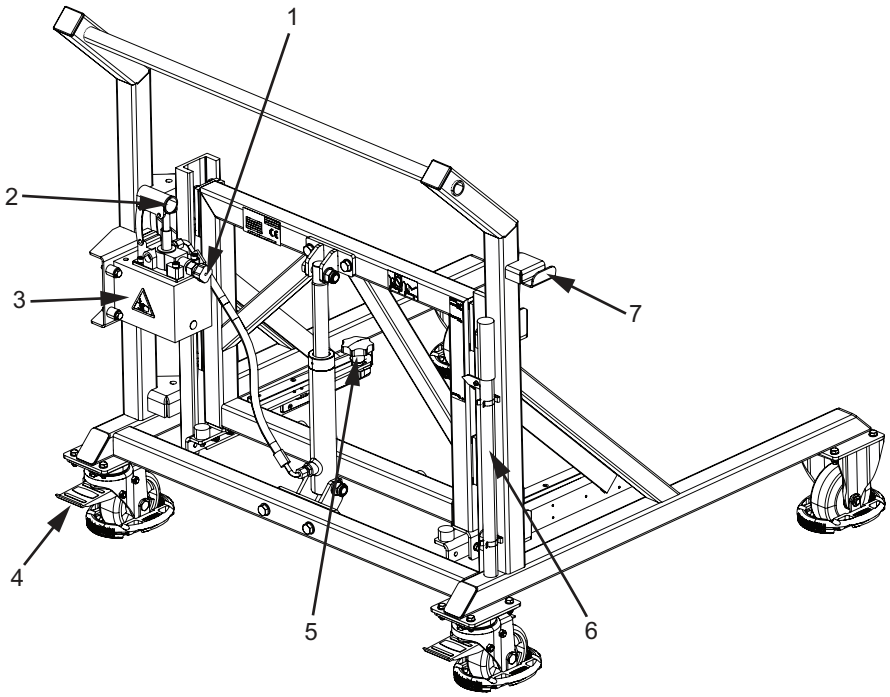
Switch Position	Description
AUTO	Normal operational state. The AMR can be controlled by either the Fleet Manager or MobilePlanner. The Power LED is on.
PAUSE	Operational pause. Selecting this option brings the AMR to a stop without engaging the safety circuit. Recovery needs a reset through the Reset Button. The Power LED is on.
OFF	Turns OFF power to the AMR. Power LED is OFF.

4-14 Manually Moving the AMR

If the AMR becomes immobilized (such as a depleted battery situation), it may need to be manually moved to a new location. The AMR can be lifted and moved to another location using an overhead hoist or forklift. Refer to *6-4 Lifting the AMR* on page 6-5 for more information.
Alternatively, the Manual Mover can be used to move the AMR over a short distance.
A fully assembled Manual Mover is shipped.

Precautions for Safe Use

At least two people are needed to roll out the Manual Mover from the wooden box after unpacking.



Item	Detail
1	Knob for lowering the level of the Manual Mover
2	Sleeve for Lever
3	Hydraulic box
4	Brake
5	Star Knob for attaching the AMR
6	Lever for raising the level of the Manual Mover
7	Hook for hanging the Lift Bridge

4-14-1 Safety Considerations

Observe the following safety considerations when using the Manual Mover to transport the AMR.

⚠ DANGER

Only qualified personnel who have read and understood this manual should manually move, operate the AMR, or install accessories.

⚠ WARNING

- The Manual Mover must be used only to transport an OL-series AMR. Do not use the Manual Mover for any other purpose.
- Inspect the Manual Mover for damage, deformation, and cracks before each use and do not lift a weight greater than the safe permissible working load indicated on the Manual Mover.
- Do not operate the Manual Mover on sloping surfaces. The weight of the AMR can cause you to lose control on a sloping surface.
- After transporting the AMR using the Manual Mover to a new location, ensure the workspace floor on which the AMR is deposited is clear and flat.

⚠ CAUTION

The Manual Mover should be used to move the AMR when needed. Avoid pushing the AMR.

Precautions for Safe Use

- Ensure the AMR is OFF when manually moving or conducting any maintenance on the AMR.
- Do not use the Manual Mover to transport people.
- Do not perform maintenance tasks on the AMR when it is suspended in the Manual Mover.
- Ensure the AMR is properly attached to the Manual Mover before transporting the AMR.
- Always remove the payload or payload carrier from the AMR before attaching the AMR to the Manual Mover and operating the Manual Mover.
- Do not leave the Manual Mover unattended and always engage the brake to keep the device stationary.

Precautions for Correct Use

When using the Manual Mover to move the AMR, the AMR must be turned OFF.

The next sub-sections describe moving the AMR under the following circumstances:

- Moving the AMR with a raised Lifting Plate (with or without a payload resting on it).
- Moving the AMR with Lifting Plate down.

4-14-2 Moving AMR with Lifting Plate Up

Follow the procedure below to manually move the AMR and lower the Lifting Plate (with or without a payload carrier resting on the Lifting Plate) using the Manual Mover and the Lift Bridge.

The following accessories are required for this procedure:

- Manual Mover (part number 28110-501)
- Lift Bridge (part number 28110-503)

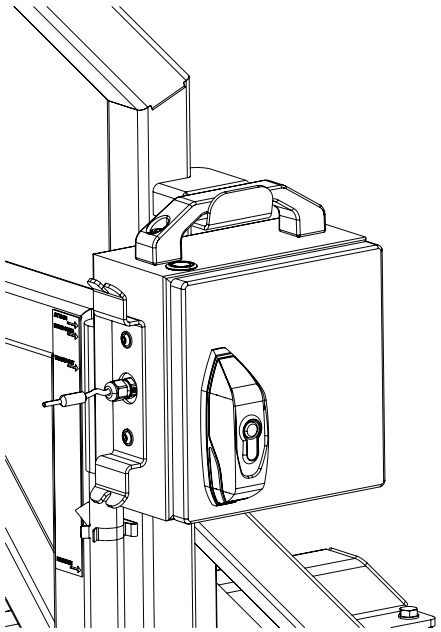
Make the following considerations before attempting this procedure:

- Ensure that the area you will be working in is adequately protected and cannot be interrupted by other AMRs.
- Ensure the AMR is powered-OFF. Refer to *4-4 AMR Shut-down Procedure* on page 4-8.
- Ensure a fully charged battery is installed in the Lift Bridge.

Precautions for Safe Use

- Ensure there is enough clearance for the movement of the AMR's Lifting Plate when using the Lift Bridge.
- To avoid a potential short circuit, do not press the button on the Lift Bridge unless the Lift Bridge is connected to the AMR.

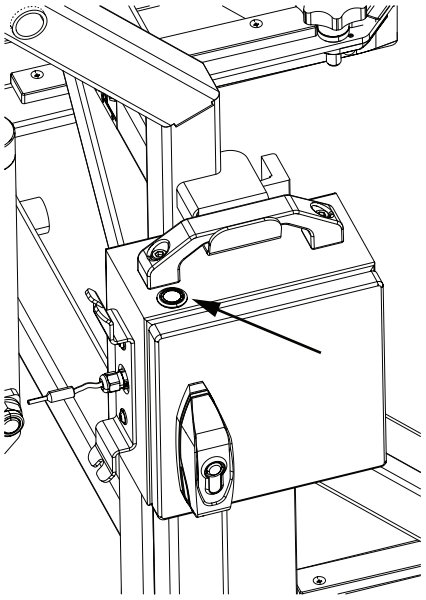
1 Hang the Lift Bridge on the designated hook on the Manual Mover.



2 Push the Manual Mover close to the AMR.

3 Connect the cable from the Lift Bridge to the Manual Lift Control Connector on the Control Strip of the AMR. Refer to *1-2-1 Control Strip* on page 1-6 for more information.

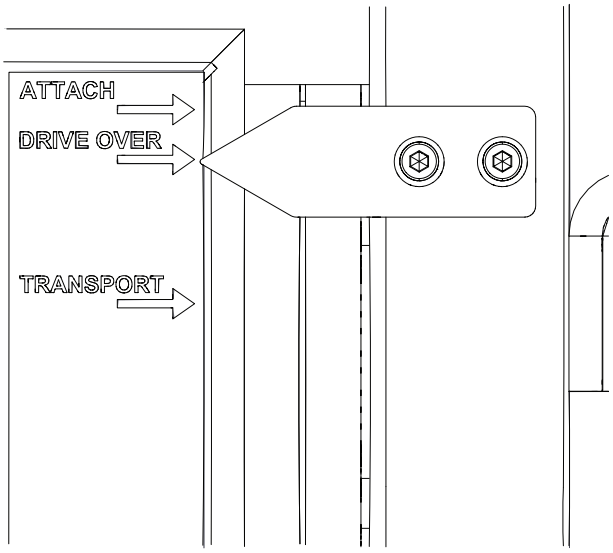
4 Press the button on the Lift Bridge and hold until the Lifting Plate cannot be lowered any further.



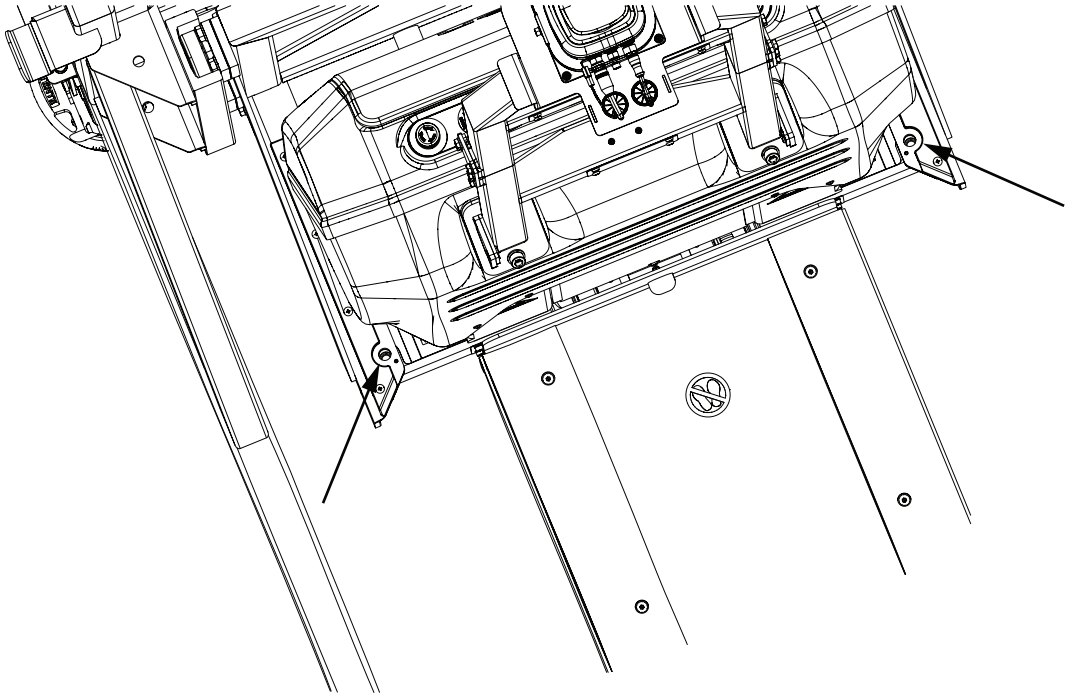
5 Disconnect the cable between the Lift Bridge and the AMR.

6 Raise or lower the Manual Mover to place the pointer in the *Drive Over* position.

1) Attach the Lever to the Hydraulic Box and pump up the Lever to raise the Manual Mover or
2) Turn the knob on the hydraulic box to lower the Manual Mover.

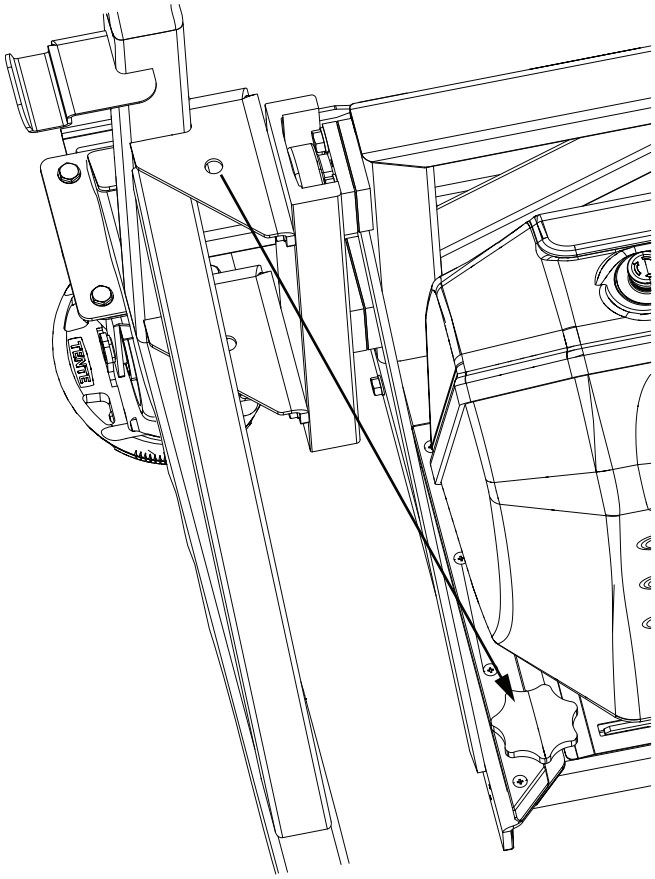


7 Position the Manual Mover over the AMR in such a way that the two holes in the Manual Mover frame align with the two holes on either side of the AMR.



8 Use the Knob of the Manual Mover to place the pointer in the *Attach* position.
The Manual Mover is now at the right level for attaching the AMR.

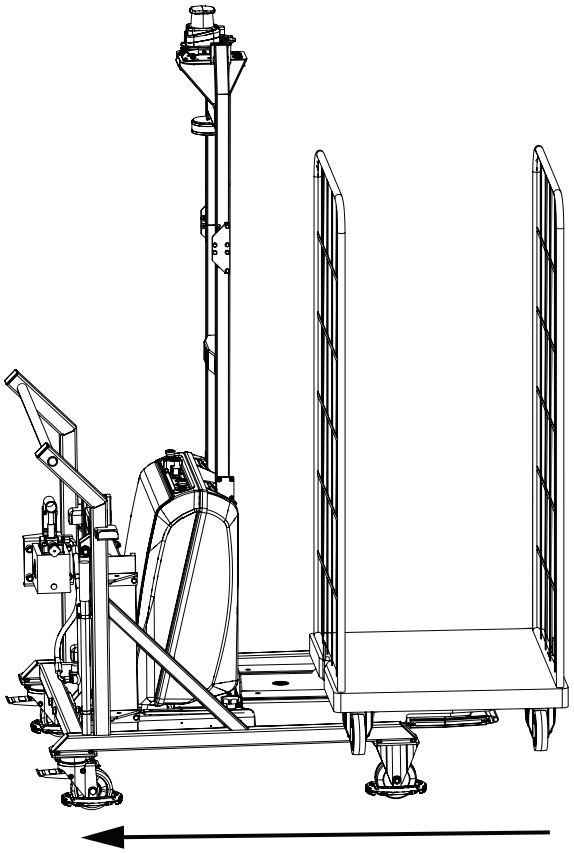
9 Unscrew the two star screws from their storage position on the Manual Mover and screw them into the holes on the AMR.



10 If your AMR does not have a payload carrier resting on it, skip to step 16.

11 Use the Lever of the Manual Mover to raise the AMR until the AMR is just high enough to be moved without the Lifting Plate making contact with the bottom of the payload carrier.

12 Carefully pull the Manual Mover backwards so that the AMR comes out from under the payload carrier.



13 Move the payload carrier to a safe storage area.

14 Use the Lever of the Manual Mover to place the pointer in the *Transport* position.
The AMR is now lifted high enough to be wheeled.

15 Move the Manual Mover (attached to the AMR) to your desired location.

16 Use the Knob of the Manual Mover to place the pointer in the *Attach* position.
The Manual Mover is now at the correct level to be detached from the AMR.

17 Unscrew the two star screws from the AMR and screw them back into their storage positions on the Manual Mover.

18 Detach the Manual Mover from the AMR and move it away to complete this procedure.

4-14-3 Moving AMR with Lifting Plate Down

Follow the procedure below to manually move the AMR (with Lifting Plate lowered) with or without a payload carrier resting on the Lifting Plate.
The Manual Mover (part number 28110-501) is required for this procedure.
Make the following considerations before attempting this procedure:

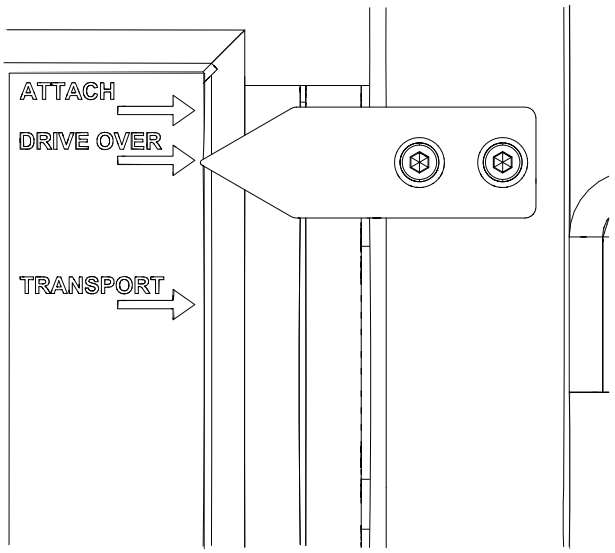
- Ensure that the area you will be working in is adequately protected and cannot be interrupted by other AMRs.
- Ensure the AMR is powered-OFF. Refer to *4-4 AMR Shut-down Procedure* on page 4-8.

1 If there is a payload carrier resting on the Lifting Plate of the AMR, move the payload carrier away from the AMR to a safe storage area.

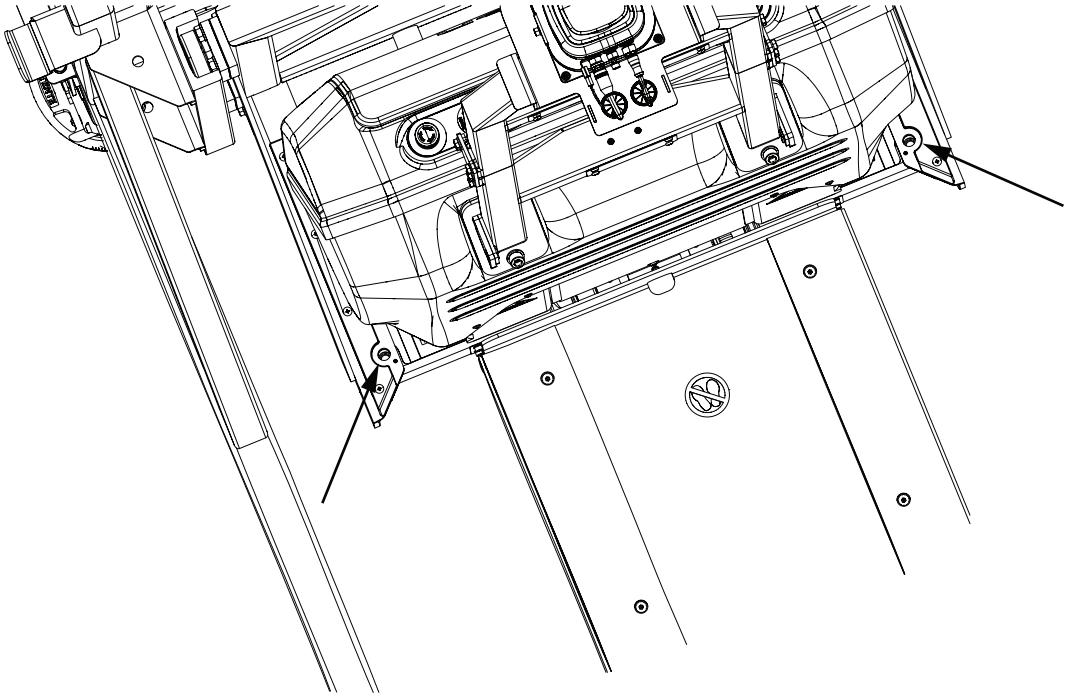
2 Push the Manual Mover close to the AMR.

3 Raise or lower the Manual Mover to place the pointer in the *Drive Over* position.

1) Attach the Lever to the Hydraulic Box and pump up the Lever to raise the Manual Mover or
2) Turn the knob on the hydraulic box to lower the Manual Mover.

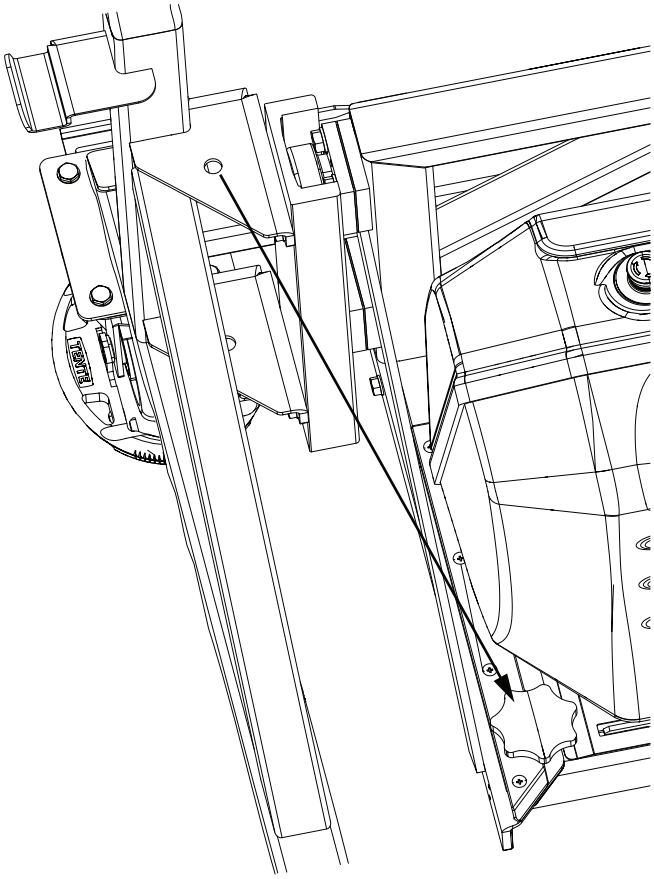


4 Position the Manual Mover over the AMR in such a way that the two holes in the Manual Mover frame align with the two holes on either side of the AMR.



5 Use the Knob of the Manual Mover to place the pointer in the *Attach* position.
The Manual Mover is now at the right level for attaching the AMR.

6 Unscrew the two star screws from their storage position on the Manual Mover and screw them into the holes on the AMR.



7 Use the Lever of the Manual Mover to place the pointer in the *Transport* position.
The AMR is now lifted high enough to be wheeled.

8 Move the Manual Mover (attached to the AMR) to your desired location.

9 Use the Knob of the Manual Mover to place the pointer in the *Attach* position.
The Manual Mover is now at the correct level to be detached from the AMR.

10 Unscrew the two star screws from the AMR and screw them back into their storage positions on the Manual Mover.

11 Detach the Manual Mover from the AMR and move it away to complete this procedure.

4-15 Protective Stops

Protective stops are initiated by the AMR in response to its environment. When a protective stop is triggered, the AMR decelerates to a stop at the maximum allowed rate. It then removes power to its motors and engages the brakes.

No user intervention is necessary to recover from a protective stop. The AMR restarts automatically after the obstacle or object on its path is removed.

The protective stop circuit is classified as a Category 1 stop according to IEC 60204-1 (NFPA79).

Protective stops can be triggered by one of the following events.

- Any time an object is detected within a Safety Scanner Zone. Refer to *4-20 Safety Scanner Zones* on page 4-48 for more information.
- Overspeed conditions. Refer to *4-17 Overspeed Protection* on page 4-42 for more information.

A protective stop differs from an emergency stop. Refer to *4-16 Emergency Stop* on page 4-41 for more information.

4-16 Emergency Stop

An emergency stop (E-STOP) is initiated usually for safety reasons either by pressing the E-STOP button or by pressing the Rear Bumper. When an emergency stop is triggered, the AMR decelerates to a controlled stop, de-energizes the safety outputs, and then disables its motors and engages the brakes.
The emergency stop circuit is classified as a Category 1 stop according to IEC 60204-1 (NFPA79).
Typical reasons to activate an emergency stop during normal operation are:

- Stopping the AMR for safety reasons such as danger to personnel or damage to the AMR.
- Manually interrupting or stopping the AMR to keep it from performing its currently scheduled Task if you do not have access to MobilePlanner.



Additional Information

- Follow your site-specific emergency and safety procedures after initiating an emergency stop function.
- The AMR will enter an Emergency Stop state if there is a disconnection or damage to the drive motor encoder cables.

The AMR will not automatically recover from an emergency stop. User intervention is required. Refer to *4-16-1 Emergency Stop Recovery Procedure* on page 4-41 for more information.
An emergency stop differs from a protective stop. Refer to *4-15 Protective Stops* on page 4-40 for more information.
Indicator lights on the AMR display the emergency stop state. Refer to *4-18 Light Strips and Signal Lamp States* on page 4-43 for more information.

4-16-1 Emergency Stop Recovery Procedure

Recovery from an emergency stop requires additional manual actions only after the operator has confirmed that it is safe to return the AMR to operation. The AMR's drive motors remain disabled until the procedure below is executed.
Use the following procedure to recover from an emergency stop event.

1. Reset (pull up) the E-STOP button.
2. Make sure that all surrounding areas are clear so the AMR has room to maneuver.
3. Press the Reset button on the Control Strip.



Additional Information

There is approximately a 2 second delay between when the Reset button is pressed and the AMR resumes its activity. During this time, the AMR scans its path for potential obstacles and will resume its commanded motion if there is adequate space to maneuver.

4-17 Overspeed Protection

The AMR's computing system uses redundant monitoring and control methods to ensure that the AMR always operates within safe speed limits. Overspeed limits are not adjustable and are independent of parameters detailed in *4-21 Motion Limits* on page 4-79.
The safe speed limits are provided below.

- Maximum forward linear speed: 1200 mm/s
- Maximum reverse linear speed: 300 mm/s
- Maximum lateral speed: 1200 mm/s
- Maximum Rotational speed: 65 deg/s

If the AMR operates outside the specified safe speed limit, the safety controller registers a system fault and begins a protective stop sequence. This event causes the AMR to execute a protective stop (Category 1 according to IEC 60204-1, NFPA79). When the protective stop is triggered, the system commands a controlled stop at the highest deceleration allowed. During the deceleration process, the safety controller continuously monitors the deceleration. If the AMR is not able to stop quickly enough, the safety controller disables the drive motors and engages the dynamic brakes in order to stop the AMR. Refer to *2-5-5 Safety Function Performance Levels* on page 2-15 for more information.
The motor brakes are powerful enough to stop a fully loaded AMR traveling at its top speed. However, engaging the brakes to stop the AMR is not a typical function. In the unlikely event that this occurs, you receive an error message in MobilePlanner which should not be ignored. This error can occur if one of the following conditions is present.

- The AMR software fails to command a controlled stop for any reason.
- The floor is excessively slippery and does not provide good traction.

If this fault occurs frequently, the operating conditions leading up to this event should be investigated. Contact your OMRON representative for support. If the problem is not resolved, the AMR may stop operating in order to prevent the use of the potentially degraded brakes. Generally, the degradation of the motor brakes requires hundreds of these occurrences.



Additional Information

Motion control configuration parameters (such as *MaxForwardSpeed* parameter) limit the maximum allowable velocities. Use MobilePlanner to modify the value of these parameters. Refer to the *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for more information.

4-18 Light Strips and Signal Lamp States

The LED Light Strips located on the front and rear of the AMR and the LED Signal Lamp on the mast provide a visual indication of its operational state. The LEDs can display one of the following states.

- Steady light
- OFF
- Pulsing (slow) at a frequency of 0.25 Hz
- Flashing (fast) at a frequency of 0.5 Hz

Use the information in the following sections to understand the operation of the Light Strips and the LED Signal Lamp.

Refer to *1-9 Coordinate System* on page 1-32 for more information about the AMR direction of motion.

4-18-1 Forward

When the AMR drives forward, the following light pattern is displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Forward	Blue with yellow light moving in front-to-back pattern		Yellow light moving in back-to-front pattern		OFF

4-18-2 Reverse

When the AMR drives backward, the following light pattern is displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Reverse	Blue with yellow light moving in back-to-front pattern		Yellow light moving in front-to-back pattern		OFF

4-18-3 Lateral Right

When the AMR moves laterally (sideways) to the right, the following light pattern is displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Lateral motion to the right	Pulsing blue light	Flashing yellow light	Pulsing blue light	Flashing yellow light	OFF

4-18-4 Lateral Left

When the AMR moves laterally (sideways) to the left, the following light pattern is displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Lateral motion to the left	Flashing yellow light	Pulsing blue light	Flashing yellow light	Pulsing blue light	OFF

4-18-5 Turning Right

In preparation for and during a right turn, the following light patterns are displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Right Turn	Flashing yellow light	Blue with yellow flashing light at the center	Flashing yellow light	Blue with yellow flashing light at the center	Blue with yellow light aligned with the direction of movement

4-18-6 Turning Left

In preparation for and during a left turn, the following light patterns are displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Left Turn	Blue with yellow flashing light at the center	Flashing yellow light	Blue with yellow flashing light at the center	Flashing yellow light	Blue with yellow light aligned with the direction of movement

4-18-7 Rotating in Place

When the AMR rotates, the following light pattern is displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Rotating	Blue with yellow light aligned with the direction of movement		Blue with yellow light aligned with the direction of movement		Blue with yellow light aligned with the direction of movement

4-18-8 Charging

When the AMR is charging its battery, the following light pattern is displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Charging	Green light moving in front-to-back pattern according to the current battery state of charge		Green light moving in front-to-back pattern according to the current battery state of charge		Flashing green light

4-18-9 Booting

When the AMR is booting, the following light pattern is displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Booting	Pulsing white light		Pulsing white light		Pulsing white light

4-18-10 Obstacle Detected / Protective Stop

When the AMR stops after detecting an obstacle in its safety zone, the following light pattern is displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Protective Stop	Flashing yellow light.		Flashing yellow light		Flashing yellow light

4-18-11 Stopped with Warning or Fault

When the AMR is stopped with a warning or a fault, the following light pattern is displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Warning / Fault	Pulsing dark orange light		Pulsing dark orange light		Pulsing dark orange light

4-18-12 Emergency Stop

When the AMR is in an emergency stop state, the following light pattern is displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Emergency Stop / Rear Bumper Stop	Flashing red light		Flashing red light		Flashing red light

4-18-13 Lost

When the AMR is lost, the following light pattern is displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Lost	Repeated cyclical pattern of orange light		Repeated cyclical pattern of orange light		Repeated cyclical pattern of orange light

4-18-14 Idle

When the AMR is in idle state, the following light pattern is displayed.

Movement	Front Light Strips		Rear Light Strips		LED Signal Lamp
	Left	Right	Left	Right	
Idle	Pulsing blue light		Pulsing blue light		Pulsing blue light

4-19 Warning Buzzer

The AMR has a warning buzzer that provides an audible alert during certain operating conditions.

⚠ CAUTION

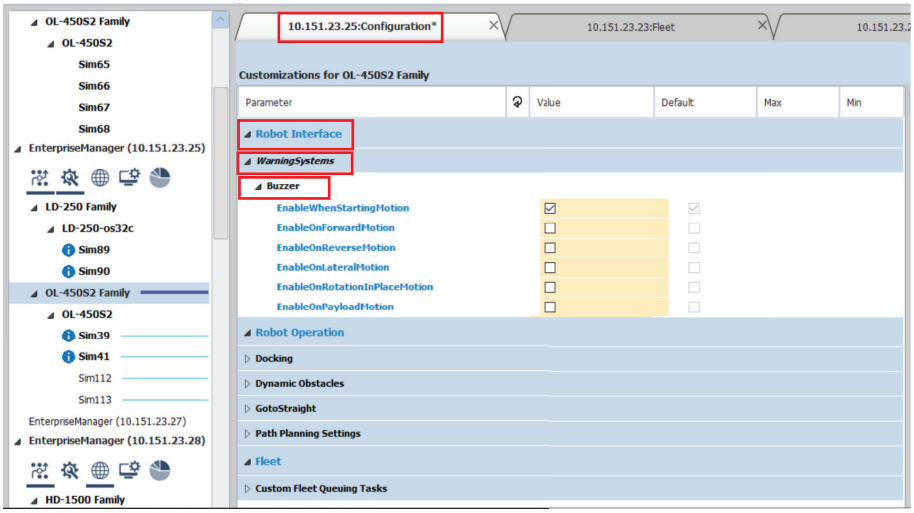
Changing warning buzzer parameter values might make the AMR unsafe and affect its compliance to safety standards. Refer to the applicable safety standards for your locale before you change any parameter values.

The warning buzzer must be audible above the ambient noise of the operating environment.

The default settings for the warning buzzer are provided below.

- The warning buzzer is active for 2 seconds prior to starting motion any time the AMR has stopped moving for at least 10 seconds. This includes the first motion after start-up.
- The warning buzzer is active for 2 seconds when an emergency stop or a protective stop from hardware-based safety zones is triggered.

To make warning buzzer parameter changes, in MobilePlanner access *Robot Interface* in the Configuration tab and under *Warning Systems*, click the *Buzzer* tab.



4-20 Safety Scanner Zones

The AMR's Front Safety Scanners are pre-programmed with several default safety zones associated with the shape and dynamics of the standard system. The safety zones adjust their detection range and shape automatically as the AMR drives forward, sideways, or turns in place.

⚠ CAUTION

OMRON is not responsible for any risks incurred by modifying safety zone sizes or other Front Safety Scanner settings.



Additional Information

Software-based obstacle protection is used regardless of the AMR speed.

4-20-1 Safety Zone Pairs

Each Front Safety Scanner has several individually configurable safety zones. Each Front Safety Scanner scans a 275° field of view. Both Front Safety Scanners can provide near-full coverage of the area around the AMR, except the small area in the rear of the Safety Bumper. When the Front Safety Scanners are working together to provide coverage, a safety zone pair is in use.
There are a total of 29 safety zone pairs for the default configuration. These safety zone pairs are associated with the following operating states of the AMR.

- Driving forward (straight or in an arc).
- Driving sideways.
- Rotating in place.



Additional Information

Safety zone pairs were designed for AMR operation with the maximum payload on a floor with a coefficient of friction specified in *2-4-1 AMR Environmental Specifications* on page 2-12.

Safety Zone Pair Operational Details

The operational details of safety zone pairs are described below.



Additional Information

Speeds provided for safety zone pairs are accurate to within ± 30 mm/s.

Safety Zone Pair(s)	Operational Conditions
1 to 14	Enabled when the AMR is driving forward (straight or in an arc). Refer to *Driving Forward or in an Arc* on page 4-49 for more information.
14 to 28	Enabled when the AMR is driving laterally (sideways). Refer to *Driving Laterally* on page 4-63 for more information.

Safety Zone Pair(s)	Operational Conditions
29	Enabled when the AMR is rotating. Refer to *Rotating in Place* on page 4-77 for more information.

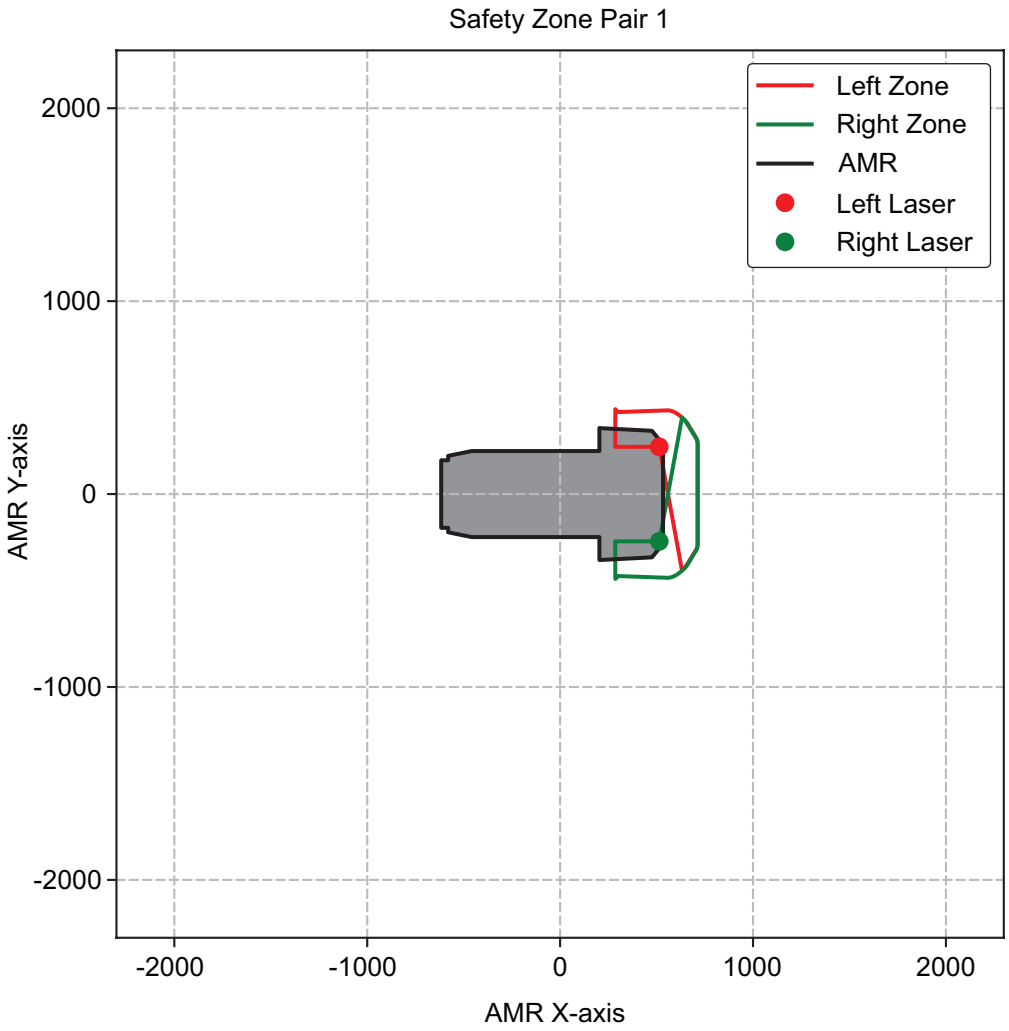
Additional Information

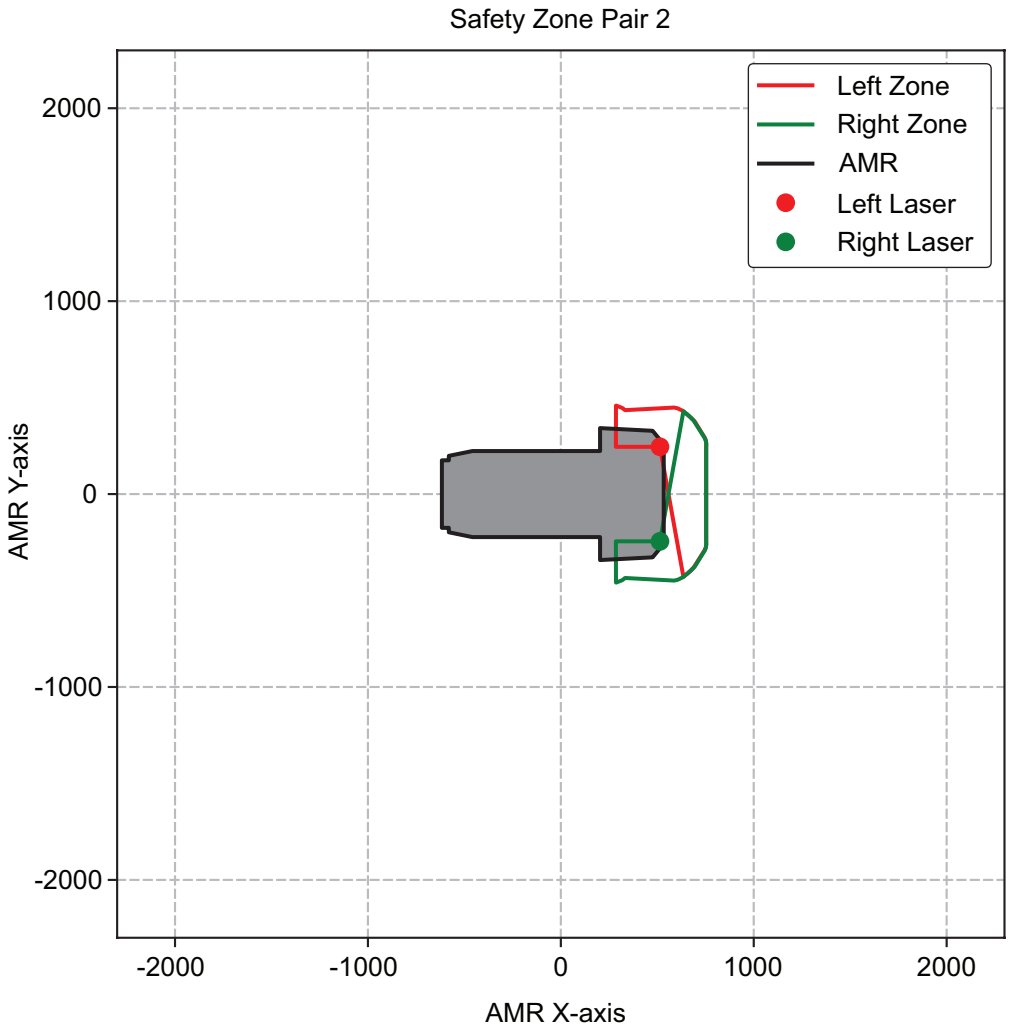
The following functionalities are not supported for the OL-series AMR.
- Switching the AMR footprint for varying payload sizes.
- Creating alternate (custom) safety scanner zone pairs using the zone generation tool.

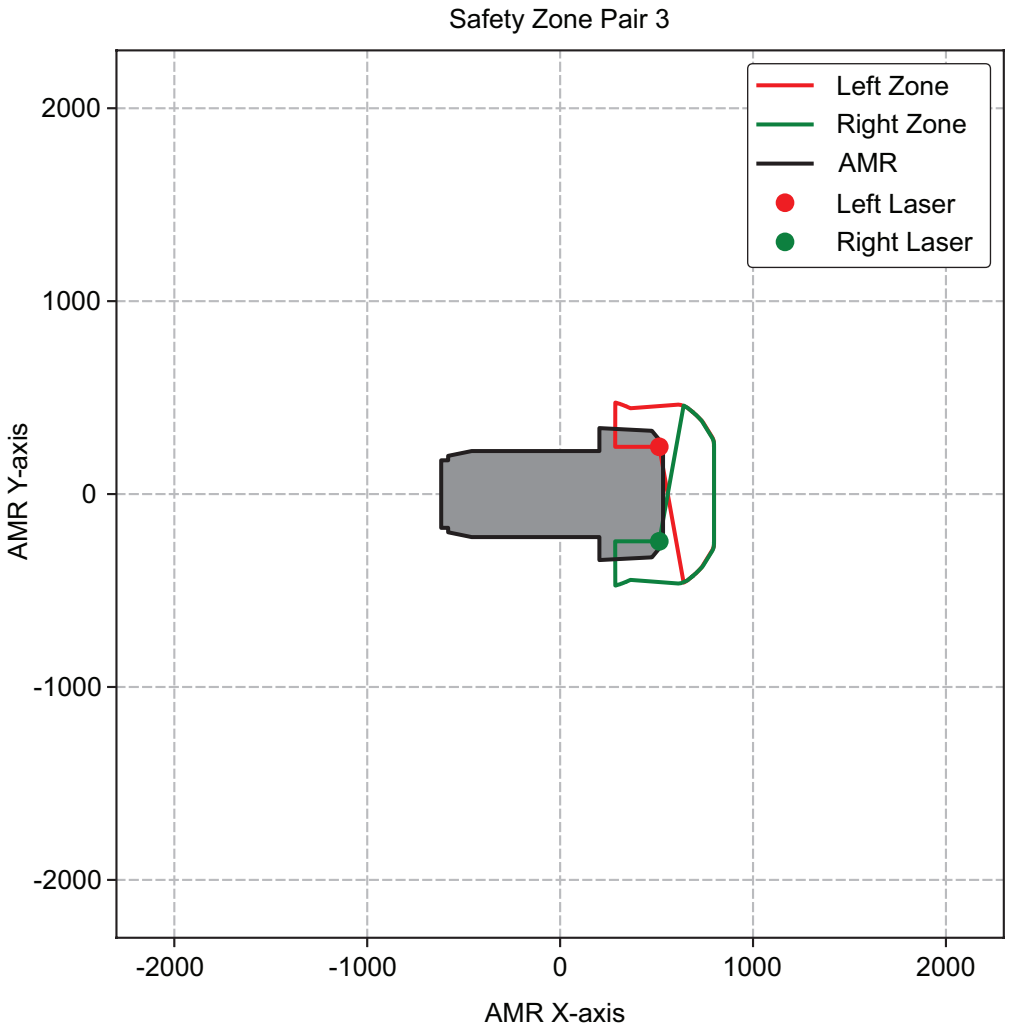
● Driving Forward or in an Arc

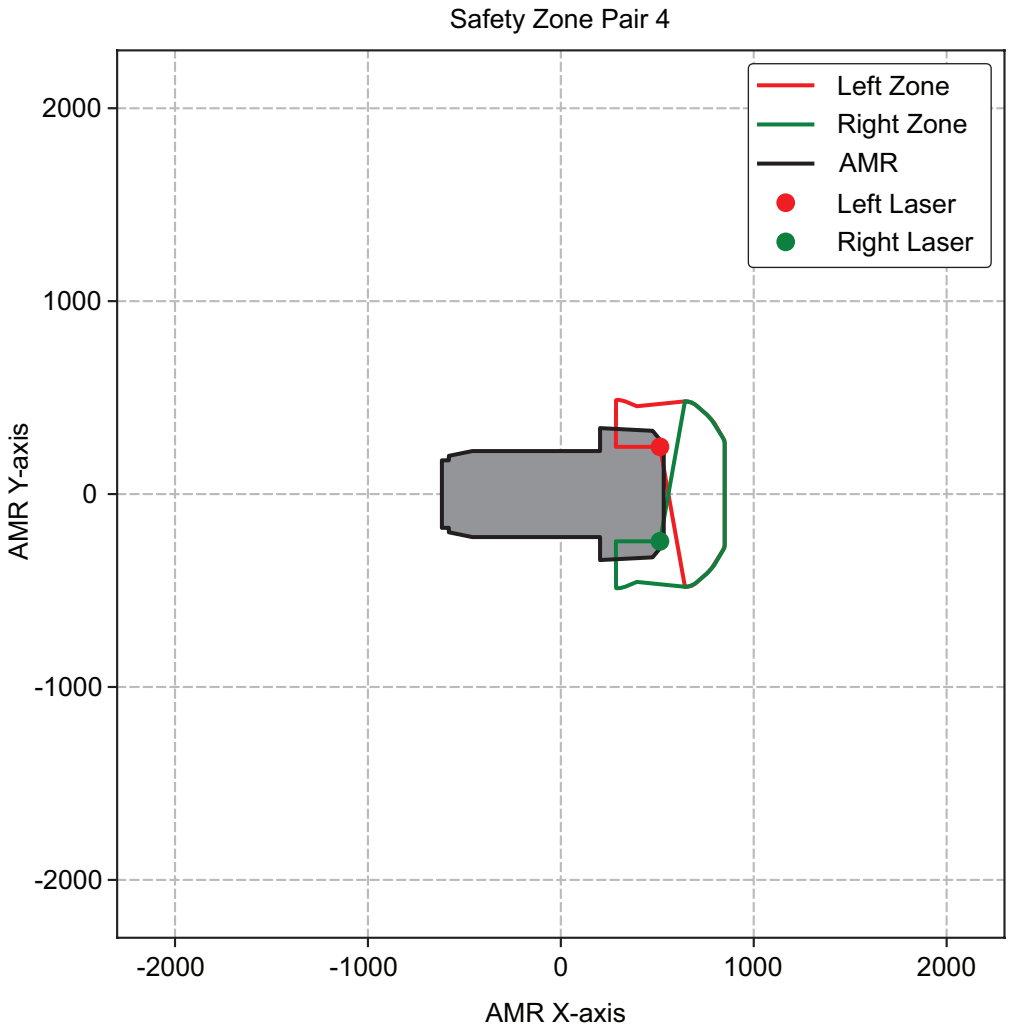
Safety zone pairs 1 to 14 are used when the AMR is driving straight forward or in an arc with the following speeds.

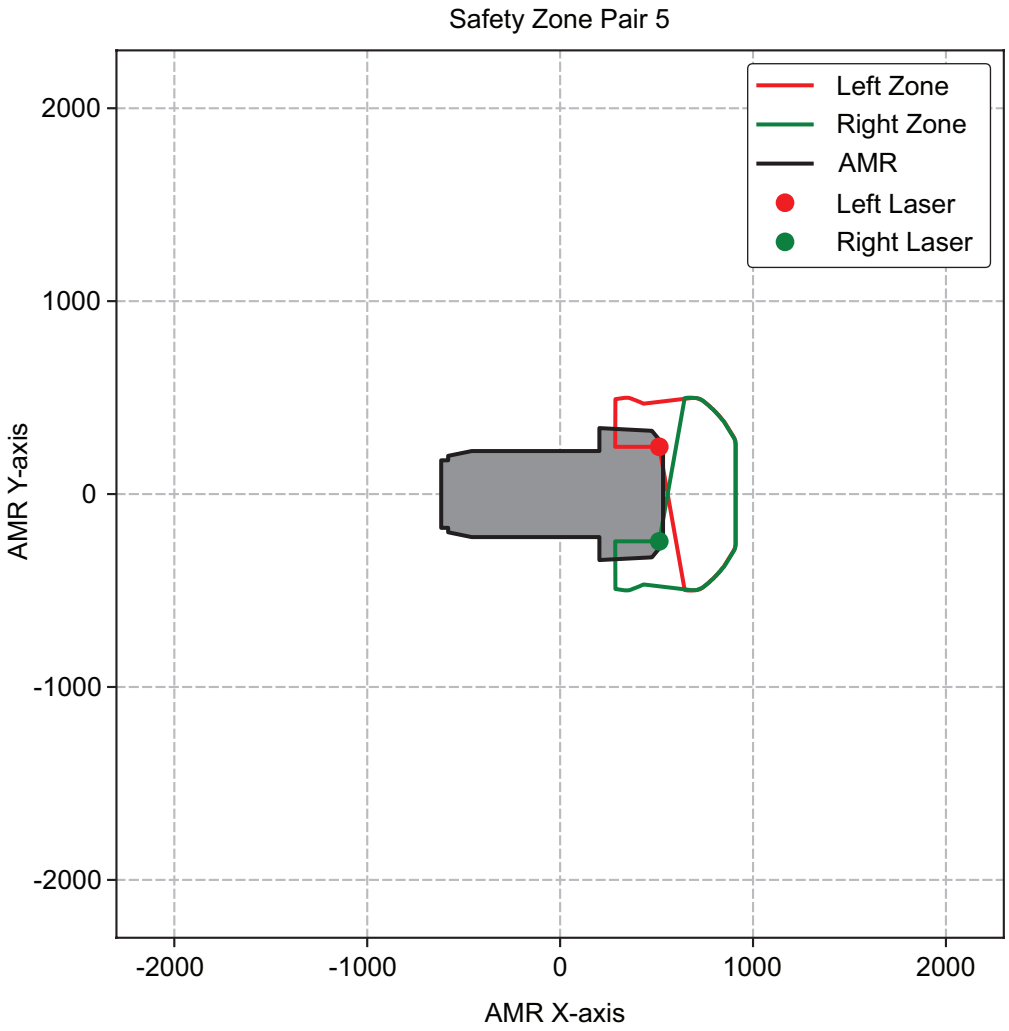
Safety Zone Pair	Max. Speed (m/s)	Safety Zone Length (m)	Braking Distance (m)	Stopping Distance from Object (m)
1	0.14	0.124	0.045	0.079
2	0.21	0.165	0.075	0.090
3	0.31	0.209	0.126	0.083
4	0.42	0.262	0.193	0.069
5	0.48	0.321	0.235	0.086
6	0.56	0.389	0.297	0.092
7	0.64	0.466	0.365	0.101
8	0.75	0.549	0.469	0.080
9	0.81	0.642	0.531	0.111
10	0.88	0.74	0.607	0.133
11	0.98	0.847	0.725	0.122
12	1.07	0.961	0.840	0.121
13	1.14	1.085	0.935	0.150
14	1.2	1.215	1.020	0.195

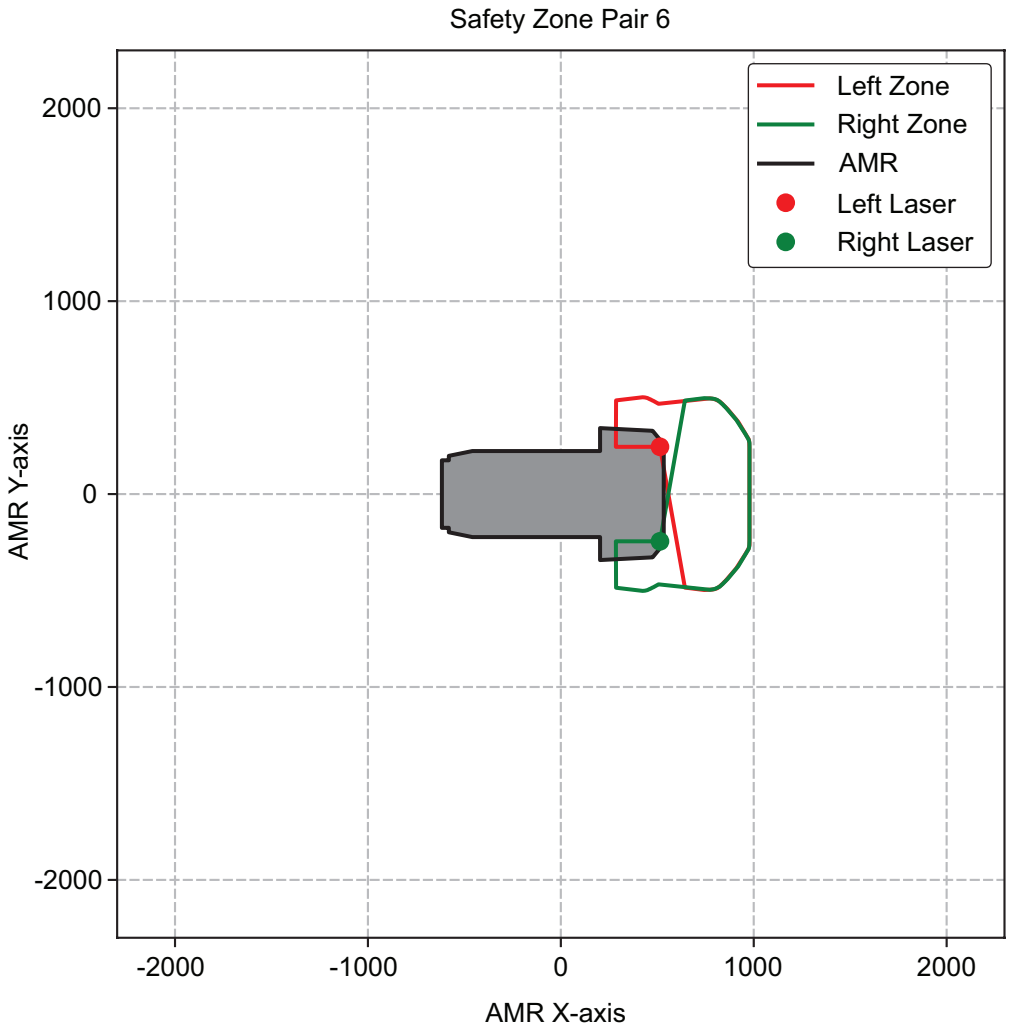

Safety Zone Pair 1
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

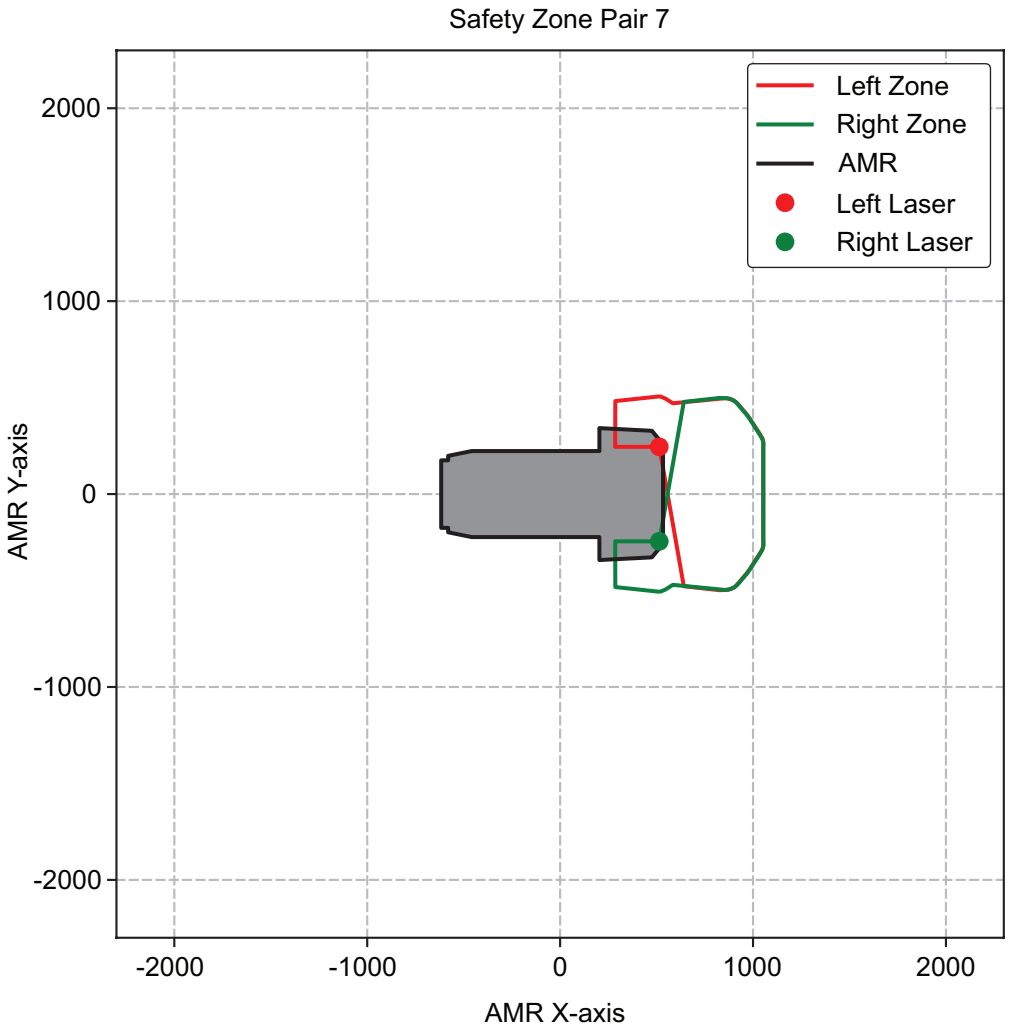

Safety Zone Pair 2
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

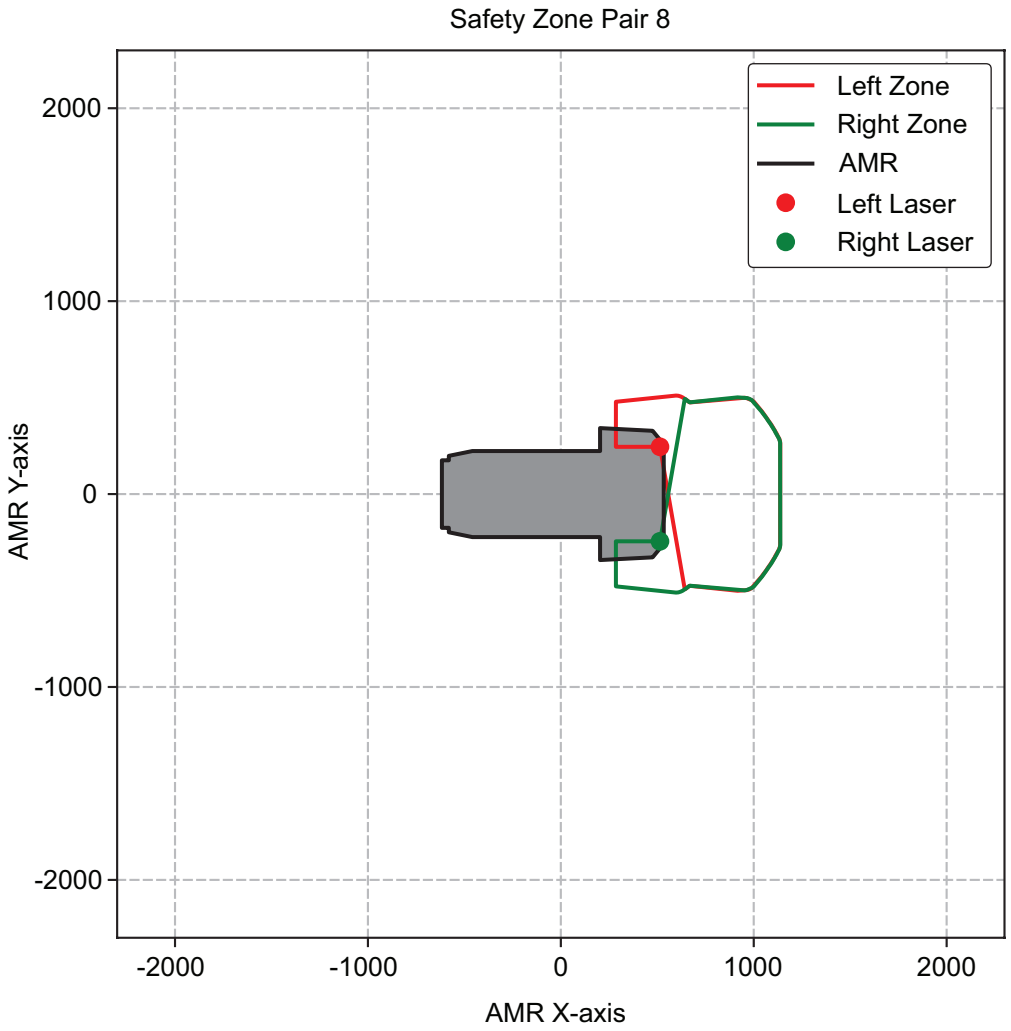

Safety Zone Pair 3
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

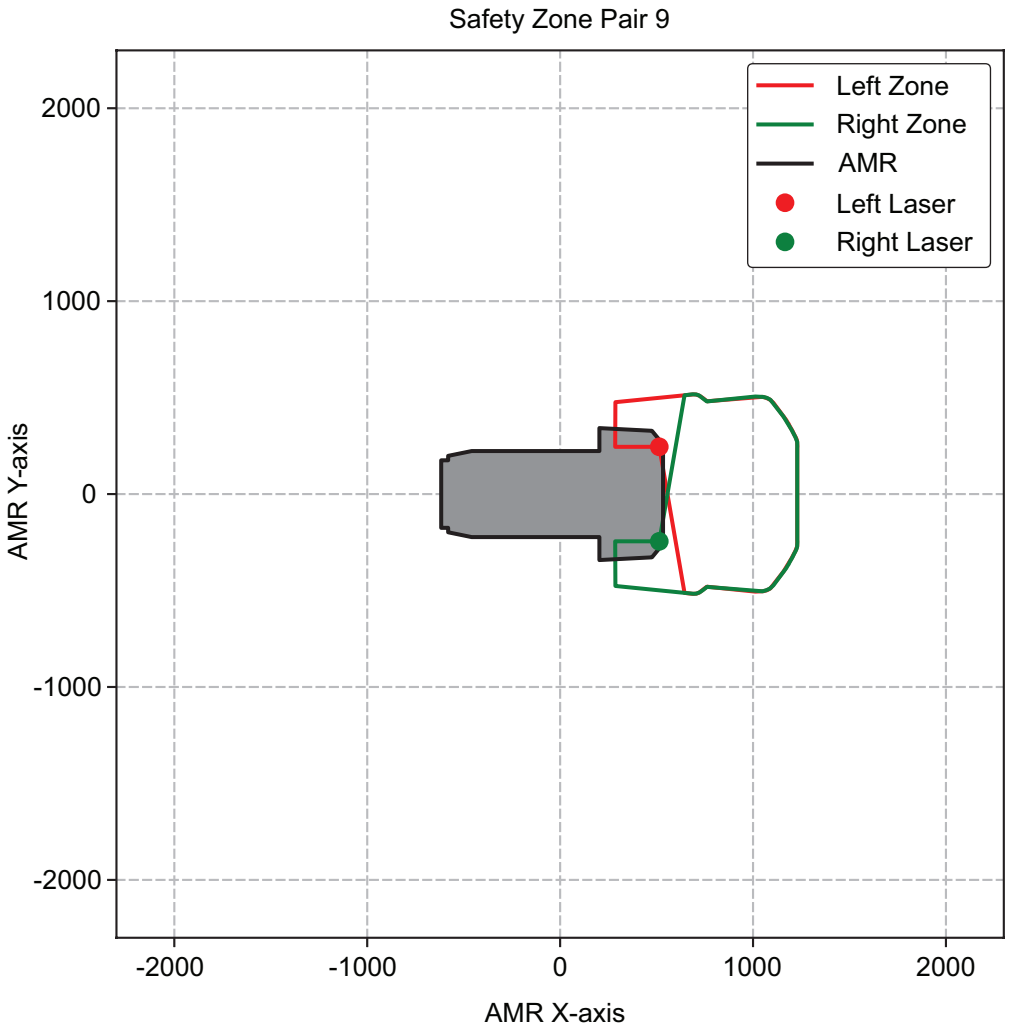

Safety Zone Pair 4
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

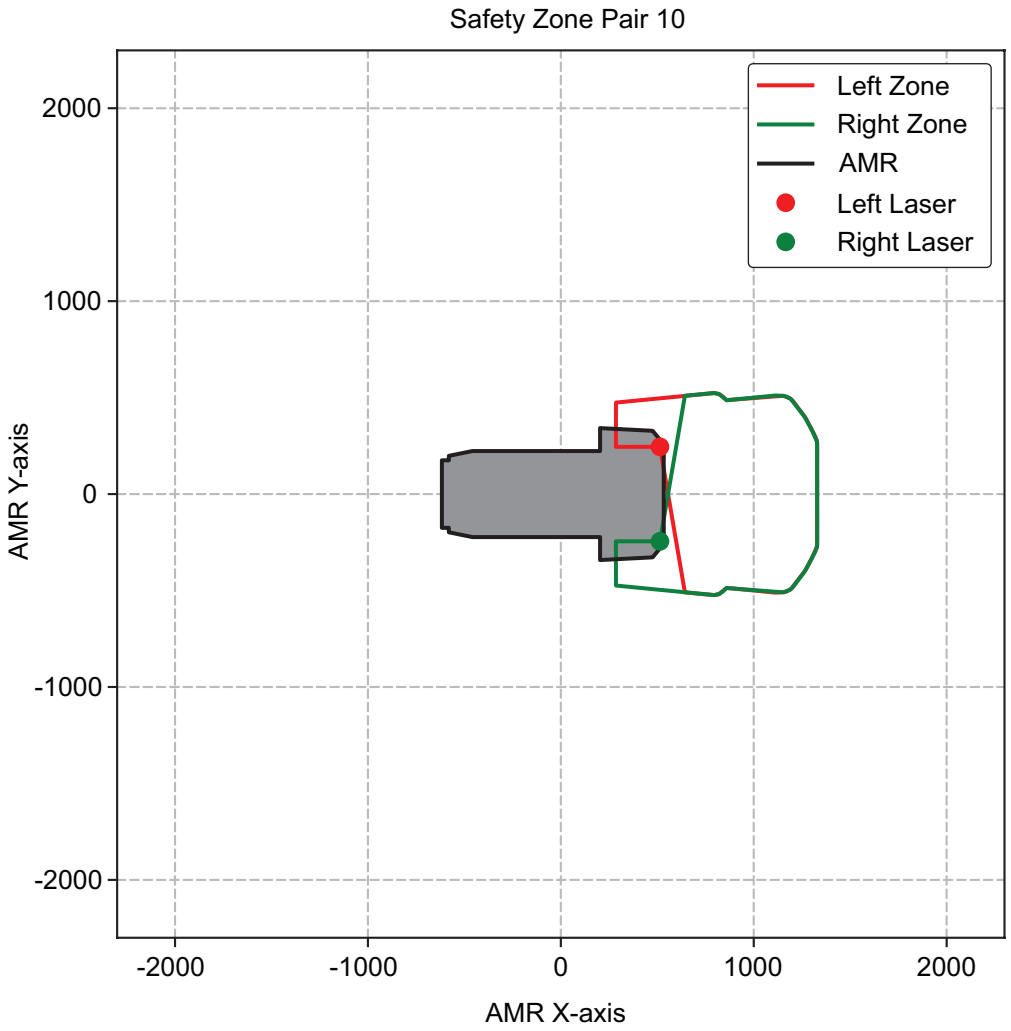

Safety Zone Pair 5
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

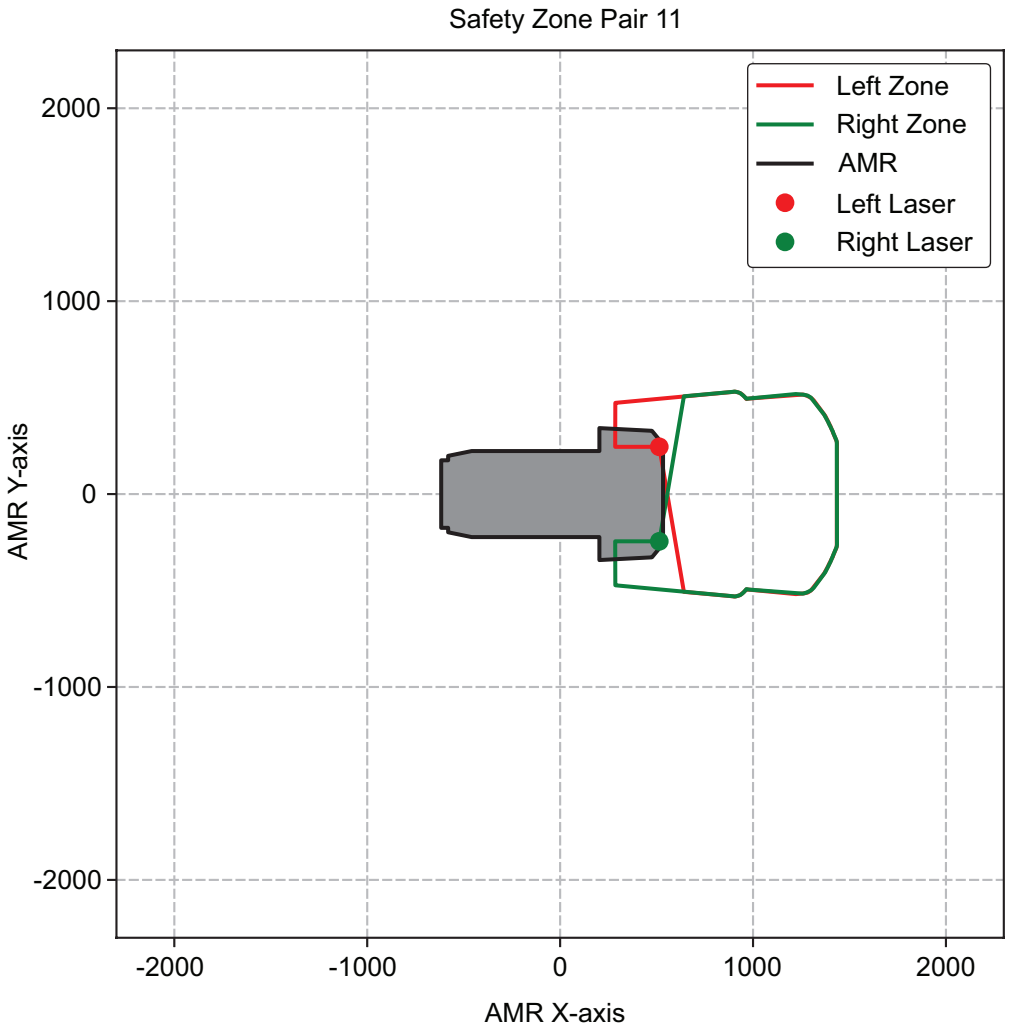

Safety Zone Pair 6
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

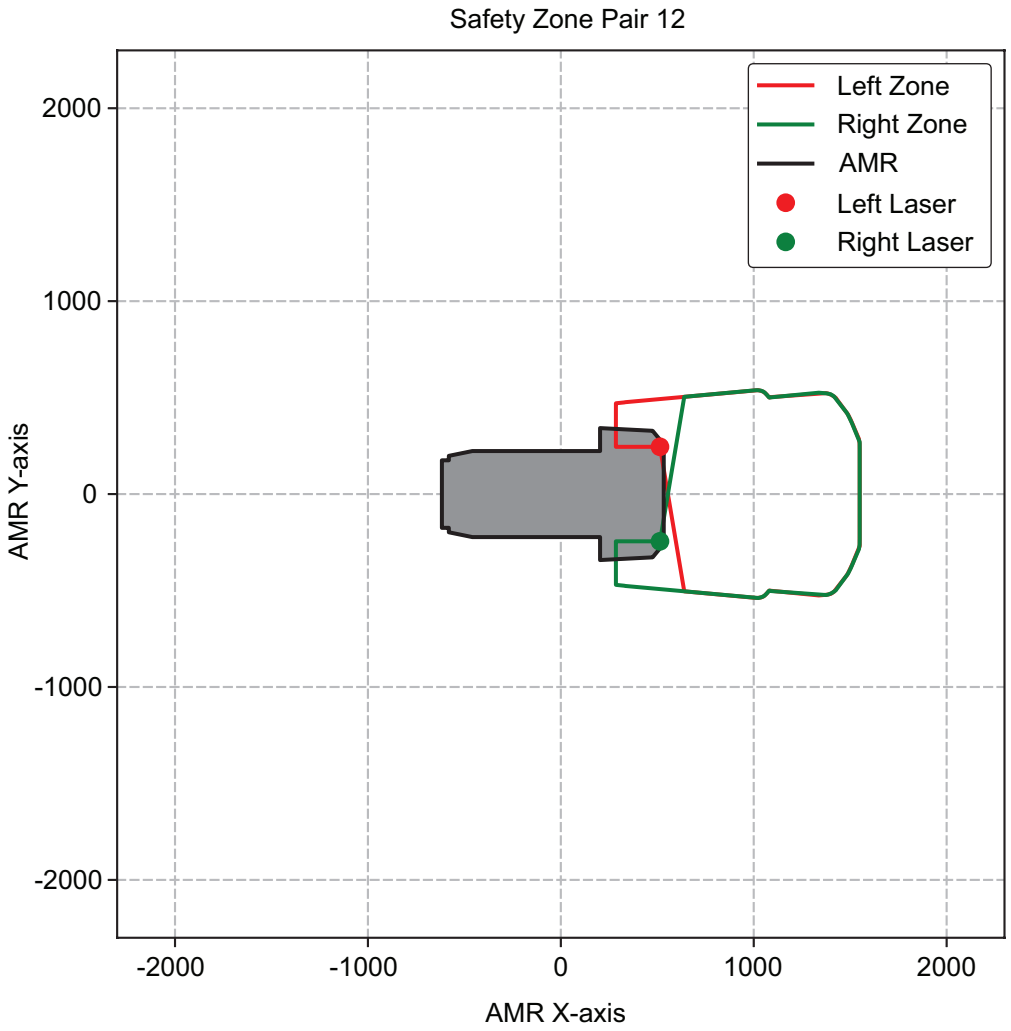

Safety Zone Pair 7
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

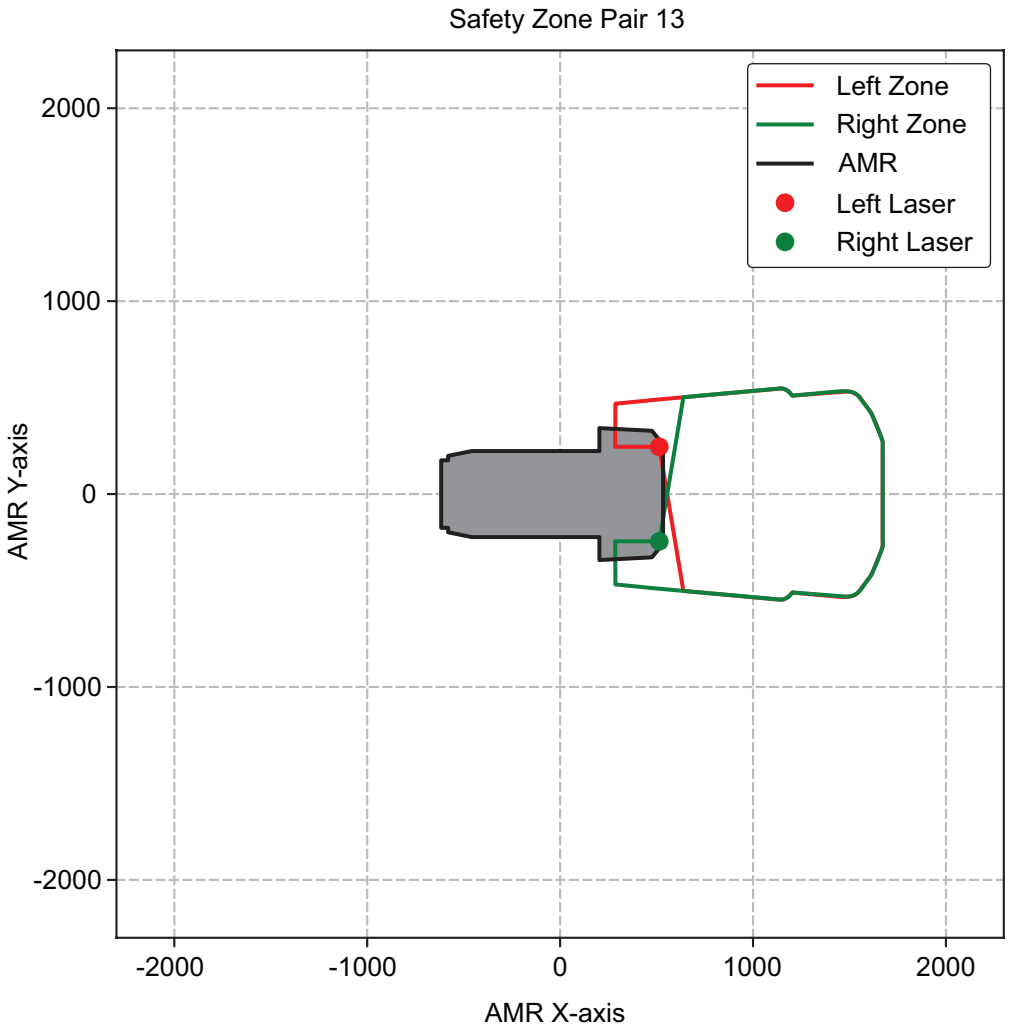

Safety Zone Pair 8
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

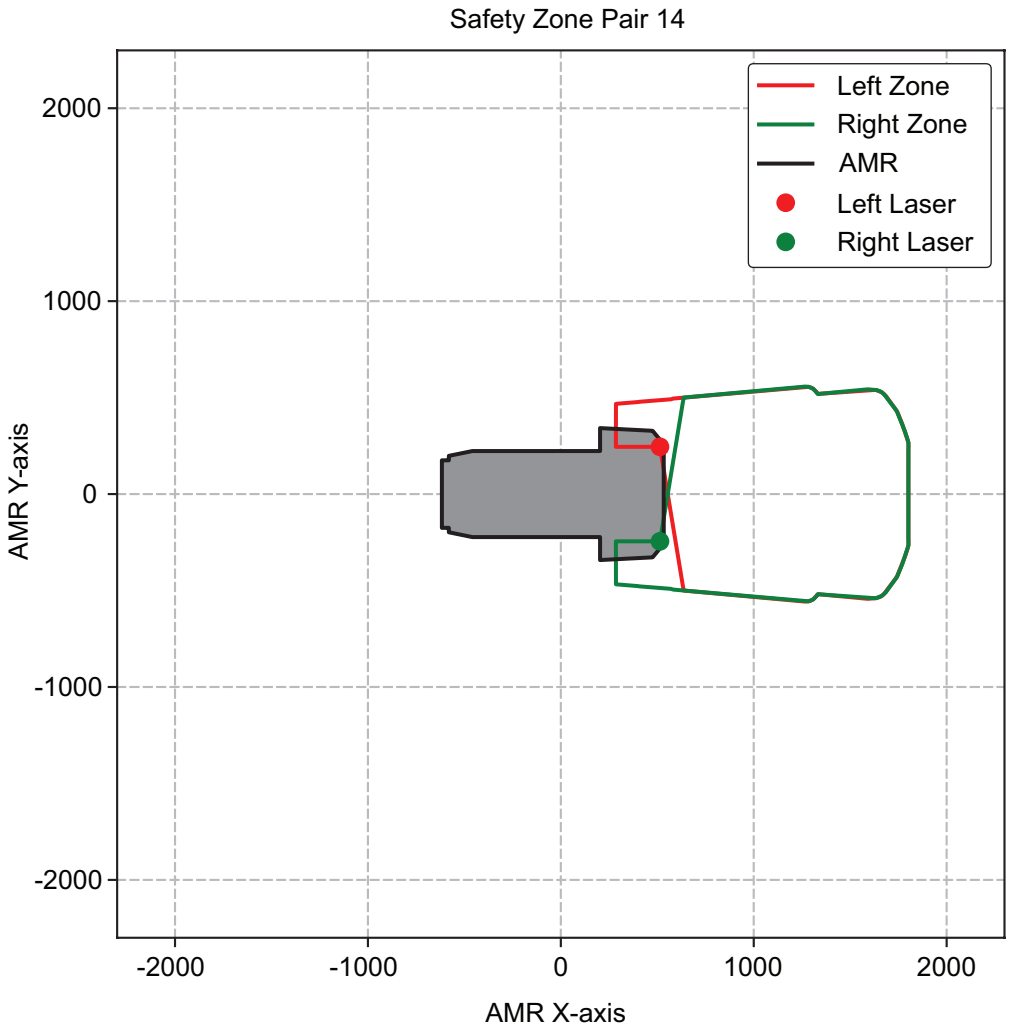

Safety Zone Pair 9
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis


Safety Zone Pair 10
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis


Safety Zone Pair 11
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis


Safety Zone Pair 12
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

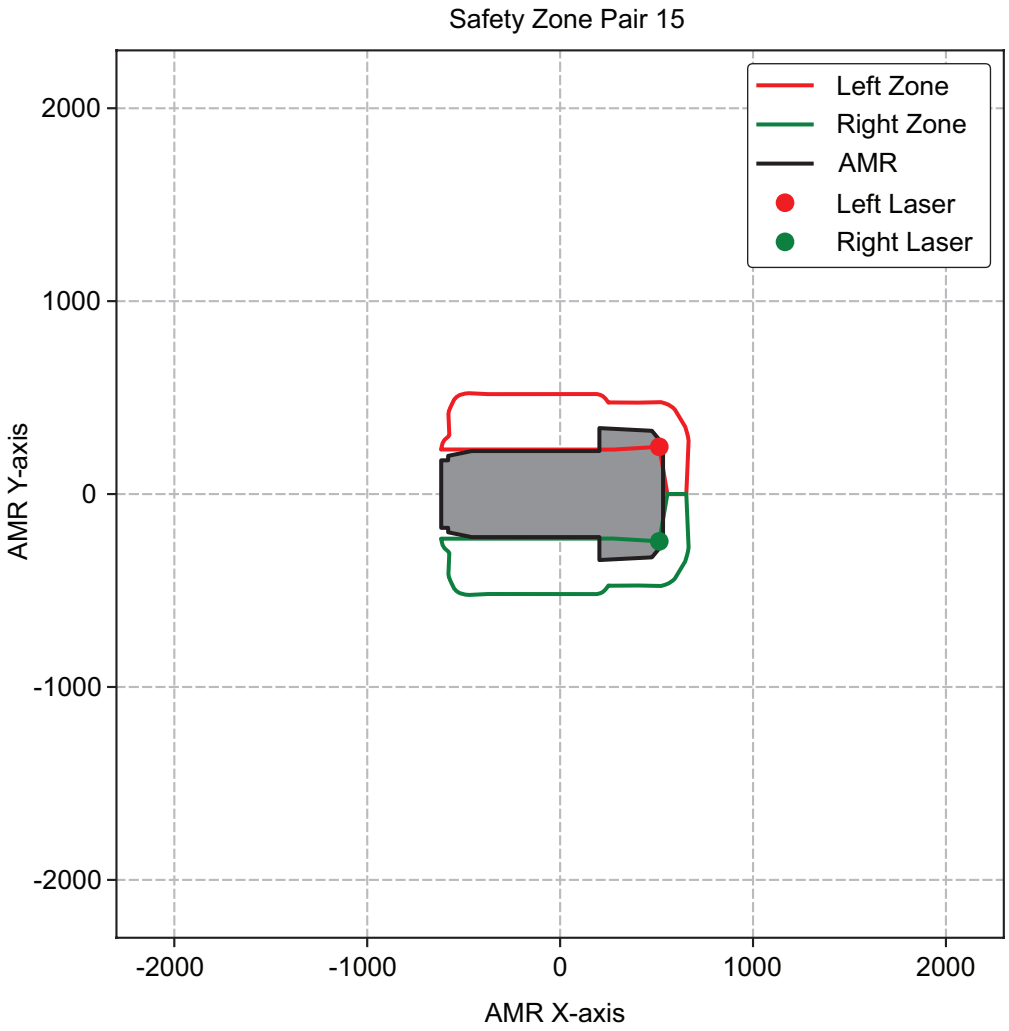

Safety Zone Pair 13
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

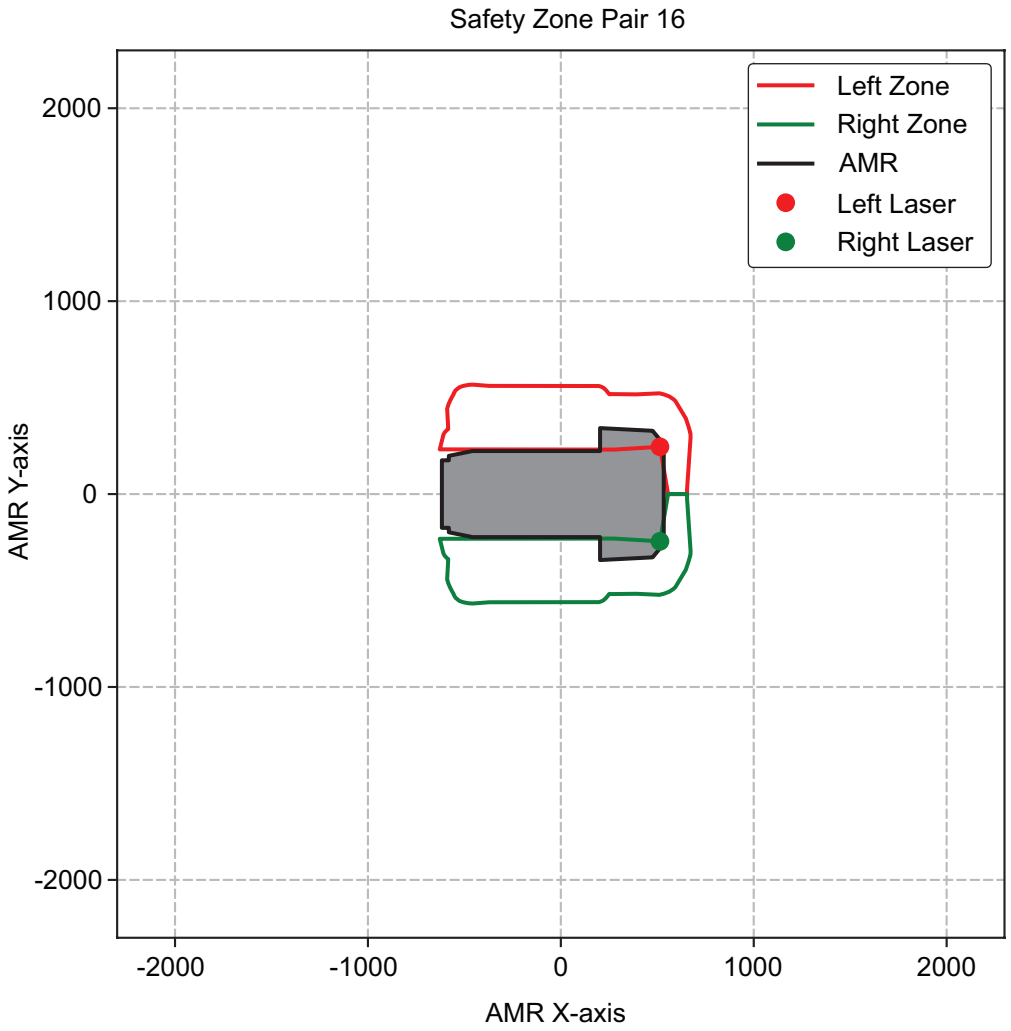


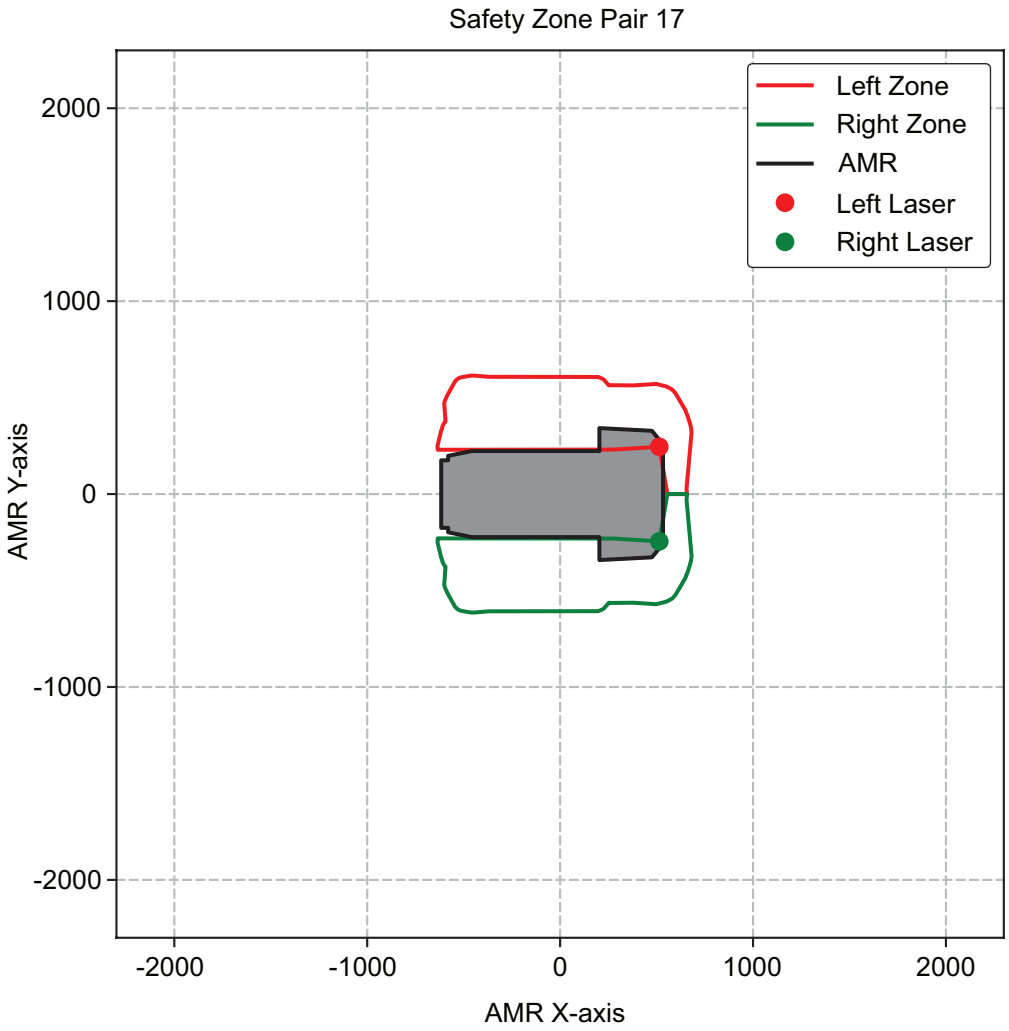
● Driving Laterally

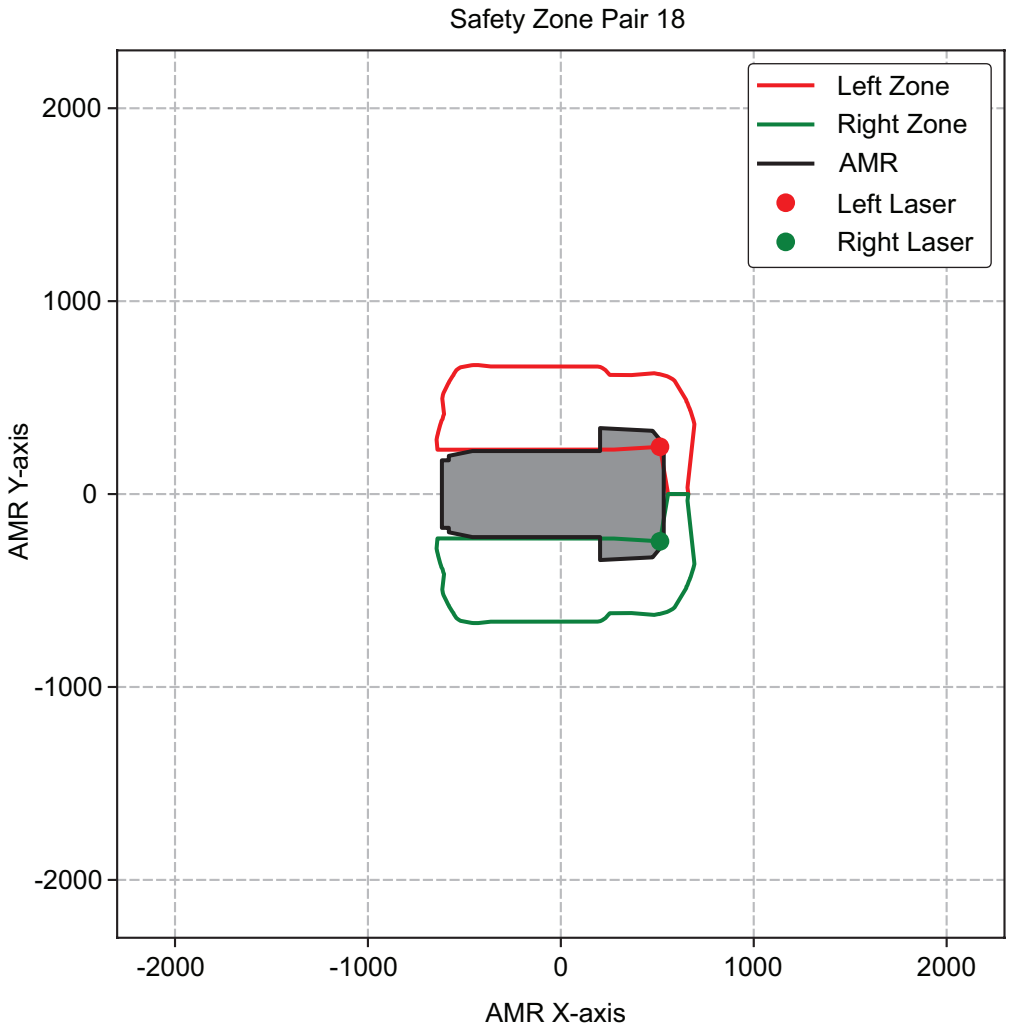
Safety zone pairs 15 to 28 are used when the AMR is driving laterally with the following speeds.

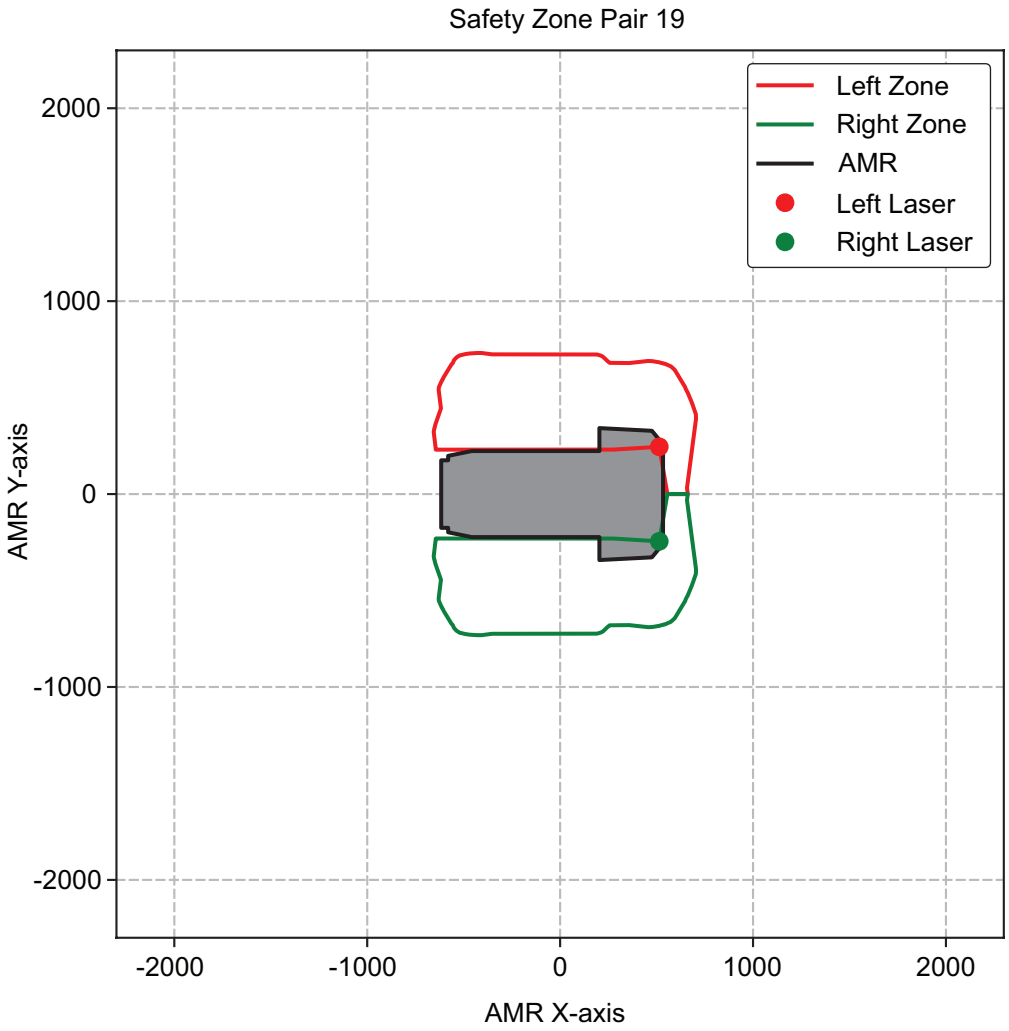
Safety Zone Pair	Max. Speed (m/s)	Safety Zone Length (m)	Braking Distance (m)	Stopping Distance from Object (m)
15	0.14	0.13	0.045	0.085
16	0.22	0.173	0.079	0.094
17	0.31	0.219	0.126	0.093
18	0.43	0.272	0.200	0.072
19	0.48	0.335	0.235	0.100
20	0.57	0.406	0.305	0.101
21	0.68	0.485	0.401	0.084
22	0.75	0.573	0.469	0.104
23	0.84	0.668	0.563	0.105
24	0.92	0.772	0.653	0.119
25	1.02	0.884	0.775	0.109
26	1.11	1.004	0.894	0.110
27	1.18	1.132	0.991	0.141
28	1.2	1.268	1.020	0.248

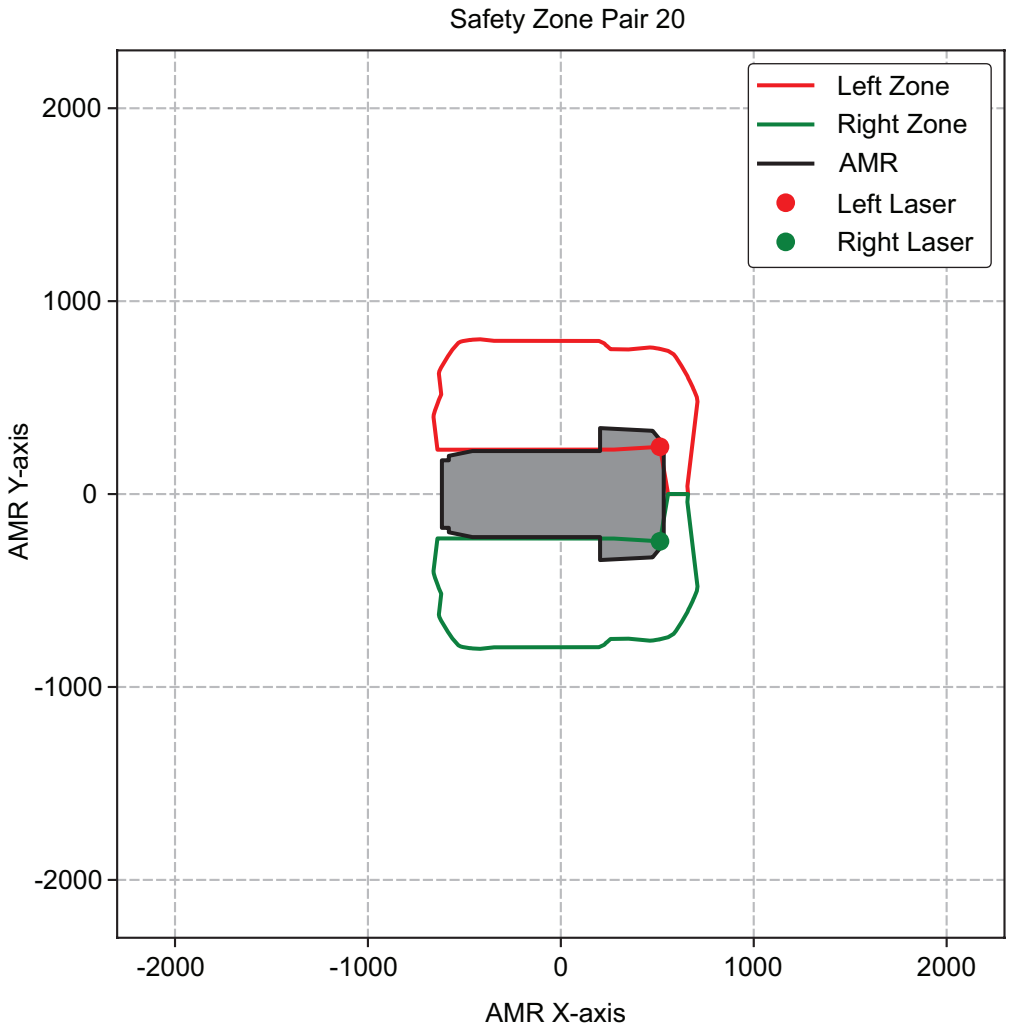

Safety Zone Pair 15
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

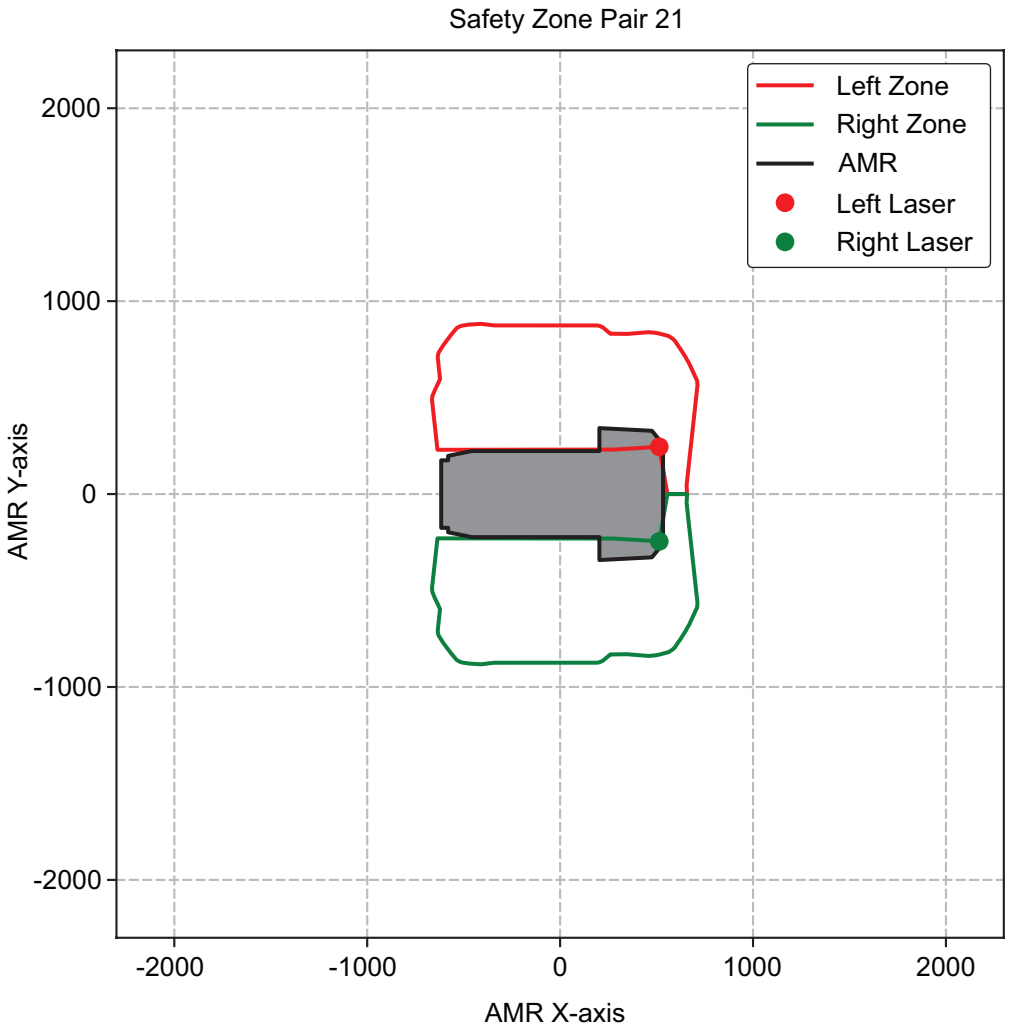

Safety Zone Pair 16
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

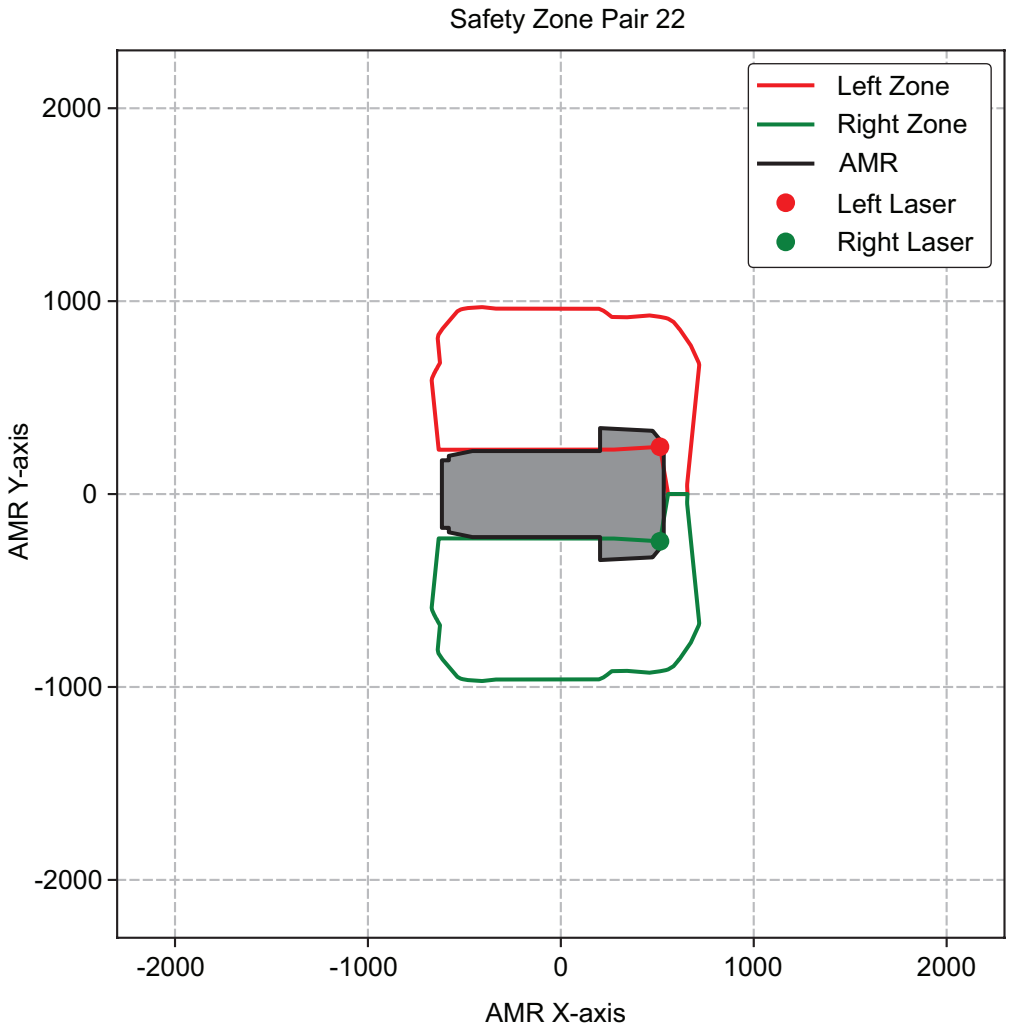

Safety Zone Pair 17
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis


Safety Zone Pair 18
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

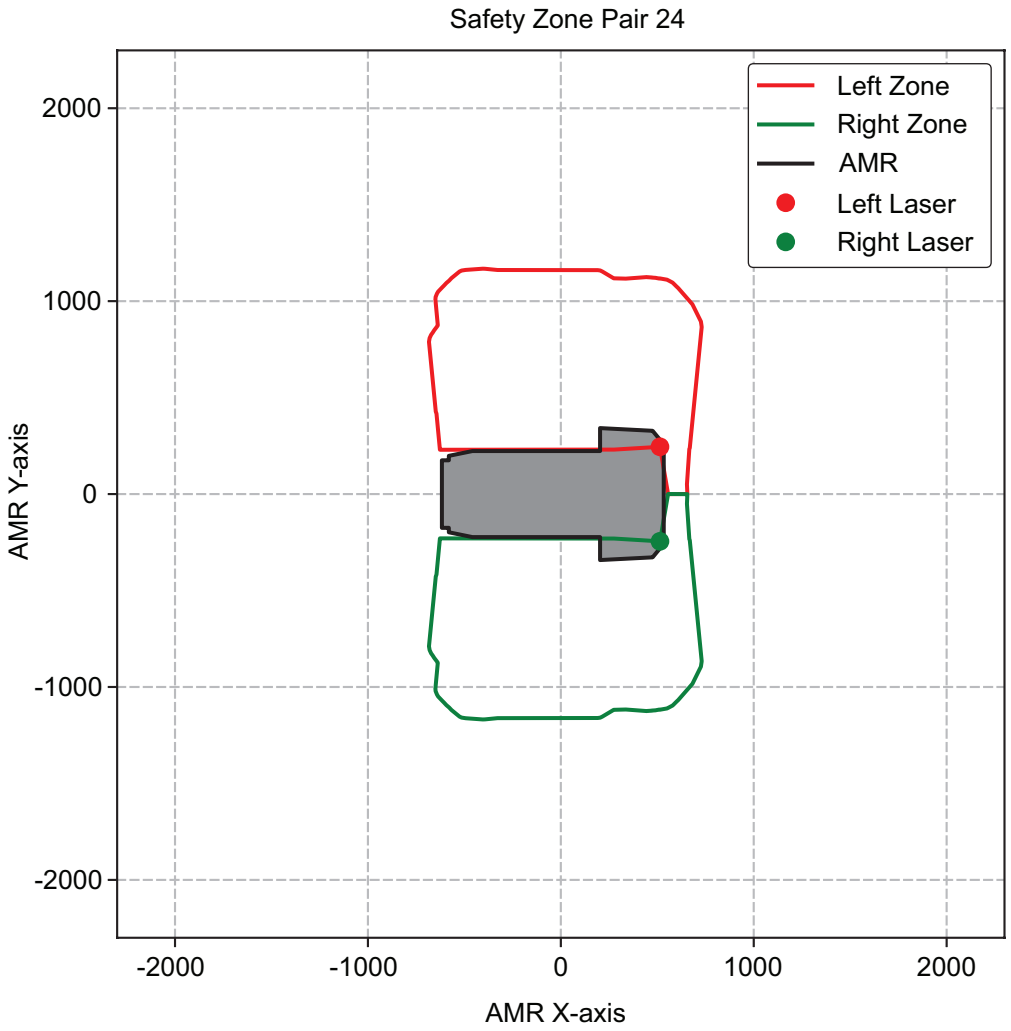

Safety Zone Pair 19
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

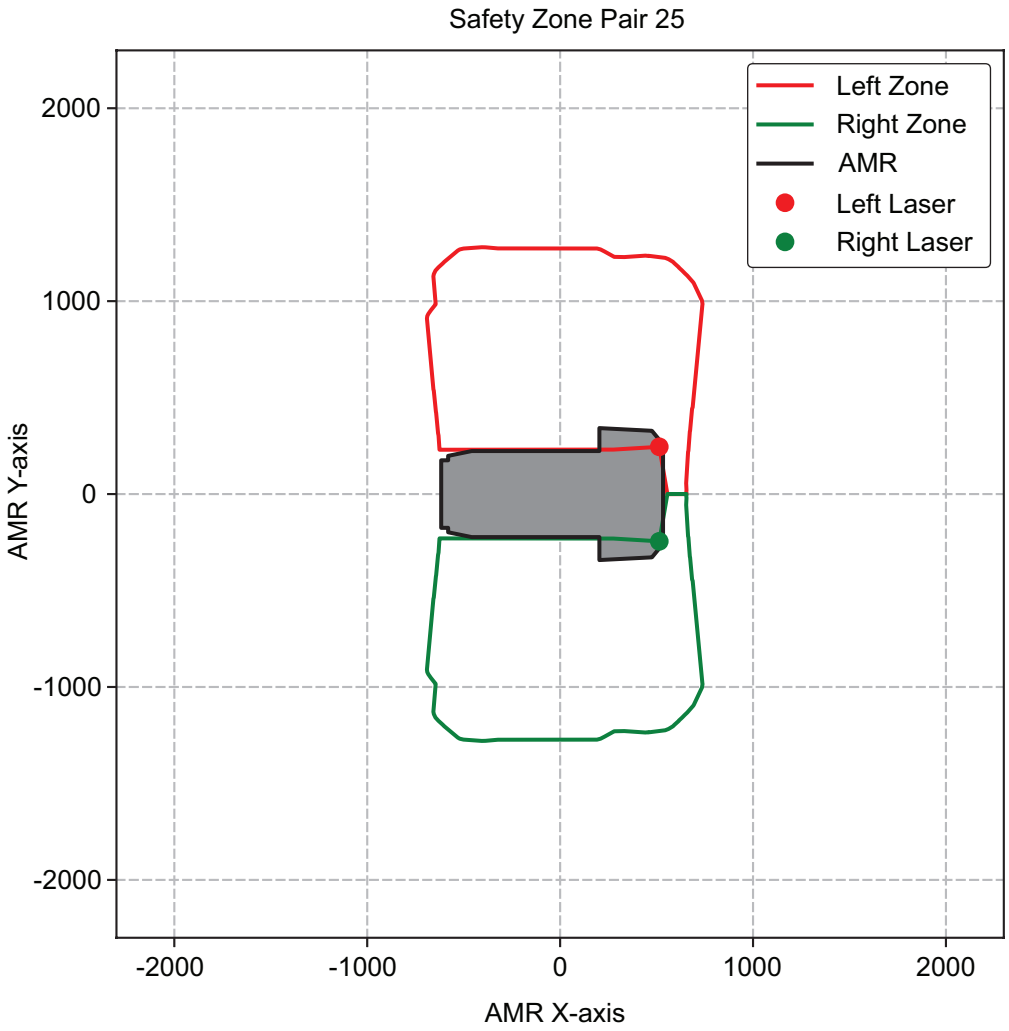

Safety Zone Pair 20
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

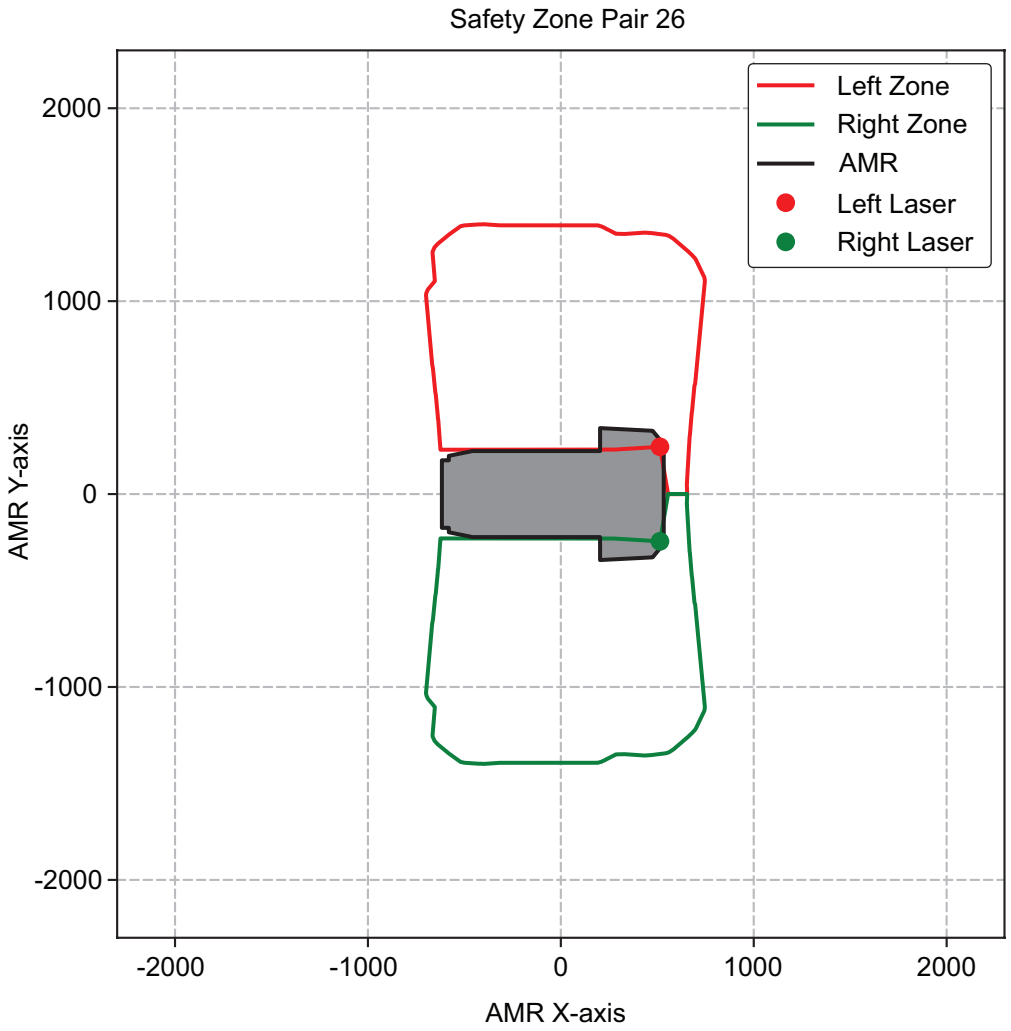

Safety Zone Pair 21
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

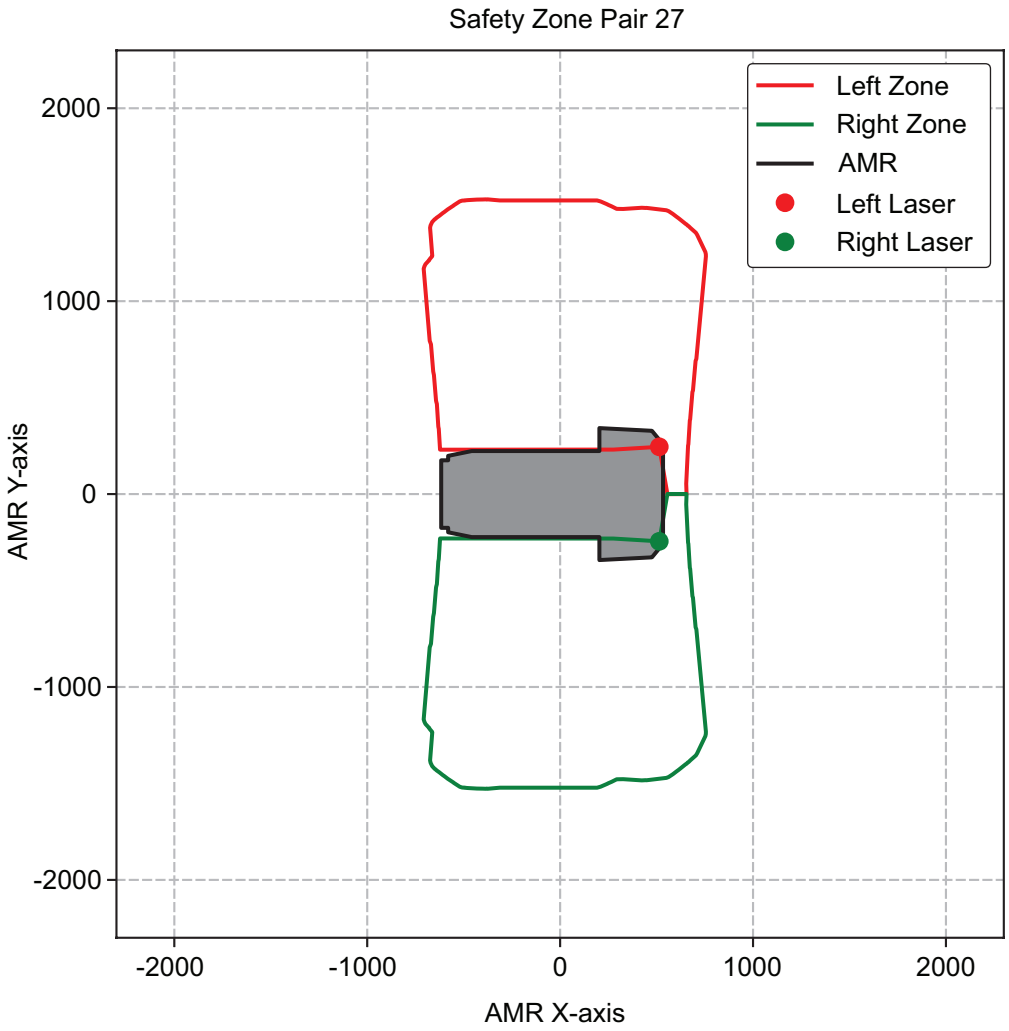

Safety Zone Pair 22
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

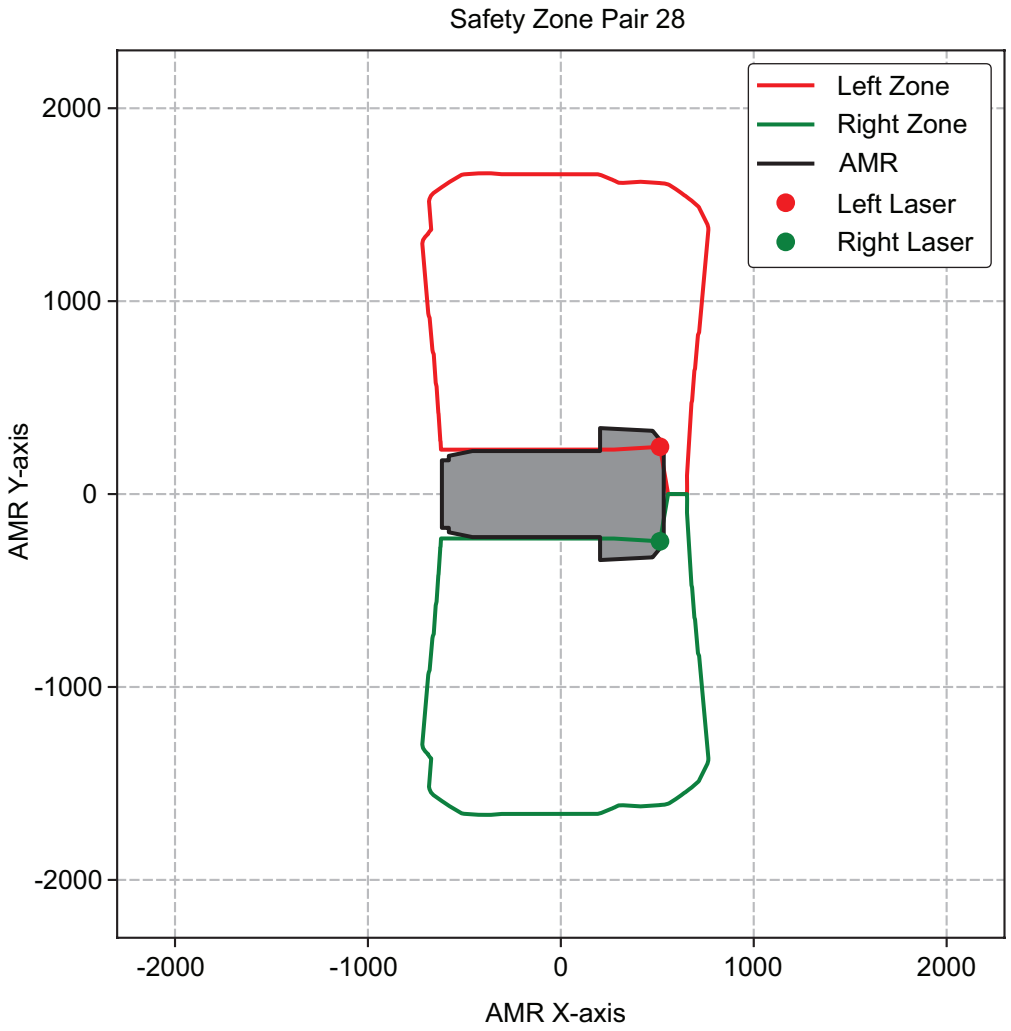

Safety Zone Pair 23
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis


Safety Zone Pair 24
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis


Safety Zone Pair 25
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis


Safety Zone Pair 26
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

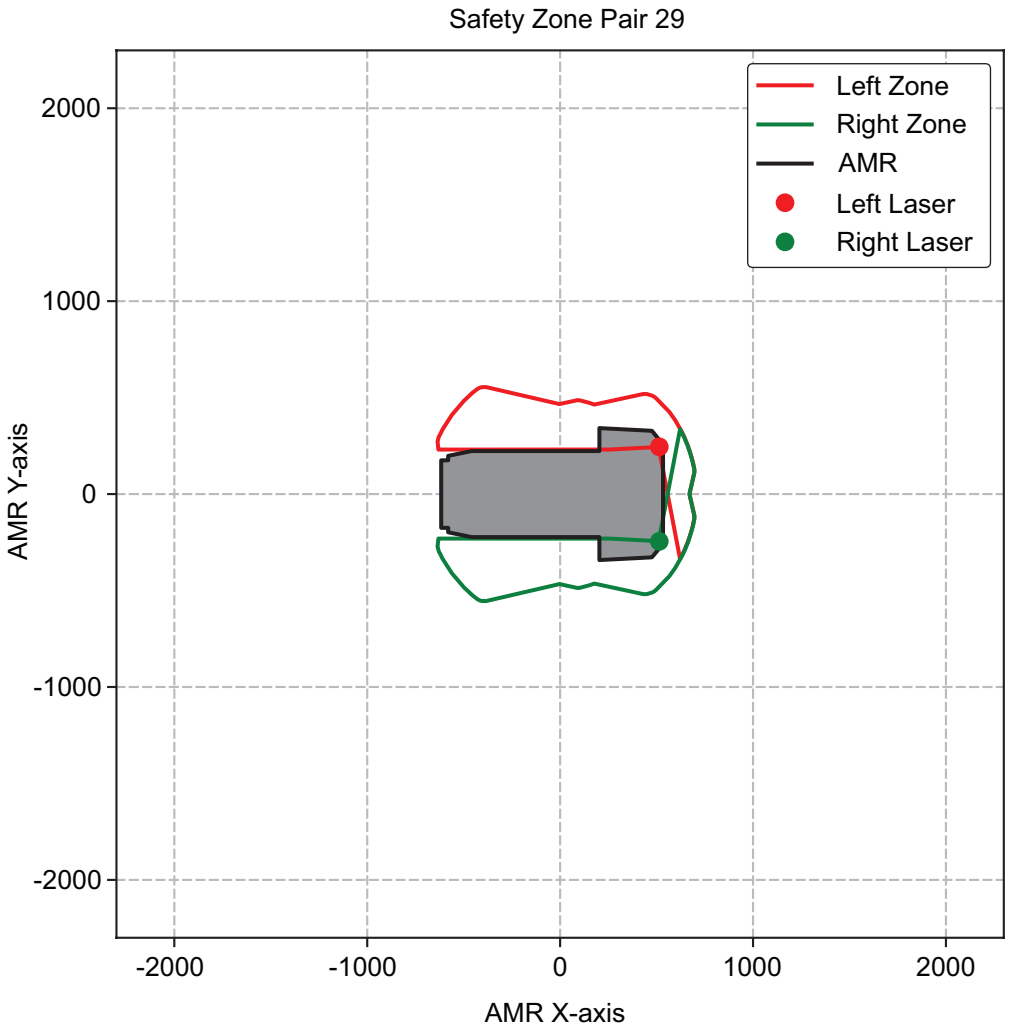

Safety Zone Pair 27
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis



● Rotating in Place

Safety zone pair 29 is used when the AMR rotates in place.

Safety Zone Pair	Max. Speed (deg/s)	Safety Zone Length (m)	Braking Distance (m)	Stopping Distance from Object (m)
29	45	0.228	0.146	0.082


Safety Zone Pair 29
Left Zone
Right Zone
AMR
Left Laser
Right Laser
2000
1000
0
-1000
-2000
AMR Y-axis
-2000
-1000
0
1000
2000
AMR X-axis

4-21 Motion Limits

An AMR has default limits on its maximum linear and rotational acceleration, deceleration, and speed for safety purposes. Changing these limits might affect the AMR's stability, depending on the center of gravity of the combined AMR and its payload.

⚠ WARNING

While it is possible to generally reduce AMR deceleration settings for normal operation, the maximum deceleration used in the case of emergency stops, or stops due to Front Safety Scanner intrusions cannot be lowered below 2000 mm/s^2. It is your responsibility to ensure that the AMR and its load will remain stable in your operating environment at all times, including during an emergency stop.



Additional Information

Use the configuration area in MobilePlanner to make parameter changes. Refer to *MobilePlanner Integrated Help* for more information.

The *Absolute Motion Limits* parameter limits and defaults are provided below. Adjusting acceleration and deceleration parameters will have a significant impact on AMR motion.

Parameter	Default	Minimum	Maximum
MaxForwardSpeed (mm/s)	1200	1	1200
MaxReverseSpeed (mm/s)	-250	-300	-20
MaxLinearAcceleration (mm/s^2)	500	1	750
MaxLinearDeceleration (mm/s^2)	500	1	750
MaxRotationalSpeed (deg/s)	45	1	65
MaxRotationalAcceleration (deg/s^2)	100	1	150
MaxRotationalDeceleration (deg/s^2)	100	1	150
MaxLateralSpeed (mm/s)	750	1	1200
MaxLateralAcceleration (mm/s^2)	500	1	1000
MaxLateralDeceleration (mm/s^2)	500	1	1000
MaxCorneringAcceleration (mm/s^2)	300	10	800

4-22 Back up and Restore the AMR

The following sections provide information about backing up and restoring the AMR.
The AMR configuration may need to be restored from a backup file under special circumstances, such as if the AMR PC has been replaced or if an AMR needs to be re-purposed with a different configuration.
You can back up and restore an AMR's configuration with one of the following methods:

- Create a restore-point and revert to this configuration later.
  Refer to *Create a Restore-Point* on page 4-80 and *Revert to a Restore-Point* on page 4-83 for more information.
- Save MobilePlanner AMR configuration settings and import them to an AMR or fleet.
  Refer to *Configuration File Backup* on page 4-81 and *Restore from Configuration File* on page 4-84 for more information.
- Save configuration settings and maps associated with an AMR or fleet, and then use them later to restore using a DebugInfo file.
  Refer to *Debug Info File Backup* on page 4-82 and *Restore from a Debug Info File* on page 4-85 for more information.
- Revert configuration settings to default ARAM values.
  Refer to *Revert to Default* on page 4-83 for more information.

Additional Information

- IP addresses shown in the following screenshots may not represent your equipment IP address.
- Although software parameters concerning the Front Safety Scanners can be restored using a method above, the Front Safety Scanner configuration and safety parameters are not stored in the SetNetGo restore function and will not be modified by restoring a configuration.
- Refer to the *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* and *MobilePlanner Integrated Help* for more information about using SetNetGo.

4-22-1 Creating Backup Files

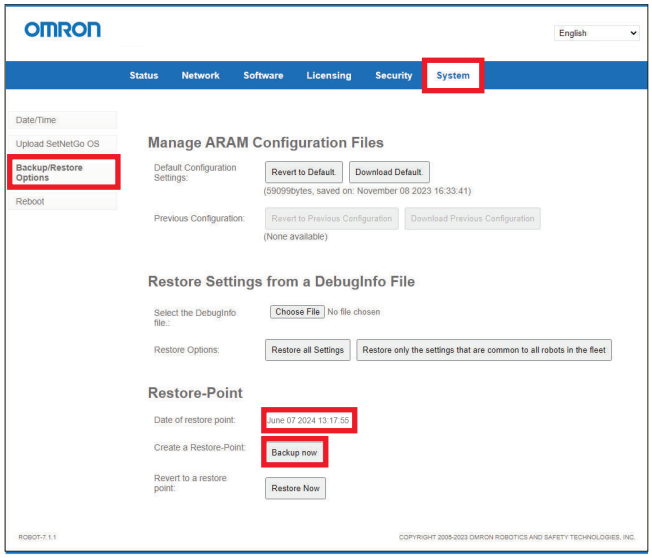
Use the information in the following sections to create backup files.

Create a Restore-Point

SetNetGo provides a restore option to revert a specific AMR to a user-defined Restore-Point, which is saved locally on the AMR. This method will revert the ARAM and AMR settings on the **Configuration** Tab and the last 10 saved maps to the saved Restore-Point. You can create a Restore-Point from the **System** Tab's **Backup & Restore Options** in SetNetGo. Click the **Backup Now** Button to create a Restore-Point of the current configuration. Once a Restore-Point has been created, the date of its creation will appear above the Backup Now button.

Additional Information

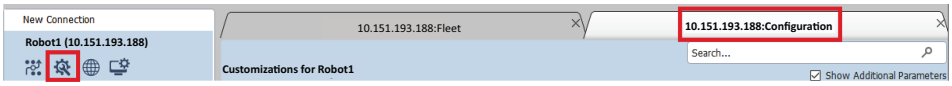
Only one Restore-Point can exist on an AMR at a time. Creating a new Restore-Point will overwrite the existing one.



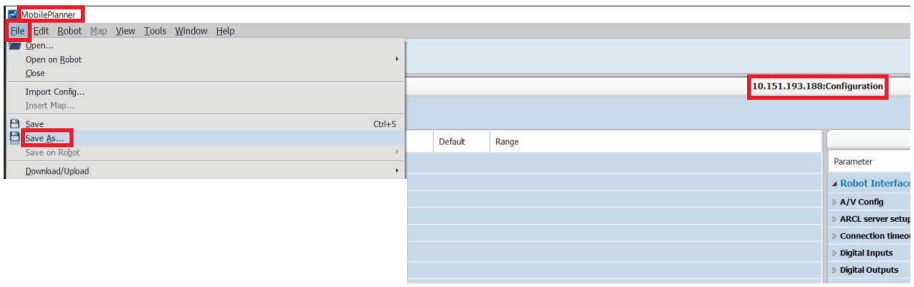
Configuration File Backup

SetNetGo provides a restore option to revert the AMR to a backed up configuration file. This method restores only user-defined software settings on the **Configuration** Tab.
Use the following procedure to back up an AMR configuration file.

1 Click the **Configuration** Icon to open the **Configuration** Tab in MobilePlanner.

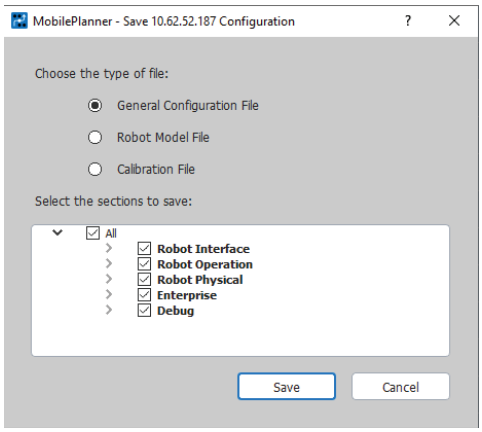


2 While the **Configuration** Tab is active, select **File** > **Save As** to save a .xml configuration file.



3 Select the type of configuration file and what sections to save.

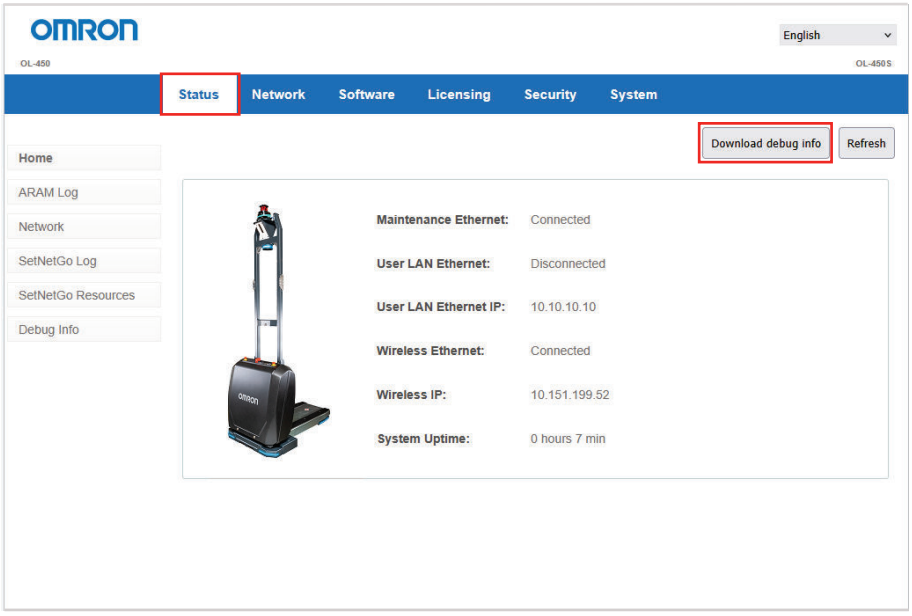
- General Configuration files are applicable to any AMR connected to MobilePlanner.
- Robot Model files are applicable to AMRs of the same model.
- Calibration files are specific to the current AMR that is connected.



4 Click Save to complete the procedure.

Debug Info File Backup

SetNetGo provides a restore option to revert an AMR to a backed up Debug Info .zip folder saved on a PC. This provides an alternate backup location compared to a Restore-Point. This method will revert the ARAM and AMR settings on the **Configuration** Tab and the last 10 saved maps to the saved Debug Info parameters. This can be used to easily bring a new AMR up to date with an existing fleet, or to completely restore all software settings to an AMR with a new PC.
Access the **Status** Area in SetNetGo and then click the **Download Debug Info** button.
This will generate a .zip folder in the Downloads folder. A pop-up is presented to open the folder or close. Clicking **Open Folder** will open the Downloads folder to show the .zip folder.



4-22-2 Restoring the AMR

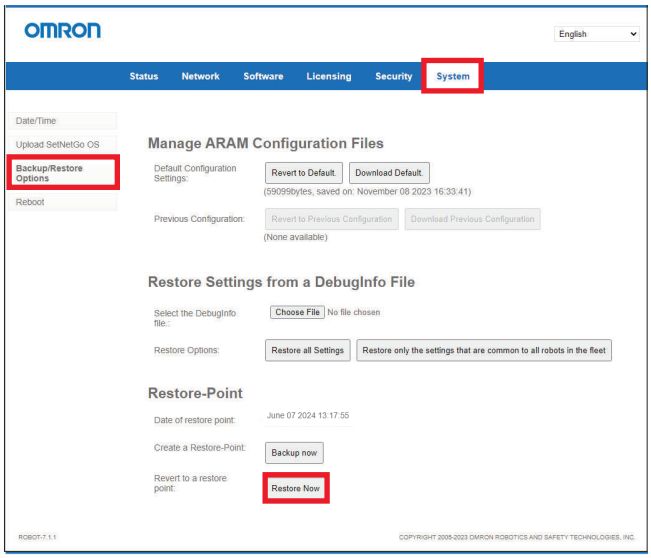
The following sections describe how to restore an AMR with a Debug Info file, Configuration file, or other method.

Revert to a Restore-Point

SetNetGo provides a restore option to revert the AMR to a user-defined Restore-Point. You can revert to a Restore-Point from the **System** Tab's **Backup & Restore Options** in SetNetGo. Click the **Restore Now** Button to revert to a saved Restore-Point.

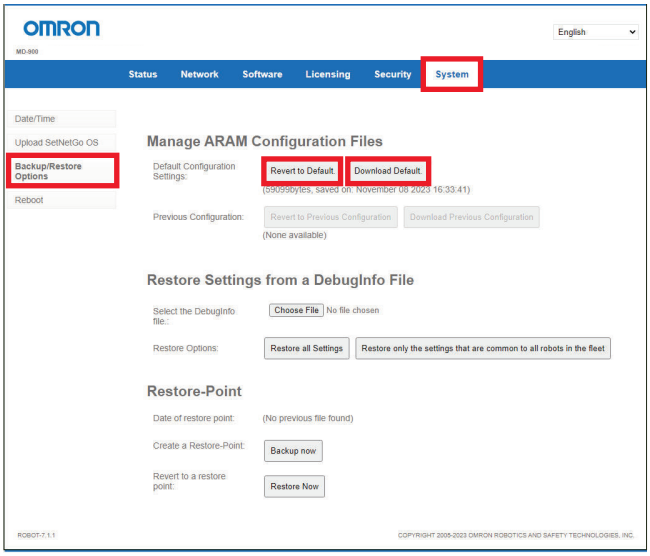
Additional Information

The MobilePlanner connection will be terminated when reverting to a Restore-Point.



Revert to Default

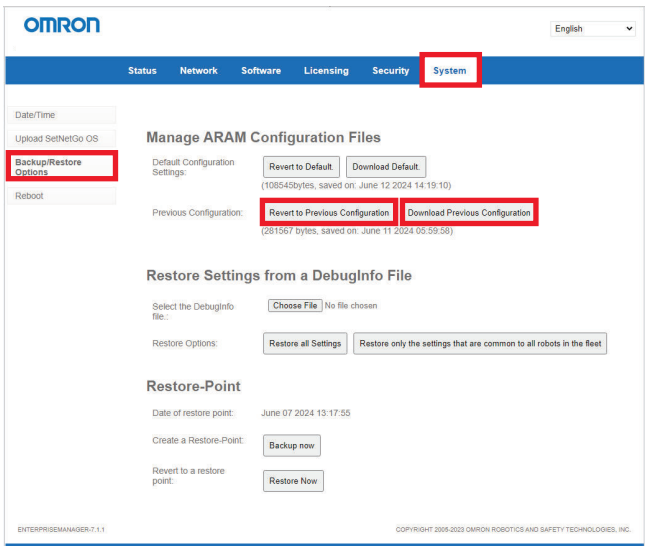
SetNetGo provides a restore option to revert the AMR to its default configuration settings. This method restores the entire **Configuration** Tab back to default values as determined by ARAM during its initial setup. You can revert to the default configuration settings from the **System** Tab's **Backup & Restore Options** in SetNetGo. Click the **Revert to Default** Button.
You may also download the default configuration file for the AMR to your computer by clicking the **Download Default** Button.



● Revert to Previous Configuration

SetNetGo provides a restore option to revert the AMR to its previous configuration settings by clicking the **Revert to Previous Configuration** Button. This method reverts the **Configuration**Tab to its previous settings before a change was made. Changes could include uploading a new Configuration file or reverting to default values.

You may also download the previous configuration file for the AMR to your computer by clicking the **Download Previous Configuration** Button.



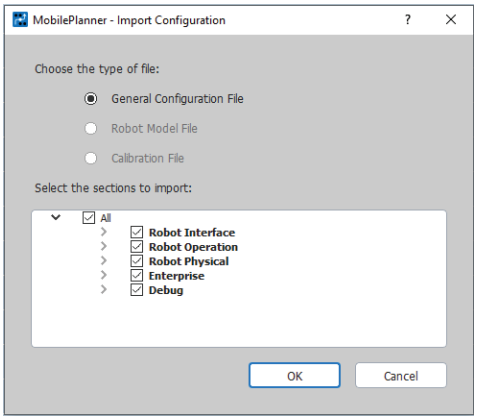
Restore from Configuration File

Use the following procedure to import a configuration file into MobilePlanner.

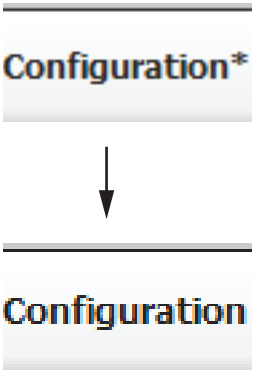
1 In the **Configuration** Tab, select **File** > **Import Config...**, then select a saved .xml configuration file to import.



2 Select the type of configuration file and what sections to import. Click **OK** to confirm the import.



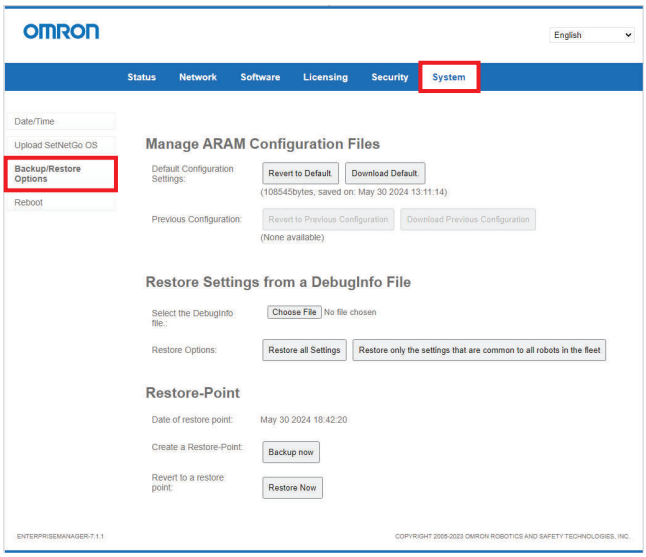
3 Save MobilePlanner using **File** > **Save** to upload the configuration to the AMRs. An asterisk will be present on the **Configuration** tab, which will clear when saving is complete. If no errors occur during importing or saving, the procedure is complete.



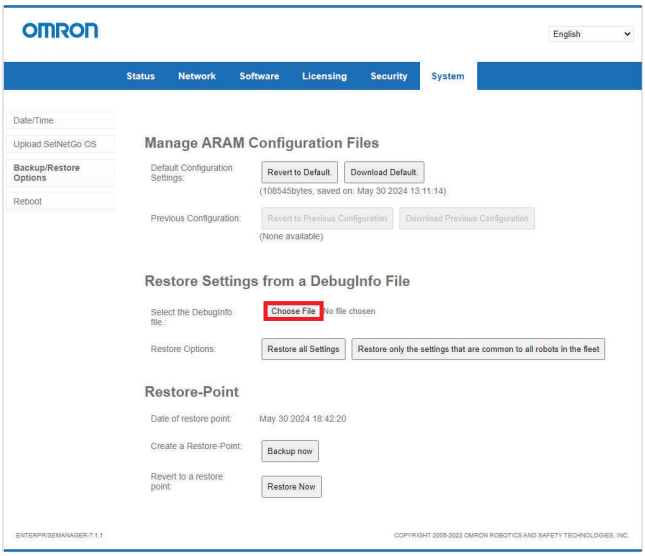
Restore from a Debug Info File

The following procedure describes how to use SetNetGo to restore an AMR from a DebugInfo File.

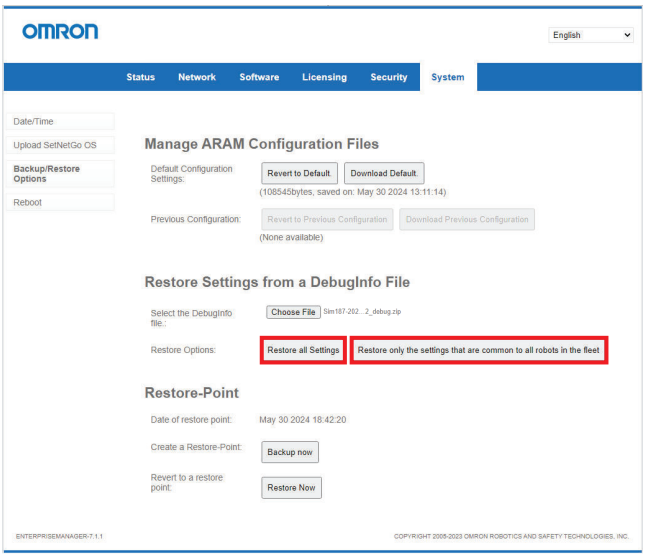
1 Access the **System** Tab and click on **Backup/Restore Options** in the left pane.



2 Click **Choose File** and select a saved DebugInfo zip folder from its saved location to upload.



3 Click either the **Restore all Settings** or **Restore only the settings that are common to all robots in the fleet** button to select which settings to import.



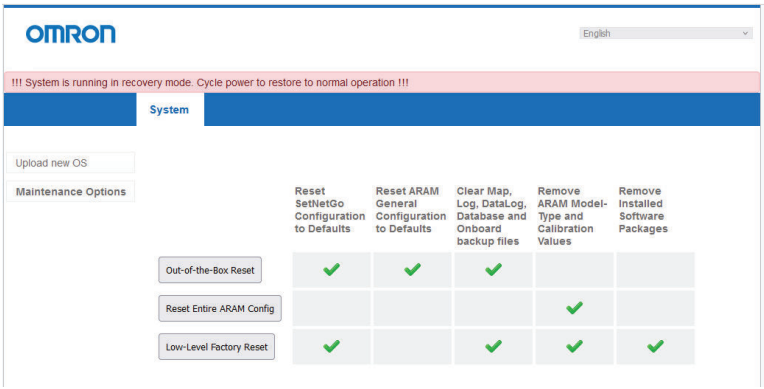
Hovering the mouse over each button will open a tooltip with more information.

- **Restore all Settings** button:
  Use this operation to restore all settings in the selected DebugInfo file to this robot PC. This feature is useful if you replace the robot PC hardware.
  You must update the WiFi security credentials (such as PSK and certificates) after you restore the PC.
- **Restore only the settings that are common to all robots in the fleet** button:
  Use this operation when you add a new robot to a fleet. It quickly restores settings that are common to all robots in the fleet. This operation does not affect robot-specific setting such as IP address and Identifier, or model-specific settings such as gear-ratio and optional hardware.
  You must update the IP address and WiFi security credentials (such as PSK and certificates) after you restore the settings to a robot.

4 Click **OK** on the dialog box to confirm the restore operation to complete the procedure.

4-22-3 SetNetGo Recovery Mode

Use SetNetGo Recovery mode in the event that an AMR experiences a software problem, and reverting the system back to a stable and working default state is the preferred solution.
There are three Maintenance Options available in Recovery Mode as shown in the figure below.



Each option will reset different combinations of configuration data, files, or software from the AMR. Exercise caution when selecting a recovery option. If you wish to cancel this procedure without making any changes, you can exit this mode by power cycling the AMR or by using the **Reboot** Button in the **Upload new OS** menu under the **System** Tab. This will revert the AMR back to normal mode in its current condition.
Refer to the table below for more information on what data or settings each Maintenance Option will reset.

Recovery Option	Details
Out-of-the-Box Reset	Clears all SetNetGo configuration items (network, accounts, port-forwarding, timezone, etc) and disables all apps. Resets ARAM configuration to the defaults for that AMR type and for that ARAM version. This maintains the settings for robot type as well as mode, but uses default parameter values for everything else. Clears all files that would have been created during testing and runtime, such as maps, log files, data files, etc. Useful for resetting back to a factory-equivalent state.

Recovery Option	Details
Reset Entire ARAM Config	Resets the ARAM configuration settings to remove all defaults. Configuration settings will need to be restored after exiting Recovery Mode. MobilePlanner can then be used to set the appropriate **Robot_Type**.
Low-Level Factory Reset	Removes all SetNetGo and ARAM configuration settings. Also deletes all content installed when uploading a FLOW package, but will preserve voice synthesis files.

AMR Recovery

Follow the procedure below to reset the AMR's settings using Recovery Mode.
The following items are required for this procedure.

- PC
- Ethernet cable
- A web browser application

This procedure will remove all user-defined configurations and settings. Configuration and setup of the AMR must be performed after following this procedure.

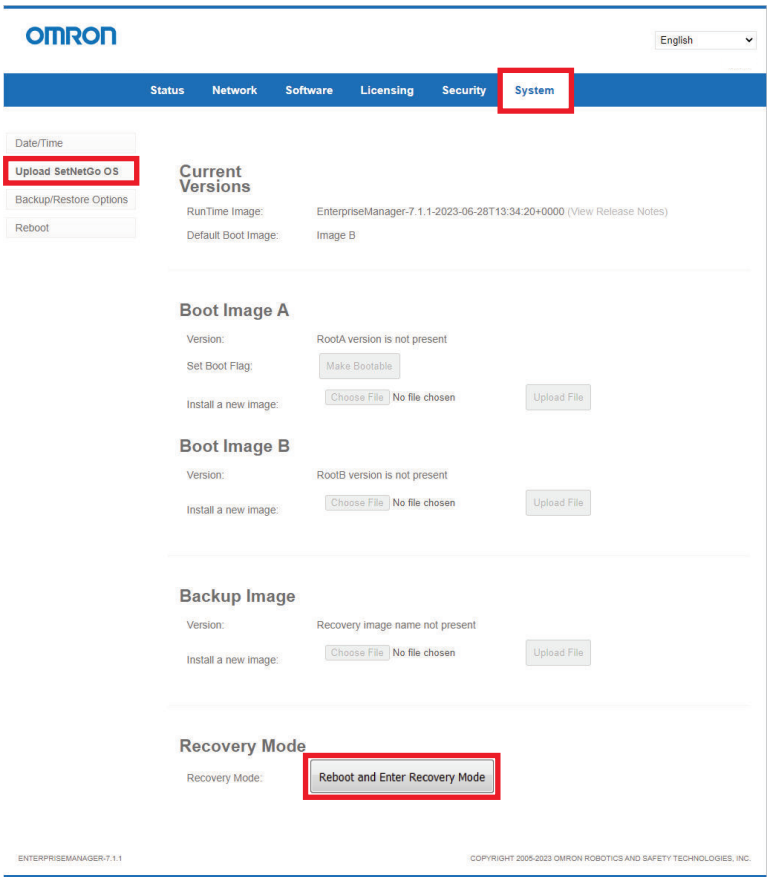
1 Connect a PC to the AMR maintenance port with an Ethernet cable.

2 Open a browser and connect to SetNetGo by typing in the maintenance IP address, 10.39.46.1..

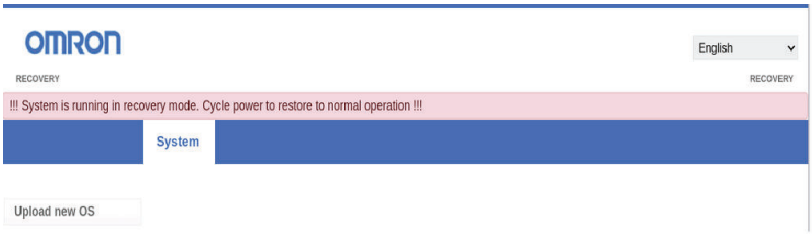
3 Download a DebugInfo file from the AMR.
This can be used to restore AMR functionality after Recovery Mode options have been set. Refer to *Debug Info File Backup* on page 4-82 for more information.

4 Access the **System** Tab's **Upload SetNetGo OS** option in the left pane.

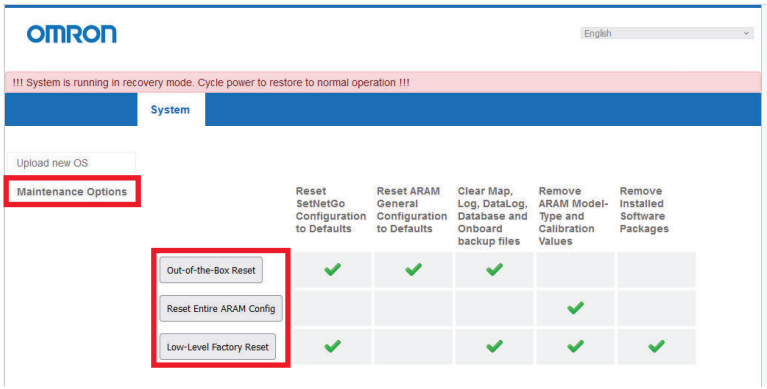
5 Click on the **Reboot and Enter Recovery Mode** Button.
You will be prompted to confirm if you want to enter the recovery mode after the selection is made.



6 Wait approximately 30 seconds and then refresh the page after entering Recovery Mode.
The SetNetGo Recovery Mode URL changes from HTTPS:// to HTTP://.
After refreshing, the following will be displayed on the top bar to confirm the AMR is in Recovery Mode.



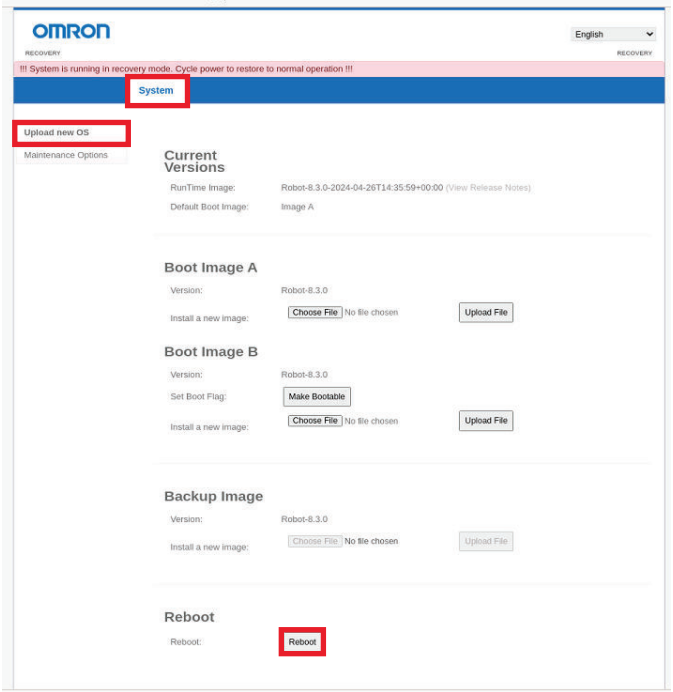
7 Access **Maintenance Options** in the left menu. There are three Maintenance Options available. Select the option appropriate for your needs.
Refer to *4-22-3 SetNetGo Recovery Mode* on page 4-87 for more information.



8 Confirm on the dialog box that pops up that you wish to reboot and disconnect all connections.

9 Wait for a message to appear stating that the change was made successfully.

10 Power cycle the AMR (push the OFF button and then push the ON button) or reboot the AMR using the Reboot Button under the **Upload new OS** Menu.



11 Allow the power cycle or reboot to complete and confirm the AMR's status. Once the AMR's status is confirmed to be in the intended post-recovery state, the procedure is complete.

4-23 Emergency Situations

In case of an emergency such as a fire or collision, you should stop the AMR quickly and safely. If the emergency situation is near the Charging Station, you must turn OFF the facility AC power to the Stationary Electronics.

⚠ DANGER

Toxic, explosive gases can be released when using a CO2 fire extinguisher or water in combination with lithium.



Precautions for Safe Use

In case of fire, use a type ABC or type BC dry chemical fire extinguisher.

5

Troubleshooting

This section provides troubleshooting information.

5-1 Collecting Troubleshooting Information 5-2

5-2 Stationary Electronics Problems 5-3

5-3 Battery Problems 5-5

5-3-1 Low Battery Recovery 5-5

5-3-2 Battery Charging Problems 5-5

5-3-3 Leaking Batteries 5-6

5-4 Exposure to Liquids 5-7

5-5 AMR Start-up Problems 5-8

5-6 Circuit Breaker Panel 5-9

5-7 Localization Problems 5-10

5-8 Other AMR Problems 5-11

5-1 Collecting Troubleshooting Information

Troubleshooting information can be collected from the AMR by downloading a Debug Info File using SetNetGo. This is a collection of configuration, log, and system status files that support personnel can use for debugging and troubleshooting. Use the following procedure to download a Debug Info File for troubleshooting or diagnostic purposes.



Precautions for Safe Use

The AMR's internal clock must be set correctly to ensure that accurate timestamps are present in the Debug Info File.



Additional Information

A connection to the AMR must be established before attempting to access SetNetGo. If your AMR is already configured to use a wireless network, use the procedure below. If it is not, you must first create a TCP/IP connection to the AMR's Maintenance Ethernet Port.

- Refer to *3-5 Network Connections* on page 3-18 for more information.
- Refer to *MobilePlanner Integrated Help* for more information.

1 Open MobilePlanner and connect to the AMR's IP address.

2 Click the SetNetGo tab to open its Web Interface.

3 Click **Status** and select **Debug Info** from the left pane.

4 Click **Download Debug Info** and then specify a location to save the file to complete this procedure.

5-2 Stationary Electronics Problems

Use the information in the following table to troubleshoot Stationary Electronics problems.



Additional Information

Upon initial power-up, all LEDs will turn ON briefly to confirm they are not faulty.

LED State	Possible Cause	Corrective Action
All indicators OFF.	Power supply wiring problem.	Check for correct wiring.
	Power supply problem.	Check for correct power supply.
Green steady, yellow flashing slowly	Battery is charging at a reduced rate because of coil misalignment.	Ensure proper alignment between Mobile and Stationary Coils. Check docking target configuration in MobilePlanner.
Green flashing slowly, yellow flashing rapidly	Stationary Electronics fan faulty.	• Replace Stationary Electronics • Contact OMRON Service representative for replacing fan.
Green flashing rapidly, yellow flashing rapidly	Facility AC power / voltage derating	• Check AC power wiring. • Verify that AC power supplied is within specifications. Refer to *2-5-3 Charging Station Specifications* on page 2-14 for more information.
Green steady, yellow flashing rapidly	Battery is charging at a reduced rate because either the temperature of the Stationary Coil or the Mobile Coil is too high.	• Ensure Stationary Electronics is installed as specified with adequate space for air movement. Refer to *3-2 Charging Station Installation* on page 3-4 for more information. • Verify that AC power supplied is within specifications. Refer to *2-5-3 Charging Station Specifications* on page 2-14 for more information.
Green steady, yellow steady	Mobile Electronics fan faulty. MOSFET temperature difference.	Contact OMRON Service representative.
Green flashing rapidly, yellow flashing slowly, red steady	Defective coil(s) (no resonance detected). This affects both coils and may also detect grounding fault on the Stationary side.	1. Turn OFF facility AC power to Stationary Electronics. 2. Check Stationary Electronics and Stationary Coil for possible shorts to ground. 3. Contact OMRON Service representative.

LED State	Possible Cause	Corrective Action
Green flashing rapidly, yellow flashing rapidly, red steady	Stationary Electronics switched OFF due to high temperature.	1. Ensure ambient temperature is within specified range. Refer to *2-4-2 Charging Station Environmental Specifications* on page 2-13 for more information. 2. Power OFF Stationary Electronics and let it cool down. 3. Contact OMRON Service representative.
Green flashing rapidly, yellow steady, red steady	Mobile side fault.	1. Power OFF and Power ON the AMR. 2. If problem persists, contact OMRON Service representative.
Green flashing slowly, red steady	Grid fault (overvoltage/undervoltage DC bus).	Check all cable connections.
Green flashing slowly, yellow flashing slowly, red steady	CAN communication error on Stationary side.	Check Stationary Electronics CAN cable connection.
Green flashing slowly, yellow flashing rapidly, red steady	CAN communication error on mobile side.	Check the CAN connection cables between the battery and the AMR. Refer to *3-3-1 Battery Installation and Connection Procedure* on page 3-13 for more information.
Green flashing slowly, yellow steady, red steady	Stationary Electronics fault.	1. Turn OFF facility AC power to Stationary Electronics. 2. If problem persists, contact OMRON Service representative.
Yellow flashing slowly, red flashing slowly	Stationary Electronics in bootloader state.	If this state persists indefinitely, contact OMRON Service representative.
Yellow steady, red steady	Software updating.	If this state persists indefinitely, contact OMRON Service representative.
Green flashing rapidly, red steady	Inadequate coil positioning, no power transfer.	Ensure proper alignment between mobile and Stationary Coils. Check docking target configuration in MobilePlanner.

5-3 Battery Problems

Use the following sections to troubleshoot and resolve battery problems.

⚠ DANGER

Toxic, explosive gases can be released when using a CO_2 fire extinguisher or water in combination with lithium.



⚠ WARNING

Risk of Fire - No User Serviceable Parts
AVERTISSEMENT: Risque d'incendie - Aucune des pièces ne peut être.



⚠ WARNING

There are no serviceable parts in battery. Only licensed / certified personal can replace the battery and it can only be with an OMRON factory-supplied battery intended for use in the AMR.



Precautions for Safe Use

In case of fire, use a type ABC or type BC dry chemical fire extinguisher.

5-3-1 Low Battery Recovery

When the battery's State of Charge (SOC) drops below 10%, the AMR automatically initiates a five minute timer before it powers OFF. This is notified through MobilePlanner indicating an impending AMR power off.
In this state, the AMR battery reserve power is available for performing essential activities such as lowering the Lifting Plate if a payload carrier is still resting on it and drive the AMR to the Charging Station.
To use the reserve power, turn the Selection Switch from AUTO to OFF and back to AUTO. When the AMR powers back up, you will have five minutes to lower the Lifting Plate and drive it to the Charging Station before the AMR powers off again.

Precautions for Safe Use

Do not allow the battery to remain discharged for an extended period of time.

If the AMR cannot drive to the Charging Station because the battery is completely depleted, use the optional Service Charger to charge the battery enough to drive it to the Charging Station. Refer to *Charge Using Service Charger* on page 4-23 for more information.

5-3-2 Battery Charging Problems

Use the information below to understand battery charging problem indications and solutions.

- Many battery charging problems are caused by incorrect Stationary Electronics electrical connections during installation. Confirm that the wiring between the Stationary Electronics, the Stationary Coil, and facility AC power is correct if battery charging problems occur. Refer to *3-2 Charging Station Installation* on page 3-4 for more information.
- Check the battery SOC% in MobilePlanner. If it is an absolutely depleted battery, use the optional Service Charger to charge the battery enough to drive it to the Charging Station. Refer to*Charge Using Service Charger* on page 4-23 for more information.
- Ensure there is proper alignment between the Mobile and Stationary Coils. Check docking target configuration in MobilePlanner to correct coil misalignment problems..
- For other battery charging problems, refer to *5-2 Stationary Electronics Problems* on page 5-3.

5-3-3 Leaking Batteries

If the battery is leaking, discontinue use immediately. Isolate the spill or leak and keep unauthorized personnel away. Absorb all spilled material with an inert absorbent substance such as dry sand, and thoroughly clean the affected area. Place the leaking battery in a bag or drum and dispose of the materials properly in accordance with national, regional, and local environmental control regulations.

⚠ WARNING

Do not dispose of the battery in a waste stream that might result in incineration or crushing. Safely dispose of the battery through a designated facility according to all local and national environmental regulations regarding lithium battery disposal.

Precautions for Safe Use

You can contribute to resource conservation and protecting the environment by the proper disposal of Waste Electronics and Electrical Equipment (WEEE). All electrical and electronic products should be disposed of separately from the municipal waste system according to local ordinances using designated collection facilities.



5-4 Exposure to Liquids

Use the following procedure if the AMR comes into contact with any liquid.

1. Power OFF the AMR immediately.
2. Remove and dry as much liquid as possible.
3. Allow the AMR to air dry thoroughly before attempting to restore power.

5-5 AMR Start-up Problems

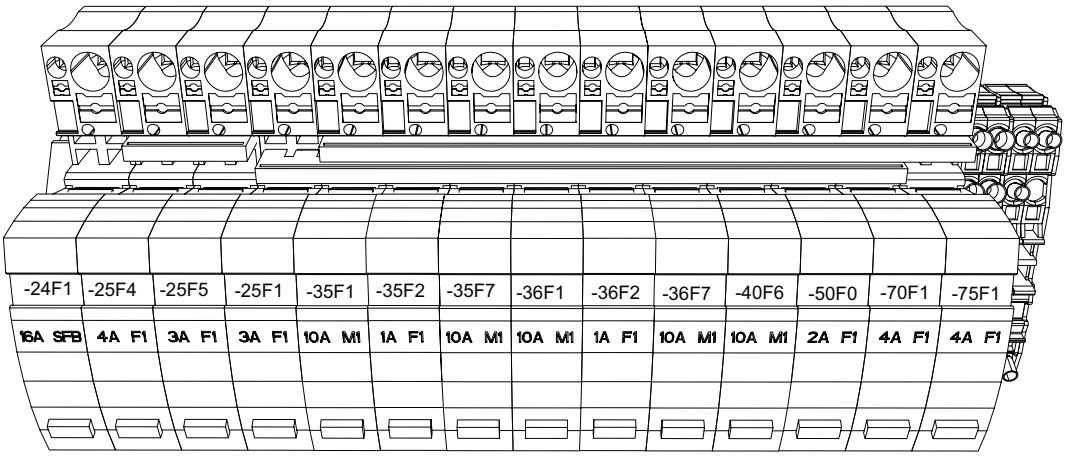
If the AMR does not start-up, shut-down the AMR and then check all connections.
If the AMR still does not start-up, check the following item(s):

- Check for tripped circuit breakers. If a circuit breaker is reset, wait 5 minutes before attempting to power ON. Refer to *5-6 Circuit Breaker Panel* on page 5-9 for more information.
- Make sure the Main Disconnect Switch is in the ON position.
- Check the battery's SOC% through MobilePlanner to ensure sufficient power is available.
- Check that the skins are in place and fastened correctly.

If the AMR does not start-up after the actions above, contact your local OMRON representative.

5-6 Circuit Breaker Panel

Use the following information to understand circuit breaker functionality.



Label	Rating	Function
24F1	16 A	Service Charger input
25F4	4 A	12 V PC power
25F5	3 A	12 V LEDs
25F1	3 A	12 V supply input
35F1	10 A	Wheel 1 motor power
35F2	1 A	Wheel 1+2 repeater / logic
35F7	10 A	Wheel 2 motor power
36F1	10 A	Wheel 3 motor power
36F2	1 A	Wheel 3 + 4 repeater/logic
36F7	10 A	Wheel 4 motor power
40F6	10 A	Brake chopper and lift motor power
50F0	2 A	Laser scanners
70F1	4 A	Not used
75F1	4A	Motion Controller

5-7 Localization Problems

Localization problems may occur that affect navigation, accuracy, or repeatability during AMR operation. Take the following actions to improve or correct localization:

- If the AMR becomes lost, use the localization feature in MobilePlanner to relocalize the AMR.
- If the AMR does not localize in a certain area, check the localization score. If the score is below 70%, remapping may be necessary.
- If more than 50% of the original map is occluded, remapping may be necessary.
- Keep the areas near the pickup and drop-off points closely aligned with the map. Frequent changes in these areas can reduce performance.



Additional Information

Refer to *3-9 Map Creation Overview* on page 3-25 for more information.

5-8 Other AMR Problems

Other AMR problems and corrective actions are provided below.

Problem	Possible Cause	Corrective Action
AMR suddenly powers OFF.	A motor circuit breaker was tripped.	Reset the motor circuit breaker, wait 5 minutes, and then turn the AMR ON.
	Battery problem.	Refer to *5-3 Battery Problems* on page 5-5 for more information. If battery will not charge, contact your local OMRON representative.

6

Maintenance

This section describes periodic maintenance and user-serviceable parts replacement for the AMR and the Charging Station.

6-1 Maintenance Introduction 6-2

6-2 AMR Lock-out Tag-out Procedure 6-3

6-3 Charging Station Lock-out Tag-out Procedure 6-4

6-4 Lifting the AMR 6-5

6-5 Mounting the AMR on Work Bench 6-7

6-5-1 Mounting Procedure 6-8

6-6 Removing and Mounting the Lifting Plate 6-10

6-7 Maintenance Tasks and Schedule 6-12

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6-7-2 Safety and Warning Labels 6-19

6-8 Cleaning 6-20

6-8-1 Cleaning Intervals 6-20

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6-9 Replacing Items 6-23

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6-9-2 Removing and Replacing Battery 6-25

6-9-3 Replacing Lifting Plate Rubber Strips 6-27

6-9-4 Replacing Motion Controller Buffer Battery 6-27

6-9-5 Replacing Grounding Chain 6-29

6-1 Maintenance Introduction

Read and understand the following information before performing any maintenance tasks.
Only properly skilled, trained, and instructed personnel can perform maintenance procedures described in this document.
Prior to performing maintenance tasks on an AMR, you should make sure that the area you will be working in is adequately protected and cannot be interrupted by other AMRs.

⚠ WARNING

- Use only the specified tools, equipment, cleaners, and OMRON-supplied spare parts to service and maintain the AMR and Charging Station according to the specified service interval. Failure to do so could result in an unsafe operating state than might result in injury to person or damage to property.
- While conducting any work on the AMR, make sure it is located on a flat, level surface with the wheels chocked and emergency stop active to prevent unexpected movement.
- If any safety or warning symbols in the charging zone are damaged or illegible, replace them with new ones.
- Do not allow liquids of any kind to come in contact with the Stationary or Mobile Coil.
- The Charging Station transfers high electric power, and contains hazardous voltage. The user must take necessary precautions when working near the Charging Station, and follow appropriate Lock-Out, Tag-Out (LOTO) instructions prior to any maintenance work done on the Charging Station.
- Due to hazardous electrical voltage / residual voltage, wait for at least two minutes before carrying out any maintenance on the AMR and the Charging Station.
- The Service Charger is not a user-serviceable device.



Precautions for Safe Use

- Remove the AMR from a Charging Station when conducting any installation or maintenance actions.
- Laser lenses can easily get scratched and damaged. Care must be taken to prevent scratching the laser lens during any maintenance or installation procedures.
- Ensure the AMR is OFF when manually moving or conducting any maintenance on the AMR.
- Follow proper maintenance schedules to ensure best performance of the AMR.



Precautions for Correct Use

The Scissor shield may be removed only for maintenance purposes after ensuring the AMR is powered off.

6-2 AMR Lock-out Tag-out Procedure

Use the following procedure to execute Lock-out Tag-out before performing any maintenance or installation work on the AMR.

1. Shut down the AMR. Refer to *4-4 AMR Shut-down Procedure* on page 4-8 for more information.
2. Secure the Main Disconnect Switch to the locking tab with a padlock or according to your facility requirement and regulations.
3. Wait 60 seconds and then turn the Mode Selection Switch to OFF.
4. Confirm that the AMR does not power ON.
   The Lock-out Tag-out procedure is complete.

6-3 Charging Station Lock-out Tag-out Procedure

Use the following procedure to execute Lock-out Tag-out before performing any maintenance or installation work on the Charging Station.

1. Disconnect the cable connections between the Stationary Electronics and the Stationary Coil. Refer to *Connection Procedure* on page 3-10 for more information.
2. Remove the retaining bracket and disconnect the AC input connector and cable from the Stationary Electronics.
3. Turn OFF the facility AC power to the Stationary Electronics.
4. Lock and tag the facility AC power supply switch according to your facility requirement and regulations.
5. Verify that all the Stationary Electronics LEDs are OFF to complete this procedure.

6-4 Lifting the AMR

Use the following procedure to lift the AMR. Four Lifting Rings are included in the package in which your AMR arrived. You must obtain Lifting Slings or Straps to lift the AMR.

⚠ WARNING

- When lifting the AMR, take care to lift it from safe lifting points and secure it with safety straps for even weight distribution and to ensure that the AMR is level and stable when lifted. OMRON recommends using a mechanical lift.
- Equipment used to lift the AMR must be adequately rated. It is the end user's responsibility to review lifting equipment and apply appropriate safety factors before lifting.

⚠ CAUTION

When placing the AMR back on the floor after lifting, you must make sure that all safety precautions have been taken to prevent personal injury or property damage.

Precautions for Safe Use

Do not attempt to lift the AMR from the bottom with a forklift or similar devices. Doing so could damage the AMR.

Precautions for Correct Use

- The Lifting Plate must be placed at the lowest position before lifting the AMR.
- The Lifting Rings and Slings must be removed before operating the AMR.

Additional Information

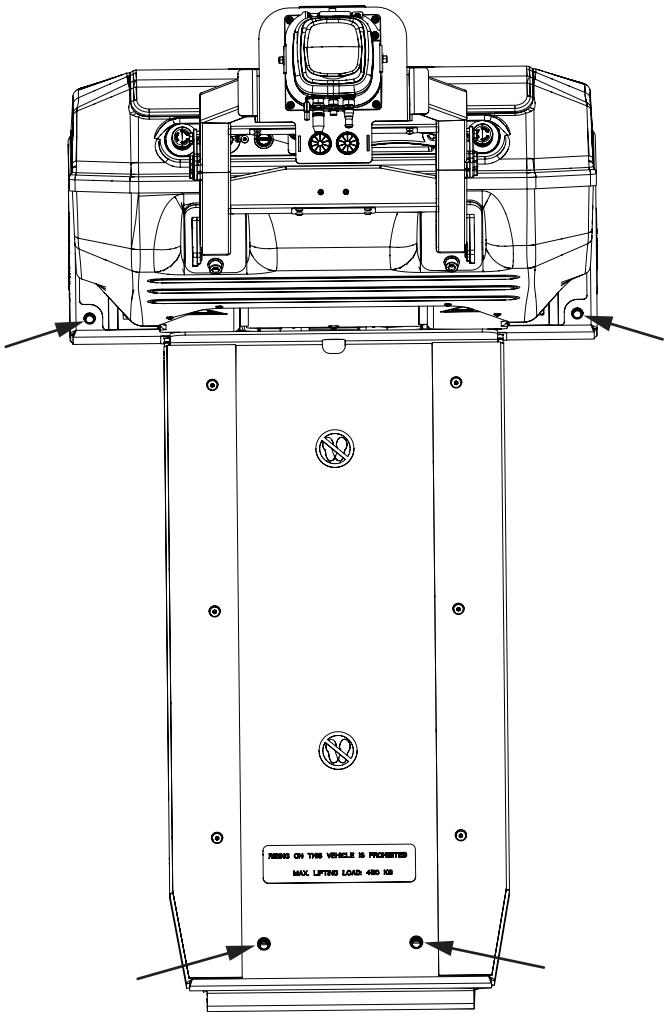
The Lifting Slings to lift the AMR are user-supplied. Use Lifting Slings rated for overhead lifting of at least 500 kg.

The following items are required for this procedure.

- 4 Lifting Rings (supplied with AMR)
- 4 Lifting Slings (user-supplied)
- Personal Protective Equipment (eye protection, toe protection, gloves).
- Overhead hoist or forklift rated for a minimum of 400 kg.

1 Perform the appropriate Lock-out Tag-out procedures.
Refer to *6-2 AMR Lock-out Tag-out Procedure* on page 6-3 for more information.

2 Attach the OMRON-supplied Lifting Rings to the locations shown in the figure below.



3 Attach the Lifting Slings to the Lifting Rings.

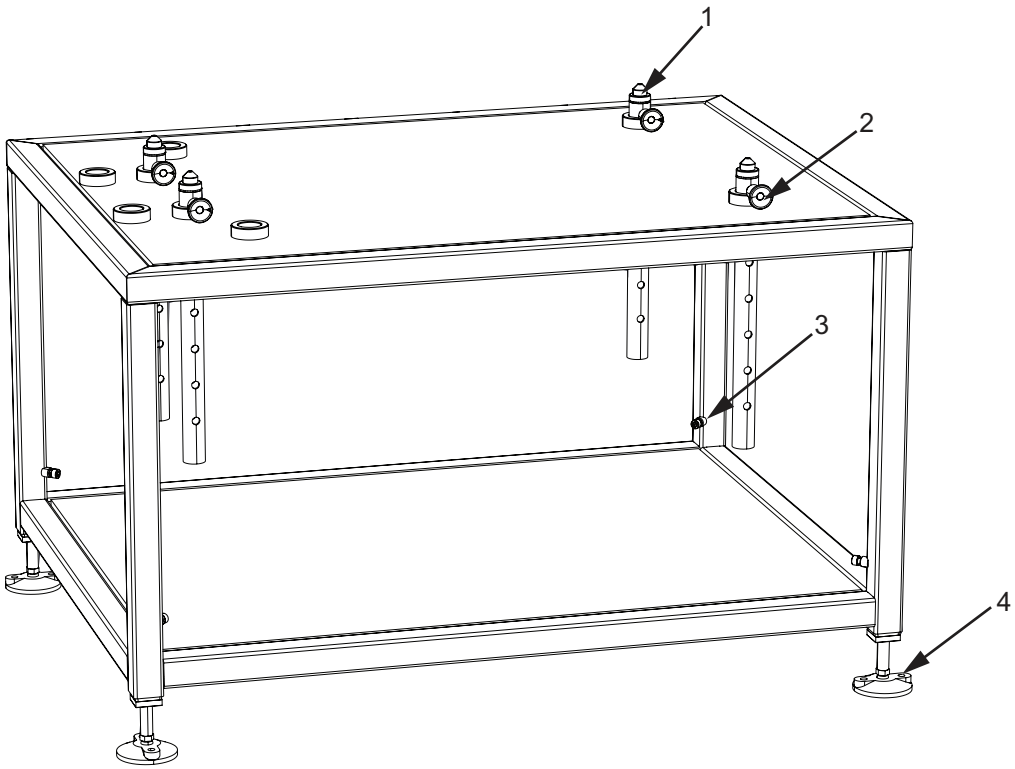
4 Using an overhead hoist or a forklift, lift the AMR.

5 Gently lower the AMR and place it on the workspace floor or the Work Bench.

6 Remove the Lifting Rings and Slings before operating the AMR to complete this procedure.
Save the Lifting Rings and Lifting Slings for future use.
Operating the AMR with the Lifting Rings will block the field of view of the Front Safety Scanners.

6-5 Mounting the AMR on Work Bench

The Work Bench (part number 28110-504) is a sturdy table with adjustable height used for performing maintenance tasks for the AMR.



Item	Description
1	Mounting Rods for holding the AMR
2	Locking Pins to secure the Mounting Rods at desired height
3	Bolts to secure the legs at desired height
4	Leg with foot pad to securely fix the Work Bench on the floor

A fully-assembled Work Bench is shipped. If your unit arrived with the mounting rods and foot pads packaged separately, open the package and drop the four mounting rods into the holes provided on top of the Work Bench and tighten using the Locking Pins. Refer to the illustration above. Attach the four foot pads under the legs and press down on the Work Bench.

⚠ WARNING

- Ensure the Work Bench is securely fixed on the floor before mounting the AMR on it.
- The Work Bench must be used only for performing maintenance tasks on the AMR.

Precautions for Safe Use

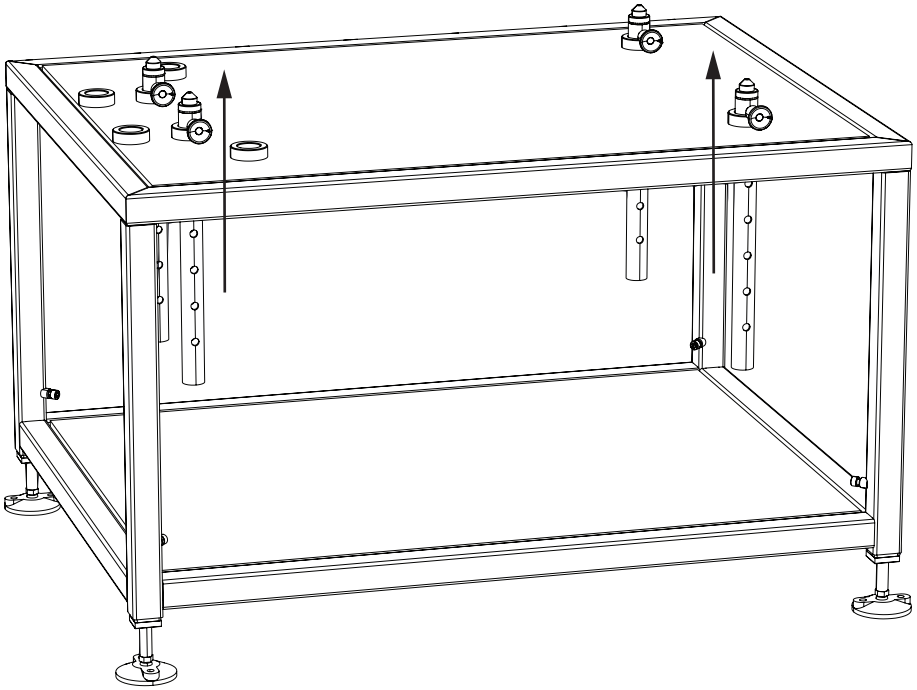
- At least two people are needed to elevate the Work Bench while installing the foot pads.
- Use a pallet jack, forklift, or dolly to move the Work Bench after unpacking.

The following section provides instructions for mounting the AMR on the Work Bench.

6-5-1 Mounting Procedure

Follow the procedure below to mount the AMR on the Work Bench.

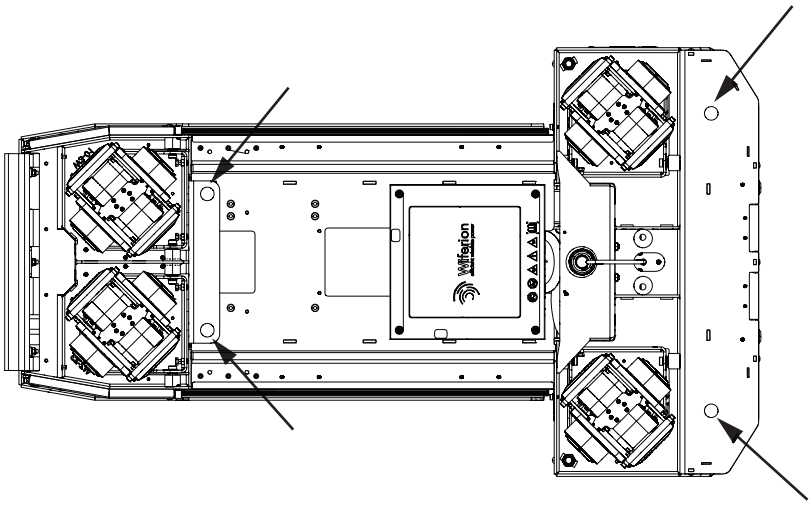
1 Prepare the Work Bench by adjusting each mounting rod to the desired height.



2 Ensure all the four mounting rods are at the same level and the locking pins are in place to fix them.
You should hear a click to indicate that the locking pin is in place.

3 To mount the AMR on the Work bench, first lift up the AMR by following the instructions in *6-4 Lifting the AMR* on page 6-5.

4 Position the AMR above the Work Bench such that the four holes on the AMR align over the mounting rods on the Work Bench.



5 Carefully place the AMR on the Work Bench to complete this procedure.

After completing the maintenance task, lift the AMR off the Work Bench and place it carefully on the floor.

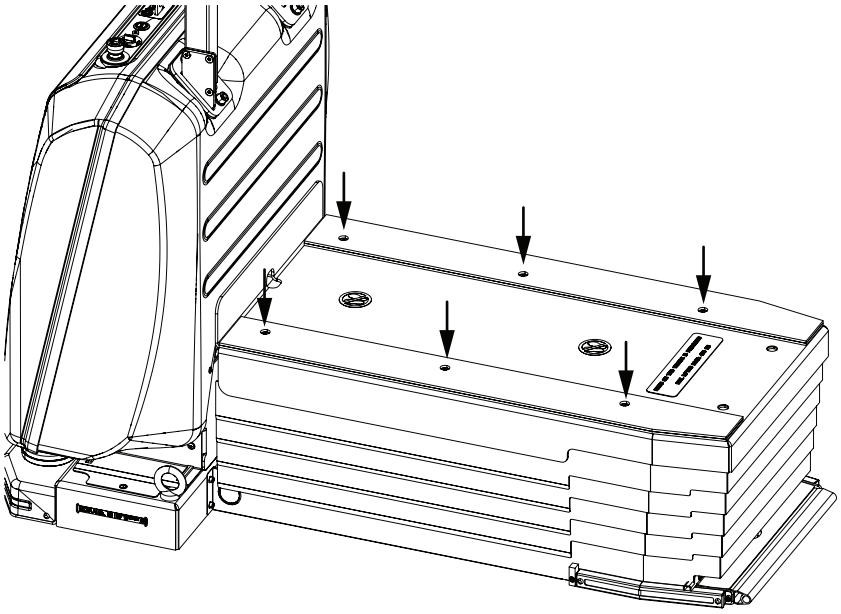
6-6 Removing and Mounting the Lifting Plate

Follow the procedure below to remove and mount the Lifting Plate.
A hex bit size 6 and torque wrench are required for this procedure.

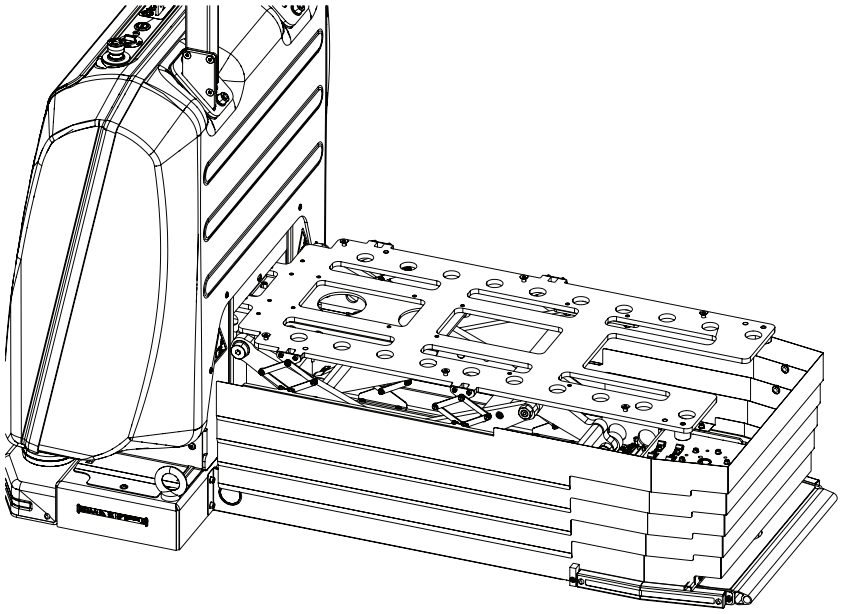
1. Position the Lifting Plate at the highest point using MobilePlanner. Refer to *4-11 Lift Mechanism* on page 4-27 for more information.

2. Power-OFF the AMR. Refer to *4-4 AMR Shut-down Procedure* on page 4-8 for more information.

3. Unscrew the six socket-head screws on the Lifting Plate of the AMR using the hex key and set the screws aside.
   The socket-head screws hold the Lifting Plate and the Rubber Strips in place.



4. Remove the Lifting Plate and Rubber Strips and set aside.



5 After completing your maintenance task, position the Lifting Plate and Rubber Strips on the lifting frame.

6 Tighten the six socket-head screws to a torque of 10 N-m.

7 Power-ON the AMR. Refer to *4-3-1 AMR Start-up Procedure* on page 4-6 for more information.

8 Lower the Lifting Plate using MobilePlanner to complete this procedure.

6-7 Maintenance Tasks and Schedule

Perform the maintenance tasks described below.

Item	Inspection Method	Inspection Frequency	Additional Information
Inspect Skins	Visual and actionable	Daily	Ensure Front and Rear Skins are installed correctly. Replace if you notice any damage. Refer to *6-9-1 Removing and Replacing Skins* on page 6-23 for more information.
Inspect Rear Bumper	Visual and Service	Daily	Check the Rear Bumper for any damage. Contact OMRON for replacement.
Charging Zone	Visual and actionable	Daily	Check and clear the charging area of any conductive materials such as metal or carbon. Clear the area of any debris.
Front and Rear Light Strips	Visual	Daily	Check that the Light Strips are functional before operating the AMR.
Check Buzzer	Auditory	Weekly	Check the audible buzzer for proper operation.
Check E-STOP Buttons	Actionable	Weekly	Check for proper operation of the E-STOP buttons.
Check safety and warning labels	Visual	Weekly	Verify all labels are present, legible, and undamaged. Refer to *1-4-3 AMR Safety and Warning Label Locations* on page 1-18 for more information.
Grounding Chain	Visual and actionable	6 months	Inspect the Grounding Chain for damage and jamming. Replace if necessary. Refer to *6-9-5 Replacing Grounding Chain* on page 6-29 for more information.
Cables	Visual and actionable	6 months	Ensure all cables are securely attached and not damaged.
Connectors • AMR battery power connector • Anderson Powerpole socket on battery	Visual and actionable	6 months	Inspect the connectors for discoloration, debris, or poorly fitting connections. Contact your local OMRON service representative for replacement details.
Charging Coils	Visual, actionable, and service	6 months	Inspect the Stationary and Mobile Coils for wear, damage, or conductive material burn-in. Replace the Stationary Coil if necessary. Refer to *3-2-4 Install Stationary Coil on Charging Ramp* on page 3-8 for more information. For Mobile Coil replacement, contact your local OMRON service representative.

Item	Inspection Method	Inspection Frequency	Additional Information
Wheel Sets	Visual and service	6 months	Check the Wheel Sets for excessive wear, uneven wear, or debris. To replace and calibrate the the Wheel Sets, contact your local OMRON service representative.
Lifting Plate	Actionable	6 months	Ensure that the Lifting Plate screws are tight. Refer to *6-6 Removing and Mounting the Lifting Plate* on page 6-10 for more information.
Lifting System	Auditory and actionable	Yearly	Check for creaking noise and lubricate the track rollers and spindle nut. Refer to *6-7-1 Lubricating the Lifting System* on page 6-13 for more information.
Motion Controller	Actionable	Yearly	Replace the buffer battery of the Motion Controller. Refer to *6-9-4 Replacing Motion Controller Buffer Battery* on page 6-27 for more information.
Lifting Plate	Visual and actionable.	Yearly	Inspect the rubber strips on the Lifting Plate for wear. Replace if necessary. Refer to *6-9-3 Replacing Lifting Plate Rubber Strips* on page 6-27 for more information.

6-7-1 Lubricating the Lifting System

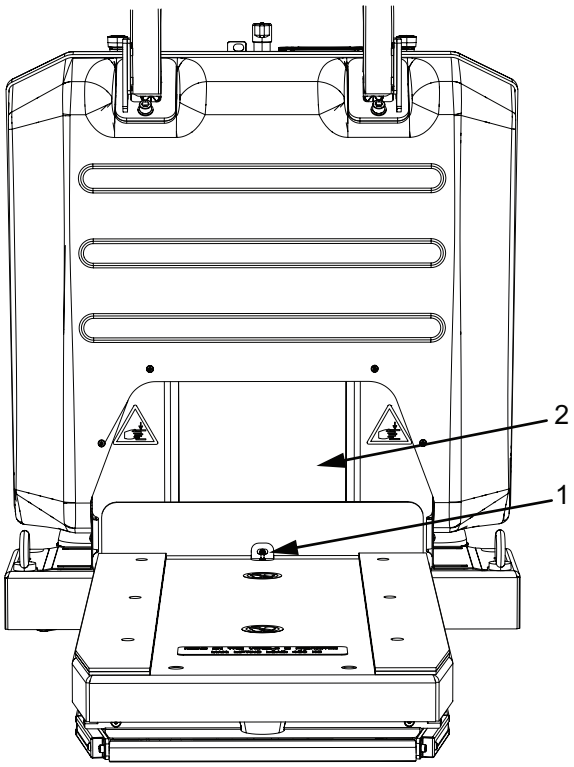
The following sections provide information about lubricating the Lifting System. Refer to *Lifting System Components* on page 1-10 for more information.

Lubricating the Spindle Nut

Follow the procedure below to lubricate the Spindle Nut.
The following items are required for this procedure:
- Lubricant. Refer to *A-5 Lubricants* on page A-7 for more information.
- hex bit size 6

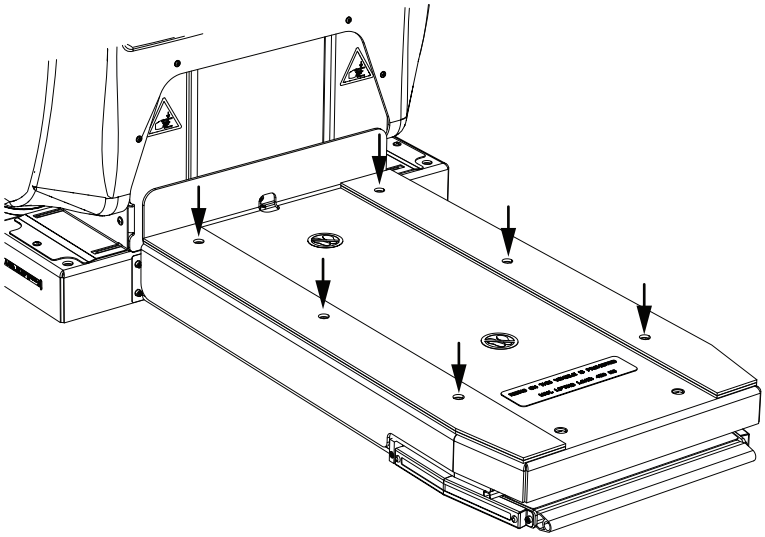
1 Power-OFF the AMR. Refer to *4-4 AMR Shut-down Procedure* on page 4-8 for more information.

2 Loosen the screw (1) of the maintenance cover (2) on the Rear Skin of the AMR.



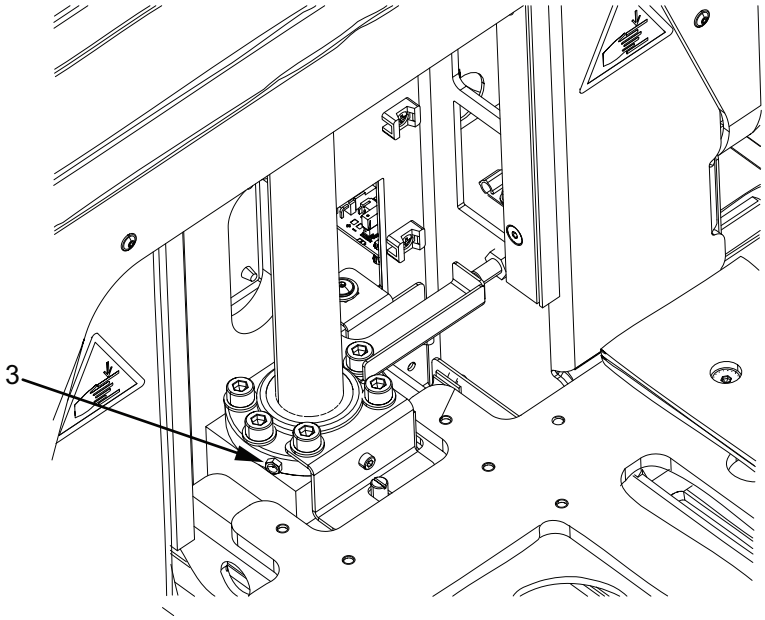
3 Slide up the maintenance cover (2).

4 Unscrew the six socket-head screws (three on each side) on the Lifting Plate of the AMR and set the screws aside.



5 Remove the Lifting Plate and set aside.

6 Inject one pump of the lubricant into the grease nipple (3) of the Spindle Nut.



7 Slide down the maintenance cover (2).

8 Tighten the screw (1) of the maintenance cover.

9 Place the Lifting Plate back on the platform and tighten the six socket-head screws to complete this procedure.

Lubricating the Track Rollers

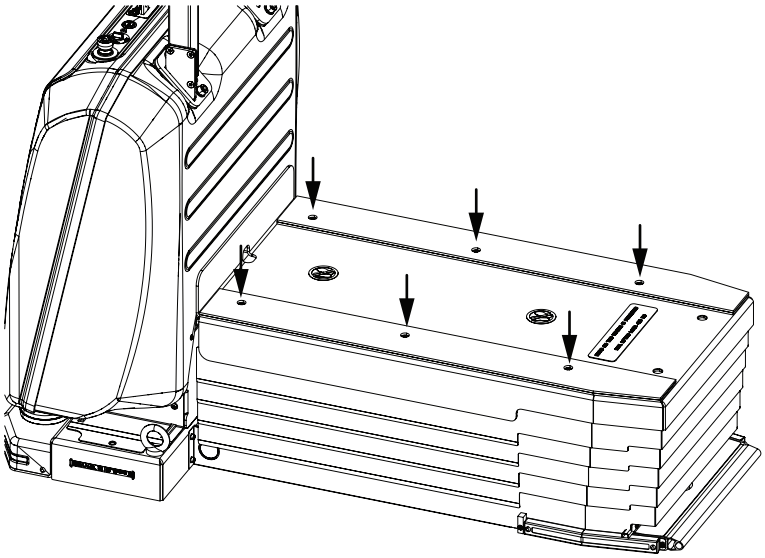
Follow the procedure below to lubricate the Track Rollers.
The following items are required for this procedure:

- Lubricant. Refer to *A-5 Lubricants* on page A-7 for more information.
- Hex bit size 6

1 Position the Lifting Plate at the highest point using MobilePlanner. Refer to *4-11 Lift Mechanism* on page 4-27 for more information.

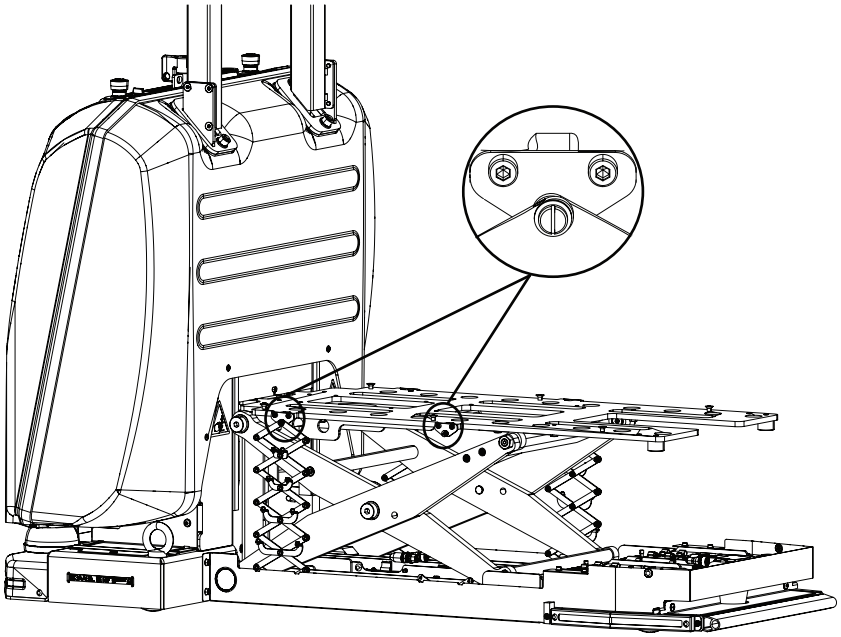
2 Power-OFF the AMR. Refer to *4-4 AMR Shut-down Procedure* on page 4-8 for more information.

3 Unscrew the six socket-head screws on the Lifting Plate of the AMR using the hex bit and set aside.



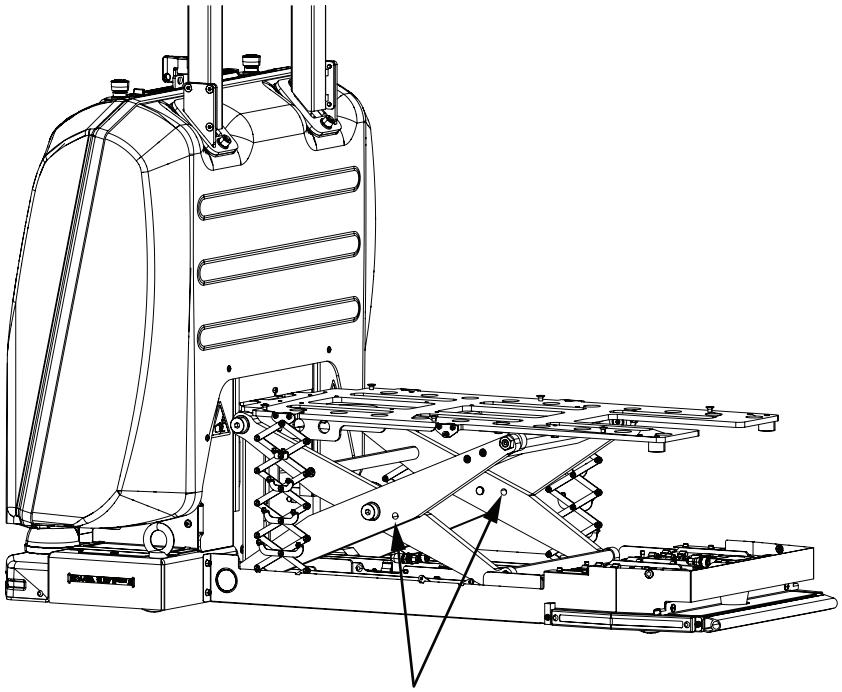
4 Remove the Lifting Plate and set aside.

5 Unscrew the two socket-head screws of each scissor assembly.
There are two scissor assemblies on each side of the AMR.

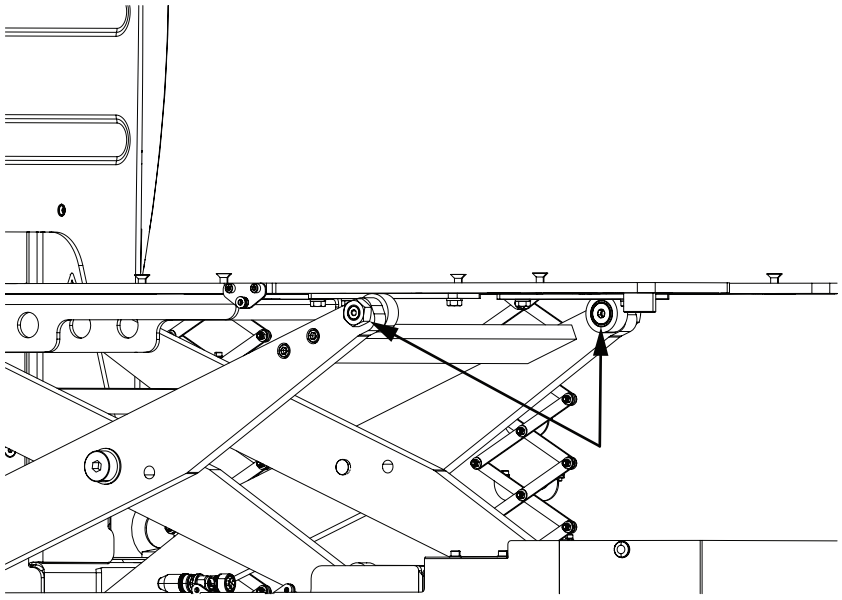


6 Lower the Scissor Lift Shield on each side.

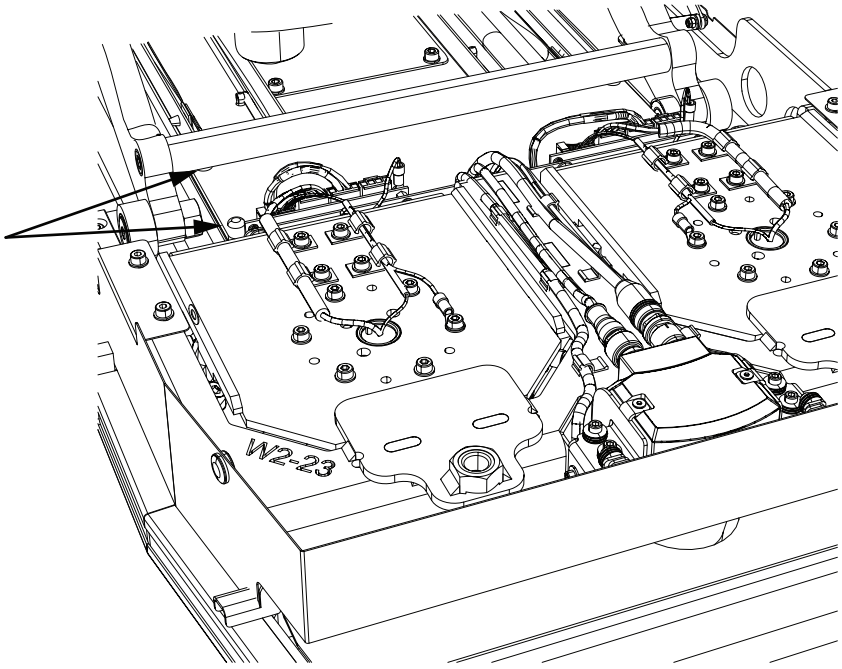
7 Insert a pin into both locking holes to secure the Scissor Lift.



8 Lubricate the inside of the two Track Rollers at the top of the Scissor Lift.

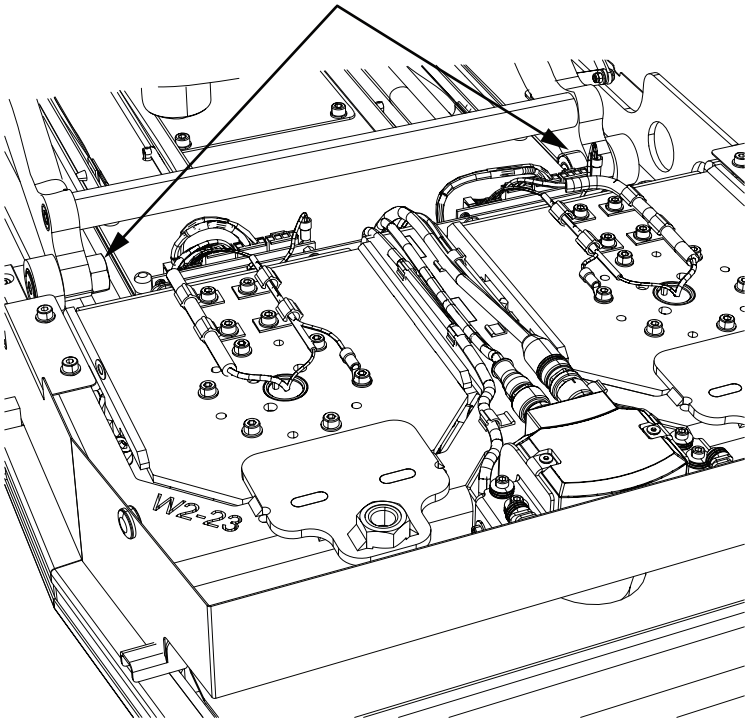


9 Remove the four snap rivets (two on each side) holding the cover plate in place and set them aside.



10 Remove the cover.

11 Lubricate the inside of the two Track Rollers at the bottom of the Scissor Lift.



12 Replace the cover removed in step 10 above and secure with snap rivets.

13 Remove both pins from the locking holes securing the Scissor Lift.

14 Hold the Scissor Lift Shield and pull it up.

15 Insert the two socket-head screws of each scissor assembly and tighten to a torque of 2.5 N-m.

16 Place the Lifting Plate on the platform, insert and secure the six socket-head screws on the Lifting Plate.

17 Lower the lifting Plate to complete this procedure.

6-7-2 Safety and Warning Labels

Perform periodic checks to ensure safety and warning labels are not damaged or removed. Yellow backings for emergency stop buttons must also remain in place. Refer to *1-4 Labels* on page 1-17 for more information about label locations.

6-8 Cleaning

Use the following information to understand how to clean the AMR and its associated components.

⚠ WARNING

Do not use organic solvents to clean any part of the AMR unless directed in the cleaning instructions. Organic solvents might damage electronics resulting in an unsafe operating state that could cause injury or damage to equipment. OMRON recommends using the Maintenance Kit from the manufacturer for cleaning supplies.

Precautions for Safe Use

The cleaning fluid in the Maintenance Kit should be kept away from oxidizing agents and strongly acidic or alkaline materials. Chemical reactions may occur if mixed.

Precautions for Correct Use

Clean accumulated dust on AMR internal components during regular maintenance.

6-8-1 Cleaning Intervals

Use the following cleaning intervals as guidelines.

Precautions for Safe Use

The frequency of cleaning intervals depends on your particular system, its operating environment, and the amount of use. Cleaning intervals may need to be shortened for certain environments.

Item	Interval	Additional Information
AMR Workspace	Daily	Keep the Workspace clean and free of debris.
Charging Zone	Daily	Check and clear the charging area of any conductive materials such as metal or carbon. Clear the area of any debris.
Laser Lenses	Weekly	Clean the Front Safety Scanners, Rear Scanner, and the 360-degree Scanner. Refer to *6-8-2 Cleaning Laser Lenses* on page 6-20 for more information.
AMR Exterior	Weekly	Clean any dust or dirt that might have accumulated on the exterior of the AMR.
Stationary Electronics	Weekly	Clean any dust or dirt that might have accumulated on the Stationary Electronics.
Cables	6 months	Ensure all cable connections are secure and clean the cables and connectors of any accumulated dust.
Wheel Sets	6 months or as needed	Inspect and clean the Wheel Sets. Hoist the AMR on the Workbench before cleaning the Wheel Sets. Refer to *6-5 Mounting the AMR on Work Bench* on page 6-7 for more information.

6-8-2 Cleaning Laser Lenses

Follow the procedure below to clean the laser lenses.

OMRON recommends that laser scanners be cleaned at least once every week; however, depending on the environment, the laser may have to be cleaned more often.
The following items are required to clean the laser lenses.

- Maintenance Kits 1 and 2 (part numbers 28110-506 and 28110-505) or
- Micro-fiber cloth and
- isopropyl based plastic window cleaner, such as *Staticide* or an isopropyl alcohol lens cleaner.

Precautions for Correct Use

- Prior to using the cleaning fluid, test its compatibility to the laser lens by first applying a small quantity of cleaner to an inconspicuous spot.
- Do not apply a bending stress to the surface of the laser lens when cleaning.

1 If the AMR is ON, press one of the E-Stop buttons.

2 Moisten the cleaning cloth with the cleaning fluid.

3 Carefully wipe the lens to lift the dust away from the safety laser surface. Use a moist, clean area on the cloth for each stroke.
Dragging a cloth embedded with dust across the lens surface will scratch it and damage the safety laser.

4 Clean the dust detection surface, if present, using the same methods as in Step 3.

5 If the AMR was E-stopped in Step 1, clear the E-stop and start-up the AMR to complete this procedure.

6-8-3 Cleaning Drive Wheels

The drive wheels provide traction during normal operation. They require regular, periodic cleaning to maintain overall AMR performance.

Drive Wheel Cleaning Procedure

Use the following procedure to clean the Wheel Sets.
The following items are required for this procedure.

- Gloves.
- Disposable lint-free cloth(s).
- Wire hook, tweezers, and sharp blade to remove any fibrous material wound around the wheel hubs.
- Soft brush.
- Isopropyl alcohol.

1 Power-OFF the AMR. Refer to *4-4 AMR Shut-down Procedure* on page 4-8 for more information.

2 Lift the AMR and Mount it on the Workbench. Refer to *6-4 Lifting the AMR* on page 6-5 and *6-5 Mounting the AMR on Work Bench* on page 6-7 for more information.

3 Use a lint-free cloth wetted with isopropyl alcohol to thoroughly clean the drive Wheel Sets. You should also remove any foreign objects embedded in the wheels (such as small rocks, staples, or screws).

4 Lift the AMR out of the Workbench and place it securely on the ground to complete this procedure.

6-9 Replacing Items

Read and understand the following information before replacing any items.
Only properly skilled, trained, and instructed personnel can replace items described in this document.
Prior to replacing items on an AMR, you should make sure that the area you will be working in is adequately protected and cannot be interrupted by other AMRs.

Precautions for Correct Use

For the Charging Station components replacement, use only the supplied Wiferion replacement parts and follow replacement instructions.

6-9-1 Removing and Replacing Skins

The Front and Rear Skins need to be removed or replaced during various maintenance and installation procedures.
The following sections gives details about removal and replacement of the Front Skin.

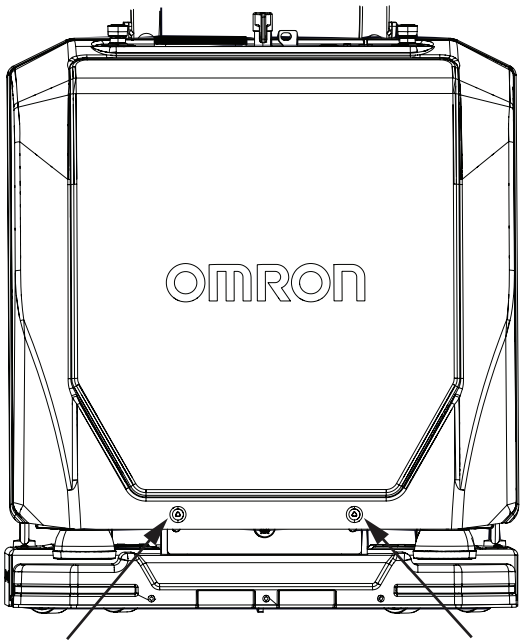
Additional Information

The Rear Skin is not a user-replaceable part. To remove or replace the Rear Skin, contact your local OMRON service representative.

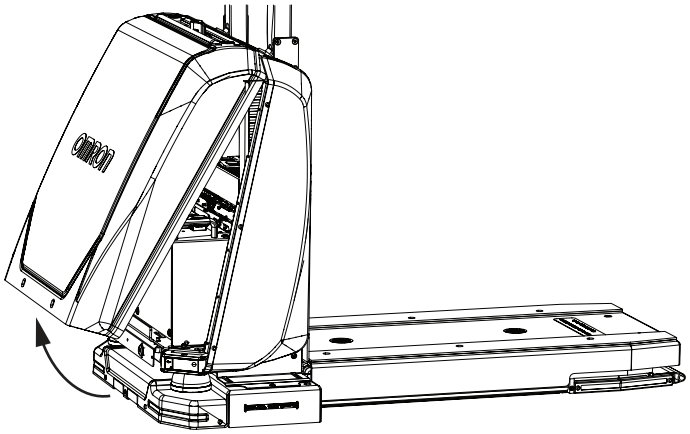
Remove Front Skin

Follow the procedure below to remove the Front Skin from the AMR.
A triangle spanner key (included) is required for this procedure.

1. Turn the AMR OFF. Refer to *4-4 AMR Shut-down Procedure* on page 4-8 for more information.
2. Loosen the two machine locks with the triangle spanner key (quarter turn to the left).



3 Lift up the Front Skin and remove it to complete this procedure.

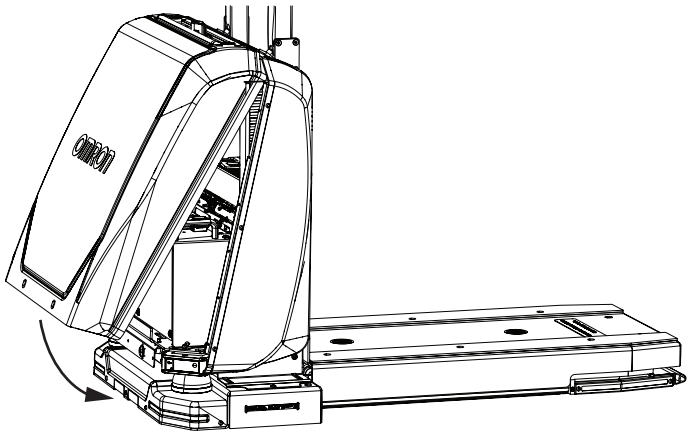


Replace Front Skin

Follow the procedure below to replace the Front Skin.
The following items are required for this procedure.

- A triangle spanner key (included)
- Replacement Front Skin (28110-726F)

1 Hook the Front Skin over the Control Strip to position it on the front of the AMR.



2 Tighten the two machine locks with the triangle spanner key (quarter turn to the right) to complete the procedure.

6-9-2 Removing and Replacing Battery

The following section provides details about removal and replacement of the AMR's battery.

⚠ WARNING

There are no serviceable parts in battery. Only licensed / certified personal can replace the battery and it can only be with an OMRON factory-supplied battery intended for use in the AMR.

Precautions for Safe Use

Never remove the battery while the AMR is powered ON. Always turn the AMR OFF before attempting to remove a battery.

Removal and Replacement Procedure

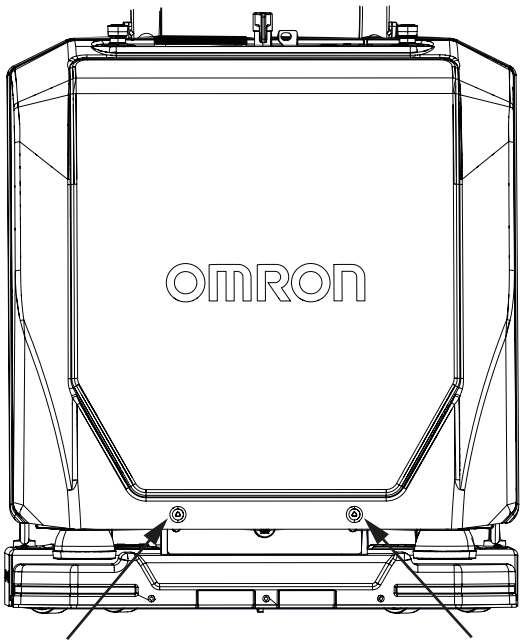
Follow the procedure below to remove and replace the battery.

The following items are required for the procedure:

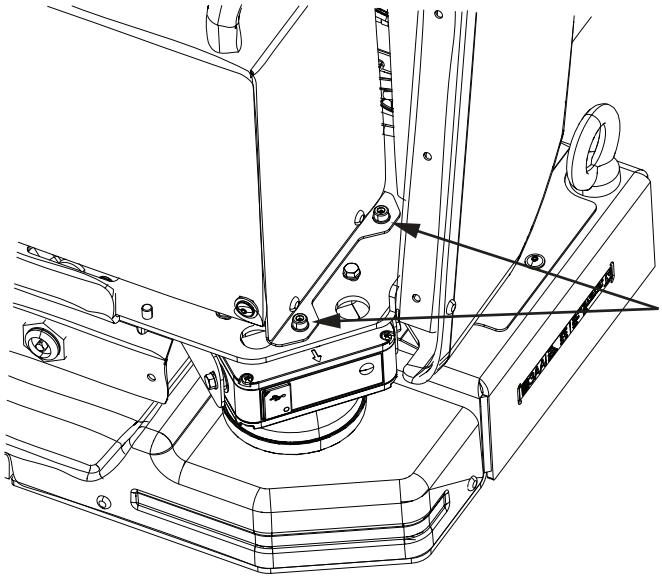
- Triangle spanner key (included)
- Replacement battery (part number 28110-020)
- 3 mm hex bit

1 Execute Lock-out Tag-out procedure. Refer to *6-2 AMR Lock-out Tag-out Procedure* on page 6-3 for more information.

2 Remove the Front Skin of the AMR using the triangle spanner key. Refer to *Remove Front Skin* on page 6-23 for more information.



3 Loosen the four bolts securing the battery to the base plate of the AMR.
Save the bolts for use later.



4 Carefully lift the battery out of the AMR.
If disposing the battery, safely dispose of the battery through a designated facility according to all local and national environmental regulations regarding lithium battery disposal.

5 Lift the replacement battery using the two handles and install the battery in the AMR. Refer to *3-3-1 Battery Installation and Connection Procedure* on page 3-13 for more information.

6 After installing and connecting the battery, replace the front cover of the AMR to complete this procedure.

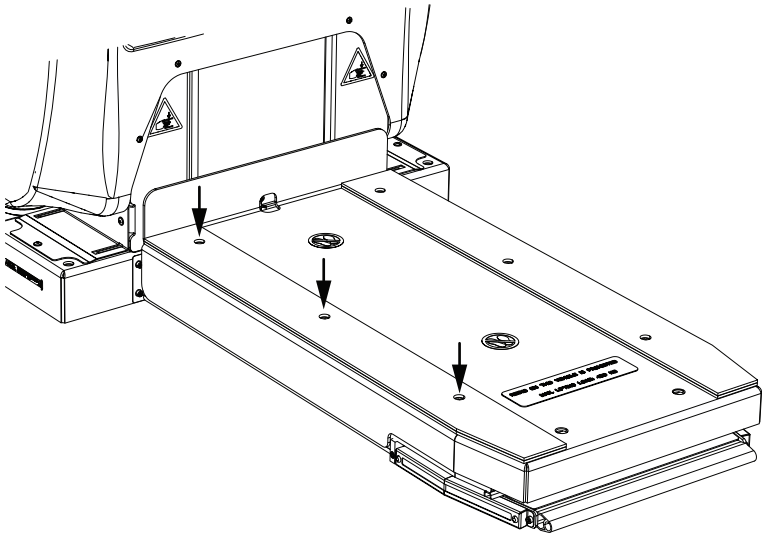
6-9-3 Replacing Lifting Plate Rubber Strips

You may need to replace the Rubber Strips on the Lifting Plate if they are worn or cracked. OMRON recommends replacing both Rubber Strips even if only one is damaged.
Follow the procedure below to replace the Rubber Strips.
The following items are required for this procedure:

- Replacement Rubber Strips
  - For AMR S2 model: part numbers 28110-715F (left), 28110-716F (right)
  - For AMR S3 model: part numbers 28110-731F (left), 28110-732F (right)
- Hex bit size 6

1 Power-OFF the AMR. Refer to *4-4 AMR Shut-down Procedure* on page 4-8 for more information.

2 Unscrew the three socket-head screws on the Lifting Plate holding the Rubber Strip and set the screws aside.



3 Remove and dispose of worn or damaged Rubber Strip according to local regulations..

4 Position the replacement Rubber Strip on the Lifting Plate and align over the holes.

5 Insert the three screws and tighten to a torque of 10 N-m.

6 Repeat steps 2 - 5 for the other Rubber Strip to complete this procedure.

6-9-4 Replacing Motion Controller Buffer Battery

The Motion Controller buffer battery ensures that the program, data, and clock time (RTC) remain stored in the memory (SRAM) when the AMR is powered off. OMRON recommends replacing the battery once every year to prevent data loss. The following section provides instructions for replacing the Motion Controller buffer battery.

Additional Information

- To avoid data loss, the AMR must remain powered on during Motion Controller battery replacement.
- OMRON recommends using only Renata battery (Cat. No. CR2032) for replacement.

Replacement Procedure

Follow the procedure below to replace the Motion Controller buffer battery.
The following items are required for the procedure:

- Triangle spanner key (included)
- Replacement battery (Renata battery Cat. No. CR2032 user-supplied)

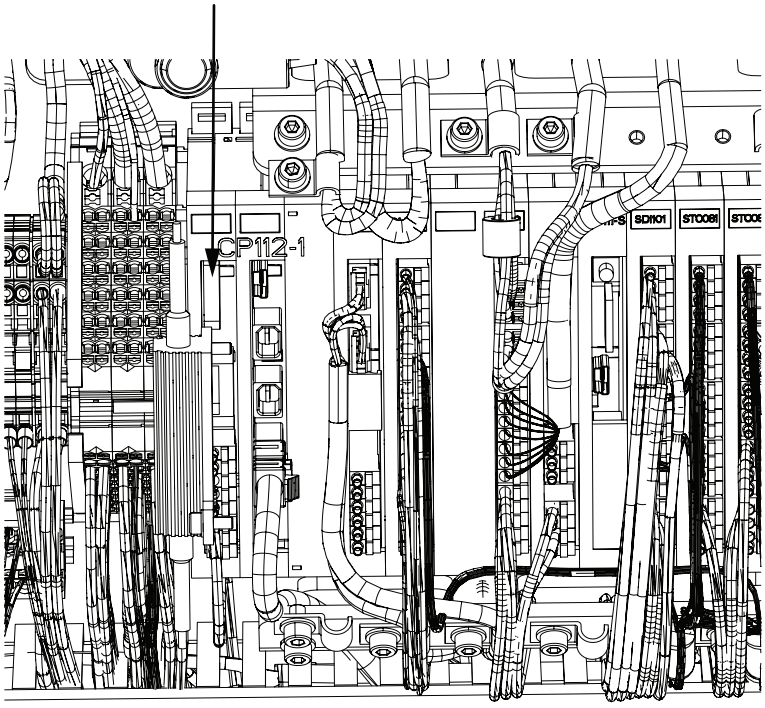
1 Ensure the AMR is powered-OFF. Refer to *4-4 AMR Shut-down Procedure* on page 4-8 for more information.

2 Remove the Front Skin of the AMR. Refer to *6-9-1 Removing and Replacing Skins* on page 6-23 for more information.

3 Power-ON the AMR. Refer to *4-3-1 AMR Start-up Procedure* on page 4-6 for more information.

4 Turn the Selection Switch to **Pause**.

5 Remove the old battery from the slot and insert the replacement battery correctly with the + pole to the right.



6 Power-OFF the AMR. Refer to *4-4 AMR Shut-down Procedure* on page 4-8 for more information.

7 Replace the Front Skin to complete this procedure.

6-9-5 Replacing Grounding Chain

The Grounding Chain is located at the bottom of the AMR. The Grounding Chain ensures that built-up floating voltages and static electricity are dissipated. Upon inspection, if the Grounding Chain no longer touches the ground, it should be replaced. OMRON recommends inspecting the Grounding Chain for damage or jamming every six months.
The following section provides instruction for replacing the Grounding Chain.

Grounding Chain Replacement Procedure

Follow the procedure below to replace the Grounding Chain.
The following items are required for the procedure:

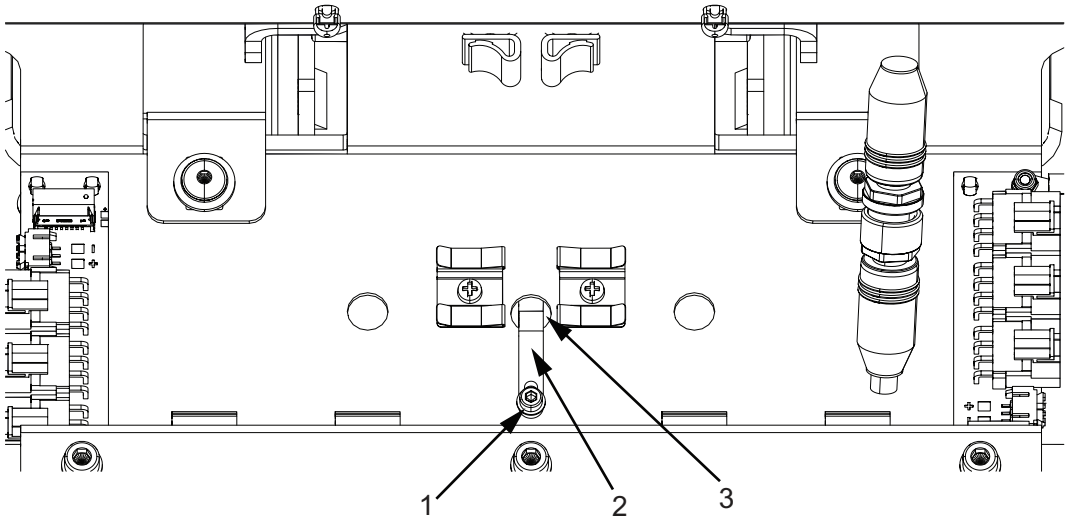
- Triangle spanner key
- Replacement Grounding Chain (part number 28110-728F)
- hex bit sizes 3 and 5

1 Power-OFF the AMR. Refer to *4-4 AMR Shut-down Procedure* on page 4-8 for more information.

2 Remove the Front Skin. Refer to *6-9-1 Removing and Replacing Skins* on page 6-23 for more information.

3 Remove the battery enclosure from the AMR. Refer to *6-9-2 Removing and Replacing Battery* on page 6-25 for more information.

4 Locate and unscrew the socket head cap screw (1) that holds the Grounding Chain in place. Retain the screw.



5 Remove the Grounding Chain (2) and discard.

6 Insert the replacement Grounding Chain through the hole (3) and ensure that it touches the floor.

7 Insert and tighten the screw to secure the Grounding Chain.

8 Reinstall the battery on the AMR.

9 Replace the Front Skin to complete the procedure.

A

Appendices

A-1 Parts List A-2
A-2 Network Port Allocation A-3
A-3 Storing the AMR A-5
A-4 Shipping the AMR A-6
A-5 Lubricants A-7

A-1 Parts List

AMR spare parts and accessories are provided in the following table.

Item		Ordering Code	Details
Rubber strip for S2	Right	28110-716F	Protective strips on the Lifting Plate that ensure the stability of the payload.
	Left	28110-715F	
Rubber strip for S3	Right	28110-732F	
	Left	28110-731F	
Front Skin		28110-726F	Exterior front removable panel of the AMR.
Grounding Chain		28110-728F	The Grounding Chain prevents static charges from building up on sensitive materials.
Stationary Electronics with Stationary Coil		28110-101	Stationary Electronics: Power supply box for charging the AMR battery. Mounting hardware and power cable are not included. Only the power connector is included. Stationary Coil: External charging coil for wireless charging. Cables and covers included.
Charging Ramp		28110-102	The platform on which the Stationary Coil is installed.
Stationary Electronics		28110-738F	Power supply box for charging the AMR battery. Mounting hardware and power cable are not included. Only the power connector is included.
Stationary Coil		28110-737F	External charging coil for wireless charging. Cables and covers included.
Battery		28110-020	Supplies power to the AMR.
Service Charger		28110-103	Portable service charger for charging AMR battery when the AMR cannot drive to the Charging Station. The Service Charger is rated for 220 to 240 V at 50 to 60 Hz.
Lift Bridge		28110-503	A portable device to lower the Lifting Plate when the AMR has no power.
Charger for Lift Bridge		28110-508	A charger for charging the Lift Bridge battery. The charger is rated for 220 - 240 V at 50 Hz.
Manual Mover		28110-501	Transports the AMR over a short distance when the AMR has no power.
Work Bench		28110-504	A table for mounting the AMR to perform AMR maintenance tasks.
Maintenance Kit 1		28110-506	Kit includes lens cloth for laser lens cleaning.
Maintenance Kit 2		28110-505	Kit includes cleaning fluid for laser lens cleaning.
Mobile I/O Box		23419-802	Used with Fleet Manager to summon an AMR to a Goal or control connected devices with I/O.
Mobile I/O Box Power Supply		23419-812	Recommended for purchase with the Mobile I/O Box.

A-2 Network Port Allocation

Network ports are assigned as described in the table below.

Port	Protocol	Category	Initiator to Recipient	Details
37	TCP	Intra-fleet Communications Ports. Used to broadcast configuration updates to AMRs, to dispatch Job commands, and to share position and trajectory updates throughout the fleet.	AMR to Fleet Manager	Maintenance, Management, and Fleet ports use this.
5000	TCP/UDP			Fleet port uses this.
Range 10000 and up	UDP			For UDP Range 10000 connections and up, such as an AMR connecting to a Fleet Manager, this protocol grows with the number of robots. For best results, allocate at least twice as many UDP ports as there are AMRs in the fleet. For instance, a fleet of 20 AMRs should have an allocated range of 10000-10039.
7272	TCP/UDP			
1884	TCP			
5672	TCP	Integration Toolkit TCP Ports. Excludes dynamically allocated port numbers.	RabbitMQ AMQP	
8443			ITK REST	
5432			PostgreSQL	
8883			MQTT	
443	TCP	Configuration and Monitoring of Fleet. Used for MobilePlanner connections to the Fleet Manager and AMRs for monitoring and configuration.	Client PC to Fleet Manager	Maintenance and Management ports use this.
Range 7272 and up	TCP/UDP		Client PC to Fleet Manager	This protocol uses as many ports as there are AMRs. Each AMR that connects uses the next available port >= 7272. For best results, allow a large number of ports, such as 7272-7999.
7272	TCP/UDP		Client PC to AMR	
Range 10000 and up	UDP		Fleet Manager Appliance to Client PC	This protocol uses as many ports as there are AMRs. Each AMR that connects uses the next available port >= 10000. For best results, allow a large number of ports such as10000-10999.
10000	UDP		AMR to Client PC	

Port	Protocol	Category	Initiator to Recipient	Details
7171	TCP	Job Monitoring and Submission (ARCL Interface). Used for managing Jobs on the Fleet Manager Appliance, typically submitted from a Warehouse Management System (WMS) or Manufacturing Execution System (MES).	WMS/MES to Fleet Manager	If ARCL Server is enabled in the configuration (*Robot Interface* and then *ARCL Server Setup*), then this port is open on the Fleet Manager and accepts unlimited incoming connections. The port number is configurable. (This port might be available on the AMR, depending on the application.)
Configurable port #	TCP		Fleet Manager Appliance to WMS/MES	If Outgoing ARCL Connection is enabled in the configuration (*Robot Interface* and then *Outgoing ARCL Connection Setup*), then the Fleet Manager initiates an outgoing connection to the specified hostname and TCP port number.
123	TCP	Optional.	Fleet Manager Appliance to NTP server	If you enable an NTP client Fleet Manager Appliance (*SetNetGo* then *System* and then *Date/Time*), the Fleet Manager Appliance attempts to set its clock from the NTP sever at the specified IP address. (This function is available on the AMR, if you do not use a client Fleet Manager Appliance.)
Range 1000 - 65535	UDP/TCP		Offboard devices to AMR	If RS232 or Ethernet Port Forwarding is enabled on the AMR (*SetNetGo* then *Network*) then the configured TCP ports are open on the AMR for incoming connections.

A-3 Storing the AMR

If the AMR will not be operated for a period of time, the AMR may be stored in a safe location following the environmental storage conditions specified in this manual. Refer to *2-4-1 AMR Environmental Specifications* on page 2-12 for more information.

Precautions for Safe Use

Make sure the AMR is switched OFF before it is stored.

Make the following considerations when storing the AMR.

- The storage area must be covered, dry, and well ventilated.
- The AMR and its parts must be stored in a dust-free area. If this cannot be guaranteed, then the AMR must be covered with plastic film.
- Ensure the battery is charged to at least 50% SOC before storing the AMR for an extended period.

A-4 Shipping the AMR

Make the following considerations when shipping the AMR to another location.

- Keep the original crate and shipping materials supplied with the AMR. Use these to repackage the AMR before shipping. Reverse the unpacking instructions provided in *AMR (Autonomous Mobile Robot) OL-series Safety, Unpacking , and Assembly Guide (Cat. No. M110)*.
- Before shipping a battery, ensure it is in good, working condition and has not been subjected to conditions that may have caused damage.
- Keep the AMR and battery within the specified environmental ranges during transportation. Refer to *2-4 Environmental Specifications* on page 2-12 for more information.
- Do not subject the AMR or battery to excessive shock or vibration during transportation.
- Place the Main Disconnect Switch in the OFF position. Refer to *Main Disconnect Switch* on page 1-7 for more information.
- Check the battery charge level for compliance with shipping regulations.
- Plan adequate shipping times to prevent battery depletion during transit or storage.



Precautions for Safe Use

- Keep fingers clear of mast joints when raising or lowering the mast.
- Carefully tilt the mast over so that the cables on the inside are not trapped.

A-5 Lubricants

OMRON recommends the use of the following lubricants for the AMR's Lifting System.
Lubricant type: Lithium saponified, Consistency: NLGI 2

Item	Brand
Energrease LS 2	BP
Longtime PD 2	Castrol
Renolit GP 2	Fuchs
Multemp PS No.2	Kyodo Yushi
Mobilux EP 2	Mobil
Multilub	Molykote
Gadus S2 V100 2	Shell
LGMT 2	SKF

OMRON Corporation **Industrial Automation Company**

Kyoto, JAPAN **Contact : www.ia.omron.com**

Regional Headquarters

OMRON EUROPE B.V.
Wegalaan 67-69, 2132 JD Hoofddorp
The Netherlands
Tel: (31) 2356-81-300 Fax: (31) 2356-81-388

OMRON ASIA PACIFIC PTE. LTD.
438B Alexandra Road, #08-01/02 Alexandra
Technopark, Singapore 119968
Tel: (65) 6835-3011 Fax: (65) 6835-3011

OMRON ELECTRONICS LLC
2895 Greenspoint Parkway, Suite 200
Hoffman Estates, IL 60169 U.S.A.
Tel: (1) 847-843-7900 Fax: (1) 847-843-7787

OMRON ROBOTICS AND SAFETY TECHNOLOGIES, INC.
4225 Hacienda Drive, Pleasanton, CA 94588 U.S.A.
Tel: (1) 925-245-3400 Fax: (1) 925-960-0590

OMRON (CHINA) CO., LTD.
Room 2211, Bank of China Tower, 200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
Tel: (86) 21-6023-0333 Fax: (86) 21-5037-2388

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