

HD-1500 Platform

Assembly Instructions

According to Machinery Directive 2006/42/EC (ANNEX VI)



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Introduction

Thank you for purchasing the HD-1500 Autonomous Mobile Robot (referred to as AMR in this document).

This document is OMRON's original instructions describing the setup and assembly of an HD-1500 Autonomous Mobile Robot.

This document does not describe all configuration steps that you perform using the software supplied with the AMR. The *Mobile Robot HD Safety Manual (Cat. No. I647)* describes the details for maintenance and operating details of the AMR. The *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* describes configuration and use of the AMR.

Please read this document and make sure you understand the functionality and performance of the AMR before attempting to use it.

Keep this document in a safe place where it will be available for reference.

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.
- 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.

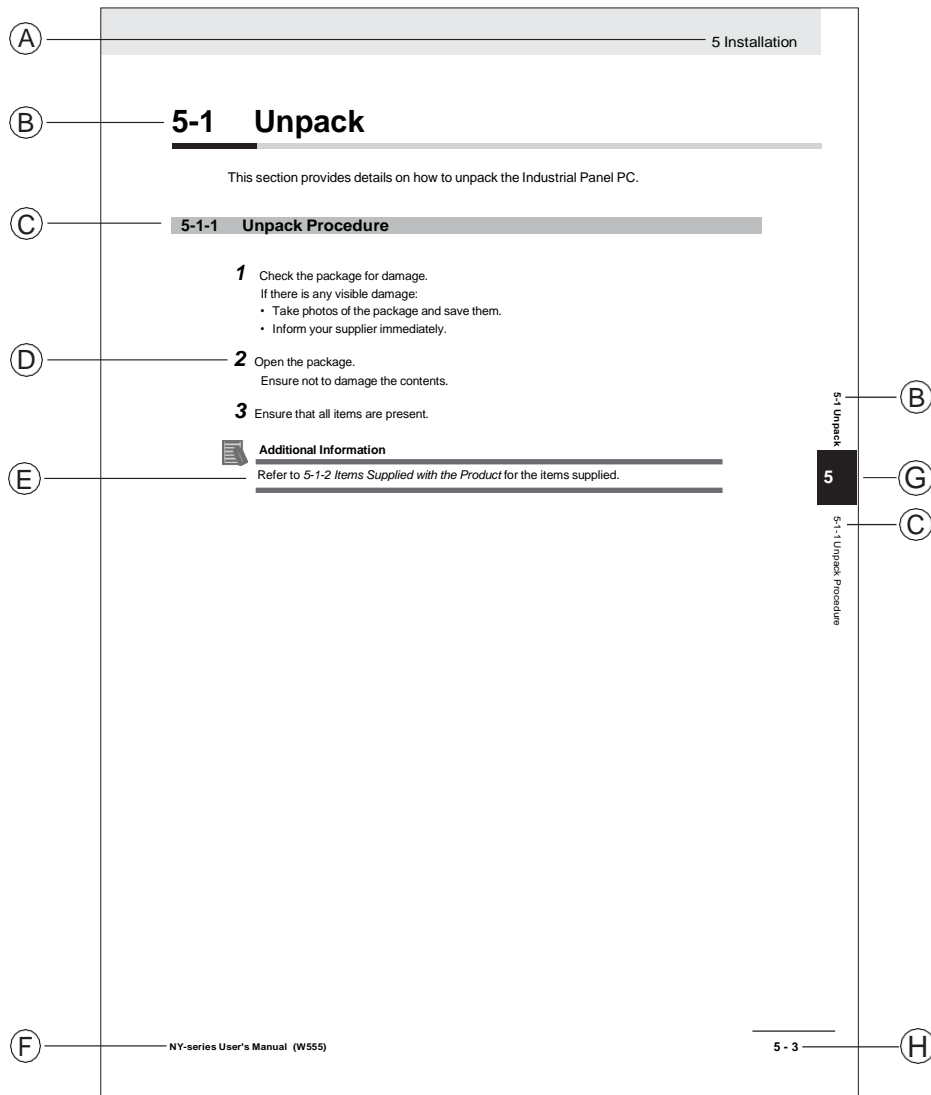
Units

Unless otherwise noted, length dimensions are in millimeters and all units are metric.

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.

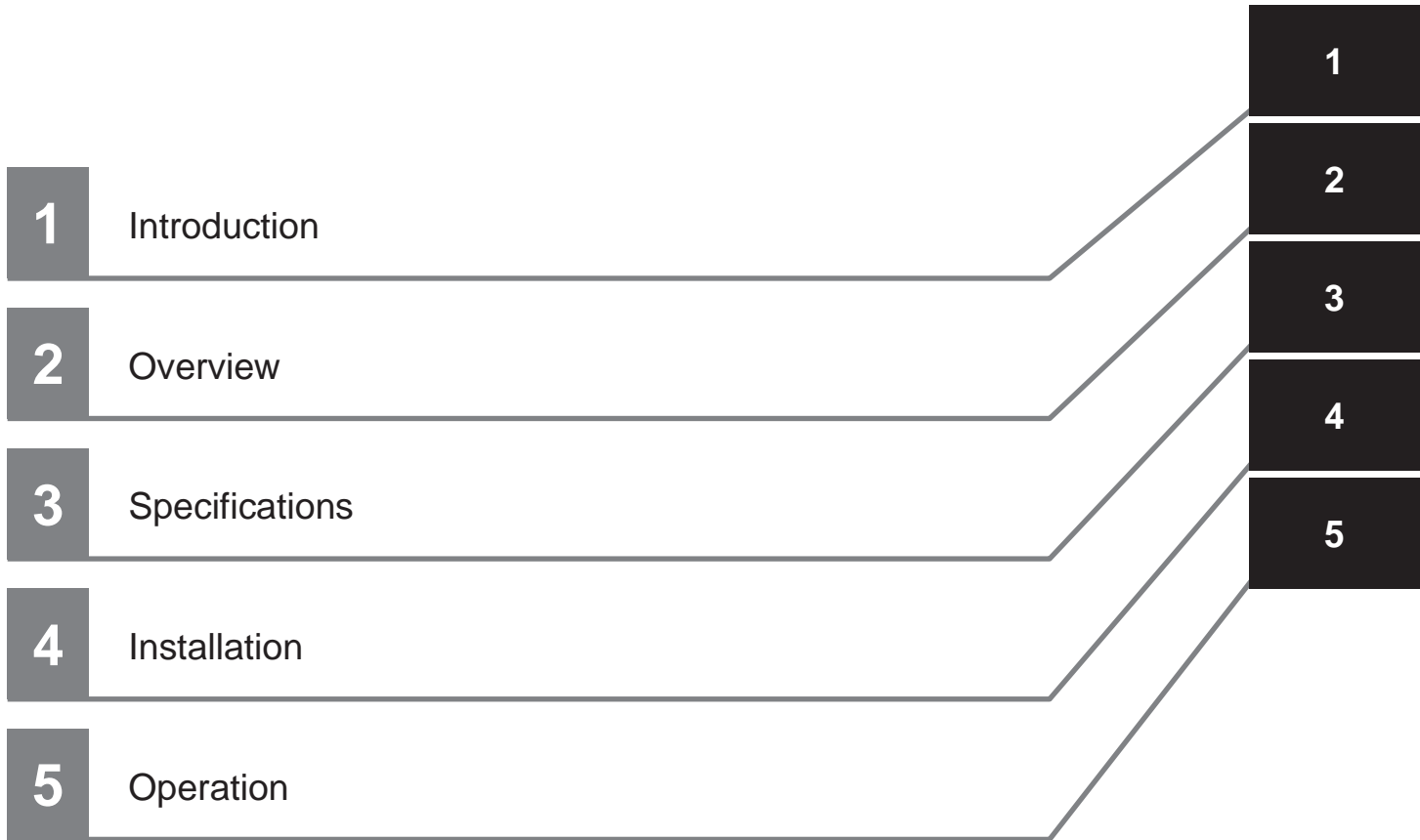
This information is provided to increase understanding or make operation easier.



Version Information

Information on differences in specifications and functionality between different versions.

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Warranty and Limitations of Liability

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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.

Dangers

DANGER

The AMR can cause serious injury to personnel or damage to itself or other equipment if it drives off of a ledge, such as a loading dock, or down stairs.



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.



Improper operation of the AMR on inclined floors that do not comply with the applicable operating specifications can result in the AMR tipping over, and consequently a serious personal injury.



Warnings

General

The following actions are strictly prohibited and could result in injury or damage to the equipment.

- Riding on the AMR.
- Towing applications.
- Exceeding the maximum payload limit.
- Operating on inclined floors or surfaces.
- Operating in environments with life support systems.
- Operating in residential areas. Operating on non-stationary areas, including moving floors or any type of land vehicle, watercraft, or aircraft.
- Exceed the maximum recommended speed, acceleration, deceleration, or rotation limits. Rotational speed becomes more significant when the payload's center of gravity is increasingly offset from the AMR's center of gravity.
- Dropping, driving off a ledge, or operating irresponsibly.
- Allowing the AMR to drive through an opening that has an automatic gate or door, unless the door and AMR are configured correctly with the Call / Door Box option.
- Throwing an object in front of the AMR or suddenly stepping into the path of the AMR. The AMR braking system cannot be expected to function as designed and specified in such instances.
- Exposing the AMR to rain or moisture.
- Using unauthorized parts to repair the AMR.
- Powering ON the AMR without its wireless antennas in place.
- Operate the AMR in hazardous environments where there is explosive gas, an oil mist, or a corrosive atmosphere.
- Operating the AMR in an environment that contains ionizing radiation.
- Using non-approved batteries or charging systems.



The Charging Station, battery, and AMR transfer high electric power and contain hazardous voltages. You must take necessary precautions to avoid electric shock. Follow appropriate Lock-Out, Tag-Out (LOTO) instructions prior to any installation and maintenance work performed on or near these items.



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



Any modifications made to the AMR can lead to loss of safety or functionality of the AMR. It is the end-user's responsibility to perform complete risk assessment after making any modifications to the AMR, and to confirm that all safety features of the AMR are fully functional.



The AMR as a partly-completed machine is intended to be incorporated into other machinery and must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of EC Machinery Directive 2006/42/EC, where appropriate.



The assembly instructions shall then form part of the technical file for the final machine.

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.



If you are using a user-supplied E-stop, you must perform safety commissioning to verify the emergency stop functionality before putting the AMR into service.



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



It is the end-user's responsibility to make sure that the AMR is operated within its specifications, intended use, and intended environments.



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.



Although the AMR is commissioned at the factory, the user must perform safety commissioning as part of the initial setup upon receipt.



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.



You need to modify the safety zones if your payload overhangs the AMR's default dimensions and if operating on a floor surface that has poor traction to the extent that the AMR cannot stop reliably within the default zones. OMRON is not responsible for any risks incurred by modifying safety zone sizes or other Safety Laser Scanner settings.



The rare-earth magnet embedded in the AMR charging contacts creates a strong magnetic field. Magnetic fields can be hazardous if you have a medical implant. Keep a minimum of 30 cm away from the AMR charging contacts.



Battery and Charging Station

You must wear proper Personal Protective Equipment (PPE) for removing, installing, and lifting the battery or when working around a leaking battery.



At least 3 people are required to lift the battery.



Always use safe lifting practices when removing or installing the battery.



Payload

The payload must be kept higher than the top of the AMR. If the payload or associated structure blocks any of the AMR's sensors, it cannot function correctly.



The total weight of your payload structure plus any objects carried by the structure must not exceed the maximum payload capacity of the AMR.



Tipping hazards are more likely if the payload center of gravity is outside the recommended specifications.



If a payload or payload structure projects or overhangs the outer dimensions of the AMR, make the following considerations.

- Contact your OMRON representative to change the size of the Safety Laser Scanners' zones.
- Repeat the safety commissioning procedure.
- Modify parameters to change the AMR's *Width*, *LengthFront*, *LengthRear*, and potentially its *Radius*. When making these modifications, ensure that the AMR's accurate dimensions are used during path planning and obstacle avoidance.



Operating Environment

The AMR is not intended to be operated on ramps or sloped surfaces. Using the brake release button while the AMR is positioned on a slope of greater than 3% will cause the AMR to roll down. You must not use the brake release button to move the AMR manually when it is positioned on a slope of greater than 3%, unless necessary precautions have been taken to prevent uncontrolled rolling of the AMR.



Use caution when stopping the AMR on a ramp. The use of the brake release will cause direct rolling of AMR down the ramp. Powering OFF the AMR on a ramp should be avoided if possible to minimize the use of brake release on a ramp.



Dust, dirt, grease, and water (or other liquids) can affect wheel traction, as well as operation of the drive wheels. If the drive wheels slip, it can potentially affect operating duration, stopping distance, and navigation accuracy.



Cautions

CAUTION

Any electrical charge that accumulates on the AMR skins does not have a path to ground, and therefore cannot discharge. This can be hazardous to electrostatic sensitive devices. Always keep electrostatic sensitive devices at least 30 cm away from the AMR skins.



All E-stop buttons must be located in areas that are easy to reach and within 600 mm of personnel. It is the end user's responsibility to ensure that any additional E-stop buttons are placed in a location where the operator can easily access them in an emergency situation.



An AMR must have a readily visible warning device such as a user-supplied flashing light, to indicate when it is either ready to move or is moving.



Pushing an AMR requires significant effort and might cause personal injury or property damage. Take appropriate care and follow all safety instructions.



The pushing points of the AMR are low to the ground. You must use safe pushing practices when manually moving the AMR.



When manually moving the AMR, do not push it from a high position on its payload or payload structure. This might cause the AMR to topple.



Manually moving a fully-loaded AMR while using the brake release button is not recommended. If you must manually move a fully-loaded AMR, make sure to do this safely as this could result in personal injury or property damage.



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.



Precautions for Safe Use

- The following actions are required for safe use of the AMR.
 - Review and understand the safety protections associated with your specific application and environment.
 - Make use of the Fleet Manager when two or more AMRs are used in the same environment and are not confined to separate workspaces. Refer to the *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for more information.
 - Make sure that any person working with or near an AMR is trained and has read and understands this document and the *Mobile Robot HD Safety Manual (Cat. No. I647)*.
 - Mechanically maintain and service AMRs for proper operation of all control and safety functions.
- All equipment must be shipped and stored in a temperature-controlled environment, within specified temperature and humidity range. It should be shipped and stored in the supplied packaging, which is designed to prevent damage from normal shock and vibration.
- OMRON recommends storing and securing the pendant when not in use to prevent an unauthorized person from operating the AMR.
- Prior to cleaning the Charging Station, you must ensure that the AMR is not engaged with the Docking Target.
- Use a rated forklift, pallet jack, or similar devices to move the shipping crates.
- To prevent damage to the lifting points, AMR chassis, or lifting rings, do not exceed a 30° angle from vertical when attaching the lifting straps to the lifting device.
- Do not exceed 25 kN per lifting mount point.
- Inspect lifting straps for signs of wear and tear or any damages before attaching to the lifting rings and lifting the AMR.
- 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.
- Do not power ON the AMR until you have read the appropriate sections of this document.
- It is the end user's responsibility to provide the necessary training to personnel to properly mark the floors around the payload transfer locations.
- It is the end user's responsibility to ensure that the person operating the overhead hoist or forklift has successfully completed the required training, and is certified to operate these machines.
- The operator must take necessary precautions to ensure that the operator's hands or other body parts do not get stuck in between the charging pad and the AMR when docking.
- Do not operate the robot in areas where environmental conditions are beyond what is specified in this document.
- You must have floor markings to prevent people from entering the operating hazard zone for pick-up / dropoff locations with inadequate clearance.
- 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.



- 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.

- Operating the AMR at high ambient temperatures (particularly when carrying a full payload at high speeds) can cause the battery to exceed its operating temperature limits. If this happens, do not try to access the battery. You must allow several hours for an overheated battery to cool sufficiently before trying to remove or replace it.
- Avoid liquid near the Charging Station and the AMR.
- If you suspect that liquid has penetrated the skins or contaminated the AMR's interior, do not attempt to power ON the system and contact your OMRON representative.
- In case of fire, use a type ABC or type BC dry chemical fire extinguisher.
- Although the lasers used are Class 1 (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.
- 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.
- Consider all safety factors related to the location of the integrated E-stop button when relocating the Operator Panel.
- The emergency stop or other protective stop devices you install on the AMR must have dual channel circuit to ensure the same performance level as the other safety devices of the AMR.
- Any E-stop buttons installed on the payload structure must be within 600 mm of reach. They must not be installed in a location that affects operator's safety in order to reach them in an emergency situation.
- You must ensure that the payload structure is properly secured to the AMR.
- 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 E-stop button.
- You must perform a complete risk assessment for your payload design and the intended use of the AMR prior to its operation.
- Intentional movement of the payload structure (such as conveyor or arm) during the AMR movement is prohibited. It is the end-user's responsibility to design an appropriate interlock to prevent this.
- For payload applications where you cannot easily reduce the size and weight of the payload, or if the AMR's center of gravity is not within the recommended limits, contact your OMRON representative.
- The tilt detection feature will not prevent an improperly loaded AMR from toppling.
- Damaged or worn casters and drive wheels can degrade the AMR stability. You must regularly inspect the casters and drive wheels for signs of damage, excessive wear, or uneven spots.
- The Power Supply Box must be installed according to the local regulations or codes, and by authorized personnel or licensed electricians.
- The Power Supply Box and the Docking Target must be properly secured to the wall or floor prior to operation.
- Never access the interior of the AMR while it is connected to the Docking Target.
- Only use chargers and batteries supplied by OMRON. The charger shall only be used to charge an HD-1500 AMR battery.
- Avoid shorting the battery terminals or connectors.
- 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 speed does not cause the AMR to move uncontrollably.

- After you remove or replace the skins, you must make sure that the light strips and discs are operational once the AMR is powered back ON.

Precautions for Correct Use

- Never expose the battery to water.
- Do not connect user-supplied equipment to the Ethernet switches located in the electronics bay.
- Rough or uneven floors can degrade the drive wheels, and shorten their life span.
- Replacement of the differential drive train, casters, and wheels require an OMRON service engineer. Contact your local OMRON representative for more information.
- When speakers are used as a means of notifying personnel of an approaching AMR, you must routinely verify that they are still functioning normally. Verify that the speakers are audible, and the sound level is at the same level as needed during the operation.
- Using the EM2100 or map features is not a substitute for physical methods of preventing collisions, such as interlocked gateways or barriers. It is the user's responsibility to provide a physical method of preventing collisions where necessary.
- Do not leave an AMR that is not localized, not connected to the EM2100, or not powered ON in a location that can be accessed by other AMRs.
- If it is not possible to prevent some interference between the payload and the Side Lasers' sensing plane, the *LaserIgnore* parameter can be used to constrain sensing to zones that do not include the payload. However, this method might compromise the detection ability of the sensors and should be avoided if possible.
- Laser lenses can easily get scratched and damaged. Care must be taken to prevent scratching the laser lens during any maintenance or installation procedures.
- Factory installed Side Lasers are protected by guards. If you relocate the Side Lasers, consider using protective guards to prevent damage. Make sure that user-installed guards do not block the scanning area or extend outward excessively.
- Map creation is required before normal operation of the AMR.
- The Integration Toolkit only runs on an EM2100 appliance configured as a Fleet Manager.
- Minimize payload power consumption whenever possible to prevent excessive battery drain.
- Vertical orientation of the Power Supply Box allows for heat dissipation, which prevents overheating and possible fire danger. Horizontal installation of the Power Supply Box is not allowed.
- If you do not use appropriate fasteners for sustained use, the Docking Target will move during the docking attempts and cause docking and charging failures.
- The Power Supply Box has cooling vents at the top and bottom of the unit. Do not block these areas.
- The main disconnect switch located on the electrical access panel controls current flow into the Power Supply Box. When the switch is in the horizontal position, it is OFF and when it is in the vertical position, it is ON.
- During the initial AMR installation and configuration, install a fully-charged battery.
- 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.
- Before you configure wireless Ethernet on your AMR, contact your network administrator to confirm the IP, radio, and security settings.
- It is the end user's responsibility to ensure that the payload does not attenuate the wireless antennas' signal.

- You must attach either a jumper or some other safety-rated devices (typically E-stop buttons) to the SCPU connector in order for the AMR to function. The jumper is provided as part number 68410-218L.
- Do not exceed 10 kN per payload structure mounting point.
- OMRON does not provide the protective coverings with the HAPS option. A protective covering needs to be installed when applying the magnetic tape to the floor to prevent damage from the AMR traffic. The protective covering must be supplied by the user.
- There may be future updates for the Safety Controller. Safety Controller updates cause the Safety Laser Scanner to decommission because the safety zone check will fail. After a Safety Controller update is complete, you must recommission the Safety Laser Scanner.
- Do not operate the robot on soft surfaces such as carpet.
- The AMR is designed and intended to operate on smooth and level floors. While it is capable of driving over a step or gap, frequent or high-speed driving over steps or gaps will shorten the lifespan of the drivetrain components.
- An environmental hazard barrier must be easily detectable by the AMR and also strong enough to stop a fully-loaded AMR traveling at its maximum speed.
- Always ship and store the AMR, Power Supply Box, and the Docking Target in an upright position in a clean and dry area. Do not lay the shipping crates on their sides or any other non-upright position. This could damage the Power Supply Box and the Docking Target.
- You must route and secure the power cords properly. They must be secured in such a way that prevents straining of the connection points.
- It is safe to connect or disconnect the power cord from the Docking Target without powering OFF the Power Supply Box.
- Always wait until the green OPERATION LED indicator on the Power Supply Box is ON solid before attempting to charge a battery.
- Do not press the Service button on the Power Supply Box if the yellow DC POWER LED indicator is flashing when there is no battery connected. Contact your OMRON representative if this condition is present.
- The AMR must be powered ON in order to charge the battery while at the Docking Target.
- Avoid moving the AMR while it is powered OFF. If you manually move the AMR while it is powered OFF, it may not be able to determine its current location when it is powered ON again. Use the localization feature in MobilePlanner to localize the AMR if this occurs.
- You should move the AMR manually only when absolutely necessary during an emergency, for safety, or if it is lost or stuck. If you find that you must frequently move the AMR, use MobilePlanner to reconfigure its route to avoid problematic areas.
- If the loaded AMR is too heavy to move manually, it is recommended that you seek additional help or remove the payload.
- OMRON recommends that you train personnel on the safe use of the brake release button and procedures for safely pushing an AMR.
- IATA regulations (UN 3480, PI 965) require that air freight shipped lithium ion batteries 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.
- The Power Supply Box can only be connected directly to the Docking Target or to one battery. Simultaneous charging configurations are not possible.
- The main disconnect switch should not be used as a frequent means of turning OFF the AMR. Use the OFF button to turn OFF the AMR with a controlled shutdown method.

- Only qualified personnel who have read and understood this manual and the *Mobile Robot HD Safety Manual (Cat. No. I647)* should manually move the AMR.
- Maintenance of the payload structure is not covered in this document and is the responsibility of the end-user.
- 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.
- Do not use solvents or chemicals other than isopropyl alcohol on the AMR charging contacts, as this could damage the AMR surfaces near the contacts. Do not expose any of the surfaces surrounding the charging contacts to isopropyl alcohol.
- Do not reduce the charging surface area of the charging contacts while cleaning. A smaller charging surface will reduce the charging speed and affect charging operations.
- The operation of the lasers may be affected by substances in the AMR operating environment, such as fog, smoke, steam, and other small particulate. You must clean the lenses of all lasers periodically and as guided in this document to avoid operational failures.
- The position of the antenna is critical to correct operation. You must make sure to attach a new antenna to the correct location etched on the base plate.
- After removing the skin panels, place them inner-side down so that the outer surfaces do not get scratched.

Regulations and Standards

Conformance to EU Directives

The AMR complies with the following EU Directives.

Directives

- 2006/42/EC
Machinery Directive
- 2014/30/EU
EMC Directive

EN Harmonized Standards

The AMR system conforms to the following EN 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.
- EN 60204-1
Safety of Machinery.
Electrical equipment of machines, Part 1 General Requirements.
- EN 61000-6-4
EMC, Part 6-4: Emissions Standard for Industrial Environments.
- EN 61000-6-2
EMC, Part 6-2: Immunity Emissions Standard for Industrial Environments.
- EN ISO 10218-1 Safety Requirements For Industrial Robots
- EN 61204-7 used in conjunction with EN 62477-1 low-voltage switch mode power supplies (Charging Station only).

EC Declaration of Incorporation

Document P/N: 22454-000 Rev. B

Original



EC DECLARATION OF INCORPORATION

According to EC Directive 2006/42/EC, Annex II 1.B.

1. Business Name & Address

Omron Robotics and Safety Technologies, Inc.
4225 Hacienda Drive, Pleasanton, CA, 94588, USA

2. Name & Address of person authorized to compile technical documentation in EU

Mr. J.J.P.W. Vogelaar, European Quality & Environment Manager, Zilverenberg 2, 5234 GM 's-Hertogenbosch, The Netherlands

3. Description and Identification of Partly Completed Machinery

Equipment	Description	Model number
Mobile Robot	HD-1500	6800-xxxxx
Battery Pack	HD Series Battery	6833-xxxxx
Charging Dock	HD Docking Station	6831/6891-xxxxx
Pendant Option	HD Pendant	68940-xxx

4. Essential Requirements of the Machinery Directive applied and fulfilled

1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.3.8, 1.3.9, 1.4.3, 1.5.1, 1.5.2, 1.5.5, 1.5.6, 1.5.7, 1.5.8, 1.5.9, 1.5.10, 1.5.11, 1.5.12, 1.5.14, 1.6.1, 1.6.2, 1.6.3, 1.6.4, 1.7.1, 1.7.2, 1.7.3, 1.7.4, 3.3, 3.3.1, 3.3.3, 3.4.1, 3.5.1, 3.6.1, 3.6.2.

Relevant technical documentation is compiled in accordance with Annex VII, Part B of the EC Machinery Directive 2006/42/EC

2006/42/EC Machinery Directive
- EN ISO 12100:2010, EN ISO 13849-1:2015, EN ISO 10218-1:2011, EN 60204-1:2018, EN 61204-7:2018, EN 62477-1:2012/A11:2014
2014/30/EU EMC Directive
- EN61000-6-4:2007/A1:2011, EN 61000-6-2:2019

5. Method of Transmission

We undertake, in response to a reasoned request by national authorities, to supply relevant information on the partly completed machinery, in electronic form, to the market surveillance authorities within a reasonable period. Provision of this information shall be without prejudice to the intellectual property rights of Omron Robotics and Safety Technologies, Inc.

6. Statement of Service for Partly Completed Machinery

Partly completed machinery described in section 3 above must not be put into service until the final machinery, into which it is to be incorporated, has been declared in conformity with the provisions of the EC Machinery Directive 2006/42/EC, where appropriate.

Signed and on behalf of: Omron Robotics and Safety Technology, Inc.

Place and date of issue: Pleasanton, California, USA; 19 May 2021

Signature:

Andrew Shruhan

Name:

Andrew Shruhan

Function:

Director of Electrical Engineering

1/1

UK Declaration of Incorporation

Document P/N: 22454-400 Rev. A

Original



UK DECLARATION OF INCORPORATION

According to the Supply of Machinery (Safety) Regulations 2008

1. Business Name & Address

Omron Robotics and Safety Technologies, Inc.
4225 Hacienda Drive, Pleasanton, CA, 94588, USA

2. Name & Address of person authorized to compile technical documentation in UK

OMRON ELECTRONICS LTD.
Attn: G. Harper, Manager, Customer Care
Opal Drive, Fox Milne, MK15 0DG, Milton Keynes, United Kingdom

3. Description and Identification of Partly Completed Machinery

Equipment	Description	Model number
Mobile Robot	HD-1500	6800-xxxxx
Battery Pack	HD Series Battery	6833-xxxxx
Charging Dock	HD Docking Station	6831/6891-xxxxx
Pendant Option	HD Pendant	68940-xxx

4. Essential Requirements of the supply of Machinery (Safety) Regulations applied and fulfilled

1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.3.8, 1.3.9, 1.4.3, 1.5.1, 1.5.2, 1.5.5, 1.5.6, 1.5.7, 1.5.8, 1.5.9, 1.5.10, 1.5.11, 1.5.12, 1.5.14, 1.6.1, 1.6.2, 1.6.3, 1.6.4, 1.7.1, 1.7.2, 1.7.3, 1.7.4, 3.3, 3.3.1, 3.3.3, 3.4.1, 3.5.1, 3.6.1, 3.6.2

Relevant technical documentation is compiled in accordance with Annex VII, Part B of the Supply of Machinery (Safety) Regulations 2008

S.I. 2008 No. 1597 Supply of Machinery (Safety) Regulations 2008
- EN ISO 12100:2010, EN ISO 13849-1:2015, EN ISO 10218-1:2011, EN 60204-1:2018, EN 61204-7:2018, EN 62477-1:2012/A11:2014
S.I. 2016 No. 1091 Electromagnetic Compatibility Regulations 2016
- EN61000-6-4:2007/A1:2011, EN 61000-6-2:2019

5. Method of Transmission

We undertake, in response to a reasoned request by national authorities, to supply relevant information on the partly completed machinery, in electronic form, to the market surveillance authorities within a reasonable period. Provision of this information shall be without prejudice to the intellectual property rights of Omron Robotics and Safety Technologies, Inc.

6. Statement of Service for Partly Completed Machinery

Partly completed machinery described in section 3 above must not be put into service until the final machinery, into which it is to be incorporated, has been declared in conformity with the provisions of the Supply of Machinery (Safety) Regulations 2008, where appropriate.

Signed and on behalf of: Omron Robotics and Safety Technology, Inc.

Place and date of issue: Pleasanton, California, USA; 19 May 2021

Signature:

Andrew Shruhan

Name:

Andrew Shruhan

Function:

Director of Electrical Engineering

1/1
IAB-SSG-042B

Related Manuals

Use the following related manuals for reference.

Manual Title	Description
HD-1500 Platform User's Manual (Cat. No. I645)	Contains information necessary to install, operate, maintain and troubleshoot HD-1500 AMRs.
HD Mobile Robot Safety Manual (Cat. No. I647)	Contains general safety information for HD-1500 AMRs.
Safety Laser Scanner OS32C Series User's Manual (Cat. No. Z296-E1)	Describes the use of the OS32C Safety Laser Scanner.
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.
Enterprise Manager 2100 User's Guide (Cat. No. I631)	Describes the installation of an EM2100 appliance, which runs the Fleet Operations Workspace software to manage a fleet of AMRs.
Fleet Simulator User's Manual (Cat. No. I649)	Describes the configuration and use of the Fleet Simulator software on an EM2100 appliance.
Fleet Operation Workspace Core Integration Toolkit User's Guide (Cat. No. I637)	Contains information that is necessary to use the Integration Toolkit facilitating integration between the Fleet Manager and the end user's client application.
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.
Sysmac Studio Version 1 Operation Manual (Cat. No. W504)	Describes the operating procedures of the Sysmac Studio.
AMR Controller User's Guide (Cat. No. I650)	Describes the information necessary to use the AMR Controller.

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 HD-1500 autonomous mobile robot.
AMR Controller	The AMR's main computing system that provides all navigational controls and mobile robot application interfaces.
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 EM2100 appliance, ARCL can help manage a fleet of mobile robots.
Auto-MDIX	A connection port feature that automatically detects the Ethernet cable type being used (straight-through or crossover) and configures the connection appropriately.
Beacon	An optional indicator lamp mounted on the AMR to provide additional visual indication and signaling of the operating state.
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 Power Supply Box, the Docking Target, 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.
Docking Target	A fixed object that is connected to the Power Supply Box that the AMR docks to that is used for autonomous charging.
Dongle	A small hardware device that contains the credentials (e.g., license key) required to run a specific program. A dongle is used in each AMR to enable the use of the ARAM software.
Dropoff	A job segment typically used where an AMR's payload is transferred from the robot to the goal.
E-Stop	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.
EM2100	A network appliance that acts as a Fleet Manager or Fleet Simulator.
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.

Term / Abbreviation	Description
Fleet Manager	The operational mode of the computing appliance (EM2100) 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).
HAPS	High Accuracy Positioning System that uses a sensor on the underside of the AMR to detect magnetic tape placed at locations where you want the AMR to achieve particularly accurate positioning.
I/O	Input and output signals that are transmitted to and from a device.
Instructed persons	Persons that are adequately advised or supervised by skilled persons to enable them to avoid electrical and mechanical dangers.
Interlock	A mechanical or electrical device intended to prevent machines from operating unless certain conditions are met.
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.
Jumper	A conductive device that electronically bridges two connection points.
LED	A light emitting diode that illuminates to provide a visual indication of some operation.
Light disc	The circular lights on the sides of the AMR that indicate motion, turns, and robot 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.
Map	A representation of the AMR's environment within MobilePlanner that it uses for navigation.
MobilePlanner	The primary software application for programming mobile robot 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.
Operator Panel	The primary interface on the AMR that provides user interaction functions.
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.
Payload structure	Any passive or dynamic device attached to and possibly powered by the AMR to support a payload.
Pendant	A handheld, external input device for manually driving AMRs that is typically used for map creation.
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.

Term / Abbreviation	Description
Power Supply Box	Unit that receives AC power from the facility and supplies power to the Docking Target and battery for charging purposes.
Safety commissioning	Testing and commissioning for verification of proper function the AMR's on-board 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 EM2100 appliance. It is used to configure the AMR's communication parameters, gather debuginfo files, and upgrade the software.
Skilled persons	Persons that have the technical knowledge or sufficient experience to enable them to avoid electrical or mechanical dangers.
Shutdown	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.
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	July 2021	Original production

Overview

This section provides general information about the robot.

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1-1 Assembly Instructions

This manual is OMRON's original instructions describing the setup and assembly of an HD-1500 Autonomous Mobile Robot (AMR).

The assembly instructions in this document detail all safety-related aspects of the AMR, as partly-completed machinery. It also identifies the interface between the partly-completed machinery and the final machinery. The interface has to be considered by the assembler to safely incorporate the partly-completed machinery into the final machinery.

WARNING

The AMR as a partly-completed machine is intended to be incorporated into other machinery and must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of EC Machinery Directive 2006/42/EC, where appropriate.

The assembly instructions shall then form part of the technical file for the final machine.



These assembly instructions for the AMR as a partly-completed machinery, provide the necessary information to enable the manufacturer of the final machinery to draft the parts of the instructions as required from ESHR 1.7.4.

1-2 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.

OMRON does not provide the method of loading the payload on or off the AMR. It is the end user's responsibility to perform a complete task-based risk assessment in accordance with EN ISO 12100, and ensure safe transfer of the payload.

The AMR shall be commissioned as instructed in this manual.

DANGER

- Improper operation of the AMR on inclined floors that do not comply with the applicable operating specifications can result in the AMR tipping over, and consequently a serious personal injury.
- The AMR can cause serious injury to personnel or damage to itself or other equipment if it drives off of a ledge, such as a loading dock, or down stairs.



WARNING

- Dust, dirt, grease, and water (or other liquids) can affect wheel traction, as well as operation of the drive wheels. If the drive wheels slip, it can potentially affect operating duration, stopping distance, and navigation accuracy.
- Any modifications made to the AMR can lead to loss of safety or functionality of the AMR. It is the end-user's responsibility to perform complete risk assessment after making any modifications to the AMR, and to confirm that all safety features of the AMR are fully functional.
- 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.
- It is the end-user's responsibility to make sure that the AMR is operated within its specifications, intended use, and intended environments.
- The rare-earth magnet embedded in the AMR charging contacts creates a strong magnetic field. Magnetic fields can be hazardous if you have a medical implant. Keep a minimum of 30 cm away from the AMR charging contacts.

The following actions are strictly prohibited and could result in injury or damage to the equipment.

- Riding on the AMR.
- Towing applications.
- Exceeding the maximum payload limit.
- Operating on inclined floors or surfaces.
- Operating in environments with life support systems.
- Operating in residential areas.
- Operating on non-stationary areas, including moving floors or any type of land vehicle, watercraft, or aircraft.
- Exceed the maximum recommended speed, acceleration, deceleration, or rotation limits. Rotational speed becomes more significant when the payload's center of gravity is increasingly offset from the AMR's center of gravity.
- Dropping, driving off a ledge, or operating irresponsibly.
- Allowing the AMR to drive through an opening that has an automatic gate or door, unless the door and AMR are configured correctly with the Call / Door Box option.
- Throwing an object in front of the AMR or suddenly stepping into the path of the AMR. The AMR braking system cannot be expected to function as designed and specified in such instances.
- Using unauthorized parts to repair the AMR.
- Powering ON the AMR without its wireless antennas in place.
- Operate the AMR in hazardous environments where there is explosive gas, an oil mist, or a corrosive atmosphere.
- Operating the AMR in an environment that contains ionizing radiation.
- Using non-approved batteries or charging systems.





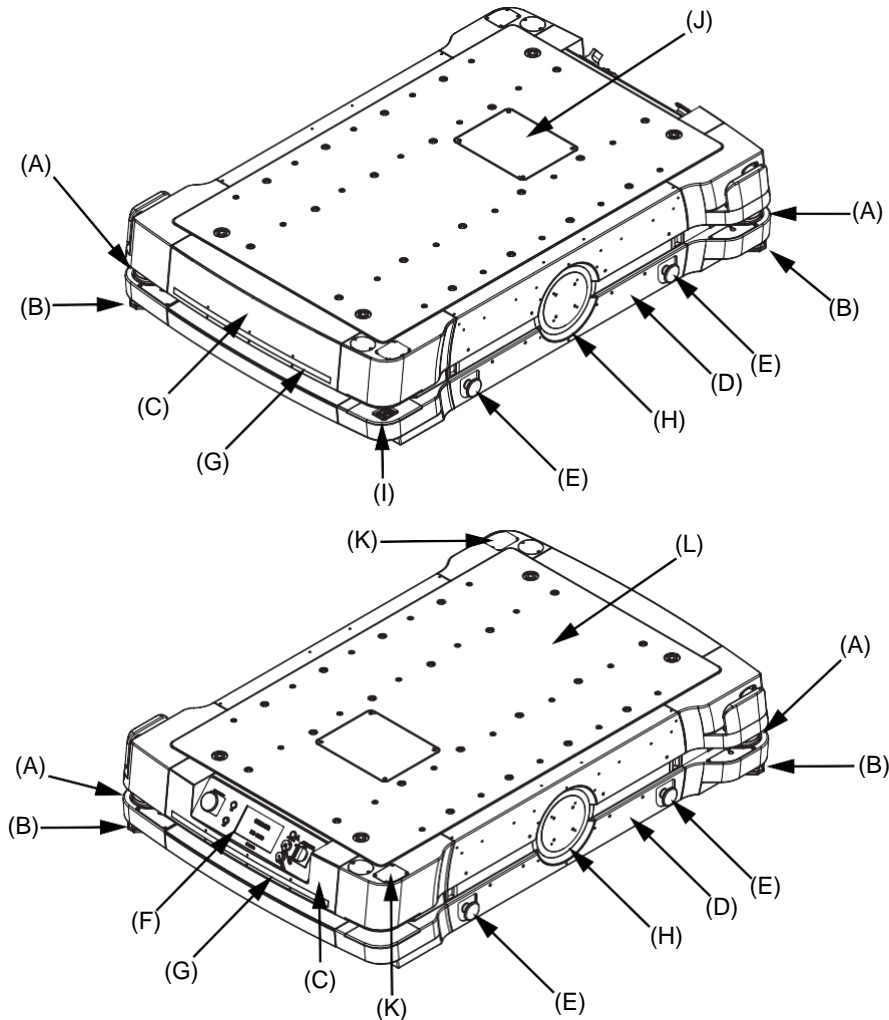
Precautions for Safe Use

The following actions are required for safe use of the AMR.

- Review and understand the safety protections associated with your specific application and environment.
 - Make sure that the environment is suitable for safe operation of the AMR.
 - Make use of the Fleet Manager when two or more AMRs are used in the same environment and are not confined to separate workspaces. Refer to the *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for more information.
 - Make sure that any person working with or near an AMR is trained and has read and understands this document and the *Mobile Robot HD Safety Manual (Cat. No. I647)*.
 - Mechanically maintain and service AMRs for proper operation of all control and safety functions.
-

1-3 Features and Components

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



Item	Description	Item	Description
A	Safety Laser Scanner	G	Light Strip
B	Low Laser	H	Light Disc
C	Front / Rear Skin	I	Charging Contacts
D	Side Skin	J	User Access Panel
E	E-stop Button*1	K	Wireless Antennas
F	Operator Panel	L	Payload Mounting Surface (Top Plate shown)

*1. Additional E-Stops are provided on the Operator Panel and also on the Pendant.

1-3-1 Lasers

Several laser sensors are provided on the robot for navigation and safety.

The Safety Laser Scanner, optional Side Lasers, and Low Lasers are Class 1 type that use invisible laser radiation and are safe under all conditions of normal use.



Precautions for Safe Use

- Although the lasers used are Class 1 (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.
- 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.

Safety Laser Scanner

Each Safety Laser Scanner provides detection in a 270° field of view with a typical maximum range of 4 m. Both Safety Laser Scanners provide a complete 360° range of detection area around the AMR. The lasers operate in a single plane positioned at 175 mm above the floor.

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.

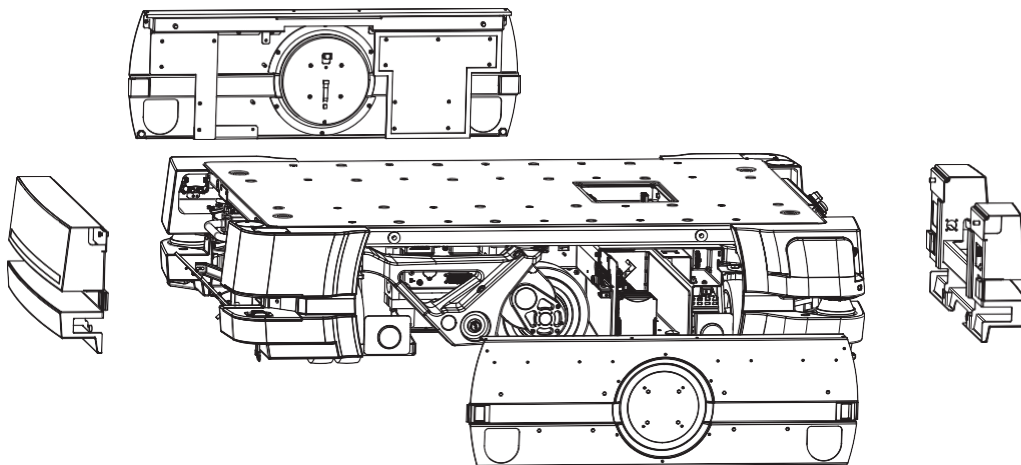


1-3-2 Skins

Skins are removable panels at various locations on the exterior of the AMR.

CAUTION

Any electrical charge that accumulates on the AMR skins does not have a path to ground, and therefore cannot discharge. This can be hazardous to electrostatic sensitive devices. Always keep electrostatic sensitive devices at least 30 cm away from the AMR skins.



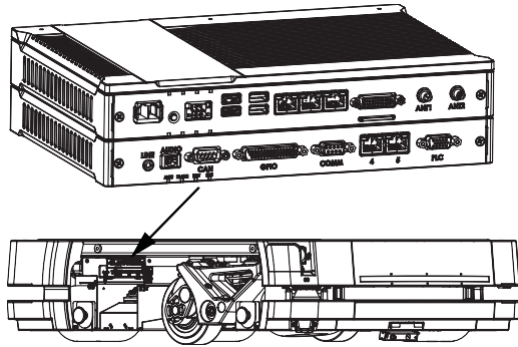
1-3-3 AMR Controller

The AMR controller is the AMR's main computing system that provides all navigational controls and mobile robot application interfaces. The AMR controller consists of two main components: the Base

Layer containing standard PC interfaces and the Mobile Robot Layer for the processing of the AMR control interfaces and network interface.

The AMR Controller runs the SetNetGo operating system and the Advanced Robotics Automation Management (ARAM) software. It also runs a variant of the Mobile Autonomous Robot Controller (MARC), called Polo. The AMR Controller is housed inside the electronics bay as displayed in the following figure.

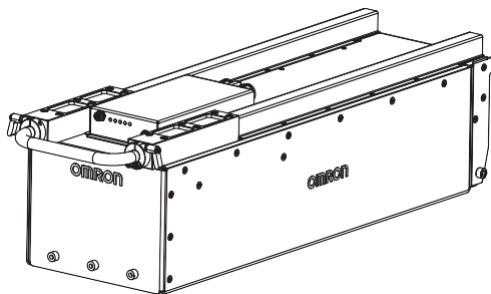
Refer to the *AMR Controller User's Guide (Cat. No. I650)* for more information.



1-3-4 Battery

A rechargeable lithium ion battery consisting of 8 modules provides power to the entire AMR and any accessories.

The battery can be automatically recharged while in the AMR, or it can be removed and charged separately.



Additional Information

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

1-3-5 E-stop Buttons

There are five E-stop buttons located on the AMR. One button is located on the Operator panel and there are two buttons located on each side of the AMR.

The Pendant also has an integrated E-stop button.



Additional Information

Additional E-stop buttons can be added to the payload structure.

1-3-6 Operator Panel

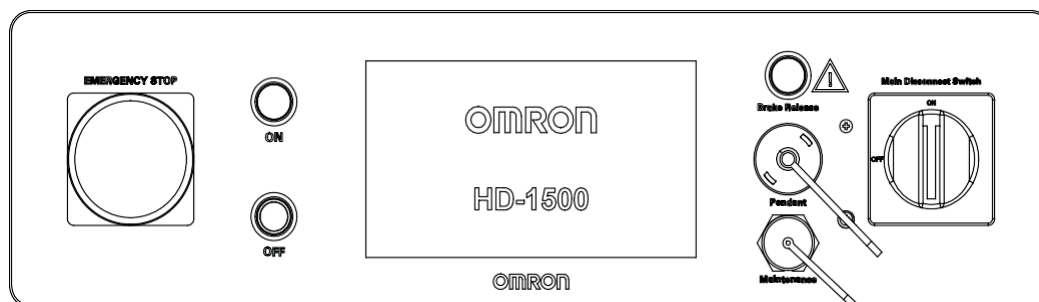
The Operator Panel features are described below.

You can relocate the operator panel to any preferred position on your payload structure.



Precautions for Safe Use

Consider all safety factors related to the location of the integrated E-stop button when relocating the operator panel.



Screen

A high-resolution, high-brightness screen provides operational status, wireless signal strength, battery level, IP address, robot identification, faults, and up to six lines of instructions.

ON and OFF Buttons

ON and OFF buttons are used to start-up and shut-down the AMR under normal operating conditions. Integrated LED ring lights are provided around the buttons for visual indication of the AMR operating states.

E-stop Button

The E-stop button is connected to the safety circuit and has the same function that all other E-stop buttons have on the AMR.

Brake Release Button

A brake release button is provided in the event of an emergency or abnormal situation where the AMR needs to be manually moved.

Pendant Port

Connect the Pendant to the pendant port when driving the AMR manually.

Maintenance Ethernet Port

A Maintenance Ethernet Port is available for configuration and troubleshooting with a PC that is directly connected with a pass-through or cross-over CAT5 (or better) Ethernet cable.

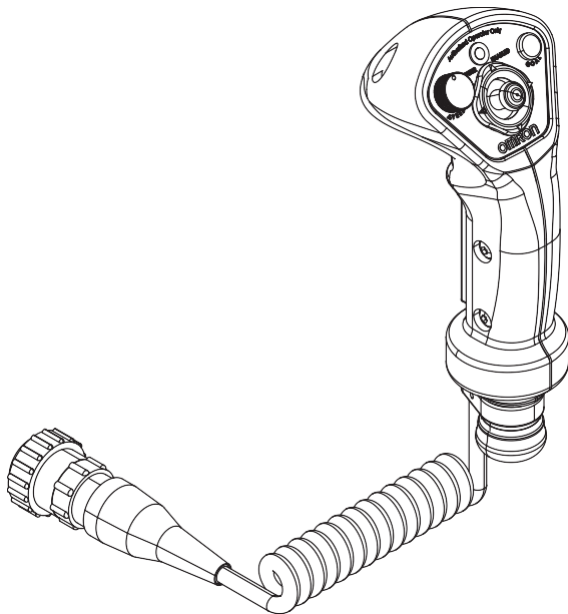
Main Disconnect Switch

The main disconnect switch completely removes all battery power from the AMR for maintenance or other abnormal situations.

1-3-7 Pendant

Connect a Pendant to manually drive the AMR. A pendant is typically used when generating a map of the workspace.

The pendant has a 3-position enable switch that puts the robot in a protective stop state unless an operator is present and holding the switch in the center position.



1-3-8 Light Strips and Discs

Colored light discs and strips are provided at highly visible locations on the exterior of the AMR. These provide visual indication about the AMR's status and its pending movement.

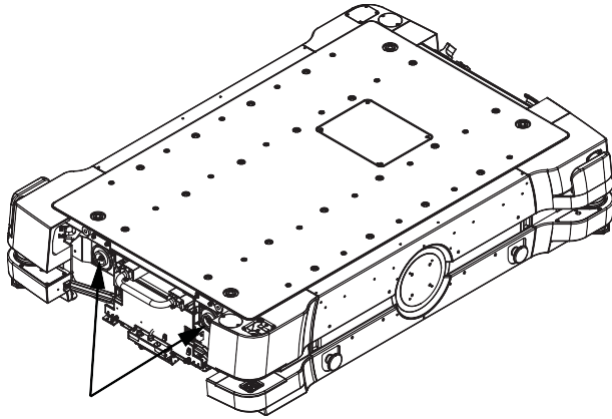
1-3-9 Speakers

Two speakers are used as a means to audibly notify personnel of an approaching AMR. Speech and sound tasks control the speakers' audio as the AMR navigates the workspace. Refer to *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for more information.



Precautions for Correct Use

When speakers are used as a means of notifying personnel of an approaching AMR, you must routinely verify that they are still functioning normally. Verify that the speakers are audible, and the sound level is at the same level as needed during the operation.

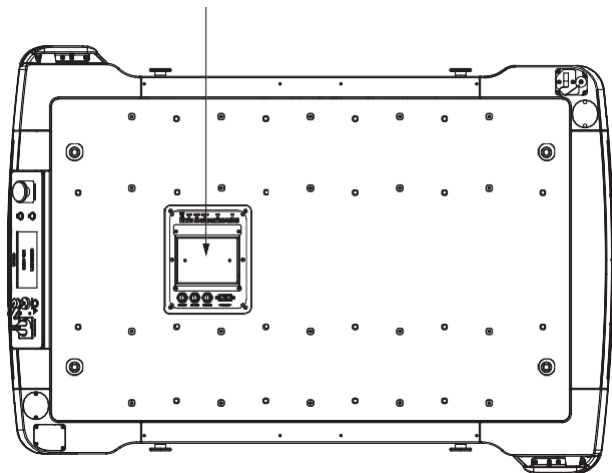


1-3-10 User Access Panel

Connections for power, communications, safety devices, inputs, outputs, and other optional items are provided in the user access panel. These connections are typically used for powering and controlling a payload structure.

The user access panel also provides space for mounting user-supplied control devices if required, such as an NX-series EtherCAT Coupler unit with various NX-series I/O units attached.

The user access panel is protected with a removable cover.

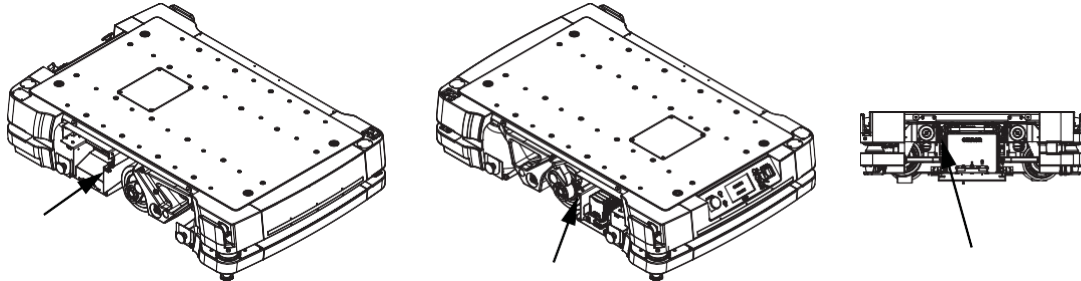


1-3-11 Wireless Antennas

Two wireless antennas are factory-installed on the top of the AMR to provide optimal range. These wireless antennas are tamper resistant and low profile. They can also be relocated if a payload structure obscures them.

1-3-12 Interlock Switches

The AMR is equipped with the interlock switches located on the battery door and the side skins. The interlock switches are continuously monitored and ensure that the battery door and the side skins are properly attached to the AMR. This is to ensure that the internal components are isolated and protected from unauthorized and unsafe access.



1-3-13 Electronics Bay

The electronics bay houses the AMR Controller, network switches, and all associated cables and connections. You can access the electronics bay compartment from the right or left side of the AMR if the skins are removed.

1-3-14 Payload Mounting Surface

Payloads are mounted directly to the top of the AMR chassis. Several mounting points are available for various payload designs.

1-4 Autonomous Navigation

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

WARNING

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



During normal start-up, the AMR powers all its on-board 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 it has been given a map of its workspace and knows where it is within that environment (localized), you need to press the on-button a second time to enable motor power, for autonomous operation start-up. Absent localization, you need to plug in a pendant in order to move the unit. After the initial, localized start-up is complete, the AMR will be capable of operating autonomously. Refer to *Fleet Operations Workspace Core User's Manual (Cat. No. I635)* for information on start-up procedure and localization.

The AMR will frequently adjust its path to go around an obstacle. Navigational parameters are stored on the AMR Controller 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 Safety Scanning Lasers 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:

- Two Low Lasers at the opposing corners of the AMR to detect objects below the plane of the Safety Scanning Lasers.
- Encoders (one on each drive motor) provide information on the distance traveled by each drive wheel and direction of travel.

Before an AMR enters a high-traffic area, you must take appropriate precautions to alert people working in those areas. The AMR provides programmable warning features such as a warning buzzer, speech synthesis, and warning indicator lights. The user access panel provides user ports that enable you to add additional warning indicators to your payload structure.

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.

1-5 Optional Items

Information about optional items is provided in this section.

1-5-1 EM2100 Fleet Manager

To manage and administer multiple AMRs in the same workspace, you must use an EM2100 appliance configured as a Fleet Manager running the Fleet Operations Workspace (FLOW) software. The EM2100 appliance 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 an EM2100 appliance 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.

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.



Precautions for Correct Use

- Using the EM2100 or map features is not a substitute for physical methods of preventing collisions, such as interlocked gateways or barriers. It is the user's responsibility to provide a physical method of preventing collisions where necessary.
- Do not leave an AMR that is not localized, not connected to the EM2100, or not powered ON in a location that can be accessed by other AMRs.



Additional Information

- The AMR requires wireless communications when operating within a fleet. Refer to 3-3-3 *Wireless Connection* on page 3-6 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)* and the *Fleet Simulator User's Guide (Cat. No. I649)*.

1-5-2 Additional E-stop Buttons

An operator should be able to easily reach an E-stop button from any angle without reaching across the moving AMR or any moving payload parts. Per relevant safety standards, E-stop buttons must be placed within 600 mm reach of the operator. A large or complex payload structure may require additional E-stop buttons.

WARNING

If you are using a user-supplied E-stop, you must perform safety commissioning to verify the emergency stop functionality before putting the AMR into service.



CAUTION

- All E-stop buttons must be located in areas that are easy to reach and within 600 mm of personnel. It is the end user's responsibility to ensure that any additional E-stop buttons are placed in a location where the operator can easily access them in an emergency situation.



Precautions for Correct Use

The emergency stop or the protective stop devices you install on the AMR must have a dual channel circuit to ensure the same performance level as the other safety devices of the AMR.



Additional Information

- Refer to *3-4-2 User Access Panel Connections* on page 3-9 for more information about additional E-stop connections.
- If no additional E-stop buttons are added, a jumper with a part number of 68410-218L must be placed on the SCPU port. Refer to *SCPU* on page 3-11 for more information.

1-5-3 Additional Warning Lights

The AMR must include warning lights appropriate for its application. It must have a highly visible flashing light to warn people that the AMR is ready to move or is moving. In most cases, the light discs and the light strips in front and back of the AMR provide sufficient light indication. When using large or complex payload structures, you may need to install additional user-supplied warning lights to ensure visibility of the AMR. The exact implementation of this warning light depends on the design of your payload or payload structure.

Make sure that the light remains visible under all operating conditions, and from all sides so that people can always see it. Consider the design of your payload structure for warning light visibility, including when the AMR is transporting objects.

A beacon or light tower is not included with the AMR. You can optionally supply and install such a device if required. To comply with relevant standards, the sequence of the lights from top down must be red, yellow, and green.

A user-supplied beacon typically mounted on the AMR payload structure can provide extra signaling. The beacon indicates movement and signals an operator that the AMR is waiting for assistance. Refer to *3-4-2 User Access Panel Connections* on page 3-9 for more information.

CAUTION

An AMR must have a readily visible warning device such as a user-supplied flashing light, to indicate when it is either ready to move or is moving.



1-5-4 Additional Warning Buzzers

The AMR Controller provides an output for controlling an additional warning buzzer as an auditory warning device. The warning buzzer is connected to the Safety Controller.

The buzzer must be audible above the ambient noise of the environment that the AMR operates in. Depending on your environment's noise level, you may need to add an additional buzzer installed on your payload structure so that the buzzer can be heard over the ambient noise level. It is the end-user's responsibility to verify this requirement.

The LIGHTS port on the user access panel can support a user-supplied warning buzzer. You can install it in either the AMR or in a location of your choice in your payload structure. Refer to *3-4-2 User Access Panel Connections* on page 3-9 for more information.

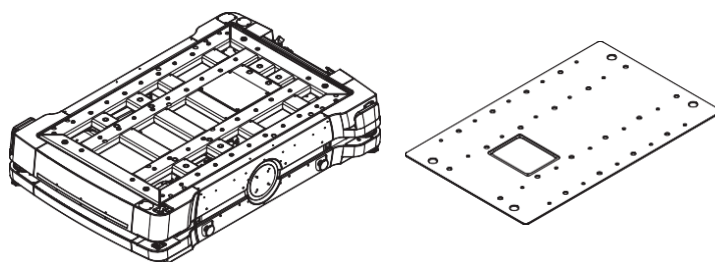


Additional Information

You can optionally supply an LED signal tower which includes a built-in warning buzzer, or a dedicated warning buzzer. Contact your OMRON representative for more information on the available options.

1-5-5 Top Plate

An optional Top Plate is available that can be attached to the AMR chassis. This Top Plate is used to protect the AMR, but it is not required. The AMR can be ordered with or without a Top Plate depending on the application requirements.



1-6 Software

The AMR requires the licensed software described in this section. Software is factory-installed on the AMR Controller. Features and functions can be added to the AMR by activating licenses as described in *Fleet Operations Workspace Core User's Manual (Cat. No. I635)*.

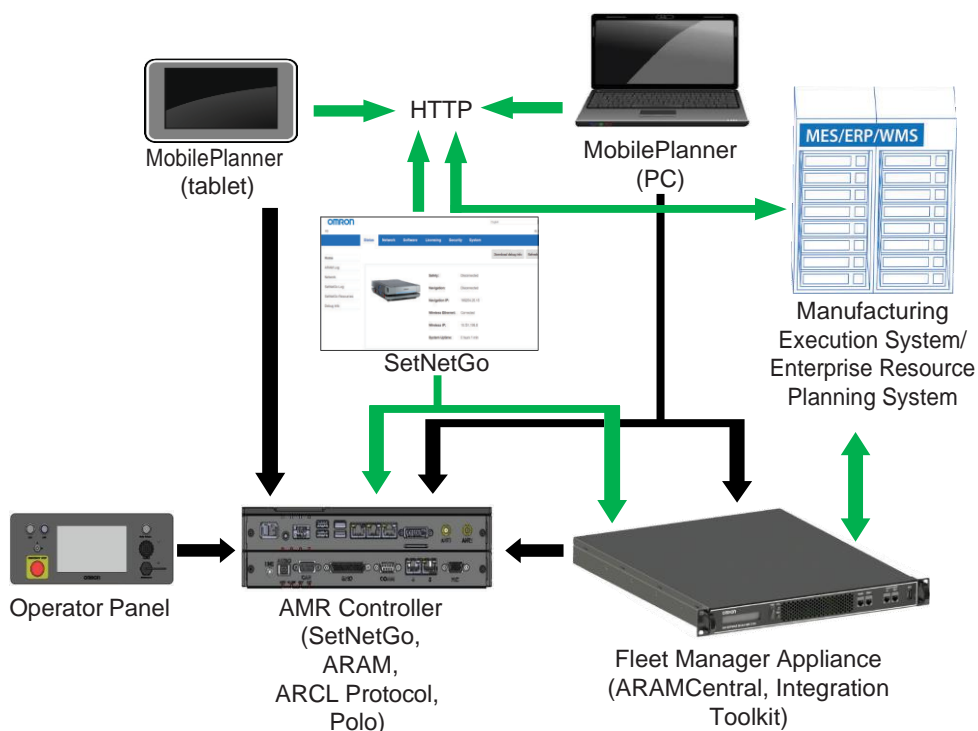
The minimal operating configuration for an AMR is managed by a person(s) using a Microsoft Windows® PC or optionally from an Android or iOS tablet.

If you have more than one AMR, you must install and configure an EM2100 appliance (running the Fleet Operations Workspace software) to manage multiple AMRs as a fleet. Refer to *1-5-1 EM2100 Fleet Manager* on page 1-15 for more information.

The following figure shows the devices that you might use to manage one or more AMRs and the software components required for each device, if applicable.

AMR administration includes both configuring and operating an AMR and also using the AMR (or a fleet of AMRs) to perform useful work. The FLOW Core software that enables you to perform these functions consists of the following items.

- MobilePlanner / MobilePlanner Tablet Edition
- ARCL protocol
- Integration Toolkit
- SetNetGo
- ARAM
- Polo



1-6-1 System Requirements

Access to software features is permitted by use of a USB license dongle that contains secure, encrypted electronic copies of the operating licenses. Some licenses might have a restricted term and expire after a specific date. You will receive several warning alerts before the license expires.

PC Requirements

A PC running a supported version of Microsoft Windows® is required to configure and manage an AMR (Windows 7, Windows 8, and Windows 10 are supported). The PC requires 200 megabytes of available hard-disk storage.



Additional Information

Wireless is a requirement for managing multiple AMRs as a fleet. Refer to the *Fleet Operations Workspace Core User's Manual (Cat. No. 1635)* for more information.

Mobile Device Requirements

If MobilePlanner Tablet Edition software is used, an Android or iOS tablet device is required to run the MobilePlanner Tablet software.

The following requirements must be met for the tablet device.

- Android OS version 9 or newer.
- iOS version 10 or newer.
- Android devices need at least 2 GB of RAM. Sites with large or complex maps may require more RAM.

1-7 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 some object. A payload structure is typically required to secure an object during transport. The end user or an integrator is responsible for designing and implementing a payload structure system. This system may include controls and other mechanical items to facilitate various functions related to the operation of the AMR and the machinery that it interacts with.

Careful considerations for the center of gravity of the payload must be made. Refer to 2-2-3 *Payload Center of Gravity* on page 2-4 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 kept higher than the top of the AMR. If the payload or associated structure blocks any of the AMR's sensors, it 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.
- The total weight of your payload structure plus any objects carried by the structure must not exceed the maximum payload capacity of the AMR.
- 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.



Precautions for Safe Use

- You must ensure that the payload structure is properly secured to the AMR.
- Damaged or worn casters and drive wheels can degrade the AMR stability. You must regularly inspect the casters and drive wheels for signs of damage, excessive wear, or uneven spots.
- 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 E-stop button.



Additional Information

The AMR provides the electrical power and controls required to operate a payload structure.

1-7-1 Payload Structures

For typical AMR applications, a payload structure must be designed and constructed for operations such as pickup, dropoff, and transportation of the payload.

The AMR provides threaded mounting holes for payload structure attachment. The mounting holes provide a secure and adaptable method of attaching payload structures to the chassis. A payload

structure can be as simple as a crate that contains manufacturing parts or a more sophisticated device such as a conveyor or robot arm.

The AMR also provides a variety of interfaces and power connections to support your application-specific sensors and accessories that may be included in the payload structure.

Payload Structure Location

Serviceability and maintenance requirements should be considered when designing a payload structure.

Provide access to the payload attachment location for serviceability. You must ensure that the mechanical connection points, as well as the electrical connections are conveniently accessible.

Always take care to not damage any cabling between your payload structure and the AMR. Provide adequate slack in all cables, or include connectors. Also, provide adequate strain relief where more flexibility is required.

● Projections and Overhangs

Your payload should not overhang or project beyond the outer dimensions of the AMR. Doing so might place parts of the structure outside the safety envelope provided by the Safety Laser Scanners.



If a payload or payload structure projects or overhangs the outer dimensions of the AMR, make the following considerations.

- Contact your OMRON representative to change the size of the Safety Laser Scanners' safety zones.
- Repeat the safety commissioning procedure.
- Modify parameters to change the AMR's *Width*, *LengthFront*, *LengthRear*, and potentially its *Radius*. When making these modifications, ensure that the AMR's accurate dimensions are used during path planning and obstacle avoidance.



● Wireless Antennas

You must ensure that the payload does not obstruct the wireless antennas. If it is not possible to prevent some interference between the payload and the wireless antennas, you may relocate the wireless antennas to a payload position where the signal does not get attenuated. Refer to *3-4-1 Wireless Antenna Connections* on page 3-8 for additional information on how to relocate the wireless antennas.



Precautions for Correct Use

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

● E-Stop Buttons

User-supplied E-stop buttons can be added to the payload structure.

You must ensure that the payload does not block or limit easy access to the E-Stop buttons. The E-Stop buttons shall be placed within 600 mm of reach. The operator should be able to easily reach an E-Stop button from any approach angle without the need to reach across the moving AMR or any moving payload parts.



Precautions for Safe Use

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 E-stop button.



Additional Information

If no E-stop buttons are added, a jumper with a part number of 68410-218L must be placed on the SCPU port. Refer to *SCPU* on page 3-11 for more information.

● **Light Discs and Light Strips**

You must ensure that the payload does not block the light discs, or front or back light strips as they provide visual indication of the AMR movement.

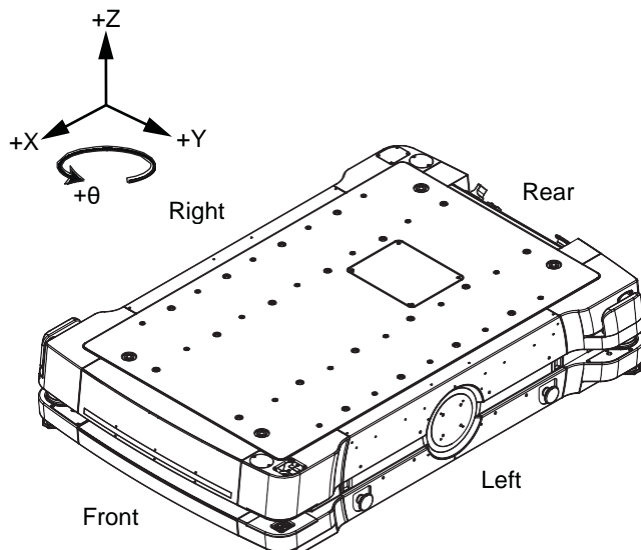
1-8 Coordinate System

AMRs use the X, Y, Z, and Theta coordinate system displayed in the figure below. This information is relevant for some of the procedures used in this manual, such as identifying which are the left or right sides of the AMR. For example, the AMR Controller is located near the rear of the AMR, and the +X direction is the direction of AMR forward travel.

The origin of the AMR coordinate system is the ideal point on the floor exactly half way between the center of the two drive wheels. The origin of the coordinate system is the AMR's center of rotation. Coordinates are required for procedures such as installing and configuring options such as lasers, and also for understanding the center of gravity envelope. 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 optional items such as Side Lasers. Positions of optional items like this are set in MobilePlanner.



2

Specifications

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2-1 Performance Specifications

Performance specifications for the AMR are provided below.

Item	Specification
Maximum payload capacity	1500 kg
Swing radius	982 mm
Turn radius	0 mm
Maximum translational speed	1800 mm/s
Maximum translational acceleration	900 mm/s ²
Maximum rotational speed	60 degrees/s
Maximum rotational acceleration / deceleration	150 degrees/s ²
Stop position repeatability and accuracy (single robot)	<ul style="list-style-type: none"> • To a position: ±50 mm • To standard target: ±25 mm, ± 2° • With HAPS: ±8 mm, ±0.4° • With CAPS: ±8 mm, ±0.5°
Stop position repeatability and accuracy (fleet)	<ul style="list-style-type: none"> • To a position: ±70 mm • To standard target: ±35 mm, ± 2° • With HAPS: ±10 mm, ±0.75° • With CAPS: ±16 mm, ±0.5°

2-2 Physical Specifications

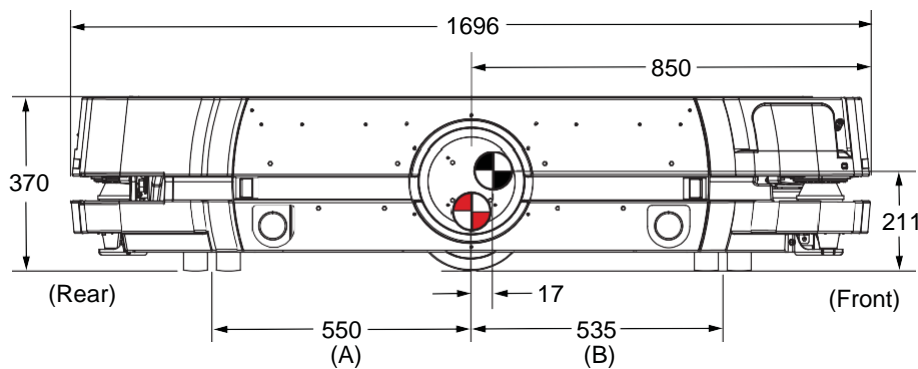
Physical specification of the AMR are provided below.

2-2-1 Dimensions

Dimensional specifications are provided in the following sections.

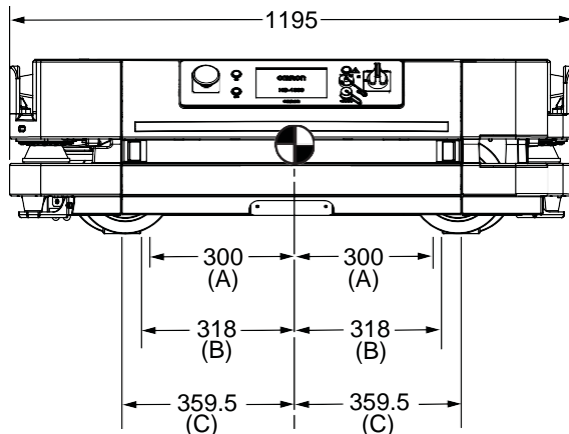
AMR Dimensions

Physical dimensions of the AMR are provided below.



= Center of Gravity = Center of Rotation

A = Rear caster pivot point to Center of Rotation
 B = Front caster pivot point to Center of Rotation



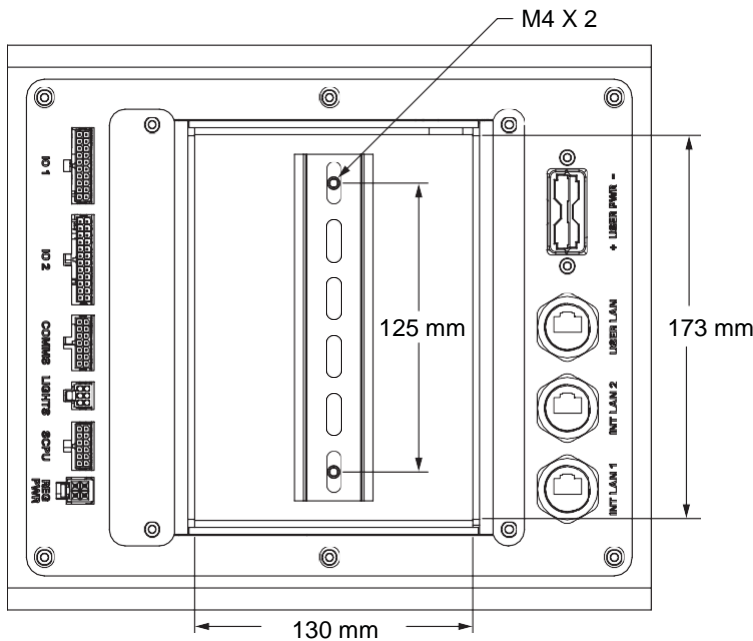
= Center of Gravity

A = Rear caster pivot point to Center of Gravity
 B = Front caster pivot point to Center of Gravity
 C = Drive wheel to Center of Gravity

User Access Panel Dimensions

Physical dimensions for the User Access Panel are provided below. User-supplied DIN rail is shown in the following figure for reference.

The distance from the base of the User Access Panel to the AMR mounting surface is 92 mm.



2-2-2 Weights

Weights are provided in the table below.

Item	Weight
AMR (no battery or accessories)	437 kg
Battery	69.5 kg
Power Supply Box	108 kg
Docking Target	27.5 kg
Top Plate Kit	21.5 kg

2-2-3 Payload Center of Gravity

Center of gravity is a critical factor when placing items on the AMR for transport. Keep the payload's center of gravity centered over the AMR's own center of gravity and as low as possible. This provides optimum stability, particularly when the AMR traverses irregularities in the floor.

The AMR has a maximum payload of 1500 kg, which includes the payload structure and any load carried by that structure. You must ensure that the payload does not extend beyond the AMR's footprint. The center of gravity of the combined mass of the payload structure, including all onboard tooling and loads being transported, must be within the specified limits. These limits must be observed to ensure stability when loading and unloading the AMR.

WARNING

Tipping hazards are more likely if the payload center of gravity is outside the recommended specifications.

Make the following considerations when designing and implementing your payload.

- If the payload overhangs or extends outward dynamically from the AMR (such as a robot arm), it has a greater effect on the center of gravity. This is particularly important if the payload is also conveying objects that add additional mass.

- If the payload can shift during AMR movement, consider its effect on the AMR's center of gravity.
- If the AMR's center of gravity is offset from the payload's center of gravity due to uneven load distribution, the maximum stable speed of the AMR may need to be reduced from default settings. It is the end user's responsibility to ensure that the AMR is configured for safe operation under these operating conditions.
- If the payload is tall and also has substantial weight, consider the effect on the AMR's center of gravity.



Additional Information

Refer to *AMR Dimensions* on page 2-3 for more information.

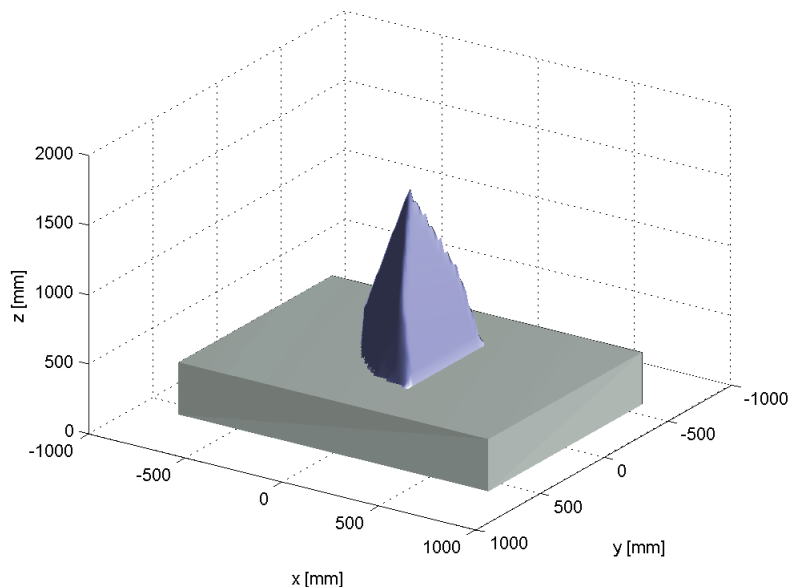
The following figures show the calculated safe center of gravity placements for AMR's maximum allowed payload weight. The payload's center of gravity must be within the area shown.

These calculations assume the following conditions.

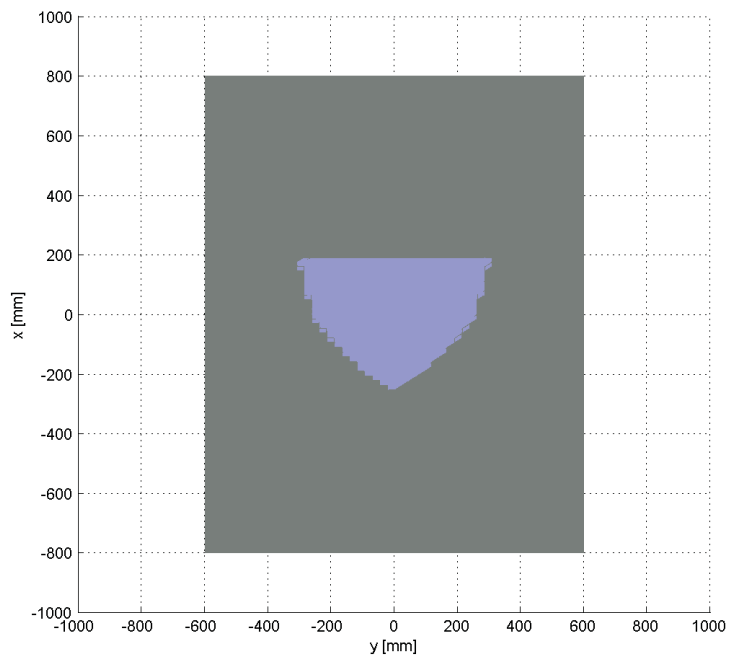
- The payload is securely attached to the AMR and it does not shift due to the AMR's motion.
- The payload does not overhang the AMR.
- The AMR does not exceed its specified default limits for acceleration, deceleration, linear velocity, angular velocity, and coefficient of friction (0.6 minimum).

In the following graphs, X represents the direction of the AMR's motion (rear to front). Y is perpendicular to the AMR's direction of motion (side-to-side). Z is the vertical dimension (height). Refer to *1-8 Coordinate System* on page 1-23 for more information.

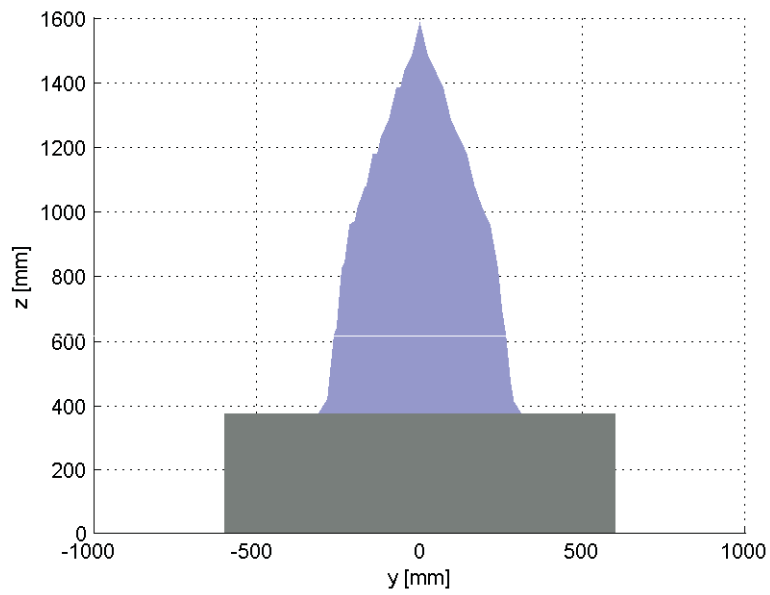
A 3D view of the recommended payload center of gravity is shown below.



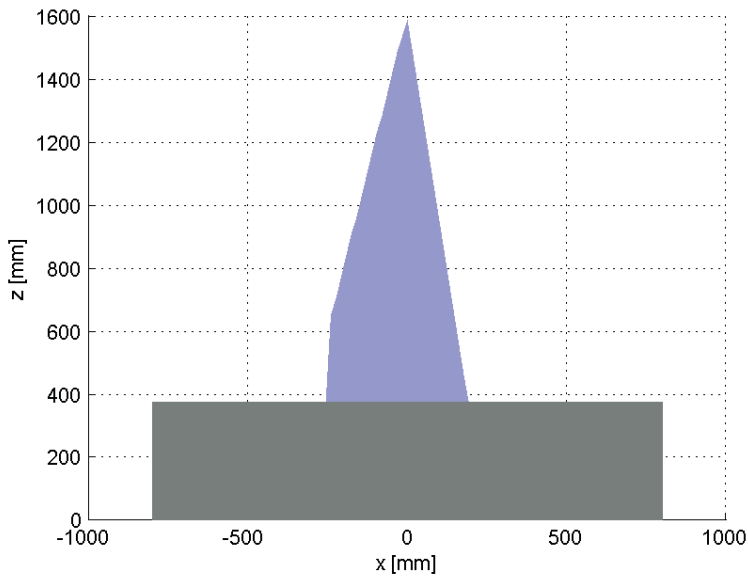
A top view of the recommended payload center of gravity is shown below.



A front view of the recommended payload center of gravity is shown below.



A side view of the recommended payload center of gravity is shown below.



2-3 Environmental Specifications

Environmental specifications are provided in the following sections.

2-3-1 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
Humidity		5% to 95%, non-condensing
Altitude		2000 m maximum
Pollution degree		2
Ingress protection class		IP20 (IP10 for charging pads)
Atmospheric		Non-hazardous environments (no explosive gas and oil mist).
Radiation		No environments with ionizing radiation.
Dust and smoke		Avoid severe smoke and particulate matter. It may degrade the efficiency of Safety Laser Scanners and result in unexpected halt of the AMR operation.
Floor surface	Step traversal	10 mm maximum
	Gap traversal	20 mm maximum
	Flatness	F _F 25 (per ACI 117 standard)
	Levelness	F _L 25 (per ACI 117 standard)
	Weight rating	2.1 MPa

2-3-2 Battery Environmental Specifications

Environmental specifications for the battery are provided below.

Item	Specification
Ambient operating temperature	5 to 40°C
Storage temperature *1	-20 to 60°C (less than 2 weeks) -20 to 35°C (more than 2 weeks)
Humidity	5% to 95%, non-condensing

*1. Refer to *Storing Batteries* on page 2-8 for more information.

Storing Batteries

Make the following considerations when storing batteries.

- The batteries must be stored in the upright position. Do not place the batteries on the side, top, or end when storing.
- 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 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.

2-3-3 Pendant Environmental Specifications

Environmental specifications for the pendant are provided below.

Item	Specification
Ambient operating temperature	0 to 40°C
Storage temperature	-20 to 65°C
Humidity	5% to 95%, non-condensing
Ingress protection class	IP3X

2-4 Laser Specifications

Specifications for the lasers are provided below.

Item		Specification
Safety Laser Scanner	Scanning plane	Horizontal plane 175 mm from floor surface
	Scanning range	15 m
Low Laser	Scanning plane	Horizontal plane 65 mm from floor surface.
	Scanning range	10 m
Side Laser	Scanning plane	Vertical plane
	Scanning range	10 m
Laser class		Class 1 in accordance with the following standards: <ul style="list-style-type: none"> • IEC 60825-1 • CDRH 21 CFR 1040.10 • 1040.11

2-5 Battery Specifications

Battery specifications are provided below.

Item	Specification
Run-time	With full payload: 9 hours, approx.
	With no payload: 12.5 hours, approx.
Duty cycle (depth of discharge)	80%
Voltage	48-56 VDC (52.8 VDC nominal)
Capacity	70 Ah nominal
Energy	3.7 kWh nominal
Recharge time	40 minutes (from empty to full)
Life span	Approximately 9000 cycles

2-6 Other Specifications

Specifications for other items are provided below.

2-6-1 Safety Functions

The Performance Level (PL) calculation for safety functions of the AMR is based on the ISO 13849 standard. PL evaluation has been performed for the AMR including the pendant.

The PL achieved and the Probability of Dangerous Failure per Hour (PFHd) are calculated using SIS-TEMA as per ISO 13849-1 for the following safety functions:

Safety Function	Safety Stop Type	Reset Type	Description	PL	Category	PFHd
E-stop button on Pendant ^{*2}	Emergency Stop	Manual Reset	Pressing the E-stop button on the pendant results in an emergency stop (controlled stop) ^{*1} . 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.	d	3	5.67E-07
Enabling device on Pendant ^{*2}	Emergency Stop.	Automatic Reset	Releasing the enabling device or compressing it beyond the center position will cause a Category 1 Stop ^{*1} on the AMR. This is a protective stop and the AMR resumes its operation automatically after a two-second delay, and when the pendant enabling device is held in the center enable position.	d	3	5.67E-07
E-stop button on Operator Panel ^{*2}	Emergency Stop	Manual Reset	Pressing the E-stop button on the Operator Panel results in an emergency stop (controlled stop) ^{*1} . 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.	d	3	5.67E-07

Safety Function	Safety Stop Type	Reset Type	Description	PL	Category	PFHd
Emergency stop connection on User Access Panel ³	Emergency Stop	Manual Re-set	User-supplied E-stop button(s) can be attached to the SCPU connection located on the user access panel. Pressing the user-supplied E-stop button(s) 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. The final functional safety rating is to be calculated using the given PFHd value (logic and output) combined with the user-supplied E-stop (input) PFHd values. Refer to <i>HD-1500 Platform User's Manual (Ca. No. I645)</i> for more information.	To be determined by the user	3	5.79E-08
E-stop buttons on sides of AMR ²	Emergency Stop	Manual Re-set	Pressing any E-stop button on the sides of the AMR initiates the emergency stop (controlled stop) ^{*1} function. 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.	d	3	5.67E-07
Safety Laser Scanner detection ²	Protective Stop	Automatic Reset	If an obstacle intrudes into the safety zones, the Safety Laser Scanner 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. In such cases, the AMR safely stops and then resumes operation after a delay of two seconds after confirming that its protected zone is clear of obstacles.	d	3	6.50E-07

Safety Function	Safety Stop Type	Reset Type	Description	PL	Category	PFHd
Overspeed protection*2	Protective Stop	Manual Re-set	This function monitors for overspeed and speed inconsistency. The AMR linear speed is limited to 1800 mm/s (both forward and backward). If the calculated speed exceeds this speed limits, the AMR protective stop is triggered.	d	3	5.67E-07
Protective Stop connection on User Access Panel*3	Protective Stop	Automatic Reset	User-supplied protective stop devices initiate a protective stop and resets automatically once the protective device signal is cleared after a two-second delay. Refer to <i>HD-1500 Platform User's Manual (Ca. No. 1645)</i> for more information. The final functional safety rating is to be calculated using the given PFHd value (logic and output) combined with the user supplied protective device (input) PFHd values.	To be calculated by the user.		5.79E-08
Brake release monitoring	Protective Stop	Manual Re-set	This function monitors the brake and ensures it is in use when necessary and not in use when not necessary. The brake release monitoring initiates a category 1 stop.	b	B	7.13E-06
Warnings	N/A	N/A	This function is for the visual warning system.	b	B	5.71E-06
Automatic battery charging	N/A	N/A	This function is used to ensure that the AMR is properly connected to the Docking Target before the charging contacts are activated.	b	1	7.13E-06

*1. Stop Categories according to IEC 60204-1 (NFPA79).

*2. The PL achieved and the Probability of Dangerous Failure per Hour (PFHd) are calculated using SISTEMA as per ISO 13849-1.

*3. The SCPU connector on the User Access Panel is provided for use with a user-supplied external E-stop along with a user-supplied protective device. The user is responsible for calculating the overall PL and PFHd, inclusive of user-supplied components, and performing a final risk assessment.

2-6-2 USER PWR Connector

Electrical and other specifications for the USER PWR connector are provided below.

Item	Specification
AMR connector	Anderson Power Pole SBS-50
User-supplied mating connector	

Item		Specification
User-supplied connector pins		Anderson Power Pole: <ul style="list-style-type: none"> • 16 mm² wire size: 1339G2 • 10 mm² wire size: 1339G5 • 2.5mm² to 6 mm² wire size: 1339G3
Voltage range		48-56 VDC (unregulated)
Current limits (REG and USER power combined)* ¹	Continuous	50 A
	100 ms	100 A
	1 ms	200 A

- *1. Momentary current spikes that are over the thresholds specified here will activate current limiting protection and cause power loss at the USER power connector. Simultaneous inrush loads might trip the over current protection at the battery. You should use external current limiting devices to prevent transient current overload.

2-6-3 REG PWR Connector

Electrical and other specifications for the REG PWR connector are provided below.

Item	Specification
AMR connector type	Molex Mini-Fit Jr., 2 x 2
User-supplied mating connector	Molex Mini Fit Jr. receptacle (part number: 0469920410)
User-supplied mating connector pins	Molex, 18-24 AWG (part number: 0039000074)
Voltage range* ¹	23.0 VDC to 25.2 VDC
Current limits (REG and USER power combined)* ²	Continuous: 50 A
	1 ms: 200 A
	100 ms: 100 A

- *1. Momentary current spikes that are over the thresholds specified here will activate current limiting protection and cause power loss at the USER power connector. Simultaneous inrush loads might trip the over current protection at the battery. You should use external current limiting devices to prevent transient current overload.
- *2. Momentary current spikes that are over the thresholds specified here will activate current limiting protection and cause power loss at the REG power connector. Simultaneous inrush loads might trip the over current protection at the battery. You should use external current limiting devices to prevent transient current overload.

2-6-4 SCPU Connector

Electrical and other specifications for the SCPU connector are provided below.

Item	Specification
AMR connector	TE Connectivity Micro Mate N Lok., 2 x 6
User-supplied mating connector	TE Connectivity Micro Mate N Lok receptacle (part number: 1-794617-2)
User-supplied mating connector pins	TE Connectivity AMP connectors, 20-24 AWG (part number 1-794610-2)
Input type	PNP / sourcing
Rated input voltage	24 VDC (20.4 to 28.8 VDC)
Safety input current	3.0 mA

Item	Specification
Safety output current	500 mA

2-6-5 LIGHTS Connector

Electrical and other specifications for the LIGHTS connector are provided below.

Item	Specification
AMR connector	TE Connectivity Micro Mate N Lok., 2 x 3
User-supplied mating connector	TE Connectivity Micro Mate N Lok receptacle (part number: 794617-2)
User-supplied mating connector pins	TE Connectivity AMP connectors, 20-24 AWG (part number 1-794610-2)
Output type	PNP / sourcing
Rated output voltage	24 VDC (20.4 to 28.8 VDC)
Maximum output current	500 mA

2-6-6 IO 1 Connector

Electrical and other specifications for the IO 1 connector are provided below.



Additional Information

The IO 1 connector is connected to the NX-ID4442 and NX-AD3603 units in the AMR. Refer to the *NX-series Digital I/O Unit User's Manual (Cat. No. W521)* and the *NX-series Analog I/O Units User's Manual for Analog Input Units and Analog Output Units (Cat. No. W522)* for more information.

Item	Specification
AMR connector	TE Connectivity Micro Mate N Lok., 2 x 10
User-supplied mating connector	TE Connectivity Micro Mate N Lok receptacle (part number 2-794617-0)
User-supplied mating connector pins	TE Connectivity AMP connectors, 20-24 AWG (part number 1-794610-2)
I/O type	8 digital PNP / sourcing inputs 4 Analog inputs \pm 10 VDC
Rated input voltage	Digital inputs: 24 VDC (15 to 28.8 VDC) Analog inputs: -10 to 10 VDC (-15 to 15 VDC max.)
Input current	Digital inputs: 3.5 mA typical at 24 VDC, rated current
ON voltage / ON current (digital inputs)	Digital inputs: 15 VDC min. / 3 mA min. (each signal)
ON / OFF response time (digital inputs)	Digital inputs: 5 VDC max. / 1 mA max. (each signal)

2-6-7 IO 2 Connector

Electrical and other specifications for the IO 2 connector are provided below.

**Additional Information**

The IO 2 connector is connected to the NX-OD4256 and NX-DA3603 units in the AMR. Refer to the *NX-series Digital I/O Unit User's Manual (Cat. No. W521)* and the *NX-series Analog I/O Units User's Manual for Analog Input Units and Analog Output Units (Cat. No. W522)* for more information.

Item	Specification
AMR connector	TE Connectivity Micro Mate N Lok., 2 x 12
User-supplied mating connector	TE Connectivity Micro Mate N Lok receptacle (part number 2-794617-4)
User-supplied mating connector pins	TE Connectivity AMP connectors, 20-24 AWG (part number 1-794610-2)
I/O type	8 digital PNP / sourcing outputs 4 Analog outputs \pm 10 VDC
Operating load voltage	Digital outputs: 15 to 28.8 VDC Analog outputs: -10 to 10 VDC
Output load current	Digital outputs: 0.5 A / signal Analog outputs: 5 k Ω min. allowable load resistance
Leakage current	Digital inputs: 0.1 mA max.
Residual voltage	Digital inputs: 1.5 VDC max.

2-6-8 COMMS Connector

Electrical and other specifications for the COMMS connector are provided below.

Item	Specification
AMR connector	TE Connectivity Micro Mate N Lok., 2 x 7
User-supplied mating connector	TE Connectivity Micro Mate N Lok receptacle (part number: 1-794617-4)
User-supplied mating connector pins	TE Connectivity AMP connectors, 20-24 AWG (part number 1-794610-2)
Communication types	RS-232, RS-422, CAN Bus

3

Installation

This chapter describes how to install and configure the robot for operation.

3-1	Installation Introduction	3-2
3-2	Battery Installation Procedure	3-3
3-3	Network Connections	3-5
3-3-1	Default Network Settings	3-5
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3-3-3	Wireless Connection	3-6
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3-7	Safety Commissioning	3-21
3-7-1	Safety Commissioning Procedure	3-21

3-1 Installation Introduction

The general AMR installation steps are provided below.

WARNING

The Charging Station, battery, and AMR transfer high electric power and contain hazardous voltages. You must take necessary precautions to avoid electric shock. Follow appropriate Lock-Out, Tag-Out (LOTO) instructions prior to any installation and maintenance work performed on or near these items.



Additional Information

Unpack all equipment before beginning the robot configuration procedure.

- 1** Configure the network connections.
Refer to *3-3 Network Connections* on page 3-5 for more information.
- 2** Attach warning labels.
Refer to *3-6 Attaching Warning Labels* on page 3-20 for more information.
- 3** Perform safety commissioning.
Refer to *3-7 Safety Commissioning* on page 3-21 for more information.
- 4** Generate a map for the robot.

3-2 Battery Installation Procedure

WARNING

- At least 3 people are required to lift the battery.
- You must wear proper Personal Protective Equipment (PPE) for removing, installing, and lifting the battery or when working around a leaking battery.



WARNING

Always use safe lifting practices when removing or installing the battery.



Precautions for Safe Use

Only use chargers and batteries supplied by OMRON. The charger shall only be used to charge an HD-1500 AMR battery.

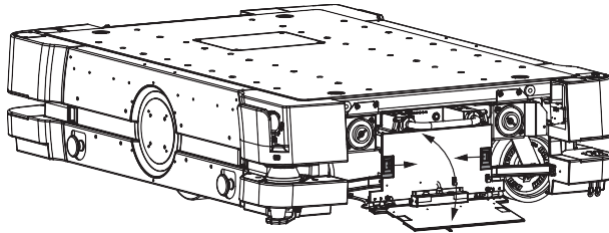


Precautions for Correct Use

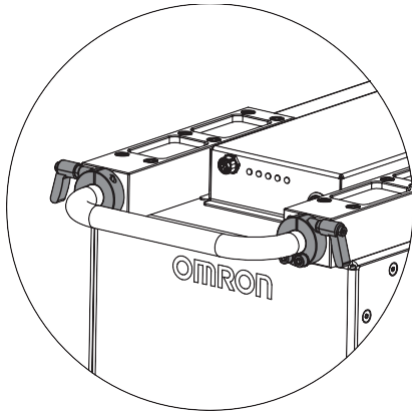
During the initial AMR installation and configuration, install a fully-charged battery.

Follow these steps to install a battery.

- 1** Remove the AMR front skin to access the battery compartment.
- 2** Unlatch and open the battery door. The battery door pivots downward and rests on the floor. This allows you to use the battery door as a ramp.

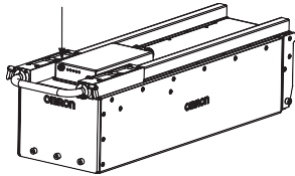


- 3** Use the extended handle to push the battery into the AMR. As the battery gets pushed in, the power connector installed on top of the battery case makes a blind-mate connection with the power connector attached to the chassis.
- 4** Collapse the handle before pushing the battery all the way into the AMR. Release the locking collars and then slide the handle into the battery.



5 Tighten the two locking collars to secure the battery handle in place.

6 Connect the cable to the battery.



7 Push the battery all the way into the AMR and then close the battery door. The battery door secures the battery in place and prevents it from shifting inside the compartment.

8 Install the AMR front skin to complete the procedure.

3-3 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.

3-3-1 Default Network Settings

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

The Maintenance Ethernet Port automatically assigns an IP address to the connected PC.



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. 1635)* for information about modifying network settings.



Additional Information

Access to the SetNetGo Web Interface is always enabled and accessible with the Maintenance Ethernet Port and does not require a password or a software license.

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	169.254.10.15
Ethernet negotiation method	Auto-MDIX
Network method	Access Point (AP)
Identifier (SSID)	Wireless Network
Security method	Unsecured

3-3-2 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.

- 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 and an IP address of 169.254.10.100 or 169.254.10.100 will typically be issued by the AMR. If a static IP is preferred, set the range between 169.254.10.100 to 169.254.10.149.

- 3 Verify the settings by opening a browser window and accessing <https://169.254.10.15>. If the settings are correct, this will display the SetNetGo web interface and complete this procedure.

3-3-3 Wireless Connection

A wireless connection is required when the AMR is operating in a workspace with other AMRs. The wireless configuration of the AMR is set using SetNetGo with one of the following methods. You must use a wired connection to access SetNetGo for the initial wireless connection configuration. Refer to *3-3-2 Wired Connection Procedure* on page 3-5 for more information.



Precautions for Correct Use

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



Additional Information

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

- Use the SetNetGo tab in the MobilePlanner software.
- Open a Web browser on your PC and enter the URL: <https://169.254.10.15> to connect directly to the SetNetGo Web Interface on the AMR.

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)	802.11b/g	802.11ac/n	802.11
Channel Set				
Wireless Watchdog IP Address				
Security Encryption	Disabled	WEP 64-bit	WEP 128-bit	

Item	Details	
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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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:

3-4 Electrical Connections

Use the following information to understand the AMR's electrical connections.

3-4-1 Wireless Antenna Connections

Wireless antennas may need to be relocated from the factory installed position to new position if the payload interferes with the signal.



Precautions for Correct Use

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

A wireless antenna extension kit is available (part number 68955-000) if wireless antennas need to be relocated. The kit includes the following items.

- Two low loss extension cables (2 m)
- Two dipole antennas with reverse SMA plug and 90° pivot (137 mm in length)



Additional Information

- Contact your local OMRON representative if longer extension cables or different antennas are required.
- The AMR Controller provides two connections for wireless antennas. Refer to *1-3 Features and Components* on page 1-6 for more information.

Wireless Antenna Relocation Procedure

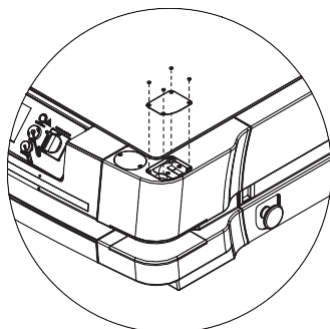
Use the following procedure to relocate the wireless antennas. This procedure details the relocation of one of the antennas and should be repeated if both antennas need to be relocated.

The following items are required for this procedure.

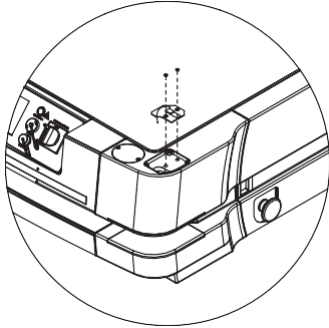
- A wireless antenna extension kit (part number 68955-000).
- 2.5 mm hex key.
- 8 mm wrench or socket driver.

- 1** Use a 2.5 mm hex key to remove the 4 screws that fasten the wireless antenna cover to the AMR and then remove the cover.

The cover is not used when the wireless antenna is relocated.



- 2 Gently pull the antenna connector off of the AMR adapter coupling. This is a friction fitting which requires very little force.
- 3 Using a 2.5 mm hex key, remove the two retaining screws that fasten the antenna backing plate to the compartment and then remove the assembly from the AMR.



- 4 Remove the adapter coupling from the antenna connector on the AMR using a 8 wrench or socket driver.
- 5 Connect the extension cable to the antenna connector on the AMR.
- 6 Route the cable to avoid pinching, chafing, or damage to the new antenna position.
- 7 Mount the antenna and then connect it using the adapter coupling and the extension cable to complete this procedure.

3-4-2 User Access Panel Connections

Use the following information to make all necessary user access panel connections.



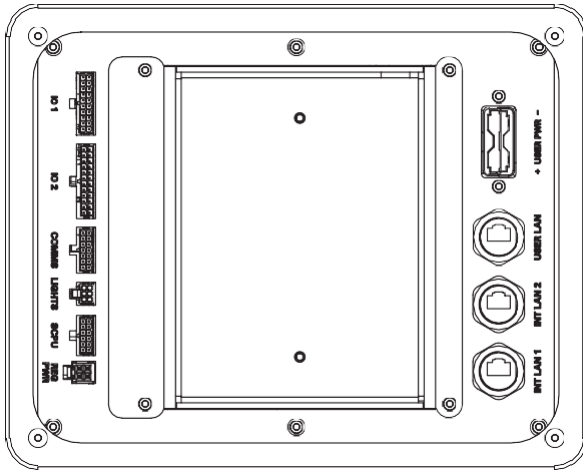
Additional Information

Refer to *2-6 Other Specifications* on page 2-12 for more information on user access panel connector and electrical specifications.

The user access panel can be reached from the top of the AMR by removing the cover. This requires a 3 mm hex key to remove the four M5 screws. After the screws are removed, the cover can be removed.

The cover may become adhered to the AMR chassis over time. Threaded holes in the cover are provided for use with the fastening screws to extract the cover in this condition.

The following connections are available on the user access panel:



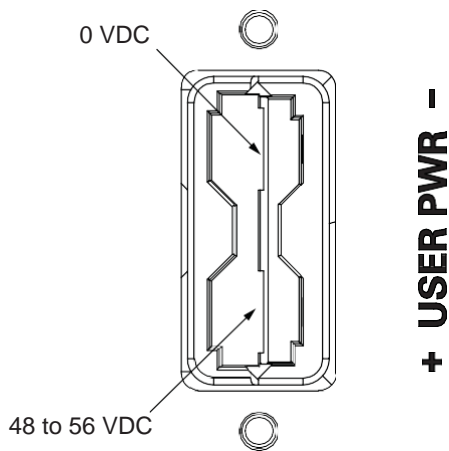
USER PWR

The USER PWR connector on the User Access Panel provides unregulated battery power for payload structure devices. Use the information below to understand all USER PWR connections.



Additional Information

Refer to 2-6-2 *USER PWR Connector* on page 2-14 for connector type and specifications.



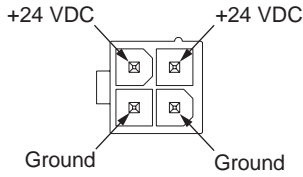
REG PWR

The REG PWR connector on the User Access Panel provides regulated 24 VDC power and is typically used for payload structure control devices. Use the information below to understand all REG PWR connections.



Additional Information

Refer to 2-6-3 *REG PWR Connector* on page 2-15 for connector type and specifications.



SCPU

The SCPU connector on the User Access Panel provides connections for user-supplied safety devices. Use the information below to understand all SCPU connections.

Each of the emergency stop inputs has a direct connection to the AMR internal Safety Controller and is not connected to any other device or input.

WARNING

If you are using a user-supplied E-stop, you must perform safety commissioning to verify the emergency stop functionality before putting the AMR into service.



CAUTION

- All E-stop buttons must be located in areas that are easy to reach and within 600 mm of personnel. It is the end user's responsibility to ensure that any additional E-stop buttons are placed in a location where the operator can easily access them in an emergency situation.
- If you are using a user-supplied E-stop, you must perform safety commissioning to verify the emergency stop functionality before putting the AMR into service.



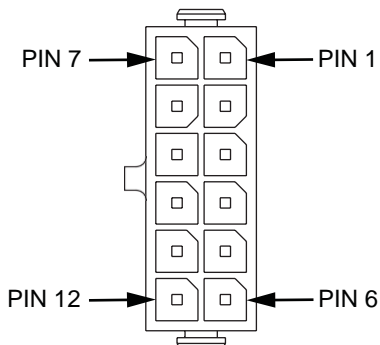
Precautions for Safe Use

The emergency stop or other protective stop devices you install on the AMR must have dual channel circuit to ensure the same performance level as the other safety devices of the AMR.

Precautions for Correct Use

You must attach either a jumper or some other safety-rated devices (typically E-stop buttons) to the SCPU connector in order for the AMR to function. The jumper is provided as part number 68410-218L.

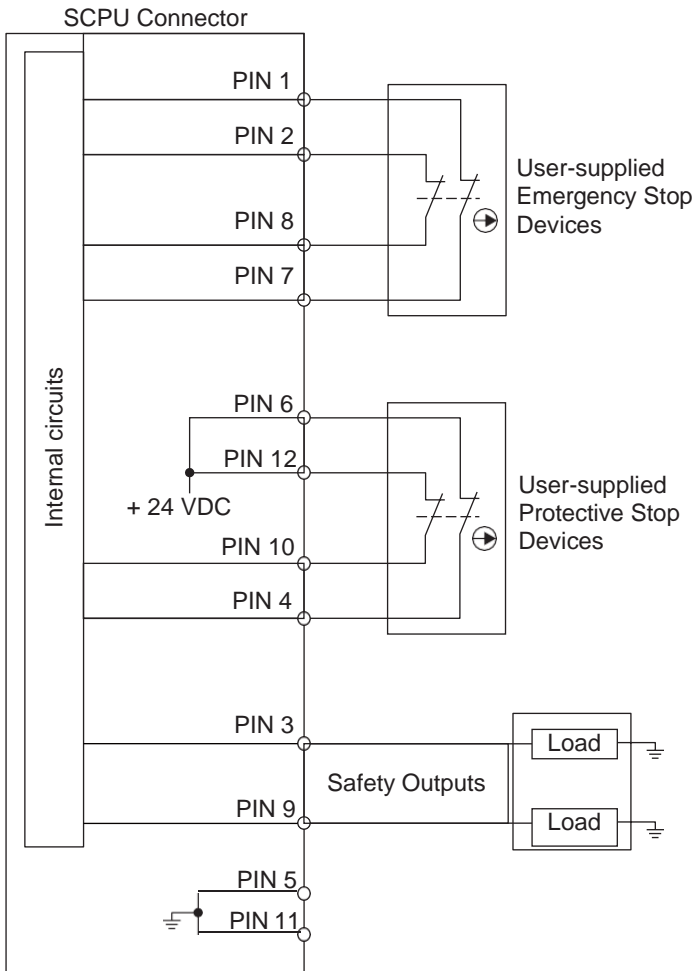
The following figure shows the pin arrangements for the SCPU connector on the AMR.



The information in the table below describes the signal designations for the SCPU connector.

Pin Number	Description
1	Emergency stop channel 1 input
2	Emergency stop channel 2 input
3	Safety output 1
4	Protective stop channel 1 input
5	Ground
6	24 VDC
7	Emergency stop channel 1 output
8	Emergency stop channel 2 output
9	Safety output 2
10	Protective stop channel 2 input
11	Ground
12	24 VDC

The user-supplied emergency stop devices and user-supplied protective stop devices must be normally closed. An open circuit for either of these will trigger a stop. An SCPU circuit diagram is provided below.



Refer to the following sections for information about the behavior of the emergency stop, protective stop, and safety output operations.

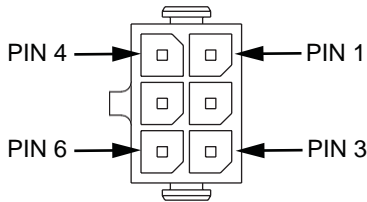
- 2-6-1 Safety Functions on page 2-12
- 4-3 AMR Response During Protective Stops on page 4-4
- 2-6-4 SCPU Connector on page 2-15

LIGHTS

The LIGHTS connector on the User Access Panel provides outputs for user-supplied signaling devices such as warning lights or buzzers.

Use the information below to understand all LIGHTS connections.

The following figure shows the pin arrangements for the LIGHTS connector on the AMR.



The information in the table below describes the signal designations for the I/O 1 connector.

Pin Number	Description
1	Red light
2	Ground
3	Yellow light
4	Green light
5	Ground
6	Buzzer*1

*1. The buzzer signal will turn ON when the AMR warning buzzer turns ON.

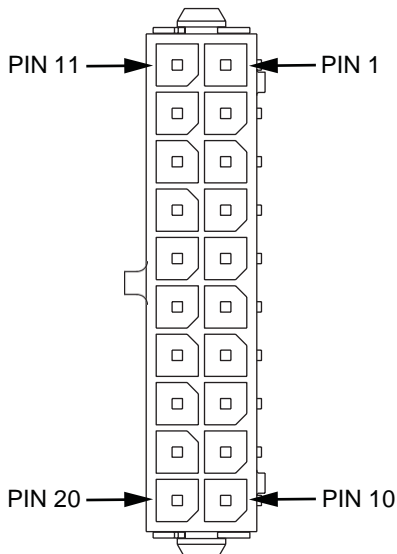
Refer to the following sections for information about the behavior of the LIGHT signals.

- 2-6-5 LIGHTS Connector on page 2-16

I/O 1

The I/O 1 connector on the User Access Panel provides analog and digital inputs for user-supplied devices that are typically used for control of a payload structure system. Use the information below to understand all I/O 1 connections.

The following figure shows the pin arrangements for the I/O 1 connector on the AMR.



The information in the table below describes the signal designations for the I/O 1 connector.

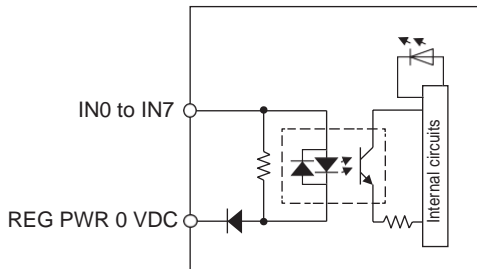


Additional Information

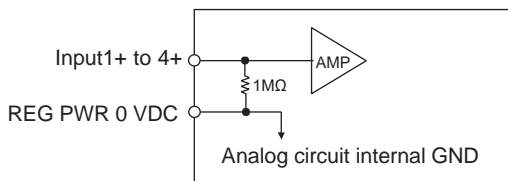
Use REG PWR pins 2 and 4 (0 VDC) for IOG ground connections. Use REG PWR pins 1 and 3 for sensor 24 VDC connections. Refer to *REG PWR* on page 3-10 for more information.

Pin Number	NX-series Unit	NX-series Unit Terminal	Description
1	NX-ID4442	IN0	24 VDC sourcing (PNP) digital input
2		IN1	
3		IN2	
4		IN3	
5 to 7	IOG		Ground
8	NX-AD3603	Input1+	-10 to +10 VDC analog input
9		Input2+	
10	IOG		Ground
11	NX-ID4442	IN4	24 VDC sourcing (PNP) digital input
12		IN5	
13		IN6	
14		IN7	
15 to 17	IOG		Ground
18	NX-AD3603	Input3+	-10 to +10 VDC analog input
19		Input4+	
20	IOG		Ground

A circuit diagram is provided below for the digital inputs.

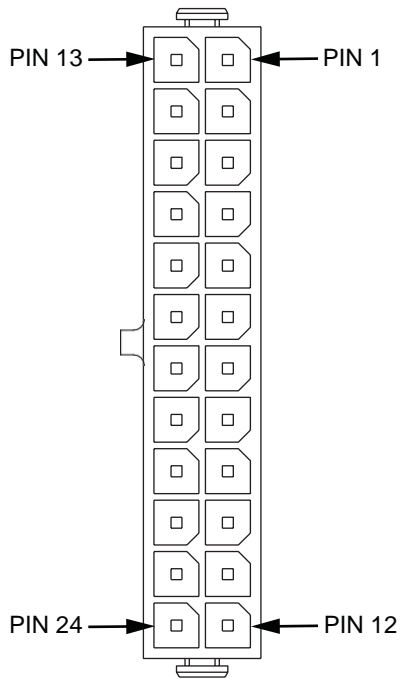


A circuit diagram is provided below for the analog inputs.



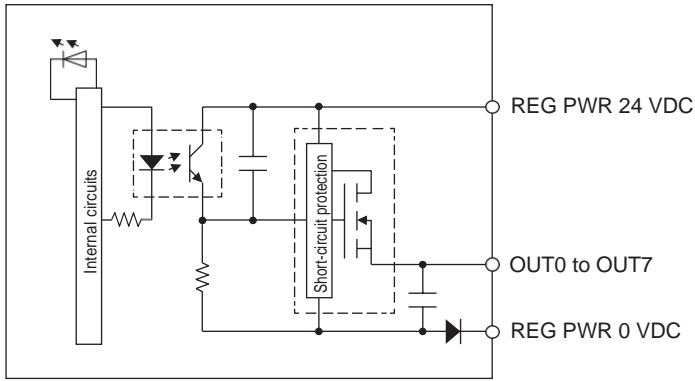
I/O 2

The I/O 2 connector on the User Access Panel provides analog and digital outputs for user-supplied devices that are typically used for control of a payload structure system. Use the information below to understand all I/O 2 connections.

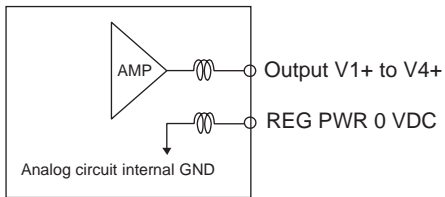


Pin Number	NX-series Unit	NX-series Unit Terminal	Description
1	NX-OD4256	OUT0	24 VDC sourcing (PNP) digital output
2		OUT1	
3		OUT2	
4		OUT3	
5 and 6	IOG		Ground
7	NX-DA3603	V1+	-10 to +10 VDC analog output
8		V2+	
9 and 10	IOG		Ground
11	NX-OD4256	OUT4	24 VDC sourcing (PNP) digital output
12	IOG		Ground
13	NX-OD4256	OUT5	24 VDC sourcing (PNP) digital output
14		OUT6	
15		OUT7	
16 and 17	IOG		Ground
18	NX-DA3603	V3+	-10 to +10 VDC analog output
19		V4+	
20 to 24	IOG		Ground

A circuit diagram is provided below for the digital outputs.



A circuit diagram is provided below for the analog outputs.



3-5 Attaching the Payload

Use the information in this section to understand design considerations and other factors for attaching a payload to the AMR.



Precautions for Safe Use

You must perform a complete risk assessment for your payload design and the intended use of the AMR prior to its operation.

3-5-1 Payload Structure Mounting Points

Several mounting points are provided for various payload structure designs. These mounting points allow you to adjust and position your payload in relationship to the AMR's center of gravity. Refer to *2-2-3 Payload Center of Gravity* on page 2-4 for more information.

Make the following considerations when using payload structure mounting points.

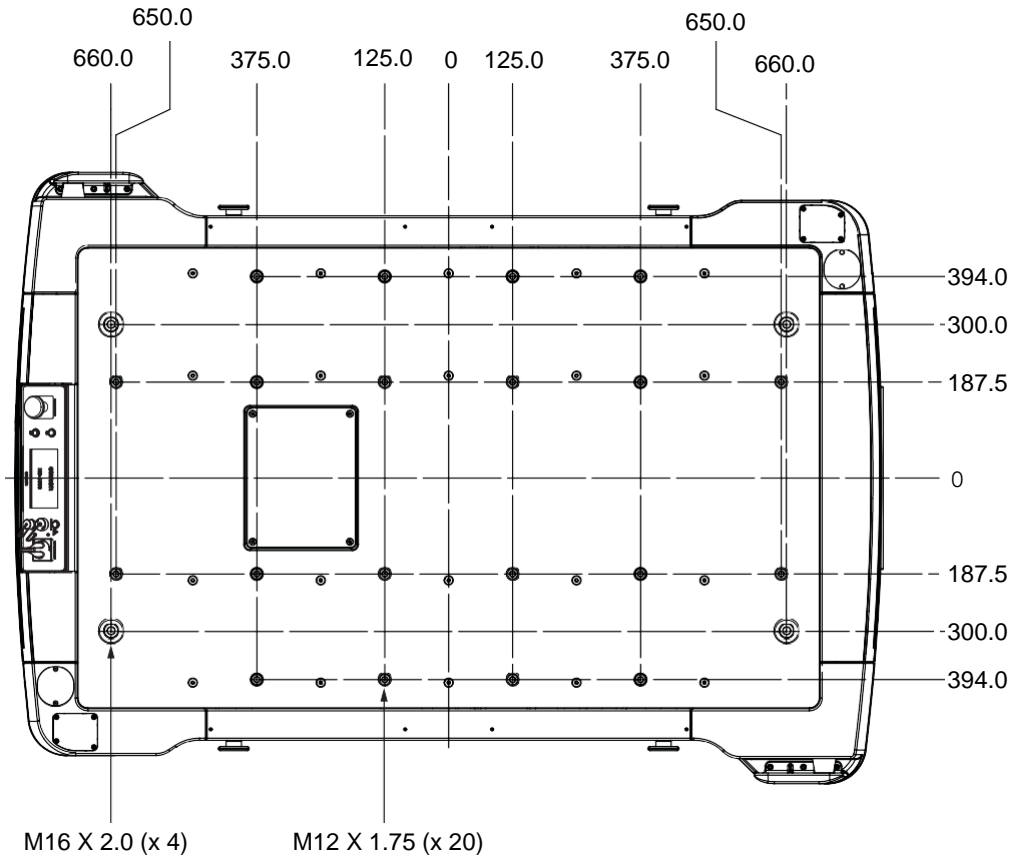
- Use mounting screws appropriate for the mass of your payload.
- Ensure that the mechanical connection points as well as the electrical connections are conveniently accessible.
- There are 4 AMR lifting points that can also be used as payload structure mounting points. The payload structure may need to be removed to lift the AMR if these are not accessible. These lifting points have M16 x 2.0 threaded holes.
- If a Top Plate is not present, the chassis mounting surface is recessed 4 mm below the top surface of the outer edges of the AMR. Design considerations should be made to avoid interferences.
- If a Top Plate is not present, special considerations for the rivet nuts must be made. Refer to *Rivet Nut Considerations* on page 3-18 for more information.



Precautions for Correct Use

Do not exceed 10 kN per payload structure mounting point.

Mounting points are arranged in a longitudinal and transverse pattern. Mounting point dimensions are provided in the following figure.



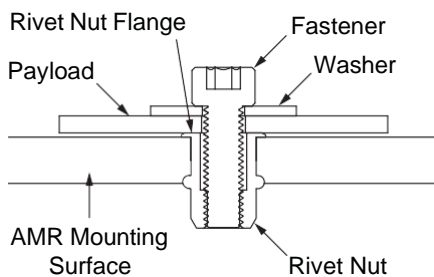
Rivet Nut Considerations

If a Top Plate is not present on the AMR, make the following rivet nut considerations when designing the payload structure.

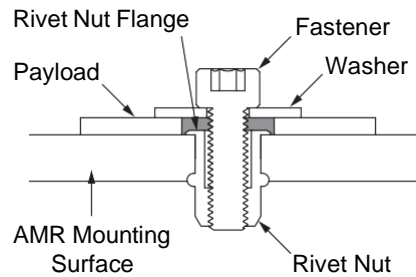
Rivet nuts are used for each payload structure mounting point. A rivet nut has internal threads used for fasteners that attach the payload to the AMR mounting surface.

The payload should be designed to rest on top of the rivet nut and make contact with its flange. If the payload structure is designed incorrectly and does not make contact with the rivet nut flange, the rivet nut could spin in place and prevent proper fastener torque.

The rivet nut flange is 1.19 mm tall. Thread engagement for fasteners should be from 18 mm to 45 mm.



Correct Installation



Incorrect Installation

● Overhanging Payloads

Increasing the AMR's physical length or width by adding an overhanging payload requires that you increase the dimension of the AMR's safety zones and repeat safety commissioning. Contact your OMRON representative for more information on modifying the safety zones.



You need to modify the safety zones if your payload overhangs the AMR's default dimensions and if operating on a floor surface that has poor traction to the extent that the AMR cannot stop reliably within the default zones. OMRON is not responsible for any risks incurred by modifying safety zone sizes or other Safety Laser Scanner settings.



3-6 Attaching Warning Labels

Two warning labels are provided with the AMR. These must be placed in a prominent location on a flat, horizontal surface on the payload structure or AMR itself, where a person could sit or stand. The labels should be placed where the operators will see them and must be visible from at least two opposing sides of the AMR.



Additional Information

- All other warning labels are attached at the factory.
 - When replacing the payload structure, you must place the provided labels on the new payload structure surface and follow the instructions noted above.
 - Any additionally required safety labels for the payload structure or specific to the end-use application shall be evaluated by the user as part of the risk assessment.
-

3-7 Safety Commissioning

Use the information in this section to understand the emergency stop and Safety Laser Scanner commissioning procedures.

WARNING

Although the AMR is commissioned at the factory, the user must perform safety commissioning as part of the initial setup upon receipt.



Precautions for Correct Use

There may be future updates for the Safety Controller. Safety Controller updates cause the Safety Laser Scanner to decommission because the safety zone check will fail. After a Safety Controller update is complete, you must recommission the Safety Laser Scanner.

You must repeat the emergency stop commissioning and the Safety Laser Scanner commissioning procedures under the following circumstances.

- Detection of an abnormality in any safety mechanism.
- Changing the shape or size of the Safety Laser Scanner zones.
- Adding user-supplied E-stops.
- During regular preventative maintenance procedures.

3-7-1 Safety Commissioning Procedure

This procedure verifies that the Safety Laser Scanners report the *MovementParametersSectors* information correctly, and that the protective stop circuitry activates when an obstacle is detected in a safety zone.

It also verifies the correct safety stop functionality when any and all E-stop buttons are pressed. You must repeat this procedure for every E-stop button in the system.



Additional Information

Ensure that all E-stop buttons are not depressed before beginning this procedure.

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

4

Operation

This section provides information about the operation of the AMR.

4-1	Releasing the Brakes	4-2
4-2	Manually Pushing the AMR	4-3
4-3	AMR Response During Protective Stops.....	4-4

4-1 Releasing the Brakes

The brakes on the drive wheels can be released with the brake release button in case of an emergency or abnormal situation. This may be required to manually move the AMR. Refer to *4-2 Manually Pushing the AMR* on page 4-3 for more information.

The brake button must be pressed continuously. Releasing the brake button will activate the brakes. Battery power is required to release the brakes.

WARNING

- The AMR is not intended to be operated on ramps or sloped surfaces. Using the brake release button while the AMR is positioned on a slope of greater than 3% will cause the AMR to roll down. You must not use the brake release button to move the AMR manually when it is positioned on a slope of greater than 3%, unless necessary precautions have been taken to prevent uncontrolled rolling of the AMR.
- Use caution when stopping the AMR on a ramp. The use of the brake release will cause direct rolling of AMR down the ramp. Powering OFF the AMR on a ramp should be avoided if possible to minimize the use of brake release on a ramp.



CAUTION

Manually moving a fully-loaded AMR while using the brake release button is not recommended. If you must manually move a fully-loaded AMR, make sure to do this safely as this could result in personal injury or property damage.



4-2 Manually Pushing the AMR

If the AMR becomes immobilized, it may need to be manually pushed to a new location.

Payloads and other user-supplied equipment can affect an AMR's stability. All operators should know the locations on the AMR (or its payload) where they can push safely without toppling the AMR over or damaging its components. Push points should be as low as possible and near the center of gravity.

Make the following considerations when manually pushing the AMR.

- Do not push the AMR by pressing on the skins.
- There is no appropriate point at which to pull the AMR. Only push the AMR when attempting to manually move it.
- Only push on the corners of the AMR. These are durable metal castings that can withstand pushing forces without damaging the AMR.
- Use at least 2 people to manually push the AMR. One person is required to hold the brake release button during the pushing process. Refer to *4-1 Releasing the Brakes* on page 4-2 for more information.

WARNING

Use caution when stopping the AMR on a ramp. The use of the brake release will cause direct rolling of AMR down the ramp. Powering OFF the AMR on a ramp should be avoided if possible to minimize the use of brake release on a ramp.



CAUTION

- Pushing an AMR requires significant effort and might cause personal injury or property damage. Take appropriate care and follow all safety instructions.
- The pushing points of the AMR are low to the ground. You must use safe pushing practices when manually moving the AMR.
- When manually moving the AMR, do not push it from a high position on its payload or payload structure. This might cause the AMR to topple.
- Manually moving a fully-loaded AMR while using the brake release button is not recommended. If you must manually move a fully-loaded AMR, make sure to do this safely as this could result in personal injury or property damage.



Precautions for Correct Use

- You should move the AMR manually only when absolutely necessary during an emergency, for safety, or if it is lost or stuck. If you find that you must frequently move the AMR, use MobilePlanner to reconfigure its route to avoid problematic areas.
- Avoid moving the AMR while it is powered OFF. If you manually move the AMR while it is powered OFF, it may not be able to determine its current location when it is powered ON again. Use the localization feature in MobilePlanner to localize the AMR if this occurs.
- If the loaded AMR is too heavy to move manually, it is recommended that you seek additional help or remove the payload.
- Only qualified personnel who have read and understood this manual and the *Mobile Robot HD Safety Manual (Cat. No. I647)* should manually move the AMR.
- OMRON recommends that you train personnel on the safe use of the brake release button and procedures for safely pushing an AMR.

4-3 AMR Response During Protective Stops

The AMR response during a protective stop depends on the AMR driving state. Use the information below to understand how the AMR responds when a protective stop is triggered.

AMR State	USER_PROTECTIVE_STOP input	ESTOP_USER input	AMR Response	USER_SAFETY_OUT
Driving	LOW	HIGH	Protective Stop Automatic Reset	LOW
Driving	HIGH	HIGH	No Change	HIGH
Driving	N/A	LOW	Protective Stop Automatic Reset	LOW
Stopped	LOW	HIGH	STO Active, Brakes engaged	HIGH
Stopped	HIGH	HIGH	No change	HIGH
Stopped	N/A	LOW	STO Active, Brakes engaged	LOW



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