ROBOTICS

Product Manual Flexley Platform

AMR P604



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Product Manual Flexley Platform

AMR P604

3HAS006173F001 & 3HAS006173F002

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Revision: B

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Overview

About this manual

This Product manual contains important information about correct operation and proper maintenance of the Autonomous Mobile Robot (AMR). For further information about maintenance see Maintenance manual – Flexley Platform AMR P604 (*References*).

It also contains safety instructions (see *Safety*), which must be strictly followed to prevent accidents from happening to persons or the AMR.

The purpose of this manual is to provide personnel with instructions for the operation (*Components of the AMR* and AMR operation) and transport (*Transport, lifting, and storage*) of the AMR.

This entire manual must be carefully read. Understanding this manual will be essential to:

- Achieve optimal use of the equipment.
- Increase the reliability and service life of the AMR.
- Maintain safety standards for personnel.

All the information in this manual is based on the most recent data available at the time of printing.

ABB reserves the right to make changes without prior notice and shall not be subject to any further obligations as a result thereof.

This manual must be considered a permanent part of the AMR and must always remain in the vehicle.

No part of this manual may be reproduced without written consent.

Usage

This manual should be used during:

- Operating the AMR
- Maintenance

Who should read this manual?

This manual is intended for:

- Operating personnel
- Maintenance personnel

Prerequisites

A maintenance/repair/installation craftsman working with an ABB mobile robot must:

- Be trained by ABB and have the required knowledge of mechanical and electrical installation/repair/maintenance work.

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Continued

References

Documentation referred to in the manual, is listed in the table below.

Document name	Document ID
Maintenance manual - Flexley Platform AMR P604	3HAS00003-001
User manual - Flexley Platform AMR P604	3HAS00072-001
Load Specifications manual - Flexley Platform AMR P604	3HAS00010-001
Laser Configuration Master manual - Flexley Platform AMR P604	3HAS00074-001
Quality Parts List - Flexley Platform AMR P604	3HAS00004-001
Manual Charging station AMR T701/T702/P604	3HAS00066-001
3HAS00063-001_Revision A_en, UM AMR Studio Suite compatible with AMR Studio Fleet Manager	3HAS00063-001
3HAS00064-001_Revision A_en, UM AMR Studio Suite compatible with AMR Studio Manager	3HAS00064-001

Revisions

Revision	Description
A	First edition.
B	Standard features and additional information included. Minor changes added.

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Visual Slam guidance vs Magnetic guidance

This Product manual contains information about two versions of the same AMR, depending on the guidance system used:

- P604 M (3HAS006173F002), using Magnetic guidance
- P604 V (3HAS006173F001), using Visual SLAM

The aim of the **Magnetic guidance** is to read and follow the magnetic tape laid on the floor or buried under the floor. The magnetic tape forms part of the AMR's guidance system. The tape provides the path followed by the AMR. This tape can either be applied on the floor’s surface, embedded in the bottom or buried under it. It is usually black in color. The AMR reads the tape to follow a circuit. For example, as shown in the figure below. The main software for this version is SIGAT.

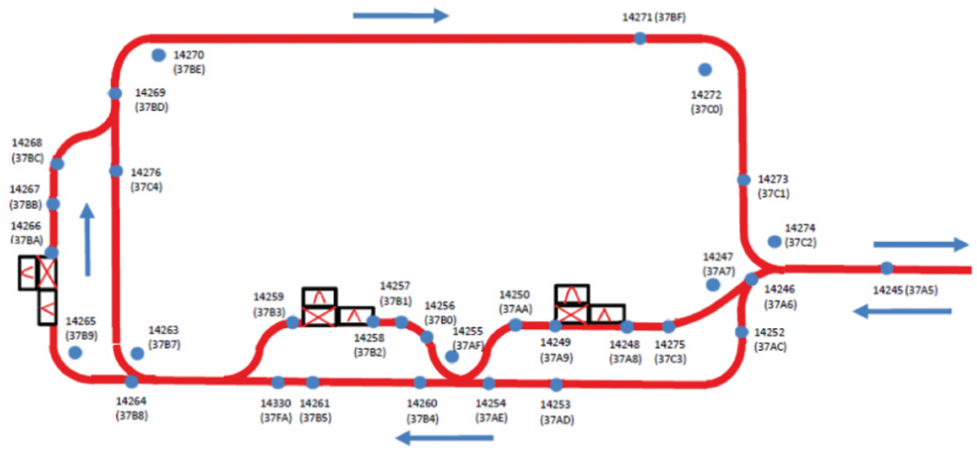


Figure 0.1: Laser scanners

Item	Representation	Description
1		AMR circuit
2		AMR direction
3		RFID Tags

The **Visual SLAM** is a technology based on AI-Perception system utilizing off-the-shelf cameras. On P604 V, 6 monocular cameras are used to detect and track natural features in the environment, then a 3D map is constructed from these tracked features. This technology can differentiate between moving and static objects in the environment to decide what are the good references that the AMR should depend on for localization. In addition, VSLAM allows the AMR to always

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track what is changing in the environment and update the map in real-time. The main software for this version is AMR Studio.



Figure 0.2: Representation of how Visual SLAM interacts with the surroundings

Most of the information in this manual is shared for both versions. When the information is related to only one of the possible vehicles, the title will indicate it. For example, **Navigation system — P604 M**.

From the point of view of an external user, the main differences are the Navigation system and the HMI display, since the information appearing on the screen is showed on a different way, but some procedures like the Insertion procedure would be different as well.

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AMR Studio Suite

Overview

AMR Studio® Suite is a powerful ABB software that provides all the necessary tools to install, manage, and monitor your AMR fleet.

This software comprises two tools that will revolutionize the way you manage your system:

- AMR Studio®
- AMR Studio® Fleet Manager

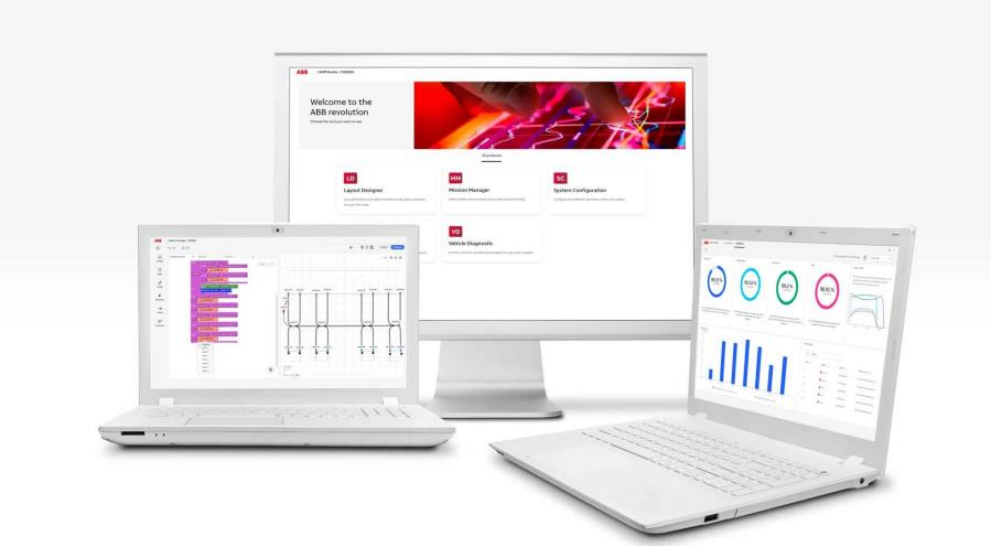


Figure 0.3: AMR Studio Suite

AMR Studio® is an easy-to-use software to set up your AMRs, reduces commissioning time and easily analyze the performance of each AMR. It includes Layout designer, Mission manager and Vehicle diagnostics.

For more details, see UM AMR Studio Suite compatible with AMR Studio Fleet Manager 3HAS00063-001 and UM AMR Studio Suite compatible with AMR Studio Manager 3HAS00064-001 (*References*).

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Conversion table

Overview

This document is written using the metric system as a reference. If the user needs to convert it to the system generally used in the USA, use the following conversion table:

Category	Metric Unit	Metric Abbreviation	US Unit	US Abbreviation	Conversion Formula or Factor
Length	meter	m	foot	ft	× 3.28084
Length	centimeter	cm	inch	in	× 0.393701
Length	kilometer	km	mile	mi	× 0.621371
Mass	kilogram	kg	pound	lb	× 2.20462
Mass	gram	g	ounce	oz	× 0.035274
Volume	liter	L	gallon (US)	gal	× 0.264172
Volume	milliliter	mL	fluid ounce (US)	fl oz	× 0.033814
Temperature	Celsius	°C	Fahrenheit	°F	(°C × 9/5) + 32
Temperature	Fahrenheit	°F	Celsius	°C	(°F – 32) × 5/9

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Product certification

AMR P604 V - 3HAS006173F001

DECLARATION OF INCORPORATION OF PARTLY COMPLETED MACHINERY

According to Machinery Directive 2006/42/EC Annex II B

The manufacturer:

COMPANY NAME	**ASEA BROWN BOVERI, S.A.**
TAX ID CODE	A-08002883
ADDRESS	Autovía A-1, Km 213,5- Polígono Industrial 09390 Madrigalejo del Monte, Burgos (Spain)

Declares only under its own responsibility that the partly completed machinery:

MODEL	Flexley Mover P604V
DESCRIPTION	Autonomous Mobile Robot
REFERENCE	3HAS006173F001
SERIAL NUMBER	0000
YEAR OF MANUFACTURE	2025
AMR Voltage (Vdc)	48
AMR Weight (Kg)	510
Nominal capacity (Kg) / Traction force (N)	1500 / -

Is in compliance with the European Directive: **Machinery Directive 2006/42/EC**

Under the following Standard(s):	
ISO 3691-4:2020	Industrial trucks - Safety requirements and verification - Part 4: Driverless industrial trucks and their systems
ANSI/ITSDF B56.5-2019	Safety Standard for Driverless, Automatic Guided Industrial Vehicles and Automated Functions of Manned Industrial Vehicles

All essential requirements of Annex I of the Machinery Directive 2006/42/EC have been applied and fulfilled, except for no. 1.3.5 and 1.3.6 of Annex I of the Machinery Directive 2006/42/EC that need to be checked by the final integrator.

We declare that the relevant technical documentation is compiled in accordance with part B of Annex VII of the Machinery Directive 2006/42/EC.

We declare that the partly completed machinery 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 Machinery Directive 2006/42/EC, where appropriate.

We undertake to transmit, in response to a reasoned request by the national authorities, relevant information on the partly completed machinery through the authorized person to compile the technical documentation.

Authorized person to compile the technical documentation:

Luis Cascajar
Head of R&D AMR GSC
Autovía A-1, Km 213,5- Polígono Industrial
09390 Madrigalejo del Monte, Burgos (Spain)

In Madrigalejo del Monte (Burgos, Spain) August 5, 2025
Signed for and on behalf of:

Alfonso Gonzalez
Managing Director GSC AMR
Autovía A-1, Km 213,5- Polígono Industrial
09390 Madrigalejo del Monte, Burgos (Spain)

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Figure 0.4: AMR P604 V: Declaration of Incorporation

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DECLARATION OF CONFORMITY

The manufacturer:

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TAX ID CODE	A-08002883
ADDRESS	Autovía A-1, Km 213,5- Polígono Industrial 09390 Madrigalejo del Monte, Burgos (Spain)

Declares only under the solo responsibility of the manufacturer that the product:

MODEL	Flexley Mover P604V
DESCRIPTION	Autonomous Mobile Robot
REFERENCE	3HAS006173F001
SERIAL NUMBER	0000
YEAR OF MANUFACTURE	2025
AMR Voltage (Vdc)	48
AMR Weight (Kg)	510
Nominal capacity (Kg) / Traction force (N)	1500 / -

Is in compliance with the European Directive: **RED Directive 2014/53/EU**

Under the following Standard(s):

ETSI EN 301 489-1 v2.2.0 (2017-03)	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements
ETSI EN 301 489-3 v2.1.1 (2019-03)	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz
ETSI EN 301 489-17 v3.2.0 (2017-03)	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems

Is in compliance with the European Directive: **EMC Directive 2014/30/EU**

Under the following Standard(s):

EN 12895:2015+A1:2019	Industrial trucks - Electromagnetic compatibility
IEC 61326-3-1:2017	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions

Authorized person to compile the technical documentation:

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In Madrigalejo del Monte (Burgos, Spain) August 5, 2025

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Figure 0.5: AMR P604 V: Declaration of conformity

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AMR P604 M - 3HAS006173F002

DECLARATION OF INCORPORATION OF PARTLY COMPLETED MACHINERY

According to Machinery Directive 2006/42/EC Annex II B

The manufacturer:

COMPANY NAME	**ASEA BROWN BOVERI, S.A.**
TAX ID CODE	A-08002883
ADDRESS	Autovía A-1, Km 213,5- Polígono Industrial 09390 Madrigalejo del Monte, Burgos (Spain)

Declares only under its own responsibility that the partly completed machinery:

MODEL	Flexley Mover P604M
DESCRIPTION	Autonomous Mobile Robot
REFERENCE	3HAS006173F002
SERIAL NUMBER	0000
YEAR OF MANUFACTURE	2025
AMR Voltage (Vdc)	48
AMR Weight (Kg)	510
Nominal capacity (Kg) / Traction force (N)	1500 / -

Is in compliance with the European Directive: **Machinery Directive 2006/42/EC**

Under the following Standard(s):

ISO 3691-4:2020	Industrial trucks - Safety requirements and verification - Part 4: Driverless industrial trucks and their systems
ANSI/ITSDF B56.5-2019	Safety Standard for Driverless, Automatic Guided Industrial Vehicles and Automated Functions of Manned Industrial Vehicles

All essential requirements of Annex I of the Machinery Directive 2006/42/EC have been applied and fulfilled, except for no. 1.3.5 and 1.3.6 of Annex I of the Machinery Directive 2006/42/EC that need to be checked by the final integrator.

We declare that the relevant technical documentation is compiled in accordance with part B of Annex VII of the Machinery Directive 2006/42/EC.

We declare that the partly completed machinery 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 Machinery Directive 2006/42/EC, where appropriate.

We undertake to transmit, in response to a reasoned request by the national authorities, relevant information on the partly completed machinery through the authorized person to compile the technical documentation.

Authorized person to compile the technical documentation:

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Head of R&D AMR GSC
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09390 Madrigalejo del Monte, Burgos (Spain)

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Figure 0.6: AMR P604 M: Declaration of Incorporation

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DECLARATION OF CONFORMITY

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TAX ID CODE	A-08002883
ADDRESS	Autovía A-1, Km 213,5- Polígono Industrial 09390 Madrigalejo del Monte, Burgos (Spain)

Declares only under the solo responsibility of the manufacturer that the product:

MODEL	Flexley Mover P604M
DESCRIPTION	Autonomous Mobile Robot
REFERENCE	3HAS006173F002
SERIAL NUMBER	0000
YEAR OF MANUFACTURE	2025
AMR Voltage (Vdc)	48
AMR Weight (Kg)	510
Nominal capacity (Kg) / Traction force (N)	1500 / -

Is in compliance with the European Directive: **RED Directive 2014/53/EU**

Under the following Standard(s):

ETSI EN 301 489-1 v2.2.0 (2017-03)	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements
ETSI EN 301 489-3 v2.1.1 (2019-03)	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz
ETSI EN 301 489-17 v3.2.0 (2017-03)	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems

Is in compliance with the European Directive: **EMC Directive 2014/30/EU**

Under the following Standard(s):

EN 12895:2015+A1:2019	Industrial trucks - Electromagnetic compatibility
IEC 61326-3-1:2017	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions

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Figure 0.7: AMR P604 M: Declaration of conformity

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AMR plates

AMR P604 V - 3HAS006173F001

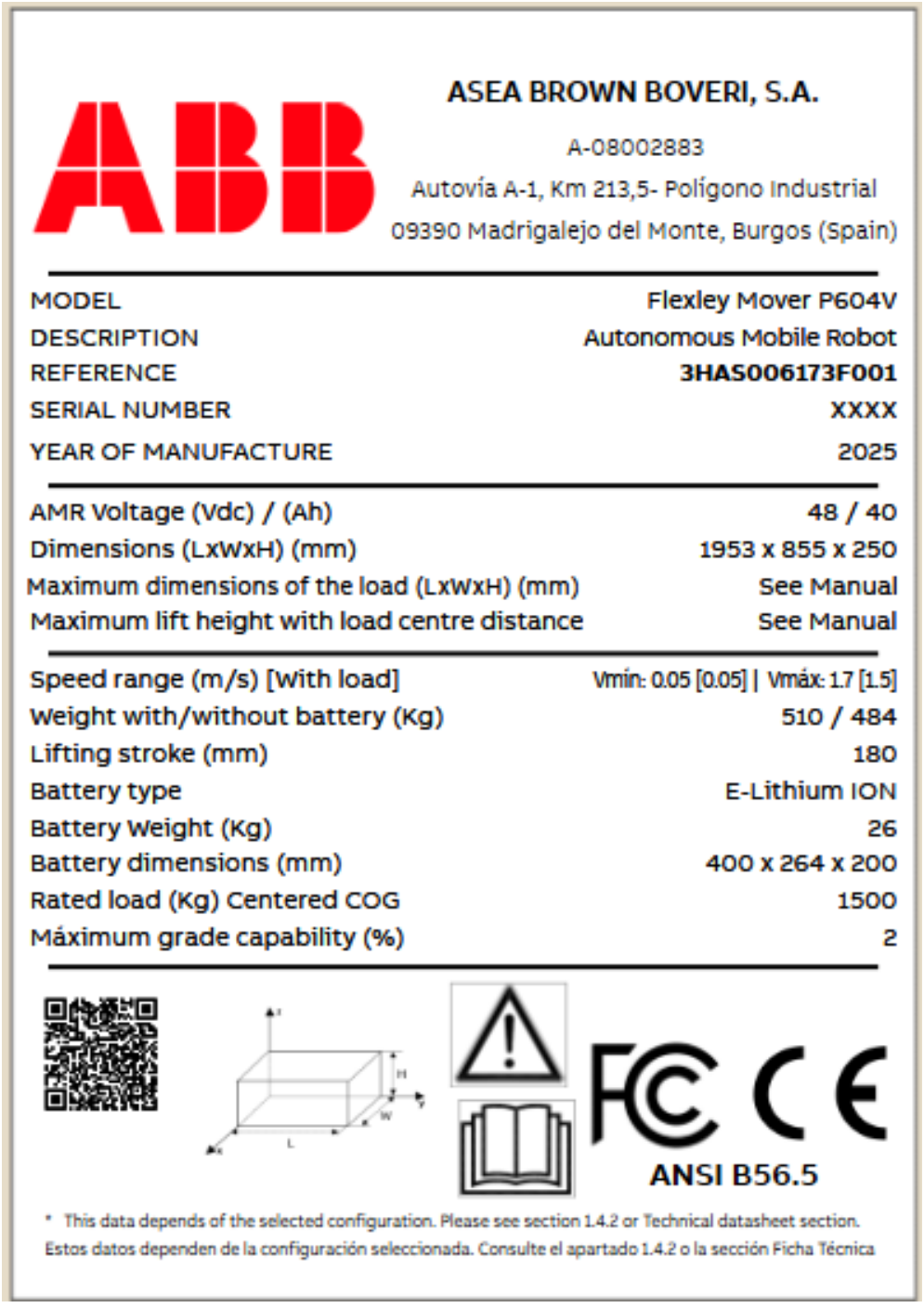


Figure 0.8: AMR P604 V CE and ANSI Plate

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AMR P604 M - 3HAS006173F002

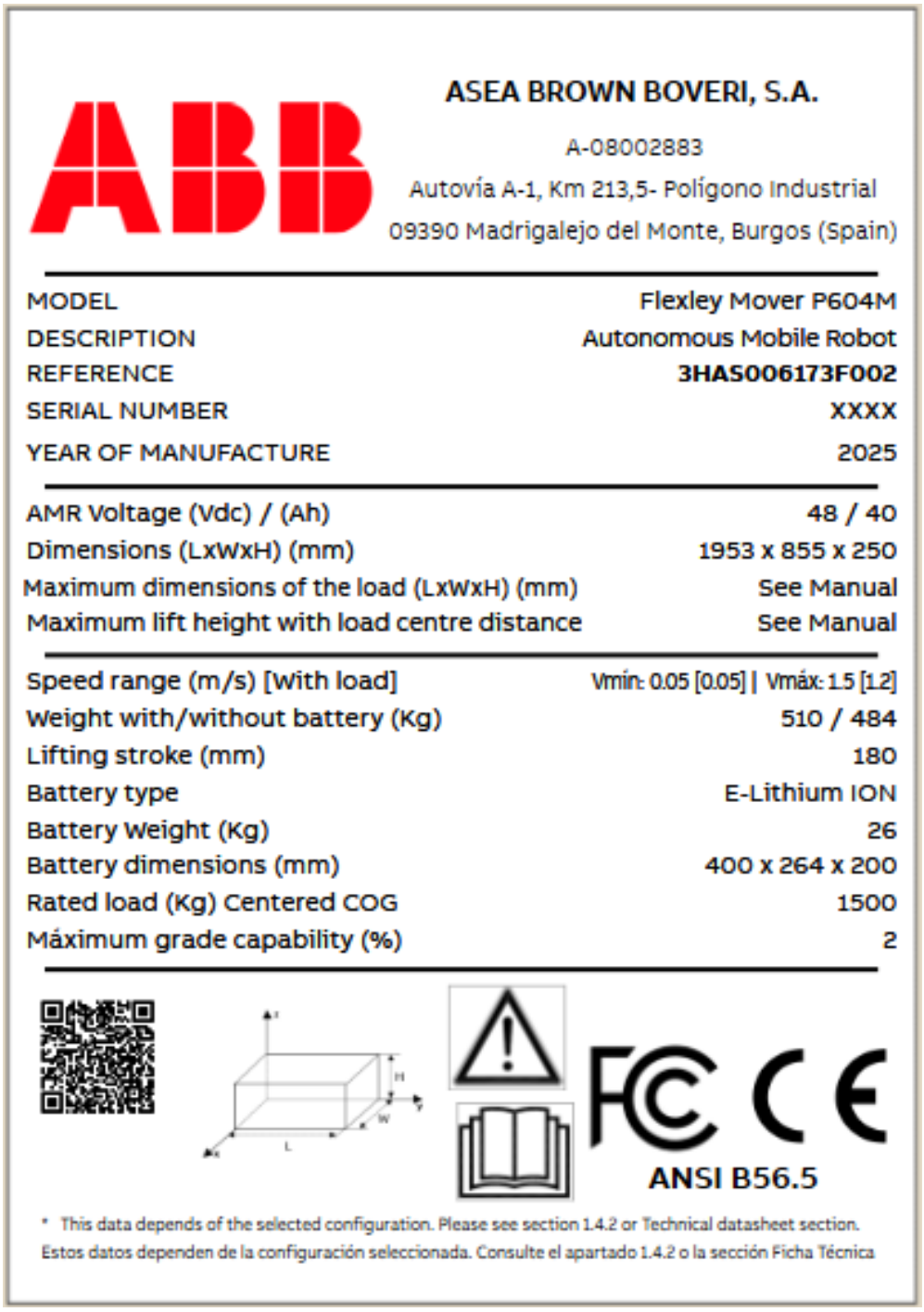


Figure 0.9: AMR P604 M CE and ANSI Plate

Note

Both format and data showed in this manual can change without prior notice. However, ABB will always respect the rules applied for this type of vehicle.

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AMR datasheet

AMR general technical data

Characteristics	AMR P604
Operating modes	Manual mode Automatic mode
Navigation system	Magnetic Visual SLAM guidance
Braking system	Electromagnetic brake
Transport type	Lifting platform
Lifting height	180 mm
Maximum payload[1]	1500 kg
Vehicle speed (P604 M)[2]	Without load: 0.05 – 1.2 m/s With load: 0.05 – 1.2 m/s
Vehicle speed (P604 V)[2]	Without load: 0.05 – 1.7 m/s With load: 0.05 – 1.5 m/s
Maximum transversal speed	Without load: 0.5 m/s With load: 0.5 m/s
Ambient operating conditions	Indoor use. From 0 ºC to 40 ºC
Ingress protection	IP20
Storage and transportation temperature	From 0ºC to 45 ºC
Maximum humidity	90% (condensation free)
Maximum slope	2 %
Battery voltage and capacity	48 Vdc / 20 Ah[3] 48 Vdc / 40 Ah[4]
Weight (with batteries)	510 kg
Weight (without batteries)	484 kg
Nominal dimensions	A: 1953 mm B: 885 mm C: 250 mm D: 430 mm
Life time[5]	7 years

[1] The maximum payload when making any turn on a stop is 1000 kg. Follow the recommendations on the Load specifications. See References.

[2] The conditions of maximum load and maximum speed are conditioned; the load conditions the speed and vice versa.

[3] AMR configuration 2 batteries (3HAS009870A001)

[4] AMR configuration 4 batteries (3HAS009973A001)

[5] Including the proper service maintenance as per the recommendation in the product maintenance manual. See References.

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AMR specific technical data

Measure A (mm)	Measure B (mm)	Measure C (mm)	Measure D (mm)
1953	885	250	430

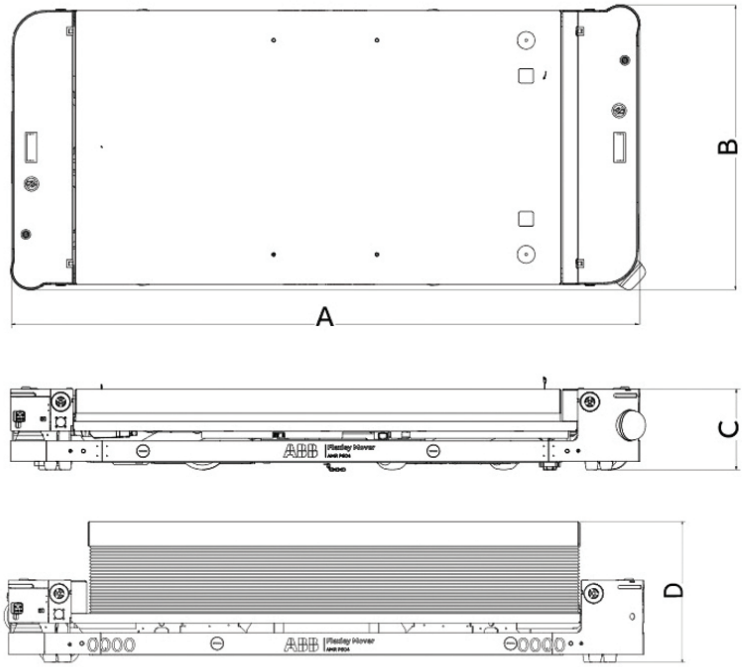


Figure 0.10: AMR Dimensions

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Frame of reference

The ON/OFF switch and display are located on the front of the AMR and therefore indicate the direction of forward travel.

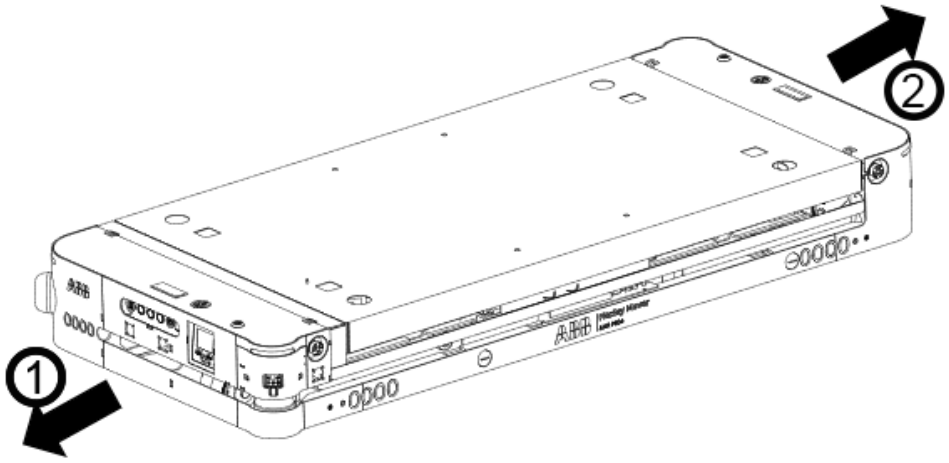
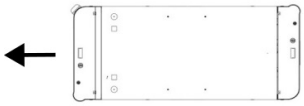
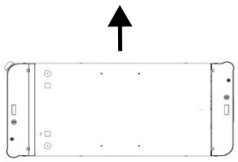
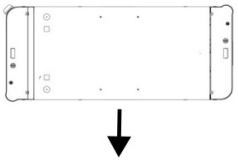


Figure 0.11: AMR forward/backward movement direction

Item	Description
1	Forward
2	Backward

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Coordinates system

Item	Definition	Drawing
1	Forwards	
2	Backwards	
3	Laterally right	
4	Laterally left	
5	Forwards right	
6	Backwards right	
7	Forwards left	
8	Backwards left	
9	Turn right	
10	Turn left	

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Note

The P604 M cannot make 180° turns on spot (also known as military turn). You can see alternatives to this movement on *Annex V – 180° turns*.

The P604 V can make 180° turns on spot if unloaded or using a load up to 1000 kg.

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Abbreviations

Term	Definition
AMR	Autonomous Mobile Robot
ABB	ASEA Brown Boveri
ESD	Electrostatic Discharge
ESPE	Electro Sensitive Protective Equipment
PDM	Personal Detection Means
PFHd	Average Probability of Dangerous Failure per Hour
PL	Performance Level
PLr	Performance Level Required
PLC	Programmable Logic Controller
VSLAM/ Visual SLAM	Visual Simultaneous Localization and Mapping

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Warranty

The warranty period is stipulated in the provisions of the contract. If in the warranty period any fault should occur, the cause of which is unclear or could be grounds for the use of the warranty, the client must promptly inform ABB of said fault.

ABB will investigate the cause of the malfunction and liability in due time. In the meantime, the AMR must be kept in the same condition as when the fault occurred.

ABB will not be liable for damage caused by improper use of the AMR or failure to comply with the instructions in this manual.

Its liability is limited to damage caused by the use of the AMR as per the instructions.

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Spare part orders

The component must be listed in the recommended Spare Parts List and the following information must be provided:

- Machine type or model.
- Serial number
- Reference number of spare part on the Spare Parts List

The first two items are on the AMR data plate.

Note

If the reference is not on the Spare Parts List contact your local ABB services department for more information.

Note

Providing precise details facilitates the acquisition of Spare parts and prevents erroneous deliveries.

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Product variants/optionals

This product manual contains information on different optionals of two AMR models.

- a29: In charge of giving the AMR remote Wi-Fi capability. See the *A29* section.
- SF29: It allows the vehicle to perform a partial SF29. See the *SF29 Bumper* section.
- Secure Wi-Fi Lite (EU/US optional): It is capable of continuously manage the communications of a robotic cell. See the *Communications* section.
- Batteries: 2 *(2 batteries)* or 4 *(4 batteries)* batteries with a voltage/capacity of 48 Vdc / 20/40 can be chosen.

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1 Safety

Note

This product manual must be considered an integral part of the AMR and must be considered with the vehicle throughout its entire deployment. Operators and persons responsible for using the AMR must read and understand this product manual before installing, using, or performing maintenance on the AMR.

WARNING

Personnel operating the AMR must be qualified for the tasks to be carried out and must be specifically instructed in the proper use of the AMR.

Safe operation is the responsibility of the operator. When operator controls are in use, automatic operation of functions under the operator's control shall be deactivated. All operating speeds or motions of manually operated functions shall be such that manual control can be maintained.

Modifications and/or additions of hardware or software which affect rated capacity, safe operation, or any emergency control or device shall not be performed by the user without the system supplier's verifiable approval. Where such authorization is granted, capacity, operation, and maintenance instruction (plates, tags, or decals) shall be changed accordingly.

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1.1 Introduction

Safety measures are a combination of the measures taken in the AMR design stage and measures the user must apply.

All AMR's built by ABB are designed and constructed to fit for their function and can be operated, adjusted, and maintained without putting persons at risk when these operations are carried out under the conditions foreseen.

The hazards, and associated risks, are identified in the AMR development phase.

This Product manual specifies the protective measures designed to reduce the risk that could not be eliminated in the design phase.

Understanding the safety measures and residual risks associated with the AMR is essential. This information is critical for carrying out any operation on the AMR, and the person responsible must provide all operators and maintenance personnel with provided information.

It is the AMR end user's responsibility to take additional measures (hazard/risk awareness, for example) and establish work procedures that minimize risk.

The end user's responsibilities include:

- Providing supplementary information about the type of operation and application.
- Facilitating maintenance, repair and operability of the AMR.

This section includes:

- Terminology that will help understand the safety section.
- Warning symbols and signs placed on the AMR.
- Intended AMR usage.
- Assessed risks and hazards that compromise the safety and health of AMR users or other persons.
- Detailed information on safety measures adopted to eliminate and reduce risks and hazards.
- Safety instructions that AMR operators, users, and other persons must follow in all stages of AMR deployment.

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1.2 Safety symbols and terms

1.2.1 Safety signals in the manual

Introduction to safety signals

This section specifies all safety signals used in the manuals. Each signal consists of:

- A caption specifying the hazard level (DANGER, WARNING, or CAUTION) and the type of hazard.
- Instructions on how to reduce the risk to an acceptable level.
- A brief description of remaining risks, if not adequately reduced.

Hazard levels

The table below defines the captions specifying the hazard levels used throughout this manual.

Symbol	Meaning	Description
	Danger	Indication of an imminently hazardous situation which, if not avoided, will result in serious injury.
	Warning	Indication of a potentially hazardous situation which, if not avoided, could result in serious injury.
	Electrical Shock	Indication of a potentially hazardous situation related to electrical hazards which, if not avoided, could result in serious injury.
	Caution	Indication of a potentially hazardous situation which, if not avoided, could result in slight injury.
	Electrostatic Discharge (ESD)	Indication of a potentially hazardous situation which, if not avoided, could result in severe damage to the product.
	Note	Indication of important facts and conditions.

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1.2.1 Safety signals in the manual
Continued

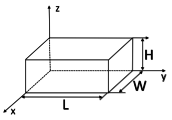
Symbol	Meaning	Description
	Environment	Procedures and characteristics for which it is recommended that the environmental repercussions of certain actions or choices be considered, mainly with regard to products used.

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1.2.2 Sign plates

AMR general sign plates

These signs are the same for all the AMRs and are located on the CE plate.

Symbol	Meaning	Description
	Recycling	Recycling of component(s).
	Read operator's manual	Indication that the operator's manual should be read before continuing the operation.
	Attention	Pictogram preceding the previous one on the CE Marking Plate, indicating the relevance of carefully reading the operator's manual.
	Coordinates	Visual aid to guide the reader on length, width, and height values.

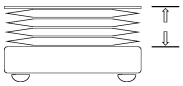
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1.2.2 Sign plates
Continued

Specific sign plates

The specific sing plates for the AMR P604 and their location are shown below:

Symbols	Meaning	Description
	"Do not Step" prohibition	It is prohibited to climb on any part of the AMR.
	"Do not seat" prohibition (CSA)	It is prohibited to sit anywhere on the AMR.
	Heat	Risk of contact with hot surface. Do not touch the indicated areas.
	Trapping	Risk of trapping. Do not insert hand, fingers, or other body parts into the indicated areas.
	Lifting platform	Risk of being hit by a moving lifting platform

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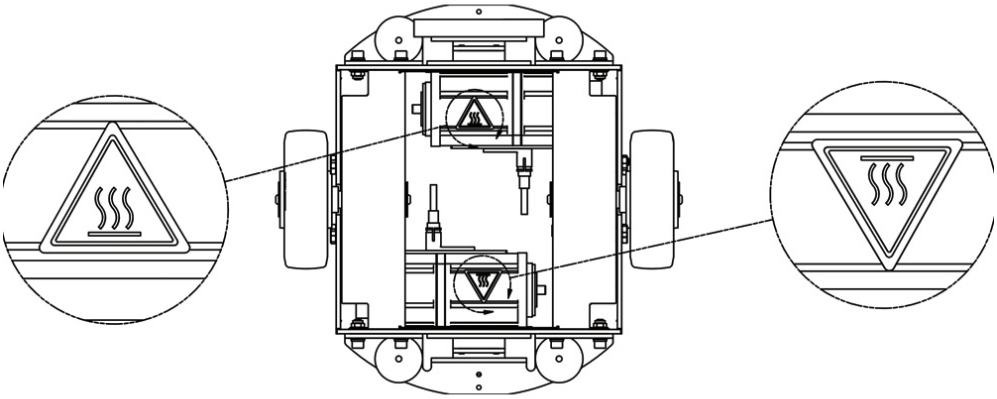


Figure 1.1: AMR sign plate locations (1)

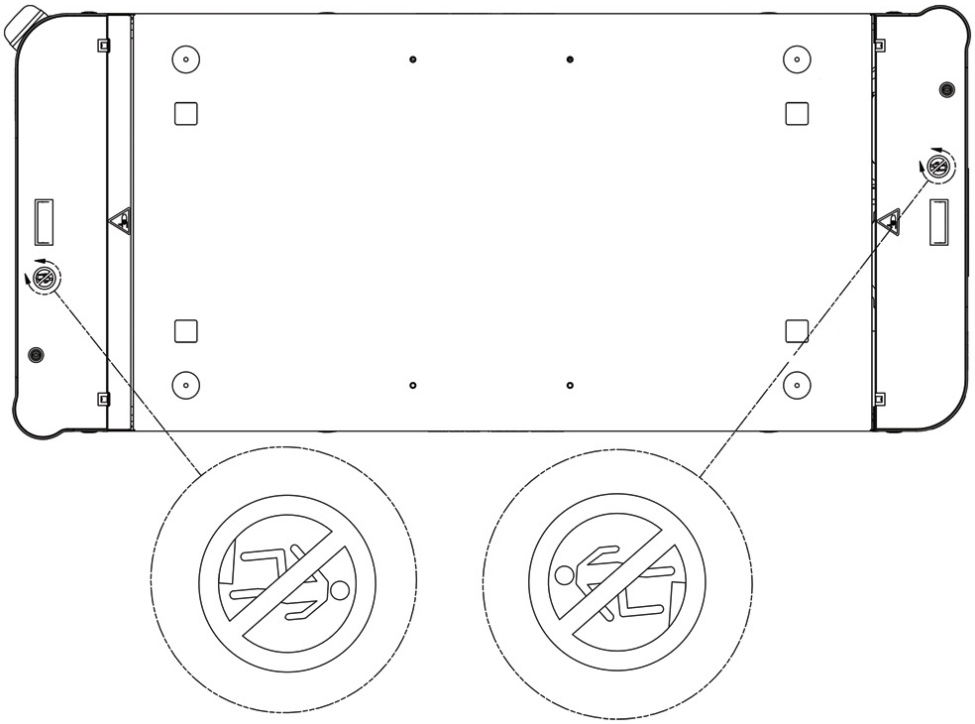


Figure 1.2: AMR sign plate locations (2)

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1.2.2 Sign plates
Continued

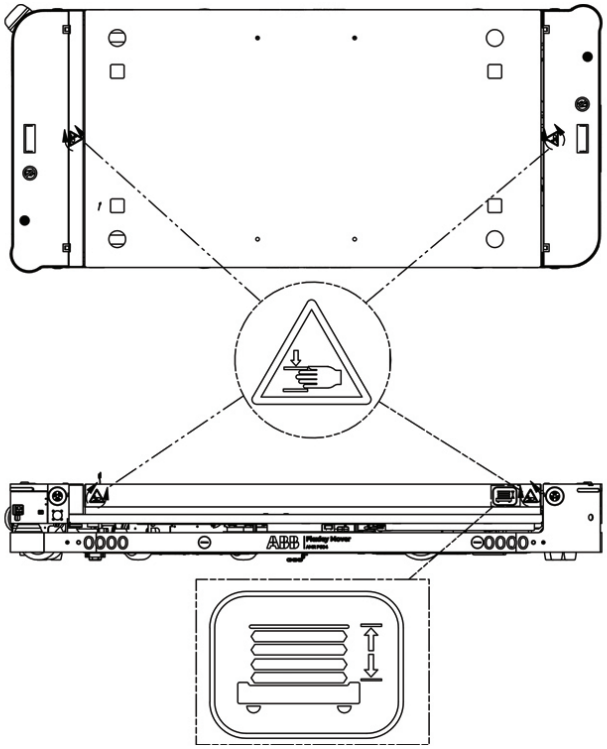


Figure 1.3: AMR sign plate locations (3)

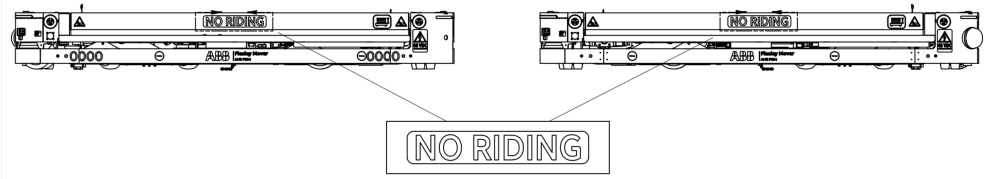


Figure 1.4: AMR sign plate locations ANSI (4)

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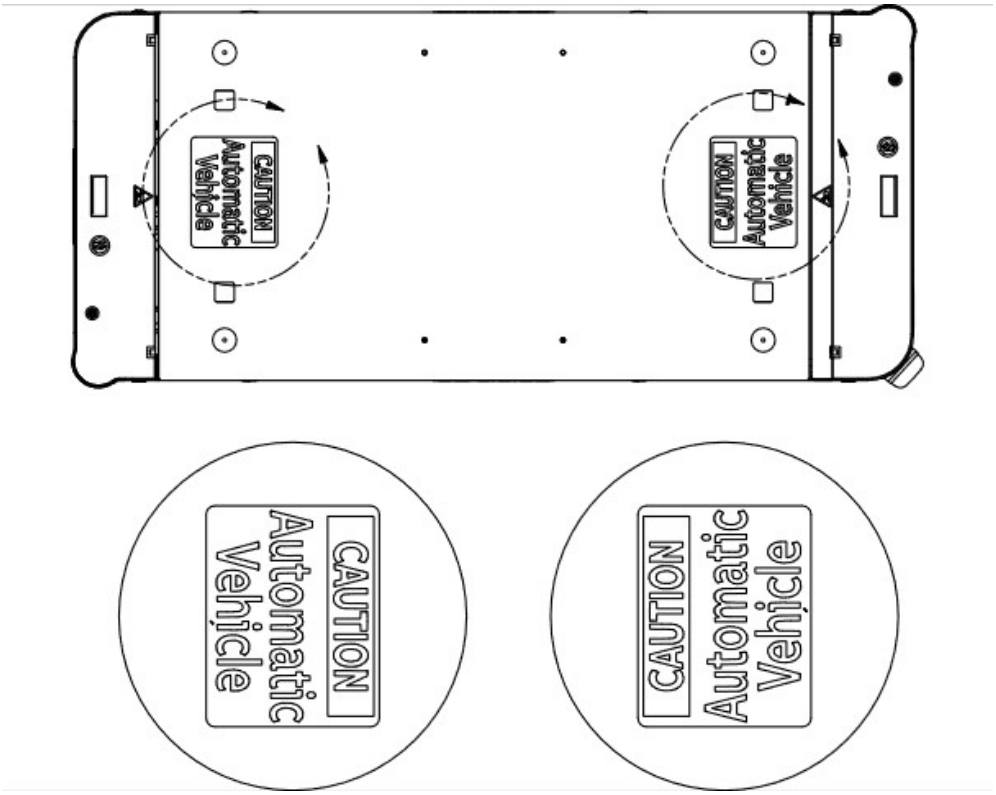


Figure 1.5: AMR sign plate locations ANSI (5)

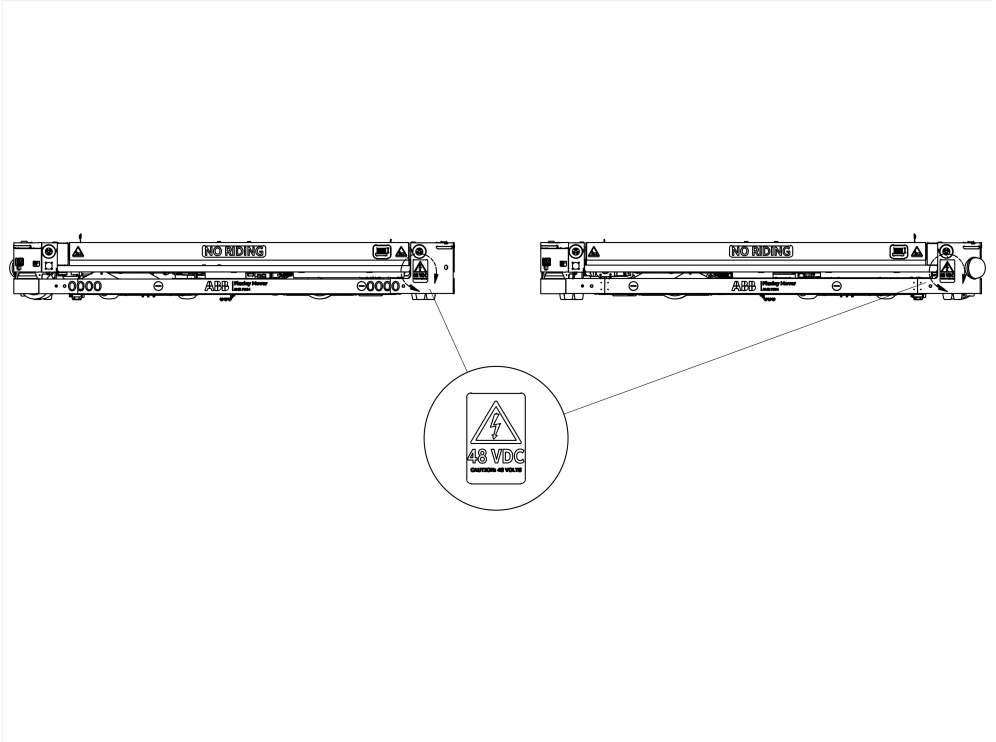


Figure 1.6: AMR sign plate locations ANSI (6)

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1.2.3 Terminology

Term	Description
Accident	Dangerous situation that causes harm to people.
Automatic mode	Operating mode in which no operator intervention is required.
Automatic restart	Resumption of truck operation without external intervention.
Confined zone	A zone in which means of personnel detection may be omitted and where any speed is allowed. This zone shall be designated as “confined zone” and shall be marked accordingly.
Escape route	Space provided for a person to exit away from a hazard. This space must be at least 0.5 m wide and 2.1 m high.
End user	A person or organization for whom the product is designed and is not necessarily the one who installs, maintains, or operates the product, or operates the product.
Exceptional operation	Tasks performed to ensure proper operation of the AMR, comprising maintenance, removal of sources of disruption and interference to the work cycle, removal of waste material, adjustment, programming, and testing.
Exposed person	Any person fully or partially in a danger zone.
Hazard	A situation that may cause injury, damage to property or the environment, or a combination thereof.
Health	The highest state of physical, mental, and social wellbeing, as well as continuous functional and biological capability, and not merely the absence of illness or ailments.
Inadequate clearance	Defined area in which a truck that has less clearance than 0.5 m wide on either side of the truck or in the direction of movement operates.
Incident	Dangerous situation that does not cause harm to people.
Injury	Harm to the body due to a blow, fall, trapping, etc.
Malfunctioning	Abnormal vehicle behaviour outside normal operating conditions.
Muting	Temporary automatic suspension of a safety function.
Operating Hazard zone	Area of operating zone in which a person can be exposed to a hazard (this can be found in a transfer Area with inadequate clearance). Notice that the operating hazard zone is considered a hazard zone according to ISO 12100:2010, 3.11. Area or zone which cannot be protected by personnel detection means.
Operating zone	Defined area in which a truck operates with a minimum clearance of 0.5 m wide on each side of the truck and in the direction of movement.
Operational stop	Functional stop of the truck until a deliberate restart action with the possibility of maintaining the power to the actuators.
Operator	There are two types of operators, level 1, and level 2, and depending on their training, they may be authorized to perform tasks such as operating, maintaining, cleaning, repairing, or transporting an AMR. For more information, see *General guidelines*.
Override	Manual suspension of a safety function.
Prevention	Activities and measures taken in all phases of the company’s activity with the aim of preventing or reducing work-related risks.

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Term	Description
Restricted zone	A physically separated space into which only authorized persons are allowed to enter. Area of inadequate clearance and which cannot be protected by means of personnel detection.
Risk	A combination of the frequency, probability, and consequences of a hazard.
Virtual bumper	Electro sensitive (non-contact) protective equipment (ESPE) fitted to the truck, having one or more detection zones that generates a signal prior to physical contact.

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1.3 Use of the AMR

1.3.1 Intended use

WARNING

The AMR must not be used for purposes other than those mentioned in this manual. Any use of the AMR that differs from the use specified in the documentation shall be considered “not in accordance with the specifications”.

ABB will not be liable for damage caused by use of the AMR that is not in accordance with the specifications.

WARNING

The AMR is a partly completed machinery and the integrator is responsible for the certification of the applicable installation under the applicable directive(s) for the entire system in which the AMR(s) and accessory(ies) are integrated.

WARNING

In areas with inadequate clearance and no escape routes, the integrator must evaluate the implementation of additional measures according to Tables A1 and A2 of ISO 3691-4.

The AMR was designed and manufactured for transporting loads by following a predetermined route.

Intended use of the AMR implies:

- Working with the safety systems provided in the AMR, and checking and maintaining them in accordance with this Product Manual.
- Using the personal protective equipment specified in this Product Manual.
- Following the general safety measures relating to working with the AMR that are legally enforceable, as well as those enforced at the place of work.
- The integrator must check that the project safety laser fields are adequate to the floor requirements indicated in section *Floor requirements* and the load conditions in Load specification manual (see *References*).

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1.3.2 Improper use

WARNING

Improper use of the AMR is strictly prohibited and extremely dangerous.

ABB shall not be held liable for any material damage or personal injury that occurs due to improper use of the AMR.

- Do not use the AMR in environments containing dust or gases that may result in an explosion or fire.
- Do not use the AMR to perform tasks other than those for which it is designed.
- It is prohibited the use of the vehicle by a human rider.
- Do not use the AMR if it has been damaged to a degree that affects safety or safe use thereof.
- Do not use the AMR near stairs or where there is a likelihood of falling.
- Do not use the AMR on confined zones according to Annex A ISO3691-4.
- Do not use the vehicle outside the product limits specified in the *AMR datasheet* section in this manual.
- The AMR is not designed to be used on wet floors.
- Climbing on top of the vehicle is forbidden.
- The AMR must not be used under the influence of strong medications, over-the-counter drugs, or alcohol.
- Any use that is not expressly indicated shall be considered improper use.

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1.4 Floor requirements

The surface on which the circuit is to be placed must be reasonably flat. For safety reasons, the floor must be fully horizontal on the entire route.

Note

Note that the AMR's suspension raises the chassis by up to 10 mm when braking sharply.

The flatness requirements are as follows:

- Maximum height difference of 8 mm between two points 1000 mm apart (height differences of 8 mm or more between points less than 1000 mm apart do not meet the flatness requirement).
- Maximum height difference of 15 mm between 2 points 10,000 mm apart.
- Static strength: 6-8 N/m^2.
- Dynamic strength: 12-16 N/m^2.
- The floor must be smooth, abrasion-resistant, and free of steps. It should be kept clean, dry, and free of oil, grease, debris, etc.
- The surface must be stable and include sealed expansion joints able to absorb potential variations.
- The floor must provide a friction coefficient for polyurethane wheels of $\mu \geq 0.3$.
- Floor hardness must be approximately 160 N/mm (Brinell test).
- The floor must have a static dissipation (ECF) rating conforming to DIN IEC 1340-4-1. The floor's electrical resistance must not exceed 1 mega ohm when measured in accordance with the UNE EN 1081 standard.
- Any electromagnetic radiation source within the vehicles travel path must be identified, isolated or removed by the customer as it could affect to the proper vehicles function. The use of materials with magnetic properties inside the concrete is not allowed.
- Wide joints of portholes cause impact damage such as broken wheels, consequently, those joints should be correctly sealed and smoothed in order to allow a free driving with no vehicle interferences. Expansion joint must be less than 10 mm.
- Provided low-height applications (<6 mm), floor flatness must satisfy the requirements of DIN 18202 (2005-10) in clause 5.4, table 3 - Permitted flatness deviations.

WARNING

It is forbidden to use the AMR on ramps that may pose a risk, such as ramps which slope percentage exceeds the specifications in this manual.

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1.4.1 Protocol for action in the event of liquid spillage on the ground

In case of spillage of liquid on the ground follow the steps below:

1. Block the AMR placing an object with a minimum height of 250 mm and a width of 200 mm in front of the safety laser which is located at the head referring on the AMR movement direction.
2. Push the operational stop button on the AMR to prevent it from self-resetting and attempting to move in an untimely manner.
3. Block the path of the AMR through this area.
4. Place appropriate signage to delineate access to the affected area.
5. Clean and dry the work area to resume AMR operation.
6. Insert the AMR in the circuit and remove the objects used as blocking devices.
7. Check that the wheels of the AMR are dry and that the AMR is moving smoothly.

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1.5 Safe practises at work

1.5.1 Training for AMR users

The different types of operators are listed below:

- **Level-1 Operator (L1)**: Unqualified personnel lacking specific training, authorized only to perform simple tasks, such as operating the AMR using the manual controller and performing loading and unloading operations during the production process. Personnel with this profile must receive basic theoretical and practical training to ensure risk and hazard-free operation of the AMR. For more information, see *User manual - Flexley Platform AMR P604* (see the *References* section).
- **Level-2 Advanced user (L2)**: Qualified technician trained to perform the following functions:
  - Operate the AMR under normal conditions.
  - Work on the electromechanical components and make all types of adjustments.
  - Perform maintenance tasks and repairs when needed.

  For more information, see *Maintenance manual - Flexley Platform AMR P604* (see the *References* section).

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1.5.2 Personal Protective Equipment (PPE)

All personal protective equipment to be used during the entire life cycle of the AMR is listed below.

The end-user may consider the use of additional personal protective equipment if deemed necessary.

List of personal protective equipment:

Stage of use	Safety footwear	Gloves	Safety goggles	Ear protectors
Transport	O	O	*	*
Functioning	O	*	-	*
Load handling	O	R	*	*
Battery handling	O	R	O	*
Maintenance	O	R	*	*

O: Obligatory

R: Recommended

*: To be assessed by the end user

Note

For information about the sound level of the AMR please refer to the Buzzer and AMR sound levels in *Control system* section.

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1.6 Safety guidelines for AMR operation

1.6.1 General guidelines

To guarantee a safe working environment, the following general precautionary guidelines must be followed:

- The operator must not wear anything that could get caught in the AMR.
- Long hair must be tied back. If necessary, a hat may be worn.
- Rings, bracelets, watches, etc. are prohibited since they can get caught in the AMR.
- Neck ties, scarves, necklaces, loose clothing, etc. must not be worn.
- It is advisable to wear appropriate gloves at different stages of use.
- It is mandatory to wear safety shoes with reinforced toes.
- Workers must use appropriate personal protective equipment that is clean and in good condition.

The work area must meet the following conditions:

- The AMR work area must be marked by warning signs.
- If routes are marked out for the AMR, they should only be used by the AMR.
- The areas for pedestrian and truck crossing must be identified and respected to ensure safe and efficient use of the AMR.
- The areas near automated loading and unloading stations are considered operating hazard zones, since the AMRs' person-detection safeguards should be disabled. These areas should be correctly marked according to the applicable regulations.
- The load-bearing capacity of the surface on which the AMR will be used must be sufficient to carry the full weight of the AMR and the maximum load.
- The AMR must only be operated on hard and level surfaces.
- When operating the AMR, special care must be taken to avoid possible projections from shelves, walls, or ceilings, since they could cause personal injury or damage the AMR.
- Check that the AMR's work area is free of pallets, other AMRs and waste material that could obstruct or damage it during the trajectory.
- It is prohibited to be near the AMR when there is a risk of personal injury from failing loads, from lifting and lowering equipment or from being in the work area of the AMR.



WARNING

Any modification to the AMR must be previously approved by ABB. Any modification to the AMR affecting the capacity, stability or safety thereof is prohibited without prior written consent by ABB or a representative or successor of ABB.

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1.6.2 Guidelines on AMR operation

- The AMR may only be operated by persons with appropriate qualifications endorsed by the company.
- Before operating the AMR, personnel must be properly trained in its use by ABB or by personnel qualified to train others in the operation of this type of automated vehicle.
- The end user is responsible for fulfilling the regulations that apply to his installation in accordance with local regulations, outside the scope of the manufacturer.
- The AMR should be insured in accordance with local standards and the legislation in force in the place of use.
- Local standards regarding protective equipment worn by operators must be fulfilled.
- Accidents resulting in personal injury or property damage must be reported immediately to the person designated by the end user and following the appropriate procedure for the investigation of the event.
- Any defect or problem with the AMR must be reported.
- The AMR must not be used if it has been damaged in a way that affects safety or safe use of it.
- Check that there are no objects in the AMR's work area when it is started in automatic mode.
- When automatic mode is activated in the AMR, the vehicle must never be left before the insertion process has been completed. Persons in the vicinity of the AMR should be warned to leave the area.
- The AMR must never be operated if the operator has oil on their hands or shoes.
- Speed must be adjusted to the operating conditions and to pedestrians and other AMRs in the work area. The speed must be reduced when visibility is limited.
- The safety laser fields must be designed and adapted by the integrator in accordance with ISO 3691-4. The integrator must validate the laser fields as indicated in *Validation of safety laser fields according to ISO 3691-4* section.
- A safety distance must be kept with respect to other AMRs that are ahead of the AMR.
- Attention must be paid to operating hazard zones.
- The AMR must never be parked in a way that blocks emergency exits or obstructs traffic or work.
- The AMR must not be parked on a slope.
- The AMR must always be parked with the loads secured, and the brake activated.
- The AMR must always be parked in designated parking areas if there are any.
- The AMR must never be parked with the power on.

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1.6.2.1 Handling an event of error

If the AMR shows an error, and the display should be consulted there are two options to perform the action in a safe manner.

If the access to manipulate the display is easy and does not pose any risk to persons:

- Push the operational stop button.

In the event of an AMR error in an area that is difficult to access:

1. Block the AMR by an object with a minimum height of 250 mm and a width of 200 mm in front of the vehicle.

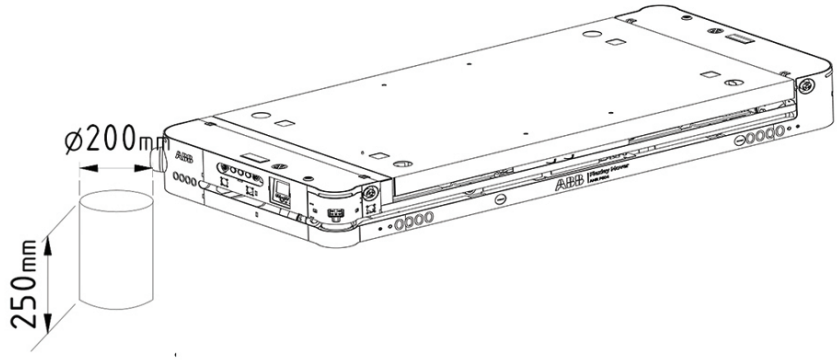


Figure 1.7: Blocking the AMR with an object

   This procedure is explained in detail in the Maintenance manual – Flexley Platform AMR P604.
2. Push the AMR operational stop button to prevent the AMR from auto resetting and attempting to move in an untimely manner.
3. Check the message/code on the display.
4. Once the error has been solved, insert the AMR again. For more information, see the *AMR insertion procedure* section.

WARNING

If there are other AMRs around, block the working area in the same way, to prevent other AMRs from interfering with the working area.

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1.6.3 Guidelines on load transport

Loads transported on the AMR must be properly positioned to prevent them from falling. The integrator shall check stability of the AMR + load according to the procedures defined by the integrator.

WARNING

It is not recommended to work on the AMR when it is moving with the load, as the safety laser will only cover in the direction of movement and not on the sides, with the risk of being hit or run over.

The integrator will be responsible for evaluating and applying the corresponding risk reduction measures according to the project conditions.

The integrator must ensure that the load couples to the vehicle properly according to the specifications.

Note

ABB is not responsible for the overhanging objects which might interfere with the normal operation of the AMR.

The integrator and the load must follow the instructions in the Load Manual to ensure the stability of the load (see *References* section).

- Operate the AMR carefully when transporting a load in manual mode.
- Only transport stable, secure loads.
- Special care must be taken when transporting long or tall loads.
- If the load is not well positioned on the platform, the vehicle should be stopped until a correct positioning of the load is ensured.
- If in the installation there are manual exchanges of loads with the AMR, the integrator must consider the possibility of placing tracks or centering devices to ensure the positioning of the load to be picked up by the AMR.
- The integrator must check that all loads used in the project attach correctly with the vehicle.

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1.6.4 Guidelines on battery handling

Overview

Handling an AMR battery requires safety guidelines to prevent accidents and ensure proper operation, such as using personal protective equipment or following the procedures outlined in the maintenance manual.

These precautions listed below are vital to prevent risks and ensure the safety of both the equipment and the operators.

General guidelines

- Always use protective goggles, and it is advisable to wear appropriate gloves.
- Handle the battery and its connections carefully.
- Ensure that the battery is properly placed in its compartment before moving the AMR.
- Do not work near the battery with an open flame, incandescent objects or anything that emits sparks.
- If any component inside the battery cells meets eyes, immediately wash them with an eye shower and seek medical attention.
- Any time the battery needs to be manipulated it is mandatory to disconnect it and switch off the AMR. See LOTO procedure in Maintenance manual (*References*).
- Pay special attention to safety when placing the battery. Lifting and transport instructions must be reviewed and approved by the end user. A submission can be found in Maintenance manual (*References*).



WARNING

There is a risk of fire. For further information, refer to the manufacturer user manual of the battery.

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1.6.5 Guidelines on battery charging

Overview

This process entails two types of risk, depending on whether the batteries are being charged manually or by an online charging.

Guidelines during battery charging

- There is an electrical risk as there is voltage in the brushes.
- The power supply of the charger must be equipped with a switch, differential or circuit-breaker (use of a residual current circuit-breaker is recommended) allowing users to fully disconnect the charger's power supply manually.



WARNING

An electrical hazard situation may occur if the AC power connector is handled or if the charger is opened. For this reason, handling of the power connector and opening of the charger’s housing by unqualified personnel is prohibited.



WARNING

The AMR must not be moved when the batteries are being charged.

The brushes must only be handled when the charger and/or the charging mat are disconnected from the power supply, the AMR is switched off and the AMR batteries are not connected.

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1.6.6 Guidelines on AMR transport and handling

Overview

The AMR must be handled by qualified personnel following the instructions detailed in *Transport, lifting, and storage* section.

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1.6.7 Guidelines on maintenance

General safety instructions

- Only personnel trained in the servicing and repair of this type of AMR are authorized to carry out maintenance and repair tasks.
- Comply with the maintenance and repair intervals specified in the preventive maintenance manual.
- Use only spare parts approved by ABB.



WARNING

Do not weld on the AMR since the electrical and electronic components could become damaged.

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1.6.8 Guidelines on cleaning the AMR

Safety instructions for cleaning the AMR

1. Move the AMR to the area designated by the end user to perform the cleaning tasks. This area must be clean and tidy.
2. Turn the AMR off using the ON/OFF switch.
3. Use a dry cloth to clean the AMR chassis.
4. For cleaning electrical panels, connections, etc. inside the AMR use pressurized air from a distance of at least 1 m to avoid possible disconnection of cables due to the force of the air.
5. Monthly cleaning tasks of the AMR should be performed.

WARNING

It is strictly forbidden to clean the AMR with liquids.

Do not perform the cleaning operation while the AMR is energized.

Do not modify or disconnect any component of the AMR during the cleaning operation.

Solvents and similar products used for cleaning and washing the unit must not be poured down drain that is not intended for such products. Follow local waste disposal regulations.

Note

For further information about safety instructions for cleaning different components of the AMR, see the Maintenance manual – Flexley Platform AMR P604. Check the *References* section.

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1.7 Emergency procedures

1.7.1 General emergency procedure

In the event of an accident/incident or malfunctioning involving the AMR, follow the steps below:

- Stop the AMR by pushing the emergency stop button (in case the emergency stop button is not operational, turn off the AMR from the On/Off switch). Make sure that the AMR is blocked and cannot be used until the cause of the accident is resolved.
- Collect information regarding the causes of the accident (identifying the layout area, AMR status, date and time, and other relevant information).
- Contact ABB services.



WARNING

If the AMR is damaged after the incident, it should not be put into operation until it has been properly checked and the safety devices have been verified to be in proper working order.

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1.7.2 Activating/Resetting emergency stop buttons

The AMR is capable of stop its operation by an emergency stop button. To find out more about the location of this button/buttons, see the *Emergency stop button* section.

If a hazardous situation is observed, push the emergency stop button to immediately stop the AMR.

Check that the load is properly positioned on the AMR.

Before releasing the emergency stop button, check the source of the hazardous situation is resolved. Verify that the AMR is in good condition, as well as its environment.

To reset the emergency stop, rotate it in the direction of the arrow included on the emergency stop button.

Once the button is released, push the Insert button to initiate the cycle and the AMR will once again operate in manual or automatic mode.

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1.7.3 In case of battery overheating

Lithium batteries have a low gas emission. This is only observed after extensive and intensive overcharging.

Batteries can generate gases which, when released, can explode and cause blindness and other serious personal injury. Always wear safety clothing and use appropriate safety tools. Eliminate any possibility of sparks, flames, or electric arcing. Batteries can cause damage or burns.

In case of battery overheating, move the device to a non-combustible area.

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1.7.4 In case of fire

- The heat-generating component and the battery must be separated by removing either the heat-generating component, the battery, or another component.
- If the batteries are being charged, disconnect them from the mains power supply and use positive pressure breathing apparatus.
- To extinguish fires in a room where lithium batteries are present, use specific extinguishers for lithium batteries and follow specific instructions for end-user's facilities determined by risk prevention.



WARNING

Water must never be poured on a burning battery as contact between the two could have serious consequences.

There is no way to stop a lithium battery fire. Cover the battery with a fire blanket and move it to a safe place until the fire is extinguished by itself.

For further information, refer to the manufacturer user manual of the battery.

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1.8 Residual risks

Overview

Even if due care is taken and all standards and regulations are met, other risks associated with the use of the AMR cannot be entirely prevented.

Both the AMR and the rest of the system's components comply with current safety requirements. However, even if the AMR is used correctly and all instructions are followed, outside of the reduced risks associated with the AMR, there are always residual risks.

Persons in the influence area of the AMR must remain alert and ready to react immediately in the case of an anomaly, incident, malfunction, etc.

The end user is responsible for communicating the residual risks of the machine to the operators and for applying the risk reduction measures indicated in this chapter.



WARNING

All persons working with the AMR must have received training on possible risks associated with use of the AMR.

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1.8.1 Residual risks during transport, lifting, and unpacking

Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Crushing or impact due to loss of stability of the AMR in the following operations: • During lifting transport. • During maintenance work requiring lifting of the AMR. • During dismantling of the AMR.	• A packing, unpacking, and shipping procedure has been carried out, see *Transport* section of this manual. • The CE marking plate specifies the weight and dimensions of the AMR. • The chassis is modified to include anchor points for elevation. • In order to avoid loss of stability during transport, the AMR is locked in a box.	Follow the packing, unpacking, and shipping procedure. See *Transport* section of this manual.
Hitting of a person by a vehicle in manual mode from the unpacking point to the starting point.	Unloading and movement of the vehicle to its final position shall be performed only by ABB trained or authorized ABB personnel.	Follow the instructions provided on this manual or the Maintenance Manual.
Accidental contact of tools, cables etc. with live parts by adjustments during commissioning.	1 The negative voltage of the devices is separated from the chassis and the chassis is bonded to the AMR ground. 2 AMR is equipped with discharge strip to discharge the electrostatic energy to the AMR. NOTE: The AMR works at safety voltage (< 50 VDC)	1 Electrical modifications must be made with the machine turned off. 2 Start-up shall be performed by ABB trained personnel or ABB authorized personnel.
Hand crushing by elevation table against the chassis during initial adjustment.	A cover has been designed in the bottom part of the elevation table in order to mitigate the possibility of introducing hands between the table and chassis.	Follow the instructions provided in this manual. Pictograms had been added to the AMR.

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1.8.2 Residual risks during movement in automatic mode

Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Entrapment or crushing of hands/fingers/ feet between the load to carry and the AMR during loading and unloading operations in automatic mode.	The AMR is equipped with accessible emergency stops. If an emergency stop is pressed, the AMR transfer stops at the current position and there are no untimely movements.	During this task, for operative reasons (not seeing the legs of the load by the laser), the safety laser has to be disabled. 1 It is forbidden to introduce hands or other limbs between the lifting table and the load meanwhile the AMR is making loading/unloading operations in automatic mode. 2 When working around AMRs, the operators must use safety boots. 3 In case of anomaly during this operation push the e-stop of the vehicle. 4 Risk information included in the vehicle's operation and Maintenance Manual
Hit or impact with the AMR by a damaged or less frictional ground surface [loss of grip, wheels skidding and not rolling], with the AMR moving in its primary direction of motion. NOTE: In case of AMR slippage, the AMR will not be able to brake in time and may move unexpectedly off the normal trajectory.	ABB sends to the end user a document with minimum ground conditions to ensure the correct operation of the AMR in safe conditions. This manual indicates that the AMR is not designed to be used on wet floors. The maintenance manual has detailed instructions. • Periodic checking of the floor to ensure proper AMR movement. • A procedure for the maintenance of the drive wheels.	Ensure that the floor complies with the minimum floor conditions document. Perform periodic checks as indicated in the maintenance manual. In case of spillage or wet ground follow the steps below: • Block the path of the AMR through this area. • Place appropriate signage. Clean and dry the affected area before putting the AMR back into operation. • Check that the wheels are dry and that the vehicle is moving properly.
Hit-and-run with vehicle movement in automatic mode with safety scanner disabled.	In automatic mode, before disabling the safety laser, it is ensured that a sweep is performed to the area to check that there are no people inside, and mute as late as possible to prevent people for getting inside the dangerous area.	Instructions for this included in the manual and residual risks report.

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1.8.2 Residual risks during movement in automatic mode
Continued

Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Hitting of a person by a vehicle with vehicle movement in automatic mode while the AMR is moving longitudinal or lateral.	Safety laser is installed in the direction of movement of the vehicle, and its field is adapted to the speed of the vehicle and the load transported. If a person is detected a controlled stop is performed. If the deceleration profile cannot be followed, a cat. 0 stop is performed. Laser documentation created.	Follow the instructions provided on the P604 Laser Configuration master and test the laser fields accordingly.
Hit or impact with the AMR due to misconfiguration of the fields with the AMR moving in its primary direction of motion.	The base safety fields have been designed to ensure people safety and tested according to ISO 3691-4 procedure.	Every time a safety field is modified during commissioning phase (to adopt to the specific load of the project, operative reasons…), the safety field has to be checked according to ISO 3691-4 procedure.
Crushing of persons by the AMR against a fixed part of the system.	Documentation has been created indicating the adequate laser configuration	• Validation test must include laser field checks • In projects circuits must be designed to have a safety distance between AMR and fixed zones Follow the P604 Laser Configuration master document, see *References*.
Hit or impact when the vehicle is making small corrections during longitudinal travel. When the AMR performs slight corrections there are dead angles which cannot be covered.	Instructions had been added to the documentation indicating no people can be around while the AMR is moving.	No people can be around the AMR while moving.

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1.8.3 Residual risks during maintenance tasks

Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Contact with hot surfaces during AMR maintenance work	A pictogram has been placed on devices that require maintenance and may be sources of heat.	Before performing a maintenance task, allow the AMR to cool down for 5 minutes after opening the main cover. Only trained and qualified personnel may perform maintenance on the AMR.
Possibility of generating an electromagnetic radiation while performing: • AMR charging. • Maintenance work	Electromagnetic Compatibility tests have been performed on the AMR ensuring that the limits according to the EMC directive are not exceeded.	If the end user deems it necessary, a special evaluation can be performed for: • Workers with active inoperable medical devices (AIMD). • Workers with passive inoperable metal-containing medical devices. • Workers with body-worn medical devices. • Pregnant workers. It is recommended to have a distance of at least 0.8 m from an open electrical panel in the AMR.
Entrapment or crushing of hands/limbs between the vehicle's lift table and the chassis during maintenance tasks.	Pictograms indicating risk of entrapment has been included in the vehicle.	Prior to maintenance operations, lift the table in manual mode with the display controls, fix two slings to the table and lift gently with the crane until the slings are taut.

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1.8.4 Residual risks during AMR checks

Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Hit or impact of the AMR or load during adjustment tasks or checking of messages on the display.	Instructions to be followed in the event of AMR failure are detailed in this manual, see the *Control system*.	Follow the steps detailed in this manual.

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1.8.5 Residual risks during AMR guidance

Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Hitting or impacting with AMR due to loss or deflection of magnetic tape.	A procedure for the maintenance of the magnetic tape in the circuit has been detailed in the maintenance manual, see *References*.	Perform periodic checks as outlined in the maintenance manual.
Hitting or impacting with the AMR due to loss of tag in the circuit. Note: In case of tag loss in a straight line, there is no risk to people.	A procedure for the maintenance of the tags in the circuit has been detailed in the maintenance manual, see *References*.	Perform periodic checks as outlined in the maintenance manual. AMR work areas should be delimited when possible.
Crushing or impact when the AMR is unintentionally directed to a ramp, shaft or staircase in manual mode.	Note added in this manual. The vehicle cannot be used in ramps. The AMR can only be moved in manual mode by an authorized operator, who is aware of the risks and restrictions related.	1 It is the sole operator's responsibility to control and follow the instructions when handling the AMR in manual mode. 2 If the vehicle is moved in manual mode, watch over the area and make sure that there are no ramps, stairs or other elements with slope where the AMR could fall.
Hitting or impacting when the vehicle is making small corrections during forward travel. **NOTE:** When AMR is making slight corrections, there are blind spots that cannot be covered.	It has been indicated in the manual that no person may be near the AMR while it is moving in automatic mode, see *Operating modes*.	Carefully read the safety instructions in this manual. Delineate an AMR work zone where they will be located when in operation. Mark pedestrian crosswalks at the facility so as not to interfere with AMR traffic routes.
Hitting or impacting a person during the insertion process.	Follow the AMR insertion process of this manual in *AMR insertion procedure* section.	Only trained personnel may operate in this mode. Follow the instructions for use in this mode detailed in this manual. Indicate on the layout the direction of travel of the vehicle to prevent insertion in the opposite direction.
Risk of hit or impact when the vehicle detects a person and stops but starts the movement again in automatic mode because the operator is standing in a dead zone.	It has been indicated in this manual not to stay close to the vehicle during turns because there may be blind spots, see *Operating modes*.	The circuit integrator must follow the laser master document supplied by ABB.
Hitting or impacting with the AMR when starting-up after a shutdown.	After restarting the AMR movement acoustic/light warnings are activated for 2 seconds.	The AMR waits 2 seconds before restarting after standstill.

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1.8.5 Residual risks during AMR guidance
Continued

Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Crushing of persons by the AMR against a fixed part of the system.	1 Safety laser is installed in the direction of movement of the vehicle 2 Assembly of emergency stops on forward and backward AMR	Safety laser is installed in the direction of movement of the vehicle. Different fields according to the speed. Emergency stops are installed in AMR
Hit or impact with the AMR when the brakes are electrically disconnected, and the AMR is moved manually (the operator pushes or pulls the vehicle). **NOTE:** this movement depends in part on the state of the drive units, as they will perform different movements depending on the state of the drive units.	Instructions has been added to this document	1 Ensure that the area is free and with no obstacles. 2 Check that there are no people around the AMR while moving. 3 Procedure to move the vehicle manually by releasing the brakes is indicated in the manual. 4 Don't move AMR in slopes and if it's possible use manual controller.
Overexertion when manually releasing a vehicle stuck in the circuit due to a power supply failure, a mechanical / electrical problem or any other situation which impedes the autonomous movement of the AMR.	Instructions to remove a vehicle from the circuit are indicated in the manual.	Instructions to remove a vehicle from the circuit are indicated in the manual.

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1.8.6 Residual risks during load transport

Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Hitting persons due to loss of the load carried by the AMR.	This risk has been mentioned in this product manual, see *Maximum load dimensions*.	1 The load placed on the carriage must be validated by the integrator for each project in the following situations: • Vehicle moving forward. • Vehicle making a turn *Sudden stop at maximum speed (by pushing the emergency stop). 2 There cannot be any overhanging obstacles that may hit the load during its transportation. 3 Where there are manual-automatic transfer of loads, the proper positioning of the load must be ensured by using centering devices or other measures.
AMR overturning or losing its load when the operator tries to lift a load which is not intended for the vehicle.	Two centering pins are designed in order to maintain stability of the load in case of movement.	The loads which can be transported and their limits are described in the *Load Specifications P604 document*.
Entrapment or crushing between the elevation table and chassis in manual mode using the manual controller.	A cover is designed in the bottom part of the elevation table in order to mitigate the possibility of introducing hands between table and chassis.	Instructions for use in this mode, in the user manual of the vehicle. Visual and acoustic signal description is indicated in the manual.
Load fall and possibility of impact with people if the AMR is trying to unload in a station which already has a load. **NOTE:** The disposal of the vehicle does not allow the AMR to detect if a station of discharge is already occupied or not.	-	If there is combination manual-automatic station loading and unloading, it is highly recommended to place sensors to detect if the station is already occupied or not before unloading. If some discharge order is going to be given in manual (from AMR fleet system), the operator must check that the position is free of load and that no other AMR will go to that position.

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1.8.6 Residual risks during load transport
Continued

Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Hit of impact because the emergency stop button is not reachable due to the load dimensions. **NOTE:** The load to carry on the AMR is not scope of this risk assessment and should be reviewed for each particular project.	To ensure access to the e-stop, load must fulfill the requirements of the load specifications on the *Load Specifications P604 document*.	The integrator must check the e-stops are accessible in all the circumstances.
Hit of people due to loss of the transported load by the AMR.	-	1 The stability of the load must be checked by the integrator of the project by making the corresponding calculations and tests 2 There cannot be any overhanging obstacles that may hit the load during its transportation. 3 Where there is manual-automatic transfer of loads, the proper positioning of the load must be ensured by using centering devices or other measures. 4 It is recommended to include an additional surface, visible by the safety scanner, in overhanging objects that otherwise would not be detected.

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1.8.7 Residual risks during online charging

Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Short-circuit if someone inserts a conductive element between the brushes during online battery charging.	It has been indicated in this manual that it is forbidden to insert any element between the brushes and the charging station when the AMR is charging. Preventive maintenance of both the charger and the female module of the AMR online charger must be carried out as indicated in the maintenance manual.	Perform preventive maintenance of the AMR charging station and charging module, as reflected in their respective manuals.
Crushing of a person between the AMR and its charging station. **NOTE:** Before reaching the loading point with the AMR, the safety laser must be disabled for operative reasons.	Charging station and vehicle design reduce this risk.	It is forbidden to introduce hands or other limbs when the AMR is approaching the charging station. It is recommended to the final user that limits the access to the chargers or paints the ground.

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1.8.8 Residual risks during manual manipulation

Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Musculoskeletal disorders associated with the handling of the drive units (weight approx. 65 kg).	The maintenance manual has detailed the process to be followed for handling the drive unit.	Follow the detailed instructions in the AMR maintenance manual. If the end user deems it necessary, an ergonomics study can be performed.
Musculoskeletal disorders associated with handling the battery box (weight approx. 29 kg).	The process to be followed for handling the battery has been detailed in the maintenance manual.	Follow the detailed instructions in the AMR maintenance manual. If the end user deems it necessary, an ergonomics study can be performed.

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Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Crushing or impact when: The AMR unexpectedly moves without any input from the operator. The AMR unexpectedly moves in a different direction than the intended by the operator. A non-trained person uses the manual control of the AMR. - The operator loses consciousness and cannot watch the operation.	Note in user manual: The AMR can only be moved in manual mode by an authorized operator, who is aware of the risks and restrictions related. When using the wire control, the operator must ensure a safety distance to the vehicle	1 Max speed is limited by SW in manual mode to 0,7 m/s and safe personnel detection means are active. 2 If the override switch is pressed more than 2 seconds personnel detection means are not active and speed is limited to 0,1 m/s. Maximum distance in override mode is 1 m. Acoustic and visible indicators are activated to indicate override status. 3 Manual mode is indicated with LEDs color. 4 The AMR manual control includes a code to enable manual mode. 5 To enable any movement, the button of the desired command must be always kept pressed to perform. 6 To enable any movement with the wire control, a specific button must be always kept pressed in combination with the button of the desired command to perform. 7 If the operator stops pressing the command button, the AMR will stop. 8 Emergency stops available on both sides of the vehicle. RISK REDUCTION: If the AMR is going to be moved by using the wire control, the operator must keep a safety distance from the AMR.

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1.8.9 Residual risks when the AMR is stationary without power

Danger	Actions taken by ABB	Risk reduction measures for the end-user/integrator
Fall on the same level when the AMR is stationary without load and the person has no visibility of the AMR due to its dimensions.	-	Delineate crosswalk areas in those areas where AMRs are located as well as parking or maintenance areas. If the area cannot be closed to pedestrians, make markings on the ground to indicate that the area is a pedestrian crossing zone for AMR's. Train operators about this hazard.
Fall on the same level of a person climbing on the AMR.	A pictogram has been added to the AMR to inform about this risk.	Delineate crosswalk areas in those areas where AMRs are located as well as parking or maintenance areas. If the area cannot be closed to pedestrians, make markings on the ground to indicate that the area is a pedestrian crossing zone for AMR's. Train operators about this hazard.

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1.9 Safety functions

The safety functions implemented in the AMR P604 are the following:

Safety Function item	Safety Function description	PFH (FIT)	Reaction Time (ms)	PL
SF1	Braking System Control	125	34	d
SF2	Parking Braking System Control	246	76	b
SF3	Over speed detection system (speed> truck rated speed)	501	110	c
SF4	Speed monitoring in case of speed <0,3m/s	501	110	c
SF5	Zone field selection consistent with actual AGV speed in linear movements (speed >0,3m/s)	492	206	d
SF6	Zone field selection consistent with actual AGV speed in turning and pivoting movements	492	206	d
SF9	Deactivation of charging connections	8311	152	b
SF10	Check that the load is in the intended position	8774	30	b
SF14	STABILITY: Speed, steering and load handling for Stability.	400	110	c
SF15	Emergency Stop S080X (X=1…4)	269	114	d
SF16	Stop the truck following the detection of a person in the direction (s) of travel. Detection by Safety Laser	333	106	d
SF18	Override of PDM	492	206	c
SF19	Muting of FWRD & BWRD Laser Scanner in Linear movements. Ensure this is done with speed<0,3 m/s	501	206	d
SF21	Zone field selection consistent with other criteria: loaded/unloaded;narrow load/wide load;different zones from A.1/A.2 . In linear movements.	439	206	d
SF28	Warnings (acoustical/visible) after different conditions	30565	20	a
SF29 (**see note**)	Perimeter Guarding (confined Zones)	559	206	d

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Note

Partial application of SF29 will be available in AMRs. The AMR will safely identify confined zones and will allow higher AMR speed (0.3 m/s) with a reduction of safety fields.

This is intended to be used in confined zones when the SF29 optional is available and active. If that is not the case, the SF29 (perimeter guarding) as described in Annex A of ISO 3691-4 is not provided at all.

SF29 optional availability should be checked considering model and software. For more information, please contact ABB.

In addition, other functions have been evaluated according to ISO 13849-1.

Safety Function item	Safety Function description	PFH (FIT)	Reaction Time (ms)	PL
SF30	Reduced Speed in Manual Mode	501	110	c
SF31	Monitored Category 2 Stop (Vehicle)	246	10	d
SF32	Category 2 Stop (Load Handling)	4398	10	b
SF33	Category 0 stop (vehicle)	168	52	d

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2 Components of the AMR

Overview

AMR systems

The vehicle is made up of the following parts and systems:

Mechanical system (1)

- **Structural system (1.1):** Metal structure (chassis) that supports the vehicle body and the equipment that provides the AMR with its towing capacity.
- **Drive and steering system (1.2):** System in charge of traction, steering and the resulting movement of the AMR by means of a motorwheel.

Lifting system (2)

- **Electromechanical components (2.1):** Responsible loading the AMR via a lift platform ready for transport on a predetermined circuit.
- **Maximum load dimensions (2.2)**
- **Load positioning for stability (2.3)**

Safety systems (3)

- **Safety PLC (3.1)**: Ensures optimal communication between all the safety devices.
- **Safety Lasers (3.2)**: Detects persons and objects around the AMR.
- **Emergency stop buttons (3.3):** Device which purpose is to stop the AMR when a hazard is found.
- **Passive safety systems (3.4):** Systems that reduce the associated hazards and prevent accidents.

Electrical system (4)

Comprises the control and power panels required for proper operation of the AMR.

Navigation system (5)

System in charge of guiding the AMR around a predetermined circuit.

Based on a system:

- **Magnetic — P604 M (5.1)**: System in charge of guiding the AMR round a predetermined circuit and reading the evaluation points (tags) by which the AMR makes appropriate movement decisions.
- **Visual SLAM — P604 V (5.2)**: Visual guidance system. Using Visual Simultaneous Localization and Mapping (Visual SLAM), based on 6 monocular cameras, odometry, IMU, and Visual-Inertial odometry; the AMR can create a map that is used to operate independently.

Control system (6)

Consists of button panel components, connectors, and buttons. In charge of making the AMR follow specific instructions or make different decisions, according to requirements, while travelling around the circuit.

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Communication system (7)

- **A29 communications systems (Optional 7.1)**: In charge of giving the AMR remote communication capability
- **Wi-Fi client communications systems (7.2)**: In charge of giving the AMR Wi-Fi capability.
- **Secure Wi-Fi Lite (EU/US optional) (Optional 7.3)**: It is capable of continuously manage the communications of a robotic cell.

Power supply system (8)

Provides power to the entire AMR. It is equipped with a 48 V battery and manages the battery recharging system.

Battery charging system (9)

System that allows the AMR to be charged:

- **Online charging (9.1):** Performs controlled charging of the AMR's battery on a charging station via a brush contact.
- **Manual charging (9.2):** Performs controlled charging of the AMR's battery on a charger via a wire harness and auxiliary connector.

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AMR components

The figures below show some of the components that make up the AMR. These components are described in detail in the following chapters.

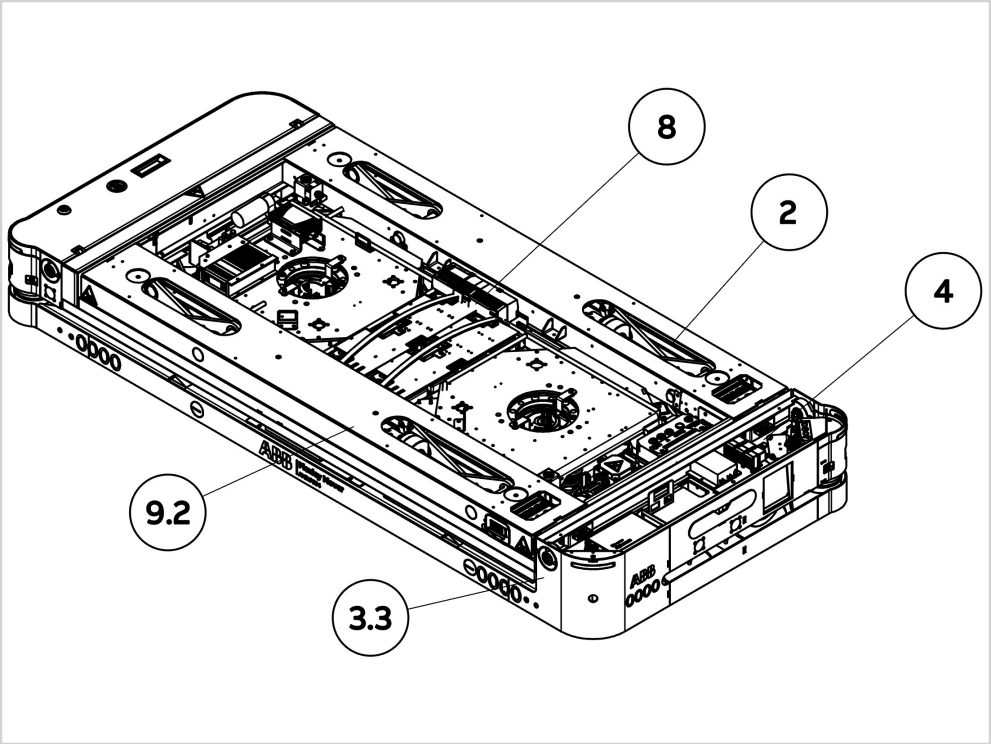


Figure 2.1: Upper view of the AMR

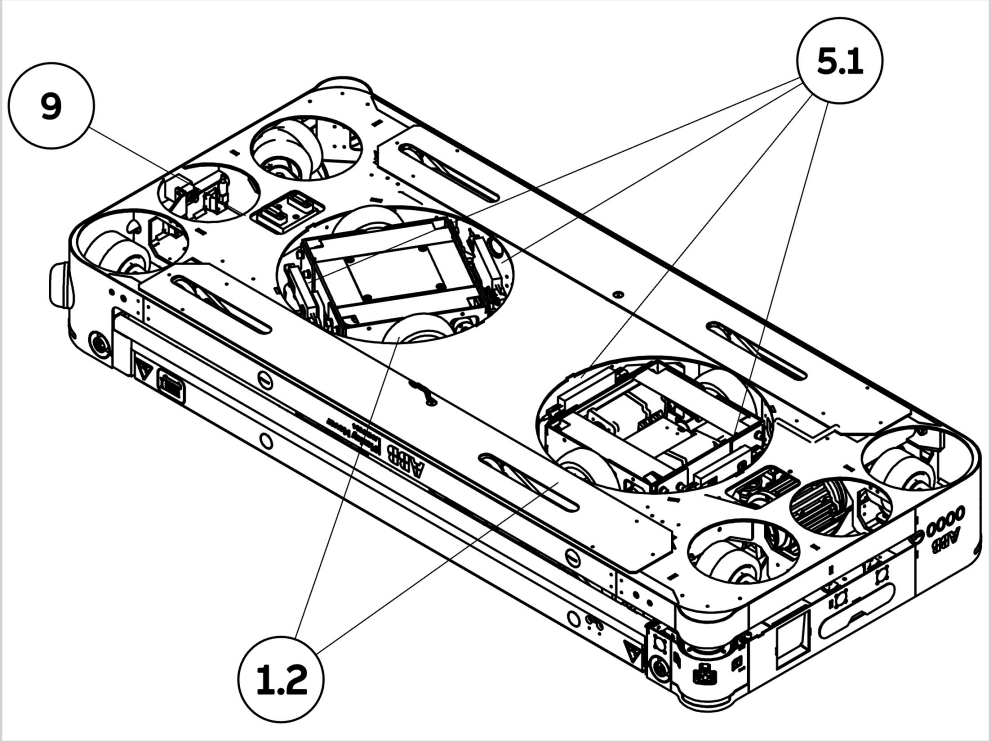


Figure 2.2: Lower view of the AMR

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Continued

Item	Function	Link
1	Mechanical system	For more details, see *Mechanical system*.
1.1	Structural system	For more details, see *Structural system*.
1.2	Drive system	For more details, see *Drive and steering system*.
2	Lifting system	For more details, see *Lifting system*.
2.1	Electromechanical components	For more details, see *Electromechanical components*.
2.2	Detection devices	For more details, see *Detection devices*
2.3	Maximum load dimensions	For more details, see *Maximum load dimensions*.
2.4	Load positioning for stability	For more details, see *Load positioning for stability*.
3	Safety systems	For more details, see *Safety systems*.
3.1	Safety PLC	For more details, see *Safety PLC*.
3.2	Safety lasers	For more details, see *Safety lasers*.
3.3	Emergency stop button	For more details, see *Emergency stop buttons*.
3.4	Passive safety systems	For more details, see *Passive safety systems*.
4	Electrical system	For more details, see *Electrical system*.
5	Navigation system	For more details, see *Navigation system*.
5.1	Magnetic guidance	For more details, see Magnetic guidance.
5.2	Visual SLAM guidance	For more details, see *Visual SLAM guidance*.
6	Control system	For more details, see *Control system*.
6.1	PLC	For more details, see *PLC*.
6.2	Datalogger (P604 M)	For more details, see *Datalogger* (P604 M).
6.3	AMR Buttons	For more details, see *AMR Buttons*.
6.4	AMR Connectors	For more details, see *AMR Connectors*.
6.5	AMR Selectors	For more details, see *AMR Selectors*.
6.6	LED lights	For more details, see *LED lights*.

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Continued

Item	Function	Link
6.7	Buzzer	For more details, see *Buzzer and AMR sound levels*.
6.8	Display	For more details, see *Display*.
7	Communications system	For more details, see *Communications system*.
7.1	A29 communications system (optional)	For more details, see *A29 communications system* (optional).
7.2	Wi-Fi client communications system	For more details, see *Wi-Fi client communications system*.
7.3	Secure Wi-Fi Lite (optional)	For more details, see *Secure Wi-Fi Lite* (optional).
8	Power supply system	For more details, see *Power supply system*.
9	Battery charging system	For more details, see *Battery charging system*.
9.1	Online charging system	For more details, see *Online charging system*.
9.2	Manual charging system	For more details, see *Manual charging system*.

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Continued

AMR scheme

The figure below shows all the electrical components of the AMR. These components are described in detail in the following chapters.

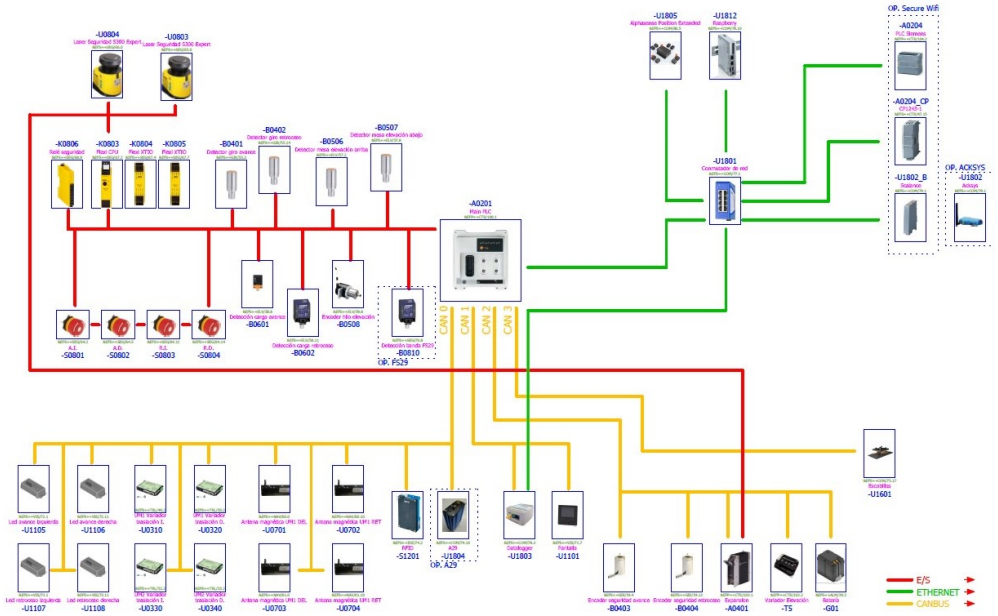


Figure 2.3: Overview of AMR components

Note

The diagram shown above is merely an indicative set of AMR components, therefore it may not fully match with the current product design.

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2.1 Mechanical system

2.1.1 Structural system

It consists of a welded steel frame that provides the AMR with a solid and durable body.

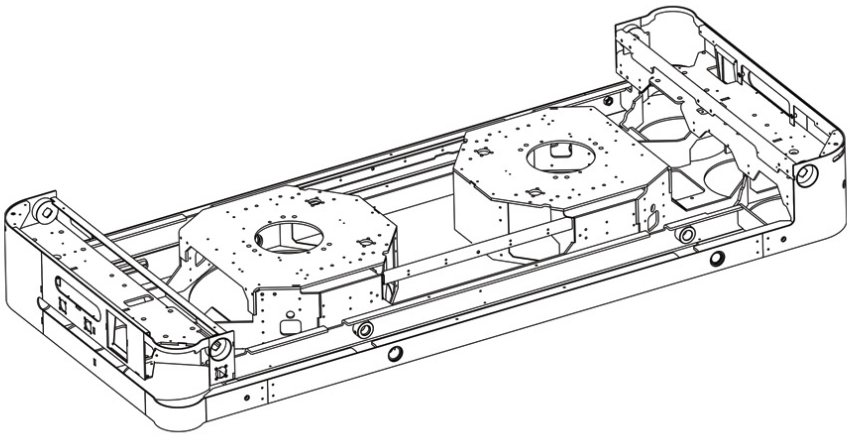


Figure 2.4: AMR Chassis

To increase vehicle stability, caster wheels are located at the four corners of the AMR.

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2.1.1 Structural system

Continued

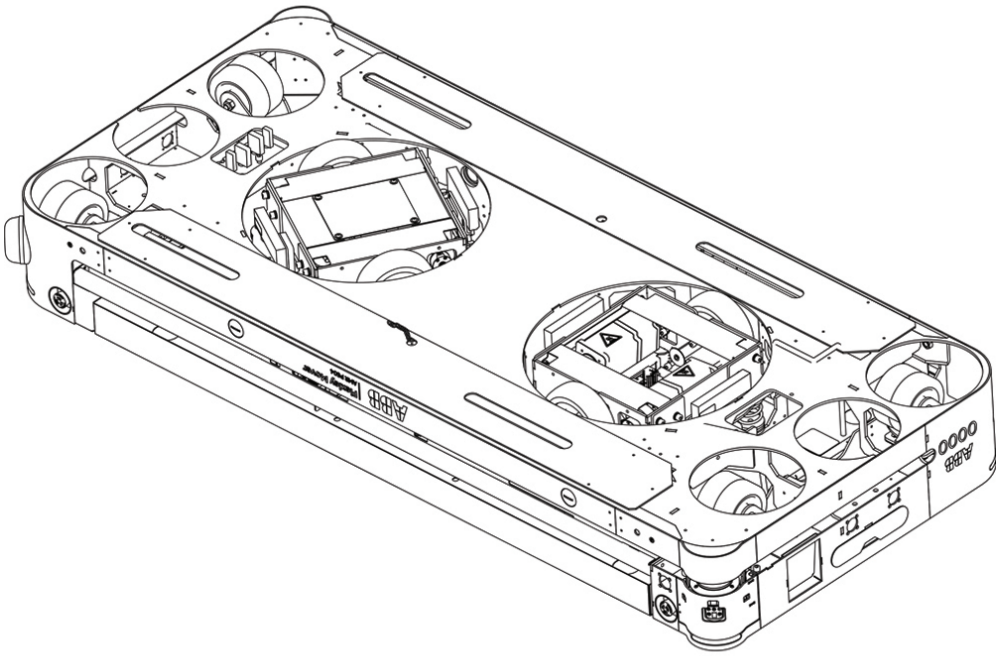


Figure 2.5: Location of caster wheels

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2.1.2 Drive and steering system

Drive unit

The system is composed of two drive units used to move and turn the AMR.

These drive units include a crown wheel, two wheels installed in parallel that function in differential mode and which each consists of a motor, a variator, an incremental encoder, an absolute encoder, and a suspension system comprising four springs fixed to the drive unit's chassis, thus offering the vehicle greater traction, control, and stability.

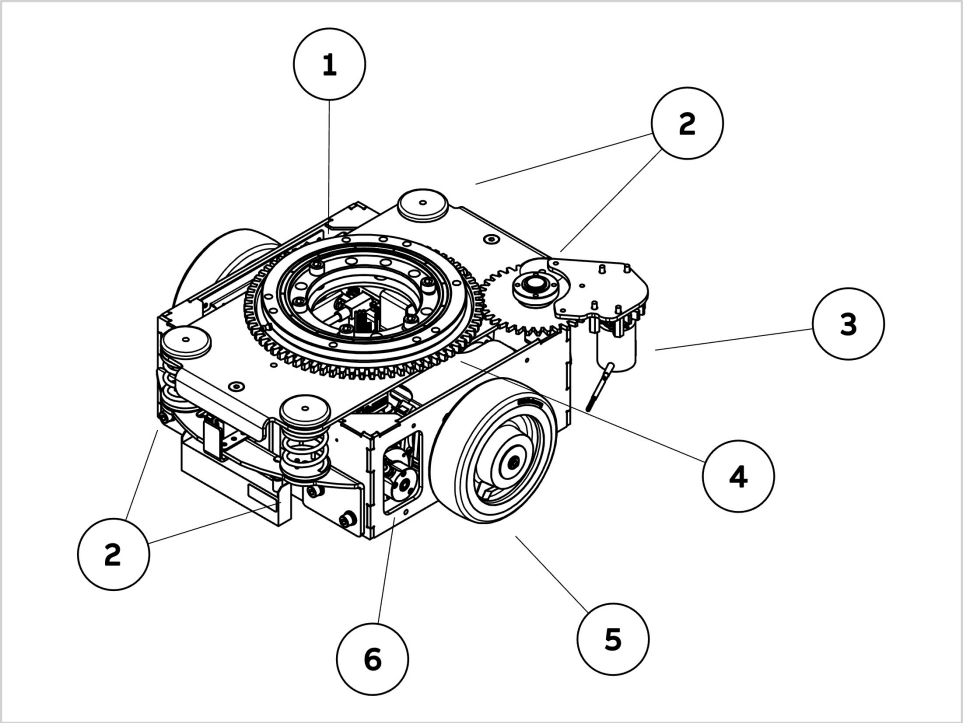


Figure 2.6: Top view of drive unit

Item	Description
1	Crown wheel
2	Shock absorber springs
3	Absolute encoder (steering system)
4	Variable-speed drive
5	Drive wheel
6	Incremental encoder (drive)

WARNING

It is forbidden to insert hands or feet between the drive and steering system during operation.

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2.1.2 Drive and steering system
Continued

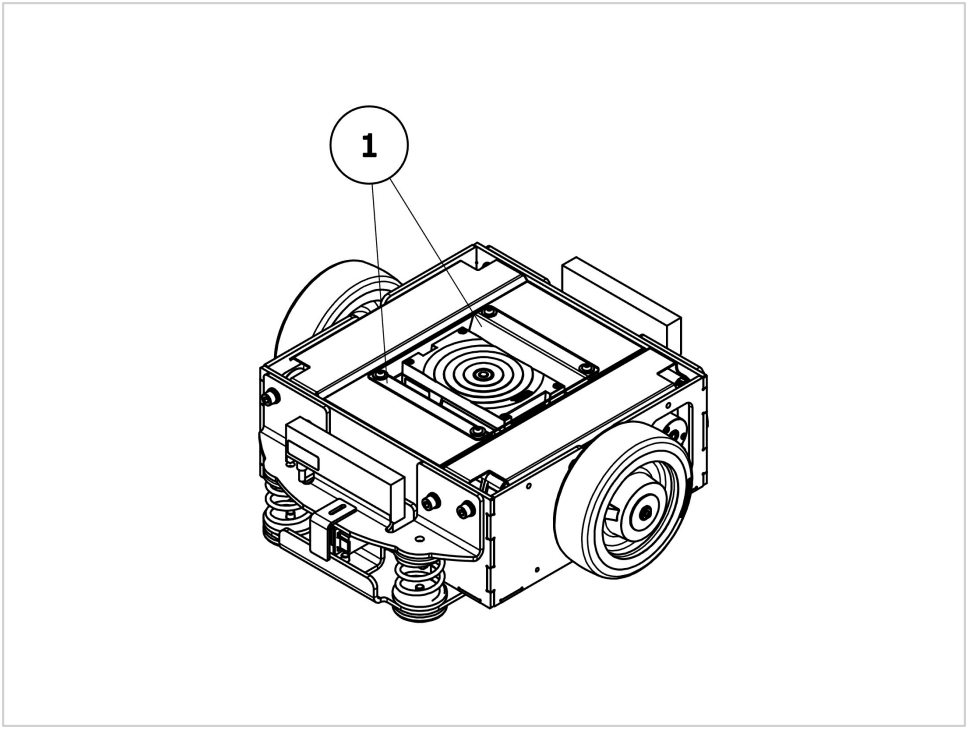


Figure 2.7: Sample bottom view of a P604 M drive unit

Item	Description
1	Drive unit motors

The drive unit motors are equipped with the following components:

1. **Incremental encoders:** Two incremental encoders per motor determine the number of times the motor turns the wheel. Based on this information, the PLC powers the variable-speed drives to apply the appropriate number of revolutions. One encoder controls the velocity and the other the safety.
2. **Variable-speed drives:** Controls the rotational speed of an alternating current (AC) motor by controlling the frequency of the power supplied to the traction motor. It communicates via CAN bus with the PLC to send set points to the motors.

The drive system is also equipped with an electric brake that prevents AMR movement. It releases before moving, either manually or in Auto mode.

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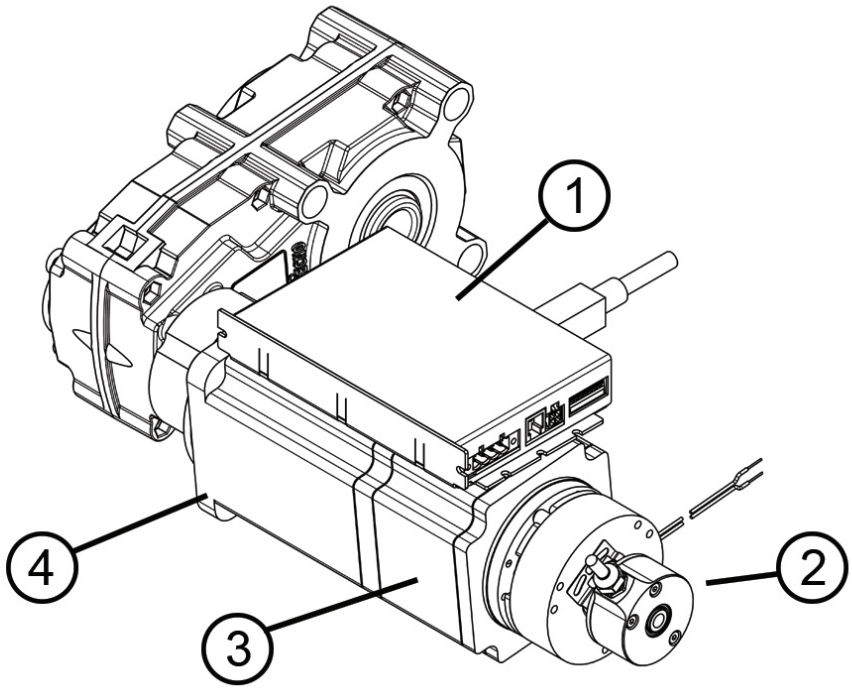


Figure 2.8: Motor assembly

Item	Description
1	Drive unit motors
2	Electromagnetic brake
3	Incremental encoders
4	Geared motor

Note

Drive units have different navigation systems depending on which type of vehicle is used. P604 V doesn't have RFID and only one magnetic antenna.

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2.2 Lifting system

Overview

This system raises and lowers a platform, also known as lift table, by means of four ball-screw lifts driven by two motors (one motor per pair of ball screws).

> **Note**
>
> This system can operate in both automatic and manual mode (via the display).

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2.2.1 Electromechanical components

Overview

The lifting system is made up of the following components:

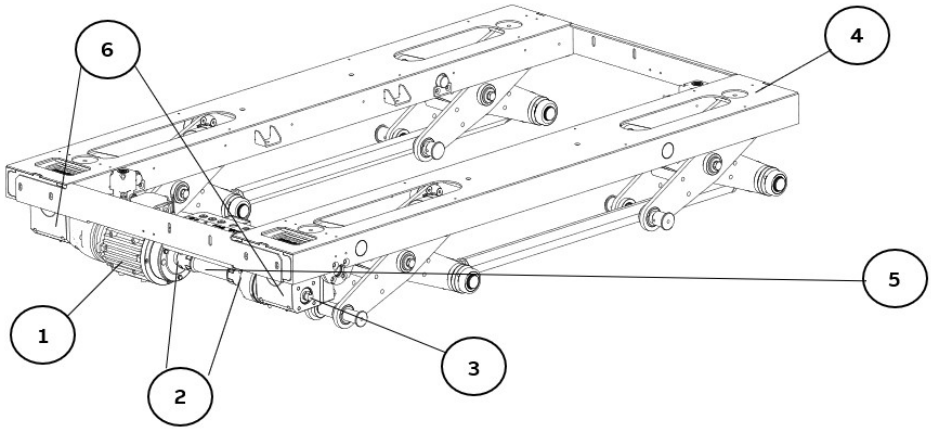


Figure 2.9: General view of the lifting system

Item	Description
1	Motor
2	Lifting brakes
3	Ball screw lift
4	Lift platform
5	Transmission shaft
6	Gearboxes

Components

- **Electric motor:** Powers the ball screw lifts.
- **Lifting brakes:** Two brakes are used to stop the lifting table in a safe way.
- **Ball screw lift:** The rotational motion that the motor transfers to the lifting system gearbox is converted into linear motion by the screw to raise the AMR's load.
- **Lift platform:** Raised or lowered by the two ball screw lifts.
- **Transmission shaft:** Two concentrically machined hubs with curved grips (concave) and fastening screws. The elastomer is fitted at pressure for zero play, absorption of vibrations and the standard versions are electrically insulated. The intermediate precision tube has great lateral straightness and rigidity.
- **Gearboxes:** They transfer energy through conical gears, with spiral teeth in optimized geometry. One of the gears is mounted on a dual-supported bushing, while the other gear is overhanging.

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2.2.1 Electromechanical components
Continued

- **Centering pins (optional):** The AMR can be fitted with M8 centering pins designed to ensure the rack is positioned correctly during transport.

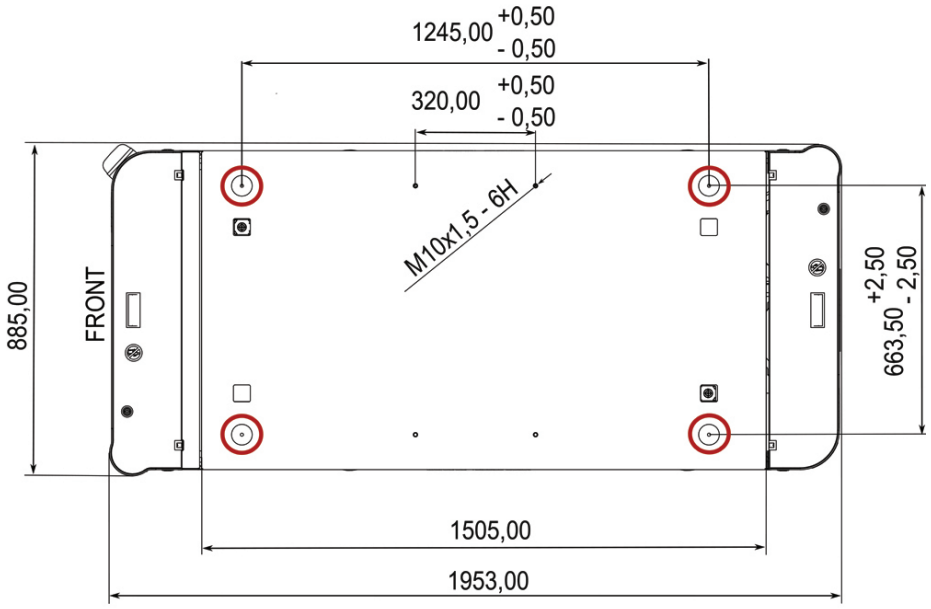


Figure 2.10: Location of centring pins

- **Draw wire encoder:** A draw wire encoder detecting the position of the lift platform. It is used to control the lifting table; the PLC reads the encoder which adjusts the lifting position. Depending on the value, the PLC raises or lowers the lifting speed.

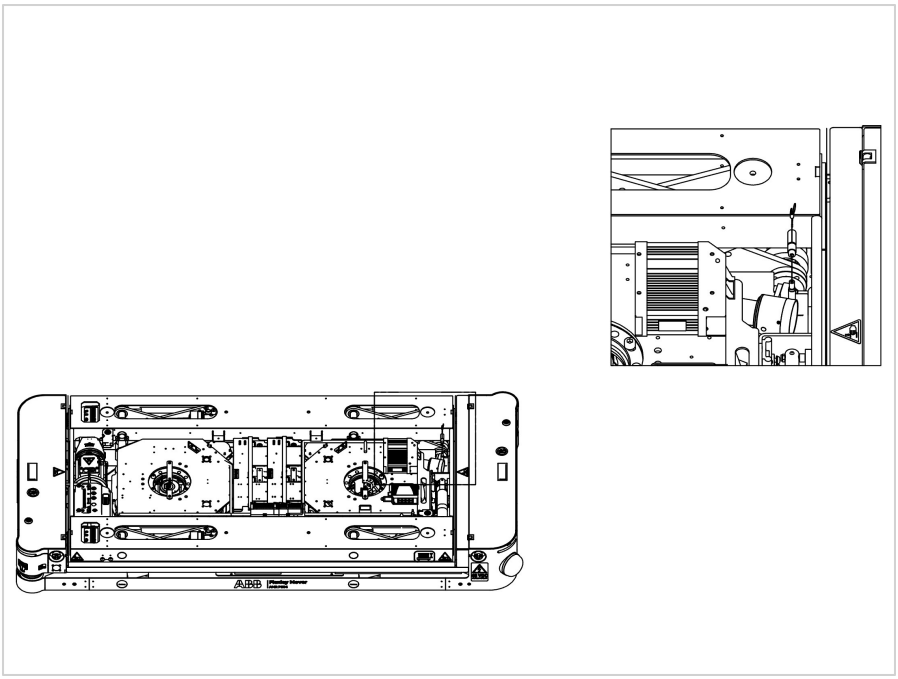


Figure 2.11: Location of the draw wire encoder

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Note

Lifting errors (inductive sensor in bad condition, for example) can no longer be avoided by using the manual mode. It is necessary to act on the vehicle to release its load or place it correctly if this is the problem. The AMR cannot be moved but the lifting table can still be raised or lowered in manual mode. **The brake will remain applied as long as these errors exist.**

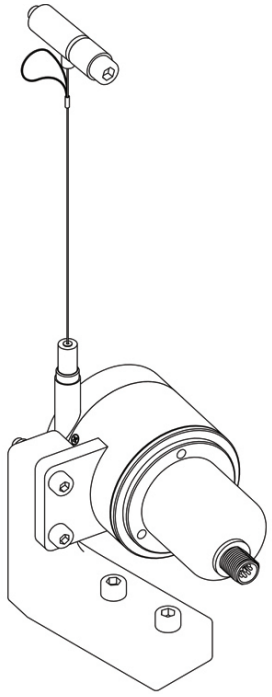


Figure 2.12: Draw wire encoder

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2.2.2 Detection devices

Overview

The necessity to monitor, measure, and improve safety, operational efficiency, and load handling leads in an implementation of inductive sensors.

They detect if the load is correctly positioned.

Inductive sensors

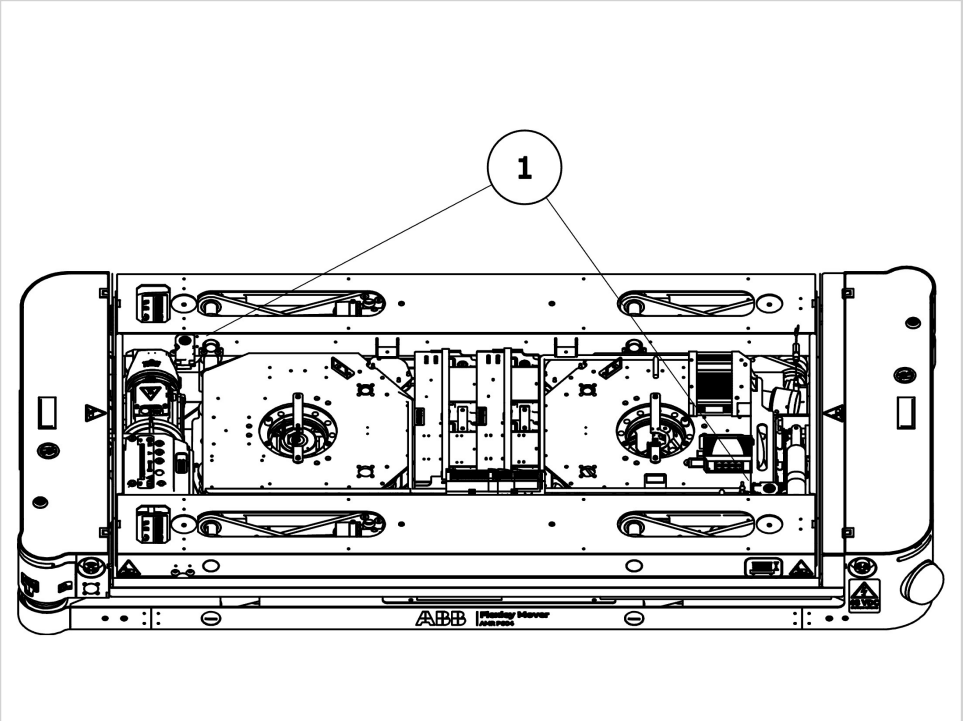


Figure 2.13: Location of inductive sensors

Item	Description
1	Inductive sensors

Two sensors located near the centring pins to ensure that the load is correctly positioned on the platform.

They detect if the load has the minimum size required, indicated by the fact that both sensors are detecting the load at the same time. Each inductive sensor is manufactured by a different company to reduce the probability of failing both at the same time.

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Figure 2.14: Inductive sensors

Note

These inductive sensors operate based on electromagnetic fields and only detect metal loads.

Both sensors should detect the load, or the lack of, at the same time. Otherwise, there will be an error and the vehicle will stop automatically.

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2.2.3 Maximum load dimensions

Refer to Load Specifications for maximum load dimensions. See *References* section.

WARNING

If these dimensions are exceeded, the emergency stop buttons won't be accessible. The integrator must study each case by means of a risk analysis.

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2.2.4 Load positioning for stability

Refer to Load Specifications for load positioning for stability. See *References* section.

Note

ABB is not responsible for the load carried by the AMR.

Stability of the final configuration is the responsibility of the integrator.

WARNING

Injury to persons due to loss of load transported in the platform of the AMR.

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2.3 Safety system

2.3.1 Safety PLC

The SICK Flexisoft module or safety PLC is the AMR's programmable safety controller. It ensures optimal communication between safety devices implemented in the AMR, thereby ensuring they operate as designed when activated.



Figure 2.15: Safety PLC

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2.3.2 Safety lasers

Overview

> **Note**
>
> The procedure for setting the laser scanner fields will be included in the Laser configuration Master (See *References* section). A copy of this document will be available to the integrator and will be for confidential use.

This section describes an active safety system. The safety laser is designed to prevent accidents. It is designed to detect people and objects on the AMR travel path and stop the AMR to avoid collisions.

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2.3.2 Safety lasers
Continued

Operation

> **Note**
>
> The procedure for setting the laser scanner fields will be included in the Laser configuration Master, see the *References*. A copy of this document will be available to the integrator and will be for confidential use.

The safety lasers are designed to prevent accidents.

This system monitors safety in the vicinity of the AMR. It is made up of two laser scanners, one at the left front corner and one at the right back corner, as can be seen in the figure below:

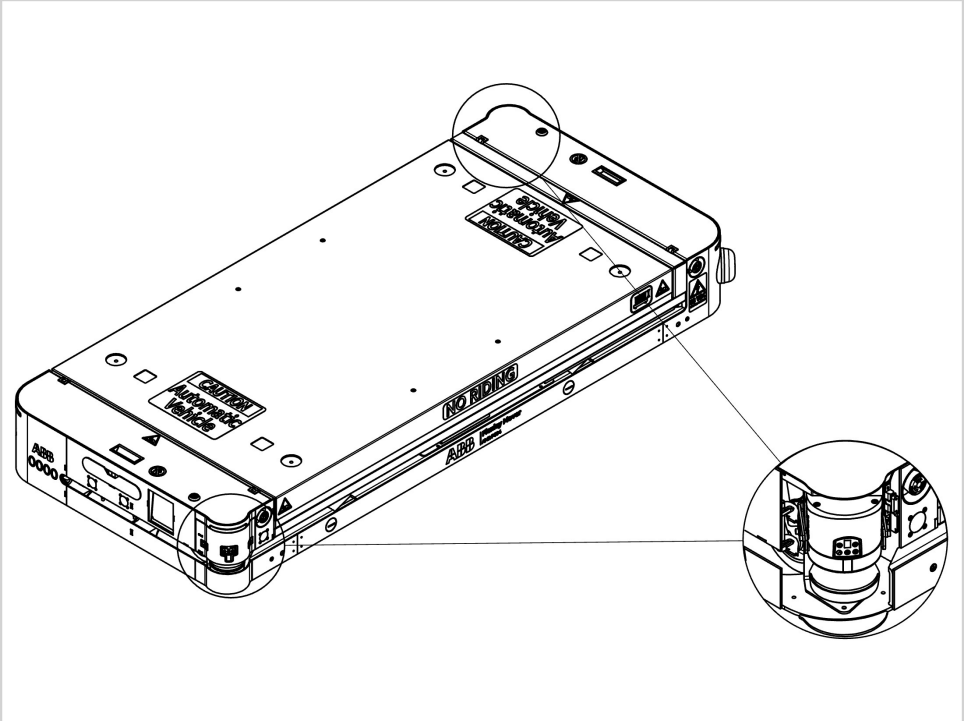


Figure 2.16: Laser scanners

Emergency stops are executed at the electrical and software level in the laser system.

- **Electrical:** By opening a safety relay when:
  - An object is found in the laser's protection field.
  - The safety PLC detects a fault in the wiring.
  - The operational stop fails.
  - The emergency stop is activated.
- **Software:** By ordering:
  - A zero speed when it detects an object in the protective field.
  - Lowering the speed if it detects an object in the warning field

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The laser constantly covers two active safety zones (warning field and protective field), the purpose of which is to prevent hazardous situations involving persons or objects.

The selection of laser fields is made according to:

- Maximum speed at some point of the vehicle.
- Load condition of the vehicle.
- Longitudinal movement configuration.
- Special configurations for the travelled segment, defined in the pre-programmed circuit map (as far as speed and direction of the special configuration is respected).

The AMR has two lasers in charge of scanning the area around, as shown in the figure below:

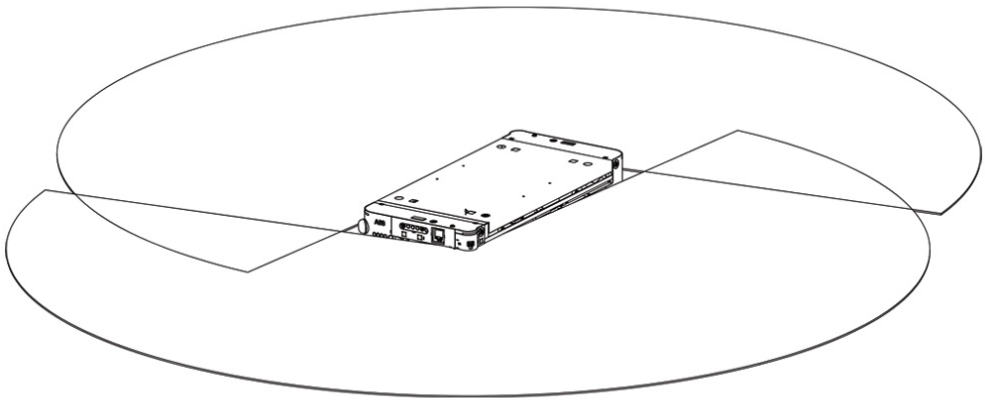


Figure 2.17: Safety lasers detection fields

The lasers scan the area around the AMR for this vehicle, as shown in the figure:

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2.3.2 Safety lasers
Continued

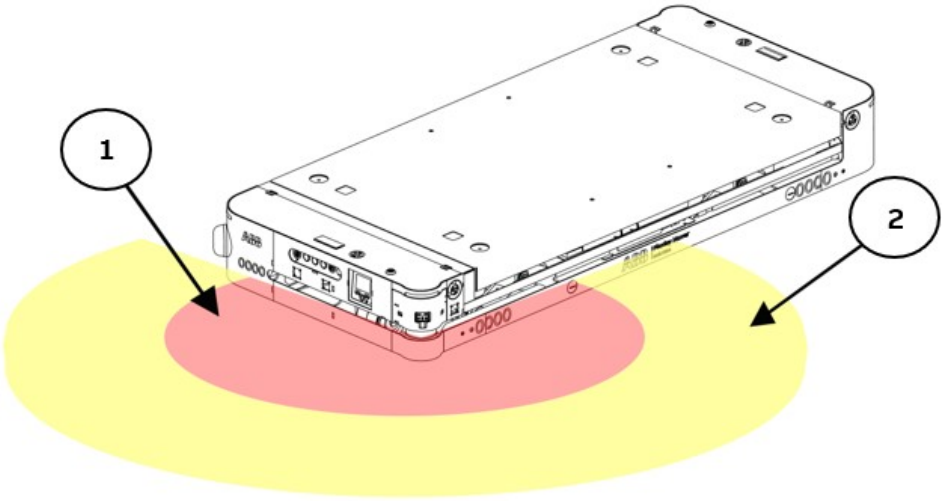


Figure 2.18: Laser safety zones

Whether these areas detect:

Item	Field	Description
1	Protective field	The AMR executes a controlled stop.
2	Warning field	The AMR slows down if a person is detected on the warning safety field. If the person does not remain detected the AMR will continue its previous speed.

The characteristics of the perimeter safety laser mounted on the AMR are described below.

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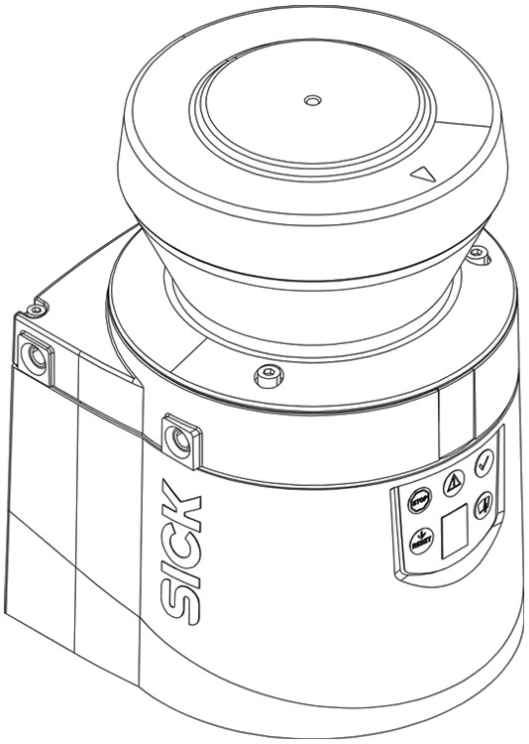


Figure 2.19: Commercial safety laser

- Category-3 system with 270° scan that can protect a circumference of 3 m from the device. For further detail, check the Master of Laser document (see *References*).
- Speed-dependent laser fields. 32 field sets configured (16 for front left laser and 16 for rear laser) with a total of 32 fields switched per speed and per load detection.
- When an object is detected in the warning field, the AMR reduces its speed. When an object is detected in the protection field, the AMR makes a controlled stop and applies the brake, these detections are shown in the display of the safety laser as in the table below.

Screen	Description
	All fields clear of any object.
	An object detected in the warning field.

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2.3.2 Safety lasers
Continued

Screen	Description
	An object detected in the protection field.

- The safety zones are larger at greater speed to accommodate the fact that braking distance also increases.
- Once the obstacle is removed, the system automatically resets after two seconds if the stop has lasted more than ten seconds.

WARNING

The safety laser's detection beam is positioned 105 mm above the ground.

Therefore, objects below or above beam height will not be detected, and the AMR could collide with them. That implies that the inclination of the ground is quite important, it shouldn’t be bigger than ±0.1 °.

There cannot be cantilevered obstacles on the AMR path. If due to the process or operative this cannot be avoided, an additional visible surface must be placed.

WARNING

If the original safety laser fields are changed, they must be validated according to ISO 3691-4 to ensure the safety of persons.

If the load to be transported by the AMR changes, it must be ensured that the safety fields are adequate for it, checking the dimensions of the fields.

Changes to safety laser have a direct implication on the safety of people, therefore, it should be performed only by trained and authorized personnel.

The AMR speed should be limited to 0.3 m/s when the safety laser fields are not large enough to cover the vehicle and the load transported, or the laser fields are not large enough to stop the vehicle before hitting.

Even with all these precautions there can be dead angles, so do not stand near the vehicle in turns.

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Validation of safety laser fields according to ISO 3691-4 and ANSI 56.X

This validation must be performed in the following situations:

- Each time a laser field of the AMR is modified.
- When the load to be transported protrudes from the AMR and the fields must be resized.

The test should be performed with at least 110% of the rated capacity defined by the manufacturer at the maximum speed for each means of human detection and adjustment as defined by the manufacturer (e.g., multiple fields).

ABB recommends that these tests be performed under the criteria of ISO3691-4 section 5.2, which details the following:

Test A

A cylindrical probe with a diameter of 200 mm and a length of 600 mm should be placed horizontally on the floor/floor and perpendicular to the direction of travel of the AMR. This test should be repeated with the probe once in the left, center, and right positions. The AMR should approach the probe and stop before contact is made between the probe and the rigid parts of the AMR or its intended load.

For contact actuated sensing means, the probe should be secured to the floor/floor to prevent movement on contact and the actuating force on the probe should not exceed 800 N.

Test B

A cylindrical probe with a diameter of 70 mm and a length of 400 mm should replace the probe described in Test A. The probe should be placed vertically.

The AMR should be brought close to the probe and stopped before contact is made between the probe and the rigid parts of the AMR or its intended load. This test should be repeated three times, once at the centerline of the detection zone and once at each end.

For contact actuated sensing means, the probe should be fixed to the floor/floor to prevent movement on contact and the actuating force on the probe should not exceed 250 N. The static force when the bumper is compressed to the position reached in a bumper from maximum energy (maximum combination of speed and gross truck weight, including load) shall not exceed 400 N.

Note

For tests A and B maximum forces are not considered.

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2.3.2 Safety lasers
Continued

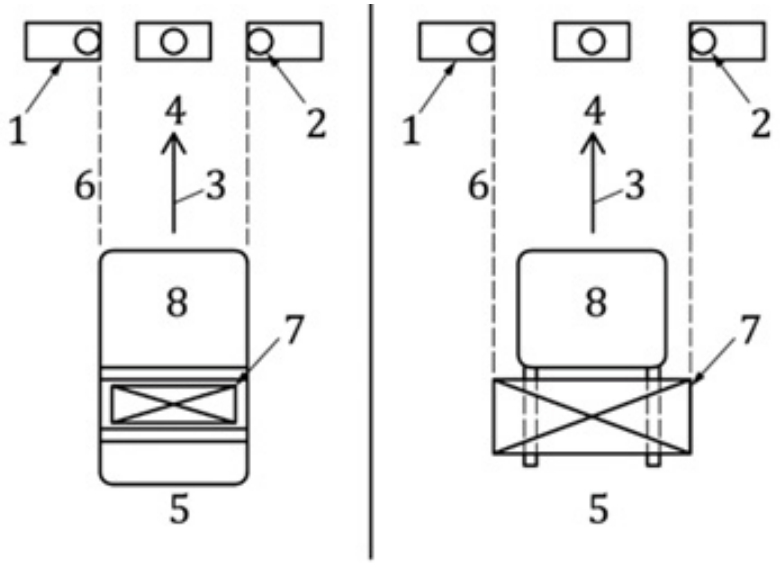


Figure 2.20: ISO 3691-4 Probe position for testing

S. No	Description
1	Probe A
2	Probe B
3	AMR travel direction
4	AMR path
5	Rear part of the AMR
6	AMR roadside
7	Load
8	AMR

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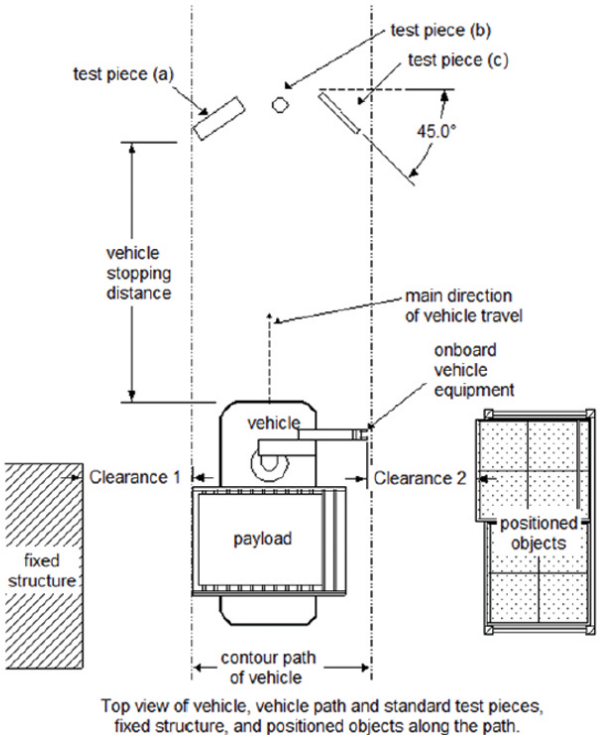


Figure 2.21: ANSI 56.X Probe position for testing

Final validation criteria:

An acceptable criterion is that AMR or most unfavorable load does not touch the probe according to ISO3691-4 section 5.2 and ANSI 56.X.

ABB recommends that whenever possible the distance between the probe and the AMR or most unfavorable load should be greater than 250 mm.

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2.3.3 Emergency stop buttons

Description

The AMR is equipped with four emergency stop buttons, located on the sides of the vehicle. When activated, the AMR immediately stops, indicating that an emergency stop has been executed.

After the emergency stop button activation, the AMR must be reset by first, releasing the emergency stop button and then from the Reset push-button to return to automatic operation.

The reset pushbutton must be pressed twice for 2 seconds.

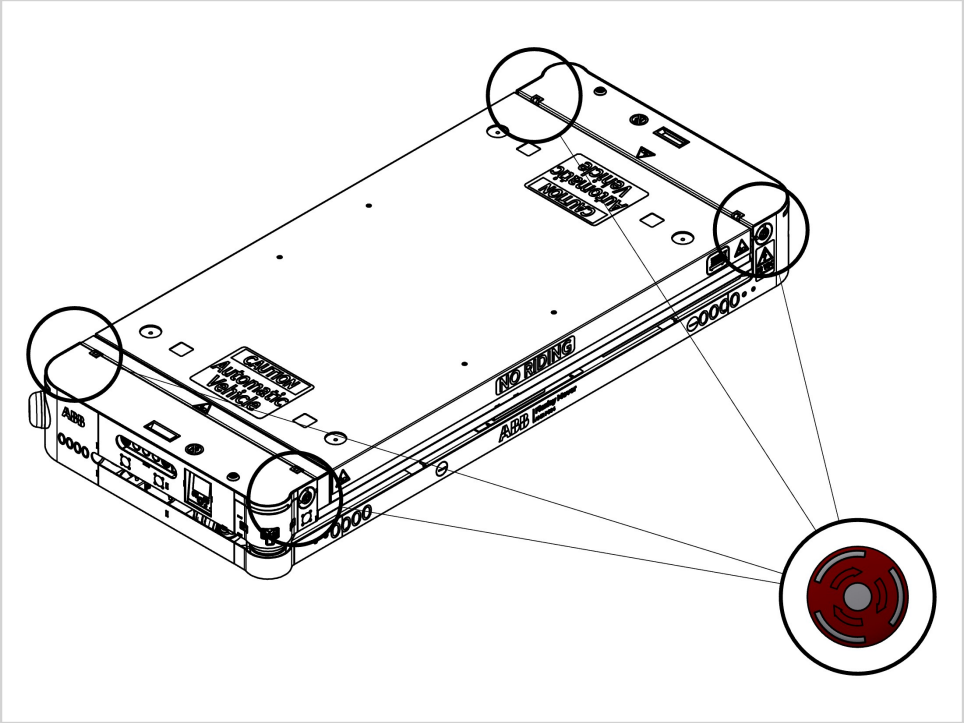


Figure 2.22: Emergency stop buttons

Note

When an emergency stop is performed, it has priority among other commands given to the machine, so that in case that other functions, buttons or orders are activated simultaneously with an emergency stop, the AMR will always perform a safe stop.

It is not possible to overturn the vehicle without load if an emergency stop is pressed.

An emergency stop button shall always be accessible, regardless of the load. For more information, see the Load specifications- Flexley Platform AMR P604.

Emergency stop buttons shall be tested regularly. For more information, see the Maintenance manual - Flexley Platform AMR P604 (*References*).

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2.3.4 Passive safety systems

Overview

These systems are designed to minimize the consequences in the case of a hypothetical accident.

The AMR is provided with the following passive safety and warning systems:

- AMR LED lights. See *AMR LED* lights.
- Operational stop button. See *Operational stop button*.

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2.3.4 Passive safety systems
Continued

AMR LED lights

The AMR is equipped with 4 signalling LEDs, each one located at each of the four corners of the AMR.

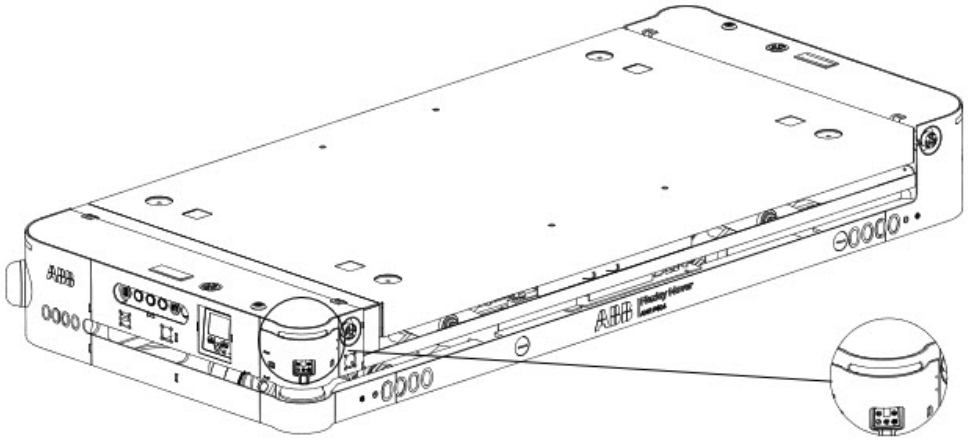


Figure 2.23: Signalling LEDs

AMR LEDS - AMR P604 M

Status	Front left LED	Front right LED	Rear left LED	Rear right LED
Initializing sequence	Blue, green, red, off	Blue, green, red, off	Blue, green, red, off	Blue, green, red, off
Forwards	White	White	Yellow	Yellow
Backwards	Yellow	Yellow	White	White
Forwards left/Backwards right	Amber with a sequence	White	Amber with a sequence	White
Forwards right/Backwards left	White	Amber with a sequence	White	Amber with a sequence
Line/Validation	Blue	Blue	Blue	Blue
S. Maintained	Light blue	Light blue	Light blue	Light blue
Traffic	Purple	Purple	Purple	Purple
Resettable malfunction	Red	Red	Red	Red
Non-resettable malfunction	Red/Off 5 Hz	Red/Off 5 Hz	Red/Off 5 Hz	Red/Off 5 Hz
Special cases (*)	White/Yellow 2 Hz	White/Yellow 2 Hz	White/Yellow 2 Hz	White/Yellow 2 Hz
Reduced safety laser fields/Muting	Red 2 Hz	Red 2 Hz	Red 2 Hz	Red 2 Hz
Manual mode	Purple 5 Hz	Purple 5 Hz	Purple 5 Hz	Purple 5 Hz
Charging	Yellow	Yellow	Yellow	Yellow
Stopped	OFF	OFF	OFF	OFF

(*) For more information about special cases refer to *Masters of Lasers document* (see *References* section).

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AMR LEDS - AMR P604 V

Status	Front left LED	Front right LED	Rear left LED	Rear right LED
Initializing sequence	Blue, green, red, off	Blue, green, red, off	Blue, green, red, off	Blue, green, red, off
Forwards	White	White	Yellow	Yellow
Backwards	Yellow	Yellow	White	White
Forwards left/Backwards right	Amber with a sequence	White	Amber with a sequence	White
Forwards right/Backwards left	White	Amber with a sequence	White	Amber with a sequence
Pushing by hand, with selector	Purple 150ms	Purple 150ms	Purple 150ms	Purple 150ms
Resettable malfunction	Red 1000ms	Red 1000ms	Red 1000ms	Red 1000ms
Non-resettable malfunction	Red 150ms	Red 150ms	Red 150ms	Red 150ms
Conexión with PC lost	Blue 150ms	Blue 150ms	Blue 150ms	Blue 150ms
Stopped in Auto	Green	Green	Green	Green
Stopped	Purple/OFF	Purple/OFF	Purple/OFF	Purple/OFF
Low battery state	Red 333ms	Red 333ms	Red 333ms	Red 333ms
Calibration	Purple	Purple	Purple	Purple
Manual mode	Purple sequence	Purple sequence	Purple sequence	Purple sequence
Traffic	Cyan	Cyan	Cyan	Cyan
Charging	Green	Green	Green	Green
S. Maintained	Blue	Blue	Blue	Blue
Line/Validation	Blue sequence	Blue sequence	Blue sequence	Blue sequence

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2.3.4 Passive safety systems
Continued

Operational stop button

The AMR has an operational stop pushbutton located on the front of the AMR which plays a support role.

Once the operational stop pushbutton is pushed, the AMR performs a controlled deceleration by progressively reducing the speed until it comes to a stop.

Once stopped, the AMR will activate the brakes as long as it remains stopped and will go into resting mode leaving the automatic mode.

To resume the path, it is necessary to push the Insert button to switch to automatic mode (see the *Operating modes* section for more information).

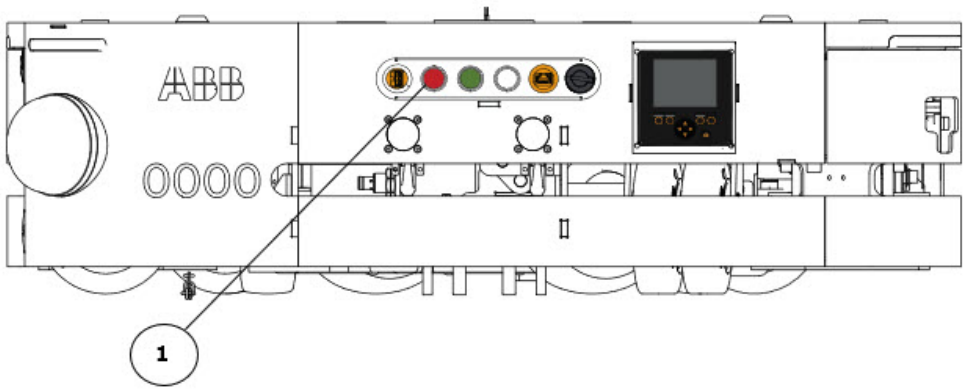


Figure 2.24: Operational stop button

Item	Description
1	Operational stop button

Continues on next page

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SF29 Bumper safety field (optional)

It allows the vehicle to perform a partial SF29. The vehicle has an inductive sensor that detects if the vehicle is in a confined zone.

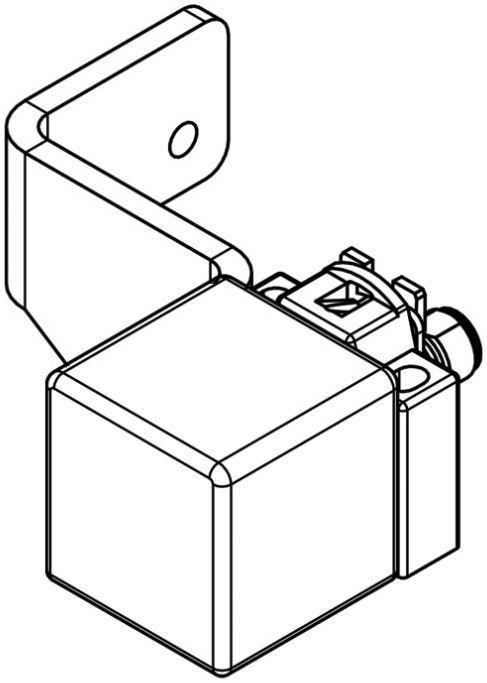


Figure 2.25: SF29 inductive and support

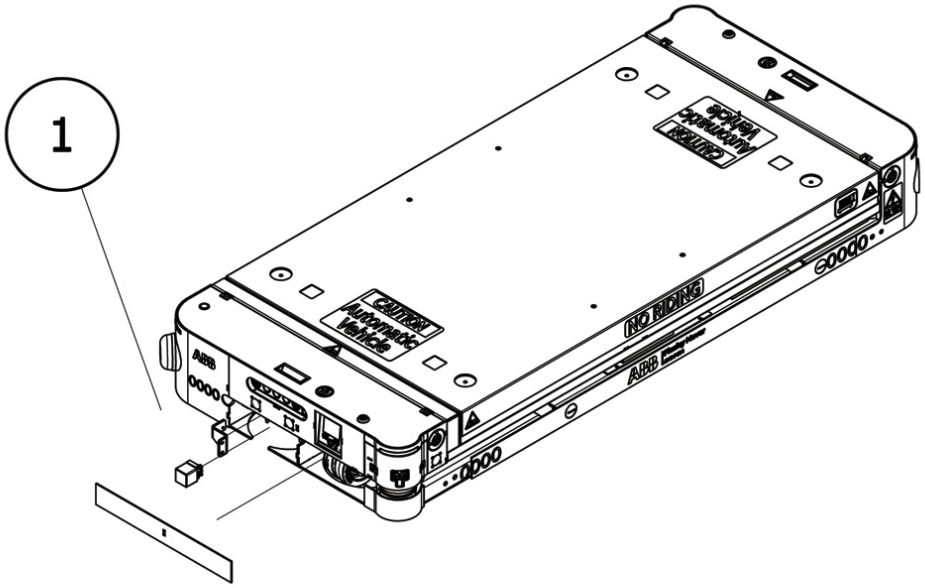


Figure 2.26: SF29 location

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2.3.4 Passive safety systems
Continued

Item	Description
1	SF29 and support location

Note

Partial application of SF29 will be available in AMRs. The AMR will safely identify confined zones and will allow higher AMR speed (0.3 m/s) with a reduction of safety fields.

This is intended to be used in confined zones when the SF29 optional is available and active. If that is not the case, the SF29 (perimeter guarding) as described in Annex A of ISO 3691-4 is not provided at all.

SF29 optional availability should be checked considering model and software. For more information, please contact ABB.

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Electrostatic discharge chain

The electrostatic discharge chain is designed to prevent sudden and momentary flows of electric current, also known as Electrostatic discharges (ESDs).

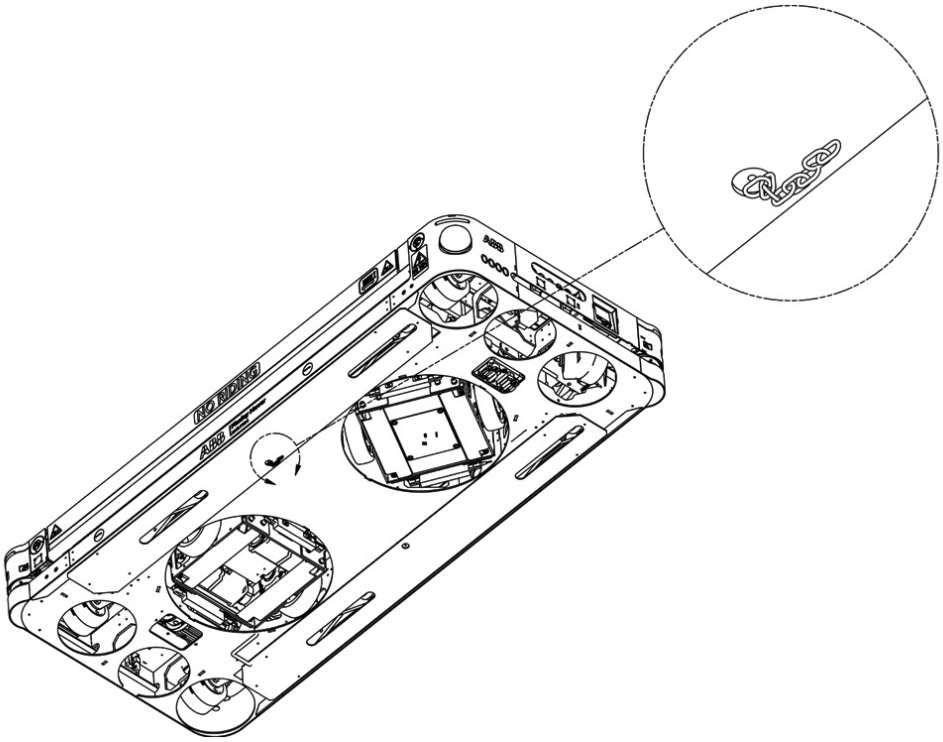


Figure 2.27: Electrostatic discharge chain

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2.4 Electrical system

Overview

The AMR's electrical system is the backbone of the vehicle’s power, control and safety systems.

Note

Users performing operations on control panels via this access point must make sure they replace and secure the protective covers properly.

Workers with active inoperable medical devices (AIMD), should keep a distance of at least 0.8 m from an open electrical panel in the AMR.

Description

The AMR's electrical system is the backbone of the vehicle’s power, control, and safety systems.

It comprises the following components:

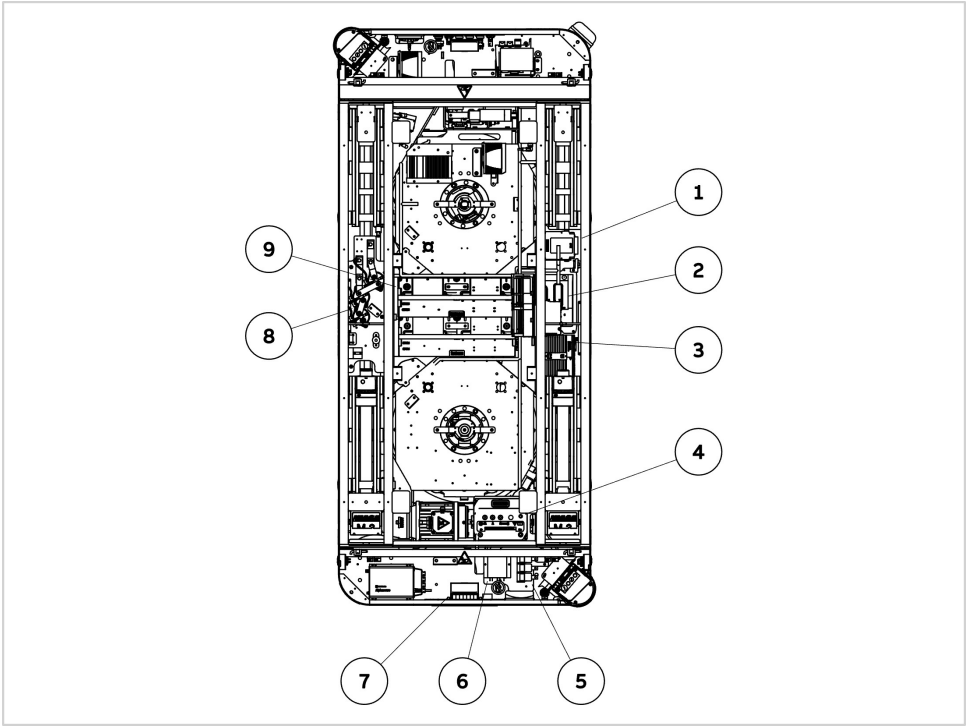


Figure 2.28: AMR Electrical system

Item	Description
1	Safety relays
2	PLC
3	Siemens PLC
4	Variable-speed drive
5	Relays

Continues on next page

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Item	Description
6	Fuses
7	Converter
8	Contactors
9	Battery
10	Switch

Note

Users performing operations on control panels via this access point must make sure they replace and secure the protective covers properly.

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2.5 Navigation system

2.5.1 Magnetic guidance - AMR P604M

Introduction

The aim of the system is to read and follow the magnetic tape laid on the floor or buried under the floor.

The magnetic tape forms part of the AMR's guidance system. The tape provides the path followed by the AMR. This tape can either be applied on the floor's surface, embedded in the bottom or buried under it. It is usually black in color.

The AMR reads the tape to follow a circuit. For example, as shown in the figure below.

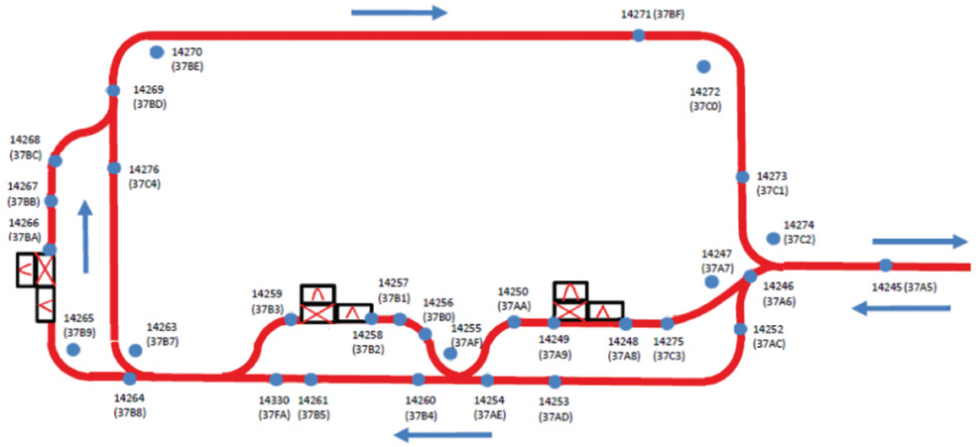


Figure 2.29: Laser scanners

Item	Representation	Description
1		AMR circuit
2		AMR direction
3		RFID Tags

The surface on which the circuit must be placed must be reasonably flat. It should consider that the AMR's suspension raises the chassis by up to 2 cm when braking suddenly. For safety reasons, the floor must be fully horizontal on the entire route. Refer for more details about the flatness requirements to *Floor requirements* chapter.

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Components for navigation

Magnetic antennas

The following figure shows the two magnetic antennas position, located at the front and the rear of each drive unit:

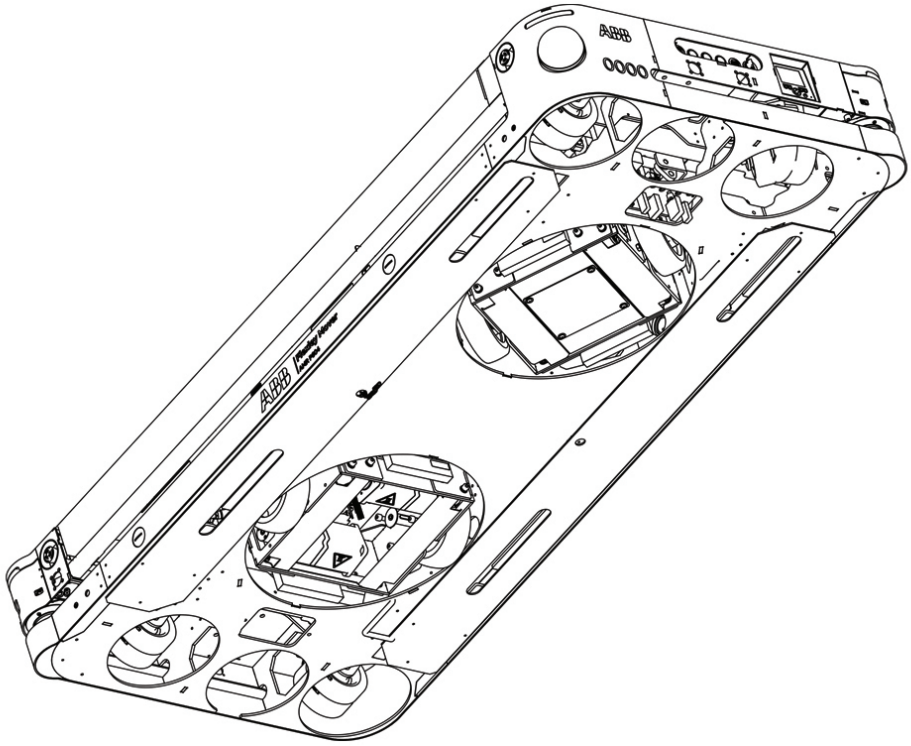


Figure 2.30: Position of magnetic antennas

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2.5.1 Magnetic guidance - AMR P604M
Continued

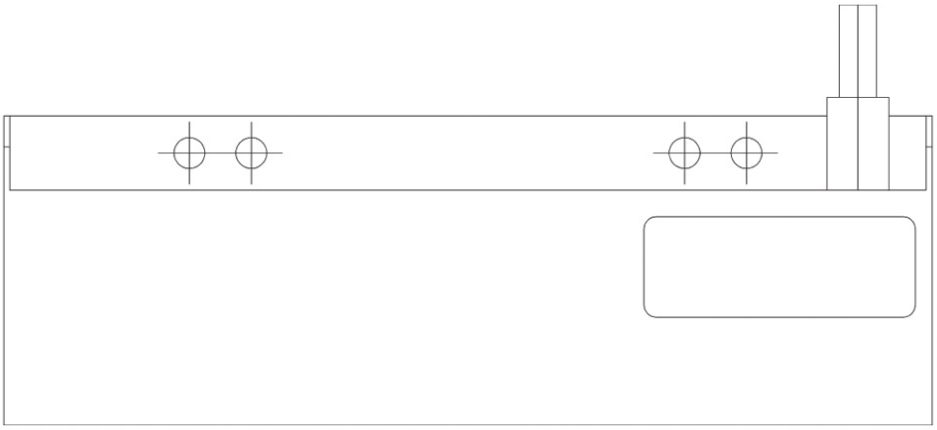


Figure 2.31: A30 magnetic antenna

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RFID

This system reads the tags (or evaluation points) and executes actions. It is made up of the RFID antenna and the tags.



Figure 2.32: RFID tag

The tags are used by the AMR's location system and are fitted on the floor. The RFID antenna reads these tags (each of which has its reprogrammable ID).

Every time the RFID antenna underneath the AMR reads a tag, it beeps and the green lamp flashes . The AMR evaluates a series of actions associated with this point, such as stopping for a pre-determined time, waiting for validation, changing speed, etc.

Note

The green light on the green button will flash the first time a tag is read. If it is constantly reading the same tag, it will be necessary to read a new tag for the green light to flash again.

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2.5.1 Magnetic guidance - AMR P604M
Continued

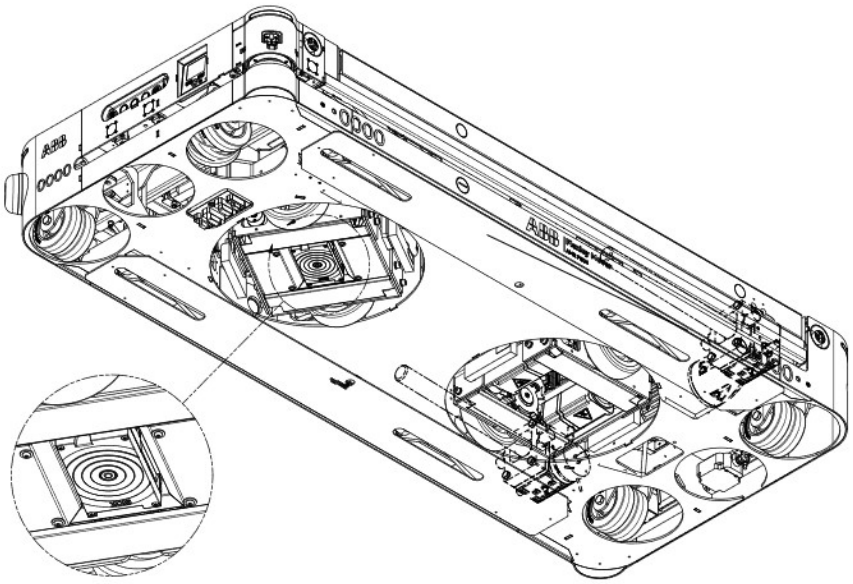


Figure 2.33: Location of the RFID antenna

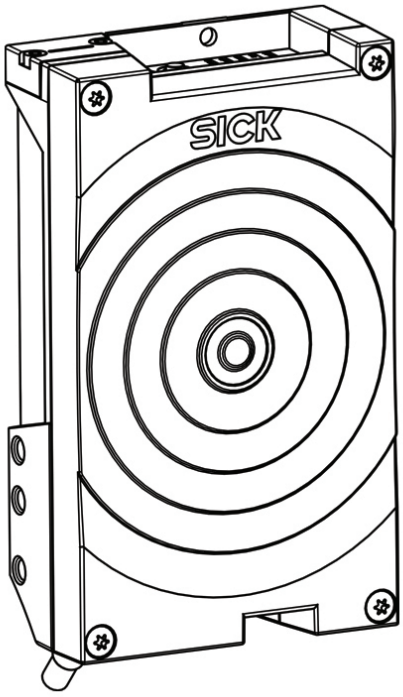


Figure 2.34: RFID antenna

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2.5.2 Visual SLAM guidance - AMR P604V

Introduction

The Visual SLAM combines AI and 3D vision, based on monocular cameras, odometry, IMU, and Visual-Inertial odometry. Visual SLAM technology enables AMRs to make intelligent decisions, differentiating between fixed and mobile objects in dynamic environments to build a rich and accurate representation of the environment.

Using Visual SLAM the AMR can create a map that is used to operate independently. Maps are constantly updated to reflect the changes happening in the environment.



Figure 2.35: Representation of how Visual SLAM interacts with the surroundings

The surface on which the circuit must be placed must be reasonably flat. It should consider that the AMR's suspension raises the chassis by up to 2 cm when braking suddenly. For safety reasons, the floor must be fully horizontal on the entire route. Refer for more details about the flatness requirements to *Floor requirements* chapter.

VSLAM cameras calibration

VSLAM monocular cameras need to be calibrated in order to work correctly.

This process should be done the first time the AMR is going to be used, in certain special cases, and after replacing or dismounting these spare parts:

1 More than one VSLAM camera.
2 The drive unit.

To know how to perform this calibration, check the AMR Studio manuals (see *References*). In case of doubt, contact ABB services.

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2.5.2 Visual SLAM guidance - AMR P604V
Continued

Components for navigation

Cameras

The figures below show the location of the 6 monocular cameras on the AMR.

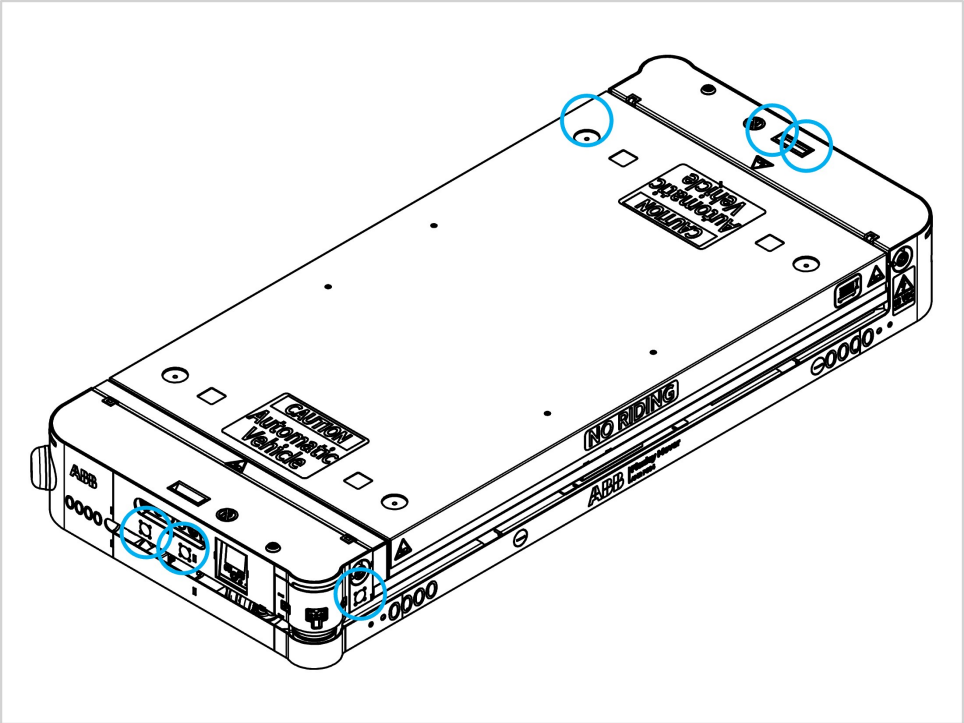


Figure 2.36: Location of the Visual SLAM cameras

Note

When adding the load, remember to not cover the visual cameras or the navigation quality will be affected.

WARNING

Lighting while operations should always be above 100 Lux; recommended minimum is 200 lux. Otherwise, the AMR stops in place.

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Alphasense module

The Alphasense module is in charge of connecting the VSLAM with the AMR Studio, it process all the information coming from the cameras and other navigation sensors and sends the AMR position to AMR Studio, so the vehicle can navigate through the mapped circuit.

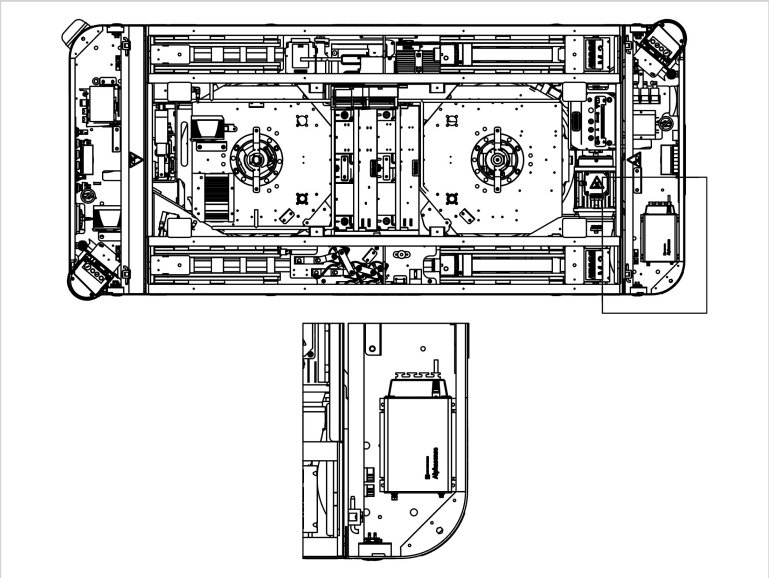


Figure 2.37: Location of the Alphasense module

Note

The VSLAM version of the P604 has one magnetic antenna per drive unit, but it is only used for calibration and online charging purposes.

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2.6 Control system

Overview

This system makes decisions on determining the AMR's actions like speed, and so on.

Its main components are as follows:

- PLC
- Datalogger - P604 M
- AMR Buttons
- AMR Connectors
- AMR Selectors
- Buzzer and AMR sound levels
- Industrial PC — P604 VSLAM
- Display

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2.6.1 PLC

PLC is the programmable logic controller of the AMR and is in charge of making decisions and determining its actions on each command that receives from the Onboard PC, in the case of the VSLAM version or the RFID for the Magnetic one.



Figure 2.38: PLC

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2.6.2 Datalogger — P604 M

The datalogger can also be used as a black box since it stores data for subsequent analysis by the Service team.



Figure 2.39: Datalogger

Note

The stored data have a specific duration, the oldest data will be automatically overwritten with an approximate age of 15 days.

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2.6.3 AMR Buttons

Overview

The user control system buttons are the following:

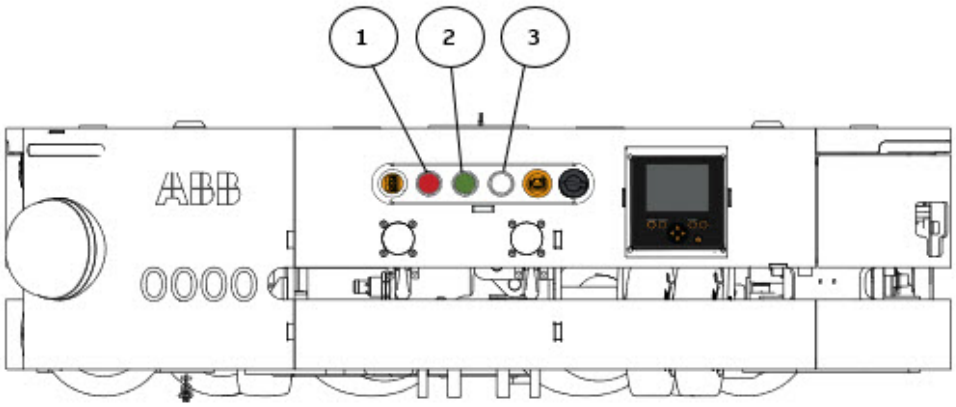


Figure 2.40: View of front button panel

Item	Description
1	Operational stop button
2	Insert button
3	Reset button

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2.6.3 AMR Buttons
Continued

Insert button

The purpose of this button is to insert the vehicle into the system and will only be enabled when the AMR is on automatic mode (identifiable via a green band on the Display as detailed in *Mode switching*). This button main functions are to insert the vehicle on its path of the circuit, but it also provides the function of a soft stop.

The status of the green button will be identified by a light indicator. When it blinks, it should be pushed, when it doesn't, it indicates the automatic mode has already been inserted. Once the button is pushed, the drive unit starts searching for the nearest starting point and once found, the AMR will go in the direction configured at the point shown on the display. Therefore, it is recommended to force a point where the direction of movement is known.

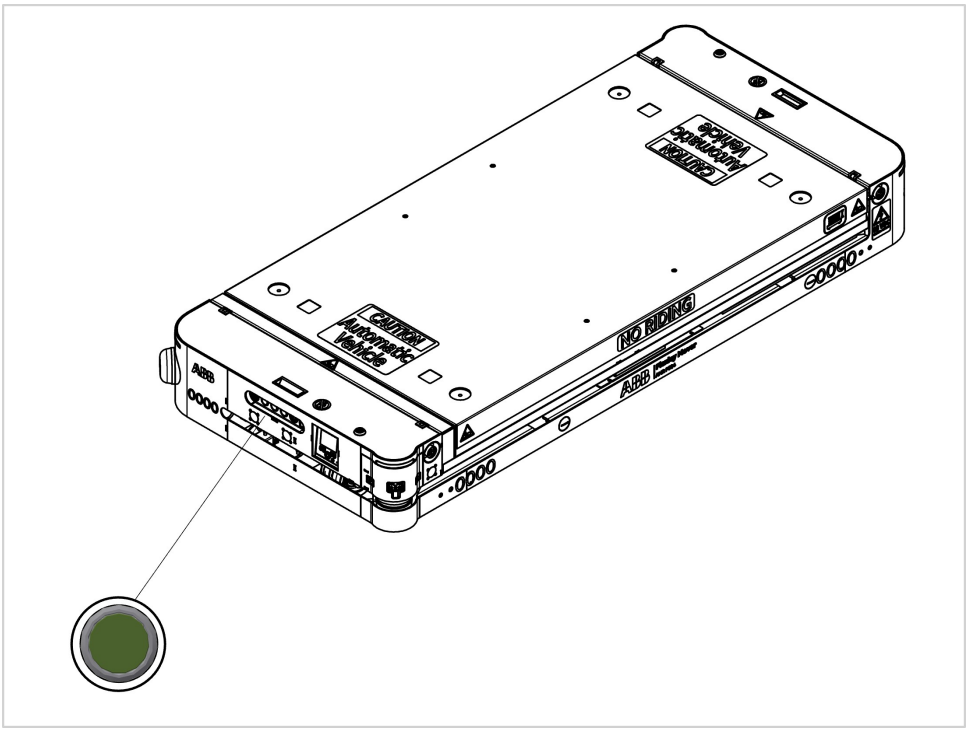


Figure 2.41: Insert button

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Reset button

The Reset button allows the AMR to be reset when needed. It blinks if the AMR needs to be reset and must be kept pushed for 2 seconds to perform an effective reset.

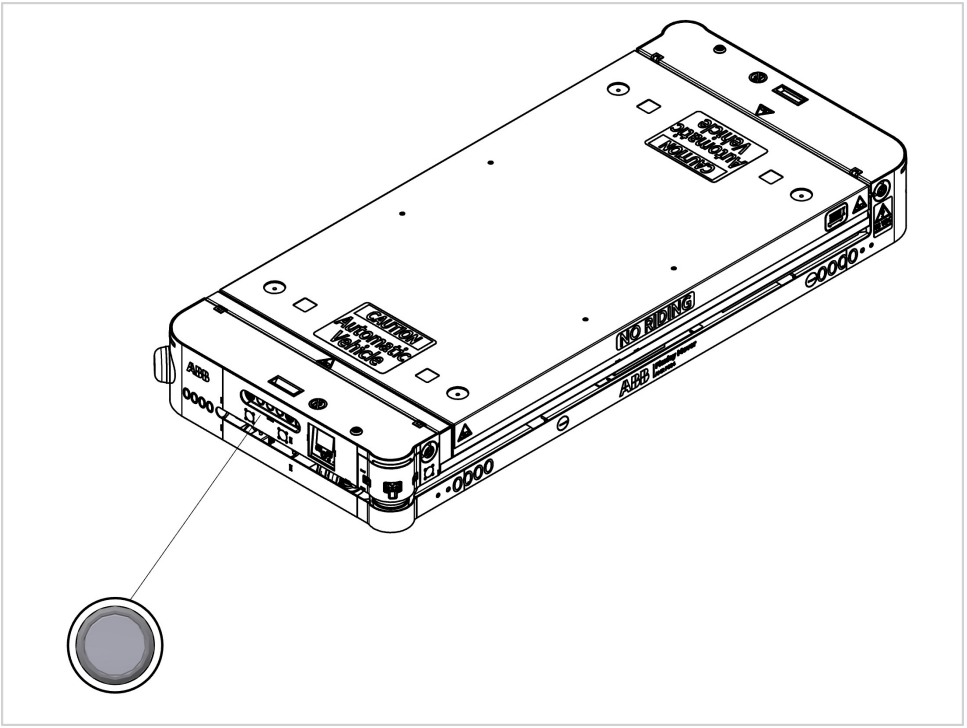


Figure 2.42: Reset button

Combination for special situations

When pressing at the same time the Insert and the Reset buttons, the laser bumper field is forced. It can help in certain situations, when this kind of laser field is temporarily needed. For more information, see the Laser Configuration Master manual (*References*).

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2.6.4 AMR Connectors

RJ45: Ethernet

This input provides access to the PLC to modify/update programs or transfer safety parameters, enables a connection to the datalogger's interface (Magnetic) or Sevensense's and Onboard's PC interface (VSLAM), and allows the working table to be transferred to the AMR via SIGAT (Magnetic); or layouts and missions to be transferred to AMR Studio (VSLAM) to perform the desired actions.

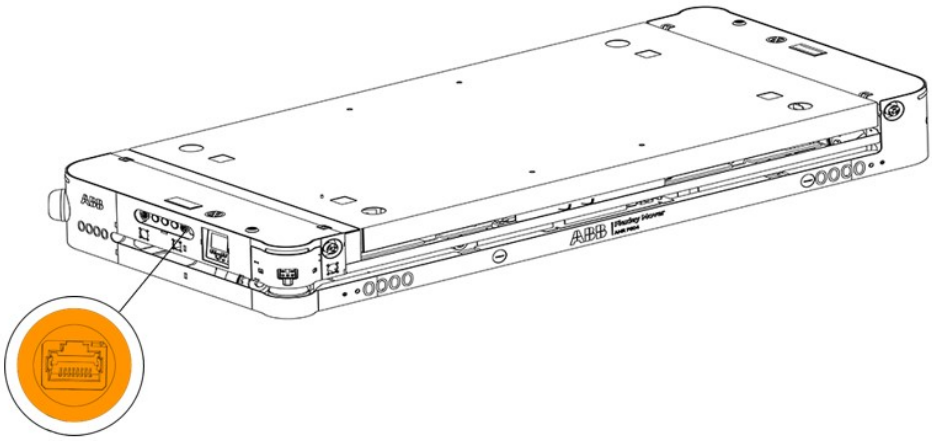


Figure 2.43: RJ45 port

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USB manual controller connector

This connector is used to initiate manual mode. On connecting the controller to the AMR, the vehicle can be moved in the required direction. For more information about moving the vehicle in manual mode see *Manual mode* section.

For the P604 M, when the AMR's controller is connected, the display will show code 180. For the P604 V error, see *ANNEX I - List of display codes*.

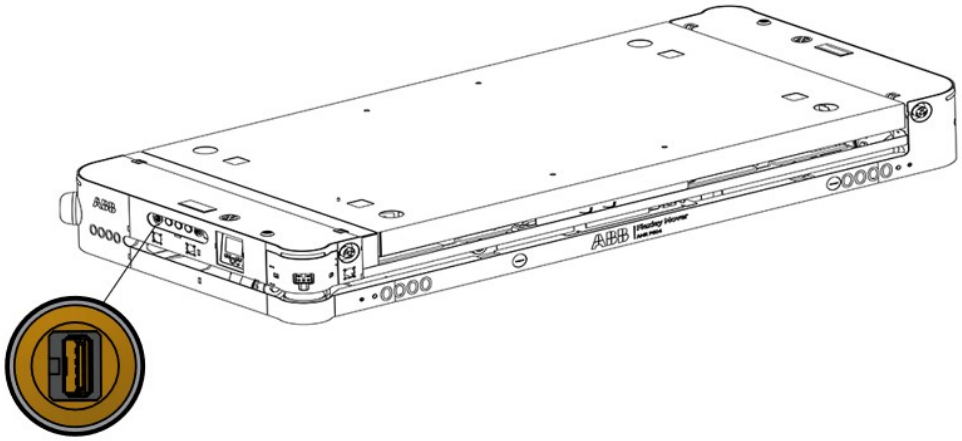


Figure 2.44: USB manual controller connector

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2.6.5 AMR Selectors

ON/OFF switch

Switches the AMR On or Off and it is located on the front button panel.

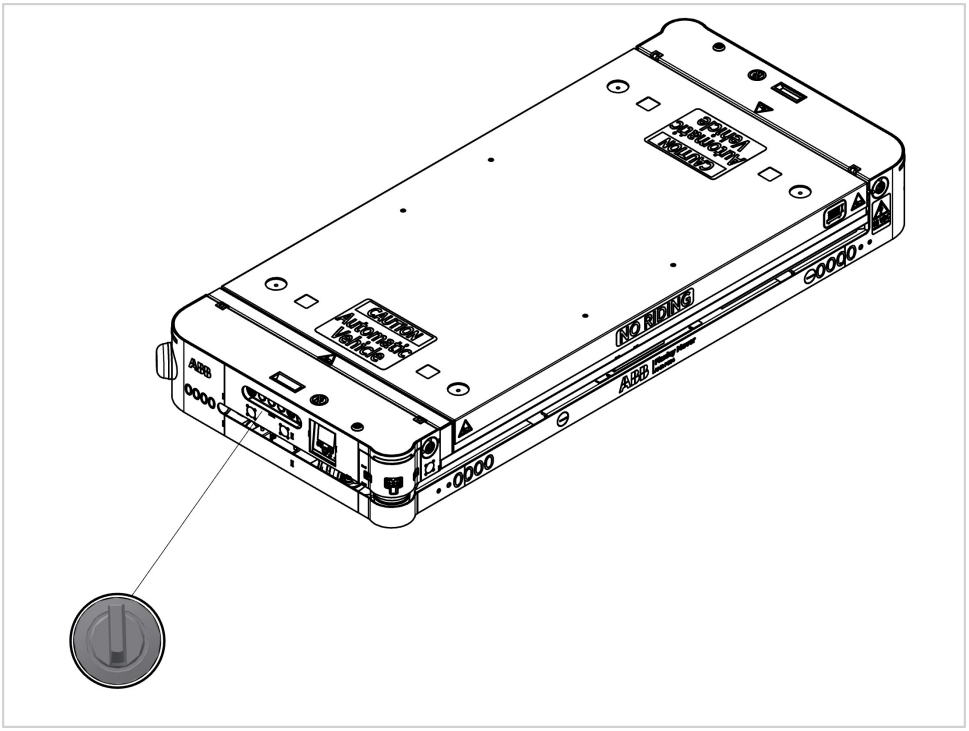


Figure 2.45: ON/OFF switch

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2.6.6 Buzzer and AMR sound levels

Buzzer

The AMR has a buzzer located in the electrical control panel which plays a support role. The tone of this buzzer can be programmed and can also be disabled from the working table. The disabling will be performed for each segment of the circuit, which means there is no option to completely disable the buzzer via software. For more information, check the software manuals mentioned on the *References* section, or the AMR Studio documentation.

The status of the buzzer is explained in the table below.

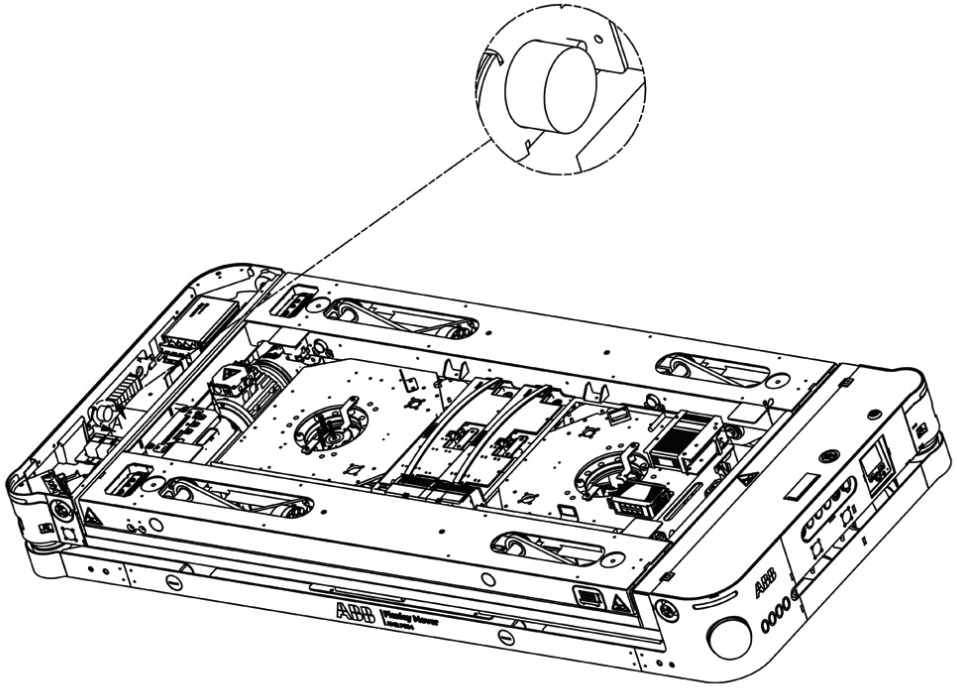


Figure 2.46: Buzzer

Status	On (ms)	OFF (ms)	Description
Continuous	--	--	Incorrectly positioned platform warning
Intermittent	500	500	Active error (requires enabling)
Intermittent	100	500	Motion announcement with a duration of 2 s after more than 10 s stop
Intermittent	100	200	Layout muted lasers
Intermittent	200	1000	Low battery level
Intermittent	250	3000	Buzzer activation by layout configuration

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2.6.6 Buzzer and AMR sound levels
Continued

AMR sound levels

A study of the measured noise levels has been carried out according to the procedure of UNE-EN 12053. The end user must decide whether to implement the use of noise protection according to local country regulations.

Continuous noise levels:

Operating phase	Acoustic power	Uncertainty
Displacement	84.8 dBa	±1.5 dBA
Elevation (loaded)	62.7 dBa	±1.5 dBA

Operationally dependent noise levels:

Operating phase	Acoustic power	Uncertainty
Operating cycle (no load)	85 dBA	±2 dBA
Acoustic warning: Programmable warning	84.9 dBA	±3.3 dBA
Acoustic warning: Start after 10 seconds stop	88.2 dBA	±3.0 dBA
Acoustic warning: Low battery	88.1 dBA	±3.0 dBA
Acoustic warning: Working without laser	90.6 dBA	±3.2 dBA
Acoustic warning: Wrong platform angle	95.3 dBA	±3.0 dBA
Acoustic warning: Emergency stop button	92.6 dBA	±3.0 dBA

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2.6.7 Onboard PC — P604 V

The AMR has an Onboard PC module, for high-level control of the AMR that is used to host and run the (non-secure) AMR control SW. It can also be used as a black box since it stores data for subsequent analysis by the aftersales service.

The Onboard PC also allows communication using the VDA5050 standard.

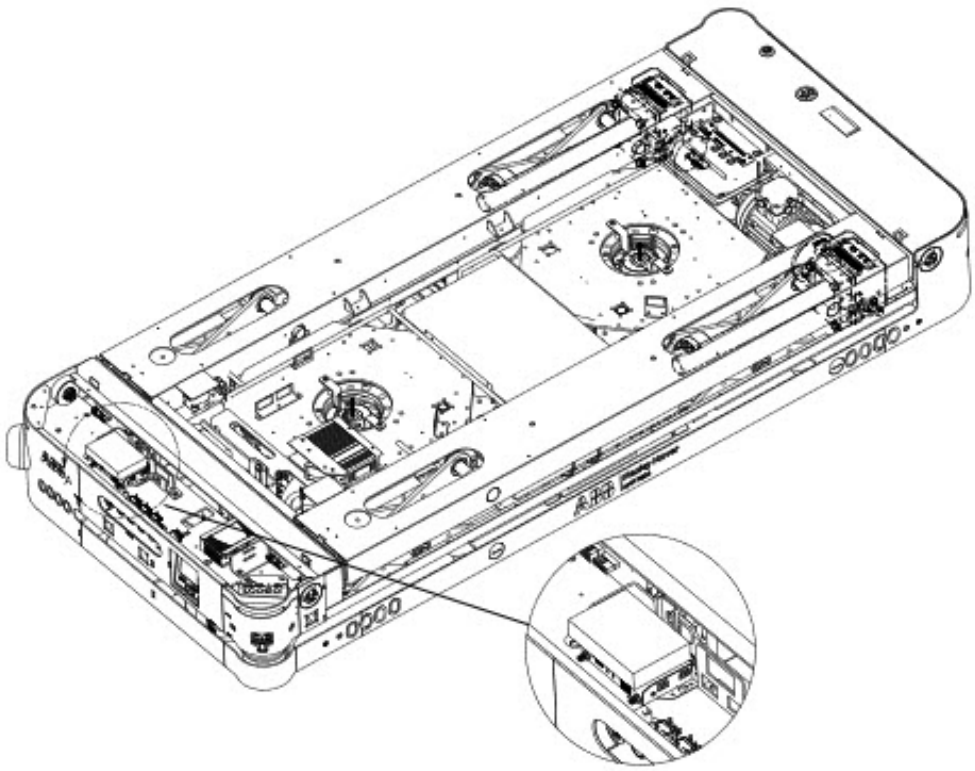


Figure 2.47: Onboard PC module inside the AMR

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2.6.8 Display

Overview

The display shows most of the information associated with the AMR. It contains the buttons and selectors detailed below. You can see a detailed list of all the screens, tabs and status messages below depending on the model.

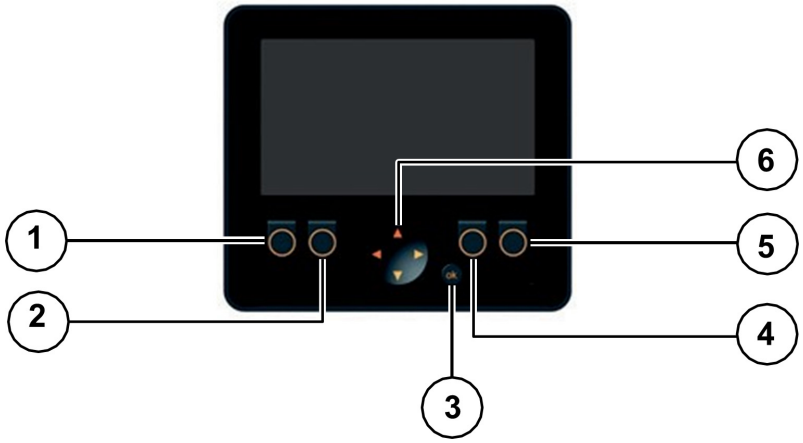


Figure 2.48: Display

S. No	Description
1	Button 1
2	Button 2
3	Enter/OK
4	Button 3
5	Button 4
6	Screen selector

Note

All display screens shown below may be subject to have changes in their design without notice.

The vehicle's mode is identifiable via a color band incorporated to the HMI display. A green display for the automatic mode and a purple one for the manual mode.

ANNEX IV - Display wireframe contains a wireframe indicating the available screens and how to browse them.

Continues on next page

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2.6.8.1 AMR P604 M

Display screen: Start-up screen

The start-up screen will show a 20-second countdown once the AMR is started.



Figure 2.49: Start-up screen

Display screen: Follow-up screen

After finishing the countdown, the screen will show the % Battery voltage (battery charge status).

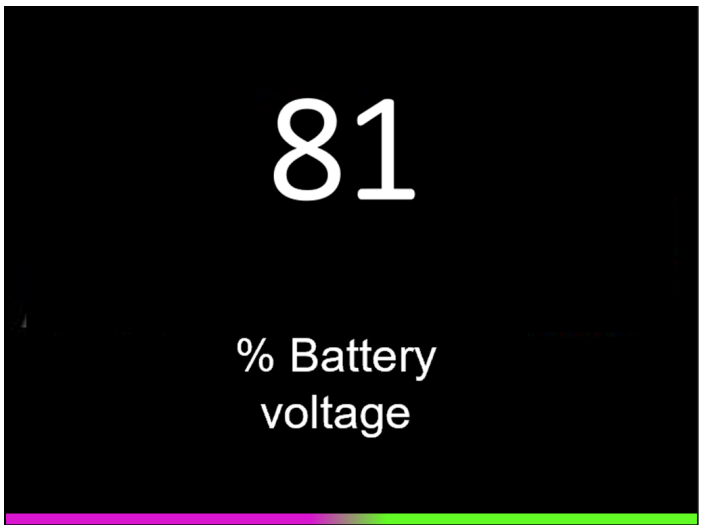


Figure 2.50: Follow-up screen

Display screen: Screen one

Provides information on the AMR status. It appears when the Insert button is pushed for the first time (see *AMR buttons*).

- Code 0: Automatic mode (no errors).
- Code 180: Manual mode.

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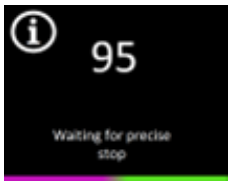
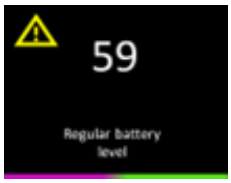
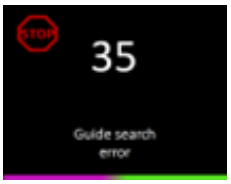
2.6.8.1 AMR P604 M
Continued

- Miscellaneous. For a complete list of display error codes, refer section *ANNEX I - List of display codes*.



Figure 2.51: Screen one

It displays three types of messages:

		
Information on the AMR's status (reading a tag, loading, etc.). **The AMR continues** operating.	**WARNING** A **warning** of an upcoming event (start of maintenance, charging, dirty laser shroud, etc.). **The AMR continues operating.**	AMR **error** (check the error code table to identify the problem). **The AMR completely stops all operation.**

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Display screen: Screen two

This screen displays the route and segment on which the AMR is located.



Figure 2.52: Screen two

Route and segment configuration:

1 Push **OK** on display to access the **SEGMENT** configuration screen. After pushing **OK**, the screen flashes red/white to indicate that the segment shown in the upper right corner of the screen can now be configured.

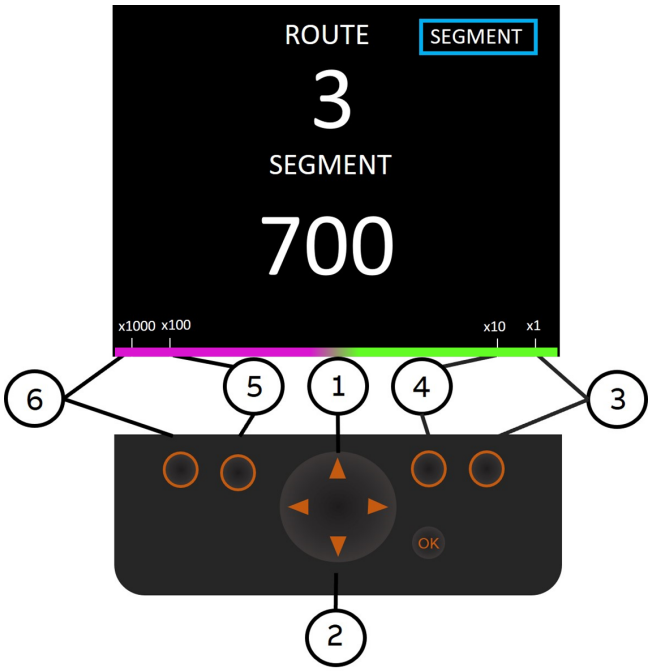


Figure 2.53: Segment configuration

Item	Description
1	Scroll forward through segments
2	Scroll backwards through segments
3	Button 4 - Segment x1

Continues on next page

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2.6.8.1 AMR P604 M
Continued

Item	Description
4	Button 3 - Segment x10
5	Button 2- Segment x100
6	Button 1 - Segment x1000

Simultaneously push the Segments x1, x10, x100 or x1000 and the up/down arrow on the central control pad.

2 Once the segment is configured, push the **OK** button again to configure the **ROUTE** shown in the upper right corner of the screen.

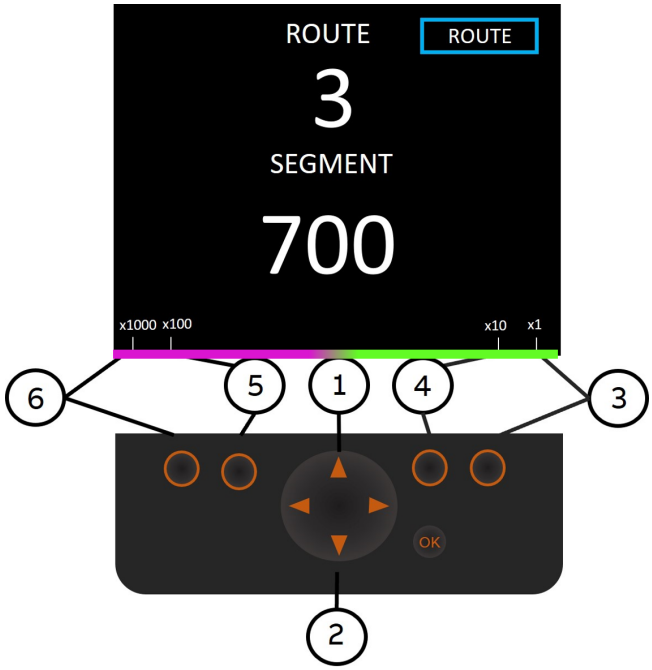


Figure 2.54: Route configuration

Item	Description
1	Scroll forward through routes
2	Scroll backwards through routes
3	Button 4 - Route x1
4	Button 3 - Route x10
5	Button 2- Route x100
6	Button 1 - Route x1000

Simultaneously push the Routes x1, x10, x100 or x1000 and the up/down arrow on the central control pad.

3 Once the route has been configured, push the **OK** button. The screen will stop flashing red/white and will continue just white.

Continues on next page

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> **Note**
>
> Do NOT push the 'OK' button to return to the previous route and segment configuration. Instead, change the screen, which will re-establish the previous values.

4 The AMR will then follow the instructions programmed.

Display screen: Screen three

This screen displays the actual status of the wired inputs coming into the PLC.

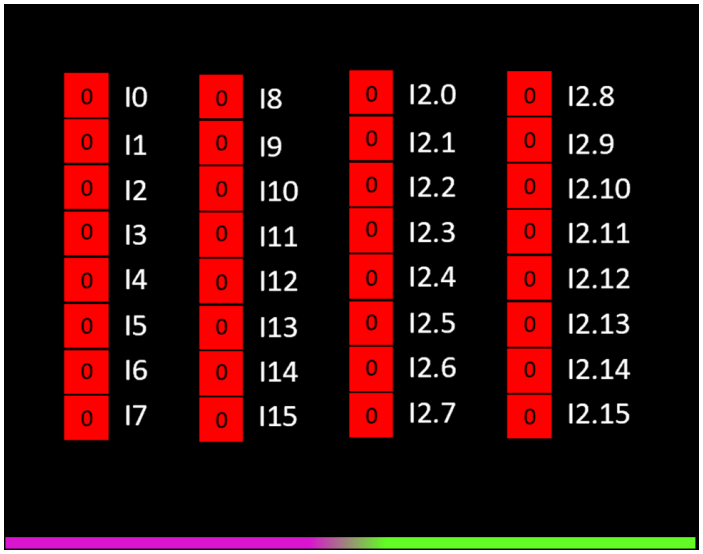


Figure 2.55: Screen three

Display screen: Screen four

This screen displays the actual status of the wired outputs coming into the PLC.

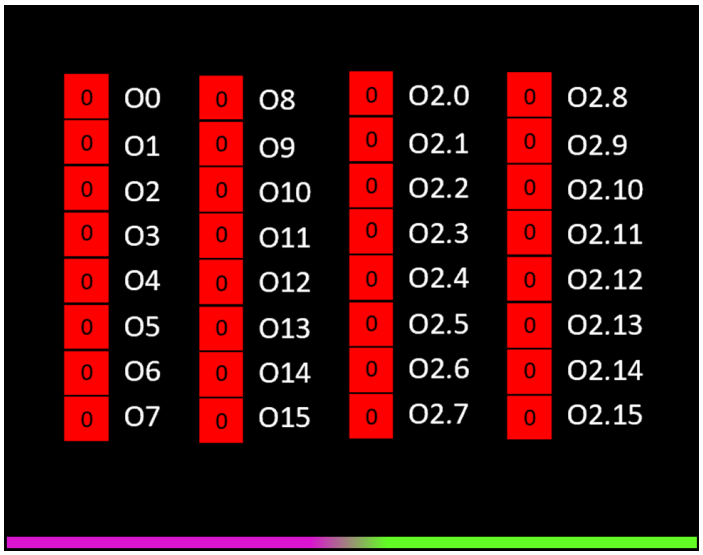


Figure 2.56: Screen four

Continues on next page

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2.6.8.1 AMR P604 M
Continued

Display screen: Screen five

This screen displays the actual status of the inputs, wired or not, coming to the AMR.

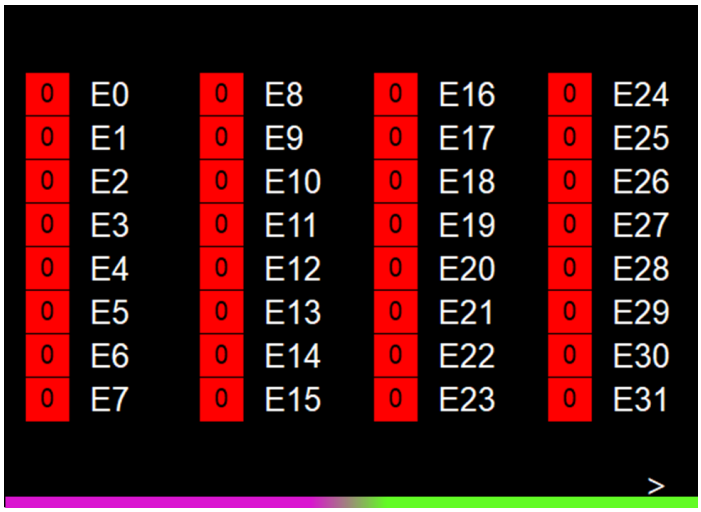


Figure 2.57: Screen five

Note

The screen shows 32 inputs. To display more, push the fourth button.

Display screen: Screen six

This screen provides the information about which mode is activated and when manual mode is on the iteration to change between manual mode via HMI to via controller and the other way.

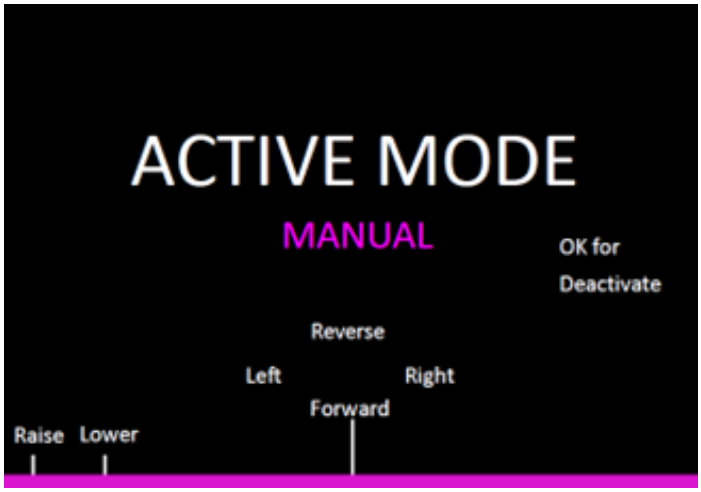


Figure 2.58: Screen six

When pushing the OK button and activate manual mode from the HMI, it allows operators to move the vehicle from the display. See *Operating modes*.

Continues on next page

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Note

For further information about enter in manual mode see *Mode switching* section.

Display screen: Screen seven

This screen displays the battery status and charge.

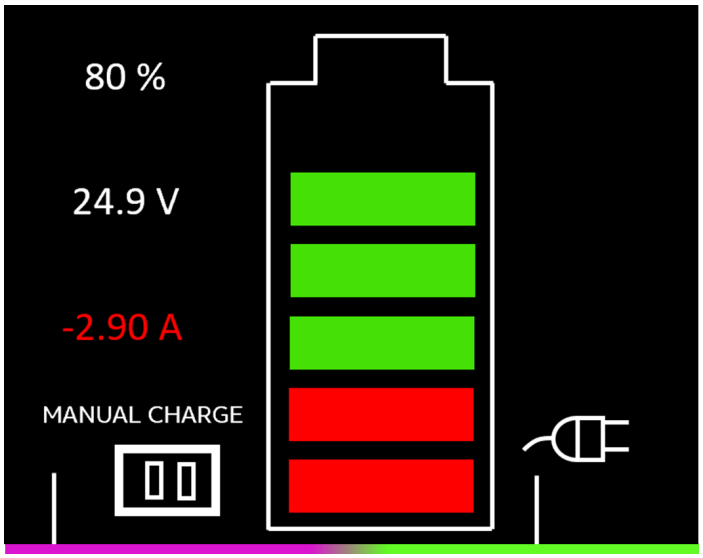


Figure 2.59: Screen seven

Display screen: Screen eight

This screen displays the direction of travel, the drive unit angle and whether the magnetic sensor is detecting or not.

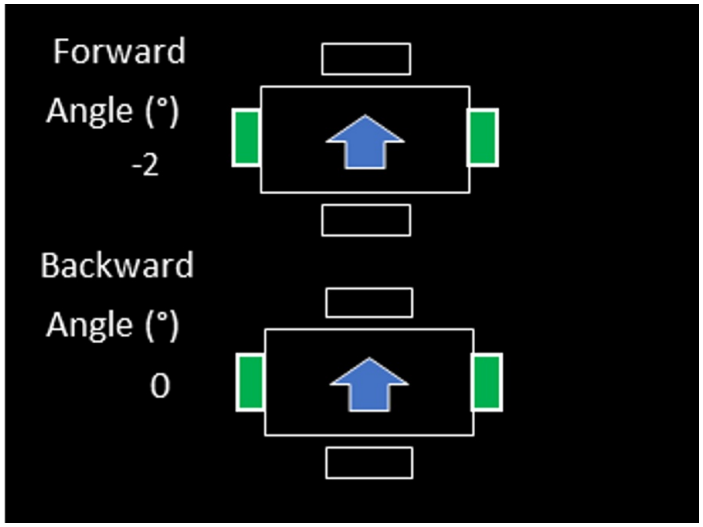


Figure 2.60: Screen eight

Continues on next page

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2.6.8.1 AMR P604 M
Continued

Display screen: Screen nine

This screen displays the parameters of the variable-speed drives and is only displayed in maintenance mode. Refer to the maintenance manual to learn more about how to access this mode (See *References*).

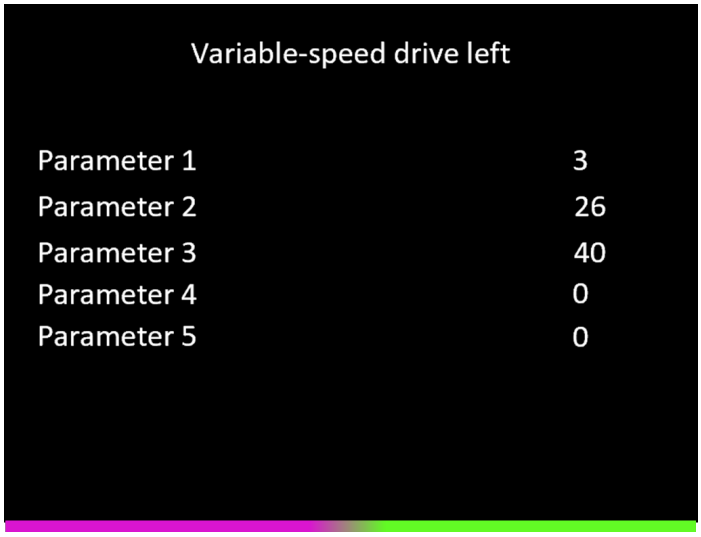


Figure 2.61: Screen nine

Display screen: Screen ten

This screen displays the parameter setting.

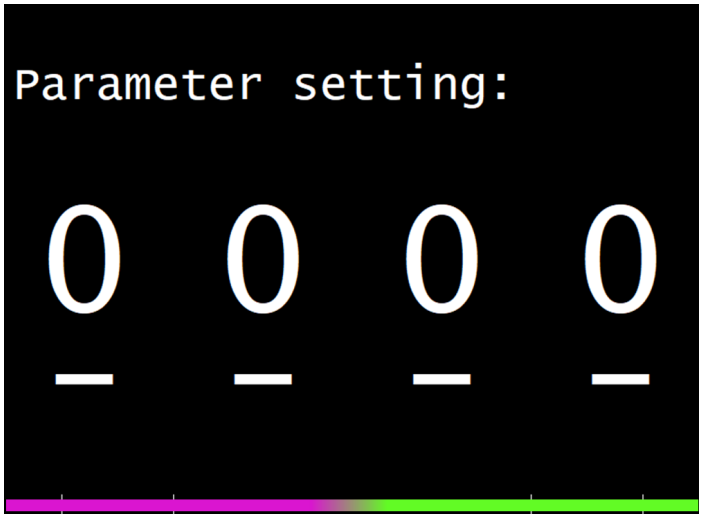


Figure 2.62: Screen ten

Note

Screen to be used by ABB personal only.

Display codes

Anomalies are indicated by audible or visual warnings using the lights at the top and on the sides. If the anomaly lasts longer than one minute, the AMR will emit a louder acoustic signal to draw the operator's attention.

Continues on next page

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When a malfunction occurs in the AMR, it stops, showing a numeric code on display indicating the problem.

The display codes indicate the status of the AMR. These codes range from 00 to 255. Each code indicates a different AMR status.

The most common codes for AMR operators are listed below:

Code	Description	Interpretation/Action
00	AMR has no anomalies	INFORMATION
01	Emergency mode	STOPS MACHINE
02	Emergency mode not reset	STOPS MACHINE
03	Error in more than one variable-speed drive	STOPS MACHINE
05	Anti-collision (automatic reset)	STOPS MACHINE
06	Battery level extremely low	STOPS MACHINE
08	Anti-collision (speed reduced)	WARNING
10	Unexpected point (found on the working table)	INFORMATION
33	Guide detection error. The AMR does not find the magnetic tape	WARNING
34	Guide sensor error	STOPS MACHINE
59	Battery level low	WARNING
60	Front left variable-speed drive error	STOPS MACHINE
61	Front right variable-speed drive error	STOPS MACHINE
80	The AMR does not execute a route	INFORMATION
81	Awaiting fulfilment of initial conditions (AMR input)	INFORMATION
86	Awaiting fulfilment of initial conditions (remote input)	INFORMATION
90	Preparing battery charging	INFORMATION
91	End of battery charging process	INFORMATION
96	Effective battery charging	INFORMATION

WARNING

Before checking display errors next to the AMR, the stop button must be pressed to avoid impacts.

If the error is not specified in this manual, please notify ABB to inform of the error and, if necessary, they will check or repair the fault.

Continues on next page

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2.6.8.1 AMR P604 M
Continued

Note

ANNEX I - List of display codes contains the complete list of display codes.

Display screen: How to access maintenance screen

The maintenance screen is also keycode protected. To access maintenance screen, follow these steps:

1 Stop the vehicle and initiate the automatic mode. The color band should become green.

2 Using the HMI display, enter maintenance screen.

While pressing the **OK** button, press **Button 3** > **Button 2** > **Button 4** > **Buttons 1 and 3** at the same time. See screenshot below.



Figure 2.63: Maintenance sequence

3 Press the **Button 1** and go to the **Maintenance** screen.

Note

For safety reasons, certain screens like the load screen doesn't allow the maintenance screen.

For more information about what tasks can be performed from the maintenance screen, see the Maintenance Manual.

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2.6.8.2 AMR P604 V

Display screen: Start-up screen

The start-up screen will show for a couple of seconds once the AMR is started. The dots will change the color into red sequentially depending on the current status of the starting process.

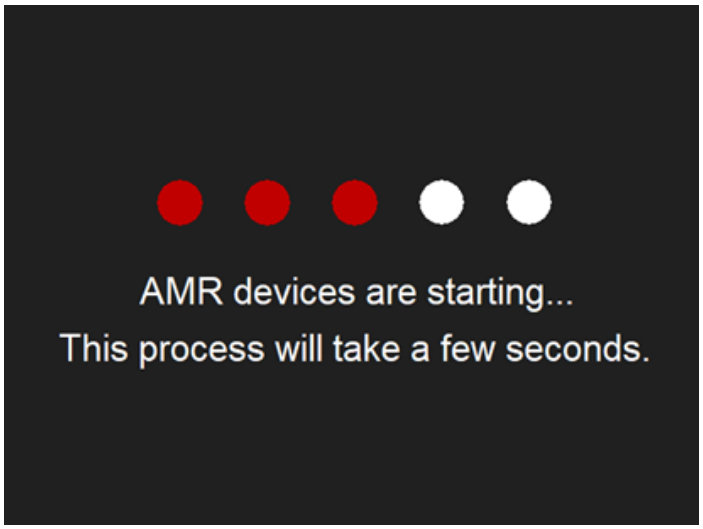


Figure 2.64: Start-up screen

Display screen: Home screen

After finishing the start-up screen, the display will show the status of the AMR, indicating any relevant errors.

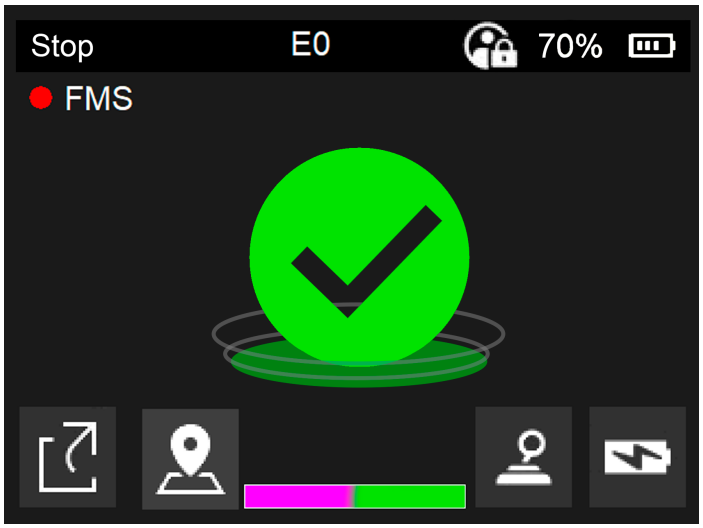


Figure 2.65: Home screen

Item	Description
1	Maintenance screen
2	Location
3	Manual movement

Continues on next page

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2.6.8.2 AMR P604 V
Continued

Item	Description
4	Battery
5	Manual/Automatic mode status bar

Display screen: Screen 0 - Vehicle information screen

From the Home screen, press **OK** to go to the Vehicle information screen. This screen allows you to access different screens using the arrows on the screen selector. After selecting one, press the **OK** button to enter any of them. You can always come back to the Home screen by pressing the button below the Home icon (in this case the **Button 4**), or to this screen pressing **Button 1**.

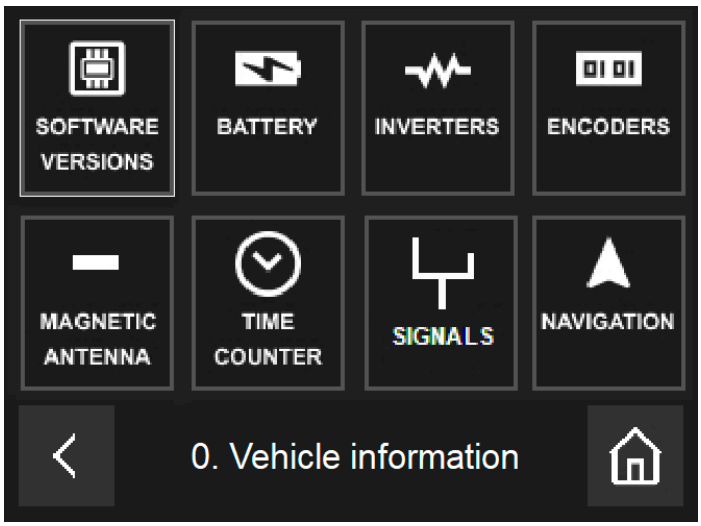


Figure 2.66: Configuration screen

Display screen: Screen 1 – Software versions

From this screen you can check the Serial number, Firmware version, and Software version for the PLC, PC, and HMI.

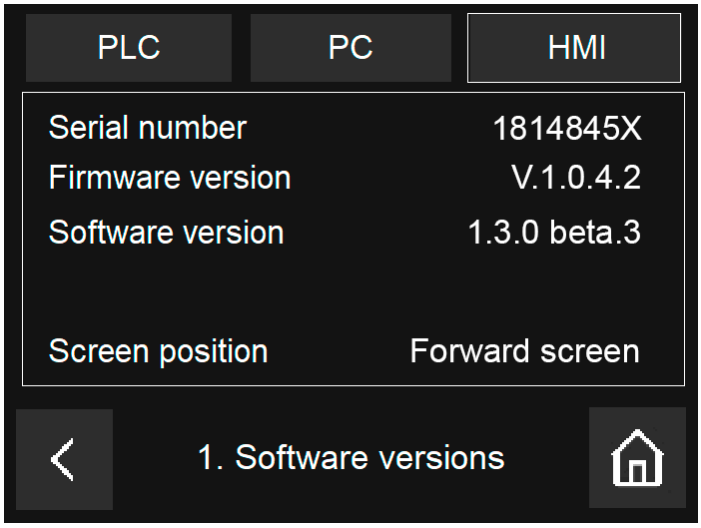


Figure 2.67: Software versions screen

Continues on next page

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Display screen: Screen 2 – Battery

From this screen you can check the Battery status and set what kind of manual charging you want to use.

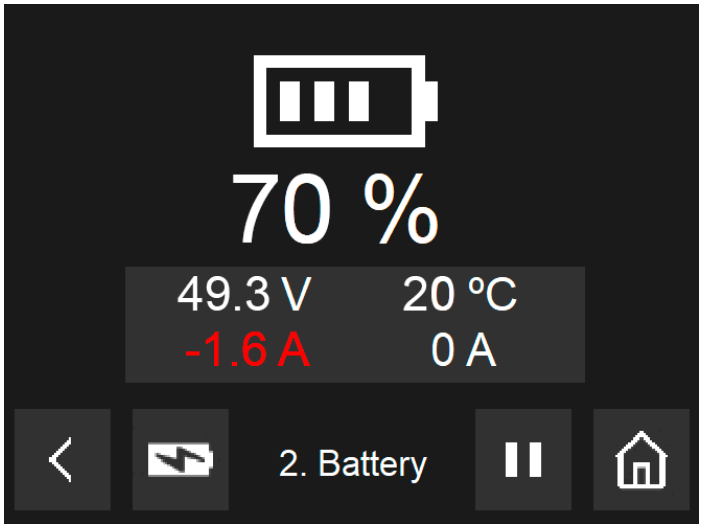


Figure 2.68: Battery screen

If you are charging the AMR manually, press Button 2 to access **Screen 2.1**.

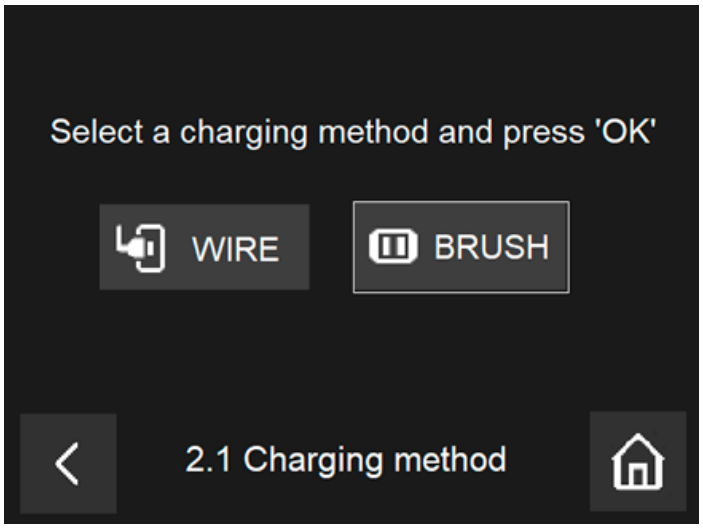


Figure 2.69: Charging method screen

Select the charging method using the arrow buttons and pressing the **OK** button.

Continues on next page

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2.6.8.2 AMR P604 V
Continued

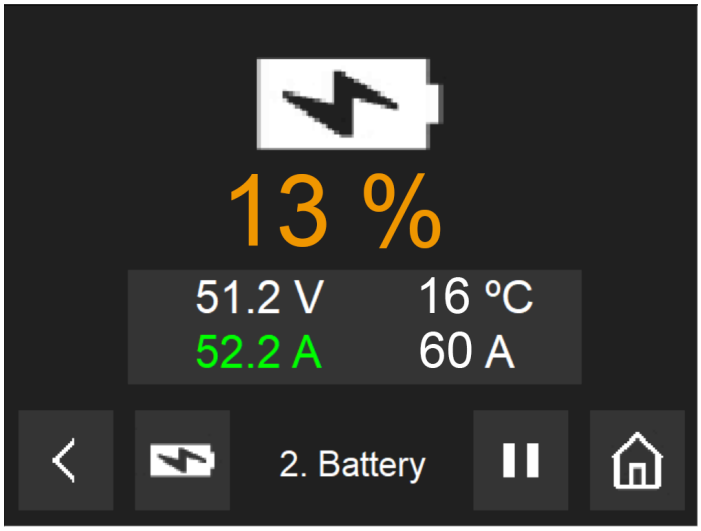


Figure 2.70: Battery charging screen

The Battery screen will show the charging icon.

Display screen: Screen 3 – Inverters

From this screen you can check the inverters status.

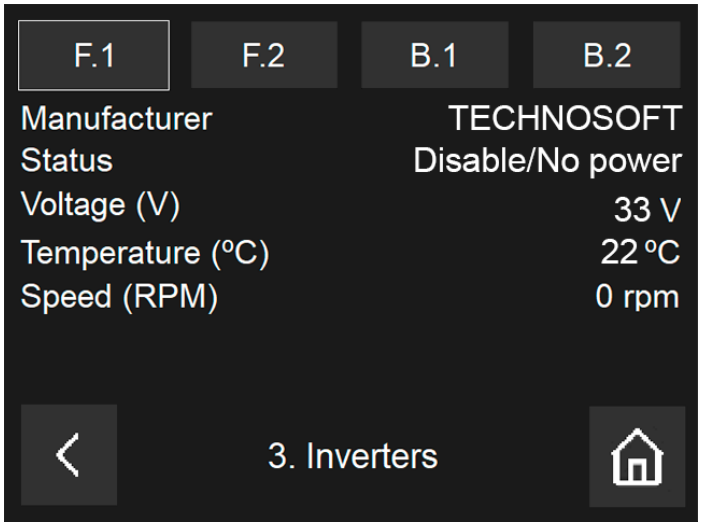


Figure 2.71: Inverters screen

Item	Description
F.1	Forward inverter 1
F.2	Forward inverter 2
B.1	Backward inverter 1
B.2	Backward inverter 2

Continues on next page

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Display screen: Screen 4 – Encoders

From this screen you can check the encoders status.

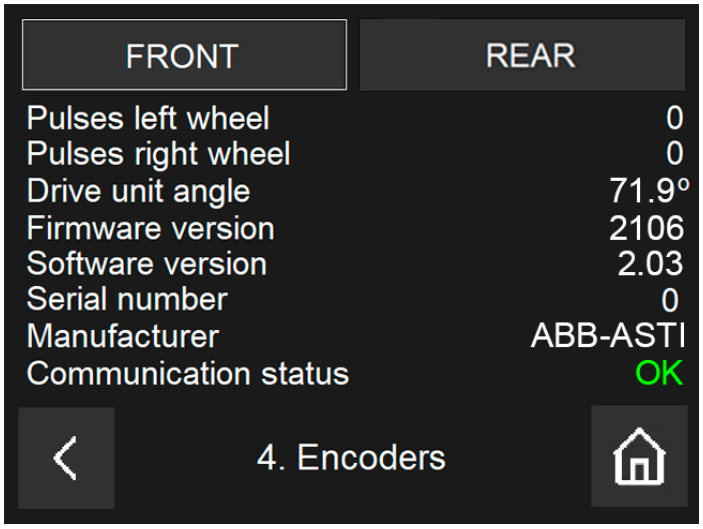


Figure 2.72: Encoders screen

Display screen: Screen 5 – Magnetic antenna

From this screen you can check the magnetic antenna.

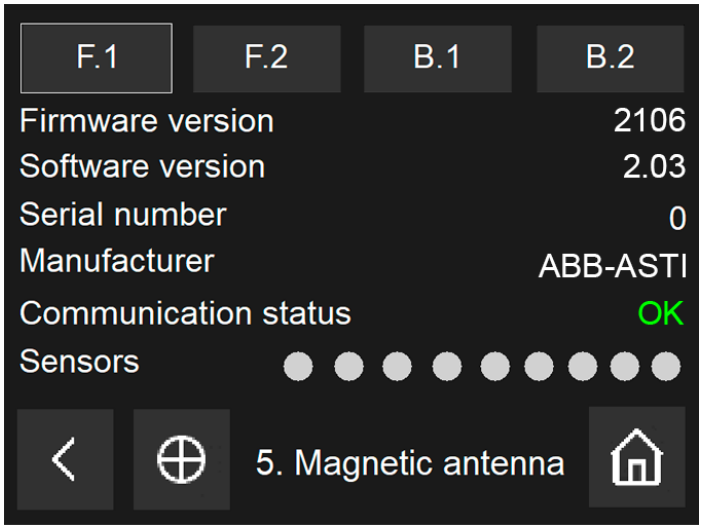


Figure 2.73: Magnetica antenna screen

Item	Description
F.1	Forward antenna 1
F.2	Forward antenna 2 **(not used in P604 V)**
B.1	Backward antenna 1
B.2	Backward antenna 2 **(not used in P604 V)**

Continues on next page

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2.6.8.2 AMR P604 V
Continued

Display screen: Screen 6 – Counter

From this screen you can check how much time the AMR has been used, in which modes, the distance traveled by it, contactors counters... etc.

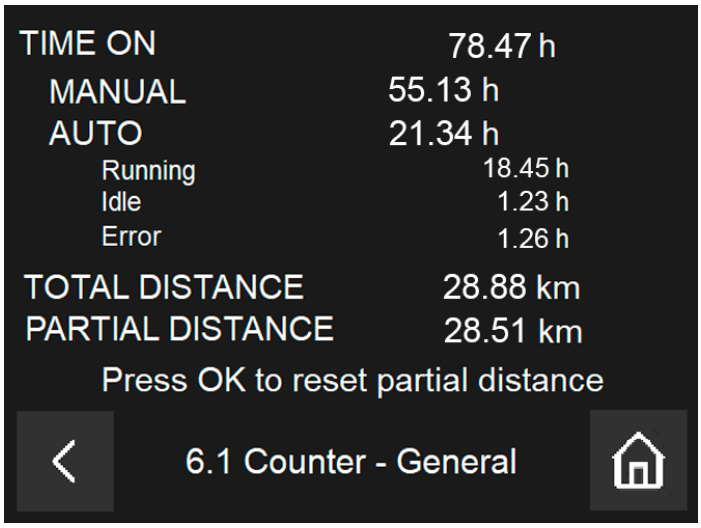


Figure 2.74: Counter screen

Item	Description
TIME ON	Time ON (General)
MANUAL	Time ON in Manual Mode
AUTO	Time ON in Auto Mode
Running	Time active (Running) in Auto Mode
Idle	Time inactive (Idle) in Auto Mode
Error	Time Error in Auto Mode
TOTAL DISTANCE	Total distance travelled
PARTIAL DISTANCE	Partial distance travelled

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Display screen: Screen 7 – Signals

This screen displays the actual status of the inputs, wired or not, coming to the AMR; and the actual status of the wired outputs coming into the PLC.

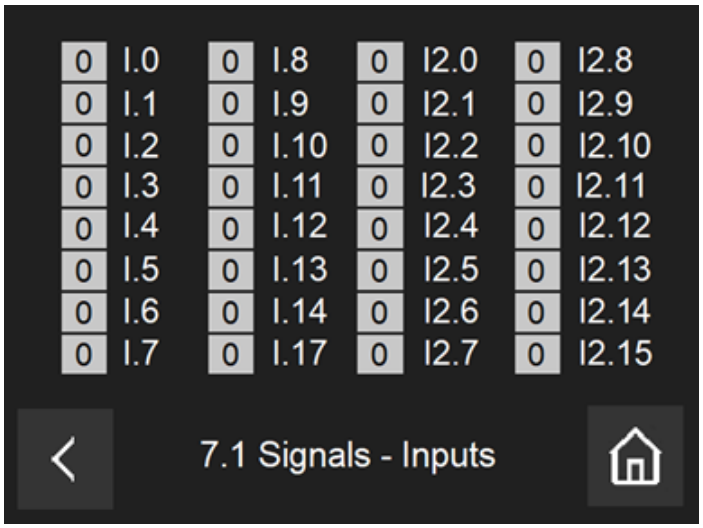


Figure 2.75: Inputs screen

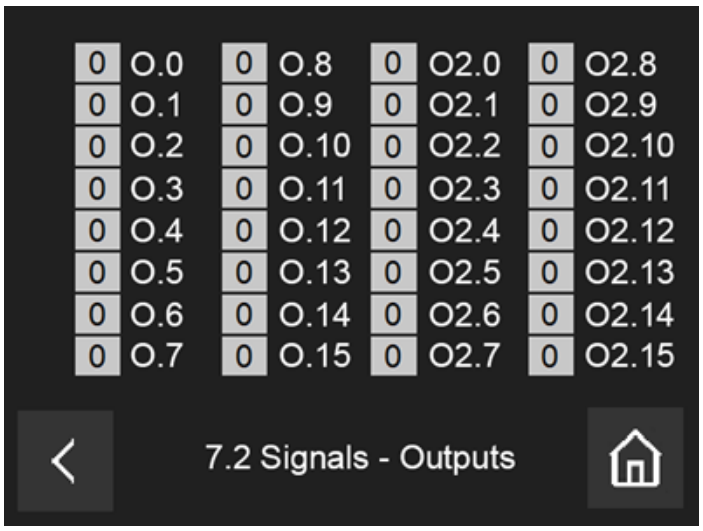


Figure 2.76: Outputs screen

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2.6.8.2 AMR P604 V
Continued

Display screen: Screen 8 – Navigation

This screen displays the direction of travel, the drive units angle, deviation, the quality of the navigation, and whether the magnetic sensor is detecting or not.

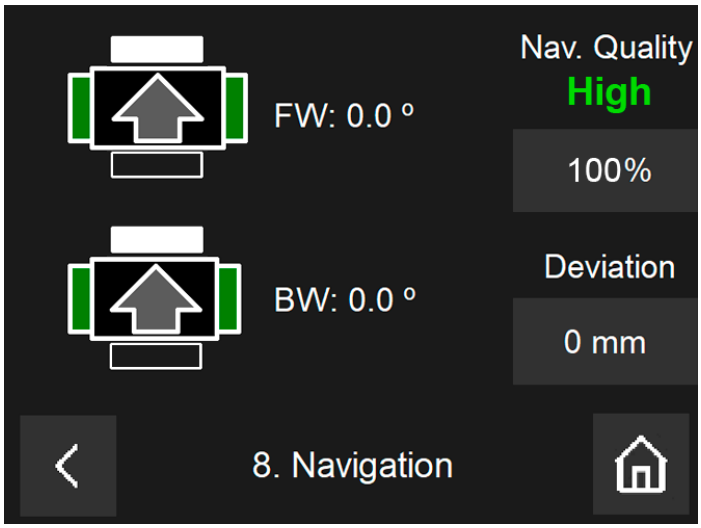


Figure 2.77: Navigation screen

Display screen: Screens 9 to 10 – Maintenance screen

On the home screen it is necessary to insert a button sequence to enable maintenance screen, while pressing the OK button, press Button 3 > Button 2 > Button 4 > Buttons 1 and 3 at the same time, the sequence has a small window of time to facilitate its insertion.

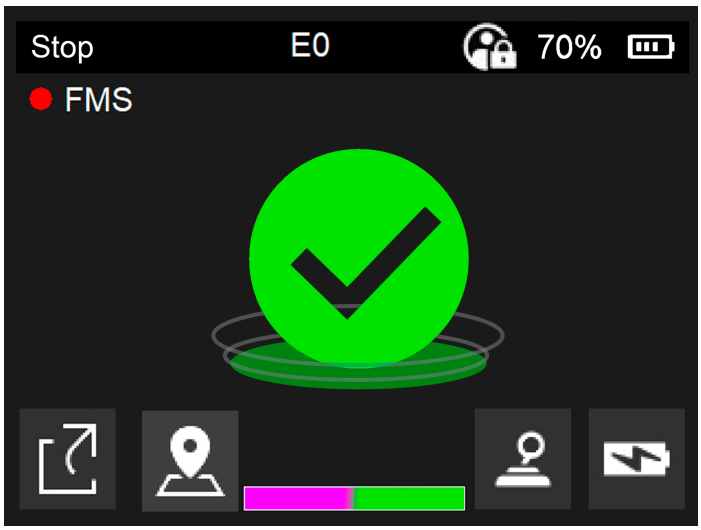


Figure 2.78: Home screen

Continues on next page

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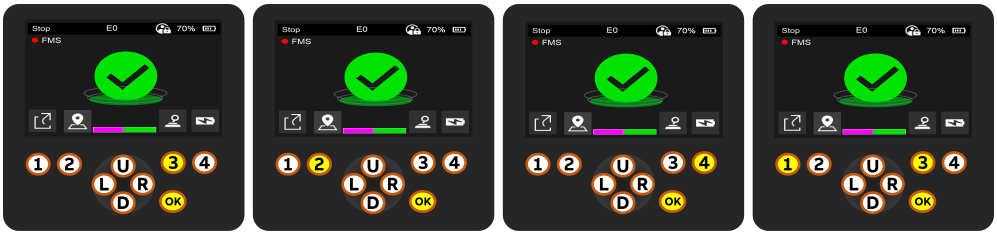


Figure 2.79: Maintenance sequence

1 To enter on maintenance screen press Button 1 in home screen and the following screen will be displayed.

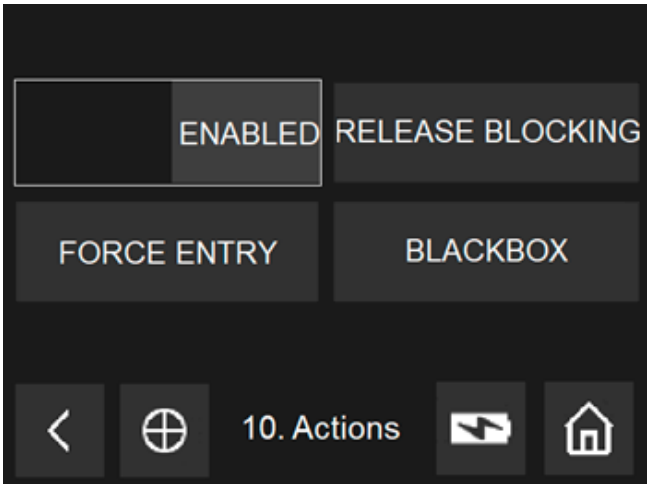


Figure 2.80: Maintenance screen

Note

If the button sequence is not used, the following message will appear when trying to access the maintenance screen:

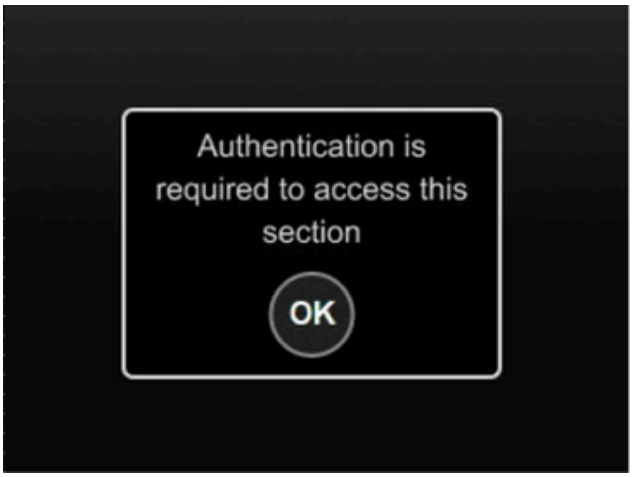


Figure 2.81: Authentication request

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2.6.8.2 AMR P604 V
Continued

2 Once on the maintenance screen it is available to fulfill an interaction with the four different blocks displayed with the help of the screen selector by pressing the **OK** button. For more information, see the Maintenance Manual.

The position screen allows the user to check in which step of the circuit the AMR is working. VSLAM steps work in a similar way to Magnetic tags for the P604 M.

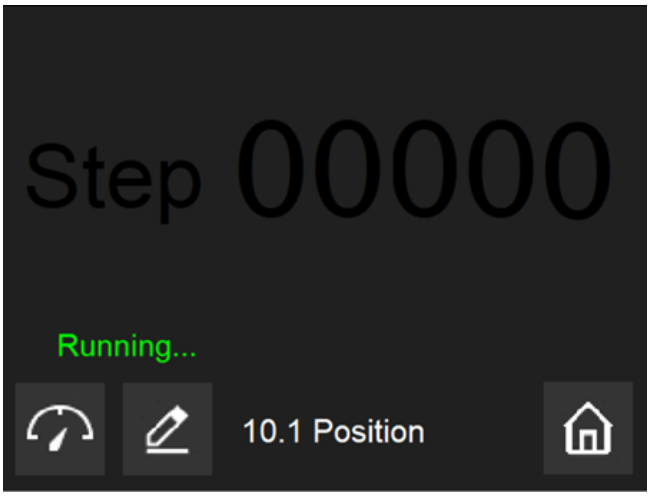


Figure 2.82: Position screen

3 To access the calibration menu in the maintenance screen, press Button 2 and the following screen will be displayed:

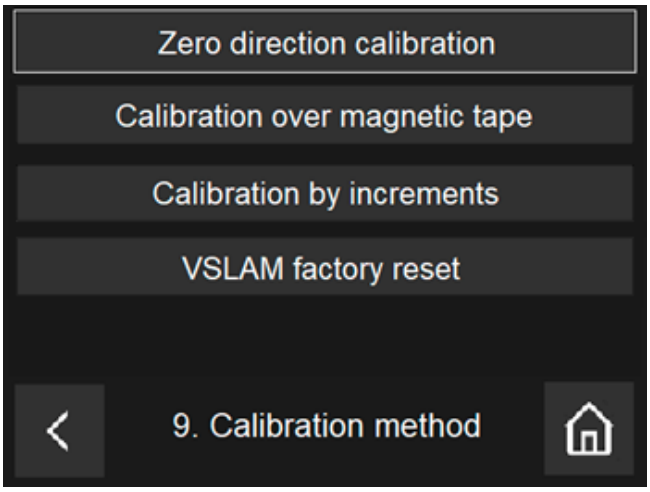


Figure 2.83: Calibration screen

Once on the calibration screen, it is possible to access the different screens with the help of the screen selector and pressing **OK** in the desired option. For more information, see the Maintenance Manual on the *References* section.

Continues on next page

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Display screen: Screen 11 – Manual

From the Home screen you can go to the Manual screen, where you can move manually (see *Manual mode*) the vehicle and the lift platform. When pressing the **OK** button, you can see all the possible movements.

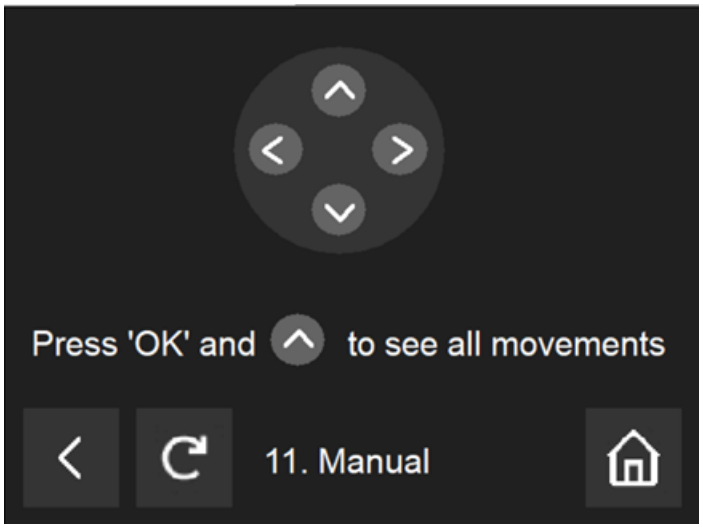


Figure 2.84: Manual movement screen (1)

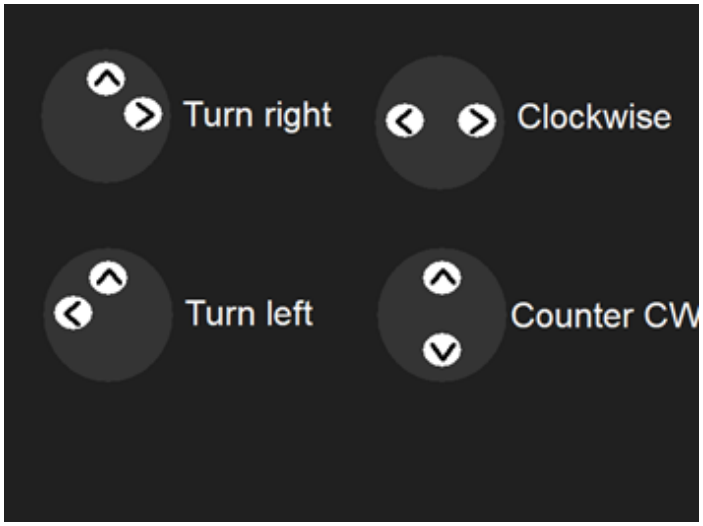


Figure 2.85: Manual movement screen (2)

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2.6.8.2 AMR P604 V
Continued

Display screen: Screen 11.2 – Manual

Allows you to elevate the lift platform

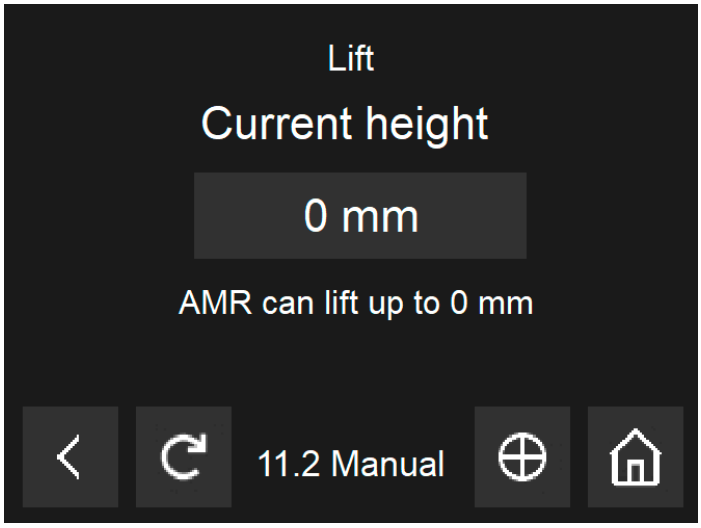


Figure 2.86: Manual lifting screen

Note

The data displayed on the screen may differ from the specifications depending on the lifting table calibration.

For further information about entering in manual mode see *Mode switching* section.

ANNEX I - List of display codes contains the list of display codes.

ANNEX IV - Display wireframe contains a wireframe indicating the available screens and how to browse them.

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2.7 Communication system

2.7.1 Wi-Fi client communications system

Overview

This device connects to the AMR via Wi-Fi or ethernet to transfer the settings.

It is used in multi-AMR environments to avoid network overload or 2.4/5 GHz network environments.

In charge of Wi-Fi communication between the AMR and the SIGAT multi-AMR/SIGAT–PLC management system or the AMR Studio.

The AMR's communication system component 1 is made up of a series of internal devices and external modules, such as:



Figure 2.87: Wi-Fi antennas

Continues on next page

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2.7.1 Wi-Fi client communications system
Continued

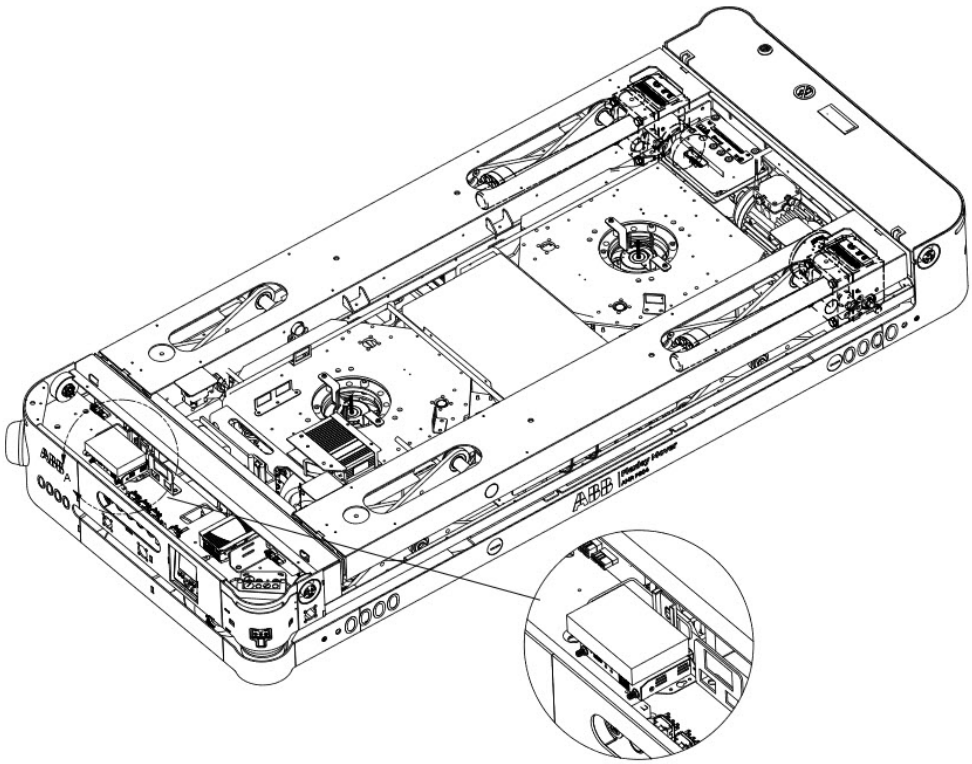


Figure 2.88: Wi-Fi system inside the AMR. For the P604 V, it is located below the Onboard PC module



Figure 2.89: Wi-Fi module and lamps

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2.7.2 A29 Communications system (optional)

Overview

The AMR's A29 communication system facilitates the vehicle to communicate with other devices in its environment.

It is made up of a series of internal devices and external modules, such as:

- User validation interfaces.
- Communication interfaces with other AMRs (e.g., traffic management functions, etc.)
- Interfaces for communicating with other machinery in the facility (robot cells, automatic door opening, etc.)

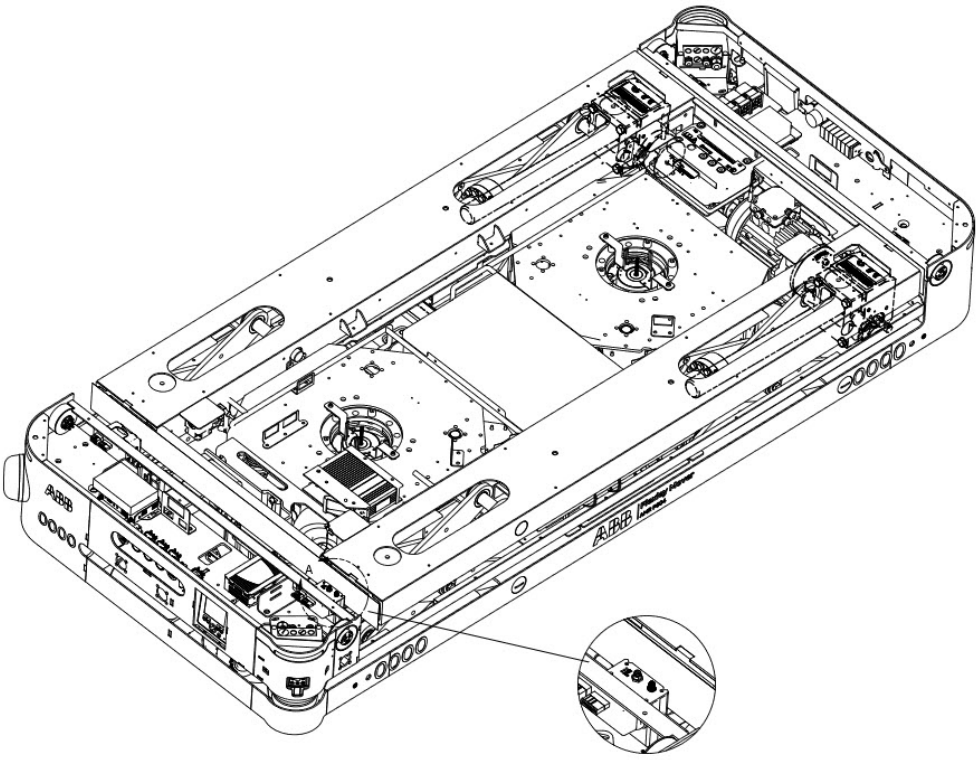


Figure 2.90: A29 location inside the AMR

Note

This optional is only valid on Europe.

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2.7.3 Secure Wi-Fi Lite (EU/US optional)

Overview

It allows the vehicle to perform an SF29 according to ISO 3691-4 without reaching the required PL. It is capable of continuously manage the communications of a robotic cell and if a safety pushbutton button is activated or there is a failure in communications, it allows the AMR group to be stopped within a safety zone.

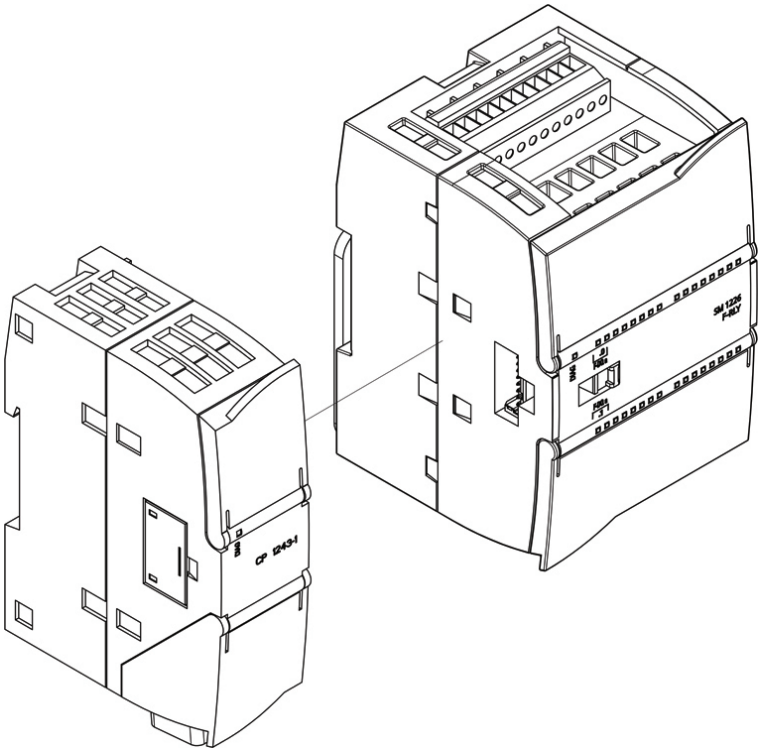


Figure 2.91: Secure Wi-Fi Lite

Components

- PLC
- Secure Radio Wi-fi (different for EU and US): for Wi-Fi connection
- I/O device: additional module for inputs and outputs

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2.8 Power supply system

2.8.1 2 Batteries (Optional)

2 Batteries

The power supply system of the AMR comprises two lithium battery (48 V, 20 Ah) that powers the vehicle, and the fuses located in the electrical control panel.

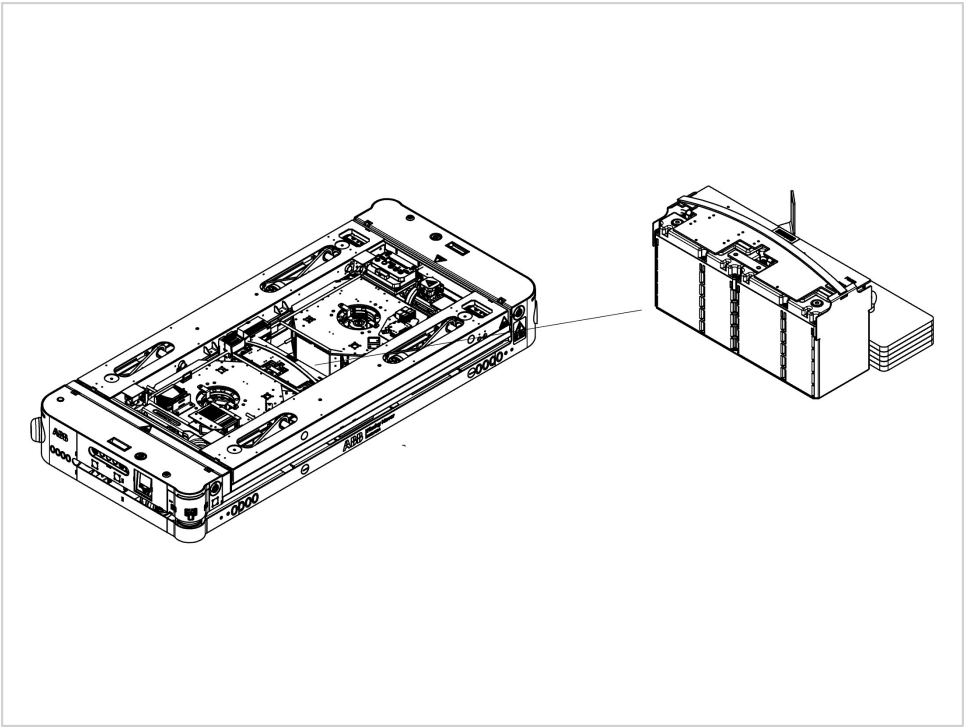


Figure 2.92: AMR batteries

The power supply system also includes a converter used to power the AMR.

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2.8.1 2 Batteries (Optional)
Continued



Figure 2.93: AMR converter

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2.8.2 4 Batteries (Optional)

4 Batteries

The power supply system of the AMR comprises four lithium battery (48 V, 40 Ah) that powers the vehicle, and the fuses located in the electrical control panel.

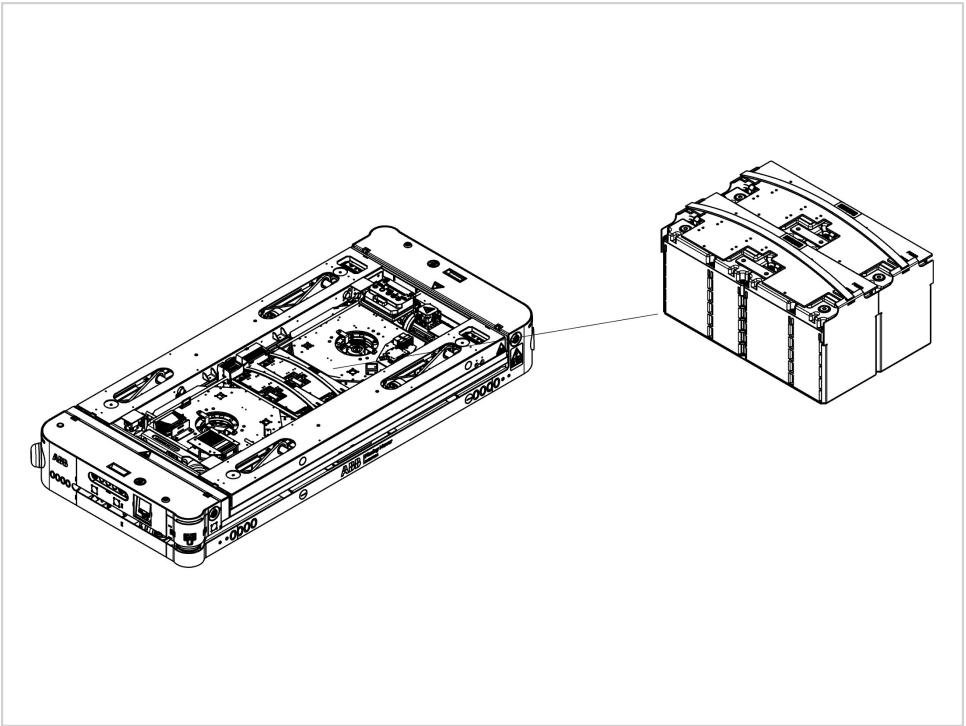


Figure 2.94: AMR batteries

The power supply system also includes a converter used to power the AMR.

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2.8.2 4 Batteries (Optional)
Continued



Figure 2.95: AMR converter

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2.9 Battery charging system

Overview

The AMR lithium battery has been parameterized at different levels according to its state of charge. These levels and the actions taken by the AMR in each case are shown below.

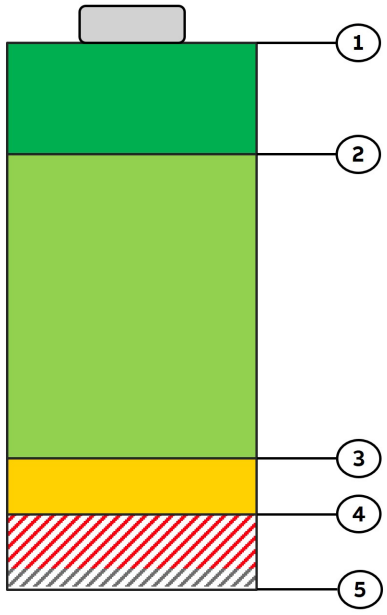


Figure 2.96: Battery levels

S. No	Description	Percentages	Actions
1	Full charge	100%	-
2	Optimum charging voltage	80%	-
3	Pre-minimum battery cell voltage	15%	Warning code
4	Minimum battery cell voltage	10%	Error code: • Error 06 for Magnetic version • BT-1 for VSLAM version.
5	Deep empty	0%	Automatic charge no available

Additionally, below there are some considerations that must be considered when charging the battery:

- The optimum charging efficiency is realized before 80% battery cell voltage.
- As in most lithium batteries, ABB recommends charging the battery of every AMR at 100% at least once a week to help extend the battery life.

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- A full charge of the AMR will need 2 h to be performed with a correct balance of the battery.

> **Note**
>
> It is necessary to let the battery charge at least this time even if the level of the battery displayed is 100%, to avoid a voltage cell unbalance.

- After a battery replacement, or charging the battery out from the AMR, it is needed to execute an automatic battery charging mission to update correctly the AMR battery level information.
- Never discharge the battery lower than the minimum battery cell voltage.
- The charge/discharge cycles and ambient temperature have an influence on cell temperature and cell voltage. When temperatures limits are reached, a charger current reduction is applied.

> **Note**
>
> For further information, refer to the manufacturer user manual of the battery.

- If the battery fully discharge reaching 0% a manual charging operation of the battery via the charger will be needed.
- The cable length between the battery and the charger shall be according ABB standard measure, which are specified in the Manual charging station (*References*).

> **WARNING**
>
> The AMR must not be moved during the charging process. Moving the AMR may create an electrical hazard.
>
> It is forbidden to insert any element between the brushes and the charging station when the AMR is charging.
>
> It is forbidden to introduce hands or limbs when the AMR is approaching the charging station.

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2.9.1 Online charging system

Overview

The basic principle when working with an online or automatic battery-charging system is to create a configuration that enables as much battery charge to be replaced in each cycle as was consumed.

Thus, it is necessary to ensure sufficient charging time on each trip, which depends on the power consumption of the AMR in the application.

- The power consumption depends on the travel speed and the load being transported.
- To optimize the ratio between charging the battery and the charging time, the charger at the station (outside the AMR) has the capacity to deliver up to 60 A. Disconnection must take place at a charge of less than 1 Ah.

Note

For proper use of the automatic battery-charging system, it is recommended that when an AMR is inserted into the circuit its batteries are fully charged. Thus, it is recommended that AMRs be fully charged before they are inserted into a circuit.

WARNING

The AMR must not be moved during the charging process. Moving the AMR may create an electrical hazard.

It is forbidden to introduce any element between the charging plates and the charging station when the AMR is charging.

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2.9.1 Online charging system
Continued

Components

The online charging system is made up of the following devices:

Internal system - M

The online charging system is located internally at the front of the AMR to enable connection of the female brush module.

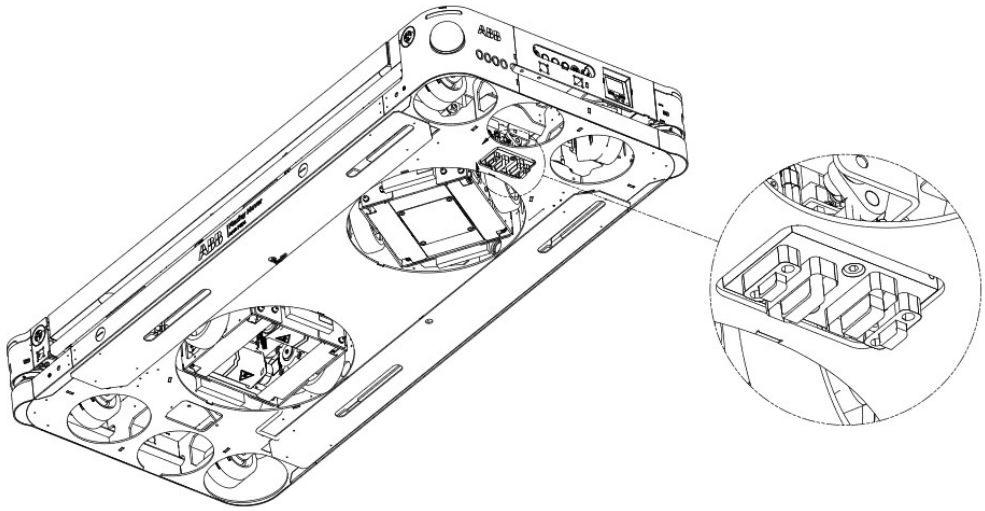


Figure 2.97: Location of internal online charging system (male brush model)

The internal system is made up of the following:

- **Male brush-holding module:** Consists of four brushes, two of which are directly connected to the battery's external charger, while the other two are connected via CAN to the PLC to vary the charging intensity based on the AMR batteries charge percentage.
- **Male brush-holding module support:** Support that keeps the brush-holding module in place to connect it to the guides.
- **Linear actuator:** Responsible for raising or lowering the brush-holding module.
- **Guides:** Mechanism that raises and lowers the brush-holding module via two linear ball bearings, each positioned on a guide.
- **Inductive sensor:** To detect the brush-holding module support's position.

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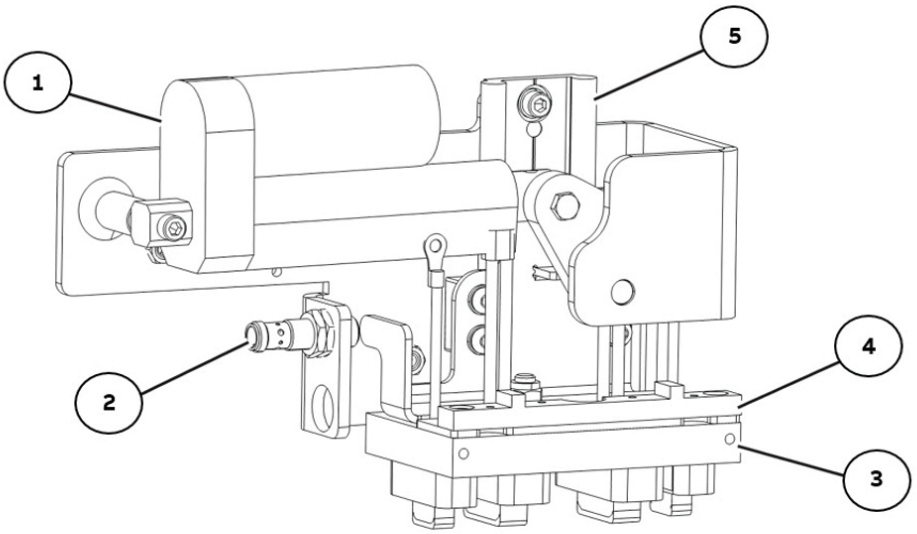


Figure 2.98: Internal brush module

Item	Description
1	Linear actuator
2	Inductive sensor
3	Male brush-holding module (internal system)
4	Brush-holding module support
5	Guides

Continues on next page

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2.9.1 Online charging system
Continued

Internal system - V

The online charging system is located internally at the front of the AMR to enable connection of the female brush module.

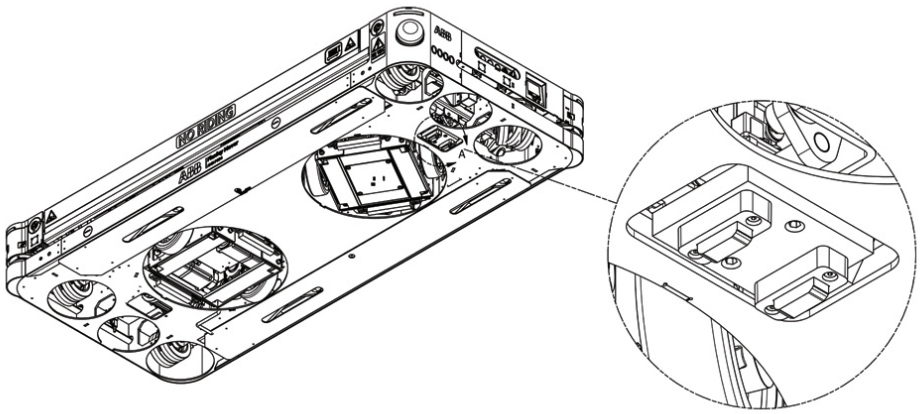


Figure 2.99: Location of internal online charging system (male brush model)

The internal system is made up of the following:

- **Male brush-holding module:** Consists of two brushes, which are directly connected to the battery's external charger.
- **Male brush-holding module support:** Support that keeps the brush-holding module in place to connect it to the guides.
- **Linear actuator:** Responsible for raising or lowering the brush-holding module.
- **Guides:** Mechanism that raises and lowers the brush-holding module via two linear ball bearings, each positioned on a guide.
- **Inductive sensor:** To detect the brush-holding module support's position.

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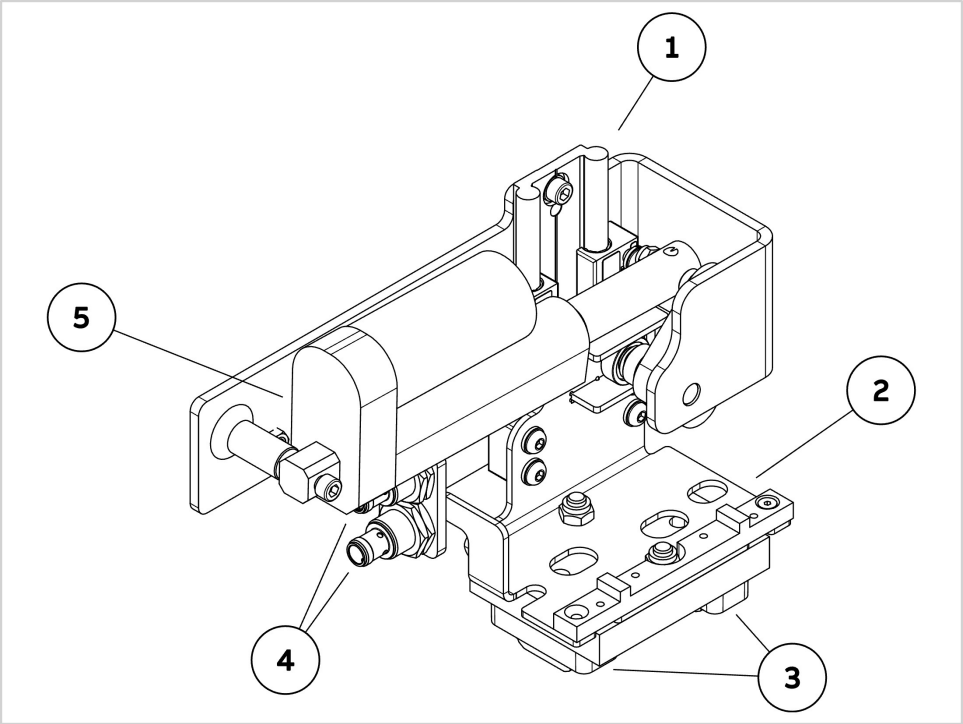


Figure 2.100: Internal brush module

Item	Description
1	Guides
2	Brush-holding module support
3	Male brush-holding module (internal system)
4	Inductive sensor
5	Linear actuator

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2.9.1 Online charging system
Continued

External system

This system is equipped with a set of female brushes used for charging.

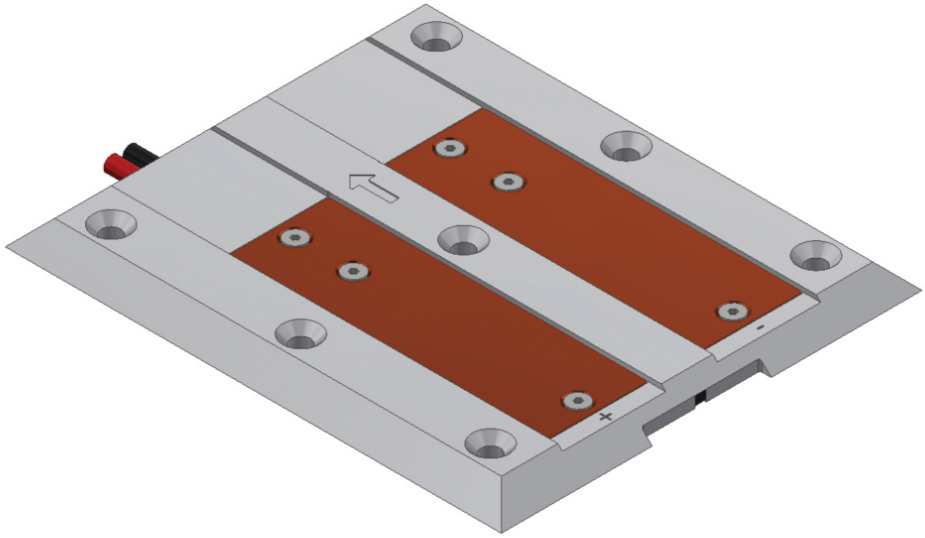


Figure 2.101: Female brush assembly

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Procedure - AMR P604 M

S.No.	Description	Note
1	The AMR battery needs recharging.	
2	The AMR approaches the charging station.	
3	The AMR detects a tag ordering it to reduce speed as it approaches the mat.	
4	The AMR detects a tag that identify the charging station and order reducing speed.	
5	The AMR detects the crosswise strip and makes the precise stop.	
6	The AMR then lowers the brushes.	
7	When the brushes contact with the mat, the AMR charge the battery.	
8	The process stops automatically after a configurable software trigger.	
9	The AMR continues its route.	

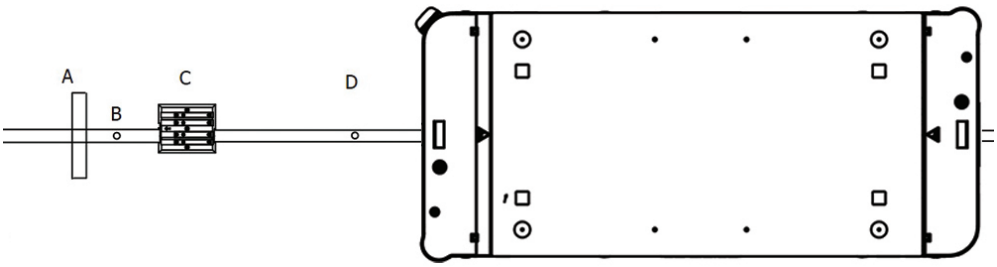


Figure 2.102: Automatic charge

Item	Description
A	Crosswise strip
B	Tag before station (speed 100 mm/s)
C	Charging mat
D	Tag after station

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2.9.1 Online charging system
Continued

For more information, check the *Manual charging station AMR T701/T702/P604* (*References*).

WARNING

Do not move the AMR during battery charging to prevent charging failures or voltage arcs between the online charging modules.

Procedure - AMR P604 V

S.No	Description	Note
1	The AMR battery needs recharging.	
2	The AMR approaches the charging station.	
3	The AMR reduce speed as it approaches the mat.	
4	The AMR detects the crosswise strip and makes the precise stop.	
5	The AMR lowers the brushes.	
6	The brushes contact with the mat.	
7	The PLC initiates CAN communication with the charger at the charging station via Wi-Fi.	
8	The AMR activates the contactor that delivers power to the brushes.	
9	The external charger detects the voltage difference. At this point, current transfer begins.	
10	The process stops automatically after a configurable software trigger.	
11	The AMR continues its route.	

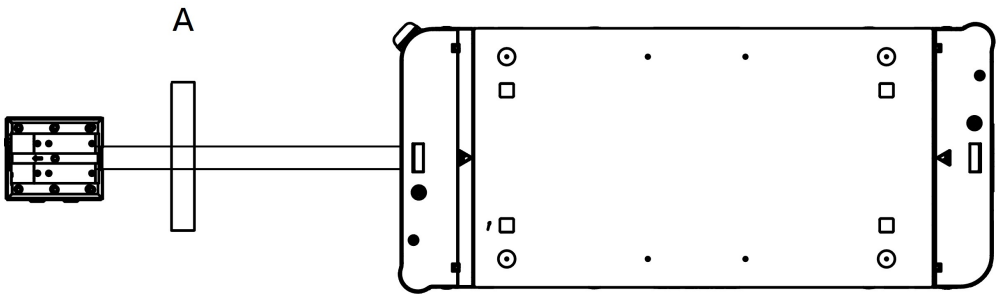


Figure 2.103: Automatic charge

Item	Description
A	Crosswise strip

For more information, check the *Manual Smart charging station AMR T701/T702/P604* (*References*).

Continues on next page

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WARNING

Do not move the AMR during battery charging to prevent charging failures or voltage arcs between the online charging modules.

Charging zone

The charging zone should be clearly marked to prevent unauthorized access during charging to prevent possible tripping or cable disconnection.

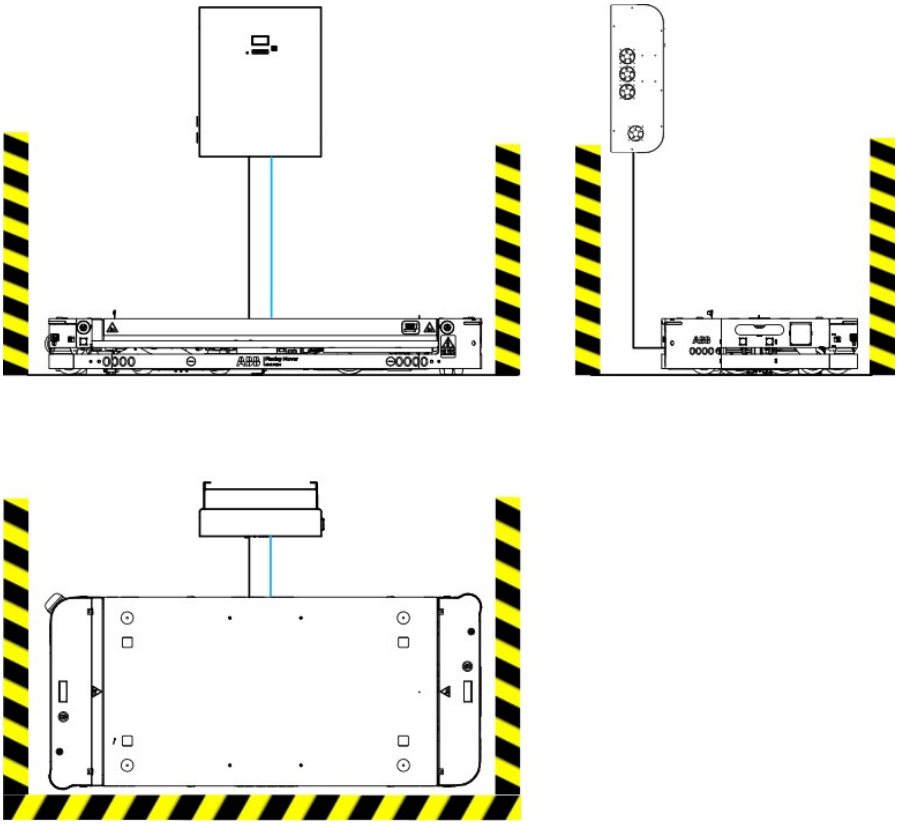


Figure 2.104: Charging zone

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2.9.2 Manual charging system

Overview

The AMR also has the possibility of charging the battery manually, to do so, a specific charger or a charging station will be needed.

Both the charger and the charging stations are equipped with extension cables that allow manual battery charging.

Continues on next page

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Components

The manual charging system is made up of the following devices:

Internal system

Internally, the manual charging system is located on the contactor panel and consists of a REMA type connector.

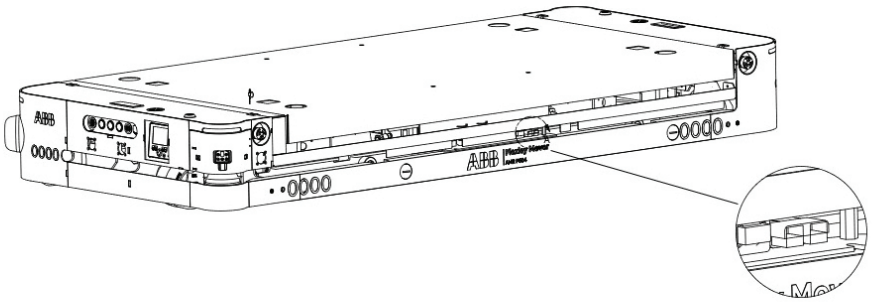


Figure 2.105: Manual charging connector

External system

The charger assembly consists of a charger and a set of extension cables that allow it to be used both in the charging station and as a manual charger.

This device charges the batteries by transferring current to the AMR via the CAN communications protocol.

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2.9.2 Manual charging system
Continued

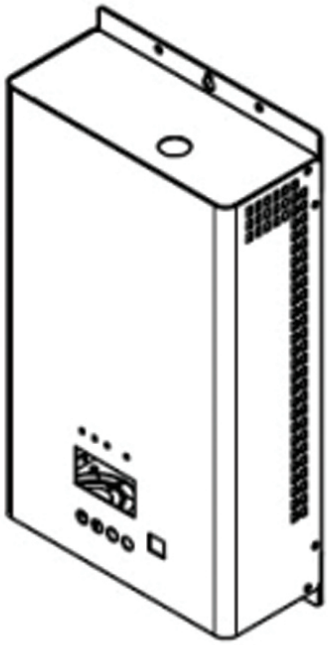


Figure 2.106: Battery charger

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Operation for manual charging from an external connector

1. Bring the AMR closer to the charger. To do so, follow the instructions for manually moving the AMR detailed in the *Manual mode* section.
2. Once at the charging station, you'll need a cable with a REMA type connection for power supply and a cable with a female SMS2 and a male SMS4 for CAN communication between the charger and the battery charger.

   The SMS connector is close to the REMA type connector.
3. Connect the female SMS2 to the battery charger and the male SMS4 to the female SMS4 CAN 2 connections located on the PLC's electrical control panel of the vehicle.
4. Once communication has been established, connect the charger's REMA connector to the AMR's REMA type connector located on the power panel.
5. After that, go to the HMI display, see *HMI display charging steps — P604 V* and *HMI display charging steps — P604 M*.

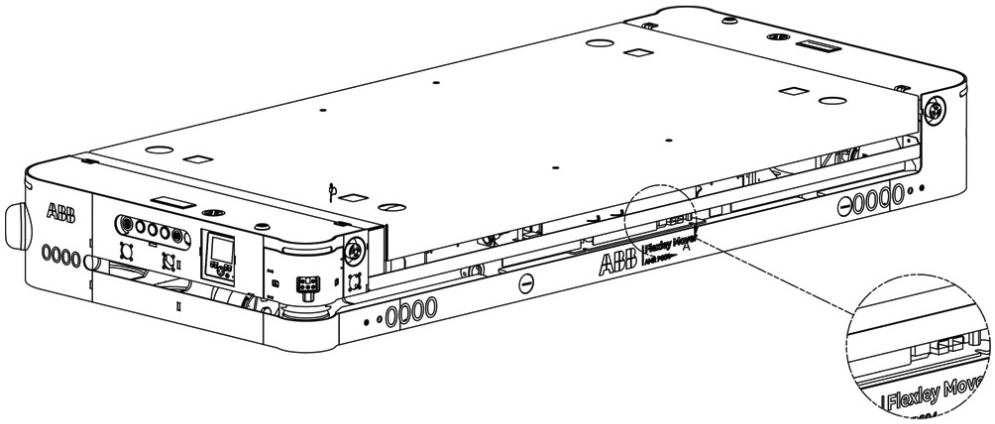


Figure 2.107: SMS and REMA connectors

For more information, check the *Manual Charging station AMR T701/T702/P604* (*References*).

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Operation for manual charging from the online charging station

1 Move the AMR closer to the online charging station. To do this, follow the instructions for manually moving the AMR detailed in the *Manual mode* section.

> **WARNING**
>
> ABB does not recommend moving the AMR manually for this charging method. Ensure the AMR is correctly positioned for this procedure.
>
> Otherwise, there is the risk of a short-circuit.

2 Position the AMR by centering the male to female brushes.

3 **If using a P604 M**, scroll to screen seven of the display (See *HMI display charging steps — P604 M* section). Press Manual charging, **Button 2**.

4 **If using a P604 V**, scroll to screen 2.1, Charging method, of the display (See *HMI display charging steps — P604 V* section). Press **BRUSH** charging button.

5 The male brushes will start to lower and, when in contact with the female brushes, the AMR charging will begin.

For more information, check the *Manual Charging station AMR T701/T702/P604* (*References*).

HMI display charging steps — P604 M

1 Once the connections from the manual charging wiring harness have been made, access the battery status and charge screen on the AMR's display and press **Button 2** for charging it using the brushes, or **Button 3** for charging it from an external connector (after resetting the AMR).

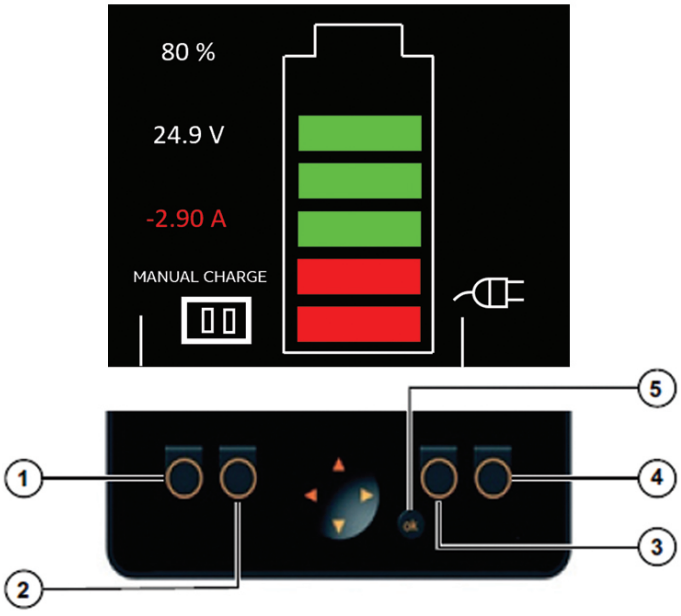


Figure 2.108: Manual charging screen

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Item	Description
1	Button 1
2	Button 2
3	Button 3
4	Button 4
5	Button OK

2 On the display's battery status and charge screen, press button 3 again to start manual charging without brush contact.

3 After charging, press button 4 (deactivate) to finish the battery charging process.

HMI display charging steps — P604 V

1 Once the connections from the manual charging wiring harness have been made, access the battery status (screen 2).

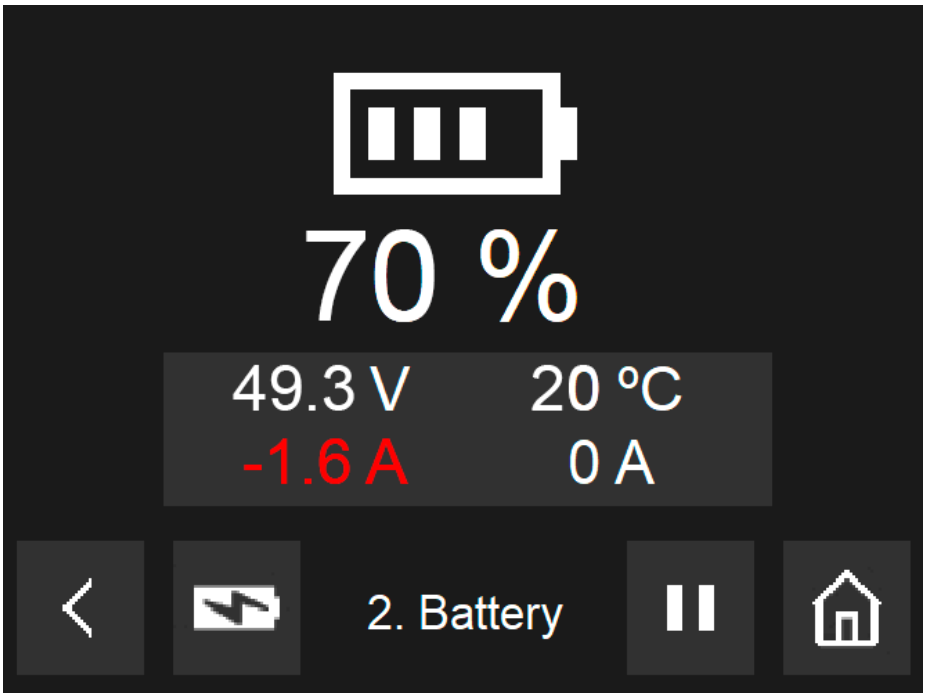


Figure 2.109: Battery screen

2 Press Button 3 and go to screen 2.1, now select **WIRE** or **BRUSH** as charging method.

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2.9.2 Manual charging system
Continued

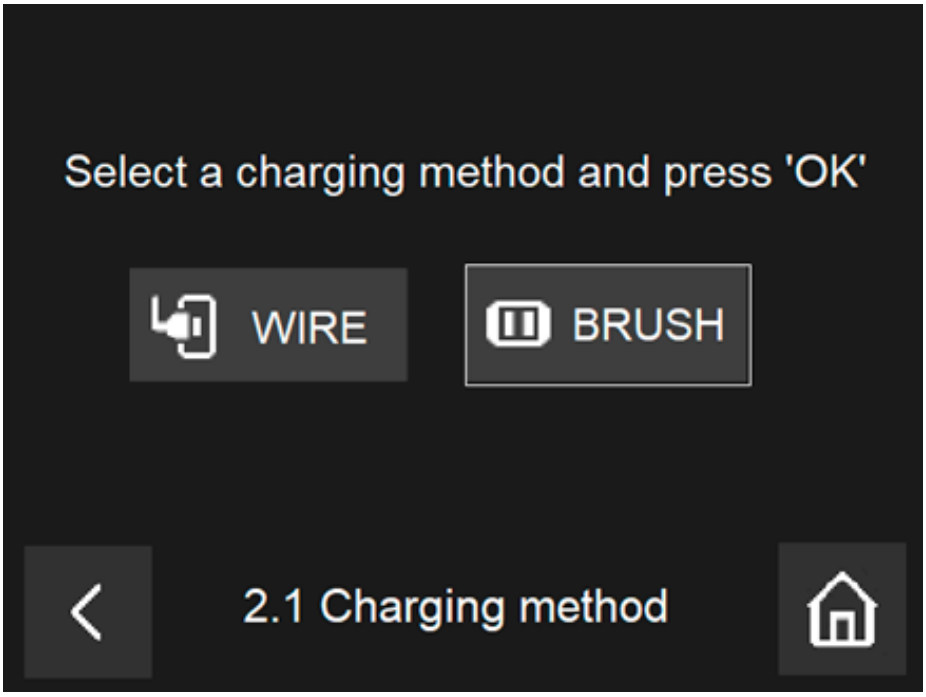


Figure 2.110: Charging method screen

3 After charging, press button 3 to finish the battery charging process.

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3 AMR Operation

WARNING

Before performing any operation, read and understand the safety instructions in the *Safety* section.

The operator must understand the functioning and operation of the devices that make up the AMR. See the *Components of the AMR* chapter. The operator must also be familiar with the operations that must be performed before using the AMR.

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3.1 AMR start-up and shutdown

If the AMR is turned off, the process to start it up is as follows:

1. Turn on the AMR using the "ON/OFF" switch.
2. Push the Reset button to reset all faults and alarms.
3. For operating the vehicle after the start-up, (see *Operating modes* section).

For AMR P604 M

To shut down the system:

1. Turn off the AMR using the "ON/OFF" switch.
2. The AMR will shut down.

For AMR P604 V

> **WARNING**
>
> When the AMR is shut down, it is recommended to place it in an area designated by the end user to avoid interference with other vehicles and/or operators.

There are three ways to shut down the system:

Mode A

1. Turn off the AMR using the ON/OFF switch.
2. The AMR will start updating the map. It may take several minutes.
3. The AMR will shut down.

Mode B

1. Turn off the AMR using the ON/OFF switch and push the Operational stop button once.
2. The AMR will not update the map, but it will close the Onboard PC software.
3. After around 25 seconds, the AMR will shut down.

Mode C

1. Turn off the AMR using the ON/OFF switch while pushing the Operational stop button.
2. The AMR will not update the map, neither will update the Onboard PC software.
3. The AMR will shut down.

> **WARNING**
>
> This mode should be used in special cases only.

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3.2 Operating modes

Overview

The AMR can function in the next operating modes or functionalities:

- **Automatic mode:** The AMR autonomously follows the route created for it.
- **Manual mode from controller:** The operator can control the movement of the AMR manually from a controller.
- **Manual mode from control panel:** The operator can control the movement of the AMR manually from control panel located at the front part of the AMR



WARNING

No person may be near the AMR while moving in automatic mode, during turns or lifting operations because of possible blind spots or spaces not covered by the safety laser or load fall.



Note

Emergency stop button is operational in all operating modes.

The AMR can only be moved in manual mode by an authorized operator, who is aware of the risks and restrictions related.

The vehicle’s mode is identifiable via a color band incorporated to the HMI display. A green display for the automatic mode and a purple one for the manual mode.

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3.2.1 Automatic mode

3.2.1.1 Automatic mode using the magnetic guidance system - AMR P604M

Overview

Automatic mode allows the AMR to carry out automatic transport orders anywhere on the working table at speed and with the perimeter protection parameters configured via the SIGAT console.

When the RFID antenna reads a tag, it evaluates its ID and, based on the actions configured by the user, it performs the programmed actions.

Note

In this operating mode, the safety systems are enabled. The safety laser will apply the corresponding fields depending on the speed, trajectory and loading status of the AMR.

Programmed actions

Common programmed actions include:

- Increase or decrease speed.
- Change the geometry of the laser safety fields.
- Operational stop of the AMR to await validation by the operator, traffic management, request of permissions, etc.
- Load transfer operations.

The speed is limited to a safely monitored maximum allowable value, depending on the movement direction and load.

For more information, see *Coordinates system*.

If any of these thresholds are exceeded, the AMR will try to stablish a restrictive laser field for this movement configuration. This restrictive laser field must be created by the user.

For more information related to laser fields and its configuration refer to Laser configuration Master (see *References*).

If a higher speed than the allowed for that enforced field is applied, the control will decrease the speed automatically. Likewise, if the value is lower, it will apply that value because it is even more restrictive than the allowed one.

For example, if the Large Laser field is configured up to 1.7 m/s and maximum speed is 1.2 m/s, the AMR will move at 1.2 m/s. If the large Laser field is configured up to 1 m/s and maximum speed is 1.2 m/s, the AMR will move at 1 m/s.

Note

Both longitudinal and lateral speed components are being supervised, taking the fastest point of the vehicle as a reference.

For more information related to speed limits, see *Technical Data*.

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3.2.1.2 Automatic mode using the Visual SLAM guidance system - AMR P604V

Overview

Automatic mode allows the AMR to carry out automatic transport orders anywhere on the layout at speed and with the perimeter protection parameters configured via the AMR Studio.

> **Note**
>
> In this operating mode, the safety systems are enabled. The safety laser will apply the corresponding fields depending on the speed, trajectory and loading status of the AMR.

Programmed actions

Common programmed actions include:

- Increase or decrease speed.
- Change the geometry of the laser safety fields.
- Operational stop of the AMR to await validation by the operator, traffic management, request of permissions, etc.
- Load transfer operations.

The speed is limited to a safely monitored maximum allowable value, depending on the movement direction and load.

For more information, see *Coordinates system*.

If any of these thresholds are exceeded, the AMR will try to stablish a restrictive laser field for this movement configuration. This restrictive laser field must be created by the user.

For more information related to laser fields and its configuration refer to Laser configuration Master (see *References*).

If a higher speed than the allowed for that enforced field is applied, the control will decrease the speed automatically. Likewise, if the value is lower, it will apply that value because it is even more restrictive than the allowed one.

For example, if the Large Laser field is configured up to 1.7 m/s and maximum speed is 1.2 m/s, the AMR will move at 1.2 m/s. If the large Laser field is configured up to 1 m/s and maximum speed is 1.2 m/s, the AMR will move at 1 m/s.

> **Note**
>
> Both longitudinal and lateral speed components are being supervised, taking the fastest point of the vehicle as a reference.
>
> For more information related to speed limits, see *Technical Data*.

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3.2.1.3 Muting/Reduced safety laser fields

If in any section of the circuit it is required to use reduced safety laser fields (not covering the area swept by the AMR and the load) or to disable the safety laser, the muting/reduced safety laser fields functionality can be activated.

The conditions for applying this function are as follows:

- The vehicle speed while maintaining reduced safety laser fields may not exceed 0.3 m/s. This speed is monitored with SF4 (PLc).
- The vehicle speed while muting is monitored SF19 (PLd).
- The vehicle emits an acoustic/visual signal to indicate or warn of danger.

For more information about SF4 and SF19 see the *Safety functions* section.

WARNING

There is a risk of being run over. Muting/reduced safety laser fields should be activated as late as possible to ensure that the area is clear of people.

The activation of muting/reduced safety laser fields is performed by manual configuration in the layout software by the integrator, who is therefore responsible for supervising the conditions under which it is executed as well as for indicating these conditions to the end user. For more information about the specific layout software see Laser Configuration Master manual - Flexley Platform AMR P604 (*References*).

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3.2.2 Manual mode

3.2.2.1 Manual mode from controller

Overview

Manual mode operation from a controller involves moving the AMR using a controller that is connected to the AMR via USB.

To access manual mode, follow the steps detailed in the *Mode switching* section.

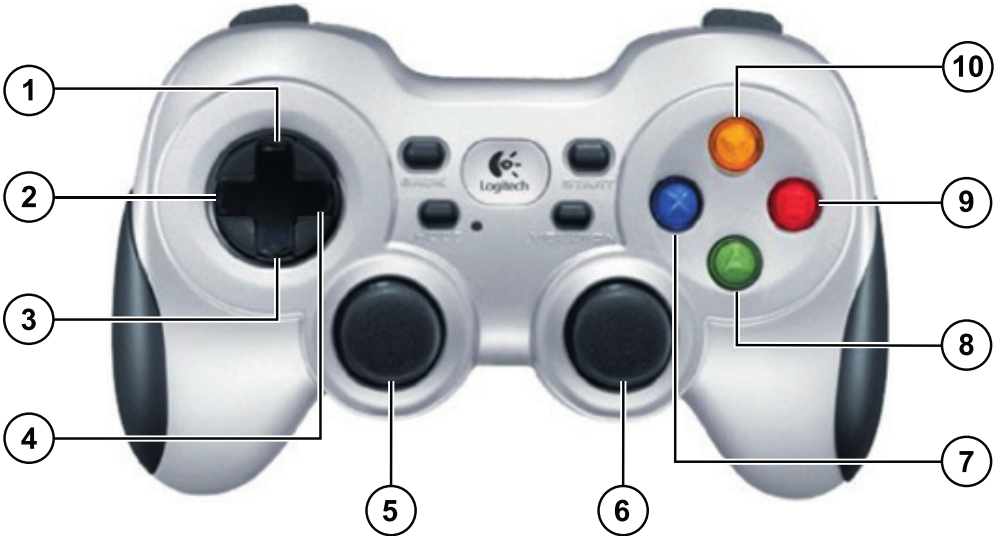


Figure 3.1: AMR controller

Item	Description/Function
1	Up button
2	Left button
3	Down button
4	Right button
5	Joystick 1
6	Joystick 2
7	X button
8	A button
9	B button
10	Y button

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3.2.2.1 Manual mode from controller

Continued



Figure 3.2: Top view of the controller

AMR P604 M 1 to 5 marking buttons

Item	Description/Function
1	Left fast speed enabling pushbutton button (LT)
2	Left slow speed enabling pushbutton button (LB)
3	Right slow speed enabling pushbutton button (RB)
4	Right fast speed enabling pushbutton button (RT)
5	DirectInput “D” – Xinput “X”

AMR P604 V 1 to 5 marking buttons

Item	Description/Function
1	Fast speed enabling pushbutton button (LT)
2	Auxiliary movements)
3	Auxiliary movements
4	Slow speed enabling pushbutton button

Operation

1 With the AMR turned on, connect the USB of the controller to the USB input.

2 Activate the communication by moving the button (DirectInput “D” – XInput “X”) left and right again. Leave it in position XInput “X”.

Note

Controller vibration can be disabled by pushing the “Vibration” button .

3 Push the Reset button during 5s.

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Note

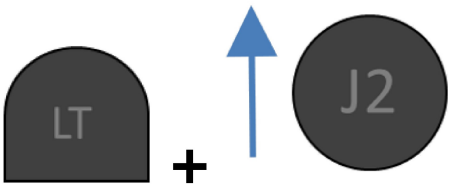
To start any movement with the AMR, the enabling pushbutton button must be held down. There are two options, left enabling pushbutton (LT) 

and right enabling pushbutton (RT) 

. They cannot be used simultaneously, and their function is to reverse the action of the joysticks depending on whether you press one or the other. They cannot be used simultaneously, and their function is to reverse the action of the joysticks depending on whether you press one or the other.

4 A mode of operation must be chosen between left or right enabling pushbutton.

Controls for manual movement using the controller - Magnetic

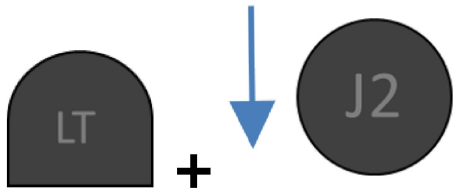
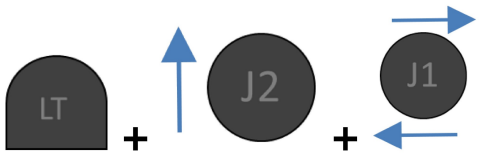
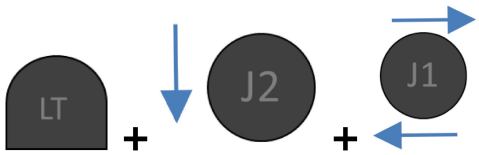
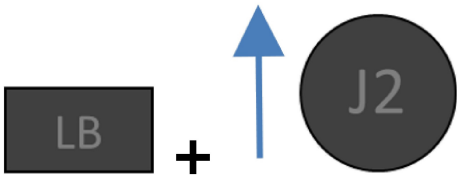
Combination	Function
	Raise platform (controlled movement)
	Lower platform (controlled movement)
	Forward (Fast movement)

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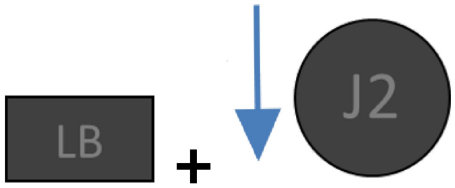
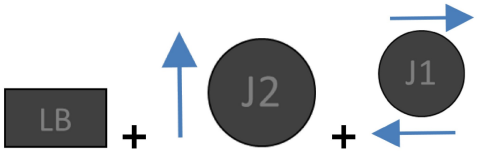
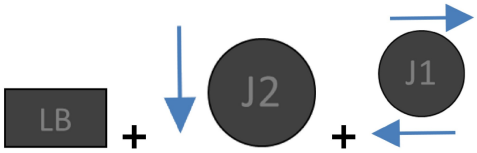
3.2.2.1 Manual mode from controller

Continued

Combination	Function
	Backward (Fast movement)
	Forward and turn right/left (Fast movement)
	Backward and turn right/left (Fast movement)
	Forward (Controlled movement)

Continues on next page

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Combination	Function
	Backward (Controlled movement)
	Forward and turn right/left (Controlled movement)
	Backward and turn right/left (Controlled movement)

Note

When accessing the manual controller movement mode, the laser remains activated and the maximum speed is 0.7 m/s.

Operation - VSLAM

When using the VSLAM version of the vehicle, there are fewer steps.

1. With the AMR turned on, connect the USB of the controller to the USB input.
2. A mode of operation must be chosen between left or right enabling pushbutton.

In summary, after connecting the controller using the USB input located at the front of the AMR, the buttons should be left at rest.

Controls for manual movement using the controller - VSLAM

Also, when using the VSLAM version of the vehicle, some auxiliary buttons are possible. In this case, RB and the LB buttons are left for auxiliary movements only.

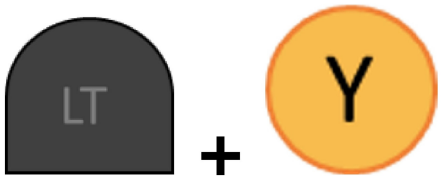
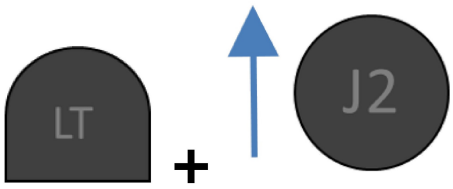
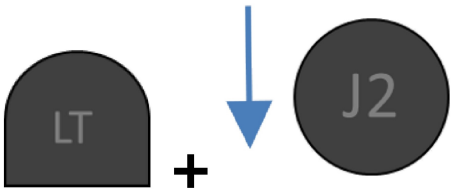
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3.2.2.1 Manual mode from controller

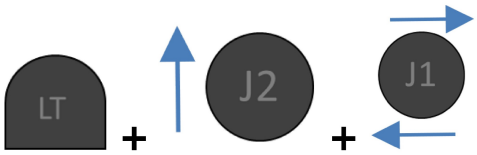
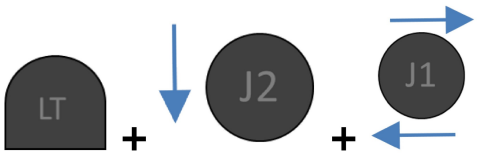
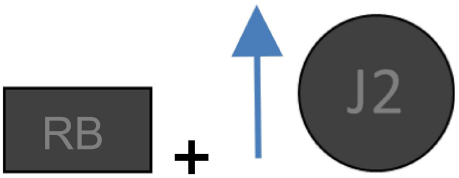
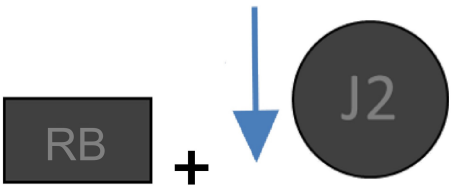
Continued

Common movements

Combination	Function
	Raise platform (controlled movement)
	Lower platform (controlled movement)
	Forward (Fast movement)
	Backward (Fast movement)

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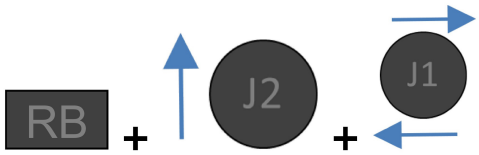
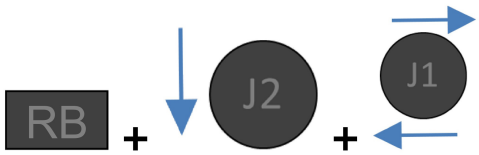
Combination	Function
	Forward and turn right/left (Fast movement)
	Backward and turn right/left (Fast movement)
	Forward (Controlled movement)
	Backward (Controlled movement)

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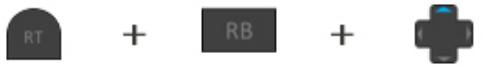
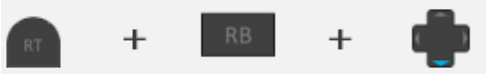
3.2.2.1 Manual mode from controller

Continued

Combination	Function
	Forward and turn right/left (Controlled movement)
	Backward and turn right/left (Controlled movement)

Auxiliary movements

RB and the LB buttons are left for auxiliary movements. The following table summarizes the auxiliary combinations.

Combination	Function
	Magnetic stripe search
	Forward / backward. Speed
	Choice of magnetic strip at a fork
	Positioning of the front drive unit
	Positioning of the rear drive unit
	Pure linear movement forward (press the button "B" repeatedly to go faster)
	Pure linear movement backward

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Note

When accessing the manual controller movement mode, the laser remains activated and the maximum speed is 0.7 m/s.

How to stop the vehicle using the controller

To stop the vehicle using the controller, it is necessary to release **ALL** buttons.

WARNING

If the vehicle doesn’t stop, and it is possible to be near the vehicle without risk, push the emergency stop button. If it’s not possible, in any case the vehicle will stop after moving 1 meter.

In any case, change the controller **immediately**.

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3.2.2.2 Manual mode from control panel

Using the control panel - AMR P604 M

To access manual mode, follow the steps detailed in the *Mode switching* section.

To raise or lower the lifting platform and to move the AMR, push and hold the corresponding button according to the table below.

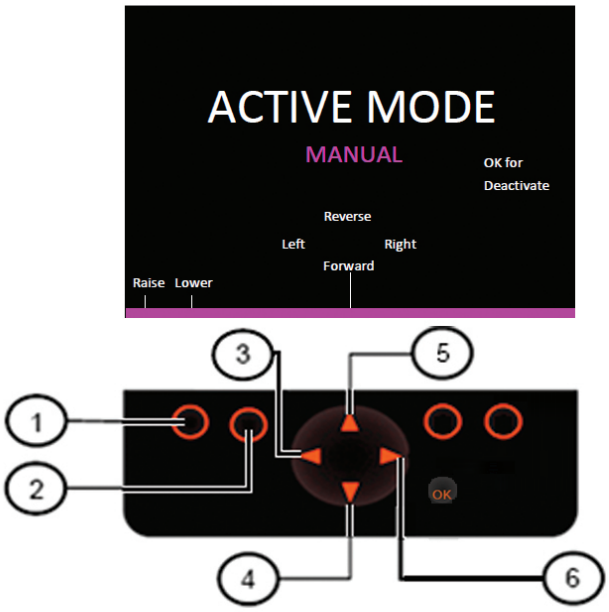


Figure 3.3: Manual mode from control panel - AMR P604 M (Magnetic)

Item	Combination	Description/Function
1	○ (Raise)	Raise lift platform
2	○ (Lower)	Lower lift platform
3	◀	Left movement
4	▼	Forward movement
5	▲	Reverse movement
6	▶	Right movement

Using the control panel - AMR P604 V

To access manual mode, follow the steps detailed in the *Mode switching* section.

To move the AMR, push and hold the corresponding button according to the table below.

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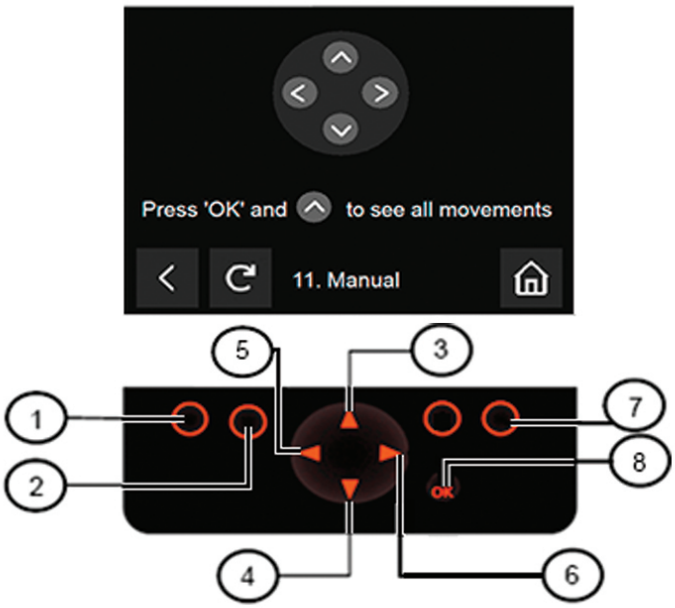


Figure 3.4: Manual mode from control panel (VSLAM)

Item	Combination	Description/Function
1	○ (Back)	Go back
2	○ (Swap)	Swap to lift platform control display
3	▲	Reverse movement
4	▼	Forward movement
5	◀	Left movement
6	▶	Right movement
7	○ (HOME)	Go back to “Home” screen
8	○ (OK)	OK
3+8	○ +▲	Other movements

To raise or low the lifting platform, push and hold the corresponding button according to the table below.

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3.2.2.2 Manual mode from control panel

Continued

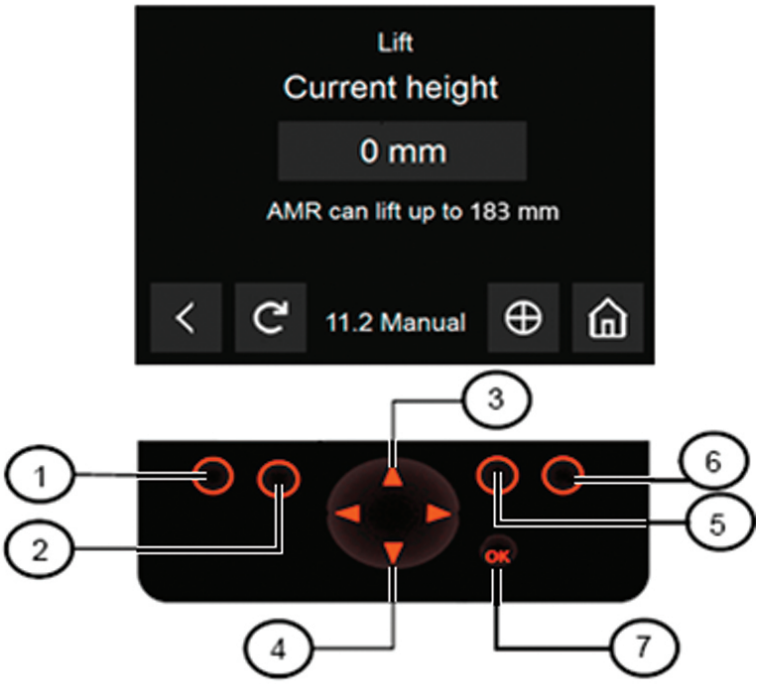


Figure 3.5: Manual lift mode from control panel (VSLAM)

Item	Combination	Description/Function
1	○ (Back)	Go back
2	○ (Swap)	Swap to movement control display
3	▲(Raise)	Raise lift platform
4	▼(Low)	Low lift platform
5	○ (HOME)	Calibration screen
6	○ (HOME)	Go back to “Home” screen
7	○ (OK)	OK

Note

The data displayed on the screen may differ from the specifications depending on the lifting table calibration.

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3.2.2.3 Laser override in manual mode

Overview

Laser fields application will be done automatically depending on the movement status of the AMR when is working on manual mode. Additionally, there is a mechanism to bypass the laser detection leading in a free moving without any protective fields.

This mechanism is limited to a reduced velocity of 0.1 m/s and a maximum distance of 1 m, after which it will automatically reapply the fields. If, after a 1 m displacement, it is necessary to activate this functionality again, it can be done using any of the previously mentioned methods.

This functionality can be accessed via HMI display using the screen selectors (the arrows).

Additionally, by pressing the left slow speed enabling pushbutton (LB + the direction) on the controller.

WARNING

During manual controlling the operator is fully responsible for a safety movement of the vehicle and for any damage sustained or caused by the AMR.

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3.3 AMR insertion

3.3.1 Insertion using the magnetic guidance system - AMR P604M

Overview

This process must be performed when the operator wants to insert the AMR in the circuit so that it starts to operate automatically.

> **Note**
>
> This operation must be done every time you want to insert a vehicle that has been removed from the circuit, regardless of whether it has been previously inserted.

> **WARNING**
>
> Before insertion, verify that there are no vehicles, doors, or charging stations within a distance of 5 meters.
>
> Traffic control will not be enabled until the insertion process is over.

Procedure

To insert the AMR, follow the steps below:

1. Move the AMR manually (see the *Manual mode* section), until the magnetic antenna is above the magnetic tape and close to a tag.
2. Start-up the vehicle according to the section *AMR start-up and shutdown*.
3. Push the Reset button for two seconds twice until the LED lights stop flashing and turn solid white.
4. Push the Insert button for a while. Then the AMR will start moving in automatic mode.

To insert the AMR into the circuit and without error, the route and segment must be identified, follow the steps bellow:

1. **Access screen two**: Route and segment on which the AMR is located (see the *Display* section).

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Figure 3.6: Screen two

2 Push **OK** on the display to access the **SEGMENT** configuration screen. After pushing **OK**, the screen flashes red/white to indicate that the segment shown in the right upper corner of the screen can now be configured.

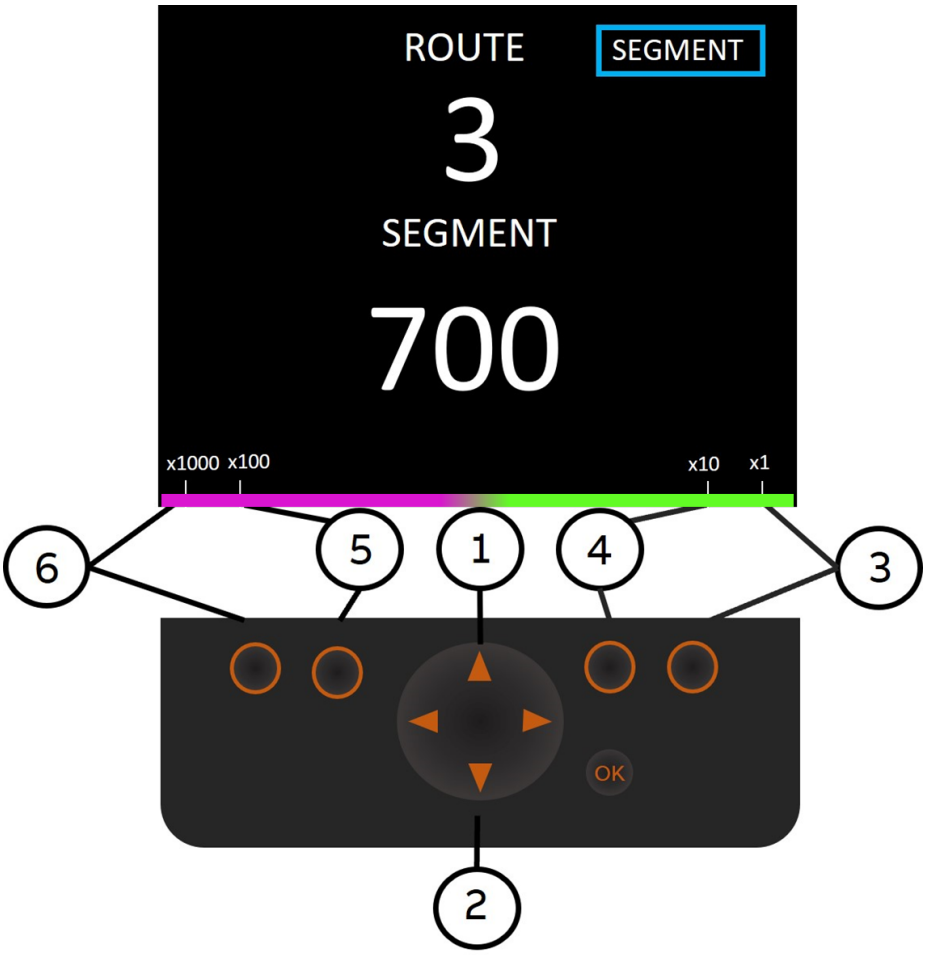


Figure 3.7: Segment configuration

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3.3.1 Insertion using the magnetic guidance system - AMR P604M
Continued

Item	Description
1	Scroll forward through segments
2	Scroll backwards through segments
3	Button 4 - Segment x1
4	Button 3 - Segment x10
5	Button 2 - Segment x100
6	Button 1 - Segment x1000

To change the segment, simultaneously push the segments x1 or segments x10 button and the up/down arrow on the central button.

Note

To return to the previous route and segment configuration, do NOT push the **OK** button. Instead, change screen (see the *Display* section), which will re-establish the previous values.

3 Once the segment has been configured, push the **OK** button again to configure the **ROUTE** shown in the right corner of the screen and follow the same steps as indicated in point 2 to change the route.

4 Once the route has been configured, push the **OK** button again.

Note

Manually reposition the AMR if the guidance antenna does not detect the tape.

WARNING

Do not insert the AMR in areas of confluence of vehicles or traffic points or points with actions (junctions, communications...) configured at that point.

The operator must supervise the insertion process until the AMR is operating automatically in the layout.

Note

Insertion is carried out with the safety laser fields automatically active (with or without trolley, straight line, or curves).

In case of inserting the AMR in the opposite direction of the programmed circulation, the behavior of the AMR will be:

1 When reading the first tag, if it is not the one configured in the working table (opposite direction to the one programmed in the circuit) the vehicle will display error code 10 (unexpected tag error).

2 After 5 seconds, this error will be automatically reset, and the vehicle will continue according to the corresponding tag read.

3 If the next tag the vehicle read confirms that the vehicle is in the wrong direction, the display will show error code 11.

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4 The vehicle will stop and not move forward until the operator has fixed the error.

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3.3.2 Insertion using the Visual SLAM guidance system - AMR P604V

Overview

This process must be performed when the operator wants to insert the AMR in the circuit so that it starts to operate automatically.

Note

This operation must be done every time you want to insert a vehicle that has been removed from the circuit, regardless of whether it has been previously inserted.

WARNING

Before insertion, verify that there are no vehicles, doors, or charging stations within a distance of 5 meters.

Traffic control will not be enabled until the insertion process is over.

Procedure

To insert the AMR, follow the steps below:

1. Move the AMR manually (see the *Manual mode* section), to a location that belongs to its original work routine (1 m far from the routine limit).
2. Start-up the vehicle according to the section *AMR start-up and shutdown*.
3. Push the Reset button for two seconds twice until the LED lights stop flashing and turn solid white.
4. Push the Insert button for a while. Then the AMR will start moving in automatic mode.
5. The AMR will find the circuit and continue the tasks related to that part of it.

To insert the AMR into the circuit without errors, try to find a part of the circuit where the vehicle doesn't have more than one possible mission and can only move in one straight direction. Sometimes these locations are indicated by some visual signs on the floor. If that's not the case, you'll need to use the Diagnostic Tool or AMR Studio to find the most convenient spot.

Note

In general, the main idea of Visual SLAM insertion is simplicity, if the AMR is in the circuit, it will find a way to continue by itself.

This simplicity implies that sometimes the user will prefer to oblige the AMR to continue working from certain place, even if the vehicle is able to find the circuit. Maybe some maintenance tasks had been performed close to the beginning of the circuit and the user prefers the vehicle to perform missions at the middle of it, or vice versa. If that's the case, follow this procedure:

1. Follow steps 1-2 from previous procedure.
2. Go to the position screen. For more information, see the *Display* section.

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The position screen allows the user to check in which step of the circuit the AMR is working.

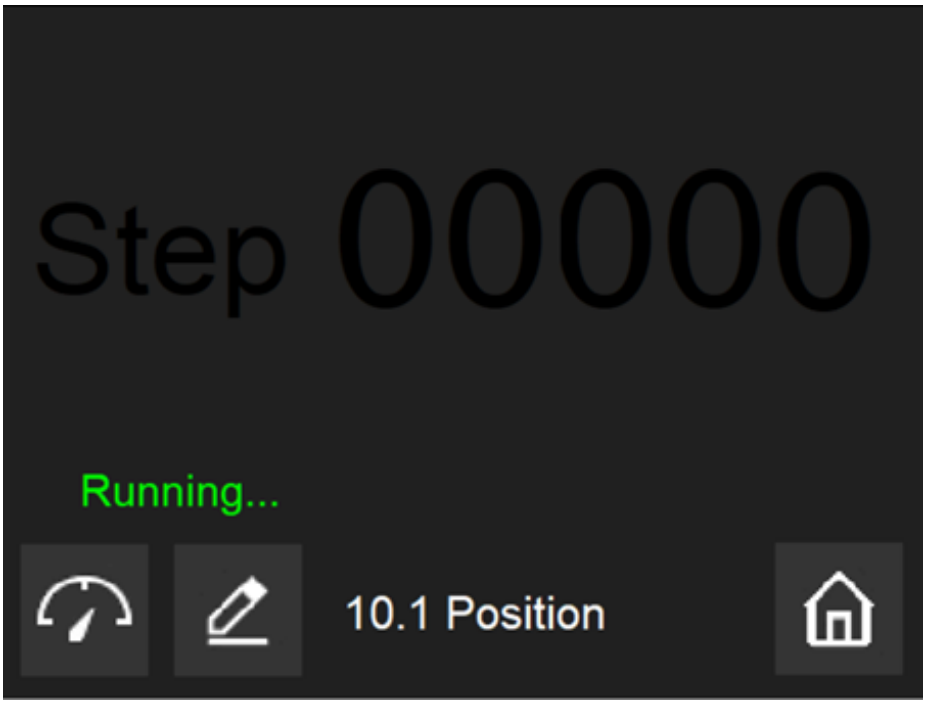


Figure 3.8: Screen two

3 Check on AMR Studio the desired step and introduce it.

If you want the AMR to initiate the circuit from the main mission, use the Step 0.

If the AMR is inserted in a wrong spot, or cannot recognize the circuit, an error will appear, and the AMR will stop.

Note

Notice that the AMR P604V needs to update the maps from time to time. This process can take until 30 minutes, so plan the circuit accordingly.

WARNING

Do not insert the AMR in areas of confluence of vehicles or traffic points or points with actions (junctions, communications...) configured at that point.

The operator must supervise the insertion process until the AMR is operating automatically in the layout.

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3.4 Mode switching

Overview

The transition from manual mode to automatic mode and the other way around is keycode protected. The keycode could be set via the HMI display or the controller.

- From HMI: The keycode, detailed in the table below, can be inserted from any screen. In magnetic guidance HMI, the battery screen does not allow it.
- From controller: Insert the USB into the USB port and wait until the purple LED lights up. Then, enter the keycode detailed in the table below.

The AMR being on automatic mode does not imply that is inserted into the circuit. The usual process for that remains. In any case, the AMR can be controlled manually when the manual mode is activated, when entering the corresponding screen on the control panel, or when communication with the gamepad has been detected.

Device	Combination
HMI display	**OK + 1,4** after **OK + 2,3**
Controller	**LT + ◄,B** after **LT + ►,X** or **◄ + B after ► + X**

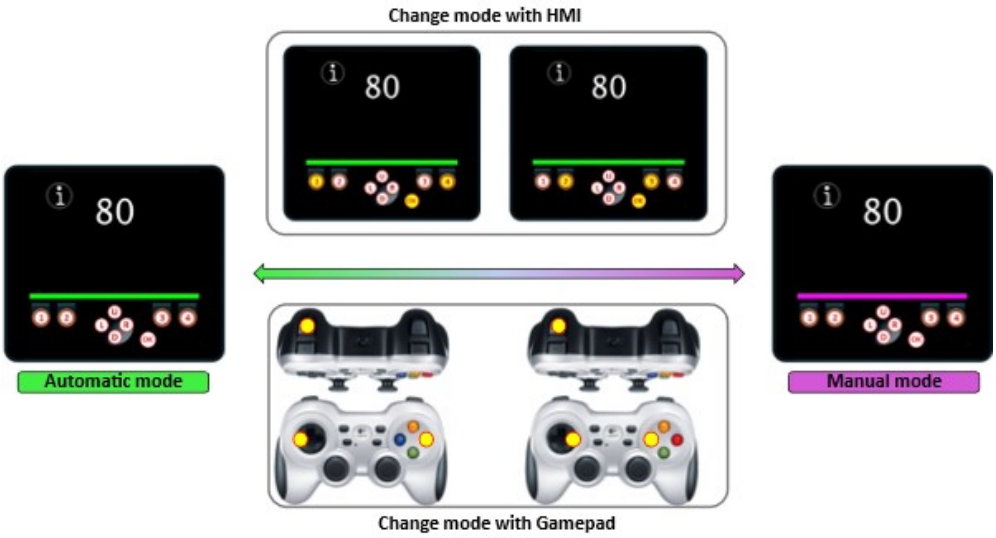


Figure 3.9: Mode switching from HMI and Controller for AMR P604M

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Figure 3.10: Mode switching from HMI and Controller for AMR P604V

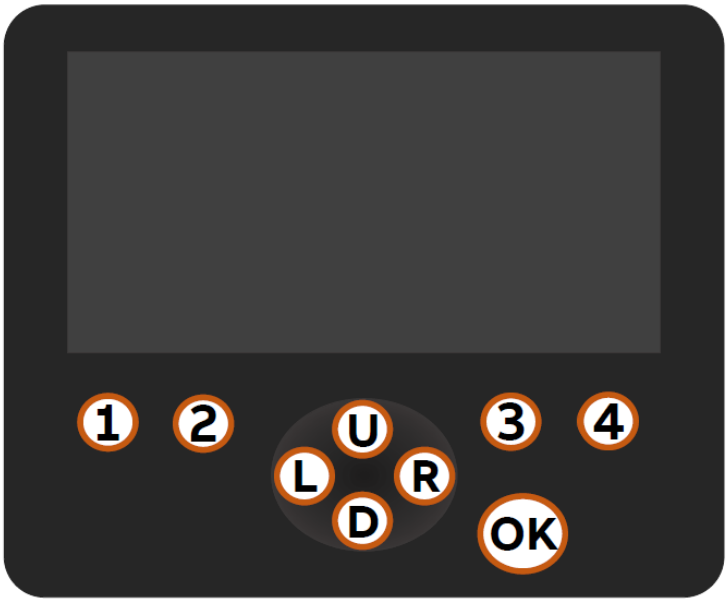


Figure 3.11: HMI buttons diagram

Note

This transition is not affected by vehicle restarting. That means, if the vehicle is already on manual mode, the vehicle will continue in manual mode even after being switched off.

The vehicle's mode is identifiable via a color band incorporated to the HMI display. A green display for the automatic mode and a purple one for the manual mode.

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3.4.1 Manual to automatic mode - AMR P604M

From control panel manual mode

Follow these steps:

1. With the AMR in manual mode, move it towards the magnetic tape.
2. Push the green Insert button located on the button panels. The AMR will follow the tape until it reads the next tag and will perform the actions associated with that tag.

From controller manual mode

Follow these steps:

1. Move the AMR in controller manual mode towards the magnetic tape.
2. Disconnect the controller.
3. Push the green Insert button located on the button panels. The AMR will follow the tape until it reads the next tag and will perform the actions associated with that tag.

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3.4.2 Manual to automatic mode - AMR P604V

From control panel manual mode

Follow these steps:

1. With the AMR in manual mode, move the AMR to a location that belongs to its original work routine (1 m far from the routine limit).
2. Push the Insert button located on the button panels. The AMR will synchronize and will continue its routine from that location.

From controller manual mode

Follow these steps:

1. Move the AMR in controller manual mode to a location that belongs to its original work routine (1 m far from the routine limit).
2. Disconnect the controller.
3. Push the Insert button located on the button panels. The AMR will synchronize and will continue its routine from that location.

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3.4.3 Automatic mode to manual

From automatic guidance to control panel manual mode

Follow these steps:

1. Push the operational stop button when the AMR is on a safe section. If work needs to be performed on the AMR, turn it off using the "ON/OFF" switch.
2. Enter the specific screen of the manual mode and move the AMR to the desired location.

From automatic guidance to controller manual mode

Follow these steps:

1. Push the operational stop button when the AMR is on a safe section. If work needs to be performed on the AMR, turn it off using the "ON/OFF" switch.
2. Connect the manual controller via the USB interface.
3. Drive the AMR to the desired location.



Note

Do not leave the AMR below doors or inside other stations.

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4 Transport, lifting, and storage

Overview

WARNING

Only personnel who have read and understood this manual and been properly trained are authorized to perform transport, load, and unloading tasks.

Always remove the load before payload or transporting the AMR.

Means for relocating the AMR will depend on the distance it must travel. There are several methods for the AMR relocating process:

- Relocation using a lifting device.
- Manual relocation by an operator.

Continues on next page

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4.1 Transport

Overview

Transport must be carried out in the original pallet or box delivered by the manufacturer to ensure that the vehicle is not damaged and that there are no risks during the transport operation.

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4.1.1 Safety instructions for transport

To correctly perform transport, loading, and unloading tasks, follow the guidelines below:

- Before transporting the AMR, check its weight and dimensions by consulting its *AMR plates* or see *AMR datasheet* on this manual.
- In the case of uncertainty about the capacity, lifting equipment, lifting methods, or procedures; please get in touch with ABB before lifting the machine.
- When the AMR is placed in its pallet or box and inside the transportation means, it must be secured to avoid any instability in the pallet or box.
- During the transport of the AMR by truck, trailer, or similar, the AMR must be turned off, the battery disconnected, and the AMR properly secured to prevent sliding or movement.



WARNING

It is strictly forbidden to move/transport the AMR by forklift or similar whenever the AMR is outside the box or the pallet.



WARNING

ABB is not responsible for any damage caused to the vehicles due to non-compliance with the transport instructions.

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4.1.2 Manual relocation by an operator

When the AMR has been unloaded on the ground or is in a storage area and is to be moved to another part of the facility without using means of transport (truck, overhead crane…) it is possible to handle the vehicle as indicated in the *Manual mode* section.

If the vehicle has been recently removed from the packaging, to move it without using means of transport (truck, overhead crane…), follow this procedure:

1. Connect the battery.
2. Switch on the AMR. See the *AMR start-up and shutdown* procedure.
3. Reset the AMR.
4. Follow the instructions indicated in the *Manual mode* section.

It is also possible to transport the vehicle by forklift in its box to the final location, where it can be removed from the packaging.

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4.2 Lifting

4.2.1 Safety instructions for lifting

To correctly perform lifting task, follow the guidelines below:

- Before lifting the AMR, check its weight and dimensions by consulting its *AMR plates* or see the *AMR datasheet* on this manual.
- In the case of uncertainty about the capacity or lifting equipment or lifting methods or procedures, please get in touch with ABB before lifting the machine.
- Before lifting the machine, make sure that the working area is clear (free of obstacles and people) and marked.
- Never work on the AMR while it is suspended by a hoist or any other lifting equipment, unless it is specified on the maintenance manual for certain operations.
- Always check that the lifting slings, chains, pulley blocks, eye bolts and other lifting devices are in good condition before using.
- Before lifting the vehicle, check that the eyebolts or hooks are correctly positioned in the anchorage points of the AMR.
- The end user can apply the internal instructions considered relevant for the lifting of the AMR as long as they do not conflict with the indications given in the manual.
- Properly secure the AMR and take appropriate measures to prevent the load from balancing.

WARNING

The systems must be certified and suitable for the weight to be lifted.

It is strictly forbidden lifting the AMR by forklift or similar.

It is forbidden to remain under a suspended load.

When handling suspended loads, make sure that there are no people on the working area.

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4.2.2 Instructions for lifting the vehicle

Overview

Note

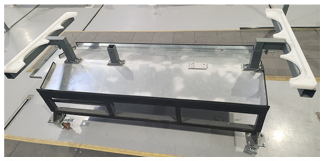
The end user can apply the internal instructions considered relevant for the lifting of the AMR if they do not conflict with the indications given in the manual.

WARNING

Before starting the work, make sure to have adequate and appropriate accident prevention clothing available and the personnel has received the corresponding training. For more information see *Safe practices at work* section.

The area must be free and clear and limit or prevent access by unauthorized persons.

Required tools and equipment

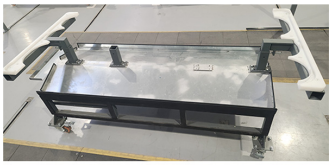
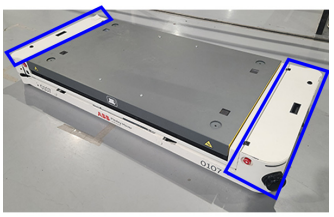
Equipment, etc.	Art. No.	Note
Standard toolkit	-	Content is defined in section Standard toolkit of the Maintenance Manual. See *References*..
Set of slings (x4 - min. 475kg per sling)	-	
AMR maintenance support	-	

Procedure

	Action	Note
1	Place the 4 lifting eye bolts (M12) on the AMR, 2 on each side of the vehicle. Each lifting point is labelled.	

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	Action	Note
2	Take 4 set of slings and self-locking hooks, or 4 lifting chains, both methods must support at least the total weight of the AMR each of them. For more information about the specific weight of the AMR P604 see *AMR datasheet*.	
3	Lift the AMR carefully and move it to the required area.	
4	For the complete development of all the maintenance tasks described in this manual, it is advisable to use an AMR maintenance support.	
5	When placing the AMR on the AMR maintenance support, it must be considered that the support points of the structure must be in the areas of the AMR indicated below.	
6	Once in the final position, proceed to lower the AMR slowly, always controlling the environment and possible balancing of the vehicle.	

Note

The end user can apply the internal instructions considered relevant for the lifting of the AMR as long as they do not conflict with the indications given in the manual.

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4.3 Storage

Overview

If storing the AMR for an extended period, a list of precautions need to be followed to protect the vehicle while it is inactive.

List of precautions

General

- Store the AMR in a dry, dust-free place at a stable ambient temperature between 0 °C and 45 °C. It is important to store the AMR in a place where there is no risk of freezing or moisture.
- Periodically check the outer appearance of the instruments. If they are dusty, clean all safety elements and moving parts to help ensure error-free start-up of the machine.
- It is advisable to cover the AMR with a cloth.

WARNING

In case the storage temperature is higher or lower than the indicated one, remove the batteries from the AMR before storing it.

Note

Before starting up the AMR after storage for more than six months, perform appropriate maintenance and service as indicated in the Maintenance manual - Flexley Platform AMR P604 to guarantee proper vehicle operation and safety. For more information, see the *References* section.

Battery

- Fully charge the battery and perform the maintenance recommended by the manufacturer of the battery.
- If the AMR is not used for three days or more, disconnect the battery.
- If the AMR is not going to be used for a month or more, charge the battery to 80% before storage.

WARNING

The process of removing the batteries is detailed in the Maintenance manual. For more information, see the *References* section.

Greasing

- The process of greasing is detailed in the Maintenance manual. For more information, see the *References* section.

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5 Decommissioning

5.1 Introduction to decommissioning

Introduction

This section contains information to consider when taking a product, AMR or charging station, out of operation.

It deals with how to handle potentially dangerous components and potentially hazardous materials.

> **Note**
>
> The decommissioning process shall be preceded by a risk assessment.

Disposal of materials used in the robot

All used grease/oils and dead batteries must be disposed of in accordance with the current legislation of the country in which the AMR and the charging station are installed.

If the AMR or the charging station is partially or completely disposed of, the various parts must be grouped together according to their nature (which is all iron together and all plastic together), and disposed of accordingly. These parts must also be disposed of in accordance with the current legislation of the country in which the AMR and the charging station are installed.

See also *Environmental information*.

Transportation

Prepare the AMR or the charging station, this to avoid hazards.

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5.2 Environmental information

Introduction

ABB AMRs and charging stations contain components in different materials. During decommissioning, all materials shall be dismantled, recycled, or reused responsibly, according to the relevant laws and industrial standards. AMRs, charging stations or parts that can be reused or upcycled helps to reduce the usage of natural resources.

Disposal symbol

The following symbol indicates that the product must not be disposed of as common garbage. Handle each product according to local regulations for the respective content (see table below).



Materials used in the AMR

The table specifies some of the materials in the product and their respective use throughout the product. Dispose components properly according to local regulations to prevent health or environmental hazards.

Material	Example application
Steel, aluminium	AMR base
Lithium	Batteries
Cast iron/nodular iron	Gears
Copper	Cables, motors
Neodymium	Motors
Oil, grease	Gears
Stainless steel	Mechanical stop
Steel	Gears, screws, washers, brackets

Oil and grease

Where possible, arrange for oil and grease to be recycled. Dispose of via an authorized person/contractor in accordance with local regulations. Do not dispose of oil and grease near lakes, ponds, ditches, down drains, or onto soil. Incineration must be carried out under controlled conditions in accordance with local regulations.

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Also note that:

- Spills can form a film on water surfaces causing damage to organisms. Oxygen transfer could also be impaired.
- Spillage can penetrate the soil causing ground water contamination.

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5.3 Scrapping of the AMR

Introduction

At the end of the useful life of the electrical and electronic components of the products, it is necessary to manage this waste in a responsible manner and in compliance with the regulations in force in each region.

Note

The decommissioning process shall be preceded by a risk assessment.

Disassembly and sorting

Components must be disassembled and properly segregated for recycling or final disposal as Waste Electrical and Electronic Equipment (WEEE).

DANGER

The risk assessment should consider hazards arising in the decommissioning, such as, but not limited to:

- Always remove all batteries. If a battery is exposed to heat, for example from a blow torch, it will explode.
- Always remove all oil/grease. If exposed to heat, for example from a blow torch, the oil/grease will catch fire.
- A used AMR does not have the same performance as on delivery. Springs, brakes, bearings, and other parts might be worn or broken.

Recycling and disposal

It is recommended to contact authorized recycling centers that comply with local regulations and promote sustainable recycling and waste management practices.

Regulations and compliance

Ensure that all waste management actions comply with applicable local and international regulations.

Contact for additional support

In case of questions about the WEEE management process, it is suggested to contact your local ABB services team for additional technical advice and support.

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5.4 Lithium batteries

Introduction

At the end of the useful of lithium batteries used in Autonomous Mobile Robots (AMRs), it is crucial to manage these waste materials responsibly and in compliance with the regulations in each region. Proper management of these batteries not only protects the environment but also ensures safety and adherence to applicable standards.

Disassembly and sorting

Batteries must be disassembled and properly segregated for recycling or final disposal. It is important to separate the batteries from other electronic components to minimize risks and streamline the recycling process. Use appropriate tools and personal protective equipment (PPE) during the disassembly process.

Recycling and disposal

It is recommended to contact authorized recycling centers that comply with local regulations and promote sustainable waste management and recycling practices. These centers are equipped to handle lithium batteries safely and efficiently, ensuring the recovery of valuable materials and the safe disposal of non-recyclable waste.

Regulations and compliance

Ensure that all waste management actions comply with applicable local and international regulations. This includes adhering to specific rules for handling lithium batteries, which may vary by region. Keep detailed records of all waste management activities to demonstrate regulatory compliance.

Contact for additional support

For any questions regarding the e-waste management process, it is suggested to contact ABB for further guidance and technical support.

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ANNEX I - List of display codes

Magnetic guidance display codes - AMR P604M

This table contains the complete list of AMR display codes for the AMR P604:

Code	Function	Interpretation/Action	Troubleshooting
00	AMR has no anomalies	INFORMATION	-
01	Emergency mode activated	STOPS MACHINE	Unlock emergency button.
02	Emergency mode not reset	STOPS MACHINE	Reset by push button.
03	Error in more than one variable-speed drive	STOPS MACHINE	Verify the condition of devices, wiring, and other elements.
04	Anti-collision (reset required)	STOPS MACHINE	-
05	Anti-collision (automatic reset)	STOPS MACHINE	1 Check the laser field. 2 Clean the lamp cover.
06	Battery level extremely low	STOPS MACHINE	1 Charge the AMR battery. 2 Replace the AMR battery.
07	PLC controller error	STOPS MACHINE	1 Contact the manufacturer for assistance. 2 Inspect the power consumption of the linear actuator outputs and replace them if necessary. 3 Review the PLC log and analyse any abnormal input or output signals.
08	Anti-collision (speed reduced)	WARNING	1 Remove any obstruction from the AMR's route. 2 Clean the lamp cover.
09	No communication with RFID antenna	STOPS MACHINE	1 Check connectors 2 Verify that the antenna is receiving power. 3 Replace the antenna.
10	Unexpected point (found on the working table)	INFORMATION	1 Verify routing chart settings. 2 Inspect the Tags programming.
11	Unexpected point (exists in the work table, wrong direction)	INFORMATION	1 Verify routing chart settings. 2 Reverse AMR's direction.
12	Unexpected point (does not exist in the work table)	INFORMATION	-
13	Location method not configured	STOPS MACHINE	Verify routing chart settings.
14	Wireless controller data not received within time limit	WARNING	-

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Magnetic guidance display codes - AMR P604M
Continued

Code	Function	Interpretation/Action	Troubleshooting
15	Incorrect data received from the wireless controller	WARNING	-
16	Wireless controller (or PC) button not set	WARNING	Reset wireless controller button.
17	Circuit values for routing have not been loaded	INFORMATION	Wait until the battery is fully charged.
18	Routing chart contains a point for which more than one ID has been defined	WARNING	Verify routing chart settings.
19	Routing chart contains a point with no following point	WARNING	Verify routing chart settings.
21	Location system lost	STOPS MACHINE	-
22	Incorrect value for Select guide in routing chart	WARNING	Verify routing chart settings.
23	Routing chart created beyond limits	WARNING	1 Verify routing chart settings. 2 Lower routing chart.
24	Point not defined in routing chart	WARNING	1 Verify routing chart settings. 2 Position AMR on its designated route.
25	Time limit for operation block 1 exceeded	STOPS MACHINE	Activate the green reset button.
26	Time limit for operation block 2 exceeded	STOPS MACHINE	Activate the green reset button.
27	Point is an anomaly on this route	STOPS MACHINE	1 Activate the green reset button. 2 Check the confirmation status of routing chart configuration.
28	Unexpected point (a tag has been missed)	WARNING	Verify the tag status.
29	Lifting system anomaly	STOPS MACHINE	Inspect the vehicle status during lifting operation.
30	Current route not defined in routing chart	WARNING	Define a correct route for the AMR.
31	Current point not defined in routing chart	WARNING	Define a correct point for the AMR.
32	A tag has been missed	INFORMATION	-

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Magnetic guidance display codes - AMR P604M
Continued

Code	Function	Interpretation/Action	Troubleshooting
33	Error in the detection of the guide	WARNING	-
34	Guide detection error	WARNING	1 Check a magnetic antenna. 2 Check the wiring.
35	Guide search error	STOPS MACHINE	Place the AMR on the magnetic strip and press the reset button.
36	Maximum blind guidance distance exceeded	STOPS MACHINE	-
37	CAN-bus anomaly	STOPS MACHINE	Verify devices and wiring.
38	Time limit for precise stop exceeded	STOPS MACHINE	Activate the green reset button.
39	Time limit for operation block 3 exceeded	STOPS MACHINE	Activate the green reset button.
40	CAN-bus anomaly. Non-RFID communication	STOPS MACHINE	Activate the green reset button.
41	Hook position error	STOPS MACHINE	Check rear hook sensors.
42	Time limit for hook movement exceeded	STOPS MACHINE	Check that the hook is not stuck.
43	Error in position of automatic battery charging system	STOPS MACHINE	Check the brush sensors.
44	Time limit for movement of battery charging system exceeded	STOPS MACHINE	1 Check that the linear actuator is not stuck. 2 Check the wiring.
45	No current detected during battery charging	STOPS MACHINE	Press green button and investigate loading issues.
46	Maximum payload force exceeded	STOPS MACHINE	Press green button and check devices (motor, wheels, wiring).
47	No current detected during battery recharging	WARNING	Investigate loading issues.
48	Time limit for half-turn exceeded	STOPS MACHINE	-
49	No current detected during battery charging	WARNING	Investigate loading issues.
50	Dirty laser	WARNING	Clean the laser cover.

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Magnetic guidance display codes - AMR P604M
Continued

Code	Function	Interpretation/Action	Troubleshooting
51	Anti-collision not safe (automatic reset)	STOPS MACHINE	1 Check the laser field. 2 Clean the lamp cover.
53	Error in some variable-speed drive, trying self-reset	-	-
55	Maximum movement percentage exceeded	STOPS MACHINE	-
56	AMR locked	STOPS MACHINE	-
57	An encoder has not been refreshed	STOPS MACHINE	-
58	An encoder is not counting	STOPS MACHINE	-
59	Low battery level	WARNING	-
60	Front left variable-speed drive error	STOPS MACHINE	-
61	Front right variable-speed drive error	STOPS MACHINE	-
62	Rear left variable-speed drive error	STOPS MACHINE	-
63	Rear right variable-speed drive error	STOPS MACHINE	-
65	Communication with control center lost when needed	STOPS MACHINE	-
76	Angle calibration needed	INFORMATION	-
77	RFID cancelled	INFORMATION	-
79	End of route (endpoint)	INFORMATION	-
80	The AMR does not execute a route	INFORMATION	-
81	Awaiting fulfilment of initial conditions (AMR input)	INFORMATION	Inspect routing chart, inputs and outputs.
82	Awaiting permission from the traffic controller (PC or A29)	INFORMATION	Inspect routing chart, inputs and outputs.

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Magnetic guidance display codes - AMR P604M
Continued

Code	Function	Interpretation/Action	Troubleshooting
83	Awaiting condition during route (AMR input)	INFORMATION	Inspect routing chart, inputs and outputs.
84	Awaiting fulfilment of initial conditions (external input)	INFORMATION	Inspect routing chart, inputs and outputs.
85	Awaiting fulfilment of initial conditions (PC input)	INFORMATION	Inspect routing chart, inputs and outputs.
86	Awaiting fulfilment of initial conditions (remote input)	INFORMATION	Inspect routing chart, inputs and outputs.
87	Awaiting condition during route (external input)	INFORMATION	Inspect routing chart, inputs and outputs.
88	Awaiting condition during route (PC input)	INFORMATION	Inspect routing chart, inputs and outputs.
89	Awaiting condition during route (remote input)	INFORMATION	Inspect routing chart, inputs and outputs.
90	Charging batteries	INFORMATION	-
91	End of battery charging process	INFORMATION	-
92	Zero-speed setpoint	STOPS MACHINE	-
93	Waiting for initial conditions to be met (battery input)	INFORMATION	-
94	Awaiting condition during route (battery input)	INFORMATION	-
95	Awaiting precise stop	INFORMATION	-
96	Effective battery charging	INFORMATION	-
97	Communication with control center lost	WARNING	-
99	Display communication error	WARNING	-
101	Safety error 1. Parameter reading error	STOPS MACHINE	Resend safety parameters to IFM PLC.

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Magnetic guidance display codes - AMR P604M
Continued

Code	Function	Interpretation/Action	Troubleshooting
102	Safety error 2. Speed comparison error	STOPS MACHINE	Check the encoders, wiring of the flexisfot. Turn the vehicle off and on to fix the issue.
103	Safety error 3	STOPS MACHINE	Check the lift encoder is correctly mounted and connected.
104	Safety error 4. Setpoint tracking error	STOPS MACHINE	-
105	Safety error 5. Wrong laser field selection	STOPS MACHINE	-
106	Safety error 6	STOPS MACHINE	Check elements near IFM PLC and connections to or from the power supply.
107	Safety error 7. Speed out of limits	STOPS MACHINE	Check forced lasers configuration and speeds of the vehicle.
108	Safety error 8. Angular speed out of limits	STOPS MACHINE	-
109	Safety error 9. EDM error	STOPS MACHINE	Error EDM power contactors or brake relay.
110	Safety error 10	STOPS MACHINE	-
111	Safety error 11. Laser case against movement	STOPS MACHINE	Check load position and inductives wiring.
112	Safety error 12	STOPS MACHINE	-
113	Safety error 13. OSSD in emergency stop button	STOPS MACHINE	Check emergency buttons wiring.
114	Safety error 14. Safety laser error	STOPS MACHINE	Check layout design and encoders wiring.
116	Safety error 16. Movement detection in stand-by	STOPS MACHINE	Check the lift state and the behaviour of the lift during the movement of the AMR.
117	Safety error 17. Deceleration ramp failure	STOPS MACHINE	Check the weight of the load and the state of the floor. .
118	Safety error 18. Steering encoder discrepancy	STOPS MACHINE	Check steer encoders wiring.
119	Safety error 19	STOPS MACHINE	-
120	CAN error in node 20 (RFID)	STOPS MACHINE	Revise the devices and wiring.
121	CAN error in node 21 (analog outputs 1 and 2)	WARNING	Revise the devices and wiring.

Continues on next page

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Magnetic guidance display codes - AMR P604M
Continued

Code	Function	Interpretation/Action	Troubleshooting
122	CAN error in node 22 (ultrasounds signals) or node 96 (display)	WARNING	Revise the devices and wiring.
123	CAN error in node 23 (A29 - remote devices)	WARNING	Revise the devices and wiring.
124	CAN error in node 24 (analog outputs 3 and 4)	WARNING	Revise the devices and wiring.
125	CAN error in node 25 (Beckhoff gateway)	WARNING	Revise the devices and wiring.
126	CAN error in node 26 (analog Beckhoff)	WARNING	Revise the devices and wiring.
128	CAN error in node 28 (A33 - automatic load)	WARNING	Revise the devices and wiring.
129	CAN error in node 8 (Front left variable-speed drive)	STOPS MACHINE	Revise the devices and wiring.
130	CAN error in node 9 (Front right variable-speed drive)	STOPS MACHINE	Revise the devices and wiring.
131	CAN error in node 10 (Variable-speed drive)	STOPS MACHINE	-
134	CAN error in node XX (Steering encoder)	STOPS MACHINE	-
135	CAN error in node XX (Magnetic antenna)	STOPS MACHINE	-
138	CAN error in node 5 (I/O expansion)	WARNING	-
139	CAN error in node XX	WARNING	-
140	Configurable anomaly	STOPS MACHINE	Verify communications with the control system and the positioning of tags.
141	Steering encoder non calibrated	STOPS MACHINE	Check the encoder and make the calibration of the zero.
142	Battery anomaly	WARNING	-
143	Clutch engaging detected	STOPS MACHINE	Verify the wiring and communication of the string encoder. Initialize it with a zero value at the home position.

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Magnetic guidance display codes - AMR P604M
Continued

Code	Function	Interpretation/Action	Troubleshooting
144	Configurable anomaly	WARNING	The elevation encoder might be faulty or improperly secured. The motor is not reacting accurately to the requested commands. The temperature sensor is not firmly attached.
145	Configurable anomaly	WARNING	Wait for the system to auto-reset, or restart manually.
146	Configurable anomaly	WARNING	-
147	Configurable anomaly	WARNING	Allow time for the drive to recover to its normal operating mode.
148	Configurable anomaly	WARNING	Restart manually.
149	Configurable anomaly	WARNING	Review the CAN connections and ensure the battery BMS is functioning properly.
150	Configurable anomaly	WARNING	-
151	Configurable anomaly	WARNING	-
152	No communication with datalogger	WARNING	Check the CAN wiring.
153	Brakes activated manually	STOPS MACHINE	-
154	Brake coils disconnected	STOPS MACHINE	-
155	Configurable anomaly (stops auxiliary movements)		-
160	Measured current is I>5A for 30s after the charging process	STOPS MACHINE	-
161	The measured current is not negative, it is between 0A<I<5A during 30s after the charging process	WARNING	-
170	Forced code from working table	-	-
171	Forced code from working table	-	-
172	Forced code from working table	-	-

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Magnetic guidance display codes - AMR P604M
Continued

Code	Function	Interpretation/Action	Troubleshooting
173	Forced code from working table	-	-
174	Forced code from working table	-	-
175	Forced code from working table	-	-
176	Forced code from working table	-	-
177	Forced code from working table	-	-
178	Forced code from working table	-	-
179	Chart reading by old console version	-	-
180	Manual mode	INFORMATION	-
181	Semi-manual mode	INFORMATION	-
254	PLC internal warning	INFORMATION	-

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Visual SLAM guidance display codes - AMR P604V

Overview

There is an introductory table of the nomenclature about the different possible actions when a failure happens:

Action	Description
0	NO ACTION
1	STOP DRIVE
3	STOP LIFT AND DRIVE
4	SLOW DOWN
8	SAFETY MUTED
FF	NO ACTION
7F	STOP ALL, BUT NOT IN MANUAL

This table lists the different abbreviations used for the error codes. For example, the BU-1 would be a reference to the Can Bus.

Abbreviation	Meaning
DR	DRIVE
LI	LIFT AND PLATFORM
ST	STEER
IG	INVERTER
BU	CAN BUS
BR	BRAKE SYSTEM
CV	CVC/NAV SYSTEM
FL	FLEXISOFT
PO	POSITION SYSTEM
SE	SENSOR
RO	ROTATION SYSTEM
SF	SAFETY
CH	ONLINE CHARGE
CO	CONTACTORS
BT	BATTERY
DE	DEVICES
LY	LAYOUT
OP	ORDERS/TRANSPORT
LD	LOAD HANDLING
HT	HOST
CM	COMMUNICATIONS
LS	LASER SCANNERS
PI	PLC INPUTS

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Abbreviation	Meaning
PQ	PLC OUTPUTS
ST	STATUS
BQ	BUTTONS AND REQUEST
PS	PLC SUPPLY
PN	PLC INPUT FROM NAV SYSTEMS
LF	LASER FRONT
LR	LASER REAR
BX	COMM. BOXES
LH	LOAD HANDLING
HF	PINHOOK 1
HR	PINHOOK 2
CF	ANTI COLLISION CAMERA FRONT
CR	ANTI COLLISION CAMERA REAR
AS	ASSERT
IL	FRONT / FRONT LEFT INVERTER
IR	FRONT RIGHT INVERTER
ILL	REAR LEFT INVERTER
IRR	REAR RIGHT INVERTER
RI	ROTATION / DIRECTION INVERTER
PL	LIFT INVERTER 1
PLL	LIFT INVERTER 2
NA	PC NAVIGATION
LO	PC LOCALIZATION
TX	PC COMMUNICATION
OT	PC OTHERS
GE	PC TO PLC
SS	PC VSLAM
MI	PC MISSIONS
IFM	PL5-IFM
CVC	PL5-CVC
SCH	PC SMARTCHARGER

Display error messages

Code	Display Code	Description	Interpretation/Actions	Troubleshooting
Devices				

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
0305FF0000	BU-0	CAN node {%} do not communicate (stop)	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem
6005000100	BU-1	CAN node {%} do not communicate (informative)	0	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem
6005000200	BU-2	Screen does not receive communication from PLC	0	1 Check wired and value resistance of bus CAN 2 Check the status of the PLC Are the lights green or red?
6005000300	BU-3	Screen is not configurated	0	If screen is not configured, set it as Rear, Front screen or the requested configuration. (Contact please to support to know how to perform this process)
6005000400	BU-4	Failure at CAN bus 0	0	Contact support.
6005000500	BU-5	Failure at CAN bus 1	0	Contact support.
6005000600	BU-6	Failure at CAN bus 2	0	Contact support.
6005000700	BU-7	Failure at CAN bus 3	0	Contact support.
0305FF0800	BU-8	No communication with front steer encoder A	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
0305FF0900	BU-9	No communication with front steer encoder B	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem
0305FF0A00	BU-10	No communication with rear steer encoder A	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem
0305FF0B00	BU-11	No communication with rear steer encoder B	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem
0305FF0C00	BU-12	No communication with lift encoder A	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem
0305FF0D00	BU-13	No communication with lift encoder B	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem

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Visual SLAM guidance display codes - AMR P604V
Continued

Code	Display Code	Description	Interpretation/Actions	Troubleshooting
0305FF0E00	BU-14	No communication with lift encoder C	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem
0305FF0F00	BU-15	No communication with lift encoder D	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem
0305FF1000	BU-16	No communication with IO Expansion 1	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem
0305FF1100	BU-17	No communication with IO Expansion 2	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem
0305FF1200	BU-18	No communication with forks carriage inclinometer	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem
601F000000	BX-ID box	Remote or traffic box with ID {%} not communicating	0	Check if the ID is correctly set at the mission / layout. Check if the wire of the sender and receiver device. Is the distance between them too far?

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
0317FF0000	PI-Code Input	Error at PLC inputs: {%}	FF	1 Reboot 2 If problem persist, contact with support
0318FF0000	PQ-Code Output	Error at PLC outputs: {%}	FF	1 Reboot 2 If problem persist, check output with the problem 3 Contact support
031BFF0000	PS-Code Output group	Error at PLC output group: {%}	FF	1 Reboot 2 If problem persist, check the output group with the problem. 3 Contact support
Inverters				
0104FF0000	IG-0	Inverters do not communicate	FF	1 Check device and its energy supply 2 Check wired and value resistance of bus CAN 3 Reboot maybe solves the problem
0304030100	IG-1	Failure in synchronism of the inverter at node: {%}	3	1 Press the emergency button, release it and press reset button again 2 Try to reboot 3 If problem persist, check the firmware of the inverters and conctac with support
3004FF0200	IG-2	Electrical reset of inverters in progress	FF	1 Wait about 10-30 seconds while reset is being performed. (Normally the problem will be solved and the vehicle continues running). 2 Only if problem persist, contact with support

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Visual SLAM guidance display codes - AMR P604V
Continued

Code	Display Code	Description	Interpretation/Actions	Troubleshooting
0304FF0300	IG-3	Electrical reset of inverters not achieved	FF	1 Reboot 2 If problem persist, contact with support
3004FF0400	IG-4	Software reset of inverters in progress at node: {%}	FF	1 Wait some time while software reset is being performed. (Normally the problem will be solved, and the vehicle continues running). 2 Only if problem persist, contact with support
0304FF0500	IG-5	Software reset of inverters not achieved at node: {%}	FF	1 Reboot 2 If problem persist, contact with support
3004FF0600	IG-6	Error at SME inverter	FF	The system would try to resolve the problem itself. Please contact support if these errors appear and they are not erased automatically in a certain time.
3041FF0000	IL-0	Inverter failure persist	FF	1 Check if there is another detail error, related to the inverter. 2 Press the emergency button, release it and reset again. 3 Check if there is some obstacle blocking the wheels of the vehicle. 4 If problem persist, check the fuses through which supply is given to the inverters 5 Extract a black box to analyze better the error of the inverter. Contact support if required. 6 Rebooting the vehicle may solve the problem.

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Visual SLAM guidance display codes - AMR P604V
Continued

Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3041FF0100	IL-1	Communication error with inverter	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter. 3 Check CAN communication.
3041FF0200	IL-2	Protection against short circuit detected by inverter	FF	1 Check connectors and wiring. 2 Check that the motor and its winding is correct.
3041FF0300	IL-3	Configuration of inverter not correct	FF	1 Check the configuration of the Inverter with the SW of the device. 2 Check the lateral switches, if they are correctly configured. 3 Contact support.
3041FF0400	IL-4	Control error. Difference in position or speed to high	FF	1. Check if the drive unit is correct. If there is some obstacles in the wheels. 2. Check if the brake is being releasing correctly, and does not block the movement. 3. Check if the encoder is correctly fixed. 4. Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3041FF0500	IL-5	Serial communication error	FF	1. Check supply, fuses and wiring. 2. Check the serial communication.

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Visual SLAM guidance display codes - AMR P604V
Continued

Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3041FF0600	IL-6	Feedback error. The position of the motor has been deflected	FF	1. Check if the drive unit is correct. If there is some obstacles in the wheels. 2. Check if the brake is being releasing correctly, and does not block the movement. 3. Check if the encoder is correctly fixed. 4. Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3041FF0700	IL-7	Switch positive limit active	FF	Contact support.
3041FF0800	IL-8	Switch negative limit active	FF	Contact support.
3041FF0900	IL-9	Overcurrent detected at inverter	FF	1. Check if the drive unit is correct. If there is some obstacles in the wheels. 2. Check if the brake is being releasing correctly, and does not block the movement. 3. Check if the encoder is correctly fixed. 4. Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3041FF0A00	IL-10	I2t overcurrent protection activated	FF	1. Check if the drive unit is correct. If there is some obstacles in the wheels. 2. Check if the brake is being releasing correctly, and does not block the movement. 3. Check if the encoder is correctly fixed. 4. Check the wiring between inverter and motor. (Maybe is moving in opposite direction). 5. Check if the load assigned to the vehicle does not exceed the datasheet limits.

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Visual SLAM guidance display codes - AMR P604V
Continued

Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3041FF0B00	IL-11	Overtemperature detected. (Only available with sensor PTC/NTC)	FF	This model does not have temperature sensor. (Error should not appear)
3041FF0C00	IL-12	Overtemperature at drive	FF	Possible causes of the over temperautre. 1. Check if the drive unit is correct. If there is some obstacles in the wheels. 2. Check if the brake is being releasing correctly, and does not block the movement. 3. Check if the encoder is correctly fixed. 4. Check the wiring between inverter and motor. (Maybe is moving in opposite direction). 5. Check if the load assigned to the vehicle does not exceed the datasheet limits. 6. Check if enviroment temperature is higher than previous days.
3041FF0D00	IL-13	Over voltage detected	FF	1. Check supply, fuses and wiring. 2. Check if power contactor is closed and supply is reaching the inverter.
3041FF0E00	IL-14	Under voltage detected	FF	1. Check supply, fuses and wiring. 2. Check if power contactor is closed and supply is reaching the inverter.
3041FF0F00	IL-15	Command error	FF	Check the inverter configuration is according to vehicle SW. Contact support if it is required.
3041FF1000	IL-16	Unit not enabled	FF	Check STO wiring.
3041FF2100	IL-33	Left inverter error	FF	Check drive manual and contact with support.
3041FF2200	IL-34	Left inverter error	FF	Check drive manual and contact with support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3041FF2300	IL-35	Left inverter error	FF	Check drive manual and contact with support.
3041FF2400	IL-36	Left inverter error	FF	Check drive manual and contact with support.
3041FF2500	IL-37	Left inverter error	FF	Check drive manual and contact with support.
3041FF2600	IL-38	Left inverter error	FF	Check drive manual and contact with support.
3041FF2700	IL-39	Left inverter error	FF	Check drive manual and contact with support.
3041FF2800	IL-40	Left inverter error	FF	Check drive manual and contact with support.
3041FF2900	IL-41	Left inverter error	FF	Check drive manual and contact with support.
3041FF2A00	IL-42	Left inverter error	FF	Check drive manual and contact with support.
3041FF2B00	IL-43	Left inverter error	FF	Check drive manual and contact with support.
3041FF2C00	IL-44	Left inverter error	FF	Check drive manual and contact with support.
3041FF2D00	IL-45	Left inverter error	FF	Check drive manual and contact with support.
3041FF2E00	IL-46	Left inverter error	FF	Check drive manual and contact with support.
3041FF2F00	IL-47	Left inverter error	FF	Check drive manual and contact with support.
3041FF3000	IL-48	Left inverter error	FF	Check drive manual and contact with support.
3041FF3100	IL-49	Left inverter error	FF	Check drive manual and contact with support.
3041FF3200	IL-50	Left inverter error	FF	Check drive manual and contact with support.
3041FF3300	IL-51	Left inverter error	FF	Check drive manual and contact with support.

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Visual SLAM guidance display codes - AMR P604V
Continued

Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3041FF3400	IL-52	Left inverter error	FF	Check drive manual and contact with support.
3041FF3500	IL-53	Left inverter error	FF	Check drive manual and contact with support.
3041FF3600	IL-54	Left inverter error	FF	Check drive manual and contact with support.
3041FF3700	IL-55	Left inverter error	FF	Check drive manual and contact with support.
3041FF3800	IL-56	Left inverter error	FF	Check drive manual and contact with support.
3041FF3900	IL-57	Left inverter error	FF	Check drive manual and contact with support.
3041FF3A00	IL-58	Left inverter error	FF	Check drive manual and contact with support.
3041FF3B00	IL-59	Left inverter error	FF	Check drive manual and contact with support.
3041FF3C00	IL-60	Left inverter error	FF	Check drive manual and contact with support.
3041FF3D00	IL-61	Left inverter error	FF	Check drive manual and contact with support.
3041FF3E00	IL-62	Left inverter error	FF	Check drive manual and contact with support.
3041FF3F00	IL-63	Left inverter error	FF	Check drive manual and contact with support.
3041FF4000	IL-64	Left inverter error	FF	Check drive manual and contact with support.
3041FF4100	IL-65	Left inverter reset	FF	Wait some time for the reset. If this alarm appears a lot, contact suppport for more information.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3042FF0100	IR-1	Communication error with inverter	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter. 3 Check CAN communication.
3042FF0200	IR-2	Protection against short circuit detected by inverter	FF	1 Check connectors and wiring. 2 Check that the motor and its winding is correct.
3042FF0300	IR-3	Configuration of inverter not correct	FF	1 Check the configuration of the Inverter with the SW of the device. 2 Check the lateral switches, if they are correctly configured. 3 Contact support.
3042FF0400	IR-4	Control error. Difference in position or speed to high	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3042FF0500	IR-5	Serial communication error	FF	1 Check supply, fuses and wiring. 2 Check the serial communication.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3042FF0600	IR-6	Feedback error. The position of the motor has been deflected	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3042FF0700	IR-7	Switch positive limit active	FF	Contact support.
3042FF0800	IR-8	Switch negative limit active	FF	Contact support.
3042FF0900	IR-9	Overcurrent detected at inverter	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction).

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3042FF0A00	IR-10	I2t overcurrent protection activated	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction). 5 Check if the load assigned to the vehicle does not exceed the datasheet limits.
3042FF0B00	IR-11	Overtemperature detected. (Only available with sensor PTC/NTC)	FF	This model does not have temperature sensor. (Error should not appear)

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Visual SLAM guidance display codes - AMR P604V
Continued

Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3042FF0C00	IR-12	Overtemperature at drive	FF	Possible causes of the over temperature: 1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction). 5 Check if the load assigned to the vehicle does not exceed the datasheet limits. 6 Check if environment temperature is higher than previous days.
3042FF0D00	IR-13	Over voltage detected	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter.
3042FF0E00	IR-14	Under voltage detected	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter.
3042FF0F00	IR-15	Command error	FF	Check the inverter configuration is according to vehicle SW. Contact support if it is required.
3042FF1000	IR-16	Unit not enabled	FF	Check STO wiring.

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Visual SLAM guidance display codes - AMR P604V
Continued

Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3042FF2100	IR-33	Extended error	FF	Check drive manual and contact with support.
3042FF2200	IR-34	Encoder not conected ABZ	FF	Check drive manual and contact with support.
3042FF2300	IR-35	Encoder internal error UVW	FF	Check drive manual and contact with support.
3042FF2400	IR-36	Encoder CRC communication disturbed	FF	Check drive manual and contact with support.
3042FF2500	IR-37	High temperature at heat sink	FF	Check drive manual and contact with support.
3042FF2600	IR-38	Over voltage detected DC bus	FF	Check drive manual and contact with support.
3042FF2700	IR-39	Under voltage detected DC bus	FF	Check drive manual and contact with support.
3042FF2800	IR-40	Power Stage of motor short circuit	FF	Check drive manual and contact with support.
3042FF2900	IR-41	Overload brake chopper resistor	FF	Check drive manual and contact with support.
3042FF2A00	IR-42	Max. Following error exceeded	FF	Check drive manual and contact with support.
3042FF2B00	IR-43	Logic drive, low supply voltage	FF	Check drive manual and contact with support.
3042FF2C00	IR-44	Motor of power stage I2t error	FF	Check drive manual and contact with support.
3042FF2D00	IR-45	Pulse input frequency too high	FF	Check drive manual and contact with support.
3042FF2E00	IR-46	Motore temperaute sensor is too high	FF	Check drive manual and contact with support.
3042FF2F00	IR-47	Motor communication, no encoder connected, not repply	FF	Check drive manual and contact with support.
3042FF3000	IR-48	EEPROM checksum fault	FF	Check drive manual and contact with support.
3042FF3100	IR-49	Current sensor signal offset or ripple too large	FF	Check drive manual and contact with support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3042FF3200	IR-50	Software watchdog exception	FF	Check drive manual and contact with support.
3042FF3300	IR-51	Invalid interrupt exception	FF	Check drive manual and contact with support.
3042FF3400	IR-52	Wrong MCU type detected	FF	Check drive manual and contact with support.
3042FF3500	IR-53	No motor data in EEPROM / motor never configured	FF	Check drive manual and contact with support.
3042FF3600	IR-54	Reserved	FF	Check drive manual and contact with support.
3042FF3700	IR-55	Reserved	FF	Check drive manual and contact with support.
3042FF3800	IR-56	Reserved	FF	Check drive manual and contact with support.
3042FF3900	IR-57	External enable	FF	Check drive manual and contact with support.
3042FF3A00	IR-58	Positive limit	FF	Check drive manual and contact with support.
3042FF3B00	IR-59	Negative limit	FF	Check drive manual and contact with support.
3042FF3C00	IR-60	Internal firmware error in SPI handling	FF	Check drive manual and contact with support.
3042FF3D00	IR-61	Reserved	FF	Check drive manual and contact with support.
3042FF3E00	IR-62	Different direction between motor and position encoder in closed loop operation by a second encoder	FF	Check drive manual and contact with support.
3042FF3F00	IR-63	Reserved	FF	Check drive manual and contact with support.
3042FF4000	IR-64	Master encoder counting error	FF	Check drive manual and contact with support.
3042FF4100	IR-65	Inverter resetting after error	FF	Wait some time for the reset. If this alarm appears a lot, contact support for more information.

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Visual SLAM guidance display codes - AMR P604V
Continued

Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3043FF0100	ILL-1	Communication error with inverter	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter. 3 Check CAN communication.
3043FF0200	ILL-2	Protection against short circuit detected by inverter	FF	1 Check connectors and wiring. 2 Check that the motor and its winding is correct.
3043FF0300	ILL-3	Configuration of inverter not correct	FF	1 Check the configuration of the Inverter with the SW of the device. 2 Check the lateral switches, if they are correctly configured. 3 Contact support.
3043FF0400	ILL-4	Control error. Difference in position or speed to high	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3043FF0500	ILL-5	Serial communication error	FF	Check supply, fuses and wiring. Check the serial communication.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3043FF0600	ILL-6	Feedback error. The position of the motor has been deflected	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3043FF0700	ILL-7	Switch positive limit active	FF	Contact support.
3043FF0800	ILL-8	Switch negative limit active	FF	Contact support.
3043FF0900	ILL-9	Overcurrent detected at inverter	FF	Check if the drive unit is correct. If there is some obstacles in the wheels. Check if the brake is being releasing correctly, and does not block the movement. Check if the encoder is correctly fixed. Check the wiring between inverter and motor. (Maybe is moving in opposite direction).

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3043FF0A00	ILL-10	I2t overcurrent protection activated	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction). 5 Check if the load assigned to the vehicle does not exceed the datasheet limits.
3043FF0B00	ILL-11	Overtemperature detected. (Only available with sensor PTC/NTC)	FF	This model does not have temperature sensor. (Error should not appear)

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3043FF0C00	ILL-12	Overtemperature at drive	FF	Possible causes of the over temperature: 1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction). 5 Check if the load assigned to the vehicle does not exceed the datasheet limits. 6 Check if enviroment temperature is higher than previous days.
3043FF0D00	ILL-13	Over voltage detected	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter.
3043FF0E00	ILL-14	Under voltage detected	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter.
3043FF0F00	ILL-15	Command error	FF	Check the inverter configuration is according to vehicle SW. Contact support if it is required.
3043FF1000	ILL-16	Unit not enabled	FF	Check STO wiring.

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Visual SLAM guidance display codes - AMR P604V
Continued

Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3043FF2100	ILL-33	Extended error	FF	Check drive manual and contact with support.
3043FF2200	ILL-34	Encoder not conected ABZ	FF	Check drive manual and contact with support.
3043FF2300	ILL-35	Encoder internal error UVW	FF	Check drive manual and contact with support.
3043FF2400	ILL-36	Encoder CRC communication disturbed	FF	Check drive manual and contact with support.
3043FF2500	ILL-37	High temperature at heat sink	FF	Check drive manual and contact with support.
3043FF2600	ILL-38	Over voltage detected DC bus	FF	Check drive manual and contact with support.
3043FF2700	ILL-39	Under voltage detected DC bus	FF	Check drive manual and contact with support.
3043FF2800	ILL-40	Power Stage of motor short circuit	FF	Check drive manual and contact with support.
3043FF2900	ILL-41	Overload brake chopper resistor	FF	Check drive manual and contact with support.
3043FF2A00	ILL-42	Max. Following error exceeded	FF	Check drive manual and contact with support.
3043FF2B00	ILL-43	Logic drive, low supply voltage	FF	Check drive manual and contact with support.
3043FF2C00	ILL-44	Motor of power stage I2t error	FF	Check drive manual and contact with support.
3043FF2D00	ILL-45	Pulse input frequency too high	FF	Check drive manual and contact with support.
3043FF2E00	ILL-46	Motore temperaute sensor is too high	FF	Check drive manual and contact with support.
3043FF2F00	ILL-47	Motor communication, no encoder connected, not repply	FF	Check drive manual and contact with support.
3043FF3000	ILL-48	EEPROM checksum fault	FF	Check drive manual and contact with support.
3043FF3100	ILL-49	Current sensor signal offset or ripple too large	FF	Check drive manual and contact with support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3043FF3200	ILL-50	Software watchdog exception	FF	Check drive manual and contact with support.
3043FF3300	ILL-51	Invalid interrupt exception	FF	Check drive manual and contact with support.
3043FF3400	ILL-52	Wrong MCU type detected	FF	Check drive manual and contact with support.
3043FF3500	ILL-53	No motor data in EEPROM / motor never configured	FF	Check drive manual and contact with support.
3043FF3600	ILL-54	Reserved	FF	Check drive manual and contact with support.
3043FF3700	ILL-55	Reserved	FF	Check drive manual and contact with support.
3043FF3800	ILL-56	Reserved	FF	Check drive manual and contact with support.
3043FF3900	ILL-57	External enable	FF	Check drive manual and contact with support.
3043FF3A00	ILL-58	Positive limit	FF	Check drive manual and contact with support.
3043FF3B00	ILL-59	Negative limit	FF	Check drive manual and contact with support.
3043FF3C00	ILL-60	Internal firmware error in SPI handling	FF	Check drive manual and contact with support.
3043FF3D00	ILL-61	Reserved	FF	Check drive manual and contact with support.
3043FF3E00	ILL-62	Different direction between motor and position encoder in closed loop operation by a second encoder	FF	Check drive manual and contact with support.
3043FF3F00	ILL-63	Reserved	FF	Check drive manual and contact with support.
3043FF4000	ILL-64	Master encoder counting error	FF	Check drive manual and contact with support.
3043FF4100	ILL-65	Inverter resetting after error	FF	Wait some time for the reset. If this alarm appears a lot, contact suppport for more information.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3044FF0000	IRR-0	Inverter failure persist	FF	1 Check if there is another detail error, related to the inverter. 2 Press the emergency button, release it and reset again. 3 Check if there is some obstacle blocking the wheels of the vehicle. 4 If problem persist, check the fuses through which supply is given to the inverters 5 Extract a black box to analyze better the error of the inverter. Contact support if required. 6 Rebooting the vehicle may solve the problem.
3044FF0100	IRR-1	Communication error with inverter	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter. 3 Check CAN communication.
3044FF0200	IRR-2	Protection against short circuit detected by inverter	FF	1 Check connectors and wiring. 2 Check that the motor and its winding is correct.
3044FF0300	IRR-3	Configuration of inverter not correct	FF	1 Check the configuration of the Inverter with the SW of the device. 2 Check the lateral switches, if they are correctly configured. 3 Contact support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3044FF0400	IRR-4	Control error. Difference in position or speed to high	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3044FF0500	IRR-5	Serial communication error	FF	1 Check supply, fuses and wiring. 2 Check the serial communication.
3044FF0600	IRR-6	Feedback error. The position of the motor has been deflected	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3044FF0700	IRR-7	Switch positive limit active	FF	Contact support.
3044FF0800	IRR-8	Switch negative limit active	FF	Contact support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3044FF0900	IRR-9	Overcurrent detected at inverter	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3044FF0A00	IRR-10	I2t overcurrent protection activated	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction). 5 Check if the load assigned to the vehicle does not exceed the datasheet limits.
3044FF0B00	IRR-11	Overtemperature detected. (Only available with sensor PTC/NTC)	FF	This model does not have temperature sensor. (Error should not appear)

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3044FF0C00	IRR-12	Overtemperature at drive	FF	Possible causes of the over temperature: 1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction). 5 Check if the load assigned to the vehicle does not exceed the datasheet limits. 6 Check if enviroment temperature is higher than previous days.
3044FF0D00	IRR-13	Over voltage detected	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter.
3044FF0E00	IRR-14	Under voltage detected	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter.
3044FF0F00	IRR-15	Command error	FF	Check the inverter configuration is according to vehicle SW. Contact support if it is required.
3044FF1000	IRR-16	Unit not enabled	FF	Check STO wiring.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3044FF2100	IRR-33	Extended error	FF	Check drive manual and contact with support.
3044FF2200	IRR-34	Encoder not conected ABZ	FF	Check drive manual and contact with support.
3044FF2300	IRR-35	Encoder internal error UVW	FF	Check drive manual and contact with support.
3044FF2400	IRR-36	Encoder CRC communication disturbed	FF	Check drive manual and contact with support.
3044FF2500	IRR-37	High temperature at heat sink	FF	Check drive manual and contact with support.
3044FF2600	IRR-38	Over voltage detected DC bus	FF	Check drive manual and contact with support.
3044FF2700	IRR-39	Under voltage detected DC bus	FF	Check drive manual and contact with support.
3044FF2800	IRR-40	Power Stage of motor short circuit	FF	Check drive manual and contact with support.
3044FF2900	IRR-41	Overload brake chopper resistor	FF	Check drive manual and contact with support.
3044FF2A00	IRR-42	Max. Following error exceeded	FF	Check drive manual and contact with support.
3044FF2B00	IRR-43	Logic drive, low supply voltage	FF	Check drive manual and contact with support.
3044FF2C00	IRR-44	Motor of power stage I2t error	FF	Check drive manual and contact with support.
3044FF2D00	IRR-45	Pulse input frequency too high	FF	Check drive manual and contact with support.
3044FF2E00	IRR-46	Motore temperaute sensor is too high	FF	Check drive manual and contact with support.
3044FF2F00	IRR-47	Motor communication, no encoder connected, not repply	FF	Check drive manual and contact with support.
3044FF3000	IRR-48	EEPROM checksum fault	FF	Check drive manual and contact with support.
3044FF3100	IRR-49	Current sensor signal offset or ripple too large	FF	Check drive manual and contact with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3044FF3200	IRR-50	Software watchdog exception	FF	Check drive manual and contact with support.
3044FF3300	IRR-51	Invalid interrupt exception	FF	Check drive manual and contact with support.
3044FF3400	IRR-52	Wrong MCU type detected	FF	Check drive manual and contact with support.
3044FF3500	IRR-53	No motor data in EEPROM / motor never configured	FF	Check drive manual and contact with support.
3044FF3600	IRR-54	Reserved	FF	Check drive manual and contact with support.
3044FF3700	IRR-55	Reserved	FF	Check drive manual and contact with support.
3044FF3800	IRR-56	Reserved	FF	Check drive manual and contact with support.
3044FF3900	IRR-57	External enable	FF	Check drive manual and contact with support.
3044FF3A00	IRR-58	Positive limit	FF	Check drive manual and contact with support.
3044FF3B00	IRR-59	Negative limit	FF	Check drive manual and contact with support.
3044FF3C00	IRR-60	Internal firmware error in SPI handling	FF	Check drive manual and contact with support.
3044FF3D00	IRR-61	Reserved	FF	Check drive manual and contact with support.
3044FF3E00	IRR-62	Different direction between motor and position encoder in closed loop operation by a second encoder	FF	Check drive manual and contact with support.
3044FF3F00	IRR-63	Reserved	FF	Check drive manual and contact with support.
3044FF4000	IRR-64	Master encoder counting error	FF	Check drive manual and contact with support.
3044FF4100	IRR-65	Inverter resetting after error	FF	Wait some time for the reset. If this alarm appears a lot, contact suppport for more information.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3045FF0000	RI-0	Inverter failure persist	FF	1 Check if there is another detail error, related to the inverter. 2 Press the emergency button, release it and reset again. 3 Check if there is some obstacle blocking the wheels of the vehicle. 4 If problem persist, check the fuses through which supply is given to the inverters 5 Extract a black box to analyze better the error of the inverter. Contact support if required. 6 Rebooting the vehicle may solve the problem.
3045FF0100	RI-1	Communication error with inverter	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter. 3 Check CAN communication.
3045FF0200	RI-2	Protection against short circuit detected by inverter	FF	1 Check connectors and wiring. 2 Check that the motor and its winding is correct.
3045FF0300	RI-3	Configuration of inverter not correct	FF	1 Check the configuration of the Inverter with the SW of the device. 2 Check the lateral switches, if they are correctly configured. 3 Contact support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3045FF0400	RI-4	Control error. Difference in position or speed to high	FF	1 Check if the drive unit is correct. If there are some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3045FF0500	RI-5	Serial communication error	FF	1 Check supply, fuses and wiring. 2 Check the serial communication.
3045FF0600	RI-6	Feedback error. The position of the motor has been deflected	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3045FF0700	RI-7	Switch positive limit active	FF	Contact support.
3045FF0800	RI-8	Switch negative limit active	FF	Contact support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3045FF0900	RI-9	Overcurrent detected at inverter	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction).
3045FF0A00	RI-10	I2t overcurrent protection activated	FF	1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction). 5 Check if the load assigned to the vehicle does not exceed the datasheet limits.
3045FF0B00	RI-11	Overtemperature detected. (Only available with sensor PTC/NTC)	FF	This model does not have temperature sensor. (Error should not appear)

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3045FF0C00	RI-12	Overtemperature at drive	FF	Possible causes of the over temperature: 1 Check if the drive unit is correct. If there is some obstacles in the wheels. 2 Check if the brake is being releasing correctly, and does not block the movement. 3 Check if the encoder is correctly fixed. 4 Check the wiring between inverter and motor. (Maybe is moving in opposite direction). 5 Check if the load assigned to the vehicle does not exceed the datasheet limits. 6 Check if environment temperature is higher than previous days.
3045FF0D00	RI-13	Over voltage detected	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter.
3045FF0E00	RI-14	Under voltage detected	FF	1 Check supply, fuses and wiring. 2 Check if power contactor is closed and supply is reaching the inverter.
3045FF0F00	RI-15	Command error	FF	Check the inverter configuration is according to vehicle SW. Contact support if it is required.
3045FF1000	RI-16	Unit not enabled	FF	Check STO wiring.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3046FFA000	PL-160	SME inverter has gone to state alarm at node: {%}	FF	Check if this alarm is automatically reset. If not, contact with support.
3046FFA100	PL-161	The lifting inverter SME has a blocking error: {%}	FF	Machine will try to reset automatically the error and continue working. Only if error persist or it appears a lot of time, check please manual of SME inverter and if necessary conctact with support
3046FFA200	PL-162	The lifting inverter SME has a stopping error: {%}	FF	Machine will try to reset automatically the error and continue working. Only if error persist or it appears a lot of time, check please manual of SME inverter and if necessary conctact with support
3046FFA300	PL-163	The lifting inverter SME has a limitation error: {%}	FF	Machine will try to reset automatically the error and continue working. Only if error persist, or it appears a lot of time, check please manual of SME inverter and if necessary conctact with support
614600A400	PL-164	The lifting inverter SME has a warning: {%}	00	It could be normal that a warning appears. Check the reason of it at manual of SME inverter
	Laser scanners			

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3016010400	LS-4	Anticollision laser detection. Field applied :{%}	01	1 Check it there is some object detected by laser. Remove the object if possible. 2 Use a cloth to clean the laser of dust and particles. 3 Verify it laser field (center, left, right) is correctly assigned. 4 Verify the laser is not scratched or damaged. 5 Check the error code in manufacturer's user manual. This error is shown in the display of the anti-collision laser
0316010400	LS-4	Anticollision laser detection. Field applied :{%}	01	1 Check it there is some object detected by laser. Remove the object if possible and press the reset button to restart. 2 Use a cloth to clean the laser of dust and particles. 3 Verify it laser field (center, left, right) is correctly assigned. 4 Verify the laser is not scratched or damaged. 5 Check the error code in manufacturer's user manual. This error is shown in the display of the anti-collision laser

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
6016000500	LS-5	Anticollision laser optics are dirty but operation is still guaranteed	00	1 Use a cloth to clean the laser of dust and particles. 2 Verify the laser is not scratched or damaged. 3 Check the error code in manufacturer's user manual. This error is shown in the display of the anticollision laser
6016000600	LS-6	Anticollision laser optics are dirty and operation is not guaranteed	00	1 Use a cloth to clean the laser of dust and particles. 2 Verify the laser is not scratched or damaged. 3 Check the error code in manufacturer's user manual. This error is shown in the display of the anticollision laser
3016010600	LS-6	Anticollision laser optics are dirty and operation is not guaranteed	01	1 Use a cloth to clean the laser of dust and particles. 2 Verify the laser is not scratched or damaged. 3 Check the error code in manufacturer's user manual. This error is shown in the display of the anti-collision laser

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
6016000700	LS-7	Anticollision laser optics are dirty and operation is not guaranteed	00	1 Check the error shown on the laser display 2 Fix the cause of the error in accordance to manufacturer's operating instructions 3 Switch the voltage supply of the laser off and then on again or restart the laser by means of CDS-S100
3016010700	LS-7	Anticollision laser in lock-out system status	01	1 Check the error shown on the laser display 2 Fix the cause of the error in accordance to manufacturer's operating instructions 3 Switch the voltage supply of the laser off and then on again or restart the laser by means of CDS-S100
301D000100	LF-1	Laser error detection - Front. Field applied: {%}	00	1 Check it there is some object detected by laser. Remove the object if possible. 2 Use a cloth to clean the laser of dust and particles. 3 Verify it laser field (center, left, right) is correctly assigned. 4 Verify the laser is not scratched or damaged. 5 Keep pressed button (or button combination) to ignore laser and move some meters until we left behind the obstacle.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
611D040200	LF-2	Laser warning detection 1 - Front. Field applied: {%}	04	1. Check it there is some object detected by laser. Remove the object if possible. 2. Verify it laser field (center, left, right) is correctly assigned.
611D000300	LF-3	Laser warning detection 2 - Front. Field applied: {%}	04	1 Check it there is some object detected by laser. Remove the object if possible. 2 Verify it laser field (center, left, right) is correctly assigned.
601D000400	LF-4	Laser error detection - Front. Field applied: {%}	00	1 Check it there is some object detected by laser. Remove the object if possible. 2 Use a cloth to clean the laser of dust and particles. 3 Verify it laser field (center, left, right) is correctly assigned. 4 Verify the laser is not scratched or damaged. 5 Keep pressed button (or button combination) to ignore laser and move some meters until we left behind the obstacle.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
301E000100	LR-1	Laser error detection - Rear. Field applied: {%}	00	1 Check it there is some object detected by laser. Remove the object if possible. 2 Use a cloth to clean the laser of dust and particles. 3 Verify it laser field (center, left, right) is correctly assigned. 4 Verify the laser is not scratched or damaged. 5 Keep pressed button (or button combination) to ignore laser and move some meters until we left behind the obstacle.
611E040200	LR-2	Laser warning detection 1 - Rear. Field applied: {%}	04	1 Check it there is some object detected by laser. Remove the object if possible. 2 Verify it laser field (center, left, right) is correctly assigned.
611E000300	LR-3	Laser warning detection 2 - Rear. Field applied: {%}	04	1 Check it there is some object detected by laser. Remove the object if possible. 2 Verify it laser field (center, left, right) is correctly assigned.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
601E000400	LR-4	Laser error detection - Rear. Field applied: {%}	00	1 Check it there is some object detected by laser. Remove the object if possible. 2 Use a cloth to clean the laser of dust and particles. 3 Verify it laser field (center, left, right) is correctly assigned. 4 Verify the laser is not scratched or damaged. 5 Keep pressed button (or button combination) to ignore laser and move some meters until we left behind the obstacle.
0116FF5000	LS-80	Laser Emergency stop. Power down.	FF	If the problem persist. Appears a lot of times, and it is not possible to find the cause of the problem, please contact with support.
0316FF5200	LS-82	Front Laser Field management error with error code: {%}	FF	Contact support.
0316FF5300	LS-83	Front Laser selection with error	FF	Contact support.
0316FF5400	LS-84	Rear Laser Field management error with error code: {%}	FF	Contact support.
0316FF5500	LS-85	Rear Laser selection with error	FF	Contact support.
6016085A00	LS-90	Laser is being reduced to fulfill an operation.	08	Check if the user / commissioner has request the laser reduction or otherwise there is some kind of error
Battery charge				
610D030000	CH-0	Charge in process.	03	Stop the charge to erase the warning
010DFF0100	CH-1	Faulty sensors (position up and down detected at the same time)	FF	Please, contact with support

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
300D030200	CH-2	Charging brush out of standby position	03	1 After rebooting brushes should go to standby position. 2 After pressing emergency and then, reset button, brushes should go also to stanby position. 3 Brushes can also be controlled by screen. 4 Check the input sensor of the brushes.
300D000340	CH-3	Excess of time in moving brushes up or down	00	If the problem persists, contact with support
300D000333	CH-3	Online charge error. No communication	00	1 Check if the position of the vehicle is correct to enable the charge. 2 Check if all wires requested are connect to the charger. 3 Check if the charger report and error. 4 Some has disconnected the wire in the middle of the process.
300D000334	CH-3	Online charge error. No power	00	1 Check if the position of the vehicle is correct to enable the charge. 2 Check if all wires requested are connected to the charger. 3 Check if the charger report and error. 4 Some has disconnected the wire in the middle of the process.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
300D000335	CH-3	Online charge error. Early finished	00	If the user has not stopped the charge, check if there is another error related to battery.
300D003036	CH-3	SmartCharger error. StartFrame not received	00	Please check communication with SmartCharger
300D000337	CH-3	SmartCharger error. EndFrame not received	00	Please check communication with SmartCharger
300D000338	CH-3	SmartCharger error. ChargeControl mismatch	00	Please check communication with SmartCharger
300D000339	CH-3	SmartCharger error. Null currrent received	00	Please check brushes connection between AMR and SmartCharger
300D00033A	CH-3	SmartCharger reports status incompatible with charge	00	Please check SmartCharger status
300D000365	CH-3	Online charge error. Communication lost	00	1 Check if the position of the vehicle is correct to enable the charge. 2 Check if all wires requested are connected to the charger. 3 Check if the charger report and error. 4 Some has disconnected the wire in the middle of the process.
300D000366	CH-3	Online charge error. Power lost	00	1 Check if the position of the vehicle is correct to enable the charge. 2 Check if all wires requested are connected to the charger. 3 Check if the charger report and error. 4 Some has disconnected the wire in the middle of the process.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
300D000367	CH-3	Online charge error. Unexpected finished	00	If the user has not stopped the charge, check if there is another error related to battery.
300D000400	CH-4	Number of consecutive charging errors: {%}	00	Informative. If the vehicle is charged correctly, this error disappears. Pressing white button also erased the error
610D030500	CH-5	Brushes are moving to connect with the charger	03	No fix requested
610D030600	CH-6	Brushes are being disconnected	03	No fix requested
600D000700	CH-7	Number of consecutive charging errors: {%}	00	Informative. If the vehicle is charged correctly, this error disappears. Pressing white button also erased the error
610D030800	CH-8	Wairing for battery contactor to deactivate.	03	No fix requested
Battery				
610F7F0000	BT-0	AMR is powering OFF with SoC: {%}	7F	Check errors and events related, in order to know the reason of power off.
600F000100	BT-1	Battery level low	00	1 Charge the vehicle manually, or wait for the vehicle reaches a station for automatic charge. 2 Check the circuit and the mission commands, to avoid doing long task in sequence without visiting a charging station.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
600F000200	BT-2	Battery level critic AMR will turn off soon	00	1 Charge the vehicle manually. 2 Check the circuit and the mission commands, to avoid doing long task in sequence without visiting a charging station.
610F000300	BT-3	Battery sensors. High difference in temperature sensors	00	1 Check the sensors 2 Contact support
020F7F0400	BT-4	Battery Error. Cell low voltage	00	1 Charge the vehicle manually. 2 Check the circuit and the mission commands, to avoid doing long task in sequence without visiting a charging station.
600F000A00	BT-10	Battery Error. Cell low voltage	00	1 Charge the vehicle manually. 2 Check the circuit and the mission commands, to avoid doing long task in sequence without visiting a charging station. **Note:** a full load might help to balance voltage battery cells.
610F000B00	BT-11	Battery Error. Cell max voltage	00	Contact support.
600FFF0C00	BT-12	Battery Error. Temperature too high	FF	After some time, temperature should reach normal working levels. If not, or this error appears again a lot of times, contact with support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
600FFF0D00	BT-13	Battery Error. Temperature too low	FF	After some time working temperature should reach normal working levels. If not, or this error appears again a lot of times, contact with support.
610F000E00	BT-14	Battery Error. Cell with high voltage difference	00	1 Try to perform a full charge of the battery, in order to balance the inner cells. 2 If the error persist or appears multiple time, consider to change to a new battery or contact with the support.
610F000F00	BT-15	Battery Error. Capacity overflowed	00	To prevent this error, peform a full load of the battery.
610F001000	BT-16	Battery Error. Reserved	00	Reserved
610F001100	BT-17	Battery Error. No communication with battery	00	1 Reboot. 2 If problem persist or appears again, contact with support.
610F001400	BT-20	Battery Warning. Cell below minimum voltage	00	1 Charge the vehicle manually. 2 Check the circuit and the mission comands, to avoid doing long task in sequence without visiting a charging station. **Note:** a full load might help to balance voltage battery cells.
610F001500	BT-21	Battery Warning. Error SoC high	00	Not fix requested
610F001600	BT-22	Battery Warning. Error SoC low	00	Not fix requested
610F001700	BT-23	Battery Warning. High temperature	00	After some time, temperature should reach normal working levels. If not, or this error appears again a lot of times, contact with support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
610F001800	BT-24	Battery Warning. Low temperature	00	After some time working temperature should reach normal working levels. If not, or this error appears again a lot of times, contact with support.
610F001900	BT-25	Battery Warning. Reserved	00	Reserved
610F001A00	BT-26	Battery Warning. Reserved	00	Reserved
610F001B00	BT-27	Battery Warning. Reserved	00	Reserved
010FFF1C00	BT-28	Inductive sensor fails to detect the presence of battery	FF	1 Verify sensor functionality 2 Inspect battery securing mechanism 3 Test sensor response
Safety				
010CFF0000	SF-0	External emergency active	FF	1 Be sure to release all emergency buttons. 2 Press reset button. 3 Check wiring.
030CFF0100	SF-1	There is currently no power.	FF	Release emergency buttons, if pressed. Press reset button to recover power. If an error cause the power lost, check the error.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0200	SF-2	Speed difference error (autoreset failure). Global odometry	FF	1 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 2 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 3 Check the correct calibration of direction encoders. 4 Check at the screen / diagnostic tool the speed measured
030CFF0201	SF-2	Speed difference error (autoreset failure). Front Wheel	FF	1 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 2 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 3 Check the correct calibration of direction encoders. 4 Check at the screen / diagnostic tool the speed measured

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0202	SF-2	Speed difference error (autoreset failure). Front Left Wheel	FF	1 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 2 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 3 Check the correct calibration of direction encoders. 4 Check at the screen / diagnostic tool the speed measured
030CFF0203	SF-2	Speed difference error (autoreset failure). Front Right Wheel	FF	1 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 2 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 3 Check the correct calibration of direction encoders. 4 Check at the screen / diagnostic tool the speed measured

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0204	SF-2	Speed difference error (autoreset failure). Rear Left Wheel	FF	1 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 2 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 3 Check the correct calibration of direction encoders. 4 Check at the screen / diagnostic tool the speed measured
030CFF0205	SF-2	Speed difference error (autoreset failure). Rear Right Wheel	FF	1 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 2 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 3 Check the correct calibration of direction encoders. 4 Check at the screen / diagnostic tool the speed measured

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0206	SF-2	Speed difference error (autoreset failure). Rear Wheel	FF	1 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 2 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 3 Check the correct calibration of direction encoders. 4 Check at the screen / diagnostic tool the speed measured
030CFF020A	SF-2	Speed difference error (autoreset failure). Front Direction	FF	1 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 2 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 3 Check the correct calibration of direction encoders. 4 Check at the screen / diagnostic tool the speed measured

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF020B	SF-2	Speed difference error (autoreset failure). Rear Direction	FF	1 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 2 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 3 Check the correct calibration of direction encoders. 4 Check at the screen / diagnostic tool the speed measured
300CFF0300	SF-3	Speed difference error (autoresetting)	FF	1 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 2 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 3 Check the correct calibration of direction encoders. 4 Check at the screen / diagnostic tool the speed measured

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0401	SF-4	Overspeed error (autoreset failure). Overspeed in auto	FF	1 Check the current working condition. You may be using vehicle in manual mode, or trying to force a laser at a high speed. 2 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 3 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 4 Check the correct calibration of direction encoders. 5 Check at the screen / diagnostic tool the speed measured 6 Consult with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0402	SF-4	Overspeed error (autoreset failure). Overspeed in manual	FF	1 Check the current working condition. You may be using vehicle in manual mode, or trying to force a laser at a high speed. 2 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 3 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 4 Check the correct calibration of direction encoders. 5 Check at the screen / diagnostic tool the speed measured 6 Consult with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0403	SF-4	Overspeed error (autoreset failure). Overspeed while mutting lasers	FF	1 Check the current working condition. You may be using vehicle in manual mode, or trying to force a laser at a high speed. 2 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 3 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 4 Check the correct calibration of direction encoders. 5 Check at the screen / diagnostic tool the speed measured 6 Consult with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0404	SF-4	Overspeed error (autoreset failure). Overspeed while override	FF	1 Check the current working condition. You may be using vehicle in manual mode, or trying to force a laser at a high speed. 2 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 3 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 4 4. Check the correct calibration of direction encoders. 5 5. Check at the screen / diagnostic tool the speed measured 6 6. Consult with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0405	SF-4	Overspeed error (autoreset failure). Overspeed in Front Laser Forward	FF	1 Check the current working condition. You may be using vehicle in manual mode, or trying to force a laser at a high speed. 2 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 3 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 4 Check the correct calibration of direction encoders. 5 Check at the screen / diagnostic tool the speed measured 6 Consult with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0406	SF-4	Overspeed error (autoreset failure). Overspeed in Front Laser Left	FF	1 Check the current working condition. You may be using vehicle in manual mode, or trying to force a laser at a high speed. 2 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 3 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 4 Check the correct calibration of direction encoders. 5 Check at the screen / diagnostic tool the speed measured 6 Consult with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0407	SF-4	Overspeed error (autoreset failure). Overspeed in Front Laser Right	FF	1 Check the current working condition. You may be using vehicle in manual mode, or trying to force a laser at a high speed. 2 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 3 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 4 Check the correct calibration of direction encoders. 5 Check at the screen / diagnostic tool the speed measured 6 Consult with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0408	SF-4	Overspeed error (autoreset failure). Overspeed in Rear Laser Backward	FF	1 Check the current working condition. You may be using vehicle in manual mode, or trying to force a laser at a high speed. 2 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 3 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 4 Check the correct calibration of direction encoders. 5 Check at the screen / diagnostic tool the speed measured 6 Consult with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0409	SF-4	Overspeed error (autoreset failure). Overspeed in Rear Laser Left	FF	1 Check the current working condition. You may be using vehicle in manual mode, or trying to force a laser at a high speed. 2 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 3 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 4 Check the correct calibration of direction encoders. 5 Check at the screen / diagnostic tool the speed measured 6 Consult with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF040A	SF-4	Overspeed error (autoreset failure). Overspeed in Rear Laser Right	FF	1 Check the current working condition. You may be using vehicle in manual mode, or trying to force a laser at a high speed. 2 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 3 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 4 Check the correct calibration of direction encoders. 5 Check at the screen / diagnostic tool the speed measured 6 Consult with support.
030CFF040B	SF-4	Overspeed error (autoreset failure). Overspeed due to transport height	FF	1 Check which transport height sensors is configured in the safety parameters. 2 Make sure that the sensor detection is active when forks are at transport height 3 If the error occurs when forks are above transport heigth, reduce the speed of the edge

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF040C	SF-4	Overspeed error (autoreset failure). Overspeed due to lateral movement	FF	1 Check which transport height sensors is configured in the safety parameters. 2 Make sure that the sensor detection is active when forks are at transport height 3 If the error occurs when forks are above transport heigth, reduce the speed of the edge
300CFF0500	SF-5	Overspeed error (autoresetting)	FF	1 Check the external encoder assembly and check if it is loose or detached. Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 2 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 3 Check the correct calibration of direction encoders. 4 Check at the screen / diagnostic tool the speed measured 5 Consult with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0600	SF-6	Movement in repose (autoreset failure) at Drive	FF	1 Check if the brakes are working correctly and the vehicle cannot move when they are applied. 2 Check if the vehicle is not pushed by an external force.
030CFF0601	SF-6	Movement in repose (autoreset failure) at Front Drive	FF	1 Check if the brakes are working correctly and the vehicle cannot move when they are applied. 2 Check if the vehicle is not pushed by an external force.
030CFF0602	SF-6	Movement in repose (autoreset failure) at Rear Drive	FF	1 Check if the brakes are working correctly and the vehicle cannot move when they are applied. 2 Check if the vehicle is not pushed by an external force.
030CFF0603	SF-6	Movement in repose (autoreset failure) at Front Stear	FF	1 Check if the brakes are working correctly and the vehicle cannot move when they are applied. 2 Check if the vehicle is not pushed by an external force.
030CFF0604	SF-6	Movement in repose (autoreset failure) at Lifty System A	FF	1 Check if the brakes are working correctly and the vehicle cannot move when they are applied. 2 Check if the vehicle is not pushed by an external force.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0605	SF-6	Movement in repose (autoreset failure) at Lifty System B	FF	1 Check if the brakes are working correctly and the vehicle cannot move when they are applied. 2 Check if the vehicle is not pushed by an external force.
030CFF0606	SF-6	Movement in repose (autoreset failure) at Lifty System C	FF	1 Check if the brakes are working correctly and the vehicle cannot move when they are applied. 2 Check if the vehicle is not pushed by an external force.
030CFF0607	SF-6	Movement in repose (autoreset failure) at Lifty System D	FF	1 Check if the brakes are working correctly and the vehicle cannot move when they are applied. 2 Check if the vehicle is not pushed by an external force.
300CFF0700	SF-7	Movement in repose (autoresetting)	FF	1 Check if the brakes are working correctly and the vehicle cannot move when they are applied. 2 Check if the vehicle is not pushed by an external force.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF0800	SF-8	Speed not reached (autoreset failure)	FF	1 Check if there is no object blocking the vehicle. 2 Check in the external encoders are correctly assembled (not loosed or detached). Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 3 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 4 Check at the screen / diagnostic tool the speed measured 5 Consult with support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
300CFF0900	SF-9	Speed not reached (autoresetting)	FF	1 Check if there is no object blocking the vehicle. 2 Check in the external encoders are correctly assembled (not loosed or detached). Option: mark a line of union between axis and encoder to see if it moves any degree with the movement. 3 Check also wires and connectors. Check if encoder has supply energy. Check the output pulses of the encoder. 4 Check at the screen / diagnostic tool the speed measured 5 Consult with support.
020CFF0A00	SF-10	Error in double channel input. Error in emergency buttons circuit	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF0B00	SF-11	Error in double channel input. Error in power contactor	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF0C00	SF-12	Error in double channel input. Error in front laser	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
020CFF0D00	SF-13	Error in double channel input. Error in front direction sensor	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF0E00	SF-14	Error in double channel input. Error in front load sensor	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF0F00	SF-15	Error in double channel input. Error in rear laser	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF1000	SF-16	Error in double channel input. Error in rear direction sensor	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF1100	SF-17	Error in double channel input. Error in rear load sensor	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF1200	SF-18	Error in double channel input. Error in pinhook 1 down detector	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
020CFF1300	SF-19	Error in double channel input. Error in pinhook 2 down detector	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF1400	SF-20	Error in double channel input. Error in front platform up	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF1500	SF-21	Error in double channel input. Error in rear platform up	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF1600	SF-22	Error in double channel input. Error in platform up sensor	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF1700	SF-23	Error in double channel input. Error in platform down sensor	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF1800	SF-24	Error in double channel input. Error in longitudinal sensor	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
020CFF1900	SF-25	Error in double channel input. Error in transversal sensor	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF1A00	SF-26	Error in double channel input. Error in front encoder	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF1B00	SF-27	Error in double channel input. Error in rear encoder	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF1C00	SF-28	Error in double channel input. Error in transport height limit switch	FF	1 Press reset button or reboot. 2 If the error persist or appears a lot of times, check wires and consult with support.
020CFF1D01	SF-29	Error in double channel input. Error in mode switch selector	FF	1 Switch to manual mode without keeping pressed deadman button 2 Press and release deadman button in case it is stuck 3 Check if deadman button signals are bypassed or short-cc to 24 V
010CFF1E00	SF-30	Zero of direction not correct	FF	1 Make the calibration of the zero of direction 2 If the alarm persist, encoders may not being working correctly

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030C7F1F01	SF-31	Front encoder calibration has a failure	7F	1 Make the calibration of the zero of direction 2 If the alarm persist, encoders may not being working correctly
030C7F1F02	SF-31	Rear encoder calibration has a failure	7F	1 Make the calibration of the zero of direction 2 If the alarm persist, encoders may not being working correctly
030C7F2001	SF-32	Front steer encoder calibration not done	7F	1 Make the calibration of the zero of direction 2 If the alarm persist, encoders may not being working correctly
030C7F2002	SF-32	Front steer encoder calibration not done	7F	1 Make the calibration of the zero of direction 2 If the alarm persist, encoders may not being working correctly
030CFF2600	SF-38	Error at CRC and Safety Parameters	FF	1 Load the parameter file again. 2 Contact support

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF2701	SF-39	Error at deceleration track. Front drive.	FF	1 Press reset button to continue working. 2 Check if the vehicle is overload for a certain speed. 3 Check in some object was put just in the middle of the trajectory while ARM was moving at high speed. 4 Check the deceleration parameters contacting with support.
030CFF2702	SF-39	Error at deceleration track. Rear drive.	FF	1 Press reset button to continue working. 2 Check if the vehicle is overload for a certain speed. 3 Check in some object was put just in the middle of the trajectory while ARM was moving at high speed. 4 Check the deceleration parameters contacting with support.
030CFF2703	SF-39	Error at deceleration track. Front steer	FF	1 Press reset button to continue working. 2 Check if the vehicle is overload for a certain speed. 3 Check in some object was put just in the middle of the trajectory while ARM was moving at high speed. 4 Check the deceleration parameters contacting with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF2704	SF-39	Error at deceleration track. Rear drive.	FF	1 Press reset button to continue working. 2 Check if the vehicle is overload for a certain speed. 3 Check in some object was put just in the middle of the trajectory while ARM was moving at high speed. 4 Check the deceleration parameters contacting with support.
030CFF2705	SF-39	Error at deceleration track. Lift System A	FF	1 Press reset button to continue working. 2 Check if the vehicle is overload for a certain speed. 3 Check in some object was put just in the middle of the trajectory while ARM was moving at high speed. 4 Check the deceleration parameters contacting with support.
030CFF2706	SF-39	Error at deceleration track. Lift System B	FF	1 Press reset button to continue working. 2 Check if the vehicle is overload for a certain speed. 3 Check in some object was put just in the middle of the trajectory while ARM was moving at high speed. 4 Check the deceleration parameters contacting with support.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF2707	SF-39	Error at deceleration track. Lift System C	FF	1 Press reset button to continue working. 2 Check if the vehicle is overload for a certain speed. 3 Check in some object was put just in the middle of the trajectory while ARM was moving at high speed. 4 Check the deceleration parameters contacting with support.
030CFF2708	SF-39	Error at deceleration track. Lift System D	FF	1 Press reset button to continue working. 2 Check if the vehicle is overload for a certain speed. 3 Check in some object was put just in the middle of the trajectory while ARM was moving at high speed. 4 Check the deceleration parameters contacting with support.
610C002800	SF-40	Speed reduced	00	Check fix of other alarms.
600C082900	SF-41	Degrade mode active (laser muted)	08	Release ignore laser button
010CFF3000	SF-48	Front bumper error	FF	1 Free front bumper from collision 2 Press reset button to continue working.
010CFF3001	SF-48	Rear bumper error	FF	1 Free rear bumper from collision 2 Press reset button to continue working.
030C013200	SF-50	Brakes of Unit Drive 1 are disconnected	01	Check wiring

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030C013300	SF-51	Brakes of Unit Drive 2 are disconnected	01	Check wiring
030CFF3400	SF-52	EDM function error. Switch 1 is maybe stucked	FF	1 Check the correct behaviour of the contactors and its related auxiliar. 2 Check wired and connectors.
030CFF3500	SF-53	EDM function error. Switch 2 is maybe stucked	FF	1 Check the correct behaviour of the contactors and its related auxiliary. 2 Check wired and connectors.
030CFF3600	SF-54	EDM function error. Safety switch is maybe stucked	FF	1 Check the correct behaviour of the contactors and its related auxiliar. 2 Check wired and connectors.
030CFF3700	SF-55	EDM function error. Brake switch is maybe stucked	FF	1 Check the correct behaviour of the contactors and its related auxiliary. 2 Check wired and connectors.
030CFF3800	SF-56	EDM function error. Charge switch is maybe stucked	FF	1 Check the correct behaviour of the contactors and its related auxiliary. 2 Check wired and connectors.
010CFF3C00	SF-60	PLC PCB Temperature out of limits	FF	1 Reboot 2 Is the environment hotter than usual ?
010CFF3D00	SF-61	PLC Processor Temperature out of limits	FF	1 Reboot 2 Is the environment hotter than usual ?
010CFF3E00	SF-62	Supply VBB30 not ok	FF	1 Reboot. 2 Check the wire supply to the PLC.
010CFF3F00	SF-63	Supply VBB15 not ok	FF	1 Reboot. 2 Check the wire supply to the PLC

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
010CFF4000	SF-64	SF PLC is in failure	FF	Contact support.
030CFF4100	SF-65	No safety PLC has stopped	FF	1 Press white button. 2 Restart by disconnecting the fuse or by other ways. (Normal switch off function will not work in this scenario). 3 It happens again, contact with support
030CFF4600	SF-70	The load of the vehicle has been moved or is not centered	FF	1 Check if the charge is stable, and it is correctly positioned at the vehicle. 2 Check if the load sensors are working correctly.
030CFF4700	SF-71	The load of the vehicle has been lost or is not enough stable	FF	1 Check the situation of the load 2 Check if the charge is stable and it is correctly positioned at the vehicle 3 Check if the load sensors are working correctly
030CFF4801	SF-72	Analog input from load distance pointer A is out of range	FF	1 Check sensor connection 2 Transfer sensor configuration 3 3. Replace component
030CFF4802	SF-72	Analog input from load distance pointer B is out of range	FF	1 Check sensor connection 2 Transfer sensor configuration 3 Replace component
030CFF4803	SF-72	Analog input from load distance pointer C is out of range	FF	1 Check sensor connection 2 Transfer sensor configuration 3 Replace component

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF4804	SF-72	Analog input from load distance pointer D is out of range	FF	1 Check sensor connection 2 Transfer sensor configuration 3 Replace component
030CFF4900	SF-73	Forks are moving while the AMR is inserting forks in load pockets	FF	1 Review mission configuration 2 Check hydraulic circuit
030CFF4A00	SF-74	Load is being pushed with the forks during pick operative	FF	1 Review mission configuration 2 Check the load for defects
030CFF4B00	SF-75	Load is being pulled with the forks after drop operative	FF	1 Review mission configuration 2 Check the load for defects
030CFF4C00	SF-76	Safety PLC has received an unknown transfer request	FF	Contact software developer
030CFF4D00	SF-77	Load status detection has changed during transport	FF	1 Check if load status is correct according to current order 2 If there is a load incoherence, pick or drop the load manually 3 Otherwise, obtain a blackbox to check for pointer malfunction
030CFF4E00	SF-78	Load pointer does not detect the load but load positioning inductive sensors do	FF	1 Check if the pointer can detect the load 2 Check if inductive sensors detection is active even if there is no load 3 Otherwise, obtain a blackbox to check for sensor malfunction

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
030CFF4F00	SF-79	Load positioning inductive sensors do not detect the load but load pointer does	FF	1 Check if the inductive sensors can detect the load 2 Check if load pointer detection is active even if there is no load 3 Otherwise, obtain a blackbox to check for sensor malfunction
030CFF5000	SF-80	There is currently no power. Reset button is requested	FF	1 Relase emergency buttons, if pressed. 2 Press reset button to recover power. 3 If an error cause the power lost, check the error. 4 Check the safety switch. 5 Check if pulse signal of emergency buttons are not crossed
030CFF5100	SF-81	Inclinometer detects that the AMR is tilting	FF	1 Check if the AMR is tilted 2 Check if inclinometer is installed correctly 3 Replace component
020CFF5201	SF-82	Deadman button channel 1 from wired controller error	FF	1 Switch to manual mode without keeping pressed deadman button 2 Press and release deadman button in case it is stuck 3 Check if deadman button signals are bypassed or short-cc to 24V

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
020CFF5202	SF-82	Deadman button channel 1 from wired controller error	FF	1 Switch to manual mode without keeping pressed deadman button 2 Press and release deadman button in case it is stuck 3 Check if deadman button signals are bypassed or short-cc to 24V
020CFF5300	SF-83	Discrepancy between left and right load proximity inductive sensors	FF	1 Position the load parallel to the forks 2 Check wiring and connections
020CFF5400	SF-84	Safety ON/OFF hydraulic lift valve command feedback does not match its command	FF	1 Review wiring 2 Check if the PLC is commanding quick changes to the valve 3 Check hydraulic circuit
States machine				
7019000100	ST-1	Initializing. Wait for some seconds.	00	Wait some time
7019000200	ST-2	AMR idle and stopped. Waiting for commands.	00	Put the vehicle in auto mode to start working
7019000300	ST-3	Vehicle in emergency state	00	Solve other alarms and press reset button
6119000400	ST-4	AMR stopped in Auto mode	00	Press auto button to continue working
0219FF0500	ST-5	Brake not applied. Movement by hand allowed	00	Turn the brake button back to normal state
7019000600	ST-6	Manual mode with joystick active	00	The message disappears once manual movement stops
6119000700	ST-7	Traffic zone requested. Waiting…	00	1 Check if the traffic zone has been correctly configured at AMR Suite. 2 Check if the connection to FMS / Local traffic boxes is working correctly

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
7019000800	ST-8	Inserted. Waiting for mission	00	1 Launch a mission manually 2 Check communication with FMS
6119000900	ST-9	Waiting for some signal to continue	00	1 Check in the mission which signal is waiting for 2 Check communication with the devices which may should give the signal
6119000A00	ST-10	Waiting for a signal which enables movement	00	1 Check in the mission which signal is waiting for 2 Check communication with the devices which may should give the signal
6119000C00	ST-12	The vehicle has been planned to be stop at this time interval	00	None
61197F1400	ST-20	Map is being updated	7F	1 Wait some time, until map is update. This could take several minutes. 2 User can also cancel map update to start working again
6119001500	ST-21	Updating map before switching OFF	00	1 Wait some time, until map is update. This could take several minutes. 2 User can also cancel map update to switch off
61197F1600	ST-22	Switching OFF due to some reason	7F	Just informative. The reason of the power off is normally inactivity time, low battery or requested by the user. Check the black box events to know more information

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
6119001700	ST-23	AMR is ready for calibration	00	1 Press white button to start the calibration 2 Pressing emergency button should abort the calibration process
6019FF1800	ST-24	PLC is not config. AMR not recognized	FF	Contact support.
0219FF1900	ST-25	AMR needs to switch off	FF	Please restart the reboot
6119FF1A00	ST-26	Movement has been cancelled	FF	The message should appear only while the robot is stopping and disappear afterwards
Positioning & guidance				
30097F0100	PO-1	Position not valid	7F	In magnetic: 1 Be sure the bifurcation commands (left/centre/right) at Layout are correctly set. 2 Be sure that the tag numbers are also correct. 3 Be sure that the speed is not too high, to be able to follow the bifurcation correctly. In other systems: 1 Update the map to be sure walls, objects and new elements are registered. 2 Clean the cameras and visual elements.

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
0309000200	PO-2	Magnetic guidance sensor: {%} lost	00	1 Check if the vehicle is above magnetic tap circuit. Maybe the magnetic tap is interrupted at some point. 2 If tap is lost during a curve, consider reducing the speed. 3 Check if magnetic tap is North or South. 4 Press reset button, the vehicle will search automatically the tap below it.
0209FF0300	PO-3	Faulty at guidance sensor: {%}	FF	1 Check guidance sensor. Green flash mean it is communicating. 2 Check wiring. Supply of guidance sensor and communication bus.
3009FF0400	PO-4	Error in segments for movement	FF	1 Wait some time. 2 Try to stop and insert the vehicle again. 3 If the problem persist, please contact with support.
3009FF0500	PO-5	Position quality low	FF	1 Update the map to be sure walls, objects and new elements are registered. 2 Clean the cameras and visual measurement elements.
6009000600	PO-6	AMR does not know its position at the layout	00	1 Move the vehicle in manual to an insertion point 2 Wait the external localization system has reboot. Check the map.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
6109000700	PO-7	AMR does not know its position at the lay-out	00	1 Move the vehicle in manual to an insertion point 2 Wait the external localization system has reboot. Check the map.
3009FF0A00	PO-10	AMR cannot perform the movement requested	FF	1 Go to manual, to erase the error 2 Check the Lay-out. Is something wrong in the related edge/nodes ? 3 Contact support
30097F1000	PO-16	Calibration of direction encoders has not been performed or it is lost	7F	1 Perform please a calibration of direction encoders. 2 If problem persist, please contact with support.
3009FF1400	PO-20	Calibration of direction encoders has not been performed or it is lost	FF	1 Go to manual and try to insert the vehicle again 2 If problem persist and appears a lot, please contact with support.
3009FF1500	PO-21	Calibration of direction encoders has not been performed or it is lost	FF	1 Go to manual and try to insert the vehicle again 2 If problem persist and appears a lot, please contact with support.
6109041600	PO-22	Far from path due to lateral error. Slow down	04	1 Until some point, this is warning is normal when trying to achieve high speeds 2 If problem persist and appears a lot, please contact with support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
6109041700	PO-23	Calibration of direction encoders has not been performed or it is lost	04	1 Until some point, this is warning is normal when trying to achieve high speeds 2 If problem persist and appears a lot, please contact with support.
3009FF1800	PO-24	Segment input point is far from current position	FF	Contact support.
0309FF1900	PO-25	Segment final point is far from current position	FF	Contact support.
3009FF1A00	PO-26	Segment final point has been overpassed	FF	1 Check position of the vehicle and obstacle for the stop. 2 Check if the Layout end point matches the real end point expected. 3 Contact support.
60097F1E00	PO-30	Localization is temporally paused	7F	Wait some time. Position should be resume after charging.
02097F1F00	PO-31	Relocalization with high position difference	7F	1 This message may be normal to appear in new projects, or after a map exchange. Just clear it with white button. 2 If it appears in normal behavior, position may be not correct. Clear the error with white button. Try to insert and check if vehicle moves in the usual path. If not, reboot and try to localize again.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
0309FF2000	PO-32	Vehicle seems to be blocked mecanically, It cannot move.	FF	1 Check if there is an obstacle. 2 Press reset button. 3 If it appears again with no clear reason, contact with support.
61097F2100	PO-33	Switching status of the positioning system	7F	If after one of this changes' localization does not comes back ready, an error may be rised.
Lift system				
0221FF0100	HF-1	Position lost at Pin Hook 1	FF	Check end of travel sensor. Maybe it is not correctly adjust, or wired signal is not received due to a broke wire or bad connection.
0222FF0100	HR-1	Position lost at Pin Hook 2	FF	Check end of travel sensor. Maybe it is not correctly adjust, or wired signal is not received due to a broke wire or bad connection.
0202FF0100	LI-1	Lost lift position in Unit {%}	FF	Check end of travel sensor. Maybe it is not correctly adjust, or wired signal is not received due to a broke wire or bad connection.
0321FF0200	HF-2	Excess of time in operation at Pin Hook 1	FF	1 Check the state of the pin-hook, if it moves or if there is some kind of obstacle. 2 Check end of travel sensor. Maybe it is not correctly adjust, or wired signal is not received due to a broke wire or bad connection.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
0322FF0200	HR-2	Excess of time in operation at Pin Hook 2	FF	1 Check the state of the pin-hook, if it moves or if there is some kind of obstacle. 2 Check end of travel sensor. Maybe it is not correctly adjust, or wired signal is not received due to a broke wire or bad connection.
0302FF0200	LI-2	Excess of time in operation lift functionality in Unit {%}	FF	Check the state of the lift system, so there is not any obstacle or blockage
0221FF0300	HF-3	Incoherence in commands at Pin Hook 1	FF	Check the mission and contact with support.
0222FF0300	HR-3	Incoherence in commands at Pin Hook 2	FF	Check the mission and contact with support.
0202FF0300	LI-3	Incoherence in commands at Lift system	FF	Check the mission and contact with support.
6121000400	HF-4	Pinhook 1 is taking the load	00	Not fix requested
6122000400	HR-4	Pinhook 2 is taking the load	00	Not fix requested
6102000400	LI-4	Lifting Lift is moving up	00	Not fix requested
6121000500	HF-5	Pinhook 1 is releasing the load	00	Not fix requested
6122000500	HR-5	Pinhook 2 is releasing the load	00	Not fix requested
6102000500	LI-5	Lifting Lift is moving down	00	Not fix requested
0321FF0600	HF-6	PH1 is detecting up and down	FF	Check the upper and bottom sensor of the pin-hook
0322FF0600	HR-6	PH2 is detecting up and down	FF	Check the upper and bottom sensor of the pin-hook
0302FF0600	LI-6	Lifting Lift is detecting up and down	FF	Check the upper and bottom sensor of the lifting Lift

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
0321FF0700	HF-7	Excess of time in operation at Pin Hook 1	FF	1 Check the state of the pin-hook, if it moves or if there is some kind of obstacle. 2 Check end of travel sensor. Maybe it is not correctly adjust, or wired signal is not received due to a broke wire or bad connection.
0322FF0700	HR-7	Excess of time in operation at Pin Hook 2	FF	1 Check the state of the pinhook, if it moves or if there is some kind of obstacle. 2 Check end of travel sensor. Maybe it is not correctly adjust, or wired signal is not received due to a broke wire or bad connection.
0302FF0A00	LI-10	Lift system speed is out of limits	FF	Check calibration and state of lift encoder (not broken cable, etc)
0302FF0B00	LI-11	Lift system cannot follow the setpoint	FF	Check for mechanical blockage in lift system, motor and/or pump
03027F0C00	LI-12	Lift system is out of limits	7F	Check calibration and state of lift encoder (not broken cable, etc)
30027F0D00	LI-13	Lift system is not correctly calibrated	7F	Perform lift calibration
30027F0E00	LI-14	Lift system calibration has not value	7F	Perform lift calibration
0302FF0F00	LI-15	Lift is moving in opposite direction as commanded	FF	Check motor phase connection, control parameters, etc
03027F1000	LI-16	System has requested a lift height out of limits	7F	Check height set point
0302FF1100	LI-17	Lift motor is not following setpoint in RPM	FF	Check motor and mechanical blockage
03027F1200	LI-18	Lift system is out of limits	7F	Check calibration and state of lift encoder (not broken cable, etc)

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
0302011300	LI-19	Lift system is out of limits	01	1 Verify inductive sensors operation 2 Verify hydraulic circuit 3 If nothing is detected in previous check, reset mast extension teach from HMI
6002001300	LI-19	Lift system is out of limits	00	Check calibration and state of lift encoder (not broken cable, etC)
0302011400	LI-20	Mast extension teach has not been done	01	1 Lift forks up until detection from mast extension inductive sensors is lost 2 Lower forks until detection from mast extension inductive sensors is active 3 Repeat previous steps two more times
6002001400	LI-20	Mast extension teach has not been done	00	1 Lift forks up until detection from mast extension inductive sensors is lost 2 Lower forks until detection from mast extension inductive sensors is active 3 Repeat previous steps two more times
30027F1500	LI-21	Lift A and B height difference is out of allowed tolerance.	7F	
03027F1600	LI-22	Lift speed is out of limits	FF	Check calibration and state of lift encoder (not broken cable, etc)
03027F1700	LI-23	Lift system is stuck when it should be moving	FF	Check lifting system and encoder

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
03027F1800	LI-24	Lift system moves in the opposite direction to the one that is commanded	FF	1 Press the reset button 2 Check if the forks can raise the load correctly 3 Check hydraulic system
30027F1D00	LI-29	Lift system is not correclty calibrated	7F	Perform lift calibration
30027F1E00	LI-30	Lift system calibration has not value	7F	Perform lift calibration
Load handling				
0320FF0100	LH-1	AMR is expected to be loaded and does not detect load while performing operation - front sensor	FF	Emplace or remove load from AMR depending on load conditions
0320FF0200	LH-2	AMR is expected to be unloaded and detects load while performing operation - front sensor	FF	Emplace or remove load from AMR depending on load conditions
0320FF0300	LH-3	AMR is expected to be loaded and does not detect load while performing operation - rear sensor	FF	Emplace or remove load from AMR depending on load conditions
0320FF0400	LH-4	AMR is expected to be unloaded and detects load while performing operation - rear sensor	FF	Emplace or remove load from AMR depending on load conditions
0320010500	LH-5	Retractable's limit switch detects that the retractable pointer is not fully extended	01	1 Check possible causes for which the retractable pointer is not fully extended. 2 Replace component
0320FF0600	LH-6	Load distance sensor is not correctly parametrized	FF	1 Identify which pointer is not working 2 Check software parametrization of the pointer
0320FF0700	LH-7	Load distance sensor output is not withing expected range	FF	1 Review wiring 2 Replace component

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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
3020010800	LH-8	Left forktip sensor short detection during transport	01	1 Remove obstacle 2 Clean the sensor 3 Check wiring and or replace sensor if damaged
0320010800	LH-8	Left forktip sensor long detection during transport	01	1 Remove obstacle 2 Clean the sensor 3 Check wiring and or replace sensor if damaged
3020010900	LH-9	Right forktip sensor short detection during transport	01	1 Remove obstacle 2 Clean the sensor 3 Check wiring and or replace sensor if damaged
0320010900	LH-9	Right forktip sensor long detection during transport	01	1 Remove obstacle 2 Clean the sensor 3 Check wiring and or replace sensor if damaged
PLC input from nav systems				
021CFF0100	PN-1	Automatic mode disabled by superior system	FF	Check superior system
301CFF0200	PN-2	No communication with superior system (Stop)	FF	1 Wait until the superior system starts 2 Check switch and communications wire
611C000300	PN-3	No communication with superior system (No-Stop)	00	1 Wait until the superior system starts 2 Check switch and communications wire
Anti-collision camera front				
3023000100	CF-1	Anti-collision camera detection	00	1 Check if there is an obstacle. 2 Clean the camera. 3 Contact support.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
6023000200	CF-2	Anti-collision camera detection	00	1 Check if there is an obstacle. 2 Clean the camera. 3 Contact support.
Anti-collision camera rear				
3024000100	CR-1	Anti-collision camera detection	00	1 Check if there is an obstacle. 2 Clean the camera. 3 Contact support.
6024000200	CR-2	Anti-collision camera detection	00	1 Check if there is an obstacle. 2 Clean the camera. 3 Contact support.
Assert				
02257F0100	AS-1	Involved signal: {%}	7F	Set AMR to manual and reset error
03257F0200	AS-2	Involved signal: {%}	7F	Restore causing conditions (input) and reset error
30257F0300	AS-3	Involved signal: {%}	7F	Error will be automatically released when causing conditions (input) are restored
30257F0400	AS-4	Involved signal: {%}	7F	Error can be overridden by holding reset button
02257F0500	AS-5	Involved signal: {%}	7F	Set AMR to manual and reset error
03257F0600	AS-6	Involved signal: {%}	7F	Restore causing conditions (input) and reset error
30257F0700	AS-7	Involved signal: {%}	7F	Error will be automatically released when causing conditions (input) are restored
30257F0800	AS-8	Involved signal: {%}	7F	Error can be overridden by holding reset button
02257F0900	AS-9	Involved signal: {%}	7F	Set AMR to manual and reset error
03257F0A00	AS-10	Involved signal: {%}	7F	Restore causing conditions (input) and reset error
30257F0B00	AS-11	Involved signal: {%}	7F	Error will be automatically released when causing conditions (input) are restored

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
30257F0C00	AS-12	Involved signal: {%}	7F	Error can be overridden by holding reset button
		PC navigation		
02A07F0100	NA-1	Out of safety zone	7F	Insert the vehicle again
02A07F0200	NA-2	Trajectory action failed	7F	Restart the mission
02A0000300	NA-3	Insertion process failed. No edge available for insertion	00	Move manually near an edge and try to insert again
		PC localization		
30A17F0100	LO-1	Localization lost	01	Move manually to a spot where localization works
60A1000200	LO-2	Error in start positioning because of the map (map name empty or not found)	01	Transfer again the project with a valid map name.
61A1000300	LO-3	Error in Sevensense RTC - date&time may not be accurate	00	Let device update clock settings
61A1000400	LO-4	Syncing time with Sevensense	00	Let device update clock settings
61A1000500	LO-5	AMR project and VSLAM mode mismatch (standalone or server)	00	Check the configuration VSLAM working mode
61A1000600	LO-6	VSLAM is not trying to position in a map	00	Send a project to the AMR, if no project has already been sent Reboot the AMR You may try to connect also directly to 7sense unit
61A1000700	LO-7	Waiting for VSLAM to localize the AMR inside the map	00	Wait some time. Move the vehicle and use AMR studio tools to localize the vehicle. Contact support.
60A1000800	LO-8	Localization quality is low inside VSLAM map	00	Update map when possible Move AMR inside map to better quality areas
61A1000900	LO-9	Relocalization in progress	00	Wait some seconds
		PC communications		

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
30A2000100	TX-1	No connection with FMS	00	1 Check FMS address 2 Check FMS encryption settings 3 Check FMS is running
30A2000200	TX-2	No connection with FMS Login error	00	Check FMS login parameters
30A2000300	TX-3	No connection with CVC700	00	1 Check PC and CVC700 cables (ethernet and CAN) 2 Restart the vehicle
60A2000400	TX-4	No connection with Sevensense controller	00	1 Check VSLAM ehternet cable 2 Restart VSLAM controller 3 Verify wiring
01A2FF0500	TX-5	AMR is under DDoS Attack	FF	Insert the vehicle again
60A2000600	TX-6	AMR has received and invalid message from FMS	00	Ensure that the FMS message is correct
30A2001100	TX-11	No connection with VDA5050 FMS	00	1 Check VDA5050 FMS address 2 Check VDA5050 FMS encryption settings 3 Check VDA5050 FMS is running
30A2001200	TX-12	No connection with VDA5050 FMS Login Error	00	Check VDA5050 FMS login parameters
PC others				
60A3000200	OT-2	An error occurred reading the layout file	00	Transfer a new layout with the correct format
60A3000201	OT-2	An error occurred reading the transferred missions file	00	Transfer a new missions file with the correct format
60A3000300	OT-3	An error occurred reading the Vault secrets	00	Restart the AMR
60A3000400	OT-4	An error occurred reading the PC software version	00	Install a correct PC software update package
60A3000500	OT-5	The system software was reverted to the backup version	00	The installed software version is invalid. Check with the software provider.

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
61A3000600	OT-6	Waiting repose detection in connected gamepad	00	Connect gamepad without touching buttons or axis.Re-plug gamepad dongle. Discard damaged gamepad if problem persists.
30A3010700	OT-7	Stop request introduced from external system to allow stopping drive functionality	01	Check External system conditions that trigger this stop
30A3020701	OT-7	Stop request introduced from external system to allow stopping lift functionality	02	Check External system conditions that trigger this stop
30A37F0702	OT-7	Stop request introduced from external system to allow stopping all functionality	7F	Check External system conditions that trigger this stop
61A3000800	OT-8	RTC battery is drained. Clock will not be saved among AMR restarts.	00	Let system synchronize clock with NTP server. Replace RTC battery
30A37F0900	OT-9	Lost communication with OPCUA server in case it is controlling the AMR system	7F	Verify communication is up and running
PC to PLC				
60A4000100	GE-1	The software version installed in the PC and PLC are not compatible with each other	00	Update PLC or PC software to align versions
60A4000200	GE-2	The message to confirm the reception of a PLC segment is taking more than 1 second	00	1 Generate a blackbox and 2 Contact support
02A47F0300	GE-3	Unsynchronized segments between PC and PLC	7F	1 Generate a blackbox and 2 Contact support
VSLAM				
60A500xx00	SS-XX	Alarm present in VSLAM controller. Module affected: {%}	00	See VSLAM documentation
PC missions				
02A6000100	MI-1	Mission in Error with unknown code	00	Use diagnotic tool to find de error.
02A6000200	MI-2	Variable not declared	00	Check the variable definition inside the mission.
02A6000300	MI-3	Task Not Enough Parameters	00	Generate a blackbox and contact support

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Visual SLAM guidance display codes - AMR P604V
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Code	Display Code	Description	Interpretation/Actions	Troubleshooting
02A6000400	MI-4	Invalid Path Definition	00	Update layout from AMR Suite
02A6000500	MI-5	Variable not declared	00	Check the mission in AMR Suite
02A6000600	MI-6	Syntax error in mission file	00	Generate a blackbox and contact support
02A6000700	MI-7	Nesting Limit Reached	00	Check the mission in AMR Suite
02A6000800	MI-8	Move task is being launched in FMS mode in mission step: {%}	00	Set the AMR in local mode or remove move tasks in mission when launched in FMS mode
60A600FF00	MI-255	No mission is running in automatic local mode	00	1 Check result of last mission executed 2 Check that the value of mission step and route are valid 3 Insert the vehicle again

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ANNEX II - FAQS

Table of general frequently asked questions

Question	Solution
Switch the power ON/OFF button does not turn the AMR on.	• The batteries are flat and require charging. Contact the maintenance department of your company. • Make sure the battery is not disconnected from the AMR.
How do I charge the AMR's battery?	• Move the AMR to the battery charging station and follow the instructions described on *Battery charging system* section.
The display shows a code that is not listed in the previous table.	• Contact ABB
How do I insert the AMR on the circuit?	• There is a specific process to insert the AMR. See *AMR insertion procedure* section.
The AMR does not move when there are no codes of displayed	• Make sure there are no objects in the wheels of the AMR and carriage that prevent the AMR from moving. • Make sure there are no objects blocking the AMR. • Contact the maintenance department of your company.
How do I move the AMR manually?	• There is a manual mode available in the AMR. See *Manual mode* section.

Table of AMR P604 frequently asked questions

P604 M	
Question	**Solution**
The AMR does not move when code 00 is displayed	• Make sure there are no objects in the wheels of the AMR and carriage that prevent the AMR from moving. • Make sure there are no objects blocking the AMR. • Contact the maintenance department of your company.
The display shows code 05, but I am not on the AMR's route.	• Check that there are no mobile objects on the route. • Clean the laser. • Contact the maintenance department of your company.
Where is the battery charge level displayed?	It is shown on display screen seven, see *Display*.

P604 V	
Question	**Solution**
The AMR does not move when the green tick is displayed	• Make sure there are no objects in the wheels of the AMR and carriage that prevent the AMR from moving. • Make sure there are no objects blocking the AMR. • Contact the maintenance department of your company.
Where is the battery charge level displayed?	It is shown on the home screen, see *Display*.

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ANNEX III - List of spare parts

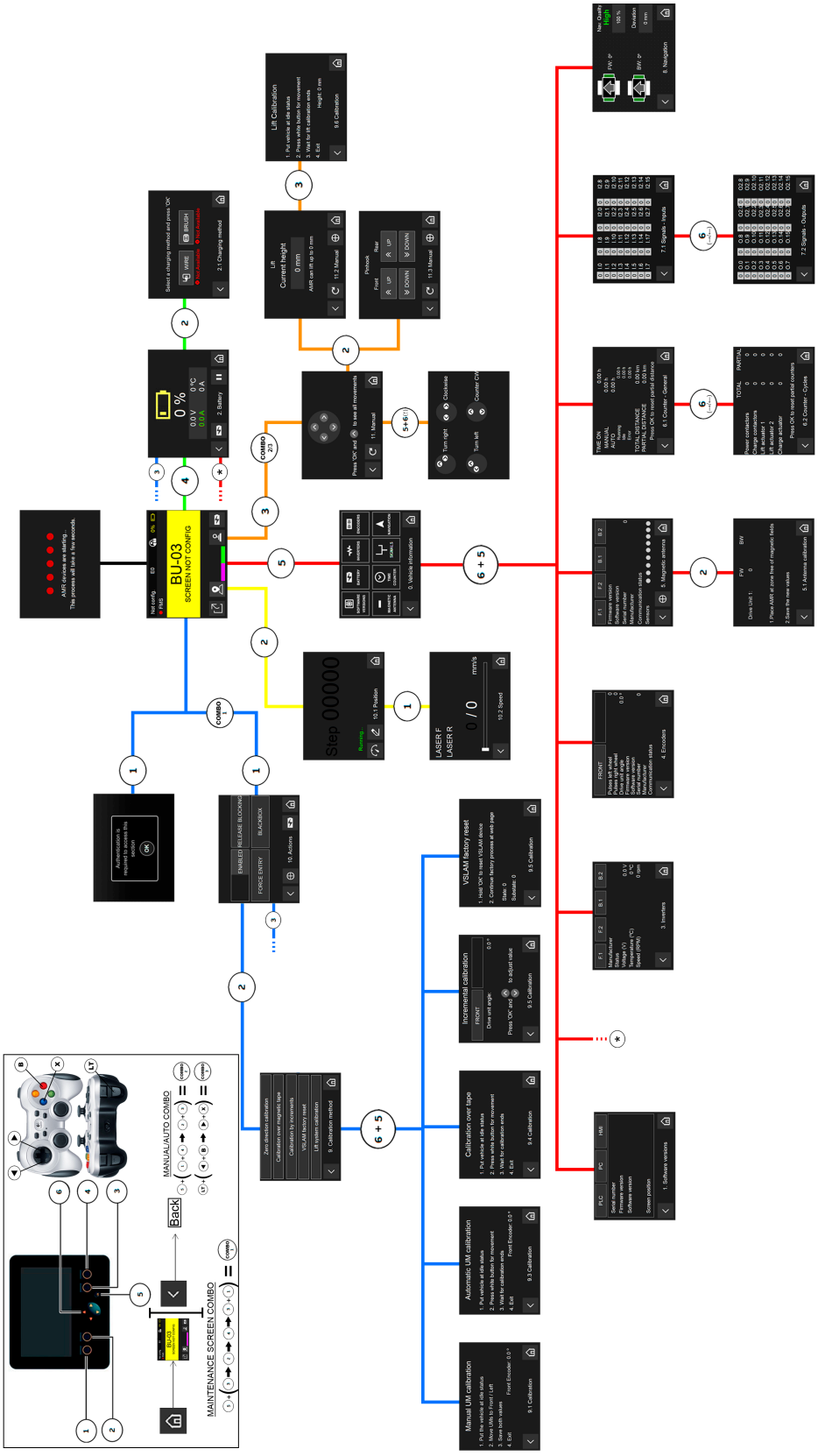
Description

See the complete list of Quality Parts in the latest version of *Quality parts - AMR P604* (*References*).

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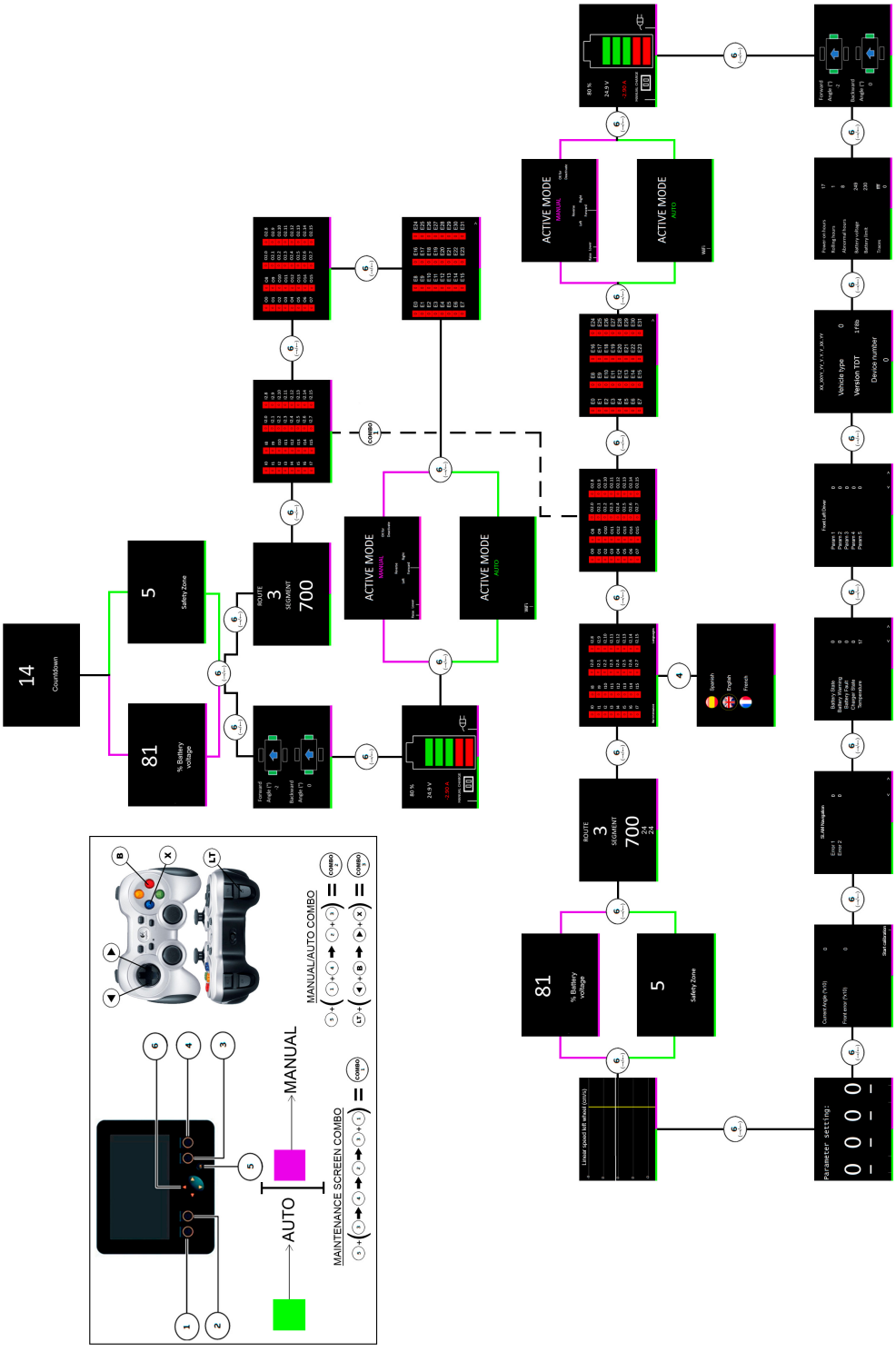
ANNEX IV - Display wireframes



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ANNEX V - 180 Turns

P604 M

The P604 M cannot make 180° turns. This is an alternative to this movement. It can be performed with and without load, and it requires 6 tags.

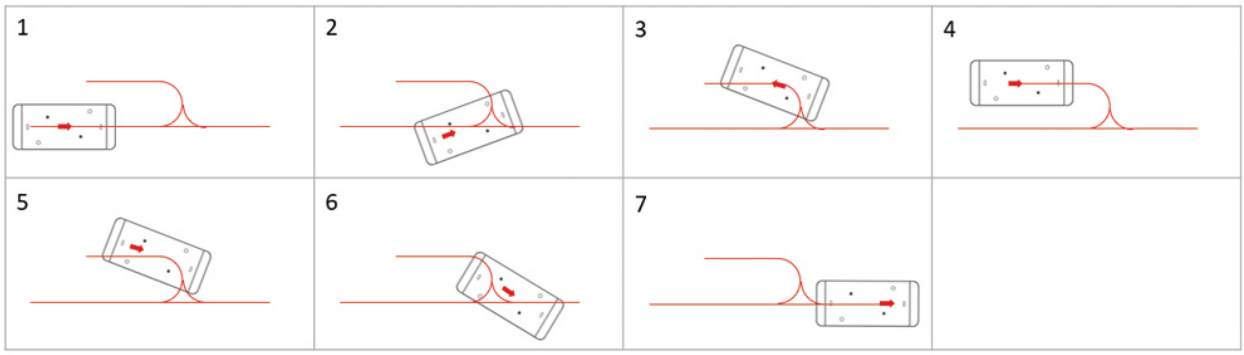


Figure .: 180 degrees turn alternative for P604 M

Area required:

- **a:** min 4630 mm
- **b:** min 2300 mm

Time: 28.5 s

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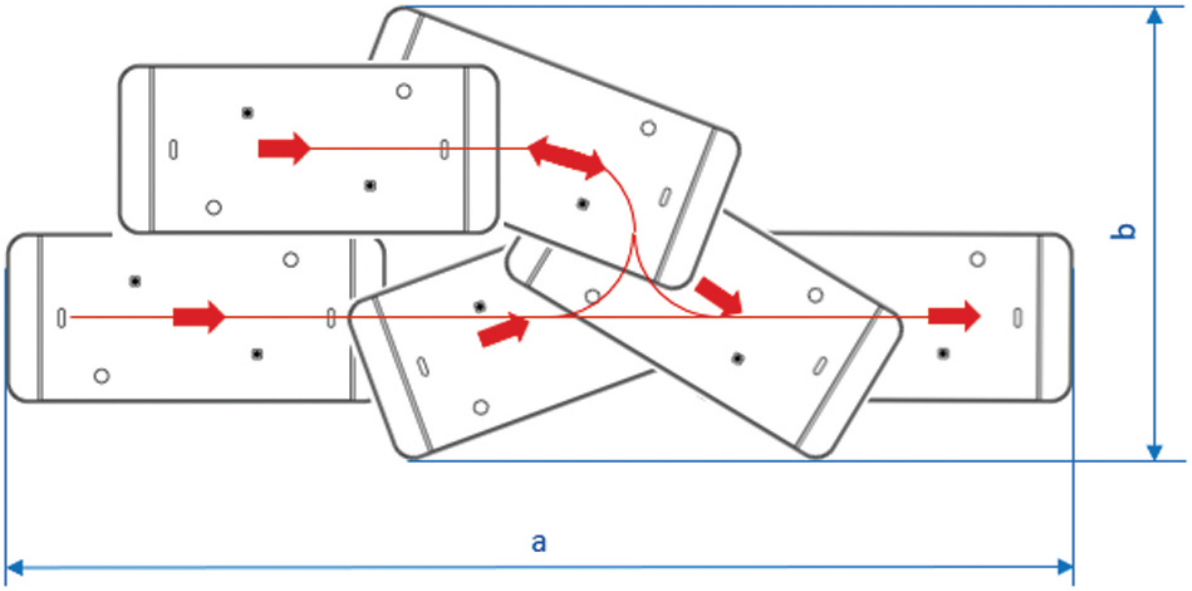


Figure .: Area required for 180 degrees turn

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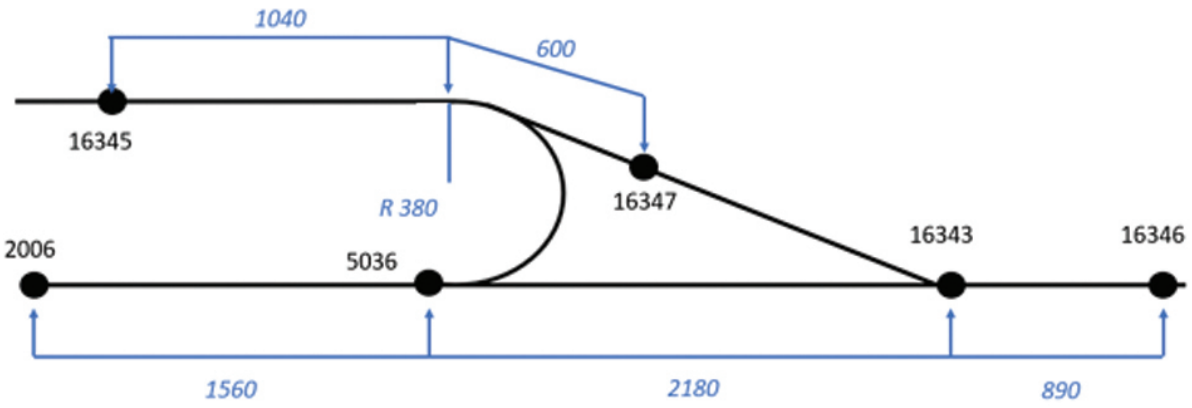


Figure .: 180° U-turn

P604 V

The P604 V can make 180° turns on spot if unloaded or using a load up to 1000 kg.

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ANNEX VI - Compatibility

Prior considerations

This vehicle uses the release bundle 3.1, compatible with different versions of AMR Studio, FMS Fleet Manager, HMI, PC Image, PC, and P604V-PLC softwares.

It is possible to check if the settings of the vehicle are compatible with the latest AMR Studio version via the vehicle's HMI Display, where the software versions can be checked, and the following table showing release bundle versions:

Release Bundle	AMR Studio	FMS Fleet Manager	UVS			
			HMI	PC Image	PC	P604V-PLC
2.2.4	2.2.4-32	2.2.4-5	1.3.5	2.2.0-release2	2.2.3-8	2.2.3
3.0.0	3.0.0-9	3.0.0-12	3.0.2	3.0.0-alpha.5	3.0.1-4	3.0.0-beta.3
3.0.2	3.0.6	3.0.5	3.0.2	3.0.0	3.0.20	3.0.5
3.0.3	3.0.7	3.0.11	3.0.2	3.0.0	3.1.2	3.0.6
3.0.4	3.0.9	3.0.16	3.0.2	3.0.0	3.1.4	3.0.9
3.1.0	3.1.5	3.1.7	3.0.2	3.0.0	3.1.7	3.0.9

For vehicles using release 3.1 version of AMR Studio, the next section includes a summary of the latest updates to this software.

There is no backward compatibility with other versions of AMR Studio, so careful consideration is required before updating to the newest version.

For more information, see the AMR Studio manual (*References*).

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AMR Studio 3.1 new functionalities

Vehicle Diagnostics

Export Logs

A log export feature has been added in the "Logs" tab. This enables users to export binary data as a .csv file to their PC. Users can:

- Select specific module logs.
- Choose a destination folder for saving logs.
-

> **Note**
>
> This feature is unavailable in online mode.

Mission Manager

Submission Execution

Users can now execute individual submissions from the Mission Manager without the need to run the entire mission. This feature is available in standalone projects when connected to an AMR in online mode. The process involves:

- Selecting a submission.
- Confirming execution.
- Cancelling if needed.

System Monitoring

Graph Min/Max Search

The ability to search for minimum and maximum values within graphs has been introduced. This helps in debugging and trend analysis. Users can:

- Select specific parameters for searching.
- Visually identify highlighted values and zoom in for clarity.
- Navigate through multiple max/min values using "Next" and "Previous" buttons.
- Reset to the default view at any time.

Order Type Selection for Throughput Calculation

Users can now select specific order types to be considered in throughput calculations, offering greater flexibility for different project needs. This feature is useful when pick/drop-based throughput calculations are not applicable. Multiple order types can be selected simultaneously.

Table Edition

A customizable table management feature has been added, allowing users to edit and create new tables for tracking relevant data. Users can mod-ify default tables (vehicles, missions, signals, anomalies) by selecting or deselecting available data columns. Changes are automatically applied for a more flexible and personalized data view.

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Manual Traffic Zone Blocking
Users can manually block or unblock specific traffic zones in the layout via an API (tablet application or FMS GUI). Key points include:

- Zones are deactivated by default and can be toggled by right-clicking on the selected area.
- Blocking prevents AMRs from passing through, while unblocking restores access.
- Users receive continuous feedback on activation status and potential errors.

Map Update Configuration Validation
The Config Tool now prevents project transfers if there is a configuration mismatch between AMR Studio and the AMR (e.g., server-based update set for a local-only AMR). Users will receive an error message and must correct the configuration before proceeding.

System Configuration

Implementing the New Robust Transfer Mechanism
The new transfer architecture includes:

- Improved handling of edge cases, rollbacks, and backups.
- Enables additional interactions, such as restoring project files from the FMS GUI.

Map Update Configuration
Users can define the map update process during project creation in AMR Suite. The system supports:

- Local updates for small-scale operations (<5 AMRs, non-24/7).
- Server-based updates for centralized management.
- If a server is selected, the Config Tool will display necessary configuration fields.

Platform Height Configuration
Users can now set platform heights from nodes in Layout Designer with multi-selection support. Key features include:

- Default heights for pick and drop actions.
- Height configuration for other nodes based on AMR options.
- Height changes are restricted to predefined nodes with best practices to prevent errors.

Server Map Update
To improve map update speed for large layouts or 24/7 operations, a server-based map update solution has been implemented. AMRs can update maps continuously without stopping, ensuring faster updates and seamless operations.

Layout Designer

Extended Map Editing
Users can now extend previously created maps, allowing them to edit and enlarge existing maps to accommodate new areas. This feature provides greater flexibility in updating and expanding map coverage.

Hover-Based Selection for Overlapping Elements
A new feature has been added to help users manage and select overlapping elements. Users can now:

- Hover over overlapping areas to view a list of elements.
- Select an element by clicking on the corresponding tag.
- Tags of other elements disappear when one is selected until the user hovers over the area again.

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AMR Studio 3.1 new functionalities
Continued

Charger Type Configuration
Users can now define the type of charger (Legacy or Smart) during battery charger configuration. Key features include.

- Legacy Chargers require no ID.
- Smart Chargers require an ID for network communication.
- Configuration accessible via the “Battery Charge” external element menu.

Angular Speed and Laser Field Customization for "Turn on Itself" Maneuver (P604)
Users can now customize the angular speed and laser safety field for the "Turn on Itself" maneuver for AMR P604. Key features include:

- Angular speed range: 10º/s to 21º/s (default 21º/s).
- The system automatically adjusts invalid values to the nearest valid setting.
- Laser safety field selection ensures safety during the maneuver.

Layout and CAD Rotation for VSLAM Map Alignment
Users can now rotate the entire layout and CAD at a specified angle to align with the VSLAM map, ensuring the layout maintains the relative positions and distances of all elements.

Mission Trigger Zones
Users can now create Mission trigger zones in Layout Designer that trigger missions without stopping at nodes. Key features include:

- "Entry Permission Required" option to control AMR access via FMS permissions.
- Seamless integration with Mission Manager and FDL.

Customizable Platform Heights for Node Actions
Users can define specific platform heights for AMRs at each station (pick, drop, charge) and edge. The platform height will remain until a node with a different height setting is reached. A new "Change platform height" option allows adjustments for loaded/unloaded status at nodes without stations. Stations are visually marked on the map with task-specific colors and sizes.

FMS

Improvement in Automatic Traffic Management
The passive traffic calculation has been improved by considering:

- Vehicle load size.
- Laser field usage.
- Support for multiple vehicle types.

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