

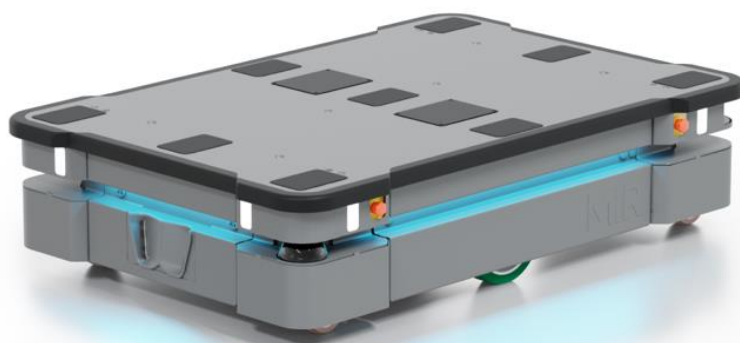


MiR600 User Guide

Date: 12/2023

Version: 2.0 (en)

Robot hardware version: 1.0



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Original instructions (English)

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1. About this document

This user guide explains how to set up and start operating your MiR600 robot. This guide also contains information regarding the external and internal components of MiR600 along with instructions for proper maintenance of the robot. You will also find information regarding safety and specifications needed to commission a safe MiR600 robot application.

**NOTICE**

Save this manual. It contains important safety and operating instructions.

1.1 Where to find more information

For the full documentation package and translations of manuals for MiR600, go to: <https://www.mobile-industrial-robots.com/product-documents/mir600-hw-10-sw-3-v1/>.

For online courses to strengthen your understanding of MiR products, go to [MiR Academy](#).

If you are looking for more documentation about all MiR products, go to [MiR Support Portal](#) where we have the following resources:

Documentation

- **Integrator Manuals** provide all the information you need to operate and maintain MiR robots. Integrator Manuals are available in multiple languages. These guides are intended for PCM (partly completed machinery) robots.
- **Quick starts** describe how you start operating MiR robots quickly. It comes in print in the box with the robots. Quick starts are available in multiple languages.
- **User guides** provide all the information you need to operate and maintain MiR products and how to set up and use top modules and accessories, such as charging stations, hooks, shelf lifts, and pallet lifts. User guides are available in multiple languages.
- **Risk assessment guide** describes how to conduct a risk assessment and provides some risk assessed use cases.
- **Commissioning guide** provides examples and guidelines to commission your robot successfully.
- **Interface guides** contain descriptions of all the elements of the robot interface and MiR Fleet interface. Interface guides are available in multiple languages.

- **Best practice guides** provide helpful information you can use when commissioning or operating your robot.
- **REST API references** for MiR robots, MiR Hooks, and MiR Fleet. HTTP requests can be used to control robots, hooks, and MiR Fleet.
- **MiR Network and Wi-Fi guide** specifies the performance requirements of your network and how you must configure it for MiR robots and MiR Fleet to operate successfully.
- **Migration guides** describe how to upgrade your MiR system from one major software version to the next.
- **Cybersecurity guide** provides important information and instructions to increase the cybersecurity of your MiR product.
- **How-to guides** are short guides providing instruction for maintenance, replacement, commissioning, and other tasks related to MiR products.
- **Troubleshooting guides** can help you determine the cause of an issue you are experiencing with your MiR product and how to resolve it.
- **Release notes** of new products and hardware updates that describe what has been changed and why.
- **Service notes** notify of issues identified in MiR products and changes that are applied.
- **Spare parts and additional products** list all spare parts and accessories you can order for robots.
- **Warranty** describes the MiR standard warranty agreement.
- **Certificates and declarations** for MiR products that prove compliance with standards.
- **Technical guides** provide in-depth information about how MiR products work.

Models and drawings

- **Wiring diagrams** are graphic representations of how the components in MiR robots are wired.
- **CAD files** of the robots that are made to scale can be used to help determine the dimensions of the robot or for illustrative purposes.

Resources

- **MiR Log Analytics** and **MiR Insights** are tools you can use to analyze how well your robots or fleet are performing. MiR Log Analytics is a free tool that lets you analyze recorded performance from error logs, and MiR Insights requires a paid license, but runs continuously alongside MiR Fleet to give real-time data on several metrics.
- **AprilTag** collection can be used instead of generating your own AprilTags.
- **Space calculator** determines the approximate amount of space your MiR robot will need to operate depending on the size of its footprint.
- **Community** is a forum of MiR users with a collection of questions, recommendations, webinars and other community driven material.
- **Marketing and brand portal** is a collection of our graphical elements where you can download color schemes, rendered images of the robots, and icons.

1.2 Version history

This table shows current and previous versions of this document.

Revision	Description
2.0	Date: 2023-12-05 Robot HW: 1.0 <ul style="list-style-type: none">• Updated for software version 3.x with new user interface and new features.
1.5	Date: 2023-09-21 Robot HW: 1.0 <ul style="list-style-type: none">• Updated checksum values for safety configuration file version 6.5. Affects sections: Safety-related functions and interfaces.• Corrected instructions for caster wheel maintenance. Affects section: Maintenance and Brake test.

Revision	Description
	<ul style="list-style-type: none"> Added instructions to test the brakes and information about how the brakes work. Affects section: Maintenance and Brake test. Added warning regarding clearing missions and re-added section Error handling section. Affects section: Error handling. Added notice that the robot cannot detect forklift forks and empty pallets reliably. Affects section: General safety precautions.
1.4	<p>Date: 2023-06-15</p> <p>Robot HW: 1.0</p> <ul style="list-style-type: none"> Updated for TÜV approval. Includes new nameplates and instructions for checking the checksum of the safety configuration. Affects sections: Safety-related functions and interfaces. Expanded list of material you can find on MiR Support Portal and added a link to a documentation package page. Affects section: Where to find more information. Added information about resetting the lift after Protective stops and Emergency stops. Affects section: How the top module works. Added warning against using MiR top modules that are not made for MiR600. Affects section: Foreseeable misuse and Intended use. Added information that the lift must be reset after each time the lift has been raised and lowered 50 times. Affects section: How the top module works. Added description of effects if maintenance is neglected. Affects section: Maintenance. Correct illustration of pins for the Power interface. Affects section: Electrical interfaces.

Revision	Description
	<ul style="list-style-type: none">• Added sections: Specifications and Space requirements.• Changed structure and order of content.
1.3	<p>Date: 2023-01-31</p> <p>Robot HW: 1.0</p> <ul style="list-style-type: none">• Updated copyright.• Updated style.• Updated references to <i>MiR Robot Reference Guide</i> to <i>MiR Robot Interface Guide</i>.• Added references to videos showing how to access internal parts. Affects section: Accessing the internal parts.• Removed section about adapter cable to connect a cable charger directly to the battery. Affects section: In the box.• Added more information about storage of robots and batteries. New section: Storage.• Added information about laser scanner range. Affects section: Obstacle detection.• Added information about camera vertical angle. Affects section: Obstacle detection.• Hold to run description removed. Affects section: Safety-related functions and interfaces.• Updated status light table. Affects section: Light indicators and speakers.• Corrected description of the robot's safety stop function. Affects section: Safety stop.

Revision	Description
	<ul style="list-style-type: none">• Improved commissioning sections, and added checklists to several sections. Affects sections: Creating user groups and users, Creating dashboards, Updating the software, Creating missions, Positions, Markers, Creating and configuring maps.• Added mounting hole information. Affects section: Mounting a top module.• Added information about grease for drive wheels. Affects section: Maintenance.
1.2	<p>Date: 2022-05-31</p> <p>Robot HW: 1.0</p> <ul style="list-style-type: none">• Improved description of Power save, Deep sleep, and storing the battery. Affects section: Battery storage.• Added that localization is disabled while brakes are released manually. Affects section: Manual brake release.• Added lower boundary in camera FoV. Affects section: Obstacle detection.• Added warning not to use two chargers to charge the robot simultaneously. Affects section: Charging the robot.• Corrected payload specifications. Affects sections: Product presentation and Shelf specifications.• Added notice that cable chargers only charge the robot's battery to 80–90%. Affects section: Charging the robot.
1.1	<p>Date: 2021-10-07</p> <p>Robot HW: 1.0</p>

Revision	Description
	<ul style="list-style-type: none">• Applied general corrections. Affects sections: Payload distribution, Footprints, and Nameplate.• Updated manual to ensure compliance with radio equipment directives. Affects sections: Safety, Connecting to the robot interface, and Connecting the robot to a Wi-Fi network.
1.0	<p>Date: 2021-08-12</p> <p>Robot HW: 1.0</p> <p>First edition.</p>

2. Product presentation

MiR600 is an autonomous mobile robot that can transport loads up to 600 kg indoors within production facilities, warehouses, and other industrial locations where access to the public is restricted.

MiR600 is classified as a driverless industrial truck.

Users operate MiR600 via a web-based user interface—see ["Connecting to the robot interface" on page 43](#).

Program missions to send the robot to locations in its work areas. Missions can be initiated on demand or scheduled to run autonomously using an external system. The robot uses a map of its work area to plan paths between positions. While operating, the robot automatically avoids obstacles and personnel and replans its route if its chosen route is blocked.



For more information about how to set up the site, see *MiR Commissioning Guide*. You can find this guide on [MiR Support Portal](#).

2.1 Intended use

MiR600 is intended to be commissioned and used in indoor industrial environments where access for the public is restricted. For details about the environmental conditions in which MiR600 should operate, see ["Specifications" on the next page](#).

MiR600 is intended to be commissioned according to the guidelines in *MiR Commissioning Guide*. This is a prerequisite for safe usage of MiR600. You can find this guide on [MiR Support Portal](#).

MiR600 is equipped with safety-related features that are purposely designed for collaborative operation where the robot operates without a safety enclosure or together with people—see ["Safety-related functions and interfaces" on page 67](#).

MiR600 is only intended to be used with top modules made for MiR600.

MiR600 is intended to be used with top modules supported by Mobile Industrial Robots or custom modules that:

- Do not have any moving parts.
- Do not extend the physical dimensions of the robot.
- Operate within the environmental conditions required for MiR600.
- Are within the weight distribution requirements—see "[Payload distribution and stability](#)" on [page 175](#).

If used with custom modules, all obligations of a manufacturer apply to the individual who performs the modifications. All modifications must be in accordance with the machinery directive.

MiR600 is designed for and all risks are considered when used with one of the following types of top modules:

- MiR Pallet Lift 600 used with MiR Pallet Rack
- MiR EU Pallet Lift 600 used with MiR EU Pallet Rack
- MiR Shelf Lift to transport MiR supported shelves

MiR600 can be used as partly completed machinery as defined in the EU machinery directive with top modules that do not meet the above limitations. Those who design, manufacture, or commission a system that does not meet the limitations of use of MiR600 carry the obligations of a manufacturer and must ensure a safe design according to EN ISO 12100. Guidelines outlined in this manual are not sufficient.

**NOTICE**

A safe machine does not guarantee a safe system. Follow the commissioning guidelines in *MiR Commissioning Guide* to ensure a safe system. You can find this guide on [MiR Support Portal](#).

2.2 Specifications



For a complete list of all the robot specifications, see [MiR Support Portal](#).

Robot specifications

Model	MiR600
-------	--------

Maximum speed	2 m/s
IP rating	IP52
Maximum payload	600 kg

Battery

Battery model	MiR 48V Battery
Battery type	Lithium-ion
Battery weight	14 kg
Battery dimensions	495×210×75 mm

Environment

Maximum incline/decline	1%
Maximum traversable gap	29 mm
Maximum traversable step	10 mm
Storage temperature (3 month storage)	-20–45°C
Operation temperature	5–40°C
Floor surface condition	Clean and dry
Floor to wheel frictional coefficient	0.60–0.80 (recommended)

Material the robots cannot detect reliably	Transparent, translucent, glossy, reflective, and light emitting ¹
Optimal light conditions	Even and steady lighting (strong directional light can cause the robot to detect non-existent obstacles)
Relative humidity (non-condensing)	20–95%

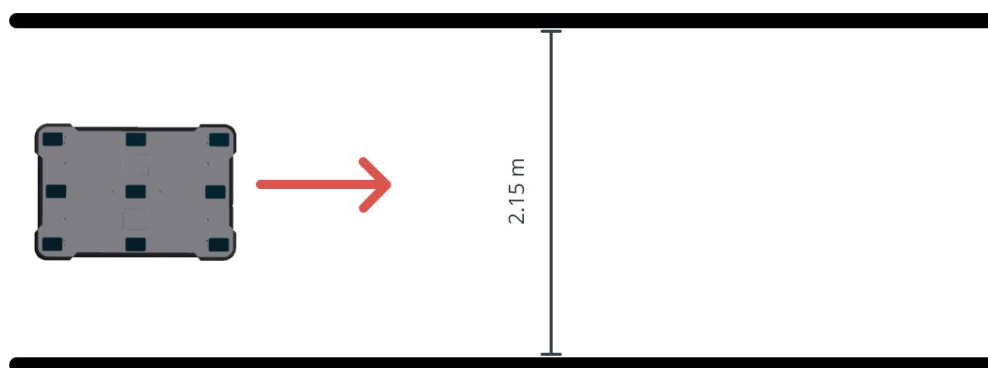
2.3 Required space

The required space dimensions for your robot are illustrated in the following images.



For more information about how you can use zones and modified settings to reduce the space requirements, see *MiR600 and MiR1350 Space Requirement Best Practices*. If you modify the footprint of the robot, you can use the Space calculator to determine an estimate of how much space the robot needs. You can find the guide and calculator on [MiR Support Portal](#).

Figure 2.1 The required space when the robot drives straight



¹We recommend either avoiding these materials, covering them with opaque and matte material the robot can detect, or ensuring the robot does not operate in areas with these materials.

Figure 2.2 The required space when the robot takes a 90° turn

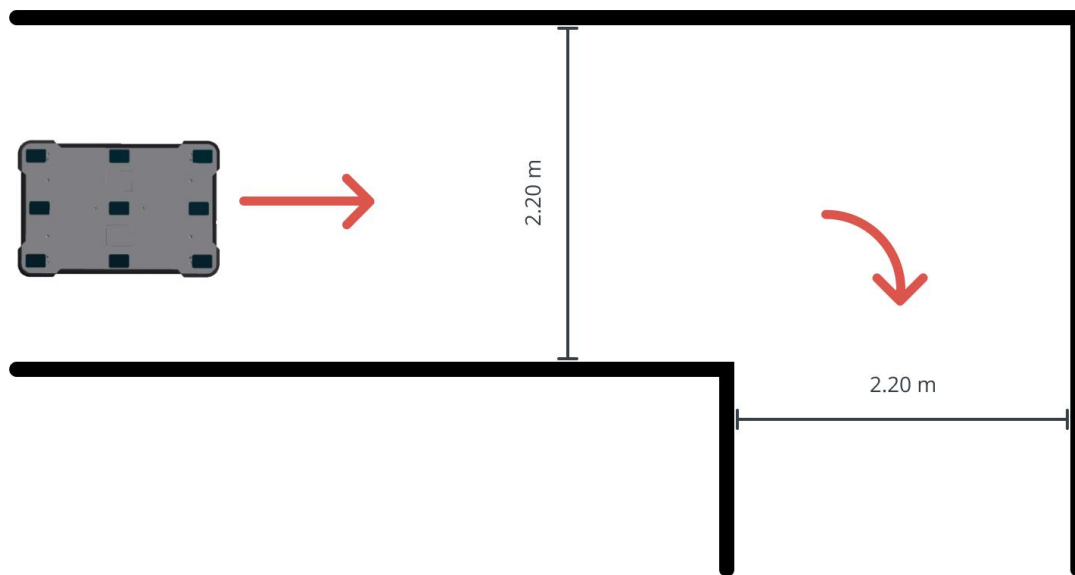


Figure 2.3 The required space when the robot drives through a doorway



Figure 2.4 The required space when two robots pass each other

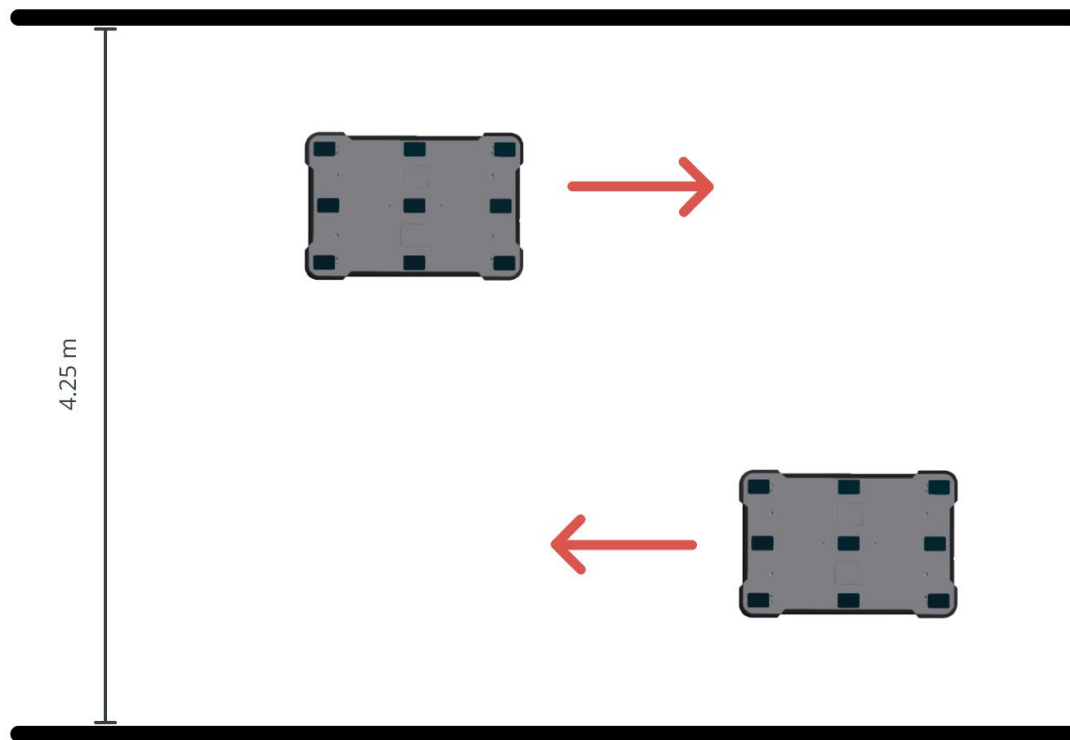
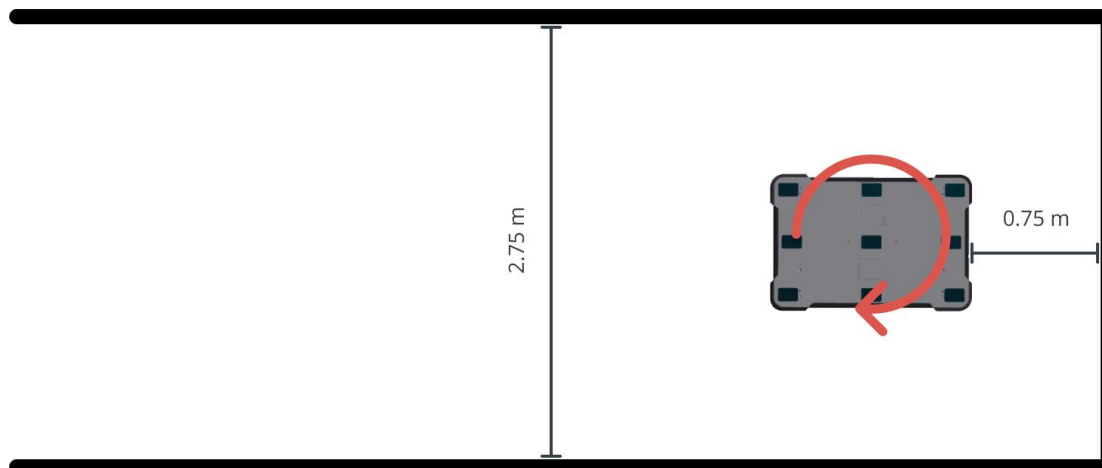


Figure 2.5 The required space when the robot pivots



2.4 Compatible products

The following top modules are available for MiR600:

- **MiR Shelf Lift**

A lift platform can be mounted on MiR600 enabling it to automate the internal transport of shelves that meet specifications outlines by MiR—see *MiR600 Shelf Lift User Guide* for the shelf requirements. You can find this guide on [MiR Support Portal](#).

- **MiR Pallet Lift 600**

A lift platform can be mounted on MiR600 enabling it to automate the internal transport of US standard 40×48 pallets.

- **MiR EU Pallet Lift 600**

A pallet lift for EU pallets can be mounted on MiR600 enabling it to automate the internal transport of EU pallets.



For more information about top modules from MiR, see [MiR Accessories](#) on www.mobile-industrial-robots.com. For more information about top modules from third parties, see [MiRGo](#) on www.mobile-industrial-robots.com.

The following accessories are available for MiR600:

- **MiR Pallet Rack**

Use a MiR Pallet Rack with MiR Pallet Lift 600. The lift places and picks up US standard 40×48 in (1016×1219 mm) pallets from the rack autonomously.

- **MiR EU Pallet Rack**

Use a MiR EU Pallet Rack with MiR EU Pallet Lift 600. The lift places and picks up EU pallets from the rack autonomously.

- **MiR Fleet**

MiR robots can be operated individually or as a part of a fleet. MiR Fleet is the compatible fleet manager for MiR robots. MiR Fleet offers centralized control of robots throughout all of your facility. MiR Fleet is available as an installation file you can install on a server of your choice or as a computer server where MiR Fleet comes pre-installed. See *MiR Fleet Server Solution User Guide* and *MiR Fleet PC User Guide* for more information. You can find these guides on [MiR Support Portal](#).

- **MiR Charge 48V**

MiR Charge 48V enable MiR robots to recharge their batteries. Together with MiR Fleet, charging of robots can be fully automated, ensuring that robots never run out of power during missions.

2.5 External parts

Figure 2.6 MiR600 external parts

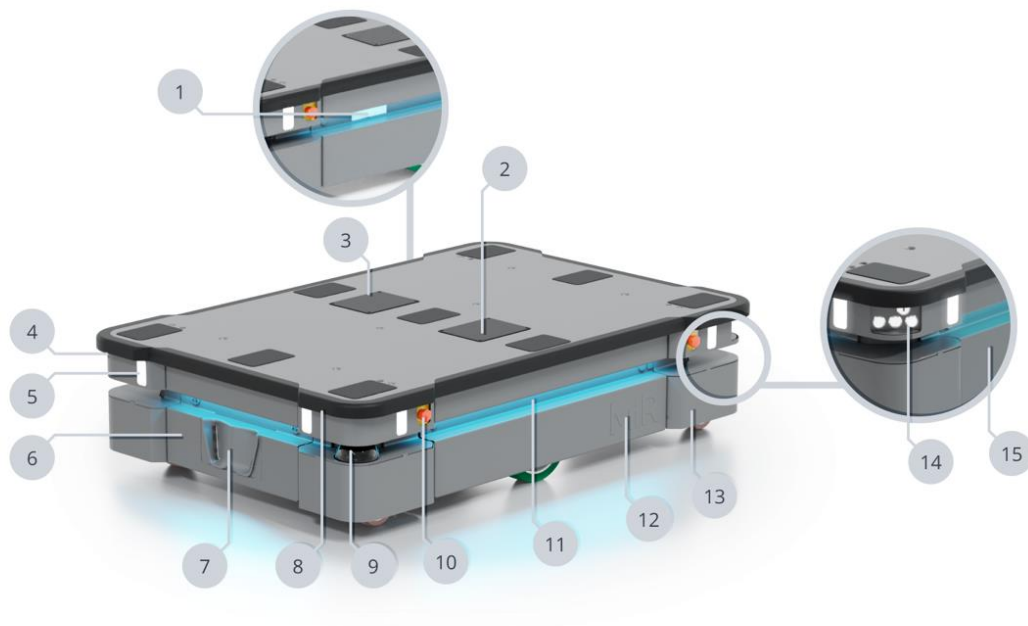


Table 2.1 Identification of the external parts in [Figure 2.6](#)

Pos.	Description	Pos.	Description
1	Nameplate	2	Left top compartment—see "Top compartments" on page 25
3	Right top compartment—see "Top compartments" on page 25	4	Antenna: two pcs, in opposite corners

Pos.	Description	Pos.	Description
5	Signal light: eight pcs, two on each corner—see "Light indicators and speaker" on page 59	6	Front maintenance hatch—see "Front compartment" on the next page
7	3D depth cameras: two pcs	8	Proximity sensors: eight pcs, two in each corner behind the corner covers
9	Safety laser scanner: two pcs, in opposite corners	10	Emergency stop button: four pcs, two on each side—see "Emergency stop" on page 76
11	Status light: on all four sides of the robot—see "Light indicators and speaker" on page 59	12	Side maintenance hatch—see "Side compartments" on page 24
13	Corner shield: four pcs, one in each corner	14	Control panel—see "Control panel" on page 48
15	Rear maintenance hatch—see "Rear compartment" on page 23		

2.6 Internal parts

Most internal parts of MiR600 are accessed through maintenance hatches that open to different compartments—see ["Accessing the internal parts" on page 104](#).



CAUTION

Opening or removing hatches from the robot exposes parts connected to the power supply, which can result in a short circuit that will damage the robot and could injure personnel.

- Before removing any hatches, turn off the robot.
- Start by removing the left hatch, and disconnect the battery—see ["Disconnecting the battery" on page 132](#).

Front compartment

Figure 2.7 Internal parts of the front compartment

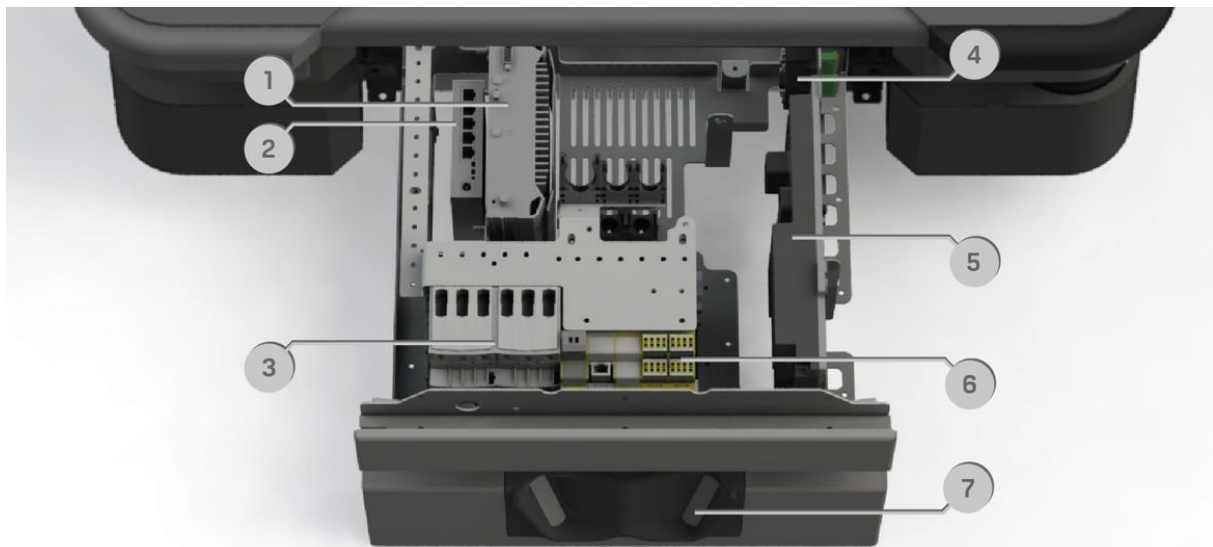


Table 2.2 Identification of internal parts in [Figure 2.7](#)

Pos.	Description	Pos.	Description
1	Robot computer	2	Switch
3	Safe Torque Off contactors	4	GPIO module
5	Power board	6	Safety PLC
7	3D cameras		

Rear compartment

Figure 2.8 Internal parts of the rear compartment**Table 2.3** Identification of internal parts in [Figure 2.8](#)

Pos.	Description	Pos.	Description
1	Connector for the status light band	2	Motor controller carrier board

Pos.	Description	Pos.	Description
3	Connection interface for MiR Controller	4	Manual brake release switch
5	Dynamic brake contactors		

Side compartments



NOTICE

The unique nameplate of your robot is on the right side maintenance hatch. Make sure you do not swap the hatch with hatches from other robots.

Figure 2.9 Internal parts of the MiR600 left and right side compartments

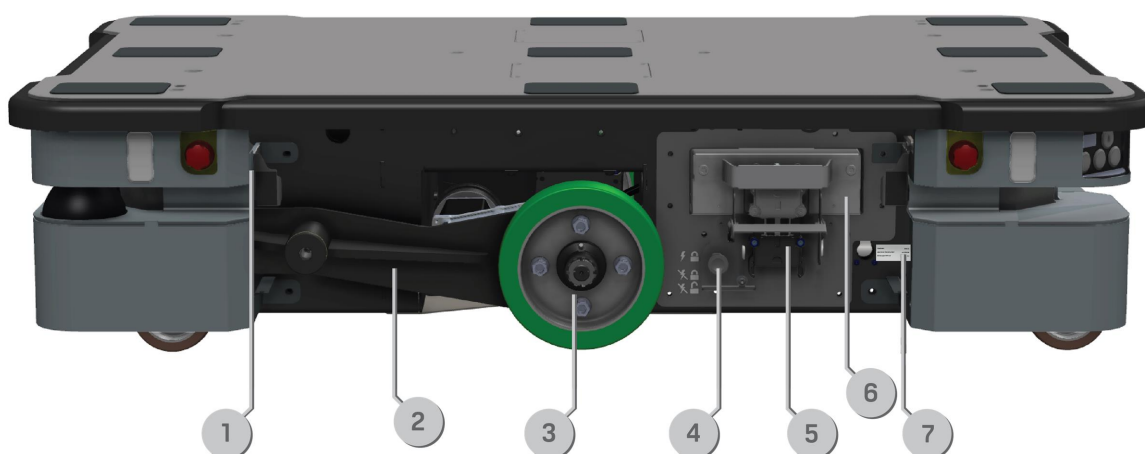


Table 2.4 Identification of internal parts in [Figure 2.9](#)

Pos.	Description	Pos.	Description
1	Connector for the status light band	2	Bogie

Pos.	Description	Pos.	Description
3	Drive wheel	4	Battery lock pin (only in left side compartment)
5	Fast-swap battery assembly (only in left side compartment)	6	Battery (only in left side compartment)
7	Identification label		

Top compartments



For more information on electrical interfaces, see ["Electrical interfaces" on page 150](#).

Figure 2.10 Interfaces in the top compartments

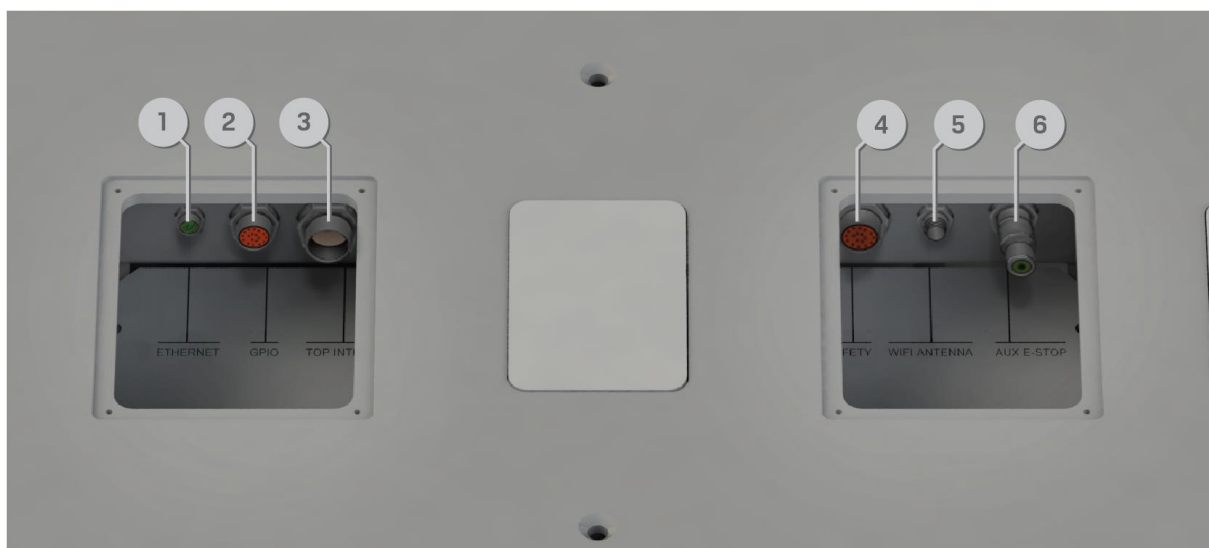


Table 2.5 Identification of interfaces in [Figure 2.10](#)

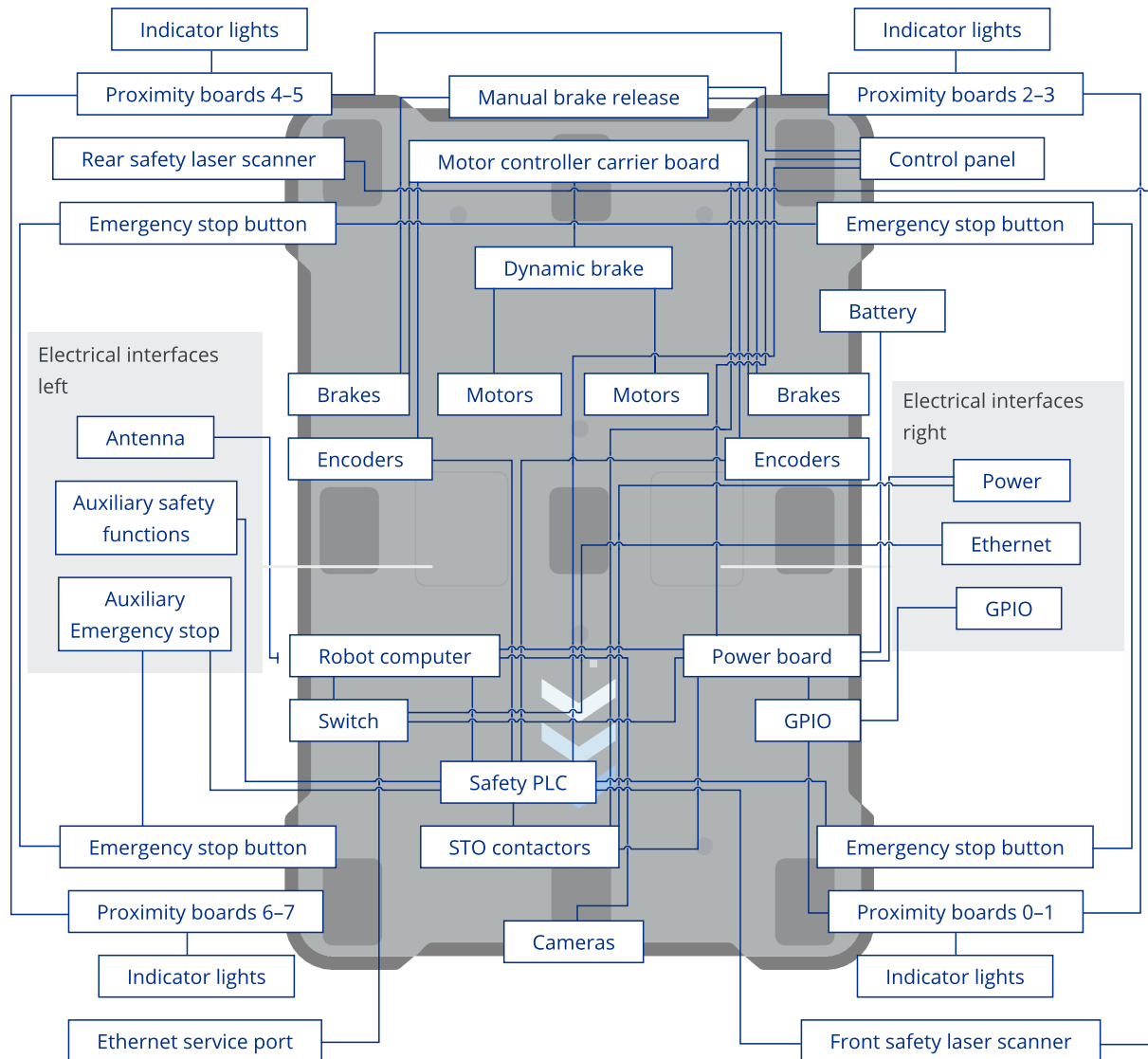
Pos.	Description	Pos.	Description
1	Ethernet	2	GPIO: General purpose I/O
3	Power	4	Auxiliary safety functions
5	Wi-Fi antenna	6	Auxiliary emergency stop with dummy plug

2.7 System overview

[Figure 2.11](#) identifies the main functional components in MiR600. They are organized in their approximate location inside the robot. To identify the exact location see "[Internal parts](#)" on [page 22](#).

The lines between components indicate a significant connection either for communication or power. For more detailed schematics, see the wiring diagram for MiR600 on [MiR Support Portal](#).

Figure 2.11 Overview of the internal components and how they are connected in MiR600



2.8 Warranty

Mobile Industrial Robots offers a standard warranty on all products.

Contact your distributor to see the terms and extent of product coverage.

**NOTICE**

Mobile Industrial Robots disclaims any and all liability if MiR600 or its accessories are damaged, changed, or modified in any way. Mobile Industrial Robots cannot be held responsible for any damages caused to MiR600, accessories, or any other equipment due to programming errors or malfunctioning of MiR600.

3. Safety

Read the information in this section before powering up and operating MiR600.

Pay particular attention to the safety instructions and warnings.

3.1 Safety message types

This document uses the following safety message types.

**WARNING**

Indicates a potentially hazardous situation that could result in death or serious injury. Carefully read the message that follows to prevent death or serious injury.

**CAUTION**

Indicates a potentially hazardous situation that could result in minor or moderate injury. Alerts against unsafe practices. Carefully read the message that follows to prevent minor or moderate injury.

**NOTICE**

Indicates important information, including situations that can result in damage to equipment or property.



Tells you where you can find more information about the topic.

3.2 General safety precautions

This section contains general safety precautions.



CAUTION

Harmful electromagnetic interference might be the result of having two radio modules transmitting at the same time. The robot is certified to have only one radio module active at any given time.

- Do not attach an access point or additional radio modules to the robot while it is connected to a wireless network.



CAUTION

If the robot starts up unexpectedly, there is a risk of injury to nearby personnel or damage to equipment.

- Inform personnel that robots may start driving without any warning.
- Design missions so the robot indicates to personnel that it will begin an action that makes it move. You can, for example, use a Play sound or Show light action to warn nearby personnel.



WARNING

If the robot is not running the correct software and is therefore not functioning properly, the robot may collide with personnel or equipment causing injury or damage.

- Ensure that the robot is always running the correct software.



WARNING

The robot may drive into a ladder, scaffold, or similar equipment that has a person standing on it. Personnel risk fall injuries, and equipment may be damaged.

- Do not place ladders, scaffolds, or similar equipment in the robot's work environment.

**WARNING**

The robot may drive down staircases or holes in the floor and cause serious injury to personnel and damage to the robot and to equipment.

- Mark all descending staircases and holes as Forbidden zones on maps.
- Install physical barriers around descending staircases and holes that are in the robot's operating area. If the hazard is not close to the robot's operating area, it may be sufficient to use a Forbidden zone on its own.
- Keep the maps up to date.
- Inform personnel that the robot cannot detect descending staircases and holes in the floor in time to stop.

**WARNING**

Contact with live electrical parts can cause electric shock.

- Do not touch any internal components of the robot while it is powered.

**NOTICE**

The robot cannot reliably detect forklift forks or empty pallets. The robot may drive into forks or pallets causing damage to the robot's load, the robot, or equipment.

- Avoid leaving empty forklifts in the robot's operating environment.
- Inform personnel that the robot will not detect forklift forks or empty pallets.
- Inform personnel that the safety laser scanners are the only safety-rated sensors, but are limited to the scanner detection plane and are not intended for detecting forks and pallets. At any other height, only the 3D cameras and proximity sensors can potentially detect obstacles.
- Any modifications to the camera filter settings or the Obstacle clearing settings may affect how well the robot can detect obstacles in front of the robot, above or below the safety laser scanner detection plane. Test and evaluate the robot's performance after applying any changes to ensure the robot performs as intended.

**CAUTION**

Robot malfunctions can cause an electrical fire, causing damage and injury to equipment and personnel.

- Personnel operating near the robot must be informed on how to use an ABC fire extinguisher to put out an electrical fire should the robot malfunction and catch on fire.

**CAUTION**

Risk of trapping or injury to personnel if robots malfunction or if personnel enter operating hazard zones.

- Personnel operating near the robot must be informed on how to engage the robot's Emergency stop function in emergency situations.
- Ensure that all personnel are instructed to stay clear of operating hazard zones when the robot is in the zone.

3.3 Warning label

MiR600 is supplied with a warning label that specifies that it is strictly prohibited to ride on the robot.

The label must be placed on the robot or top module so that it is clearly visible.

Figure 3.1 The warning label must be placed on the robot or top module



3.4 Foreseeable misuse

Any use of MiR600 deviating from the intended use is deemed as misuse. This includes, but is not limited to:

- Using the robot to transport people
- Using the robot on inclines outside the robot's specifications
- Making changes to the SICK configuration
- Driving the robot on cross slopes
- Exceeding the maximum payload
- Positioning or fastening loads incorrectly according to the specifications—see ["Payload distribution and stability" on page 175](#)
- Using Emergency stop buttons for anything other than emergency stops
- Using the robot in medical and life critical applications
- Operating the robot outside the permissible operating parameters and environmental specifications
- Using the robot in potentially explosive ATEX environments
- Using the robot outdoors
- Using the robot in hygiene zones
- Using MiR top modules that are not specifically made for MiR600
- Using the robot together with an external radio module that in any way results in simultaneously active radio transmitters

The following list gives examples of custom modules that are foreseeable misuse of MiR600:

- Top modules (including the payload) that increase the physical dimensions of MiR600
- Conveyors (powered and non-powered)
- Industrial robot arms
- Devices that tow carts
- Customized load transfer stations
- Top modules or modifications that use additional antennas or result in transmitting radio signals simultaneously with the existing radio module

3.5 Residual risks

Mobile Industrial Robots has identified the following potential hazards that commissioners must inform personnel about and take all precautions to avoid when working with MiR600:

- You risk being run over, drawn in, trapped, or struck if you stand in the path of the robot or walk towards the robot or its intended path while it is in motion.
- You risk being run over, drawn in, trapped, or struck if you stand in the path of the robot or walk towards it while it is driving in reverse. The robot only drives in reverse when undocking from a marker, such as a charging station or load transfer station.
- You risk being crushed or trapped if you touch the robot while it is in motion.
- You risk being crushed or trapped if the robot places a load outside a designated drop-off area due to faulty localization.
- You risk losing control of the robot if it is accessed by unauthorized users. Consider increasing the IT security of your product.



WARNING

Other significant hazards may be present in a specific robot installation. Failure to identify hazards may result in injury to personnel or damage to equipment.

- Identify all hazards specific to your robot installation during commissioning.

4. Getting started

To get the robot started, see the guide *MiR600 Quick Start* delivered with the robot, or follow these steps:

- 1 Unpack MiR600—see ["Unpacking MiR600" on the next page](#).
- 2 Connect the battery—see ["Connecting the battery" on page 131](#).
- 3 Connect to the robot's interface—see ["Connecting to the robot interface" on page 43](#).
- 4 If you want, connect the robot to a Wi-Fi network—see ["Connecting the robot to a Wi-Fi network" on page 45](#).
- 5 Drive the robot off the pallet using Manual mode—see ["Operating the robot" on page 51](#).
- 6 Use *MiR Commissioning Guide* to start commissioning the robot and planning your site. For help using the robot interface, see *MiR Robot Interface Guide*. For in-depth information about how MiR products work, see *MiR Technical guides*. You can find these guides on [MiR Support Portal](#).

4.1 In the box

The box contains:

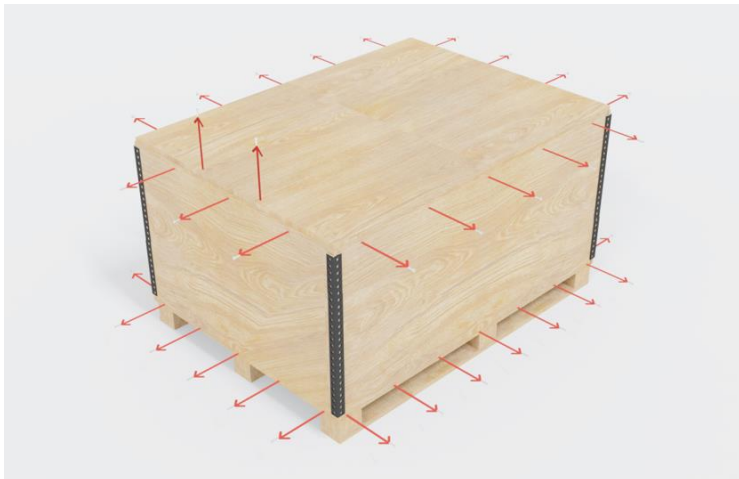
- The MiR600 robot
- Anti-slip paper
- A SICK safety laser scanner optics cover cleaning cloth
- A MiR600 document folder containing the following printed documents:
 - *MiR600 Quick Start*
 - *The CE Declaration of Conformity* for your robot
 - *Unpacking note*

4.2 Unpacking MiR600

Keep the original packaging for future transportation of MiR600.

To unpack the robot, follow these steps:

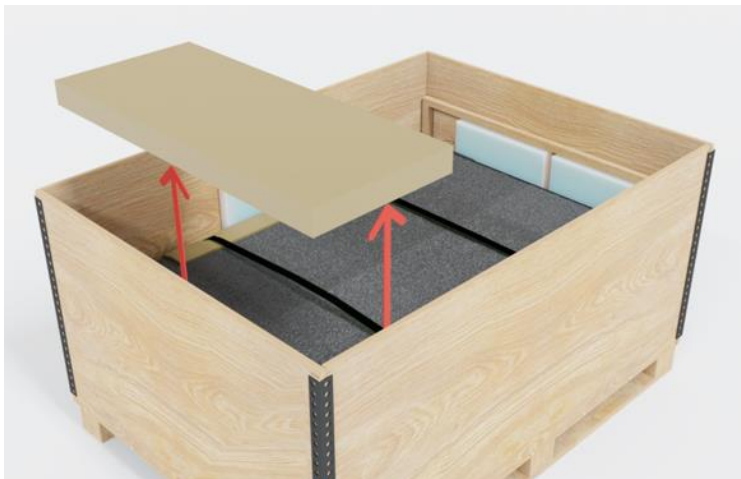
- 1 Place the box with the robot so that there is at least three meters of free space at the front or the back of the box. This is necessary as the robot drives out of the box on a ramp.
- 2 Remove the screws that attach the walls of the box to the box lid and the base of the box. Use a T20 bit.



- 3 Remove the lid from the box, and remove the wooden lath beneath the lid. Use a T20 bit.



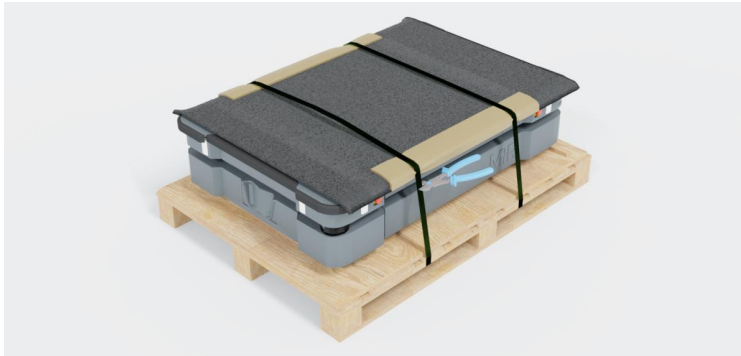
- 4 Take the package with the printed documents and accessories out of the box.



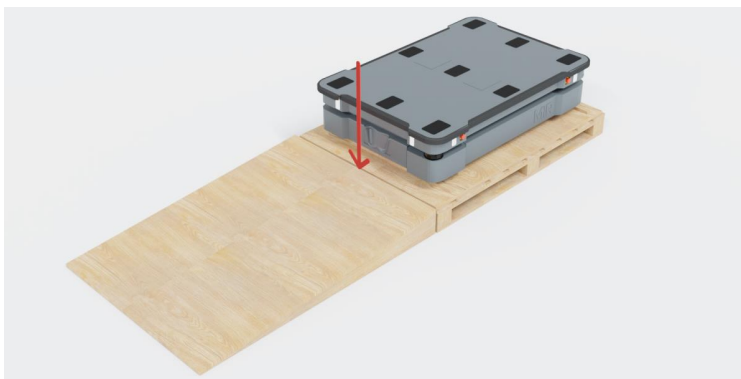
- 5 Remove the pallet collars and the protective foam blocks.



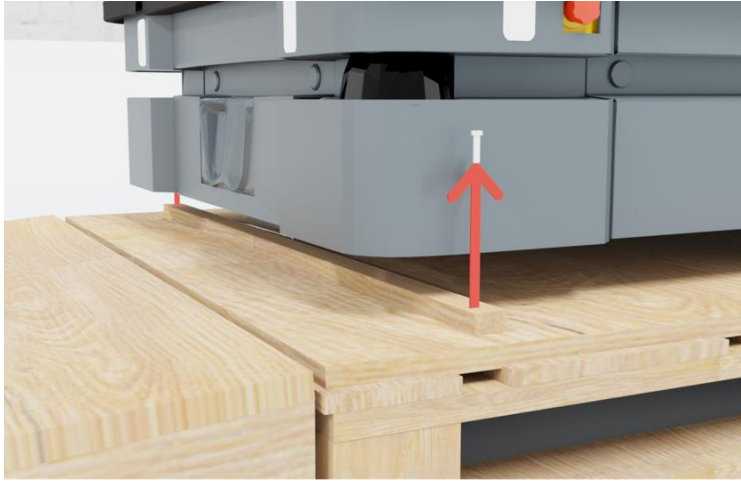
- 6 Cut the protective straps.



- 7 Place the lid of the box so that you can use it as a ramp. Align the lid so that it is flush with the base of the box.



- 8 Remove the wheel stop board from the pallet to let the robot drive on the ramp. Use a T20 bit.



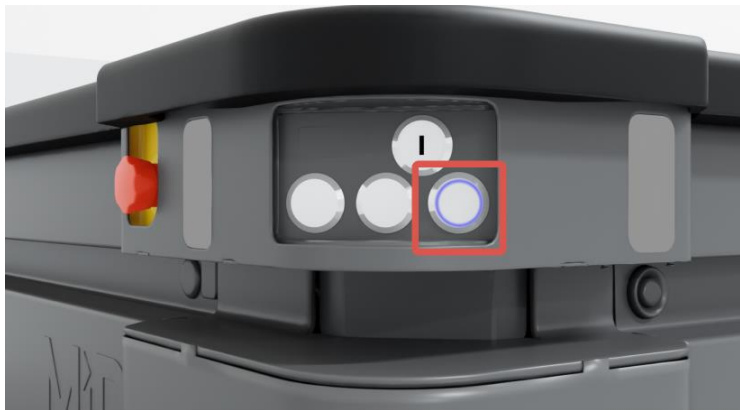
5. Usage

The following sections describe how the robot is operated and customized.

5.1 Powering up the robot

To power up the robot, follow these steps:

- 1 Press the Power button for five seconds.



The robot turns on the red signal lights and the orange wavering status lights and starts the software initialization process.




When the initialization process ends, the robot goes into Protective stop.

- 2 Press the Resume button to clear the Protective stop.




The robot is now ready for operation.



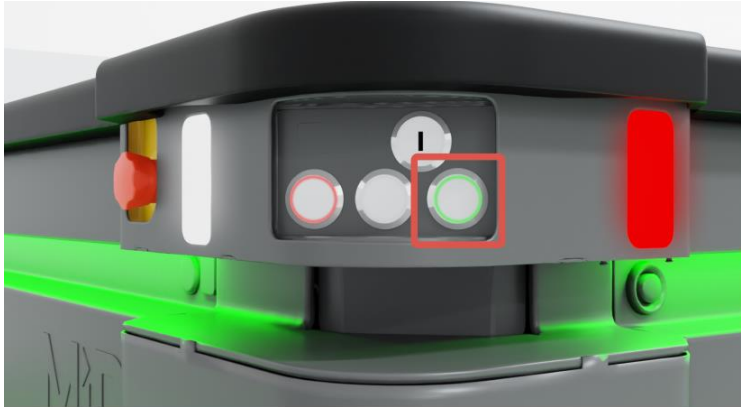
-  If you are not able to power up the robot upon delivery, see *MiR 48V Battery Technical Guide* to troubleshoot the issue. You can find this guide on [MiR Support Portal](#).

5.2 Shutting down the robot

To shut down MiR600, follow these steps:

-  See a [video](#) of the process on the MiR TechComm videos channel on vimeo.com.

- 1 Ensure that the robot is not moving or executing an action.
- 2 Press the Power button for three seconds.



- 3 Wait for the robot to finish the shutdown process. The status lights waver orange, and the Power button blinks red.



When the robot finishes the shutdown process, the status and signal lights go off.



When you shut down the robot for transportation, service, or repair, the battery must be disconnected—see ["Disconnecting the battery" on page 132](#).

5.3 Connecting to the robot interface

When the robot is turned on, you can connect a PC, tablet, or phone to the robot's internal network via the RJ45 Ethernet port on the robot. Once connected, you can configure the robot's settings and connect it to a wireless network.

You can connect to the robot using an Ethernet cable or an access point. If you are located in North America, the EU, or a part of the EAC, you can purchase a MiR Access Point from MiR. Outside these areas, you need to use your own access point that is approved for use in your region. If you choose to use an access point, you must ensure that the robot is disconnected from the wireless network before attaching the access point to remain compliant—see ["Connecting the robot to a Wi-Fi network" on page 45](#).

Whether you connect via Ethernet cable or an access point, it is recommended that your device is configured to DHCP. If you require a static IP on your device, assign an address above 192.168.12.150, and set the DNS server and Gateway address to 192.168.12.1.



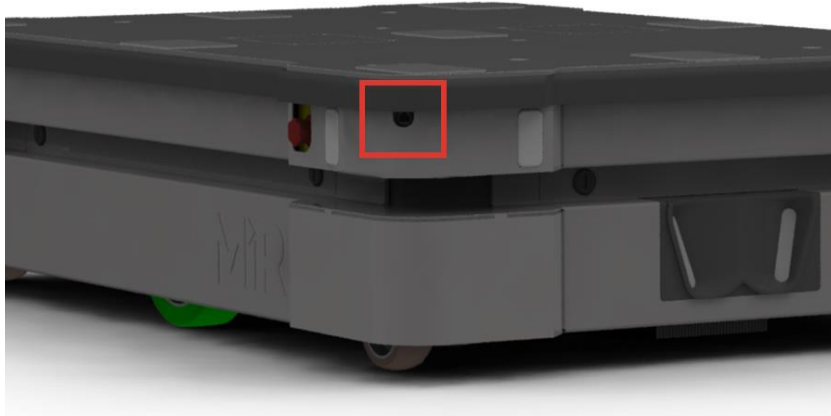
CAUTION

Harmful electromagnetic interference might be the result of having two radio modules transmitting at the same time. The robot is certified to have only one radio module active at any given time.

- Do not attach an access point or additional radio modules to the robot while it is connected to a wireless network.

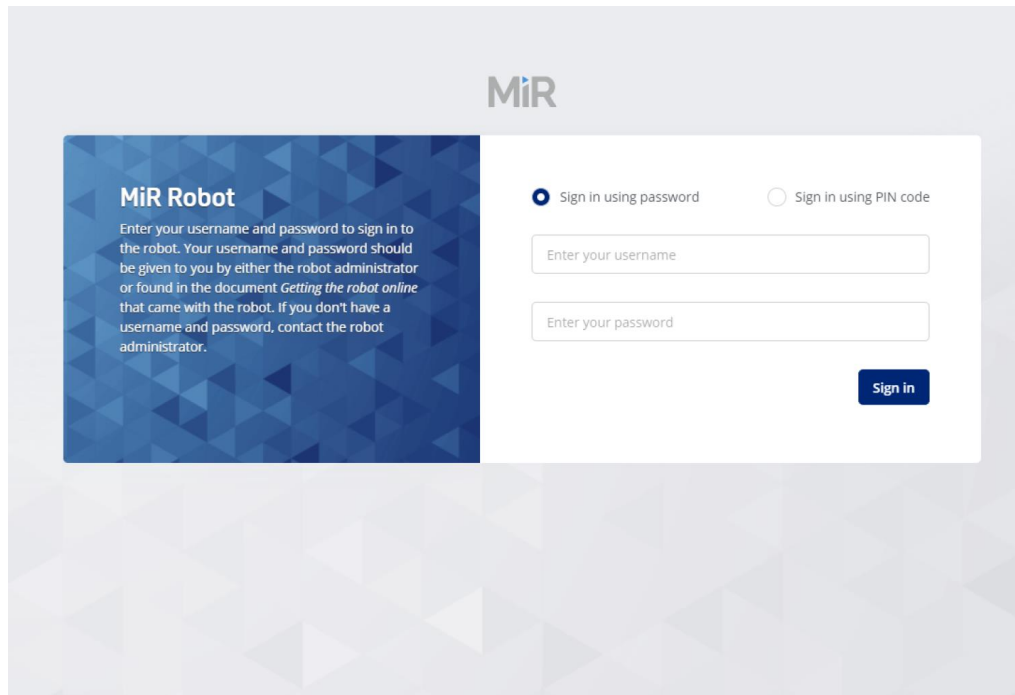
To connect to the robot interface, follow these steps:

- 1 Locate the RJ45 Ethernet port below the bumper on the front-right corner shield of the robot.



- 2 Connect your device directly to the robot using an Ethernet cable, or connect an access point to the Ethernet port for a wireless connection.
- 3 If you are using an access point, connect your device to the access point. The MiR Access Point Wi-Fi has the following format: **MiR_3042XXXXX**. Use the password shipped with the access point to connect.

- 4 In a browser, go to the address **192.168.12.20** and sign in.

The image shows the MiR Robot login web interface. At the top center is the MiR logo. Below it, on the left, is a blue box with the title "MiR Robot" and instructions: "Enter your username and password to sign in to the robot. Your username and password should be given to you by either the robot administrator or found in the document *Getting the robot online* that came with the robot. If you don't have a username and password, contact the robot administrator." On the right is a white login form. It has two radio buttons at the top: "Sign in using password" (which is selected) and "Sign in using PIN code". Below these are two input fields: "Enter your username" and "Enter your password". At the bottom right of the form is a blue "Sign in" button. The background of the entire page is a light gray with a subtle geometric pattern of triangles.

5.4 Connecting the robot to a Wi-Fi network

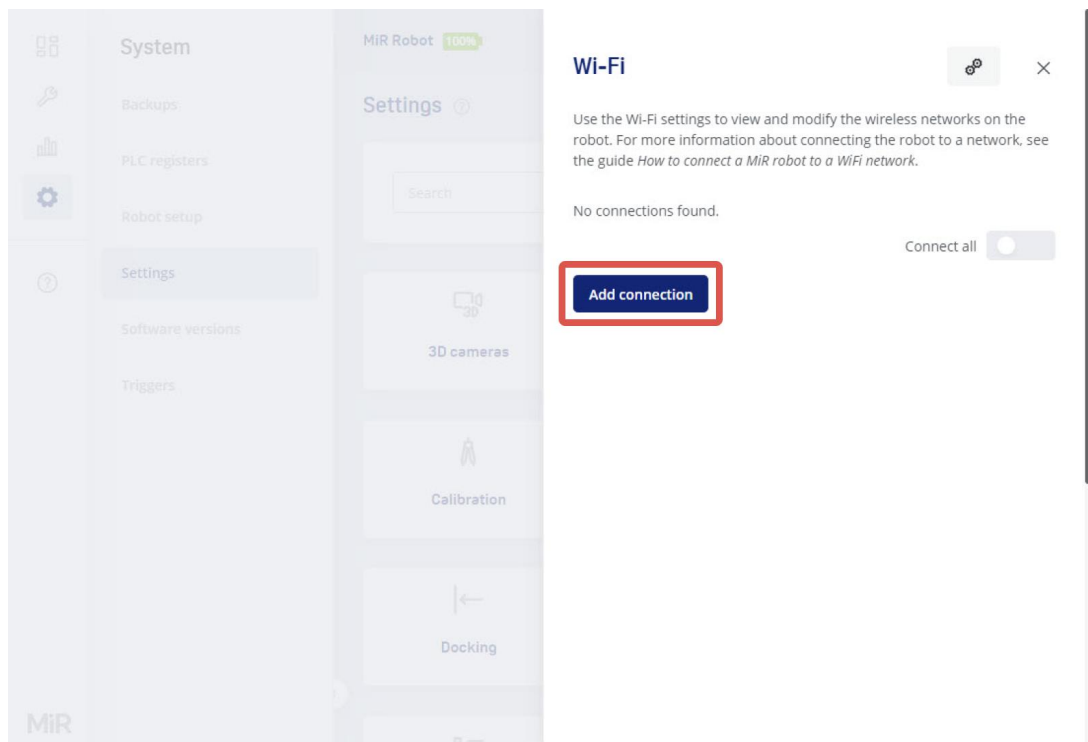
To communicate with the robot wirelessly without using an access point, connect the robot to your local Wi-Fi network. This enables you to access the robot interface via your Wi-Fi network by entering the assigned IP address of your robot in a web browser.

To connect the robot to a Wi-Fi network, follow these steps:

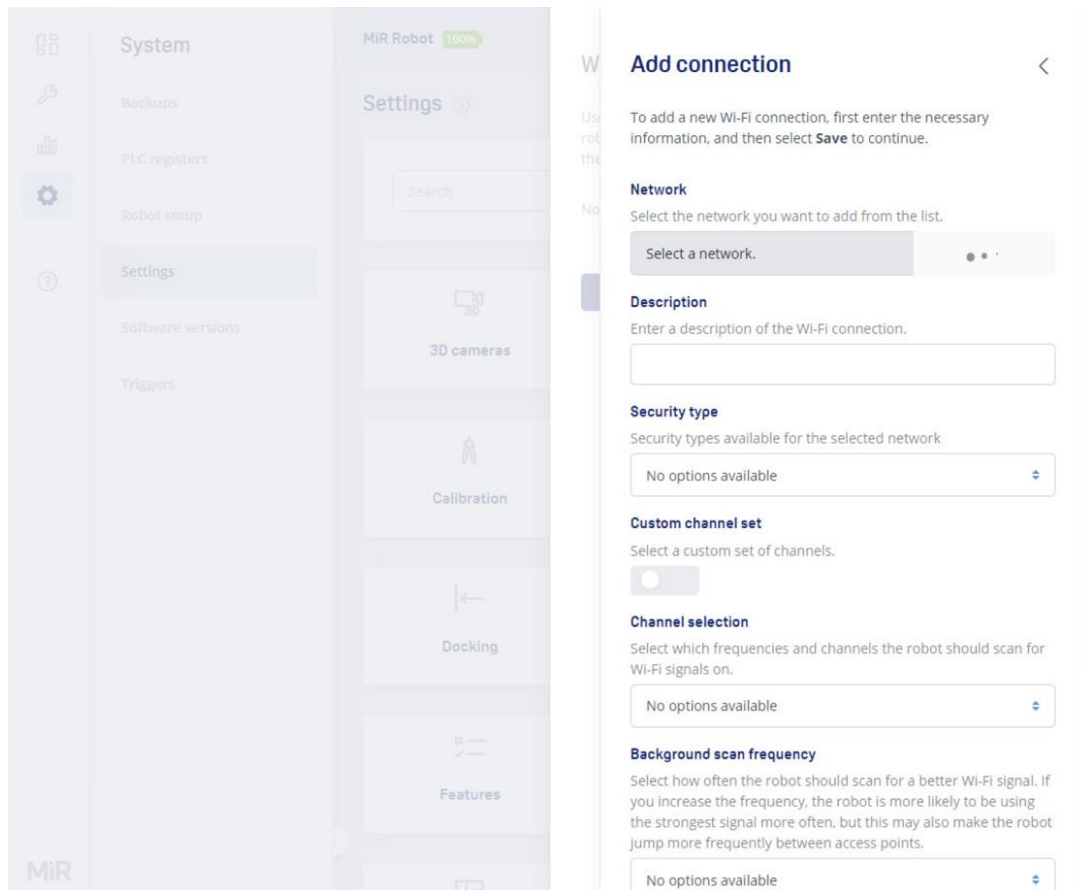
- 1 Connect to your robot as described in "[Connecting to the robot interface](#)" on page 43.

To comply with the robot's certification, you must use an Ethernet cable to avoid simultaneously active radio transmitters while setting up the connection to the local Wi-Fi network.

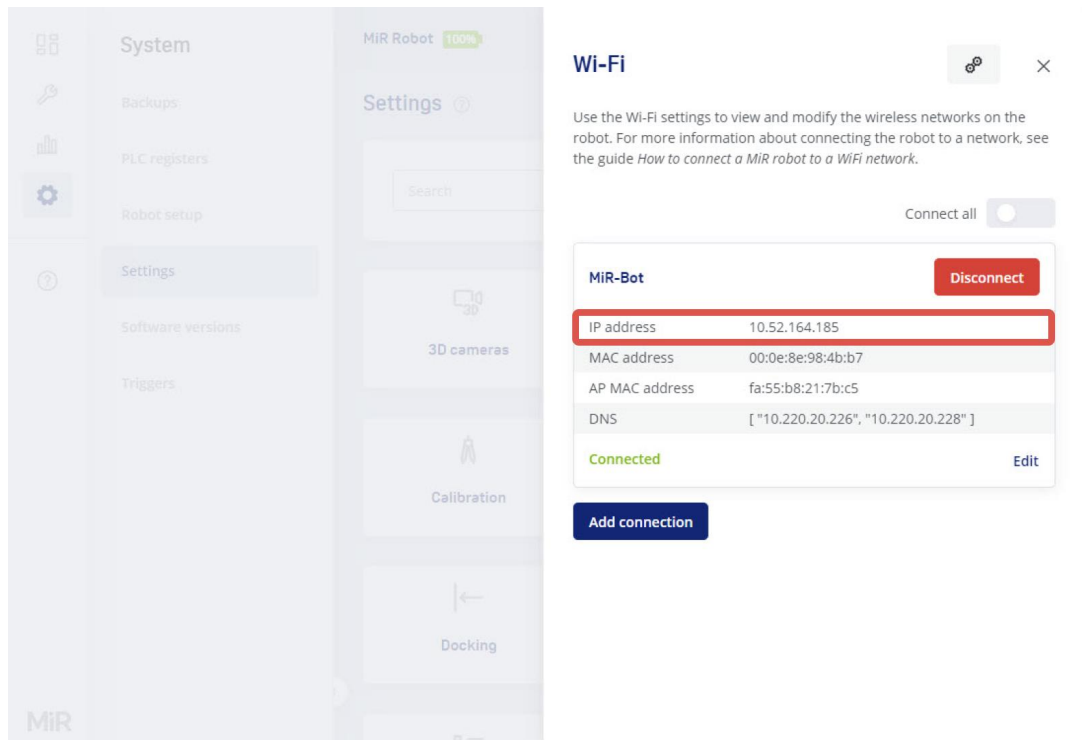
- 2 Go to **System > Settings > Wi-Fi**, and select **Add connection**.



- 3 Select the network you want the robot to be connected to, and fill out the displayed fields—see the guide *How to connect a MiR robot to a Wi-Fi network* for more information about the Wi-Fi settings. You can find this guide on [MiR Support Portal](#).



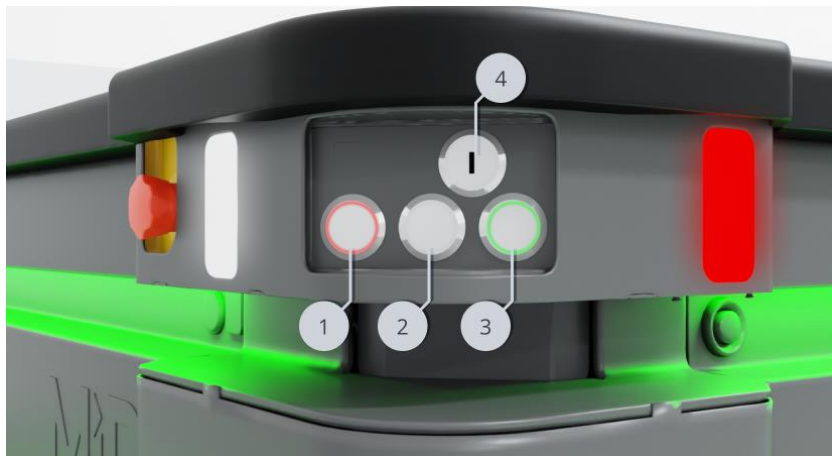
- 4 Select **Add connection** when you have finished. The robot is now connected to the network. When you are connected to the same network, you can access the robot's interface by entering the IP address displayed under the connection description into your internet browser.



To disconnect the robot from a Wi-Fi network, select **Disconnect**.

5.5 Control panel

MiR600 has a control panel in the rear-left corner of the robot.

Figure 5.1 The MiR600 control panel**Table 5.1** Identification of items on the control panel in [Figure 5.1](#)

Pos.	Description	Pos.	Description
1	Manual stop button	2	Resume button
3	Power button	4	Operating mode key

Manual stop button

Pressing this button stops the robot. After pressing this button, you must press the Resume button to let the robot continue operating.

Color indication:

- Red: It is possible to engage the Manual stop.

Resume button

Pressing this button:

- Clears the Emergency or Protective stop state.
- Lets the robot continue operating after the Manual stop button was pressed or after the operating mode changes.
- Lets the robot start operating after powering up.

Color indication:

- Blinking blue: The robot is waiting for a user action. For example, press the button to clear a Protective stop or acknowledge the change of operating mode.

Power button

Pressing this button for three seconds turns the robot on or shuts it off.

Color indication:

- Blinking green: The robot is starting up.
- Green: Normal operation.
- Blinking blue: The robot is checking that the battery level is high enough to start up.
- Blinking red: The battery level is too low to start without additional charging, or the robot is shutting down.

The Operating mode key

The Operating mode key lets you switch between operating modes.

- Left position: Autonomous mode. Puts the robot in Autonomous mode.
- Middle position: Locked mode. The robot blocks the wheels; you cannot start a mission or drive the robot manually.
- Right position: Manual mode. Puts the robot in Manual mode.

For more information on operating modes, see "[Operating the robot](#)" on the next page.

5.6 Preventing unauthorized use

To prevent unauthorized users from accessing the robot:

- Keep passwords to connect to the robot interface and the robot components strictly confidential. Assign each robot user with their own user in the interface and make sure they each have a unique username and password.

- Follow guidelines in *MiR Cybersecurity Guide*. You can find this guide on [MiR Support Portal](#).
- Always remove the Operating mode key from the robot when it is operating.



5.7 Operating the robot

MiR600 has three operating modes: Manual mode, Autonomous mode, and Locked mode.

Manual mode

In this mode, you can drive the robot manually using the joystick in the robot interface. Only one person can control the robot manually at a time.

Manual mode is only intended for initial setup, maintenance situations, or deadlocks.

To control the robot manually, you must connect to the robot interface—see "[Connecting to the robot interface](#)" on page 43.

**CAUTION**

When driving the robot in Manual mode it is the driver's responsibility to ensure the safety of nearby personnel. Failure to be aware of the risks and operate the robot with caution can result in injury to personnel or damage to equipment.

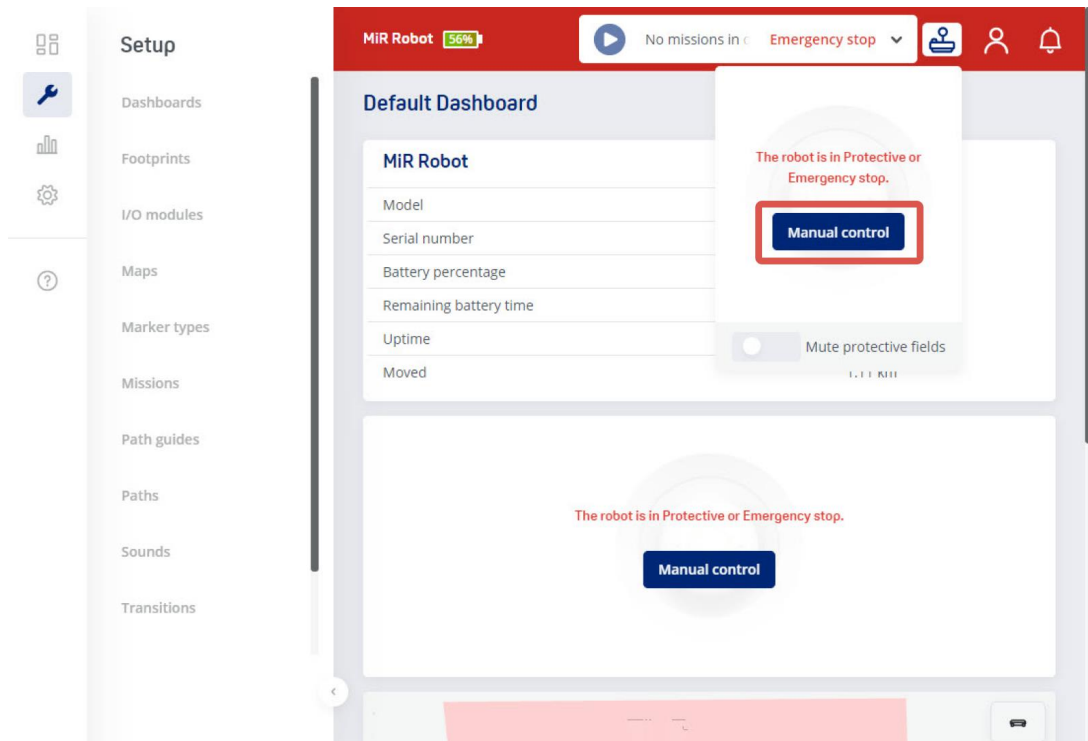
- Drive carefully to avoid collisions with any personnel or objects when driving the robot in Manual mode.
- Avoid driving the robot manually without a clear visual of the robot.
- Be aware that you can drive the robot into Forbidden zones and Unpreferred zones on the map.
- Be aware that you can make the robot collide with obstacles even if you do not mute the Protective fields. If you mute the Protective fields the robot will not stop at all for detected obstacles—see ["Muted Protective fields" on page 84](#).
- Manual mode is only intended for initialization and maintenance situations, including potential deadlocks.

To drive the robot in Manual mode, follow these steps:

1

On the robot, turn the Operating mode key to Manual mode (turn it to the right). The robot enters Emergency stop.

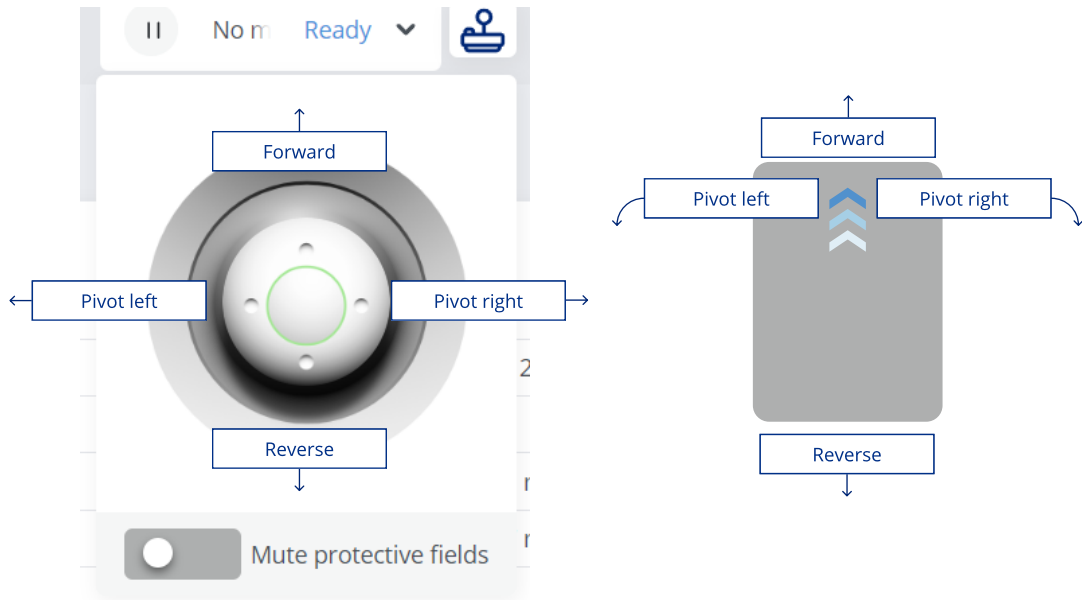
- 2 In the robot interface, select **Manual control** under the joystick icon . The Resume button on the robot starts blinking.



- 3 On the robot, press the Resume button. The status lights turn blue, indicating that the robot is in Manual mode.



- 4 Use the joystick to move the robot. The robot will go back into emergency stop after a short time of inactivity.



Autonomous mode

In this mode, the robot executes the programmed missions. After switching the key to this mode, you can remove the key, and the robot will continue driving autonomously. In Autonomous mode, the joystick is disabled in the robot interface.

There are the following ways to make the robot drive autonomously in the robot interface:


- **Schedule a mission**

To schedule a mission, go to **Setup > Missions**, and select **Queue mission** .



For more information about creating missions and to see mission examples, see *MiR Commissioning Guide* and *MiR Robot Interface Guide*. You can find these guides on [MiR Support Portal](#).

- **Send the robot to a location on the active map**

To send the robot to a selected location, open the active map, either in a dashboard or the map editor, and select **Send robot to target**  followed by the location and orientation you want the robot to drive to.

- **Send the robot to a position or marker on the active map**

To send the robot to an existing position or marker, open the active map, either in a dashboard or the map editor, and select a position or marker followed by **Go to**.

Locked mode

In this mode, the robot blocks the wheels. You cannot start a mission or drive the robot when it is in Locked mode. You put the robot in Locked mode by putting the Operating mode key in the middle position—see ["Control panel" on page 48](#).

5.8 Types of stop

There are four different stopped states:

- Operational stop
- Protective stop
- Emergency stop
- Manual stop

The last three types of stop are monitored by the safety PLC.

When the robot is in Protective stop or Emergency stop, the robot loses connection CAN bus nodes 3, 4, and 20. The connection is re-established once the robot is brought out of Protective or Emergency stop.

Operational stop

The robot is in Operational stop when it is stopped through the robot interface either through a mission action or by pausing the mission. The top module and all moving parts are still connected to a power supply.

Protective stop

The robot enters Protective stop automatically to ensure the safety of nearby personnel. When the robot enters Protective stop, internal safety contactors are switched so the robot's top module and all moving parts of the robot do not receive power. You can hear the safety contactors emit audible clicks when they are switched.

When the robot is in Protective stop, the status lights of the robot turn red, and you are not able to move the robot or send it on missions until you bring the robot out of the Protective stop. The following cases describe the various Protective stops and how to bring the robot out of them:

- **A safety laser scanner detects an object in its active Protective field**

Remove the object from the active Protective field—see ["Field switching and Personnel detection" on page 79](#). The robot will resume its operating state after two seconds.

- **The robot finishes the startup process**

The Resume button will flash after startup. Press the flashing Resume button to bring the robot out of Protective stop.

- **Switching between Manual mode and Autonomous mode**

After turning the Operating mode key to switch operating modes, the robot enters Protective stop, and the Resume button flashes. Press the Resume button to bring the robot out of Protective stop.

- **The safety system detects a fault, or the motor control system detects a discrepancy**

To bring the robot out of Protective stop, resolve the fault causing the error. Use information regarding the error from the robot interface to determine the fault. Go to **Monitoring > Hardware health** to find specific information on what caused the issue. For further guidance, see the troubleshooting guides to help troubleshooting the issue. You can find these guides on [MiR Support Portal](#).

Emergency stop

The robot enters Emergency stop when an Emergency stop button has been pressed physically. When you press the Emergency stop button, internal safety contactors are switched so the robot's top module and all moving parts of the robot do not receive power. You can hear the safety contactors emit audible clicks when they are switched.

When the robot is in Emergency stop, the status lights of the robot turn red, and you are not able to move the robot or send it on missions until you bring the robot out of the Emergency stop. To do this, you must release the Emergency stop button and then press the Resume button. The Resume button begins flashing blue after you have released the Emergency stop button. If the robot is in Emergency stop, it will immediately resume an operating state after you press the flashing Resume button.

Figure 5.2 MiR600 has four Emergency stop buttons: two on each side of the robot



CAUTION

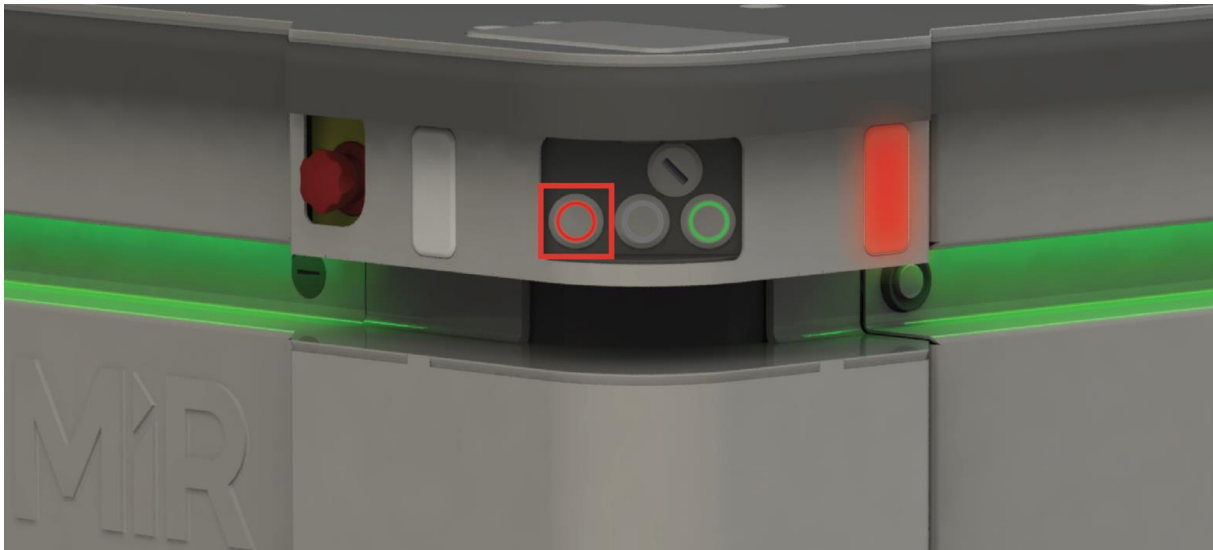
Emergency stop buttons are not designed for frequent use. If a button has been used too many times, it may fail to stop the robot in an emergency situation, and nearby personnel may be injured by electrical hazards or collision with moving parts.

- Only press Emergency stop buttons in emergencies.
- Check that all Emergency stop buttons are fully functional—see ["Maintenance" on page 113](#).
- Use the robot interface to stop the robot in non-emergency situations.

Manual stop

The robot enters Manual stop when the red Manual stop button in the control panel is pressed. Manual stop brings the robot into the same state as a Protective stop where it can only be brought to an operational state by pressing the Resume button.

Figure 5.3 The Manual stop button is the left-most button on the control panel



5.9 Manual brake release switch

The Manual brake release switch is located in the rear compartment. You release the robot's mechanical brakes by turning the Manual brake release switch clockwise.

Figure 5.4 Turn the Manual brake release switch clockwise to release the brakes



The mechanical brakes require electrical power to be released. To release the brakes, the robot must be connected to an active and charged battery when you turn the switch—see "[Connecting the battery](#)" on page 131.

When the robot is driving, the robot engages and releases the mechanical brakes automatically. You should only release the brakes manually when you want to move the robot by hand.

When you release the brakes manually, all power to the motors is cut. This means the robot loses connection to some of the CAN bus nodes and the robot does not receive data that it needs to localize itself. After moving the robot manually, you must correct the robot's location on the map—see the guide *How to use adjust localization*. You can find this guide on [MiR Support Portal](#).

Once you engage the automatic brake system, the connection to the CAN bus nodes is re-established, and the robot can update its location on the map automatically.

The robot cannot operate while the mechanical brakes are released manually.

5.10 Light indicators and speaker

The robot uses its speaker and two types of light indicators to let people in the environment know what the robot is currently doing or planning to do.

- **Status lights**

The LED light bands on all four sides of the robot use colors and light motion patterns to signal the current status of the robot.

- **Signal lights**

The signal lights at the front and back of the robot show if the robot is about to turn a corner or go backward. Front lights are white and rear lights are red. Right and left turns are indicated by blinking.

- **Speaker**


The speaker plays sounds to alert personnel. You can trigger sounds using zones and mission actions, and you can enable the robot to play warning sounds whenever the Protective fields are muted.

Figure 5.5 Light indicators on MiR600**Table 5.2** Identification of light indicators in [Figure 5.5](#)

Pos.	Description	Pos.	Description
1	Signal lights	2	Status lights

Status lights

The LED light bands running all the way around the robot indicate the robot's current operational state. Colors may also be used as part of missions, but as standard, status lights indicate the statuses described below.

			
Red Emergency stop or Protective stop	Green Ready for job	Cyan Drives to destination	Purple Goal/Path blocked
			
Wavering white Planning path	Orange Mission paused	Wavering orange Startup signal before PC is active	Fading orange Shutting down robot
			
Blinking orange Relative move, ignoring obstacles	Wavering purple and orange General error	Blue Manual drive	Wavering blue Mapping
			
State of charge Charging at charging station	Wavering cyan Waiting for MiR Fleet resource or for another MiR robot to move		

When the robot's battery reaches a critically low level of power (0-1%), the ends of the status lights flash red.

Signal lights

Signal lights are used to indicate the robot's immediate motion plans by signaling forwards-backwards-braking and left-right turns.

The signal lights work similarly to lights used on cars; white at the front, red at the back, and indicating a left or right turn by blinking.

When the robot drives with muted Protective fields, for example, when docking to a charging station, all signal lights blink yellow.

Speaker

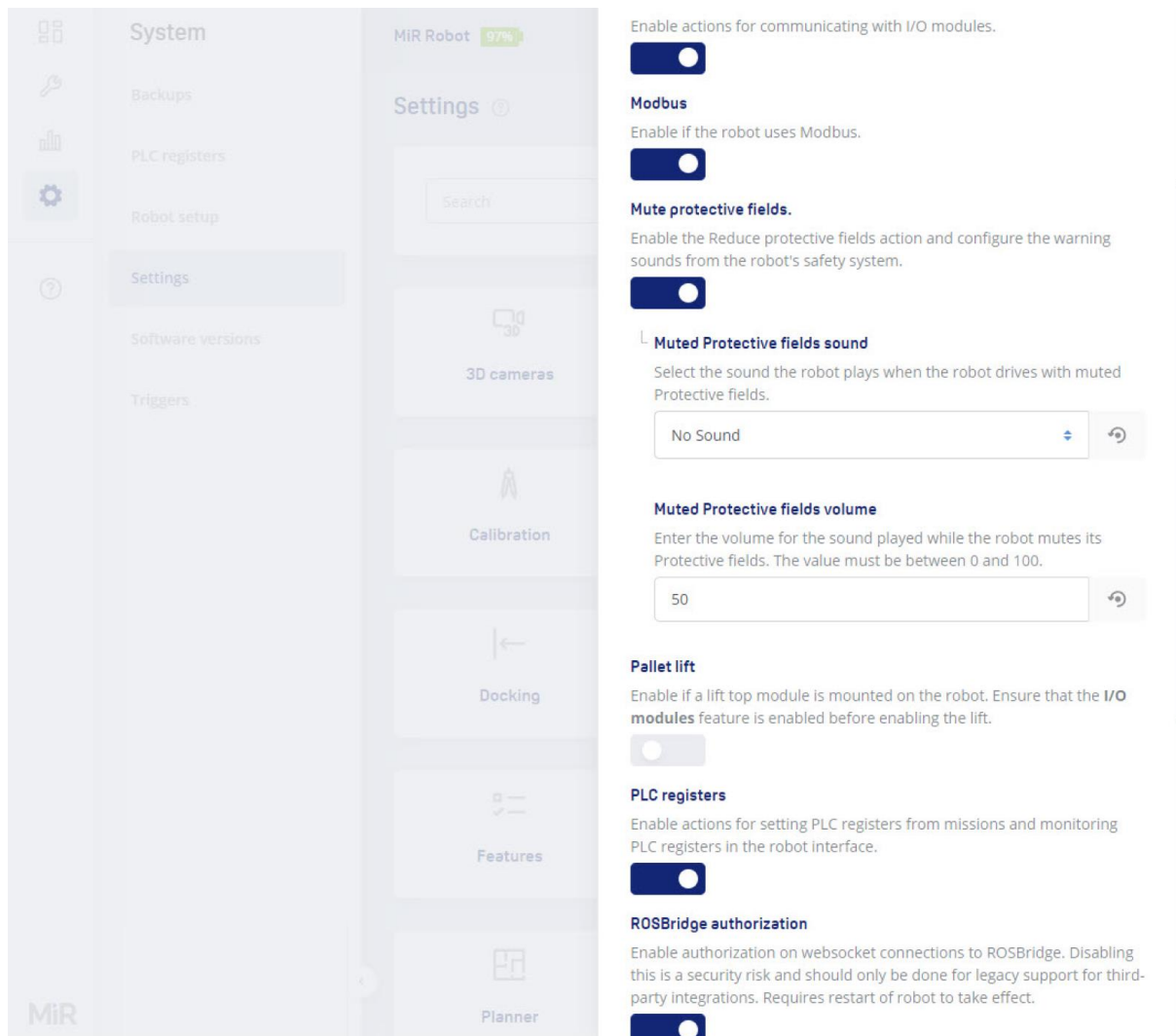
In **Setup > Sounds**, you can upload new sounds to the robot or edit the volume and length of the default sounds.

Sounds can be used in missions and zones to alert or to attract people's attention.

For more information about how to set up sounds, see *MiR Commissioning Guide*. You can find this guide on [MiR Support Portal](#).

When the robot drives with muted Protective fields it emits a warning sound. In **System > Settings > Features**, you can choose which sound the robot makes and the volume of the sound.

Figure 5.6 In the Features settings, you can modify the sounds the robot plays when the robot mutes its Protective fields



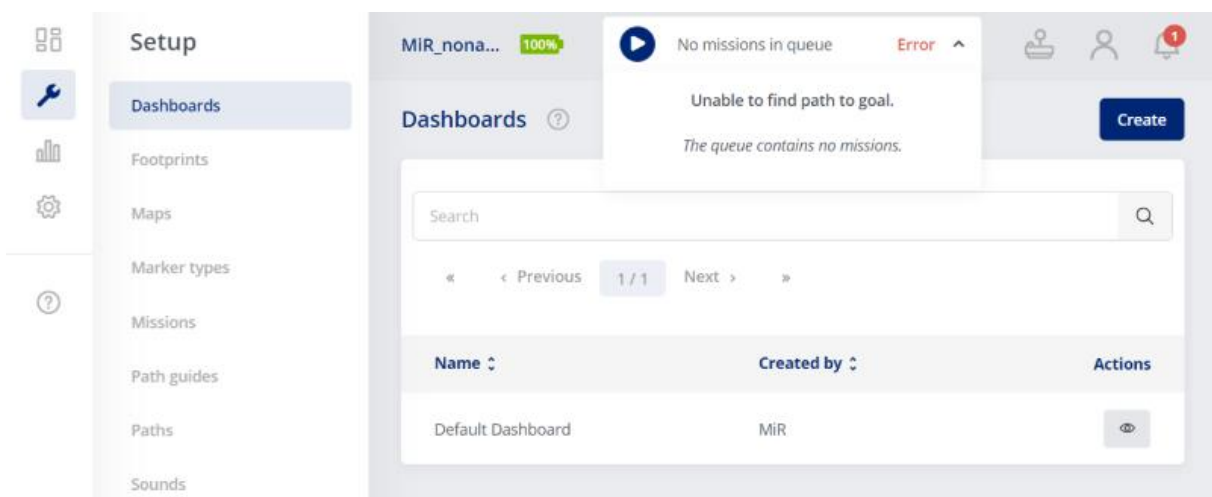
**CAUTION**

Unaware personnel may not see the robot in certain situations and risk colliding with the robot. This may result in injury to personnel or damage to equipment.

- Make sure to adjust the volume of the robot's warning sounds so they are audible in the robot's work environment.
- Implement warning sounds from the robot in missions and areas where it can reduce the risk of hazardous situations.
- Do not disable the sound in the safety system. This will also cause the robot to not comply with safety standards.

5.11 Error handling

The robot enters an error state when it can not solve a problem on its own.



Errors include:

- Hardware faults
- Failed localization
- Failure to reach destination
- Unexpected events in the system

An error triggers a Protective stop. The robot is paused until a user acknowledges the error and clears it.

Software errors

Software errors such as localization and failure to reach the goal destination can be prevented with the proper setup of maps and missions:

- Always test your missions under full observation and normal work environment conditions before leaving the robot to execute the missions autonomously.
- Use Try/Catch actions to make the robot react in a specific way if it fails to execute certain actions.
- Use Prompt user actions in missions that require intervention from users.
- Define forbidden areas with Forbidden or Unpreferred zones on the map.
- Remove noise from maps.
- Create Directional or Preferred zones to guide the robot around areas that are difficult for the robot to travel through.

For more information about commissioning your robot to fulfill these guidelines, and for setting up missions and error handling, see *MiR Robot Interface Guide* and *MiR Commissioning Guide*. You can find these guides on [MiR Support Portal](#).

To clear an error, select the red warning indicator in the interface, and select **Reset**.



NOTICE

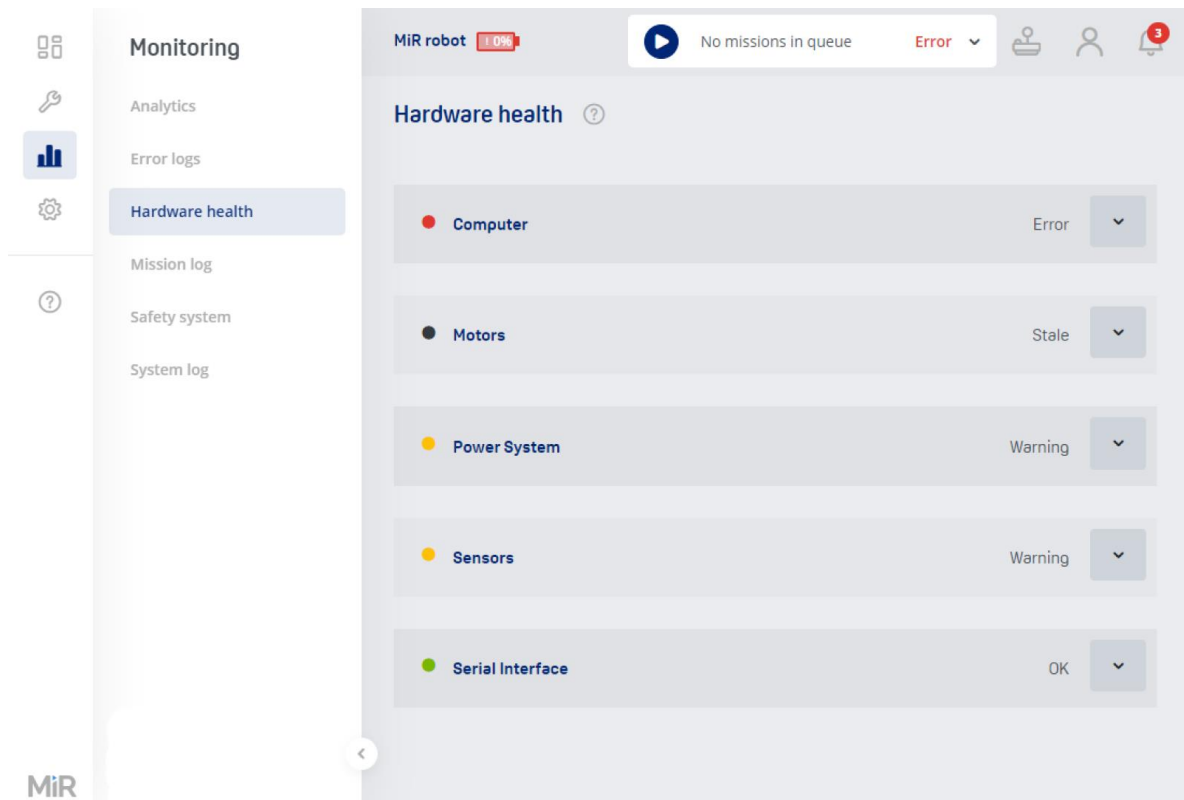
When the robot stops because of an error, it also cancels its current mission. After clearing an error, make sure the robot completes the task it was assigned, especially if the robot was transporting a load and did not finish delivering it.

Hardware errors

If the error is a fault in the hardware, either you will not be able to clear it, or the error will return until the fault is fixed. If this occurs, you can try to fix the issue with these actions:

- Turn your robot off and then on again. This resets the robot components and may resolve the issue.
- Check that all Emergency stop buttons are released.

- Check your robot for any physical damage such as cracks, dents, or severe scratches or contamination such as dust, dirt, and grease. Pay special attention to the 3D cameras, safety laser scanners, and drive wheels.
- Sign in to the robot interface and go to **Monitoring > Hardware health**. The interface displays which component is failing and often for what reason. This can help identify the source of the error. If an internal component is failing, turn off the robot, disconnect the battery, and have the commissioner or operator visually check the internal component for obvious faults.



- For further troubleshooting, see the MiR troubleshooting guides and the document *Error codes and solutions*. You can find these guides on [MiR Support Portal](#).

6. Safety-related functions and interfaces

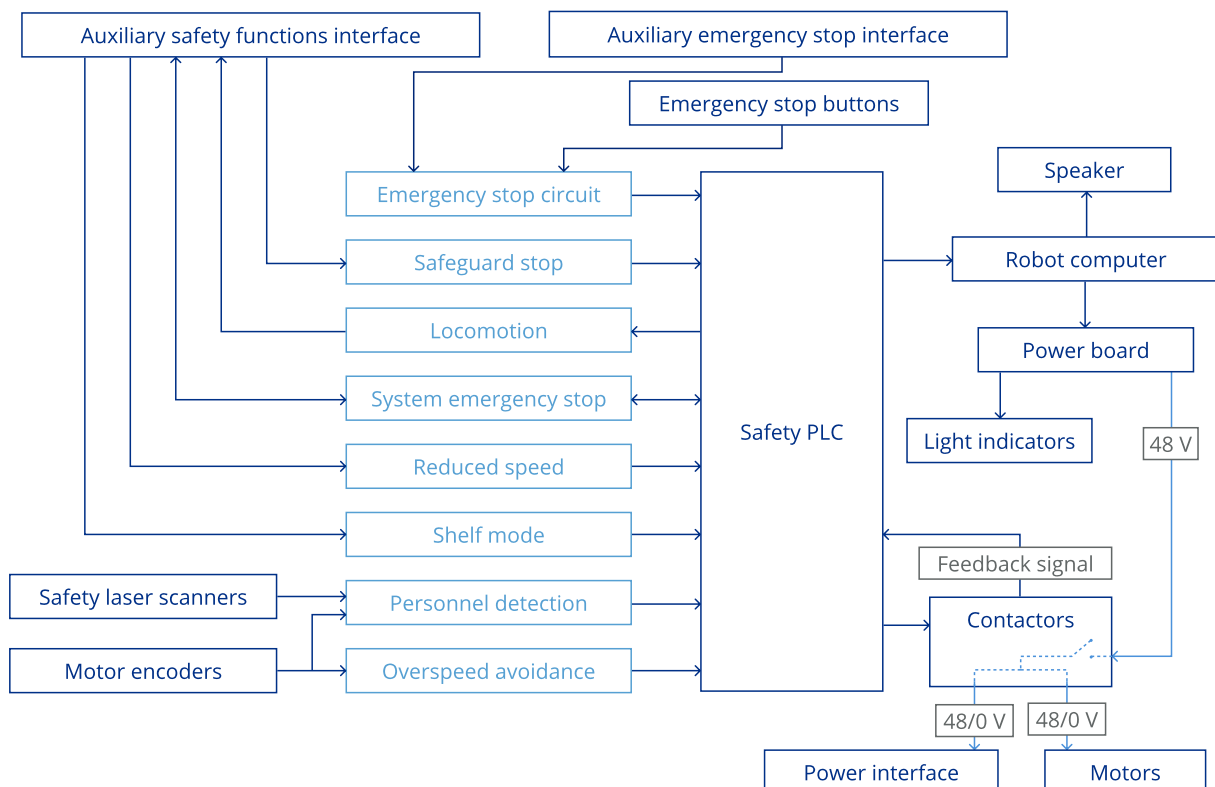
The robot's safety system is designed to mitigate significant hazards which could lead to injury.

For an overview of all the safety functions and the PFHd, PL, and Architecture as defined by ISO 13849-1:2015 of each function, see ["Safety functions overview" on the next page](#).

Several safety functions have been designed and implemented in MiR600. Some safety functions are intended for integration with a connected top module. You must use the Auxiliary safety functions and Auxiliary emergency stop interfaces to use these functions.

The diagram in [Figure 6.1](#) shows the inputs to these functions and interfaces and how they are all connected and monitored by the safety PLC. The safety PLC is able to switch the safety contactors to cut off power to the robot motors and the top module whenever a Protective or Emergency stop is triggered—see ["Types of stop" on page 55](#). Also, the safety PLC sends information to the robot computer. The robot computer displays the information in the robot interface (in **Monitoring > Hardware health**) and indicates if the robot is in Emergency or Protective stop with the status lights.

Figure 6.1 Overview of components involved in each safety function and interface



6.1 Safety functions overview

MiR600 is set up with the following safety configuration:

- **Description:** Standard safety PLC configuration for MiR600 v. 6.5
- **Supported software version:** from 2.12.3
- **Checksum:** 0x5F4C0C48

Table 6.1 lists each safety function with its associated triggering event, reaction, reliability, and how it is realized.

The following terms are used in the table:

- **PFHd:** The Probability of dangerous Failures per Hour as defined in EN ISO 13849-1:2015
- **PL:** Performance Level as defined in EN ISO 13849-1:2015
- **Architecture:** As defined in EN ISO 13849-1:2015

Table 6.1 Overview of integrated safety functions in MiR600

Function name	Description	PFHd, PL, and architecture
Emergency stop ¹	<p>Triggering event: Pressing any Emergency stop button on the robot or connected top module—see "Emergency stop" on page 76.</p> <p>Reaction: Category 0 stop (IEC 60204-1) and mechanical spring-applied brakes engage. System emergency stop pins deliver 0 V—see</p>	<p>PFHd: 4.0×10^{-8}</p> <p>PL: d</p> <p>Architecture:</p>

¹This safety function uses external input. The values in Table 6.1 are evaluated without any external input. The resulting functional safety, including the external device or equipment, is determined by the overall architecture and the sum of all PFHds. This includes the PFHd provided in the table.

Function name	Description	PFHd, PL, and architecture
	<p>"System emergency stop" on page 90. The robot enters Emergency stop.</p> <p>Reset function: Release all Emergency stop buttons, and press the Resume button on the robot.</p> <p>Active: Always</p>	Category 3
Overspeed	<p>Triggering event: The speed of the robot exceeding 2.10 m/s or the difference in speed between the drive wheels exceeding 0.37 m/s—see "Overspeed avoidance" on page 79.</p> <p>Reaction: Category 0 stop (IEC 60204-1) and mechanical spring-applied brakes engage. The robot enters Protective stop.</p> <p>Reset function: Press the Resume button on the robot.</p> <p>Active: Always</p>	<p>PFHd: 5.2×10^{-8}</p> <p>PL: c</p> <p>Architecture: Category 3</p>
Field switching ¹	<p>Triggering event: Changing the robot speed to another case interval—see "Field switching and Personnel detection" on page 79.</p>	<p>PFHd: 1.9×10^{-7}</p>

¹If you modify the SICK configuration file or apply another SICK configuration files, the PFHd and PL no longer apply. You must determine the new functional safety of the new configuration.

Function name	Description	PFHd, PL, and architecture
	<p>Reaction: A predefined protective field is selected.</p> <p>Reset function: Continuous function. No action required.</p> <p>Active: Always</p>	<p>PL: d</p> <p>Architecture: Category 3</p>
Personnel detection ¹	<p>Triggering event: Safety laser scanners detecting an object in the active Protective field—see "Field switching and Personnel detection" on page 79.</p> <p>Reaction: Category 0 stop (IEC 60204-1) and mechanical spring-applied brakes engage. The robot enters Protective stop ².</p> <p>Reset function: Resumes automatically after 2 s of cleared Protective field.</p> <p>Active: Always. Unless Protective fields are muted—see "Muted Protective fields" on page 84. Muting will enable Speed monitoring.</p>	<p>PFHd: 1.2×10^{-7}</p> <p>PL: d</p> <p>Architecture: Category 3</p>
Speed monitor	<p>Triggering event: The speed of either drive</p>	<p>PFHd:</p>

¹If you modify the SICK configuration file or apply another SICK configuration files, the PFHd and PL no longer apply. You must determine the new functional safety of the new configuration.

²The robot will stop within the active Protective field if the payload, CoM, mass inertia moment, and friction coefficient are within specifications.

Function name	Description	PFHd, PL, and architecture
	<p>wheel exceeds 0.3 m/s while the Protective fields are muted.</p> <p>Reaction: Category 0 stop (IEC 60204-1) and mechanical spring-applied brakes engage. The robot enters Protective stop.</p> <p>Reset function: Press the Resume button on the robot.</p> <p>Active: When Protective fields are muted.</p>	<p>5.2×10^{-8}</p> <p>PL: d</p> <p>Architecture: Category 3</p>
Hold-to-run ^{1 2}	<p>Triggering event: If hold-to-run device is not active and the robot's speed is above 0.1 m/s—see "Hold-to-run" on page 88.</p> <p>Reaction: Category 0 stop (IEC 60204-1) and mechanical spring-applied brakes engage. The robot enters Protective stop.</p> <p>Reset function: Press the Resume button on the robot.</p> <p>Active: In Manual mode.</p>	<p>PFHd: 5.70×10^{-8}</p> <p>PL: c</p> <p>Architecture: Category 1</p>
Safeguard stop ³	<p>Triggering event: External device delivering</p>	<p>PFHd:</p>

¹This safety function uses external input. The values in [Table 6.1](#) are evaluated without any external input. The resulting functional safety, including the external device or equipment, is determined by the overall architecture and the sum of all PFHds. This includes the PFHd provided in the table.

²The function is defeated by default.

³This safety function uses external input. The values in [Table 6.1](#) are evaluated without any external input. The resulting functional safety, including the external device or equipment, is determined by the overall architecture and the sum of all PFHds. This includes the PFHd provided in the table.

Function name	Description	PFHd, PL, and architecture
	<p>0 V to the Safeguard stop input pins—see "Electrical interfaces" on page 150.</p> <p>Reaction: Category 0 stop (IEC 60204-1) and mechanical spring-applied brakes engage. The robot enters Protective stop.</p> <p>Reset function: Resumes when external signals are active (24 V).</p> <p>Active: Always</p>	<p>3.6×10^{-8}</p> <p>PL: d</p> <p>Architecture: Category 3</p>
Locomotion	<p>Triggering event: The speed of the robot exceeding 0.1 m/s—see "Locomotion" on page 89.</p> <p>Reaction: Locomotion pins deliver 0 V.</p> <p>Reset function: Inapplicable</p> <p>Active: Always</p>	<p>PFHd: 4.4×10^{-8}</p> <p>PL: d</p> <p>Architecture: Category 3</p>
Mode selection	<p>Triggering event: Changing the operating mode of the robot by turning the Operating mode key—see "Control panel" on page 48.</p> <p>Reaction: Category 0 stop (IEC 60204-1) and mechanical spring-applied brakes engage. The robot enters Protective stop.</p> <p>Reset function: Press the Resume button on the robot.</p> <p>Active: Always</p>	<p>PFHd: 1.2×10^{-6}</p> <p>PL: c</p> <p>Architecture: Category 1</p>

Function name	Description	PFHd, PL, and architecture
System emergency stop ¹	<p>Triggering event: External device delivering 0 V to the System emergency stop input pins—see "System emergency stop" on page 90.</p> <p>Reaction: Category 0 stop (IEC 60204-1) and mechanical spring-applied brakes engage. The robot enters Emergency stop.</p> <p>Reset function: When external signals are active (24 V), press the Resume button on the robot.</p> <p>Active: Always</p>	<p>PFHd: 3.6×10^{-8}</p> <p>PL: d</p> <p>Architecture: Category 3</p>

¹This safety function uses external input. The values in [Table 6.1](#) are evaluated without any external input. The resulting functional safety, including the external device or equipment, is determined by the overall architecture and the sum of all PFHds. This includes the PFHd provided in the table.

6.2 Safety configuration checksum

Each configuration in the safety configuration file generates a checksum. The checksum will change if any modifications are made to the configuration. The configuration file on your robot has the checksums in [Table 6.2](#).

Table 6.2 Safety PLC checksums

Component	Checksum
Safety PLC	0x5F4C0C48
Rear scanner function and network	0xB72A722B
Rear scanner function	0x3205F792
Front scanner function and network	0xA322058A
Front scanner function	0x28A91939

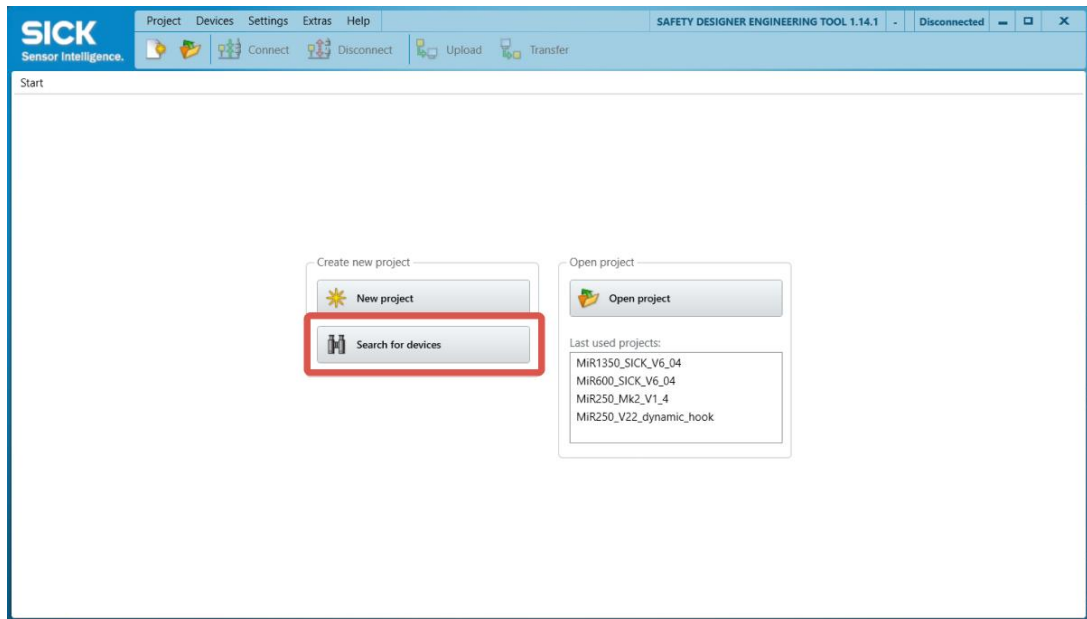
Checking the checksum

If you want to verify that the safety configuration file has not been modified, you can compare the current checksums with those in [Table 6.2](#). You will need to install the latest version of SICK's Safety Designer software to see the checksums.

To find the current checksums, follow these steps:

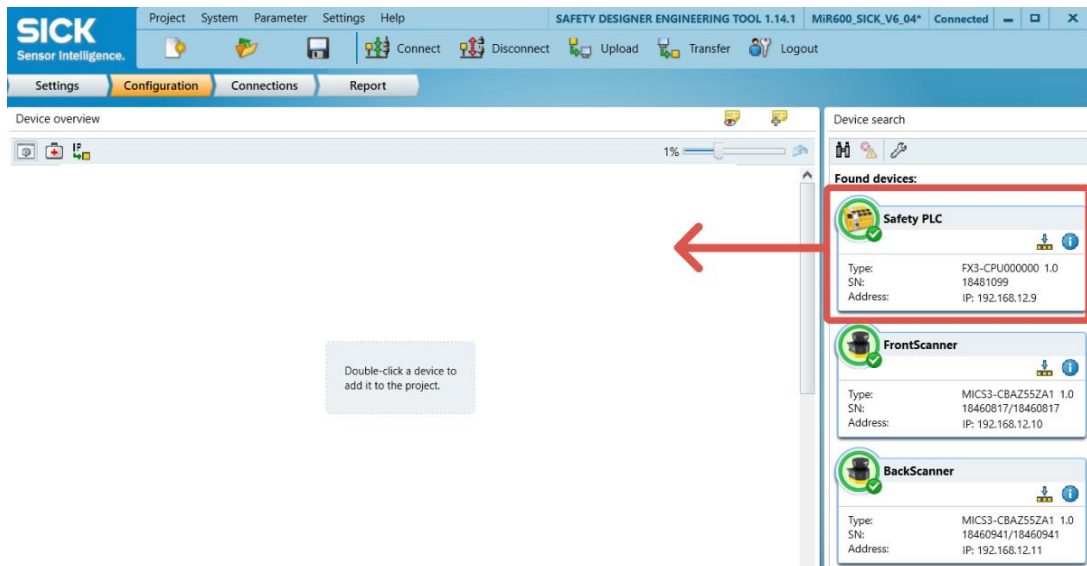
- 1 Connect to your robot's network, as described in ["Connecting to the robot interface" on page 43](#).
- 2 Open SICK Safety Designer.

3 Select **Search for devices**.

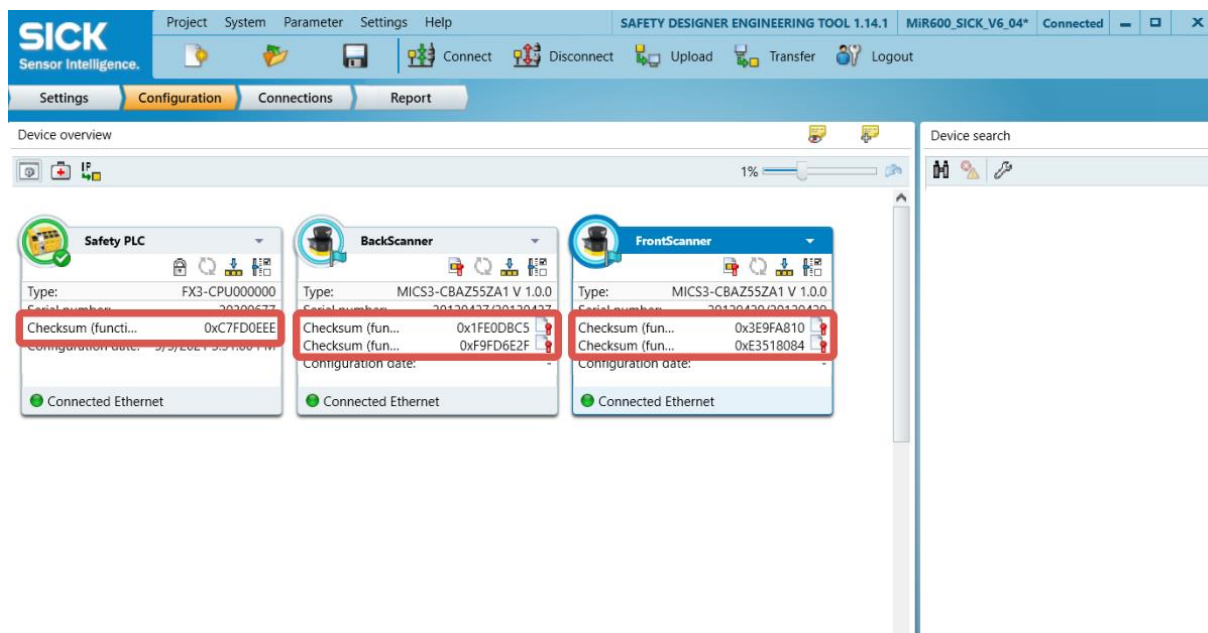


4 Drag all three devices from the **Device search** window to the corresponding device in the **Device overview** window.

When you are prompted to upload to the safety PLC, select **No**.



You can now read the current checksum values for each device configuration. If the values differ from the ones in [Table 6.2](#), the safety configuration file has been modified from the original.

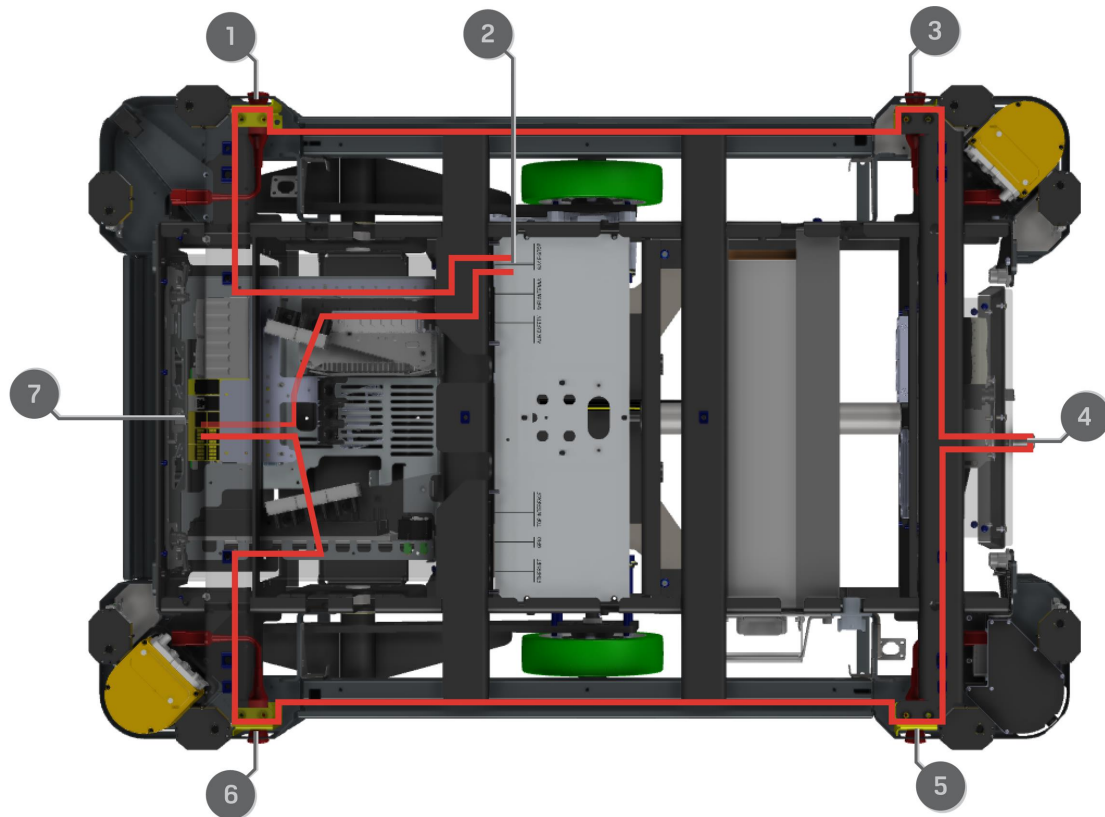


6.3 Safety-related functions

The following functions are implemented in MiR600 and are not dependent on a top module.

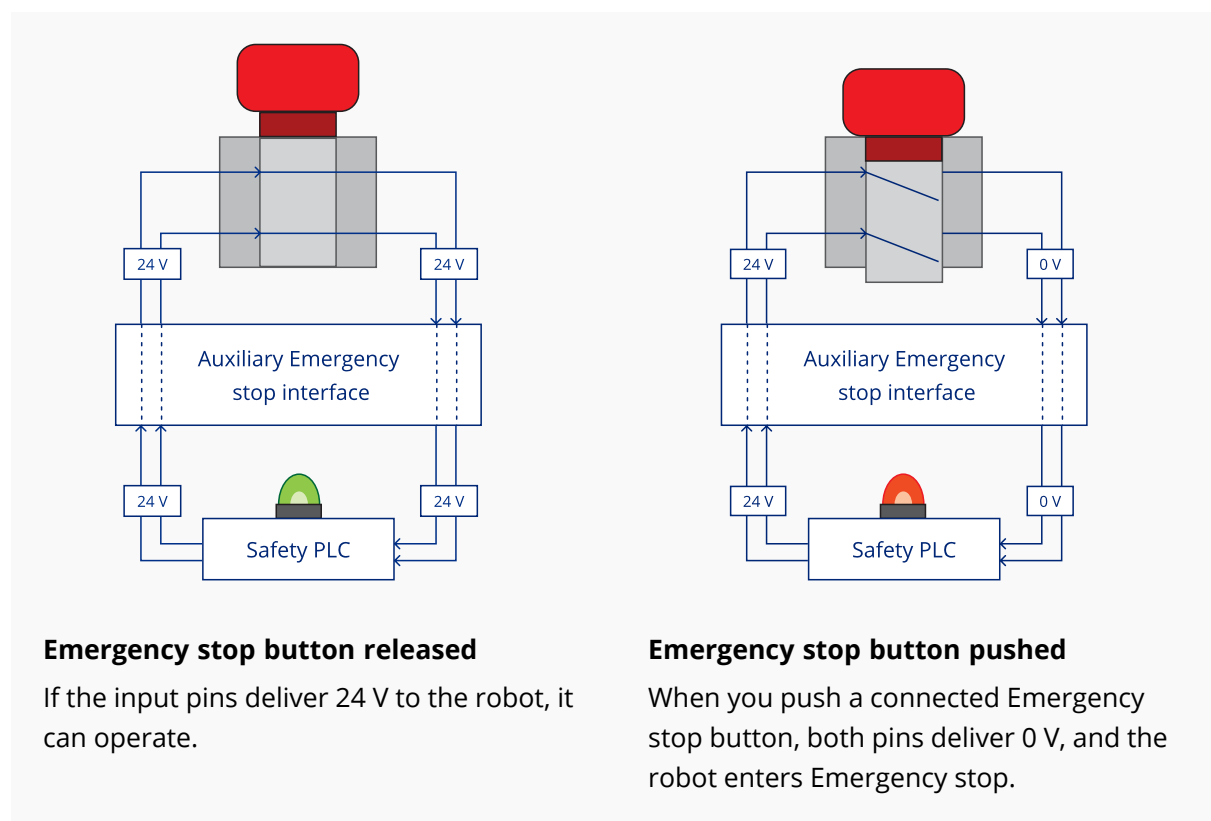
Emergency stop

The Emergency stop circuit goes through the four Emergency stop buttons in MiR600 and then through the Auxiliary emergency stop interface where you can connect external input to bring the robot into an Emergency stop. The interface uses two output pins to provide a 24 V signal and two input pins to bring the robot into Emergency stop.

Figure 6.2 The Emergency stop circuit in MiR600**Table 6.3** Identification of parts in [Figure 6.2](#)

Pos.	Description	Pos.	Description
1	Front-right Emergency stop button	2	Auxiliary emergency stop interface
3	Rear-right Emergency stop button	4	Connection interface for MiR controller with dummy plug
5	Rear-left Emergency stop button	6	Front-left Emergency stop button
7	Safety PLC		

A 24 V signal delivered from the safety PLC-outputs passes through the Emergency stop button and then continues to the two input pins. When the input pins both receive 24 V, the robot can operate. The connected Emergency stop button must break the circuit when pressed, meaning both inputs receive a 0 V signal that will bring the robot into Emergency stop. If the circuit or an Emergency stop button is installed incorrectly, the input signals are not the same and the robot enters Protective stop until the circuit is fixed.



In the Auxiliary emergency stop interface, pins 1 and 2 deliver 24 V from the safety PLC, and pins 3 and 4 connect to the Emergency stop circuit inputs of the safety PLC. 24 V must be delivered to pins 3 and 4 for the robot to operate.

**CAUTION**

Emergency stop buttons are not designed for frequent use. If a button has been used too many times, it may fail to stop the robot in an emergency situation, and nearby personnel may be injured by electrical hazards or collision with moving parts.

- Only press Emergency stop buttons in emergencies.
- Check that all Emergency stop buttons are fully functional—see ["Maintenance" on page 113](#).
- Use the robot interface to stop the robot in non-emergency situations.

Overspeed avoidance

The Overspeed avoidance function prevents the robot from driving if the motor encoders measure that the robot is driving faster than the predefined safety limit. This can occur if there is a hardware error in the robot or if it drives down a steep slope. If the robot is driving faster than the predefined safety limit, it is immediately brought into Protective stop.

Speed limit forward direction:

- 1.3 m/s

The pivot speed limit function itself does not ensure payload stability—see ["Payload distribution and stability" on page 175](#).

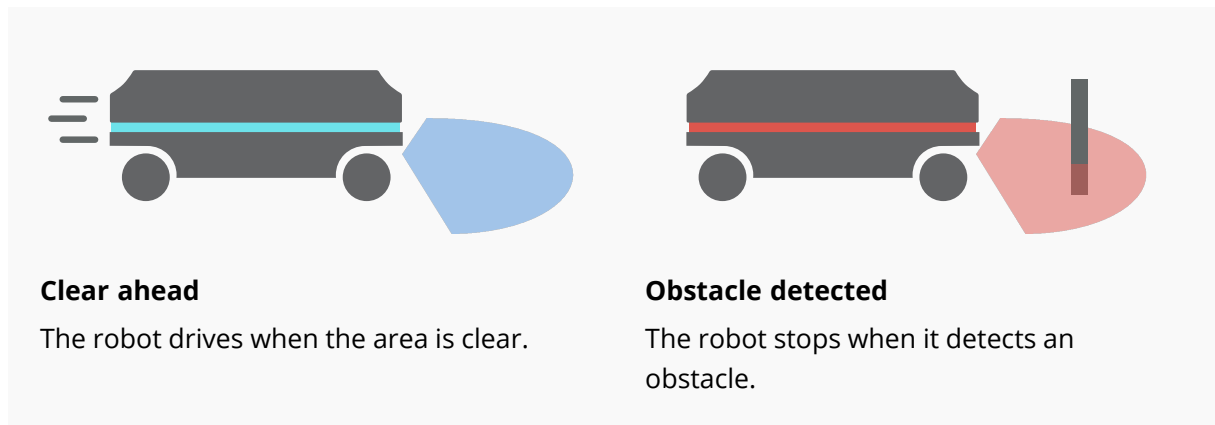
If any speed limit is exceeded, the robot reports an error. You must clear the error and press the Resume button before the robot can continue operating.

Field switching and Personnel detection

The Field switching and Personnel detection safety functions are dependent on each other. The functions make the robot enter Protective stop when the laser scanners detect a person within a predefined area around the robot. This area is called a Protective field. There are several predefined Protective fields that increase in size as the robot drives faster. The robot stays in Protective stop until the active Protective field is cleared of obstacles for at least two seconds.

The Personnel detection function makes the robot stop when the laser scanners detect an obstacle wider than approximately 70 mm within the active Protective field.

The Field switching function makes the robot switch between predefined Protective fields according to the speed. The speed is determined from the robot's motor encoders.



The Protective fields on the left and right sides of MiR600 are 350 mm when the robot is driving, and the field on the side opposite of the driving direction is always 250 mm.

The Protective fields on all sides of the robot are all 250 mm when the robot is at standstill (between 0–0.05 m/s).

**NOTICE**

Scanners measure distances to diffuse reflections, which means that a tolerance is added to the Protective fields to secure a safe detection of persons crossing the Protective fields. The tolerance distance is 65 mm.

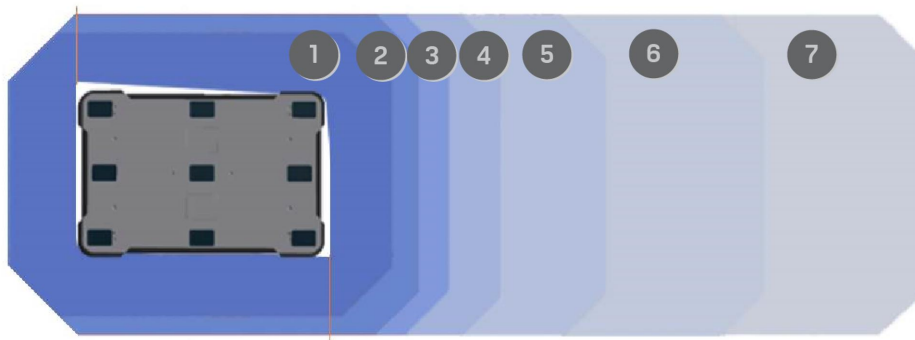
Protective fields when driving forward

The following tables show speeds and the field ranges when driving forward. [Table 6.4](#) describes the length of the Protective field in front of the robot in different cases. Each case is defined by a speed interval that the robot may operate at. The cases in [Table 6.4](#) correspond to the fields shown in [Figure 6.3](#).

Table 6.4 Range of the robot's Protective fields within its forward speed interval cases

Case	Speed	Protective field range	Comments
1	0.0 to 0.10 m/s	0–250 mm	When pivoting
2	0.10 to 0.30m/s	0–374 mm	
3	0.30 to 0.50 m/s	0–542 mm	
4	0.50 to 0.80 m/s	0–813 mm	
5	0.80 to 1.20 m/s	0–1 325 mm	
6	1.20 to 1.70 m/s	0–2 150 mm	
7	1.70 to 2.10 m/s	0–2 962 mm	Forward at max. speed

Figure 6.3 The Protective field contours when the robot drives forward

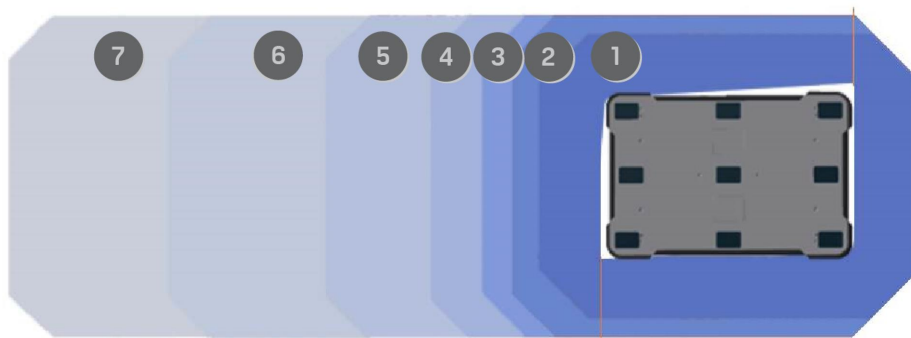


Protective fields when driving backward

The following tables show speeds and the field ranges when driving backward. [Table 6.5](#) describes the length of the Protective field behind of the robot in different cases. Each case is defined by a speed interval that the robot may operate at. The cases in [Table 6.5](#) correspond to the fields shown in [Figure 6.4](#).

Table 6.5 Range of the robot's Protective fields within its backward speed interval cases

Case	Speed	Protective field range	Comments
1	0.0 to -0.10 m/s	0–250 mm	When pivoting
2	-0.10 to -0.30 m/s	0–374 mm	
3	-0.30 to -0.50 m/s	0–542 mm	
4	-0.50 to -0.80 m/s	0–813 mm	
5	-0.80 to -1.20 m/s	0–1 325 mm	
6	-1.20 to -1.70 m/s	0–2 150 mm	
7	-1.70 to -2.10 m/s	0–2 962 mm	Backward at max. speed

Figure 6.4 The Protective field contours when the robot drives backward

Muted Protective fields

When it is required that the robot moves close to surrounding objects, the robot can be configured to mute the Protective fields. This muting is by default enabled in the template missions for docking to known markers such as charging stations or pallet racks, or it can manually be configured for any customized mission.



CAUTION

Other risk reduction means must be implemented as muted Protective fields introduce a risk for collision with personnel in its path.

- Areas where Protective fields are muted must be marked as Operating hazard zones, and personnel must be informed not to enter the zone while the robot is operating in it—see *MiR Commissioning Guide*.

When the Protective fields are muted, the robot does the following:

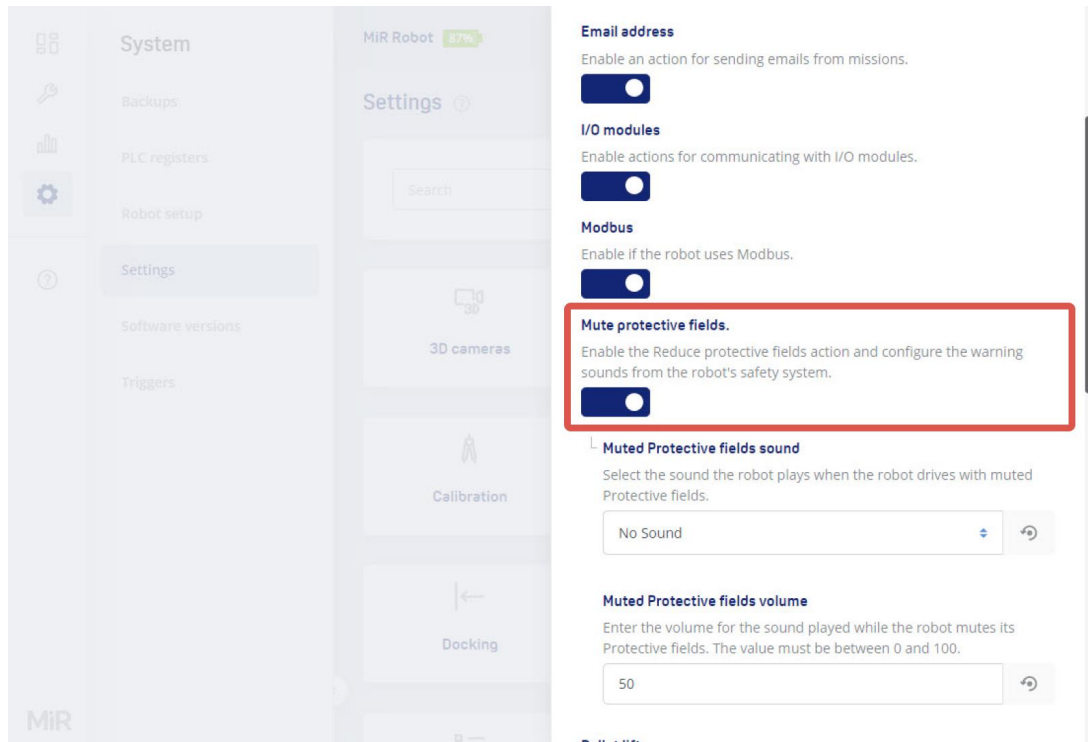
- Disables the Protective fields
- Ensures that the maximum speed is set to 0.3 m/s
- Flashes the yellow signal lights
- Emits audible warning sounds if configured to do so in the safety system settings—see ["Light indicators and speaker" on page 59](#)

User-configured muting of the Protective fields

There are two ways you can mute the Protective fields using the robot interface.

You can add the Mute protective fields action to a mission:

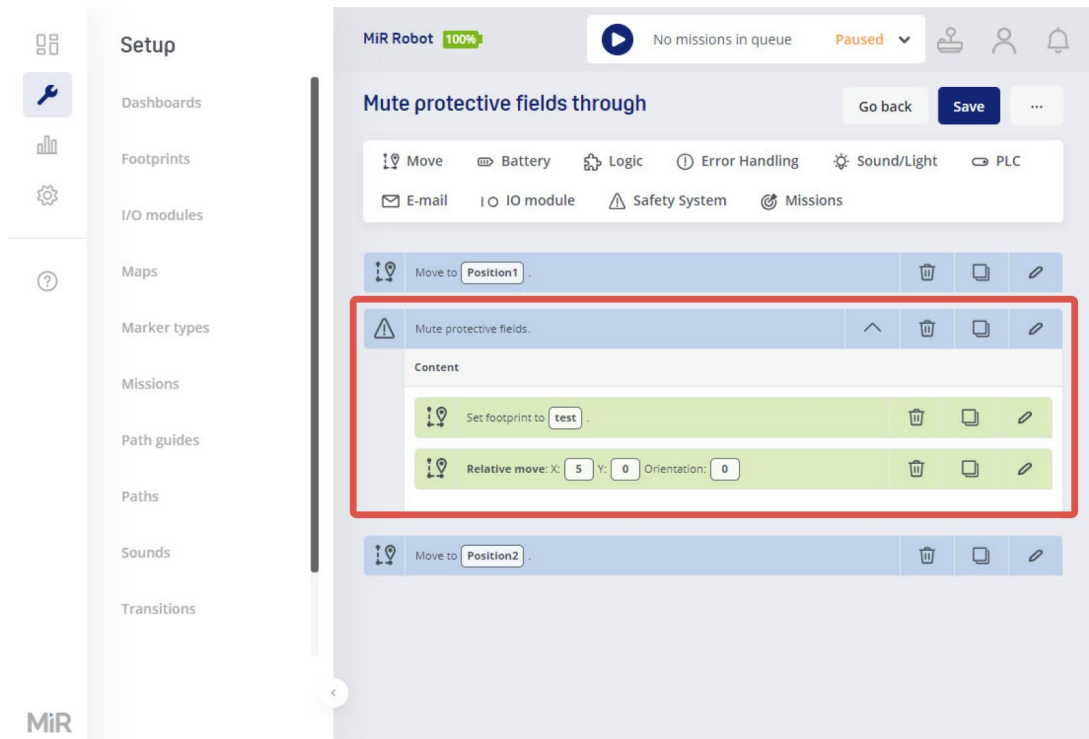
- 1 Enable **Mute protective fields** under **System > Settings > Features**.



- 2 Under **Setup > Missions**, create or edit a mission.
- 3 Add the action **Mute protective fields** from the Safety system menu.
- 4 Edit the action parameters so the Protective fields are muted.

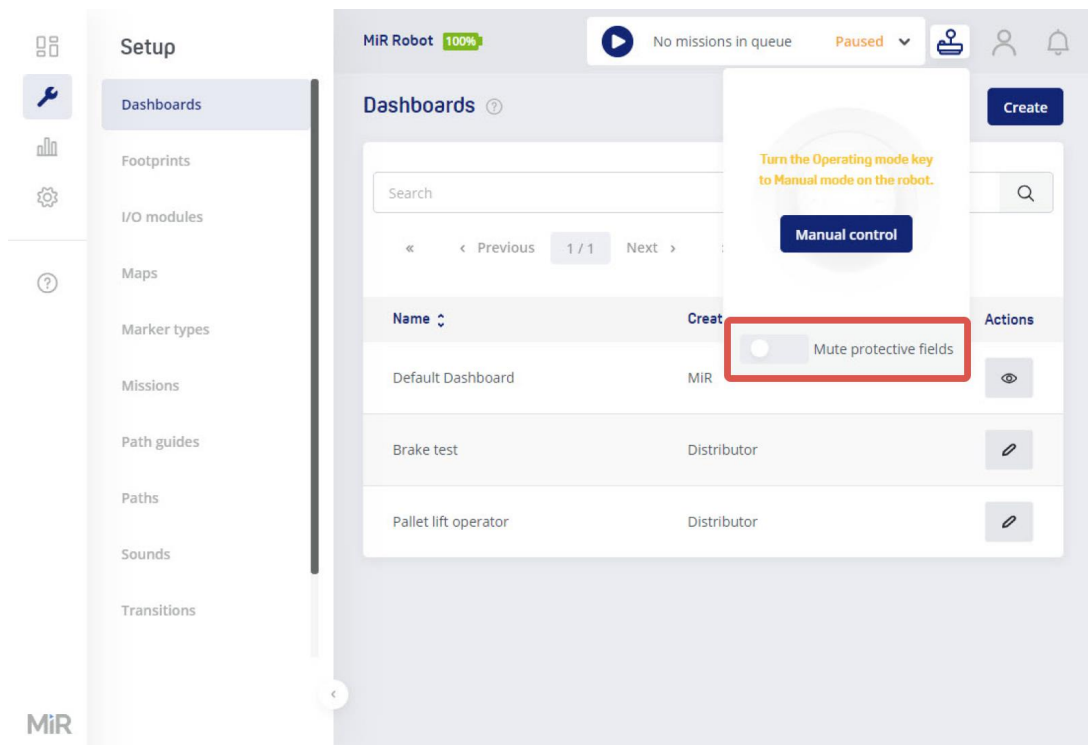
MiR600 cannot mute specific Protective fields; you can either mute all or none of the fields. Otherwise, the robot reports an error.

- 5 Add and drag all the actions you want the robot to execute with muted Protective fields inside the Mute Protective fields action.



You can mute the Protective fields when driving the robot in Manual mode:

- 1 Put the robot into Manual mode—see ["Operating the robot" on page 51](#).
- 2 In the robot interface, select **Muted Protective fields** in the joystick control.



- 3 In the dialog box, select **Yes** to acknowledge the muting of the Protective fields.

If you are using Manual mode, you can mute the Protective fields without marking the area as an operating hazard zone. It is the responsibility of the user driving the robot to ensure that it does not damage equipment or injure personnel. The robot will not stop automatically for detected obstacles.

Pre-configured muting of the Protective fields

The Protective fields are automatically muted when the robot docks to most types of markers, including shelves. This ensures that the robot can drive closely to the marker without entering Protective stop.

The only marker that does not mute the Protective fields is the L-marker.

The Protective fields are muted from when the docking starts and until the robot has undocked and has started a new action that requires the robot to plan a path.

The Protective fields will remain muted during any Relative move action that comes right after the docking action. The Protective fields will also remain muted if you engage the Manual brake release—see ["Manual brake release switch" on page 58](#).



For more information about markers, docking, and undocking, see *MiR Commissioning Guide*. You can find this guide on [MiR Support Portal](#).

Hold-to-run

The Hold-to-run function ensures that the robot does not drive when there is no signal from an external control device of the hold-to-run type. Use the Connection interface for MiR Controller in the robot's rear compartment to connect a control device—see ["Rear compartment" on page 23](#). If you connect a control device, and if the robot continues driving even though no 24 V signal is sent from the control device, the robot enters Protective stop until you press the Resume button.

By default, The Hold-to-run safety function is defeated by the dummy plug that is connected to the Connection interface when the robot is delivered. Remove the plug to enable the safety function.

The safety function does not cover the virtual joystick in the robot interface you can use when the robot is in Manual mode—see ["Manual mode" on page 51](#).

6.4 Safety-related interfaces for top modules

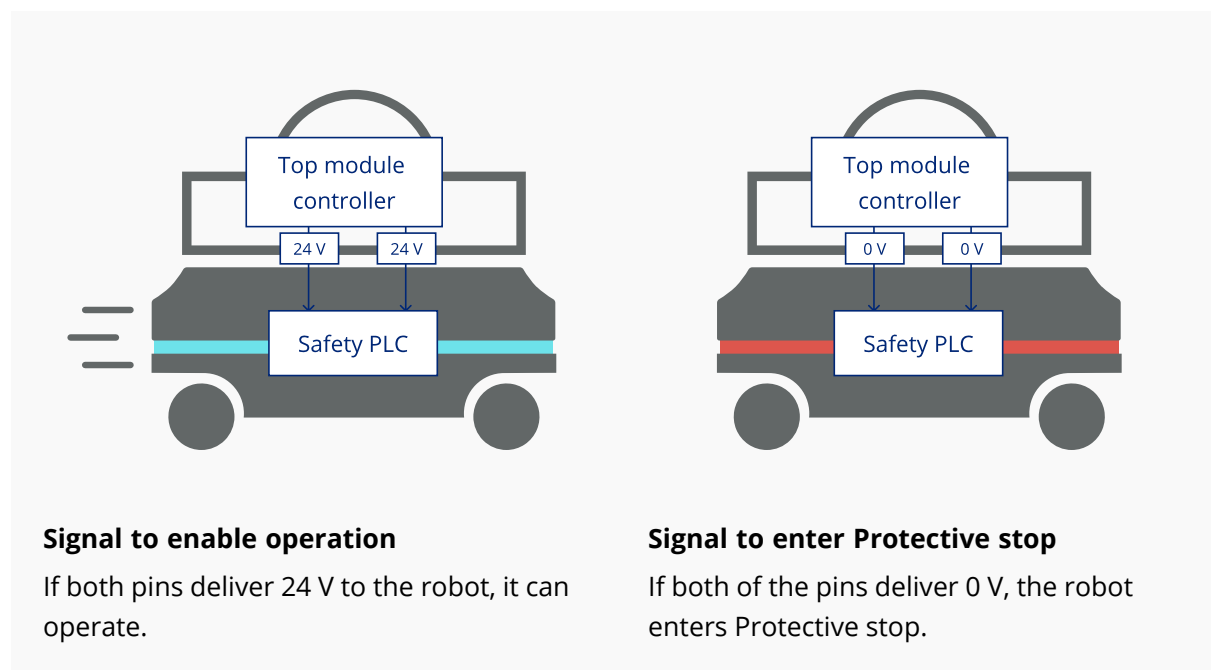
The robot has safety functions that are intended to be used with a top module with a safety device. The Auxiliary safety function electrical interface is used to connect the top module to the input and output pins for these functions.

Safeguarded stop

The Safeguarded stop function brings the robot into Protective stop when the top module safety device sends the appropriate signal. Use this function to enable the top module safety device to trigger a Protective stop.

This function uses two input pins where both pins must receive 24 V for the robot to be able to operate. If either or both pins receive 0 V, the robot is brought into Protective stop. The robot can be brought out of Protective stop again if both pins receive 24 V again.

If the input pins are unequally set for more than three seconds, the safety PLC registers this as an error in the system and needs to be reset before the robot can operate again. To do this, you must restart the robot.



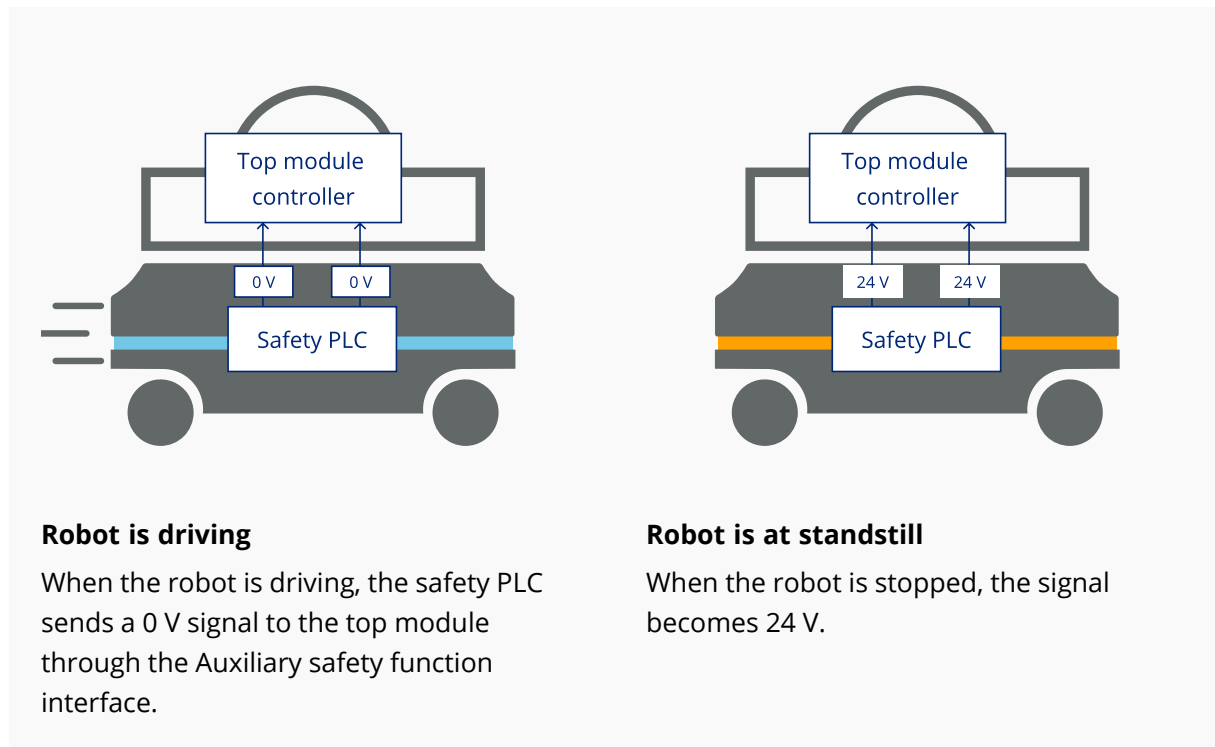
Pins 3 and 4 in the Auxiliary safety function interface are used for the Safeguarded stop function.

Locomotion

The Locomotion function indicates to the top module safety device when the robot is moving. Use this function to ensure that the top module is not powered while the robot is driving.

This function uses two output pins, where both pins deliver 0 V when the robot is driving and 24 V when the robot is stopped. You can use this interface to make your top module behave differently depending on whether the robot is driving or not.

The interface is intended to be used to program the top module to go into a safe state when the robot is driving. For example, by engaging the brakes in any actuators that may result in injury to personnel.



Pins 5 and 6 in the Auxiliary safety function interface are used for the Locomotion function.

System emergency stop

The System emergency stop function can be used if the top module has its own Emergency stop circuit. Use this function to make it so both MiR600 and the top module are brought into Emergency stop when either system is triggered.

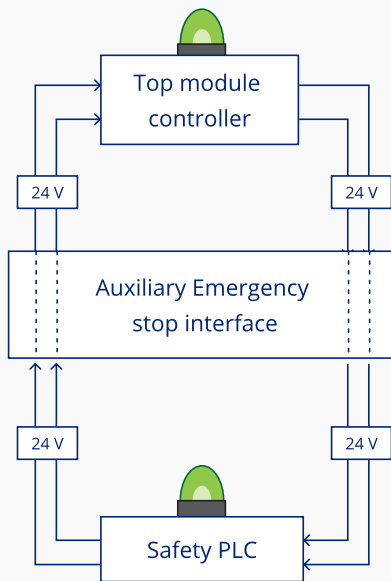
The interface has two inputs for bringing the robot into Emergency stop and two outputs for signaling when the robot is in Emergency stop.

The outputs are used to signal to the top module that the robot is in Emergency stop. When the robot is in an operational state, the outputs deliver 24 V. As soon as the robot enters Emergency stop, they deliver 0 V.

The inputs are intended to enable the top module to bring the robot into Emergency stop. When both inputs deliver 24 V, the robot can operate, but as soon as either or both of the inputs deliver 0 V, the robot enters Emergency stop.

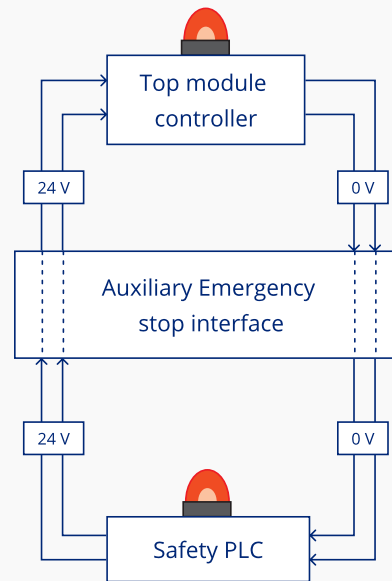
If the input pins are unequally set for more than three seconds, the safety PLC registers this as an error in the system and needs to be reset before the robot can operate again. To do this, you must restart the robot.

The robot only delivers 24 V from the System emergency stop output when one of the robot's Emergency stop buttons are pressed. The robot can be in Emergency stop but delivers 0 V from the System emergency stop outputs if the Emergency stop signal is received from the connected top module.



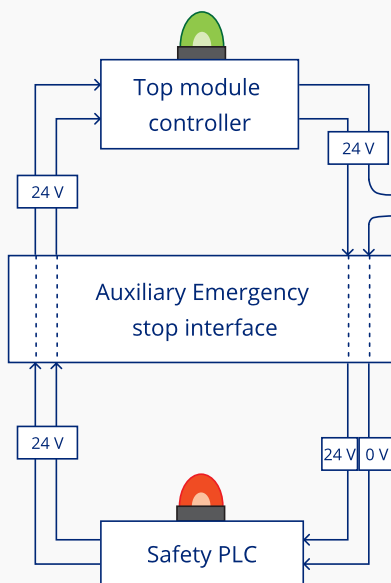
Not in Emergency stop

The robot is not in Emergency stop so the output is 24 V.



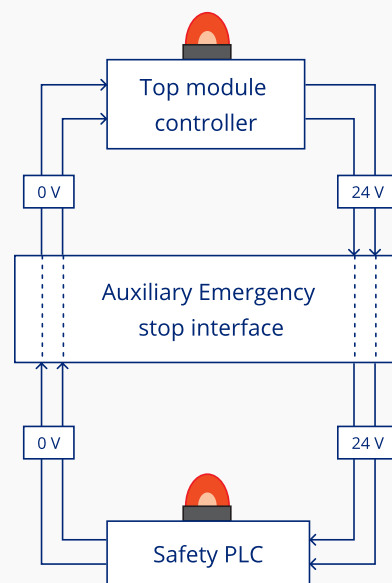
Inputs are 0 V

The robot is in Emergency stop because it receives 0 V input from the System emergency stop interface.



Inputs are unequal

The robot is in Emergency stop because the inputs are unequal.



Button on robot is pressed

The robot is in Emergency stop because an Emergency stop button has been pressed.

In the Auxiliary safety function interface, pins 7 and 8 are used for the output and pins 9 and 10 are used for the input of the System emergency stop function.

Reduced speed



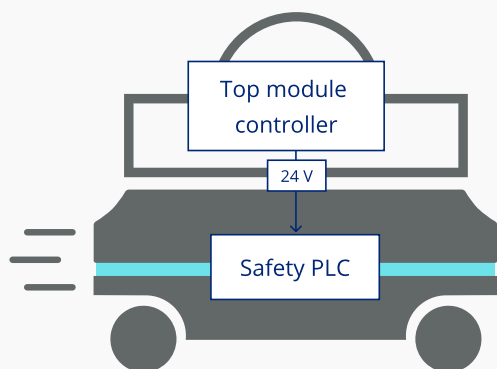
CAUTION

The Reduced speed function is not a safety-rated function. Using this function with a top module and expecting the robot to enter a safe state when the Reduced speed function is active can lead to injury of personnel.

- Do not use the Reduced speed function as a means for safety-related risk reduction.

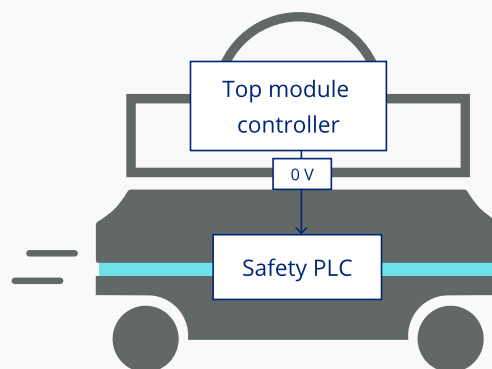
The Reduced speed function makes the robot drive at a reduced speed of 0.3 m/s. This is the same speed used when the robot mutes its Protective fields. Use this function to make the robot slow down when the top module is active or in an unsafe state, but the robot should not stop completely.

The interface uses one input pin where the robot drives at a reduced speed when it is 0 V.



Default speed

The robot drives at its default speed only when the input is 24 V.



Reduced speed

If the pin delivers 0 V, the robot drives at 0.3 m/s.

Pin 11 in the Auxiliary safety function interface is used for the Reduced speed function.

Shelf mode

If you do not have a shelf lifting top module mounted on top of the robot, this interface should remain inactive at all times.

The Shelf mode interface is a signal specifically used when MiR Shelf Lift is mounted to the robot. The signal activates when the robot is carrying a shelf, triggering the robot to change to the shelf-specific Protective fields and use the laser scanners to check that the four shelf legs are detected around the robot, ensuring that the robot has successfully picked up the shelf.

Pin 12 in the Auxiliary safety function interface is used for the Shelf mode function.

7. User training and responsibilities

When you hand over the robot application, you must ensure that all relevant users have received the necessary training and that there are training plans for future users and updates in the application.

The robot is only intended to be used by personnel that have received training in their required tasks.



NOTICE

The commissioner is obligated to provide information to limit hazards, and the training must address hazards from the risk assessment created during the commissioning.

7.1 User responsibilities

There are three main user types that interact with MiR600. All other persons in the vicinity of the robot application are considered indirect users and must know how to act when they are close to the robot. For example, they must be aware that visibly-marked operating hazard zones must be respected.

Direct users

Direct users are familiar with the safety precautions in this manual and have the following main tasks:

- Assigning missions to the robot.
- Fastening loads to the robot application securely.
- Loading and unloading from a paused robot.

Operators

Operators have thorough knowledge of the robot application and of the relevant safety precautions. Operators have the following main tasks:

- Servicing and maintaining the robot application.
- Creating and changing missions and map features in the robot interface.
- Ensuring that visitors and personnel are properly equipped and briefed regarding robot safety before entering the robot's work environment.

Commissioners

Commissioners have thorough knowledge of all aspects of commissioning, safety, use, and maintenance of the robot application and have the following main tasks:

- Commissioning of the product. This includes creating maps and restricting the user interface for other users and making brake tests with a full payload.
- Conducting the risk assessment.
- Determining the payload limit, weight distribution, safe fastening methods, safe loading and unloading of loads on the robot application, and ergonomic loading and unloading methods if relevant.
- Marking operating hazard zones.
- Ensuring that operators and direct users receive the necessary training for their responsibilities—see ["User training" below](#).

7.2 User training

When training direct users and operators, the training must adhere to the following:

- Be conducted in an area away from other workplace activities.
- Be conducted under the supervision of a trainer.
- Include all operating tasks.

Appropriate training records must be kept, and retraining must be supplied when new equipment is introduced, existing equipment is modified, or operating conditions are changed.



MiR Academy offers training material that covers most of the topics required for operators and direct users. We recommend operators to complete Bronze and Silver level training and direct users to complete Bronze level training at least. You can also apply for Specialist Classroom Training, which provides hands-on practice that builds on Bronze and Silver level training.

Training of direct users

Table 7.1 Training for operating the robot

Knowledge of	Trained to
Intended use	<ul style="list-style-type: none">• Apply the robot for tasks it is designed and well-suited for.• Identify what environments the robot can safely operate in.
Light indicators and sounds	<ul style="list-style-type: none">• Understand the robot's status and driving intentions.
All buttons and switches on the robot Buttons: Power, Resume, Manual stop, and Emergency stop Switches: Manual brake release and Operating mode switch (requires key)	<ul style="list-style-type: none">• Turn the robot on and off.• Stop the robot manually.• Resume the robot after it has stopped.• Release the brakes manually to push or pull the robot by hand.• Change the robot's mode.
Charging interfaces and charging options	<ul style="list-style-type: none">• Charge the robot.
Battery and battery connection	<ul style="list-style-type: none">• Disconnect and connect the battery.• Remove the battery.• Handle the battery outside of the robot safely.
Operating instructions	<ul style="list-style-type: none">• Send the robot to positions on the map and queue missions.

Table 7.2 Training for Emergency situations or event of failure

Knowledge of	Trained to
Emergency stop buttons	<ul style="list-style-type: none">• Use Emergency stop buttons in case of an Emergency where the robot must be stopped immediately.
Errors	<ul style="list-style-type: none">• Resolve common errors, and make the robot continue its mission or send it on a new one.
Escape routes and emergency procedure	<ul style="list-style-type: none">• React correctly and quickly in an Emergency situation in case of any dangerous scenarios described in this manual or other unexpected scenarios.

Table 7.3 Training for safety

Knowledge of	Trained to
Floor markings	<ul style="list-style-type: none">• Behave correctly and safely within pedestrian areas, operating hazard zones, and other marked areas on the site.
Stability characteristics with and without load	<ul style="list-style-type: none">• Operate the robot correctly according to the load.• Load the robot correctly and below the maximum payload.
Residual risks and warning from the user guide for your robot	<ul style="list-style-type: none">• Avoid or behave safely in any scenarios where the robot can pose a risk to personnel or equipment.• Maintain the means that have been applied to mitigate the risks.
The robot's safety functions	<ul style="list-style-type: none">• Identify in which scenarios the robot's safety functions are not sufficient for maintaining safety, for example, when the robot's Protective fields are muted, and how to behave to ensure safety.• Interact confidently with the robot in scenarios where the safety functions ensure safety.

Table 7.4 Training for understanding how the robot works

Knowledge of	Trained to
Robot's sensors	<ul style="list-style-type: none">• Identify cases where the sensors may not be able to detect obstacles.• Troubleshoot simple issues where the sensors are blocked, dirty, or are unable to detect the object type.
Navigation and localization	<ul style="list-style-type: none">• Troubleshoot localization issues.
Global and local path planning	<ul style="list-style-type: none">• Troubleshoot simple path planning issues where the robot's path has been blocked.
Wi-Fi	<ul style="list-style-type: none">• Connect to the robot over Wi-Fi.
Ideal operating environments	<ul style="list-style-type: none">• Ensure that the robot's work area supports the robot's requirements and limitations.

Table 7.5 Training for maintenance

Knowledge of	Trained to
Regular cleaning and checks	<ul style="list-style-type: none">• Clean and check the robot regularly with the tasks in "Weekly cleaning tasks for all users " on page 113.

Training of operators

Operators must be trained in all of the same content as direct users and in the additional content in the following tables.

Table 7.6 Training for site configuration

Knowledge of	Trained to
Maps	<ul style="list-style-type: none">• Update the map with new markers and positions.• Create new maps.
Missions	<ul style="list-style-type: none">• Create application specific missions.• Improve mission robustness.• Nest missions and using variables to reuse mission material efficiently.
Footprints	<ul style="list-style-type: none">• Create and apply the correct footprint for different loads and top modules.
Calibrations	<ul style="list-style-type: none">• Calibrate the robot's sensors.• Calibrate markers, shelves, and carts.
Wi-Fi	<ul style="list-style-type: none">• Identify symptoms of poor Wi-Fi coverage.• Identify ways to improve Wi-Fi coverage.

Table 7.7 Training for maintenance

Knowledge of	Trained to
Regular maintenance and replacement of parts	<ul style="list-style-type: none">• Service and check the robot regularly with the tasks in "Maintenance tasks for operators" on page 115.
Internal parts	<ul style="list-style-type: none">• Access the internal parts by removing hatches.• Identify the robot's internal parts and know their purpose.

Table 7.8 Training for MiR Fleet

Knowledge of	Trained to
Robots on MiR Fleet	<ul style="list-style-type: none">• Add and remove robots to and from MiR Fleet.• Troubleshoot synchronization issues.• Update the software version of robots.
Missions on MiR Fleet	<ul style="list-style-type: none">• Schedule missions.• Review mission statuses.

8. Accessing the internal parts

Most internal parts of MiR600 are accessed through maintenance hatches that open to different compartments.



CAUTION

Opening or removing hatches from the robot exposes parts connected to the power supply, which can result in a short circuit that will damage the robot and could injure personnel.

- Before removing any hatches, turn off the robot.
- Start by removing the left hatch, and disconnect the battery—see "[Disconnecting the battery](#)" on page 132.

8.1 Accessing the front compartment



See a [video](#) of the process on the MiR TechComm videos channel on vimeo.com.

1


Turn the two screws on the front compartment hatch 90°. Use a flat-head screwdriver.



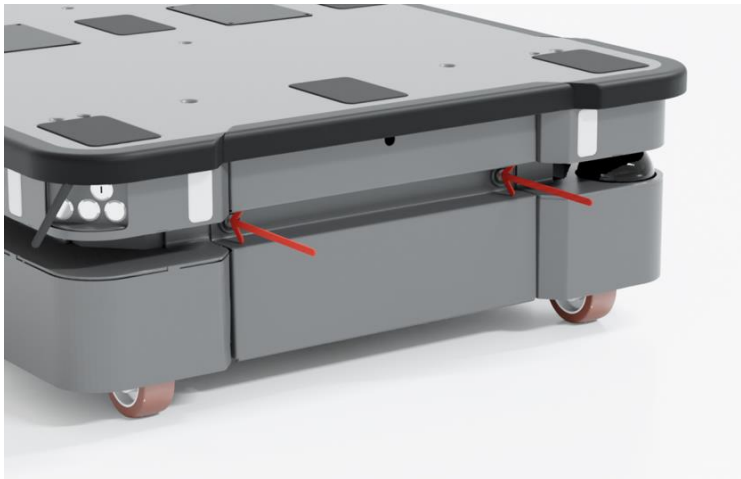
- 2 Pull out the electronics drawer.



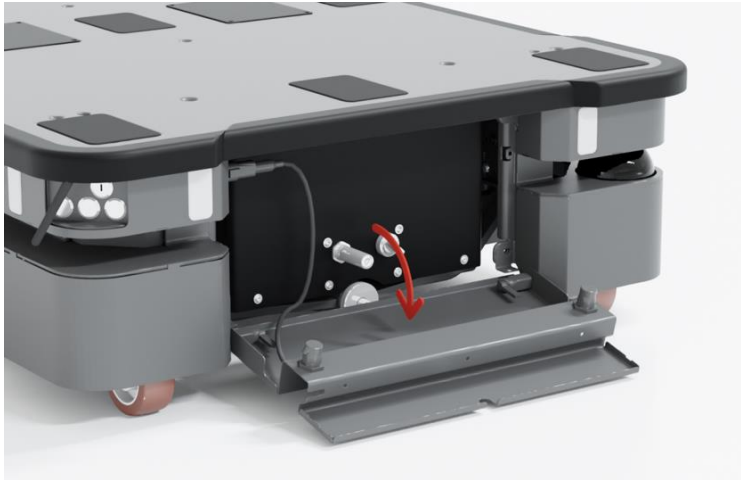
8.2 Accessing the rear maintenance compartment

-  See a [video](#) of the process on the MiR TechComm videos channel on vimeo.com.

- 1 Press the two buttons on the rear hatch.



- 2 Pull open the hatch.



You can now access the Manual brake release switch and MiR Controller interface.

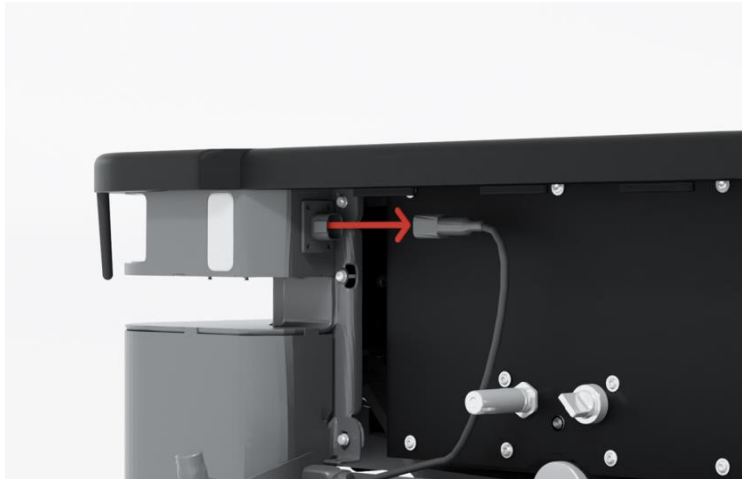
To access the motor controller carrier board and dynamic brake contactors, you must remove the rear compartment cover.



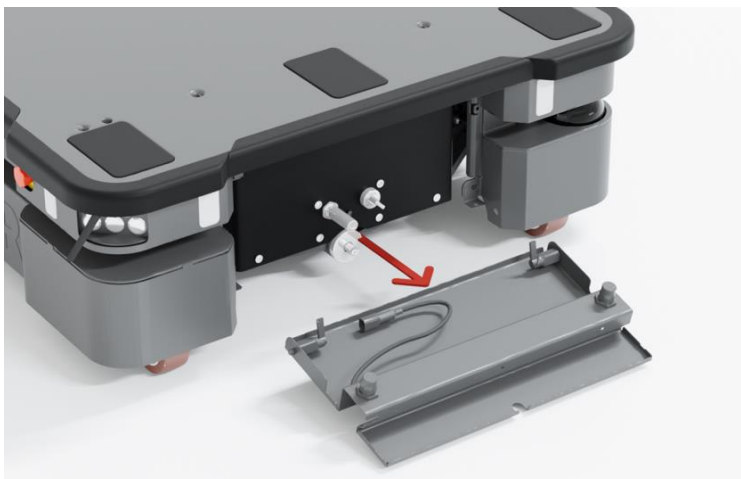
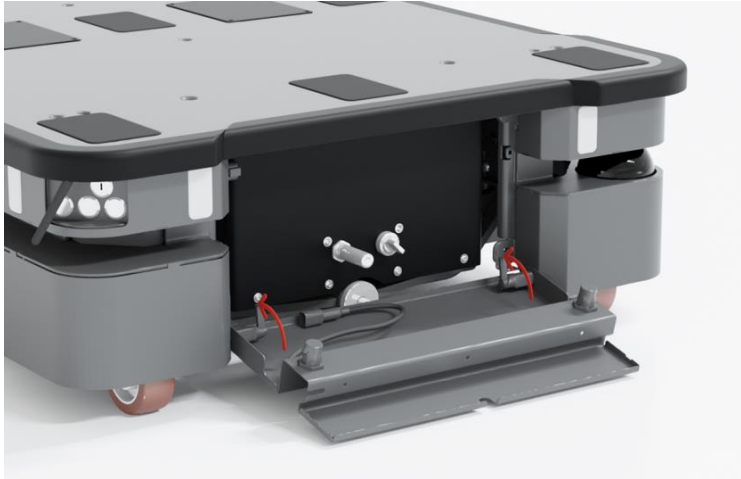
See a [video](#) of the process on the MiR TechComm videos channel on vimeo.com.

To remove the cover, follow these steps:

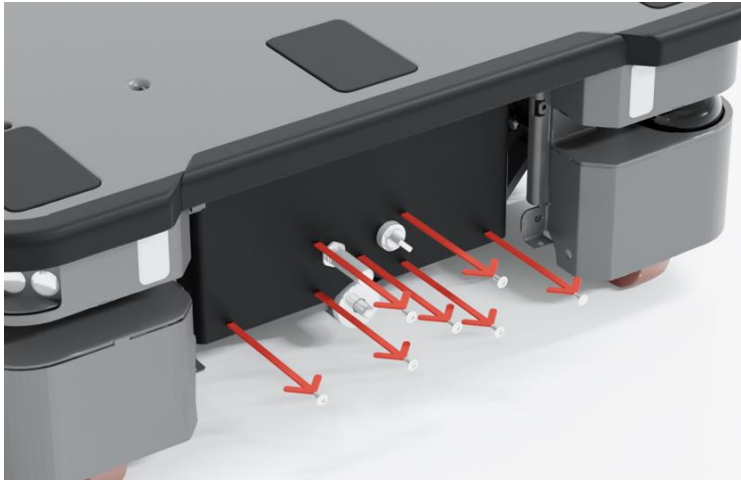
- 1 Disconnect the status light cable.



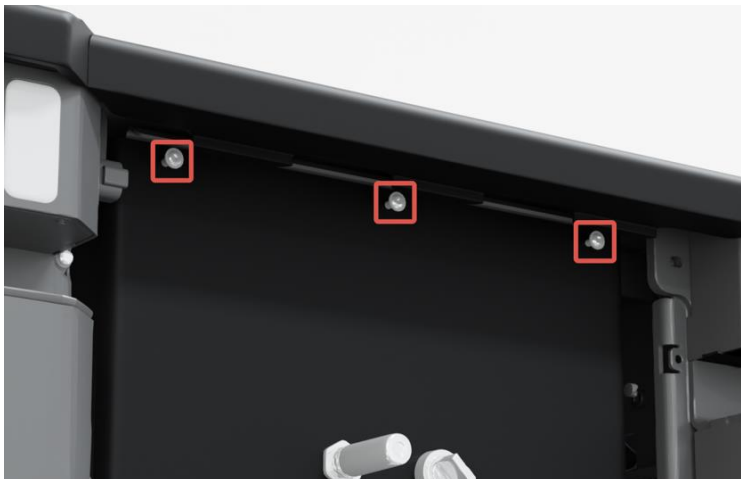
- 2 Turn the two hinges in the bottom corners to release the hatch, and remove the hatch from the robot.



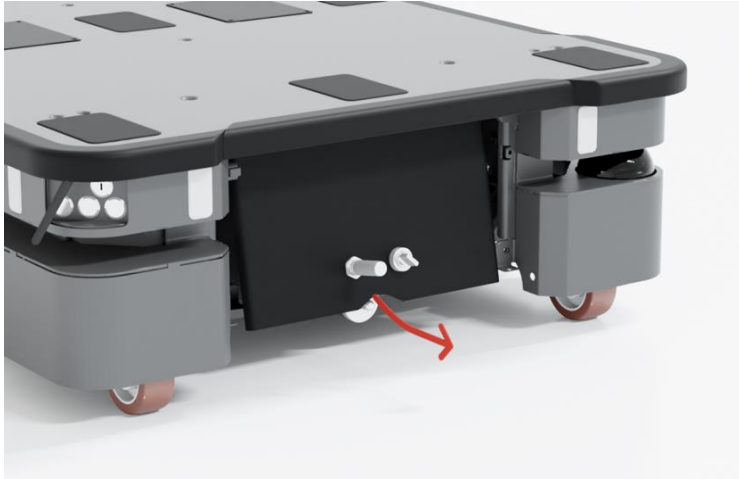
- 3 Remove the seven screws on the rear cover. Use a T25 bit.




- 4 Loosen the top three screws while holding the bottom of the cover. Use a T25 bit.



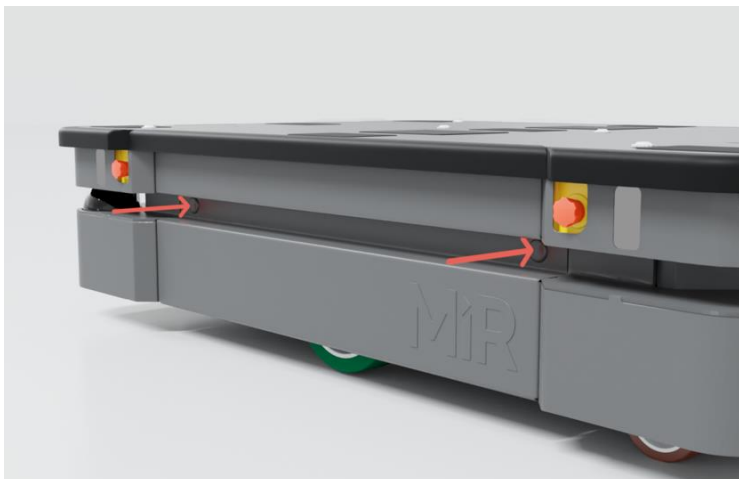
- 5 Remove the cover by sliding it downwards and out to access the rear maintenance compartment.



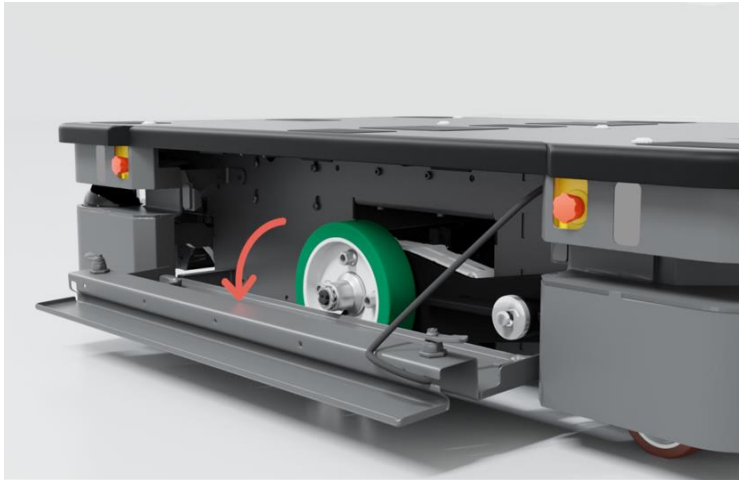
8.3 Accessing the side compartment

-  See a [video](#) of the process on the MiR TechComm videos channel on vimeo.com.

- 1 Press the two buttons on the side maintenance hatch.



- 2 Pull open the hatch.

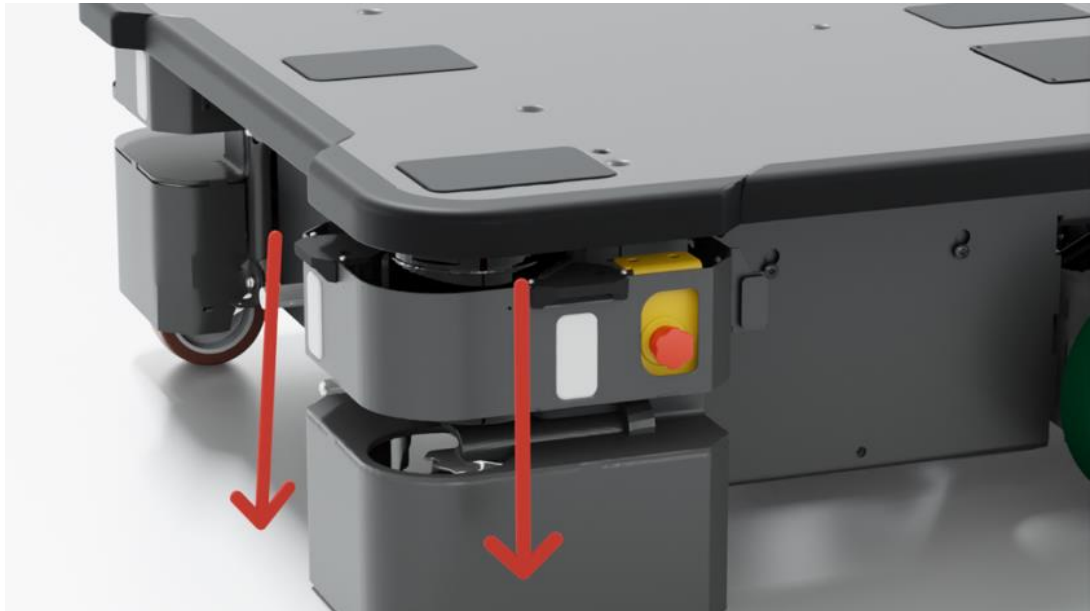


Removing the corner shield

- 1 Press the Emergency stop button on the corner shield you are going to remove. After reassembling, remember to release the button again.
- 2 Remove the four screws from the corner shield. Use a T30 screwdriver. When reattaching the corner shields, tighten the screws to 11.6 Nm.

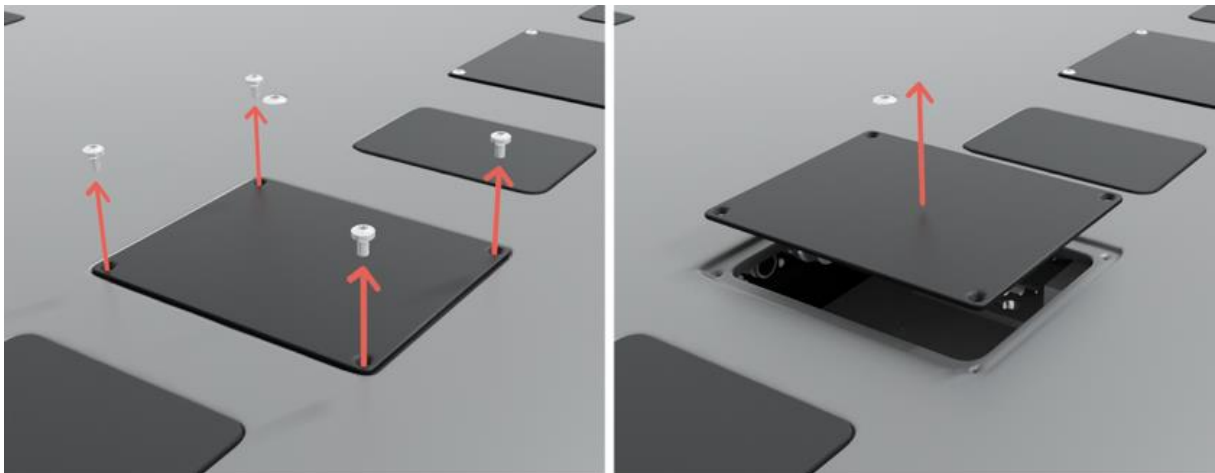


- 3 Remove the corner shield. It may require some force to disconnect the shield from the corner bumper. Pull it downward firmly to remove it from the bumper.



8.4 Accessing the top compartments

To open a top compartment, remove the four screws, and lift off the top cover. Use a T20 bit.



9. Maintenance

The following maintenance schedules give an overview of regular cleaning and parts replacement procedures. It is recommended to make a maintenance plan to make sure that all maintenance tasks are done and that the responsible(s) are aware of their tasks.

The stated intervals are meant as guidelines and depend on the operating environment and frequency of usage of the robot.

Maintenance must be performed:

- In a clean and controlled environment.
- In an open area with sufficient space and escape routes according to standards and regulations of the country where the robot is installed.
- While the robot is shut down and disconnected from the battery.



See the sections ["External parts" on page 20](#), ["Internal parts" on page 22](#), and ["Accessing the internal parts" on page 104](#) to see where the parts mentioned in the maintenance schedules are located and how to access them.



CAUTION

If the robot has been impacted, it may be structurally damaged, causing a risk of malfunction and injury to personnel.


- If you suspect the robot has suffered any damage, you need to conduct a thorough inspection to ensure that the robot's strength and structure is not compromised.

9.1 Weekly cleaning tasks for all users

Always disconnect the battery before performing maintenance tasks to prevent unexpected start-up—see ["Disconnecting the battery" on page 132](#).

Table 9.1 Regular weekly checks and maintenance tasks

Parts	Maintenance tasks
Robot top cover and maintenance hatches	Clean the robot on the outside with a damp cloth. Do not use compressed air to clean the robot.
Caster wheels (the four corner wheels)	Remove dirt with a damp cloth, and make sure nothing is entangled in the wheels.
Drive wheels (the two middle wheels)	Remove dirt with a damp cloth, and make sure nothing is entangled in the wheels. Wipe away any grease that may have leaked from the roller bearings.
Status lights	Check if the LED light band is intact. Ensure the light shows all the way around the robot. Clean with a soft cloth to ensure even lighting around the robot.
Signal lights	Check if the signal lights on the four corners blink and show light correctly.
Proximity sensors	Check for dust or dirt, and clean with a swab.
Safety marking on the floor	Check if the safety markings around operating hazard zones are intact and visible.
Information stickers	Check if the safety stickers, identification label, and nameplate on the robot are still intact and visible.

Parts	Maintenance tasks
Laser scanners	<p>Clean the optics covers of the scanners for optimum performance. Use anti-static cleaning products, and avoid aggressive or abrasive cleaning agents.</p> <p>Make sure to also clean the top part of the optics cover. The contamination sensors scan the entire optics cover glass piece.</p>  <p>In the robot interface under Monitoring > Hardware health > Safety system > Emergency stop, see if Laser (Front) Contamination Error and Laser (Back) Contamination Error is False.</p> <p>Static charges cause dust particles to be attracted to the optics cover. You can diminish this effect by using the anti-static plastic cleaner (SICK part no. 5600006) and the SICK lens cloth (part no. 4003353). See the manufacturer's own documentation.</p>

9.2 Maintenance tasks for operators

The following maintenance tasks may only be executed by an operator or commissioner—see ["User training and responsibilities" on page 95](#).

**NOTICE**

Only use approved spare parts. See the list of spare parts and the appropriate how-to guides. You can find these guides on [MiR Support Portal](#).

Mobile Industrial Robots disclaims any and all liability if unapproved spare parts are used. Mobile Industrial Robots cannot be held responsible for any damages caused to the robot, accessories, or any other equipment due to use of unapproved spare parts.

Always disconnect the battery before performing maintenance tasks to prevent unexpected start-up—see ["Disconnecting the battery" on page 132](#).

Check weekly

Part	Maintenance	Symptoms of neglect
Safety laser scanners	<p>Check for visual defects, for example cracks and scratches.</p> <p>Replace as needed. See the guide <i>How to replace a safety laser scanner on MiR500, MiR600, MiR1000, and MiR1350</i>.</p> <p>If only the optics cover is damaged, you can replace the cover alone. See SICK's documentation for microScan3 for instructions.</p>	<p>Robot goes into unexpected Protective stops or navigates around non-existent obstacles.</p> <p>Robot reports contamination errors.</p>
Mechanical brakes	Test the mechanical brakes as described in "Mechanical brake function test" on page 123 .	The mechanical brake system does not stop the robot or keep it in place at standstill.

Check monthly		
Part	Maintenance	Symptoms of neglect
Robot top cover	Check mounting. Ensure it sits evenly on top of the robot with connections accessible. Replace as needed.	Robot, top module, or load become unstable. Damage to the cover increases.
Safety PLC	In the robot interface under Monitoring > Hardware health > Communication , see if the robot is running with the correct SICK configuration or if the warning The SICK Safety PLC is running a non-standard configuration is shown.	If the safety configuration file is ever modified, there is a risk of the robot colliding with personnel or equipment.
Robot hardware	In the robot interface under Monitoring > Hardware health , check if there are any warnings (marked with yellow).	Over time, a warning can become an error and will stop the robot from operating.
Front, rear, and side maintenance hatches	Check mounting. Ensure the hatches are even and are not in contact with the wheels. If you replace the hatch with the robot's nameplate, make sure to mount a new copy of the nameplate to the replacement hatch.	Hatches hang loose, get scratched, do not protect the robot's internal parts, or are in contact with moving parts.

Check monthly		
Part	Maintenance	Symptoms of neglect
Speaker and signal lights	Check that all visual and auditory warnings function. Adjust or replace as needed.	Speaker plays low or distorted sounds.
Charging pads/broom	<p>Disconnect the battery on the robot. Using your hands, ensure that each pad moves up and down freely.</p> <p>Clean the charging pads using sandpaper—see the guide <i>How to clean the charging pads under MiR robots</i>. Also clean the pads on the charging stations.</p> <p>Clean the broom, and check that it is intact.</p>	<p>Contamination collects on the charging pads or they become stiff.</p> <p>Connection to the charging station becomes less reliable and charging is less effective.</p>
3D cameras	<p>Check for visual defects, for example cracks and scratches.</p> <p>To test the cameras, see the guide <i>How to test if the 3D cameras are working on MiR robots</i>.</p> <p>To calibrate, see the guide <i>How to calibrate a D435 3D camera</i>.</p>	Robot navigates around non-existent obstacles or fails to detect obstacles.

Check monthly

Part	Maintenance	Symptoms of neglect
Manual brake release switch	<p>Confirm that the STO contactors have deactivated for the brakes. Go to Monitoring > Hardware health > Safety system - it should display "Robot is in Emergency stop (Manual Brake Release Switch)".</p> <p>Check if the Manual brake release switch functions by releasing the brakes and pushing the robot gently forward. Remember to enable the brakes again when done.</p>	Cannot release the brakes manually.

Check every two months

Part	Maintenance	Symptoms of neglect
Heat sink	<p>See the guide <i>How to clean the heat sink on MiR600 and MiR1350</i> for instructions.</p> <p>Can be increased to three months or 1 500 km if very little dust is accumulated in the heat sink.</p>	<p>Collects dust over time and will eventually prevent the robot from cooling the front compartment effectively.</p> <p>Overheating will cause the robot's safety PLC to turn off, and the robot will cease to move.</p>

Check every three to four months

Part	Maintenance	Symptoms of neglect
Control panel	Check that all buttons on the control panel function.	Pressing a button does not affect the robot.
Emergency stop	Check that all Emergency stop buttons work. Push down the red button, and check that the Emergency stop reset button lights up and that the status lights turn red. Verify that an emergency stop message is displayed in the robot interface.	Pressing a button does not bring the robot into Emergency stop.

Check every six months

Part	Maintenance	Symptoms of neglect
Drive wheels (the two middle wheels)	<p>Check wheel surfaces for wear. If the center seam has been worn away, replace the wheels.</p> <p>You can also measure the diameter of the wheels to assess how worn down they are. Replace if the diameter is less than 185 mm.</p> <p>Replace in pairs.</p> <p>The robot's IMU must be calibrated after replacement of the wheels—see the guide <i>How to calibrate the IMU</i>.</p>	<p>Robot cannot travel over large steps and gaps without scraping the bottom of the robot.</p> <p>Robot swerves more if the wheels are uneven sizes.</p> <p>Localization becomes inaccurate due to inaccurately converted encoder data.</p>

Check every six months

Part	Maintenance	Symptoms of neglect
Caster wheels (the four corner wheels)	<p>Check bearings by pressing against them and rotating them to feel any internal wear or damage.</p> <p>Check wheel surfaces for wear. If the center seam has been worn away, replace the wheels.</p> <p>You can also measure the diameter of the wheels to assess how worn down they are, and replace if the diameter is less than 93 mm.</p> <p>Replace all four caster wheels together.</p>	<p>Robot cannot travel over large steps and gaps without scraping the bottom of the robot.</p> <p>Robot swerves more if the wheels are uneven sizes.</p>

Check yearly or every 4 000 km

Part	Maintenance	Symptoms of neglect
Drive wheels (the two middle wheels)	Lubricate the roller bearings—see the guide <i>How to lubricate the drive wheel bearings on MiR600 and MiR1350</i> .	<p>Strains the motor and drive wheels over time.</p> <p>Can eventually cause oil to leak into the motor and report a Turn Speed Violation error.</p> <p>Can cause squeaky or grinding sounds from bearings.</p>

Replace every 20 years		
Part	Maintenance	Symptoms of neglect
Emergency stop button(s)	Replace to ensure the reliability of the robot's safety functions.	Pressing the Emergency stop button does not bring the robot into Emergency stop.
Safety PLC	Replace to ensure the reliability of the robot's safety functions.	The robot begins reporting safety system errors.
STO and dynamic brake contactors	Replace to ensure the reliability of the robot's safety functions.	The robot begins reporting contactor errors.
Mechanical brakes	Replace to ensure the reliability of the robot's safety functions.	The robot reports mechanical brake errors.
Safety laser scanners	Replace to ensure the reliability of the robot's safety functions.	The robot does not detect obstacles reliably and reports safety laser scanner errors.
Manual brake release switch and control panel	Replace to ensure the reliability of the robot's safety functions.	The robot does not react to pressed buttons reliably or reports errors or false button states.
STO relays of the Shelf Carrier top module	Replace to ensure the reliability of the robot's safety functions.	The robot begins reporting contactor errors.

9.3 Mechanical brake function test

The robot has two brakes on each drive wheel:

- A mechanical brake that is engaged by power-off, controlled directly from the safety PLC by the mechanical brake relays. The relays are monitored by a force-guided feedback signal back to the safety PLC.

The mechanical brakes are always applied during any Protective or Emergency stop.

- A dynamic brake that is engaged by power-on, controlled directly from the safety PLC by the dynamic brake contactors. The dynamic brakes consist of two contactors that can short circuit the motor windings and thereby stop the wheel (permanent magnet motor). The dynamic brake relay has force-guided feedback signal, which is wired back to the safety PLC. The dynamic brakes are self-checked by this signal whenever they are actuated. If the dynamic brakes do not perform as expected, the robot interface reports a Dynamic brake error.

The dynamic brakes are only applied when the Personnel detection safety function triggers a Protective stop. The mechanical brakes are also applied simultaneously.

Testing the control function

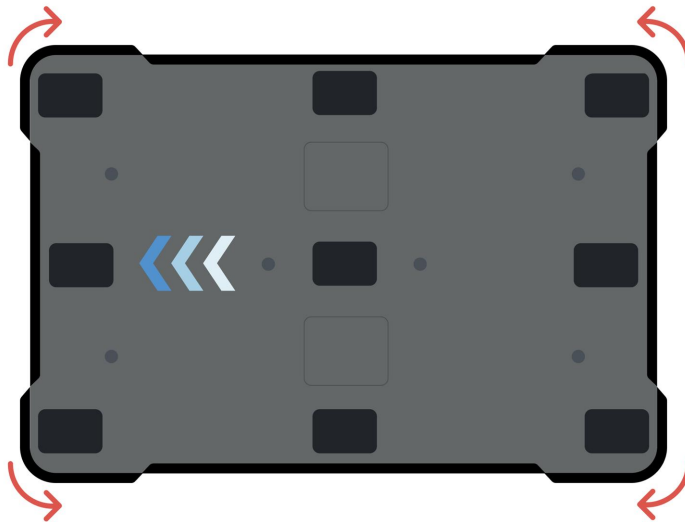
To test the mechanical and dynamic brakes, follow these steps:

- 1 Power up the robot—see ["Powering up the robot" on page 40](#).
- 2 Verify that the manual brake release is not engaged—see ["Manual brake release switch" on page 58](#).



- 3 Attempt to move or twist the robot by hand. Push it both left and right to test the brakes on both sides.

If you are unable to move the robot in either direction, the brakes are functional. If you are able to produce any movement in the robot, one or both of the mechanical brakes are faulty. Contact MiR Technical Support—see *How to create a technical support ticket*. You can find this guide on [MiR Support Portal](#).



- 4 Engage the manual brake release.



- 5 Attempt to move or twist the robot by hand. With the manual brake release on, the robot must be able to move freely on both drive wheels. If one or both wheels are still locked, contact MiR Technical Support—see *How to create a technical support ticket*. You can find this guide on [MiR Support Portal](#).

Testing the mechanical brakes

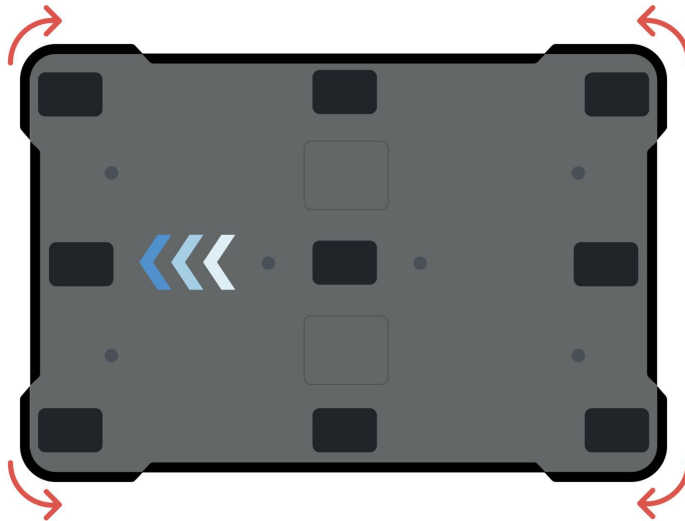
- 1 Verify that the manual brake release is not engaged.



- 2 Turn off the robot, and disconnect the battery in the left-side compartment—see ["Disconnecting the battery" on page 132](#).

This is done to isolate the mechanical brakes, and to ensure that the dynamic brakes do not interfere.

- 3 Attempt to move or twist the robot by hand. Push it both left and right to test the mechanical brakes in either side. If you are unable to move the robot in either direction, both mechanical brakes are functional. If you are able to produce any movement in the robot, one or both of the mechanical brakes are faulty. Contact MiR Technical Support—see *How to create a technical support ticket*. You can find this guide on [MiR Support Portal](#).



10. Storage

The main component that can be affected by storage is the robot's battery. It is important to keep track of the battery percentage both before and while the robot or battery is in storage to ensure the battery is not damaged by being undercharged.

10.1 Preparing the robot for storage

If you are taking the robot out of operation for any duration, we recommend the following:

- Charge the robot's battery before storage.
- Store the robot in an area at room temperature with a non-condensing relative air humidity—see specifications on MiR Support Portal. Temperatures and humidity below or above the specifications will shorten the service life of the battery.
- Disconnect the battery from the robot before storing the robot—see ["Disconnecting the battery" on page 132](#). You can store the battery inside the robot, but keeping the battery connected to the robot greatly reduces the storage time. Make sure to disconnect the battery completely.
- Protect the battery immediately after removing it from the battery charger or robot. Never allow any moisture or foreign particles to get into the battery. If you store the battery outside the robot, you can protect the battery by storing it in a clean and airtight container or plastic wrap.
- Check the state of charge of the battery regularly, and make sure to recharge the battery if the state of charge is low. Always disconnect the battery after checking or charging it.

10.2 Storage time

The storage time of the robot and battery depends on the battery's state of charge, the storage conditions, and the battery version. For more information about storage time, see *MiR 48V Battery Technical Guide*. You can find this guide on [MiR Support Portal](#).

The storage times in this guide apply for new batteries. Over time, the storage time will shorten.

**CAUTION**

If the battery is stored incorrectly or stored for too long, it will reach an undercharged state where the battery cells may be damaged or the battery shuts down permanently.

- Always check that the battery is disconnected before storing the robot. If the battery is connected to the robot, the storage time is reduced significantly.
- Check the battery percentage and charge the battery regularly to ensure it is not undercharged.

Table 10.1 Overview of battery modes where the battery stops supplying power

Battery percentage	Mode	Reactivate method
Low or battery unused for longer time	Power save mode	<ul style="list-style-type: none">• Disconnect the battery from the robot for 30 seconds, reconnect it to the robot, wait 30 seconds, and then turn on the robot.• Connect a 48V cable charger directly to the battery while it is disconnected from the robot.
Critically low	Deep sleep mode	Depending on how long the battery has been in Deep sleep, you may be able to revive it using MiR Cable Charger Lite 48V 3A.



To properly troubleshoot any battery issues and for information about the exact time periods and battery voltages that trigger the transitions between states, see *MiR 48V Battery Technical Guide*. You can find this guide on [MiR Support Portal](#).

11. Battery and charging

The robot is powered by a lithium-ion battery that can be charged with a MiR cable charger or a MiR Charge 48V charging station. Instructions for charging depend on the charger type and are described in the guides included with each charger.



NOTICE

Do not parallel couple the battery with more batteries. Parallel coupling the batteries will result in the batteries shutting down.



WARNING

Using a charging device different from the one supplied by the manufacturer can cause a fire and thereby burn injuries to nearby personnel and damage to the robot and equipment.

- Only use an original MiR charger.

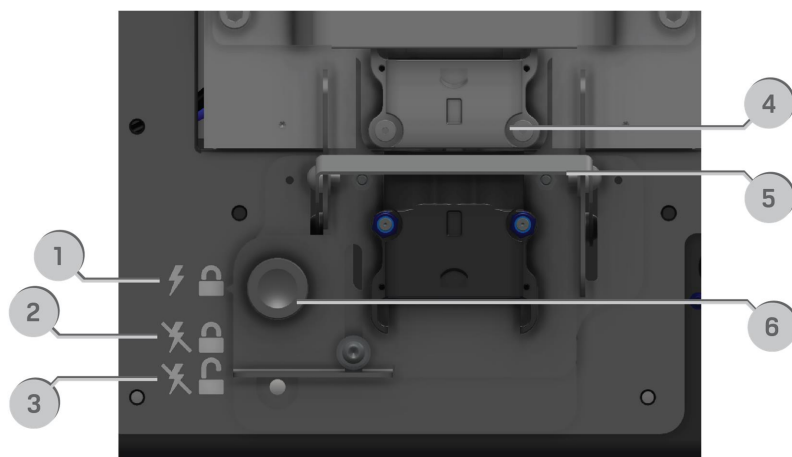
**WARNING**

Lithium-ion battery packs may get hot, explode, or ignite and cause serious injury if they are misused electrically or mechanically.

Observe the following precautions when handling and using lithium-ion batteries:

- Do not short-circuit, recharge, or connect with false polarity.
- Do not connect or charge a potentially defective or damaged battery.
- Do not expose to temperatures beyond the specified temperature range or incinerate the battery.
- Do not crush, puncture, or disassemble the battery. The battery contains safety and protection devices, which, if damaged, may cause the battery to generate heat, explode, or ignite.
- Do not allow the battery to get wet.
- In the event the battery leaks and the fluid gets into one's eye, do not rub the eye. Rinse well with water, and immediately seek medical care. If left untreated, the battery fluid could cause damage to the eye.
- In case of fire, use water to put out the fire. There is no need for special extinguishing media.
- Do not touch damaged batteries with bare hands. Only personnel using suitable Personal Protection Equipment (PPE) and tools should handle damaged batteries.
- Isolate the battery and keep clear if the following conditions are observed:
 - The battery exhibits abnormally high temperatures.
 - The battery emits abnormal odors.
 - The battery changes color.
 - The battery case is deformed or otherwise differs from the normal electrical or mechanical condition.
- Do not modify or manipulate of the battery. This may lead to considerable safety risks and is therefore prohibited.
- Never smoke or allow an open spark or flame in the vicinity of the robot's battery.
- Do not use the battery for anything other than MiR600.

Table 11.1 identifies the main components of the battery fast-swap assembly and describes the three different positions the assembly can be set to.

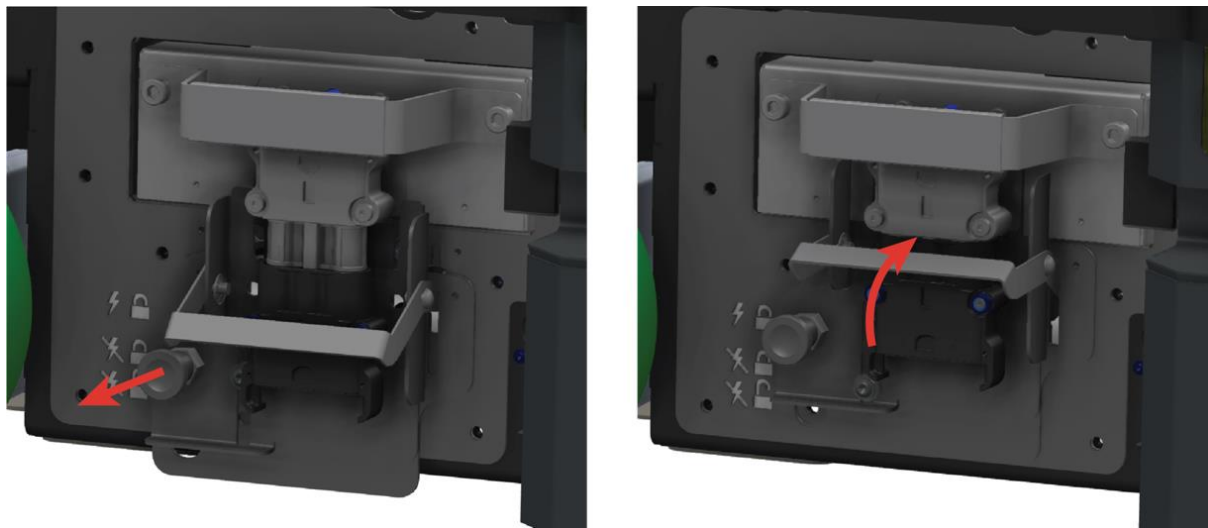
Figure 11.1 The main components of the Fast-swap battery assembly**Table 11.1** Identification of components in [Figure 11.1](#)

Pos.	Description	Pos.	Description
1	Top position: The battery is locked and connected. Use this position when you want to operate the robot.	2	Center position: The battery is locked and disconnected. Use this position when servicing or transporting the robot.
3	Bottom position: The battery is unlocked and disconnected. Use this position when removing the battery from the robot.	4	Battery connector: Connects the battery to the robot.
5	Battery lever: Used to change between top, center, and bottom positions.	6	Battery lock pin: Pull the pin out to enable you to move the Battery lever between positions.

11.1 Connecting the battery

To connect the battery to the robot, you need to open the left side compartment—see ["Accessing the internal parts" on page 104](#).

Once you have accessed the left side compartment, pull the Battery lock pin out, and pull the Battery lever to the top position. The battery is now connected, and you can close the side maintenance hatch.



11.2 Disconnecting the battery

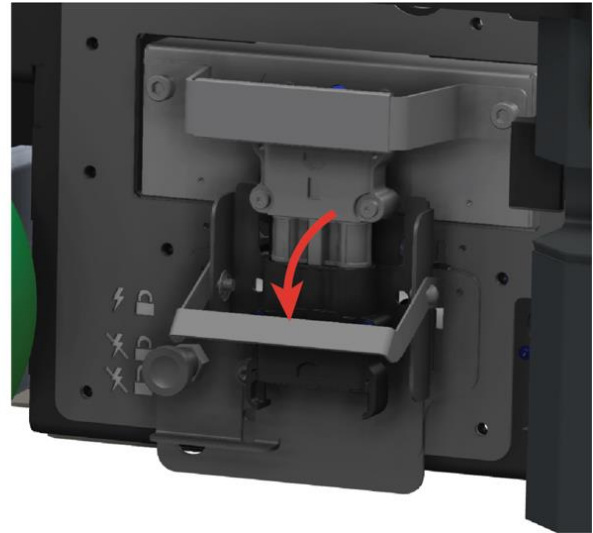
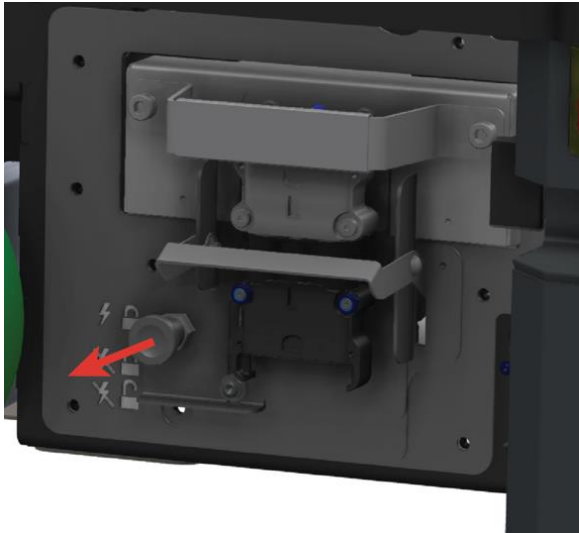
The battery can be disconnected for complete separation of all power to the robot. Disconnect the battery whenever the robot is to be transported, undergo maintenance, or stored for over 24 hours. This prevents unnecessary discharge, risk of electrocution, and risk of short circuiting.

The left side compartment holds the robot's battery. To access the side compartments, see ["Accessing the internal parts" on page 104](#).



See a [video](#) of the process on the MiR TechComm videos channel on vimeo.com.

Turn off the robot, and disconnect the battery in the left side compartment. To disconnect the battery, pull out the Battery lock pin and pull the Battery lever downwards until the Battery lock pin is in the middle position.

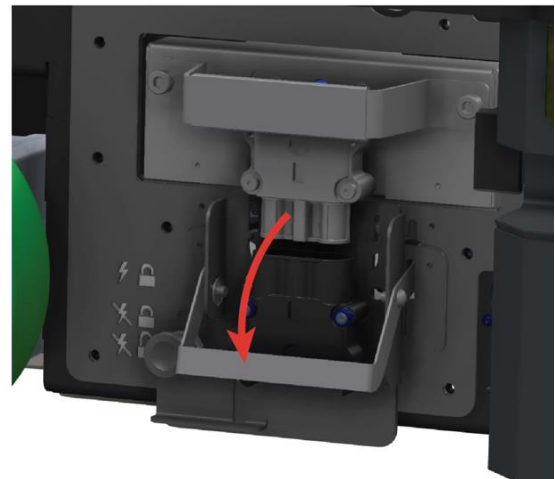
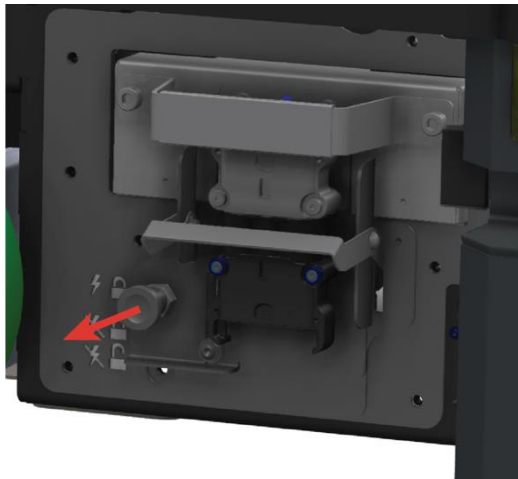


11.3 Swapping out the lithium-ion battery

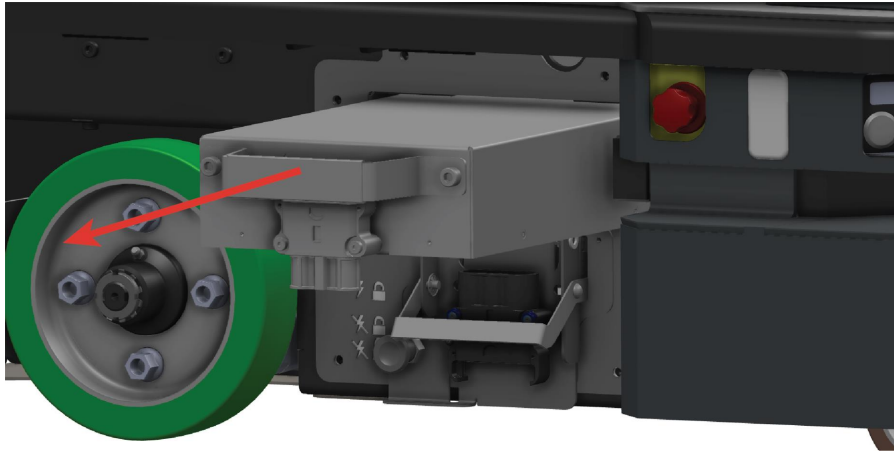
The left side compartment holds the robot's battery. To access the side compartments, see ["Accessing the internal parts" on page 104](#).

To swap out the battery, follow these steps:

- 1 Pull out the Battery lock pin, and pull the Battery lever down to the bottom level. The battery is now disconnected and unlocked from the robot.



- 2 Grab the handle, and gently pull the battery out.



- 3 Insert another battery.
- 4 Pull out the Battery lock pin, and pull the Battery lever up to the center position to lock the battery in place or to the top position to lock, and connect the battery to the robot.

12. Operating hazard zones

Operating hazard zones are areas that must be visibly marked to comply with safety standards in EN 1525 and ISO 3691-4. They must adhere to the following:

- The operating hazard zone borders must be at least one meter from the identified hazard in all directions.
- Personnel must be instructed to stay clear of operating hazard zones when a robot is approaching.
- It is not allowed to have work stations in operating hazard zones.

Areas where you must apply operating hazard zones for MiR robots are:

- Areas where the robot drives with muted Protective fields.
- Areas with inadequate clearance for escape routes.



WARNING

When the robot is in an operating hazard zone, there is a risk of injury to any personnel within the zone.

- Ensure that all personnel are instructed to stay clear of operating hazard zones when the robot is in the zone.

You can add zones to the map in the robot interface to mitigate the risks to personnel in operating hazard zones. We recommend considering whether adding the following zones can reduce the risks in an operating hazard zone:

- Speed zones can be used to reduce the speed of the robot to the minimum robot speed.
- Sound and light zones can be used to add acoustic and visual warnings when the robot drives into the zones.



For more information about zones, see *MiR Robot Interface Guide*. For examples of operating hazard zones, see *MiR Commissioning Guide*. You can find these guides on [MiR Support Portal](#).

13. Commissioning overview

Commissioning should be done without any load on the robot, except when doing brake tests where the robot should have a load equaling the heaviest load it will be driving with.

Only persons assigned with the commissioning task should be present during commissioning.

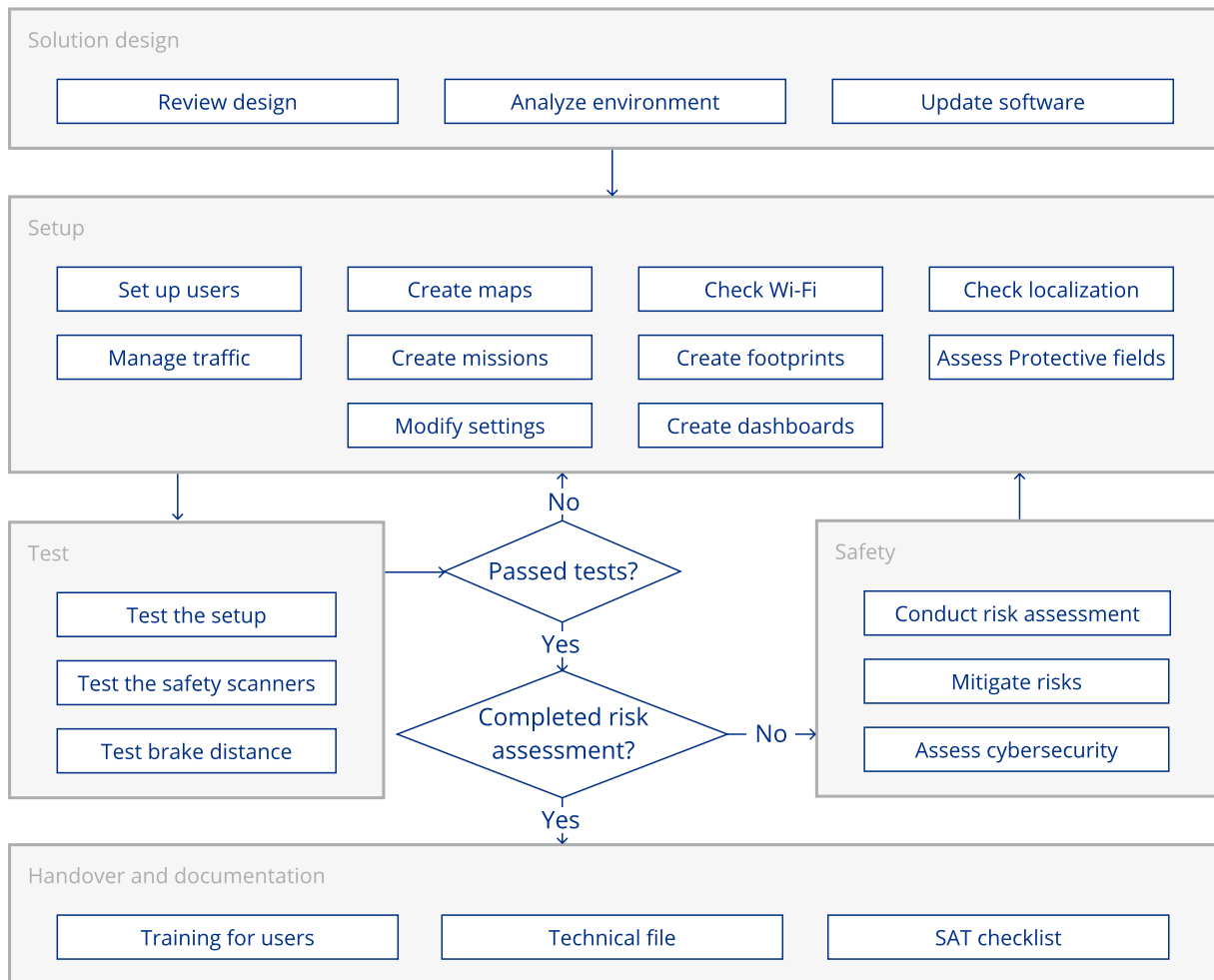
MiR Commissioning Guide contains a site acceptance checklist with the core tasks that are part of commissioning the MiR robot.

Commissioning is an iterative process that requires you to adjust the set up as issues and possible optimizations arise. Make sure to test all changes frequently and review all tasks once they are all complete. The basic commissioning process flow is illustrated in [Figure 13.1](#).

There will also be more integration-specific commissioning tasks that are not in this guide and will depend on the design of the solution and integration. Persons responsible for commissioning are also responsible for determining all other tasks required to commission the robot safely.

For more information about each commissioning step, see *MiR Commissioning Guide*. You can find this guide on [MiR Support Portal](#).

Figure 13.1 Flow diagram of the commissioning process



14. Brake test

It is the responsibility of the commissioner to perform an adequate test of the robot's braking capability under the driving conditions the robot will be operating in. The brake test must be executed:

- With maximum payload.
- Within each speed interval for each Protective field.
- At the steepest supported decline in the robot's work area.

The commissioner must iteratively adjust the modifiable parameters and then run a brake test until the robot successfully stops in time in every test.

14.1 Dependent factors

The braking distance of the robot is particularly dependent upon the parameter in [Table 14.1](#). If the robot fails a brake test, you must either modify a chosen parameter to reduce the distance, or you can increase the size of the robot's Protective fields to make the robot stop sooner. To change the Protective fields, see *MiR Commissioning Guide*.



WARNING

The Protective fields are configured to comply with the safety standards of MiR600. Modifications may prevent the robot from stopping in time to avoid collision with personnel and equipment. Any modifications of the SICK configuration requires a new CE certification of the robot and compliance to all safety standards listed in the specification of the application and in other way declared.

- Do not modify the safety system without a competent third party to evaluate the safety of the design and performance of the robot after the modifications are applied.

Table 14.1 Parameters affecting the robot's brake distance

Parameter	Design consideration for Protective fields
Top module	Adjust the length, width, and shape of the Protective fields accordingly to match the footprint of the top module if it extends beyond the top

Parameter	Design consideration for Protective fields
	<p>cover of the robot.</p> <p>Adjust the shape of the Protective fields accordingly to create cutouts for cart or shelf legs in the view of the scanners.</p>
Robot speed	Speed affects the braking distance according to a quadratic relationship. For example, 2× higher speed means 4× longer braking distance. The higher the maximum speed in a monitoring case, the longer the Protective field must be.
Mass moment of inertia	A higher mass moment of inertia increases the braking distance when the robot pivots. The higher the mass moment of inertia, the wider the Protective fields must be.
Payload weight	A higher payload increases the braking distance when the robot drives straight. The higher the payload, the longer the Protective fields must be.
Payload position	When the payload's center of gravity is behind the drive wheels, it increases the braking distance when the robot drives straight. The further the center of gravity is behind the drive wheels, the longer the Protective fields must be.
Floor surface friction	A lower friction between the wheels and floor increases the braking distance. The lower the frictional coefficient, the longer the Protective fields must be.
Floor surface grade	When the robot is driving down a decline, it increases the braking distance. The steeper the maximum slope the robot drives down, the longer the Protective fields must be.

14.2 Brake test method

This section presents a recommended approach for conducting linear and pivot brake tests for this purpose.

Test setup

In order to conduct brake tests for verifying robot Protective fields, the following items are needed:

- **Robot:** the robot including its top module and maximum payload.
- **Brake test area:** approximately 3 m × 10 m; or the distance it takes for the robot to reach maximum speed and stop safely.
- **Custom joystick in robot user interface:** joystick widget with customizable speed available from MiR software version 2.11.0.
- **Tape measure:** minimum 1 m of measuring length.
- **Test object:** An object such as a cardboard box or similar that the robot can safely collide with. Recommended size: 200 mm high and 600 mm wide (approximating a cross-section of a human body lying on the ground).

Custom joysticks

Create custom joysticks in the robot interface that set maximum speeds for the robot that correspond to the monitoring cases.

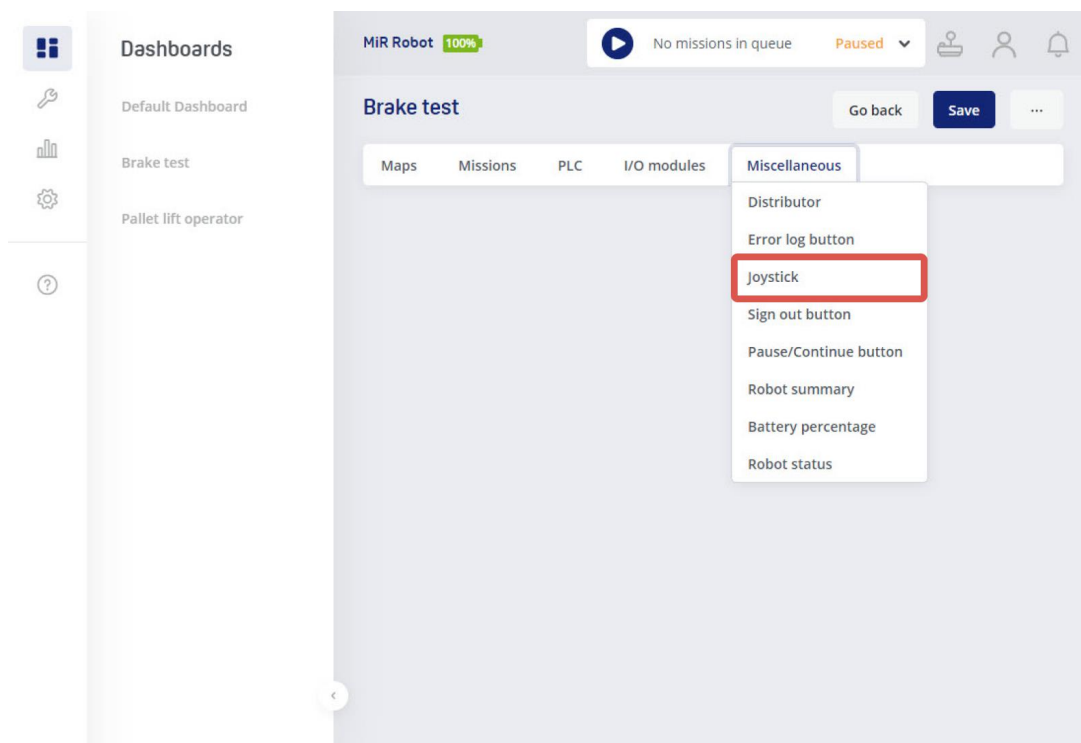
- **Number of custom joysticks:** Should be equal to the number of Protective field monitoring cases. If you are using the standard SICK configuration, you will need seven—see ["Safety-related functions and interfaces" on page 67](#).
- **Custom joystick speed:** Should be specified 0.05 m/s below the upper limit of the monitoring case speed interval.

If the 0.05 m/s margin is not used, MiR cannot guarantee that the robot will not overshoot the speed interval threshold and activate the Protective fields for the next monitoring case.

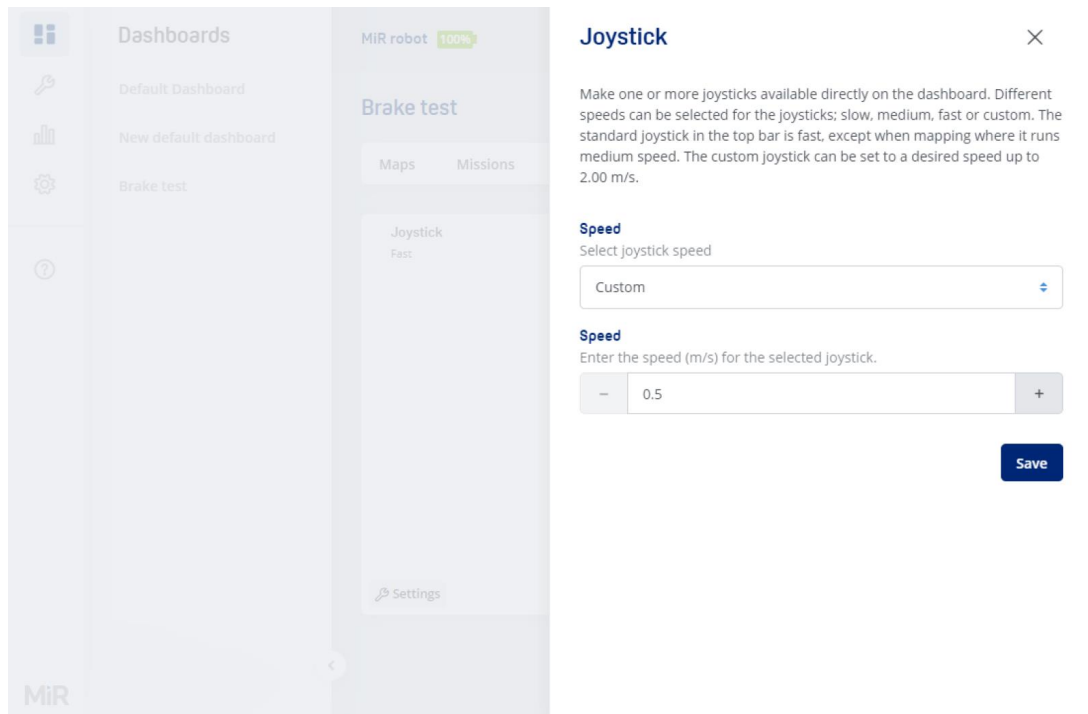
Monitoring cases for reverse driving are represented as negative values to indicate the direction of locomotion. To make the robot reverse, push the joystick directly backward.

To create custom joysticks for a brake test, follow these steps:

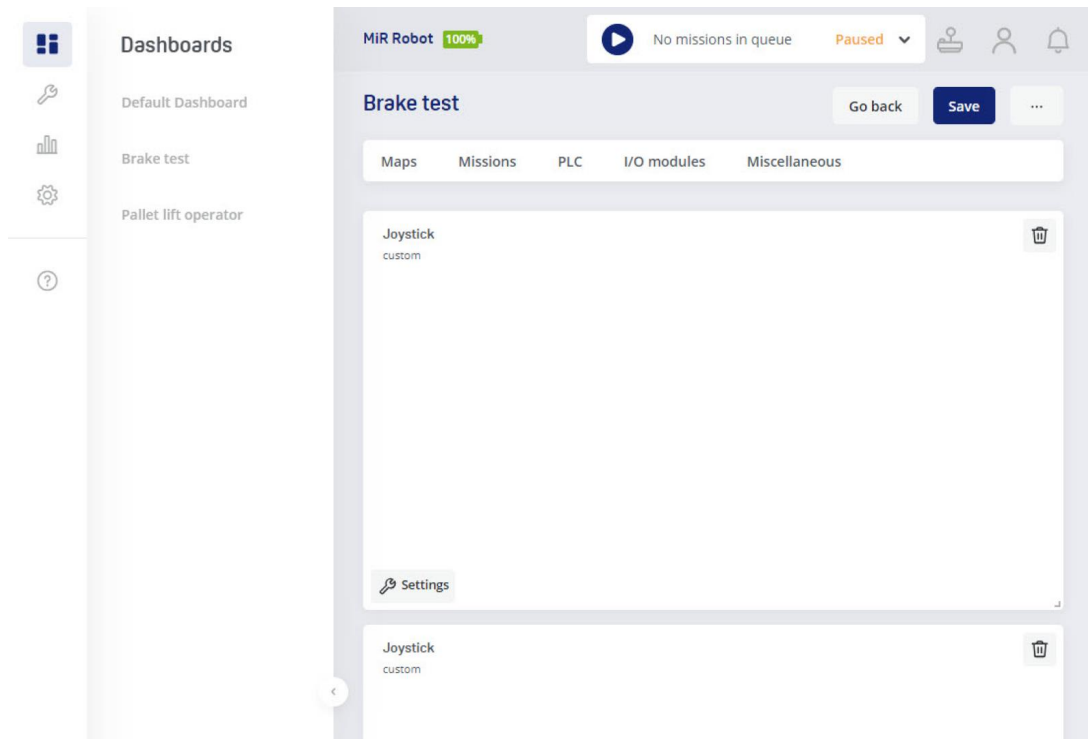
- 1 In the robot interface, go to **Dashboards** and create a new dashboard.
- 2 In the top menu of your new dashboard, select **Miscellaneous > Joystick** to create a new joystick.



- 3 Set **Joystick speed** to **Custom**, and set the first **Custom driving speed** to the desired speed in m/s. Select **Save** to apply.



- 4 Repeat step 5 and 6 until you have the desired number of joysticks with the required Custom driving speed settings on your dashboard.



Method

The following two sections describe how to perform a linear brake test and pivot brake test.

Linear brake test

A linear brake test must be conducted to ensure that the length of the Protective fields of the robot are correctly configured for each monitoring case and the planned payload.

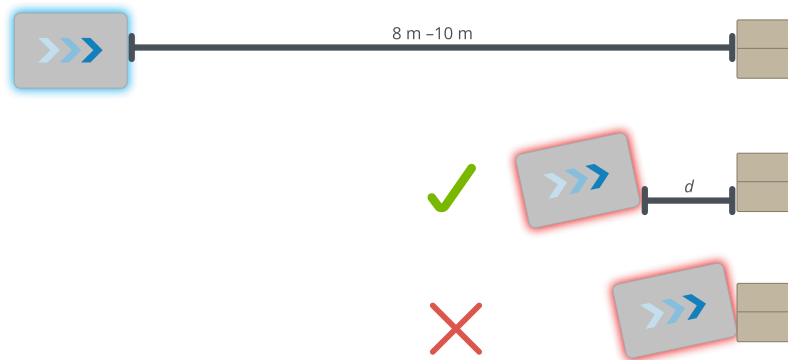
After driving the robot toward a test object and braking occurs, the distance d between the stopped robot and the test object should be measured and recorded for each brake test. Before conducting a linear brake test, a pass criterion for the test must be defined.

Pass criterion = acceptable distance d for the site (we recommend 215 mm as a starting point, or 65 mm if personnel wear safety shoes).

To conduct a linear brake test for forward and reverse driving, follow these steps:

- 1 Place a static test object front and center relative to the driving path of the robot—see [Figure 14.1](#).
- 2 Using the joystick for the lowest speed, push the joystick directly forward for forward driving (or directly backward for reverse driving) to drive the robot straight towards the test object.
- 3 Once the robot has completed braking and come to a complete stop near the test object, measure and record the distance d from the part of the robot that is closest to the test object.
- 4 Repeat steps 2–3 a total of five times for the selected joystick speed.
- 5 Repeat steps 2–4 for each joystick speed.

Figure 14.1 Linear brake test diagram



The test is considered passed when the distance d is equal to or greater than the pass criterion value. Likewise, the test is considered failed when the distance d is less than the pass criterion value. "P" for Pass or "F" for Fail should be recorded for each test in the test matrix.

Table 14.2 Linear brake test example matrix

	Forward driving speed (m/s)							Reverse driving speed (m/s)				
	0.1	0.3	...					-0.1	-0.3	...		
Test 1												
Result												
d (mm)												
Test 2												
Result												
d (mm)												
Test 3												
Result												
d (mm)												
Test 4												
Result												
d (mm)												
Test 5												
Result												
d (mm)												

Pivot brake test

The pivot brake test must be conducted to ensure that the width of the standstill Protective field for the robot is sufficient to prevent a collision when the robot is pivoting on its axis with maximum payload.

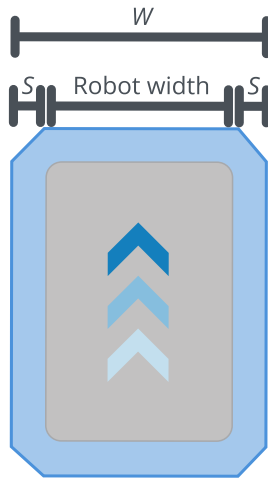
If you are using the default SICK configuration, the standstill Protective field corresponds to monitoring case 1 (0 to 0.1 m/s) for forward and reverse driving.

After pivoting the robot toward a test object and braking occurs, the distance p between the stopped robot and the test object should be measured and recorded for each brake test. Before conducting a pivot brake test, a pass criterion for the test must be defined.

Pass criterion = acceptable distance p for the site (we recommend 215 mm as a starting point, or 65 mm if personnel wear safety shoes).

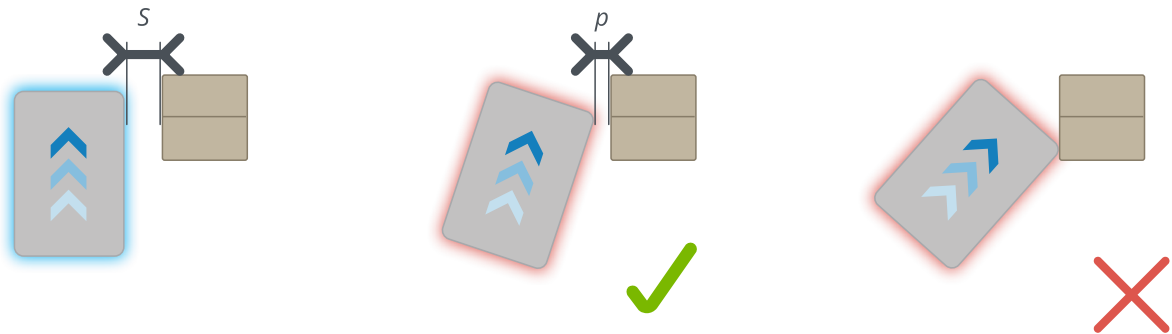
Determine the distance S for object placement relative to the side of the robot.

Figure 14.2 Illustration of W and S



To conduct a pivot brake test to the left and right of the robot, follow these steps:

- 1 Place a static test object a distance S to the left of the front-left corner of the robot (or to the right of the front-right corner of the robot). Make sure the object is placed just outside of the standstill Protective field so that the robot is not in Protective stop—see [Figure 14.3](#).
- 2 Positioned in front of the robot and using the joystick for monitoring case 1, push the joystick directly to the left for pivoting the robot in a clockwise direction (or directly to the right for pivoting the robot in a counterclockwise direction) toward the test object.
- 3 Once the robot has completed braking and come to a complete stop near the test object, measure and record the distance p from the part of the robot that is closest to the test object.
- 4 Repeat steps 2–3 a total of 5 times.
- 5 Repeat steps 1–4 for pivoting the robot to the right toward a test object.

Figure 14.3 Pivot brake test diagram

The test is considered passed when the distance p is equal to or greater than the pass criterion value. Likewise, the test is considered failed when the distance p is less than the pass criterion value. "P" for Pass or "F" for Fail should be recorded for each test in the test matrix.

Table 14.3 Pivot brake test example matrix

	Left	Right
Test 1		
Result		
p (mm)		
Test 2		
Result		
p (mm)		
Test 3		
Result		
p (mm)		
Test 4		
Result		
p (mm)		
Test 5		
Result		
p (mm)		

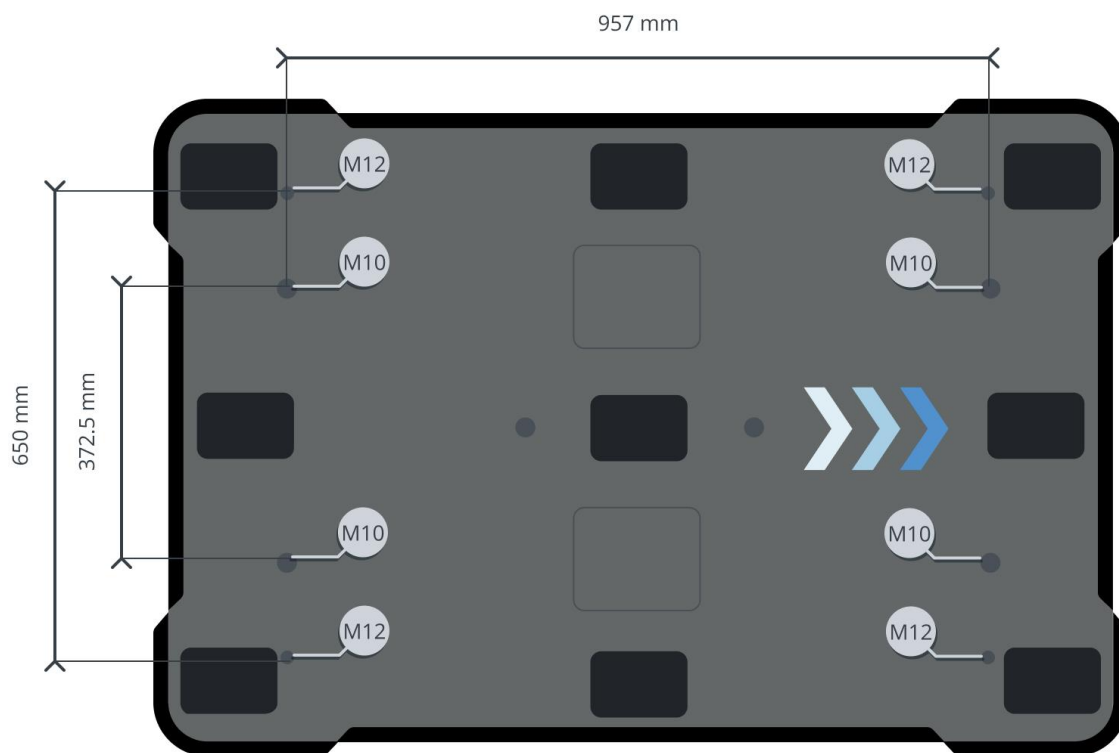
15. Mounting a top module

MiR600 has four M10 holes for mounting top modules as shown in [Figure 15.1](#). The tightening torque is 47 Nm. The mounting screws must have a length between 27–45 mm from the top of the top cover.

MiR600 also has four M12 lifting holes used for fixation of transportation eye bolts.

M12 lifting holes can also be used to mount top modules. If a top module is mounted using these holes, it is necessary to drill M12 lifting holes in the top module in order to lift the robot—see ["Maintenance" on page 113](#). Alternatively, the top module must be easily removed to access the M12 holes.

Figure 15.1 Mounting hole dimensions



**CAUTION**

Certain top modules may lead to new hazards and increased risks that cannot be eliminated or reduced by the risk reduction means applied by Mobile Industrial Robots.

- Perform a risk assessment according to standard ISO 12100 when mounting a top module.

**CAUTION**

MiR600 may tip over if weight and payload specifications are not met, risking damage to equipment or injury to nearby personnel.

- Stay within the specifications for weight and the total payload's center of gravity—see ["Payload distribution and stability" on page 175](#).

16. Electrical interfaces

This section describes the specifications of the electrical interfaces.

**NOTICE**

Read "[Safety](#)" on [page 29](#) before using the electrical interface.

MiR600 has six electrical interfaces divided into two groups:

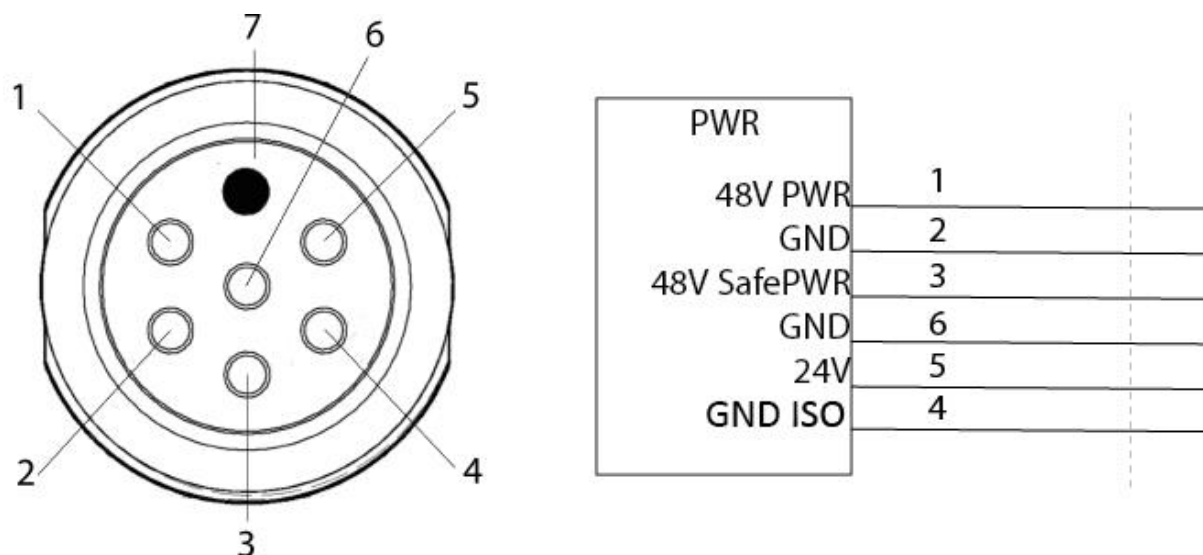
- Left top compartment
 - Power
 - Ethernet
 - GPIO
- Right top compartment
 - Auxiliary safety functions
 - Auxiliary emergency stop
 - Antenna

16.1 Left compartment interfaces

This section describes the general purpose interfaces located in the left top compartment on top of MiR600.

Power

Figure 16.1 Pin numbers: female connector viewed from the front (left) and wiring diagram (right)



The maximum current across pins 1 and 3 combined is 20 A when the robot is at standstill. When the robot is driving, the maximum combined current is 2 A.

The maximum capacitance of devices connected to pins 1 and 3 is 2 000 μ F combined. If your device has a higher capacitance, you must integrate your own softstarter that keeps the current under 2 A for the first 100 ms, and thereafter under 20 A.



NOTICE

Connecting power and ground signals to the chassis while stacking the 24 V and 48 V power supplies can lead to severe damage to the robot.

- Never connect power and ground signals to the chassis, and never stack the 24 V and 48 V power supplies.



NOTICE

Connecting 48 V power supplies to 24 V pins or vice versa can lead to severe damage to the robot.

- Never connect 48 V power supplies to 24 V pins or vice versa.

**NOTICE**

The robots are not designed to absorb inverse current from top modules. This can damage the electrical components inside the robot, and the top module will likely not work as intended.

- Never connect a top module that can deliver an inverse current to the robot interfaces.

Table 16.1 Description of the pins in the Power interface

Pin no.	Description
1	<p>Signal name: 48V PWR</p> <p>Max. current: 20 A</p> <p>Voltage range: 41.8–53.8 V with reference to pins 2 and 4.</p> <p>Standard function: Turns off during Protective and Emergency stops by default but can be changed to continuously supply power when the robot is on. This can be done in the robot interface under System > Settings > Features > Turn off TOP FUSE—see "Turn off TOP FUSE feature" on the next page. The power supply is cut via a transistor in the power board. There are no additional safety precautions taken with this power output. For this reason, it is recommended to use the power output from pin 3 instead.</p> <p>Intended use: Intended for high-power loads like motors or actuators.</p>
2	<p>Signal name: GND</p> <p>Standard function: Ground.</p>
3	<p>Signal name: 48V SafePWR</p> <p>Max. current: 20 A</p> <p>Voltage range: 41.8–53.8 V with reference to pins 2 and 4.</p> <p>Standard function: Turns off in case of a Protective or Emergency stop. This</p>

Pin no.	Description
	<p>output is controlled by the internal safety PLC and the STO contactor to ensure that power is always disconnected from this pin in case of a protective or emergency stop. For this reason, it is always recommended to use this power output instead of the output from pin 1.</p> <p>Intended use: Intended for high-power loads like motors or actuators.</p>
4	<p>Signal name: GND</p> <p>Standard function: Ground.</p>
5	<p>Signal name: 24V</p> <p>Voltage range: 18–30 V with reference to pin 6.</p> <p>Max. current: 2 A</p> <p>Standard function: Always on when robot is on. Intended for low-power use, like powering an external PLC.</p>
6	<p>Signal name: GND_ISO</p> <p>Standard function: Ground.</p>
7	Unassigned

Turn off TOP FUSE feature

You can use the **Turn off TOP FUSE** feature to disable the TOP FUSE to the Power interface during a Protective or Emergency stop. This is the fuse that cuts power to the TOP 48V pin and the TOP-Safe 48V.

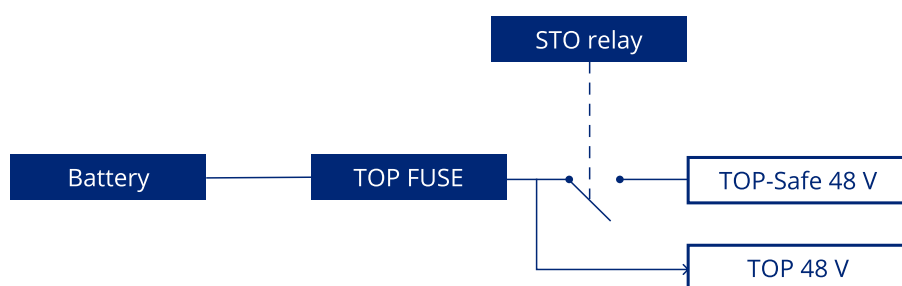
By default, the feature is enabled, meaning that:

- Neither the TOP 48V pin nor the TOP-Safe 48V pin can draw power during an Emergency or Protective stop.
- The power from both pins are softstarted by gradually raising the voltage from 0 to 48 V in 100 ms. During this period, the current should be less than 2 A.

If you disable the feature, the TOP FUSE does not turn off when the robot enters Protective or Emergency stop. This means that:

- The TOP 48V pin can still draw power from the robot during an Emergency or Protective stop.
- The TOP-Safe 48V pin cannot draw power until the robot exits the stopped state, but the inrush current is not reduced by the softstarter. If the inrush current is too high, the fuse will trip and start again with the inbuilt softstarter.

Figure 16.2 Diagram of how the TOP FUSE and STO contactors control the power connection to the Power interface

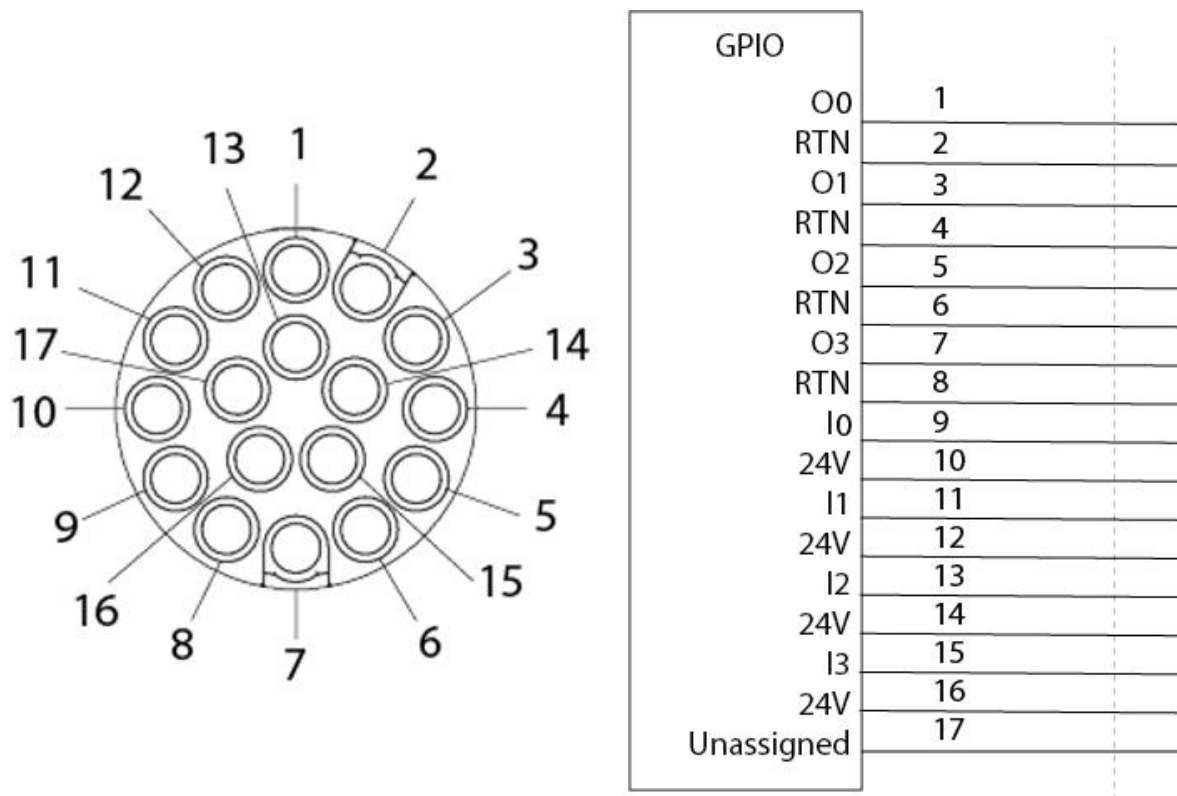


If you disable the feature and connect a load that has a capacity above 100 μ F or draws large currents in the first 100 ms to the TOP-Safe 48 V pin, and you do not integrate your own softstarter to the device, the TOP FUSE will trip when the robot exits Emergency or Protective stop. The fuse will reconnect again shortly after using the inbuilt softstarter.

There is a risk that the fuse will break when it is tripped. For this reason, we recommend that you ensure your top module does not trip the fuse as described above, even though in most cases it will reconnect.

GPIO

Figure 16.3 Pin numbers: male connector viewed from the front (left) and wiring diagram (right)

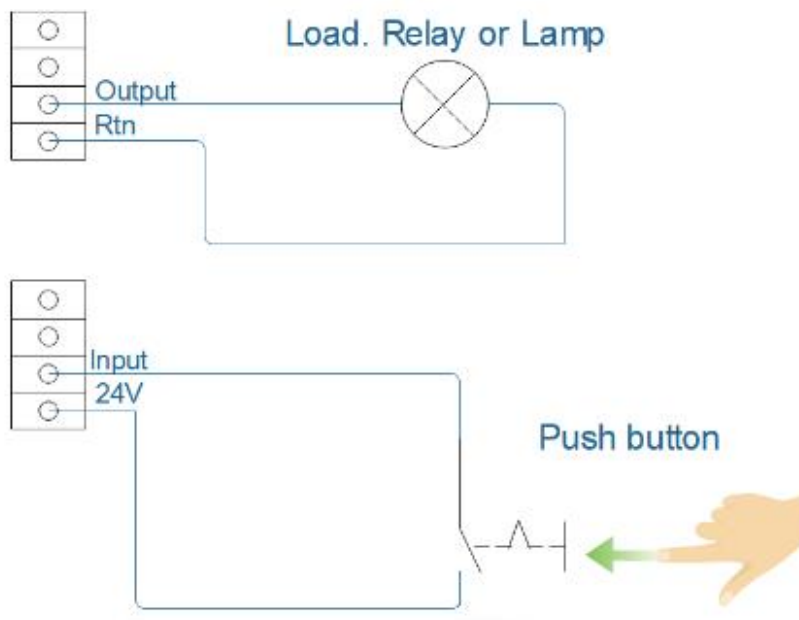


The GPIO has the following pins:

- Four inputs, for use with 24 V, but robust against 48 V.
- Four outputs, for use with 24 V.

The GPIO supports low current/power devices like relays, contactors, lamps, and separate PLC units.

Figure 16.4 Outputs and RTNs are used to send signals to the top module, and inputs and 24 V pins are used to receive signals from the top module



To use the GPIO for a top module of your own design, ensure that the **Pallet lift** and **Shelf** features are disabled under **System > Settings > Features**. This enables the GPIO interface to work as input and output to top modules that can be controlled in missions. The pallet lift and shelf features use a different kind of communication that is specific to the MiR top modules.

Outputs (O0, O1, O2, O3) can be toggled on and off by the robot in a Set I/O module mission action or manually in **Setup > I/O modules**.

A top module can be connected to the output pins and monitor when they are active at 24 V. RTN is used as ground.

Inputs (I0, I1, I2, I3) can be used by the top application to send inputs to the robot. When 24 V is connected to the input pin, the robot registers the input as active.

Figure 16.5 Example of I2 registered as high by the robot

Output pins must be connected to RTN pins, and input pins must be connected to 24 V pins.

Table 16.2 Description of the pins in the GPIO interface

Pin no.	Description
1	Name: O0 Maximum current: 1 A at 24 V Standard function: Output 0
2	Name: RTN Standard function: Protected return
3	Name: O1 Maximum current: 1 A at 24 V Standard function: Output 1

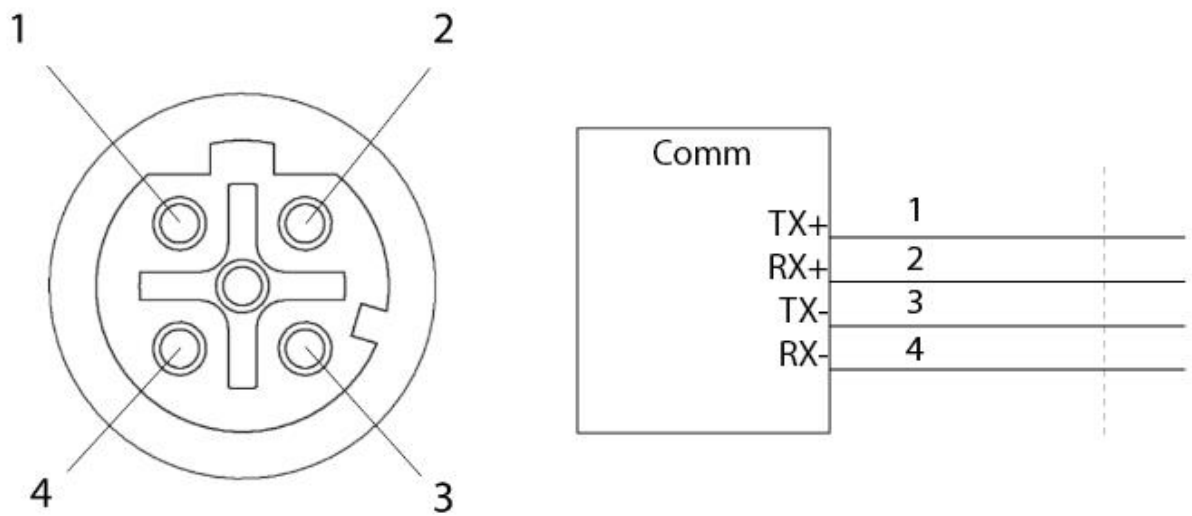
Pin no.	Description
4	Name: RTN Standard function: Protected return
5	Name: O2 Maximum current: 1 A at 24 V Standard function: Output 2
6	Name: RTN Standard function: Protected return
7	Name: O3 Maximum current: 1 A at 24 V Standard function: Output 3
8	Name: RTN Standard function: Protected return
9	Name: I0 Maximum current: 1 A at 24 V Standard function: PNP input 0
10	Name: 24V Maximum current: 1 A at 24 V Standard function: Protected output

Pin no.	Description
11	Name: I1 Maximum current: 1 A at 24 V Standard function: PNP input 1
12	Name: 24V Maximum current: 1 A at 24 V Standard function: Protected output
13	Name: I2 Maximum current: 1 A at 24 V Standard function: PNP input 2
14	Name: 24V Maximum current: 1 A at 24 V Standard function: Protected output
15	Name: I3 Maximum current: 1 A at 24 V Standard function: PNP input 3
16	Name: 24V Maximum current: 1 A at 24 V Standard function: Protected output

Pin no.	Description
17	Unassigned

Ethernet

Figure 16.6 Pin numbers: female connector viewed from the front (left) and wiring diagram (right)



The interface supports 10/100 Mbps Ethernet.

Various protocols are supported, such as Modbus. For more information on how to use Modbus, ask your distributor for the guide *How to use Modbus with MiR robots*.

Table 16.3 Description of the pins in the Ethernet interface

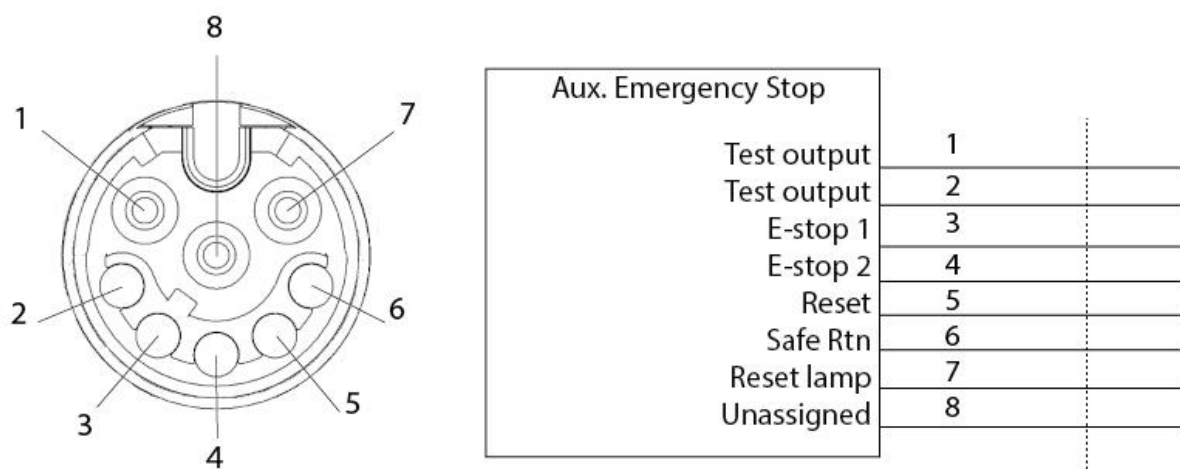
Pin no.	Signal name	Pin no.	Signal name
1	TX+	2	RX+
3	TX-	4	RX-

16.2 Right compartment interfaces

This section describes the general purpose interfaces located in the right top compartment on top of MiR600.

Auxiliary emergency stop

Figure 16.7 Pin numbers: female connector viewed from the front (left) and wiring diagram (right)



The Auxiliary emergency stop interface is designed to support Emergency stop and other safety functions—see ["Emergency stop" on page 76](#).

Table 16.4 Description of the pins in the Auxiliary emergency stop interface

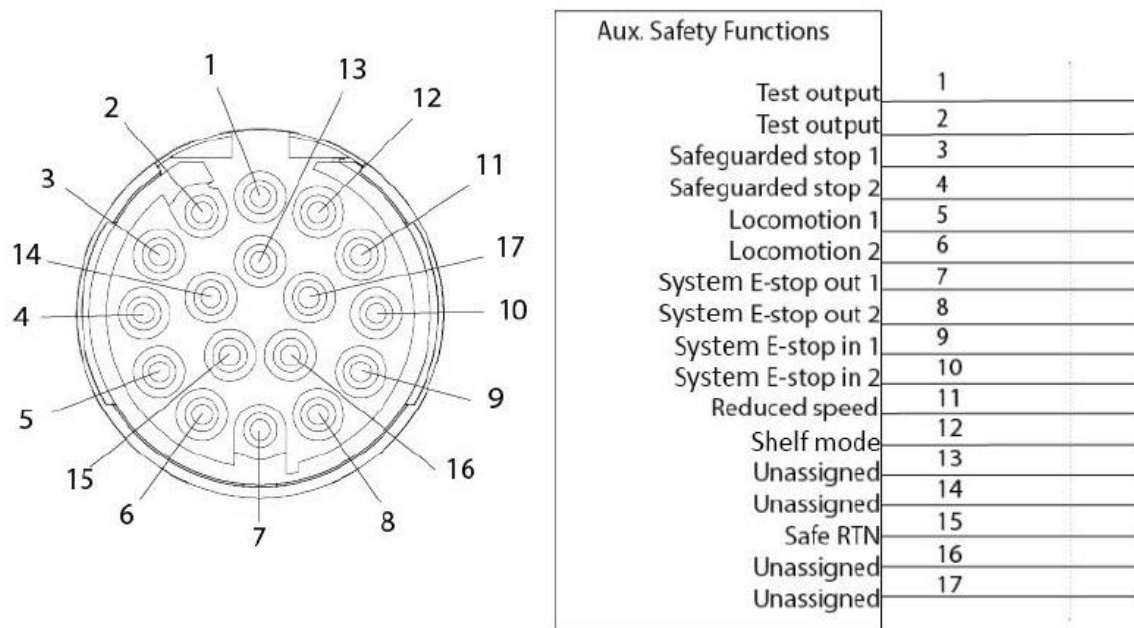
Pin no.	Description
1	Signal name: Test output Type: Output Standard function: 24 V output signal from the safety PLC for the Emergency stop circuit. Should connect to pin 3.
2	Signal name: Test output

Pin no.	Description
	Type: Output Standard function: 24 V output signal from the safety PLC for the Emergency stop circuit. Should connect to pin 4.
3	Signal name: E-stop 1 Type: Input Standard function: Input signal to the safety PLC for the Emergency stop circuit. Must receive 24 V to prevent the robot from entering Emergency stop. Should connect to pin 1.
4	Signal name: E-stop 2 Type: Input Standard function: Input signal to the safety PLC for the Emergency stop circuit. Must receive 24 V to prevent the robot from entering Emergency stop. Should connect to pin 2.
5	Signal name: Reset Type: Input Standard function: When active, the robot resets.
6	Signal name: Safe RTN Type: Ground Standard function: Safe return.
7	Signal name: Reset lamp

Pin no.	Description
Type: Output	
Standard function: Active when robot needs to be reset.	
8	Unassigned.

Auxiliary safety functions

Figure 16.8 Pin numbers: female connector viewed from the front (left) and wiring diagram (right)



The Auxiliary safety functions interface is designed to support safety functions that can trigger a Protective stop—see ["Safety-related functions and interfaces"](#) on page 67.

Table 16.5 Description of the pins in the Auxiliary safety functions interface

Pin no.	Description
1	Signal name: Test output Type: Output Standard function: 24 V output.
2	Signal name: Test output Type: Output Standard function: 24 V output.
3	Signal name: Safeguarded stop 1 Type: Input Standard function: When inactive, the robot enters Protective stop. If pins 3 and 4 are unequally set for more than three seconds, the robot must be restarted.
4	Signal name: Safeguarded stop 2 Type: Input Standard function: When inactive, the robot enters Protective stop. If pins 3 and 4 are unequally set for more than three seconds, the robot must be restarted.
5	Signal name: Locomotion 1 Type: Output Standard function: Active when the robot is standing still.

Pin no.	Description
6	Signal name: Locomotion 2 Type: Output Standard function: Active when the robot is standing still.
7	Signal name: System E-stop out 1 Type: Output Standard function: Inactive when the robot is in Emergency stop.
8	Signal name: System E-stop out 2 Type: Output Standard function: Inactive when the robot is in Emergency stop.
9	Signal name: System E-stop in 1 Type: Input Standard function: When inactive, the robot enters Emergency stop.
10	Signal name: System E-stop in 2 Type: Input Standard function: When inactive, the robot enters Emergency stop.
11	Signal name: Reduced speed Type: Input Standard function: When inactive, the robot cannot drive faster than 0.3 m/s.

Pin no.	Description
12	Signal name: Shelf mode Type: Input Standard function: When active, the robot checks for shelf legs if pin 11 is also active. Is only intended to be used with MiR Shelf Lift.
13	Unassigned.
14	Unassigned.
15	Signal name: Safe RTN Type: Ground Standard function: Safe return.
16	Unassigned.
17	Unassigned.

Wi-Fi antenna

The Wi-Fi antenna interface is an RP-SMA connector that goes to the front compartment. It is not connected to the robot computer by default.

Adding antennas is considered a modification to the robot, and it is the modifier's responsibility to ensure applicable compliance.

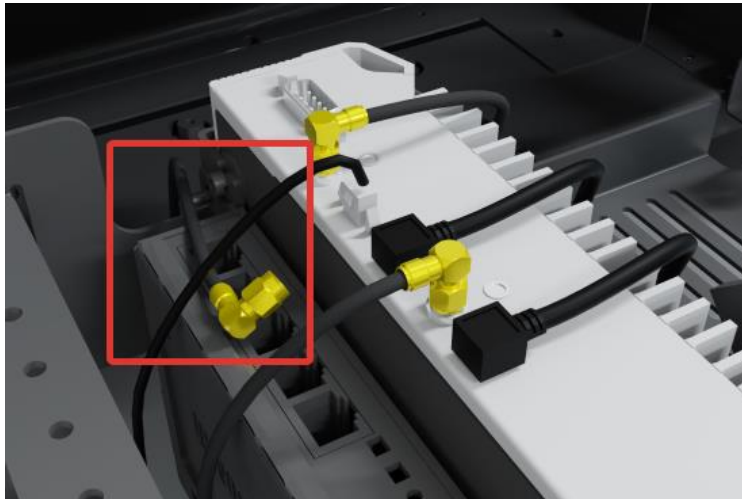
Connecting the Wi-Fi antenna interface

By default, the Wi-Fi antenna interface connector is not enabled. It is connected to an antenna cable inside the robot that leads to the front compartment, but the cable is not connected to the robot computer.

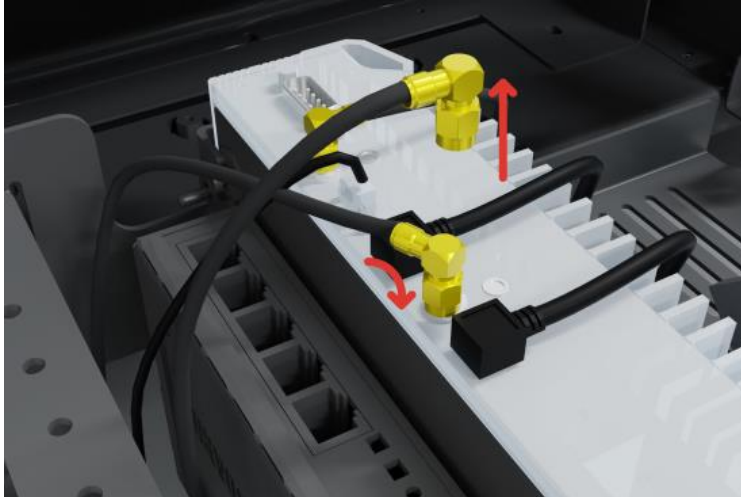
If you choose to use the Wi-Fi antenna interface, you must disconnect one of the two antennas already installed in the robot, and connect the antenna cable from the Wi-Fi interface to the robot computer instead.

To swap which antenna is connected to the robot computer, follow these steps:

- 1 Open the front compartment—see ["Accessing the internal parts" on page 104](#).
- 2 Locate the robot computer—see ["Front compartment" on page 22](#).
- 3 Locate the loose RP-SMA antenna cable that is not yet connected. The cable will be nearby the robot computer.



- 4 Disconnect one of the connected antenna cables from the robot computer and connect the other antenna cable in its place. Use an 8 mm wrench to loosen and tighten the connectors.



- 5 Close the front compartment.

16.3 Connector list

Table 16.6 Description of the connectors used for the interfaces

Connector name	Connector type	Phoenix Contact	Dimensions
Power	M23 6p	CA-06P1N8A8008S	See Figure 16.9 .
GPIO	M17 17p	ST-17S1N8A8K03S	See Figure 16.10 .
Ethernet	M12 4p	SACC-MSD-4PCT-SH PN SCO	
Auxiliary	M17 8p	ST-08P1N8A8K03S	See Figure 16.10 .

Connector name	Connector type	Phoenix Contact	Dimensions
emergency stop			
Auxiliary safety functions	M17 17p	ST-17P1N8A8K03S	See Figure 16.10 .
Wi-Fi antenna	RP-SMA	N/A	N/A

Figure 16.9 Connector dimensions for Power connector

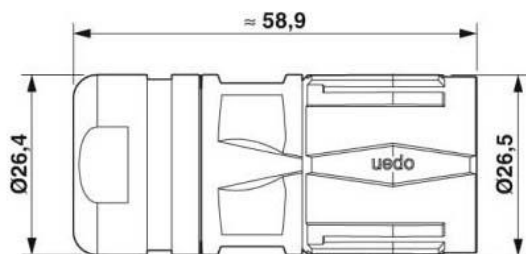
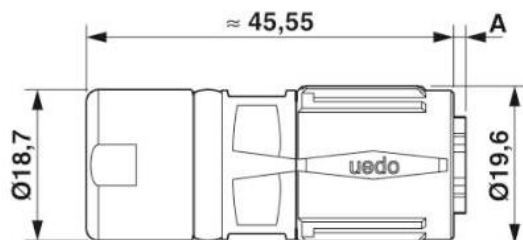


Figure 16.10 Connector dimensions for GPIO, Auxiliary emergency stop, and Auxiliary safety functions connectors



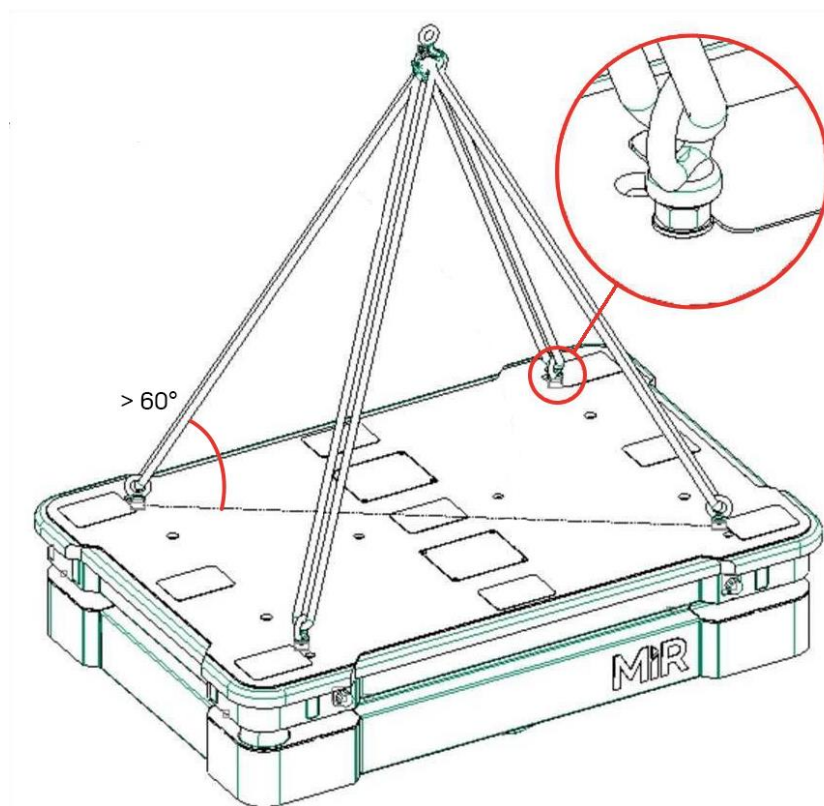
17. Transportation

This section describes how to lift the robot and how to pack the robot for transportation.

17.1 Lifting MiR600

To lift the robot, use the four M12 mounting holes in the corners of the top cover of the robot—see [Figure 17.1](#).

Figure 17.1 Illustration of how to lift MiR600



To lift the robot safely without damaging it, ensure that the following criteria are met:

- Use four M12 eye-bolts with counter nuts and washers in each corner of the robot.
- Make sure the thread engagement is at least 30 mm when a top plate is mounted to the robot.
- Tighten the counter nuts to at least 25 Nm.

- All slings must be of equal length and have a lift rating of at least 1 000 kg.
- The angle between the top cover and sling must be greater than 60°—see [Figure 17.1](#).
- The bolts must be parallel with the diagonal between opposite corners.

17.2 Packing the robot for transportation

Before packing the robot for transportation:

- Shut down the robot—see ["Shutting down the robot" on page 41](#).
- Disconnect the battery—see ["Disconnecting the battery" on page 132](#).

Use the original packaging materials when transporting the robot.

Figure 17.2 The packing materials



The packaging materials are:

- The bottom of the box (the pallet)
- The lid of the box (the ramp)
- The lath to make the ramp function as a lid
- The two laths used as wheel stops
- The walls of the box
- The wheel stop board
- Protective foam blocks: Side blocks and the top layer
- Protective corner braces

To pack the robot, repeat the steps in "[Unpacking MiR600](#)" on page 36 in the reverse order.

**NOTICE**

Pack and transport the robot in an upright position. Packing and transporting the robot in any other position voids the warranty. You can find our warranty policy on [MiR Support Portal](#).

17.3 Transporting the battery

Lithium-ion batteries are subject to special transportation regulations according to United Nations Regulation of Dangerous Goods, UN 3171. Special transport documentation is required to comply with these regulations. This may influence both transport time and costs. Different regulations apply depending on the mode of transportation.

When transporting lithium-ion batteries:

- Transport the batteries in their original packaging. If there is no original packaging, we recommend using a lithium-ion battery storage box.
The robot can be used as original packaging, provided the battery is disconnected from the robot and is securely locked in the robot.
- Do not expose the battery to direct sunlight.
- Do not expose the battery to temperatures above 35° C.
- Do not expose the battery to air humidity above 85%.

**WARNING**

Lithium-ion battery packs may get hot, explode, or ignite and cause serious injury if they are misused electrically or mechanically.

Observe the following precautions when handling and using lithium-ion batteries:

- Do not short-circuit, recharge, or connect with false polarity.
- Do not connect or charge a potentially defective or damaged battery.
- Do not expose to temperatures beyond the specified temperature range or incinerate the battery.
- Do not crush, puncture, or disassemble the battery. The battery contains safety and protection devices, which, if damaged, may cause the battery to generate heat, explode, or ignite.
- Do not allow the battery to get wet.
- In the event the battery leaks and the fluid gets into one's eye, do not rub the eye. Rinse well with water, and immediately seek medical care. If left untreated, the battery fluid could cause damage to the eye.
- In case of fire, use water to put out the fire. There is no need for special extinguishing media.
- Do not touch damaged batteries with bare hands. Only personnel using suitable Personal Protection Equipment (PPE) and tools should handle damaged batteries.
- Isolate the battery and keep clear if the following conditions are observed:
 - The battery exhibits abnormally high temperatures.
 - The battery emits abnormal odors.
 - The battery changes color.
 - The battery case is deformed or otherwise differs from the normal electrical or mechanical condition.
- Do not modify or manipulate of the battery. This may lead to considerable safety risks and is therefore prohibited.
- Never smoke or allow an open spark or flame in the vicinity of the robot's battery.
- Do not use the battery for anything other than MiR600.

18. Disposal

According to the European directive 2012/19/EU, Article 2, paragraph 4) d) and 4) e) (WEEE directive), MiR robots are not in scope of the directive.

The robot is therefore not classified as WEEE and can be disposed of in accordance with the applicable local regulations.



NOTICE

You must disconnect and remove the battery before disposal of the robot—see ["Disconnecting the battery" on page 132](#).

Legal obligations apply to the robot's battery. Disposing used batteries in the household waste is prohibited.

A recycling label indicates that the battery needs to be recycled and not disposed as municipal waste—see [Figure 18.1](#). Contact your distributor to get specific information about their take back service.

Figure 18.1 Battery disposal symbols



19. Payload distribution and stability

The following drawings illustrate where the center of mass (CoM) of payloads must be located for safe operation with different payloads.



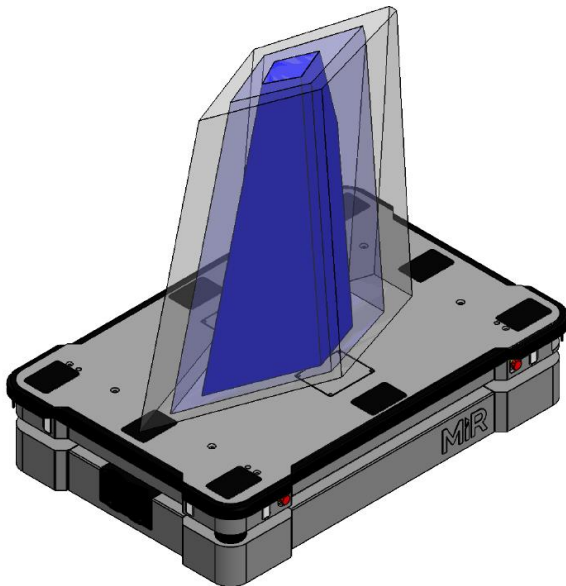
WARNING

Load falling or robot overturning if the load on MiR600 is not positioned or fastened correctly can cause damage to equipment and injury to personnel.

- Ensure that the load is positioned and fastened correctly.

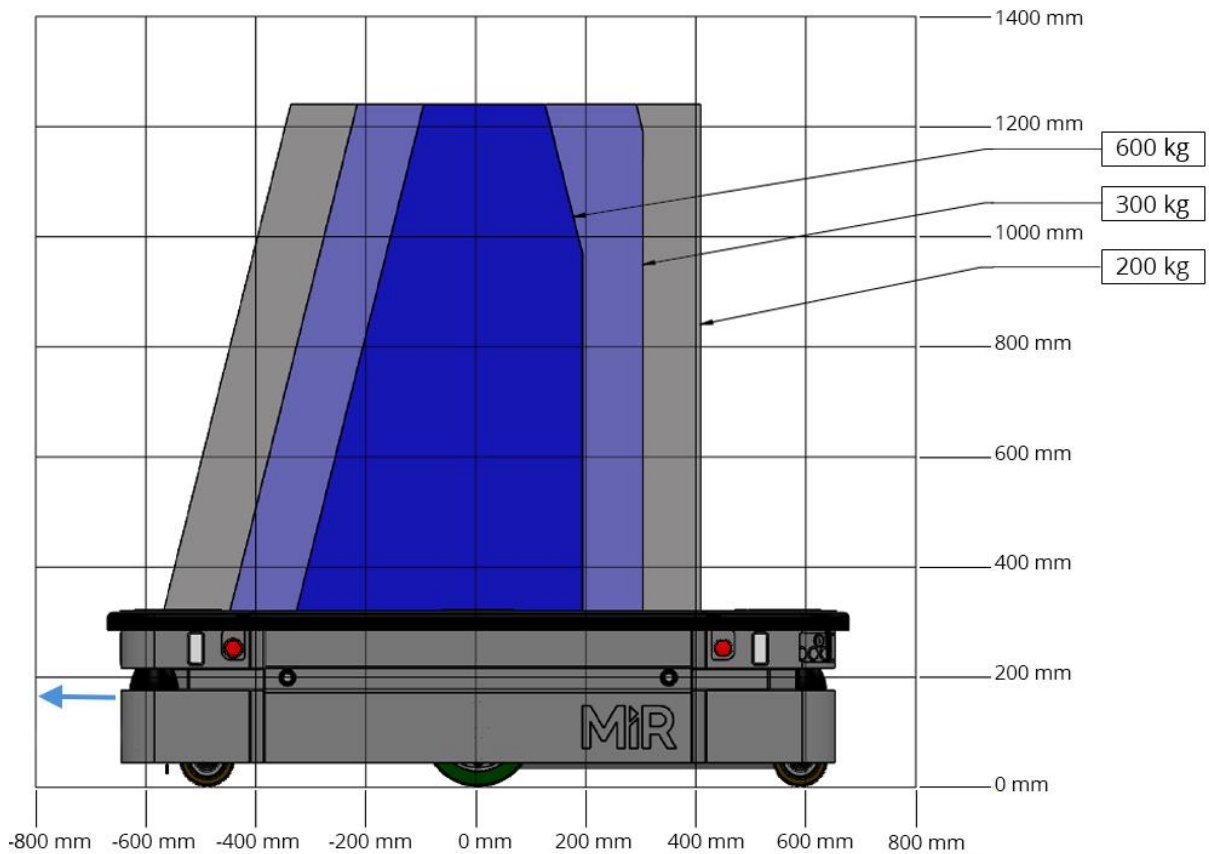
The specifications apply to total payloads of up to 600 kg.

Figure 19.1 Overview of the permitted center of mass (CoM) of payloads



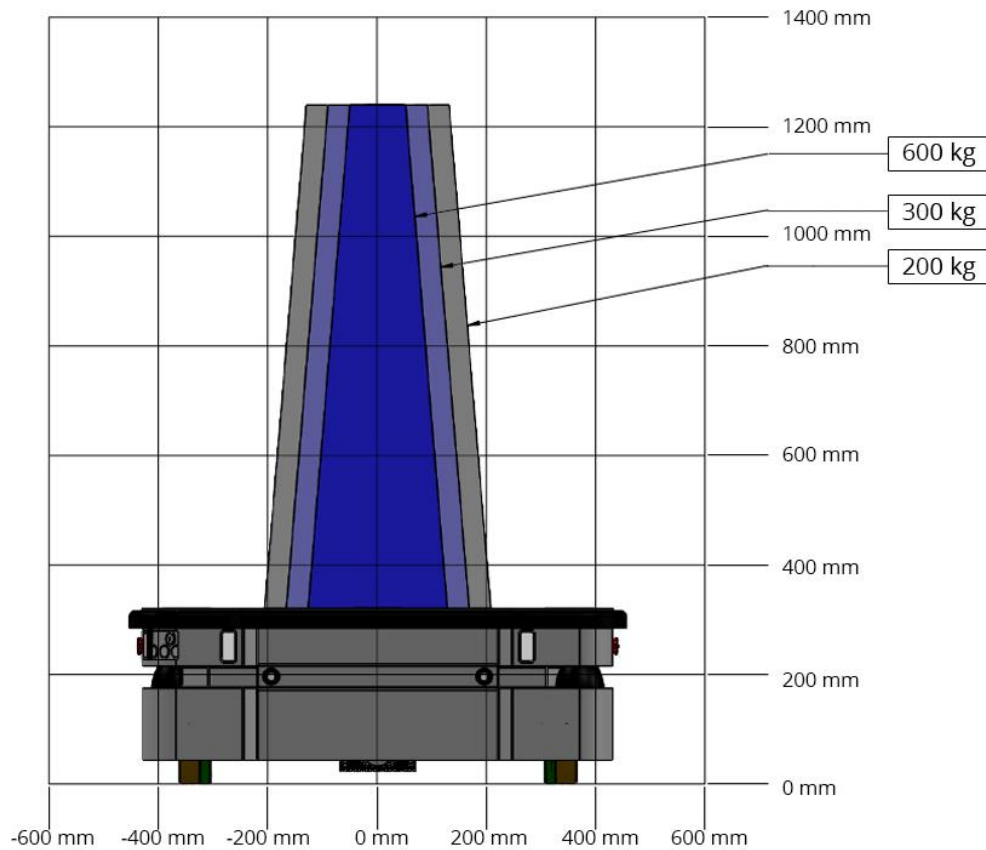
19.1 Side view

Figure 19.2 The center of mass (CoM) of payloads seen from the side at maximum speed




19.2 Front view

Figure 19.3 The center of mass (CoM) of payloads seen from the front at maximum speed



20. Declaration of Conformity example

EC Declaration of Conformity		CE	MIR
EC-overensstemmelseserklæring EG-Konformitätserklärung Declaración de conformidad UE Dichiarazione di conformità UE	Декларация за съответствие на ЕС EU Verklaring van overeenstemming EU-vaatimustenmukaisuusvakuutus EU Prohlášení o shodě	EU izjava o sukladnosti EÜ vastavusdeklaratsioon Δήλωση συμμόρφωσης ΕΕ	
Product-/Produkt/Produkt/Producto/Prodotto/продукт/Product/Tuote/Produkt/Proizvod/Toode/Προϊόν			MIR600
Type-/Type/Art/Typo/Genere/Тип/Type/Typipi/Typ/Típ/Tüüp/Tύπος			Driverless Truck
Serial number-/Serienr./Seriennr./N.º de serie/N.º de série/Nr serijny/Número de série/Sériové č./Numero di serie/Serijski broj/Seerianr./Αρ. Σειράς			100016
Year of construction-/Fremstillingsår/Baujahr/Año de fabricación/Anno di costruzione/Година на изграждане/Bouwjaar/Valmistusvuosi/Rok zkonstruování/Godina proizvodnje/Ehitusaasta/Έτος κατασκευής			2023
<p>The undersigned certifies that the above-mentioned model is produced in accordance with the following directives and standards. The authorized person is authorized to compile the technical file.</p> <p>Il sottoscritto certifica che il modello di cui sopra è prodotto in conformità alle seguenti direttive e norme. The authorized person è la persona autorizzata a costituire la documentazione tecnica.</p> <p>Niže podepsaná osoba potvrzuje, že výše uvedený model je vyráběn v souladu s následujícími směrnici a normami. The authorized person je oprávněná k sestavování technické dokumentace.</p> <p>Undertegnede bekræfter, at ovennævnte model er fremstillet i overensstemmelse med følgende direktiver og standarder. The authorized person er autoriseret til at sammensætte den tekniske fil.</p> <p>Долуподписаното лице удостоверява, че гореспоменатият модел е произведен в съответствие с директивите и стандартите по-долу. The authorized person носи отговорност за съставянето на техническото досие.</p> <p>Potpisnik potvrđuje da je prethodno navedeni model proizveden u skladu sa slijedećim direktivama i normama. The authorized person ovlašten/ovlaštena je za sastavljanje tehničke dokumentacije.</p> <p>Der Unterzeichner erklärt, dass die oben genannte Maschine in Übereinstimmung mit den folgenden Richtlinien und Normen hergestellt wurde. The authorized person ist bevollmächtigt, die technischen Unterlagen zusammenzustellen.</p> <p>De ondergetekende verklaart dat het bovengenoemde model is geproduceerd in overeenstemming met de volgende richtlijnen en normen. The authorized person is gemachtigd om het technisch dossier samen te stellen.</p> <p>Allakirjutanu kinnitab, et ülalpool nimetatud mudel on toodetud kooskõlas järgmistele direktiivide ja standardidega. The authorized person on volitatud koostama tehnilist dokumentatsiooni.</p> <p>El abajo firmante certifica que el modelo indicado arriba se fabrica de conformidad con las siguientes directivas y normas. The authorized person está autorizada para compilar el archivo técnico.</p> <p>Allekirjoitanut vakuuttaa, että edellä mainittu malli on valmistettu seuraavien direktiivien ja standardien mukaisesti. The authorized person on valtuutettu kokoamaan teknisen tiedoston.</p> <p>υπογεγραμμένος δηλώνει ότι το ανωτέρω μοντέλο παράγεται σύμφωνα με τις οδηγίες και τα πρότυπα που ακολουθούν. The authorized person είναι εξουσιοδοτημένος να καταρτίσει τον τεχνικό φάκελο.</p>			
EC Machinery Directive 2006/42/EC		ISO 3691-4:2020 except Clause 4.4, 4.9.4, 5.1, 5.2, 6 and Annex A EN ISO 12100:2010 EN ISO 13849-1:2015 EN ISO 13849-2:2014 EN ISO 13850:2015	
Radio Equipment Directive 2014/53/EU		EN IEC 61000-6-4:2019	
Mobile Industrial Robots A/S Emil Neckelmanns Vej 15F Odense SØ, Denmark Authorized person: Claus Jørgensen		Signature: Kevin Dumas 2023-02-28 	

21. Glossary

A

Action parameter

The parameters in an action that you can customize to your site.

Action variable

A variable is a flexible value that can be set each time you run a mission or nest the mission in another mission. Use variables when you want to reuse the same mission for similar robot tasks.

Auto charging

Auto charging enables MiR Fleet to send robots to charging stations autonomously when their battery percentage is low.

Auto staging

Auto staging enables MiR Fleet to send idle robots to staging positions automatically.

Autonomous mode

Mode in which the robot drives autonomously based on the missions you assign to it.

C

Charging group

Charging groups are used to organize your charging stations into groups. You can link a robot to a charging station group so it only recharges at the charging stations in that group.

Collision avoidance

Collision avoidance enables MiR Fleet to share the positions and footprints of all connected robots. This information is used to avoid collisions between robots connected to the fleet.

Commissioner

Commissioners have thorough knowledge of all aspects of commissioning, safety, use, and maintenance of MiR600 and have the following main tasks: commissioning the product, including creating maps and restricting the user interface for other users; making the risk

assessment; determining the payload limit, weight distribution, and safe methods of fastening of loads to MiR600; and ensuring the safety of nearby personnel when a MiR robot is accelerating, braking, and maneuvering.

D

Dashboard

A dashboard is a visual display of the robot's data and enables certain functions that can be adjusted to fit certain users.

Direct user

Direct users are familiar with the safety precautions in the User Guide and have the following main tasks: assigning missions to MiR600, fastening loads to MiR600 securely, and loading and unloading from a paused robot.

Dynamic obstacle

Dynamic obstacles are obstacles that are moved around, such as pallets, crates, and carts. These should not be included when creating a map.

E

Emergency stop

Emergency stop is a state the robot enters when an Emergency stop button has physically been pressed. When the robot is in Emergency stop, the status light of the robot turns red, and you are not able to move the robot or send it on missions until you bring the robot out of Emergency stop. To do this, you must release the Emergency stop button and then press the Resume button.

F

Footprint

A footprint set in the robot interface defines the size of the robot and its top module or load. It consists of a horizontal shape around the robot that should be slightly bigger than the robot itself to ensure that there is enough space along the calculated path, and a maximum height that ensures the robot does not try to drive under low obstacles. The horizontal shape is defined as coordinates relative to the robot's center.

G**Global path**

The global path is the route the robot calculates that leads it to its goal position.

I**Identification label**

The identification label is the label that is mounted to the product in production. The label is used to identify the components in your MiR application. It identifies the product model, the hardware version, and the product serial number.

L**Light indicators**

The light indicators consist of status lights and signal lights. The status lights are used to indicate the robot's current status, and the signal lights are used to indicate the robot's driving intentions.

Local path

The local path is the route the robot creates within its immediate vicinity that guides it around obstacles while still following the global path.

Localization

The method used by the robot to determine its position on the map relative to where it is in the work environment.

M**Manual mode**

The mode in which you can drive the robot manually using the joystick in the robot interface.

Map

A map is a representation of the operating area of the robot. A basic map contains walls and floor that indicate where the robot can drive. You can add various map elements to determine how you want the robot to drive.

Mapping

Mapping is the process of manually driving the robot around to create a new map. The robot uses its sensors to detect walls and obstacles and generates a map of the area based on this input.

Marker

A marker of a physical entity that the robot can dock to. This enables the robot to position itself accurately relative to the marker.

Marker type

A marker type is a description of a shelf that MiR robots can dock to. You must have a marker type for each type and size of shelf you want your robot to be able to transport.

Markers

A marker is a physical element that the robot can detect with its laser scanners to use to dock to a certain position precisely. This can for example be V, VL, L, or Bar-markers.

MiR application

A MiR application is either a single MiR product or a combination of MiR products that is able to execute certain tasks. A MiR application is often a MiR base robot combined with a MiR top module. If a custom top module is used, the CE mark on the nameplate of the base robot does not extend to the top module.

MiR Fleet License

The product license you received with MiR600. This license is used to activate your MiR Fleet. A license can only be used to activate one MiR Fleet.

MiR robot interface

The MiR robot interface is the web-based interface that enables you to control your MiR robot. It is accessed by connecting to the same network as the robot and entering the robot's IP address in a browser.

MiR Fleet interface

The MiR Fleet interface is the web-based interface that enables you to communicate with your MiR Fleet.

Mission

A mission is a user-defined series of actions the robot can be set to perform on demand. A mission can be a simple transportation task between defined positions or a more complex job that includes both moving between positions and performing actions, such as unloading a pallet, moving to a charging station when the battery is low, or sending an email on arrival at a position.

Mission group

Mission groups are used to organize your missions into various groups. You can link a mission group to a robot group so only a certain group of robots can execute a certain group of missions.

Model robot

The model robot contains all the site data you need to run the intended fleet operations. It is important that all missions are tested on the model robot before adding it to MiR Fleet.

N**Noise**

With MiR robots, noise in maps refers to recorded data that originates from interfering elements. This can be physical obstacles that make the robot record walls where there are none or more subtle interferences that can make recorded walls appear pixelated.

O**Operator**

Operators have thorough knowledge of MiR600 and of the safety precautions presented in the User guide of MiR600. Operators have the following main tasks: servicing and maintaining the robot, and creating and changing missions and map positions in the robot interface.

P**Payload**

The payload is the weight the robot carries. The maximum payload is the maximum weight the robot can carry, including the weight of any top modules, shelves, carts, or other devices.

Position

A position is a set of X-Y coordinates on the map that you can send the robot to.

Protective fields

The Protective fields are a part of the Personnel detection safety function. They are contours surrounding the robot that change size depending on the speed of the robot. When a safety laser scanner detects a person or object within the active field, the robot enters Protective stop until the field is clear.

R**REST API**

REST API is used by MiR Fleet and MiR robots to communicate status data and orders.

Robot group

Robot groups are used to organize your robots into various groups. You can link a mission group to a robot group so only a certain group of robots can execute a certain group of missions.

S**Scheduler**

The scheduler enables you to order when and which missions should be executed by a robot connected to the fleet.

Site

A site is the overall container of any number of maps and all data relevant to the map, such as missions, features, robot groups, and transitions.

Static landmark

Static landmarks are obstacles that cannot be moved, such as walls, columns, and fixed structures. These must be included on the map and are used by the robot to localize itself.

Synchronize

MiR Fleet and all connected robots constantly communicate any site changes to keep all of the site data synchronized.

W**WISE modules**

WISE modules are wireless IoT devices that enable MiR robots to communicate I/O data to other devices.

X**X-Y coordinates**

The robot's map is based on a Cartesian coordinate system. Every point on the map can be defined as an X-Y coordinate.