

User Guide (en)

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MiR 250

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1. About this document

This user guide explains how to set up and start operating your MiR250 and provides examples of simple missions you can expand to your purposes. This guide also contains information regarding the external and internal components of MiR250 along with a guide for proper maintenance of the robot. You will also find information regarding safety and specifications needed to commission a safe MiR250 robot application.



NOTICE

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

1.1 Where to find more information

At [the MiR website](#), you can find the following resources under the **Manuals** tab on each product page:

- **Quick starts** describe how you start operating MiR robots quickly. This document is 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 robots. User guides are available in multiple languages.
- **Risk Analysis Guides** include guidelines on how to create a risk assessment of your robot solution.
- **Commissioning guides** describe how to commission your robot safely and prepare it to operate in the workplace.
- **Operating guides** describe how to set up and use top modules and accessories, such as charging stations, hooks, shelf lifts, and pallet lifts.
- **Getting started guides** describe how to set up products that are mainly software-based, such as MiR Fleet.
- **Reference guides** contain descriptions of all the elements of the robot interface and MiR Fleet interface. Reference guides are available in multiple languages.
- **REST API references** for MiR robots, MiR hooks, and MiR Fleet.
- The **MiR network and WiFi guide** specifies the performance requirements of your network and how you must configure it for MiR robots and MiR Fleet to operate successfully.

1.2 Version history

This table shows current and previous versions of this document.

Revision	Release date	Description	HW
1.0	2020-06-26	First edition	1.0
1.1	2020-07-01	Minor corrections throughout manual.	1.0
1.2	2020-07-08	Minor correction throughout manual. Changes in Operating hazard zones on page 135 .	1.0

2. Product presentation

MiR250 is an autonomous mobile robot that can transport loads up to 250 kg indoors within production facilities, warehouses, and other industrial locations where access to the public is restricted.



Users operate MiR250 via a web-based user interface, which is accessed via a browser on a PC, smartphone, or tablet. Each robot has its own network—see [Connecting to the robot interface on page 47](#). The robot can be set up to run a fixed route, be called on demand, or perform more complex missions.

The robot interface of MiR250 can be accessed via Google Chrome, Apple Safari, Mozilla Firefox, and Microsoft Edge browsers.

The robot uses a map of its work area to navigate and can move to any position on the map—see [Navigation and control system on page 66](#). The map can be created or imported the first time the robot is used. While operating, the robot avoids obstacles, like people and furniture, that are not mapped.

MiR250 is supplied with a fast swap removable lithium-ion battery.

MiR250 is available both in an ESD approved version, which is black, and a non-ESD approved version, which is gray.



Specifications for MiR250 are available on the [MiR website](#).

2.1 Main features of MiR250

The main features of the MiR250 are:

- **Driving in a populated workspace**
The robot is designed to operate among people and maneuvers safely and efficiently in even highly dynamic environments.
- **Overall route planning and local adjustments**
The robot navigates autonomously to find the most efficient paths to its destinations. The robot adjusts the path when it encounters obstacles that are not on the map, like personnel and vehicles.
- **Efficient transportation of heavy loads**
The robot is designed to automate transportation of loads up to 250 kg.
- **Sound and light signals**
The robot continuously signals with light and sounds indicating where it will drive and its current status, for example waiting for a mission, driving to a destination, or destination reached.
- **User-friendly and flexible**
The web-based user interface, accessed from a PC, tablet, or smartphone, gives easy access to operation and monitoring of the robot and can be programmed without any prior experience. Different user group levels and tailored dashboards can be set up to suit different users.
- **Alert for 'lost'**
If the robot enters a situation where it is unable to find a path to its destination, it stops, turns on the yellow-purple running error light, and a custom defined **Try/Catch** action may be used to alert personnel or take other actions—see [Creating the Try/Catch mission on page 155](#).
- **Automatic deceleration for objects**
The built-in sensors ensure that the robot is slowed down when obstacles are detected in front of it.

- **Internal map**

The robot can either use a floor plan from a CAD drawing, or a map can be created by manually driving the robot around the entire site in which the robot is going to operate. When the robot is mapping, the robot's sensors detect walls, doors, furniture, and other obstacles, and the robot then creates a map based on these input. After you've finished mapping, you can add positions and other features in the map editor.

2.2 Top modules

The following top modules are available for MiR250:

- **MiR 250 Shelf Carrier**

A top application that allows MiR250 to tow shelves.



To read more about the top modules, go to [the MiR website](#).

2.3 External parts

This section presents the parts of MiR250 that are visible on the outside.



Pos.	Description	Pos.	Description
1	Corner bumper: four pcs, one on each corner	2	Front cover: opens to front compartment—see Internal parts on page 20
3	Swivel wheel with foot guard: four pcs, one in each corner	4	3D depth camera: two pcs, both in the front—see Obstacle detection on page 71

Pos.	Description	Pos.	Description
5	Nanoscan3 safety laser scanner: two pcs, in opposite corners—see Obstacle detection on page 71	6	Status light: on all four sides of the robot—see Light indicators and speakers on page 97
7	Side cover: opens to side compartment—see Internal parts on page 20	8	Control panel—see Control panel on page 16
9	Manual brake release switch—see Control panel on page 16	10	Rear cover: opens to rear compartment—see Internal parts on page 20
11	Signal light: eight pcs, two on each corner—see Light indicators and speakers on page 97	12	Proximity sensor: eight pcs, two in each corner behind corner covers—see Obstacle detection on page 71
13	Top plate	14	Left top compartment: Access to auxiliary power, emergency stop, and Ethernet interfaces. Antenna RP-SMA connector is available on the top side of the hatch—see Internal parts on page 20
15	Right top compartment: Access to Safe I/Os and GPIO interface. Antenna RP-SMA connector is available on the top side of the hatch—see Internal parts on page 20		

Identification label

MiR250 is delivered with an identification label mounted to the product. The identification label identifies the product, the product serial number, and the hardware version of the product.

The identification label of MiR250 is located behind the rear cover next to the battery.

Item number:	800253
Product serial number:	202303000
Hardware version:	V.1

Figure 2.1. Example of a MiR250 identification label.

Nameplate

Every MiR application is delivered with a nameplate that must be mounted to the robot. The nameplate of MiR250 identifies the application model and serial number and includes the CE mark, the technical specifications, and the address of Mobile Industrial Robots. The nameplate identifies the complete MiR application, for example, a robot with a top module.

It is the responsibility of the commissioner to place the nameplate on the application—see [Mounting the nameplate on page 53](#).

Mass unloaded :	83 kg	Nominal power :	2x637 W	Contains FCC ID: TV7RB952-5AC2ND
Rated speed :	2.0 m/s	Type :	Driverless truck	Contains FCC ID: RYK-261ACNBT
Max slope :	5 %	Model :	MiR250	
Rated capacity :	250 kg	S/N :	100000001	This device complies with part 15 of the
		Year of construction :	2020	FCC Rules. Operation is subject to the
Max payload footprint :	800x580 mm			following two conditions:
Lithium ion battery		Mobile Industrial Robots ApS		(1) This device may not cause harmful inter-
Nominal voltage :	48 V	Emil Neckelmannsvej 15F		ference, and (2) this device must accept any
Rated capacity :	34 Ah	5220 Odense SØ		interference received, including interferen-
Mass :	14 kg			ce that may cause undesired operation.
Dimension :	491x211x77 mm			
				CE

Figure 2.2. Example of a MiR250 nameplate.

Control panel

MiR250 has a control panel in the rear-left corner of the robot.

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**
Locks the robot. 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 modes on page 19](#).

The control panel buttons

The following table identifies the three buttons on the control panel.



Pos.	Description	Pos.	Description
1	Manual stop	2	Resume
3	Power		

Manual stop

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

Pressing this button:

- Clears the Emergency 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 (clear the Emergency stop state, acknowledge the change of operating mode).

Power

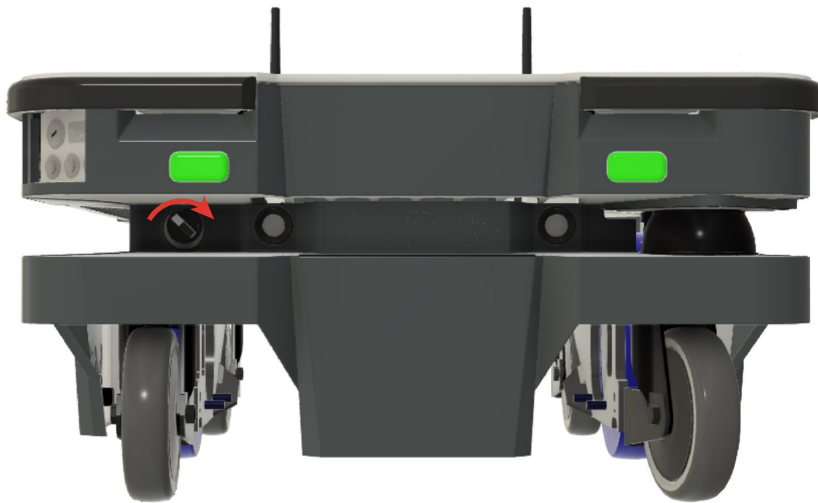
Pressing this button for three seconds turns the robot on or shuts it off.

Color indication:

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

Manual brake release switch

The manual brake release switch is located below the control panel and releases the mechanical brakes on MiR250. You release the brakes by turning the Manual brake release switch clockwise.



The mechanical brakes require electrical power to be released, so if the robot is without power, the mechanical brakes cannot be released.

When driving in Autonomous mode, the robot engages and releases the mechanical brakes automatically.



The robot cannot operate while the mechanical brakes are released.

Operating modes

MiR250 has two operating modes: Manual mode and Autonomous 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. To ensure that nobody else takes control of the robot, the robot issues a token to the device on which you activate the Manual mode.

For information about activating this mode—see [Driving the robot in Manual mode on page 49](#).

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.

2.4 Internal parts

Most internal parts of MiR250 are accessed through covers that open to different compartments:

- Front compartment
- Rear compartment
- Side compartments
- Top compartments



CAUTION

Removing covers from the robot exposes parts connected to the power supply, risking damage to the robot from a short circuit and electrical shock to personnel.

- Disconnect the battery by unlocking the Battery lever and pressing the lever down—see [Packing the robot for transportation on page 182](#).

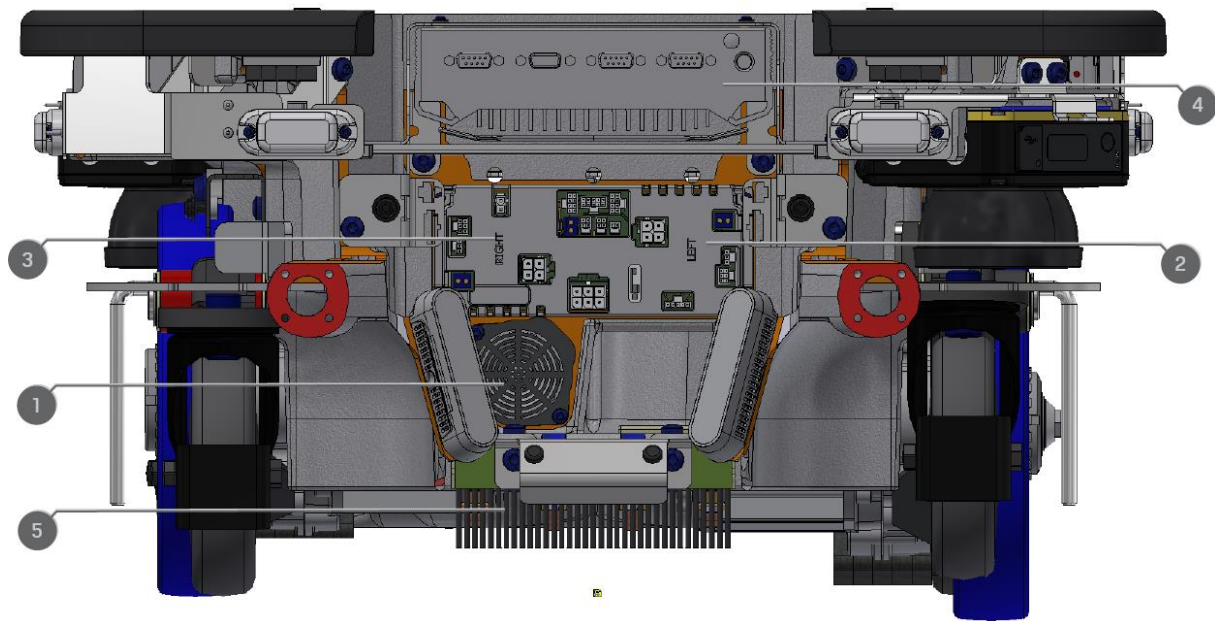
Front compartment

The front compartment holds several electronic components, such as the robot computer and the carrier board.

To open the front compartment, see [Accessing the internal parts on page 26](#).

Front compartment components

The front compartment contains the following components:



Pos.	Description	Pos.	Description
1	Loudspeaker	2	Carrier board with motor controller controlling the left-side drivetrain
3	Carrier board with motor controller controlling the right-side drivetrain	4	Robot computer
5	Charging pads under robot and broom for keeping dirt away from the charging pads		

Rear compartment

The rear compartment holds the robot's battery, Battery disconnect lever, power board, and safety PLC. The battery and Battery disconnect lever can be accessed without the use of tools. The other components in the rear compartment are only accessible via use of tools.

To open the rear compartment, see [Accessing the internal parts on page 26](#):

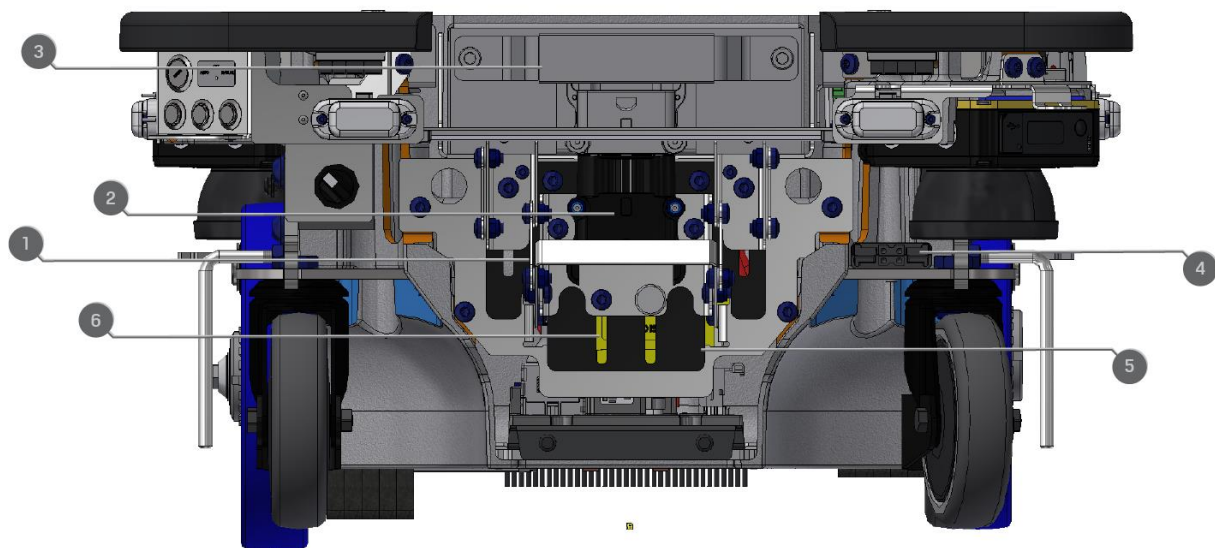


NOTICE

The unique nameplate of your robot is to be placed on the rear compartment cover—see [Mounting the nameplate on page 53](#). Make sure you do not swap the cover with covers from other robots.

Rear compartment components

The rear compartment contains the following main components:



Pos.	Description	Pos.	Description
1	Battery disconnect lever	2	Battery connector
3	Battery	4	Cable charging interface
5	Power board for motor controller, robot computer, and safety PLC	6	Safety PLC

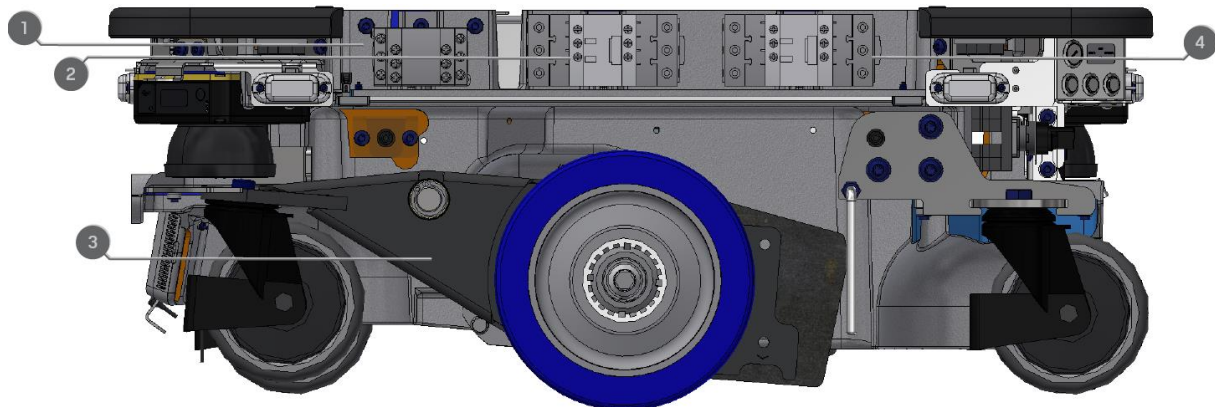
Side compartments

The side compartments contain the bogies and drive wheels.

To access a side compartment, see [Accessing the internal parts on page 26](#).

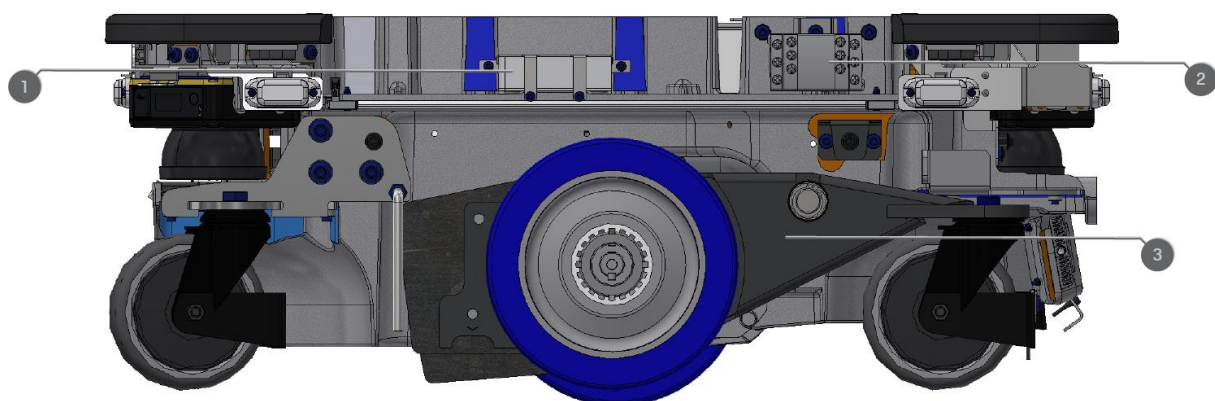
Side compartment components

The left side compartment contains the following components:



Pos.	Description	Pos.	Description
1	Safe Stop 1 contactor	2	Safe Torque Off (STO) contactor
3	Bogie and drivetrain consisting of motor, gearbox, encoder, brake, drive wheel, and assembly parts	4	Safe Torque Off (STO) contactor

The right side compartment contains the following components:



Pos.	Description	Pos.	Description
1	Router	2	Safe Stop 1 contactor
3	Bogie and drivetrain consisting of motor, gearbox, encoder, brake, drive wheel, and assembly parts		

Top compartments

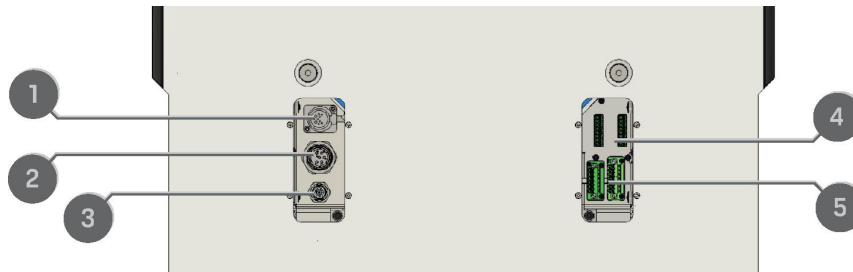
The two top compartments contain electrical interfaces that can be connected to top modules.

To open a top compartment, see [Accessing the internal parts on page 26](#).



Top compartment components

The top compartments contain the following electrical interfaces for top modules. For detailed information on electrical interfaces, see [Interface specifications on page 192](#).



Pos.	Description	Pos.	Description
1	Emergency stop	2	Auxiliary power connector
3	Ethernet	4	General purpose I/Os
5	Auxiliary safety functions I/Os		

3. Accessing the internal parts

Most internal parts of MiR250 are accessed through covers that open to different compartments:

- Front compartment
- Rear compartment
- Side compartments
- Top compartments



CAUTION

Removing covers from the robot exposes parts connected to the power supply, risking damage to the robot from a short circuit and electrical shock to personnel.

- Disconnect the battery by unlocking the Battery lever and pressing the lever down—see [Packing the robot for transportation on page 182](#).

3.1 Front compartment

Follow these steps to open the front compartment:

1. Unscrew the two screws holding the front cover with a T30 Torx screwdriver.



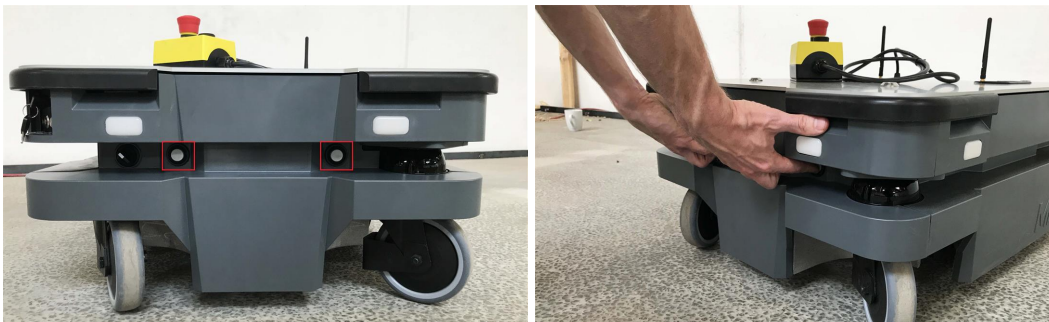
2. Pull the front cover off of the robot.



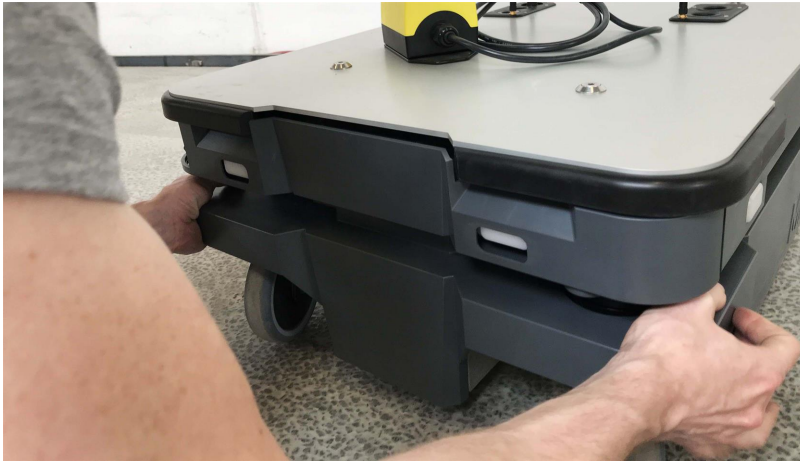
3.2 Rear compartment

Follow these steps to open the rear compartment:

1. Push the two white buttons at the same time.



2. Loosen the cover by wiggling both sides.



3. Pull off the cover.



3.3 Side compartments

Follow these steps to open a side cover:

1. Turn the two screws counterclockwise with a T30 Torx screwdriver.



2. Pull the cover off.



3.4 Top compartments

To open a top compartment, unscrew the four screws with a T8 Torx screwdriver, and lift off the black plastic top cover.



NOTICE

With the antenna cables mounted, the plastic top covers can be lifted 50 mm. If you need to remove a cover completely, the antenna cable needs to be detached from the cover first. When reattaching the covers, make sure that the antenna cables are not damaged.



Figure 3.1. The top compartments of MiR250.

4. Safety

Read the information in this section before powering up and operating MiR250.

Pay particular attention to the safety instructions and warnings.



NOTICE

Mobile Industrial Robots disclaims any and all liability if MiR250 or its accessories are damaged, changed, or modified in any way. Mobile Industrial Robots cannot be held responsible for any damages caused to MiR250, accessories, or any other equipment due to programming errors or malfunctioning of MiR250.

4.1 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.

4.2 General safety precautions

This section contains general safety precautions.



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 the original charger.



WARNING

MiR250 may drive over the feet of personnel, causing injury.

- All personnel must be informed of the side protective fields of MiR250 and be instructed to wear safety shoes near an operating robot.



WARNING

Contact with live electrical parts can cause electric shock.

- Do not touch any internal components of MiR250 while it is powered.



WARNING

MiR250 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.

- Don't 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 descending staircases and holes as forbidden zones on maps.
- 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

Lithium 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 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.
- Use only the original charger (cable charger or charging station) and always follow the instructions from the battery manufacturer.
- 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 colors.
 - The battery case is deformed or otherwise differs from the normal electrical or mechanical condition.
- Modifications or manipulations of the battery may lead to considerable safety risks and are therefore prohibited.
- Do not use the battery on anything other than MiR250.



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.

4.3 Intended use

MiR250 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 MiR250 should operate, see specifications for MiR250 on the MiR website.

MiR250 is intended to be commissioned according to the guidelines in [Commissioning on page 101](#). This is a prerequisite for safe usage of MiR250.

MiR250 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.

MiR250 is intended to be used with top modules supported by MiR or custom modules that:

- Do not have any moving parts.
- Do not extend the footprint of the robot.
- Operate within the environmental conditions required for MiR250.
- Are within the requirements in [Payload specifications on page 185](#).

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

MiR250 is designed for and all risks are considered when used with one of the following types of top modules:

- MiR Shelf Carrier 250 to transport wheeled carts.

MiR250 can be used as a partly complete machine 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 MiR250 carry the obligations of a manufacturer and shall ensure a safe design according to EN ISO 12100. Guidelines outlined in this manual are not sufficient. The following list gives examples of applications which are not intended use of MiR250:

The following list gives examples of modules that are not intended use of MiR250:

- Top modules (including total payload) that increase the footprint of MiR250
- Conveyers (powered and non-powered)
- Industrial robot arm
- Devices that tow carts
- Customized load transfer station



NOTICE

A safe machine does not guarantee a safe system. Follow the guidelines in [Commissioning on page 101](#) to ensure a safe system.

4.4 Users

MiR250 is only intended to be used by personnel that have received training in their required tasks.

There are three types of intended users for MiR250: commissioners, operators, and direct users.

Commissioners

Commissioners have thorough knowledge of all aspects of commissioning, safety, use, and maintenance of MiR250 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 MiR250, and ergonomic loading and unloading methods if relevant.
- Ensuring the safety of nearby personnel when the robot is accelerating, braking, and maneuvering.
- Marking operating hazard zones.

Operators

Operators have thorough knowledge of MiR250 and of the safety precautions presented in this User guide. Operators have the following main tasks:

- Servicing and maintaining MiR250.
- Creating and changing missions and map features in the robot interface.

Direct users

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

- Assigning missions to MiR250.
- Fastening loads to MiR250 securely.
- Loading and unloading from a paused robot.

All other persons in the vicinity of MiR250 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.

4.5 Foreseeable misuse

Any use of MiR250 deviating from the intended use is deemed as misuse. This includes, but is not limited to:

- Using MiR250 to transport people
- Using MiR250 on steep surface grades, such as ramps
- Using the wrong SICK configuration
- Driving MiR250 on cross slopes
- Exceeding the total payload
- Using the Emergency stop button for anything other than emergency stops

- Positioning or fastening loads incorrectly according to the specifications
- Using MiR250 in medical and life critical applications
- Operating MiR250 outside the permissible operating parameters and environmental specifications
- Using MiR250 in potentially explosive environments
- Using MiR250 outdoors
- Using MiR250 in hygiene zones

4.6 Warning label

MiR250 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.



4.7 Residual risks

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

- You risk being run over, drawn in, trapped, or struck if you stand in the path of MiR250 or walk towards MiR250 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. It will only drive 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 MiR250 while it is in motion.
- You risk being crushed, run over, drawn in, or trapped if the robot places a load outside a designated drop-off area due to faulty localization.
- You risk losing control of MiR250 if it is accessed by unauthorized users. Consider increasing the IT security of your product—see [IT security on page 64](#).



NOTICE

Other significant hazards may be present in a specific robot installation and must be identified during commissioning.

5. Getting started

This section describes how to get started with MiR250. To be able to use MiR250, your robot must be running software version 2.9.0 or higher.



NOTICE

Read [Safety on page 31](#) before powering up MiR250.

5.1 In the box

This section describes the contents of the MiR250 box.



The box contains:

- The MiR250 robot
- A MiR250 document folder containing a USB flash drive and the following printed documents:
 - *MiR250 Quick Start*
 - *CE declaration of Conformity*
 - *Getting the robot online*
 - *Passwords*
 - The unique nameplate for your application
- The USB flash drive in the document folder has the following content:
 - This user guide
 - *MiR250 Quick Start*
 - *MiR Network and WiFi guide*
 - *MiR Robot Reference guide*
 - *MiR Robot REST API Reference*
 - *Getting the robot online*
 - *CE declaration of Conformity*

5.2 Unpacking MiR250

This section describes how to unpack MiR250.



Keep the original packaging for future transportation of the robot.



The robot is shown with a MiR Shelf Carrier 250 top module.

1. Place the box with the robot so that there is 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. Cut the protective straps surrounding the box.

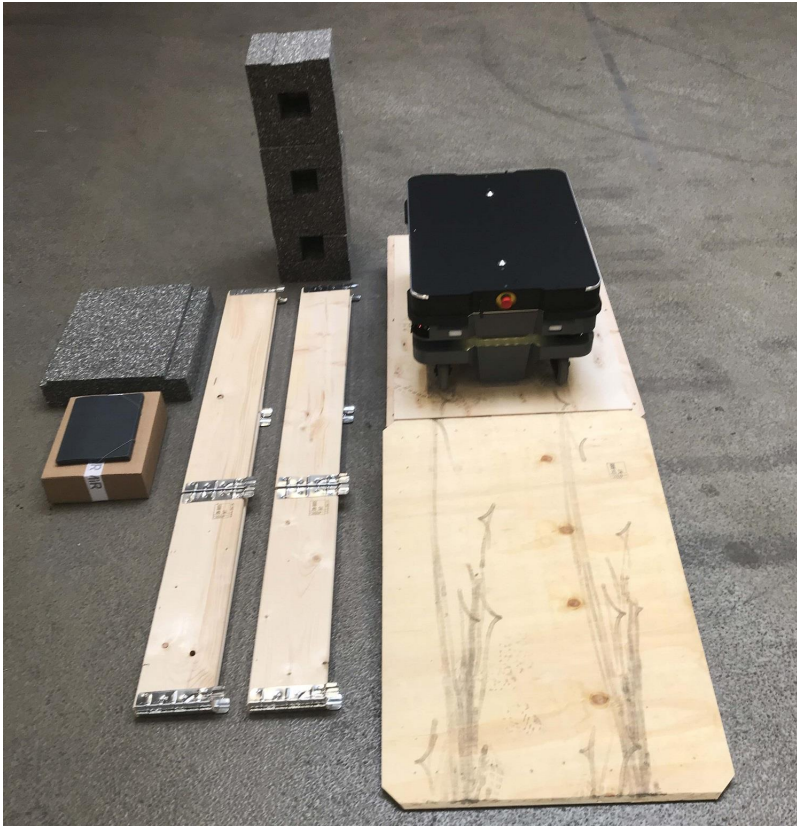


3. Remove the lid from the box.



4. Take the folder with the printed documents and the USB flash drive out of the box.

5. Remove the walls of the box and the protective foam blocks.



6. 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.



5.3 Connecting the battery and powering up

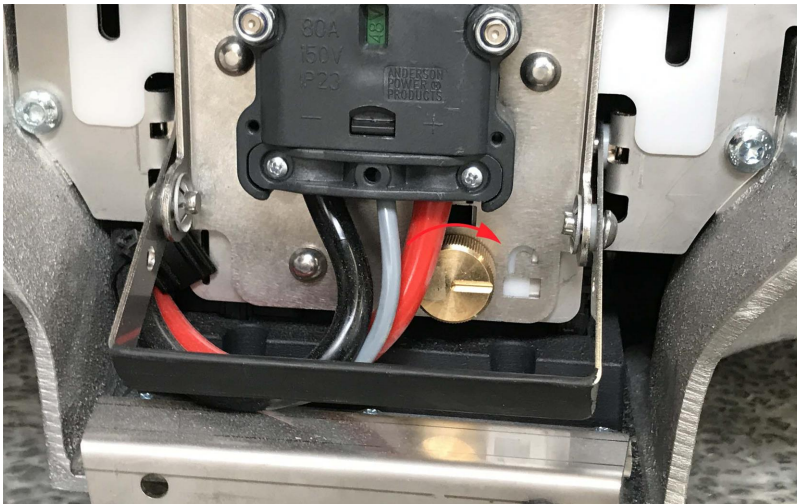
You must connect the battery before powering up the robot.

Connecting the battery

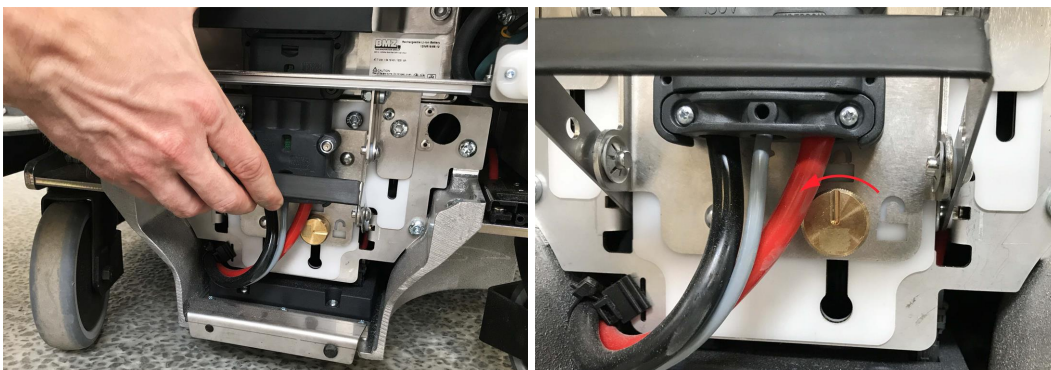
To connect the battery to the robot, you need to open the rear compartment—see [Accessing the internal parts on page 26](#).

Follow these steps to connect the battery to the robot:

1. Turn the battery lever lock clockwise to unlock the battery lever.



2. Pull up the lever to connect the battery connector to the battery. Then turn the battery lever lock counterclockwise to secure the battery lever.



3. Reattach the rear cover by inserting it into the two attachment sockets. When attaching the cover to the robot, press the two white buttons, and don't tilt the cover.



4. Click the cover in place.



Powering up

Follow these steps to power up the robot:

1. Press the Power button for three seconds to turn on the robot.



The status lights waver yellow, and the robot 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.



5.4 Connecting to the robot interface

When the robot is turned on, it enables the connection to its WiFi access point. The name of the access point appears in the list of available connections on your PC, tablet, or phone.



NOTICE

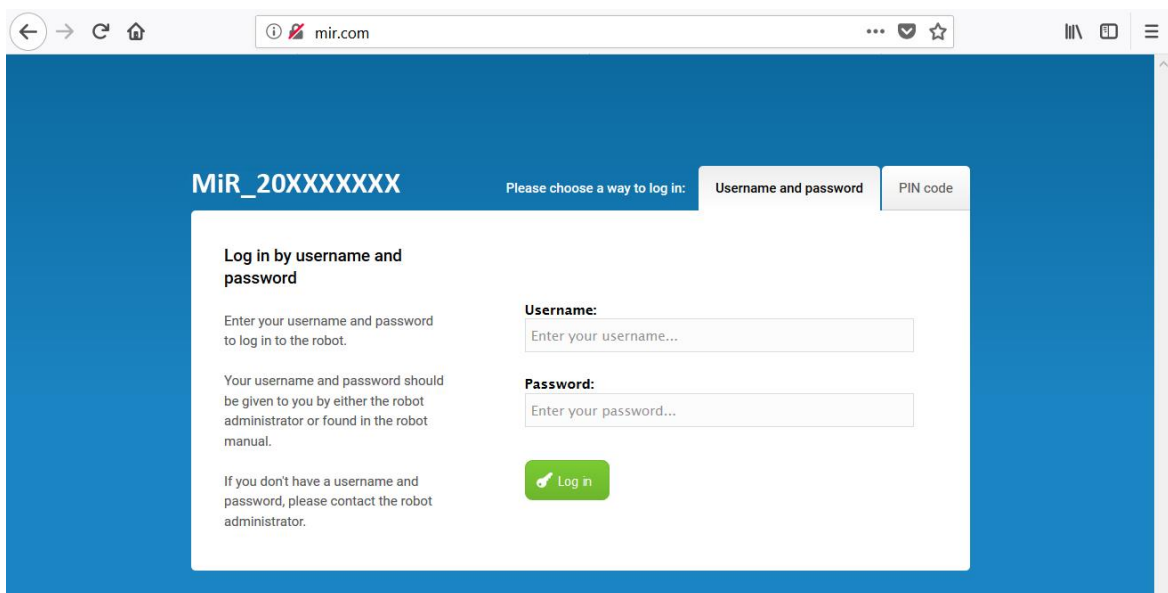
The username and password for the robot's WiFi access point and for accessing the web interface are in the Passwords document. The document is in the box with the robot.

Follow these steps to connect to the robot interface:

1. Using your pc, tablet, or phone, connect to the WiFi access point of the robot. The access point name has the following format: MiR20XXXXXXX



2. In a browser, go to the address mir.com and sign in.



3. Switch to Manual mode, and drive the robot down the ramp—see [Driving the robot in Manual mode on the next page](#).

5.5 Driving the robot in Manual mode



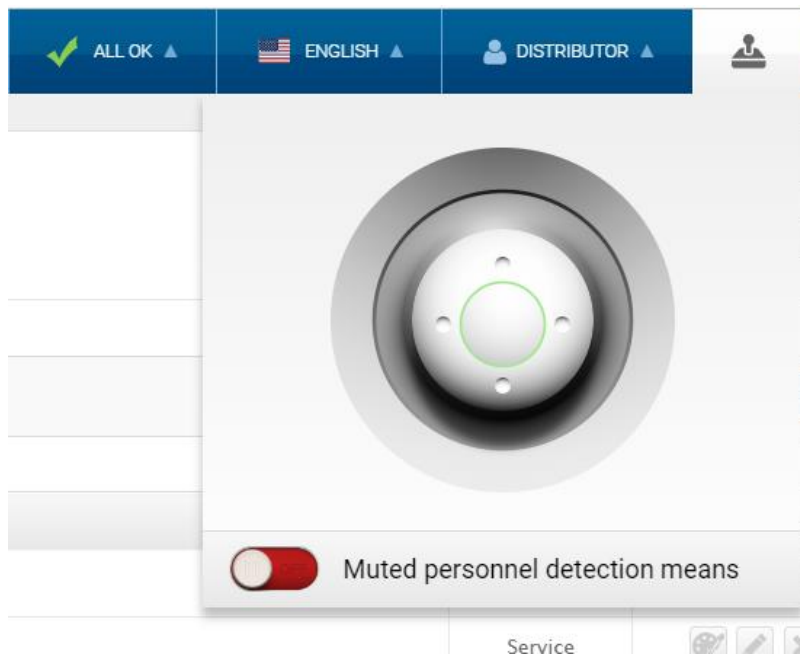
CAUTION

When driving the robot in manual mode, it is possible to mute the personnel detection means and drive the robot into Forbidden zones and Unpreferred zones in the map. This means that the robot will only stop when very close to an obstacle and will not respond to zones on the map. This can result in injury to personnel or damage to equipment if the robot is not driven carefully.

- 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.

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

1. On the robot, turn the Operating mode key into Manual mode (turn it to the right).
2. In the robot interface, select **Manual control**. The Resume button on the robot starts blinking.
3. In the robot interface, select the joystick icon. The joystick control appears.



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



5. Drive the robot off the ramp using the joystick.



Place your foot in front of the ramp while the robot drives on it to keep the ramp from slipping.



S



5.6 Moving the robot by hand

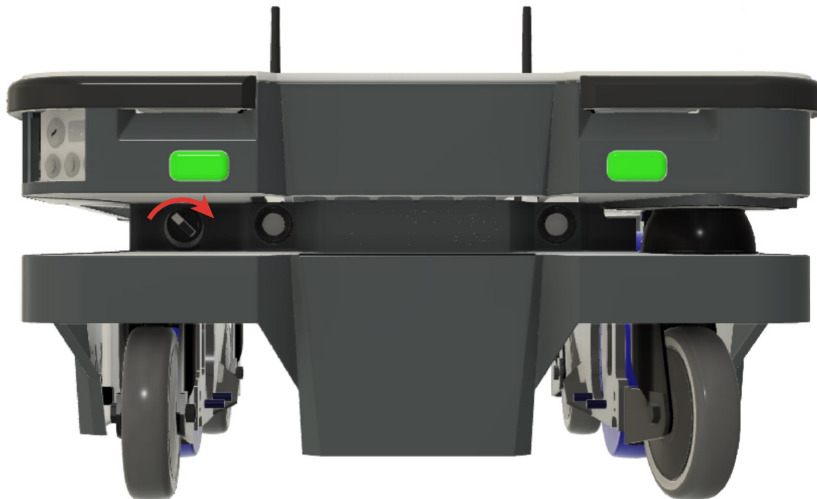
You should generally avoid moving the robot by hand, but if for example the robot gets stuck near an obstacle and cannot be moved by manual control, it is possible to do so.

Before moving the robot by hand, make sure the mechanical brakes are released.



To release the brakes, the robot must be turned on—see [Connecting the battery and powering up on page 44](#).

Release the brakes by turning the Manual brake release switch located below the control panel clockwise.



To move the robot by hand, either push or pull it.

When pushing the robot, only push on the top plate.



When pulling the robot, use either the front pull handle or the rear pull handle.



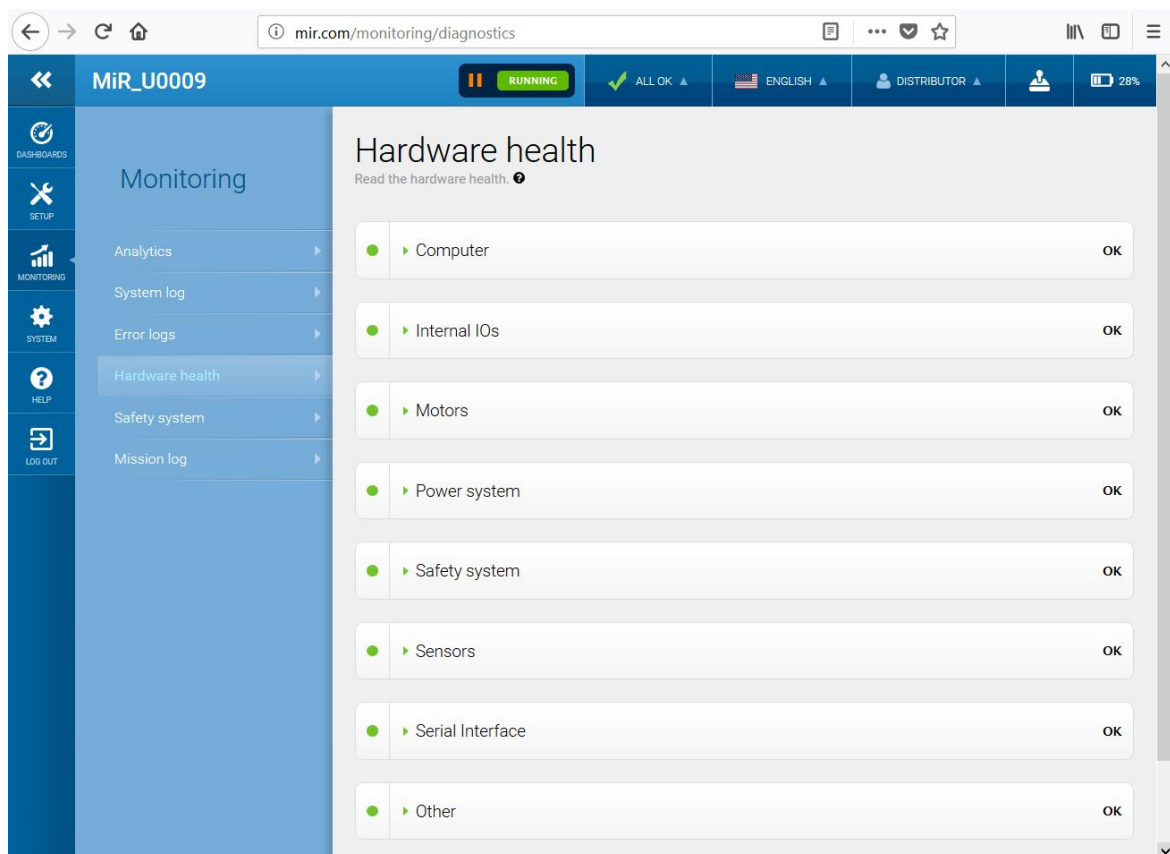
NOTICE

When handling the robot, do not push or pull the robot sideways, and do not use the covers for pushing or pulling. Only use the designated pull handles or the top plate.

5.7 Checking the hardware status

To check that all hardware components work as intended, follow these steps:

1. Sign in to the robot interface—see [Connecting to the robot interface on page 47](#).
2. Go to **Monitoring > Hardware health**.
3. Check that all elements on the page have the OK status and that they have green dots on the left.



For more information, see **Hardware health** in *MiR Robot Reference Guide* on the MiR website.

5.8 Mounting the nameplate

Before using MiR250, you must mount its unique nameplate to it. The nameplate contains information specific to your MiR application—see [Nameplate on page 15](#).



NOTICE

The nameplate must be mounted as described in the following steps. If mounted incorrectly, the CE mark is invalid.

The following steps describe how to mount the nameplate correctly:

1. Locate the rear cover—see [External parts on page 13](#).
2. Clean the area marked in the image below with a degreasing agent.



3. Mount the nameplate on the cleaned area.



5.9 Shutting down the robot

To shut down MiR250:

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



3. The robot starts the shutdown process. The status lights waver yellow, and the Power button blinks red.



4. When the robot finishes the shutdown process, the status and the signal lights go off, and the Power button turns blue.



When you shut down the robot for transportation, service, or repair, the battery must be disconnected—see [Enabling fast swap and swapping out the lithium-ion battery on page 58](#).

6. Battery and charging

The robot is powered by a fast swap lithium-ion battery that can be charged both inside and outside of the robot.

6.1 Charging the robot

This section describes how to charge MiR250 using a MiR cable charger.



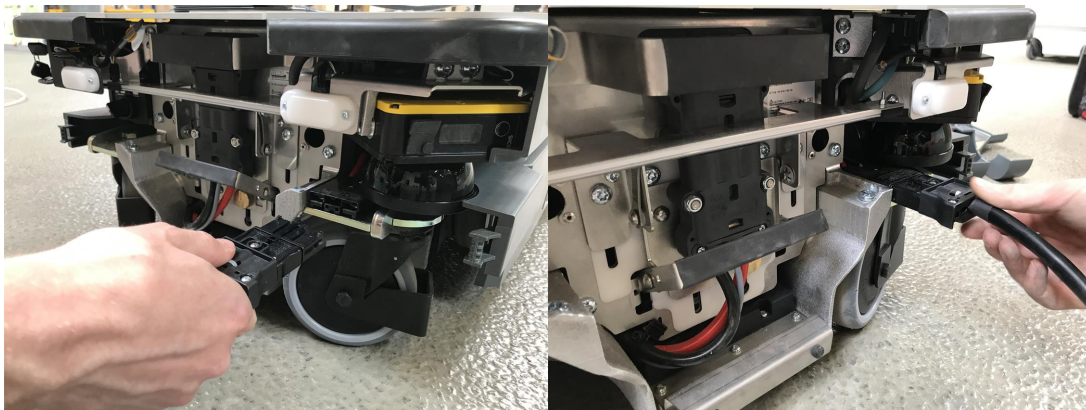
A MiR cable charger is not part of the MiR250 standard delivery. Contact your distributor for more information.



The robot is delivered fully charged.

The rear compartment holds the robot's battery. To access the rear compartment, see [Accessing the internal parts on page 26](#).

To charge MiR250 using the cable charger, connect the cable charger to the charging interface on the robot in the bottom-right corner.





If the robot has been inactive for more than a week or if its battery percentage has been below 5% for more than four hours, the battery goes into Power save mode, which disables the power to the robot.

To disable Power save mode, disconnect and connect the battery connector, or connect a MiR cable charger to the robot.

For information about the charging time, see specifications on the MiR website.

6.2 Enabling fast swap and swapping out the lithium-ion battery

MiR250 is supplied with a fast swap removable lithium-ion battery. The battery can be charged both inside and outside of the robot with a MiR cable charger.



The robot is delivered with one lithium-ion battery. Contact your distributor if you need more batteries.

The rear compartment holds the robot's battery. To access the rear compartment, see [Accessing the internal parts on page 26](#).

Enabling fast swap

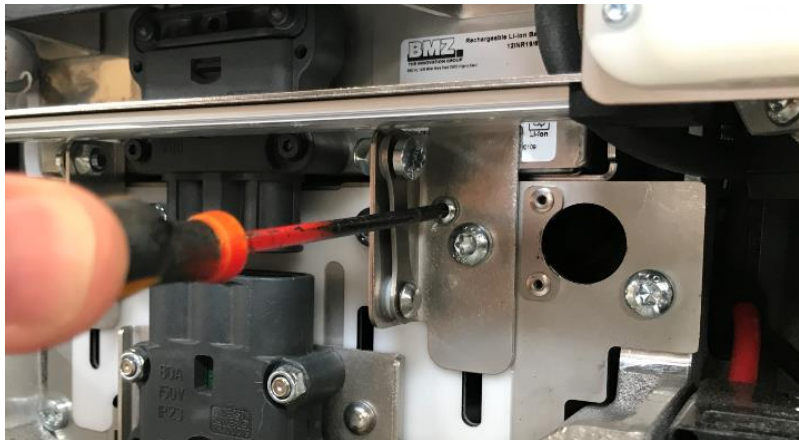
If you wish to enable the fast swap-option on the robot, you must first unscrew the plate holding these levers from the robot and then the levers themselves and fasten them to the levers controlling the connector. You only need to do this once.



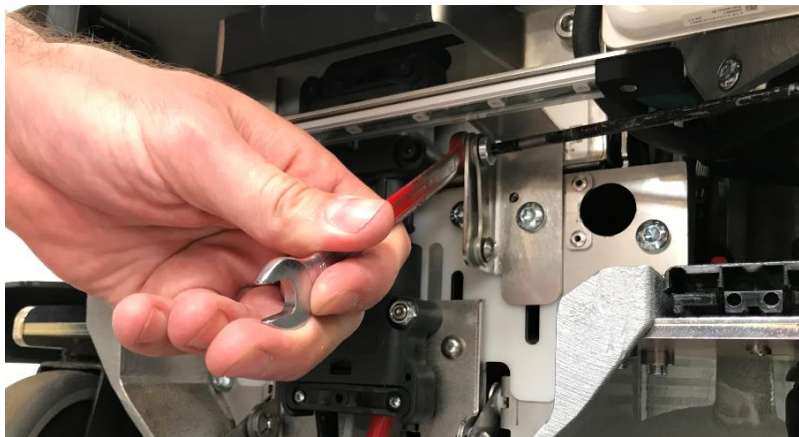
The levers holding the battery in place are fastened with screws from the factory to ensure that the battery stays disconnected during transportation.

Follow these steps to enable the fast swap-option on the robot:

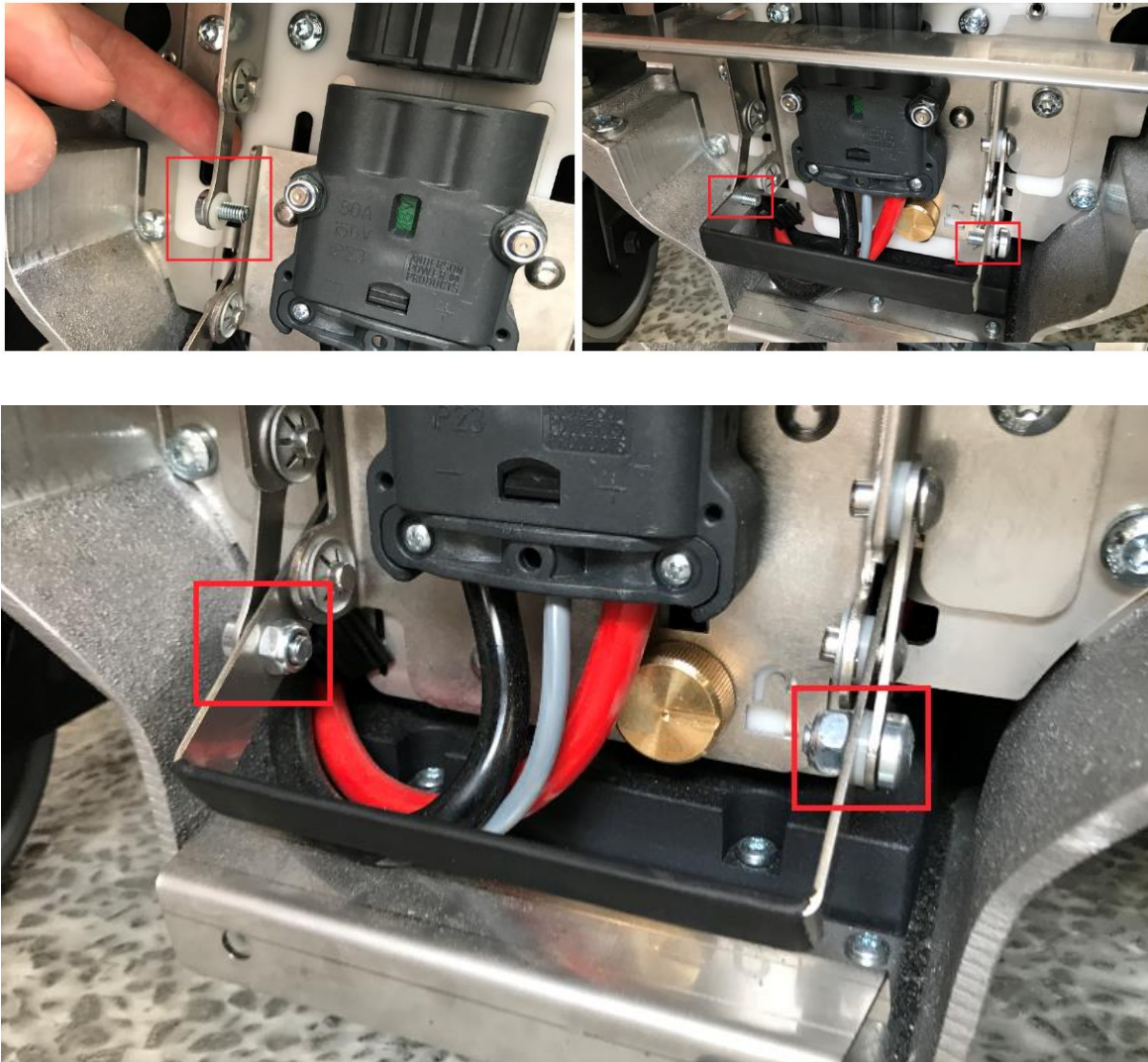
1. Unscrew this screw with a T20 Torx screwdriver.



2. Unscrew this screw with a 10 mm hex key.



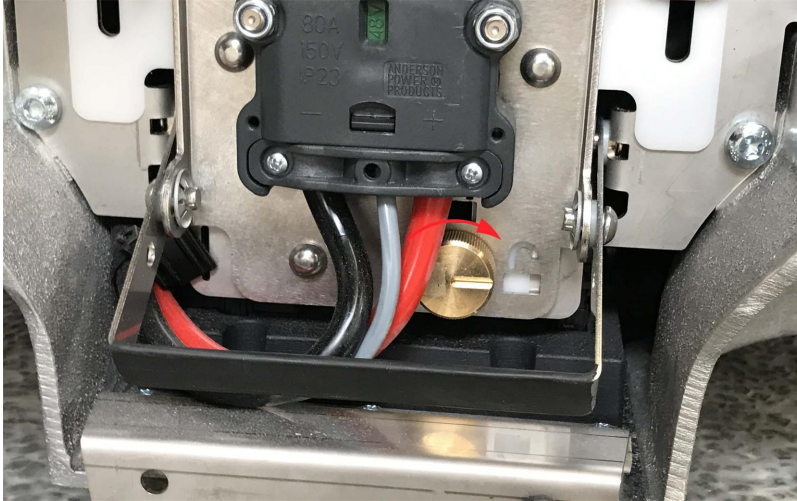
3. Fasten the two levers to the lever controlling the connector.



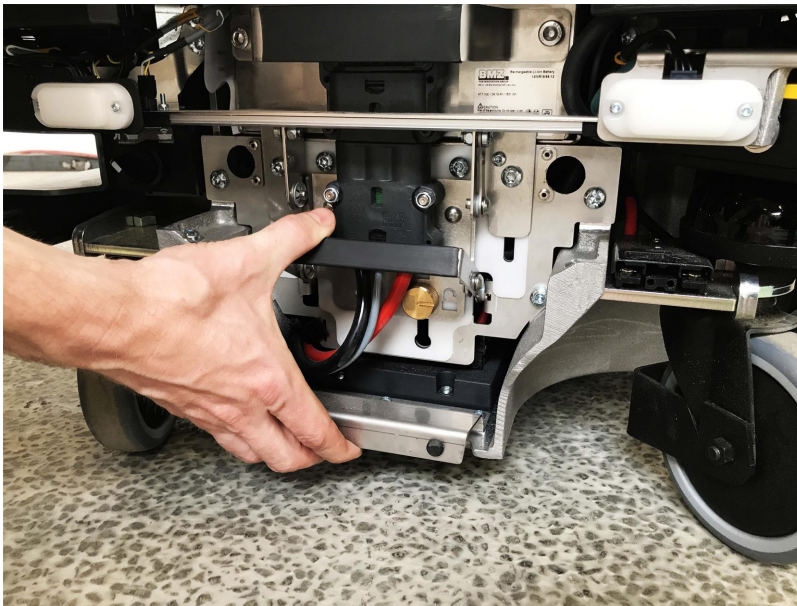
Swapping out the lithium-ion battery

Follow these steps to swap out the battery:

1. Turn the battery lever lock clockwise to unlock the battery lever.



2. Press down on the battery lever.



3. Pull out the battery.



You can now replace the battery.

4. Do the steps in reverse order when putting in the battery.

6.3 Battery storage

The battery should be stored in an area at room temperature with a non-condensing relative air humidity—see specifications on the MiR website. Temperatures and humidity below or above the specifications will shorten the service life of the battery.

The battery should not be exposed to nor submerged in any liquid as this may damage the battery.

Charge the battery before storage to preserve the service life of the battery. A 30% charged battery can be stored for seven months.

To preserve the battery, disconnect the battery from the robot before storing the robot.

6.4 Battery disposal

Return unserviceable batteries to relevant facilities in accordance with local statutory regulations.

A crossed-out wheeled bin indicates that the product needs to be disposed separately and not as municipal waste.

You are legally obliged to return used batteries and rechargeable batteries. Disposing used batteries in the household waste is prohibited. Batteries containing hazardous substances are marked with the crossed-out wheeled bin. The symbol indicates that it is forbidden to dispose the product via the domestic refuse. The chemical symbols for the respective hazardous substances are Cd= Cadmium, Hg = Mercury, Pb = Lead.



Figure 6.1. Battery disposal symbols.

7. IT security

IT security is a set of precautions you can take to prevent unauthorized personnel from accessing MiR250. This section describes the main IT-security related risks and how to minimize them when commissioning MiR250.

MiR250 communicates all data over the network that it is connected to. It is the responsibility of the commissioner to ensure that it is connected to a secure network. MiR recommends creating an IT-security risk assessment before commissioning the robot.

7.1 Managing users and passwords

Managing your users and passwords is the main way you can control access to MiR250.

There are three default users with predefined passwords for you to start using. These are described in the *MiR Robot Reference guide* along with instructions to create new users, user groups, and passwords. MiR advises you to:

- Change the default password for all predefined users if you choose to continue to use them. Make sure to choose a strong password since MiR250 does not enforce any password rules nor expire the password.
- Create new user groups if more levels of access are necessary.
- Create dedicated user accounts under the relevant user group for each person accessing MiR250, and ensure that the users change the password on their first sign-in. It is not recommended to have several users share the same account.
- Only enable users with a minimum level of access to use a pin code to sign in. Users with a higher level of access are recommended to use a strong password to sign in instead.

7.2 Software security patches

To improve the security of MiR250, MiR supplies security patches to the operating system in new MiR software update files. When you install a security patch, it takes approximately 10-15 minutes longer to update a MiR product.

Understanding MiR software versions

MiR uses the **Major.Minor.Patch.Hot fix** format to version software. For example, 2.8.1.1 means that the software is based on the second major release, the eighth minor release of the major version, the first patch release of the minor version, and in this example a single

hot fix is included too.

- **Major releases** include the most significant changes that affect the entire robot software.
- **Minor releases** often include new features and smaller changes that only affect parts of the software.
- **Patch releases** focus on fixing small issues in the software and introducing quality improvements.
- **Hot fix releases** are only created when a patch release has introduced a critical issue that needs to be fixed immediately.

Security patch policy

MiR applies the following policy when supplying security patches:

- New security patches are distributed per every minor release.
- All patch releases under a minor release include the security patches also. In other words, if you chose not to install the first software version in a minor release, such as version 2.9.0, the security patches will still be installed when you update to 2.9.1 or higher.
- Whenever there is a new minor release with new security patches, the security patches are also made available in a separate file. In this way, you are not required to update to the latest software to apply the security patches. You can use any lower software version and just install the security patches to that software instead.

8. Navigation and control system

The navigation and control system is responsible for driving the robot to a goal position while avoiding obstacles. This section describes the processes and components involved in the robot's navigation and control system.

8.1 System overview

The purpose of the navigation and control system is to guide the robot from one position on a map to another position. The user provides the map and chooses the goal position the robot must move to. The diagram in *Figure 8.1* describes the processes in the navigation and control system. The main processes involved in the navigation system are:

- **Global planner**
The navigation process starts with the global planner determining the best path for the robot to get from its current position to the goal position. It plans the route to avoid walls and structures on the map.
- **Local planner**
While the robot is driving along the path made by the global planner, the local planner continuously guides the robot around detected obstacles that are not included on the map.
- **Obstacle detection**
The safety laser scanners, 3D cameras, and proximity sensors are used to detect obstacles in the work environment. These are used to prevent the robot from colliding with obstacles.
- **Localization**
This process determines the robot's current position on the map based on input from the motor encoders, inertial measurement unit (IMU), and safety laser scanners.
- **Motor controller, motors, and brakes**
The motor controller determines how much power each motor must receive to drive the robot along the intended path safely. Once the robot reaches the goal position, the brakes are engaged to stop the robot.

Each part of the process is described in greater detail in the following sections.

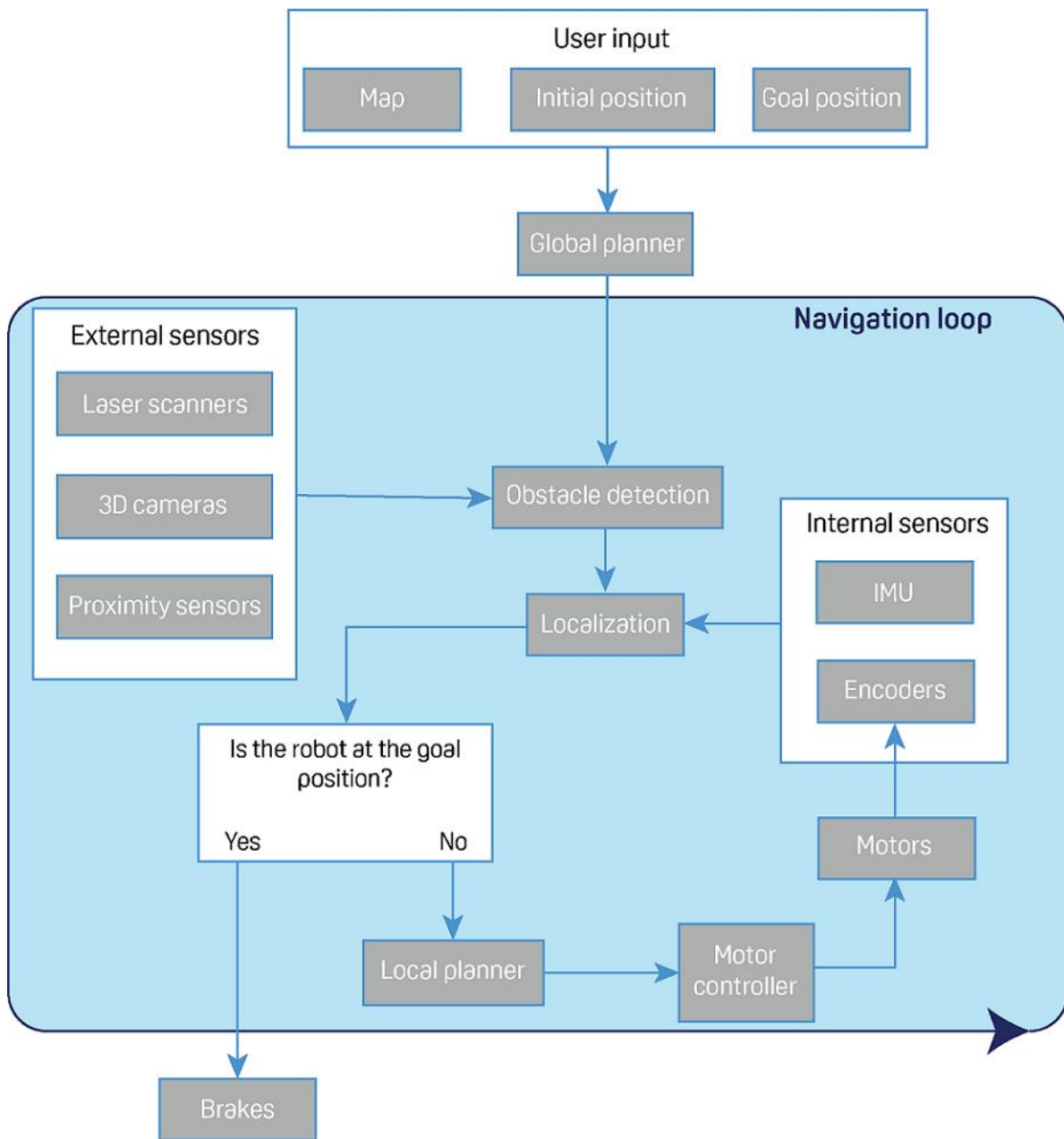


Figure 8.1. Flow chart of the navigation and robot system. The user provides the necessary input for the robot to generate a path to the goal position. The robot executes the steps in the navigation loop until it reaches the goal position and stops by engaging the brakes.

8.2 User input

To enable the robot to navigate autonomously, you must provide the following:

- A map of the area, either from a .png file or created with the robot using the mapping function—see [Creating and configuring a map on page 104](#).
- A goal destination on that map—see [Creating markers and positions on page 118](#).
- The current position of the robot on the map. This usually only needs to be provided when a new map is activated.

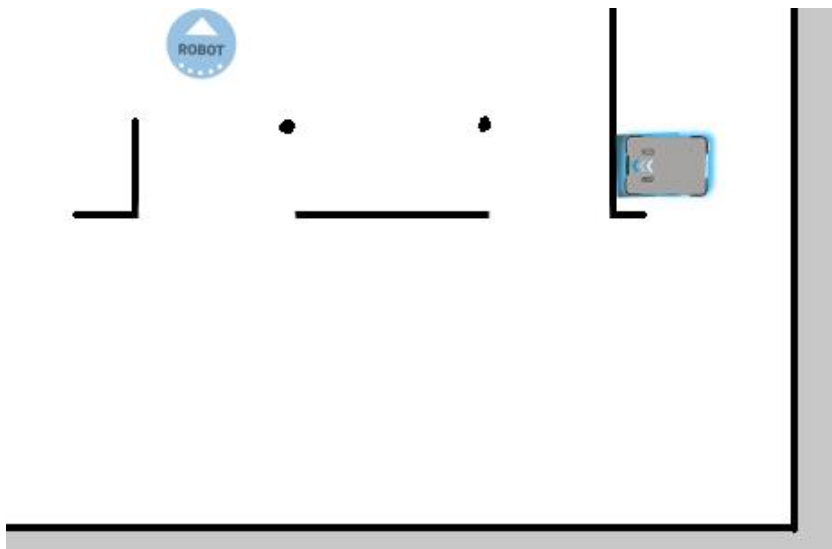




Figure 8.2. On the map, the current position of the robot is identified by the robot icon , and the goal destination is the robot position . The robot computer now determines a path from the current position to the goal position.

Once the robot computer has a map with the robot's current position and a goal destination, it begins planning a route between the two positions on the map using the global planner.

8.3 Global planner

The global planner is an algorithm in the robot computer that generates a path to the goal position. This path is known as the global path.

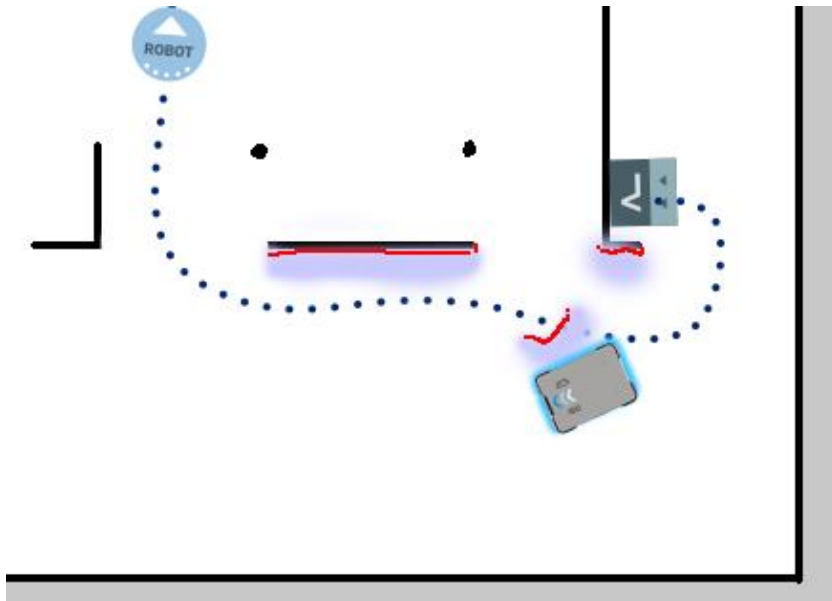


Figure 8.3. The global path is shown with the blue dotted line that leads from the start to the goal position.

The global path is created only at the start of a move action or if the robot has failed to reach the goal position and needs to create a new path. The generated path only avoids the obstacles the robot detected when the path was made and the obstacles marked on the map. The global path can be seen in the robot interface as a dotted line from the robot's start position to goal position.



Figure 8.4. The dotted line from the start position of the robot to the goal position is the global path generated by the robot computer.

8.4 Local planner

The local planner is used continuously while the robot is driving to guide it around obstacles while still following the global path.

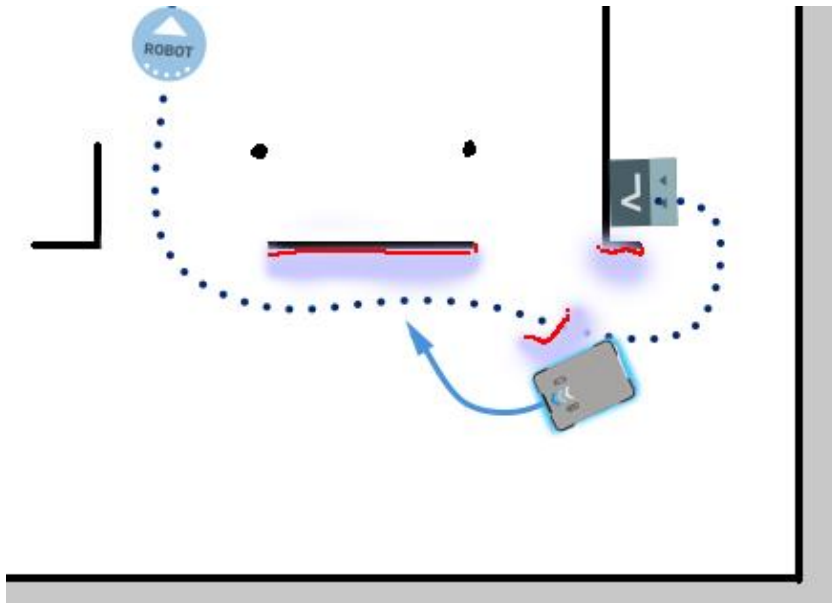


Figure 8.5. The global path is indicated with the dotted blue line. The local path is indicated with the blue arrow, showing the robot driving around a dynamic obstacle.

Whereas the global planner creates a single path from start to finish, the local planner continues to create new paths that adapt to the current position of the robot and the obstacles around it. The local planner only considers the area that is immediately surrounding the robot, using input from the robot sensors to avoid obstacles.

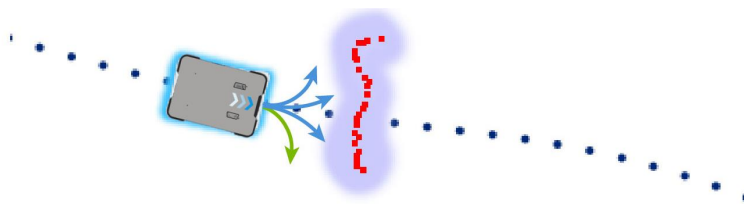


Figure 8.6. The local planner usually follows the global planner, but as soon as an obstacle gets in the way, the local planner determines which immediate path will get the robot around the obstacle. In this case, it will likely choose the path indicated with a green arrow.

Once the local path is determined, the robot computer derives a desired velocity, and acceleration that it sends to the motor controller—see [Motor controller and motors on page 79](#).


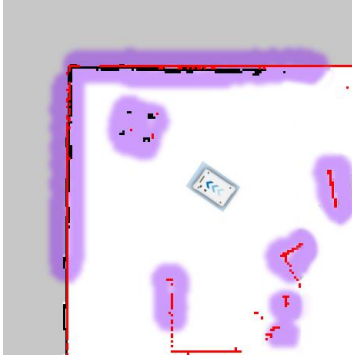
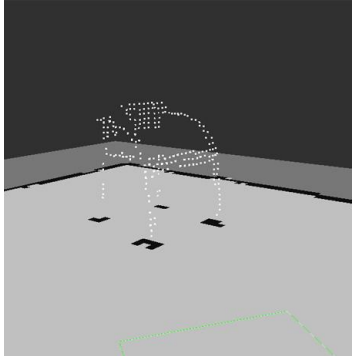
8.5 Obstacle detection

The robot continuously detects obstacles while driving. This enables it to use the local planner to drive around the obstacles and to determine its current position on the map.

There are three sensors that are responsible for detecting obstacles:

- The safety laser scanners
- The 3D cameras
- The proximity sensors

The following illustrations show how the robot sees the surrounding environment and how it is portrayed in the robot interface.

What a human sees	What the laser scanners see	What the 3D cameras see
		
<p>A chair placed in the corner of a room is detectable by the robot.</p>	<p>In the robot interface, the red lines on a map are obstacles detected by the laser scanners, and the purple clouds are an aggregate of the 3D camera and laser scanner data. The scanners only detect the four legs of the chair.</p>	<p>The 3D cameras detect more details of the chair when the robot gets close enough to it. This view cannot be seen in the robot interface.</p>

Safety laser scanners

Two safety laser scanners, diagonally placed on front and rear corners of the robot, scan their surroundings. Each safety laser scanner has a 270° field of view, overlapping and thus providing a full 360° visual protection around the robot.

When in motion, the safety laser scanners continuously scan the surroundings to detect objects.

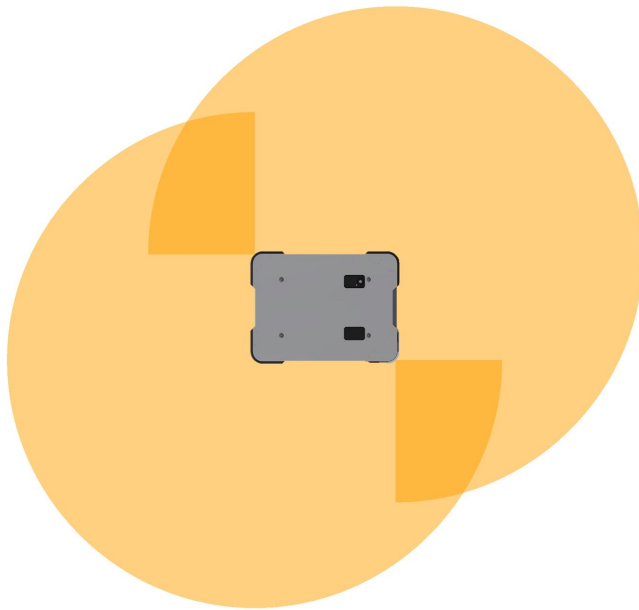


Figure 8.7. The two safety laser scanners together provide a full 360° view around the robot.

The laser scanners have the following limitations:

- They can detect only objects that intersect a plane at 200 mm height from the floor.
- They do not detect transparent obstacles well.
- The scanner data can be inaccurate when detecting reflective obstacles.



If you are using the robot in an area with walls made of glass or reflective material, mark the wall as a forbidden zone on the map and not as a wall—see [Creating and configuring a map](#) on page 104.

3D cameras

Two 3D cameras positioned on the front of the robot detect objects in front of the robot. The 3D cameras detect objects:

- Vertically up to 1800 mm at a distance of 1200 mm in front of the robot.
- Horizontally in an angle of 114° and 250 mm to the first view of ground.

The 3D cameras are only used for navigation. They are not part of the robot's safety system.



The camera readouts are used as 3D point cloud data. They are not recording recognizable objects or people.

The following illustration shows the field of view of the cameras.

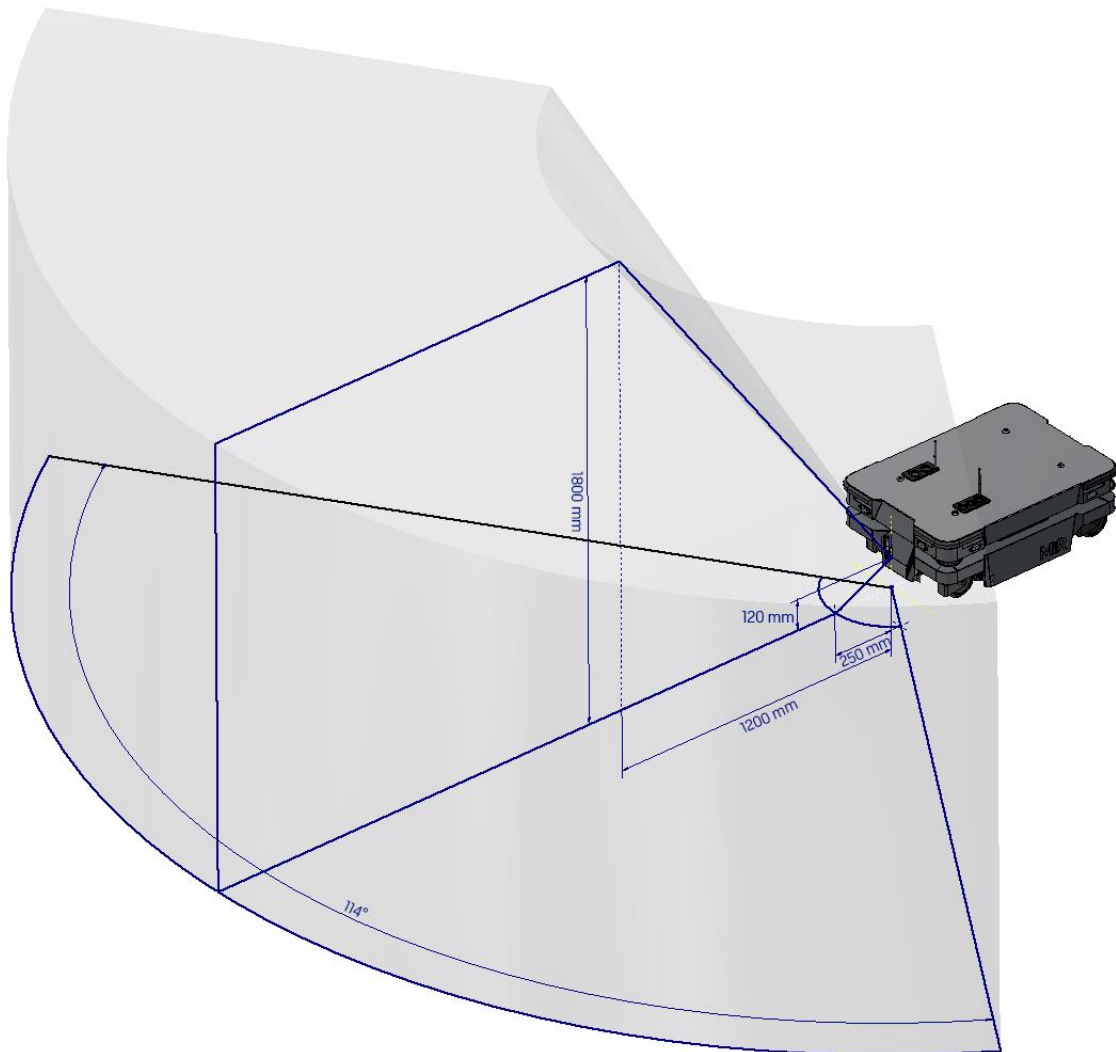


Figure 8.8. The two 3D cameras can see objects up to 1800 mm above floor height at a distance of 1200 mm in front of the robot and have a horizontal field of view of 114°.

The 3D cameras have the following limitations:

- They can only detect objects in front of the robot, unlike the full 360° view of the laser scanners.
- They do not detect transparent or reflective obstacles well.
- They do not detect holes or descending stairways.
- The cameras are not reliable at determining depth when viewing structures with repetitive patterns.

Proximity sensors

Proximity sensors placed in all four corners of the robot detect objects close to the floor that cannot be detected by the safety laser scanners.

Using infrared light, the proximity sensors point downwards and make sure that the robot does not run into low objects, such as pallets and forklift forks. They have a range between 5-20 cm around the robot.

Because of the proximity sensor's limited range, the data from them is only useful when the robot is standing still or moving at reduced speeds.

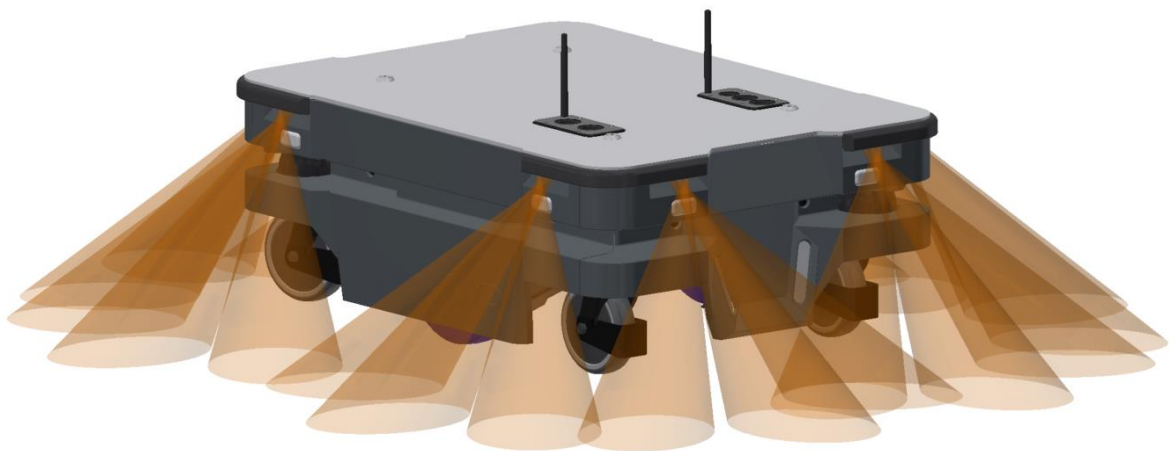


Figure 8.9. The proximity sensors in the corners of the robot detect objects below the safety laser scanners plane of view.

The proximity sensors have the following limitations:

- They do not have a long range and are mainly used to detect obstacles missed by the laser scanners and cameras.

- When the robot is driving fast, obstacles detected by the proximity sensors are too close for the robot to stop for or avoid them.

8.6 Localization

The goal of the localization process is for the robot to determine where it is currently located on its map. The robot has three inputs for determining where it is:

- The initial position of the robot. This is used as a reference point for the methods used to determine the robot position.
- The IMU and encoder data. This is used to determine how far and fast the robot has traveled from the initial position.
- The laser scanner data. This is used to determine the likely positions of the robot by comparing the data with nearby walls on the map.

This data is used by a particle filter to determine the most likely position of the robot on the map.

IMU and motor encoders

Both the data from the IMU (Inertial Measurement Unit) and motor encoders is used to derive where and how fast the robot has traveled over time from its initial position. The combination of both sets of data makes the derived position more accurate.



If the drive wheels are worn down significantly or the robot is running with an incorrect gear ratio, the robot will miscalculate how far it has traveled based on the encoder data.

Laser scanners and particle filtering

The robot computer compares the input from the laser scanners with the walls on the map to try to find the best match. This is done using a particle filter algorithm. The robot computer only compares with the area where it expects the robot to be based on the encoder and IMU data. This means it is important that the initial position of the robot is correct.

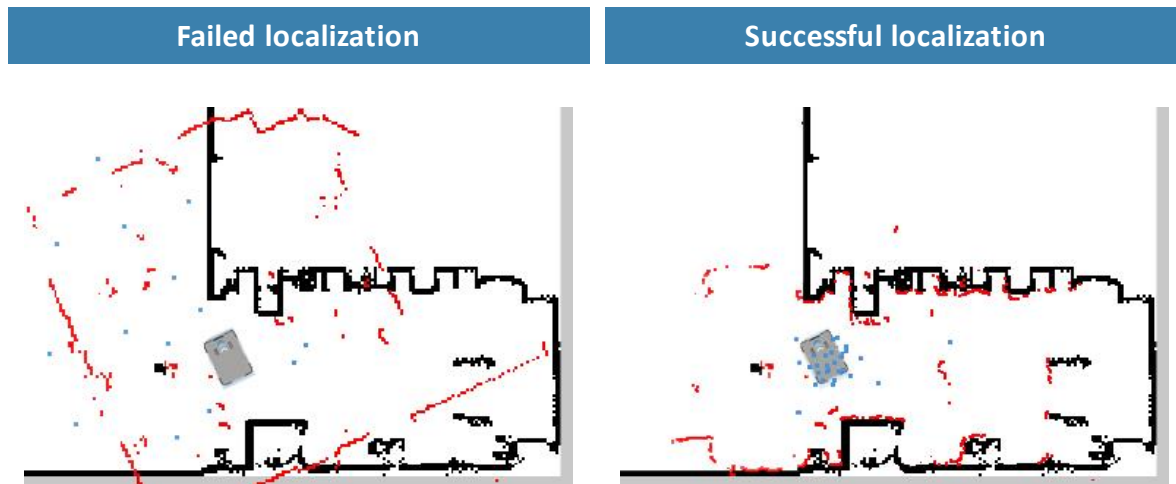
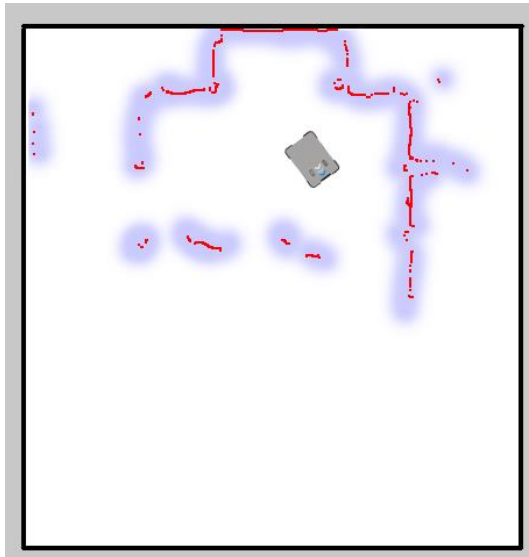


Figure 8.10. In a failed localization, the robot cannot determine a position where the red lines (laser scanner data) align with the black lines on the map. When the robot can localize itself, it determines a cluster of likely positions, indicated in the images above as blue dots.

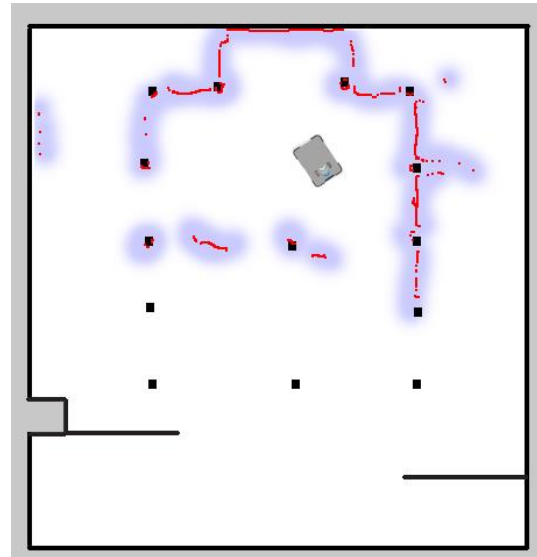
To make sure the robot can localize itself well using particle filtering, consider the following when creating a map:

- There must be unique and distinguishable static landmarks on the map that are easily recognizable. A landmark is a permanent structure that the robot can use to orient itself, such as corners, doorways, columns, and shelves.

No distinguishable landmarks

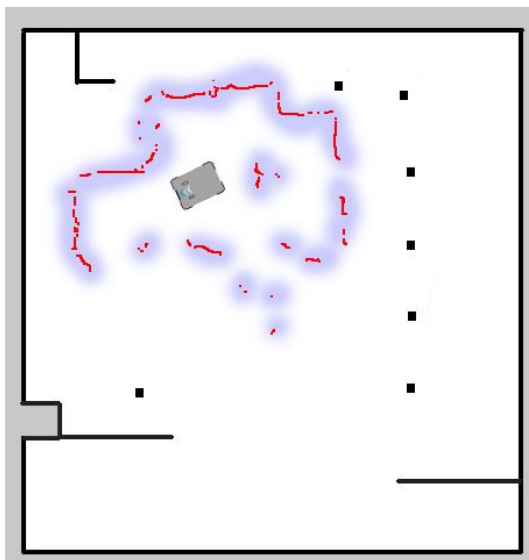


Many distinguishing landmarks

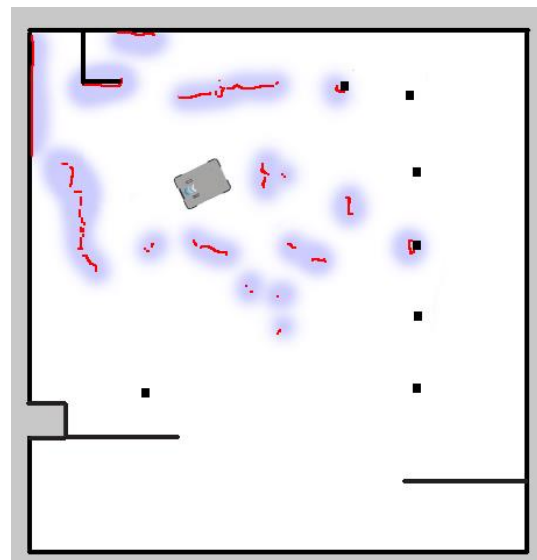


- The robot must be able to detect the static landmarks that are marked on the map to be able to approximate its current position.

Cannot detect any landmarks



Can detect enough landmarks



- The robot does not compare the laser scanner data with the entire map, but only around the area that it expects to be close to based on the IMU and encoder data and its initial position. This is why it is important that the initial position you place the robot at on the map is accurate.
- The robot can drive for a short distance without being correctly localized. As it drives, the estimated positions should converge to a small area, indicating the robot has determined an accurate estimate. If this does not occur within a set time limit, the robot reports a localization error.

8.7 Motor controller and motors

The robot keeps adjusting how much power is sent to each motor based on sensory input. This means the robot can correct its speed when going up slopes or when carrying a heavier payload, and it can change its driving direction to avoid moving obstacles.

8.8 Brakes

Once the approximated position of the robot determined from localization is the same as the goal position calculated by the global planner, the robot stops by using the dynamic brake function.

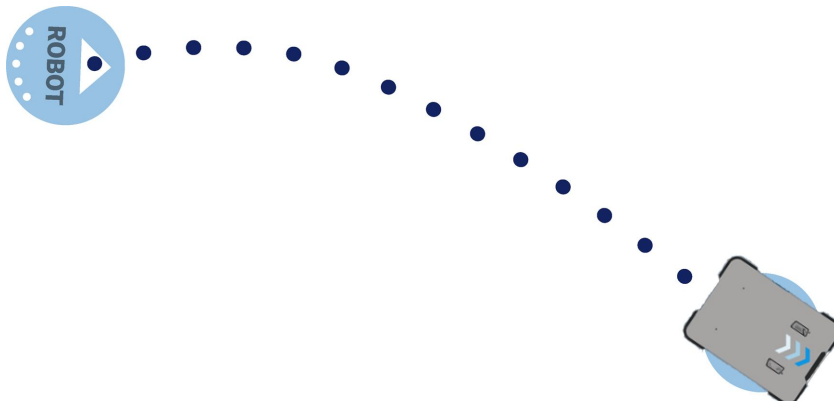


Figure 8.11. The robot has reached the goal position and stops by engaging the brakes.

The dynamic brake function stops the robot by short circuiting the power that was used to rotate the motor. When this happens, the power that was used to drive the robot forward is now reversed to stop the rotation of the drive wheels

Once the robot has stopped, the mechanical brakes are enabled. These brakes are used to keep the robot in place once it has stopped. You can compare it with the parking brake or hand brake in a car.



The mechanical brakes are only used to stop the robot when in motion in emergency situations triggered by the safety system.

The mechanical brakes are automatically released again when the robot receives a new order requiring it to move.

9. Safety system

The robot's safety system is responsible for stopping or slowing down the robot and its top module in situations where personnel are at risk of injury.

MiR250 is equipped with a range of built-in safety-related functions as well as safety-related electrical interfaces designed for integration with a top module. Each safety function and interface is designed according to the standard ISO 13849-1. The safety-related functions and interfaces are selected to support compliance with EN 1525 and ISO 3691-4.

9.1 System overview

The safety system is controlled mainly by the safety PLC. The PLC regulates inputs and outputs from safety-related functions or interfaces involved with ensuring the safety of personnel working nearby the robot.

If a safety function is triggered, the robot uses its STO (Safe Torque Off) contactors to bring the robot to a category 0 stop (stopping by "immediate removal of power to the machine actuators" according to IEC 60204-1) followed by a controlled brake using an SS1 (Safe Stop 1) function. This is known as bringing the robot into Emergency stop or Protective stop, depending on the function—see [Types of stop below](#).

Some interfaces are also used to signal safety-related states between the top module and robot, for example whether the robot is in motion or if the top module is in a state where the robot must stop or slow down. Each of these are connected through the safety-related electrical interfaces through two identical circuits to ensure redundancy.

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.

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 application 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 Protective stop:

- **A safety laser scanner detects an object in its active protective field**
Remove the object from the active protective field—see [Safety system on the previous page](#). 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. For further guidance, see the troubleshooting guides on the Distributor site.

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 application 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.

MiR250 has one Emergency stop button and an option to connect additional Emergency stop buttons through the electrical interface.



NOTICE

Only press the Emergency stop buttons in emergency situations. They are not designed for frequent use.

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.



Safety-related functions

The following functions are integrated within the robot itself and cannot be modified or used with other applications freely. The following list introduces the main safety-related functions integrated in MiR250:

- **Collision avoidance**

This function ensures that the robot stops before it collides with personnel or an object. If the laser scanners detect an object or person within a defined protective field, the robot is brought to a stop. The function determines the speed of the two drive wheels using motor encoder data and switches between predefined protective fields accordingly. The faster the speed, the larger the protective field is.

- **Overspeed avoidance**

The safety system monitors if the motor encoder data indicates that the speed of each motor is above the limits for maximum rated speed. If the limit is exceeded, the robot enters Protective stop.

- **Stability**

The safety system monitors if the motor encoder data indicates that the speed difference between the two motors are above predefined limits. If the limit is exceeded, the robot enters Protective stop.

Safety-related electrical interfaces

The following interfaces are parts of the Auxiliary emergency stop and Auxiliary safety function interfaces that can be used to connect the safety PLC to a top module—see [Internal parts on page 20](#). Each electrical interface is redundant, meaning they use two identical circuits. If one of the circuits fail, the robot enters Protective stop until both circuits are working correctly again and the robot is restarted, ensuring safe communication between the top module and robot—see [Interface specifications on page 192](#).

The following list introduces the main safety-related electrical interfaces between MiR250 and its top module:

- **Emergency stop circuit**

The Emergency stop circuit goes through the Auxiliary emergency stop interface and connects to the top module. It is intended that any number of Emergency stop buttons can be connected to the circuit. When the circuit is broken, the robot goes into Emergency stop.

- **Safeguarded stop**

This function consists of a circuit that goes through the Auxiliary safety function interface that connects to the top module. This circuit can be used to bring the robot into Protective stop until it is signaled otherwise.

- **Locomotion**

The locomotion function signals when the robot is driving. This can be connected to a top module if it should operate differently when the robot is driving, such as activating brakes or disconnecting the power to actuators.

- **Shared emergency stop**

This function consists of a shared circuit between the robot and top module, enabling them to trigger each other into an Emergency stop.

- **Reduced speed**

The reduced speed function can be connected to a top module, enabling it to make the robot reduce its speed to 0.3 m/s. This is for example used by MiR lifts to ensure that the robot does not drive fast when the lift is raised.

These functions are described in further detail in the following sections.

The diagram in *Figure 9.1* shows the inputs to these functions and interfaces and how they are all connected and monitored in the safety PLC. The safety PLC is able to switch the contactors to cut off power to the robot motors and the top module. Also, the safety PLC sends information to the robot computer to be displayed in the robot interface and to indicate the robot's status through the signal lights and the speaker.

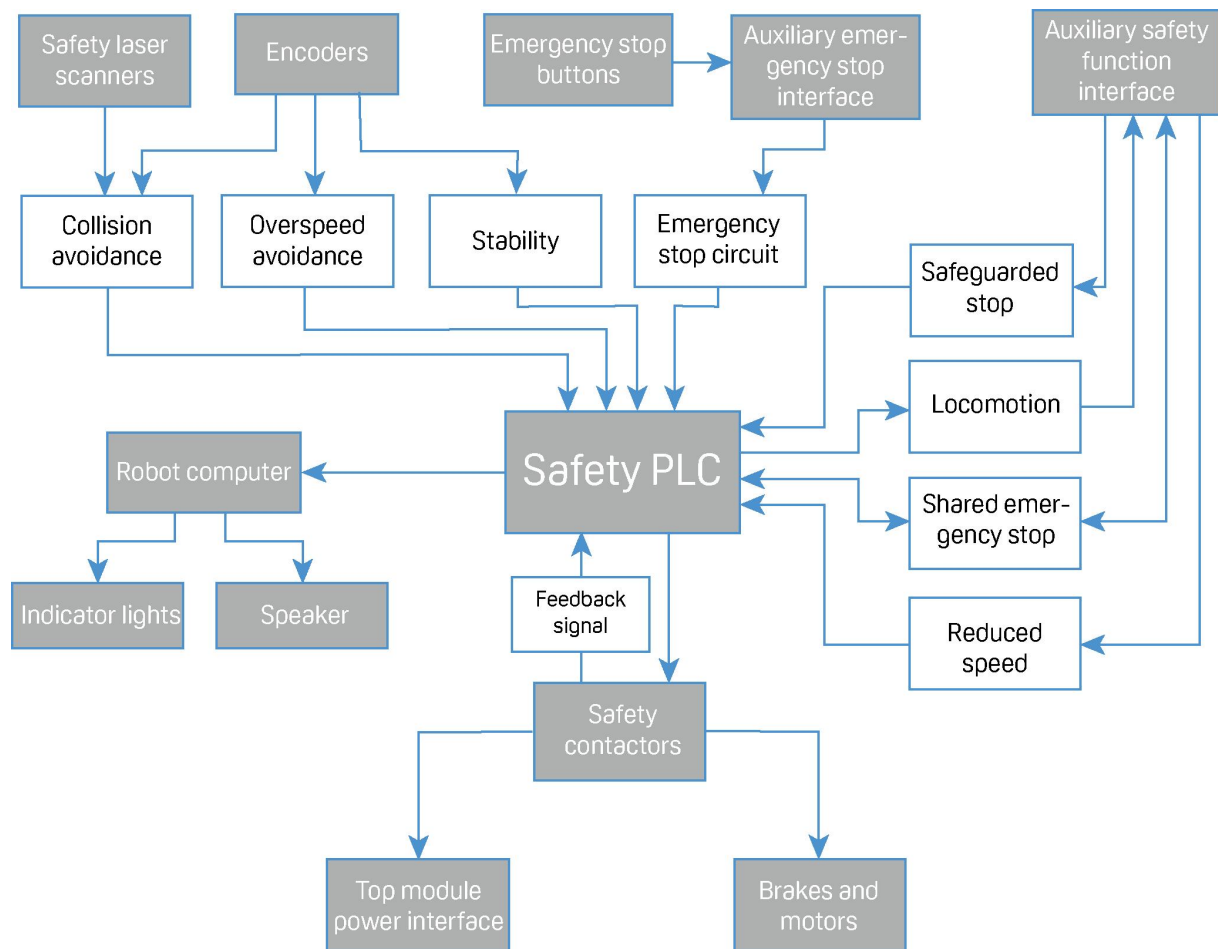


Figure 9.1. Overview of components involved in each safety function and interface. When a safety function is triggered, the safety PLC switches the STO and brake contactors so the brakes, motors, and safe power supply to the top module no longer receive power.

9.2 Collision avoidance

The collision avoidance function prevents the robot from colliding with personnel or obstacles by stopping it before it collides with any detected obstacles. It does this using the safety laser scanners.

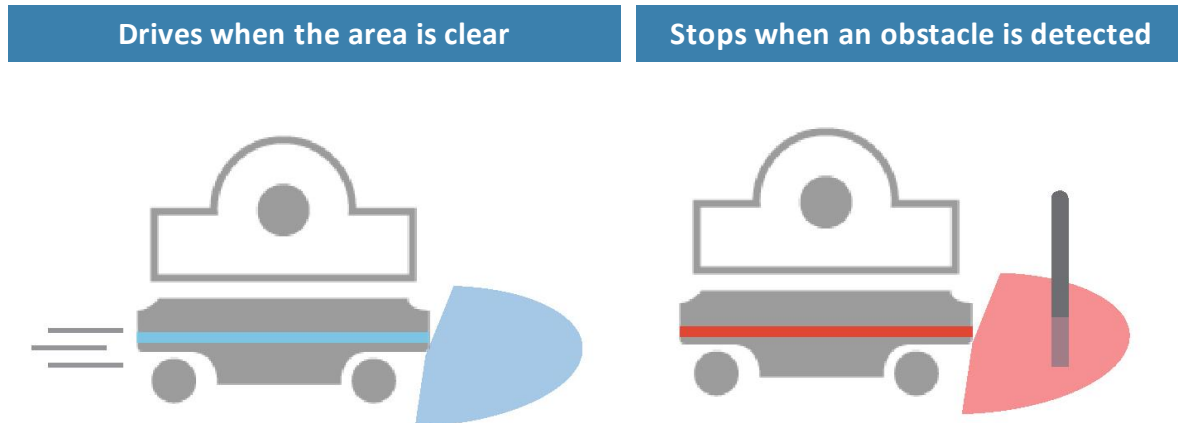


Figure 9.2. Collision avoidance ensures that the robot drives when its path is clear and stops if an obstacle is detected within its protective field.

The safety laser scanners are programmed with two sets of protective fields. One field is used when the robot is driving forward and another when it is driving backward. The protective field sets are part of the robot's personnel detection means. The protective field sets consist of individually configured contours around the robot. The robot activates the correct field set based on the speed. If a person or object is detected within the active protective field set, the robot enters Protective stop until the protective field set is cleared of obstacles for at least two seconds.

The tables in the following sections show the sizes of the protective field sets at given speeds. The faster the robot moves, the larger the scanners' field set. The speed of the robot is determined based on the encoder data.



The field sets on each side of MiR250 are 210 mm at all speeds.

**WARNING**

The protective field sets are configured to comply with the safety standards of MiR250. Modifications may prevent the robot from stopping in time to avoid collision with personnel and equipment. Any modifications of the configuration file in the safety software will void the CE mark 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 modification are applied.

Field sets when driving forward

The following table shows speeds and field sets when driving forward. The table describes the length of the field set in front of the robot in different cases. Each case is defined by a speed interval that the robot may operate at. The colors and cases in the table correspond to the field set shown in the illustration below.

Case	Speed	Protective field range	Comments
1	0.0 to 0.10 m/s	80 mm	When pivoting
2	0.10 to 0.30 m/s	180 mm	
3	0.10 to 0.50 m/s	360 mm	
4	0.50 to 0.90 m/s	780 mm	
5	0.90 to 1.30 m/s	1350 mm	
6	1.30 to 1.70 m/s	2100 mm	
7	1.70 to 2.10 m/s	2850 mm	Forward at max. speed



Figure 9.3. The illustration shows the field set contours when driving forward. The range of the field set changes with the robot's speed.

Field sets when driving backward

The field sets for driving backward are the same as the field sets for driving forward. However, the robot is limited to a top speed of 1.0 m/s when driving backward and therefore only have five fields.

Case	Speed	Protective field range	Comments
1	0.0 to -0.10 m/s	80 mm	When pivoting
2	-0.10 to -0.30 m/s	180 mm	
3	-0.10 to -0.50 m/s	360 mm	
4	-0.50 to -0.90 m/s	780 mm	
5	-0.90 to -1.00 m/s	1350 mm	Backward at max. speed

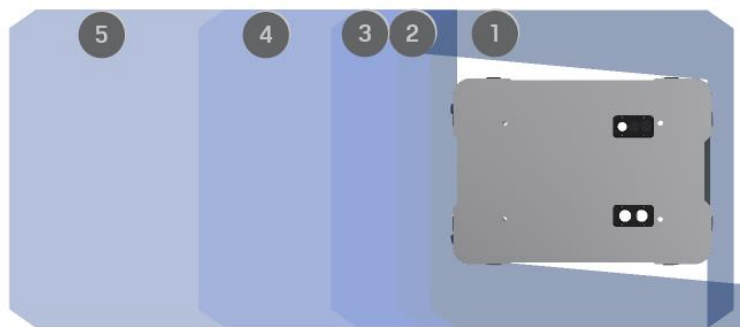


Figure 9.4. The illustration shows the field set contours when driving backward. The range of the field set changes with the robot's speed. The illustration also shows how the front scanner reduces its protective field sets to a minimum when the robot moves backward.



NOTICE

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

Muted personnel detection means

When performing tasks that require the robot to move very close to surrounding objects, the robot mutes the personnel detection means.



CAUTION

When the robot has muted personnel detection means, it may not stop in time to avoid collisions with obstacles or personnel in its path.

- Mark areas where the robot mutes its personnel detection means as operating hazard zones, and inform personnel not to enter the zone while the robot is operating in it.

When muting the personnel detection means, the robot does the following:

- Reduces the size of the field sets
- Turns off Collision detection
- Decreases the speed
- Flashes the yellow signal lights

You can also mute the personnel detection means using the robot interface:

1. Put the robot into Manual mode—see [Driving the robot in Manual mode on page 49](#).
2. In the robot interface, select **Muted personnel detection means** in the joystick control.
3. In the dialog, select **Yes** to acknowledge the muting of personnel detection means.

The status and the signal lights start flashing yellow, and the robot is ready to drive with muted personnel detection means.

9.3 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 a Protective stop. This ensures that the robot cannot drive if its speed cannot be controlled.

9.4 Stability

The stability function prevents the robot from driving if the motor encoders measure that the expected difference between how fast each wheel turns is outside the predefined safety limits. This indicates that the robot is not driving as intended, for example, if one of the wheels loses traction.

If the robot detects instability, it is immediately brought into a Protective stop. This ensures that the robot cannot drive if it has lost control of the speed of each drive wheel.

9.5 Emergency stop circuit

The Emergency stop circuit goes through the Auxiliary emergency stop interface and uses 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.

It is intended that the circuit is set up so the 24 V signal delivered from the safety PLC outputs passes through all Emergency stop buttons of the top module and then continues to the two input pins. When the input pins both receive 24 V, the robot can operate. The connected Emergency stop buttons must break the circuit when you press them so 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 so the input signals are not the same, the robot enters Protective stop until the circuit is fixed.

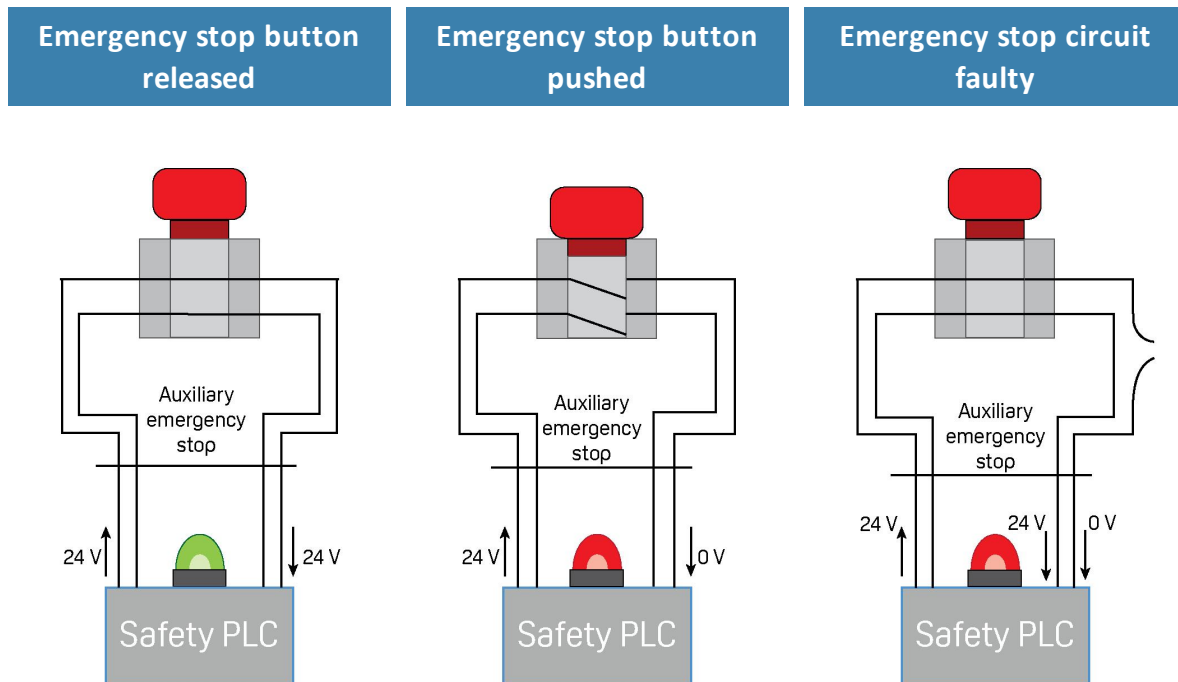


Figure 9.5. If the input pins deliver 24 V to the robot, it can operate. When you push a connected Emergency stop button, both pins deliver 0 V, and the robot enters Emergency stop. If the pins do not deliver the same input, the robot enters Protective stop until the circuits are fixed.

In the Auxiliary emergency stop interface, pins 2 and 3 deliver 24 V from the safety PLC, and pins 4 and 5 connect to the Emergency stop circuit inputs of the safety PLC. 24 V must be delivered to pins 4 and 5 for the robot to operate.

9.6 Safeguarded stop

The safeguarded stop interface provides an input to the robot that can bring the robot into Protective stop. This interface 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 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.

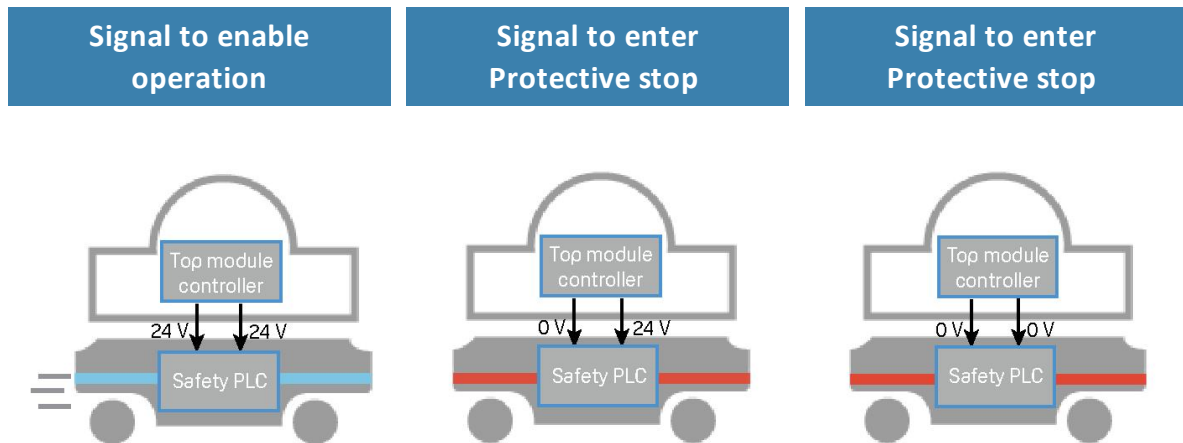


Figure 9.6. If both pins deliver 24 V to the robot, it can operate. If either or both of the pins deliver 0 V, the robot enters Protective stop.

Pins 2 in interfaces A and B of the Auxiliary safety functions are used for the Safeguarded stop function.

9.7 Locomotion

The Locomotion interface is used to signal to a top module that 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. It is intended to be used to ensure that the top module is programmed 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.

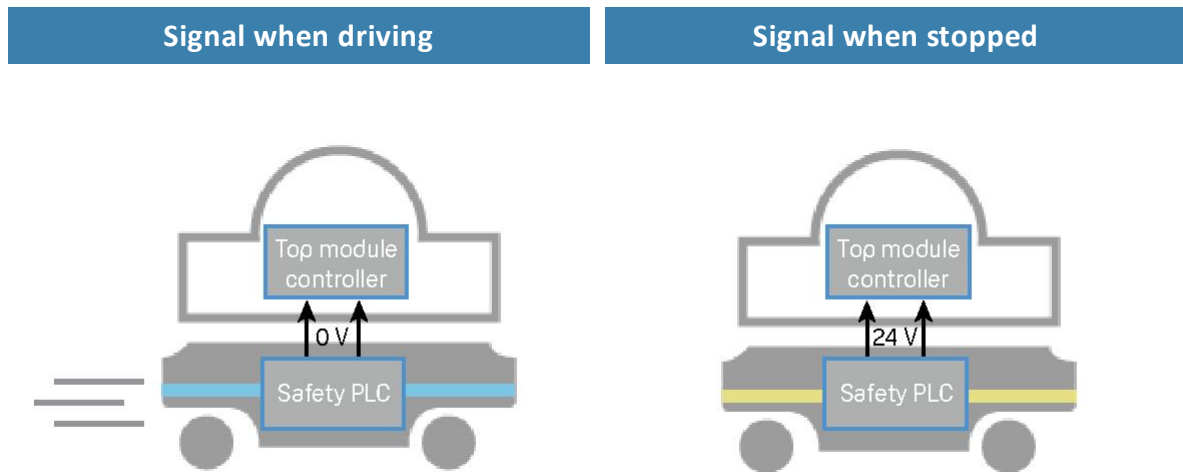


Figure 9.7. When the robot is driving, the safety PLC sends a 0 V signal to the top module through the Auxiliary safety function interface. When the robot is stopped, the signal becomes 24 V.

Pins 5 in interfaces A and B of the Auxiliary safety functions are used for the Locomotion function.

9.8 Shared emergency stop

The Shared emergency stop interface is used to control the Emergency stop state between the robot and a top module. 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 used 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.

These signals can be used if the top module has its own Emergency stop system and you want both the robot and the top module to enter Emergency stop when either system is triggered.

If the 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.

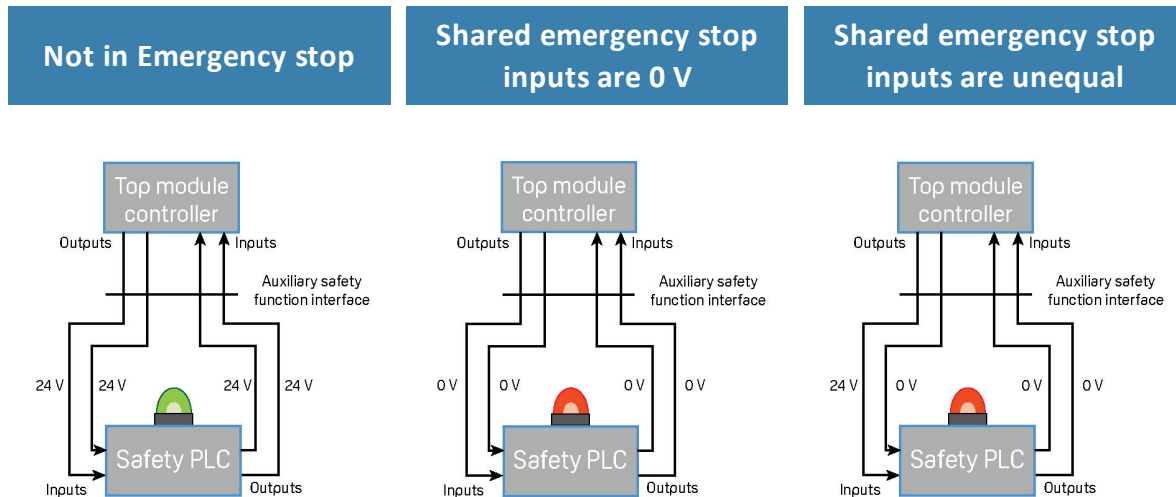


Figure 9.8. There are three cases described above. They illustrate respectively: 1. the robot is not in Emergency stop so the output is 24 V, 2. the robot is in Emergency stop because it receives 0 V input from the Shared emergency stop interface, 3. the robot is in Emergency stop because the inputs are unequal.

In interfaces A and B of the Auxiliary safety functions, pins 3 are used for the input and pins 6 are used for the input of the Shared emergency stop function.

9.9 Reduced speed

The Reduced speed interface is used to signal to the robot that it must drive at a reduced speed of 0.3 m/s. This is the same speed used when the robot mutes its personnel detection means. The interface uses two input pins where the robot drives at a reduced speed if either input is 0 V.

This can for example be used in cases where the top module can register whether the load it is carrying is not securely placed or the module is currently under operation.

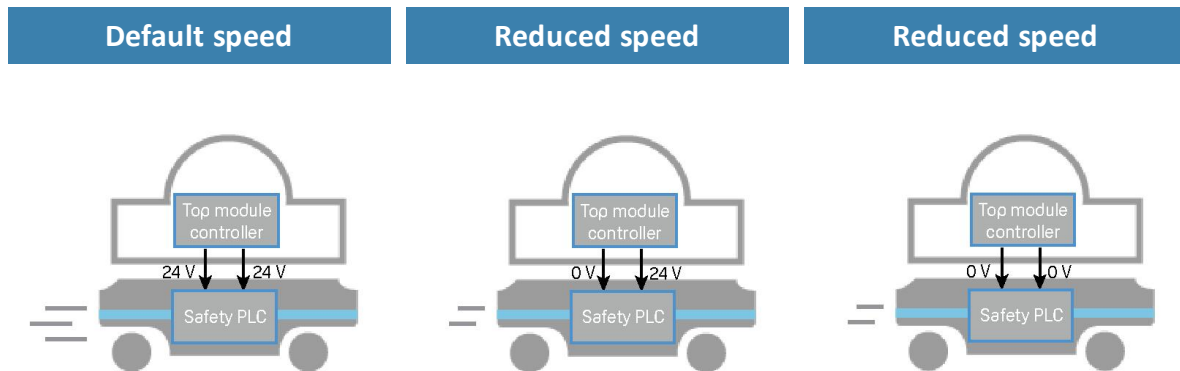


Figure 9.9. The robot drives at its default speed only when both inputs are 24 V. If either or both pins are 0 V, the robot drives at 0.3 m/s.

Pins 4 in interfaces A and B of the Auxiliary safety functions are used for the Reduced speed function.

9.10 Robot computer

The robot computer is connected to the safety PLC via an Ethernet cable. The safety PLC sends all of the statuses of its various inputs to the robot computer so the information can be sent to the robot interface. This enables you to identify which part of the safety system may be causing a Protective or Emergency stop.

Additionally, the robot computer sends the current robot state to the power board which regulates the indicator lights, ensuring that the status lights indicate which state the robot is in.

9.11 Light indicators and speakers

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

- **Status lights**

An LED light band on all four sides of the robot uses 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 backwards. Front lights are white and rear lights are red. Right and left turns are indicated by blinking.



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

Status lights

The LED light band running all the way around the robot indicates the robot's current operational state. Colors may also be used as part of missions, but as standard, the robot is delivered with the following setup.

Red	Emergency stop
Green	Ready for job
Cyan	Drives to destination
Purple	Goal / Path blocked
White	Planning / Calculating
Yellow	Mission Paused
Yellow wavering	Startup signal before PC is active
Yellow fade	Shutting down robot
Yellow blinking	Relative move, ignoring obstacles
Purple - yellow	General error e.g. hardware, localization
Blue	Manual drive joystick
Blue wavering	Mapping
Contracting white	Charging: Charging station
White wavering	Prompt user / Waiting for user's response



NOTICE

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 personnel detection means, for example when docking to a marker, all signal lights blink yellow.

Speakers

When the robot drives with muted personnel detection means it emits a warning sound. In **System > Settings > Safety system**, you can choose which sound the robot makes and the volume of the sound.



CAUTION

Changing the safety system can cause the robot to not comply with safety standards.



NOTICE

It is the responsibility of the commissioner to ensure that the warning sounds are audible in the robot's work environment.

10. Commissioning

This section describes how to commission MiR250.

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

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

It is the responsibility of the commissioner to:

- Analyze the work environment.
- Make a risk assessment of the full installation.
- Create and configure the site.
- Configure audio and light signals according to the environment.
- Create operating hazard zones.
- Make a brake test.
- Create user groups and users.
- Create dashboards.
- Update robot software.
- Change the relevant system settings.

10.1 Analysis of the work environment

The work environment of the robot must fulfill a number of requirements for the robot to function properly and safely. This section describes the factors that must be considered when the robot is being commissioned to function in a work environment.

Surfaces

The floor surface of the work environment must be dry. MiR250 functions on many different types of surfaces, but some materials can affect the performance and safety of the robot, such as very thick carpets or slippery floors.

It is the responsibility of the commissioner to test the performance and safety of the robot on the surfaces in the work environment—see [Brake test on page 136](#).

Light, reflections, and materials

Bright sunlight and reflective or transparent objects can affect the performance of the robot's laser scanners and cameras. This can result in the robot detecting nonexistent objects or failing to detect real objects.

Likewise, docking to markers made in very high gloss or transparent materials can reduce the effectiveness of the robot's scanners, hindering a successful docking.

It is the responsibility of the commissioner to test if sunlight, reflections from high gloss materials, and transparent objects affect the robot's performance or safety.

Temperature and humidity

Temperatures outside of the approved temperature range can affect the performance and durability of the robot—see specifications on the MiR website. This is especially relevant for the robot's battery—see [Battery storage on page 62](#).

Inclines, doorways, gaps, and sills

The robot must operate within the approved specifications for driving on inclines, through doorways, and over gaps and sills—see specifications on the MiR website. Operating in areas that do not meet the specifications may result in the robot failing the complete missions or losing control of its load.

Space

The robot must have sufficient space to operate efficiently. Determine during commissioning if the robot has sufficient space to drive, dock, turn, and perform other tasks. Make sure to test each mission under the most likely operating conditions to determine if there is enough space for the robot to maneuver.



CAUTION

Driving in environments with no escape routes can lead to hazardous situations. There is a risk of damage to equipment or injury to personnel.

- At all times there must be at least 0.5 m wide and 2.1 m high pedestrian escape routes on each side of the robot, also in operating hazard zones.

Dust

Dusty environments can affect the performance and durability of the robot. Dust can get into the robot computer and mechanical parts, affecting their performance and durability, and it can obstruct the view of the robot's sensor system. Make sure the environment MiR250 operates in is suitable for its IP rating—see specifications on the MiR website.

Static landmarks and dynamic obstacles

The robot uses landmarks to navigate by. If it cannot detect enough distinguishing static landmarks, it cannot navigate the map efficiently—see [Localization on page 76](#).

10.2 Risk assessment

To achieve a safe installation, it is necessary to make a risk assessment of MiR250 in the environment it will be used in. This is the responsibility of the commissioner.

The risk assessment must cover not only MiR250 itself, but also take into account potential load transfer stations, work cells, and the work environment.



NOTICE

Mobile Industrial Robots does not take any responsibility for the performance of the risk assessment, but we provide information and guidelines that may be used in this section.



CAUTION

Changing the SICK configuration on the robot requires a new CE certification. Mobile Industrial Robots does not take any responsibility for the safety of the robot if the SICK configuration is changed.

It is recommended that the commissioner follows the guidelines in ISO 12100, EN ISO3691-4, EN 1525, ANSI B56.5, or other relevant standards to conduct the risk assessment.

In EN 1525, clause 4, there is a list of possible significant hazards and hazardous situations.

A risk assessment of the application must be used to determine the adequate information for users. Special attention to at least the following Essential Health and Safety Requirements (EHSR) must be taken:

- 1.2.2 Unexpected start for potential exposed persons
- 1.3.7 Risk related to moving parts
- 1.7.1 Information and warning on the machinery
- 1.7.2 Warning of residual risks
- 1.7.3 Marking of the machinery
- 1.7.4 Instructions

The risk assessment will lead to new instructions that shall be written by the party who draw up the CE marking. The instructions must at least include:

- Intended use and foreseeable misuse.
- A list of residual risks.
- Training required for personnel.

MiR has taken worst case scenarios into account in the design of MiR250.

10.3 Creating and configuring a map

The map is visible in the robot interface and is the basis for the robot's ability to navigate its surroundings safely and efficiently. The map illustrates the physical area in which the robot operates.

By placing features such as positions and markers—see [Creating markers and positions on page 118](#)—, zones—see [Adding zones to the map on page 112](#)—, and walls in the map, you enable the robot to perform missions—see [Creating a mission on page 126](#).

It is important to create a robust, reliable map for the robot to perform effectively and safely.

To create a new map, you drive the robot around its intended work environment while its sensors gather data to generate a map from. This process is known as mapping.

As the robot moves during mapping, the laser scanners detect physical obstacles that are recorded on the map as walls. In the editing afterward, you can remove all obstacles that should not stay on the map, for example carts or boxes that were present at the time of recording but will not stay permanently.



You can also import a .png image of the map, for example extracted from a CAD drawing of the site.



For more information on creating a map, see *MiR Robot Reference Guide* and the *Creating your first map*-course in MiR Academy.

Creating the map

Before you map a new location, be sure to do the following preparations:

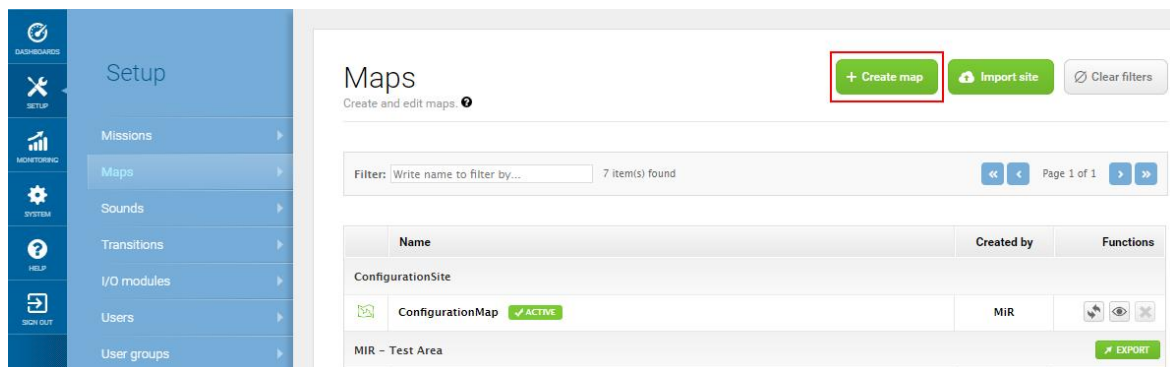
- Clear the area of dynamic obstacles, such as empty pallets and carts. Dynamic obstacles can also be deleted from the map later.
- Ensure that all doors and gates that the robot should be able to go through are opened before mapping.

Avoid doing the following:

- Starting the mapping with the robot in a very open space.
- Getting the robot stuck close to walls or objects as you will have to push it away manually.

To create a new map using the robot's mapping function, follow these steps:

1. Sign in to the robot interface, and go to **Setup > Maps**.
2. Select **Create map**.

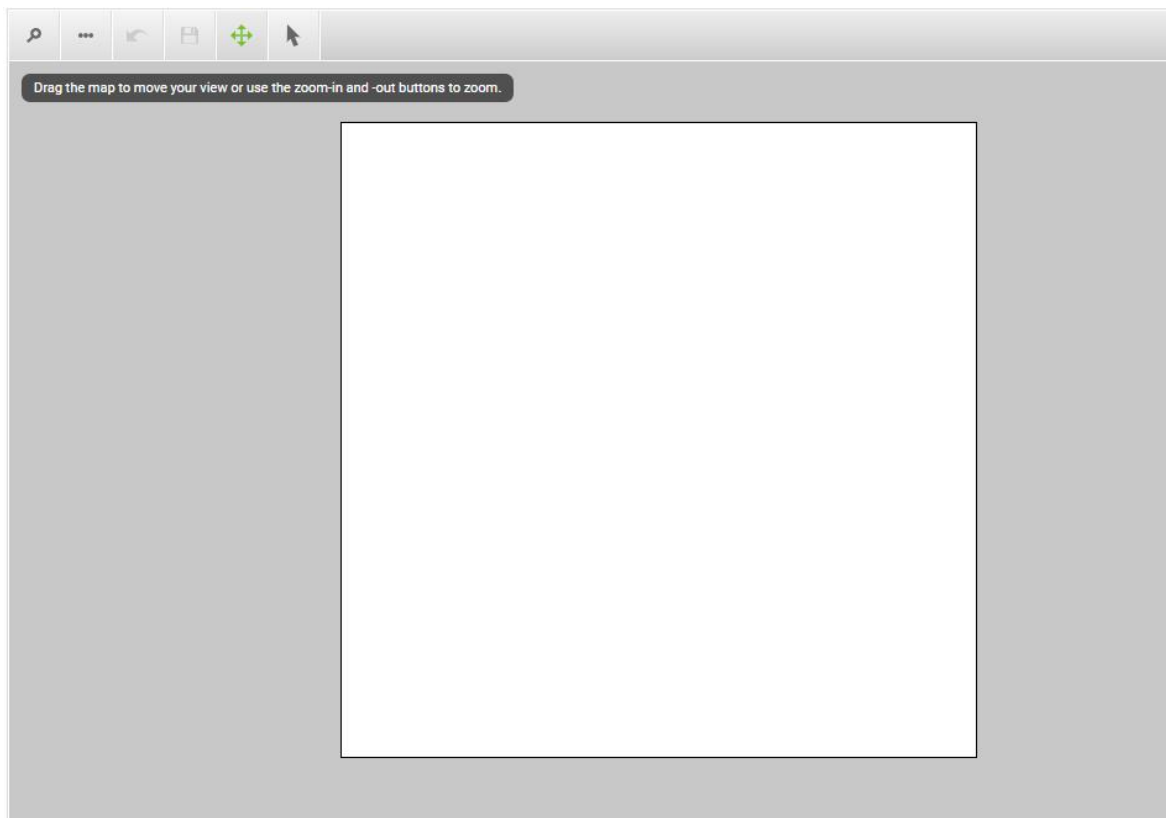


3. Name the map, and choose a site for the map in the drop down menu.

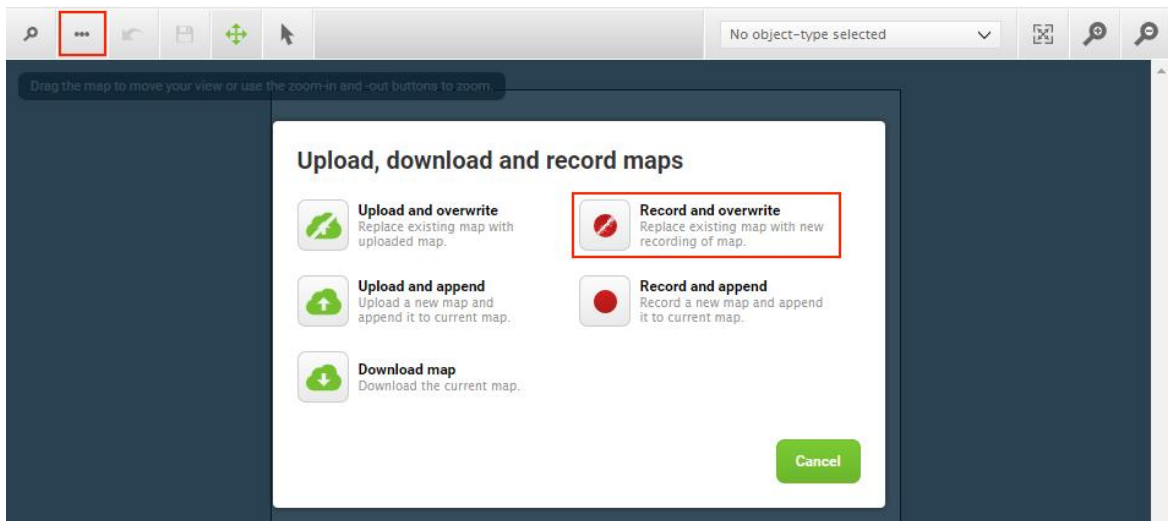


A site is a collection of information. It stores maps and all related information in a package that can be shared between robots. Ensure that maps for the same facility are in the same site. In **Setup > Maps**, you can import sites.

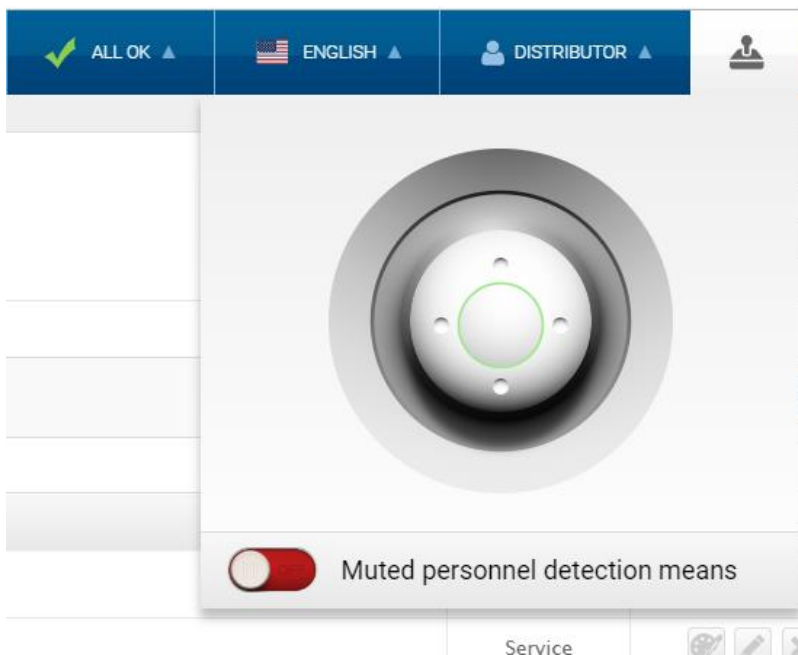
4. Wait until the white square appears (3-5 seconds). This is a blank map.




5. Select the three dots in the top left corner and start mapping by selecting **Record and overwrite**.



6. In the upper right corner, select the joystick icon. Select **Manual control**.

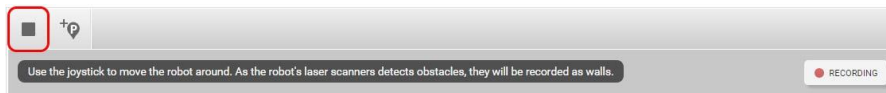


7. A blinking recording icon  indicates that the mapping has started.
 - a. Drive the robot around manually with the joystick—see [Driving the robot in Manual mode on page 49](#). The mapping window will update with new objects continuously.
 - b. Focus on mapping in a circular pattern around the perimeter of the working environment.
 - c. When reaching long corridors with few obstacles, let the robot stay in position for approximately five seconds before moving down the corridor.
 - d. Walk behind the robot as you map.
 - e. End the mapping in the same place you started it.



The joystick switches to medium speed during mapping. This ensures better coverage of the mapped area.

8. When the map looks complete, select **Stop**  in the upper-left corner of the mapping window.



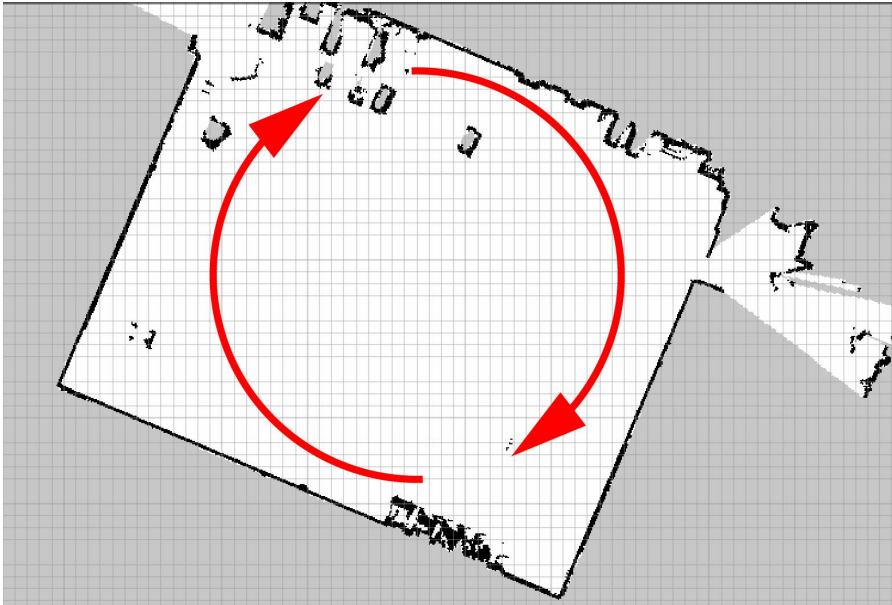
Configuring the map

Once the mapping engine stops, the interface will show the newly recorded map on a grid background.

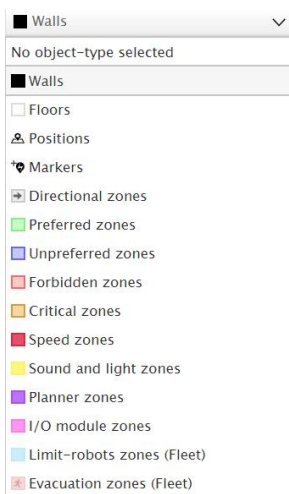
To configure the map, follow these steps:

1. Align the map so the walls are parallel to the grid lines behind it. Maps should be aligned along the X-Y axis because the robot uses the X-Y axis to plan its routes.

Drag the map to rotate it. On desktop computers, holding the Shift key when dragging the map rotates the map in increments of 11.25 degrees.



2. When the map is aligned, select **Ok** ✓ in the upper left corner of the mapping window.
3. Clean the map by drawing walls and floors and by erasing dynamic obstacles.
In the drop down menu, go to the walls layer by selecting **Walls**.



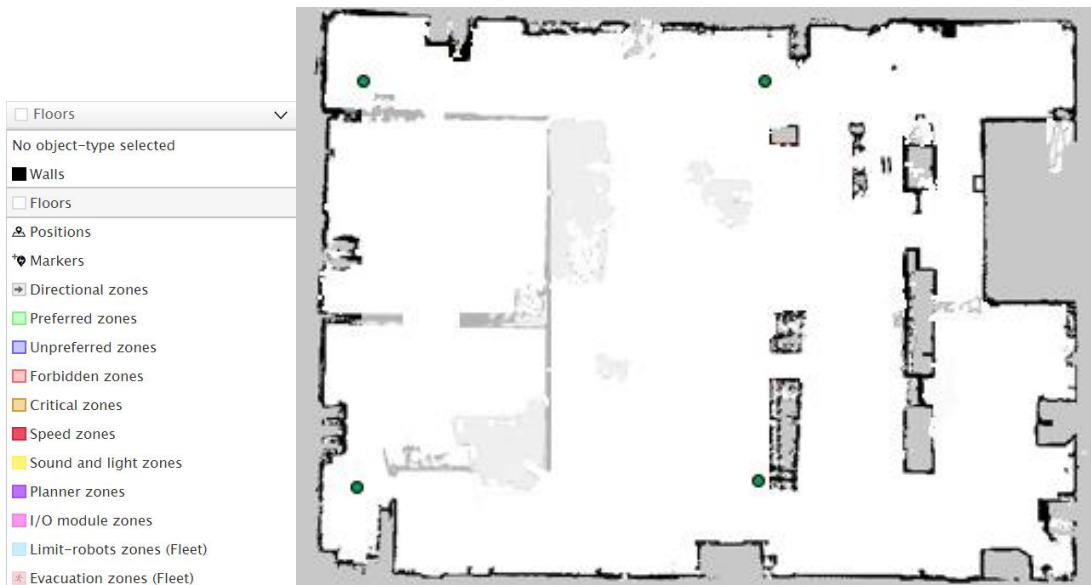
4. Select **Draw a new line** ✂, and mark on the map where there are walls or other static landmarks. It is a good idea to draw walls on top of all the walls and static objects the robot has recorded with its laser scanners. This will help the robot's localization and make the map more clean. Select **Finish current line** ✓ to finish a wall.




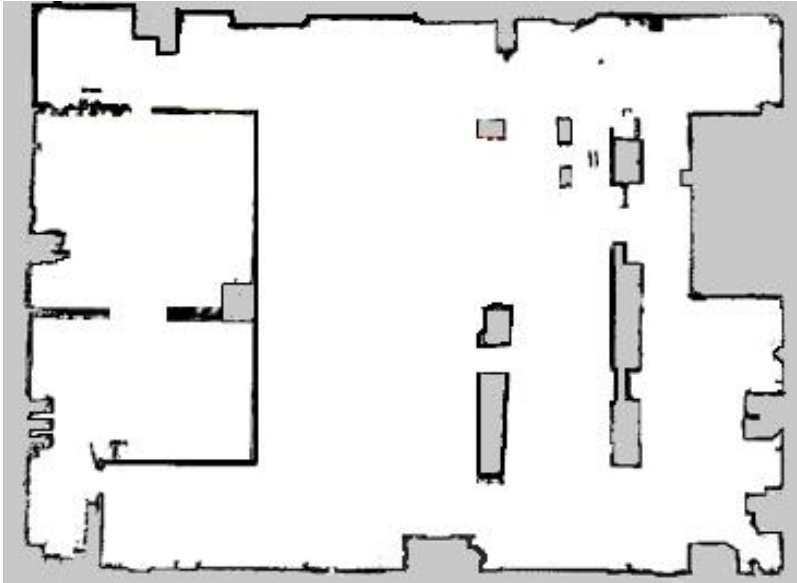
5. Select the erase tool 🗑. Use the tool to erase all unwanted objects on the map. The erase tool will only erase walls when you are on the walls layer. Select **Stop erasing uploaded or recorded data** ✓.



6. In the drop down menu, go to the floors layer by selecting **Floors**. The gray areas on the map is where the floor is missing, but often the easiest thing to do is to add a whole new floor on top of the mapped floor. Because you are on the floors layer, the new floor will not have an effect on objects on the walls layer. Draw the floor area on the map. Select **Finish current shape** ✓ to finish a floor.

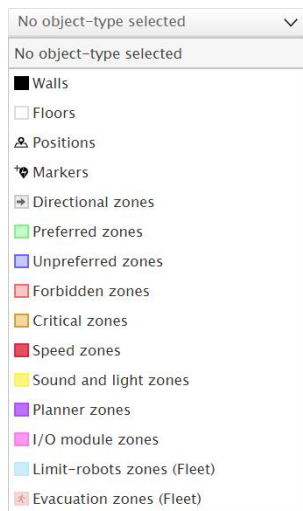


7. Once you've cleaned the map, it should look neat and only contain static landmarks. Select **Save current map**  to save the map.



Adding zones to the map

Adding zones to the map helps organize robot traffic. There are several different zones that can optimize the preferred paths and driving behavior of the robot.





NOTICE

All zones are ignored when you drive the robot in manual mode and if you use a relative move action.

- **Directional zones**

Lets you organize the motion of robots by specifying the directions in which the robots can move in specific zones.

- **Preferred zones**

The robot tries to run within a Preferred area, taking dynamic obstacles into account.

- **Unpreferred zones**

The robot tries to avoid Unpreferred zones, but may go into it them if there are no other possibilities.

- **Forbidden zones**

The robot will never enter a forbidden zone, with three exceptions: making a relative move, if a critical zone is on top of the forbidden zone, and if you drive the robot in Manual mode. Then the robot is allowed to make a plan through it, as described under Critical zones below.

- **Critical zones**

The global planner of the robot is allowed to make a path through a critical zone with complete disregard for other related zones, path guides, and obstacles.

Obstacles are not ignored by the local planner, and the robot will therefore not drive into obstacles, even though it has a global plan through them, but will try a few times to follow the plan before making a new global plan.

This zone is especially useful for driving on ramps and through automatic doors that both can seem like obstacles at a distance. It can also be useful in narrow doorways as the robot will have a global plan through it. The size of the zone should be kept to an absolute minimum, even 1 pixel wide is enough in most cases. This helps the global planner to make a simple plan through a critical fixed point in the environment.

- **Speed zones**

The robot changes its speed when driving in the zone. However, the robot will not drive faster than the limit set in **System > Settings > Planner > Maximum allowed speed**—see [System settings on page 143](#).

- **Sound and light zones**

The robot blinks and/or makes a sound to catch attention.

- **Planner zones**

Zone with six different setting options:

- **No localization**

The robot ignores data from the laser scanners and uses encoders only to localize. Useful for special driving, for example on ramps.

- **Look-ahead**

Look-ahead is used to define a decreased field of view for the robot's cameras and laser scanners.

- **Path timeout**

Maximum amount of time the robot keeps trying to complete its path if the route is blocked. It will deviate from the path unless path deviation is set to 0.

- **Path deviation**

Maximum allowed distance the robot can deviate from its path.

- **Ignore obstacles**

The robot ignores all obstacles detected with the 3D cameras with this action. This is useful if you experience problems with the robot stopping in front of windows because of sunlight.

- **Obstacle history clearing**

Selects how the robot will clear its obstacle history while driving. **No clearing:** the robot remembers all obstacles and only clears those in the field of view of cameras and laser scanners. **Clear in front of robot:** the robot only clears its memory of obstacles that it detects in a cone shape in front of it. The cone starts with the width of the robot footprint and increases by 0.3 m per meter. **Clear all:** the robot disables obstacle history altogether and only avoids obstacles that it detects with its sensors while driving.

- **I/O module zones**

The robot activates an I/O module when entering the zone. An I/O module zone may be used instead of controlling I/O modules through a mission.

- **Limit-robots zones**

Only applies when robots are controlled by MiR Fleet. The zone is used to keep an area clear of robots by setting a limit for the number of robots allowed in the zone at the same time. Additional robots will wait outside the zone for fleet permission to enter.

- **Evacuation zones**

Applies only when robots are controlled by MiR Fleet. The zone makes it possible to evacuate all robots in case of an emergency situation. Evacuation zones are inactive until activated by an operator on MiR Fleet.

Examples of when and how to use zones

Descending staircases

Issue: The 3D cameras cannot detect descending staircases. Marking a staircase as a wall on the map will only confuse the robot as it will try to navigate from a wall that is not there.

Solution: Mark staircases and areas surrounding staircases or holes in the floor as Forbidden zones on the map.

Low hanging fixtures

Issue: If a low hanging fixture is installed that is outside of the robot sensors' range, the robot may try to travel beneath it. This can be dangerous if the robot is carrying a tall top module or load that can collide with the fixture.

Solution: Mark the area where the low hanging fixture is located as a Forbidden zone.

Highly dynamic areas

A highly dynamic area is an area where objects are moved frequently. This could be a production area where pallets and boxes are often moved back and forth.

Issue: The robot will stop if a person steps out in front of it. In a transient work flow area, the robot will stop and reassess its paths many times a day, thereby wasting valuable time.

Solution: Mark highly dynamic areas on the map with for example Unpreferred zones or Forbidden zones depending on the environment. Directional zones can also be used here to guide the robot in a specific direction.



Figure 10.1. Unpreferred zones (marked with purple) can be used in highly dynamic areas to solve issues with re-planning of paths.

Doorways and ramps

Going through narrow doorways can cause problems for the robot or for the people working near the robot, as they might not see the robot coming. Going up a ramp can cause similar problems because of the upwards angle.

Issue: The robot stops because a narrow doorway is seen as an obstacle. Due to sensor input, the robot will not plan a path through a narrow doorway if it has an alternative path. The robot will always stop if a person steps out in front of it.

Solution: Add a Critical zone to the narrow doorway to force the global planner to make a path through the corridor. Place the zone right at the edges of the doorway, but don't place it on top of a wall, as this indicates to the robot that the wall isn't there. Add Sound and light zones in narrow doorways to attract attention. This will warn people near the doorway that the robot is coming through.

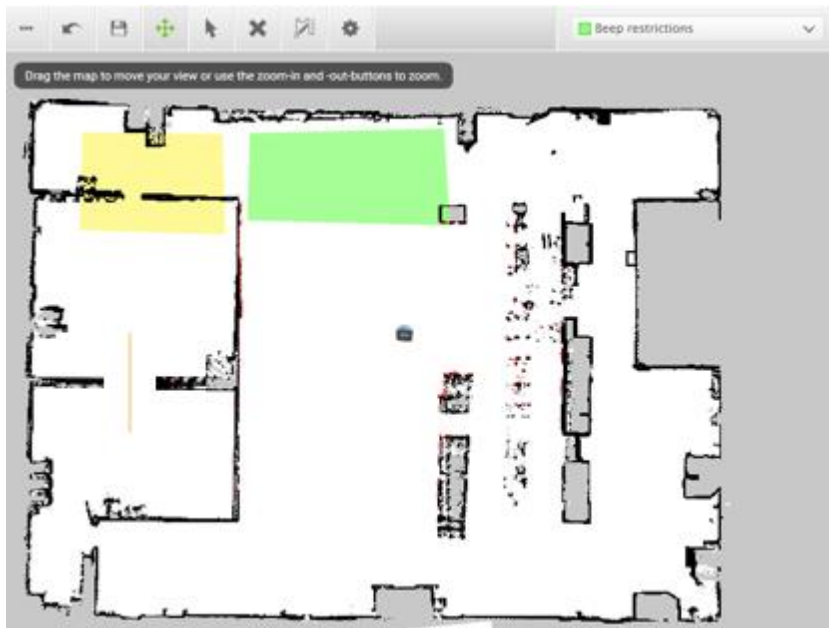


Figure 10.2. Narrow doorways can be marked with a Sound and light zone (marked with yellow) to warn people that it is coming through. A Critical zone (orange) can be placed on the narrow doorway to force the global planner to make a path through the corridor.

Shelves

Shelves are often placed in a certain height above the floor on four (or more) posts and will often appear as dots on a map for the robot. This may cause the robot to believe that there is enough space (if the posts are far enough apart) below the shelf to pass through. The robot will then plan a path underneath the shelves, but when it comes closer, the camera will see the obstacle. This could result in re-planning paths several times a day, thereby wasting valuable work time for the robot.

Issue: The robot will only see shelves as dots on the map and believe that it can make a global plan underneath the shelves.

Solution: Add a Forbidden zone (marked red in the image) around the shelves.

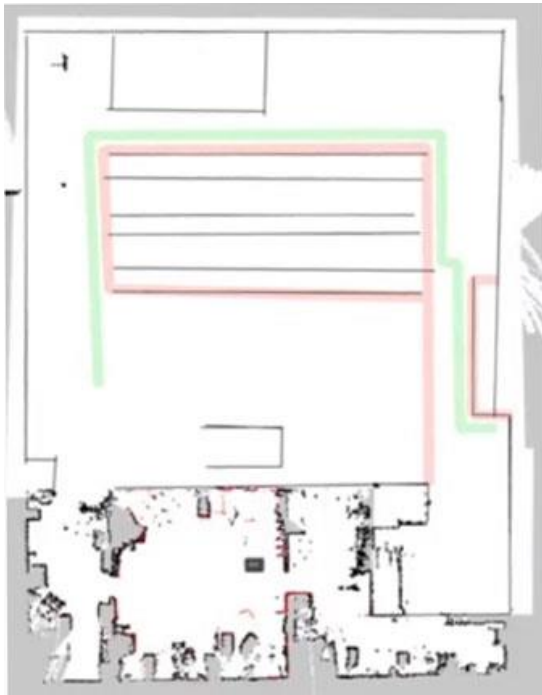


Figure 10.3. The shelves are marked as a Forbidden zone in the map.

Glass

Some types of glass cannot be detected by the safety laser scanners.

Issue: The robot will not stop before driving into a glass window, door, or other glass objects.

Solution: Make the glass visible to the safety laser scanners by gluing window film on the glass in the scanner height, 150 to 250 mm, or mark the area as a Forbidden zone.

10.4 Creating markers and positions

Markers and positions are defined as X-Y coordinates on a map that mark locations where you want the robot to travel to. Markers are used to indicate positions where the robot must position itself relative to a physical object making it more accurate, whereas positions mark a point on the map the robot travels to based on the robot's location on the map determined from localization—see [Localization on page 76](#).

Markers

Markers are points on the map that mark a physical entity, such as a charging station or a pallet rack. Markers enable the robot to position itself accurately relative to a physical object.

Markers require the robot to do a docking sequence. When the robot is docking, it uses its safety laser scanners to detect the marker and drives itself to the correct position relative to the detected marker. The robot begins docking to a marker from the marker's entry position. The entry position is automatically created approximately one meter in front of the marker and can be moved in the map editor.

There are three standard marker types that all MiR robots can use: V, L, and VL-markers.

A **V-marker** is a small, V-shaped marker. The V-marker is the simplest marker available to the robot. It consists of a V shape with an interior angle of 120° and sides of 150 mm.



A **VL-marker** is a larger marker that generally enables the robot to dock more accurately than V-markers. It consists of a V-marker with a 300 mm plate attached to the right of the V shape.



An **L-marker** makes it possible for the robot to dock sideways. It is shaped liked an L, and the dimensions are 400 mm x 600 mm. The outside have a clearly defined angle of 90°.



A few centimeters between markers should make docking possible. Determine during commissioning if more space is required.



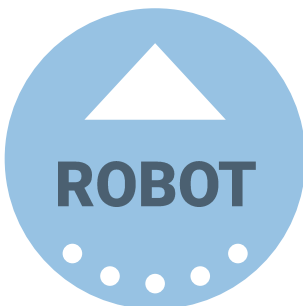
For further information on markers, see the how-to guide *Create and dock to V-, L-, and VL-markers*. Contact your distributor.

Positions

Positions are used either as destination positions or as waypoints on a route that you want to use in missions. The robot only uses its position determined from localization to drive to the position making them less accurate than markers.

The final orientation of the robot is indicated by the arrow on the position image.

There are different types of positions depending on whether the robot is part of a fleet or drives with top modules, but the standard position that is available in all MiR applications is the **Robot position**. This position has no special features, it simply marks a location where you want to be able to send the robot to.



Creating a marker

Before creating a marker, you must ensure that the robot is localized correctly on an active map. If in doubt, you can check if the red lines representing the laser scanner line match the black lines on the map, as shown in *Figure 10.4*.

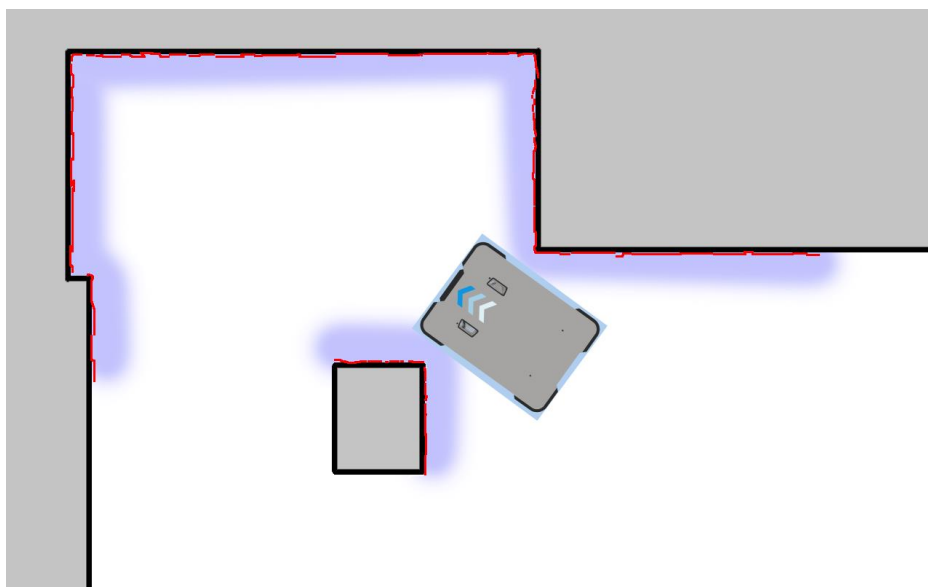


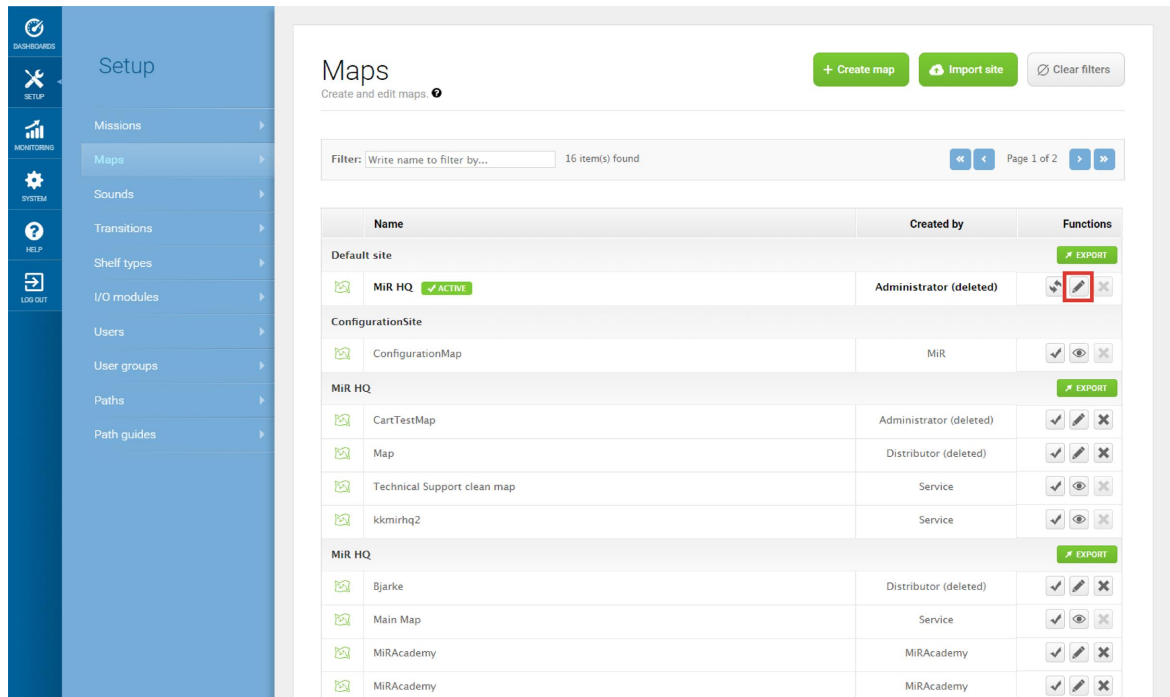



Figure 10.4. The red lines represent the obstacles the laser scanners detect. The robot is localized correctly when the red lines align with the black lines that represent walls.

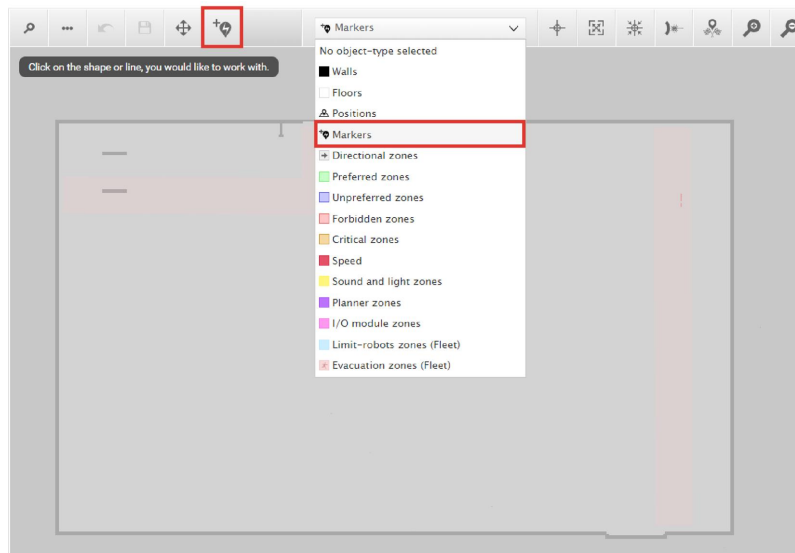
Once the robot is localized, you can insert a marker on the map. In this example, we are using a VL-marker .

1. Place your physical marker where you want the robot to dock.
2. Manually drive the robot to the marker so the robot is facing the marker.

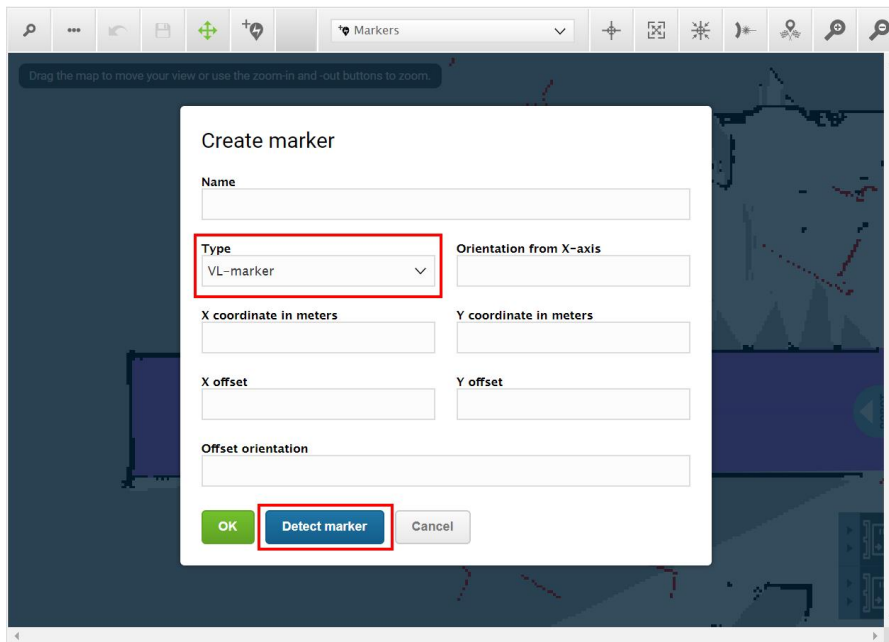
- Go to **Setup > Maps** and select **Edit**  for the active map.



- Within the editor, select **Markers** in the **Object-type** drop down menu, and then select **Draw new marker**  in the editor tools.



5. In the **Create marker** dialog box, name the marker. Under **Type**, select your marker type. In this case, a **VL-marker** is used. Then select **Detect marker**.



The X, Y, and orientation values will automatically be filled out with the current position of the robot. Set the offsets to 0. If you want to dock to the marker in reverse, set the **Offset orientation** to 180.



If the robot is too far from the VL-marker, a message that the robot failed to locate the marker is displayed. Try moving the robot closer, and ensure that the front safety laser scanner is positioned in front of the VL-marker.

6. Select **OK** to create the marker. The marker is now visible on the map.



7. The marker can be docked to by selecting it on the map and selecting **Go to**. It can also be used in missions.

GO TO	Send robot to this position.
EDIT	Edit this position's name and parameters.
DELETE	Delete this position from the map.
SHOW ENTRY POSITION(S)	Show entry position(s) for this position.
CANCEL	Close this dialogue.



To change the final position of the robot, you can select **Edit** to adjust the x or y offsets. These are valued in meters and are based on the centerpoint of the robot towards the marker.

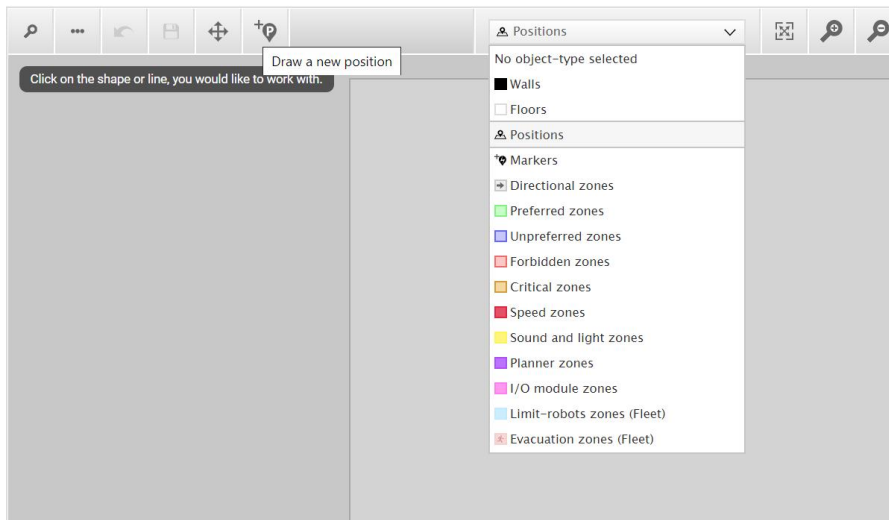
Edit marker

Name ROEQ_Docking yoyo cart	
Type VL-marker	Orientation from X-axis -91.612
X coordinate in meters 26.152	Y coordinate in meters 18.196
X offset -0.51	Y offset 0.04
Offset orientation 0	
<div> <div>OK</div> <div>Detect marker</div> <div>Cancel</div> </div>	

Creating a position

The following steps describe how to create a position on a map. In this example, we are creating a robot position 📍.

1. In the robot interface, enter the map editor of the map where you want to create a position. This is done by navigating to **Setup > Maps** and selecting **Edit**  next to the map you would like to work on.
2. In the Object-type drop-down menu, select **Positions**, and then select **Draw a new position** .

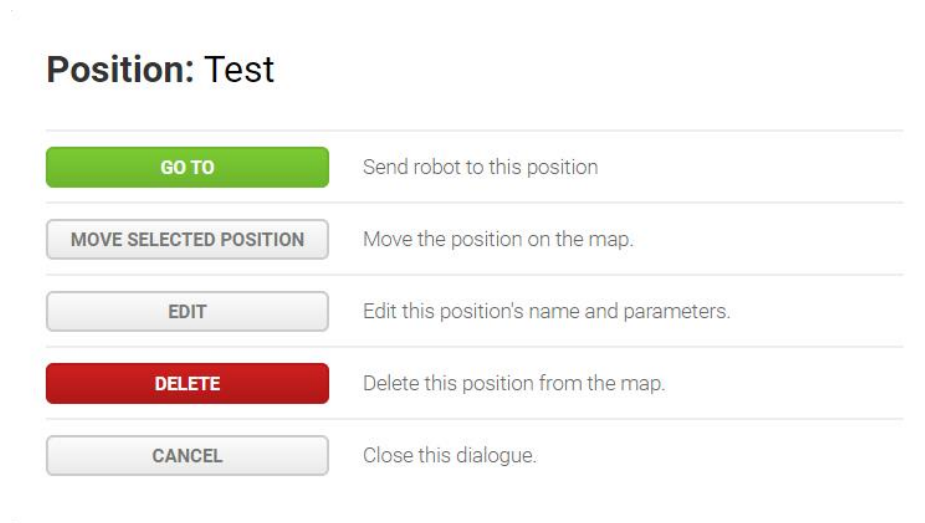


3. Select where on the map where you want the position to be, and choose in which direction you want it to face.
4. Name the position. Under **Type**, you can select which type of position you want to make. In this example we are making a robot position. Select **OK**. You have now created a robot position.

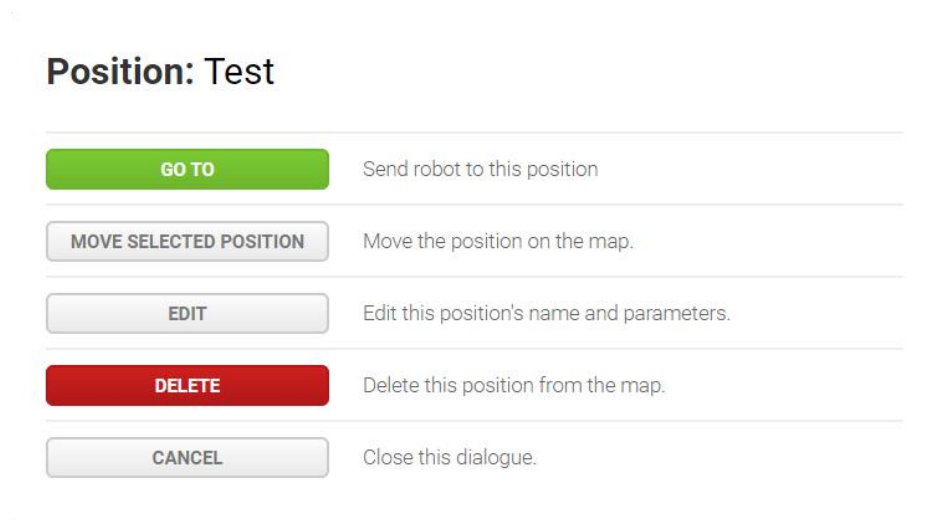
Create position

Name <input type="text" value="Test"/>	
Type <input type="text" value="Robot position"/>	Orientation from X-axis <input type="text" value="-74.604"/>
X coordinate in meters <input type="text" value="6.950"/>	Y coordinate in meters <input type="text" value="11.250"/>
<div> <input type="button" value="OK"/> <input type="button" value="Cancel"/> </div>	

You can always edit a position or send a robot to the position by selecting it in the map.



You can always edit a position or send a robot to the position by clicking on it in the map.

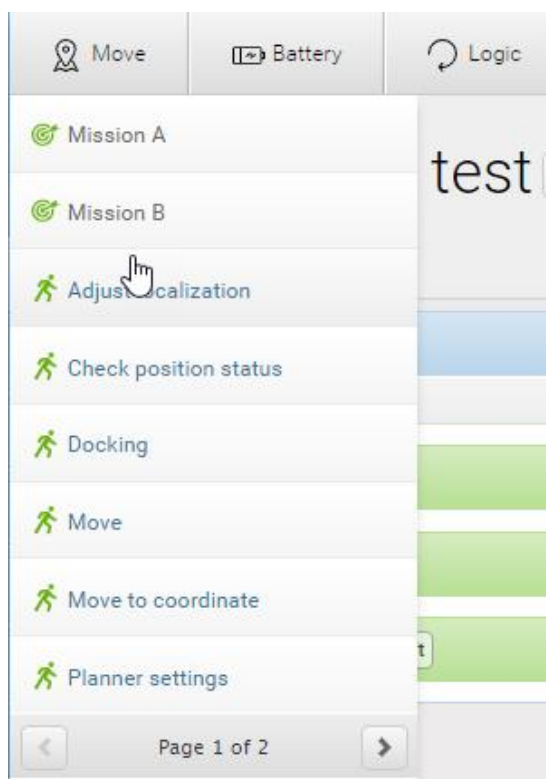


10.5 Creating a mission

MiR robots function through missions that you create. A mission is made up of actions, such as: move actions, logic actions, docking actions, and sounds, which can be put together to form a mission with as many actions as needed. Missions themselves can also be embedded into other missions.

Most actions have adjustable parameters, for example which position to go to. Most actions can also use variables, enabling the user to choose the value of a parameter each time the mission is added to the mission queue. This can be practical in cases where the robot performs the same series of actions in different areas of the site that require different parameter settings in the mission actions.

When you create a mission, you can save it in the default **Missions group**, or you can choose to save it in any of the available actions groups. The actions groups are found in the top bar of the mission editor window, and you can distinguish missions from actions by the small icons shown next to their names: missions have a target icon 🎯, and actions have a running-man icon 🚶.



You can find more information about mission groups in [Mission groups on page 129](#).

The **Mission** section also comes with a set of template missions that you can use and/or modify.

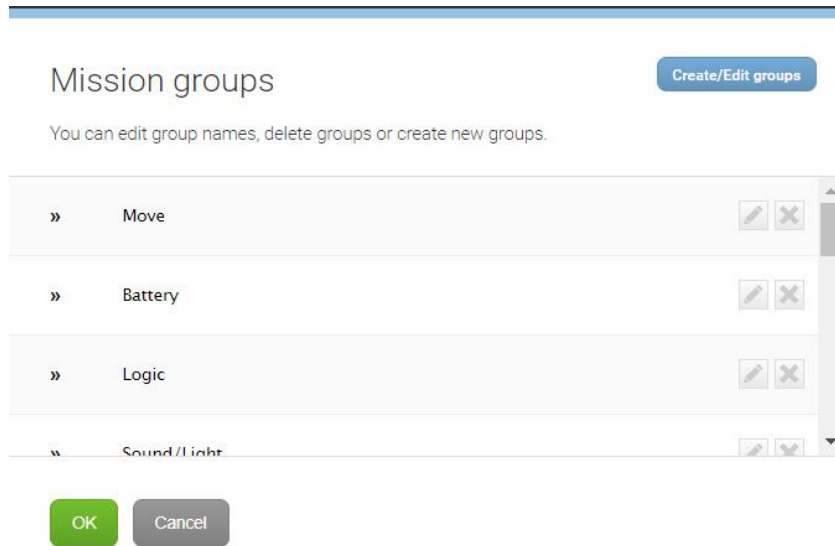
When you create a mission, you must fill in the following information:

- **Name**
The name must be unique and is used to identify the mission. For example, *Go to charging station*, *Deliver spare parts* or *Warehouse to production line 1*.
- **Mission group**
Select which group you want the mission to be part of.
- **Site**
If you are using more than one site, select which site you want the mission to belong to.

Select **Create mission** to create a new mission that you can add actions to.

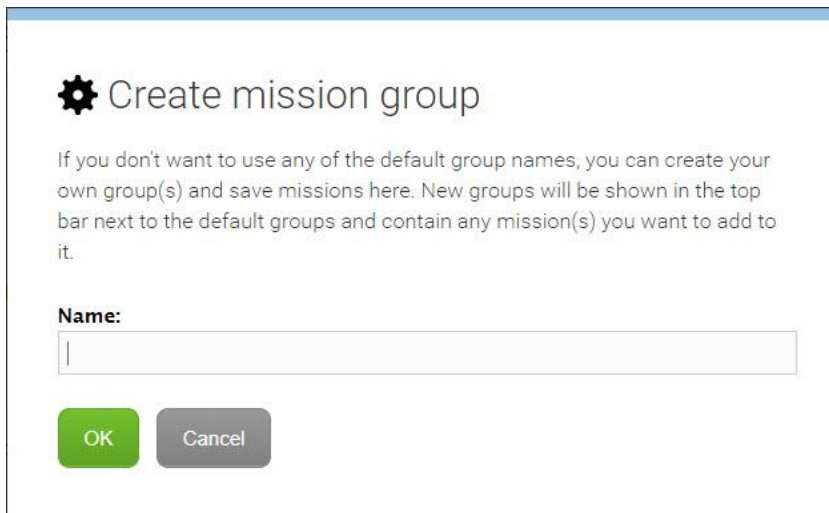
Mission groups


Each mission group has a number of predefined actions that can be selected when you build the mission. One mission can contain actions from several groups. When you save the new mission, it will be placed in the selected group and can be used as a separate mission or as an embedded mission in other missions.



Create mission group


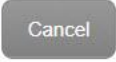
If you don't want to use any of the default group names, you can create your own group(s) and save missions here. New groups will be shown in the top bar next to the default groups and contain any mission(s) you want to add to it.



 Create mission group

If you don't want to use any of the default group names, you can create your own group(s) and save missions here. New groups will be shown in the top bar next to the default groups and contain any mission(s) you want to add to it.

Name:



10.6 Creating a footprint

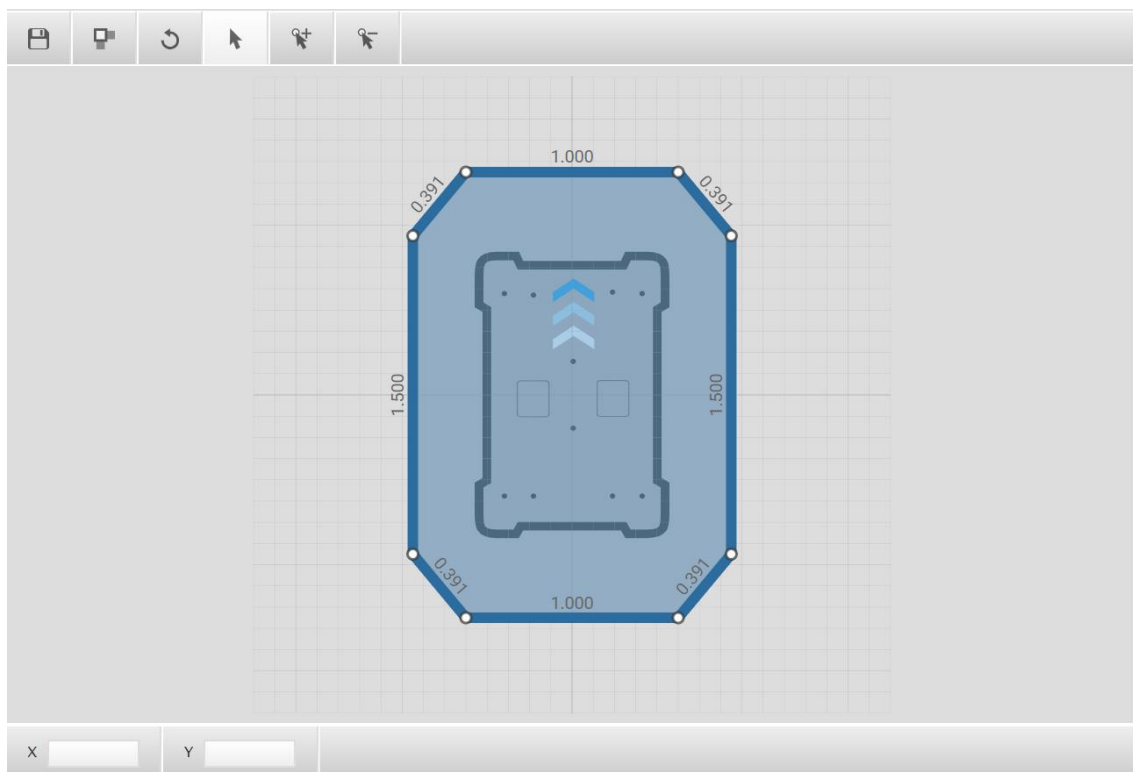
The footprint specifies how much space the robot occupies, including any loads or top applications. The footprint is defined by a number of points relative to the robot's center coordinate system. If your robot drives with loads or shelves that exceed the width or length of the robot, you should define a new footprint for the robot to ensure that the robot correctly plans its route to avoid colliding with obstacles with its top application or load.



For a more thorough guide to creating footprints, contact your distributor to see the guide *How to change the robot footprint*.

Follow these steps to create your own footprint:

1. In **Setup > Footprints**, select **Create footprint**, and name the footprint.
2. Drag the points to change the footprint.
 - You can choose to drag the points in simple mode for a rectangular footprint, or in advanced mode for a footprint defined with four or more points. To toggle between modes, select **Toggle mode**  .
 - In each editor mode you can change the position of a point by either dragging it or by inserting X and Y values for that point in meters in the text box in the bottom-left corner.

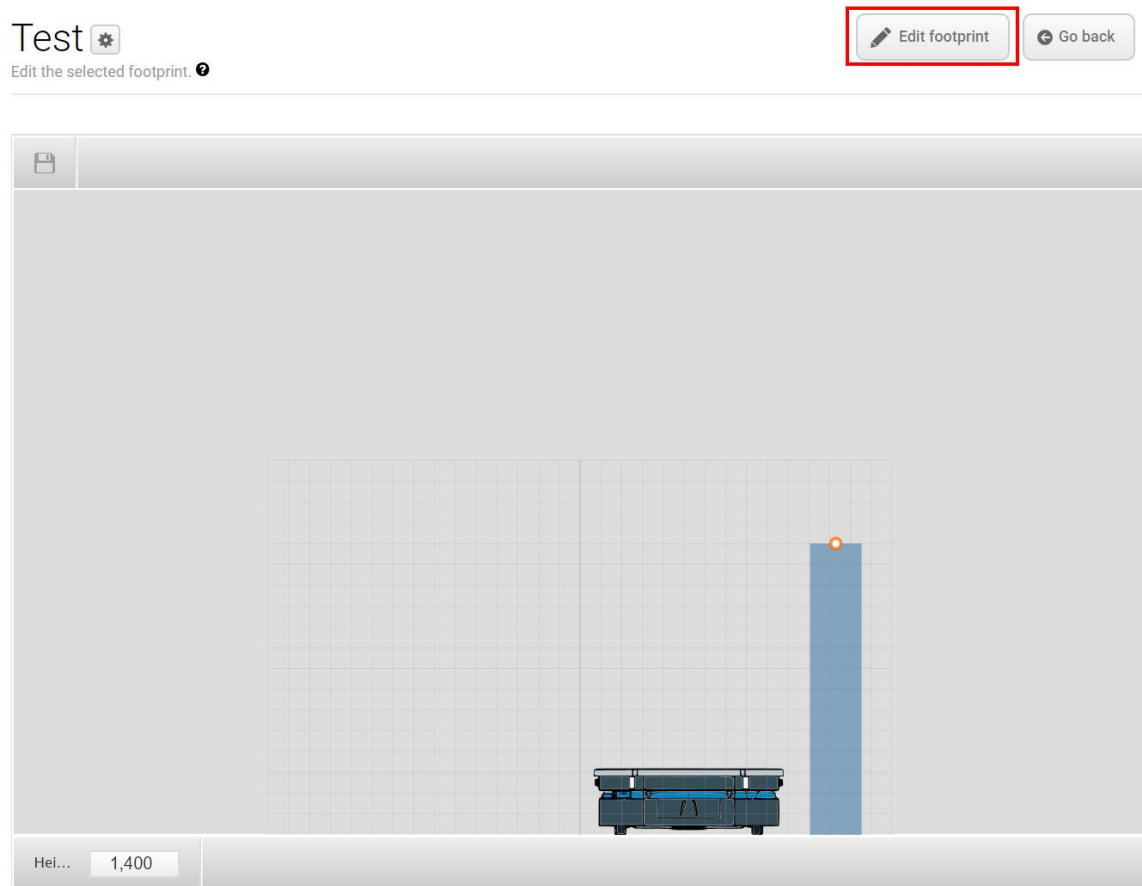


The values displayed along the lines are the distances between points in meters.



The maximum footprint is 3x3 m, and the maximum footprint height is 1.8 m.

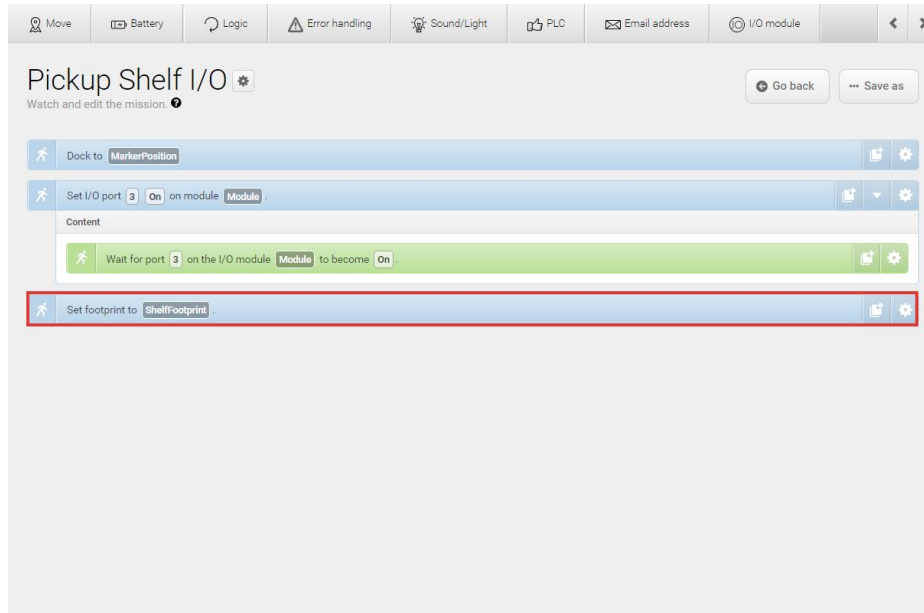
3. Select **Edit height/Edit footprint** if you need to change the height of the footprint. You can either drag the column to the right of the robot, or insert a value in meters in the text box in the bottom-left corner.



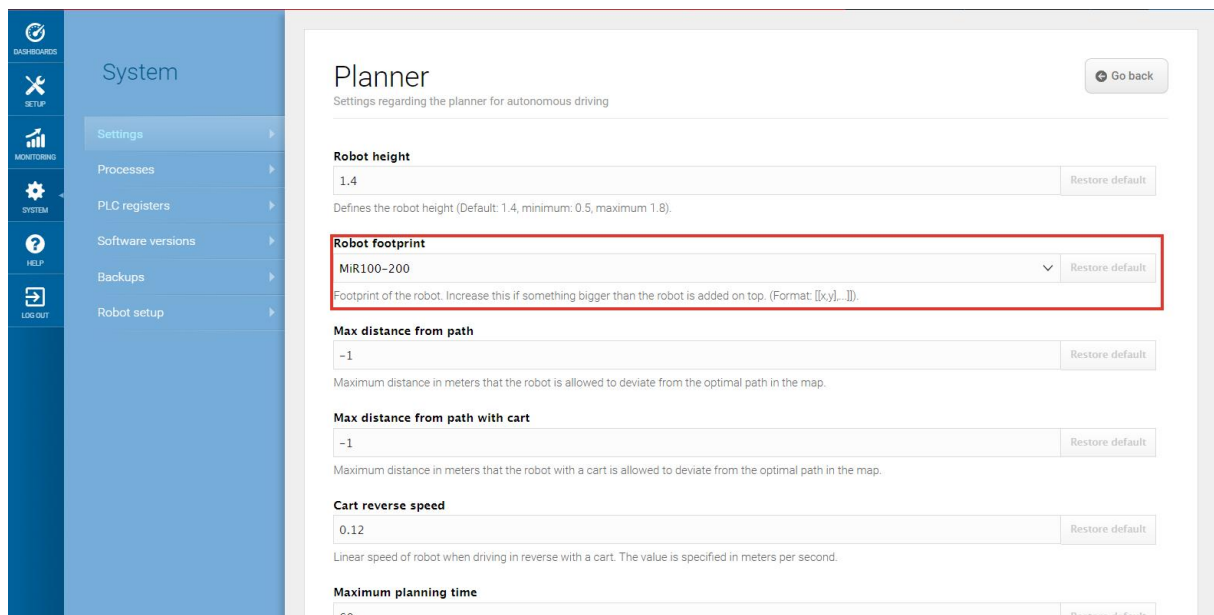
4. When you are done, select **Save**  to save the footprint.

You can use the footprint in various missions or set the footprint as the default footprint of the robot.

If you want to change the footprint in a mission, for example if the robot picks up a shelf, use the Set footprint action or a shelf template mission where the Set footprint action is already implemented.



If you want to edit the default footprint of the robot, for example if the top application is larger than the robot, go to **System > Settings > Planner**, and select a new footprint under **Robot footprint**.



10.7 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. Personnel must be instructed to stay clear of operating hazard zones when a robot is approaching.

Areas where the robot drives with muted personnel detection means and areas with inadequate clearance must be marked as operating hazard zones with signal tape or similar marking material.

To create a sufficiently large operating hazard zone, the marking must be at least one meter away from the potentially hazardous area in all directions.

It is not allowed to have work stations in operating hazard zones.

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 the 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 acoustical and visual warnings when the robot drives into the zones

For more information about zones, see [Creating and configuring a map on page 104](#).

Docking to a marker

When docking to a marker, the robot mutes its personnel detection means temporarily and the area must therefore be marked as an operating hazard zone. For more information about markers, see [Creating markers and positions on page 118](#).

The muting starts when the robot reaches the entry position approximately one meter from the marker. To indicate this to people nearby, MiR250 slows down and starts blinking yellow, using the eight signal lights on the corners of the robot.

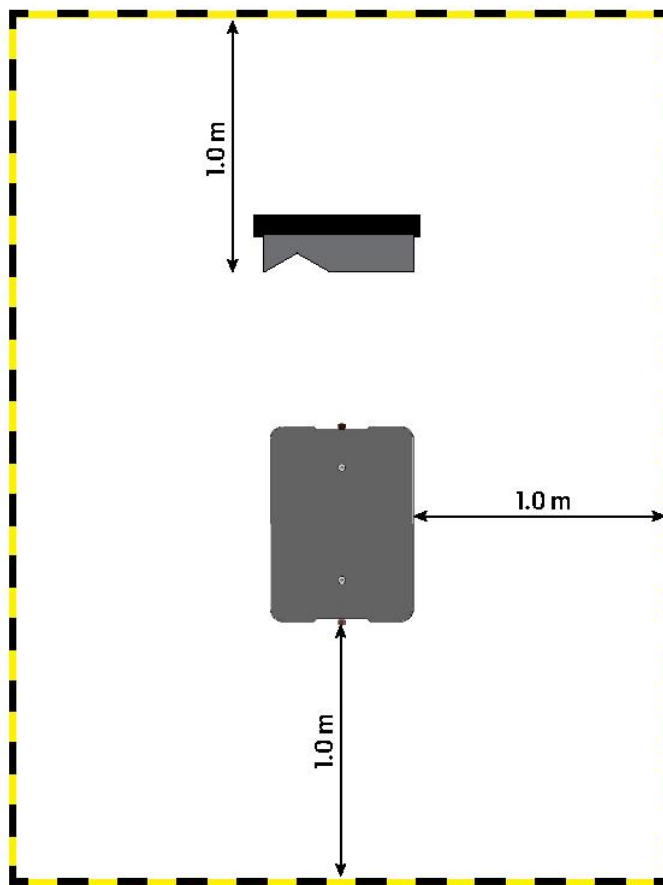


Figure 10.5. The striped black and yellow line identifies the required operating hazard zone around the marker. The robot is placed on the entry position to the marker.

You must mark the floor area one meter around the docking marker and the robot when it is at the entry position. This is illustrated in *Figure 10.5* where the robot is docking to a VL-marker.

10.8 Brake test

It is the responsibility of the commissioner to perform an adequate test of the robot's braking capability.

The braking distance of MiR250 is particularly dependent upon four factors:

1. The speed of the robot
2. The payload of the robot

3. The surface the robot drives on
4. The decline of the surface the robot drives on

Because of this, it is not possible to predetermine the exact braking distance of MiR robots. The distance has to be determined in the environment and under the driving conditions the robot will be operating in.

The goal of the brake test is to ensure that the robot will brake in time to avoid a collision with a human or object when driving with maximum payload, with different field sets for different speeds, and at the steepest supported decline.

If the measured braking distance is too long, the field sets of the robot should be made larger to ensure a safe installation. The field sets should always be at least somewhat larger than the breaking distance at all speeds. To modify the field sets, see the guide . Contact your distributor for the guide.

10.9 Creating user groups and users

All users of the robot must have a user profile in the system. Users are administered in the Users section where you set up, edit, and delete system users.

The user profiles are created during commissioning. As default, the robot has three User groups: User, Administrator and Distributor. Parts of the user interface can be locked by the commissioner. The locked parts are typically related to the safety of the robot system, and changing the settings can violate the CE-marking of the robot.

It is important to analyze and consider who is:

- Working directly with MiR250 as direct users or operators?
- Responsible for MiR250 as commissioner?

Furhtermore, the following questions should be answered:

- How many different users are there?
- What tasks do each user have with MiR250?
- What permissions (read/write) should the different users have?
- What functions or widgets should be available for the different users?



For more details on interface and dashboards, see *MiR Robot Reference Guide*.

Create user groups

In **Setup > User groups** you can create specific user groups with specific access to different parts of the robot interface.

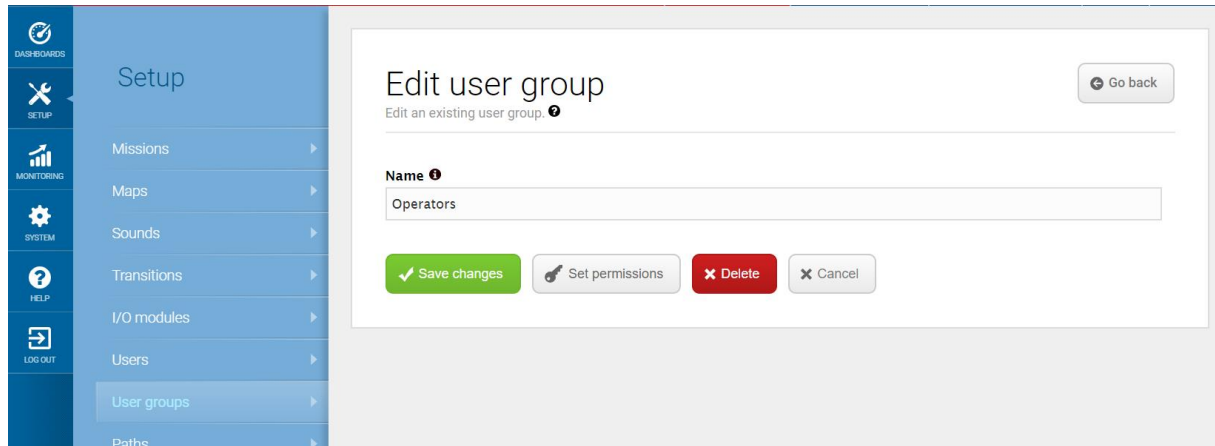


Figure 10.6. You can create specific user groups.

Under **Set permissions**, you can select the specific parts of the robot interface that the user group has access to.

Maps & positions		
	Section	<input type="checkbox"/> Write
	Sites	<input type="checkbox"/> Write
	Maps	<input type="checkbox"/> Write
	Zones	<input type="checkbox"/> Write
	Positions	<input checked="" type="checkbox"/> Write
	Paths	<input type="checkbox"/> Write
	Path guides	<input type="checkbox"/> Write
	Marker types	<input checked="" type="checkbox"/> Write

Figure 10.7. You can select the specific parts of the robot interface that the user group has access to.

Create users

In **Setup > Users**, you can create new users and select:

- Which user group they belong in.
- If they are Single dashboard users with no access to other parts of the interface than to control the robot from a dashboard.
- If they should be allowed quick access to the interface via a four digit PIN code. We only recommend PIN codes for users with no access to settings and safety system.

Figure 10.8. When you create a user, you must fill out the fields shown in this image.

Table 10.1 describes which features should be accessible to which users—see [Users on page 36](#).

Feature	User group
Controlling the robot manually	Operator
Creating maps and positions	Commissioner
Creating and editing missions	Operator
Adjusting warning sounds	Commissioner

Feature	User group
Creating new user groups	Commissioner
Assigning missions	Direct user
Changing system settings	Commissioner

Table 10.1. The table identifies which users MiR recommends should be able to edit which features.

10.10 Creating dashboards

To make the user experience as easy and simple as possible, you can build a unique dashboard for each user. Dashboards are an easy way for different user groups to control the robot giving direct access to their individual key functions.



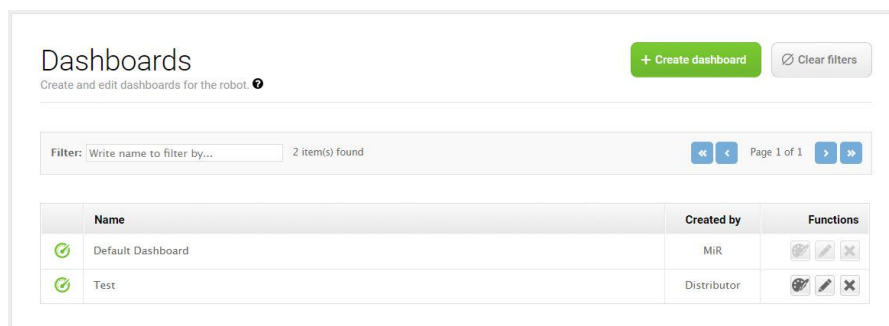
For more details on interface and dashboards, see *MiR Robot Reference Guide*.

A dashboard is made up of a number of widgets, each representing a feature in the system, for example a particular mission, the map the robot is operating on, or the current mission queue.

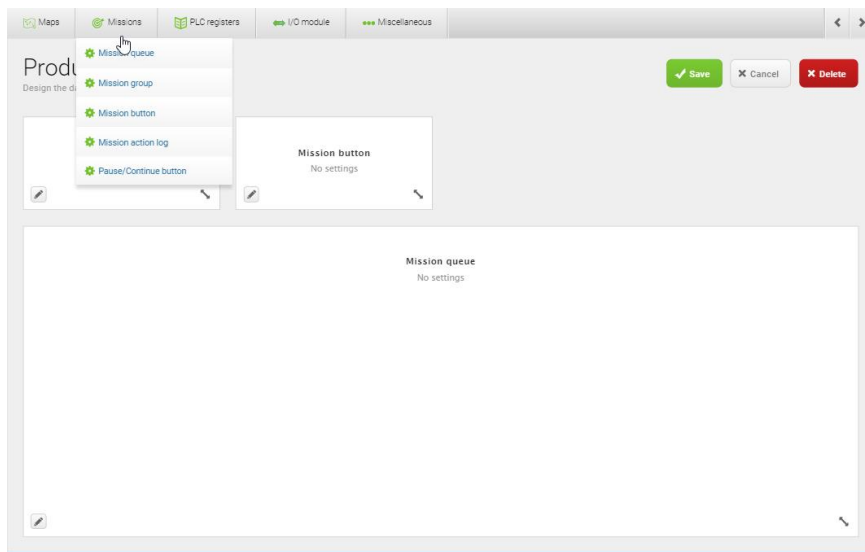
The system comes with a default dashboard, and users with access rights to create dashboards can create an unlimited number of additional customized dashboards.

To create a custom dashboard:

1. Go to **Dashboards > Dashboards**, and select **Create dashboard**.



2. Name the dashboard, and select **Create dashboard**.
3. In the design section:
 - Design the dashboard by adding widgets from the menus in the top bar that represent the features you want to assign to the dashboard.
 - Resize the widgets by pulling the arrow in the lower right-hand corner, and rearrange their order by click-dragging.
 - Some widgets require further settings. For example, you must select a particular mission for mission buttons. To do this, select the pen icon in the lower left-hand corner, and select the wanted action.



4. Select **Save** to save the dashboard. The dashboard is now available under **Dashboards**.



For details on the widgets and missions available in dashboards, see *MiR Robot Reference Guide*.

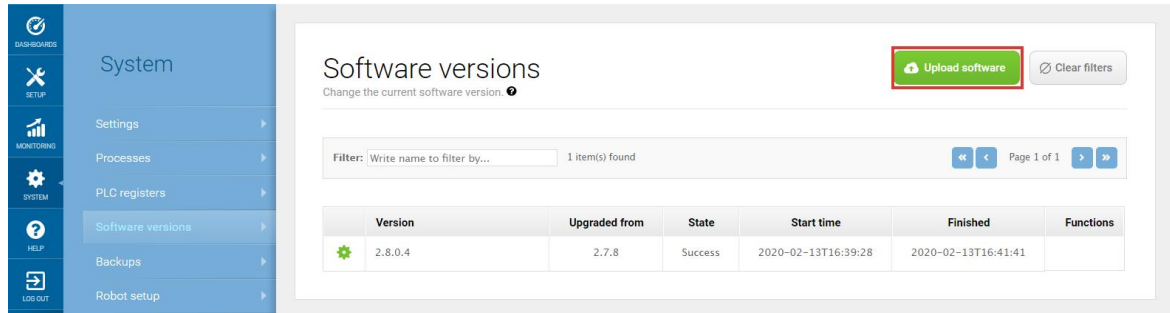
10.11 Updating MiR250 software

MiR continuously updates the software the robots use, either to fix issues, to improve existing features, or to introduce new features. Each software release is issued with a release note explaining the content of the update and its target audience.

Contact your distributor for the latest update file.

Follow the steps below to update MiR250 software:

1. Connect your computer to the WiFi of the robot you want to update, and sign in to the robot interface.
2. Go to **System > Software versions** and select **Upload software**.



3. Locate and select the downloaded software package. It may take a few minutes for the package to successfully upload.
4. Once the software is uploaded, turn the robot off and then on again.

10.12 Creating backups

It can be useful to create a backup if you want to be able to revert to the exact state of the current software, including data such as settings, missions, and reports at a later stage.

To make a backup of your system, go to **System > Backups**. Select **Create backup**.

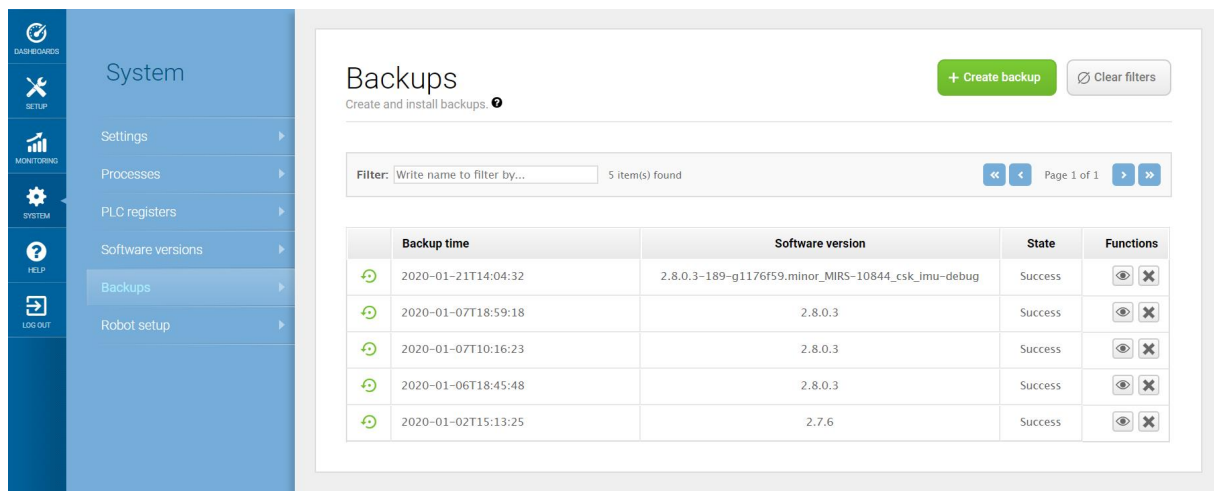




Figure 10.9. You can create backups of the current software version and setup you are running on your robot.

When the state displays **Success**, you have created a backup of your system.

Follow the steps below to revert to a previous system:

1. Go to **System > Backups**. Choose the back up version you want to revert to, and select **View** .
2. Select **Roll back**. You have now reverted your robot back to the saved version.

Backup

Information about the selected backup. 

[Go back](#)

» Backup time	2020-01-21T14:04:32
» Software version	2.8.0.3-189-g1176f59.minor_MIRS-10844_csk_imu-debug
» State	Success

[Roll back](#)
[Delete](#)
[Go back](#)

10.13 System settings

This section describes some of the commonly used system settings of MiR250 that the commissioner must be aware of.



Only the basic system settings are explained in this section, see *MiR Robot Reference Guide* for more information.

In **System > Settings**, users can access the settings of the robot. Access to the settings must be restricted by the commissioner—see [Creating user groups and users on page 137](#).

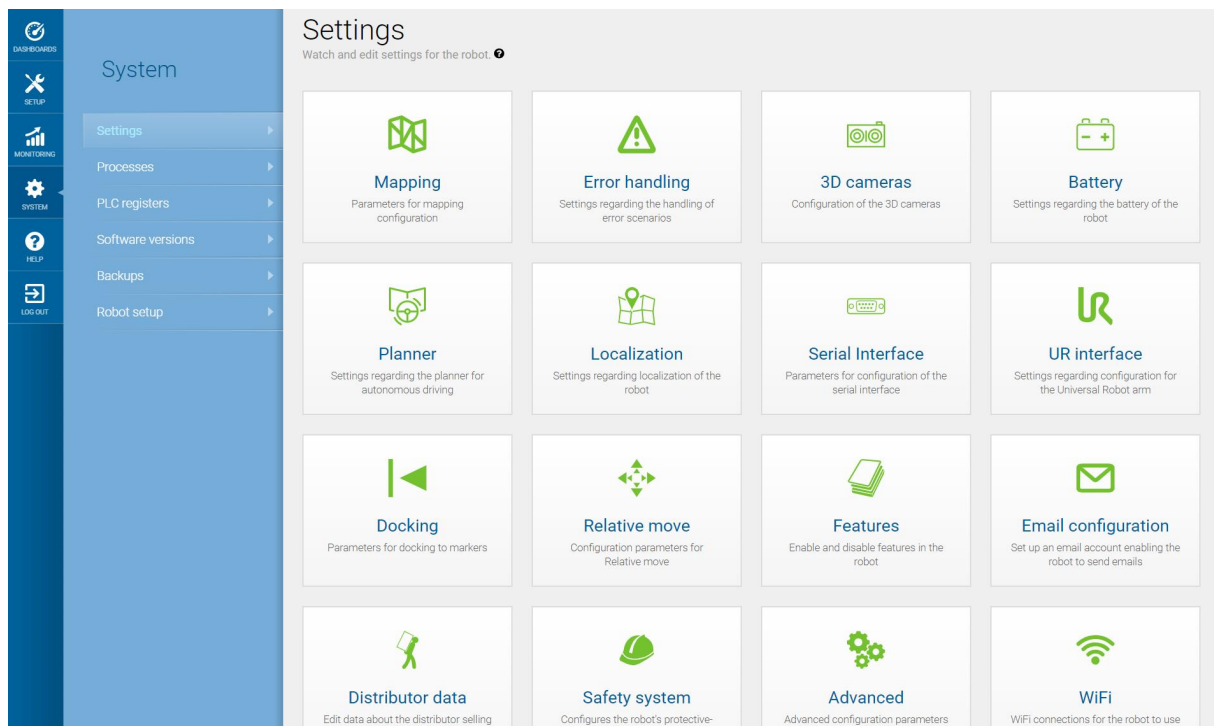


Table 10.1. Under **System > Settings**, there are several menus where you can edit your robot's settings.

Planner

In the Planner section, you set the basic parameters for driving the robot.

Planner

Settings regarding the planner for autonomous driving

Go back

Robot height

Restore default

Defines the robot height (Default: 1.4, minimum: 0.5, maximum 1.8).

Max distance from path

Restore default

Maximum distance in meters that the robot is allowed to deviate from the optimal path in the map.

Max distance from path with cart

Restore default

Maximum distance in meters that the robot with a cart is allowed to deviate from the optimal path in the map.

Maximum planning time

Restore default

The maximum time allocated for planning a path. The value is specified in seconds.

Path timeout

Restore default

Timeout before asking for a new global plan [in seconds]. Note! Negative value means infinite waiting time.

Path deviation

Restore default

Maximum distance in meters that the robot is allowed to deviate from the path planner in the map. Note! Negative value disables the feature.

Indicator light

▼

Restore default

Set to True to enable indicator lights while driving autonomously.

Robot height defines the height of the robot including top modules. Use this setting if your robot operates permanently with a top module that makes the combined robot application higher than the robot itself. This prevents the robot from colliding with obstacles from above.

Max distance from path and **Max distance from path with cart** defines the maximum allowed distance in meters that the robot is allowed to deviate from the optimal path in the map.

Maximum planning time defines the maximum time allowed in seconds for planning a path.

Path timeout defines the maximum time allowed in seconds before the robot asks for a new plan if the robot's path is blocked.

Path deviation defines the maximum distance in meters that the robot is allowed to deviate from the path planner in the map before it makes a new path.

Optimizing the distance, time, timeout, and deviation of paths is useful in situations where you want to configure how strictly the robot should follow the path it has planned. Making the robot follow the exact path it has planned with little or no deviation is known as Line-following. This can be useful, for example, in narrow corridors where there isn't enough space for the robot to go around dynamic obstacles—see *Figure 10.10*. When there isn't enough space for the robot to go around an obstacle, it will often spend more time trying to maneuver around the obstacle and correct its trajectory afterward than it would have just waiting for the obstacle to move out of the way itself.

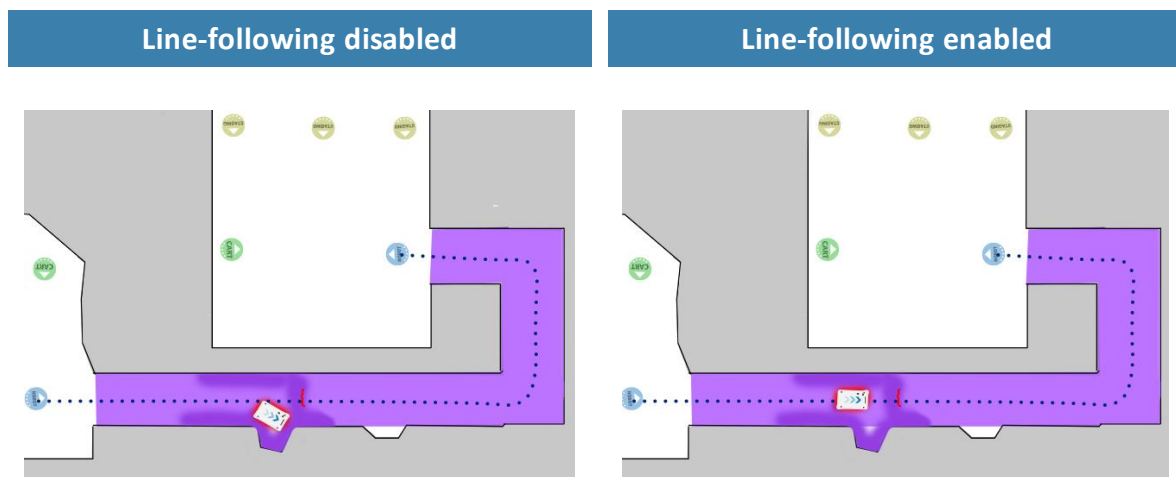


Figure 10.10. Example of where the robot might benefit from using a Line-following configuration.

Maximum allowed speed defines the overall speed limit of the robot in meters per second. The maximum allowed speed will never be exceeded no matter what is stated in the mission. This setting can be useful if, for example, the robot transports motion sensitive objects, or if the work environment in other ways require the robot to always stay below a certain speed threshold.

Desired speed sets the default speed of the robot. This setting can be useful in the same way as maximum allowed speed, but with this setting, the robot will drive faster than the set desired speed in a speed zone that requires it.

Docking

In the Docking section, you can change the parameters regarding docking to and from markers.

Docking

Parameters for docking to markers

Go back

Undock from markers

True Restore default

Select True to make the robot undock before starting move from docked position.

Hide advanced settings

Distance to marker for disabling collision checks.

0.2 Restore default

Distance to marker where collision detection is disabled.

Docked at marker side threshold

0.4 Restore default

Side threshold for being docked to a marker

Docked at marker angle threshold

20 Restore default

Angular threshold for being docked to a marker

Parameter for driving more straight during docking

1.0 Restore default

Setting of maximum allowed change to marker estimate when the robot moves towards a marker (in meters per meter). Reducing the value of this parameter makes the robot move more straight during docking. However, it also reduces the precision of the docking.

Relative move target when docking to markers.

0.5 Restore default

Relative move target offset when docking to markers. The value is specified in meters.

In **Undock from markers**, you can select if the robot should undock from a marker before it starts moving from a docked position. It is usually best to set this setting to **True** to prevent the robot going into protective stop when moving away from markers.

In the advanced settings, you can adjust the parameters for docking to markers. This can be useful in case of docking issues. To see the advanced docking settings, select **Show advanced settings**.

Safety system

In the Safety system section, you can change the safety settings of the robot.

Safety system

Configures the robot's protective-fields system

Go back

Muted-protective-fields sound

Beep



Restore default

When the robot drives with muted protective fields, this warning sound is played.

Muted-protective-fields volume

50

Restore default

The volume for warning sounds

Save changes

Cancel

Select **Muted protective fields sound** to change the warning sound that is played when the robot drives with muted protective fields.

Select **Muted protective fields volume** to set the volume in decibel for the warning sound that is played when the robot drives with muted protective fields.



CAUTION

Driving with with muted protective fields without audible warning sound risks damage to personnel and voids the CE marking of the application.

- Always have the robot play an audible warning sound when driving with muted protective fields.

Features

In the features setting, you can disable and enable robot features.

Features

Enable and disable features in the robot

Go back

Shelf

False	▼	Restore default
-------	---	-----------------

Select **True** if the robot is used to pick up and place shelves.

Email address

True	▼	Restore default
------	---	-----------------

Select True to add an action for sending emails from missions.

PLC registers

True	▼	Restore default
------	---	-----------------

Select True to add actions for setting PLC registers from missions and monitoring PLC register in the robot interface.

Universal Robots Interface

False	▼	Restore default
-------	---	-----------------

Select True to add an action for running UR-programs from missions.

Fleet

False	▼	Restore default
-------	---	-----------------

Select True if the robot is part of a fleet

Modbus

False	▼	Restore default
-------	---	-----------------

Select True if the robot uses Modbus

I/O modules

True	▼	Restore default
------	---	-----------------

Add actions for communicating with IO modules

Shelf enables the shelf feature. Select **True** if the robot is used to pick up and place shelves.

Email address enables an action for sending emails from missions.

PLC registers enables actions for setting PLC registers from missions and monitoring PLC registers in the robot interface.

Universal Robots Interface enables an action for running Universal Robots-programs from missions. It can be set to **True** if MiR250 drives with an application from Universal Robots.

Fleet makes the robot visible for a MiR Fleet. Select **True** if the robot is part of a fleet.

Modbus enables modbus.

I/O modules adds actions for communicating with **I/O modules**. Select **True** if the robot uses I/O modules.

11. Usage

The main way to use MiR250 is through missions that you create.

In the following sections, you will find practical examples of how missions can be tailored to different tasks. The examples include:

- Creating a mission that uses a Prompt user action. The example mission is titled *Prompt user*.
- Creating a mission that uses a Try/Catch action. The example mission is titled *Try/Catch*.
- Creating a mission that uses variables. The example mission is titled *Variable footprint*.
- Creating a mission that makes the robot drive through an 80 cm doorway. The example mission is titled *80 cm doorway*.

11.1 Creating the *Prompt user* mission

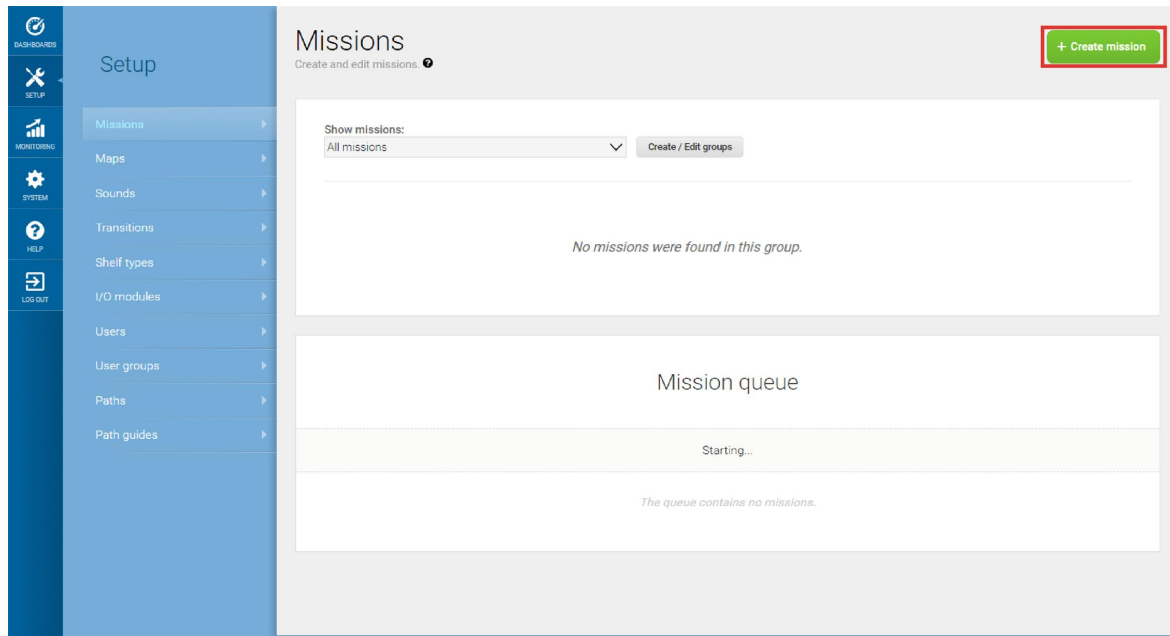
Prompt user actions are used for prompting the user with a question on how the robot should proceed. The *Prompt user* mission uses a Prompt user action that lets you choose whether to send the robot to one position or another.

To create the *Prompt user* mission, it is assumed that you have completed the following:

- Created two robot positions named **p1** and **p2** as described in [Creating markers and positions on page 118](#).
- Defined a user group named **Users**.

To create the mission, follow the steps below:


1. Go to **Setup > Missions**. Select **Create Mission**.



2. Name the mission *Prompt user*. Select the group and site you want it to belong to. Select **Create mission**.

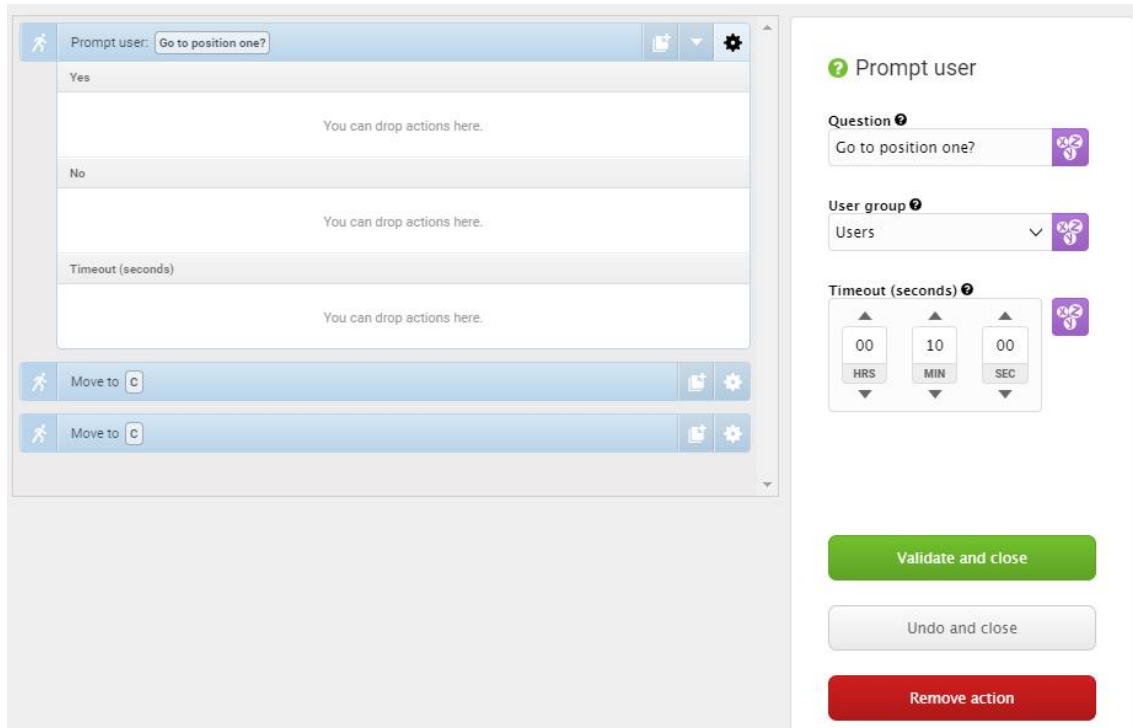
3. Select the following actions:

- In the **Logic** menu, select **Prompt user**.
- In the **Move** menu, select **Move**.
- In the **Move** menu, select **Move**.

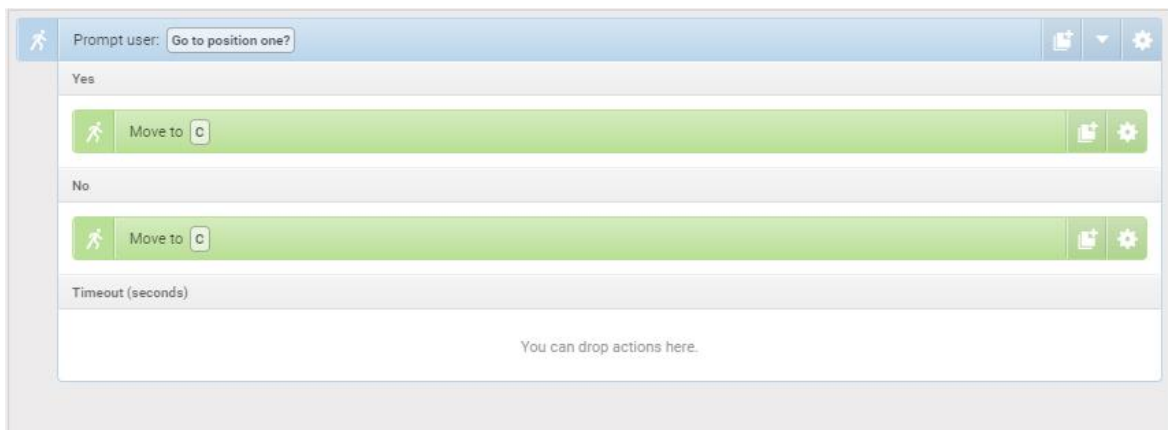
The following steps describe which parameters each action should be set to. To modify the parameters, select the gearwheel  at the right end of the action line to open the action dialog box. When you have set the parameters, select **Validate and close**.

4. In the **Prompt user** action, set the parameters as follows:

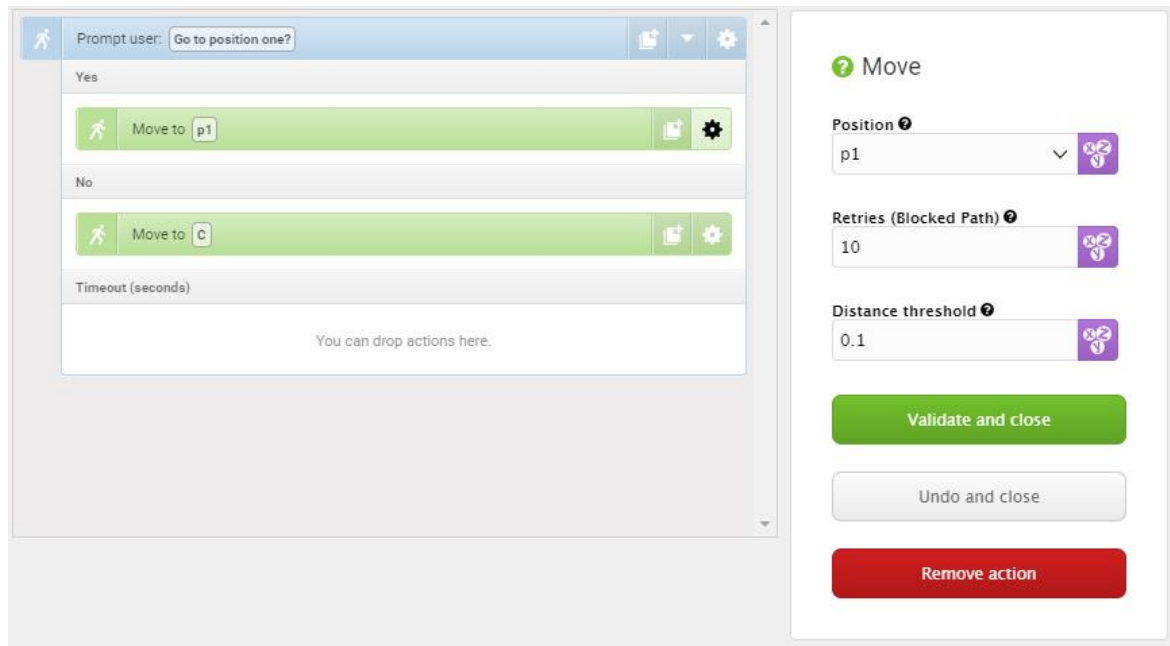
- **Question:** Enter the question **Go to position one?**
- **User group:** Select **Users**.
- **Timeout:** Set the timeout to 10 minutes.



5. In the **Prompt user** action, drag a **Move to** action into the **Yes** box and a **Move to** action into the **No** box.



6. In the first **Move to** action, under **Position**, select **p1**.



7. In the second **Move to** action, under **Position**, select **p2**.

The screenshot shows the MiR mission editor interface. On the left, a mission flow is visible with a 'Prompt user: Go to position one?' action. Below it, there are two 'Move to' actions. The first 'Move to' action is set to 'p1'. The second 'Move to' action is set to 'p2'. Below these actions is a 'Timeout (seconds)' field with the text 'You can drop actions here.' On the right, a configuration panel for the 'Move' action is shown. It includes a 'Position' dropdown menu set to 'p2', a 'Retries (Blocked Path)' field set to '10', and a 'Distance threshold' field set to '0.1'. At the bottom of the configuration panel are three buttons: 'Validate and close' (green), 'Undo and close' (grey), and 'Remove action' (red).

The mission should look like this:

The screenshot shows the MiR mission editor interface with the mission flow completed. At the top, there is a 'Prompt user' section with a 'Watch and edit the mission' link. Below this, there are four buttons: 'Go back', 'Save' (green), 'Save as', and 'Delete' (red). The mission flow is visible on the left, showing the 'Prompt user: Go to position one?' action, followed by two 'Move to' actions. The first 'Move to' action is set to 'p1' and the second 'Move to' action is set to 'p2'. Below these actions is a 'Timeout (seconds)' field with the text 'You can drop actions here.' The 'Save' button is highlighted in green.

8. Select **Save** to save the mission.

11.2 Creating the *Try/Catch* mission

Try/Catch actions are used to handle mission errors. When you use a Try/Catch action, you can define what the robot should do if it at any point fails to execute its main mission. This prevents the robot from going into an error state and stopping in the middle of a mission by

providing an alternative course of action if the main mission fails.

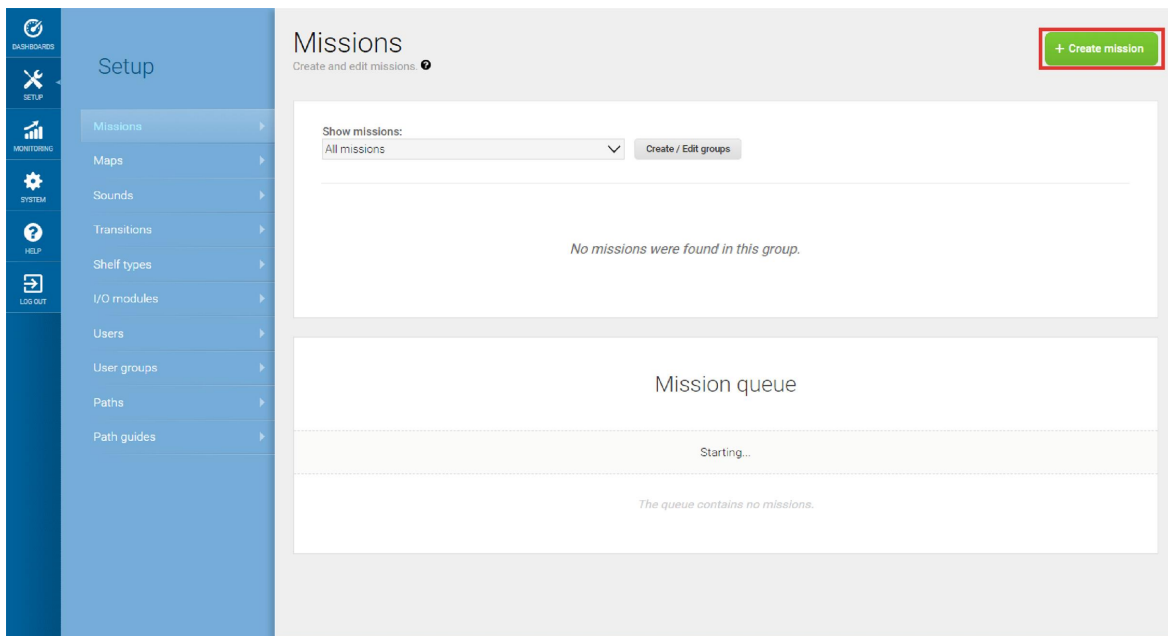
In the *Try/Catch* mission example, the robot runs the *Prompt user* mission created in [Creating the Prompt user mission on page 150](#), and if the robot for some reason fails to complete the mission, the robot plays a sound.

To create the *Try/Catch* mission, it is assumed you have completed the following:

- Created the *Prompt user* mission as described in [Creating the Prompt user mission on page 150](#).

To create the mission, follow the steps below:

1. Go to **Setup > Missions**. Select **Create Mission**.



2. Name the mission *Try/Catch*. Select the group and site you want it to belong to. Select **Create mission**.

3. Select the following actions:

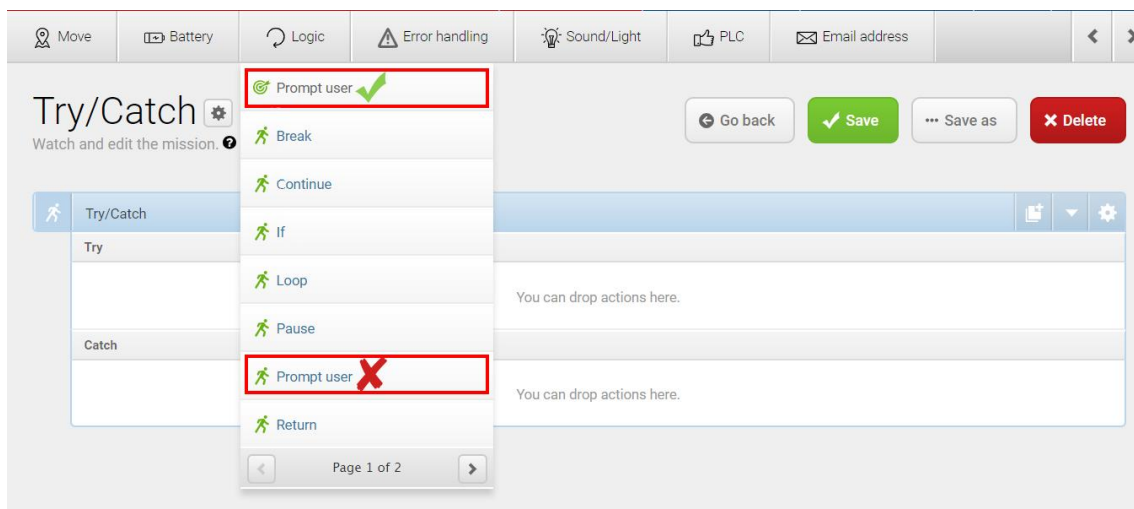
- In the **Error handling** menu, select **Try/Catch**.
- Select the **Prompt user** mission you have made.

The mission group you have saved the mission under will figure as a menu in the mission editor. The menus contain both missions and actions.

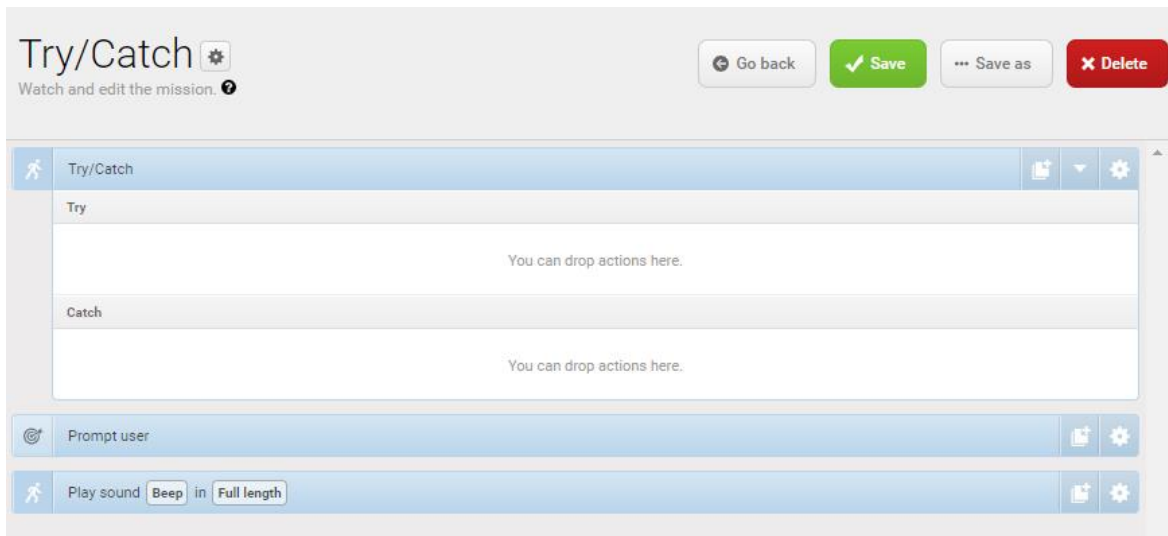



Missions have this icon and actions have this icon .

In this example, the mission is saved under the **Logic** menu that also includes the **Prompt user** action . Be sure to select the **Prompt user** mission .

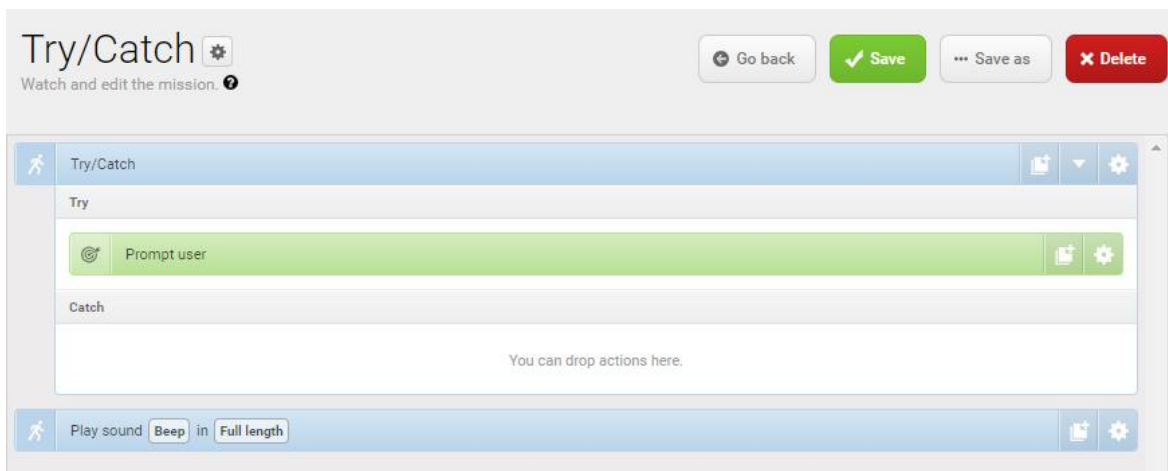


- In the **Sound/Light** menu, select **Play sound**.

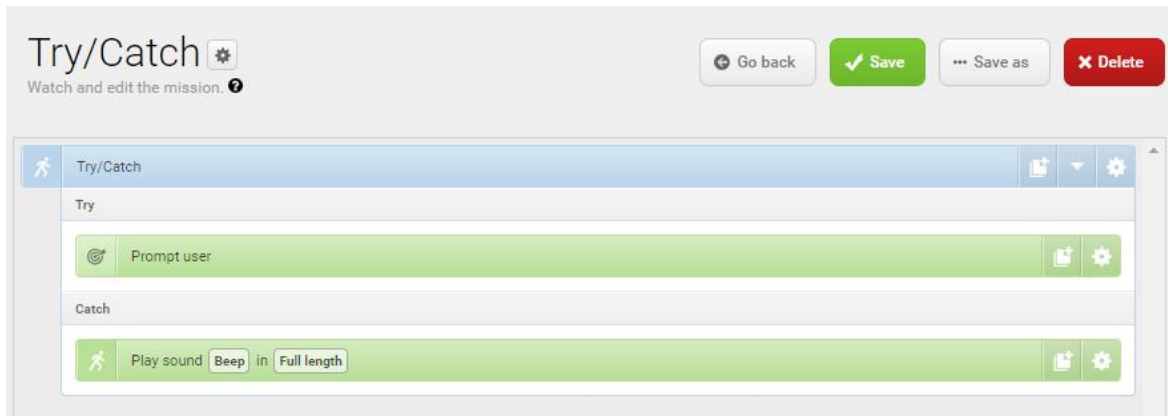


The following steps describe which parameters each action should be set to. To modify the parameters, select the gearwheel  at the right end of the action line to open the action dialog box. When you have set the parameters, select **Validate and close**.

4. Drag the **Prompt user** mission into the **Try** box under **Try/Catch**.

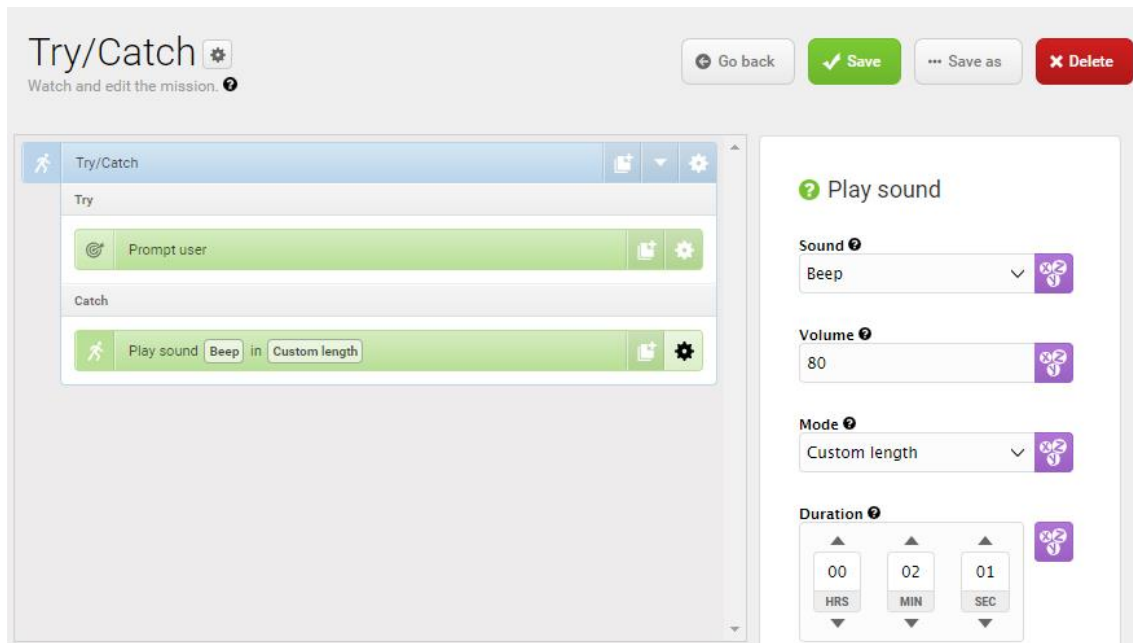


5. Drag the **Play sound** action under the **Catch** box under **Try/Catch**.

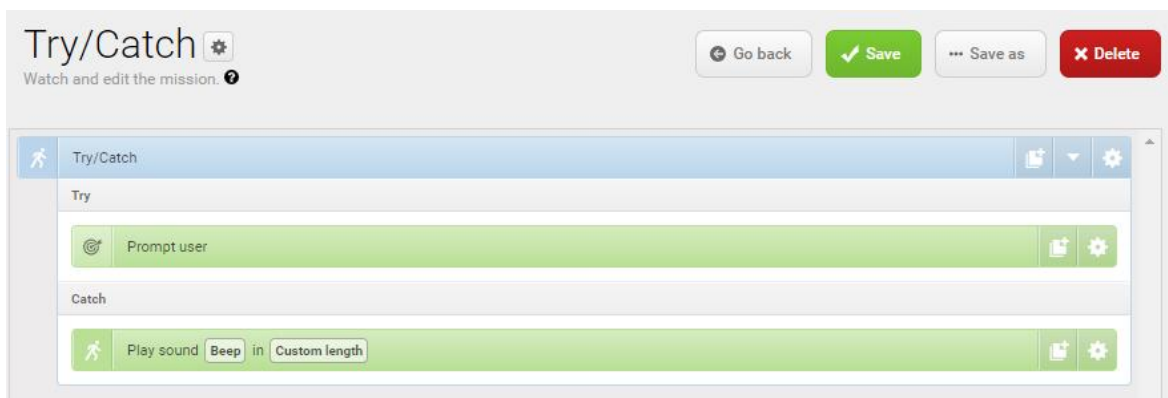


6. In the **Play sound** action, set the parameters as follows:

- **Sound:** Select **Beep**.
- **Volume:** Enter the value **80**. This is approximately 64 dB.
- **Mode:** Select **Custom length** so you can enter the duration of time the sound is played.
- **Duration:** Set the duration to two minutes.



The mission should look like this:



7. Select **Save** to save the mission.

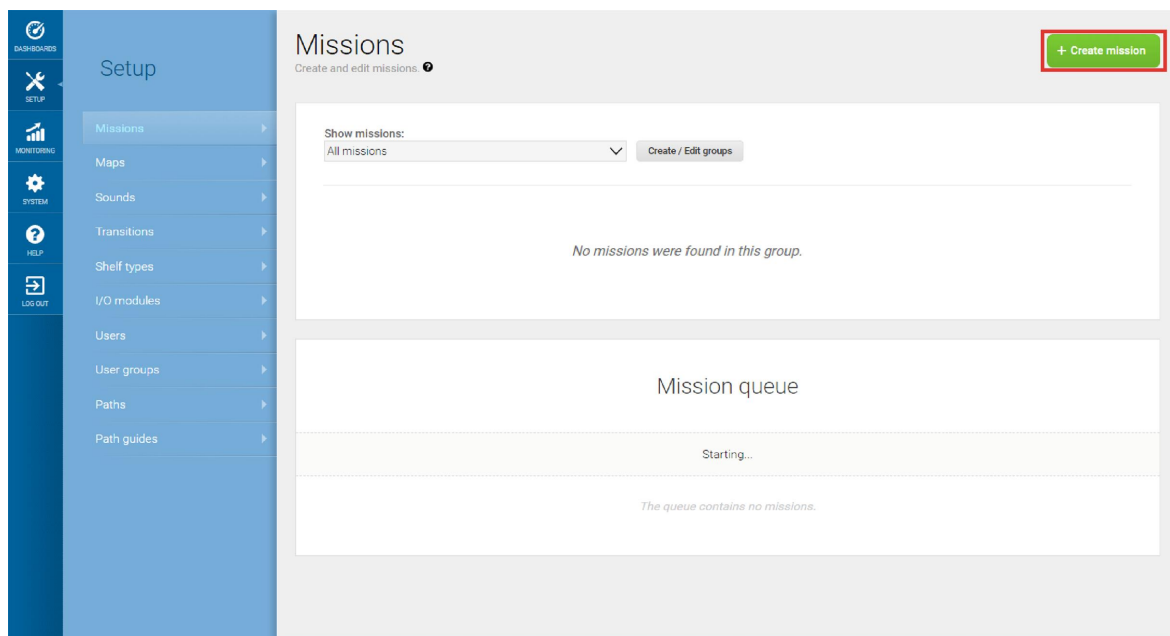
11.3 Creating the *Variable footprint* mission

All mission actions that require the user to specify the value of a parameter when they choose to use the mission have the option of defining a variable. If you use a variable in a mission when you add the mission to the mission queue or nest it inside another mission, you must select a value for the parameter where the variable is used. This allows you to reuse the same mission for different but still similar tasks.

The *Variable footprint* mission enables you to select which footprint the robot should use each time the mission is run.

To create the mission, follow the steps below:

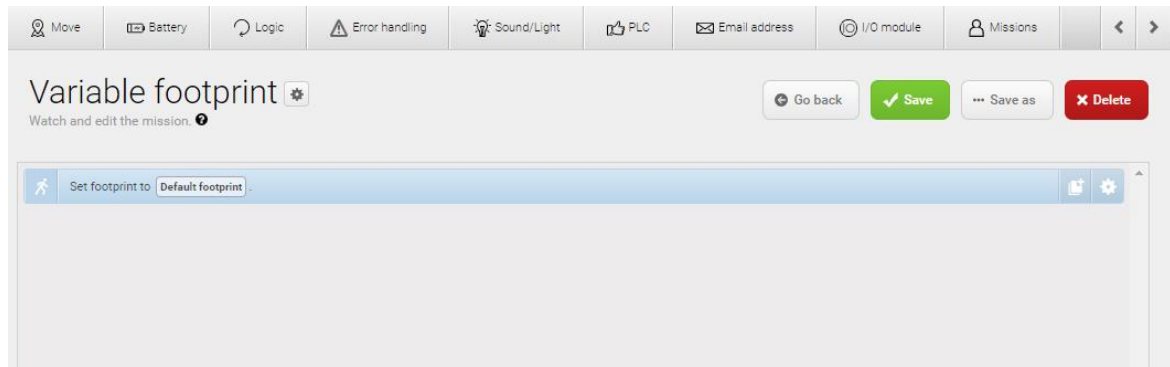
1. Go to **Setup > Missions**. Select **Create Mission**.




2. Name the mission *Variable footprint*. Select the group and site you want it to belong to. Select **Create mission**.

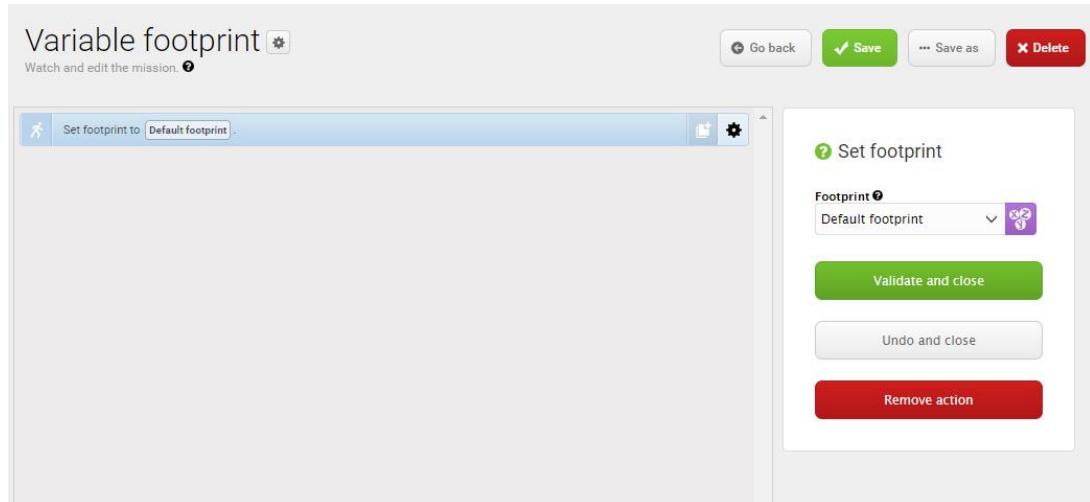
3. Select the following actions:

- In the **Move** menu, select **Set footprint**.



The following steps describe which parameters each action should be set to. To modify the parameters, select the gearwheel ⚙ at the right end of the action line to open the action dialog box. When you have set the parameters, select **Validate and close**.

4. In the **Select footprint** action, make the parameter **Footprint** a variable that can be set each time you use the mission. The following steps describe how to create a variable:
 - a. Under **Footprint**, select **Variables** .



- b. Select **Create variable** in the upper-right corner.
- c. Name the variable *Use default footprint or narrow footprint?*. Select **OK**.

Create variable

In the **Name** field, enter a question that describes what the variable is used for, for example, "How far should the robot move?" In the **Default value** field, enter a default distance.

Variable name

Use default footprint or narrow footprint?

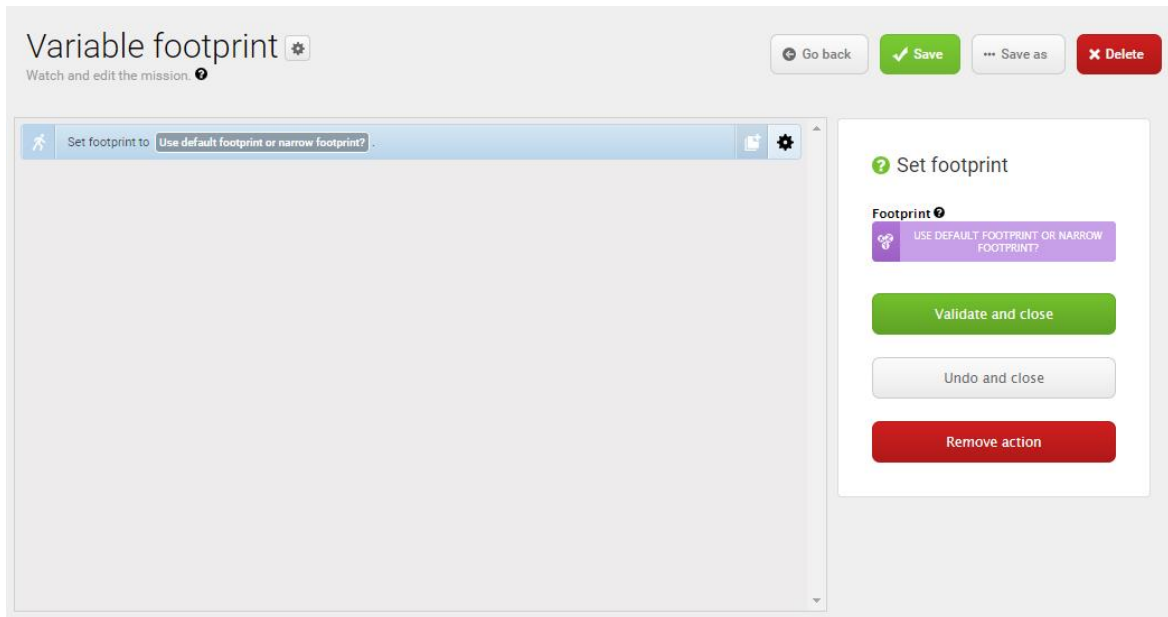
Default value

Default footprint

OK

Cancel

The mission should look like this:



5. Select ✓ **Save** to save the mission.

11.4 Creating the *80 cm doorway* mission

This section describes how to create a mission that makes the robot drive through a doorway that is 80 cm wide in one direction. To do this the robot does the following actions:


1. Moves to a position in front of the 80 cm wide doorway (the narrowest possible for MiR250).
2. Adjusts its localization.
3. Sets a defined narrow footprint.
4. Mutes its protective fields so it can traverse the doorway.
5. Goes through the doorway to a position on the other side.
6. Changes its footprint back to default.

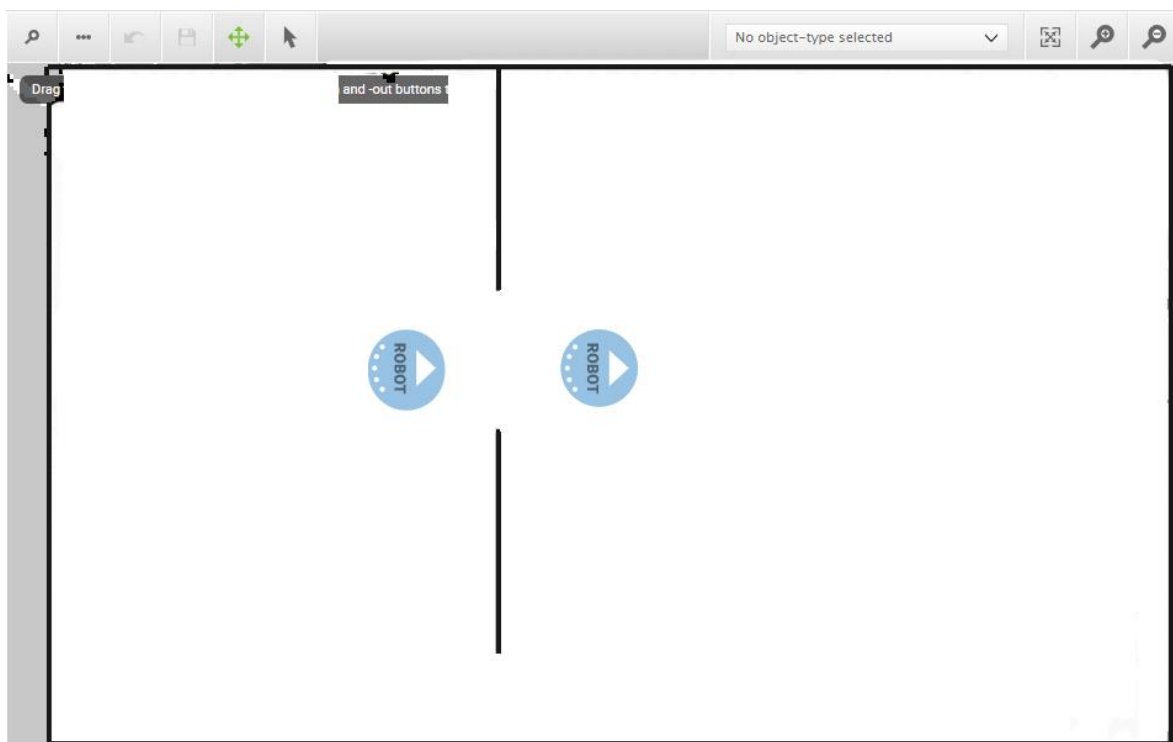
To create the mission, it is assumed that you have completed the following:

- Created a map. To drive through narrow doorways, it is very important that the map is accurate and thoroughly cleaned, and that the robot is localized accurately—see [Creating and configuring a map on page 104](#).



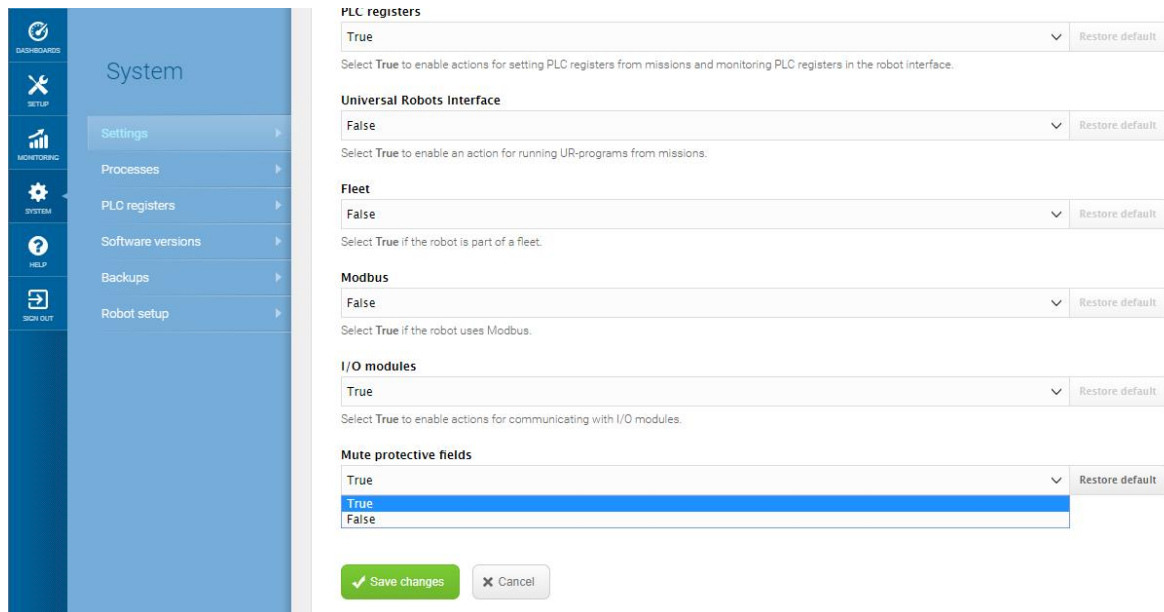
For better localization, draw the walls where the doorway is, and make the doorway approximately one meter wide in the map by deleting some of the walls on each side of the doorway. You may need to delete more of the wall if the robot will not go through the doorway.

- Placed a robot position  on each side of the doorway where the first position is named **pos 1** and the second **pos 2**. The positions must be placed in front of and directly in the middle of the doorway, and they must point in the same direction (the driving direction of the robot).



- Made the area around the doorway an operating hazard zone as the robot will be driving through the doorway with muted personnel detection means—see [Operating hazard zones on page 135](#).

- Enabled the muting of personnel detection means. Go to **System > Settings > Features**, and set **Mute protective fields** to **True**.



The screenshot shows the 'System' settings page with a sidebar on the left containing icons for Dashboards, Setup, Monitoring, System, Help, and Sign Out. The 'System' section is expanded, showing options for Settings, Processes, PLC registers, Software versions, Backups, and Robot setup. The 'Settings' option is selected, leading to a configuration page for various system features.

PLC registers
True Restore default
Select True to enable actions for setting PLC registers from missions and monitoring PLC registers in the robot interface.

Universal Robots Interface
False Restore default
Select True to enable an action for running UR-programs from missions.

Fleet
False Restore default
Select True if the robot is part of a fleet.

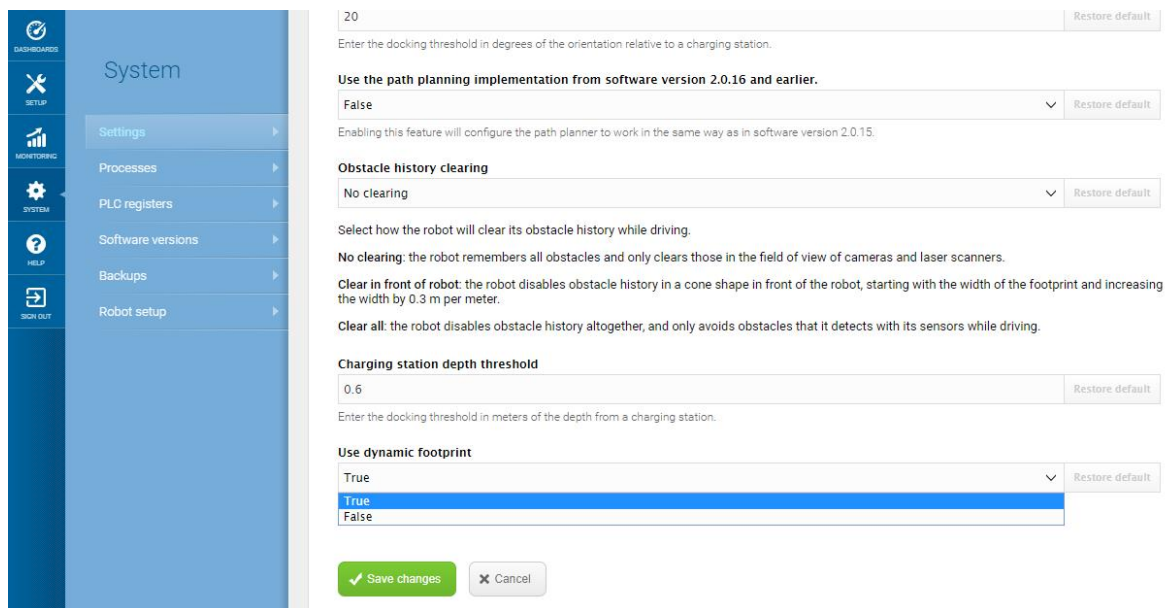
Modbus
False Restore default
Select True if the robot uses Modbus.

I/O modules
True Restore default
Select True to enable actions for communicating with I/O modules.

Mute protective fields
True Restore default
True
False

✓ Save changes ✕ Cancel

- Enabled the use of dynamic footprints. Go to **System > Settings > Planner > Show advanced settings**, and set **Use dynamic footprint** to **True**.



The screenshot shows the 'System' settings page with the 'Planner' section expanded. The 'Show advanced settings' option is selected, leading to a configuration page for various planning parameters.

20 Restore default
Enter the docking threshold in degrees of the orientation relative to a charging station.

Use the path planning implementation from software version 2.0.16 and earlier.
False Restore default
Enabling this feature will configure the path planner to work in the same way as in software version 2.0.15.

Obstacle history clearing
No clearing Restore default
Select how the robot will clear its obstacle history while driving.
No clearing: the robot remembers all obstacles and only clears those in the field of view of cameras and laser scanners.
Clear in front of robot: the robot disables obstacle history in a cone shape in front of the robot, starting with the width of the footprint and increasing the width by 0.3 m per meter.
Clear all: the robot disables obstacle history altogether, and only avoids obstacles that it detects with its sensors while driving.

Charging station depth threshold
0.6 Restore default
Enter the docking threshold in meters of the depth from a charging station.

Use dynamic footprint
True Restore default
True
False

✓ Save changes ✕ Cancel

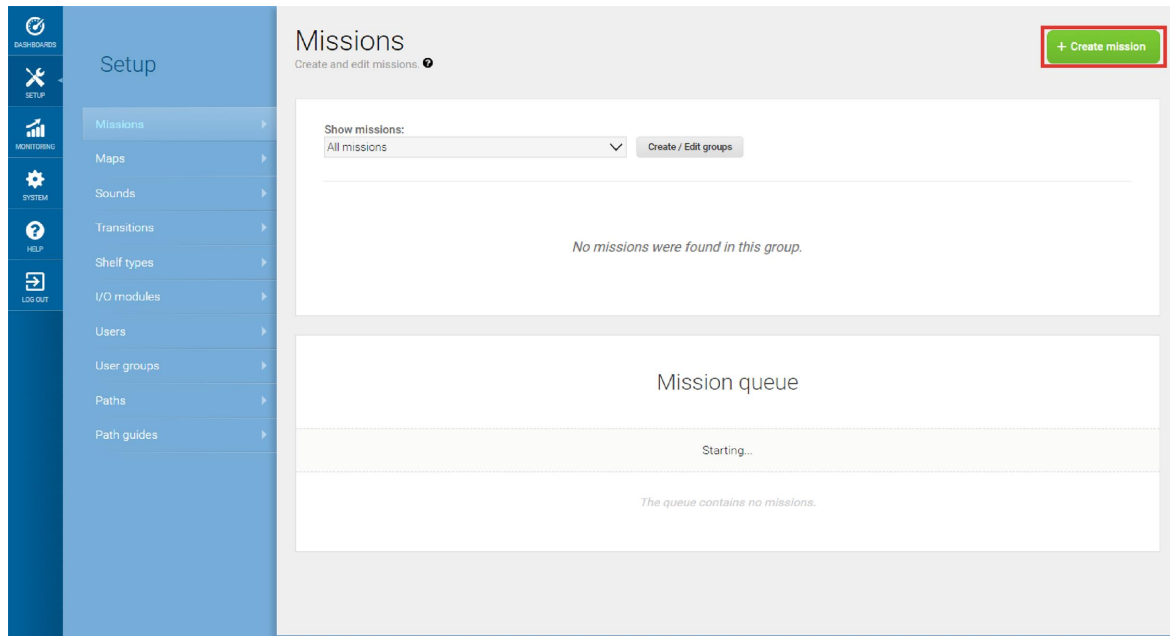
- Created a footprint named **Narrow doorway** that is 620 mm wide and 1300 mm long—see [Creating a footprint on page 130](#). The robot must be centered in the middle of the footprint.



This mission only drives the robot through the doorway in one direction. If you want the robot to go both ways, you need to make a new set of position facing the opposition direction and a new mission using these positions.

To create the mission, follow the steps below:

1. Go to **Setup > Missions**. Select **Create Mission**.



2. Name the mission *80 cm doorway*. Select the group and site you want it to belong to. Select **Create mission**.

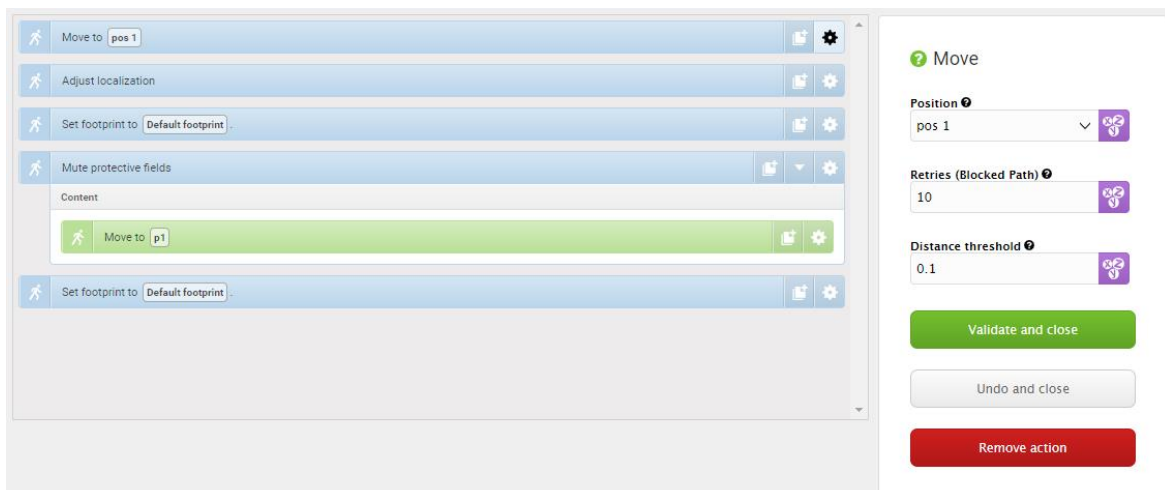
3. Select the following actions:

- In the **Move** menu, select **Move to**.
- In the **Move** menu, select **Adjust localization**.
- In the **Move** menu, select **Set footprint**.
- In the **Safety system** menu, select **Mute protective fields**.
- In the **Move** menu, select **Move to** and drag it into the **Mute protective fields** action.
- In the **Move** menu, select **Set footprint**.

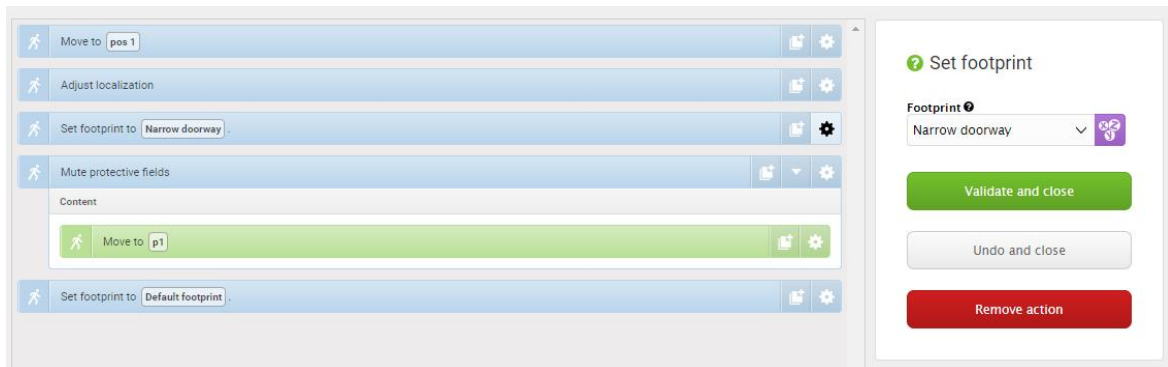


The following steps describe which parameters each action should be set to. To modify the parameters, select the gearwheel ⚙ at the right end of the action line to open the action dialog box. When you have set the parameters, select **Validate and close**.

4. In the **Move** action, under **Position**, select **pos 1**.

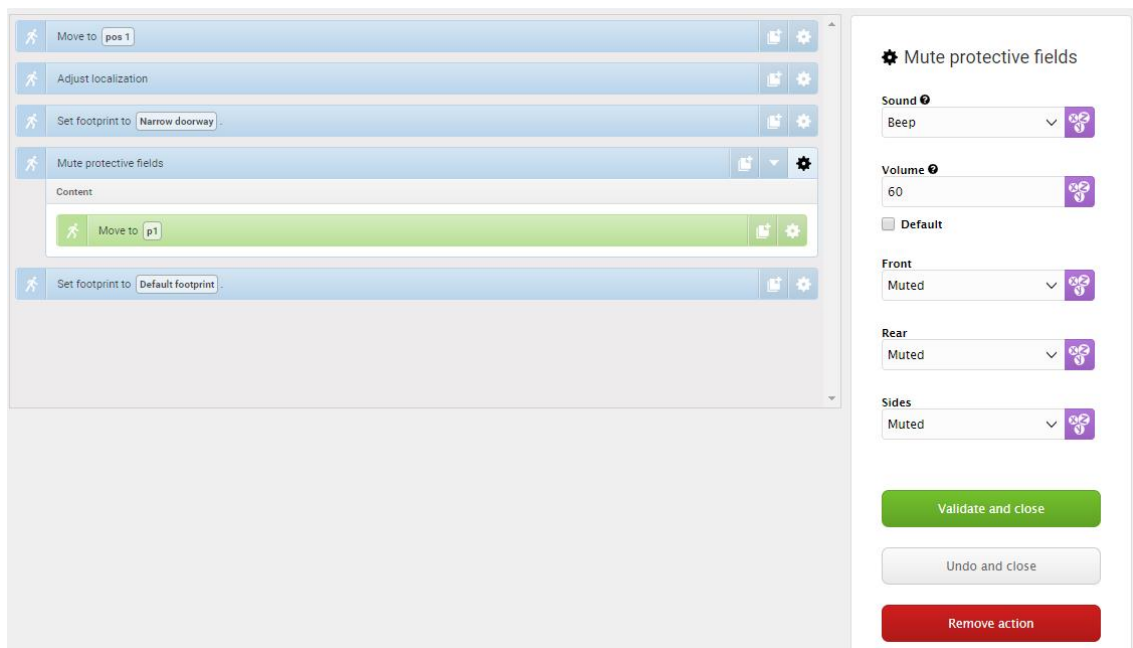


5. In the **Set footprint** action, select **Narrow doorway**.

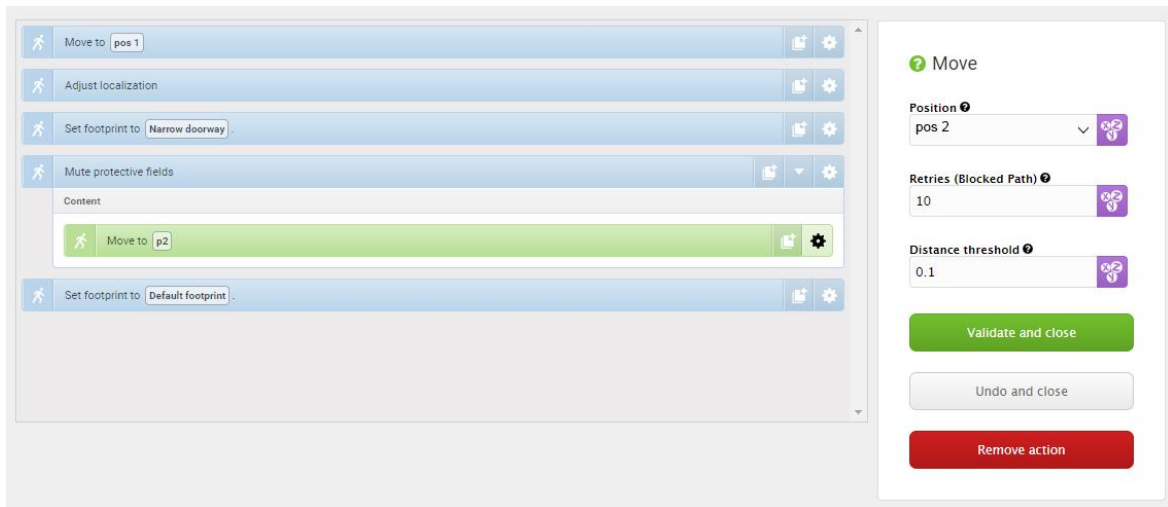


6. In the **Mute protective fields** action, set the parameters as follows:

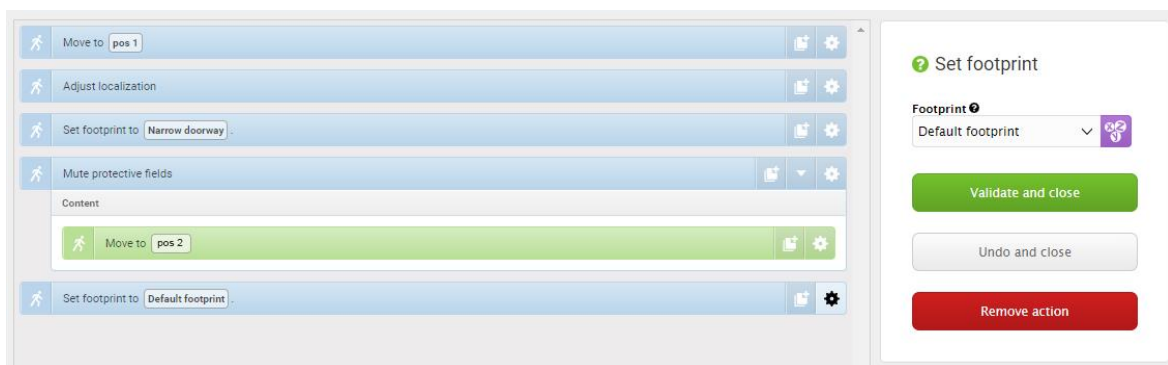
- **Sound:** Select **Beep**.
- **Volume:** Enter the value 60. This is 48 dB approximately.
- **Front:** Select **Muted**.
- **Rear:** Select **Muted**.
- **Sides:** Select **Muted**.



- In the **Move** action, under **Position**, select **pos 2**.



- In the **Set footprint** action, select the robot's default footprint.



- Select **Save** ✓ to save the mission.

11.5 Testing a mission



Run the mission to test that the robot executes the mission correctly.



NOTICE

Always test missions without payload to minimize potential hazards.

To run the mission, follow these steps:

1. Go to **Setup > Missions**.
2. Select **Queue mission**  next to the mission you just created. The mission is now added to the mission queue.
3. Select **Continue**  to start the mission.
4. Watch the robot execute the mission, and verify that it performs as expected.

12. Applications

You can install top modules on top of MiR250 for specific applications. For more information about top modules, go to the MiR webpage.

For instructions on how to mount top modules and accessories, contact your distributor.

12.1 Mounting a top module

MiR250 has four M8 holes for mounting top modules as shown in *Figure 12.1*. The tightening torque is 18 Nm.

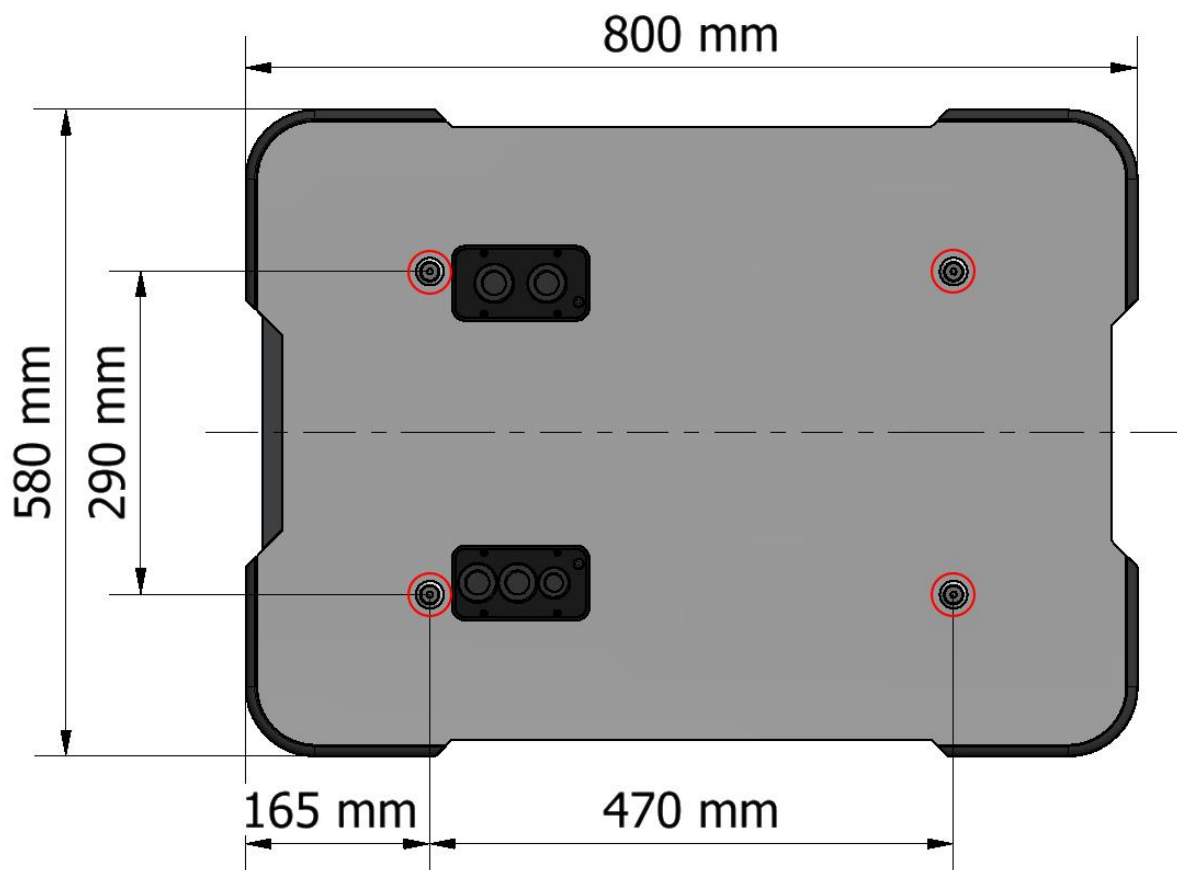


Figure 12.1. Mounting holes on the top of MiR250.

Certain top modules may require the installation of an extra Emergency stop button. Perform a risk assessment according to standard ISO 12100—see [Risk assessment on page 103](#)

The mounting holes are in the chassis, so the top cover does not need to be on the robot when you mount a top application.



CAUTION

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

- Perform a risk assessment according to standard ISO 12100 when mounting a top module—see [Risk assessment on page 103](#)



CAUTION

MiR250 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 specifications on page 185](#).

13. Maintenance

The following maintenance schedules give an overview of regular cleaning and parts replacement procedures.

It is the responsibility of the operator to perform all maintenance tasks on the robot.



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




NOTICE


Only use approved spare parts. Contact your distributor for the list of spare parts.

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

13.1 Regular weekly checks and maintenance tasks

Once a week, carry out the following maintenance tasks:

Parts	Maintenance tasks
Robot top plate and covers	<p>Clean the robot on the outside with a damp cloth.</p> <div>  <p>Do not use compressed air.</p> </div>

Parts	Maintenance tasks
Laser scanners	<p>Clean the optics covers of the scanners for optimum performance. Avoid aggressive or abrasive cleaning agents.</p> <p>In the robot interface under Monitoring > Hardware health > Emergency stop, see if Front scanner cover and Back scanner cover is Clean.</p> <div>  <p>NOTICE</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> </div>
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.
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 correctly.


13.2 Regular checks and replacements

Before starting replacement tasks that involve removal of the top plate or side covers or accessing the rear compartment:



- Shut down the robot—see [Shutting down the robot on page 55](#).
- Disconnect the battery—see [Packing for transportation on page 181](#).

The following table contains the parts that you should check and how often you should do that:

Part	Maintenance	Interval
Robot top cover	Check mounting. Ensure it sits evenly on top of the robot with connections accessible.	Check monthly, and replace as needed.
Laser scanner	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 appears.	Check monthly and after commissioning, or if you make any changes to the robot setup.
Robot hardware	In the robot interface under Monitoring > Hardware health , check if there are any warnings (marked with yellow).	Check monthly and after commissioning, or if you make any changes to the robot setup.
Front, rear, and side compartment covers	Check mounting. Ensure the covers are even and are not in contact with the wheels.	Check monthly, and replace as needed.



If you replace the cover with the robot's nameplate, make sure to mount a new copy of the nameplate to the replacement cover.

Part	Maintenance	Interval
Loudspeaker and signal lights	Check that all visual and auditory warnings function.	Check monthly, and replace as needed.
Caster wheels (the four corner wheels)	Check bearings and tighten, and check the wheels for wear and tear.	Check weekly, and replace as needed.
Drive wheels (the two middle-wheels)	Check wheel surfaces for wear.	Check every six months, and replace as needed. <div>  NOTICE The robot must be calibrated after replacement of the wheels. </div>
Safety laser scanners	Check for visual defects, for example cracks and scratches.	Replace as needed. <div>  NOTICE The robot must be calibrated after replacement of the scanners. </div>
Control panel	Check that all buttons on the control panel function.	Every three to four months.

Part	Maintenance	Interval
Emergency stop	Check that the Emergency stop buttons work, push down the red button, and check that the Emergency reset button lights up.	Every three to four months / according to <i>EN/ISO 13850 Safety of machinery - Emergency stop function</i> .
Charging pads/broom	Check if the charging pads are dirty or dusty and if the broom is intact. Clean the broom.	Check every six months, and replace as needed.
3D cameras	Check for visual defects, for example cracks and scratches.	Check monthly, and replace as needed.
Proximity sensors	Check for dust or dirt and clean with a swab.	Check weekly.
Manual brake release switch	Check if the Manual brake release switch functions. Release the brakes, and push the robot gently forward. Remember to enable the brakes again when done.	Check monthly, and replace as needed.
Safety marking on the floor	Check if the safety markings around operating hazard zones are intact and visible.	Check every six months and replace as needed.
Safety stickers and nameplate	Check if the safety stickers, ID label, and nameplate on the robot are still intact and visible.	Check every six months, and replace as needed.



CAUTION

A robot that has been impacted may be structurally damaged, risking malfunction and damage 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.

13.3 Battery maintenance

The battery is generally maintenance-free but should be cleaned if it gets very dirty. When cleaning, the battery must be removed from any power source. Only use a dry and soft cloth to clean the housing of the battery and do not use abrasives or solvents.

For storage of the battery, see [Battery storage on page 62](#).

For disposal of the battery, see [Battery disposal on page 62](#).

14. Packing for transportation

This section describes how to pack the robot for transportation.

14.1 Original packaging

Use the original packaging materials when transporting the robot.



The packaging materials are:

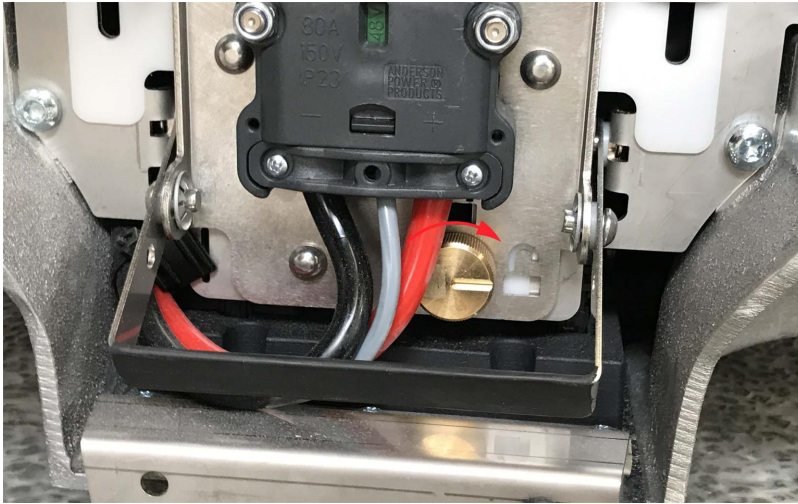
- The bottom of the box (the pallet)
- The lid of the box (the ramp)
- The walls of the box
- Protective foam blocks: Side blocks and the top layer
- Protective corner braces. The braces prevent the robot from being damaged by the transport straps

14.2 Packing the robot for transportation

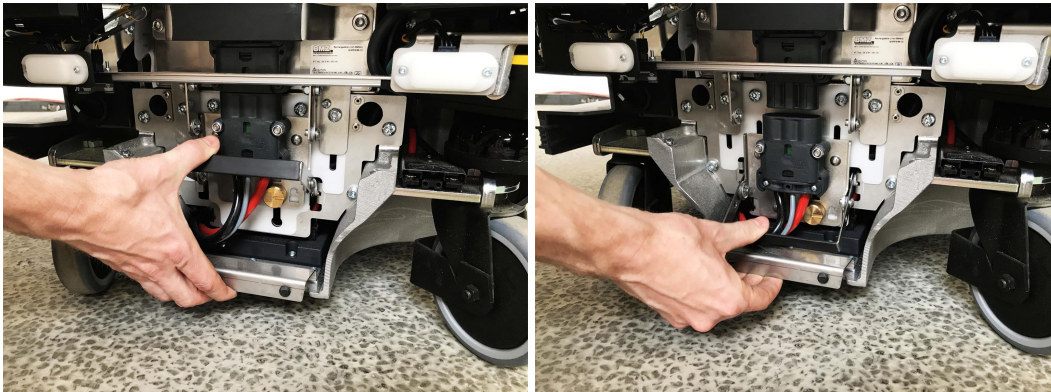
Before packing the robot for transportation, you need to access the rear compartment—see [Accessing the internal parts on page 26](#)—, and shut down the robot—see [Shutting down the robot on page 55](#).

Follow these steps to pack the robot for transportation:

1. Turn the battery lock clockwise to release it.



2. Press down on the battery lever to disconnect the battery.





NOTICE

Pack and transport the robot in an upright position. Packing and transporting the robot in any other position voids the warranty.

14.3 Battery

The lithium-ion battery is subject to transport regulations. Make sure that you follow the safety precautions in this section and the instructions in [Packing for transportation on page 181](#). Different regulations apply depending on the mode of transportation: land, sea, or air.

Contact your distributor for more information.



CAUTION

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.

15. Disposal of robot

MiR250 robots must be disposed of in accordance with the applicable national laws, regulations, and standards.

Fee for disposal and handling of electronic waste of Mobile Industrial Robots A/S robots sold on the Danish market is prepaid to DPA-system by Mobile Industrial Robots A/S. Importers in countries covered by the European WEEE Directive 2012/19/EU must make their own registration to the national WEEE register of their country. The fee is typically less than 1€ per robot. A list of national registers can be found here: <https://www.ewrn.org/national-registers>.

For battery disposal, see [Battery disposal on page 62](#).

16. Payload specifications

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 MiR250 is not positioned or fastened correctly can cause fall injuries to nearby personnel or damage to equipment.

- Ensure that the load is positioned according to the specifications and is fastened correctly.



CAUTION

Bumps and holes can cause payloads to fall off the robot, causing damage to equipment and injury to personnel.

- The floor the robot drives on must be even without bumps and holes for the payload specifications to be valid. If bumps and holes are present, the commissioner must take additional measures to ensure a safe operation.



CAUTION

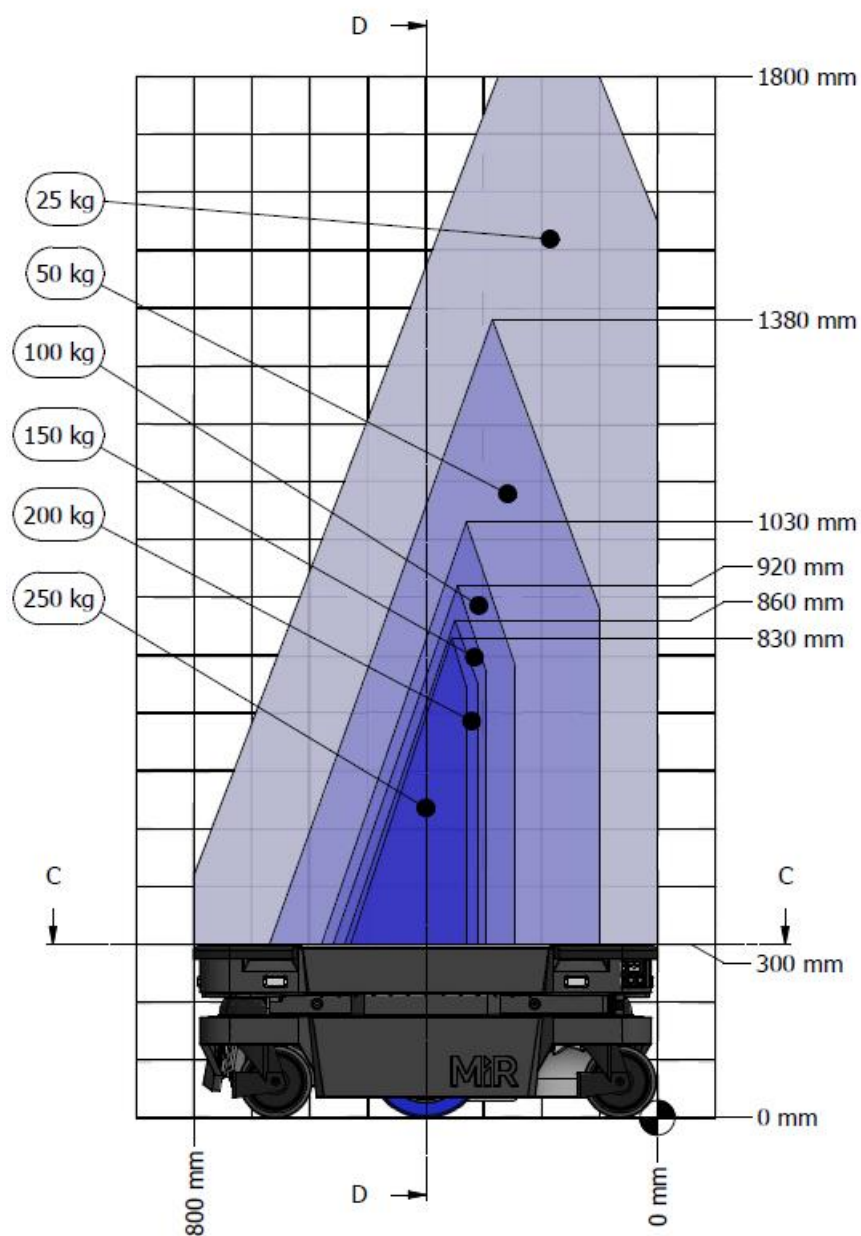
A slippery surface can cause instability when driving with payloads, causing damage to equipment and injury to personnel.

- The friction coefficient between the floor and the driven wheels on the robot must be in the range of 0.60 to 0.80 for the payload specifications to be valid. If the friction coefficient is not in this range, the commissioner must take additional measures to ensure a safe operation.

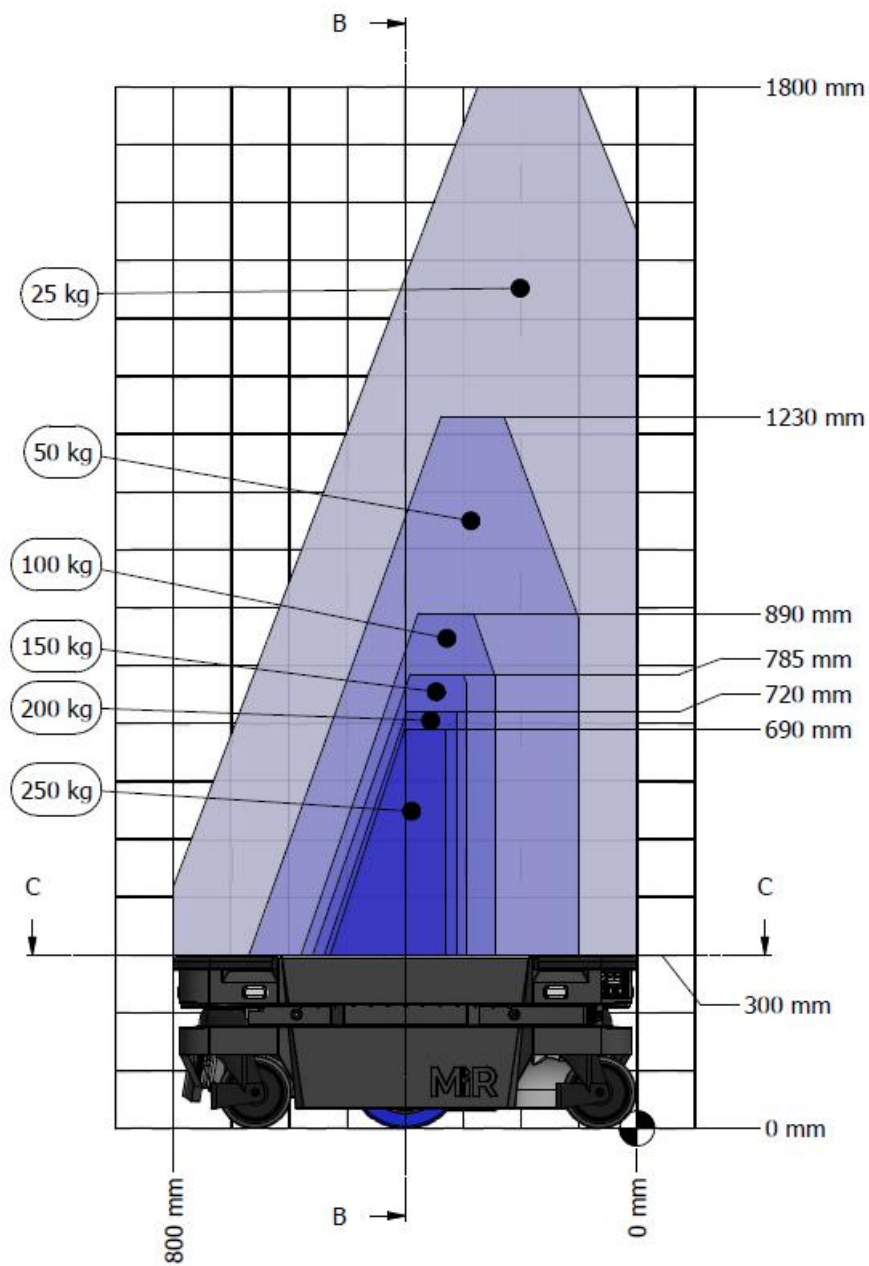
The specifications apply to total payloads of up to 250 kg.

16.1 Side view

At 1.2 m/s with no incline

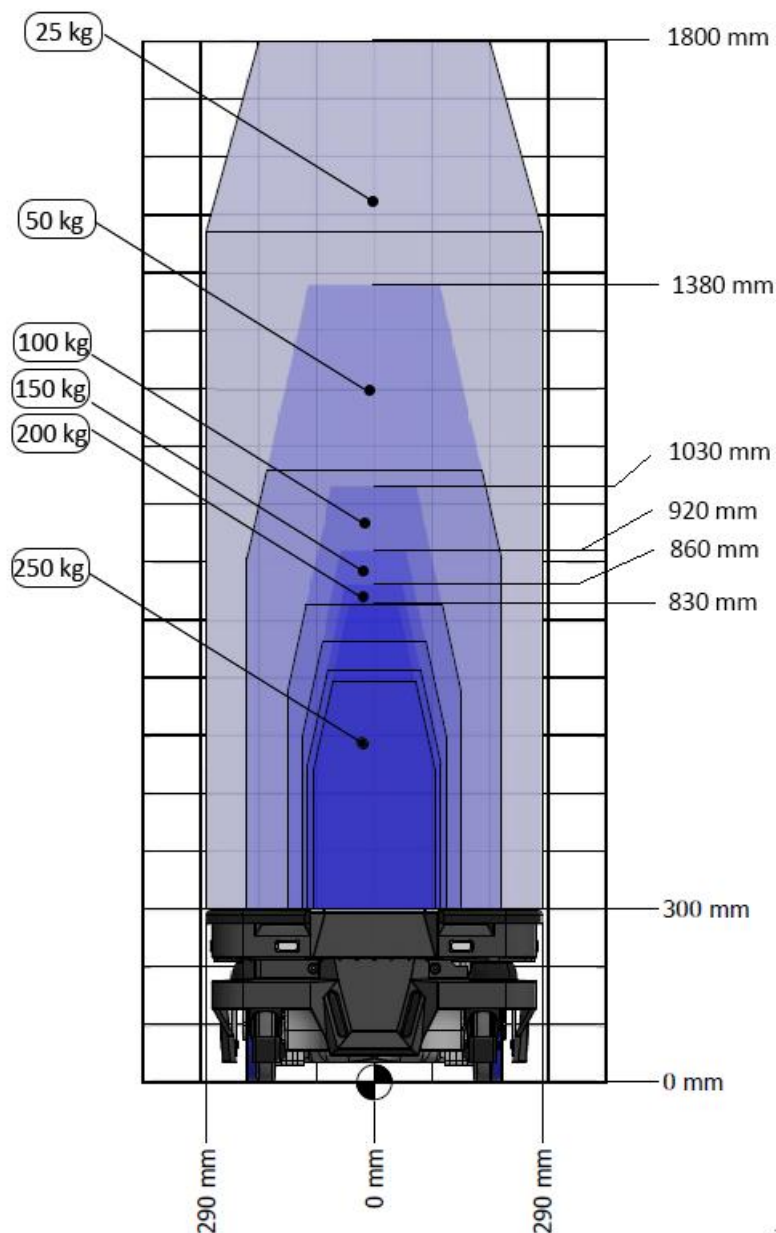


At 2.0 m/s with no incline

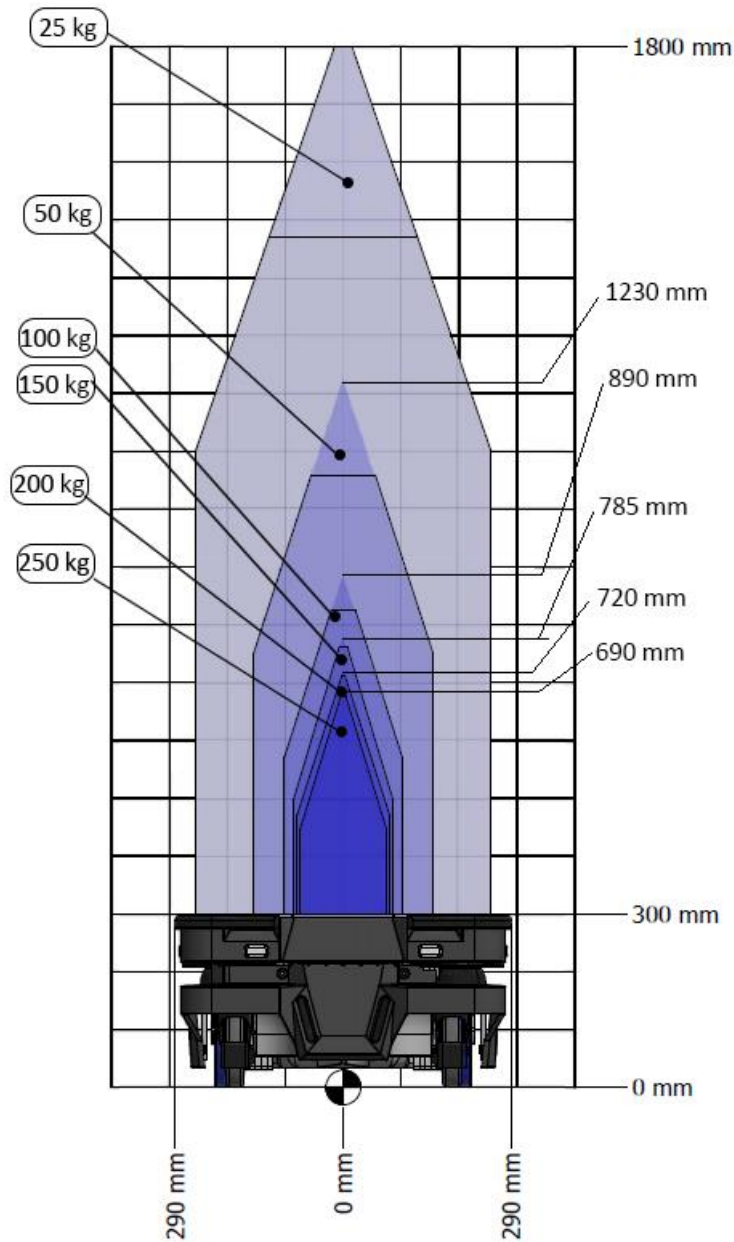


16.2 Front view

At 1.2 m/s with no incline

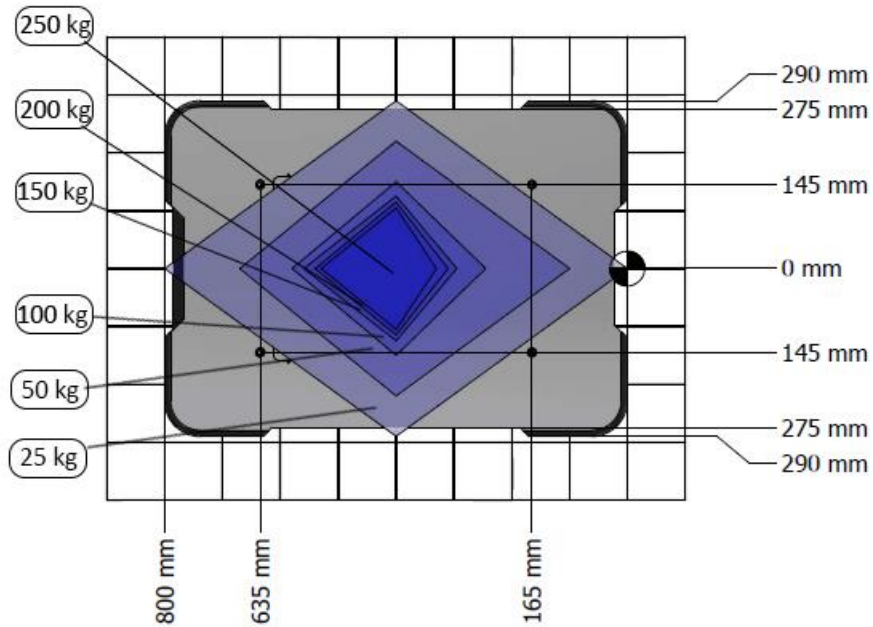


At 2.0 m/s with no incline

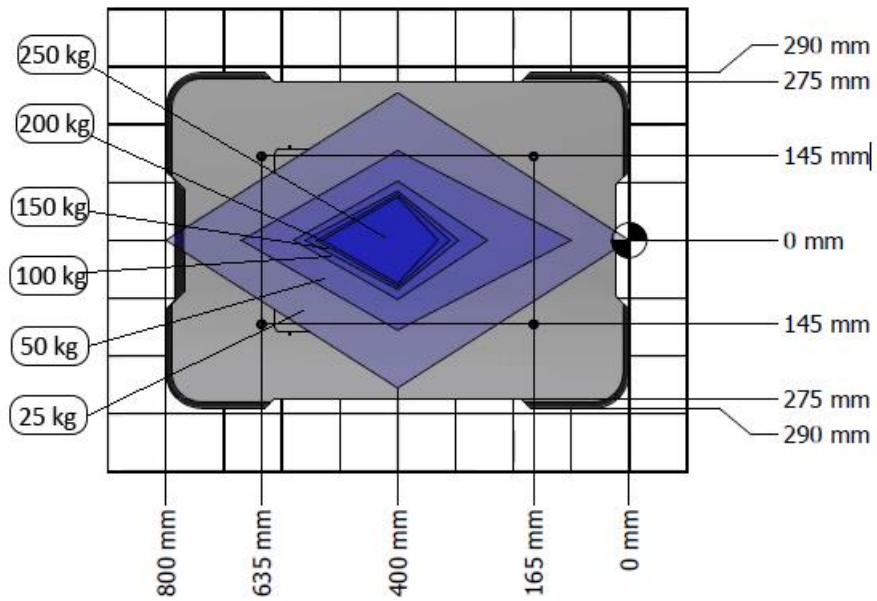


16.3 Top view

At 1.2 m/s with no incline



At 2.0 m/s with no incline



17. Interface specifications

This section describes the specifications of the top application interfaces.



NOTICE

Read [Safety on page 31](#) before using the electrical interface.

MiR250 has seven electrical interfaces divided into two groups:

- Robot's left side:
 - Power
 - Emergency stop
 - Ethernet
- Robot's right side:
 - GPIO A
 - GPIO B
 - Auxiliary Safety Functions A
 - Auxiliary Safety Functions B

To see the locations of the interfaces on the robot, see [Internal parts on page 20](#).

17.1 Left side interfaces

This section describes the general purpose interfaces located in the left side compartment on top of MiR250.

Emergency stop

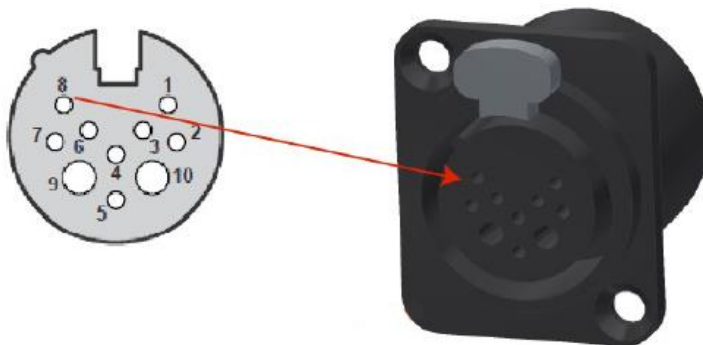


Table 17.1 describes the pins of the Emergency stop interface.

Pin no.	Signal name	Type	Description
1	SAFE_ RETURN	Ground	Return for lamp signal
2	Test output 1	Output	Safety output 1. Should be connected through E-stop switch to input 1 and 3.
3	Test output 2	Output	Safety output 2. Should be connected through E-stop switch to input 2.
4	E-stop 1	Input	Safety input 1.
5	E-stop 2	Input	Safety input 2.
6	Restart	Input	Safety input 3
7	RST_LAMP_ 24_V	Output	24 V output for powering the lamp on the Emergency stop box.
8	NC		Not connected to the robot.
9	NC		Not connected to the robot.
10	NC		Not connected to the robot.

Table 17.1. Description of pins in the Emergency stop interface.

Power

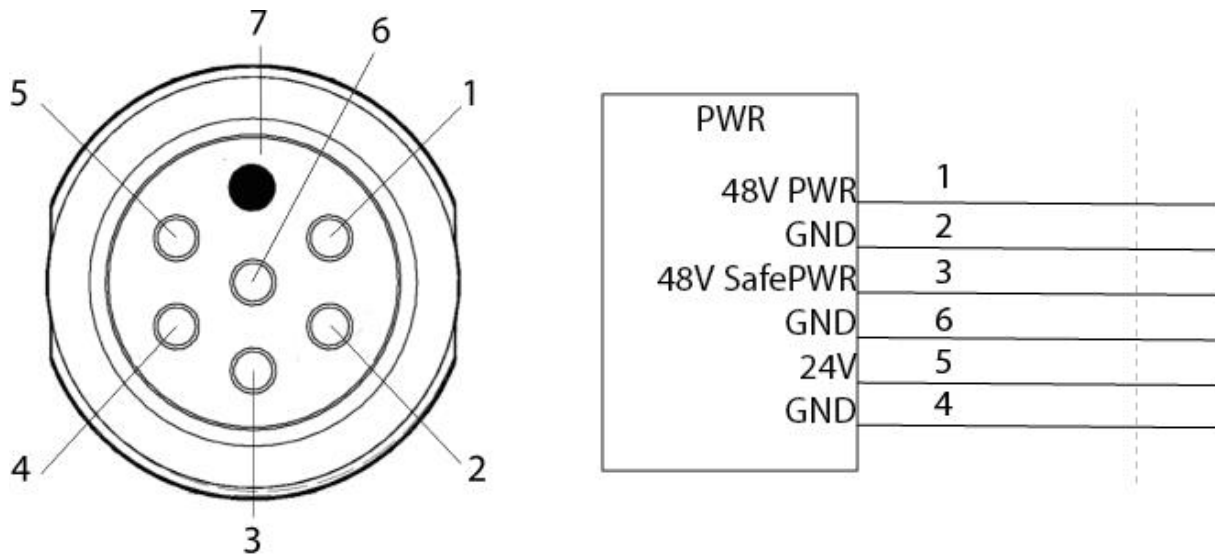


Figure 17.1. Pin numbers: female connector viewed from the front (left) and wiring diagram (right).



The maximum current across pins 1 and 3 combined is 10A. You cannot receive 10A from both of them at the same time.



CAUTION

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 and electrical shock.

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



CAUTION

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

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



CAUTION

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 17.2 describes the pins of the power interface.

Pin no.	Signal name	Max. current	Description
1	48V power	10A	<p>Always active when robot is on.</p> <p>Intended for high power loads like motors and actuators.</p> <p>Voltage range before the powerboard shuts off: 41 V to 53.8 V.</p>
2	GND		Power ground.
3	48V safe power	10A	<p>Inactive in case of a Protective or Emergency stop.</p> <p>This output is controlled by the internal safety PLC through the STO contactor to ensure that power is always disconnected from this pin in case of a Protective or Emergency stop.</p> <p>Intended for high power loads like motors or actuators.</p> <p>Voltage range before the powerboard shuts off: 41 V to 53.8 V.</p>
4	GND		Power ground.
5	Isolated 24V		Fully isolated from the robot.

Pin no.	Signal name	Max. current	Description
6	Isolated GND		Fully isolated from the robot.
7	Unassigned		Unassigned.

Table 17.2. Description of the pins in the power interface.

Ethernet

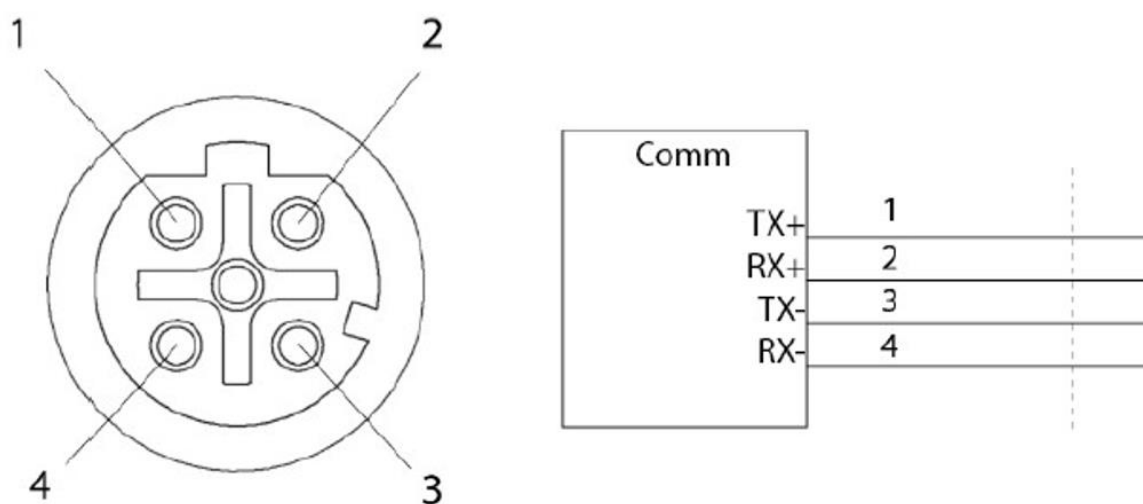


Figure 17.2. Ethernet connection. Pin numbers (left) and wiring diagram (right).

The communication interface is 10/100 Mbit Ethernet using a M12 connector—see [Connector list on page 204](#).

Various protocols can be supported, for example Modbus. For more information on how to use Modbus, contact your distributor for the how-to guide *How to use Modbus with MiR robots*.

Table 17.3 describes the pins of the Ethernet interface.

Pin number	Signal name
1	TX+

Pin number	Signal name
2	RX+
3	TX-
4	RX-

Table 17.3. Description of the pins in the Ethernet interface.

17.2 Right side interfaces

This section describes the general purpose interfaces located in the right side compartment on top of MiR250.

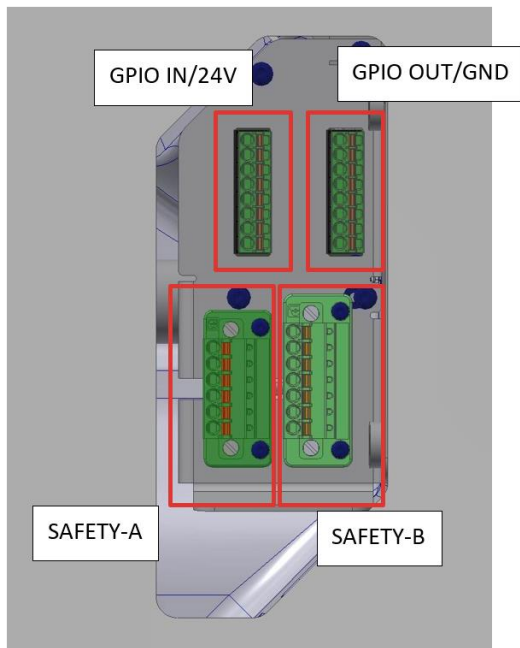


Figure 17.3. Overview of the interfaces in the right side compartment.

GPIO A and B

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

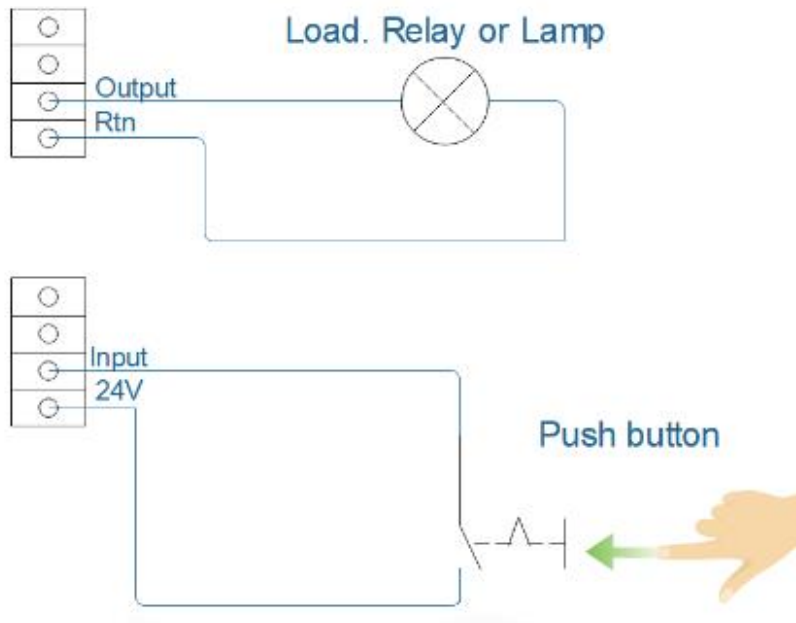


Figure 17.4. Outputs and RTNs are intended for sending signals to the top application, and inputs and 24V pins are intended to receive signals from the top application.

The GPIO interfaces have the following pins:

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

To use the GPIO for a top application of your own design, ensure that the **Shelf** feature is disabled by setting it to **False** under **System > Settings > Features** and that **I/O modules** is enabled by setting it to **True**.

System

- Settings
- Processes
- PLC registers
- Software versions
- Backups
- Robot setup

Features

Enable and disable features in the robot

Shelf
False Restore default
Select True if a shelf lift application is mounted to your robot.

Email address
True Restore default
Select True to enable an action for sending emails from missions.

PLC registers
True Restore default
Select True to enable actions for setting PLC registers from missions and monitoring PLC registers in the robot interface.

Universal Robots Interface
False Restore default
Select True to enable an action for running UR-programs from missions.

Fleet
True Restore default
Select True if the robot is part of a fleet.

Modbus
False Restore default
Select True if the robot uses Modbus.

I/O modules
True Restore default
Select True to enable actions for communicating with I/O modules.

This enables the GPIO interface to work as input and output to top modules that can be used in missions.

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 module to send inputs to the robot. When 24 V (or more than 20 V) is connected to the input pin, the robot registers the input as active.

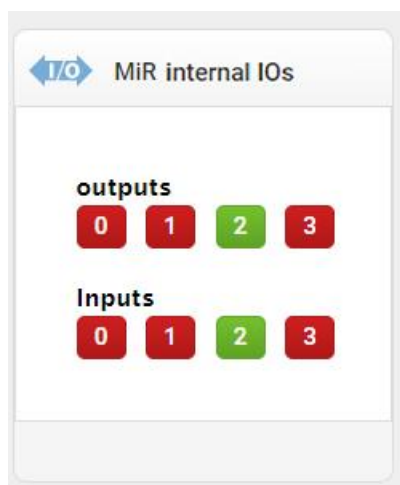


Figure 17.5. Example of I2 registered as active by the robot and O2 set to active by the user.

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

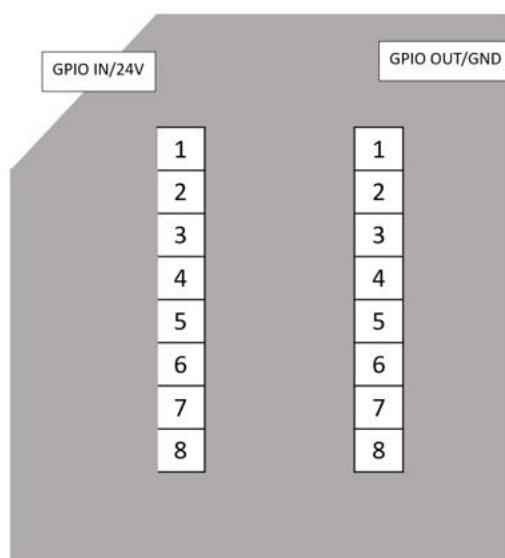


Figure 17.6. Pin numbers for the GPIO interfaces.

Table 17.4 describes inputs and 24 V supply.

Pin no.	Signal name	Type	Description
1	IN1	Input	Input 1.
2	24V	Output	24 V output. 2 A maximum total over all 24 V output.
3	IN2	Input	Input 2.
4	24V	Output	24 V output. 2 A maximum total over all 24 V output.
5	IN3	Input	Input 3.
6	24V	Output	24 V output. 2 A maximum total over all 24 V output.
7	IN4	Input	Input 4.
8	24V	Output	24 V output. 2 A maximum total over all 24 V output.

Table 17.4. Description of the pins in the input interface.

Table 17.5 describes outputs and ground.

Pin no.	Signal name	Type	Description
1	OUT1	Output	Output 1. Maximum 1 A at 24 V
2	GND	Ground	Protected return.
3	OUT2	Output	Output 2. Maximum 1 A at 24 V.
4	GND	Ground	Protected return.
5	OUT3	Output	Output 3. Maximum 1 A at 24 V.
6	GND	Ground	Protected return.

Pin no.	Signal name	Type	Description
7	OUT4	Output	Output 4. Maximum 1 A at 24 V.
8	GND	Ground	Protected return.

Table 17.5. Description on the pins in the outputs interface.

To use the GPIO functionality, it is necessary to connect the fitting FMC 1.5/ 8-ST-3.5 (1952322) connector – made by Phoenix Contact.

Auxiliary Safety Functions A and B

The Auxiliary safety functions interfaces are designed to support Emergency and Protective stops and other safety functions.

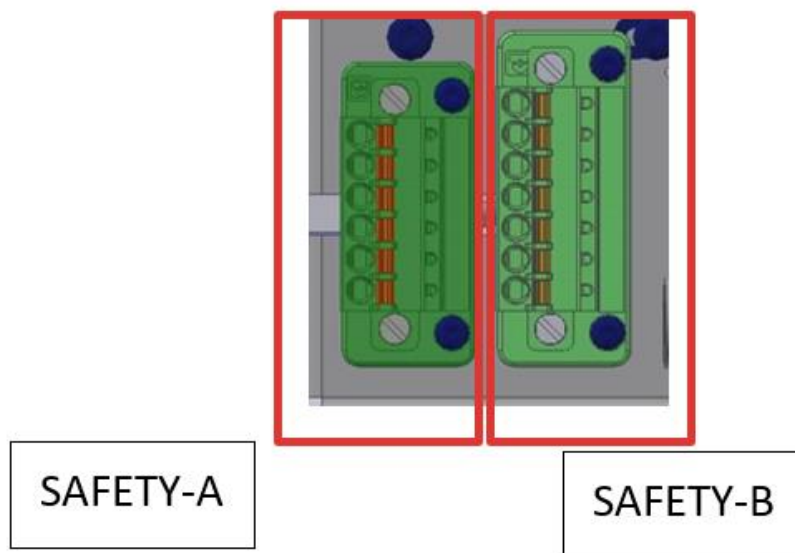


Table 17.6 and Table 17.7 describe the pins of the Auxiliary safety functions interfaces.

Safety A:

Pin no.	Signal name	Type	Description
1	Test output 1	Output	24 V test signal. Sends test pulses (not on constantly).
2	Safeguarded stop 1	Input	Safeguarded stop 1. Set any or both pin(s) to inactive to enter Protective stop. If pins are unequally set for a period greater than three seconds, PLC will have to be reset by setting both pins inactive, then active.
3	Shared emergency stop in 1	Input	Shared emergency stop in input 1. Inactive = robot goes into emergency stop.
4	Reduced speed 1	Input	Circuit broken (logic inactive) will result in the robot being unable to drive fast.
5	Locomotion 1	Output	Active when the robot is standing still.
6	Shared emergency stop out 1	Output	Inactive when the robot is in emergency stop.

Table 17.6. Description of the pins in the Auxiliary safety function interface A.

Safety B:

Pin no.	Signal name	Type	Description
1	Test output 2	Output	24 V out test signal. Sends test pulses (not on constantly).

Pin no.	Signal name	Type	Description
2	Safeguarded stop 2	Input	Safeguarded stop 2. Set any or both pin(s) to inactive to enter emergency stop. If pins are unequally set for a period greater than three seconds, PLC will have to be reset by setting both pins inactive, then active.
3	Shared emergency stop in 2	Input	Shared emergency stop in input 2. Inactive = robot goes into emergency stop.
4	Reduced speed 2	Input	Circuit broken will result in the robot being unable to drive fast.
5	Locomotion 2	Output	Active when the robot is standing still.
6	Shared E-Stop out 2	Output	Active when the robot is in emergency stop.
7	SAFE_RETURN		Safe return for output signals.

Table 17.7. Description of the pins in the Auxiliary safety function interface B.

17.3 Connector list

Table 17.8 describes the connectors for the seven different interfaces that we recommend using.

Connector	Description	Manufacturer	Part number
Power	Cable connector, M23, 6 way, male	Phoenix Contact	1619775

Connector	Description	Manufacturer	Part number
GPIO	Single wire connector, female, pitch 3.5mm 8 way.	Phoenix Contact	1952322
Ethernet	Cable assembly, 1m, M12, 4 way to RJ45	Lumberg	0985 806 103/1M
Auxiliary emergency stop	Cable connector, 8 + 2 way, XLR, male	Neutrix	NC10MXX-14-B
Auxiliary safety functions - long connector	Single wire connector, female, Pitch 3,81mm, 7 way	Phoenix Contact	1851287
Auxiliary safety functions - short connector	Single wire connector, female, pitch 3,81mm, 6 way	Phoenix Contact	1851274
Antenna	Cable connector, RP-SMA, male, gold	AMPHENOL RF	RSMA1111A1-3GT50G-1A-50

Table 17.8. Description of the connectors used for the different interfaces.

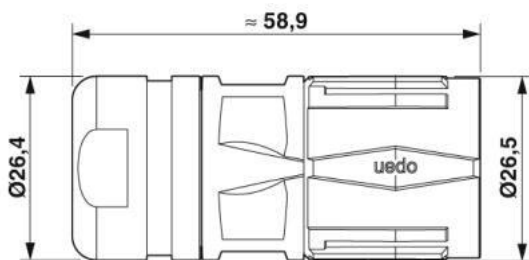
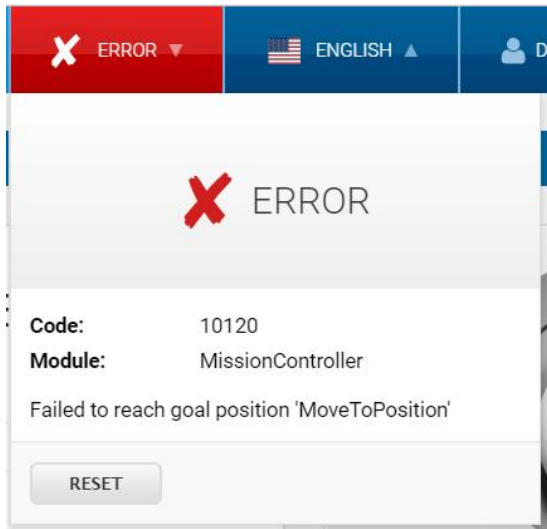


Figure 17.7. Connector dimensions for the Power connector.

18. Error handling

The robot enters an error state when it can't 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.

18.1 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 them 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.

See [Creating and configuring a map on page 104](#) for more information.

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

For more details on setting up missions and error handling, see the *MiR Robot Reference Guide* on the MiR website.

18.2 Hardware errors

If the error is a fault in the hardware, you will either 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 the Emergency stop button is 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, contact your distributor for specific MiR troubleshooting guides or assistance from MiR Technical Support.

Glossary

A

Autonomous mode

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

C

Cart

A cart can be towed by a MiR robot with a MiR hook mounted to it.

Commissioner

Commissioners have thorough knowledge of all aspects of commissioning, safety, use, and maintenance of MiR250 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 fastening methods of loads to MiR250; and ensuring the safety of nearby personnel when a MiR robot is accelerating, braking, and maneuvering.

D

Direct user

Direct users are familiar with the safety precautions in the user guide and have the following main tasks: assigning missions to MiR250 and fastening loads to MiR250 properly.

Dynamic obstacle

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 to 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.

G

Global path

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

I

Identification label

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

L

Local path

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.

Marker

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

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 robot interface

The robot interface is the web-based interface that enables you to communicate to your MiR robot. It is accessed by connecting to the robot's WiFi and then going to the site mir.com.

Muted personnel detection means

When personnel detection means are muted, the robot moves at a reduced speed, and the protective field sets are minimized so the robot does not enter protective stop until it is very close to an obstacle.

N

Nameplate

The label delivered with your MiR application that must be mounted before you commission the robot. The nameplate identifies the MiR application model, application number, mechanical and electrical specifications, and includes the CE mark of your application.

O

Operating hazard zone

A zone where the personnel detection means of the robot are reduced or muted to a level where personnel safety is at risk.

Operator

Operators have thorough knowledge of MiR250 and of the safety precautions presented in the User guide of MiR250. Operators have the following main tasks: servicing, maintaining, and creating and changing missions and map positions in the robot interface.

P

Position

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

Protective stop

Protective stop is a state the robot enters automatically to ensure the safety of nearby personnel. When the robot enters Protective stop, the status light of the robot turns red, and you are not able to move the robot or send it on missions until it is brought out of Protective stop. The robot goes into Protective stop in a number of situations: if a safety laser scanner detects an object in its active protective field, when the robot finishes the startup process, when the robot has switched between Manual mode and Autonomous mode, if the safety system detects a fault, or if the motor control system detects a discrepancy.

S

Static landmark

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.