



Operating Guide (en)

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MiR shelf lift applications

for MiR100 and MiR200

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1. About this document

This guide describes how to set up and use a MiR shelf lift application with MiR100/MiR200. A MiR shelf lift application is a shelf lifting device that is mounted on MiR100/MiR200 to autonomously transport shelves. This guide includes information regarding safe usage, how to commission and operate a MiR shelf lift application, and how to create missions that use MiR shelf lift application to transport shelves.



NOTICE

Save this manual. It contains important setup 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. It comes in print in the box with the robots. Quick starts are available in multiple languages.
- **User guides** provide all the information you need to operate and maintain MiR robots and how to set up and use top modules and accessories, such as charging stations, hooks, shelf lifts, and pallet lifts. User guides are available in multiple languages.
- **Operating guides** describe how to set up and use MiR accessories or supported functions that are mainly hardware-based, such as charging stations and shelf functions.
- **Getting started guides** describe how to set up MiR accessories 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.
- **Best practice guides** specify how much space MiR robots need to execute common maneuvers.
- **REST API references** for MiR robots, MiR hooks, and MiR Fleet. Simple http requests can be used to control robots, hooks and MiR Fleet.
- **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 manual and their interrelations with hardware releases.

Revision	Release date	Description
1.0	2016-04-08	First edition.
1.1	2016-04-29	Updated for SW 1.6. Improved technical specifications.
1.2	2016-09-23	Updated for SW 1.7. New dimension drawing. Pick up and place shelf actions improved.
1.3	2017-19-01	Updated for SW 1.8.
1.4	2020-02-12	Updated for SW 2.8. Improved technical specifications and safety.
1.5	2020-10-29	Added new information about payload. Small corrections to Shelf specifications on page 25 .

2. Safety

Read the information in this section before powering up and operating MiR shelf lift application.

Pay particular attention to the safety instructions and warnings.



NOTICE

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

2.1 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.

2.2 Users

MiR shelf lift application is only intended to be used by personnel that have received training in their required tasks.

There are three types of intended users for MiR shelf lift application: commissioners, operators, and direct users.

Commissioners

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

- Commissioning of the product. This includes creating maps and restricting the user interface for other users and making brake tests with a full payload.
- Conducting the risk assessment.
- Determining the payload limit, weight distribution, safe fastening methods, safe loading and unloading of loads on MiR shelf lift application, and ergonomic loading and unloading methods if relevant.
- Ensuring the safety of nearby personnel when the robot is accelerating, braking, and maneuvering.

Operators

Operators have thorough knowledge of MiR shelf lift application and of the safety precautions presented in this user guide. Operators have the following main tasks:

- Servicing and maintaining MiR shelf lift application.
- Creating and changing missions and map features in the robot interface.

Direct users

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

- Assigning missions to MiR100/MiR200.
- Fastening loads to MiR shelf lift application securely.
- Loading and unloading from a paused robot.

All other persons in the vicinity of MiR100/MiR200 are considered indirect users and must know how to act when they are close to the robot.

2.3 General safety precautions

This section contains general safety precautions.



WARNING

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

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



WARNING

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

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



WARNING

The robot may drive over the feet of personnel, causing injury.

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



WARNING

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

- 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**

Contact with live electrical parts can cause electric shock.

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

**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**

Attempting to charge batteries outside the robot can lead to electrical shock or burns.

- Never charge the batteries outside the robot.

**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 for anything other than MiR shelf lift application.

**WARNING**

Load falling or the robot overturning if the load on the robot 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—see the user guide of your robot for payload specifications.

**WARNING**

Personnel standing next to the robot when it is docking to a shelf risk being injured by an impact.

- Ensure that docking positions are clearly marked as operating hazard zones with visible tape or similar marking, and that all personnel are instructed not to stand in the hazard zone when the robot is docking.

**WARNING**

- Ensure that docking positions are clearly marked as operating hazard zones with visible tape or similar marking and that all personnel are instructed not to stand close to the robot when it is placing a shelf.
- All personnel must be instructed to wear safety shoes near an operating robot.

**WARNING**

Personnel risk serious hand injuries if they reach in between the robot and a shelf when the robot is picking up the shelf.

- Ensure that docking positions are clearly marked as operating hazard zones with visible tape or similar marking and that all personnel are instructed not to stand close to the robot when it is picking up a shelf.

**WARNING**

the robot risks damage and mechanical failure if it is used to transport pallets or anything other than safely commissioned shelves. Nearby equipment and personnel risk damage or injury if payloads fall from the robot.

- Only use the robot to transport safely commissioned shelves.

**WARNING**

Personnel standing in the blind spot of the robot when it is pivoting with a shelf risk being struck and injured.

- Ensure that all nearby personnel are instructed not to stand close to the robot when it is pivoting.
- Inform personnel that the signal lights indicate when the robot is intending to turn or pivot.

**WARNING**

If a load is positioned incorrectly on a shelf, the load may fall off. Nearby personnel or equipment risk injury or damage.

- Ensure that each load is positioned correctly on the shelf. It is the responsibility of the commissioner to determine correct and safe methods of loading shelves.
- Conduct a brake test while the robot is transporting a fully loaded shelf.

**WARNING**

If the robot transports a shelf with a load that extends the footprint of the robot, the load may collide with personnel or equipment causing injury or damage.

- Do not load the shelves with loads that exceeds the robot's footprint.

**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.

2.4 Risk assessment

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

The risk assessment must cover both MiR shelf lift application itself and also take into account potential load transfer stations, work cells, and the work environment.

**NOTICE**

Mobile Industrial Robots takes no responsibility for the creation and performance of the risk assessment, but we provide information and guidelines that may be used in this section.

For more guidelines, see the guide *MiR100 and MiR200 Risk Analysis* found on the robot product page under **Manuals** on the MiR website.

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 that the commissioner should consider.

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.

2.5 Intended use

MiR shelf lift application is intended to be commissioned and used in indoor industrial environments where access for the public is restricted.

MiR shelf lift application 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.

MiR shelf lift application is a completed MiR application that consists of a the robot with a mounted the top module. The application is CE marked as long as it is not modified or altered. However, a CE marked application does not guarantee a CE marked setup. It is the responsibility of the commissioner to commission MiR shelf lift application safely.

2.6 Foreseeable misuse

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

- Using the robot to transport people
- Using the robot on steep surface grades, such as ramps
- Making changes to the SICK configuration
- Driving the robot on cross slopes
- Exceeding the total payload
- Positioning or fastening loads incorrectly according to the specifications
- Using Emergency stop buttons for anything other than emergency stops
- Driving the robot with anything other than safely commissioned shelves
- Using the robot in medical and life critical applications
- Operating the robot outside the permissible operating parameters and environmental specifications
- Using the robot in potentially explosive environments
- Using the robot outdoors
- Using the robot in hygiene zones

**NOTICE**

If the robot is misused, the warranty becomes void. Only use the robot as described in [Intended use on the previous page](#).

2.7 Residual risks

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

- You risk being run over, drawn in, trapped, or struck if you stand in the path of the robot or walk towards the robot or its intended path while it is in motion.
- You risk being run over, drawn in, trapped, or struck if you stand in the path of the robot or walk towards it while it is driving in reverse. 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 the robot 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 docking to a shelf.
- You risk being crushed or trapped between the robot and a shelf while the lift is picking up the shelf.

- You risk being crushed or trapped if the robot places a load outside a designated drop-off area due to faulty localization.
- You risk losing control of the robot if it is accessed by unauthorized users. Consider increasing the IT security of your product.

**NOTICE**

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

2. Product presentation

AMiR shelf lift application is a top module that can be mounted on a MiR100/MiR200 robot. The application can autonomously pick up and place shelves. A robot with a MiR shelf lift application works indoors within production facilities, warehouses, and in a host of other industrial locations.

Robot payloads apply, so the total shelf payload is affected by whether the MiR shelf lift application is mounted on MiR100 or MiR200. For more information, see the payload specifications in [Shelf specifications on page 25](#).



MiR100/MiR200 can transport loads with a total payload of . The total payload consists of the top module and its payload.

The commissioner or operator provides the destination of product delivery or pick up via the web-based robot interface. MiR100/MiR200 with a MiR shelf lift application can be set up to run a fixed route, be called on demand, and perform complex missions.

A MiR shelf lift application picks up standalone shelves that are not required to be in a docking station, pallet rack, or similar. MiR100/MiR200 locate shelves solely by shelf positions on the map, and use the sidebars to dock to the shelf correctly. For increased precision when placing shelves, it is possible to use markers, such as VL-markers, to specify an exact position where the robot can place a shelf. This is described in [Creating the mission Place shelf at VL-marker on page 37](#).

For a MiR shelf lift application to comply with safety standards and to function properly with MiR100/MiR200, shelves must be designed according to specifications supplied in [Shelf specifications on page 25](#).

2.8 How MiR shelf lift application works

With a standard MiR shelf lift application, the robot communicates to the MiR shelf lift application using PLC registers.



Some MiR shelf lift applications may use other methods of communication. Your MiR shelf lift application distributor must inform you if another method is used.

When using the actions in the **Shelf** menu in the mission editor, MiR100/MiR200 operates the shelf lift application using PLC registers 13 and 14 and expects to read the current position of the lift through registers 7 and 8. The exact procedure for the shelf operation are described in the following sections.

How the robot lowers the shelf lift

The following points describe how the robot uses registers to lower a shelf:

1. The MiR robot sets the register 13 to 1 to begin lowering the shelf.
2. The robot waits for register 7 to be set to 1, signaling that the lift is lowered completely. There is a 40 second timeout before the robot reports an error.
3. Once the MiR robot registers that the shelf device has been lowered, it clears register 13, setting it to 0.

How the robot raises the shelf lift

The following points describe how the robot uses registers to raise a shelf:

1. The MiR robot sets register 14 to 1 to begin raising the shelf.
2. The robot waits for register 8 to be set to 1, signaling that the lift is raised completely. There is a 40 second timeout before the robot reports an error.
3. Once the MiR robot registers that the shelf device has been lowered, it clears register 14, setting it to 0.

Clearing the registers

The following points describe in which states the registers are cleared to 0:

- When the shelf device is in its lowered position, register 7 should be 1. As soon as the shelf begins rising, register 7 is cleared to 0.
- When the shelf device is in its raised position, register 8 should be 1. As soon as the shelf begins rising, register 8 is cleared to 0.
- When the shelf is moving between raised and lowered, registers 8 and 7 should both be cleared to 0.

Error mode

If the registers are set in an invalid configuration, you will receive an error. The following two cases are invalid configurations:

- The shelf will report an error if both registers 13 and 14 are set to 1.
- The shelf will report an error if both registers 7 and 8 are set to 1.

3. Getting started

This section describes how to get started with MiR shelf lift application.



It is expected that your MiR shelf lift application distributor has provided instructions on how to mount your MiR shelf lift application. If not, refer to the MiR100/MiR200 User guide for information regarding the interfaces from the robot to a top application.



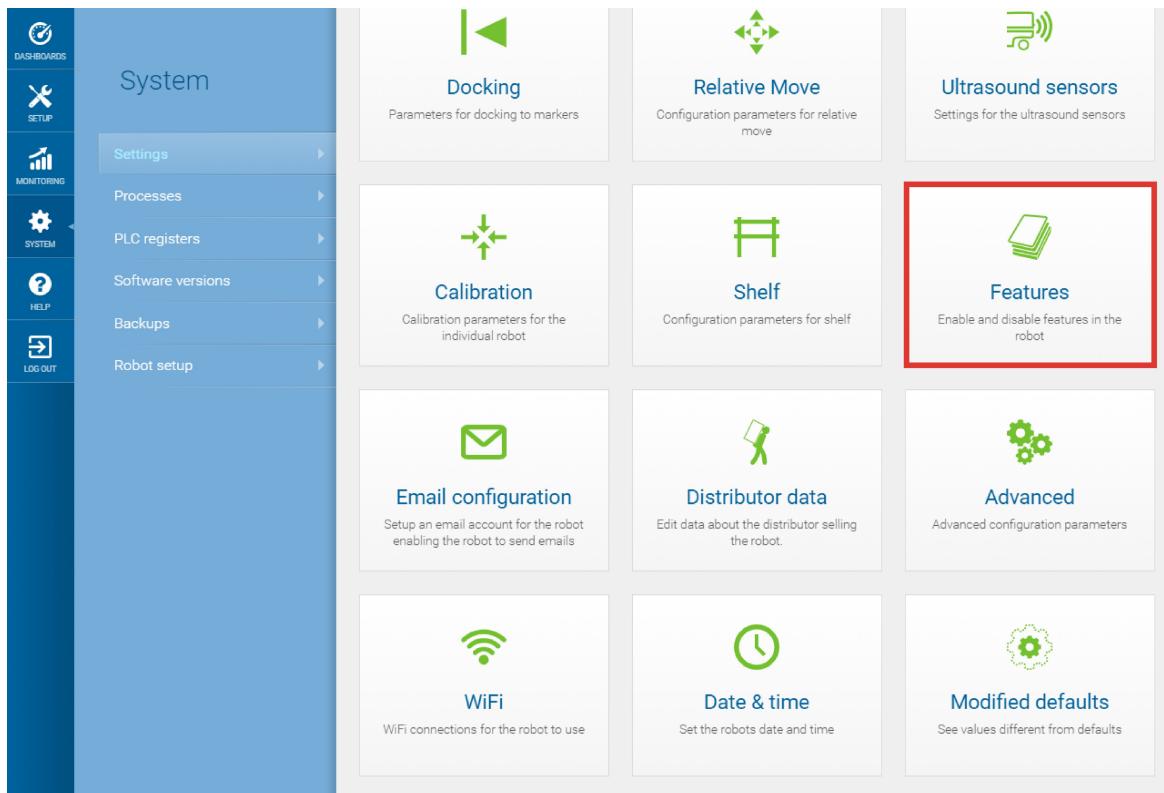
NOTICE

Read [Safety on page 7](#) before powering up MiR shelf lift application.

3.1 Enable MiR shelf lift application feature

To access the MiR shelf lift application settings and mission menus, the MiR shelf lift application features must be enabled. Follow these steps to check that they are enabled:

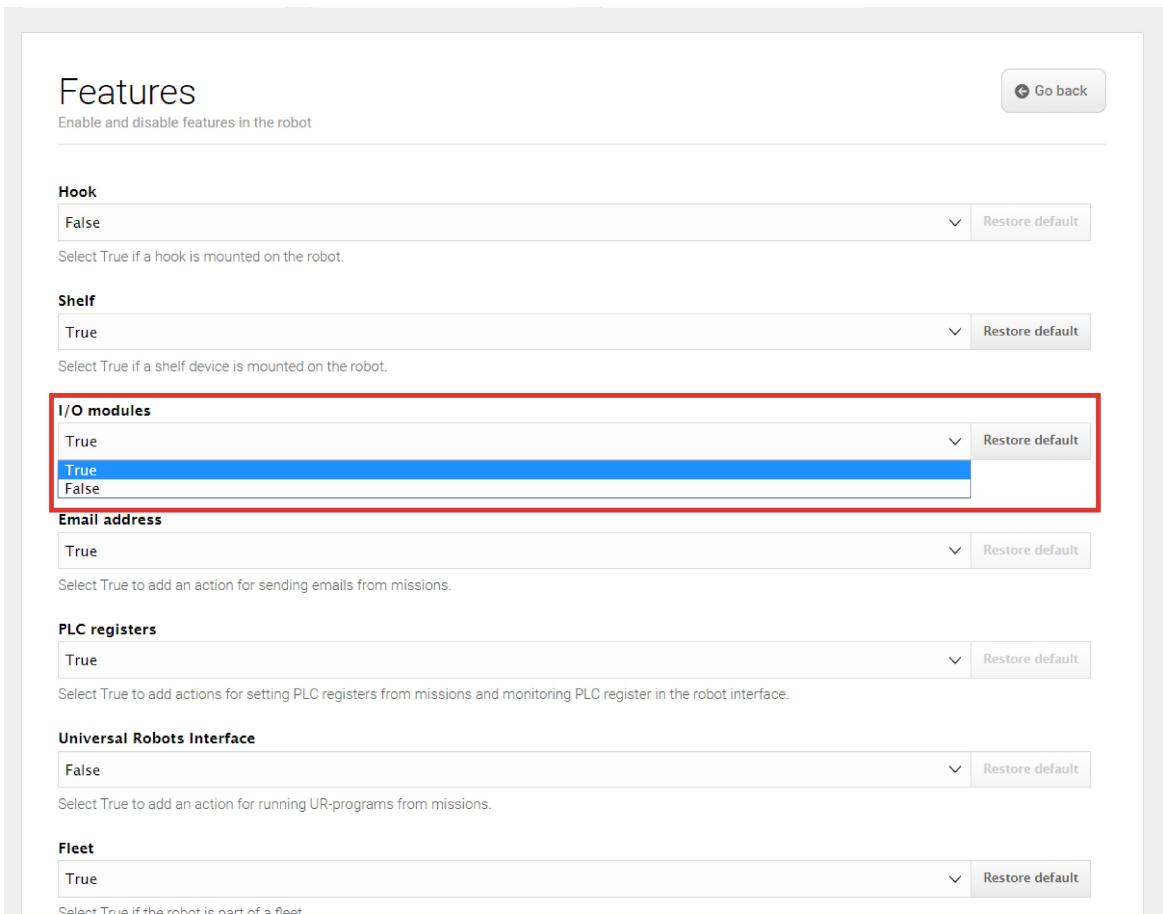
1. Sign in to the robot interface, and go to **System > Settings > Features**.



2. Under **Shelf**, select **True**.

The screenshot shows the 'Features' configuration page. At the top right is a 'Go back' button. Below it, a section titled 'Hook' has a dropdown menu set to 'False' with a 'Restore default' button. A note says 'Select True if a hook is mounted on the robot.' Below this is a section titled 'Shelf' with a dropdown menu set to 'True' (which is highlighted with a blue selection bar), with a 'Restore default' button. A note says 'Select True if a shelf is mounted on the robot.' This 'Shelf' section is enclosed in a red rectangular box. Below it is a section titled 'I/O modules' with a dropdown menu set to 'True' and a 'Restore default' button. A note says 'Select True to add actions for communicating with I/O modules from missions and zones.' Finally, there is a section titled 'Email address' with a dropdown menu set to 'True' and a 'Restore default' button. A note says 'Select True to add an action for sending emails from missions.'

3. If your MiR Shelf uses I/O modules to operate, select **True** under **I/O modules** to enable them.



Features

Enable and disable features in the robot

Hook

False Restore default

Select True if a hook is mounted on the robot.

Shelf

True Restore default

Select True if a shelf device is mounted on the robot.

I/O modules

True Restore default

True
False

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

True Restore default

Select True if the robot is part of a fleet

4. Commissioning

This section describes how to commission the MiR shelf lift application.

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.
- Procure shelves with specifications supported by MiR.
- 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.

4.1 Shelf specifications

It is up to the user to create and design their own shelf. It is required that the shelf fulfills the design specifications described in this section.

Dimensions

Figure 4.1 illustrates the various shelf dimensions. MiR shelf lift application can accommodate shelves with the following dimensions:

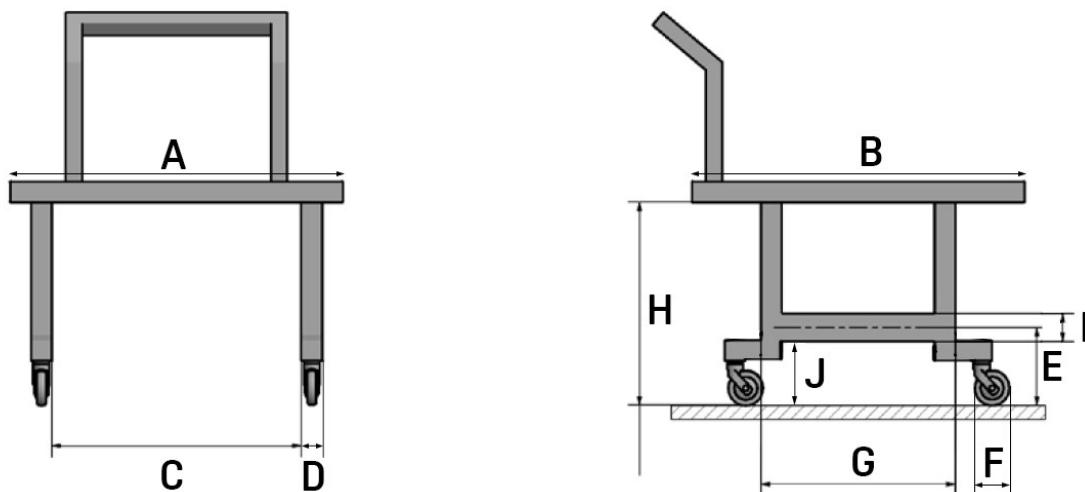
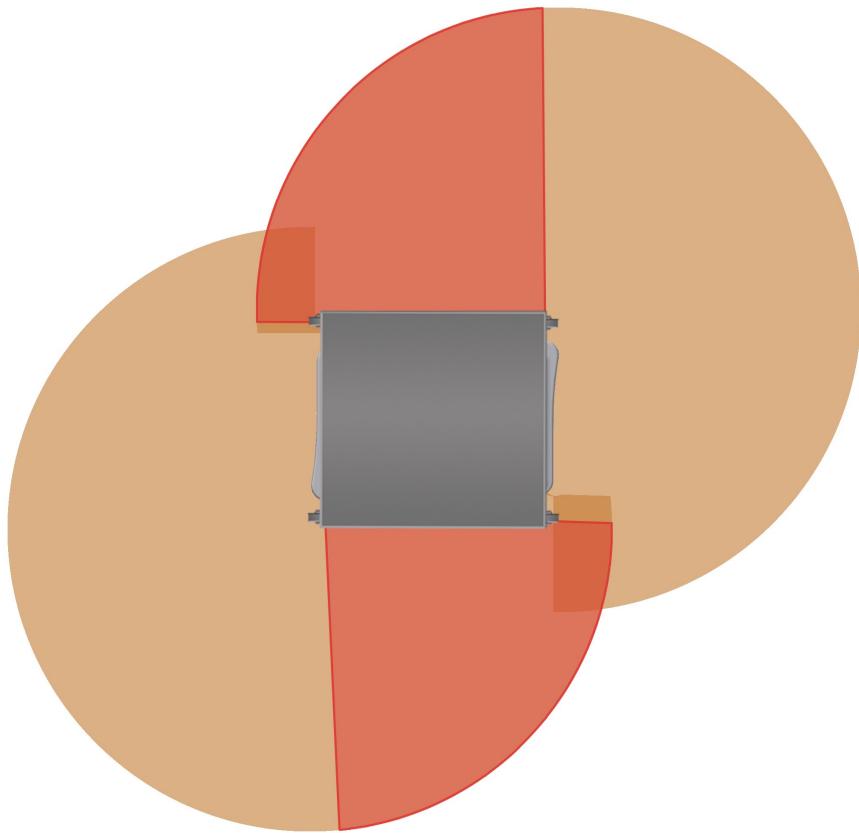


Figure 4.1. Front view of a shelf (left), and side view of a shelf (right).

Label	Description	Label	Description
A	Width: maximum 1200 mm	B	Length: maximum 1200 mm
C	Side bar distance: minimum 750 mm	D	Thickness of shelf legs: minimum 25 mm
E	Side bar clearance from ground: 200 mm from ground to side bar center	F	Wheel diameter: As large as possible without interfering with the safety scanners—maximum 150 mm
G	Side bar length: between 400 mm and 750 mm (see note below)	H	Shelf height: depends on the lifting device
I	Side bar height: minimum 100 mm	J	Side bar clearance: maximum 150 mm



A long side bar reduces the field of view of the safety scanners. The appropriate length of the sidebar depends on the application of the robot. It is recommended that the front and rear scanner each have at least a 180° free field of view in total to ensure that the robot can navigate the area.



Using the specified dimensions of the side bar is vital for the robot's navigation and guidance. If the side bar is not correctly positioned or sized, it may obstruct the field of view of the laser scanners. Furthermore, the side bar is used by the robot as a reference to correctly dock to the shelf.

**NOTICE**

The inside of the side bar must be coated with a non reflective material that has a light, neutral color. We recommend using a matte light gray.

Payload

MiR shelf lift application is designed to lift up to 100/200 kg depending on which robot you mount the top module to.

The weight of any add-ons mounted on the robot is part of the total payload.

It is possible that the shelf itself cannot support the weight due to the shelf design.

It is the responsibility of the commissioner to determine the safe total payload each shelf type can support regardless of the robot's payload.

The exact payload limit depends on the shelf design, payload distribution, application, and driving surface. The total payload should be determined during commissioning.

**CAUTION**

Risk of injury if excessive or incorrectly distributed loads are fastened to the MiR shelf lift application.

- Determine the safe total payload for your shelf application during commissioning.

4.2 Adjusting the Protective field sets

When MiR100/MiR200 is driving with a shelf, the legs and side bars of the shelf may be located in the Protective field set of the robot if the shelf is not lifted above the scanners. Therefore, for MiR100/MiR200 to drive with a shelf without going into Protective stop, the Protective field sets need to be adjusted. There are two how-to guides you can request from your distributor for adjusting the Protective field sets:

- For instructions on uploading a standard safety configuration for MiR shelf lift application, see *How to set up the SICK safety system for a shelf (MiR100, MiR200)*.
- For instructions on editing the field sets manually, see *How to adjust Protective field sets on MiR100/MiR200*.

4.3 Mark potentially hazardous floor areas and clear the required space

Before taking your MiR shelf lift application into use, it is necessary to mark the area where MiR100/MiR200 with MiR shelf lift application docks to a shelf as an operating hazard zone.

Why marking is required

When a robot approaches a shelf, it slows down, reducing the size of its protective field sets. The status light band emits a wavering white light to indicate that it is docking when the robot reaches the entry position approximately one meter from the shelf marker.



WARNING

Risk of being trapped or crushed between MiR100/MiR200 and the shelf.

- Mark the floor one meter around the hazard and instruct personnel to stay clear on the zone when the robot is entering it.

Marking the operating hazard zone



NOTICE

The required operating hazard zone and the required space for docking are not the same.

The yellow and black striped line in *Figure 4.2* illustrates the area around the shelf that should be marked as a hazard zone. The marked area must span at least one meter from the identified hazards in [General safety precautions on page 9](#).

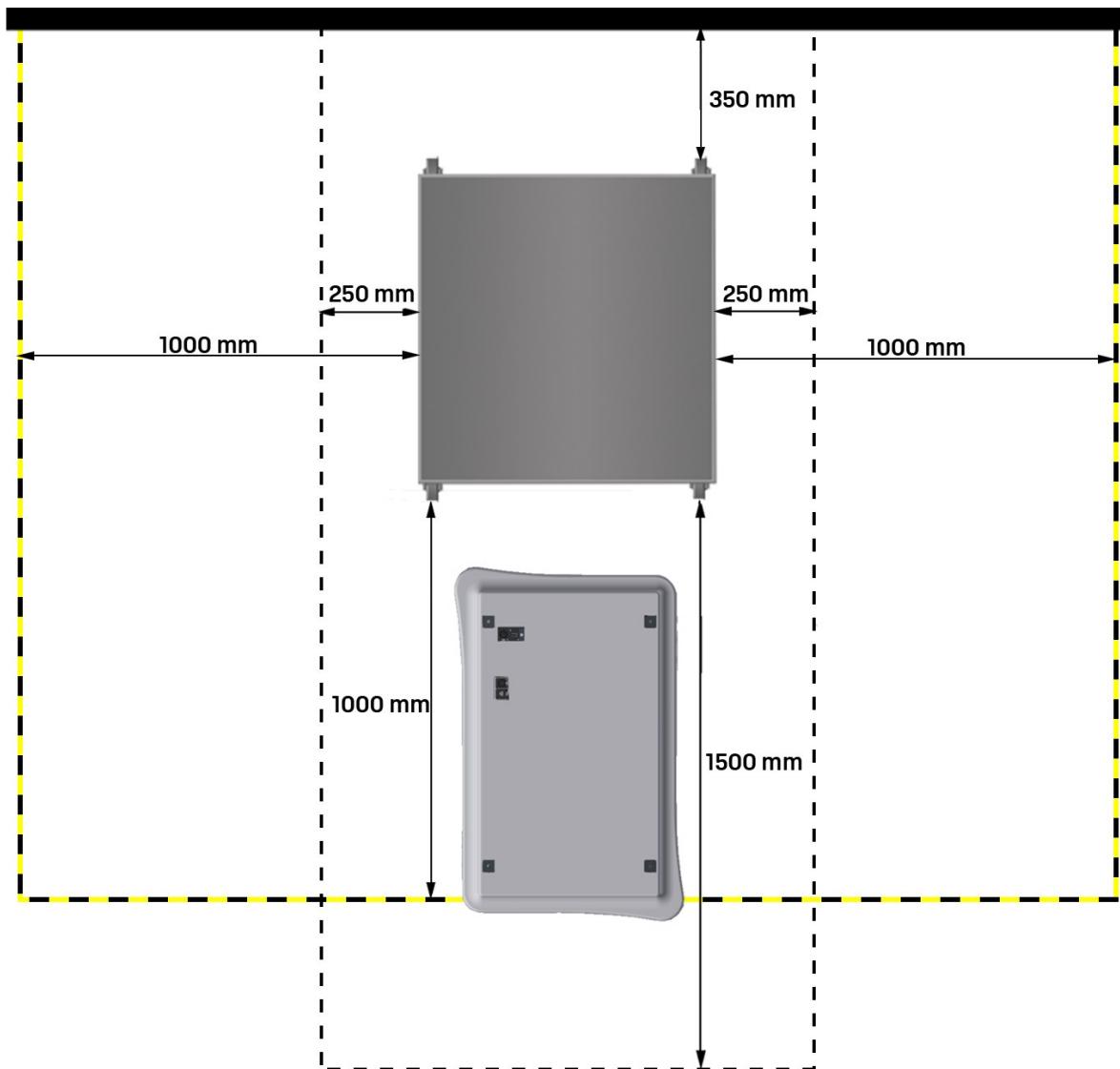


Figure 4.2. The striped black and yellow line identifies the hazard zone around a shelf that should be marked with signal tape or similar marking. The dashed black line indicates the required minimum free space for the robot to dock successfully.

Required free space

The robot requires a certain amount of free space around the shelf to ensure a smooth docking.

It is the commissioner's responsibility to ensure an installation that functions, so the commissioner must be aware that:

- The required space varies between specific local environments.
- The size and material of the obstacles surrounding the shelf influence the docking procedure.

The minimum required free space for a successful docking is indicated in *Figure 4.2* with the black dashed line. The space defined in *Figure 4.2* is based on the robot's path going to the shelf and takes into account that the robot may have to make a turn of up to 90° when docking. In some cases, a larger free space may be required. It must be determined during commissioning if more space is required.



NOTICE

The space required for a successful docking can be larger than the operating hazard zone.

Multiple shelves

If you have multiple shelves lined up next to each other, it is important to place the shelves with enough space to at least one side of each shelf to ensure there are sufficient escape routes in case of an emergency situation.

To fulfill the safety requirements, place the shelves so there is at least 500 mm of free space to one side of each shelf that leads to an open area outside of the operating hazard zone.

There are two recommended setups: escape routes between every second shelf or an escape route behind the shelves. These setups are visualized in *Figure 4.3* and *Figure 4.4* respectively.

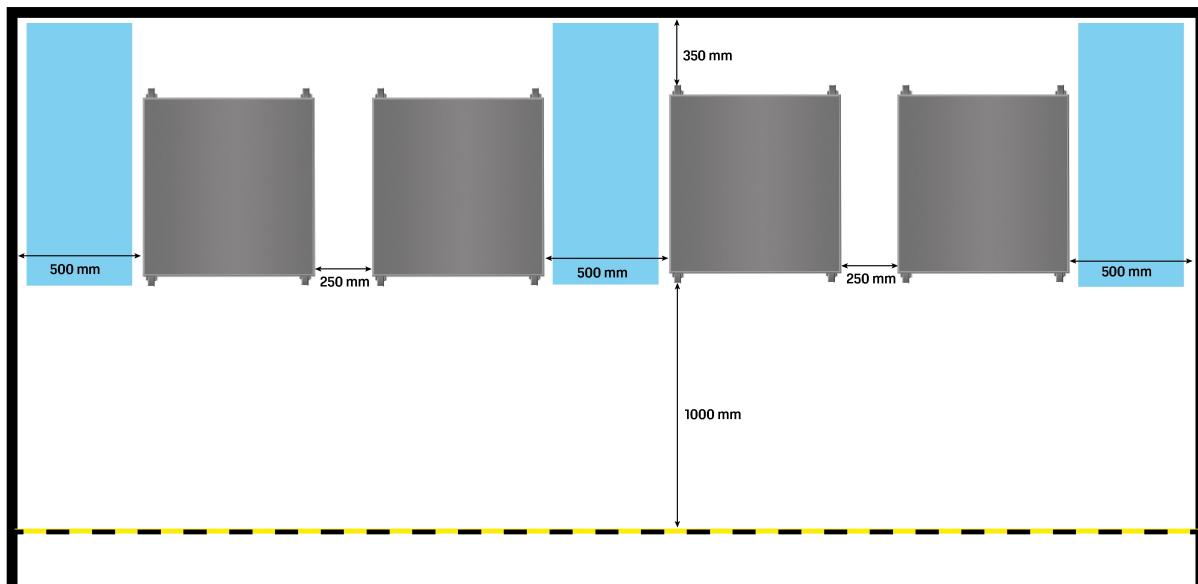


Figure 4.3. The blue areas indicate the escape routes that are located between every second shelf.

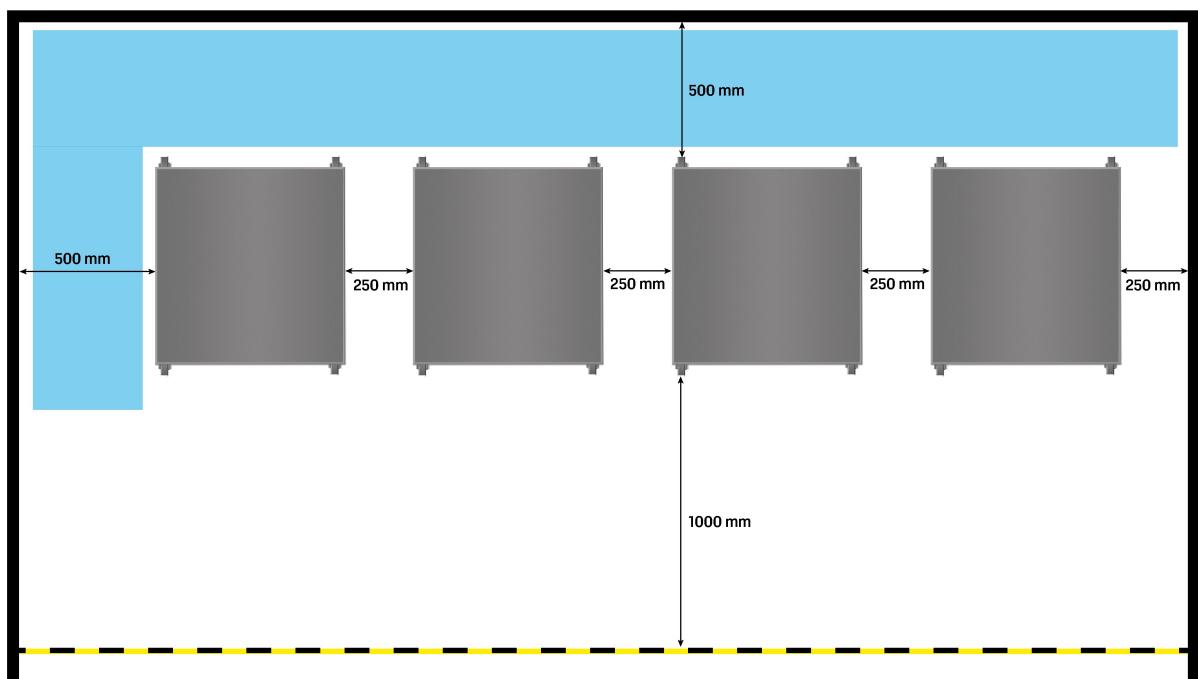


Figure 4.4. The blue area indicates the escape route behind the row of shelves, and includes an exit to the open area.

4. Usage

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

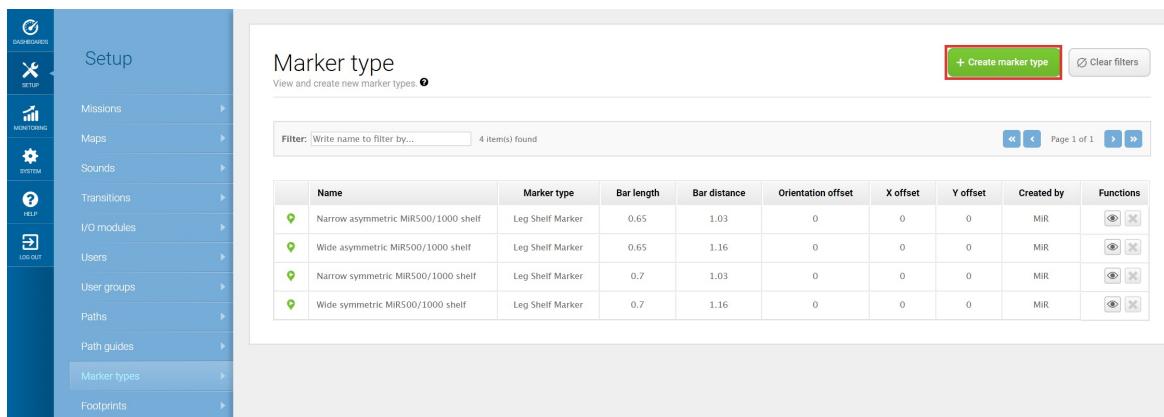
- Setting markers and positions on the map.
- Defining marker types that the robot uses when docking to a shelf.
- Creating a mission that uses a *Prompt* user action. The example mission is titled *Prompt user*.
- Creating a mission that uses a *Try/Catch* action. The example mission is titled *Try/Catch*.
- Creating a mission that uses variables. The example mission is titled *Variable footprint*.
- Creating a shelf position and integrating it with a VL-marker for higher precision and closer placement of shelves. The example mission is titled *Place shelf at VL-marker*.
- Creating a mission where the robot picks up and places a shelf using the template missions. The example mission is titled *Pick up and place shelf*.

4.4 Creating a marker type

Before creating missions with shelves, you need to define the different marker types that your robot will be docking to. Marker types are used to define what type of shelf is located on a shelf position and how the robot docks to it, ensuring that the robot picks up the shelf correctly.

Follow these steps to create a new marker type:

1. To create a new marker type, go to **Setup > Marker types**, and select **Create marker type**.



Name	Marker type	Bar length	Bar distance	Orientation offset	X offset	Y offset	Created by	Functions
Narrow asymmetric MIR500/1000 shelf	Leg Shelf Marker	0.65	1.03	0	0	0	MiR	
Wide asymmetric MIR500/1000 shelf	Leg Shelf Marker	0.65	1.16	0	0	0	MiR	
Narrow symmetric MIR500/1000 shelf	Leg Shelf Marker	0.7	1.03	0	0	0	MiR	
Wide symmetric MIR500/1000 shelf	Leg Shelf Marker	0.7	1.16	0	0	0	MiR	

2. Fill in the parameters with the dimensions of your shelf. Each parameter is described below.

Create marker type

Create a new marker type. [?](#)

[Go back](#)

Name [?](#)

Enter the marker type's name

Shelf type [?](#)

Bar Shelf Marker

Bar length in meters [?](#)

Enter the marker type's width in meters ...

Bar distance in meters [?](#)

Enter the marker type's bar distance in meters ...

Orientation offset in degrees [?](#)

Enter the marker type's orientation offset in degrees ...

Offset X in meters [?](#)

Enter the marker type's X-offset in meters

Offset Y in meters [?](#)

Enter the marker type's Y-offset in meters

✓ Create marker type ✗ Cancel

- **Name:** Identifies the shelf type when using it in mission actions. The marker-type name must be unique.
- **Shelf type:** Identifies the type of shelf that is going to be used. **Bar shelf markers** are for MiR100 and MiR200 robots, and **Leg shelf markers** are for MiR250, MiR500 and MiR1000 robots.
- **Bar length in meters:** Defines the length of the side bars. This dimension is also identified in [Shelf specifications on page 25](#).
- **Bar distance in meters:** Defines the distance between the inner sides of the two side bars. This can also be interpreted as the width of the space under the shelf where the robot docks. This dimension is also identified in [Shelf specifications on page 25](#).
- **Orientation offset in degrees:** Adjusts the angle of the robot's orientation when docking to the shelf. A value of 180 will make the robot dock in reverse. With a positive offset, the robot will turn to the left, and a negative value will turn it to the right.
- **Offset X in meters:** Adjusts how far forward the robot should go under the shelf when picking it up. By default, the robot should dock to the center. With a positive X-offset, the robot will move more forward, and a negative value will move it backward.

- **Offset Y in meters:** Adjusts how far to either side the robot goes under the shelf when picking it up. By default, the robot should dock to the center. With a positive Y-offset, the robot will move more to the left side, and a negative value will move it to the right.



If the robot is not docking correctly, try adjusting the X and Y offsets.

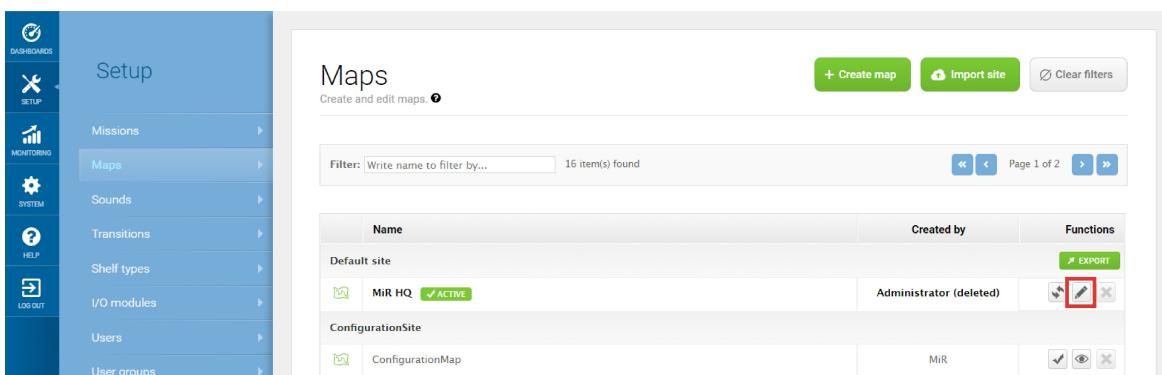
3. Select **Create marker type** when you are done. The marker type is now displayed in the list of marker types.

4.5 Setting shelf positions on the map

To create a mission where the robot picks up or places a shelf, shelf positions must be defined in the map. It is only at shelf positions that the robot is able to pick up shelves.

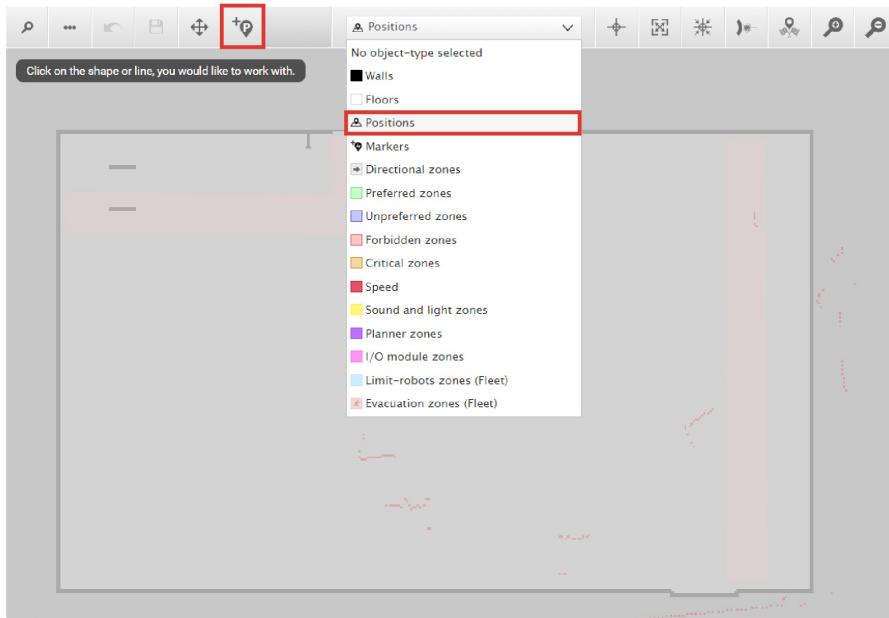
Follow these steps to create a shelf position:

1. To create a new position, go to **Setup > Maps**. Select **Edit**  for the active map.



Name	Created by	Functions
MiR HQ ACTIVE	Administrator (deleted)	
ConfigurationSite	MiR	
ConfigurationMap		

- Within the editor, select **Positions**  in the **Object-type** drop down menu, and select **Draw new position**  in the editor tools.



- Select the point on the map where you want the shelf position to be placed.
- In the **Create position** dialog box, name the position, and under **Type**, select **Shelf position**.

Create position

Name	<input type="text" value="Shelf position A"/>
Type	<input type="button" value="Robot position"/> <input type="button" value="Emergency position"/> <input type="button" value="Robot position"/> Shelf position (selected) <input type="button" value="Staging position"/>
Orientation from X-axis	<input type="text" value="-15.154"/>
Y coordinate in meters	<input type="text" value="13.150"/>
<input style="background-color: #0070C0; color: white; padding: 5px; margin-right: 10px;" type="button" value="OK"/> <input type="button" value="Cancel"/>	

5. Select **OK** to create the shelf position. The position is now visible on the map.



6.



If you want to make more than one position on the map, repeat the previous steps. Make sure that the minimum distances between shelf positions fulfill the dimensions specified in **Mark potentially hazardous floor areas and clear the required space** on page 28.

4.6 Creating the mission *Place shelf at VL-marker*

If you need to place shelves with greater precision, you can do so by creating shelf positions in front of markers.



We recommend using VL-markers to place shelves, but you can also use other types of markers if preferred.

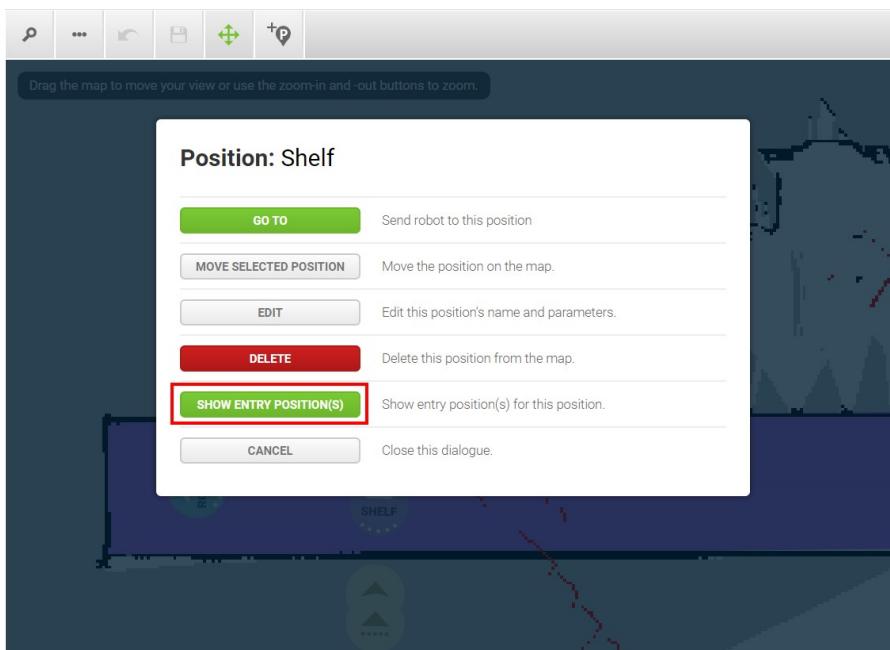
To use a marker with a shelf position correctly, you must make the robot dock to the marker when placing a shelf and make the robot dock to the shelf when picking it up. *Place shelf at VL-marker* is an example mission that makes the robot place a shelf accurately on a shelf position by docking to a VL-marker. The mission uses a variable for the marker, enabling you to reuse the mission for any marker placed in front of a shelf position.

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

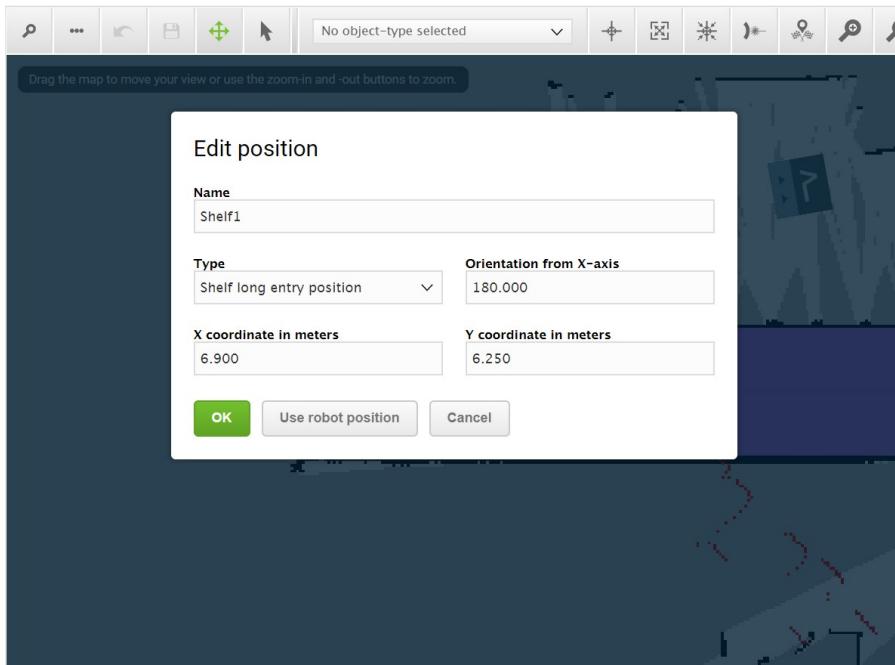
- Created a marker titled **Shelf VL-marker**
- Defined a mission group titled **Missions**.

The following steps describe how to create a mission that makes the robot dock to a marker and place a shelf:

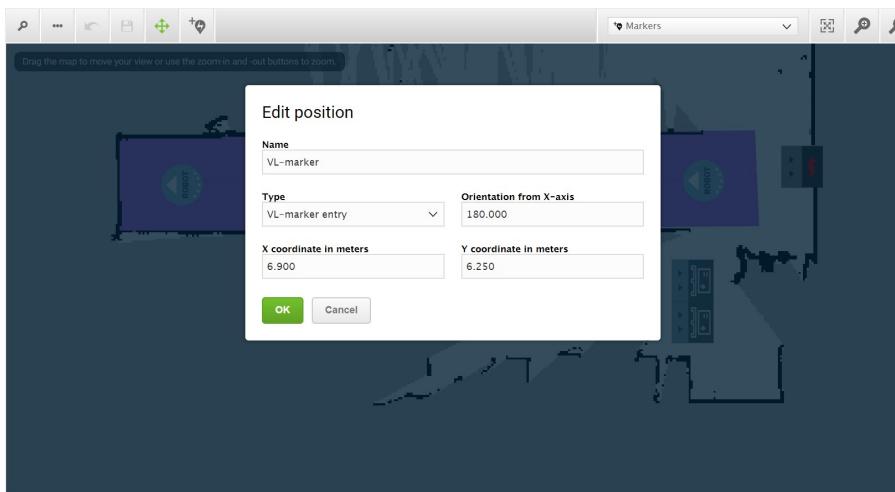
1. Go to the map editor of the active map.
2. Create a shelf position directly in front of the VL-marker you created
3. Select the shelf position on the map. Then select **Show entry position**. Two entry positions are displayed. They indicate where the robot will go to first when docking to the position. The entry position closest to the shelf position is for MiR100/MiR200.



- Select **Edit** if you want to adjust the entry position. Note the X and Y coordinates of the entry position.

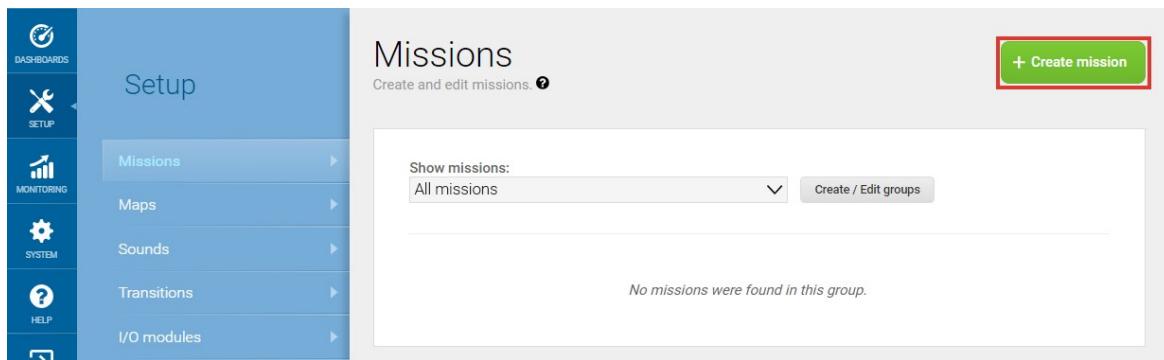


- Select the VL-marker on the map. Then select **Show entry position**.
- Select the VL-marker's entry position, and insert the same X and Y coordinates of the shelf position's entry position.



- Repeat the previous steps with all other markers where you want the robot to place shelves accurately.

8. Go to **Setup > Missions**, and select **+ Create Mission**.



9. Name the mission *Place shelf at VL marker*, and select **Missions** under **Mission group**.

10. Select the following actions:

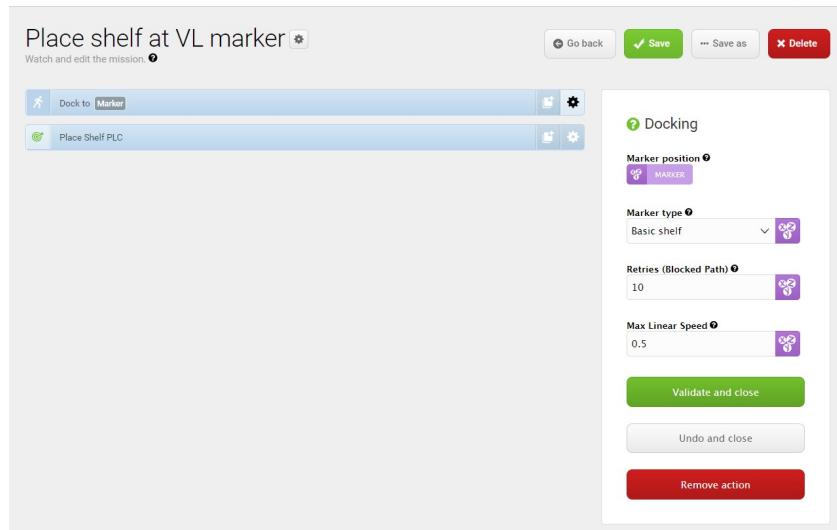
- In the **Move** menu, select **Docking**.
- In the **Shelf** menu, select the **Place Shelf PLC** template mission.



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**.

11. For the **Dock to** action, make the parameter **Marker position** a variable that can be set each time you use the mission. The following steps describe how to create a variable:

- a. Under **Marker position**, select **Variables** .



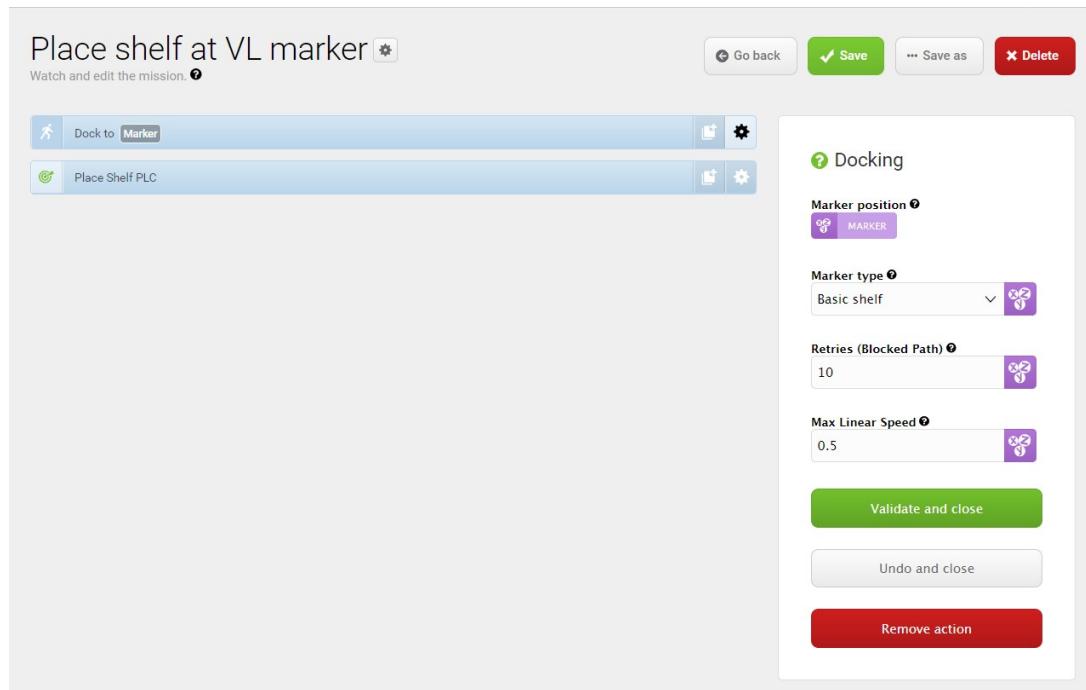
- b. Select **Create variable** in the upper-right corner.
 c. Name the variable **Marker**, and set the **Shelf VL-marker** as the **Default value**.
 Select **OK**.

Create variable

In the Name field, enter a question that the operator must answer before the mission can begin, e.g. "How many meters forwards or backwards?" In the Default value field, enter a default distance.

Variable name <input type="text" value="Marker"/>	Default value <input type="text" value="Shelf VL-marker"/>
<input type="button" value="OK"/> <input type="button" value="Cancel"/>	

- d. Leave the other parameters at their default values. The **Marker type** is not used as long as you select a V, VL, or L-marker when using the mission.



12. The mission is now ready. Select **Save** to save your mission.

When you are creating other missions in the mission editor, you can now select this mission from the **Missions** menu and select any type of marker to make the robot place a shelf in front of it. Make sure you have modified the entry point of the marker as described in the first steps.

4.7 Creating a footprint

The footprint specifies how much space the robot occupies, including any loads or top modules. The footprint is defined by a number of points relative to the robot's center coordinate system and the total height of the robot application.

If your robot drives with loads or top modules that exceed the width or length of the robot, you must define new footprints for the robot to ensure that the robot plans its route correctly and avoids colliding with obstacles with its top module or load.

When a MiR robot carries a shelf, it is important to set the footprint of the robot to the dimensions of the shelf.

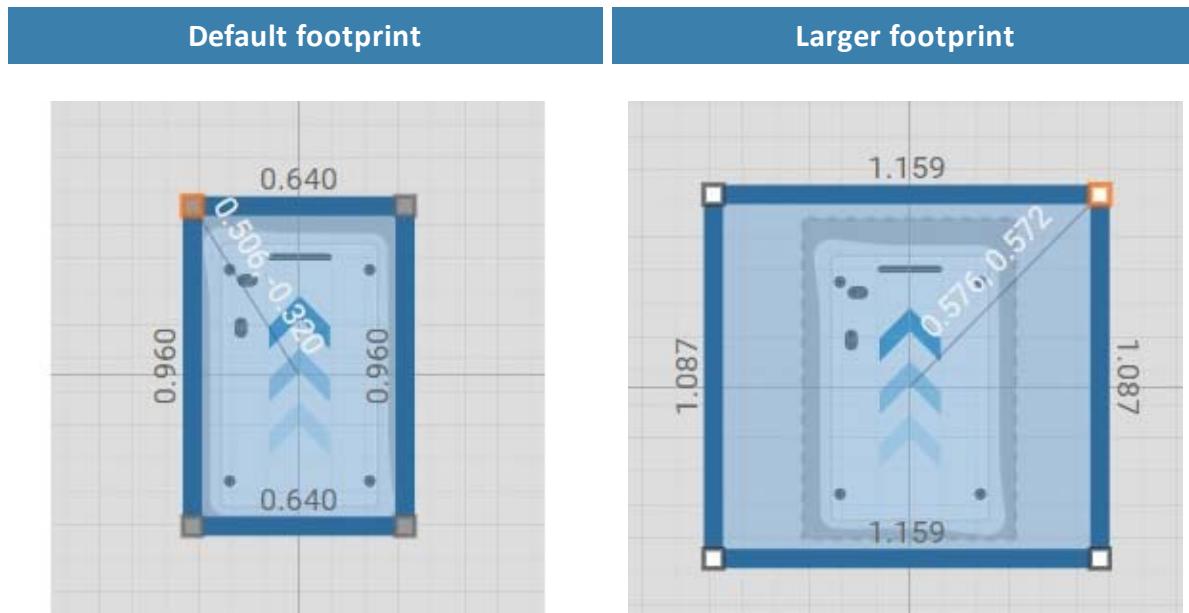


Figure 4.5. Examples of the default robot footprint and an extended footprint. The values displayed along each line is the length of the edge in meters.

The number of footprints you need to define depends on:

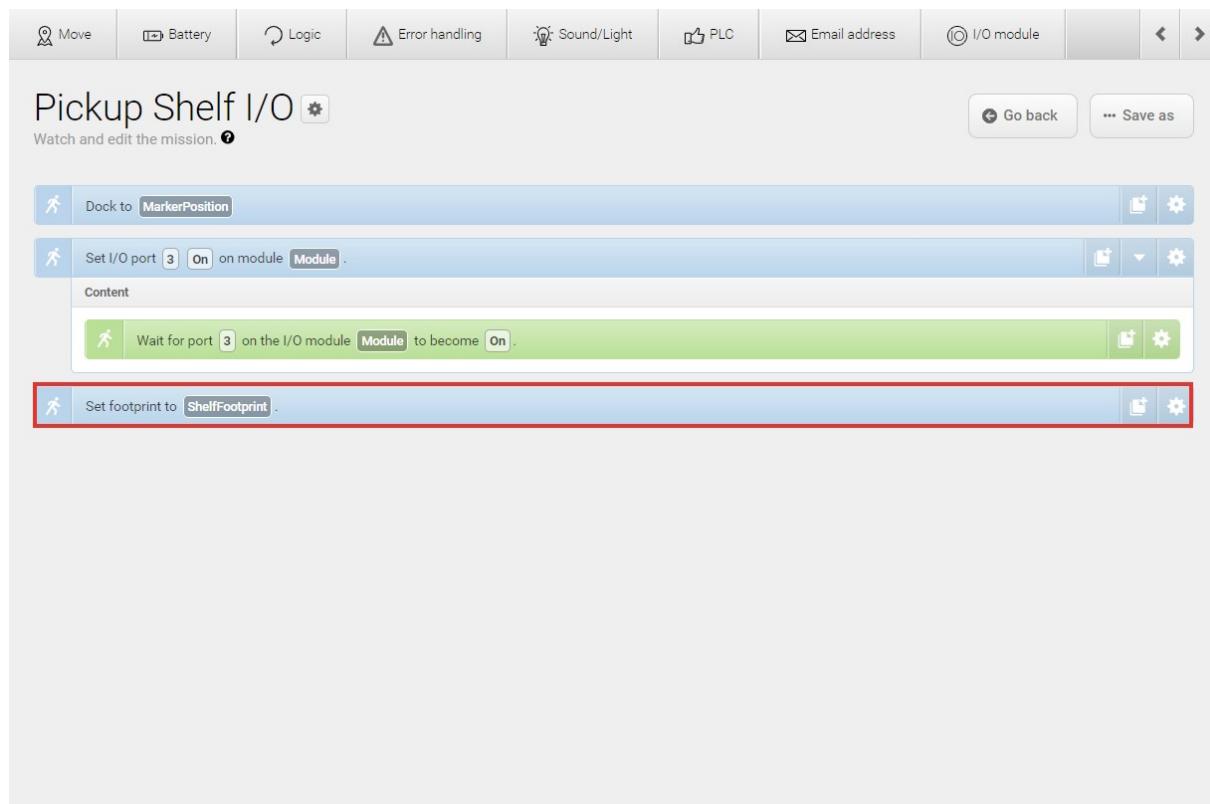
- If there are low hanging fixtures that the robot can pass under only when it is not carrying certain loads or top modules, you must define new footprints for the various heights that the robot and its load can have to ensure that they don't collide with the low hanging fixtures.
- The top modules you use with your robot.
 - If a robot's top module exceeds the width or length of the robot, you must define a new footprint for that top module.
 - If a top module has moving parts that can extend over the edges of the robot's footprint while the robot is moving, you must define a footprint that includes the moving parts when they are at their most extended positions.
- The loads the robot transports.
 - For each load the robot transports that exceeds the length or width of the robot, you must define a footprint for that load.
 - If you prefer to only have one footprint for the robot when it is carrying oversized loads, create a footprint that is suitable for the load that has the largest footprint.



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

For more information about the footprint editor, see *MiR Robot Reference Guide* on the MiR website.

If you want to change the footprint in a mission, use the Set footprint action found under the Move action group. This is used to change the footprint when the robot picks up a load that extends the footprint or places a load and the footprint returns to the default.



The screenshot shows the MiR Mission Planner interface. At the top, there is a navigation bar with icons for Move, Battery, Logic, Error handling, Sound/Light, PLC, Email address, and I/O module, along with back and forward arrows. Below the navigation bar, the title 'Pickup Shelf I/O' is displayed with a gear icon for settings. A sub-instruction 'Watch and edit the mission.' is shown with a question mark icon. To the right of the title are 'Go back' and 'Save as' buttons. The main area contains four mission steps:

- Dock to MarkerPosition**
- Set I/O port 3 On on module Module**
- Wait for port 3 on the I/O module Module to become On**
- Set footprint to ShelfFootprint** (This step is highlighted with a red border)

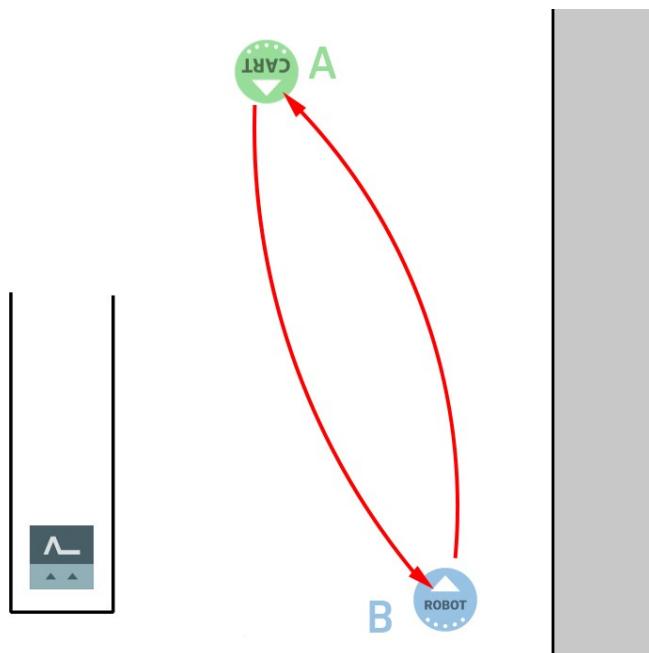
If you want to edit the default footprint of the robot, for example if the mounted top module is larger than the robot, go to **System > Settings > Planner**, and select a new footprint under **Robot footprint**.

4.8 Creating a cart mission

This section describes how you create the example mission Cart mission. The mission demonstrates how you use cart actions in your mission. After creating this example mission, you can modify the mission to include more complex actions. To make the example yourself, it is assumed that you completed the following:

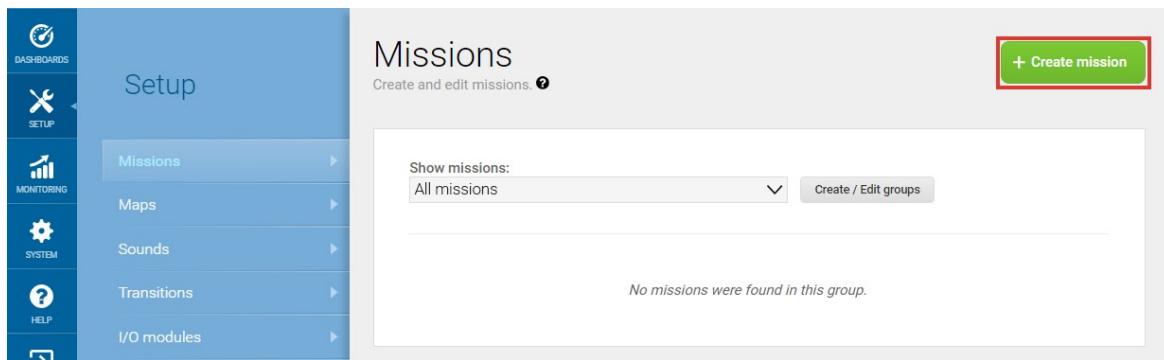
- Enabled the **Hook** feature, as described in [Enable MiR shelf lift application feature on page 22](#).
- Created two cart positions titled **Position A** and **Position B**
- Placed a cart at the physical location of **Position A** and defined the cart, as described in [Creating a marker type on page 33](#). In this example, the name of the cart is **Basic cart**.

The goal of the mission is to pick up a cart at **Position A**, drive to **Position B** with the cart, and drive back to position A to place the cart.

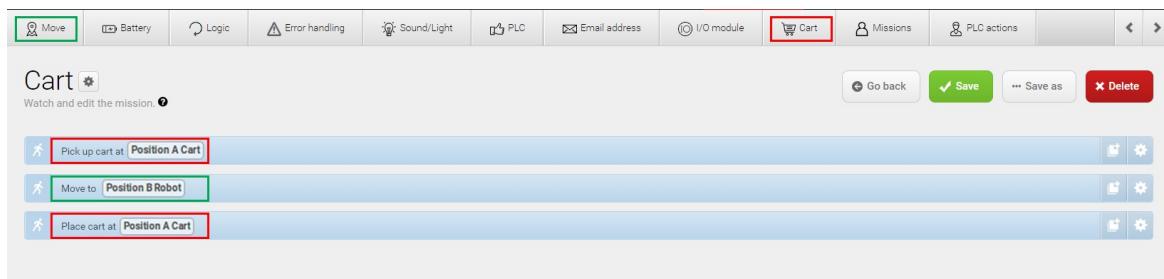


Follow these steps to create the example mission *Cart mission*:

- To create a new mission, go to **Setup > Missions** and select **Create mission**.



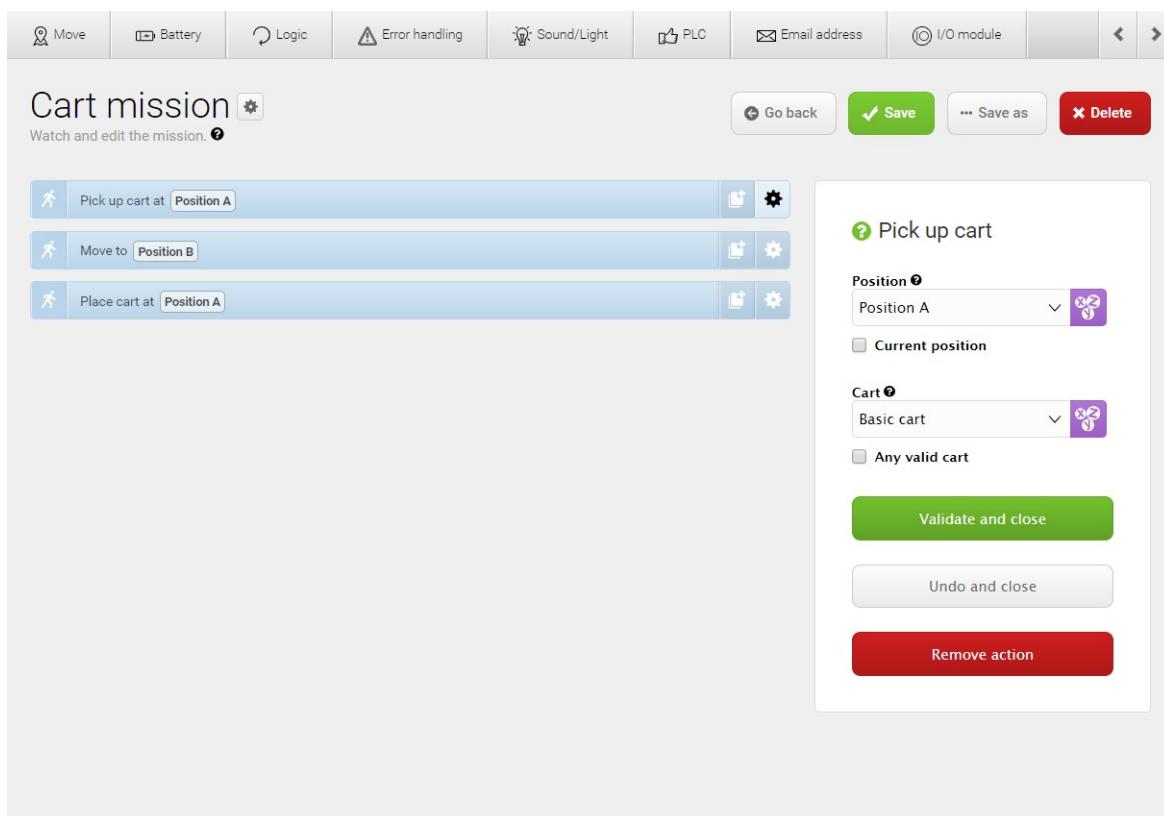
- Name the mission **Cart mission**, and select a mission group and site. Select **Create mission** when you are done.
- Select the following actions:
 - In the **Cart** menu, select **Pick up cart**.
 - In the **Move** menu, select **Move**.
 - In the **Cart** menu, select **Place cart**.



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**.

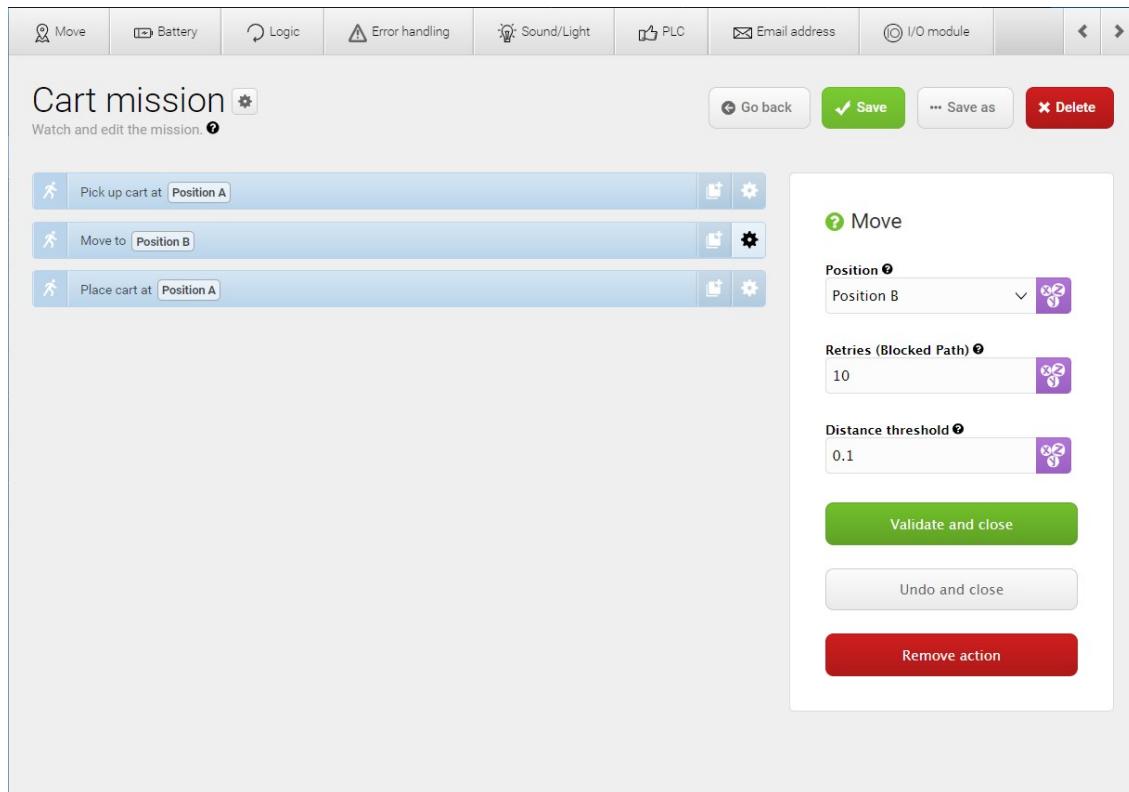
4. For the **Pick up cart** action, set the parameters as follows:

- **Position:** Select **Position A**.
- **Cart:** Select the cart that is placed at **Position A**. In this example, the type is **Basic cart**.



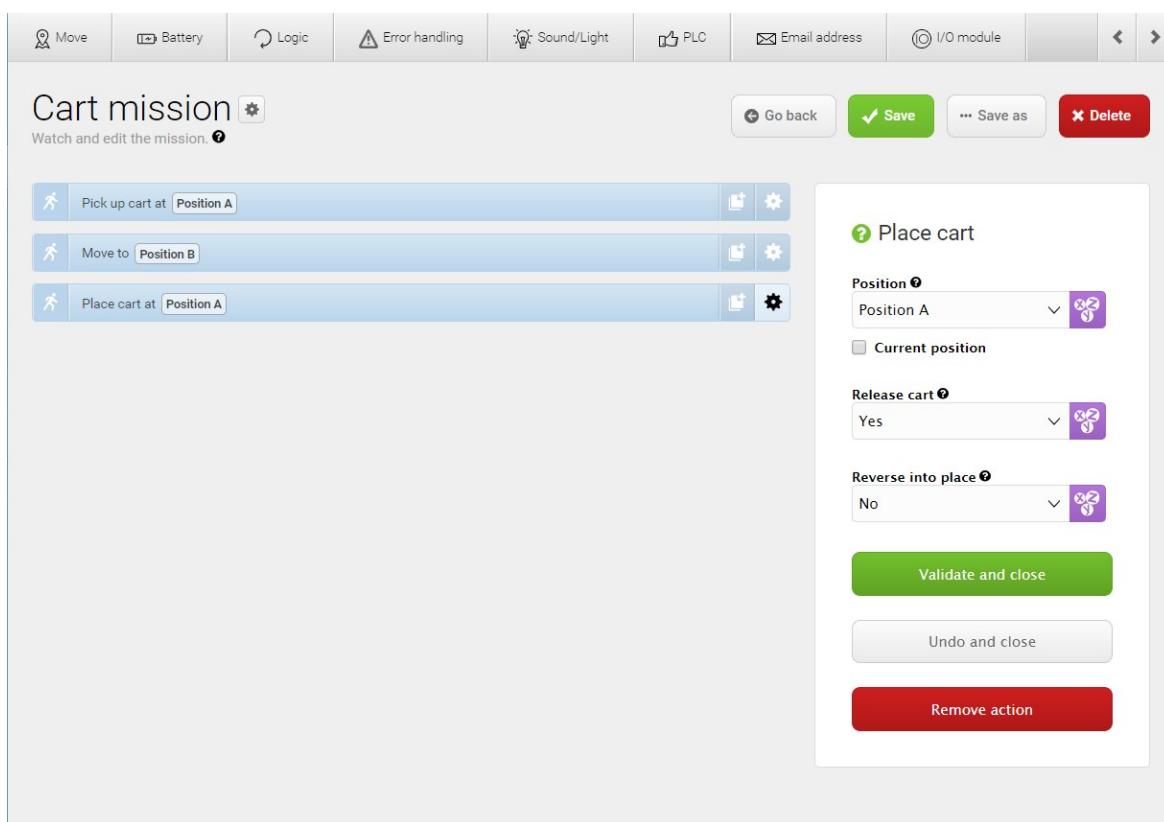
5. For the **Move to** action, set the parameters as follows:

- **Position:** Select **Position B**.
- **Position type:** Select **Main**.
- **Retries:** Leave the number of retries at the default value of 10.
- **Distance threshold:** Leave the threshold at the default value of 0.1.



6. For the **Place cart** action, set the parameters as follows:

- **Position:** Select **Position A**.
- **Release cart:** Select **Yes** to make MiR shelf lift application release the cart and leave it at the position.
- **Reverse into place:** This parameter describes how you want your robot to move to the cart position. There are the following options:
 - **No:** The robot will drive to the position in any way it can. This can be used if the position is in an open area with enough space for the robot to drive behind the position. For this example, select **No**. There is enough space for the robot to drive through the back of the position.
 - **Yes, with collision check:** The robot will reverse into the position and activate collision check so it scans for obstacles while reversing.
 - **Yes, without collision check:** The robot will reverse into the position without activating collision check so it does not scan for obstacles.



7. The mission is now ready. Select **Save** to save your mission.

Testing a mission

After you create a mission, always run the mission to test that the robot executes it correctly.



NOTICE

Always test missions without payload to minimize potential hazards.

To run a mission, follow these steps:

1. Go to **Setup > Missions**.
2. Select **Queue mission**  next to the mission you want to run. 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.



We recommend running the mission 5-10 times to ensure that it runs smoothly. If something interrupts the mission, use a Try/Catch action in that step of the mission and decide what the robot has to do if a mission action fails.

5. Troubleshooting

This section describes how to handle some of the common issues experienced with MiR shelf lift applications. If the solutions described below do not remedy the issue, contact your distributor.

5.1 Shelf options are not available in the robot interface

If you are not able to create shelf positions or new shelf types, and the shelf actions are not available in the mission editor, go to **System > Settings > Features**. Under **Shelf**, select **True** in the drop down menu.

5.2 Robot docking imprecisely or not docking at all to shelf

If the robot is not able to drive under the shelf to dock to it, check the dimensions and offsets you specified in the marker type. If the dimensions are incorrect or the offsets too large, the robot may not be able to dock. The dimensions and offsets must be specified in meters—see [Creating a marker type on page 33](#).

5.3 Robot turning strangely when docking

If the robot turns strangely when docking to a shelf, there may be an issue with the sidebars. There are two common causes for the robot not being able to dock to a shelf correctly:

- The sidebars are reflective, or there are obstructions under the shelf. Make sure the area under the shelf is clear, and that the sidebars are not in a very high gloss material.
- The robot is detecting more than one side bar. Make sure there are only two sidebars with no gaps or holes. If there are multiple shelves next to each other, try increasing the distance between them to make sure the robot is not detecting the sidebars of another shelf.
- The laser scanner covers may need to be cleaned. Refer to the maintenance chapter in the MiR100/MiR200 User guide.

5.4 Robot failing to pick up shelf after docking

If the robot has docked to the shelf and is positioned beneath it correctly, but does not activate the mechanism to pick up the shelf, the registers are likely set incorrectly—see [How MiR shelf lift application works on page 18](#).

5.5 Robot placing shelf imprecisely

If the robot does not place shelves precisely enough for your application, you will need to use a docking marker, such as VL. This will increase the accuracy of the shelf placement. Markers should only be used to increase the accuracy of shelf placement and cannot be used to increase the accuracy of picking up shelves—see [Creating the mission Place shelf at VL-marker on page 37](#).

5.6 Robot going into Protective stop while driving with shelves

If the robot goes into Protective stop while driving with shelves, it might be because the field sets of the safety laser scanners need adjustment—see [Adjusting the Protective field sets on page 28](#).