Operating guide (en)

Date: 10/2019

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MiR 1000 Lift

Copyright and disclaimer

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Table of contents

1. About this document

This document contains the following information:

- How to install MiR1000 Lift and take precautions for safe use.
- How to create missions with MiR1000 Lift.
- Product presentation.

1.1 Where to find more information

At www.mir-robots.com, several additional resources are available. To access more information, sign in to the Distributor site with your distributor account at http://www.mobile-industrial-robots.com/en/account/. The following relevant resources are available:

- **Distributor site > Manuals**
  http://www.mobile-industrial-robots.com/en/account/manuals/
  This page contains the following resources:
  - **MiR1000 Quick start**
    The short guide that lets you start operating the robot quickly. This document is in the box with the robot in the printed format. Available in multiple languages.
  - **MiR1000 User guide**
    The user guide of the robot. Available in multiple languages.
  - **MiR Robot Reference guide**
    The reference guide that describes the elements of the robot interface. Available in multiple languages.
  - **MiR1000 REST API reference.**
    The REST API reference for the robot.
- **Distributor site > Download**
  http://www.mobile-industrial-robots.com/en/account/download/
  This page contains the following resources:
  - **CAD drawings.**
    Select **Show CAD-files** to see the list of available CAD drawings.
  - **Certificates.**
    Select **Show Certificates** to see the list of certificates for the robot.
- **Distributor site > How to**
  http://www.mobile-industrial-robots.com/en/account/how-to/
  This page contains how-to articles that describe how to perform specific tasks with MiR products.

- **Distributor site > Troubleshooting**
  https://www.mobile-industrial-robots.com/en/account/troubleshooting/
  This page contains troubleshooting guides to solve common issues with MiR products.
- **MiR1000 Lift product page**
  https://www.mobile-industrial-robots.com/en/products/mir-add-ons/mir1000-lift/
  This page contains specifications, pictures, and brochures for MiR1000 Lift.

1.2 Document history

This table shows the latest and previous versions of this document and their interrelations with product software releases, when applicable.

Revision	Release date	Description	SW	HW
1.0	2019-09-04	First edition.	2.5.0	1.0
1.1	2019-10-30	Added reset section. Safety corrections. General corrections.		

2. Safety

Read the information in this section before powering up and operating MiR1000 Lift.

Pay particular attention to the safety instructions and warnings.

NOTICE

Mobile Industrial Robots disclaims any and all liability if MiR1000 Lift or its accessories are damaged, changed or modified in any way. Mobile Industrial Robots cannot be held responsible for any damages caused to MiR1000 Lift, accessories or any other equipment due to programming errors or malfunctioning of MiR1000 Lift.

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.

- Take proper precautions to avoid damage or injury.

CAUTION

Indicates a potentially hazardous situation that could result in minor or moderate injury. Alerts against unsafe practices.

- Take proper precautions to avoid damage or injury.

NOTICE

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

2.2 General safety precautions

This section contains general safety precautions.
(missing or bad snippet)

WARNING

Using a charger different from the one supplied by the manufacturer can cause a fire.

- Use only the original charger.

CAUTION

The robot can not see staircases going downwards and holes in the floor.

- Mark staircases or holes on maps with **Forbidden zones**.
- Keep the maps up to date.

CAUTION

Use Flight Mode with smartphone control of the robot. Risk of personal injury and/or damage to the robot.

- If you use Manual control with a smartphone to drive the robot, make sure that the phone is set to Flight Mode. An incoming call on the smartphone will interrupt control of the robot.

WARNING

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

Observe the following precautions when handling and using lithium batteries:

- Do not short-circuit, recharge or connect with false polarity.
- Do not expose to temperature 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.

2.3 Intended use

MiR1000 Lift is a partly completed machine as defined in the EU machinery directive and does not have a CE mark. A correctly installed MiR1000 Lift is covered by the CE mark of MiR1000. However, a CE marked product does not guarantee a CE marked setup. It is the responsibility of the integrator to safely commission MiR1000 Lift.

MiR1000 Lift is designed for MiR1000. MiR1000 Lift is only intended to transport pallets that do not extend the footprint of MiR1000 and loaded according to the Payload Specifications defined in the MiR1000 User guide.

NOTICE

A safe machine does not guarantee a safe system. Follow the Commissioning guide to ensure safe commissioning.

MiR1000 Lift is intended to be commissioned indoor in a light industrial environment where public access is restricted. For detailed description of the environment in which the robot should operate, see technical specifications on our website.

NOTICE

Before commissioning MiR1000 Lift, it is important to make a risk assessment. All risks and foreseeable misuses relevant to MiR1000 also apply to MiR1000 Lift. Refer to the MiR1000 User guide for more information.

3. Getting started

This section describes how to get started with MiR1000 Lift.

3.1 In the box

This section describes the content of the MiR1000 Lift box.

The box contains:

1. MiR1000 Lift
2. A MiR1000 Lift document folder containing the following printed documents:
   - MiR1000 Lift
   - CE declaration of conformity

In the box

This section describes the content of the MiR1000 Lift box.

The box contains:

1. MiR1000 Lift
2. A MiR1000 Lift document folder containing the following printed documents:
   - MiR1000 Lift
   - CE declaration of conformity

3.2 Mounting MiR1000 Lift

This section describes how to mount MiR1000 Lift to MiR1000. Before mounting, turn off the robot and read section Safety on page 7.

The images in this guide feature MiR500, but the procedure is the same for MiR1000.

For another description of mounting the MiR1000 Lift, see the How to guide on the Distributor site titled *How to Mount the MiR500 Lift*.

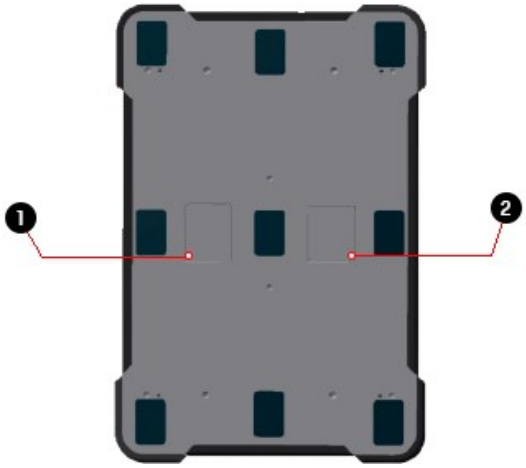
CAUTION

Before mounting MiR1000 Lift to MiR1000 read Safety on page 7.

Connecting the cables

When mounting MiR1000 Lift, it is important that the end with the six screw holes is placed at the front end of the robot.

3.1. The side with the six screw holes (circled with red) must be placed at the front end of the robot.

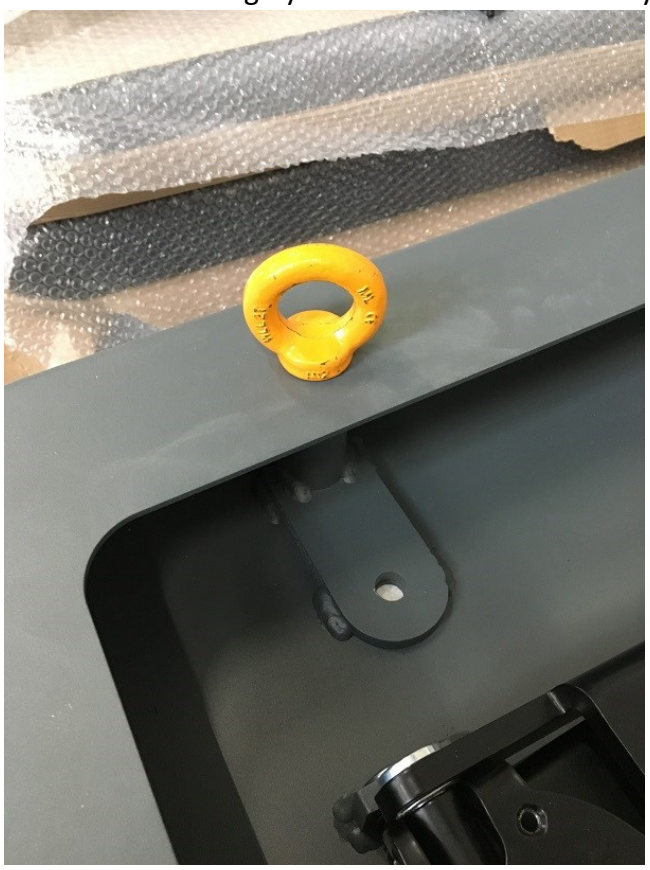


3.2. Top view of MiR1000

Number	Description	Number	Description
1	Left-side middle compartment plate	2	Right-side middle compartment plate

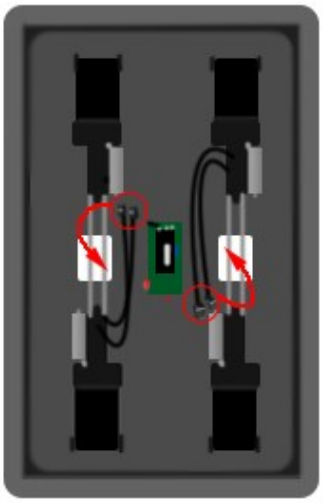
1. Remove the two middle compartment plates on the top cover of MiR1000.
2. Unscrew the four bolts from the lifting device.

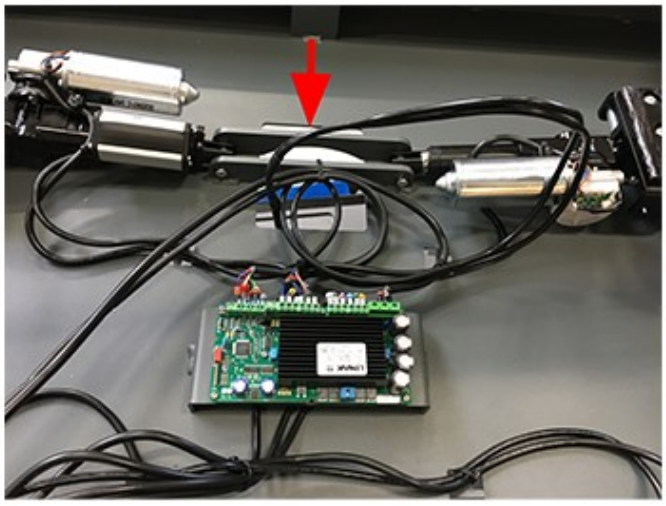
3. Screw in four lifting eye bolts in the holes where you just removed the four bolts.



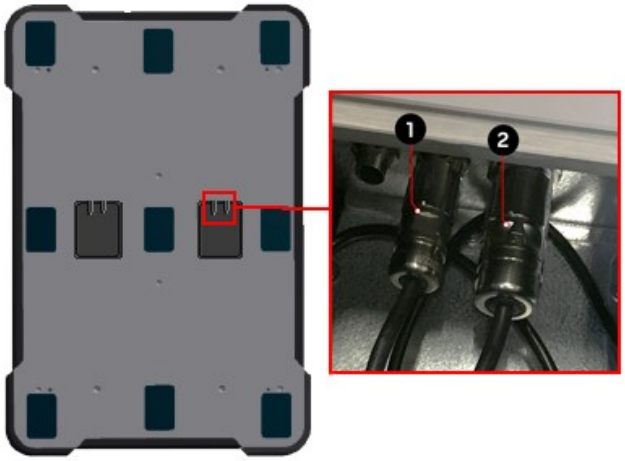
4. Use a crane to move the lifting device to the robot.

5. Remove the cables from the bag. Notice that there are two cables for the right side and two cables for the left side of the lifting device. Feed the right-side cables through the hole on the right side and vice versa with the left side.





6. Connect the plugs of the right-side cables with the socket in the right-side compartment of MiR1000. These are the power (1) and GPIO (2) connections. Repeat the process for the plugs and sockets on the left side.

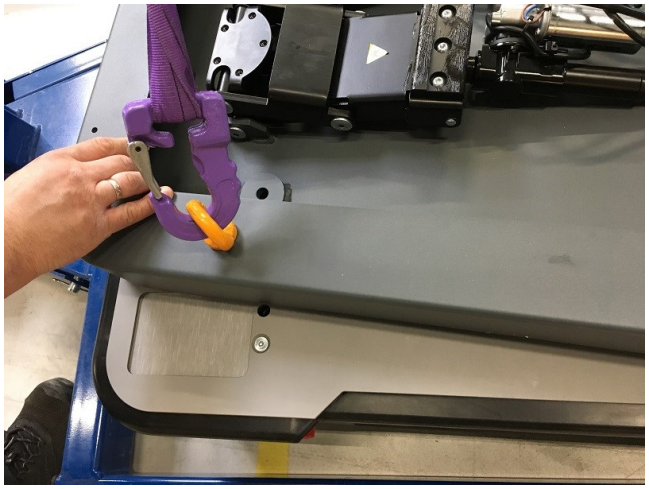


When connecting the plugs, make sure to turn the plug to the left to open the plug and to the right to close it once connected to its socket. The plugs only fit with one socket each, so it is not possible to connect them incorrectly.

Fixing MiR1000 Lift to MiR1000

When fixing MiR1000 Lift to MiR1000, it is important to check that no cables are pinched between the devices. To avoid this, use cable ties to keep the cables collected.

1. Lower the lift onto the robot.



2. Dismount the crane, remove the lifting eye bolts, and remove the crane.

3. Screw in one of the four M12 bolts without tightening it completely.

4. Adjust the lift until the M12 mounting holes are correctly aligned, and screw in the remaining bolts. Ensure that all bolts are tightened completely.

5. Screw in the four bolts that were removed for the eye bolts.

6. Put the lift cover on the lifting device using suction cups.

7. Screw in all twenty screws to fix the cover to the lifting device. Ensure the screws are plane with the lift cover.

If you are having difficulty screwing in the short screws, start by using a long screw to make the others easier to screw in. Remember to replace the long screw with a short one when you are finished.

8. Put on the four safety stickers.

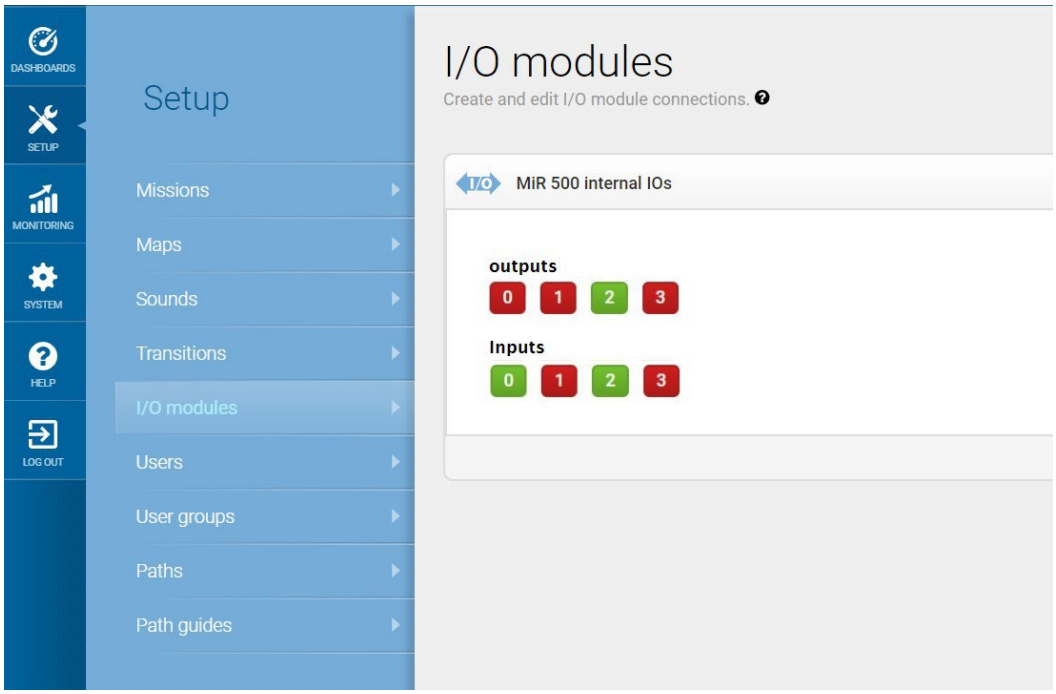
9. Put the anti-slip paper on the sides as shown in the image.

10. Four additional square pieces of anti-slip paper are included with the lift. It is optional to place these on the cover of the lift.

Reset Lift when turning on robot

When you turn on the robot, you must reset the MiR1000 Lift before it can operate.

1. Go to **Setup > I/O modules.**Input 0 and input 2 will be high (green).
2. Set output 0 or 2 to high (green) for five seconds before turning it back. The Lift will now reset. It takes approximately 13 seconds and can be monitored in **Monitoring > System log**.

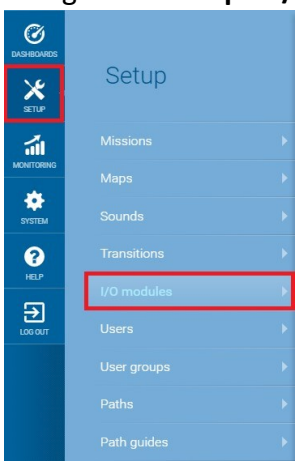


3.3 Testing MiR1000 Lift

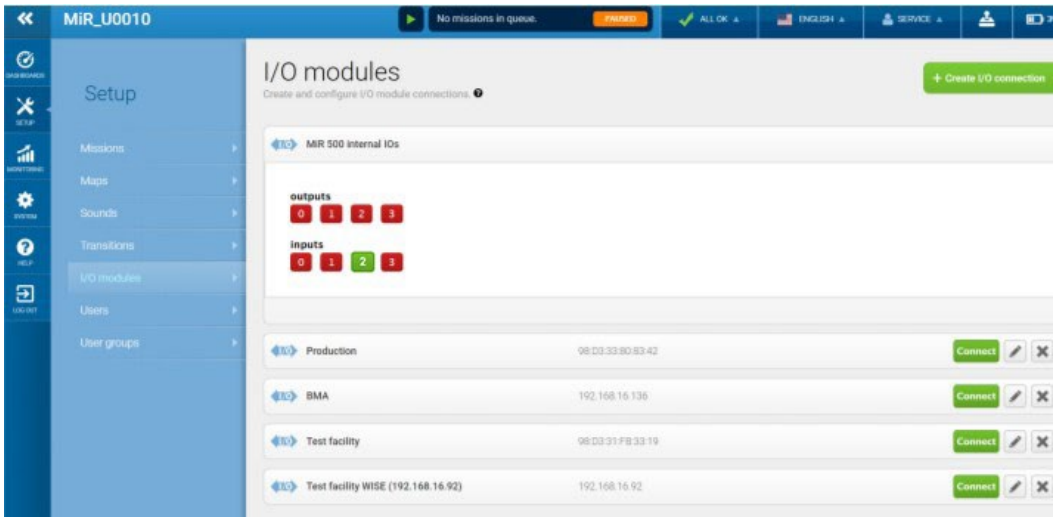
The following steps must be used to test that the lift is correctly mounted. Be sure to verify that the lift performs as expected in each step.

1. Turn on the robot.
2. Connect to the robot interface using a PC, tablet or phone.

3. Navigate to **Setup** > **I/O modules** in the interface.



4. Select **MiR1000 internal IOs**. The following is displayed:

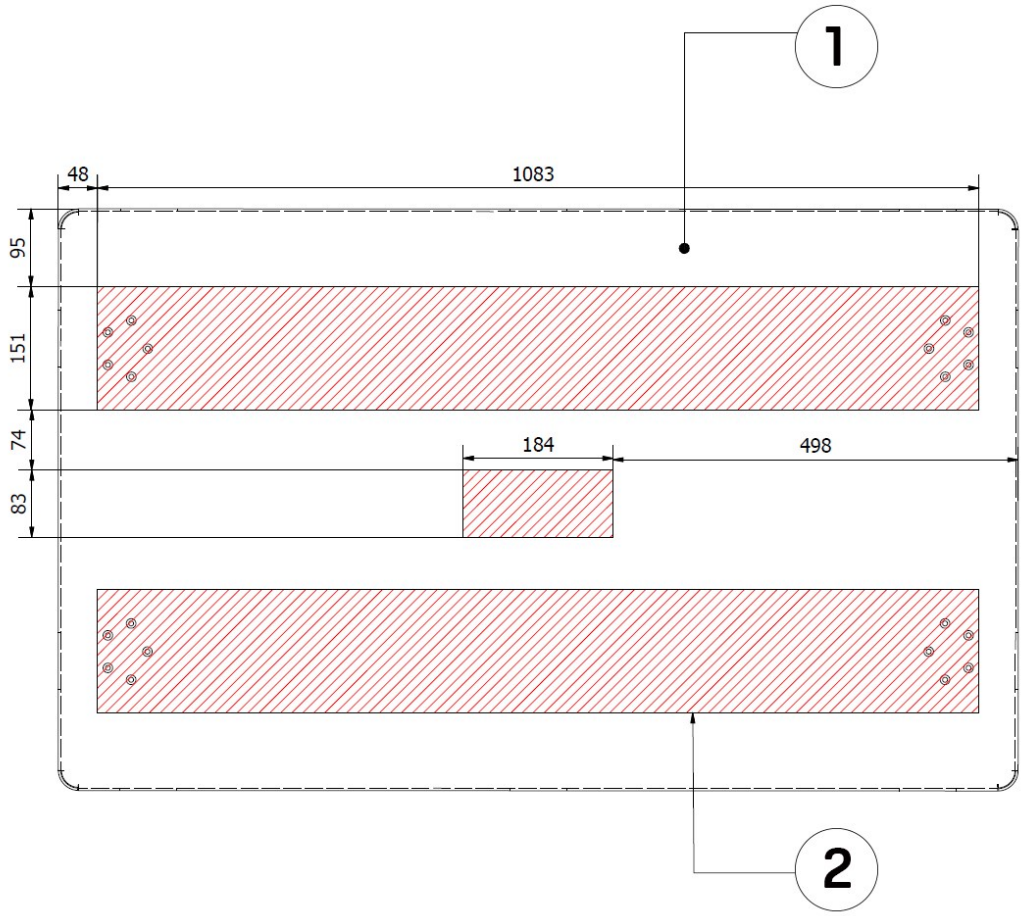


5. Select **0** under **outputs** and wait for clicking sounds. This is the initialization of the calibration process.
6. Select **3** under **outputs** to raise the lift.
7. Select **2** under **outputs** to lower the lift.

3.4 Lift modifications

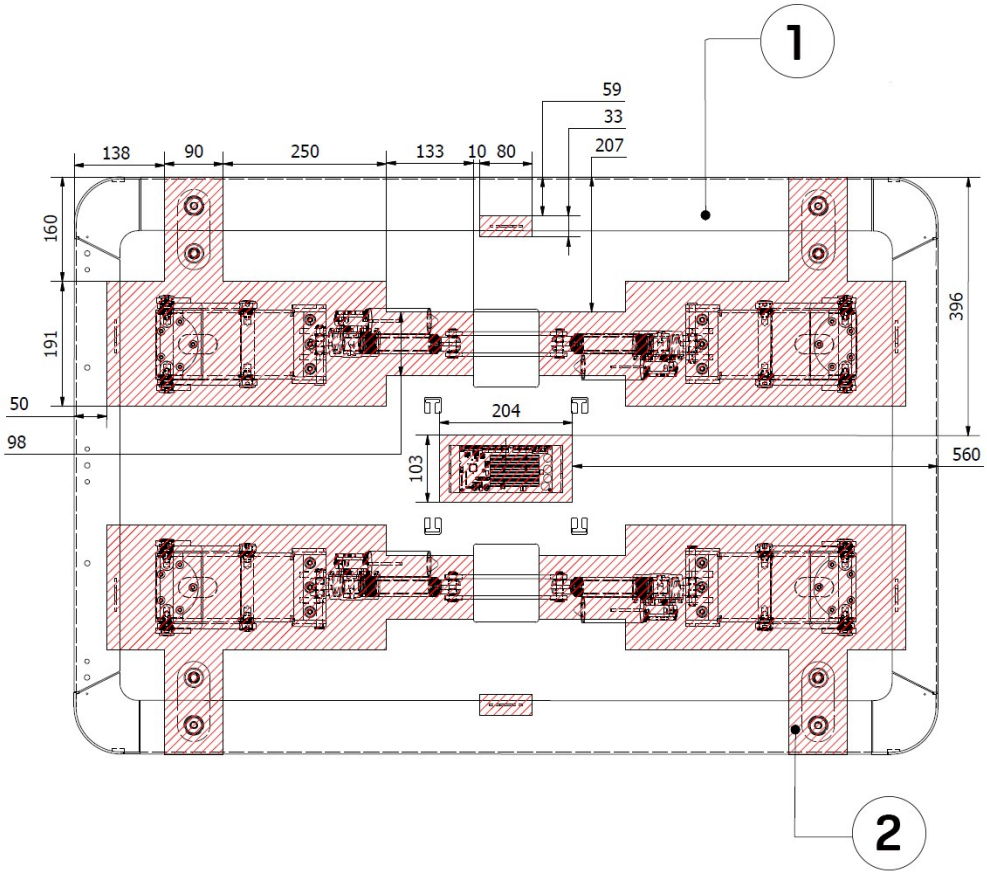
Additional holes can be added to the MiR1000 Lift for custom applications. However, it is important not to damage any vital parts of the lift when doing so.

Top plate of the lift



1.	Material: Steel (S355) Thickness: 3 mm Treatment: Powder coating RAL 9005	2.	Areas marked with red indicate where you are not allowed to make modifications, such as drilling holes or mounting accessories.

Bottom frame of the lift



1.	Material: Steel (S355) Thickness: 3 mm Treatment: Powder coating RAL 7011	2.	Areas marked with red indicate where you are not allowed to make modifications, such as drilling holes or mounting accessories.

NOTICE

The drawings above only show where you can make minor modifications without damaging the product. You should not use it for any other measurements or calculations.

4. Product presentation

MiR1000 Lift is a top module that can be mounted on a MiR1000 and autonomously pick up and drop off heavy loads of up to 1000 kg. The robot with a MiR1000 Lift works internally within production facilities, warehouses, and a host of other industrial locations.

The user provides the destination of product delivery via a web-based user interface. MiR1000 with a MiR1000 Lift can be set up to run a fixed route, be called on demand or perform more complex operations (missions).

MiR1000 Lift can be activated in various missions and ensures stable handling and transport of pallets to and from a MiR Lift Pallet Rack.

For MiR1000 Lift to comply with safety standards and function properly, shelves must be set up according to specifications supplied in this manual. See ()

4.1 How the lift works

When MiR1000 with a MiR1000 Lift docks to a pallet rack, the lift can either be elevated to pick up a pallet or lowered to place a pallet.

MiR1000 Lift uses I/O modules and includes four inputs and four outputs. The tables below show the functionality of these. To use MiR1000 Lift correctly, these internal I/O modules must be used.

To be able to use and see the menu options for the I/O modules and the pallet liftMiR1000 Lift, they must be enabled first. See Enable MiR1000 Lift feature on page 30 for more information.

Output	Function
0	Initiates calibration process after five seconds on
1	Lift is moving
2	Lowers the lift
3	Raises the lift

Input	Function
0	Indicates that there is an error from the lift controller

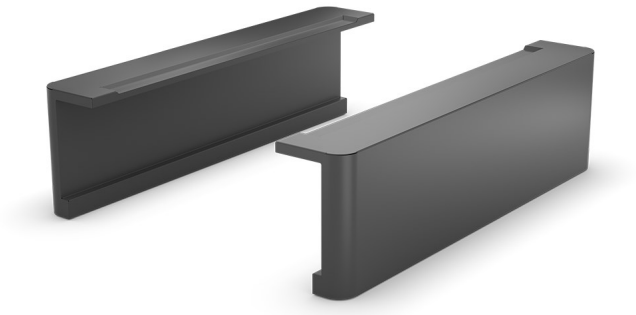
Input	Function
1	Lift is moving
2	Lift is either low or stopped, but not raised
3	Lift is raised

When the lift is raised, the robot can only drive with a maximum velocity of 0.3 m/s.

4.2 MiR Lift Pallet Rack

MiR1000 with MiR1000 Lift mounted on top can be used together with one or more MiR Lift Pallet Racks

MiR Lift Pallet Rack is the delivery station for your heavy loads. MiR1000 drives autonomously into the MiR Lift Pallet Rack and delivers or picks up heavy loads safely with a payload of up to 1000 kg.



To see how to mount MiR Lift Pallet Rack, see the mounting guide on our Distributor website at https://www.mobile-industrial-robots.com/en/account/how-to/hardware/install-mir-pallet-rack-eulift/.

WARNING

When MiR1000 with a MiR1000 Lift docks to a MiR Lift Pallet Rack, the robot mutes Personnel Detection Means and blinks yellow. Do not step in front of the robot and keep distance to the pallet rack. Read Safety on page 7 for more information.

4.3 Mark potentially hazardous floor area

Before taking your MiR1000 Lift into use, it is necessary to mark up the floor in the area where MiR1000 with MiR1000 Lift docks to MiR Lift Pallet Rack.

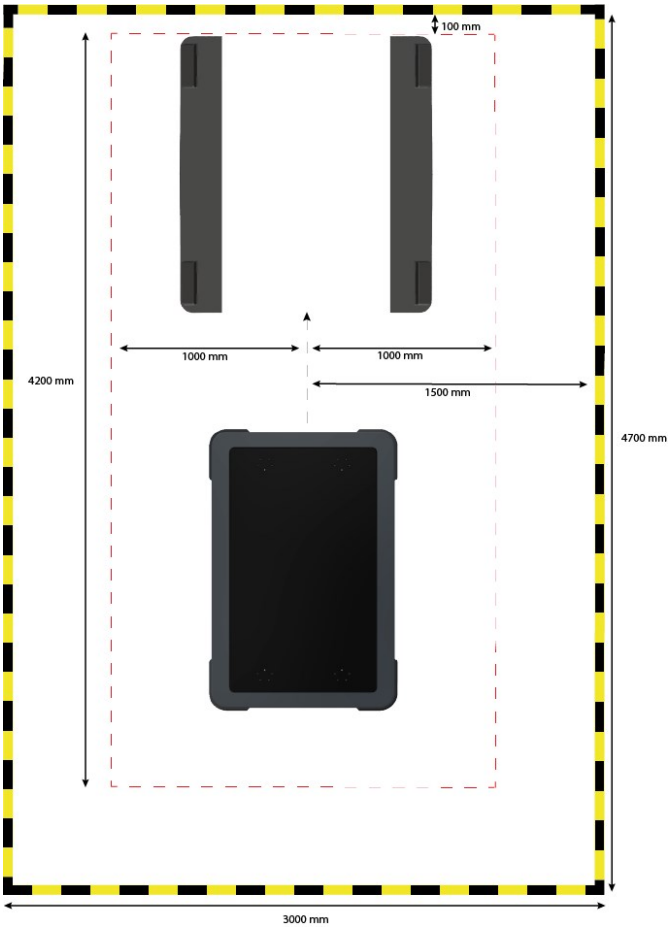
When docking to MiR Lift Pallet Rack, the robot mutes its personnel detection means temporarily. This includes turning off the protective fields around the scanner.

The muting starts when the robot reaches the entry position approximately one meter from the pallet rack. To indicate this to people nearby, MiR1000 slows down and starts blinking yellow, using the eight indicator lights on the corners of the robot.

To avoid potentially hazardous situations as a consequence of the muted personnel detection means, you must mark the physical area around MiR Lift Pallet Rack with tape or similar.

The size of the marked area must be calculated based on the robot's path going to the pallet rack and take into account that the robot may make a turn of up to 90° in front of the pallet rack.

Figure 4.1 illustrates where the floor marking should be.



4.1. The floor around the pallet rack must be marked to indicate where the personnel protection means are muted. This can for example be done with signal tape.

- The red dotted line shows the area where the robot mutes the personnel detection means. This is the potentially hazardous zone.
- The yellow/black striped line indicates the area that should be marked with signal tape. The space between the red dotted zone line and the tape marking should be held free of objects to ensure a smooth entry to the pallet rack.

For more information on personnel detection means and protective fields, see MiR1000 User Guide.

5. Usage

It takes four steps in the robot interface to be able to pick up and place heavy loads autonomously with MiR1000 with a MiR1000 Lift mounted on top. This chapter describes the necessary steps that will enable the robot to pick up and place heavy loads:

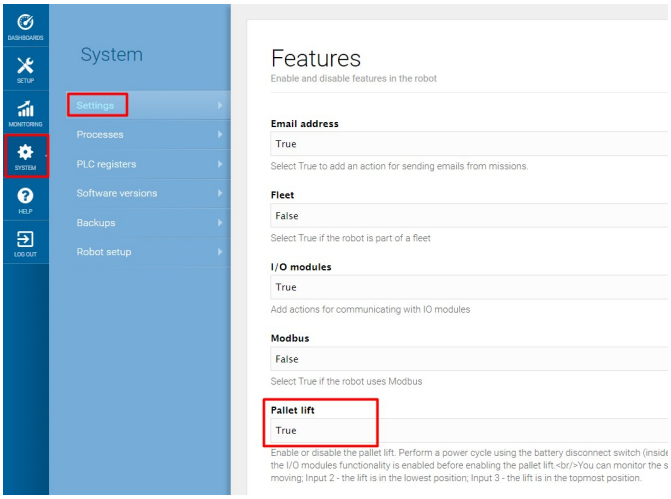
1. Enabling the pallet lift feature, see Enable MiR1000 Lift feature below.
2. Creating a pallet rack marker and entry position on the map on the location where MiR Lift Pallet Rack is located, see Set entry and pallet rack positions on the next page.
3. Creating two simple missions that lowers the lift and raises the lift in order to carry out more complex missions, where MiR1000 picks up and puts down pallets, see Lower lift mission on page 32 and Raise lift mission on page 34.
4. Creating two missions where MiR1000 drives to the pallet rack, picks up a pallet and exits the rack and drives to another pallet rack, puts down the pallet and exits, see Pick up pallet mission on page 36 and Put down pallet mission on page 38.

After these steps are carried out, the robot is able to pick up and put down heavy loads autonomously.

5.1 Enable MiR1000 Lift feature

To access MiR1000 Lift settings and mission pages, you must first enable them.

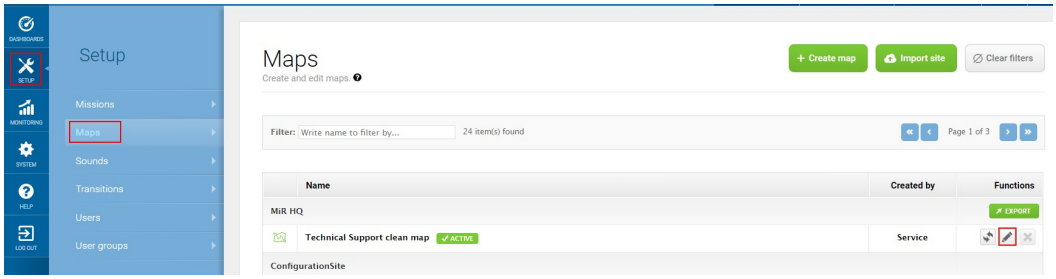
1. Go to **System** > **Settings** > **Features**.
2. Under **Pallet lift**, select **True**.
3. Under **I/O modules**, select **True** if this is not set already. MiR1000 Lift communicates through I/O modules, so they have to be activated for the lift to work.



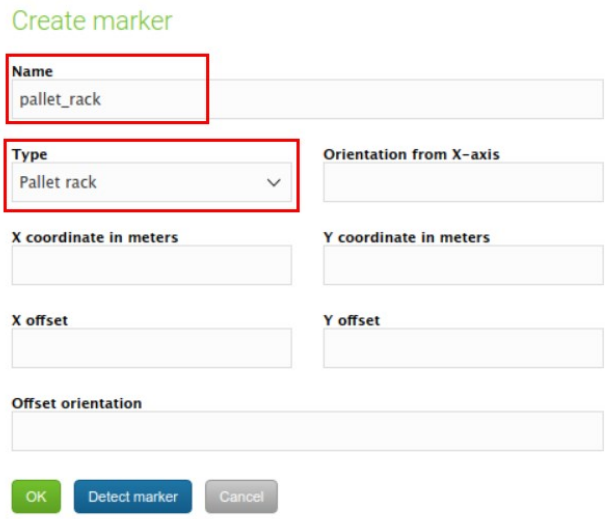
5.2 Set entry and pallet rack positions

Before creating missions to pick up and put down pallets, entry and pallet rack positions must be defined on the map first.

1. Turn the key to manual mode on the robot, and manually drive MiR1000 with a MiR1000 Lift in front of a pallet rack, facing front.
2. Go to **Setup** > **Maps** and select the **Edit** icon for the active map.



3. In the menu, select **Markers**. Select **Draw a new marker**.
4. In the dialog box, name the marker and choose **Pallet rack** under Type.



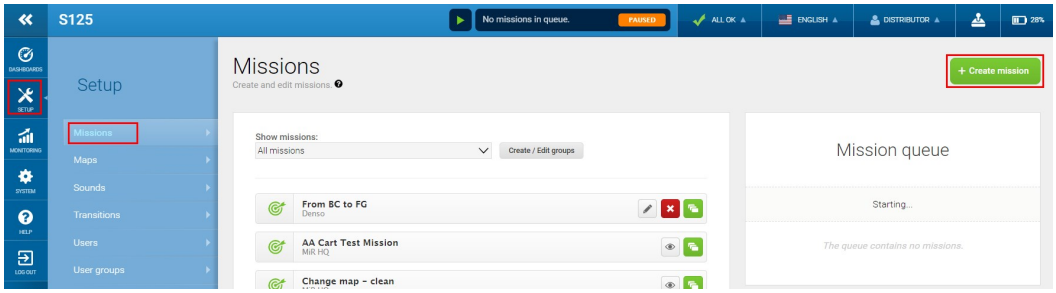
5. Select **Detect marker**. The X, Y, and Orientation values will automatically fill with the current position of the robot. Set the offsets to 0.
6. Select **OK**. The map now has a pallet rack marker.

If you have more than one pallet rack, repeat the previous steps to mark all your pallet racks on the map.

5.3 Lower lift mission

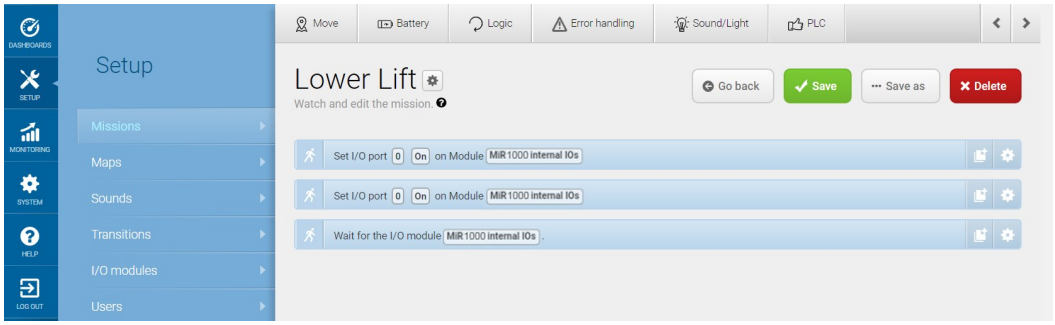
In the *Lower Lift* mission, MiR1000 will lower the lift on the robot to prepare to pick up a pallet.

1. Go to **Setup** > **Missions** and select **Create mission**.



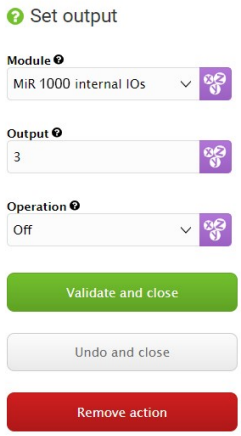
2. Give the mission a name, for example *Lower Lift*. Select the group and site it should belong to.
3. Insert the following actions:
    1. In the **I/O module** menu, select **Set output**.
    2. In the **I/O module** menu, select **Set output**.
    3. In the **I/O module** menu, select **Wait for input**.

    The mission dialog should look like this:

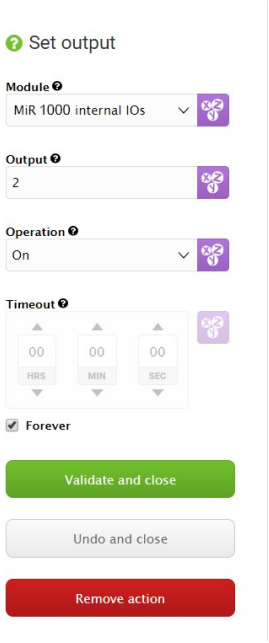


    The following steps describe which parameters each action should be set to. To modify the parameters, select the gearwheel icon of the action in question to open the dialog of that action.

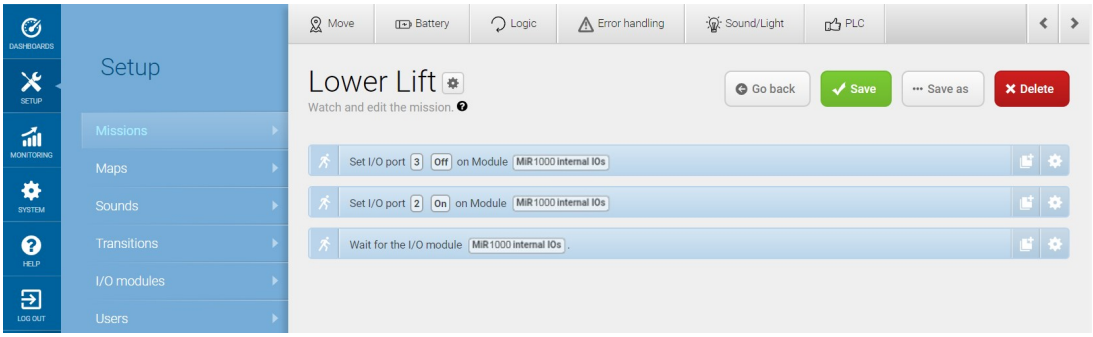
4. In the first **Set I/O port** action dialog, under **Module**, select **MiR1000 internal IOs**. Under **Output**, type in 3. Under **Operation**, select **Off**. This ensures that any raising movement is stopped.



5. In the second **Set I/O port** action dialog, under **Module**, select **MiR1000 internal IOs**. Under **Output**, type in 2. Under **Operation**, select **On**. This is to ensure that the lowering action is performed. Select **Validate and close**.



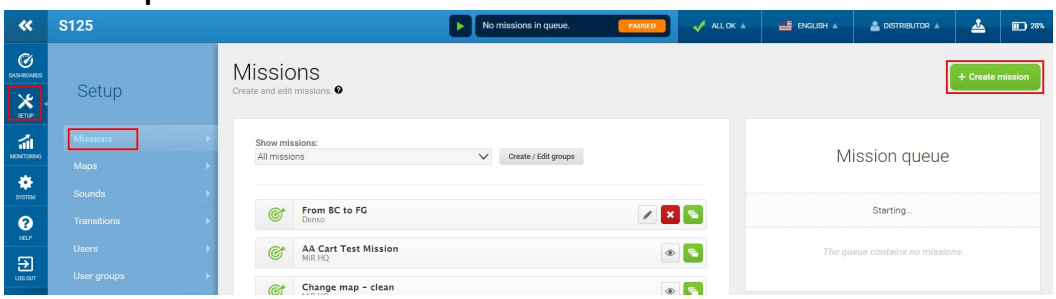
6. Remember to save the mission. The mission should look like this:



5.4 Raise lift mission

In the *Raise Lift* mission, MiR1000 will raise the lift to prepare to pick up a a pallet from a pallet rack.

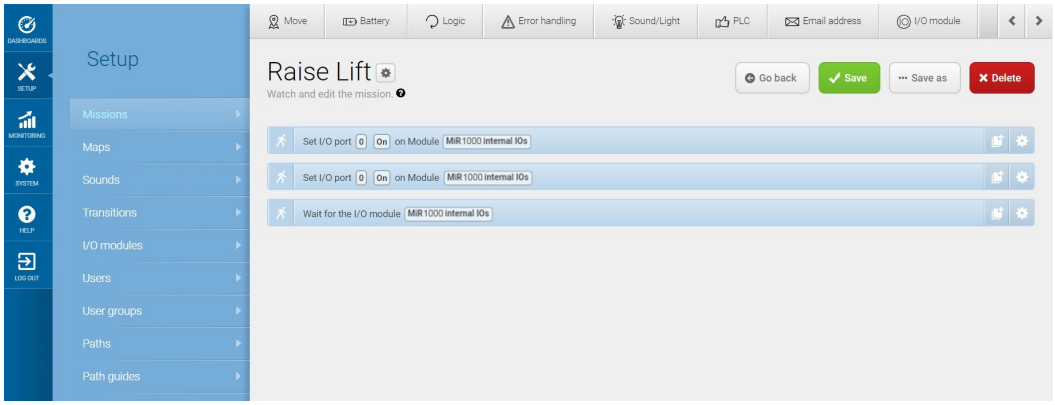
1. Go to **Setup** > **Missions** and select **Create mission**.



2. Give the mission a name, for example *Raise Lift*. Select the group and site it should belong to.

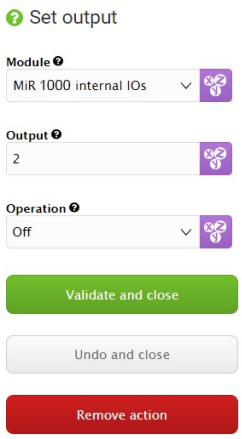
3. Insert the following actions:
    1. In the **I/O module** menu, select **Set output**.
    2. In the **I/O module** menu, select **Set output**.
    3. In the **I/O module** menu, select **Wait for input**.

    The mission dialog should look like this:

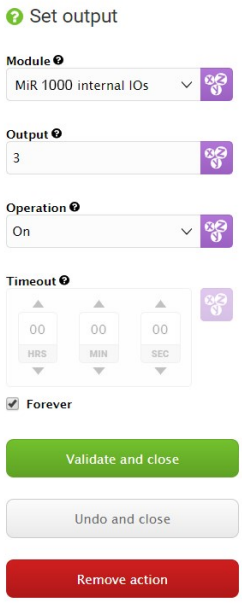


    The following steps describe which parameters each action should be set to. To modify the parameters, select the gearwheel icon of the action in question to open the dialog of that action.

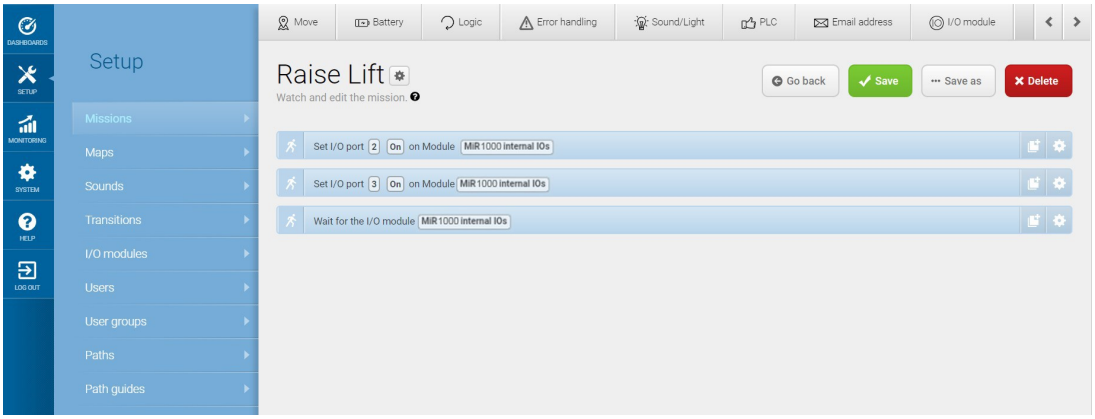
4. In the first **Set I/O port** action dialog, under **Module**, select **MiR1000 internal IOs**. Under **Output**, type in 2. Under **Operation**, select off. This is to ensure that the lift is in a fully lowered state. Select **Validate and close**.



5. In the second **Set I/O port** action menu, under **Module**, select **MiR1000 internal IOs**. Under **Output**, type in 3. Under **Operation**, select On. This is to ensure that the lift is raised. Select **Validate and close**.



6. Remember to save the mission. The mission should look like this:



5.5 Pick up pallet mission

The two simple missions *Lower Lift* and *Raise Lift* are now ready to use in missions to pick up and put down pallets.

In the *Pick Up Pallet* mission, MiR1000 will dock into a pallet rack, pick up a pallet and undock from the pallet rack.

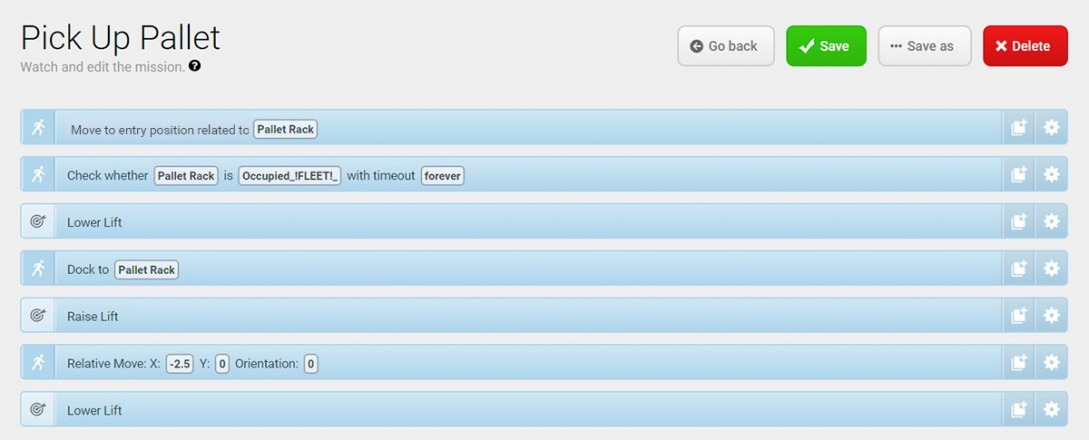
1. Go to **Setup** > **Missions**. Select **Create mission**.
2. Give the mission a name, for example *Pick Up Pallet*. Select the group and site it should belong to. Select **Create mission**.
3. Select the following actions:
    1. In the **Move** menu, select **Move to entry position**
    2. In the **Move** menu, select **Check position status** (Optional)
    3. In the **Missions** select the **Lower Lift** mission. This is the mission created in the previous tutorial.
    4. In the **Move** menu, select **Docking**
    5. In the **Missions** select the **Raise Lift** mission. This is the mission created in the previous tutorial.
    6. In the **Move** menu, select **Relative Move**

    The mission dialog should look similar to this:

    The following steps describe which parameters each action should be set to. To modify the parameters, select the gearwheel icon of the action in question to open the dialog of that action.

4. In the **Move to entry position** action dialog, under **Position** select the pallet rack marker. Select **Validate and close**
5. If included, in the **Check position status** action dialog, under **Position**, select the pallet rack marker. Under **Option**, select **Occupied**. Set the time for 10 seconds. Select **Validate and close**. Check position status is an action that can be set up to tell the robot what to do, if a position is occupied, such as if a pallet is placed on a pallet rack and the robot can not deliver a pallet.
6. In the **Dock to** action dialog select the pallet rack marker. Select **Validate and close**.
7. In the **Relative move** action dialog, under **X**, type in 2.0 (minimum) and then select **Validate and close**.

8. Remember to save the mission. The mission should look similar to this:



5.1. MiR1000 drives to the entry position in front of the MiR1000 Lift and checks if there is a pallet (check position status is optional). If there is a pallet, MiR1000 lowers the lift, docks to the pallet rack, lifts off the pallet, exits the pallet rack and lowers the lift again.

5.6 Test the mission

1. Go to **Setup** > **Missions**.
2. Select the Queue mission icon next to the mission you want to test. The mission is now added to the mission queue.
3. Select the **Play button** to start the mission.

WARNING

When MiR1000 with a MiR1000 Lift docks to a pallet rack, the robot mutes personnel detection means and blinks yellow. Do not step in front of the robot and keep distance to the pallet rack. Read Safety on page 7 for more information.

5.7 Put down pallet mission

In the *Put Down Pallet* mission, MiR1000 will dock into a pallet rack, put down a pallet and undock from the pallet rack.

1. Go to **Setup** > **Missions**. Select **Create mission**.
2. Give the mission a name, for example *Put Down Pallet*. Select the group and site it should belong to. Select **Create mission**.

3. Select the following actions:
    1. In the **Move** menu, select **Move to entry position**
    2. In the **Move** menu, select **Check position status** (Optional)
    3. In the **Missions** select the **Raise Lift** mission. This is the mission created in the previous tutorial.
    4. In the **Move** menu, select **Docking**
    5. In the **Missions** select the **Lower Lift** mission. This is the mission created in the previous tutorial.
    6. In the **Move** menu, select **Relative Move**

    The mission dialog should look like this:

    The following steps describe which parameters each action should be set to. To modify the parameters, select the gearwheel icon of the action in question to open the dialog of that action.

4. In the **Move to entry position** action dialog, under **Position** select the pallet rack marker. Select **Validate and close**
5. If included, in the **Check position status** action dialog, under **Position**, select the pallet rack marker. Under **Option**, select **Occupied**. Set the time for 10 seconds. Select **Validate and close**. Check position status is an action that can be set up to tell the robot what to do, if a position is occupied, such as if a pallet is placed on a pallet rack and the robot can not deliver a pallet.
6. In the **Dock to** action dialog select the pallet rack marker. Select **Validate and close**.
7. In the **PLC** action dialog, select the PLC register for the pallet status and set it to 0. Select **Validate and close**.
8. In the **Relative move** action dialog, under **X**, type in 2.0 (minimum) and then select **Validate and close**.
9. Remember to save the mission.

If you experience that MiR1000 with a MiR1000 Lift mounted on top picks up or delivers loads imprecisely on a MiR Lift Pallet Rack, try adjusting the offset of the pallet rack marker. Select the pallet rack marker on your map, select **Edit** and adjust the coordinates (by approximately up to 1 cm). You might have to try out a few different combinations to make it precise.

5.8 Test the mission

1. Go to **Setup** > **Missions**.
2. Select the Queue mission icon next to the mission you want to test. The mission is now added to the mission queue.
3. Select the **Play button** to start the mission.

WARNING

When MiR1000 with a MiR1000 Lift docks to a pallet rack, the robot mutes personnel detection means and blinks yellow. Do not step in front of the robot and keep distance to the pallet rack. Read Safety on page 7 for more information.