![MiR - A BETTER WAY]

Quick start (en)

Date: 07/2019

Revision: v.1.2

MiR 500

Table of contents

1. Getting started

This section describes how to get started with MiR500.

1.1 In the box

This section describes the content of the MiR500 box.

The box contains:

1. The MiR500 robot
2. MiR500 document folder containing the printed documents and the USB flash drive.
3. Printed documents:
   - MiR500 Quick Start
   - MiR username and passwords
   - CE declaration of conformity
4. USB flash drive with the following content:
   - MiR500 User Guide
   - MiR Robot Interface 2.0 Reference guide
   - MiR robot REST API reference
   - MiRCharge 48V Operating Guide
   - MiR500 Lift Operating Guide
   - MiR500 EU Pallet Lift Operating Guide
   - MiR username and passwords
   - CE declaration of conformity

1.2 Unpacking MiR500

This section describes how to unpack MiR500.

ℹ️ Keep the original packaging for the future transportation of the robot.

ℹ️ The robot is shown with a EU pallet lift.

1. Place the box with the robot so that there is 3 m of free space at the front or the back of the box. This is necessary since the robot drives out of the box on the ramp.

2. Remove the screws that attach the walls of the box to the box lid and the base of the box.
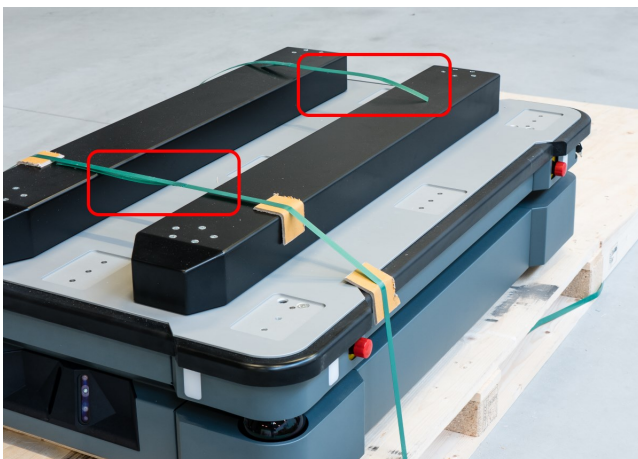

3. Remove the lid from the box.

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

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

6. Cut the protective straps.

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

8. Remove the wheel stop board from the pallet to let the robot drive on the ramp.

2. Commissioning

This section describes how to get started with MiR500.
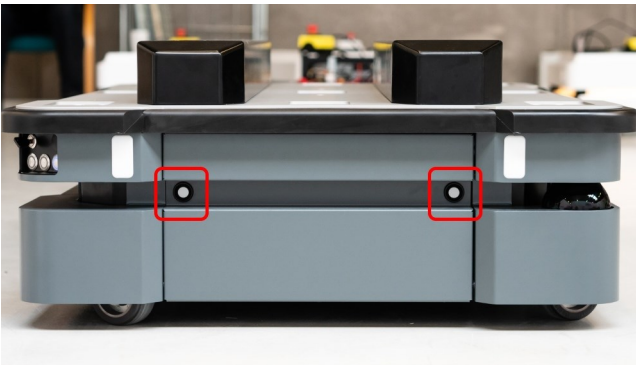
> **(!) NOTICE**
>
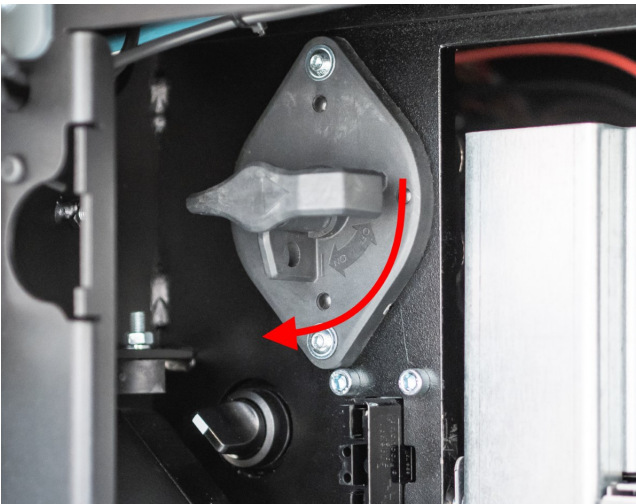> Read Safety on page 22 before powering up the robot.

2.1 Powering up

Follow these steps to power up MiR500.

1. Open the rear maintenance hatch. To open the hatch, push two buttons on the hatch and pull the hatch.

2. Turn the battery disconnect switch to position **ON**.

3. The **On/Off** button turns blue.
   See MiR500 control panel on page 15.

4. Close the maintenance hatch.

5. Ensure that all four emergency stop buttons are in the released state. Turn an emergency stop button clockwise to release it.

6. Press the **On/Off** button for five seconds.
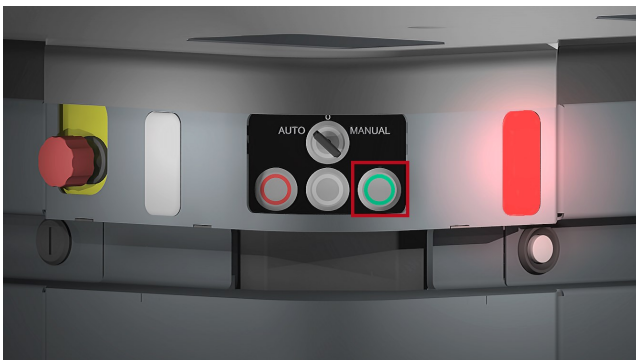
7. The robot turns on the red indicator lights and starts the software initialization process. When the initialization process ends, the robot goes into the emergency stop mode.

8. Press the **Restart** button to clear the emergency stop. The robot is ready for operation, the status lights turn constant red.
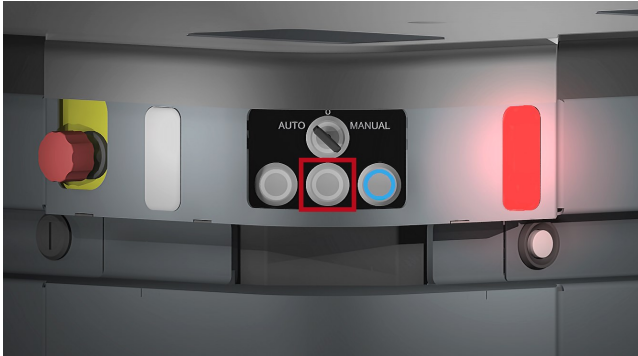
2.2 Connecting to the robot interface

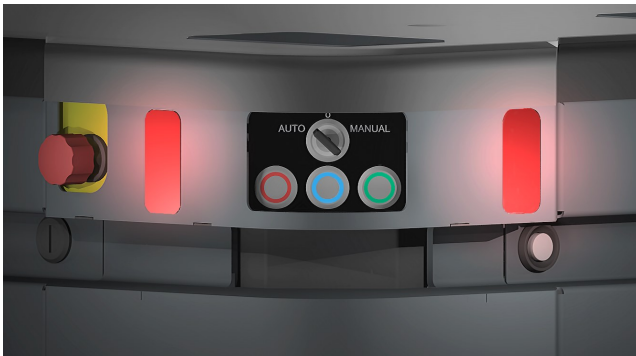When the robot is on, it enables the connection to its WiFi access point. The name of the access point appears in the list of available connections on your PC, tablet or phone.

> (!) **NOTICE**
>
> The username and password for the robot's WiFi access point and for accessing the web interface are in the MiR username and 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 the WiFi access point of the robot. The access point name has the following format: MiR_UXXXX.

2. In a browser, go to the address mir.com and sign in.
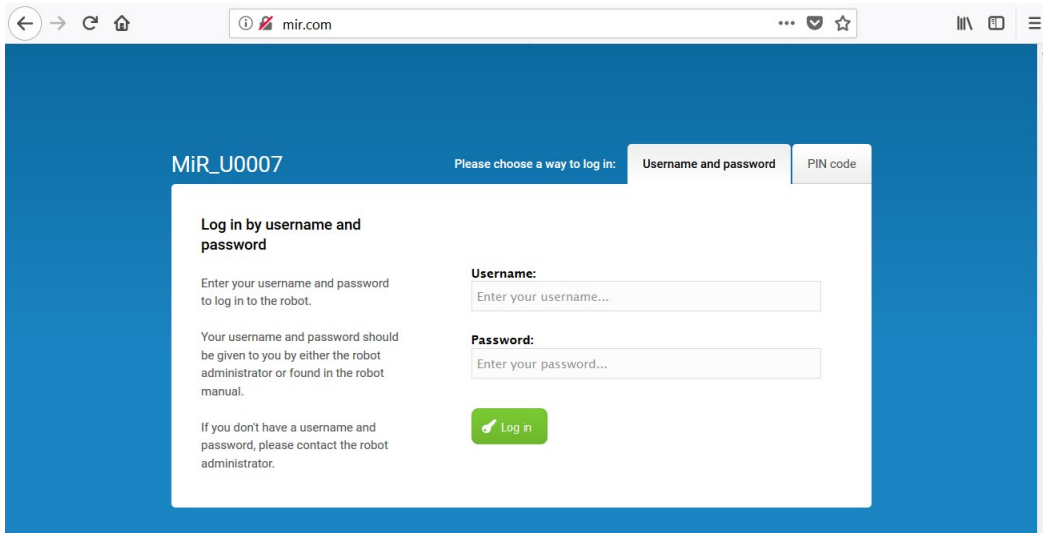
3. Switch to manual mode, and drive the robot down the ramp, see section Driving the robot in manual mode on page 1.

2.3 Driving the robot in manual mode

To drive the robot in Manual mode:

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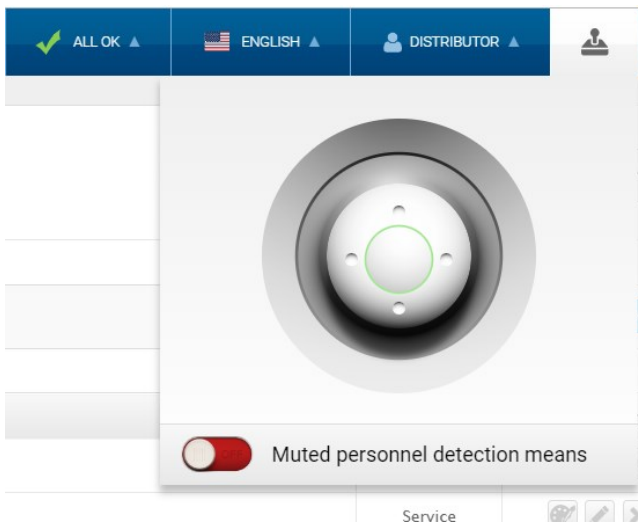
3. Select **Manual control**. The **Restart** button on the robot starts blinking.

4. Press the **Restart** button. The status lights turn blue indicating that the robot is in Manual mode.

   Note! The robot is shown with an EU pallet lift.

5. Drive the robot using the joystick.

2.4 Checking the hardware status

To check that all hardware components work as intended follow the steps below:

1. Sign in to the robot interface. See the section Connecting to the robot interface on page 1.
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.
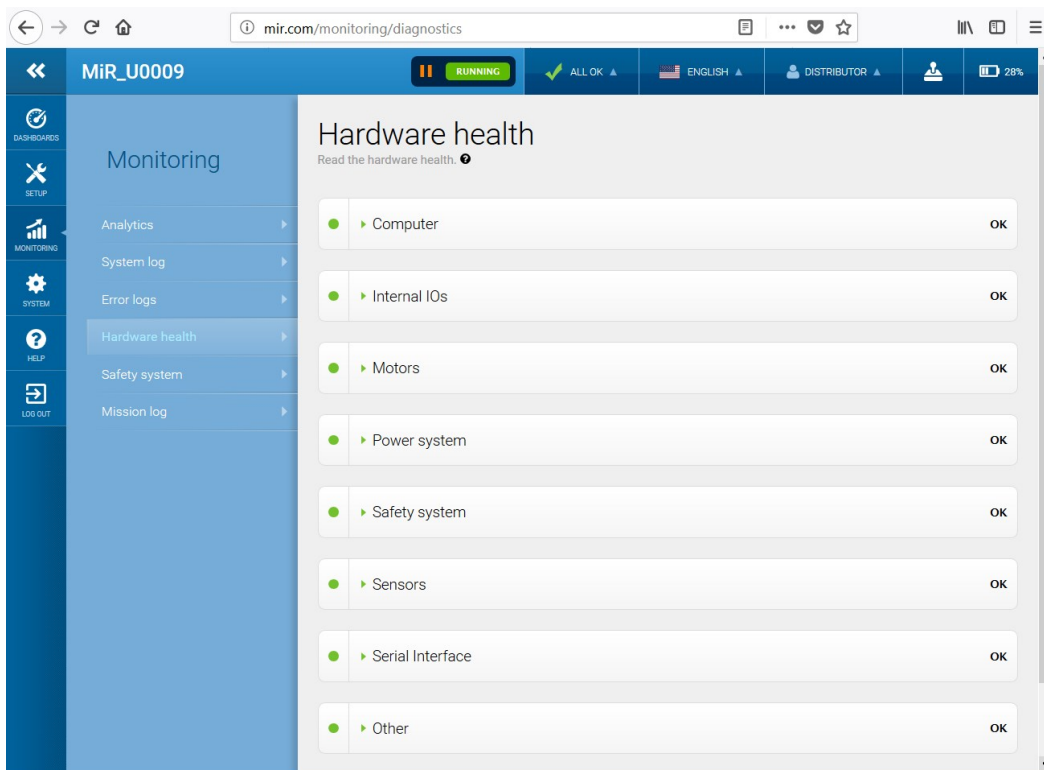
For more information, see **Hardware health** in MiR Robot Interface 2.0 Reference Guide.

2.5 Shutting down the robot

To shut down MiR500:

1. Ensure that the robot is not moving or executing an action.

2. Press the **On/Off** button for five seconds.
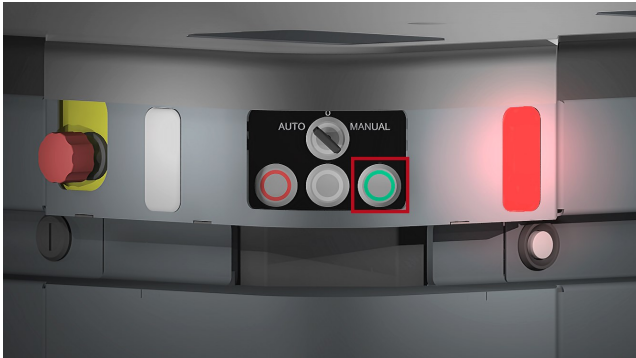
3. The robot starts the shutdown process. Status lights blink yellow, the **On/Off** button blinks red.

4. When the robot finishes the shutdown process, the status and the signal lights go off, the **On/Off** button turns blue.

If shutting the robot down for transportation or service/repair, the battery disconnect switch must be turned off as well and the battery cable disconnected, see MiR500 User guide.

2.6 Charging the robot

> A charger cable and an external charger is not part of the MiR500 standard delivery.

To charge MiR500 using the cable charger:

1. Open the maintenance hatch at the back of the robot. To open the hatch, push two buttons on the hatch and pull the hatch.
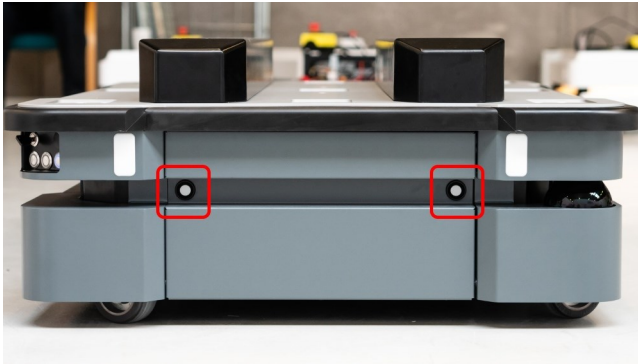
2. Connect the charger cable to the charging connector on the robot.
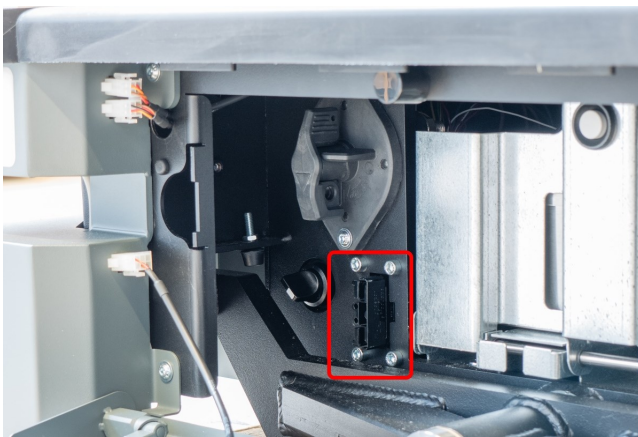
For information about the charging time, see the robot specifications at www.mir-robots.com.

2.7 MiR500 control panel

MiR500 has a control panel in the rear-left corner of the robot.
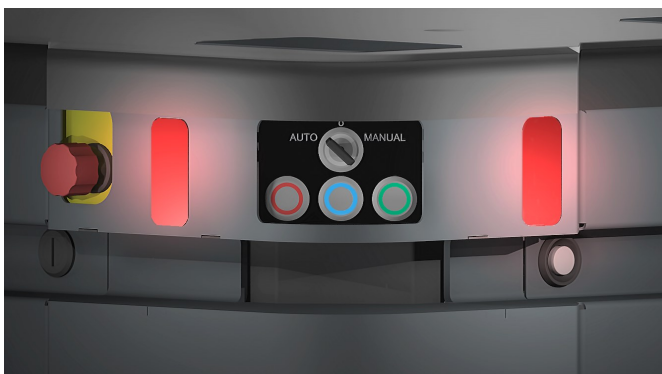
The Operating mode key

The Operating mode key lets you switch between operating modes.

- Left position: Autonomous mode.
  Puts the robot in the Autonomous mode.
- Middle position: Stop.
  Stops 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 the Manual mode.

For more information on operating modes, see MiR500 operating modes on the next page.

The control panel buttons

The buttons on the control panel have the following functions.
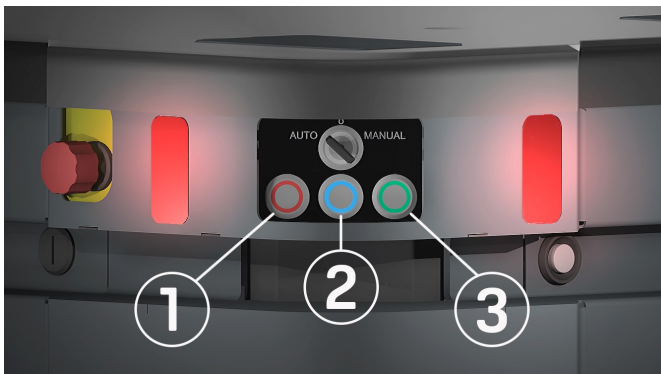
1. Stop	3. On/Off
2. Restart	

Stop

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

Color indication:

- Red: The robot is on.

Restart

Pressing this button:

- Clears the emergency stop state.
- Lets the robot continue operating after the **Stop** button was pressed.
- Lets the robot continue operating after powering up or after the operating mode change.

Color indication:

- Blinking red: The robot is waiting for a user action (clear the emergency stop state, acknowledge the change of operating mode, etc.)

On/Off

Pressing this button for five seconds turns the robot on or shuts it down.

Color indication:

- Blue: The robot is off.
- Blinking green: The robot is starting up.
- Green: Normal operation.
- Red: The robot detected an error.
- Yellow: The battery level is low.

2.8 MiR500 operating modes

MiR500 has the following operating modes:

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 section .

Autonomous mode

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

Muting of the personnel detection means

When performing tasks that require to move very close to surrounding objects, the robot mutes the personnel detection means. Docking to a pallet rack is the example of such task.

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

- Reduces the size of the safety zones.
- Turns the collision detection off.
- Decreases the speed.
- Flashes the yellow indicator lights.

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

- Put the robot into the Manual mode. See section
- In the robot interface, in the Joystick control, select **Mute personnel detection means**.
- In the prompt dialog, select **Yes** to acknowledge the muting of personnel detection means.

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

2.9 Packing for transportation

This section describes how to pack the robot for transportation.

Original packaging

Use the original packaging materials when transporting the robot.

Note! The robot is shown with a EU pallet lift.

The packaging materials are:

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

Packing the robot for transportation

To pack the robot for transportation:

1. Shut down the robot. See section .
2. Open the rear maintenance hatch.
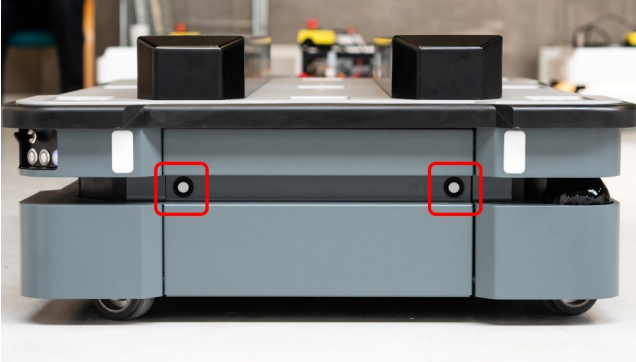
3. Turn the battery disconnect switch to position **OFF**.
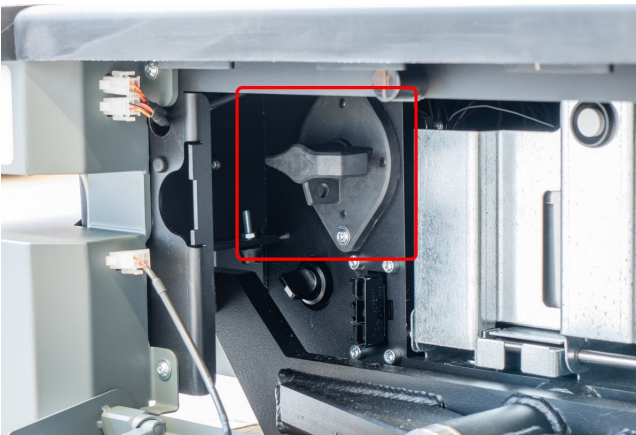
Repeat the steps in section Getting started on page 3 in the reverse order.

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

Battery

The lithium battery is subject to transport regulations. Make sure that you follow the safety precautions in this section and the instructions in section Packing for transportation on the

. Different regulations apply depending on the mode of transportation: Land, sea, or air.

Contact your distributor for more information.

> ⚠️ **CAUTION**
>
> Lithium 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.

3. Safety

Read the information in this section before powering up and operating MiR500.

Pay particular attention to the safety instructions and warnings.

> **⚠ NOTICE**
>
> Mobile Industrial Robots disclaims any and all liability if MiR500 or its accessories are damaged, changed or modified in any way. Mobile Industrial Robots cannot be held responsible for any damages caused to MiR500, accessories or any other equipment due to programming errors or malfunctioning of MiR500.

3.1 Safety message types

This document uses the following safety message types.

> **⚠ WARNING**
>
> Indicates a potentially hazardous situation that could result in death or serious injury.
>
> - 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.

3.2 General safety precautions

This section contains general safety precautions.

> ⚠️ **WARNING**
>
> If the load on the robot is not positioned or fastened correctly, the load may fall or the robot may overturn.
>
> - Ensure that the load is positioned according to the specifications and fastened correctly. Refer to the User guide of your robot for payload specifications.

> ⚠️ **WARNING**
>
> Using a charger different from the one supplied by the manufacturer can cause a fire.
>
> - Use only the original charger.

> ⚠️ **WARNING**
>
> Make sure the UR Robot Arm is properly and securely bolted in place. Unstable mounting can lead to accidents.

> ⚠️ **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.

3.3 Intended use

MiR500 is a partly completed machine as defined in the EU machinery directive and does not have a CE mark. A correctly installed MiR500 is covered by the CE mark of MiRFleet PC. However, a CE marked product does not guarantee a CE marked setup. It is the responsibility of the integrator to safely commission MiR500.

MiR500 is designed for MiRFleet PC. MiR500 is only intended to be used as described in this operating guide

> **(!) NOTICE**
>
> A safe machine does not guarantee a safe system. Follow the Commissioning guide to ensure safe commissioning.

MiR500 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 MiR500, it is important to make a risk assessment. All risks and foreseeable misuses relevant to MiRFleet PC also apply to MiR500. Refer to the MiRFleet PC User guide for more information.

3.4 Foreseeable misuse

Any use or application deviating from the intended use is deemed to be misuse. This includes, but is not limited to:

- **Use of the robot to transport people.**
  Risk of injury.
- **Steep ramps on the route.**
  Risk of injury. Steep surface grades (ramps etc.) may cause the robot to skid. See Technical specifications on the website.
- **Use outdoor.**
  Risk of injury. MiR500 is designed and intended for indoor use only.
- **Overloading of the robot.**
  Risk of injury. If the maximum payload on top of the robot is exceeded, it may cause overturning, falling load. See Technical specifications on the website.
- **Failure to follow the guidelines for commissioning**
  See Commissioning on page 7
- **Failure to make a risk assessment of the full installation**
  See Risk assessment on the next page. This applies to the robot with any extra modules installed.
- **Operation outside the permissible operating rating parameters and environmental specifications**
  Risk of instability, impact or tipping over.

- **Transportation of liquids or food**
  Risk of instability.
- **Use in potentially explosive environments**
- **Use in medical and life critical applications**

3.5 Risk assessment

One of the most important steps in achieving a safe installation is to make a risk assessment. The risk assessment is the responsibility of the individuals who are commissioning MiR500 in the environment it will be used in. Most often it will be an integrator who also designs and/or builds work cells or other required infrastructure related to MiR500.

The risk assessment must cover not only MiR500 itself, but also take into account potential potential load transfer stations, work cells and the environment it will be used in. See MiR100 and MiR200 Risk Analysis on the distributor page.

It is recommended that the integrator uses guidelines in ISO 12100, EN 1525, ANSI B56.5 or other relevant standards to conduct the risk assessment.

The risk assessment shall at least consider the following scenarios:

- Detailed description of the robot installation.
- Normal operation of the robot installation.

In EN 1525, clause 4 there is a list of significant hazards, hazardous situations and events which can be used for inspiration.

The risk assessment shall be written and saved as part of the technical file.

3.6 Residual risks

Mobile Industrial Robots has identified the potential significant hazards listed below as hazards that must be considered by the integrator.

- Being run over, drawing-in, trapping or impact if a person steps into the route or walks towards MiR500 while in motion.
- Crushing or trapping if user touches MiR500. Please notice the warnings on MiR500.
- Crushing, drawing-in or trapping at load transfer stations, work cells or charging stations.

> ⚠ **NOTICE**
>
> Other significant hazards will be present in a specific robot installation and shall be identified during Commissioning.

3.7 Safety-related functions and interfaces

MiR500 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 and/or top manipulator. 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.

3.8 Limiting safety-related functions

MiR500 has several built-in safety-related functions that are used to ensure safe operation in the environment it is designed to be used in.

Advanced control software ensures that locomotion and the drive pattern are within safety related limits and thereby avoid triggering a safety function. Violations of limits will hence only occur in exceptional cases. Nevertheless, if a limit is violated, the safety system issues a category 0 stop (stopping by "immediate removal of power to the machine actuators according to IEC 60204-1") followed by a controlled brake which brings MiR500 to a stop.

See Technical specifications on our website for more details.

Collision avoidance

The collision avoidance safety function ensures that the robot will come to a stop before it collides with a human or object.

The function measures the speed on the two driving wheels and switches between the predefined protective fields accordingly. The faster the speed, the larger the protective fields will be.

This ensures that the robot will be brought to a stop in case a human or object is detected within the active protective field.

Collision avoidance is automatically deactivated two seconds after the protective field is free.

Safe load position

The safe load position safety function ensures that the robot will not drive, while MiR500 Lift or MiR500 EU Pallet Lift is not in the lowest position and hence there is a risk of compromising stability.

The safe load position safety system consists of interlock switches that detect if the lift modules are in the lowest position or not.

The input can be used for a customized top module/manipulator when a MiR500 Lift or MiR500 EU Pallet Lift is not installed.

The safe load position safety function must be manually deactivated by activation of the restart button.

Overspeed avoidance

The safety system monitors if the speed of each motor is above limits for maximum rated speed and hence an indication of speed control is lost for any reason.

The overspeed avoidance safety function must be manually deactivated by activation of the restart button.

Stability

The safety system monitors if the speed difference between the two motors are above predefined limits and hence an indication of speed control is lost for any reason.

The stability safety function must be manually deactivated by activation of the restart button.

Emergency stop

MiR500 has four emergency stop buttons and an option to connect additional emergency stop buttons through the electrical interface.

The emergency stop is only intended to be used in case of an emergency and shall not be used for operational stop.

Emergency stop must be manually deactivated by activation of the restart button.

3.9 Safety-related electrical interfaces

The robot is equipped with several safety-related electrical inputs and outputs. All safety-related electrical inputs and outputs are dual channel. They are safe when low, e.g. the

emergency stop is not active when the signal is high (+24V).

Safety-related electrical inputs

This section contains the safety-related electrical inputs of the robot.

External emergency stop button input

This input is for connection of an optional emergency stop button. If activated, the safety system issues a category 0 stop followed by a controlled brake which brings MiR500 to a stop.

Must be manually deactivated by activation of the restart button.

System emergency stop input

This input should be used in case a top manipulator has its own emergency stop circuit. The input must be used in combination with a system emergency stop output. With this, it is possible to ensure that activation of any emergency stop button will cause an emergency stop of both MiR500 and top manipulator. If activated, the safety system issues a category 0 stop followed by a controlled brake which brings the robot to a stop.

Must be manually deactivated by activation of the restart button.

Safeguard stop input

This input can be used to issue a category 0 stop followed by a controlled brake which brings MiR500 to a stop.

Will be automatically deactivated when signal is driven high again.

Load handling position (position control of load)

This input can be used to apply the safe load position (position control of load) safety function on a system with customized top modules or manipulators. A variety of sensors or interlock switches that detect load handling position or position of load can be connected and thereby enable the safe load position safety function.

Safety-related electrical outputs

This section contains the safety-related electrical outputs of the robot.

Locomotion

This safety related output is activated if the robot is in locomotion or intend to locomote within two seconds.

The safety function is limited if locomotion is detected while the output is deactivated.

Shared emergency stop output

This output should be used in case a top manipulator has its own emergency stop circuit. The output should be used in combination with a system emergency stop input. With this, it is possible to ensure that activation of any emergency stop button will cause an emergency stop of both the robot and top manipulator.

Activated by an emergency stop button or emergency stop input.

3.10 Lithium battery

This section contains safety precautions related to lithium batteries in MiR robots.

> **(!) NOTICE**
>
> MiR does not support any additional batteries applied to the MiR500 by the customer.

> **⚠ 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.

Copyright and disclaimer

Contact the manufacturer:

Mobile Industrial Robots A/S
Emil Neckelmanns Vej 15F
DK-5220 Odense SØ

www.mir-robots.com
Phone: +45 20 377 577
Email: support@mir-robots.com

CVR: 35251235