User guide (en)

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Copyright and disclaimer

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Table of contents

1. About this document

This document contains the following information:

- How to start up and operate MiR100.
- Product presentation.
- Typical applications.
- Guidelines for proper maintenance of the robot.

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:
  - **MiR100 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.
  - **MiRCharge 24V Operating guide**
    The operating guide that describes how to set up MiRCharge 24V and configure MiR100 for automatic battery charging at the charging station.
  - **MiR Robot Reference guide**
    The reference that describes the elements of the robot interface. Available in multiple languages.
  - **MiR100 REST API reference.**
    The REST API reference for MiR100/MiR200the 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**
  This page contains troubleshooting guides to solve common issues with MiR products.
- **MiR100 product page**
  http://www.mobile-industrial-robots.com/en/products/mir100/
  This page contains specifications, pictures, and brochures for MiR100.

- **Universal Robots:**
  http://www.universal-robots.com/support

1.2. Document history

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

Revision	Release date	Description	SW	HW
1.0	2017-11-27	First edition.	2.0.2	1.0
1.1	2018-08-17	Updated for hardware release 2.1 Updates and improvements throughout the manual	2.2.0 and higher	2.1
1.2	2019-01-04	Updated for hardware release 3.0 Updates and improvements throughout the manual	2.3.0 and higher	3.0
1.3	2019-06-26	Updated for hardware release 4.0 Updates and improvements throughout the manual	2.6.0 and higher	4.0
1.4	2019-08-20	Updated for hardware release 5.0 Updates and improvements throughout the manual	2.7.6 and higher	5.0

2. Safety

Read the information in this section before powering up and operating MiR100.

Pay particular attention to the safety instructions and warnings.

NOTICE

Mobile Industrial Robots disclaims any and all liability if MiR100 or its accessories are damaged, changed or modified in any way. Mobile Industrial Robots cannot be held responsible for any damages caused to MiR100, accessories or any other equipment due to programming errors or malfunctioning of MiR100.

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.

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 Payload specifications on page 50

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

Removing the top cover from the robot exposes parts connected to the power supply.

- Turn off the main power relay to avoid a short circuit. To see the location of the power relay, refer to Product presentation on page 29

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

MiR100 is intended to be commissioned and used in indoor industrial environments where access for the public is restricted. For details about the environmental conditions in which the robot should operate, see Technical specifications on our website.

MiR100 is intended to be commissioned according to Commissioning on page 18 and prepared to the environment according to the guidelines. This is a prerequisite for safe usage of MiR100.

MiR100 is designed and all risks are considered when used with one of the following types of top applications:

- MiRHook 100 to tow trailers.
- A custom designed top application (including payload) designed to fulfill the following requirements:
  - Must not increase the footprint of MiR100 and be within the requirements in Payload specifications
  - Must not have any moving parts

MiR100 can be used as a partly complete machine as defined in the EU machinery directive, with top applications that do not meet above limitations. Those who design, manufacture or commission a system that does not meet the limitations of use of MiR100, carry the obligations of a manufacturer and shall ensure a safe design according to EN ISO 12100. Guidelines outlined in this manual are not sufficient. Examples of top applications, which are not intended use of MiR100, but not limited to, are:

- Shelf on supporting legs (with or without wheels)
- Top applications (including payload) which increase the footprint of MiR100
- Conveyers (power and non-powered)
- Industrial robot arm
- Customized load transfer station

2.4. 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. MiR100 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 18.
- **Failure to make a risk assessment of the full installation**
  See Risk assessment below. 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**

2.5. 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 MiR100 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 MiR100.

The risk assessment must cover not only MiR100 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.

2.6. 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 MiR100 while driving in reverse. The MiR100 will only drive in reverse when parking or picking up a cart or undocking from a marker such as the MiRCharge 24V.
- Crushing or trapping if user touches MiR100. Please notice the warnings on MiR100.
- 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.

2.7. Safety-related functions and interfaces

MiR100 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.

2.8. Limiting safety-related functions

MiR100 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 MiR100 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.

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.

Emergency stop

MiR100 has one emergency stop device.

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.

2.9. Lithium battery

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

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. Getting started

This section describes how to get started with MiR100.

3.1. In the box

This section describes the content of the MiR100 box.

The box contains:

1. The MiR100 robot
2. MiR100 Kit
   - Emergency stop box, external antenna and 4 pcs. M10x40 bolts
   - One charging cable
   - One external charger, 24VDC, 10A
3. MiR100 document folder containing the printed documents and the USB flash drive.

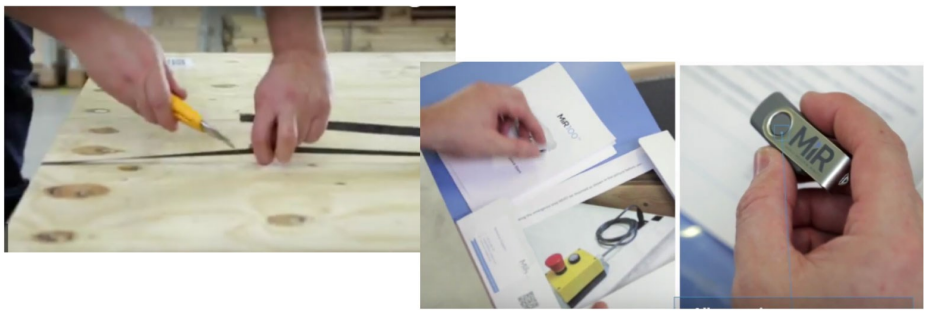
4. Printed documents:
   - MiR100 Quick Start
   - MiR username and passwords
   - CE declaration of conformity
5. USB flash drive with the following content:
   - MiR100 User Guide
   - MiR Robot Interface 2.0 Reference guide
   - MiR robot REST API reference
   - MiR username and passwords
   - CE declaration of conformity

3.2. Unpacking MiR100

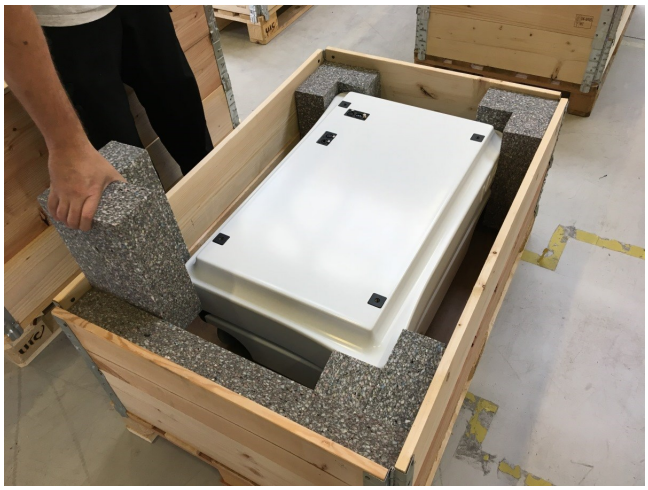
This section describes how to unpack MiR100.

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

1. Remove pallet lid and take out the box with the MiR100 kit. Keep the original packaging for future transportation of the robot.



2. Remove the top foam, foam blocks on the sides and the pallet frames.



3. Place the pallet cover as a ramp at the robot's rear end.

4. Commissioning

This section describes how to get started with MiR100.

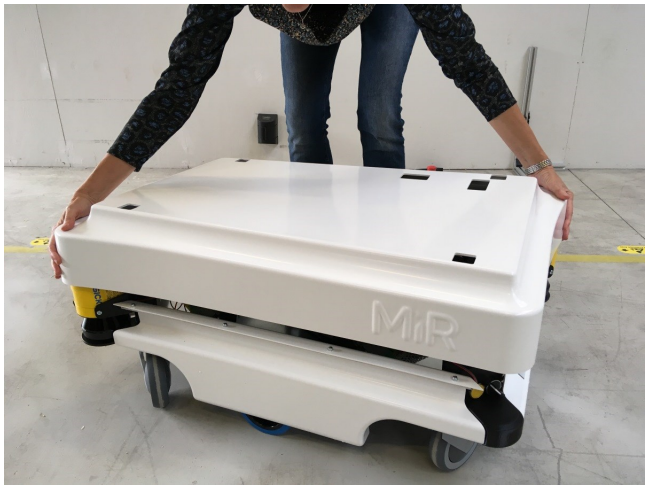
NOTICE

Read the Safety chapter before powering up the robot.

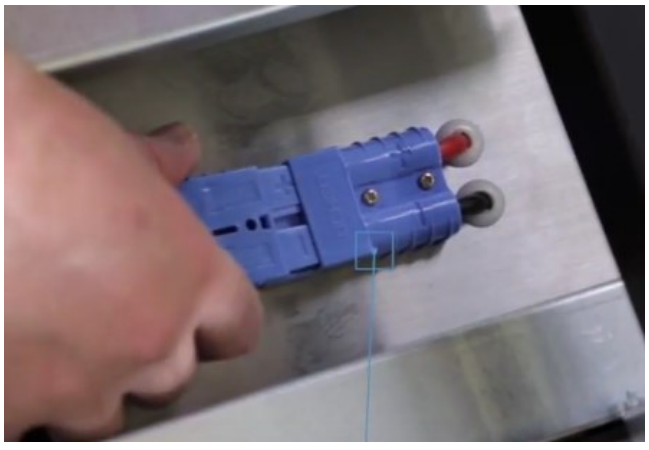
4.1. Powering up

Follow these steps to power up MiR100.

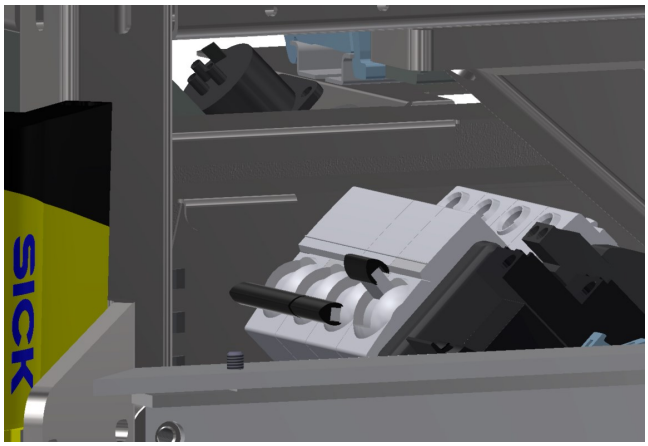
1. Grab the two rounded corners and carefully lift off the cover.



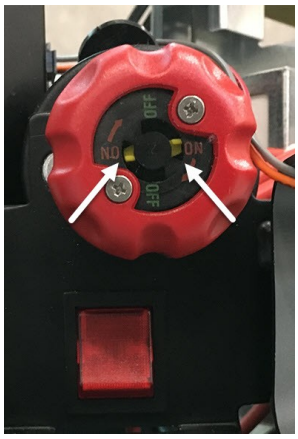
2. Connect one of the two battery cables to the plug on top of the battery box. The second cable is for an extra battery.



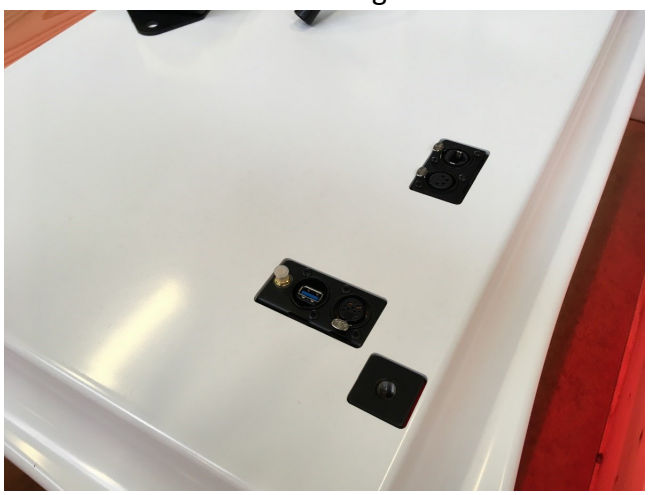
3. Switch on the three relays placed in the corner by the front laser scanner. Start with 32A main power, i.e. from the outer frame in.



4. Ensure that the battery disconnect switch is on (the two yellow indicators pointing to On).



5. Put the cover back on making sure to fit it correctly over the connector openings.



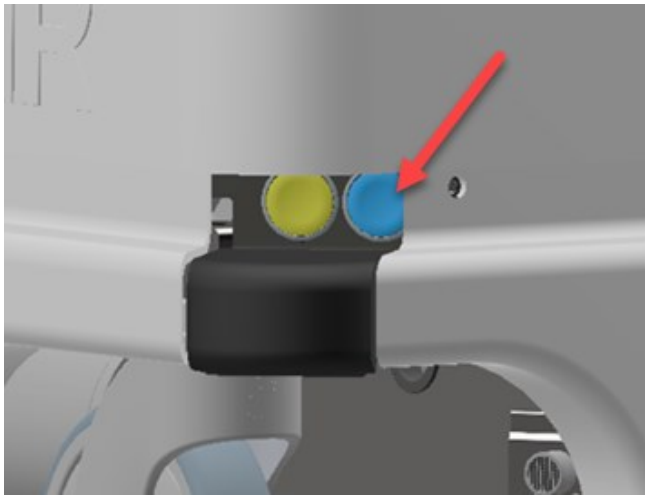
6. Mount and connect the emergency stop box on top of the robot cover.

If a top module is going to be mounted on top of the robot, the emergency stop must be placed in a position where it is easy to reach. See Mounting a top module on page 48.

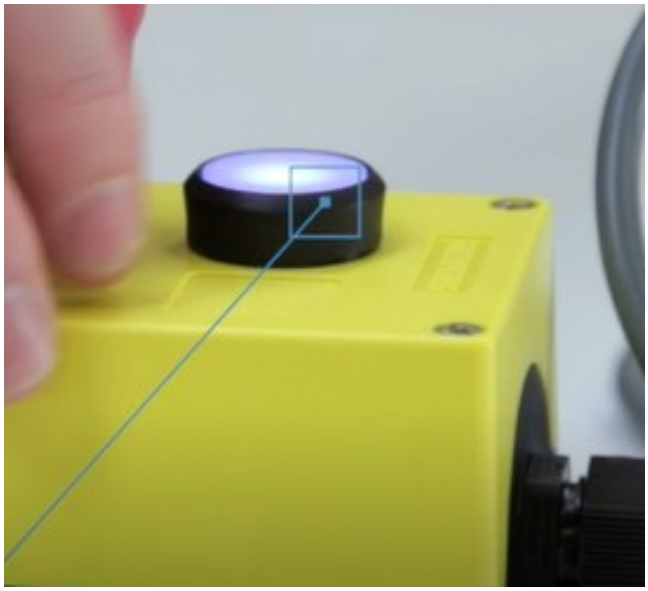
7. Connect the antenna to the connector on top of the robot cover. Remove the plastic cap from the connector before fixing the antenna.

The antenna can be lowered and rotated in all directions to fit under a top module.

8. Push the blue power button in the corner to turn on the robot. The robot lights up with a yellow running light for a short moment, then enters emergency stop mode indicated by a constant red light.



9. Press the reset button on the emergency stop when it has lit up. The robot light now switches to yellow constant light, indicating that the robot is paused and ready to operate.



4.2. Connecting to the robot interface

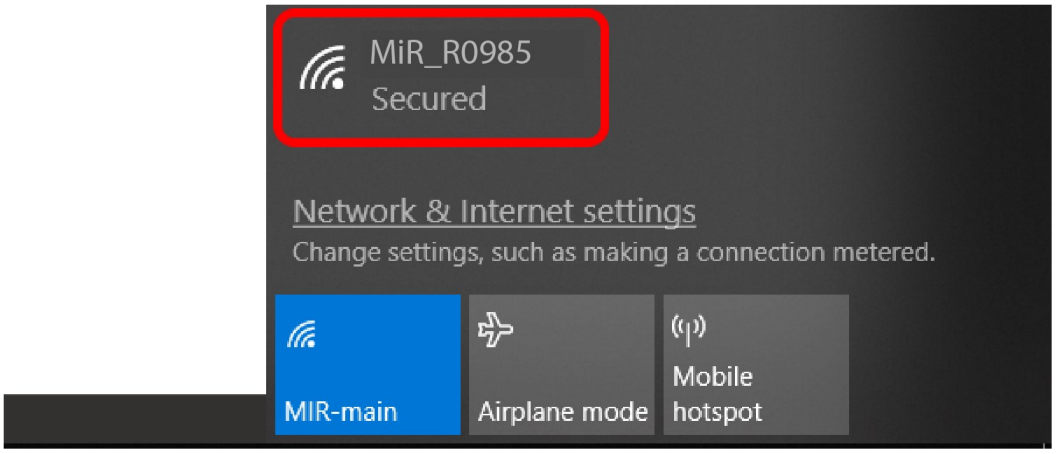
When the robot is on, it enables the connection to its WiFi access point. The name of the access point appears in the list of available connections on your pc, tablet or phone.

NOTICE

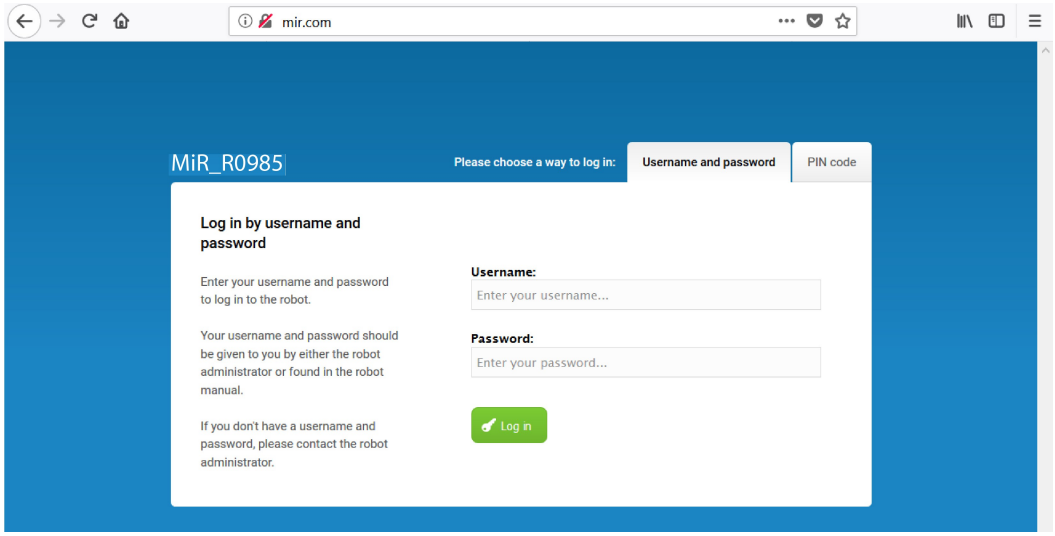
The username and password for the robot's WiFi access point and for accessing the web interface are in the MiR username and passwords document. The document is in the box with the robot.

Follow these steps to connect to the robot interface:

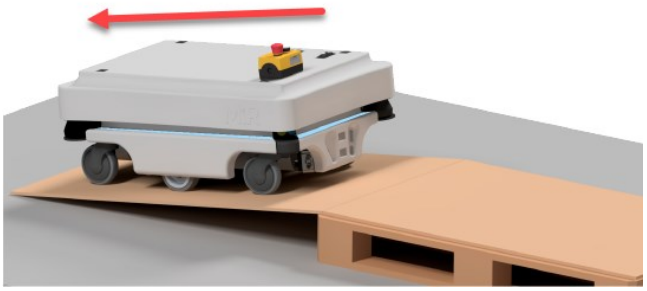
1. Using your pc, tablet or phone, connect the WiFi access point of the robot. The access point name has the following format: MiR_RXXXX.



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



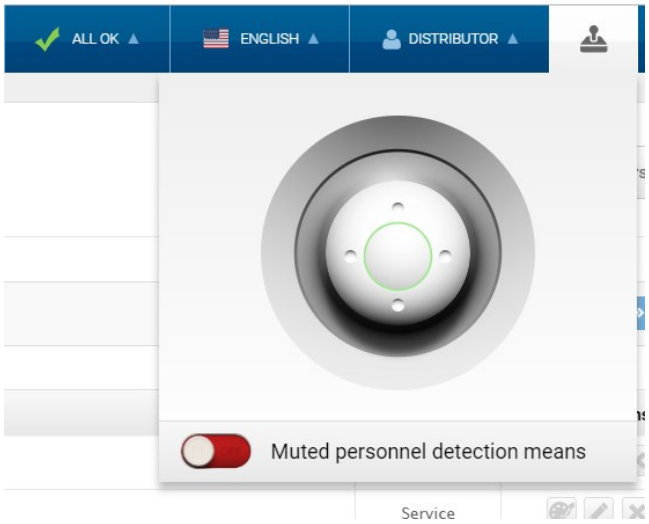
The robot is now ready to move down the ramp. To do this switch to manual mode and use the electronic joystick in the robot interface. See next section Driving the robot in manual mode below.



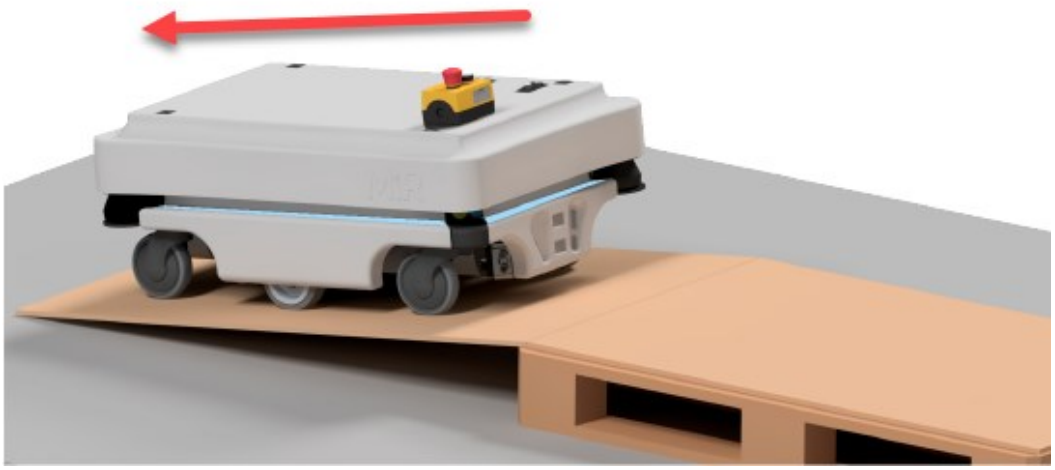
4.3. Driving the robot in manual mode

To drive the robot in Manual mode:

1. In the robot interface, select the joystick icon. Then press **Manual control** and the joystick control opens.



2. The status light on the robot turns blue indicating that the robot is in Manual mode.
3. Drive the robot using the joystick.



We recommend to reverse the robot down the ramp.

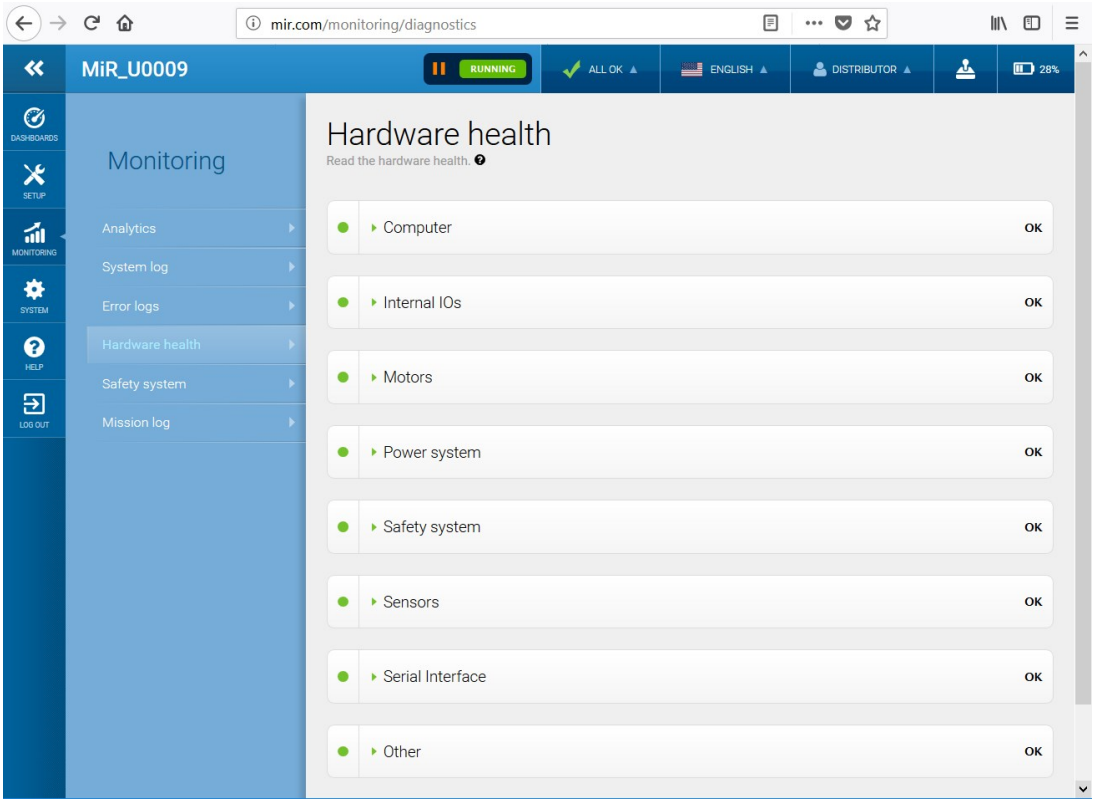
4.4. Checking the hardware status

To check that all hardware components work as intended:

Sign in to the robot interface. See the section Connecting to the robot interface on page 22.

Go to **Monitoring** > **Hardware health**.

Check that all elements on the page have the OK status and that they have green dots on the left.

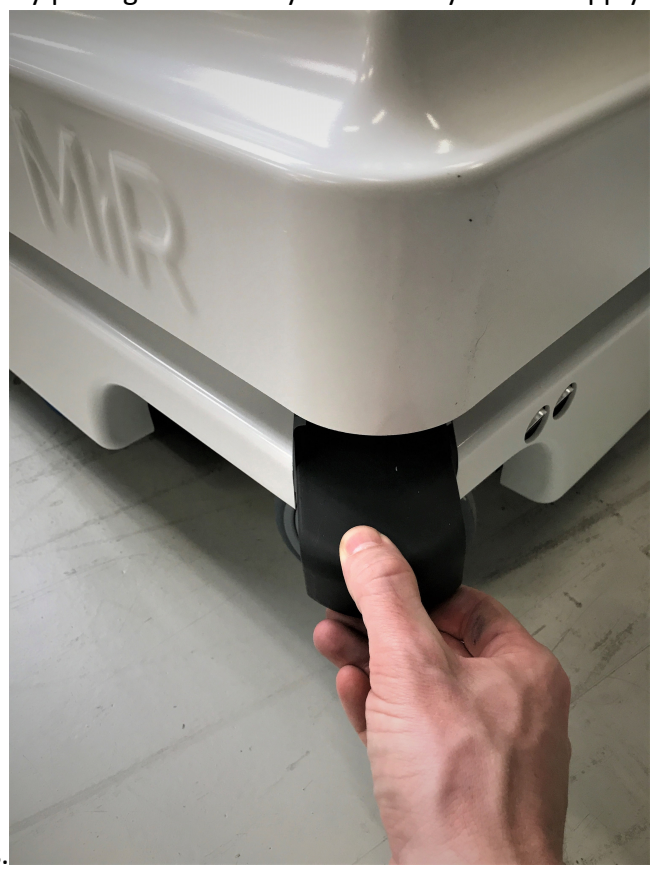


For more information, see **Hardware health** in MiR Robot Interface 2.0 Reference Guide.

4.5. Charging the robot

The robot arrives with a charged battery and can drive for up to three hours before recharging is required. Follow these steps to charge the robot using the enclosed charging cable:

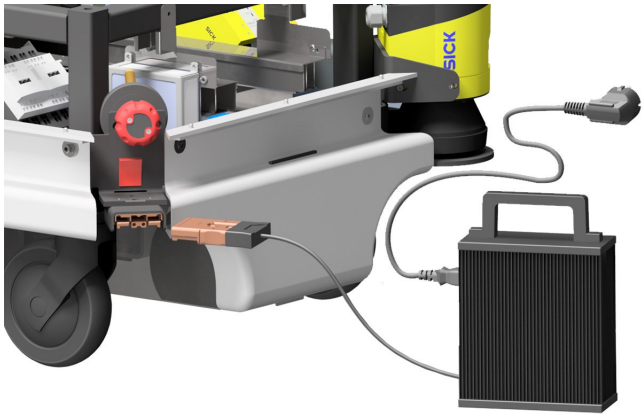
1. Remove the rear corner by pulling it towards you. You may have to apply a bit of force the first couple of times.



To avoid fast discharging and a depletion of the battery, we recommend that you turn off the robot while charging with a cable.

If charging two robots right after each other with a cable, wait approximately one minute between unplugging the first robot and plugging in the second. This will ensure that the charger registers that a new robot is being charged.

2. Attach the charger to the robot's charging socket and to a power outlet. Turn on the rocker switch on the robot to begin charging.



Use only the original charging cable.

3. After a maximum of four and a half hours, the robot is fully charged.
4. Turn off the rocker switch and disconnect the charging cable from the robot. Slide the corner cover back on.

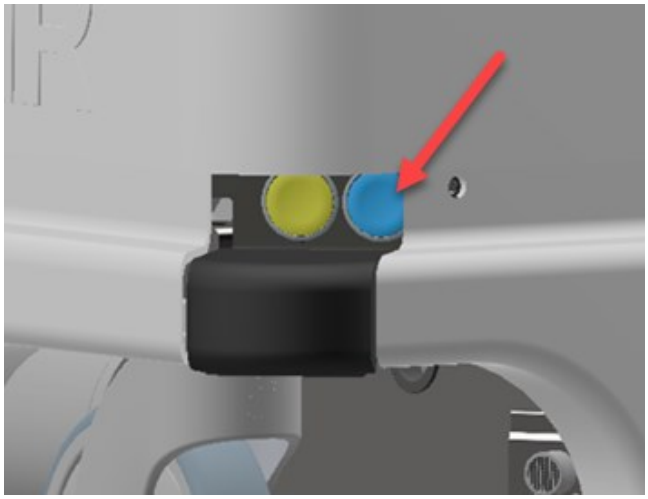
The robot detects both cable and activated charging-button and will go into emergency stop in both cases.

For information about the charging time, see the robot specifications at www.mir-robots.com.

4.6. Shutting down the robot

To shut down MiR100:

1. Ensure that the robot is not moving or executing an action.
2. Press the **On/Off** button.



3. The robot starts the shutdown process. During shutdown, status lights show yellow fading light.
4. You'll know that the shutdown process is finished when the status lights are off.

If you're shutting the robot down for transportation or service/repair, the battery disconnect switch must be turned off as well and the battery cable disconnected.

5. Product presentation

MiR100 is an autonomous mobile robot that can transport loads up to 100 kg and pallets indoors within production facilities, warehouses, and other industrial locations.

Users operate MiR100 via a web-based user interface, which is accessed via a browser on a PC, smartphone or tablet. Each robot has its own network. See Connecting to the robot interface on page 22. The robot can be set up to run a fixed route, be called on demand or perform more complex operations (missions).

The robot performs localization and navigation via a map which can be created or imported the first time the robot is used. The internal map contains defined locations (office, product delivery, production hall etc.) that are used for logistical planning. While operating, the safety laser scanners ensure that the robot avoids dynamic obstacles (people, furniture) that are not mapped.

With a MiRCharge 24V, the robot handles moving to a charging station automatically. All it takes is the definition of a charging mission and a charging position on the map.

5.1. Main features of MiR100

The main features of the MiR100 are:

- **Driving in a populated workspace**
  The robot is designed to operate among people and maneuvers safely and efficiently in even highly dynamic environments.
- **Overall route planning and local adjustments**
  The robot autonomously navigates to find the most efficient path to its destinations. The robot adjusts the path when it encounters obstacles which are not on the map (like people and objects).
- **Efficient transportation of heavy loads**
  The robot is designed to automate transportation of loads up to 100 kg across industries, allowing employees to focus on higher value activities.
- **Sound and light signals**
  The robot continuously signals with light and sounds indicating its current mode, for example waiting for job, driving to destination, destination reached or alert mode.

- **User friendly and flexible**
  The web-based user interface, accessed from a PC, tablet or smartphone, gives easy access to operation and monitoring of the robot and can be programmed without any prior experience. Different user group levels and tailored dashboards can be set up to suit the different users.
- **Alert for 'lost'**
  If the robot enters a situation where it is unable to find a path to its destination, it stops, turns on the yellow-purple running error light and a customer defined 'catch' action may be used to alert people or take other actions.
- **Automatic deceleration for objects**
  The built-in sensors ensure that the robot is slowed down when obstacles are detected in front of it.
- **Optimal surface operations**
  The robot is made to run on a level, dry floor and 3D cameras detect and avoid objects.
- **Internal map**
  The robot can either use a floor plan from a CAD system or a map can be created by manual navigation around the entire site in which the robot is going to operate. When mapping, the robot's sensors detect walls, doors, furniture and then creates a map based on this input. After creation of the map, positions and other features can be added in the map editor.

Add-ons

The following add-ons are available for the MiR100:

- **MiRHook 100**
  A hook may be mounted on MiR100 enabling it to automate the internal transport of carts.

To read more about the add-ons, go to www.mir-robots.com.

5.2. Identification label

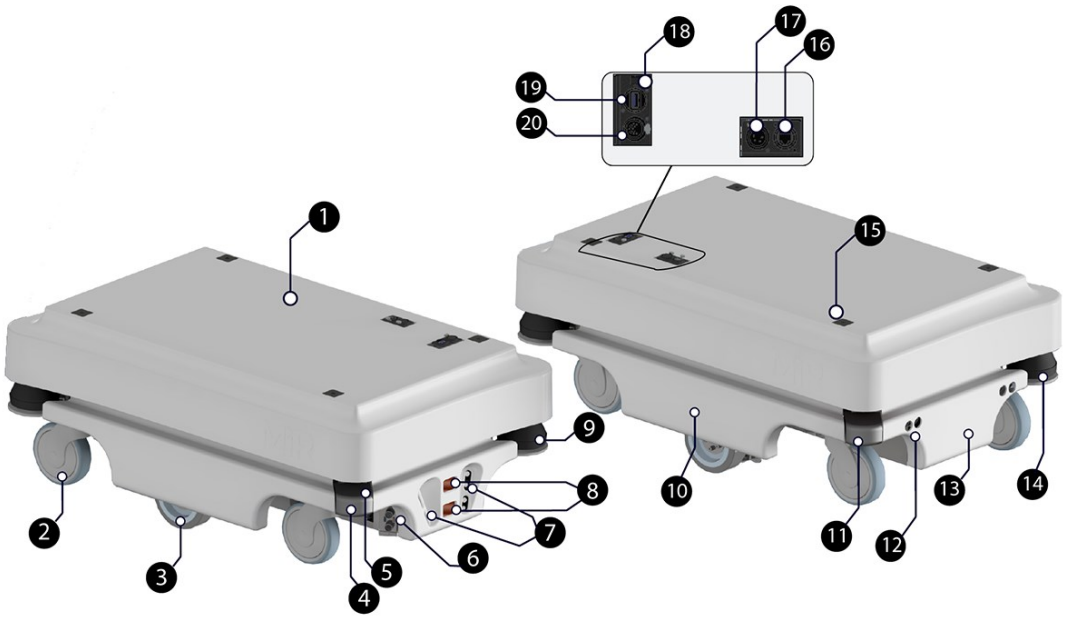
The identification label of MiR100 is placed on the back of the battery box.

CE	Mobile Industrial Robots A/S declares that MiR100 meets the requirements of the applicable EC directives.
Serial number	The 15-digit serial number is a unique identifier of the robot. The last four digits form part of the original name of the robot, e.g. MiR R635.
MiR100 4.0	Product name and hardware version.

Example of MiR100 CE marking and identification label.

5.3. MiR100 external parts

This section presents the parts of MiR100 that are visible on the outside.

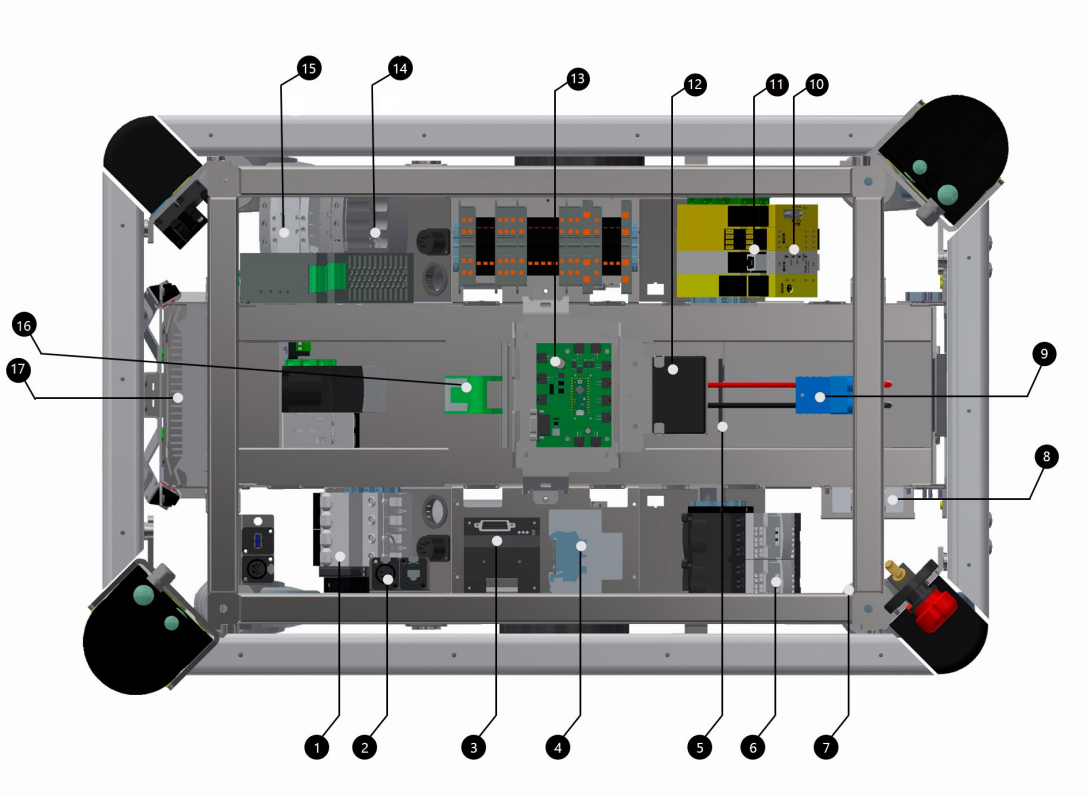


1.	Top cover	11.	Behind removable rear corner cover: Charging port with switch
2.	Caster wheel - all four corner wheels	12.	Ultrasound sensors for detection of transparent objects (rear)
3.	Drive wheel - differential control	13.	Rear cover
4.	Behind removable corner cover: HDMI port and USB “service port” - connects to the robot’s PC	14.	Rear laser scanner
5.	Scanner reset button (yellow) and on/off button (blue)	15.	Mooring hole - one in each corner for fixation of top modules
6.	Ultrasound sensors for detection of transparent objects (side)	16.	RJ45 Ethernet connection
7.	3D depth cameras	17.	Application interface - for connection to hardware such as hook - see Interface specifications on page 53
8.	Pad connectors - for connection to charging poles on MiRCharge 24V charging station	18.	Antenna socket
9.	Front laser scanner	19.	USB port “service port” - connects to the robot's PC
10.	Side cover	20.	Emergency stop interface with added options for connection to small units and I5 input on SICK scanners - see Interface specifications on page 53

MiR100 external parts

5.4. MiR100 internal parts

This section presents the parts of MiR100 that are visible on the inside.



1.	Breaker - automatic fuse between battery and components	10.	SICK safety PLC
2.	Robot power off relay - releases the latching relay (pos. 16) when the robot is shutting down.	11.	Optocoupler - emergency stop signal to motorcontroller
3.	Motorcontroller - manages the two motor drives	12.	Loudspeaker
4.	Brake relay - short circuits motor windings for faster braking	13.	MiR board - interface board for gyroscope, accelerometer, ultrasound, light, on/off circuit and CAN bus communication
5.	Battery connector for extra battery	14.	24 V power supply - secures stable voltage for PC and PLC
6.	Safe torque off relay (controlled by SICK)	15.	Latching relay - activates the 24V power supply turning on the robot

7.	CAN bus connection for Battery Management System, logging data e.g. no of charge cycles. See MiR Robot Interface 2.0 Reference guide.	16.	Transient protection - provides circuit protection for the power supplies by absorbing voltage spikes from battery or top mounted applications
8.	Router - local network, 2.4 and 5 GHz	17.	DFI Computer
9.	Battery with connector - main power to the robot		

MiR100 internal parts

5.5. Sensor system

Collaboration between the robot's internal and external sensors ensures that the robot can navigate in the environment and most importantly secures that it can operate safely among people and objects, like furniture, machines, pallets etc.

This section describes the functionality of the different parts of the sensor system.

Safety laser scanners

The safety laser scanners on MiR100 are of the type SICK S300. In this guide, the term safety laser scanner is used.

Scanner functions

Two safety laser scanners, diagonally placed on front and rear corners of the robot, scan their surroundings. Each safety laser scanner has a 360° field of view up to 1 meter around the robot, providing visual protection around the robot.

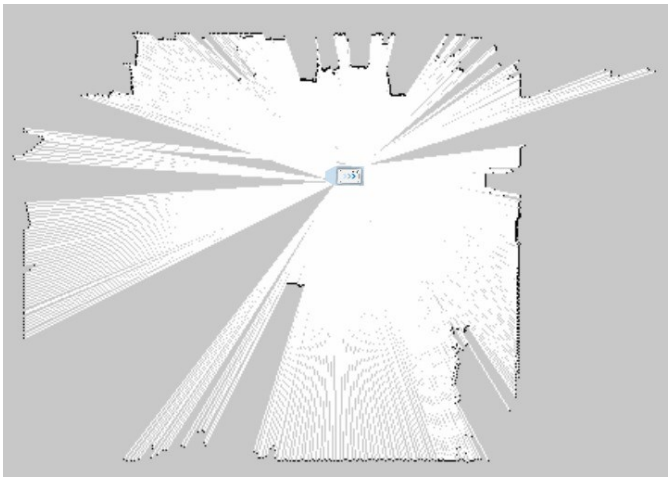
The safety laser scanners serve three purposes:

- They are used for mapping, see also MiR Robot Interface 2.0 Reference Guide.
- They are used to localize the robot in the environment and plan routes between points.
- They continuously scan the surroundings when the robot operates, thereby avoiding collision with objects and people.

The safety laser scanners detect objects in a plane approximately 200 mm above ground. Objects above or below are not detected by the safety laser scanners.

When in motion, the safety laser scanners continuously scan the surroundings using a distance of up to 2.5 m.

When mapping, the safety laser scanner's view is reduced to 20 m to support that maps will get the highest possible quality.



The safety laser scanners see up to 20 m when mapping an area.

Signals from safety laser scanners are combined with input from 3D cameras and proximity sensors and used to evaluate if an object or person is in the path of travel. In that case, the robot gradually slows down while trying to avoid the obstacle. If unable to make its way around the obstacle, the robot stops and waits for clearance.

Protective field sets

The protective field sets are part of the robot's personnel detection means. The protective field sets consist of individually configured contours around the robot. MiR100 activates the correct field set based on the speed. If a person or object within the area active protective field set, the robot will do a protective stop and remain stopped until the protective field set is free.

The following tables show the sizes of the protective fields sets at given speeds. The faster the robot moves, the larger the scanners' field set.

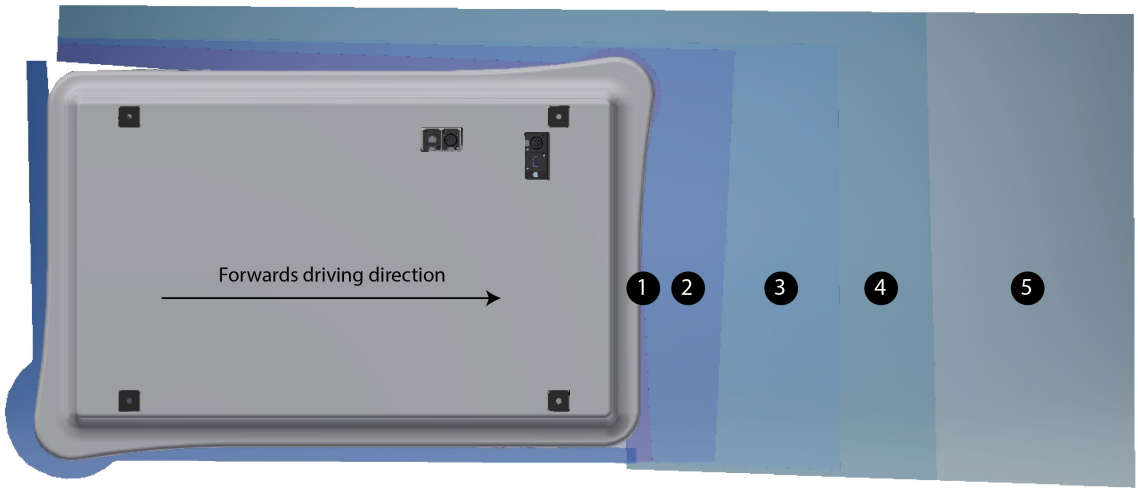
The protective field sets differ for forwards and backwards driving.

Field sets for forwards driving direction

The following table shows speeds and field sets in forwards driving direction. The table describes the length of the field set in front of the robot in different cases. Each case is

defined by a speed interval that the robot may operate at. The colors and cases in the table correspond to the field set shown in the illustration below.

Case	Speed	Field set in front of robot	Comments
1	-1.40 to 0.20 m/s	20 mm	Reversing and slowly forwards
2	0.21 to 0.40 n/s	120 mm	
3	0.41 to 0.80 m/s	290 mm	
4	0.81 to 1.10 m/s	430 mm	
5	1.11 to 2.00 m/s	720 mm	Forwards at max. speed

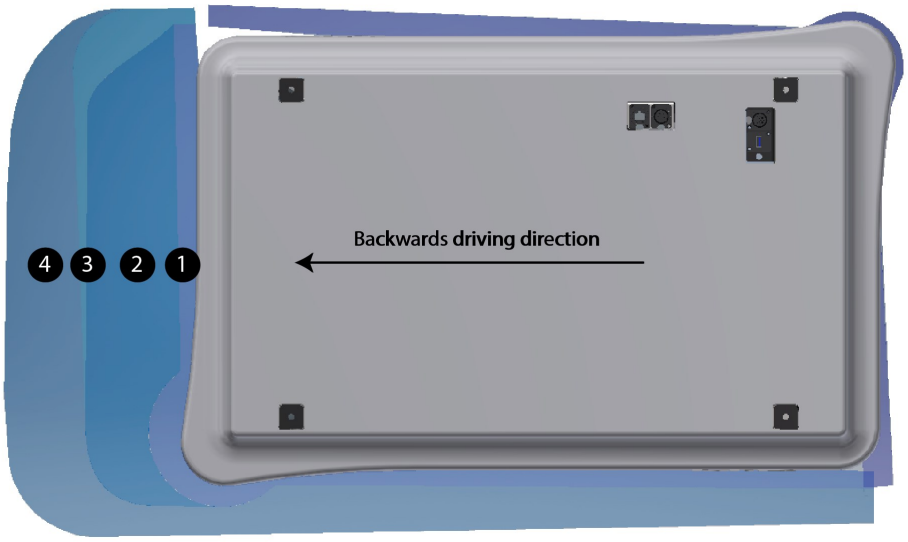


The illustration shows the field set contours in forwards driving direction. The reach of the field set changes with the robot's speed. In Case 1 the field set reaches 20 mm ahead, in Case 2 it reaches 120 mm ahead etc.

Field sets for backwards driving direction

This table shows speeds and field sets in backwards driving direction. The colors correspond to the field set shown in the illustration below.

Case	Speed	Field set	Comments
1	-1.14 to 1.80 m/s	30 mm	Reversing and slowly backwards
2	-0.20 to 0.15 m/s	120 mm	
3	0.40 to 0.21 m/s	290 mm	
4	-1.50 to 0.41 m/s	430 mm	Backwards at max. speed



The illustration shows the field set contours in backwards driving direction. The reach of the field set changes with the robot's speed. The illustration also shows how the front scanner reduces its protective field sets to a minimum when the robot moves backwards.

NOTICE

Protective field tolerances

Scanners measure distances to diffuse reflections which means that a tolerance is added to the protective field sets to secure a safe detection of persons crossing the protective field sets. The tolerance distance is 100 mm.

CAUTION

The protective field sets are configured to comply with the safety standards of MiR100.

If they are changed, Mobile Industrial Robots takes no responsibility for any safety related incidents, and the warranty becomes void.

3D cameras

Two 3D depth cameras positioned on the front of the robot detect objects in front of the robot while the robot's local planner continuously adjusts its planned routes around such objects.

The 3D cameras detect objects:

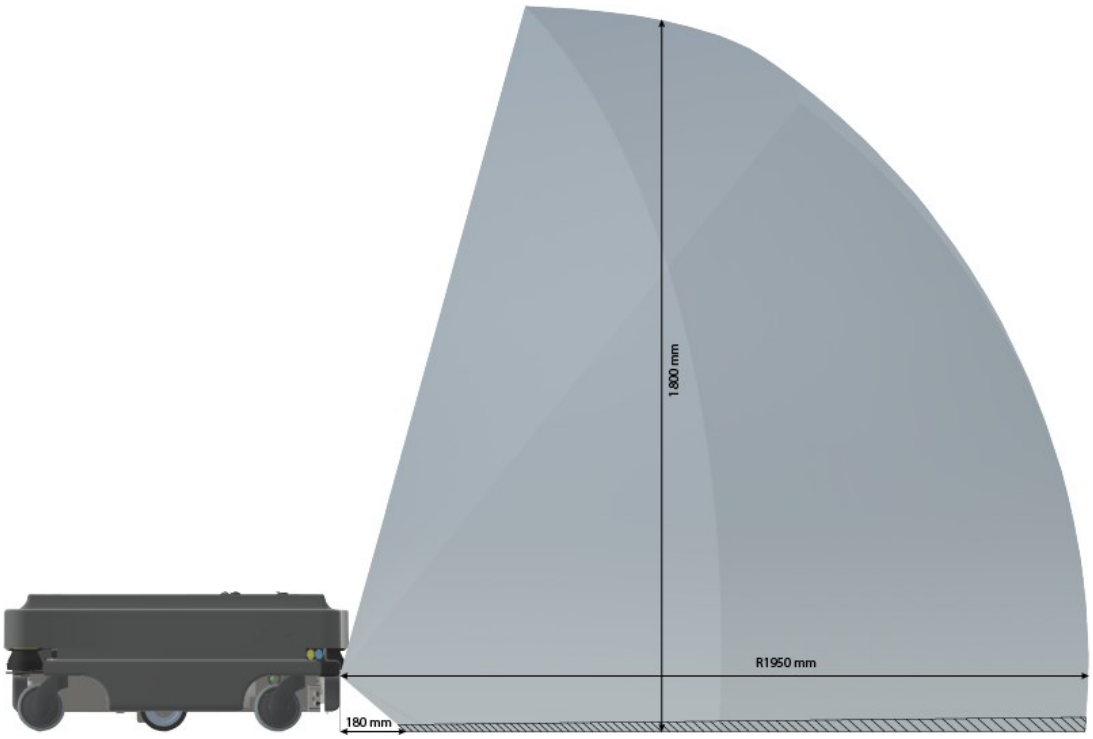
- Vertically up to 1800 mm at a distance of 1950 mm in front of the robot.
- Horizontally 180 mm to the first view of ground.

The 3D cameras do not detect objects within 50 mm of the lenses.

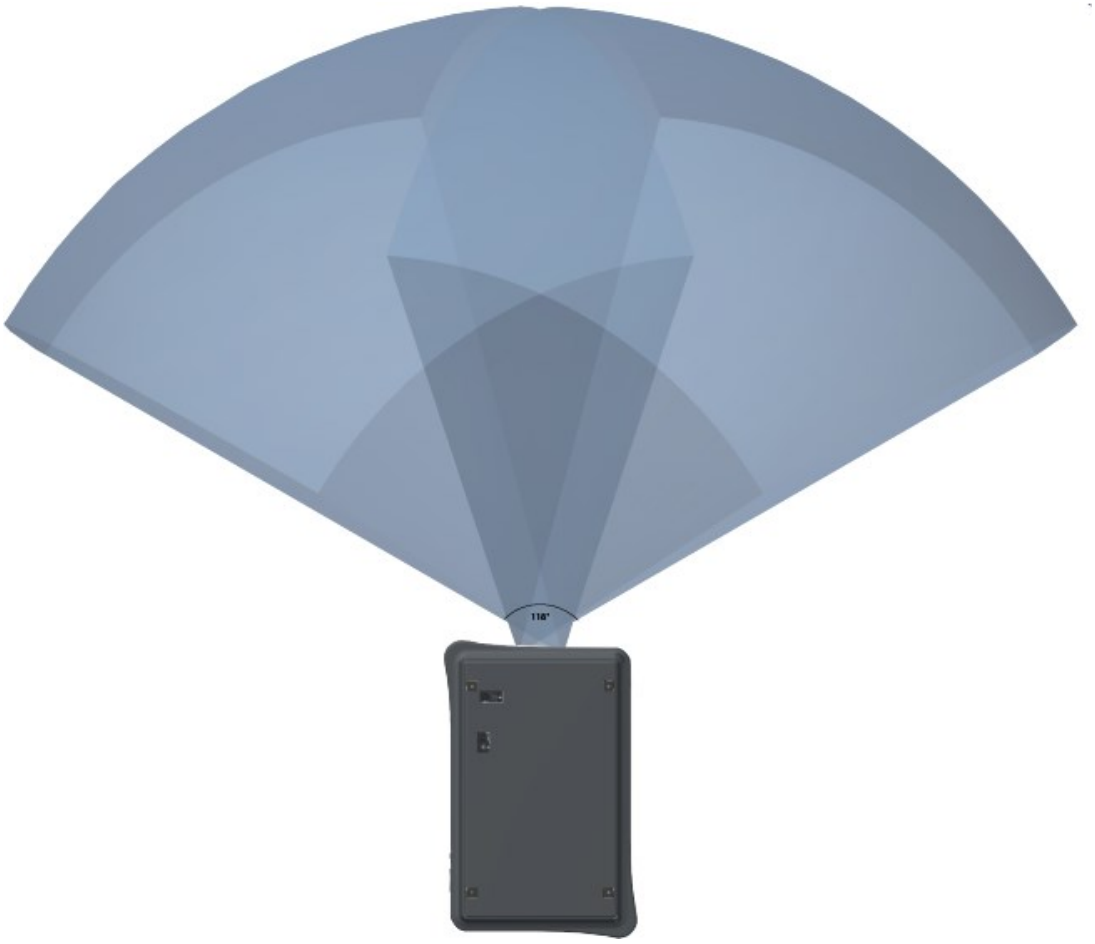
The space from the floor and vertically up to 50 mm is ignored. This space increases by 10 mm for every one meter horizontally.

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

The following illustrations show the field of view of the cameras.



The two 3D cameras can see objects up to 1800 mm above floor height.



The two 3D cameras have a horizontal field of view of 118°.

Ultrasound sensors

Four ultrasound sensors are placed on the robot: two at the front and two at the rear of the robot. The ultrasound sensors are used to detect transparent objects.

Internal sensors

The internal sensor system of the robot consists of the following components:

- **Gyroscope (IMU)**
  Measures the orientation and angular velocity of the robot.
- **Motor encoder**
  Provides closed loop feedback signals by tracking the speed and/or position of the motor shaft.
- **Accelerometer**
  Measures non-gravitational acceleration.

- **Wheel encoders**
  Detect wheel movements.

5.6. Light indicators

The robot uses light indicators to let people in the environment know what the robot is currently doing.

Status lights

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

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

Status lights show the current operational state on MiR100

6. Maintenance

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

The stated intervals are indicative and depend on the operating environment and frequency of usage of the robot.

NOTICE

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

6.1. Regular weekly checks and maintenance tasks

Once a week, carry out the following maintenance tasks:

Parts	Maintenance tasks
Robot cover and sides	Clean the robot on the outside with a damp cloth. Do not use compressed air.

Parts	Maintenance tasks
Laser scanners	Clean the optics covers of the scanners for optimum performance. Avoid aggressive or abrasive cleaning agents. Clean the laser scanners using a damp cloth, or for better maintenance see the notice below. Also do this before contacting your local technical support with any of the issues mentioned below. We recommend cleaning the laser scanners daily to increase the chance of avoiding these issues. Possible problems from not cleaning the laser scanners: • The robot fails to detect markers / pallet racks • The robot goes into emergency stop without obvious reason **NOTICE** Static charges cause dust particles to be attracted to the optics cover. You can diminish this effect by using the anti-static plastic cleaner (SICK part no. 5600006) and the SICK lens cloth (part no. 4003353). See the manufacturer's own documentation.
Caster wheels (the four corner wheels)	Remove dirt with a damp cloth, and make sure nothing is entangled in the wheels.
Drive wheels (the two middle wheels)	Remove dirt with a damp cloth, and make sure nothing is entangled in the wheels.
LED light band	Check if the LED light band is intact. Ensure that the light shows all the way around the robot.

6.2. Regular checks and replacements

Before starting replacement tasks that involve removal of the top cover:

- Press the **On/Off** button to turn off the robot
- Push the battery switch button to remove power from the battery
- Turn off relays and unplug the battery

The following table contains the parts that you should check and the intervals when you should do that:

Part	Maintenance	Interval
Robot cover	Check for cracks. Check mounting. Does it sit evenly on top of the robot with connections accessible.	Check monthly and replace as needed.
Caster wheels (the four corner wheels)	Check bearings and tighten.	Check weekly and replace once a year.
Drive wheels (the two middle-wheels)	Check wheel surfaces for wear.	Check every six months and replace as needed. **NOTICE** You must calibrate the robot after replacing the wheels. To do this, access the robot's user interface and navigate to System > Robot setup. Further instructions are provided here.

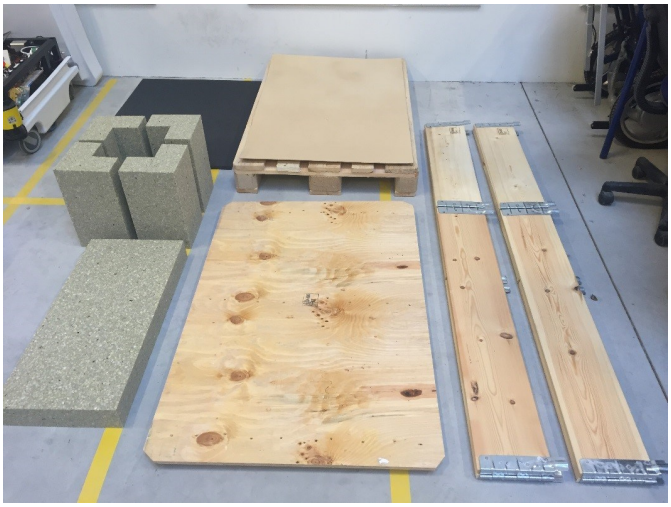
Part	Maintenance	Interval
Scanners	Check for visual defects, e.g. cracks and scratches.	Replace as needed. **NOTICE** You must calibrate the robot after replacing the scanners. To do this, access the robot's user interface and navigate to System > Robot setup. Further instructions are provided here.
Emergency stop	To check that the emergency stop buttons work, push down the red button and check that the emergency reset button lights up.	Every three to four months / according to EN/ISO 13850 Safety of machinery - Emergency stop function.
3D cameras	Check for visual defects, e.g. cracks and scratches.	Check monthly and replace as needed.
Manual brake release	Check if the brakes can be deactivated. Activate the brakes and push the robot gently forward. Remember to deactivate the brake after testing.	Check monthly and replace as needed.
Internal cabling	Check if all network/USB cables are plugged in properly.	Check every six months and replace as needed.
Safety marking on the floor	Check if the safety markings made with e.g. tape around cart pick-up and drop-off points are intact and visible.	Check every six months and replace as needed.
Safety stickers	Check if the safety stickers on the robot are still intact and visible.	Check every six months and replace as needed.

6.3. Packing for transportation

This section describes how to pack the robot for transportation.

Original packaging

Use the original packaging materials when transporting the robot.



The packaging materials are:

- The bottom of the box (the pallet).
- The lid of the box (the ramp).
- The walls of the box.
- Protective foam blocks: Side blocks and the top layer.
- Screws.

Packing the robot for transportation

To pack the robot for transportation:

1. Shut down the robot. See section .
2. Turn the battery disconnect switch to position **OFF** (the two yellow indicators pointing to off).

Repeat the steps in section Getting started on page 15 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 previous page. 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.

7. Applications

You can install top modules on top of MiR100 for specific applications. For more information about top modules, go to the following page:

http://www.mobile-industrial-robots.com/en/mir-tradeforum/

For instructions on how to mount top modules and accessories, refer to the application manuals at www.mir-robots.com or contact your distributor.

7.1. Mounting a top module

Top modules must be fastened using the self-tightening conically shaped mooring holes in each corner of the robot and should be mounted with a tightening torque of 47 Nm.

Top modules are fastened through the mooring holes in the top cover.

CAUTION

Certain top modules may require the installation of an extra emergency stop button. Perform risk assessment according to standard ISO 12100.

CAUTION

Certain top modules may lead to new hazards and/or increased risks which cannot be eliminated or reduced by the risk reduction measures applied by Mobile Industrial Robots. Perform risk assessment according to standard ISO 12100.

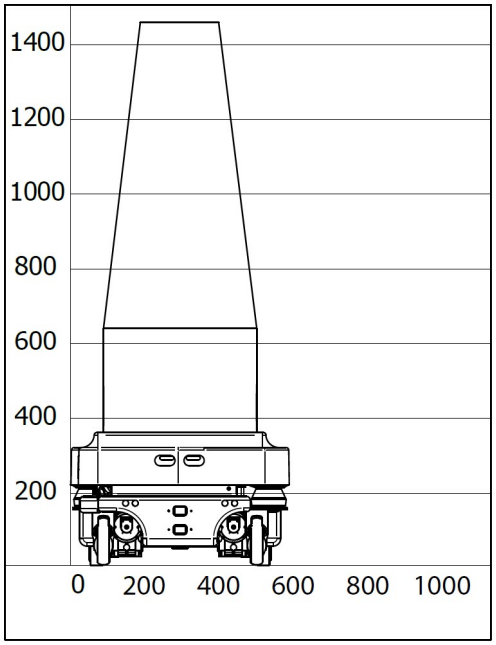
CAUTION

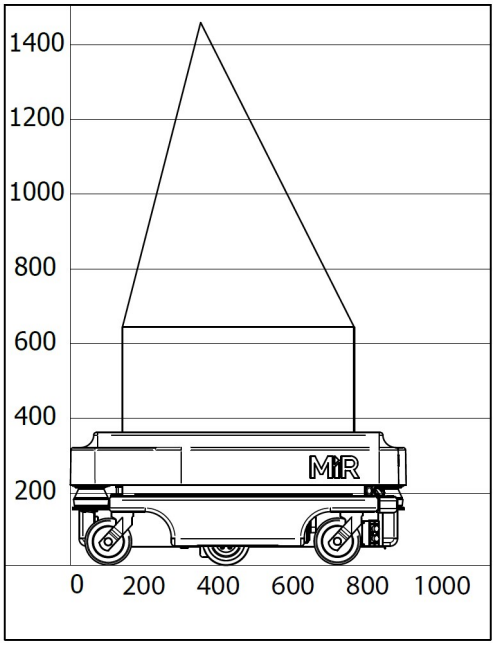
Stay within the specifications for weight and the payload's center of gravity, see Payload specifications on page 50.

8. Payload specifications

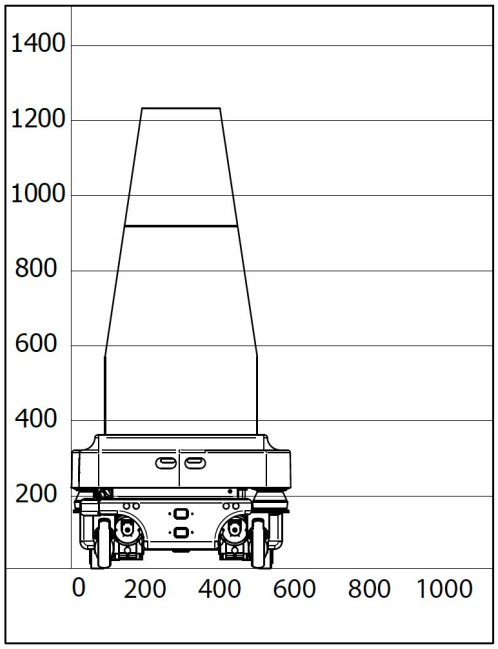
The following drawings illustrate the center of mass (CoM) specifications for safe operation at different payloads.

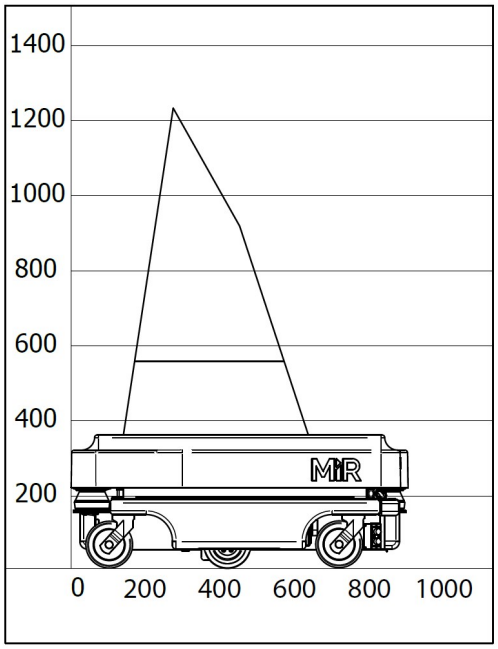
Payload: 25 kg



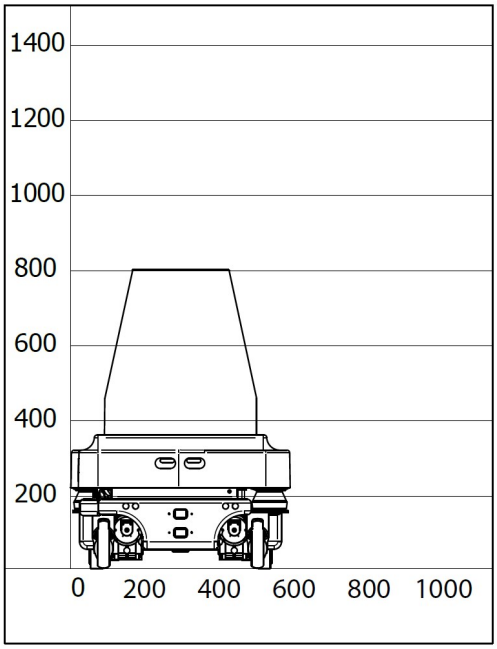


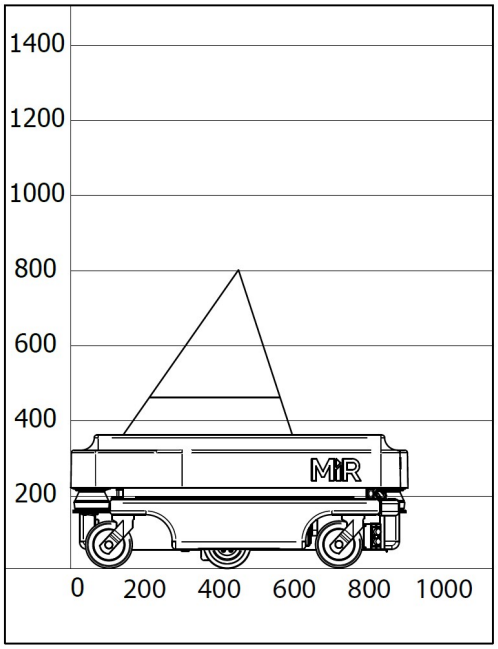
Payload: 50 kg



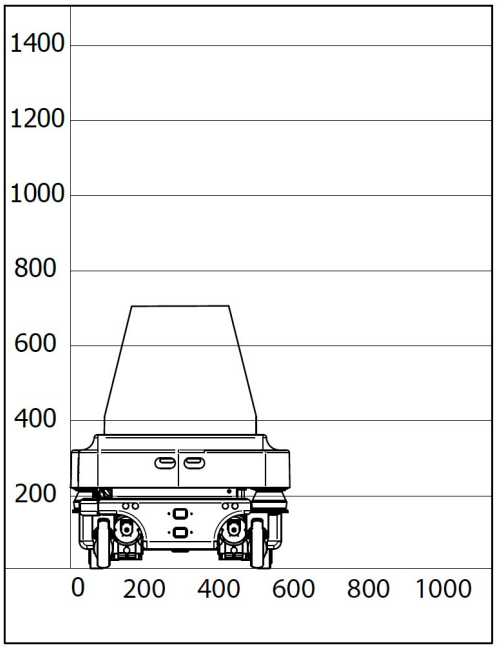


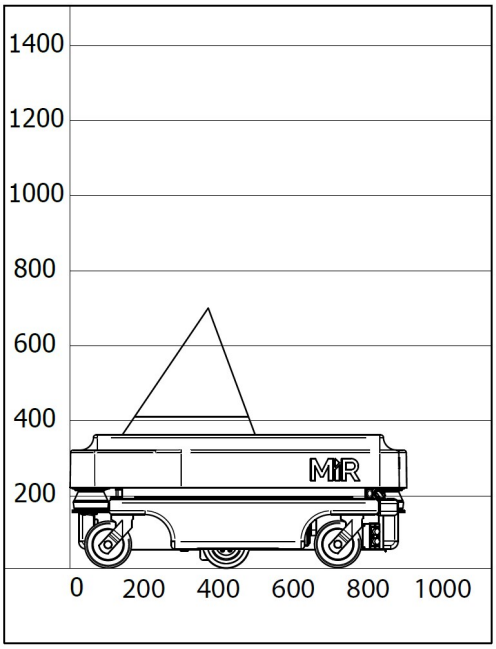
Payload: 75 kg





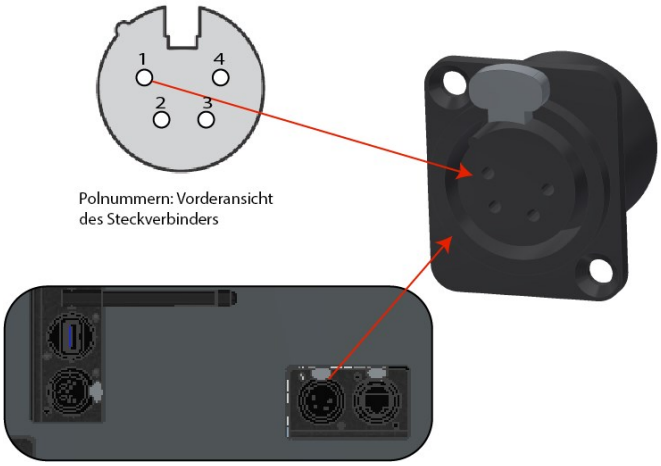
Payload: 100 kg





9. Interface specifications

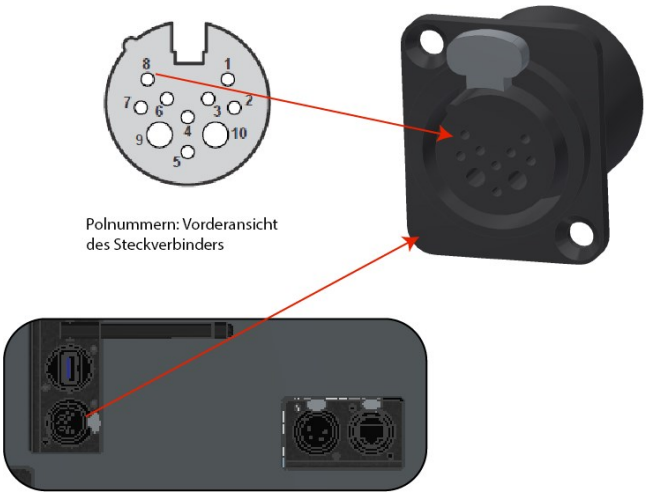
9.1. Application interface



Pin number	Voltage	Max. current	Description
1	Battery voltage (24 V)	3A	Starts with the robot.
2	Battery voltage (24 V)	3A	Starts with the robot.
3	Battery voltage (24 V)	10A	Stops by emergency stop.
4	GND	10A	Ground.

Application interface

9.2. Emergency stop



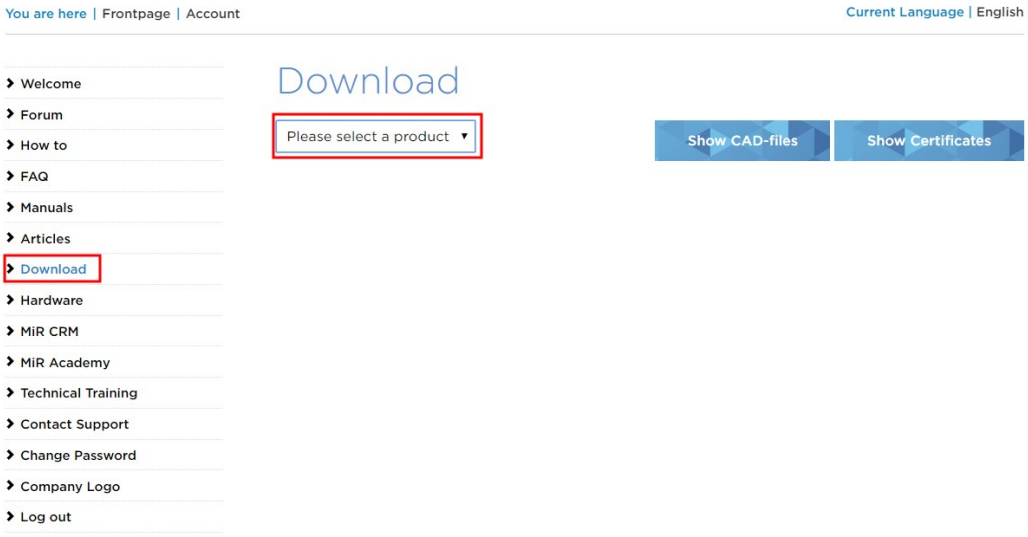
Pin number	Signal name	Description
1	DIN 19	
2	DIN 14	
3	DIN 70	
4	Emergency stop, 1 GN	
5	Emergency stop, GN-WH/RD	
6	Reset button, BWN-WH	
7	SICK XTIO, Q3	For SICK scanner
8	I5	For SICK scanner
9	GND	To use with the 24V signal from pin 10
10	24V max. 1A	Can be used to connect small external unitsusing up to 1 amp. such as tablets and PLC interfaces. Must use the GND from pin 9.

Emergency stop interface

10. Updating MiR100 software

Follow the steps below to update MiR100 software:

1. Go to MiR Distributor site and sign in with your credentials at mirfleet.com.
2. Select **Download** and select MiR100 in the product drop down menu.



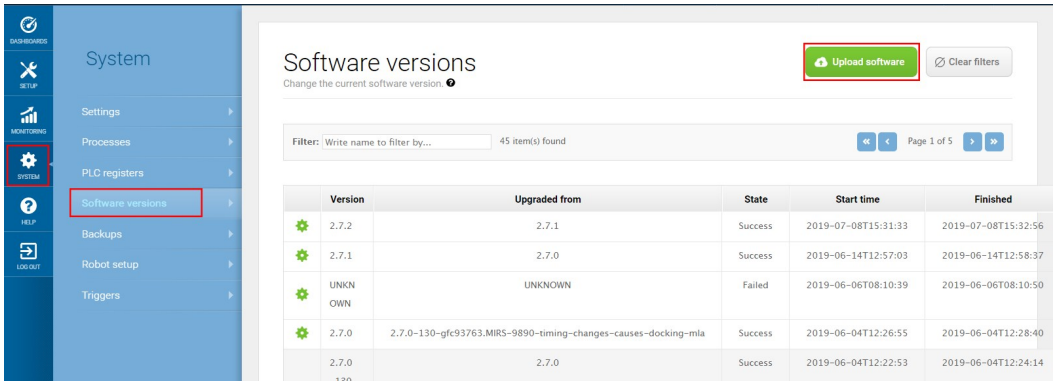
3. Download the latest version of MiR Software Robot / Hook / Fleet 2 version x.x.x.

Software

File	Last update	
MiR Software Robot / Hook / Fleet 2 version 2.7.2	8 Jul 2019	Download
Product release note 2.7.2.pdf	8 Jul 2019	Download
MiR Software Robot / Hook / Fleet 2 version 2.7.1	8 Jul 2019	Download
Product release note 2.7.1.pdf	8 Jul 2019	Download
MiR Software Robot / Hook / Fleet 2 version 2.7.0	8 Jul 2019	Download
Product release note SW 2.7.0.pdf	8 Jul 2019	Download
Known Product Issues note_2.7.x.pdf	15 Jul 2019	Download

4. Connect your computer to the WiFi of the robot you would like to update.
5. Access the robot's interface by going to the website mir.com in your preferred web browser and sign in.

6. Navigate to **System** > **Software versions** and select **Upload software**



7. Locate and select the downloaded software package.
8. It may take a few minutes for the package to successfully upload.

NOTICE

When updating MiR100 with an attached MiRHook 100, the Hook software must be updated first to ensure that the robot is compatible with the hook when uploading the software.