# MiR200™

with MiR Robot Interface 2.0

# User Guide

en

MOBILE INDUSTRIAL ROBOTS

11/2018 v1.2

## Copyright and disclaimer



Contact the manufacturer:
**Mobile Industrial Robots**
Emil Neckelmanns Vej 15F
DK-5220 Odense SØ

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

CVR: 35251235

MOBILE INDUSTRIAL ROBOTS

For more material,
go to our website

# Table of contents

# 1 About this manual

## 1.1 Overview

This User Guide contains all essential information about how to start up and operate a MiR200 robot. It also includes necessary information about safe handling of the robot, technical specifications, troubleshooting and guidelines for proper maintenance of the robot. The User Guide is intended for Mobile Industrial Robots' distributors as well as end users responsible for the daily operation of the MiR200 robot.

## 1.2 Document history

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

| Doc version | Release date | Description | SW rel | HW rel |
|---|---|---|---|---|
| 1.0 | 2017-11-24 | First edition | 2.0 | 1.0 |
| 1.1 | 2018-08-17 | • Updated for Hardware release 1.2<br>• Updates and improvements throughout manual | 2.2.0 and higher | 1.2 |
| 1.2 | 2018-11-28 | • Updated for Hardware release 2.0<br>• Updates and improvements throughout the manual | 2.3.0 and higher | 2.0 |

## 1.3 Where to find more information

At mobile-industrial-robots.com, the following extra resources on MiR200 robots are available. To access the pages in the Distributor site, sign in with your distributor account at http://www.mobile-industrial-robots.com/en/account.

- Distributor site > Downloads
  http://www.mobile-industrial-robots.com/en/account/download/
  The section contains the following resources:
  - MiR200 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 Operating guide
    The operating guide that describes how to set up MiRCharge and configure the MiR200 robot for automatic battery charging at the charging station.
  - MiR Robot Interface 2.0 Reference Guide
    The reference that describes the elements of the MiR robot interface. Available in multiple languages.
  - MiR200 REST API reference.
    The REST API reference for the robot.
  - CAD drawings.
    Click Show CAD-files to see the list of available CAD drawings.

- Certificates.
  Click 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 the robot.

MiR200 product page
http://www.mobile-industrial-robots.com/en/products
This page contains specifications, pictures, and brochures for the robot.

# 2 Safety

## 2.1 Overview

This manual contains notices you have to observe to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol. The notices shown below are graded by signal words to indicate degree of danger.

## 2.2 Safety concept

| | |
|---|---|
| **DANGER!** | Indicates an immanently hazardous situation that **will** result in death or severe personal injury if proper precautions are not taken. |

| | |
|---|---|
| **WARNING!** | Indicates a potentially hazardous situation that **could** result in death or severe personal injury if proper precautions are not taken. |

| | |
|---|---|
| **CAUTION!** | Indicates a situation that **could** result in minor personal injury or damage to the equipment if proper precautions are not taken. |

| | |
|---|---|
| **NOTICE!** | Indicates a situation that **could** result in property damage if proper precautions are not taken. |

## 2.3 General safety instructions

This section contains general safety notes. Some safety notes are repeated or further specified in other sections of the manual and further safety notes are present throughout the manual.

### 2.3.1 Warning notes

| | |
|---|---|
| **WARNING!** | • **Ensure proper mounting of loads during transport**<br>Danger of personal injury from overturning robot or falling load.<br><br>All accessories and loads mounted on top of the robot should be fastened correctly and meet specifications. See Technical specifications on our website.<br><br>• **Avoid leakage of fluid during transport**<br>Danger of personal injury from leaking fluid.<br><br>Make sure that loads containing fluids do not leak during transport.<br><br>• **Use only the original charger**<br>Danger of personal injury and/or damage to the robot.<br><br>Use of other charger than the one supplied by the manufacturer can ruin the battery and may cause fire.<br><br>• **Update maps to avoid hazards on the route**<br>Danger of personal injury and/or damage to the robot.<br><br>Make sure to update maps to avoid driving in hazardous zones such as close to stairways.<br><br>• **Do not drive the robot irresponsibly**<br>Danger of personal injury and/or damage to the robot.<br><br>The robot should not be driven over edges or in other ways operated irresponsibly. |

### 2.3.2 Caution notes

| | |
|---|---|
| **CAUTION!** | • **Do not use the robot to transport people**<br>Risk of personal injury and/or damage to the robot.<br><br>The robot should never be used to transport people. This will revoke compliance with the standard EN 1525 Safety for unmanned trucks.<br><br>• **Avoid gradients above 5% on the route**<br>Risk of personal injury and/or damage to the robot.<br><br>The surface grade (ramps etc.) cannot exceed 5% as this may cause the robot to skid.<br><br>• **Only drive on even and dry surface**<br>Risk of personal injury and/or damage to the robot.<br><br>Wet and uneven surfaces may cause the robot to skid.<br><br>• **Do not overload the robot**<br>Risk of personal injury and/or damage to the robot.<br><br>The maximum payload for the load on top of the robot is 200 kg 440 lbs kg. If exceeded, it may cause overturning, falling load and damage to the robot. See also Payload specifications on page 31.<br><br>• **Do not use robot on board ships**<br>Risk of personal injury and/or damage to the robot.<br><br>Unstable surface caused by moving vessel may cause the robot to skid.<br><br>• **Turn off the main power immediately after removal of the top cover**<br>Risk of personal injury and/or damage to the robot.<br><br>Turn off main power relay to avoid short circuit. See Product presentation on page 19 |

### 2.3.3 Notices

| | |
|---|---|
| **NOTICE!** | • **Indoor use only**<br>Risk of damage to the robot.<br><br>The robot is made for indoor use only and should never be used outdoor.<br><br>• **Avoid small objects on the floor in the robot's area**<br>Risk of property damage and/or minor damage to the robot.<br><br>The robot cannot detect obstacles lower than 50 mm and may overrun smaller objects.<br><br>• **Remove unwanted objects from the floor in the robot's area**<br>Risk of inefficient execution of orders.<br><br>The robot will go around objects that are not parts of the map, but this may influence the efficiency of the planned route.<br><br>• **Avoid overheating of components**<br>Risk of damage to the robot or robot components.<br><br>The ambient temperature in the robot's environment must not exceed 50° C - 122° F.<br><br>• **Avoid exposure of the robot to excessively humid or dry environment**<br>Risk of damage to the robot or robot components.<br><br>The ambient humidity in the robot's environment must be within the specifications, see Technical specifications on our website. |

## 2.4 Lithium battery

Lithium batteries are primary power sources with high energy content designed to represent the highest possible degree of safety.

| | |
|---|---|
| **WARNING!** | **Potential hazard**<br><br>Lithium battery packs may get hot, explode or ignite and cause serious injury if they are abused electrically or mechanically.<br><br>Observe the following precautions handling and using lithium batteries:<br><br>• Shut off the battery when not in use.<br><br>• Do not short-circuit, recharge or connect with false polarity.<br><br>• Do not expose to temperature beyond the specified temperature range or incinerate the battery.<br><br>• 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.<br><br>• Do not allow the battery to get wet.<br><br>• 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.<br><br>• Use only the original charger and always follow the instructions from the battery manufacturer. |

## 2.5 Safety circuit

If a person or other moving object enters the safety zones of the robot where the planner due to response time, errors etc. does not respond, the safety circuit will force the robot into emergency stop, and the robot stops immediately. When the person or object is out of the safety zone again, the robot will automatically reset the emergency stop.

MiR200™ is designed with total redundant electrical safety circuit including Sick Safety components. If any internal errors in the safety circuit occur, the robot will immediately go into emergency stop which means that all moving parts will be voltage free by mechanical disconnection. Only when the redundancy is provided, it is possible to reset the emergency stop and continue.

# 3 Certifications

## 3.1 Overview

This chapter presents certificates and declarations applying to the robot.

Copies of the CE declarations of conformity in various languages and 3rd party certificates are posted and can be downloaded from the Distributor login site: (http://www.mir-robots.com/downloads/certificates).

## 3.2 Certificates

The MIR200 has been tested and awarded the following certificates by a recognized test institute.

**Cleanroom** The MiR200 has been assessed and rated suited for operation in cleanrooms fulfilling the specifications of Air Cleanliness Classes according to ISO 14644-1.

**Electrical resistance** The MiR200 has been examined and awarded a certificate for its electrical resistance in accordance with DIN EN 61340-2 -3.

Signed copies of the certificates are found in the appendix Certificates on page 40

## 3.3 Applied standards

The MiR200™ is certified and fulfills all relevant provisions according to the EU directives or regulations listed below.

The European directives are available on the official website: https://eur-lex.europa.eu

| Ref. no. | Title |
|---|---|
| 2006/42/EC | Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast) (1). |

Reference to the harmonized standards used, as referred to in Article 7(2):

| Ref. no. | Title |
|---|---|
| EN 60204-1:2006+A1:2009 | Safety of machinery – Electrical equipment of machines – Part 1: General requirements |
| EN ISO 12100:2010 | Safety of machinery – General principles for design – Risk assessment and risk reduction (ISO 12100:2010) |
| EN ISO 13849-1:2015 | Safety of machinery – Safety related parts of control systems – Part 1: General principles for design (ISO 13849-1:2015) |
| EN ISO 13849-2:2012 | Safety of machinery – Safety related parts of control systems – Part 2: Validation (ISO 13849-2:2012) |
| EN ISO 13850:2015 | Safety of machinery – Emergency stop function – Principles for design (ISO 13850:2015) |

| Ref. no. | Title |
|---|---|
| EN 1175-1:1998+A1:2010 | Safety of industrial trucks – Electrical requirements – Part 1: General requirements for battery powered trucks |

Reference of the other technical standards and specifications used:

| Ref. no. | Title |
|---|---|
| EN 1525:1997-09 | Safety of industrial trucks – Driverless trucks and their systems |

See also signed copy of Declaration of conformity in Appendix C Declaration of conformity on page 42.

# 4 Getting started

## 4.1 In the box


Figure 4.1. The shipment

1. The robot

2 MiR200 Kit

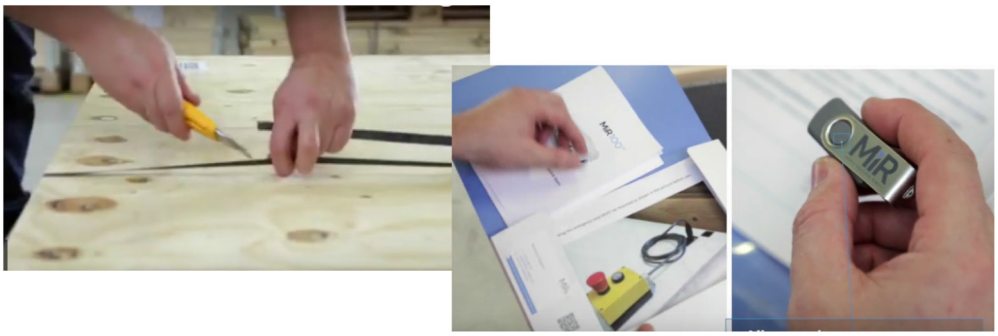
- Emergency stop box, external antenna and 4 pcs. M10x40 bolts
- Two charging cables, one for 110 V and one for 220 V
- One external charger, 24VDC, 10A

3. MiR folder containing:

- Printed documents: MiR200 Quick Start in English and local language if applicable, Passwords sheet, CE declaration of conformity, mounting instructions for emergency stop
- USB flash drive: Getting started video, MiR200™ User Guide, CE declaration of conformity, other manuals

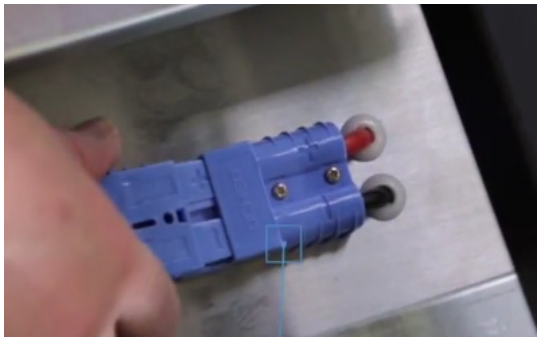
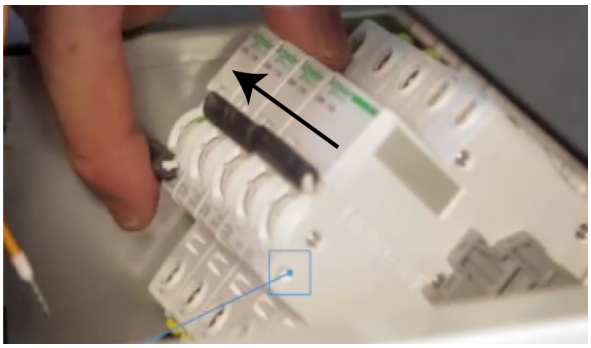
## 4.2 Unpacking the MiR200™

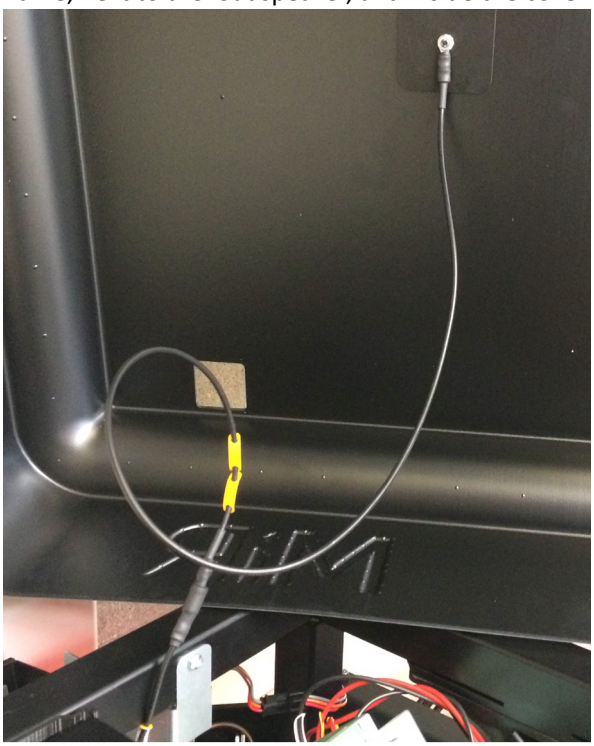
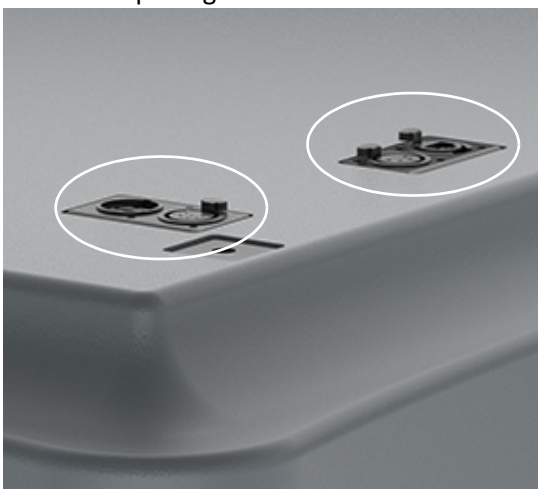
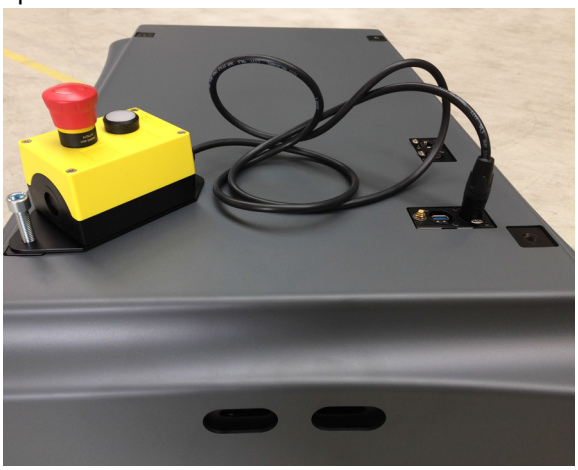
### 4.2.1 Unboxing

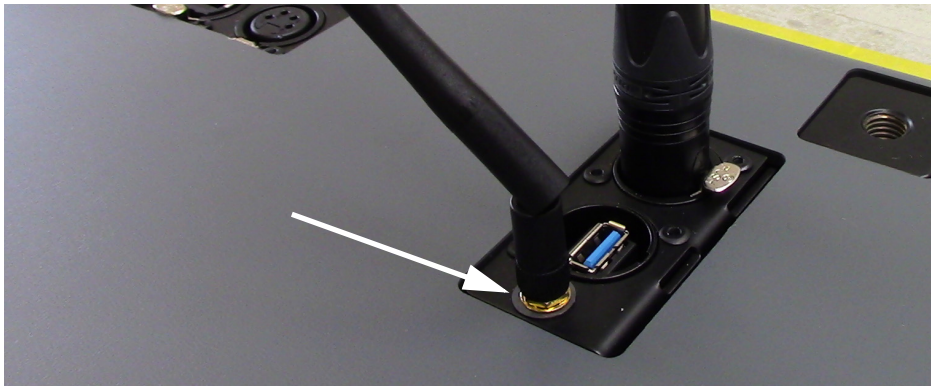
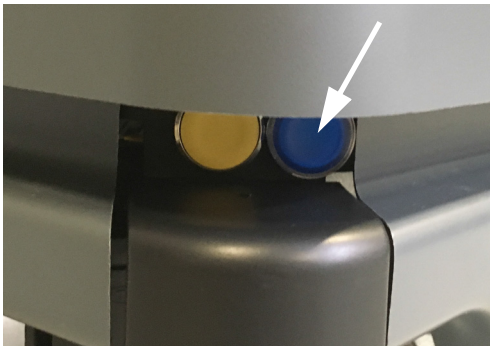
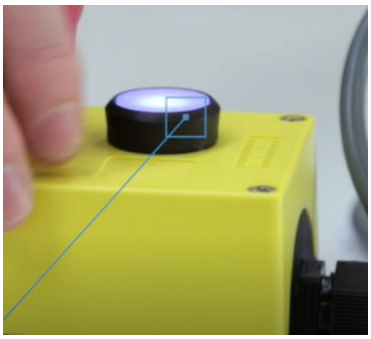
| Step | Action |
|---|---|
| 1 | Remove pallet lid and take out the box with the MiR200 Kit.<br>  |
| 2 | Remove the top foam, foam blocks on the sides and the pallet frames.<br>  |
| 3 | Place the pallet cover as a ramp at the robot's rear end.<br>  <br>**NOTICE!** Keep the packaging for any future transportation of the robot. |

### 4.2.2 Powering up

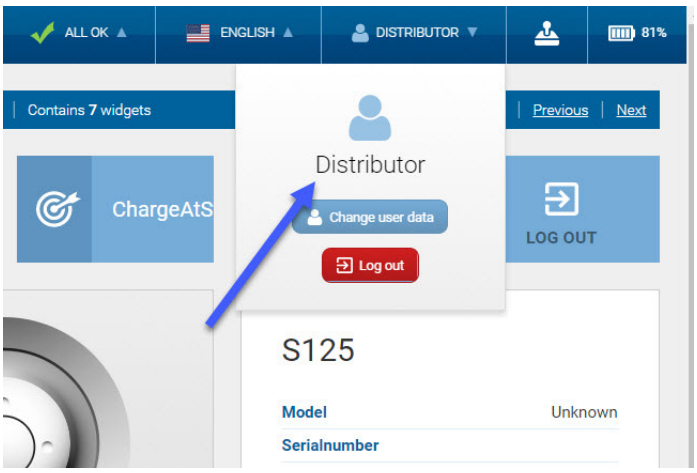
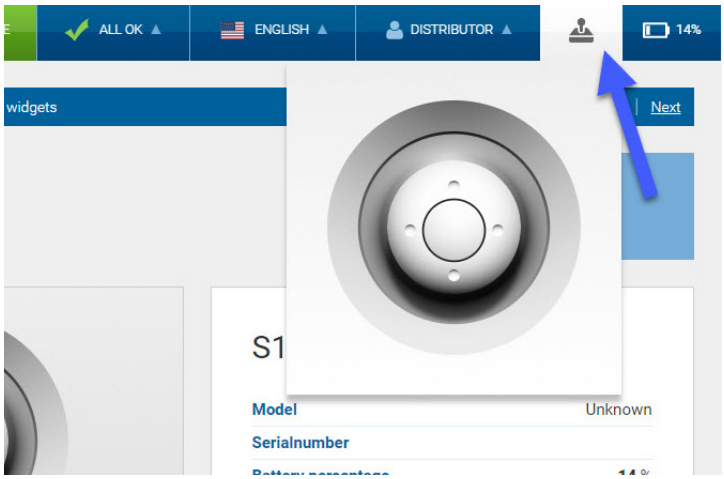
Follow these steps to power up the MiR200™

| Step | Action | |
|---|---|---|
| 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.<br><br>The second cable is for an extra battery if installed.<br><br>  | Switch on the four relays placed in the corner by the front laser scanner. Start with 32A main power, i.e. from the outer frame in.<br><br>  |

| Step | Action | |
|---|---|---|
| 3 | Before putting the cover back on:<br><br>Make sure that the battery disconnect switch is on (the two yellow indicators pointing to On).<br>  | Connect the two ESD cables attached to the robot frame, next to the loudspeaker, and inside the cover.<br>  |
| 4 | Carefully fit the cover correctly over the connector openings.<br>  | Mount and connect the emergency stop box on top of the robot cover.<br>  |
| | **NOTICE!** If a top module is to be mounted on top of the robot, the emergency stop must be moved and placed in a position where it is easy to reach. See Placing the top module on page 26. | |

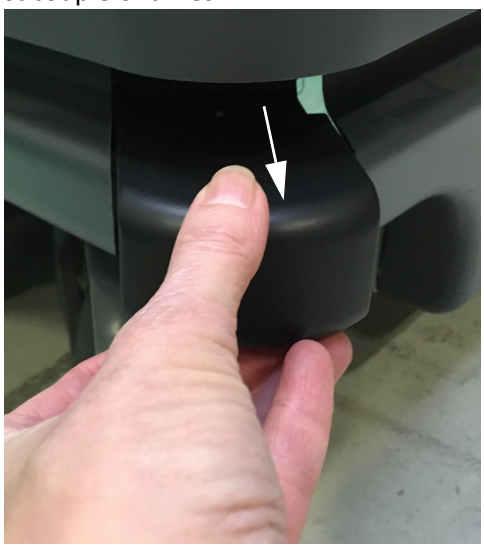
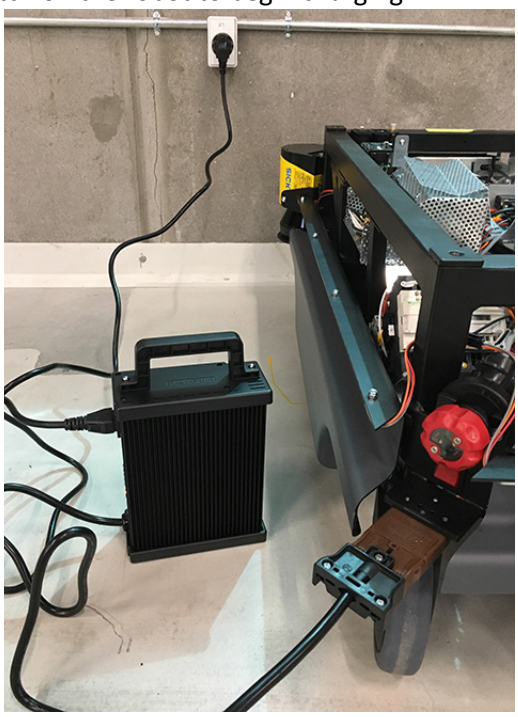
| Step | Action | |
|---|---|---|
| 5 | Connect the antenna to the connector on top of the robot cover. Remove the plastic cap from the connector before fixing the antenna.<br>  <br>Note The antenna can be lowered and rotated in all directions to fit under a top module. | |
| 6 | Push the blue power button in the corner to turn on the robot.<br>  <br>The robot lights up with a yellow running light for a short moment, then enters emergency stop mode indicated by a constant red light. | Press the reset button on the emergency stop when it has lit up.<br>  <br>The robot light now switches to yellow constant light, indicating that the robot is paused and ready to operate. |

## 4.3 Getting connected

| Step | Action | |
|---|---|---|
| 1 | On a PC, tablet or smartphone, go to the WiFi menu, find the name of your robot and connect to it.<br><br>Open a browser and enter mir.com. Log in to the MiR Robot<br><br>Note: Access name and passwords required to log on to the robot's WiFi and the robot interface are found on the enclosed paper slip, see **In the box on page 10**. |  |
| 2 | When logged in, press **Manual control** on the joystick icon to put the robot in manual driving mode, and use the joystick to drive the robot down the ramp<br><br>Note: The robot light switches to blue, indicating that the robot is in manual mode and can be controlled by the joystick. |  |
| 3 | Note: It is recommended to reverse the robot down the ramp. |  |

## 4.4 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:

| Step | Action | |
|---|---|---|
| 1 | Remove the rear corner by pulling it towards you. You may have to apply a bit of force the first couple of times.<br>  <br>NOTICE! To avoid fast discharging, it is recommended to turn off the robot while charging. | Then 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.<br>  <br>NOTICE! Use only the original charging cable. |
| 2 | After a maximum of four and a half hours, the robot is fully charged. The robot emits a green light when the battery is full. | |
| 3 | Turn off the rocker switch and disconnect the charging cable from the robot. Slide the corner cover back on.<br>NOTICE! The robot detects both cable and activated charging-button and will go into emergency stop in both cases. | |

## 4.5 Testing the robot

Before using the robot, you are recommended to check that all components and processes inside the robot work as intended.

1. Log on to the MiR Robot interface, see **Getting connected on page 15**.
2. Go to **Monitoring** > **Hardware health**.
3. When all components in a group are OK, it is marked with a green dot**.** If one or more components in a group are not in perfect condition, the group will be marked with a yellow or red dot and you can expand the group by clicking on the green arrow and see which components are not functioning correctly and why.

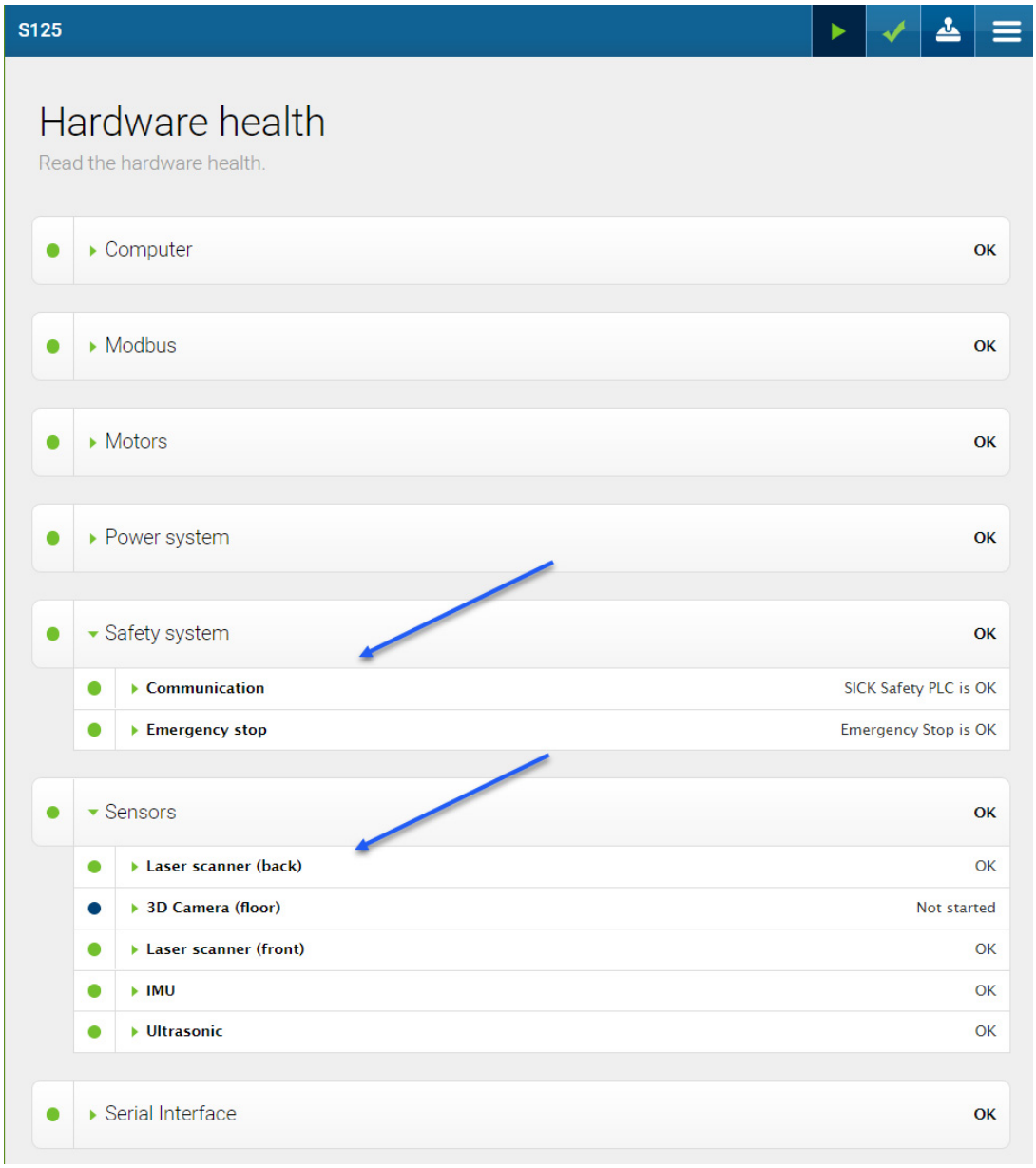
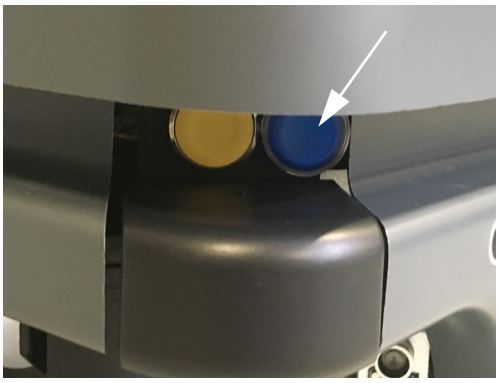



Figure 4.1. Extract of **Hardware Health** menu. Message: OK indicates that the components of the group are OK.

## 4.6 Shutting down the robot

Follow these steps to shut down the robot correctly.

| Step | Action | |
|---|---|---|
| 1 | Bring the robot to a halt. Then push the blue on/off switch to turn off the robot. The light switches to yellow fading light during shut-down.  | NOTICE! Wait for the light on the robot to turn off. This means that there is no more power going to the robot. |

Note

If shutting the robot down for transportation or service/repair, the battery disconnect switch must be turned off, see Packing the robot for transportation on page 30.

# 5 Product presentation

## 5.1 About the MiR200™

The MiR200™ is an autonomous mobile robot that can transport materials internally within production facilities, hospitals, warehouses, and a host of other industrial locations.

The user provides the destination of product delivery via a web-based user interface. MiR200™ can be set up to run a fixed route, be called on demand or perform more complex operations (missions). It can also operate as part of a fleet of MiR robots, centrally controlled from a single web based user interface. It is recommended to use the MiRFleet application when two or more robots operate on the same site.

The MiR200™ operates via a map which can be created the first time the robot is used. While operating, the safety scanners ensure that the robot avoids obstacles (people, furniture) that are not mapped. The internal map contains defined locations (office, product delivery, production hall etc.) that are used for logistical planning.

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

The robot is controlled from a web-based user interface, which is accessed via a browser on a PC, smartphone or tablet. Each robot has its own network. See Getting connected on page 15.

## 5.2 Identification label

The identification label of the MiR200™ is placed on back of the battery box.


Figure 5.1. Example of MiR200™ CE marking and identification label

- CE — Mobile Industrial Robots ApS declares that the MiR200™ meets the requirements of the applicable EC directives. See Declaration of conformity on page 42
- 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 S200.
- MiR200 2.0 — Product name and hardware version

## 5.3 MiR200™ Outer parts

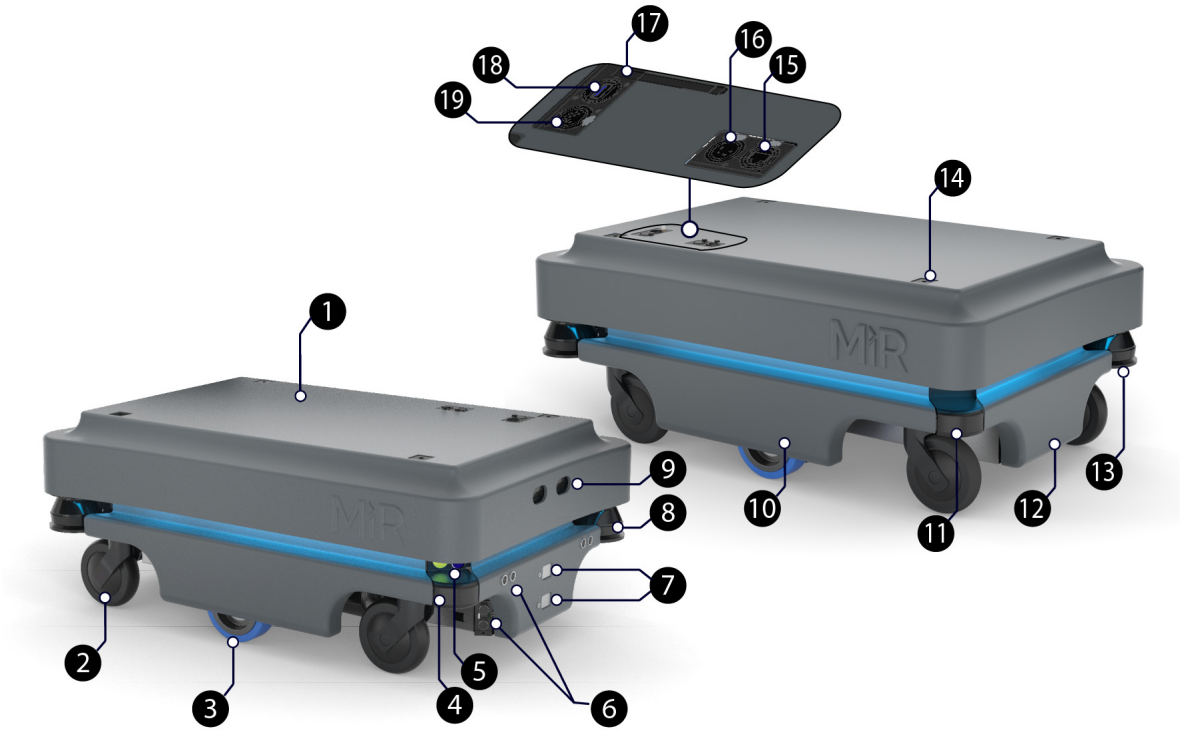



Figure 5.2. MiR200™ Outer parts

1. Top cover
2. Caster wheel - all four corner wheels
3. Drive wheel - differential control
4. Behind removable corner cover: HDMI port and USB port “service port” - connects to the robot’s PC
5. Scanner reset button (yellow) and on/off button (blue)
6. Ultrasonic sensors for detection of transparent objects (feature in progress).
7. Pad connectors - for connection to charging poles on MiRCharge charging station
8. Front laser scanner
9. 3D depth camera
10. Side cover
11. Behind removable rear corner cover: Charging port with switch
12. Rear cover
13. Rear laser scanner
14. Mooring hole - one in each corner for fixation of top modules
15. RJ45 Ethernet connection
16. Application interface - for connection to hardware such as hook - see also Appendix C, Connectors - pinout on page 38
17. Antenna socket
18. USB port “service port” - connects to the robot’s PC
19. Emergency stop interface with added options for connection to small units and I5 input on SICK scanners - see also Appendix C, Connectors - pinout on page 38

## 5.4 MiR200™ Inner parts

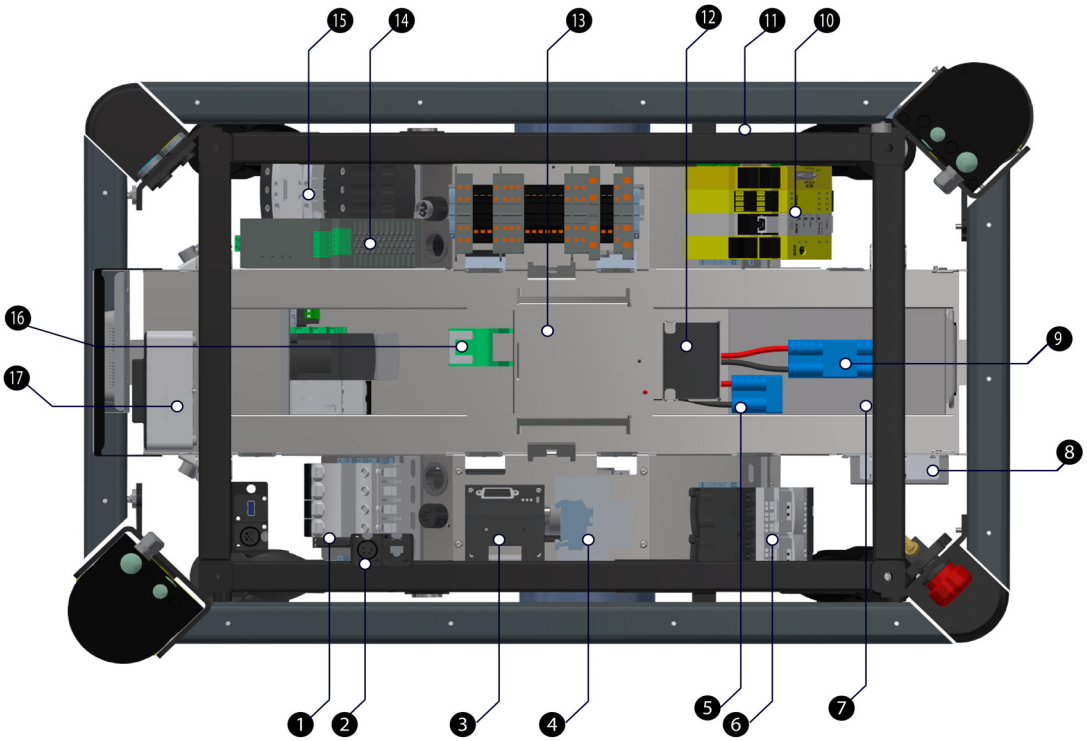



Figure 5.3. MiR200™ Inner parts

1. Breaker - automatic fuse between battery and components

2. Solid state relay - releases the latching relay (pos. 16) when the robot is shutting down.

3. Motor controller - manages the two motor drives

4. Brake relay - short circuits motor for faster braking

5. Battery connector for extra battery

6. Redundant power for motor controller relays (controlled by SICK)

7. CAN bus connection for Battery Management System, logging data e.g. no of charge cycles. See MiR Robot Interface 2.0 reference guide

8. Router - local network, 2.4 and 5 GHz

9. Battery with connector - main power to the robot

10. SICK safety PLC

11. Optocoupler - emergency stop signal to motor controller

12. Loudspeaker

13. MiR board - interface board for gyroscope, accelerometer, ultrasound, light, on/off circuit and CAN bus communication

14. 24 V power supply - secures stable voltage for PC and PLC

15. Latching relay - activates the 24V power supply turning on the robot

16. Transient protection - provides circuit protection for the power supplies by absorbing voltage spikes from battery or top mounted applications

17. NUC PC

## 5.5 Sensor systems

The MiR200™ has a number of internal and external safety sensors to secure safe operation among people and equipment.

### External sensors

External sensors (see alsoMiR200™ Outer parts on page 20)

| | |
|---|---|
| • 3D camera Intel RealSense™ | Detection of objects in front of robot:<br>• 0-1950 mm ahead<br>• 50-995 mm above floor |
| • SICK safety laser scanners S300 (front and back) | 360° visual protection |
| • Ultrasonic scanners (4 pcs.) | Feature in progress for detection of transparent objects |

Note

The camera records 3D point cloud data only; it is not filming.

The two laser scanners located diagonally in the front and rear corners provide 360° protection up to 1 meter around the robot.

The range of the safety zones is dynamic and changes with the speed of the robot.

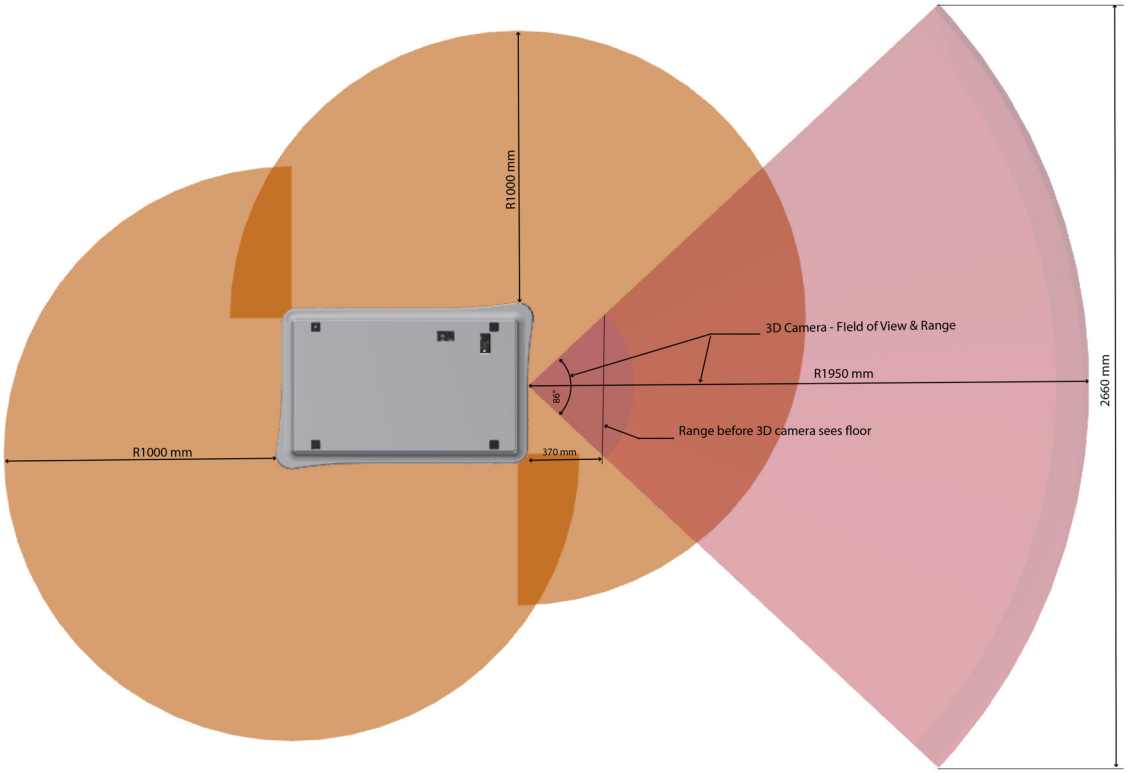



Figure 5.4. 3D camera and laser scanners fields of view provide safety all around the robot

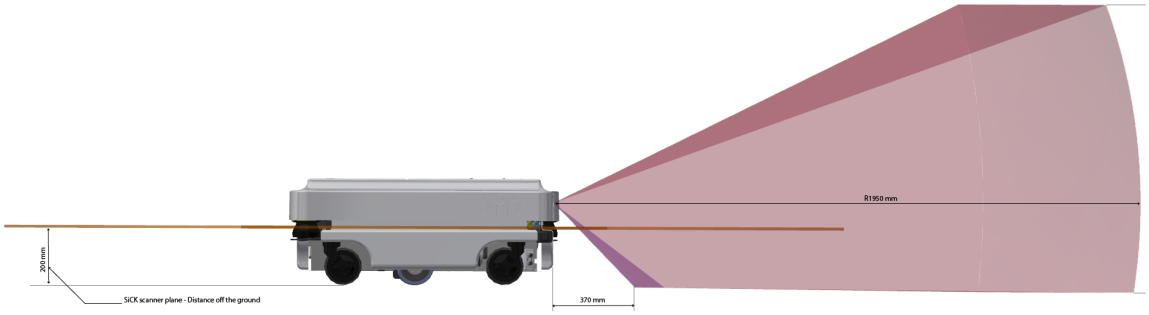



Figure 5.5. The laser scanners detect objects 200 mm above ground and the 3D camera detects objects from ground level and up to 995 mm above ground

**Safety zones**

The MiR Safety zones change depending on the speed of the robot.

The speed regulations are as follows for the front scanner:

| Zone name | Speed minimum | Speed maximum | Zone size |
|---|---|---|---|
| Front Field Set 1 | -1.4 m/s | 0.1 m/s | 5 cm |
| Front Field Set 2 | 0.11 m/s | 0.4 m/s | 18 cm |
| Front Field Set 3 | 0.41 m/s | 0.68 m/s | 33 cm |
| Front Field Set 4 | 0.69 m/s | 1.1 m/s | 48 cm |
| Front Field Set 5 | 1.11 m/s | 2.0 m/s | 76 cm |

The speed regulations are as follows for the rear scanner:

| Zone name | Speed minimum | Speed maximum | Zone size |
|---|---|---|---|
| Rear Field Set 1 | -0.1 m/s | 1.8 m/s | 5 cm |
| Rear Field Set 2 | -0.15 m/s | -0.2 m/s | 14 cm |
| Rear Field Set 3 | -0.21 m/s | -0.4 m/s | 18 cm |
| Rear Field Set 4 | -0.41 m/s | -1.5 m/s | 28 cm |

The robot uses laser scanner data up to 2.5 m away from the robot for dynamic object identification. It will actively try to avoid objects within 2.5 m. The scanners will only see objects at 0.2 m height. No more or less. The scanners can be obstructed by direct sunlight.

**Internal sensors**

Internal sensors (see also MiR200™ Inner parts on page 21)

- 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 — Detection of wheel movements

Both gyroscope and accelerometer are placed on the MiR board

## 5.6 Light indicators

The light indicators on the MiR200™ indicate current operational state. Colors may be adapted to individual user needs, but the robot is delivered with the following setup.

| | |
|---|---|
| Red | Emergency stop |
| Green | Waiting for job |
| Cyan | Drives to destination |
| Purple | Goal / Path blocked |
| White | Planning / Calculating |
| Dark Orange | 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 (blinking) | Mapping |
| Rainbow | Charging: Charging station or cable |
| White (blinking) | Prompt user / Waiting for user's response |

Figure 5.6. MiR200™ light indicators

## 5.7 Main features of the MiR200™

- **Driving in a populated workspace**
  The robot is designed to operate among people.
- **Overall route planning and local adjustments**
  The robot plans a general path to its target destinations. When the robot encounters obstacles which are not in the map (like people and objects), adjustments are made to the path.
- **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.
- **Planning of driving and receiving a package**
  The web-based user interface, accessed from a PC, tablet or smartphone, gives easy access to operation and monitoring of the robot.
- **Alert for 'lost'**
  If the robot enters a situation where it is unable to find a safe 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 he robot is slowed down when obstacles are detected in front of it.
- **Optimal surface operation**s
  The robot is made to run on a level, dry floor with a maximum incline of 5%. The 3D camera detects and avoids objects from 50 mm above floor level.
- **Internal map**
  The MiR200™ uses an internal map for route planning. 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.
- **MiRHook**
  A hook may be mounted on the MiR200™ enabling it to tow carts with a payload of up to 500 kg.

# 6 Applications

## 6.1 Overview

The MiR200™ can be equipped with a range of applications to suit the specific purpose the robot will be used for. Some are user-provided and others are purchased directly from Mobile Industrial Robots.

For instructions on how to mount an application, for example a top camera, please refer to the relevant application manual found on Mobile Industrial Robot's website or contact your distributor.

In the following, you can read the general rules for how to mount a top module.

## 6.2 Placing the top module

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

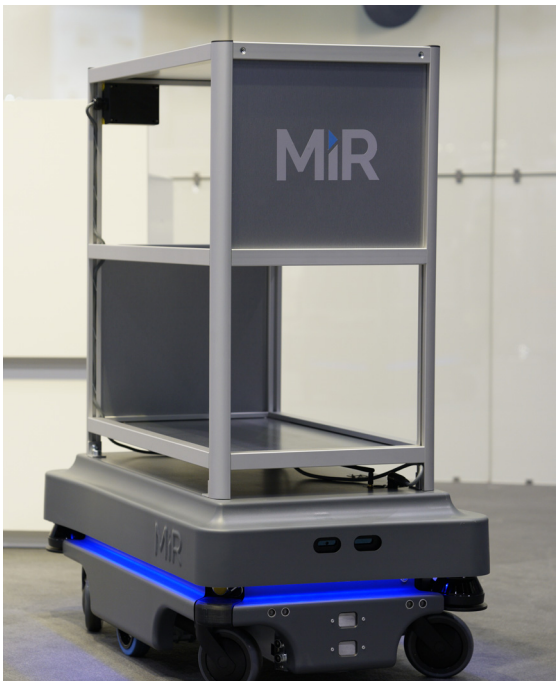



Figure 6.1. Top modules are fastened through the mooring holes in the top cover.

**CAUTION!** Before adding the top module, the emergency stop box must be removed and remounted on the top module in a position where it is easy to reach. The correct position must be assessed in each individual case taking into account potential risks. Requirements of the harmonized standard EN ISO 13850 should be followed.

**NOTICE!** Stay within the specifications for weight and the payload's center of gravity, see Payload specifications on page 31.

# 7 Maintenance

## 7.1 Overview

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

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

### 7.1.1 Regular checks and maintenance tasks

**Weekly** Once a week carry out the following maintenance tasks:

| Parts | Maintenance task |
|---|---|
| Robot cover and sides | Clean the robot on the outside with a damp cloth.<br>**NOTICE!** Do not use compressed air. |
| Laser scanners | Clean the optics covers of the scanners for optimum performance. Avoid aggressive or abrasive cleaning agents.<br>**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. Does the light show all the way around the robot. |

### 7.1.2 Regular checks and replacements

**NOTICE!**

Before starting replacement tasks that involve removal of the shield:

- Press the On/Off button to turn off the robot
- Push the battery switch button to remove power from the battery
- Remove the cover and unplug the ESD cable if applied, see Getting connected on page 15
- Turn off relays and unplug the battery, see Powering up on page 12

| Part | Maintenance | Interval |
|---|---|---|
| Robot cover | Check for cracks.<br><br>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 as needed. |
| Drive wheels (the two middle-wheels) | Check wheel surfaces for wear. | Check every six months and replace as needed.<br><br>**NOTICE!** The robot must be calibrated after replacement of the wheels. |
| Scanners | Check for visual defects, e.g. cracks and scratches | Replace as needed.<br><br>**NOTICE!** The robot must be calibrated after replacement of the scanners. |
| Emergency stop | To check that the emergency stop works, push down the red button and check that the emergency reset button lights up. | Every three to four month / according to EN/ISO 13850 Safety of machinery - Emergency stop function. |

# 8 Repacking for transport

## 8.1 Preparations

**Packaging** Use the original packaging when transporting the robot.

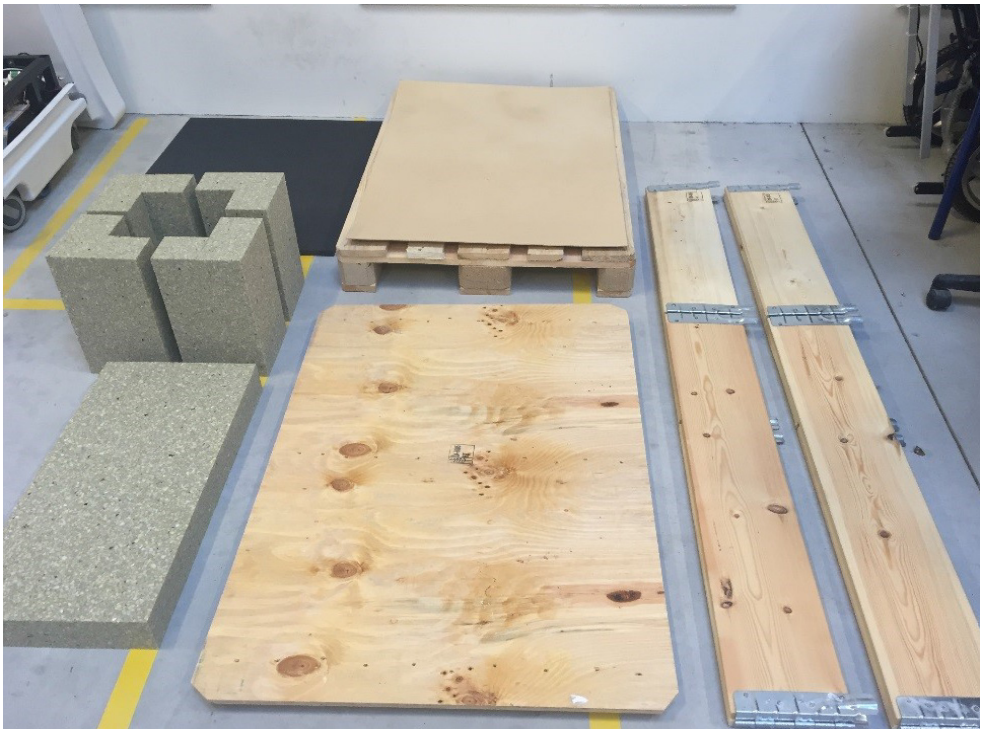


Figure 8.1. The original packing material consists of pallet bottom and top plates, pallet frames, foam blocks and foam top layer.

**Battery** The lithium battery is subject to transport regulations, see Caution below. If the robot is to be sent back for service and repair, the battery connector must be disconnected from the battery.

**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 observe these regulations. This may influence both transport time and costs.

Different regulations apply depending on the mode of transportation; land, sea or air. Contact your distributor for more information.

## 8.2 Packing the robot for transportation

Before packing the robot, it must be shut down as follows:

1. Bring the robot to a halt and push the blue power button to turn off the robot.
2. Turn off the battery disconnect switch (the two yellow indicators pointing to Off).

To pack the robot, reverse the steps of the unpacking procedure, see Unpacking the MiR200™ on page 11.

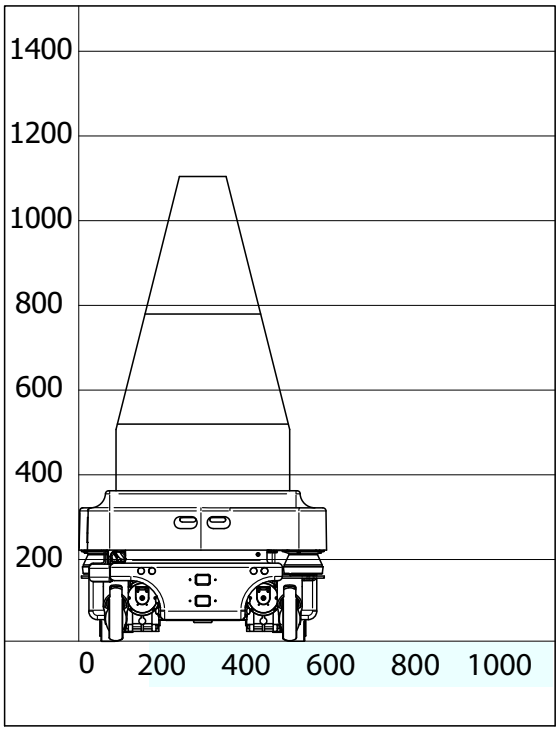
**NOTICE!** The robot must always be packed and transported in an upright position. Packing and transporting the robot in any other position will void the warranty.

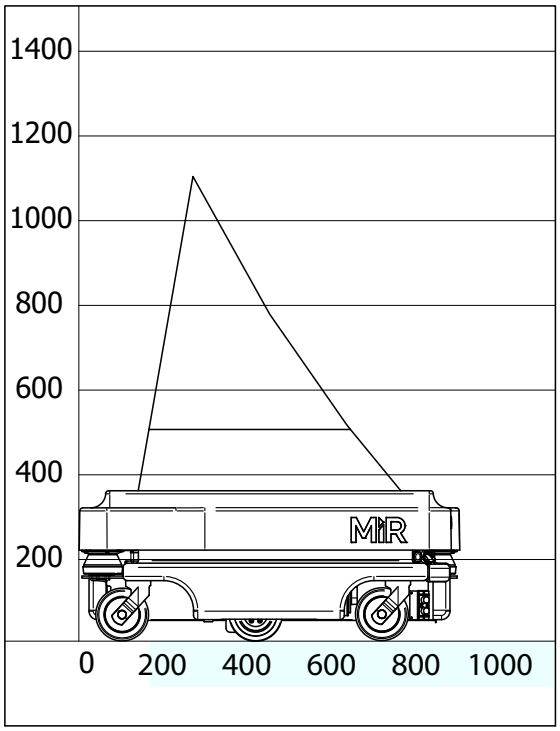
# A Payload specifications

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

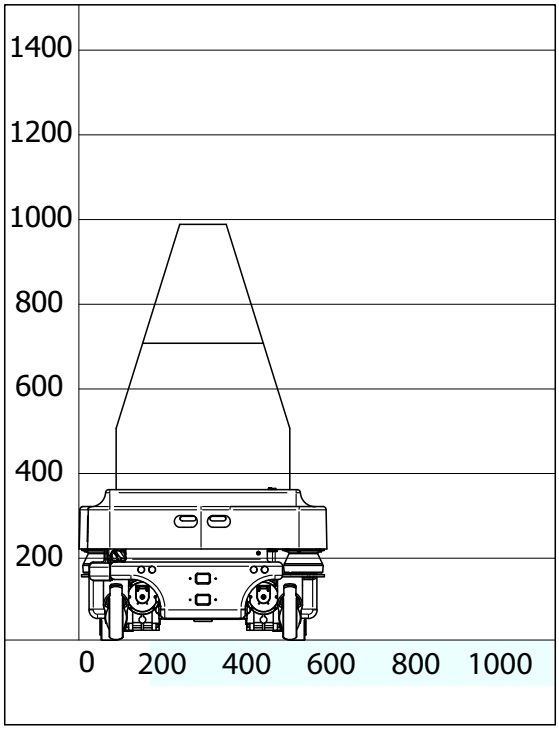
The specifications apply to payloads of:

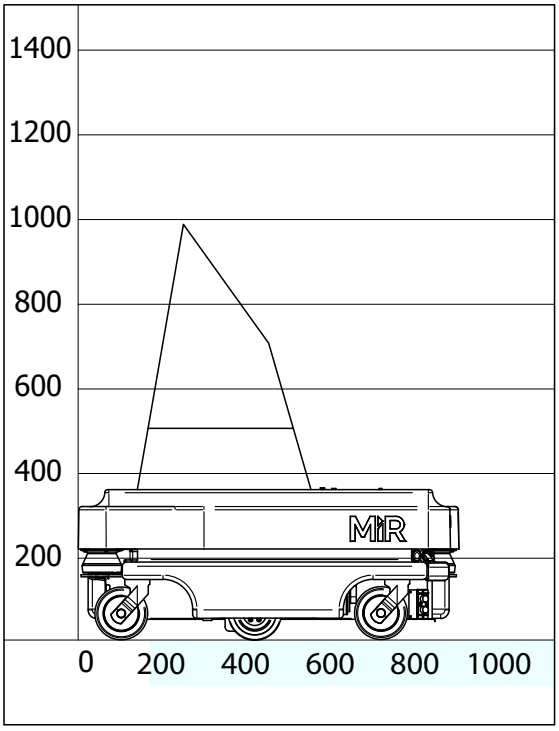
- 50 kg
- 75 kg
- 100 kg
- 125 kg
- 150 kg
- 175 kg
- 200 kg



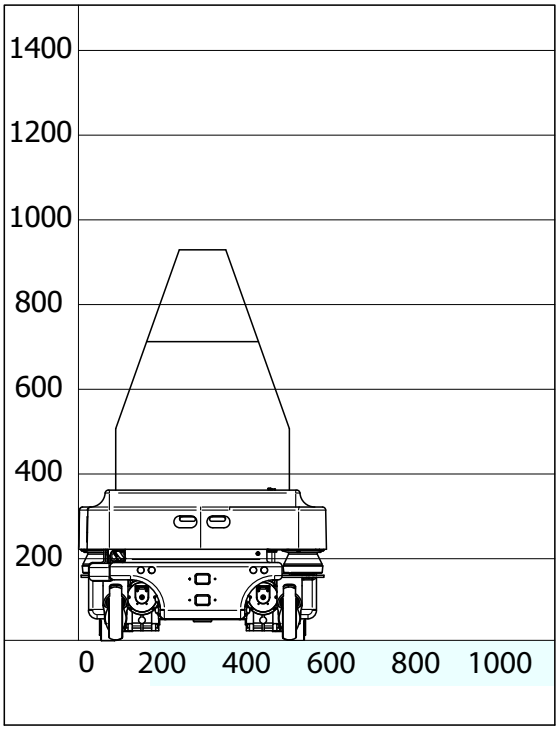



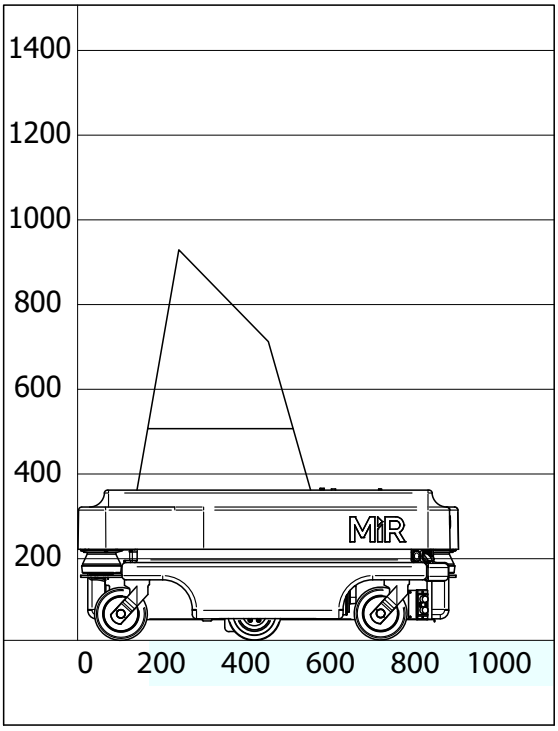

Units: mm
50kg payload



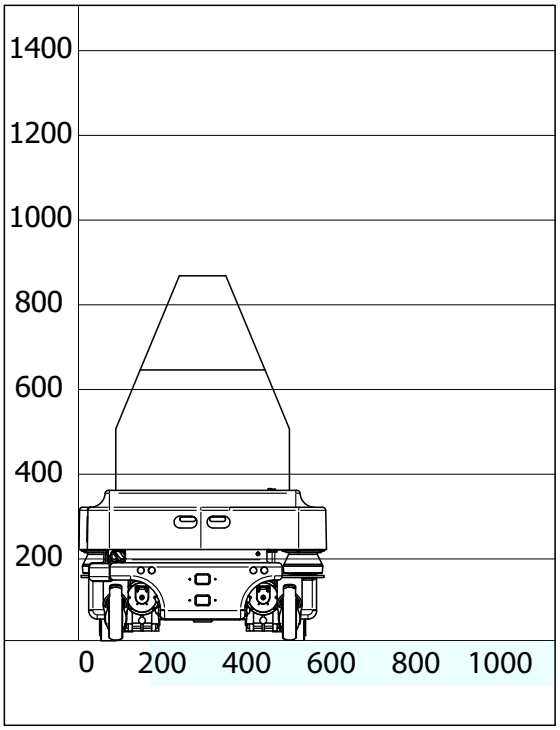



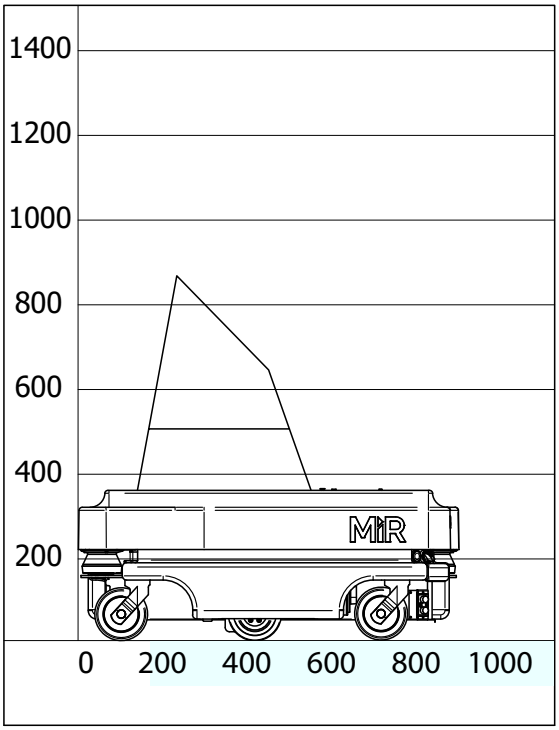

Units: mm
75kg payload



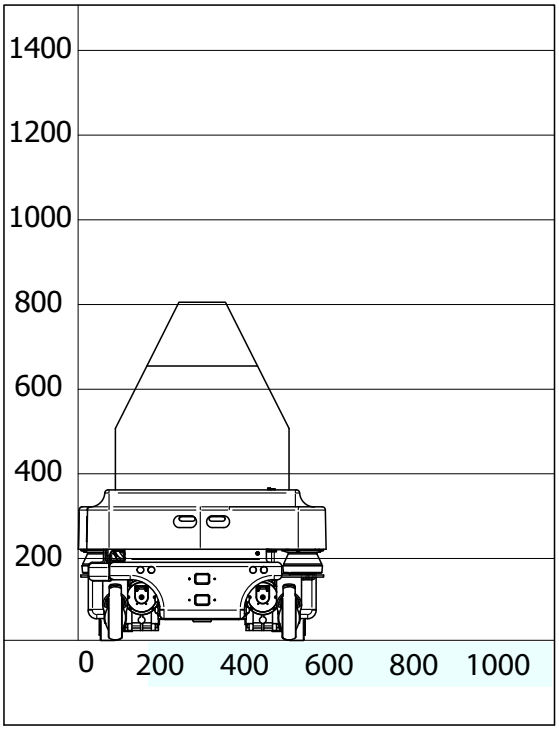



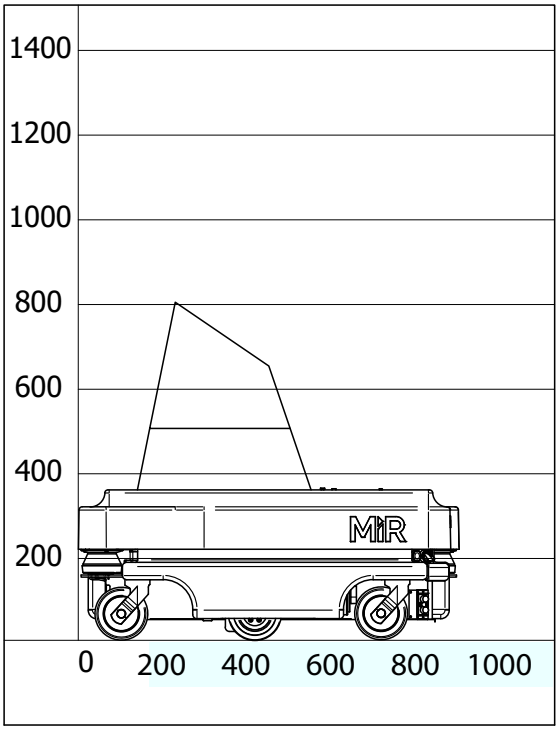

Units: mm
100 kg payload



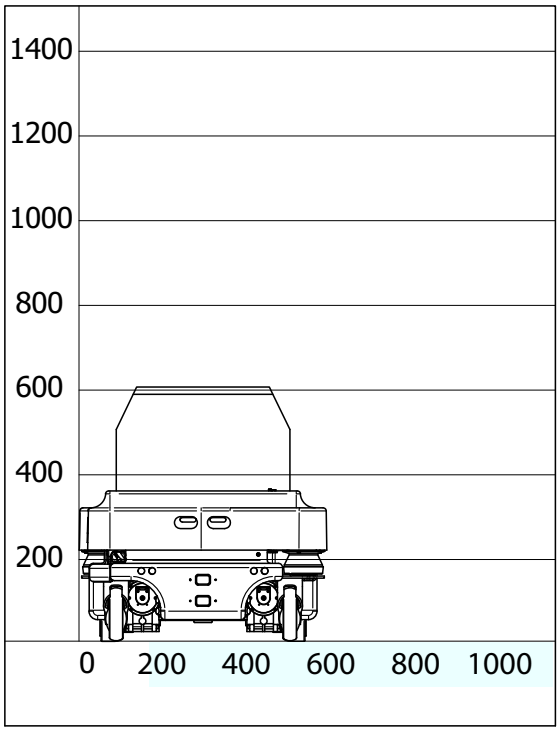



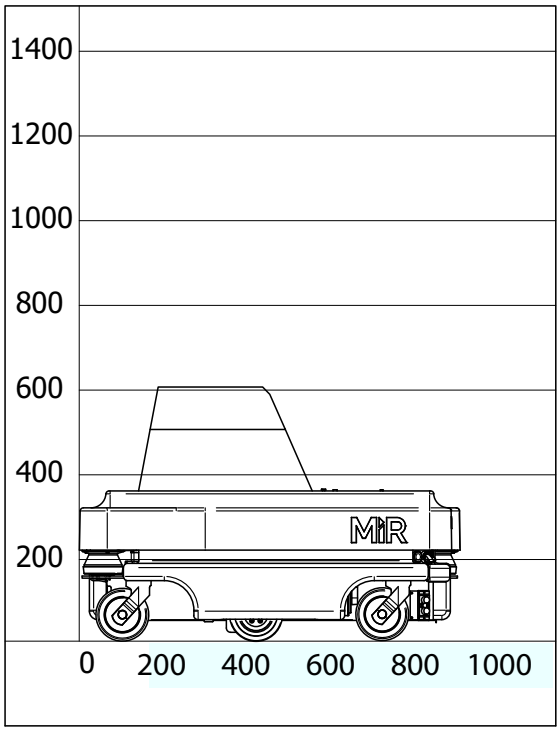

Units: mm
125kg payload



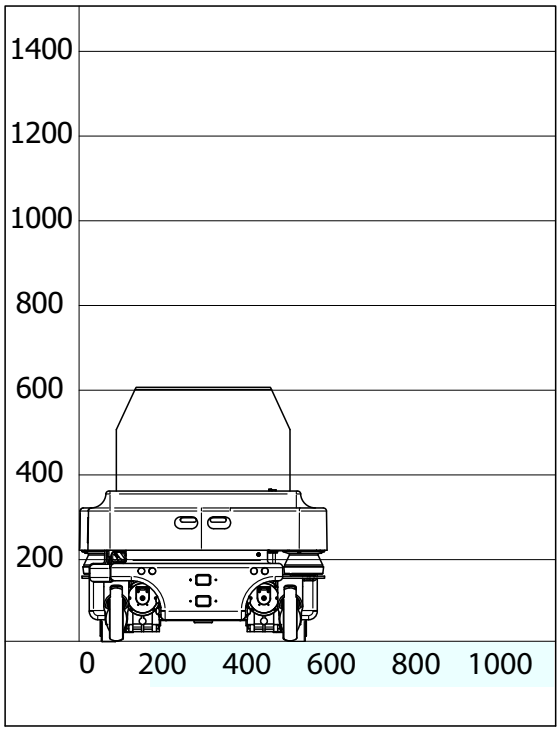



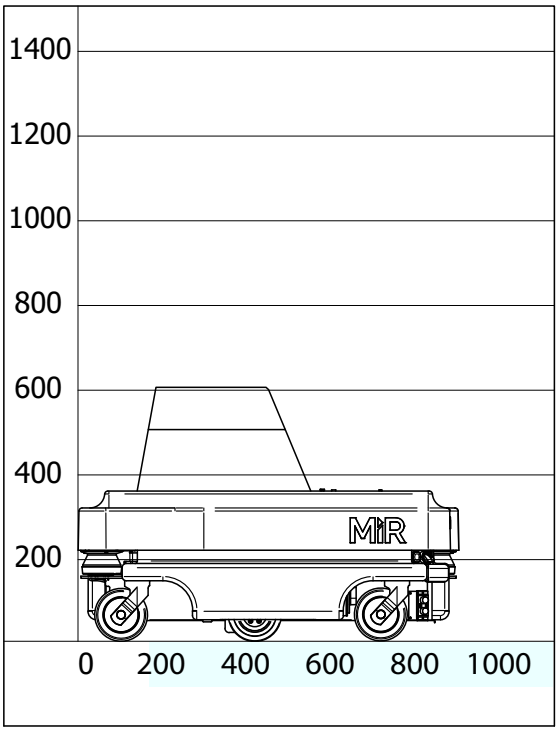

Units: mm
150kg payload




Units: mm
175kg payload

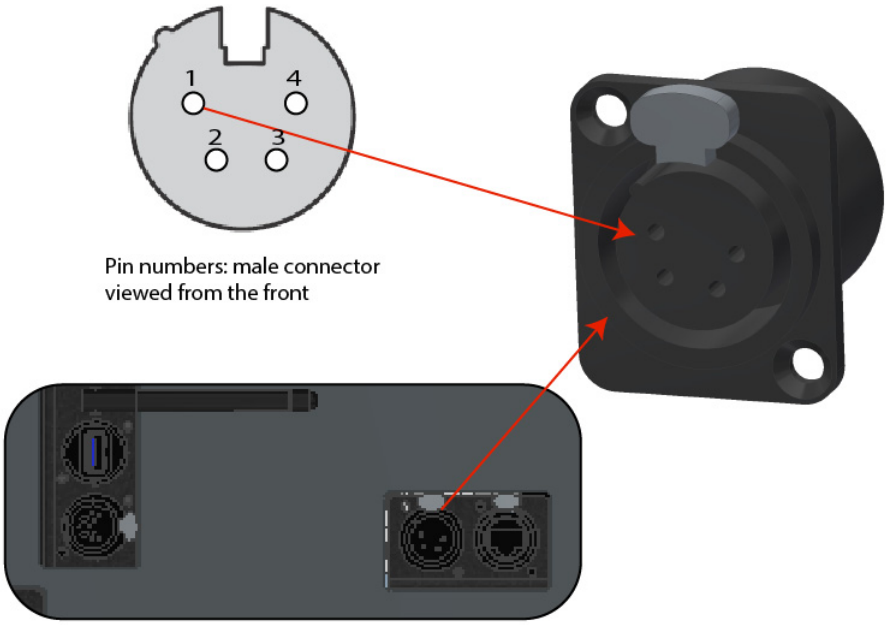



Units: mm
200kg payload

# B Connectors - pinout

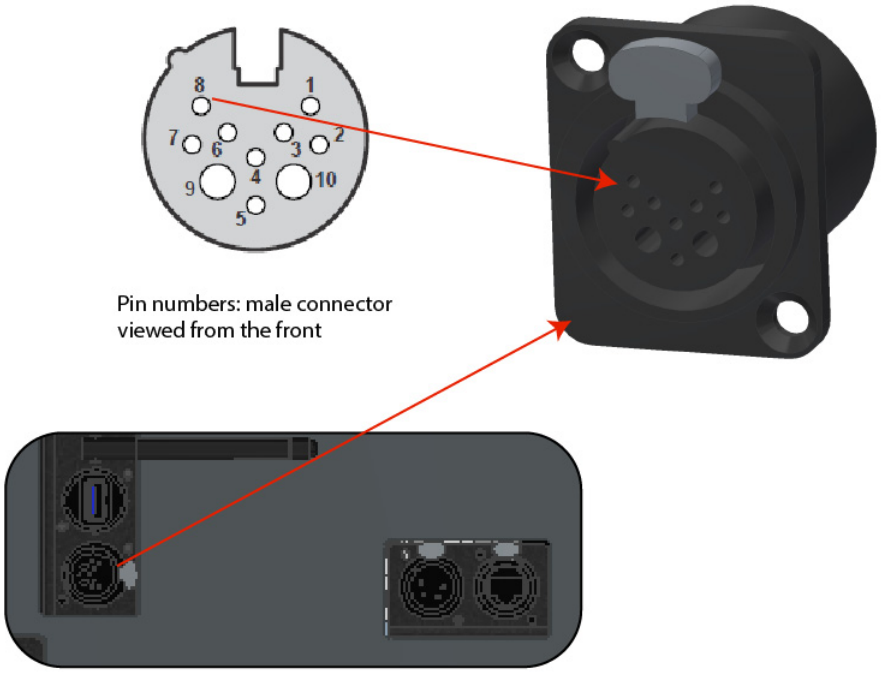
## B.1 Application interface




| Pin number | Signal name | Max. current | Remarks |
|---|---|---|---|
| 1 | Battery voltage | 3A | Starts with the robot |
| 2 | Battery voltage | 3A | Starts with the robot |
| 3 | Battery voltage | 10A | Stops by emergency stop |
| 4 | GND | 10A | Ground |

Figure 1. Application interface

## B.2 Emergency stop




| Pin number | Signal name | Remarks |
|---|---|---|
| 1 | DIN 19 | |
| 2 | DIN 14 | |
| 3 | DIN 70 | |
| 4 | E-stop, 1 GN | |
| 5 | E-stop, 2, 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. max. 1A | Can be used to connect small external units using up to 1 amp. such as tablets and PLC interfaces<br><br>Must use the GND from pin 9. |

Figure 2. Emergency stop interface

# C Certificates

## C.1 Electrical resistance

Fraunhofer

TESTED® DEVICE

Mobile Industrial Robots ApS
MIR200
**Report No. MI 1703-901**

Electrical Resistance

DUPLICATE

### Qualification Certificate

This is to certify that the product mentioned above, provided by

**Mobile Industrial Robots ApS**
Odense SØ, Denmark

has been awarded a Fraunhofer certificate TESTED DEVICE bearing the report number MI 1703-901.

The robot MIR200 was examined for its electrical resistance at representative points in accordance with DIN EN 61340-2-3.
The resistance to groundable point ($R_{gp}$) values obtained from the test piece lies within the limits of the limiting value of 1 x $10^9$ Ω required by DIN EN 61340-5-1 for ESD control elements.
The point-to-point resistance ($R_{p-p}$) values obtained from the test piece lies within the limits of the limiting value of 1 x $10^9$ Ω required by DIN EN 61340-5-1 for ESD control elements.

| | Operating voltage [V] | Max. value [Ω] | Compliance with limit value as per DIN EN 61340-5-1 |
|---|---|---|---|
| Resistance to groundable point ($R_{gp}$) | 100 | 8.0 x $10^8$ | **fulfilled** |
| Point-to-point resistance ($R_{p-p}$) | 100 | 6.4 x $10^7$ | **fulfilled** |

MI 1703-901
Report No. first document

Stuttgart, January 18, 2018
Place, date of first document issued

--
Report No. current document

--
Place, current date

on behalf of
Dr.-Ing. Frank Bürger, Project Manager Fraunhofer IPA

Fraunhofer IPA

This document only applies to the named product in its original state and is valid for a period of 5 years from the date the first document was issued. The document can be verified under **www.tested-device.com**.

Detailed information and parameters of the test environment can be found in the Fraunhofer IPA test report.

## C.2 Particle emission (Cleanroom)

# Fraunhofer

TESTED® DEVICE

Mobile Industrial Robots ApS
MiR200
**Report No. MI 1805-1036**

### Particle Emission

DUPLICATE

### Qualification Certificate

This is to certify that the product mentioned above, provided by

**Mobile Industrial Robots ApS**
Odense, Denmark

has been awarded a Fraunhofer certificate TESTED DEVICE bearing the report number MI 1805-1036.

The mobile robot MiR200 (color: gray) was assessed in compliance with ISO 14644-14. When operated under the specified test conditions, it is suitable for use in cleanrooms fulfilling the specifications of the following Air Cleanliness Classes according to ISO 14644-1:

| Test parameter(s) | Air Cleanliness Class |
|---|---|
| Parameter Set 1 (180°-straight–180°):<br>Test load: m = 200 kg<br>Velocity: $v_1$ = 0.8 m/s<br>Acceleration: $a_1$ = 0.5 m/s²<br>Distance: $s_1$ = 2 m | 4 |
| Parameter Set 2 (back–forth):<br>Test load: m = 200 kg<br>Velocity: $v_2$ = 0.8 m/s<br>Acceleration: $a_2$ = 0.5 m/s²<br>Distance: $s_2$ = 4 m | 2 |
| **Overall result** | **4** |

| | |
|---|---|
| MI 1805-1036 | Stuttgart, May 14, 2018 |
| Report No. first document | Place, date of first document issued |
| -- | -- |
| Report No. current document | Place, current date |

on behalf of
Dr.-Ing. Frank Bürger, Project Manager Fraunhofer IPA

Fraunhofer IPA

This document only applies to the named product in its original state and is valid for a period of 5 years from the date the first document was issued. The document can be verified under **www.tested-device.com**.

Detailed information and parameters of the test environment can be found in the Fraunhofer IPA test report.

# D Declaration of conformity

## EU declaration of Conformity

according to the EU Machinery Directive 2006/42/EC, Annex II 1.A

**Manufacturer**

Mobile Industrial Robots ApS
Emil Neckelmanns Vej 15 F
DK-5220 Odense SØ

**Person established in the Community authorized to compile the technical file**

Flemming Thinggaard
Mobile Industrial Robots ApS
Emil Neckelmanns Vej 15F
DK - 5220 Odense SØ

**Description and identification of the machinery**

| | |
|---|---|
| Product | MiR200 2.0 - Serial no. 180200012000608 and higher |
| Commercial name | MiR200 |
| Function | MiR200: self-propelled vehicle (battery)<br>MiR200 is an automatic vehicle that can transport materials internally within factories, warehouses, hospitals and a host of other industrial locations.<br>The user provides the destination of product delivery via a web interface. MiR200 can be set up to run a fixed route or be called on demand besides more special operations.<br>MiR200 has a map that can be programmed the first time the vehicle is used. While operating, the MiR200 automatically avoids obstacles (people, furniture) that are not mapped.<br>MiR200's internal map contains specific locations (office, hall, John's room etc.) which can be used for logistical planning.<br>Each vehicle has its own network.<br>The vehicle is controlled from a website (HTML5), which is accessed via a browser on a PC, tablet or smartphone. |

**It is expressly declared that the machinery fulfills all relevant provisions of the following EU Directives or Regulations:**

| | |
|---|---|
| 2006/42/EC | Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast) (1) |

**Reference to the harmonized standards used:**

| | |
|---|---|
| EN 60204-1:2006+A1:2009 | Safety of machinery – Electrical equipment of machines – Part 1: General requirements |
| EN ISO 12100:2010 | Safety of machinery – General principles for design – Risk assessment and risk reduction (ISO 12100:2010) |
| EN ISO 13849-1:2015 | Safety of machinery – Safety related parts of control systems – Part 1: General principles for design (ISO 13849-1:2015) |
| EN ISO 13849-2:2012 | Safety of machinery – Safety related parts of control systems – Part 2: Validation (ISO 13849-2:2012) |
| EN ISO 13850:2015 | Safety of machinery – Emergency stop function – Principles for design (ISO 13850:2015) |
| EN 1175-1:1998+A1:2010 | Safety of industrial trucks – Electrical requirements – Part 1: General requirements for battery powered trucks |

**Reference of the other technical standards and specifications used:**

| | |
|---|---|
| EN 1525:1997-09 | Safety of industrial trucks – Driverless trucks and their systems |

Odense SØ, 27 November 2018

Signature
Søren E. Nielsen
CTO

Translations of this CE declaration are available on www.mobile-industrial-robots.com > Distributor login. page 1/1