

# Operating Guide (en)

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# MiRCharge 48V



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Contact the manufacturer:

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

[www.mobile-industrial-robots.com](http://www.mobile-industrial-robots.com)

Phone: +45 20 377 577

Email: [support@mir-robots.com](mailto:support@mir-robots.com)

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# 1. About this document

This operating guide explains how to install and take precautions for safe use of your MiR Charge 48V. This guide also contains information on how to set up MiR250, MiR500 and MiR1000 robots for automatic charging with MiR Charge 48V.



## NOTICE

Save this manual. It contains important safety and operating instructions.

## 1.1 Where to find more information

At [www.mobile-industrial-robots.com](http://www.mobile-industrial-robots.com), you can find the following resources under the **Manuals** tab on each product page:

- **Quick starts** describe how you start operating MiR robots quickly. This document is in print in the box with the robots. Quick starts are available in multiple languages.
- **User guides** provide all the information you need to operate and maintain MiR robots. User guides are available in multiple languages.
- **Risk Analysis Guides** include guidelines on how to create a risk assessment of your robot solution.
- **Commissioning guides** describe how to commission your robot safely and prepare it to operate in the workplace.
- **Operating guides** describe how to set up and use top modules and accessories, such as charging stations, hooks, shelf lifts, and pallet lifts.
- **Getting started guides** describe how to set up products that are mainly software-based, such as MiR Fleet.
- **Reference guides** contain descriptions of all the elements of the robot interface and MiR Fleet interface. Reference guides are available in multiple languages.
- **REST API references** for MiR robots, MiR hooks, and MiR Fleet.
- The **MiR network and WiFi guide** specifies the performance requirements of your network and how you must configure it for MiR robots and MiR Fleet to operate successfully.

## 1.2 Version history

This table shows current and previous versions of this document and their interrelations with hardware releases.

Revision	Release date	Description	HW
1.0	2019-01-24	First edition	1.0
1.1	2019-07-31	Small updates to the document	1.0
1.2	2019-10-07	Small updates to the document	1.0
1.3	2019-11-13	Layout changes	1.0
1.4	2020-06-17	New chapter: Nameplate Small updates to the document	1.0

## 2. Safety

Read the information in this section before powering up and operating MiR Charge 48V.

Pay particular attention to the safety instructions and warnings.



### NOTICE

Mobile Industrial Robots disclaims any and all liability if MiR Charge 48V or its accessories are damaged, changed, or modified in any way. Mobile Industrial Robots cannot be held responsible for any damages caused to MiR Charge 48V, accessories, or any other equipment due to programming errors or malfunctioning of MiR Charge 48V.

### 2.1 Safety message types

This document uses the following safety message types.



### WARNING

Indicates a potentially hazardous situation that could result in death or serious injury. Carefully read the message that follows to prevent death or serious injury.



### CAUTION

Indicates a potentially hazardous situation that could result in minor or moderate injury. Alerts against unsafe practices. Carefully read the message that follows to prevent minor or moderate injury.



### NOTICE

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

## 2.2 General safety precautions

This section contains general safety precautions.



### WARNING

Contact with live electrical parts can cause electric shock.

- Do not touch any internal components of MiR Charge 48V while it is powered.



### WARNING

MiR Charge 48V is not approved for installation in areas with explosive gas atmosphere according to hazardous area classification zones 0, 1 and 2.

Sparks from static electricity may cause fire or explosions.

- Do not install MiR Charge 48V in any of the mentioned zones.



### WARNING

Failure to ground MiR Charge 48V may cause electric shock.

- Ensure to ground MiR Charge 48V properly using one of the supplied three-prong plugs.
- If none of the supplied plugs fit the local wall outlet, consult a licensed electrician.



### WARNING

If MiR Charge 48V is used by children, they risk injury and electrical shock.

- Children should be supervised to ensure that they do not play with the appliance.

**WARNING**

If MiR Charge 48V is used by unqualified personnel, they risk injury and electrical shock.

- This appliance is not intended for use by persons (including children) with reduced physical, sensory, or mental capabilities or lack of experience and knowledge unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety.

**CAUTION**

Operating the charger in a closed-in area with restricted ventilation as well as covered or blocked vents on the sides of MiR Charge 48V can lead to overheating of the battery and/or the charger.

- Do not operate the charger in a closed-in area, restrict ventilation or cover or block the vents in any way.

**CAUTION**

The only intended use of MiR Charge 48V is to charge the internal battery of MiR250, MiR500, and MiR1000 robots. Using it to charge other robot types or external batteries can damage MiR Charge 48V.

- Only use MiR Charge 48V to charge MiR250, MiR500, and MiR1000 robots.





**CAUTION**

Metal parts placed or dropped on the charging connectors during charging may short circuit MiR Charge 48V or the robot, possibly resulting in damage to equipment or injury to nearby personnel.

The charging connectors have electric potential difference only when in contact with the robot. Both robot (including battery) and charging station are protected by fuses to prevent dangerous situations should the terminals be short circuited during charging.

- Do not place or drop metal parts on to the charging connectors during charging.



**CAUTION**

Connecting one of the supplied power cables to a wall outlet that does not fit the cable plug can damage MiR Charge 48V.

- Only connect the power cable to a wall outlet that fits one of the supplied cable plugs.



**CAUTION**

Charging a frozen battery can damage the battery.

- Never charge a frozen battery.



**CAUTION**

Robot malfunctions can cause an electrical fire, causing damage and injury to equipment and personnel.

- Personnel operating near the robot must be informed on how to use an ABC fire extinguisher to put out an electrical fire, should the robot malfunction and catch on fire.



**CAUTION**

Risk of trapping or injury to personnel if robots malfunction or if personnel enter operating hazard zones.

- Personnel operating near the robot must be informed on how to engage the robot's Emergency stop function in emergency situations.

## 3. Product presentation

MiR Charge 48V is a charging station that autonomously recharges docked MiR250, MiR500, and MiR1000 robots.

It is possible for multiple robots to share the same charging station. However, to avoid bottleneck situations, we recommend integrating the robots in MiR Fleet. For more information see the *MiR Fleet Getting Started Guide*.

### 3.1 How charging works

To connect to MiR Charge 48V, the robot moves to a position in front of the charging station to locate the VL-marker (1). It then moves onto the charging plate (2), and the charging begins.

3.1 identifies the features of MiR Charge 48V.

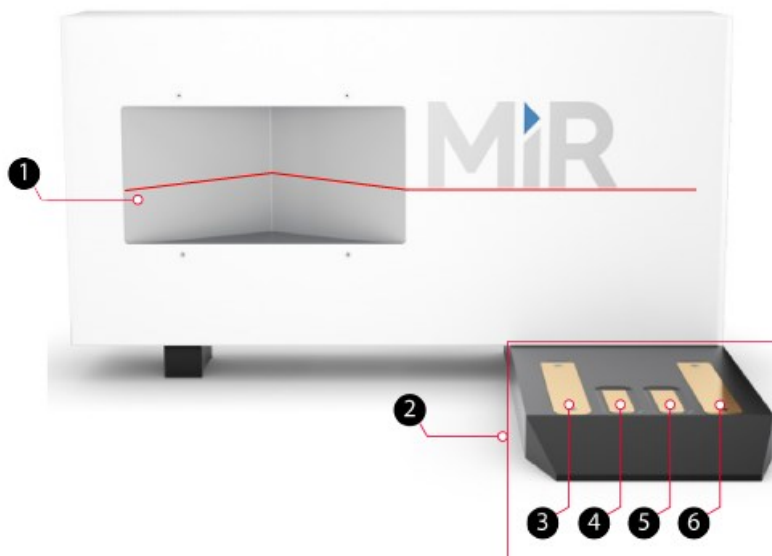


Figure 3.1. Front view of MiR Charge 48V.

Label	Description	Label	Description
1	VL-marker: the V-shaped recess combined with the front plate to the right forms a VL-marker that the robot's front safety scanner uses to dock to the charging station	2	Charging plate
3	Charging connector, positive terminal	4	CAN high: CAN bus communication between robot and charging station processor
5	CAN low: CAN bus communication between robot and charging station processor	6	Charging connector, negative terminal

To connect to MiR Charge 48V, the robot moves to the entry position in front of the charging station to locate the VL-marker (1). It then moves onto the charging plate (2) and establishes a communication to the charger through (4) and (5). When a communication has been successfully done, the charging will begin from (3) and (4).



The connectors on both charging plates (3) and (6) and underneath the robot are voltage-free until a connection between the robot plates and the charger plates is made, and a CAN bus communication is established via plates (4) and (5).



If the robot's battery is completely discharged, you must connect an external cable charger. For information on how to do this, see the user guide or quick start of the robot.

## 3.2 Nameplate

MiR Charge 48V is delivered with two nameplates mounted to the charger. The nameplates of MiR Charge 48V identify the model and serial number and includes the CE mark, the technical specifications, and the address of Mobile Industrial Robots.



MiRCharge 48V	S/N :	01000001	Number of phases :	230VAC [L, N, PE] 120V [L, N, PE] 240V [L1, L2, PE] PE = Protective earth
Input : 100-240V ~ Max. 14A 50/60HZ	Mobile Industrial Robots ApS	CE		
Output at 240V : 48V == Max. 40A	Emil Neckelmanns vej 15F			
Output at 120V : 48V == Max. 20A	5220 Odense SØ			
Specific battery : Lithium-NMC 16P13S and 12P13S 41,6Ah	Before charging read the instructions For indoor use only IP20			

### Caution :

Charge only lithium type batteries. Other types of batteries may burst causing personal injury and damage.  
Risk of electric shock. Do not touch uninsulated portion of output connector or uninsulated battery terminal.

### Attention :

Utiliser pour charger uniquement les accumulateurs du type lithium d'autres types d'accumulateurs pourraient éclater et causer des blessures ou dommages.  
Danger: Risqué de chocs électriques.  
Ne pas toucher les parties non isolées du connecteur de sortie ou bornes non isolées de l'accumulateur.

Figure 3.2. Example of MiR Charge 48V nameplates.

Item	Description
CE	Mobile Industrial Robots A/S declares that MiR Charge 48V meets the requirements of the applicable EC directives.
Serial number	The 8-digit serial number is a unique identifier of the robot. The last four digits form part of the original name of the robot.

## 4. Getting started

This section describes how to get started with MiR Charge 48V.

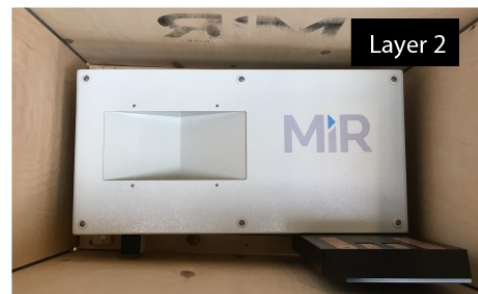


### NOTICE

Read [Safety](#) on [page 6](#) before powering up MiR Charge 48V.

### 4.1 In the box

This section describes the content of the MiR Charge 48V box.



The box contains:

1. MiR Charge 48V
2. Power cables for different wall outlets:
  - NEMA L6-15 plug - for use in 230/240 V installations



- NEMA 5-15P plug - for use in 110/120 V installations; (only delivers 50% of the max. rated charging power)



- CEE 7/7 plug - for use in 230/240 V installations



3. MiR document folder containing EC Declaration of Conformity.



## 4.2 Installing and powering up

This section describes how to install and power up MiR Charge 48V.

### Before installing

Before installing, please complete the following:

- Place MiR Charge 48V against a wall on a clean, even and dry floor.
- Keep the air vents on both sides of the charging station free to avoid overheating.
- Install MiR Charge 48V on an electric circuit that is protected by a circuit breaker with current rating 16 A (EU) / 15 A (US).
- Make sure there's a suitable wall outlet that supports the necessary power. For national electric codes, consult a licensed electrician.
- Make sure that the charger is connected to ground to avoid getting electric shock. If you are in doubt, consult a licensed electrician.



Wall fixing is not required, but if the charging station is moved even a few centimeters, the robot will be unable to dock precisely. We therefore recommend fixing it.

*Figure 4.1* shows the parts of MiR Charge 48V relevant for the installation and powering up.

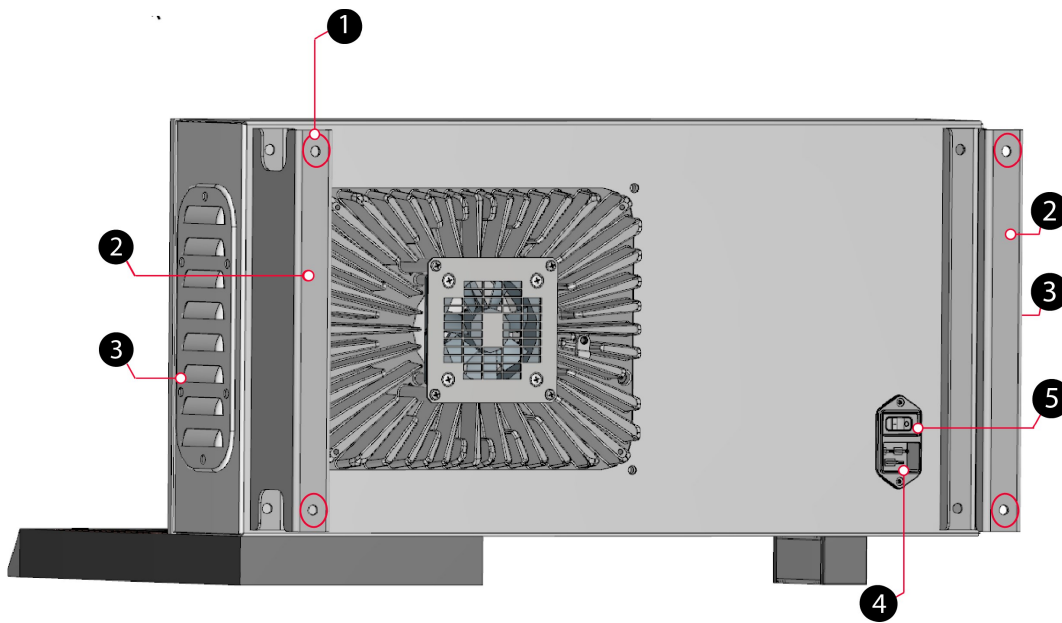


Figure 4.1. Rear view of MiR Charge 48V.

Pos.	Description	Pos.	Description
1	Four M8 mounting holes for fixation to wall (all four corners)	2	Mounting brackets
3	Air vents	4	Power inlet
5	Power button		

## Mounting

Follow these steps to mount MiR Charge 48V to a wall:

1. Place MiR Charge 48V against the wall where it should be mounted.
2. Mark the position of the four M8 mounting holes on the wall.
3. Remove the charging station and drill four holes of a suitable size for M8 bolts at the marked positions in the previous step. Consider inserting wall plugs to ensure a secure mounting, in which case the drilled holes must accommodate the size of the chosen plugs.
4. Place the MiR Charge 48V against the wall again in the desired position. Ensure that the drilled holes align with the M8 mounting holes.
5. Fasten the charging station securely to the wall by screwing M8 bolts through the bolting holes and into the wall.

## Powering up



### NOTICE

Read [Safety on page 6](#) before powering up the charging station.

Follow these steps to power up the MiR Charge 48V:

1. Insert the power cord into the power inlet, then into the wall power outlet.
2. Press the power button to turn on MiR Charge 48V.

## 4.3 Mark potentially hazardous floor areas

Before taking your MiR Charge 48V into use, it is necessary to mark up the floor in the area where the robot docks to MiR Charge 48V.

### Why marking is required

When docking to a charging station, the robot mutes its personnel detection means temporarily. This includes turning off the protective field sets around the robot.

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

To avoid potentially hazardous situations as a consequence of the muted personnel detection means, you must mark the physical area around MiR Charge 48V with tape or similar marking material.



For more information on personnel detection means, see the user guide for your robot.

## Marking the operating hazard zone

The size of the operating hazard zone is based on the robot's path going to the charging station and takes into account that the robot may have to make a turn of up to 90° when docking to the charging station.

Figure 4.2 illustrates where the floor markings should be for a single charging station.

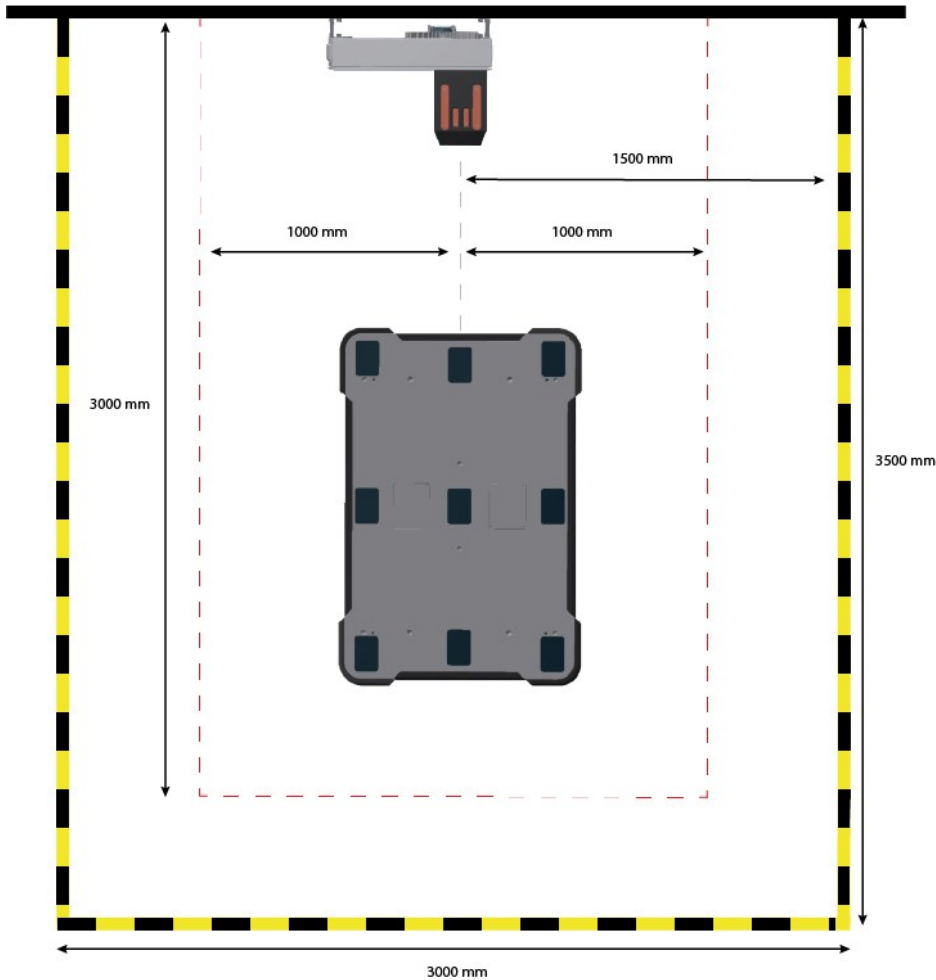


Figure 4.2. The floor around MiR Charge 48V must be marked to indicate an operating hazard zone, illustrated by the striped yellow and black line.

## Multiple charging stations

If you have multiple charging stations lined up next to each other, it is important to place the chargers with at least 750 mm between them to ensure a successful docking.

## 5. Usage

The most effective way to use MiR Charge 48V is to set up a mission for the robot to dock to the charger and recharge its battery when it is low on power.



If you are using MiR Fleet, charging is handled autonomously, and you should not create charging missions. Refer to the *MiR Fleet Getting Started Guide* to set up MiR Fleet to enable auto charging.

This section describes how to do the following tasks:

- Setting charging station markers on the map.
- Creating the *Charge at station* mission. The robot docks to a charger and recharges to 40% power.
- Creating the *Recharge loop* mission. A **Loop** and an **If** action makes the robot dock to the charger when it is low on power.


### 5.1 Setting charging station markers on the map

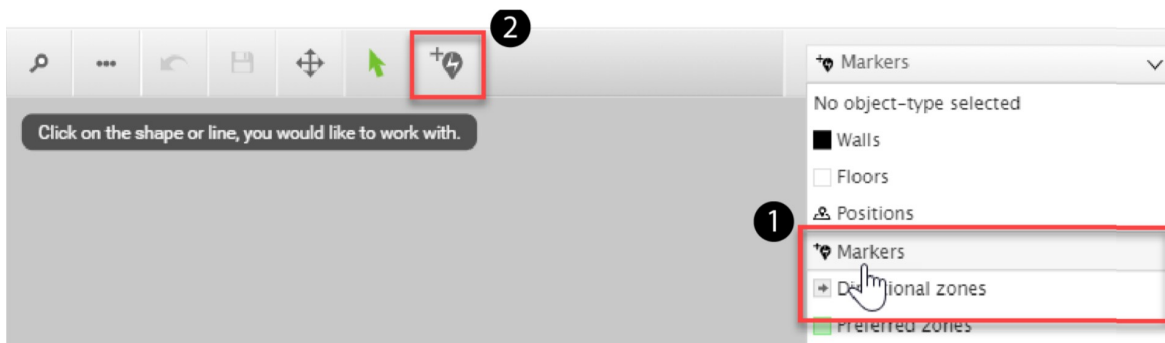
Before creating the marker, you must ensure that the robot is localized correctly on an active map. If in doubt, you can check if the red lines representing the laser scanner line match the black lines on the map as shown in *Figure 5.1*.



Figure 5.1. The red lines represent what the laser scanners detect. The robot is correctly localized when they align with the black lines that represent walls.

Once the robot is localized, it is possible to insert a charging station marker correctly on the map using the following steps:

1. Manually drive the robot so its front is facing the MiR Charge 48V and is within one meter from it.
2. In the robot interface, enter the map editor of the map where you want to create a marker. This is done by navigating to **Setup > Maps** and selecting **Edit**  next to the map you would like to work on.
3. In the Object-type drop-down menu, select **Markers** (1), and then select the icon **Draw a new marker** (2).



4. In the **Create marker** window, enter a name for the marker and select **Type** > **MiRCharge 500/1000**.

Create marker

Name

Type    
L-marker  
MiRCharge 100/200  
MiRCharge 500/1000  
Pallet rack  
V-marker  
VL-marker

Orientation from X-axis

Y coordinate in meters

Y offset

Offset orientation



5. Select **Detect marker**. The Detect-marker function tracks the position of the charging station using the VL-marker and automatically sets the X, Y and Orientation values in the robot, enabling it to dock to the charging station.

**Name**  
Charger 1

**Type**  
Charging station

**Orientation from X-axis**  
-90.418

**X coordinate in meters**  
8.242

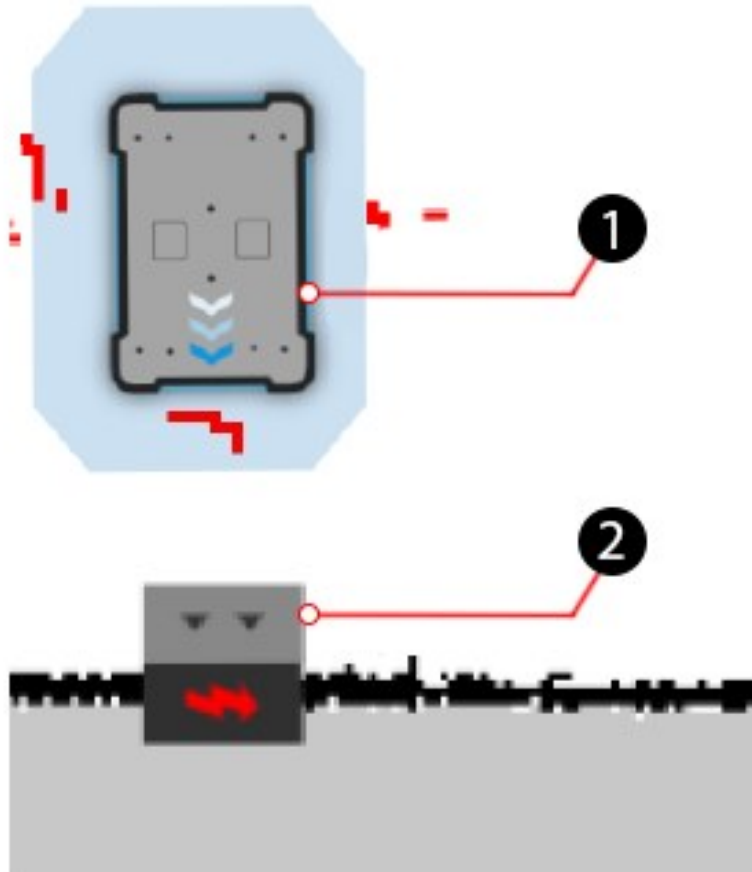
**Y coordinate in meters**  
0.218

OK

Detect marker

Cancel

6. Select **OK** to create the marker. A new marker icon (2) represented by a lightning symbol is now visible on the map in front of the robot (1) and is ready to be used in missions.



If the robot is too far from the charging station, a message that the robot failed to locate the marker is displayed. Try to move the robot closer to the charging station, and ensure that the front safety laser scanner is positioned in front of the VL-marker of the charging station.

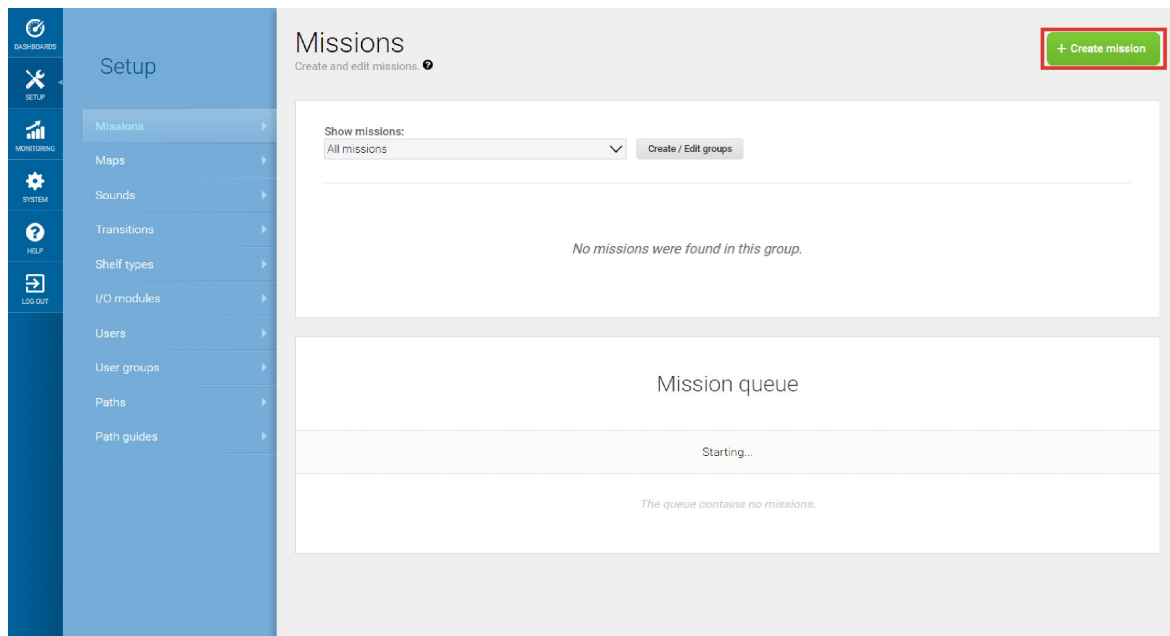
## 5.2 Creating the *Charge at station* mission

This section describes how you create the example mission *Charge at station*. The mission demonstrates how you use docking and charging actions in your mission. To make the example yourself, it is assumed that you completed the following:

- Create a MiR Charge 48V marker titled **Charger**, as described in [Setting charging station markers on the map on page 22](#).

The goal of the mission is to make the robot dock to MiR Charge 48V and recharge its battery up to 40%.

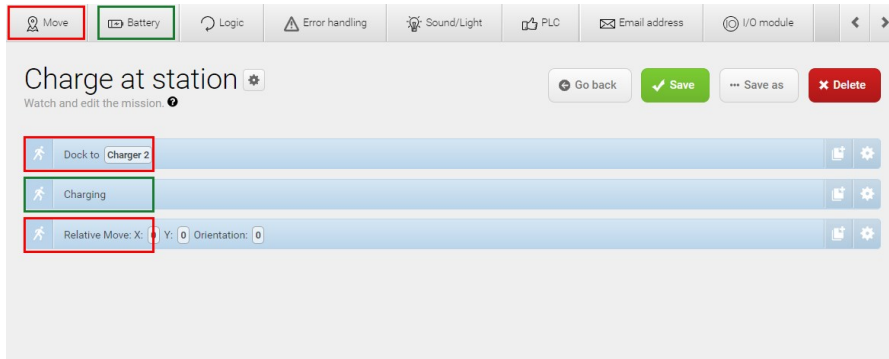
1. To create a new mission, go to **Setup > Missions** and select **Create mission**.




2. Name the mission *Charge at station*, and select a mission group and site. Select **Create mission** when you are done.

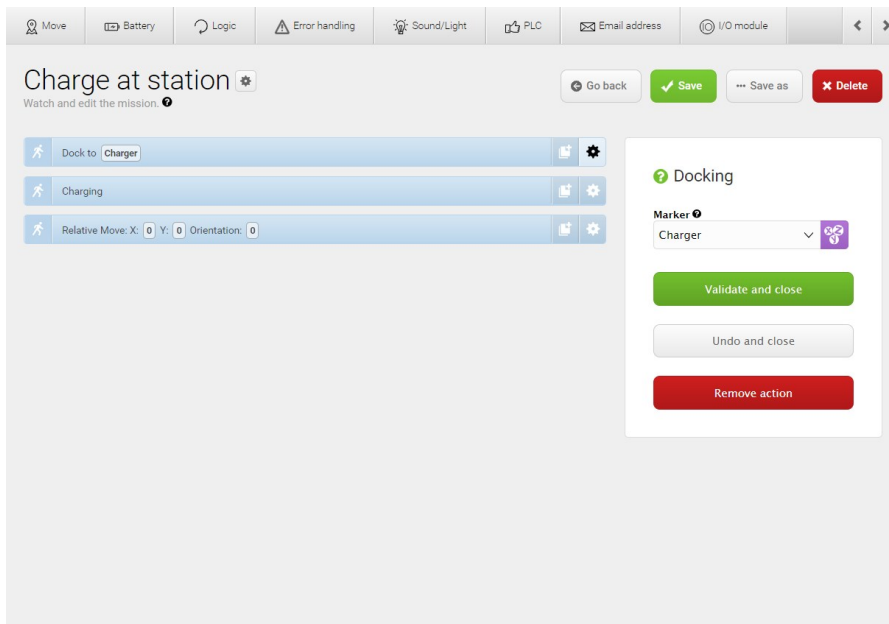
3. Select the following actions:

- In the **Move** menu, select **Docking**.
- In the **Battery** menu, select **Charging**.
- In the **Move** menu, select **Relative move**.



The following steps describe which parameters each action should be set to. To modify the parameters, select the gearwheel  at the right end of the action line to open the action dialog box. When you have set the parameters, select **Validate and close**.

4. For the **Dock to** action, under **Marker**, select **Charger**. This is the marker you created on the map in front of the charging station.



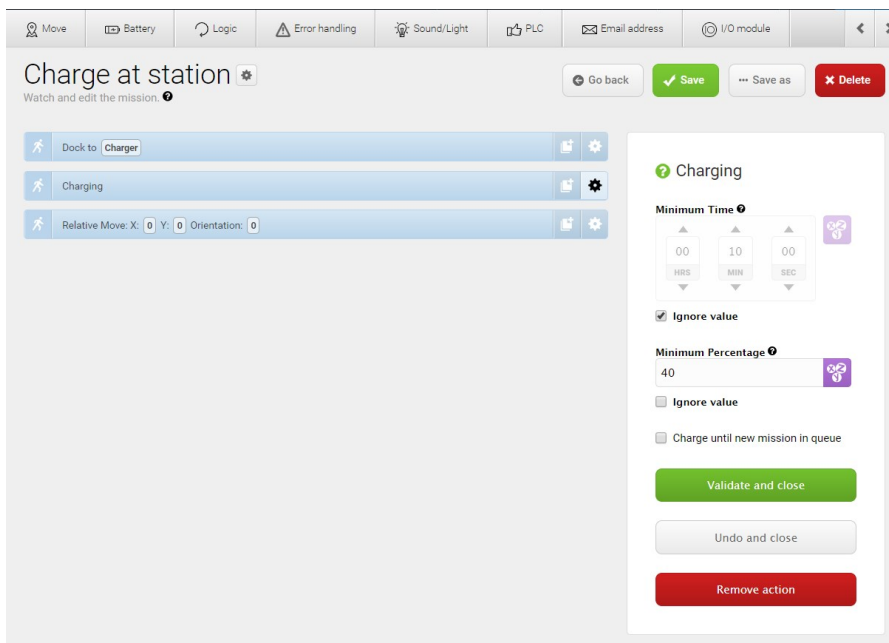
5. For the **Charging** action, set the parameters as follows:

- **Minimum time:** Select **Ignore value**.
- **Minimum percentage:** type **40**.

In our example, there is no minimum time. When the battery reaches 40%, the charging is completed.



To read more about the different **Charging** action combinations, see [Charging action parameters explained on page 37](#).



- For the **Relative move** action, under **X**, change the value to **-2**. This will make the robot drive two meters backward after charging.

The screenshot shows the 'Charge at station' mission configuration screen. At the top, there is a navigation bar with tabs for Move, Battery, Logic, Error handling, Sound/Light, PLC, Email address, and I/O module. Below the navigation bar, the mission title 'Charge at station' is displayed with a gear icon for settings. To the right of the title are buttons for 'Go back', 'Save', 'Save as', and 'Delete'. The main area contains three mission steps: 'Dock to Charger', 'Charging', and 'Relative Move: X: -2 Y: 0 Orientation: 0'. The 'Relative Move' step is selected, and its configuration panel is open on the right. This panel includes fields for X (-2), Y (0), Orientation (0), Max Linear Speed (0.5), and Max Angular Speed (0.5). There is also a checked checkbox for 'Collision Detection'. At the bottom of the panel are 'Validate and close' and 'Undo and close' buttons.

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



The mission can also be inserted in other missions. In that case, the **Relative move** action is unnecessary.



## Testing the mission

To test that the robot executes the mission correctly, you can try running the mission.



### NOTICE

Always test missions without payload to minimize potential hazards.

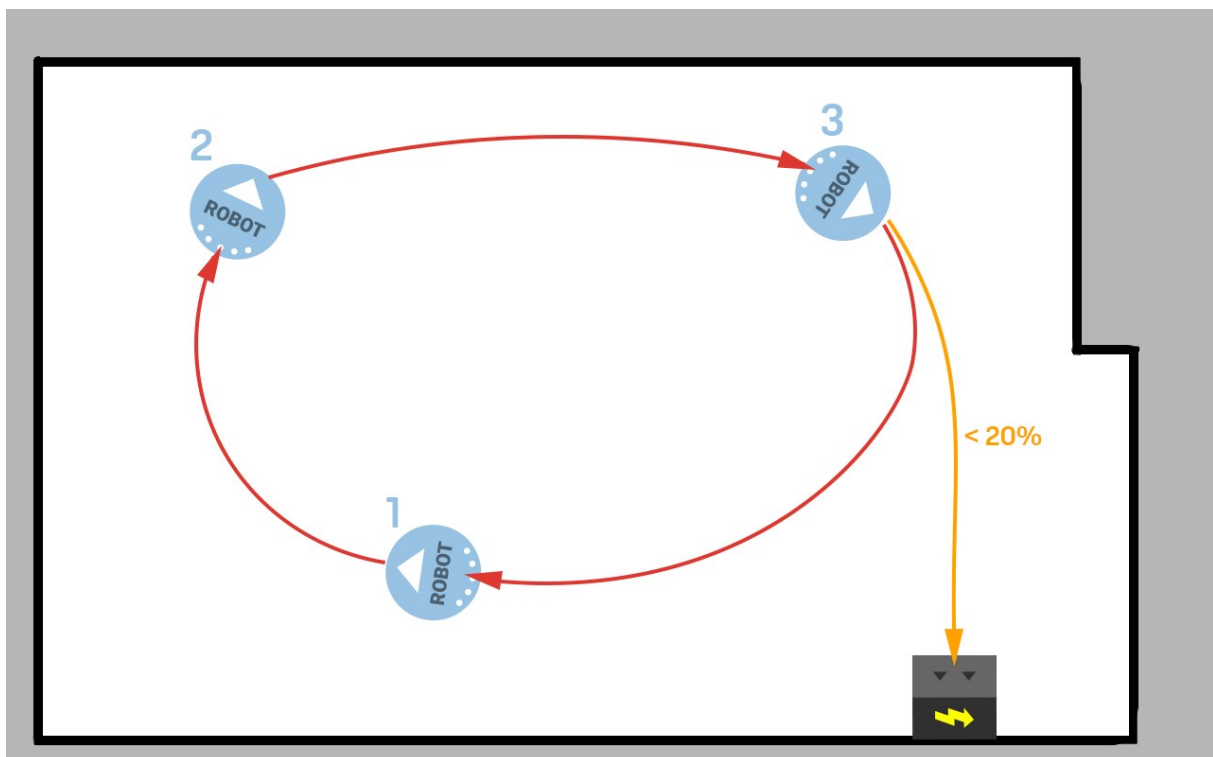
1. Go to **Setup > Missions**.
2. Select **Queue mission**  next to the mission you just created. The mission is now added to the mission queue.
3. Select **Continue**  to start the mission.
4. Watch the robot execute the mission, and verify that it performs as expected.

## 5.3 Creating the *Recharge loop* mission

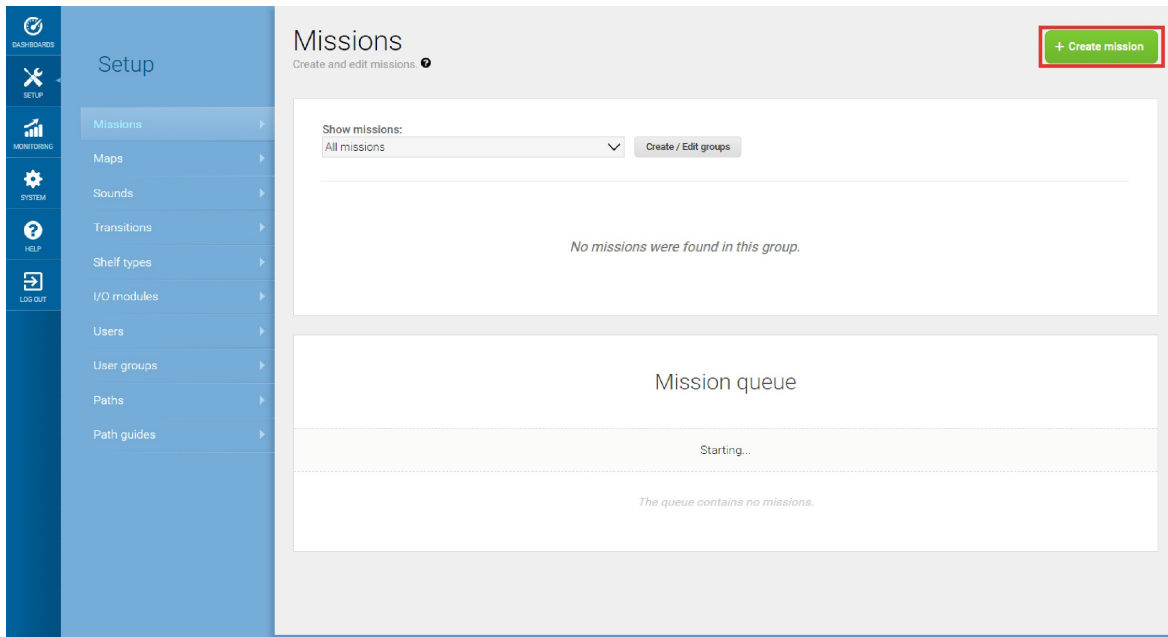
This section describes how you create the example mission *Recharge loop*. The mission demonstrates how you use a Loop and If action to make the robot dock to a charger when it reaches low power. To make the example yourself, it is assumed that you completed the following:

- Created a MiRCharge marker titled **Charger**, as described in [Setting charging station markers on the map on page 22](#).
- Created three robot positions titled **Position 1**, **Position 2** and **Position 3**.

The goal of the mission is to make the robot drive between the three robot positions until it reaches a battery percentage below 20%, where it then docks to MiR Charge 48V and charges its battery up to 50%.



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

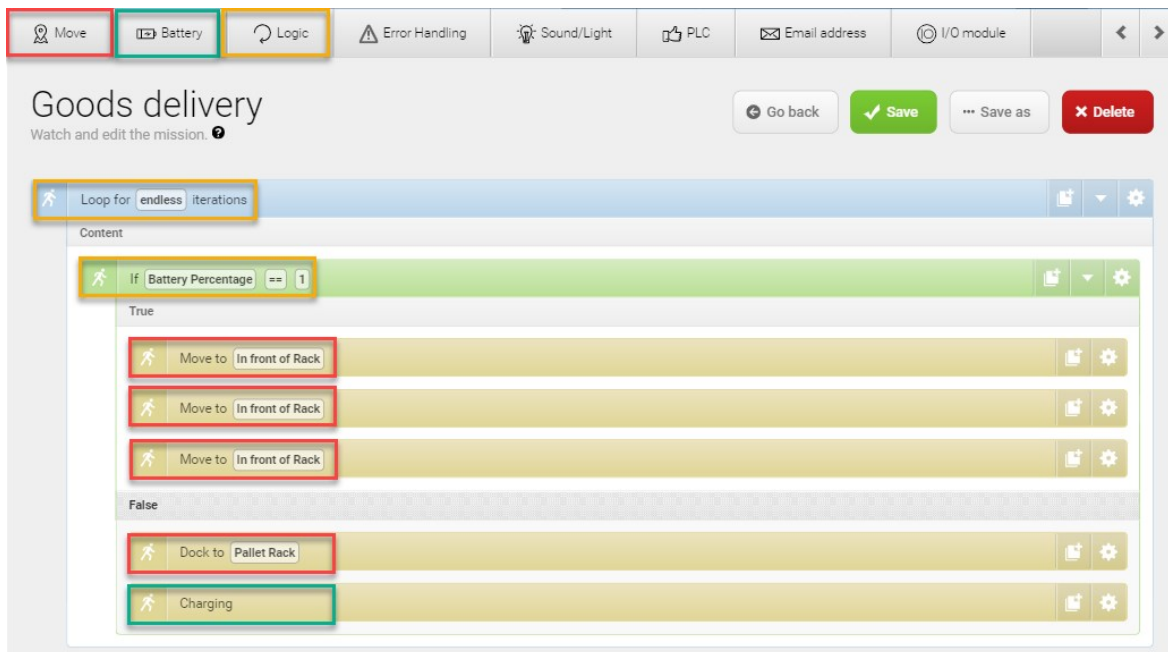


2. Name the mission *Recharge loop*, and select a mission group and site. Select **Create mission** when you are done.



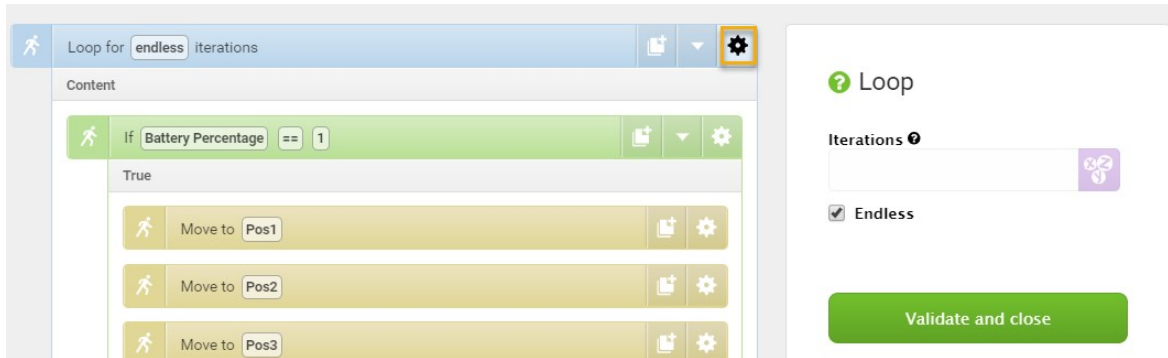
3. Select the following actions:

- In the **Logic** menu, select **Loop**.
  - Select the gray bar that reads **Content** to embed the next action into the **Logic** action.
- In the **Logic** menu, select **If**.
  - Select the gray bar that reads **True** to embed the next actions into the **If** action.
- In the **Move** menu, select **Move** three times.
  - Select the gray bar that reads **False** to embed the next actions into the **If** action.
- In the **Move** menu, select **Move**.
- In the **Battery** menu, select **Charging**.



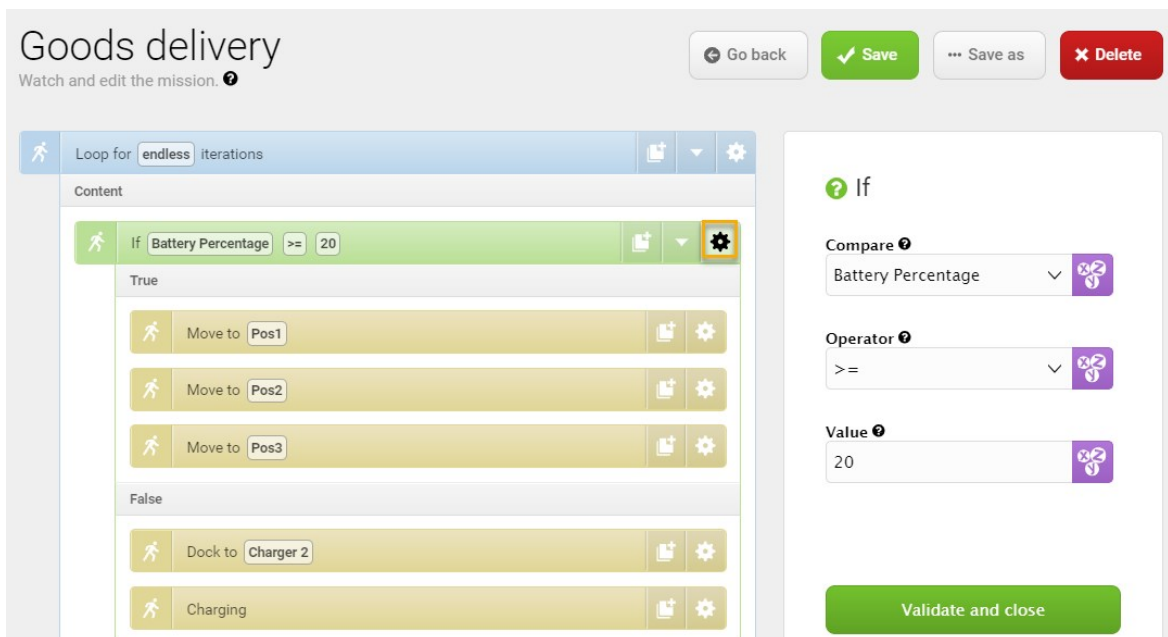
The following steps describe which parameters each action should be set to. To modify the parameters, select the gearwheel ⚙ at the right end of the action line to open the action dialog box. When you have set the parameters, select **Validate and close**.

4. For the **Loop** action, select **Endless**.



5. For the **If** action dialog, set the parameters as follows:

- **Compare:** Select **Battery Percentage**.
- **Operator:** Select **>=** (greater than or equal to).
- **Value:** Type **20**.



- For the three **Move** actions, under **Position**, select one of the robot positions for each of the actions.

The screenshot shows a programming loop for 'endless' iterations. The content area contains an 'If' block with the condition 'Battery Percentage >= 20'. The 'True' branch is circled in red and contains three 'Move to' actions: 'Move to Pos1', 'Move to Pos2', and 'Move to Pos3'. The settings for the first 'Move' action are displayed on the right in a 'Move' configuration panel. The 'Position' dropdown is set to 'Pos1', 'Retries (Blocked Path)' is set to 10, and 'Distance Threshold' is set to 0.1. A 'Validate and close' button is at the bottom of the panel.

- For the **Dock to** action, under **Marker**, select **Charger**.

The screenshot shows the same programming loop, but now the 'False' branch is circled in purple and contains a 'Dock to Charger' action. The settings for this action are displayed on the right in a 'Docking' configuration panel. The 'Marker' dropdown is set to 'Charger'. Below the configuration panel are three buttons: 'Validate and close' (green), 'Undo and close' (grey), and 'Remove action' (red).

8. For the **Charging** action, set the parameters as follows:
  - **Minimum Time:** Select **Ignore value**.
  - **Minimum Percentage:** Type **50**.



To read more about the different **Charging** action combinations, see [Charging action parameters explained on the next page](#).

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



## Testing the mission

To test that the robot executes the mission correctly, you can try running the mission.



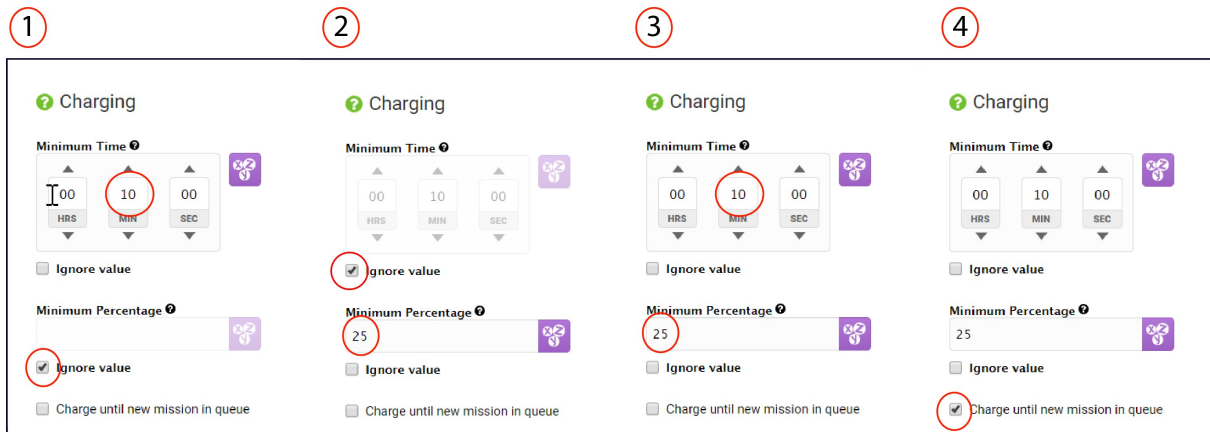
### NOTICE

Always test missions without payload to minimize potential hazards.

1. Go to **Setup > Missions**.
2. Select **Queue mission**  next to the mission you just created. The mission is now added to the mission queue.
3. Select **Continue**  to start the mission.
4. Watch the robot execute the mission, and verify that it performs as expected.

## 5.4 Charging action parameters explained

A charging action can be defined with a minimum time, a minimum percentage, or a combination of those two. This section explains the four options for setting the charging duration.



### 1. Minimum Time

If you want to ensure that the battery stays in the charging station for a minimum amount of time, you can select the **Ignore value** check box under **Minimum Percentage**. The robot will then charge for the set minimum amount of time before moving on with the mission.

### 2. Minimum Percentage

If you want to ensure that the battery is charged to a certain percentage, you can select the **Ignore value** check box under **Minimum Time**. The robot will then charge the battery up to the set minimum percentage before moving on with the mission.

### 3. Combination of minimum time and/or minimum percentage

When you select neither of the **Ignore value** check boxes, you combine minimum time and minimum percentage, so the robot stays in the charging station until it fulfills one of the two parameters before initiating the next mission.

#### 4. Charge until new mission in queue

You can choose to let the robot stay in the charging station until it receives a new mission by selecting **Charge until new mission in queue**. This is useful, for example when the charging action is not followed by other actions, or the charging action is not included in a looped mission in which case the robot will continue after the set charging time or percentage is fulfilled.

##### Topping up cycle



If the battery reaches 100% while the robot is waiting for a new mission, the charger disconnects and lets the battery discharge until it has dropped to 90%. It then connects again and tops up until the battery is back to 100%. This may mean that even if the robot has been in the charging station overnight, you might find it with a battery level just above 90% the next morning depending on where it is in the topping up cycle.