Autonomous Units

DMD4000 MANUAL

Userguide (eng)

03/2021

v.1.1

COPYRIGTH & DISCLAIMER

Manifacture:

Autonomous Units
Nyhavevej 6
5550 Langeskov
Danmark

www.a-units.com
Tel:+4593872270
E-mail: support@a-units.com

CVR: 41554819

INDHOLDSFORTEGNELSE

1. DOKUMENT INFORMATION

This document contains the following:

- Startup & operation of DMD4000
- Safety protokols
- Product presentation
- Guidelines for correct use & maintenance of the robot
- Update guide

1.1 Find more information at:

Dealer Page > Manuals

https://www.a-units.com/dmd4000manuals/

This segment contains the following resources:

- **DMD4000 Quick Start**
  The short guide, which teach you the essentials for using the robot. The document is to be found, inside of the shipment box.
- **MiRCharge 24V Operation instructions**
  Operation instructions describes how to setup & install MiRCharge 24V & MiR200 configures to automatic battery charging in the docking station.
- **DMD4000 product site**
  https://www.a-units.dk/
  This page contains specifications, pictures & brochures for the DMD4000.

1.2. Document history

This table shows the latest and previous versions of this document and the individual relation to the product-software version.

Revision	Release date	Description	SW	HW
1.0	15.03.2021	Userguide	1.0	1.0

2. SAFETY

Read the information in this segment thoroughly before you start and operate the DMD4000. Pay special attention to the safety instructions and warnings.

Autonomous Units disclaims any responsibility or claims, if the DMD4000 or its accessories is damaged, changed or modified in any way. Autonomous Units cannot be held liable for damage to the DMD4000 accessories or anything else if the guidelines are not followed.

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2.1. Types of safety warnings

Warning
Indicates a potentially dangerous situation, that can lead to death or serious person injuries.

- Take proper precautions to avoid injury or limb damage.

Caution
Indicates a potentially dangerous, that can lead to minor or moderate person injuries. Warns about practices that are not safe.

- Take proper precautions to avoid injury or limb damage.

Notice
Indicates important information under specific circumstances, that can lead to damage to equipment or property.

2.2. General safety precautions

This segment describes the general safety precautions to be considered, with use of the DMD4000.

Warning
While disinfection is in process **NO** humans or animals are permitted in the area.

- If entering the disinfection area leave at once! If severe discomfort is experienced contact your doctor.

Warning
Use of other liquids other than those provided by the manufacturer. As an example, alcohol, petrol, or chlorine may lead to poisoning, explosion, fire hazard or other. This may lead to health issues or death.

- **ONLY** use the liquids provided by manufacturer.

Warning

Touching the liquid without protection equipment, can lead to serious injuries. Comply with the following precautions for handling and use of the liquid H202.

- Always wear safety goggles and safety gloves when filling the robot with the liquid.
- If you spill liquid on clothes or skin, rinse with plenty of water.
- If the Liquid is exposed to eyes. Rapidly rinse with plenty of water and contact a doctor.
- Do not drink the liquid or inject in any way.
- Never pour remains of the liquid back to the original canister.
- Keep the liquid in the recommended temperature boundaries. Do not try to ignite the liquid.

Warning

Use of another charger than delivered by the manufacturer can lead to a fire hazard.

- Only use the original charger.

Warning

When operating in environments with children and people that suffer from mental disabilities (loss of short term memory, dementia, etc.) supply doors to rooms where the robot operates with a door monitoring (category 3, Pld, ISO138491:2015 is suggested) or a safe lock system. A full facemask shall be made available for staff, e.g. at door entries.

Caution
The emergency stop button performs a category 0 stop (IEC 60204-1:2018) of the operation with a performance of PLc (ISO183849-1:2015) in accordance with ISO13850:2015

Caution
A safety function measures the pressure of the compressor during operation with a performance of category 1, PLc.

Caution
The robot is unable to see stairs going downwards, holes in in the floor.

- Always mark stairs or holes on the map with forbidden areas.
- Always keep the maps updated.

Caution
Use fly function when the robot is controlled by a smartphone. Risk of injuries or damage to the robot.

- If the robot is being operated by a smartphone you must ensure the smartphone has the fly function enabled. An incoming call will disconnect the controls of the robot.

Notice

- Ventilation must be powered off or covered. Windows and door must remain closed. Ensure small vent shaft by door or windows are sealed.

- Fire alarms must be disconnected or adjusted. Sprinklers are heat sensitive and will not be affected.

Notice
In areas the robot is disinfecting, warning signs must **always** be setup, before usage.

2.3. Intended use

DMD4000 is intended for disinfection to indoor environment. Where access is prohibited.

DMD4000 shall be used as shown on the guide on page 13. And be prepared for the envioriment in accordance with the guidelines. This is a condition for safe use of the DMD4000.

2.4. Abuse that can be foreseen

For any usage that differentiate from intended use is seen at abuse, this also includes:

• **Missing safety wear when filling robot with the disinfection liquid.**
Risks of severe injuries.

• **Use of other liquids than manufacture.**
Risks of explosion

• **The liquid canister may not be used for other liquids or substances.**
Risks of explosion.

• **Direct inhaling of the liquid.**

Risks of severe injuries.

• **Consuming the liquid.**

Corrosive and probability of death

• **Do not modify the liquid canister.**

May lead to leakage of the liquid.

• **Usage of person transport on the robot.**

Risks of injuries.

• **Steep ramps on the route.**

Risks of damage to the robot when operating on steep platforms such as ramps, can cause the robot to slip.

• **Outdoor usage.**

Risk of damage to the DMD4000. It is strictly designed to indoor use only.

• **Non-compliance of the guidelines for operating the robot.**

Read section 4.0

• **Operating past the nominal operation parameters and specification for the environment.**

Risks of unitability, electrocution, or tilt of the robot.

• **Operating in potential explosive areas.**

Risk of personal injury

• **Modification of the MIR robot's safety configuration or safety system**

Risk of personal injury

2.5. Safety related functions and interface.

DMD4000 combined with the platform MiR200 is equipped with safety function and safety electrical interface. Each safety function and interface are designed in compliance, with the standard ISO 13849-1.

2.6. Restrictive safety related functions

DMD4000 has built-in safety related functions, that ensures a safe operating procedure in its designated work environment. An advanced software controller ensures that the movement and driving pattern is within the safety related boundaries. This leads to that the safety functions wont trigger unless a boundary is met. If a boundary is met the safety system will trigger a category 0-stop (immediate stops the power to the machines activators in compliance to IEC 60204-1) Afterwards the DMD4000 will make an appropriate break, which leaves the robot in a stationary position.

Read the technical specification on the webpage for more info.

Evading collision

The safety function of evading collisions ensures the robot stops before it collides with a human or an object. The function measures the speed of the front wheels, and exchanges between predefined protective fields. Which means as speed increases the protective field will enlarge. This ensures that the robot will stop before any collision with humans or objects. The safety function will automatically deactivate after 2 seconds, when the protective field no longer breached.

Avoidance of over speeding

The safety system monitories for each engine the maximum speed. If the speed limitation is reached indicates that the speed controller is not implied.

The safety function avoidance of over speed needs to be deactivated manually by pressing the restart button.

Emergency stop.

DMD4000 has an emergency stop. The button is only intended for emergency situations and may not be used to stop normal operating procedures.

The emergency stop needs to be manually disabled by releasing the button and press the restart button. Look at section 4.4 page 26 for further information.

2.7. Lithium battery

This segment contains information of safety measures related to lithium batteries in the MiR200 platform.

Warning
Lithium battery containers can become hot, explode, or ignite which can lead to severe injuries, If mistreated electrical or mechanically. Comply with the following rules for handling and usage of lithium batteries.
the battery may not be short-circuited, recharged, or connect with the wrong polarities.

- the battery may not be short-circuited, recharged, or connect with the wrong polarities.
- Do not expose the battery for temperatures outside of the boundaries. Do not burn the battery.
- The battery may not be crushed, perforated, or torn apart. The Battery contains safety and protection parts, if damaged it can lead heat generating, explode or ignite.
- Keep the battery dry.
- If the battery leaks and the fluid encounter the eyes, do not rub your eyes, and wash the exposed area with plenty of water. Seek immediate medical attention. Without treatment it can lead to damage to the eye.
- Only use the original charger (mobile charger or docking station) Always follow the guidelines from the battery manufacturer.

3. PRODUCT PRESENTATION

DMD4000 is an autonomous disinfection robot. The robot uses an airborne disinfection method. DMD4000 produce a dry mist with the liquid H2O2 which contains hydrogen peroxide and peracetic acid which saturates the air in a room. The mist contains drops (8-12µ) that applies to all available surfaces.
The user operates DMD400 by a web-based interface that can be operated by browser on a PC, smartphone, or a tablet. Each robot has its own unique Wi-Fi.

For further details lookup on segment 4.2 *Connecting to the DMD4000 web interface* on page 14.

DMD4000 **Must** be configured by a technician to create a specific route or used for more advanced missions.

DMD4000 executes its disinfection through a map by using its position to navigate through the map. The map is created or imported by a technician, the first time the robot is operated. The internal map contains a floor plan of the desired disinfection area. The robot has installed laser scanners that helps evade obstacles (Humans, furniture, plants, et cetera) That is not already recorded in the map.

With a MiR charge 24V its possible for the robot to automatically move to a docking station. All it takes is to define charging mission and a charge position on the map.

3.1 Main functions on the DMD4000

Main functions on the DMD4000 are:

• disinfect automated all surfaces in a room.

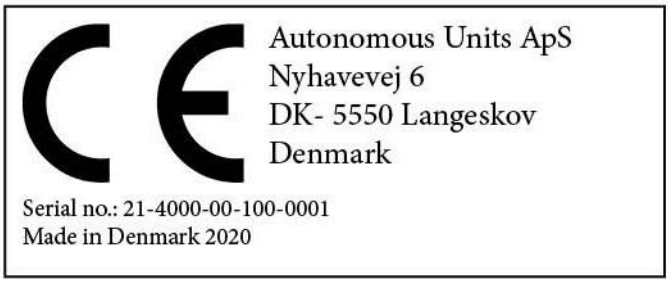
Kills up to 99,9999% (up to Log6 reduction) of bacteria and other harmful microorganisms.

- **DMD4000 is designed to maneuver efficient in a furnished and dynamic work environment.**

3.2 Identification label.

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

Example of MiR200 CE-marking and identification label.



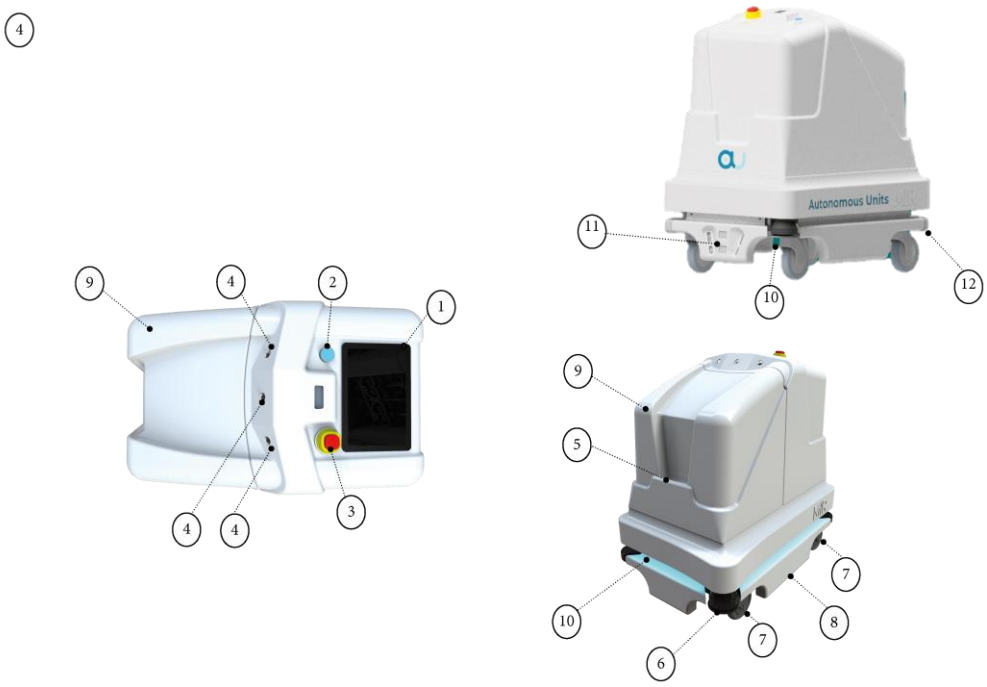
CE	Autonomous Units ApS declares, that DMD4000 follow the requirements in the relevant EF-directives
Seriel number	Serial numbers are the robot's unique indicator. The last 4 digits tells the robots original name, example 21- 4000-00-100-XXXX
DMD4000 1,0,0	Product name og hardware-version.

3.3. Extra parts for DMD4000.

This segment describes the parts on DMD4000, that are visible on the exterior surface.

1	Tablet	7	Steerwheel - all four steeringwheels

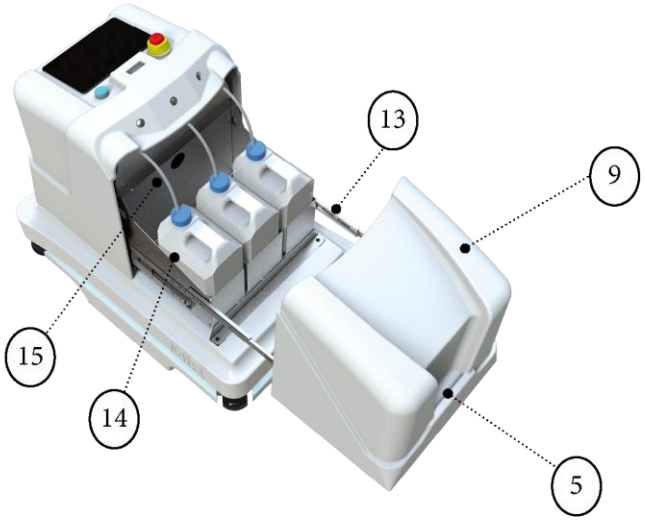
2	Start / Stop button	8	MiR Platform
3	Emergency stop	9	Ejectable topshields
4	Spray nozzles	10	Ultrasound sensor for detecting transparent objects
5	Handle to open the robot	11	3D-depthcamera
6	Laserscanner	12	Removeable plastic shield for protection of charging socket.



3.4. Internal parts on DMD4000

This segment describes internal parts on the DMD4000.

5	Handle for shield opening
9	Ejectable topshields
13	sliderails
14	Liquid Canisters
15	Liquid hoses



3.5. Sensor system

Collaboration between the external and internal sensors ensure the robot can navigate in the environment. what is most important DMD4000 operates safely among humans or objects as furniture, machines, stairs, et cetera.

3D-Cameras

Two depth cameras are installed both in the front and the back. The cameras register object and the distance to the object. The cameras are used for maneuver around obstacles.

3D-cameras register objects:

- Vertical measure up to 1800m and in a range of 1950 mm in proximity of DMD4000.
- horizontal 180 mm until the field touch the floor.

3D-cameras does not register object within 50mm of the lens.

The cameras feedback is used as 3D-point-cloud-data. They do not register familiar objects or persons.

Ultrasound sensors

Four ultrasound sensors are installed on DMD4000 two in the front and two rear. The sensors purpose is to register transparent objects.

3.6. Ligth indicator

This segment describes the light indicators the DMD4000 use.

Status indicator

The led strips mounted on all sides of robot the color indicates the status of the robot. The colors are also used as part of missions. As default the DMD4000 is delivered with the following setup.

Rød	Nødstop
Grøn	Klar til job
Cyan	Kører til destination
Lilla	Mål/rute blokeret
Hvid	Planlægning/beregning
Gul	Mission sat på pause
Blafrende gul	Opstartssignal inden pc er aktiv
Udtonet gul	Nedlukning af robotten
Blinkende gul	Relativ bevægelse, ignorerer forhindringer
Lilla – gul	Generel fejl, f.eks. hardware, lokalisering
Blå	Joystick til manuel kørsel
Blafrende blå	Kortlægning
Regnbue	Opladning: Ladestation
Blafrende hvid	Prompt user/Venter på brugers respons

4. HOW TO GET STARTED.

This segment describes how to get started with the DMD4000.

5.1. Part list

When you receive the DMD4000 it contains.

- 1 x DMD4000
- 1 x Mobile charger
- 1 x Userguide
- 1 x Quick start guide
- 1 x *DMD4000 usernames & passwords*
- 2 x Warningsigns
- 1 x Tablet

5.2. Extracting DMD4000

This segment describes how to extract the DMD4000.

1. Remove the pallet lid and take the DMD4000 kit.
2. Remove the layer of foam blocks.
3. Use the packaging as a ramp at the backend of DMD4000.

5. STARTUP GUIDE

This segment describes how to get started with DMD4000.

Notice
Read the safety chapter before booting the robot.

Notice
The robot should always be setup by an authenticated technician.

Warning
Pattens of operation areas **shall always** be executed by a technician. If changes are made on the maps, will Autonomous Units disclaim any liability when using DMD4000.

5.1 Startup

Follow these steps for booting the DMD4000.

Step 1	Press the blue button in the MiR platform, on the frontside. The robot will start flashing yellow.	

Step 2	Wait while the robot is flashing yellow. Wait until a solid red light is shown.	
Step 3	When the light is red the blue button on the top will start flashing. Press the button while its flashing blue and a click sound will be made.	
Step 4	After the click the robot will change its color to yellow. The robot is now ready but in pause mode.	For more information see section 5.5

Notice
DMD4000's automatically and manual routes for mapping shall be made by a technician.

5.2 Connecting to the DMD4000 web interface.

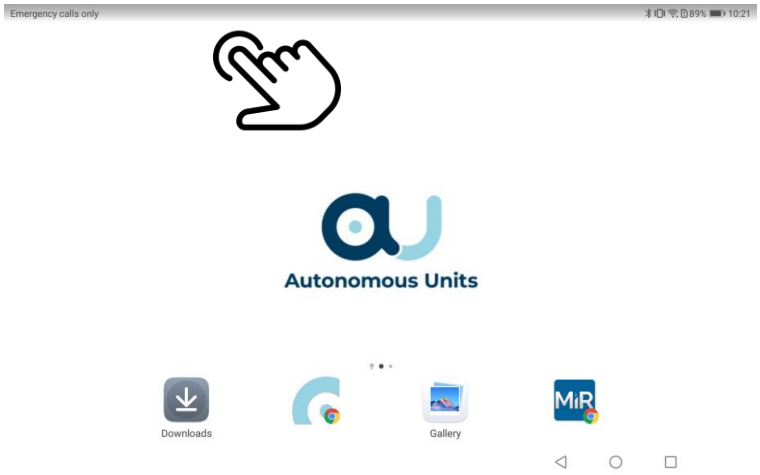
Once the robot is booted it transmits a Wi-Fi access point. The Wi-fi is available for connection by PC, tablet and phone.

Notice
Username and password for the Wi-Fi for managing the DMD4000 interface is in the document under *DMD4000 username and password.* The document is to be found inside the box along with the robot.

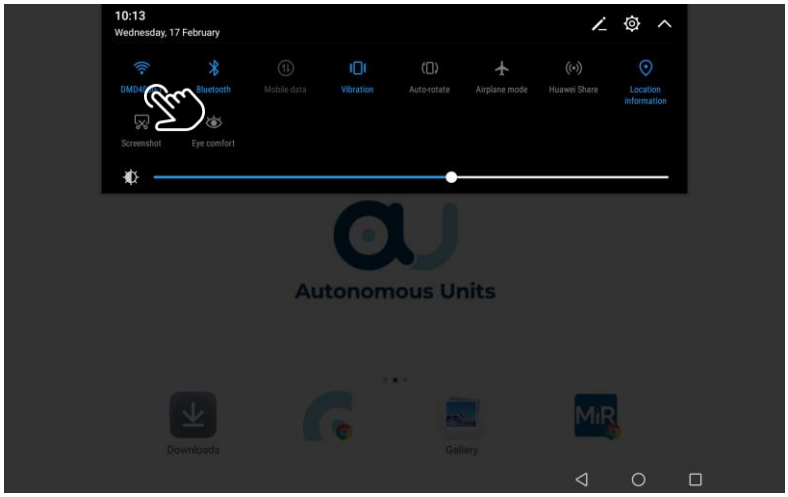
Follow the steps to connect to the DMD4000 web interface.

Use the tablet included tablet to access the Wi-Fi Acesspoint

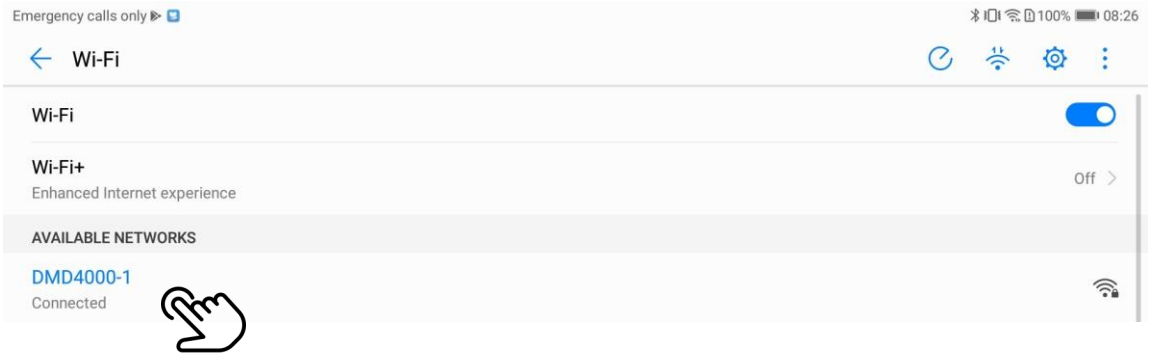
1. Boot the tablet - Connect to the DMD4000 Wifi by pulling down from the top screen.



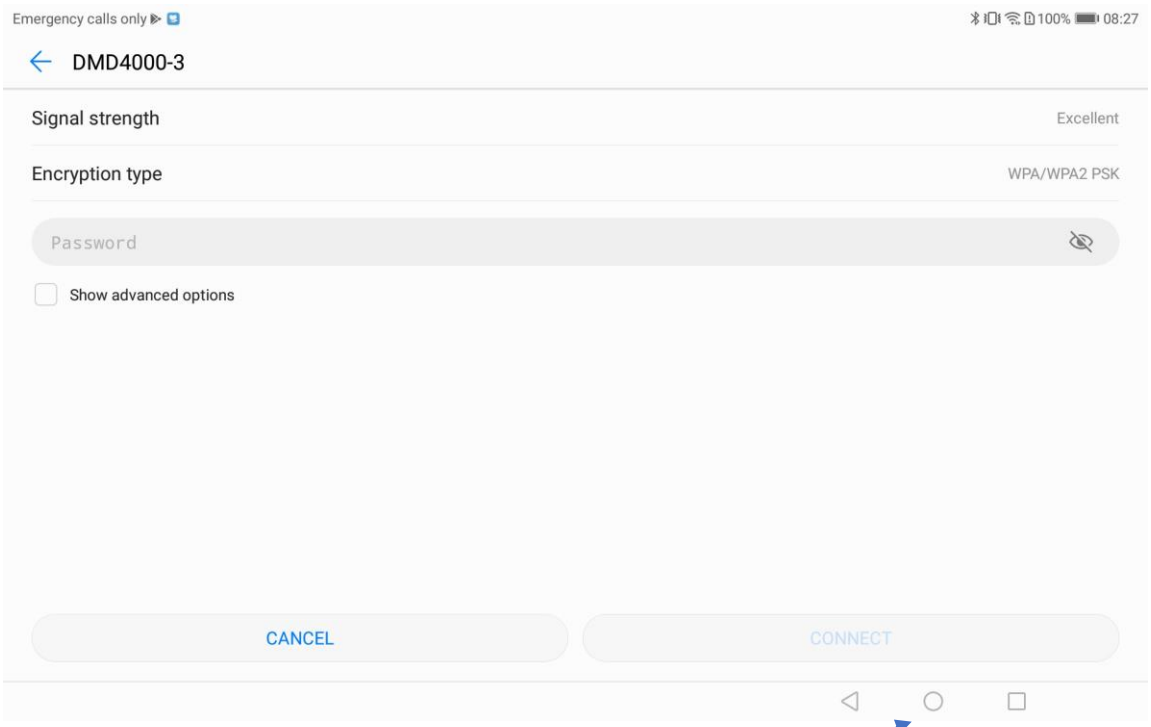
2. Press and hold for a few seconds in the top left side.



3. The Wi-Fi name should be listed as: DMD4000-XXX



4. Enter the password.



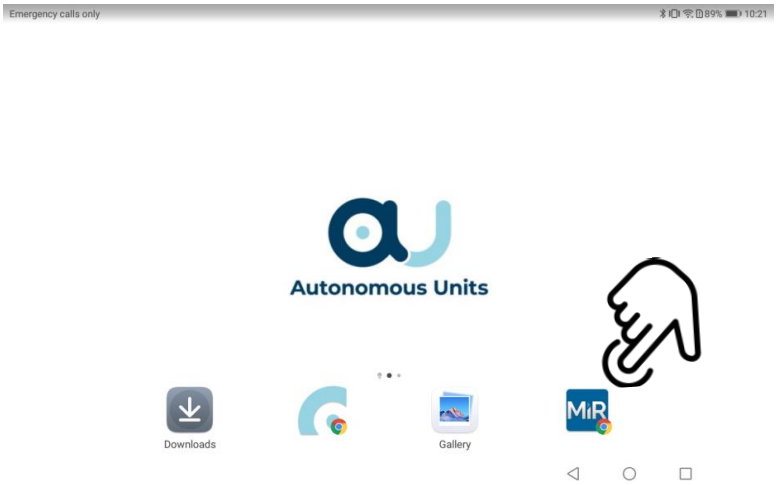
You have now established Wi-Fi connection to the DMD4000.

In the bottom of the tablet, press the cicular icon to return to the homescreen.

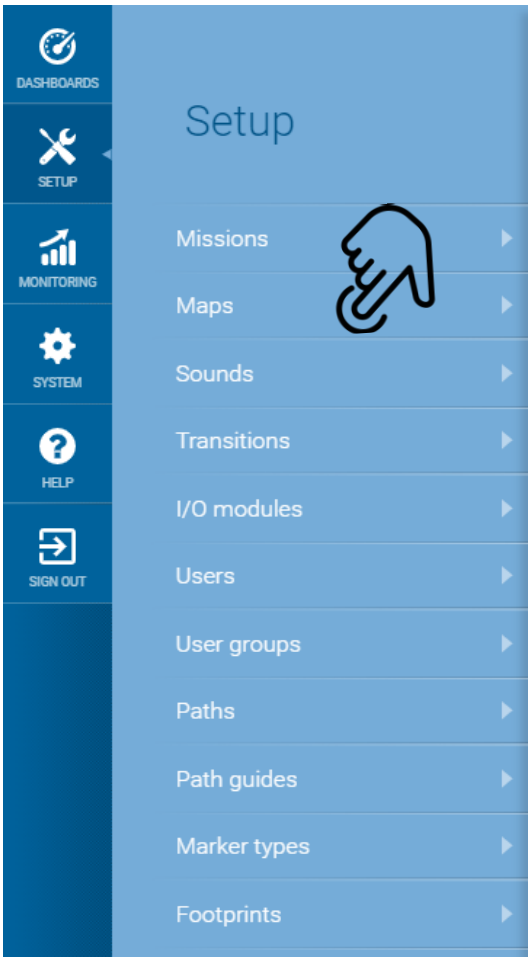
5.3 Use of manual driving control.

This segment will guide you how to use the manual driving controls.

1. Unlock the tablet and press on the MiR logo.

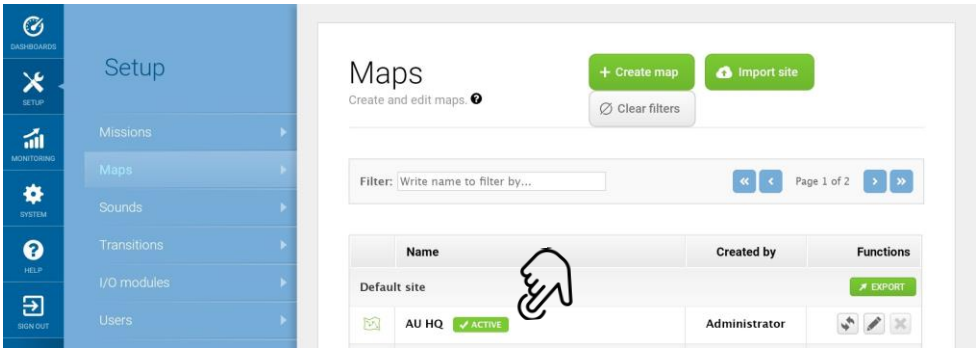


2. To change map press on *setup* in the navigation tab and select maps.

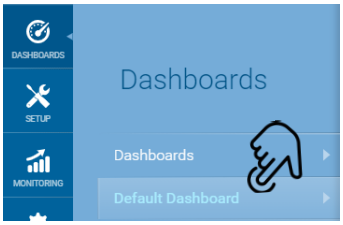


3. A list of maps will appear. Choose the request map by pressing the tick for the specific map. Await while the robot is changing map.

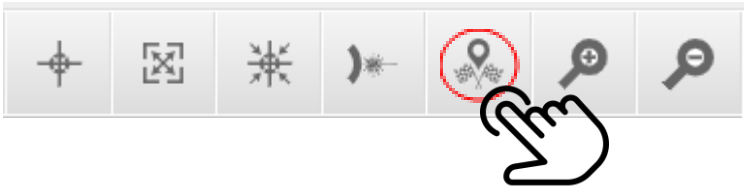
4. Double check the correct map is chosen. A green box with "*Active*" will appear next the map name if done correct.



5. When the correct map is loaded go to the navigation tab choose *dashboards* and select *Default dashboard.*



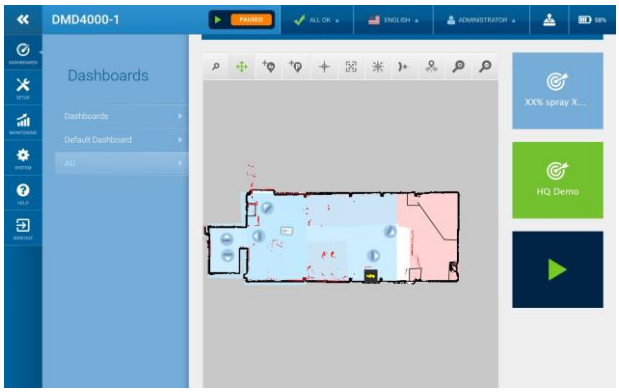
6. The selected map is shown on the tablet. To calibrate the DMD4000 select the tool "*Set robot's start-position*" Once the tool is selected press on the map where the robot should be on the map and drag the marker to orientate the robot.

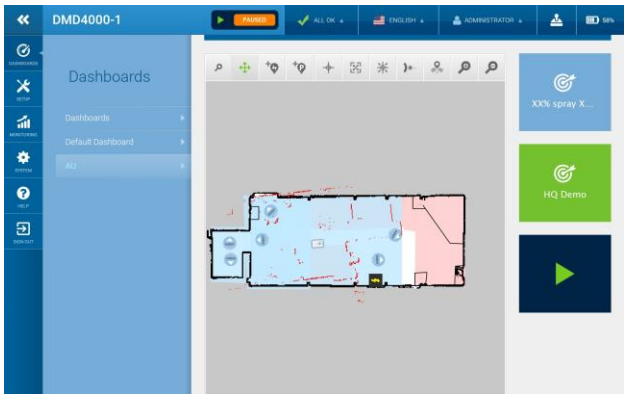


On the tablet you are now able to see the DMD4000 orientation. The red dots show the orientation of the robot. If the robot is not correctly orientated read the next step

✓ Correct orientation.

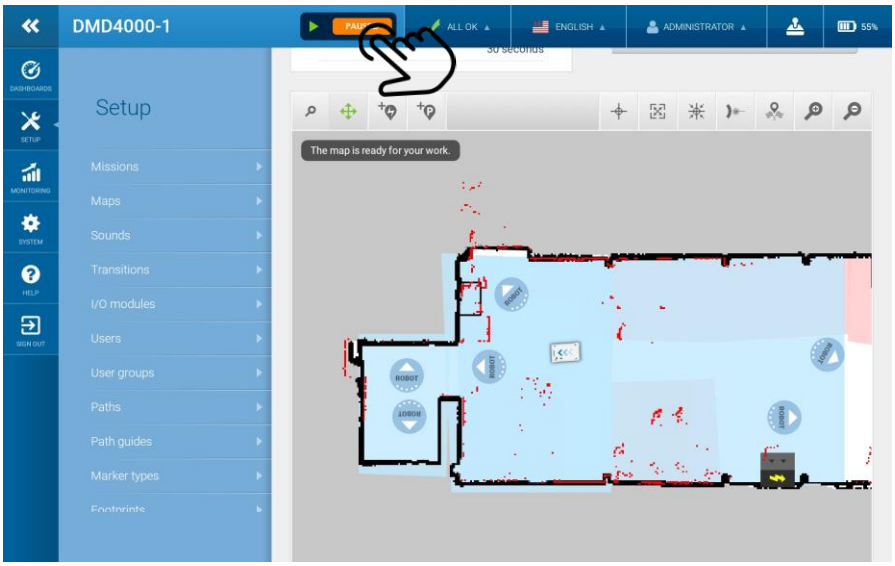
⊘ Wrong orientation (follow next step)



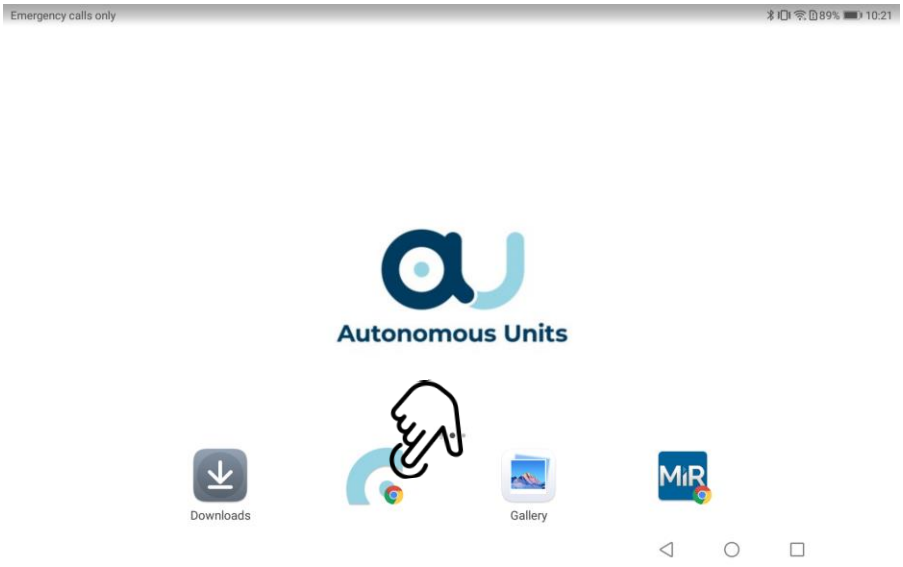


If the DMD4000 orientation does not line up with the map- the red dots on the map visualize the orientation. If the red dots do not align with the map press “Adjust robot position” until the dots align with the map.

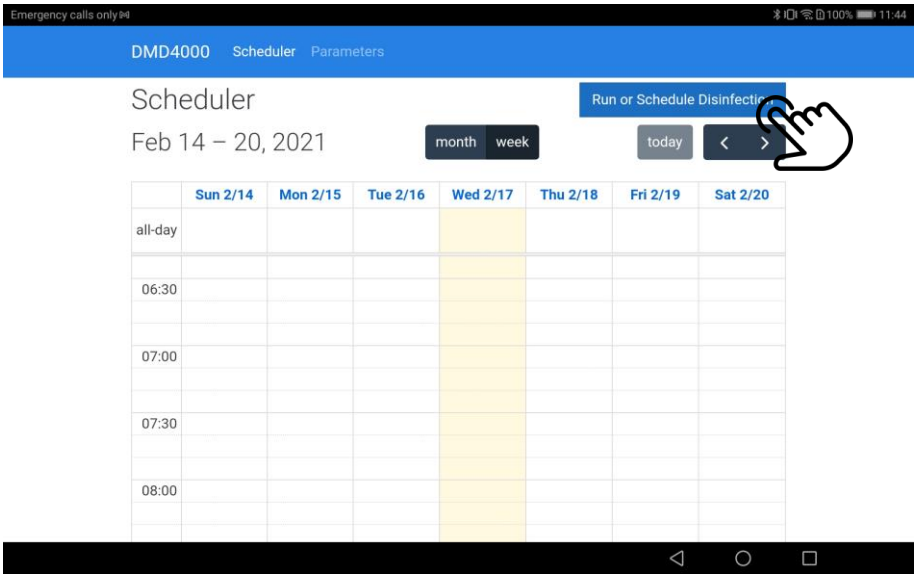
7. When the DMD4000 dots align with the actual map, press PLAY in the top of the screen. The robot is now ready for requests.



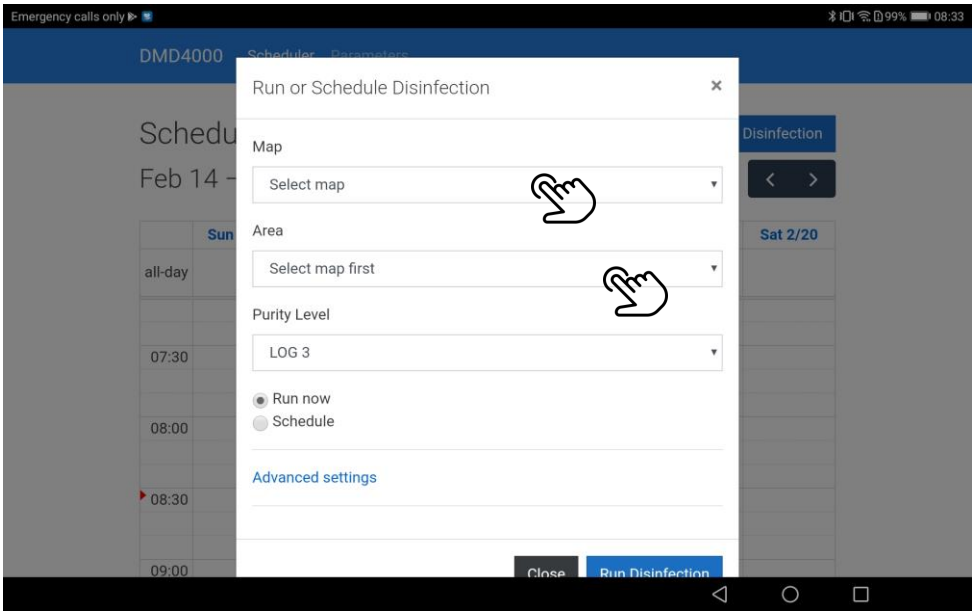
8. Minimize the MiR application and open Scheduler.



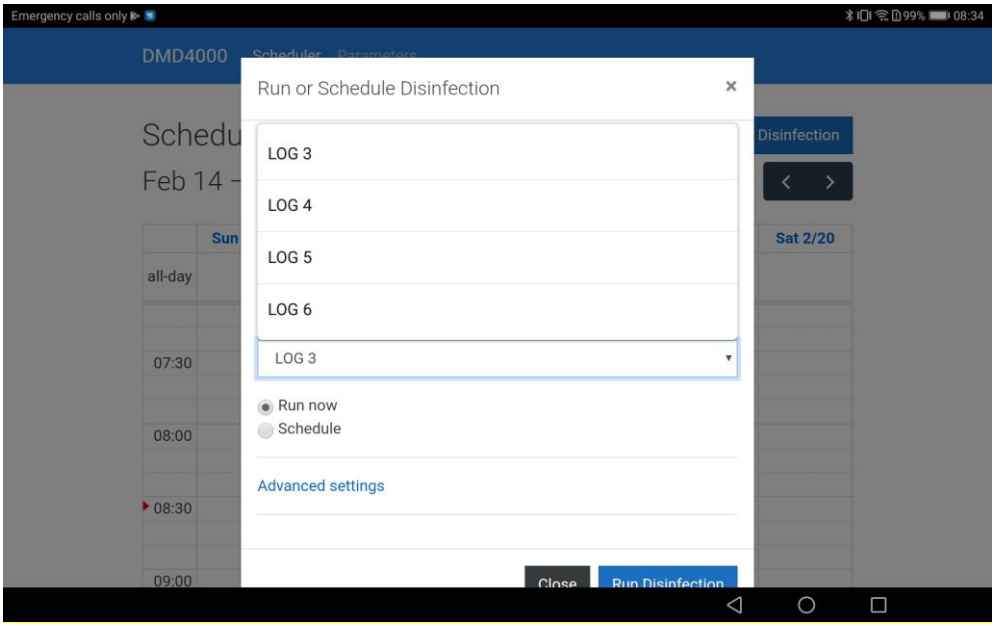
9. Press the tab “Run or Schedule Disinfection”



10. Choose which *Map and Area* you desire to disinfect.



11. Then select which type of purity level to disinfect with. Look at the guide on our homepage for log levels www.a-units.com

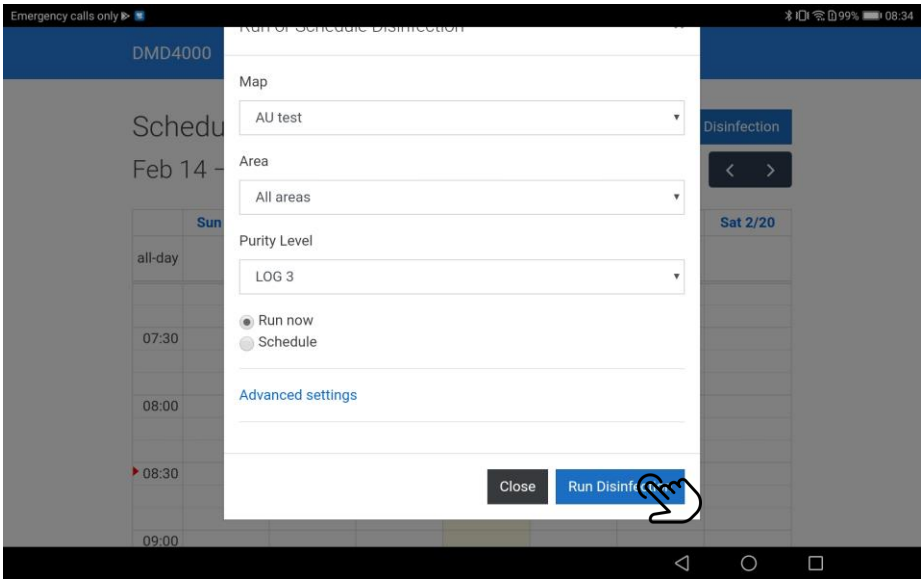


12. Run Now or Schedule

In this segment the Run Now function and Schedule is described

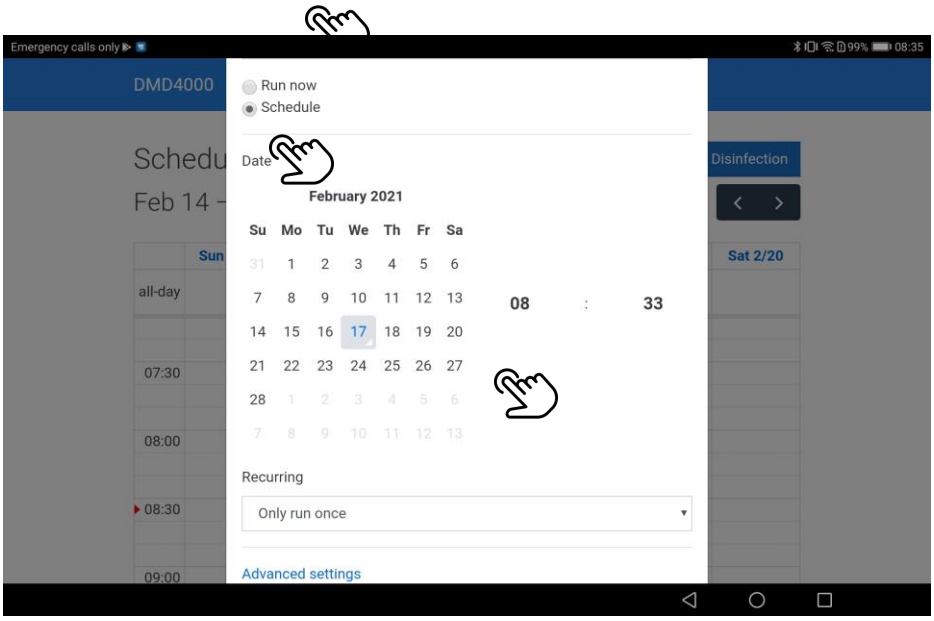
Run Now

To start the manual driving immediately select “Run Now” and press ***Run disinfection.*** The robot will now start its route.

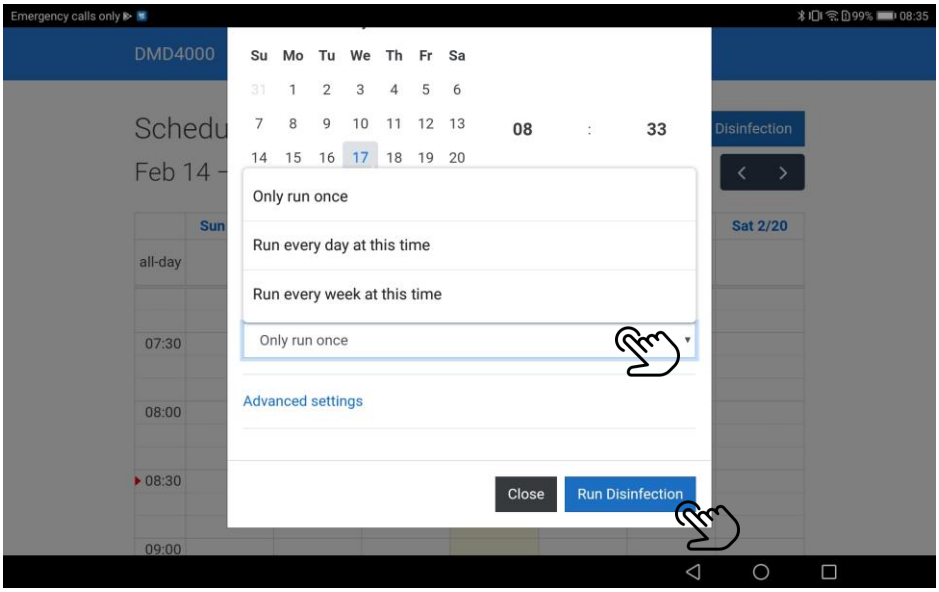


Schedule

If you wish to schedule the robot for start at a specific date and time. Select "Schedule" and select the desired date and time.



Recurring function is to choose if the route should be run more than once. If done press ***Run Disinfection.***



13. When pressing ***Run Disinfection,*** the robot will emit 3 beeps and a voice from the robot will say “Keep distance I am disinfection now”.

If the DMD4000 is blocked by a door with no automatic open function. Wedge the doors for the route.

Notice
If DMD4000 does not start, go to segment 7 on page 20 to ensure the DMD is set to “**running**”

14. DMD4000 maneuvers to the to the selected disinfection area. When DMD4000 is in position it emits a warning signal for a duration of 10 seconds, after the

disinfection starts. **Remember to place the warning sign "Warning no entry while disinfection is in progress" on the door to the disinfection area.**

Caution
Remember to always put up the sign *"Warning no entry while disinfection is in progress"* on the door where disinfection is ongoing.

Warning
Its not allowed for humans or animals within the area under disinfection.

- Entering the area while disinfection is in progress. Leave the area at once. If experiencing serve discomfort, contact a doctor.

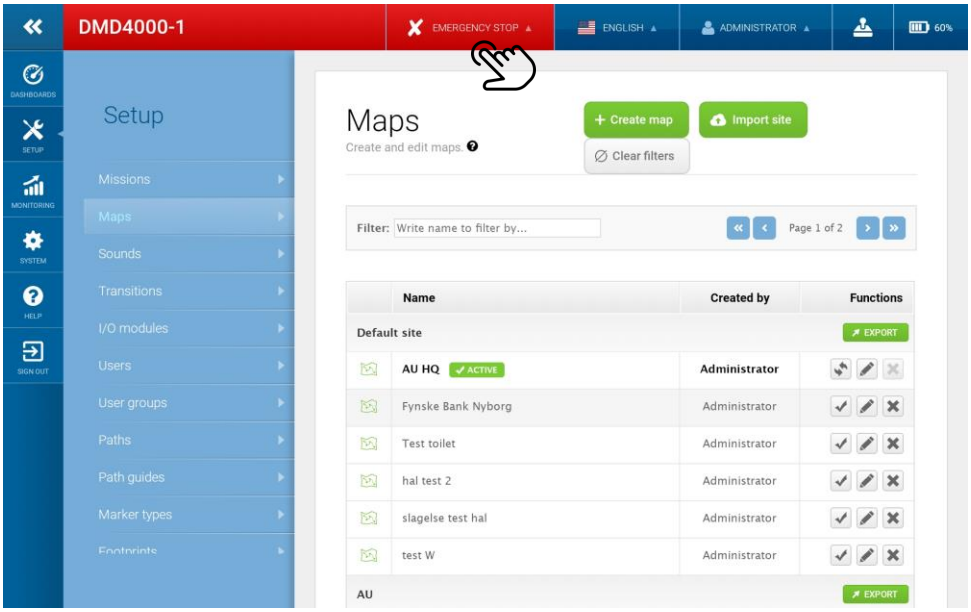
15. Once the robot is finished disinfecting it will automatically maneuver to the charging docking station.

Notice
If DMD4000 is within a room without automatic open. You need to manually open the door after the disinfection.

- Press on the home icon on the tablet. DMD4000 will emit 3 warning beeps and return to the charging station.

5.4 Activating emergency stop while mission is active.

When emergency stop is pressed while mission is ongoing it will stop immediately and the led will glow red. You can also see in the MiR application in the top that emergency stop is pressed.



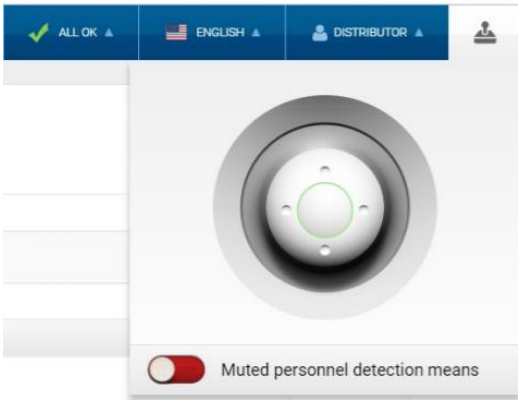
1. **Restart after emergency stop.**
   DMD4000 can be restarted by turning the emergency knob clockwise.

2. After releasing the emergency stop the blue button on the top will start flashing. Press the button and a click sound which signals that the robot is ready and will reinitialize the planned route. The DMD4000 Is now changing its light to green.

5.5 Driving the robot in manual mode.

To control the DMD4000 in manual mode is to be done through the Mir application.

1. Select the joystick-icon in the MiR application then press *manual control* a joystick will appear.



2. Status light on the DMD4000 will change to blue which indicates the robot is being controlled manually.

3. Drive the robot with the joystick.

5.6. Manual charging of DMD4000.

The DMD4000 is delivered with a fully charged battery, it can be operational in up to three hours before a recharge is necessary. Follow these steps for a guidance to recharge the robot with the included charger.

1. From the back end pull the black plastic shield off to expose the charging socket.

To speed up the charging its recommended to shutdown the robot.

if two robots need to be charged right after each other, you need to wait approx. 1 min before the next robot can be charged. This ensures that the charger knows a new robot is attached.

2. Connect the charger to the socket and a power socket. Flip the switch on the DMD4000 to start the charging.

Use only the original charger.

3. After a maximum of 3,5 hour the robot is fully charged.

4. Flip the switch and remove the charging cable from the socket and put back the plastic shield.

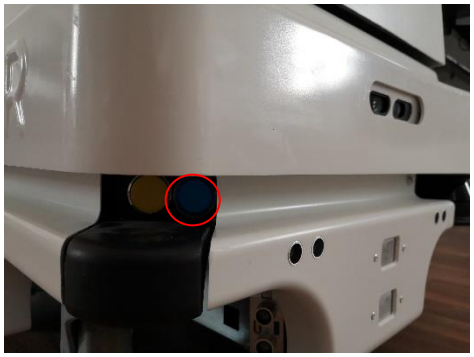
DMD4000 detects the cable and the flip switch both will trigger an emergency stop.

5.7. Shutdown DMD4000

To shutdown DMD4000 follow these steps.

6. Ensure the robot is not moving or executing a command.

7. Press the power on/off button.



8. DMD4000 will initialize a shutdown process. In the process a fading yellow light will show from the status indicator.
9. Once the shutdown sequence is done the status indicator will power off.

If intended to transfer the robot or bring it to service its important to pull the battery connector apart while undergoing transport.

6 MAINTENANCE

The maintenance program gives an overview for procedures for regular cleaning and replacement of parts.

The intervals between maintenance may differ in work environment and number of usages.

6.1 Regular weekly inspection and maintenance tasks.

Once a week the following maintenance tasks must be done.

Parts	Maintenance tasks
Nozzles	Remove dirt with a moist cloth and ensure the nozzles is not blocked. ⓘ Do not use compressed air.
Liquid Cannister	Inspect for lime scaling at the liquid. Remove it with a moist piece of cloth and gloves. ⚠ **Caution** equip protective equipment before you clean the canister. ⚠ **Warning** • If the liquid is exposed to clothing or skin clean with plenty of water. • If the liquid is exposed to the eye immediately clean with plenty of water and contact medical attention. • **The liquid many never** be poured back to the original canister.
Shields	With a moist cloth wipe the surfaces.
Laser scanners	Clean the optical covers on the scanners for best functionality. Avoid using agressive or scrubbing detergent. Clean the laser scanners with a moist piece of cloth or read further for better instructions for maintenance.

	Follow the instructions before reaching out to your local technical support. We recommend cleaning the scanners daily to increase the DMD4000 performance and minimize the risk of issues. Common issues with dirty scanners: • DMD4000 are unable to detect marks. • DMD4000 trigger emergency stop without reason. **Notice** Static electricity is the main reason the optical cover is attracts dust particles. It is possible to reduce dust particles by using anti-static plastic cleaner.
Steeringwheels	Remove dirt with a moist piece of cloth and ensure that nothing is stuck in the wheels.
LED-strips	Check that the led strips are fully functional if light is visible all around the DMD4000.

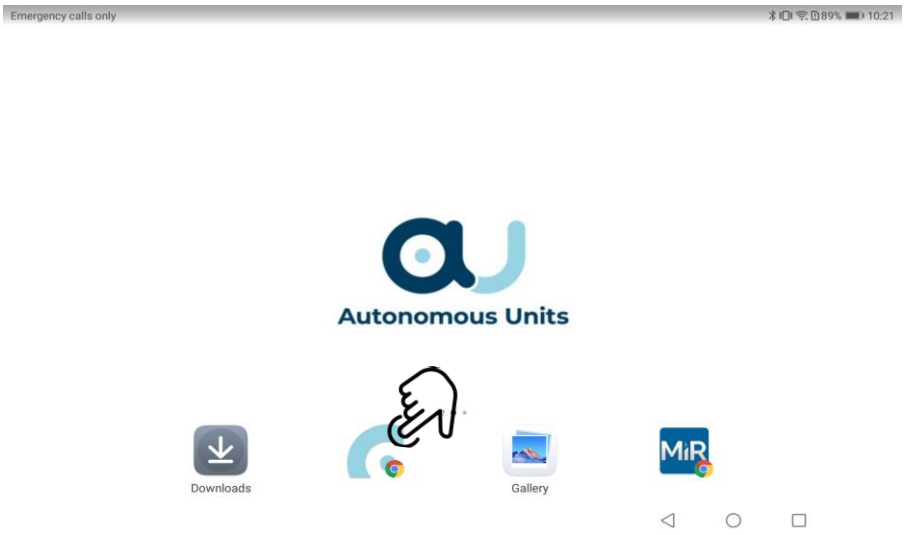
6.2 Regular inspections

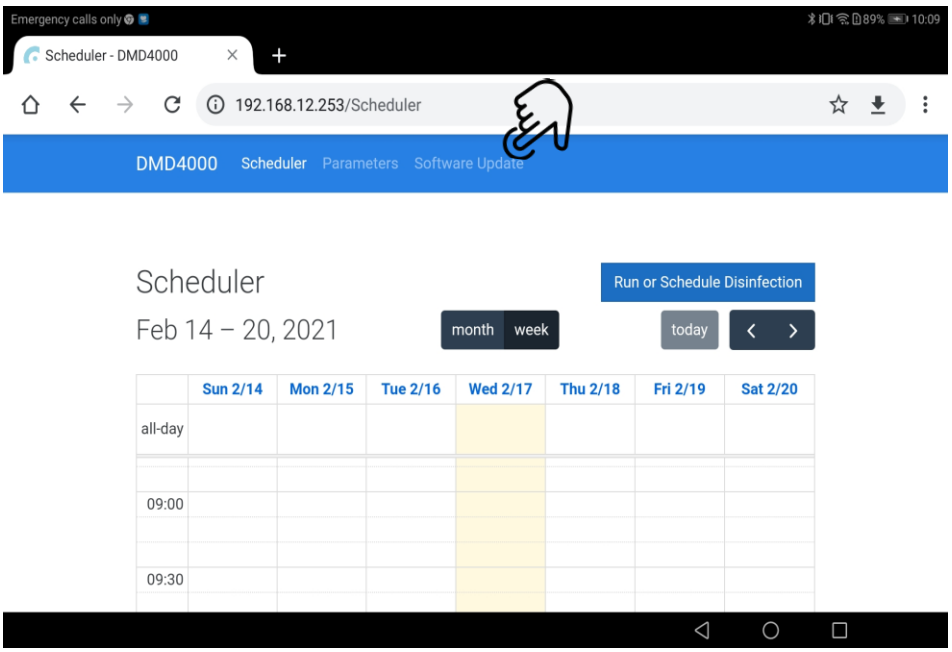
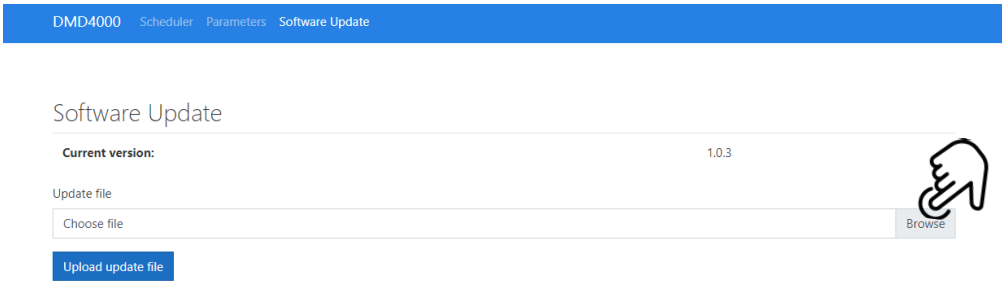
- Press the power button to shutdown DMD4000.
- Flip the battery switch to cut the power from the battery.
- Power off the Relays and disconnect the battery.

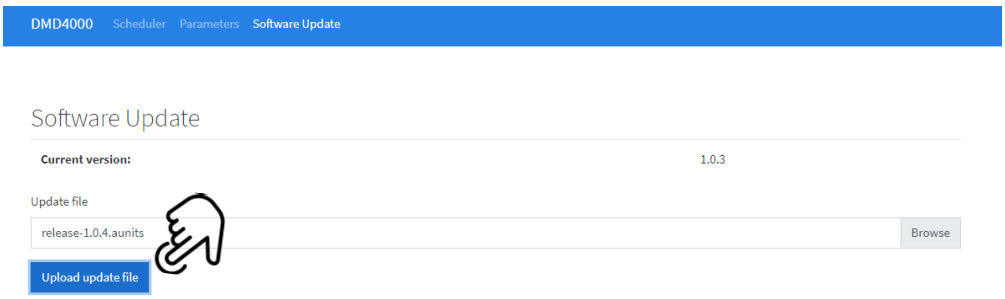
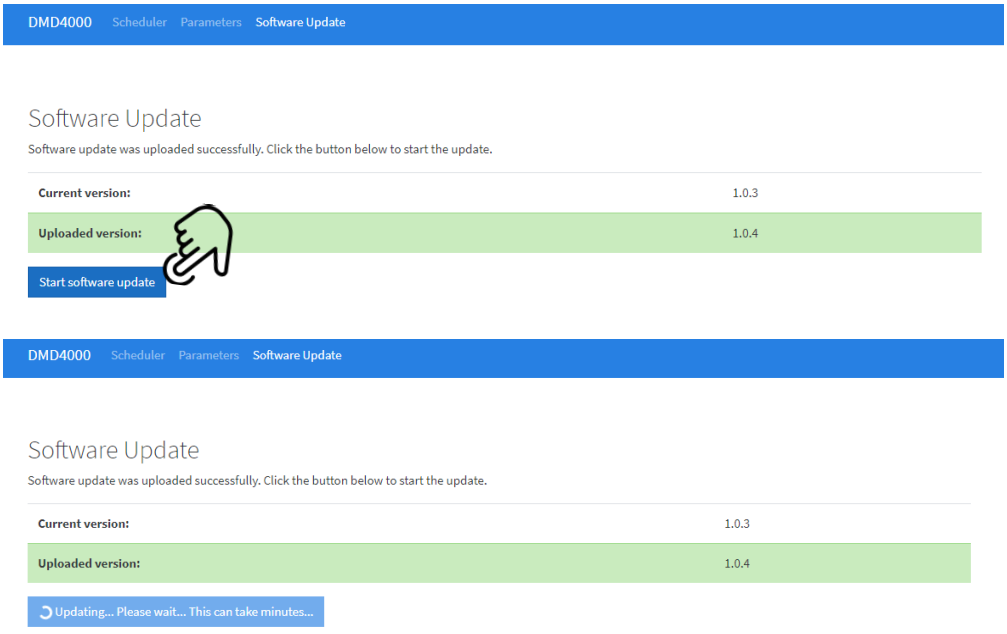
7 UPDATE OF DMD4000-SOFTWAREN

7.1 Update guide

Follow the steps to update the software on DMD4000.

Step 1	Unlock the tablet. Open the Scheduler application. 

Step 2	Press the ”software Update” tab. 
Step 3	Press browse at ”choose file” and upload the send firmware update. 

Step 4	Once the file is found press “Upload update file” 
Step 5	Press ”Start software update” and wait. 

Step 6	The update was successful, you can now close Scheduler and continue to use the robot.