Technical Manual
Range Picker
RP-1200

EN   **ENGLISH**

1 Important Information

©2019 ECHO Incorporated. All Rights Reserved.

This manual, or parts thereof, may not be reproduced in any form, by any method, for any purpose.

ECHO has taken reasonable care in compiling this document, however ECHO accepts no liability whatsoever for any error or omission in the information contained herein and gives no other warranty or undertaking as to its accuracy.

ECHO can accept no responsibility for damages, resulting from the use of the operating software. In addition, we refer to the conditions of use specified in the license contract. ECHO reserves the right to amend this document at any time without prior notice.

ECHO and its affiliates are not liable for damages or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

This manual contains the original instructions. Information contained in this manual is provided as an indication and is in no way contractual. It can be changed by ECHO, without the need for prior announcement. Obtain updated information at: myrobot.echorobotics.com.

The robot has been designed to high safety standards. Risk is always possible. Read and understand all *Safety Information*.

This manual refers to Generation 2.0 series of robots with software version 4.0.

1.1 Administrative Support

Send emails to: admin@echorobotics.com.

1.2 Service and Parts

Only use an authorized Authorized ECHO Robotics Dealer for service procedures.

Genuine ECHO Robotics parts and are available only from an Authorized ECHO Robotics Dealer. Always supply a model and serial number when purchasing parts and assemblies.

www.echorobotics.com

1.3 FCC Declarations

This equipment has been tested and found to comply with the limits/or a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

> ⚠ **DANGER**

1.4 California Proposition 65

Cancer and Reproductive Harm

www.P65Warnings.ca.gov

2 Safety Information

Throughout this manual and on the product itself, you will find safety alerts and helpful, informational messages preceded by symbols or key words. The following is an explanation of those symbols and key words and what they mean to you.

Circle and Slash Symbol:

🚫

This symbol means the specific action shown is prohibited. Ignoring this symbol can result in damage to property and serious or fatal injury.

The safety alert symbol accompanied by the word "DANGER" calls attention to an act or condition which WILL lead to serious personal injury or death if not avoided.

The safety alert symbol accompanied by the word "WARNING" calls attention to an act or condition which CAN lead to serious personal injury or death if not avoided.

The safety alert symbol accompanied by the word "CAUTION" calls attention to an act or condition which may lead to minor or moderate personal injury if not avoided.

The enclosed message provides information necessary for the protection of the unit.

2.1 Safety Symbols

	Safety and Information Label
⚠️	Caution: The robot can be dangerous if misused.
⚠️	Never place hands or feet under the robot while operating.
⚠️	Beware of projectiles. Keep a safe distance.
🚫	Keep animals away from the robot.
🚫	Water cleaning with high pressure jet systems can cause damage.
🔢	The robot is protected by an access code.
📖	Read the technical manual before using the robot.
STOP 🔧	Always stop the robot and wait for the cutting blades to stop before handling the robot.
🚶	Always keep a safe distance from the robot while handling.
🚫	Do not ride the robot.
👪	Keep bystanders away from the robot.
🧤	Protective gloves must be worn when handling the robot, especially the cutting system.
🔒	The robot is equipped with an anti-theft system.

3 Theory of Operation

The robot collects golf balls in a random pattern. The robot fills its internal collection basked with balls. When the basket is full, the robot moves to a charging station with a ball drop pit. When the robot docks at this charging station, it triggers the release of the balls from the basket.

A peripheral wire buried in the ground defines the collection area.The charging station energizes the peripheral wire. An electromagnetic field is generated within the working area.When the robot senses the location of the peripheral wire, it stops, turns back into the field, and continues to collect balls.

The robot is equipped with obstacle detection sensors. When the robot detects an obstacle it will slow down, contact the obstacle, then perform a maneuver to avoid it.

When the battery of the robot needs to be charged, or the robot is filled with balls, it will stop, move toward the peripheral wire, then follow a trackborder back to the station loop wire. When the robot detects the station loop wire, it follows it to the charging station. The station loop wire guides the robot into and out of the charging station.

When the robot docks at the charging station it releases the collected balls into a drop pit.
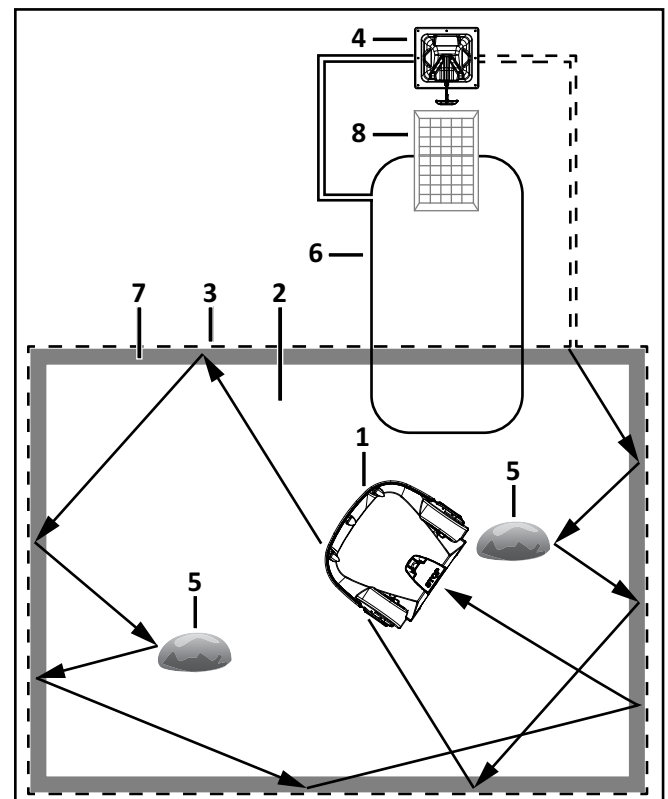
1 – Robot
2 – Collection area

3 – Peripheral wire

4 – Charging station

5 – Obstacle

6 – Station loop peripheral wire

7 – Trackborder

8 – Drop pit

4 System Components
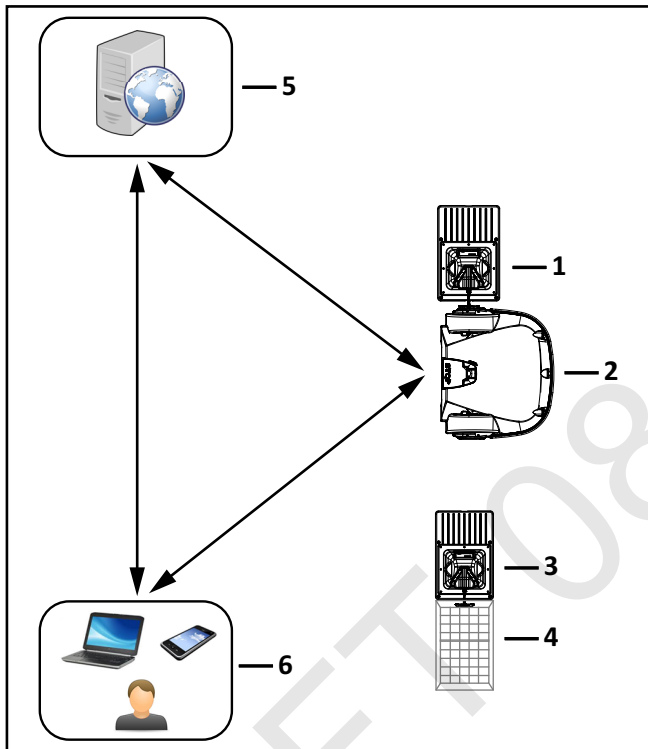
1 – Charging station (for mowing robot)

2 – Robot

3 – Charging station (for ball-collecting robot)

4 – Drop pit

5 – Internet portal

6 – End user

4.1 Robot Components
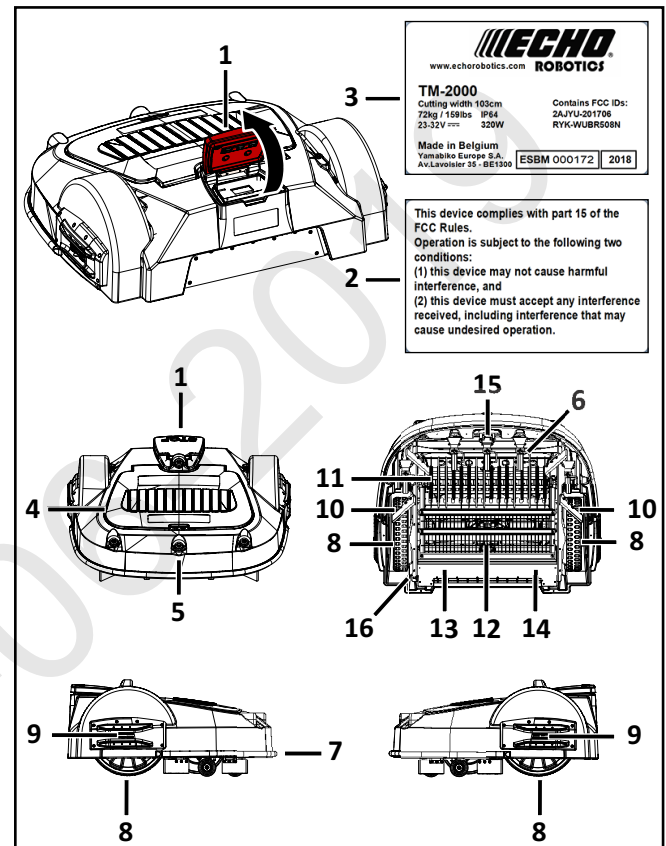
1 – Stop button - Press to stop the robot.
Smartbox - A graphical user interface used to set configuration parameters.

2 – FCC label

3 – Serial number label

4 – Cover

5 – Sonar sensors - Detects object in the path of the robot.

6 – Front wheel

7 – Bumper - A pressure sensor which will cause the robot to change direction when it touches an obstacle.

8 – Rear wheel

9 – Charge contact- Connects to the charging arm on the charging station.

10 – Ball deflectors - Pushes balls outwards to prevent the wheels from rolling over them.

11 – Collecting roller - A set of rotating discs which picks up balls and drops them into a collection basket.

12 – Collecting basket - The basket that holds the balls before they are unloaded into a drop pit.

13 – Li-Ion (Lithium Ion) battery - Supplies power to the robot.

14 – Electrical box - Contains the electronics and the gear drive motors.

15 – Coil - Detects the magnetic field generated by the peripheral wires.

16 – Power switch

4.1.1 STOP Button

Located on the top of the robot. Press or lift to stop the robot.
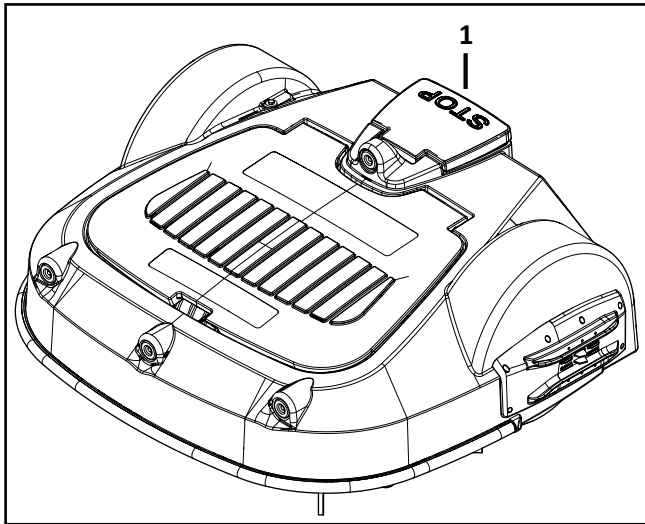
1 – Stop button

4.1.2 The Smartbox

The smartbox is used to set configuration parameters, it is located under the stop button lid.

1 – Numeric buttons - Press to select menu choices and enter numeric values.

2 – LED screen - Displays the current information.

3 – LED - Indicates the smartbox is switched ON.

4 – ON button - Press to turn the smartbox ON.

5 – Navigation buttons - Press to highlight menu options.

6 – Back button - Press to exit a menu and return to previous level.

7 – Accept button - Press to accept an operation or setting.

8 – Service menu button - Press to access the service menu.

9 – Settings menu button - Press to access the settings menu and define operational settings.

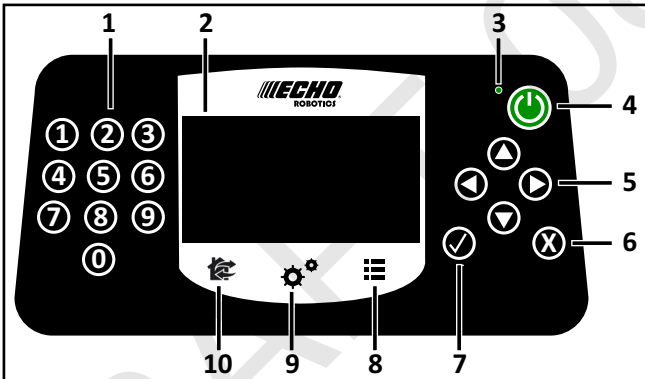10 – Actions menu button - Press to access the actions menu.

The LCD Screen
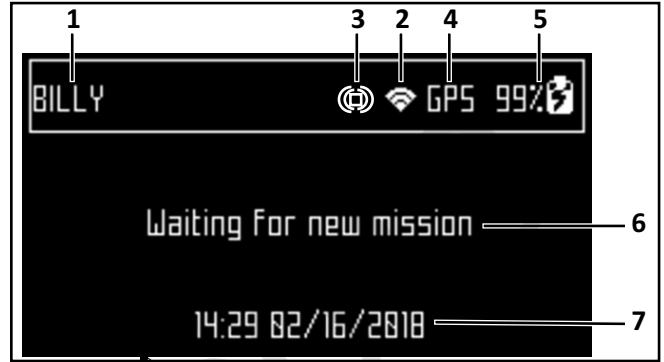
1 – Name - The name of the robot.

2 – WiFi / Mobile connection - Indicates the robot is connected as a WiFi client. When blinking, it is trying to connect. When steady, it is connected.

3 – WiFi access point - Indicates the robot is connected.

4 – GPS - Indicates the robot can detect at least four satellites and that it knows its current location. If blinking, it indicates the robot can not detect enough satellites.

5 – Battery charge level - Percentage of battery charge.

6 – Message - Shows the current status of the robot (also displays error messages).

7 – Time and date (24-hour clock only).

4.1.3 Sonar Sensors

Four obstacle detection sonar sensors transmit a sonar signal of 40 kHz. The sensors allow the robot to detect and react to obstacles.

Sensors detect obstacles with minimum height of 15.7 in. (400 mm), and a minimum width of 2.0 in. (50 mm).

When the signal hits an obstacle, it is reflected back to the sensors. The speed of the robot is reduced to less than 0.5 mph (0.2 m/s).
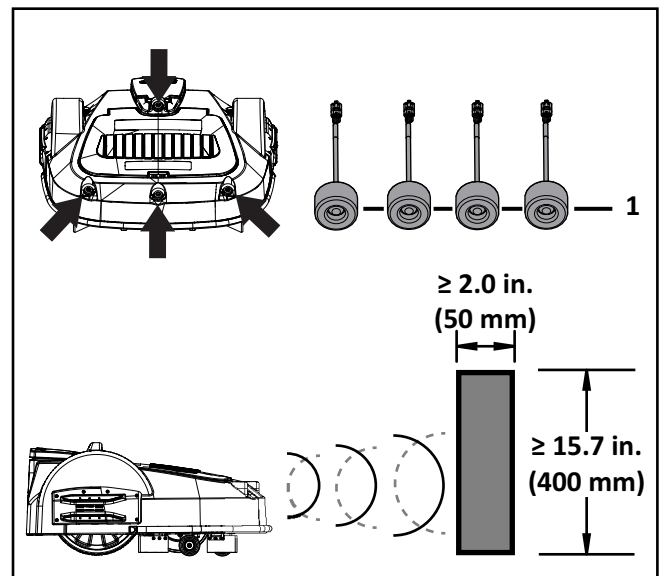
1 – Sensor assembly

When the bumper contacts an object, the robot will touch the object, stop, move backwards, and by default, turn between 60° and 120°, then continue moving forward.

4.1.4 Cover Displacement Sensors

The robot has two cover displacement sensors. If an obstacle causes the cover to be pushed backwards, the robot will, stop, move backwards, and by default, turn between 60° and 120°, then continue moving forward. If the robot cannot avoid the obstacle it will register and alarm and remain in safe mode.

1 – Sensor attachment point
2 – Sensor assembly

4.1.5 Coil

The coil detects the intensity of the magnetic field that is generated by the peripheral wire.

1 – Coil assembly

4.1.6 Tilt / Rollover / and Temperature Sensors

These sensors are located on the main circuit board inside of the electrical box.
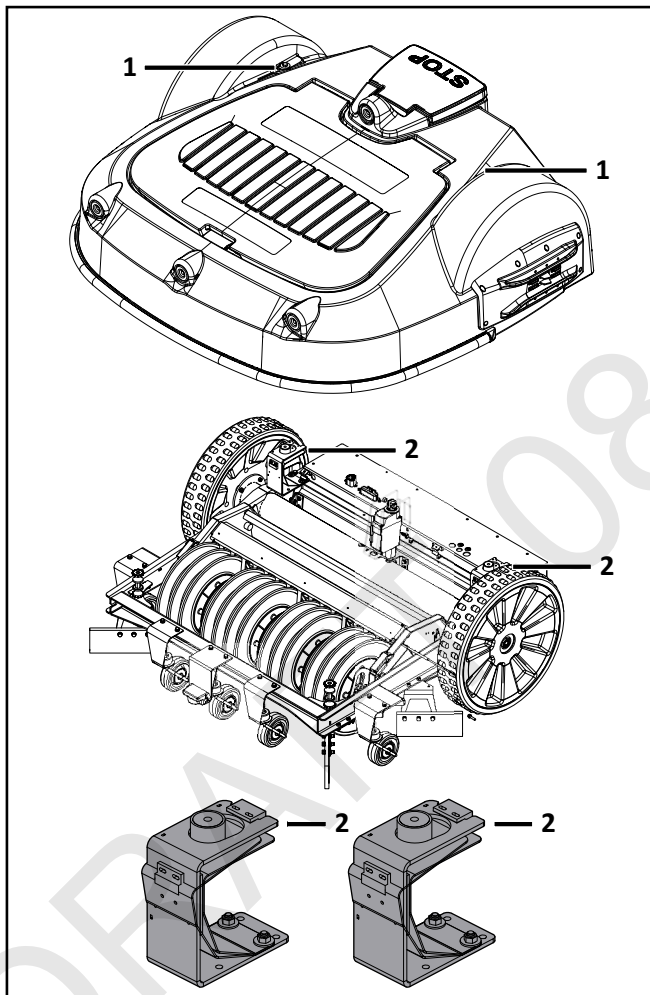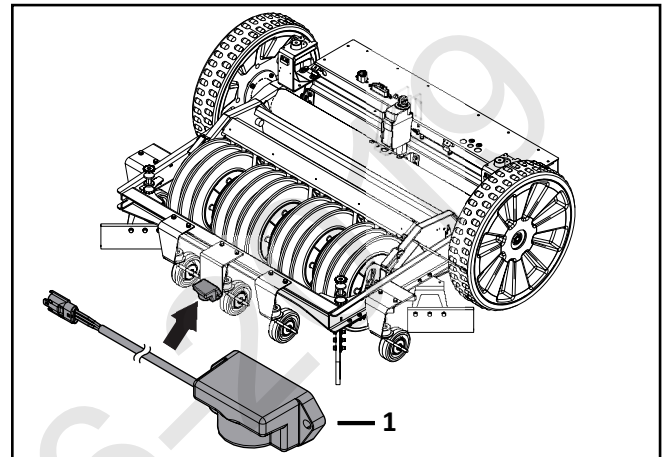
The tilt sensor detects the angle of the slope on which the robot is working. If this angle exceeds 30° (58%), an alarm will be raised and the robot will stop moving.

The rollover sensor detects if the robot has been tipped upside down, or whether someone is trying to start the robot when it is upside down.

The temperature sensor measures the ambient outdoor temperature and will prevent the robot from operating if this temperature is too low. The minimum temperature is set as an operating parameter.

4.1.7 Detectors

1) Full Basket Detector – This flap is rotated upward by the presence of balls in the basket. When this basket is full, the robot will go to the drop pit to unload the balls.

2) Ball Counting Band – A pressure sensitive band located on the underside of this component. As the balls are ejected from between the collection discs and hit this band, they are counted.

3) Rotational Speed Detector – The rotational speed of a marker on the roller is picked up by a sensor on the chassis. If the speed is too low, the roller may be blocked. The robot will try to remove the blockage. If the blockage cannot be removed, the robot will return to the charging station and issue an alarm.
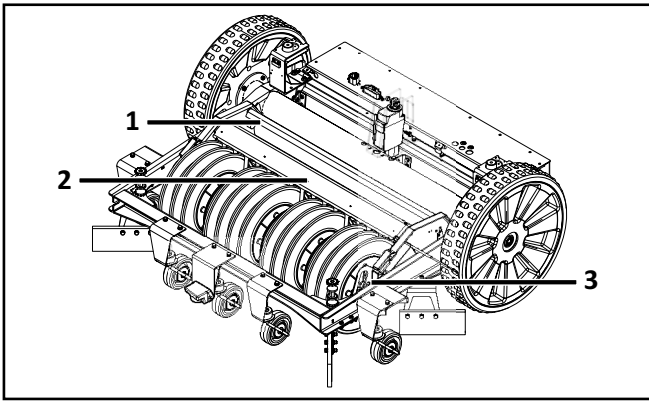
1 – Full basket detector
2 – Ball counting band
3 – Rotational speed detector

4.2 Charging Station Components
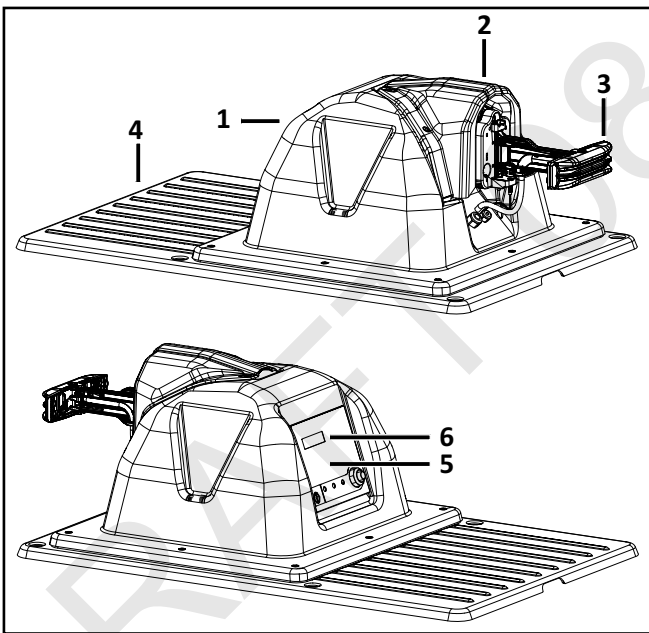
1 – Enclosure top
2 – Dust cover
3 – Charging arm
4 – Enclosure base
5 – Input panel
6 – Serial number location

4.3 Drop Pit

The drop pit is where the balls are deposited by the robot. It is located in front of a charging station.

When the robot has collected a certain number of balls, or after a defined time period, it moves to the charging station with a drop pit. When the robot docks at the charging station it will release balls into the drop pit.
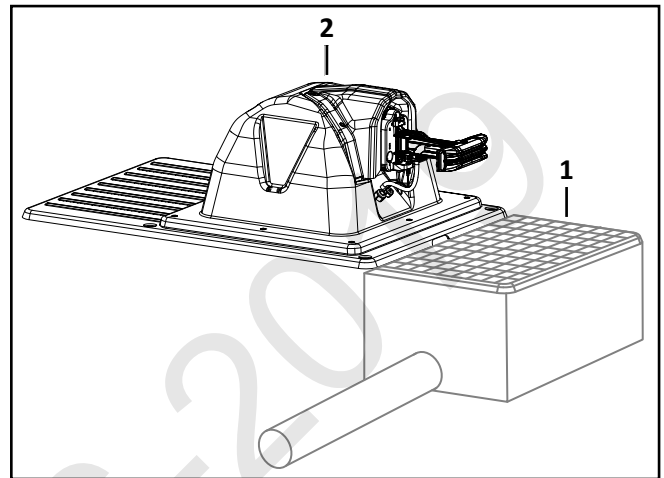
1 – Drop pit
2 – Charging station

4.3.1 Location of the Drop Pit

4.3.2 Drop Pit With Elevator

4.3.3 Drop Pit Without Elevator

4.3.4 Drop Pit Ramp

4.4 How the Robot Works

The robot works in the Autonomous Mission State, Inactive State, or the Service State.

4.4.1 Operational States and Descriptions

Operational State	Description
Autonomous Mission State	The robot operates in cycles in which it collects balls or charges the battery.
Inactive State	The robot can enter an inactive state if there is a condition that causes the Autonomous Mission State to stop. The robot will return to the autonomous mission state when the problem has been resolved or when a specific command has been issued.
Service State	Initiate this state to access the Demonstration and Maintenance Test modes.

4.4.2 Autonomous Mission State

The robot performs programmed instructions when in the Autonomous Mission State. **NOTE:** Programmed instructions can be over-ridden by instructions activated from the smartbox.

For a single robot application, one charging station can activate the function of the drop pit, and charge the robots battery.

For a multiple robot application, one charging station is dedicated for drop pit functions only. This charging station does not charge a robot's battery. Other charging stations are dedicated for battery charging only.

Autonomous Mission Modes	Robot Function
Work Mode	The robot moves randomly over its work area collection balls.
Return to Station Mode	The robot will to return to a charging station to unload balls, charge its battery, or wait until its next working session begins.
Unload Balls Mode	The robot collects balls and holds them in a basket. When either a certain number of balls has been collected or a certain amount of time has passed, the robot will go to the drop pit to unload the balls.
Charge Battery	Docks at a charging station and charges the battery.
Wait in station	Remains at the charging station.
Go Zone	The robot goes through a set of maneuvers before going to the required work zone.

Work Mode

The robot randomly collects balls from the area inside the peripheral wire.
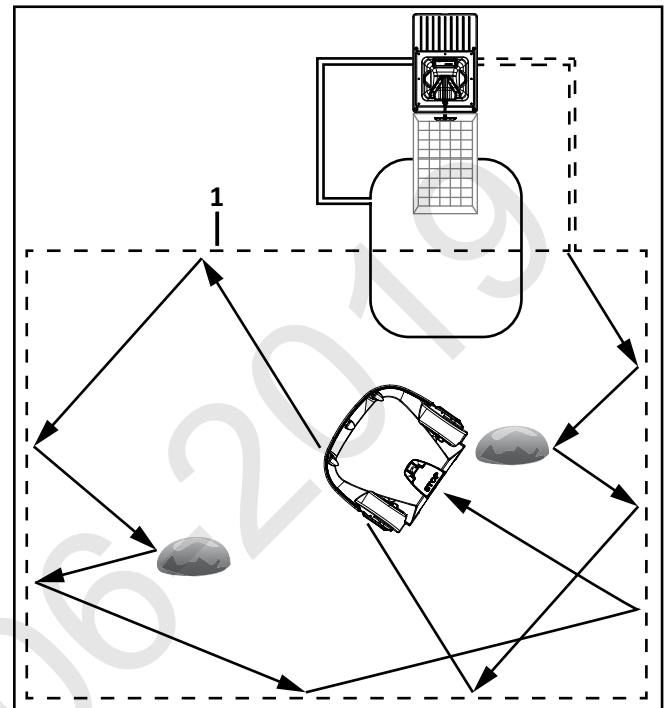
1 – Peripheral wire

When the robot approaches the peripheral wire it slows down and passes over the wire. The coil senses a change in phase. This causes the robot to stop, move in reverse, turn through a defined angle, then continue in a new direction.

When the robot contacts an obstacle it will maneuver away from it.
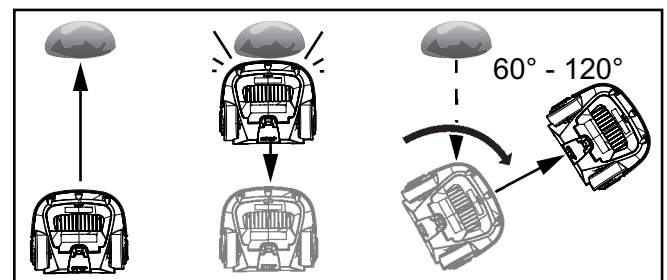
While the robot is working balls are collected and stored in its basket. When the number of balls collected has reached a certain number, or a certain time period has passed, the robot will move towards the charging station connected to the drop pit in order to unload the balls. The parameters for defining when the balls should be unloaded are set as part of the installation configuration.

At a certain moment, the robot will make the decision to return to charging station. The reasons may be:

• the battery needs to be charged

• programmed collection time has ended (for multi-field installations, this corresponds to the collection schedule for the field in which the robot is currently working)

- a specific command has been issued
- the temperature is too low

Return to Station Mode

The robot will return to a station to:
- to unload balls
- charge its battery
- wait until the next working session is scheduled

The station it returns to depends on:
- whether the station is connected to a drop pit
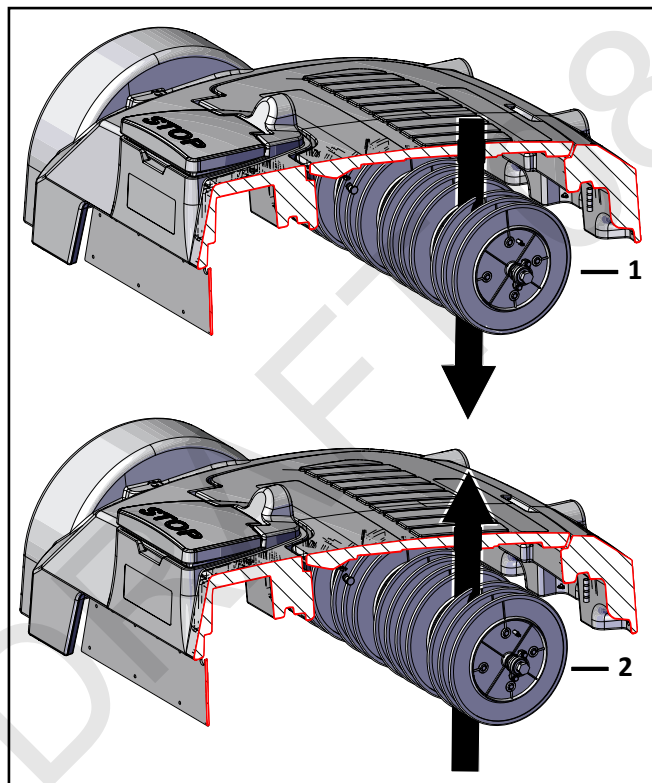- whether the installation contains more than one ball-collecting robot

When the robot is working, the roller that picks up the balls contacts the ground. The roller is rotated by the movement of the robot.

When the robot is returning to the station, it is not collecting balls. The roller is lifted up into the chassis and does not contact the ground.

1 – **NOTE:** Cutaway view of robot shown.
2 – Roller position collecting balls
3 – Roller position **not** collecting balls

Unload Balls Mode

The robot collects balls and holds them in a basket. When either a certain number of balls has been collected or a certain amount of time has passed, the robot will go to the drop pit to unload the balls.

Charge Battery Mode

The robot will return to a charging station specifically to charge when:
- the battery need to be charged
- the scheduled work period has ended
- a specific command has been issued

If there is only one ball-collecting robot operating, it will return to the charging station with the drop pit. If there are multiple robots working in the area, it will return to its specific charging station.

When the robot decides it needs to return to a charging station (at Point A), it will take the shortest route to the trackborder of the field it is working in.

NOTE: This may not be the working field nearest to the drop pit. In this case, the robot will follow the track-border of the outer field until it reaches the track-border of the field closest to the station.

It will then follow the trackborder of the field closest to the station until it detects the specific frequency of the station loop wire connected to its charging station (Point B). In this example, it is charging station 2.

At Point B it will follow this station loop wire until it arrives at the charging station, where it will charge the battery, or, wait in that station until required to continue working.
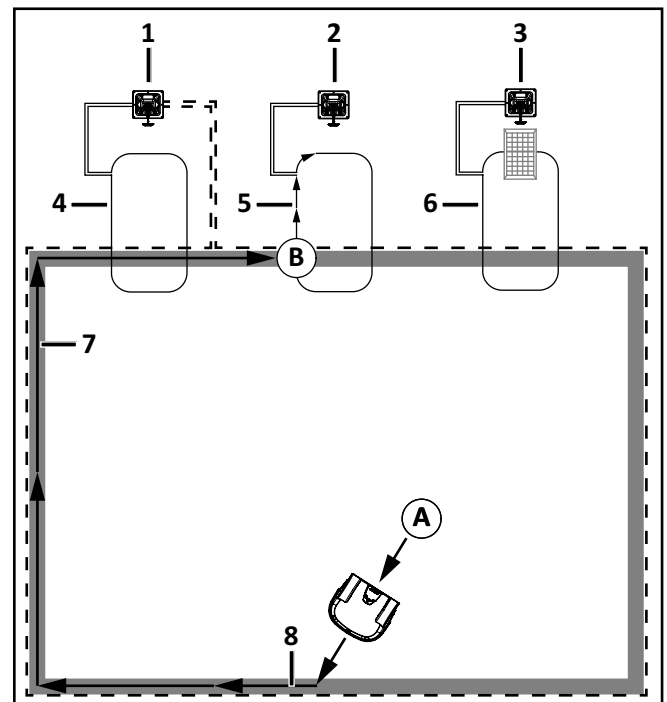
1 – Charging station 1
2 – Charging station 2
3 – Charging station 3 (with drop pit)
4 – Station loop 1
5 – Station loop 2
6 – Station loop

7 – Trackborder

8 – Peripheral wire of field closest to charging station

Wait In Station Mode

The robot will stay in the charging station once the battery has been charged until:

• the normal program needs to commence

• a specific command is issued

Go Zone Mode

In this mode the robot performs a maneuver to leave the charging station and continue working.

This same maneuver is executed whether the robot is leaving the drop pit station or a charging station. In the example shown below, the robot is leaving a charging station.

The robot will leave the charging station and follow the station loop wire until it reaches Point A, which is inside the trackborder of the field nearest the charging station.

At this point it will turn and follow the trackborder of this field until it reaches point B, when it will turn into the zone to work. The distance traveled long the trackborder and the angle at which the robot turns into the field are set as installation parameters.
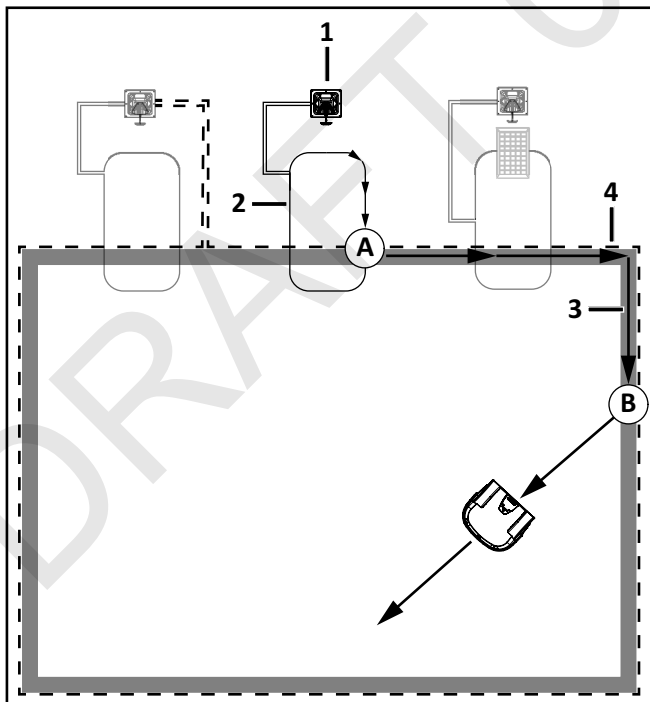
1 – Charging station

2 – Station loop wire

3 – Trackborder

4 – Peripheral wire

NOTE: The robot will move along the trackborder of the field closest to the station until it reaches an outer field.

It will then follow the trackborder in this field before turning into it to start working.

Go Zone Mode describes the maneuvers the robot makes to leave the charging station and start collecting balls.

4.4.3 Inactive Modes

There are four inactive modes: Alarm Mode, Standby Mode, Self Test Mode, and OFF Mode.

Alarm Mode

When the robot encounters a problem it will register an alarm and enter the inactive mode. When the cause for the alarm has been corrected, the user can manually clear the alarm and the robot will then enter the Standby mode. If no intervention takes place, the robot will turn off and enter the OFF mode.

Standby Mode

The robot will enter the Standby mode if:

• the autonomous mission has been stopped due to an external command

• an alarm situation has been corrected and the alarm cleared by manual intervention

• it is manually switched ON

Self Test Mode

Whenever the robot has been in the Standby Mode it will perform a self test to check the integrity of the entire system (including electronics, sensors, mechanics and software). When the result of the self test is successful, it will resume the autonomous working state. If the result of the self test is not successful, it will register an alarm.

OFF Mode

The robot will be in the OFF mode when:

• it has been manually switched OFF

• an alarm situation has not been corrected after a certain period of time

4.4.4 Go Zone Mode

Go Zone Mode describes the maneuvers the robot makes to leave the charging station and start working.

One Field With Station Loop

This configuration contains one peripheral wire and one station loop wire.

When the robot leaves the charging station it follows the station loop wire until it reaches Point A. This is a predefined distance along the field peripheral wire. At Point A, the robot will follow the trackborder of the field until it reaches Point B. At Point B, the robot will turn into the field and start working. The distance traveled along the trackborder and the angle at which the robot turns into the field, are specified in the StartZone parameters for the field.
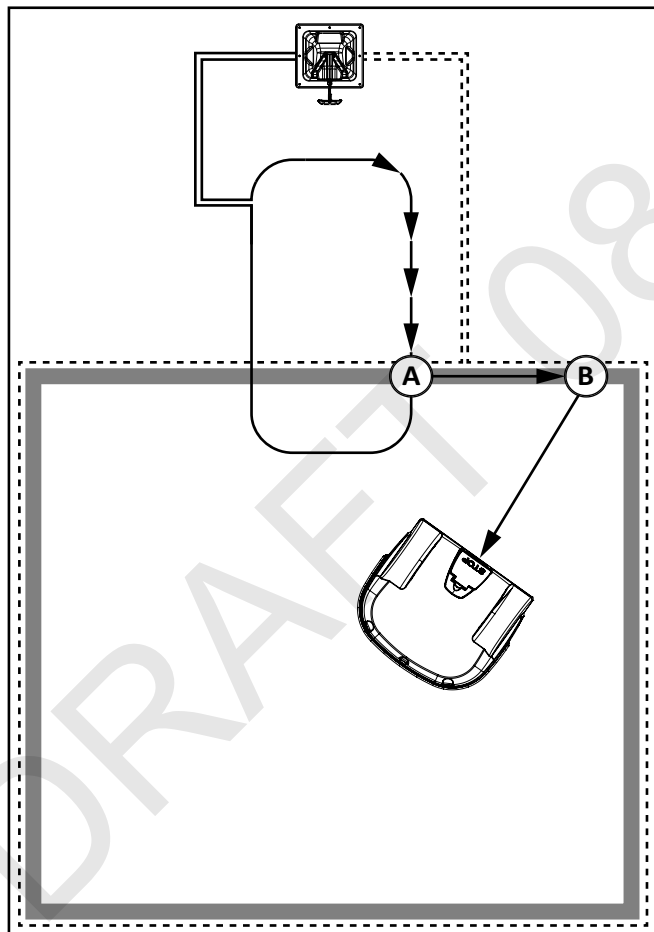

Two Fields With Station Loop

This configuration contains a peripheral wire for each field and one station loop wire.

Before leaving the charging station the robot will determine which field to start working in. This will depend on the defined working schedule for each field. If the schedule dictates that a specific field must be worked at this time, the robot will startworking in that field.

If there are no schedule constraints, the robot will choose the field based on the percentage values. Over a period of time the robot ensures that it starts in each field according the defined proportions.

When the robot leaves the charging station it follows the station loop wire until it reaches Point A. At Point A, the robot will turn and follow the trackborder of Field 1, until it reaches Point B. Point B is where the two fields overlap.

When the robot is in Field 2, it will travel for a certain distance along the Field 2 trackborder until it reaches Point C. At Point C, the robot will turn into the field and start working. The distance traveled along the Field 2 trackborder, and the angle at which the robot turns into Field 2, are specified in the StartZone parameters for Field 2.
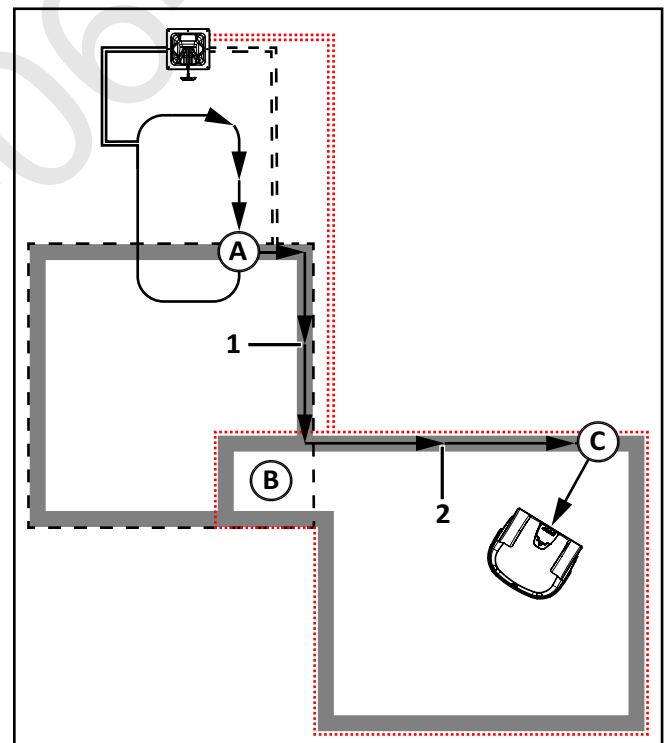
Field 1 trackborder
Field 2 trackborder

4.4.5 Service State

Initiate this state to access the Demonstration and Maintenance Test modes.

Maintenance Test

A set of maintenance tests are available from the Technicians Settings menu.

5 Installation Example

The following figure represents the components of a typical golf course installation.

Area A is the high-density ball area. Area B is the working area.
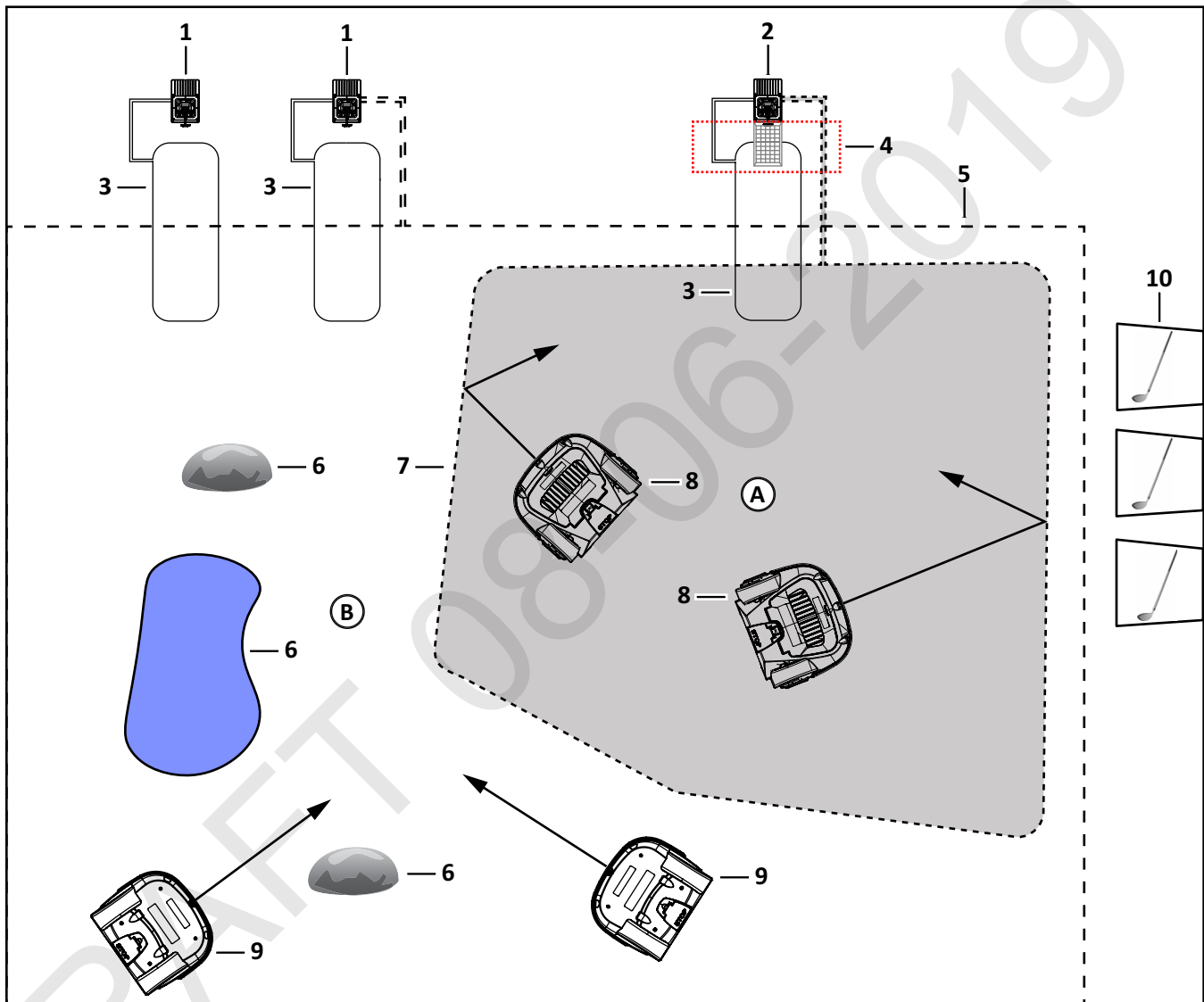
1 – Mower charging station
2 – Range picker charging station
3 – Station loop wires
4 – Busy wire
5 – Peripheral wire (for working area)
6 – Obstacles
7 – Peripheral wire (for high-density ball area)
8 – Range picker robot
9 – Mowing robot
10 – Driving range bay

Use a minimum of one range picker and one mower for a typical installation.

Install a peripheral wire to encompass the entire working area. This peripheral wire defines the limits in which the robots will work. Preparation and mainte- nance of the outfield is essential for the optimal opera- tion of the robots.

Install an additional peripheral wire to encompass the area of the driving range where most of the balls will need to be collected.

Install a charging station and a station loop wire for each mowing robot used in the working area. The station loop wire is required to enable the robot to return to its specific charging station.

Install one charging station combined with a drop pit for the ball-collecting robots to deposit the balls.

If more than one ball-collecting robot is in use, install the "busy loop wire". If two ball-collecting robots are approaching the drop pit at the same time, this wire ensures that the second robot will wait until the first

ROBOTS, BALL-COLLECTING CAPACITY, AND WORKING AREAS
MOWING ROBOTS

robot has discharged all its balls and moved away. The second robot will then dock with the charging station attached to the drop pit.

Obstacles must be avoided. This is achieved by movements executed by the robot when a sensor has detected the obstacle. Permanent obstacles may need to be avoided by the positioning of the peripheral wire around them, thus creating islands and pseudo islands.

Clean and inspect the robot everyday.

NOTE: The presence of an operator is essential for the management of the golf course. This operator should receive alarm messages from both the ball-collecting and the mowing robots.

6 Robots, Ball-Collecting Capacity, and Working Areas

Use a minimum of one mowing and one ball-collecting robot for the installation.

6.1 Mowing Robots

Correct mowing affects the quality of the grass and the efficiency of the ball-collecting robots. If the grass is too long it will be torn by the collecting process and will accumulate in robot's collection basket. This would require an in increase in the frequency of cleaning.

6.2 Adapting the Mowing Robots to Work On a Golf Course

Cutting Blade Installation
Ball Deflector Installation

6.3 Ball Collecting Robots

Ball collecting robots work within the area defined by the peripheral wire. Install the ball-collecting robot to operate in the area with the highest ball density. Productivity is greatly reduced if the ball density is low.

6.4 Ball Collecting Capacity

Asses the number of ball-collecting robots required and the definition of the areas in which they will work.

Identify the number of balls hit per weekday and weekend day. This can be estimated by considering the following:

- Each driving range bay is used by 5 to 10 players per day during summer.
- Each player plays for about 30 minutes, meaning each bay is used between 2.5 and 5 hours per day.
- Each player hits between 50 and 100 balls per during the 30 minute session.
- The minimum number balls/day/bay is 5 x 50 = 250.
- The maximum number balls/bay/day is 10 x 100 = 1,000.

Identify the number of balls available at the facility. This is the number of balls which can be hit without collection. In general, multiply the number of balls used on a peak day by 1.5.

The robot can collect a maximum of 10,000 balls per day.

The capacity of the basket is 250 balls. When it is full the robot must return to the drop pit.

The robot requires 1.5 hours to charge the battery. It can work for 4.5 hours per charge.

The optimal situation is to have the robot operating for a maximum of 4 hours per day in the high density zone. Having it work for more than 4 hours results in an "empty" high density zone and an "over-populated" outer zone.

It is recommended to send the robot to the high density zone 3 hours after start of the peak period. If the peak period goes from 9:00 AM till 5:00 PM, make robot focus on the high density zone from noon till 4:00 PM.

6.5 Working Areas

Assuming that the grass is correctly mowed, the productivity of the robot operating in the total working area would be too low because of the low density of balls. It is recommended to restrict the robot to working in the high density area and to use an alternative method to collect balls over the balance of the entire working area once a week.

Consider using two separate fields if:

12

- There a clear high density zone (four times higher than the density elsewhere) on busy days.
- The high density zone is 30% of the entire working area.
- The robot is working close to its collection capacity (8,000 to 12,000 balls per day depending on density).

7 Charging Station Requirements

The ball-collecting robots require one charging station which is connected to a drop pit where the balls are discharged. One charging station is also required for each of the other ball-collecting and mowing robots.

All charging stations require a station loop wire.

If more than one ball-collecting robot is in use, install the "busy loop wire". If two ball-collecting robots are approaching the drop pit at the same time, this wire ensures that the second robot will wait until the first robot has discharged all its balls and moved away. The second robot will then dock with the charging station attached to the drop pit.

7.1 Type of Charging Stations

Single Zone - This charging station supports the station loop wire. This wire is required for the robot to return to the charging station.
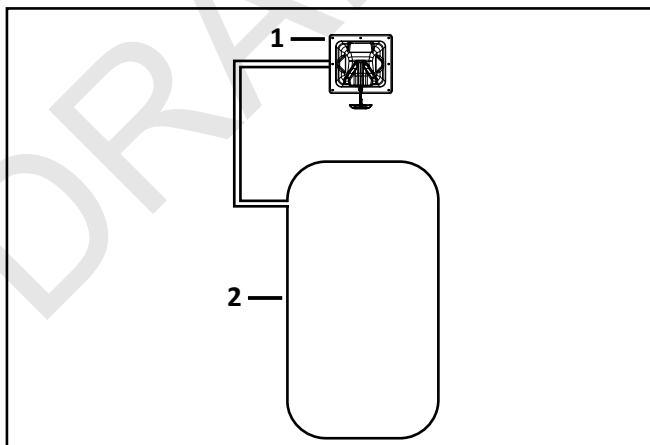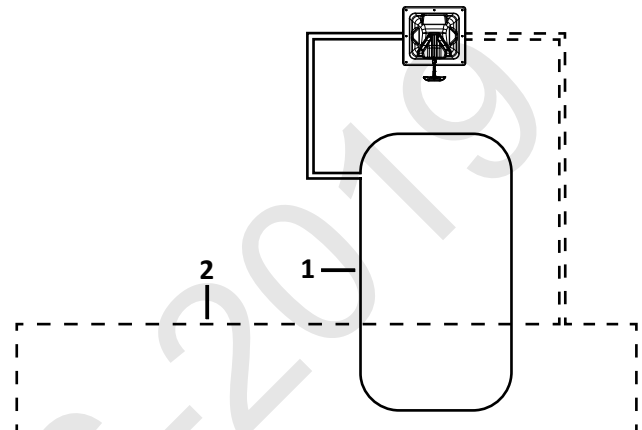
1 – Charging station
2 – Station loop wire

Single Zone and Station Loop - This station supports:

- one peripheral wire (defines the single zone working area)

- one station loop wire (returns robot to charging station)

1 – Station loop wire
2 – Peripheral wire

Two Zone and Station Loop - This station supports:

- one station loop wire
- one busy-loop wire (for multi-robot operation)
  Note: See the installation dimensions in the following image
- one peripheral wire (defines the working area)

≥2.0 in. (≥50 mm)   ≥2.0 in. (≥50 mm)

≥2.2 in. (≥55 mm)
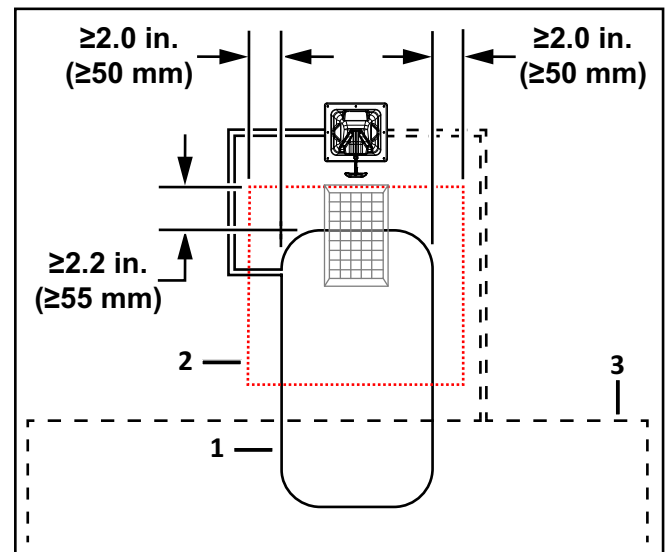
1 – Station loop wire
2 – Busy loop wire
3 – Peripheral wire

7.2 Positioning of Charging Stations

- place charging stations together as a group with easy access to a power supply

- position the charging station on a straight section of the peripheral wire
- minimum length of wire on the incoming and outgoing side is 8.2 ft. (2.5 m)
- minimum distance between charging stations is 49.2 ft. (15 m)
- the minimum obstacle-free zone is 20 ft. (6.0 m)
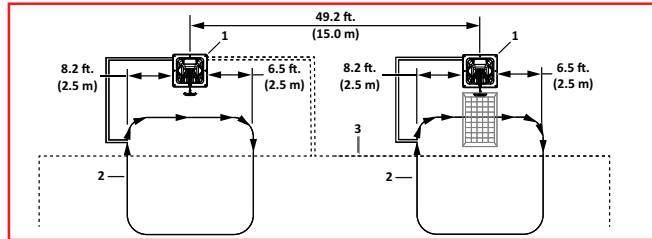
1 – Charging station
2 – Station loop wire (–>–>–>–> movement of robot)
3 – Peripheral wire

When the charging stations are located in a driving range, place them a minimum of 100 ft. (30 m) from the driving range bays. This will reduce the risk of damage to the if they are struck by a ball.
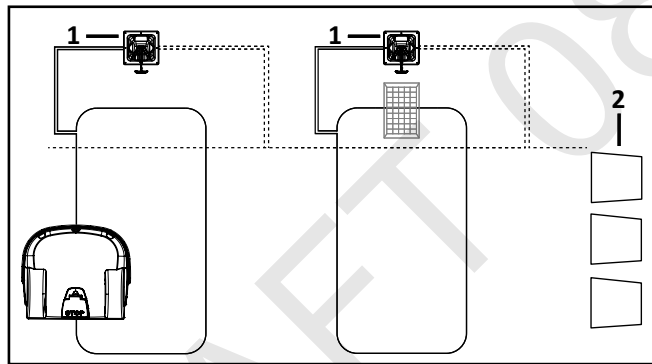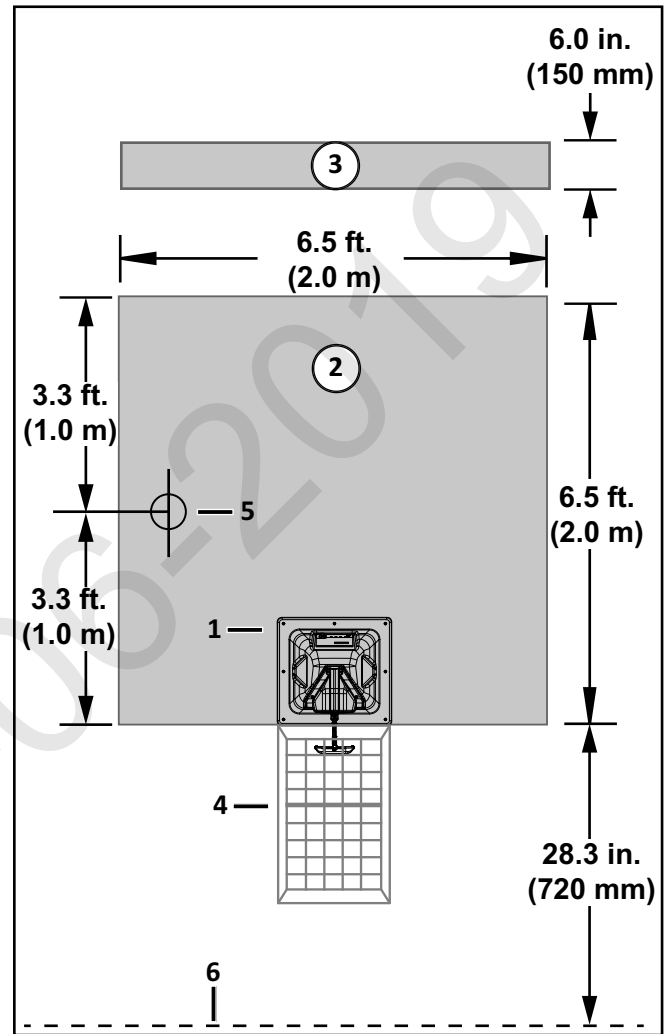

1 – Charging station
2 – Driving range bay

7.3 The Drop Pit Charging Station

Mount the drop pit charging station on a concrete base witch contains no reinforcing mesh or any other metallic parts.

Recommended dimensions of the concrete base:

cate that the drop pit is in use and that a second robot

1 – Charging station
2 – Concrete base (top view)
3 – Concrete base (end view)
4 – Drop pit
5 – Power supply location
6 – Peripheral wire

8 Drop Pit

The drop pit is required for the robot to deposit the balls it has collected.

If there is only one ball-collecting robot, only one charging station is required. This charging station will trigger discharge of the balls and charge the robot's battery.

When the robot arrives at the drop pit, contact with the charging station arms triggers the release of the balls.

If there is more than one ball-collecting robot, the drop pit charging station needs to be accessible to all of them. In this case the busy loop wire is installed to indi-

must wait to access it.

8.1 Location of the Drop Pit

The robot will dock at the drop pit charging station multiple times per day. Consider the location carefully.

Reinforce the surface leading to the drop pit to avoid excessive wear.

Place the drop pit charging station so the robots do not pass in front of the driving range bays. Failure to do so may allow a ball to hit the robot, bounce back, and cause injury.

Placing the drop pit charging station **close** to the driving rang bays has advantages and disadvantages.

Advantages:

• Best solution when balls are being retrieved manually at the drop pit.

• Only solution if the transfer of the balls to the washer or dispenser is close the driving range bays and is made using lifts or conveyors.

Disadvantages:

• The robot visits the drop pit 30 to 50 times a day, leaving visible tracks over the wire and next to the drop pit.

• The movements of the robot and the noise of the ball transfer system can distract players.

• The distance from the high density area where the robot is working to the drop pit is very long.

Placing the drop pit charging station **away** from the driving range bays has advantages and disadvantages also.

Advantages:

• Tracks made by the robot are out of sight.

• Movements and noise is kept away from the players.

• The drop pit is close to the high density area.

Disadvantages:

• A hydraulic or a pneumatic transfer system is required to transfer balls between the drop pit and the washer or dispenser.

• The movements of the robot and the noise of the ball transfer system can distract players.

8.2 Drop Pit Elevator

8.3 Drop Pit Without Elevator

8.4 Drop Pit Ramp

9 Wire Installation

Avoid standing water, holes and ruts, and obstacles when installing wire.

To avoid standing water (and damp areas):

• install drains

• stake the area

• use islands or pseudo-islands

To correctly prepare holes and ruts:

• drain all water

• fill with topsoil

• plant grass seed

To avoid obstacles

• install islands

• install pseudo-islands

9.1 Station Loop Wire Installation

The station loop wire can be installed completely inside of the field (Figure A), or partially inside of the field (Figure B). The wire must extend a minimum of 13 ± 1.6 ft. (4.0 ± 0.5 m) into the field.

The distance between the center of the charging station and the end of the station loop wire is 8.2 ft. (2.5 m) minimum.

13 ± 1.6 ft.
(4 ± 0.5 m)

8.2 ft.
(2.5 m)

8.2 ft.
(2.5 m)

13 ± 1.6 ft.
(4 ± 0.5 m)

8.2 ft.
(2.5 m)

8.2 ft.
(2.5 m)
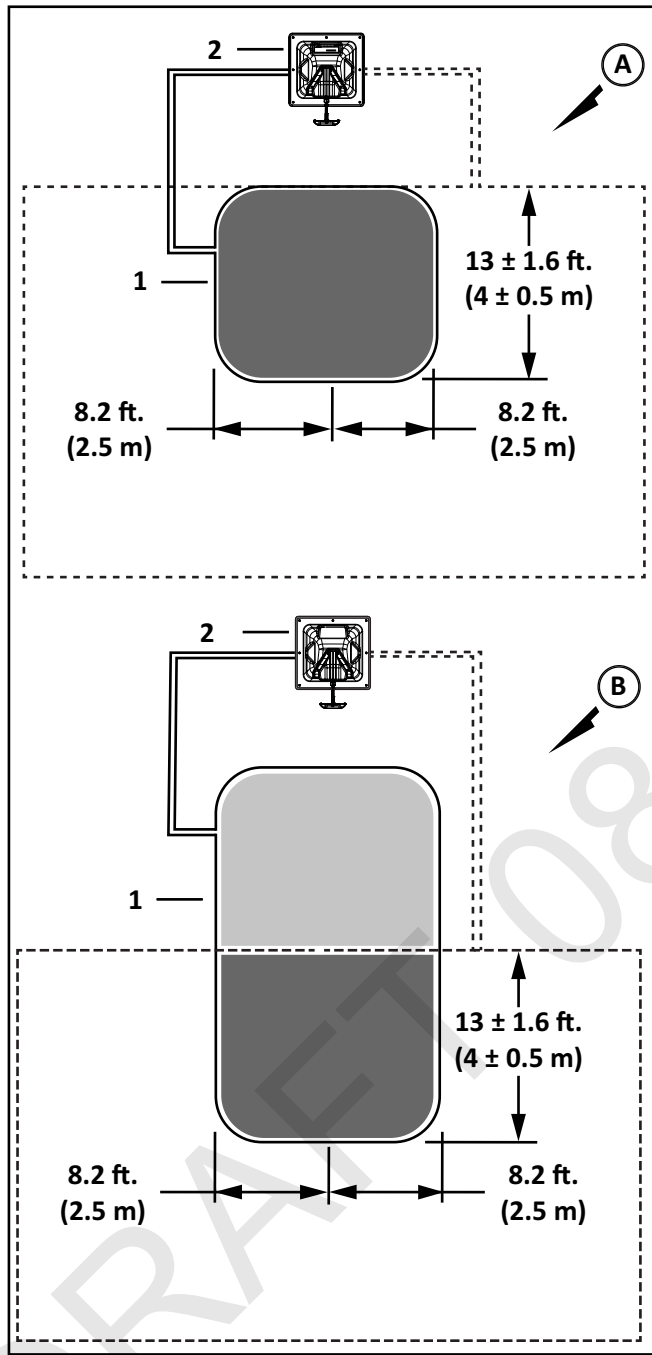
1 – Station loop wire
2 – Charging station

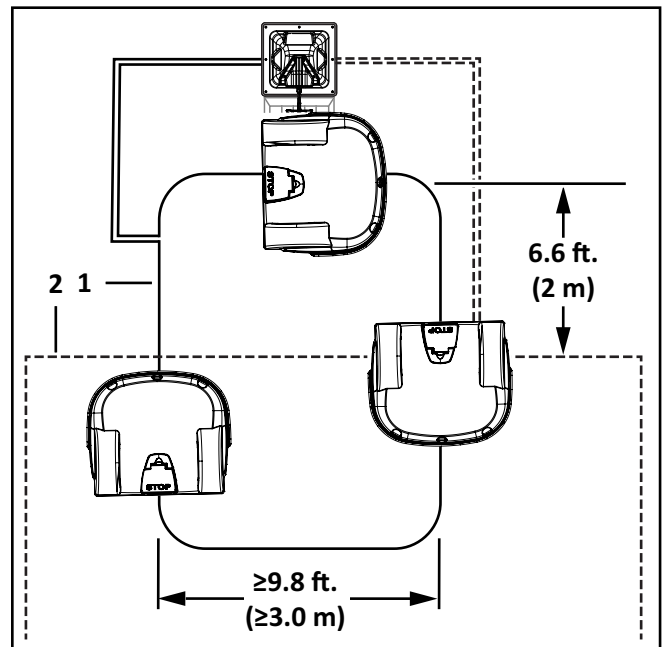## 9.2 Station Loop Wire Inside of Peripheral Wire

If the station loop wire must be located inside of the peripheral wire, and multiple robots are being used, install the peripheral wire as shown in the following figure. This installation ensures that robots will not collide with each other, or with the charging station.

6.6 ft.
(2.0 m)

R 8.2 ft.
(2.5 m)

11.5 ft.
(3.5 m)
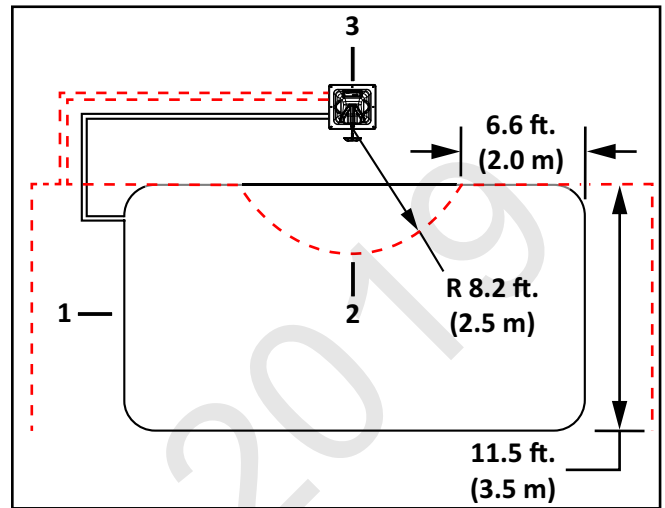
1 – Station loop wire
2 – Peripheral wire
3 – Charging station

9.3 Station Loop Wire Installation With Multiple Robots

The following figure shows required dimensions. Use this installation for a working robot to avoid hitting a robot at the charging station. This installation will also stop ball-collecting robots from entering and exiting the station loop at the same time.

6.6 ft.
(2 m)

≥9.8 ft.
(≥3.0 m)

1 – Station loop wire
2 – Peripheral wire

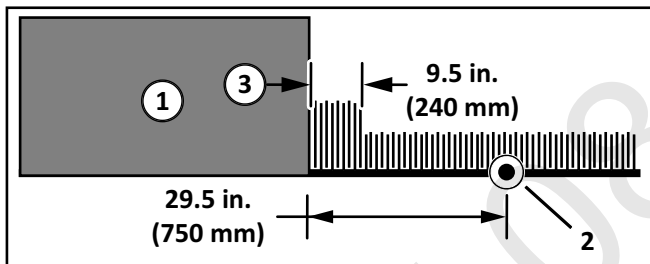# 9.4 Peripheral Wire Installation Next to Landscaping

NOTE: The dimensional values shown apply when the "Wire crossing distance" parameter is at the default setting of 20 in. (510 mm).
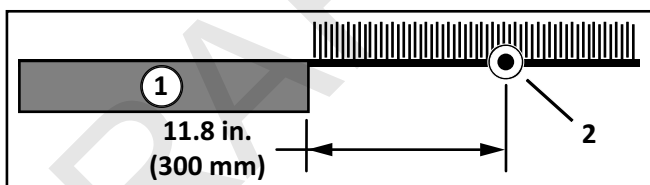
9.4.1 Rough grass that does not need to be mowed:
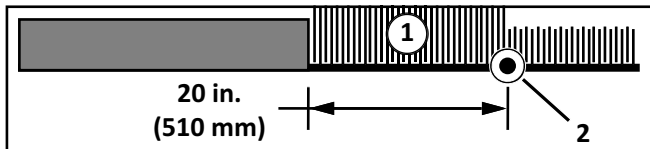
1 – Rough grass
2 – Peripheral wire

9.4.2 Raised hard landscaping:

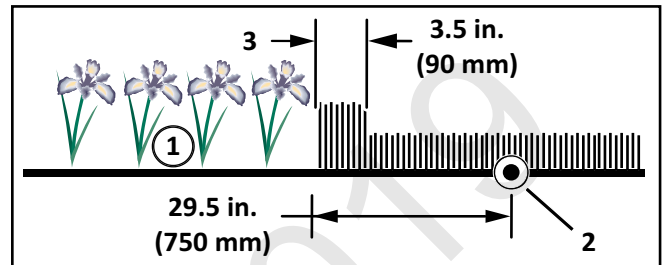1 – Terrace / Path / Wall
2 – Peripheral wire
3 – Area not mowed

9.4.3 Hard landscaping level with grass:

1 – Terrace / Path
2 – Peripheral wire

NOTE: A path that crosses the field to be mowed should be level with the grass.

9.4.4 Lawn-level planting (e.g. flower bed).

1 – Flower bed
2 – Peripheral wire
3 – Area not mowed

9.5 Multiple Peripheral Wire Installation

An installation may require multiple peripheral wires.

Each working area is defined by a peripheral wire that starts and ends at a charging station. Each peripheral wire contains a single parcel.

Each parcel must overlap with a neighboring parcel.

Each pair of wires or parcels which overlap must be designated as neighboring parcels.

Multi-Field Installation

Wire 1 /Field 1 is the station loop. When in this field the robot will follow the wire to dock at the charging station.

Wire 2/Field 2 is a neighbor of Wire 1/Field 1. Wire 3/Field 3 is a neighbor of Wire 2/ Field 2.

The proportion of time that the robot spends working in Fields 2 and 3 can determined by the percentage values assigned to the corresponding fields through the robot's working schedule. For Wire 1/Field 1 the percentage can be set to 0.

The start and finish sides of the peripheral wire must lie next to each other when they enter the charging station. Install the start and finish sides of the peripheral wire for one field around the other field. The distance between the peripheral wires for each field must be greater than or equal to 23.6 in. (600 mm).
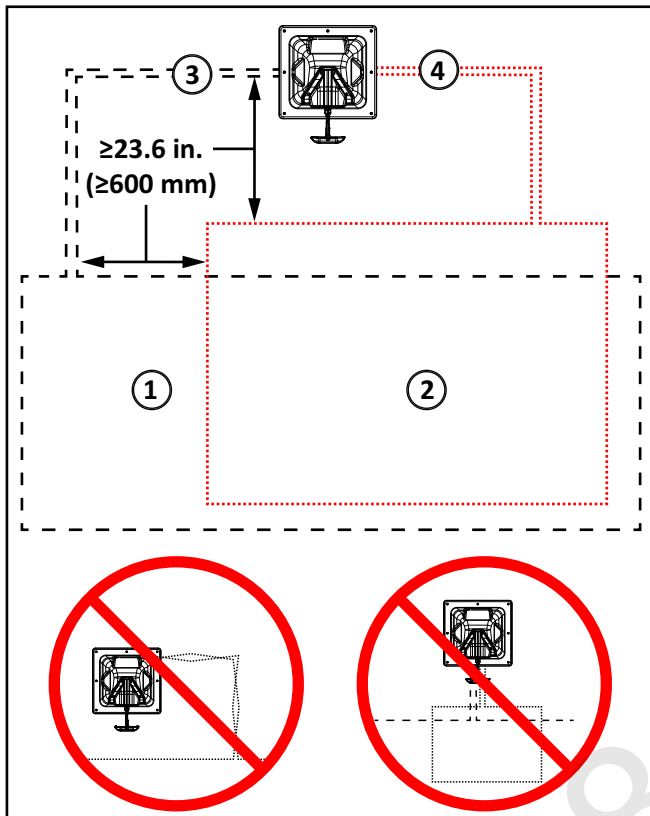
1 – Field 1

2 – Field 2

3 – Start and finish side of Field 1 peripheral wire

4 – Start and finish side of Field 2 peripheral wire
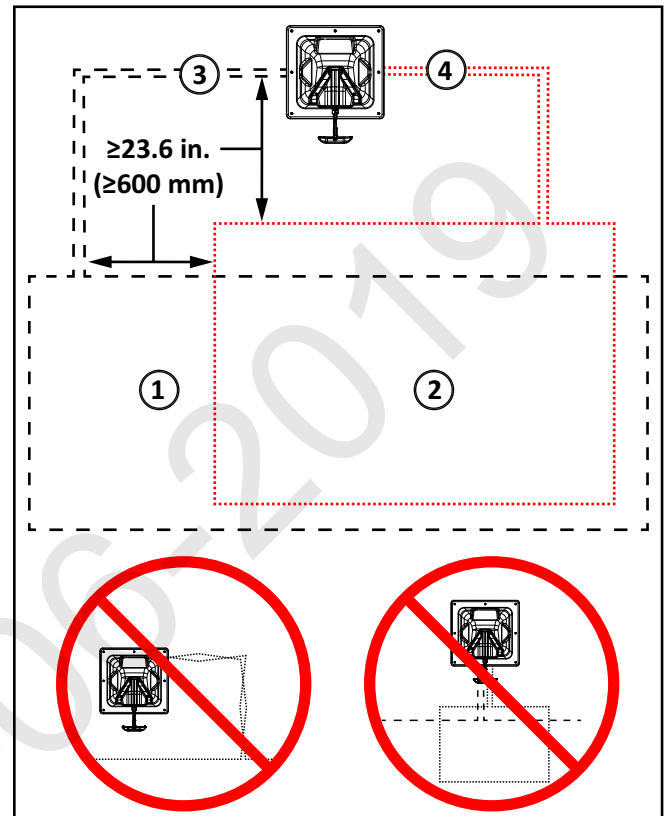
1 – Field 1

2 – Field 2

3 – Start and finish side of Field 1 peripheral wire

4 – Start and finish side of Field 2 peripheral wire

9.6 Multi-Field Peripheral Wire Installation

The start and finish sides of the peripheral wire must lie next to each other when they enter the charging station. Install the start and finish sides of the peripheral wire for one field around the other field. The distance between the peripheral wires for each field must be greater than or equal to 23.6 in. (600 mm).

9.6.1 Multi-Field Overlaps

An overlap is an area that lies within two fields. It is used for the robot to transition from one field to another. The length and width of the overlap must be greater than 9.8 ft. (3 m).

Overlap With Station Loop Wire In Single Field
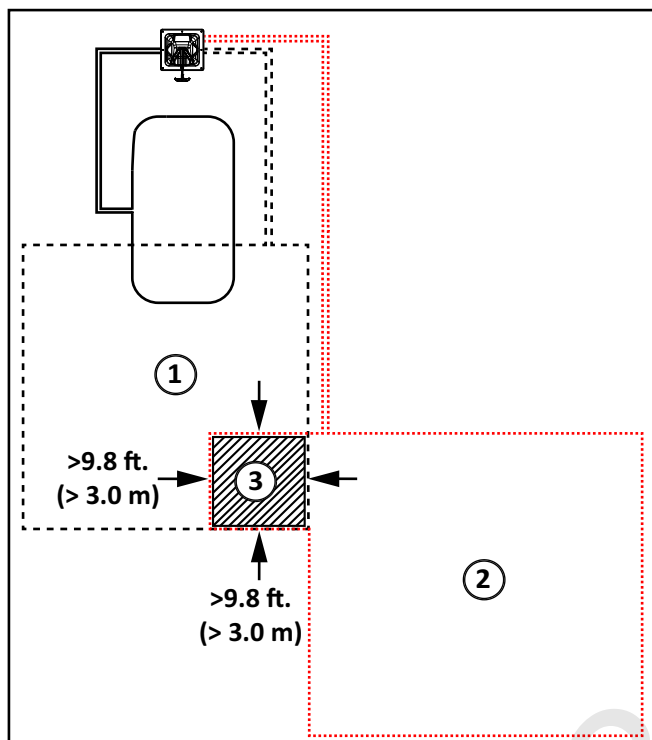
1 – Field 1
2 – Field 2
3 – Overlap area

Overlap With Station Loop Wire Across Multiple Fields

In this example the station loop wire overlaps the larger peripheral wires and fields. If the robot is in the station loop field, and needs to return to the charging station, it will not use the trackborder. The robot will simply follow the station loop wire to enter the charging station.
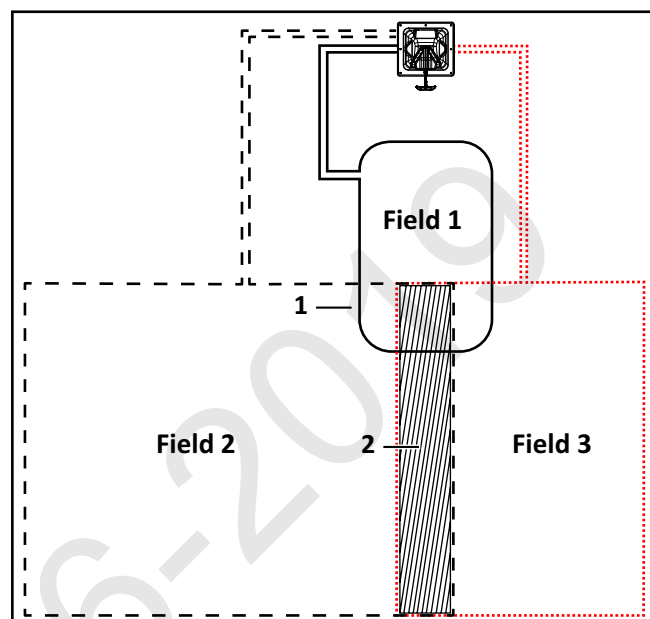
1 – Station loop wire
2 – Overlap area

All three fields are neighbors to each other.

The proportion of time that the robot spends working in fields 2 and 3 is determined by the percentage values assigned to the corresponding fields. For the station loop fields 1), the percentage can be set to 0.

9.7 Obstacles

Obstacles are objects that the robot must avoid. Examples are:

- trees, flower beds
- swing sets, climbing frames, trampolines
- sidewalks, walking paths, terraces
- ponds, swimming pools

On a golf course installation, examples are:

- distance markers and flags
- Target ball nets
- bunkers
- water hazards

Some obstacles are detected by the sonar sensors on the robot. Other obstacles require the installation of the peripheral wire to create an island, or a pseudo-island.

If an island is created, the robot will not approach the obstacle. The robot will move across the peripheral wire to avoid the obstacle.

If a pseudo-island is created, the robot will approach the obstacle, and then maneuver around it.

9.7.1 Water Obstacle

> ⚠ **CAUTION**
>
> ### WATER AMPLIFIES THE ELECTROMAGNETIC SIGNAL OF THE PERIPHERAL WIRE
>
> The robot is attracted towards higher signal levels. Failure to correctly avoid a water obstacle can result in submersion of the robot.
>
> • Use an island or a pseudo-island to avoid a water obstacle.

Install the peripheral wire a minimum distance of 5.3 ft. (1.6 m) from the edge of the water. Increase this distance if the ground slopes towards the water, is slippery, or can become wet or flooded.

If meeting the minimum distance of 5.3 ft. (1.6 m) is not possible, install a physical barrier around the water.

Install the charging station a minimum of 49.2 ft. (15 m) from the edge of the water.

Two possible installations for the charging station are shown in the following figure.

NOTE: The robot should return to the charging station from the direction away from the water.

If the charging station is located at Point A, program the robot to return to it in a clockwise direction.

If the charging station is located at Point B, program the robot to return to it in a counterclockwise direction.
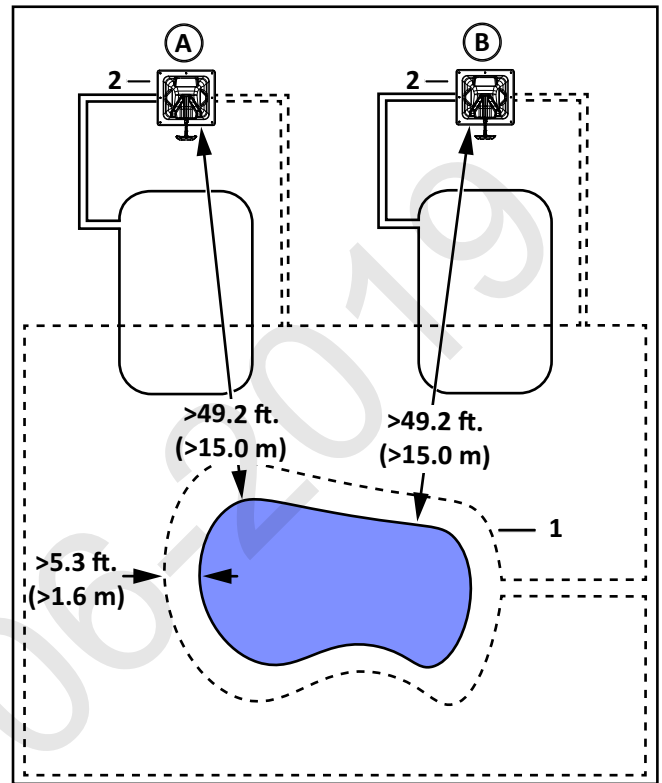
1 – Peripheral wire
2 – Charging station

9.7.2 Obstacles Near the Boundary to be Mowed

If an obstacle is less than 3.3 ft. (1.0 m) from the boundary, install the peripheral wire around the obstacle. If the distance between the obstacle and the boundary is greater than 3.3 ft. (1.0 m), but less than 16.4 ft. (5.0 m), install a pseudo-island.
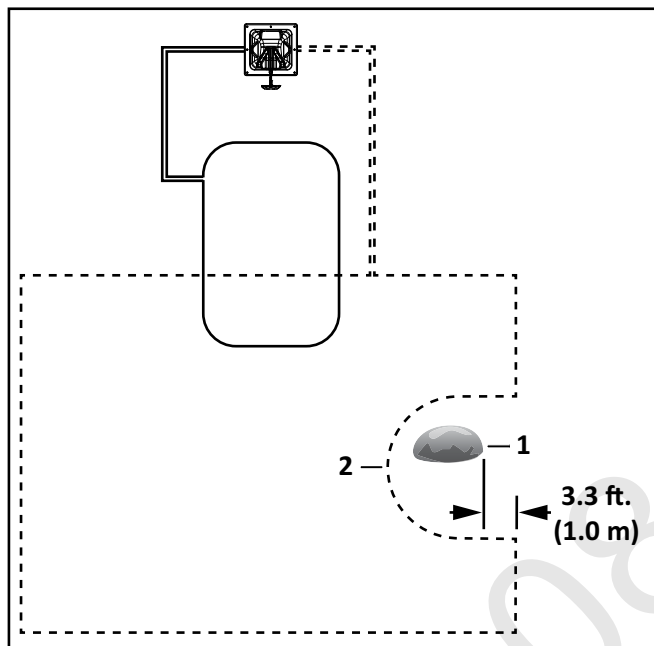
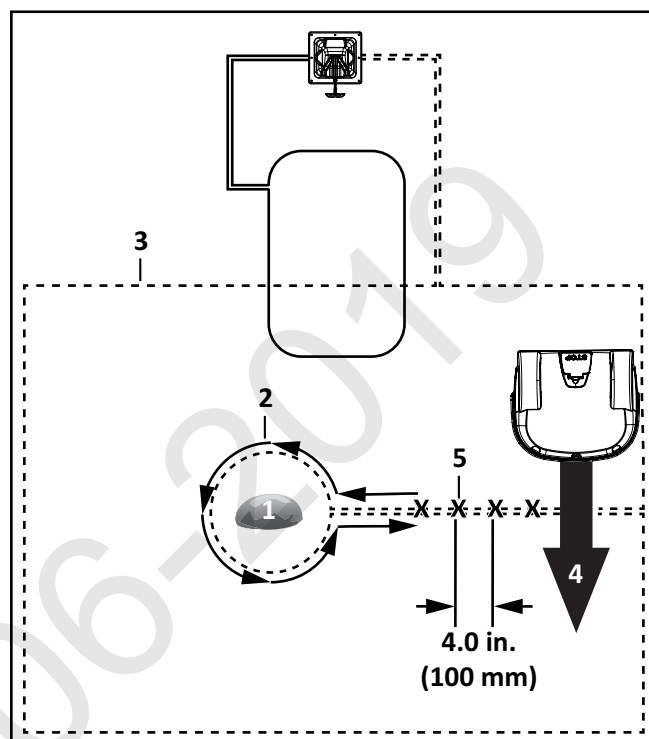1 – Obstacle
2 – Peripheral wire

9.8 Islands

Create an island when an obstacle is more than:

- 16.4 ft. (5.0 m) from the peripheral wire
- 49.2 ft. (15.0 m) from the charging station
- 16.4 ft. (5.0 m) from another island or pseudo-island

Install the peripheral wire around an obstacle to create an island. A maximum of five islands can be installed.

Requirements for an island:

- install the peripheral wire in a counterclockwise direction around an object
- place the approach and return sides of the peripheral wire directly next to each other (do not cross or twist the wire) secure with tie straps at 0.4 in. (10 mm) increments

1 – Obstacle
2 – Direction to install peripheral wire
3 – Peripheral wire
4 – Movement of robot
5 – Tie strap locations

9.9 Pseudo-Islands

Create a pseudo-island when an obstacle is less than:

- 16.4 ft. (5.0 m) from the peripheral wire
- 49.2 ft. (15.0 m) from the charging station
- 16.4 ft. (5.0 m) from another island or pseudo-island

Install the peripheral wire around an obstacle to create a pseudo-island.

Installation requirements for a pseudo-island:

- counterclockwise direction around an object
- allow a fixed distance of 15.7 - 23.6 in. (400 - 600 mm) between the approach and return sides
- do not cross or twist the approach and return side of the peripheral wire
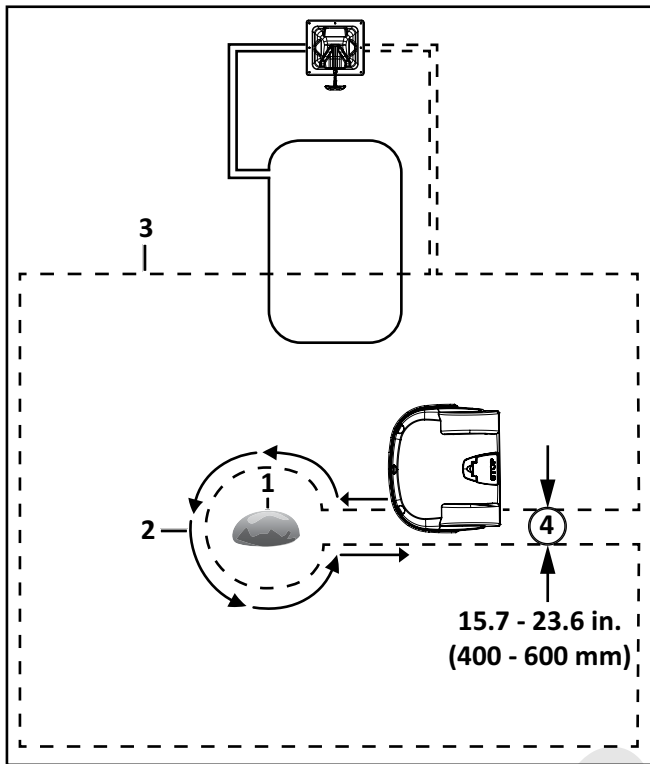
1 – Obstacle
2 – Direction to install peripheral wire (and movement of robot)
3 – Peripheral wire
4 – Fixed distance between approach and return sides

9.10 Sloped Fields

The maximum slope on any part of the field must be less than or equal to 17°.
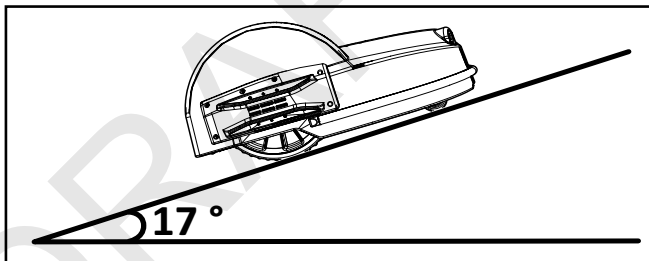
If a sloping part of the field is well away from the peripheral wire, no specific programming of the robot is required. If the sloping part of the field is near the peripheral wire, program the robot to return to the charging station by descending the slope.

9.11 Configuration Settings, Single Ball-Collecting Robot, Single Field Installation

The instructions given are the minimum set of configuration parameters that must be set for this type of installation.
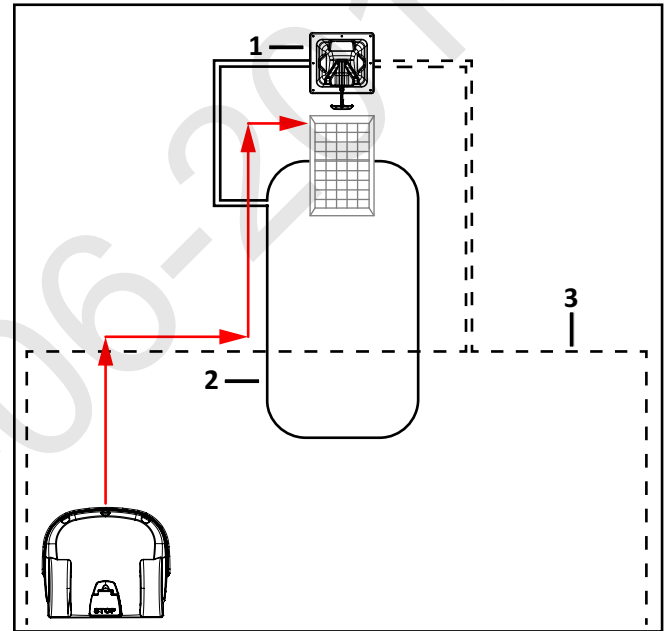
1 – Charging station with drop pit
2 – Station loop wire
3 – Peripheral wire

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✅. **Select Peripheral wires the press** ✅.

3) On the **WIRE SETTINGS** screen, select **Wire CH{X},** then press ✅.

4) Select **Signal channel**, then press ✅. Press ◀ or ▶ to assign the channel number for the wire.

5) Check the value shown at the top of the screen. This should be *positive*. If it is not, select **Reverse phase**, then press ✅ to check button ON.

6) Press ✕ once to return to the **WIRES SETTINGS** menu.

7) Select **Create new wire**, then press ✅,

8) Confirm creation of the new wire, then press **OK.**

9) Select the wire in the list and press ✅.

10) Select **Signal channel**, then press ✅. Press ◀ or ▶ to assign the channel number for the wire.

11) Check the value shown at the top of the screen. This should be *positive*. If it is not, select **Reverse phase**, then press ✅ to check button ON.

12) Press ✖ twice to return to the **INFRASTRUC-TURE** screen.

13) Select **Parcels**, then select the parcel associated with the wire CH{X}, press ✅.

14) Rename this parcel to D RANGE.

15) Select **Return Direction**, then press ✅. Press ◀ or ▶ to set the return in a clockwise (CW) or counterclockwise (CCW) direction.

16) Select **Use trackborder** and check the button ON. This ensures that when the robot is in this field, it will follow the trackborder until it reaches the LOOP wire.

17) Press ✖.

18) Select the parcel associated with the wire CH1, then press ✅.

19) Rename this parcel to **LOOP**.

20) Select **Return Direction**, then press ✅. Press ◀ or ▶ to set the return in a clockwise (CW) or counterclockwise (CCW) direction.

21) Select **Use trackborder** and check the button OFF. Since this is the return to station loop, the robot just needs to follow the wire when it is in this parcel.

22) Select **Neighboring parcels**. Select the **D RANGE** parcel and check the button ON.

23) Press ✖ once to return to the **PARCELS** menu.

24) Select **Edit parcels percentage**. Set the value to 100% for the **D RANGE** parcel.

25) Press ✖ once to return to the **INFRASTRUC-TURE** menu.

26) Select **Infrastructure > Stations > Create manual station**

27) Select **Charge** and check the button ON (this indicates the station will be used to charge the robot).

28) Select **Balls unload** and check the button ON. (this indicates the station is used as a drop pit).

29) Select **Connected to parcels**. A list of wires is presented. Select the wire associated with the loop parcel and scroll through the list to choose **LOOP**.

30) Select **Station inside parcel's wire**. Check the button ON if the station is inside the LOOP wire.

9.12 Configuration Settings, One Mowing Robot, One Ball-Collecting Robot, Single Field Installation

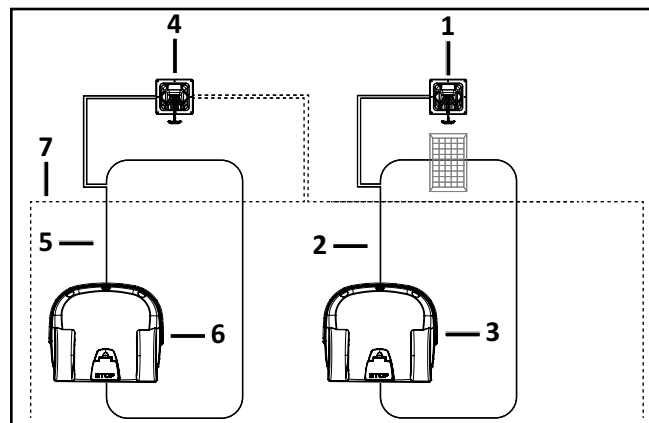The instructions given are the minimum set of configuration parameters that must be set for this installation.

1 – Charging station for ball-collecting robot (with drop pit)
2 – Station loop wire for ball-collecting robot (CH1) / Loop BC
3 – Ball-collecting robot
4 – Charging station for mowing robot
5 – Station loop wire for mowing robot (CH2)
6 – Mowing robot
7 – Peripheral wire (CH0) / D RANGE (driving range working area)

9.12.1 Configuration Settings for the Mowing Robot

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✅. **Select Peripheral wires the press** ✅.

3) On the WIRE SETTINGS screen, select the first wire in the list. Set the **Signal channel number** to the signal to be used for the peripheral wire (CH0 in this example).

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "return to station loop" wire (CH4 in this example).

5) Return to the **INFRASTRUCTURE** screen and select **Parcels**.

6) Select the parcel associated with the first wire (CH0).

7) Rename the parcel to indicate this is the working area (D RANGE in this example.) Define the return direction required and check the **Use trackborder** parameter ON.

8) Return to the **PARCELS** screen and select the parcel associated with the station loop wire (CH2 in this example). Rename the parcel to indicate this is the station loop (station loop wire for the mowing robot in this example.) Define the return direction required and check the **Use trackborder** parameter OFF.

9) Select **Neighboring parcels**, then press ▶. Select the D RANGE parcel and check the button ON.

10) Return to the **PARCELS** screen. **Select Edit parcels percentage**. Set the value to 100% for the D RANGE parcel.

11) Return to the **INFRASTRUCTURE** screen and select **Stations**.

12) Select **Create manual station**. Set the **Charge** parameter ON.

13) Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP M). Define whether the station is inside or outside the parcel's wire. In the example above the station is outside the parcel's wire.

9.12.2 Configuration Settings for the Ball-Collecting Robot

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✅. **Select Peripheral wires the press** ✅.

3) On the **WIRE SETTINGS** screen, select the first wire in the list. Set the **Signal channel number** to the signal to be used for the peripheral wire (CH0 in this example).

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "return to station loop" wire (CH1 in this example).

5) Return to the **INFRASTRUCTURE** screen and select **Parcels**.

6) Select the parcel associated with the first wire (CH0). Rename the parcel to indicate this is the working area (D RANGE in this example). Define the return direction required and check the **Use trackborder** parameter ON.

7) Return to the **PARCELS** screen and select the parcel associated with the loop wire (CH1 in this example). Rename the parcel to indicate this is the station loop (LOOP BC in this example). Define the return direction required and check the **Use trackborder** parameter OFF.

8) Select Neighboring parcels, then press ▶. Select the D RANGE parcel and check the button ON.

9) Return to the PARCELS screen. Select **Edit parcels percentage**. Set the value to 100% for the D RANGE parcel.

10) Return to the **INFRASTRUCTURE** screen and select **Stations**.

11) Select **Create manual station**. Set the **Charge** parameter ON. Set the **Balls Unload** parameter ON.

12) Select **Connected to parcels** parameter, then select the parcel in the loop wire (LOOP BC). Define whether the station is inside or outside the parcel's wire. In the example above the station is outside the parcel's wire.

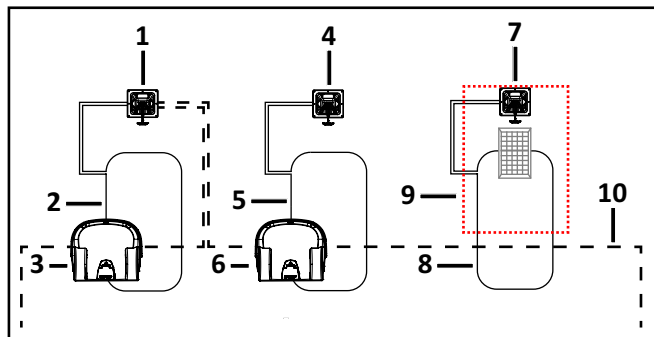## 9.12.3 Configuration Settings, Two Ball-Collecting Robots, Single Field Installation

In this configuration three charging stations are required; a charging station for each of the robots, and a third connected to the drop pit.

1 – Charging station 1
2 – Station loop (CH1)
3 – Ball-collecting robot 1
4 – Charging station 2
5 – Station loop wire (CH3)
6 – Ball-collecting robot 2
7 – Charging station with drop pit
8 – Station loop wire (CH2)
9 – Busy loop wire
10 – Peripheral wire

9.12.4 Configuration Settings for Ball-Collecting Robot 1

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✅. Select **Peripheral wires the press** ✅.

3) On the **WIRE SETTINGS** screen, select the first wire in the list. Set the **Signal channel number** to the signal to be used for the peripheral wire. (CH0 in this example).

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "return to station loop" wire (CH1 in this example).

5) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "drop pit loop" wire (CH2 in this example).

6) Return to the **INFRASTRUCTURE** screen and select **Parcels**.

7) Select wire CH0 and rename it to D-RANGE. Define the return direction required and check the **Use trackborder** parameter ON.

8) Return to the **PARCELS** screen and select the parcel associated with the loop wire (CH1 in this example). Rename the parcel (LOOP BC1 in this example). Define the return direction required and check the **Use trackborder** parameter OFF.

9) Select **Neighboring parcels**. Select the D RANGE parcel and check the button ON.

10) Return to the **PARCELS** screen. Select **Edit parcels percentage**. Set the value to 100% for the D RANGE parcel.

11) Return to the **INFRASTRUCTURE** screen and select **Stations**.

12) Select **Create manual station**. Set the **Charge** parameter ON. Set the Balls Unload parameter OFF. Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP BC1).

13) Return to **PAIRED STATIONS** screen. **Create manual station** (for the drop pit). Set the **Charge** parameter OFF. Set the **Balls Unload** parameter ON. Select **Busy loop** and choose the required channel from those available. (CH4 in this example.) Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP DP).

9.12.5 Configuration Settings for Ball-Collecting Robot 2

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✅. Select **Peripheral wires the press** ✅.

3) On the **WIRE SETTINGS** screen, select the first wire in the list. Set the **Signal channel number** to the signal to be used for the peripheral wire. (CH0 in this example.)

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "return to station loop" wire (CH3 in this example).

5) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "drop pit loop" wire (CH2 in this example. 0.

6) Return to the **INFRASTRUCTURE** screen and select **Parcels**.

7) Select wire CH0 and rename it to D-RANGE. Define the return direction required and check the **Use trackborder** parameter ON.

8) Return to the **PARCELS** screen and select the parcel associated with the loop wire (CH3 in this example). Rename the parcel (LOOP BC2 in this example). Define the return direction required and check the **Use trackborder** parameter ON.

9) Select **Neighboring parcels**. Select the D RANGE parcel and check the button ON.

10) Return to the **PARCELS** screen. Select **Edit parcels percentage**. Set the value to 100% for the D RANGE parcel.

11) Return to the **INFRASTRUCTURE** screen and select **Stations**.

12) Select **Create manual station**. Set the **Charge** parameter ON. Set the Balls Unload parameter OFF. Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP BC2).

13) Return to **PAIRED STATIONS** screen. **Create manual station** (for the drop pit). Set the **Charge** parameter OFF. Set the **Balls Unload** parameter ON. Select **Busy loop** and choose the required channel from those available (CH4 in this example). Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP DP).

9.12.6 Configuration for Two Ball-Collecting Robots and Two Mowing Robots

NOTE: Channel for can be used twice. The ball-collecting robot is aware that the busy loop channel 4 is inside the station loop channel 1.
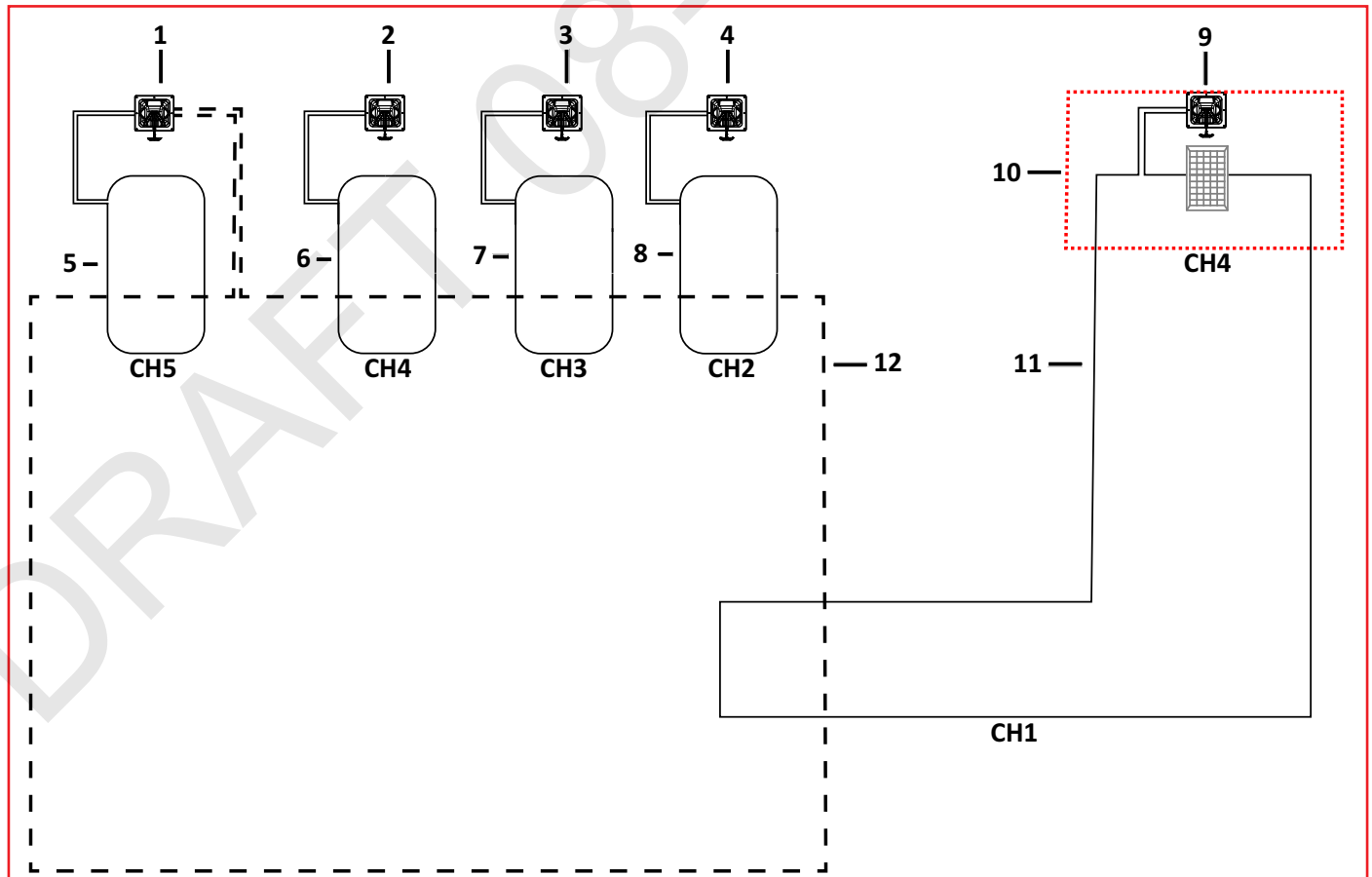
1 – Charging station mowing robot #2
2 – Charging station mowing robot #1
3 – Charging Station ball-collecting robot #2
4 – Charging Station ball-collecting robot #1

7 – Station loop wire (CH3)
8 – Station loop wire (CH2)
9 – Charging station with drop pit
10 – Busy loop wire

5 – Station loop wire (CH5)
6 – Station loop wire (CH4)

11 – Station loop wire (CH1)
12 – Peripheral wire / Working area (W-area)

9.12.7 Configuration for Mowing Robot 1

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✅. **Select Peripheral wires the press** ✅.

3) On the **WIRE SETTINGS** screen, select the first wire in the list. Set the **Signal channel number** to the signal to be used for the peripheral wire. (CH0 in this example.)

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel** number to the signal to be used for the "return to station loop" wire (CH4 in this example).

5) Return to the INFRASTRUCTURE screen and select Parcels.

6) Select the parcel associated with the first wire (CH0).

7) Rename the parcel to indicate this is the working area (W AREA in this example). Define the return direction required and check the Use trackborder parameter ON.

8) Return to the **PARCELS** screen and select the parcel associated with the loop wire (CH2 in this example). Rename the parcel to indicate this is the station loop (LOOP M1 in this example). Define the return direction required and check the **Use trackborder** parameter OFF.

9) Select **Neighboring parcels**. Select the W AREA parcel and check the button ON.

10) Return to the **PARCELS** screen. Select **Edit parcels percentage**. Set the value to 100% for the W AREA parcel.

11) Return to the **INFRASTRUCTURE** screen and select **Stations**.

12) Select **Create manual station**. Set the **Charge** parameter ON.

13) Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP M1). Define whether the station is inside or outside the parcel's wire. In the example above the station is outside the parcel's wire.

9.12.8 Configuration for Mowing Robot 2

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✅. **Select Peripheral wires the press** ✅.

3) On the **WIRE SETTINGS** screen, select the first wire in the list. Set the **Signal channel number** to the signal to be used for the peripheral wire. (CH0 in this example).

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "return to station loop" wire (CH5 in this example).

5) Return to the **INFRASTRUCTURE** screen and select **Parcels**.

6) Select the parcel associated with the first wire (CH0).

7) Rename the parcel to indicate this is the working area (W AREA in this example). Define the return direction required and check the **Use trackborder** parameter ON.

8) Return to the **PARCELS** screen and select the parcel associated with the loop wire (CH2 in this example). Rename the parcel to indicate this is the station loop (LOOP M2 in this example). Define the return direction required and check the **Use trackborder** parameter OFF.

9) Select **Neighboring parcels**. Select the W AREA parcel and check the button ON.

10) Return to the PARCELS screen. **Select Edit parcels percentage**. Set the value to 100% for the W AREA parcel.

11) Return to the **INFRASTRUCTURE** screen and select **Stations**.

12) Select **Create manual station**. Set the **Charge** parameter ON.

13) Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP M2). Define whether the station is inside or outside the parcel's wire. In the example above the station is outside the parcel's wire.

9.12.9 Configuration for Ball-Collecting Robot 1

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✅. **Select Peripheral wires the press** ✅.

3) On the **WIRE SETTINGS** screen, select the first wire in the list. Set the **Signal channel number** to the signal to be used for the peripheral wire. (CH0 in this example.)

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "return to station loop" wire (CH2 in this example).

5) Return to the WIRE SETTINGS screen. Select Create new wire and set the Signal channel number to the signal to be used for the "drop pit loop" wire (CH1 in this example).

6) Return to the **INFRASTRUCTURE** screen and select **Parcels**.

7) Select wire CH0 and rename it to W AREA. Define the return direction required and check the Use trackborder parameter ON.

8) Return to the **PARCELS** screen and select the parcel associated with the loop wire (CH1 in this example). Rename the parcel (LOOP BC1 in this example). Define the return direction required and check the **Use trackborder** parameter OFF.

9) Select **Neighboring parcels**. Select the W AREA parcel and check the button ON.

10) Return to the **PARCELS** screen. **Select Edit parcels percentage**. Set the value to 100% for the W AREA parcel.

11) Return to the **INFRASTRUCTURE** screen and select Stations.

12) Select **Create manual station**. Set the **Charge** parameter ON. Set the **Balls Unload** parameter OFF. Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP BC1).

13) Return to **PAIRED STATIONS** screen. **Create manual statio**n (for the drop pit). Set the **Charge parameter** OFF. Set the Balls Unload parameter ON. Select **Busy loop** and choose the required channel from those available. (CH4 in this example.) Select **Connected to parcels** param-

eter and select the parcel in the loop wire (LOOP DP).

9.12.10 Configuration for Ball-Collecting Robot 2

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✅. **Select Peripheral wires the press** ✅.

3) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "return to station loop" wire (CH3 in this example).

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "drop pit loop" wire (CH1 in this example).

5) Return to the **INFRASTRUCTURE** screen and select Parcels.

6) Select wire CH0 and rename it to W AREA. Define the return direction required and check the **Use trackborder** parameter ON.

7) Return to the **PARCELS** screen and select the parcel associated with the loop wire (CH1 in this example). Rename the parcel (LOOP BC2 in this example). Define the return direction required and check the **Use trackborder** parameter OFF.

8) Select **Neighboring parcels**. Select the W AREA parcel and check the button ON.

9) Return to the **PARCELS** screen. Select **Edit parcels percentage**. Set the value to 100% for the W AREA parcel.

10) Return to the **INFRASTRUCTURE** screen and select Stations.

11) Select **Create manual station**. Set the **Charge** parameter ON. Set the **Balls Unload** parameter OFF. Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP BC2).

12) Return to **PAIRED STATIONS** screen. **Create manual station** (for the drop pit). Set the **Charge** parameter OFF. Set the **Balls Unload** parameter ON. Select **Busy loop** and choose the required channel from those available (CH4 in this example). Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP DP).

9.12.11 Configuration for One Ball-Collecting Robot, One Mowing Robot, and Two Working Areas

In this configuration, two working areas are defined. One is a "high density" area, close to the driving range where there are a high number of balls to be collected. The second is a "low density" area with fewer balls. Both the ball-collector and the mower work in both areas, but not necessarily at the same time. The mowing in the high density area could be done when the players are not present.
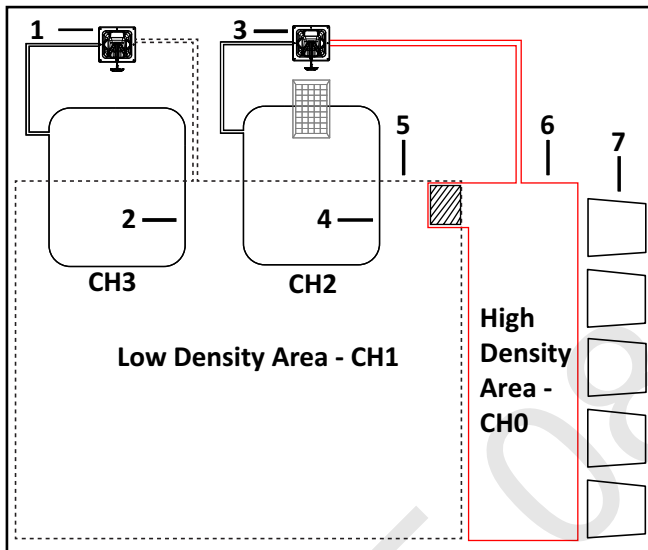
1 – Charging station for mower
2 – Station loop wire (CH3)
3 – Charging station with drop pit
4 – Station loop wire (CH2)
5 – Low density area peripheral wire (CH1)
6 – High density area peripheral wire (CH0)
7 – Driving range bays
8 – Station loop wire (CH2)
9 – Busy loop wire
10 – Peripheral wire

9.12.12 Configuration for the Mowing Robot

1) Select **INFRASTRUCTURE, then press** ✅. Select **Peripheral wires the press** ✅.

2) On the **WIRE SETTINGS** screen, select **Wire CH{X},** then press ✅.

3) On the **WIRE SETTINGS** screen, select the first wire in the list. Set the **Signal channel number** to the signal to be used for the "high density area" wire. (CH0 in this example.)

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel numbe**r to the signal to be used for the "low density area" wire. (CH1 in this example.)

5) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "return to station loop" wire. (CH3 in this example.)

6) Return to the **INFRASTRUCTURE** screen and select **Parcels**.

7) Select the parcel associated with the first wire (CH0). Rename the parcel to indicate that this is the high density working area (HD AREA in this example.) Define the return direction required and check the **Use trackborder** parameter ON.

8) Return to the **PARCELS** screen and select the parcel associated with the low density area wire (CH1 in this example.) Rename the parcel to indicate this is the low density working area (LD AREA in this example.) Define the return direction required and check the **Use trackborder** parameter OFF.

9) Select **Neighboring parcels**. Select the HD AREA parcel and check the button ON.

10) Return to the PARCELS screen and select the parcel associated with the loop wire (CH3 in this example.) Rename the parcel to indicate this is the station loop (LOOP M in this example.) Define the return direction required and check the Use trackborder parameter OFF.

11) Select **Neighboring parcels**. Select the LD AREA parcel and check the button ON.

12) Return to the **PARCELS** screen. Select **Edit parcels percentage**.

13) Set the proportion of time that the robot needs to spend in each of the working area. (For example: for LD AREA set 60%, for HD AREA set 40%, for LOOP M set 0%.)

14) Return to the **INFRASTRUCTURE** screen and select **Stations.**

15) Select **Create manual station**. Set the **Charge** parameter ON.

16) Select Connected to parcels parameter and select the parcel in the loop wire (LOOP M). Define whether the station is inside or outside the parcel's wire. In the example above the station is outside the parcel's wire.

9.12.13 Configuration for the Ball-Collecting Robot

1) Select **Infrastructure > Peripheral wires**

2) On the **WIRE SETTINGS** screen, select the first wire in the list. Set the **Signal channel number** to the signal to be used for the "high density area" wire (CH0 in this example).

3) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "low density area" wire (CH1 in this example).

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "return to station loop" wire (CH2 in this example).

5) Return to the **INFRASTRUCTURE** screen and select **Parcels**.

6) Select wire CH0 and rename it to HD AREA. Define the return direction required and check the **Use trackborder** parameter ON.

7) Return to the **PARCELS** screen and select the parcel associated with the "low density area" wire (CH1 in this example). Rename the parcel (LD AREA in this example). Define the return direction required and check the **Use trackborder** parameter ON.

8) Select **Neighboring parcels**. Select the HD AREA parcel and check the button ON.

9) Return to the **PARCELS** screen and select the parcel associated with the loop wire (CH2 in this example). Rename the parcel (LOOP BC in this example). Define the return direction required and check the **Use trackborder** parameter OFF.

10) Select **Neighboring parcels**. Select the LD AREA parcel and check the button ON.

11) Return to the **PARCELS** screen. Select **Edit parcels percentage**. Set the proportion of time that the robot needs to spend in each of the working area. (For example: for LD AREA set 40%, for HD AREA set 60%, for LOOP BC set 0%.)

12) Return to the **INFRASTRUCTURE** screen and select **Stations**.

13) Select **Create manual station**. Set the **Charge** parameter ON. Set the **Balls Unload** parameter ON. Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP BC).

9.12.14 Two Ball-Collecting Robots, One Mowing Robot, Two Working Areas

In this example, there are two ball-collecting robots that work predominately in the high ball density area near the driving range. Each robot requires a charging station. An additional station connected to the drop pit is required with a busy loop to ensure that the only one robot is using it at a time.

There is one mowing robot that works predominately in a low ball density area.

The set up is shown in the following image:
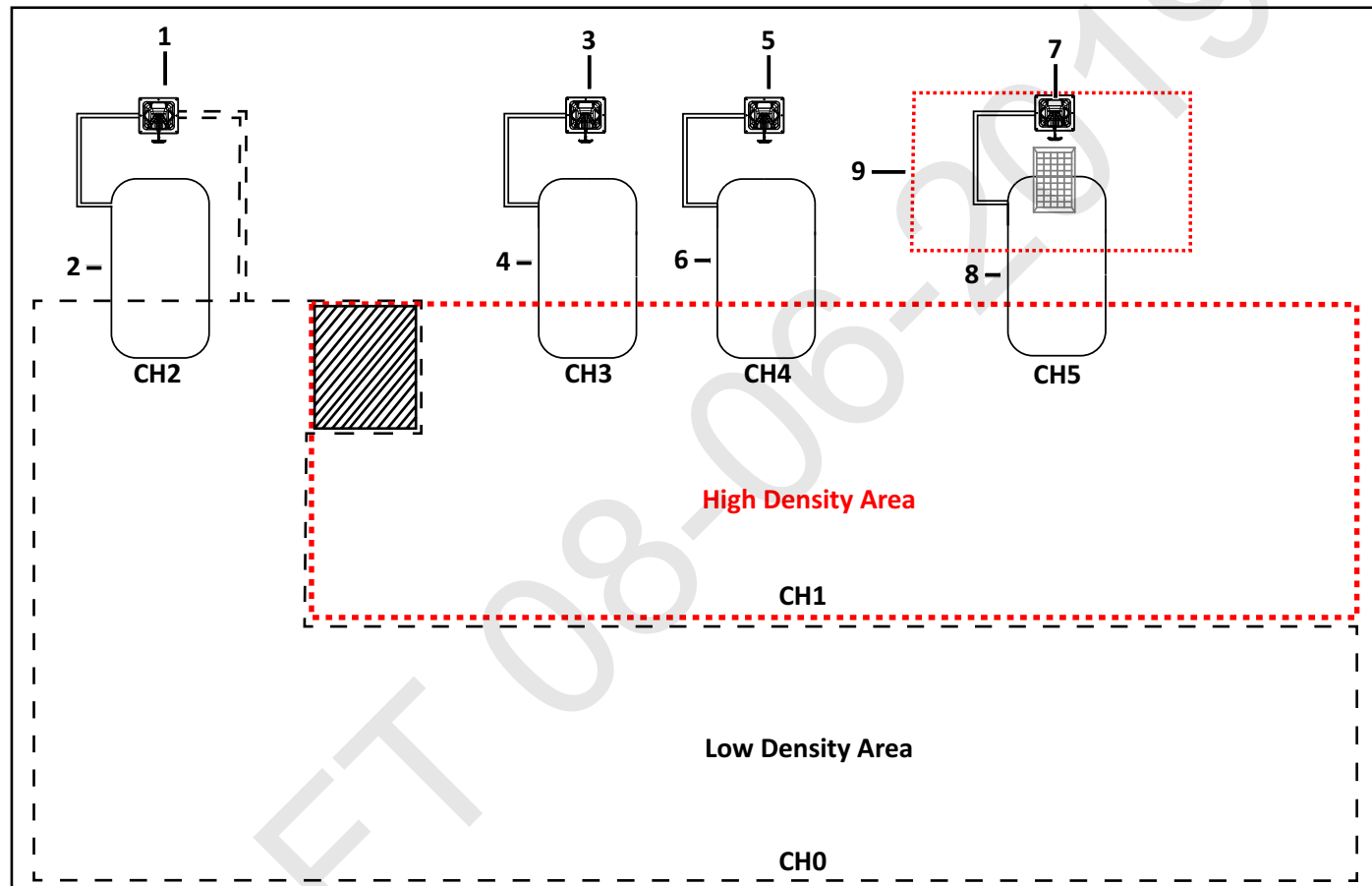
1 – Charging station for mower
2 – Station loop wire (CH2)
3 – Charging station for ball-collecting robot 1
4 – Station loop wire (CH3)

5 – Charging station for ball-collecting robot 2
6 – Station loop wire (CH4)
7 – Charging station with drop pit
8 – Station loop wire (CH5)

NOTE: Channel 1 is used twice. This is possible because the robots can distinguish the Channel 1 which is inside station loop with Channel 5, from the other Channel 1.

9.12.15 Configuration for the Mowing Robot

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✅. **Select Peripheral wires the press** ✅.

3) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "high density area" wire (CH1 in this example) .

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "return to station loop" wire (CH2 in this example).

5) Return to the **INFRASTRUCTURE** screen and select **Parcels**.

6) Select the parcel associated with the first wire (CH0). Rename the parcel to indicate that this is the low density working area. Define the return direction required and check the **Use track-border** parameter ON.

31

7) Return to the **PARCELS** screen and select the parcel associated with the high density area wire (CH1 in this example). Rename the parcel to indicate this is the high density working area. Define the return direction required and check the Use trackborder parameter OFF.

8) Select Neighboring parcels. Select the Low Density Area (LD AREA) parcel and check the button ON.

9) Return to the **PARCELS** screen and select the parcel associated with the loop wire (CH2 in this example). Rename the parcel to indicate this is the station loop (Station Loop for Mower in this example). Define the return direction required and check the **Use trackborder** parameter OFF.

10) Select **Neighboring parcels**. Select the LD AREA parcel and check the button ON.

11) Return to the PARCELS screen. Select **Edit parcels percentage.**

12) Set the proportion of time that the robot needs to spend in each of the working area. For example: for the Low Density Area (LD AREA) set 70%, for the High Density Area (HD AREA) set 30%, for the station loop wire for the mower charging station, set 0%.

NOTE: Define the times that the robot works in the two parcels using the Schedule in the Settings menu

13) .

14) Return to the **INFRASTRUCTURE** screen and select **Stations**.

15) Select **Create manual station**. Set the Charge parameter ON.

16) Define whether the station is inside or outside the parcel's wire. In the example above the station is outside the parcel's wire.

9.12.16 Configuration Setting for Ball-Collector 1

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✓. **Select Peripheral wires the press** ✓.

3) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used

for the "return to station loop" wire (CH3 in this example).

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "drop pit loop" wire (CH5 in this example).

5) Return to the **INFRASTRUCTURE** screen and select **Parcels**.

6) Select wire CH0 and rename it to LD AREA. Define the return direction required and check the **Use trackborder** parameter ON.

7) Return to the **PARCELS** screen and select the parcel associated with the "high density area" wire (CH1 in this example). Rename the parcel (HD AREA in this example). Define the return direction required and check the **Use trackborder** parameter ON.

8) Select **Neighboring parcels**. Select the LD AREA parcel and check the button ON.

9) Return to the **PARCELS** screen and select the parcel associated with the loop wire (CH3 in this example). Rename the parcel (LOOP BC1 [ball-collecting robot 1] in this example). Define the return direction required and check the **Use trackborder** parameter OFF.

10) Select **Neighboring parcels**. Select the HD AREA parcel and check the button ON.

11) Return to the **PARCELS** screen and select the parcel associated with the drop pit wire (CH5 in this example). Rename the parcel (LOOP DP [station loop wire for the drop pit] in this example. Define the return direction required and check the **Use trackborder** parameter OFF.

12) Select **Neighboring parcels**. Select the HD AREA (high density area) parcel and check the button ON.

13) Return to the **PARCELS** screen. Select **Edit parcels percentage**.

14) Set the proportion of time that the robot needs to spend in each of the working areas. For example: for LD AREA set 20%, for HD AREA set 80%, for LOOP BC1 set 0%, for LOOP DP set 0%.

15) Return to the **INFRASTRUCTURE** screen and select **Stations**.

16) Select **Create manual station**. Set the **Charge** parameter ON. Set the **Balls Unload** parameter OFF. Select **Connected to parcels** parameter and

select the parcel in the loop wire (station loop wire for ball-collecting robot 1).

17) Return to **PAIRED STATIONS** screen. **Create manual station** (for the drop pit). Set the **Charge** parameter OFF. Set the **Balls Unload** parameter ON. **Select Busy loop** and choose the required channel from those available (CH1 in this example). Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP DP).

9.12.17 Configuration for Ball-Collecting Robot 2

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✅. **Select Peripheral wires the press** ✅.

3) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "high density area" wire(CH1 in this example).

4) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "return to station loop" wire (CH4 in this example).

5) Return to the **WIRE SETTINGS** screen. Select **Create new wire** and set the **Signal channel number** to the signal to be used for the "drop pit loop" wire(CH5 in this example).

6) Return to the **INFRASTRUCTURE** screen and select **Parcels**.

7) Select wire CH0 and rename it to LD AREA. Define the return direction required and check the **Use trackborder** parameter ON.

8) Return to the **PARCELS** screen and select the parcel associated with the "high density area" wire (CH1 in this example). Rename the parcel (HD AREA in this example). Define the return direction required and check the **Use trackborder parameter** ON.

9) Select **Neighboring parcels**. Select the LD AREA parcel and check the button ON.

10) Return to the **PARCELS** screen and select the parcel associated with the loop wire (CH4 in this example). Rename the parcel (LOOP BC2 in this example). Define the return direction required and check the **Use trackborder** parameter OFF.

11) Select **Neighboring parcels**. Select the HD AREA parcel and check the button ON.

12) Return to the **PARCELS** screen and select the parcel associated with the drop pit wire (CH5 in this example). Rename the parcel (LOOP DP in this example). Define the return direction required and check the **Use trackborder** parameter OFF.

13) Select **Neighboring parcels**. Select the HD AREA parcel and check the button ON.

14) Return to the PARCELS screen. Select **Edit parcels percentage**.

15) Set the proportion of time that the robot needs to spend in each of the working area. (For example: for LD AREA set 20%, for HD AREA set 80%, for LOOP BC2 set 0%, for LOOP DP set 0%.)

16) Return to the **INFRASTRUCTURE** screen and select **Stations**.

17) Select **Create manual station**. Set the **Charge** parameter ON. Set the **Balls Unload** parameter OFF. Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP BC2).

18) Return to **PAIRED STATIONS** screen. **Create manual station** (for the drop pit). Set the **Charge** parameter OFF. Set the **Balls Unload** parameter ON. Select **Busy loop** and choose the required channel from those available. (CH1 in this example.) Select **Connected to parcels** parameter and select the parcel in the loop wire (LOOP DP).

10 Technician Settings Menu

Use the Technicians Settings menu to define the following installation and configuration parameters.

- Infrastructure
- Mobile connection
- Demonstration
- Service
- Advanced parameters

From the Home screen, press and hold **9** on the numeric keypad until the **TECHNICIAN SETTINGS** screen appears.

10.1 Infrastructure

Use this menu to configure wires, parcels, and stations.

10.1.1 Wires

Wire CH#

A list of defined wires is presented, with the corresponding channel number. The list of parcels associated with the wire is listed below it.

This needs a screen shot to support the text above.

Create new wire

Use to create a new wire.

Create a New Wire

1) Press and hold 9 on the numeric keypad until the TECHNICIANS SETTINGS menu appears.

2) Select **INFRASTRUCTURE, then press** ✅. **Select Peripheral wires the press** ✅.

3) Select **OK** to confirm that you want to create the new wire.

4) The new wire and its associated parcel will appear in the wire settings list.

5) Select the new wire and press ✅.

6) Select the required channel number. This must correspond to the value set using the rotating switch in the charging station.

7) Check the sign of the magnetic distance displayed at the top of the screen. If this value is negative, check the Reverse phase button ON.

8) Press ❌ to exit the menu

The newly created wire will appear in the Wire settings screen.

Wire Properties

Wire id and magnetic distance

The identification of the wire in terms of the associated channel is displayed. In addition the current value and sign of the magnetic distance between the robot and the wire is indicated.

Signal channel

The signal (frequency) channel for the peripheral wire. This corresponds to the channel set using the rotating switch in the charging station. In the case of a multi-field installation, each wire used, must be assigned to a specific channel.

Reverse phase

The sign of the phase on the inside of the field is opposite to that on the outside. This is how the robot can detect whether it has crossed the peripheral wire. The phase should be positive inside the field.

To determine if this is the case, examine the magnetic distance value shown at the top of the screen. If the value is positive the phase is correct. If it is negative, check this option to reverse the phase.

Delete Wire CH#

This option only appears if there is more than one wire defined. It allows the current wire to be deleted. NOTE: At least one wire must be defined.

10.2

10.2.1 Parcels

The Parcels menu lists the defined channels and their associated parcels. There is, by default, one parcel associated with each wire.

For each parcel, the name and indication of the return direction is shown.

Selecting a parcel and pressing ✅ displays the list of parcel properties given below.

Parcel properties

Name

The current name of the parcel. The name can be edited.

Return direction

Defines the default direction (clockwise or counter-clockwise) in which the robot returns to its charging station following the wire.

Set the value of this parameter to ensure that the robot can return to the charging station in the most efficient manner. This is important if a problem has occurred and the robot does not know which parcel it is in.
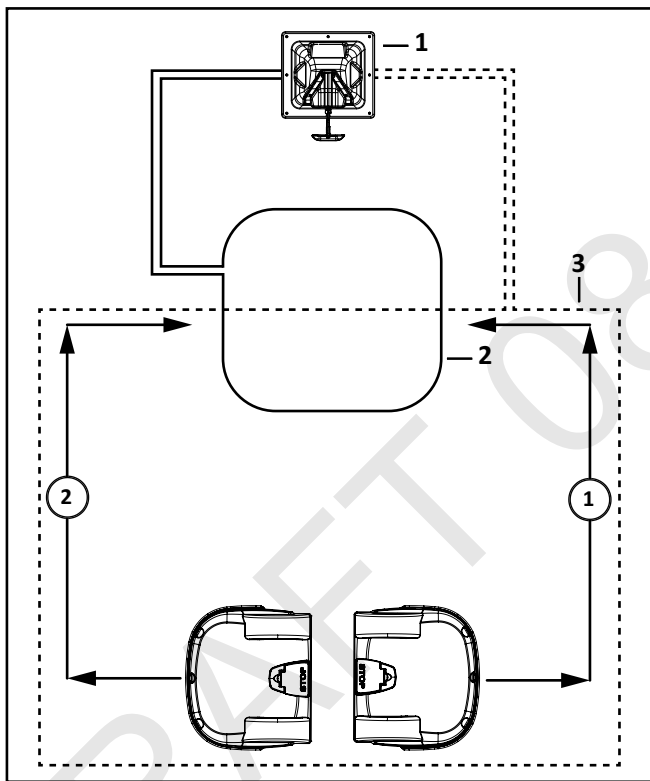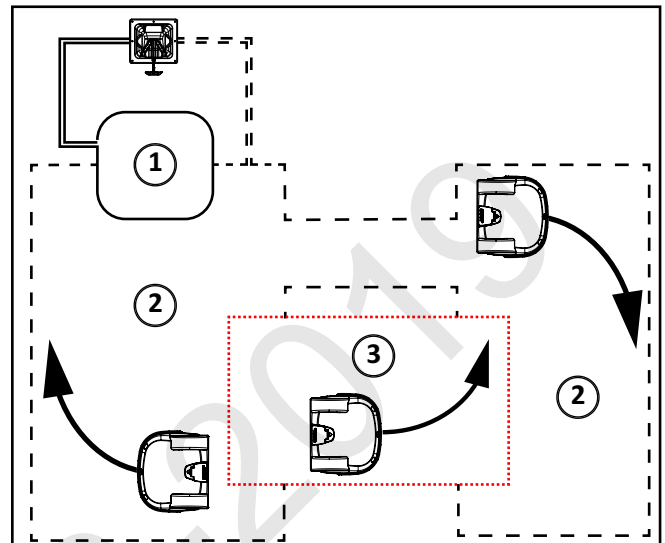

1 – Counterclockwise return direction
2 – Clockwise return direction

The current return direction is indicated in the list of parcels.

The following figure illustrates the advantage of setting different return directions in different parcels to facilitate the most efficient way for the robot to return to the charging station.

1 – Parcel 1 (area inside station loop wire)
2 – Parcel 2
3 – Parcel 3

Use trackborder

This parameter defines whether the robot uses the trackborder when leaving or returning to the charging station.

NOTE: This parameter value must be checked ON in all parcels which are not the station loop.

This parameter can be checked OFF for the station loop

Trackbord. Min. / Trackbord. Max.

The minimum and maximum values allowed for the trackborder. The robot will select a random value between the defined values.

The default minimum value for **Trackbord Min**.is 2.6 ft. (0.8 m). The default maximum value for **Trackbord. Max.** is 9.8 ft. (3 m).

Min. Bounce Angle / Max. Bounce Angle

This is the angle through which the robot turns when it arrives at the peripheral wire. The range of values for this parameter is typically between 60° and 120°.

1 – Peripheral wire

35
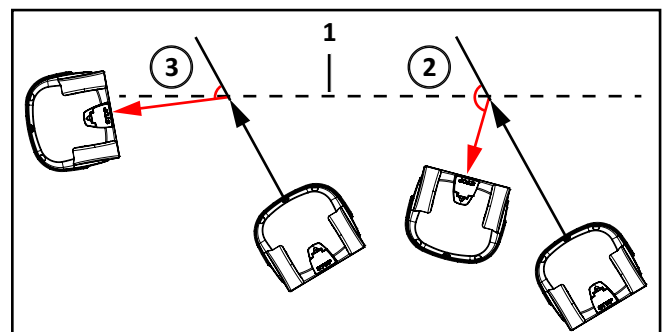
2 – Min. Bounce Angle

3 – Max. Bounce Angle

Perimeter

This defines a distance the robot will travel along the trackborder to return to the charging station. If the robot travels the distance defined by this parameter and does not find the station, it will issue an alarm.

The recommended value of this parameter is the length of the peripheral wire around the working area, the default value is 1000 m.

Neighboring parcels

It is necessary to define how parcels are located relative to each other so that the robot can determine the route required to reach a particular parcel. Two parcels are considered neighbors if they overlap. In the following figure:

• Parcel 1 is a neighbor of Parcel 2

• Parcel 3 is a neighbor of Parcel 2
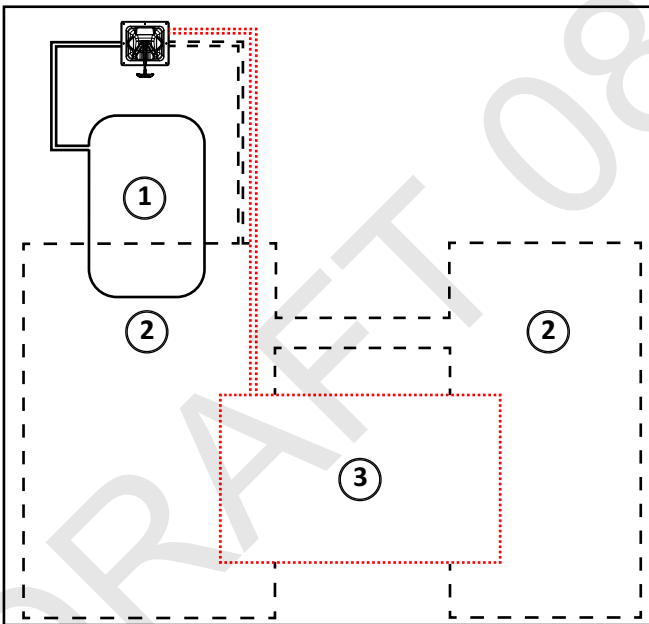
1 – Parcel 1 (area inside station loop wire)

2 – Parcel 2

3 – Parcel 3

StartZones

This menu displays a list of the defined start zones and enables you to create a new start zone. Start zones define where the robot will start working after it has left the station.

10.2.2 Start Zones

Start zones define where and how the robot starts working.

• A start zone is defined for a parcel.

• Multiple start zones can be defined for the same wire/parcel.

The Start Zone screen displays the following:

List of defined start zones

For each start zone the line below it shows some characteristics of the zone.

Create new start zone

Enables you to create a new start zone and define it's properties.

Start Zone Properties

Coming from

This option appears if you are defining a start zone for a parcel.

It defines the parcel preceding the one in which the start zone will be implemented.

Edit percentage

Allows you to edit the percentages applied to different parcels.

If only one parcel is defined this value must be set to 100%.

Do not edit the percentage until more than one start zone has been defined.

Direction

This specifies the clockwise or counterclockwise direction the robot will take to move along the trackborder after leaving the charging station.

When the robot leaves the charging station, it follows the station loop wire for a predefined distance until it arrives in the trackborder of the field, it then takes the specified direction.
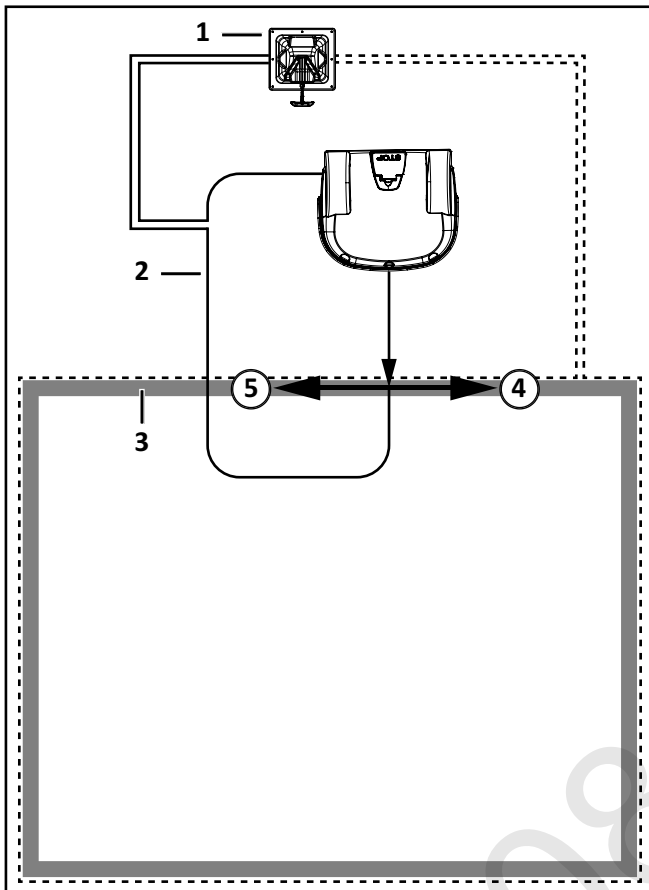
1 – Charging station
2 – Station loop wire
3 – Trackborder
4 – Clockwise direction on trackborder
5 – Counterclockwise direction on trackborder

Distance Min. / Distance Max.

This is the distance that the robot will travel along the trackborder after leaving the station and start working. A random value between the minimum and maximum values will be selected.

Distance Min. and Distance Max. are measured from the point where the robot enters the parcel, if this differs from the one in which the charging station is located.

If the start zone is located in a different parcel than the one containing the charging station, the distances are measured from the entry point into the parcel (shown in the figure below).
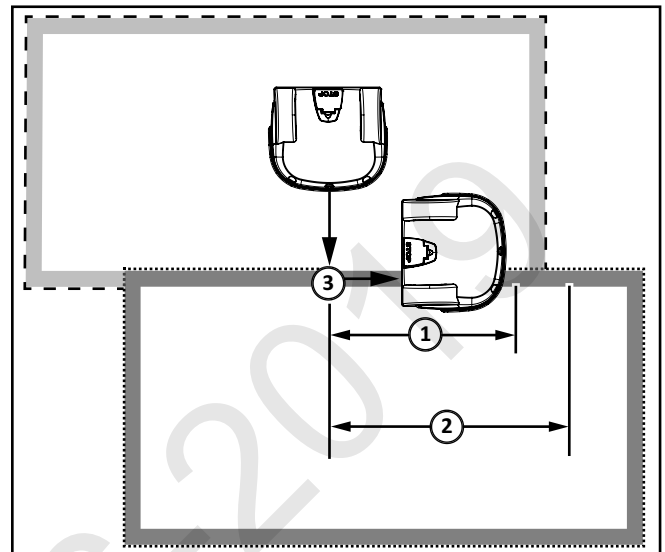
1 – Distance Min.
2 – Distance Max.
3 – Trackborder

Angle Min. / Angle Max.

This is the angle that the robot will turn through to take it into the field to start working. Minimum and maximum values are defined and the robot will choose a random value between the defined limits.
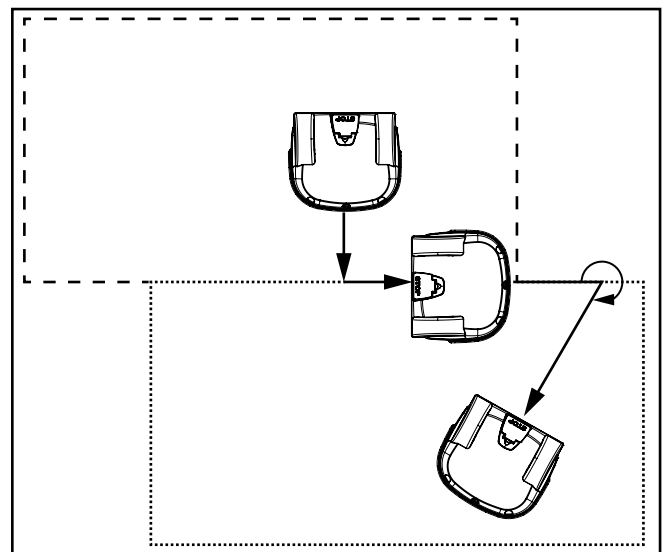
Delete StartZone

Allows the start zone to be deleted.

10.3 Stations

The **Paired Stations** screen appears.

Existing stations

If stations have already been defined a list of them is presented.

Selecting a station enables you to view and edit the properties of the station. These are the same as those used in creating the station.

Create manual station

Allows you to manually create a new station.

This procedure is required to define a station that does not use a positioning beacon.

Create new station

The charging station must be defined manually. Define the following parameters.

Charge

This defines whether the charging station is used to charge the robot or not.

Connected to parcels

This defines which of the defined parcels the station is connected to. For a multi-field installation a list of defined parcels will be presented and button next to the required one must be checked ON.

NOTE: This parameter must be defined for a multi-field installation.

Station Inside Parcel's Wire

This specifies whether the station is located inside or outside of the peripheral wire.

If the station is inside the wire, check the button ON.

Delete

Use to remove the manually created station from the installation.

10.3.1 Station Properties

Station properties include details of a station. This menu also allows you to specify **Access parameters**, which determine how the robot will enter and leave the station, and **Start Zones**, which are the points at which the robot starts working after leaving the station.

Charge

Defines whether the station is used to charge the robot or not.

Software version

The current version of the software for the station.

Connected to parcels

This defines to which of the defined parcels the station is connected. For a multi-field installation a list of defined parcels will be presented and button next to the required one must be checked ON.

NOTE: This parameter must be defined for a multi-field installation.

Station inside Parcel's wire

This specifies whether the station is located inside or outside of the peripheral wire loop.

If the station is inside the loop, check the button ON.

Start Zones

This menu displays a list of the defined start zones and enables you to create a new one. Start zones define where the robot will start working after it has left the station.

NOTE: A start zone defined here is only used for a installation that contains a single wire and a positioning beacon.

10.4 Mobile Connection

In the absence of a wireless network, the robot contains a SIM card that enables you to use 4G technology in the field.

Select the **Mobile connection** in the list and press .

Mobile Connection Options

Status

Displays the current mobile network status.

Network

Displays the name of the current network operator.

Network Carrier

Displays the name of the current network carrier.

APN

Displays the current id of the Access Point Name of the SIM card.

Radio

3G/2G/UMTS/4G.

Signal Strength

Signal strength in dB.

Bit Error Rate

Number of errors during transmission. Very standard in every communication.

ICCID

Integrated circuit card identifier.

IMEI

International Mobile Equipment Identity.

IMSI

International Mobile Subscriber Identity

PLMN

Public land mobile network.

MCC

Mobile Country Code. This code identifies the country. For example, in China MCC is equal to 460, in USA - 310, Hungary - 216, Belorussia - 257.

MNC

Mobile Network Code. This code identifies the mobile operator.

LAC

Location Area Code.

Cell ID

A unique number used to identify each Base transceiver station (BTS) or sector of a BTS within a Location area code.

10.5 Demonstration

<div style="background-color: yellow;">

⚠ **CAUTION**

</div>

Check the option ON. Confirm you want to ignore the peripheral wire.

Use this mode to demonstrate the performance of the robot before installation of the peripheral wire.

OPERATIONAL HAZARD

The robot will ignore the electromagnetic field generated by the peripheral wire when operating in demonstration mode.

• Do not leave the robot unsupervised when it is operating in demonstration mode.

10.6 Service

The Service menu contains the following options:
• Calibrations
• Information
• Tests
• Software update

10.6.1 Calibrations

Yet to be determined.

10.6.2 Information

Total distance

This is the total distance traveled by the robot to date. This information is used to decide when maintenance is required.

Bumper resistance

Displays the current value of the bumper resistance. The range is 82-94 kΩ.

Yet to be determined.

10.6.3 Tests

These tests are only to be run by an authorized ECHO Robotics Technician.

They will be carried out before the robot is delivered to a customer, and at the end of a regular service.

To execute a test:

1) Press ⬇ to select the test(s) you want to execute.

2) Press ✓ to select the test.

3) Repeat this for all tests required.

4) Select **Start** and press ✓.

5) The robot will start executing each of the selected tests. Follow the instructions given on the screen.

Charge

This test checks if the:
• robot can detect a charge
• received charging current is sufficient

When this option is selected, the following information is displayed:

X/Y CHARGE _LR

X represents the current test in the current sequence.

Y represents the total number of tests to be performed in the current sequence.

Charge_LR is the name of the current test.

Detect

This displays whether the robot can detect a voltage on the left and right sides.

KO means it *can not* detect a voltage on the left or right side. OK means that it *can* detect a voltage.

Current

This displays whether a sufficient charge current can be detected (>7A).

KO means it *can not* detect sufficient charge current on the left or right side. OK means that it *can* detect sufficient charge current.

[value]

The current on the connected side.

Discharge required for current test

You will see this message if the current battery level is above 95%. It is best to perform this test when the battery charge level is lower.

To test the charge:
1) Connect one side of the robot to the charging station.
2) The result will be displayed.
3) Repeat this for the other side.

If the results of the test are KO, check the connections between the robot and the charge station arms.

Bumper

This test checks that the electrical resistance of the bumper is within the correct range and that it responds to pressure from an obstacle.
The following information is shown.

X/Y BUMPER SENSORS

X represents the current test in the current sequence.

Y represents the total number of tests to be performed in the current sequence.

BUMPER SENSORS is the name of the current test.

Activate sensors

The sides of the bumper that need to be tested by activating. (Bumper Left Bumper Right)

Disable Sensors

The sides of the bumper that need to be disabled (Bumper Left Bumper Right)

To test the Bumper
1) Check that Bumper Left Bumper Right are listed below **Activate sensors**.
2) If these are listed under **Disable Sensors**, remove any constrictions that are compressing the bumper.
3) Press your hand against the right or left side of the bumper.
4) If the resistance is modified sufficiently the item will be removed from the list.
5) Repeat this process on the other side of the bumper.
6) If an item remains in the list, the bumper is not functioning correctly and needs to be replaced.

Smartbox

This test checks all the functionality of the smartbox panel.

To test the Smartbox
1) Follow each of the instructions as they appear on the screen.
2) Press ✅ to answer Yes to a question and ❌ to answer No.
3) If the item being tested is operating correctly it will disappear from the list.

If there is a problem with any of the items, replace the Smartbox.

Backwards Sensors

This test checks that the backwards sensors are operating correctly.
The following information is shown.

X/Y BACK_SENSORS

X represents the current test in the current sequence.

Y represents the total number of tests to be performed in the current sequence.

BACK_SENSORS is the name of the current test.

Activate sensors

The number of sensors that need to be tested by activating them (CollisionLeft, CollisionRight).

Disable Sensors

The number of sensors that need to be deactivated (CollisionLeft, CollisionRight).

To test the Back Sensors

1) Check that CollisionLeft and CollisionRight are listed below **Activate sensors**.

2) If these are listed under **Disable Sensors**, remove any constrictions activating them.

3) Push the body of the robot backwards on one side so that it moves relative to the chassis.

4) If the backward sensor on this side is functioning correctly it will be removed from the list.

5) Repeat this on the other side.

6) If an item remains in the list, the backward sensor is not functioning correctly. Visually inspect it to see if there is a constriction that is impeding its function. If not, replace it if necessary.

Signal Sensors

This test checks the functionality of the coil that is used to detect a signal on a peripheral wire.

The following information is shown.

X/Y COIL0_CENTER

X represents the current test in the current sequence.

Y represents the total number of tests to be performed in the current sequence.

COIL0_CENTER is the name of the current test.

Detecting wire < {value}

{value} is the value of the "track value". If the result of the test is less than this value, the test is successful.

CH{A}:{result value}

If the test result is greater than the defined "track value", it will be listed here.

Move the robot closer to the signal wire detected. When the value is less than the "track value", the item should be removed from the list.

If the robot is close to the wire and the displayed values are high (900 or more) it is an indication that the coil connections are not good.

Drive Motor

This checks the function of the drive motor. It checks that:

- the motor drives the wheel forward at 0.2 mph (0.1m/s)
- a current of 2.5 A is delivered to the motor

To test the Drive Motor

1) Press ✅ to start the test.
2) Close the lid when requested.

3) The robot will move forward a short distance then stop and beep.

4) Open the lid.

5) If the robot moved forward, answer Yes to the question by clicking ✅.

6) If the robot moved backwards answer No to the question by clicking ❌. If this is the case, reverse the connections on the drive motor cable.

If the robot did not move, or only one wheel moved, the test will fail, and the report will indicate the problem.

1) Visually inspect the drive motors to see if there is a blockage.

2) Check the fuse and the cabling for the drive motors.

Sonars System

This performs a test to verify that the sonar sensors are operating correctly.

If any of the sonar sensors are found to be defective, they need to be replaced. An indication of which sensor needs to be replaced is given.

Lid

In order for the robot to be able to execute its missions the lid needs to be shut, and to form a closed circuit between magnets on the lid and relays on the body. This circuit needs to be open when the lid is open and when the lid is pressed down and acts as the stop button. This requires that all magnets and relays are functioning correctly and there is some precision in their positioning.

Linear Actuator

The linear actuator controls the position of the roller, moving it between the lowest position (for picking) to an intermediate position (used when following the wire) and the highest position (for unloading). This is the same as the roller calibration test. It moves the

roller position up and down to check that it moves between the two stops.

To test the Linear Actuator

1) Press ✅ to start the test

2) Press ✅ to continue if you don't want to continue with the test, keep pressing ❌ until you exit the menu.)

3) To initiate the movement of the roller by the linear actuator, press 0 and keep it depressed.

The roller will be moved up to its highest position and then down to its lowest. Switch UP

checks that the switch to stop the up movement works. Switch DOWN checks that the

actuator stops at the lowest position.

Collecting Roller

The purpose of this test is to check that the rotation sensor works correctly.

1) Press ✅ to start the test

2) Rotate t collecting roller

Counting System

This test checks that the pressure band that counts the ball collected and the lever that detects when the basket is full are operating correctly.

1) Remove the body of the robot.

2) Press ✅ to start the test.

3) When prompted press your fingers against the pressure sensor band.

4) When prompted lift the bracket at the rear of the basket.

10.6.4 Software update

Use this menu to perform a software update. The current software version is displayed.

Select **Update now,** then press ✅. The robot will contact the server, download and then install the latest software version.

10.7 Technician Settings Advanced parameters

Max speed

Sets the maximum speed at which the robot will move (maximum speed is 2.2 mph [3.2 km/hr]).

Wire crossing distance

Sets the distance the robot will move when it crosses the peripheral wire, before turning back into the field again.

The default value is 0.2m. This distance represents the distance between the front of the

robot and the position of the coil that detects the presence of the wire.

NOTE: he distance between the peripheral wire and the edge of the working area depends on this value.

Min temp

Sets the lowest outside operating temperature in which the robot will operate,

11 Using the Robot

PERSONAL INJURY HAZARD

Contact with the robot during operation can cause personal injury.

• Press the STOP button before handling the robot.

Safety and information symbols are located on the back of the robot. Follow and understand all *Safety Symbols* before using the robot.

Maintain and service the robot on a regular basis.

Configure the operation of the robot with the

11.1 Safety Measures

The operator or user is responsible for accidents or hazards occurring to other people or their property.

• Remove all non-stationary obstacles from the working area before using the robot.

• Never leave the robot on a slope.

- Only use the robot charging station to charge the robot's battery. Use of any other charger can cause damage and loss of warranty coverage.
- Remove power from the charging station before opening it.
- Never connect an external electrical element to the battery cable.
- Do not open sealed components.
- When installing any component, do not over-reach and keep your balance.
- Wear appropriate foot wear and long pants.
- Never pick up or carry the robot while the motor is running.
- Do not leave the robot to operate unattended if there are pets, children or people in the vicinity.
- Never operate the robot if it has defective guards or shields, or without safety devices.
- Avoid using the robot in bad weather conditions especially when there is a risk of lightning or flooding.

11.2 Actions Menu

The operations provided in this menu depend on the current state of the robot when it is in the field and in the charging station.

11.2.1 Operation In The Field

Perform these operations when the robot:
- is stopped and not in the charging station
- has been stopped during its normal operation schedule
- has stopped because an alarm has been raised

If an alarm has been raised, correct the problem before executing the operations.

Charge & stay

Return to the charging station and stay there until it a new instruction is issued.

Mow

Continue the working schedule after an interruption.

Go charge

Return to the charging station, charge the battery and then resume working.

To execute the operations:

NOTE: If the STOP button cover is not closed withing 10 seconds, the operation is canceled and will need to be repeated.

1) Open the STOP button lid.

2) Press ![icon] .

3) Press ![icon] or ![icon] to highlight the required command, then press ![icon].

4) Close the STOP button cover.

11.2.2 Operation In the Charging Station

Perform these operations when the robot is in the charging station.

Use these operations to override the regular operating schedule.

Mow now

Leave the charging station and continue working.

Mow after charge

Remain in the charging station until the battery is charged and then start working.

Stay in station after charge

Stay in the charging station until a new command is issued.

Mow now on...

Leave the charging station and continue working in a specific parcel. A list of parcel appears in which you can choose the required one.

To execute the operations:

1) Open the STOP button cover.

2) Press ![icon] .

3) Press ![icon] or ![icon] to highlight the required command, then press ![icon].

4) Close the STOP button cover. If the STOP button cover is not closed within 10 seconds, the operation is canceled and will need to be repeated.

11.3 Service Menu

Use the options in this menu to set specific operating parameters.

11.3.1 Regional Parameters

Use this option to set the robot time zone and the language.

To set the time zone:

1) Press ▤.

2) Press the arrow keys to highlight **Regional parameters**, then press ✓.

3) Use ◀ and ▶ to scroll to the required time zone.

```
┌──────────────────────────────────┐
│       REGIONAL PARAMETERS         │
├──────────────────────────────────┤
│                                   │
│  Time zone      ◄ Europe/London ► │
│                                   │
│  Language       ◄    English    ► │
│                                   │
└──────────────────────────────────┘
```

4) Press ✓ to accept the time zone.

5) Press ✗ to exit the menu.

To set the language:

1) Press ▤.

2) Press the arrow keys to highlight **Regional parameters**, then press ✓.

3) Press ▼ to highlight **Language**.

4) Press ✓.

5) Use ◀ and ▶ to highlight the required language.

```
┌──────────────────────────────────┐
│       PARAMÈTRES RÉGIONAUX        │
├──────────────────────────────────┤
│                                   │
│  Fuseau horaire  ◄ Europe/London ►│
│                                   │
│  Langue          ◄   Français   ► │
│                                   │
└──────────────────────────────────┘
```

6) Press ✓ to accept the language.

7) Press ✗ to exit the menu.

11.3.2 Connections

To display the connections screen:

1) Press ▤.

2) The Connections screen will display. Use the arrow keypad to select an option.

IP address

Select to display the current IP address of the robot, depending on the mode on which it is operating.

Modes can be mobile, vpn, or WiFi.

Mode

Select to set the mode in which the robot is to operate. Mode selections are:

- OFF - The robot will not be connected to a network.
- Client - The robot will connect to the selected network as a client.
- Access point - The robot will use its inbuilt modem to generate its own WiFi network to which you can connect.

Search for networks

This option appears when the robot is not connected or cannot detect a WiFi network.

SSID

This displays the name of the WiFi network to which the robot is connected, and allows you to modify it.

Highlight **{network name}** and press ✓.

A list of networks will display.

- Entries in bold text are ones that the robot has connected to.
- Entries in normal text are available but which have not been used.
- [*] indicates the actual network to which the robot is connected.
- [!] indicates that the network to which the robot is connected, is *not* encrypted using either WPA or WPA2 technologies. This is therefore an insecure network and the [!] indicates a warning.
- [-] indicates that the network has been disabled.
- To connect to a different known network, highlight the network, press ✓ and select **Enable Network**.

- To modify the current network, highlight the network, press ✅. The following operations are available:

  – Disable Network - Disconnects the robot from this network.

  – Change Password - Allows modification of the password to access the network from the robot.

  – Forget Network - Removes the recognition of this known network from the robot.

11.3.3 Using the Robot as a Client

For normal operation, set up the robot as a WiFi client. This will enable the robot to communicate with the portal on the web-server.

To set up the robot as a client:

1) Press ▤.

2) Highlight **Connections** and press ✅

3) Highlight **Mode** and set it to **Client**. If the robot has not been connected to a WiFi network, selecting the option Search for networks will search for networks and present a list of those available.

4) Highlight the WiFi network required and press ✅.

5) Enter the password for the network using the keyboard.

6) Highlight **V** and press ✅.

11.3.4 Operations

Use this menu to set the following operating parameters:

Min temp

Sets the lowest operating temperature for the robot. The default value is 41.0 °F (5.0 °C).

Edit parcels percentage

Use this option to view and modify each of the parcels that have been defined. The percentage value assigned to a parcel determines the proportion of times the robot will start working in the parcel.

To set the operating parameters:

1) Press ▤.

2) Use the arrow keys to highlight **Operations**, then press ✅.

3) Press 🔼 or 🔽 to highlight the required parameter.

4) Enter the required value.

5) Check that the current values have been updated.

6) Press ❌ to return to the main menu.

11.3.5 Device

Use this menu to display the characteristics of the device and change the robot's name.

```
┌─────────────────────────────────────┐
│           IDENTIFICATION            │
├─────────────────────────────────────┤
│ Robot Name              BRBM000104  │
│ 1. Device info ▸                    │
│ 2. System version ▸                 │
│                                     │
└─────────────────────────────────────┘
```

By default the name of the robot corresponds to the serial number.

To change the name of the robot:

1) Press ▤.

2) Press the arrow keys to highlight **Device info**, then press ✅.

3) Highlight **Robot name** and press ✅.

4) Highlight the back arrow to delete the current name.

5) Use the alpha-numeric keyboard to enter the new name. Highlight each character required and press ✅ to select it.

6) Highlight **V** in the bottom row and press ✅.

7) Press ✅ to accept the new name.

8) Press ❌ to return to the main menu.

45

11.3.6 Device info

To see the device info:

1) Press ▤.
2) Press the arrow keys to highlight **Device** then press ✅.

3) Highlight **Device info** and press ✅.

4) Press ⬆ or ⬇ to scroll through the list.

Robot name

The name of the robot.

Serial number

Serial number of the robot.

Latitude

Current latitude of the robot position.

Longitude

Current longitude of the robot position.

Visible satellites

Number of satellites that the device can currently detect.

Lat [GF center]

The current latitude of the center of the Geofence security zone.

Long [GF center]

The current longitude of the center of the Geofence security zone.

Radius

Current radius of the Geofence security zone.

Dist. to beacon

This option is not used in North America.

DW board not installed

This option is not used in North America.

Magnetic distance

The distance between the robot and the peripheral wire.

This value should be positive when the robot is inside the peripheral wire loop. If the distance is shown as a negative value, it is necessary to reverse the phase. See **Infrastructure > Peripheral wires > WireCH#** from the technician's menu.

APN

Identification of the Access Point Network

MAC address

MAC address.

11.3.7 System version

To see the System version information:

• Press ▤.
• Press the arrow keys to highlight **Device**, then press ✅.

• Highlight **System version**, then press ✅.

• Press ⬆ or ⬇ to scroll through the list.

Version

Current software version.

Brain version

Current AI version.

System version

Current version of the system software.

Software version

Current version of the application software.

Bootloader ver.

Current bootloader version.

11.3.8 Security

Use this menu to enable or disable the use of a PIN code and to define a security area in which the robot is allowed to operate.

NOTE: By default the pin code is 0000. To obtain the Pin Code menu, enter 0000.

Enable pin code

Highlight the check box. Press ✅ to toggle the setting.

Enable the PIN code ON or OFF.

Press ✅ to accept the new setting.

From now on certain commands will require the PIN code to be entered before they can be executed.
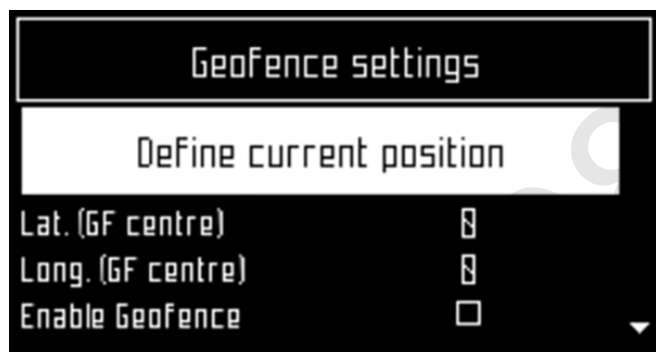
Change pin code

Use to change the pin code.

Enter the required numbers and press ✅.

11.3.9 Geofence

NOTE: This option is not available in North America.

A Geofence is a circular security zone in which the robot is allowed to operate. If the robot moves out of this area, a security notification will be issued. The circular area is defined by its center and a radius.

The current location of the center point can be viewed in the device settings menu.

```
┌─────────────────────────────────┐
│       Geofence settings         │
├─────────────────────────────────┤
│     Define current position     │
│                                 │
│  Lat. (GF centre)          0    │
│  Long. (GF centre)         0    │
│  Enable Geofence           □   ▼ │
└─────────────────────────────────┘
```

To define and implement a security zone:
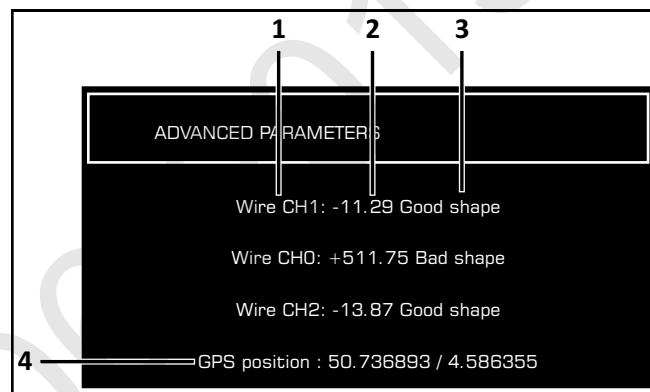
1) Move the robot to the required center of the security zone.

2) Press ☰.

3) Press the arrow keys to highlight **Security**, then press ✅.

4) Press the arrow keys to highlight **Geofence** and press ✅.

5) Highlight **Define current position**. The latitude and longitude of the current position is displayed.

6) Press ⬇ to highlight **Enable Geofence**.

7) Make sure this option is checked on. Press ✅ to toggle the setting.

8) Use ⬇ to highlight **Radius value**, then press ✅.

9) Use the numeric keypad to enter the required value.

10) Press ❌ to return to the main menu.

11.3.10 Advanced Parameters

Press and hold **0** on the numeric keypad until the **ADVANCED PARAMETERS** screen appears.

```
              1        2        3
        ┌─────────────────────────────────┐
        │ ADVANCED PARAMETERS              │
        │                                 │
        │   Wire CH1: -11.29 Good shape   │
        │                                 │
        │   Wire CH0: +511.75 Bad shape   │
        │                                 │
        │   Wire CH2: -13.87 Good shape   │
        │                                 │
4 ──────── GPS position : 50.736893 / 4.586355 │
        └─────────────────────────────────┘
```

1 – Wire channel numbers (Wire CH#). This is a list of currently defined peripheral wires.

2 – Distance the robot is from the peripheral wire. - A positive value indicates the robot is inside the peripheral wire. A negative value indicates the robot is outside of the peripheral wire.

3 – Wire integrity - "Good shape" indicates a good wire connection. "Bad shape" indicates the wire is damaged or not connected properly.

4 – GPS position (longitude and latitude).

11.4 Service Menu

Use the options in this menu to set specific operating parameters.

11.4.1 Regional Parameters

Use this option to set the robot time zone and the language.

To set the time zone:

1) Press ☰.

2) Press the arrow keys to highlight **Regional parameters**, then press ✅.

3) Use ◀ and ▶ to scroll to the required time zone.

REGIONAL PARAMETERS

Time zone ◄ Europe/London ►

Language ◄ English ►

4) Press ✓ to accept the time zone.

5) Press ✕ to exit the menu.

To set the language:

1) Press ☰.

2) Press the arrow keys to highlight **Regional parameters**, then press ✓.

3) Press ▼ to highlight **Language**.

4) Press ✓.

5) Use ◄ and ► to highlight the required language.

PARAMÈTRES RÉGIONAUX

Fuseau horaire ◄ Europe/London ►

Langue ◄ Français ►

6) Press ✓ to accept the language.

7) Press ✕ to exit the menu.

11.4.2 Connections

To display the connections screen:

1) Press ☰.

2) The Connections screen will display. Use the arrow keypad to select an option.

IP address

Select to display the current IP address of the robot, depending on the mode on which it is operating.

Modes can be mobile, vpn, or WiFi.

Mode

Select to set the mode in which the robot is to operate. Mode selections are:

- OFF - The robot will not be connected to a network.
- Client - The robot will connect to the selected network as a client.
- Access point - The robot will use its inbuilt modem to generate its own WiFi network to which you can connect.

Search for networks

This option appears when the robot is not connected or cannot detect a WiFi network.

SSID

This displays the name of the WiFi network to which the robot is connected, and allows you to modify it.

Highlight **{network name}** and press ✓.

A list of networks will display.

- Entries in bold text are ones that the robot has connected to.
- Entries in normal text are available but which have not been used.
- [*] indicates the actual network to which the robot is connected.
- [!] indicates that the network to which the robot is connected, is *not* encrypted using either WPA or WPA2 technologies. This is therefore an insecure network and the [!] indicates a warning.
- [-] indicates that the network has been disabled.
- To connect to a different known network, highlight the network, press ✓ and select **Enable Network**.
- To modify the current network, highlight the network, press ✓. The following operations are available:
  - Disable Network - Disconnects the robot from this network.
  - Change Password - Allows modification of the password to access the network from the robot.
  - Forget Network - Removes the recognition of this known network from the robot.

11.4.3 Using the Robot as a Client

For normal operation, set up the robot as a WiFi client. This will enable the robot to communicate with the portal on the web-server.

To set up the robot as a client:

1) Press ▦.

2) Highlight **Connections** and press ✅

3) Highlight **Mode** and set it to **Client**. If the robot has not been connected to a WiFi network, selecting the option Search for networks will search for networks and present a list of those available.

4) Highlight the WiFi network required and press ✅.

5) Enter the password for the network using the keyboard.

6) Highlight **V** and press ✅.

11.4.4 Operations

Use this menu to set the following operating parameters:

Min temp

Sets the lowest operating temperature for the robot. The default value is 41.0 °F (5.0 °C).

Edit parcels percentage

Use this option to view and modify each of the parcels that have been defined. The percentage value assigned to a parcel determines the proportion of times the robot will start working in the parcel.

To set the operating parameters:

1) Press ▦.

2) Use the arrow keys to highlight **Operations**, then press ✅.

3) Press ⬆ or ⬇ to highlight the required parameter.

4) Enter the required value.

5) Check that the current values have been updated.

6) Press ❌ to return to the main menu.

11.4.5 Device

Use this menu to display the characteristics of the device and change the robot's name.


```
IDENTIFICATION

Robot Name            BRBM000104
1. Device info ▶
2. System version ▶
```

By default the name of the robot corresponds to the serial number.

To change the name of the robot:

1) Press ▦.

2) Press the arrow keys to highlight **Device info**, then press ✅.

3) Highlight **Robot name** and press ✅.

4) Highlight the back arrow to delete the current name.

5) Use the alpha-numeric keyboard to enter the new name. Highlight each character required and press ✅ to select it.

6) Highlight **V** in the bottom row and press ✅.

7) Press ✅ to accept the new name.

8) Press ❌ to return to the main menu.

11.4.6 Device info

To see the device info:

1) Press ▦.

2) Press the arrow keys to highlight **Device** then press ✅.

3) Highlight **Device info** and press ✅.

4) Press ⬆ or ⬇ to scroll through the list.

Robot name

The name of the robot.

Serial number

Serial number of the robot.

Latitude

Current latitude of the robot position.

Longitude

Current longitude of the robot position.

Visible satellites

Number of satellites that the device can currently detect.

Lat [GF center]

The current latitude of the center of the Geofence security zone.

Long [GF center]

The current longitude of the center of the Geofence security zone.

Radius

Current radius of the Geofence security zone.

Dist. to beacon

This option is not used in North America.

DW board not installed

This option is not used in North America.

Magnetic distance

The distance between the robot and the peripheral wire.

This value should be positive when the robot is inside the peripheral wire loop. If the distance is shown as a negative value, it is necessary to reverse the phase. See **Infrastructure > Peripheral wires > WireCH#** from the technician's menu.

APN

Identification of the Access Point Network

MAC address

MAC address.

11.4.7 System version

To see the System version information:

- Press ▤.
- Press the arrow keys to highlight **Device**, then press ⊘.

- Highlight **System version**, then press ⊘.

- Press ⬆ or ⬇ to scroll through the list.

Version

Current software version.

Brain version

Current AI version.

System version

Current version of the system software.

Software version

Current version of the application software.

Bootloader ver.

Current bootloader version.

11.4.8 Security

Use this menu to enable or disable the use of a PIN code and to define a security area in which the robot is allowed to operate.

NOTE: By default the pin code is 0000. To obtain the Pin Code menu, enter 0000.

Enable pin code

Highlight the check box. Press ⊘ to toggle the setting.

Enable the PIN code ON or OFF.

Press ⊘ to accept the new setting.

From now on certain commands will require the PIN code to be entered before they can be executed.

Change pin code

Use to change the pin code.

Enter the required numbers and press ⊘.

11.4.9 Geofence

NOTE: This option is not available in North America.

A Geofence is a circular security zone in which the robot is allowed to operate. If the robot moves out of

this area, a security notification will be issued. The circular area is defined by its center and a radius.

The current location of the center point can be viewed in the device settings menu.

To define and implement a security zone:

1) Move the robot to the required center of the security zone.

2) Press ☰.

3) Press the arrow keys to highlight **Security**, then press ✓.

4) Press the arrow keys to highlight **Geofence** and press ✓.

5) Highlight **Define current position**. The latitude and longitude of the current position is displayed.

6) Press ▼ to highlight **Enable Geofence**.

7) Make sure this option is checked on. Press ✓ to toggle the setting.

8) Use ▼ to highlight **Radius value**, then press ✓.

9) Use the numeric keypad to enter the required value.

10) Press ✗ to return to the main menu.

11.4.10 Advanced Parameters

Press and hold **0** on the numeric keypad until the **ADVANCED PARAMETERS** screen appears.

1 – Wire channel numbers (Wire CH#). This is a list of currently defined peripheral wires.

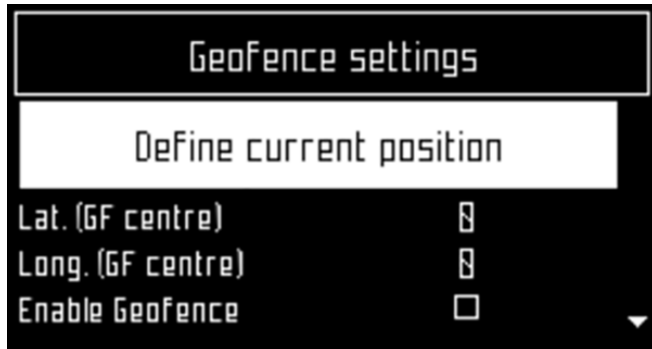2 – Distance the robot is from the peripheral wire. - A positive value indicates the robot is inside the peripheral wire. A negative value indicates the robot is outside of the peripheral wire.

3 – Wire integrity - "Good shape" indicates a good wire connection. "Bad shape" indicates the wire is damaged or not connected properly.

4 – GPS position (longitude and latitude).

12 Error Messages

Refer to the Dealer Portal for a description of error messages.

13 Connecting to Robots

Communication with a robot is available through:

• direct interaction with the robot
• remote access via the web server

13.1 Direct Interaction with the Robot

NOTE: There are some instructions which can only be issued using this type of communication.
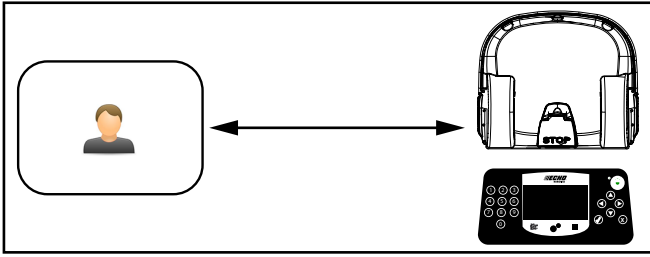
13.2 Remote Access Via the Web Server

- Remote access via the web server. Use this method of communication to connect to the robot using a smartphone, tablet, or personal computer, via a web server using the internet. A user account is required to access the web server. This depends on the concepts of Entities, Users and Roles, and Robots.
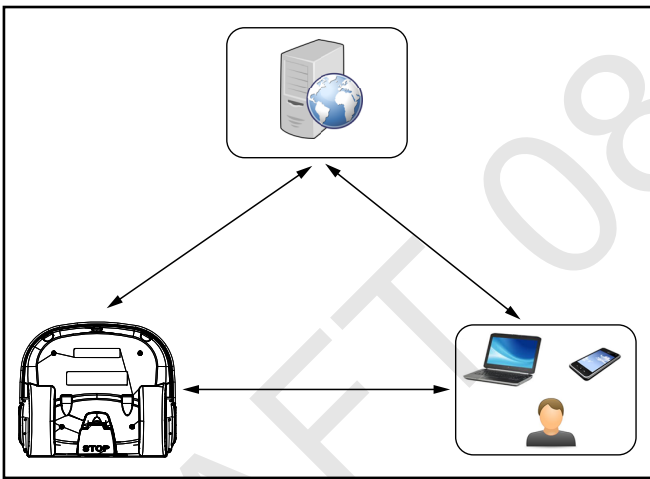
Through access to the web server the user can:
- Receive notifications about problems encountered by the robot (alarms and warnings).
- Issue commands to remotely control the robot, such as send to station, start from station, etc.
- Change or remotely configure some parameters, such as the working hour.
- Monitor the performance of the robot.
- Implement automatic software updates.

13.2.1 Entities, Users and Roles, Robots

Entities

An entity is a group of users and robots associated with a "site". Each entity can have a number of robots that are used within the site.

There are five entities in the image below that are related in a hierarchical structure. The parent entity is the "City Authority". It has four child entities:
- Sports Field 1
- Sports Field 2
- Park West
- Park East

The entity "Park West" has a child entity "Golf Course".
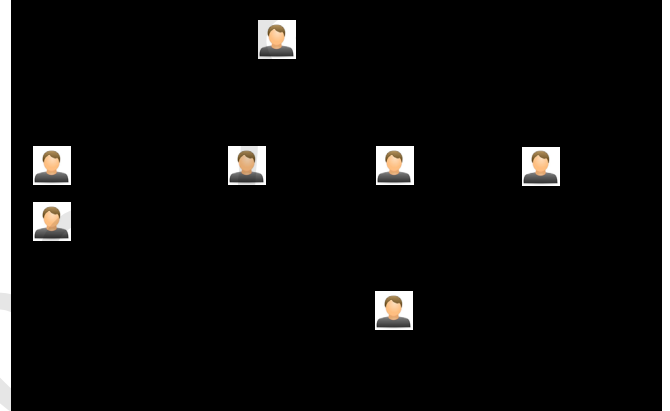
Users and Roles

A user has an account that is associated with an entity. This is referred to as the user's "home" entity. The information and the operations available to a user depend on the roles the have been assigned to the user. The following roles are available:

Standard User

A user with this role can view and follow the robots but has no control over them.

RobotControl

A user with this role can send commands from the portal or from the application, and change schedules on line.

EntityManager

A user with this role can create or delete other users or sub-entities as part of its hierarchy. The user can also move robots between sub-entities.

Technician

A user with this role can see and read more details on the robot versions. The capabilities of this user will be progressively increased with access to technical data not available to end users.

Robots

Robots are transferred from a parent entity to a child entity when the robot is "sold" by the parent to its child. The end-user entity and the end-user account

used to access the web server are created at the moment when the robot is commissioned. Following this, the account holder will receive an email from which the account can be activated.

In the case where an end-user purchases a robot directly, an account will be created using the information received on the registration card supplied with the robot.

13.2.2 Creating Accounts

The creation of an end-user account can be done by:

- The parent entity (a distributor or dealer for example). This is done when the parent entity sells the robot to the user entity.
- By the end-user who has purchased a robot. This uses the information on the registration card supplied with the robot.
- Once the account has been created, it needs to be activated.

Creation of Accounts by a Parent Entity

This consists of a number of stages.

Stage 1: The parent creates a new child entity

This step is performed by the representative from the parent entity who currently owns the robot.

For this procedure, an example of creating a new entity called "New distributor" is used.

To create a new child entity

1) Log on to the web-server.
2) Click on Management.
3) Click on [Create Entity].
4) Enter the "Last name" of the new entity ("New distributor" in this example).
5) Enter a description if necessary (this is optional).
6) Enter the "Street", "Number", "City", "Postcode" and "Country" fields (all are required).
7) Click 🖫.

A message will appear to show that the new entity has been created.

To see the new entity

1) Click on Management.
2) Search for the "Last name" of the newly created entity and click on 🔍. The newly created entity will appear in the hierarchy under the "Entities" tab.

Stage 2: The parent entity creates a user account for the new entity manager

Once the new entity has been created, a user account for the manager of this entity can be created.

For this procedure the email address of the manager is required.

1) Click on the newly created entity in the "Entities" list ("New distributor" following the example above). This will be reflected in the hierarchy at the top of the page.
2) Click on [Create user].
3) Enter the details of the new entity manager.

   NOTE: The fields "First name", "Last name" and "E-mail address" are required.

4) Click 🖫.

The new user will receive an email from the web server to activate the account.

Stage 3: The robot is transferred to the new entity

This step is performed by the representative from the original parent entity.

1) On the web server click on Management.
2) Search for robots.
3) Click on the "Robots" tab.
4) Select the robot to be transferred.
5) Click on [Change Parent Entity].
6) Search for the entity to which the robot is to be transferred.
7) Click on the entity.

The robot will be transferred and the information updated on the screen. Click 🖫.

Creation of an Account by an End-user

The procedure is for a user who has purchased a robot from ECHO Incorporated. It requires information on the registration card that was delivered with the robot which contains the serial number and the activation code for the robot.

To Open an Account

1) Go to https://myrobot.echorobotics.com an click on **Create an account.**

2) Enter all the details required. All fields are required.

3) Click [Confirmation].

At this point, the account will be created and an email sent to the email address supplied. Follow the procedure to add the robot to your account.

NOTE: If you do not receive the email, or you do not respond rapidly enough, follow the procedure to initiate an account activation.

To Add the Robot to Your Account

1) Copy the link in the email into the address bar of your browser and press the <Enter> key.

2) On the Home page click on "Add 1st Robot".

3) Enter the Serial number for the robot (see the registration card).

4) Enter the validation code (see the registration card).

5) Enter a name for the robot.

6) Enter the number of the charging station to be used with the robot.

7) Click "Validate".

The robot will be added to your user account and you can now use the web server to access information about the robot.

Account Activation

An account must be activated before full access to the web server can be made. An account is created by your dealer. Following the creation of the account, an email is sent to the account holder enabling the account to the activated. Activate the account within 24 hours of receiving the email.

If you did not receive the email, or you did not respond rapidly enough, follow the procedure to initiate an activation.

To Activate an Account

1) Open the "Account validation" email received from ECHO Robotics.

2) Copy the link in the email into the address bar of a browser.

3) Enter the password you wish to use. There are no restrictions on the password. Use a strong password that has at least 12 characters and which includes numbers, symbols, and a mixture of upper and lower case letters. You can change the password later by modifying your profile.

4) Re-enter the same password.

5) Click [Send].

You can now login to the web server using your email address and the password that you defined above.

To Initiate an Account Activation

If you did not receive the activation email, or you did not respond rapidly enough to it, you can follow the procedure below to gain access to your account.

1) Go to https://myrobot.echorobotics.com

2) Enter the email address used when the account was created.

3) Enter the password defined in the creation of the account.

4) Click [Login].

You will be able to request an activation email to be sent to your address. You can then follow the instructions given above to activate the account.

13.2.3 Accessing the Web Server

NOTE: Before you can access the web server you need to have set up an account. See *Creating Accounts*.

The web server can be accessed using a web browser, on a personal computer, or by using the application that can be downloaded onto a smart phone or tablet.

NOTE: This section refers to the use of the web-server through a browser.

To access the web server:

1) Enter the URL https://myrobot.echorobotics.com in the browser.

2) Enter the email address used to activate the account.

3) Enter the password defined when you activated the account.

4) Click [Login].

You can then:
• Modify your profile parameters.
• Change your password.
• See a list of your robots and information about their activity, alarms, statistics and the map of the field they work in.

- Create and manage users and entities. This functionality is only available to users who have a suitable role.
- Specify the type of notifications you want to receive and how they will be delivered.
- Access documentation.

To Modify Your Profile

1) Click on the gear wheel next to your user name.
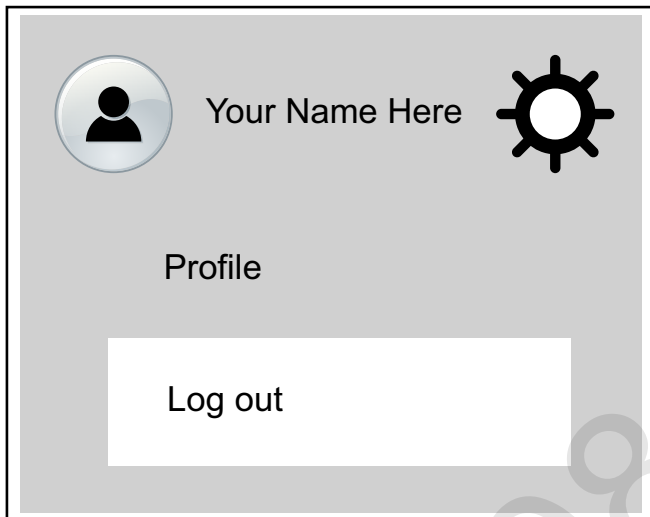
2) Click on **Profile**.

3) Modify any of the settings.

4) Click [Register].

To Change Your Password

The password was set when you activated the account.

1) Click on the gear wheel next to your user name.

2) Click on **Profile**.

3) Scroll down to the Password panel.

4) Enter your current password. (If you have forgotten the password, click on the gear wheel, and logout. Enter your email address and then click on "Forgotten password". An email will be sent with a link which will allow you to enter a new password.

5) Enter the new password in the two fields provided.

   NOTE: There are no restrictions on the password. Use a strong password which has at least 12 characters and includes numbers, symbols, and a mixture of upper and lower case letters.

6) Click [Register].

My Robots
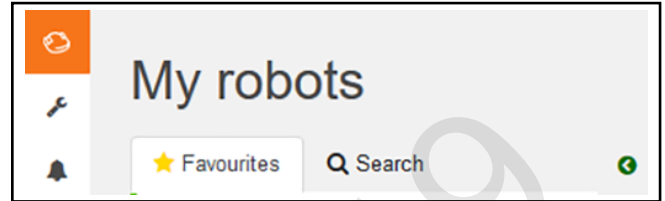
This page enables the user to:

- search for a robot
- add a robot to the favorites list
- view the current status and issue a command
- view the robot history
- view the alarm history of a robot
- view a map of the robot's movement
- view a robot's statistics
- view identification information for a robot

Search for a Robot

1) Click on the Search tab.
2) Enter the name or part of the name of the robot you are searching for (there is no need to add any wild cards.)

3) Click on the search icon.

The list of robots that match the search criteria will appear.

Add a Robot to the Favorites List

1) Search for robots as described above.

2) Click on ⭐ . The robot will be added to the list of Favorites.

3) Click on the Favorites tab to see the list of Favorites.

View the Current Status and Issue a Command

1) Click on the robot in the Favorites list.
2) Click on the "Report and Commands" tab.

3) Click on the required command.

View the Robot History

1) Click on the robot in the Favorites list.
2) Click on the "History" tab.

This page provides information on the activities and status of the selected robot over a period of time.

The time period is shown in the period field. To adjust the time period, use the up and down arrows to choose the number of days and then click ↻.

The information is provided in two formats: as a chart, or in a table.

Viewing the History as a Chart

This shows the time the robot spent in various states over a period of time. The number of days for which the data is displayed is set using the period field. Select a part of this period by clicking on a button above the chart.

You can also restrict the time period, by dragging the sliders at the bottom of the chart.

A set of tools are available to manipulate the view of the chart. These will appear when the mouse is hovered on the top right side of the chart.

In each case the function of the tool can be seen by hovering over it as shown above.

Viewing the History In a Table

Sort the data in the table on any of the columns by clicking ⊙ or ⊙ to select Ascending or Descending order.

For some items you can filter the data displayed by selecting required content from the drop-down list.

Different states are shown in different colors.

To View the Alarm History of a Robot

If the robot is in an alarm state, this will be indicated in the Favorites list.
1)   Click on the robot in the Favorites list.
2)   Click on the "Alarms" tab.

A list of alarms and the times when they occurred as well a map showing where the alarm occurred will be displayed.

To View a Map of a Robot's Movement

1)   Click on the robot in the Favorites list.
2)   Click on the "Map" tab.
3)   Choose the time period for which the movements are required.
4)   Click on the calender icon next to the date and choose the start and end date required.
5)   Click Set.
6)   Click [Obtain Data].

NOTE: You can add a "Symbolic" map of the field which improves the visualization of the robot movements.

To do this:
1)   Go to http://geojson.io (Satellite/OSM views)
2)   Follow the instructions on their site.
3)   Copy the contents of the generated file.
4)   On the robot's map page click on [Manage Geojson].
5)   Import the contents of the file.

To View a Robot's Statistics

1)   Click on the robot in the Favorites list.
2)   Click on the "Statistics" tab.
3)   Choose the time period for which the statistics are required
4)   Click in the date field and choose the date required.
5)   Click [Set].
6)   Click on ↻.
7)   To change the presentation of the data click on ◔ to see cumulative data in a pie chart. Click on ▫ to see daily information in a bar chart.
8)   To download the information click on the download icon.

To View Identification Information for a Robot

1)   Click on the robot in the Favorites list.
2)   Click on the "Robot Info" tab.

Management

Use this option to search for and manage Entities, Robots, and Users.

Manage Entities

This enables the user to:
•   view information about your entity and its child entities
•   create a new entity
•   change the properties of an entity
•   change the parent entity

Manage Robots

This enables the user to:
• view the robots in an entity
• view the properties of a robot
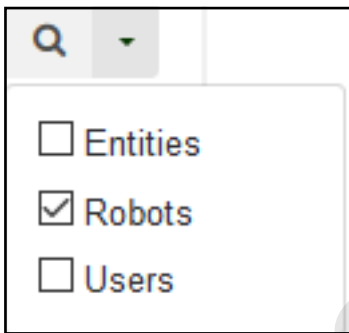• move a robot to another entity

Manage Users

This enables the user to:
• view the users in an entity
• view the properties of a user
• create a new user

On this page you can search for entities, users and robots. To search for particular items use the filter list.
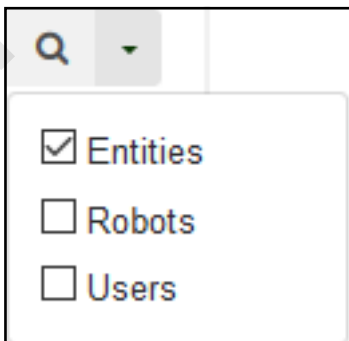

Managing Entities

When you login, your account is associated with your parent entity.

To View Information About Your Entity and its Child Entities

1) Click on .
2) Enter the name of the entity or part of it in the search field (enter * to search for all entities).

3) Set the filter to Entities:

4) Click .

5) Click on an entity to see the details.

The breadcrumb above the list is adapted. Clicking on any entry will take you to that level.

To Create a New Entity

1) Select the parent of the new entity in the Entities list.

2) Click on [Create entity].

3) Fill in all the details required.

4) Click .

To Change the Properties of an Entity

1) Search for the entity.

2) Click on it in the list.

3) Modify the required information.

4) Click (located on the far right-hand side of the screen).

To Change the Parent Entity

1) Search for the entity.

2) Click on it in the list.

3) Click [Change parent entity]

4) Select the new parent entity.

5) Click (located on the far right-hand side of the screen).

Managing Robots

NOTE: The information given here, refers to the operations available from the Management section of the web-server.

To View the Robots in an Entity

1) Enter the name (or part of the name) in the search field. Enter * to search for all robots.'

2) Set the filter to Robots.
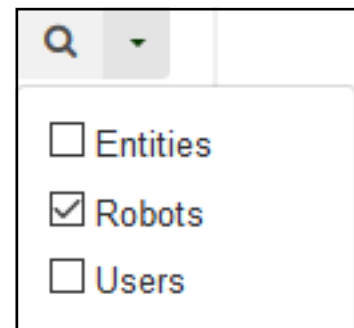
3) Click . The list of robots and their parent entity will be displayed.

To View the Properties of a Robot

1) Click on the robot in the list. The properties of the robot will be displayed.

To Move a Robot to Another Entity

1) Click on the robot in the list.

2) Click [Change parent entity]. A pop-up window will appear.

3) Enter the name of the new parent entity, or choose one from the list. The pop-up window closes.

4) Click ![save icon] (located on the right hand side of the screen).

Managing Users

To View the Users in an Entity:

1) Click on ![wrench icon].

2) Enter the name (or part of the name) in the search field. Enter * to search for all users.

3) Set the filter to Users.

![search filter showing Entities, Robots, Users checkboxes with Users checked]

4) Click ![magnifier icon]. The list of users and their parent entity will be displayed.

To View the Properties of a User

1) Click on the user in the list. The properties of the user will be displayed.

NOTE: The properties of a user can not be modified here. This must be done by the user adapting his profile.
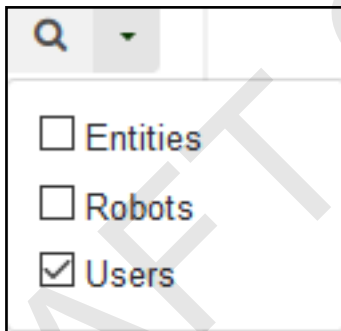
To Create a New User:

1) Select the parent entity to which the user is to be added.

2) Click [Create user].

3) Enter the details of the new user.

The fields "First name", "Last name" and "E-mail address" are required.

4) Click ![save icon].

An email will be sent to the new users email address, from which the user can activate the account.

To Delete a User:

1) Click on the user in the list.

2) Click **X**.

3) Click ![save icon].

Notifications

This section allows the user to set the robot notifications to receive, and the manner in which they will be delivered.

To Add a New Notification

1) Click **+**.

2) Enter the name of the robot (serial number).

3) Select the Notification type.

4) Choose the delivery method:

- Email - to your email address
- Smartphone - the notification can be viewed in the ECHO Robotics application

5) Click ![save icon].

To Modify a Notification

1) Click ![edit icon].

2) Modify the notification.

3) Click ![save icon]
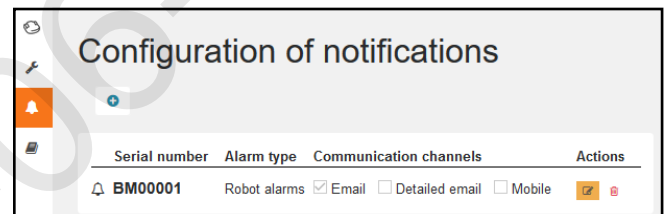
To Delete a Notification

1) Click ![delete icon].

Documentation

Provides access to the documentation available.
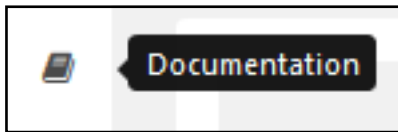
13.3 Using the Application

You can view information about your robots using an application that can be downloaded onto a tablet or a smartphone.

You can find the application by searching for "ECHO Robotics" in the application store.

NOTE: Before you can use the application your need to have set up an account and activated it.

The functionality available from the application is a subset of the functions available when accessing the server through a web browser.

To see information about a robot, click on the robot in the list.

To see the alarm history, click on .

To see the location of the robot, click on .

To see the battery level and the robot details, swipe on the image of the robot.

14 Accessing the Web Server

NOTE: Before you can access the web server you need to have set up an account. See *Creating Accounts*.

The web server can be accessed using a web browser, on a personal computer, or by using the application that can be downloaded onto a smart phone or tablet.

NOTE: This section refers to the use of the web-server through a browser.

To access the web server:

1) Enter the URL https://myrobot.echoro-botics.com in the browser.

2) Enter the email address used to activate the account.

3) Enter the password defined when you activated the account.

4) Click [Login].

You can then:

• Modify your profile parameters.

• Change your password.

• See a list of your robots and information about their activity, alarms, statistics and the map of the field they mow.

• Create and manage users and entities. This functionality is only available to users who have a suitable role.

• Specify the type of notifications you want to receive and how they will be delivered.

• Access documentation.

14.1 To Modify Your Profile

1) Click on the gear wheel next to your user name.
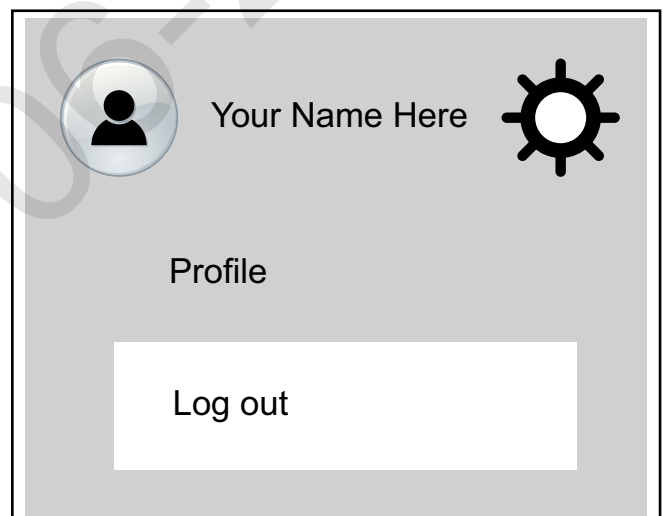
2) Click on **Profile**.

3) Modify any of the settings.

4) Click [Register].

14.2 To Change Your Password

The password was set when you activated the account.

1) Click on the gear wheel next to your user name.

2) Click on **Profile**.

3) Scroll down to the Password panel.

4) Enter your current password. (If you have forgotten the password, click on the gear wheel, and logout. Enter your email address and then click on "Forgotten password". An email will be sent with a link which will allow you to enter a new password.

5) Enter the new password in the two fields provided.

NOTE: There are no restrictions on the password. Use a strong password which has at least 12 characters and includes numbers, symbols, and a mixture of upper and lower case letters.

6)   Click [Register].

15 My Robots
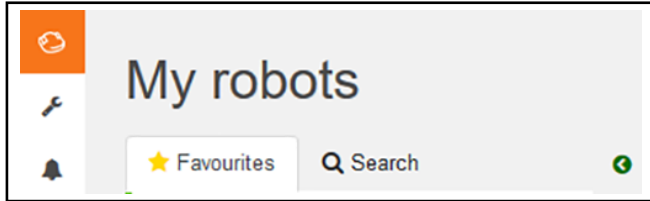
This page enables the user to:

• search for a robot
• add a robot to the favorites list
• view the current status and issue a command
• view the robot history
• view the alarm history of a robot
• view a map of the robot's movement
• view a robot's statistics
• view identification information for a robot

15.1 Search for a Robot

1)   Click on the Search tab.
2)   Enter the name or part of the name of the robot you are searching for (there is no need to add any wild cards.)
3)   Click on the search icon.

The list of robots that match the search criteria will appear.

15.2 Add a Robot to the Favorites List

1)   Search for robots as described above.

2)   Click on ⭐ . The robot will be added to the list of Favorites.

3)   Click on the Favorites tab to see the list of Favorites.

15.3 View the Current Status and Issue a Command

1)   Click on the robot in the Favorites list.
2)   Click on the "Report and Commands" tab.

3)   Click on the required command.

15.4 View the Robot History

1)   Click on the robot in the Favorites list.
2)   Click on the "History" tab.

This page provides information on the activities and status of the selected robot over a period of time.

The time period is shown in the period field. To adjust the time period, use the up and down arrows to choose

the number of days and then click ↻ .

The information is provided in two formats: as a chart, or in a table.

15.5 Viewing the History as a Chart

This shows the time the robot spent in various states over a period of time. The number of days for which the data is displayed is set using the period field. Select a part of this period by clicking on a button above the chart.

You can also restrict the time period, by dragging the sliders at the bottom of the chart.

A set of tools are available to manipulate the view of the chart. These will appear when the mouse is hovered on the top right side of the chart.

In each case the function of the tool can be seen by hovering over it as shown above.

15.6 Viewing the History In a Table

Sort the data in the table on any of the columns by clicking 🔼 or 🔽 to select Ascending or Descending order.

For some items you can filter the data displayed by selecting required content from the drop-down list.

Different states are shown in different colors.

15.7 To View the Alarm History of a Robot

If the robot is in an alarm state, this will be indicated in the Favorites list.

1) Click on the robot in the Favorites list.
2) Click on the "Alarms" tab.

A list of alarms and the times when they occurred as well a map showing where the alarm occurred will be displayed.

15.8 To View a Map of a Robot's Movement

1) Click on the robot in the Favorites list.
2) Click on the "Map" tab.
3) Choose the time period for which the movements are required.
4) Click on the calender icon next to the date and choose the start and end date required.
5) Click Set.
6) Click [Obtain Data].

NOTE: You can add a "Symbolic" map of the field which improves the visualization of the robot movements.
To do this:
1) Go to http://geojson.io (Satellite/OSM views)
2) Follow the instructions on their site.
3) Copy the contents of the generated file.
4) On the robot's map page click on [Manage Geojson].
5) Import the contents of the file.

15.9 To View a Robot's Statistics

1) Click on the robot in the Favorites list.
2) Click on the "Statistics" tab.
3) Choose the time period for which the statistics are required
4) Click in the date field and choose the date required.
5) Click [Set].

6) Click on .

7) To change the presentation of the data click on to see cumulative data in a pie chart. Click on to see daily information in a bar chart.

8) To download the information click on the download icon.

15.10 To View Identification Information for a Robot

1) Click on the robot in the Favorites list.
2) Click on the "Robot Info" tab.

16 Creating Accounts

The creation of an end-user account can be done by:
- The parent entity (a distributor or dealer for example). This is done when the parent entity sells the robot to the user entity.
- By the end-user who has purchased a robot. This uses the information on the registration card supplied with the robot.
- Once the account has been created, it needs to be activated.

16.1 Creation of Accounts by a Parent Entity

This consists of a number of stages.

16.1.1 Stage 1: The parent creates a new child entity

This step is performed by the representative from the parent entity who currently owns the robot.

For this procedure, an example of creating a new entity called "New distributor" is used.

To create a new child entity
1) Log on to the web-server.
2) Click on Management.
3) Click on [Create Entity].
4) Enter the "Last name" of the new entity ("New distributor" in this example).

5) Enter a description if necessary (this is optional).

6) Enter the "Street", "Number", "City", "Postcode" and "Country" fields (all are required).

7) Click ⬛.

A message will appear to show that the new entity has been created.

To see the new entity

1) Click on Management.

2) Search for the "Last name" of the newly created entity and click on 🔍. The newly created entity will appear in the hierarchy under the "Entities" tab.

16.1.2 Stage 2: The parent entity creates a user account for the new entity manager

Once the new entity has been created, a user account for the manager of this entity can be created.

For this procedure the email address of the manager is required.

1) Click on the newly created entity in the "Entities" list ("New distributor" following the example above). This will be reflected in the hierarchy at the top of the page.

2) Click on [Create user].

3) Enter the details of the new entity manager.

   NOTE: The fields "First name", "Last name" and "E-mail address" are required.

4) Click ⬛.

The new user will receive an email from the web server to activate the account.

16.1.3 Stage 3: The robot is transferred to the new entity

This step is performed by the representative from the original parent entity.

1) On the web server click on Management.

2) Search for robots.

3) Click on the "Robots" tab.

4) Select the robot to be transferred.

5) Click on [Change Parent Entity].

6) Search for the entity to which the robot is to be transferred.

7) Click on the entity.

The robot will be transferred and the information updated on the screen. Click ⬛.

16.2 Creation of an Account by an End-user

The procedure is for a user who has purchased a robot from ECHO Incorporated. It requires information on the registration card that was delivered with the robot which contains the serial number and the activation code for the robot.

16.2.1 To Open an Account

1) Go to https://myrobot.echorobotics.com an click on **Create an account.**

2) Enter all the details required. All fields are required.

3) Click [Confirmation].

At this point, the account will be created and an email sent to the email address supplied. Follow the procedure to add the robot to your account.

NOTE: If you do not receive the email, or you do not respond rapidly enough, follow the procedure to initiate an account activation.

16.2.2 To Add the Robot to Your Account

1) Copy the link in the email into the address bar of your browser and press the <Enter> key.

2) On the Home page click on "Add 1st Robot".

3) Enter the Serial number for the robot (see the registration card).

4) Enter the validation code (see the registration card).

5) Enter a name for the robot.

6) Enter the number of the charging station to be used with the robot.

7) Click "Validate".

The robot will be added to your user account and you can now use the web server to access information about the robot.

16.3 Account Activation

An account must be activated before full access to the web server can be made. An account is created by your dealer. Following the creation of the account, an email is sent to the account holder enabling the account to the activated. Activate the account within 24 hours of receiving the email.

If you did not receive the email, or you did not respond rapidly enough, follow the procedure to initiate an activation.

16.3.1 To Activate an Account

1) Open the "Account validation" email received from ECHO Robotics.

2) Copy the link in the email into the address bar of a browser.

3) Enter the password you wish to use. There are no restrictions on the password. Use a strong password that has at least 12 characters and which includes numbers, symbols, and a mixture of upper and lower case letters. You can change the password later by modifying your profile.

4) Re-enter the same password.

5) Click [Send].

You can now login to the web server using your email address and the password that you defined above.

16.3.2 To Initiate an Account Activation

If you did not receive the activation email, or you did not respond rapidly enough to it, you can follow the procedure below to gain access to your account.

1) Go to https://myrobot.echorobotics.com
2) Enter the email address used when the account was created.

3) Enter the password defined in the creation of the account.

4) Click [Login].

You will be able to request an activation email to be sent to your address. You can then follow the instructions given above to activate the account.

17 Management

This section allows users to search for and manage Entities, Robots, and Users.

17.1 Manage Entities

This enables the user to:
• view information about your entity and its child entities
• create a new entity
• change the properties of an entity
• change the parent entity

17.2 Manage Robots

This enables the user to:
• view the robots in an entity
• view the properties of a robot
• move a robot to another entity

17.3 Manage Users

This enables the user to:
• view the users in an entity
• view the properties of a user
• create a new user

On this page you can search for entities, users and robots. To search for particular items use the filter list.
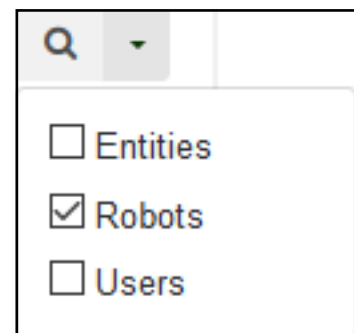
17.4 Managing Entities

When you login, your account is associated with your parent entity.

17.4.1 To View Information About Your Entity and its Child Entities

1) Click on .
2) Enter the name of the entity or part of it in the search field (enter * to search for all entities).

3) Set the filter to Entities:

4)   Click .

5)   Click on an entity to see the details.

The breadcrumb above the list is adapted. Clicking on any entry will take you to that level.

17.4.2 To Create a New Entity

1)   Select the parent of the new entity in the Entities list.

2)   Click on [Create entity].
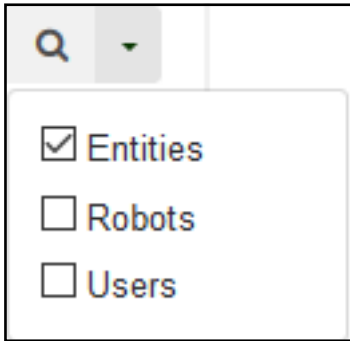
3)   Fill in all the details required.

4)   Click .

17.4.3 To Change the Properties of an Entity

1)   Search for the entity.

2)   Click on it in the list.

3)   Modify the required information.

4)   Click (located on the far right-hand side of the screen).

17.4.4 To Change the Parent Entity

1)   Search for the entity.

2)   Click on it in the list.

3)   Click [Change parent entity]

4)   Select the new parent entity.

5)   Click (located on the far right-hand side of the screen).

17.5 Managing Robots

NOTE: The information given here, refers to the operations available from the Management section of the web-server.

17.5.1 To View the Robots in an Entity

1)   Enter the name (or part of the name) in the search field. Enter * to search for all robots.'

2)   Set the filter to Robots.
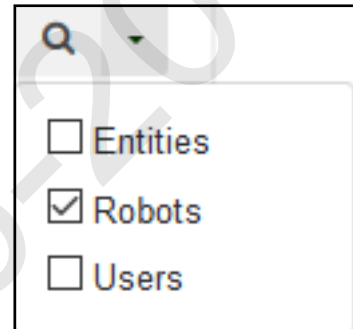
3)   Click . The list of robots and their parent entity will be displayed.

17.5.2 To View the Properties of a Robot

1)   Click on the robot in the list. The properties of the robot will be displayed.

17.5.3 To Move a Robot to Another Entity

1)   Click on the robot in the list.

2)   Click [Change parent entity]. A pop-up window will appear.

3)   Enter the name of the new parent entity, or choose one from the list. The pop-up window closes.

4)   Click (located on the right hand side of the screen).

17.6 Managing Users

17.6.1 To View the Users in an Entity:

1)   Click on .

2)   Enter the name (or part of the name) in the search field. Enter * to search for all users.

3)   Set the filter to Users.
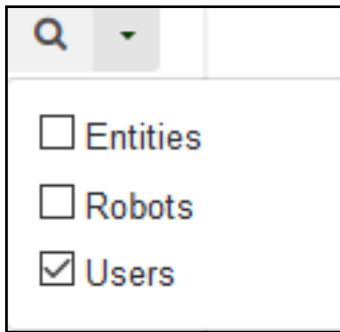
4) Click 🔍. The list of users and their parent entity will be displayed.

17.6.2 To View the Properties of a User

1) Click on the user in the list. The properties of the user will be displayed.

NOTE: The properties of a user can not be modified here. This must be done by the user adapting his profile.

17.6.3 To Create a New User:

1) Select the parent entity to which the user is to be added.

2) Click [Create user].

3) Enter the details of the new user.

    The fields "First name", "Last name" and "E-mail address" are required.

4) Click 💾.

An email will be sent to the new users email address, from which the user can activate the account.

17.6.4 To Delete a User:

1) Click on the user in the list.

2) Click **X**.

3) Click 💾.

18 Notifications

This section allows the user to set the robot notifications to receive, and the manner in which they will be delivered.
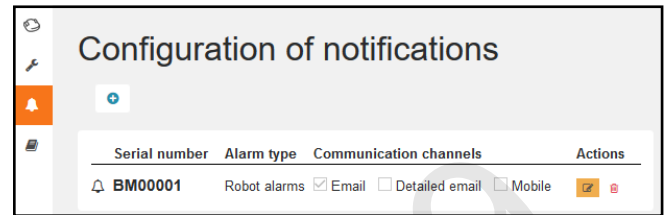
18.1 To Add a New Notification

1) Click **+**.

2) Enter the name of the robot (serial number).

3) Select the Notification type.

4) Choose the delivery method:

   • Email - to your email address
   • Smartphone - the notification can be viewed in the ECHO Robotics application

5) Click 💾.

18.2 To Modify a Notification

1) Click 📝.

2) Modify the notification.

3) Click 💾.

18.3 To Delete a Notification

1) Click 🗑.

19 Documentation

Provides access to the documentation available.
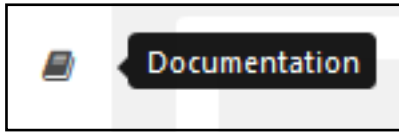
20 Using the Application

You can view information about your robots using an application that can be downloaded onto a tablet or a smartphone.

You can find the application by searching for "ECHO Robotics" in the application store.

NOTE: Before you can use the application your need to have set up an account and activated it.

The functionality available from the application is a subset of the functions available when accessing the server through a web browser.

To see information about a robot, click on the robot in the list.

To see the alarm history, click on .

To see the battery level and the robot details, swipe on the robot.

To see the location of the robot, click on .

21 Robot Maintenance

Follow all *Safety Information* when performing maintenance.

Perform maintenance procedures regularly throughout the season. Have an authorized Authorized ECHO Robotics Dealer service the robot once a year.

When maintaining the robot for optimum performance, do not attempt to make any changes to the robot. Making changes may disturb the robot's operation, causing an accident, and damaging parts.

NOTE: If unusual operation or physical damage is noticed, contact an authorized Authorized ECHO Robotics Dealer.

IMPORTANT: Keep all nuts, bolts and screws tight to be sure the robot is in safe working condition.

Always use OEM (Original Equipment Manufacturer) parts supplied by ECHO Incorporated. In addition to the risk of accidents, the use of any non-OEM parts will result in the annulment of the warranty for any resulting damage. ECHO Incorporated declines all

liability in case of accident due to the use of non-OEM parts.

21.1 Maintenance Chart

Component	Weekly	6 months	Annual
Cover	Inspect /Clean		
Charge contacts	Clean		
Sonars			
Coil			
Bumper	Inspect /Clean		
Chassis			
Electrical cables		Inspect	
Front and rear lift sensors	Inspect /Clean		
Front wheels	Clean	Inspect	
Rear wheels			
Battery			Charge

21.2 Winter Service Check List

Basic Information			
Client		Technician	
Serial number		Field	
Date		Installation date	

Robot Information (record as appropriate)	
Software version	
Check history on Myrobot	

Perform the service tests listed in the following table. Access the smartbox and select **Technician's menu > Service > Test**.
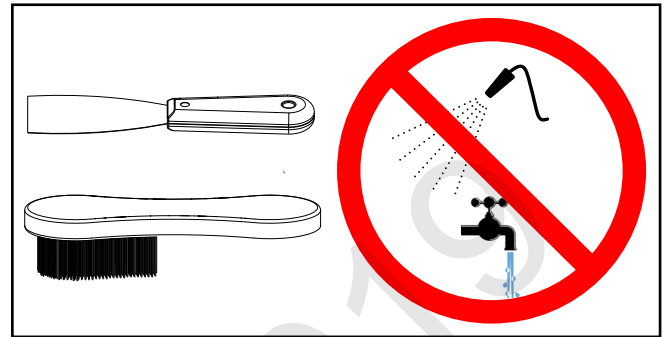
Service Tests (indicate condition as appropriate)	
Charge	
Bumper	
Smartbox	
Lift Sensors	

Service Tests (indicate condition as appropriate)	
Backward Sensors	
Signal Sensors	
Drive Motor (gear motor)	
Sonar Sensors	
Lid (stop button lid)	
Select a trajectory along a straight line without obstacles and verify that the robot follows the line.	
Start the robot, listen for any abnormal noises. Check the wheels, rear wheel motors. Also listen for excessive body vibrations.	

Service Inspections (indicate condition as appropriate)	
Body	
Check the body fixing screws for rust. Tighten all screws. If necessary, replace with A4 type screw during service.	
Check for scratches or cuts on the bumper. Verify that all bumper retention screw are tight.	
Check the integrity of the sonar electrical connectors, clean as necessary.	
Clean the charge contacts.	
Clean the smartbox screen. Check that there is no moisture on the exterior of the screen or condensation on the interior of the screen.	
Smartbox: If a problem has been indicated with the GPS signal, replace the Smartbox.	

Service Inspections (indicate condition as appropriate)	
Inspect the inside of the cover and the chassis: • cable condition (check for cuts or abrasions) • attachment and routing of cables • cable electrical connections • inspect for corrosion on the chassis • check the JEA40 connector for corrosion • check the charge connector for corrosion	
Frame	
Verify that the coil is securely tightened to the chassis. Check the coil electrical connector.	
Check that the front wheel axles rotate freely and the axle nuts are securely tightened.	
Front wheels: check the rotation, wheels should spin freely without wobbling. Verify that the wheel bearings are sealed.	
Check the rear tires for excessive wear, replace as necessary.	
Front lift sensors: verify that the lift sensors move up and down with no resistance, lubricate as necessary.	
Check the front and rear silentblocs for cracking or splitting, replace as necessary. Replace the silentblocs once every two years regardless of their condition.	

Service Inspections (indicate condition as appropriate)	
Inspect the backwards sensors.	
Inspect all electrical cables for cuts or abrasions. Verify that all connectors are securely assembled. Replace damaged cables.	
Electrical box: check cable connections, inspect the interior for the presence of moisture.	
Drive motor: Lubricate the motors during every service. Check and replace the axle, bearing and the seal on the outlet of the gear unit if necessary.	

21.3 General Inspection and Cleaning.

During periods of wet weather, perform inspection and cleaning once per day.

1) Move the power switch to the OFF position.
2) De-energize AC power at the mains (charging station only).
3) Remove robot from charging station (if required).
4) Visually inspect the unit, replace damaged components.
5) Check all electrical connectors, reconnect if necessary.
6) Use a plastic scraper, nylon brush, compressed air, or a damp cloth to clean dirt, grass, sticks, or obstructions.

NOTE: Do not use a high-pressure washer or running water for cleaning. **Never use solvents.**

21.3.1 Charge Contacts

Clean once per week.
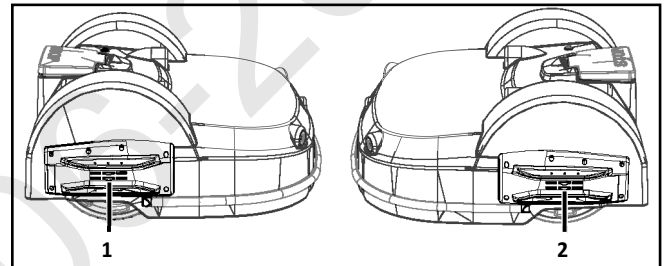
1 – Right side charge contact

2 – Left side charge contact

21.3.2 Sonar Sensors and Bumper

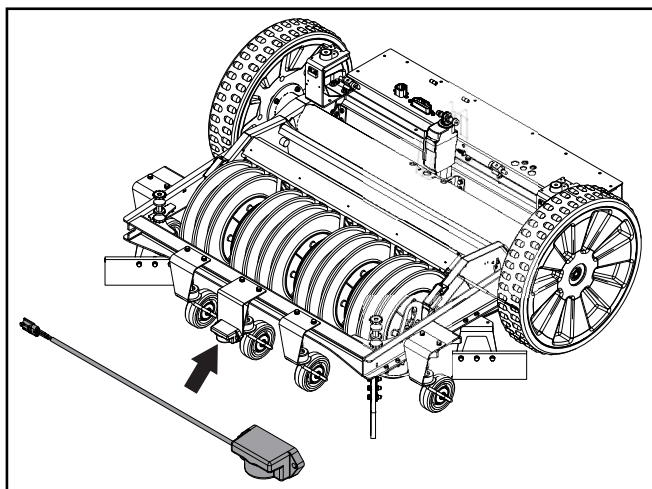Clean once per week. Check that the bumper material is intact and not cut or torn. If the bumper is damaged, replace it.
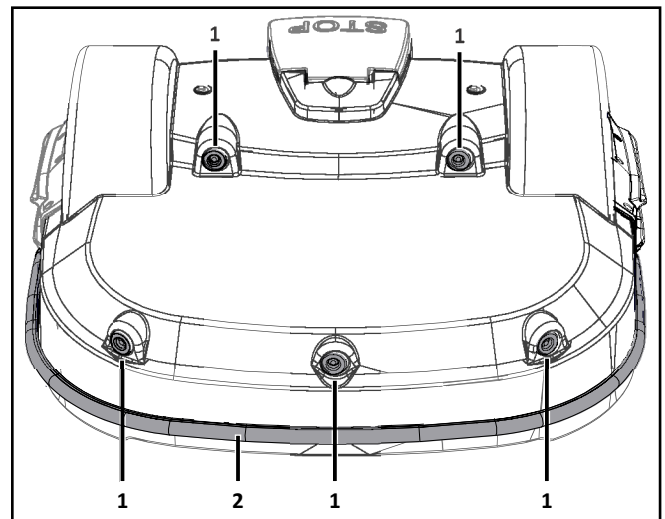
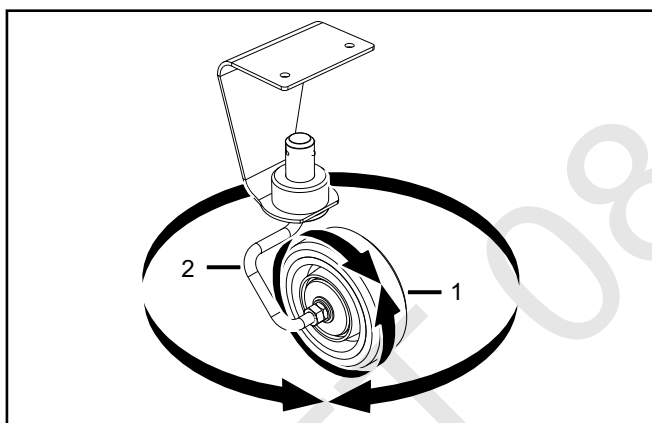1 – Sonar sensors (5X)

2 – Bumper

21.3.3 Chassis and Coil

Clean once per week. Inspect the coil for damage or exposed wires.

21.3.4 Front Wheel Assemblies

Verify that the wheels (and wheel axle) rotate easily. Clean the front wheel assemblies once per week.

1 – Wheel
2 – Wheel axle

21.3.5 Rear Wheels and Rear Wheel Brushes

Clean the rear wheels and rear wheel brushes (if installed) once per week.

21.3.6 Winter Storage

• Charge the battery to 100% before storing.
• Complete all weekly, 6 month, and annual maintenance procedures.
• Schedule service procedures with an authorized ECHO Robotics dealer (if required).
• Store the robot in a protected dry location where the temperature is above 32° F (0° C).

At the start of a new season:

1) Move the power switch to the ON position.
2) Place the robot onto the charging station and allow the battery to fully charge.

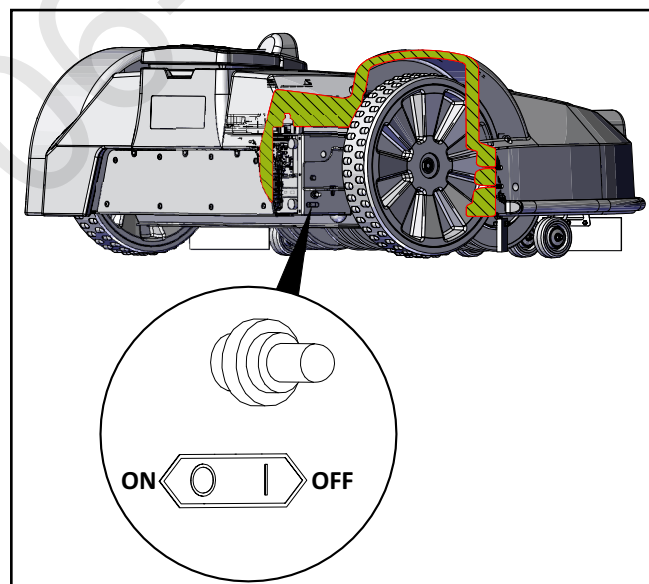3) Run the robot as normal and observe for correct operation.

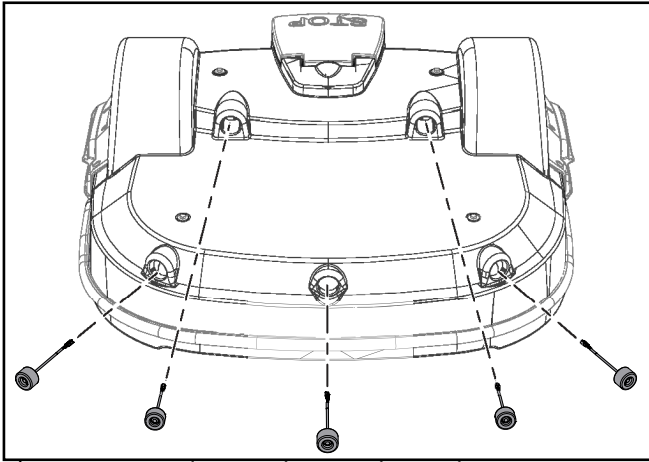# 22 Service Procedures

SHARP PARTS AND ROTATING COMPONENTS

• Wear protective gloves when handling the robot.

IMPORTANT: Move the power switch to the OFF position before starting any service procedures.

22.1 Sonar Replacement

1) Remove the cover.
2) Disconnect the sonar cables and push the sonars out of the cover (from inside out).

3) Insert and securely seat the replacement sonars into the cover.

4) Connect the sonar cables and replace the cover.

5) Complete the Sonar Sensor Service Test.

22.2 Bumper Replacement

NOTE: Left side cut-away view of cover shown.

1) Remove the cover.

2) Disconnect the bumper cable from the bumper.

3) Remove the bumper retaining screws.
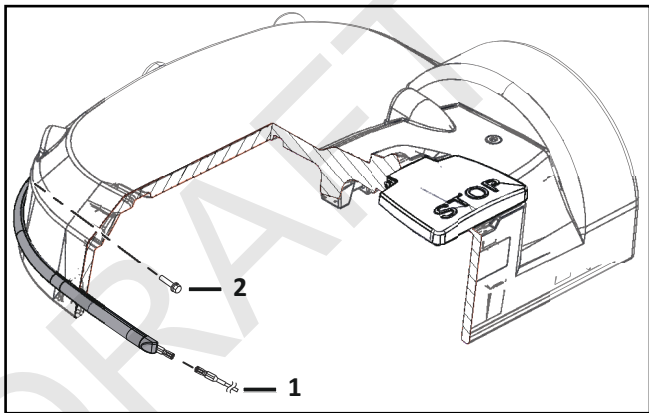
1 – Bumper cable
2 – Bumper retaining screw (11X)

4) Remove the bumper assembly.
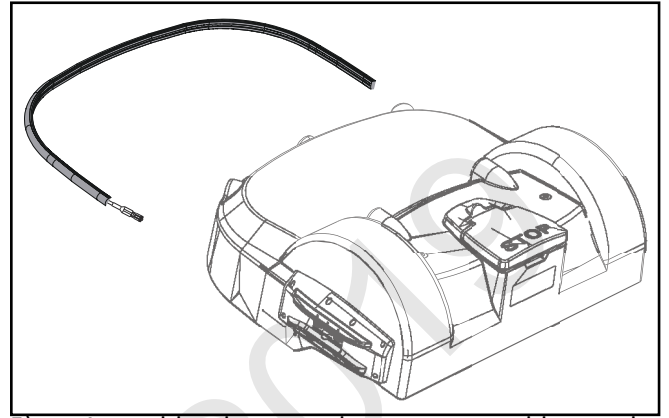
5) Assemble the new bumper assembly to the cover.

6) Assemble the bumper retaining screws, tighten to 1.5 lbf• ft (2 N•m).

7) Connect the bumper cable to the bumper.

8) Complete the Bumper Service Test.

22.3 Front Lift Cushion Replacement

NOTE: Detail of left side shown.

1) Remove the collecting wheel access hatch.

2) Remove top and bottom screws and washers.

3) Assemble the new front cushion kit in the original location.

4) Assemble top and bottom washers and screws, tighten to 4.5 lbf•ft (6 N•m).

5) Complete the Lift Sensor Service Test.
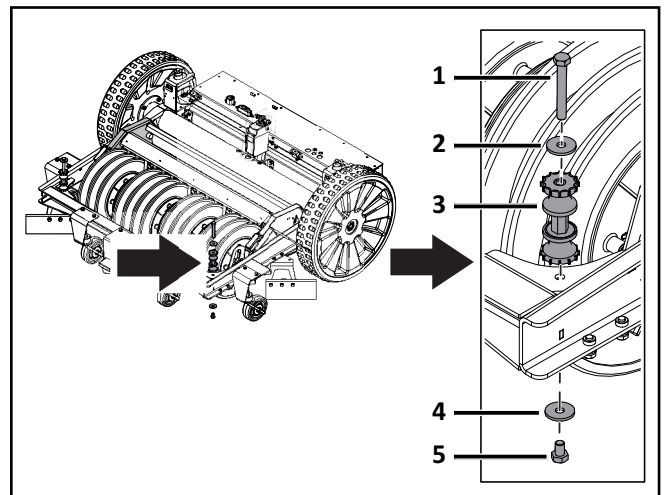
1 – Top screw
2 – Top washer
3 – Cushion kit

4 – Bottom washer
5 – Bottom screw

22.4 Rear Lift Cushion Replacement

1) Remove the cover.
2) Remove the rear lift cushion from the bracket. The bracket is captive to the chassis.
3) Assemble the new rear lift cushion.
4) Complete the Lift Sensor Service Test.
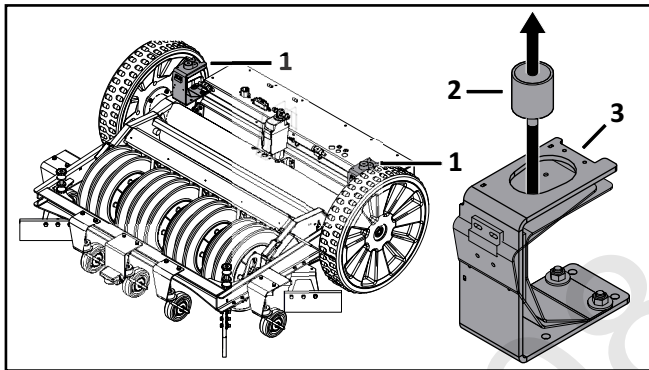
1 – Rear lift cushion location on robot
2 – Rear lift cushion
3 – Nut

22.5 Front Wheel Replacement

1) Remove the nut, washer, and wheel from the axle.
2) Assemble the new wheel to the axle.
3) Assemble the washer and nut. Tighten the nut to 7.5 lbf•ft (10 N•m).
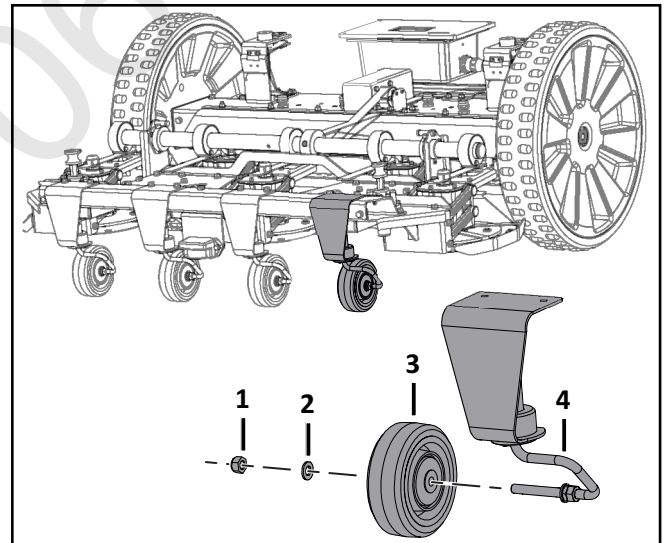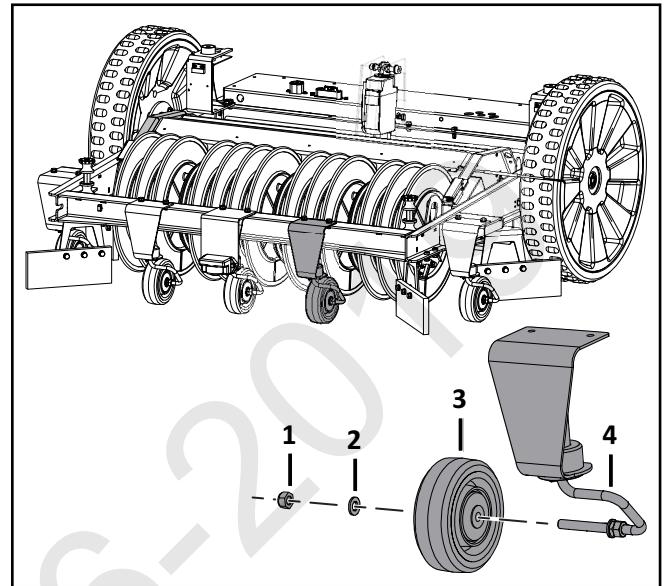
1 – Nut
2 – Washer
3 – Wheel
4 – Axle

22.6 Rear Wheel and Gear Motor Replacement

Removal:

1) Remove the cover.
2) Loosen the wheel nut and remove the rear wheel assembly (the wheel nut remains captive with the rear wheel assembly). Remove the wave washers from the gear motor output shaft. Discard the wave washers. **NOTE:**
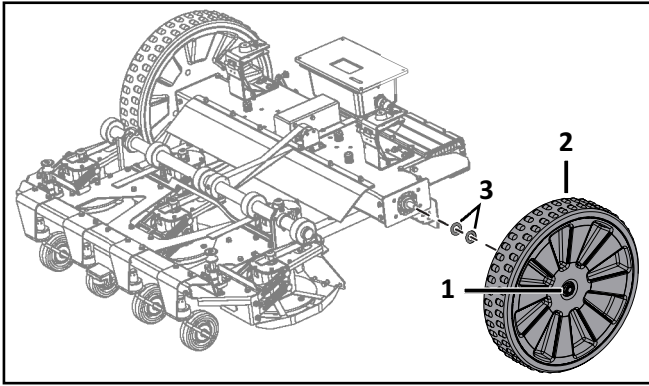
1 – Nut
2 – Washer
3 – Wheel
4 – Axle

3) Remove the four nuts and washers from the axle flange.

4) Remove the gear motor assembly from the axle.

5) Disconnect the gear motor cable.
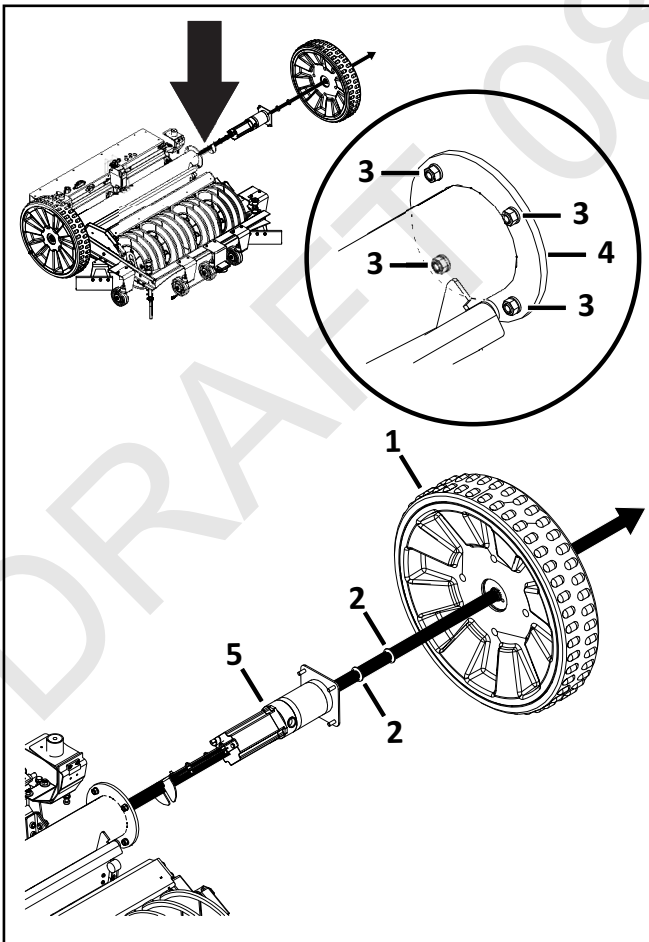
1 – Wheel
2 – Washer
3 – Nut

4 – Axle
5 – Gear motor assembly

Installation:

1) Connect the gear motor cable.

2) Place the gear motor assembly into the axle. Seat the assembly into the holes of the axle flange.

3) Assemble the washers and nuts to the gear motor assembly.

4) Place new wave washers on the gear motor output shaft. Do not reuse old wave washers.

5) Apply Loctite® 243 Blue Threadlocker to the interior threads of the wheel nut. Place the rear wheel assembly onto the gear motor output shaft, tighten the nut to 48 lbf•ft (65 N•m).

6) Complete the Drive Gear Motor Test.

22.7 Battery Removal and Installation

Removal:

1) Stand the robot on end. Disconnect the two electrical cables (located in circled area).
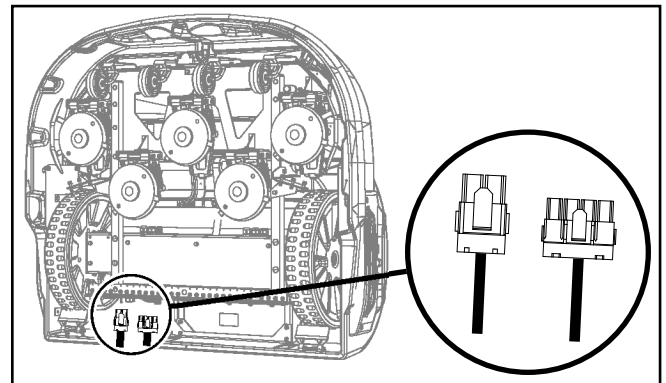
2) Lay the robot back onto flat ground.

3) Remove the front cover screws, rear cover screws, rear washers, and cover.

4) Disconnect the battery cables from the battery.

5) Remove the battery fastener nuts, washers, battery fastener, and battery.
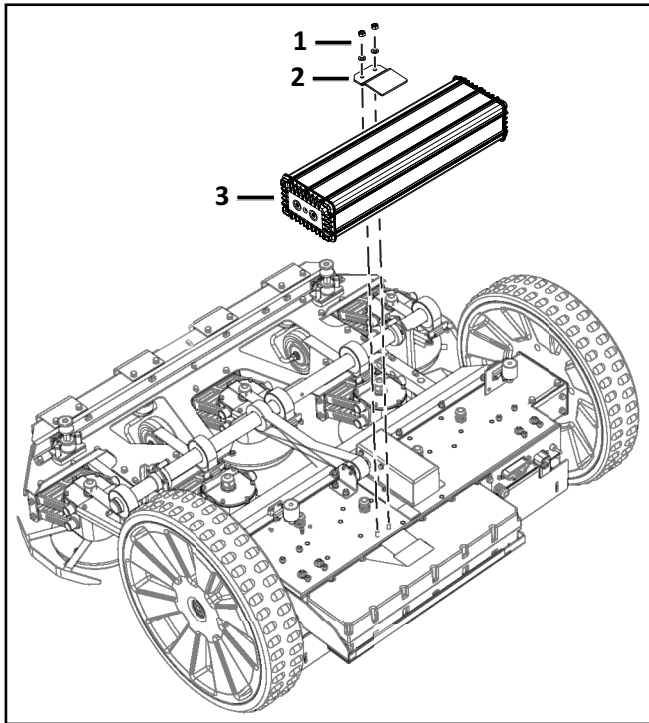
1 – Nuts, washers
2 – Battery fastener
3 – Battery

Installation:

1) Place the new battery in the robot.

2) Assemble the battery fastener, washers, and nuts.

3) Connect the battery cable to the battery.

4) Place the cover on the robot.

5) Assemble the cover screws and washers. Tighten screws to 5 lbf• ft (7 N•m).

6) Stand the robot on end.

7) Re-connect the two electrical cables.

8) Lay the robot back onto flat ground.

9) Complete the Charge Service Test.

22.8 Correcting Stop Button Lid Closure Problems

The stop button lid needs to be properly closed before the robot can perform its specified missions. On occasions, even when the cover has been closed properly, the robot does not start its mission and the message "Lid not closed, please select option again" is displayed.

In order for the robot to be able to execute its missions the lid needs to be shut, and to form a closed circuit between magnets on the lid and relays on the body. This circuit needs to be open when the lid is open. When the lid is pressed down, it acts as the stop button. This requires that all magnets and relays are functioning correctly, and there is precision in their positioning.

The next figure shows a representation of the lid, body, magnet, and relays. There are two magnets on the lid and two sets of relays on the body.

A - Rear view of robot with lid open.
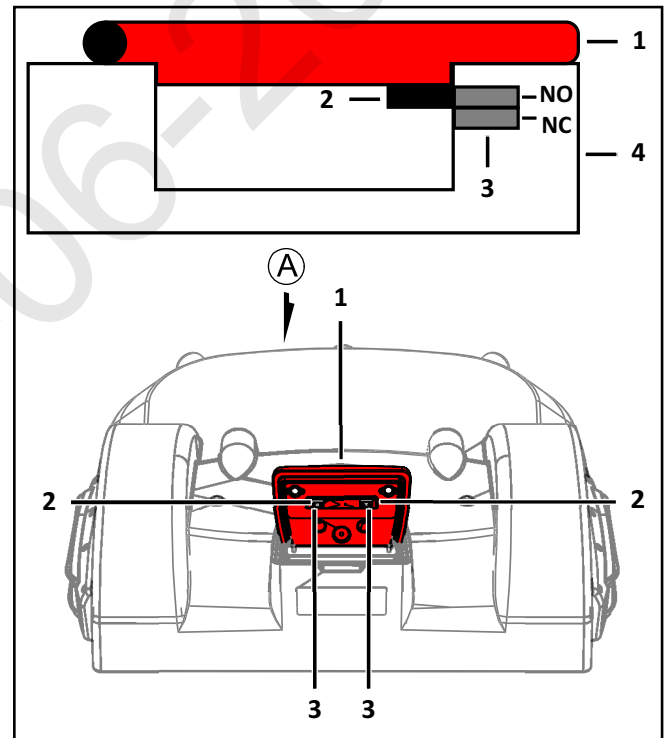
1 – Stop button lid
2 – Magnet
3 – Relays
4 – Body (cover of robot)

One relay is "Normally Open" (NO), the other is "Normally Closed" (NC). The circuit is shown below.
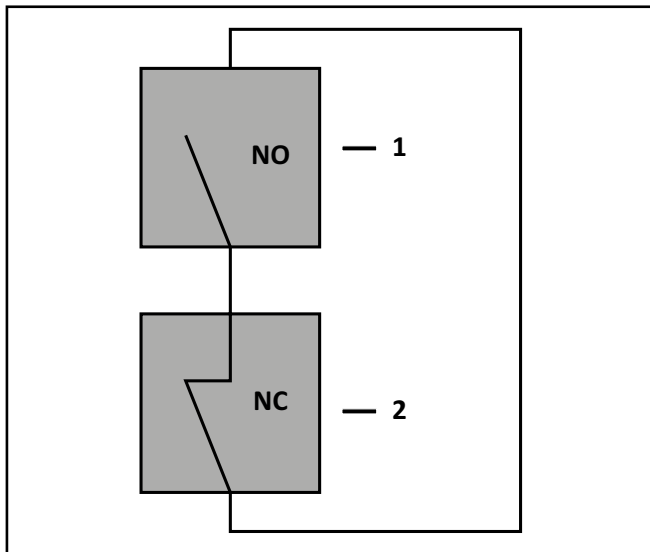
1 – Relay (NO - normally open)

2 – Relay (NC - normally closed)

When the lid is closed the magnet must be in a position to align with the reed relays on the cover. This alignment allows the circuit to close and the robot to operate.

When the lid is open, the circuit is open, preventing the robot from operating.

When the lid is closed and pressed down, the roles of the two relays are reversed and the circuit is open, preventing the robot from operating.

If there are problems with the lid closure, run a service test. Select **Service > Tests > Lid** from the service menu.

22.8.1 Relays

The pairs of relays must be installed one above the other in the correct order:

NO must be on top. This relay is identified as having the digit "1" in the reference number.

NC must be on the bottom. This relay is identified as having the digit "4" in the reference number.

NOTE: The reference numbers are etched on the surface of the relays.

The relays are supplied as an assembly. The assembly contains two pairs of relays and the cabling between them.
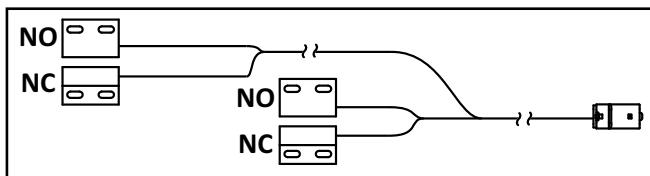
When installing replacement magnets and relays, visually examine the position to ensure correct alignment. Run the service test to ensure the relays correctly align

to the magnets. Select **Service > Tests > Lid** from the service menu.

22.8.2 Magnets

Assemble the magnets to the lid at the positions shown in the figure below.
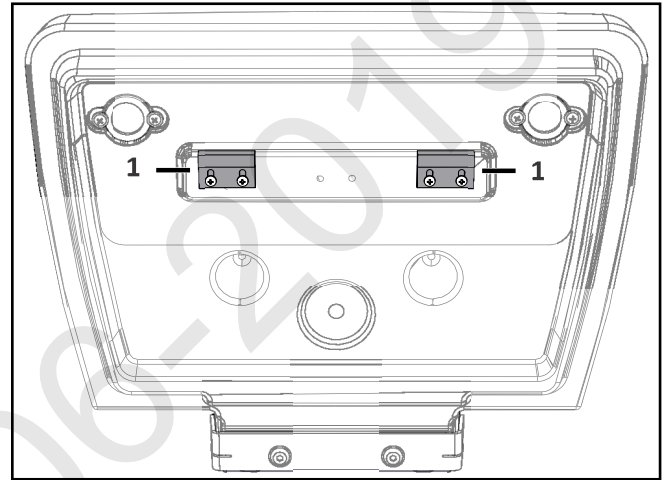
1 – Magnets

The magnets must be at the correct height so that when the lid is closed or pressed down they connect with the correct relays. If necessary, spacers must be placed behind the magnets. Run the service test to ensure the magnets correctly align to the relays. Select **Service > Tests > Lid** from the service menu.

23 Torque References

IMPORTANT: The values in the following table apply only when a specific torque for a fastener is not listed.

Size	lbf•ft	N•m
No. 6	0.58 - 0.83	0.8 - 1.1
No. 8	1.25 - 1.83	1.7 - 2.5
No. 10	2.0- 3.0	2.7 - 4.0
No. 12	3.0 - 4.0	4.0 - 5.4
M3	1.25 - 1.83	1.7 - 2.5
M4	2.0 - 2.9	2.7 - 4.0
M5	2.9 - 5.0	4.0 - 6.8
M6	7.0- 8.8	9.5 - 12.0
M8	14.7 - 17.0	20.0 - 23.0
M10	25.8 - 28.0	35.0 - 38.0

23.1 Range Picker Body

1.5 lbf·ft
(2 N·m)[†]

1.5 lbf·ft
(2 N·m)[†]

<1 lbf·ft
(<0.7 N·m)

6 lbf·ft
(5 N·m)[†]

Ⓑ

1.5 lbf·ft
(2 N·m)

5 lbf·ft
(7 N·m)

1.5 lbf·ft
(2 N·m)[†]

1.5 lbf·ft
(2 N·m)

1.5 lbf·ft
(2 N·m)[†]

5 lbf·ft
(7 N·m)

Ⓐ

Ⓐ

1.5 lbf·ft
(2 N·m)

Ⓑ

1.5 lbf·ft
(2 N·m)[†]

Ⓑ

1.5 lbf·ft
(2 N·m)[†]

1.5 lbf·ft
(2 N·m)[†]

<1 lbf·ft
(<0.7 N·m)

1 lbf·ft
(1.5 N·m)[†]

[†]**Loctite 243**
 Blue Threadlocker

[††]**Loctite 2701**
 Green Threadlocker

23.2 Electrical Box, Battery, and Housing

4.5 lbf·ft
(6 N·m)

4.5 lbf·ft
(6 N·m)

9 lbf·ft
(12 N·m)†

2 lbf·ft
(3 N·m)

9 lbf·ft
(12 N·m)†

2 lbf·ft
(3 N·m)

2 lbf·ft
(3 N·m)

1.5 lbf·ft
(2 N·m)†

2 lbf·ft
(3 N·m)

2 lbf·ft
(3 N·m)

†Loctite 243
Blue Threadlocker

††Loctite 2701
Green Threadlocker

View A

View A

23.3 Chassis

A

9 lbf·ft†
(12 N·m)†

2 lbf·ft†
(3 N·m)†

2 lbf·ft†
(3 N·m)†

2 lbf·ft†
(3 N·m)†

A

7

2 lbf·ft†
(3 N·m)†

4.5 lbf·ft†
(6 N·m)†

9 lbf·ft†
(12 N·m)†

2 lbf·ft†
(3 N·m)†

4.5 lbf·ft†
(6 N·m)†

9 lbf·ft† —
(12 N·m)†

2 lbf·ft†
(3 N·m)†

9 lbf·ft†
(12 N·m)†

†**Loctite 243**
 Blue Threadlocker

††**Loctite 2701**
 Green Threadlocker

23.4 Rear Sensors

16

0.75 - 1 lbf·ft
(1.0 - 1.5 N·m)†

9 lbf·ft
(12 N·m)†

1.5 lbf·ft
(2 N·m)†

9 lbf·ft
(12 N·m)†

1.5 lbf·ft
(2 N·m)

1.5 lbf·ft
(2 N·m)

A

9 lbf·ft
(12 N·m)

A

†Loctite 243
 Blue Threadlocker

††Loctite 2701
 Green Threadlocker

23.5 Wheels

9 lbf·ft (12 N·m)†

0.75 - 1.0 lbf·ft (1.0 - 1.5 N·m)

7.5 lbf·ft (10 N·m)

7.5 lbf·ft (10 N·m)

7.5 lbf·ft (10 N·m)

9 lbf·ft (12 N·m)†

33 lbf·ft (45 N·m)†

1.5 lbf·ft (2 N·m)†

9 lbf·ft (12 N·m)†

33 lbf·ft (45 N·m)†

48 lbf·ft (65 N·m)

†**Loctite 243
Blue Threadlocker**

††**Loctite 2701
Green Threadlocker**

23.6 Wheel Gearbox

**4 lbf·ft
(3 N·m)†**

**1 lbf·ft
(1.5 N·m)**

**4.5 lbf·ft
(6 N·m)††**

**2 lbf·ft
(3 N·m)†**

**†Loctite 243
Blue Threadlocker**

**††Loctite 2701
Green Threadlocker**

23.7 Barrow Components

3 lbf·ft (4 N·m)†

15 lbf·ft (20 N·m)††

9 lbf·ft (12 N·m)†

15 lbf·ft (20 N·m)††

3 lbf·ft (4 N·m)†

1.5 lbf·ft (2 N·m)

Hand assembly only††

15 lbf·ft (20 N·m)†

1.5 lbf·ft (2 N·m)

1.5 lbf·ft (2 N·m)††

15 lbf·ft (20 N·m)†

9 lbf·ft (12 N·m)†
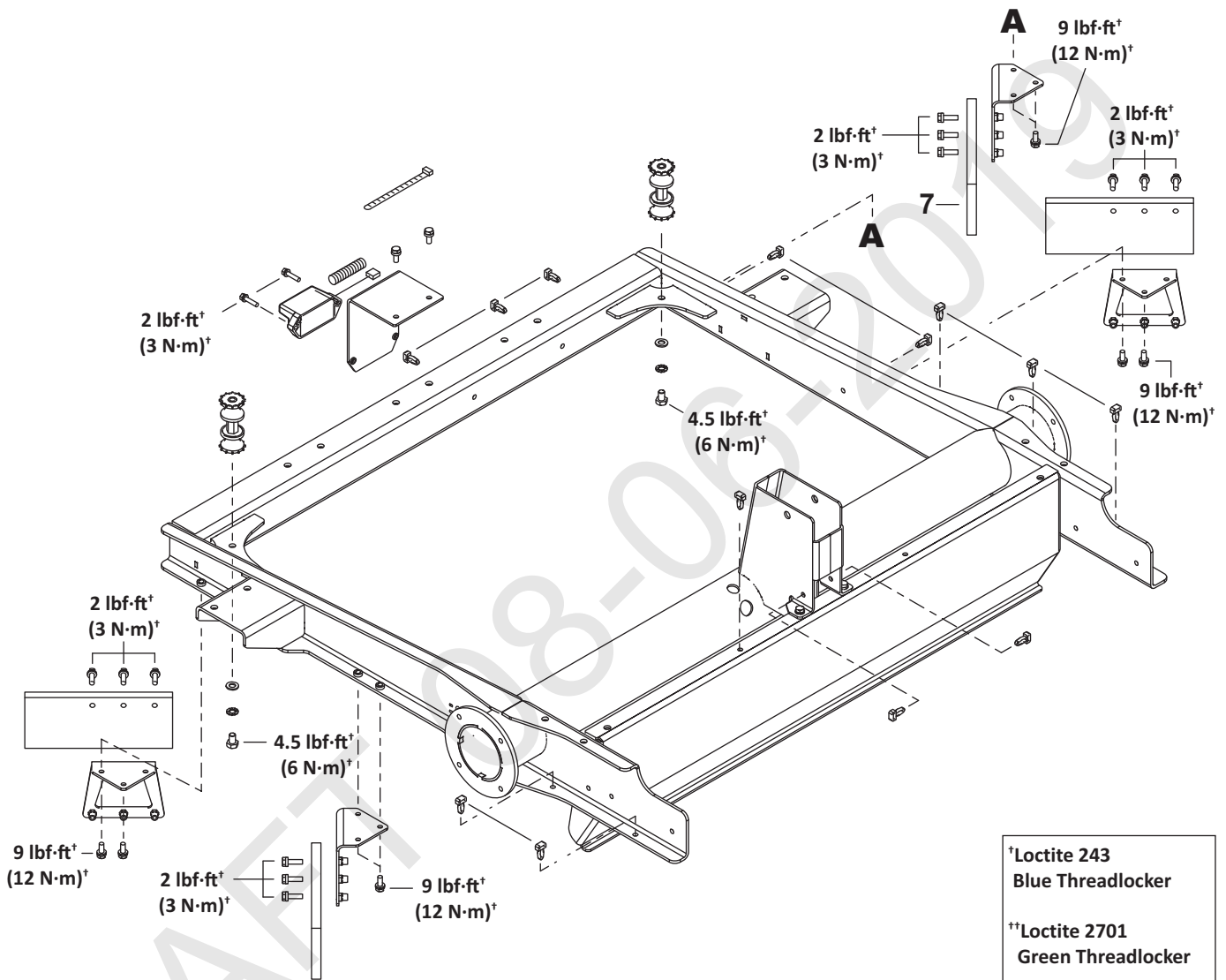
†Loctite 243
 Blue Threadlocker

††Loctite 2701
 Green Threadlocker

23.8 Barrow Frame

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)†

A

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)†

A

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)†

†Loctite 243
Blue Threadlocker

††Loctite 2701
Green Threadlocker

24 Technical Specifications

24.1 Battery

Type	Lithium-ion
Nominal Voltage	25.6 V
Nominal Capacity	19.2 Ah
Standard charge voltage	29.2 V
Maximum charge current	19.2 A
Energy	491.5 Wh
Working temperature range	Between -4 °F and 140 °F (-20 °C and 60 °C)
Time to fully charge (minimum)	80 minutes
Average mowing time per charge	110 minutes
Average annual consumption	830 kWh

24.2 Weight and Dimensions

Weight	XXXXXX
Length	46.4 in. (1178 mm)
Width	53.0 (1344 mm)
Height	21.3 (542 mm)

24.3 Software and Monitoring

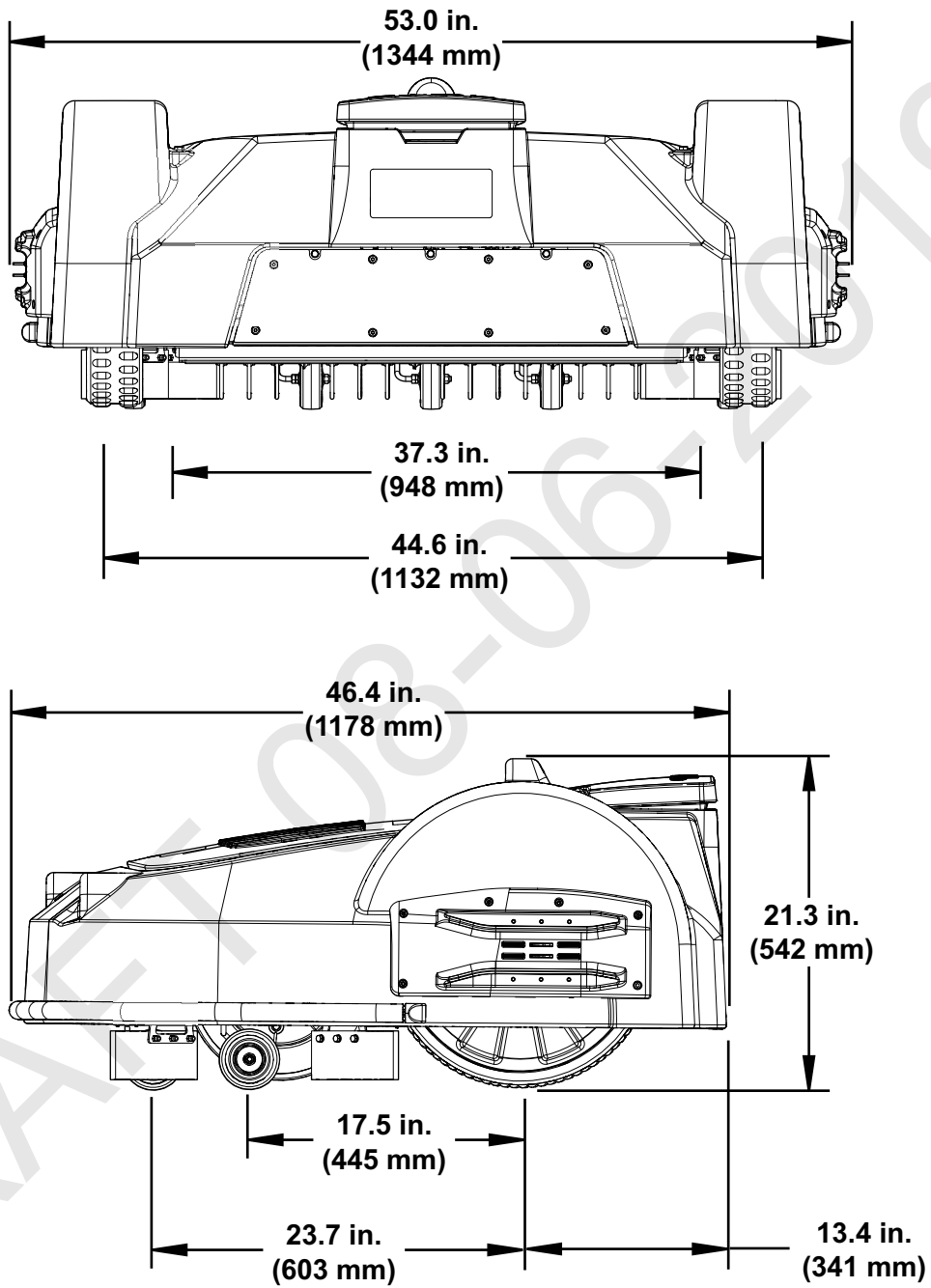| Security PIN code	Yes
GPS positioning	Standard
APP robot management	

24.4 Intelligence

Sonar detection of obstacle (height and diameter)	Height 15.7 in. (400 mm) Diameter 2.0 in. (50 mm)
Return to station via GPS	N/A
Multiple starting zone	
Multi field (optional)	
Multi robot	

24.5 Safety

Lift sensors	Yes
Reverse sensors	No
Bumper	Electronic

24.6 Dimensions

ECHO Incorporated
400 Oakwood Road
Lake Zurich, IL 60047
1-800-392-0329
www.echorobotics.com