# ECHO ROBOTICS

www.echorobotics.com

# Technical Manual
# Robotic Mower
# TM-1000

P/N 99922205440

VERSION 1.0

07/03/2019

EN    ENGLISH

# 1 Important Information

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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.echoro-botics.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 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.

## 1.3 California Proposition 65

| ⚠ DANGER |
|---|

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.

| ⚠ DANGER |
|---|

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.

| ⚠ WARNING |
|---|

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.

| ⚠ CAUTION |
|---|

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.

| NOTICE |
|---|

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. |
| | 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 works in a random pattern. A peripheral wire buried in the ground defines the working area.

The charging station energizes the peripheral wire. An electro magnetic field is generated within the working area. The robot senses the magnetic field.

When the robot senses the location of the peripheral wire, it stops, turns back into the field, and continues working.

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, the robot 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.
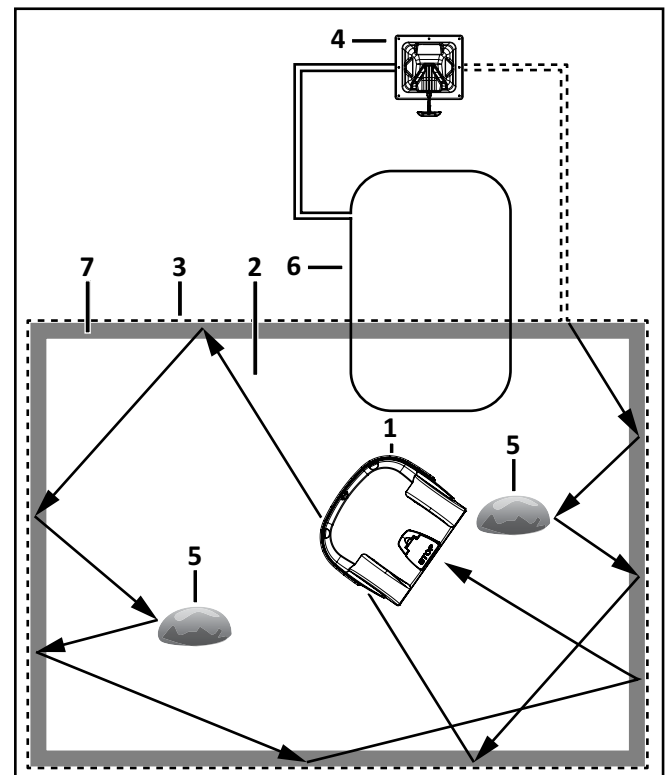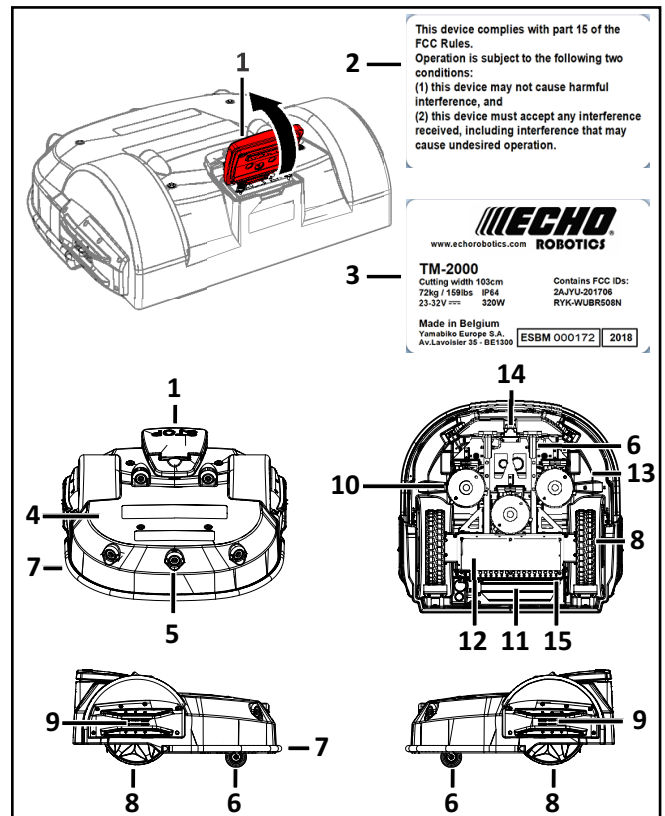


1 – Robot
2 – Mowing area
3 – Peripheral wire
4 – Charging station
5 – Obstacle
6 – Station loop wire
7 – Trackborder

# 4 System Components
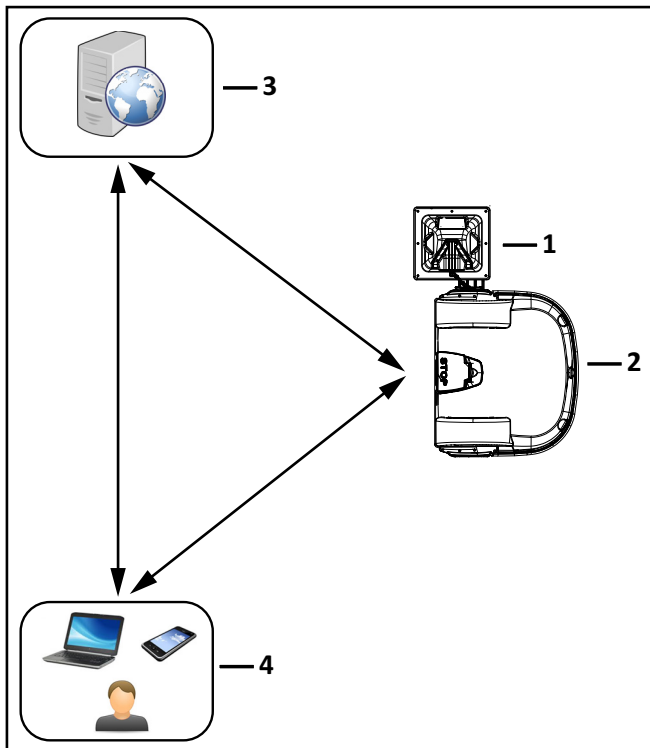


1 – Charging station
2 – Robot
3 – Internet portal
4 – End user

# 4.1 Robot Components



1 – Stop button - Press to stop the robot.

2 – FCC label (lift stop button lid to view)

3 – Serial number label (lift stop button lid to view)

4 – Body

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 – Cutting heads - Equipped with three cutting blades.

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

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

13 – Disc safety guard - A protective guard which inhibits contact with the cutting heads.

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

15 – Power switch

## 4.1.1 User Interface

Located under the stop button lid.
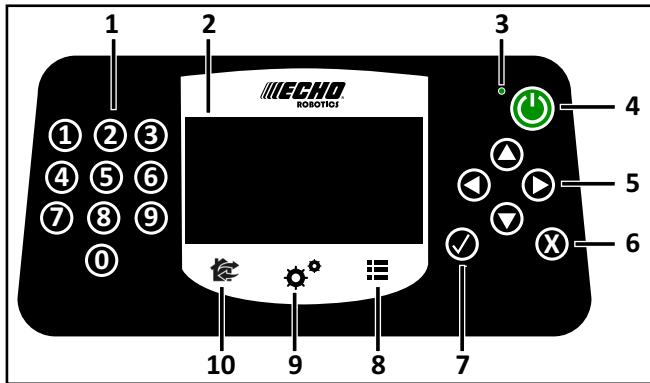


1 – Numeric buttons - Press to select menu choices and enter numeric values.

2 – LED screen - Displays the current information.

3 – LED - Indicates the user interface is switched ON.

4 – ON button - Press to turn the user interface 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.

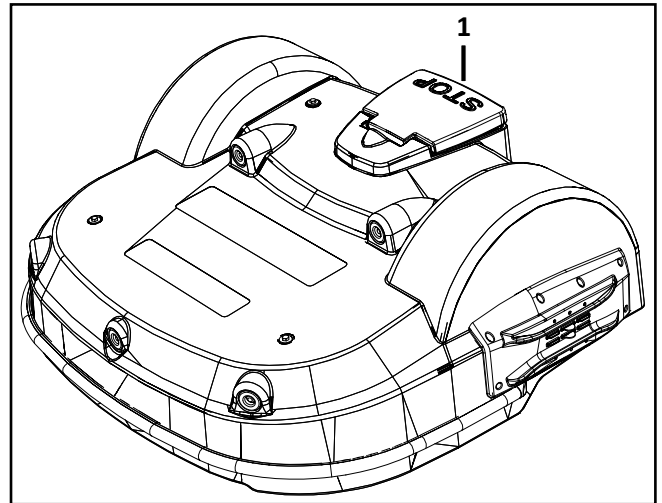10 – Actions menu button - Press to access the actions menu.

## 4.1.2 Cutting Head
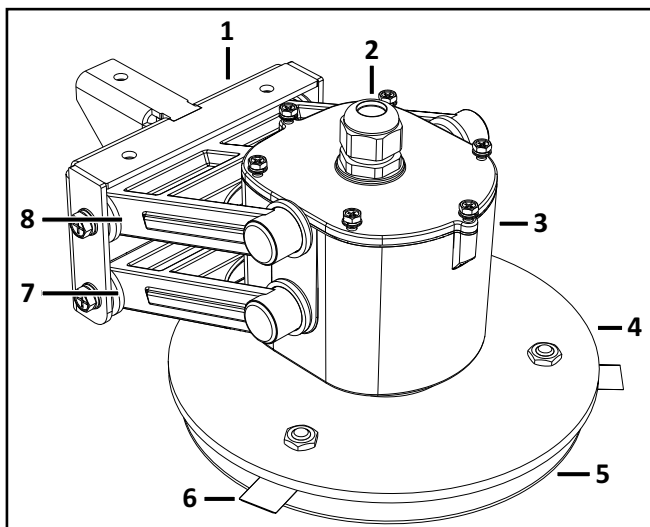


1 – Bracket unit

2 – Cable gland

3 – Motor case

4 – Blade disc

5 – Anti friction disc

6 – Cutting blade

7 – Lower stay

8 – Upper stay

## 4.1.3 STOP Button

Located on the top of the robot. Press or lift to stop the robot.



1 – Stop button

## 4.1.4 Obstacle Detection Sensors

Five 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).
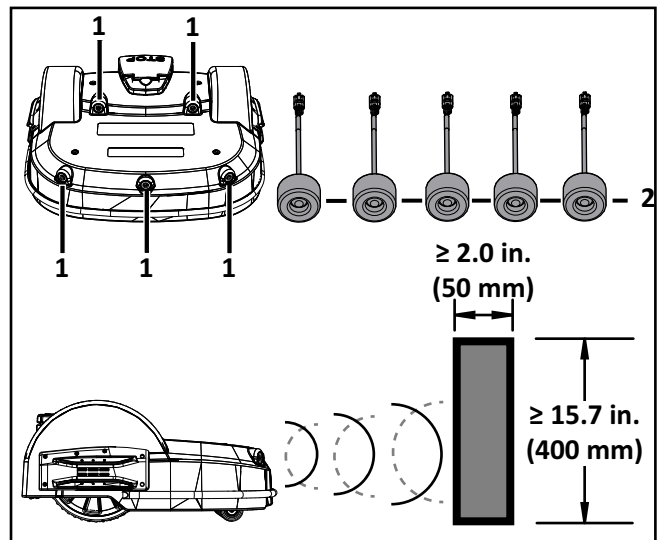


1 – Sensor location

2 – 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.

## 4.1.5 Lift Sensors

Each lift sensor is attached to the body and the chassis of the robot. The two sensors on the front are lift sensors, the two sensors on the rear are a combination of lift and body displacement sensors.

If the body is lifted upwards, all functions will stop, and the robot will remain stationary. If the body is moved horizontally, the robot will, stop, move backwards, and by default, turn between 60° and 120°, then continue moving forward.
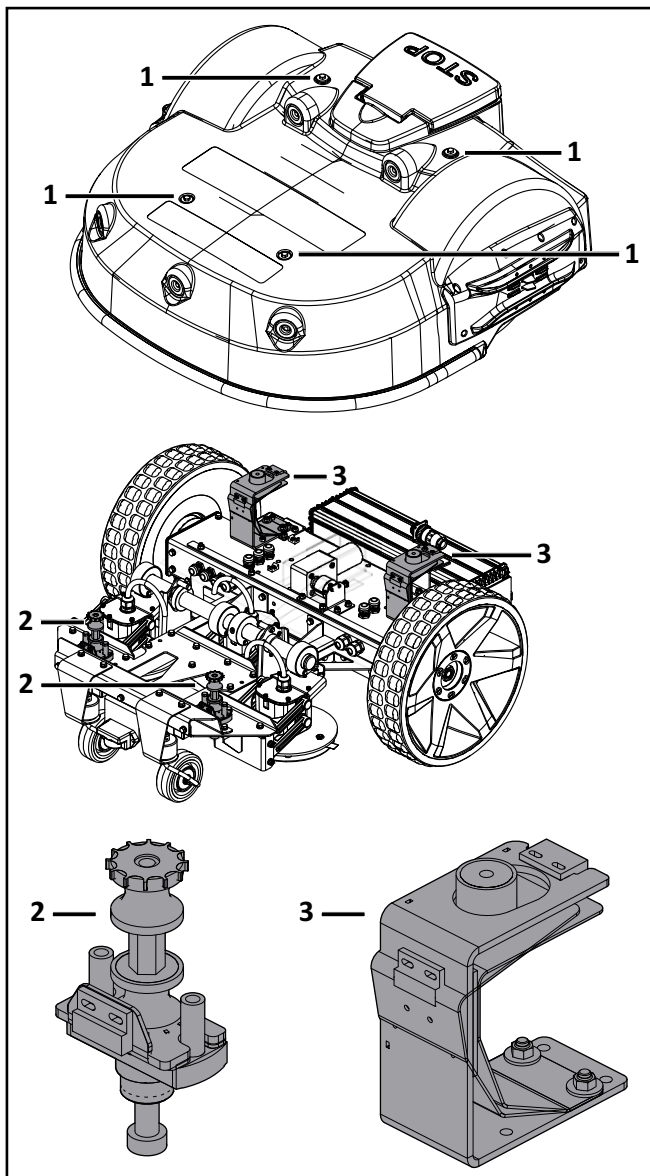


1 – Lift sensor attachment point
2 – Front lift sensor assembly
3 – Rear lift sensor assembly

## 4.1.6 Coil

Detects the intensity of the magnetic field that is generated by the peripheral wire.
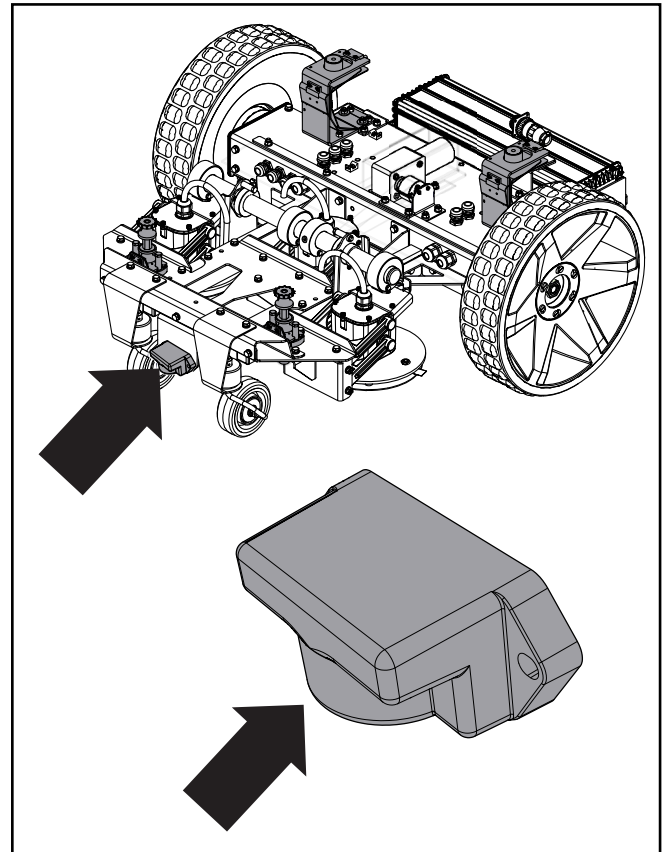


## 4.1.7 Tilt / Rollover / and Temperature Sensors

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.

## 4.2 The Charging Station
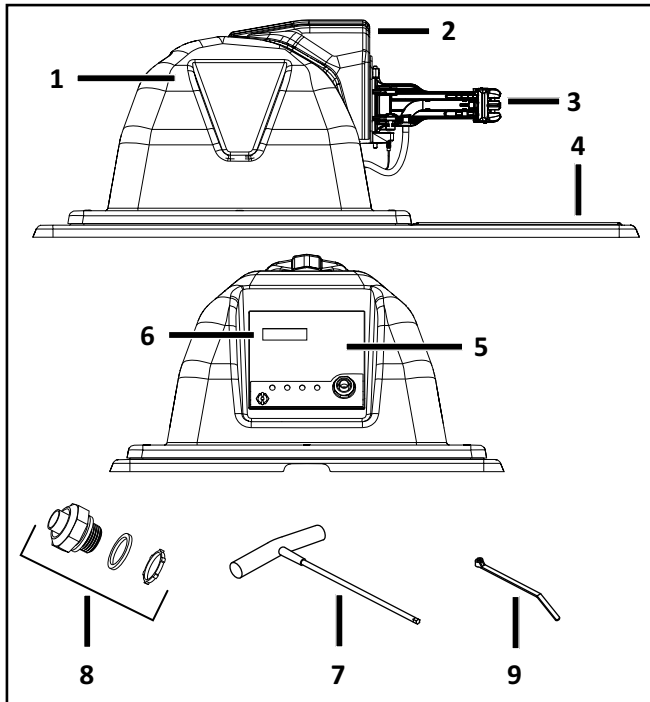


1 – Enclosure top
2 – Dust cover
3 – Charging arm
4 – Base
5 – Input panel – Caution label
6 – Serial number location
7 – T-27 Torx® driver
8 – Conduit connector
9 – Tie strap (2X)

# 5 How the Robot Works

The robot works in a number of operational states. Within these states the robot is programmed to operate in a number of modes.

| Operational State | Description |
|---|---|
| Autonomous Mission State | The robot operates in cycles in which it works, 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. |

## 5.1 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 user interface.

| Autonomous Mission Modes | Robot Function |
|---|---|
| Go zone | Performs a set of maneuvers before entering the work mode. |
| Work | Mows the grass in a random pattern. |
| Go to charging station | Returns to the charging station. |
| Charge | Connects to the charging station and charges the battery. |
| Wait in station | Remains at the charging station. |

### 5.1.1 Go Zone Mode

The robot will leave the charging station when the working schedule demands it, or a specific command has been issued.

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.
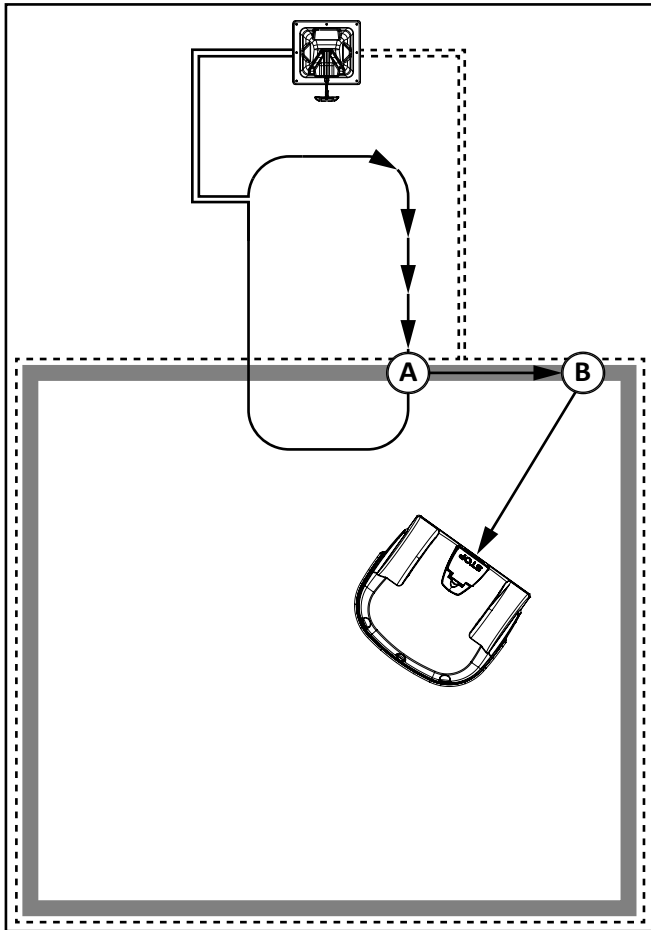


## Two Fields With Station Loop

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.
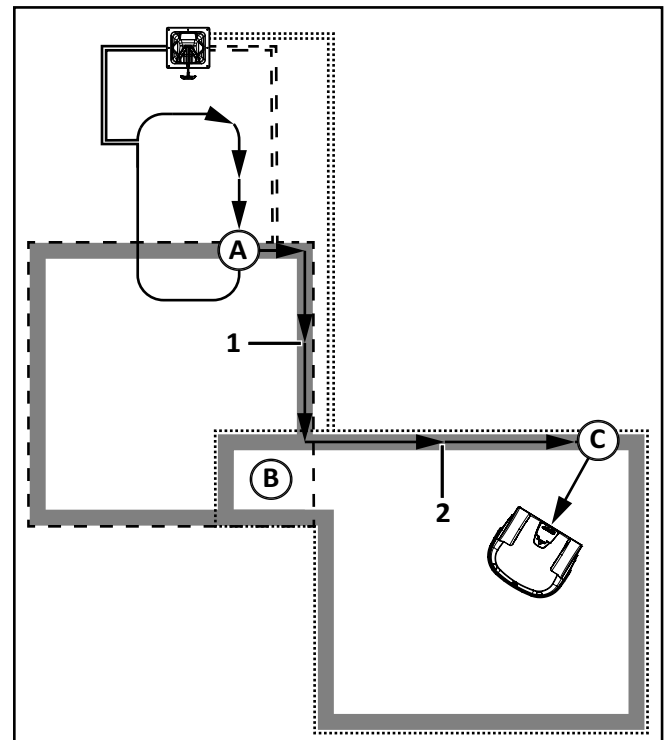


1 – Field 1 trackborder
2 – Field 2 trackborder

## 5.1.2 Work Mode

The robot randomly works inside the peripheral wire at a normal speed of 2.2 mph (1.0 m/s).
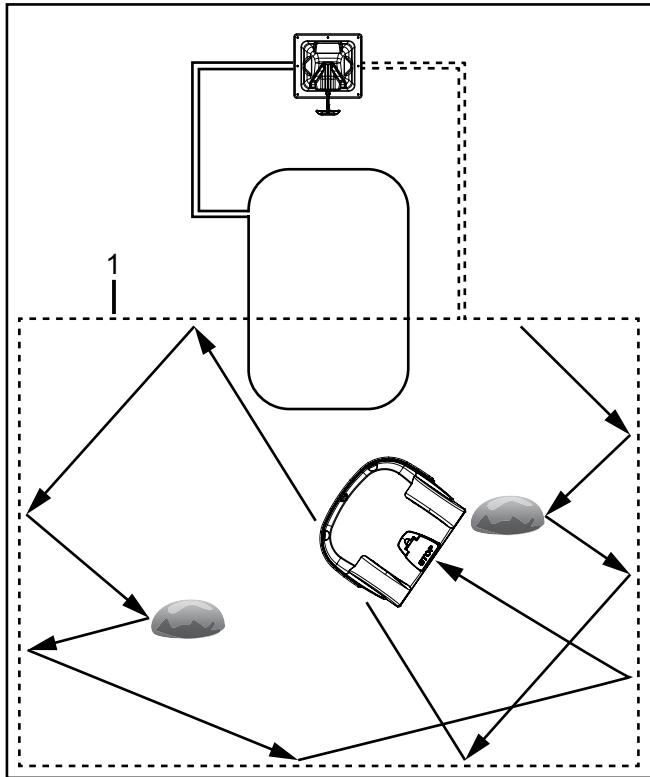


1 – Peripheral wire

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.

In an area of long grass the robot will automatically reduce speed and start working in spiral pattern until it senses that the grass is short. It will then continue in normal operating mode.
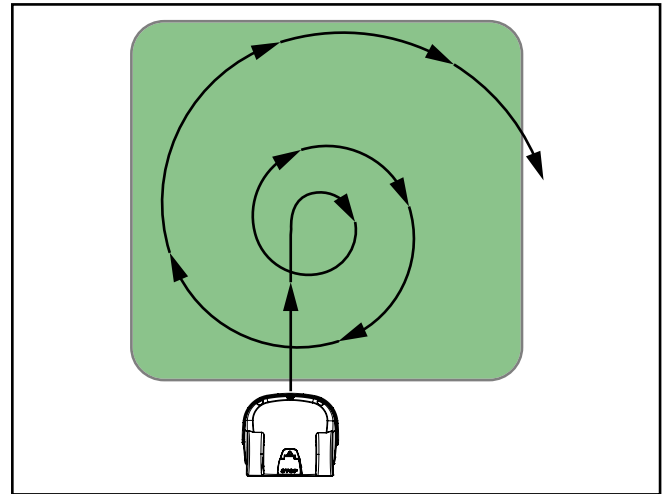


When the robot contacts an obstacle it will maneuver away from it.
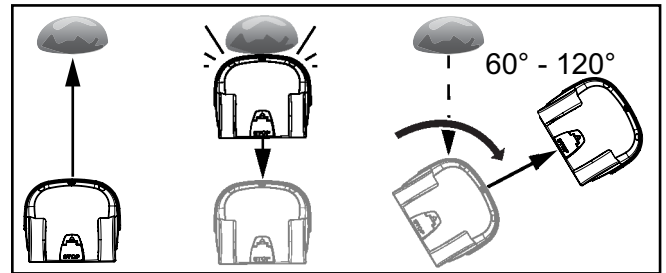


## 5.1.3 Go To Charging Station Mode

When working, the robot checks the current conditions and its programmed instructions. Examples are:

- the battery needs to be charged
- programmed working time has ended (for multi-field installations, this corresponds to the schedule for the field which the robot is currently working)
- a remote command has been issued

As a result of the condition or programmed instruction, the robot will return to the charging station and enter the charge mode.

## One Field With Station Loop
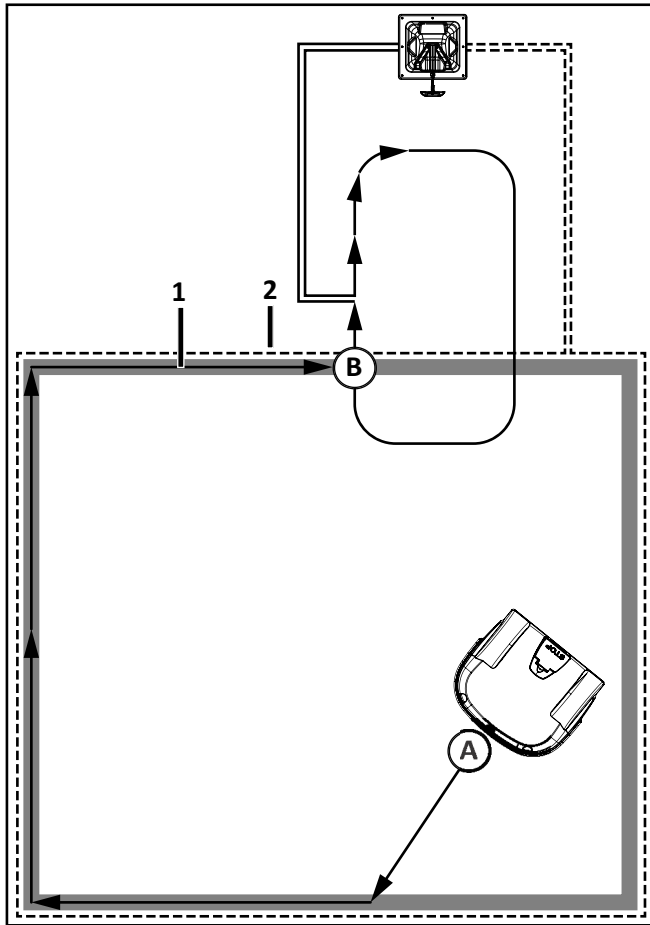


1 – Trackborder
2 – Peripheral wire

## Two Fields With Station Loop

At Point A, the robot returns to the charging station. It moves towards the Field 2 peripheral wire and follows the Field 2 trackborder until it reaches Point B. This is the area where both fields overlap. It then follows the Field 1 trackborder until it reaches Point C. This is where the Field 1 peripheral wire and station loop wire overlap. Next, the robot follows the station loop wire until it docks at the charging station.
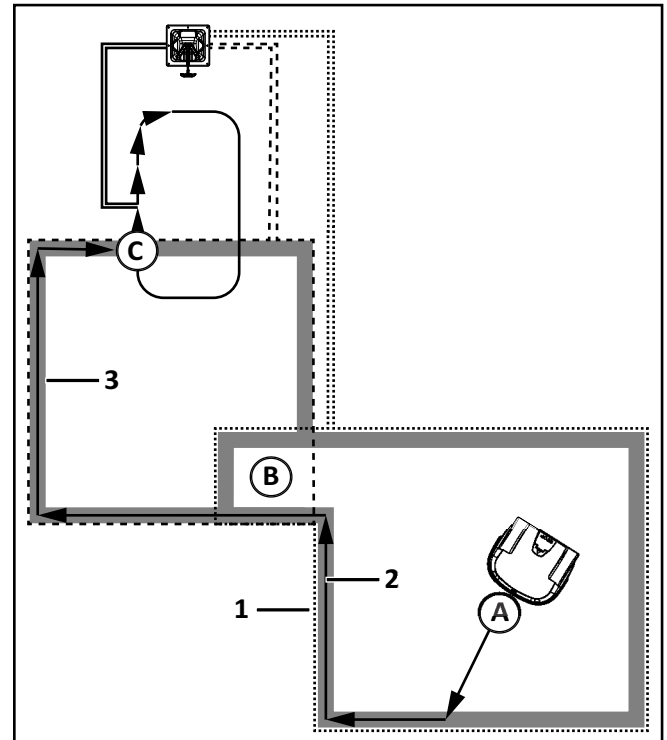


1 – Field 2 / Field 2 peripheral wire
2 – Field 2 trackborder
3 – Field 1 trackborder

## 5.1.4 Charge Mode

In Charge Mode the robot will dock and remain in the charging station until the battery is fully charged.

The next operations that will be performed depend on programming and external conditions.

The robot will remain at the charging station if:

- rest periods have been scheduled
- it has been programmed to stay in the station
- the temperature is too low

Otherwise, it will continue with the scheduled program.

The robot will remain at the charging station once the battery has been charged until:

- the normal program needs to commence
- a specific command is issued

## 5.1.5 Wait In Charging Station Mode

The robot will stay in the charging station once the battery has been charged until the normal program needs to commence, or a specific command issued.

# 5.2 Inactive Modes

The Alarm Mode and Standby Mode will cause the robot to enter an inactive mode.

## 5.2.1 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.

## 5.2.2 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

The robot will leave the Standby mode when a command is issued. It will then enter the Self Test Mode before recommencing any activity.

## 5.2.3 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.

## 5.2.4 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

# 5.3 Service State

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

## 5.3.1 Demonstration Mode

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

### ⚠ WARNING

**OPERATIONAL HAZARD**

The robot will ignore the electromagnetic field generated by the peripheral wire when operating in demonstration mode.
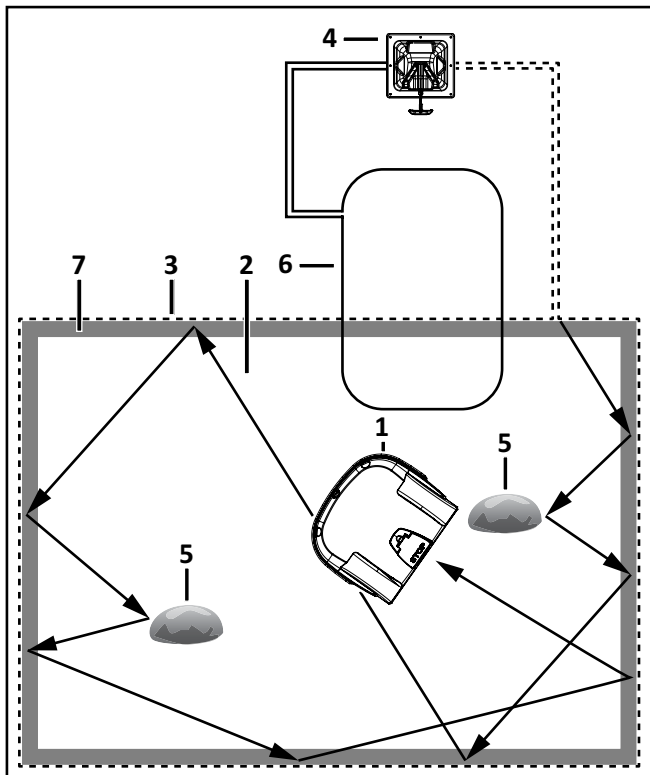
- Do not leave the robot unsupervised when it is operating in demonstration mode.

## 5.3.2 Maintenance Test

A set of maintenance tests are available from the Technician's menu.

# 6 Installation

The following figure illustrates the components of a single field installation.



1 – Robot
2 – Mowing area
3 – Peripheral wire
4 – Charging station
5 – Obstacle
6 – Station loop wire
7 – Trackborder

Only install the system on a field with a slope that is less than or equal to 17°. If the slope is near the peripheral wire, program the robot to return to the charging station by descending the slope.

## 6.1 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.
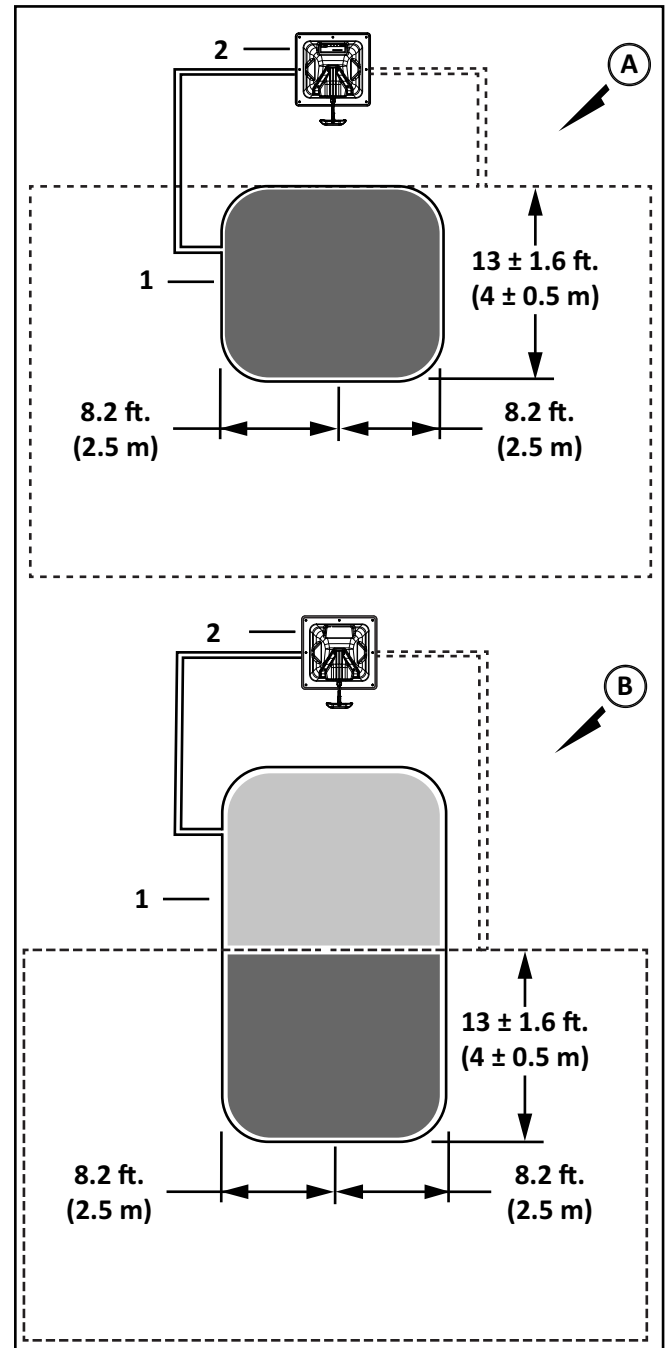


1 – Station loop wire
2 – Charging station

# 6.2 Peripheral Wire Installation

IMPORTANT: Only use peripheral wire which is supplied by ECHO Inc.

Each end of a peripheral wire is connected to the charging station.

Install the peripheral wire in a clockwise direction around the field. Do not cross or form loops with the peripheral wire.

Minimum peripheral wire length is 656 ft. (200 m). If this minimum length is not possible, install an inductor.

Maximum peripheral wire length is 3937 ft. (1,200 m).

Use a second charging station when:

- total length of the peripheral wire (including islands and pseudo-islands) exceeds 3,281 ft. (1,000 m)
- more than five obstacles are on the trackborder

Peripheral wire installation dimensions:
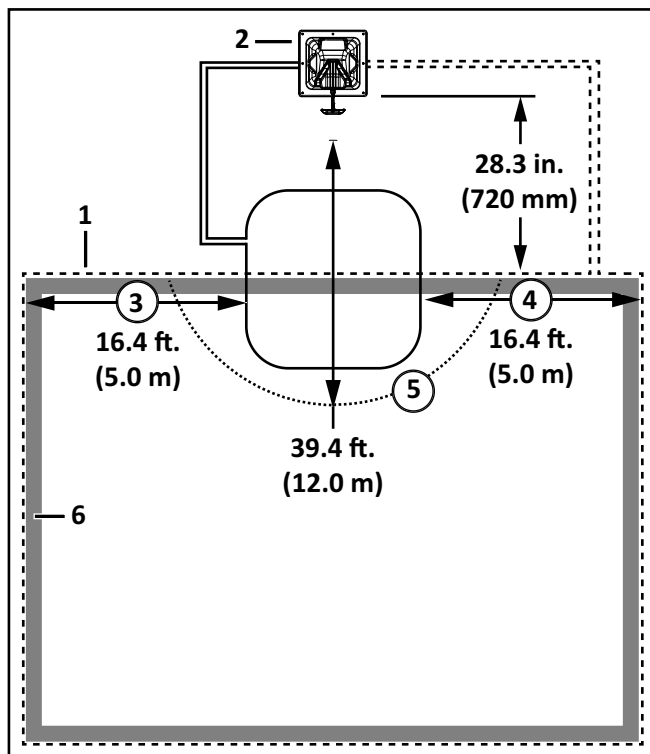


1 – Peripheral wire
2 – Charging station
3 – Recommended length incoming side
4 – Recommended length outgoing side
5 – Obstacle free zone
6 – Trackborder

Peripheral wire installation angles must be greater than or equal to 90°, with a radius greater than or equal to 3.3 ft. (1.0 m).
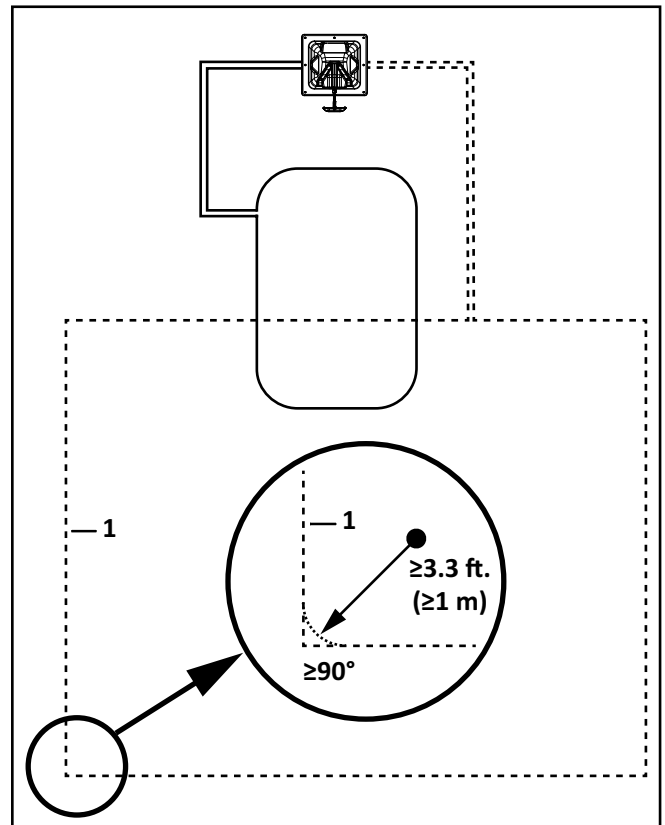


1 – Peripheral wire

The peripheral wire needs to take obstacles into account. Some obstacles can be detected by the sonar sensors on the robot, others require specific placement of the peripheral wire, or the use of islands or pseudo-islands.

# 6.3 Peripheral Wire Installation Offsets

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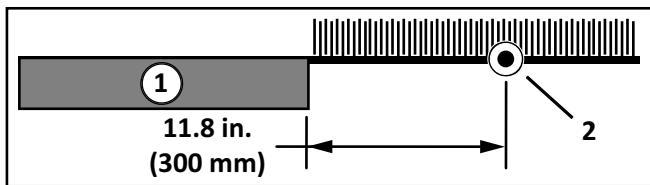
Rough grass that does not need to be mowed:
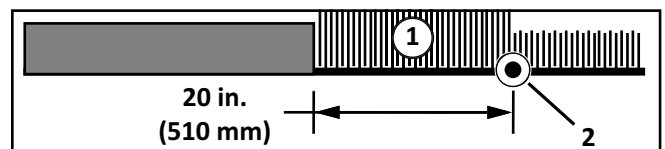


1 – Rough grass
2 – Peripheral wire

Raised hard landscaping:
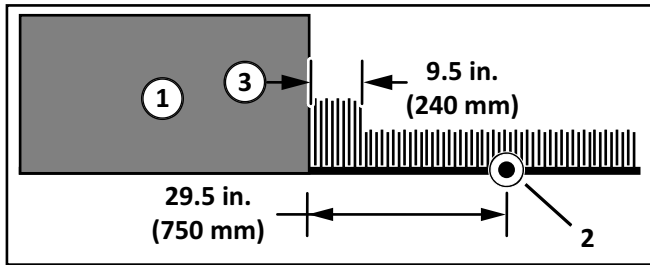


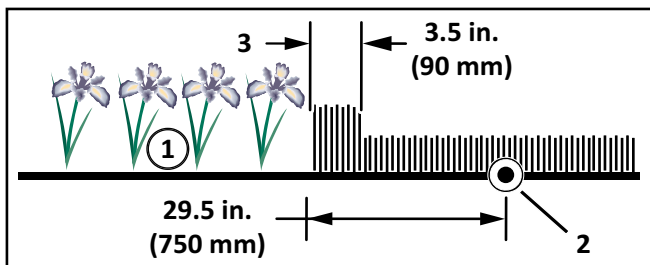1 – Terrace / Path / Wall
2 – Peripheral wire
3 – Area not mowed

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.

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



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

# 6.4 Sites Containing Narrow Straits

These sites require specific installation of the peripheral wire.

The required minimum width of the strait, depends on the length of the strait. If this minimum width is not available when the robot is in Zone B, it will not be able to pass through the strait and return to the charging station. In this case, installation of an additional charging station in Zone B is required.
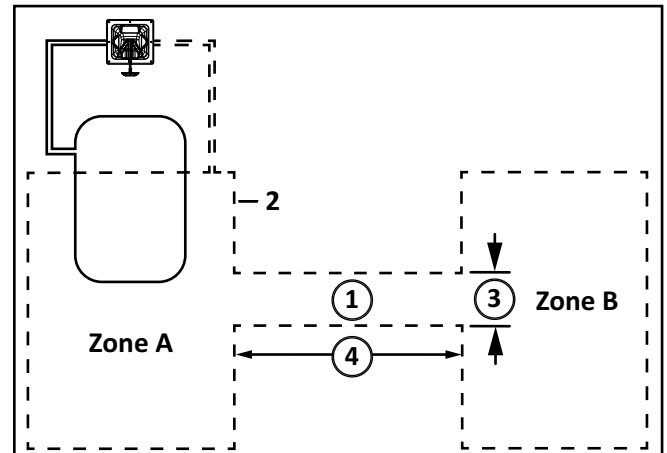


1 – Narrow strait
2 – Peripheral wire
3 – Minimum distance between peripheral wire
4 – Length of strait

The table below presents the minimum distance between wires required to enable the robot to follow its trackborder from Zone B through the strait and return to the charging station in Zone A.

# 6.5 Sites With Long Lanes

A long lane represents an area where a minimum distance for the installation of the peripheral wire is required. If this minimum distance is not met, the robot may not be able to detect the peripheral wire. If the peripheral wire is not detected, the robot cannot return to the charging station to charge its battery.
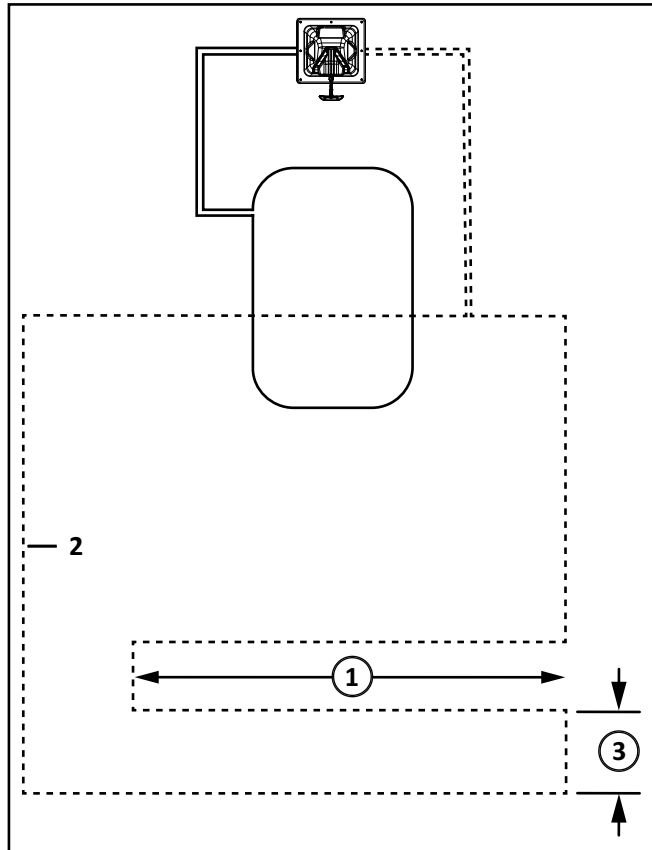


1 – Lane

2 – Peripheral wire

3 – Minimum distance between peripheral wire

If the length of the lane is less than 49.2 ft. (15 m), then the minimum distance between the peripheral wire must be greater than 32.8 ft. (10 m).

# 6.6 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.

## 6.6.1 Obstacles Near the Boundary to be Mowed
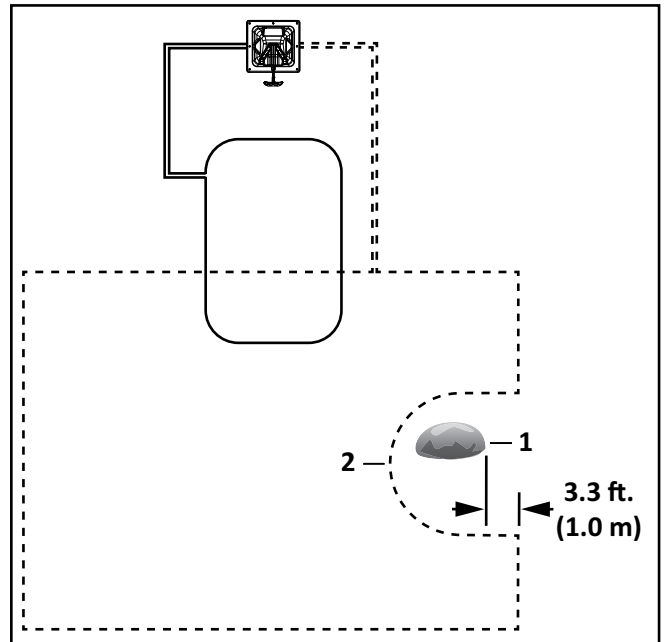


1 – Obstacle

2 – Peripheral wire

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.
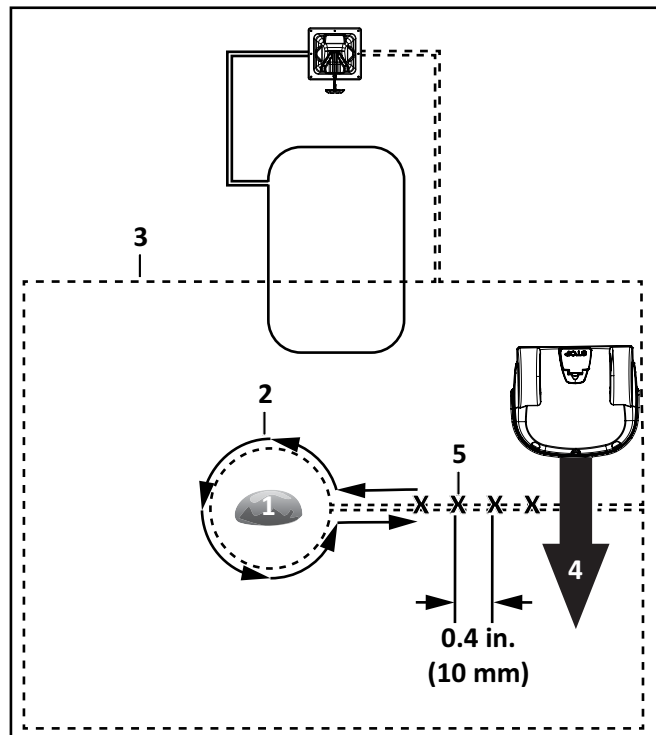
# 6.7 Islands

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.

Installation requirements for an island:

- 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

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
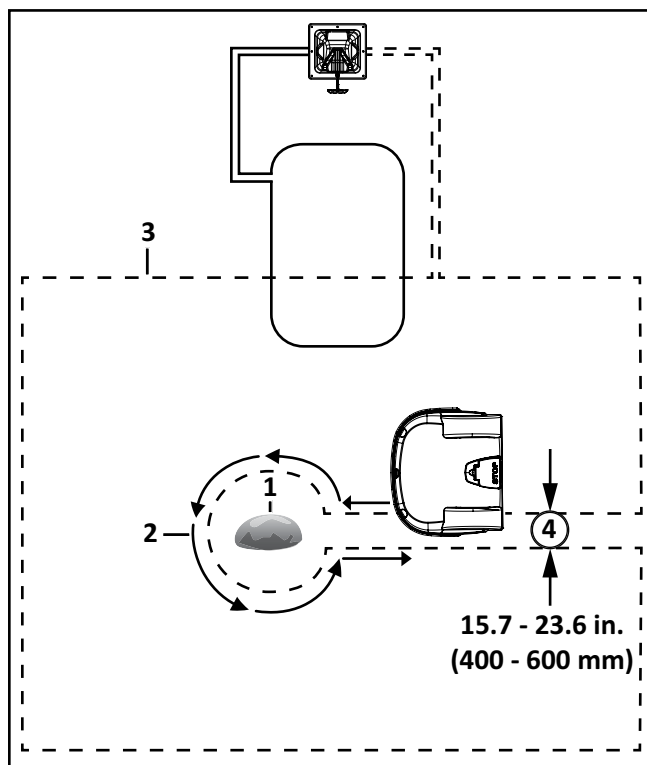


1 – Obstacle
2 – Direction to install peripheral wire (and movement of robot)
3 – Peripheral wire
4 – Fixed distance between approach and return sides

# 6.8 Water Obstacle

## NOTICE

### 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.
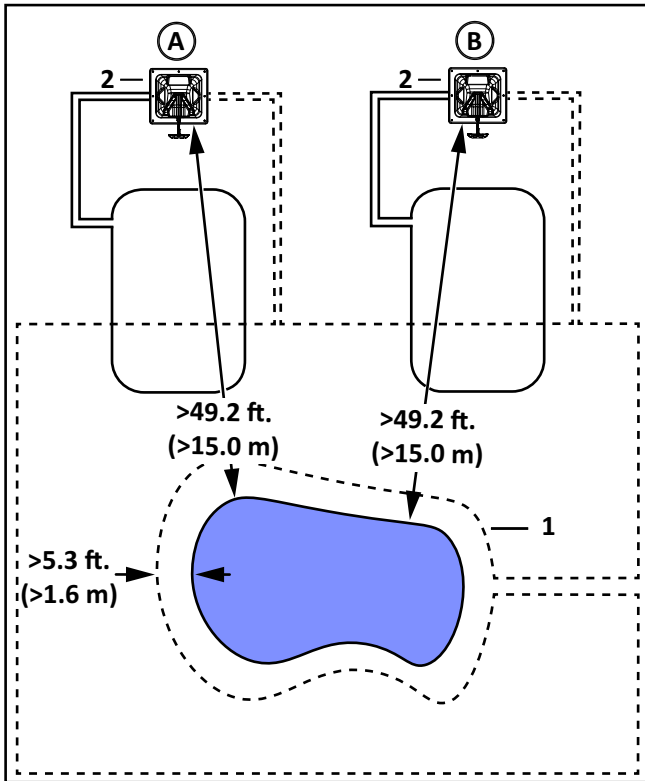


1 – Peripheral wire
2 – Charging station

## 6.9 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.

# 7 Configuration

Configuration of this installation is completed through the through *User Interface*. The instructions given are the minimum set of configuration parameters that must be set for this type of installation.

1) Press and hold **9** on the user interface screen until the technician's menu appears.

2) Select **Infrastructure > Peripheral wires**.

3) On the "Wire settings" screen, select **Wire CH{X},** then press ✓.

4) Rename this Wire to **LOOP**.

5) Select **Signal channel**, then press ✓. Assign the channel number for the station loop.

6) Check the value shown at the top of the screen. This should be *positive*. If it is not, select **Reverse phase** and check the button ON.

7) Press ✗ twice to return to the Infrastructure menu.

8) Select **Parcels**, then press ✓. Select the parcel associated with the LOOP wire.

9) Select **Return direction**, then press ✓. Choose whether you want the robot to return in a clockwise or counterclockwise direction.

10) Disable the use of the trackborder. Select **Use trackborder** and check the button OFF. This ensures that when the robot is in this field, it will just follow the wire to reach the station.

11) Press ✗ twice to return to the Infrastructure menu.

12) Select **Create new wire, then press** ✓.

13) Select the newly created wire, then press ✓.

14) Rename this field to **LAWN**.

15) Select **Signal channel**, then press ✓ Assign the channel number for the large field to be mowed.

16) Check the value shown at the top of the screen. This should be positive. If it is not, select **Reverse phase** and check the button ON.

17) Press ⊗ twice to return to the Infrastructure menu.

18) Select **Parcels**, then press ✓. Select the parcel associated with the LAWN wire.

19) Set the **Return direction** to the same as above.

20) 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 field.

21) Select **Neighboring parcels,** then press ✓. Check the button next to the LOOP parcel.

22) Press ⊗ to exit this menu.

23) Select **Edit parcels percentage**, then press ✓. Set the value to 100% for the lawn parcel.

24) Press ⊗ to return to the Infrastructure menu.

25) Select **Infrastructure > Stations > Create new station, then press** ✓.

26) A name is generated that you can modify if you want.

27) Select **Connected to parcels, then press** ✓. A list of parcels is presented. Select the parcel inside the LOOP wire and check the button ON.

28) Select **Station inside parcel's wire**. Check the button ON if the station is inside the LOOP wire. In the example shown above it is outside the wire.

Connect a total of one station loop and two peripheral wires to a single charging station.

- Each field is defined by a peripheral wire that starts and ends at the charging station.
- Each peripheral wire is assigned to a different signal channel in the charging station.
- The charging station must contain one signal channel board for every peripheral wire required.
- The area inside of each peripheral wire is defined as a field. Each peripheral wire must overlap with its neighboring one.
- Each pair of wires which overlap must be designated as neighboring fields.

Station loop wire 1 / Field 1, is the small wire to which the charging station is connected. In this example it overlaps the larger peripheral wires and fields. When in this field, the robot will not use the trackborder, it will follow the station loop wire to enter the charging station.

All three fields are neighbors to each other.

The overlap area is a transition zone used to connect the main working areas of the fields.

The proportion of time that the robot spends working in fields 1 and 2 is determined by the percentage values assigned to the corresponding fields. For the station loop field, the percentage can be set to 0.The elements of a multiple field installation are shown in the following figure.
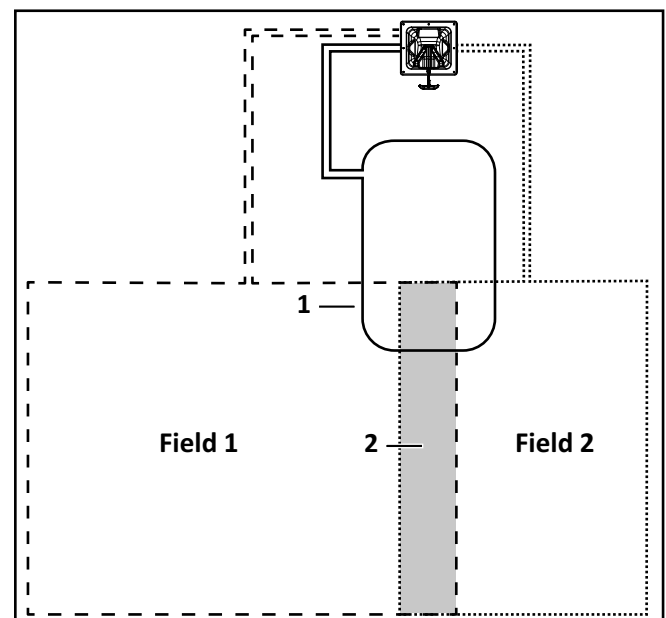


1 – Station loop wire
2 – Overlap area

# 7.1 Overlaps

An overlap is an area that lies within two fields and 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).
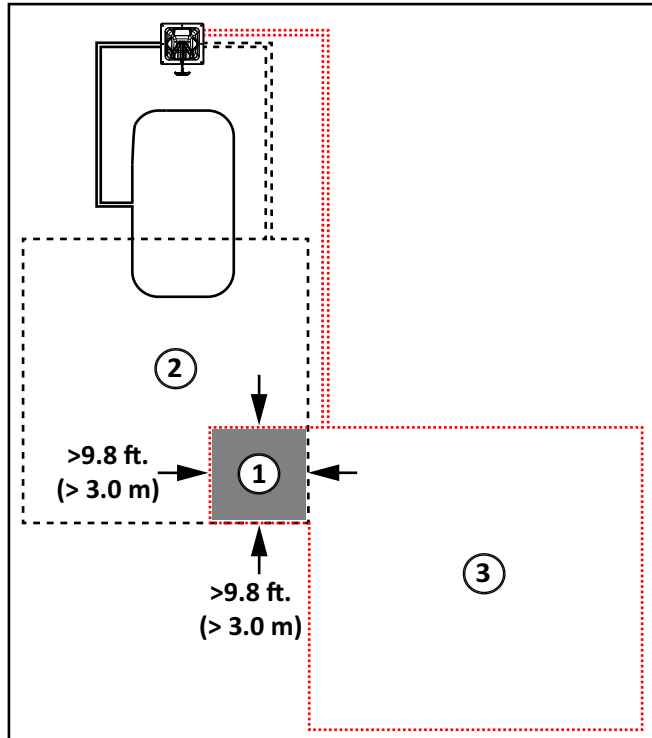


1 – Overlap area
2 – Field 1
3 – Field 2

# 7.2 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).
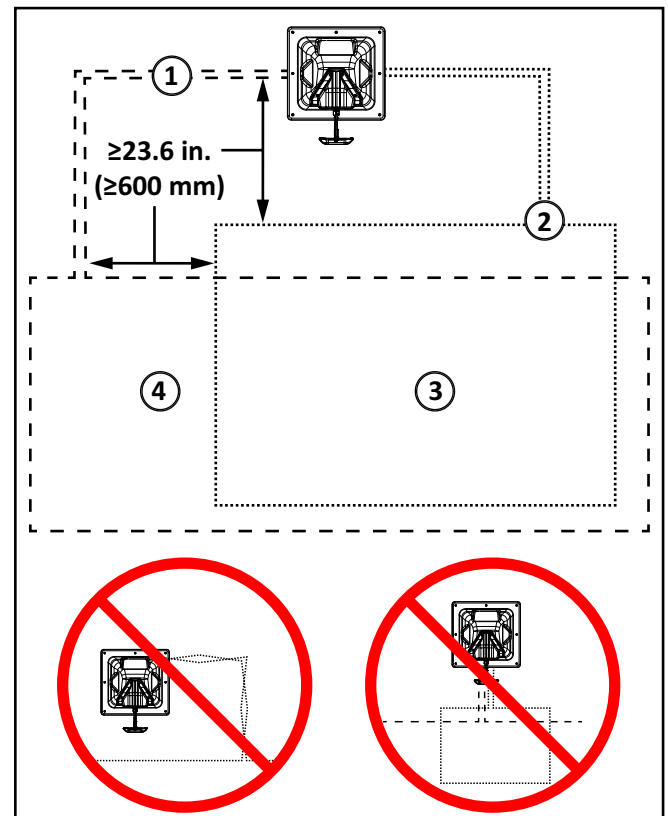


1 – Start and finish side of Field 1 peripheral wire
2 – Start and finish side of Field 2 peripheral wire
3 – Field 2
4 – Field 1

# 7.3 Configuration

Once the peripheral wire(s) and the charging station have been set in place, the installation needs to be configured.

Access the *User Interface* to configure single and multi-field installations.

## 7.3.1 General Configuration Procedure Using a Station Loop

1) Open the technician's menu.

2) Select **Infrastructure > Peripheral wires** and create the required number of wires for the installation.

3) For each wire assign the channel number and check the reverse phase.

4) Select **Infrastructure > Parcels**.

5) Define the properties of the parcel that is associated with each wire.

6) Create new parcels if necessary.

7) If the installation is a multi-field installation, define the start zone parameters for a parcel.

8) Select **Infrastructure > Stations**.

9) Select **Create new station**.

10) Select **Connected to parcels** and connect the station to the loop parcel.

11) Select **Station Inside Parcel's Wire** and specify whether the station is on the inside or the outside of the station loop wire.

## 7.3.2 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 one the line below shows some characteristics of the zone.

**Create new start zone**

Enables you to create a new zone with all the properties listed below.

## 7.3.3 Start Zone Properties

**Following from**

This option appears if you are defining a start zone for station with a positioning beacon. It specifies the parcel in which the start zone is implemented.

For a multi-field installation, you can specify the specific parcel.

Default means coming from any other parcel.

**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.
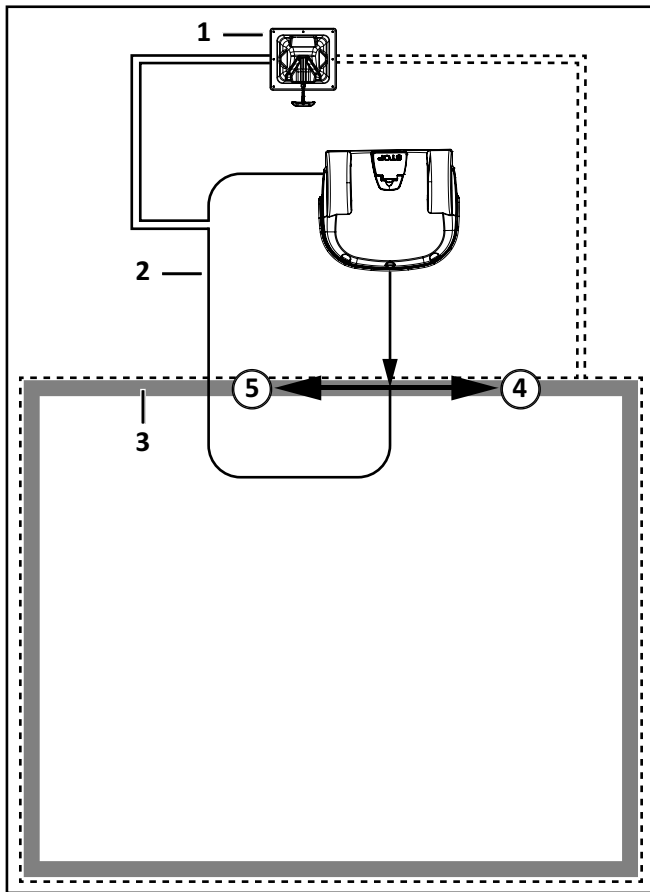
1 – Charging station
2 – Station loop wire
3 – Trackborder
4 – Clockwise direction on trackborder
5 – Counterclockwise direction on trackborder

### 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).
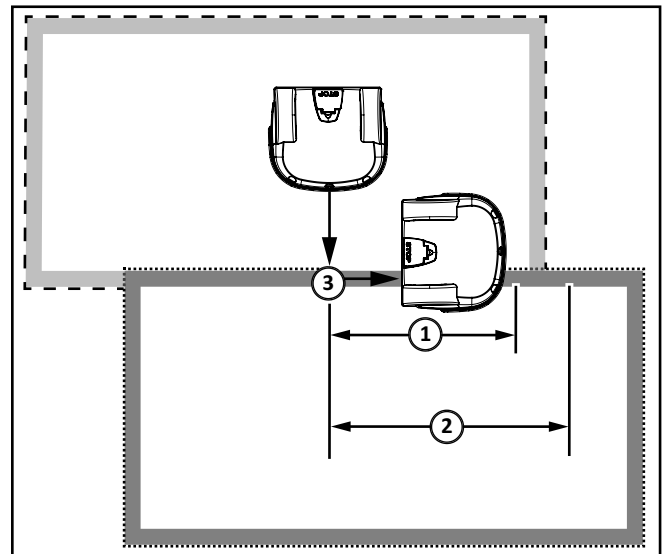


1 – Distance Min.
2 – Distance Max.
3 – Trackborder

### 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.
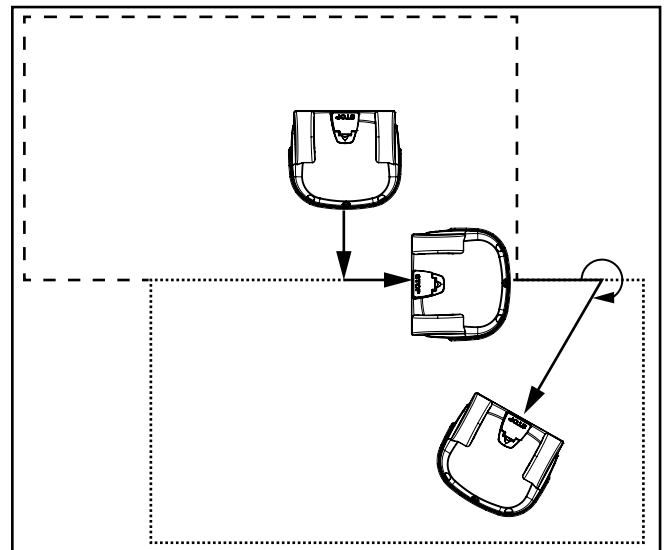


### Delete StartZone

Allows the start zone to be deleted.

# 7.4 Configuration Examples

## 7.4.1 Wire Configuration - One Zone Installation
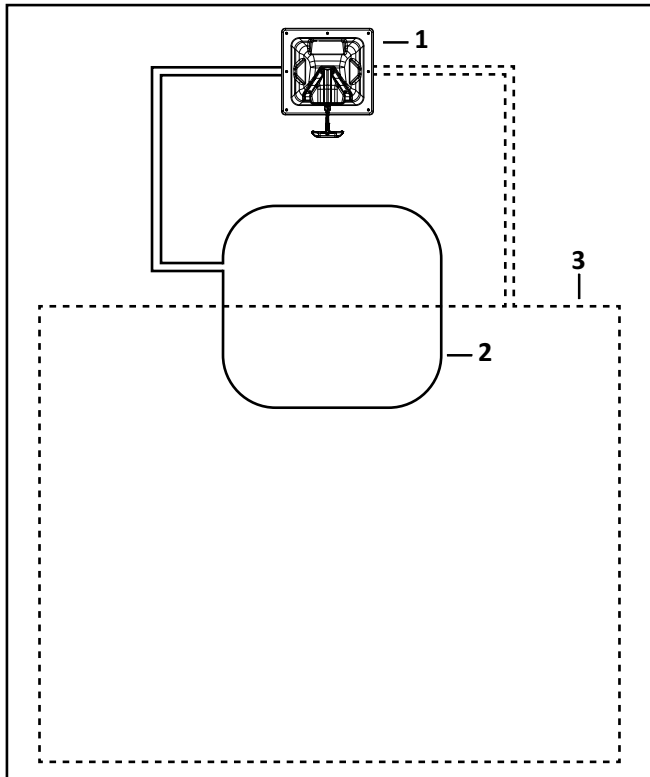


1 – Charging station
2 – Station loop wire
3 – Peripheral wire

Access the *User Interface* to set the following parameters.

**Peripheral Wire Configuration**

1) Press and hold **9** on the numeric keypad until the technician's menu appears.

2) The **TECHNICIAN SETTING** menu will display. Select **1. Infrastructure**, then press ▶.

3) The **INFRASTRUCTURE** menu will display. Select **1. Peripheral wires**, then press ▶.

4) The **WIRES SETTINGS** menu will display. Select **1. Wire CH0**, then press ▶.

5) The **WIRE CH0: NO SIGNAL** menu will display. Select the numeric option next to **Signal channel,** set the value to **0**, then press ▶.

**NOTE:** The station loop wire will always be set to **0.**

6) Check the value shown at the top of the screen. The value should be positive, if it is not, select **Reverse phase**, then press ▶.

7) Press ✖ once, the **WIRES SETTINGS** menu will display. Select **9. Create new wire**, then press ▶.

8) The **VALIDATE** screen will display. Select **OK**, then press ✅.

9) The **WIRES SETTINGS** menu will display. Select **Wire CH5**, then press ▶.

10) The **Wire CH5: No Signal** screen will display. Select the numeric option next to **SIGNAL CHANNEL**, press ◀ or ▶ and set the value to **1**, then press ✅.

11) Check the value shown at the top of the screen. The value should be positive, if it is not, select **Reverse phase**, then press ▶.

12) Press ✖ twice to return to the **INFRASTRUCTURE** screen.

**Parcels Configuration**

1) From the **INFRASTRUCTURE** menu, select **Parcels**, then press ▶.

2) The **PARCELS** menu will display. Select **1. Parcel 1**, then press ▶.

3) The **Parcel 1** menu will display. Parcel 1 will be highlighted, press ✅. Use ▲, ▼, ◀, or ▶, rename **Parcel 1** to **LOOP**. After renaming, select **V** (located in the bottom row), then press ✅.

4) Press ✖ once to return to the **PARCELS** screen.

5) Select **Parcel 2**, then press ▶. Use ▲, ▼, ◀, or ▶, rename **Parcel 2** to **Field.** After renaming, select **V** (located in the bottom row), then press ✅.

6) The **FIELD** screen will display. Select **Use Track-border**, then press ✓.

7) Scroll down to **8. Neighboring parcels**, then press ✓.

8) The **NEIGHBORING PARCELS** screen will display. Select **LOOP**, then press ✓. Select **Confirm**, then press ✓.

9) The **FIELD** screen will display. Press ✗ twice to return to the **INFRASTRUCTURE** screen.

**Station Configuration**

1) Select **3. Stations**, then press ▶.

2) Select **9. Create manual station**, then press ▶.

3) The **VALIDATE** screen will display. Select **OK**, then press ✓.

4) The **Manual Station 1** screen will display. Select **Connected to parcels**, then press ▶.

5) The **VALIDATE** screen will display. Select **OK**, then press ✓.

6) The **Connected Parcels** screen will display. The option for **Wire CH0** will be highlighted. Press ▶ to change it to **LOOP**, then press ✓.

7) Press ✗ once to return to the **Manual Station** screen.

8) Select **Station inside parcel's** wire. Press ✓ if the charging station is inside of the station loop wire.

9) Press ✗ twice to return to the **INFRASTRUCTURE** screen.

10) Press ✗ twice, the **Waiting for new mission** screen will display.

11) Press ▤ once, the **SERVICE SETTINGS** screen will display. Select **3. Operations**, then press ▶.

12) The **OPERATIONS** screen will display. Select **Edit parcels percentage**, then press ▶.

13) The **PARCELS PERCENTAGE** screen will display. Select the numeric option next to **LOOP**, set the number to **O**. Select the numeric option next to **FIELD**, set the number to 100. Select **CONFIRM**, then press ✓.

## 7.4.2 Wire Configuration - Two Zone Installation
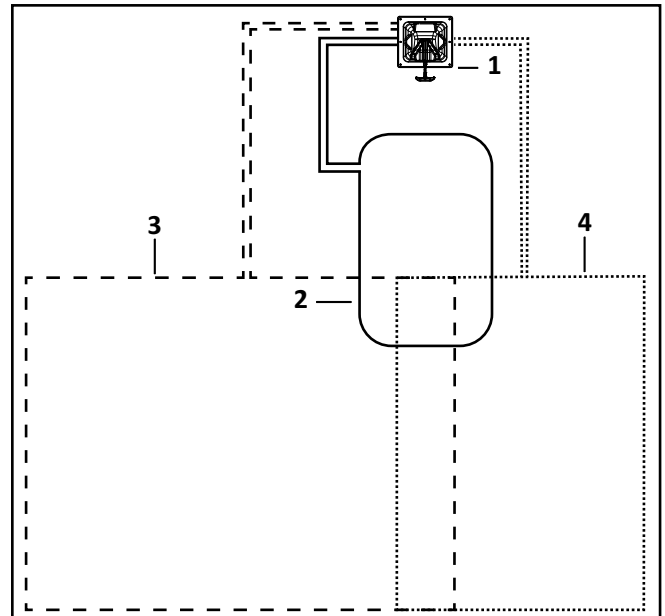


1 – Charging station
2 – Station loop wire
3 – Field Zone 1 peripheral wire
4 – Field Zone 2 peripheral wire

**Peripheral Wire Configuration**

1) Press and hold **9** on the numeric keypad until the technician's menu appears.

2) The **TECHNICIAN SETTING** menu will display. Select **1. Infrastructure**, then press ▶.

3) The **INFRASTRUCTURE** menu will display. Select **1. Peripheral wires**, then press ▶.

4) The **WIRES SETTINGS** menu will display. Select **1. Wire CH0**, then press ▶.

5) The **WIRE CH0: NO SIGNAL** menu will display. Select the numeric option next to **Signal channel,** set the value to **0**, then press ▶.

**NOTE:** The station loop wire will always be set to **0.**

6) Check the value shown at the top of the screen. The value should be positive, if it is not, select **Reverse phase**, then press ▶.

7) Press [X] once, the **WIRES SETTINGS** menu will display. Select **9. Create new wire**, then press [▶].

8) The **VALIDATE** screen will display. Select **OK**, then press [✓].

9) The **WIRES SETTINGS** menu will display. Select **Wire CH5**, then press [▶].

10) The **Wire CH5: No Signal** screen will display. Select the numeric option next to **SIGNAL CHANNEL**, press [◀] or [▶] and set the value to **1**, then press [✓].

11) Check the value shown at the top of the screen. The value should be positive, if it is not, select **Reverse phase**, then press [▶].

12) Press [X] once, the **WIRES SETTINGS** menu will display. Select **9. Create new wire**, then press [▶].

13) The **VALIDATE** screen will display. Select **OK**, then press [✓].

14) The **WIRES SETTINGS** menu will display. Select **Wire CH5**, then press [▶].

15) The **Wire CH5: No Signal** screen will display. Select the numeric option next to **SIGNAL CHANNEL**, press [◀] or [▶] and set the value to **2**, then press [✓].

16) Check the value shown at the top of the screen. The value should be positive, if it is not, select **Reverse phase**, then press [▶].

17) Press [X] twice to return to the **INFRASTRUCTURE** screen.

**Parcels Configuration**

1) From the **INFRASTRUCTURE** screen, select **Parcels**, then press [▶].

2) The **PARCELS** menu will display. Select **1. Parcel 1**, then press [▶].

3) The **Parcel 1** menu will display. Parcel 1 will be highlighted, press [✓]. Use [▲], [▼], [◀], or [▶], rename **Parcel 1** to **LOOP**. After renaming, select **V** (located in the bottom row), then press [✓].

4) Press [X] once to return to the **PARCELS** screen.

5) Select **Parcel 2**, then press [▶]. Use [▲], [▼], [◀], or [▶], rename **Parcel 2** to **Field 1.** After renaming, select **V** (located in the bottom row), then press [✓].

6) The **FIELD 1** screen will display. Select **Use Track-border**, then press [✓].

7) Press [X] once to return to the **PARCELS** screen.

8) Select **Parcel 3**, then press [▶]. Use [▲], [▼], [◀], or [▶], rename **Parcel 3** to **Field 2.** After renaming, select **V** (located in the bottom row), then press [✓].

9) The **FIELD 2** screen will display. Select **Use Track-border**, then press [✓].

10) Scroll down to **8. Neighboring parcels**, then press [✓].

11) The **NEIGHBORING PARCELS** screen will display. Scroll down to select **LOOP**, then press [✓]. Scroll down to **Confirm**, then press [✓].

12) Press [X] once to return to the **PARCELS** screen.

13) Scroll down to **Field 1**, then press [▶].

14) Scroll down to **Neighboring parcels**, then press [▶].

15) The **NEIGHBORING PARCELS** screen will display. Scroll down to select **LOOP**, then press [✓]. Scroll down to **Confirm**, then press [✓].

16) The **FIELD** screen will display. Press [X] twice to return to the **INFRASTRUCTURE** screen.

**Station Configuration**

1) Select **3. Stations**, then press ⏵.

2) Select **9. Create manual station**, then press ⏵.

3) The **VALIDATE** screen will display. Select **OK**, then press ✓.

4) The **Manual Station 1** screen will display. Select **Connected to parcels**, then press ⏵.

5) The **VALIDATE** screen will display. Select **OK**, then press ✓.

6) The **Connected Parcels** screen will display. The option for **Wire CH0** will be highlighted. Press ⏵ to change it to **LOOP**, then press ✓.

7) Press ⓧ once to return to the **Manual Station** screen.

8) Select **Station inside parcel's** wire. Press ✓ if the charging station is inside of the station loop wire.

9) Press ⓧ twice to return to the **INFRASTRUC-TURE** screen.

10) Press ⓧ twice, the **Waiting for new mission** screen will display.

11) Press ☰ once, the **SERVICE SETTINGS** screen will display. Select **3. Operations**, then press ⏵.

12) The **OPERATIONS** screen will display. Select **Edit parcels percentage**, then press ⏵.

13) The **PARCELS PERCENTAGE** screen will display. Select the numeric option next to **LOOP**, set the number to **O**. Select the numeric option next to **FIELD**, set the number to100. Select **CONFIRM**, then press ✓.

## 7.4.3 Single Field With Two Start Zones

This is an example of an installation that might be used in a large field with two areas. Even though it is set up as a single field, two start zones are used to ensure that the robot starts working in both areas on a regular basis.

The layout of the installation is shown in the figure below.
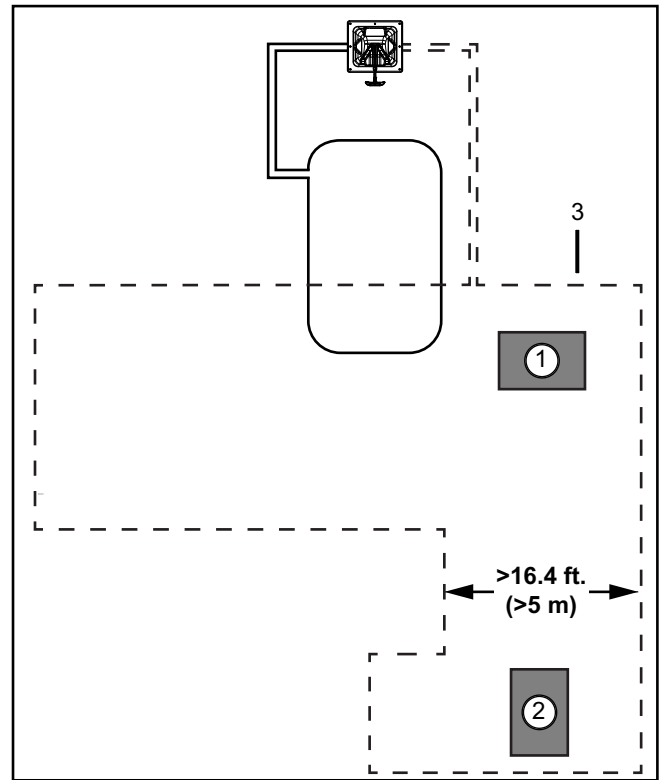


1 – Start zone 1
2 – Start zone 2
3 – Peripheral wire

Access the *User Interface* to set the following parameters.

**Peripheral Wire Configuration**

1) Press and hold **9** on the numeric keypad until the technician's menu appears.

2) The **TECHNICIAN SETTING** menu will display. Select **1. Infrastructure**, then press ⏵.

3) The **INFRASTRUCTURE** menu will display. Select **1. Peripheral wires**, then press ⏵.

4) The **WIRES SETTINGS** menu will display. Select **1. Wire CH0**, then press ⏵.

5) The **WIRE CH0: NO SIGNAL** menu will display. Select the numeric option next to **Signal channel,** set the value to **0**, then press ⏵.

**NOTE:** The station loop wire will always be set to **0.**

6) Check the value shown at the top of the screen. The value should be positive, if it is not, select **Reverse phase**, then press ⏵.

7) Press ⊗ once, the **WIRES SETTINGS** menu will display. Select **9. Create new wire**, then press ▶.

8) The **VALIDATE** screen will display. Select **OK**, then press ✓.

9) The **WIRES SETTINGS** menu will display. Select **Wire CH5**, then press ▶.

10) The **Wire CH5: No Signal** screen will display. Select the numeric option next to **SIGNAL CHANNEL**, press ◀ or ▶ and set the value to **1**, then press ✓.

11) Check the value shown at the top of the screen. The value should be positive, if it is not, select **Reverse phase**, then press ▶.

12) Press ⊗ twice to return to the **INFRASTRUCTURE** screen.

**Parcels Configuration**

1) From the **INFRASTRUCTURE** menu, select **Parcels**, then press ▶.

2) The **PARCELS** menu will display. Select **1. Parcel 1**, then press ▶.

3) The **Parcel 1** menu will display. Parcel 1 will be highlighted, press ✓. Use ▲, ▼, ◀, or ▶, rename **Parcel 1** to **LOOP**. After renaming, select **V** (located in the bottom row), then press ✓.

4) Press ⊗ once to return to the **PARCELS** screen.

5) Select **Parcel 2**, then press ▶. Use ▲, ▼, ◀, or ▶, rename **Parcel 2** to **Field.** After renaming, select **V** (located in the bottom row), then press ✓.

6) The **FIELD** screen will display. Select **Use Trackborder**, then press ✓.

7) Scroll down to **8. Neighboring parcels**, then press ✓.

8) The **NEIGHBORING PARCELS** screen will display. Select **LOOP**, then press ✓. Select **Confirm**, then press ✓.

9) The **FIELD** screen will display. Scroll down to **Start Zones**, then press ▶.

10) The **Start Zones** screen will display. Press ▶ once.

11) The VALIDATE screen will display. Select OK, then press ✓.

12) The **Start Zones** screen will display.
For the **Coming from parcel** option, **DEFAULT** is correct.
For the Direction option, **CW** is correct.
Set the **Distance Min.** value.
Set the Distance Max. value.
Set the **Angle Min.** value (between 0° - 180°).
Set the **Angle Max.** value (between 0° - 180°).

13) Press ⊗ once. The **Start Zones** screen will display. Scroll down to Create new start zone, then press ▶.

14) The **VALIDATE** screen will display, select **OK**, then press ✓.

15) The **Start Zones** screen will display.
For the **Coming from parcel** option, **DEFAULT** is correct.
For the Direction option, **CW** is correct.
Set the **Distance Min.** value.
Set the Distance Max. value.
Set the **Angle Min.** value (between 0° - 180°).
Set the **Angle Max.** value (between 0° - 180°).

16) Scroll to **Edit Percentage,** then press ▶.

17) The **Edit Percentage** screen will display. Set the **Start Zone 2** values to 80%. Set the **Start Zone 3** value to 20%. Select **CONFIRM**, then press ✓.

18) The **START ZONE** screen will display. Press ⊗ four times to return to the **INFRASTRUCTURE** screen.

**Station Configuration**

1) Select **3. Stations**, then press ▶.

2) Select **9. Create manual station**, then press ▶.

3) The **VALIDATE** screen will display. Select **OK**, then press ✓.

4) The **Manual Station 1** screen will display. Select **Connected to parcels**, then press ▶.

5) The **VALIDATE** screen will display. Select **OK**, then press ✓.

6) The **Connected Parcels** screen will display. The option for **Wire CH0** will be highlighted. Press ▶ to change it to **LOOP**, then press ✓.

7) Press ⊗ once to return to the **Manual Station** screen.

8) Select **Station inside parcel's** wire. Press ✓ if the charging station is inside of the station loop wire.

9) Press ⊗ twice to return to the **INFRASTRUCTURE** screen.

10) Press ⊗ twice, the **Waiting for new mission** screen will display.

11) Press ▤ once, the **SERVICE SETTINGS** screen will display. Select **3. Operations**, then press ▶.

12) The **OPERATIONS** screen will display. Select **Edit parcels percentage**, then press ▶.

13) The **PARCELS PERCENTAGE** screen will display. Select the numeric option next to **LOOP**, set the number to **O**. Select the numeric option next to **FIELD**, set the number to 100. Select **CONFIRM**, then press ✓.

# 8 Using the Robot

> ### ⚠ CAUTION
>
> **PERSONAL INJURY HAZARD**
>
> Contact with the robot during operation can cause personal injury.
>
> - Press the STOP button before handling the robot.

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

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.

## 8.1 Safety Measures

- 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.
- Never connect an external electrical element to the battery cable.
- 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.

## 8.2 The LCD Screen
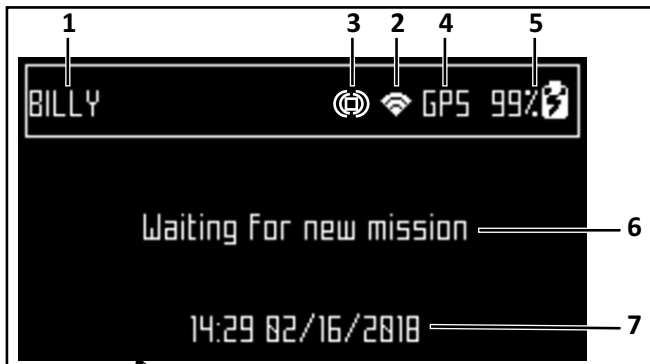


1 – Name - The name of the robot.

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).

## 8.3 The 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.

### 8.3.1 Operation In the Field

Perform these operations when the robot is stopped and not in the charging station.

Perform the operations if the robot has been stopped during its normal operation schedule, or if it has stopped because an alarm has been raised. If an alarm has been raised, correct the problem before executing the operations.

**Go charge**

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

**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.

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.

### 8.3.2 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.

# 8.4 The Settings Menu

Use the options in this menu to control the operation of the robot.

## 8.4.1 Schedule

NOTE: The schedule is based on a 24-hour clock.

Use this command to:

- Define the weekly working schedule.
- Define a schedule for each day of the week.
- Define working periods for each day and each parcel. Each defined period can be active (implemented) or inactive (ignored).
- Copy a schedule for one day, and for one parcel, to other days of the week.
- Set the robot to work at all times (which is a default factory setting).

To define a working schedule:

1) Press .

✿°

2) Press ⬆ or ⬇ to highlight **Schedule**, then press ✅. The following screen will appear. There are two columns for each day because there are two parcels that have been defined. This screen shows the current schedule, where the white blocks represent the time when the robot will be operating in one parcel. By default, all the time periods will appear white, meaning the robot will work continuously.
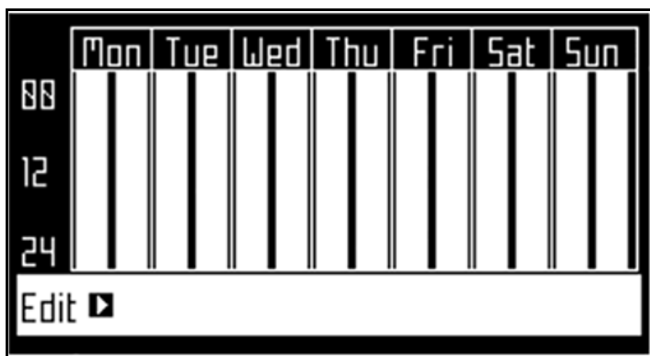


3) Use ⬆, ⬇, ⬅, or ➡ to highlight **Edit**, then press ✅. The following screen appears:
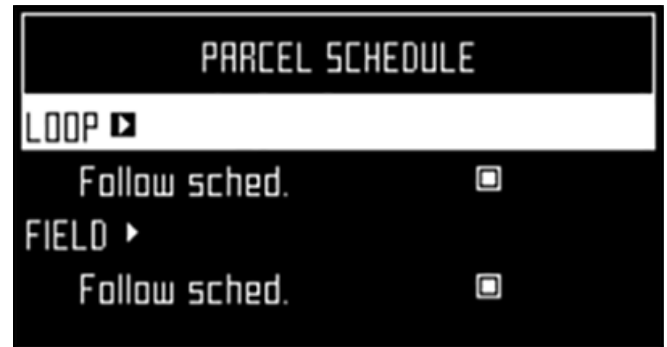


4) To edit the schedule, highlight the parcel, then press ✅.

5) Use ⬅ and ➡ to select the required day of the week, then press ✅.
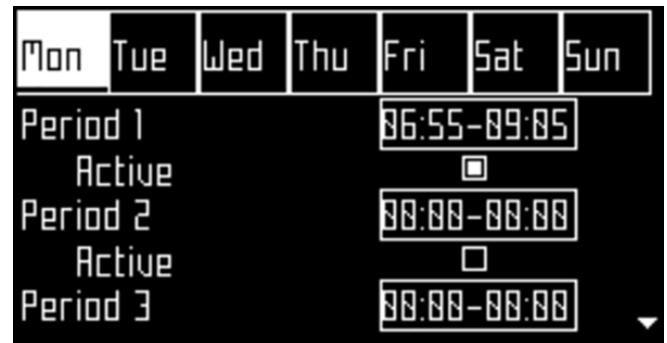


6) Use ⬇ to select the required period in the day, then press ✅.
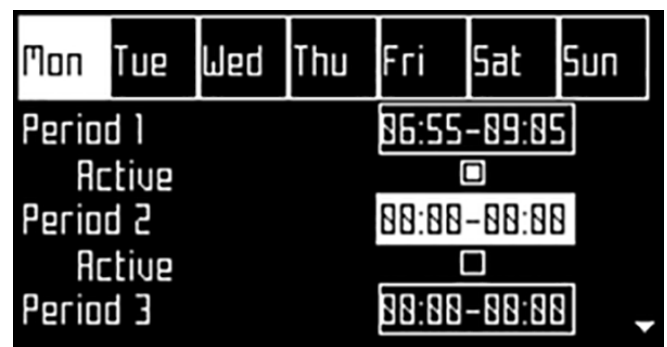


7) Use the numeric keyboard to enter the start and end time values where the cursor is flashing, then press ✅.

8) Press ⬇ to select the active check box, then press ✅ to activate the defined session.

NOTE: In the figure above, Period 1 is active, Period 2 is inactive.

9) Repeat the process for all days and time periods required. note: The defined schedule can be copied to another day.

10) Press ⊗ to return to the "Parcel Schedule" screen.

11) Use the arrows to select **Follow sched**. Press ✅ to check the button ON to ensure that the robot follows the defined schedule. When unchecked, the robot will ignore the timetable and work continuously.

To copy the schedule from one day to another:
1) Follow the procedure above to define the working schedule for one day.
2) When all the required periods have been defined, press ⬇ to highlight **Copy**, then press ✅. The following screen will appear:

```
          COPY

Mon  Tue  Wed  Thu  Fri  Sat  Sun

 ▣    ▢    ▢    ▢    ▢    ▢    ▢

 1    2    3    4    5    6    7
```
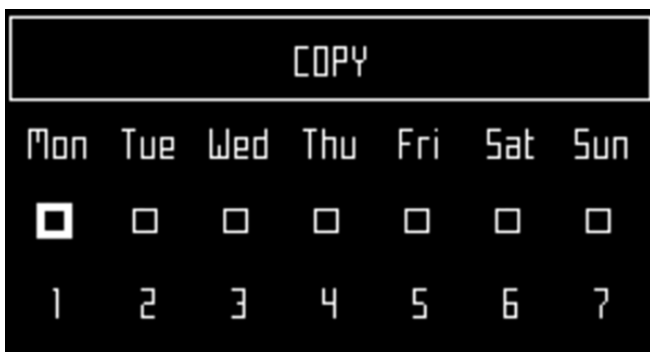
3) Press the number key that corresponds to the day to which the schedule is to be copied (more than one day can be selected).

```
          COPY

Mon  Tue  Wed  Thu  Fri  Sat  Sun

 ▣    ▢    ▢    ▢    ▢    ▣    ▣

 1    2    3    4    5    6    7
```
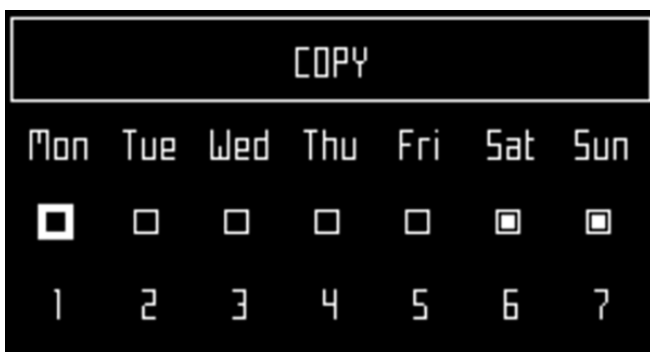
4) Press ⚏.

5) Highlight **Edit**.

6) Press ✅.

7) Use the arrow keys to highlight **Follow sched.** then press ✅ to uncheck the button.

## 8.4.2 Cutting Heads

The robot is supplied with three cutting heads which, under normal conditions, should all be used. When there is a problem with a cutting head, use this menu to disable it.

To enable or disable specific cutting heads:

1) Press ⚏.

2) Press or ⬇ to highlight **Cutting heads**, then press ✅. The following screen appears:

```
    CUTTING HEADS ON/OFF

0 = All
             ②
         ①       ③
```

3) Press the number key(s) that corresponds to the cutting head(s) to enable or disable it. NOTE: Press 0 on the numeric keypad to select all cutting heads.

4) Press ✅.

5) Press ⊗ to return to the main menu.

To enable a disabled cutting head, repeat the procedure above, selecting the disabled head.

## 8.4.3 Cutting Height

Use this command to set the height of the blades.
- lowest cutting height is 0.8 in. (20.0 mm)
- highest cutting height is 4.7 in. (120.0 mm)

The cutting height is adjusted in 0.20 in. (5.0 mm) increments.

To set the cutting height:

1) Press ⚏.

2) Press ⬆ or ⬇ to highlight **Cutting height**, then press ✅. The following screen appears, which shows the current cutting height. NOTE: If this value is negative, a reset of the parameters

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has taken place and the cutting height needs to be re-calibrated.

```
┌─────────────────────────────┐
│        CUTTING HEIGHT       │
├─────────────────────────────┤
│ Current              60 mm  │
│ Set          ◄       65 mm ►│
└─────────────────────────────┘
```

3) Press ▼ to highlight the **Set** value.

4) Use ◄ and ► to scroll to the required value.

```
┌─────────────────────────────┐
│        CUTTING HEIGHT       │
├─────────────────────────────┤
│ Current              60 mm  │
│ Set          ◄       55 mm ►│
└─────────────────────────────┘
```

5) Press ⊗ to return to the main menu.

### 8.4.4 System Locking

Use this command to lock the use of the robot. The command is useful if the field area is in use during the time when the robot is scheduled to be working. The robot will remain locked until the system is unlocked.

NOTE: It is also possible to create PIN code which must be entered before specific commands can be issued.

To lock the system:

1) Press ▤.

2) Press ▲ or ▼ to highlight **System locking**, then press ✓.

3) Highlight **OK**, then press ✓. Enter the robot's PIN code to access the menu again.

To unlock the system:

1) Enter the PIN code, then press ✓. The robot will wait for a new command to be issued.

### 8.4.5 LCD Settings

To modify the LCD settings:

1) Press and hold ▤ for three seconds. The LCD Setting screen will appear.

```
┌─────────────────────────────┐
│         LCD Settings        │
├─────────────────────────────┤
│ Temperature Auto Adj.    ▣  │
│ ◄ ███████████          ░░ ► │
│ 9        Reverse mode       │
│ 0       Factory Settings    │
└─────────────────────────────┘
```
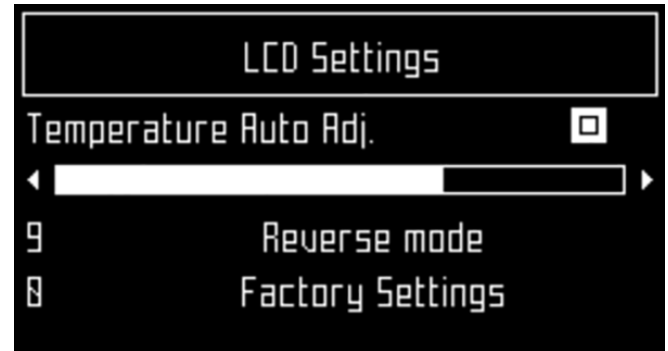
2) Press ◄ or ► to change the contrast.

3) Press ▲ or ▼ to highlight **Temperature Auto Adj.** When this option is checked ON, the LCD contrast is automatically adjusted according to the ambient temperature. Press ✓ to check or uncheck this option.

4) Press the **9** key to invert the black and white colors.

5) Press the **0** key to revert to the factory settings.

6) Press ⊗ to exit the menu.

## 8.5 Service Menu

### 8.5.1 Regional Parameters

Use this menu 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.

6) Press ✓ to accept the language.

7) Press ✗ to exit the menu.

## 8.5.2 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.

## 8.5.3 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 ✓

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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 ✅.

## 8.5.4 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.

## 8.5.5 Device

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



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.

## 8.5.6 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.

**MAC address**

MAC address.

## 8.5.7 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.

## 8.5.8 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 PIN code OFF

Enable PIN code ON

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 ⊘.

## 8.5.9 Geofence

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.
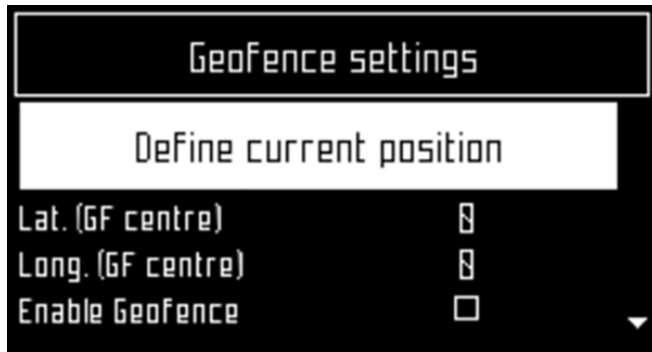


To define and implement a security zone:

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.

# 8.6 Advanced Parameters

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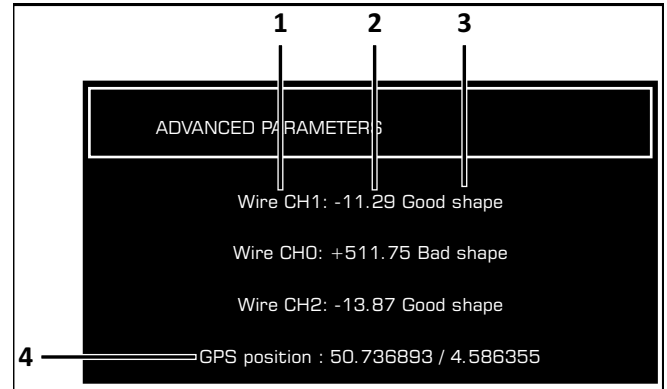


1 – Wire channel numbers (Wire CH#). This is a list of currently defined peripheral wires.

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).

# 8.7 Technician's Menu

Press ⊗ repeatedly until the home screen appears.
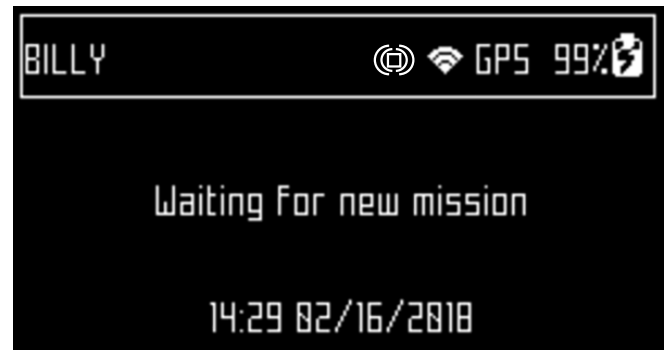


From the Home screen, press and hold **9** on the numeric keypad until the **TECHNICIAN SETTINGS** screen appears.

## 8.7.1 Infrastructure

Use the operations in this menu to configure the robot's installation in the field.

**Peripheral wires**

Use to configure the "Wires Setting" screen.

**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.

Select a wire and press  to see the wire properties.

**Create new wire**

Use to Create a new wire.

## Wire CH#

**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.

## Create New Wire

1) Select Infrastructure > Peripheral wires > Create new wire.
2) Select **OK** to confirm that you want to create the new wire.
3) The new wire and its associated parcel will appear in the wire settings list.
4) Select the new wire and click on .

5) Select the required channel number. Station Loop is always channel 0. Field 1 is always channel 1. Field 2 is always channel 2
6) 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.
7) Click  to exit the menu.

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

## Peripheral 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.

Select a wire and press  to see the Wire properties.

**Create new wire**

Use to Create a new wire.

**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.

**Create a New Wire**

1)    Select Infrastructure > Peripheral wires > Create new wire.

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

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

4)    Select the new wire and click on ✅.

5)    Select the required channel number. Station Loop is always channel 0. Field 1 is always channel 1. Field 2 is always channel 2

6)    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.

7)    Click ❌ to exit the menu.

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

## 8.7.2 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.
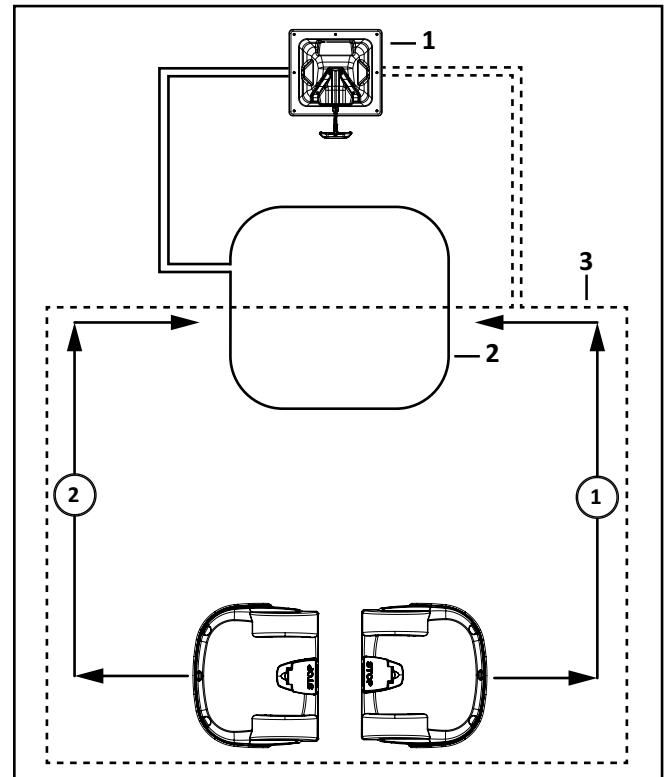


1 – Counterclockwise return direction
2 – Clockwise return direction

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.
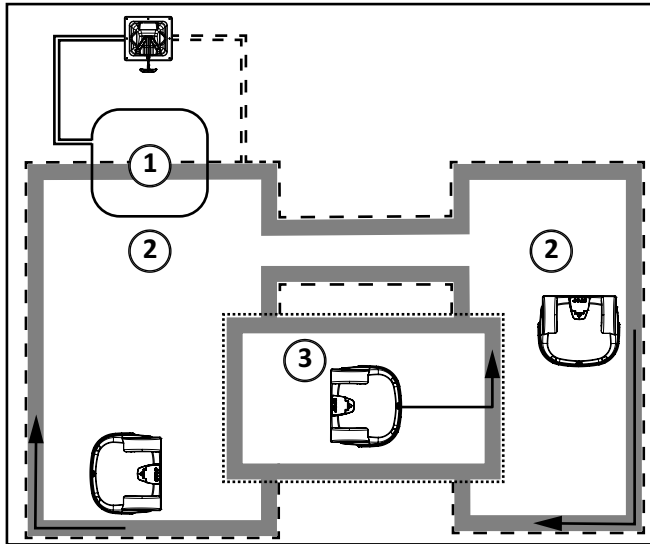


1 – Parcel 1 (area inside station loop wire)
2 – Parcel 2
3 – Parcel 3

## 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°.
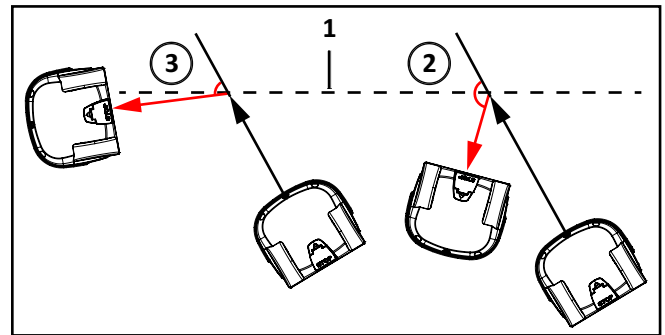


1 – Peripheral wire
2 – Min. Bounce Angle
3 – Max. Bounce Angle

## 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
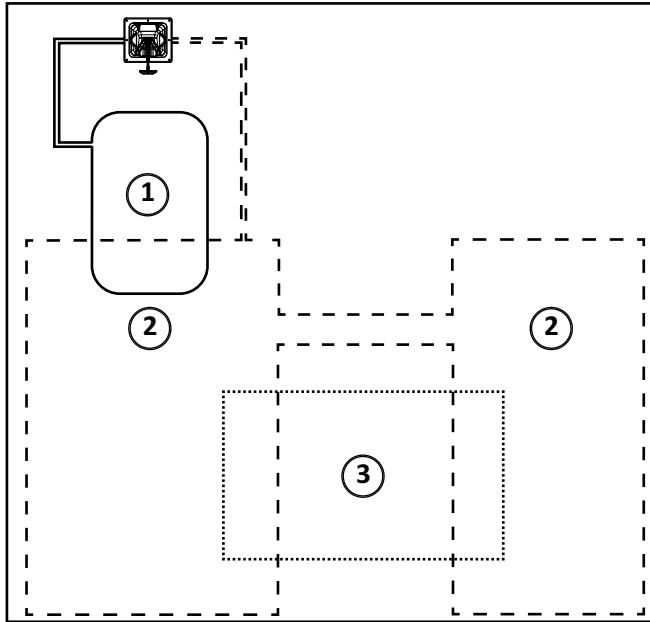


1 – Parcel 1 (area inside station loop wire)

2 – Parcel 2

3 – Parcel 3

### StartZones

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

## 8.7.3 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.

### 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.

## 8.7.4 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.

## 8.7.5 Demonstration

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.

### ⚠ WARNING

#### 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.

## 8.7.6 Service

**Cutting heads**

Use this option to calibrate the rotational speed of the cutting heads.

1) If a cutting head has been modified, or if a new cutting head has been installed, press  to select **Calibrate now**, then press .

2) Close the lid.

3) The cutting heads will be rotated and the rotational speed evaluated.

4) When an audible beep is heard, open the lid and view the results.

5) If any of the heads display a NOK value that is not in line with the others, examine the heads and see if there is any sort of blockage that is preventing the head from rotating normally.

## Cutting height

The cutting height values need to be calibrated if
- erroneous values (negative) values are displayed
- a cutting head has been replaced
- the belt lifting the cutting heads has been modified or replaced

During the calibration procedure the cutting heads are lifted until they reach their maximum height. Their position during this movement is termed the "raw position" and when the maximum height is reached, it is termed the "homing position" and assigned a scalar value. When the homing position has been reached, the cutting heads can be lowered to the required height.

1) To calibrate the cutting height, press ▶ to select **Calibrate now,** then press ✓.
2) The robot will move the cutting heads up to the maximum height. The cutting heads will then be lowered to the required height.
3) When the value is OK, set the required cutting height.
4) If there is a problem, examine the cutting heads and see if there is anything blocking the movement over the complete range.

## Information

### Total distance

This is the total distance (in meters) traveled by the robot to date. Use this information to decide when maintenance is required.

### Bumper resistance

Displays the current value of the bumper resistance. This should lie in the range 82-94 kΩ.

## Tests

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

Use this menu to execute tests on a number of components. These tests 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 Test

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 user interface 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.

## Lift Sensors

This checks whether each of the lift sensors is responding correctly.

### X/Y LIFT_SENSORS

X represents the current test in the current sequence.

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

LIFT_SENSORS is the name of the current test.

### Activate sensors

The lift sensors that need to be tested by activating by lifting (Lift1, Lift2, Lift3, Lift4).

### Disable Sensors

The lift sensors that need to be disabled by depressing them (Lift1, Lift2, Lift3, Lift4).

### To test the Lift Sensors

1) Check which Lift sensors are listed below **Activate sensors**.

2) Lift each of sensors in turn.

3) If the lift sensor is operating correctly, the item will be removed from the list.

4) Repeat for the remaining lift sensors.

5) If there are sensors listed under **Disable Sensors**, push down on the lift sensor to deactivate it.

6) When all the items have been removed from the list the test is complete.

7) Any items that remain in the list are not functioning correctly and need to be replaced.

## Backwards Sensors

This 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 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.

## Cutting Motor

This test rotates each of the cutting heads and verifies that their rotational speed is correct.

If any of the heads display a NOK value that is not in line with the others, you will need to examine those heads and see if there is any sort of blockage that is preventing it from rotating normally.

## 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.

## Software update

This menu enables you 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.

### 8.7.7 Advanced Parameters

**Max speed**

Use this menu to set the maximum speed of the robot. The maximum speed is 2.2 mph (1.0 m/s). This is also the default speed setting for the robot.

**Wire crossing distance**

Use this menu to set the distance the robot will move when it crosses the peripheral wire, before turning back into the field again.

The default value is 8.0 in. (0.2 m). 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: The values of distances between the peripheral wire and boundary of the working area are based on the use of a wire crossing distance of 8.0 in. (0.2 m).

**Min temp**

Sets the lowest temperature at which the robot will operate. The default value is 41.0 ° F (5.0 °C).

NOTE: Mowing at too low a temperature can damage the grass.

## 8.8 Error Messages

Report error messages to your authorized ECHO Robotics Dealer. Always note the date, time, and robot serial number.

| Error Message | Description |
|---|---|
| Battery temperature issue | Battery temperature is above or below the allowed limit. |
| Battery over voltage | One, or more, battery cell voltage is over the limit. |
| Bad battery connection | Internal problem with the battery. |

| Error Message | Description |
|---|---|
| Bad battery measure | Values displayed for the battery on the GUI screen do not correspond to the actual values. |
| BMS communication wire is not connected | BMS (Battery Management System) wire is not connected properly. This refers to the electronic part of the battery. |
| Shutdown in 2 min / inhibit shutdown principal / unblock brakes | GUI (Graphical User Interface) screen displays the alarm- and asks if you want to inhibit the shutdown.<br><br>The LED is blinking very fast (~5x per second).<br><br>The brakes are deactivated.<br><br>Battery charge level is critically low. |
| Some wires not well configured. Please add at least one parcel to each wire | Configuration of wires and parcels is incorrect.<br><br>At least one wire must be defined in the installation configuration, and at least one parcel must be assigned to each wire. |
| No charge current; Check contacts and charging station | Charging station voltage is detected but there is no supply current. |
| The robot has no wire to mow. Please configure at least one wire. | No wire has been configured. |
| The robot has no parcel to mow. Please configure least one parcel. | No parcel has been configured. At least one wire must be configured defining a field to mow, and a parcel must be defined for each wire. |
| No peripheral signal! | Robot is unable to detect a valid magnetic signal. |

| Error Message | Description |
|---|---|
| Station contact lost for {0}s! | Robot has reached the charging station and started to charge, but at a certain time the charging station contact is lost. If the contact loss lasts for more than one hour, this alarm is triggered. |
| Wrong wire and parcels Configuration | Robot has encountered a problem while mowing in a particular parcel. When the robot re-starts it is not sure in which parcel it is located, and where it should start mowing. |
| No station contact detected | The robot has executed the loopstep, but has not made contact with the charge arms after 29 m (by default). |
| Wire Lost during TrackWire! | Robot is following the trackwire and is then unable to detect a signal on the wire. When this happens the robot will rotate 360° in an attempt to detect a phase difference, and then issue this message. |
| Unlock system: bad pin code | "System blocking" is set and must be unblocked by entering a pin code. An incorrect code has been entered. |
| Unable to find the working area | The robot is unable to find a valid magnetic signal. |
| Failed to dock to station | Robot has tried to return to the charging station but failed. |
| Head {0} is blocked! | Occurs when a cutting head should be spinning, but is not |
| Head {0} did not start! | Cutting head should be spinning but it does not start. |
| Motor blocked when going {0} to {1}mm | A command to change the cutting height has been issued, but the cutting head can not move. |
| There is no 12V peripheral for {0} | 12 V power supply does not work properly. |

| Error Message | Description |
|---|---|
| There is no 5V for {0}. | 5 V power supply does not work properly. |
| STOP button issue detected | Stop button is not operating correctly. The Stop button lid must be closed when the robot is operating.<br><br>The Stop button lid is determined to be closed by detecting a closed circuit between magnets on the lid and relays in the body. If these magnets are and relays are not connecting correctly the correct state of the lid can not be determined. This can arise due to wide temperature fluctuations. |
| Unexpected exit zone event | Robot did not exit from the charging station correctly, possibly turning in the wrong direction. |
| The {L/R} fuse is blown or the {L/R} motor is not connected | Robot can not detect any current in either the left or the right wheel motor.<br><br>Either a fuse or a connection is faulty. |
| Failed to consistently re-enter the zone | Robot has crossed the peripheral wire, but is not able to re-enter the field where it is mowing.<br><br>Possible reasons are a loss of signal or the robot is physically unable to re-enter the field because of mud or obstacles. |
| SelfTest failed to clear within 15s | When the robot starts up, it executes a self-test of a range of functions. This error occurs if a failure occurred on any of the functions tested. |
| Unhandled exit zone! | A problem arises as the robot exits the charging station. |

| Error Message | Description |
|---|---|
| Waiting for station contact | Robot is in the charging station and it loses contact. It will wait one hour before generating the alarm. |
| Wait for 5 Seconds of full contact | Contact with the charging station arm has been lost.<br><br>There is insufficient voltage on the charging station arm to charge the robot. |
| Waiting for signal | The signal on the peripheral wire is lost. The robot will wait for a period of 12 hours and then start again - if the signal has been restored. This message appears if the Stop button lid is opened during the 12 hour period.<br><br>There is no signal on the peripheral wire. |
| Noise on bumper | Electrical (background) noise level on the bumper is high enough to impair the proper operation |
| Lift(X) Detected - Front/Rear Left/Right | A cover lift is detected.<br><br>An obstacle has caused the cover to be lifted. |
| Too many repetitive collisions! | A series of repetitive collisions is detected.<br><br>Too many obstacles. |
| Unhandled collision event! | Robot has detected small obstacles in the mowing field, which are not large enough to trigger the operation of the lift sensors. |
| Sonars issue detected | One of the sonar sensors is malfunctioning. |
| Collisions at start-up: {0} | The robot can not resolve a collision at start up.<br><br>There is an obstacle blocking the robot start up. |

| Error Message | Description |
|---|---|
| Collision too close to station ({X}m) | The robot is leaving the charging station. The robot encountered an obstacle (at {X} meters from the charging station), but was unable to move around it because it was too close to the charge arms.<br><br>Obstacle too close to the charging station. |
| DMA Error, on sonars: {0} | A hardware error in the sonar control system. |
| LongCollision ({0}) event detected | either a lift or a backwards sensor has been blocked for at least 10 seconds. |
| Still in collision ({0})!alarm | A maneuver to avoid a collision has failed after one minute. |
| Wait for no collision | Occurs after a collision. The robot moves backwards and then checks if the obstacle is still there. It will then wait until the obstacle has been removed. This message appears while it is waiting. |
| Did not find the zone due to collision ({0}) | Robot has crossed the peripheral wire, but was unable to re-enter the zone to be mowed because of an obstacle. |
| ManualTask shall not complete: MotorDrive is in safety. | Robot did not start. |
| The wire is currently configured to be ignored. | Robot sends a cautionary message before starting work. It can come out of its area and there is a risk it could fall into water |
| Cannot start MotorMow If we are in Alarm/Safety. Check navigation. | Robot was asked to start, but an existing alarm has not been cleared. |

# 8.9 Connecting to Robots

Communication with a robot is available through:

- Direct interaction with the robot. This type of communication refers to the direct operation of the robot using the user interface. There are some instructions which can only be issued using this method of communication.
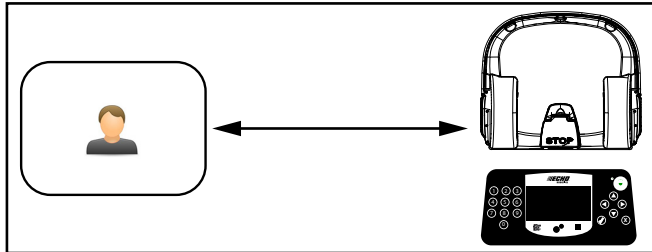


- Direct access using a smartphone, tablet, or personal computer.
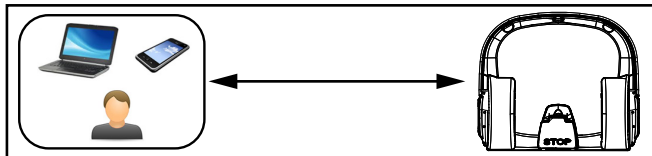


- Remote access via the web server. This method of communication allows a user to connect to the robot using a smartphone, tablet, or personal computer, via a web server using the internet.

- 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.

## 8.9.1 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".
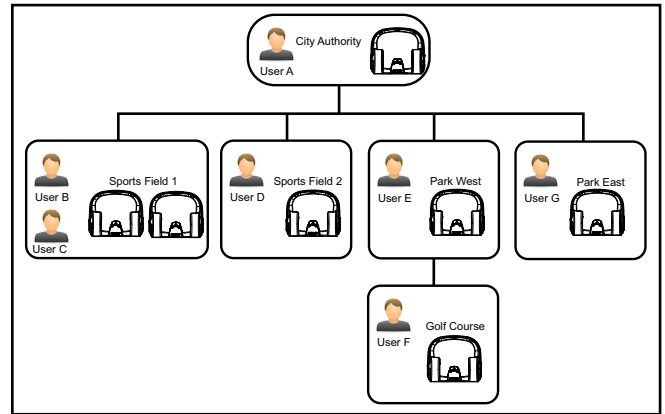


### User Roles

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 thathave 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.

## 8.9.2 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.
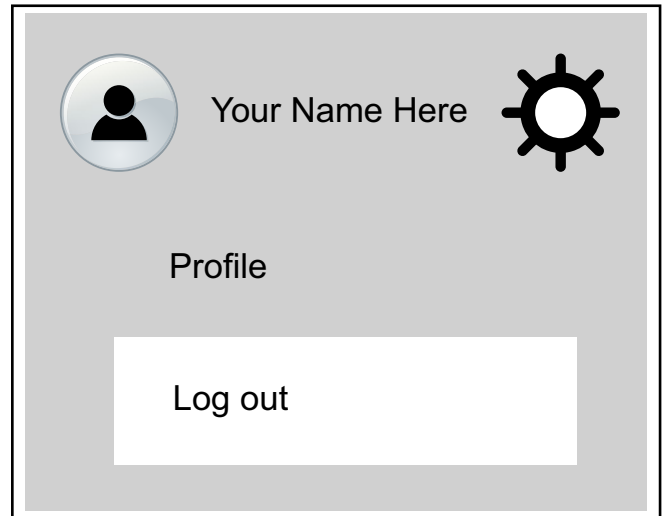


2) Click on **Profile**.

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].

## 8.9.3 My Robots
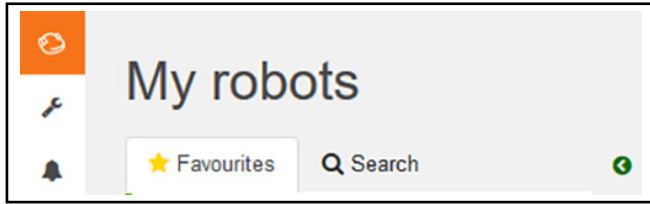


This page enables the user to:

- 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.

## 8.9.4 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.

## 8.9.5 Management

This section allows users 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.
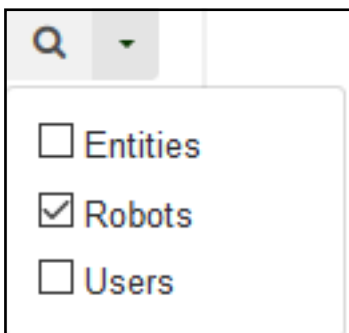


## Managing Entities

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:
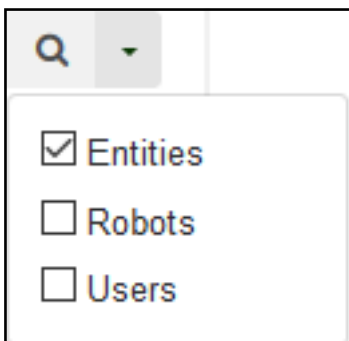


4)  Click .
5)  Click on an entity to see the details.

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.
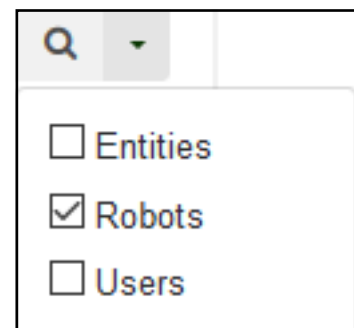
3) Click 🔍. The list of robots and their parent entity will be displayed.

**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 💾 (located on the right hand side of the screen).

**Managing Users**

**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.
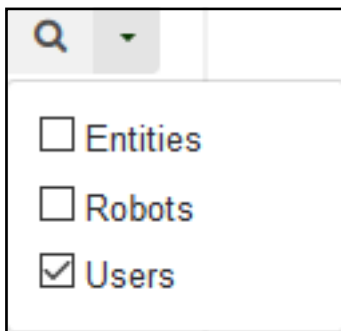


4) Click 🔍. The list of users and their parent entity will be displayed.

**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 💾.

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 💾.

## 8.9.6 Notifications

This section allows the user to set the robot notifications to receive, and the manner in which they will be delivered.
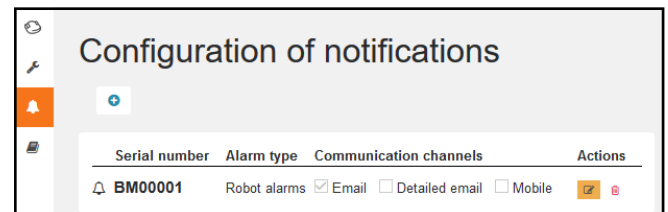


**To Add a New Notification**

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 💾.

**To Modify a Notification**

1) Click 🖉.

2) Modify the notification.

3) Click 💾.

**To Delete a Notification**

1) Click  .

### 8.9.7 Documentation

Provides access to the documentation available.
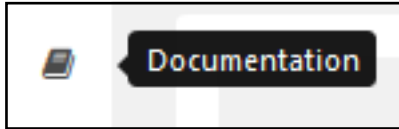


### 8.9.8 Using the Application

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  .

# 9 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.

## 9.1 Maintenance Chart

| Component | Weekly | 6 months | Annual |
|---|---|---|---|
| Cover | Inspect /Clean | | |
| Charge contacts | Clean | | |
| Sonars | Clean | | |
| Coil | Clean | | |
| Bumper | Inspect /Clean | | |
| Chassis | Inspect /Clean | | |
| Electrical cables | | Inspect | |
| Front and rear lift sensors | Inspect /Clean | | |
| Front wheels | Clean | Inspect | |
| Rear wheels | Clean | | |
| Cutting height system | Clean | | |
| Cutting heads | Clean | | |
| Cutting discs | Clean | | |
| Cutting blades | Inspect | Replace | |
| Battery | | | Charge |

## 9.2 Winter Service Check List

| Basic Information | | | |
|---|---|---|---|
| Client | | Technician | |
| Serial number | | Field | |
| Date | | Installation date | |

| Robot Information (record as appropriate) | |
|---|---|
| Software version | |
| Height of cutting heads (mm) | |
| Check history on Myrobot | |

Perform the service tests listed in the following table. Access the user interface and select **Technician's menu > Service > Test**.

| Service Tests (indicate condition as appropriate) | |
| --- | --- |
| Charge | |
| Bumper | |
| Smartbox | |
| Lift Sensors | |
| Backward Sensors | |
| Signal Sensors | |
| Drive Motor (gear motor) | |
| Cutting Motor | |
| Sonar Sensors | |
| Lid (stop button lid) | |
| Complete two cutting height tests: highest and lowest. Check that all cutting heads go to the correct height. | |
| 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, cutting heads, cutting height motors, 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. | |

| Service Inspections (indicate condition as appropriate) | |
| --- | --- |
| Check the integrity of the sonar electrical connectors, clean as necessary. | |
| Clean the charge contacts. | |
| Clean the GUI 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. | |
| Inspect the inside of the cover and the chassis:<br>• cable condition (check for cuts or abrasions)<br>• attachment and routing of cables<br>• cable electrical connections<br>• inspect for corrosion on the chassis<br>• check the JEA40 connector for corrosion<br>• 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. | |

| Service Inspections (indicate condition as appropriate) | |
|---|---|
| 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. | |
| • Cutting heads and cutting system:<br>• cable condition (check for cuts or abrasions)<br>• check the lifting strap<br>• check for moisture in the interior of the cutting motor housing (always replace the top seal when servicing the cutting motor housing)<br>• check for excessive lateral movement of the cutting head upper and lower brackets<br>• verify that the cutting disc spins freely and does not wobble<br>• verify that the anti-friction disc spins freely (this disc must spin independently from the cutting disc). | |
| Inspect the cutting blades, replace if dull, cracked, or chipped. | |
| Inspect the cutting head motor. | |
| Inspect the backwards sensors. | |

| Service Inspections (indicate condition as appropriate) | |
|---|---|
| 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. | |

# 9.3 Maintenance Procedures

## 9.3.1 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.**
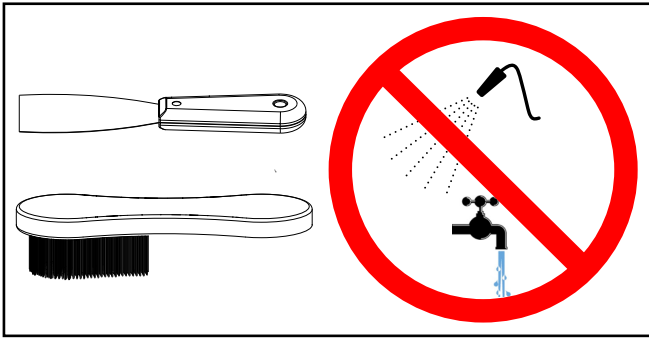


## 9.3.2 Cover and Electrical Cables

1) Clean the outside of the cover.
2) Stand the robot on end. Disconnect the two electrical cables (located in circled area).
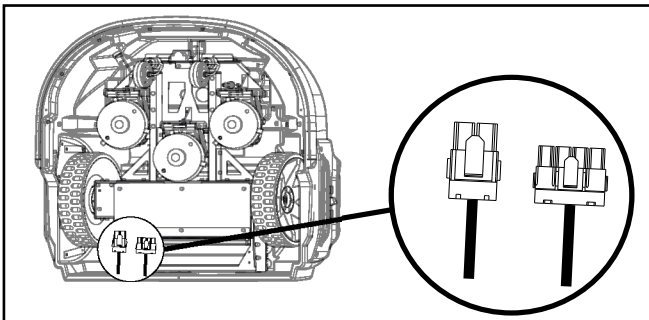


3) Lay the robot back onto flat ground.

4) Remove the front cover screws, rear cover screws, rear washers, and cover.
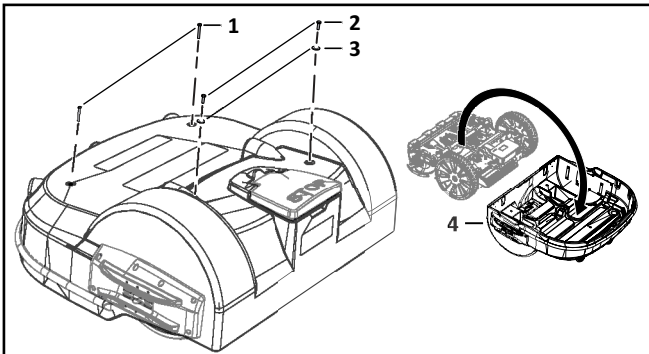


1 – Front cover screw (2X)
2 – Rear cover screw (2X)
3 – Rear washer (2X)
4 – Cover

5) Lift the cover off and turn it over.

6) Clean the inside of the cover, clean all electrical cables.

7) Place the cover onto the chassis.

8) Assemble the cover screws and washers. Tighten the screws to 5 lbf•ft (7 N•m).

9) Stand the robot on end.

10) Connect the electrical cables.

11) Lay the robot back onto flat ground.

## 9.3.3 Charge Contacts

Clean once per week.
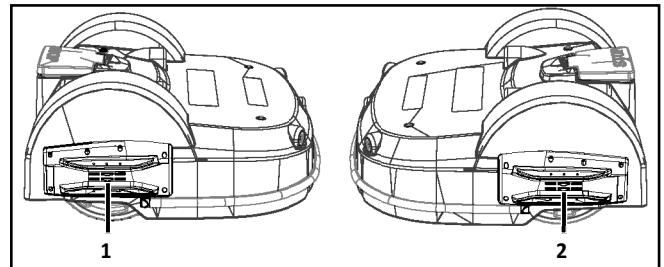


1 – Right side charge contact
2 – Left side charge contact

## 9.3.4 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.
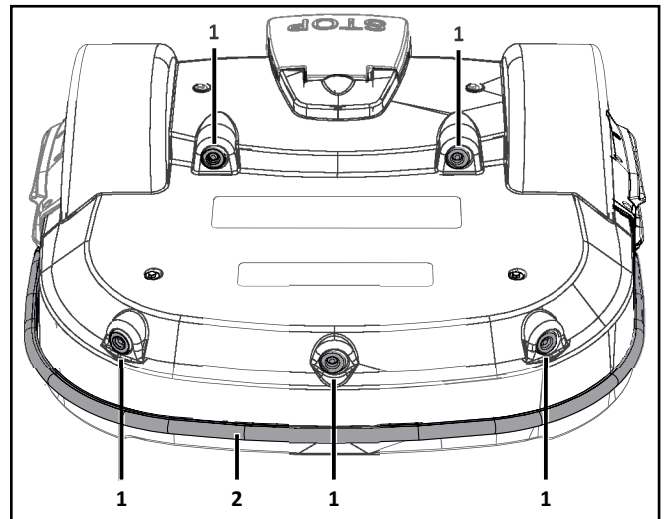


1 – Sonar sensors (5X)
2 – Bumper

## 9.3.5 Coil

Clean once per week.

1) Visually inspect the coil for damage.
2) Inspect the cable. If there are exposed wires, replace the cable.
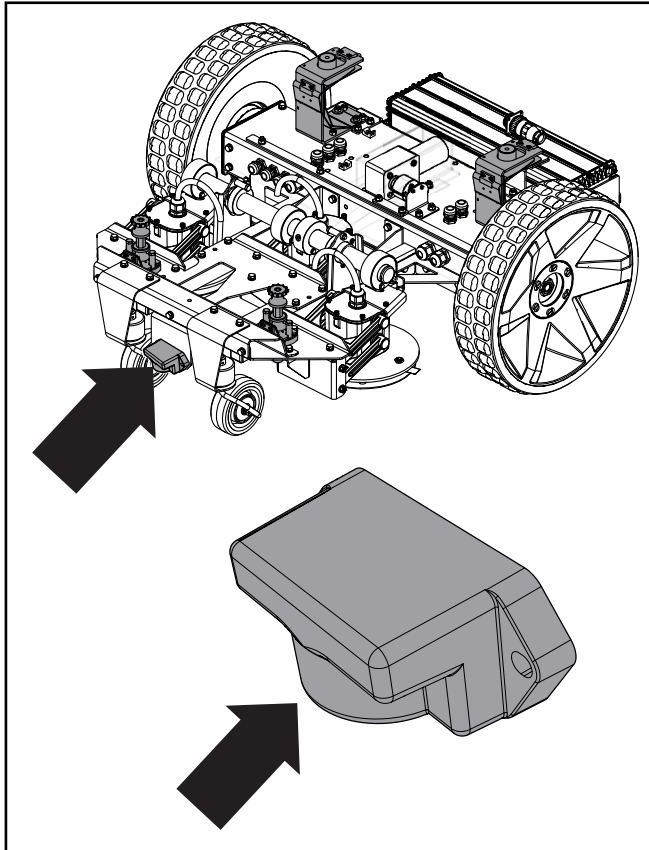


## 9.3.6 Chassis

Clean the chassis once per week.
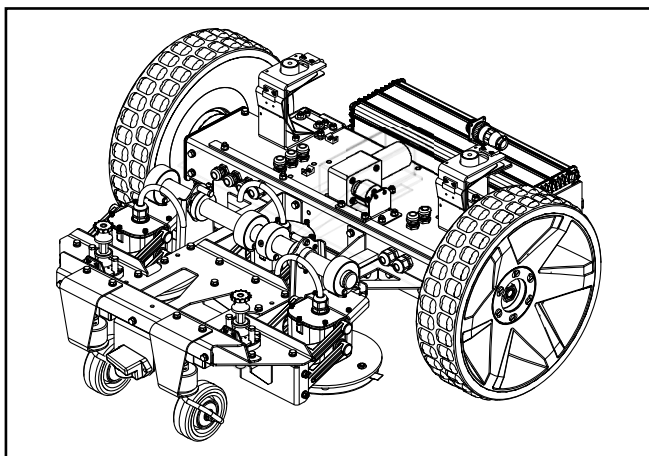


## 9.3.7 Front and Rear Lift Sensors

Clean once per week. Verify that the front lift sensors move up and down with no resistance.
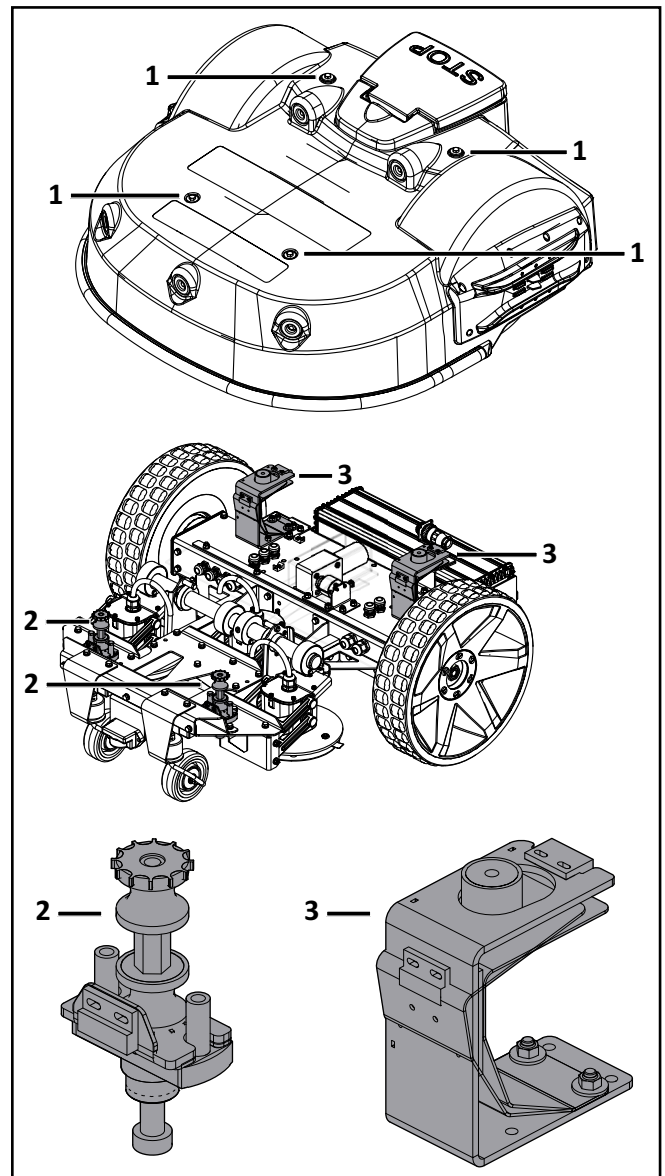


1 – Lift sensor attachment point
2 – Front lift sensor assembly
3 – Rear lift sensor assembly

## 9.3.8 Front Wheel Assemblies

Verify that the wheels (and wheel axle) rotate easily. Clean the front wheel assemblies once per week.
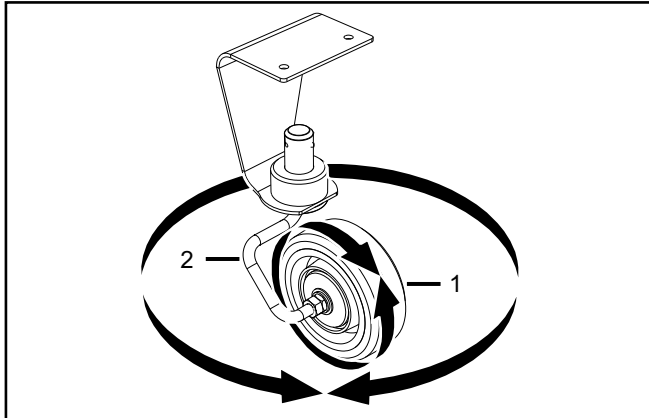


1 – Wheel
2 – Wheel axle

## 9.3.9 Rear Wheels and Rear Wheel Brushes

Clean the rear wheels and rear wheel brushes (if installed) once per week.
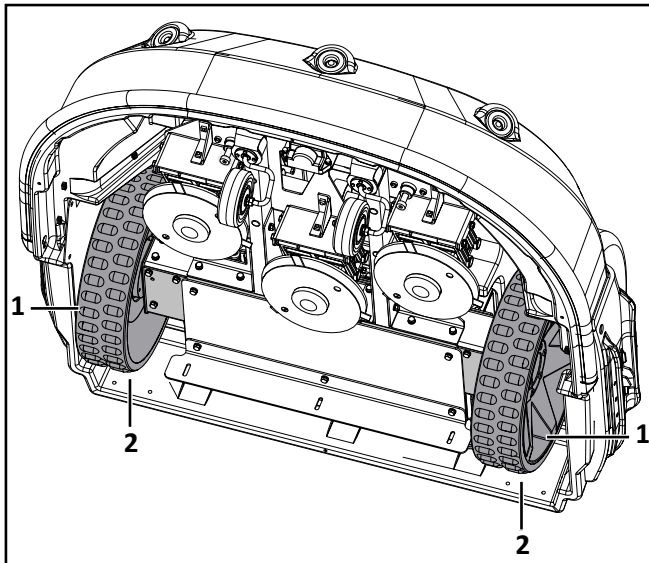


1 – Rear wheel
2 – Wheel brush

## 9.3.10 Cutting Height System

Clean the cutting height system once per week. Rotate the lifting axle by hand and verify that the cutting heads move up and down smoothly.
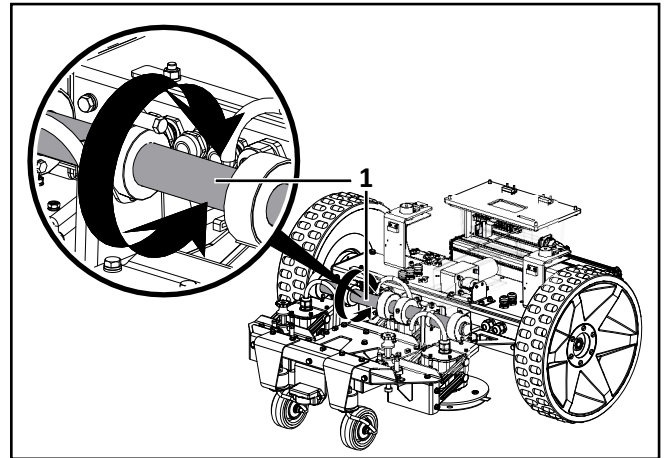


1 – Lifting axle

## 9.3.11 Cutting Heads

### ⚠ CAUTION

**SHARP BLADES**

Contact with cutting blades can result in cutting of fingers or hands.

• Wear protective gloves when handling the robot.

Clean the cutting head assemblies once per week.

Verify that the cutting head assemblies move smoothly up and down and the cutting discs and anti-friction discs rotate freely. The cutting head should not have an excessive amount of lateral movement.
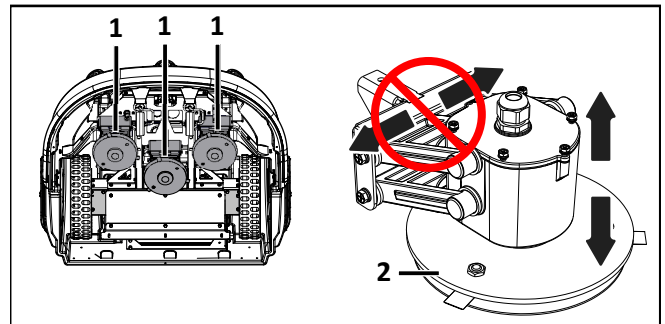


1 – Cutting head assembly
2 – Cutting disc (one per cutting head assembly)

### 9.3.12 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.

# 10 Service Procedures

## ⚠ CAUTION

### SHARP BLADES

Contact with cutting blades can result in cutting of fingers or hands.

- Wear protective gloves when handling the robot.

Follow all on the robot.

Only use an authorized ECHO Robotics dealer for service procedures.

Genuine ECHO Robotics parts and assemblies for ECHO Robotics products are available only from an authorized ECHO Robotics dealer. Always supply a model and serial number when purchasing parts and assemblies.

Move the power switch to the OFF position before starting any service procedures.

## 10.1 Sonar Replacement

1) Remove the cover.
2) Disconnect the sonar cables and push the sonars out of the cover (from inside out).
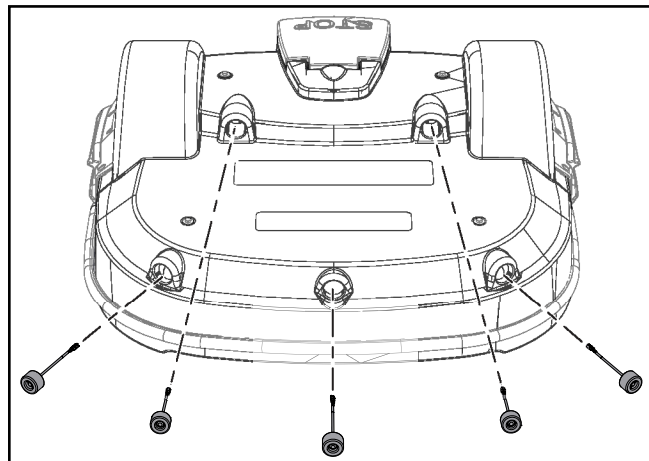


3) Insert and securely seat the replacement sonars into the cover.
4) Connect the sonar cables and replace the cover.
5) Complete the Sonar Sensor Service Test.

## 10.2 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.
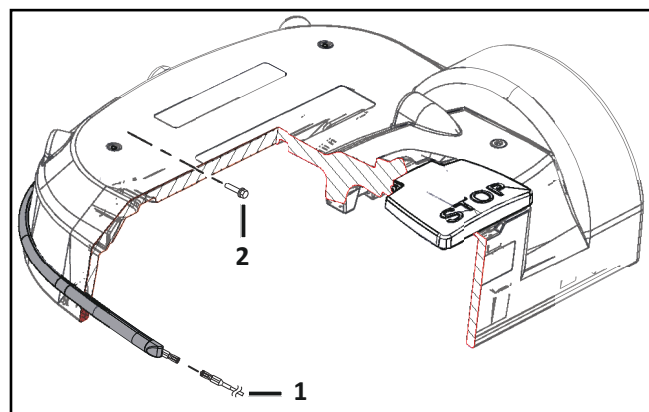


1 – Bumper cable
2 – Bumper retaining screw (11X)

4)      Remove the bumper assembly.
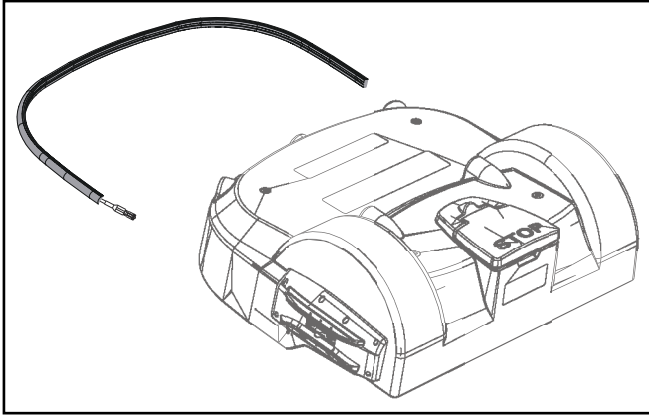


5)      Assemble the new bumper assembly to the cover.

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.

# 10.3 Front Lift Cushion Replacement

NOTE: Detail of left side shown.

1)      Remove the flexible cap and the screw.

2)      Remove the front lift cushion.

3)      Assemble the new front lift cushion in the original location.

4)      Assemble the screw, tighten to 4.5 lbf•ft (6 N•m).

5)      Replace the flexible cap.

6)      Complete the Lift Sensor Service Test.
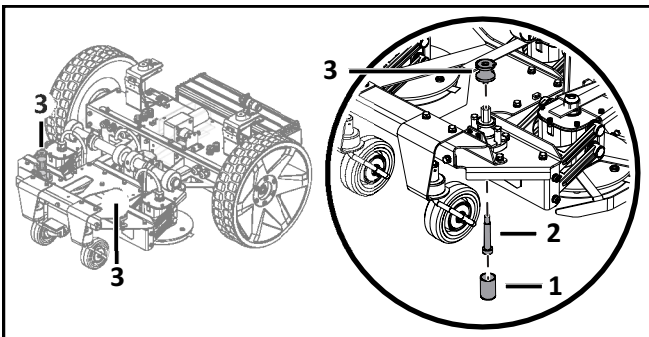


1 – Flexible cap
2 – Screw
3 – Cushion

# 10.4 Rear Lift Cushion Replacement

1)      Remove the cover.

2)      Remove the rear lift cushion.

3)      Assemble the new rear lift cushion.

4)      Complete the Lift Sensor Service Test.
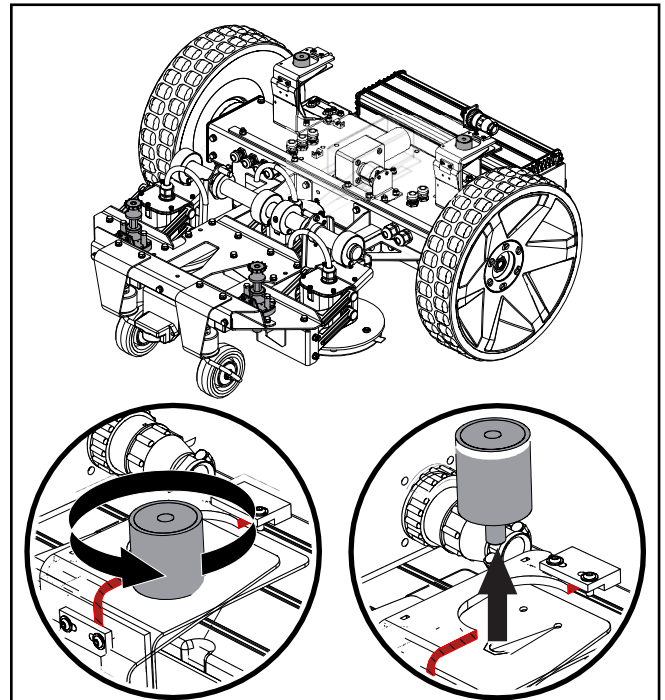


1 – Rear lift cushion

# 10.5 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).
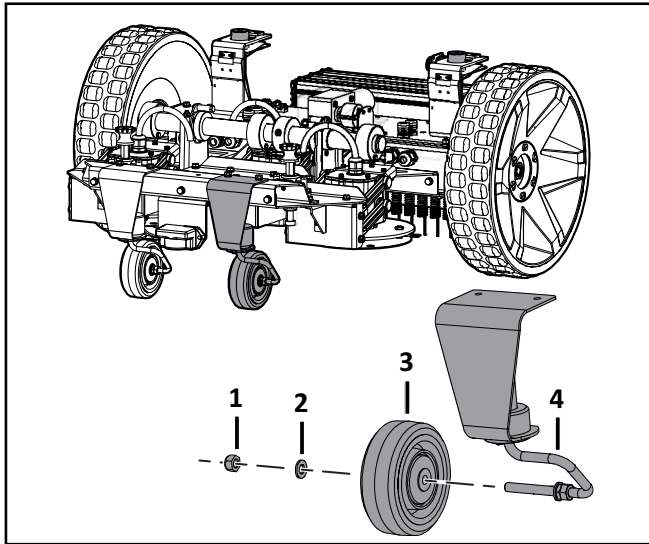


1 – Nut
2 – Washer
3 – Wheel
4 – Axle

## 10.6 Rear Wheel Replacement

1) Remove the cover.

2) Loosen the wheel nut and remove the rear wheel assembly and washers from the gear motor output shaft. Discard the washers. The wheel nut remains captive with the rear wheel assembly.

3) Place new washers on the gear motor output shaft. Do not reuse old washers.

4) 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).
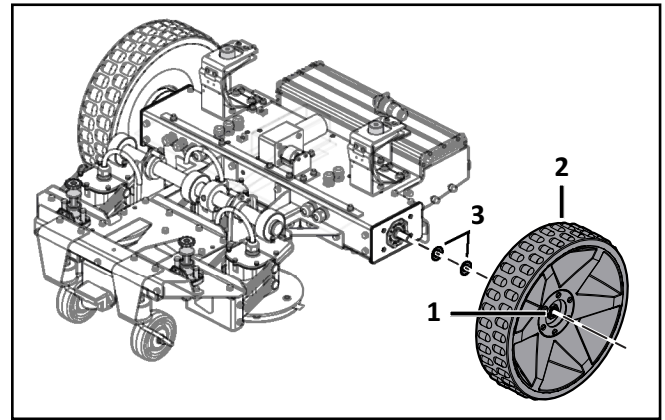


1 – Wheel nut
2 – Wheel assembly
3 – Wave washer

## 10.7 Gear Motor Replacement

Bottom view of robot shown.

1) Remove the rear wheel and washers. Discard the washers.

2) Remove the six screws and cover from the electrical box.
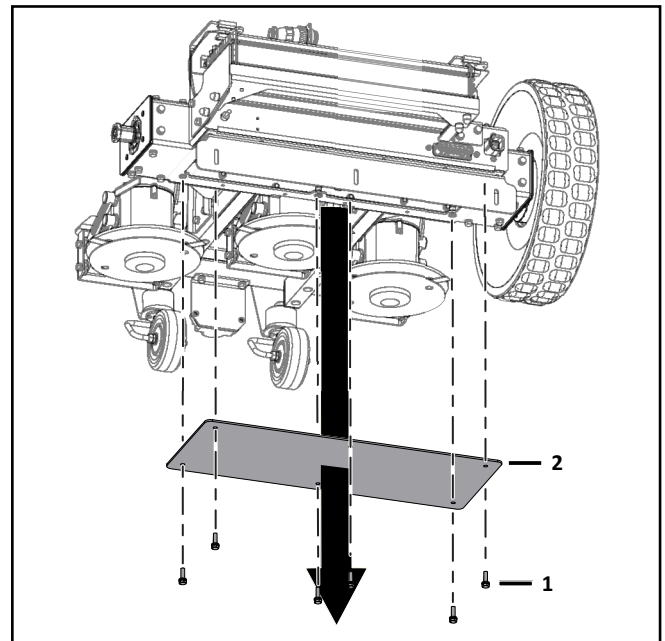


1 – Screw
2 – Cover

3) Disconnect the gear motor cables from the traction drive card.

4) Remove the six bolts from the gear motor support.
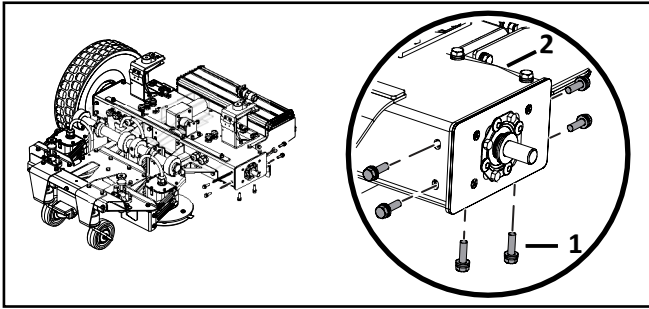
1 – Bolt
2 – Gear motor support

5)  Remove the gear motor assembly.
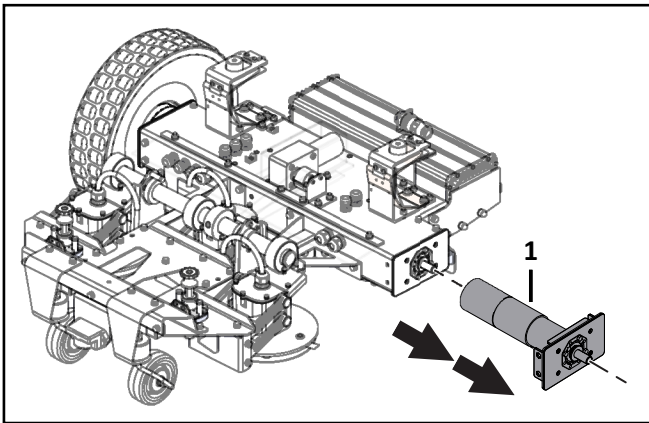


1 – Gear motor assembly

6)  Remove the four screws from the gear motor, then remove the c-clip from the output shaft. Remove the gear motor from the bracket assembly.
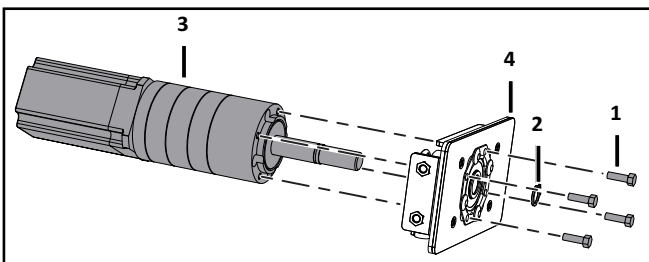


1 – Screw
2 – C-clip
3 – Gear motor
4 – Bracket assembly

7)  Place new motor into the bracket assembly. Assemble the four mounting bolts, tighten to 4.5 lbf•ft (6 N•m). Replace the clip on the output shaft.

8)  Use compressed air to remove any moisture from the inside of the electrical box.

9)  Place the new motor and bracket assembly into the electrical box.

10)  Assemble the six bolts to the gear motor support.

11)  Reconnect the gear motor cables to the traction drive card.

12)  Assemble the electrical box cover onto the electrical box.

13)  Place new washers on the gear motor output shaft. Do not reuse old washers.

14)  Assemble the rear wheel.

15)  Complete the Drive Motor Service Test.

# 10.8 Battery Removal and Installation

**Removal:**

1)  Stand the robot on end. Disconnect the two electrical cables (located in circled area).
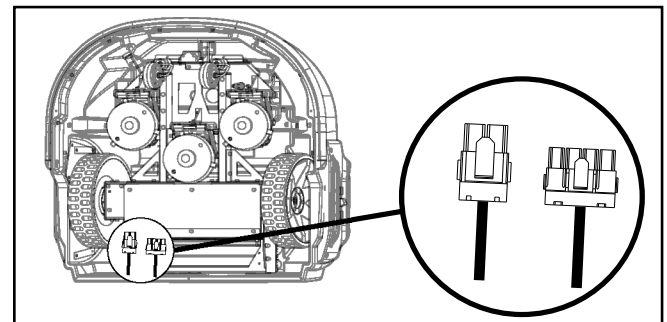


2)  Lay the robot back onto flat ground.

3)  Remove the front cover screws, rear cover screws, rear washers, and cover.
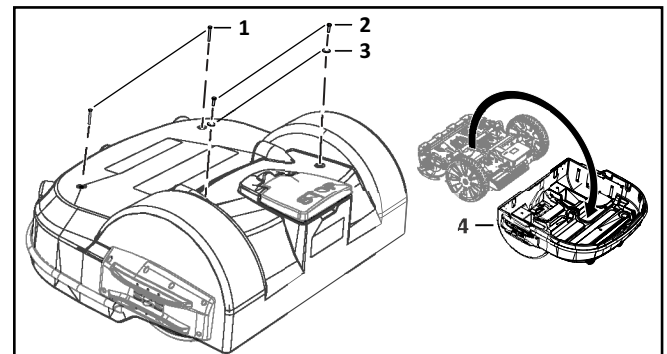


1 – Front cover screw (2X)
2 – Rear cover screw (2X)
3 – Rear washer (2X)
4 – Cover

4)  Disconnect the battery cables from the battery.

5)    Remove the battery.

**Installation:**

1)    Place the new battery in the robot.

2)    Connect the battery cable to the battery.

3)    Place the cover on the robot.

4)    Assemble the cover screws and washers. Tighten screws to 5 lbf• ft (7 N•m).

5)    Stand the robot on end.

6)    Re-connect the two electrical cables.

7)    Lay the robot back onto flat ground.

8)    Complete the Charge Service Test.

# 10.9 Cutting Disk Service

⚠ **CAUTION**

## SHARP BLADES

Contact with cutting blades can result in cutting of fingers or hands.

•    Wear protective gloves when handling the robot.

1)    Rotate the cutting head so the retention screw aligns with the slot in the guard. Loosen the retention screw to remove the cutting head.
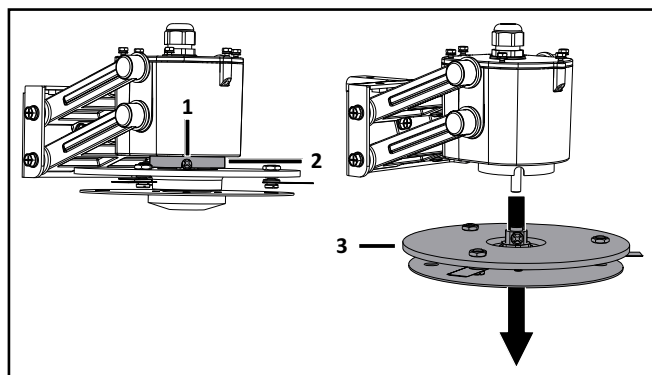


1 – Retention screw
2 – Guard
3 – Cutting head

2)    Remove the retention screw, nut, and washer from the cutter shaft. Separate the two discs.



1 – Retention screw
2 – Nut
3 – Washer
4 – Cutter shaft

# 10.10 Blade Replacement

1)    Remove the blades from the upper cutting disc. Replace the blades, tighten the screws to 1.5 lbf•ft (2 N•m).
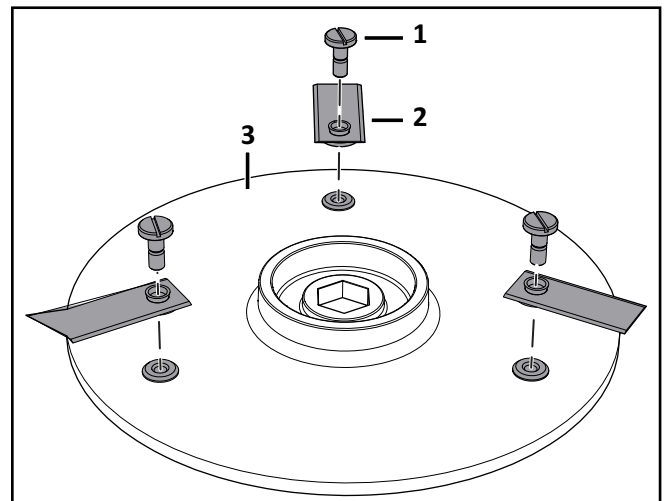


1 – Screw
2 – Blade
3 – Upper cutting disc

# 10.11 Aluminum Anti-friction Disc Replacement

1)   Remove the four screws from the cap, then remove the cutter shaft, collar, and cap.
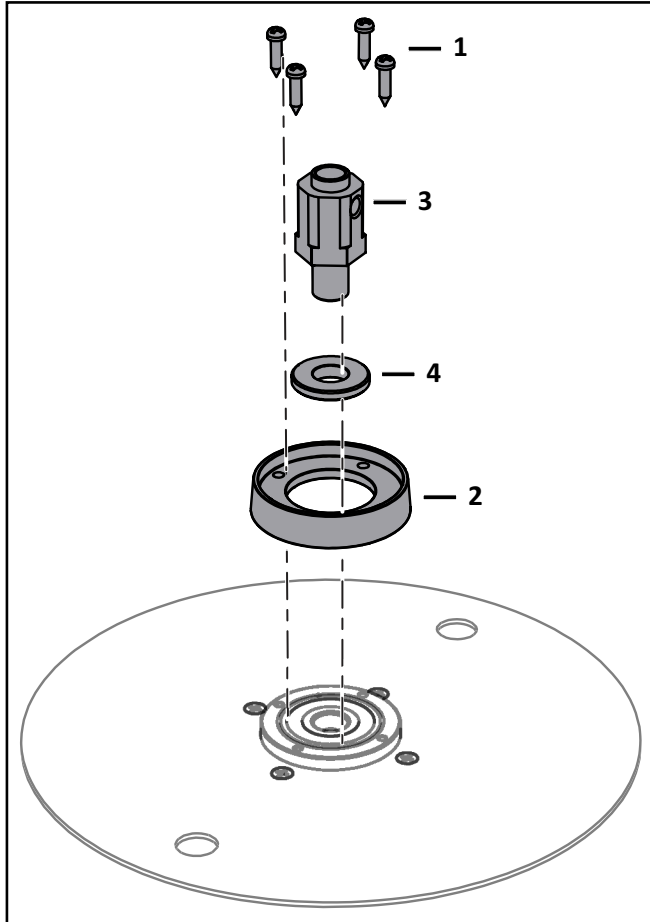


1 – Screw
2 – Cap
3 – Cutter shaft
4 – Collar

2)   Place the new disc on a flat surface.

3)   Assemble the cap to the disc using the four screws.

4)   Securely seat the collar into the cap.

5)   Securely seat the cutter shaft into the disc.

# 10.12 Cutting Head Reassembly

1)   Place the cutting disc onto the anti-friction disc.

2)   Assemble the washer and nut onto the cutter shaft, tighten the nut to 15 lbf•ft (20 N•m).

3)   Assemble the screw to the cutter shaft.
NOTE: Do not allow the screw to extend into the center of the cutter shaft.
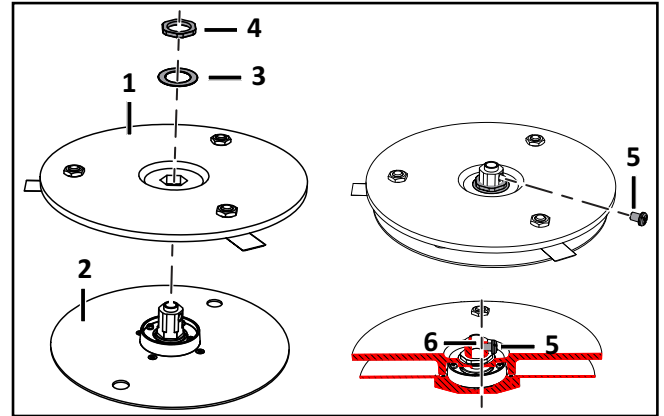


1 – Cutting disc
2 – Anti-friction disc
3 – Washer
4 – Nut
5 – Screw
6 – Center of cutter shaft

4)   Place the assembled cutting head back onto the cutting head axle. NOTE: Align the screw with the flat surface of the cutting head axle.

5)   Tighten the screw to 4.5 lbf•ft (6 N•m).
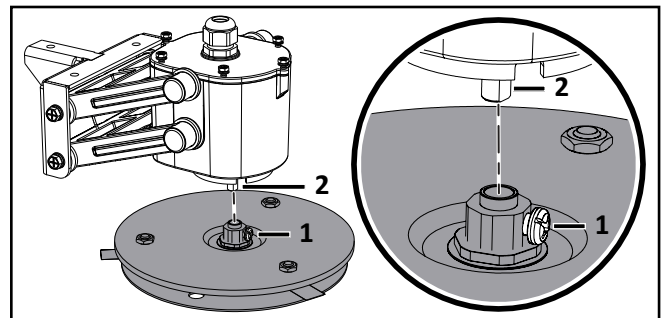


1 – Screw
2 – Flat surface of cutting head axle

# 10.13 Cutting Motor Service

1) Remove the screws, bracket, cap, and gasket from the motor case. NOTE: Slowly lift the cap off from the motor case. Do not pull the wiring.

2) Inspect the interior of the motor case the cutting drive card for condensation or water accumulation. Use compressed air to dry as necessary.

3) Reassemble the gasket, cover, bracket, and screws to the motor case. Tighten the screws to 1.0 lbf•ft (1.5 N•m).
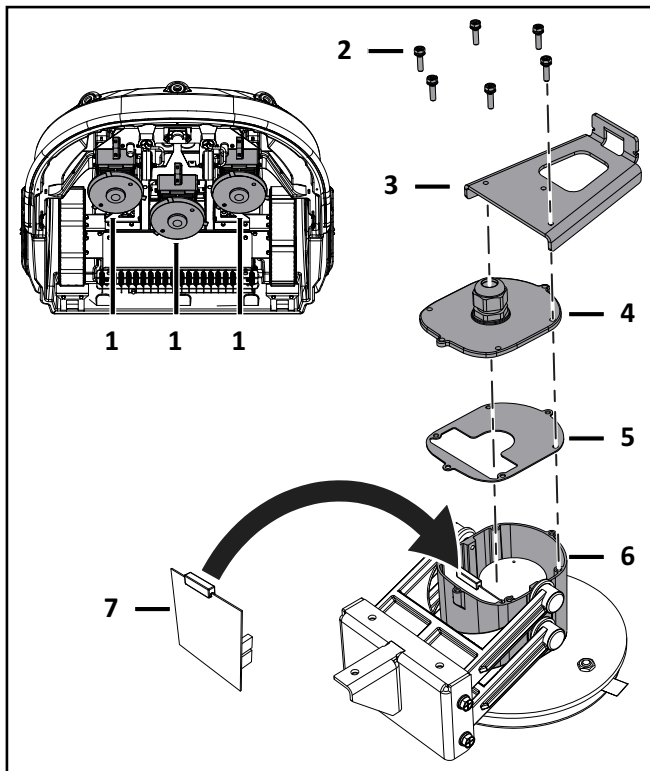


1 – Cutting head assembly on robot
2 – Screw
3 – Bracket
4 – Cap
5 – Gasket
6 – Motor case
7 – Cutting drive card (located in motor case)

4) Complete the Cutting Motor Service Test.

## 10.13.1 Cutting Motor Cable Replacement

1) Visually inspect the cables for cuts or abrasions.

2) Replace damaged cables.

3) Replace cable retention clips if necessary.

# 10.14 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.
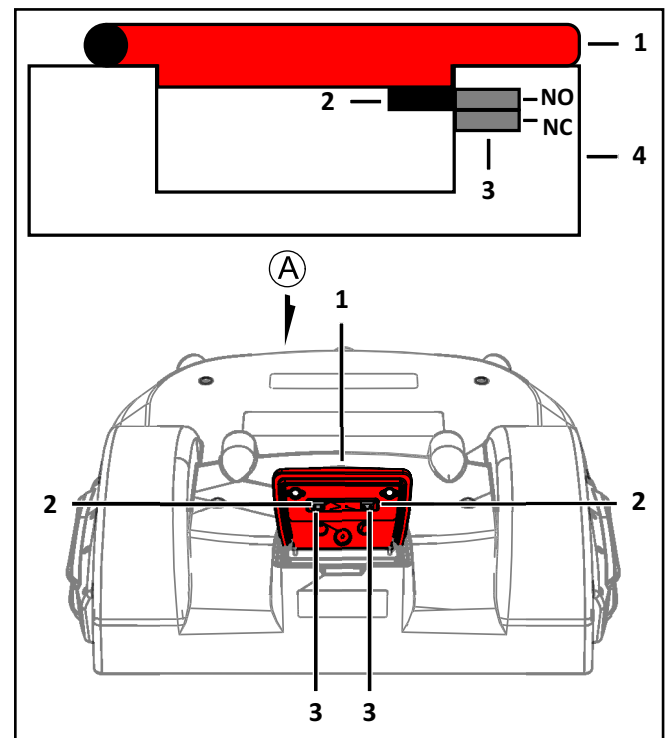


1 – Stop button lid
2 – Magnet
3 – Relays
4 – Body (cover of robot)

One relay is "Normally Open" (NO), the other is "Normally Closed" (NC). The circuit is shown below.
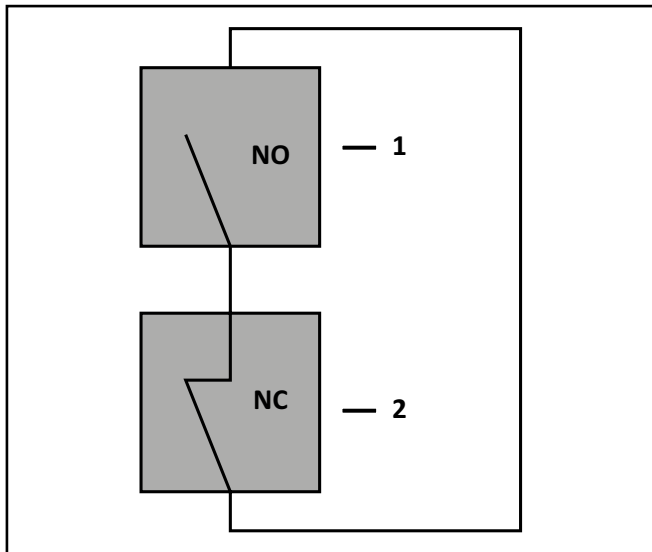


1 – Relay (NO - normally open)

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.

## 10.14.1 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.
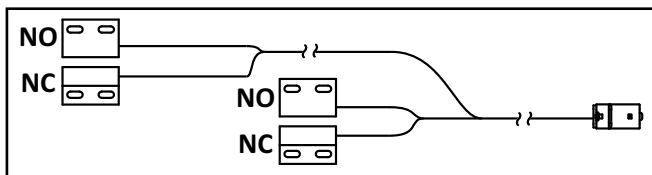


When installing replacement magnets and relays, visually examine the position to ensure correct alignment. Run the service test to ensure the relays correctly align to the magnets. Select **Service > Tests > Lid** from the service menu.

## 10.14.2 Magnets

Assemble the magnets to the lid at the positions shown in the figure below.
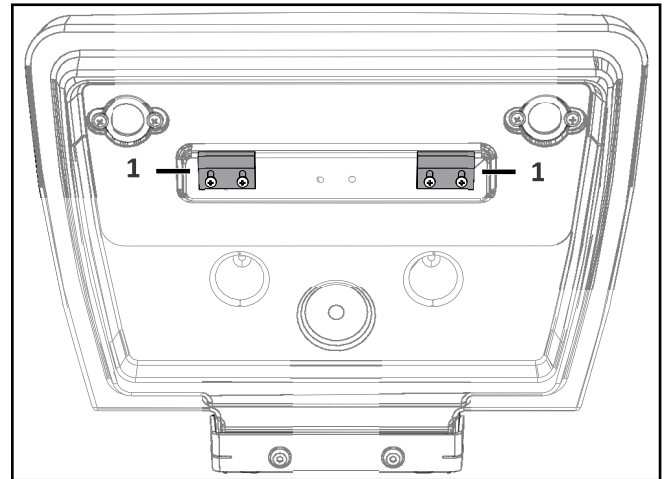


1 – Magnets

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.

# 11 Robot Accessories

## 11.1 Wheel Brush Kit

Assemble the wheel brush kit to the inside rear of the cover behind each rear wheel.

1) Assemble the wheel brush to the brush holder.
2) Assemble the brush holder to the inside rear of the cover behind each rear wheel.
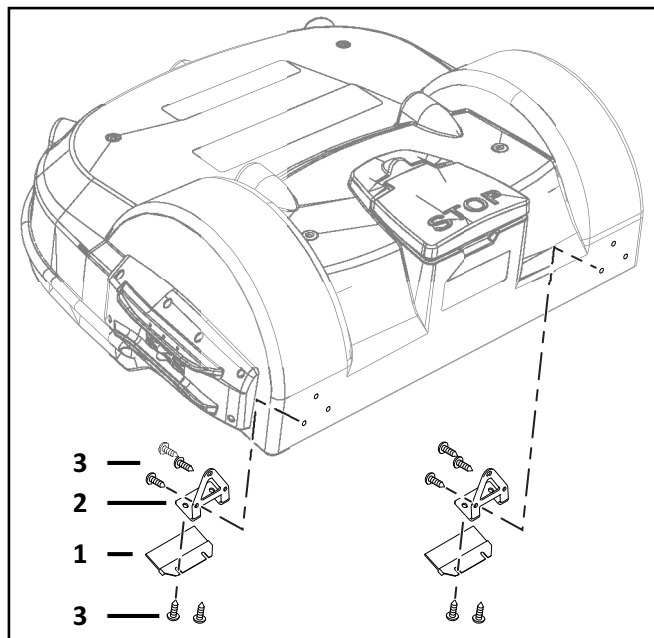


1 – Wheel brush
2 – Brush holder
3 – Screw M6 x 16 (10X)

## 11.2 Groomer Kit

Assemble the groomer kit to the rear guard of the robot. The rear guard is factory assembled to the bottom of the robot's chassis.

1) Assemble the springs to the support bar.
2) Assemble the groomer support to the rear guard.
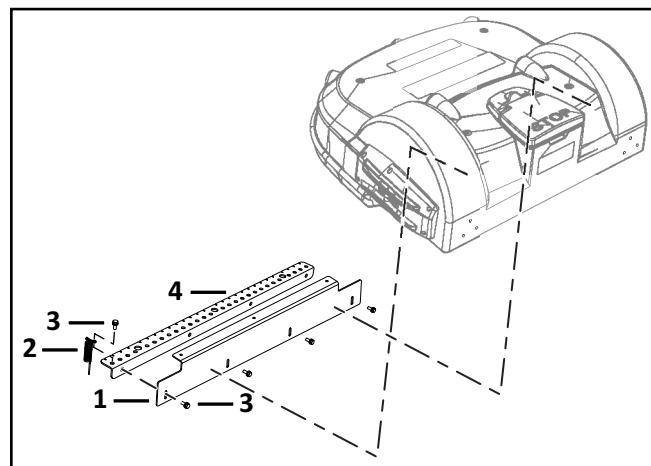


1 – Rear guard plate
2 – Springs (28X)
3 – Screw M6 x 16 (32X)
4 – Groomer support

# 12 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 |

# 12.1 Mower Body

**<1 lbf·ft
(<0.7 N·m)**

**1.5 lbf·ft
(2 N·m)**

**<1 lbf·ft
(<0.7 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)†**

**5 lbf·ft
(7 N·m)**

Ⓑ

Ⓐ  Ⓐ

Ⓑ

**1.5 lbf·ft
(2 N·m)**

Ⓑ

Ⓑ

**1.5 lbf·ft
(2 N·m)†**

**<1 lbf·ft
(<0.7 N·m)**

†**Loctite 243
Blue Threadlocker**

††**Loctite 2701
Green Threadlocker**

# 12.2 Cutting Height

18 lbf·ft
(3 N·m)

18 lbf·ft
(3 N·m)

1 lbf·ft
(1.5 N·m)

2 lbf·ft
(3 N·m)

Ⓑ

Ⓐ

Ⓐ

Ⓐ

Ⓐ

Ⓑ

Ⓑ

Ⓐ

Ⓒ

Ⓒ

Ⓓ

9 lbf·ft
(12 N·m)

4.5 lbf·ft
(6 N·m)†

9 lbf·ft
(12 N·m)

2 lbf·ft
(3 N·m)

1-1.5 lbf·ft
(1.5-2 N·m)

1 lbf·ft
(1.5 N·m)

1 lbf·ft
(1.5 N·m)

1 lbf·ft
(1.5 N·m)

1-1.5 lbf·ft
(1.5-2 N·m)

Ⓒ

Ⓓ

1 lbf·ft
(1.5 N·m)†

0.7 - 1.5 lbf·ft
(1 - 2 N·m)

9 lbf·ft
(12 N·m)

1 lbf·ft
(1.5 N·m)†

†Loctite 243
 Blue Threadlocker

††Loctite 2701
 Green Threadlocker

## 12.3 Electrical Box, Battery, and Housing

2 lbf·ft
(3 N·m)

2 lbf·ft
(3 N·m)

<0.7 lbf·ft
(<1 N·m)†

2 lbf·ft
(3 N·m)

2 lbf·ft
(3 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)†

11 lbf·ft
(15 N·m)†

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)

2 lbf·ft
(3 N·m)
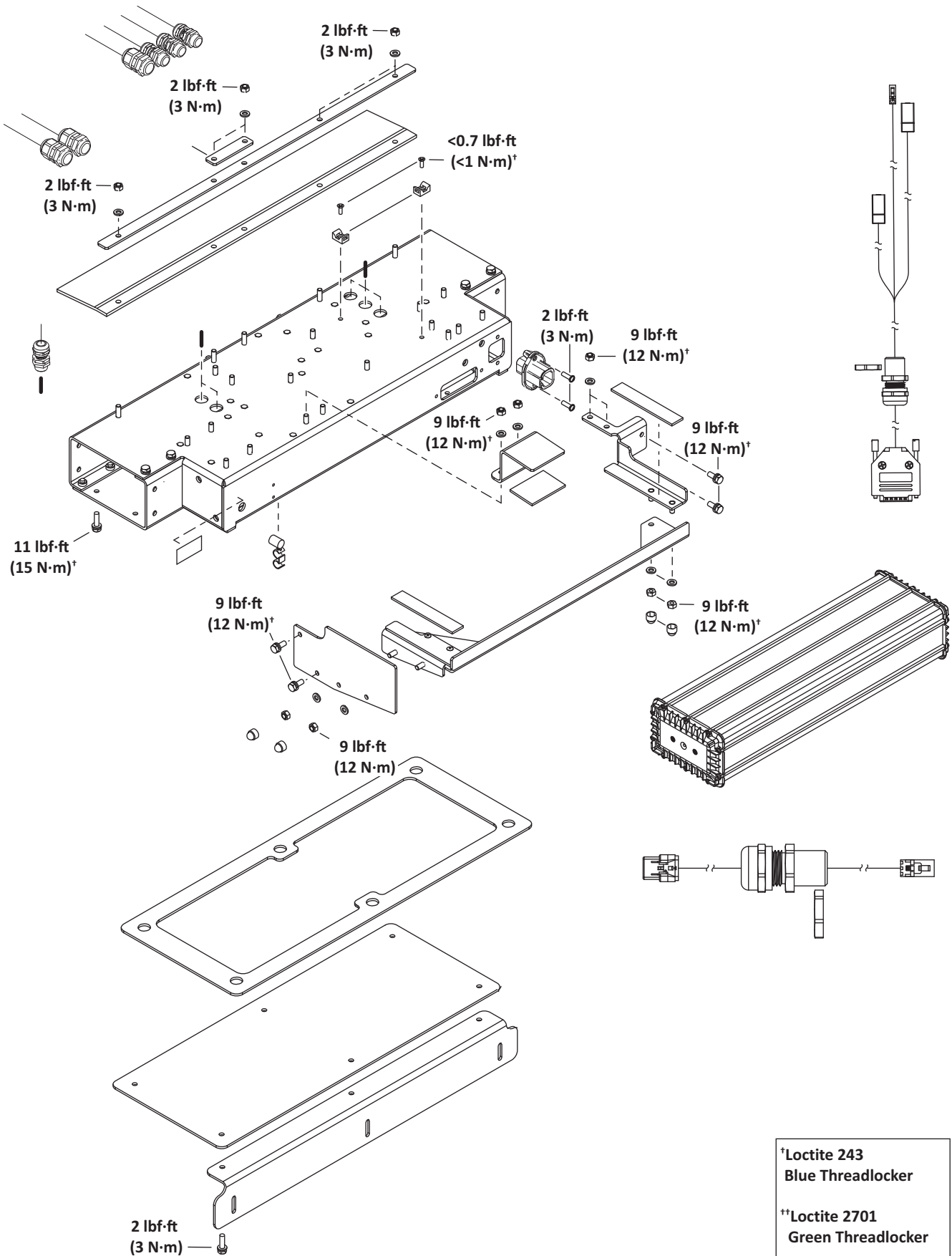
†Loctite 243
 Blue Threadlocker

††Loctite 2701
 Green Threadlocker

# 12.4 Lift Sensors

**2 lbf·ft (3 N·m)†**

**2 lbf·ft (3 N·m)††**

**1 lbf·ft (1.5 N·m)†**

**4.5 lbf·ft (6 N·m)†**

**0.7-1.0 lbf·ft (1-1.5 N·m)†**

**0.7-1.0 lbf·ft (1-1.5 N·m)†**

**9 lbf·ft (12 N·m)**

**1 lbf·ft (1.5 N·m)†**

†**Loctite 243 Blue Threadlocker**

††**Loctite 2701 Green Threadlocker**
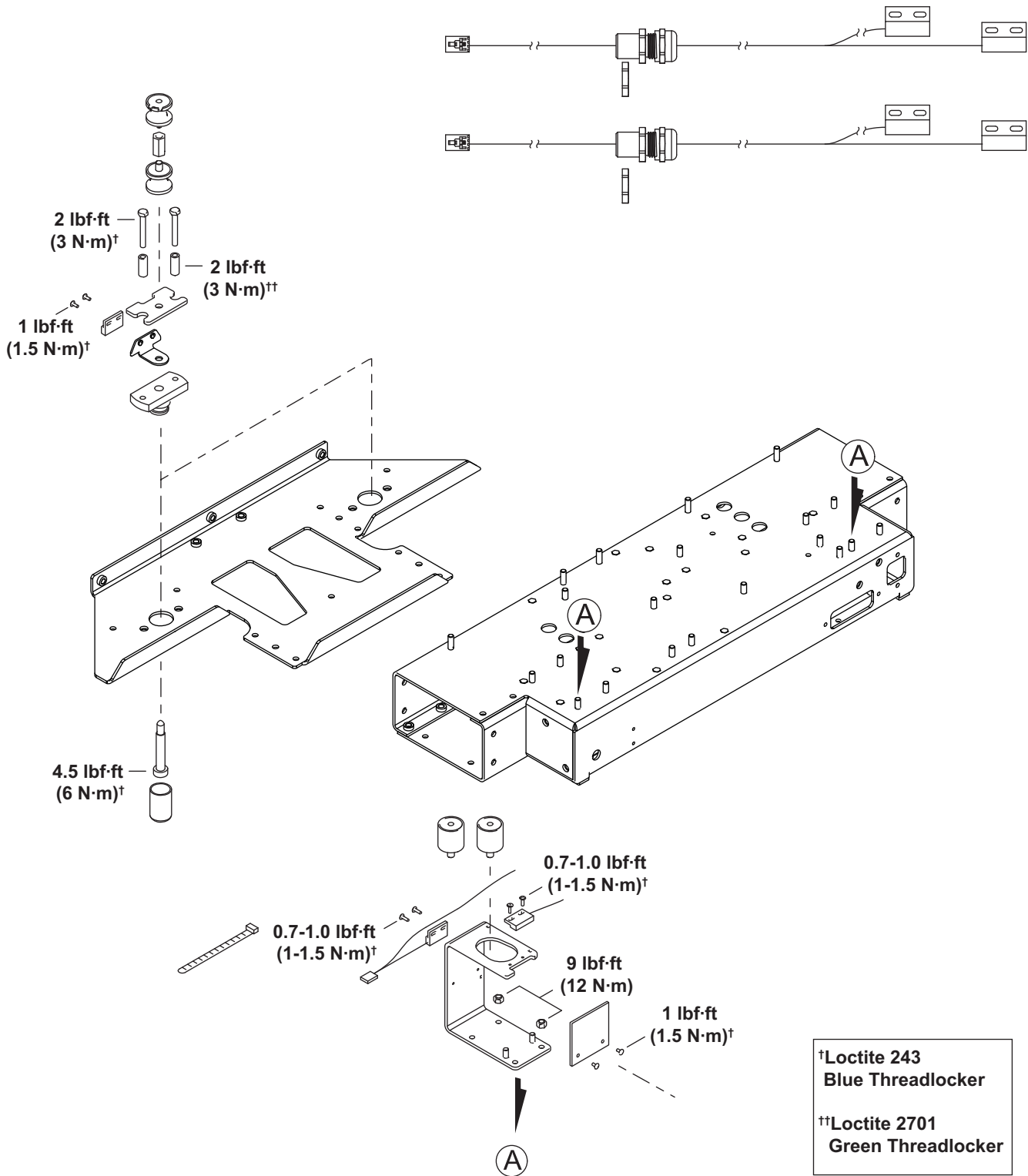
# 12.5 Wheels, Motor and Gear Box

**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)**

**2 lbf·ft
(3 N·m)†**

**4.5 lbf·ft
(6 N·m)††**

**4.5 lbf·ft
(6 N·m)†**

**4.5 lbf·ft
(6 N·m)†**

†**Loctite 243
Blue Threadlocker**

††**Loctite 2701
Green Threadlocker**

# 12.6 Cutting Head

1.0-1.5 lbf·ft
(1.5-2.0 N·m)

**A**

1.5 lbf·ft
(2 N·m)†

1.5 lbf·ft
(2 N·m)†

4.5 lbf·ft
(6 N·m)†

15 lbf·ft
(20 N·m)†

4.5 lbf·ft
(6 N·m)††

9 lbf·ft
(12 N·m)†

4.5-6.0 lbf·ft
(6-8 N·m)

3.7-5.0 lbf·ft
(5-7 N·m)†

0.75-1.5 lbf·ft
(1-2 N·m)

4.5-6.0 lbf·ft
(6-8 N·m)†

3.7-5.0 lbf·ft
(5-7 N·m)†

3.5-5.0 lbf·ft
(5-7 N·m)†

4.5-6.0 lbf·ft
(6-8 N·m)†

**A**

†Loctite 243
 Blue Threadlocker

††Loctite 2701
 Green Threadlocker

# 12.7 Electrical Parts

1 lbf·ft
(1.5 N·m)†

2 lbf·ft
(3 N·m)

**B**

1 lbf·ft
(1.5 N·m)

View A

**B**

†**Loctite 243**
 **Blue Threadlocker**

††**Loctite 2701**
 **Green Threadlocker**

View A

# 12.8 Main Frame

**1 lbf·ft
(1.5 N·m)†**

**9 lbf·ft
(12 N·m)†**

**1 lbf·ft
(1.5 N·m)†**

**9 lbf·ft
(12 N·m)†**

**9 lbf·ft
(12 N·m)†**

**4.5 lbf·ft
(6 N·m)†**

**9 lbf·ft
(12 N·m)†**

†**Loctite 243
Blue Threadlocker**

††**Loctite 2701
Green Threadlocker**

# 12.9 Main Bars

4.5 lbf·ft
(6 N·m)††

4.5 lbf·ft
(6 N·m)†

1 lbf·ft
(1.5 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)†

4.5 lbf·ft
(6 N·m)†

4.5 lbf·ft
(6 N·m)††

1 lbf·ft
(1.5 N·m)†

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

# 12.10 Accessories

†**Loctite 243**
 **Blue Threadlocker**

††**Loctite 2701**
 **Green Threadlocker**

A

A

**5 lbf·ft**
**(7 N·m)**†

**4.5 lbf·ft**
**(6 N·m)**

**9 lbf·ft**
**(12 N·m)**†

# 12.11 Cover and Chassis

11 lbf·ft
(15 N·m)

STOP

2.25 lbf·ft
(3 N·m)

1 lbf·ft
(1.5 N·m)†

11 lbf·ft
(15 N·m)

1 lbf·ft
(1.5 N·m)

4.5 lbf·ft
(6 N·m)†

48 lbf·ft
(65 N·m)†

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)

5 lbf·ft
(7 N·m)

†Loctite 243
 Blue Threadlocker

††Loctite 2701
 Green Threadlocker

A - Rear View

B - Bottom View



2.2 lbf·ft
(3 N·m)

2.2 lbf·ft
(3 N·m)

7.5 lbf·ft
(10 N·m)

4.5 lbf·ft
(6 N·m)

4.5 lbf·ft
(6 N·m)

## 12.12 Gear Motor, Cutting Head, and Front Wheel

A - Gear motor assembly

B - Cutting head assembly

C - Front wheel assembly

**A**

**2.2 lbf·ft (3 N·m)[†]**

**4.5 lbf·ft (6 N·m)[†]**

**B**

**4.5 lbf·ft (6 N·m)** **1.5 lbf·ft (2 N·m)[†]**

**4.5 lbf·ft (6 N·m)[†]**

**1.5 lbf·ft (2 N·m)**

**C**

**9 lbf·ft (12 N·m)**

**1.0 lbf·ft (1.5 N·m)**

**7.5 lbf·ft (10 N·m)**

**[†]Loctite 243 Blue Threadlocker**

**[††]Loctite 2701 Green Threadlocker**
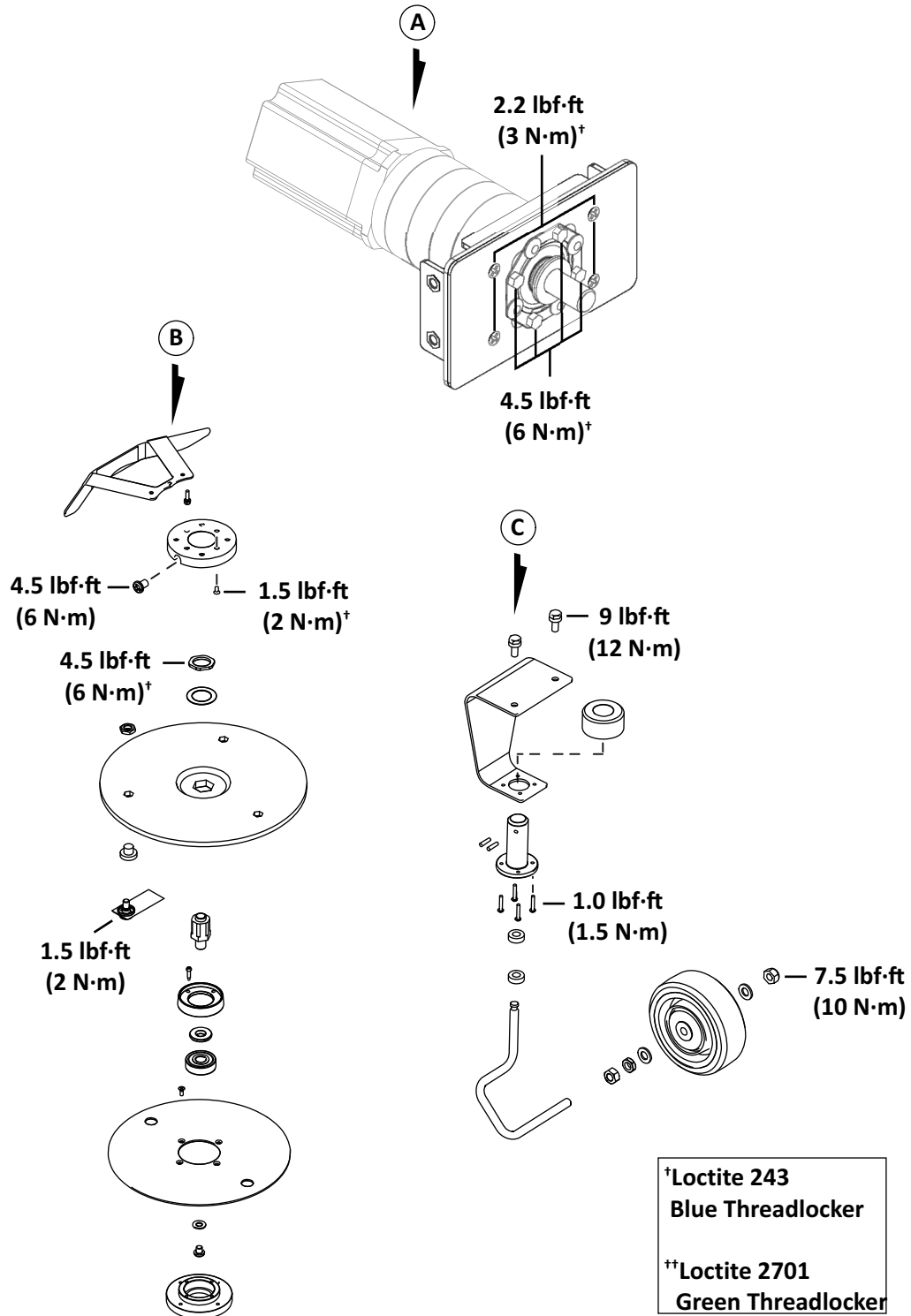
# 13 Specifications

## 13.1 Capacity

| Recommended working area[1] | 2.5 acres (10,000 m$^2$) |
|---|---|
| Number of sports fields per robot | 1 |
| Mowing width | 25 in. (633 mm) |
| Speed | 1.7 mph (2.8 km/h) |
| Maximum slope | 35% |

[1]Valid for a lawn that is rectangular, flat, without obstacles, with fertilizer and watering, being worked 24 hours per day, seven days per week.

## 13.2 Cutting

| Number of cutting heads | 3 |
|---|---|
| Number of cutting blades | 9 |
| Low cut (minimum) | 0.9 in. (22 mm) |
| High cut (maximum) | 3.4 in. (100 mm) |
| Adjustment of cutting heads | Electronic |
| Maximum noise level | <70 dB(A) |

## 13.3 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 working time per charge | 260 minutes |
| Average annual consumption | 580 kWh |

## 13.4 Weight and Dimensions

| Weight | 106 lbs. (48 kg) |
|---|---|
| Length | 39.4 in. (1002 mm) |
| Width | 41.1 (1044 mm) |
| Height | 20.3 in. (466 mm) |

## 13.5 Software and Monitoring

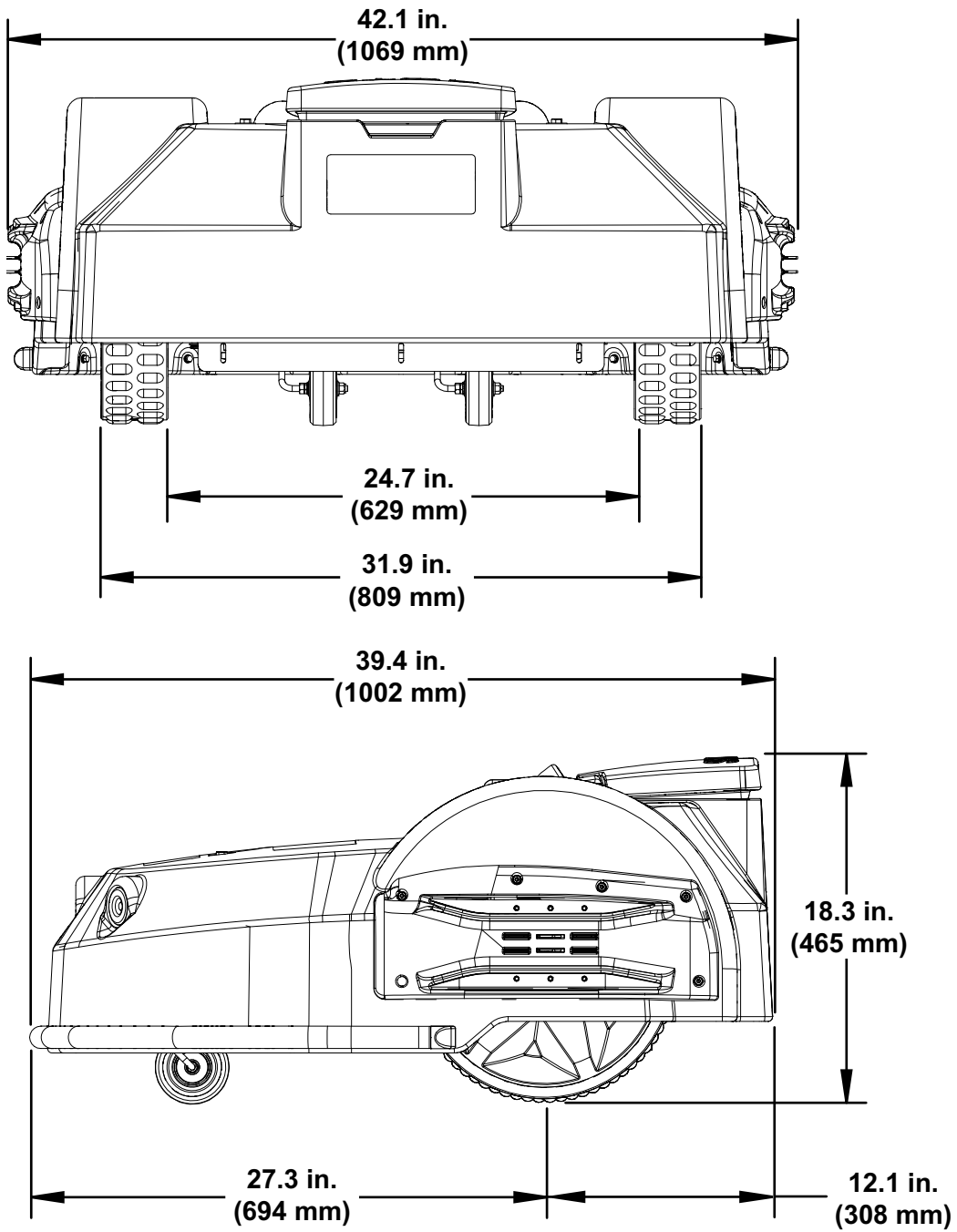| Security PIN code | Yes |
|---|---|
| GPS positioning | |
| APP robot management | |

# 13.6 Intelligence

| Sonar detection of obstacle (height and diameter) | Height 15.7 in. (400 mm) Diameter 2.0 in. (50 mm) |
| --- | --- |
| Adaptive cut | In a future release |
| Return to station via GPS | |
| Multiple starting zone | |
| Multi field (optional) | |
| Multi robot | |

# 13.7 Safety

| Lift sensors | Yes |
| --- | --- |
| Reverse sensors | No |
| Bumper | Electronic |
| Deflectors on the cutting head | Exterior |

# 13.8 Dimensions

**42.1 in.**
**(1069 mm)**

**24.7 in.**
**(629 mm)**

**31.9 in.**
**(809 mm)**

**39.4 in.**
**(1002 mm)**

**18.3 in.**
**(465 mm)**

**27.3 in.**
**(694 mm)**

**12.1 in.**
**(308 mm)**