www.echorobotics.com

Robotic Mower
Technical Manual
TM-2000

P/N 99922205383

VERSION 2.0

08/31/2020

EN   ENGLISH

Table of Contents

1 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.

⚠ 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.

1.1 Safety Symbols

	Safety and Information Label
	Caution: The robot can be dangerous if misused.
	Never place hands or feet under the robot while it is powered ON.
	Beware of projectiles.
	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.
	Press the STOP button and wait for the cutting disc to stop rotation before handling the robot.
	Always keep a safe distance from the robot when is it powered ON and the cutting discs are rotating.
	Do not ride on the robot.
	Keep bystanders away from the robot.
	Wear protective gloves when handling the robot.
	The robot is equipped with an anti-theft system.
	General Prohibition Symbol This symbol means the specific action shown is prohibited. Ignoring this symbol can result in damage to property and serious or fatal injury.

2 Charging and Turning the Robot ON

1) Place the robot on the charging station. Turn the charging station ON.
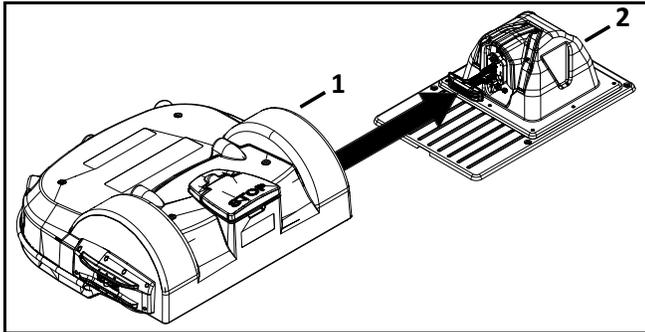
1 – Robot
2 – Charging station

2) Turn the robot ON. Use the power switch located under the cover on the back of the robot.
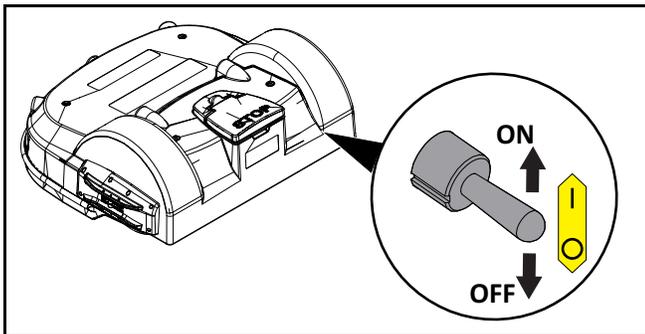
3) Open the stop button lid to access the Smartbox.
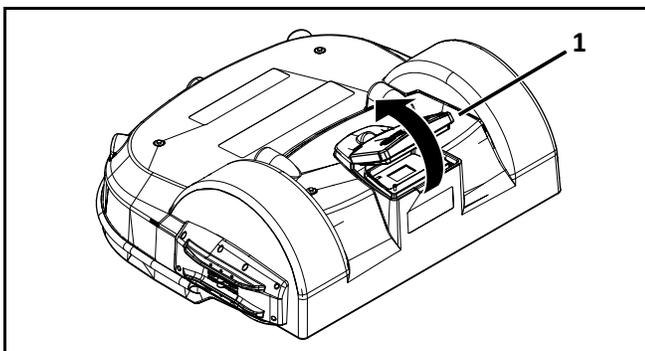
1 – Stop button lid

4) Press and hold the power button for five seconds, then release it. The start-up procedure takes approximately two minutes.

1 – Power button

3 System Components
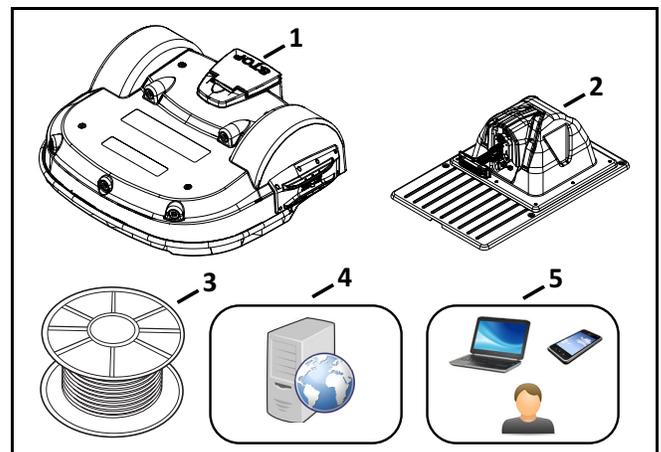
1 – Robot
2 – Charging station
3 – ECHO -branded peripheral wire
4 – Internet portal
5 – End user

4 Theory of Operation

The robot works in a random pattern. A peripheral wire buried in the ground defines the border of the working area. The charging station energizes the peripheral wire which generates a magnetic field within the working area.

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

The robot has obstacle detection sensors. When it detects an obstacle, it will slow down, make contact with the obstacle then perform a maneuver to avoid it.
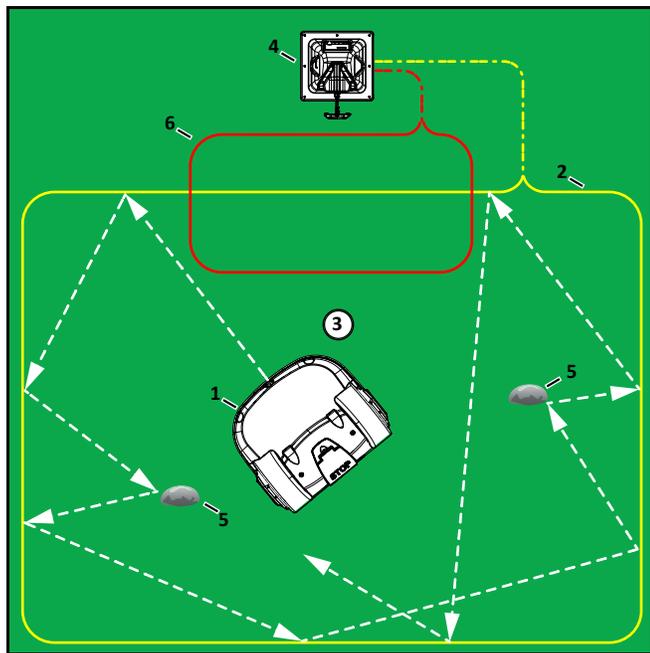
1 – Robot   4 – Charging station
2 – Peripheral wire   5 – Obstacle
3 – Working area   6 – Station Loop wire

The robot will automatically return to the charging station to charge its battery.

Return to charging station procedure:

•	the robot stops
•	moves to the peripheral wire
•	follows the Track Border range to the Station Loop wire
•	follows the Station Loop wire to the charging station
•	docks at the charging station

4.1 Peripheral Wire

The energized peripheral wire creates an electromagnetic signal that is positive (+) inside the working area, and negative (–) outside the working area.
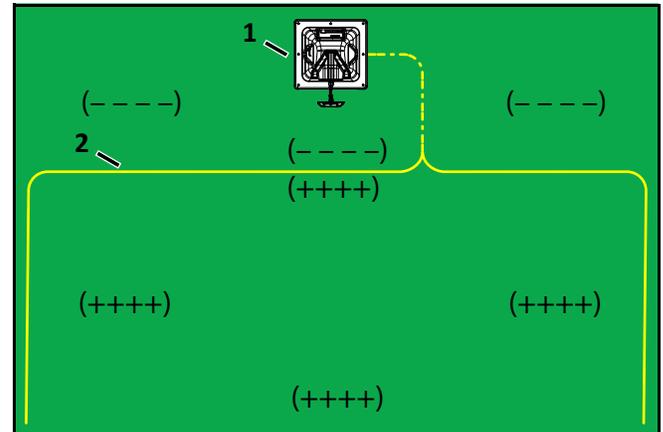
1 – Charging station
2 – Peripheral wire

The signal can encounter interference from:

•	water pipes
•	metal structures
•	electric cables/power lines/electronic pet fences

The peripheral wire defines the working area.

•	Each peripheral wire is assigned to a different signal channel in the charging station (the charging station must contain one signal channel board for each peripheral wire).
•	The ends of each peripheral wire are connected to a single charging station.
•	Install the wire in a clockwise direction around the field.
•	Do not cross or form loops with the wire.
•	Minimum wire length is 656 ft. (200 m). If this minimum length is not possible, install Inductive Coil Kit, P/N M114000040.

	NOTE: The Station Loop wire does not require an inductor. There is already an inductor in the circuit that it connects to.
•	Maximum peripheral wire length is 3281 ft. (1,000 m).

Peripheral wire installation angles must be greater than 90°.

Peripheral wire installation radii must be greater than or equal to 3.3 ft. (1.0 m).
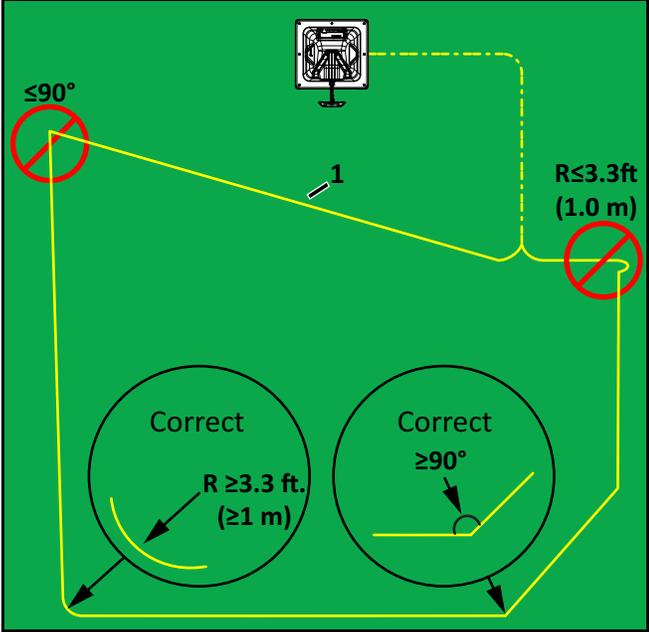
1 – Peripheral wire

4.2 Parcel

A parcel is a working area inside of a wire. A parcel can also be referred to as a "Zone".
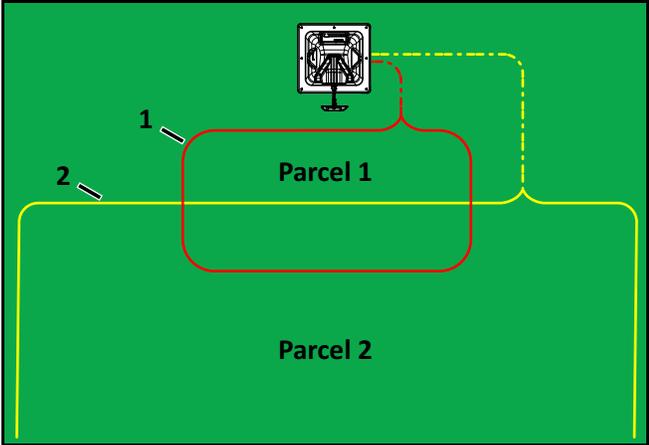
1 – Station Loop wire
2 – Peripheral wire

4.3 Station Loop Wire

The station loop guides the robot to and from the charging station. This wire starts and ends at the charging station.
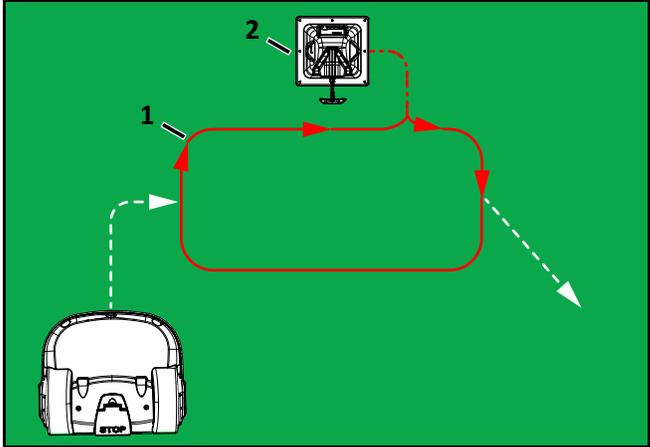
1 – Station Loop wire
2 – Charging station

The wire must extend a minimum of 11.5 ft. (3.5 m) into the field zone.

The distance between the center of the charging station and the end of the Station Loop wire must be a minimum of 8.5 ft. (2.5 m).
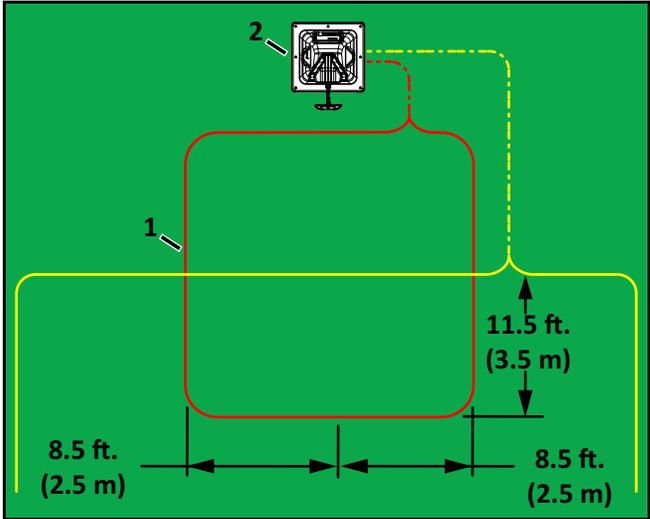
1 – Station Loop wire
2 – Charging station

The Station Loop wire can be placed so the charging station can be located around a corner or behind a building or obstacle.
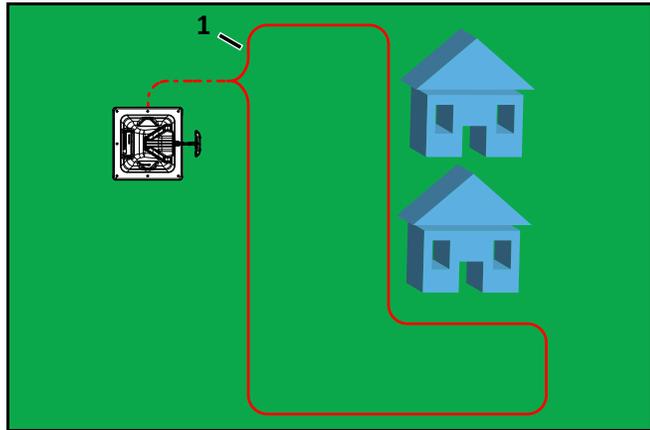
1 – Station Loop wire

4.3.1 Tied Pairs

Tying a pair of wires together in parallel is referred to as a Tied Pair. Tied pairs cancel the electromagnetic signal of the wire so the robot cannot see it. They are used to route the robot back to the charging station and when wiring Islands (Floating Islands). It is recommended to secure the Tied Pair with cable ties placed 4.0 in. (100 mm) apart.

NOTE: Tied Pairs cannot cross each other or run through a parcel.

4.0 in. (100 mm)

Not Correct
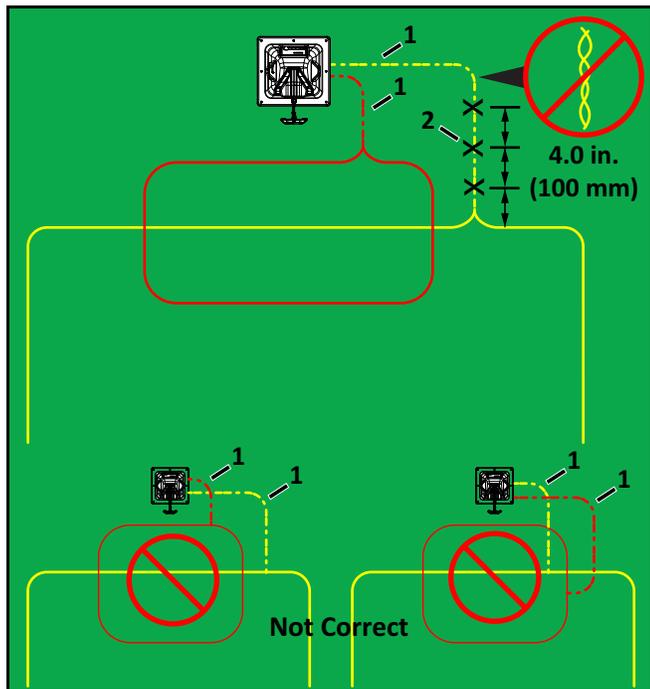
1 – Tied Pair
2 – Cable tie

4.4 Track Wire and Track Border

Track Wire and Track Border are behaviors that allow the robot to get to and from the charging station and working zones.

4.4.1 Track Wire

Track Wire is a behavior of the robot where it will accurately track on top of the wire.

The robot moves at a very slow speed during the Track Wire movement. The robot must accurately follow the Station Loop wire to correctly dock at the charging station.
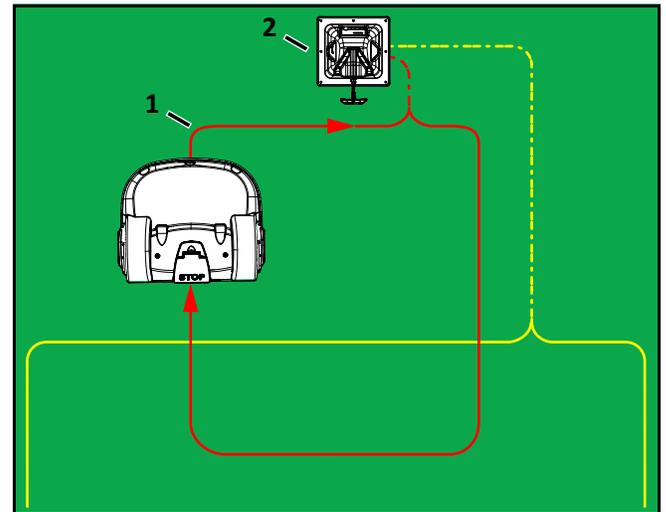
1 – Station Loop wire
2 – Charging station

The Track Wire behavior causes the robot to drive over the same exact path repeatedly. This may cause tracks or ruts in the parcel.

4.4.2 Track Border

The Track Border is a behavior where the robot will follow a path at a distance from the wire.

The Track Border range has a minimum distance of 2.62 ft. (0.8 m) and maximum distance of 9.84 ft. (3.0 m) from the wire.

The robot randomly chooses a value between the minimum and maximum distance to avoid tracking.

The Station Loop wire must extend past the maximum Track Border distance or the robot can miss the charging station.
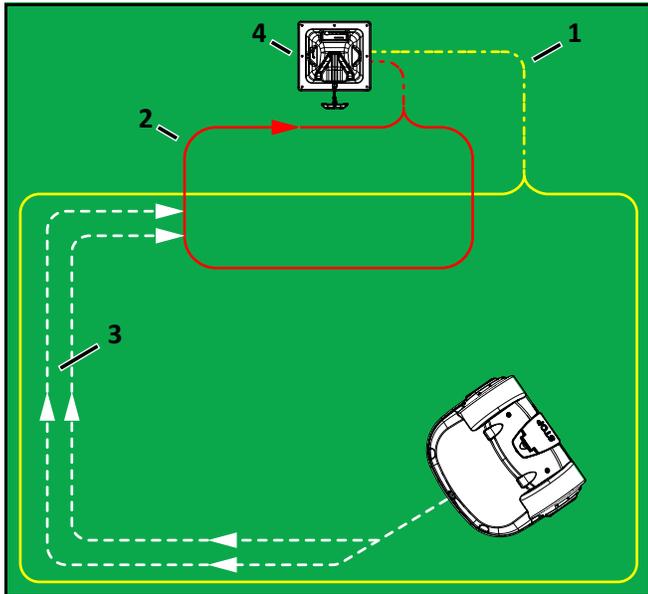
1 – Peripheral wire
2 – Station Loop
3 – Track Border range
4 – Charging station

4.5 Installation Restriction and Guidelines

Guidelines and restrictions for handling obstacles, installing Pseudo-Islands (Bridged-Islands) and Islands (Floating-Islands) need to be closely followed for a successful installation.

4.5.1 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, obstacles include:

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

The sonar sensors on the robot detect certain obstacles. Other obstacles require the installation of a

Pseudo-Island (Bridged-Island) or an Island (Floating-Island).

> ## ⚠ CAUTION
>
> ### WATER INTERFERES WITH THE ELECTROMAGNETIC SIGNAL OF THE PERIPHERAL WIRE
>
> Electromagnetic signal interference can cause unpredictable robot behavior.
>
> - Do not operate the robot where the ground has accumulated surface water or is flooded.

Install the peripheral wire a minimum distance of 5.5 ft. (1.5 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 5.5 ft. (1.5 m) is not possible, install a physical barrier around the water.

Install the charging station a minimum of 49.0 ft. (15.0 m) from the edge of the water. Two possible installations 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.
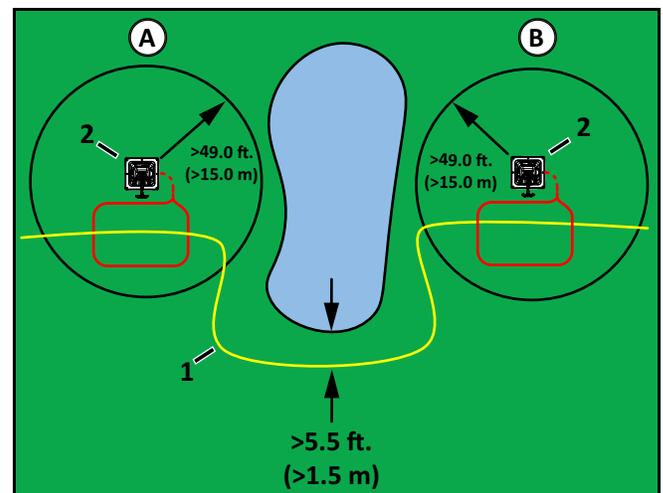
1 – Peripheral wire
2 – Charging station

Obstacles Near the Boundary of the Working Area

If an obstacle is less than 3.3 ft. (1.0 m) from the boundary of the working area, 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 (Bridged-Island).
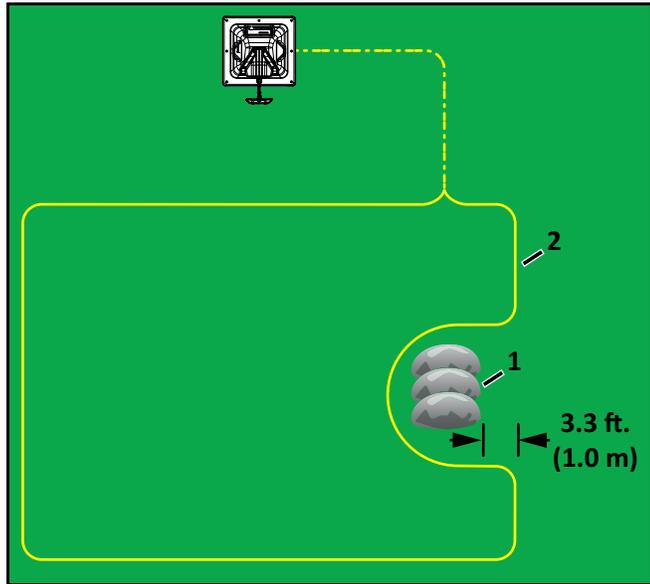
1 – Obstacle
2 – Peripheral wire

4.5.2 Installation Next to Landscaping
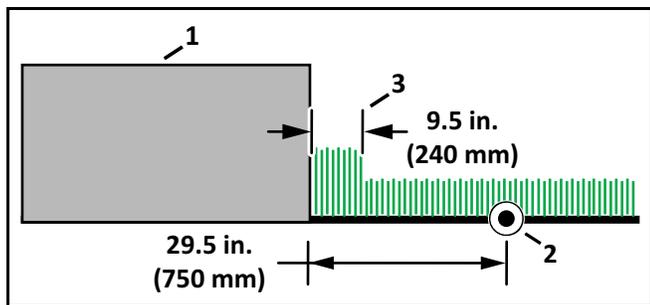
1 – Terrace/Path/Wall
2 – Peripheral wire
3 – Area not accessed by robot

4.5.3 Pseudo-Islands (Bridged-Islands)

If a Pseudo-Island (Bridged-Island) is created, the robot will approach the obstacle, and then maneuver around it.

Peripheral wire installation requirements for a Pseudo--Island (Bridged-Island) require:

*   a counterclockwise installation direction around an object
*   a fixed distance of 16.0 in. (400 mm) between the approach and return sides (if this distance exceeds 16.0 in. [400 mm], the robot will miss the area between the wires)
*   do not cross or twist the approach and return sides of the peripheral wire
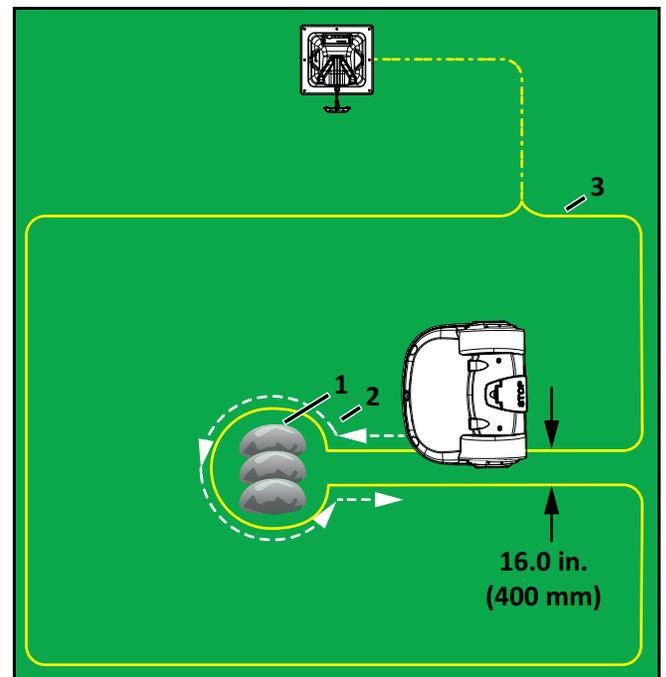
1 – Obstacle
2 – Direction to install peripheral wire (and movement of robot)
3 – Peripheral wire

4.5.4 Islands (Floating Islands)

Create an Island (Floating-Island) when an obstacle is more than:

• 16.5 ft. (5.0 m) from the peripheral wire
• 49.0 ft. (15.0 m) from the charging station
• 16.5 ft. (5.0 m) from another Pseudo-Island (Bridged-Island) or Island (Floating-Island)

If all three of these requirements are not met, a Pseudo-Island (Bridged-Island) must be used.

Islands (Floating Islands) need to use a Tied Pair.

When the robot approaches the Tied Pair it will move over it. The robot will not follow the peripheral wire toward the obstacle.
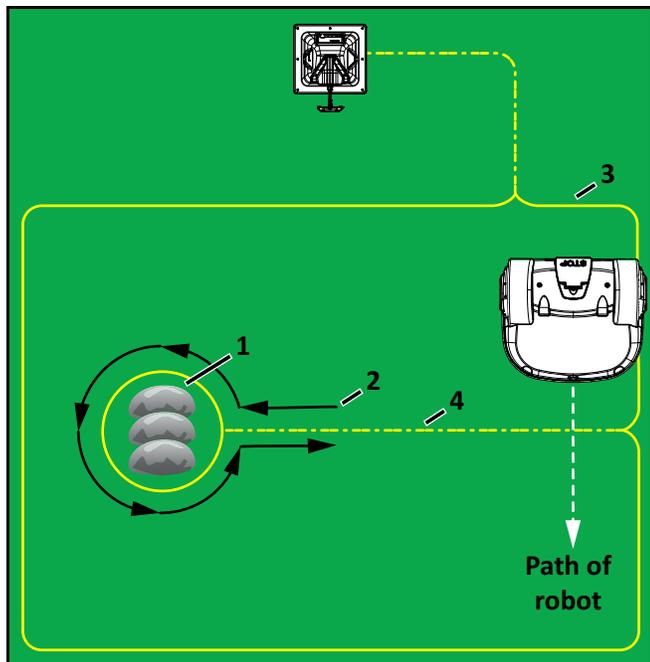
1 – Obstacle
2 – Direction to install peripheral wire
3 – Peripheral wire
4 – Peripheral wire Tied Pair

4.5.5 Sloped Fields

Ideally, the peripheral wire should not be placed on a slope, but if absolutely necessary, the peripheral wire should be placed on a slope such that the slope descends into the field.

NOTE: If the slope descends away from the field, the robot could roll out of the field.

The maximum slope on any part of the field must be less than or equal to 17°.
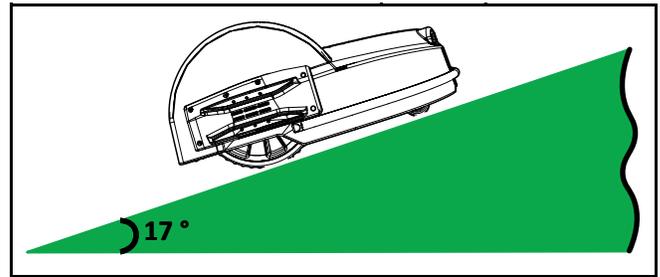
4.5.6 Sites Containing a Narrow Corridor

These sites require specific installation of the peripheral wire.

The required minimum width of the Corridor, depends on its length. The table below presents the minimum distance between wires required to enable the robot to follow its Track Border range from Zone B through the Corridor and return to the charging station in Zone A.

Length of the Corridor	Minimum distance between peripheral wire
3.3 ft. (1.0 m)	13.1 ft. (4.0 m)
3.3 - 16.4 ft. (1.0 - 5.0 m)	14.7 ft. (4.5 m)
16.4 - 49.2 ft. (5.0 - 15.0 m)	16.4 ft. (5.0 m)

If this minimum width is not available when the robot is in Zone B, it will not be able to pass through the Corridor and return to the charging station.
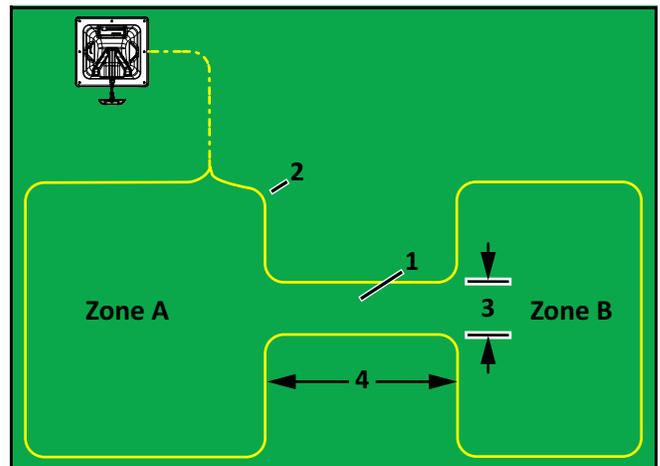
1 – Narrow corridor
2 – Peripheral wire
3 – Minimum distance between peripheral wire
4 – Length of corridor

4.5.7 Sites With Long Lanes

A long isolated lane represents an area where the length or the area is very long compared to width. In a long lane, the electromagnetic signal is strong on both sides of the robot and can cause the robot to be confused and not be able to perform Track Border correctly, or at all.

If the peripheral wire is not detected, the robot cannot return to the charging station to charge its battery.

If the length of the lane is greater than 49.2 ft. (15 m), then the minimum distance between the peripheral wire must be greater than 32.8 ft. (10 m).
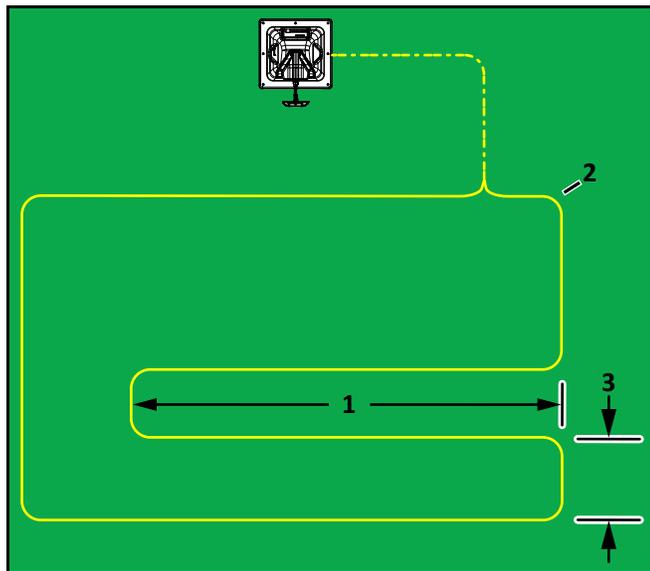
1 – Lane length
2 – Peripheral wire
3 – Minimum distance between peripheral wire

4.6 Multiple Peripheral Wire Installation

An installation may require multiple peripheral wires.

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

The start and finish sides of the peripheral wire must lie next to each other when they enter the charging station. This portion of the wire can not cross itself, or cross parcels.

Multi-Parcel Overlaps

An overlap is an area that lies within two parcels. The overlap allows the robot to transition from one parcel to another. The length and width of the overlap must be greater than 10.0 ft. (3.5 m).

Parcel Overlap Example
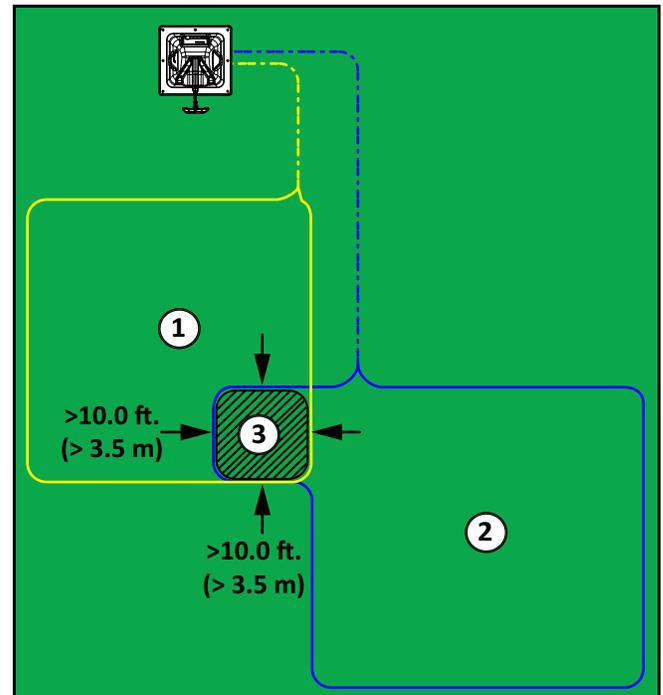
1 – Parcel 1
2 – Parcel 2
3 – Overlap area

4.6.1 Minimum Installation Dimensions for Multiple Robots

The minimum dimensions of an installation with multiple robots ensure that one robot will not collide with another robot that is charging.
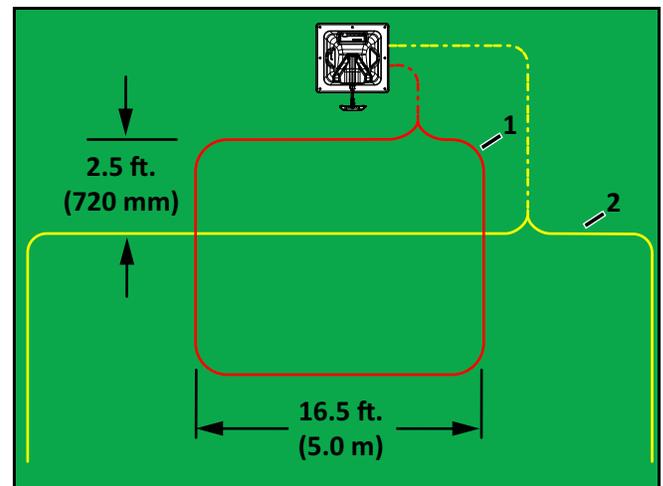
1 – Station Loop wire
2 – Peripheral wire

5 Robot Components

NOTE: The serial/model number and FCC labels are located on the bottom side of the Stop button lid.

Cover Assembly

Chassis Assembly
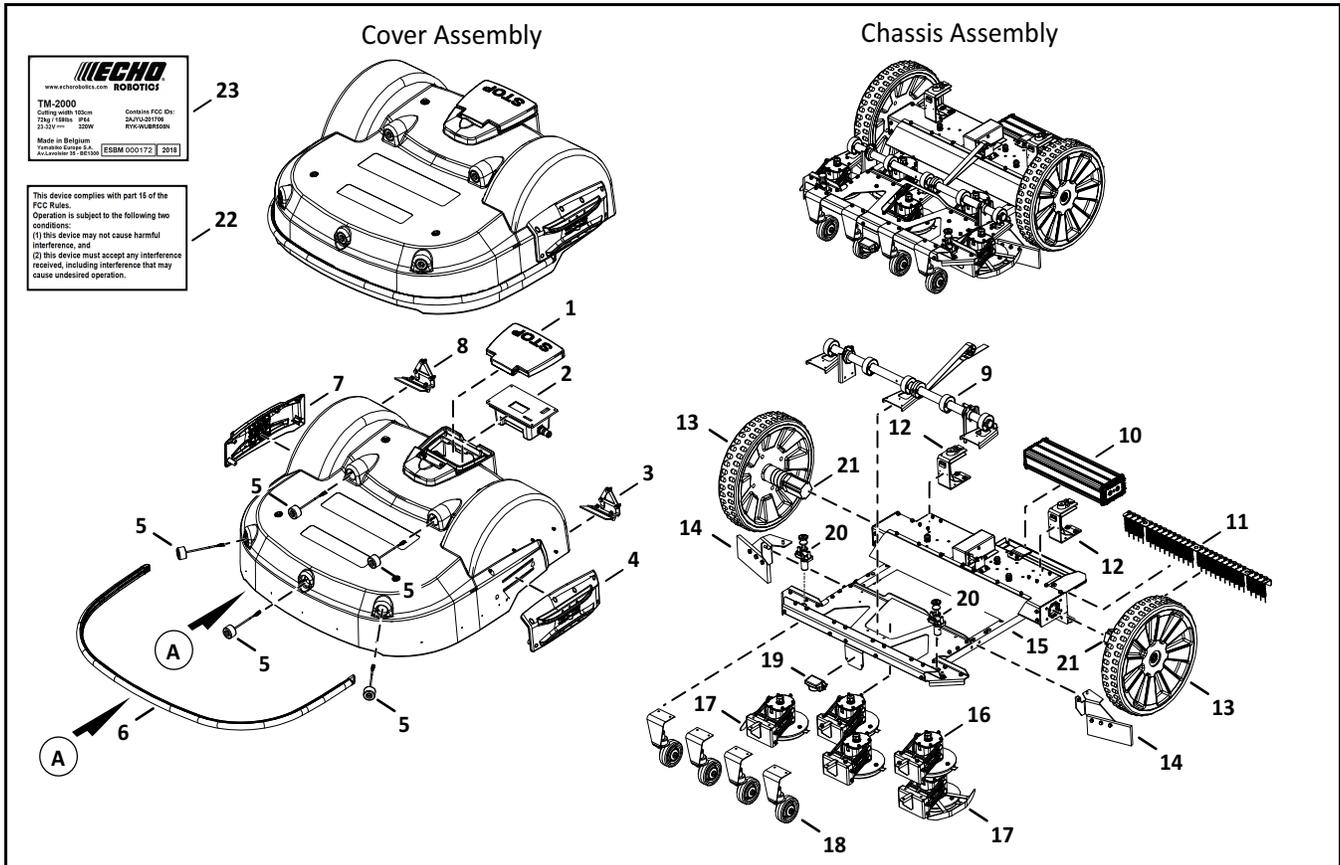
1 – Stop button lid
2 – Smartbox
3 – Left wheel brush
4 – Left charge panel
5 – Sonar sensor
6 – Bumper
7 – Right charge panel
8 – Right wheel brush
9 – Cutting height assembly
10 – Li-Ion (Lithium Ion) battery
11 – Groomer kit
12 – Rear lift sensor

13 – Rear wheel
14 – Ball deviation flap kit
15 – Chassis
16 – Cutting head
17 – Blade guard
18 – Front wheel
19 – Coil
20 – Front lift sensor
21 – Wheel motor
22 – FCC Label
23 – Serial / Model number label

5.1 STOP Button

Press or lift the stop button lid to stop the robot.
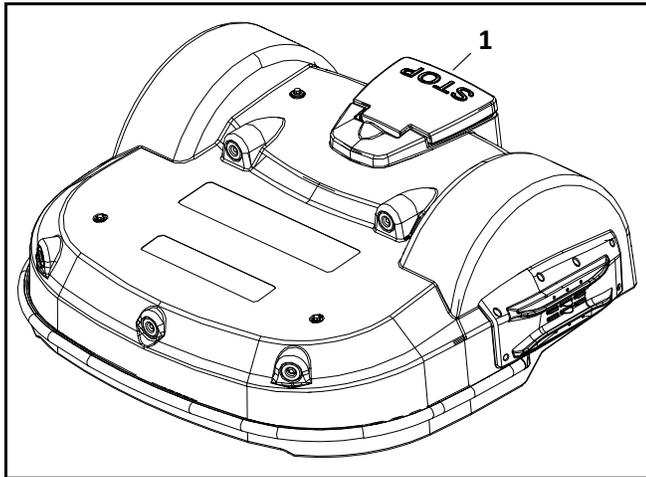
1 – Stop button lid

5.2 The Smartbox

Lift the stop button lid to access the Smartbox. Use the Smartbox to set configuration parameters.
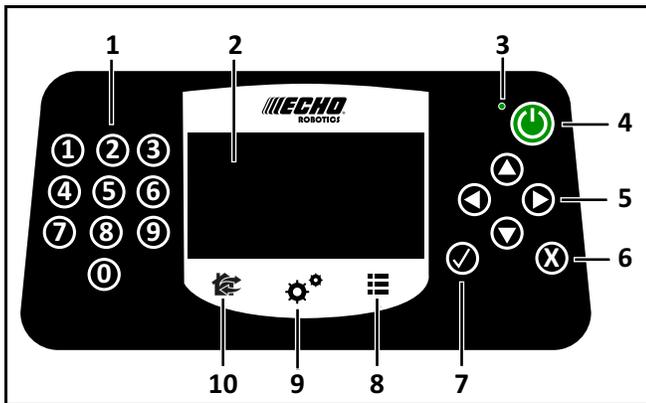
1 – **Numeric buttons** – Press to select menu choices and enter numeric values.
2 – **LCD menu** – Displays the current information.
3 – **Power ON/OFF LED** – Indicates the Smartbox is switched ON.
4 – **Power button** – Press to turn the Smartbox ON.
5 – **Arrow buttons** – Press to highlight menu 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 settings 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.

5.3 The LCD menu

The LCD menu provides a graphical user interface for the robot.

1 – **Name** – A user assigns this name to the robot.
2 – **Battery charge level** – Percentage of battery charge
3 – **Message** – Shows the current status of the robot (also displays error messages).
4 – **Time and date** – 24-hour clock only.

5.4 Sonar Sensors and Bumper

The sonar sensors and bumper detect obstacles. The robot will reduce its speed to less that 0.5 mph (0.2 m/s) when an obstacle is detected.
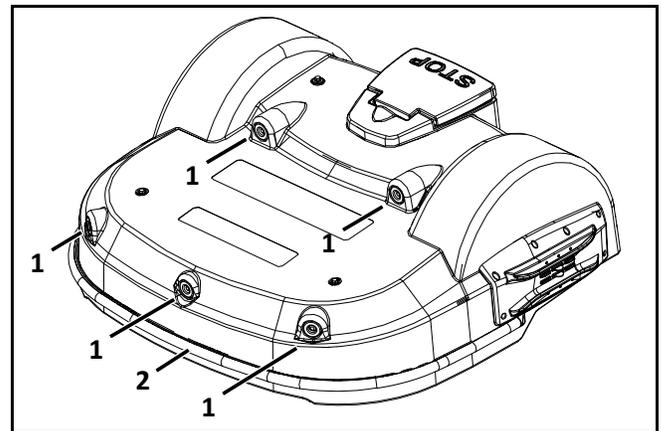
1 – Sonar sensor
2 – Bumper

Sonar Sensors:
- transmit a signal of 40 kHz
- detect obstacles which have a minimum height of 15.7 in. (400 mm), and a minimum width of 2.0 in. (50 mm)

Bumper:

When the bumper contacts an obstacle the robot will stop, move backward, turn between 60° and 120°, then continue moving forward.
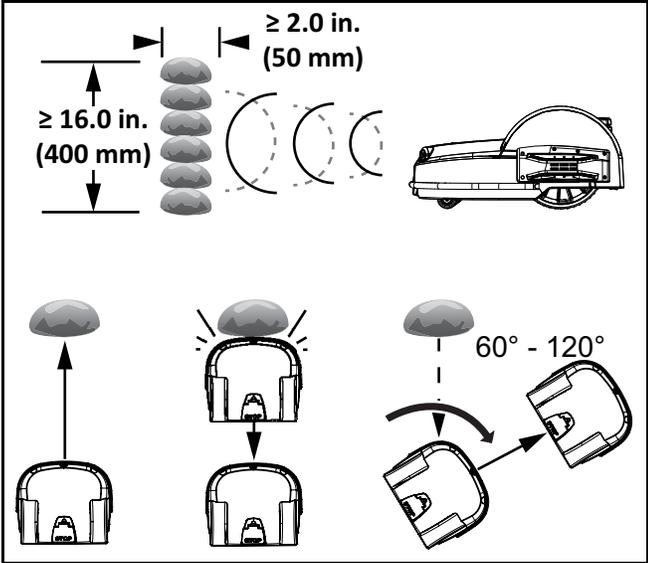
5.5 Lift Sensors

When a lift is detected the robot will stop the cutting heads, reverse its direction, rotate, and try to escape the situation causing the lift. If the lift is cleared the cutting heads will restart and the robot continues working.
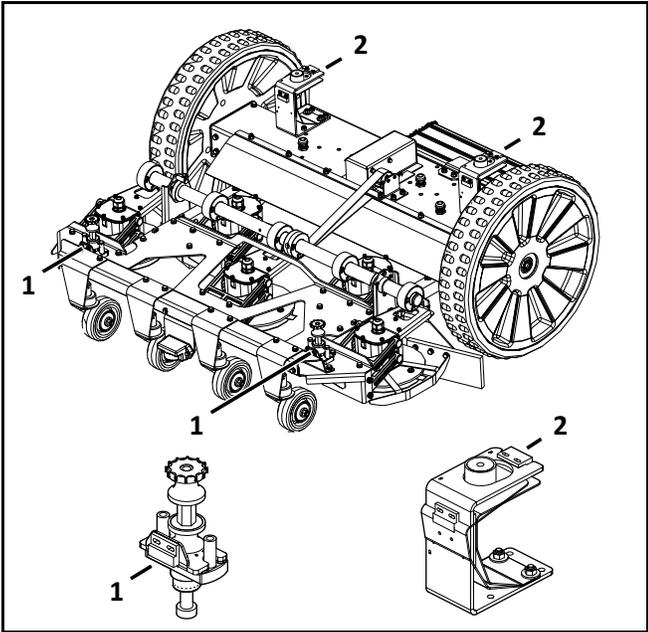
1 – Front lift sensor

2 – Rear lift sensor

5.6 Coil

The coil detects the intensity of the electromagnetic field generated by the peripheral wire.
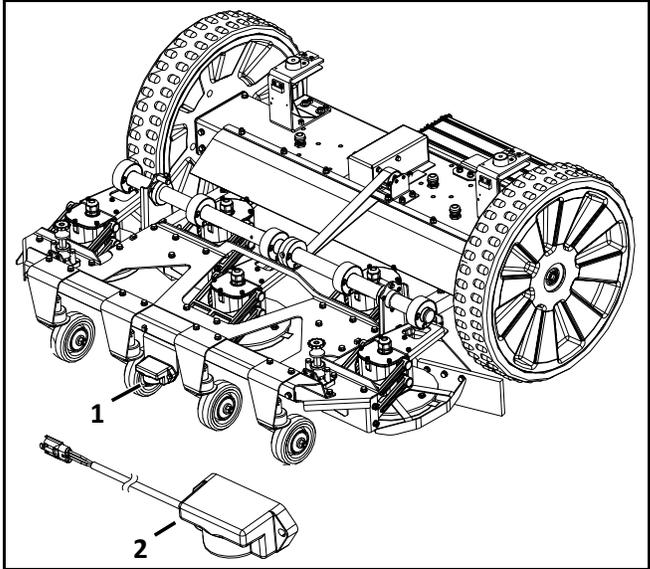
1 – Coil location on robot

2 – Coil assembly

5.7 Tilt, Rollover, and Temperature Sensors

These sensors are located on the main circuit board inside of the electrical box.

Tilt Sensor - 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.

Rollover Sensor - The rollover sensor detects if the robot has been tipped upside down.

Temperature Sensor - The temperature sensor measures the ambient outdoor temperature. It will prevent the robot from operating if the temperature is too low. The minimum temperature is a programmed operating parameter.

5.8 Cutting Heads

The robot has five cutting head assemblies.
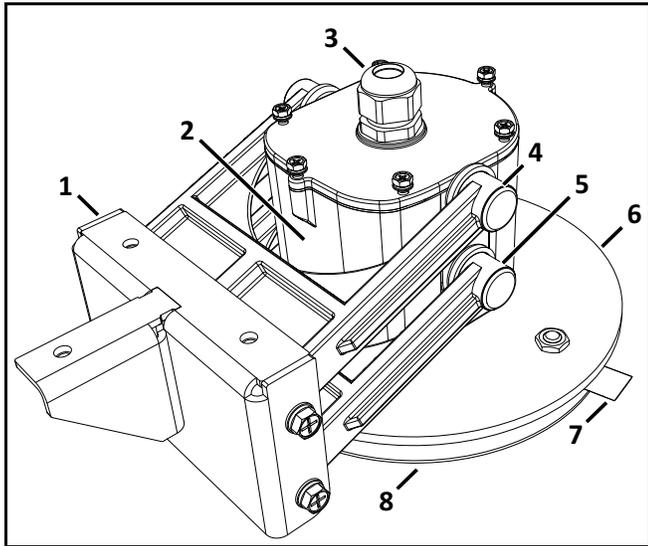
1 – Bracket unit   5 – Lower stay
2 – Motor case   6 – Blade disc
3 – Cable gland   7 – Cutting blade
4 – Upper stay   8 – Anti-friction disc

Cutting Head Function	Description
Set cutting height per parcel	Configure a different cutting height for each individual parcel.
Option to continue mowing with a blocked cutting head	This option allows the robot to continue the current work cycle with a blocked cutting head. The robot will try to unblock the cutting head when he is back at the station. This option is disabled by default as it can cause damage to the field or the robot.

6 Peripheral Wire Installation Setup

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

Install Pseudo-Islands (Bridged-Islands) or Islands (Floating-Islands) to avoid holes, ruts, obstacles, and standing water.

6.1 Description of the Smartbox Interface
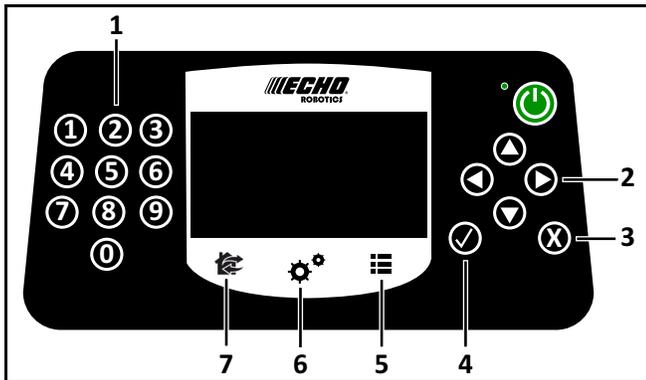
1 – **Numeric buttons** – Press to select menu choices and enter numeric values.

2 – **Arrow buttons** – Press to highlight menu options.

3 – **Back button** – Press to exit a menu and return to previous level.

4 – **Accept button** – Press to accept an operation or setting.

5 – **Service settings menu button**– Press to access the Service menu.

6 – **Settings menu button** – Press to access the Settings menu and define operational settings.

7 – **Actions menu button** – Press to access the Actions menu.

6.2 Station Loop and Peripheral Wire Configuration - Single Field Installation
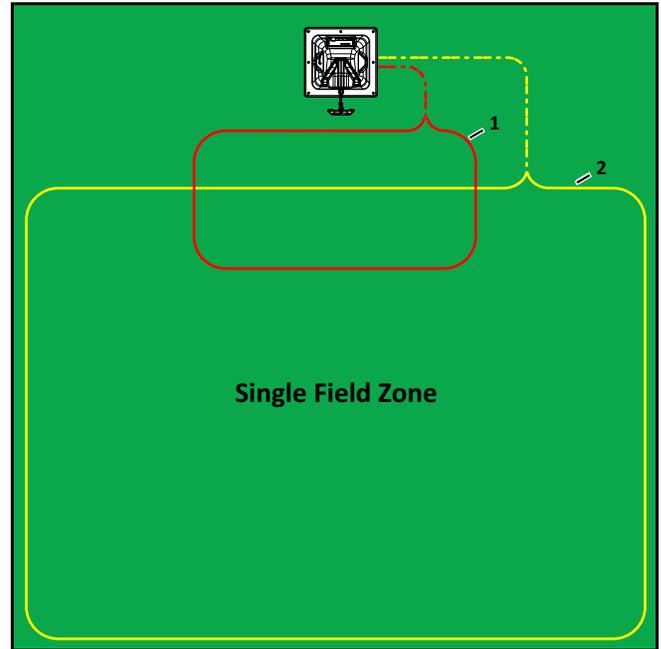
1 – Station Loop wire
2 – Peripheral wire (for single field zone)

1) Press and hold the **number 9** on the numeric keypad until the **TECHNICIAN SETTINGS** menu appears.

2) Select **INFRASTRUCTURE**, then press the **Accept** button.

3) Select **Peripheral wires** then press the **Accept** button.

4) On the **WIRE SETTINGS** menu, select **Wire CH{X},** then press the **Accept** button.

5) Select **Signal channel**, then press the **Accept** button. Assign the channel number for the Station Loop.

6) Check the value shown at the top of the menu. This value should be positive. If the signal is negative, Peripheral Wires must be switched in the charging station.

7) Press the **Back** button twice to return to the **INFRASTUCTURE** menu.

8) Select P**arcels,** then press the **Accept** button. Select the parcel associated with the LOOP wire

9) Highlight the existing name and press the **Accept** button. Use the Arrow keypad and rename to **LOOP.** To save the name, select the "check" mark on the bottom and press the **Accept** button.

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

11) Press the **Back** button twice to return to the **INFRASTRUCTURE** menu.

12) Select **Peripheral wire** and press the **Accept** button.

13) Select **Create new wire**, then press the **Accept** button. Select OK and press the **Accept** button to create a new wire

14) Select the newly created wire, the press the **Accept** button.

15) Select **Signal channel 1**, then press the **Accept** button. Assign the channel number for the large field to be mowed.

16) Check the value shown at the top of the menu. It should be a positive signal. If it is not, reverse the wires inside the charging station.

17) Press the **Back** button twice to return to the **INFRASTRUCTURE** menu.

18) Select **Parcels**, then press the **Accept** button. Select the parcel associated with the Wire CH1.

19) Highlight existing name and press select. Use the Arrow keypad and rename the robot to **Zone 1**. To save the name you must select the "check" mark on the bottom and press the **Accept** button.

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

21) Select Use Track Border and check the button ON. This ensures that when the robot is in this field, it will follow the Track Border until it reaches the LOOP field.

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

23) Press the **Back** button twice to exit this menu.

24) Select **Edit parcels percentage**, then press the **Accept** button. Set the value to 100% for Zone 1.

25) Press the **Back** button twice to return to the **INFRASTRUCTURE** menu.

26) From the **INFRASTRUCTURE** menu, select **STATIONS**, then press the **Accept** button

27) Select **Create new station**, then press the **Accept** button. Select OK and press the **Accept** button.

28) Select **Connected to parcels**, then press the **Accept** button. A list of parcels is presented. Select the channel that the charging station is associated with (CH0). Use the arrow keypad until LOOP is displayed and press the **Accept** button.

29) Press the **Back** button once to exit this menu.

30) Select **Station inside wire** and press the **Accept** button.

31) Use the arrow keypad to select if the station is inside or outside the field, then press the **Accept** button.

32) Configuration is now complete. Press the **Back** button five times to get to the **Home** screen.

6.3 Shared Station Loop Multi-Field Installation Configuration
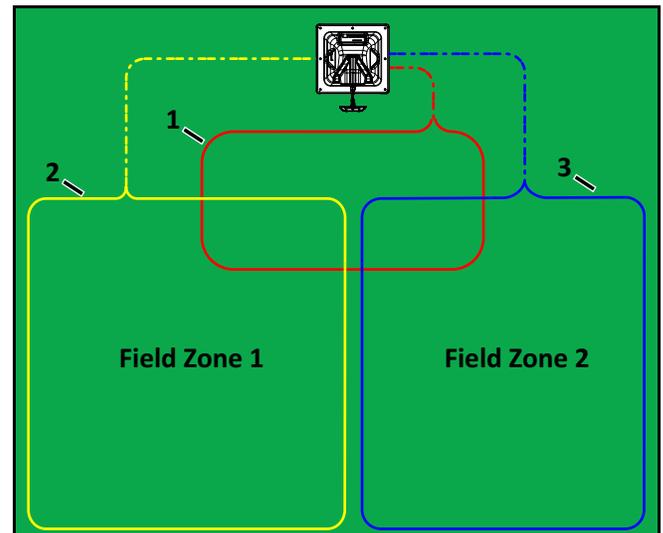
1 – Station Loop wire
2 – Field Zone 1 Peripheral wire
3 – Field Zone 2 Peripheral wire

Use the following procedure to set up a Shared Station Loop in addition to the procedure for a single field installation.

1) Create a new wire.

2) Press and hold the **number 9** on the numeric keypad until the **TECHNICIAN SETTINGS** menu appears.

3) Select **INFRASTRUCTURE**, then press the **Accept** button.

4) In the **INFRASTRUCTURE** menu, select the **Peripheral wires** menu. Use the **Arrow** buttons and select the option to **Create New Wire**, then press the **Accept** button.

5) Select **OK** to **Create New Wire**.

6) After the new wire has been created, select the new wire and designate the correct channel (CH2).

7) Once the correct channel has been selected, be sure that the robot is in the correct Field/Zone and verify that there is a positive signal within that Zone. If the signal is negative, reverse the wires inside of the charging station.

8) Press the **Back** button twice, then select the **Parcels** menu.

9) Enter the **Parcels** menu and select the newly created wire (CH2).

10) Within the menu of the selected wire (CH2) you can rename that field/zone. Rename it to Zone 2.

11) Choose the return direction. This must match the Station Loop return direction.

12) Select and turn ON **Use Track border**.

13) Set the perimeter. While it may be impossible to know the exact amount of wire used, try to be as accurate as possible when entering the length of the wire used.

14) Enter the **Neighboring parcels** menu and select that it is neighboring (CH0) or LOOP. With a shared Station Loop, both field/zones need to neighbor the Station Loop.

15) Press the **Back** button five times to return to the **Home** menu.

6.4 Chained Multi-Field Installation Configuration
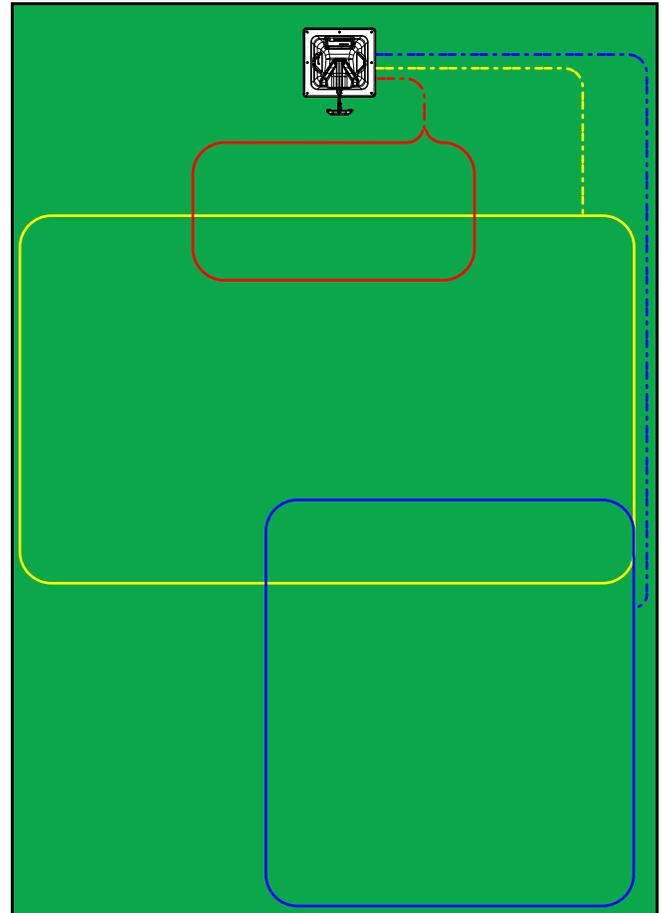
To set up a Chained Field Installation, use the following procedure in addition to Shared Station Loop installations. **Note:** It is important to know the location of your Zones/Fields and which channel they are associated with. Setting up a Chained Field Installation is configured in **Neighboring parcels.**

1) Press and hold the **number 9** on the numeric keypad until the **TECHNICIAN SETTINGS** menu appears.

2) Select **INFRASTRUCTURE**, then press the **Accept** button.

3) From the **INFRASTRUCTURE** menu, select **Parcels,** then press the **Accept** button.

4) Select Zone2/Field2, then press the **Accept** button.

5)   Use the **Arrow** buttons to move down to **Neigh-boring parcels**, then press the **Accept** button.

6)   Once in **Neighboring parcels**, use the **Arrow** buttons to highlight **Zone1/Field 1 (CH1)**, then press the **Accept** button. Verify that the LOOP is not selected as a **Neighboring parcel**.

6.5 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.

Safety and information symbols are on the back of the robot. Look at the safety symbols before using the robot.

Maintain and service the robot on a regular basis.

6.5.1 Safety Measures

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

- • Remove all non-stationary obstacles from the working area before using the robot.
- • Never leave the robot on a slope.
- • Only use the robot charging station to charge the robot's battery. Use of any other charger can cause damage and loss of warranty coverage.
- • Remove power from the charging station before opening it.
- • Never connect an external electrical element to the robot's battery cable.
- • When servicing the robot, do not overreach and keep your balance.
- • Wear appropriate foot wear and long pants.
- • Never pick up or carry the robot while the power is ON.
- • Do not leave the robot to operate unattended if there are animals or people in the vicinity.
- • Never operate the robot if it has defective blade guards.
- • Avoid using the robot when there is a risk of lightning or flooding.

6.5.2 Demonstration Mode

⚠ CAUTION

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.

Demonstration mode allows the robot to run without the use of peripheral wires. The robot will not change course unless stopped by a physical barrier. The robot also does not have the capability of finding the charging station on its own when in demonstration mode.

6.5.3 ACTIONS Menu

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

Generally, there are three actions that can be commanded to the robot. Depending on the situation, they will appear in slightly different variants, but the ideas are the same.

Options	Description
Charge	The robot will go to charge and will resume its mission upon completion.
Stay	The robot will stay at the charging station until commanded otherwise.
Mow	The robot will go to mow,

6.5.4 Settings Menu

Press the **Settings** menu button to access the **Settings** menu.

Settings menu options include:

- Schedule
- Cutting Heads
- Cutting Height
- System Locking

Schedule

From the **Settings** menu access the **Schedule** menu.

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

Use this command to:

- Define the daily or weekly working schedule.
- 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).

The check box for **Follow Schedule** means that the robot will either follow the schedule defined in the **Schedule** menu (checked) or it will operate 24 hours (unchecked).

To define a working schedule:

1) Press the **SETTINGS** menu button.

2) Press the **Arrow** buttons to highlight **Schedule**, then press the **Accept** button. The following menu will appear:

   This menu shows the current schedule. The white blocks represent the time when the robot will be operating in one parcel. By default, all the times will appear white, meaning the robot will work continuously.

3) Select **Edit**, then press the **Accept** button. The **PARCEL SCHEDULE** menu appears:

4) To edit the schedule, highlight the parcel, then press the **Accept** button.

5) Press the **Arrow** buttons to select the required day of the week, then press the **Accept** button.

6) Press the **Arrow** buttons to select the required period in the day, then press the **Accept** button.

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

8) Press the **Arrow** buttons to select the active check box, then press the **Accept** button to activate the defined session.

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

10) Press the **Back button** to return to the **PARCEL SCHEDULE** menu.

11) Use the **Arrow** buttons to select **Follow sched**. Press the **Accept** button 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 the **Arrow** buttons to highlight **Copy**, then press the **Accept** button The **COPY** menu will appear:

3) Press the **Numeric** button that corresponds to the day to which the schedule is to be copied (more than one day can be selected).

4) Press the **Accept** button.

System Locking

From the **Settings** menu access the **System Locking** menu.

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 a PIN code which must be entered before specific commands can be issued.

To lock the system:

1) Press the **Settings** menu button.

2) Press the Arrow **buttons** to highlight **System locking**, then press the **Accept** button.

3) Highlight **OK**, then press the **Accept** button. The robot is now locked with a PIN.

To unlock the system:

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

LCD Settings

To modify the LCD settings:

1)   Press and hold the **Settings** menu button for three seconds. The LCD Setting menu will appear.

2)   Press the **Arrow** buttons to change the contrast.

3)   Press the **Accept** button to highlight **Temperature Auto Adj.** When this option is checked ON, the LCD contrast is automatically adjusted according to the ambient temperature. Press the **Accept** button to select or clear this option.

4)   Press the **number 9** button on the numeric keypad to invert the black and white colors.

5)   Press the **number 0** button on the numeric keypad to revert to the factory settings.

6)   Press the **Back** button to exit the menu.

Cutting Heads

From the **Settings** menu access the **Cutting Heads** menu.

Individual cutting head motors can be turned off using this menu. This allows the robot to be run without a cutting head in case one gets damaged or cannot operate for whatever reason. The illustration shown on the LCD screen is a top down view of the cutting heads.

Cutting Height

NOTE: Cutting when the outside ambient temperature its too low may cause permanent damage to the turf.

From the **Settings** menu access the **Cutting Height** menu.

Cutting height can be adjusted through this menu. Each parcel can be adjusted to a different height if desired. For the best results, cutting height should be adjusted so the robot cuts small amounts at a time and dropped slowly until the desired height is reached.

6.5.5 SERVICE SETTINGS Menu

From the **Home** menu press the **Service** menu button to display the **SERVICE SETTINGS** menu. The **SERVICE SETTINGS** menu options include:

•   Regional Parameters

•   Connections

•   Operations

•   Device

•   Security

Regional Parameters

From the **SERVICE SETTINGS** menu, select **Regional Parameters**. **Regional Parameters** menu options include:

•   Date Format

•   Time zone

•   Language

•   Unit system

To set the **Date Format**:

1)   Use the Select **Date Format**.

2)   Use the **Arrow** buttons to select the month, day, and year. Press the **Accept** button to save your selection.

3)   Press the **Back** button to exit the menu

To set the **Time zone**:

1)   Use the **Arrow** buttons to select **Time zone**. Check the **Accept** button to save your selection.

2)   Press the **Back button** to exit the menu.

To set the **Language**:

1)   Select **Language**.

2)   Use the **Arrow** buttons to highlight the required language. Press the **Accept** button to save your selection.

3)   Press the **Back** button to exit the menu.

To set the **Unit system**:

1)   Select **Unit system**.

2)   Use the **Arrow** buttons to select **Imperial** or **Metric**. Press the **Accept** button to save your selection.

Connections

To display the connections menu:

1) Press the **Service** menu button.

2) The Connections menu will display. Use the **Arrow** buttons 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 modem to generate its own WiFi network to which you can connect.

Press the **Accept** button to retain the chosen mode selection.

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 the **Accept** button.

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 the **Accept** button and select **Enable Network**.
* To modify the current network, highlight the network, press the **Accept** button. 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.

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 the **Service** menu button.

2) Highlight **Connections** and press the **Accept** button.

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

4) Highlight the WiFi network required and press the **Accept** button.

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

6) Highlight **V** (located at bottom of LCD display) and press the **Accept** button.

Operations

Use this menu to set the following operating parameters:

* Min temp
* Edit parcels percentage
* Always brake
* Add short cycle

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 defined parcel. 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 the **Service** menu button.

2) Use the **Arrow** buttons to highlight **Operations**, then press the **Accept** button.

3) Press the **Arrow** buttons to highlight the required parameter.

4) Enter the required value.

5) Check that the current values have been updated.

6) Press the **Back** button to return to the main menu.

Always brake- This option will always apply the brake to at least one drive wheel when the robot is stationary. This will prevent the robot from rolling down slopes when stopped. If this option is enabled, press the **number 5** button on the numeric keypad to release the brakes and allow the robot to be pushed.

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 its serial number.

To change the name of the robot:

1) Press the **Service** menu button.

2) Press the **Arrow** buttons to highlight **Device**, then press the **Accept** button.

3) Highlight **Robot name** and press the **Accept** button.

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

5) Use the alpha-numeric keyboard to enter the new name. Highlight each character. Press the **Accept** button to accept each character. To delete a character, highlight it then press the **Accept** button.

6) Highlight **V** (in the bottom row) and press the **Accept** button.

7) Press the **Accept** button to accept the new name.

8) Press the **Back** button to return to the main menu.

Device info

To see the **Device info**:

1) Press the **Service** menu button.

2) Press the **Arrow** buttons to highlight **Device** then press the **Accept** button.

3) Highlight **Device info** and press the **Accept** button.

4) Press the **Arrow** buttons to scroll through the list.

Device info options include:

Option	Description
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.
MAC address	Media Access Control address.

System version

To see the System version information:

1) Press the **Service** menu button.

2) Press the **Arrow** buttons to highlight **Device**, then press the **Accept** button.

3) Highlight **System version**, then press the **Accept** button.

4) Software version - 4.2.*X*. (*X* indicates the latest version).

5) Details - Select **Details** and press the **Accept** button.

6) Press the **Arrow** buttons to scroll through the list.

System version options include:

Option	Description
Brain version	Current artificial intelligence version.
Bootloader details	Bootloader version.
Firmware details	Firmware version.

Security

Press the **Service Settings** button, press the **number 5** on the keypad, or scroll down to **Security,** and press the **Accept** button.

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.

To enable the pin code:

1) Highlight the check box. Press the **Accept** button to toggle the setting. Enable the PIN code ON or OFF.

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

2) Press the **Accept** button to accept the new setting.

To change the pin code:

1) Enter the required numbers and press the **Accept** button.

6.5.6 Advanced Parameters

Press and hold the **number 0** on the numeric keypad until the **ADVANCED PARAMETERS** menu appears. **ADVANCED PARAMETERS** options include:

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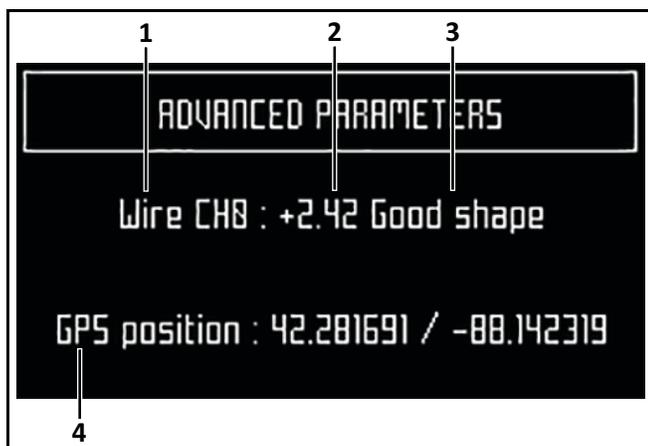
1 – **Wire channel numbers (Wire CH#) -** This is a list of currently defined peripheral wires.

2 – **Distance from 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.

6.5.7 TECHNICIANS SETTINGS Menu

Use this menu to configure advanced operations of the robot.

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

The following options are provided:

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

Smartbox Replacement

Replacing the Smartbox will void the warranty if not performed by ECHO Robotics.

Infrastructure

Use the operations in this menu to configure peripheral wires, parcels, and stations.

Peripheral wires

From the **TECHNICIANS SETTINGS** menu select **Infrastructure** then select **Peripheral wires.** The **WIRES SETTINGS** menu will display.

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

Select a wire and press the **Accept** button to see the wire properties.

Wire properties include:

- Signal channel
- Reverse phase (Do not use the reverse phase option in the robot. The person installing the wiring must switch its polarity instead of using this option.)
- Delete Wire CH#

Create new wire

Use to Create a new wire. This option is only present if no wires have been defined.

To 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 press the **Accept** button.

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 menu. This value must be positive. If this value is negative, reverse the wires in the charging station.

7) Click the **Back** button to exit the menu.

The newly created wire will appear in the **Wire settings** menu. Wire settings options include:

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 menu. 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.

Parcels

The Parcels menu lists the defined channels and their associated parcels. One parcel is associated with each wire.

Press the **Back** button until the **TECHNICIAN SETTINGS** menu appears. Select **INFRASTRUCTURE** then select **Parcels**.

Selecting a parcel and pressing the **Accept** button displays the following options:

- Name
- Return direction
- Min/Max cycle times
- Use Track Border
- Trackbord. Min.
- Trackbord. Max.
- Min. bounce angle
- Max. bounce angle
- Perimeter
- Neighboring parcels
- Start zones

Name

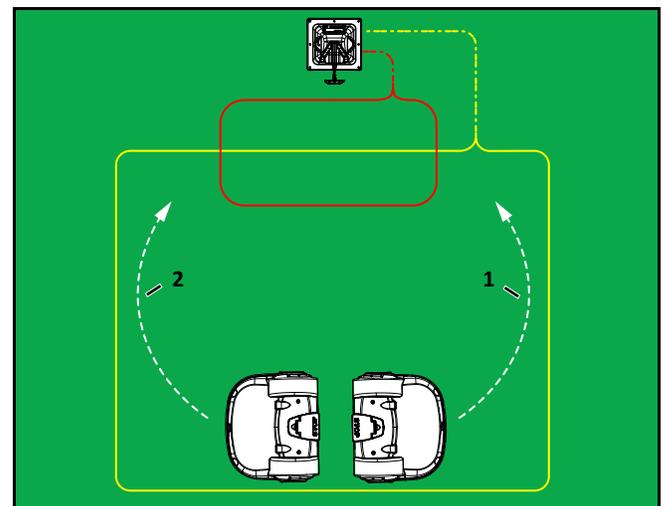This indicates the current name of the parcel. The name can be edited.

Return Direction

This defines the direction (clockwise or counterclockwise) in which the robot returns to its charging station.

Set the value of this parameter to ensure that the robot can return to the charging station in the most efficient manner.

1 – Counterclockwise return direction
2 – Clockwise return direction

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

Min/Max Cycle Times

Use Min/Max Cycle Times to override any autonomous behavior that would normally define cycle times and force the robot to always return within a certain amount of time (max), or always stay out for at least a certain amount of time (min).

Use Track Border

This parameter defines whether the robot uses the Track Border range 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 must be checked OFF for the Station Loop.

Trackbord. Min./Trackbord. Max.

Theses are minimum and maximum values allowed for the Track Border range. The robot will select a random value between the defined values.

The default minimum value for **Trackbord Min**.is 2.62 ft. (0.8 m). The default maximum value for **Trackbord. Max.** is 9.84 ft. (3.0 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 between 60° and 120°.
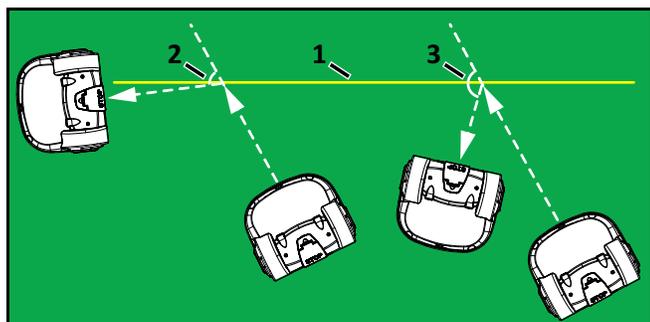
1 – Peripheral wire
2 – Min. Bounce Angle
3 – Max. Bounce Angle

Perimeter

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

The recommended value of this parameter is the length of the peripheral wire around the working area. The default value is 3280.84 ft. (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 the robot can move directly from one parcel to the other. In the following figure:

• Parcel 1 is a neighbor of Parcel 2
• Parcel 3 is a neighbor of Parcel 2
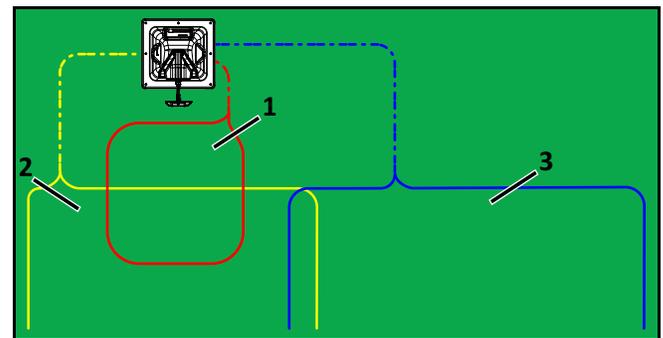
1 – Parcel 1 (area inside Station Loop wire)
2 – Parcel 2
3 – Parcel 3

StartZones

Use this option to display a list of the defined start zones and allow the creation of a new start zone. Start zones define where the robot will start working after it has left the charging station. Start zones are set for each zone. The robot will begin working in the start zone that is set for that zone.

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

Edit Parcels Percentage

Use this start zone menu option to view and set the percentage values for all parcels. The percentage value determines the probability that a zone will be selected by the robot when leaving to work. The percentage does not represent the ratio of time the robot will spend working in a particular zone. Once a zone is selected by the robot, the robot will work an entire work cycle in that zone.

Create new start zone

Use this option to create a new start zone and define it's properties. For each start zone the line below it

shows some characteristics of the start zone. Start zone properties include:

1) **Coming from Parcel** - This option appears of you are defining a start zone for a parcel.

2) **Direction** - This specifies the clockwise or counterclockwise direction the robot will take to move along the Track Border range after leaving the charging station.
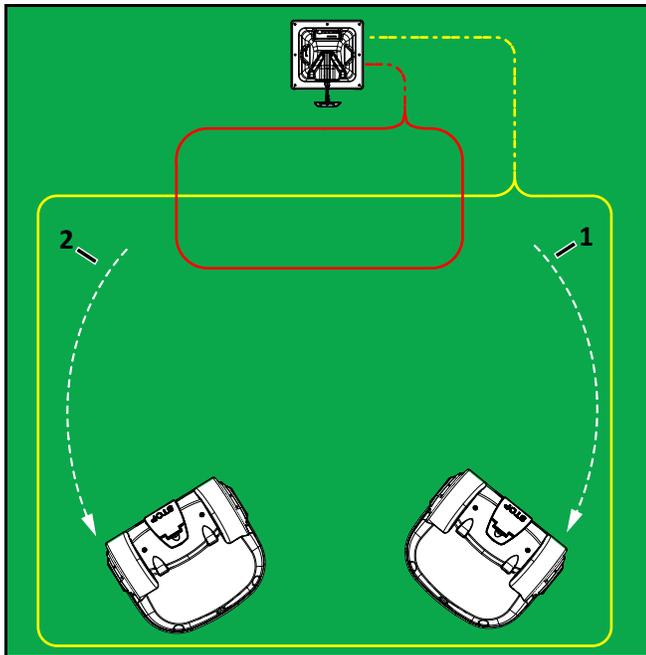
1 – Counterclockwise direction on the Track Border range
2 – Clockwise direction on the Track Border range

3) **Distance Min/Max -** This is the distance the robot will travel along the Track Border range after leaving the charging station and then turn into a parcel to start working. A random value between the minimum and maximum values will be selected.
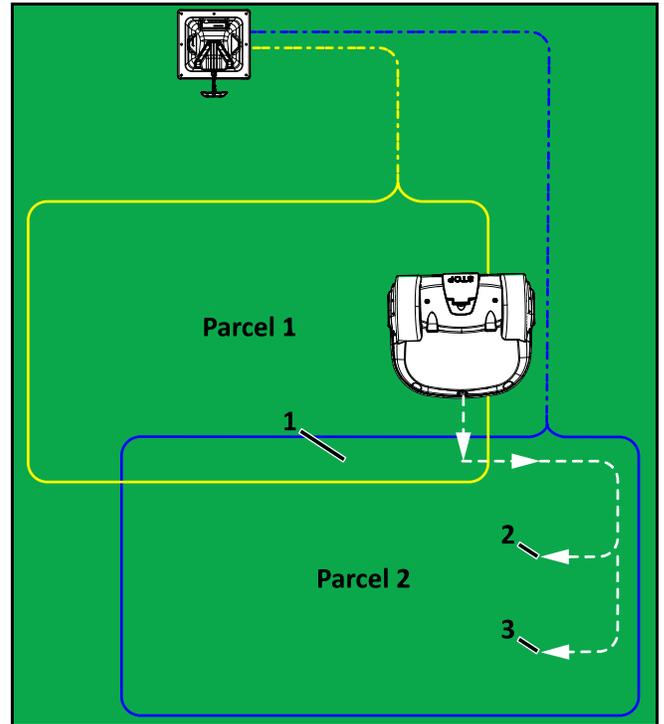
1 – Track Border range
2 – Distance minimum
3 – Distance maximum

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 following figure).

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

4)   **Angle Min/Max -** This is the angle that the robot will turn through to take it into the parcel to start working. Minimum and maximum values are defined and the robot will choose a random value between the defined limits.
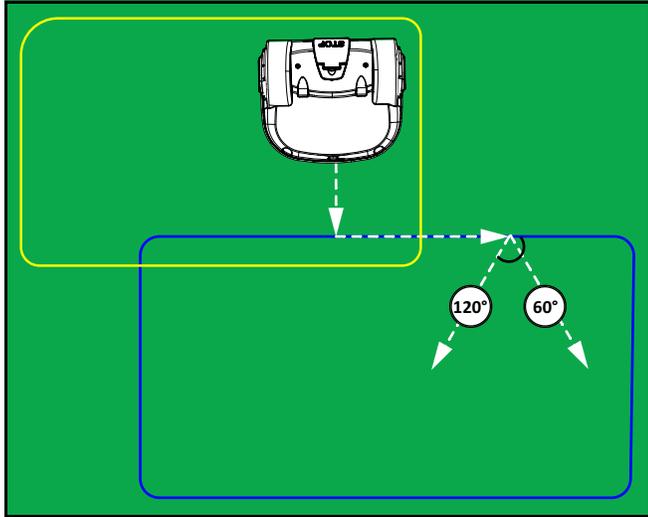
5)   **Delete Start Zone -** Allows you to select and delete a specific start zone.

Edit percentage

Use this start zone menu option to edit the percentages applied to different start zones. If only one start zone is defined this value must be set to 100%. Do not edit the percentage until more than one start zone has been defined.

Stations

In the **TECHNICIAN SETTINGS** menu, select **INFRA-STRUCTURE** then **Stations** then press the **Accept** button, the **Paired Stations** menu will appear.

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. Station properties include:

| Property	Description
Create manual station	Allows the manual creation of a station.
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 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.
Exit Parameters	This property is used to create a specified exit minimum and maximum distance while on track once the robot leaves the station.
Delete	Use to remove the manually created station from the installation.

Service

In the **TECHNICIANS SETTINGS** menu, select **Service**, then press the **Accept** button. The **Service** menu contains the following options:

- Calibrations
- Information
- Tests
- Software Update
- Mapping
- Replace the Smartbox
- Factory Reset

Calibrations

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

1) If a new cutting head has been installed, press the **Arrow** buttons to select **Calibrate now**, then press the **Accept** button.

2) Close the lid.

3) The cutting heads will be rotated and the rotational speed will be 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 - Use this option to calibrate cutting height values. Cutting height values need to be calibrated if:
• erroneous (negative) cutting height 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 will lift to their maximum height. Their position during this movement is the raw position. When the maximum height is reached, it is the homing position. The homing position is assigned a scalar value. When the homing position is reached, lower the cutting heads to the required height.

1) To calibrate the cutting height, press the **Arrow** buttons to select **Calibrate now,** then press the **Accept** button.

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

Options in the **Information** menu include:
• **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. The correct range is 82-94 kΩ.
• **Battery current -** Displays the value of the battery current.
• **Battery voltage -** Displays the value of the battery voltage.
• **Left side voltage -** Will only display voltage while connected to charger on the left side.
• **Right side voltage -** Will only display voltage while connected to charger on the right side.

Tests

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

Complete the tests before the robot is delivered to a customer, and at the end of a regular service.

To execute a test:
• Press the **Arrow** buttons to select the test(s) you want to execute.
• Press the **Accept** button to select the test.
• Repeat this for all tests required.
• Select **Start** and press the **Accept** button.

The robot will start executing each of the selected tests. Follow the instructions given on the menu. Tests option include:

1) **Charge -** This test checks if the robot can detect a charge, and if the 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 test displays whether the robot can detect a voltage on the left and right side.
	KO means it can not detect a voltage on the left or right side. OK means that it can detect a voltage.

Current	This test displays whether a sufficient charge current can be detected. The value must be greater than 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.

Discharge required for current test - This message will display if the current battery level is above 95%. It is best to perform this test when the battery charge level is lower. |
| Physical charge test | Connect one side of the robot to the charging station.

The result will be displayed.

Repeat this for the other side.

If the results of the test are KO, check the connections between the robot and the charging station. |

2) **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) |

Physical bumper test	Check that Bumper Left Bumper Right are listed below Activate sensors.

If these are listed under Disable Sensors, remove any constrictions that are compressing the bumper.

Press your hand against the right or left side of the bumper.

If the resistance is modified sufficiently the item will be removed from the list.

Repeat this process on the other side of the bumper.

If an item remains in the list, the bumper is not functioning correctly and needs to be replaced |

3) **Smartbox -** This test checks all the functionality of the Smartbox panel.

   – Follow each of the instructions as they appear on the menu.
   – Press to answer Yes to a question and Go to Next Page to answer No.
   – If the item being tested is operating correctly it will disappear from the list.

4) **Lift Sensors -** This test checks whether each of the lift sensors is responding correctly.

X/Y LIFT_SENSOR	X represents the current test in the current sequence.

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

Physical lift sensor test	Check which Lift sensors are listed below Activate sensors. If the lift sensor is operating correctly, the item will be removed from the list. Repeat for the remaining lift sensors. If there are sensors listed under Disable Sensors, push down on the lift sensor to deactivate it. When all the items have been removed from the list the test is complete. Any items that remain in the list are not functioning correctly and need to be replaced.

5) **Backwards Sensors -** This checks that the backwards sensors are operating correctly.

X/Y BACK_SENSORS	X represents the current test in the 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 activiting them. (CollisionLeft CollisionRight)
Disable Sensors	The number of sensors that need to be de-activated. (CollisionLeft CollisionRight)
Physical lift sensor test	Check which Lift sensors are listed below Activate sensors. If the lift sensor is operating correctly, the item will be removed from the list. Repeat for the remaining lift sensors. If there are sensors listed under Disable Sensors, push down on the lift sensor to deactivate it. When all the items have been removed from the list the test is complete. Any items that remain in the list are not functioning correctly and need to be replaced.

6) **Signal Sensors** - This test checks the functionality of the coil that is used to detect a signal on a peripheral wire. The following information is shown:

X/Y COIL0_CENTER	X represents the current test in the current sequence. Y represents the total number of tests to be performed in the current sequence. COIL0_CENTER is the name of the current test.
Detecting wire < {value}	{value} is the value of the "track value". If the result of the test is less than this value, the test is successful. CH{A}:{result value} If the test result is greater than the defined "track value", it will be listed here. Move the robot closer to the signal wire detected. When the value is less than the "track value", the item should be removed from the list.

7) **Drive Motor -** This test checks the functions of the drive motor.

Drive Motor Test	Press the check button to start the test. Close the lid when requested. The robot will move forward a short distance then stop and beep. Open the lid. If the robot moved forward, answer Yes to the question by pressing the **Accept** button. If the robot moved backwards answer No to the question by pressing the **Back** button. If this is the case, reverse the connections on the drive motor cable. Close the lid when requested. If the robot did not move, or only one wheel moved, the test will fail and the report will indicate the problem. Visually inspect the drive motors to see if there is a blockage.

8) **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.

9) **Sonar Sensors -** This test verifies if the sonar sensors are operating correctly. Replace any defective sensor. An indication of which sensor needs to be replaced is given.

10) **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 cover. This circuit needs to be open when the lid is open and when the lid is pressed down acts as the stop button. This requires that all magnets and relays are functioning properly and that they are correctly positioned.

11) **Battery Balancing -** The robot must be connected to the charging station to conduct this test. This test checks the levels of each of the battery cells and waits at the station until they are equally balanced. Having cells with equal levels improves the life of the battery.

Software Update

This menu enables you to perform a software update. The current software version is displayed.

Mapping

This option enables you to clear the maps that robot stores when it is using GPS to return to a station.

This operation should also be performed if the robot is moved to work in a different geographical location and a new GPS location point is to be defined.

Reset Factory

This performs a factory reset of all the robot configuration parameters.

This operation removes all the configuration parameters but RETAINS the current software version.

After a reset power cycle the robot.

6.5.8 Advanced Parameters

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

From the **TECHNICIAN SETTINGS** menu, select **Advanced Parameters**. The options in this menu include:

Option	Description
Max. speed	Sets the maximum speed at which the robot will move (maximum speed is 2.2 mph [1.0 m/s]).
Wire crossing dist.	This value should not be changed unless consulted by an ECHO Robotics representative.
Min. temp.	Sets the lowest outside operating temperature in which the robot will operate.
Disable sleep mode	Enables or disables sleep mode. Turns on/off idle time.
Max idle time	Sets the maximum idle time. Default time is 15 minutes.

7 Error Messages

Error messages are displayed when an alarm has been raised. For more detail on the alarm and recommend action, visit myrobot.echorobotics.com and access the alarm tab. Report error messages to your authorized ECHO Robotics dealer. Always note the date, time, and robot serial number.

8 Maintenance

Follow all Safety Information when performing maintenance procedures.

Perform maintenance procedures regularly throughout the season. Have an authorized ECHO Robotics dealer service the robot once a year.

When maintaining the robot for optimum performance, do not attempt to make any physical changes to the robot. Doing so may disturb the robot's operation, causing an accident, and damaging parts.

NOTE: If unusual operation or physical damage is noticed, contact an 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.

8.1 Maintenance Chart

Component	Weekly	6 months	Annual
Cover	Inspect /Clean		
Charge contacts			
Sonars	Clean		
Coil			
Bumper	Inspect /Clean		
Chassis			
Electrical cables		Inspect	
Front and rear lift sensors	Inspect /Clean		
Front wheels	Clean	Inspect	
Rear wheels			
Battery			Charge

8.2 Winter Service Check List

Basic Information			
Client		Technician	
Serial number		Field	
Date		Installation date	

Robot Information (record as appropriate)	
Software version	
Check history on www.myrobot.echorobotics.com	

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

Service Inspections
Cover Assembly
Check the cover retaining 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 screws are tight.
Check the integrity of the sonar electrical connectors, clean as necessary.
Clean the charge contacts.
Clean the Smartbox LCD screen. Check that there is no moisture on the exterior of the screen or condensation in the interior of the screen.
Smartbox: If a problem has been indicated with the GPS signal, contact ECHO Robotics.
Inspect the inside of the cover and the chassis:
Check all electrical cables and connections for corrosion, cuts or abrasions.
Verify proper attachment and routing of cables.
Inspect for corrosion on the chassis.
Chassis
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 should spin freely without wobbling. Verify that the wheel bearings are sealed.
Check the rear tires for excessive wear, replace as necessary.
Verify that the front lift sensors move up and down with no resistance, lubricate as necessary.

Service Inspections
Check the front and rear lift cushions for cracking or splitting, replace as necessary. Replace them once every two years regardless of their condition.
Verify that the lifting strap has no cuts or abrasions
Check for excessive lateral movement of the cutting head upper and lower brackets.
Verify that the cutting discs spin freely and do not wobble
Verify that the anti-friction discs spin freely (discs must spin independently from the cutting discs).
Inspect the rear lift sensors.
Inspect all electrical cables for cuts or abrasions. Verify that all connectors are securely assembled. Replace damaged cables.

8.3 General Inspection and Cleaning

During periods of wet weather, perform inspection and cleaning once per day.

1) Remove the robot from the charging station and place it on a clean, flat surface.

2) Turn the robot OFF.

3) Visually inspect the unit, replace damaged components.

4) Check all electrical connectors, reconnect if necessary.

5) Use a plastic scraper, nylon brush, compressed air, or a damp cloth to clean away dirt, grass, sticks, or obstructions.

**NOTE**: Do not use a high-pressure washer or running water for cleaning. **Never use solvents.**
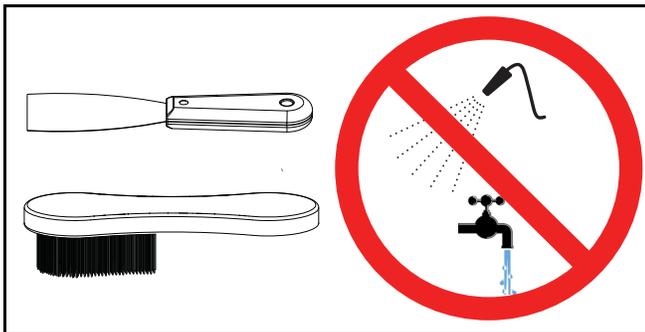
8.3.1 Cover and Electrical Cables

1) Clean the outside of the cover.

2) Stand the robot on end. Disconnect the two electrical cables (located in circled area).
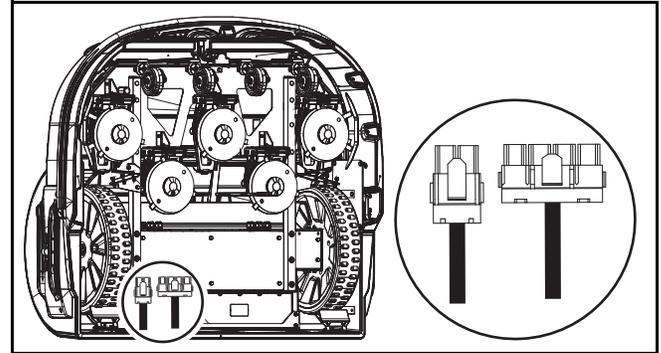
3) Lay the robot back onto flat ground.

4) Remove the screws and washers (2 front cover screws and 2 rear cover screws and washers) to remove cover.
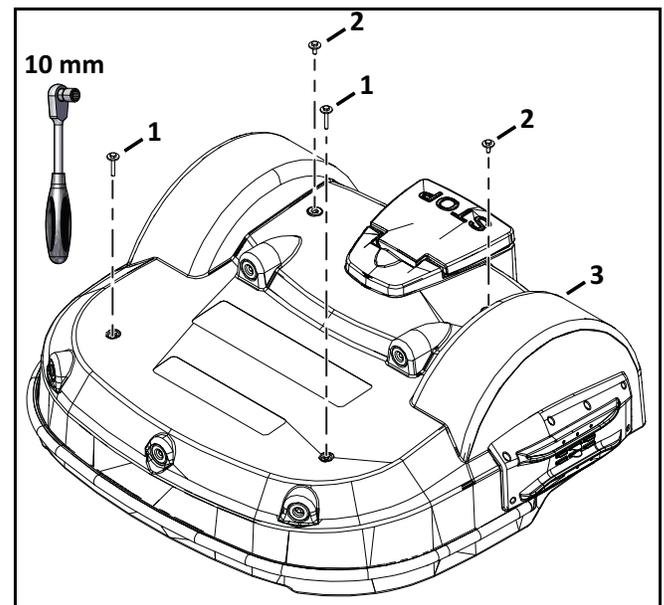
1 – Front cover screw
2 – Rear cover screw and washer
3 – Cover

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.

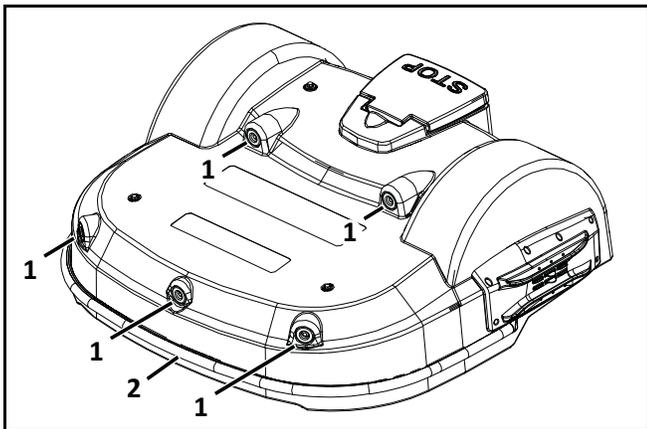11) Lay the robot back onto flat ground.

8.3.2 Charge Contacts

Clean the right and left side charge contacts once per week.
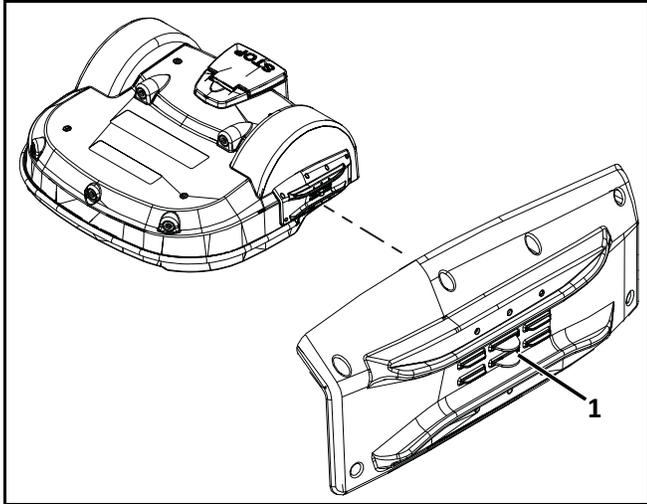
1 – Charge contact (left side shown)

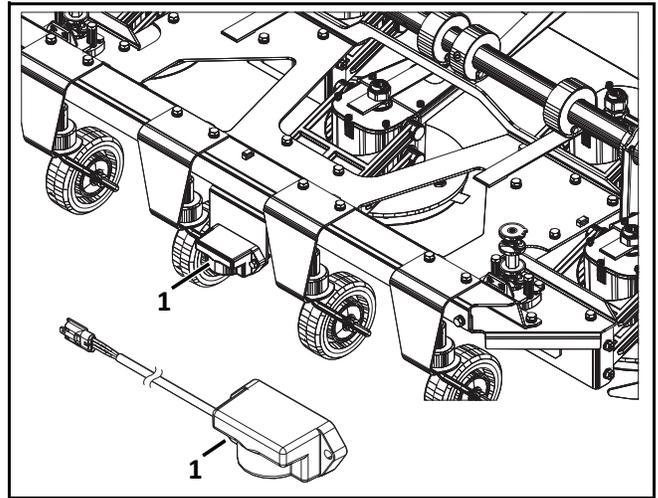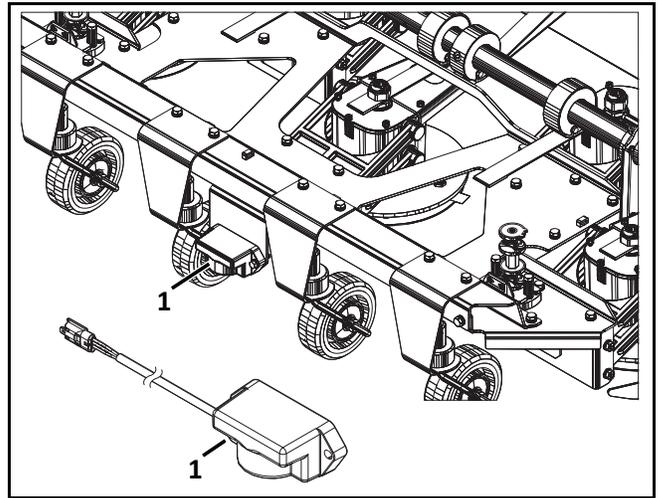### 8.3.3 Sonar Sensors and Bumper

Clean the sonar sensors and bumper 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
2 – Bumper
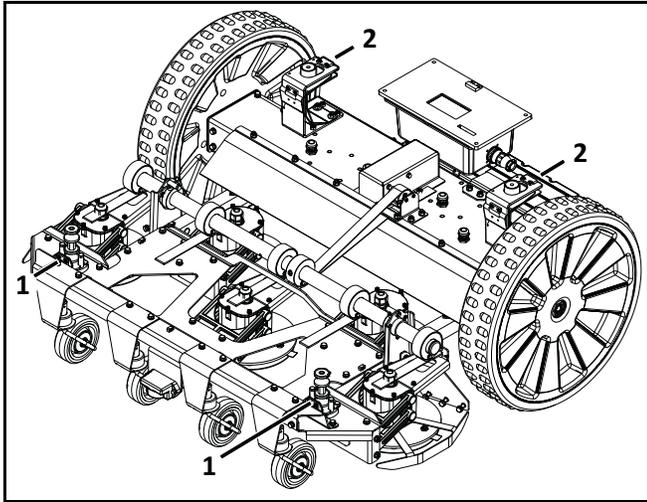
8.3.4 Chassis and Coil

Clean the chassis and coil once per week. Inspect the coil for damage or exposed wires on the cable.

1 – Coil

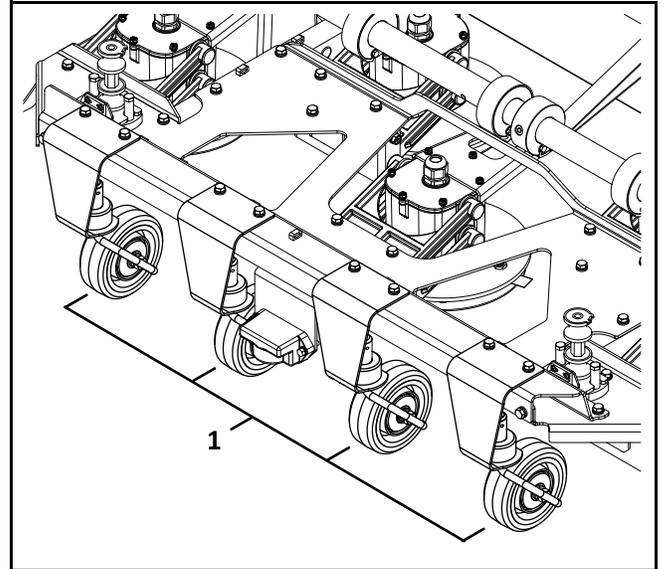### 8.3.5 Front and Rear Lift Sensors

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

1 – Front sensor
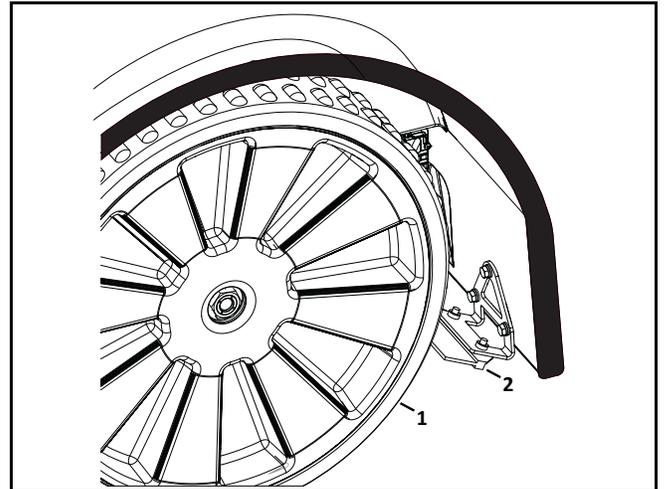2 – Rear sensor

8.3.6 Front Wheel Assemblies

Verify that the front wheels and wheel axles rotate easily. Clean the front wheel assemblies once per week.

1 – Front wheel

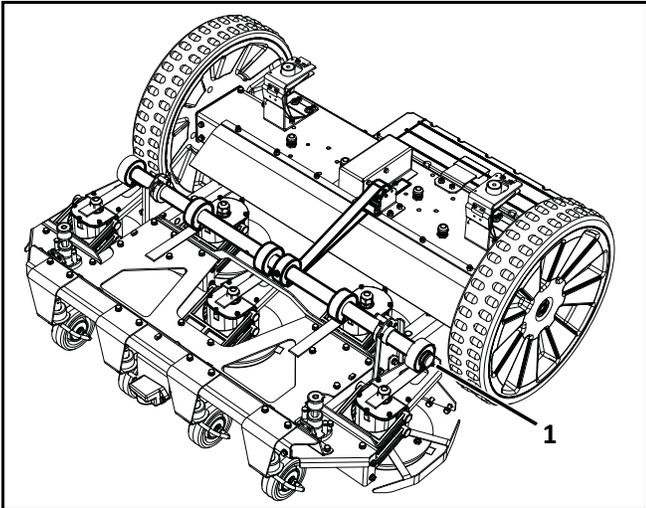### 8.3.7 Rear Wheels and Rear Wheel Brushes

Clean the rear wheels and rear wheel brushes (if installed) once per week. **NOTE:** Cut-away view of cover shown.

1 – Rear wheel
2 – Wheel brush

8.3.8 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

8.3.9 Cutting Heads

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.
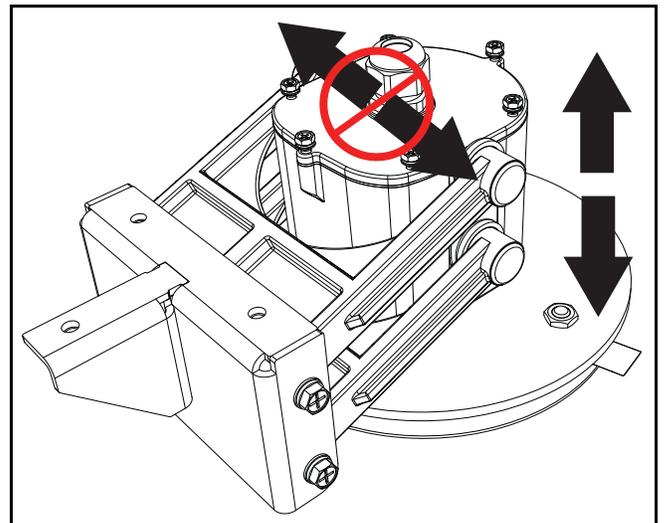
1 – Cutting Head Assembly

8.3.10 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.

9 Service Procedures
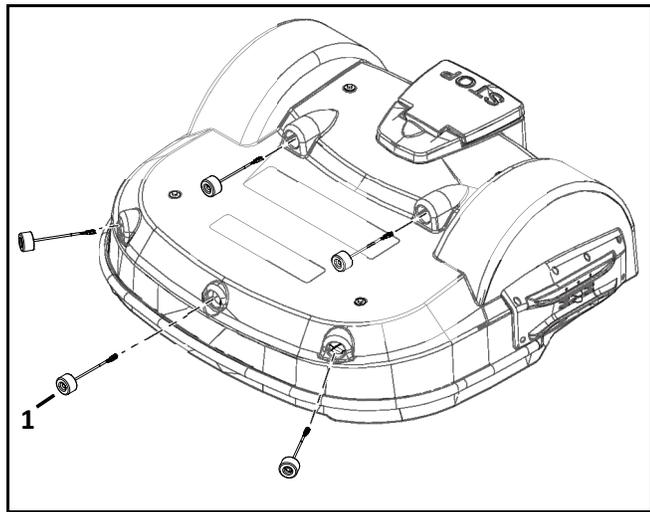
IMPORTANT: Move the power switch to the OFF position before starting any service procedures.
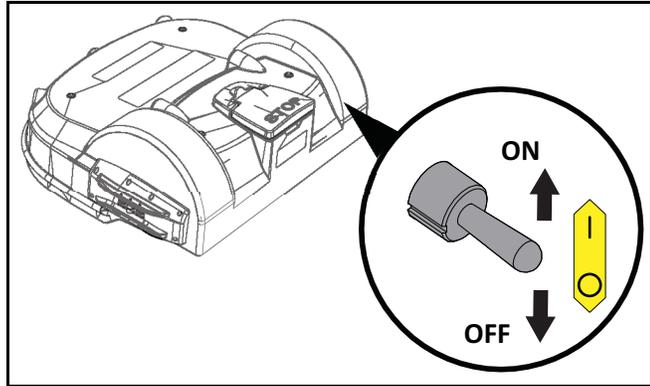
9.1 Sonar Replacement

1) Remove the cover.

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

1 – Sonar

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.

9.2 Bumper Replacement

NOTE: The bumper screws are accessed from the inside of the cover.

1) Remove the cover.

2) Remove the plastic retaining clips that secure the wiring protection panels to the body.

3) Remove the right and left side bumper caps from the bumper.
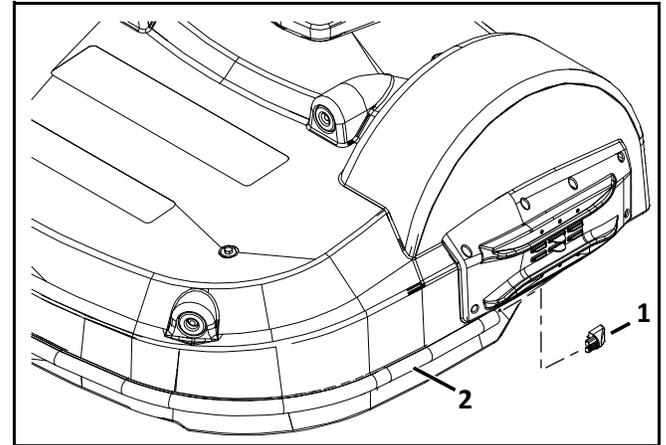
1 – Bumper cap
2 – Bumper

4) Disconnect the bumper cable from the bumper.

5) Remove the bumper retaining screws, washers, and bumper assembly.

1 – Bumper retaining screw and washers

6) With the body in the upright position, lay the new bumper in position and feed the connector through the body.
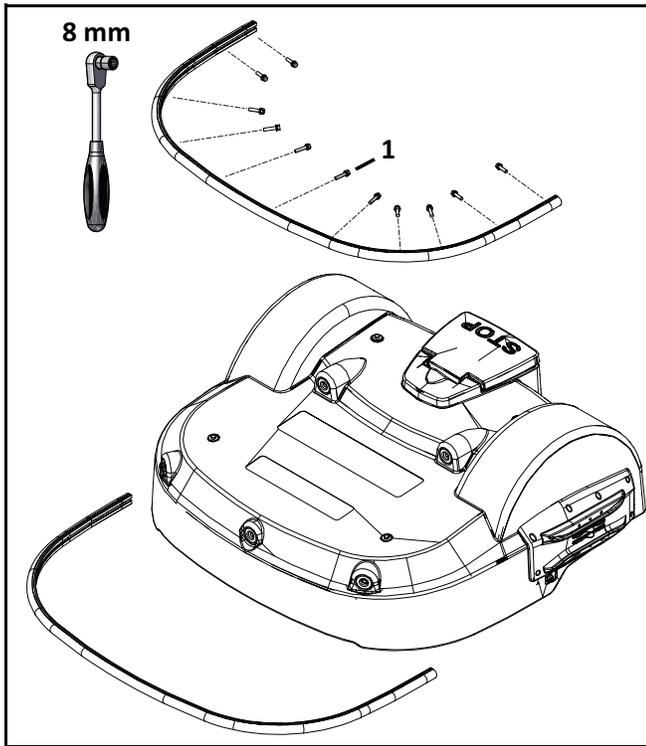
7) Install the bumper caps to the body.

8) Secure the bumper with bolt closest to the connector (right side).

9) Next, secure the bumper on the opposite side with the bolt closest to the bumper cap (left side).

   NOTE: You may need to stretch the bumper towards the bumper cap to insure a flush fit between the bumper and bumper cap.

10) Once the bumper is secured on both ends, install the remaining bolts and tighten to 1.5 lbs•ft (2 N•m).

11) Connect the bumper cable.

12) Reinstall wiring protection panels with retaining clips.

13) Reinstall body using the four bolts and reconnect wiring harnesses.

14) Complete the Bumper Service Test.

9.3 Front Lift Cushion Replacement

NOTE: Detail of left side shown.

1) Remove the cover

2) Remove the flexible cap and screw.

3) Remove the front lift cushion.
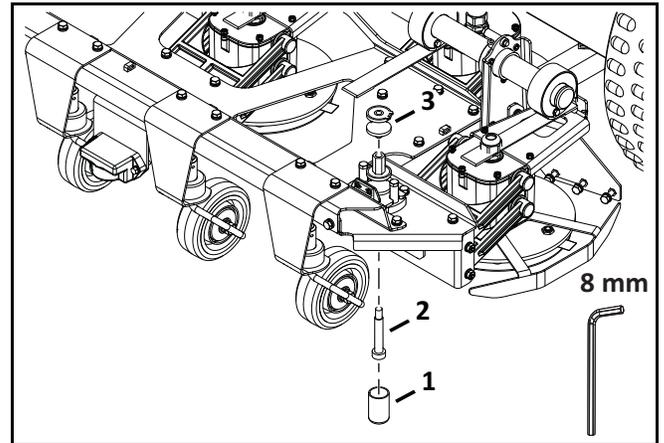
1 – Flexible cap
2 – Screw
3 – Cushion

4) Assemble the new front lift cushion.

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

6) Replace the flexible cap.

7) Complete the Lift Sensor Service Test.

9.4 Rear Lift Cushion Replacement

1) Remove the cover.

2) Use pliers to loosen the rear lift cushion and remove it from the bracket.

3) Assemble the new rear lift cushion.

4) Complete the Lift Sensor Service Test.
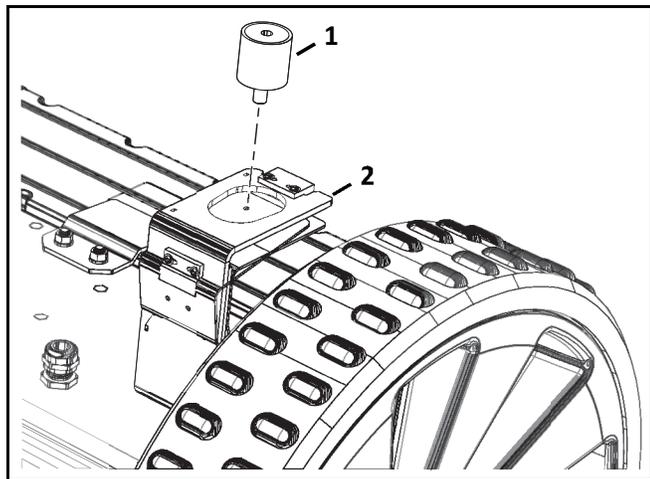
1 – Rear lift cushion
2 – Bracket

9.5 Front Wheel Replacement

1) Remove the outside 10 mm nut and washer.

2) Remove the wheel.

3) Replace inside nuts and washer if required.

4) Assemble the new wheel to the axle.

5) Assemble the washer and nut. Tighten the nut to 7.5 lbf•ft (10 N•m).
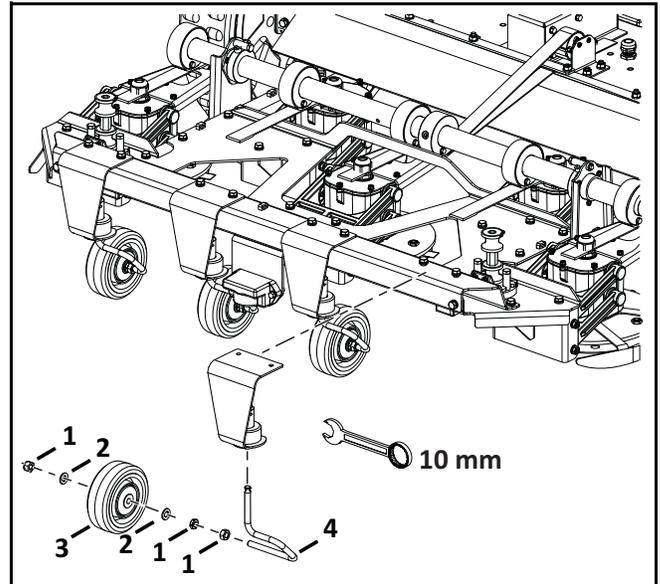
1 – Nut
2 – Washer
3 – Wheel
4 – Axle

9.6 Rear Wheel Replacement

NOTE: The wheel nut remains captive with the rear wheel assembly.

1) Remove the cover.

2) Loosen the wheel nut and remove the rear wheel.

3) Remove the washers from the gear motor output shaft. Discard the washers.

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

5)   Apply Loctite® 243 Blue Threadlocker to the interior threads of the wheel nut. Place the rear wheel assembly onto the gear motor output shaft, tighten the wheel nut to 48 lbf•ft (65 N•m).
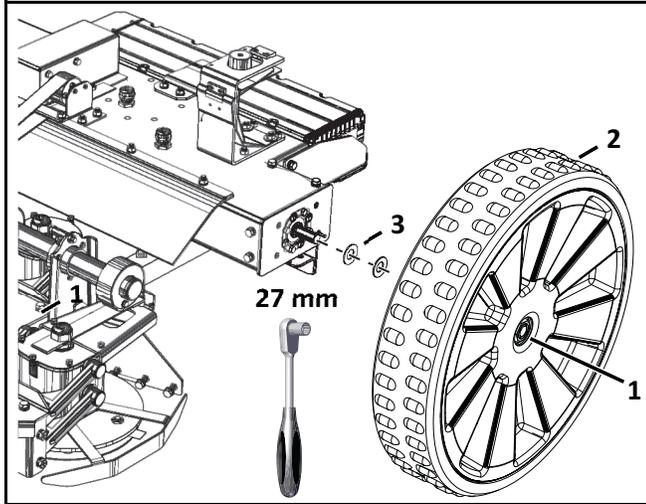
1 – Wheel nut
2 – Wheel assembly
3 – Washer

9.7 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 washers from the electrical box.

1 – Screw
2 – Cover

3)   Disconnect gear motor cables from traction drive card.

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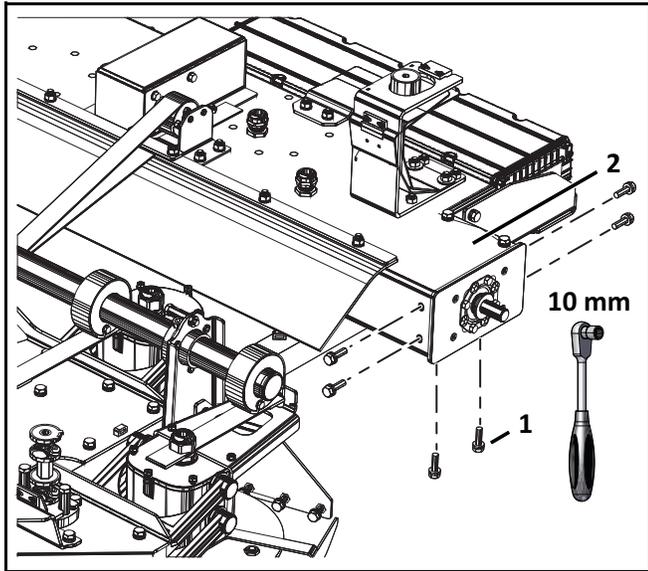
1 – Bolt
2 – Gear motor support

5) Remove gear motor assembly.
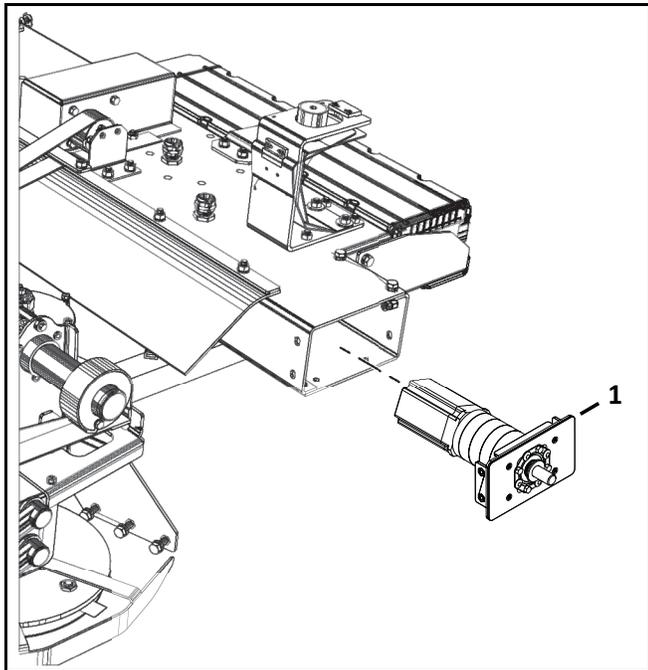
1 – Gear motor assembly

6) Remove the four screws from the gear motor.

7) Remove c-clip from output shaft.
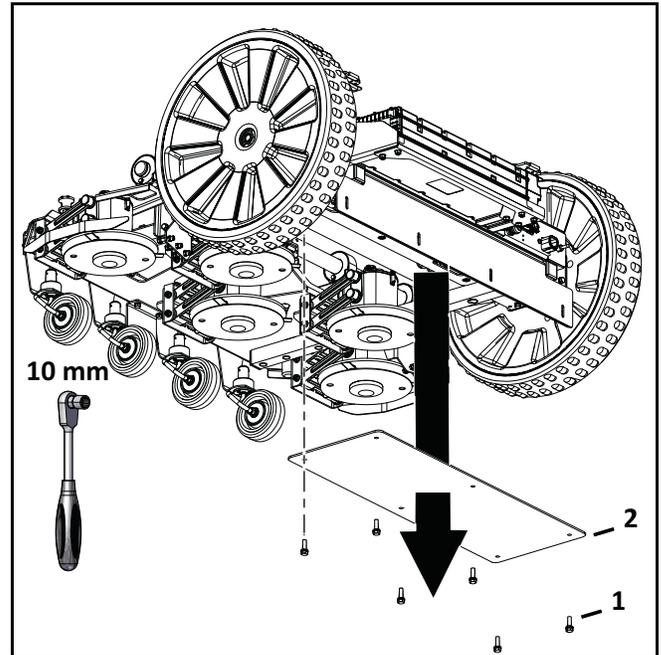
8) Remove gear motor from bracket assembly.
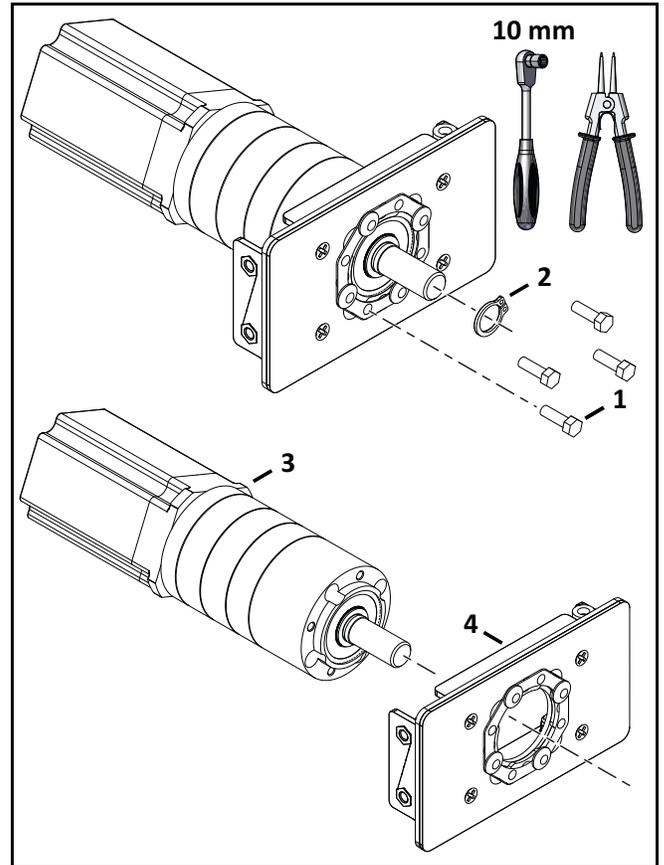
1 – Screw
2 – C-clip
3 – Gear motor
4 – Bracket assembly

9) 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.

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

11) Place new motor and bracket assembly into electrical box.

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

13) Reconnect gear motor cables to traction drive card.

14) Assemble electrical box cover onto electrical box.

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

16) Assemble rear wheel.

17) Complete the Drive Motor Service Test.

9.8 Cutting Motor Cable Replacement

1) Visually inspect cables for cuts or abrasions.

2) Replace damaged cables.

3) Replace cable retention clips if necessary.

9.9 Lid Closure Problems

When the lid is closed, the message "Lid not closed, please select option again" may be displayed.

A closed circuit must exist between magnets on the lid and relays on the cover. 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 are positioned correctly.

The following image shows a representation of the lid, cover, magnet, and relays. There are two magnets on the lid and two sets of relays on the cover.
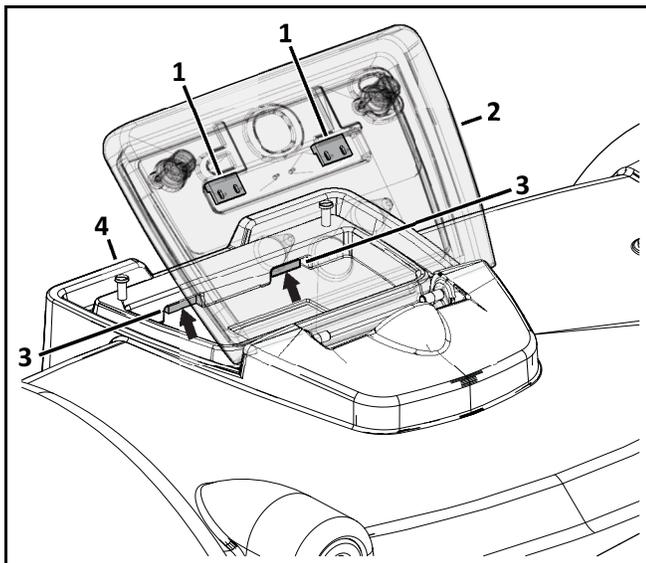
1 – Magnet (on stop button lid)
2 – Stop button lid
3 – Relay (on cover)
4 – Cover of robot

When the lid is closed the magnet must be in a position to correctly align with the reed relays on the cover. This alignment allows the circuit to close and the robot to operate.
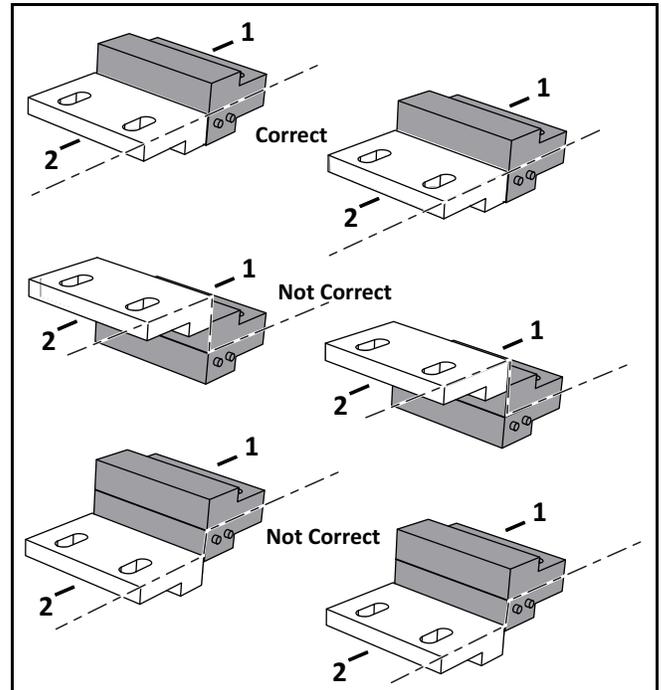
1 – Reed relay on cover
2 – Magnet (on stop button lid)

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 closing the lid, complete the Lid Service Test.

9.9.1 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 it's reference number.

NC must be on the bottom. This relay is identified as having the digit "4" it's reference number.

NOTE: The reference numbers are etched on the surface of the relays.
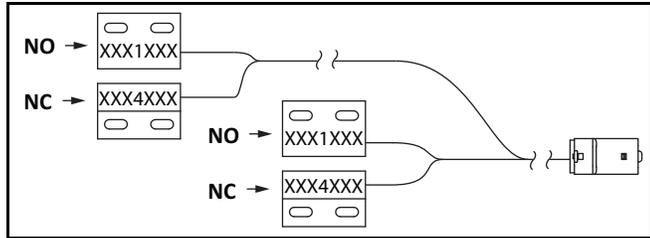
The relays are supplied as an assembly. The assembly contains two pairs of relays and the cabling between them.

When installing replacement magnets and relays, visually examine the position to ensure correct alignment. Complete the Lid Service Test

9.9.2 Magnets

Assemble the magnets to the lid as shown.
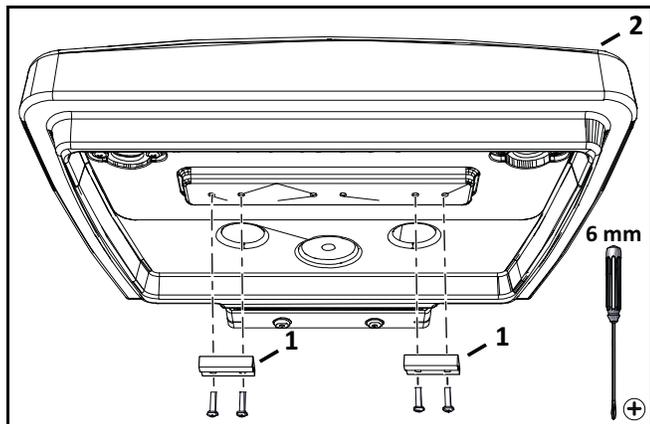
1 – Magnets

Place the magnets at the correct height so when the lid is closed or pressed down, the magnets connect with the correct relays. If necessary, place spacers behind the magnets. Complete the Lid Service Test after installing the magnets.

10 Robot Accessories

The Wheel Brush Kit and Groomer Kit are optional accessories for the robot.

10.1 Wheel Brush Kit

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

1) Remove the hole plugs from the cover.

2) Assemble the wheel brush to the brush holder.

3) Assemble the brush holder to the inside rear of the cover behind each rear wheel.
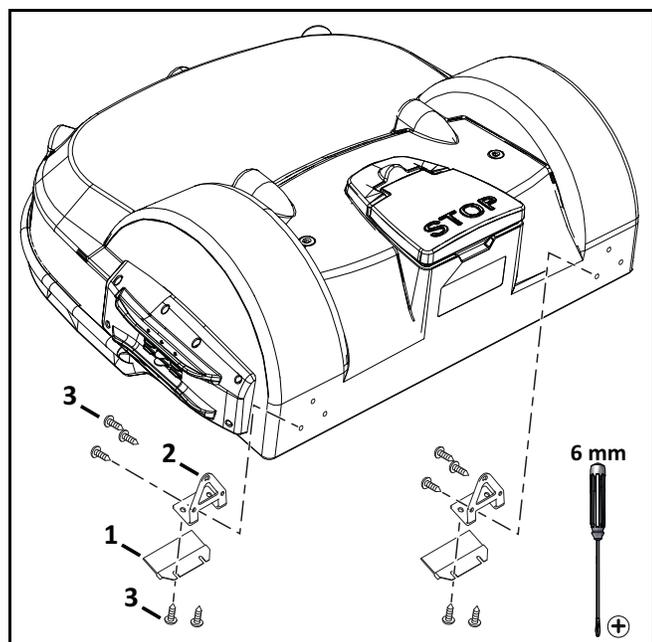
1 – Wheel brush
2 – Brush holder
3 – Screw M6 x 16 (10X)

10.2 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) Connect the springs to the support bar.

2) Connect the groomer support to the rear guard.
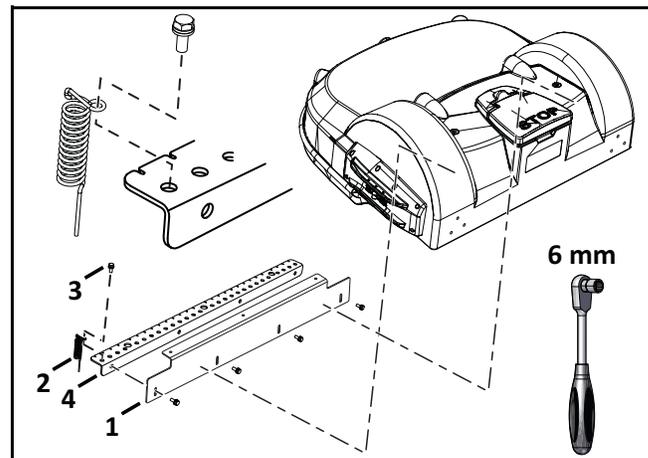
1 – Rear guard plate
2 – Springs (28X)
3 – Screw M6 x 16 (32X)
4 – Groomer support

11 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

11.1 Mower Cover

<1 lbf·ft
(<0.7 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)

1.5 lbf·ft
(2 N·m)

5 lbf·ft
(7 N·m)

5 lbf·ft
(7 N·m)

Ⓐ

Ⓐ

Ⓑ

Ⓑ

Ⓑ

Ⓑ

1.5 lbf·ft
(2 N·m)†

<1 lbf·ft
(<0.7 N·m)

†Loctite 243
 Blue Threadlocker

††Loctite 2701
 Green Threadlocker

11.2 Cutting Height

18 lbf·ft
(3 N·m)

18 lbf·ft
(3 N·m)

2 lbf·ft
(3 N·m)

1 lbf·ft
(1.5 N·m)

9 lbf·ft
(12 N·m)

4.5 lbf·ft
(6 N·m)†

9 lbf·ft
(12 N·m)

18 lbf·ft
(3 N·m)

1 lbf·ft
(1.5 N·m)

1 lbf·ft
(1.5 N·m)

1-1.5 lbf·ft
(1.5-2.0 N·m)

1-1.5 lbf·ft
(1.5-2.0 N·m)

1 lbf·ft
(1.5 N·m)

1 lbf·ft
(1.5 N·m)†

9 lbf·ft
(12 N·m)

1 lbf·ft
(1.5 N·m)

0.7 - 1.5 lbf·ft
(1 - 2 N·m)

1 lbf·ft
(1.5 N·m)†

†Loctite 243
 Blue Threadlocker

††Loctite 2701
 Green Threadlocker

11.3 Electrical Box, Battery, and Housing

2 lbf·ft
(3 N·m)

2 lbf·ft
(3 N·m)

2 lbf·ft
(3 N·m)

2 lbf·ft
(3 N·m)

11 lbf·ft
(15 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)†

A

A

9 lbf·ft
(12 N·m)

2 lbf·ft
(3 N·m)

†Loctite 243
 Blue Threadlocker

††Loctite 2701
 Green Threadlocker

11.4 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**

11.5 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)

4.5 lbf·ft
(6 N·m)††

2 lbf·ft
(3 N·m)†

48 lbf·ft
(65 N·m)

†Loctite 243
 Blue Threadlocker

††Loctite 2701
 Green Threadlocker

11.6 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)

0.75-1.5 lbf·ft
(1-2 N·m)

3.7-5.0 lbf·ft
(5-7 N·m)†

4.5-6.0 lbf·ft
(6-8 N·m)†

3.5-5.0 lbf·ft
(5-7 N·m)†

3.7-5.0 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

11.7 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

View A

†Loctite 243
 Blue Threadlocker

††Loctite 2701
 Green Threadlocker

11.8 Main Frame

1 lbf·ft
(1.5 N·m)†

9 lbf·ft
(12 N·m)†

9 lbf·ft
(12 N·m)†

1 lbf·ft
(1.5 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

11.9 Main Bars

1 lbf·ft
(1.5 N·m)[††]

4.5 lbf·ft
(6 N·m)[†]

1 lbf·ft
(1.5 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

11.10 Accessories

**4.5 lbf·ft
(6 N·m)**

**5 lbf·ft
(7 N·m)†**

A

A

**9 lbf·ft
(12 N·m)†**

†**Loctite 243
Blue Threadlocker**

††**Loctite 2701
Green Threadlocker**

11.11 Cover and Chassis

**11 lbf·ft
(15 N·m)**

**5 lbf·ft
(7 N·m)**

**2.25 lbf·ft
(3 N·m)**

**1 lbf·ft
(1.5 N·m)†**

**4.5 lbf·ft
(6 N·m)†**

**11 lbf·ft
(15 N·m)**

**1 lbf·ft
(1.5 N·m)†**

**1 lbf·ft
(1.5 N·m)**

**9 lbf·ft
(12 N·m)**

**48 lbf·ft
(65 N·m)†**

**9 lbf·ft
(12 N·m)†**

**9 lbf·ft
(12 N·m)**

**†Loctite 243
 Blue Threadlocker**

**††Loctite 2701
 Green Threadlocker**

12 Specifications

12.1 Capacity

Recommended working area[1]	Up to 6 acres (24, 281 m^2)
Number of sports fields per robot	1-2
Mowing width	41 in. (1033 mm)
Speed	2.2 mph (3.6 km/h)2.2 mph (1.0 m/s)
Maximum slope	30%

[1]Working area is highly dependent on shape, terrain, and working schedule.

12.2 Cutting

Number of cutting heads	5
Number of cutting blades	15
Rotation speed of cutting head	3000 rpm
Low cut (minimum)	0.75 in. (20 mm)
High cut (maximum)	4.0 in. (100 mm)
Adjustment of cutting heads	Electronic
Maximum noise level	<70 dB(A)

12.3 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 32 °F and 140 °F (0 °C and 60 °C)
Average annual consumption	830 kWh

12.4 Weight and Dimensions

Weight	156.5 lbs. (71 kg)
Length	43.7 in. (1110 mm)
Width	50.3 in. (1278 mm)
Height	20.3 in. (466 mm)

12.5 Software and Monitoring

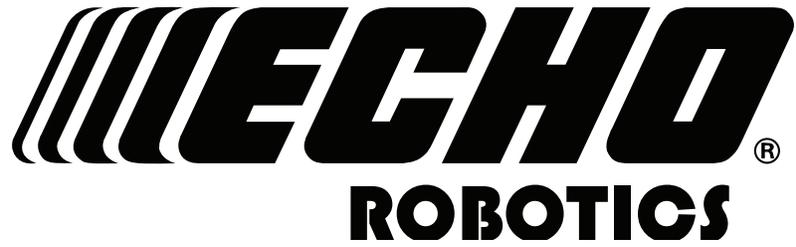| Security PIN code	
GPS positioning	Yes
APP robot management	

12.6 Safety

Sonar detection of obstacle (height and diameter)	Height 15.7 in. (400 mm) Diameter 2.0 in. (50 mm)
Lift sensors	
Collision sensors	
Bumper	Yes
Deflectors on the cutting head	
Tilt sensor	
Rollover sensor	

12.7 Dimensions

50.3 in.
(1278 mm)

39.4 in.
(1000 mm)

43.6 in.
(1110 mm)

20.3 in.
(515 mm)

31.6 in.
(804 mm)

12.0 in.
(306 mm)
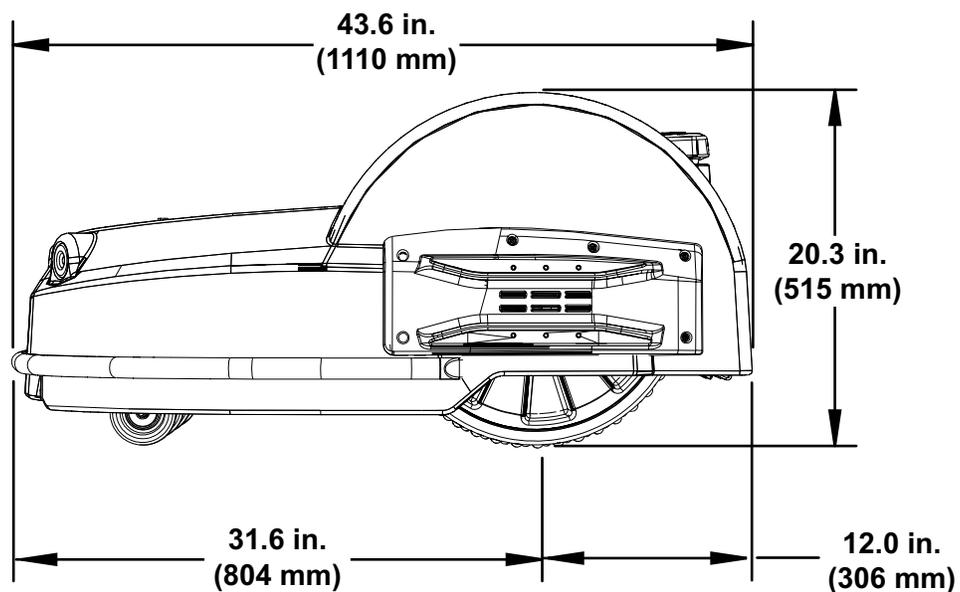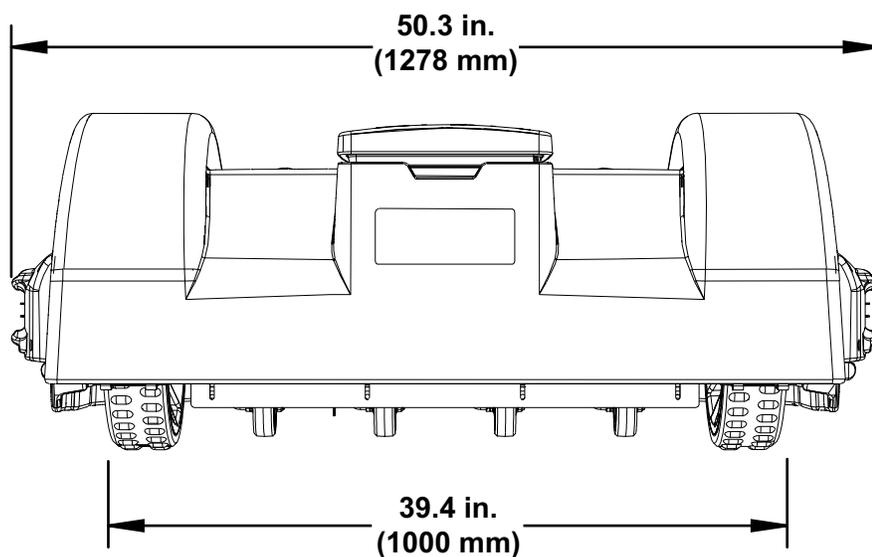
ECHO ROBOTICS

⚠ WARNING

Cancer and Reproductive Harm

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