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Robotic Mower Technical Manual TM-2000

P/N 99922205383

VERSION 1.3

03/23/2020

EN ENGLISH

Table of Contents

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

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

Genuine ECHO Robotics parts are available only from an authorized ECHO Robotics Dealer. Always supply a model and serial number when purchasing parts and assemblies. Only use and authorized ECHO Robotics Dealer for service procedures.

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

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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

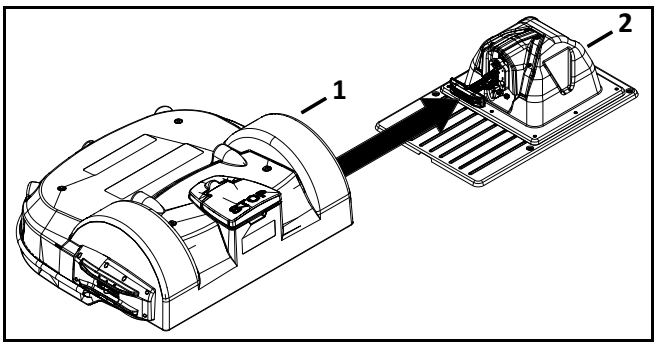
The enclosed message provides information necessary for the protection of the unit.

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.

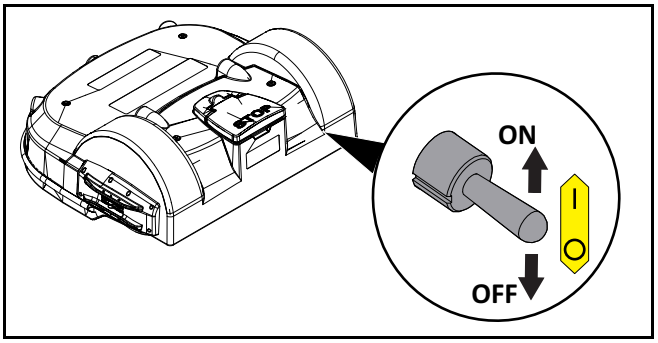
2 Charging and Turning the Robot ON

1) Place the robot on the charging station. Turn the charging station ON and charge the robot for a minimum of 80 minutes.

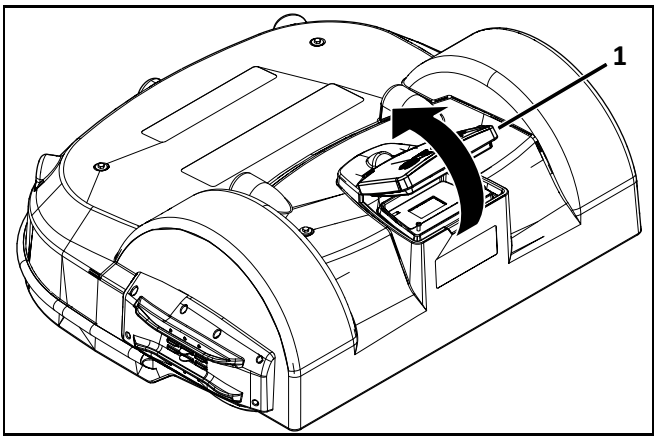


1 – Robot
2 – Charging station

2) Turn the robot ON. Use the power switch located under the cover on the back of the robot.

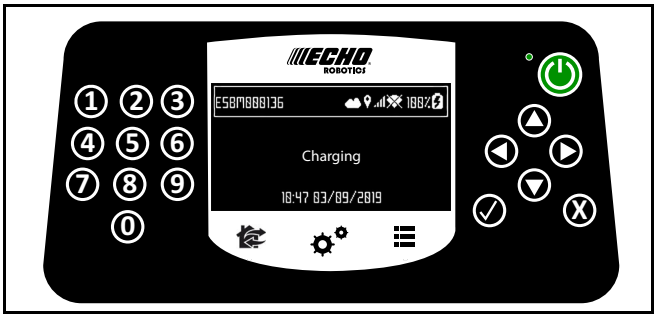


3) Open the stop button lid to access the Smartbox.



1 – Stop button lid

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



1 – Start button

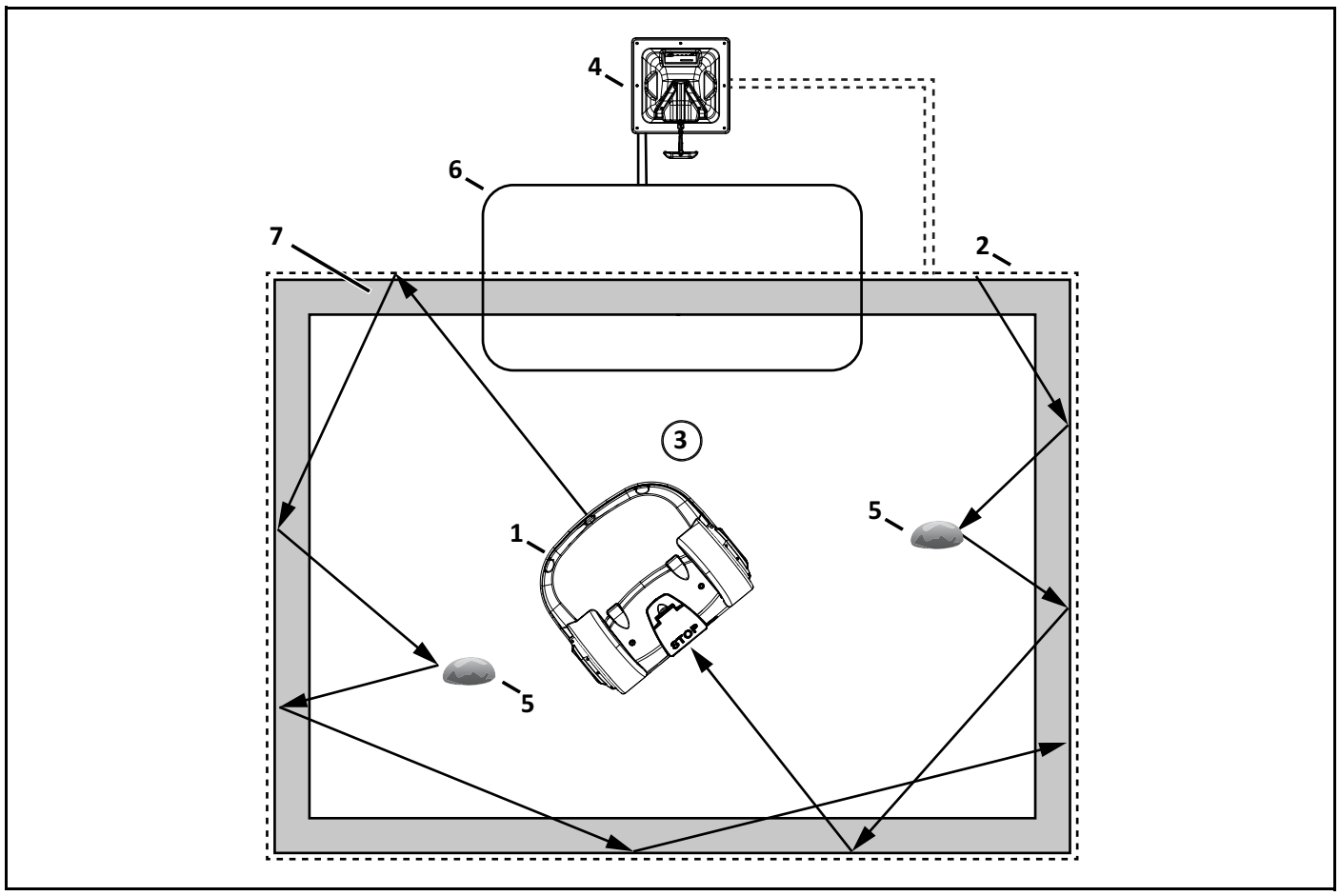
If the Smartbox does not turn ON, return the robot to the charging station and completely charge the battery.

3 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 it, then perform a maneuver to avoid it.



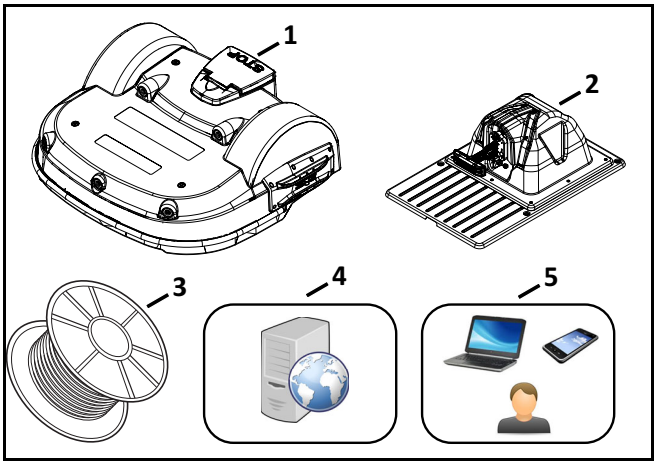
1 – Robot
2 – Working area
3 – Peripheral wire
4 – Charging station
5 – Obstacle
6 – Station loop wire
7 – Track border

The robot will automatically return to the charging station to charge it's battery.

Robot Charging Procedure:

- the robot stops
- moves to the peripheral wire
- follows the track border to the station loop wire
- follows the station loop wire to the charging station
- docks at the charging station

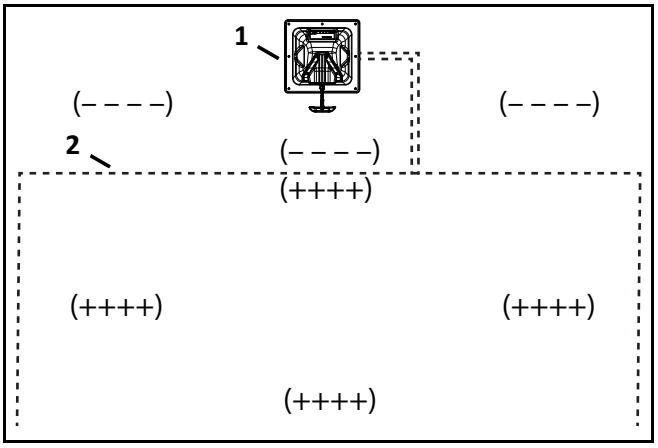
4 System Components



1 – Robot
2 – Charging station
3 – ECHO -branded peripheral wire (1000 ft. spool)
4 – Internet portal
5 – End user

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.



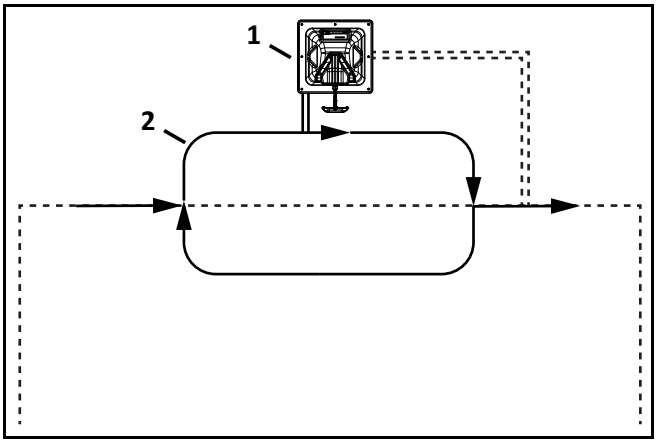
Charging station
Peripheral wire

The signal can encounter interference from:

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

4.2 Station Loop Wire

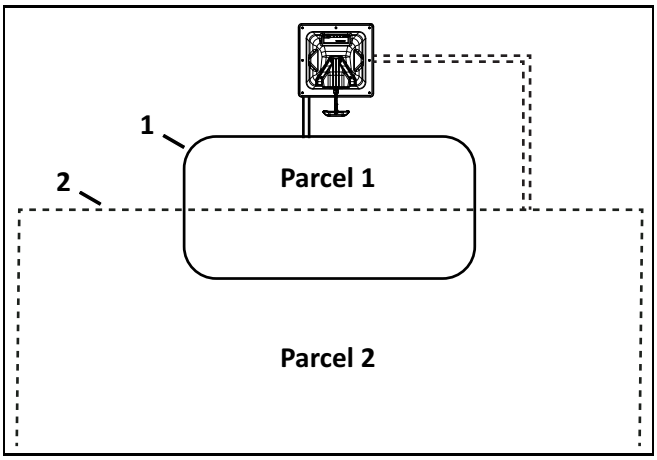
The station loop wire guides the robot in and out of the charging station.



1 – Station loop wire
2 – Charging station

4.3 Parcel

A parcel is the working area inside of a wire.



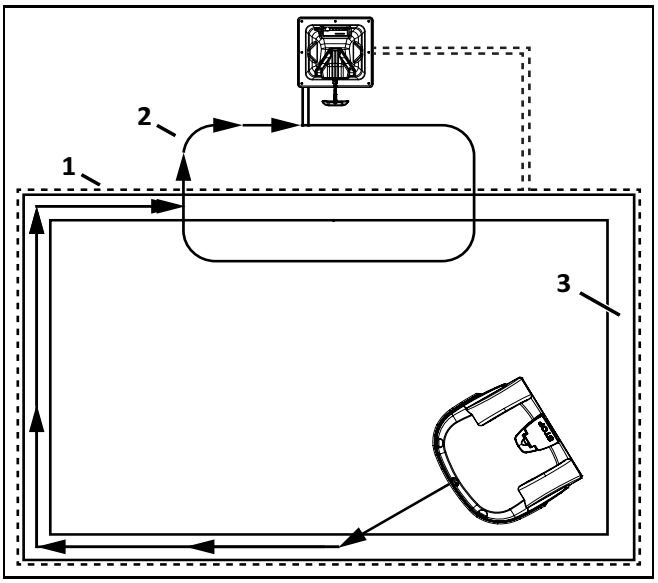
1 – Station loop wire
2 – Peripheral wire

4.4 The Track Border

The track border is a path the robot follows when returning to a charging station.

The minimum width is 2.5 ft. (0.8m), the maximum width is 10 ft. (3.0 m).

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



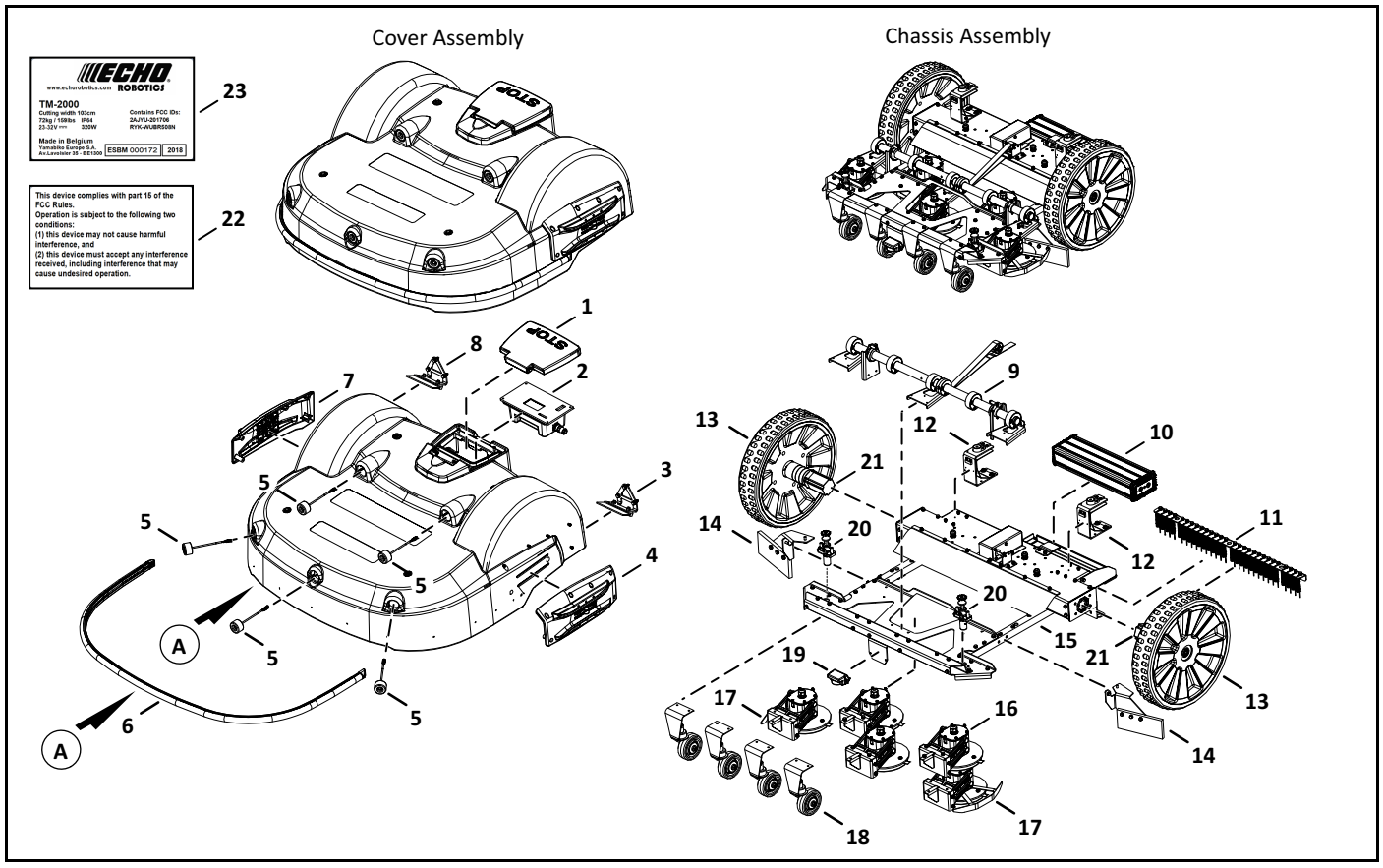
1 – Peripheral wire
2 – Station loop
3 – Track border

If the robot encounters an obstacle on the track border it will:

- back up
- turn around the obstacle with a 6 ft. (1.5 m) arcing radius
- find the track border and continue moving along it

5 Robot Components

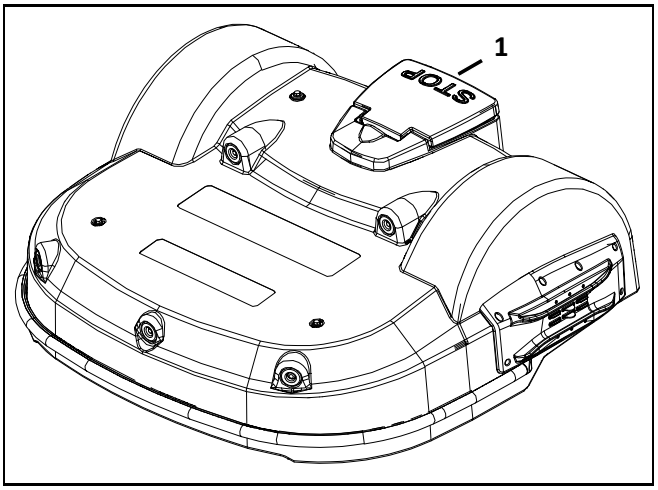
NOTE: The serial/model number and FCC labels are located on the bottom side of the stop button lid.



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 number label

5.1 STOP Button

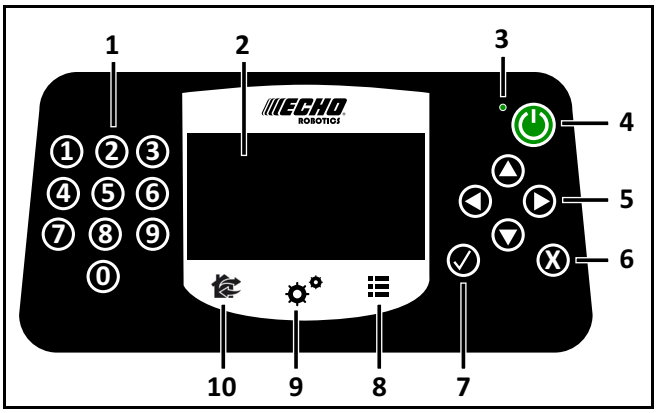
Press or lift the stop button lid to stop the robot.



1 – Stop button

5.1.1 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 – **LED menu** – Displays the current information.

3 – **Power ON/OFF LED** – Indicates the Smartbox is switched ON.

4 – **ON button** – Press to turn the Smartbox ON.

5 – **Navigation buttons** – Press to highlight menu options.

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

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

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

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

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

The LCD menu

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

1 – **Name** – A user assigns this name to the robot.

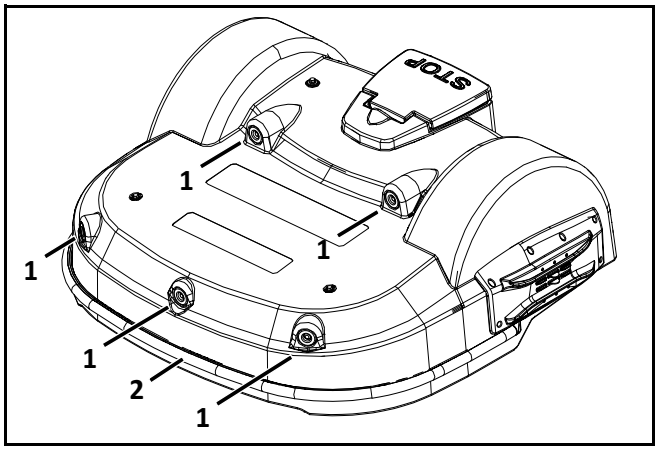
2 – **Battery charge level** – Percentage of battery charge

3 – **Message** – Shows the current status of the robot (also displays error messages).

4 – **Time and date** – 24-hour clock only.

5.2 Sonar Sensors and Bumper

The sonar sensors and bumper detect obstacles.



1 – Sonar sensor

2 – Bumper

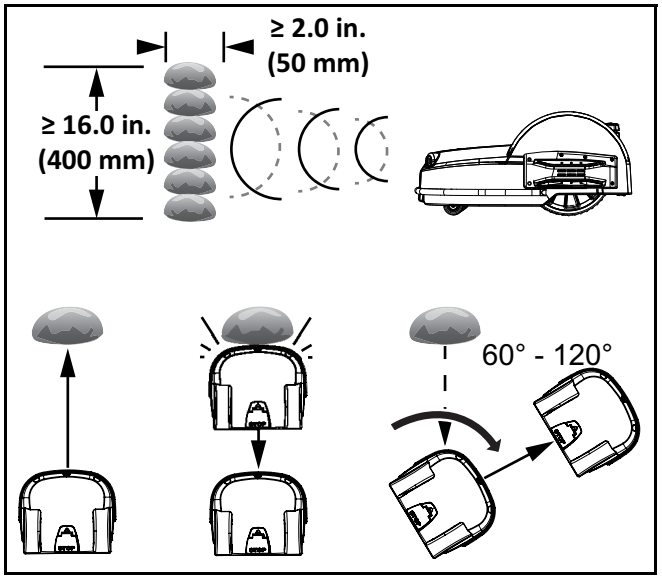
Sonar Sensors:

- 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)
- process reflected signals from obstacles

The robot will reduce its speed to less than 0.5 mph (0.2 m/s) when an obstacle is detected.

Bumper:

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

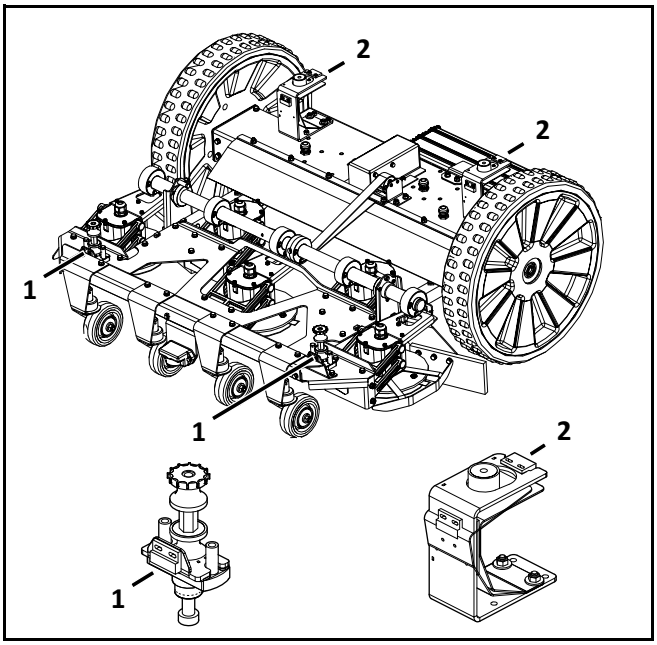


5.3 Lift Sensors and Cover Displacement Sensors

Each sensor is attached to the cover and the chassis of the robot. The font sensors lift sensors detect if the cover is lifted. The rear sensors detect if the cover is lifted or moved horizontally.

Lifting the cover will stop all functions of the robot.

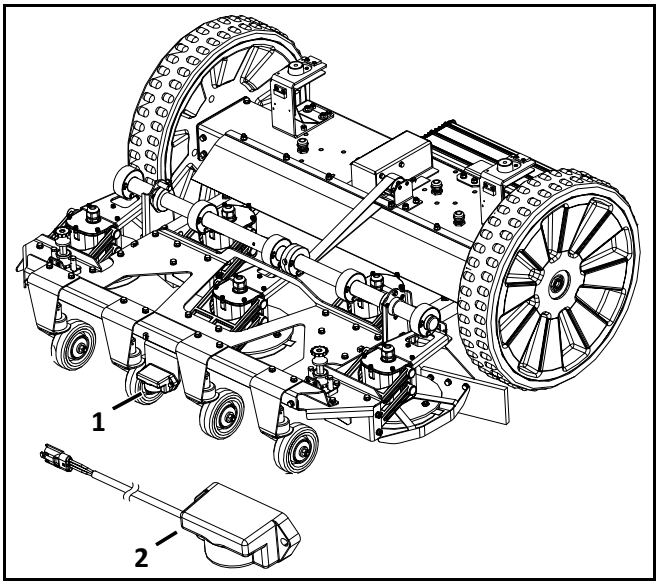
Moving the cover horizontally will cause the robot to move backward, turn between 60° and 120°, and continue moving forward.



1 – Front lift sensor
2 – Rear lift sensor

5.4 Coil

The coil detects the intensity of the electromagnetic field generated by the peripheral wire.



1 – Coil location on robot
2 – Coil assembly

5.5 Tilt, Rollover, and Temperature Sensors

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

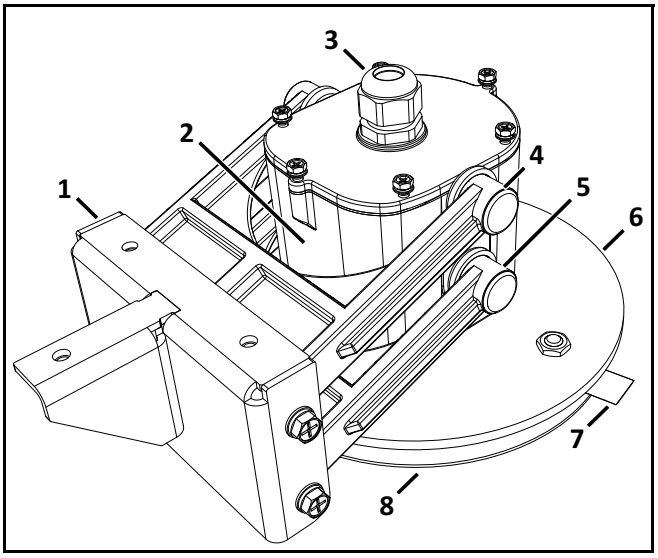
Tilt Sensor - The tilt sensor detects the angle of the slope on which the robot is working. If this angle exceeds 30° (58%), an alarm will be raised and the robot will stop moving.

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.

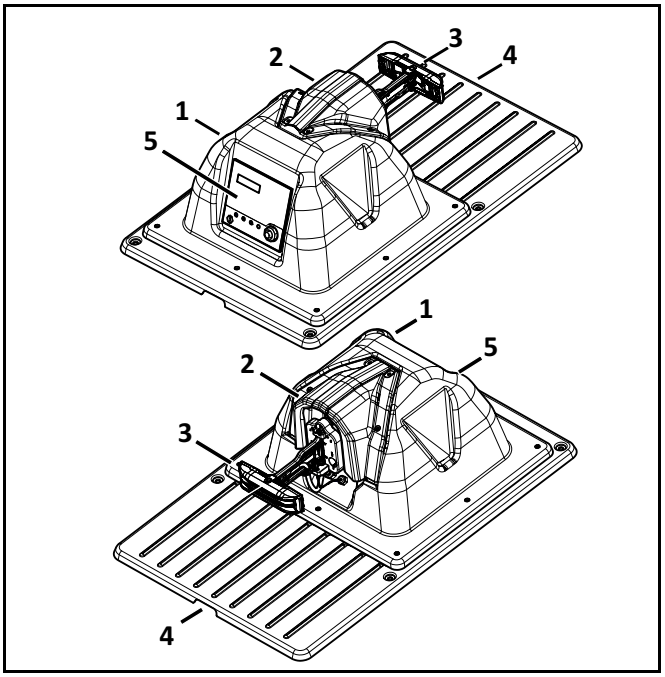
5.6 Cutting Head

The robot has five cutting head assemblies.



1 – Bracket unit
2 – Cable gland
3 – Motor case
4 – Blade disc
5 – Anti friction disc
6 – Cutting blade
7 – Lower stay
8 – Upper stay

5.7 Charging Station Components



1 – Enclosure top
2 – Debris cover
3 – Charging arm
4 – Enclosure base
5 – Input panel / Serial number location

6 Operational States

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

6.1 Autonomous Mission State

The robot performs programmed instructions within specific modes when in the Autonomous Mission State.

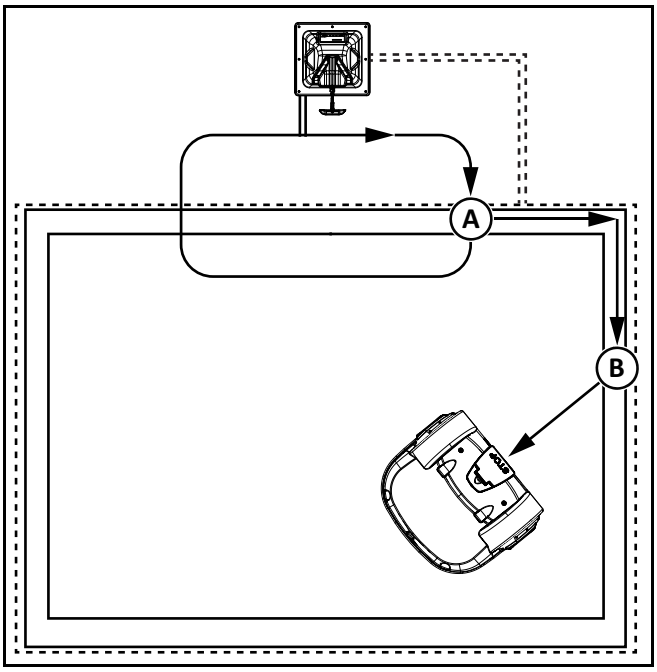
NOTE: Remotely programmed instructions can be over-ridden by instructions activated from the Smartbox.

Autonomous Mission Modes	Robot Function
Go Zone Mode	Leave the charging station and start working.
Work Mode	Mows the grass in a random pattern.
Go to charging station Mode	Returns to the charging station.
Charge Mode	Connects to the charging station and charges the battery.
Wait In Station Mode	Remains at the charging station.

6.1.1 Go Zone Mode

Go Zone Mode commands the robot to leave the charging station and start working.

- at Point A it begins to follow the Filed 1 track border
- at Point B it turns into the field to begin working



The distance traveled along the track border and the angle at which the robot turns into the field are specified in the StartZone parameters.

Multi -Field Installation

A multi-field installation includes:

- one station loop wire
- two peripheral wires
- one charging station
- one robot

A start zone parameter determines which field the robot will start working in before it leaves the charging station.

The robot can be programmed to work in a specific area during a specific time.

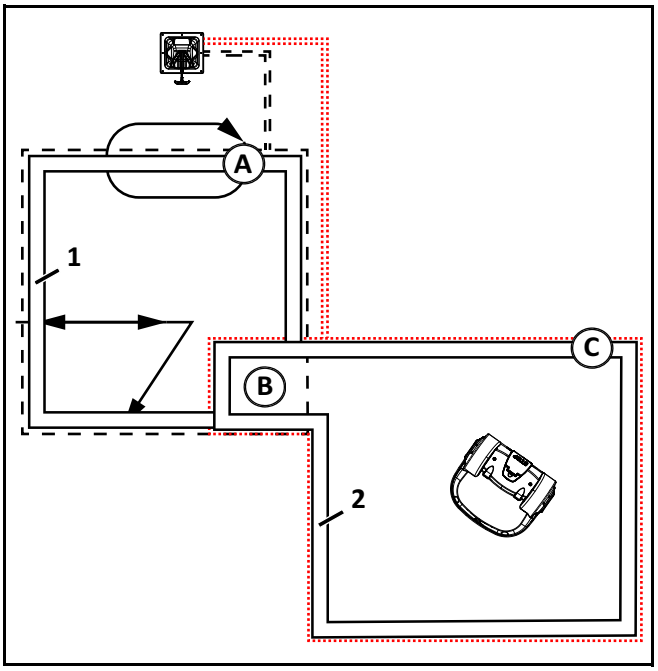
The robot can also be programmed to work in a specific area based on a pre-programmed percentage value.

Over a period of time the robot ensures that it starts in each field according to programmed percentage values.

The following describes the path of the robot exiting the field for a multi-field installation:

- at Point A the robot begins to follow the Field 1 track border
- at Point B it turns into the Field 2 track border (this is where the fields overlap)
- at Point C it turns into Field 2

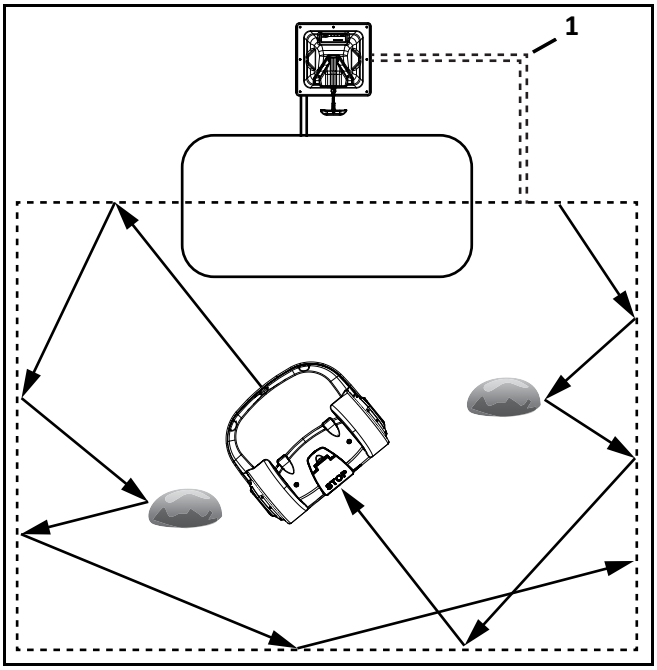
The distance traveled along the Field 2 track border, and the angle at which the robot turns into Field 2, is specified in the StartZone parameters for Field 2.



1 – Field 1 track border
2 – Field 2 track border

6.1.2 Work Mode

In the work mode the robot operates within the working area at a default speed of 2.2 mph (1.0 m/s).



1 – Peripheral wire

When the robot approaches the peripheral wire it slows down and crosses over it by a predefined distance. It will then stop, move in reverse, turn randomly between 60° and 120° and continue in a new direction.

6.1.3 Go To Charging Station Mode

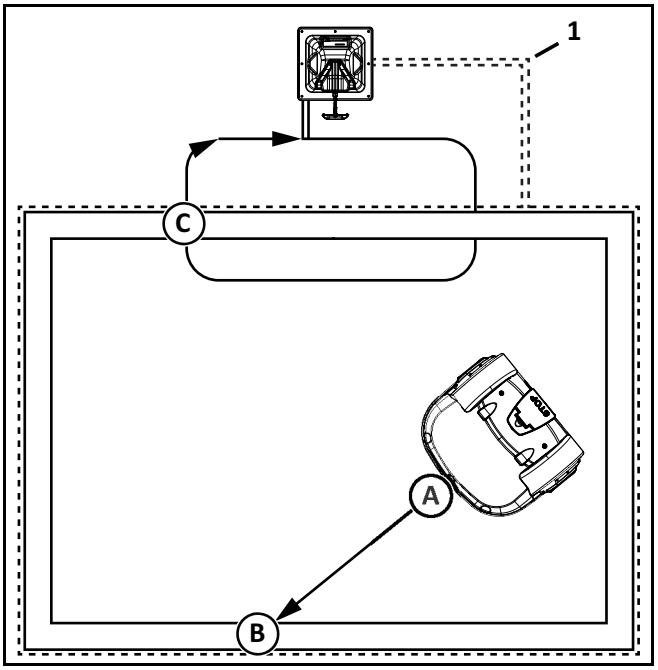
When working, the robot checks its current conditions and programmed instructions. Examples are:

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

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

Single Field With Station Loop

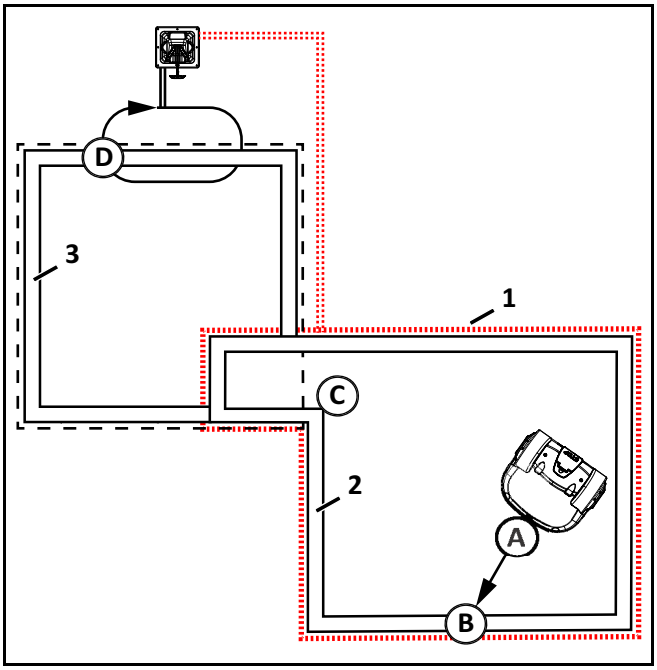
- at Point A the robot moves towards the peripheral wire
- at Point B it follows the track border and begins to return to the charging station
- at Point C it follows the station loop wire until it docks at the charging station



1 – Peripheral wire

Two Fields With Station Loop

- at Point A, the robot begins to return to the charging station
- at Point B it begins to follow the Field 2 track border
- at Point C it follows the Field 1 track border
- at Point D it follows the station loop wire until it docks at the charging station



1 – Field 2 peripheral wire
2 – Field 2 track border
3 – Field 1 track border

6.1.4 Charge Mode

This mode instructs the robot to dock and remain in the charging station until the battery is fully charged.

The next operations depend on programming and external conditions.

The robot will remain at the charging station if:

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

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

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

6.1.5 Wait In Charging Station Mode

This mode instructs the robot to stay in the charging station until normal programming starts or a specific command is issued.

6.2 Inactive Modes

There are four inactive modes:

- Alarm Mode
- Standby Mode
- SelfTest Mode
- OFF Mode

6.2.1 Alarm Mode

The robot enters the alarm mode when it encounters a problem. If the problem is not corrected it enters the OFF mode. When the problem is corrected the user can manually clear the alarm.

6.2.2 Standby Mode

The robot will enter the Standby mode if:

- the autonomous mission has been stopped due to an external command
- an problem has been corrected and the alarm cleared
- it is manually switched ON

6.2.3 Self Test Mode

When the robot is in the Standby Mode it will perform a self-test to check the integrity of:

- internal electronics
- sensors
- mechanical operation
- operating software

When the result of the self-test is successful, it will resume the autonomous working state. If the result of the self test is not successful, it will register an alarm.

6.2.4 OFF Mode

The robot will be in the OFF mode when:

- it has been manually switched OFF
- an alarm situation has not been corrected after a certain period of time

6.3 Active Modes

Active modes are available in the Technician Settings menu.

Active modes include:

- Infrastructure
- Mobile connection
- Advanced Parameters
- Service
- Demonstration

6.3.1 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.

7 Wire Installation

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

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

Install islands or pseudo islands to avoid obstacles

To avoid standing water and damp areas:

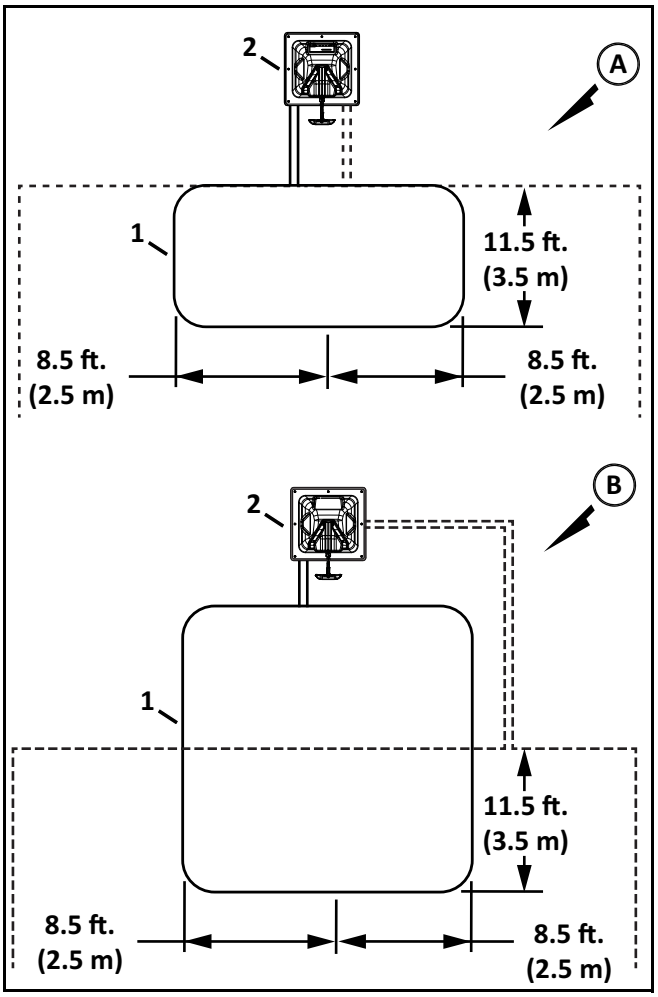
- install drains
- restrict access to the area
- install islands or pseudo-islands

7.1 Station Loop Wire

The station loop wire starts and ends at a charging station.

Install the station loop wire completely inside of the field (Figure A), or partially inside of the field (Figure B).The wire must extend a minimum of 11.5 ft. (3.5 m) into the field.

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).

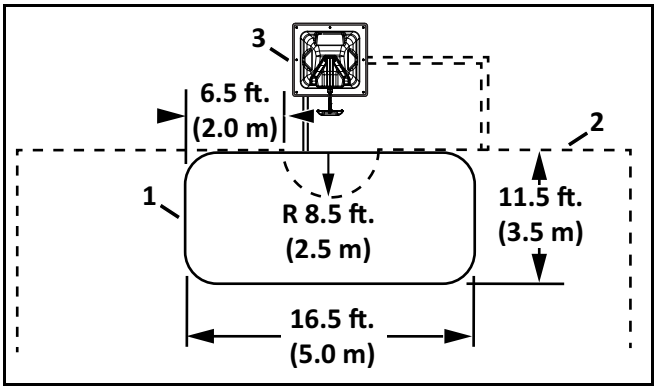


1 – Station loop wire
2 – Charging station

7.1.1 Minimum Installation Dimensions for Multiple Robots

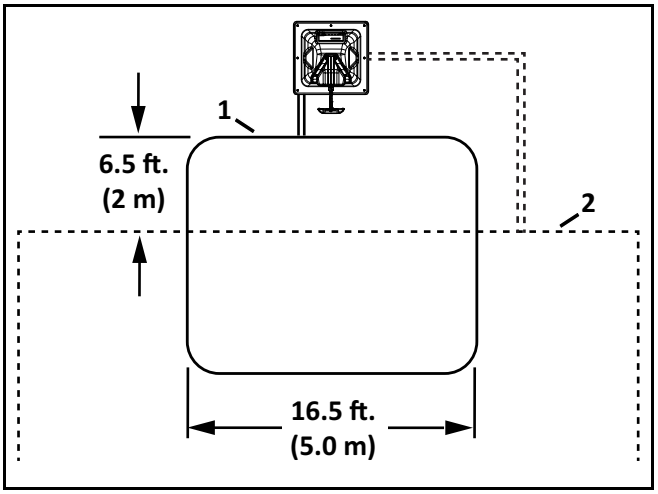
This installation ensures that robots will not collide with each other or with the charging station. The following figure shows minimum dimensions.

If the station loop wire is completely **inside** of the peripheral wire, install as shown:



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

If the station loop wire is partially inside of the peripheral wire, install as shown:



1 – Station loop wire
2 – Peripheral wire

7.2 Peripheral Wire

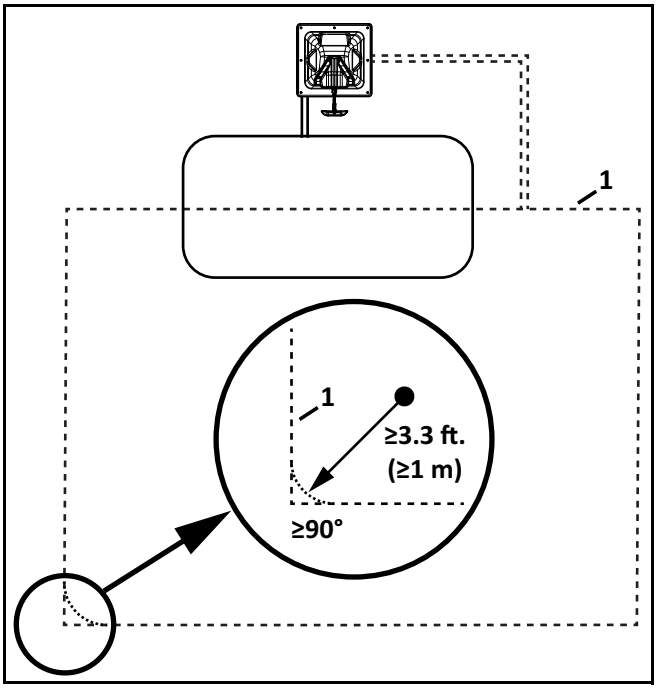
The peripheral wire defines the working area.

- 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).
- Each peripheral wire must overlap with its neighboring one.
- Each pair of peripheral wires which overlap must be designated as neighboring fields.
- 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.
- Maximum peripheral wire length is 3937 ft. (1,200 m).

Use a second charging station when:

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

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

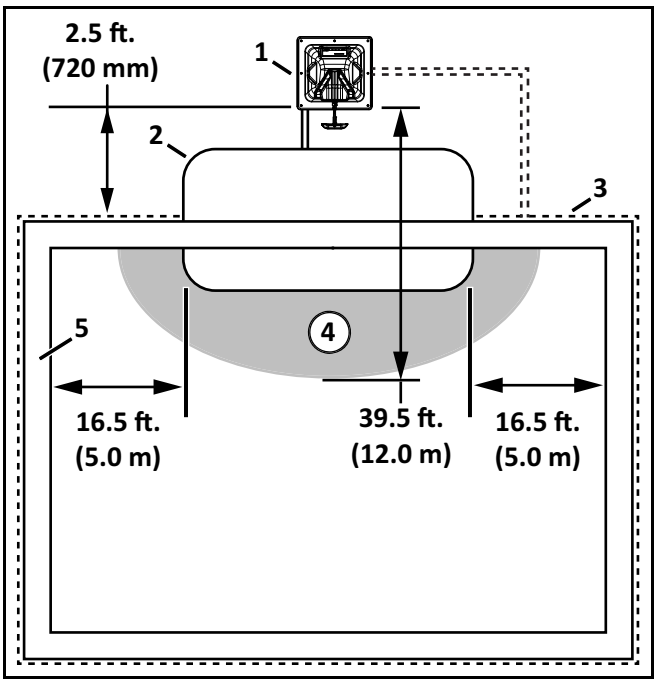


1 – Peripheral wire

Obstacles may require specific placement of the peripheral wire, or the use of islands or pseudo-islands.

7.2.1 Installation for Multiple Robots

This installation ensures that robots will not collide with each other, or with the charging station. The following figure shows minimum dimensions.

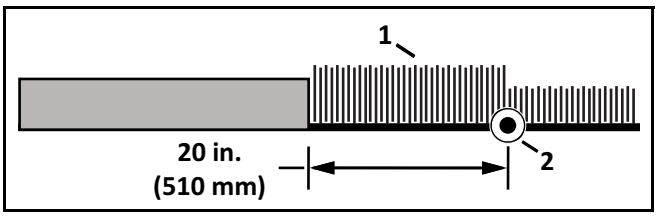


1 – Charging station
2 – Station loop wire
3 – Peripheral wire
4 – Obstacle free zone
5 – Track border
6 –

7.2.2 Installation Next to Landscaping

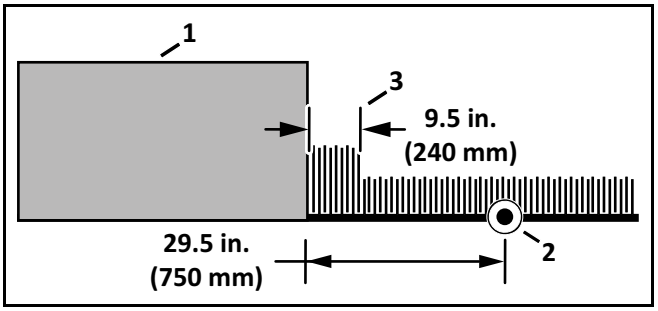
NOTE: The dimensional values shown apply when the wire crossing distance parameter is at the default setting of 8.0 in. (200 mm). This is the distance the robot travels past a peripheral wire. When the robot reaches this distance it will turn back into the working area.

Rough grass that does not need to be mowed:



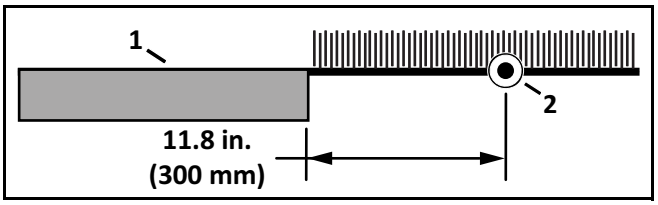
1 – Rough grass
2 – Peripheral wire

Raised hard landscaping:



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

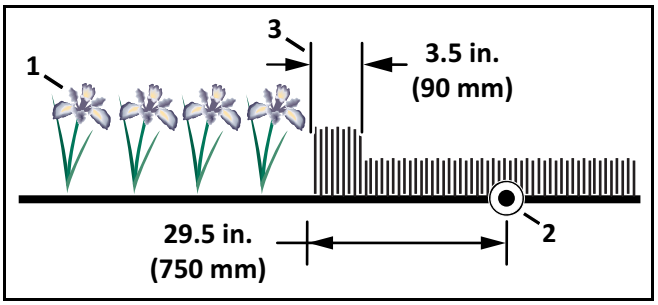
Hard landscaping level with grass:



1 – Terrace / Path
2 – Peripheral wire

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

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



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

7.2.3 Multiple Peripheral Wire Installation

An installation may require multiple peripheral wires.

Each working area is bordered by a peripheral wire. The area inside each peripheral wire defines a single parcel.

Each parcel must overlap with a neighboring parcel.

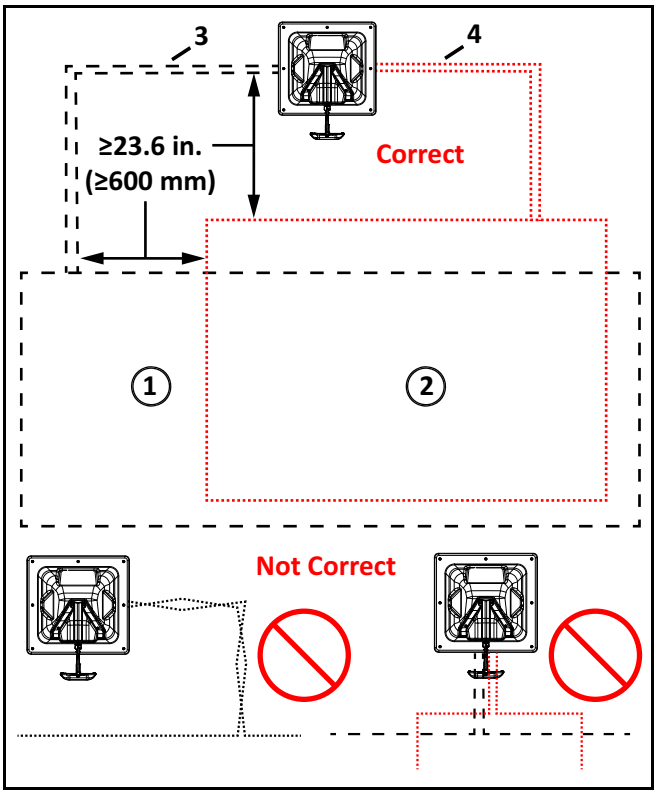
Each pair of wires or parcels which overlap must be designated as neighboring parcels.

Multi-Field Installation

Wire1/Field 1 is a neighbor of Wire 2/Field 2.

The amount of time that the robot spends working in each field is determined by the percentage values of the working schedule. For Wire 1/Field 1 the percentage can be set to 0.

The start and finish sides of the peripheral wire must lie next to each other when they enter the charging station. Peripheral wires can not cross fields. The distance between the peripheral wires for each field must be greater than or equal to 23.5 in. (600 mm).

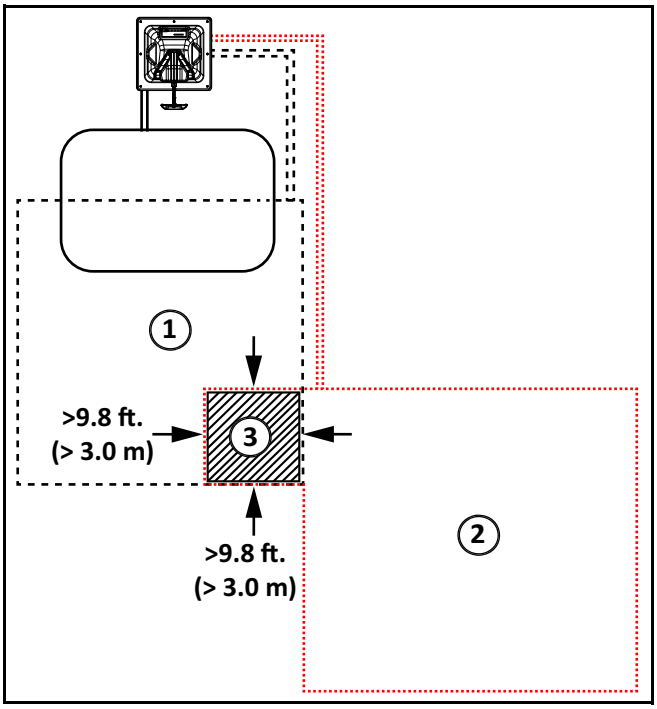


1 – Field 1
2 – Field 2
3 – Start and finish side of Field 1 peripheral wire
4 – Start and finish side of Field 2 peripheral wire

Multi-Field Overlaps

An overlap is an area that lies within two fields. It is used for the robot to transition from one field to another. The length and width of the overlap must be greater than 10.0 ft. (3.0 m).

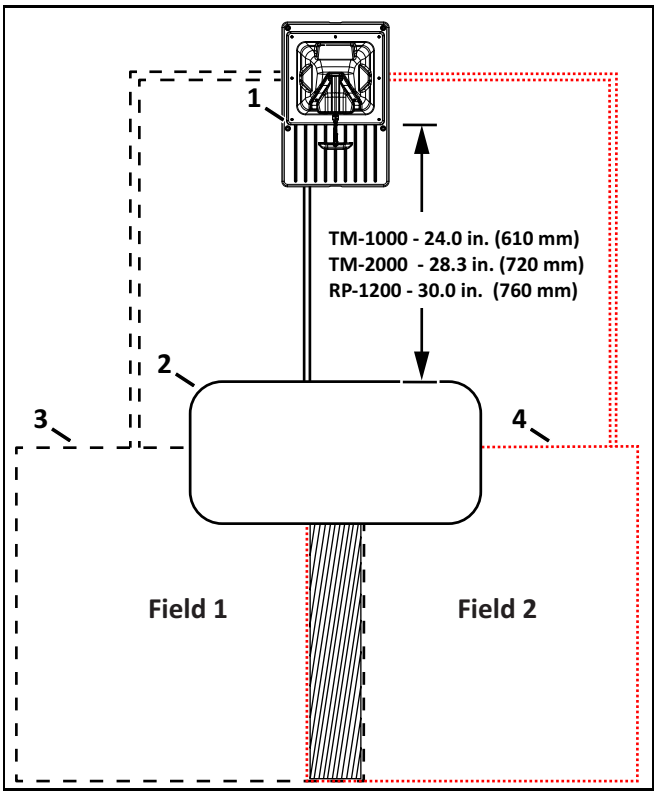
Overlap with Station Loop Wire in Single Field



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

Overlap with Station Loop Wire Across Multiple Fields

In this example the station loop wire overlaps the larger peripheral wires and fields. If the robot is in the station loop field, and needs to return to the charging station, it will not use the track border. The robot will simply follow the station loop wire to the charging station.



1 – Station loop wire
2 – Overlap area

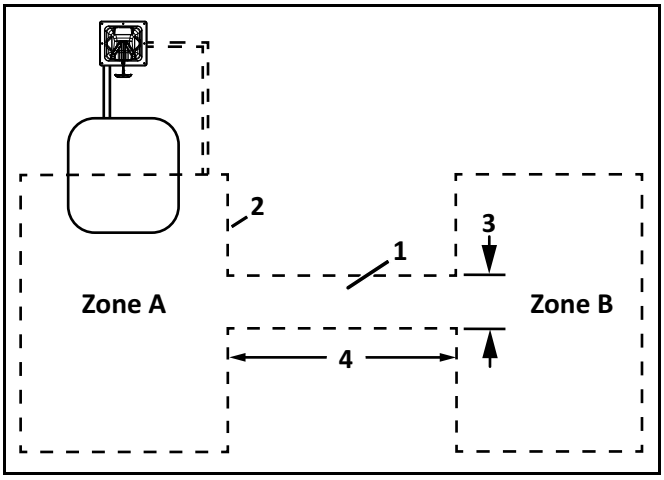
7.2.4 Sites Containing Narrow Straits

These sites require specific installation of the peripheral wire.

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

Length of the strait	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 pass through the strait and return to the charging station. In this case, installation of an additional charging station in Zone B is required.

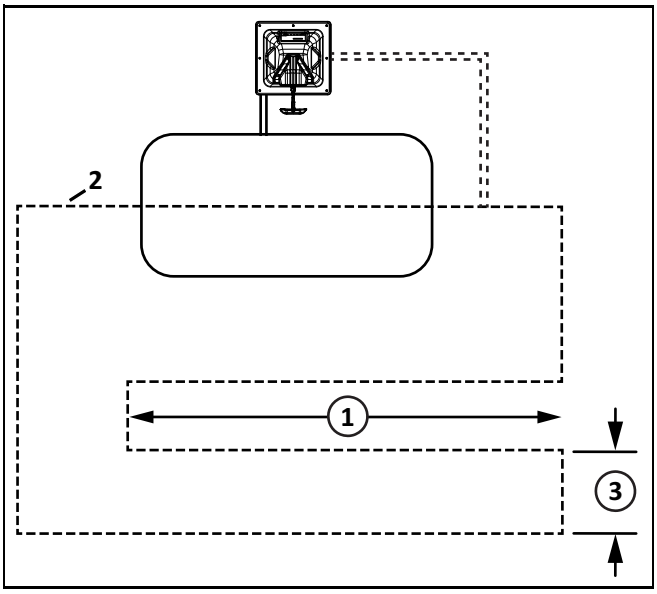


1 – Narrow strait
2 – Peripheral wire
3 – Minimum distance between peripheral wire
4 – Length of strait

7.2.5 Sites With Long Lanes

A long lane represents an area where a minimum distance for the installation of the peripheral wire is required. If this minimum distance is not met, the robot may not be able to detect the peripheral wire.

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



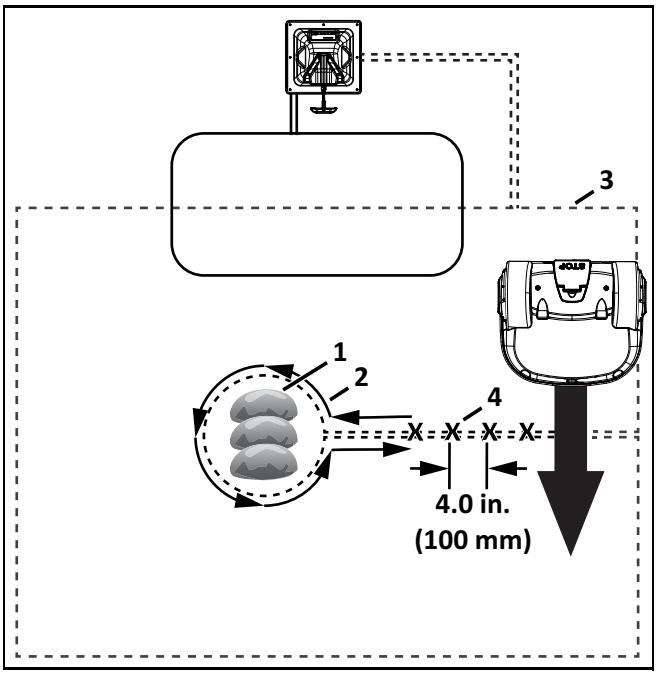
1 – Lane
2 – Peripheral wire
3 – Minimum distance between peripheral wire

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

7.2.6 Islands

Create an island when an obstacle is more than:

- 16.5 ft. (5.0 m) from the peripheral wire
- 49.0 (15.0 m) from the charging station
- 16.5 ft. (5.0 m) from another island or pseudo-island



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

7.2.7 Pseudo-Islands

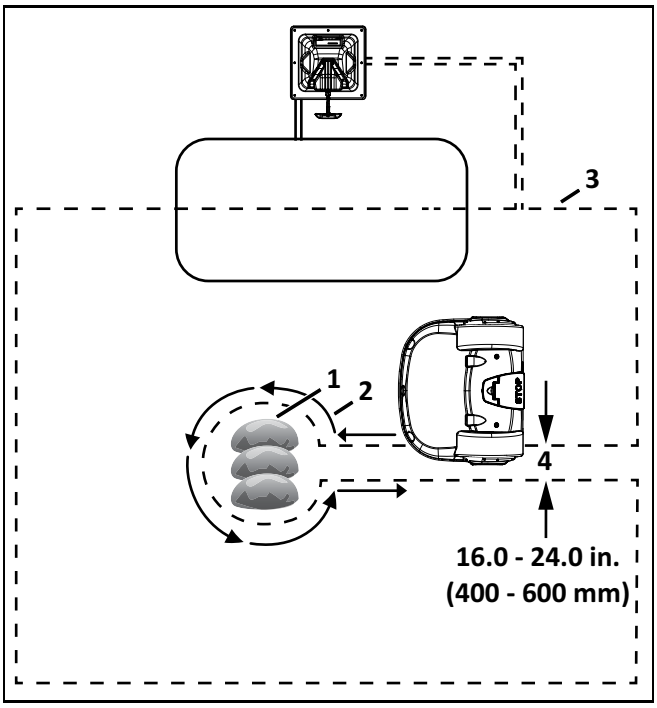
If a pseudo-island is created, the robot will approach the obstacle, and then maneuver around it.

Create a pseudo-island when an obstacle is less 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 island or pseudo-island

Peripheral wire installation requirements for a pseudo-island require:

- a counterclockwise installation direction around an object
- a fixed distance of 16.0 - 24.0 in. (400 - 600 mm) between the approach and return sides
- do not cross or twist the approach and return side of the peripheral wire



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

7.2.8 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 an island or a pseudo-island.

⚠ CAUTION

WATER DEFORMS THE ELECTROMAGNETIC SIGNAL OF THE PERIPHERAL WIRE

The robot can get confused on its location of the electromagnetic signal is deformed.

- Use an island or a pseudo-island to avoid a water obstacle.

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.

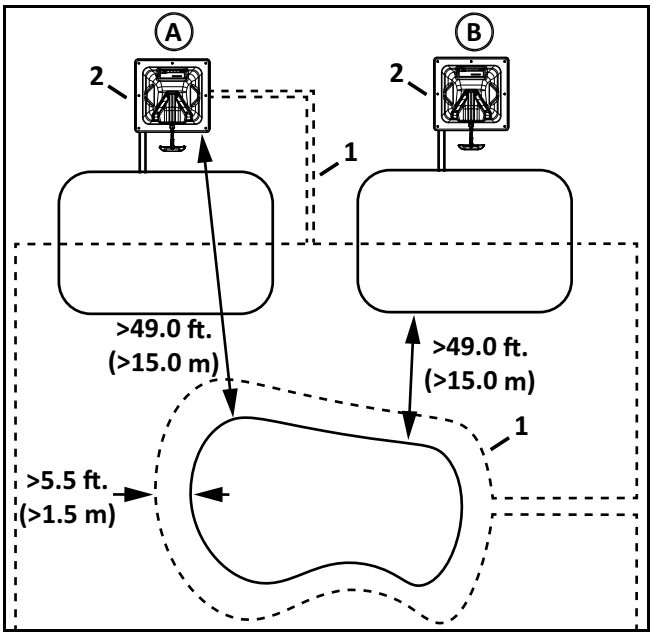
Install the charging station a minimum of 49.0 ft. (15.0 m) from the edge of the water.

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

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

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

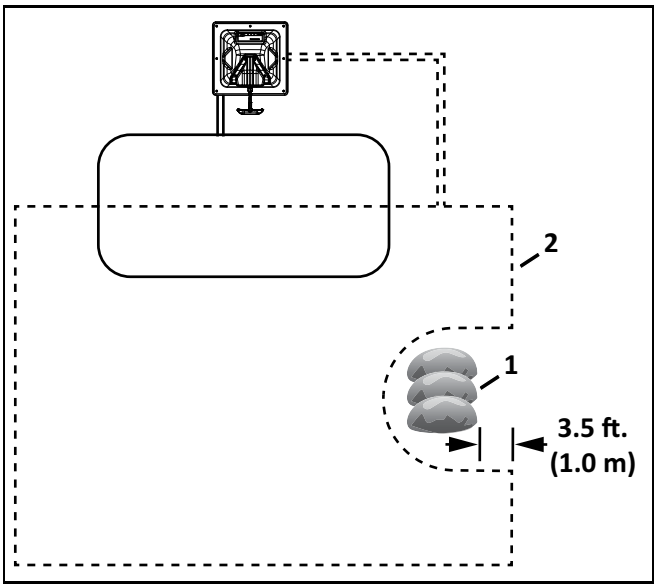
If the charging station is located at Point B, program the robot to return to it in a counterclockwise direction.



1 – Peripheral wire
2 – Charging station

Obstacles Near the Boundary of the Working Area

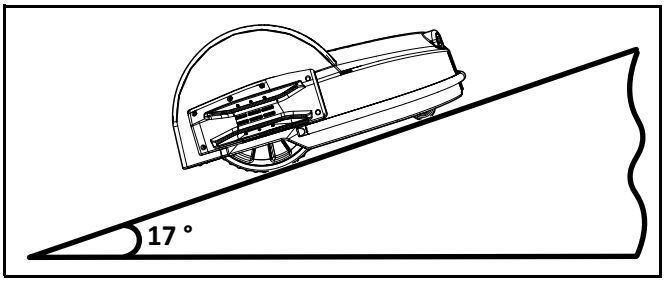
If an obstacle is less than 3.3 ft. (1.0 m) from the boundary of the working area, install the peripheral wire around the obstacle. If the distance between the obstacle and the boundary is greater than 3.3 ft. (1.0 m), but less than 16.4 ft. (5.0 m), install a pseudo-island.



1 – Obstacle
2 – Peripheral wire

7.2.9 Sloped Fields

The maximum slope on any part of the field must be less than or equal to 17°.



If a sloping part of the field is well away from the peripheral wire, no specific programming of the robot is required. If the sloping part of the field is near the peripheral wire, program the robot to return to the charging station by descending the slope.

7.3 Station Loop and Peripheral Wire Configuration - Single Field Installation

The instructions given are the minimum set of configuration parameters.

1) Press and hold **9** on the numeric keypad until the **TECHNICIAN SETTINGS** menu appears.
2) Select **INFRASTRUCTURE, then press ✓. Select Peripheral wires the press ✓**.
3) On the **WIRE SETTINGS** menu, select **Wire CH{X},** then press ✓.
4) Rename this Wire to **LOOP**.
5) Select **Signal channel**, then press ✓. Assign the channel number for the station loop.
6) Check the value shown at the top of the menu. This should be *positive*. If it is not, select **Reverse phase** and check the button ON.
7) Press ✗ twice to return to the Infrastructure menu.
8) Select **Parcels**, then press ✓. Select the parcel associated with the LOOP wire.
9) Select **Return direction**, then press ✓. Choose whether you want the robot to return in a clockwise or counterclockwise direction.
10) Disable the use of the track border. Select **Use track border** and check the button OFF. This ensures that when the robot is in this field, it will just follow the wire to reach the station.
11) Press ✗ twice to return to the Infrastructure menu.
12) Select **Create new wire, then press ✓**.
13) Select the newly created wire, then press ✓.
14) Rename this field to **LAWN**.
15) Select **Signal channel**, then press ✓. Assign the channel number for the large field to be mowed.
16) Check the value shown at the top of the menu. This should be positive. If it is not, select **Reverse phase** and check the button ON.
17) Press ✗ twice to return to the Infrastructure menu.
18) Select **Parcels**, then press ✓. Select the parcel associated with the LAWN wire.
19) Set the **Return direction** to the same as above.
20) Select **Use 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.
21) Select **Neighboring parcels,** then press ✓. Check the button next to the LOOP parcel.
22) Press ✗ to exit this menu.
23) Select **Edit parcels percentage**, then press ✓. Set the value to 100% for the lawn parcel.
24) Press ✗ to return to the **INFRASTRUCTURE** menu.

25) From the **INFRASTRUCTURE** menu, select **STATIONS, then press ✓. Next, select Create new station, then press ✓**.

26) A name is generated. The name can be changed as applicable.

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

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

8 Using the Robot

⚠ CAUTION

PERSONAL INJURY HAZARD

Contact with the robot during operation can cause personal injury.

- Press the STOP button before handling the robot.

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.

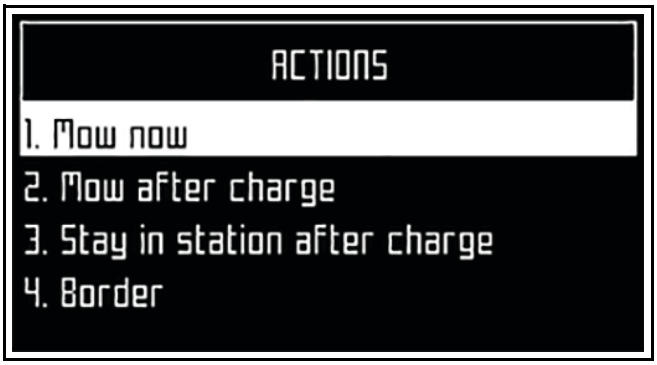
8.1 Safety Measures

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.

8.2 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.



ACTIONS Menu

8.2.1 Operation In The Field

Perform these operations when the robot:

- is stopped and not in the charging station
- has been stopped during its normal operation schedule
- has stopped because of an alarm

Clear any alarm before programming the robot.

ACTIONS menu options for operation in the field include:

Options	Description
Charge & stay	Return to the charging station and stay there until it a new instruction is issued.
Mow	Continue the working schedule after an interruption.
Go charge	Return to the charging station, charge the battery and then resume working

To execute the operations:

1) Open the STOP button lid.
2) Press  .
3) Press  or  to highlight the required command, then press  .
4) Close the stop button lid.

NOTE: Close the stop button lid within 10 seconds of executing the operation.

8.2.2 Operation In the Charging Station

Perform these operations when the robot is in the charging station. Use these operations to override the regular operating schedule.

ACTIONS menu options for operation in the charging station include:

Option	Description
Mow now	Leave the charging station and continue working.
Mow after charge	Remain in the charging station until the battery is charged and then start working.
Stay in station after charge	Stay in the charging station until a new command is issued.
Mow now on...	Leave the charging station and continue working in a specific parcel. A list of parcel appears in which you can choose the required one.

To execute the operations:

1) Open the STOP button lid.
2) Press  .
3) Press  or  to highlight the required command, then press  .
4) Close the STOP button lid.

8.3 Settings Menu

Settings menu options include:

- Schedule
- System Locking
- LCD Settings

8.3.1 Schedule

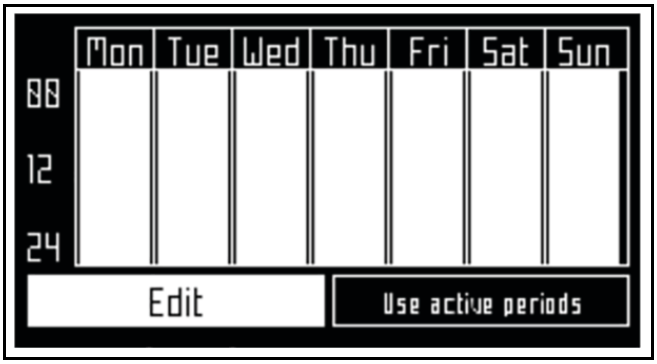
NOTE: The schedule is based on a 24-hour clock.

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).

To define a working schedule:

1) Press  .
2) Press  or  to highlight **Schedule**, then press  . The following menu will appear:

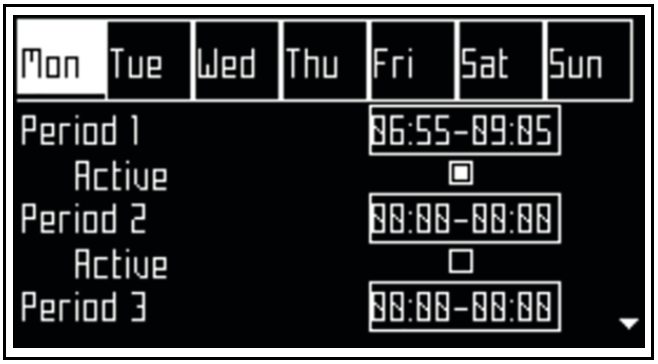


This menu shows the current schedule. The white blocks represent the time when the robot will be operating in one parcel. By default, all the times will appear white, meaning the robot will work continuously.

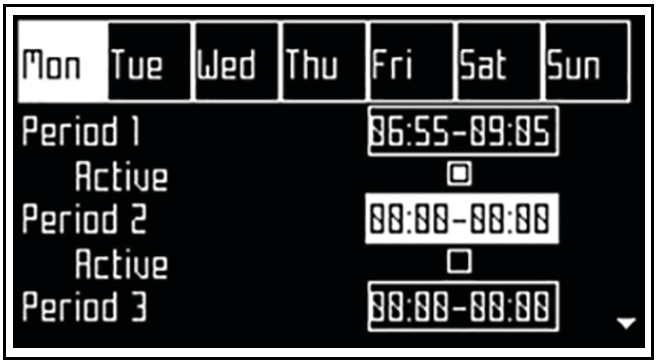
3) Select **Edit**, then press  . The **PARCEL SCHEDULE** menu appears:

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

5) Press ◀ or ▶ to select the required day of the week, then press ✓.



6) Press ▼ to select the required period in the day, then press ✓.



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

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

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

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

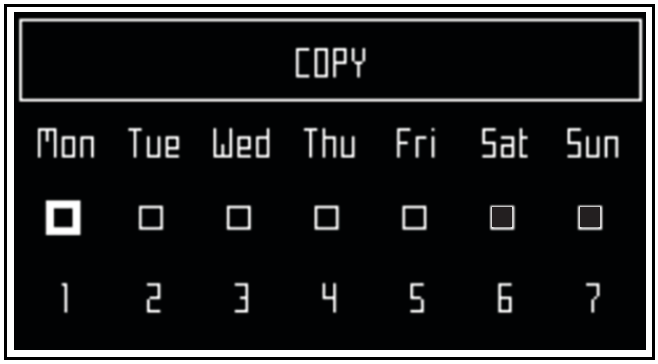
10) Press ✗ to return to the **PARCEL SCHEDULE** menu.

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

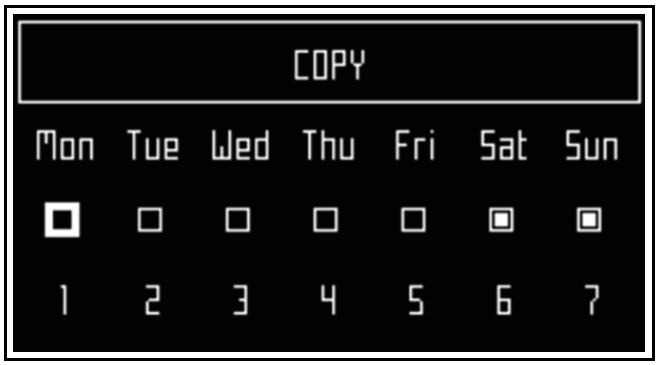
To copy the schedule from one day to another:

1) Follow the procedure above to define the working schedule for one day.

2) When all the required periods have been defined, press ▼ to highlight **Copy**, then press ✓. The **COPY** menu will appear:



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



4) Press ☰.

5) Highlight **Edit**.

6) Press ✓.

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

8.3.2 System Locking

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

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

To lock the system:

1) Press .

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

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

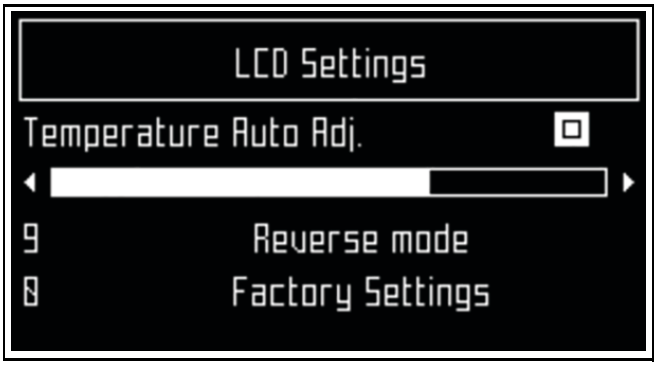
To unlock the system:

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

8.3.3 LCD Settings

To modify the LCD settings:

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



2) Press or to change the contrast.

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

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

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

6) Press to exit the menu.

8.4 SERVICE SETTINGS Menu

Press repeatedly to return to the Home menu.

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

- Regional Parameters
- Connections
- Using the Robot as a Client
- Operations
- Device
- Device info

8.4.1 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) Select **Date Format**.

2) Use and to select the month, day, and year. Use the numeric keypad to enter the required values.

3) Press to exit the menu.

To set the **Time zone**:

1) Select **Time zone**.

2) Press to exit the menu.

To set the **Language**:

1) Select **Language**.

2) Use  and  to highlight the required language.

3) Press  to exit the menu.

To set the **Unit system**:

1) Select **Unit system**.

2) Use  and  to select **Imperial** or **Metric**.

8.4.2 Connections

To display the connections menu:

1) Press  .

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

IP address

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

Modes can be mobile, vpn, or WiFi.

Mode

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

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

Search for networks

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

SSID

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

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

A list of networks will display.

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

8.4.3 Using the Robot as a Client

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

To set up the robot as a client:

1) Press  .

2) Highlight **Connections** and press 

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

4) Highlight the WiFi network required and press  .

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

6) Highlight **V** and press ✓.

8.4.4 Operations

Use this menu to set the following operating parameters:

- Min temp
- Edit parcels percentage

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 ☰.
2) Use the arrow keys to highlight **Operations**, then press ✓.
3) Press ▲ or ▼ to highlight the required parameter.
4) Enter the required value.
5) Check that the current values have been updated.
6) Press ✗ to return to the main menu.

8.4.5 Device

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

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

To change the name of the robot:

1) Press ☰.
2) Press the arrow keys to highlight **Device info**, then press ✓.
3) Highlight **Robot name** and press ✓.
4) Highlight the back arrow to delete the current name.
5) Use the alpha-numeric keyboard to enter the new name. Highlight each character required and press ✓ to select it.
6) Highlight **V** in the bottom row and press ✓.
7) Press ✓ to accept the new name.
8) Press ✗ to return to the main menu.

8.4.6 Device info

To see the device info:

1) Press ☰.
2) Press the arrow keys to highlight **Device** then press ✓.
3) Highlight **Device info** and press ✓.
4) Press ▲ or ▼ to scroll through the list.

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.
Lat [GF center]	The current latitude of the center of the Geofence security zone.
Long [GF center]	The current longitude of the center of the Geofence security zone.
Radius	Current radius of the Geofence security zone.
Dist. to beacon	This option is not used in North America.
DW board not installed	This option is not used in North America.
Magnetic distance	The distance between the robot and the peripheral wire. This value should be positive when the robot is inside the peripheral wire loop. If the distance is shown as a negative value, it is necessary to reverse the phase.
APN	Identification of the Access Point Network.
MAC address	Media Access Control address.

8.4.7 System version

To see the System version information:

1) Press  .
2) Press the arrow keys to highlight **Device**, then press  .
3) Highlight **System version**, then press  .
4) Press  or  to scroll through the list.

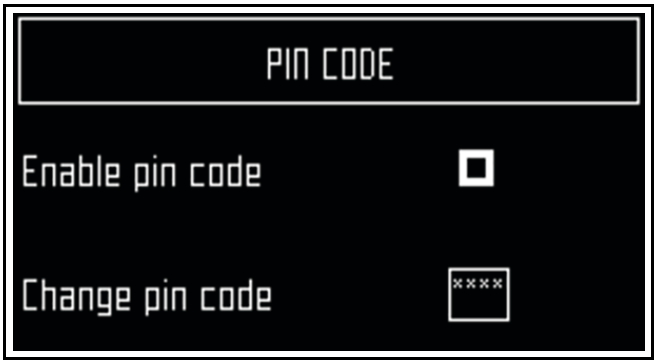
System version options include:

Option	Description
Version	Current software version.
Brain version	Current artificial intelligence version.
System version	Current version of the system software.
Software version	Current version of the application software.
Bootloader ver.	Current bootloader version.

8.4.8 Security

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

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



To enable the pin code:

1) Highlight the check box. Press ✓ 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 ✓ to accept the new setting.

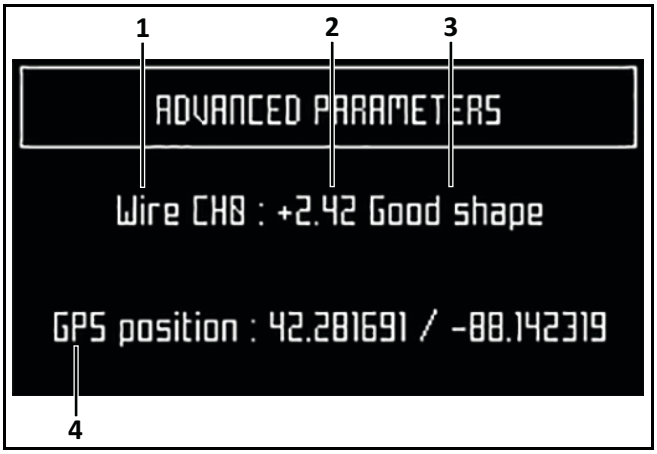
To change the pin code:

1) Enter the required numbers and press ✓

8.4.9 Advanced Parameters

Press and hold **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.

8.5 TECHNICIANS SETTINGS Menu

Use this menu to configure advanced operations of the robot.

From any menu, press ✗ repeatedly until the home menu appears.

Home menu

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

The following options are provided:

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

8.5.1 Infrastructure

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

Peripheral wires

From the TECHNICIANS SETTINGS menu select **Infrastructure > 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 ✓ to see the wire properties.

Wire properties include:

- Create new wire
- Signal channel
- Reverse phase
- Delete Wire CH#

Create new wire

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

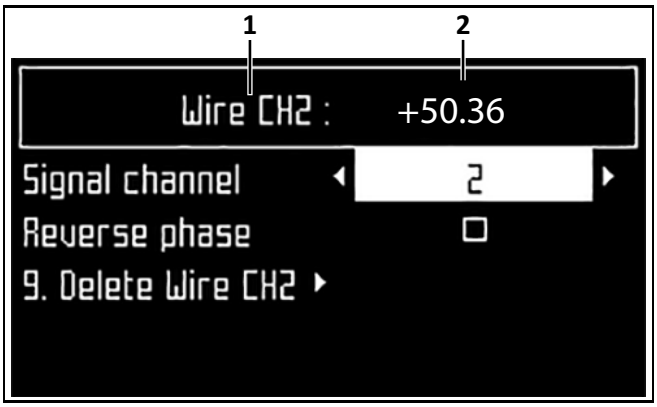
To Create a New Wire:

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 click on ✓.
5) Select the required channel number. Station Loop is always channel 0. Field 1 is always channel 1. Field 2 is always channel 2.
6) Check the sign of the magnetic distance displayed at the top of the menu. If this value is negative, check the Reverse phase button ON.
7) Click ✗ to exit the menu.

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



1 – Wire channel
2 – Magnetic distance

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 ⓧ until the **TECHNICIAN SETTINGS** menu appears. Select **INFRASTRUCTURE > Parcels**.

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

Selecting a parcel and pressing ✓ displays following options:

- Name
- Return direction
- Use track border
- Trackbord. Min. / Trackbord. Max.
- Min. bounce angle / Max. bounce angle

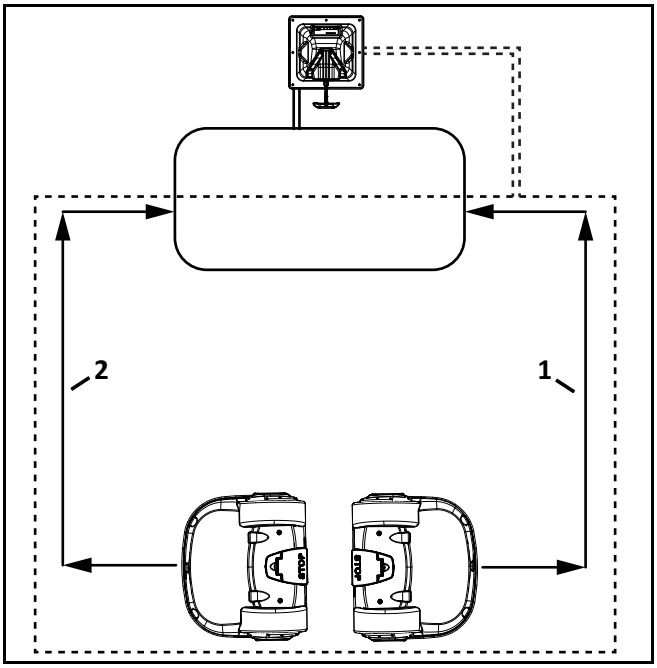
Name

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

Return direction

This defines the default 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. This is important if a problem has occurred and the robot does not know which parcel it is in.



1 – Counterclockwise return direction
2 – Clockwise return direction

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

Use track border

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

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

This parameter can be checked OFF for the station loop.

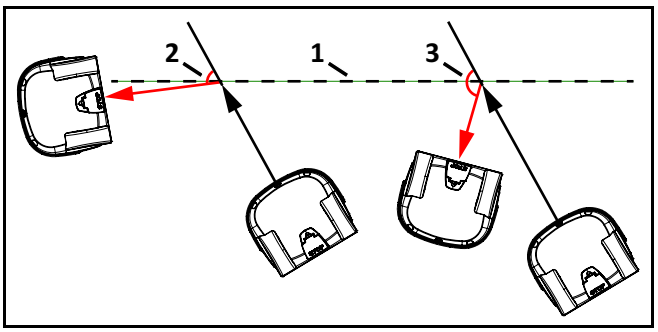
Trackbord. Min. / Trackbord. Max.

Theses are minimum and maximum values allowed for the track border. The robot will select a random value between the defined values.

The default minimum value for **Trackbord Min**.is 2.5 ft. (0.8 m). The default maximum value for **Trackbord. Max.** is 10.0 ft. (3 m).

Min. bounce angle / Max. bounce angle

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



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

Perimeter

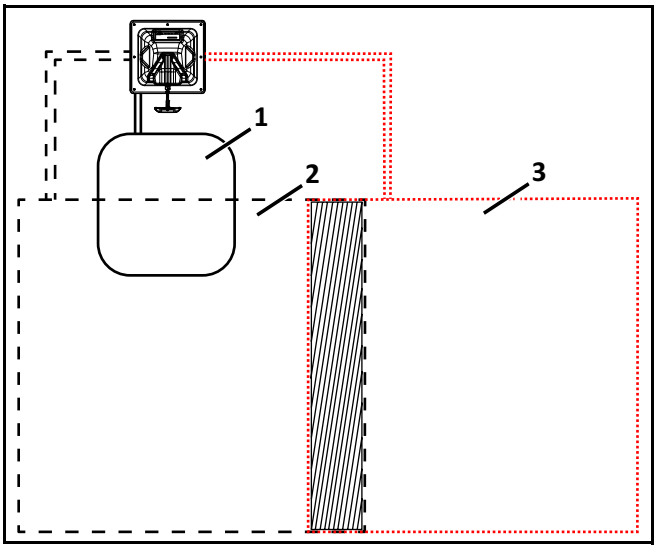
This defines a distance the robot will travel along the track border to return to the charging station. If the robot travels the distance defined by this parameter and does not find the station, it will set an alarm.

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

Neighboring parcels

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

- Parcel 1 is a neighbor of Parcel 2
- Parcel 3 is a neighbor of Parcel 2



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

StartZones

This menu displays a list of the defined start zones and allows the creation of a new start zone. Start zones define where the robot will start working after it has left the charging station.

A start zone is defined for each parcel.

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

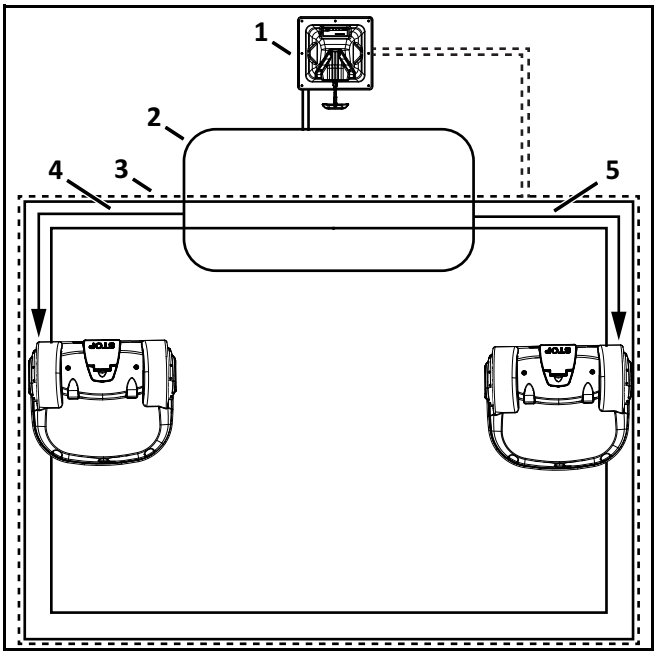
Create new start zone

Enables you 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

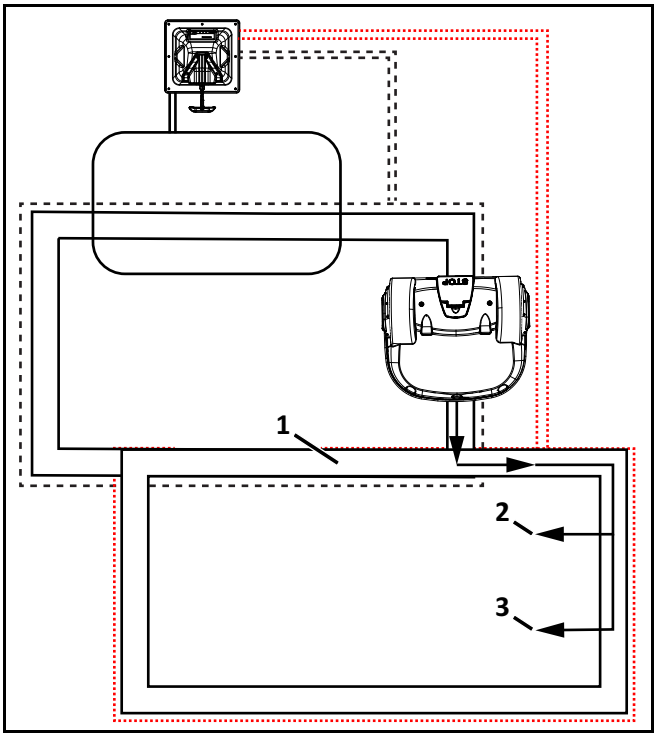
move along the track border after leaving the charging station.



1 – Charging station
2 – Station loop wire
3 – Peripheral wire
4 – Counterclockwise direction on the track border
5 – Clockwise direction on the track border

3) **Distance Min / Max -** This is the distance the robot will travel along the track border after leaving the charging station and start working. A random value between the minimum and maximum values will be selected.

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).

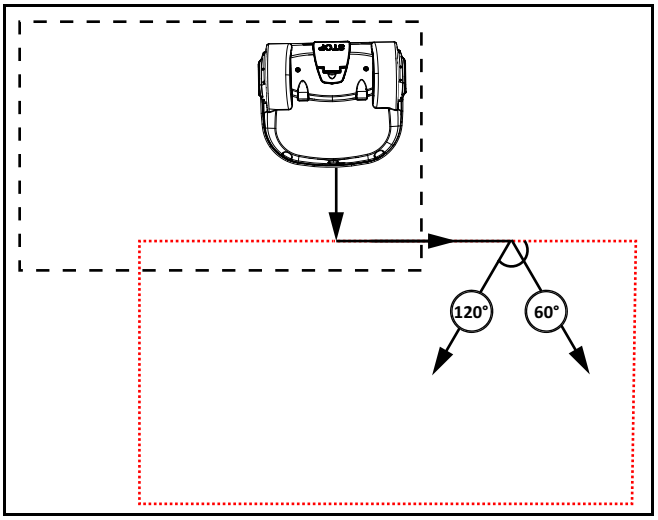


1 – Track border
2 – Distance Min.
3 – Distance Max.

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 field 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

Allows you to edit the percentages applied to different parcels. If only one parcel is defined this value must be set to 100%. Do not edit the percentage until more than one start zone has been defined.

Edit Parcels Percentage

This allows you to view and set the percentage values for all parcels. The percentage value determines the proportion of time that the robot will start working in a parcel.

Stations

Press ⊗ until the **TECHNICIAN SETTINGS** menu appears. Select **INFRASTRUCTURE > Stations**, then press ✓, 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.
Balls unload	This defines whether the balls should be unloaded at the specific charging station.
Busy loop	This defines whether the charging station has a busy-loop wire connected to it or not.
Connected to parcels	This defines which of the defined parcels the station is connected to. For a multi-field installation a list of defined parcels will be presented and button next to the required one must be checked ON. NOTE: This parameter must be defined for a multi-field installation
Station Inside Parcel's Wire	This specifies whether the station is located inside or outside of the peripheral wire. f the station is inside the wire, check the button ON.
Delete	Use to remove the manually created station from the installation.

8.5.2 Mobile Connection

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

Press X until the **TECHNICIANS SETTINGS** menu appears. Select **Mobile connection**, then press ✓. Mobile Connection options include:

Option	Description
Status	Displays the current mobile network status.
Network	Displays the name of the current network operator.
Network Carrier	Displays the name of the current network carrier.
APN	Displays the current id of the Access Point Name of the SIM card.
Radio	3G/2G/UMTS/4G.
Signal Strength	Signal strength in dB.
Bit Error Rate	Number of errors during transmission. Very standard in every communication.
ICCID	Integrated circuit card identifier.
IMEI	International Mobile Equipment Identity.
IMSI	International Mobile Subscriber Identity
PLMN	Public land mobile network.
LaC	Location Area Code.
Cell ID	A unique number used to identify each Base transceiver station (BTS) or sector of a BTS within a Location area code.
MCC	Mobile Country Code. This code identifies the country. For example, in China MCC is equal to 460, in USA - 310, Hungary - 216, Belorussia - 257.
MNC	Mobile Network Code. This code identifies the mobile operator.

8.5.3 Demonstration

Use this mode to demonstrate the performance of the robot.

⚠ 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.

How, from what menu?

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

8.5.4 Service

Press X until the **TECHNICIANS SETTINGS** menu appears. Select **Service**, then press ✓. The Service menu contains the following options:

- Calibrations
- Information
- Tests
- Software update

Calibrations

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

1) If a cutting head has been modified, or if a new cutting head has been installed, press ▶ to select **Calibrate now**, then press ✓.
2) Close the lid.
3) The cutting heads will be rotated and the rotational speed 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 to select **Calibrate now,** then press .
2) The robot will move the cutting heads up to the maximum height. The cutting heads will then be lowered to the required height.
3) When the value is OK, set the required cutting height.
4) If there is a problem, examine the cutting heads and see if there is anything blocking the movement over the complete range.

Information

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.

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 to select the test(s) you want to execute.
- Press to select the test.
- Repeat this for all tests required.
- Select **Start** and press .

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) **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.

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

7) **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.

8) **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.

9) **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.

8.5.5 Advanced Parameters

From any menu, press ✗ repeatedly until the home menu appears. From the home menu, press and hold **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.	Sets the distance the robot will move when it crosses the peripheral wire, before turning back into the field again. The default value is 0.2m. This distance represents the distance between the front of the robot and the position of the coil that detects the presence of the wire. **NOTE:** The distance between the peripheral wire and the edge of the working area depends on this value.
Min. temp.	Sets the lowest outside operating temperature in which the robot will operate.
Disable sleep mode	Enables or disables sleep mode.
Max idle time	Sets the maximum idle time.

9 Error Messages

Error messages are displayed an alarm has been raised. Report error messages to your authorized ECHO Robotics Dealer. Always note the date, time, and robot serial number.

Error Message	Description
Battery temperature issue	Battery temperature is above or below the allowed limit.
Battery over voltage	One, or more, battery cell voltage is over the limit.
Bad battery connection	Internal problem with the battery.
Bad battery measure	Values displayed for the battery on the GUI menu do not correspond to the actual values.
BMS communication wire is not connected	BMS (Battery Management System) wire is not connected properly. This refers to the electronic part of the battery.
Shutdown in 2 min / inhibit shutdown principal / unblock brakes	GUI (Graphical User Interface) menu displays the alarm- and asks if you want to inhibit the shutdown. The LED is blinking very fast (~5x per second). The brakes are deactivated. Battery charge level is critically low.
Some wires not well configured. Please add at least one parcel to each wire	Configuration of wires and parcels is incorrect. At least one wire must be defined in the installation configuration, and at least one parcel must be assigned to each wire.
No charge current; Check contacts and charging station	Charging station voltage is detected but there is no supply current.
The robot has no wire to mow. Please configure at least one wire.	No wire has been configured.
The robot has no parcel to mow. Please configure least one parcel.	No parcel has been configured. At least one wire must be configured defining a field to mow, and a parcel must be defined for each wire.
No peripheral signal!	Robot is unable to detect a valid magnetic signal.
Station contact lost for {0}s!	Robot has reached the charging station and started to charge, but at a certain time the charging station contact is lost. If the contact loss lasts for more than one hour, this alarm is triggered.
Wrong wire and parcels Configuration	Robot has encountered a problem while mowing in a particular parcel. When the robot re-starts it is not sure in which parcel it is located, and where it should start mowing.
No station contact detected	The robot has executed the loop step, but has not made contact with the charge arms after 29 m (by default).
Wire Lost during TrackWire!	Robot is following the track wire and is then unable to detect a signal on the wire. When this happens the robot will rotate 360° in an attempt to detect a phase difference, and then issue this message.
Unlock system: bad pin code	“System blocking” is set and must be unblocked by entering a pin code. An incorrect code has been entered.
Unable to find the working area	The robot is unable to find a valid magnetic signal.
Failed to dock to station	Robot has tried to return to the charging station but failed.
Head {0} is blocked!	Occurs when a cutting head should be spinning, but is not
Head {0} did not start!	Cutting head should be spinning but it does not start.
Motor blocked when going {0} to {1}mm	A command to change the cutting height has been issued, but the cutting head can not move.
There is no 12V peripheral for {0}	12 V power supply does not work properly.
There is no 5V for {0}.	5 V power supply does not work properly.
STOP button issue detected	Stop button is not operating correctly. The Stop button lid must be closed when the robot is operating. The Stop button lid is determined to be closed by detecting a closed circuit between magnets on the lid and relays in the cover. If these magnets are and relays are not connecting correctly the correct state of the lid can not be determined. This can arise due to wide temperature fluctuations.

Error Message	Description
Unexpected exit zone event	Robot did not exit from the charging station correctly, possibly turning in the wrong direction.
The {L/R} fuse is blown or the {L/R} motor is not connected	Robot can not detect any current in either the left or the right wheel motor. Either a fuse or a connection is faulty.
Failed to consistently re-enter the zone	Robot has crossed the peripheral wire, but is not able to re-enter the field where it is mowing. Possible reasons are a loss of signal or the robot is physically unable to re-enter the field because of mud or obstacles.
SelfTest failed to clear within 15s	When the robot starts up, it executes a self-test of a range of functions. This error occurs if a failure occurred on any of the functions tested.
Unhandled exit zone!	A problem arises as the robot exits the charging station.
Waiting for station contact	Robot is in the charging station and it loses contact. It will wait one hour before generating the alarm.
Wait for 5 Seconds of full contact	Contact with the charging station arm has been lost. There is insufficient voltage on the charging station arm to charge the robot.
Waiting for signal	The signal on the peripheral wire is lost. The robot will wait for a period of 12 hours and then start again - if the signal has been restored. This message appears if the Stop button lid is opened during the 12 hour period. There is no signal on the peripheral wire.
Noise on bumper	Electrical (background) noise level on the bumper is high enough to impair the proper operation
Lift(X) Detected - Front/Rear Left/Right	A cover lift is detected. An obstacle has caused the cover to be lifted.
Too many repetitive collisions!	A series of repetitive collisions is detected. Too many obstacles.
Unhandled collision event!	Robot has detected small obstacles in the mowing field, which are not large enough to trigger the operation of the lift sensors.
Sonars issue detected	One of the sonar sensors is malfunctioning.
Collisions at start-up: {0}	The robot can not resolve a collision at start up. There is an obstacle blocking the robot start up.
Collision too close to station ({X}m)	The robot is leaving the charging station. The robot encountered an obstacle (at {X} meters from the charging station), but was unable to move around it because it was too close to the charge arms. Obstacle too close to the charging station.
DMA Error, on sonars: {0}	A hardware error in the sonar control system.
LongCollision ({0}) event detected	either a lift or a backwards sensor has been blocked for at least 10 seconds.
Still in collision ({0})!alarm	A maneuver to avoid a collision has failed after one minute.
Wait for no collision	Occurs after a collision. The robot moves backwards and then checks if the obstacle is still there. It will then wait until the obstacle has been removed. This message appears while it is waiting.
Did not find the zone due to collision ({0})	Robot has crossed the peripheral wire, but was unable to re-enter the zone to be mowed because of an obstacle.
ManualTask shall not complete: MotorDrive is in safety.	Robot did not start.
The wire is currently configured to be ignored.	Robot sends a cautionary message before starting work. It can come out of its area and there is a risk it could fall into water
Cannot start MotorMow If we are in Alarm/Safety. Check navigation.	Robot was asked to start, but an existing alarm has not been cleared.

10 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.

10.1 Maintenance Chart

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

10.2 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 screw are tight.
Check the integrity of the sonar electrical connectors, clean as necessary.
Clean the charge contacts.
Clean the Smartbox menu. Check that there is no moisture on the exterior of the menu or condensation on the interior of the menu.
Smartbox: If a problem has been indicated with the GPS signal, replace the Smartbox.
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.

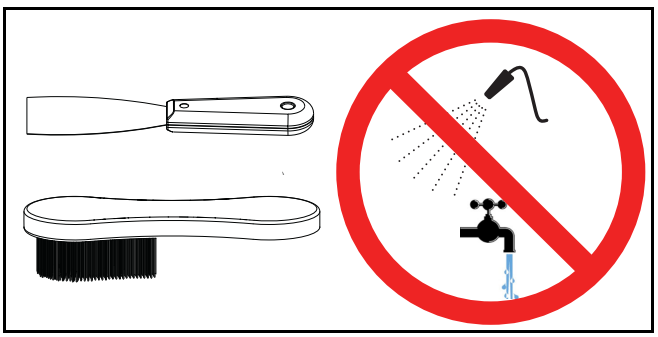
Service Inspections
Check that the front wheel axles rotate freely and the axle nuts are securely tightened.
Front wheels should spin freely without wobbling. Verify that the wheel bearings are sealed.
Check the rear tires for excessive wear, replace as necessary.
Verify that the front lift sensors move up and down with no resistance, lubricate as necessary.
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.

10.3 General Inspection and Cleaning

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

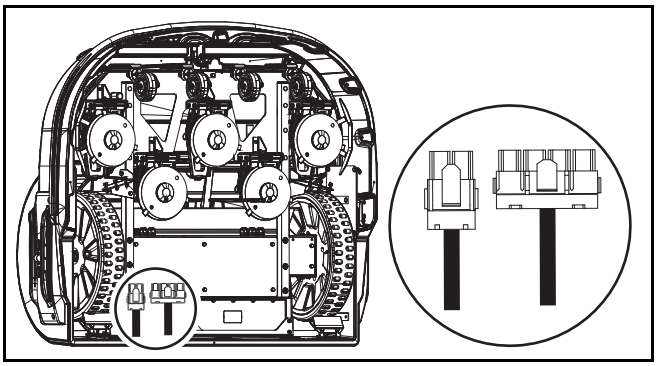
1) Remove the robot from the charging station and place it on a clean, flat surface.
2) Turn the robot OFF.
3) Visually inspect the unit, replace damaged components.
4) Check all electrical connectors, reconnect if necessary.
5) Use a plastic scraper, nylon brush, compressed air, or a damp cloth to clean away dirt, grass, sticks, or obstructions.

NOTE: Do not use a high-pressure washer or running water for cleaning. **Never use solvents.**

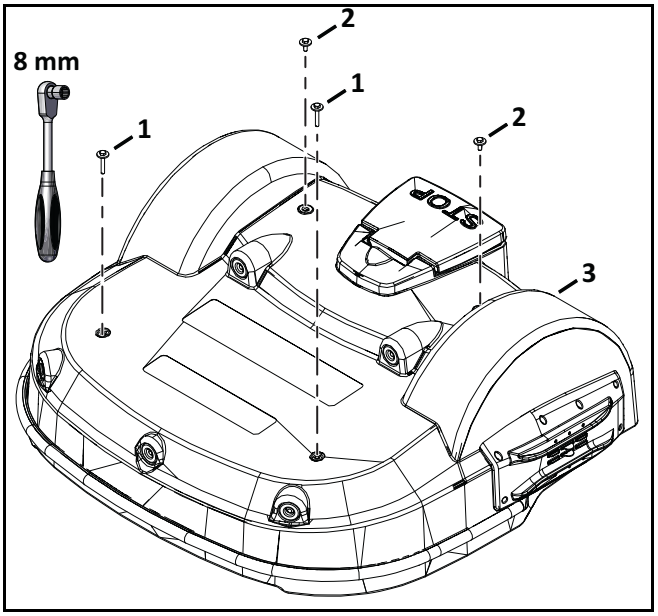


10.3.1 Cover and Electrical Cables

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 front cover screws, rear cover screws, rear washers, and 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).

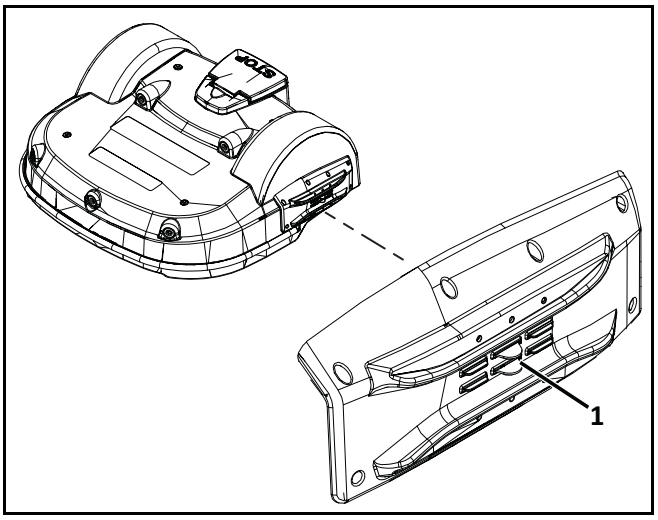
9) Stand the robot on end.

10) Connect the electrical cables.

11) Lay the robot back onto flat ground.

10.3.2 Charge Contacts

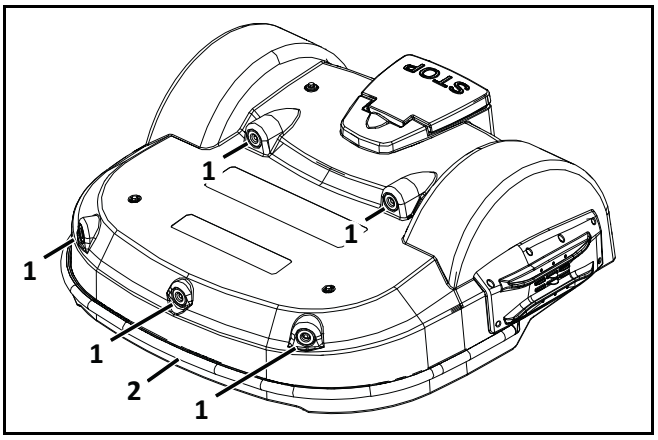
Clean the right and left side charge contacts once per week.



1 – Charge contact (left side shown)

10.3.3 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.

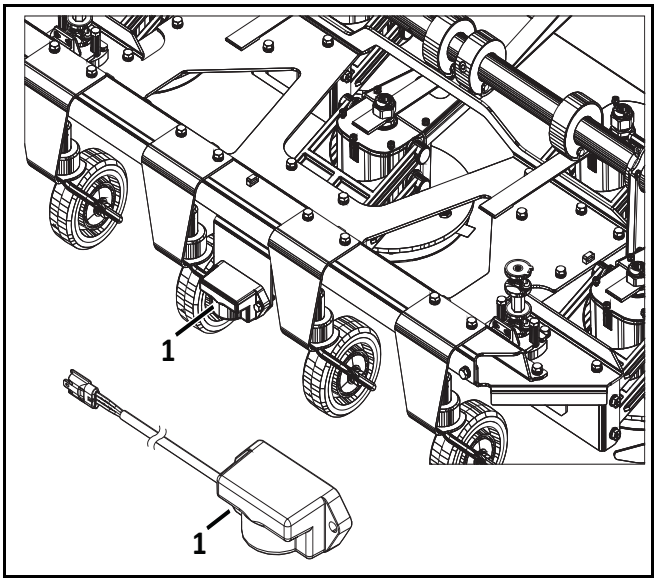


1 – Sonar sensors

2 – Bumper

10.3.4 Chassis and Coil

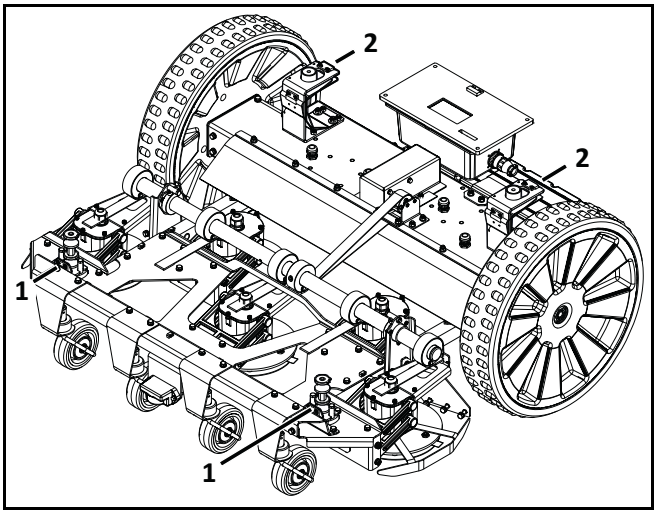
Clean the chassis and coil once per week. Inspect the coil for damage or exposed wires on the cable.



1 – Coil

10.3.5 Front and Rear Lift Sensors

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

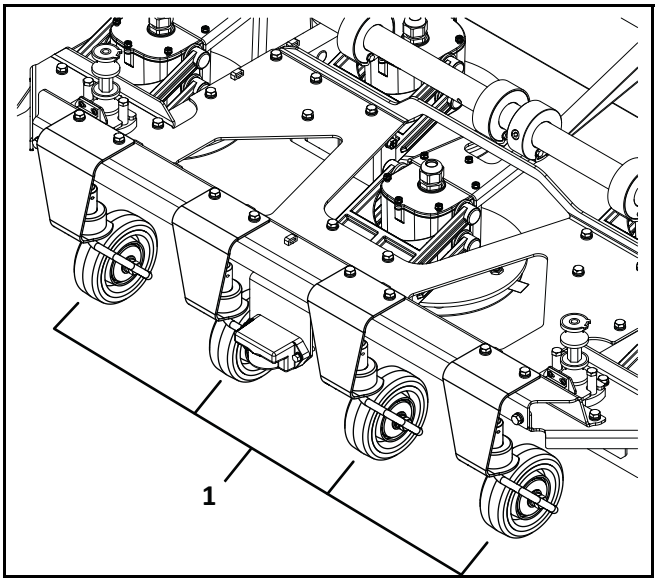


1 – Front sensor

2 – Rear sensor

10.3.6 Front Wheel Assemblies

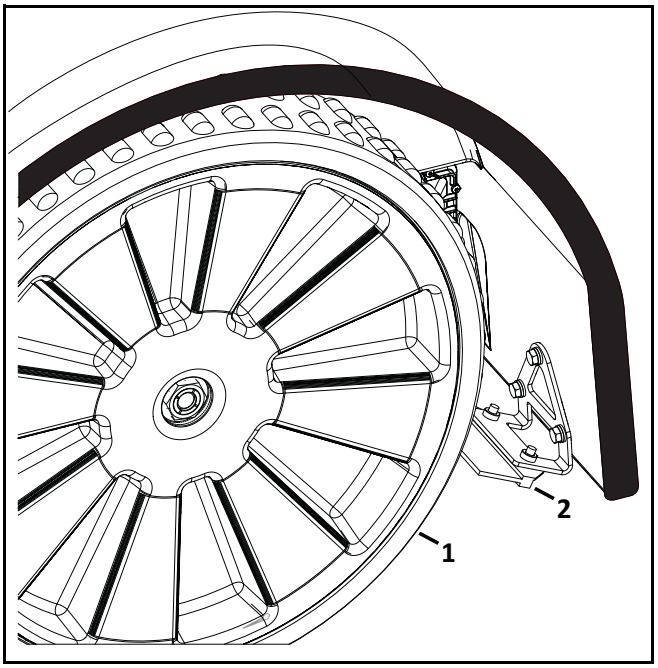
Verify that the wheels and wheel axles rotate easily. Clean the front wheel assemblies once per week.



1 – Wheel

10.3.7 Rear Wheels and Rear Wheel Brushes

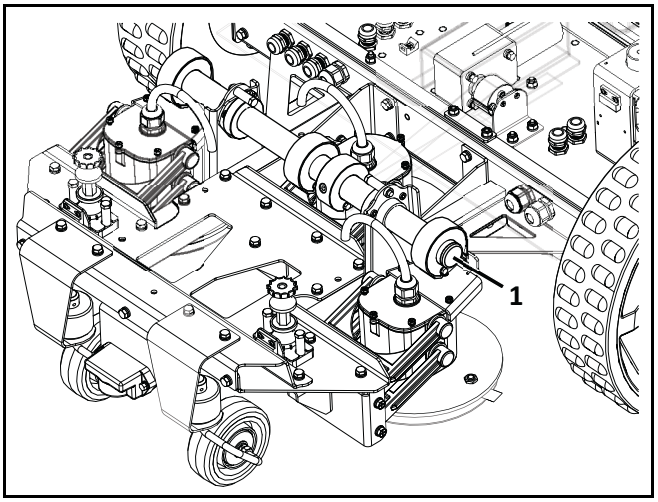
Clean the rear wheels and rear wheel brushes (if installed) once per week. **NOTE:** Cut-away view of cover shown.



1 – Rear wheel
2 – Wheel brush

10.3.8 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

10.3.9 Cutting Heads

⚠ CAUTION

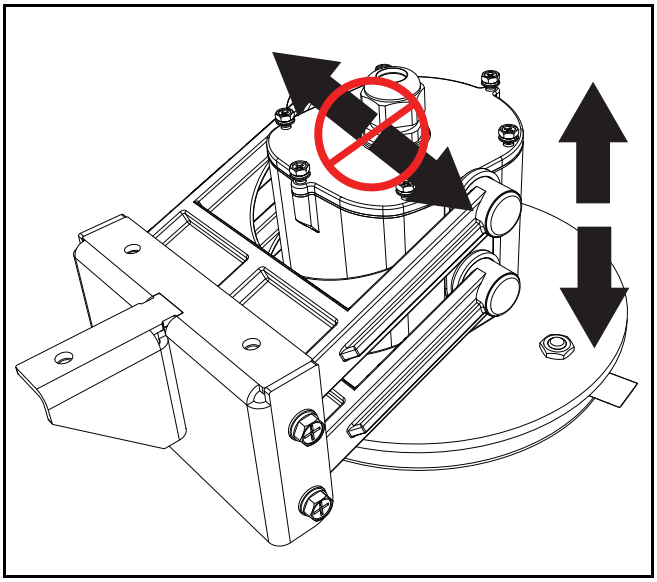
SHARP BLADES

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

- Wear protective gloves when handling the robot.

Clean the cutting head assemblies once per week.

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



1 – Cutting Head Assembly

10.3.10 Winter Storage

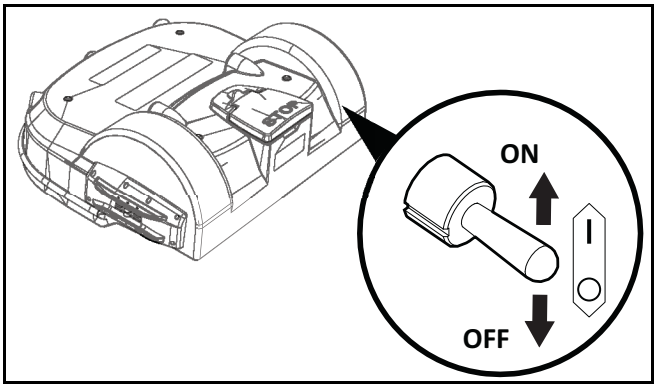
- Charge the battery to 100% before storing.
- Complete all weekly, 6 month, and annual maintenance procedures.
- Schedule service procedures with an authorized ECHO Robotics Dealer (if required).
- Store the robot in a protected dry location where the temperature is above 32° F (0° C).

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.

11 Service Procedures

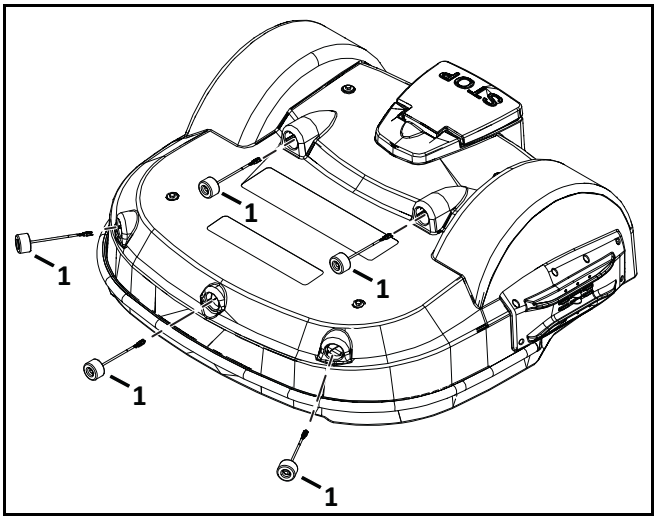
IMPORTANT: The power switch is located under the cover on the back of the chassis. Move the power switch to the OFF position before starting any service procedures.



11.1 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.

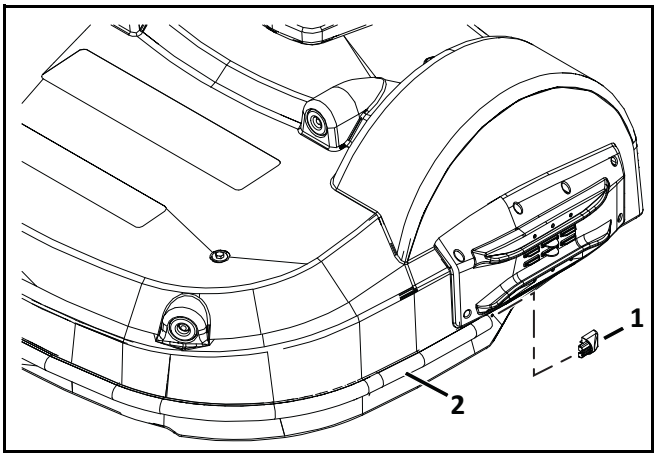
5) Complete the Sonar Sensor Service Test.

11.2 Bumper Replacement

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

1) Remove the cover.

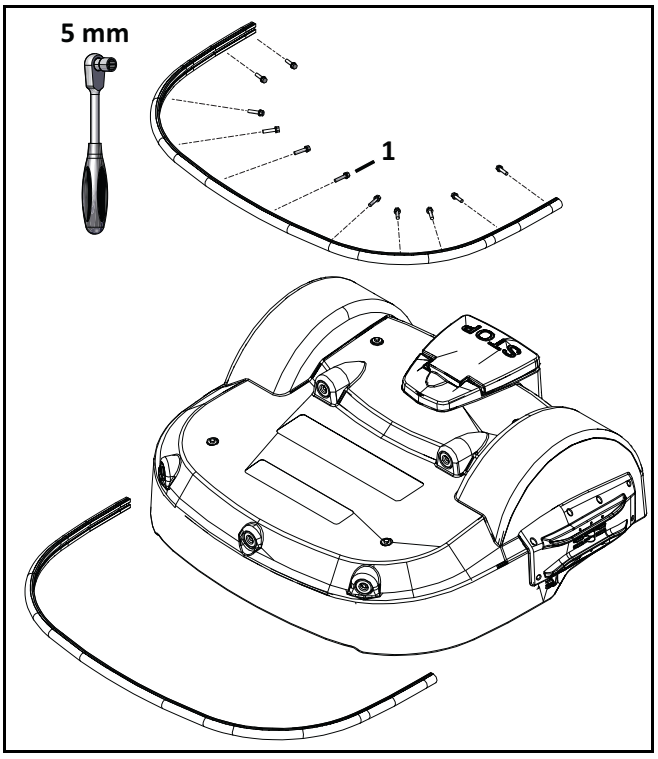
2) Remove the right and left side bumper caps from the bumper.



1 – Bumper cap
2 – Bumper

3) Disconnect the bumper cable from the bumper.

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



1 – Bumper retaining screw and washers

5) Assemble the new bumper to the cover.

6) Assemble the bumper retaining screws, tighten to 1.5 lbf• ft (2 N•m).

7) Assemble the bumper caps.

8) Connect the bumper cable to the bumper.

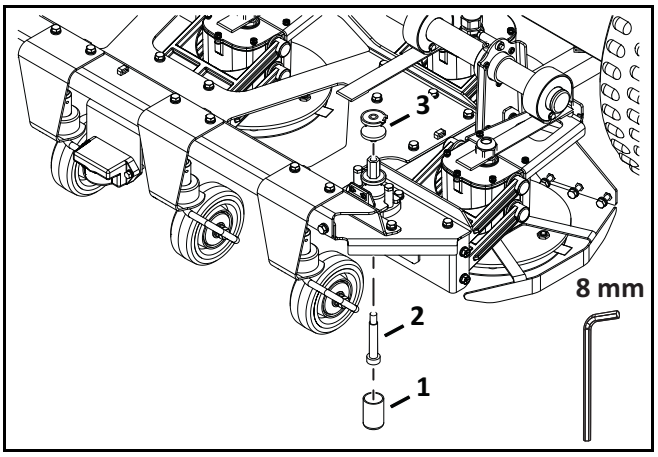
9) Complete the Bumper Service Test.

11.3 Front Lift Cushion Replacement

NOTE: Detail of left side shown.

1) Remove the flexible cap and screw.

2) Remove the front lift cushion.



1 – Flexible cap
2 – Screw
3 – Cushion

3) Assemble the new front lift cushion.

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

5) Replace the flexible cap.

6) Complete the Lift Sensor Service Test.

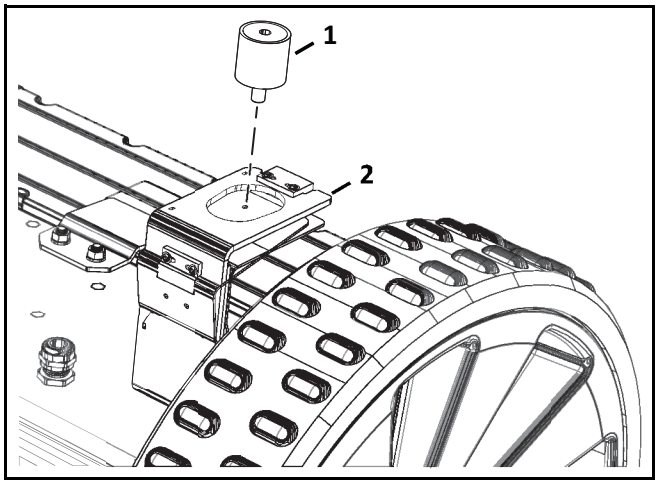
11.4 Rear Lift Cushion Replacement

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

11.5 Front Wheel Replacement

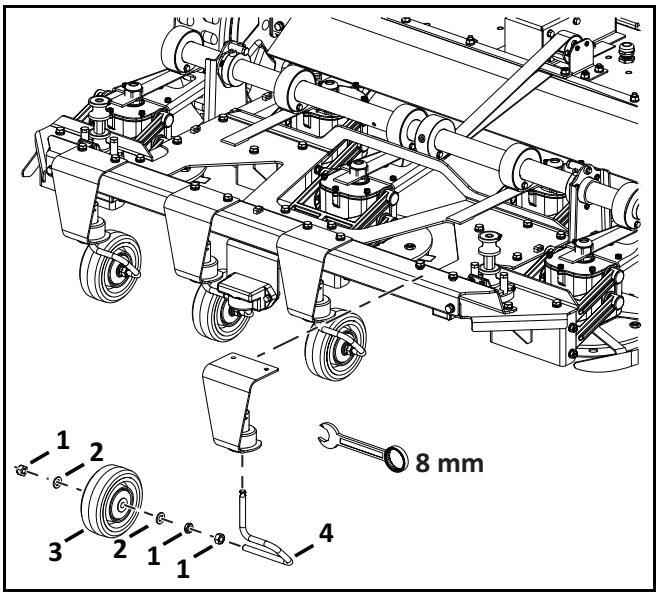
1) Remove the outside 8 mm nut and washer.

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

11.6 Rear Wheel Replacement

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

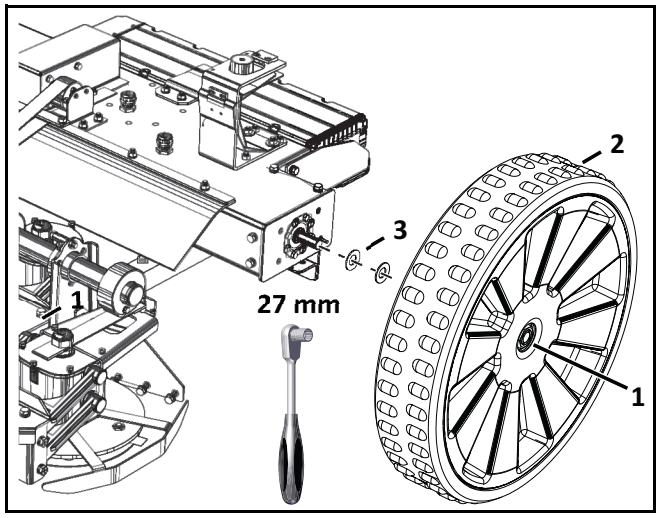
1) Remove the cover.

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).



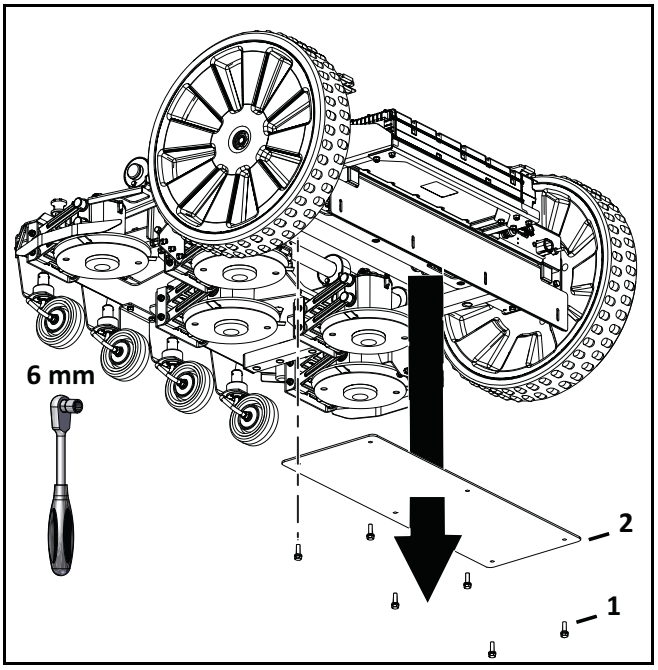
1 – Wheel nut
2 – Wheel assembly
3 – Washer

11.7 Gear Motor Replacement

Bottom view of robot shown.

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

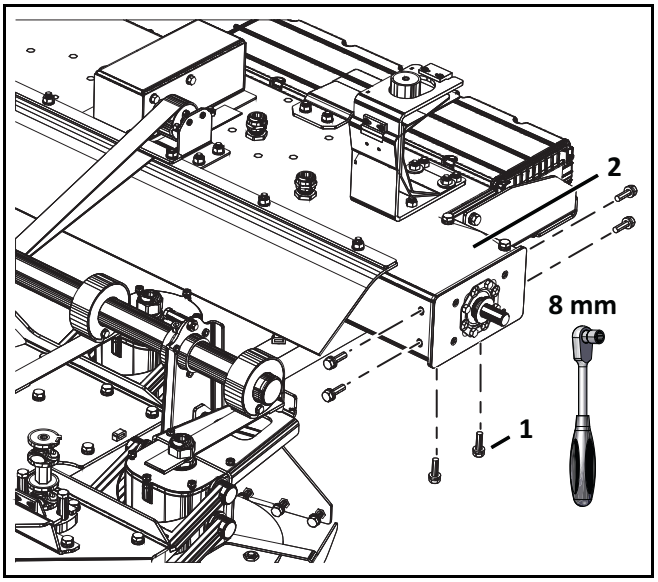
2) Remove the six screws and cover washers from the electrical box.



1 – Screw
2 – Cover

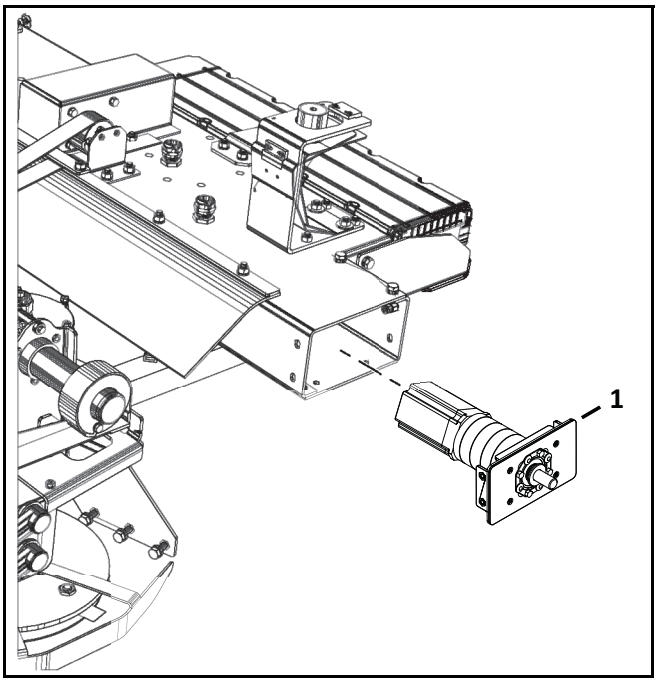
3) Disconnect gear motor cables from traction drive card.

4) Remove the six bolts from the gear motor support.



1 – Bolt
2 – Gear motor support

5) Remove gear motor assembly.

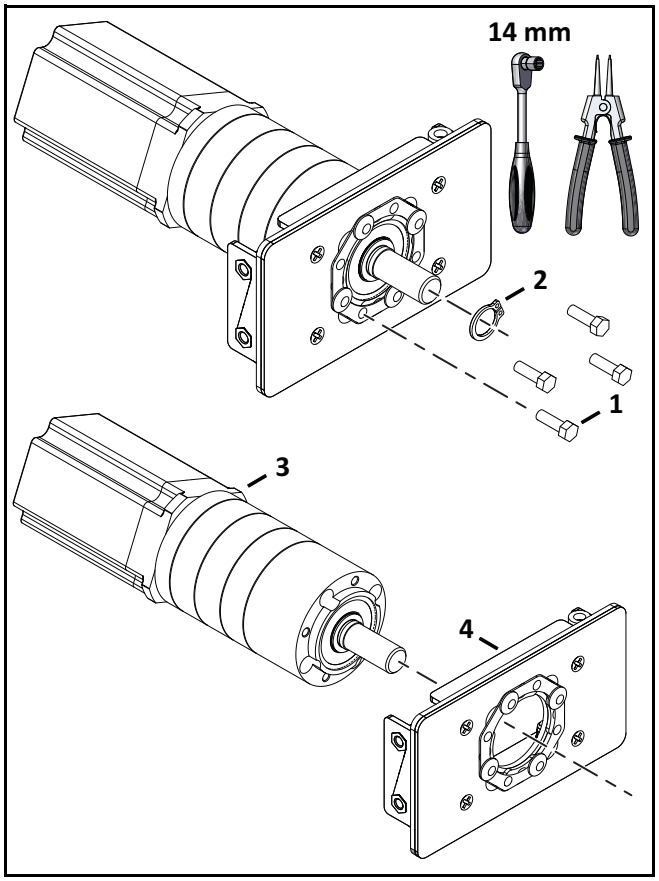


1 – Gear motor assembly

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.

11.8 Cutting Motor Cable Replacement

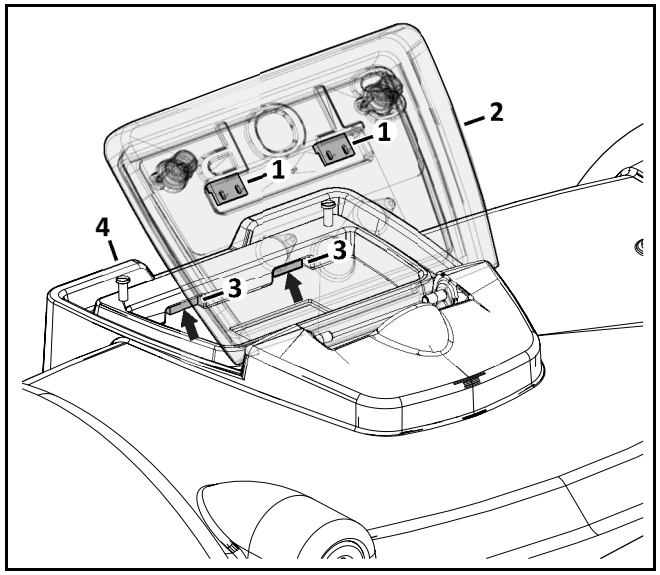
1) Visually inspect cables for cuts or abrasions.
2) Replace damaged cables.
3) Replace cable retention clips if necessary.

11.9 Lid Closure Problems

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

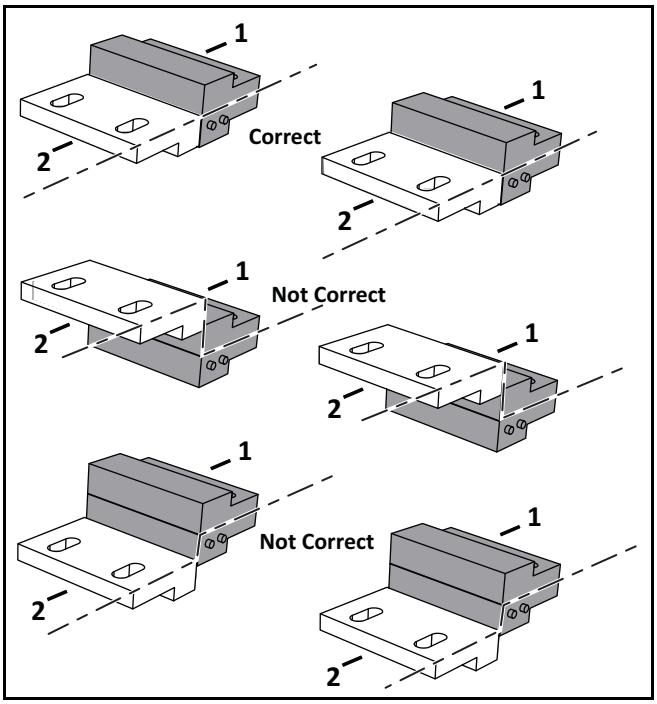
A closed circuit must exist between magnets on the lid and relays on the cover. This circuit needs to be open when the lid is open. When the lid is pressed down, it acts as the stop button. This requires that all magnets are positioned correctly.

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.

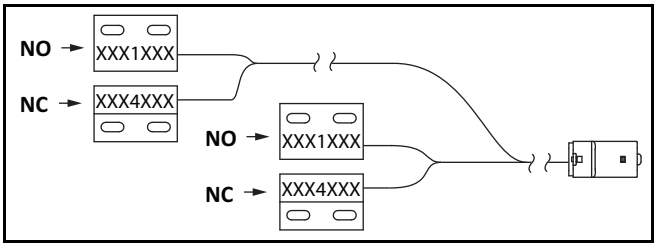
11.9.1 Relays

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.

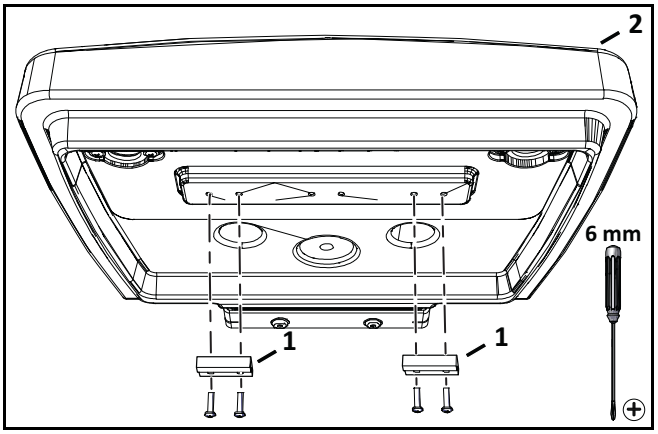


The relays are supplied as an assembly. The assembly contains two pairs of relays and the cabling between them.

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

11.9.2 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.

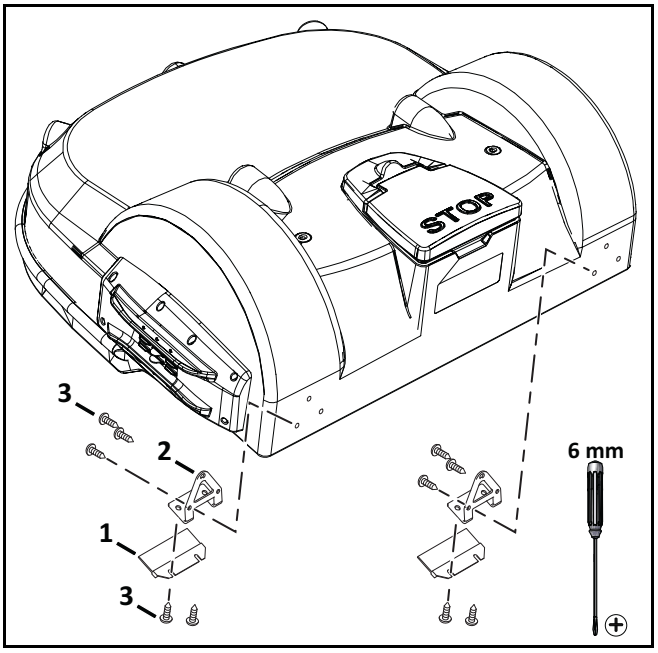
12 Robot Accessories

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

12.1 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.

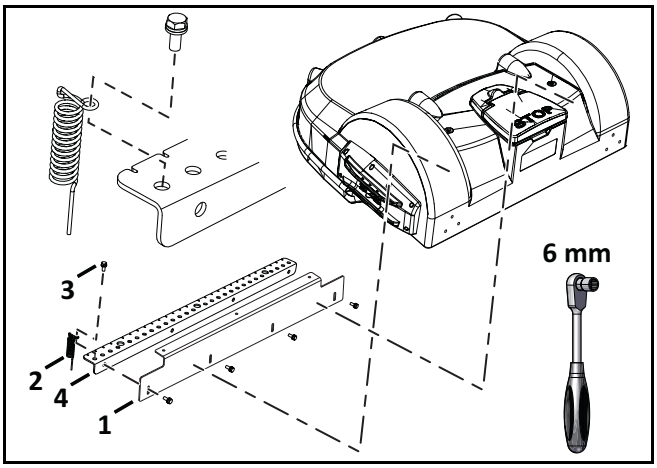


1 – Wheel brush
2 – Brush holder
3 – Screw M6 x 16 (10X)

12.2 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.



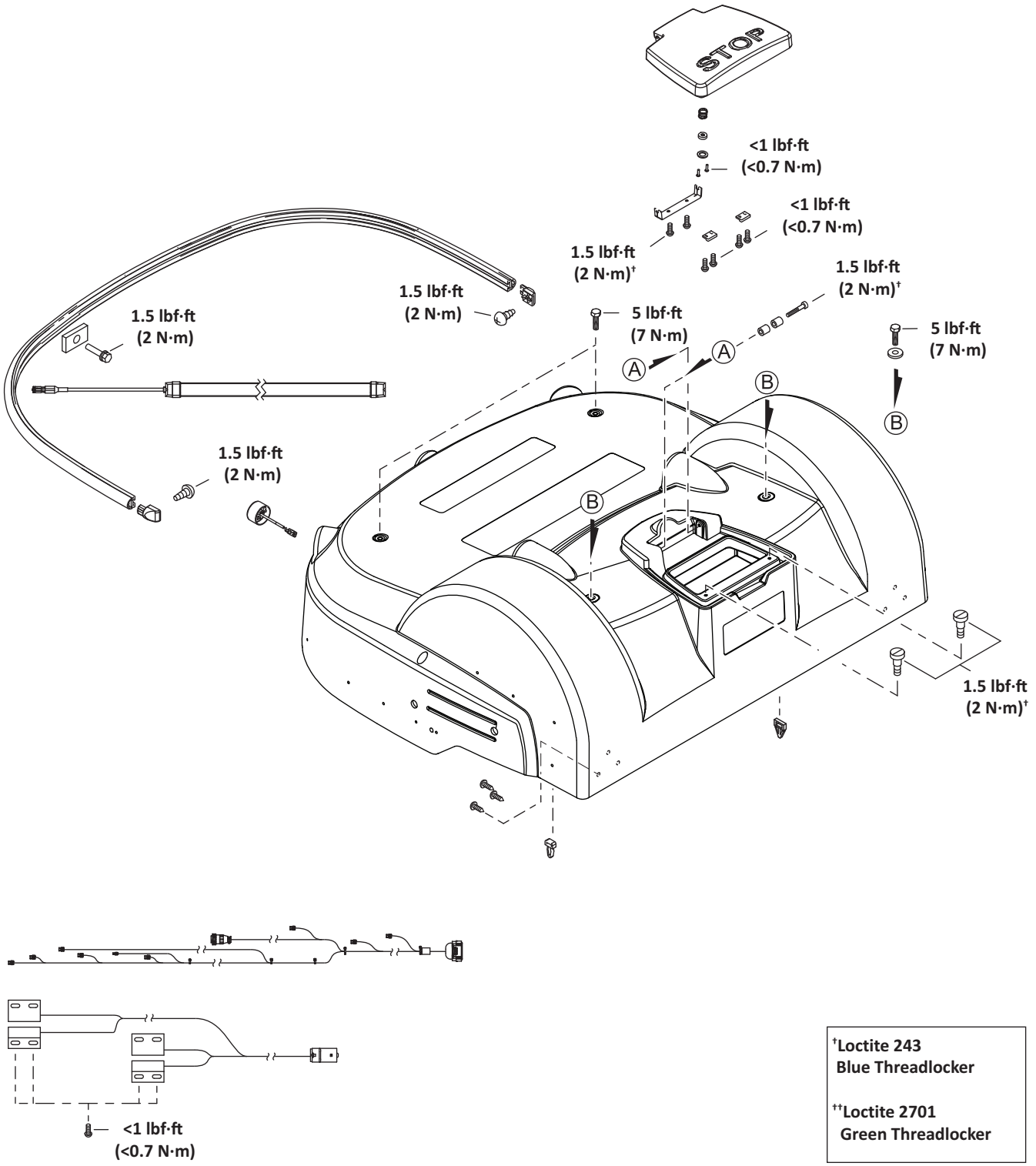
1 – Rear guard plate
2 – Springs (28X)
3 – Screw M6 x 16 (32X)
4 – Groomer support

13 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

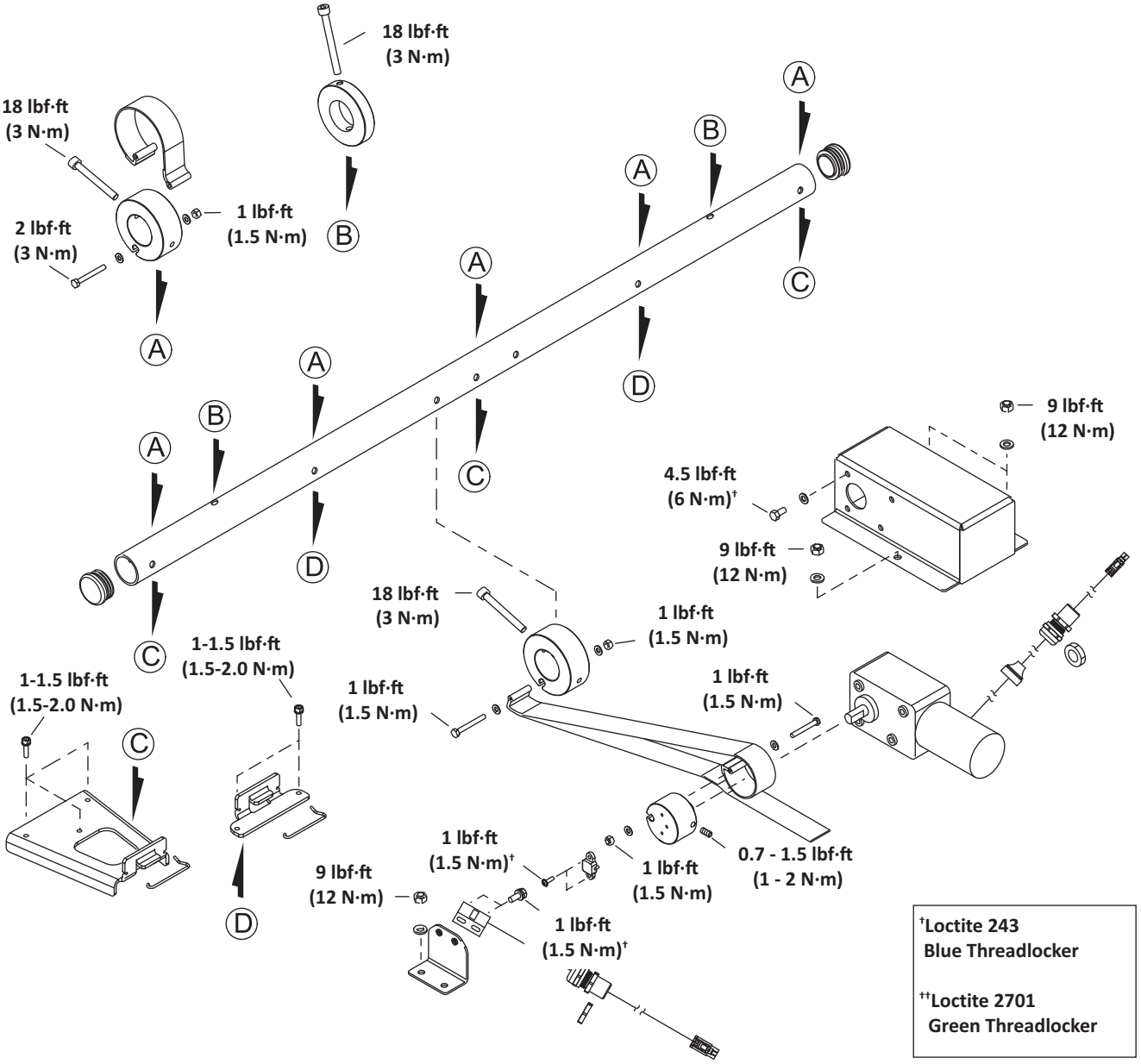
13.1 Mower Cover



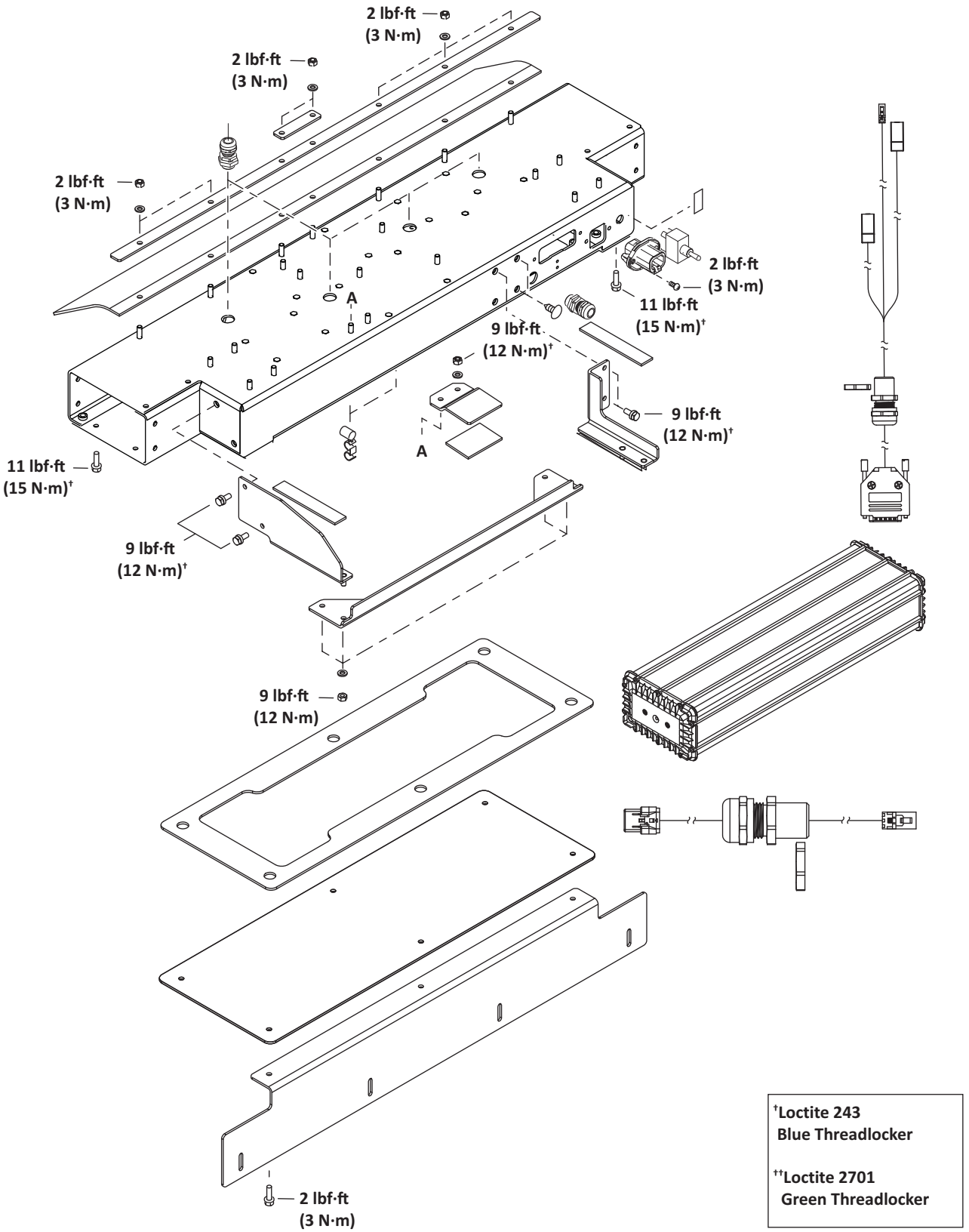
†Loctite 243
Blue Threadlocker

††Loctite 2701
Green Threadlocker

13.2 Cutting Height



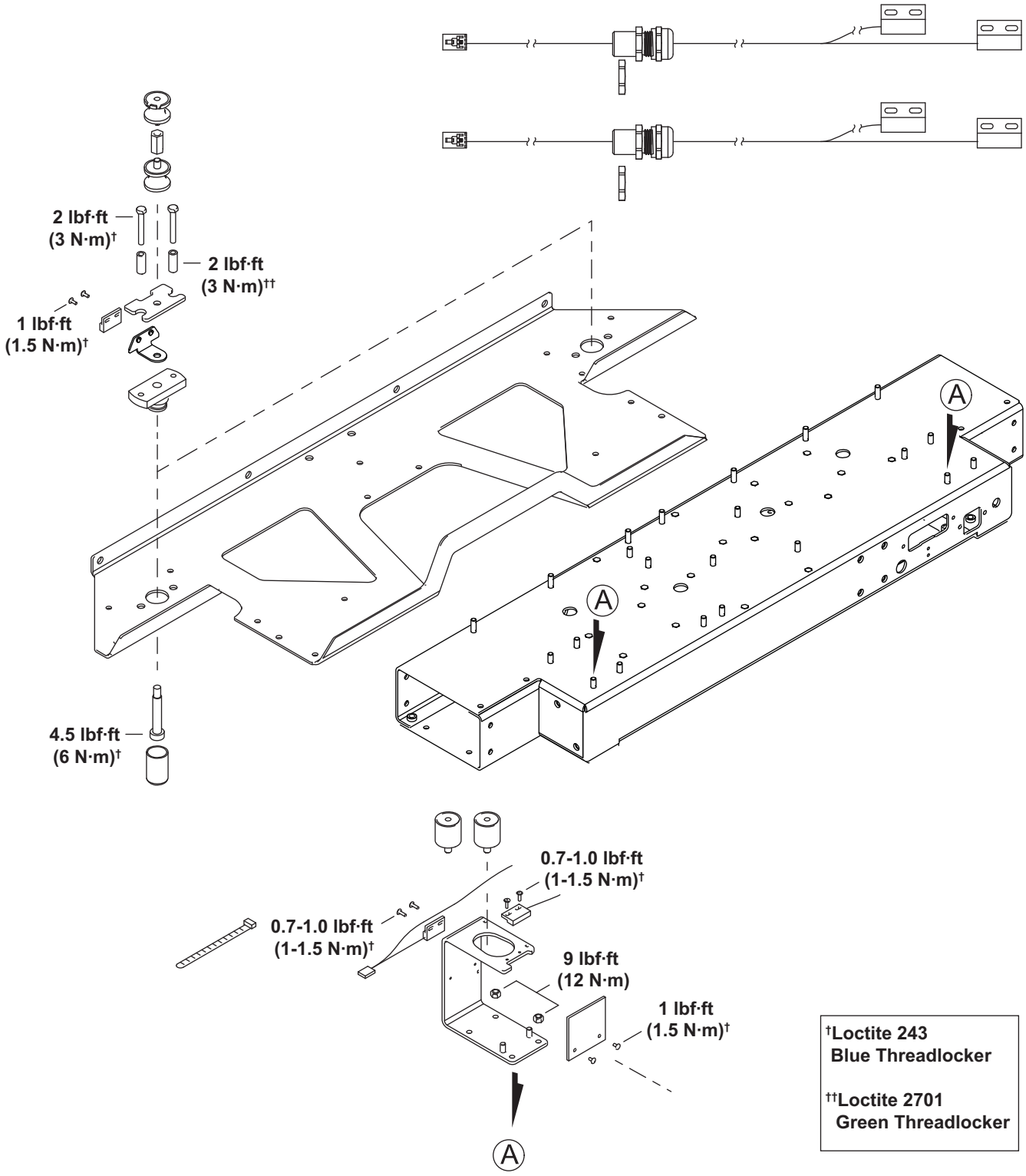
13.3 Electrical Box, Battery, and Housing



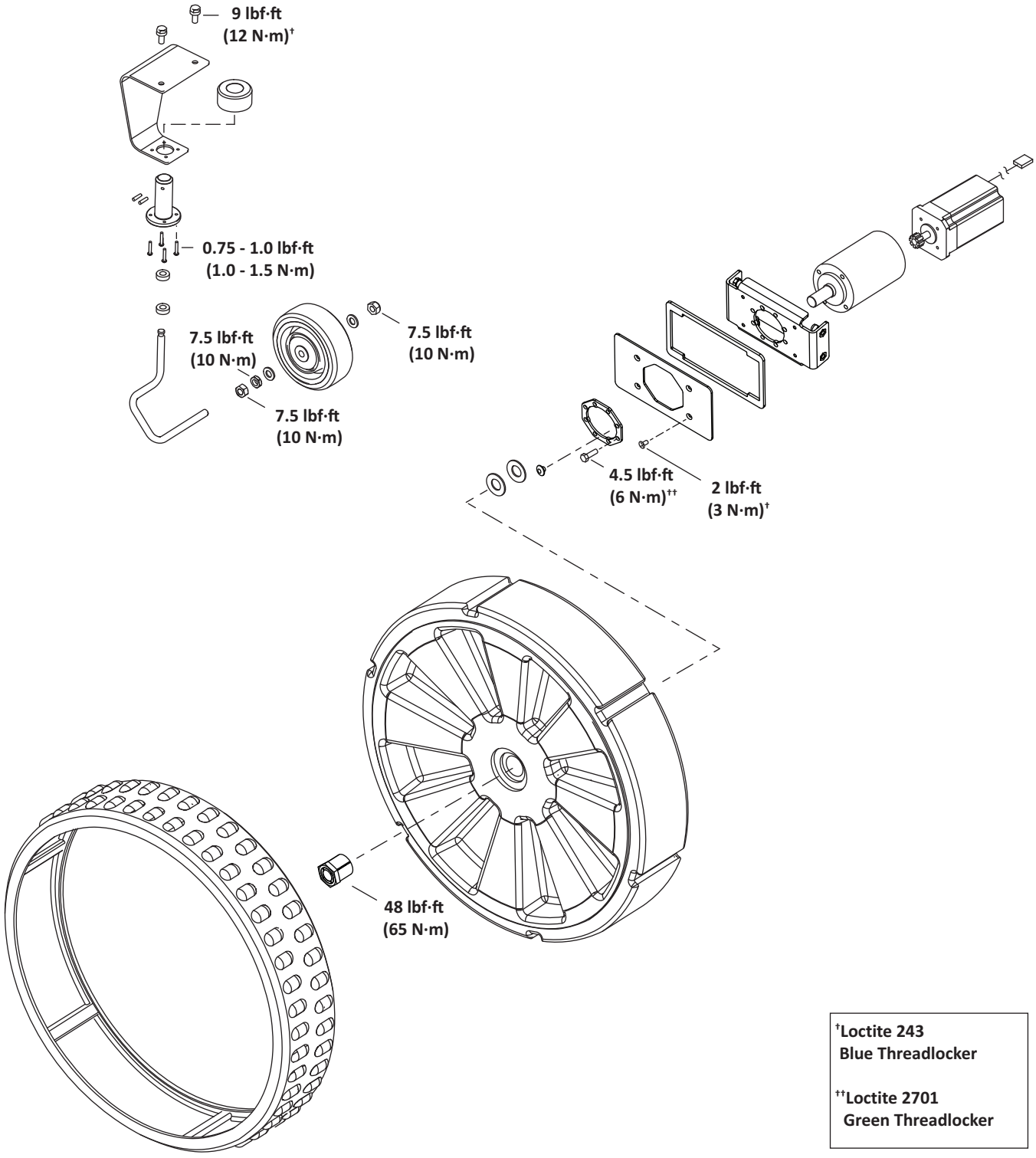
†Loctite 243
Blue Threadlocker

††Loctite 2701
Green Threadlocker

13.4 Lift Sensors



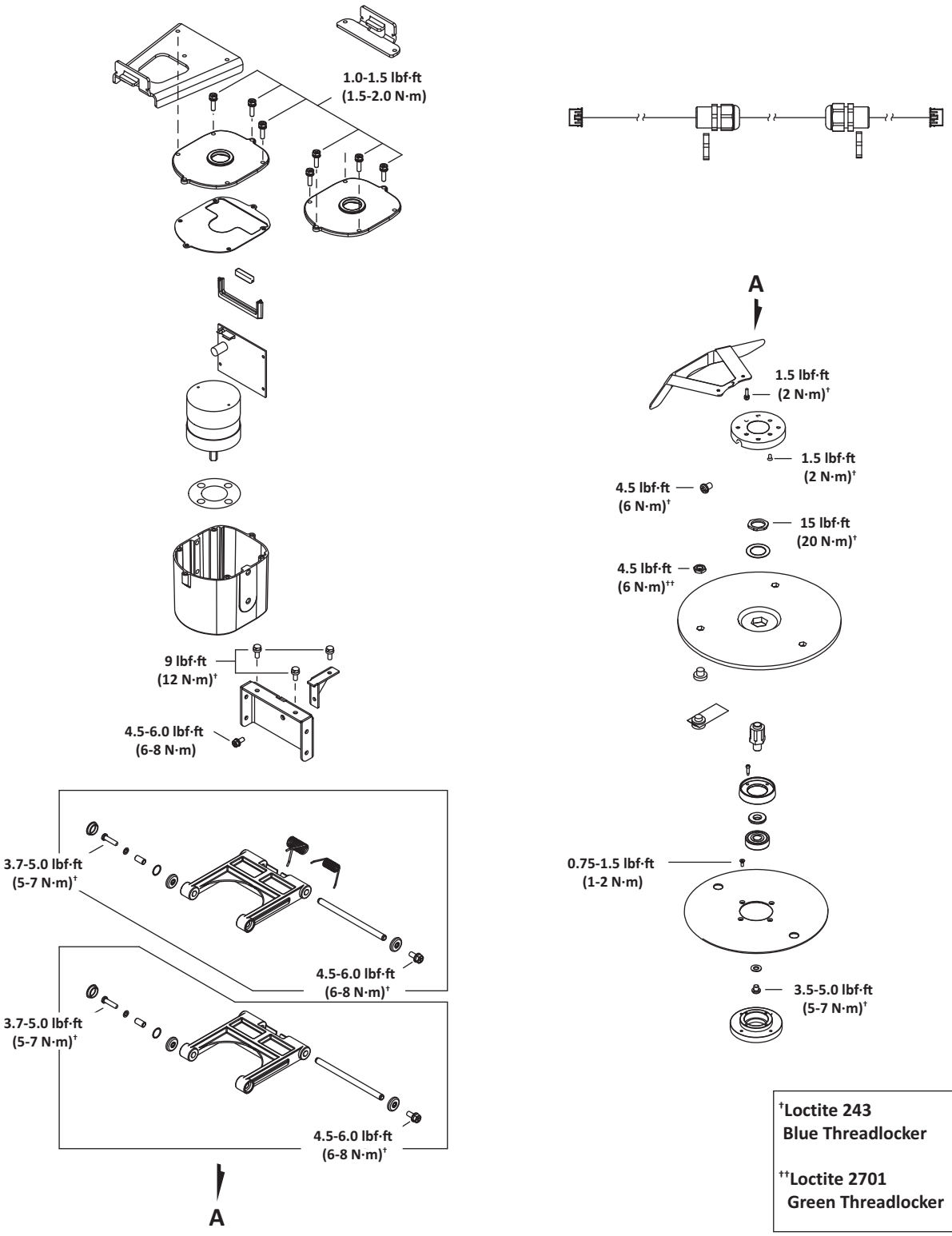
13.5 Wheels, Motor, and Gear Box



†Loctite 243
Blue Threadlocker

††Loctite 2701
Green Threadlocker

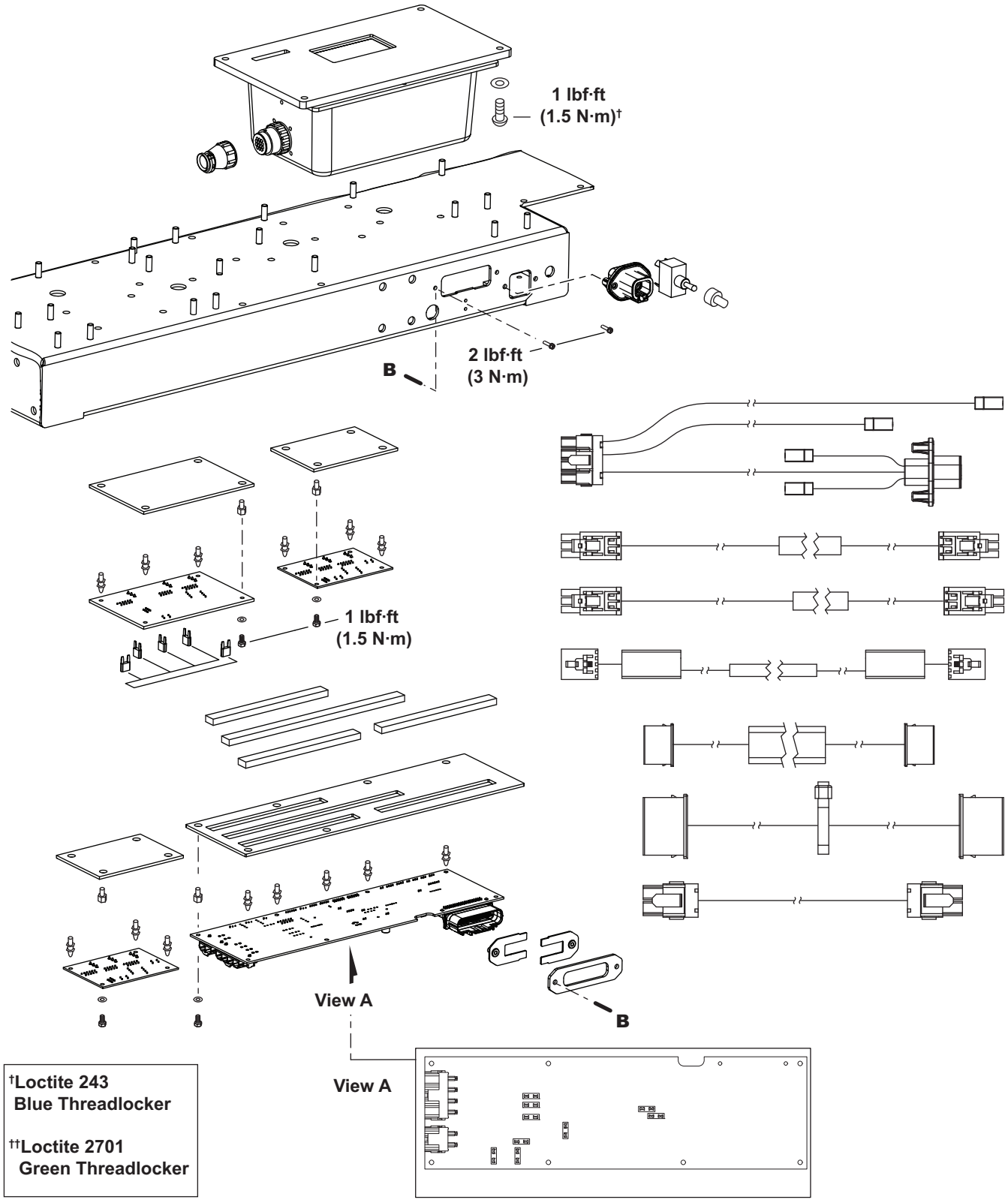
13.6 Cutting Head



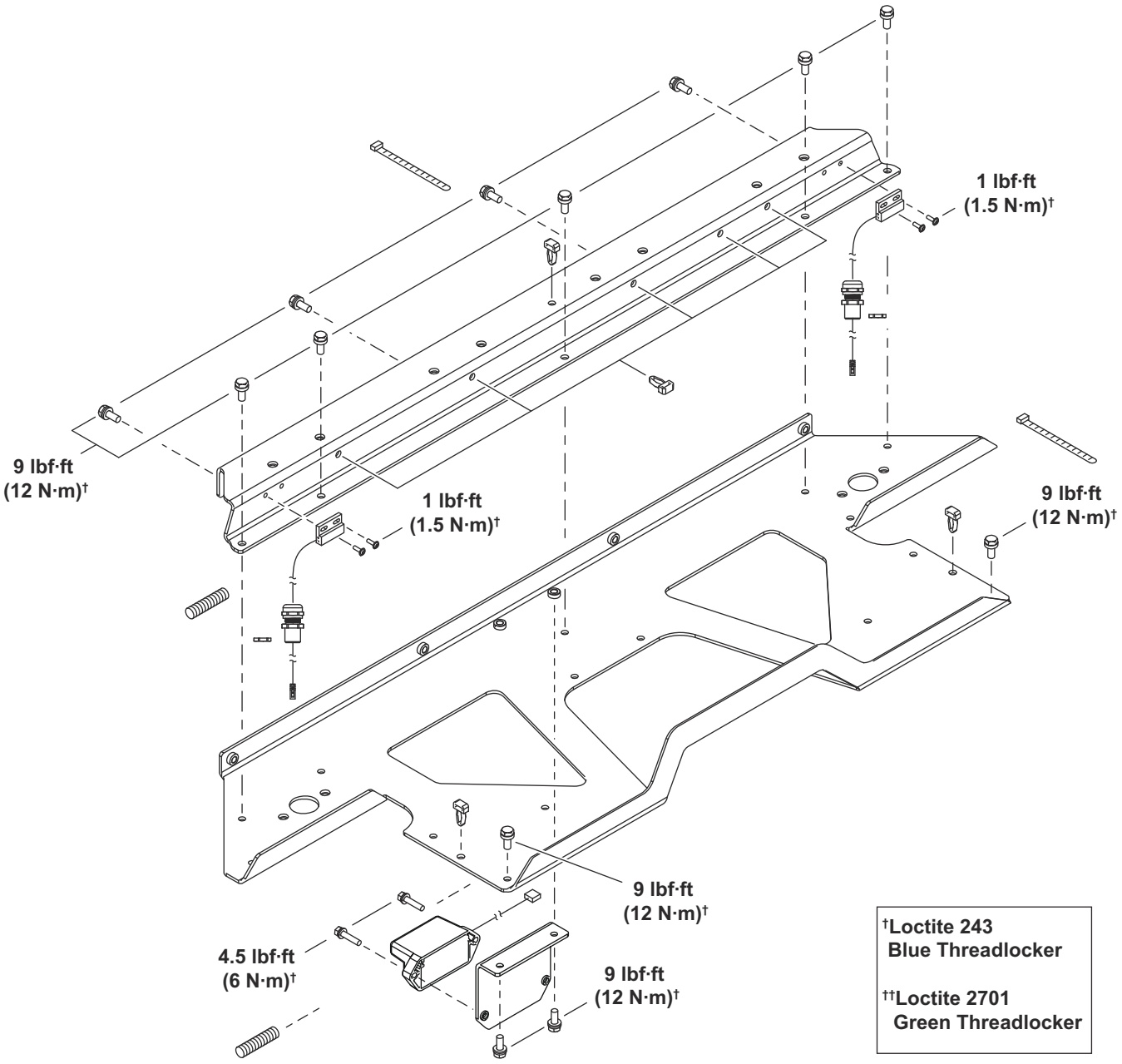
†Loctite 243
Blue Threadlocker

††Loctite 2701
Green Threadlocker

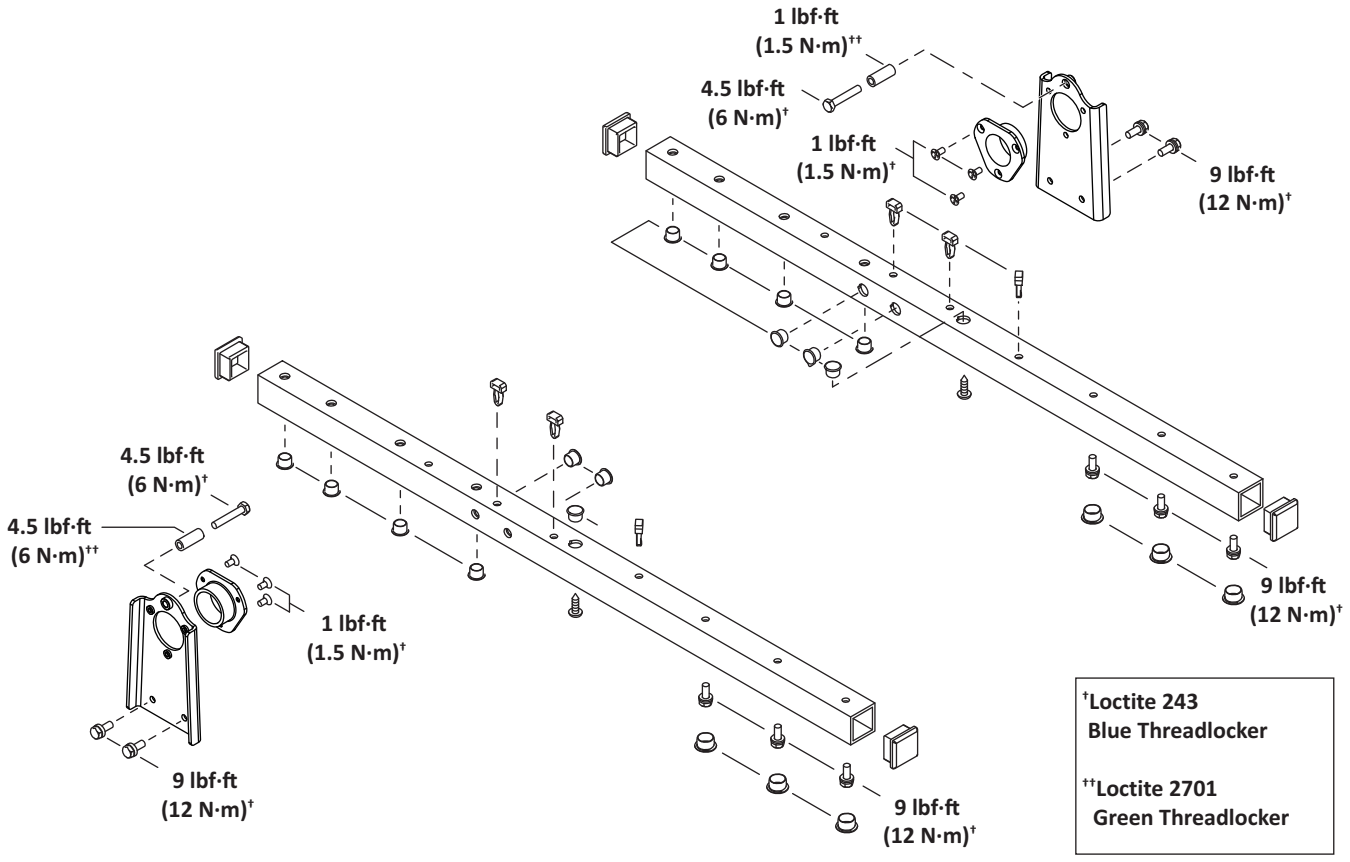
13.7 Electrical Parts



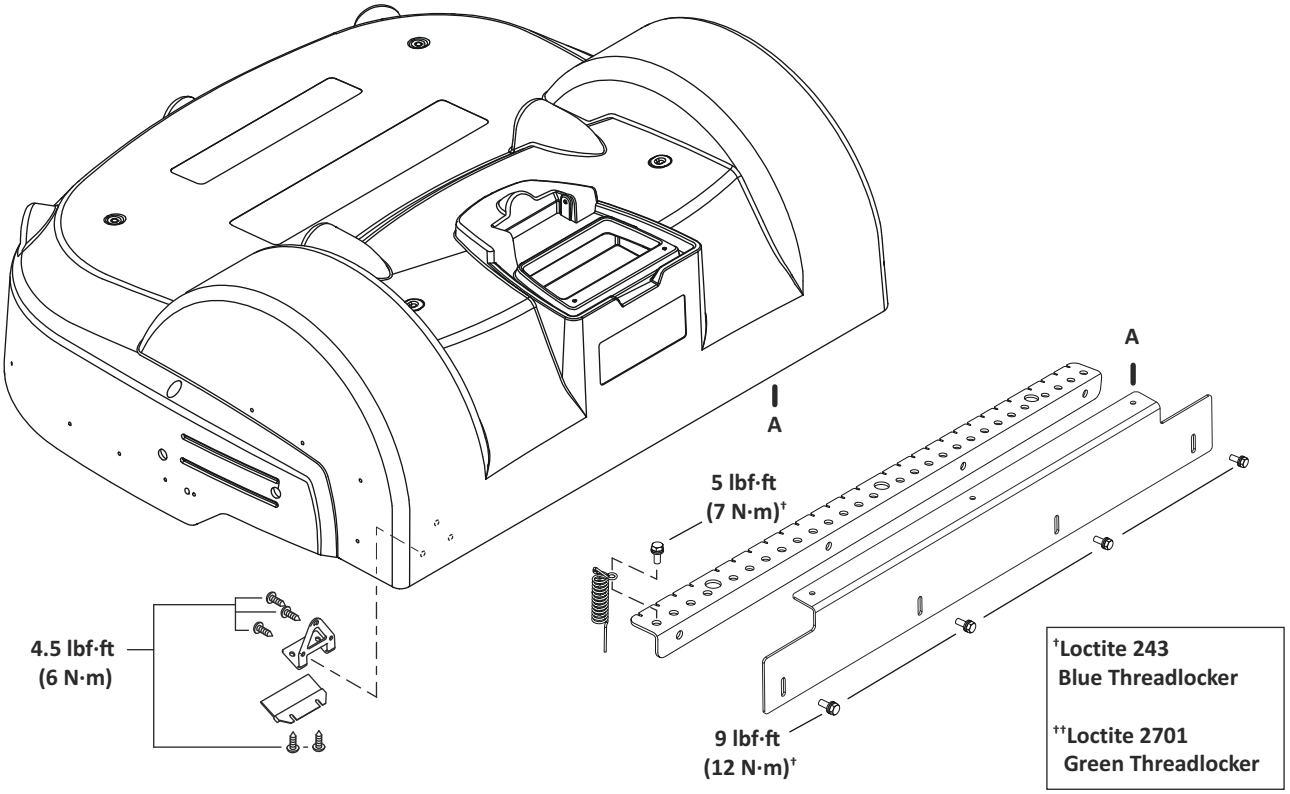
13.8 Main Frame



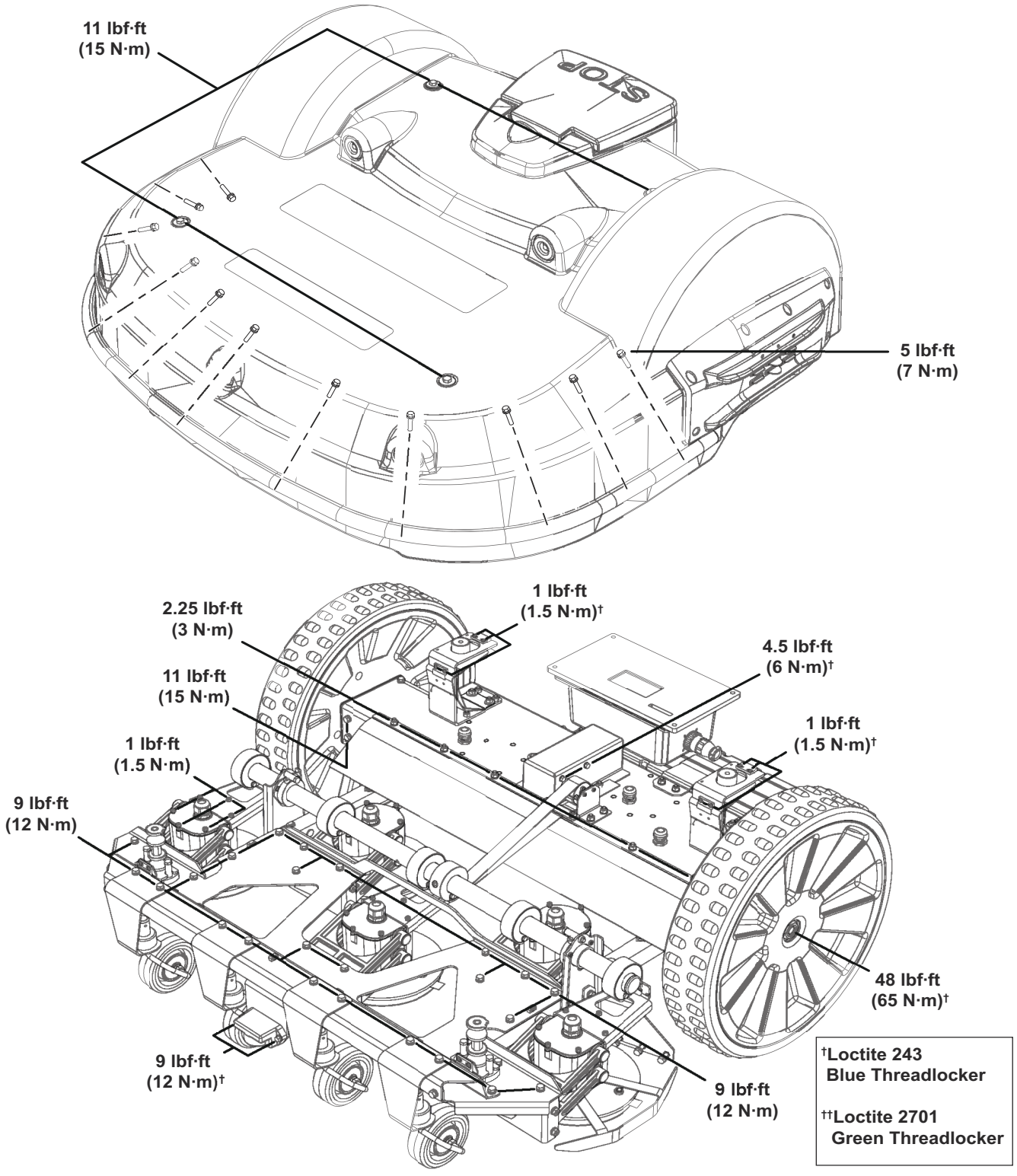
13.9 Main Bars



13.10 Accessories

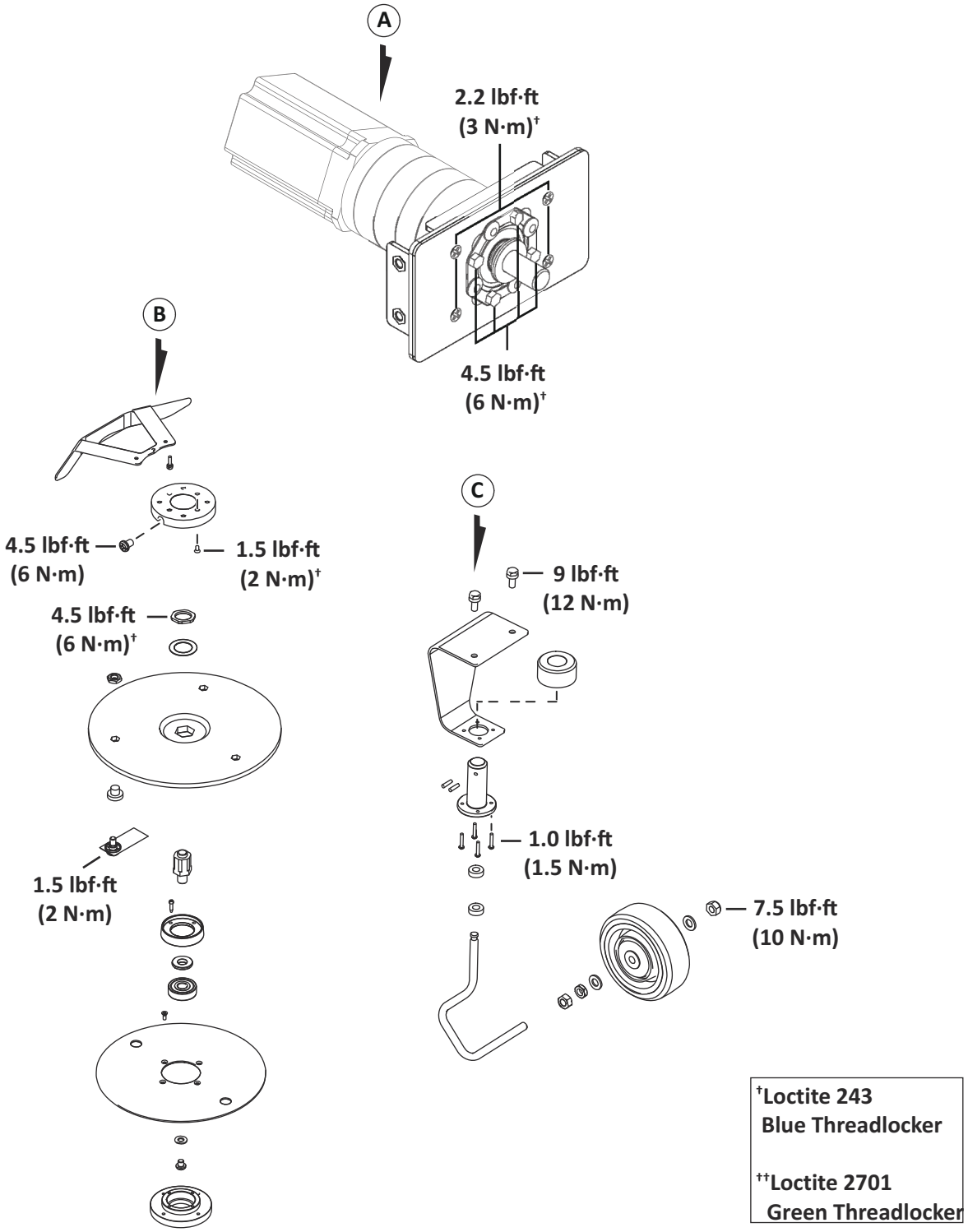


13.11 Cover and Chassis



1 –
2 –

13.12 Gear Motor, Cutting Head, and Front Wheel



1 – A - Gear motor assembly
2 – B - Cutting head assembly
3 – C - Front wheel assembly

14 Specifications

14.1 Capacity

Recommended working area[1]	Up to 6 acres (20,000 m^2)
Number of sports fields per robot	1-2
Mowing width	41 in. (1033 mm)
Speed	2.2 mph (3.6 km/h)
Maximum slope	30%

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

14.2 Cutting

Number of cutting heads	5
Number of cutting blades	15
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)

14.3 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

14.4 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)

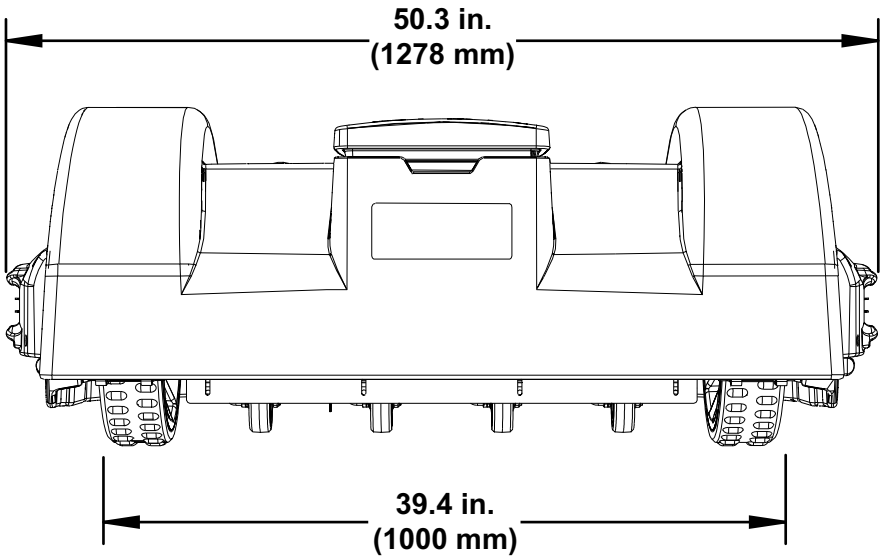
14.5 Software and Monitoring

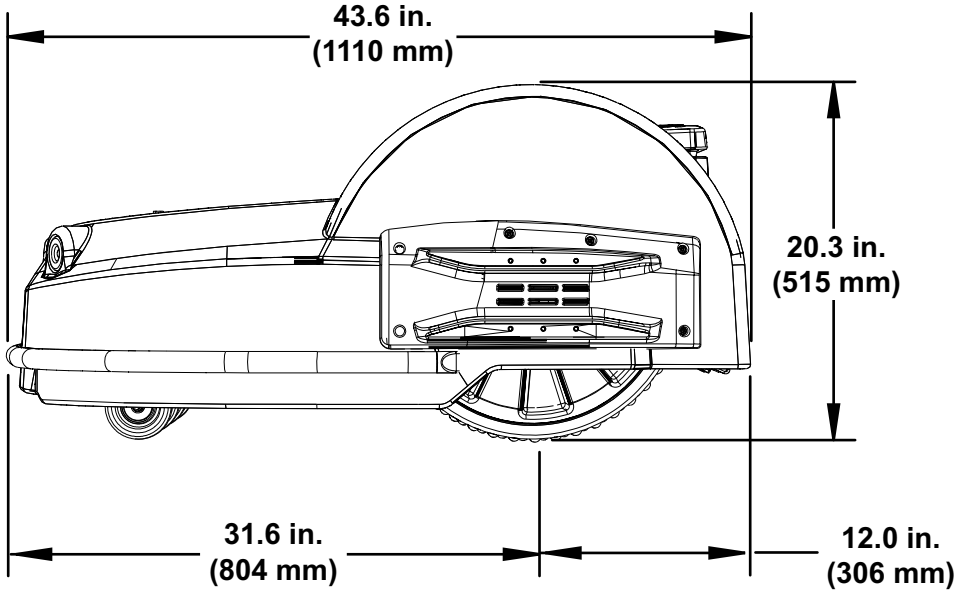
Security PIN code	Yes
GPS positioning	
APP robot management	

14.6 Safety

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

14.8 Dimensions





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