

User Guide BrainOS-Powered Vacuum

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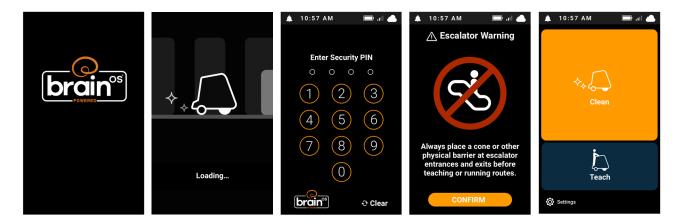
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Autonomous operation

The machine is equipped with BrainOS technology that provides an autonomous operation feature. Autonomous operation provides the ability for the machine to clean floors by following one of the saved cleaning routes without direct, real-time operator control. The machine can only operate in autonomous operation in areas where cleaning routes have been taught and saved. BrainOS software is accessible from the screen and provides the ability to teach a new cleaning route, run an existing route autonomously, access triggered alert messages, and more. The screen also provides constant visibility to the current battery life, the cleaning progress, and the ROC connection status.

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Establish the Home Markers

Home Markers must be permanently installed before the machine can operate in autonomous operation. A Home Marker is a unique scan code identifier—like a QR code—that the machine scans to determine its current physical location, and any routes that have been saved to—or associated with—that specific Home Marker. The machine works with up to 10 Home Markers. Each Home Marker can store up to 6 routes for a total of 60 routes.



Figure 1: Home Marker

Home Markers establish the start and end point of a cleaning route. The number of Home Markers required depends on the size of the space in which the machine operates in autonomous operation.

- Multiple Home Markers might be required for large or unusually mapped areas where more than six cleaning routes are required.
- Establish a unique Home Marker for each floor of a multilevel building.
- Install Home Markers in a permanent location on an open, flat wall near commonly cleaned areas that do not change from day-to-day. If the Home Marker is moved even slightly, the route might not be followed correctly.
- Make sure the entire Home Marker is clearly visible, and not hidden behind furniture or shelving.
- Make sure there is adequate light for the camera to see the Home Marker, and that no shadows obscure the Home Marker.
- Do not install Home Markers near stairways, fire exits, or fire, first aid, or emergency equipment.
- Affix Home Markers securely to the wall so that the machine can easily scan them with the camera on its right side:
 - 40 in (100 cm) from the ground
 - At a distance of no less than 24 in (61 cm)

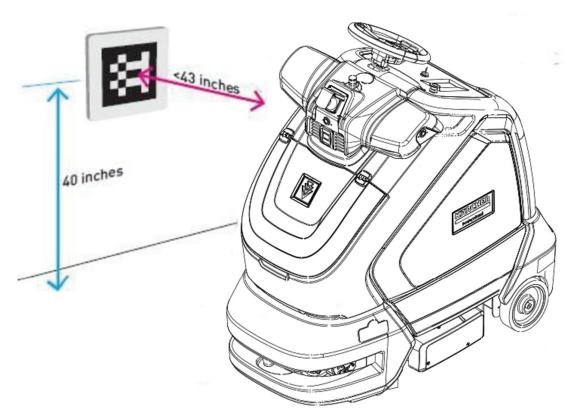


Figure 2: Home Marker distance and height measurements



Figure 3: Home Marker mounted on a wall

- After mounting, remove the protective film from the face of the Home Marker.
- Do not photocopy, laminate, or place Home Markers in a glossy sleeve or cover, which could prevent the machine from scanning the Home Marker.
- If a Home Marker is lost or damaged, contact customer service for a replacement.

Turn on the machine

To turn on the machine, follow these steps:

- 1. To turn on the machine, insert the ignition key and turn to the right (clockwise). The screen briefly displays the BrainOS logo while the software loads, then displays maintenance reminders before transitioning to the PIN entry screen.
- 2. Enter the 4-digit PIN (1337) on the screen.



Figure 4: PIN entry screen

To improve machine effectiveness and efficiency, the machine displays proactive maintenance reminders on the User Interface (UI) at the beginning of every power-on cycle.

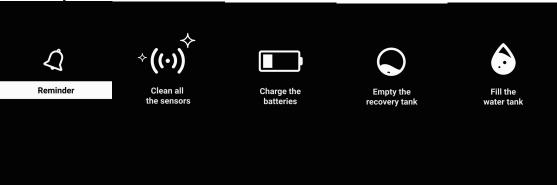


Figure 5: Maintenance reminder screens

3. Read and perform the instructions on the Escalator Warning screen.



4. The Main Menu displays the notification center, time, battery level, LTE signal strength, and the ROC synchronization status at the top of the screen.



Figure 6: Main Menu

Robotic Operations Center

BrainOS software provides access to the Brain Corporation Robotic Operations Center (ROC). The ROC is cloud-based and managed by Brain Corporation technicians. The ROC enhances the machine abilities by providing remote monitoring and analytics. The ROC is connected by a built-in 4G LTE modem and does not require user action to connect. New versions of the BrainOS software automatically download to the machine without disrupting service. If a new firmware update is available, the user will be prompted to start the update the next time they power on the machine.

- When the machine is connected to the ROC, the screen displays the left icon.
- If the machine is uploading or downloading data with the ROC, the screen displays the center icon.
- If the machine is not connected to the ROC, the screen displays the right (grayed out) icon. If the machine is not connected to the ROC, the ROC cannot be paired with a mobile device.







Figure 7: ROC connected (left), ROC syncing (center), and not connected (right)

• If the machine is not connected to the ROC and a number displays next to the icon—as shown in Figure 8—that number indicates how many items the machine needs to upload to the ROC. After the machine is connected to the ROC and uploads its items, the number decreases and eventually disappears.



Figure 8: ROC not connected but with six items to upload

Pair a mobile device with the ROC

Before running an autonomous route, Brain Corporation recommends that the operator pair their mobile device with the ROC. After pairing, the ROC sends messages to the mobile device if the machine requires assistance and a notification when the cleaning routes are complete.

To make sure that only the on-site operator receives alerts from the ROC, only one mobile device can be paired with the ROC at a time. A paired mobile device is automatically disconnected when the machine is turned off or when a new mobile device is paired.

To pair a mobile device to the ROC, follow these steps:

- 1. To turn on the machine, insert the ignition key and turn to the right (clockwise).
- 2. Wait for the screen to initialize.
- 3. Enter the 4-digit PIN (1337) on the screen. Upon successful PIN entry, the screen displays the Main Menu.
- 4. From the Main Menu, select Settings.
- 5. Select Mobile Alerts.
- 6. To pair the mobile device with the ROC, follow the instructions on the screen.

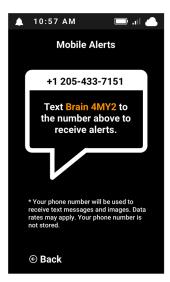


Figure 9: Send a text message to pair the mobile device with the ROC

Pairing is successful when the mobile device receives a confirmation text message.



Figure 10: Mobile device pairing confirmation

Teach an autonomous route

The machine must be taught one or more cleaning navigation routes before it can run in autonomous mode. The route is the precise path that the machine runs while in autonomous mode. New routes can be taught by deployment staff, supervisors, and operators. Proper planning and execution during this process is critical to the successful deployment of the machine. This process involves preparing the workspace for the route and driving the machine in a specific manner, as described below.

Best practices when teaching a route

- See the Route Strategy Guide for detailed guidelines in different environments.
- The machine requires more space when running autonomously.
- Drive in a straight line as much as possible.
- Teach only flat routes with no inclines or declines.
- Try to limit each route to 45 minutes or less. Shorter routes allow more flexibility to change based on location traffic and conditions, but longer routes provide the operator a larger window of time to focus on other tasks. Shorter routes also make it easier to work with high- traffic areas that need more cleaning, and help to avoid low clean water and full waste water conditions during the route.
- Do not teach routes that include driving into an elevator or through automatic doors.
- Avoid sudden turns or turning the steering wheel too sharply when driving.
- Make smooth wide turns, avoid narrow aisles, and do not drive in reverse. For best performance, observe the turn restrictions for the machine, as defined in the operational manual for the machine.
- Because U-turns slow down the machine, circle around or alternate aisles wherever possible.
- Maintain a safe distance of approximately 1.5 ft (0.5 m) from the edge of ramps, platforms, cliffs, and glass. This includes escalators, elevators, and loading docks. Place a barrier or series of cones to prevent the machine from getting too close to these areas. The barrier or cones must measure at least 8 inches (20 cm) in height.
- Divide the space into contiguous routes for maximum efficiency and yield.
- Teach routes when the area is mostly clear of obstacles and people that could block the path of the machine. This might require teaching routes outside of normal run times.
- Optimize routes to account for other activities, such as restocking shelves.
- If a route is taught in an area with obstructions that are later removed, the machine does not clean any areas previously occupied by those obstructions.
- Reteach a route whenever the dimensions of the space change significantly or whenever new features have been introduced or removed—such as merchandise displays—or if there are performance issues with an existing route.

Teach a new route

To teach a new route, follow these steps:

- 1. Stand on the operator platform.
- 2. To turn on the machine, insert the ignition key and turn to the right (clockwise).
- 3. Enter the 4-digit PIN (1337) on the screen. Upon successful PIN entry, the screen displays the Main Menu.
- 4. Select Teach.



Figure 12: Teach a new route

The screen displays *Drive to scan my home location*.

5. Drive the machine to the correct Home Marker and position the machine so that the right- side camera is approximately 2 ft (0.6 m) away. The machine automatically scans the Home Marker.



Figure 13: Scanning the Home Marker

NOTE: If the machine is unable to scan the Home Marker, the screen displays an error message with instructions on how to resolve it.

After the machine successfully scans the Home Marker, the confirmation message briefly displays on the screen, followed by the available route locations.

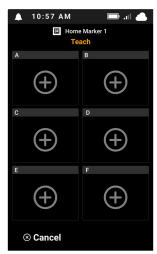


Figure 14: Select an undefined route

NOTE: If all six routes for the Home Marker are already defined, an existing route must be deleted first.

- 6. Select an available route slot.
- 7. Select the type of route; Route or Area Fill.
 - **a. Route** The machine will follow the same path you take. Suited for environments with aisles, complex layouts, and unique cleaning patterns.
 - **b. Area Fill** The machine will clean the interior in a zamboni pattern after you teach it the perimeter. Suited for large, open spaces with little to no change.



NOTE: Area Fill is off by default and is not available in retail spaces. For machines that do not have Area Fill enabled, the above screen will not appear.

The screen confirms that the machine is ready to learn the new route.

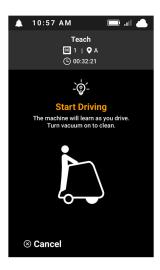


Figure 15: Machine is ready to learn the route

8. To engage the cleaning components, choose a Mode and Drive direction. Programmed paths can only use a Forward Direction. The UI message to "Turn vacuum on to clean" will disappear.

NOTE: If the vacuum button is not pressed, the machine saves the route with no cleaning components engaged. Cleaning components cannot be added to the route later.

- 9. Select the preferred cleaning settings.
- 10. Set the direction switch for the forward direction. The machine only cleans when driving forward.
- 11. Press the accelerator pedal and drive the machine through the entire cleaning route. Similar to an automobile, the speed is proportional to the force applied to the pedal; light is slower, and heavy is faster.

After driving begins, the screen confirms that the machine is learning the new route and displays the elapsed time.

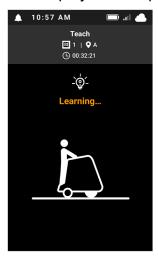


Figure 16: Learning the new route

NOTE: When teaching a new route that includes a non-cleanable area, press the Transport button to raise the cleaning components approximately 10 ft (3 m) before reaching the area. Drive past the non-cleanable area and press the Clean button again to lower the cleaning components. The BrainOS navigation software remembers where in the route the cleaning components were lifted and lowered when operating in autonomous mode.

- 12. If driving stops, the screen displays the *Learning Paused* message.
 - a. To continue the route, resume driving.
 - b. To cancel the route, select Cancel.

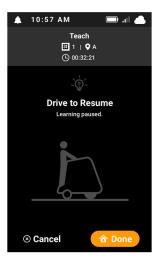


Figure 17: Route learning paused

13. When the route is complete, drive to the same Home Marker scanned at the beginning of the route and select 'Done'.

The machine scans the Home Marker.



Figure 18: Scanning the Home Marker

NOTE: A new route cannot be saved until the machine scans the same Home Marker in the same physical location a second time. The machine can only detect the Home Marker from its right- side camera, the screen displays the "Drive to scan my home location" message.

If the machine scans a different Home Marker, it will inform the operator to drive to the original Home Marker.

14. If the machine displays the Incorrect Home Marker error, drive to the correct Home Marker. After a successful Home Marker scan, the machine saves the route while it displays the

Saving message.



Figure 20: Saving the route

15. To label the route, select Choose Label.



Figure 21: Choose the route label

16. Enter in your own label that is most applicable to the route that was just trained.



Figure 22: Type a label

NOTE: There is a 15 character limit. All saved labels will appear in the Portal and in the Email Reports for managerial awareness. If the selected language on the UI is Japanese or Korean, the keyboard will change to a pre-set list of "Grocery" centric route labels.

- 17. The machine displays the route with the new label.
 - a. To save the route with the new label, select Save.
 - b. To change the route label, select Edit Label.



Figure 23: Route displays with the new label

The machine displays the Route saved message.



Figure 24: Route save

NOTE: If the route is saved without a label, the machine assigns it <NO LABEL> by default.

18. After teaching a route, test it to make sure that the machine can run the route in autonomous operation successfully. If multiple assists are triggered during the test run, the route might include maneuvers that are difficult for the machine to perform in autonomous operation and must be retaught. See "Run autonomous routes" on page 26.

Route management

Each Home Marker supports a maximum of six routes. If all six spaces displayed on the screen are already filled with routes, the operator can only train more routes by deleting one or more of the existing routes associated with that Home Marker.

The operator can also change or remove route labels whenever the machine is not in autonomous mode.

This section describes how to delete a route or edit a route label. For each procedure in this section, follow these steps:

- 1. To turn on the machine, insert the ignition key and turn to the right (clockwise).
- 2. Wait for the screen to initialize.
- 3. Enter the 4-digit PIN (1337) on the screen. Upon successful PIN entry, the screen displays the Main Menu.
- 4. From the Main Menu, select Settings.



Figure 26: Access the settings

5. Select Routes.

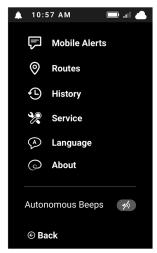


Figure 27: Access the routes

6. Select the applicable Home Marker.



Figure 28: Select the Home Marker

7. Select the route to edit.

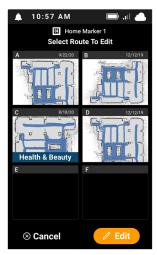


Figure 29: Select the route to edit

- 1) Select the applicable procedure:
 - a) "Delete a route" on page 22.
 - b) "Change a route label" on page 23.
 - c) "Remove a route label" on page 24.

Delete a route

To delete a route from the machine and free up memory space for a new route, follow these steps:

1. To delete the selected route, select Delete Route.



Figure 30: Delete the route

2. To confirm the permanent deletion, select Delete.

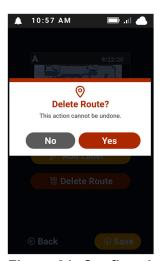


Figure 31: Confirm the route deletion

3. To return to the Main Menu, select Back four times.

Change a route label

NOTE: Although the BrainOS software no longer supports letter designations A–F for routes, the machine can still run older routes with letter designations in autonomous operation. The operator can change any route label—if the machine is not currently in autonomous operation— by following this procedure.

To change a route label, follow these steps:

1. Select Edit Label.



Figure 32: Change the route label

2. Enter in a new label that is most applicable to the trained route.



Figure 33: Select a new route label

- 3. Select Add Label.
- 4. To return to the Main Menu, select Back four times.

Remove a route label

To remove a route label, follow these steps:

1. Select Remove Label.



Figure 34: Remove the route label

NOTE: If the route is saved without a label, the machine assigns it <NO LABEL> by default.

2. To return to the Main Menu, select Back four times.

Run autonomous routes

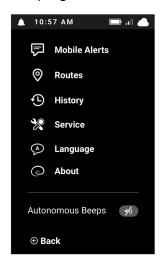
This section describes how to configure the machine to run one or more existing routes in autonomous mode.

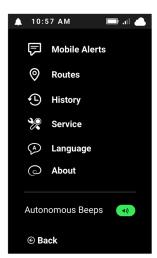
Best practices when running routes



WARNING: Do not attempt to ride on the machine, use the steering wheel, or put hands or arms through the steering wheel when the machine is running a route in autonomous mode. The steering wheel can move rapidly and unexpectedly, which could cause physical injuries and disrupt machine operations.

- Pair a mobile device with the machine via MMS/SMS or the Mobile App to receive alerts regarding assists and cleaning complete notifications. See "Pair a mobile device with the ROC" on page 9.
- Enable beeping during autonomous cleaning if preferred in your environment. Go to "Settings", then select the icon next to "Autonomous Beeps". When green, additional beeping is enabled.





- Monitor the machine during the first minute of running the route to ensure that its cleaning mechanisms are functioning properly.
- Whenever possible, run routes when the area is most free of people and obstacles.
- Prepare the routes by removing obstructions such as boxes, protruding merchandise, rugs, and mats.
- Visually inspect all sensors and wipe them down with a dry microfiber cloth before starting an autonomous route. Dirty sensors can affect the machine's performance. Do not apply any water or cleaning solution to the cloth.
- If applicable, visually inspect the machine to ensure there are no items hanging off of it that could trigger the side sensors.
- Test all routes to ensure the machine can run them successfully. Monitor the machine from the back during testing and note any areas of difficulty.
- At the start of a route, do not crowd the front of the machine. This could impair the ability of the machine to to recognize the environment.

- If the machine calls for frequent assists when running routes, assess the environment and remove any obstructions. If the assists persist after obstructions are removed, the routes could include maneuvers that the machine cannot replicate autonomously or there could be an environmental factor such as reflection; the routes might need to be retaught.
- Environmental considerations can vary, depending on the type of location. For more information, see the *BrainOS-Powered Vacuum Process Guide* (139-00113-01).

NOTE: Test each new route for trouble-free operation before using the route for daily cleaning.

Run one or more routes

To run one or more autonomous routes, follow these steps:

- 1. Stand on the operator platform.
- 2.To turn on the machine, insert the ignition key and turn to the right (clockwise).
- 3. Wait for the screen to initialize.
- 4.Enter the 4-digit PIN (1337) on the screen. Upon successful PIN entry, the screen displays the Main Menu.
- 5. From the Main Menu, select Clean.



Figure 35: Run one or more existing routes

6. Drive the machine to the applicable Home Marker.



Figure 36: Scanning the Home Marker

The machine displays the available routes associated with the Home Marker.

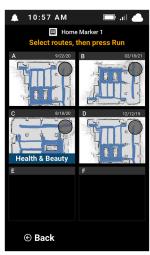


Figure 38: Available routes displayed

7. Select one to six existing routes from the menu in the preferred order. The figure below shows three routes selected, and the number in the right corner of each shows the order in which each route is scheduled to run.

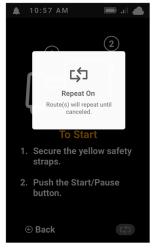


Figure 39: Select one to six routes. In this case, there are only four trained routes to choose from.

8. To deselect a route, select the route again. The number in the upper right corner clears.

- 9. Select the route again or select another route, as applicable. When the route selections are complete, select Run.
- 10. If you'd like the machine to repeatedly run the selected route(s), enable the *Route Repeat* feature at the bottom right of the UI.
 - If enabled, the machine will repeat the route(s) over and over until it calls for an assist or it is low on battery.
 - Select the button again to disable Route Repeat.
- 11. Step off the machine.
 - 12. Push the Start/Pause button.









The yellow warning light flashes and the horn momentarily sounds 2 times as a warning that autonomous operation is starting. The screen displays the *Cleaning In Progress* message.



Figure 43: Cleaning in progress

The screen is disabled while the machine is in autonomous operation. Touching the screen during this time results in the *Screen Disabled* message but does not halt operations.



Figure 44: Screen disabled in autonomous operation

13. Make sure that the machine is performing correctly. If anything requires adjustment, press the Start/Pause button and reconfigure the cleaning settings. To resume the route, press the Start/Pause button again.



Figure 45: Route paused

14. If the machine is paired with a mobile device, the mobile device receives route cleaning status updates as each route completes.

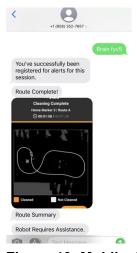


Figure 46: Mobile device route cleaning status updates

15. If the mobile device receives an assist message, locate the machine and attempt to resolve the assist.

- 16. The screen will be locked, as indicated by the 'Tap screen to unlock' message on the UI, but the cause of the assist and the recommended resolution steps will be readily available to start troubleshooting.
- 17. When the cleaning routes are complete, the machine will stop at the Home Marker and enter a manual lockout mode. Enter the 4-digit PIN (1337) to access the UI and unlock the machine.



Figure 47: Enter the security PIN

The screen shows the routes taken by the machine. How much of the routes were actually cleaned depends on whether the cleaning components were engaged or not while teaching the routes.



Figure 48: Cleaning is complete

- 18. To view the history for consecutively run routes, select the left or right arrows, as applicable.
- 19. When finished viewing, select Done.

Cancel a route

To cancel an active cleaning route, follow these steps:

- 1. Press the Start/Pause button.
 - a. To resume the route, press the Start/Pause button.
 - b. To cancel the route, select Cancel Route. Then select Yes.

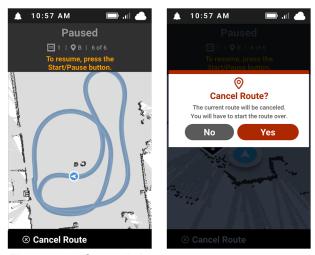


Figure 49: Cancel the route

NOTE: Canceling a route only stops the machine from running the route at the present time. It does not delete the route from the machine.

Manually stop the machine

While in autonomous operation, it might be necessary to stop the machine using the Start/Pause button for any number of reasons. Whenever possible, press this button instead of the Emergency Stop button, unless the machine is about to run into a person or an obstacle.

The machine can automatically pause itself when an assist is triggered. In the case an assist occurs, the UI will provide instructions to resolve it and resume autonomous cleaning.

To pause autonomous operation, follow these steps:

1. To pause the machine, press the Start/Pause button.



Figure 50: Route paused

- 2. Make any necessary adjustments to the machine configuration or environment.
- 3. Perform one of the following steps:
 - a. To resume the autonomous route, press the Start/Pause button.
 - **b.** To cancel the autonomous route, select Cancel Route.

Emergency stop the machine

The Emergency Stop button removes the power from all motors. If an emergency, follow these steps to stop the machine:

1. Press the Emergency Stop button.

The lights flash. The screen displays the Emergency Stop message.



Figure 51: Emergency Stop button pressed

- 2. Inspect the surrounding environment and the machine itself.
- 3. Remove any obstacles that can be moved.
- 4. To release the Emergency Stop, twist the button clockwise (to the right).
- To confirm that the environmental/machine issues have been resolved, select OK.

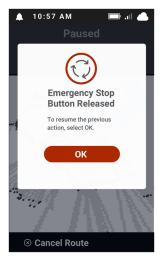


Figure 52: Emergency Stop button released

6. To resume autonomous operation, press the Start/Pause button.

Access the route history

The route history shows the duration of each route and the overall route coverage for any routes run over the past seven days. This feature shows what areas of the route were cleaned autonomously by the machine (and which areas were not cleaned). It can be used by both operators and supervisors to ensure that the machine was utilized properly.

To access the route history of the machine for the past week, follow these steps:

- 1. To turn on the machine, insert the ignition key and turn to the right (clockwise).
- 2. Wait for the screen to initialize.
- 3. Enter the 4-digit PIN (1337) on the screen. Upon successful PIN entry, the screen displays the Main Menu.
- 4. From the Main menu, select Settings.



Figure 53: Select the Settings menu

5. Select HISTORY.

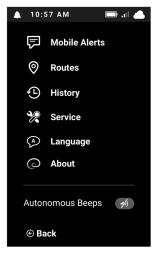


Figure 54: Select the History menu

The Weekly History screen displays the time of day and runtime for each route.

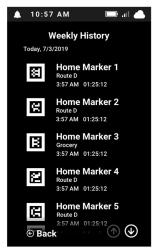


Figure 55: Weekly History

- 6. Select a route from the list.
 - Scroll up or down to see more routes by selecting the up or down arrows at the bottom of the screen.
 - Collapse or expand routes for a day by selecting that day.
- 7. View the results of the History screen:
 - Blue shows the route taken by the machine. How much of the route was actually cleaned depends on whether the cleaning components were engaged or not while teaching the route.
 - Grey shows the route taken by the machine while the deck was not turned on
 - White shows the area that was in the trained route, but was not cleaned.



Figure 56: Cleaning History for the selected route

Park and store the machine

When not in use, store the machine in a designated parking station:

- 1. Make sure the designated parking station is secure from public access.
- 2. Park the machine with the front facing a wall or barrier. This helps to protect the lower LIDAR sensor from potential damage from passersby, shopping carts, and so on.
- 3. Always park the machine away from stairways, fire doors, fire equipment, and emergency medical equipment, such as defibrillators. Park the machine facing a wall.

Figure 57: Park the machine facing the wall

- 4. To turn off the machine, turn the ignition key to the left (counterclockwise).
- 5. To prevent unauthorized use, remove the key.
- 6. Park and store the machine indoors in a dry area.
- 7. Store the machine in its upright position.
- 8. Store the machine with the cleaning components raised off the floor

Update the BrainOS software

Over-the-air updates allow new versions of BrainOS software to be downloaded remotely over the built-in modem. This capability ensures that the machine has the latest BrainOS software, which is important for implementing new features and improvements.

It is critical that all machines have the latest version of BrainOS software installed. For details on viewing the current version of BrainOS software installed on the machine, see "Access the About screen" on page 46. Contact customer service if it is not clear if the machine has the latest BrainOS software version.

NOTE: Do not drive the machine when a new software update is available, or while the software is being updated.

When the New Update Available screen displays, follow these steps:

- 1. Park the machine. See "Park and store the machine" on page 43.
- 2. On the New Update Available screen, select Update to begin the software update.



Figure 58: New software update available

NOTE: Do not drive or turn off the machine until the update is complete.



Figure 59: Software update in progress

3. When the software update completes, select Done.



Figure 60: Software update complete

Access the About screen

The About screen displays which versions of machine hardware, software, and firmware are installed. This information is useful during troubleshooting, and customer service might ask for it to help diagnose and resolve issues.

To access the About screen, follow these steps:

- 1. To turn on the machine, insert the ignition key and turn to the right (clockwise).
- 2. Wait for the screen to initialize.
- 3. Enter the 4-digit PIN (1337) on the screen. Upon successful PIN entry, the screen displays the Main Menu.
- 4. From the Main menu, select Settings.



Figure 61: Select the Settings menu

5. Select About.

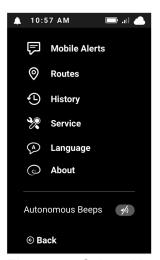


Figure 62: Select About

The About screen displays the following information:

- BrainOS Version: Installed BrainOS software version
- Serial Number: Unique serial number of the machine
- Software Hash: GIT hash—or unique build identifier—of the installed BrainOS software
- IMEI: International Mobile Equipment Identity of the modem
- SIM: Subscriber Identity Module of the modem

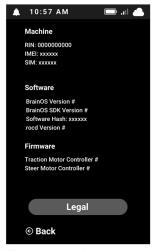


Figure 63: About screen

6. To view the legal disclaimer, select Legal.