

OEM - LIDAR Troubleshooting Guide

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Revision History

Revision	Date	Description
Draft	4/27/2021	Submitted for Peer Review
01		Initial Release

Definitions, Acronyms, and Abbreviations

Term	Definition
BCM	Brain Control Module
Lidar	Light detection and ranging
OEM	Original Equipment Manufacturer
	Examples of commands
	Caution, this might cause serious system problems. Stop and ensure you understand what is being asked.

Overview

This guide provides information on how to troubleshoot Lidar related issues for any autonomous floor scrubbers powered by BrainOS. In order to effectively troubleshoot any issue, please review this troubleshooting guide in the order given to determine the proper resolution.

When To Use It

Please proceed with this document if you encounter any of the codes below:

Error Codes: 223 (Planar Lidar Timeout), 224 (Slanted Lidar Timeout),
225 (Both Lidar Timeout), 6000 (Planar Lidar Dirty), 6001 (Slanted Lidar Dirty),
8100 (Sensor Monitoring Error: Planar Lidar), 8200 (Sensor Monitoring Error: Slanted Lidar)

For more information on the error codes please refer to the OEM Error Code Reference Document

Brain Internal Assist Codes

<https://braincorporation.atlassian.net/wiki/spaces/TS/pages/298582085/Error+Codes+and+Error+Inventory>

OEM Assist Code Doc <https://braincorp.zendesk.com/hc/en-us/articles/360060279731-OEM-Brain-OS-Error-Code>

How To Use It

The Lidar Troubleshooting Guide walks you through several important steps in troubleshooting an Autonomous Scrubber:

1. Part 1: Check Emerging Issues
2. Part 2: ROC Portal
3. Part 3: Connectivity Testing

Print and update the checklist!

To assist with troubleshooting, there is a troubleshooting checklist on the last page of this document. This checklist needs to be printed, filled out, and submitted along with the pictures and notes.

Complete the steps in the order they are listed!

The following steps are intended to be performed in the exact order listed in this document. It is essential to collect pictures and take notes throughout the process.

Required Tool List

The following is the list of tools needed to service Lidar related issues for any autonomous floor scrubbers powered by BrainOS.

Item	Image Details
Hex Drivers • 2 mm • 2.5 mm • 3 mm	
Microfiber Cloth	
Digital Multimeter (DMM, Fluke 101 Model or equivalent)	
Fine Test Leads 992-0732 https://shop.usaclean.com/breadboard-jumper-wires-992-0732/	
Cable Tie Cutter	

OEM Diagnostics



Both of these Lidars require calibration after adjustment or replacement



Assists

1. Below are some example assists that you might run into when having Slanted and/or Planar Lidar issues.

Go to the ROC Portal and review the assists for that specific machine. The following are some common assist codes when running into Lidar issues (Listed above). When reviewing each assist it is really important to look at the images and assist replay to see what triggered this assist to happen. By reviewing assists it allows us to get a better understanding of what type of issues the machine could be having. For the latest list of assist codes please reference the most updated error code document. Make sure to watch the playback as it gives a better understanding of what you are looking at in the static maps.

NOTE: Some examples of the assist types are listed at the following Google Doc page.

<https://braincorp.zendesk.com/hc/en-us/articles/360060279731-OEM-Brain-OS-Error-Code>

Planar/Slanted Lidar Is Dirty

1. Because autonomous operation relies on all these sensors, it is imperative to keep the sensors clean and free from damage. Debris, streaks, or smudges can inhibit the ability of the machine to run an autonomous route.
2. The most common sensor that needs to be cleaned is the Planar LIDAR that resides underneath the front of the scrubber unit.



Figure 1: Dirty Planar Lidar



Figure 2: Clean Planar Lidar

3. Use a flashlight when inspecting the sensor to make sure it is thoroughly cleaned. Also, make sure the area between the wheel and anti-roll bar is free of cob webs, zip ties etc. If a foreign object is in the view of the LIDAR, it can show up as an obstruction and cause assist.



Figure 3: Lidar Inspection

4. Wipe down the sensors and cameras before each autonomous operation. Use the provided microfiber cloth and cleaning solution; if needed, to clean all sensor surfaces.



Figure 4: Microfiber Cloth

5. Take pictures of the lidars before and after they've been cleaned
6. If the lidar is damaged or scratched, it will most likely need to be replaced. Send pictures to Brain in order to verify if a replacement is needed. Also refer to solution codes [UPPERLIDAR-01](#)/[LOWERLIDAR-01](#)

Planar/Slanted Lidar Disconnected

1. If you are receiving 8100/8300 assists or error code 223 check the connection for the particular Lidar that is having issues.
 - a. The Slanted Lidar is connected to the BCM via the up trunk (Upper Harness) cable. The up trunk is a wiring bundle that connects the BCM to numerous sensors, encoders and indicators throughout the upper half of the robot.
 - b. Check to make sure there is no damage to the pins on the up trunk.

- i. If the up trunk cable has an pins or wiring damaged (bent, missing pins) Use Solution Code [UPTRUNK-01](#)
- c. Make sure the connection to the BCM is tight after reseating.
- d. The Planar Lidar is connected to the BCM via the Down trunk (Lower Harness) cable. The Down trunk is a wiring bundle that connects the BCM to numerous sensors, encoders, and indicators throughout the lower half of the robot.
- e. Check to make sure there is no damage to the pins on the down trunk.
 - i. If the down trunk cable has an pins or wiring damaged (bent, missing pins) Use Solution Code [DOWNTRUNK-01](#)
- f. Make sure the connection to the BCM is tight after reseating.

Planar Lidar Pitched Down

1. A blue line crossing the machine's path during route replay that moves with the robot along the path indicates the planar lidar is pitched down.

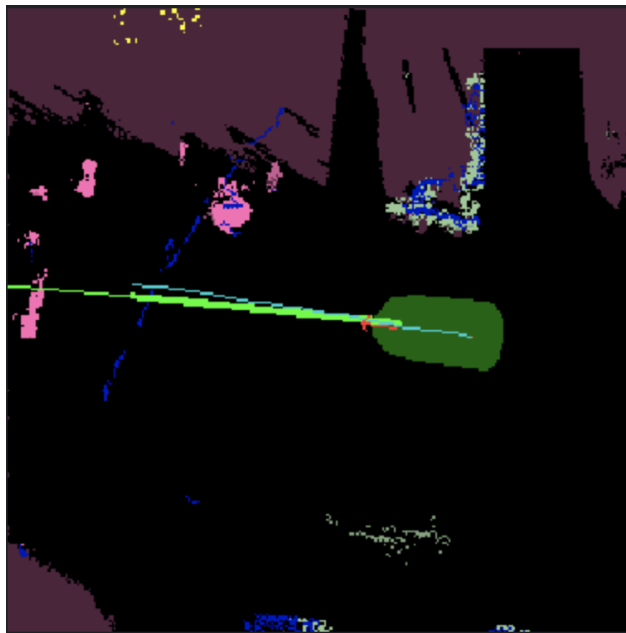


Figure 5: Planar Lidar Pitched Down

2. Take pictures of the lower lidar from the side to see any possible misalignment
3. Performing a lidar calibration is likely to resolve the issue.

Field Tech Diagnostics

UI based diagnostics (OS version 3.1.x +)

Tech will need to click the following path to get to the sensor tests

Settings → Service → Service Tools → Confirm to Launch Service tools

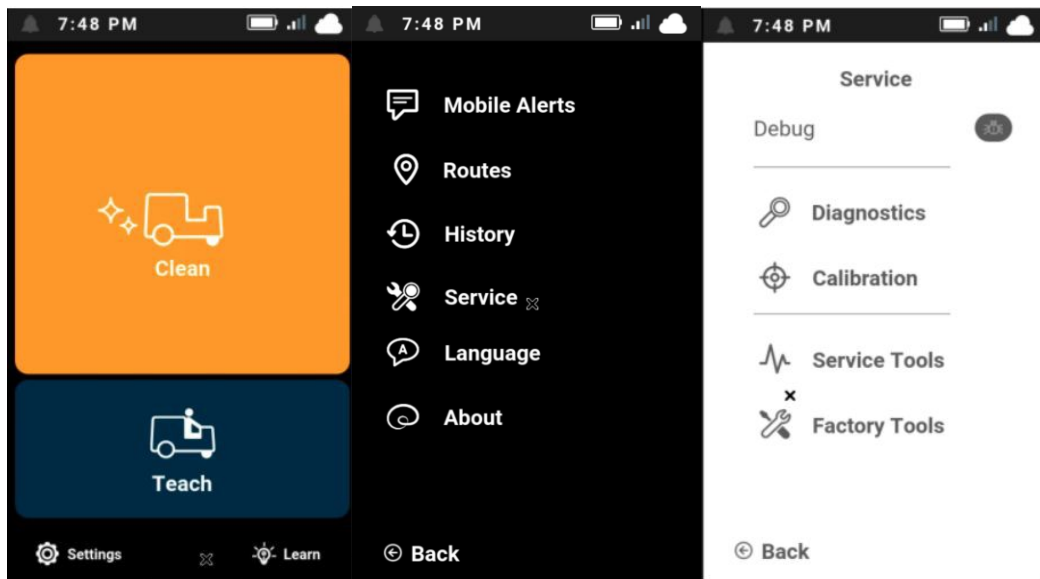


Figure 1: Menu

Figure 2: Settings Menu

Figure 3: Service Menu

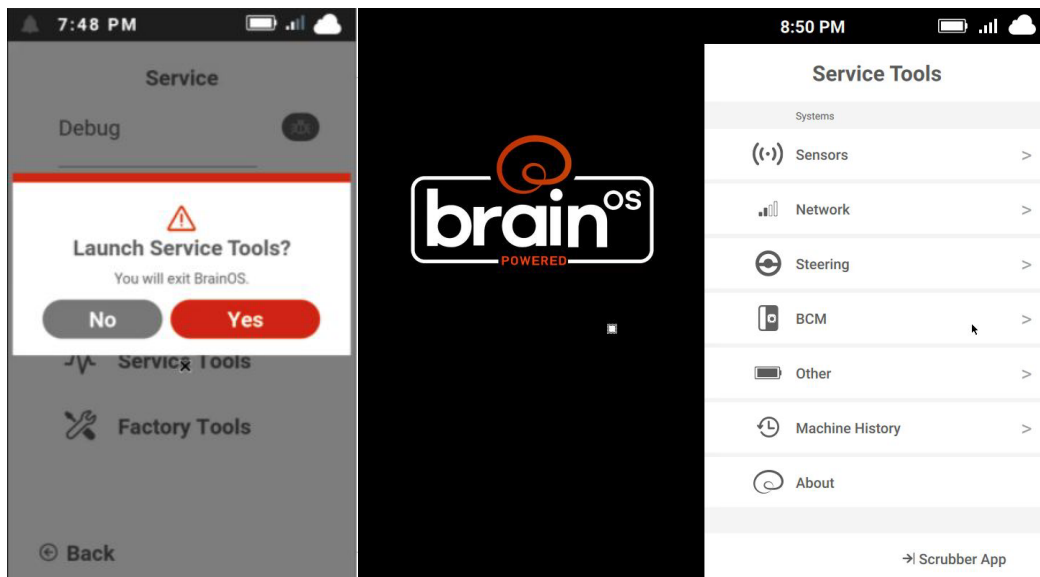


Figure 4: Confirm Y/N

Figure 5: Brain Screen

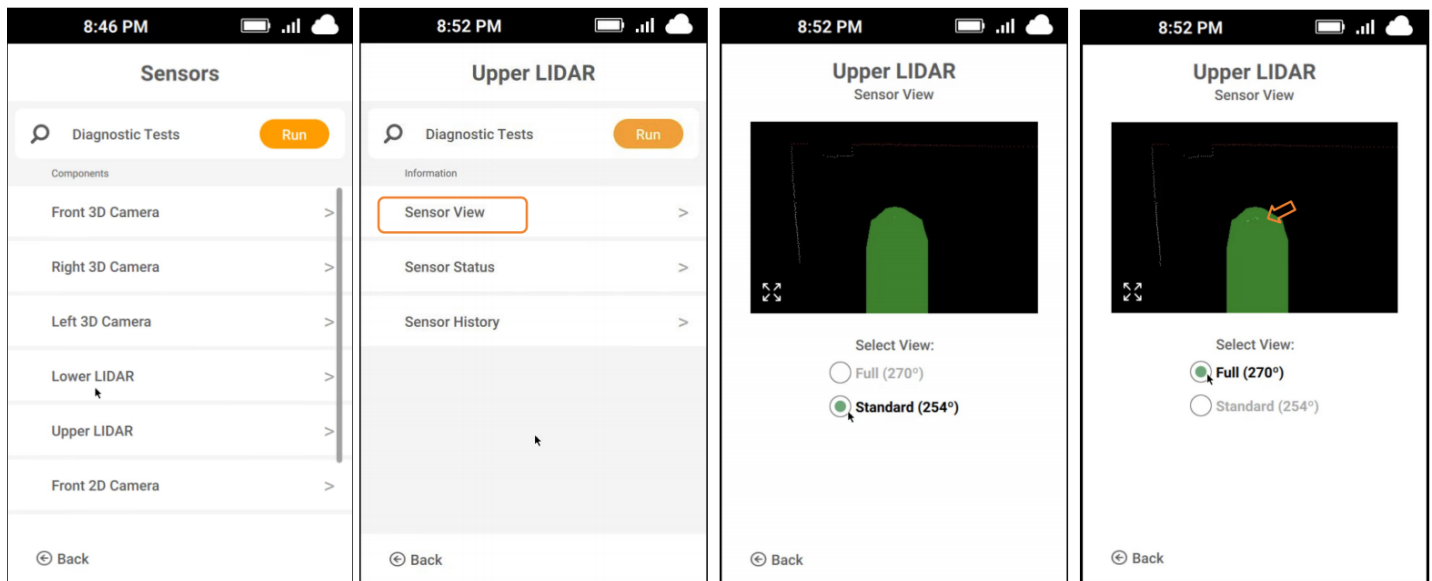
Figure 6: Service Tools

Click Sensors → You will now see all the SENSORS.

The tech can choose the specific sensor he wants to test and run the tests for that Sensor only. We will be doing the Upper Lidar and Lower Lidar based on the assists codes we've seen. Choose the Sensor and click run. This will give us a pass/fail on tests. You will be able to interact with the error messages.

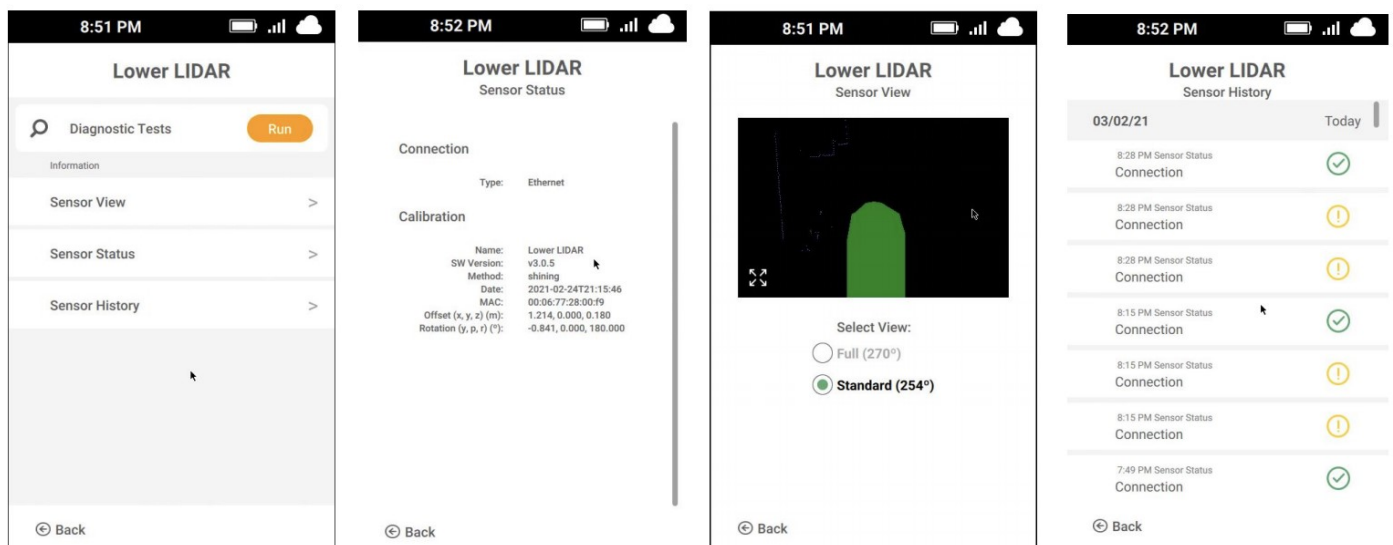
Sensor Menus

Upper Lidar



Toggle to full view of lidar
to be able to see pixels around bracket or to see if the sensor is detecting the bracket

Lower Lidar

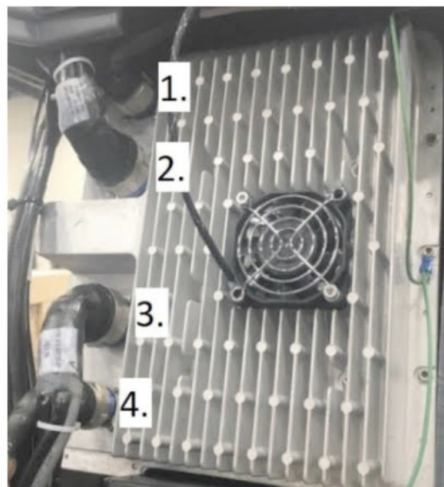


Hardware Inspection

1. Turn off the machine.
2. Raise the seat and decouple the red Anderson connector.



3. Check the connections to see if the cable is loose or unplugged.
4. Unscrew the up trunk (connection #2) check pins, and rescrew. inspect wiring for physical issues.



- a. If the up trunk cable has any pins or wiring damaged (bent, missing pins) Use Solution Code [UPTRUNK-01](#)
- b. Take pictures of the up trunk male connector on the BCM side and the condition of the pins on the cable side.
- c. If no issue found try reseating the connection and check to see if the issue is resolved.
- d. If the issue is not resolved, please continue to the Voltage / Continuity Testing section below.

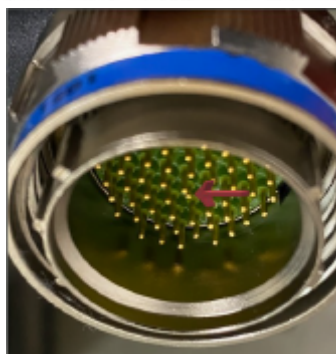
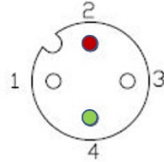


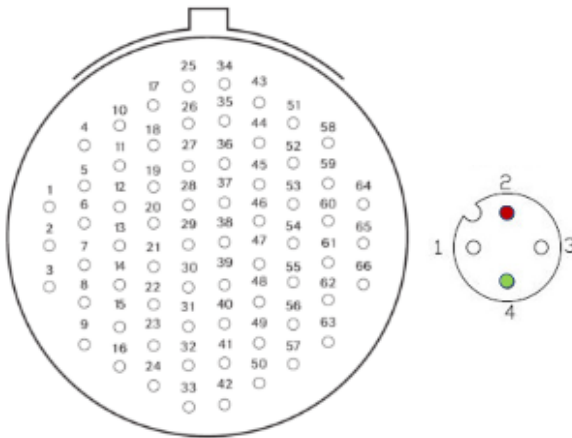
Figure 17: Example of Up Trunk with pushed pins

Voltage / Continuity Testing

- Have tech disconnect the Lidar sensor affected.
- Check the Voltage on Pin 2 and 4. Should be 12V
- If voltage is not present, test the following for continuity for the suspect Lidar.
 - Power off the Scrubber and disconnect the batteries
 - You will start with the M12 Connector



- Then identify the Up Trunk (for Slanted Lidar) or Down Trunk (for Planar Lidar) cable on the BCM



Cable Pairs to check			
Lidar	M12 Connector	Description	D38999 Up Trunk
Upper Lidar Power	1	P12V	49
	3	GND	50
Lidar	M12 Connector	Description	D38999 Down Trunk
Lower Lidar Power	1	P12V	49
	3	GND	50

- If continuity testing fails for the Upper Lidar please Use Solution Code [UPTRUNK-01](#)
- If continuity testing fails for the Lower Lidar please Use Solution Code [DOWNTRUNK-01](#)
- If continuity testing passes please contact Brain Corp for further troubleshooting of BCM connector/BCM.

Status Indicator

Status Indicators



Both Sensors have the Status indication panel that shows current state of the device. See table below for status description.

* Push-button with no function

Status displays

LED  (red)	LED  (green)	Status
—		Device ready/monitoring mode
	—	Error
—	—	Device without supply voltage

● = illuminated;  = flashing

Appendix A - Tech Solution Codes

The following tables are provided as individual solutions for issues that were identified in the preceding document.

Tech Solution Codes

Solution Code	Recommended Actions
UPTRUNK-01	If the uptrunk cable has no voltage measured or wiring is damaged (bent, missing pins), please perform the following steps: 1) Send any photos, notes, and/or a filled out Troubleshooting Checklist to Brain Corp using the e-mail address specified in the work order. 2) Place an order for a new up trunk. 3) Please schedule the next site visit based on the tracking information for the part. 4) Replace the up trunk
DOWNTRUNK-01	If the downtrunk cable has no voltage measured or wiring is damaged (bent, missing pins), please perform the following steps: 5) Send any photos, notes, and/or a filled out Troubleshooting Checklist to Brain Corp using the e-mail address specified in the work order. 6) Place an order for a new downtrunk. 7) Please schedule the next site visit based on the tracking information for the part. 8) Replace the down trunk
UPPERLIDAR-01	• Please order Slanted Lidar • Replace Slanted Lidar • Calibration Needed
LOWERLIDAR-01	• Please order Planar Lidar • Replace Planar Lidar • Calibration Needed • Calibration Kit required

Appendix B1 – TSE Troubleshooting Checklist

Use the following checklist to keep track of the troubleshooting results, referring to the relevant section in this document for details.

Table 2: LIDAR troubleshooting checklist

Description	Completed? (Yes/No)	Results (Pass/Fail/Measurements)
Check ROC Portal Dashboard for any errors		
Check ROC Portal for Errors in Event Log		
Check ROC Portal for Assists		
Check Connectivity - SSH to the machine - issue command ping No packet loss should occur		
Check Logz.io portal with “Error” and “Lidar” keywords		

Appendix B2 – Field Technician Troubleshooting Checklist

Use the following checklist to keep track of the troubleshooting results, referring to the relevant section in this document for details.

Table 2: LIDAR troubleshooting checklist

Description	Completed? (Yes/No)	Results (Pass/Fail/Measurements)
LIDAR Sensor inspection and photos		
Test Route completed		
Wire, plugs/connectors check		
Voltage/Continuity		
Status Panel Check (Indicator light)		
UI Auto Check		

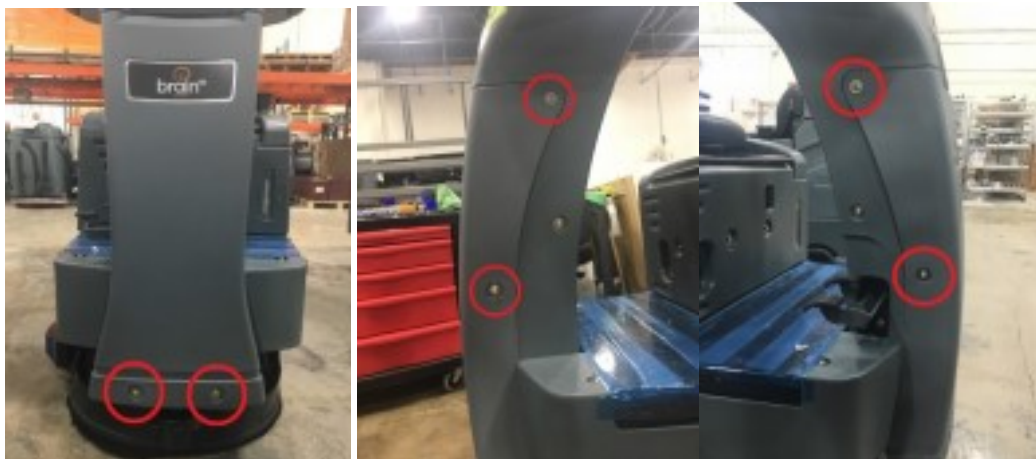
Appendix C - How to Replace the Lower (Planar) LIDAR

The Lower LIDAR is one of five sensors responsible for autonomous navigation. Once replaced, it must be calibrated.

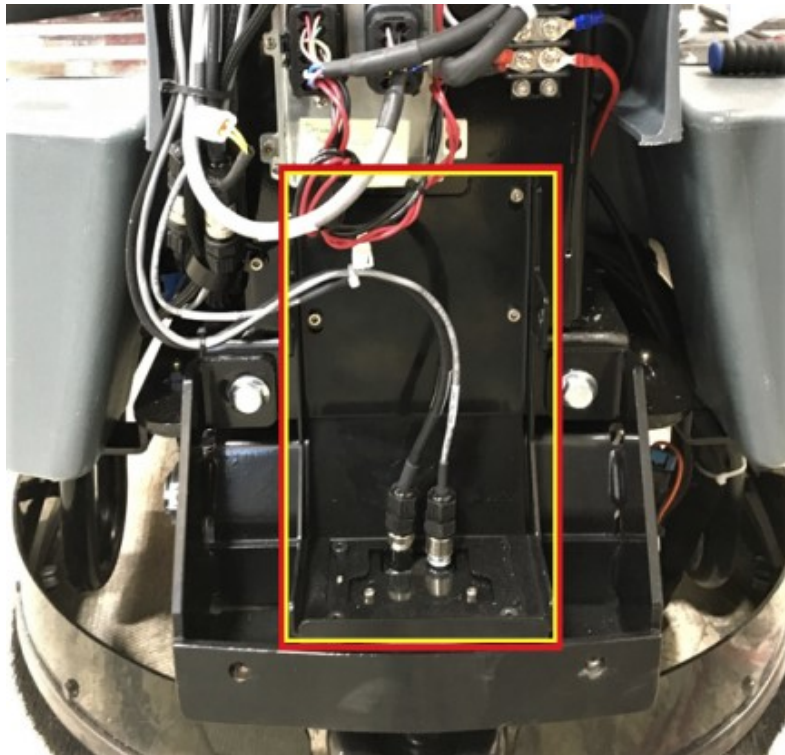
Turn off the unit and disconnect the red battery coupling



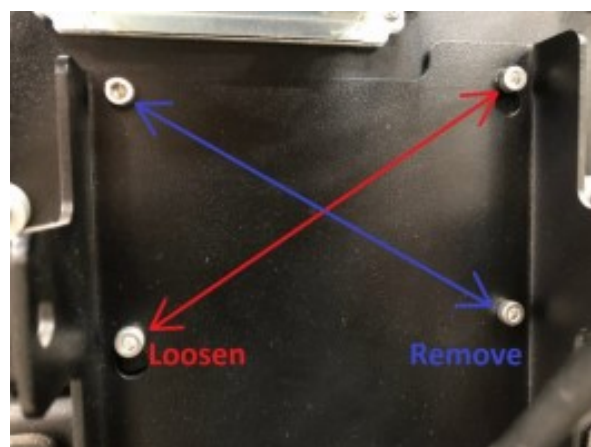
Remove the twelve screws indicated below, then remove the front cover and place it to the side.



Unscrewing the two silver ends, disconnect the two connectors that engage the LIDAR.

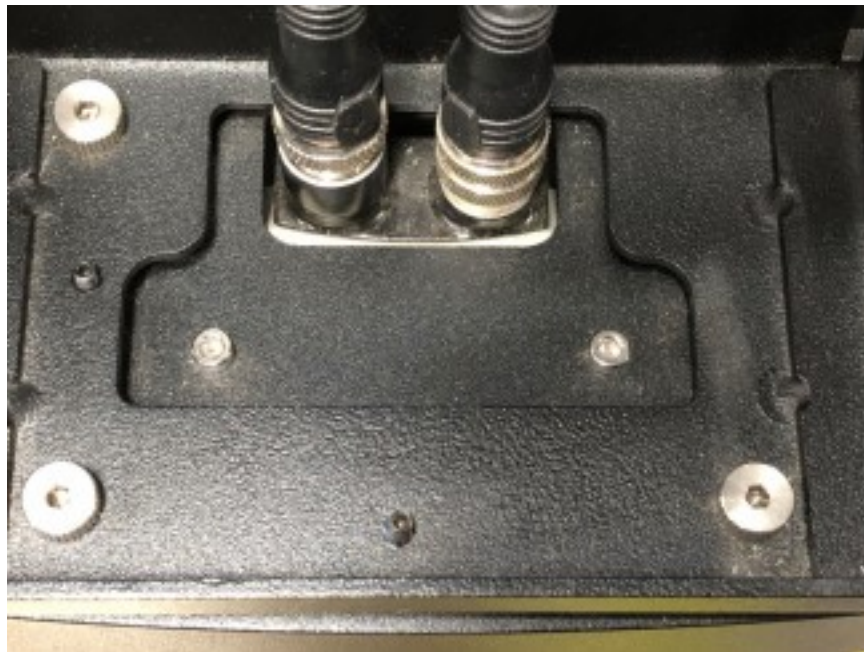


Loosen/Remove the screws indicated in the photo below. The entire bracket/LIDAR assembly may now be lifted up and out.





Remove the two screws to free the LIDAR sensor





Use care when handling the LIDAR sensor. It must not be scratched or damaged when reinstalling it onto the bracket or the scrubber unit. Avoid handling it by the lens.

If available, use a couple drops of blue Loctite thread lock on the screws that directly secure the LIDAR sensor.

Please ensure to return the old Lower (Planar) LIDAR and Calibration Kit back to Brain using the provided return shipping label.

Appendix D – How to Replace the Upper (Slanted) LIDAR

The Upper LIDAR is one of five sensors responsible for autonomous navigation. Once replaced, it must be calibrated.

Power down the unit and disconnect the red battery coupling.

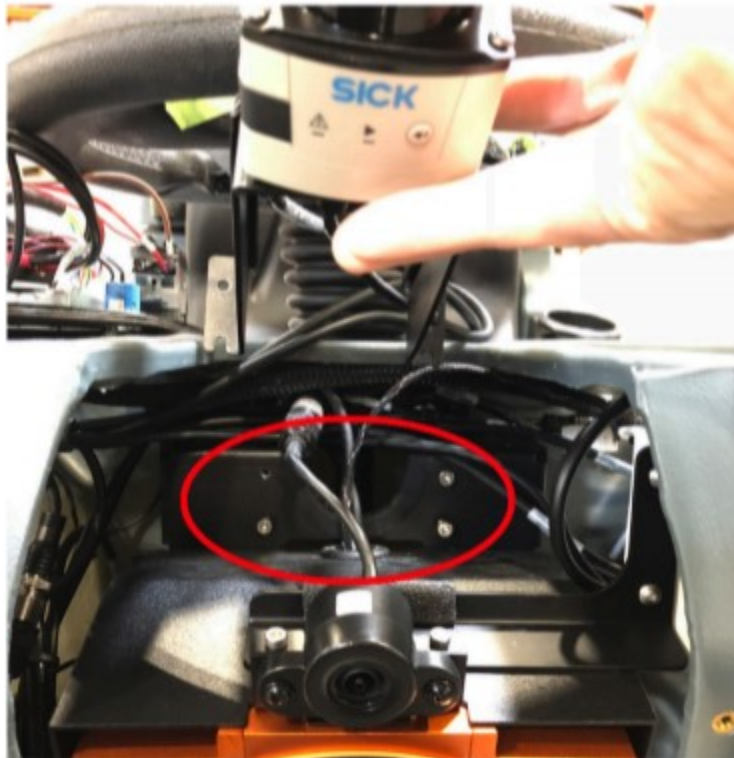


Remove the eight 2.5 mm hex screws that secure the top black cover.





Remove the top black cover. Remove the Slanted LIDAR top left screw completely, but only loosen the other three. Then lift out the Slanted LIDAR and decouple the two rear cables.



Remove the two silver screws to detach the Upper LIDAR from the mounting bracket.



Use care when handling the LIDAR sensor. It must not be scratched or damaged when reinstalling it onto the bracket or the scrubber unit. Avoid handling it by the lens.

If available, use a couple drops of blue Loctite thread lock on the screws that directly secure the LIDAR sensor.

Please ensure to return the old Upper (Slanted) LIDAR back to Brain using the provided return shipping label. Thank you!

Appendix E - Lidar Calibration Procedures

For Calibration procedures Refer to Calibration Document below:

https://drive.google.com/file/d/1ldfxq5VgfLifqu_h1LwlnEcBGlNgbbR/view?usp=sharing

Appendix F - SLAB Calibration Procedures

For Calibration procedures Refer to Calibration Document below:

<https://drive.google.com/drive/folders/1OyhFOqTDJaBh7k8u1HaZNa7yertCdeY->