Minuteman®

RoboScrub 20
Technical Support

brain OS®

rev: 04302025

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Additional Technical Support References

In addition to the material presented here, also refer to:

OEM Operations Manual
OEM Service Manual
Brain Route Strategy Guide
LiDAR Field Calibration Procedures
Various Brain Troubleshooting/Calibration Procedures
Brain Corporation Training Video Library

Acronyms

BCM -Brain Control Module - Gen2

cm - centimeter

CP - Control Processor (Brain)

FW - Firmware

HLC - Home Location Code or Home Marker

IFM - infrared 3D cameras

IR - infrared

LiDAR - Light Detection And Ranging

p/n - Part Number

RGB - Red Green Blue or 2D cameras

SP - Safety Processor (Brain)

SW - Software

UI - User Interface (Touch Screen)

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Various Machine Parameters

Dimensions with Squeegee - Length - 47.5 in/120.65 cm
Width - 29 in/73.66 cm
Height - 45 in/114.3 cm
Weight, Empty - 342 lbs/155.13 kg
Weight with Batteries & Full Solution - 691 lbs/313.43 kg
Solution Tank Capacity - 18 gal/68.14L
Cleaning Path - 20 in/50.6 cm
Squeegee Width - 26.73 in/67.95 cm
Maximum Speed - 2.0 mph/3.2 kph autonomous mode
3.1 mph/5.0 kph manual mode
Scrub Head Type - Disc
Brush Pressure - 60 lbs/27.22 kg
Brush Speed - 175 - 400 rpm
Solution Flow - .07 - .38 gpm/.27 - 1.44 lpm
Decibel rating - 68 dbs
Batteries - 2 each 12 volt AGM Sealed or LiFePo4
Battery Charger -
Minimum Run Time - 3 to 3.5 hours
Machine Voltage - 24 volts 450 watts
Maximum Incline/Decline Grade Level - 0% Robotic, 2% Manual

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Autonomy Kit Components

- Brain Control Module (BCM) - Autonomous Navigation SW & Diagnostics
- Touch Screen User Interface (UI)
- Two LiDAR Sensors - Upper & Lower - to map the environment
- Three InfraRed Cameras (3D) Front, Left & Right - for object detection and avoidance
- Three RGB Cameras (2D) Front, Left & Right - Home Marker Localization & assist pictures
- Steering - stepper motor and gearbox, motor amplifier (MAM), absolute encoder for direction
- Traction Drive Wheel incremental encoder for distance and speed
- LTE Modem and antenna - LTE & Cloud connectivity
- Vehicle interface Board (VIB) - manages the vehicle LED Control Panel
- Kinetek - Base Machine Signals
- Start/Pause Button - located on the back of the vehicle
- Home Marker Kit - pack of 10
- E-Stop Switches (two each)

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Autonomy Kit Components

BCM

UI Screen

Modem & Antenna

Side 2D Camera

Right Side IR Camera

Upper LiDAR

Front IR Camera

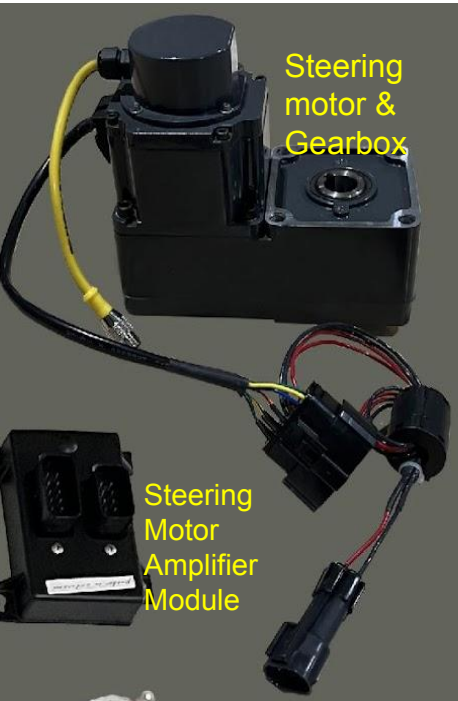
Front 2D Camera

Lower LiDAR

Left Side IR Camera

Steering Encoder

Side 2D Camera



Steering motor & Gearbox

Steering Motor Amplifier Module

Traction Encoder

RoboScrub 20 Overview

1. Side 2D RGB Cameras
2. Front 2D RGB Camera
3. Front 3D IR Camera
4. Side 3D IR Cameras
5. Lower LiDAR
6. Front Perimeter Guard
7. Traction drive Wheel
8. Scrub Deck
9. Squeegee Assembly
10. Accelerator Pedal
11. Solution/Recovery Tank
12. Seat/Recovery Tank Lid
13. Upper LiDAR

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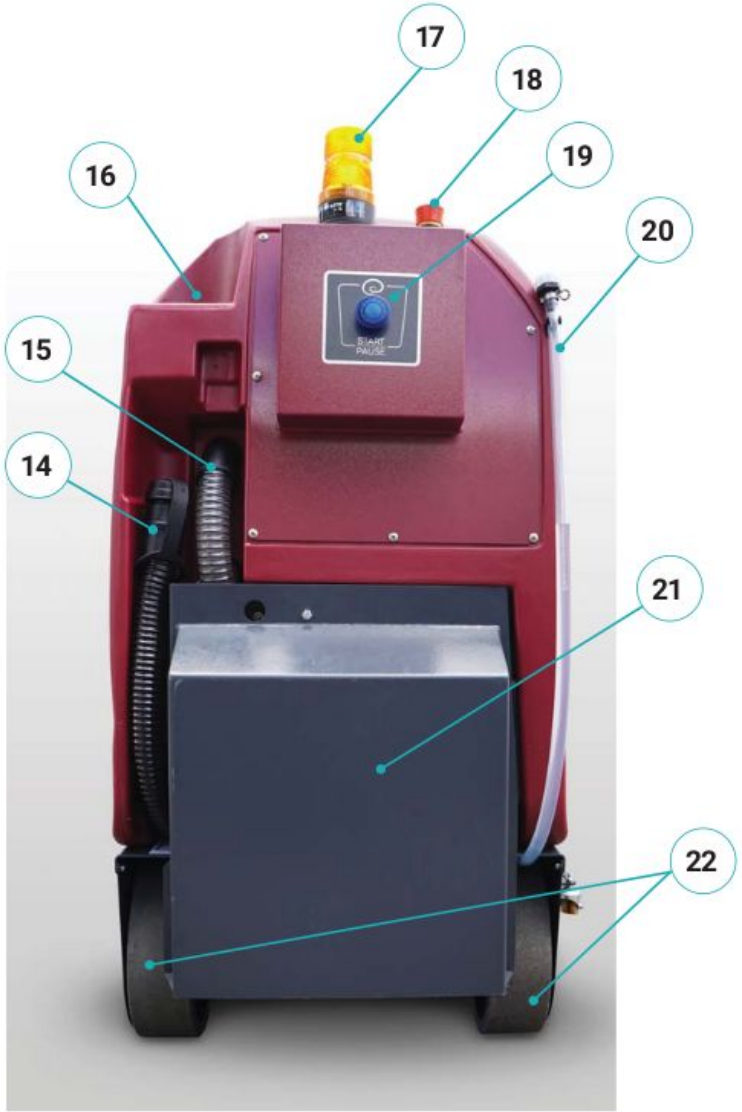
RoboScrub 20 Overview



14. Recovery Tank Drain Hose
15. Vacuum Motor Muffler
16. Solution Fill Port
17. Beacon
18. Rear Emergency Stop Button
19. Start/Pause Button
20. Solution Tank Gauge/Drain Hose
21. Battery Compartment
22. Rear Tires and Wheels

RoboScrub 20 Overview

23. Key Switch
24. User Interface (UI) Touch Screen
25. Steering Wheel
26. Front Emergency Stop Button
27. Horn Button
28. Recovery Tank Full Indicator
29. Solution Tank Empty Indicator
30. Solution Flow Control
31. One-Touch Button
32. Vacuum Button
33. Forward. Reverse Direction Buttons

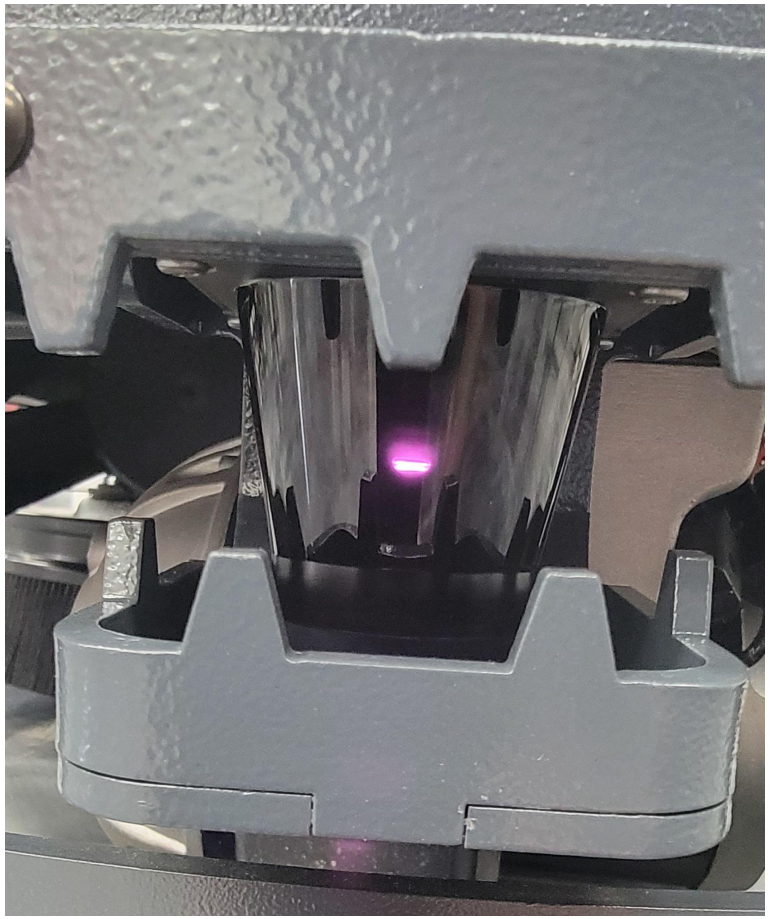
LiDARs

LiDAR - **Li**ght **D**etection **A**nd **R**anging

an active-sensor technique that generates spatial data from the reflection of Infrared light pulses from objects in the scan plane
Mechanical 2D LiDAR - 1 emitter/receiver pair creating a PLANE of detection

Emits a narrow scanning beam - approx 2 cm - of Infrared (IR) Light
10 Meter range (32.75 feet) with 10% reflectivity
250 degree Field of View
Detects objects near the floor to a minimum of about 10 cm (4 inches)

for reference: a wooden pallet is approximately 5 inches tall
the most common forklift tines are only about 4 inches tall



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LiDARs

- One Planar (aka lower, horizontal) LiDAR
- One Slanted (upper) LiDAR
- Class 1 Lasers - safe for eyes and skin

Upper & Lower LiDARs are NOT interchangeable

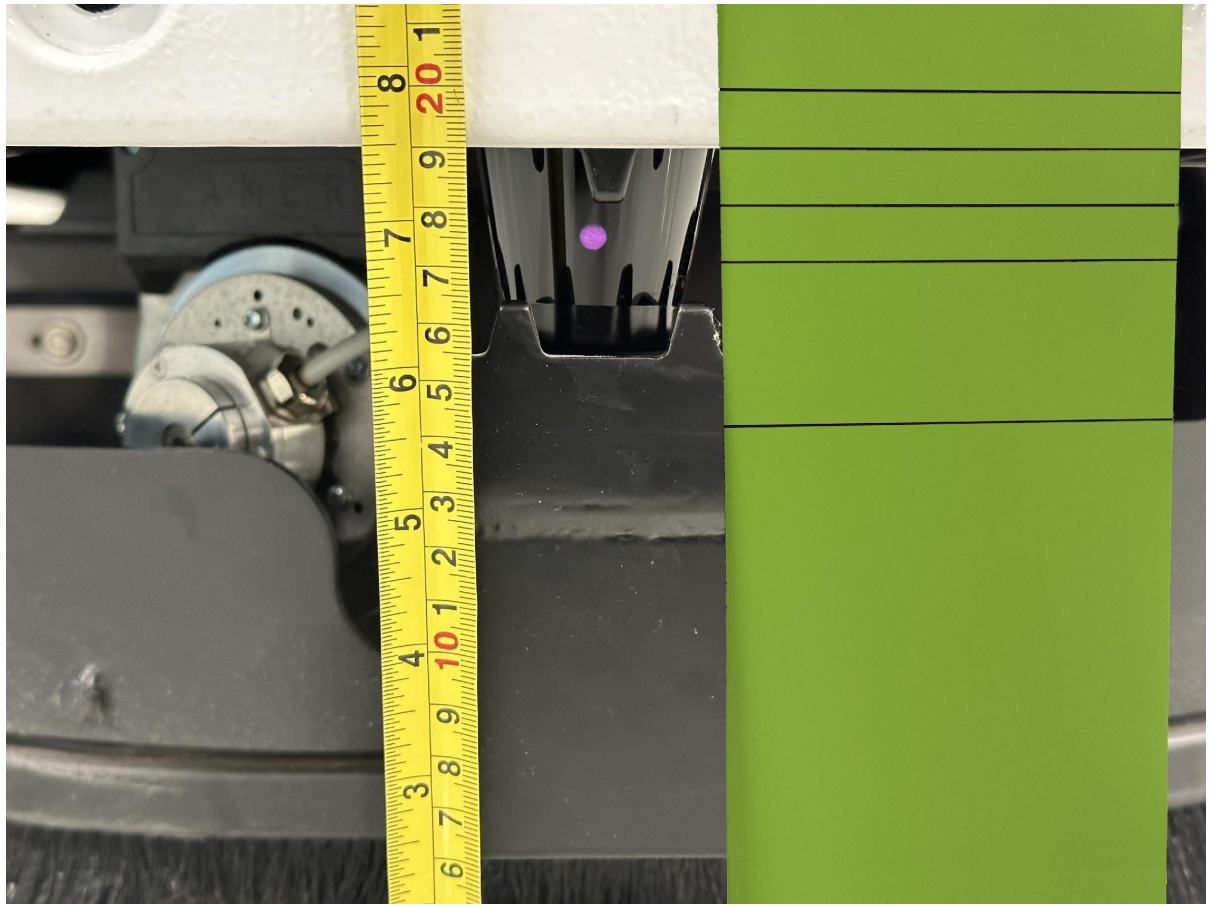
Different MAC & IP Addresses
A sticker on the side of the Lidar body indicates
either Horizontal or Slanted LiDAR

LiDAR beams **MUST be Properly Aligned** (aimed) before calibration.

LiDARs are shipped with the M12 connectors in the position shown on the Right. The connectors can be rotated 90° to the use position as shown on the Left

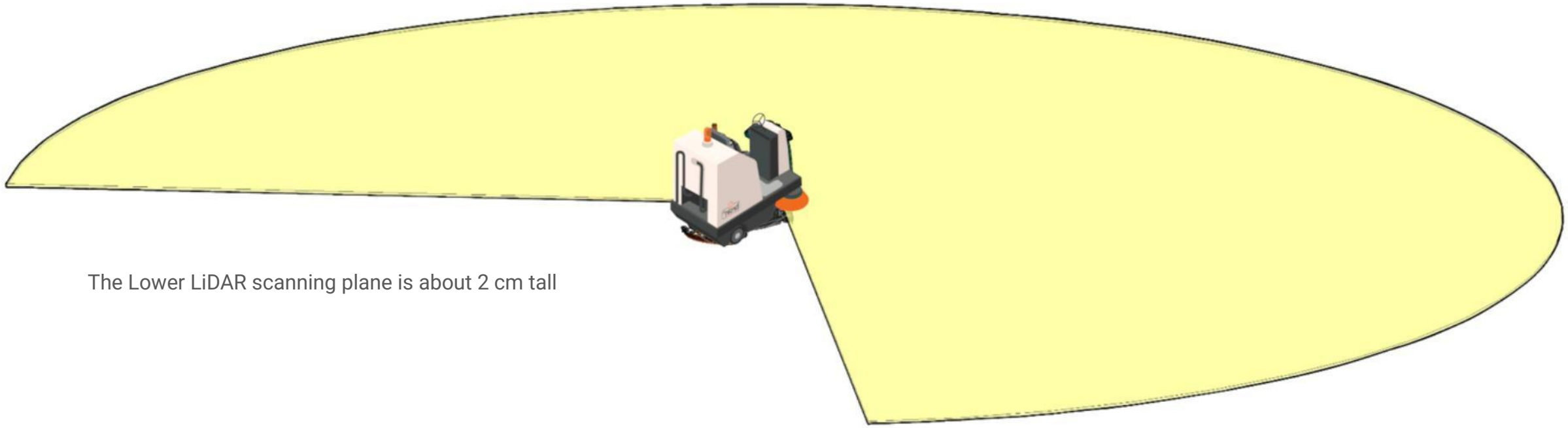
Lower LiDAR

- 250-degree forward field of view
  - (approx 2cm wide IR beam)
- 10 Meter Range with 10% Reflectivity
- Mapping and Obstacle Detection - sees objects near the floor to a minimum of 10cm/4 inches
- Ethernet Interface to BCM (unique IP address)
- Protected by Jaws
- Plastic lens to be cleaned with a 500 lumen flashlight, Endust Screen and Electronics Anti-Static Wipes and/or a CLEAN, lint- free microfiber cloth.
- The area between the Lower LiDAR and the Left & Right anti-tips bars must be clear i.e. no cobwebs, dust bunnies, loose cables, wire ties, etc.



ToC

Lower LiDAR



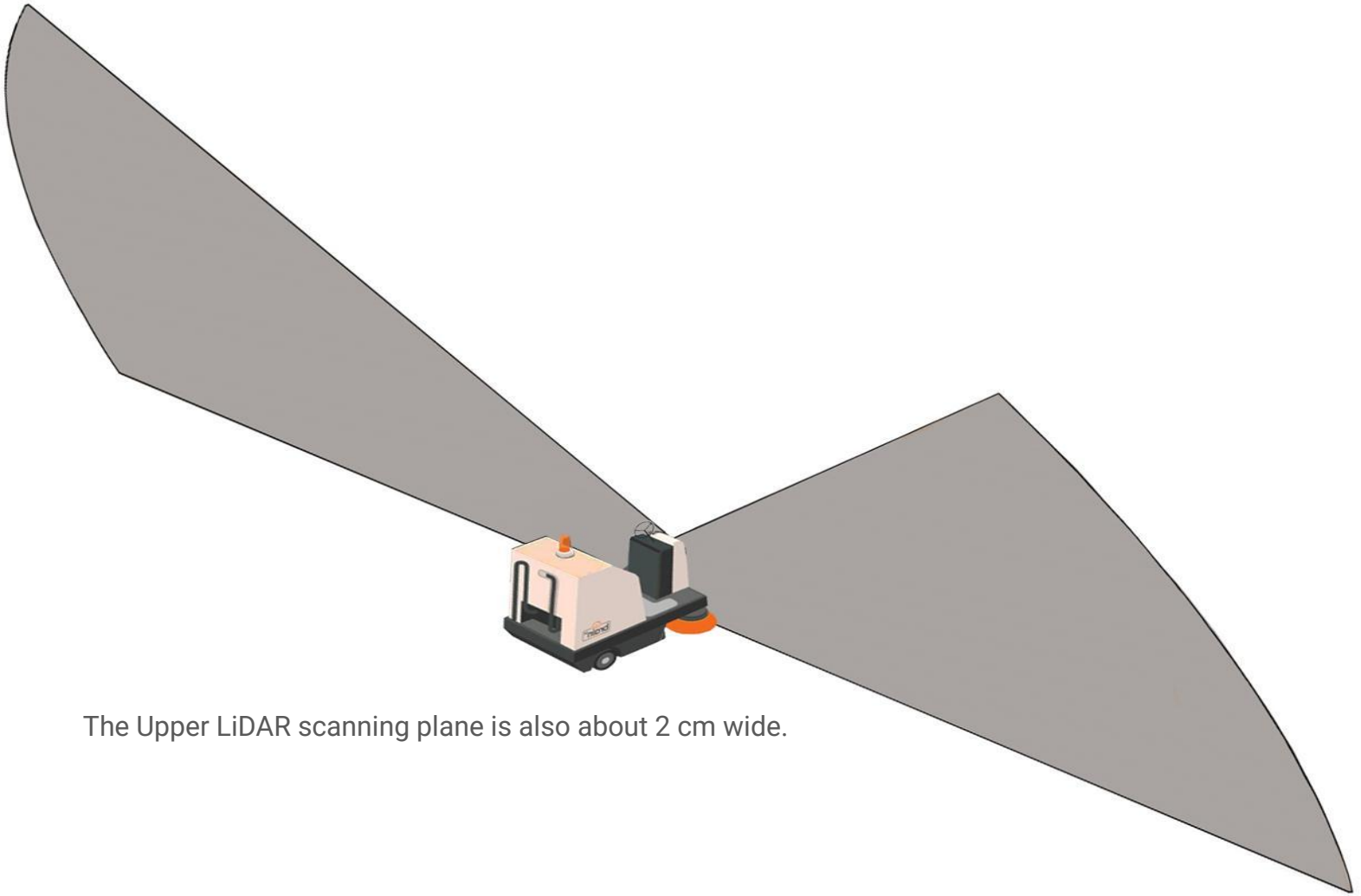
The Lower LiDAR scanning plane is about 2 cm tall

Upper LiDAR

- Scans from a height of 1.3 Meters on both sides to the floor
- Angled at 50° from horizontal
- 10 Meter Range with 10% Reflectivity to the sides
- Cliff Detection and Hanging Obstacle Detection
- Susceptible to reflections
  - Vertical Glass/Highly Reflective Surfaces – Keep 18” away
- Ethernet Interface to BCM (Unique IP address)
- Plastic lens to be cleaned with a 500 lumen flashlight, Endust Screen and Electronics Anti-Static Wipes and/or a CLEAN, lint- free microfiber cloth.

ToC

Upper LiDAR



The Upper LiDAR scanning plane is also about 2 cm wide.

Infrared Cameras

3 IFM InfraRed Cameras - Front, Left and Right

- Infrared Time of Flight Cameras (ToF)
- Emit broad flashes of IR light
- A time-of-flight (ToF) camera is a system that measures the distance between the camera and a subject in an image by calculating the time it takes for light to travel between them. IFM cameras use InfraRed light to illuminate a scene and then measure the phase shift between the light emitted and the light reflected back. The phase shift is then translated into a distance measurement for each pixel in the image.

Each IR camera must be individually calibrated

- Camera lenses to be cleaned with a 500 lumen flashlight, Endust Screen and Electronics Anti-Static Wipes and/or a CLEAN, lint- free microfiber cloth.

The front camera is labeled TOP & BOTTOM and does fit in upside down

The LEFT & RIGHT IR cameras are labeled and not interchangeable

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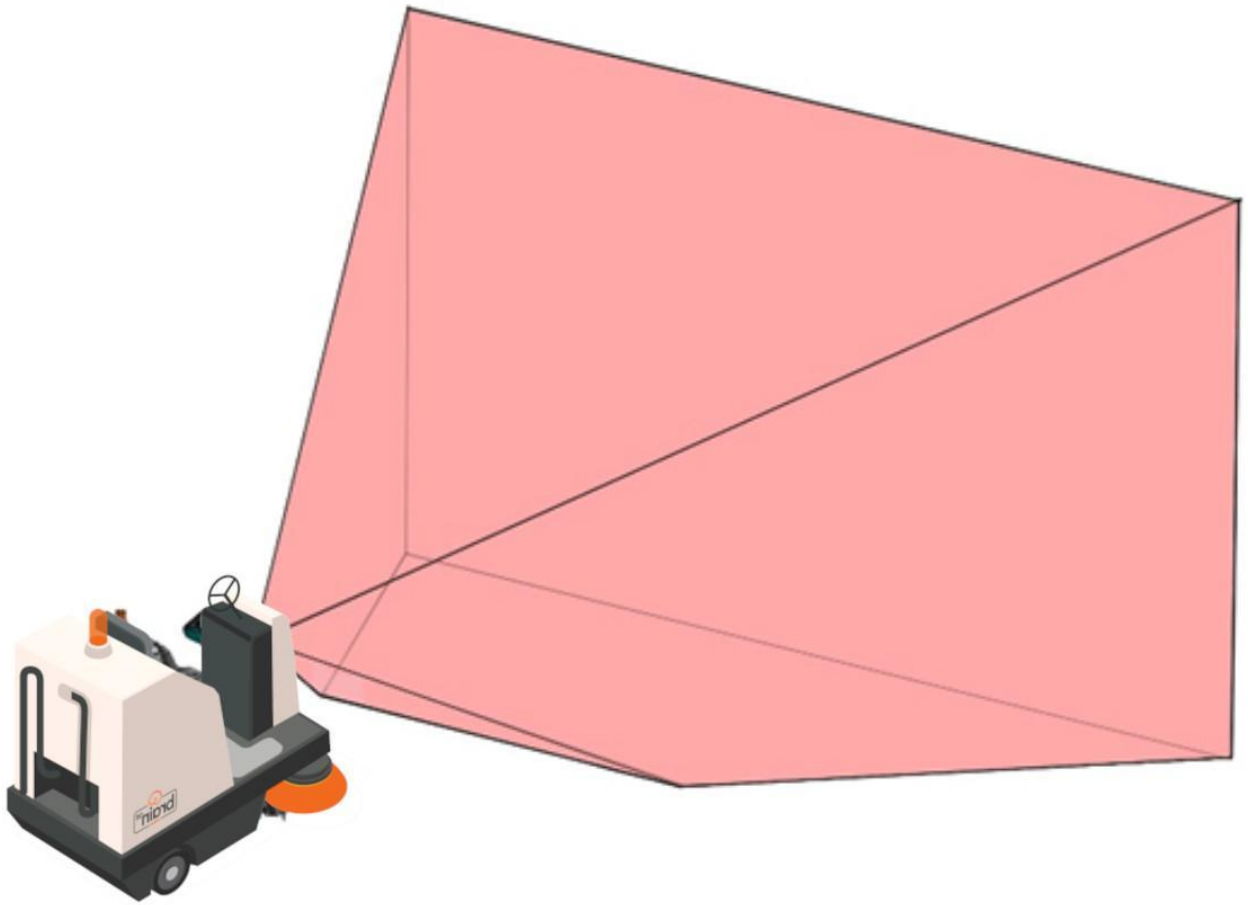
Infrared Camera - Front



Four visible flashing red leds

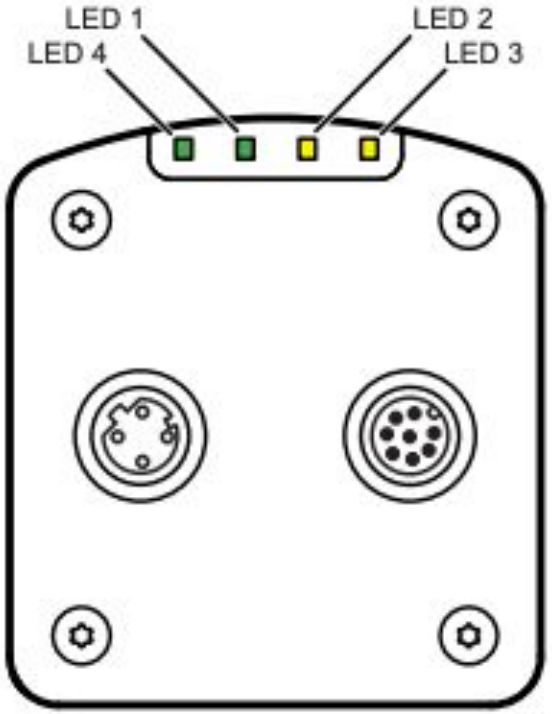
Front IFM Camera is Labeled TOP and BOTTOM. Care should be taken that it is installed correctly

Three Phillips head pan screws hold the front IR camera in pace, two on top and one on the bottom in the center.

ToC

Infrared Camera - Front

There are four LED indicators on the back side of the front IFM camera an these signal the current operating state of the camera.



LED 4 (Ethernet)	LED 1 (Power)	LED 2 (Out 1)	LED 3 (Out 2)	Description
	On			Camera is ready for operation, supply voltage applied
	Flashes at 0.5 Hz			No parameters set or parameter setting was not loaded into the camera On Off 
	Flashes 2x at 0.5 Hz			Camera is in the parameter setting mode On Off 
		On		Switching output 1 switched
		Flashes at 8 Hz		Switching output 1 shorted
			On	Switching output 2 switched
			Flashes at 8 Hz	Switching output 2 shorted
On				Ethernet connected
Flashes				Ethernet transmitting data
Off				Ethernet not connected
		Flashes at 8 Hz	Flashes at 8 Hz	Camera signals internal error
		Flashes at 2 Hz	Flashes at 2 Hz	Camera signals correctable error. The error information can be read via Ethernet
	Running light ⇒			Camera booting
	Running light ⇐			Camera carrying out firmware update

Infrared Camera - Side

Side 3D Camera

- Downward and back facing
- Detects Obstacles along the side and approaching from the rear
- Illuminated Red Power LED
- 12 inch Safety Zone on each side of the Robot
  - Robot slows down
- Includes an 8 inch No-Go Zone
  - Robot Stops
- Labeled LEFT & RIGHT - Not Interchangeable.
- Ethernet Interface to BCM (Unique IP address)

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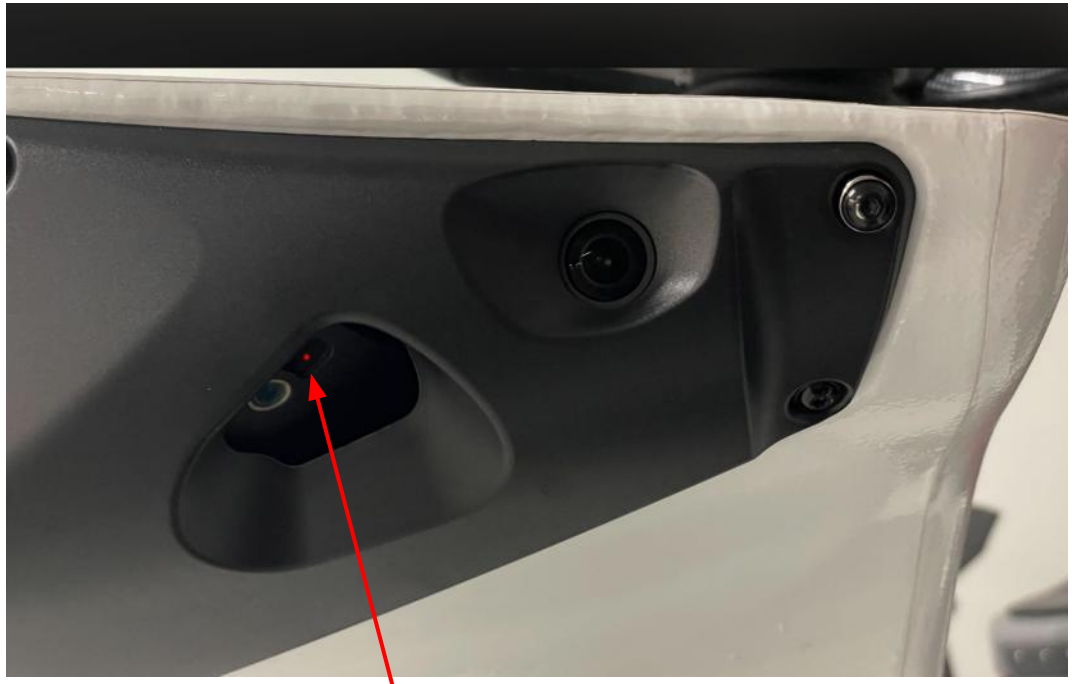
Infrared Camera - Side



Red Power LED

RGB Cameras

- 2D RGB (Red Green Blue) Cameras
- Visible Imaging Sensors
  - Three on each AMR. Front, Left and Right
  - Right camera scans Home Locator Code (HLC) or Home Marker
  - Not used in navigation
  - Take still photos and videos - when an assist is generated
    - Sent via BrainOS Mobile APP or Text
  - Records video when scrubbing autonomously
    - Stored locally on BCM
    - Need to be retrieved manually by BC for safety purposes
    - Facial Blurring Recognition

The three RGB Cameras are <u>Interchangeable</u> and do not require Calibration

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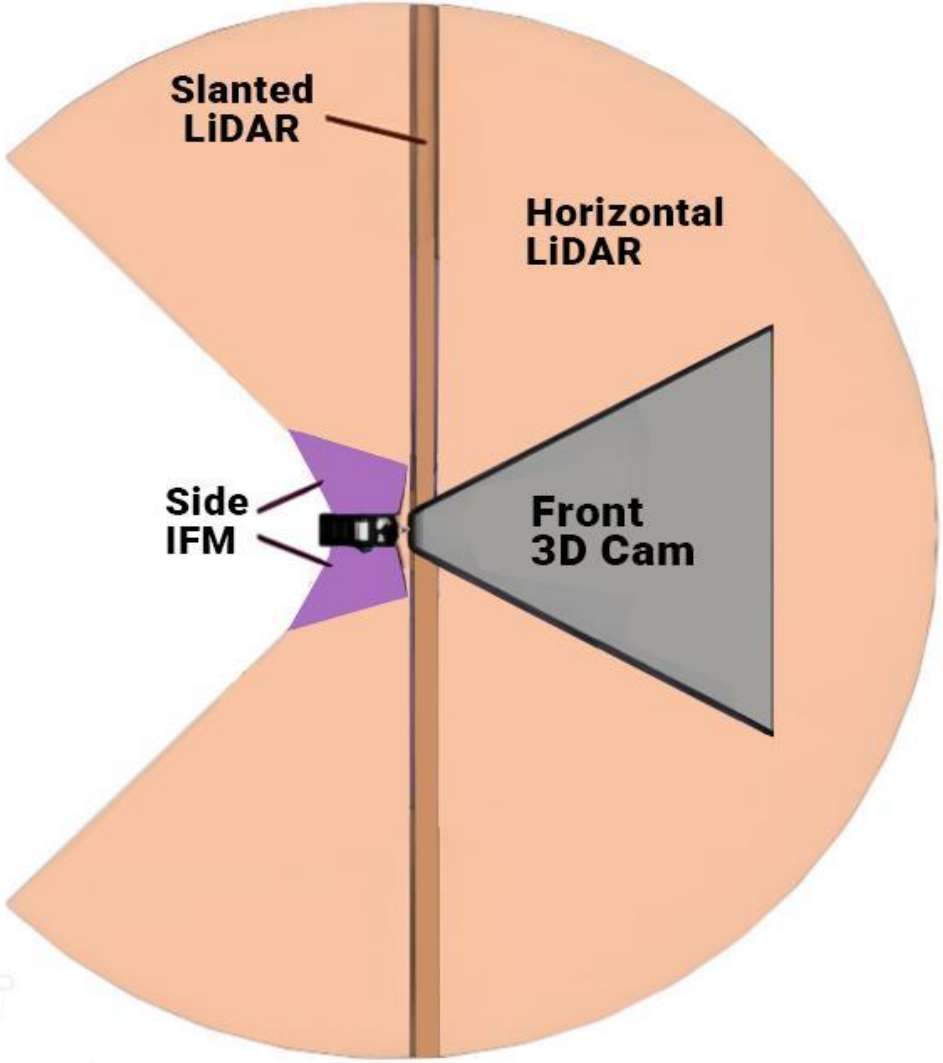
Sensors

Virtual view of the Robot's view of the environment through all the navigation sensors



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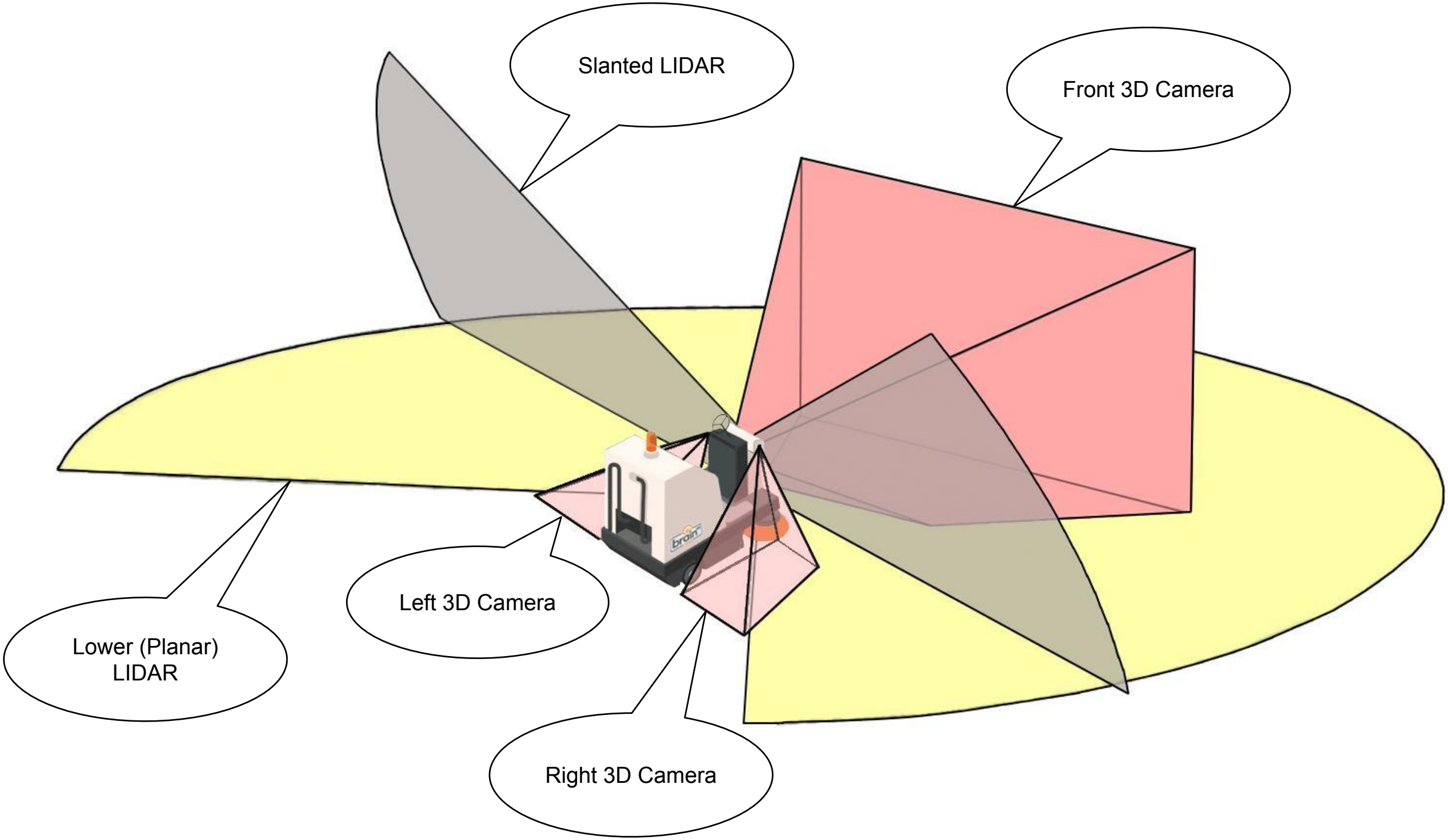
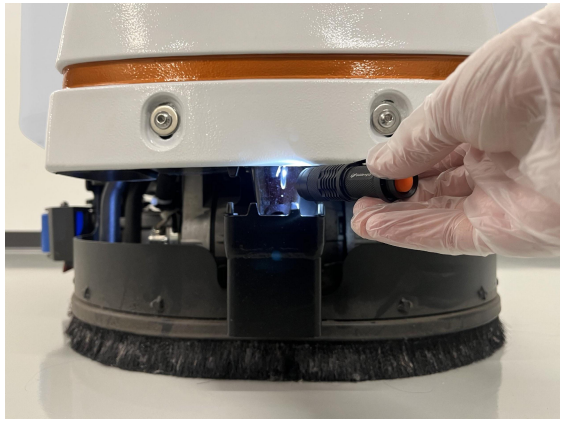

Slanted LIDAR
Front 3D Camera
Lower (Planar) LIDAR
Left 3D Camera
Right 3D Camera

Cleaning the Camera & Sensor Lenses

All LiDAR and Camera lenses must be inspected and cleaned before initiating autonomy

- Use a 500 lumen flashlight (**not a cell phone flashlight**) to inspect the sensors for dust, debris, water spots, damage
- Only Endust Brand Screen and Electronics Anti-Static Wipes and a clean lint free microfiber cloth may be used to clean the sensor/camera lenses



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Modem & Antenna

The modem connects to a LTE cellular network with the global antenna.

This connects BCM with the Brain Corporation Cloud network.

Data uploads, usage reports, diagnostic information and software and firmware updates all occur on this connection.

Cloud communication can be impacted by a poor LTE signal

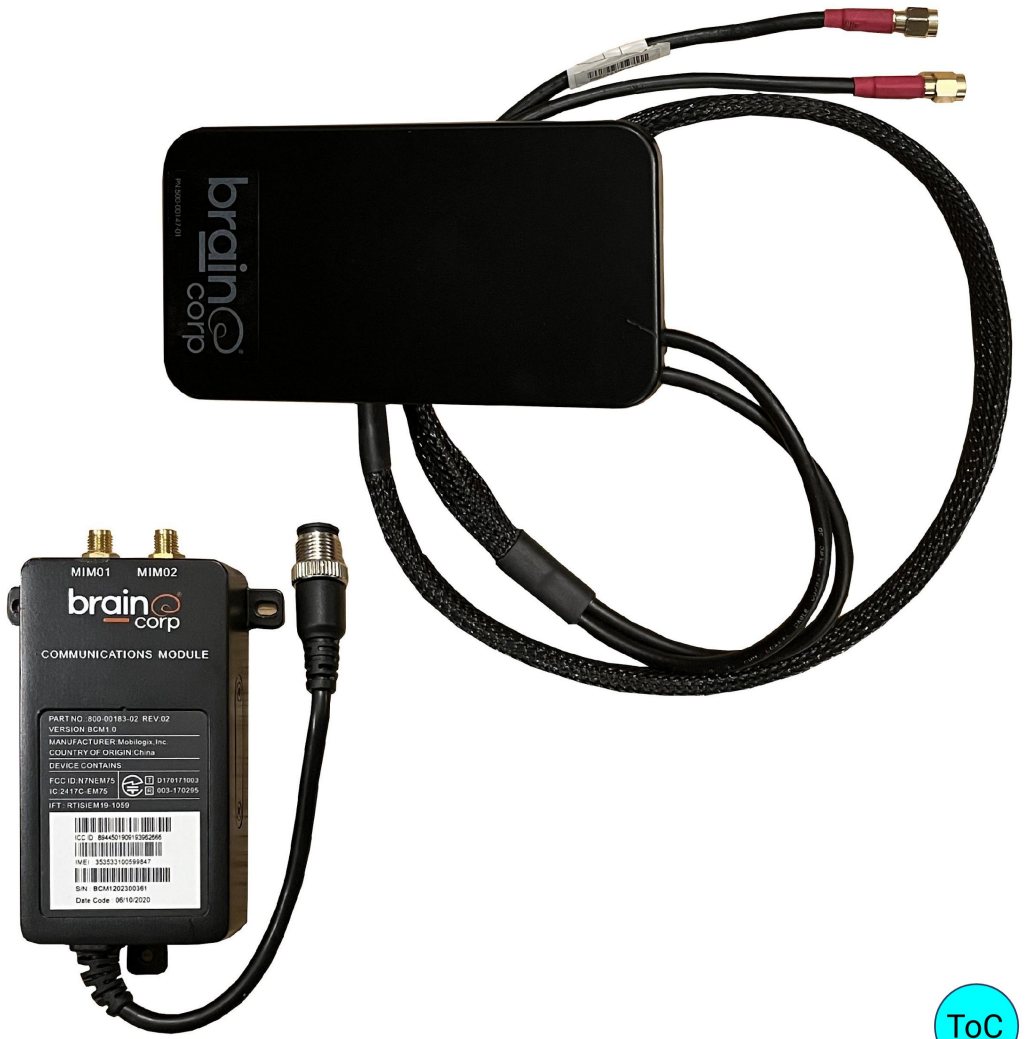
Icons are on the status bar on the UI

Connected

Not Connected

Modem is a USB Device and wired the same as the RGB Cameras

Modem MUST BE Properly Isolated from the mounting bracket with SIX Nylon Flange Washers



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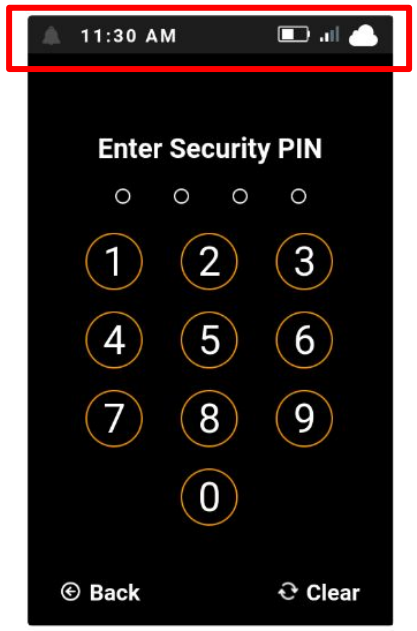
Modem Troubleshooting

This is a summary of the Modem Troubleshooting Guide for BrainOS, version 8. View the official procedure for additional notes.

Ensuring Proper Connectivity for the Robot

1. **Check Network Reception**: Make sure the robot is in an area with good cellular network reception, typically near a door (like an open loading dock) or in a parking lot away from the building. Avoid testing connectivity in areas with poor cell phone coverage, such as the back of a store or in a basement.
2. **Perform a Hard Reboot**:
    - When the PIN screen appears, check the LTE & Cloud icons in the status bar at the top of the screen:
        - **Grayed out and crossed out**: No connectivity.
        - **Illuminated in White**: Connectivity is established.
3. To perform a Hard Reboot:
        1. Turn off the machine using the key.
        2. Wait for the fan noise behind the front InfraRed camera to stop.
        3. Open the rear battery cover and disconnect the Red Anderson battery pack connector.
        4. Wait approximately 3 minutes, then reconnect the battery pack connector and close the battery cover..
        5. Turn the machine back on and wait for the PIN screen to appear.
        - **Check Connectivity**:
    - If the LTE & Cloud icons are illuminated, verify with Brain Support that the robot is online.
        - Check if any pending uploads are decreasing in number.
    - If the LTE & Cloud icons are grayed out and crossed out, take a picture of the "About" page and submit it to Brain Corp:
        - From the Main Menu, select **Settings**, then **About**.
4. **Next Steps**: Hardware checks are on the next slide.

Status Bar



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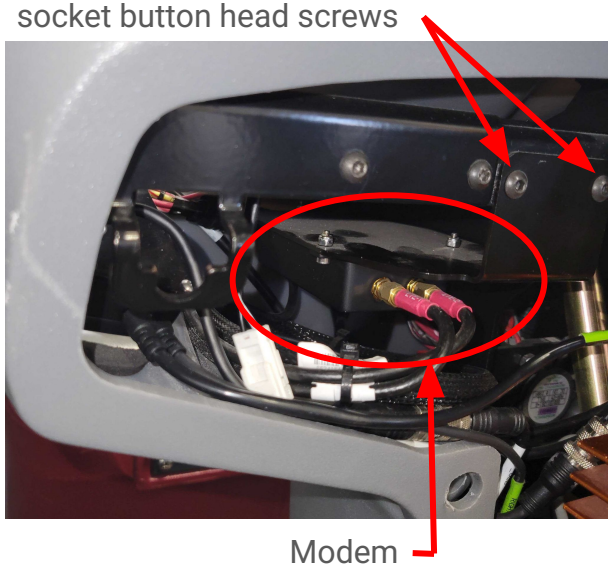
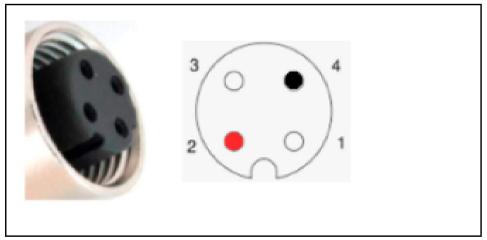
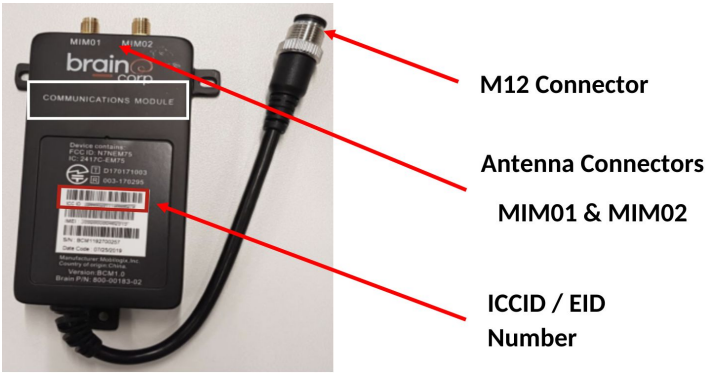
Modem Troubleshooting

1. **Remove Covers**:
   - Remove the slanted LiDAR cover and the front cover from the machine.
2. **Access the Modem**:
   - The modem is mounted on a bracket underneath the control panel.
   - Remove the two ⅛” socket button head screws and pull the modem and bracket out.
3. **Check Modem Mounting**:
   - Ensure the modem is mounted on the bracket with **six** nylon shoulder washers—**three** on each side of the bracket.
4. **Inspect Modem and Connections**:
   - The modem has three connectors: two antenna connections and one M12 connector with a knurled nut.
   - Inspect the modem and connectors for any physical issues such as damage, pinched, or loose cable connections.
   - Verify that the ICCID number on the modem label matches the ICCID number on the "About" page.
5. **Reconnect the Modem**:
   - Connect the modem's M12 connector to the left-side 2D camera’s M12 connector after the robot is fully booted up..
6. **Check Connectivity**:
   - Wait approximately 5 minutes to see if the modem connects by observing the icons on the Status Bar of the touchscreen.
   - While waiting, check for voltage across pins 2 & 4 on the Modem’s M12 female connector.
     - Refer to the picture to locate pins 2 and 4 (with the connector key positioned at 6 o’clock).
   - The voltage across pins 2 and 4 should be approximately 5VDC when the machine is fully booted up.







Kinetek Controller

This is the Vehicle Control Unit or VCU or just Kinetek.
The KCCA0237 Kinetek Controller provides control of all base machine functions.
Provides variable speed control and regenerative braking for the traction drive motor, and a current limit for the vacuum and brush drive motors.
The Kinetek has over current protection, short-circuit protection and over/under voltage protection. It also provides self-testing, continuous diagnostics and can flash an error code with its single red power LED.

Uses CAN communication between the VIB and BCM.
These are the only 3 devices on the Can Bus - the BCM, VIB, and Kinetek.

The Kinetek has a specific Battery Type Parameter and must be used with that Battery type.

Minuteman only uses two different battery types in the RoboScrub20
MM p/n 748526 - CONTROLLER, MR20, AGM BATTERY
MM p/n 748576 - CONTROLLER, MR20, LITHIUM ION BATTERY

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Kinetek Controller

The Kinetek is behind the back panel on the back of the RoboScrub 20.

Remove 4, Phillips head screws, 2 each on the left and right sides. The 3 Phillips screws along the bottom only have to be loosened as the bottom of the panel is notched and will lift out of those screws once they're loosened.

There is enough slack in the wiring that the panel will sit in the battery cover once that cover is opened. There aren't any wires to disconnect to remove this panel.

Eight 10 mm Brass Hex Head Bolts: (Left to Right)

- Traction Drive Motor + and -
- Battery + and -
- Brush Drive Motor + and -
- Vacuum motor + and -

Four Molex Connectors:

P1 Brake - 2 wires 29 ohms on the circuit
P2 Deck & Squeegee actuator, seat switch, water valve
P3 Key Switch, clean & dirty water level switches, forward & reverse switch
P4 CAN Communication - 3 wires

Kinetek Controller

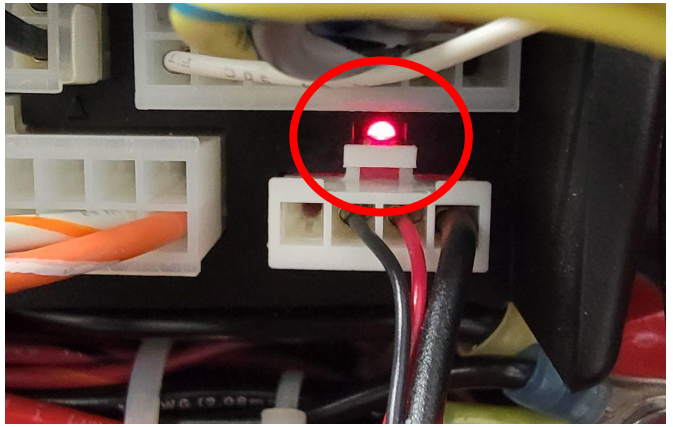
When the Kinetek controller software detects an error condition, it will shut down the operation of the controller and provide a visual indication of the error code via the red LED, flashing in a Hexadecimal format.

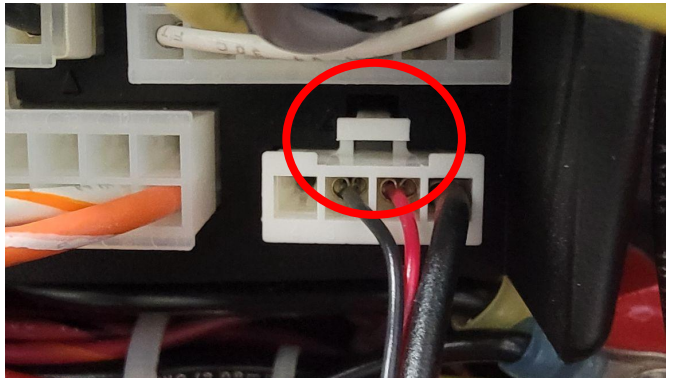
The red LED is located above the P4 connector, recessed above the lock of the connector. It is difficult to located when not illuminated.

The Hexadecimal system is a 16 digit number representation of numbers 0 to 9 and letters A to F. In other words, the first 9 numbers or digits are represented as numbers while the next 6 digits, 10 to 15, are represented by the letters A to F.

When in a error state, the Red LED will flash a series of Long and Short flashes. Count the number of Long and Short flashes to get the error code.

Error codes are described in the Kinetek Controller Operator's Manual starting on page 34.





Decimal	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Hexadecimal	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

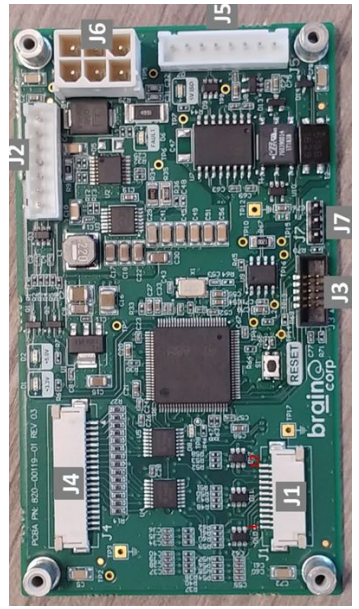
VIB - Vehicle Interface Board

Located under the Control Panel

This is the module that the BCM uses to communicate with the Vehicle Control Unit, VCU or Kinetek.

- Manages the vehicle LED control panel.
    - Horn
    - Recovery Tank Full Indicator
    - Solution Tank Full Indicator
    - Solution Flow Control
    - One-Touch Button
    - Vacuum Button
    - Forward/Reverse Directional Button

This board is usually replaced with the Control Panel Assembly, if necessary; not individually.



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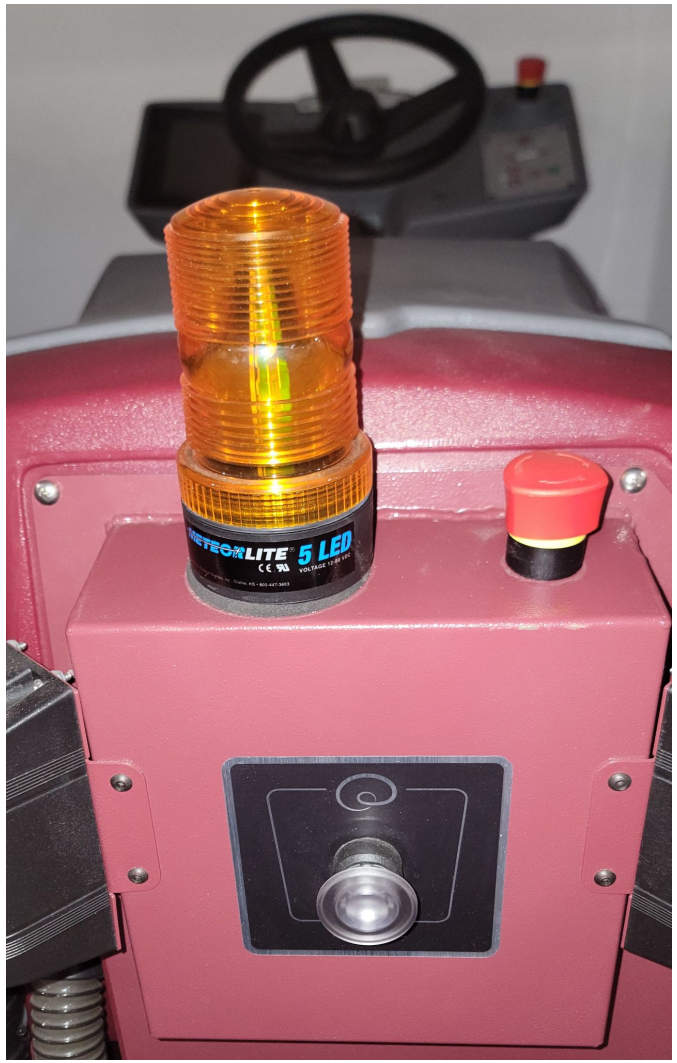
E-Stop Switches

There are two E-Stop switches on Roboscrub 20, one located at the front of the machine by the Control Panel and one at the back of the machine by the Beacon.



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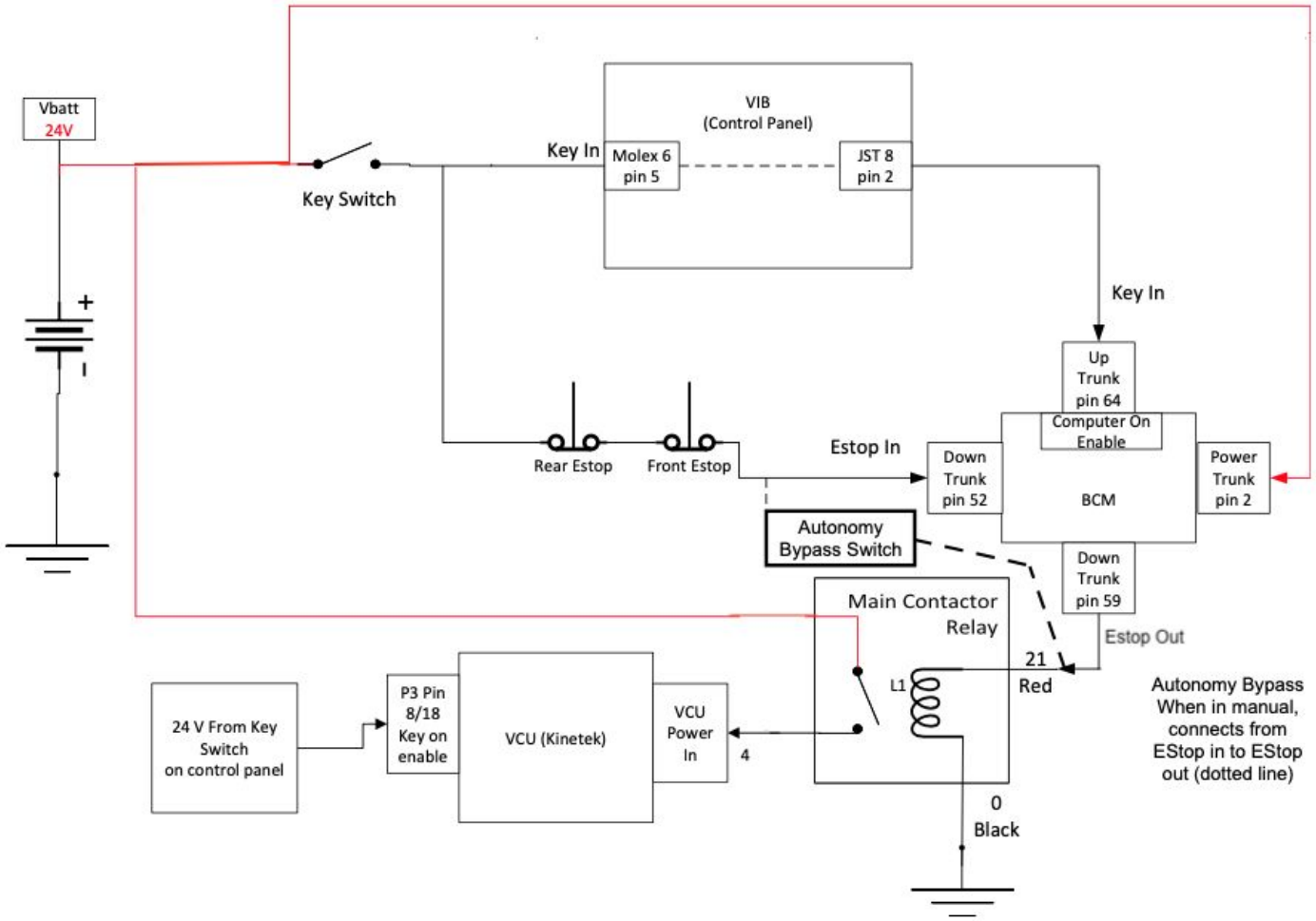
E-Stop Circuit



Start/Pause Button

The Start/Pause Button is located on the back of the RoboScrub20

This Button is used to:

- Start an Autonomous Route
- Pause an Autonomous Route
- Resume an Autonomous Route

After a Home Marker is read, an autonomous route is selected and RUN is pressed on the UI, the Start/Pause Button will be illuminated.
Press the Button to start the autonomous route.

During autonomous route running, the button can be pressed to pause the route.

After pausing the autonomous route, the button can be pressed again to resume the autonomous route.

ToC

Home Marker

The Home Marker defines the origin point for the robot or Homing Localization for autonomous usage. This marker is read only by the right side 2D RGB camera.

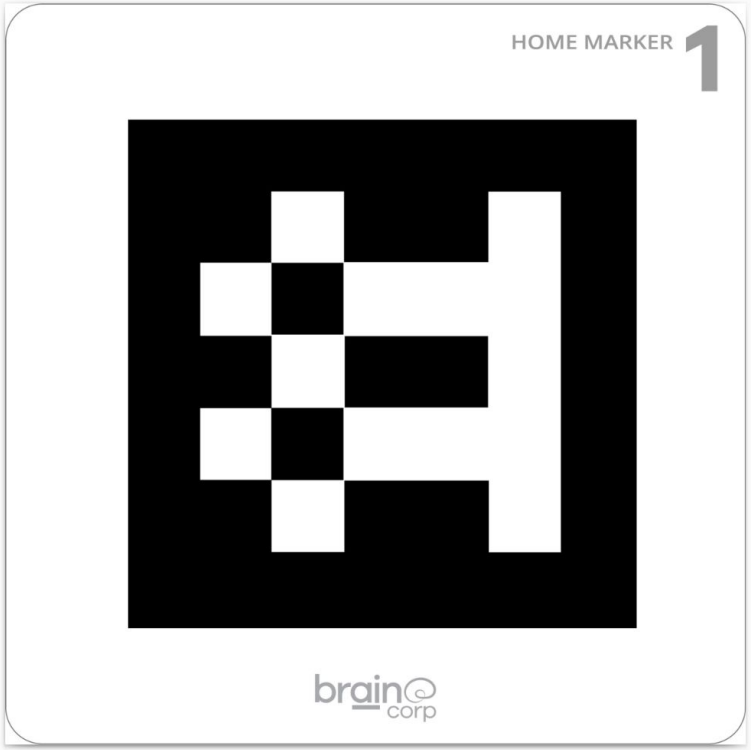
A Home Marker is a unique code identifier that the robot scans to determine its current physical location and any autonomous routes that have been saved to that specific Home Marker.

The machine is designed to work with up to 10 Home Markers, numbered from 1 to 10.

Each Home Marker can store up to 12 routes for a total of 120 routes.

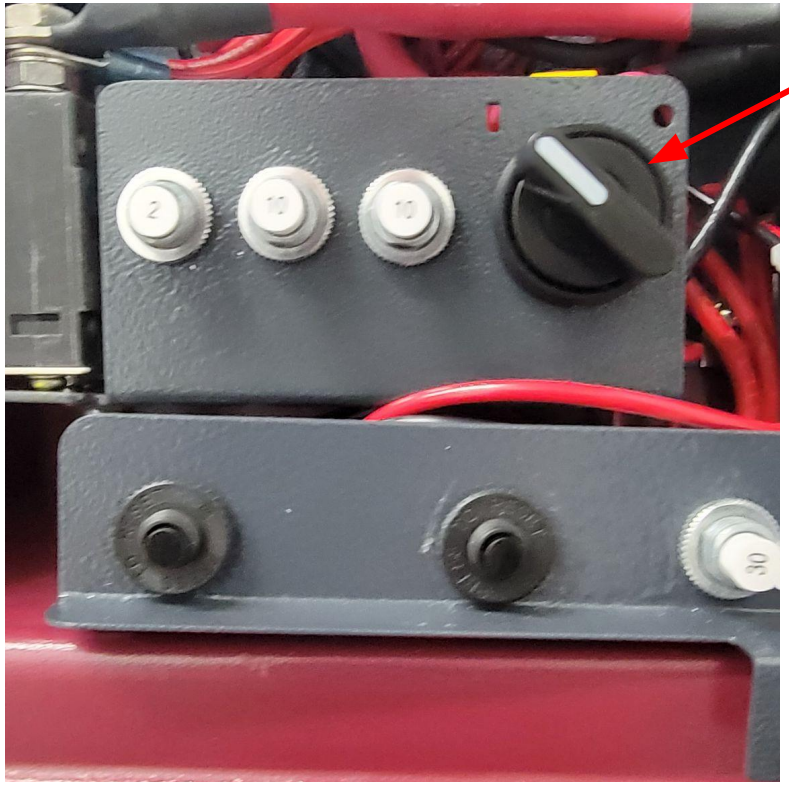
Home Markers are used to establish the start and end points of cleaning routes. The number of Home Markers needed may vary, depending on the size of the space where the machine will be operating in robotic mode.

Home Markers must be permanently installed, the bottom of the Home Marker being 41 inches from the floor.



ToC

AMR Switch



AMR Switch
shown in the ON position

The AMR (Autonomous Mobile Robot) Switch is located behind the back panel, below the Kinetek controller, on a bracket with three breaker switches.

Turning the AMR Switch clockwise will turn off the BCM and the entire Autonomous Navigation System.

This is useful in diagnosing base machine issues.

ToC

LiDAR Beam Alignment Kit

- **Field Calibration Kit: Brain part number 800-00282-01**
  - IR viewer
  - 3 Tape measures (> 2 meters)
  - 3 Targets with graduations at 14, 17 and 20 cm
  - for the lower Lidar and graduations for the slanted Lidar

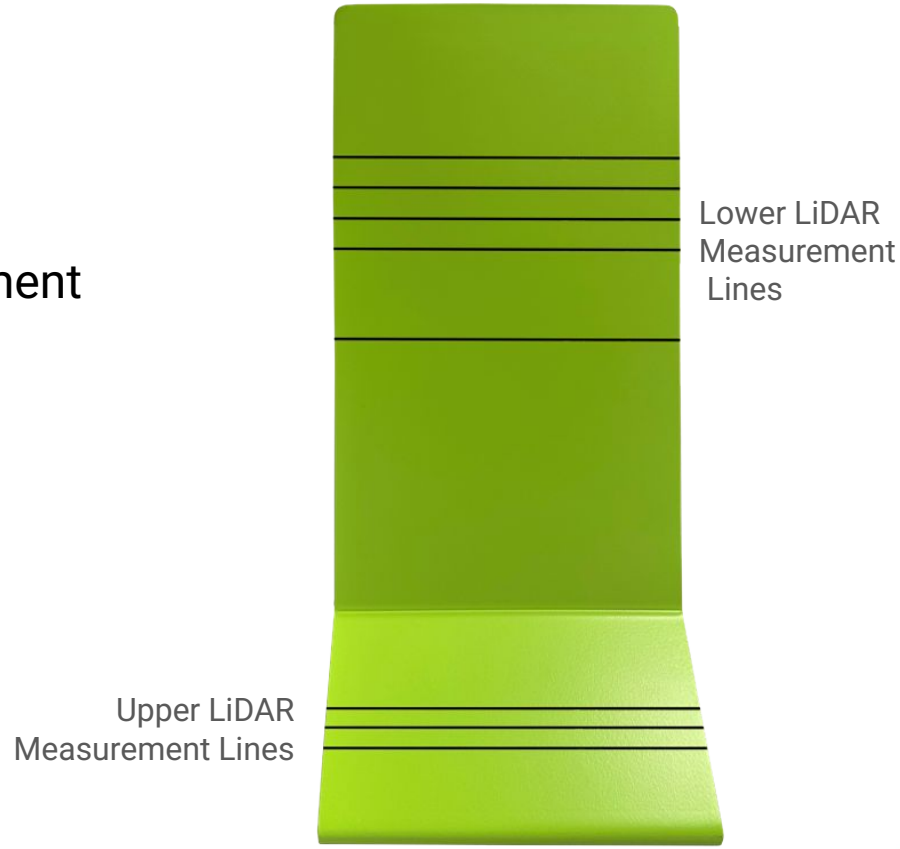
Also need Electrical Tape (to shield front IFM Camera IR light)

- **4 Steps to Lower & Upper Lidar Calibration:**
  - Align the Beam to specifications
  - Reset the Lidar
  - Collect Data - Two, 10 or 5 minute long maps
  - Calibrate the Lidar

ToC

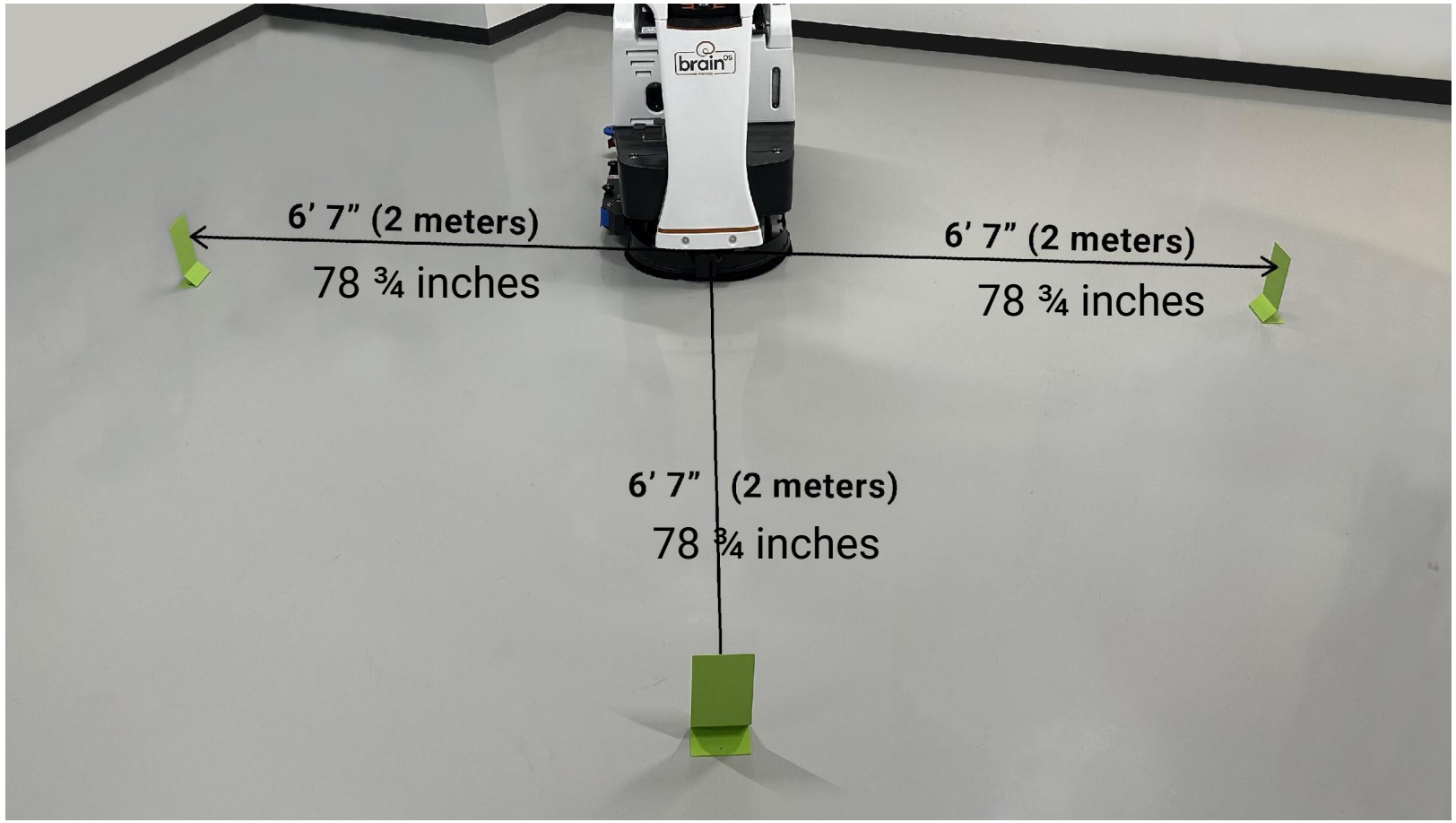
Lower LiDAR Calibration - Field

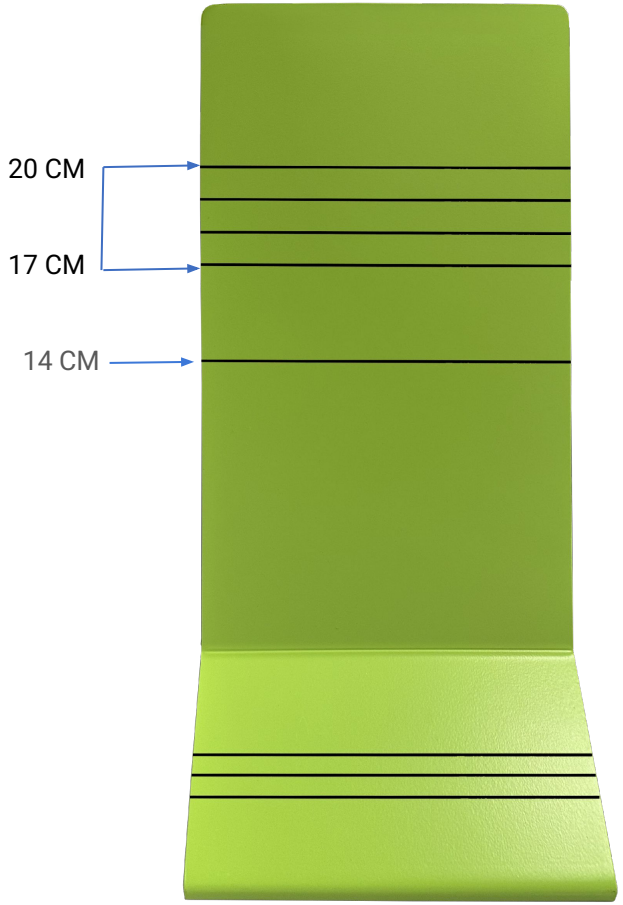
- Set up each of the three Targets 2 Meters in front of and 2 Meters to each side of the Lower Lidar
- Block the Front IFM Camera IR Light
- Using an IR Viewer, Align the Front and Side Beam Height
    - Front Beam Height **MUST BE 17 to 20 cm**
    - Sides Bean Height a minimum of 14 cm but **LEVEL**
- Snug the hold down screws and re-check for proper beam alignment
- In the Service Calibration Menu, Reset the Lower LiDAR
- Create and Save TWO new maps, 10 minutes in length
- Back to the Service Calibration Menu, Calibrate the lower LiDAR
- Power Cycle the Robot when directed.



ToC

Lower LiDAR Beam Alignment - Field





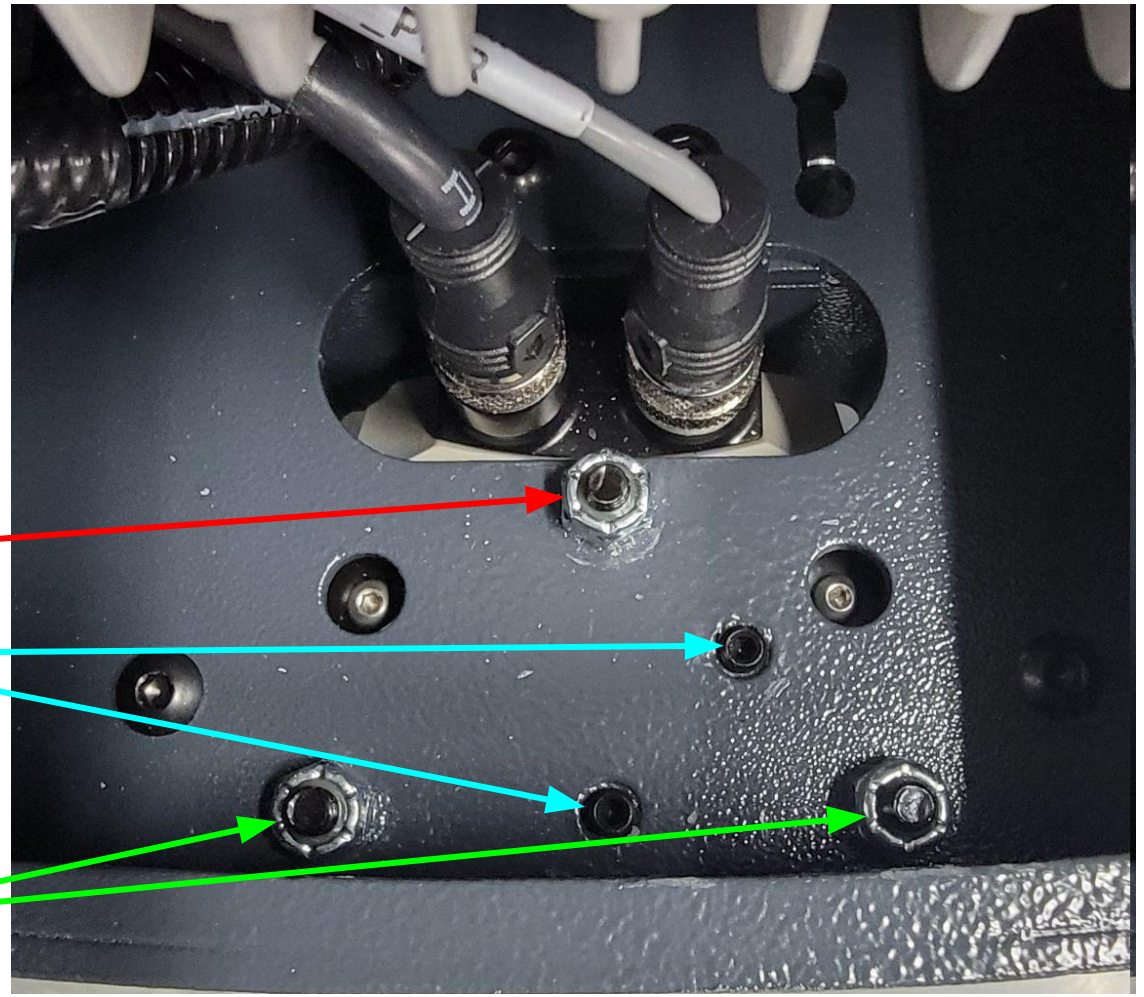
Lower LiDAR Beam Alignment

Loosen the Lidar Mounting Plate hold down Set Screws

The BACK ⅜” Hex Nut is for straight ahead beam height adjustment.

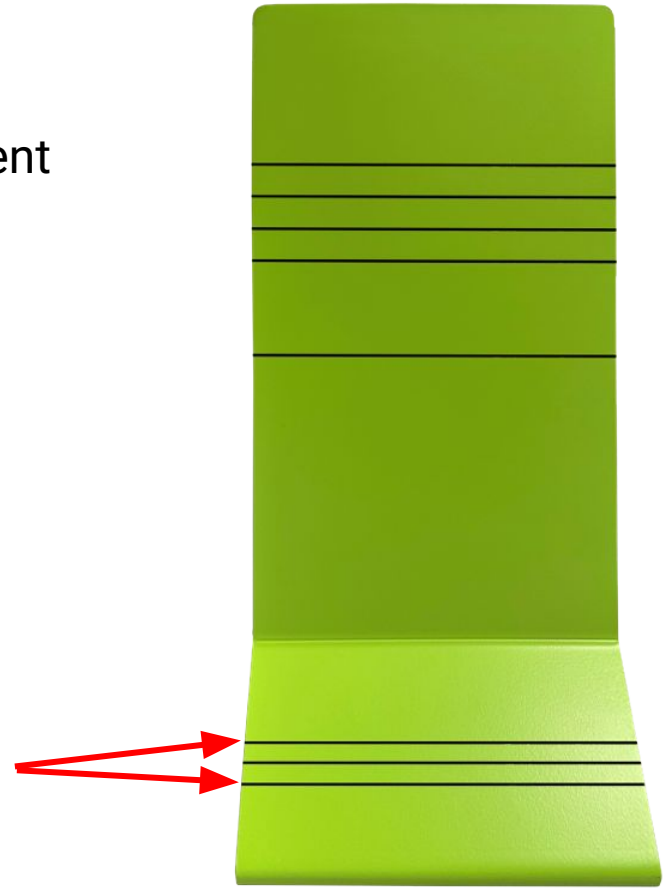
The Front Two ⅜” Hex Nuts are to level the side to side beam adjustment.

Snug down the set screws to hold the LiDAR mounting plate in place after beam adjustment.



Upper/Slanted LiDAR Calibration

- Set up 2 Targets:
    - 203cm/80in from the center of the Rear Axle and 30cm/12in to each side
- Block the Front IFM Camera IR Light
- Block the Lower LiDAR beam
- Using an IR Viewer, Align the Beam
- Snug the hold down screws and re-check for proper beam alignment
- In the Service Calibration Menu, Reset the Slanted LiDAR
- Create and Save Two new maps, each 5 minutes in length
- Back in the Service Calibration Menu, Calibrate the Slanted LiDAR
- Power Cycle the Robot when directed.



Upper LiDAR Beam must be aligned within these lines on the calibration targets

ToC

Upper/Slanted LiDAR Beam Alignment

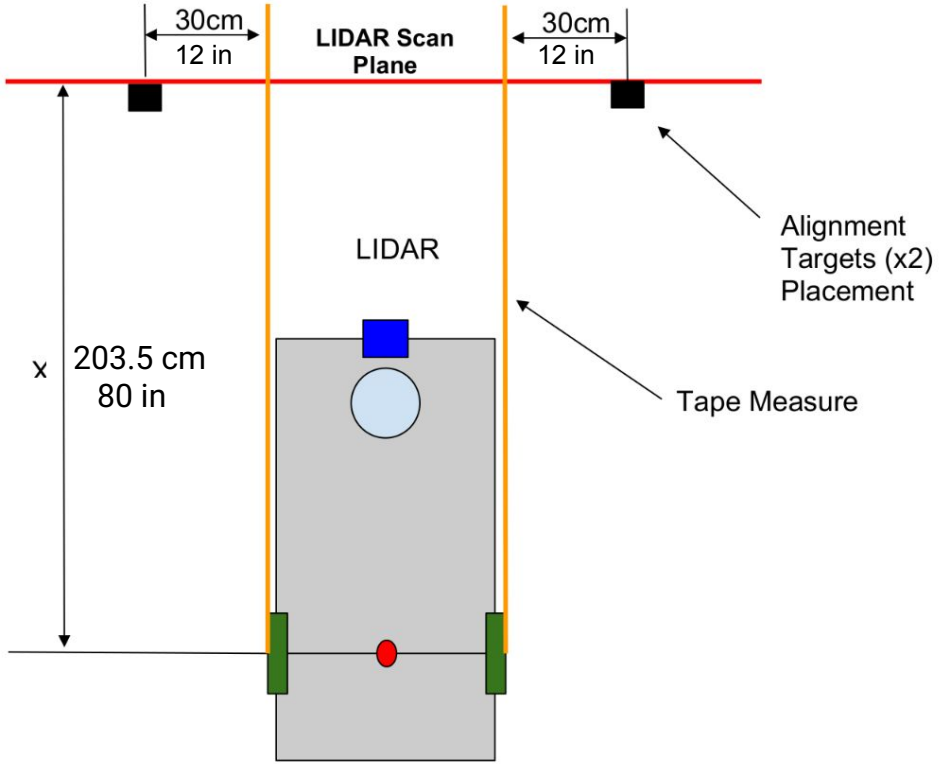
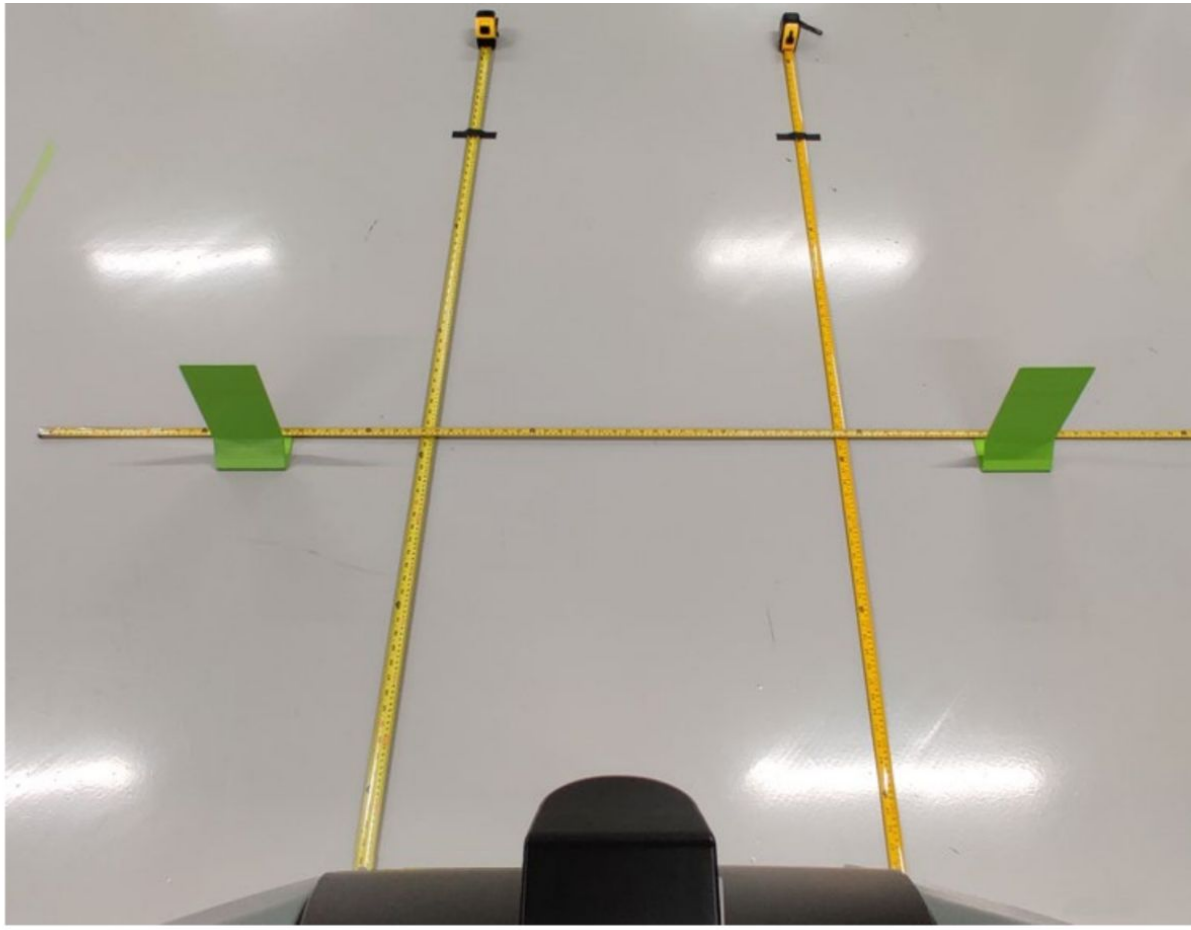


Figure 8: LIDAR scan plane target alignments

NOTE: If the Brain Targets are not available, mark the floor at 200cm/78.75in. The Slanted LiDAR beam can then be adjusted to this mark.



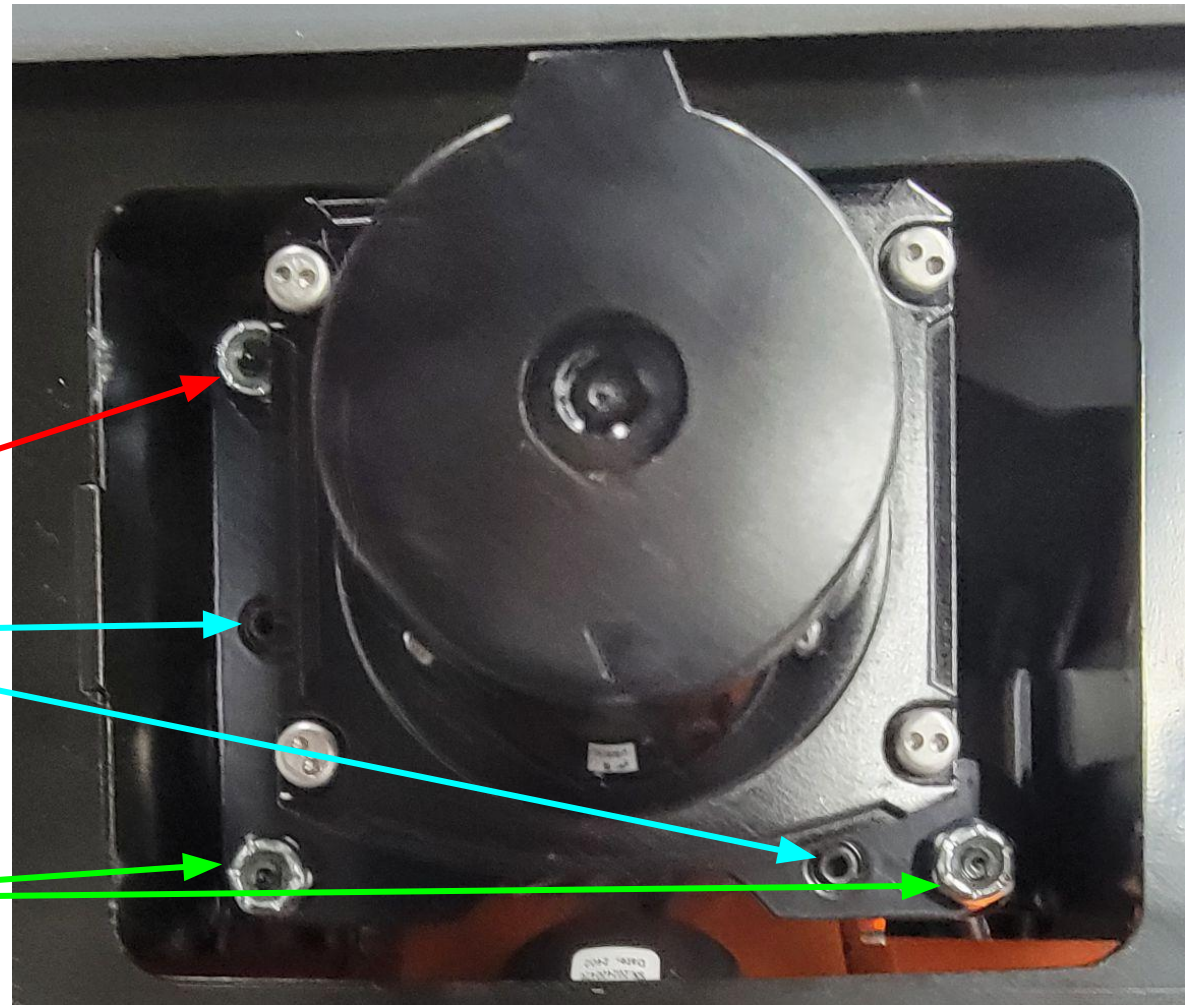
Upper/Slanted LiDAR Calibration

Loosen the Lidar Mounting Plate hold down Set Screws

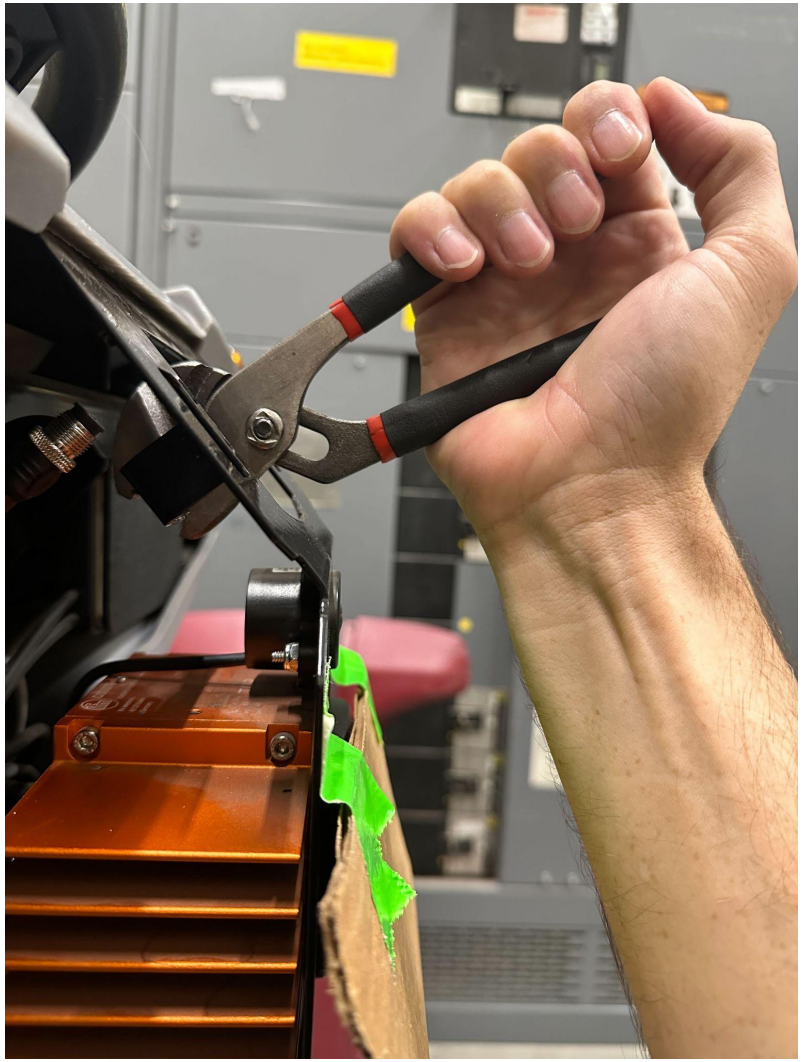
The Top ⅜” Hex Nut is for straight ahead beam height adjustment.

The Bottom Two ⅜” Hex Nuts are for side to side or level beam adjustment.

Snug down the set screws to hold the LiDAR mounting plate in place after beam adjustment.



Upper/Slanted LiDAR Calibration



Adjusting the Slanted LiDAR Beam on RoboScrubs (Without SLAB)

For RoboScrubs that don't have the **Slanted LiDAR Adjustable Bracket (SLAB):**

1. **Manual Adjustment**:
   - The **mounting bracket** can be carefully bent by hand to align the Slanted LiDAR beam properly.
2. **Use Caution**:
   - The bracket is **delicate** and can be easily over-bent. Adjust slowly and carefully to avoid damage.

IR Cameras Calibration

Follow these steps to replace and recalibrate the IR camera:

1. Install a new IR Camera

- **Note**: No alignment is needed for the replacement IR camera.

2. Recalibration Steps

1. Go to:
   - **Service** → Enter the **Service PIN** → Select **Calibration** → Choose which camera - Left, Right or Front 3D Camera - Then select **Teach Route.**
2. Teach and save a new route:
   - Create a new **5-minute route.**
3. Continue with calibration:
   - **Service** → Enter the **Service PIN** → Select **Calibration** → Choose that specific camera again to calibrate.

3. Calibration Times

- **Front IFM Camera**: Takes approximately **18 minutes**.
- **Side IFM Cameras**: Take approximately **8 minutes**.

4. Final Step

- Perform a **power cycle** on the robot after a successful calibration.

ToC

Steering

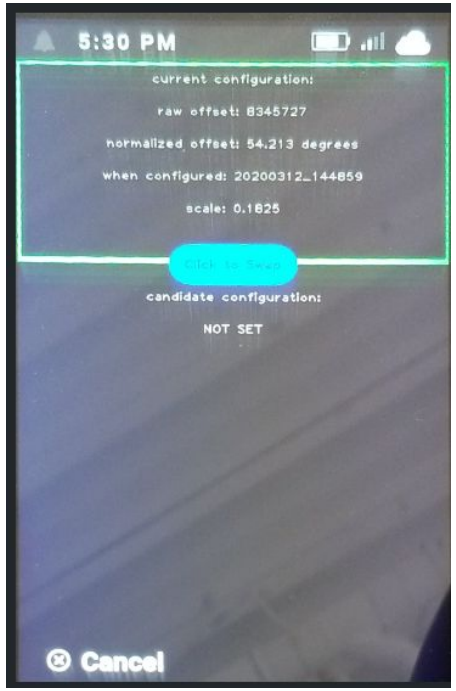
For Diagnosis:
From the Home Screen select **Settings** - **Service** - enter Service PIN - **Diagnostics** - **Steering Angle**. Drive the machine in a straight line. The Green Steering Angle Indicator line should track perfectly straight ahead. If there's any variation, a new Steering Calibration is needed.

For Calibration:
From the Home Screen select **Settings** - **Service** - enter Service PIN - **Calibration** - **Steering Offset**. Check the 'When Configured' date (4th line down) - press the Click To Swap button - check to make certain that the Calibration Candidate is now present at the top of the screen as the Calibration Configuration and outlined in a Green Rectangle. Power cycle the machine for the swap to take place.

If no candidate configuration is set or if the steering shafts (upper and lower) have been separated for a repair, a new steering calibration candidate will need to be formulated.

Create a new 5 minute long map. The map used for a steering calibration should have:
- tight left hand turns
- tight right hand turns
- figure 8's
- long straight runs

The 'When Configured' date should be the date that the steering candidate configuration was created. After installing the candidate configuration, power cycle the machine for the swap to take place.



Steering Calibration screen

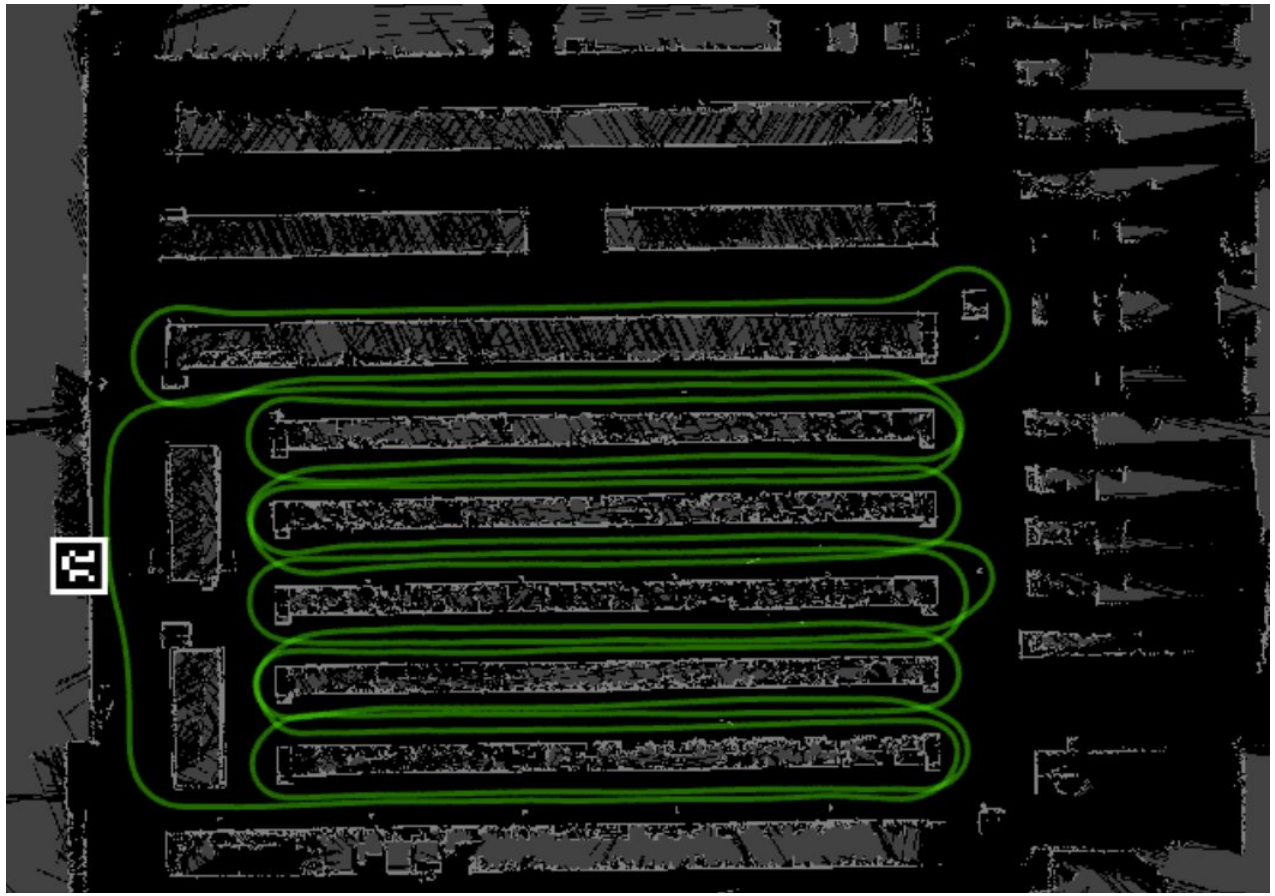
Steering Angle Indicator screen

ToC

Autonomous Routes

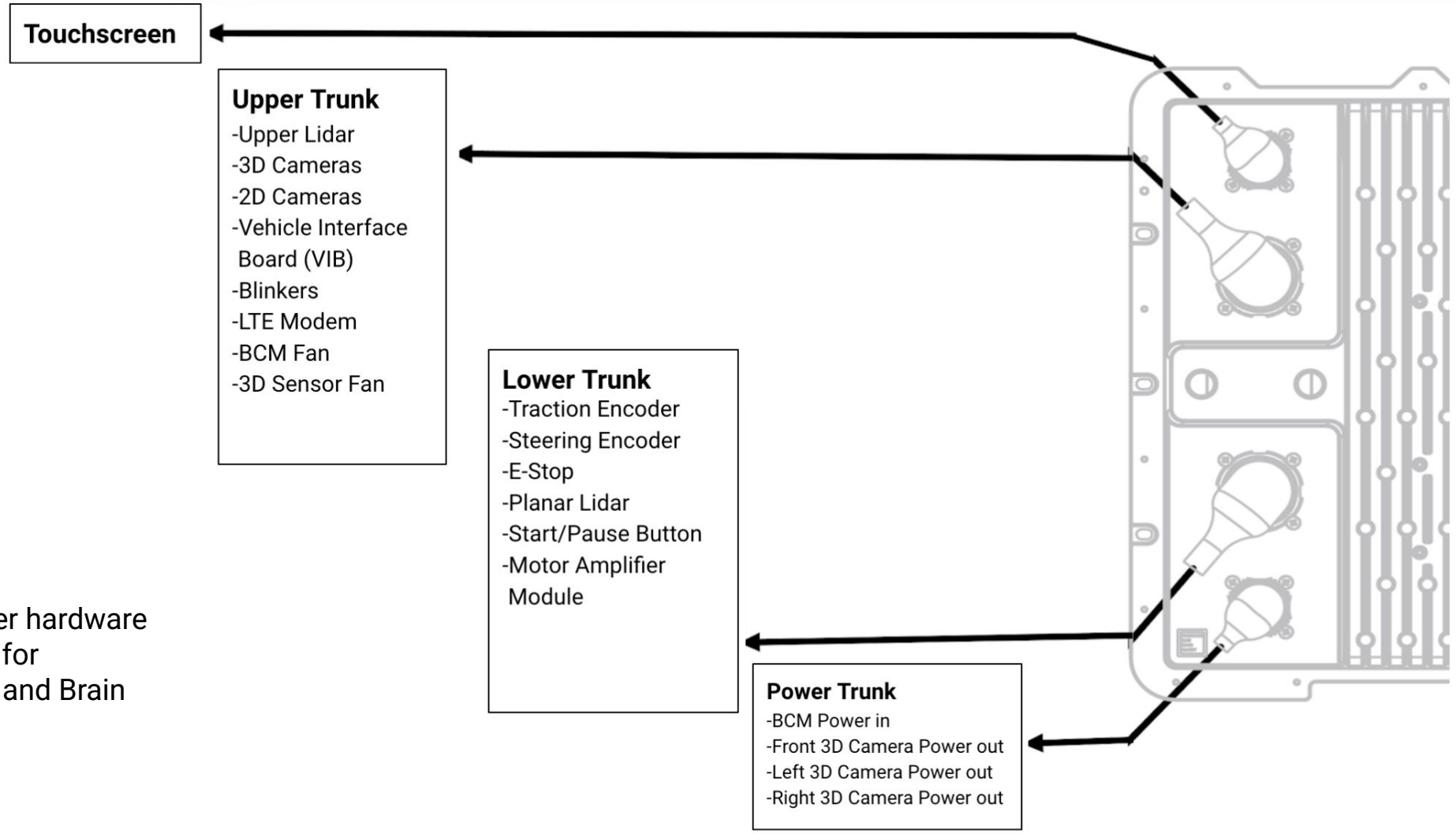
Why are you making an autonomous route?

1. Cleaning -
   - 100% coverage; contiguous path
   - Must Start & Finish at the same Home Marker
   - Best to walk/plan the route first
2. Calibrating -
   - which sensor?
   - Put you Mind's Eye where that sensor is
   - What does it detect or 'See'?
3. Testing -
   - proving autonomy after service
4. Demonstration Purposes
   - to show off the BrainOS navigation and obstacle avoidance capabilities



ToC

BCM - Brain Control Module



The BCM is the computer hardware component responsible for autonomous navigation and Brain Cloud communication.

ToC

BCM - Brain Control Module

Is 24 vdc available at pins 1 & 2 on the Power Trunk?
24 vdc should always be available to the BCM with the battery pack plugged in and the Key switch off.

BCM is turned On by the Key switch.

BCM turns off at 19 vdc

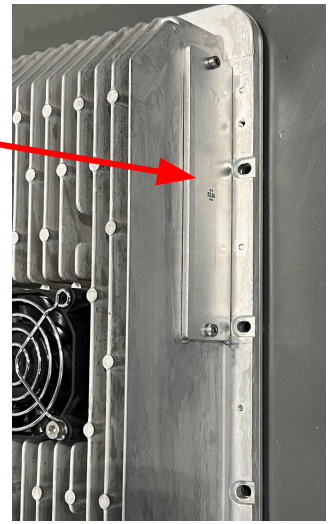
Remove the Side Access Panel to view the BCM LEDs

With 24 vdc to the BCM and the Key Switch off, one LED should always be illuminated

RGxGGGGGG - BCM has passed all self checks and powered up and should be running. The 3rd LED from the bottom is never illuminated.

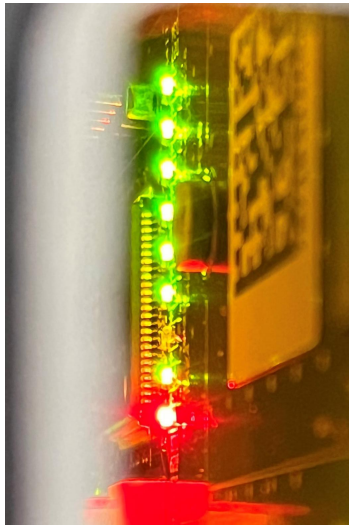
The BCM will need to be replaced if 24 vdc is available and one or more LEDs failed to illuminate.

The BCM Must have the Access Port Cover and Seal Installed.

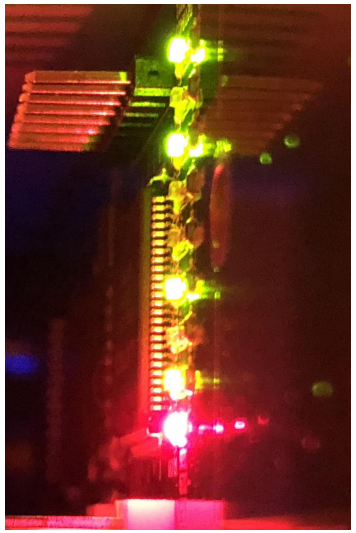


BCM Access Port

Key Switch Off
1 LED Illuminated



Good BCM LEDs



Bad BCM LEDs

Main and PIN Screens

4 Buttons on the Main Screen:

Clean
Teach
Setings
Learn

Clean & Teach will turn on the right side 2D camera.

Security PIN Screen

Either the Operator's PIN or the Service PIN are entered on this screen.

Never give out the SERVICE PIN

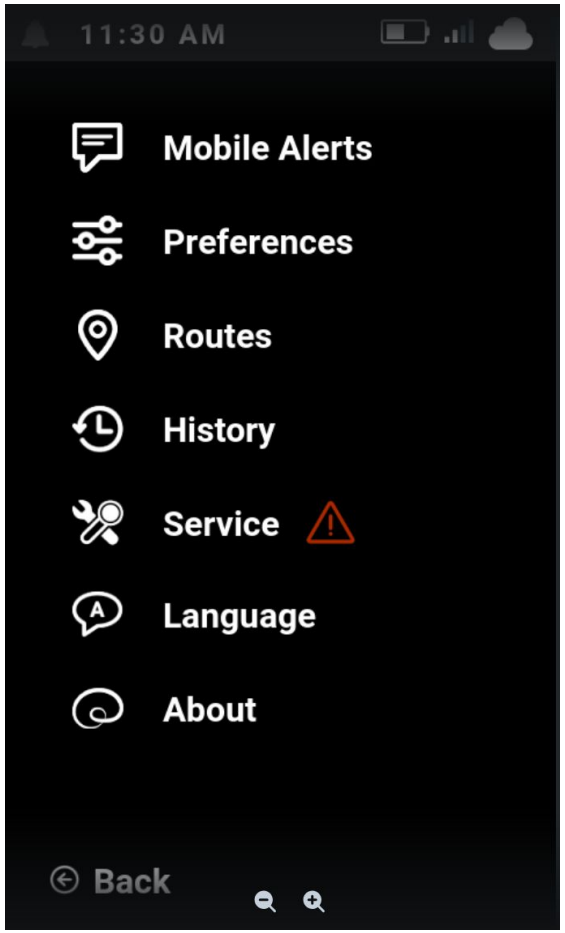
ToC

Settings Menu - Mobile Alerts

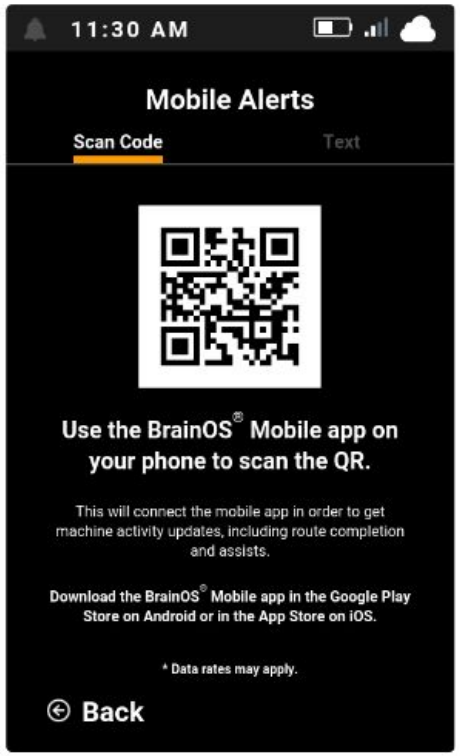
Settings Menu:

Pressing **Settings** in the lower left hand corner of the Main Menu brings up the **Settings** Menu.

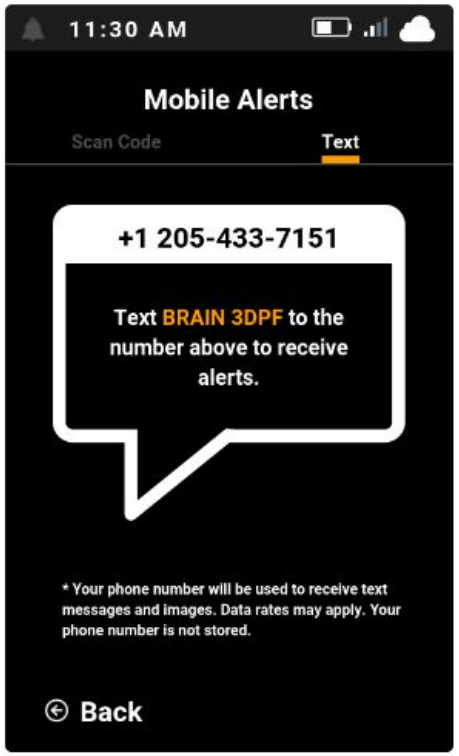
Pressing **Mobile Alerts** will open up one of the three screens to the right.



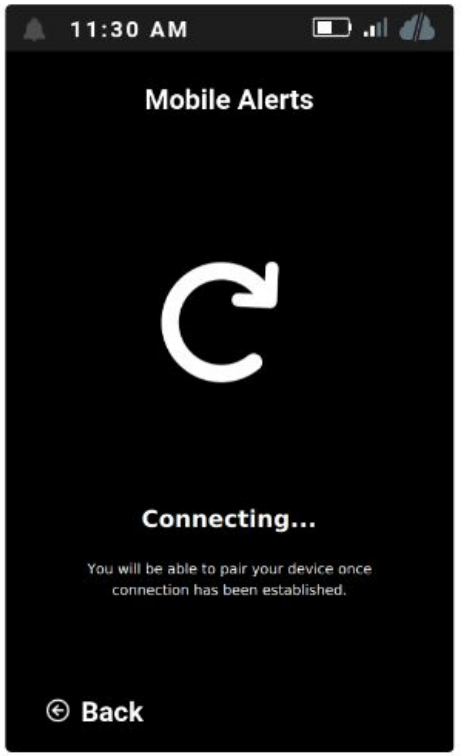
Scan the QR code to download or open the BrainOS Mobie APP



Or select Text and send a text to the robot to be registered for alerts.



This screen appears when trying to connect.



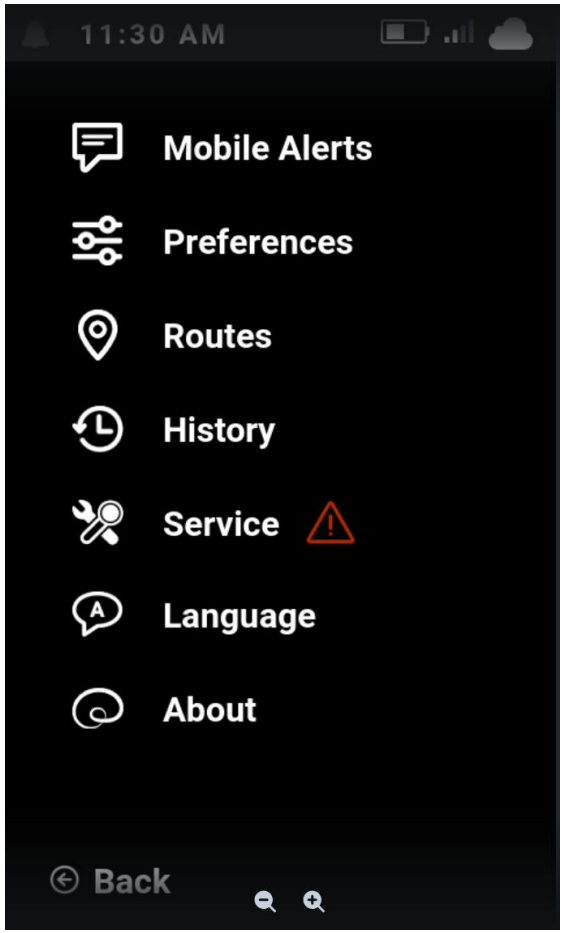
ToC

Settings Menu - Preferences

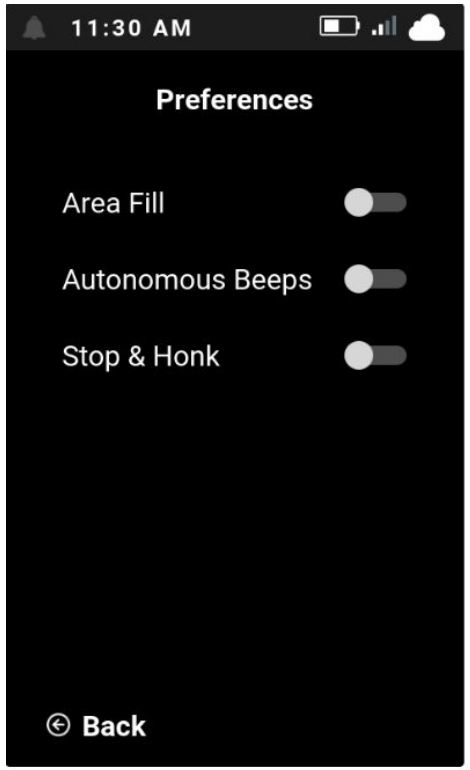
Settings Menu:

Pressing **Settings** in the lower left hand corner of the Main Menu brings up the **Settings** Menu.

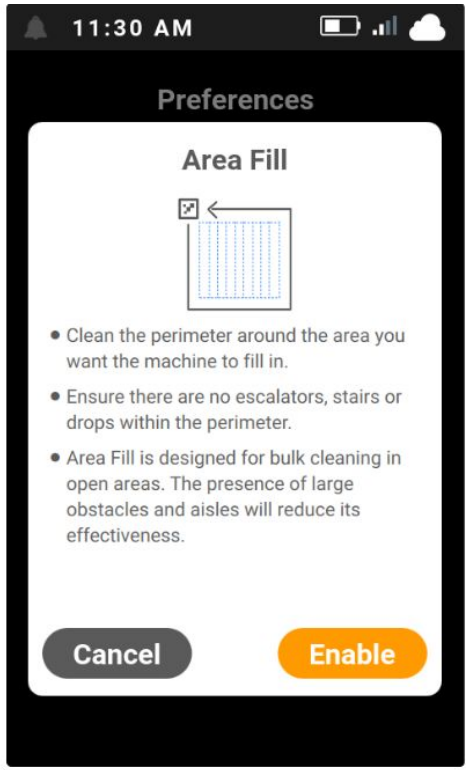
Pressing **Preferences** will open up one of the two screens to the right.



Area Fill, Autonomous Beeping or Stop and Honk can be enabled or disabled on this screen



If Area Fill is enabled, this screen will appear.



Area Fill - Map out the perimeter of an open area you want to clean and the robot will fill in that section.
Autonomous Beeps - The robot will sound the horn at each intersection.
Stop & Honk - The robot will stop and each intersection and sound the horn each time this is selected while creating a cleaning map. Typically for industrial use.

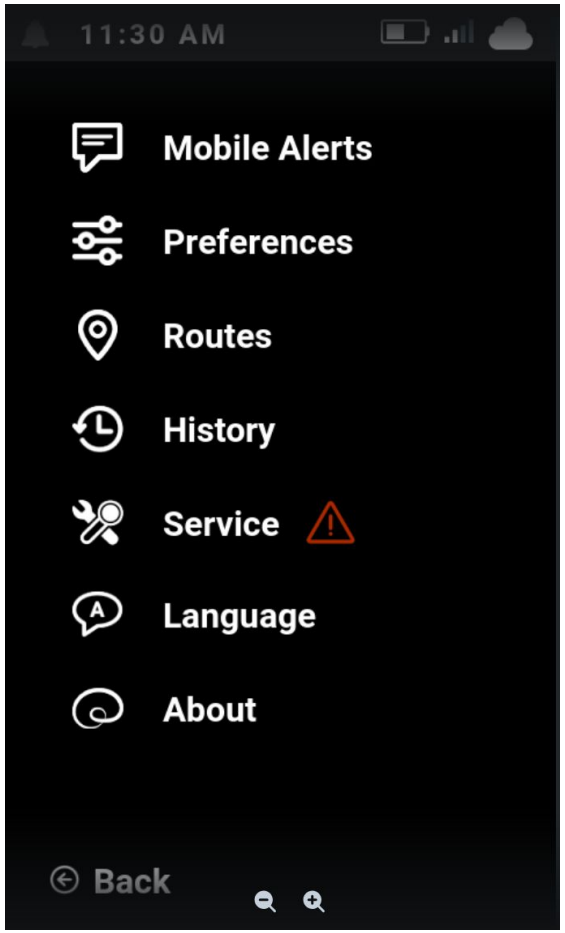
ToC

Settings Menu - About Screen

Settings Menu:

Pressing **Settings** in the lower left hand corner of the Main Menu brings up the **Settings** Menu.

Pressing **About** will open up the About screen.



About Menu:

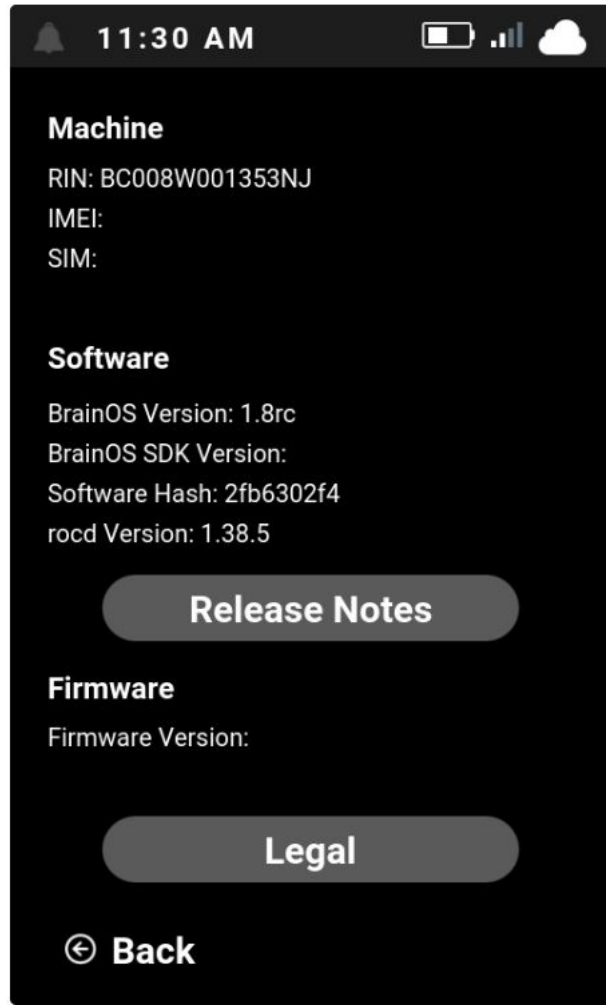
Machine Information

- RIN
- IMEI
- SIM

Software Information

Release Notes

Legal



ToC

Diagnostic Menu

Diagnostic Menu under Service

Planar LiDAR View - invisible zoom in & out buttons, top & center of the screen

Slanted LiDAR View - (jumps around)

Raw Camera Data - invisible buttons on each side of the screen

Side Camera Data - Go/No-Go zones; invisible side buttons

Print Calibration - Calibration Data

Print Parameter Overrides - this an an empty folder

Steering Angle - Green Steering Angle Indicator Line

Control Panel - control panel information

ToC

Calibration Menu

Calibration Menu under Service

Planar LiDAR Yaw - select then press Green button to reset

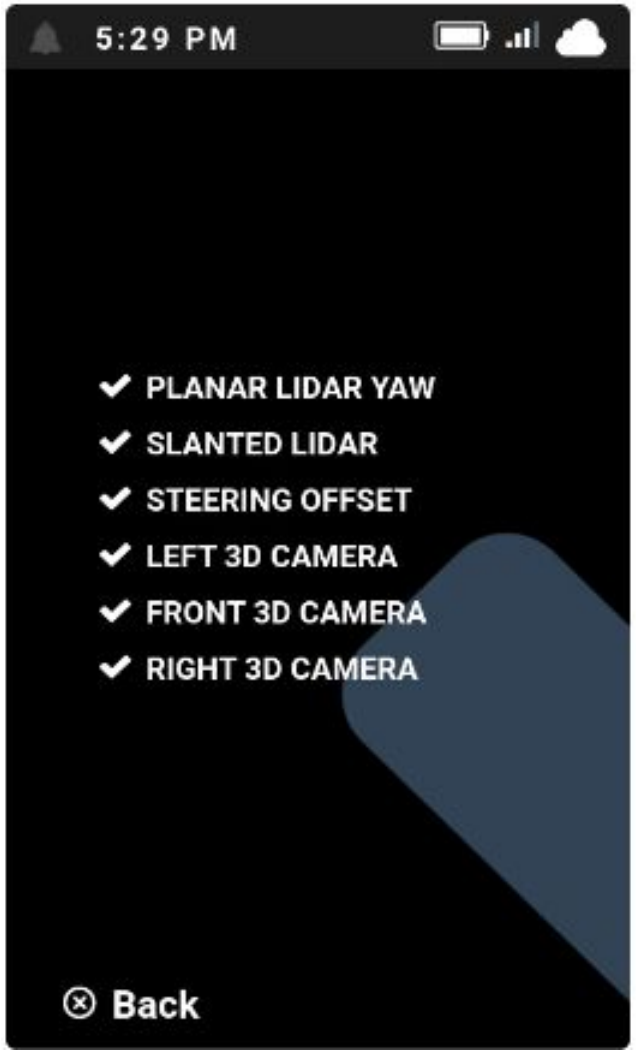
Slanted LiDAR View - select then press Green button to reset

Steering Offset - Current & Candidate calibration configurations

Left 3D Camera - select then press **Teach Route**

Front 3D Camera - select then press **Teach Route**

Right 3D Camera - select then press **Teach Route**

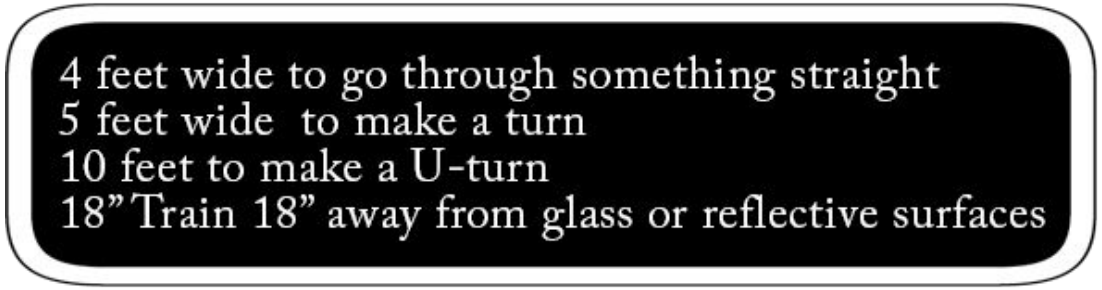


ToC

Autonomous Performance Issues

Assists - Legitimate?

- Environmental
  - Not enough clearance to navigate around a newly introduced obstacle
  - Dangling Objects? Impulse Strips; Pool Noodles; Plant Branches
- Poorly trained routes
  Adhere to Best Practices in the Route Strategy Guide
- Maintain 4-5-10-18”:
  4 feet wide to go straight through
  5 feet for a turn
  10 feet for a u-turn
  18 inches away from highly reflective surfaces
- False Path Blocked
  - Sensor Faults - Dirty Sensors;
  - Lower LiDAR - clear area to anti-tip bars
  - Delocalization - traction drive wheel slippage



Poor performance - Planar and Slanted LiDAR beams properly aimed?

ToC

RoboScrub 20

Parts Manual

Eight pages of electrical schematic for the RoboScrub 20 are available towards the back of the Parts Manual

Minuteman®
Excellence Meets Clean

ToC

Technical Support Assistance

A service ticket MUST exist before phone assistance can be supported.

To create a service ticket, email: oem.support@braincorp.com

Minuteman can also open Service Tickets via the Partner Portal

- Include machine type, site location, store number (if applicable),
  RIN (Robot Identification Number),
  a description of the issue, contact name and contact phone number

Phone Support: 844-809-5543

Normal support hours are between 5AM – 5PM PST, Mon-Fri

ToC