

Planar LIDAR Calibration Procedure

Tools needed:



A. Painters tape, electrical tape or similar

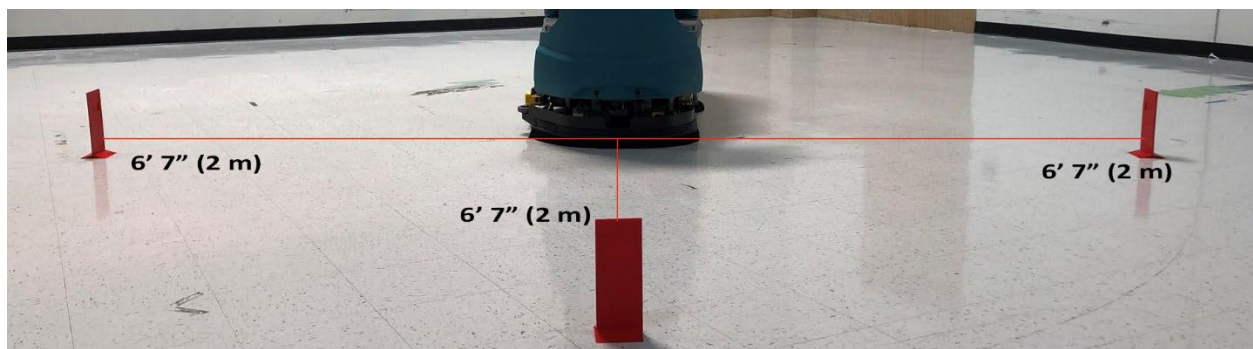


B. 1.5 HEX key



C. Calibration kit

1. Park the machine in an open space with at least 1.5 meters of distance straight ahead from any wall or objects and 1 meter on either side. The floor must be level throughout this area. Avoid floor areas with visible damage, holes, slopes, steps, etc.
2. Cover the front 3D camera with painter tape, electrical tape, or similar. (shown to the right)
3. Align the scrubber to LIDAR targets. The LIDAR to target distance is 6' 7" (2 m) as shown below:

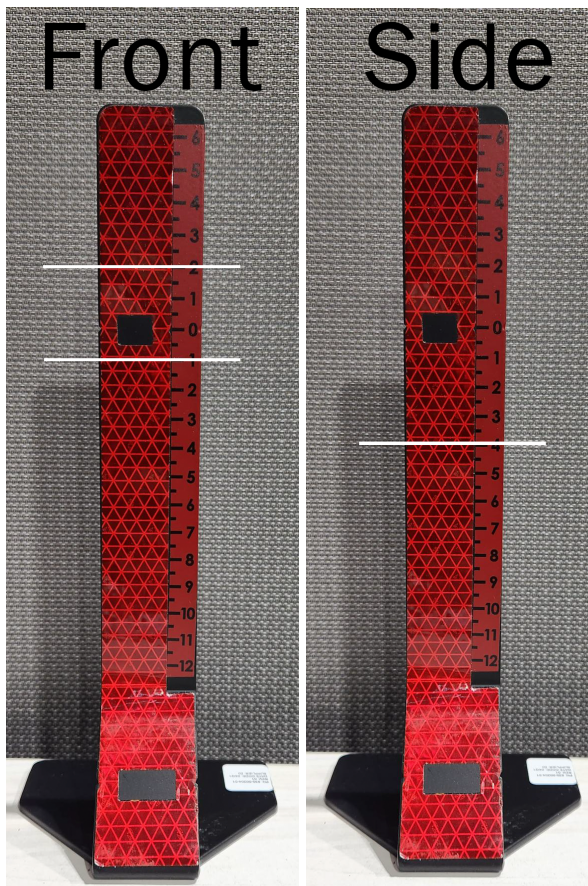


4. If you can, turn off the lights (the lidar beam is easier to see in the dark)
 5. Kneel next to the machine and get level with the targets, so you can view the beam.
- Turn on the IR goggles and press the IR + button (shown below)



TIP:

If you are unable to turn the lights off you can get a cardboard box and hold it above you to block the overhead lights to create a light tunnel for the lidar beam.



Ensure that the beam is within acceptable range on the target

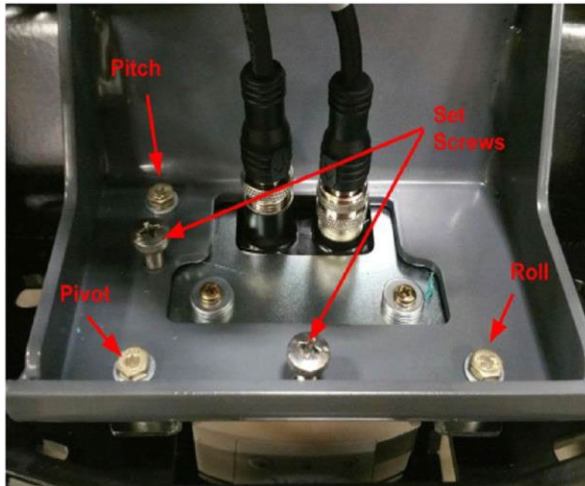
- The beam on the front target must be within acceptable range 17cm to 20cm (top black box)
- The side beam values must be above 14 cm (13.5 cm is the absolute lowest value.) The most important thing is that the beam is LEVEL and values match on both sides.

If the beam is NOT within the acceptable range, perform the Beam Alignment Procedure below.

If the beam is aligned proceed to the section “Lower LIDAR yaw field calibration”

Beam Alignment Adjustment

1. Using a 1.5 mm hex key, rotate the two set screws counterclockwise just until it is no longer touching the bracket.
2. While watching the beam with the IR goggles, pick ONE screw to loosen either the 'Pivot' or 'Roll'.
3. Loosen/tighten the screw until the LIDAR beam is within the acceptable range.
4. Once the beam is within the acceptable range, tighten the set screws while watching the beam. When the beam starts to move STOP.

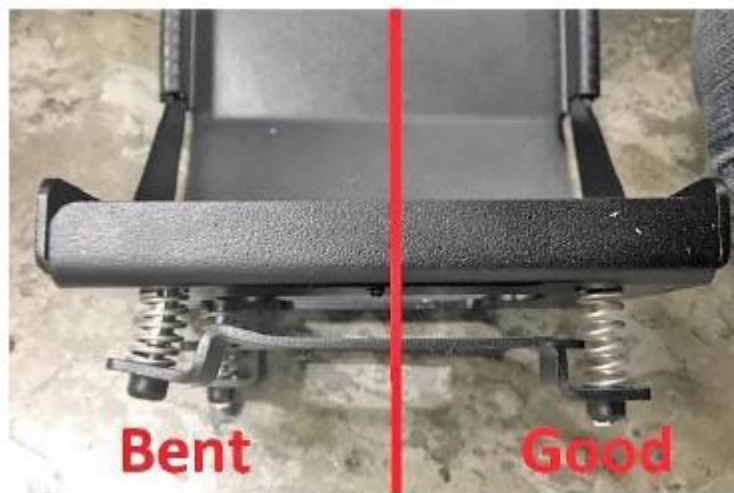


TIP:

Keep the beam towards the high end of the acceptable range, because when you tighten the set screws the plate will adjust down.

NOTE: The Pivot and Roll screws adjust the level of the beam. The Pitch screw adjust the height of the beam. First, get the beam level on both side targets (above 14cm). Then adjust the Pitch screw only if needed.

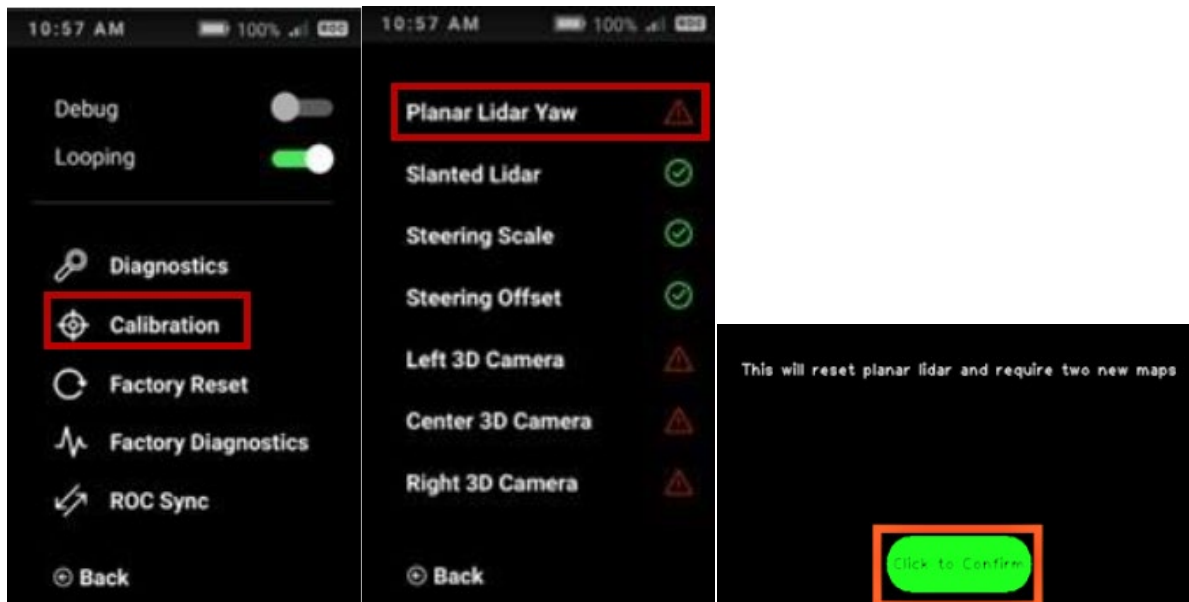
NOTE: If you can't get the beam high enough, then most likely the plate is bent and not at a 90-degree angle. You can use a square ruler to check and see if it is bent. You can tap it back into place using a rubber mallet.



Lower LIDAR yaw field calibration

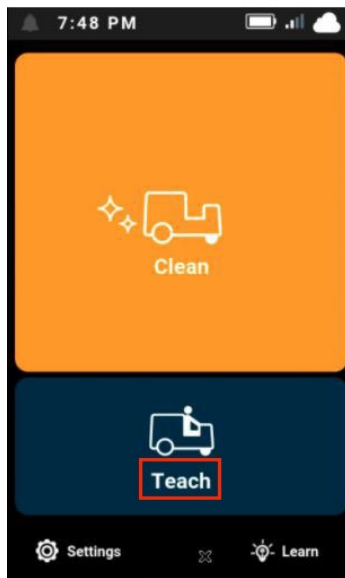
After you have aligned the beam follow these steps:

1. On the machine, select **Settings > Service** from the BrainOS main menu.
2. Enter the 4-digit service PIN (this is different than the user PIN used for the user menus).
3. Select **Calibration > Planar LIDAR Yaw > Click to Confirm**



You will be prompted that there are not enough maps to perform the calibration. **This is expected**. Select **Back** several times to return to the Main Menu so you can train two new routes.

From the Main Menu Select **Teach Route**



Train and save **two** routes that are each at least **10 minutes** in length. Use the following guidance to optimize these routes for the subsequent field calibration:

- Routes should be trained along straight vertical solid walls and corners, both concave and convex.
- Run close to walls and corners (1-4 feet away) in both directions.
- Avoid open spaces.
- Avoid irregular/dynamic environments such as areas with foot traffic, chairs, desks, and open shelves.
- Slower speeds work better but you do not have to slow to a crawl.
- When saving the routes, use a new empty route every time to avoid overwriting a production route or the other trained route.

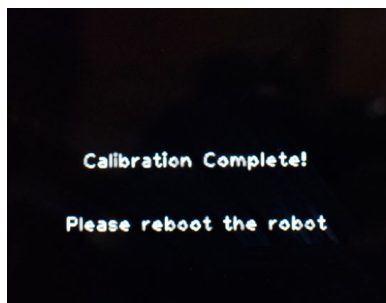
After training and saving both routes, **Select Settings > Service > Calibration > Planar LIDAR Yaw**

The screen request to use the last maps made after a reset, click **Confirm**.

The auto calibration will run and show the screen below.



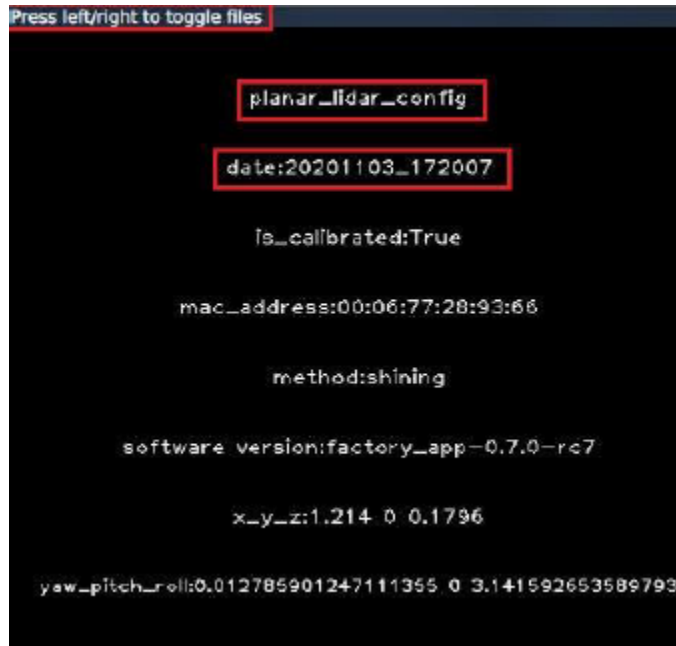
If calibration is successful, you will see Calibration Complete! Please reboot the robot. Key off the machine, wait until the machine completely shuts down, and key the machine back on to complete the reboot.



Post-calibration Photos, Test Route and Obstacle Avoidance Tests

1. Select the Settings -> Service-> PIN Code -> Print Calibration
2. Press the left or right side of the screen until the applicable file for the LiDAR you just calibrated is shown **planar_lidar_config** or **slanted_lidar_config**

NOTE: There are invisible buttons on the sides of the Print Calibration screen. Keep pressing different parts of the left or right side of the screen until it changes to show the applicable LiDAR Config.



3. Photograph the screen and verify the calibration date is today's date

Planar_lidar_config showing the calibration method and date BEFORE performing the calibration

Planar_lidar_config.yaml showing the calibration method and date AFTER performing the calibration

Test Route and obstacle avoidance tests

1. Run one of the routes that was created during field calibration or one of the production routes. Ideally chooses a route with walls or shelves on both the right and left side of the machine.
2. Position yourself in front of the machine with no room to navigate around you. Ensure that it slows down when approaching then stops.
3. Approach the front of the machine from each side and ensure that the machine stop when you step in front of it.
4. Place a stationary obstacle with a height of 5" and a diameter of 2.5" (such as a standard 12-ounce soda can or a 14 oz canned food item) at least two meters in front the path of the machine and verify that the machine drives around the obstacle. Note that this obstacle must be shorter than the Lower LiDAR beam which is at 7".

Troubleshooting

The following issues may be encountered during Lower LIDAR beam alignment:

- The beam cannot be seen: Use a box to shade the targets. Initially move the targets close until you can see the beam or find a spot with less ambient light.
- The beam appears split into two narrow beams, with a small gap between them: This is normal.
- The sides cannot be adjusted to be within the nominal range: This is normal. Only the front needs to be within the nominal range (17 cm to 20 cm). The sides must be equidistantly away from the nominal range (in other words, their values should match), and must be above 14 cm(13.5 cm is the absolute lowest value).
- Turning the adjustment screws does not move the beam: Push on the center of the plate with a finger or loosen/tighten the set screws during the procedure.
- The beam moves when tightening the set screws: This is normal. Fine tune the adjustment screws as the set screws are being tightened.
- Many rotations are needed on one or more of the adjustment screws (more than 8 full rotations), or the sides can't be adjusted to be equal: Inspect the brackets for damage or bent parts.