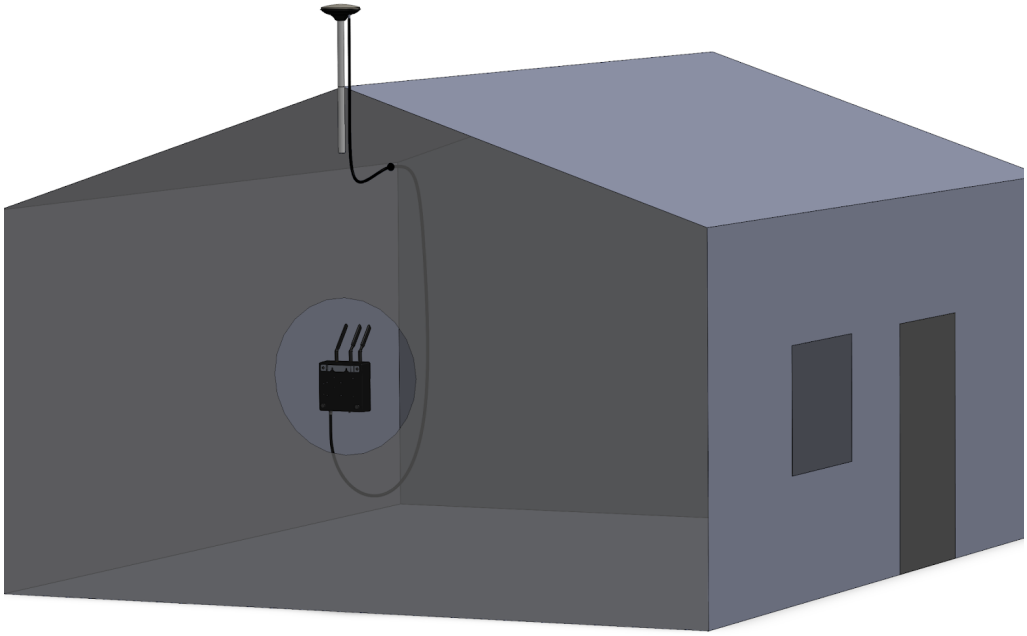
TinyMobileRobots

Reference Station Setup Guide



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Before you begin

This guide describes what a Reference Station is, how to set it up and how to configure it using the TinyLineMarker software.

Description of TMR Reference Station

The purpose of the TMR Reference Station is to monitor and assess the quality of the GNSS signal at a fixed position. This monitoring enables the creation of a relative correction signal, which is then transmitted to a GNSS rover. By utilizing this correction signal, the atmospheric disturbances affecting the GNSS signals can be corrected, leading to enhanced accuracy in GNSS positioning. Once installed the TMR Reference Station is a permanent installation and should, as a rule, not be moved.

One of the advantages of using the TMR Reference Station is its convenience for maintenance purposes. The TMR Reference Station consists of separate components, such as the Reference Station box and the antenna. This design allows for easier access to the Reference Station box, facilitating tasks like rebooting or performing software updates when necessary.

The following equipment is in the box

1x Reference Station Setup Guide
1x Antenna cable - 10 metres
1x Reference Station box including Data SIM card (installed in the Reference Station)
1x GNSS Antenna
1x 220/110 v power supply
1x Mounting kit - screws and brackets
1x Mounting kit - 3x GNSS rods 25 cm.
1x Power plug (EU/UK/US/AUS/CH depending on your region)
1x Bag with antennas - 2x 4G/5G antenna and 1x Bluetooth

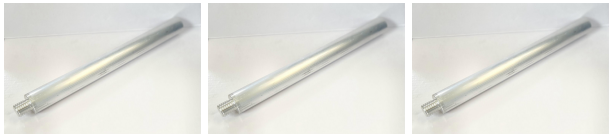
Mechanical and electrical installation

A mounting kit is delivered with the Reference Station. This kit contains a basic set of mounting items; alternative mounting options should be researched by yourself (e.g. equipment for satellite discs or pipe mounting).

In the subsequent descriptions, please read how to mount the Reference Station using the supplied mounting kit and which electrical parts to be aware of.

Mounting kit

The mounting kit consists of the following:

3x 25 cm rods with ⅝” thread	
4x Ø25 mm pipe holder pieces	
2x Mounting plate	
4x M6x30mm bolt	
4x 40 mm screw	
4x 45 mm spacers	
4x 90 mm screw	
2x 40 mm screw (box wall mount)	

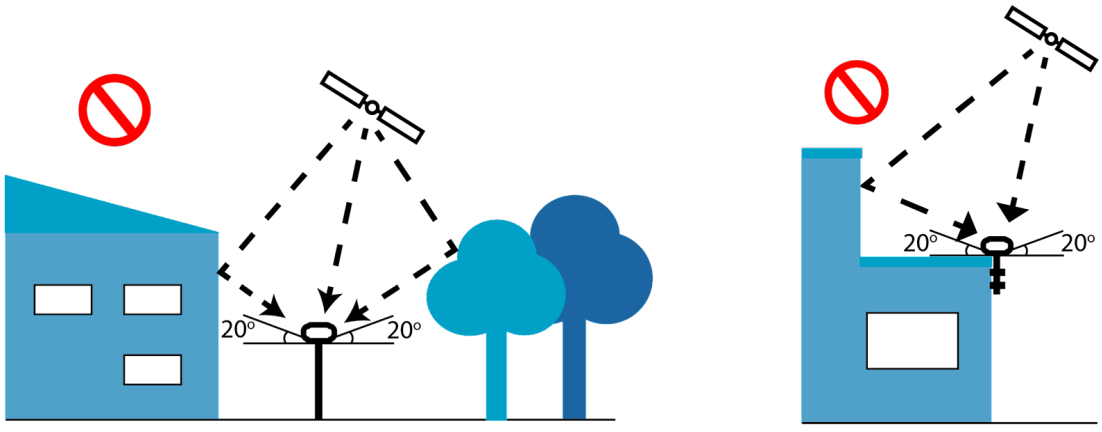
How to setup your Reference Station

Location guidelines

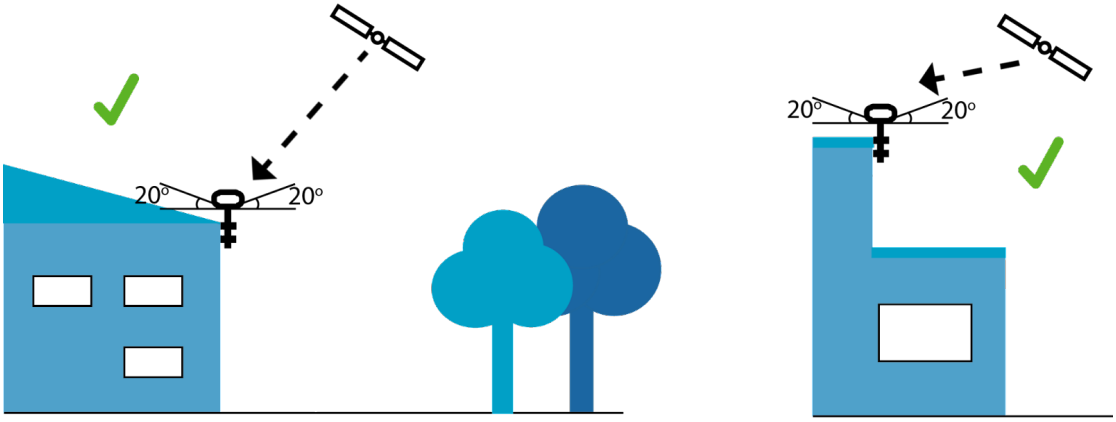
Important: Finding the right location

To get the best performance of the Reference Station, the location needs to be correct.
The location for the Reference Station needs to fulfil these requirements:

- Clear view to the sky.
- No obstacles sticking up more than **20 degrees** from the horizontal line (see illustrations below for a description of a good and bad location).
- **Maximum 20 km** away from the area where the robot should work.
- Easy access to the location of the box. In case a restart of the Reference Station is needed, this is done pressing the ON/OFF button on the Reference Station.
- Maximum operating ambient temperature is 40 celcius.
- The Reference Station box must not be above 2 metres from the ground.



*Two illustrations of **bad** locations for the Reference Station. Satellite signal will reflect off buildings and trees, which decrease the accuracy*



*Two illustrations of **good** locations for the Reference Station. No buildings or trees are above the 20 degrees limit, which gives best possible accuracy*

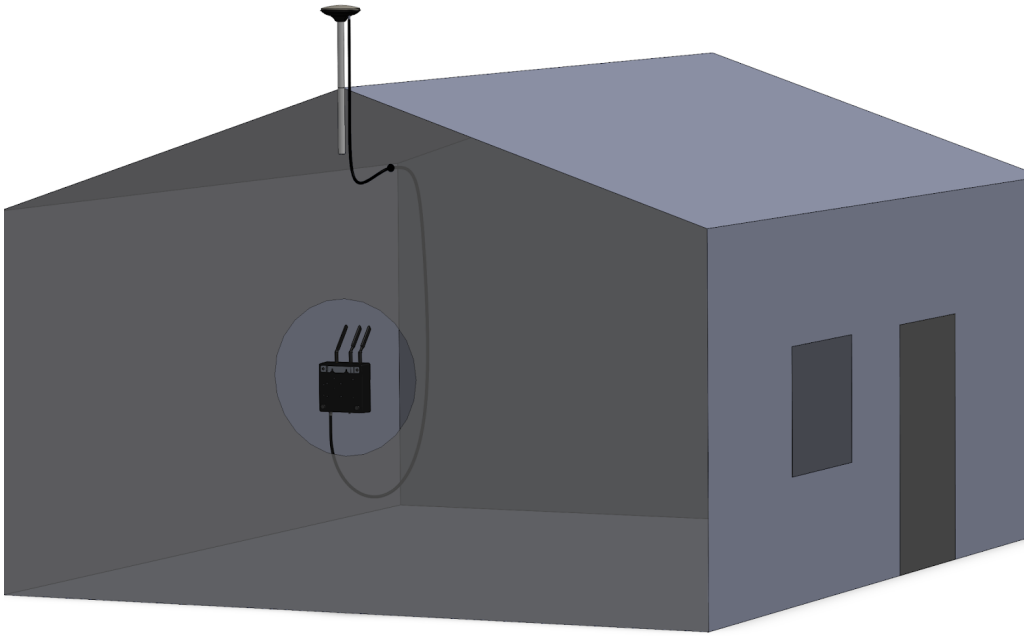


Illustration of completed installation. The Reference Station antenna is mounted outside on top of the building and the Reference Station box is mounted inside. The two components are connected using the antenna cable

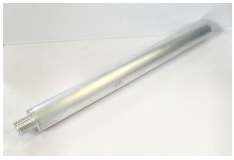
Installation guidelines

Indoor components

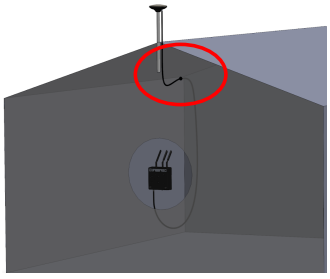
One power supply and one EU/UK/US/AU/CH plug are delivered with the Reference Station. **Important note:** The power supply is not waterproof and should be placed indoors or protected with a waterproof cover!

One Reference Station box including all electronics (GNSS, Modem, etc.). **Important note:** The Reference Station box is not waterproof and should be placed indoors or protected with a waterproof cover!

The following guide describes how to install the Reference Station and set it up with the TinyLineMarker software. The section “Location guidelines” contains important instructions which should be read and understood before installation of the Reference Station.

Step 1 Screw the 25 cm pole onto the Reference Station antenna. **Note:** 3 x poles are included – these can be connected to extend the length.	 
Step 2 Fasten the two mounting plates with the 40 mm screws. The mounting plates should be placed on a vertical line. **Note:** 45 mm spacers are included. These can be used to get past roof tiles etc. If these are used, mount the plates with the 90 mm screws.	

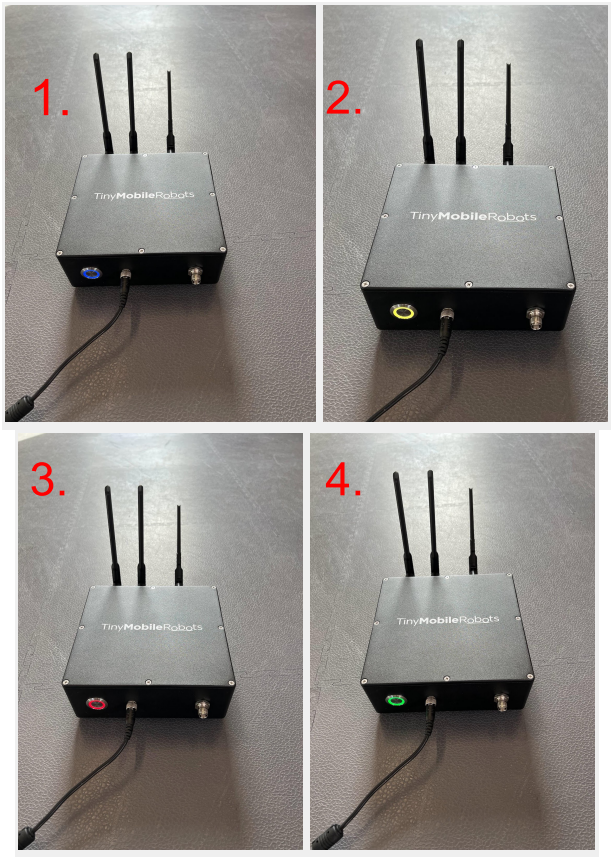
Step 3 Use the four pipe holder pieces and M6x30 bolts to fasten the 25 cm pole(s) to the mounting plates.	
Step 4 Mount the Reference Station antenna in a fixed position where it has a clear view to the sky, e.g. on top of a building, on a roof or on a pole. **Note:** The Reference Station antenna must not be moved from this fixed position!	
Step 5 Mount the Reference Station box indoor. It is designed to be mounted on a wall to avoid the risk of water and other things hitting it. Remember to fasten the antennas. **Note**: The Reference Station box is NOT waterproof and direct contact with water (rain etc.) must be avoided.	  

Step 6 Connect the antenna cable to the Reference Station box.	
Step 7 Connect the antenna cable to the Reference Station antenna. **Note**: To connect the antenna cable from the Reference Station box to the Reference Station antenna, you need to run the cable from indoor to outdoor. Therefore you need to use an existing hole in the wall, drill a new hole or contact an electrician to do it.	 
Step 8 Push the power plug into the socket as shown. **Note**: <u>DO NOT</u> twist the plug when mounting or dismounting it! **Note**: The power supply is NOT waterproof and direct contact with water (rain etc.) must be avoided.	 

Step 9

1. Push the power button to turn on the Reference Station. The light will start with a blue solid light.
2. After a few seconds it will flash yellow until everything is ready. It can shortly flash red if it encounters errors, but will try and resolve the issue itself within a few seconds.
3. If the light flashed red for more than half a minute, go to Error handling [Page 16 & 17].
4. If the light flashed green, go to the next step.

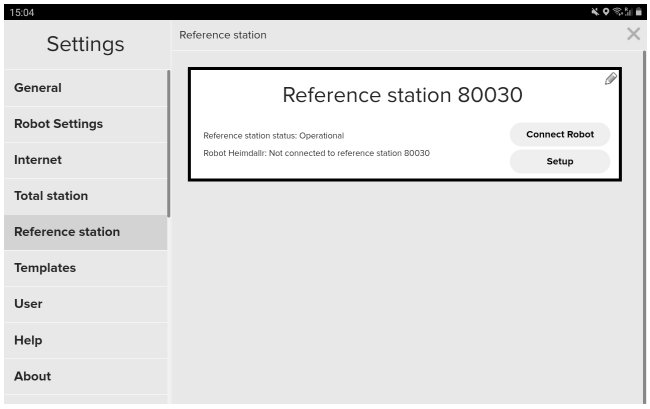
The Reference Station will try and set up everything by itself but if it encounters errors, the light will flash red.



Regular start-up sequence of the Reference Station box after turning it on

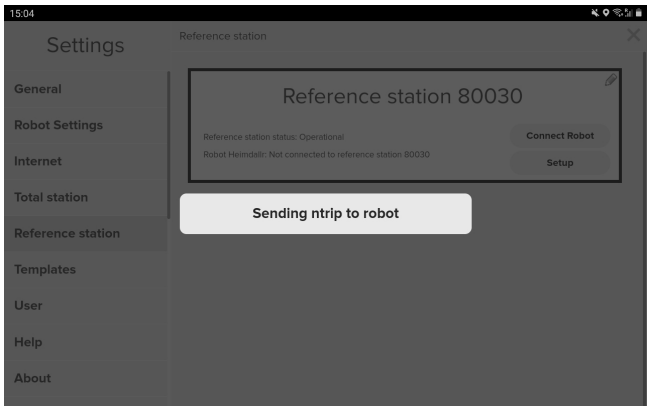
Step 10

When everything is working, you should be able to see an operational status in the Reference Station overview on your tablet under *Settings → Reference Station*.



Step 11

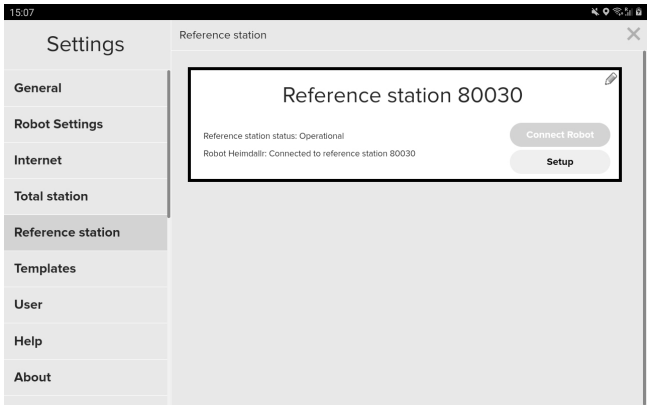
When connecting the robot to the Reference Station, you have to press the Connect button on the screen seen in step 10. When connecting, an info box will show while the tablet configures the robot to use the Reference Station.



Step 12

After successful setup, the second status line will say that your robot is connected to the Reference Station and the Reference Station is operational.

DO NOT TURN OFF the Reference Station!



Additional information

- The Reference Station can be used for all TinyLineMarker robots from TinyMobileRobots.
- Setting up the Reference Station is only required when it is installed the first time, or if the Reference Station is moved to another fixed position.
- Connecting the robot to the Reference Station is only needed the first time after the installation, or if the robot needs to switch to another Reference Station.
- If it is necessary, for some reason, to move the Reference Station it is important to turn it OFF. After the move, it might be necessary to redo any saved fields.
- Advanced settings are available in the setup menu (Settings → Reference Station → Setup). These are not needed for normal operation. Options are:
    - Set modem APN
    - Set modem Operator
    - Set WiFi
    - Additionally internet status can be seen in the advanced settings menu.
- The setup of the Reference Station is recommended to be performed by an electrician.
- It is recommended to look into Lighting Protection Systems (LPS) when setting up the Reference Station with the purpose to reduce the risk of lighting hitting the antenna, thereby entering the structure and electricity in the box. As an example, an air termination system can be applied for LPS. This is done by placing a lighting rod higher and nearby the antenna and ensuring it to be connected to the ground. The lighting would then hit the lighting rod instead of the antenna, as lighting will always seek to travel the shortest distance to the ground.

Information about Reference Stations

The Reference Station provides a correction signal to the GNSS receiver of the robot. The correction signal is also called an RTK signal. The RTK signal is needed to obtain cm precision with a GNSS receiver. The RTK signal is therefore crucial for the robot to mark lines precisely. If the Reference Station is not continuously sending an RTK signal to the robot, then the robot will no longer be able to operate.

A Reference Station is a GNSS receiver fixed to a position. The Reference Station needs a clear view to the sky to be able to receive signals from all the satellites, i.e. no trees, buildings or other obstacles should be between the Reference Station and the sky. The more satellites the Reference Station sees, the better the robot accuracy gets.

A Reference Station needs to be fixed to a position at all times. All corrections that the Reference Station is sending out are relative to its fixed position, i.e. if the Reference Station is moved one metre from the fixed position, then all corrections will be moved likewise and the robot will not mark as expected.

Information about correction signal (RTK signal)

The robot can receive an RTK signal from either a single Reference Station or from a network of Reference Stations. The difference between the two set-ups are listed below:

RTK from a single Reference Station (this guide):

- First time installation needed.
- Fixed installation, install it and forget it.
- Robot can operate within a limited area (max 20 km/12 miles from mounting position).
- Supports more satellites (GPS, GLONASS, BEIDOU, GALILEO).
- Not suited for robots used at multiple locations (e.g. service providers).
- Suited in case of bad connectivity to RTK providers.

Troubleshooting

The below table lists awareness points, if the installation is not successful.

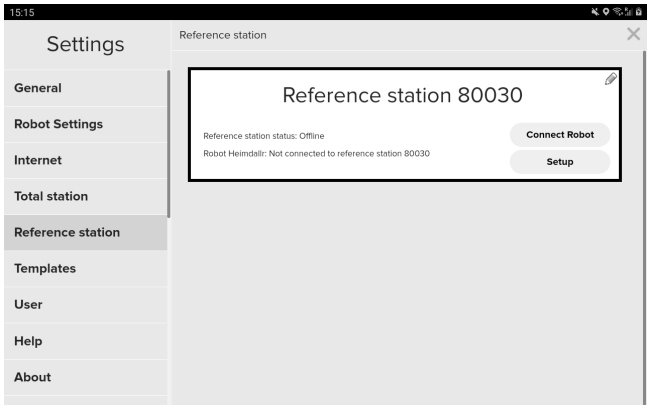
Symptom	Possible cause	Possible solution
Cannot turn ON	Power on Reference Station	Check if power cables and power supply are correctly connected. Check that the Reference Station is turned ON; the icon on the Reference Station will light up.
Cannot get a good fix. Keep getting float fix on the tablet	Number of satellites	If the Reference Station has been turned OFF, wait about 2-3 minutes after it has been turned ON, before using. This allows the Reference Station to discover as many satellites as possible.
Some or all lines has been moved/offset	Mounting the Reference Station	Check if the Reference Station antenna is still correctly mounted or have moved in any way → correct the setup and try again.
ON/OFF button flashing red	-Sim card APN -Network provider -WiFi	Go to Error Handling on the next page. 

Troubleshooting of installation process

Step 1 - Error handling - Reference Station status: Offline.

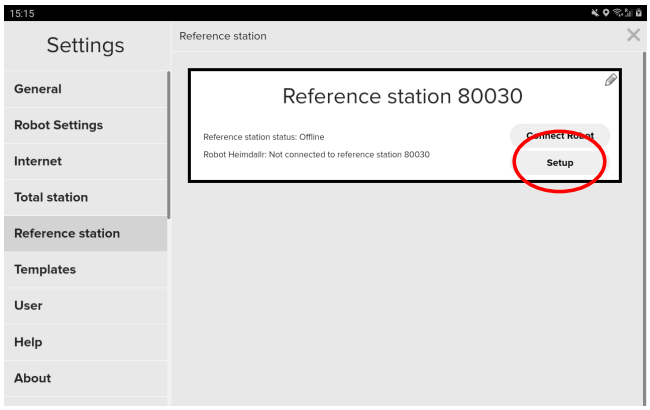
Go to *Settings → Reference Station* in the TinyLineMarker app.
The Reference Station should show up here.

Note: Multiple Reference Stations can be shown simultaneously.



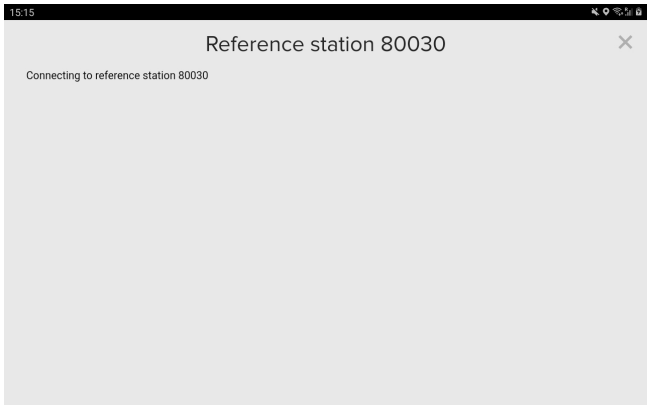
Step 2

In order to show the advanced settings, you have to press the Setup button.



Step 3

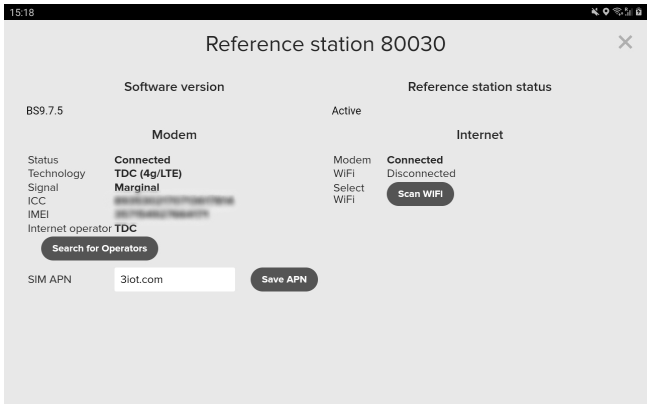
The tablet will try to connect to the Reference Station via Bluetooth.
Please be in range of 20 metres from Reference Station for best success.

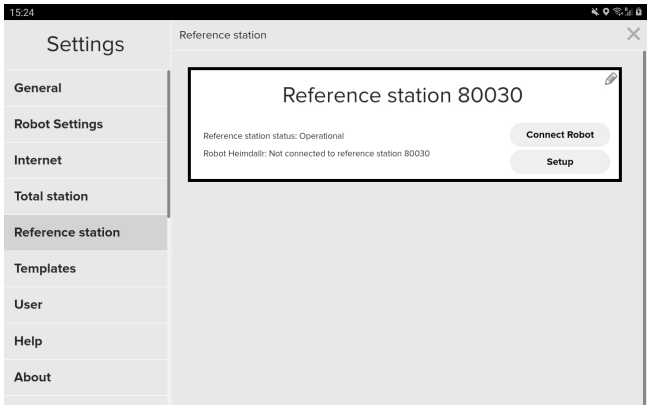
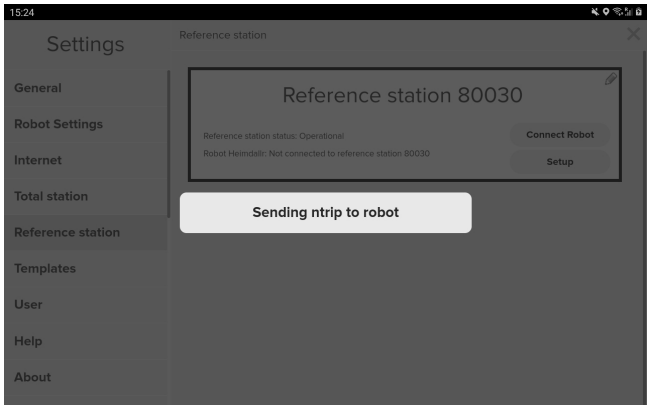


Step 4

From here, different setup options can be configured.

- Sim card APN
  With our sim card i.e., 3iot.com
- Network provider
  Press search for operator or select operator
- WiFi
  Press scan WiFi and choose



Please adjust to best fit the needs. When done, close the screen in the top right corner.	
Step 5 When everything is working, you should be able to see an operational status in the Reference Station overview.	
Step 6 When connecting the robot to the Reference Station, you have to press the Connect button on the screen seen in step 1. When connecting, an info box will show while the tablet configures the robot to use the Reference Station. After successful setup, the second status line will say that your robot is connected to the Reference Station and the Reference Station is operational.	

Error handling Reference Station