



REACH RS2/RS2+

USER DOCUMENTATION

Firmware version **31.8**

Emlid Flow app version **10.6** or newer

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1 Before you start

1.1 Power supply

1.1.1 Battery

Reach RS2 and Reach RS2+ have a built-in LiFePO4 battery providing up to 22 hours of autonomous work when logging data and up to 16 hours as a 3.5G or LTE rover, respectively.

1.1.2 Charging over USB

You can power and charge your Reach RS2/RS2+ over a USB-C cable using power supplies like:

- Power bank
- USB wall adapter

1.1.3 Powering from external connector

Reach RS2/RS2+ can automatically turn on when the power is supplied to the device via an external 9-pin bottom connector with a voltage in the range from 6 V to 40 V. You can enable this feature in the Emlid Flow settings.

To charge the receiver 5 W is required. To operate the receiver, 7.5 W on average is required (10 W maximum).

1.2 First setup

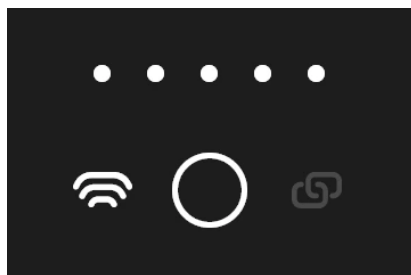
In this tutorial, we will walk you through the following steps:

- Installing the Emlid Flow app
- Connecting to Reach RS2/RS2+
- Performing firmware update

To do that, you will need Reach RS2/RS2+, a Wi-Fi network with an internet access, and a smartphone or a tablet.

1.2.1 Download Emlid Flow

To manage Reach RS2/RS2+, download the Emlid Flow app on your mobile device [iOS](#) or [Android](#) mobile device.



Using Reach with Android devices: *Some Android devices have the Battery optimization setting enabled by default. Make sure you disabled it for Emlid Flow to avoid disconnection.*

1.2.2 Power up Reach RS2/RS2+

To power up your Reach, follow the steps below:

- Hold the power button for 5 seconds to turn the unit on.
- Wait for about 30 seconds until the Power LEDs will stop blinking and the Network LED stays solid white.

Reach RS2/RS2+ is now broadcasting Wi-Fi.

Tip: *You can read more about power supply in the [Power supply guide](#).*

1.2.3 Connect to Reach RS2/RS2+

Using Reach with Android device: *Turn off the mobile data on your device before connecting to Reach's hotspot.*

To connect to your Reach, follow the steps below:

- Open a list of Wi-Fi networks on your smartphone or tablet.
- Connect to a network named **reach:xx:xx**.
- Type network password: **emlidreach**.

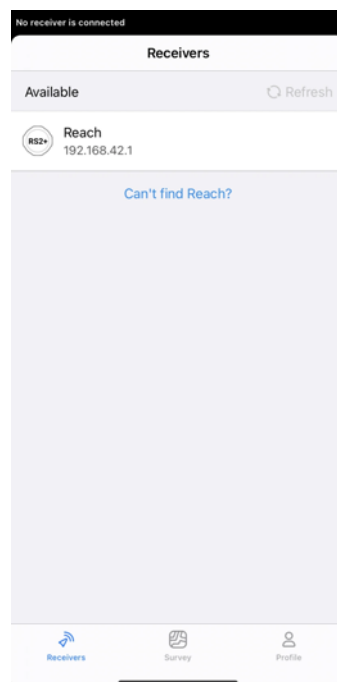
Once you successfully connected to Reach's hotspot, you can go to Emlid Flow and set up connection to your Wi-Fi network.

1.2.4 Set up Wi-Fi connection

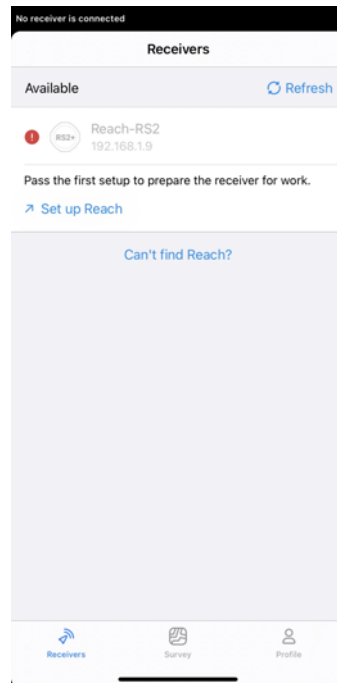
Note: *Make sure that your Wi-Fi network uses 2.4 GHz band.*

To connect Reach to your Wi-Fi network, follow the steps below:

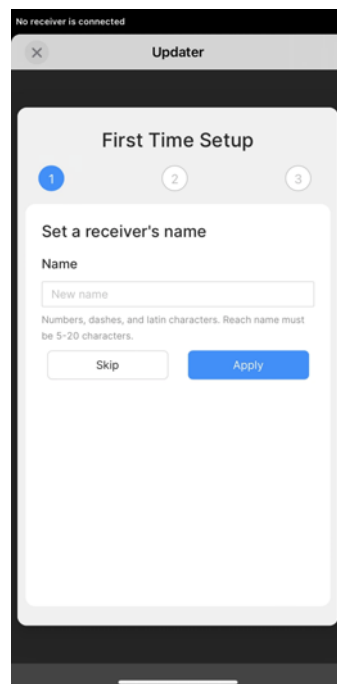
1. Open Emlid Flow and choose your Reach from the list.



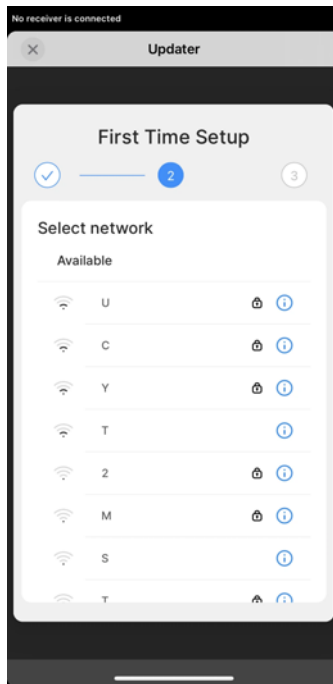
2. Tap the *Set up Reach* button to open Updater for further setup process.



3. Name your Reach and apply changes.



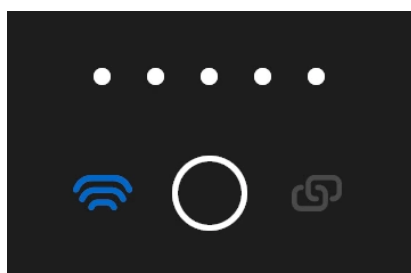
4. Select your Wi-Fi network from the list of available networks.



5. Enter the password and tap *Connect*.



Reach RS2/RS2+ will stop broadcasting Wi-Fi and connect to your network. The Network LED will blink rapidly while scanning for networks. Once Reach connects to Wi-Fi, the Network LED will be solid blue.



When the connection of Reach with the Wi-Fi network is established, you can connect to your unit using Emlid Flow:

1. Connect your smartphone or tablet to the same Wi-Fi network.
2. Open the Emlid Flow app.
3. Choose your Reach from the list of available devices.

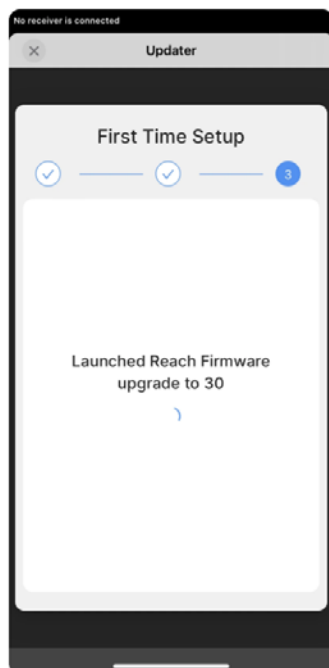
Note: *If there is only one receiver, the app will automatically try to connect to this Reach.*

Tip: *If your device did not connect to your Wi-Fi network, it will switch back to hotspot mode. In that case, repeat the steps and double-check the network name and password.*

1.2.5 Update Reach Firmware

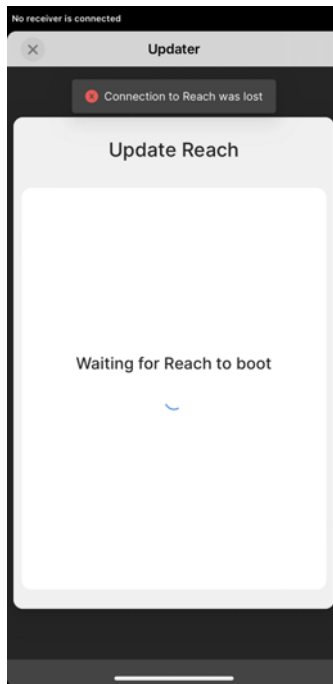
After connecting to Reach RS2/RS2+, the app will check available firmware updates. Follow the steps below to get the latest update:

1. Wait until Emlid Flow checks for the latest update. If there is an update available, it will start the updating process.



Note: *The process may take a few minutes.*

2. When the update is complete, wait until your Reach reboots.



3. Wait for the Network LED to stop blinking, showing that Reach RS2/RS2+ has joined your Wi-Fi network again. Close the *Updater* page.
4. Refresh the list of available devices.
5. Choose your Reach from the list of available devices.

Note: *If there is only one receiver, the app will automatically try to connect to this Reach.*

1.3 Connecting to Reach RS2/RS2+

Emlid Flow allows controlling Reach RS2/RS2+ receivers with iOS or Android devices. Using the app, you can access your receiver over Wi-Fi network, set it up for the survey, and collect and stake out points.

In this guide, you will find information on how to connect to your Reach RS2/RS2+ using the Emlid Flow app.

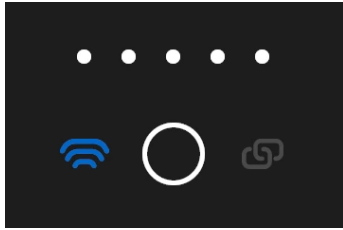
Note: *The connection process for both iOS and Android devices is similar.*

1.3.1 Setting up Wi-Fi connection

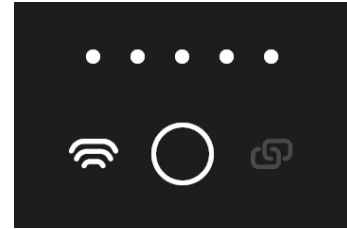
Establish Wi-Fi connection between your Reach and your device:

1. Power up the unit and wait until it is loaded.
2. Look at the Network LED of the receiver to check the mode.

Hotspot mode



Client mode



When Reach is in hotspot mode, it shares its own network. In this case, perform the following steps:

1. Open Wi-Fi settings of your device and turn on Wi-Fi.
2. Find a network with the name **reach:XX:XX**.
3. Type the password **emlidreach** to connect to this network.
4. Wait until it shows that you are successfully connected to the network.

When Reach is in client mode, it is connected to the external Wi-Fi network. In this case, perform the following steps:

1. Open Wi-Fi settings of your device.
2. Connect it to the same Wi-Fi network.
3. Wait until it shows that you are successfully connected to the network.

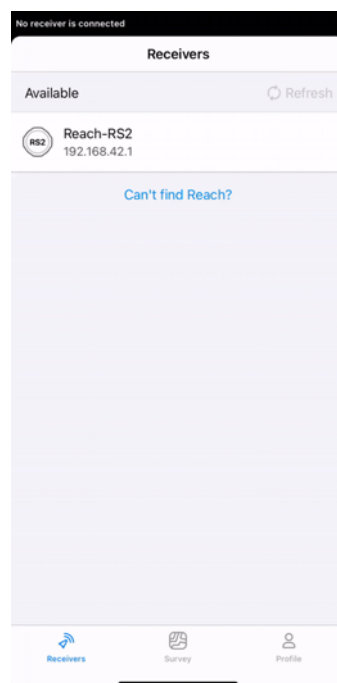
1.3.2 Connecting to Reach RS2/RS2+ using Emlid Flow

When the Wi-Fi connection is established, you can connect to your unit using Emlid Flow.

1. Open the app.
2. Choose your unit from the list of available devices.

Note: *If there is only one receiver, the app will automatically try to connect to this Reach.*

Tip: *When you connect to your Reach, all LEDs will blink simultaneously.*



Once you connect to your Reach RS2/RS2+ via Emlid Flow, you can access the settings and set it up for the survey.

1.4 Placement

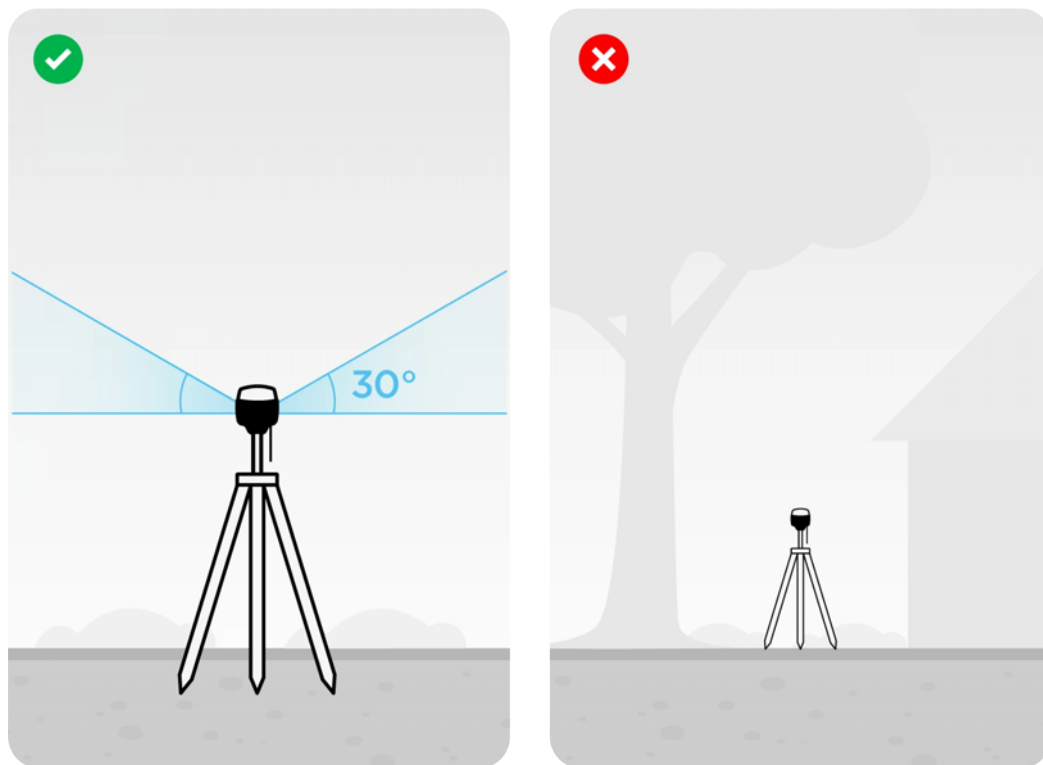
Tip: A well-placed Reach base is essential for achieving good RTK positioning results.

You can place your smartphone near the window in your house and it will obtain GNSS coordinates after some time, but for RTK such environment won't be sufficient. For RTK to work, there are special requirements for placing the base.

Clear sky view without any obstacles

Reach needs to have a clear sky view 30 degrees above the horizon. There should be no obstacles that could block the view like buildings, trees, cars, humans, laptops, etc.

Take a look at 2 pictures below. The left picture demonstrates desirable conditions for Reach location. The right one is an example of bad surrounding conditions such as the reduced view of the sky, possible obstructions or vegetation nearby.



Examples of **good** environments for Reach placement:

- field
- top of the hill
- rooftop

Examples of **bad** environments for Reach placement:

- indoors
- urban area

- forestry area

No electronics nearby

Electronic devices may produce RF noise that could affect the reception of the GNSS signal. Keep all electronics as far as possible from Reach.

Setting up the base

Learn more about placing the base in the corresponding guide.

1.5 LED status

Reach RS2/RS2+ has several LEDs which are used as status indicators for different parts of the system.



Battery

The lights above the power button indicate the battery charge level. If the loading animation is over, then you can connect your phone to Reach.

Network

During boot, Reach RS2/RS2+ enters a network scan state and searches for known networks to connect to. If it doesn't find a known network, it switches to hotspot mode.

RTK Status

This LED is used to display Emlid Flow RTK status. RTK status has two colors: white and blue. White indicates incoming corrections, and blue indicates whether outgoing corrections are enabled. If the outgoing ones are turned off, there will only be a white LED. If enabled, the light will switch between white and blue every two seconds.

Power

The LED on the Power button shows two things: whether the receiver is on/off and the point collection process. When Reach is turned on, it lights up with a solid white light. When the point collection has started, the light flashes rapidly.

2 RTK quickstart

2.1 How RTK works

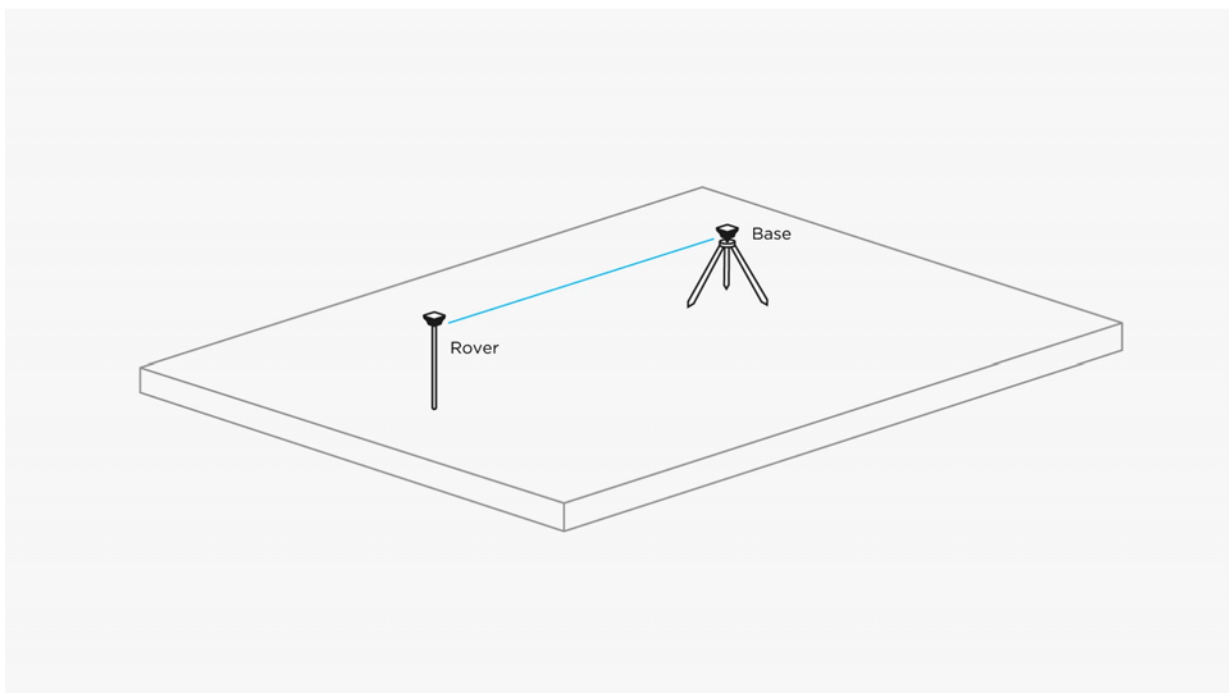
RTK is a technique used to improve the accuracy of a standalone GNSS receiver. Traditional GNSS receivers, like the one in a smartphone, could only determine the position with 2–4 meters (7–13 feet) accuracy. RTK can give you centimeter accuracy.

GNSS receivers measure how long it takes for a signal to travel from a satellite to the receiver. Transmitted signals travel through the ionosphere and atmosphere and are slowed down and perturbed on the way. For example, travel time on a cloudy day and in clear sky conditions would be different. That is why it is difficult for a standalone receiver to precisely determine its position. RTK is a technology that solves this issue.

Our YouTube channel has [a video](#) that will show you how RTK technology works.

2.1.1 High real-time precision

Two receivers are used in RTK. One of them is stationary, another moves freely. They are called **base station** and **rover**.

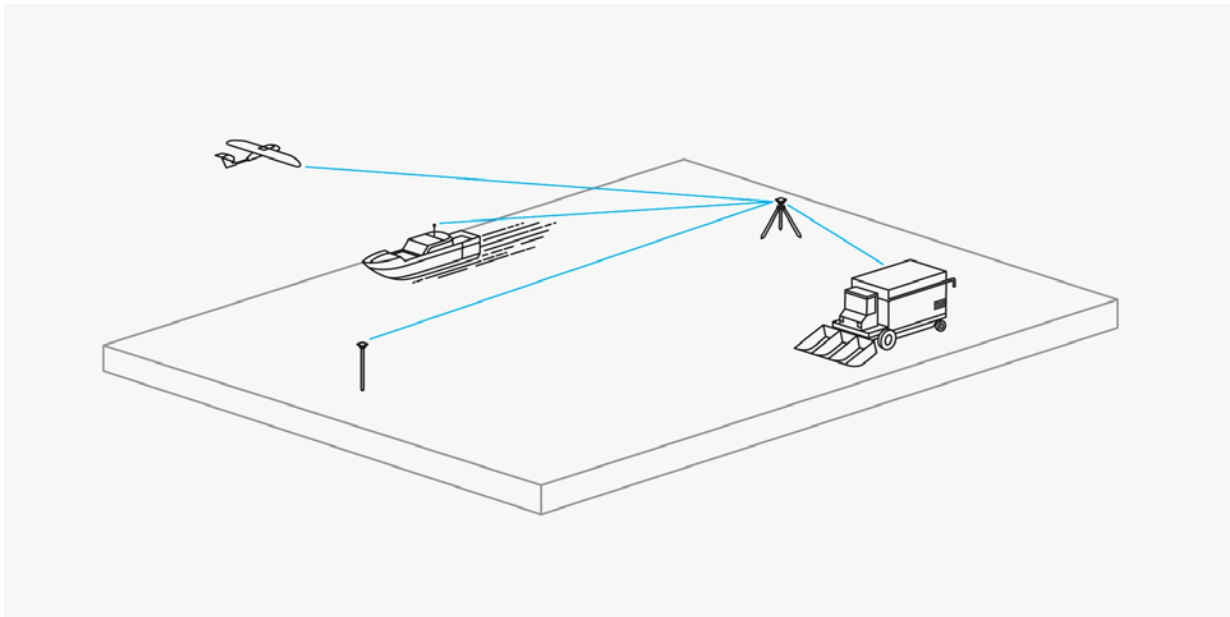


The base's mission is to stay in one place and send corrections to a moving receiver. Rover uses that data to achieve centimeter precise position. Any number of rovers can connect to one base if their input settings match the base's output.

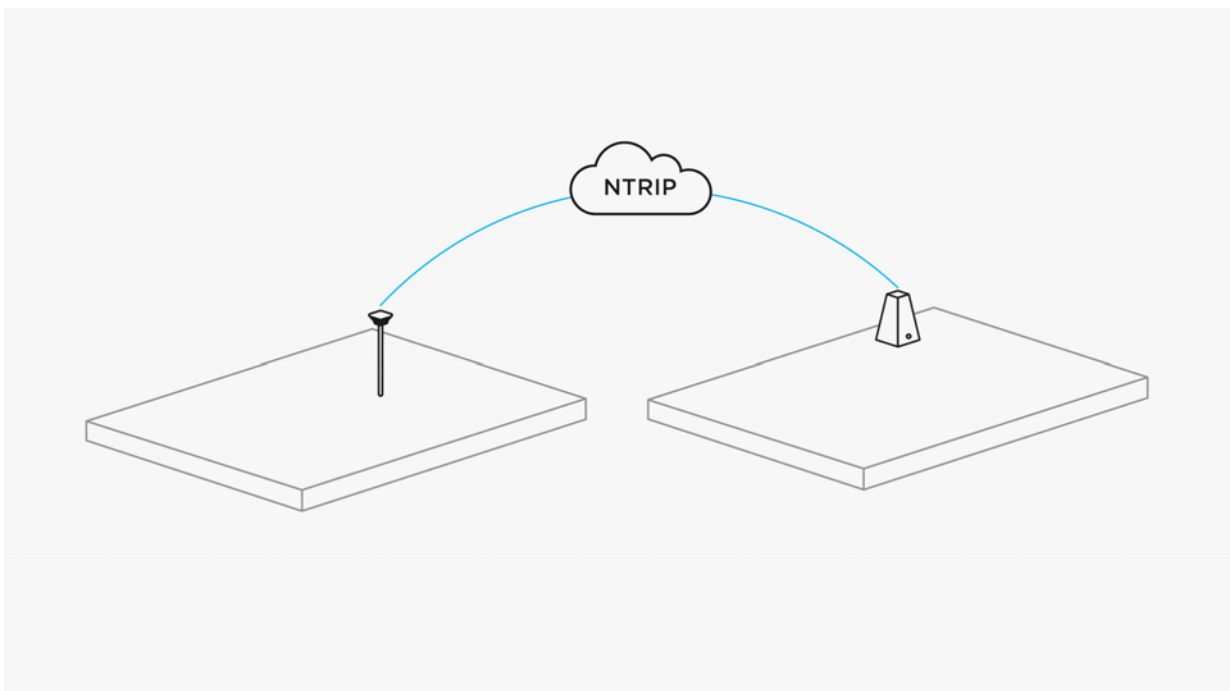
2.1.2 Corrections over NTRIP

You do not necessarily need a second unit for RTK all the time. Usually, there are local services that share base corrections over the internet. This technology is called NTRIP.

NTRIP is a good option for areas with strong 3G/LTE coverage and a vast network of NTRIP bases nearby. In other cases, using the second receiver as a local base station has two advantages:



- autonomy in remote areas as there's no need in the internet connection;
- independency from local providers, no additional fees by NTRIP service.



2.1.3 Single-band and multi-band receivers

Roughly speaking, there are two types of receivers: single-band (L1) and multi-band (L1/L2 or more). Their differences come from how much data they can receive from satellites.

For example, it helps to increase the maximum distance between base and rover, which is also called **baseline**:

	Single-band maximum baseline	Multi-band maximum baseline
RTK	10 km (6 mi)	60 km (36 mi)
PPK	30 km (18 mi)	100 km (60 mi)

Multi-band receiver is also way more robust when it comes to sky view. It can maintain centimeter precision even if you survey in challenging conditions: forest, city, mining sights, quarries, etc.

2.2 Base and rover setup

This guide shows how to set up two Reach RS2/RS2+ units as a rover and a base and how to make them work over LoRa radio in RTK mode.

2.2.1 Rename Reach devices

By default, every Reach RS2/RS2+ has the same name, and the first thing you need to do is to rename them, so it is easier to distinguish between the base and the rover in the field. To rename the units, follow the steps below:

1. Connect to Reach RS2/RS2+ you want to use as a base.

How to define Reach RS2/RS2+?: When you connect to your Reach, all LEDs will blink simultaneously. If you need to flash LEDs during a survey—tap the cell with your receiver's name on the Receivers screen and get access to the Flash LEDs button.

2. Go to *Settings* and tap *Receiver info*.
3. In *Receiver and hotspot name*, change the name of your Reach to **reach-base**.

Note: The name you enter will also be used as a Wi-Fi network label when Reach is in hotspot mode.

4. Press *Save*.

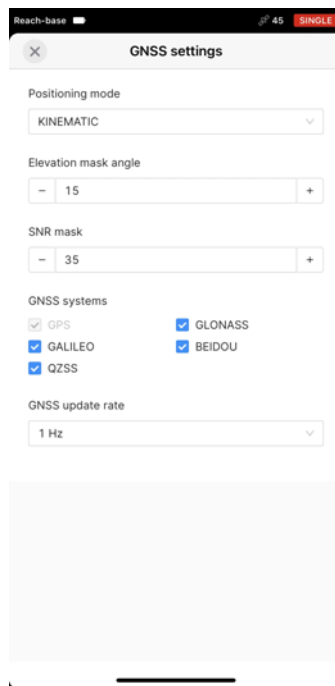
Tip: Use a special sticker from the package to mark the unit.

Do the same with the second Reach RS2/RS2+. However, use **reach-rover** name instead of reach-base.

2.2.2 Set up your base

Now you need to configure RTK settings and communication over LoRa radio between the base and the rover. Let's start with the base, follow the steps below:

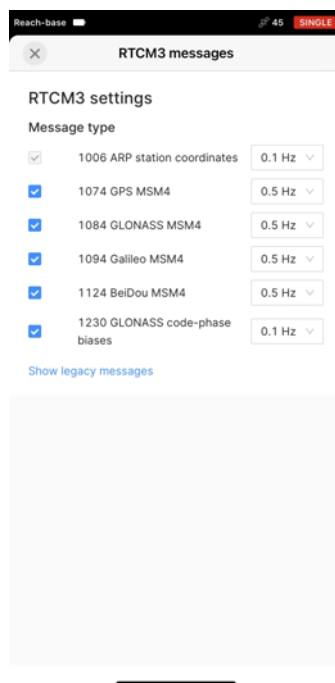
1. Connect to the base unit.
2. Go to *Settings* and tap *GNSS settings*. Pick each of the satellite systems.
3. Set the GNSS update rate at 1 Hz.



4. Return to the *Receivers* screen. On the *Base settings* screen, go to *RTCM3 messages*.

5. Select to output RTCM3 messages as follows:

- ARP station coordinates at 0.1 Hz
- Other MSM4 messages at 0.5 Hz



6. Tap *Apply*.

7. Return to the *Receivers* screen. On the textitBase output screen, select *LoRa*.

8. Tap the *Edit* button in the *LoRa* cell. Select frequency and set the output power at 20 dBm.

Note: Make sure to select appropriate frequency and output power according to your local regulations. In case there are restrictions, frequency band limitations will be applied automatically.

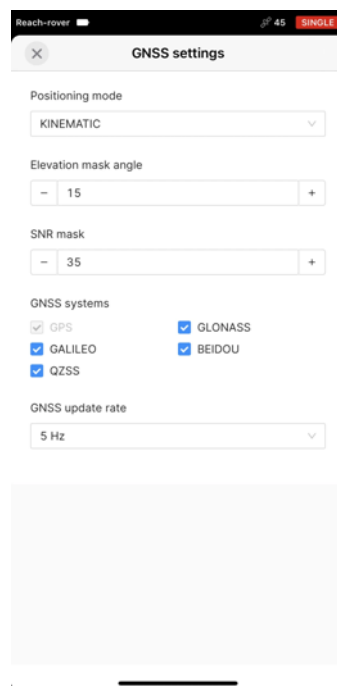
9. Set air data rate at 9.11 kb/s. Tap *Save*.

Now you can proceed to set up your rover unit.

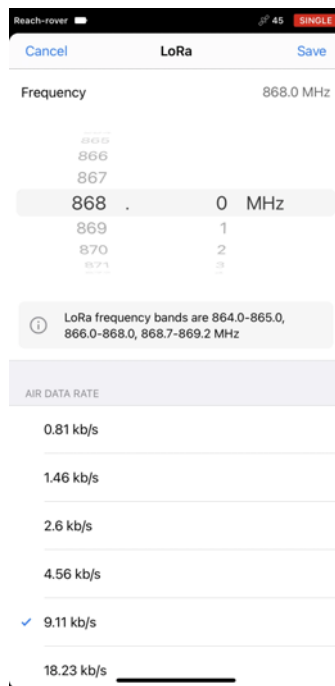
2.2.3 Set up your rover

To complete configuring RTK settings and communication over LoRa radio between the base and the rover, you need to set up your rover. Follow the steps below:

1. Connect to the rover unit.
2. Go to *Settings* and tap *GNSS settings*.
3. Set the positioning mode to *Kinematic*.
4. Select the same GNSS systems as for the base, and set 5 Hz GNSS update rate. Apply changes.



5. To configure LoRa radio on the rover unit to receive the corrections, return to the *Receivers* screen and tap *Correction input*.
6. Select *LoRa*. Set the same frequency and air rate as for the base. Tap *Save*.



Tip: To make sure that corrections are passing from the base to the rover, you can put both receivers by the window for a few minutes to provide the sky visibility. After that, open Emlid Flow, connect to the rover and go to the Status screen. Scroll down to the Corrections section and make sure that your rover is receiving corrections.

2.2.4 Place Reach RS2/RS2+ units

When you configured settings on both base and rover, you are ready to go outside to place the base and complete the setup process. For the field works, you will need a tripod and a survey pole. To place the units, follow the steps below:

Note: Before placing the base, make sure that you are in an open area with a clear sky view. This will ensure good signal reception and a fair number of available satellites.

1. Mount Reach RS2/RS2+ base.
2. Accurately level the tripod.
3. Put the rover on the pole.
4. Attach LoRa antennas to both units.
5. Turn on the receivers.

Tip: To learn more about placement, check the [Placement guide](#).

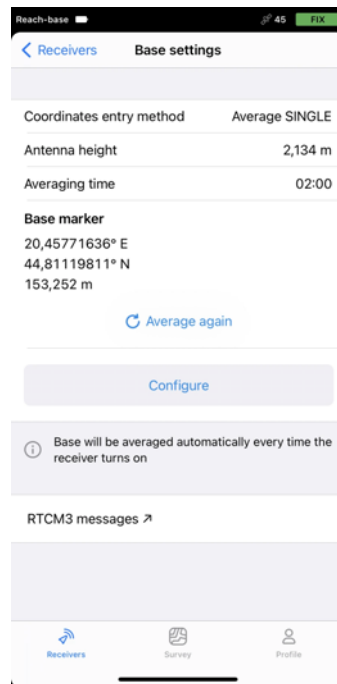
After placing the base on the tripod, you can complete its setup:

1. Connect to the base.
2. On the *Receivers* screen, tap *Base settings*.
3. To configure base settings, tap the *Configure* button.
4. Select *Average SINGLE* as the base coordinates entry method and set averaging time. Tap *Save*.

Caution: Do not move the base while Reach is accumulating data.

Note: Base position is averaged automatically every time the receiver turns on.

After accumulating the data, you will see averaged coordinates in the *Base marker* section. Now your base is set up and transmits corrections to the rover.



2.2.5 View results

When you completed your RTK setup over LoRa radio, you can see the current solution status in the top right corner of the Emlid Flow app:

SINGLE means that the rover has found a solution relying on its own receiver and base corrections are not applied. In this case, the receiver calculates its position with the precision of a few meters.

FLOAT means that the rover receives corrections from the base but cannot resolve all ambiguities and calculate its position with the centimeter accuracy.

FIX means that the rover using corrections from the base resolved the ambiguities in its positional calculation and achieved the solution with the centimeter-level precision.

After a short period of time, the rover gets a fixed solution. In good environments, it will take a few seconds to get a fixed solution. In tough conditions, it may take a little longer. Once rover gets FIX, you are all set for surveying.

You can also find the current solution status as well as your position in real time on the Status screen.

Tip: When you learn how to set up RTK over LoRa radio, you can also check [how to connect your Reach to the internet and work with NTRIP service.](#)

2.3 Connecting Reach to internet via Wi-Fi

This guide shows how to connect Reach to the internet via your local Wi-Fi network to update the device to the latest firmware or get the corrections from your NTRIP service.

2.3.1 Get access to Reach in Emlid Flow

Android device: *Make sure mobile data and battery optimization are turned off before connecting to Reach's hotspot.*

To establish the connection between your mobile device and Reach, follow the steps below:

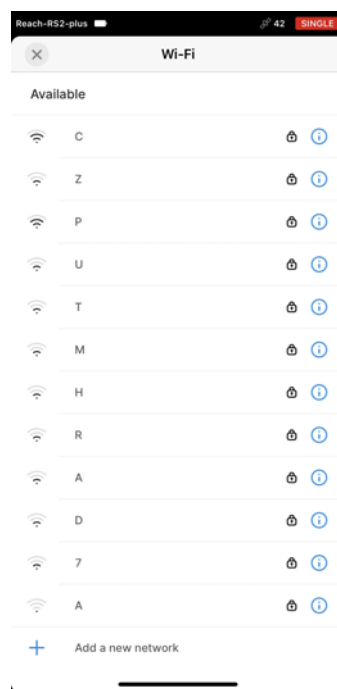
1. Download the app from Google Play or App Store.
2. Go to Wi-Fi settings on your device.
3. Connect to Reach hotspot. It appears as reach:XX:XX.
4. Enter password emlidreach.
5. Launch the Emlid Flow app.
6. Choose Reach from the list of available devices.

2.3.2 Configure Wi-Fi connection settings in Emlid Flow

Note: *Make sure that your Wi-Fi network uses 2.4 GHz band.*

After connecting to the Reach hotspot in Emlid Flow, set up the connection to your local Wi-Fi network:

1. On the *Receivers* screen, tap *Wi-Fi*.
2. Choose your Wi-Fi network from the list.



3. Fill in the password for the selected network.

Double-check the password: *You can unmask the password by tapping an eye symbol at the end of the password field.*



4. Press the *Connect* button. The Network LED will start blinking blue. It means that Reach is trying to connect to your network.
5. Check the connection status after the blue LED stops blinking:
 - The Network LED is solid blue. It means that Reach is connected to your Wi-Fi network.
 - The Network LED is solid white. It means that the connection to your Wi-Fi network failed. Reach returned to the hotspot mode.

Failed connection: *If the connection to your Wi-Fi network failed, do the following:*

- *Check the entered password.*
- *Check that your network is configured correctly.*
- *Try connecting to another Wi-Fi network.*
- *Access Reach in your Wi-Fi network.*

2.3.3 Access Reach in your Wi-Fi network

After configuring Wi-Fi connection settings in Emlid Flow, connect your mobile device to Reach:

1. Connect your smartphone or tablet to the same Wi-Fi network as Reach.
2. Go back to Emlid Flow.
3. Refresh the list of available devices.
4. Choose Reach from the list.

Now Reach is connected to your Wi-Fi network and ready for work.

2.4 Connecting Reach to the internet via mobile hotspot

This guide shows how to connect Reach to the internet via your control device's hotspot to update it to the latest firmware or get the corrections from your NTRIP service.

2.4.1 Get access to Reach in Emlid Flow

Android device: *Make sure mobile data and battery optimization are turned off before connecting to Reach's hotspot.*

To establish the connection between your mobile device and Reach, follow the steps below:

1. Download the app from Google Play or App Store.
2. Go to Wi-Fi settings on your device.
3. Connect to Reach hotspot. It appears as **reach:XX:XX**.
4. Enter password **emlidreach**.
5. Launch the Emlid Flow app.
6. Choose Reach from the list of available devices.
7. Configure Wi-Fi connection settings in Emlid Flow.

After connecting to the Reach hotspot in Emlid Flow, set up the connection to your mobile device hotspot:

Note: *Check that your device's mobile hotspot is disabled to ensure a successful connection.*

1. On the *Receivers* screen, tap *Wi-Fi*.
2. Tap *Add a new network*. As your device's mobile hotspot has been temporarily disabled, this network is not visible.



Caution: *Make sure that there are no available saved networks to ensure successful connection.*

3. Fill in the credentials of your device's hotspot:

- Type the network name.
- Choose a security type.
- Add a password if you have it.

Double-check the password: *You can unmask the password by tapping an eye symbol at the end of the password field.*



4. Press the *Connect* button. The Network LED will start blinking—it means that Reach is trying to connect to your device's hotspot.

But since it is off, Reach will start sharing its hotspot again.

5. To detect your device's hotspot and connect to it, you need to reboot Reach. Press the power button for a while to turn your Reach off and then press it again to turn Reach on.

Rebooting Reach using Emlid Flow *Alternatively, you can reboot your Reach using Emlid Flow. Connect your device to the Reach hotspot again. Then open Emlid Flow and refresh the list of devices to connect to your Reach. After that, tap the name of your Reach and restart it. Finally, proceed to step 7.*

6. Enable the mobile hotspot on your mobile device.

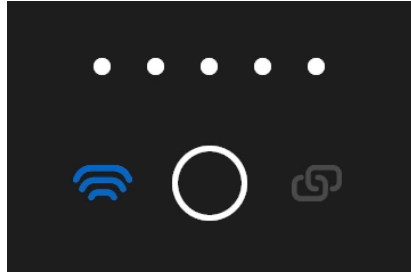
iOS device: *To ensure successful connection, pay attention to the following:*

- *Make sure that your iOS device is not connected to any other Wi-Fi networks. iOS hotspot may drop once your iOS device finds an available Wi-Fi network and connects to it.*
- *Starting with the iPhone 12 series, enable the Maximize compatibility option on its Personal hotspot page. This will switch its hotspot to 2.4 GHz and ensure connection to Reach.*
- *Keep the Personal Hotspot page on the iOS device open while the Reach is loading.*

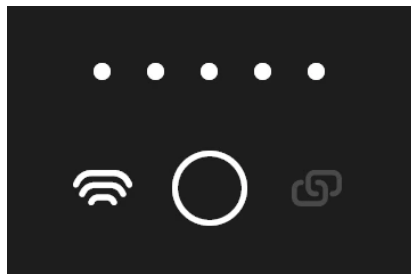
When Reach reboots, check the connection status:

iOS device: *If the connection to the device's hotspot is successful, you will see the blue notification at the top left corner of the screen.*

The Network LED is solid blue: It means that Reach is connected to your mobile hotspot.



The Network LED is solid white: It means that the connection to your mobile hotspot failed and Reach returned to the hotspot mode.



Failed connection: *If the connection to your device's hotspot failed, do the following:*

- *Check the entered password.*
- *Check that your network is configured correctly.*
- *Try connecting to another Wi-Fi network.*
- *Access Reach in your Wi-Fi network.*

2.4.2 Access Reach in your Wi-Fi network

When your Reach is connected to your mobile hotspot, access it following the steps below:

1. Open Emlid Flow.
2. Refresh the list of available devices.
3. Choose Reach from the list.

Now Reach is connected to your mobile hotspot and ready for work.

2.5 Connecting Reach to the internet via built-in modem

This guide shows how to connect Reach to the internet via built-in cellular modem to get corrections from your NTRIP service.

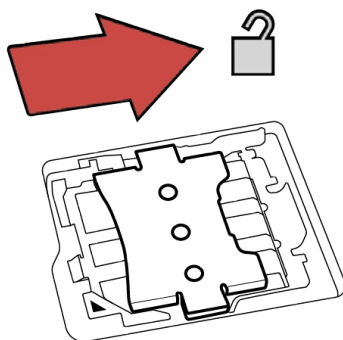
2.5.1 Insert a SIM card

Note: Make sure you have a nano-SIM card. You can cut your SIM card to match the format.

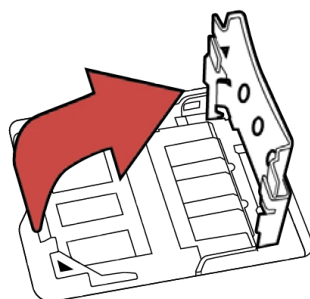
To insert the SIM card into your Reach, follow the steps below:

1. Find the SIM card slot under the black sealing.
2. Slide the metallic cover to the right to unlock the slot.

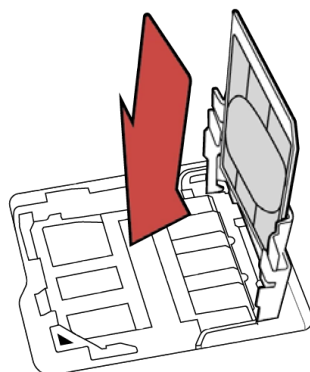
Caution: To prevent slot damage, please use it with care.



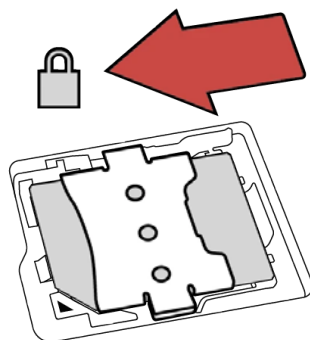
3. Pull up the cover to open the SIM card slot.



4. Insert your SIM card into the metallic cover.



5. Return the slot cover into the horizontal position and slide left to lock the slot.



2.5.2 Enable mobile data

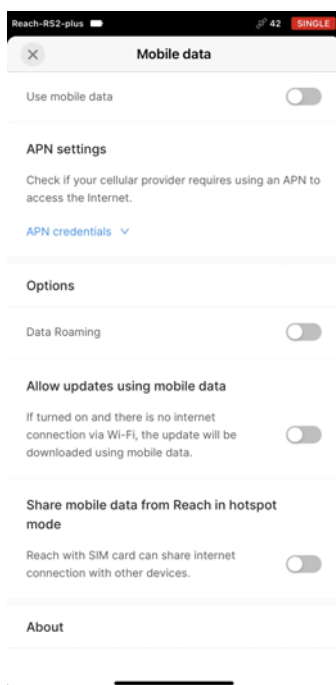
When the SIM card is inserted, connect your Reach to the internet as follows:

1. Connect your device to the receiver's hotspot using the Emlid Flow app.

Tip: *You can read how to connect to the receiver's hotspot using the Emlid Flow app in the [Connecting to Reach guide](#).*

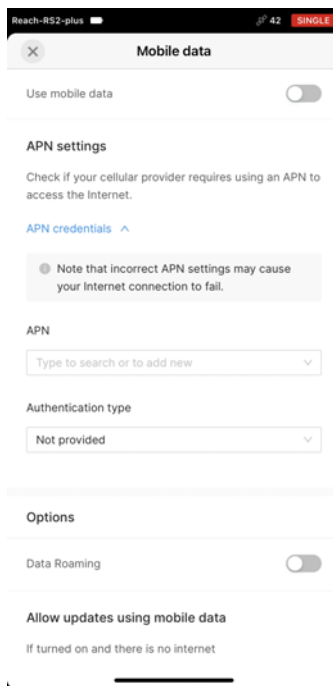
2. In Settings, go to the Mobile data section.

Note: *If the SIM card requires a PIN code, type it into the pop-up field on the Mobile data screen.*

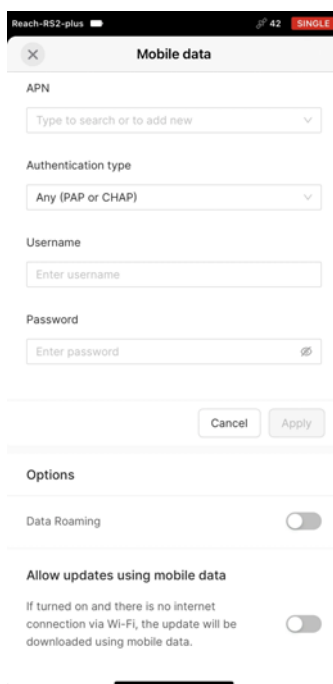


3. Configure APN settings.

Tip: *This step is optional. If you don't know your APN settings, contact the network carrier.*
Tap *APN settings* and enter your APN.



Some SIM cards may require filling in all the fields in the dropdown menu.



Tap *Apply*.

4. Switch mobile data on.

Note: Some SIM cards require enabling the Data roaming option to connect to the network.

Tip: If you can't connect to a cellular network, do the following:

- Make sure you're in an area with cellular network coverage.
- Check APN settings.
- If you still can't connect to a cellular network, contact your carrier.

If everything is correct, you will see network bars and connection type next to the battery icon. Once Reach connects to the internet, you can set it up to get corrections from NTRIP service.

2.6 Working with NTRIP

This guide explains how to configure your Reach RS2/RS2+ to receive RTK corrections from an NTRIP service via the internet.

2.6.1 Overview

An NTRIP service allows you to configure RTK using only one GNSS receiver acting as a rover. With the help of an NTRIP protocol, the service allows your rover to receive corrections from the nearest third-party base, a continuously operating reference station (CORS). This way, there is no need for you to have your own local base.

Note: *In order to access NTRIP services, you need to register and get a subscription. The cost and coverage area depends on your NTRIP service provider.*

2.6.2 Connect Reach RS2/RS2+ to internet

To get NTRIP corrections, connect your Reach to the internet via your control device's hotspot or built-in cellular modem.

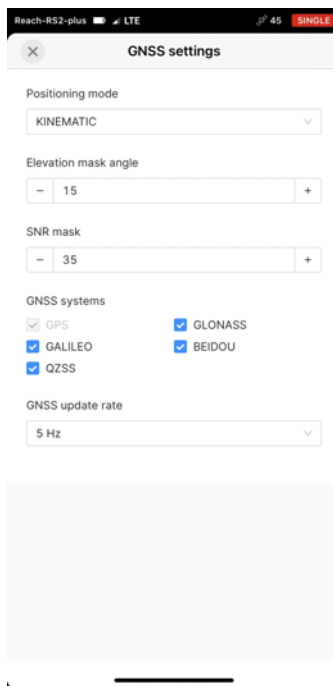
Tip: *To learn more about connecting your Reach RS2/RS2+ to the internet, check the following guides:*

- [Connecting Reach to internet via built-in modem](#)
- [Connecting Reach to internet via Wi-Fi](#)
- [Connecting Reach to the internet via mobile hotspot](#)

2.6.3 Configure Reach RS2/RS2+ as rover

To set up your Reach as a rover for RTK mode with NTRIP, you need to configure GNSS settings and correction input in Emlid Flow. First, configure GNSS settings following the steps below:

1. Open Emlid Flow and connect to your receiver.
2. Go to *Settings* and tap *GNSS settings*. Make sure you have the following settings:
 - The positioning mode is set to Kinematic.
 - The elevation mask angle is set at 15 degrees.
 - The SNR mask angle is set at 35 degrees.
 - All satellites systems are selected.
 - The GNSS update rate is set at 5Hz.



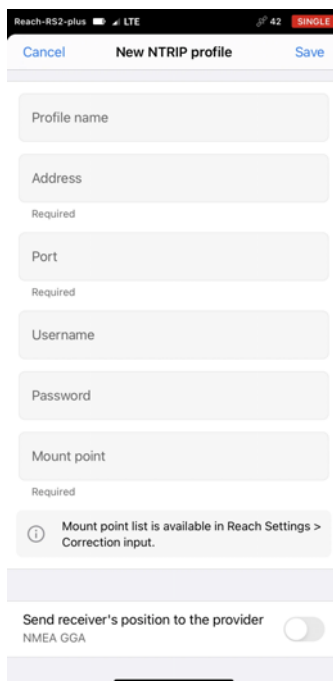
3. Tap *Apply*.

After configuring GNSS settings, set up the correction input as follows:

1. Go to the *Correction input* screen.
2. Select *NTRIP*.
3. Tap *Add profile* and fill in the information from your NTRIP provider.

Tip: To find out which mount point suits you better, check the website of your NTRIP provider. The closer the mount point, the more precise your solution will be.

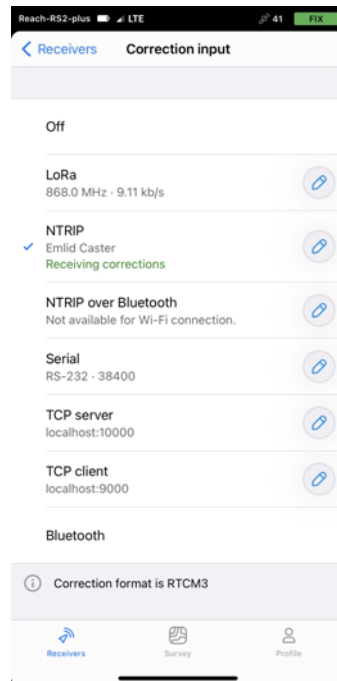
Android keyboard tech tip: On some Android devices, default keyboards do not provide a minus sign. To get access to it, we recommend downloading Gboard, a virtual keyboard app, from the Google Play Store.



Note: If you are using a VRS service, you need to enable Send receiver's position to the provider.

4. Tap **Save**. If you are outdoors and everything is configured correctly, you will start receiving corrections in a few seconds.

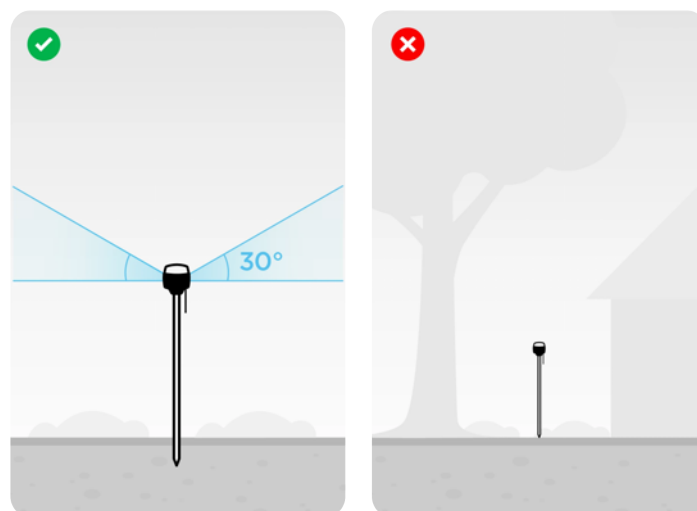
Note: To start receiving corrections, make sure that your receiver has satellite visibility.



Tip: You can add a required number of NTRIP profiles and choose between them right on the Correction input screen later.

2.6.4 Provide Reach RS2/RS2+ with clear sky view

Before surveying, make sure your Reach has a clear sky view of at least 30 degrees above the horizon. There should be no obstacles that could block the view like buildings, trees, cars, humans, laptops, etc.



Tip: Learn more about Reach setup in the [Placement](#) guide.

3 PPK quickstart

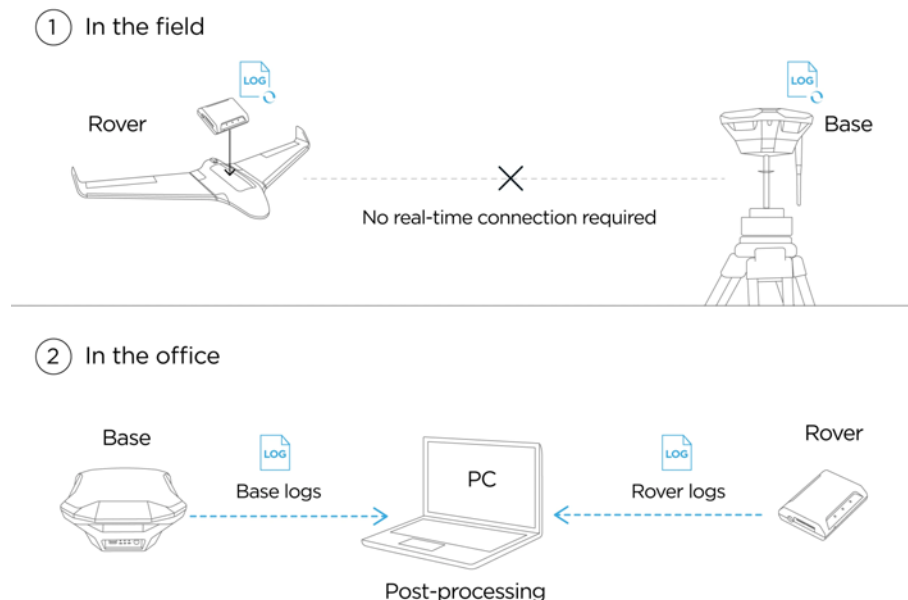
3.1 How PPK works

Note: To learn more about post-processing with our cross-platform desktop application Emlid Studio, check out our [documentation](#).

PPK stands for Post-Processed Kinematic.

3.1.1 Definitions and differences from RTK

Post-Processed Kinematic (PPK) is an alternative technique to Real-Time Kinematic (RTK). With PPK workflow, accurate positioning doesn't happen in real time, all algorithms are applied afterwards. Both base on the ground and rover (usually on a UAV) record raw GNSS logs, which are then processed to receive an accurate positioning track.



While PPK is mainly used in UAV mapping, it can also be used as a back up for RTK for any surveying job. PPK offers more flexible workflow, allowing to run the processing multiple times using different settings. It also doesn't require a correction link between base and rover, making equipment setup simpler.

3.1.2 PPK for UAV mapping

Note: For PPK mapping, it is recommended to have few GCPs on site for data check (checkpoints).

There are several advantages of using PPK for mapping with a drone. PPK doesn't require placing Ground Control Points (GCPs), which allows to inspect much wider areas. It is especially useful when you need to map large territories or places with difficult terrain.

The most critical part of PPK for UAV mapping is synchronisation of a camera and Reach M+, because:

There is always a delay between camera trigger and the actual moment the photo is taken.

1. When a drone flies at high speeds, the autopilot receives position readings only each several meters. The accuracy of, say, 2 meters is not enough for surveying.
2. Reach M2/M+ solves this by connecting to a camera shutter via hot shoe. The time of each photo is logged with a resolution of less than a microsecond. During PPK you receive coordinates of exact moments of each photo taken.

There's no need in integrating Reach to autopilot for UAV mapping.



Connecting a camera and Reach M+ with a hot shoe adapter

As a result of UAV PPK mapping with Reach, you'll have a set of images and a text file containing a list of accurate coordinates corresponding to each photo. This data is then imported in mapping software such as Agisoft PhotoScan, DroneDeploy, Pix4D, etc.

DJI drones workaround: *You can't easily integrate Reach M2/M+ with DJI Mavic or Phantom, as their cameras don't have hot shoe. But you can always stick to working with GCPs, which is simple and efficient for small areas – just like your DJI drone.*

3.2 Preparing ground control points for PPK UAV mapping

This tutorial shows how to prepare ground control points for precise PPK UAV mapping.

Tip: Check the [How PPK works](#) and [Configuring Reach UAV kit for PPK mapping](#) guides to learn more.

3.2.1 Overview

Ground control points (GCPs) are points with known coordinates on the ground in the survey area that serve as reference points and help accurately map areas.

Use ground control points for any of the following purposes:

- To check and improve the accuracy of the map.

- To get the correct scale and orientation of the map.
- To ensure absolute positioning of the map.

Tip: *Learn more about absolute and relative accuracy and positioning in the [Choosing base setup method article](#).*

3.2.2 Workflow

To ensure precise drone mapping, you need to place and collect GCPs in RTK mode in the survey area.

Tip: *In most cases, GCPs are necessary to obtain absolute accuracy and georeference the map. In this case, you should place the base over a known point and manually enter its coordinates. To learn more, check the [Choosing base setup method article guide](#).*

Placing GCPs

When placing GCPs, follow the requirements below:

- Make your GCPs clearly visible on the drone's images: they should be big enough and contrast with the surroundings.
- Provide enough GCPs depending on the survey area. Usually, you need 5–10 points.
- Place GCPs evenly in the survey area. For example, if you use 5 points, set one for each corner and the last one in the center of the area.

Tip: *To ensure good area cover, avoid placing GCPs in single straight lines.*

- Try to place GCPs at the highest and lowest points on the site. It will help perform the correct flat projection.

Measuring GCPs

After placing GCPs, you need to collect them. Follow the steps below.

Configuring Reach RS2/RS2+

First, you need to configure your Reach RS2/RS2+ to receive RTK corrections. You can do it in the following ways:

- Working with RS2/RS2+ base
- Working with NTRIP service

Collecting GCPs

To collect points using Emlid Flow, follow the steps below.

1. Go to the *Survey* tab and create a project.

Tip: *To learn more, check the [How to create a project guide](#).*

2. Collect your ground control points.

Tip: *To learn more, check the [Collect points guide](#).*

3. Export the project once you collected GCPs.

Tip: *To learn more, check the [Export projects guide](#).*

Now the list of your points is ready for import to photogrammetry software.

3.3 Configuring Reach UAV Kit for PPK Mapping

This guide explains how to set up your Reach receivers for PPK mapping with UAV.

Tip: We recommend checking the [How PPK works](#) article before you start.

3.3.1 Overview

To configure Reach UAV kit for PPK mapping, you will need the following:

- Reach RS3/RS2/RS2+ or Reach RS+ base
- Reach M2/M+ rover with GNSS antenna
- Hot shoe adapter (HSA) for a camera
- Any camera that provides hot shoe access (e.g. Sony, Canon, Nikon)

Note: Reach RS+ cannot act as a base for a Reach M2 rover as Reach M2 requires multi-frequency corrections. Still, you can use Reach RS3/RS2/RS2+ as a base for Reach M+. Note that you will not get all advantages of the multi-band receiver in this case. You can learn more about the differences between single-band and multi-band receivers in the [Single-band VS Multi-band](#) article.

Additionally, you will need a few Ground Control Points (GCPs). To place GCP, a base and a rover are required, or you can use one receiver connected to an NTRIP.

In this guide, we are mostly focused on the GNSS equipment part of the integration. However, you also need a UAV and a PC with a Ground control station and photogrammetric software. There are 2 main requirements for UAV:

- The presence or ability to install a camera with a hot shoe connector
- Functionality allowing triggering the camera: by camera itself or by autopilot

3.3.2 Reach M2/M+ hardware setup

Connecting Reach M2/M+ to a camera using HSA

HSA allows Reach M2/M+ to precisely record a time mark at every moment the camera takes a photo.

Note: The camera requires to have a hot shoe for integration with Reach M2/M+. If you use DJI Mavic or Phantom which does not provide hot shoe access, you can always stick to working with GCPs.

To connect Reach to a camera with a hot shoe adapter use 5-pin JST-GH cable that comes with Reach M2/M+. Plug the hot shoe connector in a camera hot shoe and the JST-GH connector in the C1 port on Reach M2/M+.



Camera triggering

Depending on your application, there are several ways you can trigger a camera.

- **Triggering via camera.** Some cameras provide a Timelapse feature that allows taking a photo at regular intervals. If your camera supports this option, we recommend using it as it is the easiest and straightforward way.

Note: Each camera uses different ports for triggering. It might be a USB or HDMI port. Read the camera manual to find out how to trigger your camera.

- **Triggering via autopilot.** There are several options of triggering the camera via autopilots:
 - **Triggering the camera shutter at waypoints.** Autopilot can trigger the shutter each time the drone reaches a waypoint. If you use a flight controller based on

ArduPilot, check the [Camera control in auto missions](#) guide from ArduPilot for more details.

- **Triggering camera shutter at regular intervals.** Check the [Camera shutter configuration](#) guide from ArduPilot to learn more.

The majority of Ground Control Station software allows and even requires a mission plan preparation before the flight. You need to configure your camera and autopilot the way it obtains images with overlaps. This is necessary because common points in adjacent images are required to create an orthogonal mosaic. We recommend the front overlap to be at least about 60% and the side – about 30%.



Antenna placement

GNSS antenna should be placed on a ground plane. Antenna ground plane should be conductive and at least 70 x 70 mm. A usual metal plate should be good for this purpose.

Note: *Helical antennas do not require a ground plane. Still, a ground plane can improve observation quality significantly.*

Tip: Check the [Antenna placement](#) guide to learn more.

Isolating Reach M2/M+ from potential interference

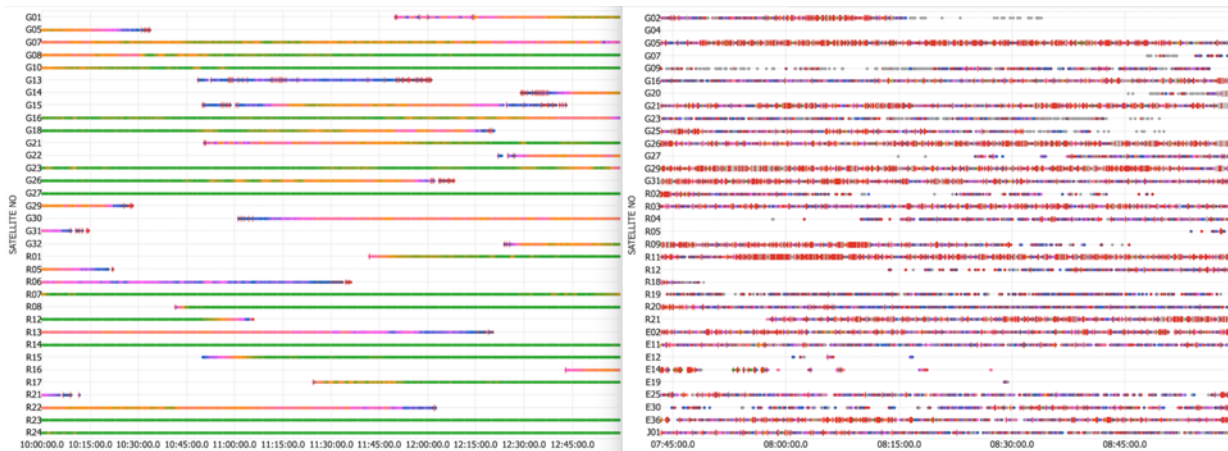
In some cases, you might need to isolate your Reach to ensure the best logging quality. The reason is that the transmitted power of GNSS signals is rather low relative to the possible noise from other hardware components installed on your UAV. It means that the antenna signal strength might be unstable and even sometimes interrupted. Interruption and temporary signal loss on RTK receiver are called cycle slip.

To avoid cycle slips we recommend isolating Reach M2/M+ unit and connect it to the ground to eliminate interference. Also, RC components, such as radio transmitters, might affect the signal as well. Reach should be located as far as possible from them.

The effects of bad hardware setup are substantial. Poor signal quality with low SNR values, lots of cycle slips pose issues with getting fixed solutions and missing time marks. Take a

look at the figures below that demonstrate examples of good (the left picture) and bad (the right one) satellite reception.

You can read more about the signal quality assessment in this section of our docs.

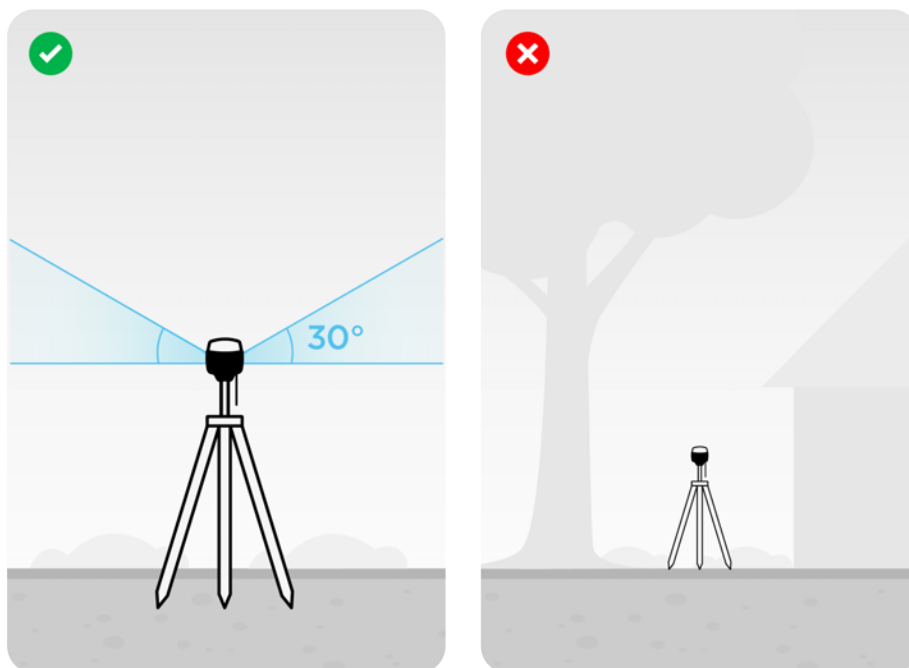


Tip: Create a topic on the [Emlid community forum](#) in case you experience any difficulties at this stage.

3.3.3 Reach RS3/RS2/RS2+/RS+ base setup

Check out the figure below and choose an appropriate location to place Reach RS3/RS2/RS2+ or Reach RS+ base station. The basic rules are:

- Good sky angle over 30 degrees
- Away from trees and buildings
- No electricity nearby



Tip: Learn more about base placement and setup in the [Placement and Choosing base setup method](#) articles.

3.3.4 Configuring base and rover before the flight

Reach M2/M+ rover settings

1. Power your Reach M2/M+ from an external power source or drone battery.

Tip: Check the [Power supply guide](#) to learn more.

2. Access Reach M2/M+ in the Emlid Flow.

Tip: Check the [Connecting to Reach](#) and [Connecting Reach to the Internet](#) guides to learn more.

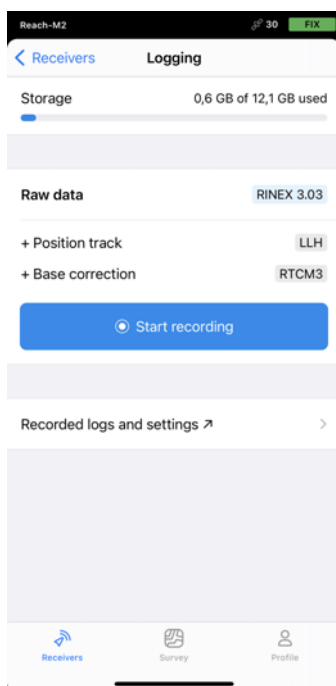
3. Go to the RTK settings and configure one of the recommended GNSS selection and update rate for time mark logging:

Tip: M2: Reach M2 tracks GPS, GLONASS, GALILEO, QZSS, and BeiDou satellite systems. The data can be logged with 1 Hz, 5 Hz, or 10 Hz update rate. For a drone flight, it is better to set up the update rate to 10 Hz.

Reach M+ tracks the following:

GNSS Selection	Reach M+ allowed update rates
GPS + GLONASS + GALILEO + SBAS + QZSS	1 Hz
GPS + GLONASS + QZSS	5 Hz
GPS + GALILEO	5 Hz
GPS	10 Hz

4. Enable raw data recording on the *Logging* screen:



Reach RS3/RS2/RS2+/RS+ base settings

1. Turn on the Reach RS3/RS2/RS2+ or Reach RS+ unit.

2. Access the receiver in Emlid Flow.
3. Go to the *GNSS settings* screen.
4. Choose the same GNSS as for Reach M2/M+ with 1 Hz GNSS update rate.
5. Enable raw data recording on the *Logging* screen.

3.3.5 Placing Ground Control Points

Ground Control Points (GCPs) are points with known coordinates on the ground in the area of your interests. GCPs usually help to improve and check the accuracy, get the correct scale and orientation of the map. Also, they are needed for the absolute positioning of your map in relation to the real world around it.

Tip: Check the [*Choosing base setup method*](#) guide to learn more about absolute and relative accuracy.

Reach provides centimeter-accurate coordinates in PPK. Also, if you place the base on a point with known coordinates, you will get the coordinates with absolute accuracy. In such a case, GCPs can help you to verify the accuracy.

GCPs should be clearly visible on the drone's images. Make sure the mark is a contrast to its surroundings and that it is big enough. Place a survey pole with a receiver exactly in the center of the mark to take its coordinates.

Enough quantity of GCPs depends on the site area. Usually, it is 5-10 points. There are some basic rules of checkpoints placing:

- They should be allocated evenly in the area where you survey. For example, if you use 5 points, set per one for each corner and the last in the center of the area
- They must not be on the same line

Also, it is great if you have the possibility to place GCPs at the highest and lowest points on site. It helps to perform the correct flat projection.



It's important to meet these requirements if you want to get the same accuracy across the entire plot.

Tip: Check the [*Placing GCPs*](#) guide to learn more.

3.3.6 Survey flight

We do not pay much attention to this step due to the differences in the drone flight settings from model to model. Please, check the manual of your drone manufacturer before the flight.

After all the configurations are done, you can proceed to flight with your drone.

Caution: *Make sure:*

- *Raw data logging on both Reach M2/M+ and Reach RS3/RS2/RS2+ or Reach RS+ units are enabled before the flight.*
- *Camera triggering is on. Trigger the camera and check the last time mark on the Camera control screen in Settings in Emlid Flow.*

When the flight is finished, you can disable logs recording. Before turning the devices off, please wait until the logs processing is done.

You can download raw data logs from both base and rover later on.

As a result of mapping mission with Reach you will have the following dataset:

- Raw log from a base
- Raw log from a rover
- Set of images from a drone
- List of GCPs

Now you can prepare the dataset for further processing.

3.4 Geotagging Photos with Emlid Studio

Note: *To learn more about post-processing with our cross-platform desktop application Emlid Studio, check out our [documentation](#).*

This guide walks you through the process of geotagging of the drone images in Emlid Studio that are used for further mapping in photogrammetry software.

3.4.1 Overview

With the Drone data PPK feature, you can easily add geotags to the drone images' EXIF data and process them later in the photogrammetry software. To perform geotagging, you need raw data logs from the base and the rover, or a ready POS file with the events, and drone images. The process includes two steps: processing and geotagging. You can skip processing and upload your own _events.pos files to obtain geotagged photos.

3.4.2 Getting started

Tip: *To learn more, check out the [How PPK works](#) article.*

As a result of the mapping mission, you should have the following files:

- RINEX log from a base
- RINEX log from a rover

- Set of images from the drone's camera
- Emlid Flow CSV file with the coordinates of ground control points

The RINEX data will be used to get precise coordinates for the image geotagging. The CSV file is not needed at this step, but it's essential for further mapping in photogrammetry software.

3.4.3 Workflow

Post-processing

Tip: *If you already post-processed RINEX files from the base and the rover and obtained the `_events.pos` file, go straight to the Geotagging section.*

To post-process the files from the base and the rover, follow the steps below:

1. Add the RINEX observation file from the rover.
2. Set the antenna height in meters.

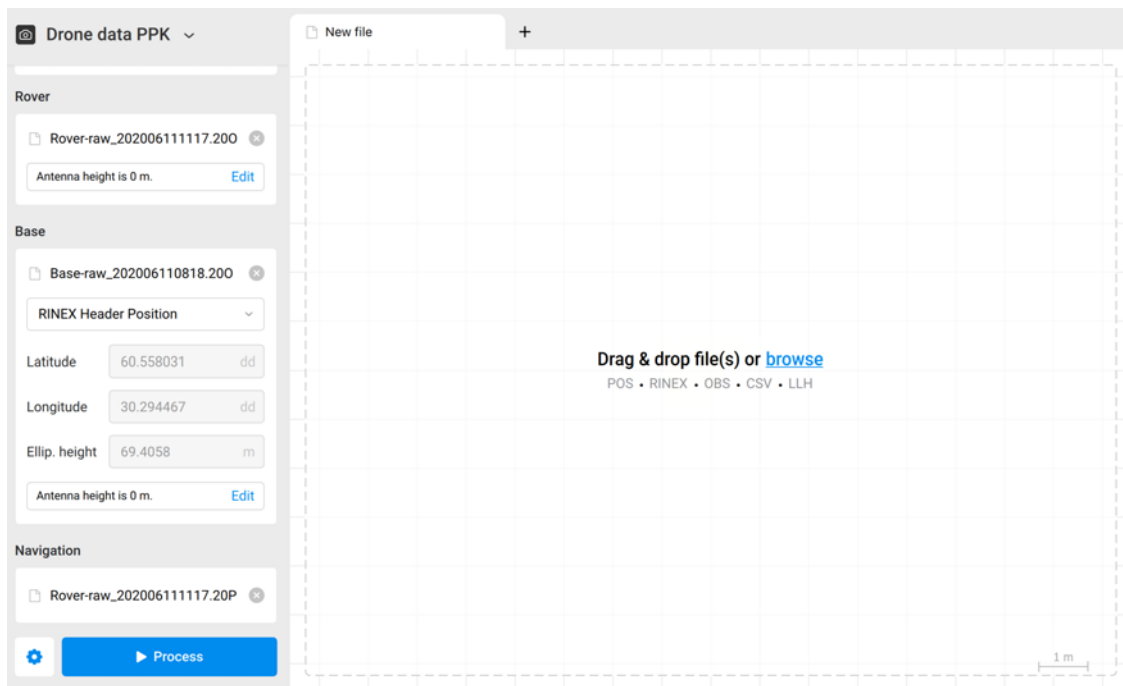
Tip: *We recommend leaving antenna height to 0. Usually, photogrammetry software has the feature of calculating the antenna offset (camera center position relative to the antenna position).*

3. Add the RINEX observation file from the base.
4. Set the base coordinates.

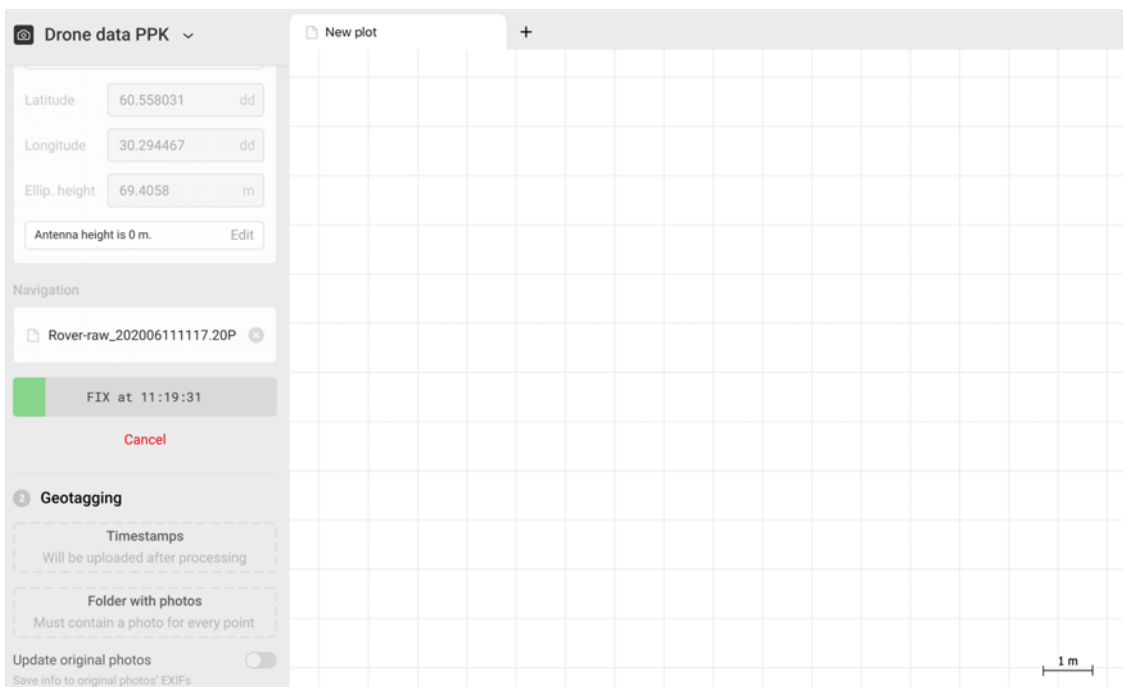
Tip: *By default, the RINEX Header Position is used. If you place your base over the point with known coordinates, enter the coordinates and the antenna height manually. This way, you will obtain absolute accuracy.*

The screenshot shows the Emlid Post-Processing software interface. On the left, there is a sidebar with a 'Processing' section. Under 'Processing', the 'Kinematic' mode is selected. Below this, the 'Rover' section shows a file named 'Rover-raw_202006111117.200' and an 'Antenna height is 0 m.' field with an 'Edit' button. The 'Base' section shows a file named 'Base-raw_202006110818.200' and a 'RINEX Header Position' dropdown menu. Below this, there are input fields for 'Latitude' (60.558031), 'Longitude' (30.294467), and 'Ellip. height' (69.4058), each with a unit dropdown (dd, dd, m respectively). There is also an 'Antenna height is 0 m.' field with an 'Edit' button. At the bottom of the sidebar, there is a 'Navigation' section with a 'RINEX • NAV' button. The main area of the software is a large grid with a dashed border. In the center of the grid, there is a text prompt: 'Drag & drop file(s) or browse' followed by a list of file types: 'POS • RINEX • OBS • CSV • LLH'. A scale bar indicating '1 m' is visible in the bottom right corner of the grid.

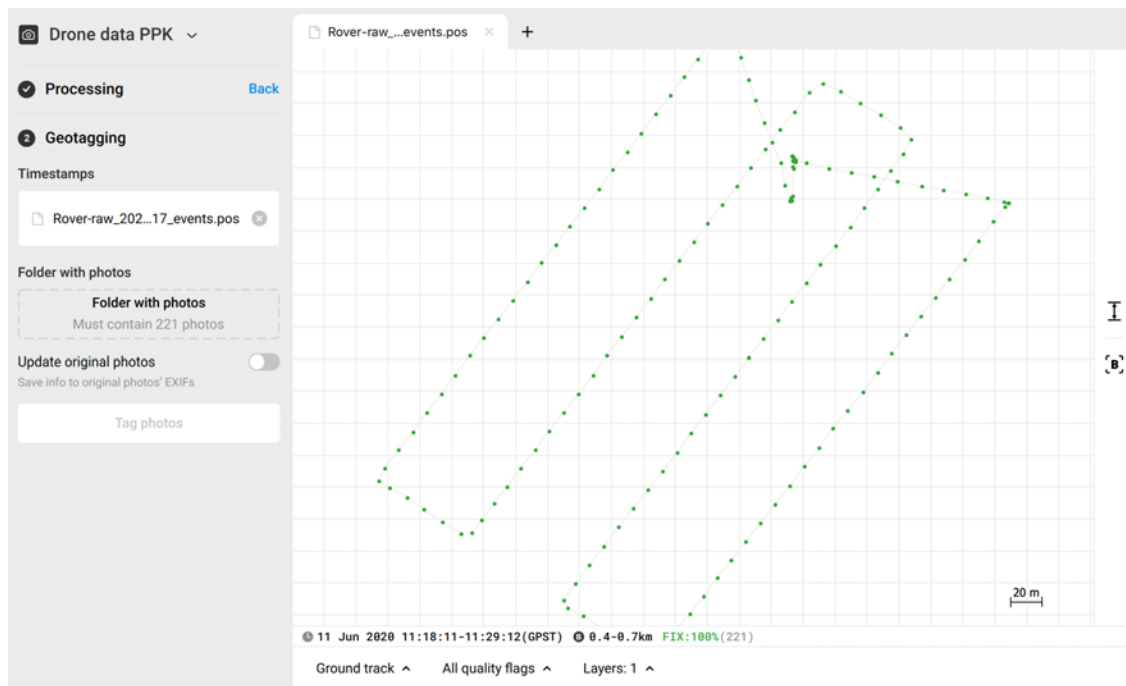
5. Add the RINEX navigation file from the base or the rover.



6. Click *Process*. You will see the progress bar in the bottom left corner.



7. Once the .pos file is ready, Emlid Studio will show it on the plot. The `_events.pos` file with the precise photos' positions will be automatically added to the *Timestamps* field in the *Geotagging* section.



3.4.4 Geotagging

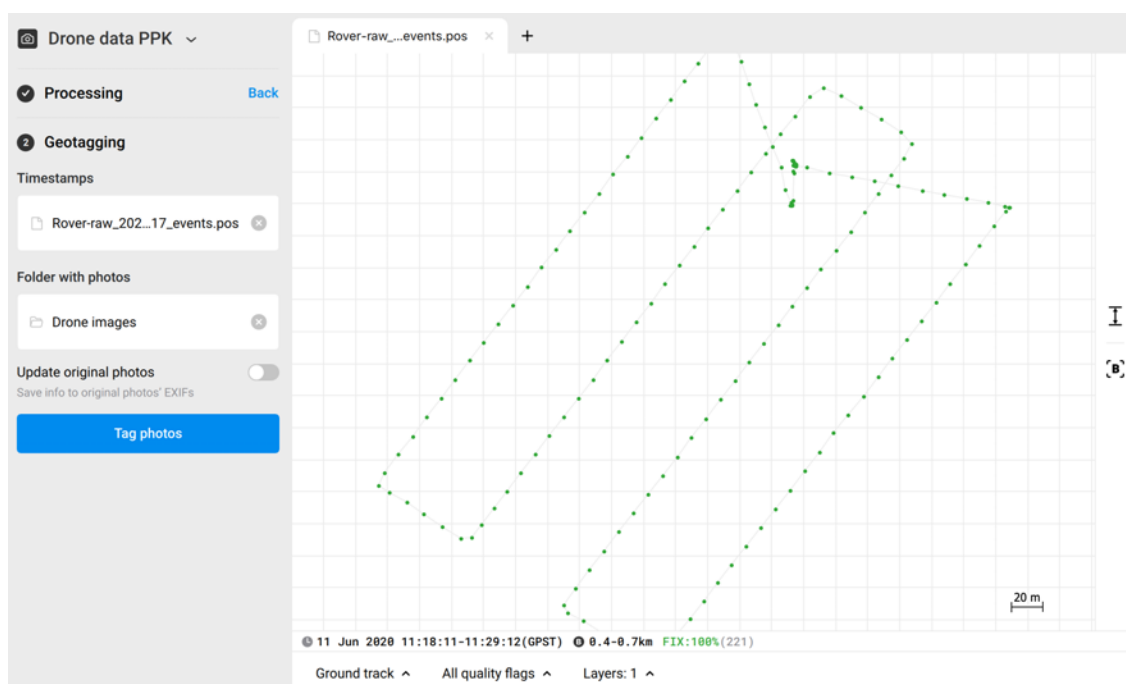
Tip: If you skipped the steps above, you need to add the `_events.pos` file manually. Drag and drop it to the *Timestamps* field.

To geotag your photos, follow the steps below:

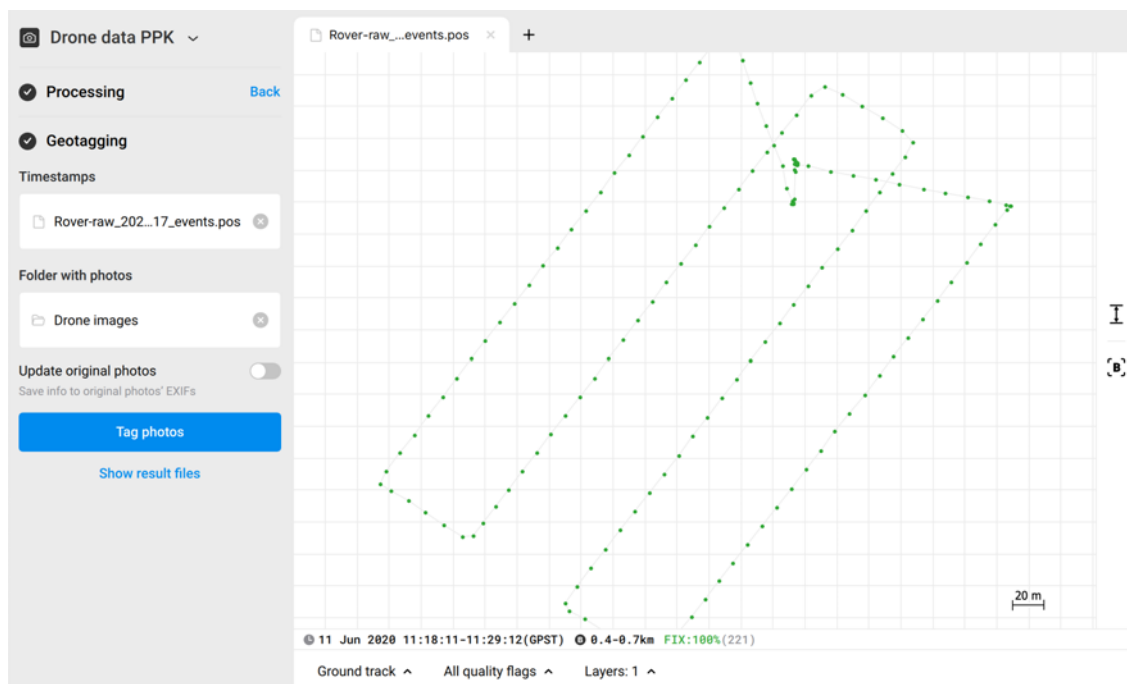
1. Select the folder that contains the photos from the drone's camera.

Note: Emlid Studio can only geotag photos when the number of timestamps is equal to the number of photos.

Tip: If you want to update the original photos with geotags, toggle *Update original photos*. By default, Emlid Studio creates geotagged copies of the photos in a new folder.



2. Click on the *Tag photos* button. The geotagging process will start. When the processing is over, you can click on *Show result files* to see the geotagged photos.



Once you have the geotagged photos, you can proceed with creating a map in the photogrammetry software.

Note: To create a map using Pix4DMapper, check the [Creating the map in Pix4DMapper tutorial](#).

3.5 Creating map in Pix4Dmapper

Tip: This is the third part of a guide describing the PPK mapping workflow with Reach. It implies you already have raw logs from both base and rover, set of images, and Ground Control Points. If you do not, please check the [Geotagging photos with Emlid Studio first](#).

At previous steps, we got centimeter-accurate geotags from Reach and georeferenced a set of images using this data in Emlid Studio. Now, we will turn it into a map.

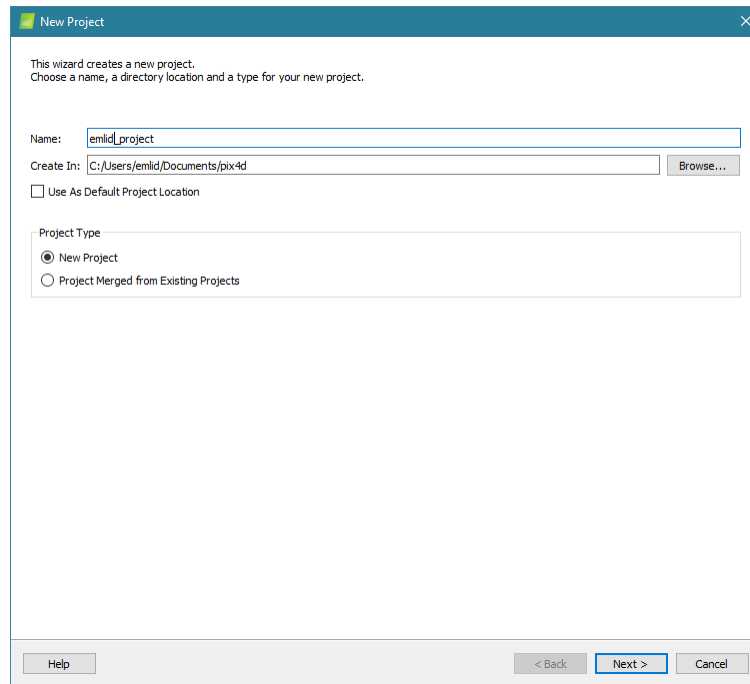
3.5.1 Create the map in Pix4Dmapper

Pix4Dmapper is a photogrammetry software for drone mapping by [Pix4D](#). It provides tools for creating digital maps and models and taking measurements based on them.

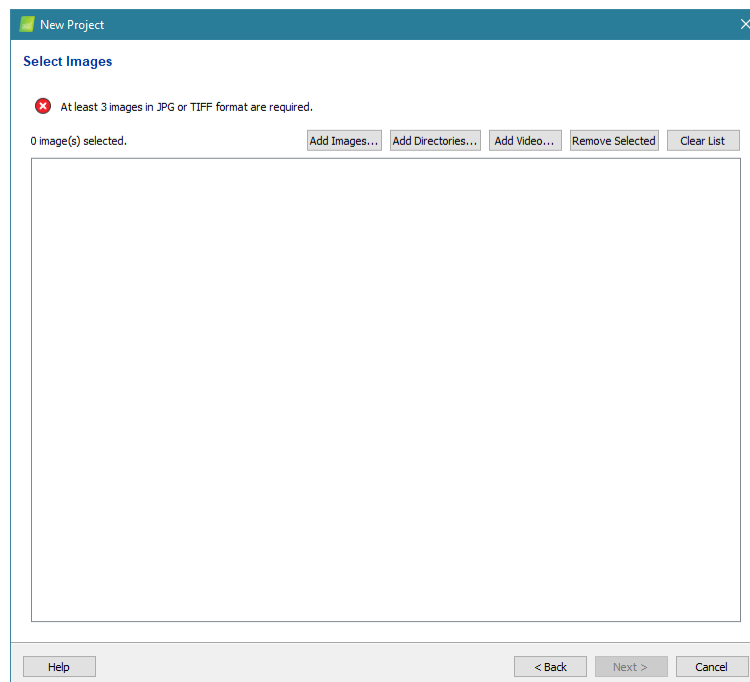
Create a new project

To create a new project in Pix4Dmapper:

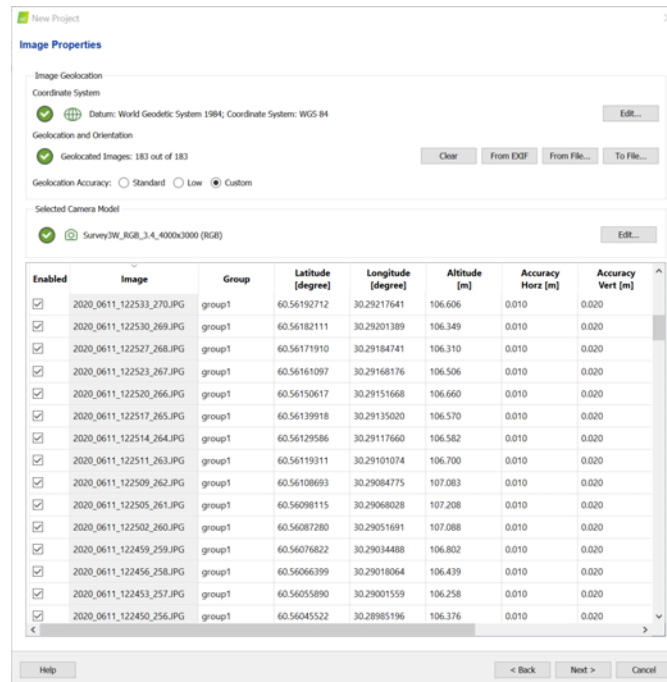
1. Start Pix4Dmapper.
2. Click *Project > New project...* The *New Project* window opens.
3. In the *New Project* window, enter a name and browse for a directory.



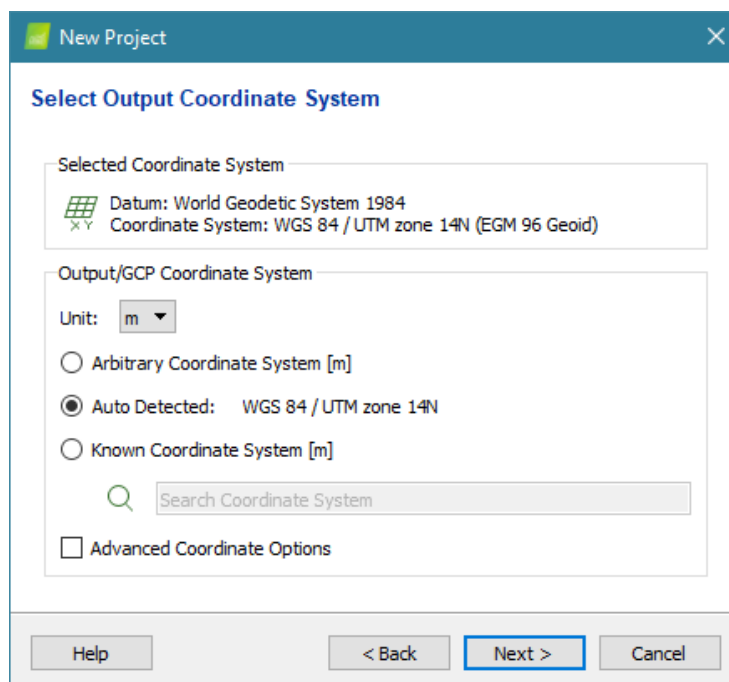
4. Click *Next*. The *Select Images* window opens.



5. Click *Add images*. Browse to the image folder and select the images. They will display in the window. Click *Next*.



6. In *Image Geolocation Editor - Coordinate System*, click *Edit...* and select *WGS 84* and *Geoid Height Above WGS 84 Ellipsoid [m] = 0* in *Advanced Coordinate Options*.
7. In *Image Properties Editor - Images Table* adjust the *Accuracy Horz* and *Accuracy Vert* values to reflect the estimated accuracy of image geolocation.
Tip: *The Camera Model is usually defined automatically from images' metadata. However, it can be changed if necessary.*
8. Select the *Output Coordinate System* that will be assigned to the generated results, for example, *DSM* and *orthomosaic*. If the images are georeferenced, a corresponding *UTM zone* will be auto-detected by default.

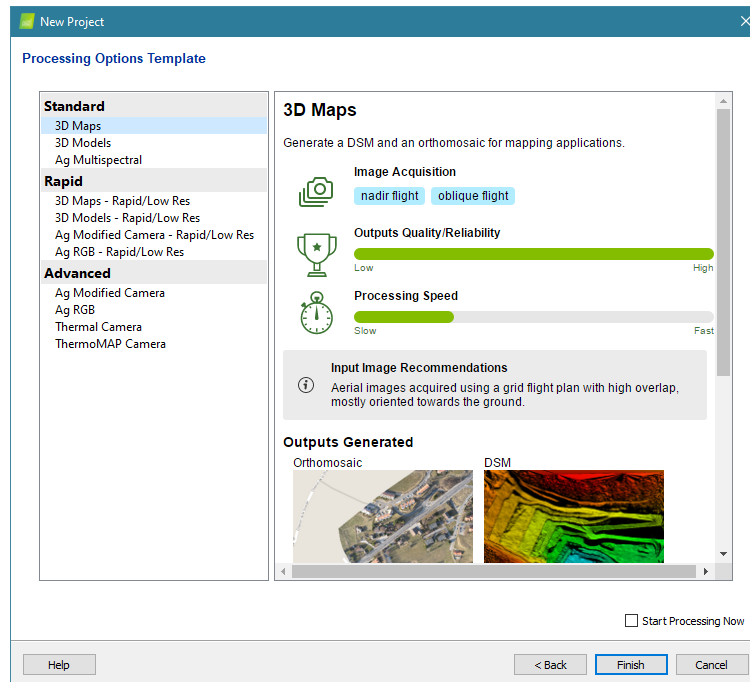


9. Choose *Processing Options Template*. The template defines parameters for each

processing step and generated outputs.

The quality of the reconstruction and the processing time depend on the chosen parameters. If the goal is to generate a DSM and an orthomosaic, the 3D Maps template can be selected.

Tip: *Digital Surface Model (DSM) is a raster data format with an elevation value for each pixel. Orthomosaic is a 2D map generated based on multiple images using orthorectification. This method removes the perspective distortions from the images using the DSM.*



Import GCPs

Tip: *Ground control points are optional for PPK mapping. If you do not have them, please, go to the Processing section.*

For this step, the file with Ground Control Points (GCPs) is needed. The file must be in either a .csv or .txt file format and contain a point name, latitude and longitude in degrees, and altitude for each point. Use a comma to separate the values:

GCP0,46.23456,6.56114,299.931

GCP1,46.23234,6.56234,299.823

...

Note: *Reach supports points export in .csv format only.*

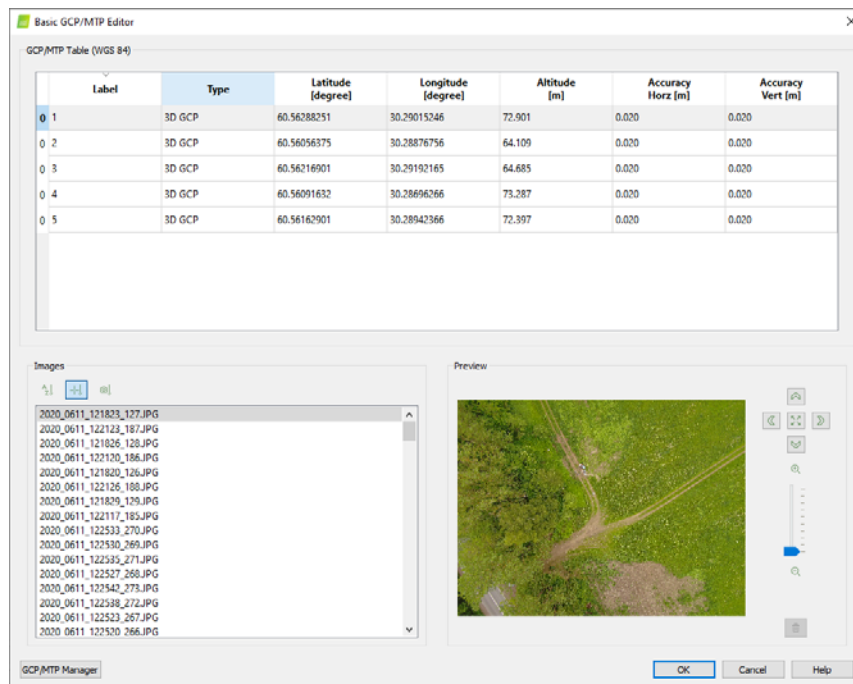
To mark the GCPs on images:

1. Click *Project > GCP/MTP Manager*.... The GCP/MTP Manager window opens.
2. Click *Import GCPs*. In the *Coordinates Order* drop-down list, choose an appropriate option, browse to the points file, press OK.

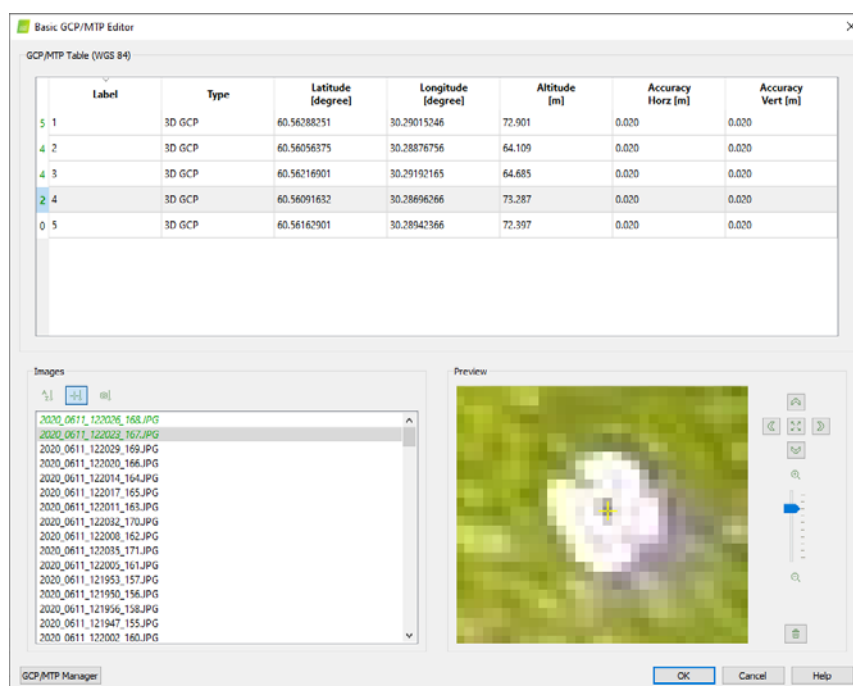
Tip: *For Reach, the default order of coordinates is longitude, latitude, altitude.*

3. In section *GCP/MTP Editor*, click *Basic Editor*.

Tip: *GCPs can also be marked in the rayCloud after Initial Processing has been completed. Learn more about this method on [Pix4D documentation](#).*



4. Choose *Sort Images by Distance to GCP* in *Images* section. The images are displayed in order from the closest to the selected GCP to the farthest.
5. Find and mark every point on 3 images at least. Marking instruments are in the *Preview* window.



6. Once all the points are marked, press *OK*.

Process data

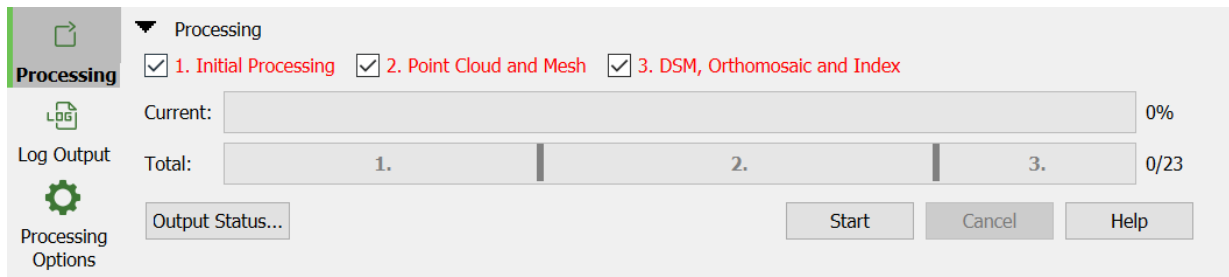
Note: *There are 3 parts of processing:*

1. *Initial processing:* Keypoints are identified and matched in neighboring images and used for project reconstruction.

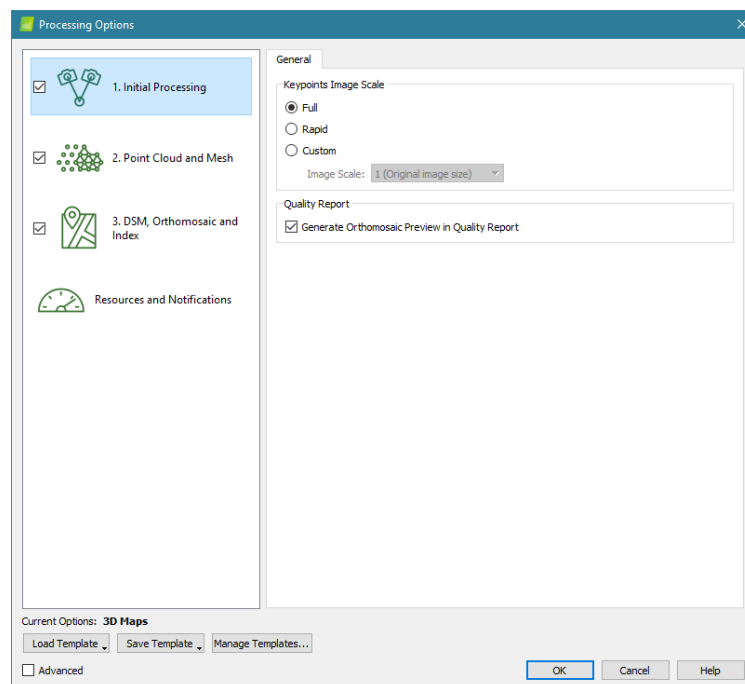
2. *Point Cloud and Mesh*: The dense point cloud and 3D triangulated mesh are computed based on the results of the previous step.
3. *DSM, Orthomosaic, and Index*: The DSM and orthomosaic are generated based on the dense point cloud.

To start processing the project:

1. Click *Processing* in the bottom left corner of the main window.
2. Select all three processing steps and click *Start*:

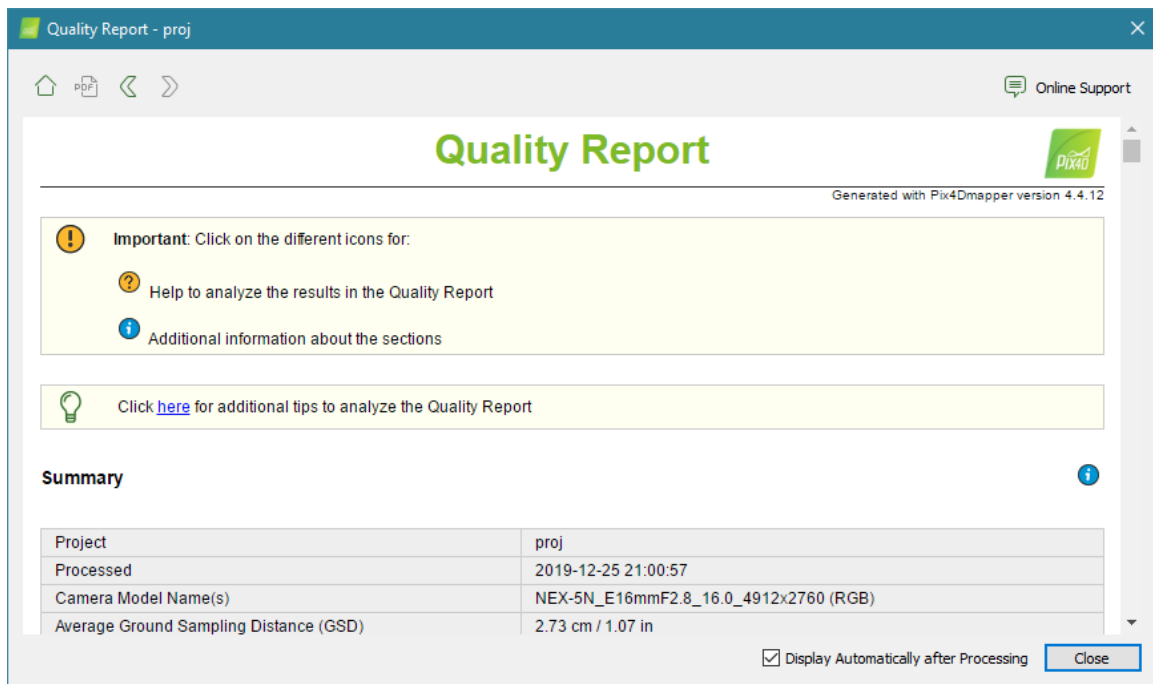


Tip: If necessary, processing steps' parameters can be changed in the *Processing Options* menu. For example, the density of point cloud or DSM/orthomosaic resolution. In this guide, we use the standard settings of the 3D Maps template.



At the end of each step, a Quality report is generated and can be used to verify the success of processing.

The processing is finished! Now you can export this orthomosaic to any GIS software to create a vector map based on it.



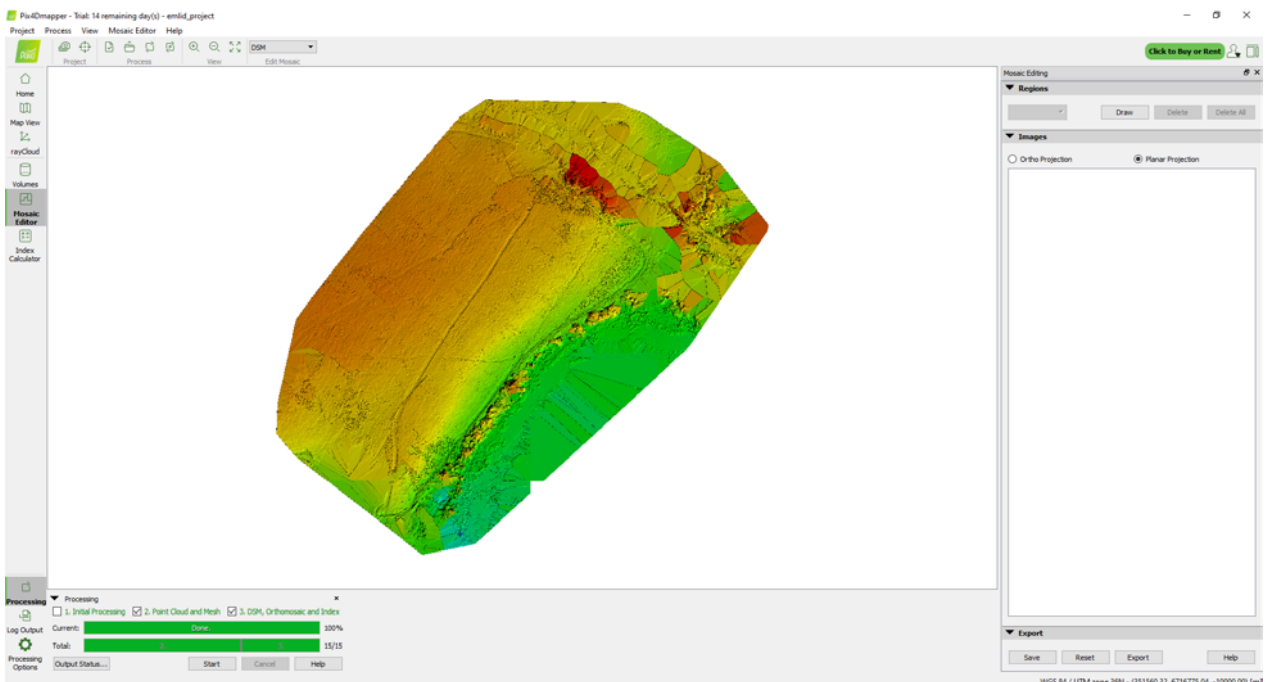
Get results

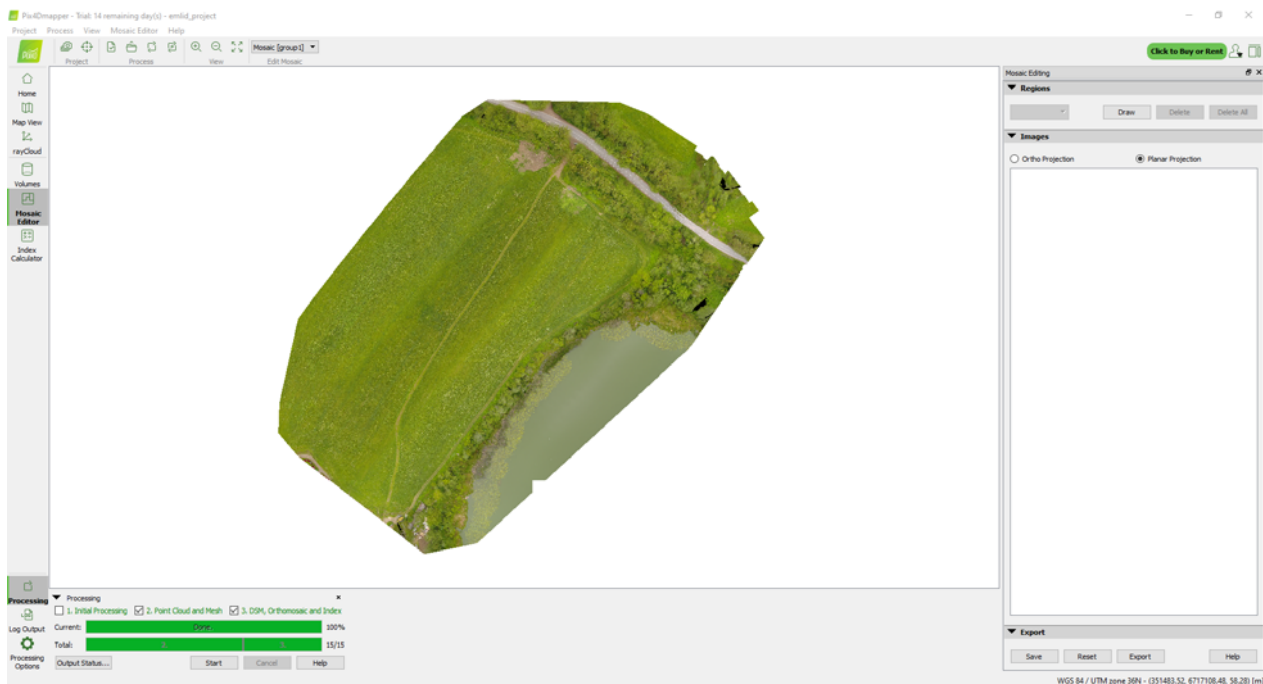
Once the project has been processed, it is possible to analyze and display results directly in Pix4Dmapper or import them in third-party software.

To open the folder with the results, on the Menu bar, click *Process > Open Results Folder...*

Tip: The *Orthomosaic* and *DSM* are stored in the */3_dsm_ortho/2_mosaic/* folder.

To visualize the orthomosaic or DSM in Pix4Dmapper, click the *Mosaic Editor* tab.





The processing is finished! Now you can export this orthomosaic to any GIS software to create a vector map based on it.

Note: To learn more about processing projects in the Pix4Dmapper, check the [Pix4D documentation](#).

3.6 How to Log Data for PPK

This guide shows how to record logs for Post-Processed Kinematic and download them using Emlid Flow.

3.6.1 Overview

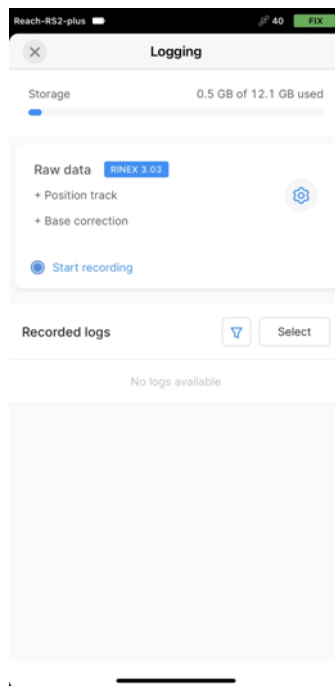
Post-Processed Kinematic or simply PPK is a technique that requires processing raw GNSS logs from both base and the rover to receive an accurate positioning track or separate points after the survey.

Tip: Check the [How PPK works](#) and [Configuring Reach UAV kit for PPK mapping guides](#) to learn more.

3.6.2 Recording RINEX logs on Reach

To record logs for PPK, perform the following steps both on your base and rover:

1. Open Emlid Flow and connect to your Reach.
2. On the *Receivers* screen, tap *Settings*.
3. Go to *GNSS settings* and set the update rate at 1 Hz for the base and at 5 Hz for the rover.
4. Go back to the *Receivers* screen and tap *Logging*.

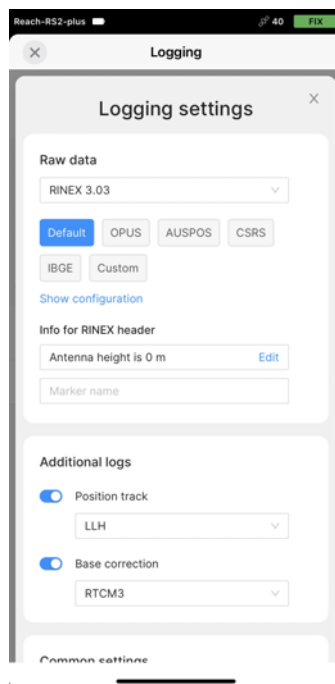


5. To configure logging, tap the *Settings* button.

6. Choose the required RINEX format in the *Raw data* section.

Note: *If you do not know which version of RINEX you need, we recommend using RINEX 3.03.*

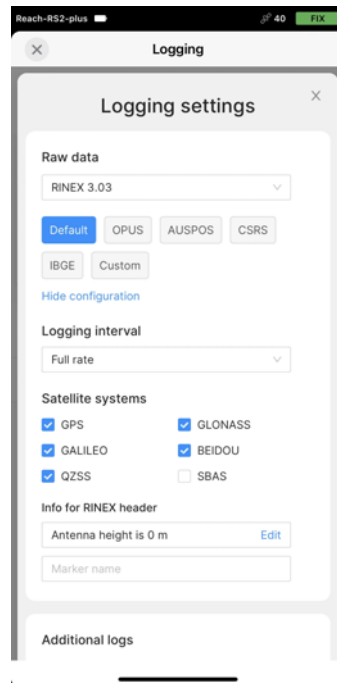
Tip: *While recording in the RINEX format, you can log the UBX file as a backup. UBX file can be used to adjust RINEX file settings in the Converter tool in Emlid Studio. You can enable logging in the UBX format in the logging settings in Emlid Flow.*



7. Tap *Show configuration* and select the required satellite systems.

Note: *Make sure that you have chosen the same set of satellite systems both on the rover and the base.*

8. Set the logging interval at *Full rate*.

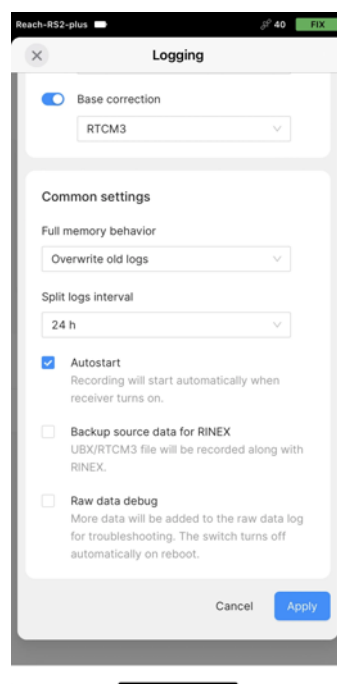


9. Tap *Show configuration* and enter the measured height to the bottom of the receiver in the corresponding field.

10. Leave the *Marker name* field empty.

11. Tap *Apply* and start.

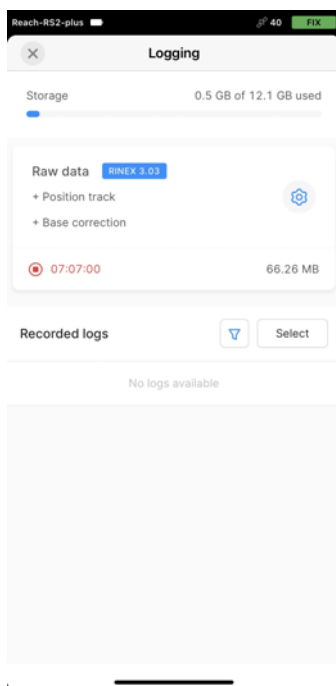
Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the *Raw data settings* screen.



12. Enable log recording by tapping the *Start recording* button.

13. To finish recording logs, tap the *End recording* button.

Caution: *Wait for data processing to finish.*

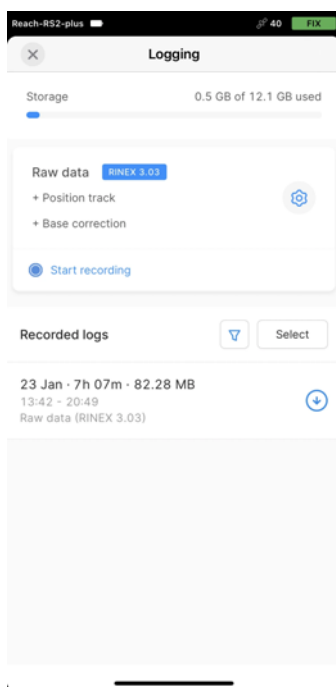


3.6.3 Download logs

After you finish raw data logging, you need to download RINEX data from Reach to your mobile device.

1. Go to the *Logs* section at the bottom of the *Logging* screen.

Note: *You can also find information on the logs size and recording date and time here.*



2. To export the file, tap the *Download* button.

3. Save your log depending on the device you use.

Tip: *If you do not need your logs anymore, you can delete them using the Select button.*

When your logs are downloaded, you can start working with your data in Emlid Studio.

3.7 How to Log Data for Stop & Go with Emlid Flow

This guide shows how to record logs for Stop & Go with Emlid Flow and download them using Emlid Flow.

3.7.1 Overview

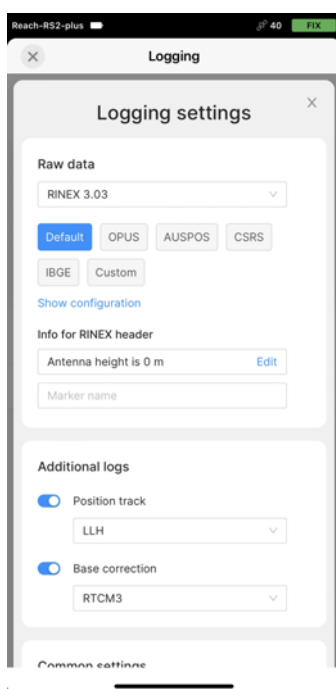
Stop & Go with Emlid Flow is a technique that involves the use of a base placed at a known point and a rover attending all unknown points and occupying each one for a short time. This workflow allows you to get separate points from the track of measurements using the logs from the base and the rover and a CSV from the Emlid Flow app.

Tip: *To learn more, check the [Stop & Go with Emlid Flow tutorial](#).*

3.7.2 Recording RINEX logs on Reach

To record the logs for Stop & Go with Emlid Flow, follow the steps below:

1. Open Emlid Flow and connect to your Reach.
2. On the *Receivers* screen, tap *Settings*.
3. Go to *GNSS settings* and set the update rate at 1 Hz for the base and at 5 Hz for the rover.
4. Go back to the *Receivers* screen and tap *Logging*.



5. Tap the *Recorded logs and settings* button.

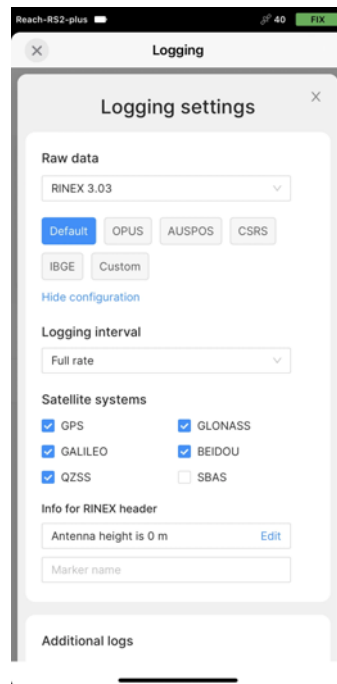
6. Choose the required RINEX format in the *Raw data* section.

Note: If you do not know which version of RINEX you need, we recommend using RINEX 3.03.

Tip: While recording in the RINEX format, you can log the UBX file as a backup. UBX file can be used to adjust RINEX file settings in the Converter tool in Emlid Studio. You can enable logging in the UBX format in the logging settings in Emlid Flow.

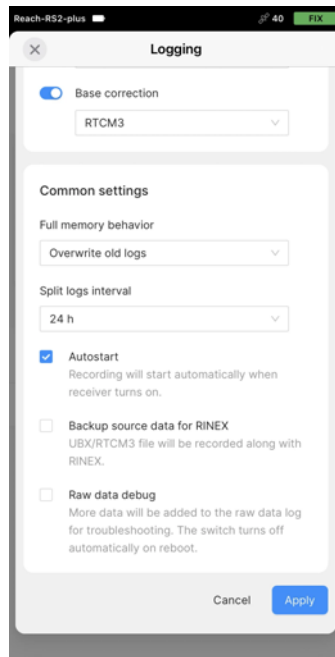
7. Tap *Show configuration* and select the required satellite systems.

Note: Make sure that you have chosen the same set of satellite systems both on the rover and the base.



8. Set the logging interval at *Full rate*.
9. Use antenna height and enter the measured height to the bottom of the receiver for the base. Don't use it for the rover.
10. Leave the *Marker name* field empty.
11. Tap *Apply* and start.

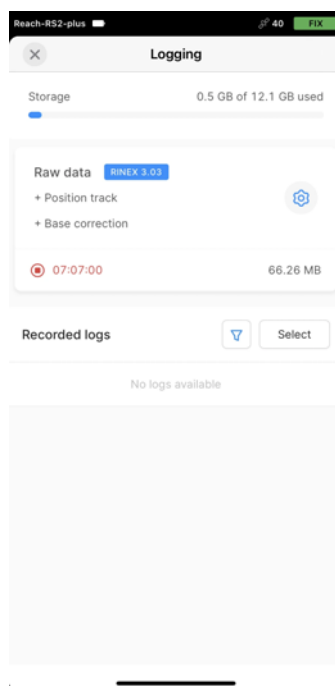
Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the Raw data settings screen.



12. Enable log recording by tapping the *Start recording* button.

Tip: Now you are ready to collect the points. To learn more, check the [Collect points guide](#).

13. To finish recording logs, tap the *End recording* button.



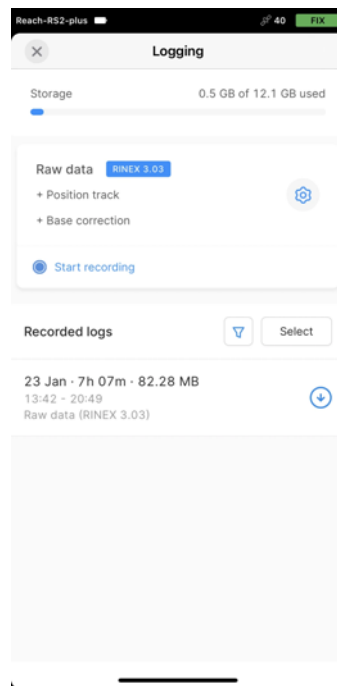
Caution: Wait for data processing to finish.

3.7.3 Download logs

After you finish raw data logging, you need to download RINEX data from Reach to your mobile device.

1. Go to the *Logs* section at the bottom of the *Logging* screen.

Note: You can also find information on the logs size and recording date and time here.



2. To export the file, tap the *Download* button.
3. Save your log depending on the device you use.

Tip: If you do not need your logs anymore, you can delete them using the *Select* button.

When your logs are downloaded, you can start working with your data in Emlid Studio.

3.8 How to log data for PPP

This guide shows how to record logs for the Precise Point Positioning services and download them using Emlid Flow.

3.8.1 Overview

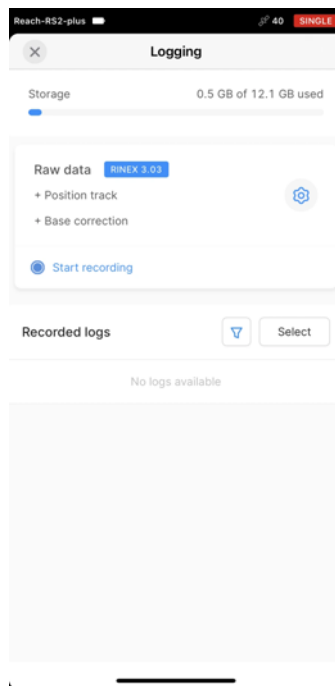
Precise Point Positioning is a technique that requires processing a raw data log from the standalone receiver for further removing or modeling GNSS system errors to provide a high level of position accuracy.

Tip: To learn more about PPP, check the [How PPP works](#) article.

3.8.2 Recording RINEX logs on Reach

To record logs for PPP, perform the following steps:

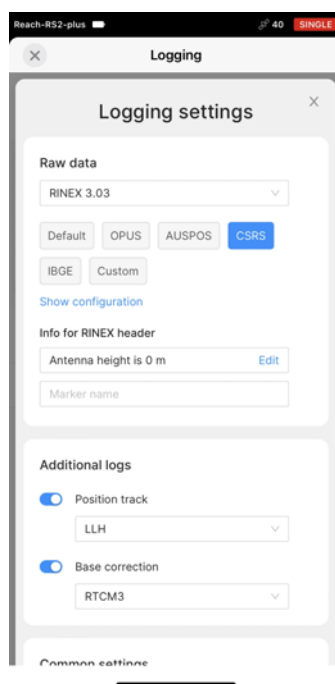
1. Open Emlid Flow and connect to your Reach.
2. Go to the *Logging* screen.



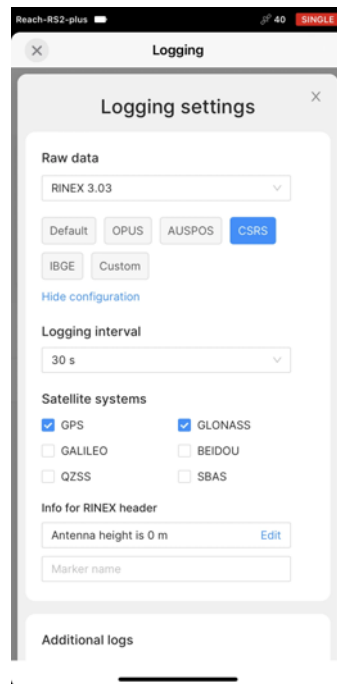
3. Tap the *Recorded logs and settings* button.
4. To configure logging, tap the *Settings* button.
5. Select the preset depending on the PPP service you choose.
6. Choose the required RINEX format in the *Raw data* section.

Note: If you do not know which version of RINEX you need, we recommend using RINEX 3.03. However, make sure the PPP service you choose supports this version of RINEX.

Tip: While recording in the RINEX format, you can log the UBX file as a backup. UBX file can be used to adjust RINEX file settings in the Converter tool in Emlid Studio. You can enable logging in the UBX format in the logging settings in Emlid Flow.



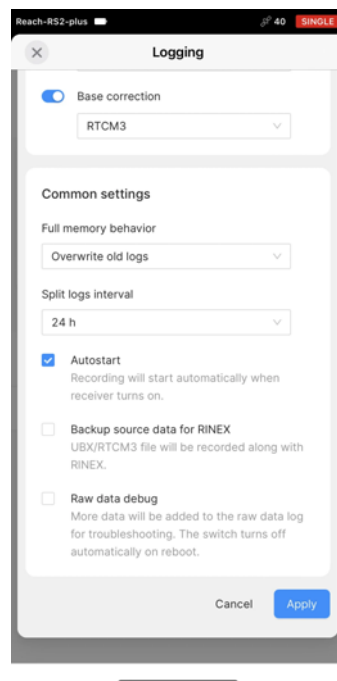
7. Tap *Show configuration* and enter the measured height to the bottom of the receiver in the corresponding field.



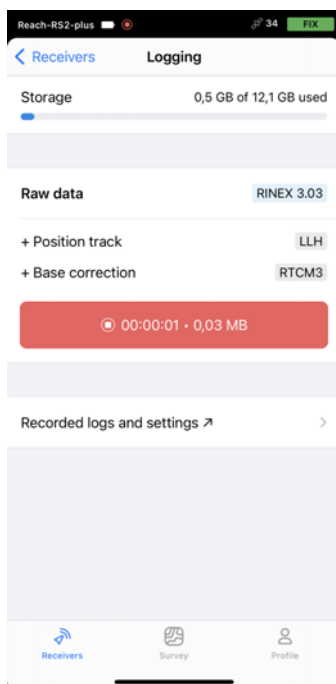
8. Fill in the point's name in the *Marker name* field.

9. Tap *Apply*.

Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the *Raw data settings* screen.

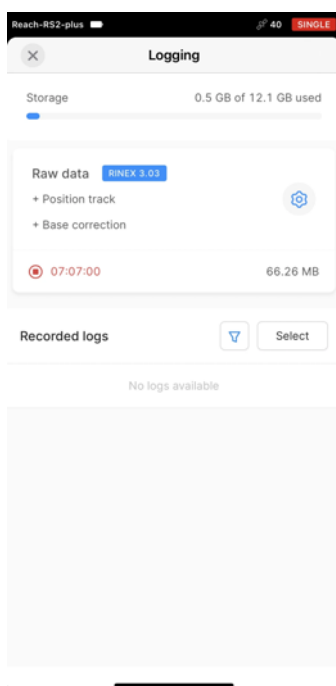


10. Enable log recording by tapping the *Start recording* button. The red recording icon will appear in the status bar.



Note: PPP services requires recording the data for at least 4 hours to get the best accuracy.

11. To finish recording logs, tap the *End recording* button.



Caution: Wait for data processing to finish.

Tip: You may log the data for up to 24 hours, depending on the accuracy required.

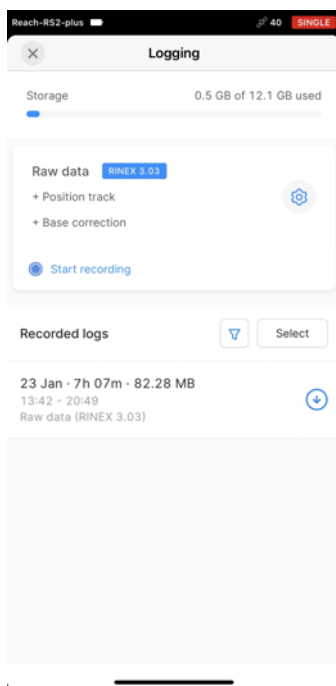
Once you finish the survey, don't forget to turn off raw data recording in the logging settings.

3.8.3 Downloading logs

After you finish raw data logging, you need to download RINEX data from Reach to your mobile device.

1. Go to the *Logs* section at the bottom of the *Logging* screen.

Note: You can also find information on the logs size and recording date and time here.



2. To export the file, tap the *Download* button.
3. Save your log depending on the device you use.

Tip: If you do not need your logs anymore, you can delete them using the *Select* button.

When the logs are downloaded, you can start working with your data in the PPP service.

3.9 How to log data for OPUS

This guide shows how to record logs for NOAA's Online Positioning User Service (OPUS) and download them using Emlid Flow.

3.9.1 Overview

Online Positioning User Service (OPUS) is provided by the National Oceanic and Atmospheric Administration (NOAA). With OPUS, you may accurately determine the coordinates of a static point mostly on the territory of the US without real-time corrections or a base station nearby.

Tip: Check this [map](#) to see if the service is available in your region.

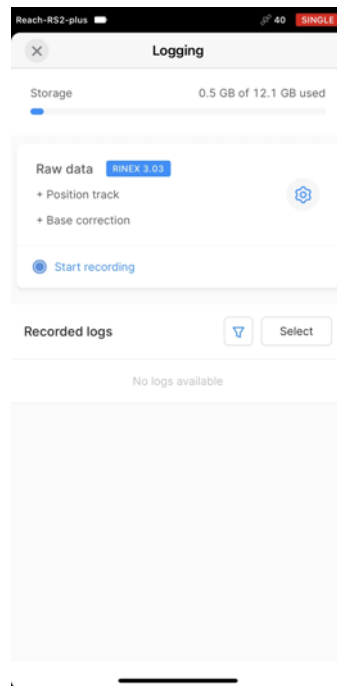
Tip: You can learn more about the NOAA's OPUS on their [official site](#).

3.9.2 Recording RINEX logs on Reach

To record logs for OPUS, follow the steps below:

1. Open Emlid Flow and connect to your Reach.

2. Go to the *Logging* screen.



3. Tap the *Recorded logs and settings* button.

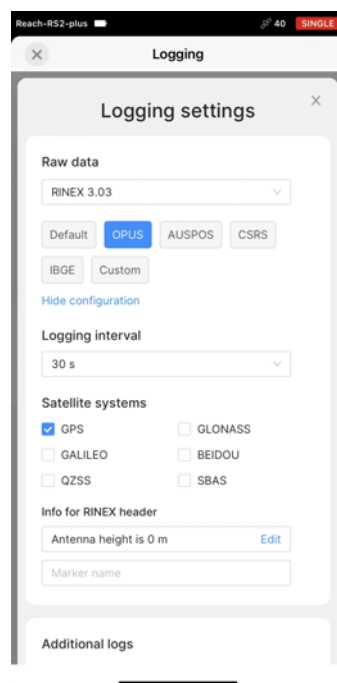
4. To configure logging, tap the *Settings* button.

5. Select the *OPUS* preset.

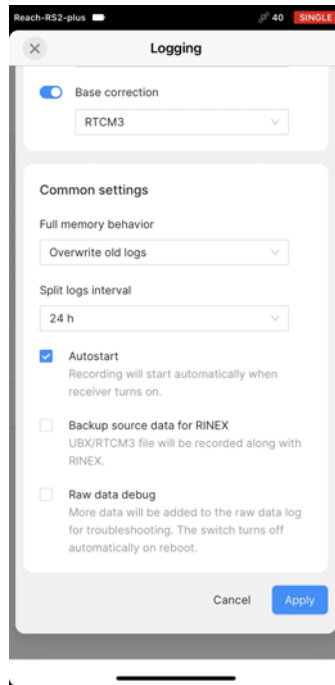
6. Choose the required RINEX format in the *Raw data* section.

Note: If you do not know which version of RINEX you need, we recommend using RINEX 3.03.

Tip: While recording in the RINEX format, you can log the UBX file as a backup. UBX file can be used to adjust RINEX file settings in the Converter tool in Emlid Studio. You can enable logging in the UBX format in the logging settings in Emlid Flow.

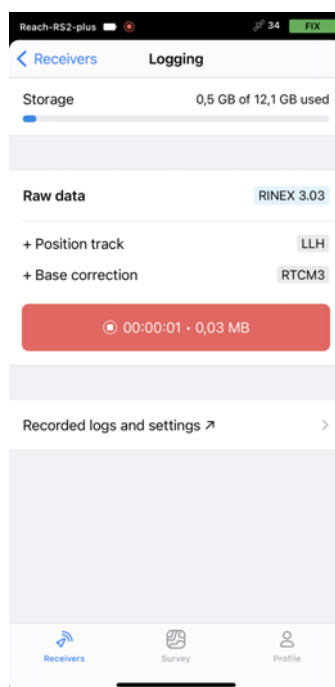


7. Tap *Show configuration* and enter the measured height to the bottom of the receiver in the corresponding field.
8. Fill in the point's name in the *Marker name* field.
9. Tap *Apply*.



Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the *Raw data settings* screen.

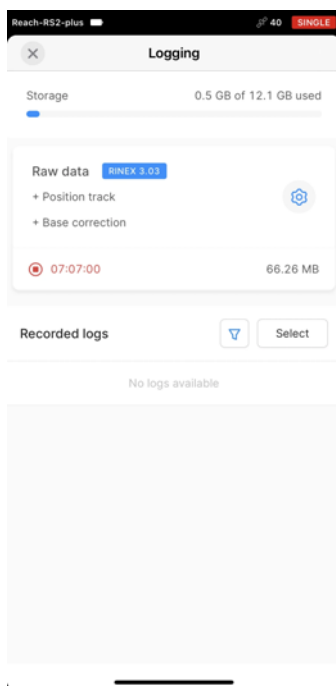
10. Enable log recording by tapping the *Start recording* button. The red recording icon will appear in the status bar.



Note: NOAA's OPUS requires recording the data for at least 4 hours to get the best accuracy.

11. To finish recording logs, tap the *End recording* button.

Caution: *Wait for data processing to finish.*



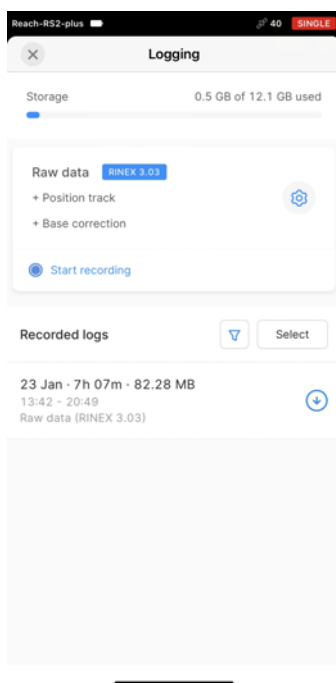
Tip: *You may log the data for up to 24 hours, depending on the accuracy required.*
Once you finish the survey, don't forget to turn off raw data recording in the logging settings.

3.9.3 Downloading logs

After you finish raw data logging, you need to download RINEX data from Reach to your mobile device.

1. Go to the *Logs* section at the bottom of the *Logging* screen.

Note: *You can also find information on the logs size and recording date and time here.*



2. To export the file, tap the *Download* button.

3. Save your log depending on the device you use.

Tip: *If you do not need your logs anymore, you can delete them using the Select button.*

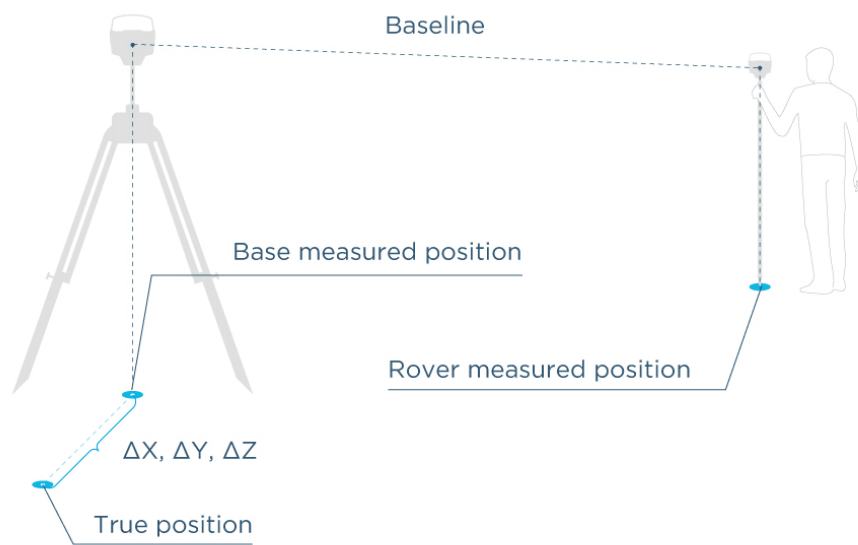
When the logs are downloaded, you can submit the data to NOAA's OPUS for processing.

4 Base Setup

4.1 Choosing base setup method

4.1.1 Overview

Real-Time Kinematic (RTK) is a technique that enhances the accuracy of GNSS positioning by using two receivers—a stationary base with known coordinates and a moving rover. The rover measures its position relative to the base. This means that even though measured with the centimeter precision, the coordinates of the rover are only as accurate as the base placement. Any shift in the absolute base position will also be present in the rover measurements.



For some applications, it is sufficient when the position of an object is only accurate relative to the base station, but for surveying and mapping, it is critical to know the true position with high absolute accuracy. To achieve this, the error in the base station position should be avoided or reduced by placing it over a known point or carefully determining its coordinates.

That's why it's important to pay close attention to proper positioning when setting up the base. Let's take a look at the key concepts that will help you understand how to properly set up the base for your needs.

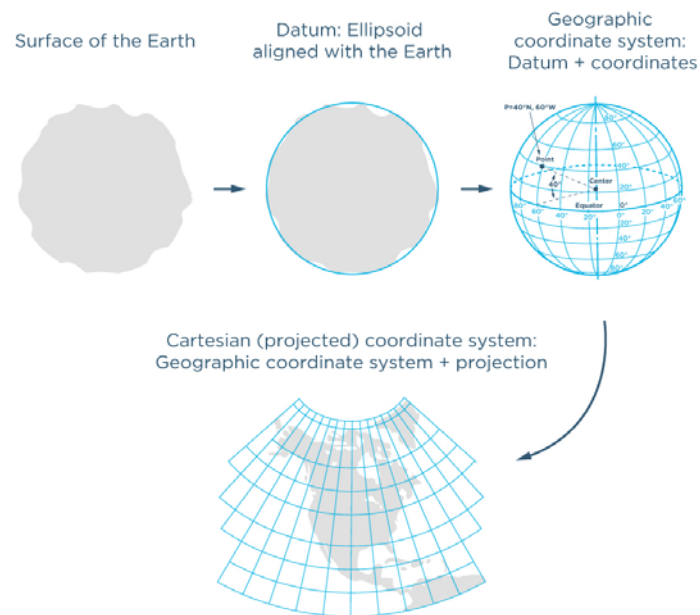
4.1.2 Coordinate systems and datums

The first thing to consider before setting up the base for RTK is the coordinate system that you are going to use for the measurements.

In surveying, the position of an object in space is defined by a coordinate system. There are many coordinate systems designed for different applications and countries. The foundation of every coordinate system is datum.

Datum contains the information about the mathematical model of the Earth (ellipsoid) and how it is aligned with the Earth's surface, providing the reference frame for the

measurements. A coordinate system is then used to describe the positions relative to the datum with latitude and longitude. For a flattened Cartesian representation of the coordinates, a cartographic projection is applied.



It is important to choose the correct datum and coordinate system for the area you are working in if you want your measurements to be compatible with the other existing data. Mixing datums is like mixing kilometers and miles—your measurements won't make sense.

The required datum and coordinate system are usually given in the technical assignment or official documentation. In some cases, you can look for the coordinate system optimized for your area in the EPSG Geodetic Parameter Dataset (aka EPSG registry).

The whole setup then ends with the project setup on your rover which requires specifying a coordinate system that is usually based on the datum of your base.

Tip: Learn more about the coordinate system setup in Emlid Flow & Emlid Flow 360 in the [Introduction to the coordinate systems](#) article.

4.1.3 Positioning

After setting up a coordinate system, you need to decide how you are going to set the base coordinates. In general, there are two ways to set the position of your base—specify the known point coordinates or average the position of your base in SINGLE.

In both cases, the rover measurements will be centimeter-precise, but the absolute accuracy will always depend on the accuracy of the base position. Depending on the base setup method, you can obtain high relative accuracy (averaging in SINGLE) or absolute accuracy (using the known coordinates).

Tip: Learn more about absolute and relative accuracy in the [Simple intro to accuracy and precision](#) article in our blog.

Relative positioning

As mentioned earlier, in RTK, the base serves as the main reference point for the rover. Coordinates collected by the rover are always accurate relative to the base, but may not

be accurate relative to the selected coordinate system. This is called relative positioning and occurs when the position of the base station is not accurately defined in the selected reference frame.

For example, when you don't know the base position, you can average it in SINGLE. Averaging is done in standalone mode without using any corrections, and the position is determined with the accuracy of several meters. Each time you average the base position from the same point, the measured coordinates may differ by several meters from the previous results and from the true position. Thus, the actual (absolute) accuracy of the rover measurements will be at meter level. See Figure 1 below.

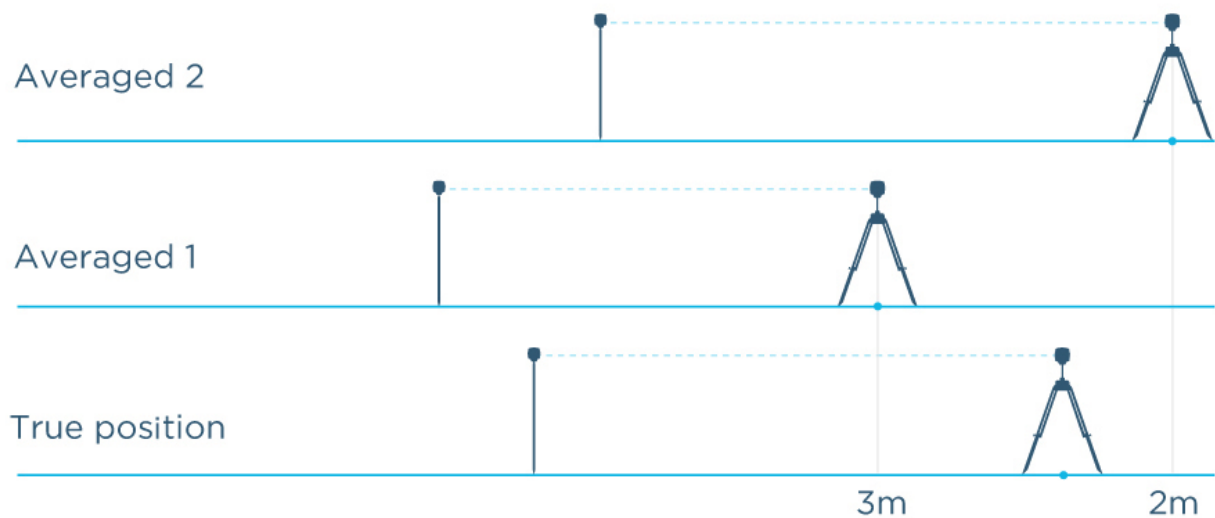


Figure 1

This type of setup is suitable when you need to measure the objects relative to each other. For example, this method can be used to measure areas and distances, or to keep an autonomous tractor on the right track. To reuse the setup and get the same coordinates for the same points, you'll need to place the base over the same point (using a mark on the ground is a good idea) and enter the same previously determined base coordinates manually or pick them from the saved ones in Emlid Flow. Otherwise, you may end up with a different base position that won't fit your project and lead to coordinates mismatch.

If you want to learn more about this method, check out our [guide on using Average SINGLE coordinates entry method in Emlid Flow](#).

Absolute positioning

When the positions collected in RTK are accurate both relative to the base and to the selected coordinate system, it is called absolute positioning. To achieve this, the coordinates of the base must be known and set manually. Entering the known position of the base “pins” your RTK setup to the right place on the ground. This way, the positions measured with the rover will be precise and accurate in the selected coordinate system to the centimeter level. See Figure 2 below.

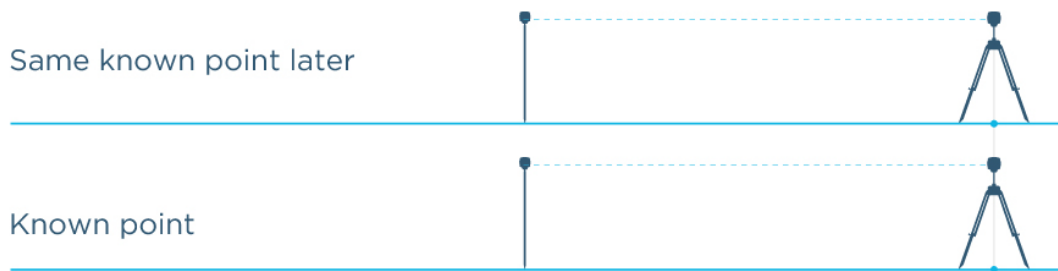


Figure 2

We recommend setting up the base using the manual coordinates entry method if you want to get precise and repeatable results in a selected coordinate system. Working with a known base position is necessary when you plan to use the collected measurements with the other data, for example, submit the surveyed parcel boundaries to the land registry. There are several ways to get known coordinates to set up the base:

- Place the base over the existing known point or benchmark using the Manual coordinates entry method in the Emlid Flow app;
- If the benchmark is located in hard to reach point but you're nearby, you can use the benchmark coordinates to apply the base shift feature in Emlid Flow;
- Set your base's coordinates with absolute centimeter accuracy using the Average FIX coordinates entry method by setting it up as a rover and receiving corrections from the NTRIP service;
- Determine the coordinates of a point using the Static processing workflow in Emlid Studio or online post-processing services such as OPUS, AUSPOS, NRCAN, IBGE.

4.2 Setting up base position manually

This guide explains how to use the Manual coordinates entry method in the Emlid Flow app to set up base over a known point.

4.2.1 Overview

The Manual coordinates entry method in the Emlid Flow app allows you to enter the position of your base when you have a point with known coordinates in DD or DMS LLH format. In this case, the positions measured with the rover will be precise and accurate in the selected coordinate system to the centimeter level.

Note: To learn more about the accuracy for RTK and PPK measurements, read our [Simple Intro to Accuracy and Precision](#) article.

4.2.2 Workflow

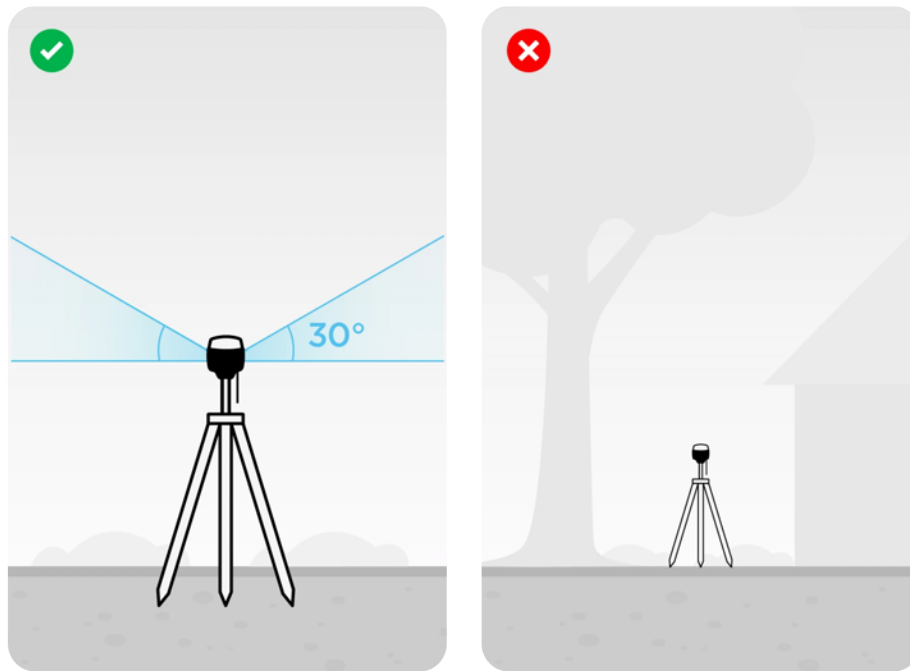
Placing base in field

To place your base station in the field, follow the recommendations below.

Clear sky view without any obstacles

Reach base needs to have a clear sky view 30 degrees above the horizon. There should be no obstacles that could block the view like buildings, trees, cars, humans, laptops, etc.

Take a look at 2 pictures below. The left picture demonstrates desirable conditions for Reach location. The right one is an example of poor surrounding conditions such as the reduced view of the sky, possible obstructions or vegetation nearby.



Examples of **recommended** environments for Reach placement:

- field
- top of the hill
- rooftop

Examples of **poor** environments for Reach placement:

- indoors
- urban area
- forestry area

No electronics nearby

Electronic devices may produce RF noise that could affect the reception of the GNSS signal. Keep all electronics as far as possible from Reach.

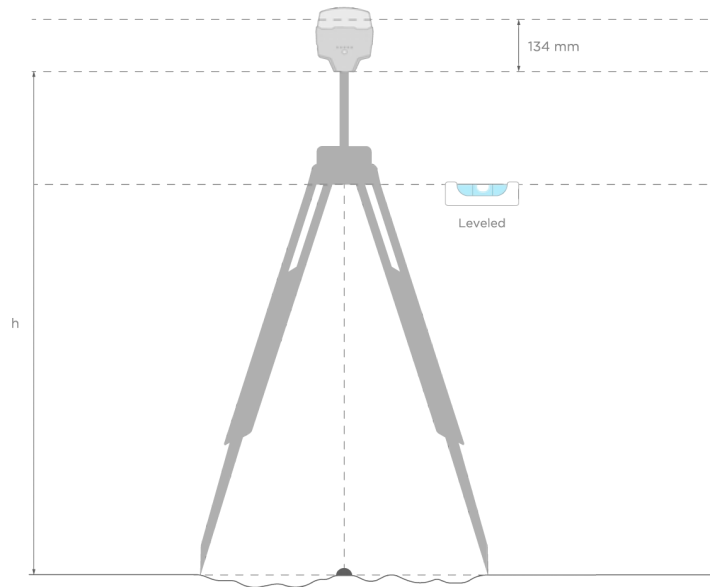
Measuring antenna height offset

When placing your Reach in the field, make sure your Reach device is placed precisely above the marked point on the tripod and leveled. When you are setting up base coordinates manually, you need to measure the antenna height offset. Follow the steps below:

1. Measure the distance from the mark to the bottom of your Reach (h in Figure 1).

2. Specify the measured distance in Emlid Flow. It will automatically calculate the antenna height.

Note: For Reach RS2/RS2+, the antenna height is the distance from the mark on the ground to the center point on the Reach's bottom (h in Figure 1), antenna reference point (ARP), plus the height of the receiver to the antenna phase center (APC), antenna height offset. Emlid Flow automatically adds the antenna height offset, which is 134 mm.

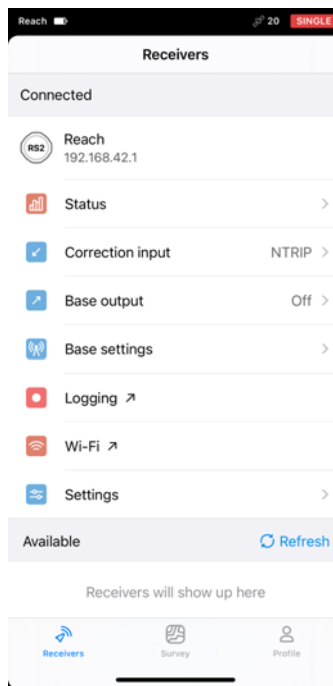


When you placed Reach over the mark and measured the antenna height, you are ready to set up the base position in the Emlid Flow app.

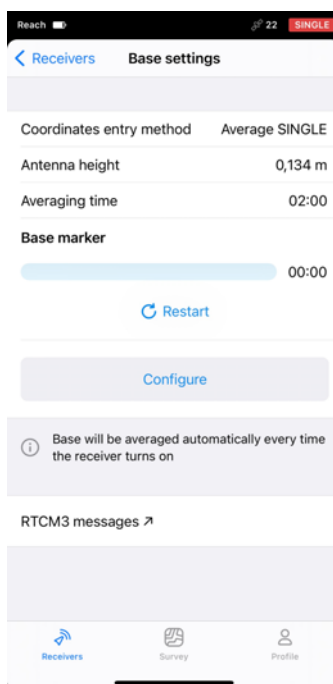
Setting up base's coordinates in Emlid Flow

To set up your base using the Manual coordinates entry method in Emlid Flow, follow the steps below:

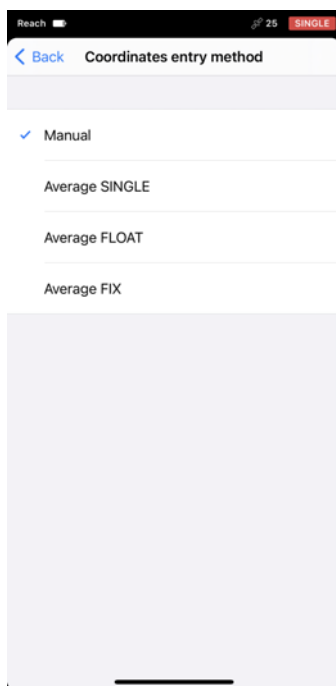
1. Open the Emlid Flow app and connect to your Reach.



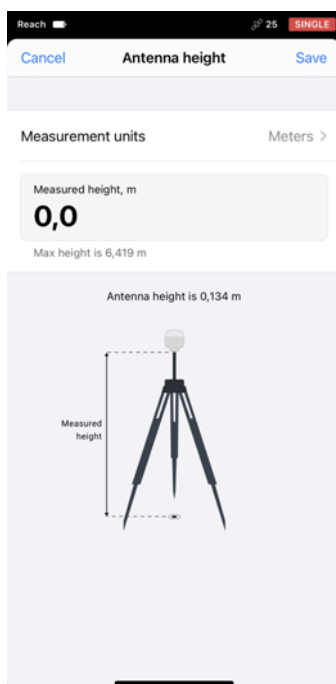
2. Go to *Base settings* of your Reach and tap *Configure*.



3. Tap *Coordinates entry method* and select *Manual* from the menu.



4. Tap *Antenna height* to set the antenna height and save it.



5. Enter the geographic coordinates of your point in DD or DMS format, or import a point from your Emlid project by tapping *Choose from project*.

Note: *If your known point has local coordinates, add it to your Emlid project and use the point picker option to set it as a base's coordinates. Emlid Flow will convert this coordinates into geographic ones.*

Reach 30 SINGLE

Cancel Configure base Save

Coordinates entry method
Manual

Antenna height 1,934 m

COORDINATES

Choose from project

DD DMS

Longitude, deg
Required

Latitude, deg
Required

Ellipsoidal height, m
Required

Reach 26 FIX

< Point Confirm base position

66
FIX Djuro Strugar Park

Point name
66

Description
pavement

Import time
08 Aug 2023 · 18:46:01

Collection time
Start: 08 Aug 2023 · 17:08:33
End: 08 Aug 2023 · 17:08:33
Dur.: 00:00:00
Samples: 1

Apply

6. Once you've set the coordinates of the point, tap *Save* in the upper right corner. The coordinates of your base are now set, and you are ready to proceed with creating a project on your rover.

Note: After setting up coordinate system for your project on the rover, make sure to specify the same datum as on the base while configuring rover's coordinate system in the survey project.

4.3 Averaging base position in FIX

This guide explains how to use the Average FIX coordinates entry method in the Emlid Flow app to obtain the coordinates of a known point and set up your base over it.

4.3.1 Overview

The Average FIX method allows you to determine the base's coordinates with absolute centimeter accuracy. In this case, your base acts as a rover which receives the correction data from an NTRIP service via the internet.

Tip: *You can find out how to get corrections from an NTRIP service in the [Working with NTRIP service guide](#).*

4.3.2 Workflow

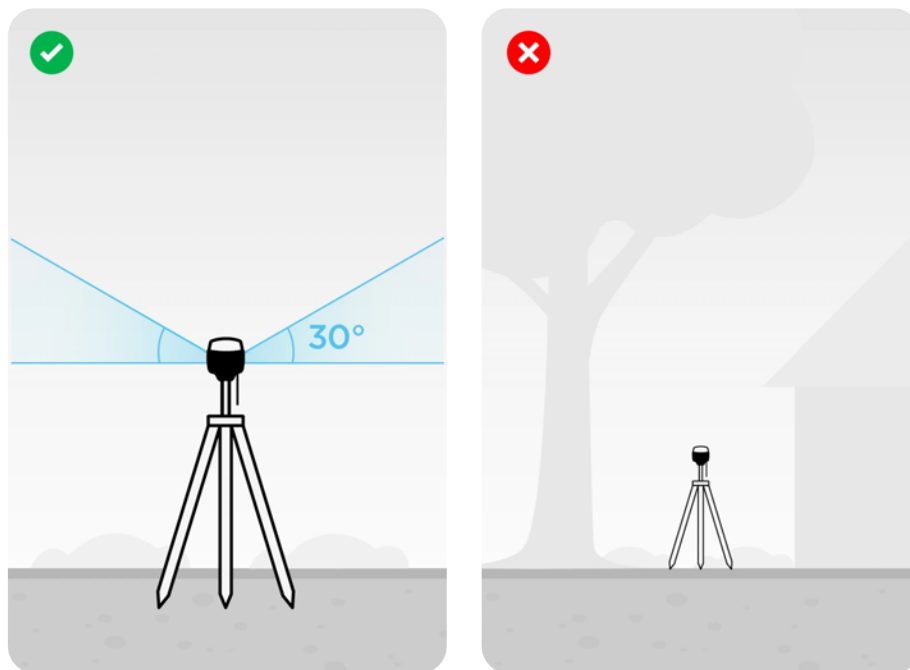
Placing base in field

To place your base station in the field, follow the recommendations below.

Clear sky view without any obstacles

Reach base needs to have a clear sky view 30 degrees above the horizon. There should be no obstacles that could block the view like buildings, trees, cars, humans, laptops, etc.

Take a look at 2 pictures below. The left picture demonstrates desirable conditions for Reach location. The right one is an example of poor surrounding conditions such as the reduced view of the sky, possible obstructions or vegetation nearby.



Examples of **recommended** environments for Reach placement:

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- top of the hill
- rooftop

Examples of **poor** environments for Reach placement:

- indoors
- urban area

- forestry area

No electronics nearby

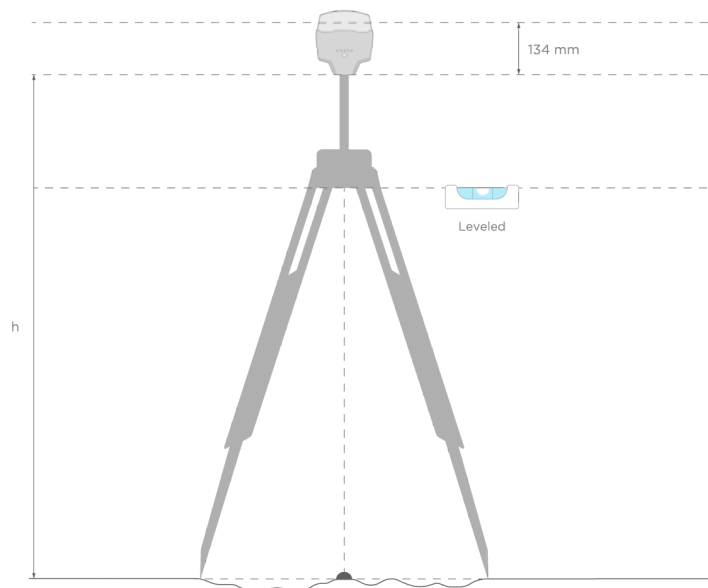
Electronic devices may produce RF noise that could affect the reception of the GNSS signal. Keep all electronics as far as possible from Reach.

Measuring antenna height offset

When placing your Reach in the field, make sure your Reach device is placed precisely above the marked point on the tripod and leveled. When you are setting up base coordinates manually, you need to measure the antenna height offset. Follow the steps below:

1. Measure the distance from the mark to the bottom of your Reach.
2. Specify the measured distance in Emlid Flow. It will automatically calculate the antenna height.

Note: For Reach RS2/RS2+, the antenna height is the distance from the mark on the ground to the center point on the Reach's bottom (h in Figure), antenna reference point (ARP), plus the height of the receiver to the antenna phase center (APC), antenna height offset. Emlid Flow automatically adds the antenna height offset, which is 134 mm.

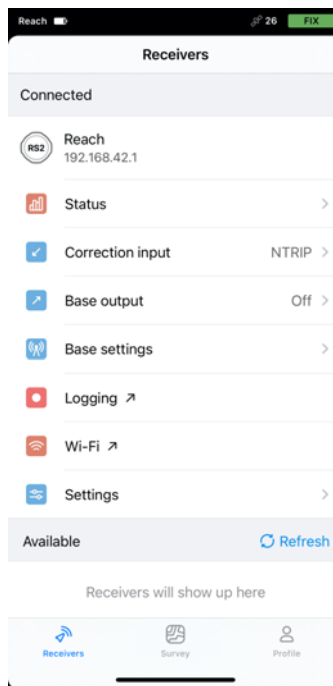


When you placed Reach over the mark and measured the antenna height, you are ready to set up the base position in the Emlid Flow app.

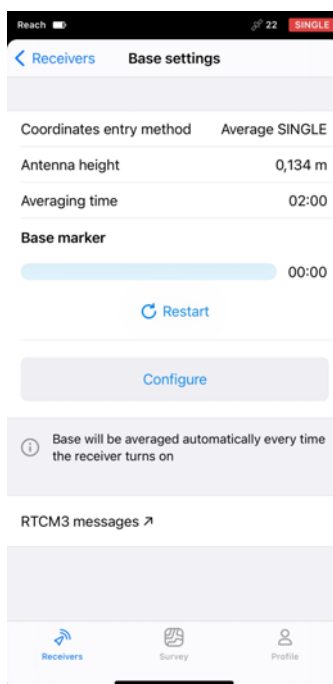
Setting up base's coordinates in Emlid Flow

Once your base receives RTK corrections from the NTRIP service, follow these steps to get your base's coordinates in the Emlid Flow app:

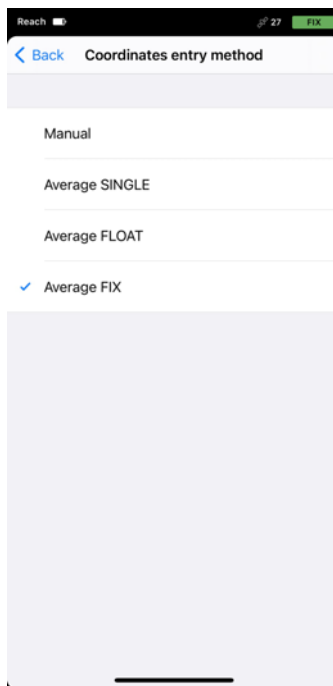
1. Open the Emlid Flow app and connect to your Reach.



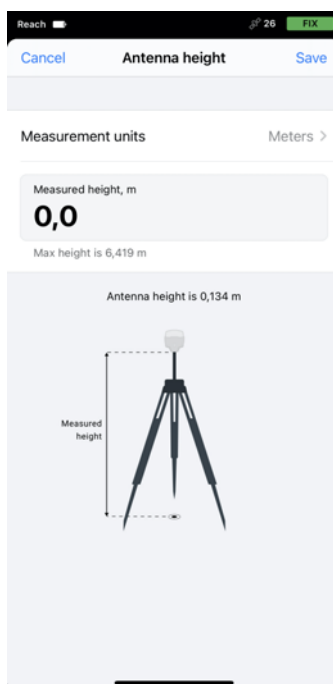
2. Go to *Base settings* and tap *Configure*.



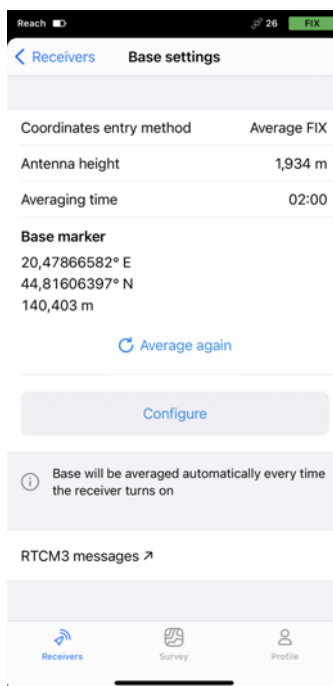
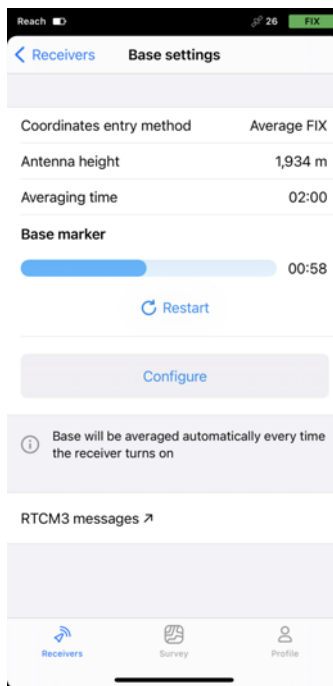
3. Tap *Coordinates entry method* and select *Average FIX* from the menu.



4. Tap *Antenna height* to set the antenna height and save it.



5. Set averaging time and tap *Save*. After accumulating the data, you will see averaged coordinates in the *Base marker* section.



Note: After setting up coordinate system for your project on the rover, make sure that your rover and base are in the same datum by checking the note in the project info.

Now your base's coordinates are set, and you can continue setting up a project on your rover.

4.4 Applying base shift

This guide explains how to apply the base shift in Emlid Flow to calibrate all further collected data in your survey project.

4.4.1 Overview

With the Base shift feature, Emlid Flow helps you calibrate your survey project data based on one point—it applies an XYZ shift to the base's ECEF coordinates in real time. The app calculates the difference between the known and measured points and applies a linear shift to all further collected points within one project.

Base shift can be applied independently of the used coordinate system—you can apply it to survey projects in local coordinate systems, for example, in UTM.

The Base shift feature helps you calibrate the survey data when there is a difference between the known and current base coordinates. You may need this in the following cases:

- When it is impractical to place your base over a permanent survey mark (PSM). For example, you cannot provide a clear sky view in this area, which may compromise the quality of the base logs.
- When you exceed the baseline and need to relocate your base.

Note: *The calculated shift is stored in the attributes of a particular survey project, applies to all further collected points, and cannot be auto-applied to another project.*

4.4.2 Calibrate your base's position relative to a PSM

This workflow describes the case when you want to survey the field using a permanent survey mark located in a hard-to-reach place. It is not convenient to install a tripod in this area or leave the base unattended. Or it is just simply a limited sky view that may compromise the quality of base logs. Here, the Base shift feature comes in handy—you can place your base in proper conditions nearby the permanent survey mark, collect the permanent survey mark with a rover and calibrate all further collected data in your survey project relative to it.

In this case, all you need is two points in the project:

- A known point, which is the PSM you want to calibrate with.
- A measured point, which is the same PSM collected with a rover in the field.

To calculate and apply base shift to your survey project data, follow the steps below:

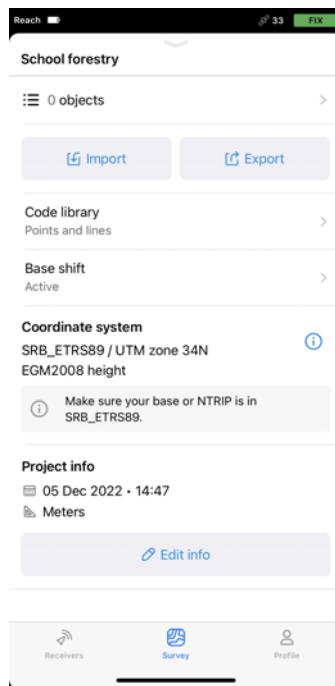
1. Place your base and average its position in SINGLE.

Tip: *Learn more about base placement and setup in the [Placement and Choosing base setup method](#) articles.*

2. Configure RTK communication between the base and the rover and wait for FIX.

Tip: *To learn more, check the following guides in the [Reach RS2/RS2+ RTK quickstart](#) section.*

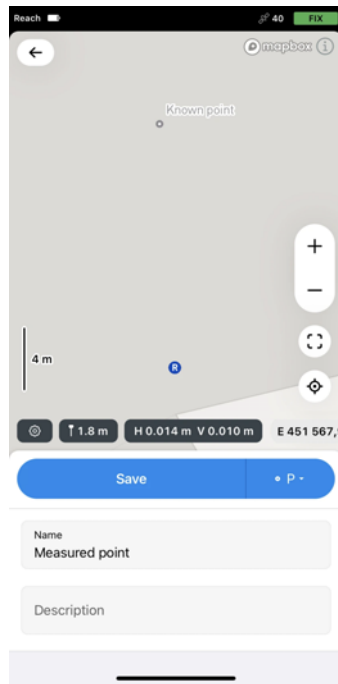
3. Create a survey project in Emlid Flow.



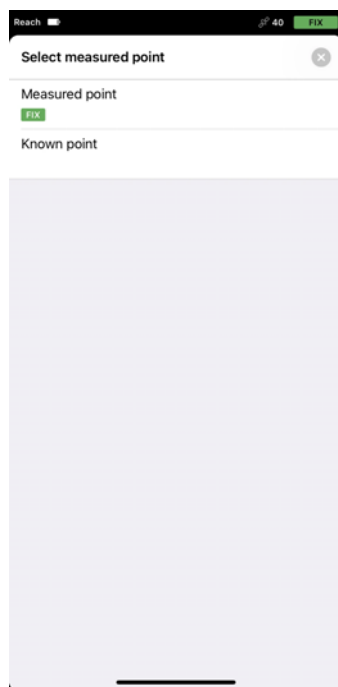
4. Manually add a point with coordinates of your PSM and save it. This will be a known point.

Note: You can also do it later on the Base shift screen, tap Add a point and fill in the coordinates of your PSM.

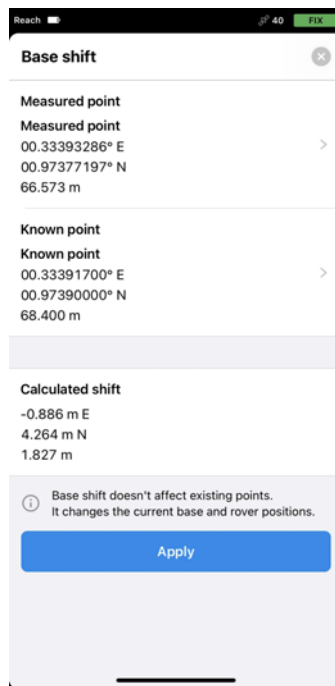
5. Place the rover over the PSM and collect it. This will be a measured point.



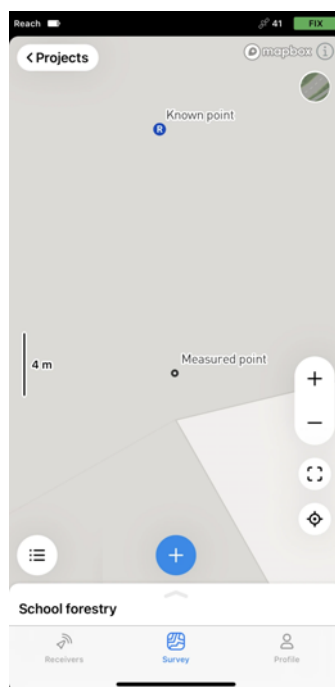
6. Swipe up the project drawer and tap *Base shift*.
7. Tap *Measured point*.
8. Select the point that you collected. We called it 'Measured point'.



9. Tap *Known point*.
 10. Select the point with the PSM coordinates. We called it 'Known point'. After that, the app will calculate the shift.
- Note:** If you did not add a known point in advance, tap Add a point and fill in the coordinates of your PSM.
11. Tap the *Apply* button to activate the shift.



When the shift is applied, you'll see that it's active in the project's overview, and the rover icon on the map appears shifted.



Right from this moment, Emlid Flow starts applying base shift to all the points you collect further. In our case, it means that all points collected after base shift will be positioned exactly relative to the permanent survey mark.

4.5 AUSPOS-Online GPS processing service

This guide explains how to get the precise coordinates of a standalone receiver using the Australian online GPS processing service AUSPOS.

4.5.1 Overview

AUSPOS is an online GPS processing service provided by Geoscience Australia. With AUSPOS, you may accurately determine the coordinates of a static point worldwide without real-time corrections or a base station nearby.

Tip: You can learn more about the AUSPOS service on their [official site](#).

4.5.2 How AUSPOS works

A standalone receiver finds its position by relying on the raw data obtained from satellites only. In this case, it can determine its position at the several-meter level. To improve the accuracy, the receiver can be used with a base station in the RTK setup. Since both receivers work in the same conditions, the base station sends corrections that eliminate ionospheric and tropospheric delays, clock errors of the receiver and satellites and improve accuracy.

With AUSPOS, you can achieve a centimeter-level accurate position of a point with one receiver. When you upload your observation file, AUSPOS chooses up to 15 nearest International GPS Service (IGS) and Asia-Pacific Reference Frame (APREF) stations for processing.

These stations form a local network that provides the data required to eliminate ionospheric and tropospheric delay errors. With the help of the data from these stations, the service calculates the approximate coordinates of the receiver.

The last stage of the processing is computing a solution. AUSPOS eliminates clock errors of the receiver and the satellites to obtain precise coordinates of the point. It computes precise coordinates in International Terrestrial Reference Frame (ITRF) anywhere on Earth and Geocentric Datum of Australia (GDA) within Australia.

AUSPOS provides a network solution (relative positioning) using a double-difference strategy.

Note: AUSPOS uses dual-frequency GPS data for solution computation and supports only Static Positioning mode.

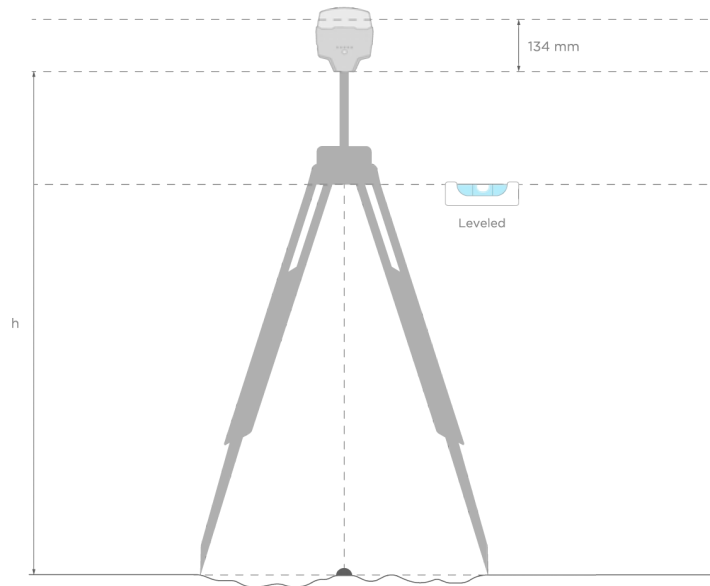
Depending on the accuracy level and time that is required to get the solution, the AUSPOS service can calculate the data in the following modes:

Orbit type	When the orbit is ready for use	Accuracy
ULTRA-RAPID	3–9 hours after the end of the survey	~5 cm
RAPID	17–41 hours after the end of the survey	~2.5 cm
FINAL	12–8 days after the end of the week after the survey	~2.5 cm

4.5.3 Workflow

Placing the base

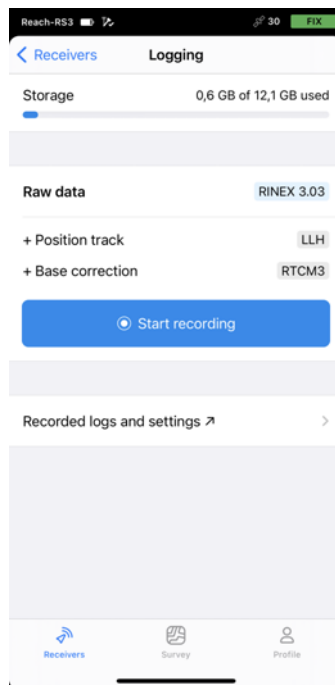
Place your Reach precisely above the marked point on the tripod and level it. You can learn more about placing Reach in the Placement tutorial.



Recording RINEX logs on Reach

To record logs for AUSPOS, perform the following steps:

1. Open Emlid Flow and connect to your Reach.
2. Go to the *Logging* screen.

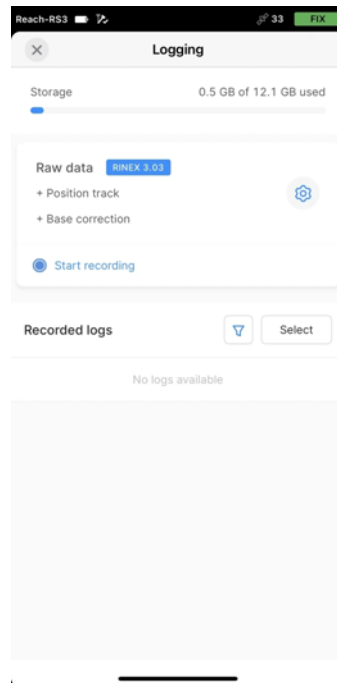


3. Tap the *Recorded logs and settings* button.
4. To configure logging, tap the *Settings* button.
5. Select the *AUSPOS* preset.

6. Choose the required RINEX format in the *Raw data* section.

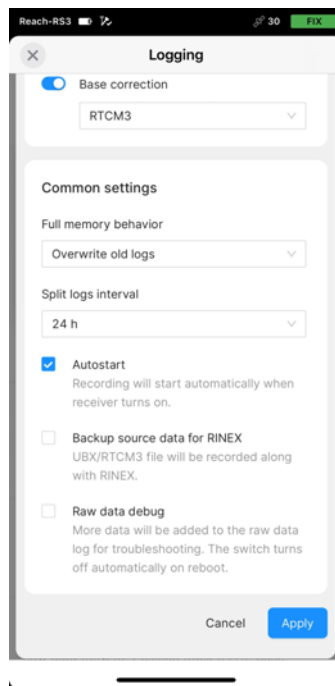
Note: If you do not know which version of RINEX you need, we recommend using RINEX 3.03.

Tip: While recording in the RINEX format, you can log the UBX file as a backup. UBX file can be used to adjust RINEX file settings in the Converter tool in Emlid Studio. You can enable logging in the UBX format in the logging settings in Emlid Flow.



7. Tap *Show configuration* and enter the measured height to the bottom of the receiver in the corresponding field.
8. Fill in the point's name in the *Marker name* field.
9. Tap *Apply and start*.

Note: You can start recording automatically when your receiver is turned on. Check the corresponding field on the Raw data settings screen.

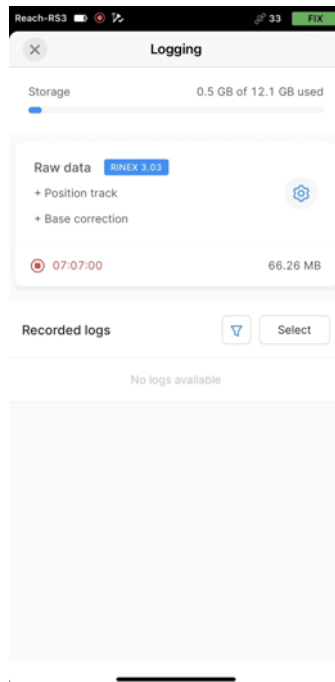


10. Enable log recording by tapping the *Start recording* button.

Note: AUSPOS requires recording the data for at least 4 hours to get the best accuracy.

11. To finish recording logs, tap the *End recording* button.

Caution: Wait for data processing to finish.



Tip: You may log the data for up to 24 hours, depending on the accuracy required.

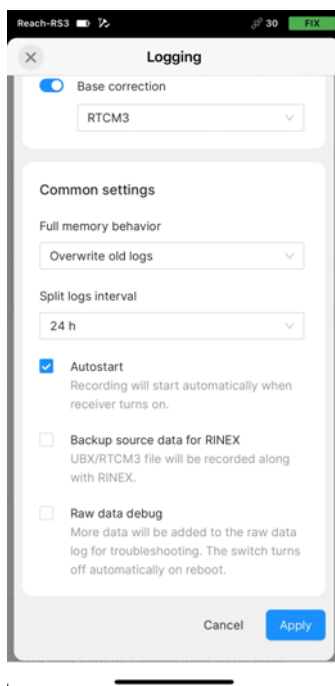
Once you finish the survey, don't forget to turn off raw data recording in the logging settings.

Downloading logs

After you finish raw data logging, you need to download RINEX data from Reach to your mobile device.

1. Go to the *Logs* section at the bottom of the *Logging* screen.

Note: You can also find information on the logs size and recording date and time here.



2. To export the file, tap the *Download* button.
3. Save your log depending on the device you use.

Note: If you do not need your logs anymore, you can delete them using the *Select* button.

Submitting data to AUSPOS service

Once the logs are downloaded, export them to your PC in a preferred way and submit the data to AUSPOS for processing.

1. Go to AUSPOS [submission page](#).
2. In the *Load RINEX Files* field, click the *Choose File(s)* button and browse for the observation file (*.O). You can upload up to 20 files at once.

Note: The observation file name should not contain any special characters, symbols, or spaces. Otherwise, the file will be rejected.

3. Enter the pole height in the *Height (m)* field.
4. Choose *EML_REACH_RS2 NONE* in the *Antenna Type* field.

Note: For Reach RS2+, choose *EML_REACH_RS2+ NONE*.

5. In the *Email Address* field, enter your email address to get the results.
6. Click *Submit*.

Load RINEX Files*

File Name	Height (m)	Antenna Type
rover.22O Scan	2.0	EML_REACH_RS2 NONE x

Email Address*

You have successfully submitted 1 file(s) for processing. Please quote job number 1654708342545-99999999 should you need to enquire about the status.

- Name: rover.22O Height: 2 Antenna Type: EML_REACH_RS2 NONE

AUSPOS will assign the job number to your submission and send the file with the solution to your email address.

Assessing AUSPOS results

In the solution report, you will get the following information:

- Computed coordinates in 3 different formats:
 - Cartesian (XYZ)

3.1 Cartesian, ITRF2014

Station	X (m)	Y (m)	Z (m)	ITRF2014 @
R000	0000000.000	0000000.000	0000000.000	07/06/2022

- Geodetic (LLH)

3.2 Geodetic, GRS80 Ellipsoid, ITRF2014

Geoid-ellipsoidal separations, in this section, are computed using a spherical harmonic synthesis of the global EGM2008 geoid. More information on the EGM2008 geoid can be found at <http://earth-info.nga.mil/GandG/wgs84/gravitymod/egm2008/>.

Station	Latitude (DMS)	Longitude (DMS)	Ellipsoidal Height(m)	Derived Above Geoid Height(m)
R000	00 00 00.00000	00 00 00.00000	33.370	8.913

- UTM Grid

3.3 UTM Grid, GRS80 Ellipsoid, ITRF2014

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived Above Geoid Height(m)
R000	000000.000	0000000.000	00	33.370	8.913

- Positional uncertainty showing the estimated accuracy of the computed coordinates

3.4 Positional Uncertainty (95% C.L.) - Geodetic, ITRF2014

Station	Longitude(East) (m)	Latitude(North) (m)	Ellipsoidal Height(Up) (m)
R000	0.020	0.024	0.018

Additionally, you can check the ambiguity resolution for every reference station used in the computation.

Note: *After you get the solution report, it might be useful to check how accurate the results are. The most accurate AUSPOS solutions have no warning messages in the report.*

Setting up obtained base coordinates in Emlid Flow

If you want to use the obtained coordinates as a base position, you can enter the base coordinates in Emlid Flow.

1. Open Emlid Flow and connect to the Reach you want to use as a base.
2. On the *Receivers* screen, tap *Base settings*.
3. Tap the *Configure* button.
4. Set the *Coordinates entry method* to *Manual*.
5. Specify the antenna height and enter the coordinates.

The screenshot shows the 'Configure base' screen in the Emlid Flow application. At the top, there are three buttons: 'Cancel', 'Configure base', and 'Save'. Below these, the 'Coordinates entry method' is set to 'Manual'. The 'Antenna height' is set to '0 m'. Under the 'COORDINATES' section, there is a button labeled 'Choose from project'. Below this, there are three input fields: 'Longitude, deg', 'Latitude, deg', and 'Ellipsoidal height, m'. Each of these fields has a 'Required' label below it. At the bottom of the screen, there is a horizontal bar.

6. Tap *Save*.

After setting up the base position, you can continue working in RTK or PPK.

4.6 NOAA's Online positioning user service (OPUS)

This guide explains how to get the precise coordinates of a standalone receiver using the NOAA's Online Positioning User Service (OPUS).

4.6.1 Overview

Online Positioning User Service (OPUS) is provided by the National Oceanic and Atmospheric Administration (NOAA). With OPUS, you may accurately determine the coordinates of a static point mostly on the territory of the US without real-time corrections or a base station nearby.

Tip: Check [this](#) map to see if the service is available in your region.

Tip: You can learn more about the NOAA's OPUS on their [official site](#).

4.6.2 How OPUS works

A standalone receiver finds its position by relying on the raw data obtained from satellites only. In this case, it can determine its position at the several-meter level. To improve the accuracy, the receiver can be used with a base station in the RTK setup. Since both receivers work in the same conditions, the base station sends corrections that eliminate the offsets and improve the accuracy.

OPUS allows achieving a centimeter-level accurate position of a point if you have only one receiver. When you upload your observation file, OPUS determines the date of a log recording and the receiver's approximate position. Based on this information, OPUS retrieves Global Navigation Satellite System (GNSS) observation data sets distributed by the International GNSS Service (IGS) and then selects up to the best 9 reference stations from the IGS or Continuously Operating Reference Stations (CORS) network for a solution computing process.

Then these solutions are performed between each reference station and the receiver within the ITRF reference frame. The results are compared and averaged, and if the results from any reference station fail to pass the quality tests, then the next reference station is used in the computation. After the successful solution is obtained, OPUS software transforms the ITRF coordinates into the NAD83 datum, UTM, and State Plane Coordinates mapping projections. OPUS uses dual-frequency GPS data logs for solution computation and supports the Static mode only. The Static data is required to be recorded on the stationary receiver.

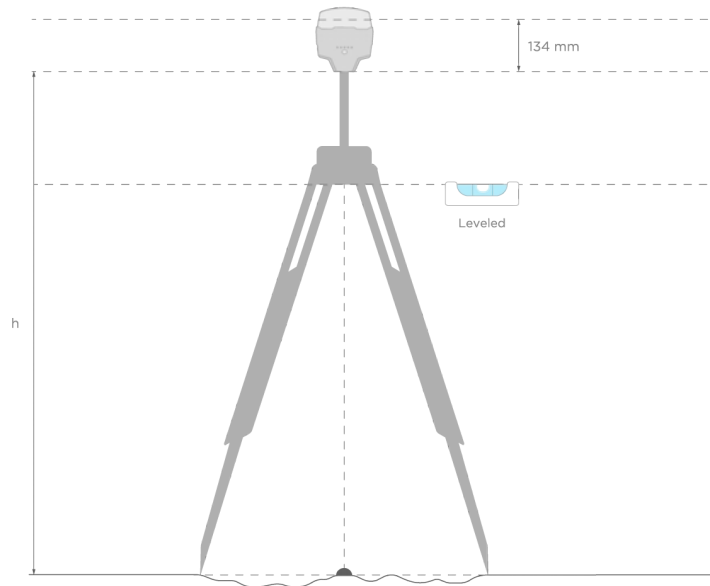
There are 2 ways you can process the data in OPUS:

- Static (for data that are 2 to 48 hours in duration)
- Rapid-Static (for data that are 15 minutes to 2 hours in duration)

The Static and Rapid-Static methods use different processing software and provide relatively similar horizontal accuracy. Rapid-Static processing has more strict requirements for data quality in comparison with the Static approach.

4.6.3 Placing Reach

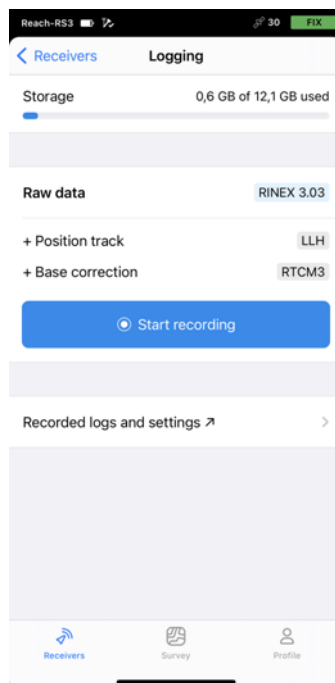
Place your Reach precisely above the marked point on the tripod and level it. You can learn more about placing Reach in the [Placement](#) tutorial.



4.6.4 Recording RINEX logs on Reach

To record logs for OPUS, follow the steps below:

1. Open Emlid Flow and connect to your Reach.
2. Go to the *Logging* screen.

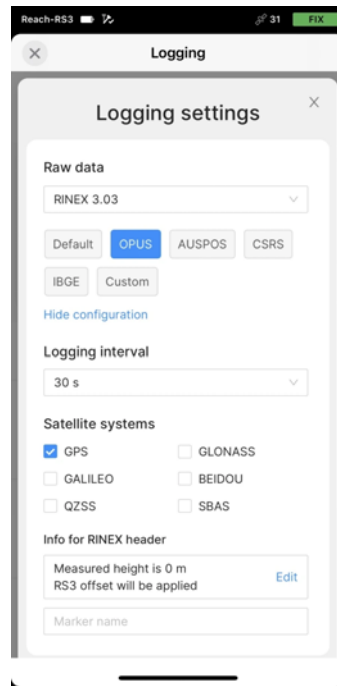


3. Tap the *Recorded logs and settings* button.
4. To configure logging, tap the *Settings* button.
5. Select the *OPUS* preset.

6. Choose the required RINEX format in the *Raw data* section.

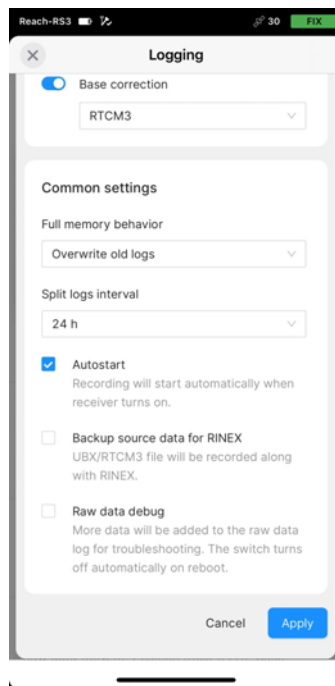
Note: If you do not know which version of RINEX you need, we recommend using RINEX 3.03.

Note: While recording in the RINEX format, you can log the UBX file as a backup. UBX file can be used to adjust RINEX file settings in the Converter tool in Emlid Studio. You can enable logging in the UBX format in the logging settings in Emlid Flow.

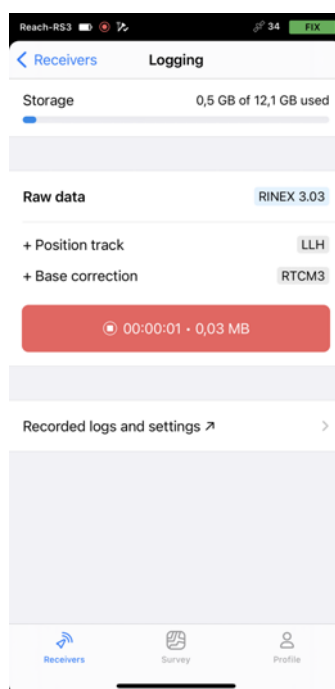


7. Tap *Show configuration* and enter the measured height to the bottom of the receiver in the corresponding field.
8. Fill in the point's name in the *Marker name* field.
9. Tap *Apply*.

Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the *Raw data* settings screen.



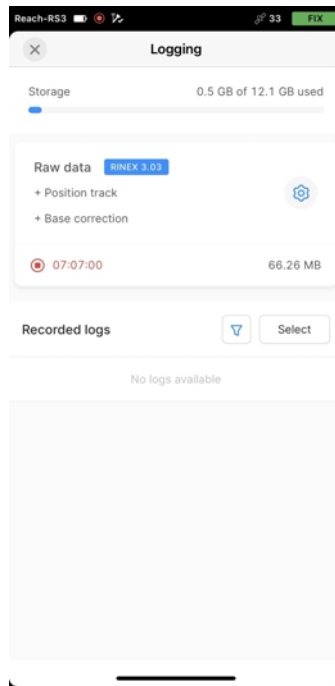
10. Enable log recording by tapping the *Start recording* button. The red recording icon will appear in the status bar.



Note: NOAA's OPUS requires recording the data for at least 4 hours to get the best accuracy.

11. To finish recording logs, tap the *End recording* button.

Caution: Wait for data processing to finish.



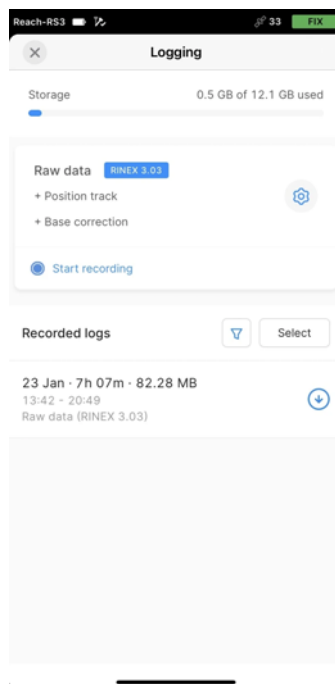
Tip: You may log the data for up to 24 hours, depending on the accuracy required. Once you finish the survey, don't forget to turn off raw data recording in the logging settings.

4.6.5 Downloading logs

After you finish raw data logging, you need to download RINEX data from Reach to your mobile device.

1. Go to the *Recorded logs* section at the bottom of the *Logging* screen.

Note: You can also find information on the logs size and recording date and time here.



2. To export the file, tap the *Download* button.

3. Save your log depending on the device you use.

Tip: If you do not need your logs anymore, you can delete them using the Select button.

4.6.6 Submitting data to NOAA's OPUS service

Once the logs are downloaded, export them to your PC in a preferred way and submit the data to NOAA's OPUS for processing.

1. Go to the NOAA's OPUS site [submission page](#).
2. Click on the *Choose file* button and browse for the observation file (*.**O).
3. Choose *EML_REACH_RS2 NONE* in the *Antenna* field.

Tip: For Reach RS2+, choose *EML_REACH_RS2+ NONE*.

4. Type a pole height in the *Antenna Height* field.
5. In the *email address* field, enter your email address to get the results.
6. Click on the *Upload to Static* button.

The screenshot shows the NOAA OPUS website interface. At the top is the NOAA logo and the title 'OPUS: Online Positioning User Service' under the 'National Geodetic Survey' banner. A navigation bar includes links for NGS Home, About NGS, Data & Imagery, Tools, Surveys, Science & Education, and a search bar. A blue banner on the right contains a message about BETA OPUS projects released in September 2021, encouraging users to provide feedback and try BETA projects v5.0 or use projects v4.0. The main content area is titled 'Upload your data file.' and instructs users to solve their GPS position and tie it to the National Spatial Reference System. It includes a 'Choose file' button, a dropdown menu for 'Antenna' (currently set to 'EML_REACH_RS2 NONE'), and a text input for 'Antenna Height' (set to '2.000'). Below these is an email address field (set to 'support@emlid.com') and a section for 'Options' to customize the solution. At the bottom, there are two buttons: 'Upload to Rapid-Static' (for data 15 min. - 2 hrs.) and 'Upload to Static' (for data 2 hrs. - 48 hrs.). A small bar chart on the left titled 'OPUS Today as of 2022-07-07T07:10 EDT' shows the number of solutions for 'Rapid-Static' and 'Static' processing. The 'Static' bar is significantly higher than the 'Rapid-Static' bar.

OPUS will send the file with the solution to your email address.

4.6.7 Assessing NOAA's OPUS results

In the solution report, you will get the name of the used reference frame, the XYZ and LLH coordinates of the point, and the estimated accuracy in meters. Additionally, you can check these fields: OBS USED, FIXED AMB, OVERALL RMS.

After you get the solution report, it might be useful to check how accurate the results are. The most accurate OPUS solutions meet the following conditions:

- Orbits used in the computation are precise or rapid.
- Over 90% of observations are used.

- Over 50% of ambiguities are fixed.
- Overall RMS is less than 3 cm.

4.6.8 Setting up obtained base coordinates in Emlid Flow

If you want to use the obtained coordinates as a base position, you can enter the base coordinates in Emlid Flow.

1. Open Emlid Flow and connect to the Reach you want to use as a base.
2. On the *Receivers* screen, tap *Base settings*.
3. Tap the *Configure* button.
4. Set the *Coordinates entry method* to *Manual*.
5. Specify the antenna height and enter the coordinates.

The screenshot shows the 'Configure base' interface in the Emlid Flow application. At the top, there are 'Cancel', 'Configure base', and 'Save' buttons. The 'Coordinates entry method' is set to 'Manual'. Below this is a field for 'Antenna height' currently set to '0 m'. A section titled 'COORDINATES' contains a 'Choose from project' button. Further down, there are two radio buttons for coordinate format: 'DD' (selected) and 'DMS'. At the bottom, there are three required input fields: 'Longitude, deg', 'Latitude, deg', and 'Ellipsoidal height, m'.

6. Tap *Save*.

After setting up the base position, you can continue working in RTK or PPK.

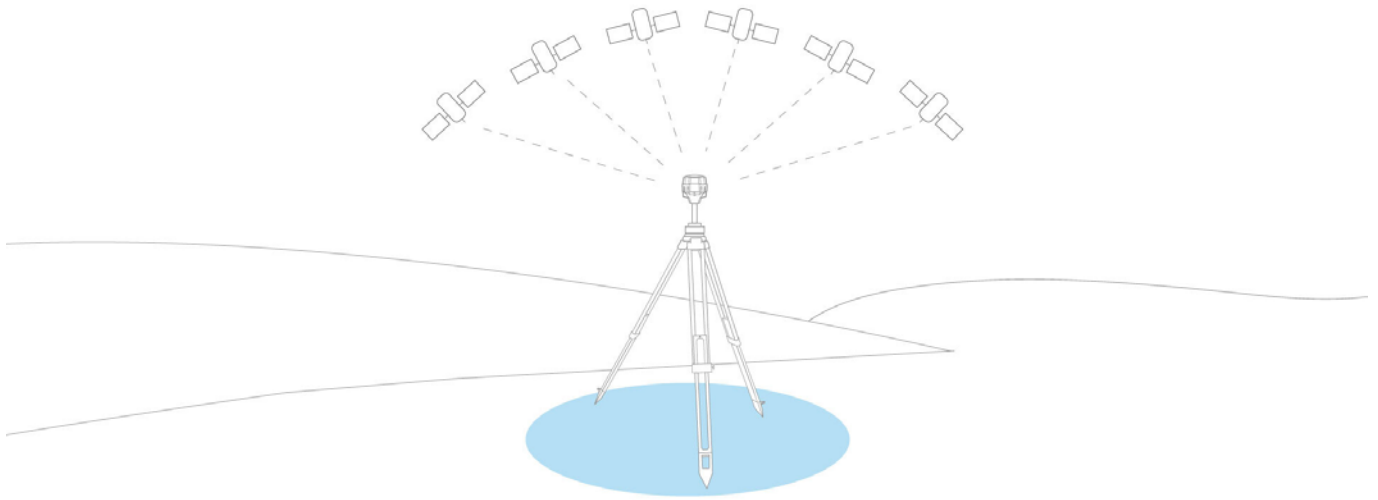
4.7 How PPP works

With the Precise Point Positioning (PPP) technique, you may accurately determine the coordinates of a static point anywhere in the world without real-time corrections or a base station nearby.

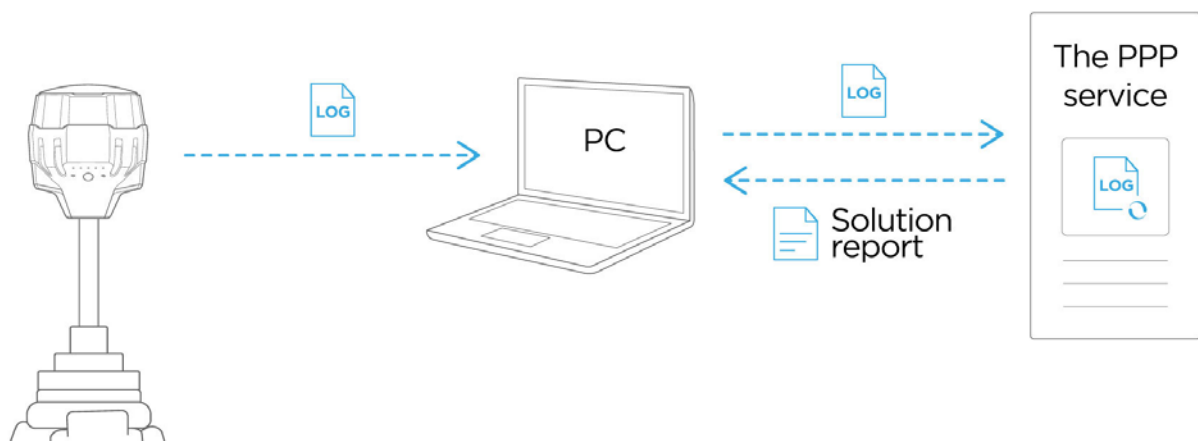
4.7.1 Overview

A standalone receiver finds out its position relying on the data obtained from satellites only. Along with raw data, it gets navigation messages with satellite clock offset, the ionospheric and tropospheric corrections, etc. Using the information about these offsets, the receiver

may calculate its position with a several-meter level accuracy. If there were no navigation data, the accuracy would be much worse.



In RTK and PPK, these offsets might be eliminated since both the base and the rover operate in quite similar conditions. Compared with these two methods, PPP allows the single receiver to achieve a high-level accuracy without the use of corrections from the base station. To calculate the coordinates, PPP uses the same data that is provided by the navigation message generated from a network of global reference stations. Thereby, the single receiver might determine its position with a centimeter-level accuracy using only its own raw data, precise ephemerides, and clock offsets provided by a PPP service.



With the PPP technique, it is possible to determine the base position with absolute accuracy for further RTK and PPK surveys anywhere around the world. The PPP technique doesn't require an additional receiver and the presence of an internet connection during the survey. As to the requirements, most of the PPP services are capable of working with GPS and GLONASS satellites only.

Feature	PPP	PPK	RTK
Real-time corrections required	No	No	Yes
Base station required	No	Yes	Yes
Internet during surveying required	No	Yes	Yes, but not necessary when radio is used
Logging required	Yes	Yes	No, but can be used as backup data
Possible accuracy	Cm	Cm	Cm
Corrections	Offsite	Offsite	Onsite
Baseline	No	Up to 100 km	Up to 60 km

4.7.2 PPP services overview

There are several PPP services available:

- [Brazilian IBGE-PPP service](#), mainly used in South America region, is capable of working with both single-band and multi-band Reach receivers.
- [Canadian NRCAN CSRS-PPP service](#) can process both single-frequency and multi-frequency logs.

4.8 Canadian Spatial Reference System Precise Point Positioning (CSRS-PPP)

This guide explains how to get the precise coordinates of a standalone receiver using the Canadian NRCAN CSRS-PPP service.

4.8.1 Overview

The Canadian Spatial Reference System (CSRS) PPP service is provided by Natural Resources Canada's Canadian Geodetic Survey. It uses single or dual-frequency GPS and GLONASS data for solution computation and supports both Static and Kinematic modes.

Tip: *Static computation is accomplished with a receiver sitting on one point. As the result of Static mode, you will get the absolutely determined position of this point. Kinematic mode allows surveying with a moving receiver and provides a path as the solution.*

Depending on the accuracy level and time that is required to get the solution, the NRCAN CSRS-PPP service can calculate the data in the following modes:

Orbit type	When the orbit is ready for use	Accuracy
ULTRA-RAPID	about 60 minutes after the end of each hour	~15 cm
RAPID	about 12 hours after the end of each day	~5 cm
FINAL	12 days after the end of each week	~2 cm

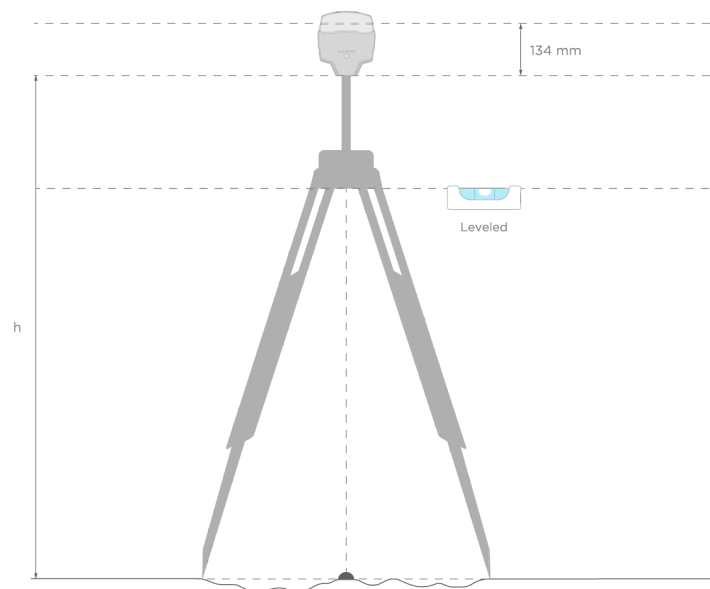
Tip: You can learn more about NRCan CSRS-PPP service on their [official site](#).

4.8.2 Workflow

Tip: This guide will show you how to process raw data recorded in the Static mode.

Placing the base

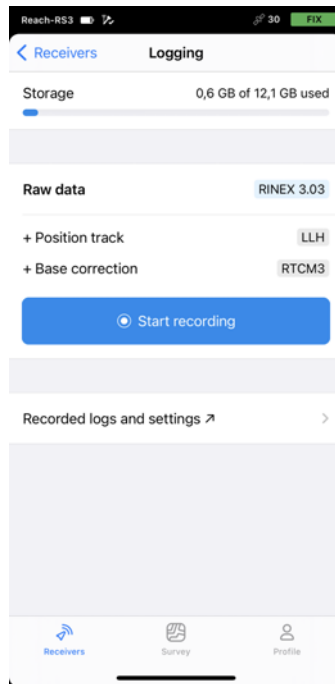
Place your Reach precisely above the marked point on the tripod and level it. You can learn more about placing Reach in the [Choosing base setup method tutorial](#).



Recording RINEX logs on Reach

To record logs for NRCan CSRS-PPP, perform the following steps:

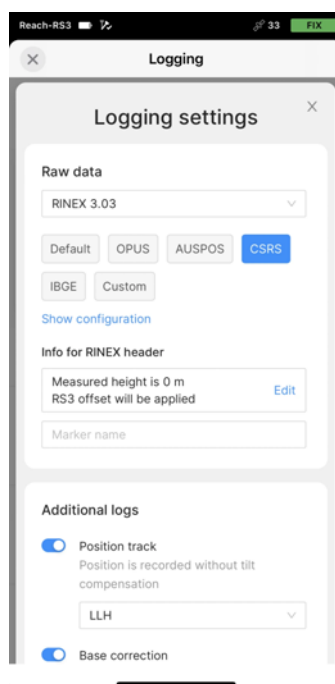
1. Open Emlid Flow and connect to your Reach.
2. Go to the *Logging* screen.



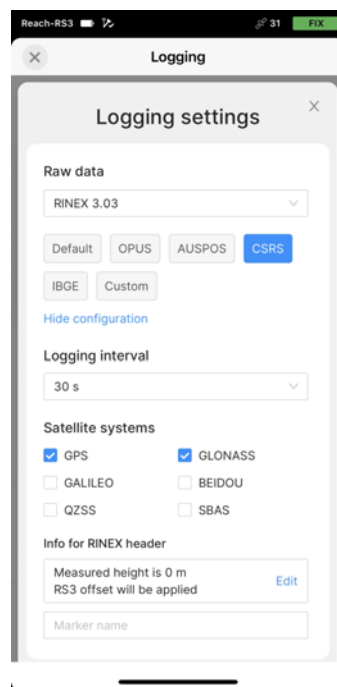
3. Tap the *Recorded logs and settings* button.
4. To configure logging, tap the *Settings* button.
5. Select the *CSRS* preset.
6. Choose the required RINEX format in the *Raw data* section.

Note: If you do not know which version of RINEX you need, we recommend using RINEX 3.03.

Top: While recording in the RINEX format, you can log the UBX file as a backup. UBX file can be used to adjust RINEX file settings in the Converter tool in Emlid Studio. You can enable logging in the UBX format in the logging settings in Emlid Flow.



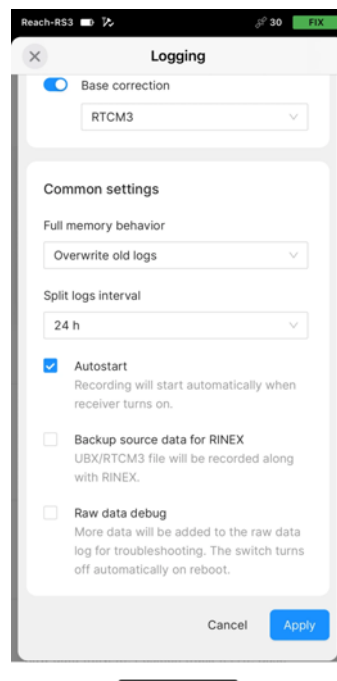
7. Tap *Show configuration* and enter the measured height to the bottom of the receiver in the corresponding field.



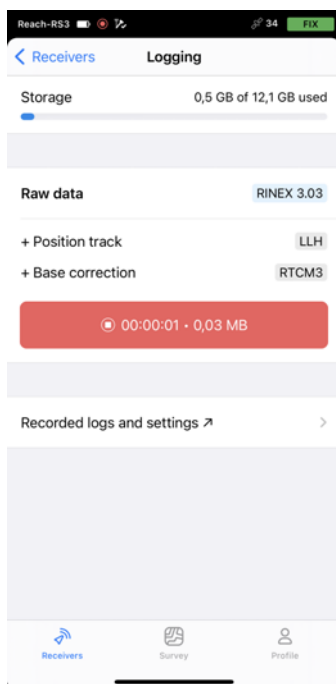
8. Fill in the point's name in the *Marker name* field.

9. Tap *Apply*.

Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the Raw data settings screen.



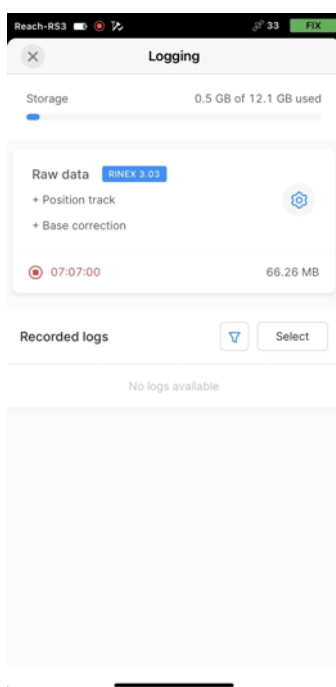
10. Enable log recording by tapping the *Start recording* button. The red recording icon will appear in the status bar.



Note: *NRCan CSRS-PPP requires recording the data for at least 4 hours to get the best accuracy.*

11. To finish recording logs, tap the *End recording* button.

Caution: *Wait for data processing to finish.*



Tip: *You may log the data for up to 24 hours, depending on the accuracy required.*

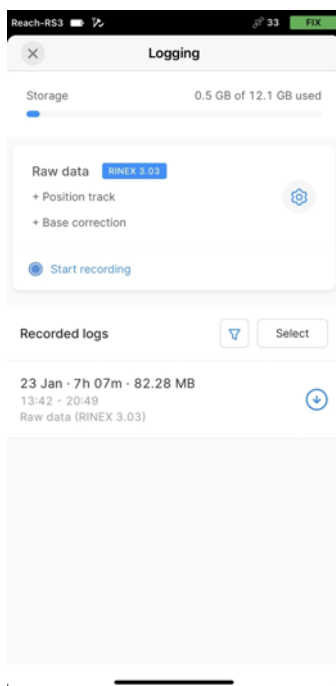
Once you finish the survey, don't forget to turn off raw data recording in the logging settings.

Downloading logs

After you finish raw data logging, you need to download RINEX data from Reach to your mobile device.

1. Go to the *Recorded logs* section at the bottom of the *Logging* screen.

Note: You can also find information on the logs size and recording date and time here.



2. To export the file, tap the *Download* button.
3. Save your log depending on the device you use.

Tip: If you do not need your logs anymore, you can delete them using the *Select* button.

Submitting data to NRCAN CSRS-PPP service

Once the logs are downloaded, export them to your PC in a preferred way and submit the data to NRCAN CSRS-PPP for processing.

1. Go to NRCAN CSRS-PPP [official site](#).
2. Click the *Sign in* button and enter your login and password to access the NRCAN CSRS-PPP submission page or create a new account in case you don't have it yet.
3. In the *Email for results* field, enter your email address to get the results.
4. In *Processing mode*, choose Static.
5. Choose the datum in which you would like to get the position. In this guide, we will work with the ITRF option.
6. In the *RINEX observation file* field, click the *Choose file* button and browse for the observation file (*.**O).
7. Click the *Submit to PPP* button to send the file for processing.

Email for results (required)

Processing mode

☒ Static ☐ Kinematic

☒ NAD83 ☐ ITRF

- The epoch will be the same as the GPS data.
- A UTM zone will be calculated from the longitude.

Vertical datum

Contribute to passive control maintenance? ([What is this?](#))

☐ Authorize the Canadian Geodetic Survey to archive and publish CSRS-PPP submission and solution

Official Canadian federal or provincial geodetic marker number

[More options](#)

RINEX observation file(s), 300 MB max (.zip, .gz, .z, .tar, .??O)
 Note: You may submit multiple RINEX files in a single .zip or .tar archive

ReachBase.22O

☐ Remove plots from CSRS-PPP solution PDF report ([Why?](#))

NRCan CSRS-PPP will send the file with the solution to your email address.

Assessing NRCan CSRS-PPP results

In the solution report, look for the Estimated Position. There should be a table with 4 rows:

Estimated Position for ReachBase.22O

	Latitude (+n)	Longitude (+e)	Ell. Height
ITRF14 (2020.8)	00° 00' 00.00000"	-00° 00' 00.00000"	264.293 m
Sigmas(95%)	0.008 m	0.009 m	0.034 m
A priori*	00° 00' 00.00000"	00° 00' 00.00000"	262.946 m
Estimated – A priori	-0.770 m	-0.524 m	1.348 m

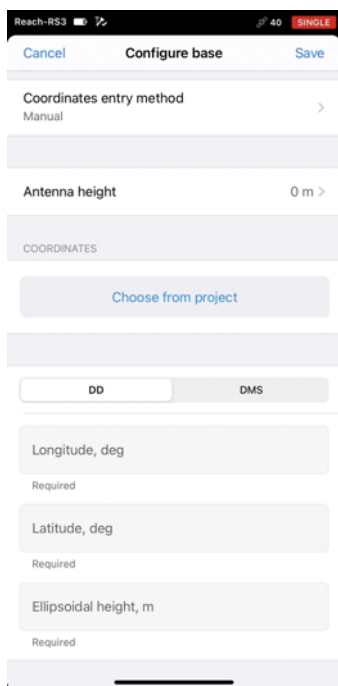
- The first row contains calculated LLH coordinates in the chosen coordinate system.
- The Sigmas row shows an estimated accuracy.
- In the A Priori row, there is a few-meter accurate position taken from the RINEX header.
- The Estimated - A Priori row displays the accuracy from this position specified in the RINEX header.

Setting up obtained base coordinates in Emlid Flow

If you want to use the obtained coordinates as a base position, you can enter the base coordinates in Emlid Flow.

1. Open Emlid Flow and connect to the Reach you want to use as a base.
2. On the *Receivers* screen, tap *Base settings*.
3. Tap the *Configure* button.
4. Set the *Coordinates entry method* to *Manual*.

5. Specify the antenna height and enter the coordinates.



6. Tap *Save*.

After setting up the base position, you can continue working in RTK or PPK.

4.9 IBGE-PPP-Online service for post-processing GNSS data

This guide explains how to get the precise coordinates of a standalone receiver using the IBGE-PPP service.

4.9.1 Overview

IBGE-PPP is a free online GNSS data processing service provided by Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics). The service is based on the CSRS-PPP software provided by NRCAN. It uses single or dual-frequency GPS and GLONASS data for solution computation and supports both Static and Kinematic modes.

Tip: *Static computation is accomplished with a receiver sitting on one point. As the result of Static mode, you will get the absolutely determined position of this point. Kinematic mode allows surveying with a moving receiver and provides a path as the solution.*

Depending on the accuracy level and time that is required to get the solution, the IBGE-PPP service can calculate the solution using 3 types of orbits: **Ultra-Rapid**, **Rapid** and **Final**. These orbits' parameters vary depending on the territory of the survey.

If you conduct a survey on the territory of Brazil, IBGE-PPP will use the following orbits in the solution computation:

Orbit type	When the orbit is ready for use	Accuracy
ULTRA-RAPID	1.5-2.5 hours after the end of the survey	~15 cm
RAPID	12-36 hours after the end of the survey	~5 cm
FINAL	11-17 days after the end of the survey	~2 cm

If you conduct a survey outside of Brazil, IBGE-PPP will use the following orbits in the solution computation:

Caution: *Outside of Brazil, IBGE-PPP uses only GPS satellites in solution computation.*

Orbit type	When the orbit is ready for use	Accuracy
RAPID	17-41 hours after the end of the survey	~2.5 cm
FINAL	12-20 days after the end of the survey	~2.5 cm

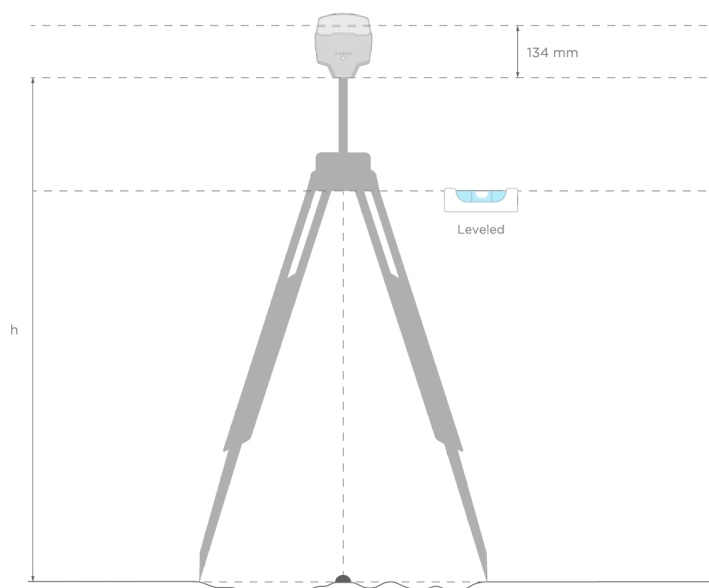
Tip: *You can learn more about the IBGE-PPP service on their [official site](#).*

4.9.2 Workflow

This guide will show you how to process raw data recorded in the Static mode.

Placing the base

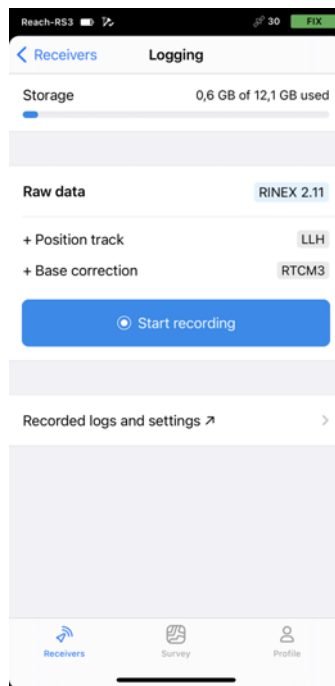
Place your Reach precisely above the marked point on the tripod and level it. You can learn more about placing Reach in the [Choosing base setup method tutorial](#).



Recording RINEX logs on Reach

To record logs for IBGE-PPP, perform the following steps:

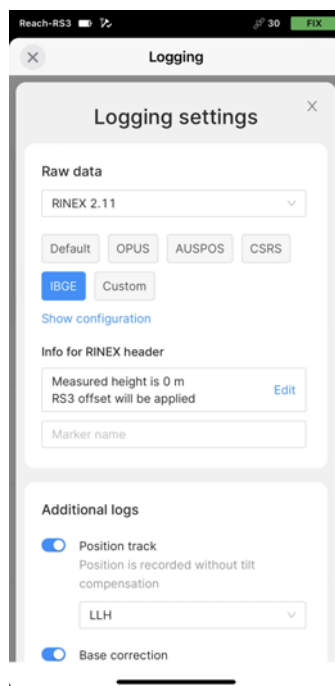
1. Open Emlid Flow and connect to your Reach.
2. Go to the *Logging* screen.



3. Tap the *Recorded logs and settings* button.
4. To configure logging, tap the *Settings* button.
5. Select the *IBGE* preset.
6. Choose the required RINEX format in the *Raw data* section.

Caution: *IBGE-PPP* accepts files in the RINEX format only of version 2.11 or older.

Tip: While recording in the RINEX format, you can log the UBX file as a backup. UBX file can be used to adjust RINEX file settings in the [Converter tool](#) in Emlid Studio. You can enable logging in the UBX format in the logging settings in Emlid Flow.

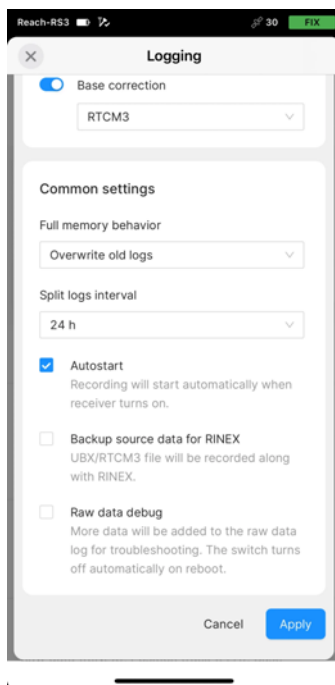


6. Tap *Show configuration* and enter the measured height to the bottom of the receiver in the corresponding field.

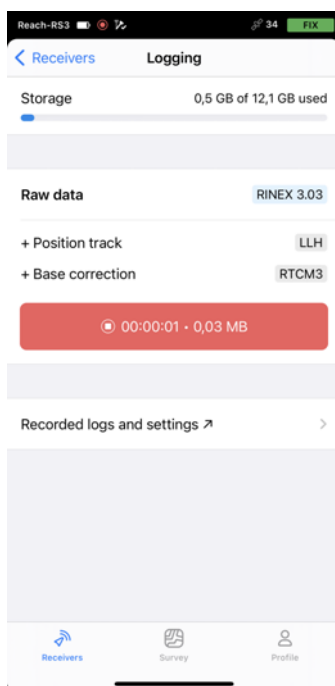
7. Fill in the point's name in the *Marker name* field.

8. Tap *Apply*.

Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the *Raw data settings* screen.



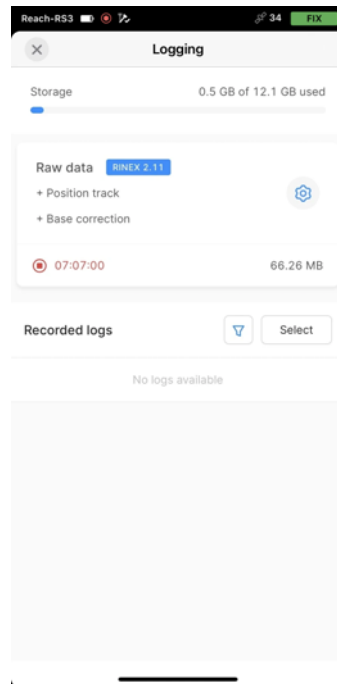
9. Enable log recording by tapping the *Start recording* button. The red recording icon will appear in the status bar.



Note: For IBGE-PPP, there is no minimum required time for an observation session. However, we recommend recording data not less than 4 hours to get the best accuracy.

10. To finish recording logs, tap the *End recording* button.

Caution: *Wait for data processing to finish.*



Tip: *You may log the data for up to 24 hours, depending on the accuracy required.*

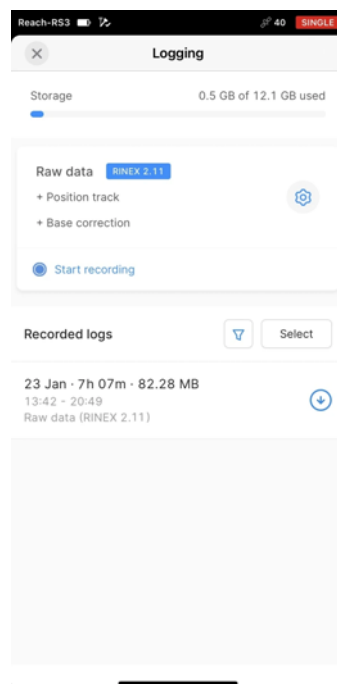
Once you finish the survey, don't forget to turn off raw data recording in the logging settings.

Downloading logs

After you finish raw data logging, you need to download RINEX data from Reach to your mobile device.

1. Go to the *Recorded logs* section at the bottom of the *Logging* screen.

Note: *You can also find information on the logs size and recording date and time here.*



2. To export the file, tap the *Download* button.

3. Save your log depending on the device you use.

Tip: If you do not need your logs anymore, you can delete them using the Edit button.

Submitting data to IBGE service

Once the logs are downloaded, export them to your PC in a preferred way and submit the data to NRCan CSRS-PPP for processing.

1. Go to IBGE-PPP [submission page](#).
2. In *Selecione o Modo de Processamento (Select Processing Mode)*, choose *Estático (Static)*.
3. In the *Selecione um arquivo RINEX (Select a RINEX file)* field, click the *Choose file* button and browse for the observation file (*.**O).
4. Choose *EML_REACH_RS2 NONE* in the *Tipo de Antena (Antenna Type)* dropdown menu.

Tip: For Reach RS2+, choose *EML_REACH_RS2+ NONE*.

5. Enter the pole height in the *Altura da antena (Antenna height)* field and apply changes by checking the *A altura da antena somente será alterada se esta caixa estiver marcada (The antenna height will only change if this box is checked)* checkbox.
6. In the *E-mail válido do usuário (User's valid email)* field, enter your email address to get the results.
7. Click the *Processar (Process)* button. IBGE-PPP will process your file.

The screenshot shows the IBGE-PPP submission interface. It has two main sections for configuration. The first section, 'Selecione o Modo de Processamento:', has two radio buttons: 'Estático' (selected) and 'Cinemático'. The second section, 'Selecione um arquivo RINEX:', includes a text box with the filename 'rover.22O' and a 'Choose file' button. Below these is a summary line: 'Os valores selecionados abaixo serão adotados para todos os RINEX que estejam comprimidos em um único arquivo:'. This is followed by two fields: 'Tipo de Antena:' with a dropdown menu showing 'EML_REACH_RS2 NONE', and 'Altura da antena (m):' with a text box containing '1800'. A checkbox labeled 'A altura da antena somente será alterada se esta caixa estiver marcada.' is checked. Below these is the 'E-mail válido do usuário. (não pode conter espaços ou tabs!):' field with the email 'support@emlid.com'. At the bottom, there is a disclaimer checkbox 'Concordo que os resultados dos processamentos poderão ser utilizados pelo IBGE para a avaliação de produtos e informações cartográficas e geodésicas, bem como para a avaliação do próprio serviço IBGE-PPP', which is unchecked. A 'Nota:' states that processing starts after file transfer and may take minutes, and to reprocess if results don't appear within 2 hours. At the very bottom are two buttons: 'Processar' and 'Limpar Dados'.

8. To download the results, click the *Download dos resultados (Download the results)* button in the *Resultado do processamento (Result of processing)* section. IBGE-PPP will also send the file with the solution to your email address.

After you get the solution file, you can continue working with the coordinates of a point you observed.

Setting up obtained base coordinates in Emlid Flow

If you want to use the obtained coordinates as a base position, you can enter the base coordinates in Emlid Flow.

1. Open Emlid Flow and connect to the Reach you want to use as a base.
2. On the *Receivers* screen, tap *Base settings*.
3. Tap the *Configure* button.
4. Set the *Coordinates entry method* to *Manual*.
5. Enter the coordinates and specify the antenna height.

The screenshot shows the 'Configure base' screen in the Emlid Flow application. At the top, there are three buttons: 'Cancel', 'Configure base', and 'Save'. Below these, the 'Coordinates entry method' is set to 'Manual'. The 'Antenna height' is set to '0 m'. Under the 'COORDINATES' section, there is a button labeled 'Choose from project'. Below this, there are two radio buttons for 'DD' and 'DMS', with 'DD' selected. At the bottom, there are three input fields: 'Longitude, deg', 'Latitude, deg', and 'Ellipsoidal height, m'. Each of these fields has a 'Required' label below it.

6. Tap *Save*.

After setting up the base position, you can continue working in RTK or PPK.

4.10 Static processing

This tutorial shows how to post-process static data in Emlid Studio to get the precise position of a single point.

Tip: Learn more about Emlid Studio and download it for free [here](#).

4.10.1 Overview

The Static processing workflow allows you to obtain an accurate position of a single point. Usually, it is used to get coordinates of a local base station when you cannot access an NTRIP service for RTK. For example, when the Internet coverage is too poor, or the baseline to the nearest station is too long.

In this case, you need to log the raw data on your base and get logs from the nearest continuously operating reference station (CORS) for further post-processing.

4.10.2 Getting started

To get coordinates of your local base station using the Static processing workflow, you will need the following files:

- a RINEX observation file from a CORS
- a RINEX observation file from a local base
- a RINEX navigation file from a CORS or a local base

Note: *If you recorded raw data in the UBX format or got corrections from the NTRIP service in the RTCM3 format, Emlid Studio will automatically convert them to RINEX using the background conversion feature.*

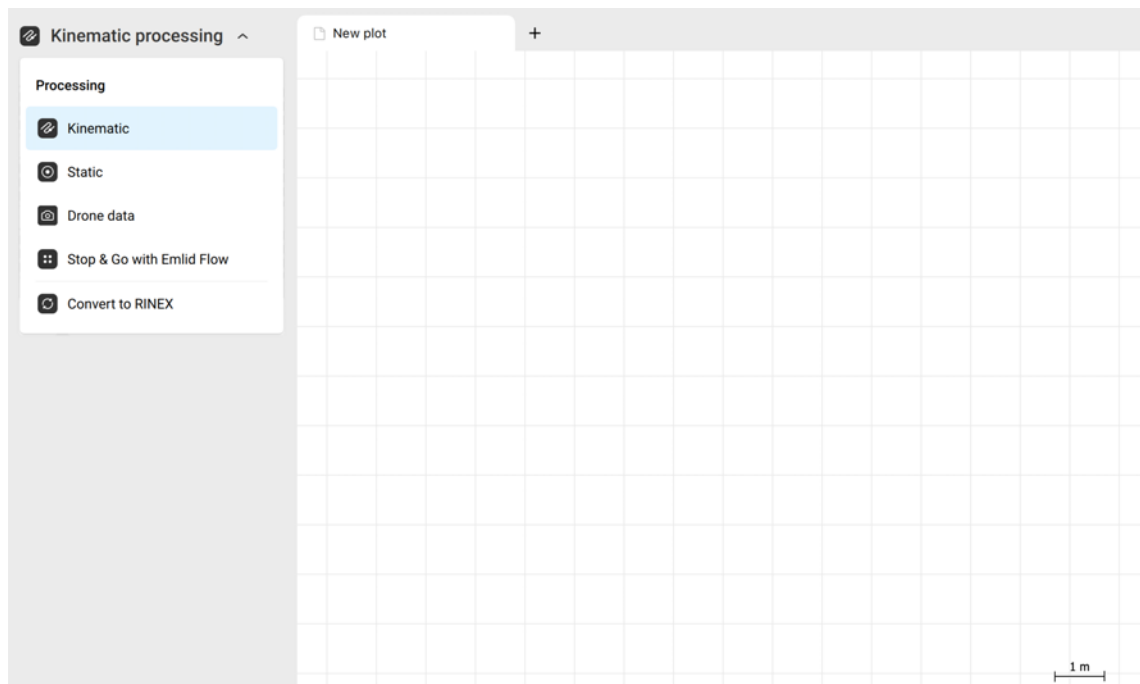
4.10.3 Workflow

To post-process the collected data, follow the steps below:

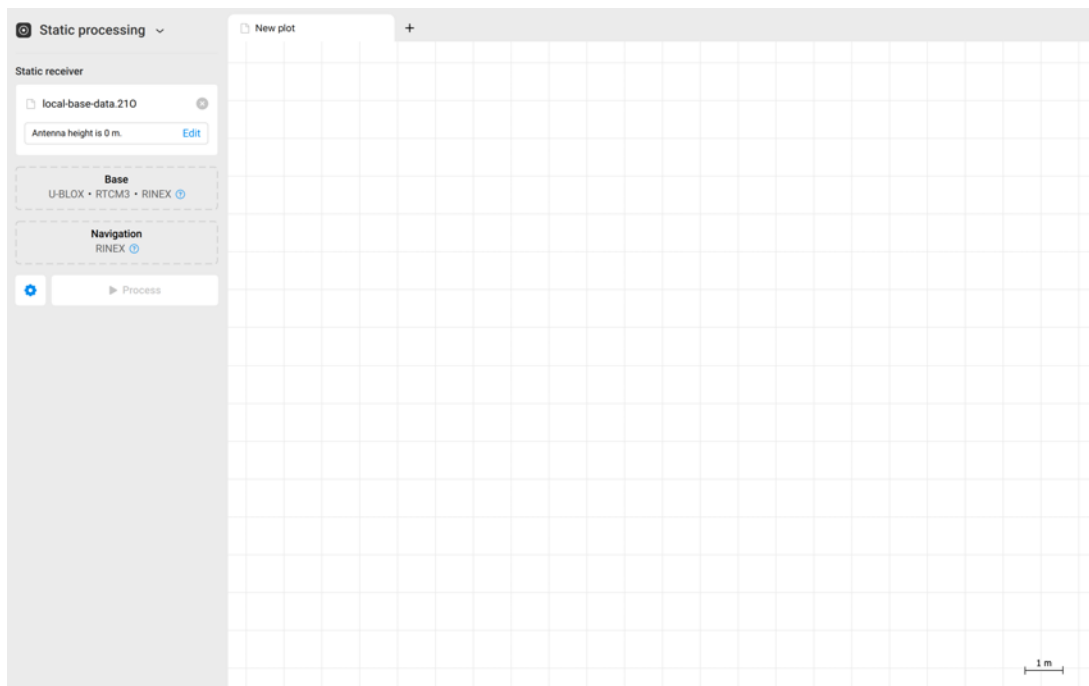
Tip: *Emlid Studio selects the One best solution by default. To double-check it, click the blue gear and you will access the settings. There, find the Output solution field and make sure that One best is chosen.*

Tip: *To add a file, simply drag and drop it from your desktop.*

1. Select the workflow from the drop-down list in the upper-left corner.



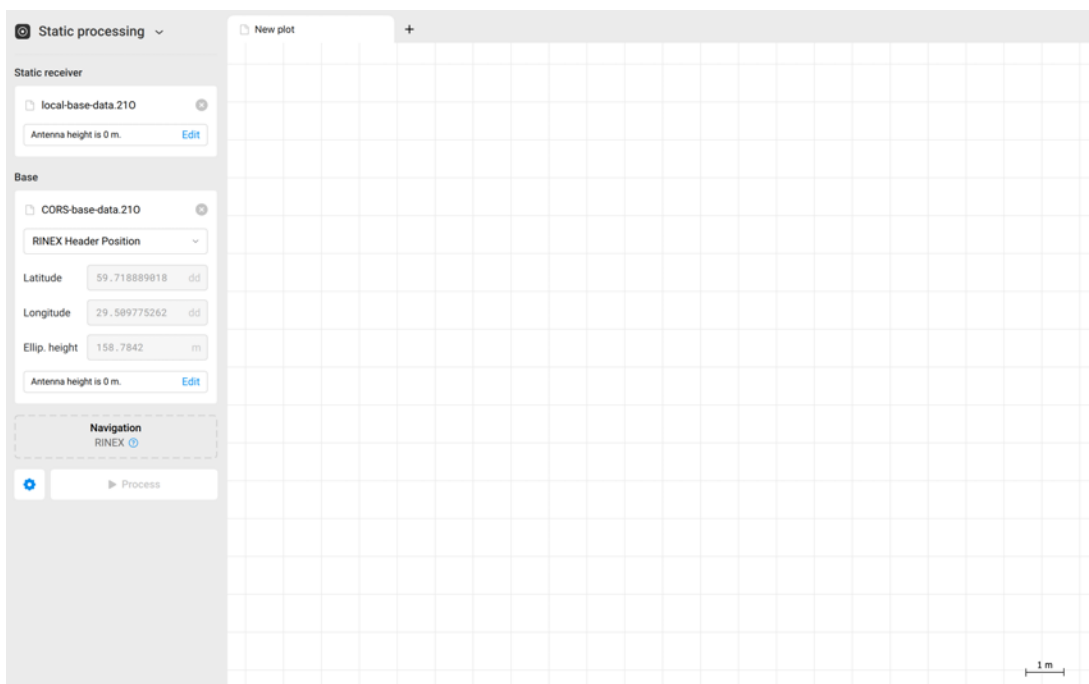
2. Add the RINEX observation file from the local base to the *Static receiver* field.
3. Set the antenna height by clicking *Edit*.



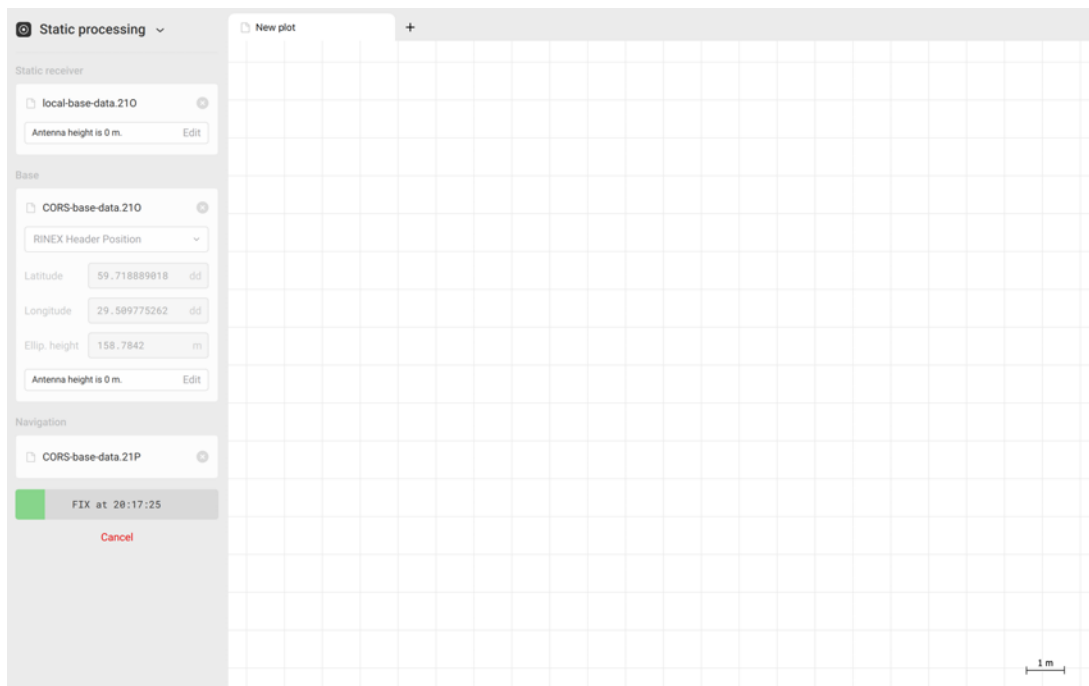
Note: If you use antenna height for your static receiver, you need to fill in the same antenna height in the base field when continuing post-processing your survey data using the Kinematic processing, Drone Data PPK, Stop & Go with Emlid Flow workflows. This will ensure data consistency.

4. Add the RINEX observation file from the CORS to the *Base* field. You will see the CORS coordinates.

Note: By default, the RINEX Header Position is used.



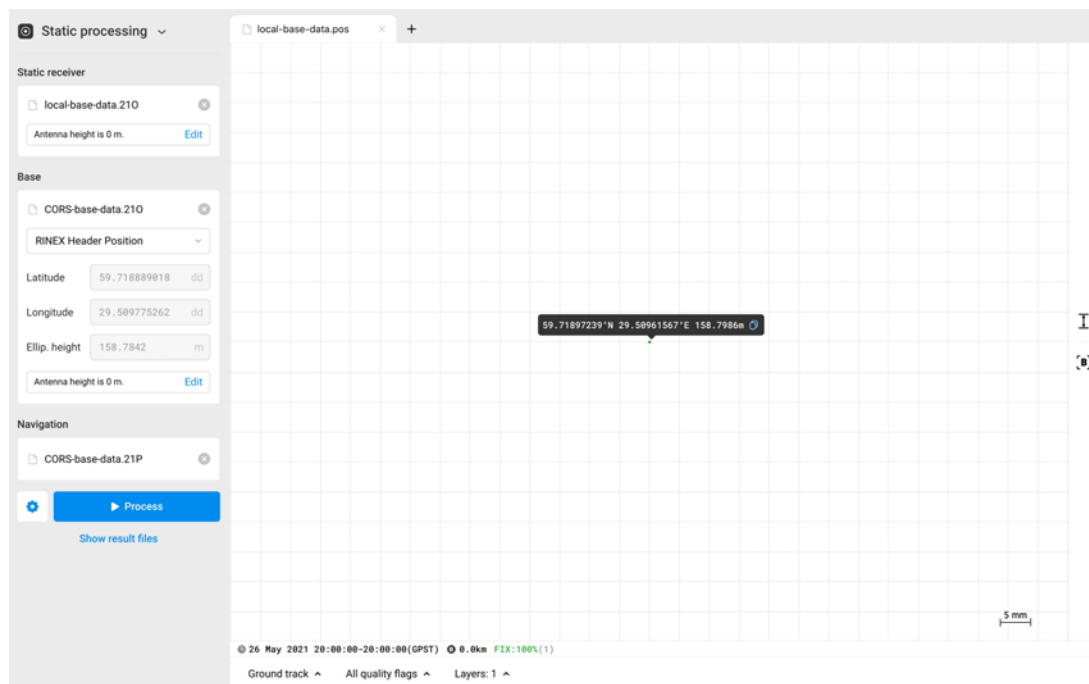
5. Add the RINEX navigation file from the local base or from the CORS.
6. Click *Process*. You will see the progress bar in the bottom left corner.



7. Once the processing is finished, Emlid Studio will show you the processed point on the plot.

Tip: To check the local point's coordinates, just click on it on the plot.

Note: You can also find the coordinates of your local base in the generated .pos file. Click the Show result files button to move to the resulting folder.



Tip: If you want to continue post-processing using the obtained .pos file, you can simply drag and drop the obtained position of your local base from the plot to the base's field in the required workflow.

Now that you have obtained the coordinates of your local base station, you can set up your base coordinates in Emlid Flow.

Note: Learn more in the [Setting up base position manually guide](#).

4.11 Averaging base position in SINGLE

This guide explains how to use the Average SINGLE entry method in the Emlid Flow app to set up base position.

4.11.1 Overview

When you don't know your base's position, you can average it in SINGLE using the Average SINGLE coordinates entry method in Emlid Flow. Averaging is done in standalone mode without using any corrections and the position of the base is determined with the accuracy of several meters. In this case, the rover measurements will be centimeter-precise only relative to the base but their actual (absolute) accuracy in the selected coordinate system will be at meter level.

Tip: To learn more about the accuracy for RTK and PPK measurements, read our [Simple Intro to Accuracy and Precision](#) article.

4.11.2 Workflow

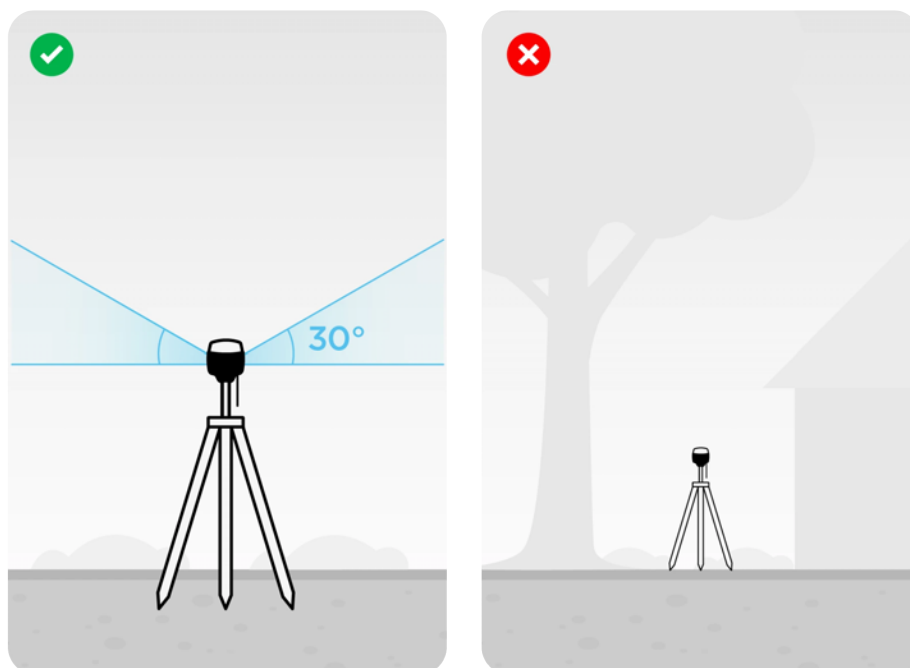
Placing base in field

To place your base station in the field, follow the recommendations below.

Clear sky view without any obstacles

Reach base needs to have a clear sky view 30 degrees above the horizon. There should be no obstacles that could block the view like buildings, trees, cars, humans, laptops, etc.

Take a look at 2 pictures below. The left picture demonstrates desirable conditions for Reach location. The right one is an example of poor surrounding conditions such as the reduced view of the sky, possible obstructions or vegetation nearby.



Examples of **recommended** environments for Reach placement:

- field

- top of the hill
- rooftop

Examples of **poor** environments for Reach placement:

- indoors
- urban area
- forestry area

No electronics nearby

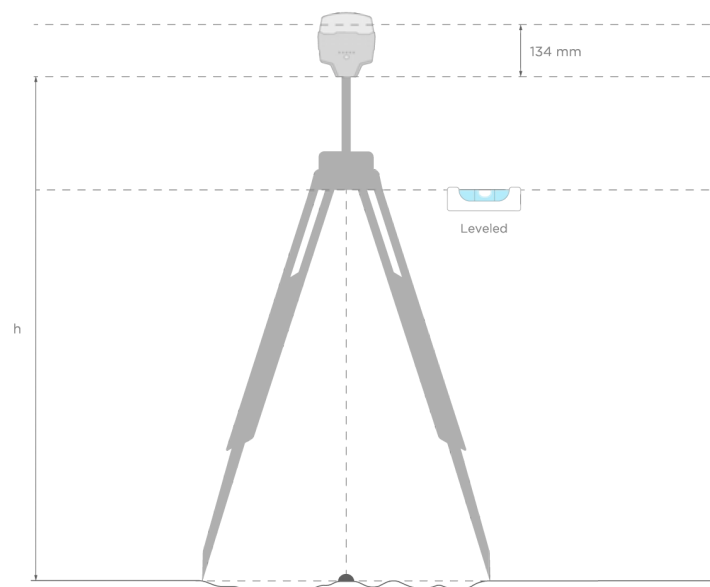
Electronic devices may produce RF noise that could affect the reception of the GNSS signal. Keep all electronics as far as possible from Reach.

Measuring antenna height offset

When placing your Reach in the field, make sure your Reach device is placed precisely above the marked point on the tripod and leveled. When you are setting up base coordinates manually, you need to measure the antenna height offset. Follow the steps below:

1. Measure the distance from the mark to the bottom of your Reach (h in Figure 1).
2. Specify the measured distance in Emlid Flow. It will automatically calculate the antenna height.

Tip: For Reach RS2/RS2+, the antenna height is the distance from the mark on the ground to the center point on the Reach's bottom, antenna reference point (ARP), plus the height of the receiver to the antenna phase center (APC), antenna height offset. Emlid Flow automatically adds the antenna height offset, which is 134 mm.

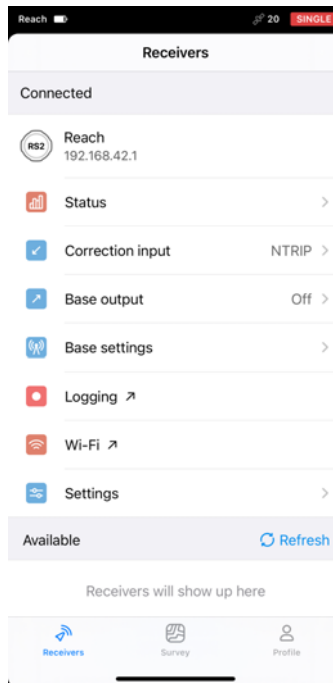


When you placed Reach over the mark and measured the antenna height, you are ready to set up the base position in the Emlid Flow app.

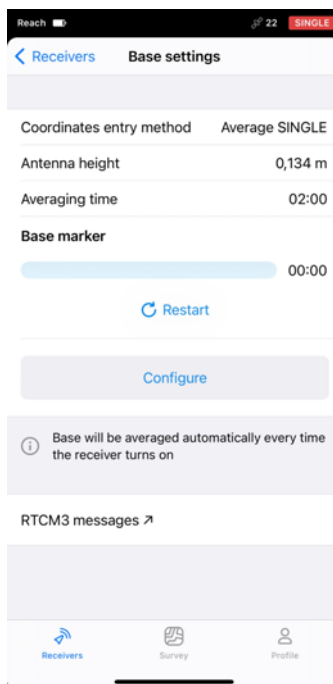
Setting up base's coordinates in EmlidFlow

Let's see how to set up the base's position using the Average SINGLE coordinates entry method in the Emlid Flow app:

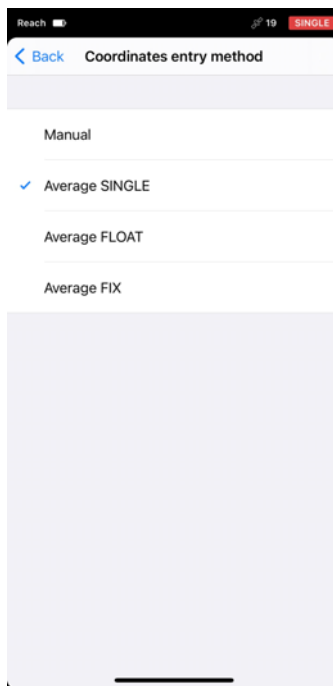
1. Open Emlid Flow and connect to your Reach.



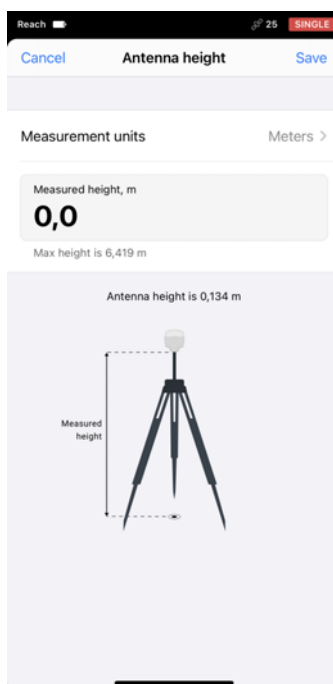
2. Go to *Base settings* and tap *Configure*.



3. Tap Coordinates entry method and choose *Average SINGLE* from the menu.



4. Tap *Antenna height* to set the antenna height and save it.



5. Set averaging time, tap *Save*.

Now, when your base coordinates are averaged, you can continue creating up a project on your rover.

Tip: You can save these coordinates and use them later within the same project. Without knowing them, you won't be able to reproduce this project.

5 Integration

5.1 Getting Reach coordinates on Android via BT

This guide describes how to get precise coordinates from Reach on an Android device over Bluetooth.

5.1.1 Overview

Caution: *Make sure your Android device provides Bluetooth connectivity.*

Some of the survey and GIS apps for Android used with Reach:

- Mobile Topographer Pro
- PointMan
- ESRI ArcGIS Collector
- Mapit GIS
- LandStar
- Autocad360
- QField

5.1.2 Pairing Reach with Android device

Tip: *To output a centimeter accurate position, Reach should be in RTK mode. To learn more, check the [How RTK works](#) article.*

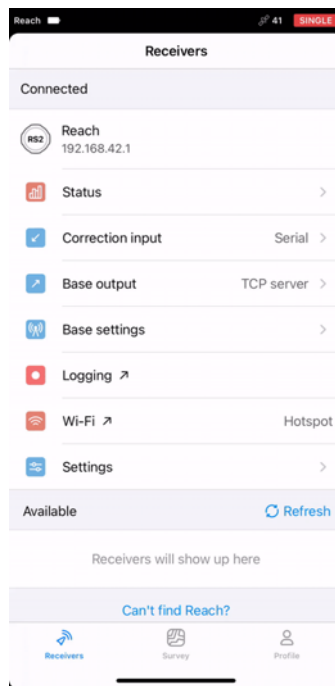
Configure Reach unit to act as a rover in RTK.

Getting corrections from Reach RS2/RS2+ base on Reach RS2/RS2+ rover: *Set up RTK communication between 2 Reach RS2/RS2+ units over LoRa radio [following this video guide](#).*

Getting corrections from NTRIP/CORS: *Configure NTRIP/CORS network as a source of positioning corrections for Reach rover [following this guide](#).*

5.1.3 Access Reach rover using Emlid Flow

1. Go to Wi-Fi settings on your device.
2. Connect to Reach hotspot. It appears as **reach:XX:XX**.
3. Enter the password **emlidreach**.
4. Open Emlid Flow and connect to your Reach.
5. Go to *Settings* and tap *Bluetooth*.
6. Enable Bluetooth by tapping the *Turn on Bluetooth* button.
7. Tap *Discoverability* and turn on the *Discoverability* option. Tap *Save* to apply changes.

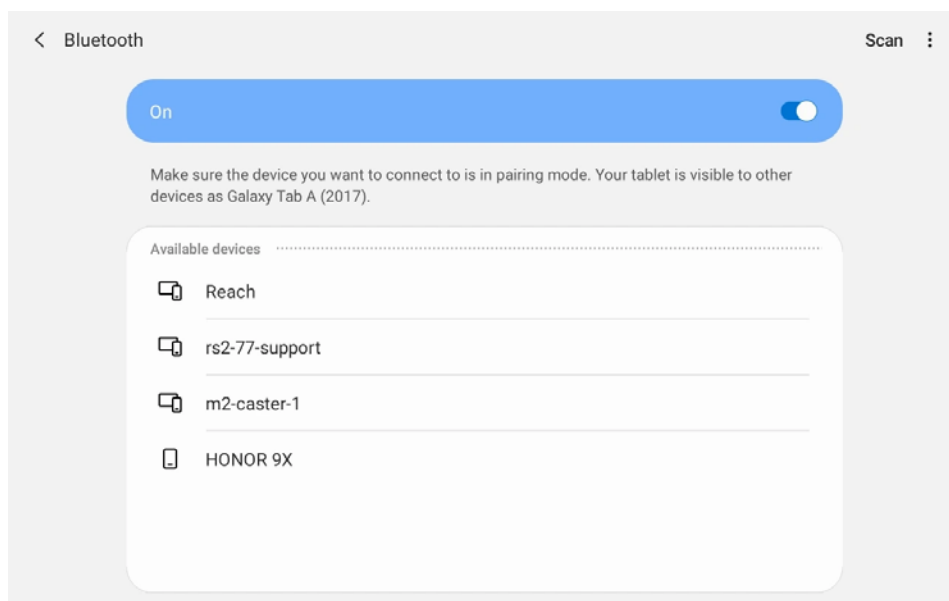


Note: Reach name is displayed just above its MAC. In this guide, we used the unit named as *Reach*.

5.1.4 Access an Android device

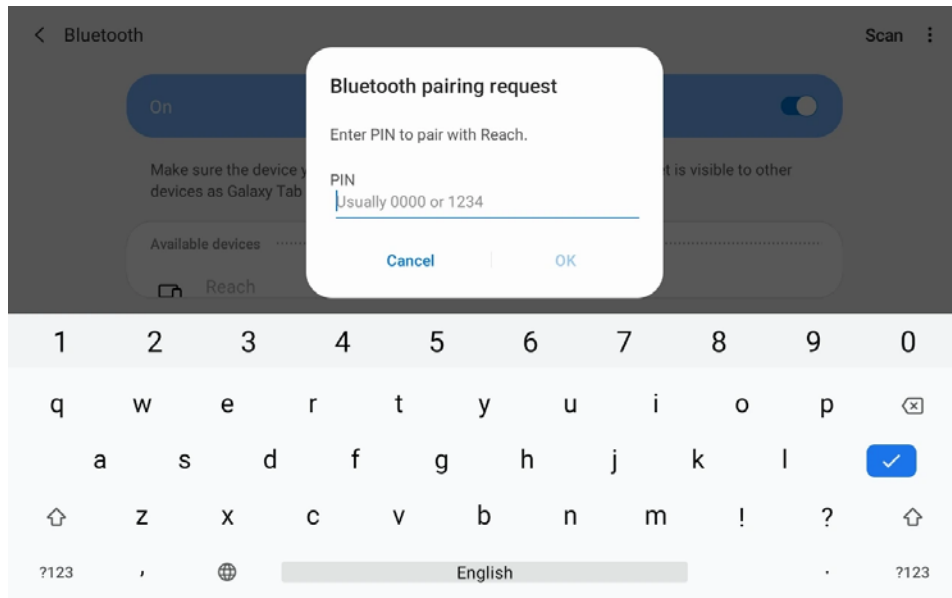
1. Navigate to the *Bluetooth configuration* screen. Activate the Bluetooth connection.
2. Wait for Reach to be listed as an available device.

Tip: Keep Reach within a few meters from your Android device.

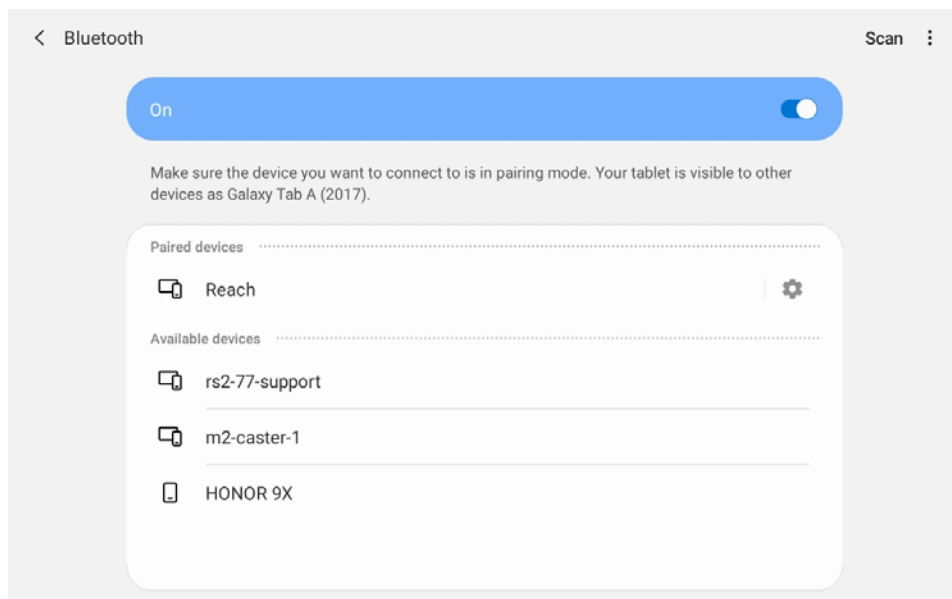


3. Tap the name of your Reach in the list of available devices on the Android device.
4. You should receive a pairing request from Reach.

5. Enter the PIN code of your Reach unit and confirm it.

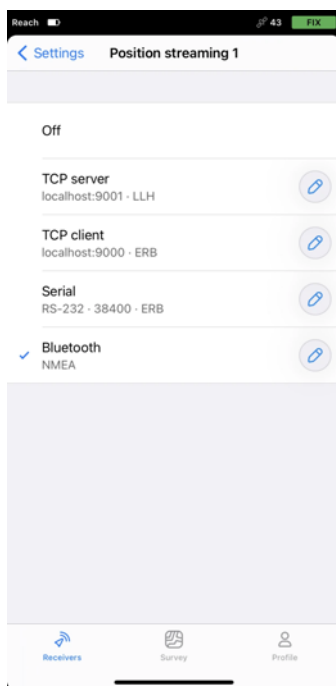


Reach and Android device are now paired.

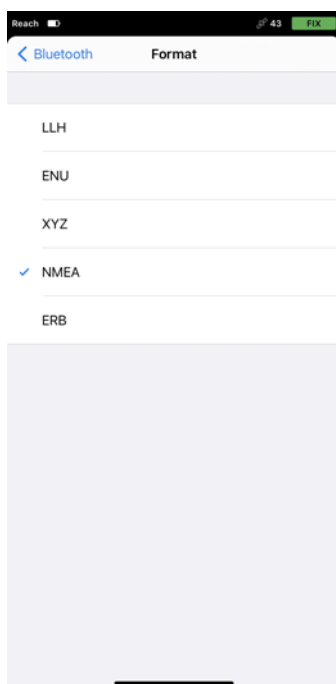


5.1.5 Position Streaming from Reach to Android

1. Open Emlid Flow and connect to your Reach.
2. Go to *Settings* and tap *Position streaming 1*.
3. Select *Bluetooth*.
4. To configure position streaming, tap the *Edit button* in the *Bluetooth* cell.



5. Tap *Format* and choose *NMEA*. Apply changes.



5.1.6 Android mock location

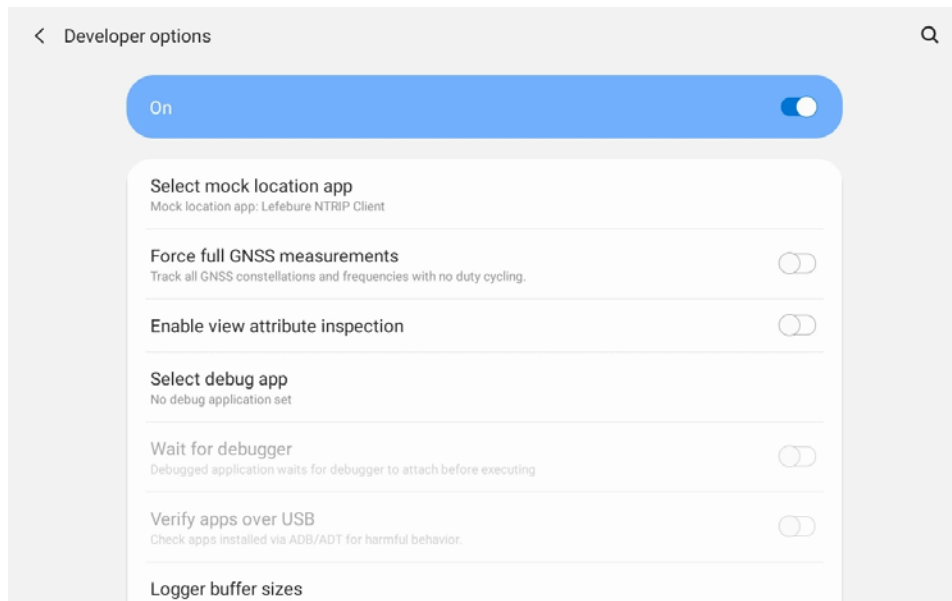
We provide a guide on how to use Reach with Lefebure NTRIP Client.

Besides being an NTRIP Client, this app also allows NMEA data input via Bluetooth and supports Android feature called **mock location**. This feature allows substituting your device's built-in GPS receiver with an external location provider.

Note: *Lefebure NTRIP Client allows the survey and GIS apps on the Android device to use accurate coordinates from Reach.*

1. Install the app Lefebure NTRIP Client on your Android device.

2. Open *Developer options* on your Android device and choose Lefebure NTRIP Client in the *Select mock location app* field.

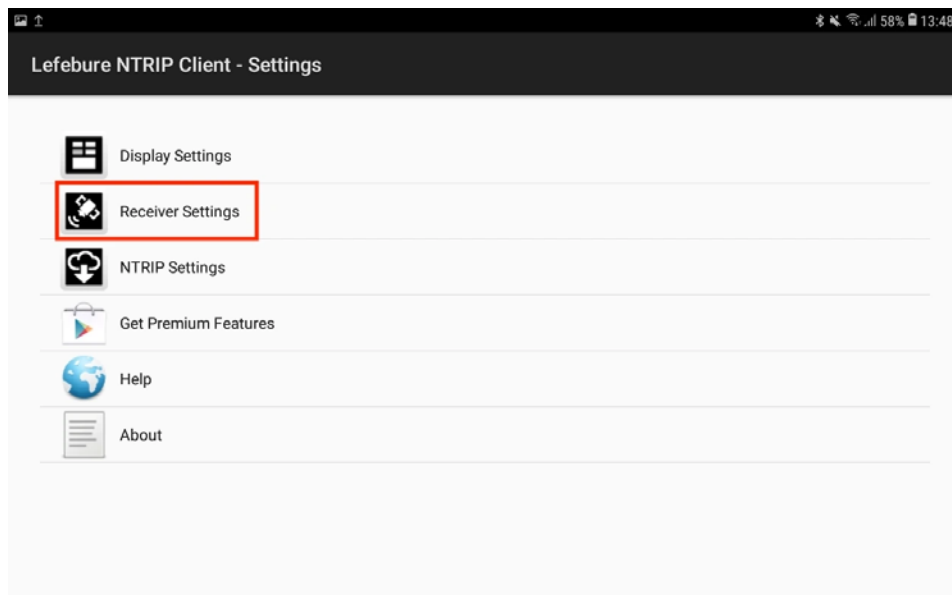


Note: *It is recommended to switch off the power-saving mode on your phone as it may limit background data usage for the Lefebure NTRIP client app.*

3. Launch the Lefebure NTRIP Client app and tap on the settings icon (gear in the upper right corner).

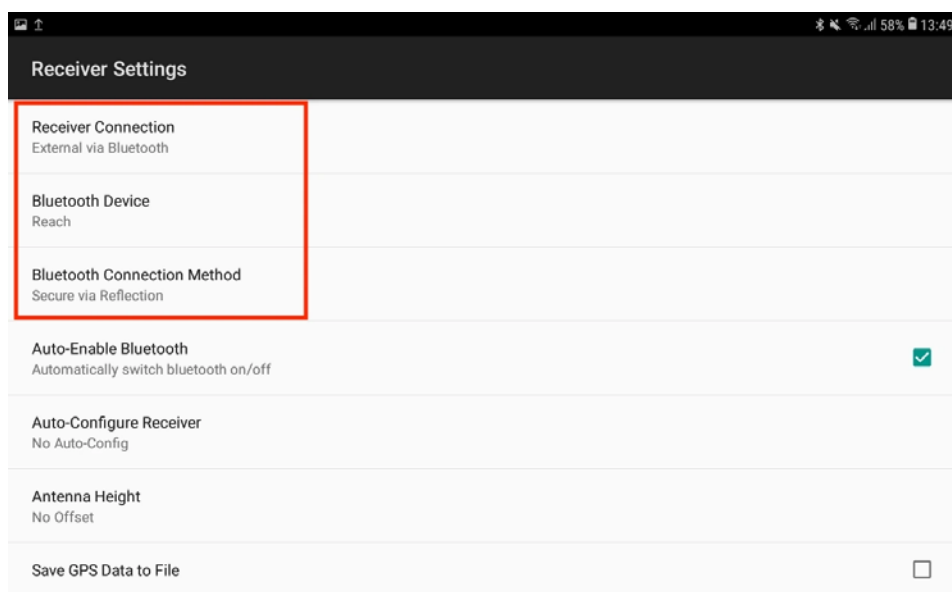


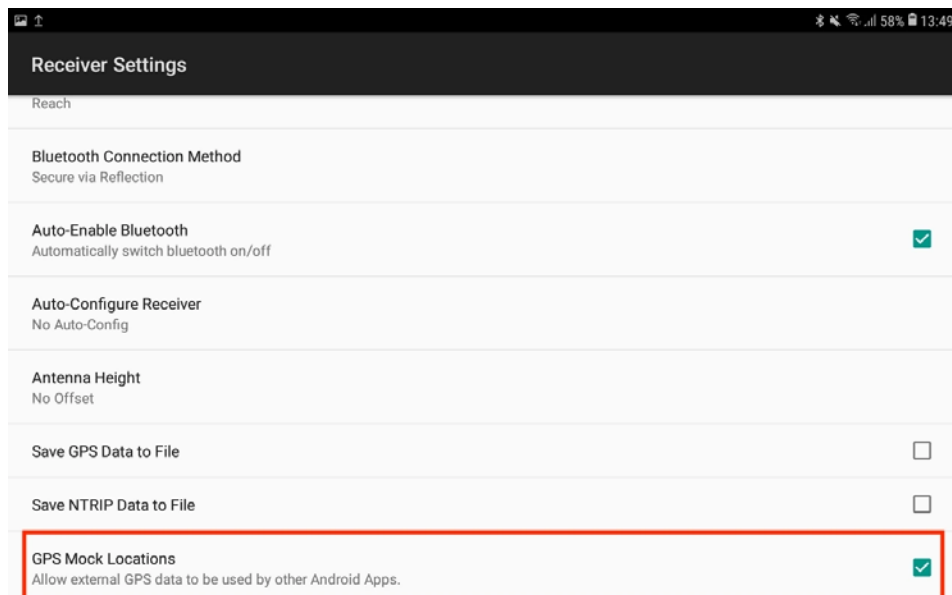
4. Go to the *Receiver Settings*.



Inside the receiver's settings set the following:

- *Configure Receiver Connection as External via Bluetooth.*
- *Change Bluetooth device to the Reach you are paired with.*
- *Change Bluetooth Connection Method to Secure via Reflection.*
- *Enable GPS Mock Locations.*





5. Go back to the main screen and tap the *Connect* button.

Tip: Check the log messages to confirm the Bluetooth connection got established and the information about satellites is updated.



From this moment on, all apps on the Android device that use location services will automatically have access to the positional data streamed from Reach. You can just open a survey or GIS app you want to use and start surveying.

Note: Tapping the *Disconnect* button in the Lefebure NTRIP Client will revert back to the Android built-in GNSS.

5.2 ArcGIS Survey123 integration

This tutorial provides step-by-step instructions on how to perform integration of Reach RS2/RS2+ with ArcGIS Survey123 via TCP using an iOS or Android device to create, share and analyse surveys.

5.2.1 What is ArcGIS Survey123?

ArcGIS Survey123 is an app for creating, sharing, and analyzing surveys. With this app, you can collect data via web or mobile devices, even when disconnected from the internet.

Note: Visit the [site](#) to learn more.

5.2.2 Getting started

To perform the integration, you will need the following:

- an iOS or Android device
- Emlid Flow
- Reach Reach RS2/RS2+

To start, download the ArcGIS Survey123 app from the App Store or Google Play and connect your Reach Reach RS2/RS2+ to the iOS or Android device using the Emlid Flow app. In this tutorial, we use an iOS device.

Note: Make sure that your iOS or Android device and Reach Reach RS2/RS2+ are connected to the same Wi-Fi network.

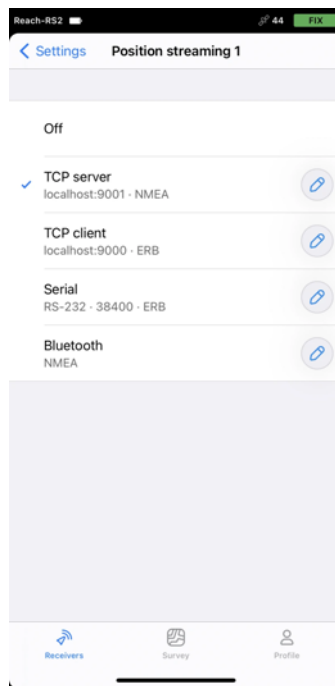
5.2.3 Establishing TCP connection

To establish a TCP connection between your Reach Reach RS2/RS2+ and ArcGIS Survey123, configure settings both in Emlid Flow and ArcGIS Survey123.

Configuring settings in Emlid Flow

1. Open Emlid Flow and connect to your Reach.
2. Go to *Settings* and tap *Position Streaming 1*.
3. Choose *TCP server*.
4. Tap the *Edit* button in the *TCP server* cell.
5. Tap *Format* and choose *NMEA*. Save changes.

Note: By default, the receiver will be configured on the TCP port 9001.

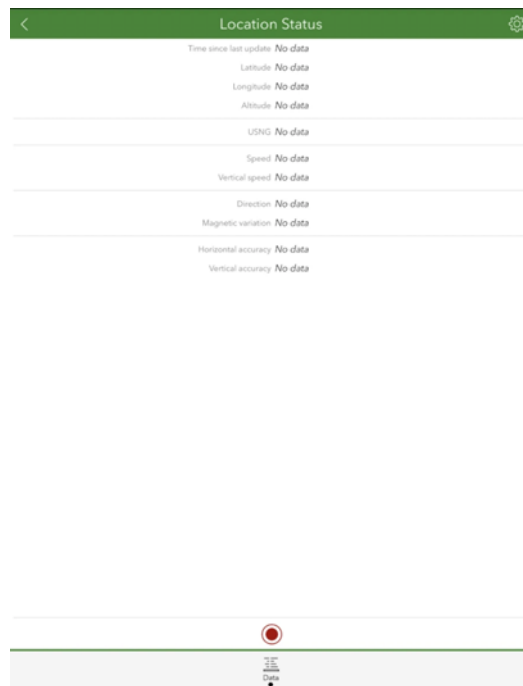


Configuring settings in ArcGIS Survey123

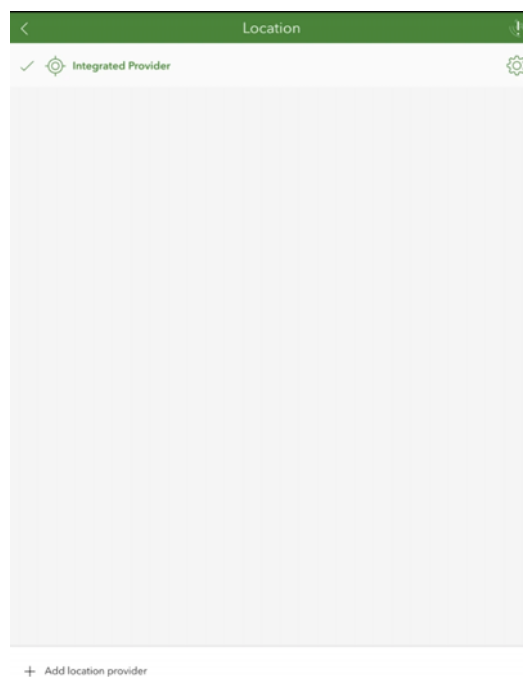
1. Open the ArcGIS Survey123 app.
2. Tap the *GNSS location* icon.



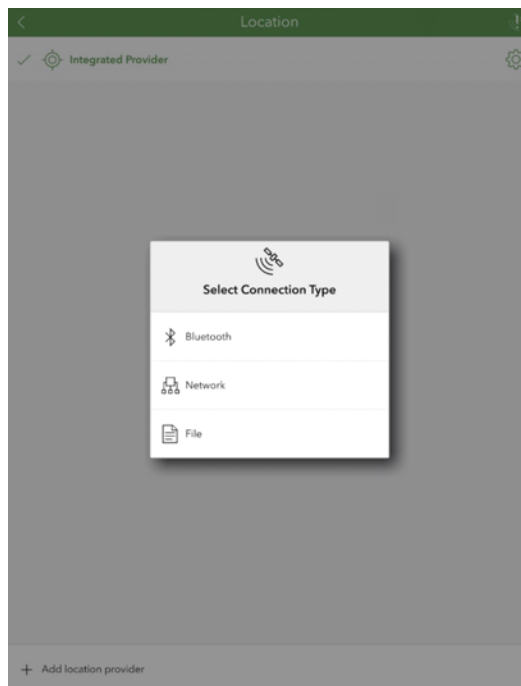
3. Tap the *Settings* icon.



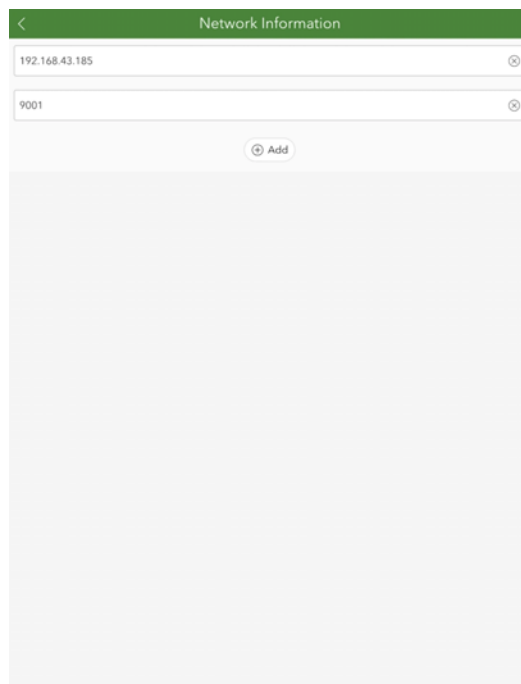
4. Tap *Add location provider*.



5. Choose the *Network connection* type.



6. Enter the Reach Reach RS2/RS2+ IP address in the *Hostname* field and the port that was configured on the receiver in the *Port* field.



Tip: You can check the IP address of your Reach Reach RS2/RS2+ in the Emlid Flow app. Go to the Settings screen and find it under the name of your receiver.

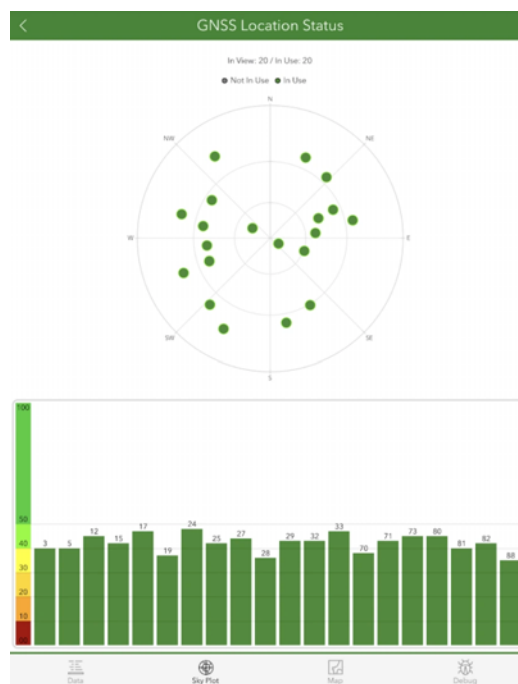
Note: Make sure that the port corresponds to the one configured on the receiver.

7. Tap the *Add location provider* button and press the back button to check the location providers list. Once the app is connected to your Reach Reach RS2/RS2+, you will see a tick near the hostname.

Once you successfully integrated your Reach Reach RS2/RS2+ with ArcGIS Survey123, you are ready for the survey. Tap on the GNSS location icon to check the GNSS location status:



You can also check the SNR and sky plot in the *Sky Plot* tab:



Note: To survey with ArcGIS Survey123, you will need to sign in with your ArcGIS account. After that, you can create a new survey following these [instructions](#).

5.3 Using QGIS as survey tool

5.3.1 Overview

QGIS (previously known as Quantum GIS) is the cross-platform free and open-source desktop geographic information system (GIS) app that provides data viewing, editing and analysis. It can be used for almost any GIS application.



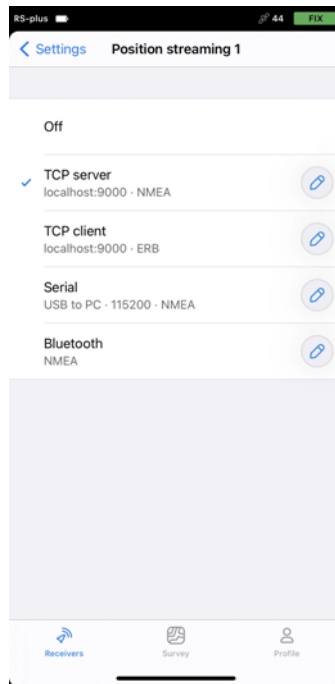
5.3.2 Connecting QGIS to Reach

First of all, we need to connect survey equipment to QGIS. There are two simple ways. One, over local network, or second by USB.

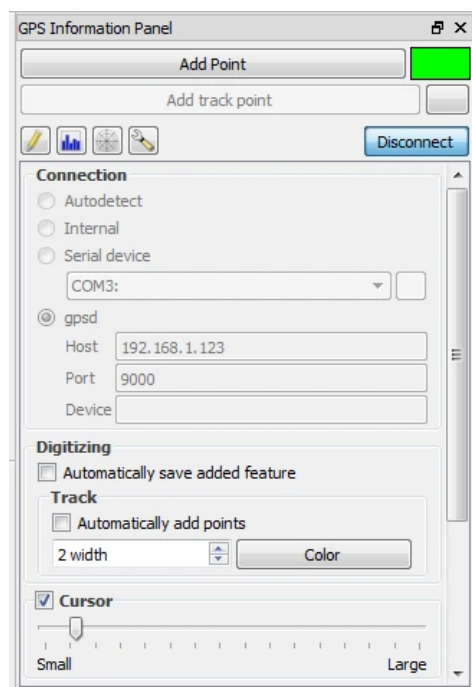
Tip: *To configure the connection in QGIS, you might need to enable the GPS Information panel first. Go to the View list in the Menu bar and tick this option in the Panels field to accomplish this.*

TCP

In order to connect over local network, the computer running QGIS needs to be on the same network as the rover. This can be via the rover's hotspot. This screenshot shows the rover configuration and QGIS configuration. The port number is the same as we will enter in QGIS to find the position string.



In QGIS, the color panel turns green to indicate connection when we enter in the IP address of the rover and the port number.



USB

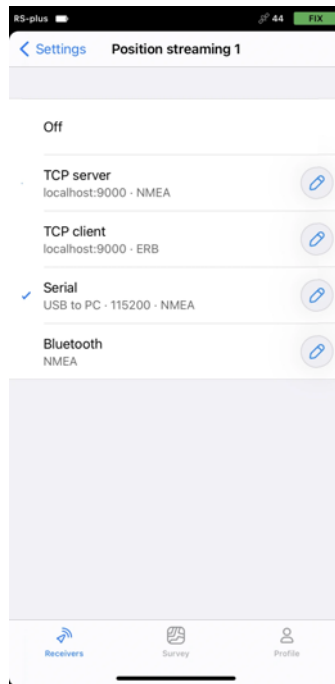
The second way to connect is via "serial device", actually USB. First plug the micro USB into the opening on the rover.



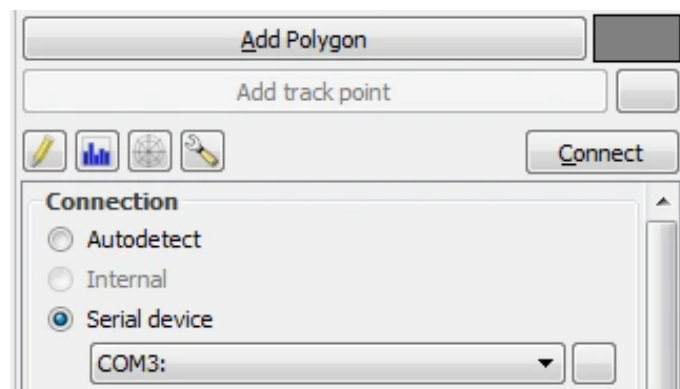
Then, plug the other end into the computer usb port.



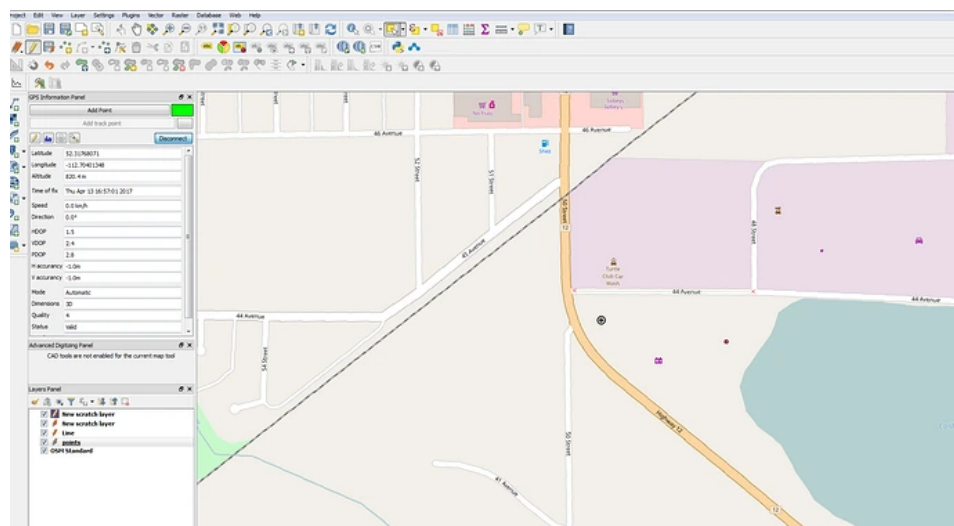
For this, the settings on your rover should be as on the screenshot below.



In QGIS, choose to connect by serial device and use the same COM port as is shown in connected devices.

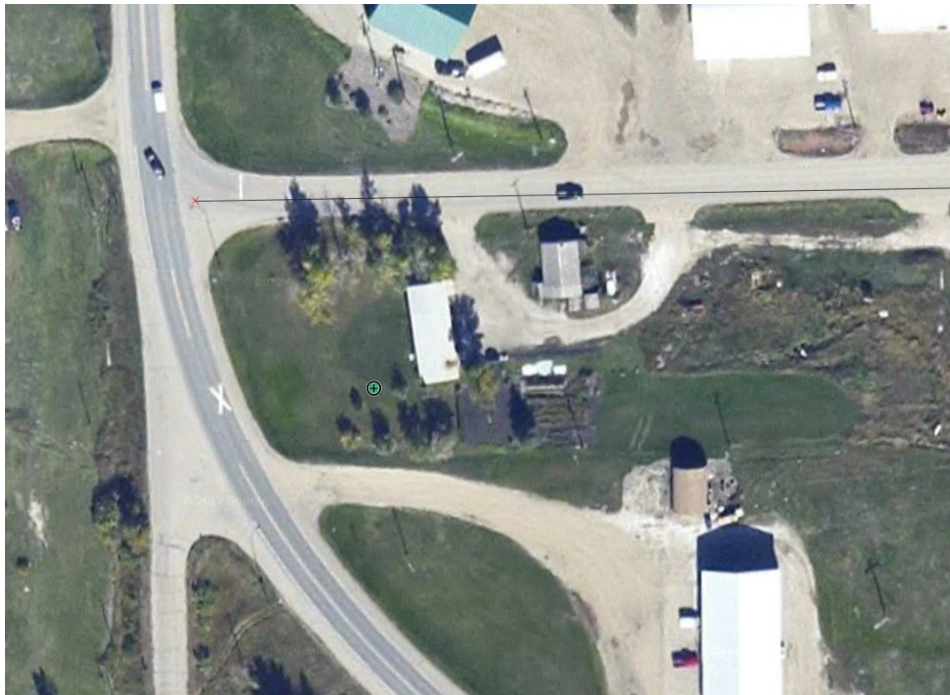


Now that we are connected, we should see Reach position in QGIS.

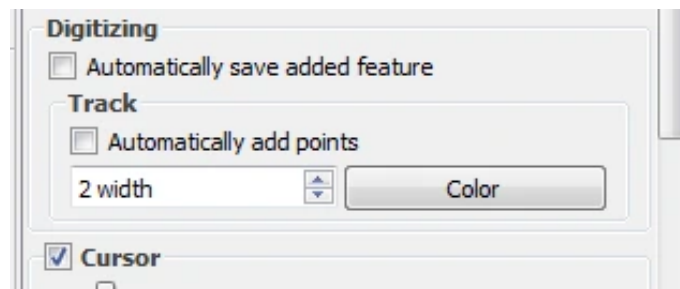


5.3.3 QGIS basics

In QGIS, we can choose from a wide range of the background maps, including your own drone imagery.

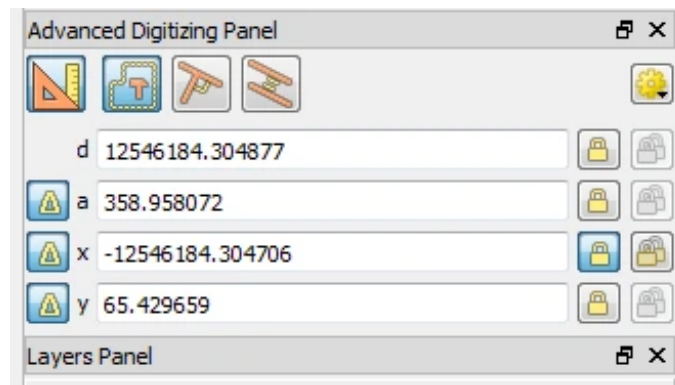


The GPS panel shows status, but if you want to check for the solution status, it is better to keep an eye on the Emlid Flow app for that. Once we are connected and have our layers and snapping settings ready, we can add points, lines, and polygons, based on our location.



QGIS CAD tools

Let's see at the feature of manually entering lines. Often we need to enter a line and then enter distances and directions based on that line, e.g., 30 m at 90 degrees relative to a given line. QGIS has a feature called CAD tools that should work for this. First, enter the line (for example, property line). Then, draw parallel or perpendicular lines from that one. This is found in the advanced digitizing panel. Here you can select start point by vertex and then begin drawing from that point at a direction relative to a selected line.



Distances and angles can be preset. Back in the office after the survey, there are options to trim, extend, fillet linework, convert points to arcs, etc. These features could be used while surveying as well. Check out the plug-in QAD.



Also check out plug-in CadTools.



Tip: Check out the tutorial for QGIS CAD tool by Klas Karlsson.

5.3.4 Credits

We want to thank Brent Wiebe for sharing his experience of using QGIS as survey tool with Reach.

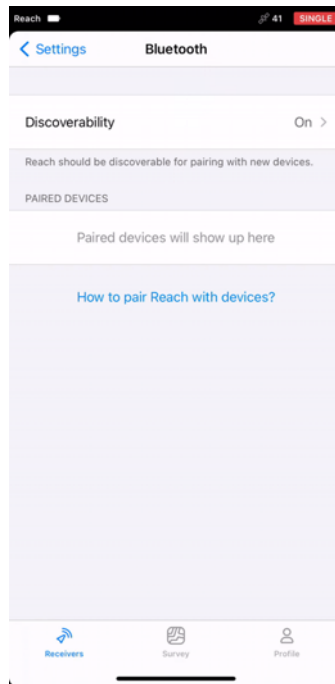
5.4 Microsurvey FieldGenius setup guide

In this tutorial, you will find the information on how to set up data collector running FieldGenius with Reach via Bluetooth. Step-by-step guide can be also found on MicroSurvey knowledge base.

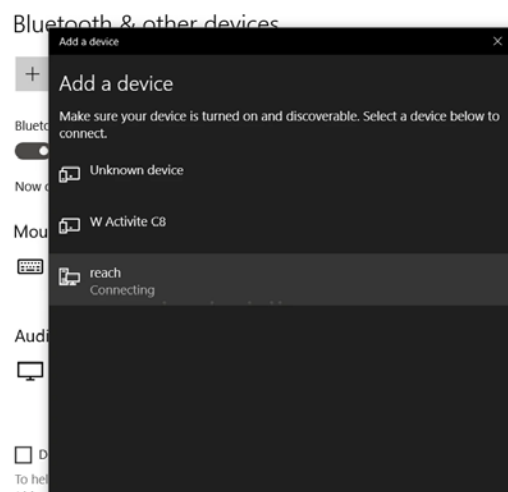
Note: *If you use FieldGenius for Android, please refer to the [Bluetooth output and Android mock location guide](#).*

5.4.1 Configuring Bluetooth connection

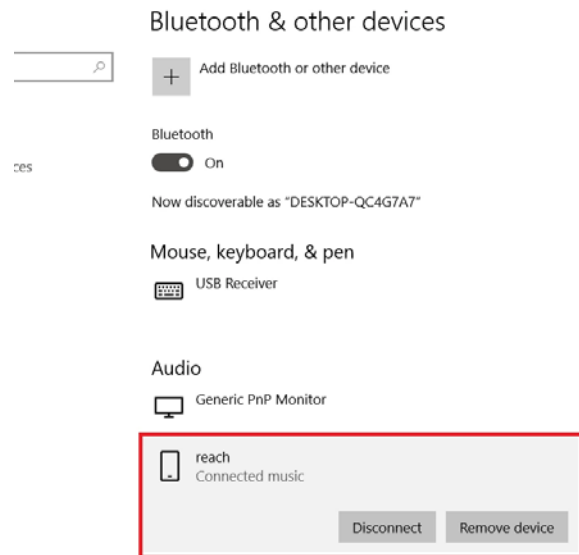
1. Open Emlid Flow and connect to your Reach.
2. Go to *Settings* and tap *Bluetooth*.
3. Enable Bluetooth by tapping the *Turn on Bluetooth* button.
4. Tap *Discoverability* and turn on the *Discoverability* option. Tap *Save* to apply changes.



5. In Windows, go to *Bluetooth settings* and select *Add a Bluetooth Device*. Select Reach from the list of discovered devices and confirm the connection.



When pairing is completed you will see Windows device is listed in the Emlid Flow app. Reach device will be listed as a device in Windows.



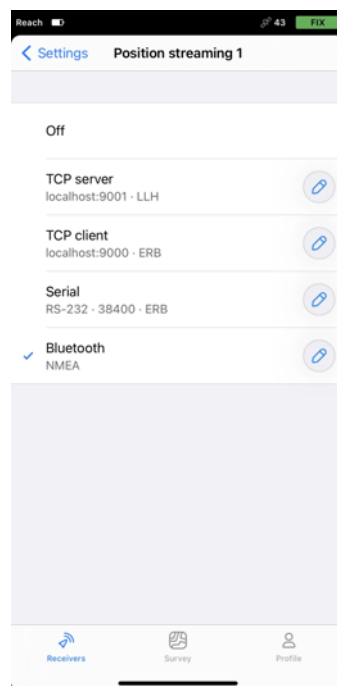
5.4.2 Configuring Emlid Flow

After successful Bluetooth pairing you should configure BT position streaming and correction input if needed.

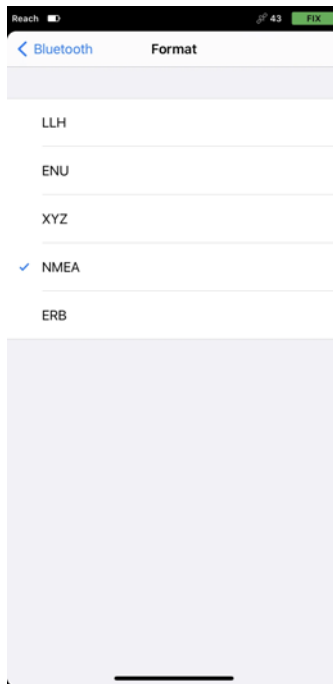
Position streaming

Set up position streaming as follows:

1. Go to *Settings* and tap *Position streaming 1*.
2. Choose *Bluetooth*.
3. To configure position streaming, tap the *Edit button* in the *Bluetooth* cell.



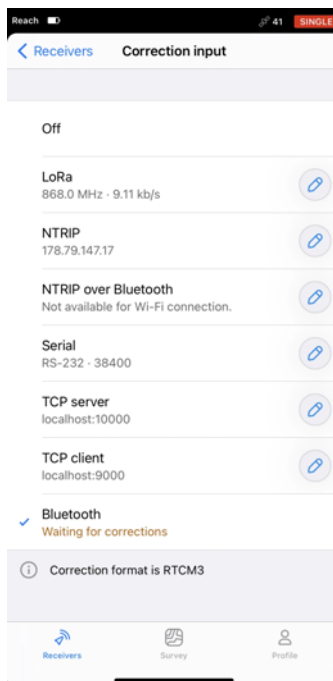
4. Tap *Format* and choose *NMEA*. Apply changes.



Correction input

To send the corrections from your controller via Bluetooth, do the following:

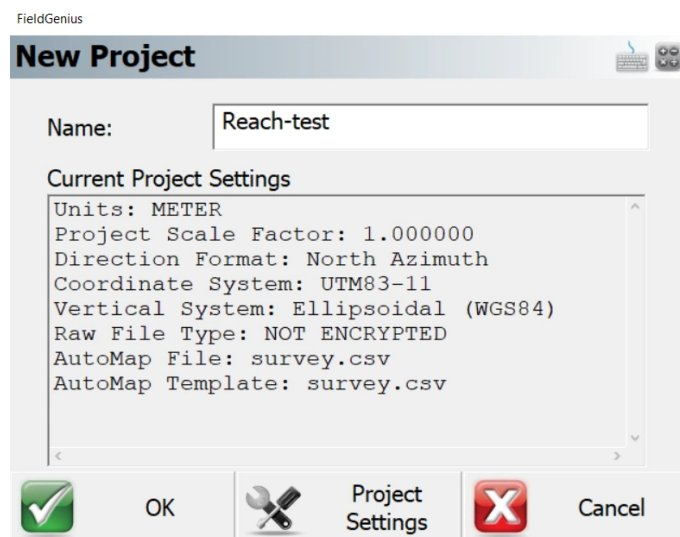
1. Go to the *Receivers* screen and tap *Correction input*.
2. Choose *Bluetooth*.



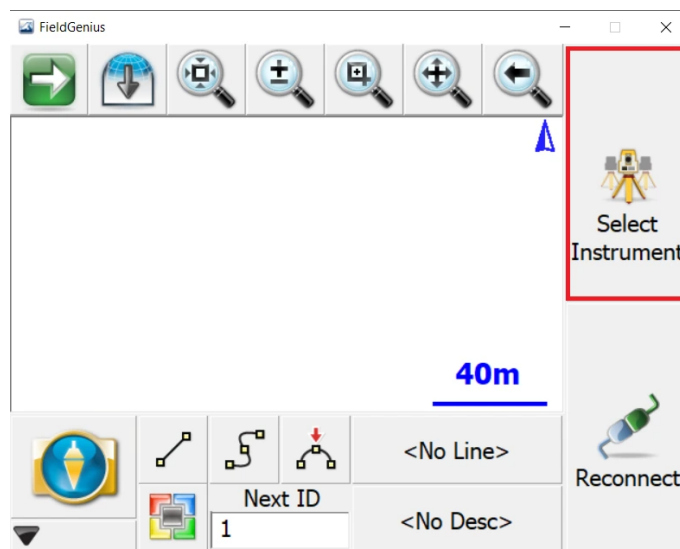
5.4.3 Configuring FieldGenius

Creating a new project and instrument profile

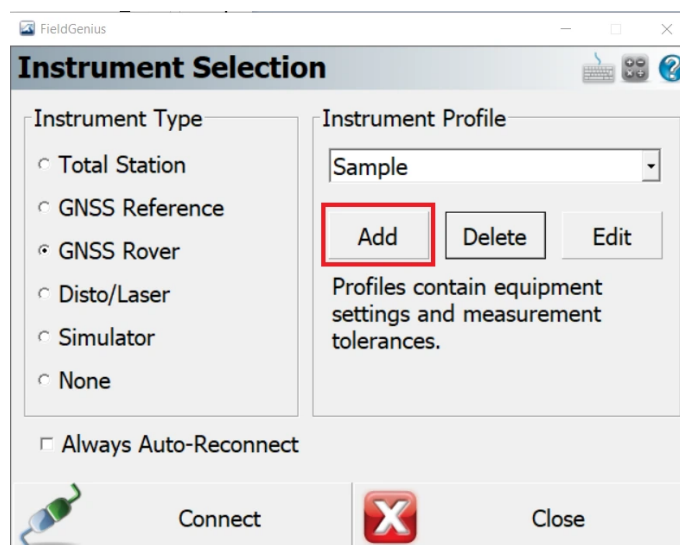
1. Launch FieldGenius. It will ask to create a new project. On this step, you can go to *Project Settings* to configure units and coordinate system. Click *OK* to proceed.



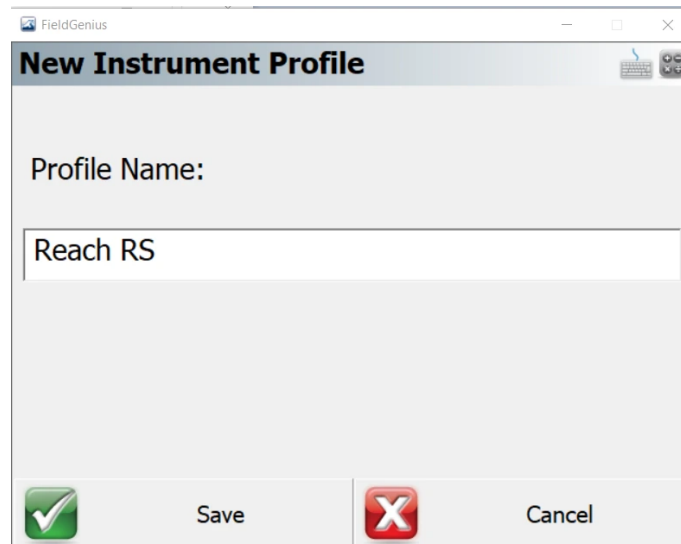
2. You will see FieldGenius interface. Choose *Select Instrument*.



3. Choose the *GNSS Rover* instrument type and add a new instrument profile.

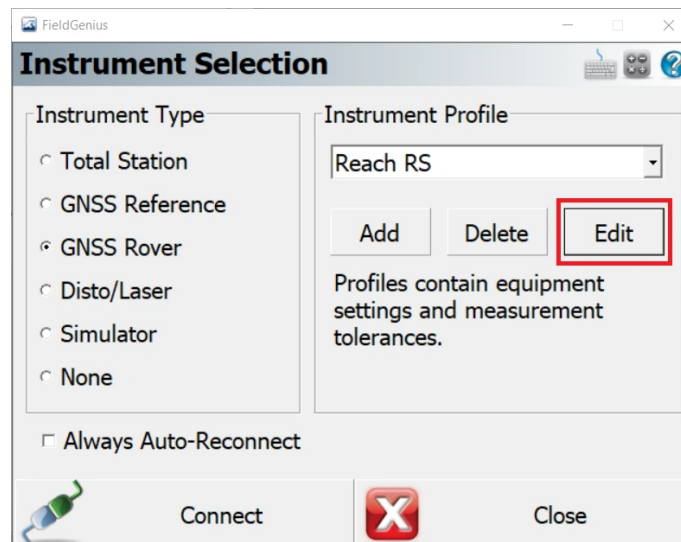


4. Set *Reach* profile name and click *Save*.

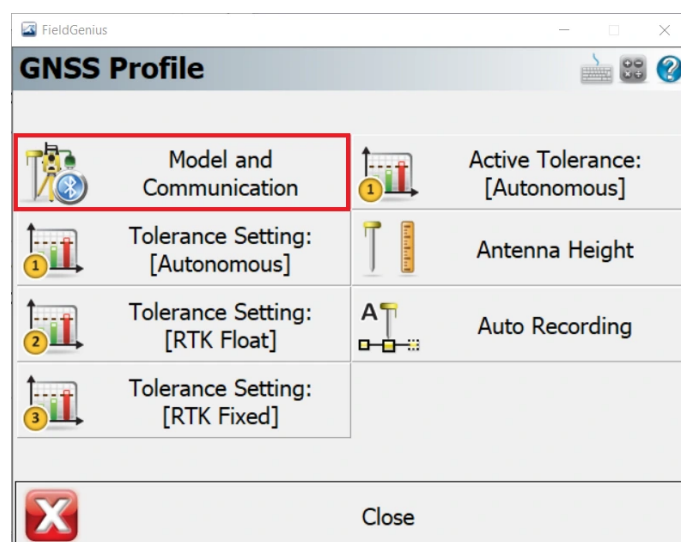


Configuring the communication between FieldGenius and Reach

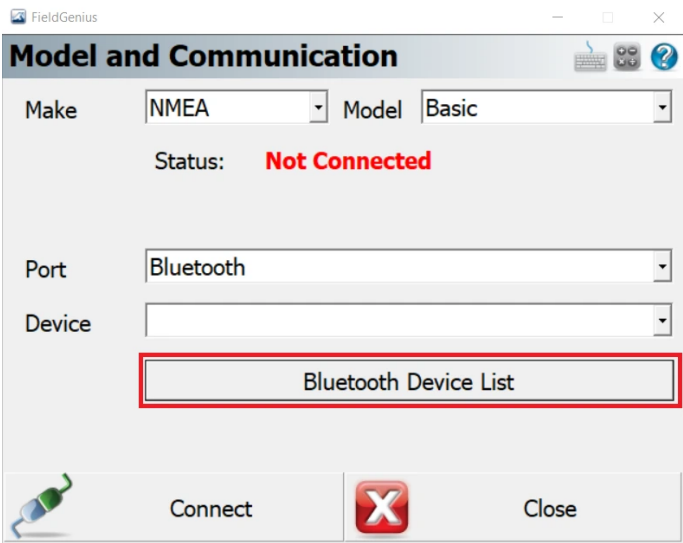
1. Pick the *Edit* option to configure the receiver parameters.



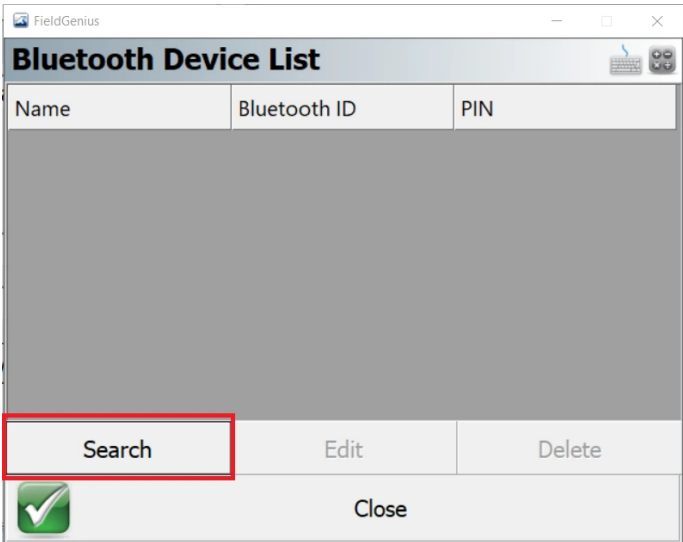
2. Select *Model and Communication*.



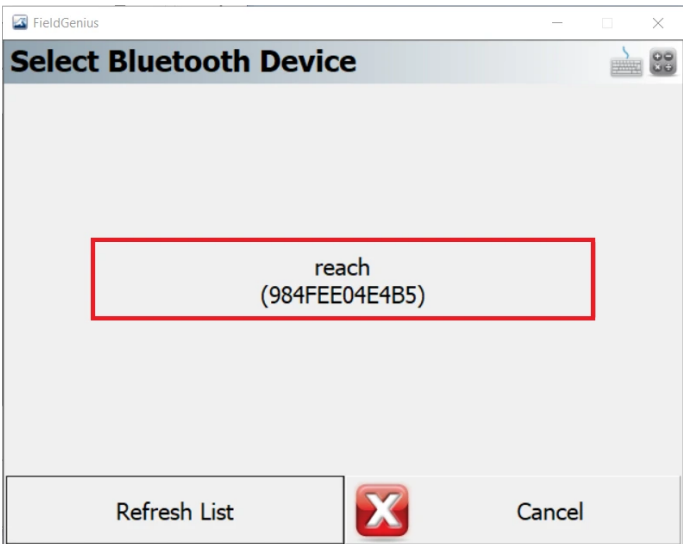
3. Select *NMEA* from the *Make* list and *Basic Model*. Click on *Bluetooth Device List*.



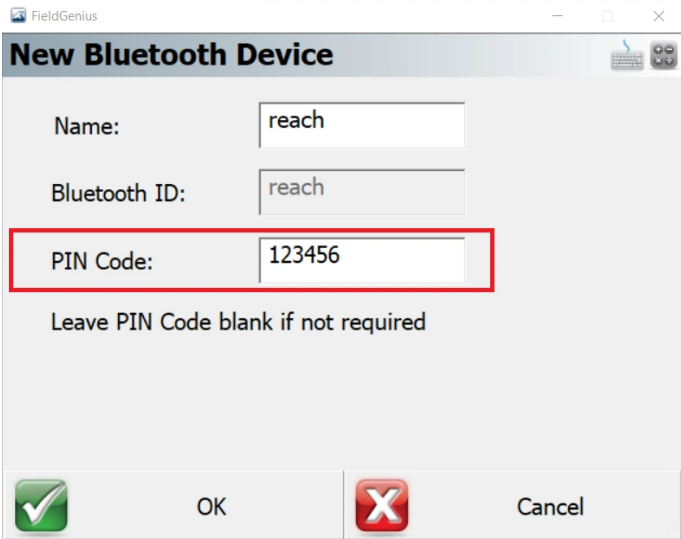
4. Click *Search* in *Bluetooth Device List*.



5. Select *Reach* device.



6. Enter the default PIN Code (it is "123456" for Reach) and press **OK**.



FieldGenius

New Bluetooth Device

Name: reach

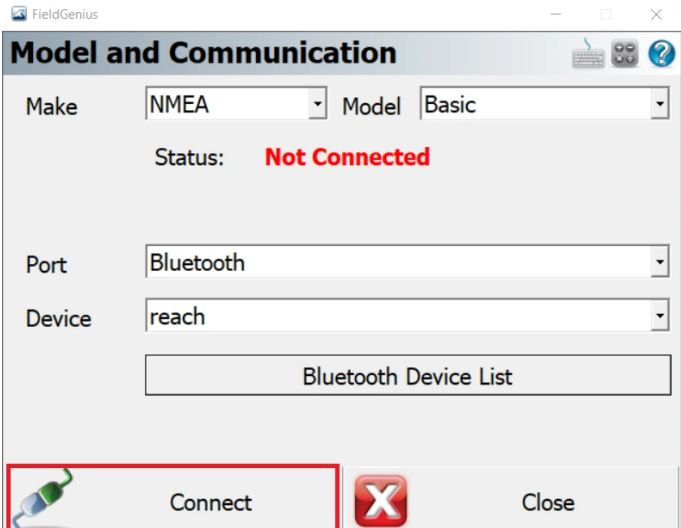
Bluetooth ID: reach

PIN Code: 123456

Leave PIN Code blank if not required

OK Cancel

7. After adding Reach device in *Bluetooth Device List*, return to *Model and Communication settings* and click *Connect*.



FieldGenius

Model and Communication

Make: NMEA Model: Basic

Status: **Not Connected**

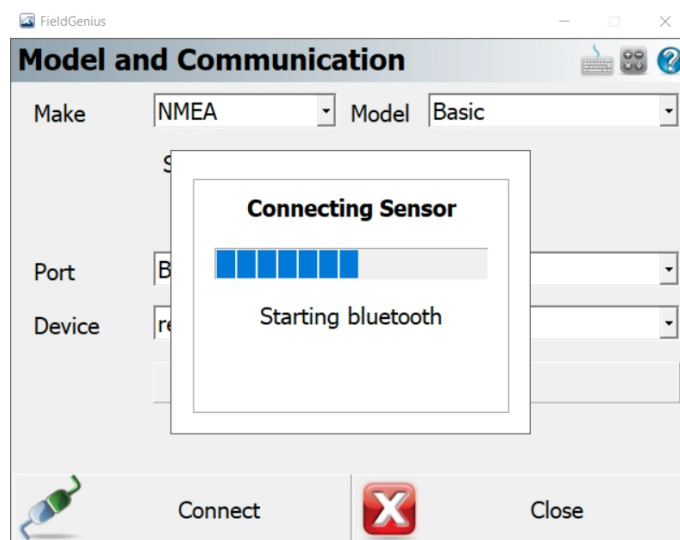
Port: Bluetooth

Device: reach

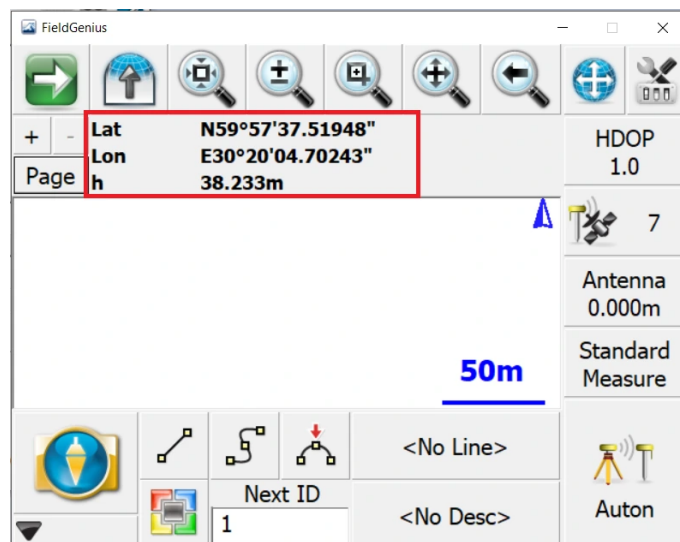
Bluetooth Device List

Connect Close

You will see progress dialog.

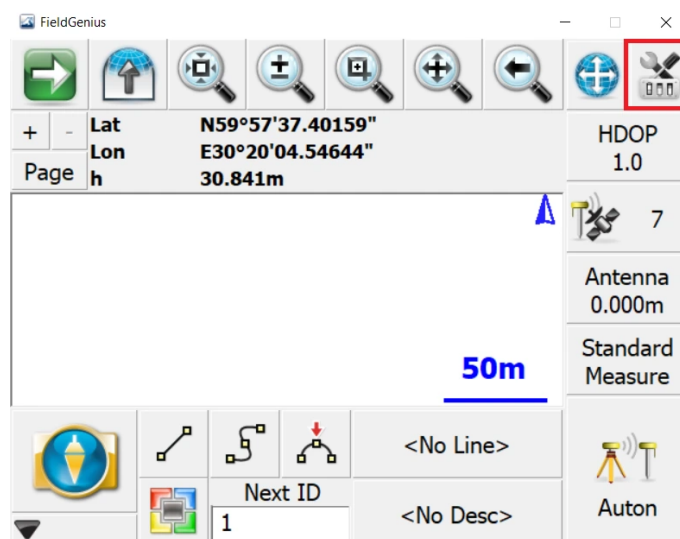


If the connection is successful, the position will be displayed with a number of satellites and PDOP.

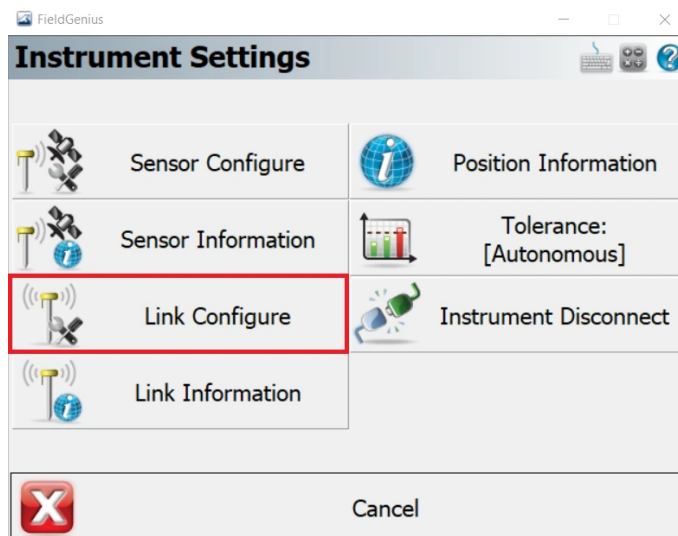


Configure FieldGenius to receive RTK corrections from an NTRIP caster

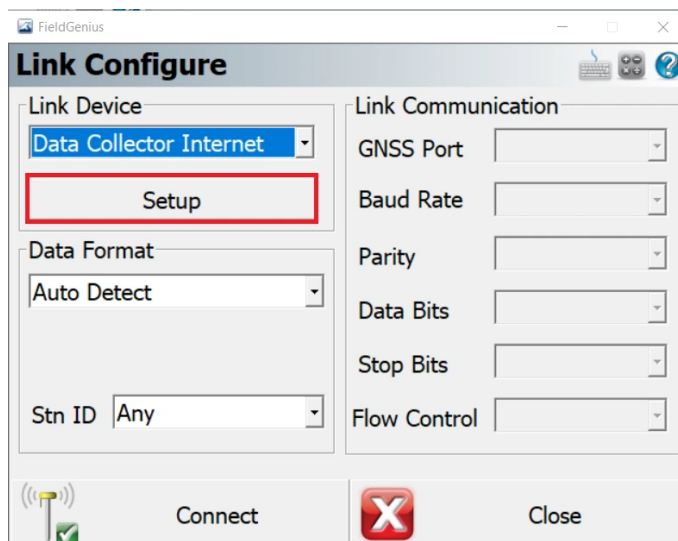
1. Go to *Instrument Settings*.



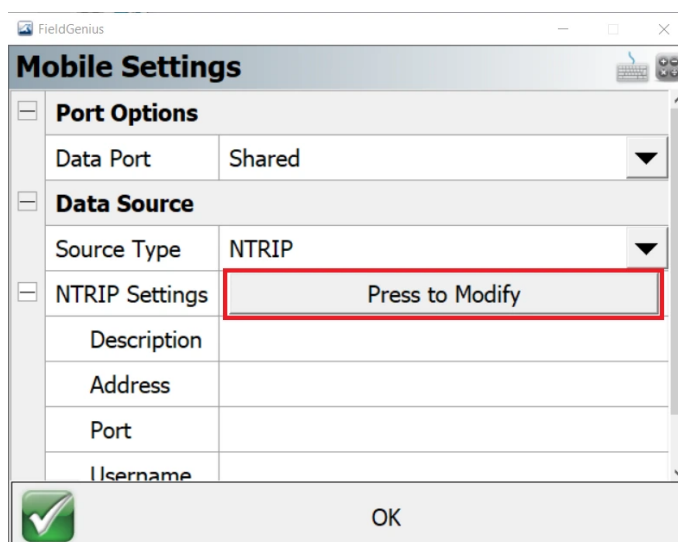
2. Choose *Link Configure*.



3. Pick *Data Collector internet* in *Link Device* and click *Setup*.



4. In the *Dialog* window, click *Press to Modify*.



5. Click *Add* in *NTRIP Casters* dialog and enter NTRIP caster details. Press *OK*.

FieldGenius

NTRIP Casters

Settings

Description	test caster
Address	my-ntrip-caster.org
Port	1010
Username	user
Password	password

OK Cancel

6. Select the created caster.

FieldGenius

NTRIP Casters

Description	Address	Port	Username	Password
test caster	my-ntrip-caster.org	1010	user	password

Add Edit Delete

7. Click *OK* to finish the setup.

FieldGenius

Mobile Settings

Port Options

Data Port: Shared

Data Source

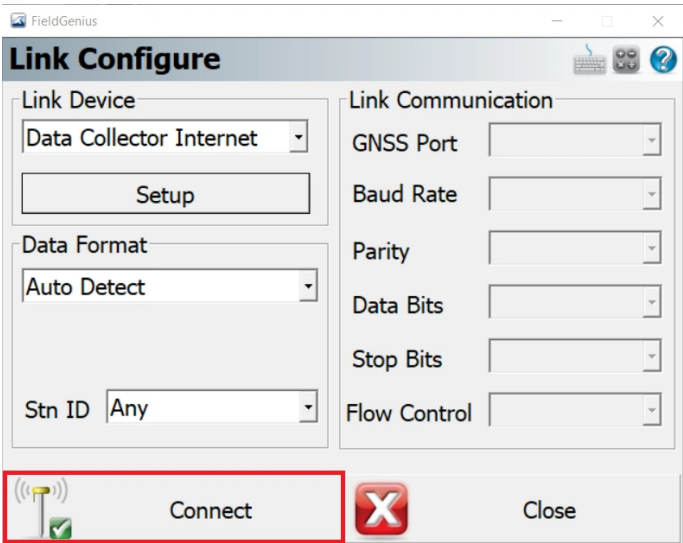
Source Type: NTRIP

NTRIP Settings Press to Modify

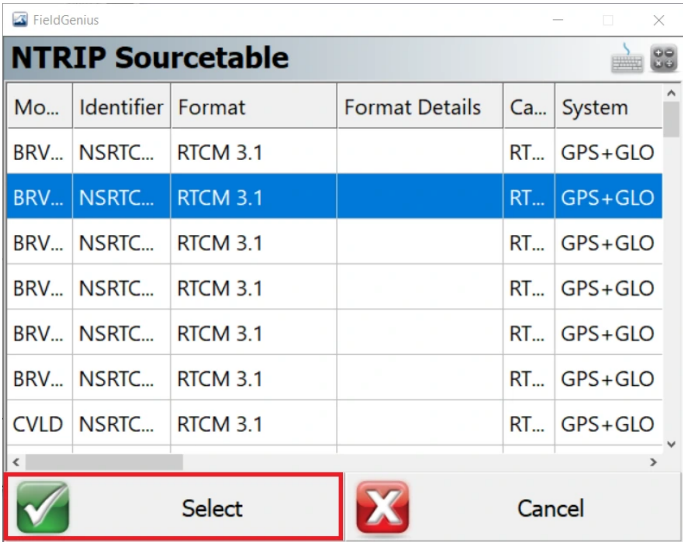
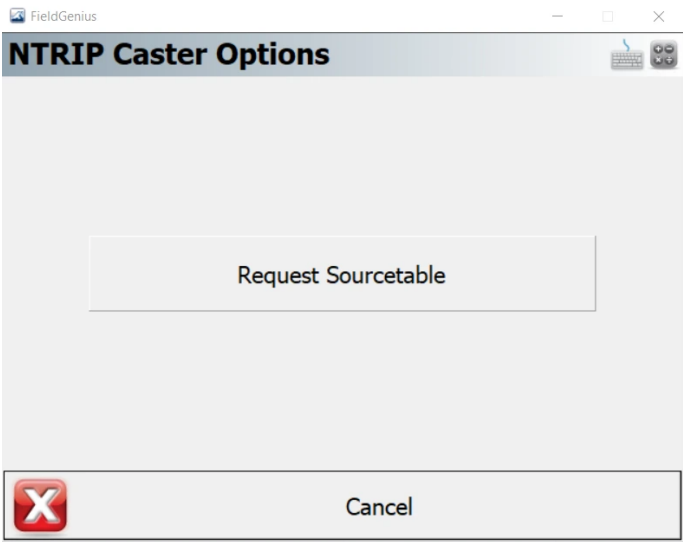
Description	test caster
Address	my-ntrip-caster.org
Port	1010
Username	user

OK

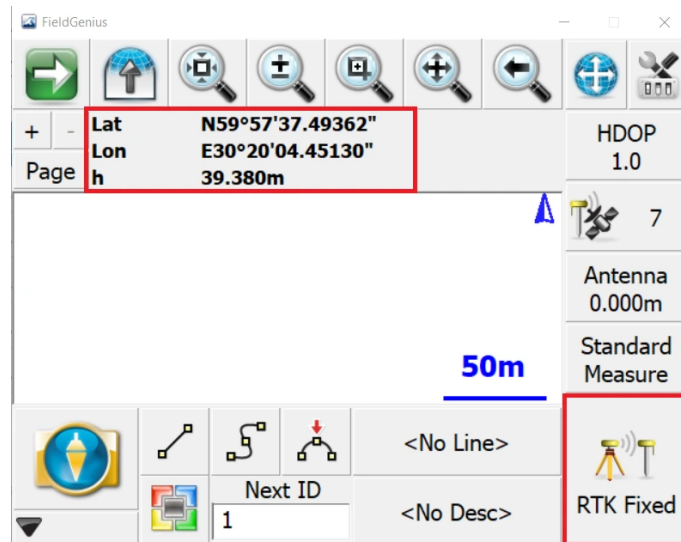
8. In the *Link Configure* dialog, click *Connect*.



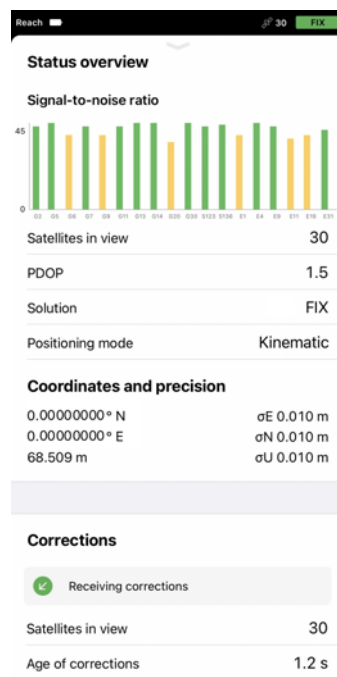
9. Once connected to the internet, request the sourcetable and choose a mountpoint.



In a moment you will see the solution status in FieldGenius interface.



You can also go to Emlid Flow to check the solution status.



5.5 DJI RTK drone and Reach RS2/RS2+ base integration

This guide shows how to set up your Reach RS2/RS2+ as a base for DJI RTK drones like Phantom 4 RTK, Mavic 3E, and Matrice 300 RTK to geotag drone images for further mapping in photogrammetry software.

Tip: Learn more about RTK and PPK in the guides below:

- [How RTK works](#)
- [How PPK works](#)

5.5.1 Overview

DJI RTK drones use NTRIP to receive corrections which allows you to use Reach RS2/RS2+ as a base station. Reach can send NTRIP corrections via Emlid Caster through the internet or using the Local NTRIP option in Emlid Flow without connection to the internet.

To set up your Reach RS2/RS2+ as a base for DJI RTK drone, you will need the following:

- DJI RTK drone with GS RTK as a rover
- Controller
- Reach RS2/RS2+ as a base
- A smartphone or tablet with the Emlid Flow app installed internet connection on both devices if you use Emlid Caster
- Access to Emlid Caster

In this guide, we will use DJI Phantom 4 RTK drone, but the process is the same for the other DJI RTK drones.

5.5.2 Workflow

The text below covers the process of setting up Reach RS2/RS2+ as a base for DJI Phantom 4 RTK drone using Emlid Caster through the internet or the Local NTRIP option in Emlid Flow.

Set up Reach RS2/RS2+ as base

Reach RS2/RS2+ can send NTRIP corrections via Emlid Caster or using the Local NTRIP option in Emlid Flow. The difference is that Emlid Caster requires an internet connection, and Local NTRIP allows you to set up RTK without an internet connection. Select the method depending on your use case and follow the steps below.

Set up Reach RS2/RS2+ as base using Local NTRIP

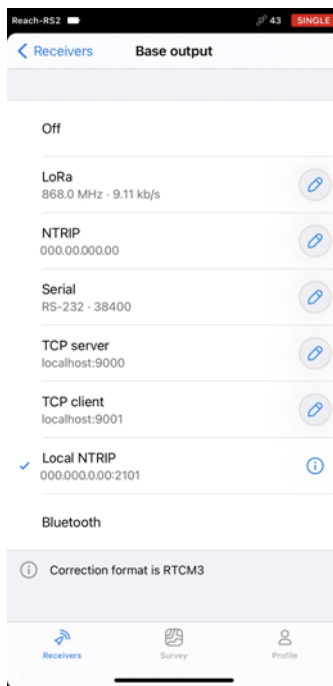
Caution: *This setup will work for your DJI RTK drone only if it supports a Wi-Fi connection.*

To set up your Reach as a base for the DJI Phantom 4 RTK drone using the Local NTRIP option in Emlid Flow, follow the steps below:

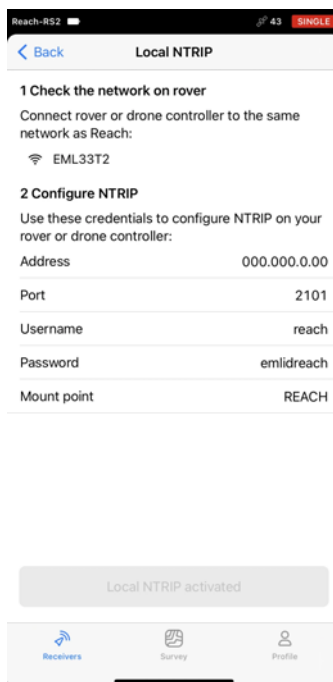
1. Place your Reach on the tripod and provide it with a clear sky view.

Tip: *Learn more about base placement in the [Placement](#) and [Choosing base setup method](#) articles.*

2. Open Emlid Flow and connect to your Reach.
3. Tap *Base output* and select the *Local NTRIP* option.



4. Tap the information button to access the page with rover credentials.



5. Connect your controller to the same Wi-Fi network as your Reach.

Note: To ensure proper connection, keep the distance between the drone's controller and your base within several meters.

Set up Reach RS2/RS2+ as base using Emlid Caster

To set up your Reach RS2/RS2+ as a base for DJI Phantom 4 RTK using Emlid Caster, you need to get access to Emlid Caster and get NTRIP credentials. Follow the steps below:

1. Access Emlid Caster and get NTRIP credentials for both base and rover.

Tip: To learn more, check the [Emlid Caster docs](#).

2. Place your Reach on the tripod and provide it with a clear sky view.

Tip: *Learn more about base placement in the [Placement](#) and [Choosing base setup method](#) guides.*

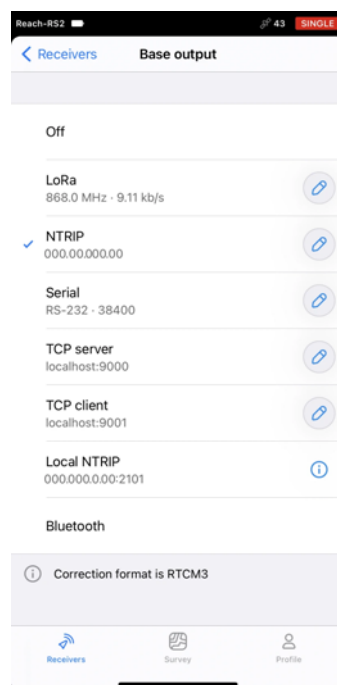
3. Open Emlid Flow and connect to your receiver.

4. Connect your Reach to the internet.

Tip: *To learn more about connecting your Reach RS2/RS2+ to the internet, check the following guides:*

- [Connecting Reach to Internet via built-in modem](#)
- [Connecting Reach to Internet via Wi-Fi](#)
- [Connecting Reach to the Internet via mobile hotspot](#)

5. On the *Receivers* screen, tap *Base output* and select the *NTRIP* option.



6. Tap the *Edit* button and insert the NTRIP credentials for the base.

Note: To ensure successful corrections transmitting, double-check the credentials you entered. Once you place and set up your base, you can proceed to the drone's setup.

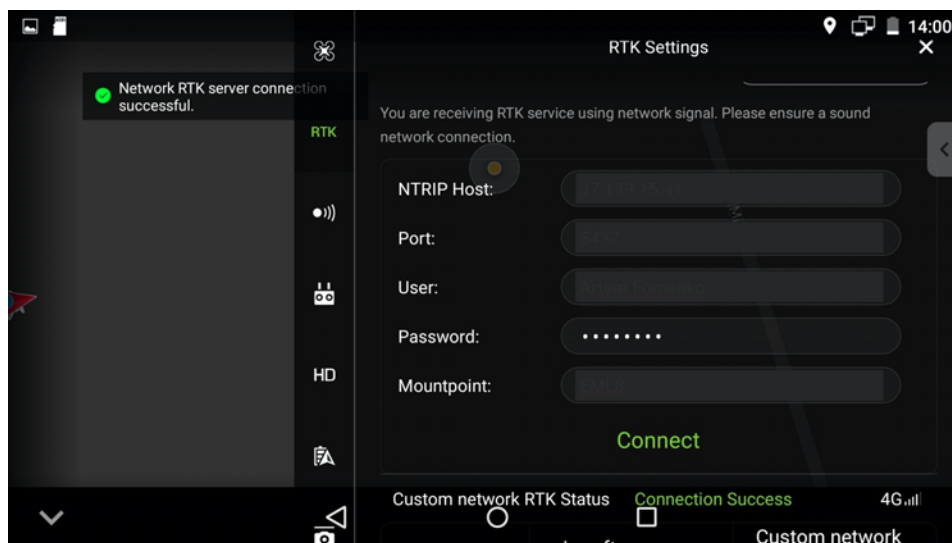
Set up DJI Phantom 4 RTK as rover

To set up your DJI Phantom 4 RTK as a rover, follow the steps below:

1. Connect the controller to your drone.
2. Open GS RTK.
3. Select *Plan* or *Fly* menu. If you choose *Plan*, select a planning method.
4. Open *Settings* by tapping the 3 dots icon at the top right corner.
5. Go to the *RTK Settings* tab.
6. In *RTK Service Type*, choose *Custom network RTK* and fill in the *NTRIP credentials* form.

Note: Fill in the credentials you obtained when accessing Emlid Caster or enabling the Local NTRIP option in Emlid Flow. Make sure that you use the credentials for the rover.

7. Tap the *Connect* button. The "Network RTK server connection successful" message will appear. That means that the base is successfully connected.



5.5.3 Perform flight

When you set up communication between your Reach RS2/RS2+ and a drone, you can perform the flight. Provide DJI Phantom RTK with a clear sky view and proceed to the mission.



Once the flight is completed, you can download the geotagged images and use them for further mapping in photogrammetry software.

Tip: To create a map using Pix4DMapper, check the *Creating the map tutorial*.

5.6 Autel EVO II Enterprise and Reach RS2/RS2+ base integration

This guide shows how to set up Reach RS2/RS2+ as a base for the Autel EVO II Enterprise drone to geotag drone images for further mapping in photogrammetry software.

Note: It is also possible to use the Autel EVO II RTK Series drone with Reach RS2/RS2+ base.

Tip: Learn more about RTK and PPK in the guides below:

- [How RTK works](#)
- [How PPK works](#)

5.6.1 Overview

Autel EVO II Enterprise uses NTRIP to receive corrections, which allows you to use Reach as a base station. Reach can send NTRIP corrections via Emlid Caster through the internet or using the Local NTRIP option in Emlid Flow without connection to the internet.

Note: *To use the Local NTRIP option, the base and the rover should be connected to the same Wi-Fi network.*

To set up your Reach as a base for the Autel EVO II Enterprise drone, you will need the following:

- Autel EVO II Enterprise drone as a rover
- Controller
- Reach RS2/RS2+ as a base
- A smartphone or tablet with the Emlid Flow app installed
- internet connection on both Reach RS2/RS2+ and Autel
- Smart Controller if you use Emlid Caster
- Access to Emlid Caster

5.6.2 Workflow

Set up Reach RS2/RS2+ as base

Reach RS2/RS2+ can send NTRIP corrections via Emlid Caster or using the Local NTRIP option in Emlid Flow. The difference is that Emlid Caster requires an internet connection, and Local NTRIP allows you to set up RTK without an internet connection. Select the method depending on your use case and follow the steps below.

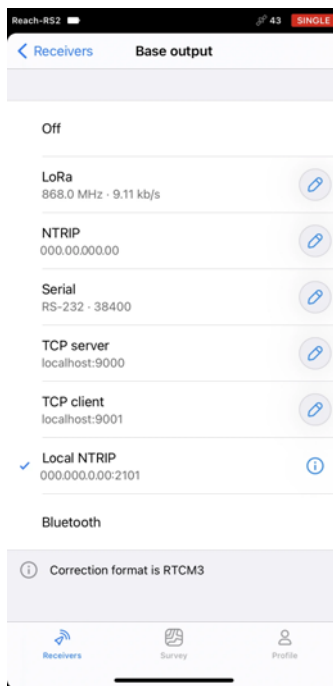
Set up Reach RS2/RS2+ as base using Local NTRIP

To set up your Reach as a base for the Autel EVO II Enterprise drone using the Local NTRIP option in Emlid Flow, follow the steps below:

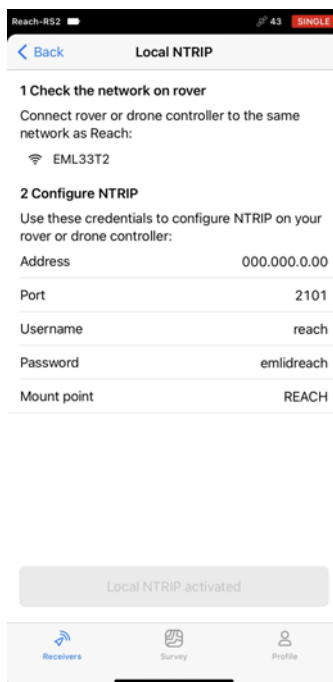
1. Place your Reach on the tripod and provide it with a clear sky view.

Tip: *Learn more about base placement in the [Placement](#) and [Choosing base setup method](#) articles.*

2. Open Emlid Flow and connect to your Reach.
3. Tap *Base output* and select the *Local NTRIP* option.



4. Tap the information button to access the page with rover credentials.



5. Connect Autel Smart Controller to the same Wi-Fi network as your Reach.

Note: To ensure proper connection, keep the distance between the drone's controller and your base within several meters.

Set up Reach RS2/RS2+ as base using Emlid Caster

To set up your Reach as a base for Autel EVO II Enterprise using Emlid Caster, you need to get access to Emlid Caster and get NTRIP credentials. Follow the steps below:

1. Access Emlid Caster and get NTRIP credentials for both base and rover.

Tip: To learn more, check the Emlid Caster docs.

2. Place your Reach on the tripod and provide it with a clear sky view.

Tip: *Learn more about base placement in the [Placement](#) and [Choosing base setup method](#) guides.*

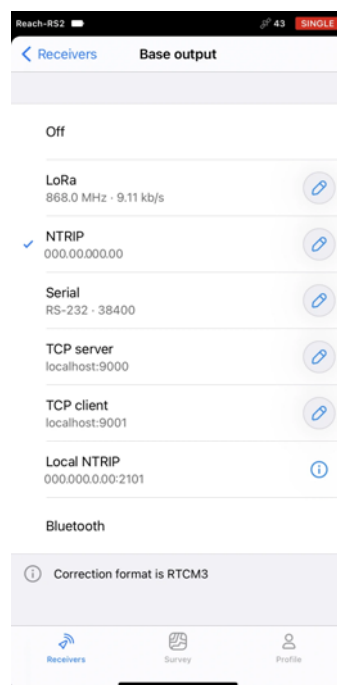
3. Open Emlid Flow and connect to your receiver.

4. Connect your Reach to the internet.

Tip: *To learn more about connecting your Reach RS2/RS2+ to the internet, check the following guides:*

- [Connecting Reach to Internet via built-in modem](#)
- [Connecting Reach to Internet via Wi-Fi](#)
- [Connecting Reach to the Internet via mobile hotspot](#)

5. On the *Receivers* screen, tap *Base output* and select the *NTRIP* option.



6. Tap the *Edit* button and insert the NTRIP credentials for the base.

Reach-RTK 43 SINGLE

Cancel NTRIP Save

Address
Required

Port
Required

Password

Mount point
Required

Note: To ensure successful corrections transmitting, double-check the credentials you entered.

Once you place and set up your base, you can proceed to the drone's setup.

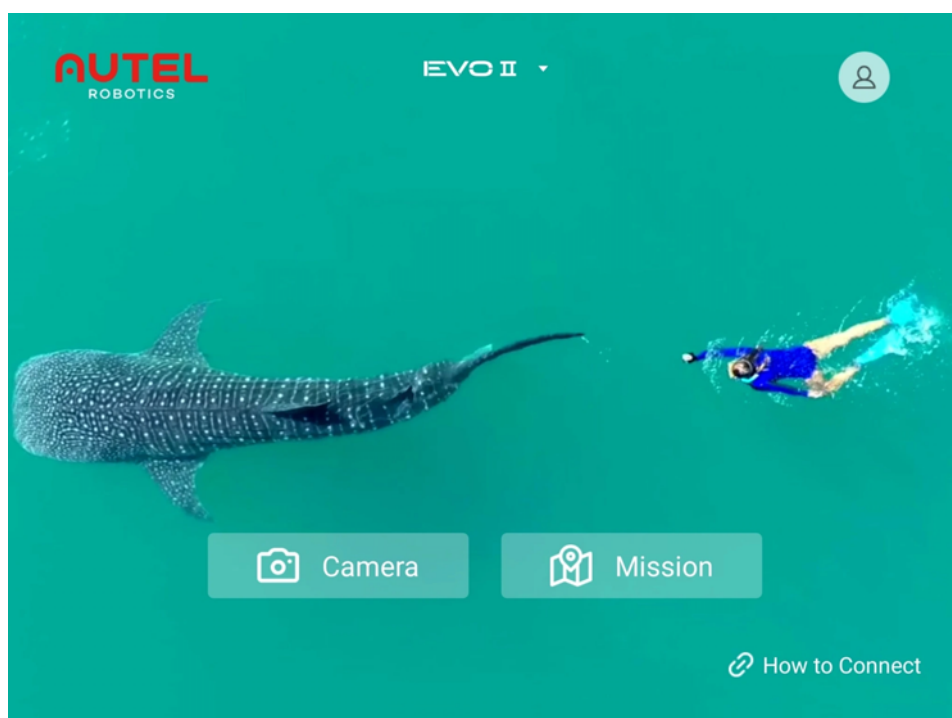
Set up Autel EVO II Enterprise as rover

To set up your Autel EVO II Enterprise as a rover, follow the steps below:

1. Attach the RTK Module to your drone.

Tip: Skip this step, if you use the Autel EVO II RTK Series drone.

2. Connect the controller to your drone.
3. Open the Autel Explorer app. Tap the *Camera* button.



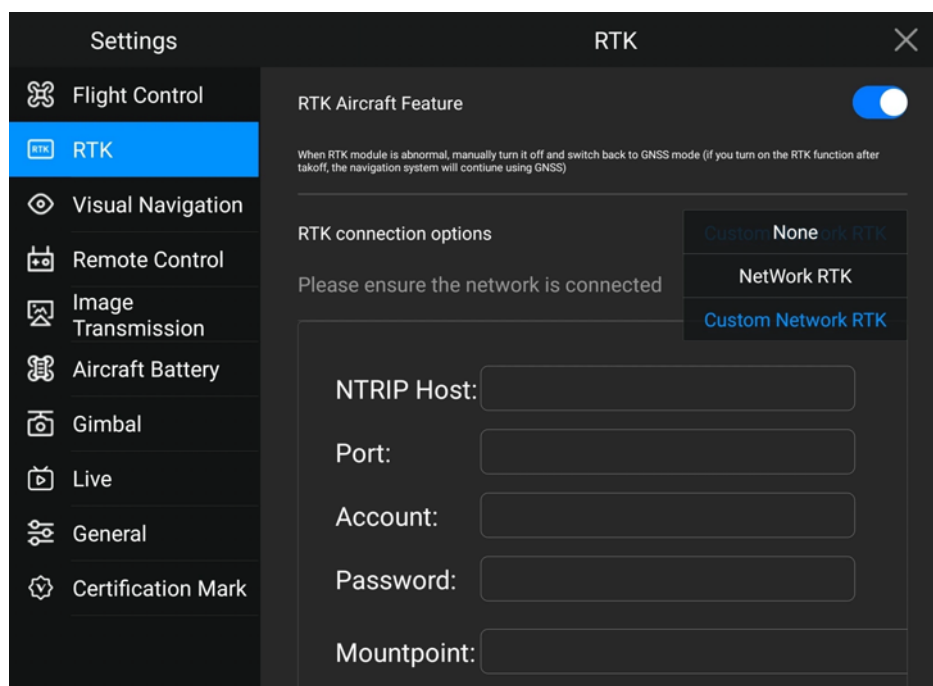
4. To open the *Settings* screen, tap the gear icon at the top right corner.



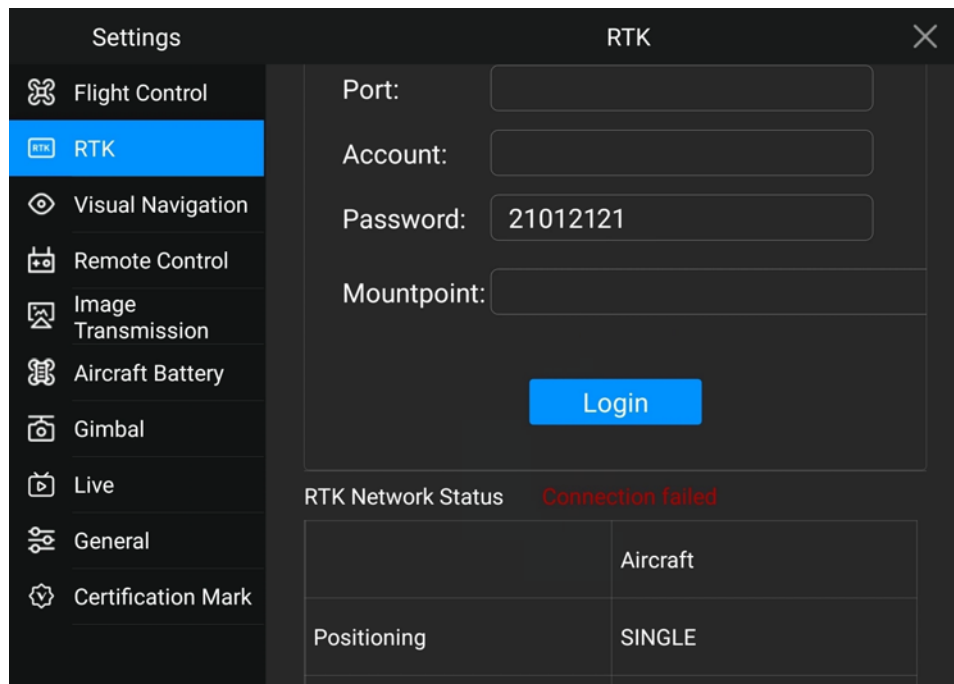
5. Go to the *RTK* screen.

6. Turn on the *RTK Aircraft Feature* option. In *RTK connection options*, choose *Custom Network RTK* option and fill in the NTRIP credentials.

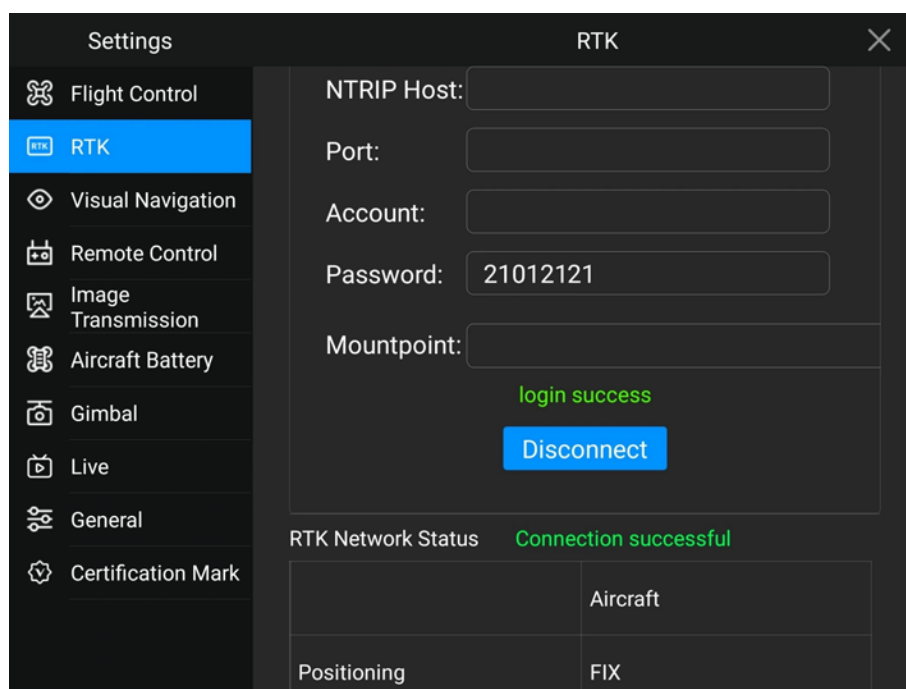
Note: Fill in the credentials you obtained when accessing Emlid Caster or enabling the Local NTRIP option in Emlid Flow. Make sure that you use the credentials for the rover.



7. Tap *Login*.



8. The *login success message* will appear if the base is successfully connected. RTK Network Status should change to the Connection successful state.



5.6.3 Perform Flight

When you set up communication between your Reach and a drone, you can perform the flight. Provide Autel EVO II Enterprise with a clear sky view and proceed to the mission.

Once the flight is completed, you can download the geotagged images and use them for further mapping in photogrammetry software.

Tip: To create a map using Pix4DMapper, check the *Creating the map tutorial*.

Credits

We want to thank Dave Pitman for sharing his experience of using the Autel Robotics drone as a survey tool with Reach RS2/RS2+.

5.7 Using Reach RS2/RS2+ base station for YellowScan LiDAR systems

This guide explains how to record a raw data log on your Reach RS2/RS2+ used as a base station for the YellowScan LiDAR systems for drone mapping and prepare it to get the corrected trajectory SBET file for further processing in the CloudStation software.

5.7.1 Overview

You can use your Reach RS2/RS2+ as a part of the YellowScan LiDAR system setup for drone mapping. During a drone flight mission, Reach RS2/RS2+ acts as a base station that records the RINEX observation data. This data, along with the raw trajectory data from the drone, is used to obtain a corrected flight trajectory file, SBET, in the Applanix POSPac software. The obtained SBET file is then processed together with the scanner data in the CloudStation software to get the geotagged point cloud.

This guide covers only the setup of Reach RS2/RS2+ base and the recording of a RINEX observation log on it, and the further preparation of the log for processing in Applanix POSPac to ensure the generation of a corrected flight trajectory trajectory SBET file.

5.7.2 Workflow

To record logs on Reach RS2/RS2+ base and prepare them for further processing in the Applanix POSPac software, follow these steps:

1. In the Emlid Flow app, set up your Reach as a base. in GNSS settings, select the same satellite systems in GNSS settings that you have on your drone. Set the update rate to 1 Hz.

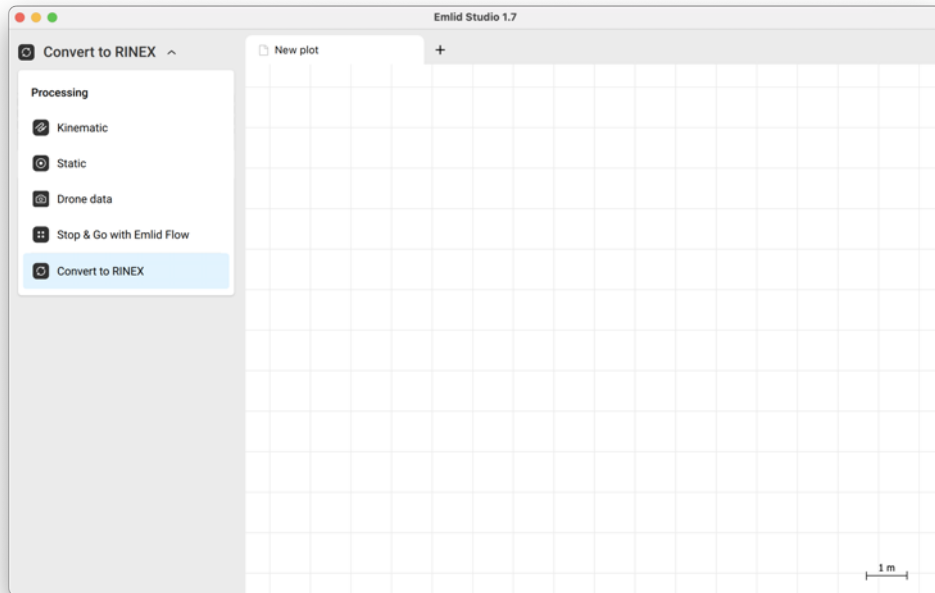
Tip: *Learn more about base setup in the [Base setup guides](#).*

2. Set up log recording on Reach. In *Logging settings*, select the RINEX format, specify the antenna height, and keep the *Full rate* logging interval. We recommend that you start your flight 2 minutes after you start recording the log, and trim it afterwards. This will improve the log's quality for further processing.

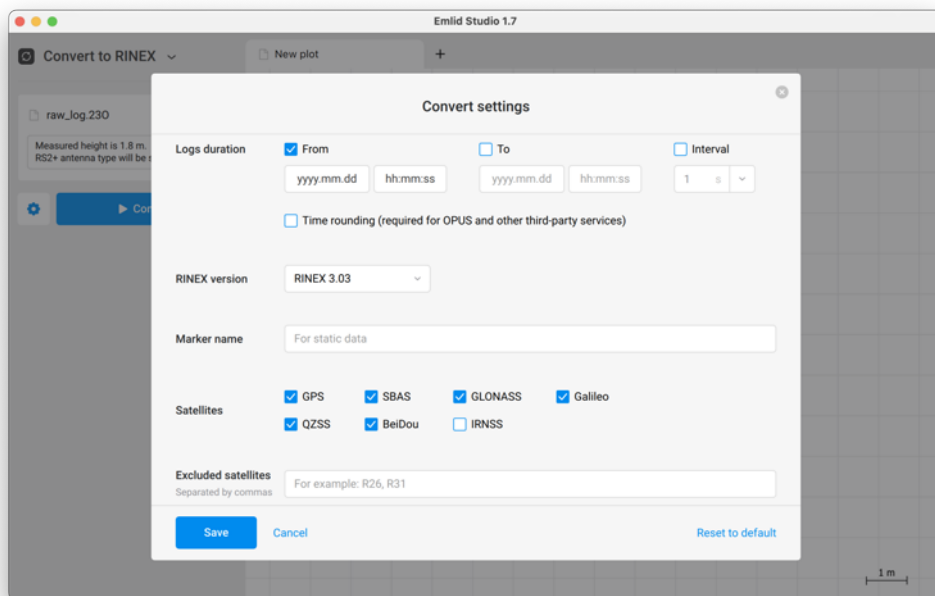
Tip: *You can learn how to record logs on your Reach base and download them in the [How to log data for PPK guide](#).*

3. Open Emlid Studio, select *Convert to RINEX*.

Note: *Learn more about Emlid Studio and download it for free on the [Emlid Studio landing page](#).*



4. Upload your log to Emlid Studio, and tap on the blue gear button to access the processing settings.
5. In the *Logs duration* section, set the time 2 minutes after log recording starts to trim the log. Tap *Save*, and then *Convert*.



Once you got the trimmed log, you can upload it together with the raw trajectory T04 file from your LiDAR survey to Applanix POSPac to get the corrected trajectory SBET file. Then you can upload it to CloudStation to generate a LAS file.

5.8 Integration of Reach RS2/R2+ with Mergin Maps for Android

This tutorial provides step-by-step instructions on how to integrate your Reach RS2/RS2+ with Mergin Maps for Android via Bluetooth.

5.8.1 Overview

Mergin Maps is a mobile app for Android devices that allows you to collect, share and publish geodata and collaborate with teams using instant sync with QGIS.

To integrate your Reach RS2/RS2+ Mergin Maps via Bluetooth, you will need the following:

- Reach RS2/RS2+
- A device on Android
- Mergin Maps mobile app installed on your Android device
- Mergin Maps account

5.8.2 Workflow

Configuring receiving corrections in Emlid Flow

To achieve centimeter-level accuracy when surveying with Reach RS2/RS2+, configure it to act as a rover in RTK in the following ways:

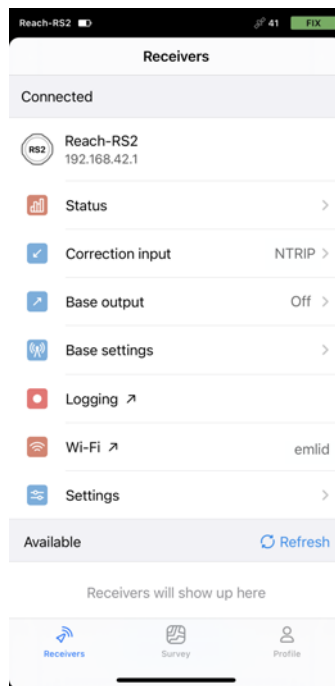
- Set up RTK communication between 2 Reach RS2/RS2+ units over LoRa radio according to the *[guide about base and rover setup](#)*.
- Configure your Reach RS2/RS2+ to receive corrections from an NTRIP service by following the steps from the *[Working with NTRIP service guide](#)*.

Note: *To start receiving corrections, make sure that your receiver has satellite visibility.*

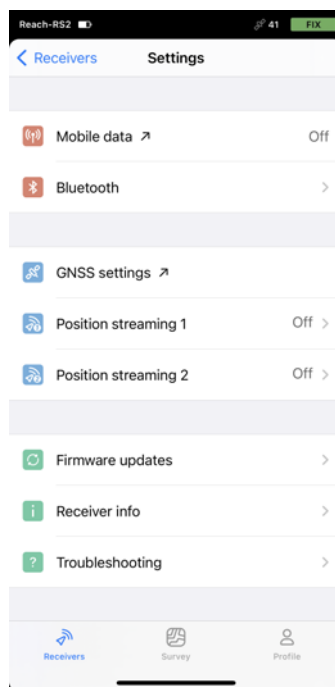
Setting up position streaming from Reach RS2/RS2+

To stream your Reach RS2/RS2+ position in the NMEA format to the Android device, proceed as follows:

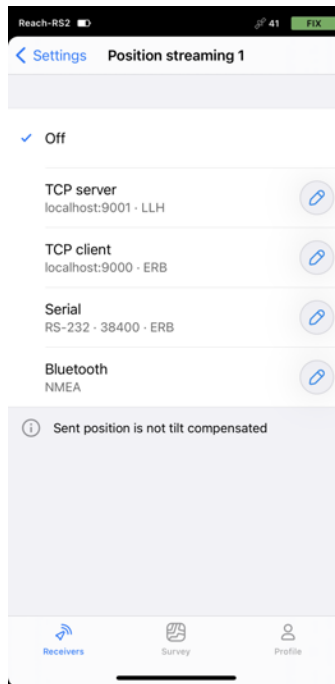
1. Open Emlid Flow and connect to your Reach.



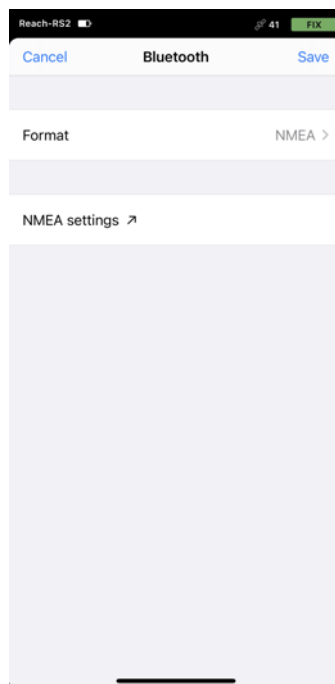
2. Go to Settings and tap *Position streaming 1*.



3. Select Bluetooth.



4. To configure position streaming, tap the *Edit* button in the Bluetooth cell.

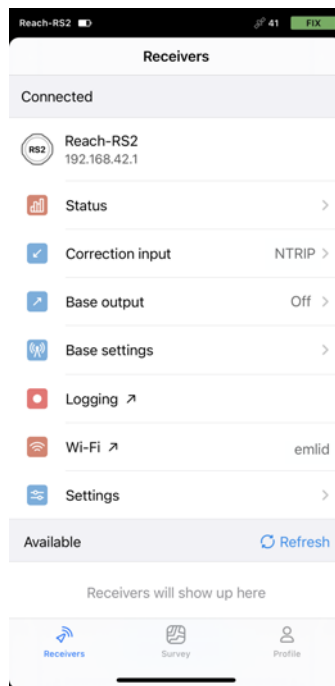


5. Tap Format and choose *NMEA*. Save changes.

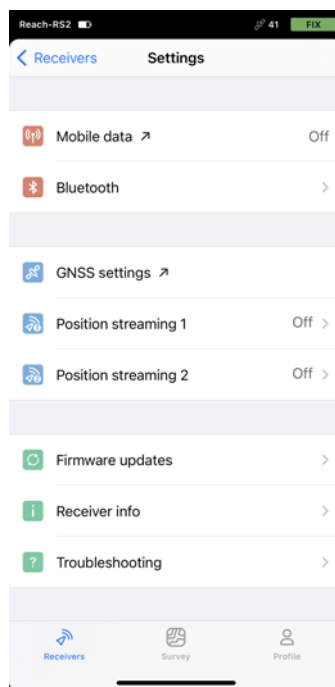
Enabling Reach RS2/RS2+ discoverability

To make your Reach RS2/RS2+ discoverable via Bluetooth, follow these steps:

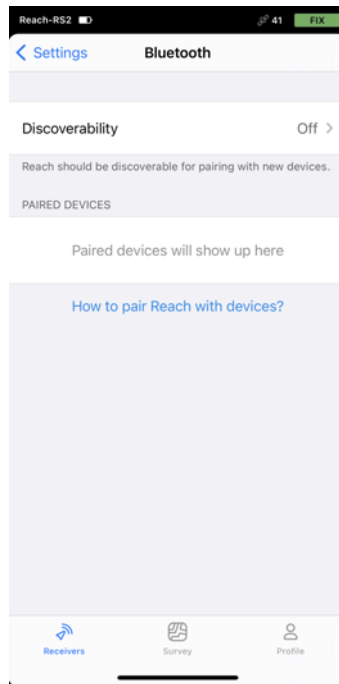
1. Connect to your Reach RS2/RS2+ using Emlid Flow.



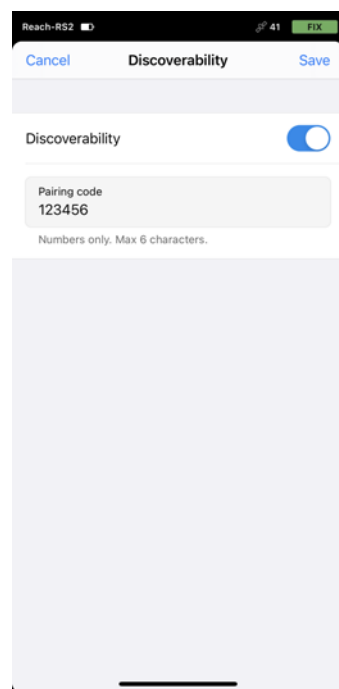
2. Go to *Settings* and tap *Bluetooth*.



3. Enable Bluetooth by tapping the *Turn on Bluetooth* button.



4. Tap *Discoverability* and turn it on. Tap *Save* to apply changes.



Pairing Reach with Android device

To pair your Reach RS2/RS2+ with the Android device, do the following:

1. Navigate to the *Bluetooth* configuration screen on your Android device and enable *Bluetooth*.
2. Wait for your Reach to be listed as an available device.

Tip: *Keep Reach within a few meters from the device.*

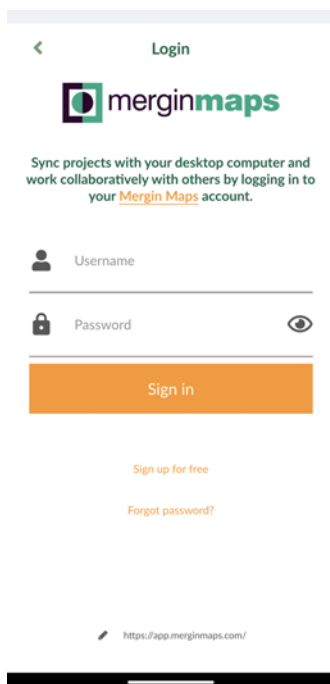
3. Tap the name of your Reach in the list of available devices on the Android device.

Note: *If your device requires a PIN code, enter 123456.*

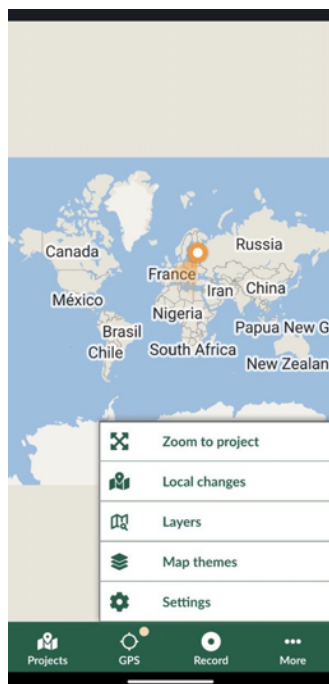
4. Pair Reach with the Android device.

Configuring communication between Mergin Maps and Reach RS2+

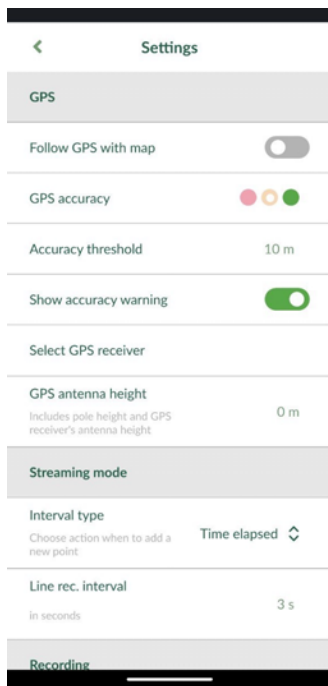
1. Open the Mergin Maps app and create an account if you don't have it yet to access the app.



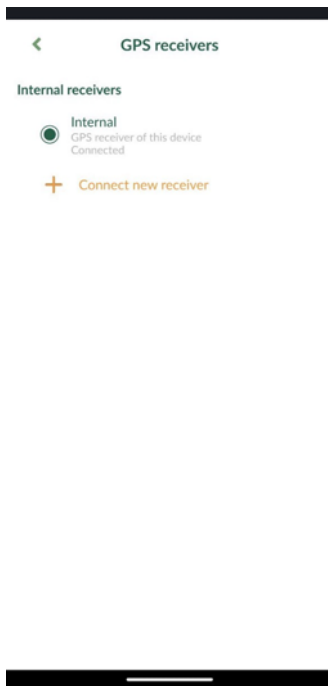
2. Open or create a new project.
3. On the opened screen in the lower right corner, tap *More* and *Settings*.



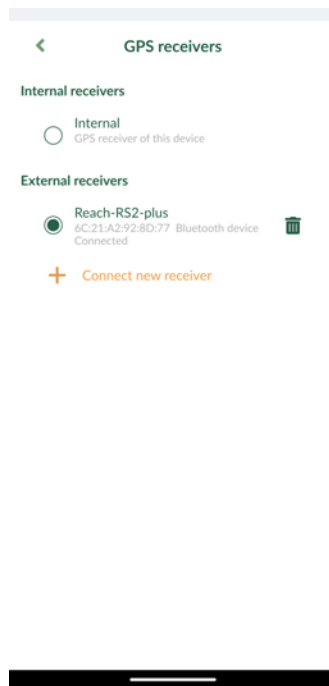
4. In *Settings*, tap *Select GPS receiver*.



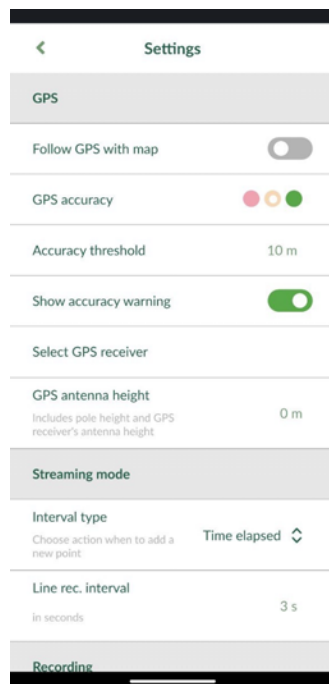
5. Tap *Connect new receivers*.



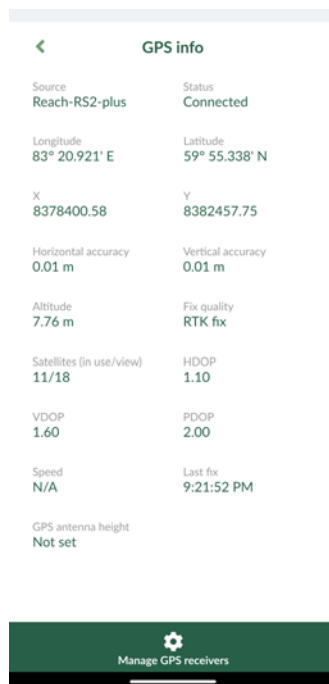
6. Choose your GPS receiver from the list of Bluetooth devices and wait until it's connected.



7. Go back to *Settings* and set the antenna height. For Reach RS2/RS2+, the antenna height is the distance from the mark on the ground to the center point on the Reach's bottom, antenna reference point (ARP), plus the height of the receiver to the antenna phase center (APC), antenna height offset. The antenna height offset equals to 134 mm.



8. Go to the *GPS* tab and check the RTK status and accuracy on the map. To check the detailed GPS info, tap the tab one more time.



Now you are ready to start collecting data!

5.9 Integration of Reach RS2/RS2+ with AplitoP TcpGPS for Android

This tutorial shows how to integrate your Reach RS2/RS2+ with the TcpGPS app for Android devices over Bluetooth to collect and stake out data in the field in RTK mode.

5.9.1 Overview

AplitoP TcpGPS is a mobile app for Android devices that allows you to collect and stake out data in the field in RTK mode.

To integrate your Reach with the AplitoP TcpGPS app, you'll need the following:

- Reach RS2/RS2+
- A device on Android OS v7.0+
- Emlid Flow v9.2+
- Aplitop TcpGPS v2.6+

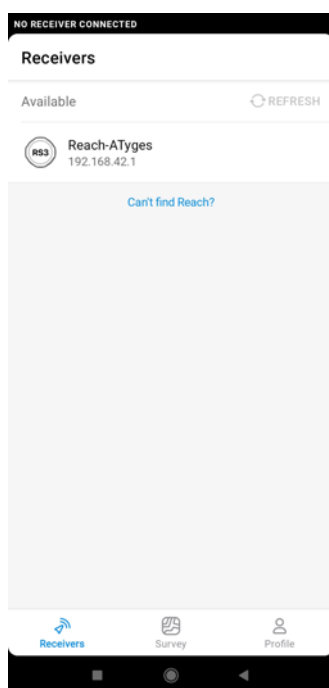
5.9.2 Workflow

To integrate your Reach RS2/RS2+ with the Aplitop TcpGPS app follow the steps below.

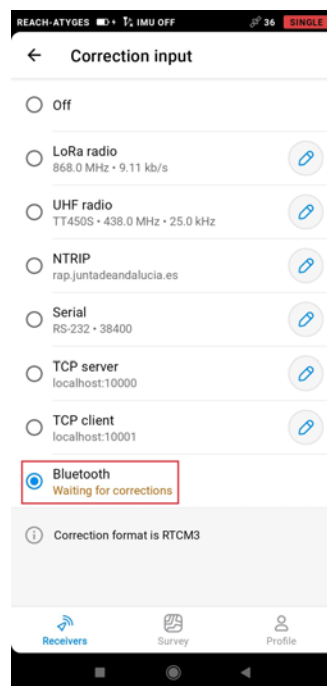
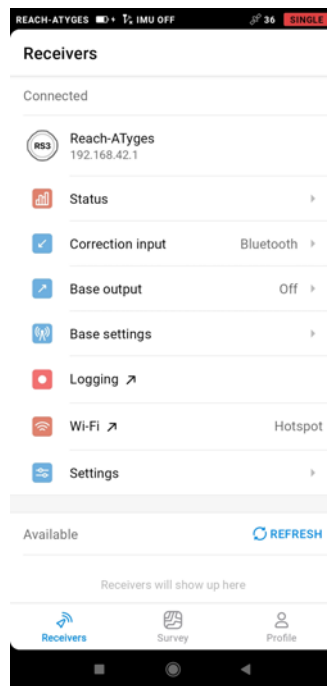
Configuring Reach RS2/RS2+ settings in Emlid Flow

First you need to configure correction input, enable tilt compensation, and set up position streaming in the NMEA format on your Reach RS2/RS2+ in the Emlid Flow app. Follow the steps below:

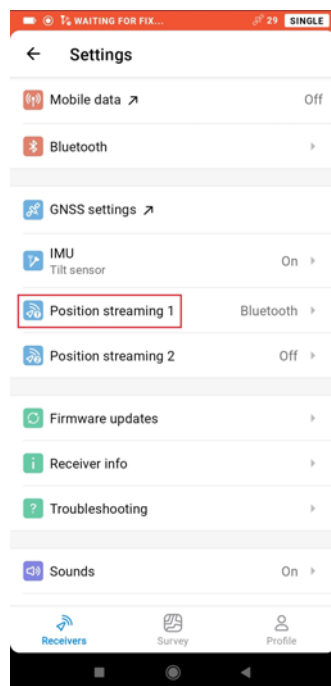
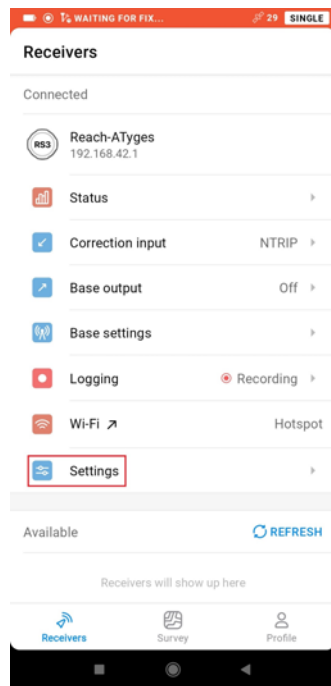
1. Open the Emlid Flow app and connect to your Reach using Wi-Fi.



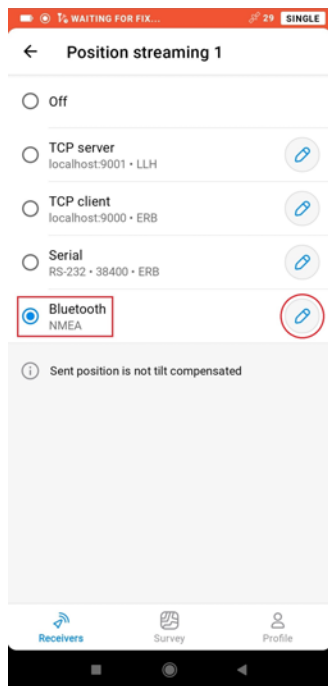
2. Go to Correction input and select *Bluetooth*.



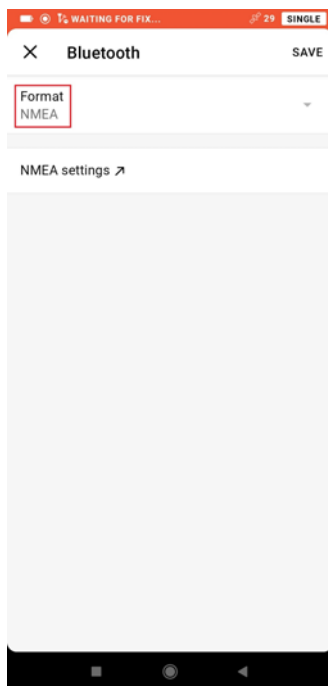
3. Go back, In *Settings* aselect *Position Streaming 1*.



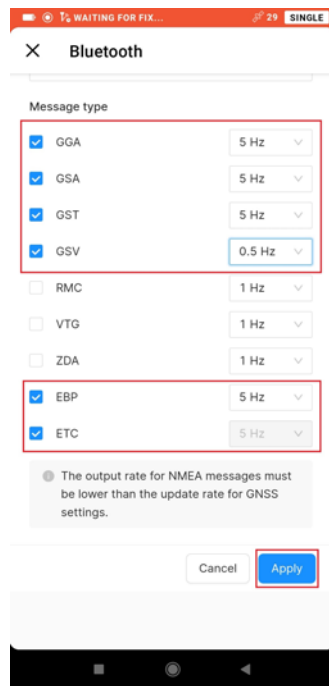
4. Select *Bluetooth* and tap the *Edit* button.



5. Select *NMEA* as format.



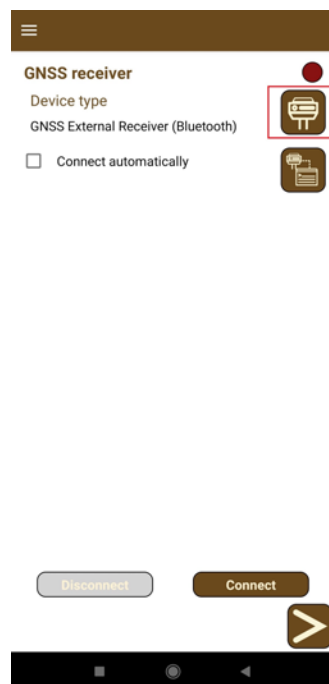
6. Tap *NMEA* settings. Select GGA, GSA, GST and EBP messages with 5Hz frequency and GSV message with 0.5Hz frequency. Then, tap the *Apply* button.



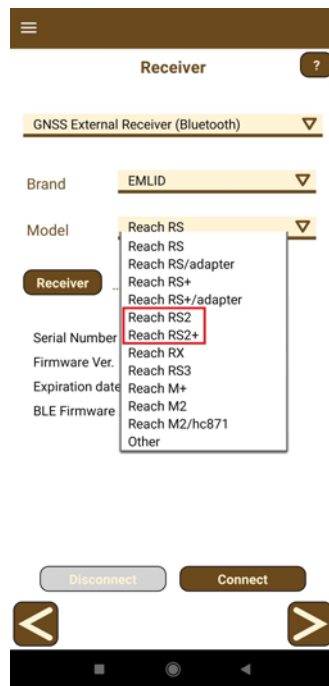
Configuring communication between ApliTop TcpGPS and Reach RS2/RS2+

Note: Make sure Bluetooth is enabled on your Android device.

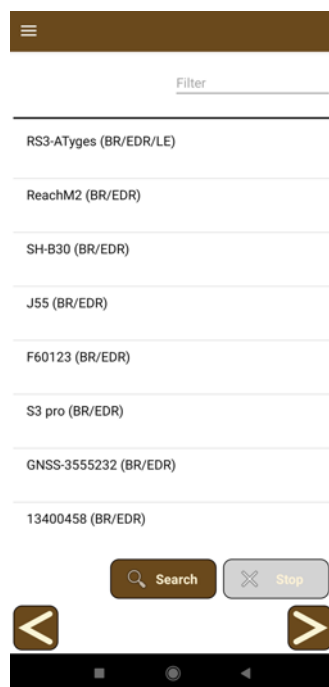
1. Open the ApliTop TcpGPS app and tap the receiver icon next to *Device type*.



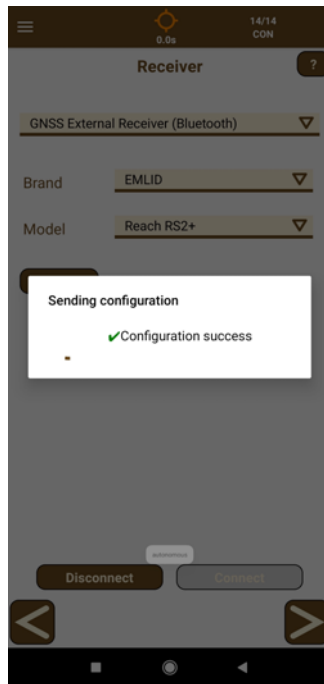
2. On the opened screen, select the following:
 - GNSS External Receiver (Bluetooth) for *Device type*
 - EMLID for *Brand*
 - Reach RS2/RS+ for *Model*



3. Tap the *Receiver* button and select the Bluetooth device. If the receiver is not on the list, tap the *Search* button.



4. Tap the *Connect* button and wait for the configuration of Reach.



5. Tap the forward arrow button and on the opened *Working mode* screen, tap the *Rover* button.



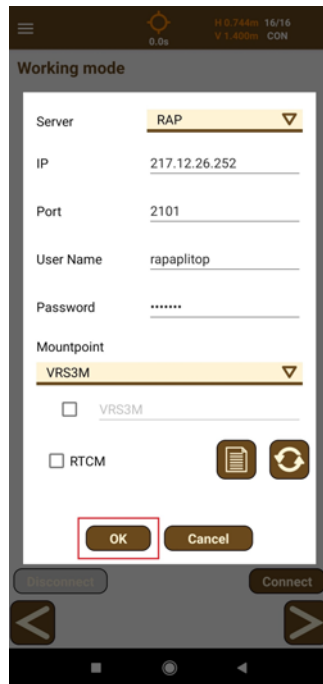
6. Configure NTRIP to send RTK corrections over *Bluetooth*.



7. To set up the NTRIP server, tap the three dots button and specify the following parameters:

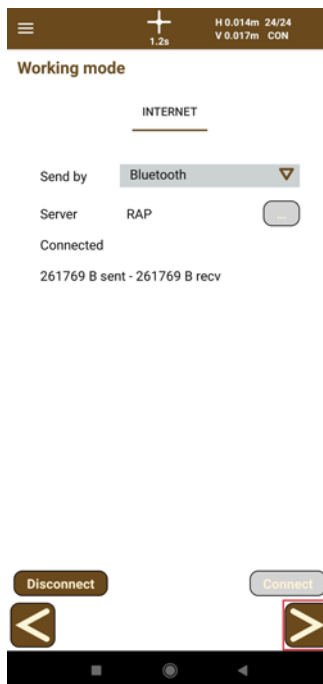
- Name of the profile
- IP
- Port
- User name
- Password
- Mountpoint



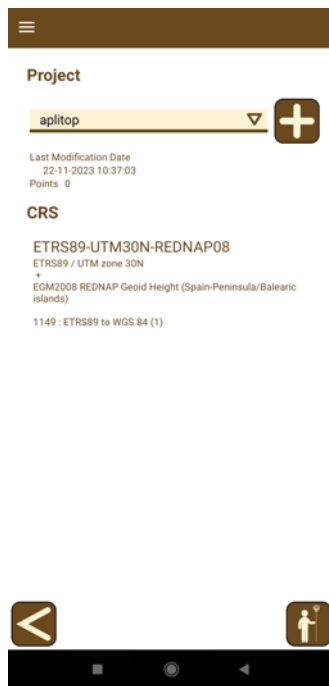


After that, tap the *OK* button.

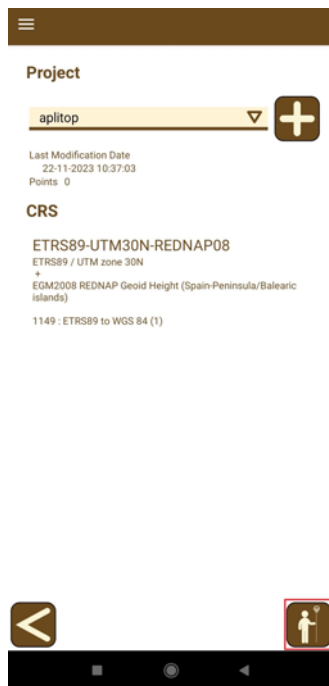
8. Tap the *Connect* button and check that the number of bytes sent and received grows.



9. Tap the forward arrow button and select or create a project.



10. Tap the survey button, enter the antenna height on the right side of the status bar, and start working with TcpGPS for Android and the Reach RS2/RS2+.





5.10 Processing of project from Emlid Flow in TcpMDT

This tutorial shows how to create a digital terrain model (DTM), contour lines and profiles in TcpMDT using a topographic survey imported from Emlid Flow.

5.10.1 Summary

TcpMDT by Aplito is a land survey software that runs on AutoCAD®, BricsCAD®, GstarCAD®, or ZWCAD® and provides tools for creating digital terrain models, profiles, volume calculations, roads, etc.

To integrate Emlid Flow data with the Aplito TcpMDT application, you'll need the following:

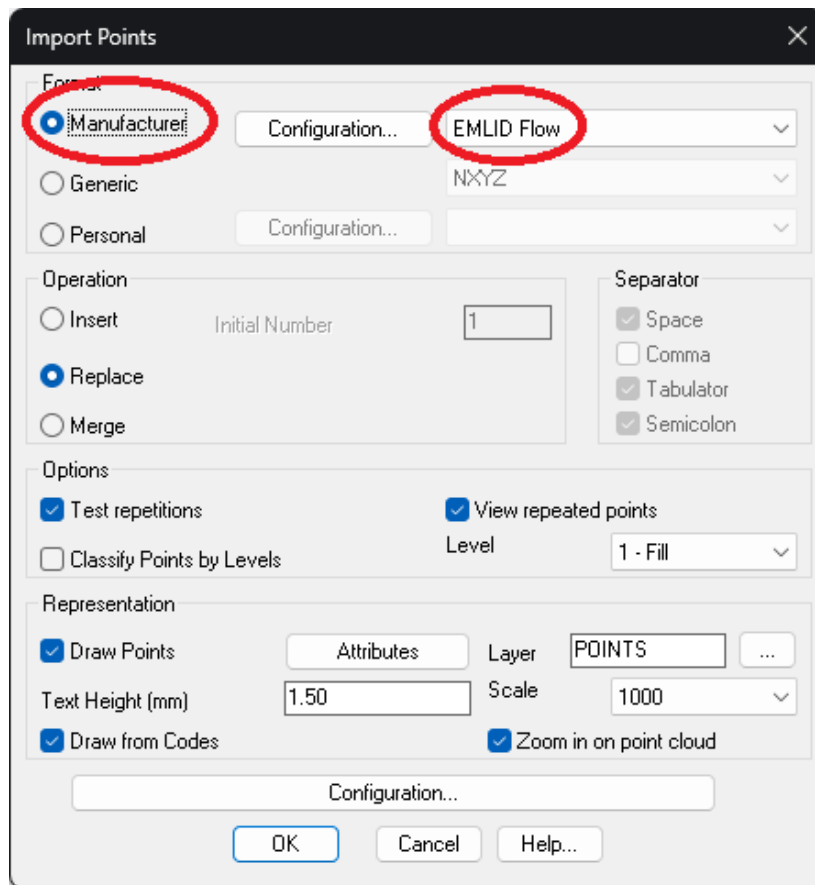
- Emlid Flow v9.2+
- AutoCAD® v2007+, BricsCAD® Pro v16+, GStarCAD® Professional v2021+, or ZWCAD Professional® v2012+
- TcpMDT Standard v9.0+

5.10.2 Workflow

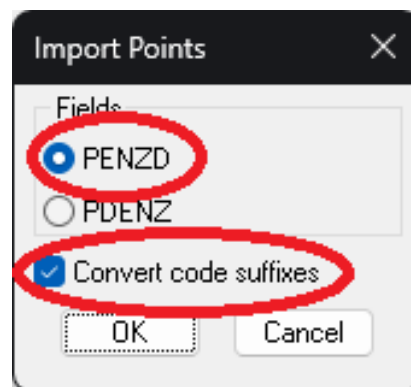
Below is one of the possible workflows, which consists of drawing the survey points, creating the digital terrain model, generating the contour lines, creating an alignment, and obtaining long and cross sections.

Importing points

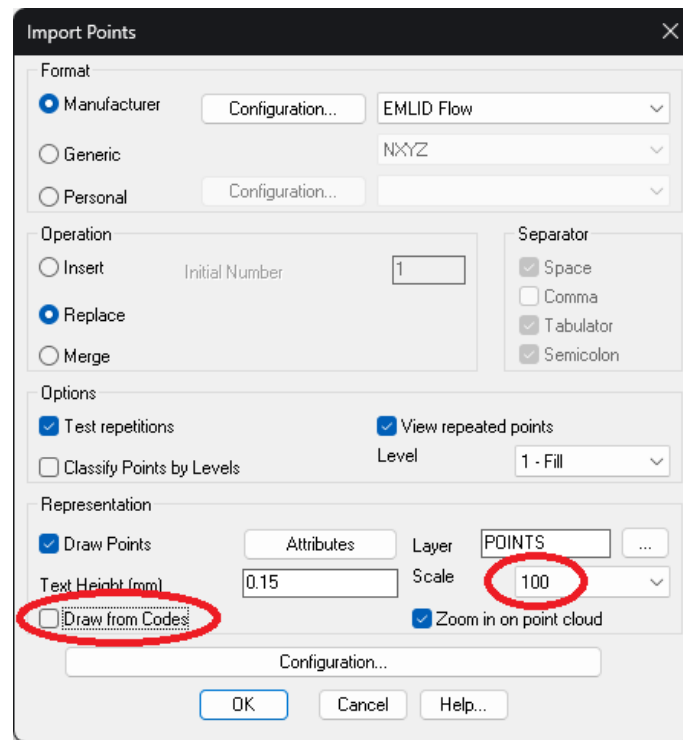
1. Start TcpMDT.
2. Run *MDT9 > Points > Import*.
3. Select the *Manufacturer* format and choose Emlid Flow.



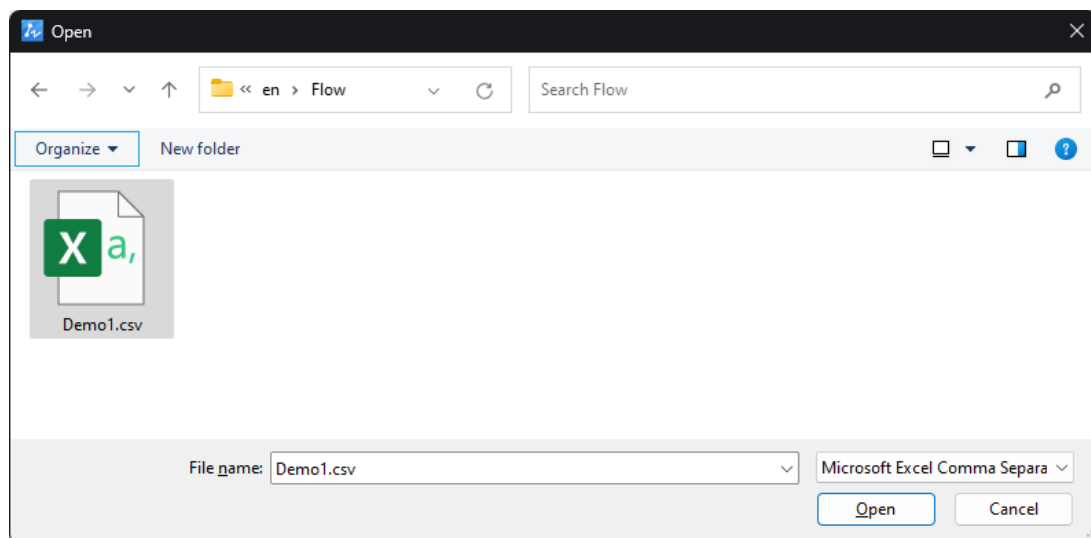
4. Press the *Configuration* button and choose the *PENZD* option (Point Number, East, North, Z, Description). Also leave the *Convert code* suffixes checked. Click OK.



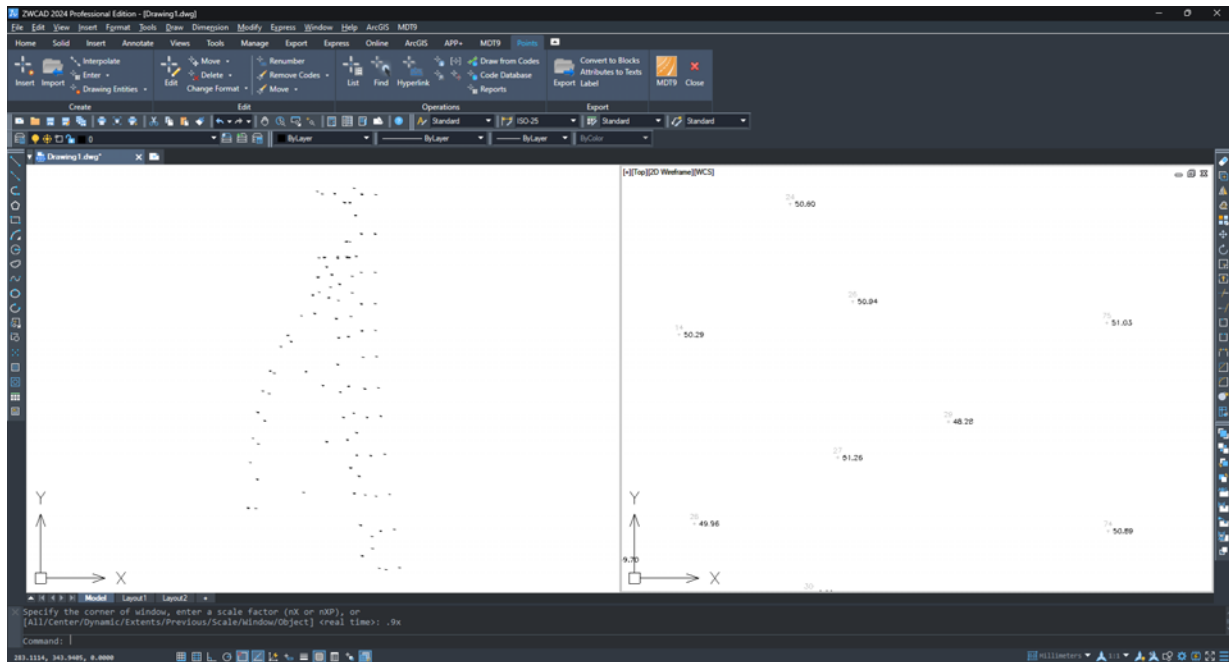
5. Choose a suitable scale for the representation of texts and uncheck the *Draw from Codes* option.



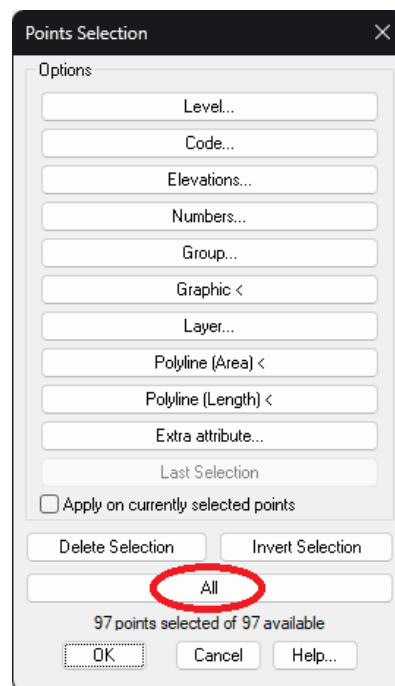
6. Click OK and choose the CSV file exported from Emlid Flow.



7. The points will be drawn with their numbering and elevations.



8. Run *MDT9 > Points > List* and make sure that the points in the file have been imported.



9. Press the *All* button and check that the point codes have been converted correctly. The ones with point geometry, e.g., TREE, appear as is, and the ones with the linear geometry are completed with the suffixes "S" for start and "E" for end.

Name	Level	X Coord.	Y Coord.	Z Coord.	Code
29	1 Fill	293.558	336.082	48.280	LS S
30	1 Fill	289.114	330.595	48.280	LS
31	1 Fill	283.615	324.281	47.820	LS
32	1 Fill	274.145	313.060	47.650	LS
33	1 Fill	267.333	300.542	47.180	LS
34	1 Fill	265.398	292.393	46.730	LS
35	1 Fill	263.682	281.514	46.310	LS
36	1 Fill	261.106	272.171	46.120	LS
37	1 Fill	260.662	258.043	45.690	LS
38	1 Fill	260.012	246.336	45.440	LS E
39	1 Fill	279.269	252.746	45.540	TREE

Buttons: OK, Find, Delete..., Edit, Print..., Attributes, Help

Drawing break lines and blocks (Optional)

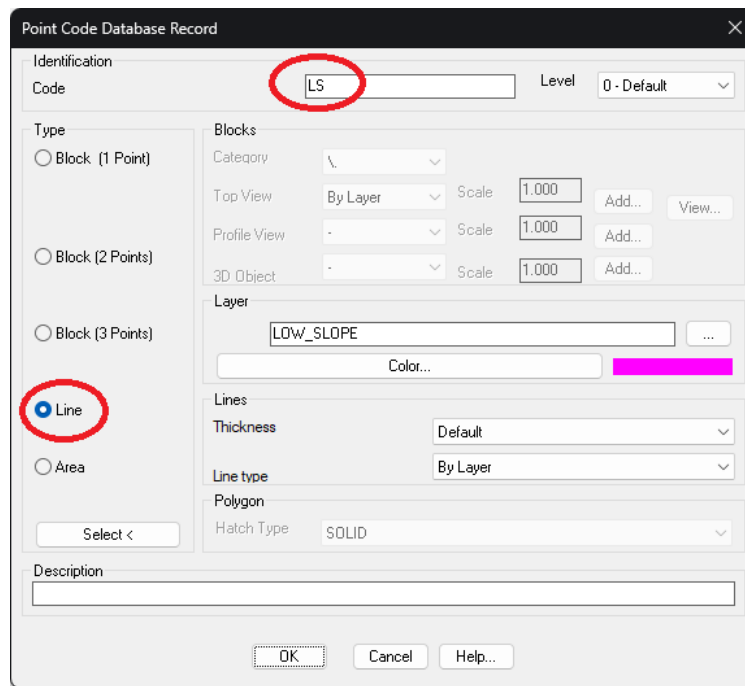
TcpMDT can generate the digital terrain model more accurately by drawing changes in the terrain slope, known as break lines. These can be drawn as polylines on different layers with CAD tools, or automatically generated if the points have been coded on the site. Blocks can also be automatically inserted from the codes, e.g. trees, manholes, posts, street furniture, etc.

1. Run MDT9 > Points > Codes > Code Database.

Code	Level	Type	Layer	Color	Thickness	Element
Facade	Break	Line	Facade	1	Default	Continuous
Fence	Break	Line	Fence	4	Default	Continuous
Filling	Fill	Point	Filling	3	Default	-
Garden	Break	Line	06_Garden	83	Default	Continuous
Headslope	Break	Line	Headslope	30	Default	Continuous
Kerbstone	Break	Line	Kerbstone	161	Default	Continuous
Lampost	Fill	Point	LAMPPOSTS	4	Default	Lampost
Limit	Break	Line	Limit	6	Default	Continuous
Line1	Default	Line	Line	4	Default	By Layer
LS	Default	Line	LOW_SLOPE	6	Default	By Layer
Manhole	Information	Point	MANHOLES	6	Default	03_P65
Newjersy	Fill	Line	Newjersy	195	Default	Continuous
OliveTree	Break	Point	OliveTree	3	Default	06_Olivo
PARCEL	Break	Line	PARCEL	0	Default	By Layer
Parking	Break	Line	Parking	252	Default	Continuous
PATH	Break	Line	PATH	7	Default	Continuous

Buttons: Edit... (circled), Insert..., Delete, Print..., Save As..., OK, Cancel, Help...

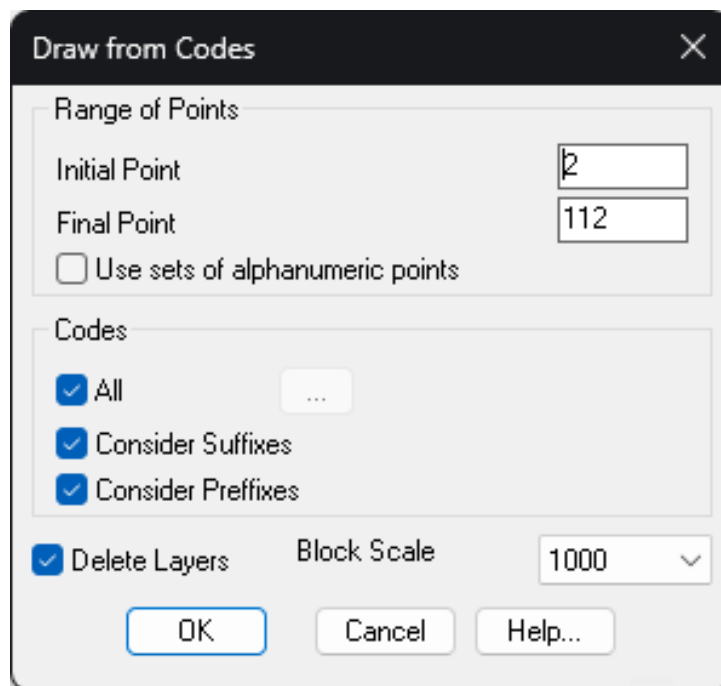
2. Select the item from the list to be modified and click the *Edit* button. The figure shows the LS code (Low Slope) which is of line type and will be drawn on the layer LOW-SLOPE in magenta color.



The 'Point Code Database Record' dialog box is shown. The 'Code' field is set to 'LS' and is circled in red. The 'Type' section has the 'Line' radio button selected and circled in red. The 'Level' dropdown is set to '0 - Default'. The 'Blocks' section includes 'Category' (set to '\'), 'Top View' (set to 'By Layer'), 'Profile View' (set to '-'), and '3D Object' (set to '-'). The 'Layer' section shows 'LOW_SLOPE' and a color selection button. The 'Lines' section has 'Thickness' set to 'Default' and 'Line type' set to 'By Layer'. The 'Polygon' section has 'Hatch Type' set to 'SOLID'. The 'Description' field is empty. At the bottom are 'OK', 'Cancel', and 'Help...' buttons.

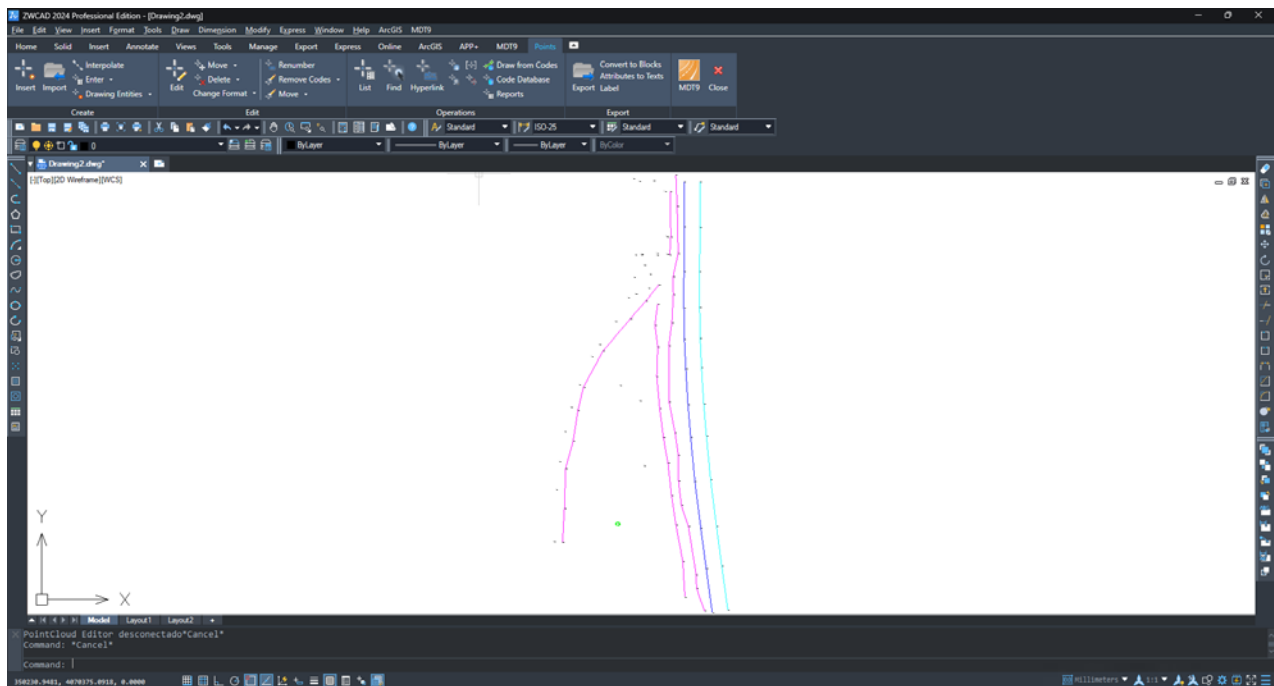
3. Press **OK** twice.

4. Run *MDT9 > Points > Codes > Draw from Codes*.



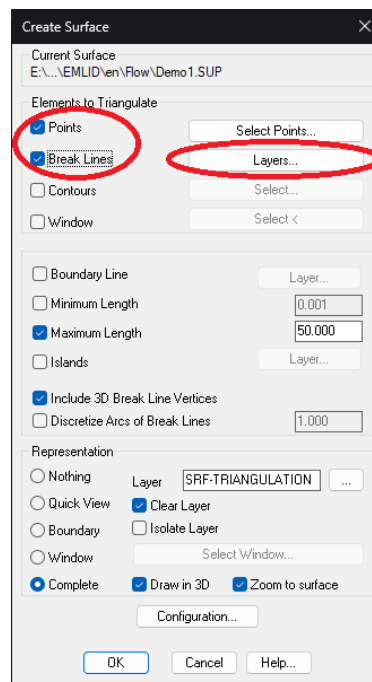
The 'Draw from Codes' dialog box is shown. The 'Range of Points' section has 'Initial Point' set to '2' and 'Final Point' set to '112'. The 'Use sets of alphanumeric points' checkbox is unchecked. The 'Codes' section has 'All', 'Consider Suffixes', and 'Consider Prefixes' all checked. The 'Delete Layers' checkbox is checked. The 'Block Scale' dropdown is set to '1000'. At the bottom are 'OK', 'Cancel', and 'Help...' buttons.

5. Keep the default options and click **OK**.

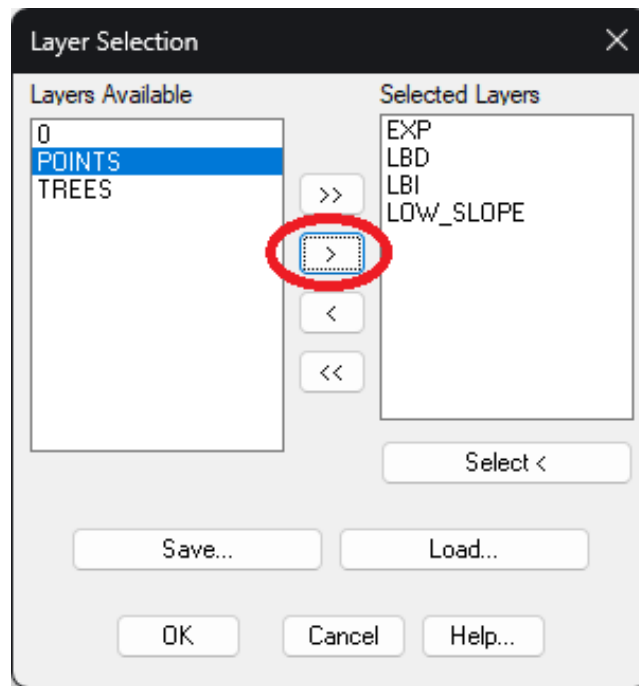


Creating digital terrain model

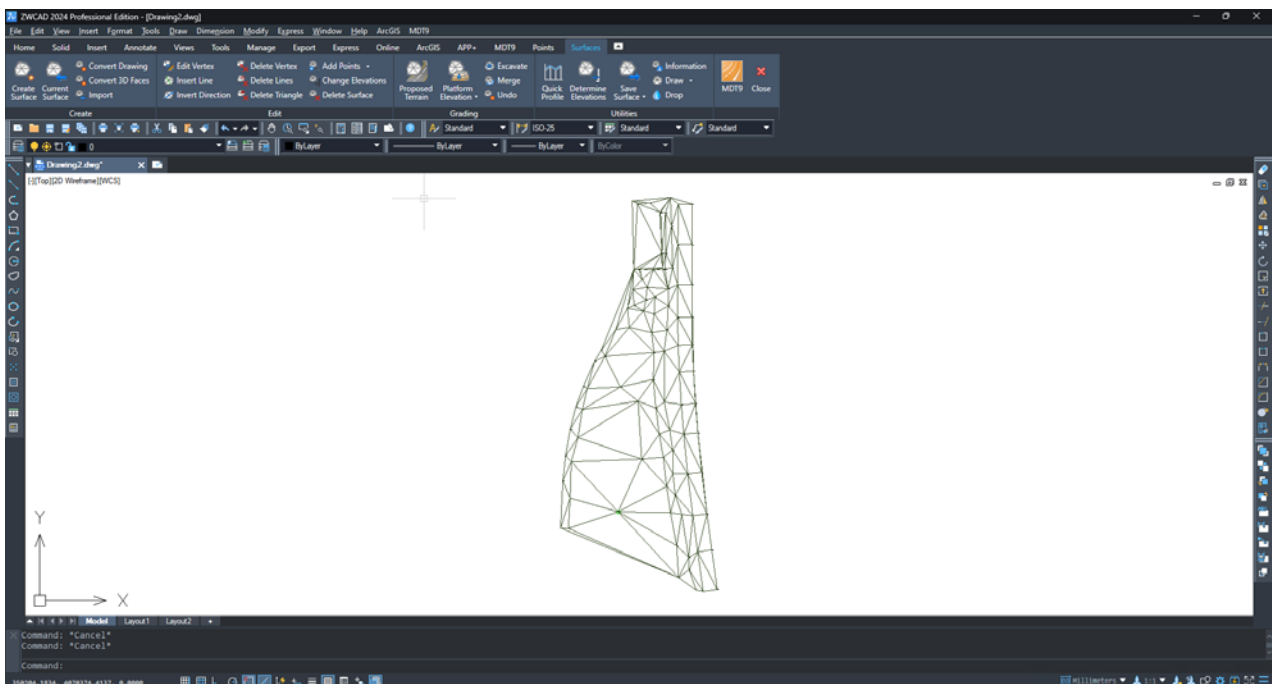
1. Run *MDT9 > Surfaces > Create Surface* and accept the proposed file name.
2. In the dialog, check that within *Elements to Triangulate* there are the *Points* and *Break Lines* elements. Tap the *Layers* button.



3. Choose the list of layers that should be considered as break lines, drawn automatically or manually, using the > button, and press *OK*.

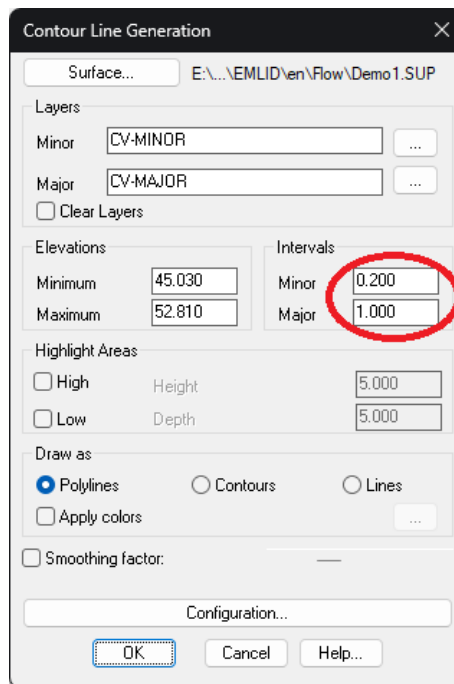


4. Click *OK* again to generate and draw the triangulation.

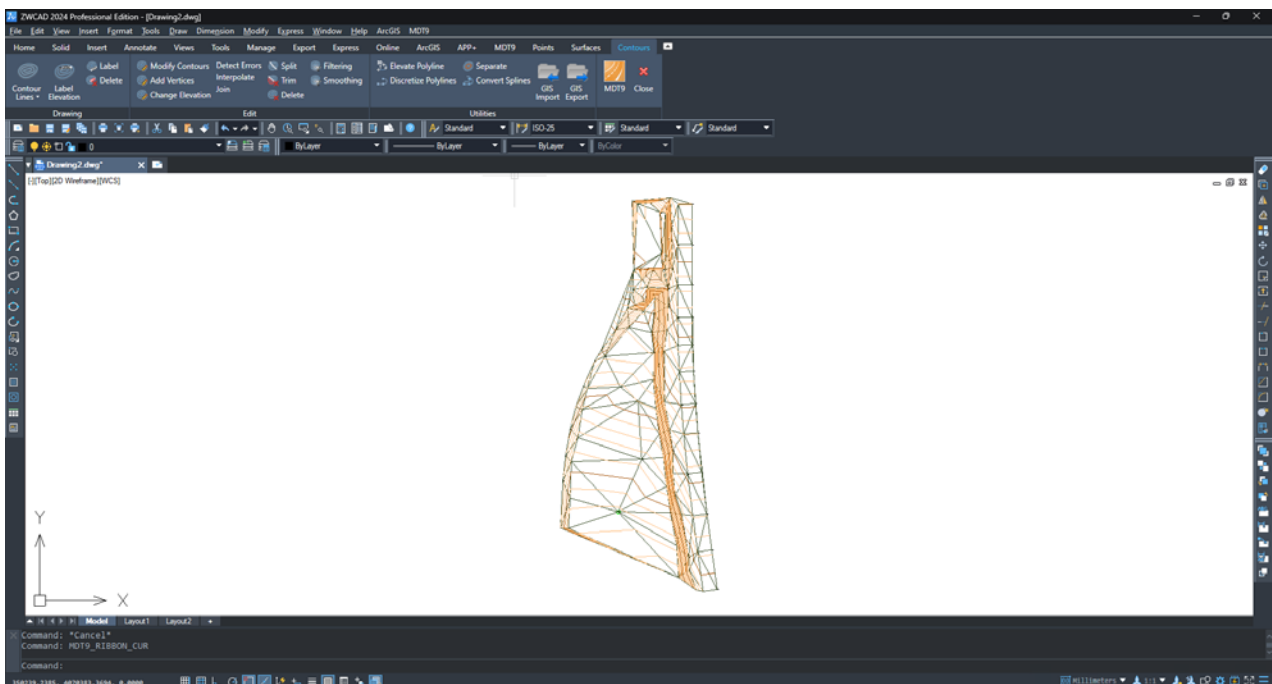


Generating contour lines

1. Run *MDT9 > Contour Lines/Mapping > Create Contour Lines*.
2. Set the intervals between minor and major contour lines.

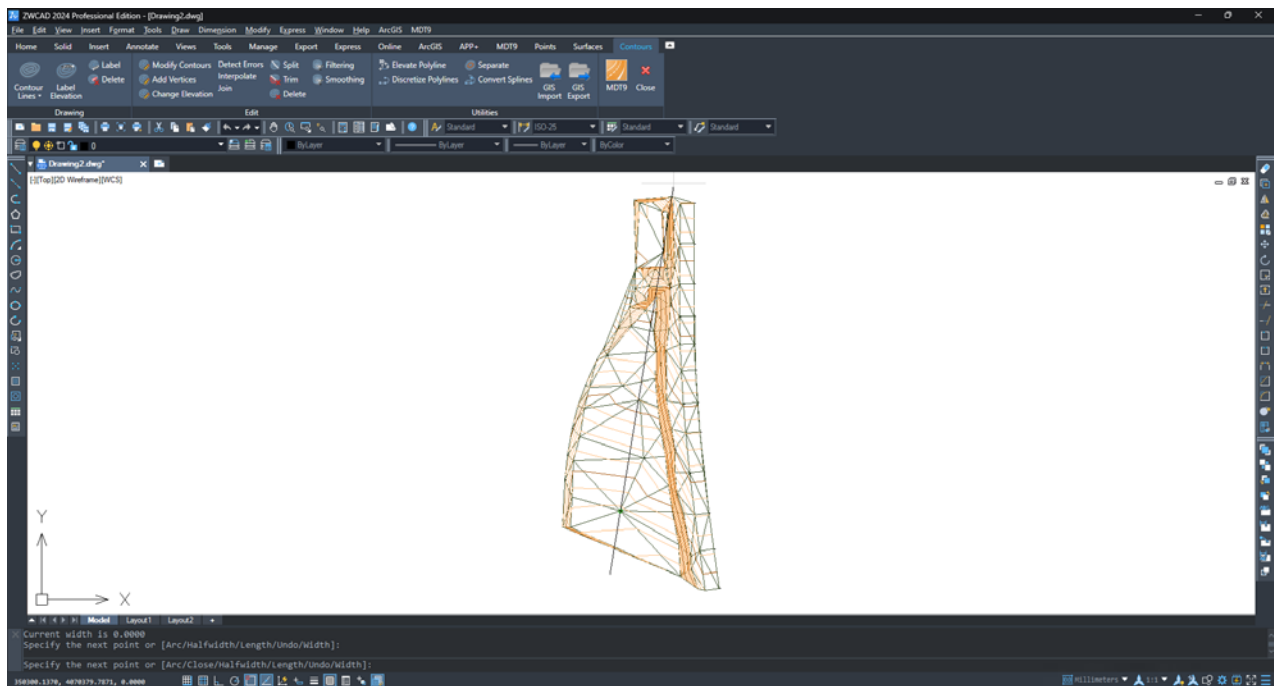


3. Click *OK* to generate the contour lines.

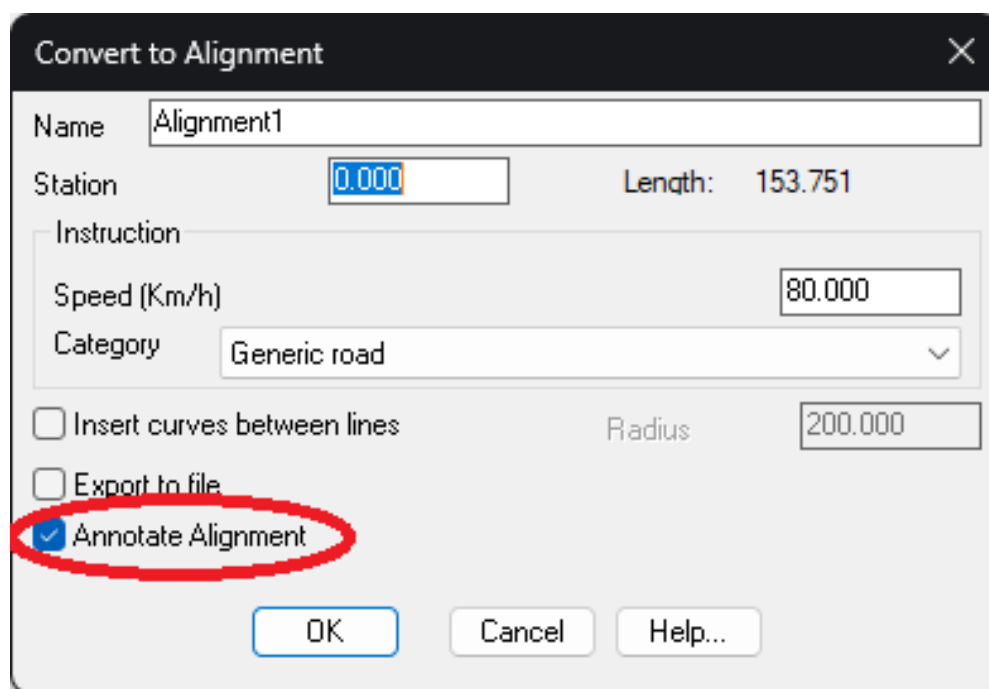


Creating alignment

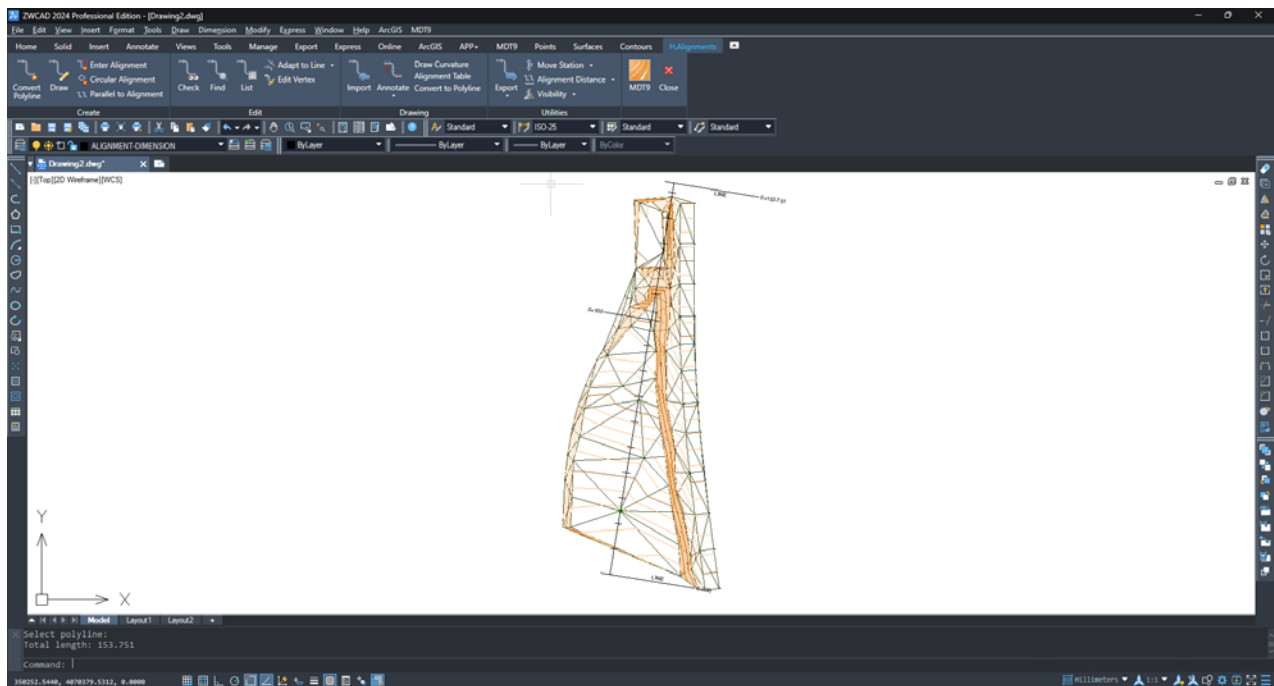
1. Run *Draw > Polyline* and draw an alignment that we'll use to create profiles.



2. Run *MDT9 > Horizontal Alignments > Convert Polyline to Alignment* and select the previous polyline.

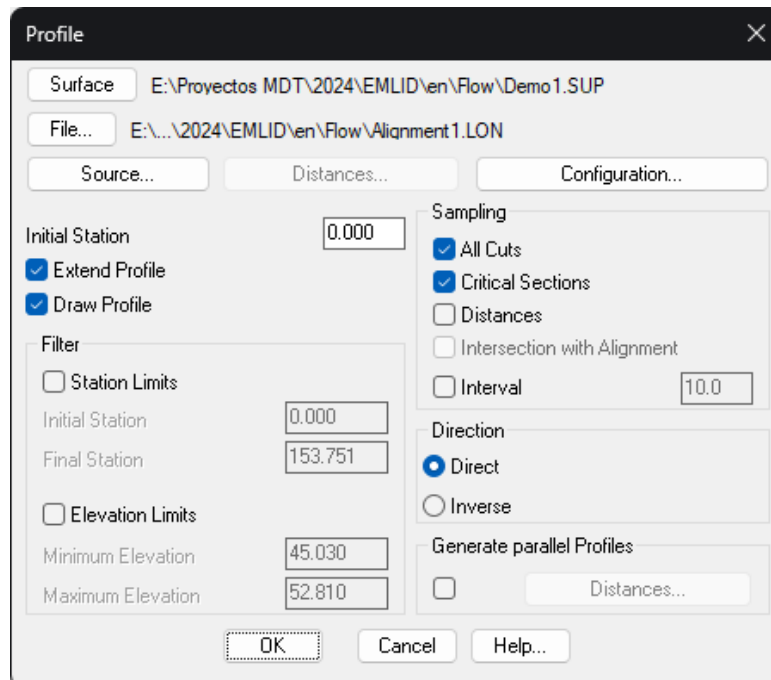


3. Enable the *Annotate Alignment* option and click *OK* two times.

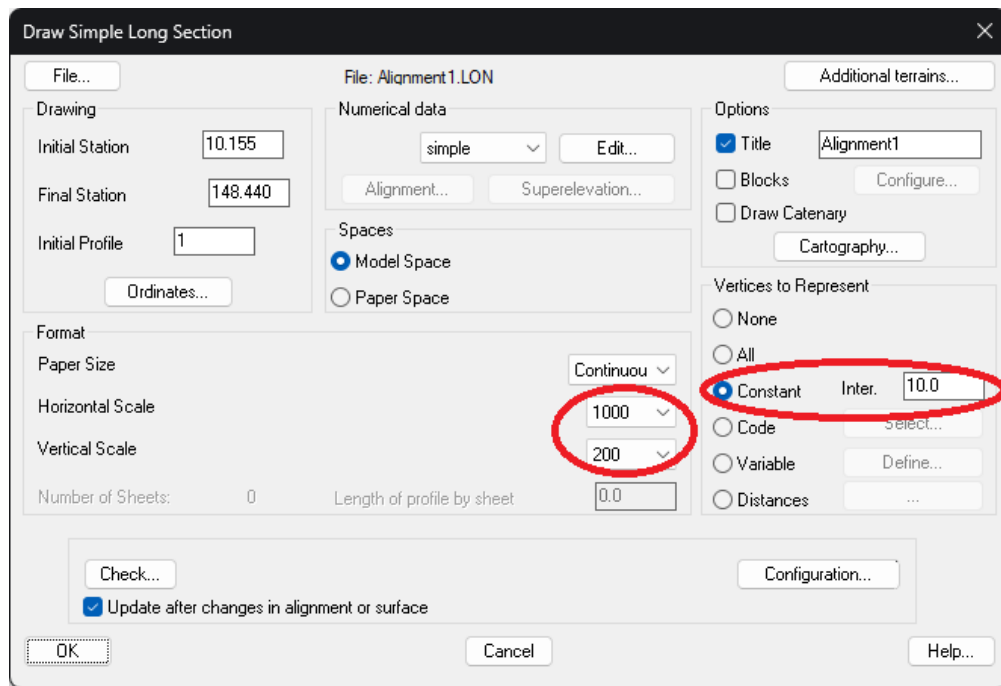


Creating profiles

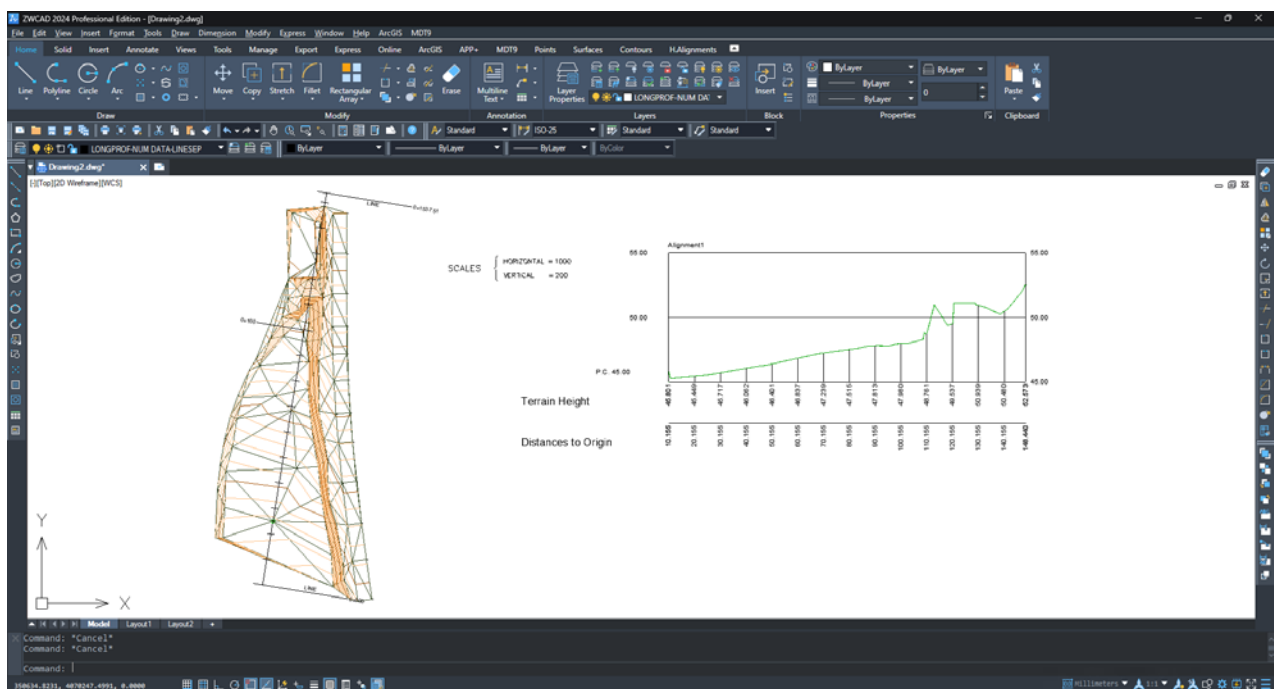
1. Run *MDT9 > Long Sections > Create Long Section* and select the alignment created in the previous step.
2. In the dialog, leave all options by default and press *OK*.



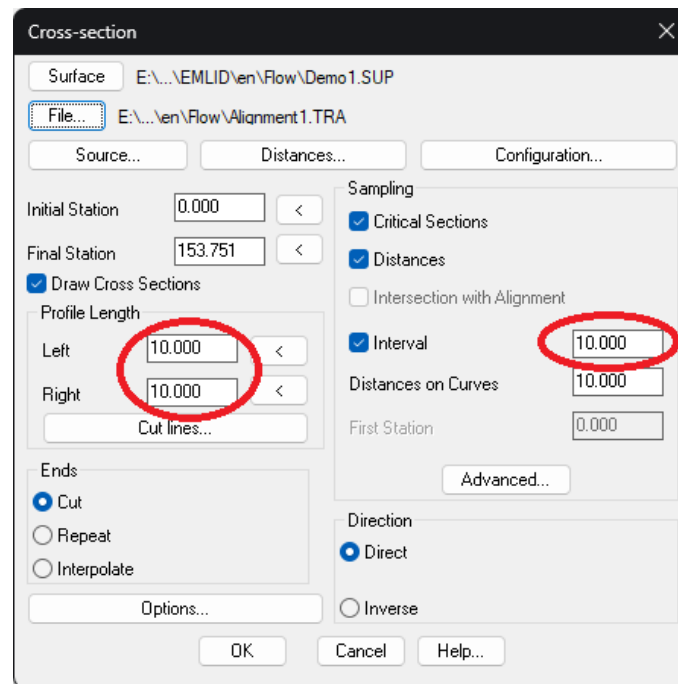
3. Choose the appropriate values for *Horizontal Scale* and *Vertical Scale*. In the *Vertices to Represent* frame, choose *Constant* and set an interval.



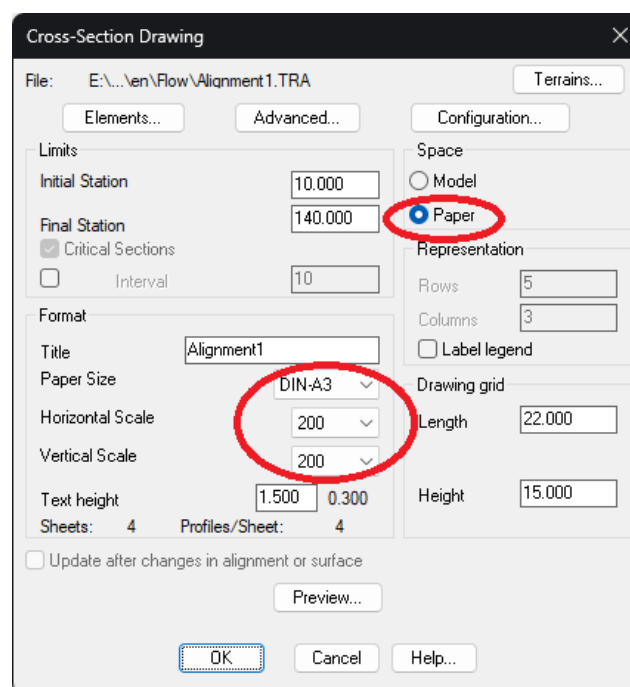
4. Click *OK* to draw the longitudinal profile in model space and choose an insertion point in a clear area of model space.



5. Run *MDT9 > Cross Sections > Create Cross Sections* and select the alignment again.
6. In the dialog, set the left and right profile lengths and the interval between sections and press *OK*.



7. In the dialog, chose *Paper Space* and set the horizontal scale, vertical scale, and paper size.



8. Click *OK* to proceed with the drawing.

5.11 Processing of project from TcpGPS in TcpMDT

This tutorial shows how to create a digital terrain model (DTM), contour lines and profiles in TcpMDT using a topographic survey imported from TcpGPS.

5.11.1 Summary

TcpMDT by Aplitop is a land survey software that runs on AutoCAD®, BricsCAD®, GstarCAD®, or ZWCAD® and provides tools for creating digital terrain models, profiles, volume calculations, roads, etc.

To integrate Emlid Flow data with the Aplitop TcpMDT application, you'll need the following:

- TcpGPS for Android 2.7+
- AutoCAD® v2007+, BricsCAD® Pro v16+, GStarCAD® Professional v2021+, or ZWCAD Professional® v2012+
- TcpMDT Standard v9.0+

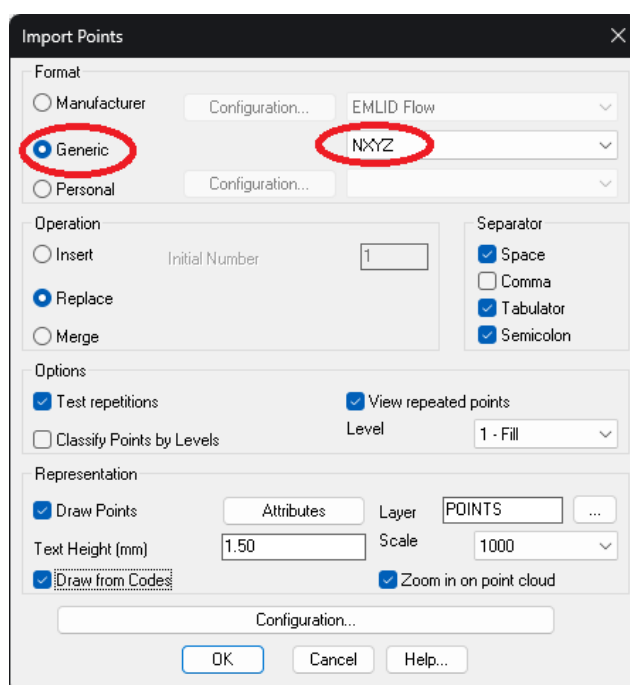
Tip: Check the data collection procedure in the [Integration of Reach RS2/RS2+ with Aplitop TcpGPS for Android guide](#).

5.11.2 Workflow

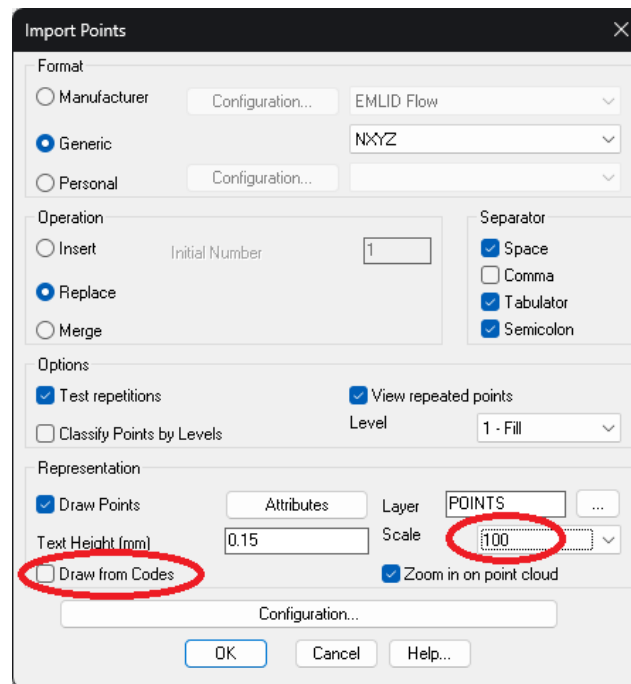
Below is one of the possible workflows, which consists of drawing the survey points, creating the digital terrain model, generating the contour lines, creating an alignment and obtaining long and cross sections.

Importing points

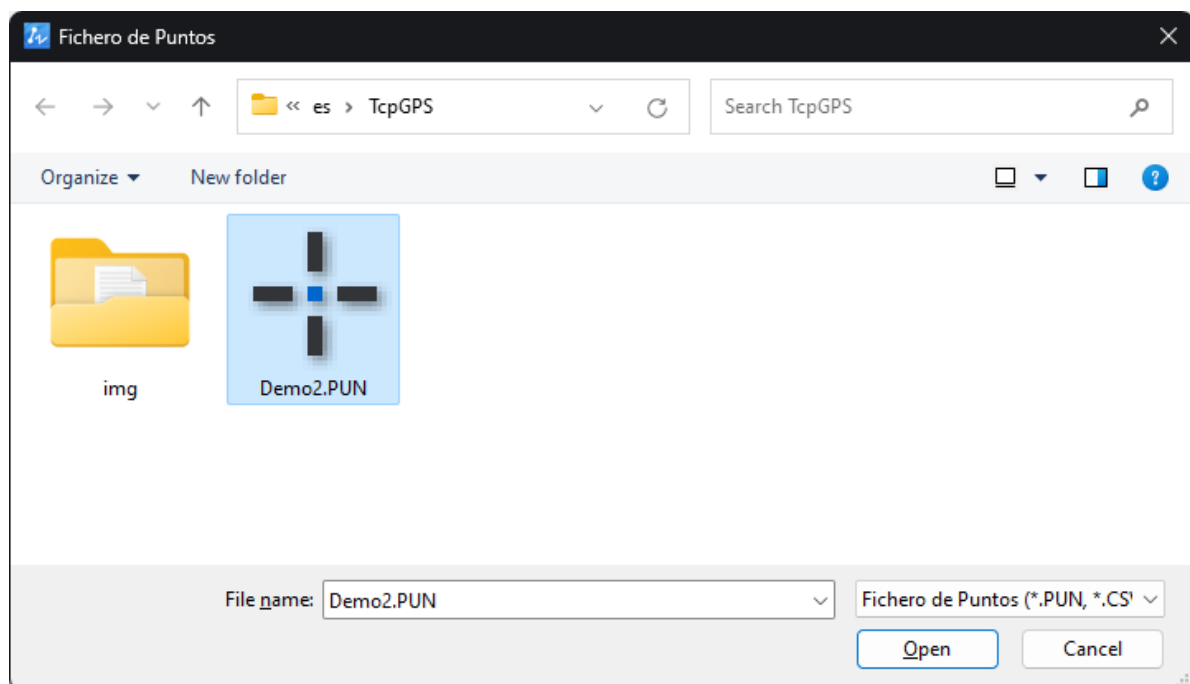
1. Start TcpMDT.
2. Run *MDT9 > Points > Import*.
3. Select format *Generic* and choose *NXYZ*.



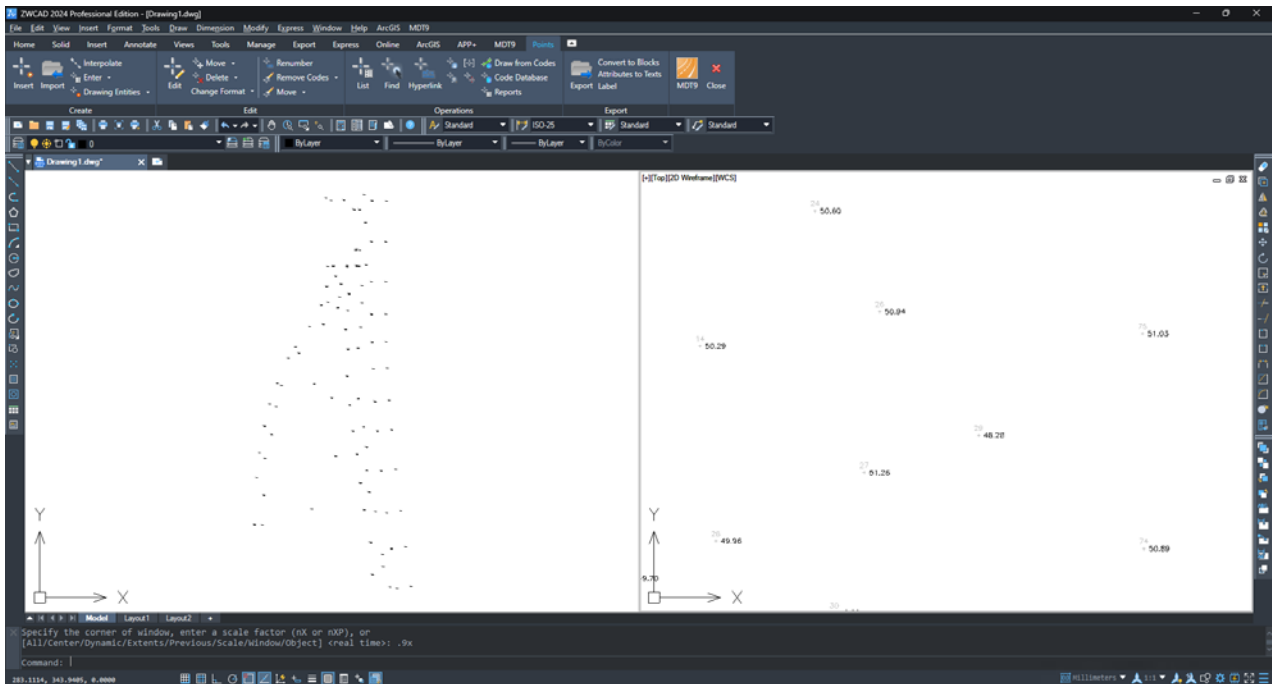
4. Choose a suitable scale for the representation of texts and uncheck the *Draw from Codes* option.



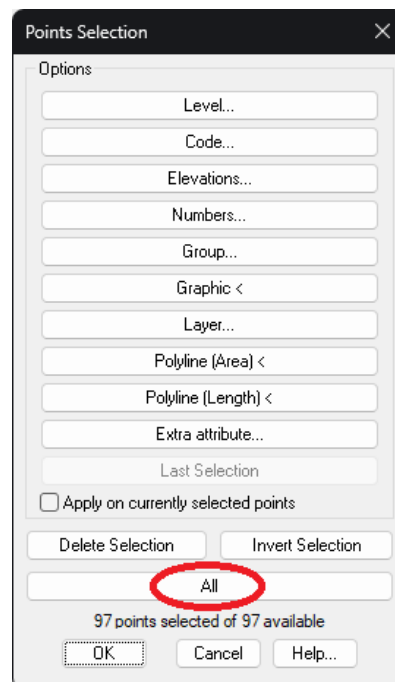
5. Click *OK* and choose the PUN file previously exported from TcpGPS in MDT format.



6. The points will be drawn with their numbering and elevations.



7. Run *MDT9 > Points > List* and make sure that the points in the file have been imported.



8. Press the *All* button and check that the point codes have been converted correctly. The ones with point geometry, e.g., TREE, appear as is, and the ones with the linear geometry are completed with the suffixes "S" for start and "E" for end.

Name	Level	X Coord.	Y Coord.	Z Coord.	Code
29	1 Fill	293.558	336.082	48.280	LS S
30	1 Fill	289.114	330.595	48.280	LS
31	1 Fill	283.615	324.281	47.820	LS
32	1 Fill	274.145	313.060	47.650	LS
33	1 Fill	267.333	300.542	47.180	LS
34	1 Fill	265.398	292.393	46.730	LS
35	1 Fill	263.682	281.514	46.310	LS
36	1 Fill	261.106	272.171	46.120	LS
37	1 Fill	260.662	258.043	45.690	LS
38	1 Fill	260.012	246.336	45.440	LS E
39	1 Fill	279.269	252.746	45.540	TREE

Buttons: OK Find Delete... Edit Print... Attributes Help

Drawing break lines and blocks (Optional)

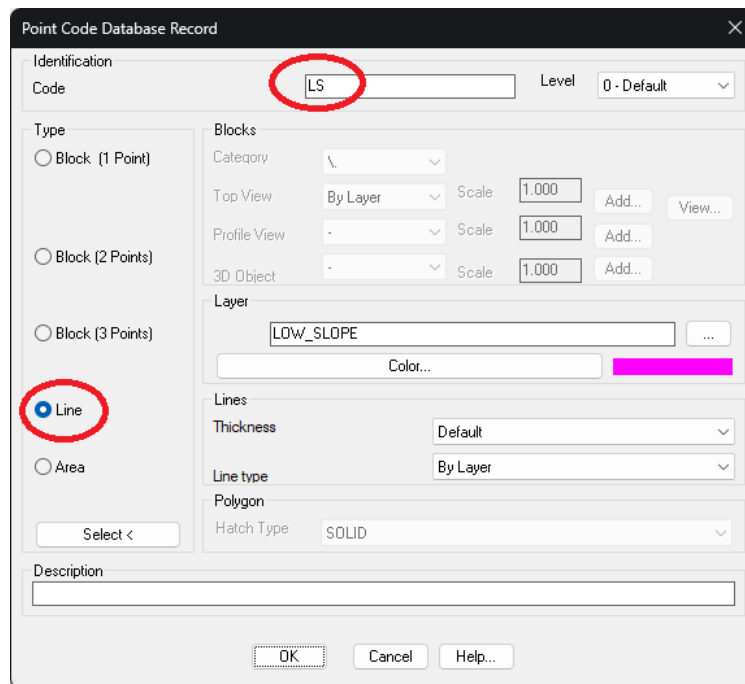
TcpMDT can generate the digital terrain model more accurately by drawing changes in the terrain slope, known as break lines. These can be drawn as polylines on different layers with CAD tools, or automatically generated if the points have been coded on the site. Blocks can also be automatically inserted from the codes, e.g. trees, manholes, posts, street furniture, etc.

1. Run *MDT9 > Points > Codes > Code Database*.

Code	Level	Type	Layer	Color	Thickness	Element
Facade	Break	Line	Facade	1	Default	Continuous
Fence	Break	Line	Fence	4	Default	Continuous
Filling	Fill	Point	Filling	3	Default	-
Garden	Break	Line	06_Garden	83	Default	Continuous
Headslope	Break	Line	Headslope	30	Default	Continuous
Kerbstone	Break	Line	Kerbstone	161	Default	Continuous
Lampost	Fill	Point	LAMPPOSTS	4	Default	Lampost
Limit	Break	Line	Limit	6	Default	Continuous
Line1	Break	Line	Line	4	Default	By Layer
LS	Default	Line	LOW_SLOPE	6	Default	By Layer
Manhole	Information	Point	MANHOLES	6	Default	03_P65
Newjersy	Fill	Line	Newjersy	195	Default	Continuous
OliveTree	Break	Point	OliveTree	3	Default	06_Olivo
PARCEL	Break	Line	PARCEL	0	Default	By Layer
Parking	Break	Line	Parking	252	Default	Continuous
PATH	Break	Line	PATH	7	Default	Continuous

Buttons: Edit... Insert... Delete Print... Save As... OK Cancel Help...

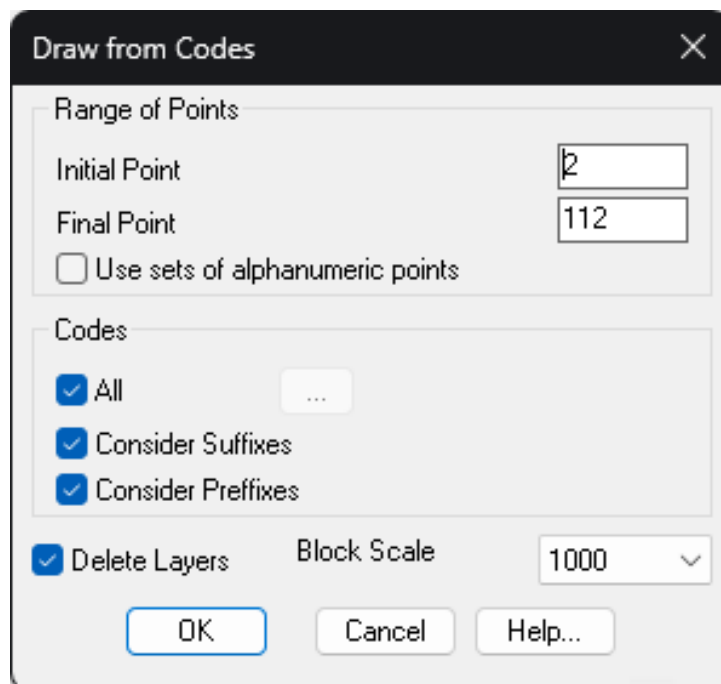
2. Select the item from the list to be modified and click the *Edit* button. The figure shows the LS code (Low Slope) which is of line type and will be drawn on the layer LOW-SLOPE in magenta color.



The 'Point Code Database Record' dialog box is shown. In the 'Identification' section, the 'Code' field contains 'LS' and the 'Level' is set to '0 - Default'. In the 'Type' section, the 'Line' radio button is selected. The 'Blocks' section includes 'Category' (set to '\'), 'Top View' (set to 'By Layer'), 'Profile View' (set to '-'), and '3D Object' (set to '-'). The 'Layer' section shows 'LOW_SLOPE' and a color selection button. The 'Lines' section shows 'Thickness' (set to 'Default') and 'Line type' (set to 'By Layer'). The 'Polygon' section shows 'Hatch Type' (set to 'SOLID'). At the bottom are 'OK', 'Cancel', and 'Help...' buttons.

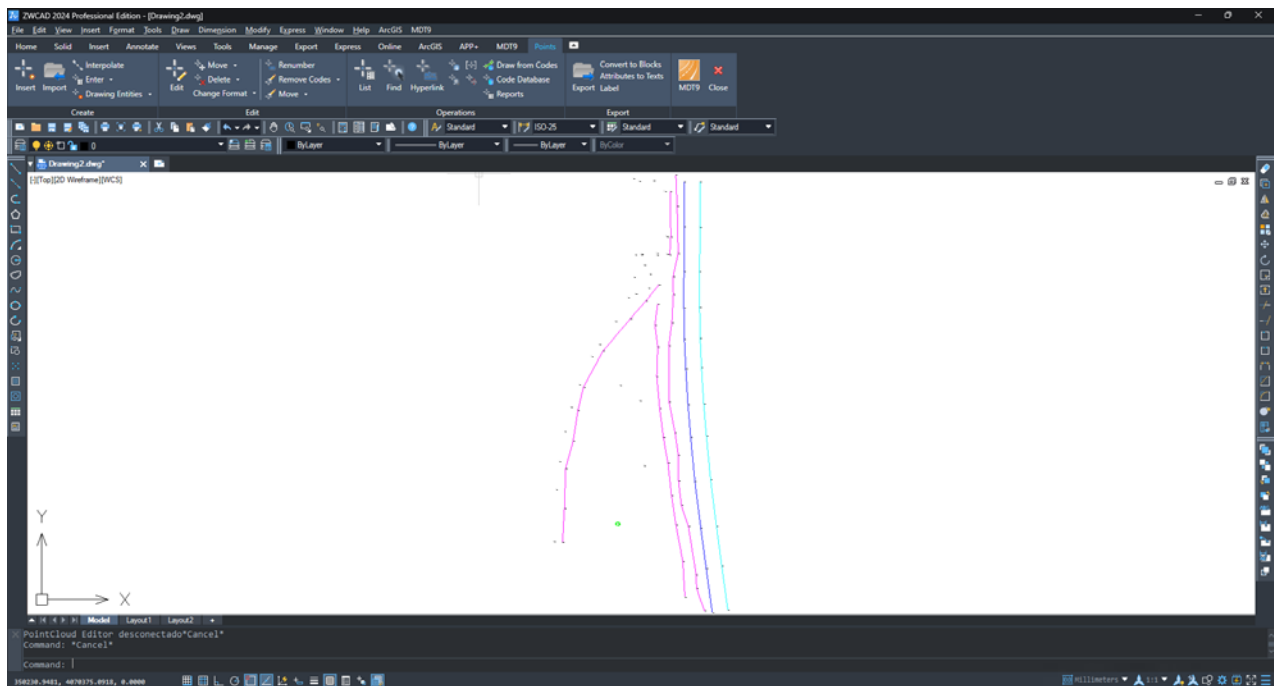
3. Press **OK** twice.

4. Run *MDT9 > Points > Codes > Draw from Codes*.



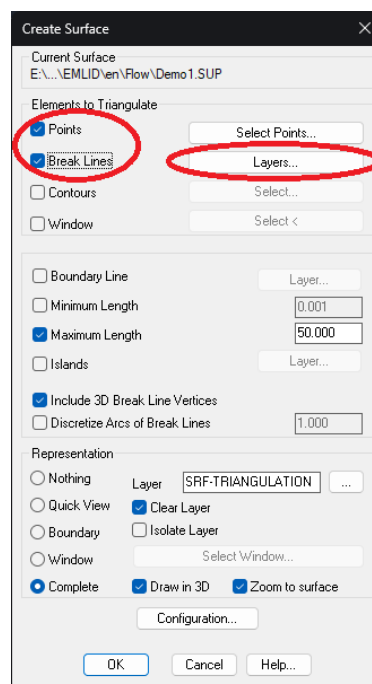
The 'Draw from Codes' dialog box is shown. In the 'Range of Points' section, 'Initial Point' is '2' and 'Final Point' is '112'. The 'Use sets of alphanumeric points' checkbox is unchecked. In the 'Codes' section, 'All', 'Consider Suffixes', and 'Consider Prefixes' are all checked. At the bottom, 'Delete Layers' is checked, 'Block Scale' is '1000', and there are 'OK', 'Cancel', and 'Help...' buttons.

5. Keep the default options and click **OK**.

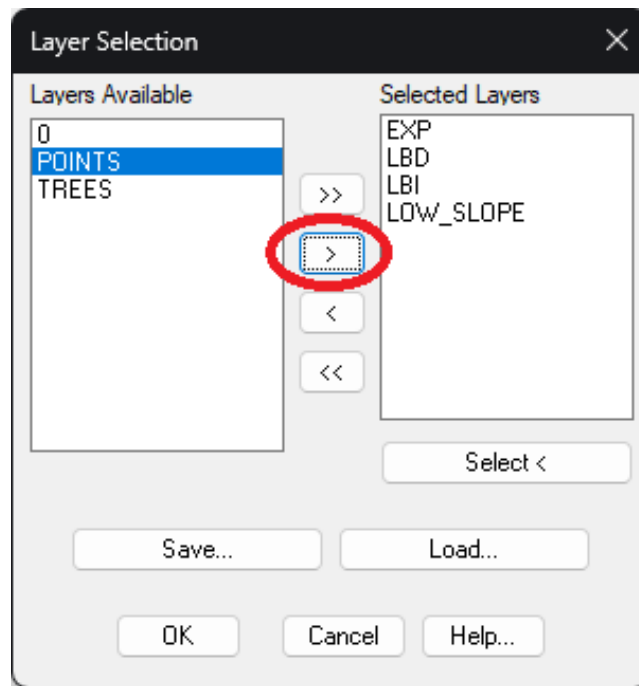


Creating digital terrain model

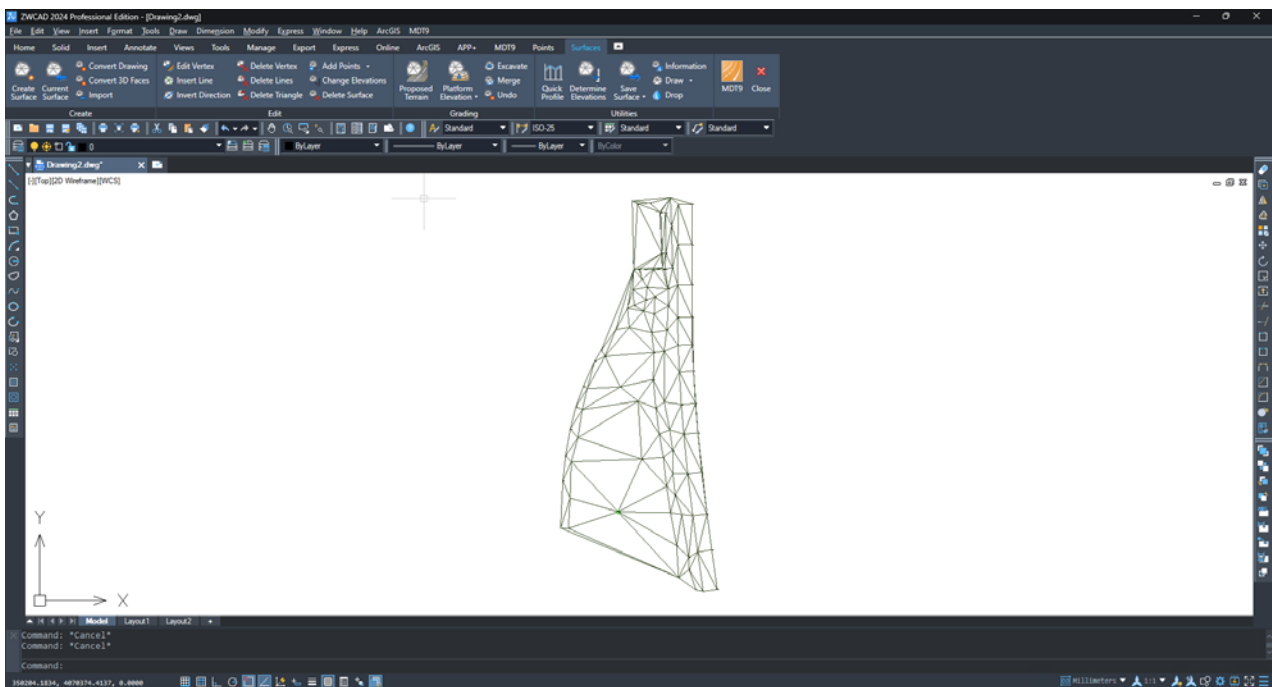
1. Run *MDT9 > Surfaces > Create Surface* and accept the proposed file name.
2. In the dialog, check that within *Elements to Triangulate* there are the *Points* and *Break Lines* elements. Tap the *Layers* button.



3. Choose the list of layers that should be considered as break lines, drawn automatically or manually, using the > button, and press *OK*.

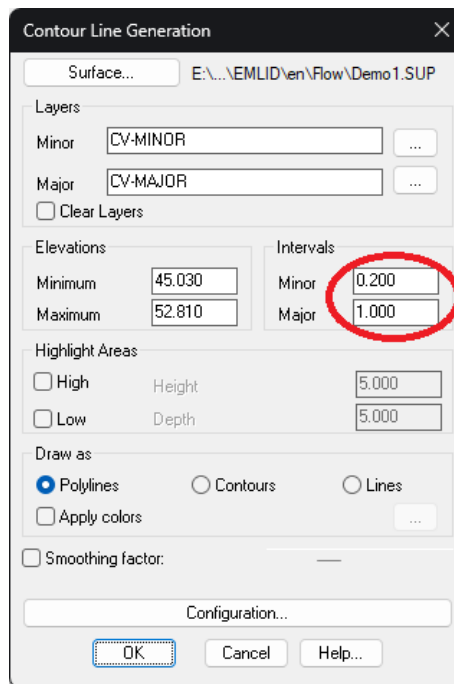


4. Click *OK* again to generate and draw the triangulation.

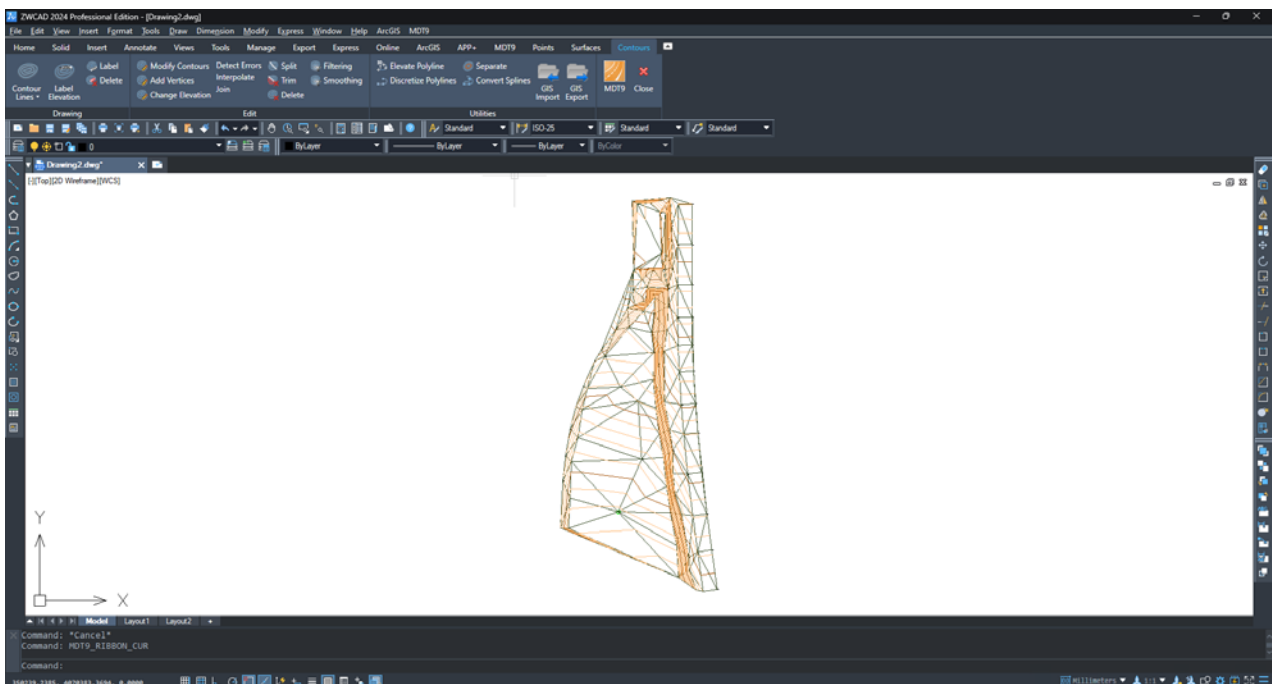


Generating contour lines

1. Run *MDT9 > Contour Lines/Mapping > Create Contour Lines*.
2. Set the intervals between minor and major contour lines.

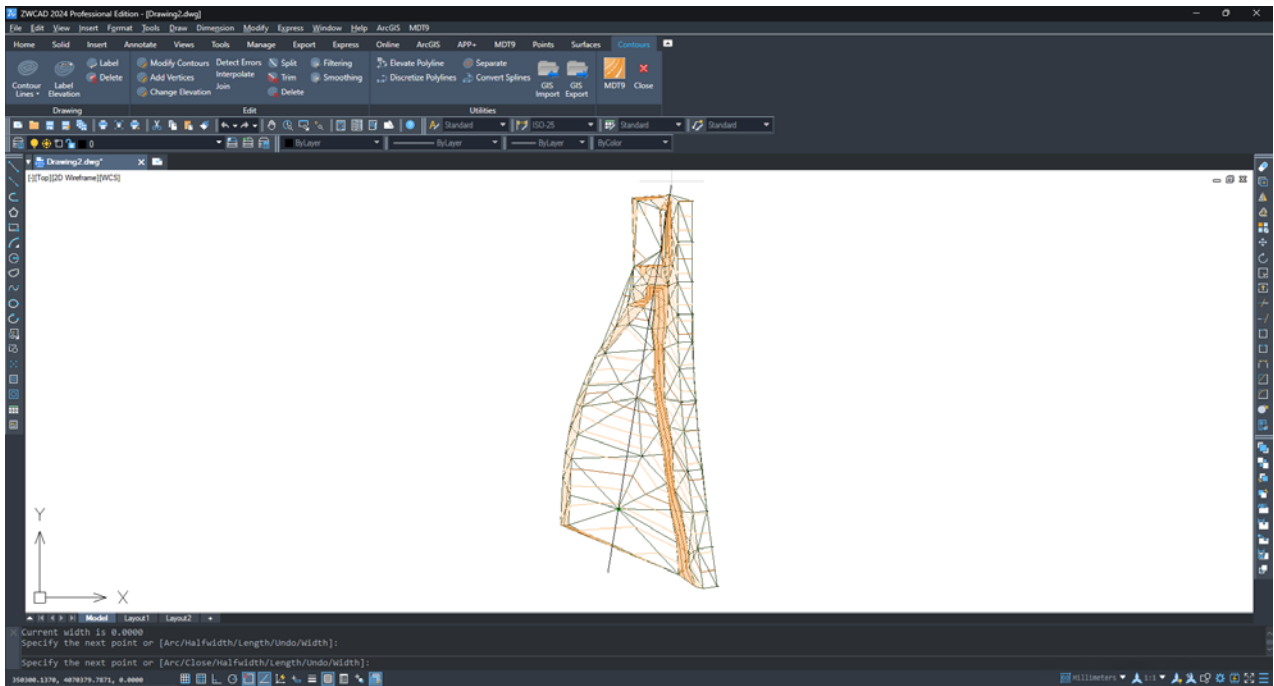


3. Click *OK* to generate the contour lines.

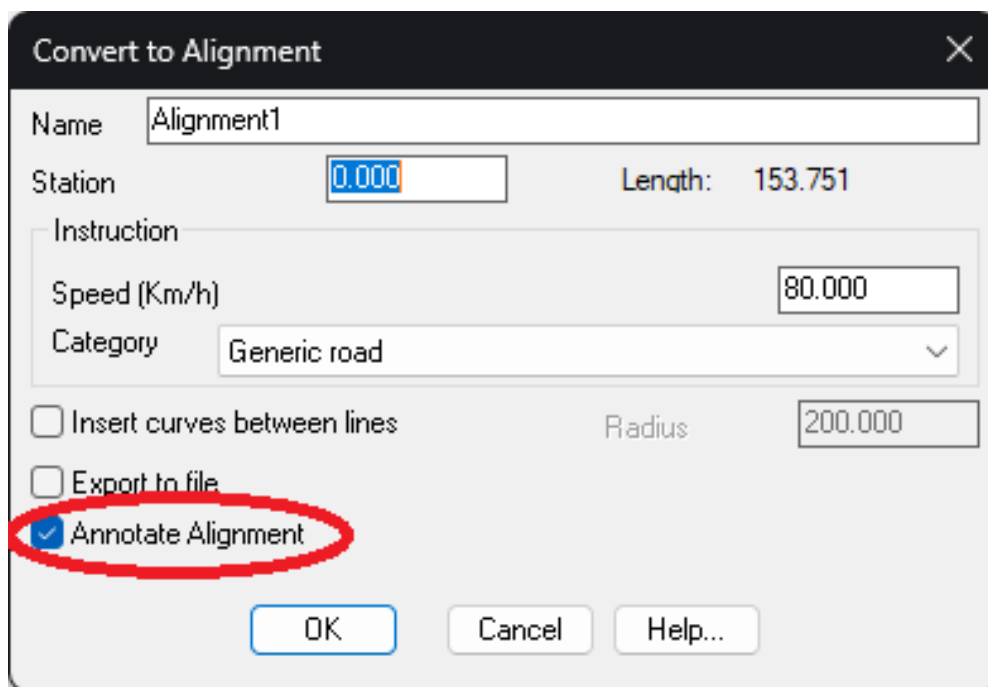


Creating alignment

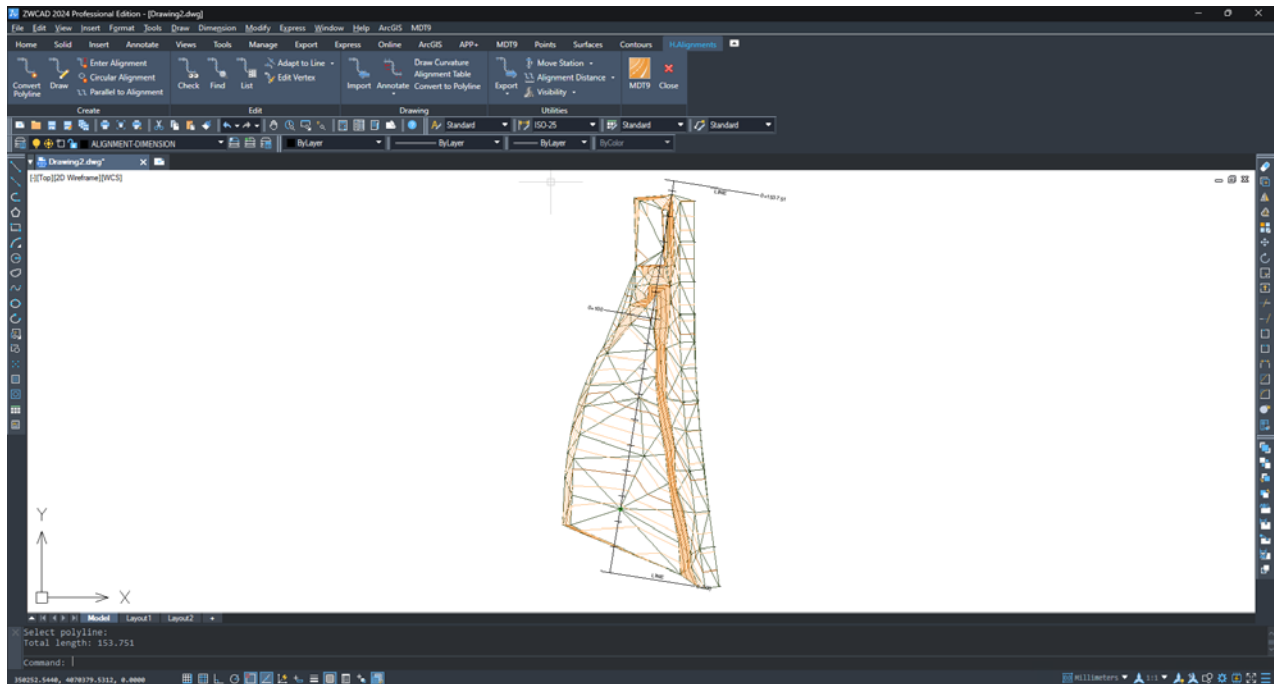
1. Run the *Draw > Polyline CAD* command and draw an alignment that we'll use to create profiles.



2. Run *MDT9 > Horizontal Alignments > Convert Polyline to Alignment* and select the previous polyline.

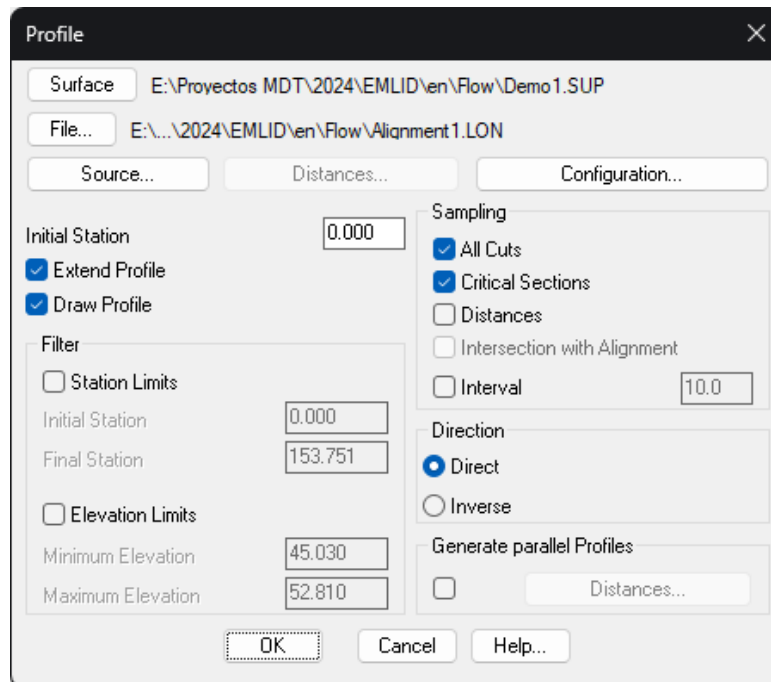


3. Enable the *Annotate Alignment* option and click *OK* two times.

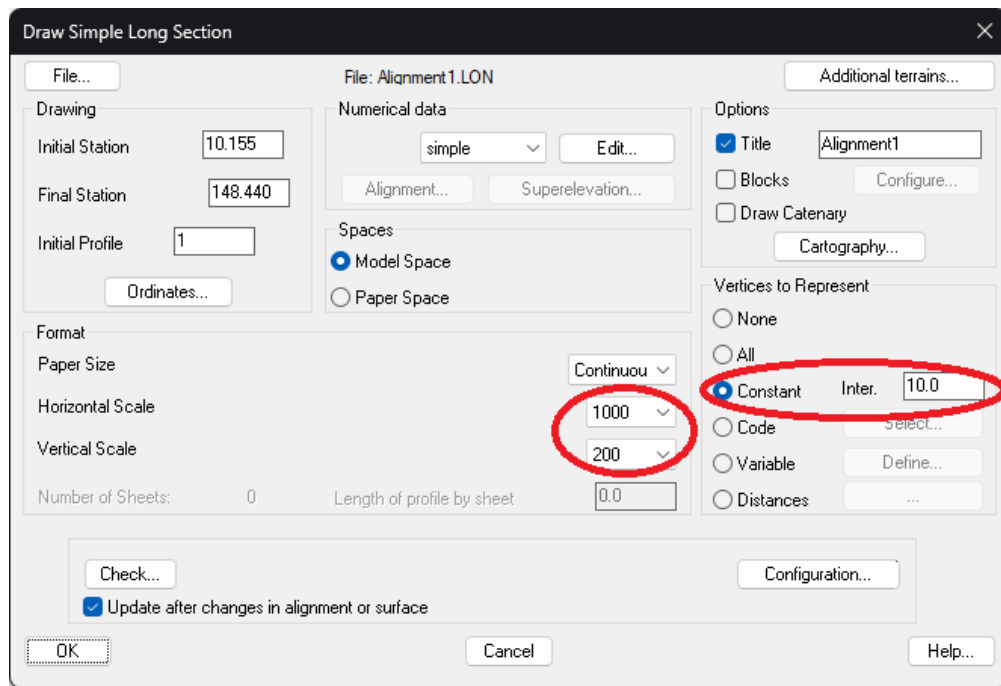


Creating profiles

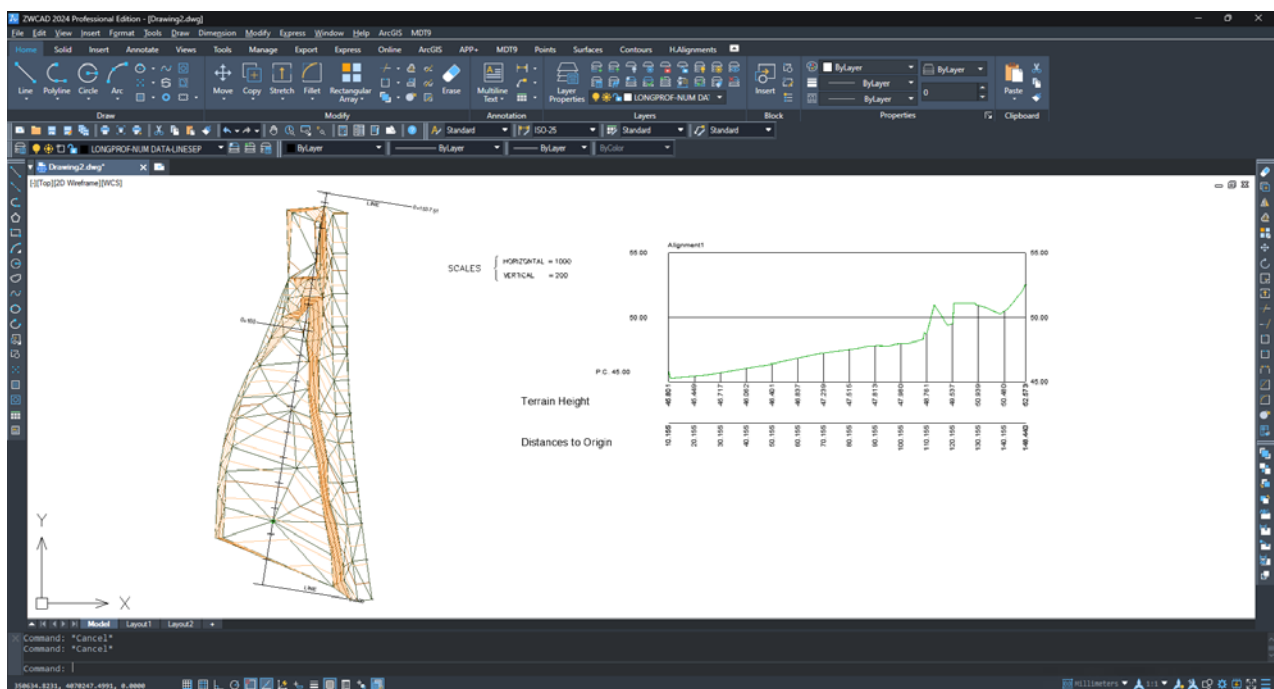
1. Run *MDT9 > Long Sections > Create Long Section* and select the alignment created in the previous step.
2. In the dialog, leave all options by default and press *OK*.



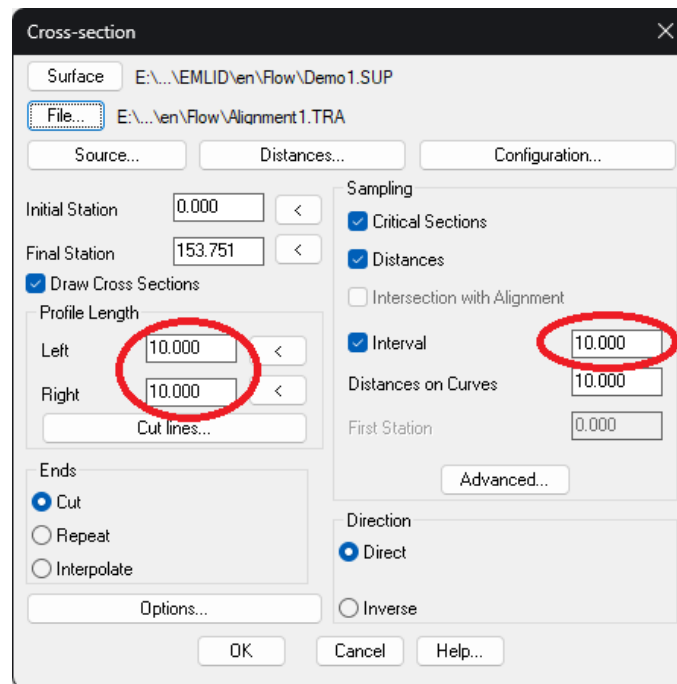
3. Choose the appropriate values for *Horizontal Scale* and *Vertical Scale*. In the *Vertices to Represent* frame, choose *Constant* and set an interval.



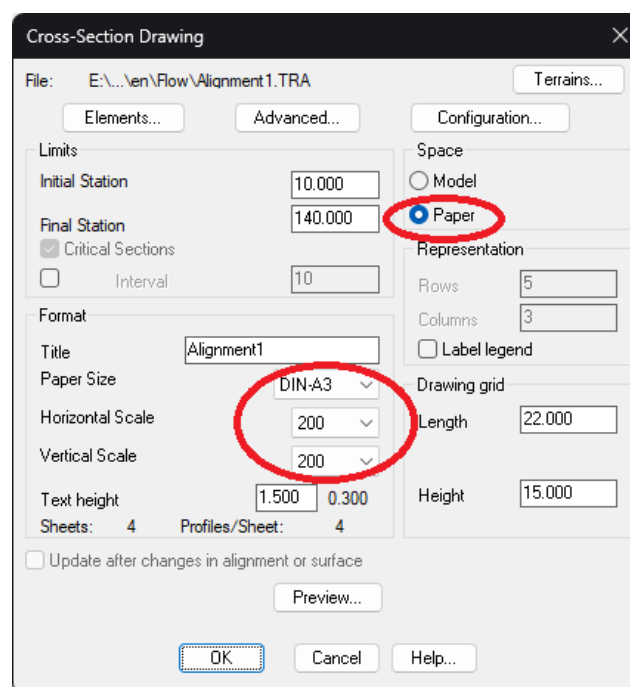
4. Click *OK* to draw the longitudinal profile in model space and choose an insertion point in a clear area of model space.



5. Run *MDT9 > Cross Sections > Create Cross Sections* and select the alignment again.
6. In the dialog, set the left and right profile lengths and the interval between sections and press *OK*.



7. In the dialog, chose *Paper Space* and set the horizontal scale, vertical scale, and paper size.



8. Click *OK* to proceed with the drawing.

5.12 senseFly RTK guide

In this tutorial, you will find the information on how to survey in RTK with senseFly drones and Reach RS2/RS2+.

Note: Step-by-step guide can be also found on [senseFly Knowledge Base](#).

5.12.1 Setting up Reach RS2/RS2+

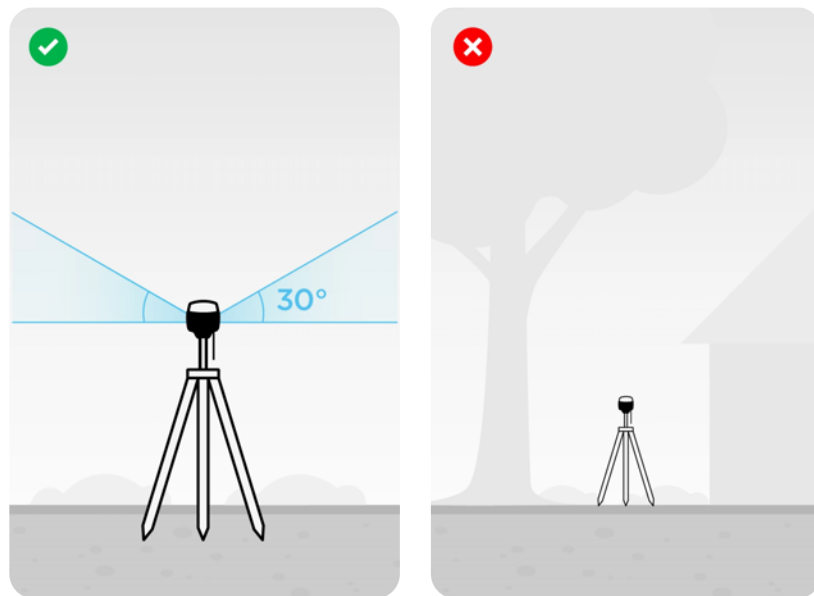
In this part, we will explain how to configure Reach RS2/RS2+ to transmit corrections to the PC via Bluetooth.

Placing the Reach RS2/RS2+ receiver

Tip: To find out other ways of placing the local base station, check the [Placing the base guide](#).

The general steps for placing the base receiver are described below.

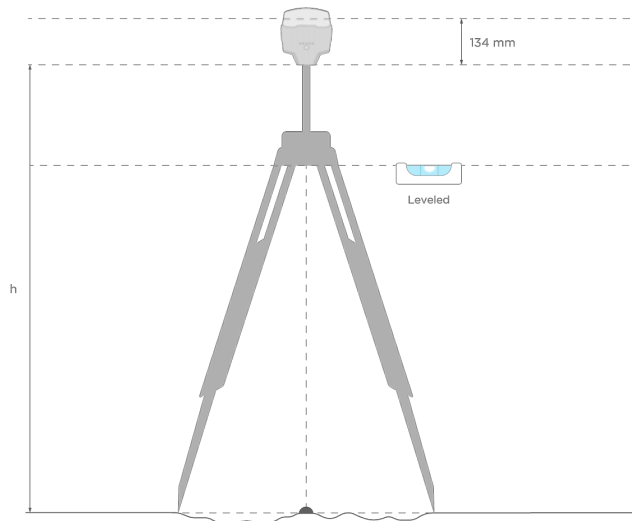
1. Make sure you choose an appropriate location to place Reach RS2/RS2+ base station. Take a look at 2 pictures below. The left picture demonstrates desirable conditions for the base location. The right one is an example of bad surrounding conditions such as the reduced view of the sky, possible obstructions or vegetation nearby.



2. Make sure your Reach RS2/RS2+ is placed precisely above the marked point on the tripod and leveled.
3. If you are setting up base coordinates manually, measure the antenna height offset.

Note: Antenna height is measured as the distance between the mark and the antenna reference point (ARP).

For Reach RS2/RS2+, consider the antenna height as the distance between the mark and the bottom of Reach RS2/RS2+ (h on the figure below) plus 134 mm.



Note: If you require absolute centimeter-level accuracy, you need to calculate an absolute base coordinate.

If you require relative centimeter-level accuracy, you can average base position.

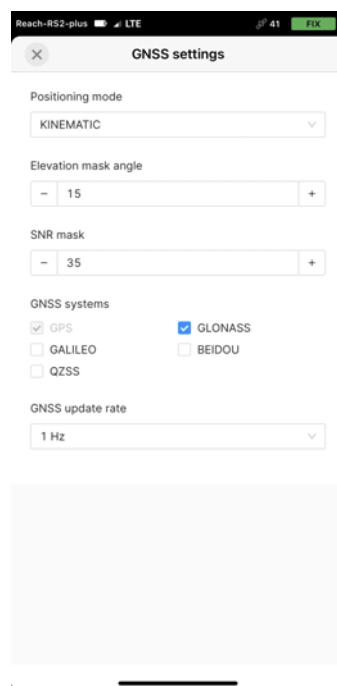
Pairing with PC

1. Open Emlid Flow and connect to your Reach.

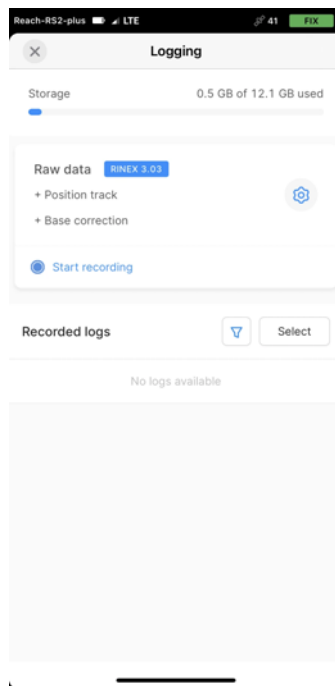
Steps for connecting via hotspot: To learn more, check the [Connecting to Reach guide](#).

2. On the *Settings* screen, tap *GNSS settings*.
3. Select GNSS constellations as follows.

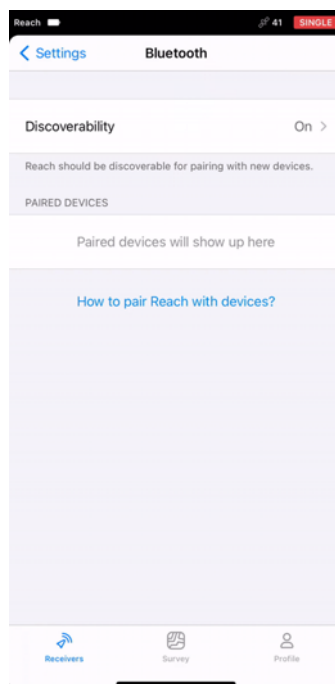
Note: For working with eBee drones, enable GPS and GLONASS at 1 Hz.



4. Go back to the *Receivers* screen and tap *Logging*.

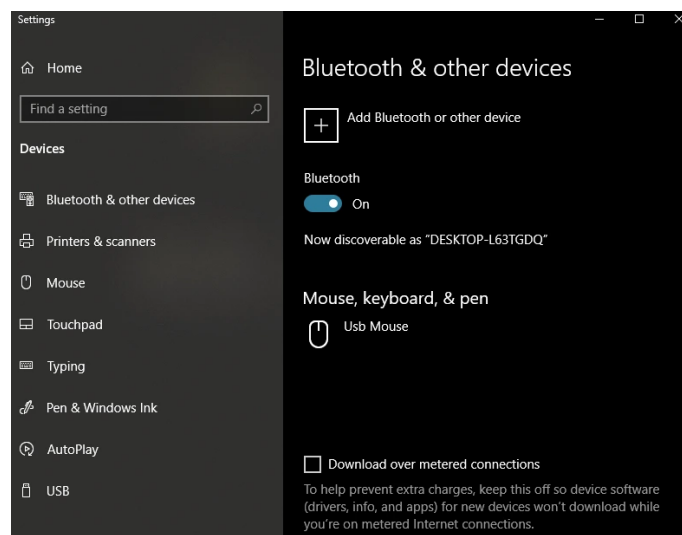


5. Tap the *Settings* button.
6. In the *Format* dropdown menu, choose *UBX*. Apply changes and close the *Logging* screen.
7. Go to *Settings* and tap *Bluetooth*.
8. Enable *Bluetooth* by tapping the *Turn on Bluetooth* button.
9. Tap *Discoverability* and turn on the *Discoverability* option. Tap *Save* to apply changes.

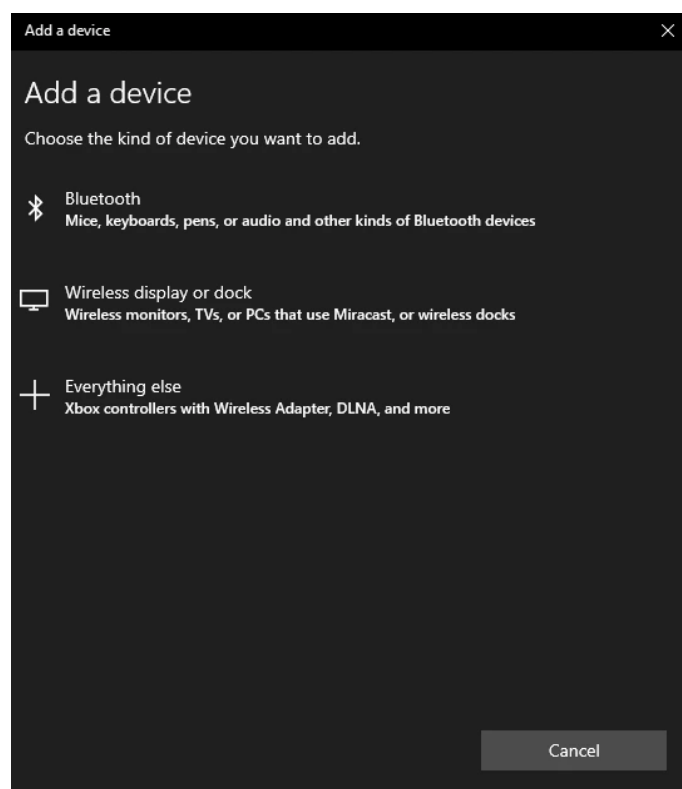


10. Enable Bluetooth on your PC.
11. Open Bluetooth settings.

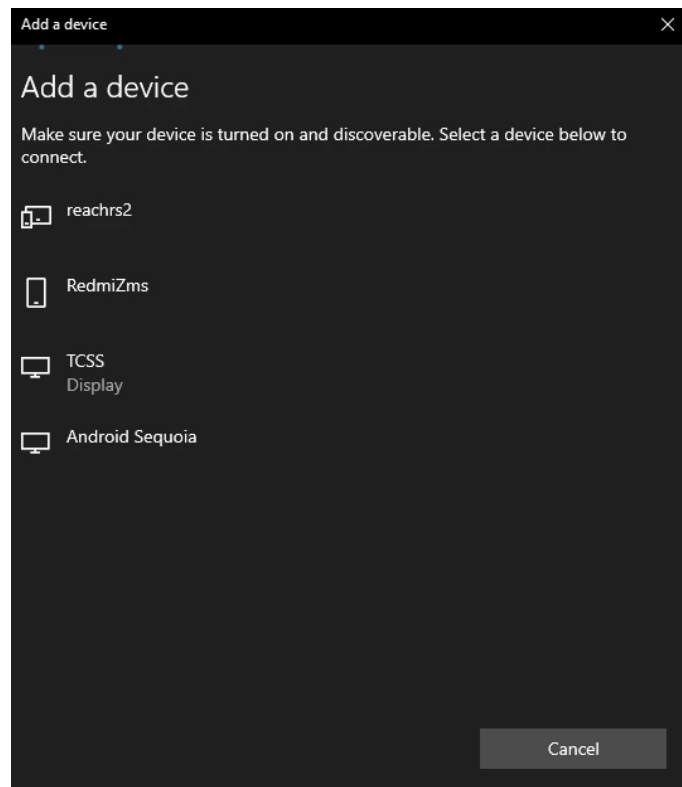
12. Click on *Add Bluetooth or other device*.



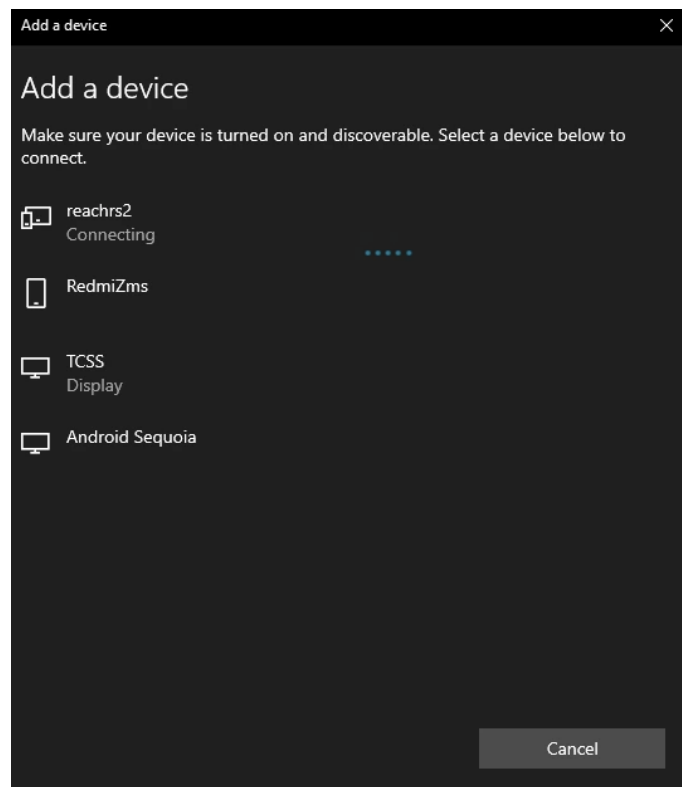
13. Choose the *Bluetooth* option in the *Add a device* window.



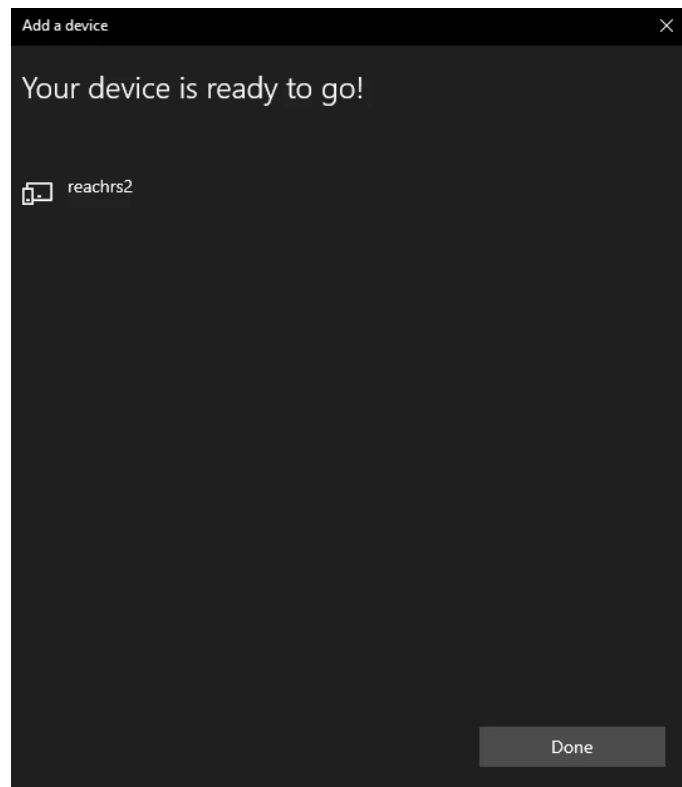
14. Make sure your Reach RS2/RS2+ is discoverable and can be seen in the list of devices.



Once you can see Reach RS2/RS2+ in the list, connect to it.



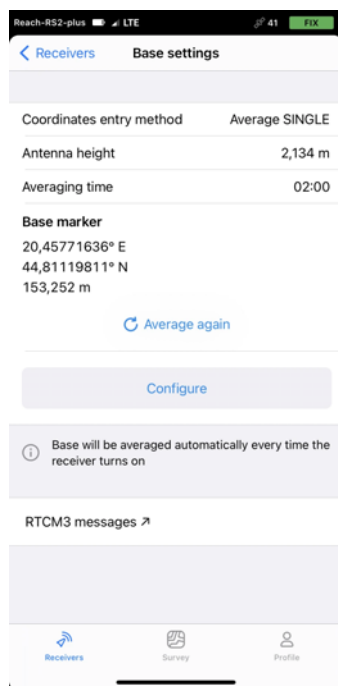
If the connection is successful, you will get a message "Your device is ready to go!"



Now you can proceed to the next step.

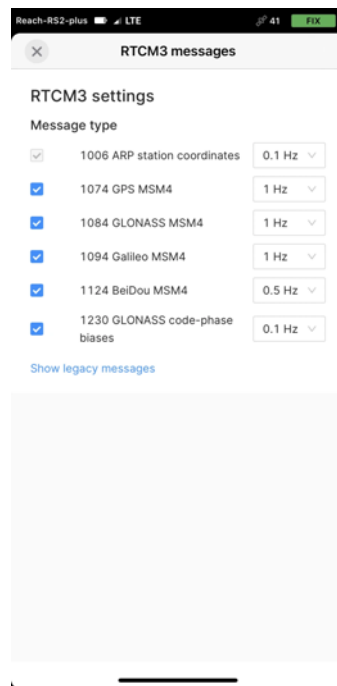
Configuring base output

1. On the *Receivers* screen in Emlid Flow, tap *Base output*.
2. Choose *Bluetooth*.
3. Go back to the *Receivers* screen and tap *Base settings*.
4. Choose *Coordinate entry method*. In this guide, we use *Average Single*.
Tip: To learn more, check the *Placing the base guide*.
5. Fill in *Antenna height* and then specify *Averaging time*.



6. Tap *RTCM3 messages* and specify transmitted RTCM3 messages.

RTCM3 messages	Message type
	Minimal required messages
1006	ARP station coordinate
1074	GPS MSM4
	Optional messages for other GNSS
1084	GLONASS MSM4
1094	Galileo MSM4
1124	BeiDou MSM4

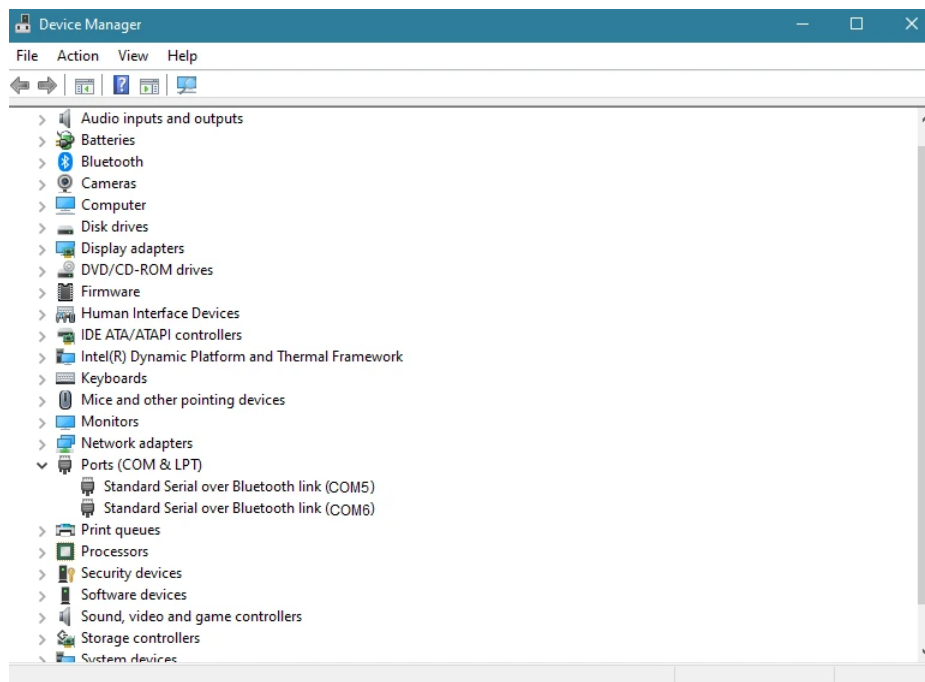


Checking connection

You will need to find out what COM port on your PC is used by Reach RS2/RS2+. For that, we

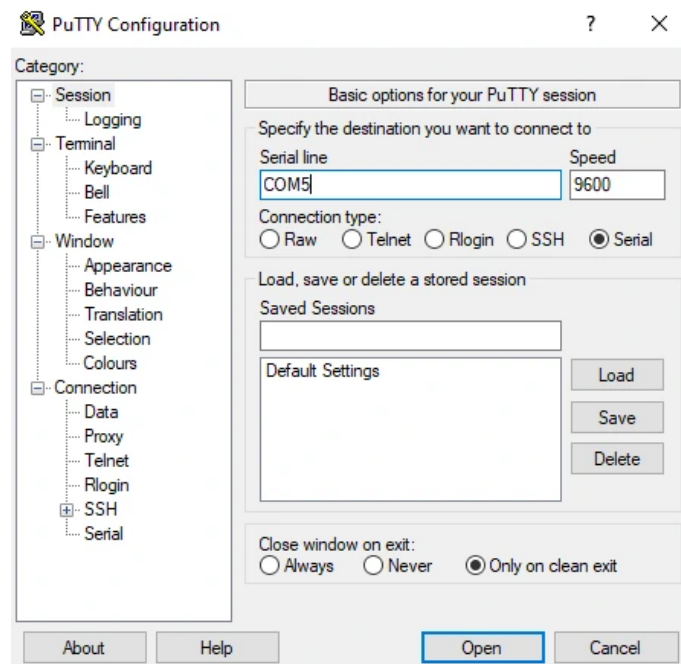
recommend using the PuTTY client for Windows.

1. Download and install PuTTY.
2. Open Device Manager on your computer.
3. Check available Standard Serial over Bluetooth link ports.



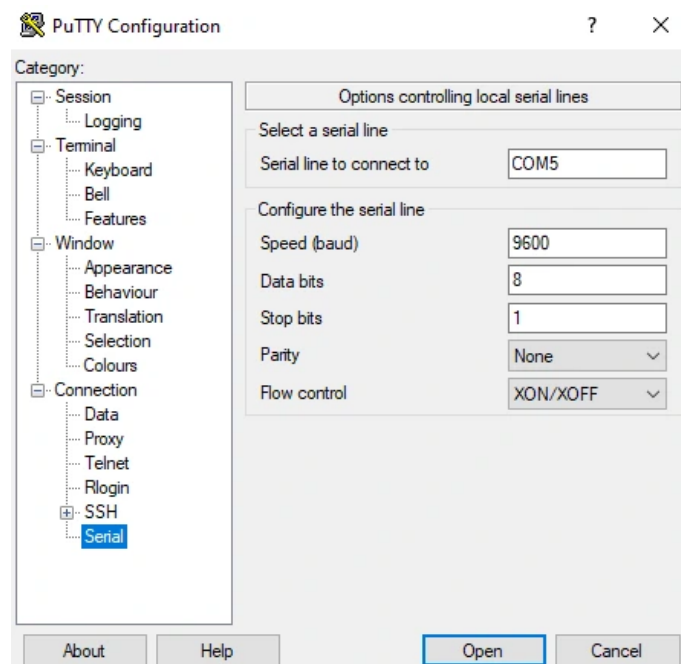
4. Open PuTTY.
5. Go to the *Session* tab.

6. Specify the COM port in the *Serial line*.
7. Choose speed at 9600.
8. Choose the connection type *Serial*.



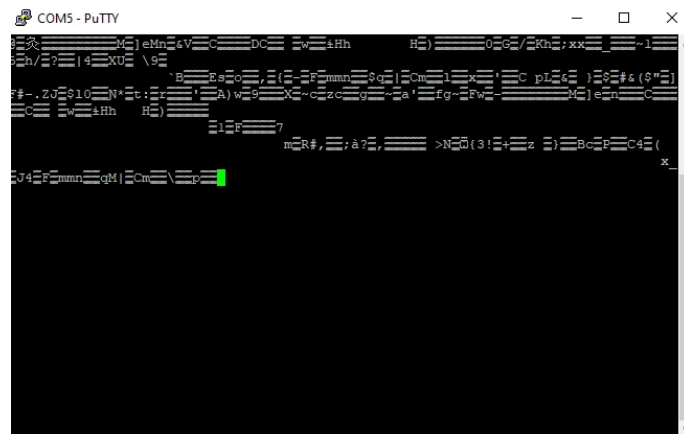
You can do the same in the *Serial* tab:

1. Go to the *Serial* tab.
2. Specify the COM port in the *Serial line* to connect to.
3. Choose speed at 9600.



4. Press *Open*.

If you have chosen the correct port, you will see the corrections from Reach RS2/RS2+ in the RTCM3 format on the screen. If you cannot see the data coming, choose another COM port in *Serial line*.

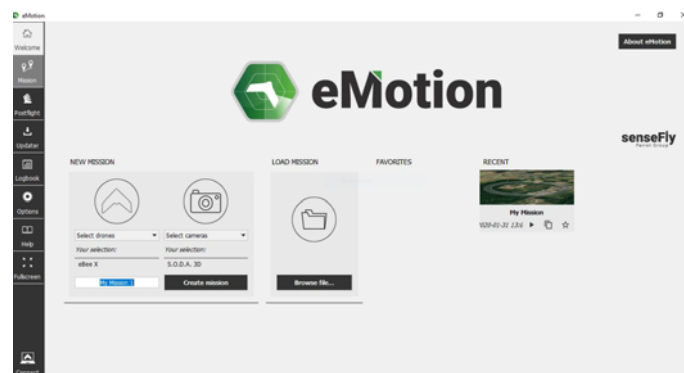


Now you are ready to configure the RTK link in eMotion3.

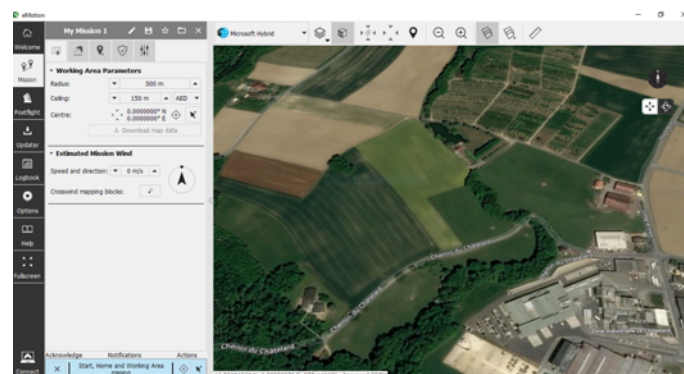
5.12.2 Connecting to eMotion3

Now we will show you how to establish an RTK link with Reach RS2/RS2+ base on your eBee drone.

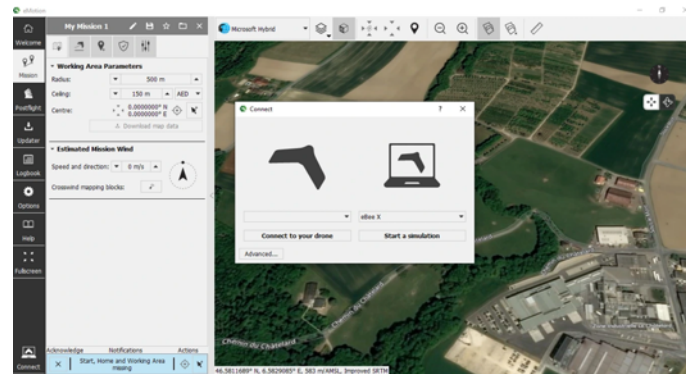
1. Launch eMotion3.



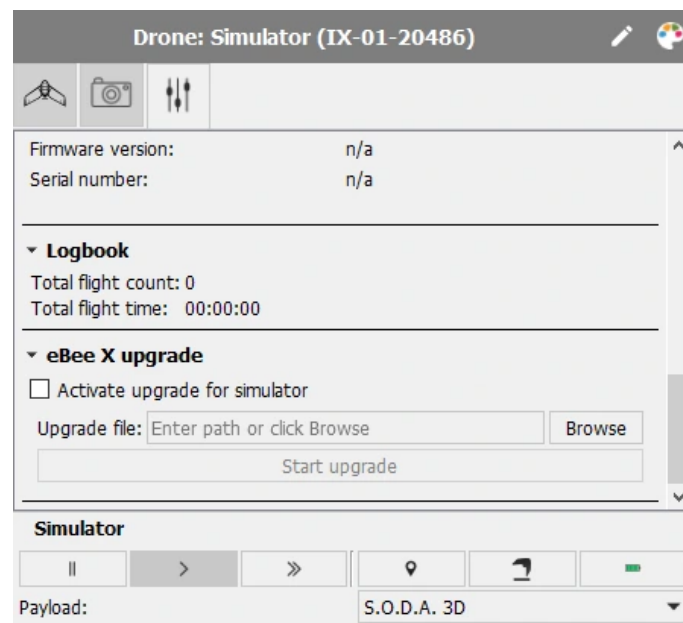
2. Create mission and go to the *Mission* tab.



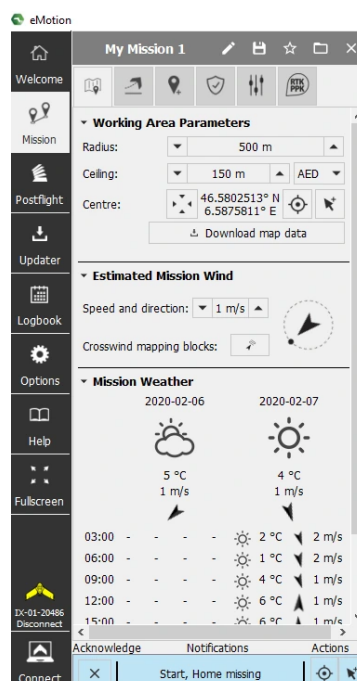
3. Press the *Connect* button. Connect to the drone by pressing *Connect to your drone* or simulate your flight by pressing *Start a simulation*.



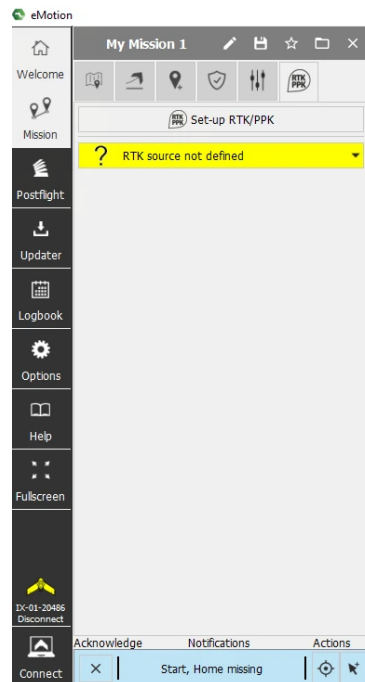
4. Activate your RTK/PPK license in the *eeBee plus upgrade* tab of the Drone's panel. To activate a license for simulation, tick an *Activate update for simulator* box.



Now you can see the *RTK* tab enabled on your *Mission panel* on your left.



5. Go to the *RTK* tab in the *Mission panel*.



6. Press *Set-up RTK/PPK* to configure your base.



7. In the opened window, you can specify either a base station, reference points, or a VRS. To configure the base station, press *Add base + in the Base tab*.

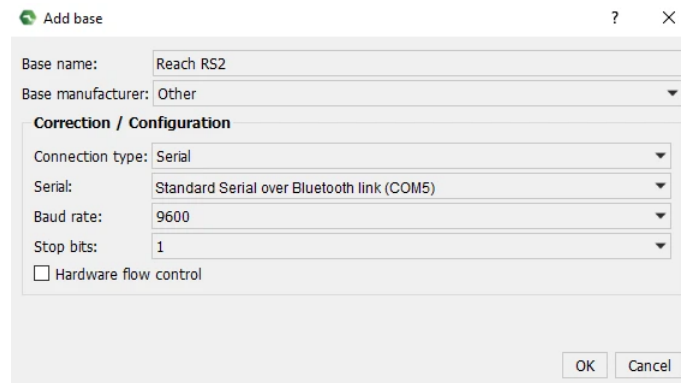
8. Set Reach RS2/RS2+ to a base name.

9. Set Other to a base manufacturer.

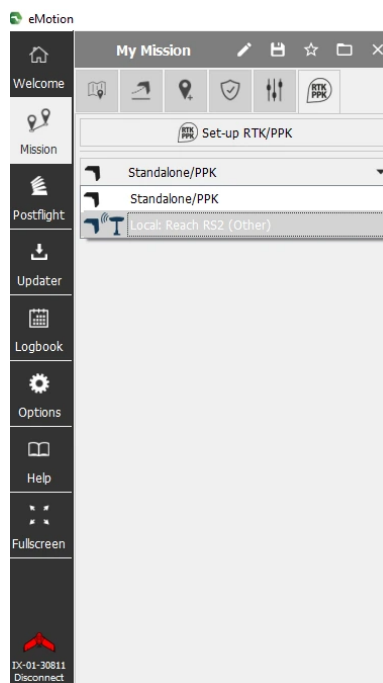
10. Set Connection type to Serial.

11. Choose the COM port that you checked on the previous step.

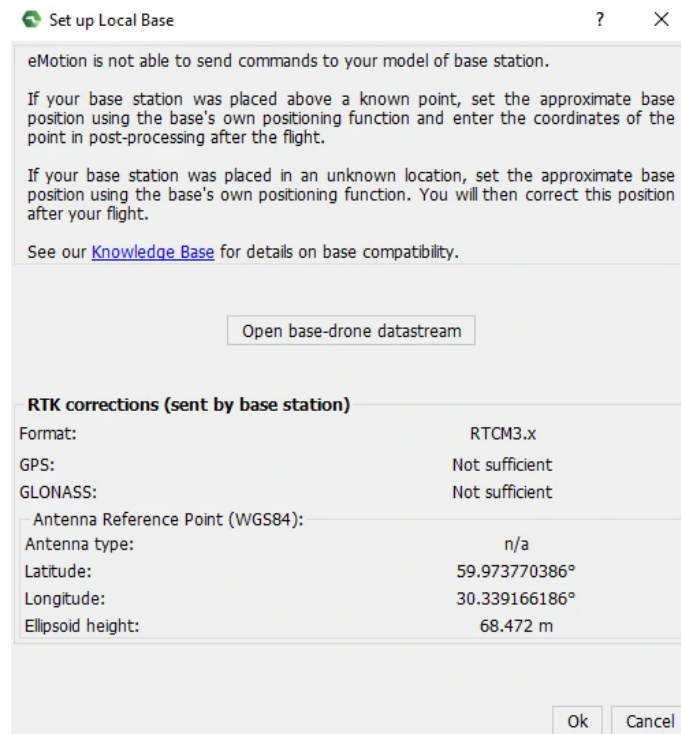
12. Set the same baud rate for all connected devices.
13. Press *OK*.



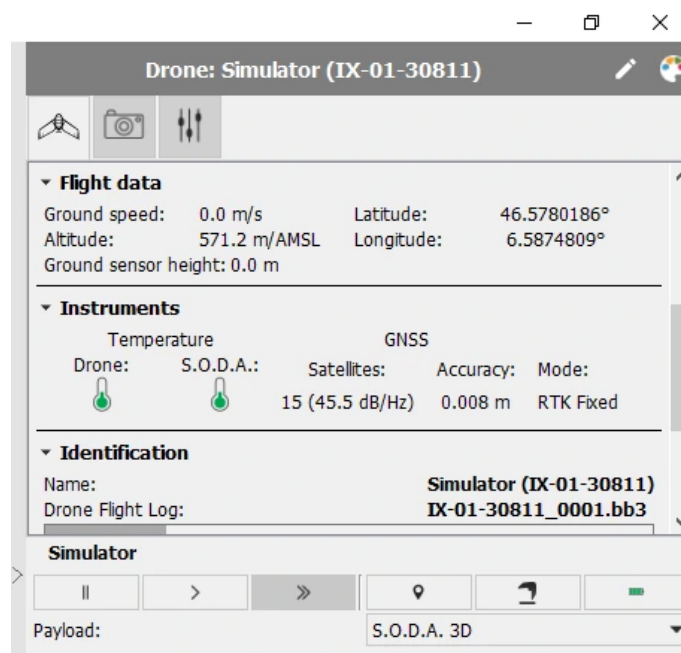
Once you configured the connection, you can choose the base station in the *RTK* tab.



14. Press on the chosen base station to see the *Set up Local Base* window.
15. Press *Open base-drone datastream*.
Note: *If you are testing the setup inside, the GPS and GLONASS fields will show Not sufficient message.*
16. Check the base position the drone receives.



- Go to the *Drone's panel*. In the *Instruments* tab, you can see that the drone provides centimeter-level accuracy and the mode is RTK-fixed.



Now you have successfully configured RTK corrections on your drone from Reach RS2/RS2+.

5.13 senseFly PPK guide

In this tutorial, you will find the information on how to perform PPK with senseFly drones and Reach RS2/RS2+ in eMotion software.

Note: Step-by-step guide can be also found on senseFly Knowledge Base.

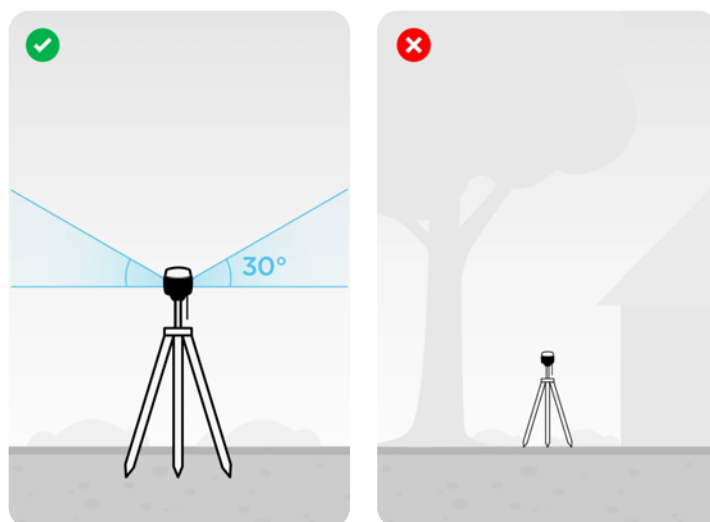
5.13.1 Preparing Reach RS2/RS2+ data

In this part, we will explain how to place Reach RS2/RS2+ to record logs for PPK.

Note: To find out other ways of placing the local base station, check the [PBase setup guide](#).

The general steps for placing the base receiver are described below.

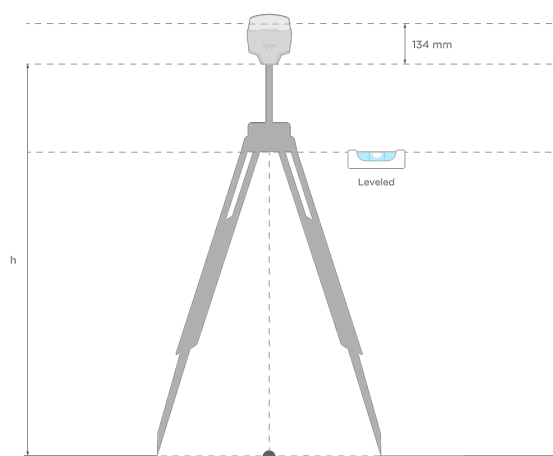
1. Make sure you choose an appropriate location to place Reach RS2/RS2+ base station. Take a look at 2 pictures below. The left picture demonstrates desirable conditions for the base location. The right one is an example of bad surrounding conditions such as the reduced view of the sky, possible obstructions or vegetation nearby.



2. Make sure your Reach RS2/RS2+ is placed precisely above the marked point on the tripod and leveled.
3. If you are setting up base coordinates manually, measure the antenna height offset.

Note: Antenna height is measured as the distance between the mark and the antenna reference point (ARP).

For Reach RS2/RS2+, consider the antenna height as the distance between the mark and the bottom of Reach RS2/RS2+ (h on the figure below) plus 134 mm.

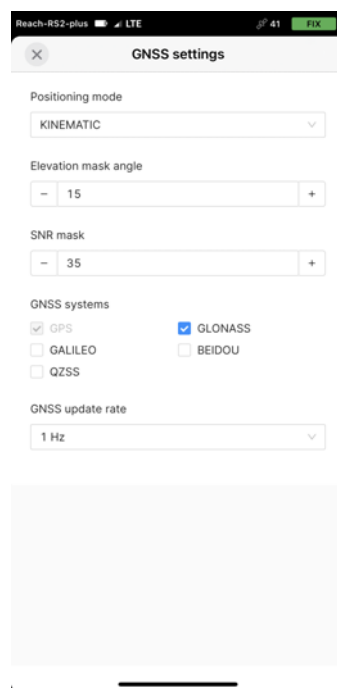


Note: *Precise base coordinates will be needed for post-processing in eMotion.*

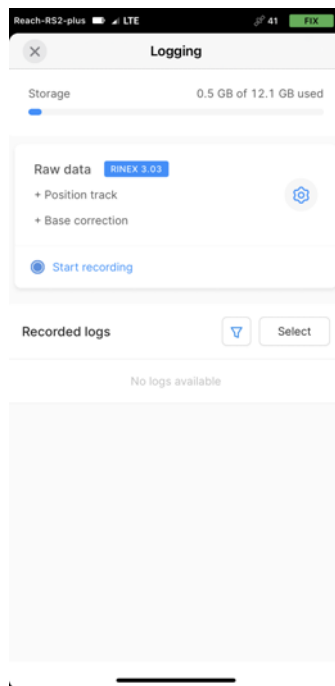
Raw data logging

1. Open a list of Wi-Fi networks on your smartphone/tablet.
2. Connect to a network named **reach:xx:xx**.
3. Type the network password **emlidreach**.
4. Choose Reach RS2/RS2+ from the list of available devices in the Emlid Flow app.
5. On the *Settings* screen, tap *GNSS settings*.
6. Select GNSS constellations as follows.

Note: *Our default recommendation is all GNSS enabled at 1 Hz.*



7. Go back to the *Receivers* screen and tap *Logging*.



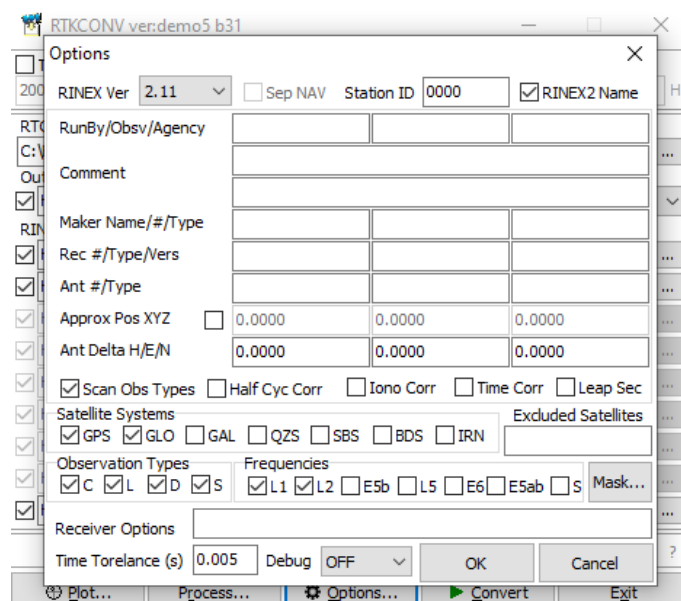
8. Tap the *Setting* button.

9. In the *Format* dropdown menu, choose *UBX*. Apply changes.

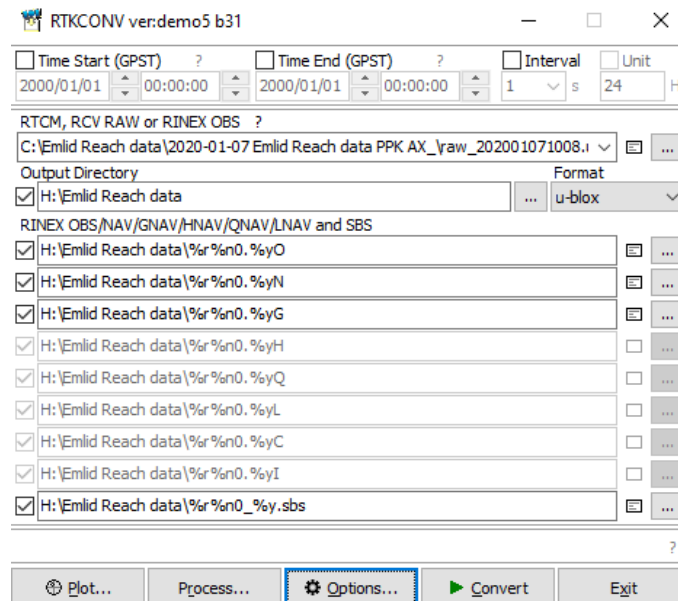
Once Reach RS2/RS2+ base starts data logging, you can fly your eBee in a standalone mode.

Converting raw data log

1. Download RTKLIB QT apps.
2. Download raw files from Reach to your PC.
3. Start RTKLIB RTKConv.
4. Push *Options* button.
5. Choose *RINEX Version 2.11*.
6. Turn on satellite systems you need.
7. Press *OK*.



- Add your rover raw log in the first field and choose an output directory.
- Choose format of your log in the pop-down menu. Set format to u-blox.

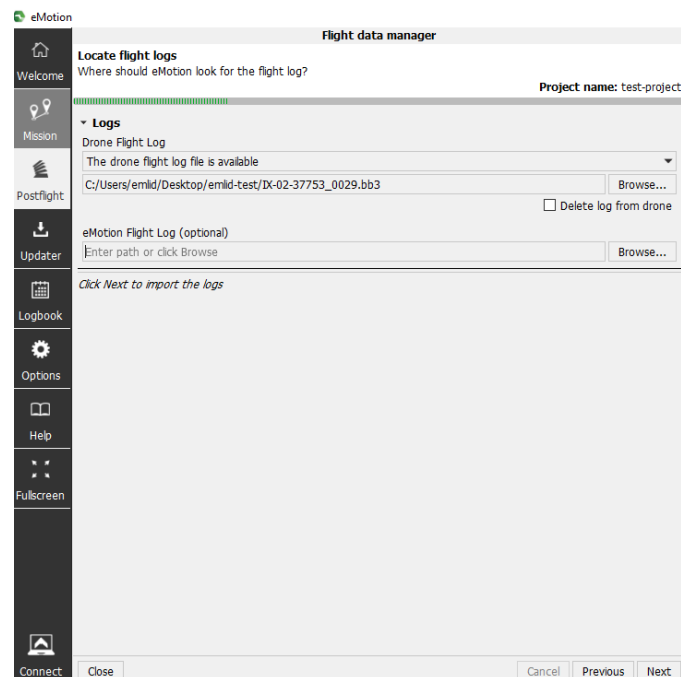


- Press *Convert*.

Now you can proceed to post-processing your logs in eMotion3.

5.13.2 Post-processing with eMotion

- Launch eMotion3 and select post flight FDM (Flight Device Manager).



- Create a project and import the flight logs. Proceed to the *RTK/PPK workflow* tab.
- Set *Input file format* to *RINEX*.

4. Select newly converted RINEX O, N, and G files from the Reach RS2/RS2+ base.
5. Set *Antenna model* to *UNKNOWN*.
6. Fill the base position field with the known coordinates of the marked ground point (ground marker).
7. Set *Height Reference* to *Ground marker*.
8. Enter the antenna height calculated according to explanation in this step for the receiver.
9. Press *Next* to calculate solution.

RTK/PPK
Select your RTK/PPK workflow

Project name: 2020-01-07 __Emlid Reach PPK test

PPK: Process drone's raw GNSS data

Flight (GPS time): 2020-01-07 10:18 - 2020-01-07 10:42

▼ **Base station log:**

Input file format: Rinex

Observation: H:/Emlid Reach data/00000070.20O Browse

Navigation: H:/Emlid Reach data/00000070.20n Browse

H:/Emlid Reach data/00000070.20g Browse

Antenna model: UNKNOWN

▼ **Base station position (WGS84):**

Enter manually your base station position

Latitude: 46.616602749°

Longitude: 6.607419739°

Ellipsoid height: 644.329 m

Height reference: Ground marker

Antenna height: 1.644 m

Resulting ARP: 46.616602749°, 6.607419739°, 645.973 m

▼ **Geotags in flight:**

RTK fixed:	0	0 %	σ: 0.000 m
Standalone:	315	100 %	σ: 2.493 m
Overall:	315	100 %	σ: 2.493 m

10. Once the solution is calculated, the geotags are post-processed based on the RINEX file with corrected base position.

Flight data manager

RTK/PPK
Results page

Project name: 2019-12-04 __Emlid Reach Aeria X PPK

▼ **Base station position (ARP)**

Latitude: 46.616602749°

Longitude: 6.607419739°

Ellipsoid height: 645.910 m

▼ **Geotags**

▼ **Geotags in flight**

RTK fixed:	0	0 %	σ: 0.000 m
Standalone:	316	100 %	σ: 2.206 m
Overall:	316	100 %	σ: 2.206 m

▼ **Geotags post-processed**

PPK fixed:	316	100 %	σ: 0.034 m
Standalone:	0	0 %	σ: 0.000 m
Overall:	316	100 %	σ: 0.034 m

11. Proceed to the remaining FDM steps to complete the postflight process.
- Now you have successfully post-processed logs from Reach RS2/ES2+ and eBee drone.

6 Troubleshooting

6.1 How to update firmware

This guide explains how to update the firmware on your Reach RS2/RS2+ using the Updater tool in the Emlid Flow app.

6.1.1 Overview

Updater is a tool in Emlid Flow that helps update the firmware on your receiver. Firmware refers to the background program that runs your receiver and requires updates to upgrade the receiver with new features, optimize its performance, and protect it from vulnerabilities.

Tip: *We recommend updating firmware every time it is available.*

Note: *You can also subscribe for Beta updates in Emlid Flow. In Settings, go to Firmware updates, tap Beta Updates and enable Beta updates.*

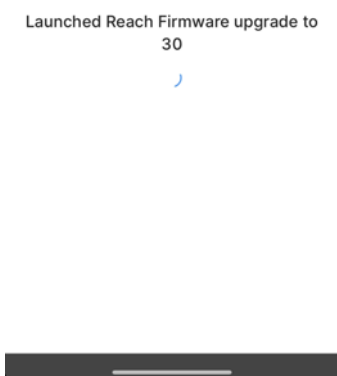
6.1.2 When to update your Reach

You need to update firmware on your Reach when you use the receiver for the first time or when the update is available. To get access to Updater, follow the steps below.

When you use a receiver for the first time:

Check the First setup guide and perform the following steps:

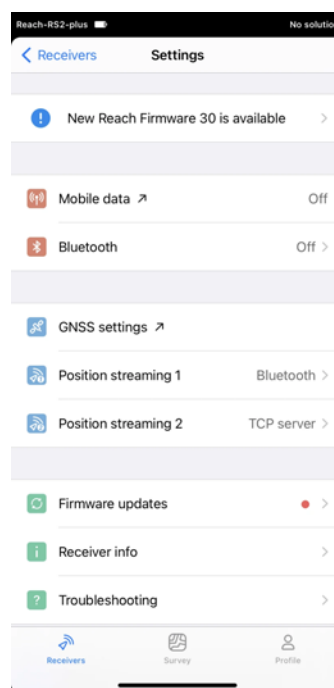
1. Install the Emlid Flow app.
2. Connect to the receiver.
3. Update the firmware following the on-screen instructions.



When the update is available:

Perform the following steps:

1. Connect the receiver to the internet following one of the guides:
 - Connecting to the internet via Wi Fi
 - Connecting to the internet via mobile hotspot
2. Open Emlid Flow. If the update is available, you will see the notification in *Settings*.
3. Tap the notification.
4. Update the firmware following the on-screen instructions.

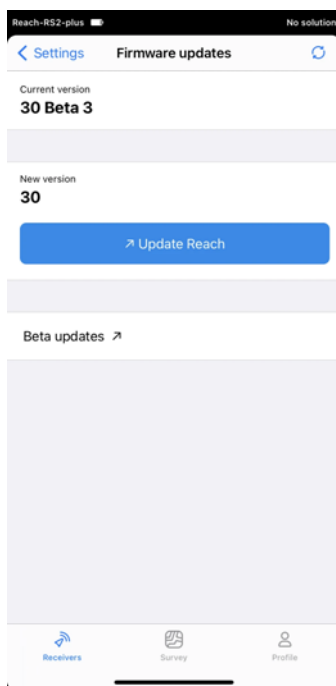


6.1.3 Update firmware

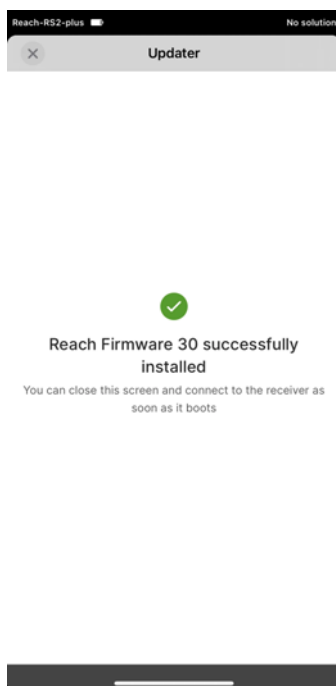
Note: You can allow using mobile data for updates by turning on the Allow updates using mobile data option on the Mobile data screen. However, we recommend updating your Reach using Wi-Fi network due to the large bulk of data.

To update the receiver, perform the following steps:

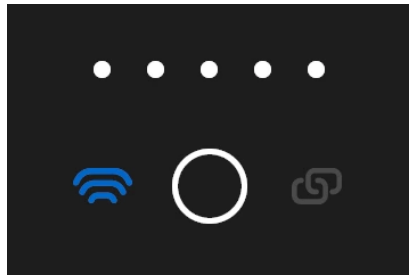
1. Tap the *Update Reach* button.



2. On the *Updater* screen, tap the *Upgrade Reach Firmware* button to start the update.
3. Wait until Reach reboots. Keep the Wi-Fi network on.



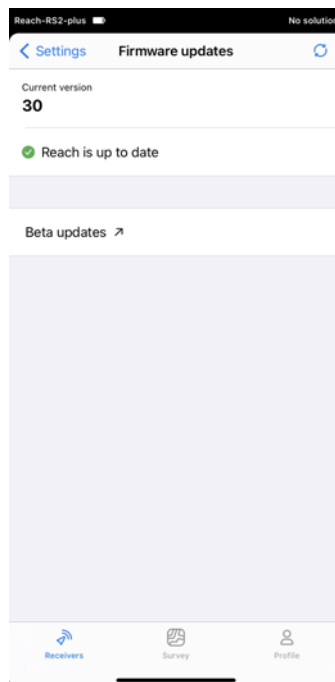
4. After reboot, wait for the Network LED to turn blue, showing that Reach RS2/RS2+ has joined your network again.



5. Close the *Updater* screen.
6. Go back to the *Receivers* tab.
7. Refresh the list of available devices.
8. Connect to your receiver.

Note: *If there is only one receiver, the app will automatically try to connect to this Reach RS2/RS2+.*

9. Go to the *Firmware updates* screen and make sure you are up to date.



Now your Reach RS2/RS2+ is ready for work.

6.2 Firmware reflashing

Note: *You do not need to reflash the firmware unless you want to bring your Reach to its initial state. This will delete all the data on your unit.*

This tutorial shows how to reflash Reach RS2/RS2+ firmware using Reach Firmware Flash Tool.

Tip: *Most new features are released via the Emlid Flow app and can be updated simply via its interface.*

6.2.1 Reach Firmware Flash Tool installation

To flash your Reach R2/RS2+, you'll need to download and install Reach Firmware Flash Tool on your computer which is available for Windows, Ubuntu, and macOS. Please, refer to [the guide](#) in our official online documentation to get the links.

Follow the instructions to install Reach Firmware Flash Tool on your PC.

6.2.2 Windows installation

1. Double-click on the downloaded file.
2. Follow the instructions to install Reach Firmware Flash Tool on your PC.
3. Reboot your PC.

6.2.3 Ubuntu installation

Tip: *We recommend using the terminal to install the Flash Tool on your PC.*

Tip: *If your Flash tool version is 1.7.1 or older, to update to the latest version you will need to add the new GPG key. Run the following command in the terminal:*

```
sudo apt-key adv --keyserver keyserver.ubuntu.com --recv-keys 90F3927E0416B765
```

1. Press Ctrl+Alt+T to open the terminal.
2. Navigate to the directory with the downloaded file using `cd ~/Downloads` command.
3. Run `sudo dpkg -i reach-firmware-flash-tool_1.9.2_amd64.deb` to start installation.

Caution: *Please confirm adding the current user to plugdev and dialout groups during the installation process. In case of a negative answer, the application might not work as expected.*

4. Reboot your PC.

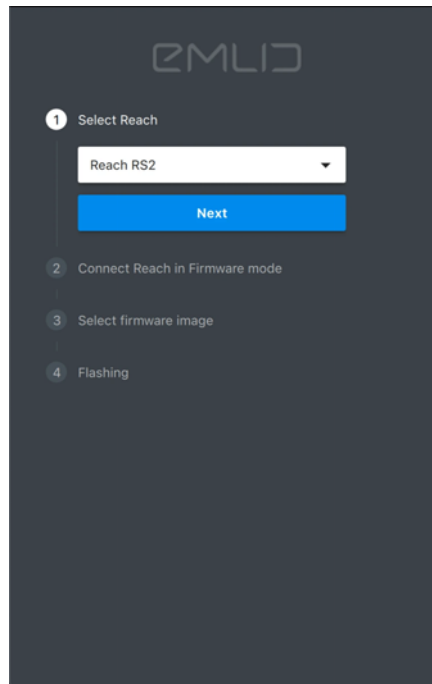
6.2.4 macOS installation

1. Double-click on the downloaded file.
2. Follow the instructions to install Reach Firmware Flash Tool on your Mac.
3. Drag the application icon to the Applications folder.

6.2.5 Reflash your Reach RS2/RS2+

Reflash your Reach following the steps below:

1. Open Reach Firmware Flash Tool and choose Reach RS2/RS2+.



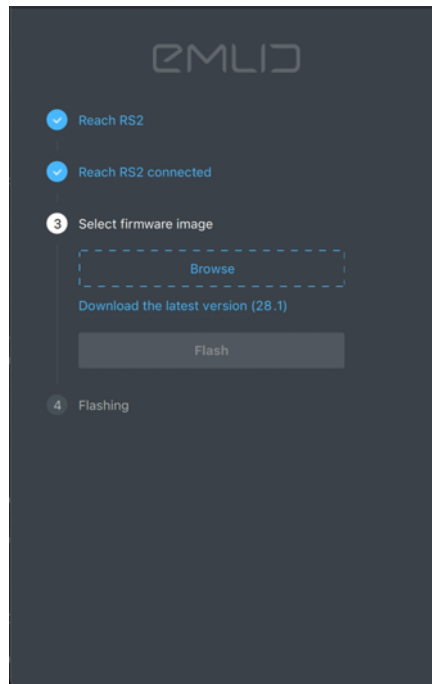
2. Connect your Reach in Firmware mode.

How to switch your Reach to firmware mode: *Make sure that Reach RS2/RS2+ is turned off and perform the following steps:*

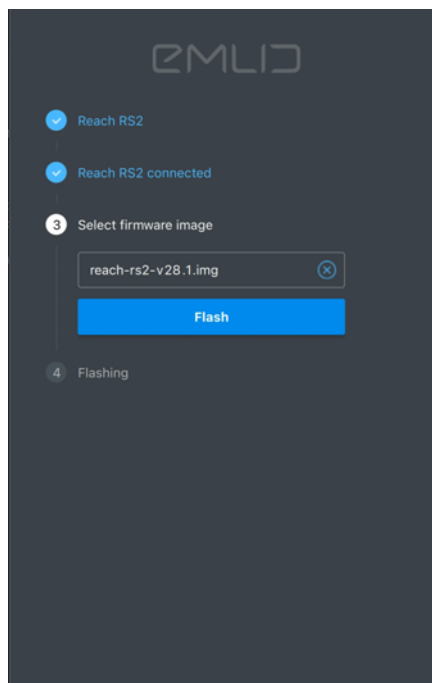
- (a) *Press and hold the power button.*
- (b) *Plug the USB cable into PC.*
- (c) *Release the power button.*
- (d) *All LEDs should blink several times simultaneously, and then start blinking one after another.*

3. Download the proposed Reach Firmware .zip file.

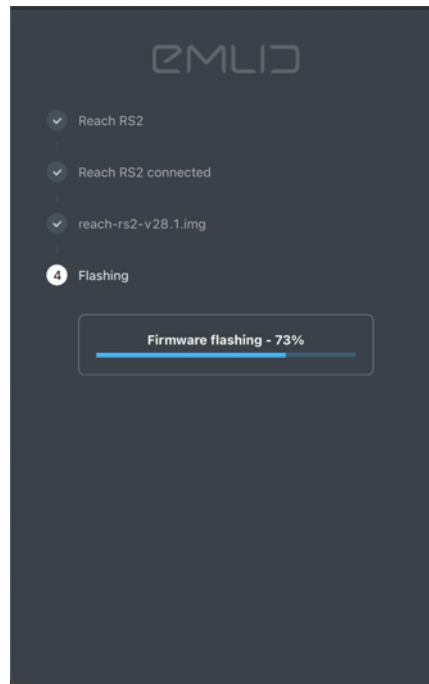
Note: *Make sure you have enough disk space. Reach Firmware Flash Tool creates 2 folders: one to download the image and another one to unpack it. Once you close the Flasher tool, the folder with the unpacked image will be deleted.*



4. Click *Flash*.

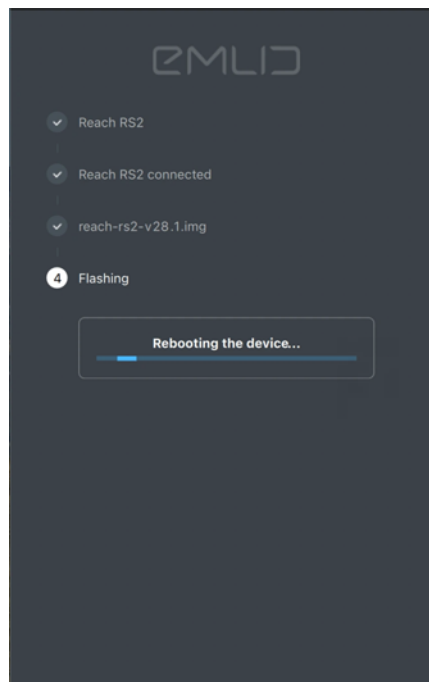


5. Wait until the end of the flashing process.



6. Wait until Reach reboots after reflashing. When Reach successfully reboots, you will see "Reach is flashed and ready to use" message.

Caution: *Do not unplug your unit on this step.*



7. Set up your Reach.

Tip: *You can check the First setup guide to ease setup process.*

6.3 How to download Simple system report

This guide explains how to download a Simple system report (SSR) in the Emlid Flow app to facilitate Reach troubleshooting.

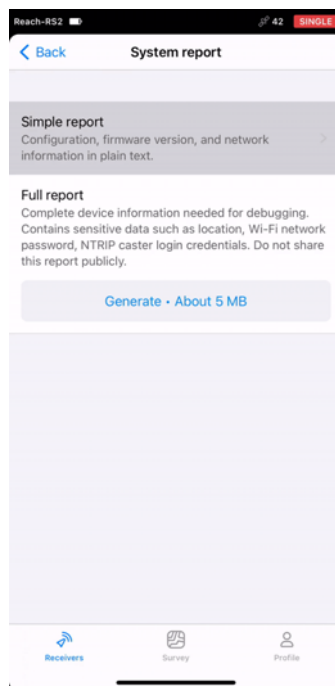
6.3.1 Overview

An SSR is a tool used to facilitate Reach troubleshooting. It provides information about your Reach configuration, network, and the Emlid Flow version in a plain text format.

6.3.2 Download Simple system report

To generate and download an SSR, perform the following steps:

1. Open the Emlid Flow app and connect to your Reach.
2. Go to `textitSettings`.
3. In *Troubleshooting*, tap *System report*.
4. Select *Simple report* and generate it.



5. Save the report depending on your device.

Now you can send the SSR of your Reach to the Support team at support@emlid.com.

6.4 How to download Full system report

This guide explains how to download a Full system report (FSR) in the Emlid Flow app to facilitate Reach troubleshooting in complicated cases.

6.4.1 Overview

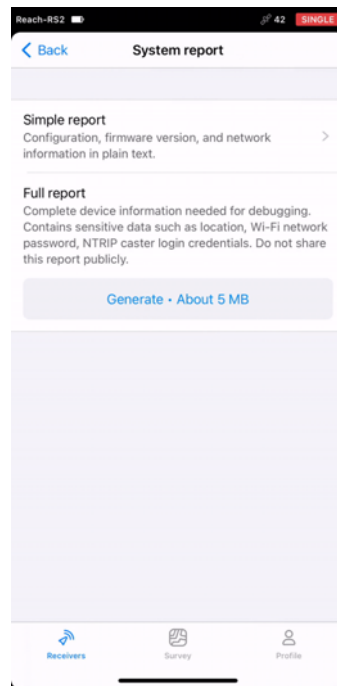
An FSR is a tool used to facilitate Reach troubleshooting. It comes in a ZIP archive and contains system logs and technical details of your Reach.

Caution: *We do not recommend sharing FSR publicly—it contains information such as your location, Wi-Fi network password, NTRIP caster login credentials.*

6.4.2 Download Full system report

To generate and download an FSR, perform the following steps:

1. Open the Emlid Flow app and connect to your Reach.
2. Go to *Settings*.
3. In *Troubleshooting*, tap *System report*.
4. In the *Full report* section, tap *Generate*.



5. Save the report depending on your device.

Now you can send the FSR of your Reach to the Support team at support@emlid.com.

6.5 How to find serial number

This guide explains how to find the serial number of your Reach.

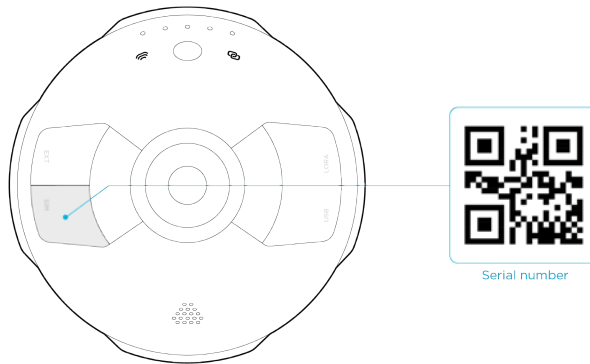
6.5.1 Overview

The serial number is assigned to your Reach unique string of numbers and letters.

6.5.2 Find serial number

To find the serial number of your Reach, perform the following steps:

1. Scan the QR code under the SIM card slot cover.



2. Copy the serial number of your Reach that appeared on the screen of your mobile device.

Now you can send the serial number of your Reach to the Support team at support@emlid.com.

6.6 How to enable raw data debug option

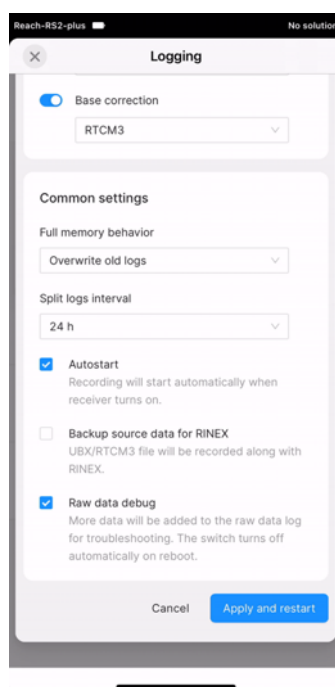
Caution: We recommend enabling the option only on the Support team request since the debug data adds extra weight to the logs.

This guide explains how to enable the raw data debug option on your Reach to facilitate troubleshooting in complicated cases.

6.6.1 Overview

Caution: The raw data debug option works only for the raw data logs in the UBX format. You can enable logging in the UBX format in the logging settings in the Emlid Flow app.

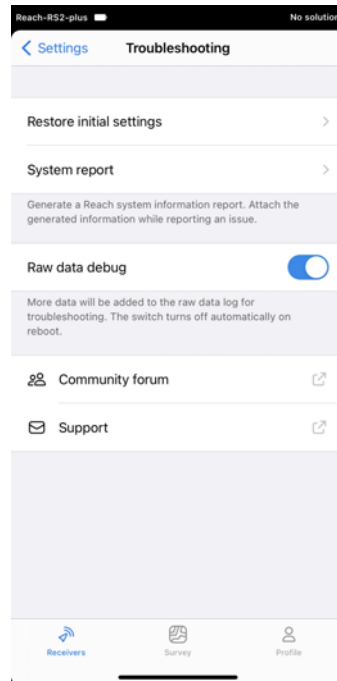
The raw data debug option adds additional internal information to the raw data logs in the UBX format. This feature provides more detailed information on the RTK calculation processes that can be used for debugging purposes in particular cases.



6.6.2 Enable raw data debug option

To enable the raw data debug option on your Reach, take the following steps:

1. Open the Emlid Flow app and connect to your Reach.
2. Go to *Settings*.
3. In *Troubleshooting*, turn the Raw data debug option on.



4. Record raw data logs as usual.

Tip: You can read how to record logs [here](#).

5. Save the raw data logs depending on your device.
6. Go back to *Troubleshooting* and turn the *Raw data debug* option off.

Tip: The raw data debug option turns off automatically on a reboot of your Reach.

Now you can send the raw data logs recorded using the raw data debug option to the Support team at support@emlid.com.

6.7 How to restore initial settings

This guide explains how to restore the initial settings on your Reach RS2/RS2+.

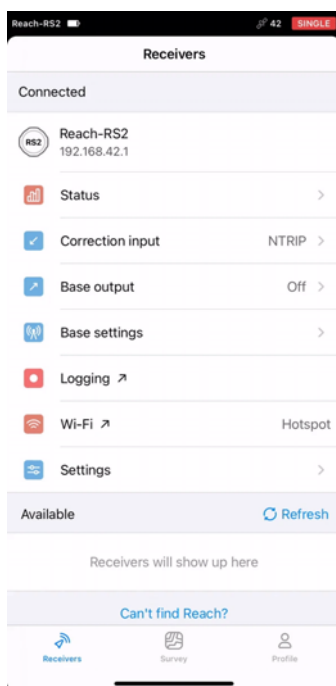
6.7.1 Overview

You can restore initial settings on your Reach using the Restore initial settings option in Emlid Flow. The option allows restoring GNSS settings, Correction input, Base output, and Base mode to an initial state. All other settings, including receiver name, Wi-Fi settings, logs, and projects will be saved.

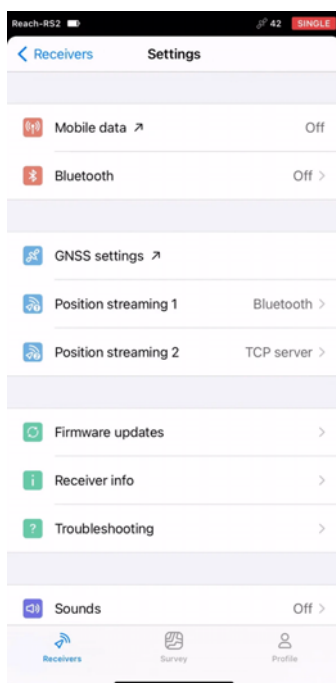
6.7.2 Workflow

To restore the initial settings on your receiver, follow the steps below:

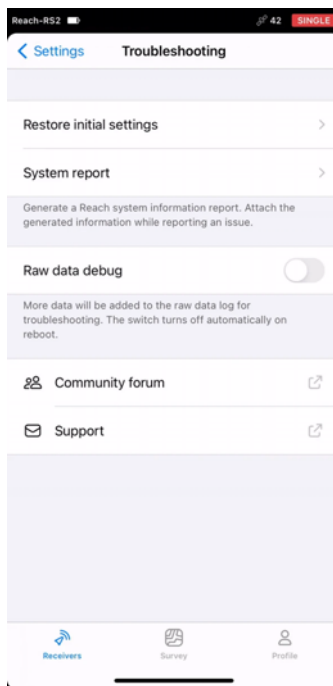
1. Connect to your Reach via Emlid Flow.



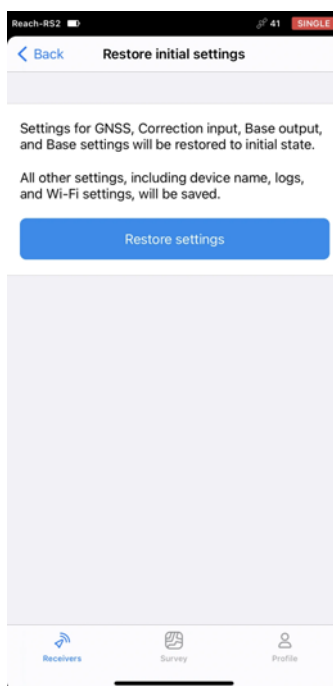
2. Tap *Settings* and go to the *Troubleshooting* section.



3. Tap *Restore initial settings*.



4. Tap the *Restore settings button*.



Once it's done, you will see that the button becomes gray and its name changes to Done. After that, you can proceed to set up your Reach.

6.8 How to access Reach panel from a web browser

This guide explains how to access Reach Panel in a web browser to work with the Reach device.

6.8.1 Overview

You can access your Reach from a PC using Reach Panel. Reach Panel is a web interface that allows you to work with Reach devices in a browser. For example, you may want to download heavy logs directly to your laptop for post-processing in your desktop application, or you may want to preset your Reach from your laptop before working in the field.

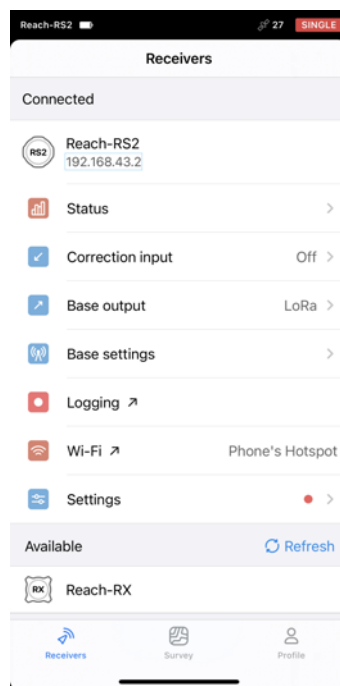
Note: *Your Reach and PC must be connected to the same Wi-Fi network.*

6.8.2 Workflow

To access Reach Panel to work with your Reach, you need an IP address for your device. In hotspot mode, your Reach has a default static IP address of 192.168.42.1. When you connect your Reach to a Wi-Fi network, your receiver is assigned a dynamic IP address.

To access your Reach in Reach Panel, follow the steps below:

1. Open the Emlid Flow app.
2. Find your Reach in the list of available devices and connect to it. If there is only one available device, Emlid Flow will automatically connect to it.
3. Find an IP address under the name of your Reach. Type this IP address in the address bar of your browser to open Reach Panel.



You can open Reach Panel from your phone's browser. To do this, tap the name of your Reach to open a menu, then go to Reach Panel.



You are now ready to work with your Reach in the Reach Panel web interface.

7 Specifications

7.1 Reach RS2 Specification

7.1.1 Performance specs

[Datasheet for Reach RS2 \[PDF, 5,7 MB\]](#)

[Datasheet for Reach RS2+ \[PDF, 1,4 MB\]](#)

7.1.2 Ports overview



SIM card slot

RS2+: Reach RS2+ has a built-in LTE modem with 3G/2G fallback and global coverage. To get the corrections from NTRIP, you can simply insert the GSM SIM card inside Reach RS2+ and set it up following the [Connecting Reach to Internet via built-in modem](#) guide.

RS2: Reach RS2+ has a built-in 3.5G modem with 2G fallback and global coverage. To get the corrections from NTRIP, you can simply insert the GSM SIM card inside Reach RS2 and set it up following the [Connecting Reach to Internet via built-in modem](#) guide.

External bottom connector

Reach RS2/RS2+ has External bottom connector which can be used in several ways:

- To supply constant power from an external battery. In Emlid Flow, you can also configure the receiver to automatically turn on and off when an external battery is connected or disconnected. It's useful when you want to set up RS2/RS2+ as a permanent base or integrate it with a tractor for precision agriculture.
- To establish RTK communication with third-party devices. You can connect an external radio via External bottom connector and stream corrections using RS-232 serial communication protocol.

- To stream Reach's position to other devices or third-party apps. You can connect a device or third-party app via External bottom connector and stream Reach's position using RS-232 serial communication protocol. You just need to enable the Position streaming option in Emlid Flow.

USB-C port

Reach RS2/RS2+ receiver can be charged via a USB-C cable connected to the power bank or USB adapter.

To establish RTK communication with third-party devices, you can connect external radio via USB-C port.

You can enable the Position Streaming to other devices or third-party apps via USB-C port. You just need to turn on Position Streaming in Emlid Flow.

LoRa radio port

Reach RS2/RS2+ has a built-in low-powered LoRa radio for RTK communication between Reach devices. Attach the LoRa antenna and set up the LoRa link following the [How to set up RTK over LoRa](#) guide to work on the baselines up to 8 km in the line of sight Emlid Flow.

5/8" thread

Reach RS2/RS2+ can be placed on the survey pole or tripod using this thread.

7.1.3 Mechanical specs

File name	Download link
Reach RS2/RS2+ general drawing	reach-rs2-rs2plus-drawing [PDF, 807 KB]
Reach RS2/RS2+ 3D model in STEP format	reach-rs2-rs2plus [STEP, 38.6 MB]
Reach RS2/RS2+ 3D model in IGES format	reach-rs2-rs2plus [IGES, 43.7 MB]

7.1.4 Electrical specs

Antenna reference point (ARP) of Reach RS2/RS2+ is located on the bottom of the receiver. For Reach RS2/RS2+, the distance between the ARP and GNSS antenna is 134 mm.

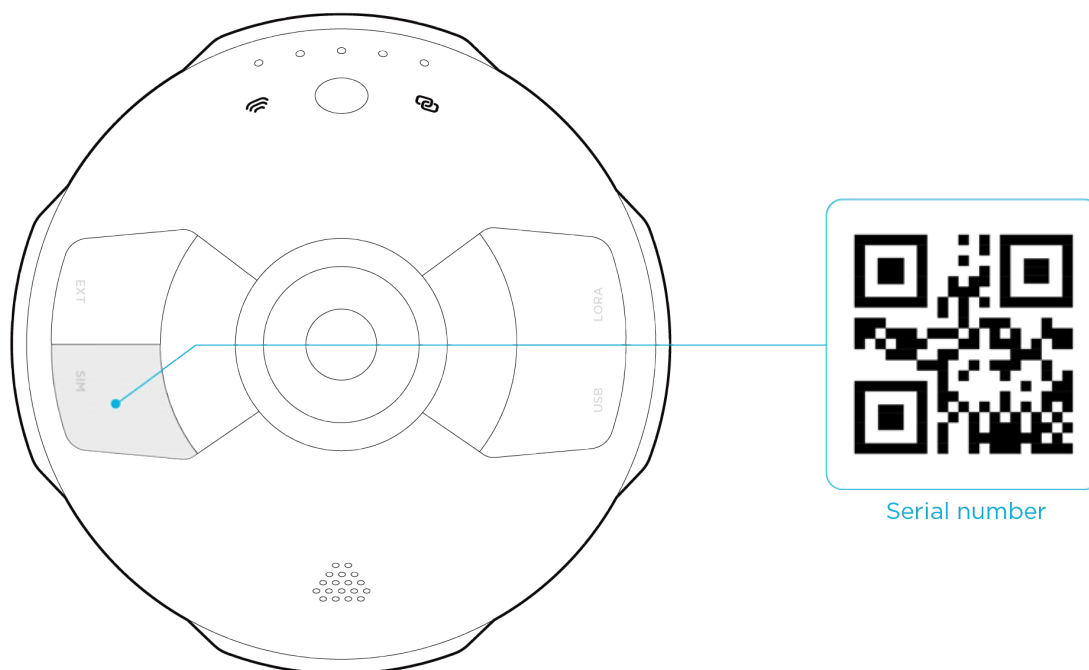
[Reach RS2/RS2+ extension connector pinout \[PDF, 836 KB\]](#)

7.1.5 Extension cables specs

Cable type	Download link
Without second connector 2m	without-connector [PDF, 135 KB]
DB9F 2m	DB9F [PDF, 139 KB]
DB9 2m	DB9F [PDF, 139 KB]

7.1.6 Serial Number

Scan the QR code under the SIM card slot cover to see serial number of your Reach RS2/RS2+.



8 Glossary

2D Grid distance

2D Grid distance between points A and B is the length of the straight line AB on a flat plane.

2D Ground distance

2D Ground distance between points A and B is the length of the shortest AB line on the surface of the ellipsoid.

2D perimeter

2D perimeter of an enclosed object is the sum of 2D distances of its sides without the height difference consideration.

Absolute positioning

Absolute positioning shows your actual global coordinates relative to the Earth's surface. Absolute positioning is a key to RTK surveys where you need absolute geographical accuracy (e.g, mapping, surveying the borders of the property, etc). In this case, your base absolute position is crucial for high accuracy results.

Accuracy

Accuracy is the closeness of the measurements to a specific value. In surveying, accuracy refers to whether the coordinates you collected are true relative to the global coordinates. Not to be confused with Precision.

Age of differential

Age of differential is the measure of how old are the corrections your receiver is getting. It is calculated by subtracting the time when the correction message has been generated from the current receiver time. The standard Age of Differential for RTK is normally 1-2 seconds.

Antenna Phase Center

Antenna Phase Center could be referred to as the antenna's source of radiation. All GNSS measurements referred to the phase center. The phase center does not correspond to the physical center of the antenna and its real position depends on the direction of the coming radio signal. In addition, every band has its own phase center respectively.

Antenna Reference Point

The antenna reference point is the center point on the bottom of the receiver. It is used for calculation of the antenna height.

Area

Area of an object is the total amount of space enclosed by its shape on flat surface.

AR ratio

This is a result of the ratio test performed on the potential "Fix" solution, it shows how many times is the best solution better than the next one. If this number is more than 3, Reach will consider RTK solution Fixed.

This parameter corresponds to single-band Reach devices only (Reach RS/RS+, Reach Module/M+).

Base

Base is one of the receivers that act as a reference station in RTK or PPK scenarios. It is a static unit with the determined coordinates that sends corrections to the moving unit or rover. If the base is set over the known point, it provides absolute accuracy.

Base Correction log

This log contains the corrections from the base station in RTCM3 format.

Baseline

Baseline is the distance between a rover and a base. If the baseline is bigger than recommended, the solution will be less accurate, the fix time will be longer or it won't be calculated at all.

BeiDou

BeiDou is a Chinese navigation system. Back in 2000, BeiDou-1 was only covering China. Then, in 2012, BeiDou-2 began covering the Asia-Pacific region. Since 2015, BeiDou offers global coverage. We recommend using this system if you are located in the Asia-Pacific region.

Client mode

The client mode means that Reach is connected to an external Wi-Fi network.

Continuous

Continuous is a strategy for solving the ambiguities in RTK and PPK. In this case, ambiguities are resolved epoch by epoch. Less stable than Fix-and-Hold, but no risk of holding a false fix.

Coordinate system

Coordinate system is a coordinate-based local, regional or global system used to locate geographical entities. A spatial reference system defines a specific map projection, as well as transformations between different spatial reference systems.

Correction input

This is the part of the rover's settings that is responsible for configuring the acceptance of the corrections. Using the correction input configuration in the Emlid Flow app, you can choose the way your rover receives the corrections: via Serial, TCP, NTRIP, Bluetooth, or LoRa. Reach receivers support the correction input in RTCM3 format.

Corrections

The corrections are the data that is used to eliminate ionospheric and tropospheric delays, and satellite clock errors. The static base transmits corrections to the moving rover in the RTK scenario.

CORS

Continuously Operating Reference Stations or CORS network is the network of the static stations that provide exact GNSS data (carrier phase, code range, etc) and corrections as well. Surveyors can access this information to increase the accuracy of their post-processed survey data or to work in RTK on site.

Delta E/N

Delta E/N between points A and B is the difference in their coordinates along the corresponding Easting and Northing axes.

Dilution of Precision or DOP

Dilution of Precision or DOP is the term used to evaluate the geometrical position of the satellites relative to the receiver. When the satellites are too close to each other in the field of view, it means the satellite geometry is weak (a high DOP value). If the distance between the satellites is sufficient and they are allocated evenly and cover more space, the geometry is considered strong, therefore, the DOP value is low. The lower the DOP, the more accurate your data is. A good DOP value is considered to be below 2.

Direction (azimuth)

Direction (azimuth) of a line AB, or from point A to B, is a horizontal angle in degrees, measured at point A clockwise between the direction to the north and the direction to point B.

Dynamic IP address

A dynamic IP address is an Internet Protocol (IP) address that is automatically assigned to your Reach device by a DHCP (Dynamic Host Configuration Protocol) server each time your Reach device connects to the network or reboots. These addresses are temporary and can change over time, which is in contrast to static IP addresses, which remain the same.

Elevation mask

Elevation mask can be configured in RTK settings in the Emlid Flow app. Satellites lower than set elevation will be excluded from the computation. The default setting is 15 degrees. Usually, satellites with a lower elevation provide too noisy measurements as the signal passes through the most atmosphere.

Emlid Flow

Emlid Flow is the mobile app created by Emlid. It is used to control and configure the Reach receivers, create projects, collect points, etc.

ENU

One of the formats for Position Streaming available for Reach devices. Simple text protocol for East, North and UP components of the baseline as well as solution status.

ERB

One of the formats for Position Streaming available for Reach devices. Used for communication to ArduPilot. ERB stands for Emlid Reach Binary protocol.

External bottom connector

External bottom connector is a 9-pin connector located at the bottom of Reach RS/RS+, RS2/RS2+, and RS3. It is used to supply constant power from an external battery, to establish RTK communication with third-party devices, and to stream Reach's position to other devices or third-party apps. It uses RS-232 serial communication protocol.

Fix-and-Hold

Fix-and-Hold is a strategy for solving the ambiguities in RTK and PPK. After the first ambiguity fix holds them constrained. Fix is more stable but in case first initialization was not correct it will take longer to recover and initialize correctly. You can think of it as if Fix had inertia.

Full System report

A full system report is a tool used to facilitate issues reports. It comes in ZIP archive, and contains system logs and technical details of your device as well as some sensitive information like your NTRIP credentials or network passwords. That is why we do not recommend sharing the report publicly. These are used to debug complicated cases in support.

Galileo

Galileo is a European satellite navigation system. It first started operating in 2011 and now has global coverage.

Global datum

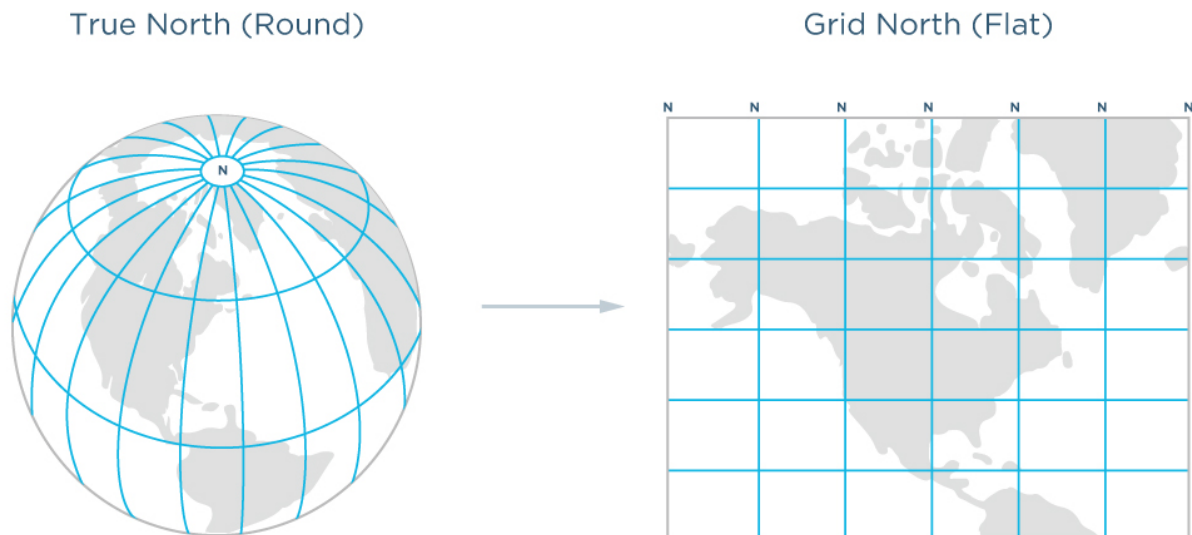
Global datum is an ellipsoidal coordinate reference system that is used by the receiver to measure coordinates before any transformations are applied.

Grade

Grade of a line is the measure of its steepness, with larger values standing for steeper slopes and 0 percent indicating a horizontal line.

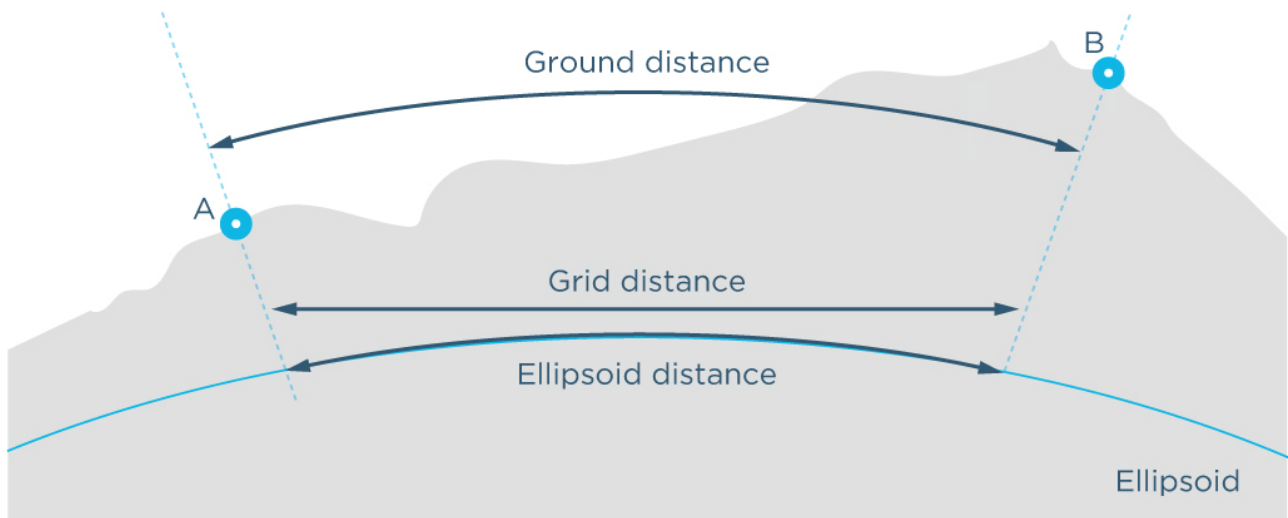
Grid North azimuth

Grid North azimuth is the angle measured clockwise between a line parallel to the central meridian, and the direction to a point of interest (a straight line between two points on the projection flat plane).



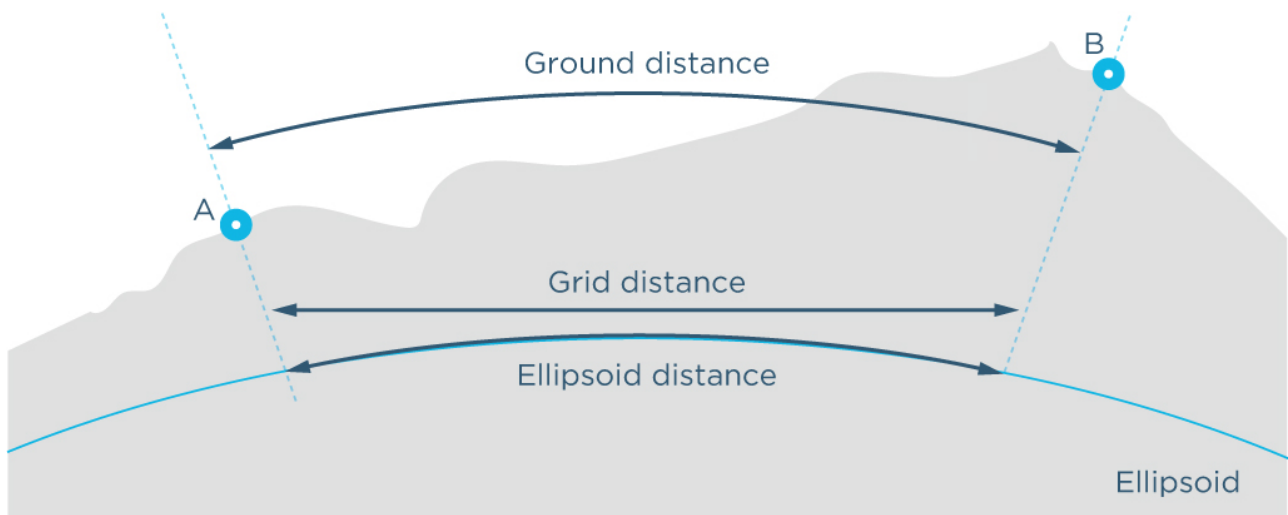
Grid distance

Grid distance is the distance measured on the projection flat plane.



Ground distance

Ground distance is the distance measured on the actual surface of the Earth, taking the mean elevation of the measured points into account.



Ground Control Point or GCP

Ground Control Point is a point on a surface with known coordinates. The GCPs are actively used in aerial mapping and photogrammetry. The surveyors set GCPs over the area, mark them so they can be visible from the drone. The GCPs are then surveyed to find their exact coordinates and used as reference points for future data processing.

GIS

Geographic Information System or GIS is a system for collecting, storing, analyzing, and graphically visualizing spatial data and related information about required objects.

GLONASS

GLONASS is a global satellite navigation system. It was created as an alternative to GPS in Soviet Union and first launched in 1982.

GLONASS AR mode

A processing parameter enabling to turn on and off the ambiguity resolution for the GLONASS signal separately. Contrary to GPS, all GLONASS satellites transmit on different frequencies, which results in Inter Channel Biases (ICB) that are unique for each receiver model.

Reach devices can correct GLONASS ICBs, allowing for GLONASS AR with non-Reach bases such as NTRIP casters. The general recommendation is to always have GLONASS AR set to on.

This parameter corresponds to single-band Reach devices only (Reach RS/RS+, Reach Module/M+).

GNSS

Global Navigation Satellite System or GNSS is a system designed to determine the location (geographical coordinates) of land, water, and air objects. Such systems consist of space equipment, a ground segment called control systems, and individual receivers. The operation of GNSS is based on measuring the distance from the antenna on the object (receiver) to satellites whose position is known with great accuracy.

GPS

Global Positioning System or GPS is a global satellite navigation system that measures distance, time, and location in the WGS 84 world coordinate system. The system was developed in 1978, and is operated by the United States.

Ground plane

A ground plane is a conductive plate providing insulation for the antenna. It may be a piece of metal, a roof of a car, a metal roof of a building, and etc. It is recommended to use at least a 70x70 mm ground plane.

Hot shoe adapter Hot shoe is a point on the top of a camera that is used to attach accessories or other equipment to the camera. Using hot shoe adapter, you can connect your camera to Reach M2/M+ for UAV mapping.

Hotspot mode

The hotspot mode means that the Reach is broadcasting its own Wi-Fi network.

Kinematic Positioning

Kinematic positioning is one of two positioning modes. It implies that the rover is moving during the positioning process.

LLH One of the formats for Position Streaming available for Reach devices. Simple text protocol for Latitude, Longitude, and Height as well as solution status.

Localization

Localization in GNSS surveying is a feature for calculating local coordinate system parameters or adjusting the existing one to fit control points in the survey area.

LoRa radio

Long Range or LoRa radio is used for Reach receivers to send or receive corrections without an internet connection. Reach RS3/RS2/RS2+/RS+ is equipped with internal Lora radio. Reach M2/M+ has external LoRa radio available: you can connect it via S2 port. The radio works only one way: it either sends correction or receives them. Using LoRa modulation it is possible to hit up to 19 km (11.8 mi) in line of sight.

Mock location

Mock location feature of Android devices enables you to manually change the location of your device to any other place. In the case of Reach devices, it enables the GPS collector apps to get the GPS observations directly from the receiver instead of the internal GPS of the unit.

Mount Point

Mount point is a correction data source related to the specific physical or virtual reference station chosen or created based on your location respectively. When you get corrections from a VRS, you need to enable sending your receiver's position in the NMEA format.

Multi-band receiver

A multi-band receiver is a receiver that can accept signals from the satellite on more than one frequency band. It means the receiver takes less time to establish the first fix solution, has a longer baseline, and has more chances to maintain fix solution in the blocked sky view conditions.

Multipath

Multipath is an effect occurring when the GPS signal is deflected from the obstacles, so the GNSS receiver detects signals not only directly from the satellites but also from the local objects. Multipath effect results in an error in pseudo-range measurements and thus affects the positional accuracy.

Night mode

Night mode allows you to turn off the LEDs until the next reboot of the Reach device.

NMEA 0183

One of the formats for Position Streaming available for Reach devices. The most popular standard in the industry. Supported messages: GNRMC, GNGGA, GPGSA, GLGSA, GAGSA, GPGSV, GLGSV, GAGSV, GNGST, GNVTG, GNZDA.

NTRIP

The Networked Transport of RTCM via internet Protocol or NTRIP network is an alternative source of corrections. NTRIP allows your rover to accept corrections over the internet with no need for the second local receiver acting as a base. A reference station collects data, then sends it to NTRIP caster, where it is retransmitted through the internet port to the client rover connected via a particular port and authorized.

Point cloud

Point cloud is a set of vertexes in a three-dimensional coordinate system. Point clouds are created with 3D scanners and are used in photogrammetry and 3D-modeling.

Point Collection

Point collection is a feature in the Emlid Flow app that allows you to find the exact coordinates of the point. The receiver determines the coordinates (x, y, z) of a ground point and records it to your project for further processing .

Point Stakeout

Point stakeout is a feature in the Emlid Flow app that allows finding points with known coordinates on the site.

Pole Height

When preparing for point collection, configure the height of your survey pole in Emlid Flow. It will help the app to automatically calculate the antenna height.

Position log

This log contains positional information. Reach devices can log their position in LLH, XYZ, ENU, NMEA, and ERB formats.

Position Streaming

Reach devices can send the position data to third-party GIS apps and external devices including tractors, drones, robots, and more. The position could be out shared via Serial, TCP, and Bluetooth. Various applications require different formats of the positional data, that is why Reach outputs its position in LLH, XYZ, ENU, NMEA, and ERB.

PPK

Post-Processed Kinematic is one of the techniques used for highly accurate surveys. Same as in RTK, one needs two units: a base and a rover. The core difference is that in PPK scenario there is no need for a real-time connection between two units. Base and rover record logs separately, and these logs are processed together later using specific post-processing software, for example, RTKLib.

PPP

Precise Point Positioning or PPP is a technique used for determining the centimeter-level accurate coordinates of the point. The receiver put over a point is recording data for a certain period. Then this data is sent to the PPP services.

Precision

Precision is the closeness of two or more measurements to each other. Precision means that the coordinates you collected are true relatively to another object. In this case, you do not need exact georeferencing coordinates of the points, you only need to know that the collected points are, say, situated on the same distance from each other. Not to be confused with Accuracy.

QZSS

QZSS stands for Quasi-Zenith Satellite System—the Japanese satellite system. It primarily serves the Asia-Pacific region, with a particular focus on Japan's needs for precise and reliable positioning information. The first satellite was launched on September 11, 2010, and became operational in 2018.

Raw data log

A raw data log contains GNSS observations from the receiver without the calculation of accurate coordinates. It can be recorded in UBX or directly in industry-standard RINEX format.

Reach Panel

Reach Panel is a tool that allows you to access your Reach in a browser, monitor its status and get additional options such as downloading a large number of logs and configuring NMEA messages output on your Reach to integrate it with old agricultural machinery.

Relative positioning

Relative positioning shows your coordinates relatively to another reference object. The base sends information about its absolute position to the rover. Using this information, the rover determines its position relative to the base with centimeter accuracy.

RINEX

RINEX is a standard raw-data format that allows storing satellite observations and navigational data measurements made by the receiver. It also allows the post-processing of the received data by various applications from different manufacturers of receivers and programs.

RMS

The square root of the average of the squared error. The RMS calculations are used to evaluate the accuracy of the position measurement. A horizontal or vertical dilution of precision multiplied by three RMS could give the horizontal or vertical precision value respectively.

Rover

Rover is one of the two GNSS receivers that is used for collecting data in RTK or PPK scenarios. Rover is a moving unit: the surveyor uses rover to record the points, while rover receives the corrections from the static base.

RTCM3

RTCM3 is an industry standard format for correction output.

RTK

Real-Time Kinematic or RTK is one of the techniques used to improve the accuracy of the data collected from the satellites by the receiver. For RTK one needs two receivers: a base and a rover. The base sends corrections to the moving rover during data collection.

RTKCONV

RTKCONV is a tool in RTKLIB that converts UBX raw data or RTCM3 base correction data from a receiver to RINEX format.

RTKLIB

RTKLIB is an open-source program package for standard and precise positioning with GNSS. It is used for PPK data processing. Works with signals from GPS, GLONASS, Galileo, QZSS, BeiDou, and SBAS. Emlid produces the version of RTKLib tailored for Reach products.

RTKPLOT

RTKPLOT is a tool in RTKLIB that allows viewing and plotting the position solutions from RTKPOST as well as observation data from RTKCONV.

RTKPOST

RTKPOST is a tool for post-processing raw logs in RTKLIB. The result is stored in the position solution file in LLH WGS 84 – POS file. In this file, we will get centimeter-accurate track of the receiver.

Serial Port (UART, USB, RS-232)

A serial communication interface in which the information transfers in or out sequentially one bit at a time. That kind of communication could be realized via various devices like UART, USB, or RS-232. Reach receivers can use a serial port to exchange the position and correction data with 3rd party devices.

Signal-to-noise ratio

Signal-to-Noise Ratio or SNR is the primary indicator of how good the reception is. The value is equal to the ratio of the power of the useful signal to the noise power. You can find the SNR indicator on the main screen of the Emlid Flow app. When the SNR of a satellite is over 45, it will be marked green. Grey bars indicate SNR of the base station. The more satellites are in a green zone, the more precise your measurements are and the faster your ambiguity resolution is.

Simple System report

A Simple System report is a tool used to facilitate issues reports. It provides information about the Emlid Flow version, configurations, and network in a plain text format.

Single-band receiver

A Single-band receiver is a device that accepts signals from the satellite on one frequency band. It has the same level of accuracy as the multi-band one. Single-band receiver has shorter baseline in comparison to multi-band, and might not even find fix solution in blocked sky view conditions.

Slope distance

Slope distance from point A to point B is the length of the straight line AB, measured along the slope, taking the height difference between the points into account.

Slope perimeter

Slope perimeter of an enclosed object is the sum of slope distances of its sides with the height difference consideration.

SNR mask

Signal-to-Noise ratio mask or SNR mask is a tool that filters the satellites used for the fix solution. Satellites with low SNR will be excluded from the computation. The default setting in the Emlid Flow app is 35.

Solution status (FIX, FLOAT, SINGLE)

Solution status defines the precision that can be achieved at the moment. There are three solution statuses you can see when working with Reach devices.

SINGLE means that the rover has found a solution relying on its own receiver and base corrections are not applied. In this case, the receiver calculates its position with the precision of a few meters.

FLOAT means that the rover receives corrections from the base but cannot resolve all ambiguities and calculate its position with the centimeter accuracy.

FIX means that the rover using corrections from the base resolved the ambiguities in its positional calculation and achieved the solution with the centimeter-level precision.

Static Positioning

Static positioning is one of the positioning modes. It assumes that the Reach rover is static. Constraining the system helps to resolve ambiguities faster as well as produce measurements with higher precision.

TCP

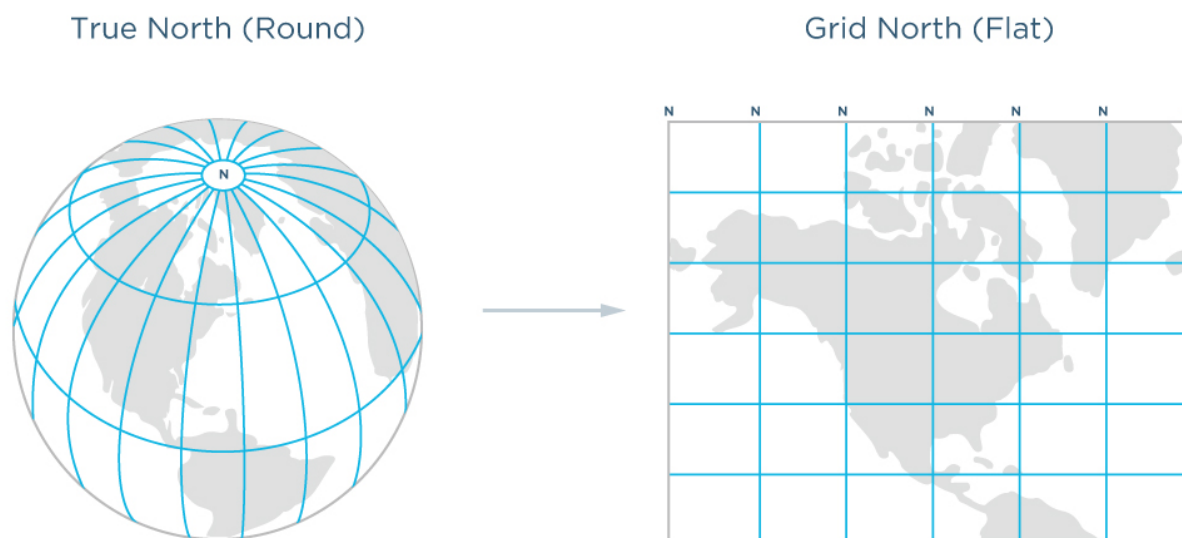
Transmission Control Protocol or TCP is one of the main internet data transfer protocols designed to control data transfer. Typical scenario for using TCP is sending correction data to an application on the same network or to a server with public IP.

Time mark

The time mark function verifies the exact moment when the camera takes a photo. After the flight, you can process the raw logs from the base and a rover to get an «*_events.pos» file. This file includes information about the time and coordinates of each photo. You can use geotagging software to write this information to the photos' EXIF data.

True North azimuth

True North azimuth is the angle ranging from 0 to 360 degrees measured clockwise between True North and the direction to a point of interest.



UBX

UBX is the GNSS raw data format. The UBX protocol is a u-blox proprietary binary protocol that outputs in hexadecimal format.

Update rate

The update rate is a value that shows how frequently the receiver calculates and reports its position. For Reach receivers, we recommend having 1 Hz update rate on the base and 5 Hz on the rover.

VRS

Virtual Reference Station or VRS is a useful tool for long baselines. It is an imaginary, unoccupied reference station generated nearby the RTK user. The rover sends data back to the NTRIP caster. NTRIP allows the uniting of the data from your rover and the data from dense NTRIP bases and models a virtual base next to you.

WGS 84

World Geodetic System 1984 or WGS 84 is the global system of geodetic parameters of the Earth, including the system of geocentric coordinates. It was accepted in 1984 and defines coordinates relative to the Earth's center of mass, with an error of less than 2 cm.

XYZ

One of the formats for Position Streaming available for Reach devices. Simple text protocol for X, Y, Z ECEF coordinates as well as solution status.