



REACH RS2/RS2+

USER DOCUMENTATION

Firmware version **30**

Emlid Flow app version **8.1** 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

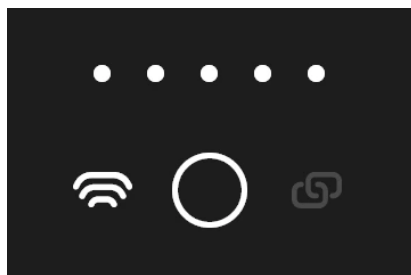
In this tutorial, we will walk you through the following steps:

- 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.

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**.

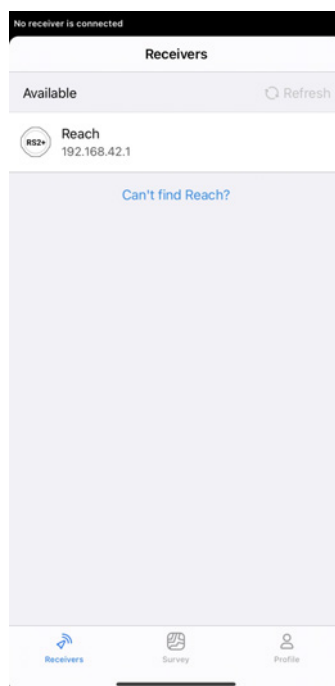
Once you successfully connected to Reach's hotspot, you can go to Emlid Flow and set up connection to your Wi-Fi network.

1.2.4 Set up Wi-Fi connection

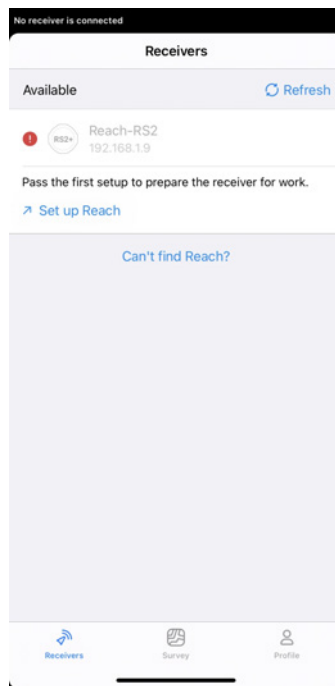
Note: *Make sure that your Wi-Fi network uses 2.4 GHz band.*

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

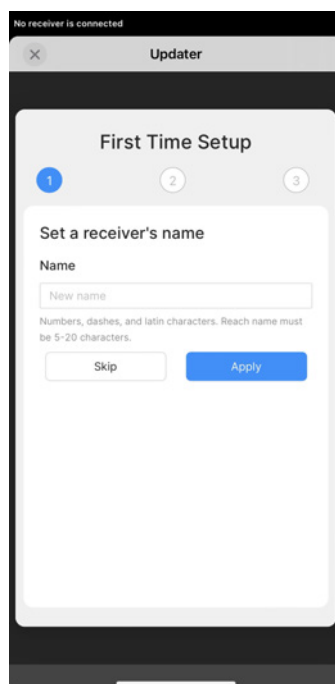
1. Open Emlid Flow and choose your Reach from the list.



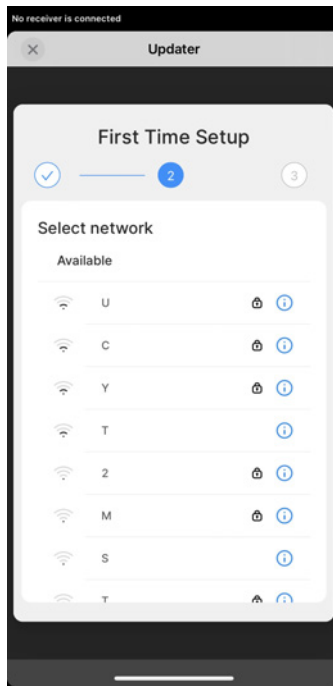
2. Tap the *Set up Reach* button to open Updater for further setup process.



3. Name your Reach and apply changes.



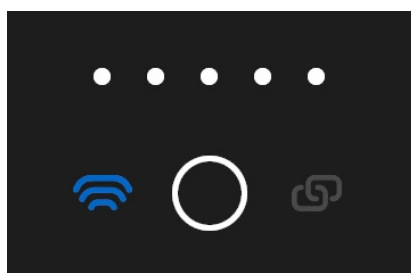
4. Select your Wi-Fi network from the list of available networks.



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.

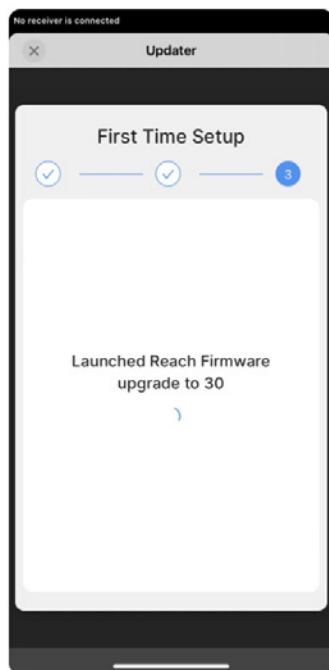
Note: *If there is only one receiver, the app will automatically try to connect to this Reach.*

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

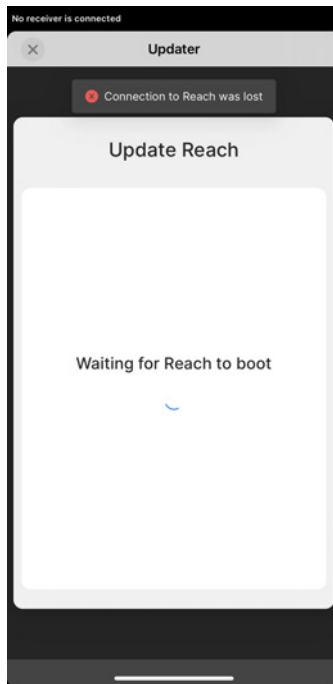
After connecting to Reach RS2/RS2+, the app will check available firmware updates. Follow the steps below to get the latest update:

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.

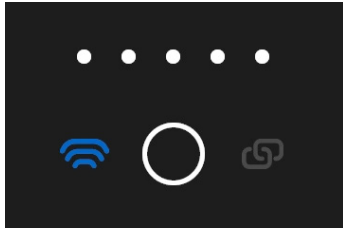
Note: *The connection process for both iOS and Android devices is similar.*

1.3.1 Setting up Wi-Fi connection

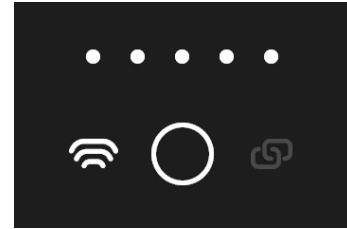
Establish Wi-Fi connection between your Reach and your device:

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.

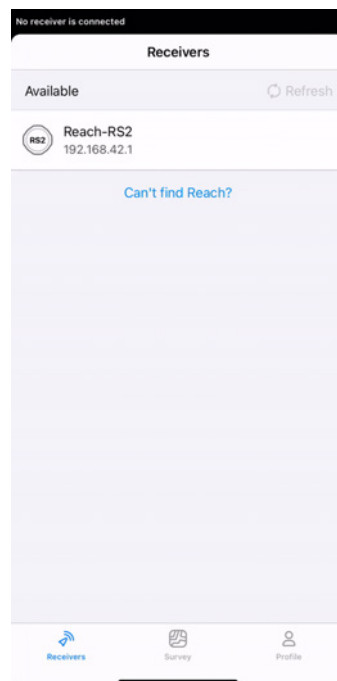
1.3.2 Connecting to Reach RS2/RS2+ using Emlid Flow

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

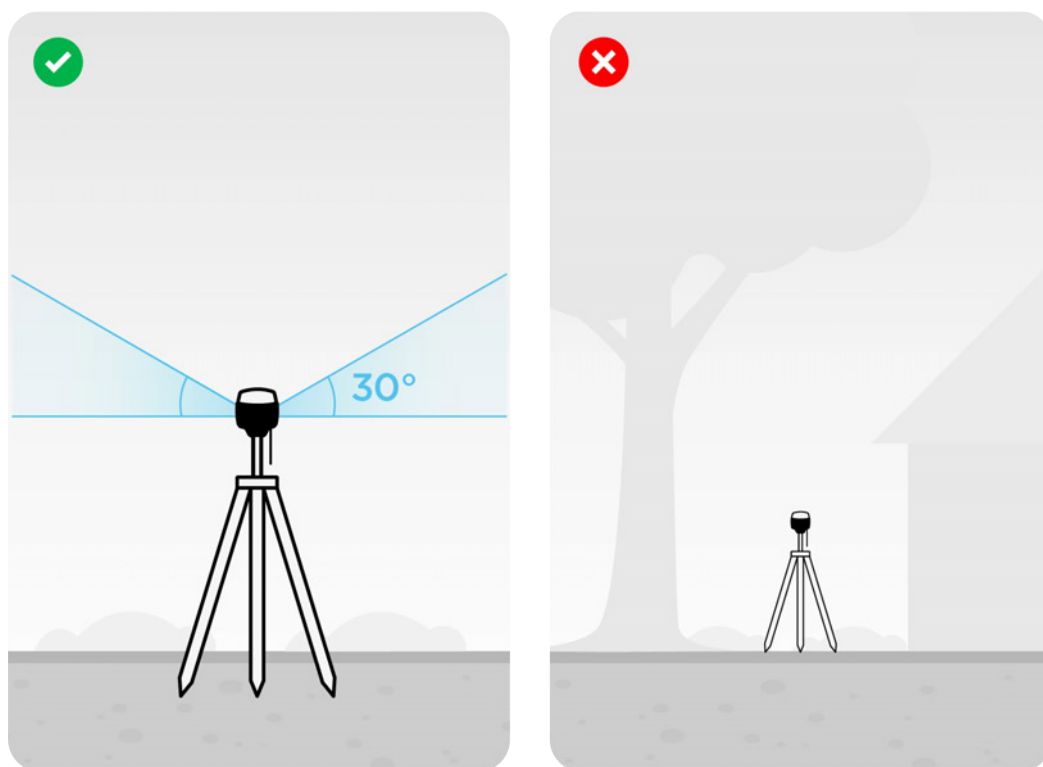
Tip: A well-placed Reach base is essential for achieving good RTK positioning results.

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.

1.4.1 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

1.4.2 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.

1.4.3 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

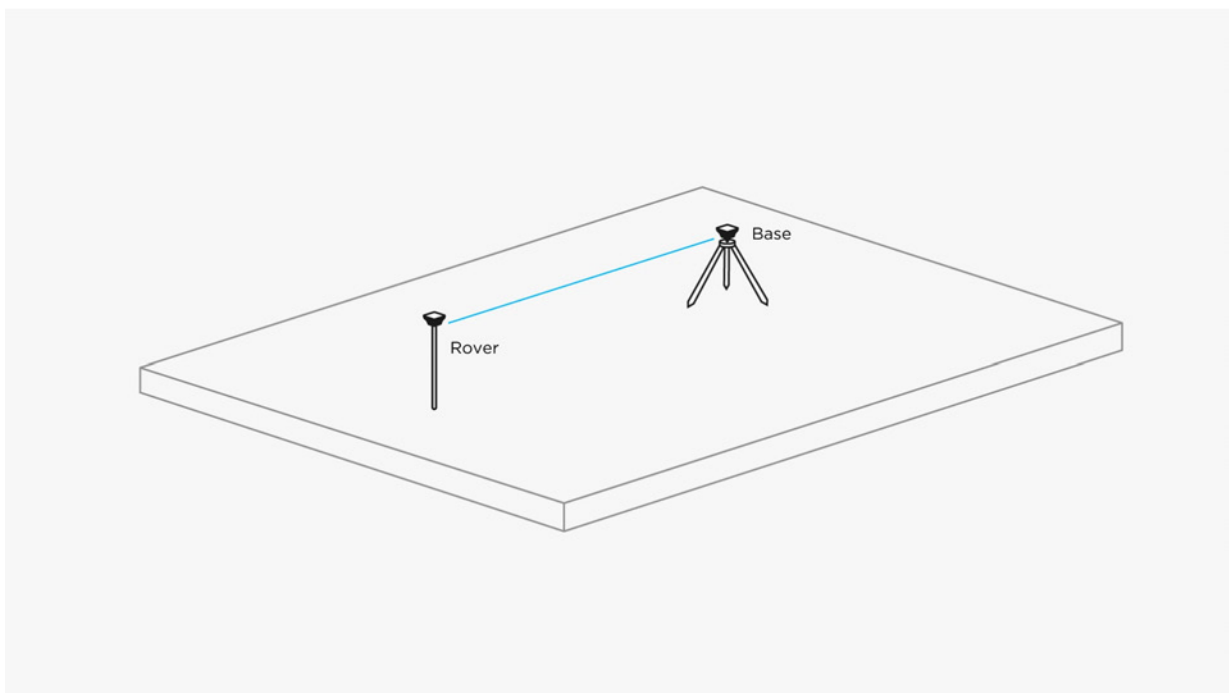
RTK is a technique used to improve the accuracy of a standalone GNSS receiver. Traditional GNSS receivers, like the one in a smartphone, could only determine the position with 2–4 meters (7–13 feet) accuracy. RTK can give you centimeter accuracy.

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**.



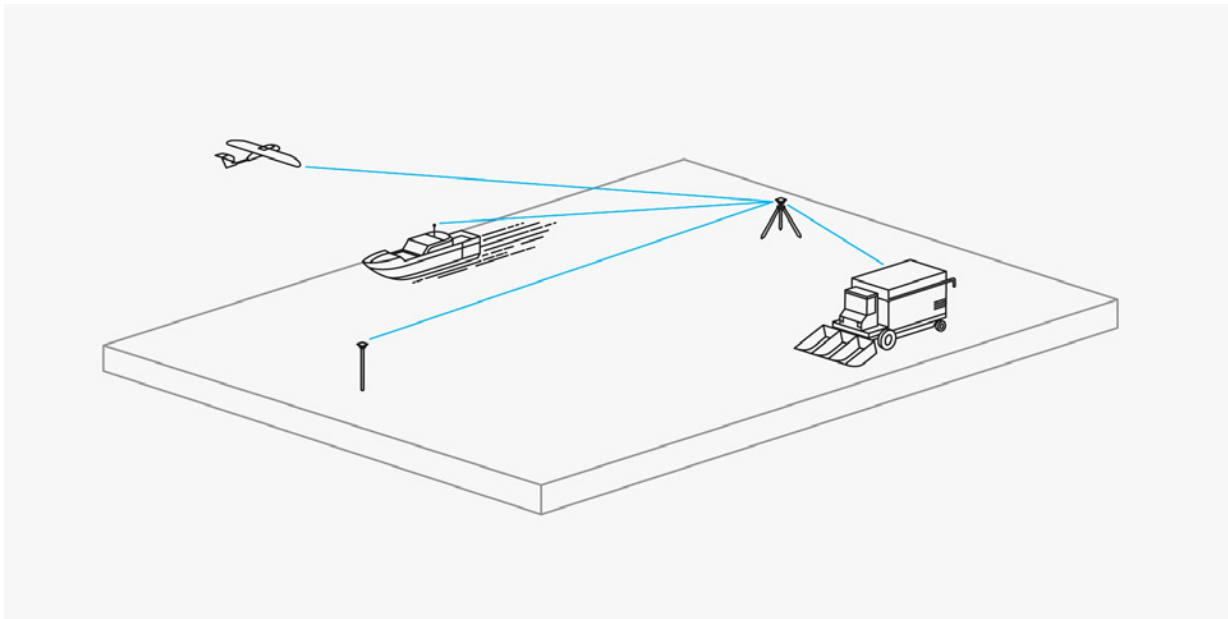
The base's mission is to stay in one place and send corrections to a moving receiver. Rover uses that data to achieve centimeter precise position. Any number of rovers can connect to one base if their input settings match the base's output.

2.1.2 Corrections over NTRIP

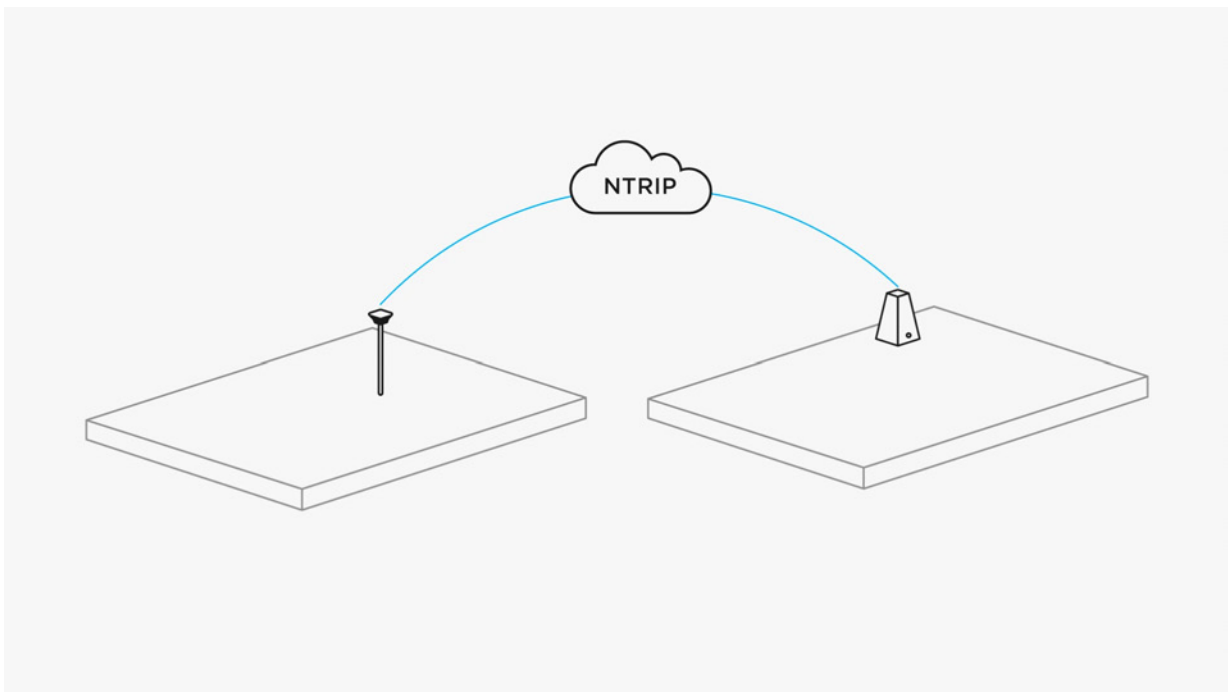
You do not necessarily need a second unit for RTK all the time. Usually, there are local services that share base corrections over the internet. This technology is called NTRIP.

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*.

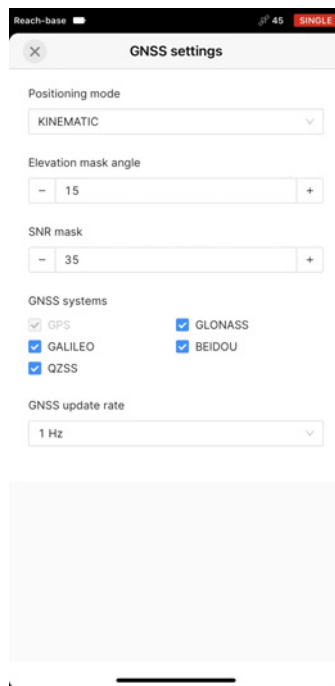
Tip: *Use a special sticker from the package to mark the unit.*

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:

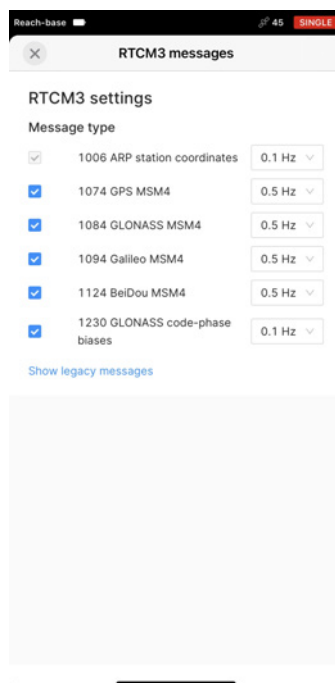
1. Connect to the base unit.
2. Go to *Settings* and tap *GNSS settings*. Pick each of the satellite systems.
3. Set the GNSS update rate at 1 Hz.



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.

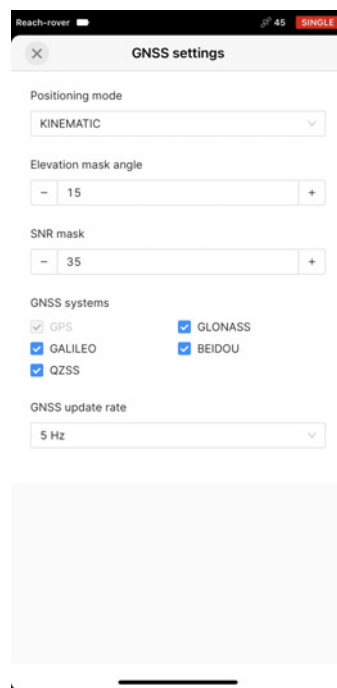
9. Set air data rate at 9.11 kb/s. Tap *Save*.

Now you can proceed to set up your rover unit.

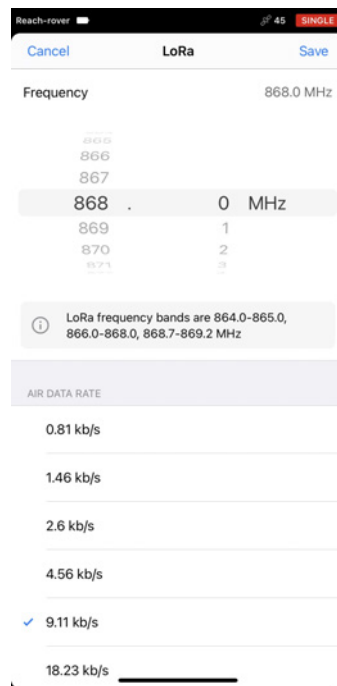
2.2.3 Set up your rover

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](#).

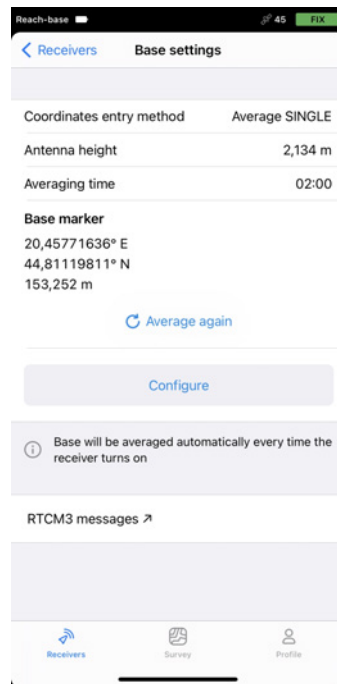
After placing the base on the tripod, you can complete its setup:

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.



Tip: To learn more about methods of placing the base, check the [Placing the base guide](#).

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: Turn off the mobile data before connecting to Reach's hotspot.

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

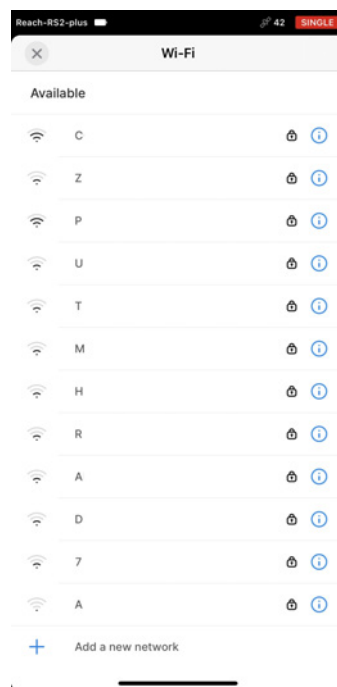
1. Download the app from Google Play or App Store.
2. Go to Wi-Fi settings on your device.
3. Connect to Reach hotspot. It appears as reach:XX:XX.
4. Enter password emlidreach.
5. Launch the Emlid Flow app.
6. Choose Reach from the list of available devices.

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.*

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: *Turn off the mobile data 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.

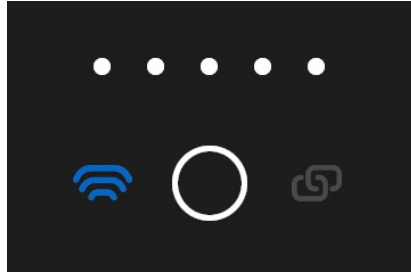
iOS device: *To ensure successful connection, pay attention to the following:*

- *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.*

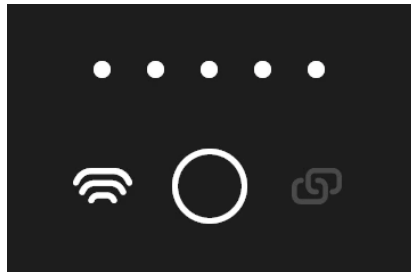
When Reach reboots, check the connection status:

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.*

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.

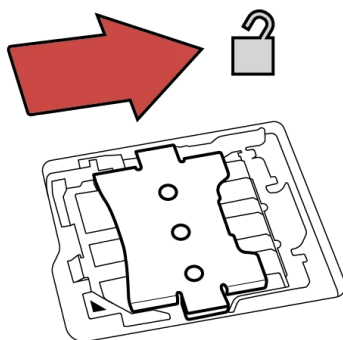
2.5.1 Insert a SIM card

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

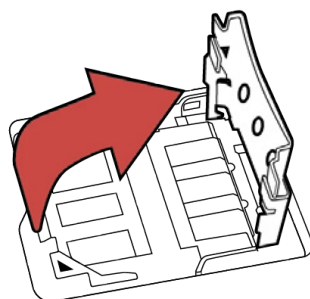
To insert the SIM card into your Reach, follow the steps below:

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

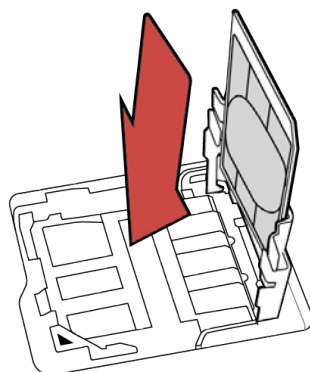
Caution: To prevent slot damage, please use it with care.



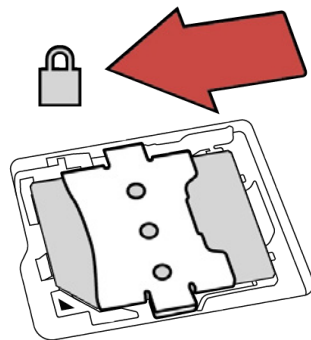
3. Pull up the cover to open the SIM card slot.



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

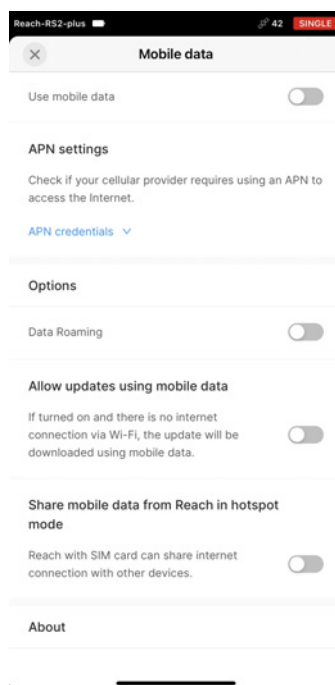
When the SIM card is inserted, connect your Reach to the internet as follows:

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.

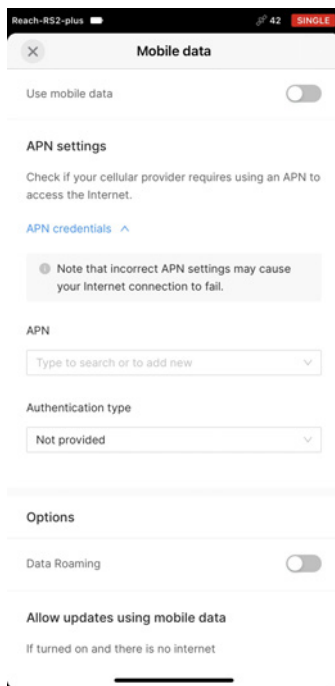
Note: If the SIM card requires a PIN code, type it into the pop-up field on the Mobile data screen.



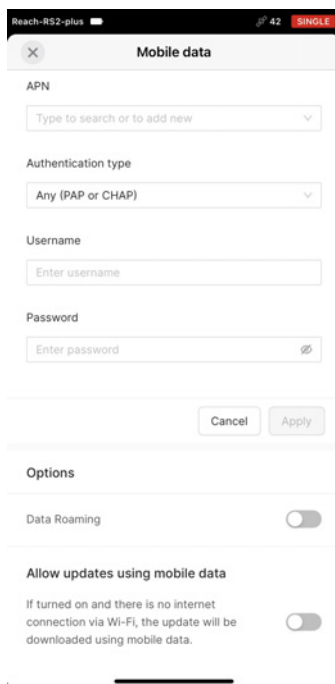
3. Configure APN settings.

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

4. Tap *APN settings* and enter your APN.



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



5. Tap *Apply*.

6. 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.

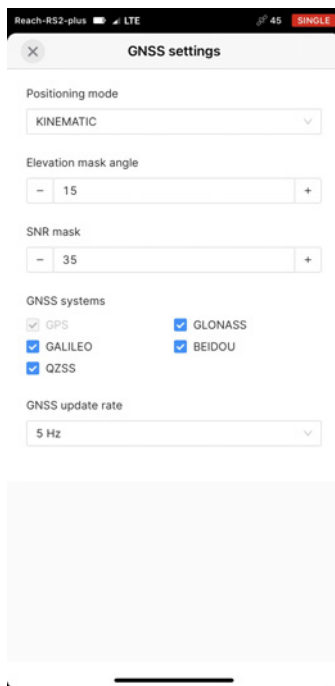
Tip: *To learn more about connecting your Reach RS2/RS2+ to the internet, check the following guides:*

- [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.



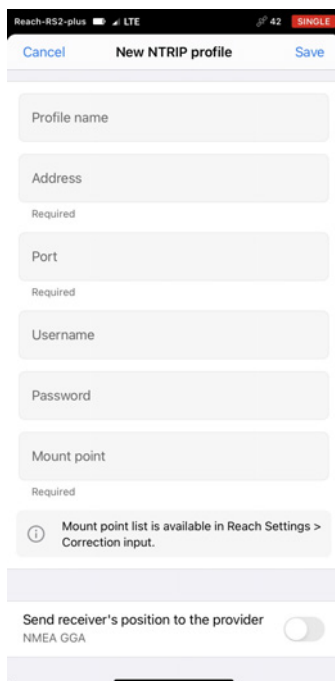
3. Tap *Apply*.

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.*

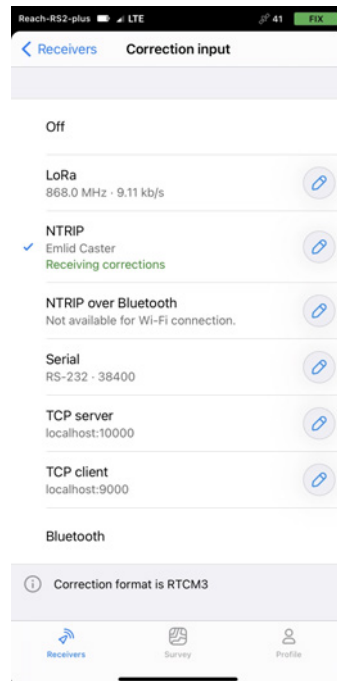
Android keyboard tech tip: *On some Android devices, default keyboards do not provide a minus sign. To get access to it, we recommend downloading Gboard, a virtual keyboard app, from the Google Play Store.*



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.

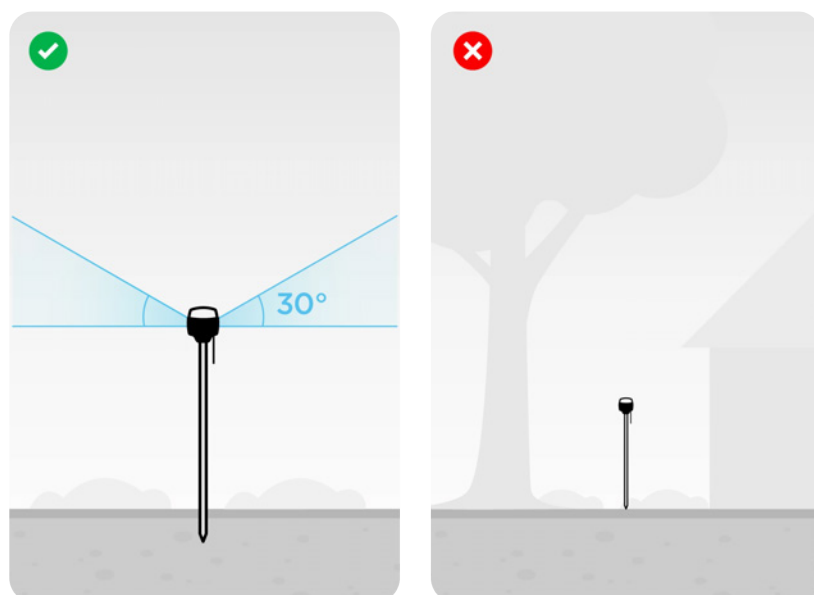
Note: To start receiving corrections, make sure that your receiver has satellite visibility.



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.

2.7 Placing the base

Real-Time Kinematic technique requires 2 receivers. One of them is stationary and is called “base station”, the other one is “rover”. The base station measures errors, and knowing that it is stationary transmits corrections to the rover. Sometimes CORS and NTRIP networks take the place of traditional base stations. They provide accurate absolute position and send corrections over the internet. Typically the distance between the reference station and the local rover shouldn't exceed 10-15 km due to the ionospheric effect. So if the reference station is located too far or simply is absent in the area you will need a local base station. Other advantages of your own base are independence from the internet connection and lack of NTRIP subscription fees.

If you are setting up your own base it is important to pay attention to this article. A good understanding of different ways to set up the base will help you to reach the desired accuracy for your application.

2.7.1 Absolute and relative position

Emlid Flow has several ways to determine or set the base station position providing various levels of accuracy. Let's take a look at the illustration below (figure 1). RTK algorithm precisely calculates the distance between the base and the rover. This distance is called the Baseline. The Rover position is precisely determined relative to the Base position. At the same time, the rover coordinates offset from the real location depends on the position accuracy of the base. If the position that has been set in the base station is different from the actual True position on earth, the offset equal to this difference will be in the rover position as well.

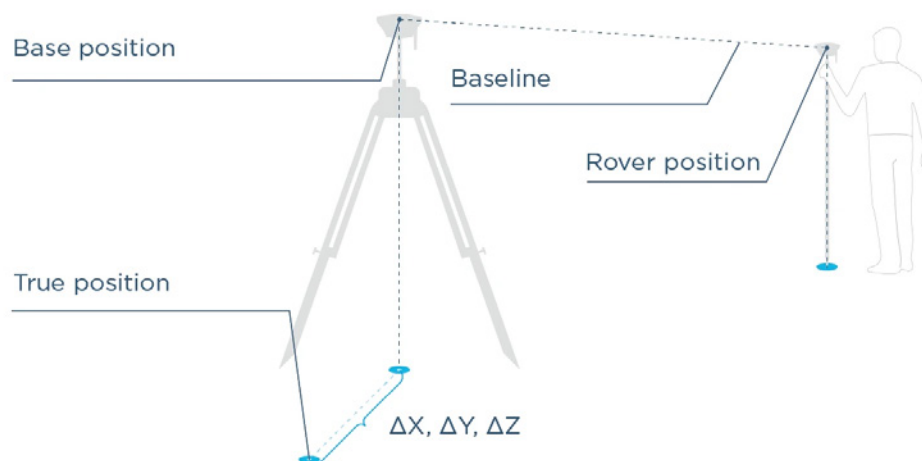


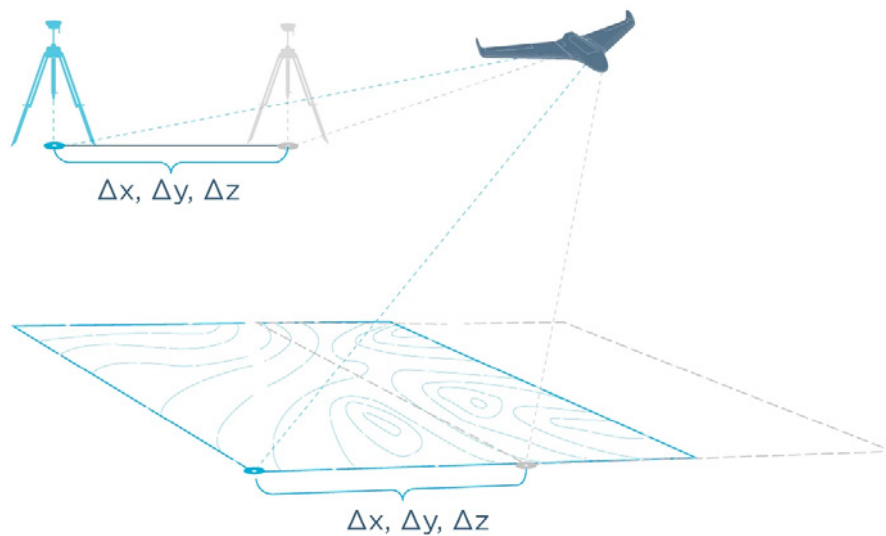
Figure 1

It is often enough to know the precise position of an object relative to the base station but for some applications like survey and mapping it is critical to get an accurate absolute

position. In this case, the offset ΔX , ΔY , ΔZ between actual True position and the Base station position should be avoided or reduced.

Caution: *The absolute position of the rover is accurate only to the same accuracy as the position of the base station.*

Proper positioning of the base station is a key to successful data collection. The shift of base coordinates will keep the collected data precise but will make it inaccurate (which is absolutely fine for volumetric measurements but unacceptable if you have to tie collected data to the global coordinates). For example, if you are processing the map using data collected by RTK-equipped drone using corrections from the shifted base your map will be later geo-referenced with the same offset (figure 2).



The same shift producing effect may be noticed if the base is placed inaccurately over a known point or just moved from its determined position without relevant amendments.

Note: *If the accurate absolute position of the base has been determined only after the job has been done, the offset of the map can be determined and corrected.*

2.7.2 Ways to set the base

As already mentioned Reach used as a base may be positioned using various ways. You can manually enter the base coordinates, use the averaging feature or use PPP and PPK techniques to determine the coordinates.

Base setup method	Accuracy	Requirement	Observation time	Processing time	Cost
Manual, on a known point	same as the point	Known point	0 min	Immediate, no processing required	Free
Average single position	~2.5 m	-	<5 min	Immediate, processing on Reach	Free
RTK FIX position	H:7mm+1ppm V:14mm+1ppm	NTRIP stream from base <10km for RS/RS+ <60km for RS2/RS2+	<5 min	Immediate, processing on Reach	Free/\$\$ depending on local provider
RTK Float position	1.0m	NTRIP stream from base <10km for RS/RS+ <60km for RS2/RS2+	<15 min	Immediate, processing on Reach	Free/\$\$ depending on local provider
Static processing	H:4mm+0.5ppm V:8mm+1ppm	RINEX logs from base <30km for RS/RS+ <100 km for RS2/RS2+	~1 h	15min on PC after log from reference station available, usually posted hourly	Free/\$\$ depending on local provider
Precise Point Positioning	~30cm for RS/RS+ ~1-2cm for RS2/RS2+	-	~4 h	In ~24h after submitting logs to NRCan online service	Free

Numbers in the table are approximate and only for reference purposes. Your experience may vary in different conditions, always follow appropriate survey practices!

No matter which method you use, the relative position of the rover will always be cm-precise, the actual accuracy will be set by the accuracy of the base position.

2.7.3 Manual

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.*

Manual input of the position is rather straightforward and is used when you have access to a known point. The most popular scenarios include finding a trig point or hiring a surveyor who will set the benchmark point. In this case, absolute accuracy depends on how accurately the point's coordinates were determined.



Triangulation station also known as trig point or trig beacon with Reach RS/RS+ on top (photo by Luke Wijnberg)

Pay attention and carefully place the base over a known point and measure the height of the antenna from the mark. It will help to avoid shifts from the absolute position and keep measurements accurate. Refer to Placing Reach RS2/RS2+ in the field for detailed instructions.

2.7.4 Average

Let's take a closer look at setting up the base using the position averaging with single, float and fix solutions. All these ways provide different levels of base coordinates accuracy and are suitable for different applications.

Averaged single

This approach is used when you don't require absolute accuracy. The averaging happens in stand-alone GPS mode without using any corrections and this provides you with a several meters absolute accuracy.

The left illustration below (see figure 3) shows the paths of the rover which passes the marked rectangular contour several times. This rover receives the corrections from the base configured using averaged single solution. While the position for each individual path lies within the receiver precision limits, the absolute position may differ by up to a few meters. We can see this if we repeat averaging of the static base station and build the path of rover immediately after each reaveraging. Take a look on the right of figure 3.

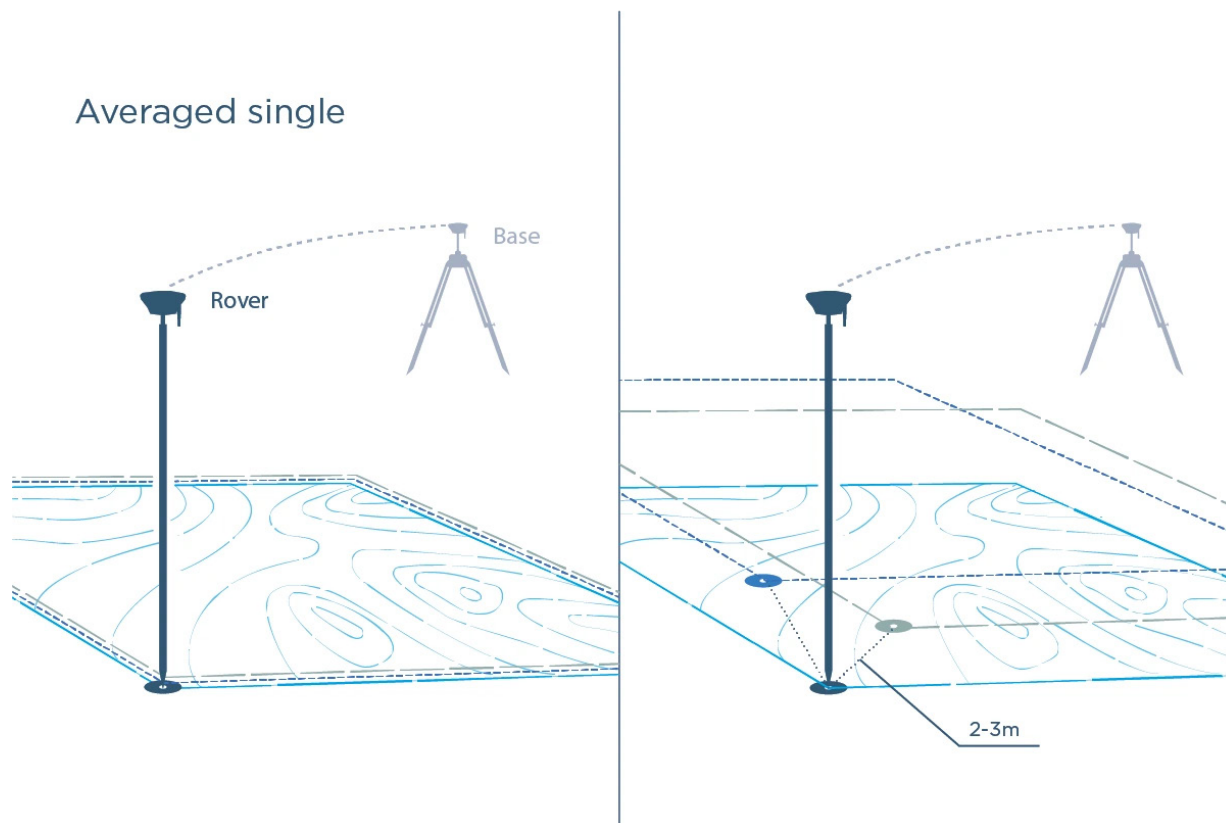


Figure 3

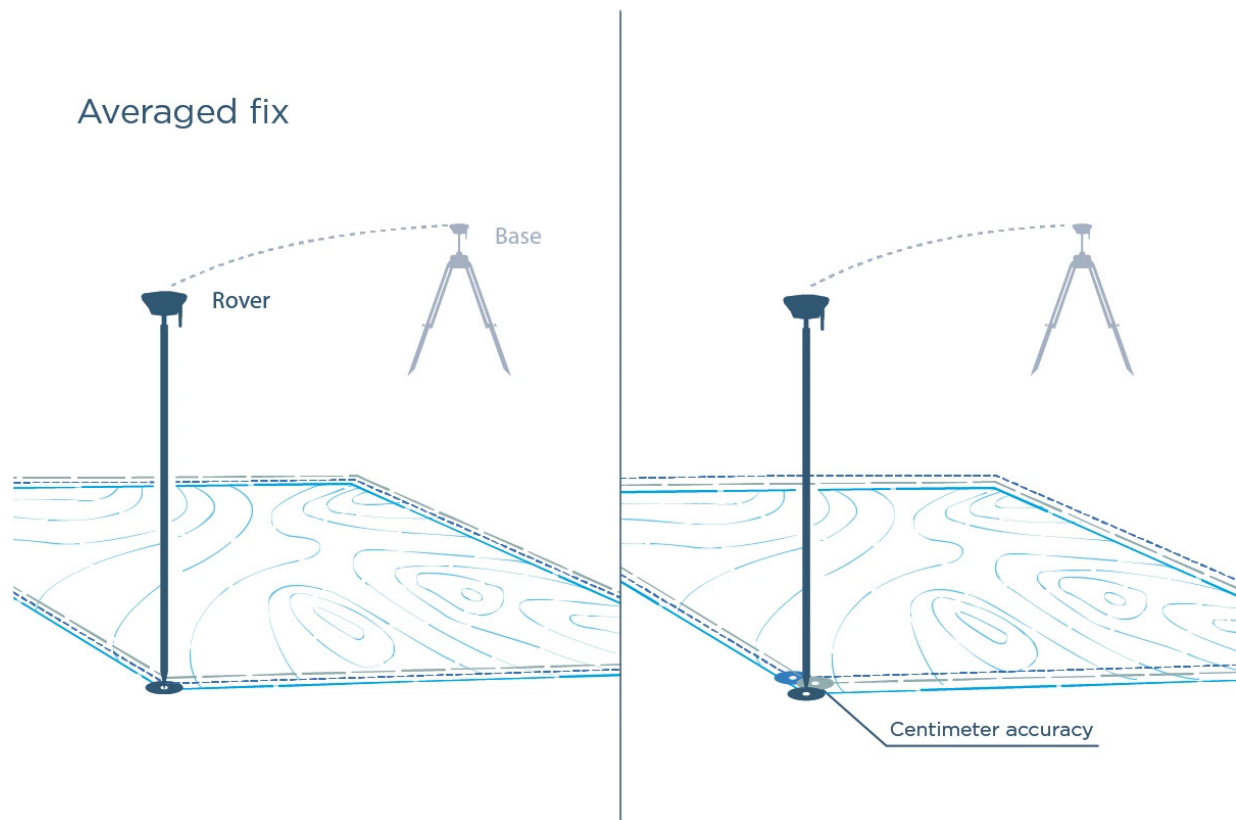
Perfect for repeatable precise relative positioning (GPS tractor guidance, autonomous flights and landing): *If you only need accurate relative positioning the easiest way is to average the position using single solution. Just physically mark the point on the ground and save coordinates to manual in ReachView. Day-to-day result would look almost identical to those obtained using NTRIP corrections.*

Averaged FLOAT and FIX

Averaging RTK FIX solution is much more accurate than SINGLE averaging and is made possible when the receiver used as the base is configured to obtain NTRIP corrections over the internet. This might be useful if the reference station is located far away. Reducing the baseline by installing the local base improves the positioning performance of rover.

On the left of the next illustration (see figure 4) the rover passes the marked rectangular contour several times. This rover receives the corrections from the base configured using averaged FIX position.

When the base is set up using averaged FIX solution, the coordinates are determined with centimeter accuracy (if obtaining survey-grade NTRIP corrections). In this case, the deviations of each path built immediately after reaveraging several times will be within a few centimeters. Take a look on the right of figure 4.



If the baseline is too long to obtain FIX, averaging float solution will still improve the position to 1m level.

Perfect for data collection and surveying, placing GCPs, and drone mapping: *The base position averaged using FIX solution provides several centimeters accuracy and works great when you need accurate absolute position!*

2.7.5 Post-Processed Kinematics

With Static processing, you may determine base coordinates without real-time corrections with centimeter accuracy. You will need RINEX logs from the reference station in the area of 100 km and the raw data log from the receiver.

General steps:

1. Enable logging of raw data and record log for about an hour.
2. Export log with the collected data from Emlid Flow to your PC.
3. Refer to the PPK in Static mode tutorial.
4. After you get the coordinates you may enter them manually in the Base coordinates section. **Comparing the position obtained using Static processing to the averaged position and applying corrections to the collected data is the way to compensate the shift shown in the example in Figure 2.**

2.7.6 Precise Point Positioning

With the Precise Point Positioning technique, you may accurately determine base coordinates anywhere in the world without real-time correction or base station nearby however it may take a considerable time to get coordinates.

General steps:

1. Enable logging of raw data and record log for a few hours.
2. Export log with the collected data from Emlid Flow to your mobile device or PC.
3. Upload the collected file to PPP service (for example, NRCan).

After you get the coordinates you may enter them manually in *Base coordinates* section.

2.7.7 Placing the base station in the field

Caution: *The mismeasured height of the antenna above the mark is probably the most pervasive and frequent blunder in GPS control surveying.*

2.7.8 Placing Reach RS2/RS2+

When placing your Reach RS2/RS2+ in the field, make sure your Reach device is placed precisely above the marked point on the tripod and leveled. If you are setting up base coordinates manually, you need to measure the antenna height offset. Follow the steps below:

1. Measure the distance between the mark and the bottom of your Reach (h on Figure 6).
2. Specify the measured distance in Emlid Flow. It will automatically calculate the antenna height.

Reach RS2/RS2+ antenna height: *For Reach RS2/RS2+, the antenna height is the distance between the mark and the bottom of the receiver (h on Figure 6) plus the receiver's height to the antenna reference point (ARP) which is equal to 134 mm and automatically added by Emlid Flow.*

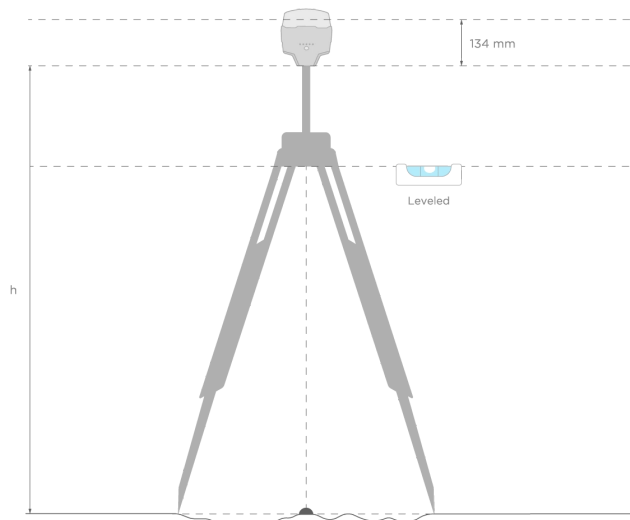


Figure 6

3 PPK quickstart

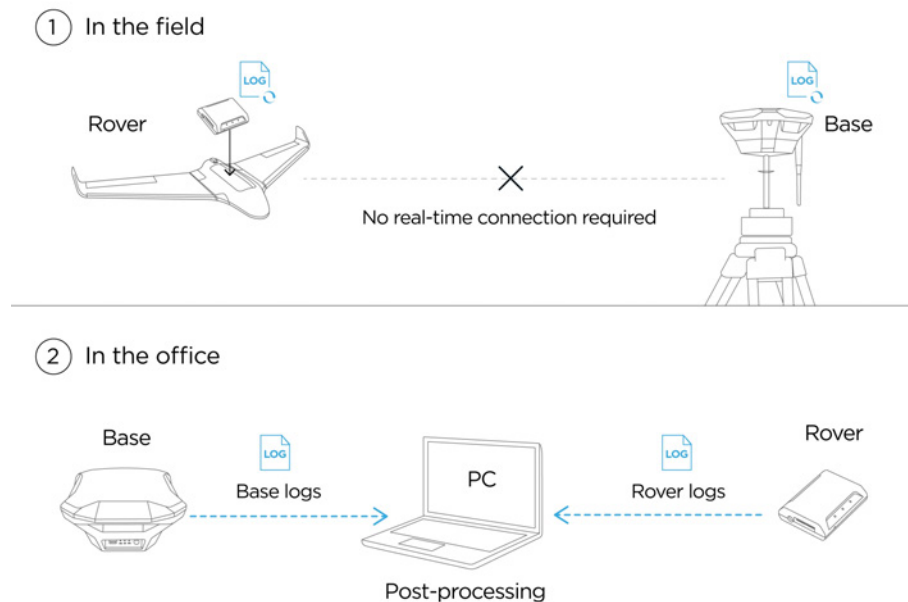
3.1 How PPK works

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.



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 How to Log Data for PPK

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

3.2.1 Overview

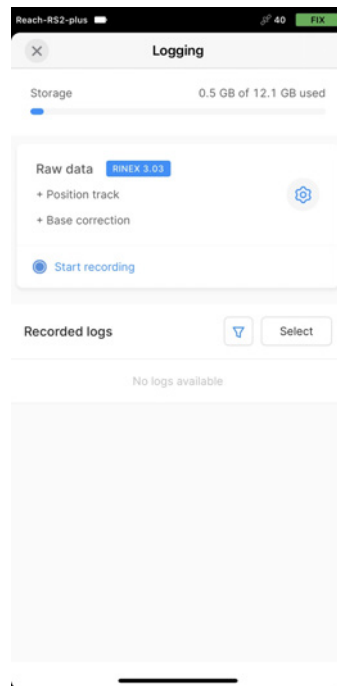
Post-Processed Kinematic or simply PPK is a technique that requires processing raw GNSS logs from both base and the rover to receive an accurate positioning track or separate points after the survey.

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

3.2.2 Recording RINEX logs on Reach

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

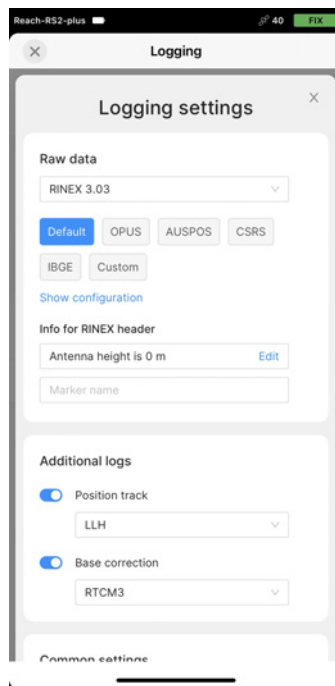
1. Open Emlid Flow and connect to your Reach.
2. On the *Receivers* screen, tap *Settings*.
3. Go to *GNSS settings* and set the update rate at 1 Hz for the base and at 5 Hz for the rover.
4. Go back to the *Receivers* screen and tap *Logging*.



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.

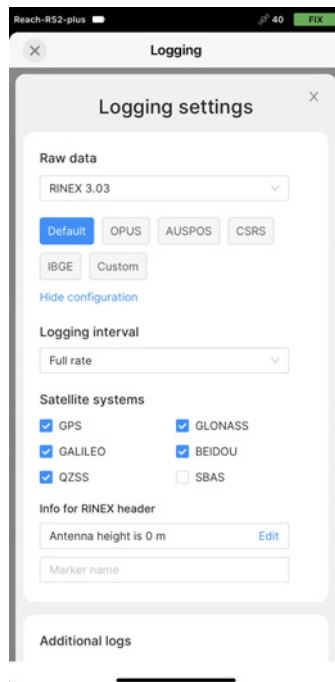
Tip: While recording in the RINEX format, you can log the UBX file as a backup. UBX file can be used to adjust RINEX file settings in the Converter tool in Emlid Studio. You can enable logging in the UBX format in the logging settings in Emlid Flow.



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*.

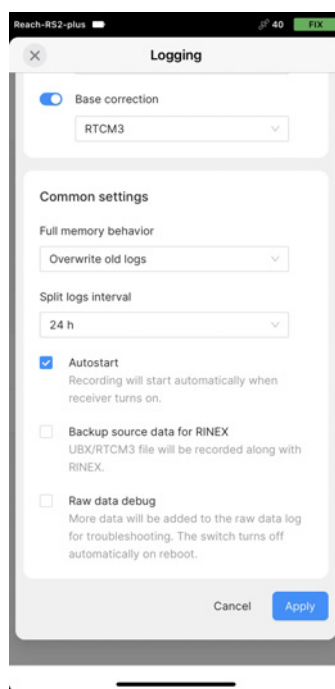


9. Tap *Show configuration* and enter the measured height to the bottom of the receiver in the corresponding field.

10. Leave the *Marker name* field empty.

11. Tap *Apply* and start.

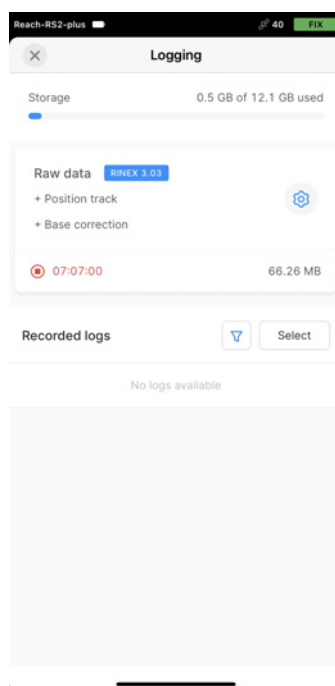
Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the Raw data settings screen.



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.

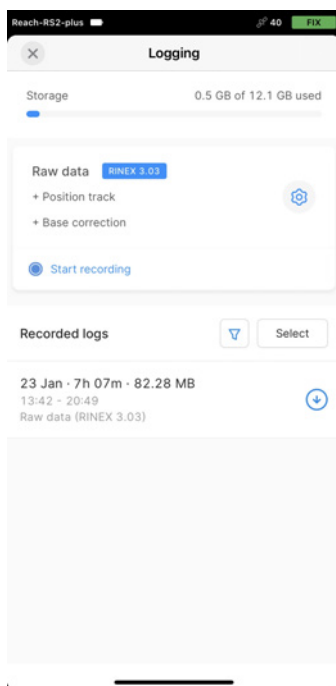


3.2.3 Download logs

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.

3.3 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.

3.3.1 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.

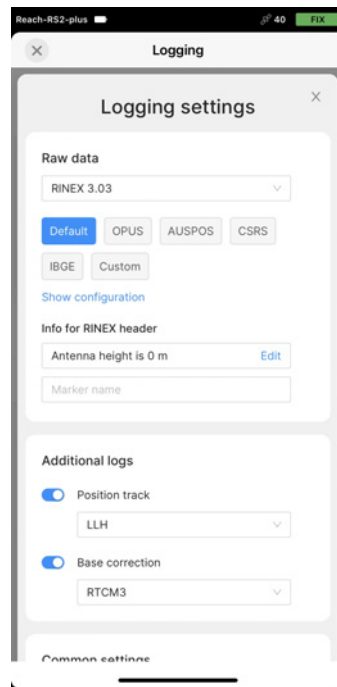
Tip: To learn more, check the [Stop & Go with Emlid Flow tutorial](#).

3.3.2 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*.



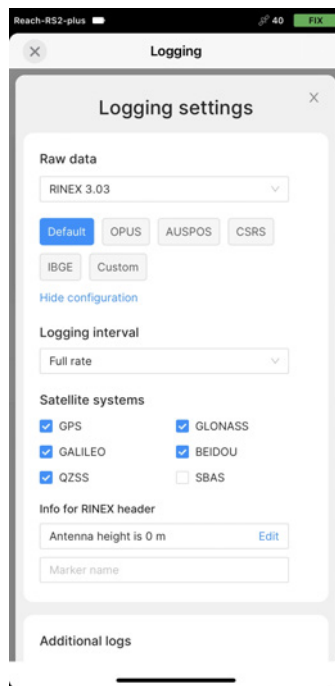
5. To configure logging, tap the *Settings* button.
6. Choose the required RINEX format in the *Raw data* section.

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.

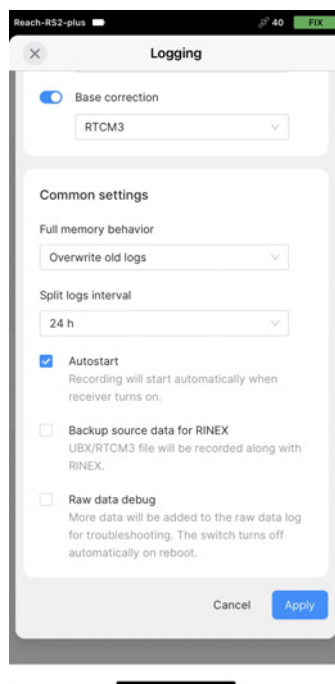
7. Tap *Show configuration* and select the required satellite systems.

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. 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.

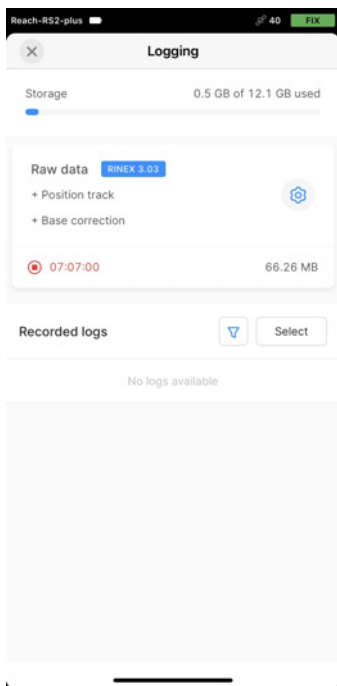
Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the *Raw data settings* screen.



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*.



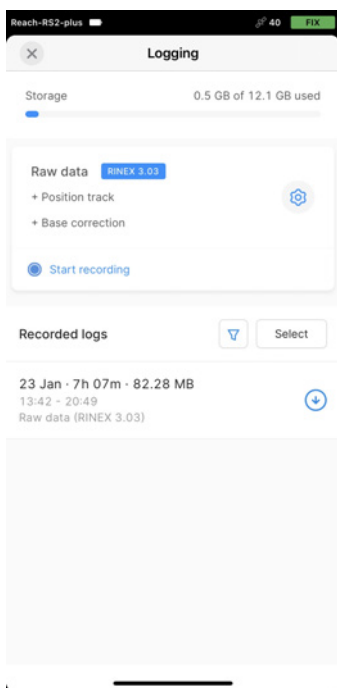
Caution: *Wait for data processing to finish.*

3.3.3 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.

3.4 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.

3.4.1 Overview

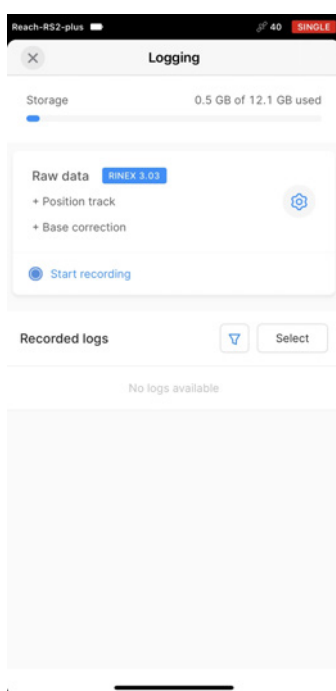
Precise Point Positioning is a technique that requires processing a raw data log from the standalone receiver for further removing or modeling GNSS system errors to provide a high level of position accuracy.

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

3.4.2 Recording RINEX logs on Reach

To record logs for PPP, perform the following steps:

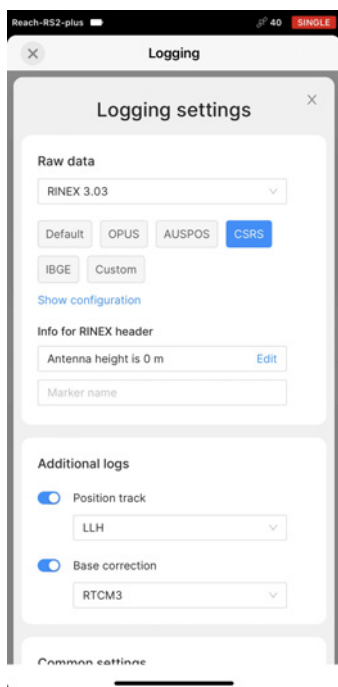
1. Open Emlid Flow and connect to your Reach.
2. Go to the *Logging* screen.



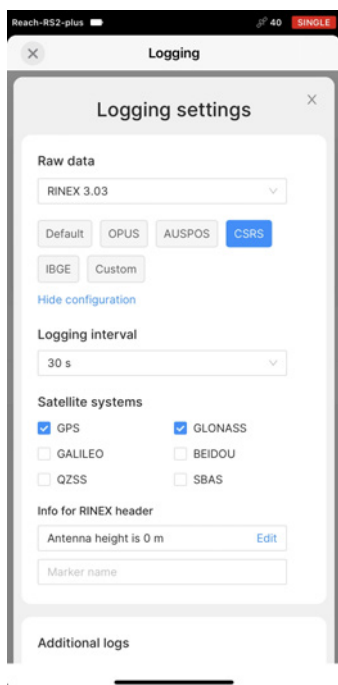
3. On the *Receivers* screen, tap *Settings*.
4. Select the preset depending on the PPP service you choose.
5. Choose the required RINEX format in the *Raw data* section.

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.

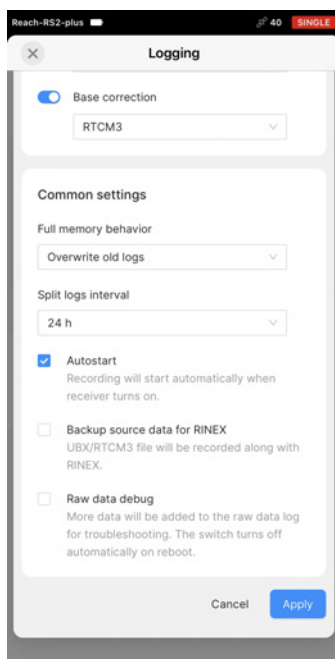


6. Tap *Show configuration* and enter the measured height to the bottom of the receiver in the corresponding field.



7. Fill in the point's name in the *Marker name* field.
8. Tap *Apply and start*.

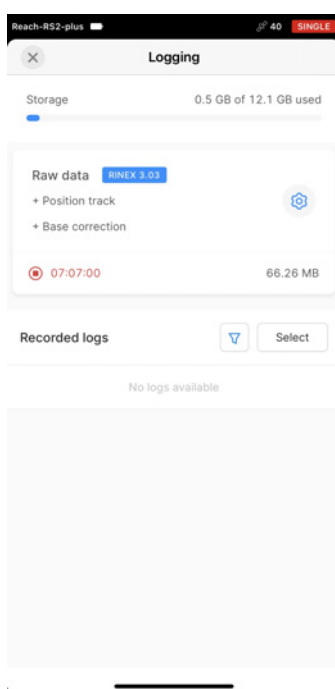
Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the Raw data settings screen.



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

Note: PPP services requires recording the data for at least 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.

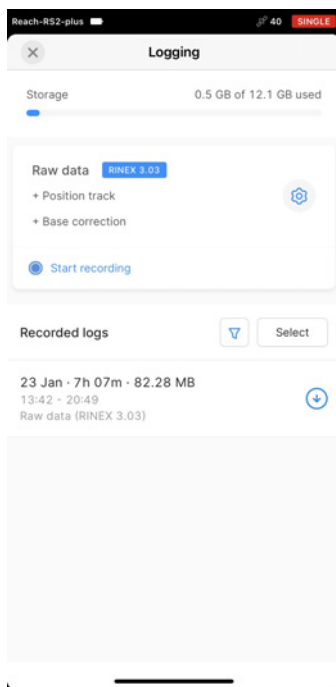
Once you finish the survey, don't forget to turn off raw data recording in the logging settings.

3.4.3 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.

3.5 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.

3.5.1 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.

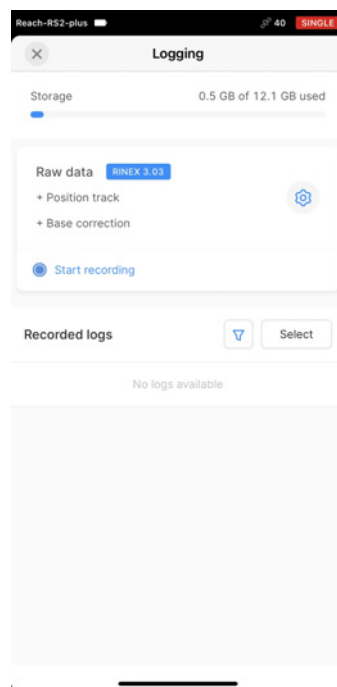
Tip: Check this [map](#) to see if the service is available in your region.

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

3.5.2 Recording RINEX logs on Reach

To record logs for OPUS, follow the steps below:

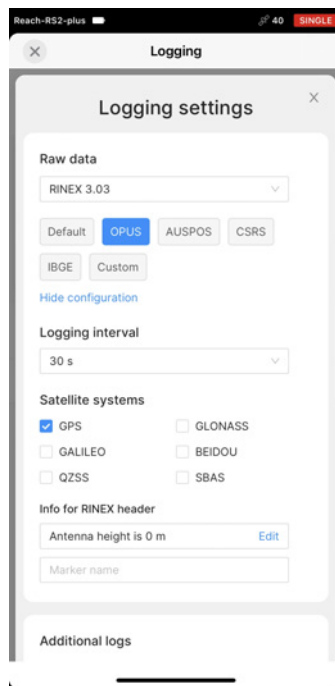
1. Open Emlid Flow and connect to your Reach.
2. Go to the *Logging* screen.



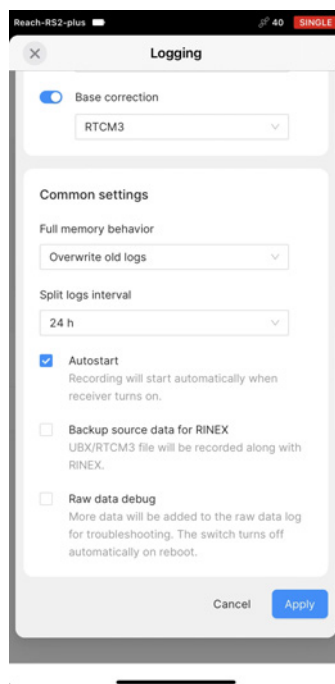
3. Tap the *Settings* button.
4. Select the *OPUS* preset.
5. Choose the required RINEX format in the *Raw data* section.

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.



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 and start*.



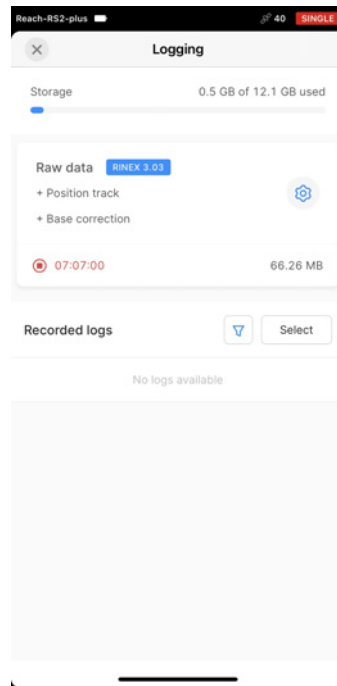
Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the Raw data settings screen.

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

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

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

Caution: *Wait for data processing to finish.*



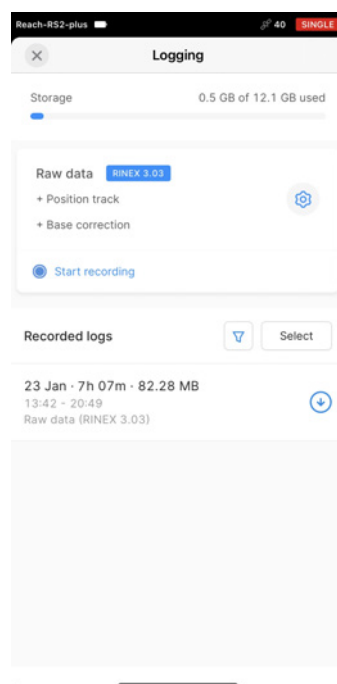
Tip: *You may log the data for up to 24 hours, depending on the accuracy required.*
Once you finish the survey, don't forget to turn off raw data recording in the logging settings.

3.5.3 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 Tutorials: Post-processing

4.1 How PPP works

sec: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.

4.1.1 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.

4.1.2 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.

4.2 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.

4.2.1 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:

FINAL: the accuracy is about 2 cm, available 13-15 days after the end of the week **RAPID:** the accuracy is about 5 cm, available the next day **ULTRA RAPID:** the accuracy is about 15 cm, available every 90 minutes

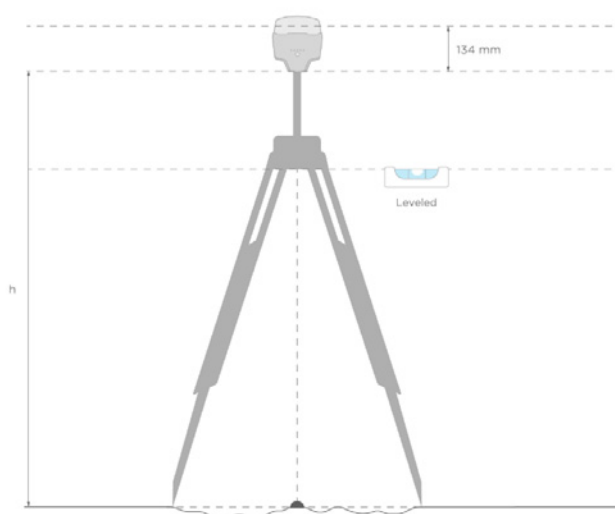
Tip: *You can learn more about NRCan CSRS-PPP service on their [official site](#).*

4.2.2 Workflow

Tip: *This guide shows how to process raw data recorded in the Static mode.*

4.2.3 Placing the base

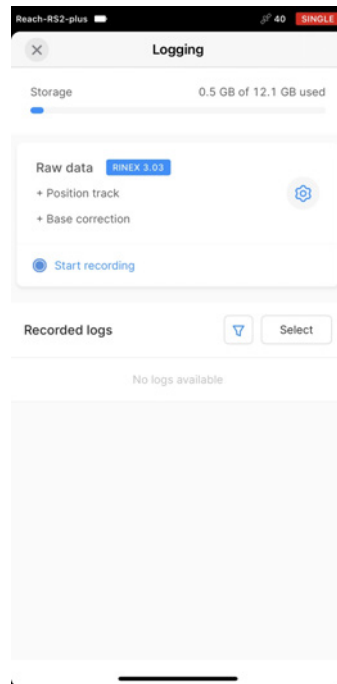
Place your Reach precisely above the marked point on the tripod and level it. You can learn more about placing Reach in the [Placing the base](#) tutorial.



4.2.4 Recording RINEX logs on Reach

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

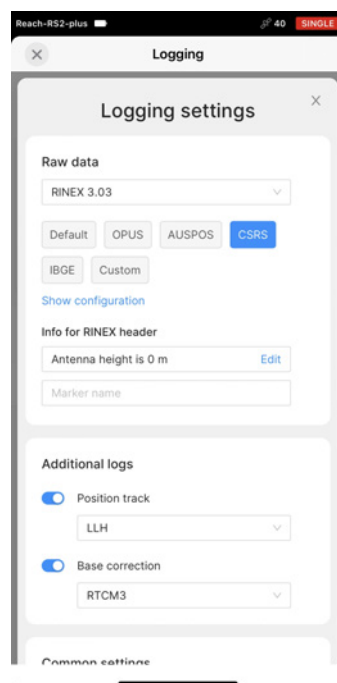
1. Open Emlid Flow and connect to your Reach.
2. Go to the *Logging* screen.



3. On the *Receivers* screen, tap *Settings*.
4. Select the *CSRS* preset.
5. Choose the required RINEX format in the *Raw data* section.

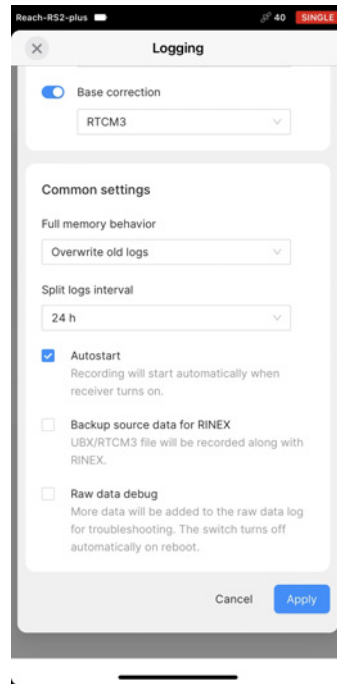
Note: If you do not know which version of RINEX you need, we recommend using RINEX 3.03.

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.



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 and start*.

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

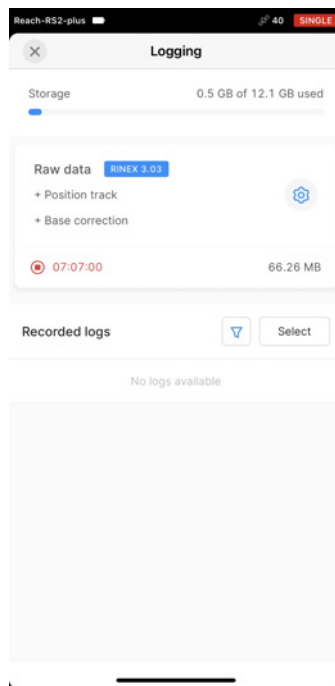


9. Enable log recording by tapping the *Start recording* button.

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

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

Caution: Wait for data processing to finish.



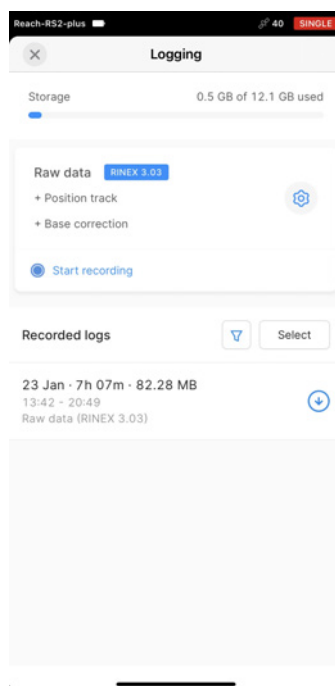
Tip: You may log the data for up to 24 hours, depending on the accuracy required. Once you finish the survey, don't forget to turn off raw data recording in the logging settings.

4.2.5 Downloading logs

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

1. Go to the *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.

4.2.6 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 the 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.

The screenshot shows the NRCan CSRS-PPP submission form. It includes fields for 'Email for results (required)' with the value 'support@emlid.com', 'Processing mode' with 'Static' selected and 'ITRF' as the datum, and a 'Vertical datum' dropdown set to 'CGVD2013'. There are checkboxes for 'Contribute to passive control maintenance?' and 'Remove plots from CSRS-PPP solution PDF report'. The 'RINEX observation file(s)' section shows a 'Choose file' button and a file named 'ReachBase.22O'. A 'Submit to PPP' button is at the bottom.

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

4.2.7 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.220

	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.

4.2.8 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.

6. Tap *Save*.

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

4.3 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.

4.3.1 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	every 2.5 hours	~15 cm
RAPID	12-36 hours after the end of the survey	~5 cm
FINAL	11-17 days after the end of the survey	~2.5 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.*

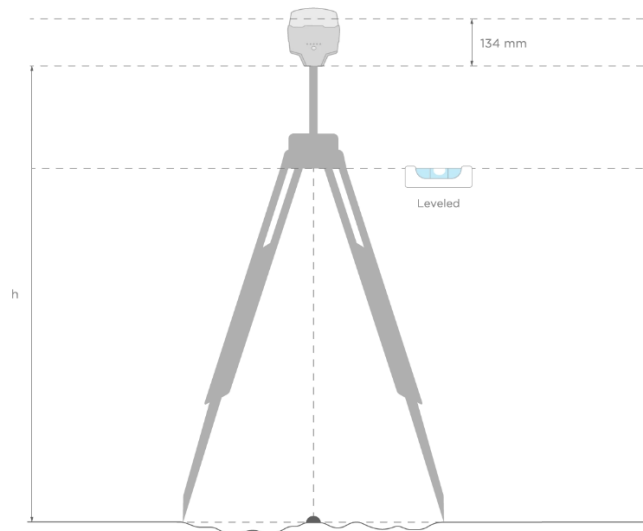
Orbit type	When the orbit is ready for use	Accuracy
RAPID	17-41 hours after the end of the survey	~2.5 cm
FINAL	12-20 days after the end of the survey	~2.5 cm

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

4.3.2 Placing the base

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

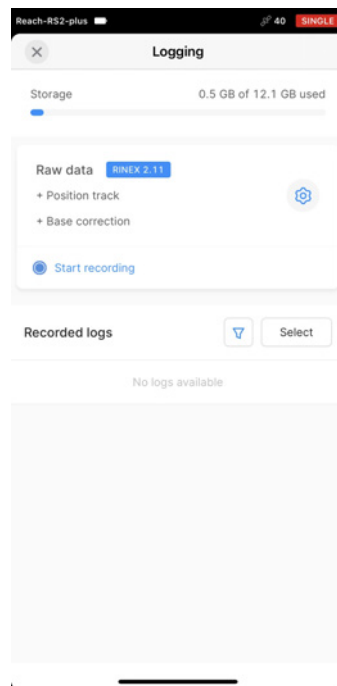
Place your Reach precisely above the marked point on the tripod and level it. You can learn more about placing Reach in the [Placing the base](#) tutorial.



4.3.3 Recording RINEX logs on Reach

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

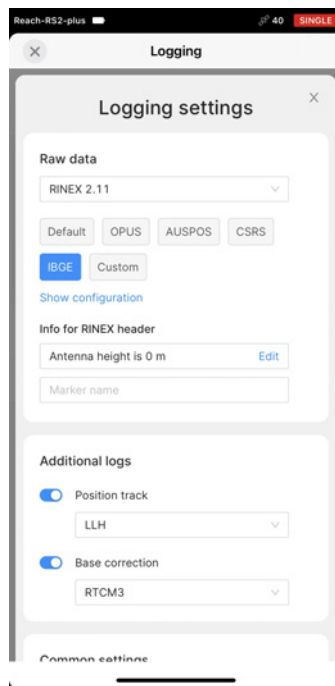
1. Open Emlid Flow and connect to your Reach.
2. Go to the *Logging* screen.



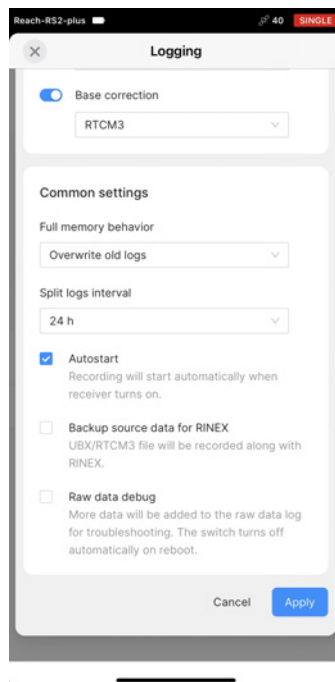
3. On the *Receivers* screen, tap *Settings*.
4. Select the *IBGE* preset.
5. Choose the required RINEX format in the *Raw data* section.

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 and start*.



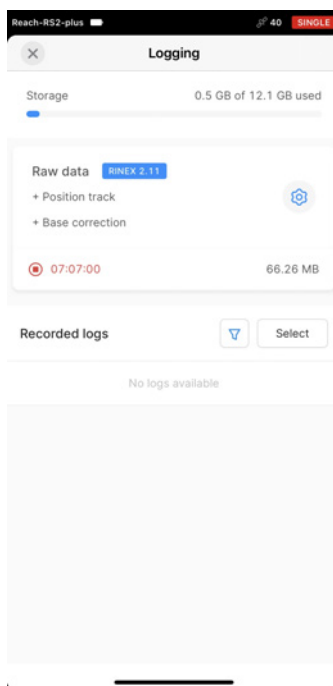
Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the Raw data settings screen.

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

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.*



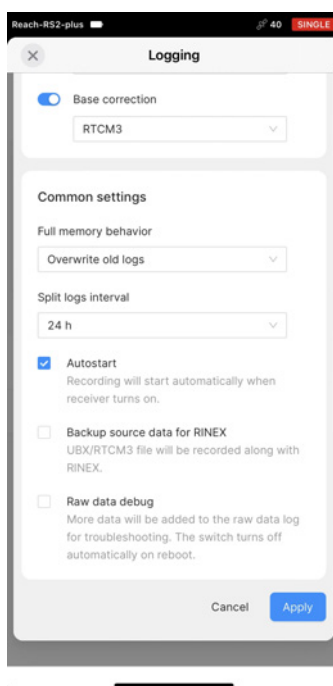
Tip: *You may log the data for up to 24 hours, depending on the accuracy required.*

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

4.3.4 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 *Edit* button.

4.3.5 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 the 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 a web form for submitting RINEX data to the IBGE-PPP service. The form is divided into several sections. At the top, there are two main sections: 'Selecione o Modo de Processamento:' with radio buttons for 'Estático' (selected) and 'Cinemático', and 'Selecione um arquivo RINEX:' with a text input field containing 'rover.22O' and a 'Choose file' button. Below these, a note states: 'Os valores selecionados abaixo serão adotados para todos os RINEX que estejam comprimidos em um único arquivo:'. This is followed by two input fields: 'Tipo de Antena:' with a dropdown menu showing 'EML_REACH_RS2 NONE', and 'Altura da antena (m):' with a text input field showing '1.800'. A checkbox labeled 'A altura da antena somente será alterada se esta caixa estiver marcada.' is checked. Below these fields is the 'E-mail válido do usuário. (não pode conter espaços ou tabs!):' field with the text 'support@emlid.com'. At the bottom, there is a checkbox for a disclaimer: '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'. Below the disclaimer, there is a 'Nota:' section stating: 'O processamento iniciará após a transferência do arquivo, o que pode demorar alguns minutos. Caso o resultado não comece a aparecer em 2 horas, por favor reprocessse.' At the very bottom, there are two buttons: 'Processar' and 'Limpar Dados'.

8. To download the results, click the *Download do resultado (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.

4.3.6 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 app. At the top, there are three buttons: 'Cancel', 'Configure base', and 'Save'. Below these, the 'Coordinates entry method' is set to 'Manual'. There is a section for 'Antenna height' currently set to '0 m'. Below that is a section titled 'COORDINATES' with a button labeled 'Choose from project'. Further down, there are three input fields: 'Longitude, deg', 'Latitude, deg', and 'Ellipsoidal height, m', each with a 'Required' label below it. At the bottom, there are two tabs: 'DD' and 'DMS', with 'DD' currently selected.

6. Tap *Save*.

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

4.4 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.

4.4.1 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](#).

4.4.2 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.

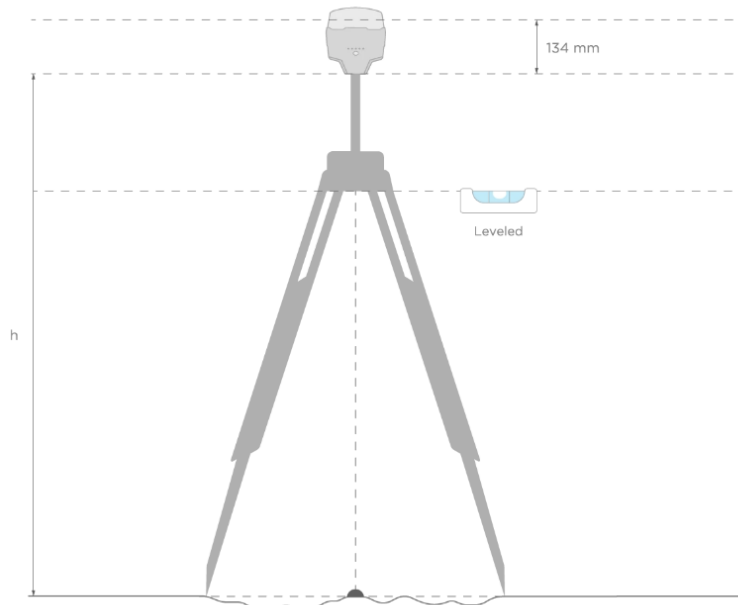
Note: AUSPOS uses dual-frequency GPS data for solution computation and supports only Static Positioning mode.

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

4.4.3 Placing the base

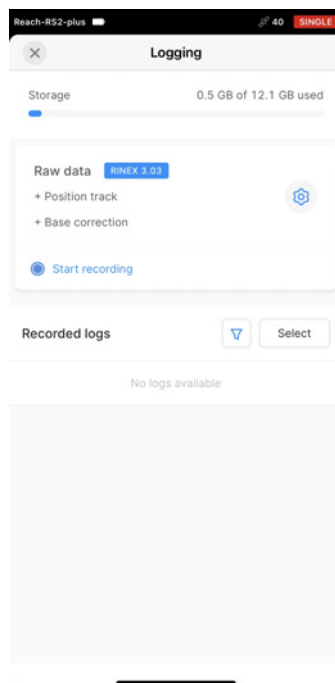
Place your Reach precisely above the marked point on the tripod and level it. You can learn more about placing Reach in the [Placing the base tutorial](#).



4.4.4 Recording RINEX logs on Reach

To record logs for AUSPOS, perform the following steps:

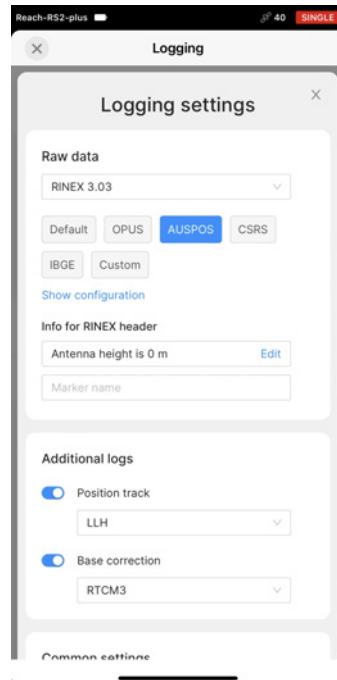
1. Open Emlid Flow and connect to your Reach.
2. Go to the *Logging* screen.



3. On the *Receivers* screen, tap *Settings*.
4. Select the *AUSPOS* preset.
5. 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.

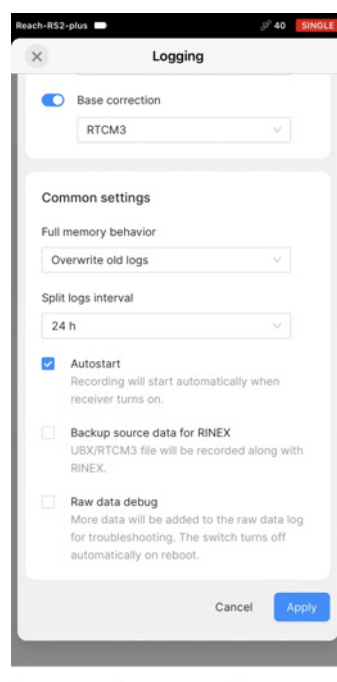
Tip: While recording in the RINEX format, you can log the UBX file as a backup. UBX file can be used to adjust RINEX file settings in the Converter tool in Emlid Studio. You can enable logging in the UBX format in the logging settings in Emlid Flow.



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 and start*.



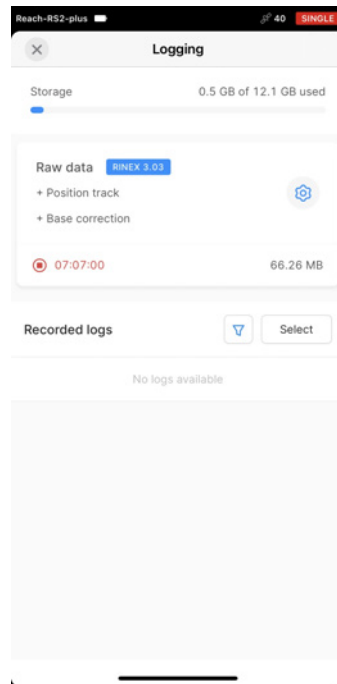
Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the Raw data settings screen.

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

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

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.

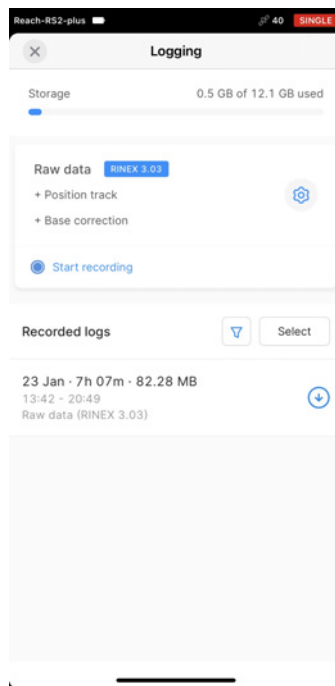
Once you finish the survey, don't forget to turn off raw data recording in the logging settings.

4.4.5 Downloading logs

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

1. Go to the *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.*

4.4.6 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 the 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.

Caution: *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.

Tip: *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*.

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

4.4.7 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.

Tip: 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.

4.4.8 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' 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 with a 'Required' label below it.

6. Tap *Save*.

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

4.5 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).

4.5.1 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](#).

4.5.2 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.

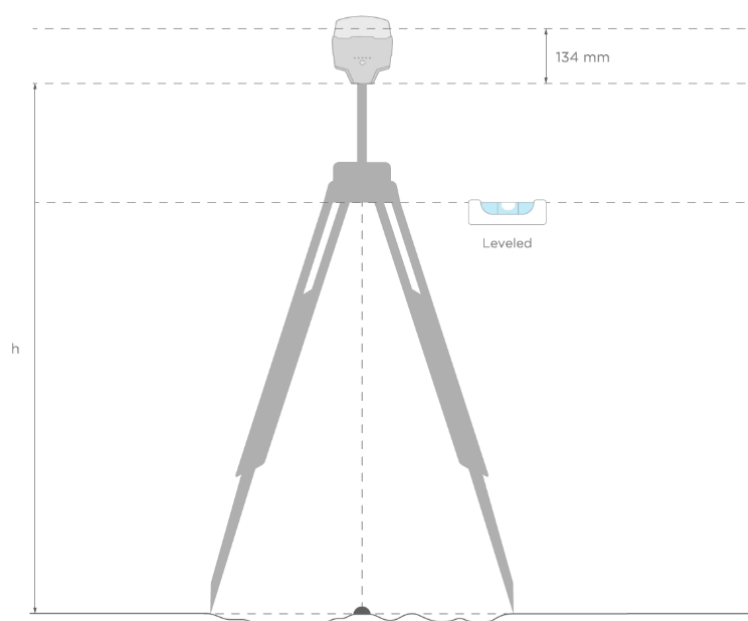
There are 2 ways you can process the data in OPUS:

- 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.

4.5.3 Placing Reach

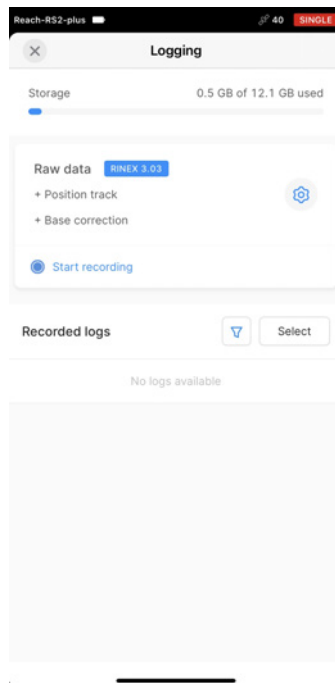
Place your Reach precisely above the marked point on the tripod and level it. Learn more about placing Reach receiver in the Placing the base guide.



4.5.4 Recording RINEX logs on Reach

To record logs for OPUS, follow the steps below:

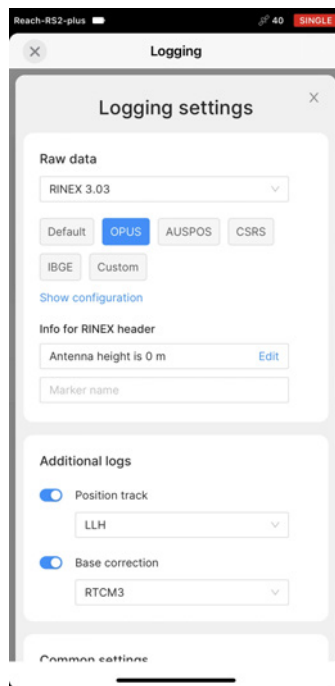
1. Open Emlid Flow and connect to your Reach.
2. Go to the *Logging* screen.



3. Tap the *Settings* button.
4. Select the *OPUS* preset.
5. Choose the required RINEX format in the Raw data section.

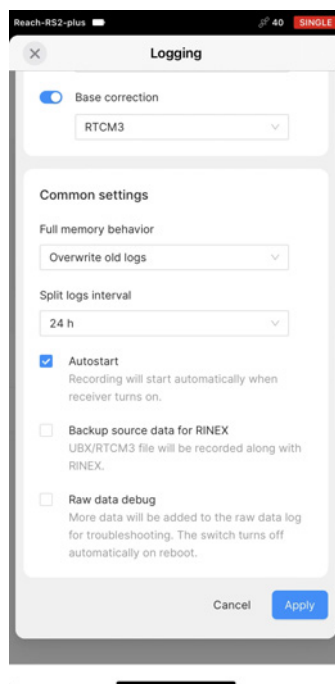
Note: If you do not know which version of RINEX you need, we recommend using RINEX 3.03.

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.



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 and start*.

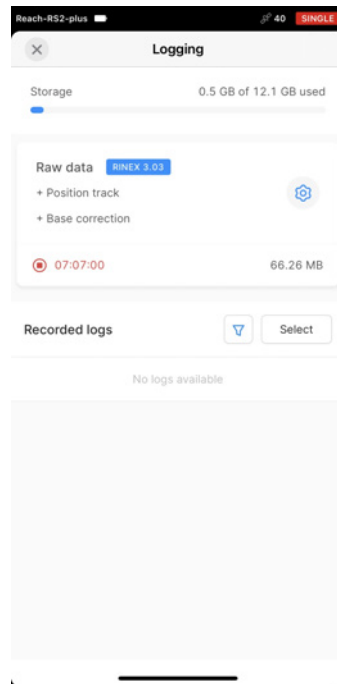
Tip: You can start recording automatically when your receiver is turned on. Check the corresponding field on the Raw data settings screen.



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

Note: NOAA's OPUS requires recording the data for at least 4 hours to get the best accuracy. To finish recording logs, tap the *End recording* button.

Caution: *Wait for data processing to finish.*

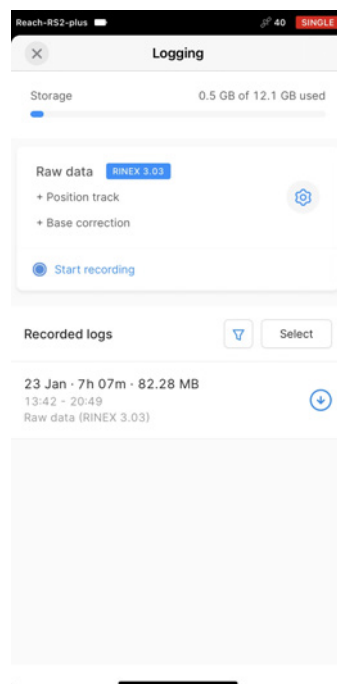


Tip: You may log the data for up to 24 hours, depending on the accuracy required.
Once you finish the survey, don't forget to turn off raw data recording in the logging settings.

4.5.5 Downloading logs

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

1. Go to the *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.

4.5.6 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.

OPUS: Online Positioning User Service
National Geodetic Survey

NGS Home About NGS Data & Imagery Tools Surveys Science & Education Search

Sept 2021: BETA OPUS projects released! Please **provide your feedback**

- Try **BETA projects v5.0** to test adding real-time and post-processed GPS vectors.
- Use **projects v4.0** to publish static GPS observations to NGS datasheets.

Upload your data file.
Solve your GPS position & tie it to the National Spatial Reference System.
What is OPUS? FAQs

Choose file ReachBase.220
* data file of dual-frequency GPS observations. **sample**

EML_REACH_RS2 NONE
INTEGRATED GPS/QZSS L1C/A, L2C
antenna - choosing wrong may degrade your accuracy.

2.000 meters above your mark.
antenna height of your antenna's reference point.

support@emlid.com
* email address - your solution will be sent here. **Privacy Act Statement**

Options to **customize** your solution.

Upload to Rapid-Static
for data 15 min. - 2 hrs.

Upload to Static
for data 2 hrs. - 48 hrs.

* required fields
We may use your data for internal evaluations of OPUS use, accuracy, or related research.

OPUS menu
home / upload
about OPUS
projects
shared solutions
planned improvements
support / feedback

OPUS Today
as of 2022-07-07T07:10 EDT

Website Owner: National Geodetic Survey / Last modified by NGS.OPUS V 2.6 May 24 2022

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

4.5.7 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.

4.5.8 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' 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.

5 Tutorials: Integration with external software and devices

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.*

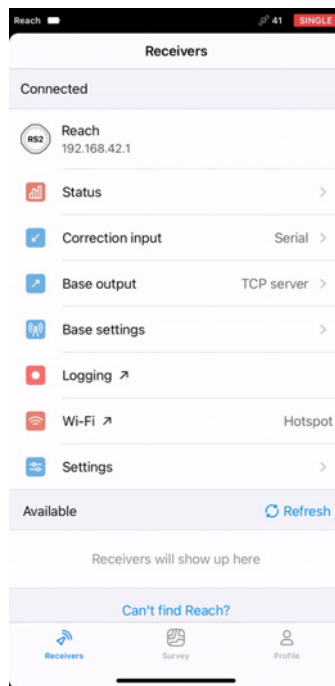
Configure Reach unit to act as a rover in RTK.

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.

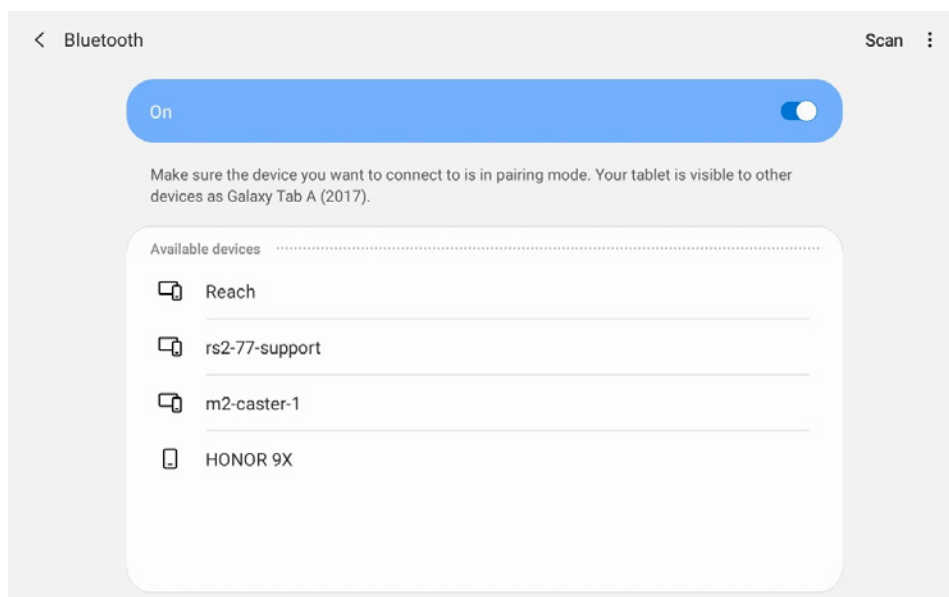


Note: *Reach* name is displayed just above its MAC. In this guide, we used the unit named as **Reach**.

5.1.4 Access an Android device

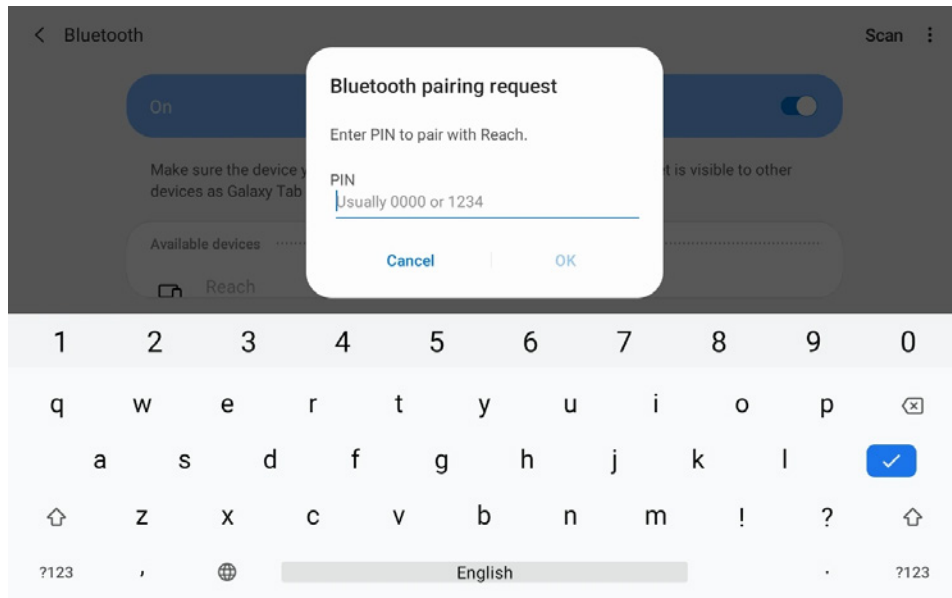
1. Navigate to the *Bluetooth configuration* screen. Activate the Bluetooth connection.
2. Wait for Reach to be listed as an available device.

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

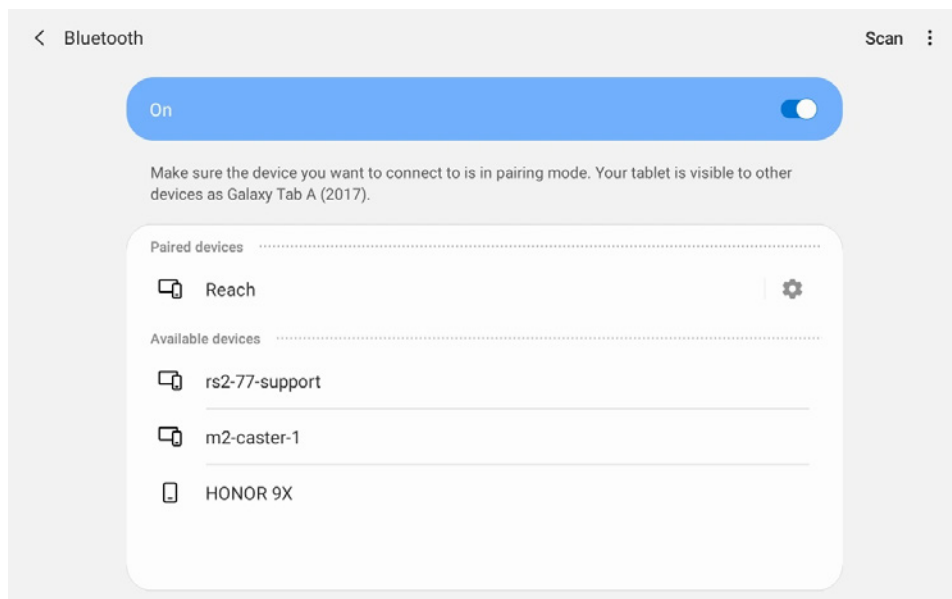


3. Tap the name of your Reach in the list of available devices on the Android device.
4. You should receive a pairing request from Reach.

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

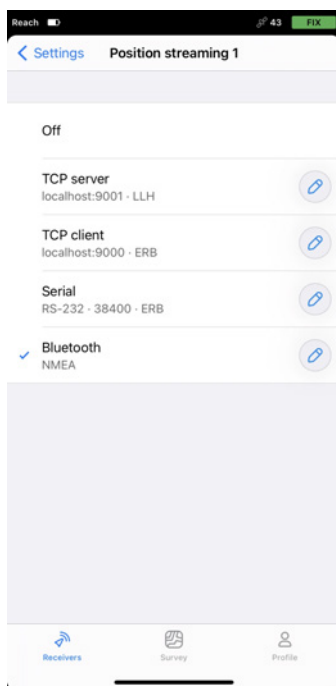


Reach and Android device are now paired.

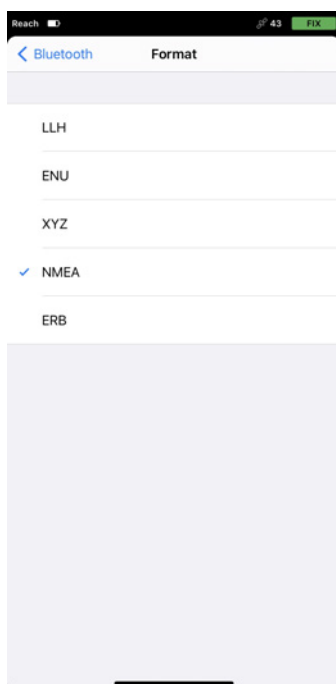


5.1.5 Position Streaming from Reach to Android

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

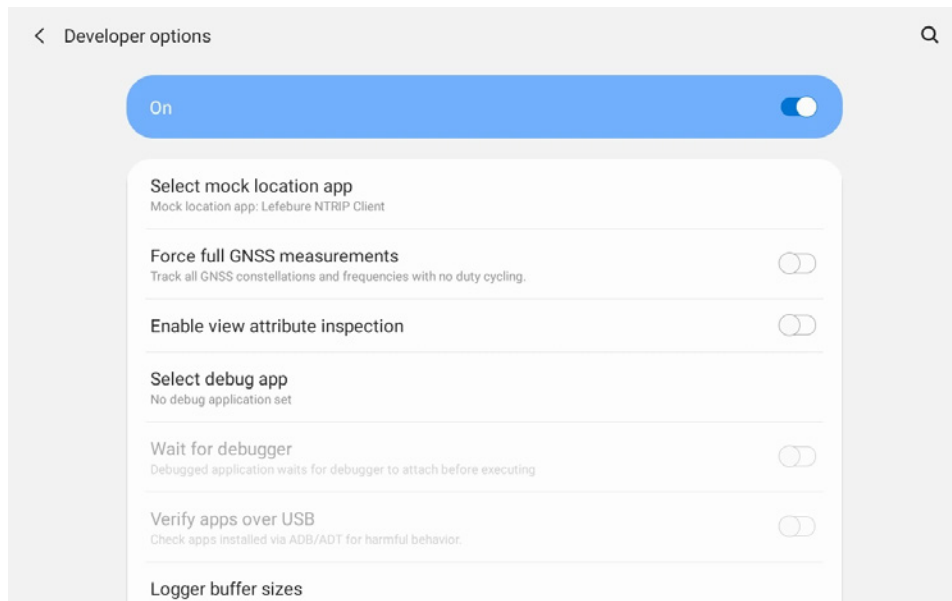
We provide a guide on how to use Reach with Lefebure NTRIP Client.

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.

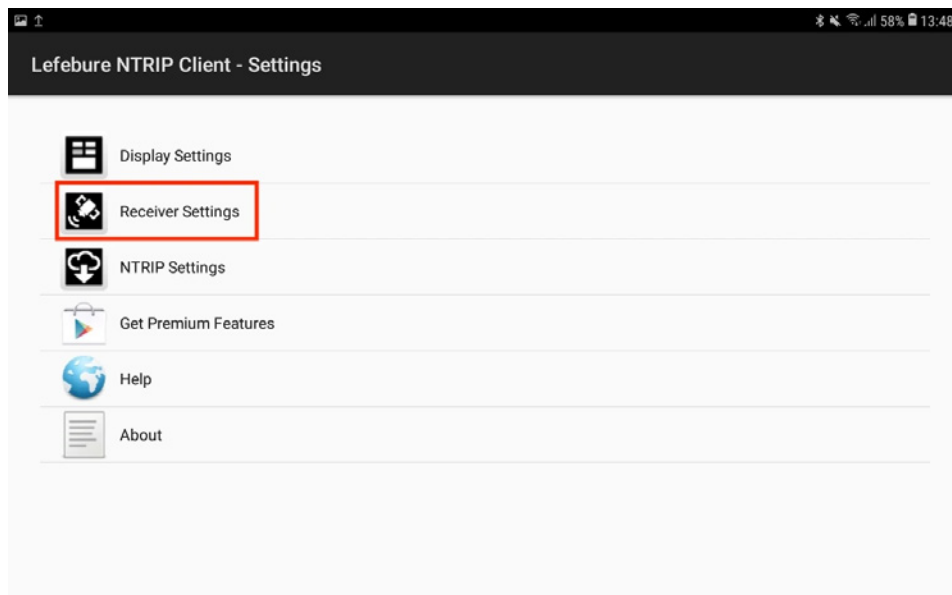


Note: *It is recommended to switch off the power-saving mode on your phone as it may limit background data usage for the Lefebure NTRIP client app.*

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

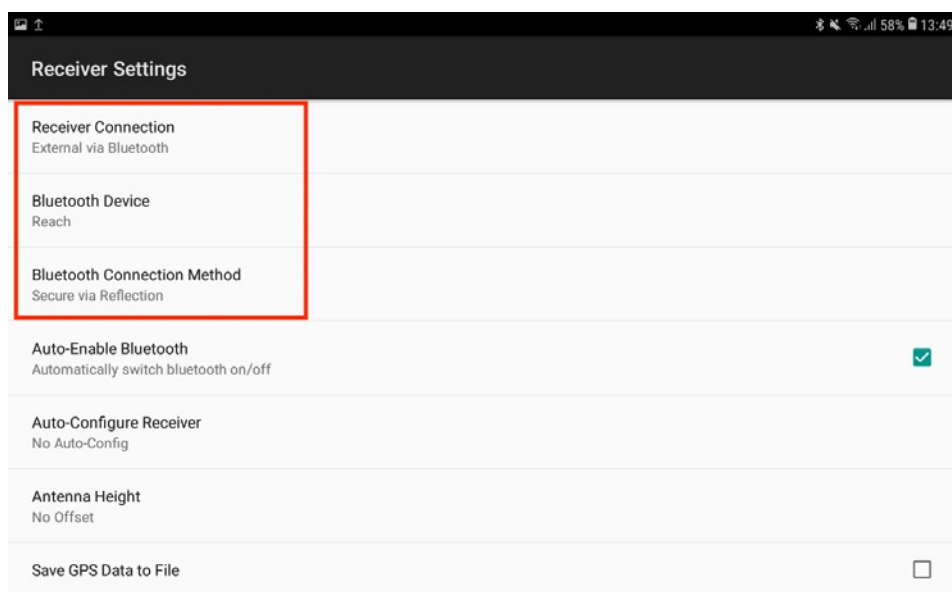


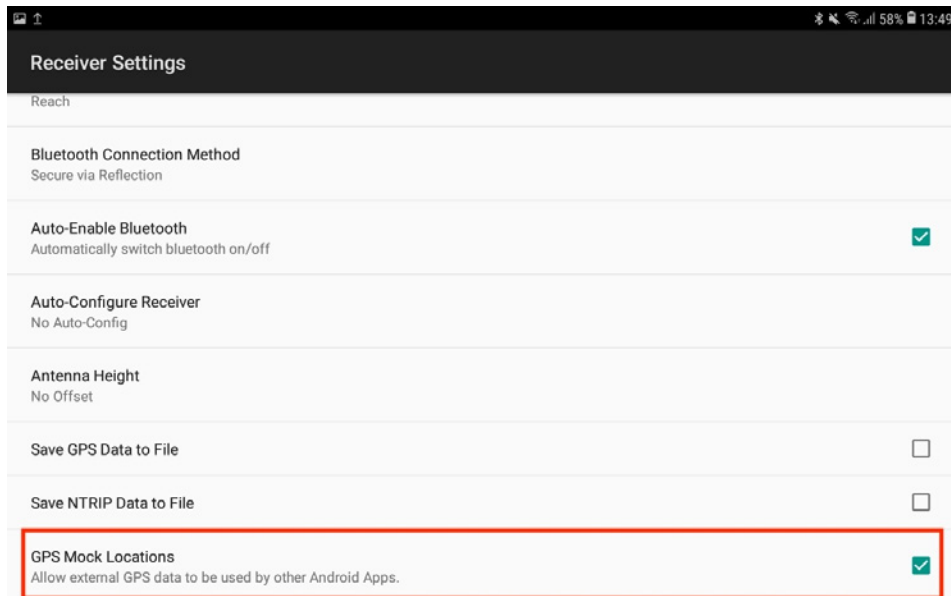
4. Go to the *Receiver Settings*.



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.

5.1.7 Collecting Data with Reach and ArcGIS

We provide a [video tutorial](#) explaining how to use Reach with ArcGIS.

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 RS2/RS2+

To start, download the ArcGIS Survey123 app from the App Store or Google Play and connect your 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 RS2/RS2+ are connected to the same Wi-Fi network.*

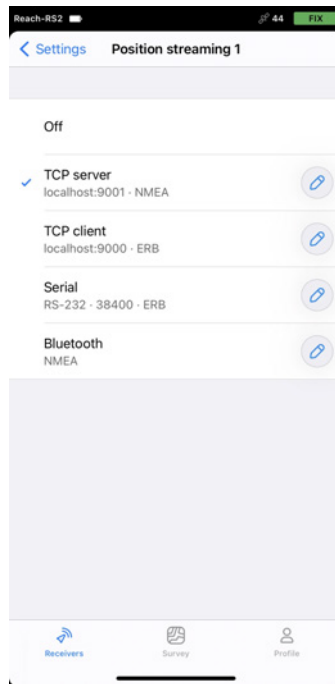
5.2.3 Establishing TCP connection

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

5.2.4 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.*

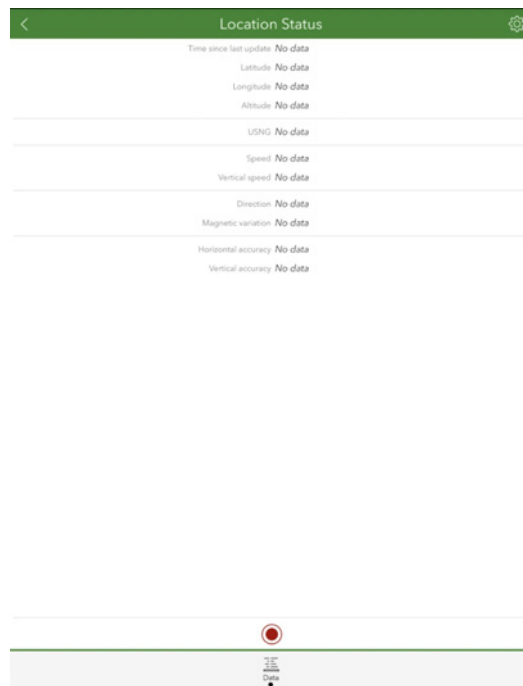


5.2.5 Configuring settings in ArcGIS Survey123

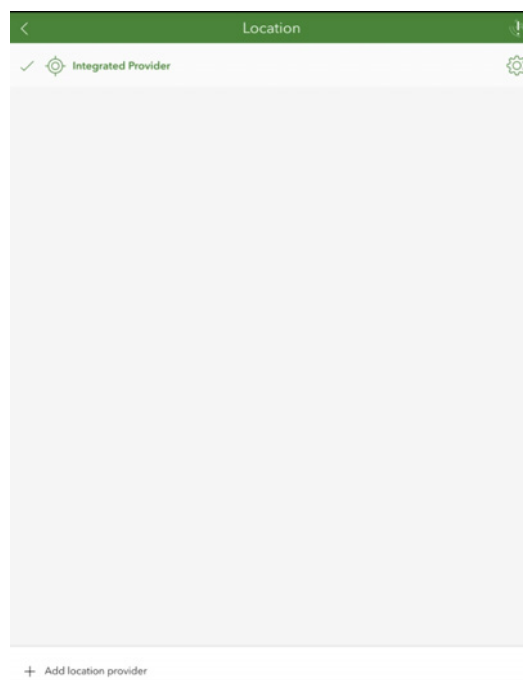
1. Open the ArcGIS Survey123 app.
2. Tap the *GNSS location* icon.



3. Tap the *Settings* icon.



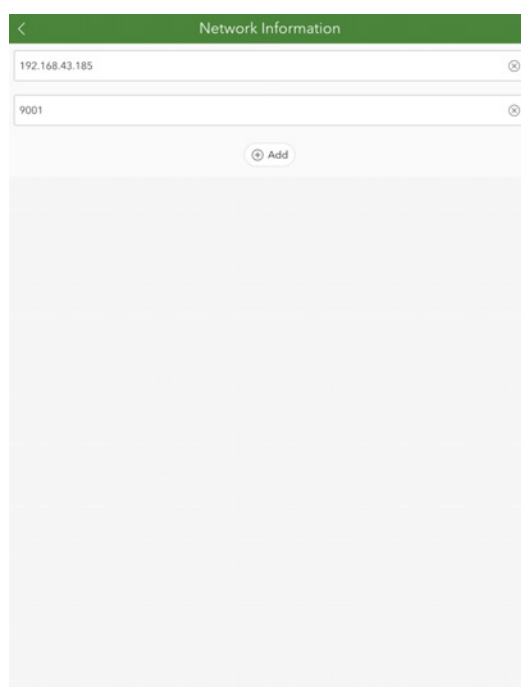
4. Tap *Add location provider*.



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.

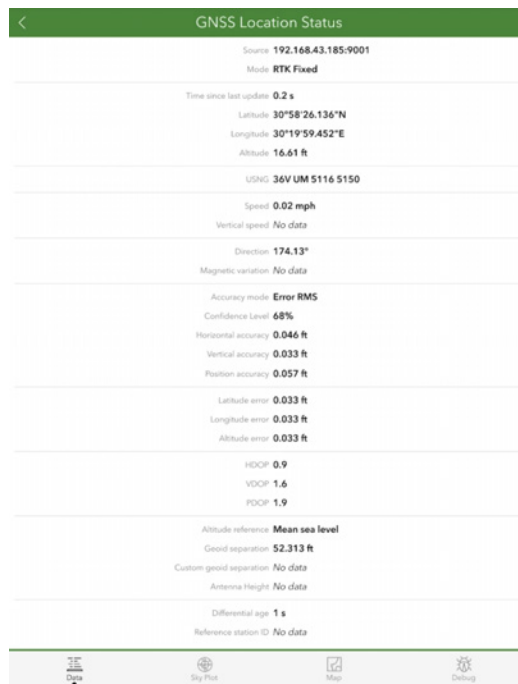


Tip: You can check the IP address of your Reach Reach RS2/RS2+ in the Emlid Flow app. Go to the Settings screen and find it under the name of your receiver.

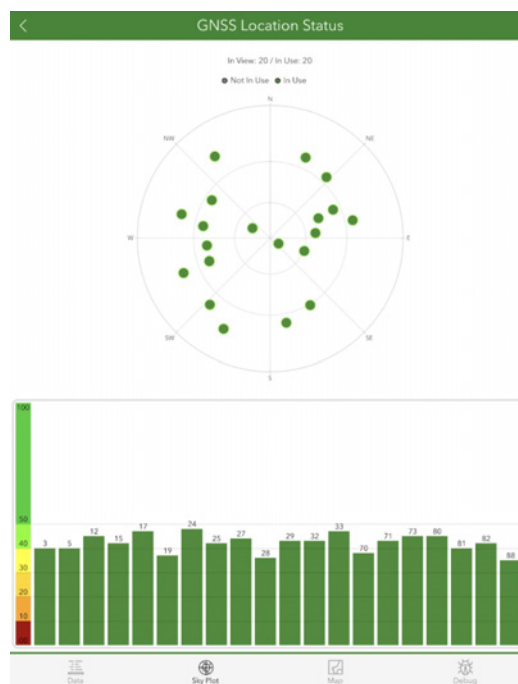
Note: Make sure that the port corresponds to the one configured on the receiver.

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.



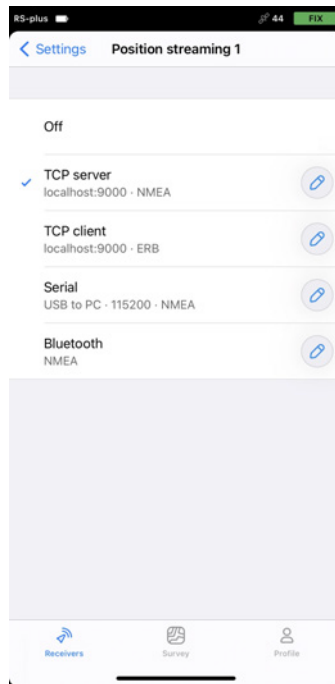
5.3.2 Connecting QGIS to Reach

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

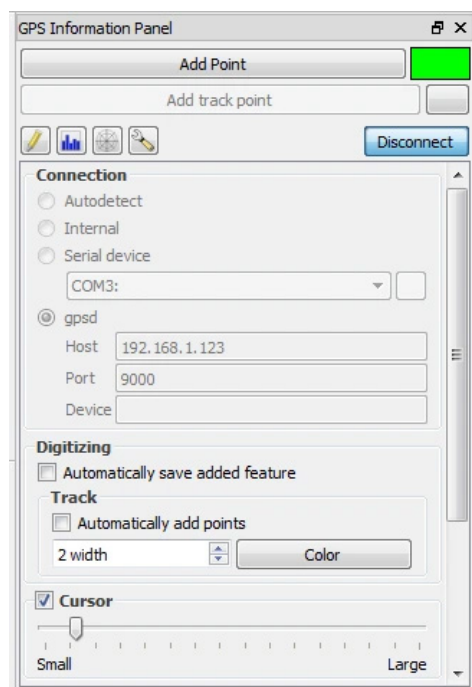
Tip: *To configure the connection in QGIS, you might need to enable the GPS Information panel first. Go to the View list in the Menu bar and tick this option in the Panels field to accomplish this.*

5.3.3 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.



5.3.4 USB

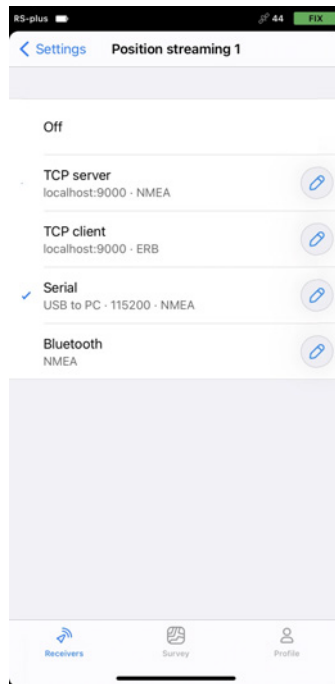
The second way to connect is via "serial device", actually USB. First plug the micro USB into the opening on the rover.



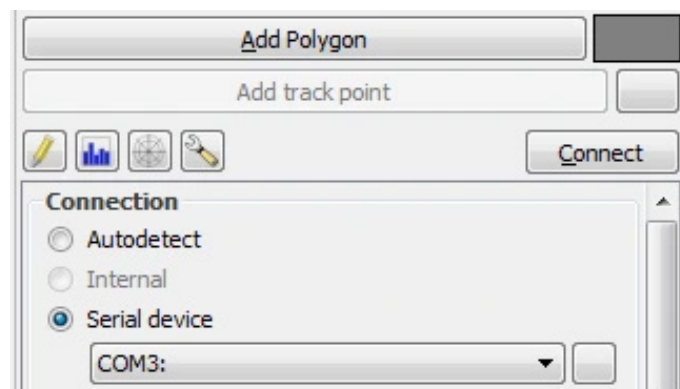
Then, plug the other end into the computer usb port.



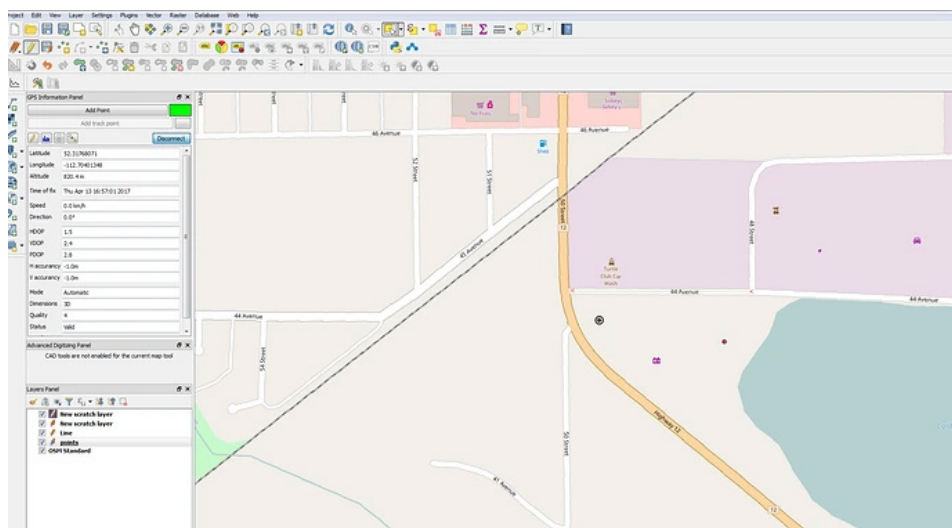
For this, the settings on your rover should be as on the screenshot below.



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

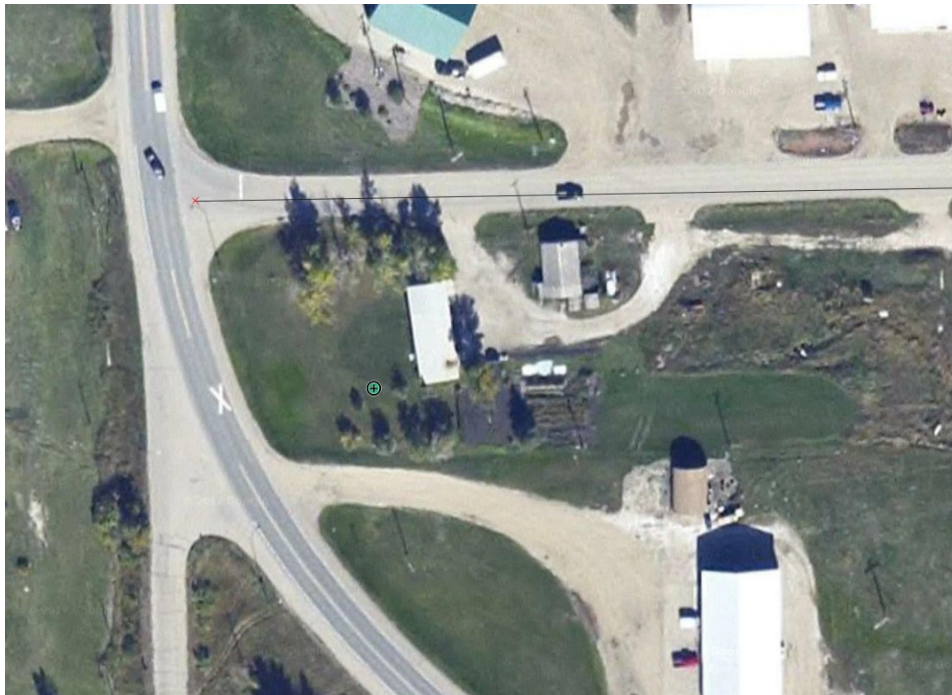


Now that we are connected, we should see Reach position in QGIS.

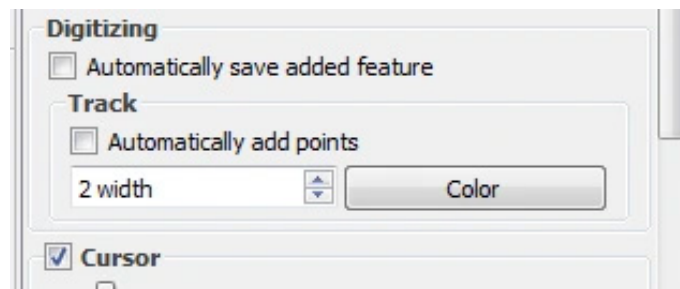


5.3.5 QGIS basics

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

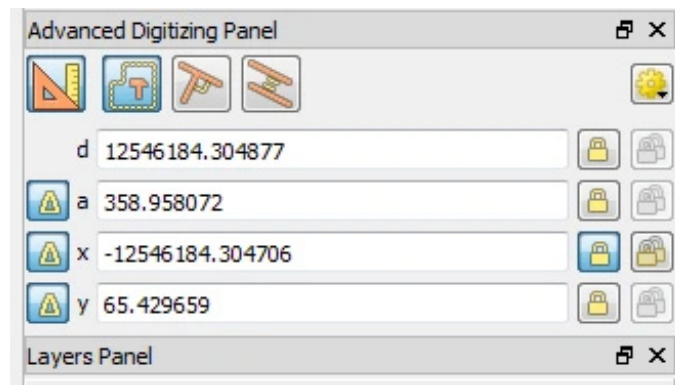


The GPS panel shows status, but if you want to check for the solution status, it is better to keep an eye on the Emlid Flow app for that. Once we are connected and have our layers and snapping settings ready, we can add points, lines, and polygons, based on our location.



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.

5.3.6 Credits

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

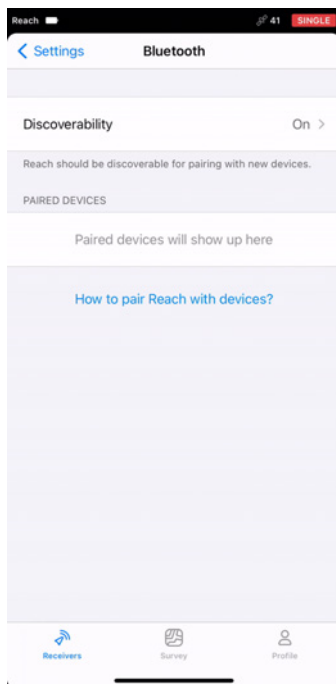
5.4 Microsurvey FieldGenius setup guide

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.

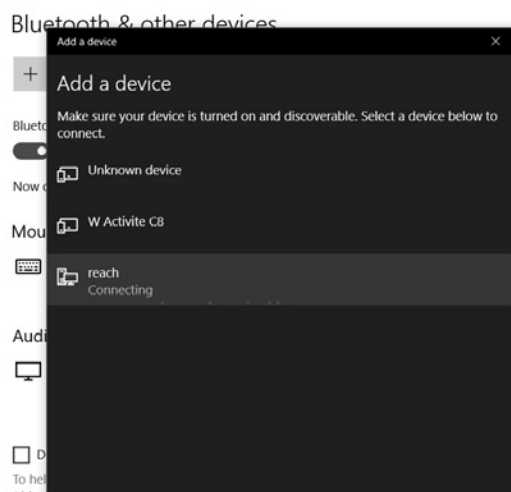
Note: If you use FieldGenius for Android, please refer to the Bluetooth output and Android mock location guide.

5.4.1 Configuring Bluetooth connection

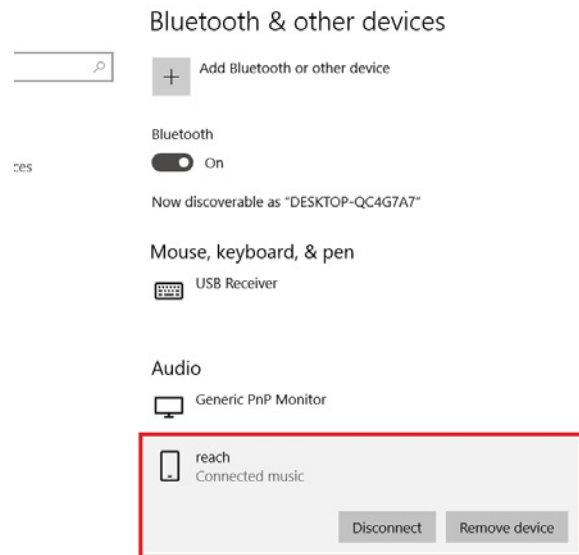
1. Open Emlid Flow and connect to your Reach.
2. Go to *Settings* and tap *Bluetooth*.
3. Enable Bluetooth by tapping the *Turn on Bluetooth* button.
4. Tap *Discoverability* and turn on the *Discoverability* option. Tap *Save* to apply changes.



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.



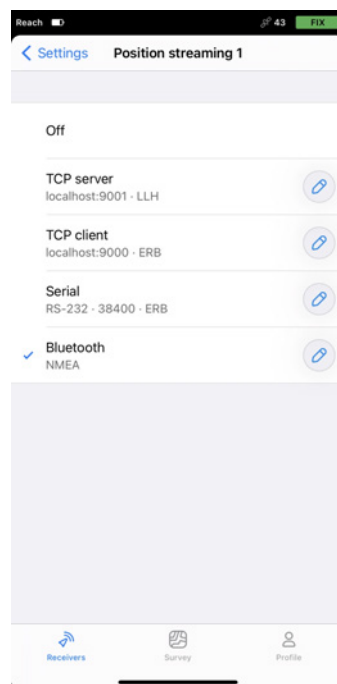
5.4.2 Configuring Emlid Flow

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

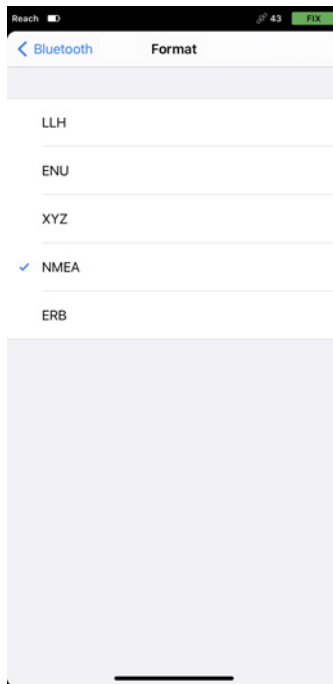
5.4.3 Position streaming

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.



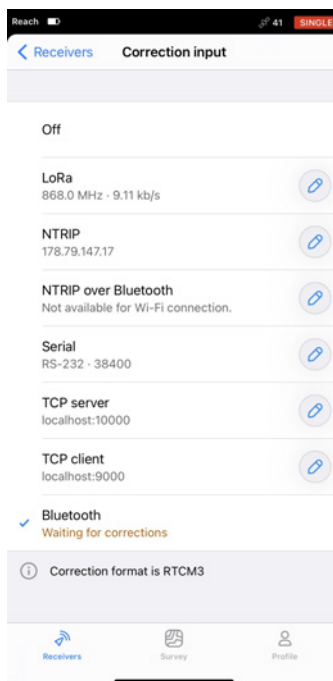
4. Tap *Format* and choose *NMEA*. Apply changes.



5.4.4 Correction input

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

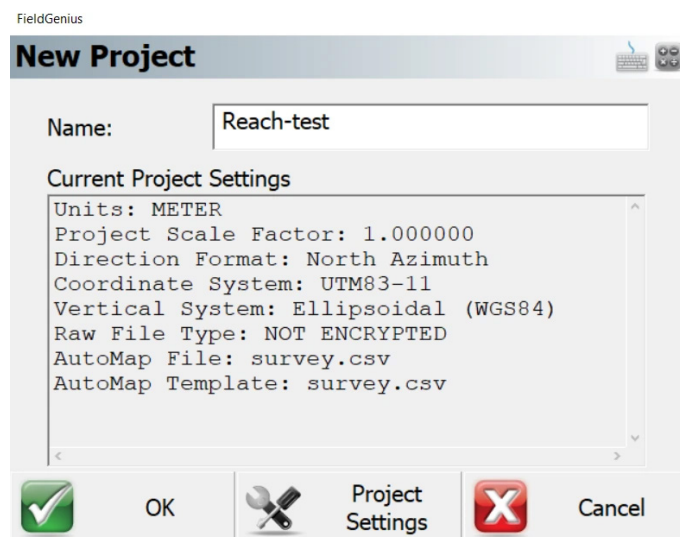
1. Go to the *Receivers* screen and tap *Correction input*.
2. Choose *Bluetooth*.



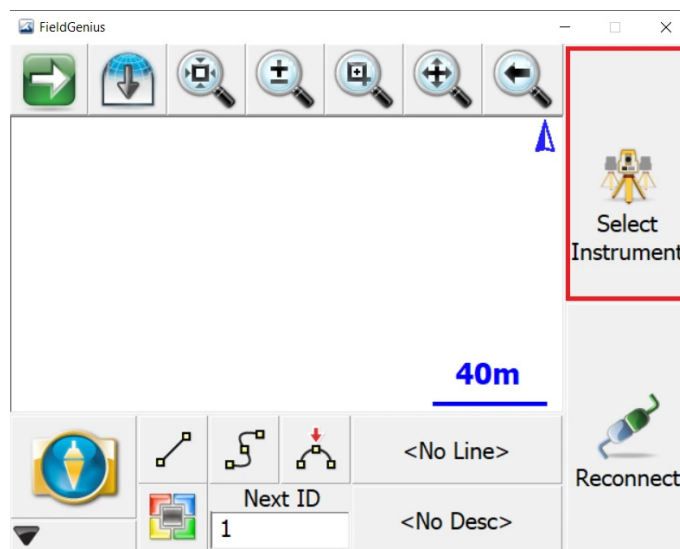
5.4.5 Configuring FieldGenius

Creating a new project and instrument profile

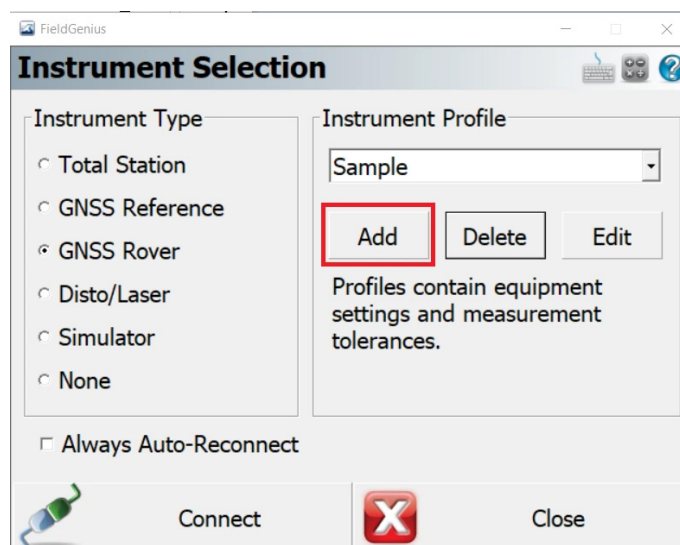
1. Launch FieldGenius. It will ask to create a new project. On this step, you can go to *Project Settings* to configure units and coordinate system. Click *OK* to proceed.



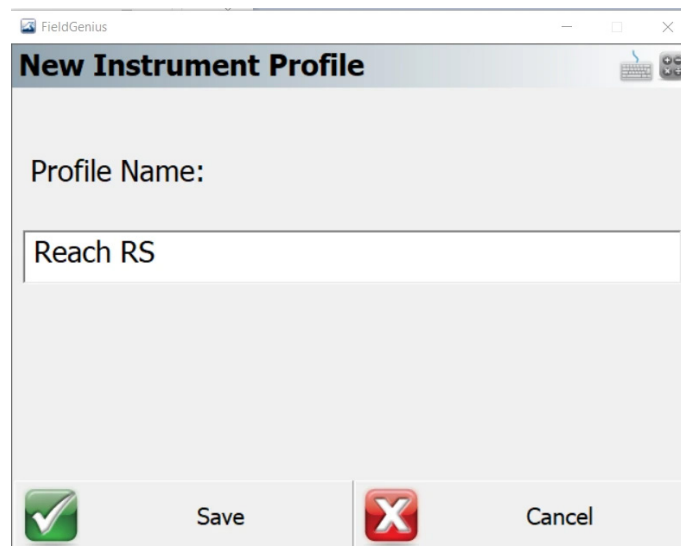
2. You will see FieldGenius interface. Choose *Select Instrument*.



3. Choose the *GNSS Rover* instrument type and add a new instrument profile.

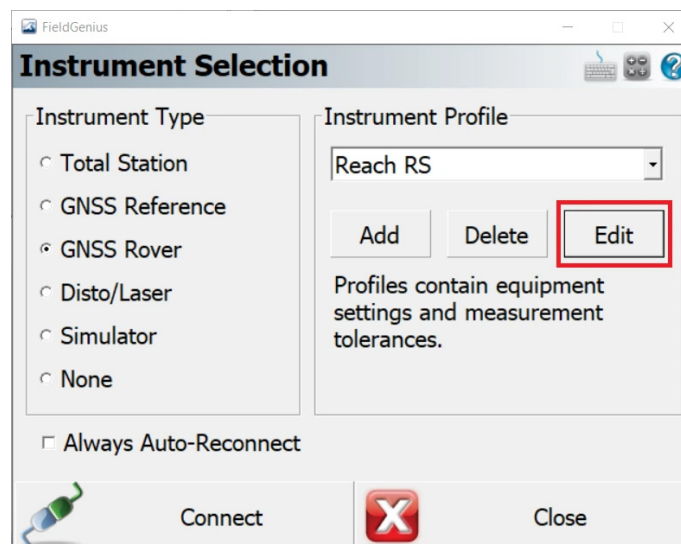


4. Set *Reach* profile name and click *Save*.

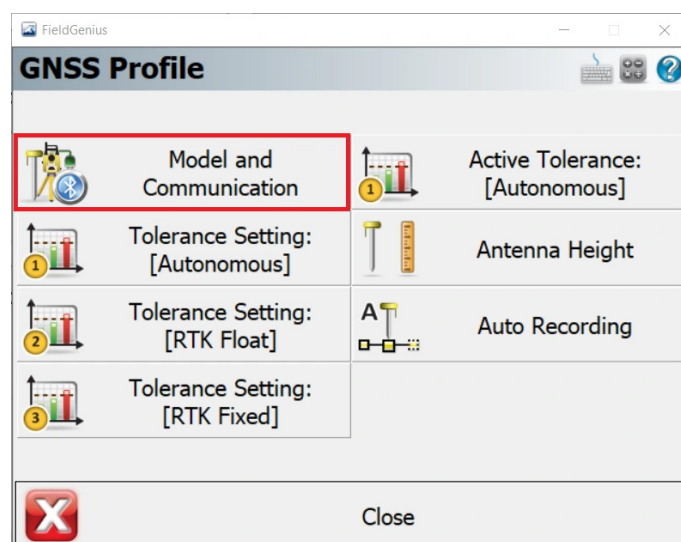


5.4.6 Configuring the communication between FieldGenius and Reach

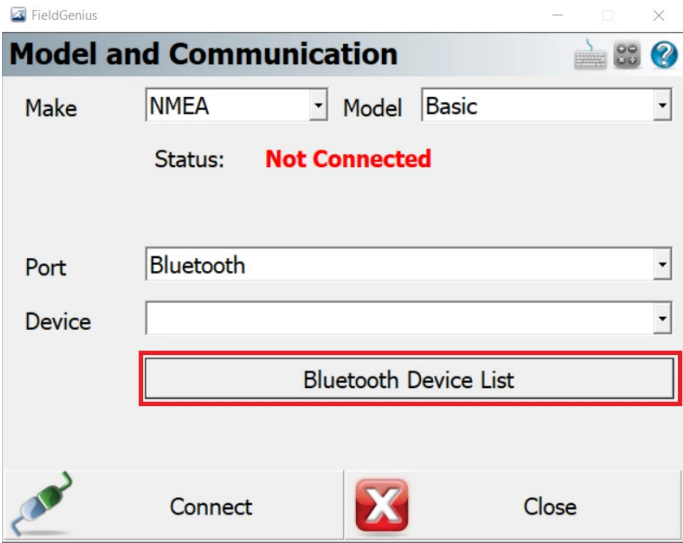
1. Pick the *Edit* option to configure the receiver parameters.



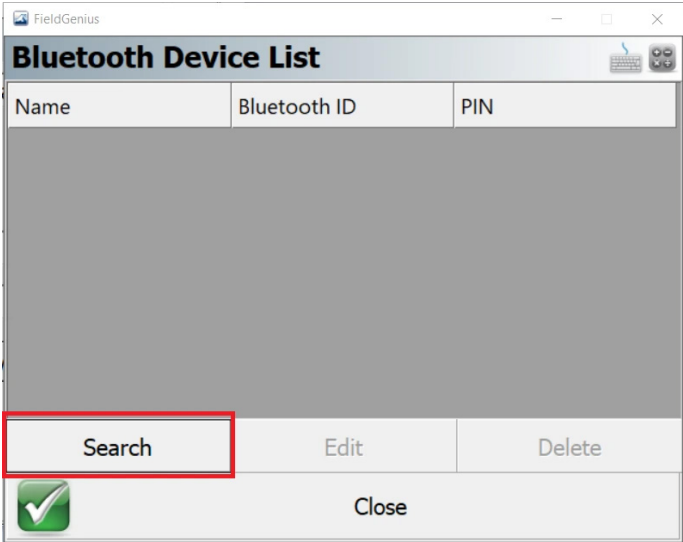
2. Select *Model and Communication*.



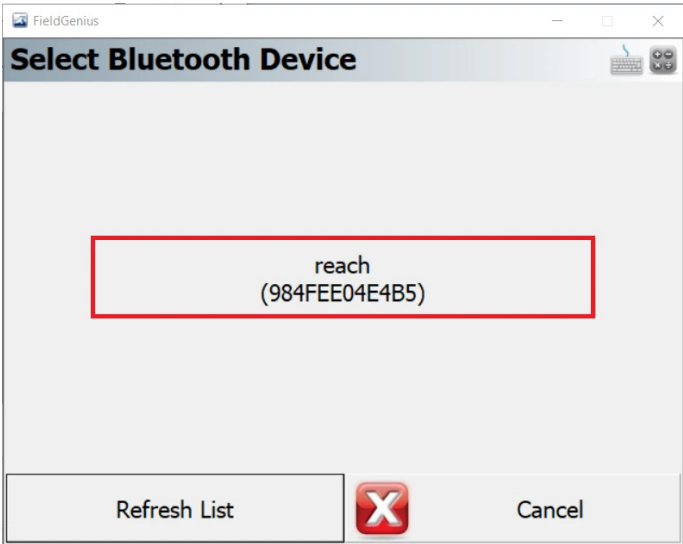
3. Select *NMEA* from the *Make* list and *Basic Model*. Click on *Bluetooth Device List*.



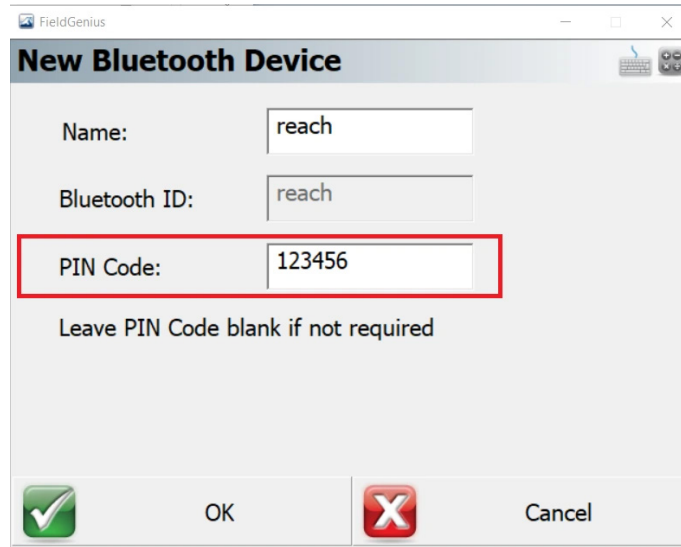
4. Click *Search* in *Bluetooth Device List*.



5. Select *Reach* device.



6. Enter the default PIN Code (it is "123456" for Reach) and press **OK**.



FieldGenius

New Bluetooth Device

Name: reach

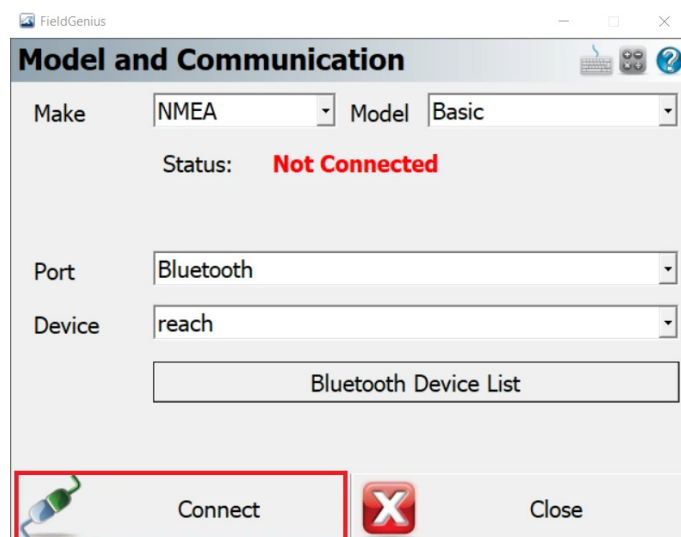
Bluetooth ID: reach

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**

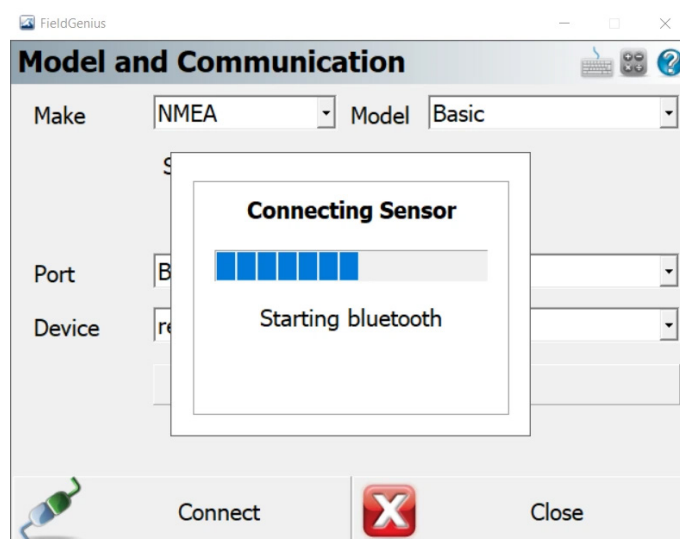
Port: Bluetooth

Device: reach

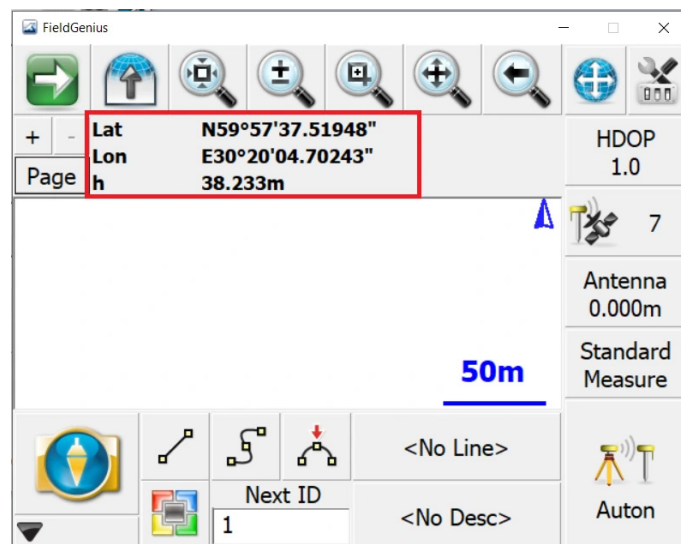
Bluetooth Device List

Connect Close

You will see progress dialog.

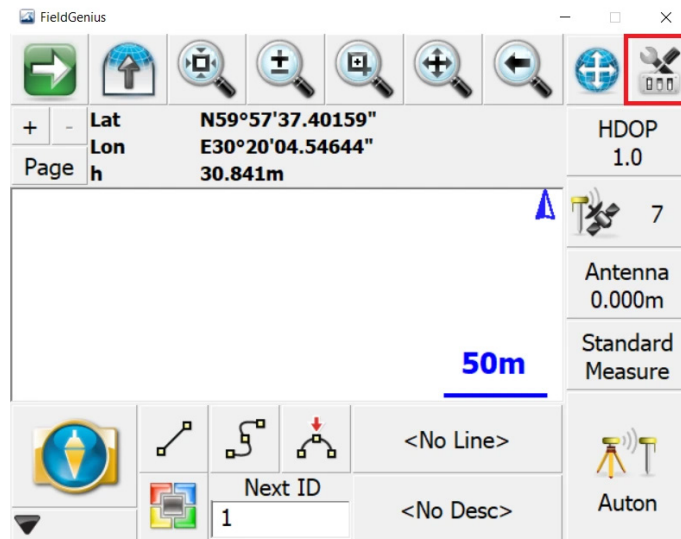


If the connection is successful, the position will be displayed with a number of satellites and PDOP.

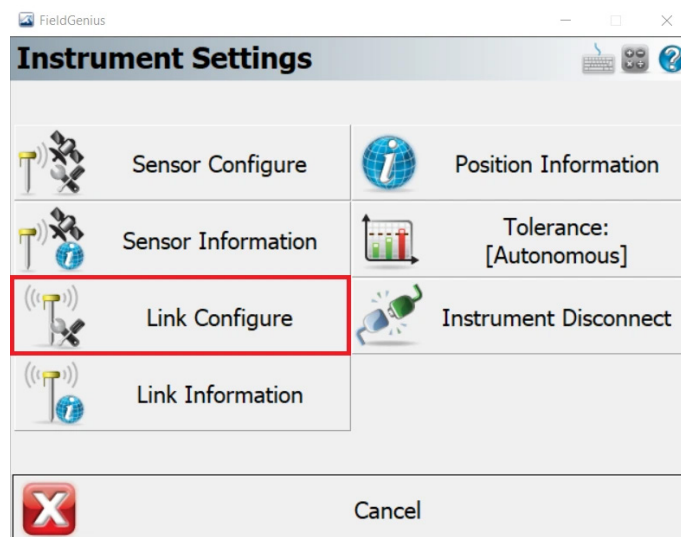


5.4.7 Configure FieldGenius to receive RTK corrections from an NTRIP caster

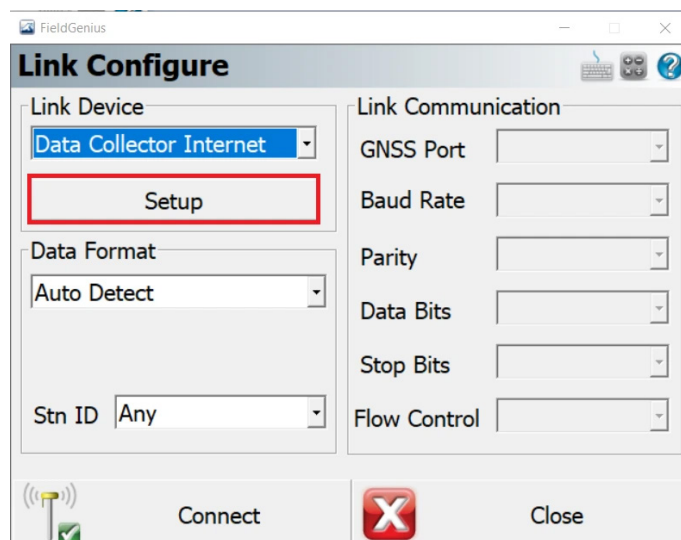
1. Go to *Instrument Settings*.



2. Choose *Link Configure*.



3. Pick *Data Collector internet* in *Link Device* and click *Setup*.



4. In the *Dialog* window, click *Press to Modify*.

The screenshot shows the 'Mobile Settings' dialog box. It has a sidebar with 'Port Options', 'Data Source', and 'NTRIP Settings'. The 'NTRIP Settings' section is expanded and highlighted with a red box. It contains a 'Press to Modify' button. Below this are fields for 'Description', 'Address', 'Port', and 'Username'. At the bottom are 'OK' and 'Cancel' buttons.

Mobile Settings	
Port Options	
Data Port	Shared
Data Source	
Source Type	NTRIP
NTRIP Settings	Press to Modify
Description	
Address	
Port	
Username	
OK	

5. Click *Add* in *NTRIP Casters* dialog and enter NTRIP caster details. Press *OK*.

The screenshot shows the 'NTRIP Casters' dialog box. It has a sidebar with 'Settings'. The 'Settings' section is expanded and highlighted with a red box. It contains fields for 'Description', 'Address', 'Port', 'Username', and 'Password'. At the bottom are 'OK' and 'Cancel' buttons.

NTRIP Casters	
Settings	
Description	test caster
Address	my-ntrip-caster.org
Port	1010
Username	user
Password	password
OK	
Cancel	

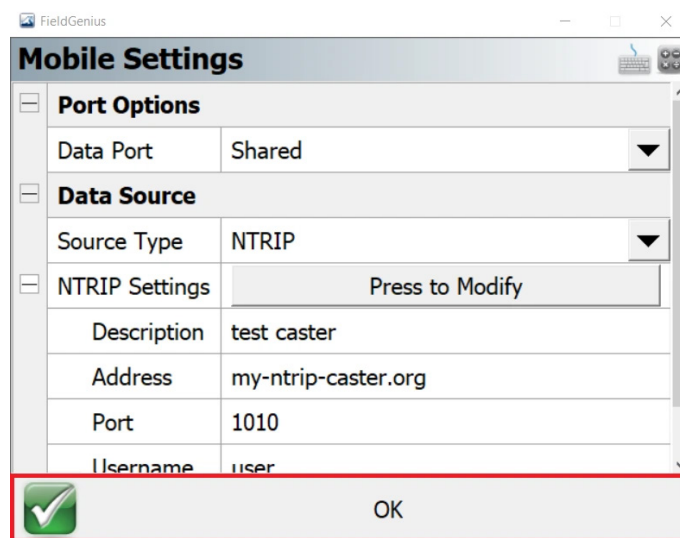
6. Select the created caster.

The screenshot shows the 'NTRIP Casters' dialog box. It has a table with columns: Description, Address, Port, Username, and Password. The first row is highlighted in blue. Below the table are buttons for 'Select', 'Add', 'Edit', 'Delete', and a red 'X' button.

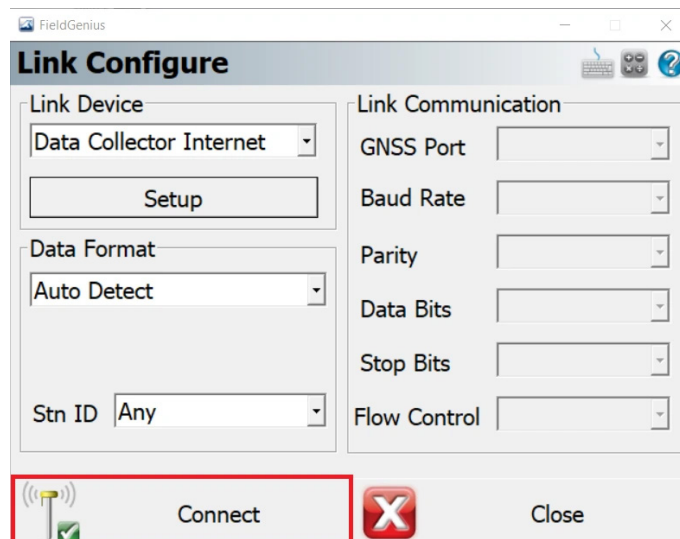
Description	Address	Port	Username	Password
test caster	my-ntrip-caster.org	1010	user	password

Select Add Edit Delete

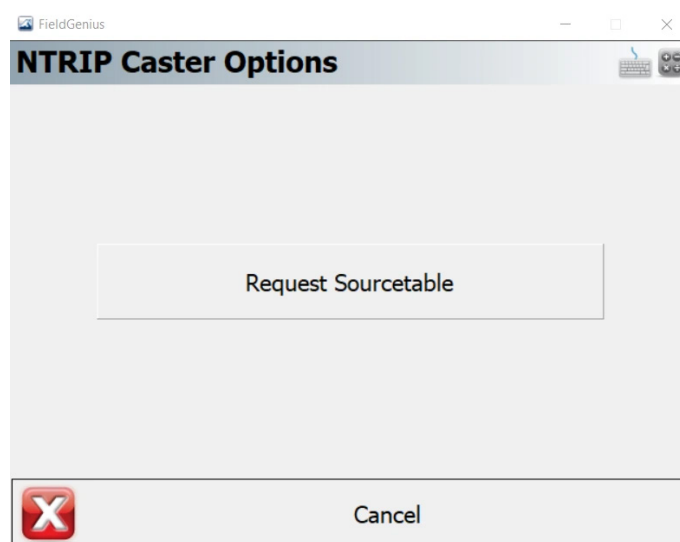
7. Click *OK* to finish the setup.

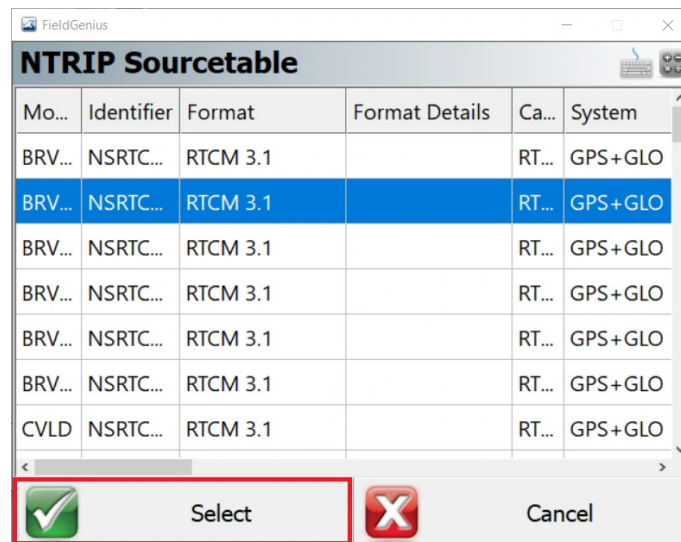


8. In the *Link Configure* dialog, click *Connect*.

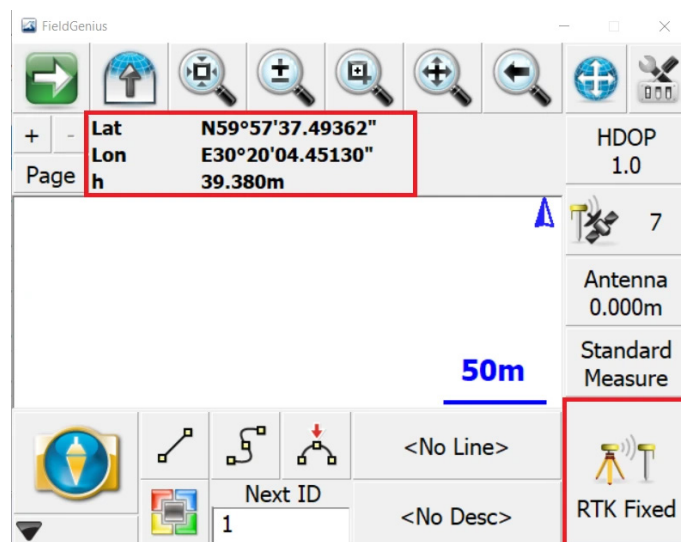


9. Once connected to the internet, request the sourcetable and choose a mountpoint.

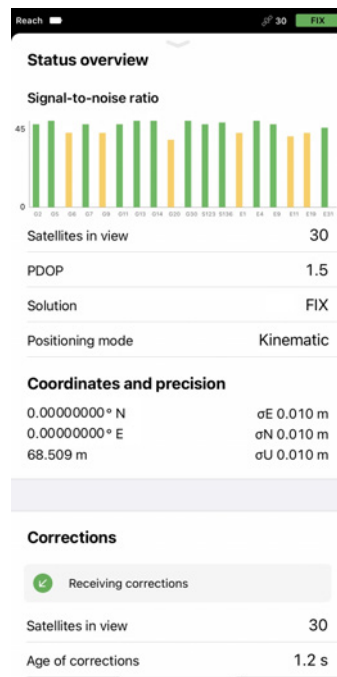




In a moment you will see the solution status in FieldGenius interface.



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

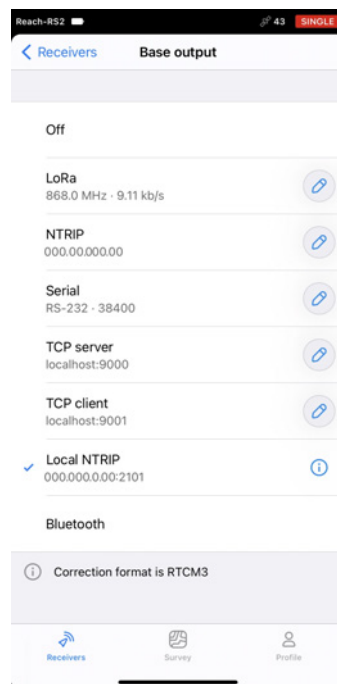
Caution: *This setup will work for your DJI RTK drone only if it supports a Wi-Fi connection.*

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:

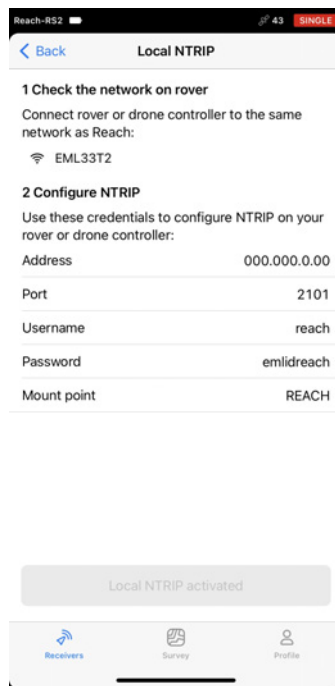
1. Place your Reach on the tripod and provide it with a clear sky view.

Tip: *Learn more about base placement in the [Placement](#) and [Placing the base](#) 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.

5.5.3 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 Placing the base guides](#).

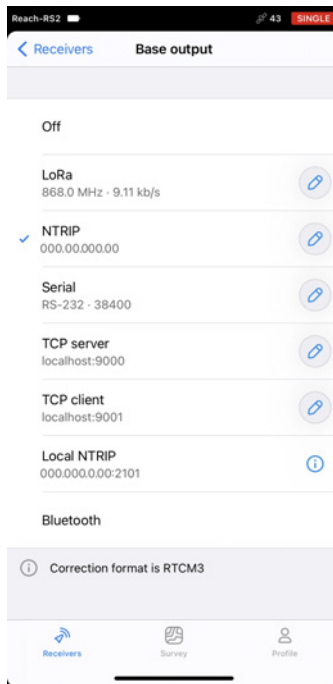
3. Open Emlid Flow and connect to your receiver.

4. Connect your Reach to the internet.

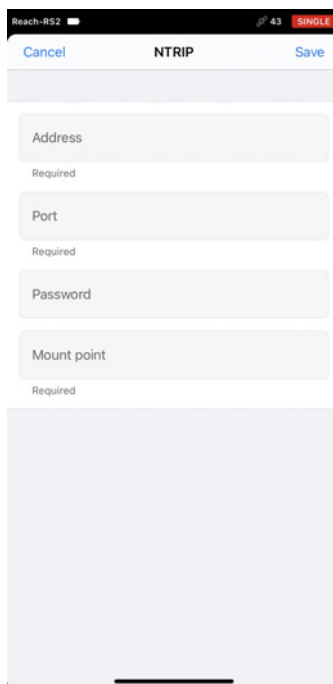
Tip: To learn more about connecting your Reach RS2/RS2+ to the internet, check the following guides:

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

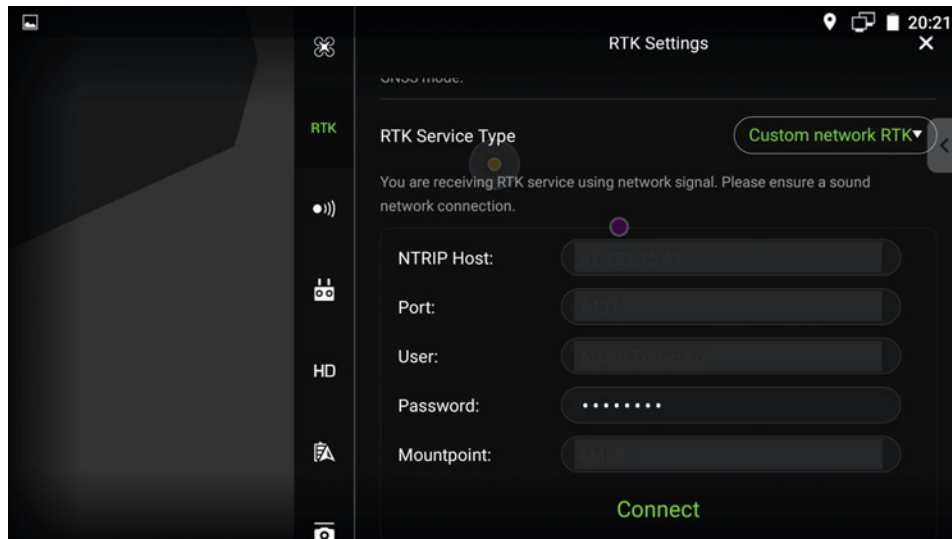
5.5.4 Set up DJI Phantom 4 RTK as rover

To set up your DJI Phantom 4 RTK as a rover, follow the steps below:

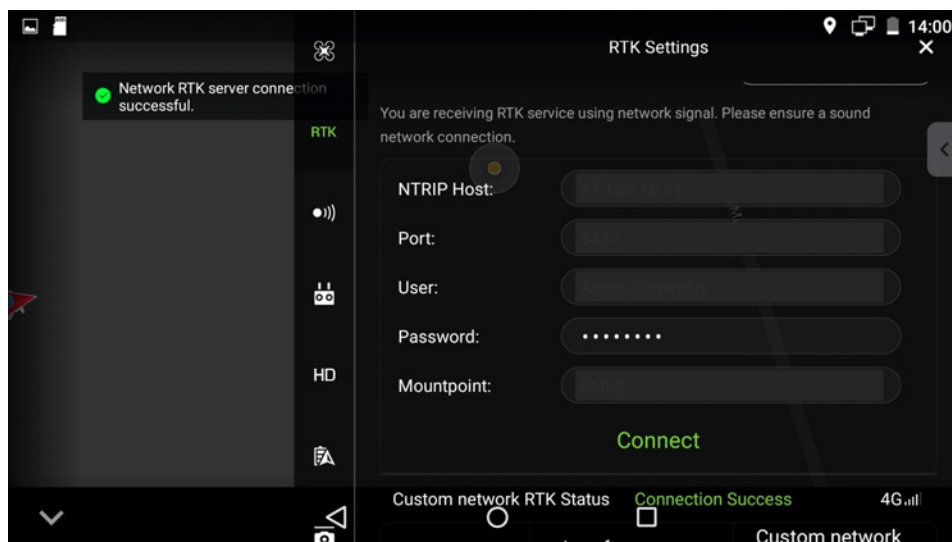
1. Connect the controller to your drone.
2. Open GS RTK.

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.



5.5.5 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.

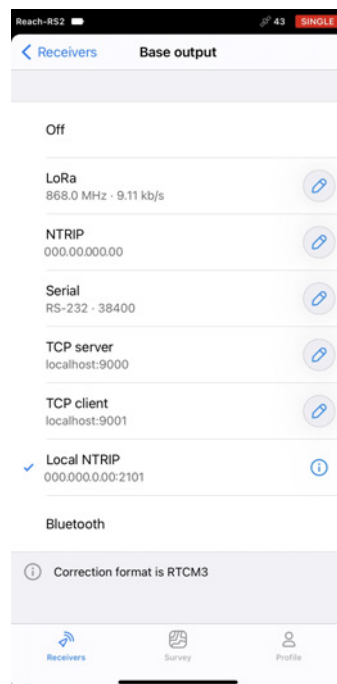
5.6.3 Set up Reach RS2/RS2+ as base using Local NTRIP

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:

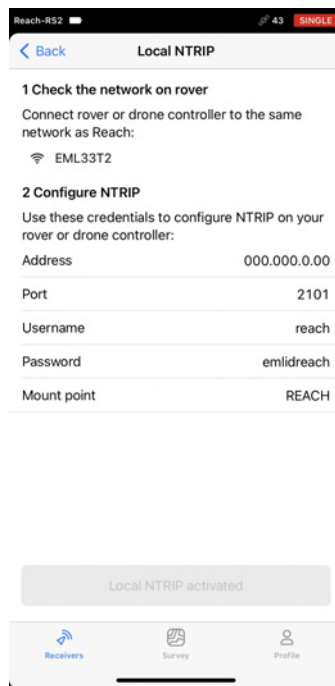
1. Place your Reach on the tripod and provide it with a clear sky view.

Tip: *Learn more about base placement in the [Placement](#) and [Placing the base](#) 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.

5.6.4 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 Placing the base guides.

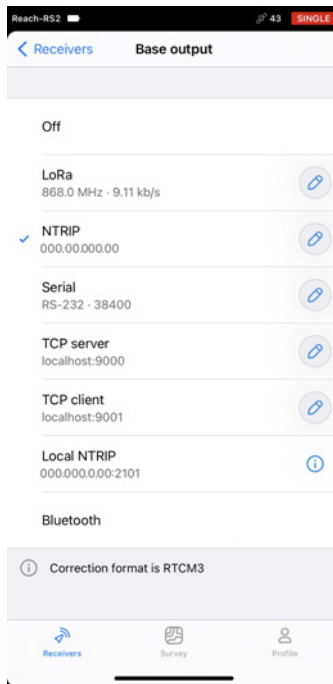
3. Open Emlid Flow and connect to your receiver.

4. Connect your Reach to the internet.

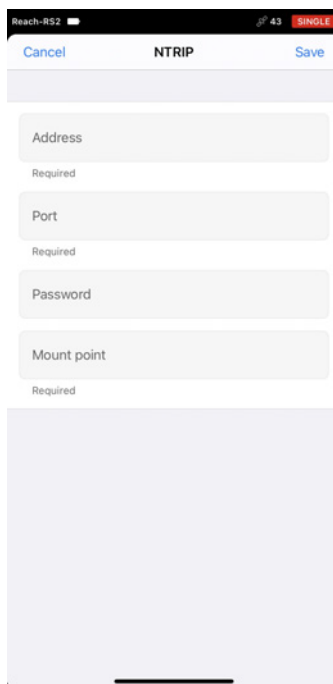
Tip: To learn more about connecting your Reach RS2/RS2+ to the internet, check the following guides:

- Connecting Reach to internet via built-in modem
- Connecting Reach to internet via Wi-Fi
- Connecting Reach to 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.

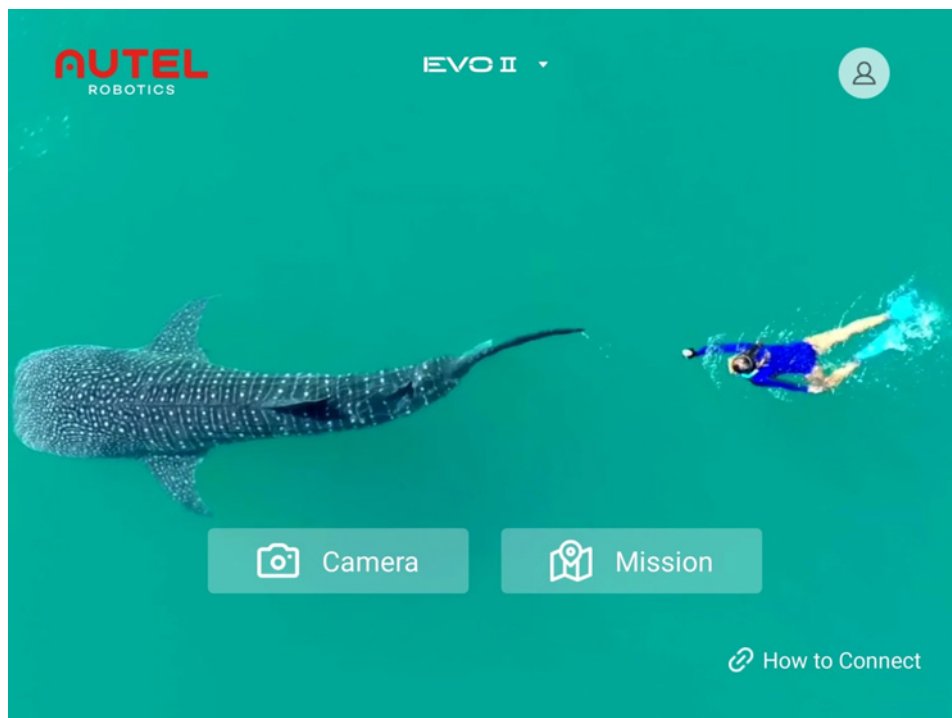
5.6.5 Set up Autel EVO II Enterprise as rover

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.

Settings RTK

Flight Control

RTK

Visual Navigation

Remote Control

Image Transmission

Aircraft Battery

Gimbal

Live

General

Certification Mark

RTK Aircraft Feature ☒

When RTK module is abnormal, manually turn it off and switch back to GNSS mode (if you turn on the RTK function after takeoff, the navigation system will continue using GNSS)

RTK connection options

Please ensure the network is connected

Custom None [Link RTK](#)

NetWork RTK

Custom Network RTK

NTRIP Host:

Port:

Account:

Password:

Mountpoint:

7. Tap *Login*.

Settings RTK

Flight Control

RTK

Visual Navigation

Remote Control

Image Transmission

Aircraft Battery

Gimbal

Live

General

Certification Mark

Port:

Account:

Password:

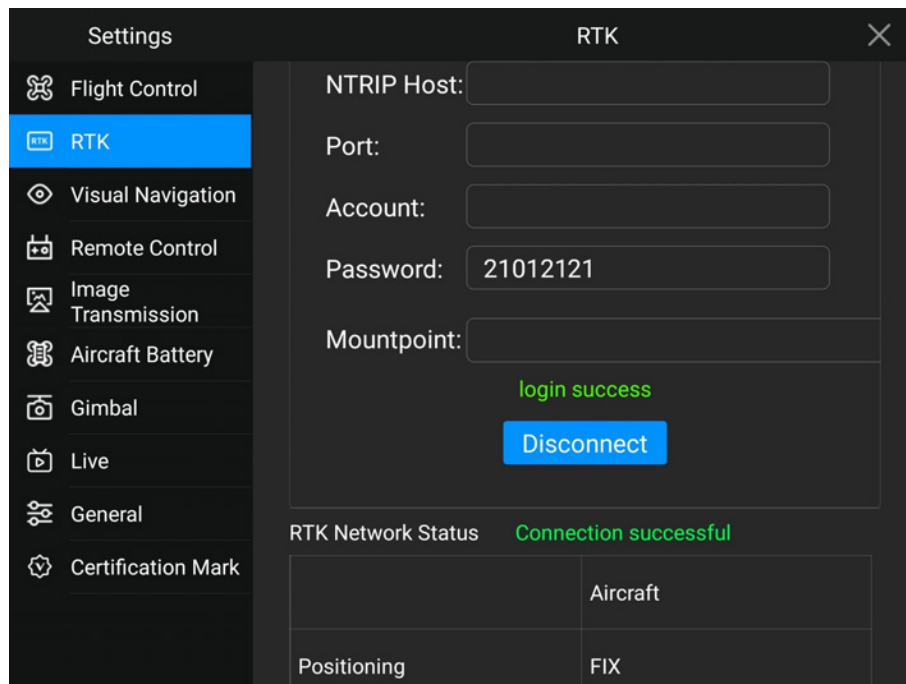
Mountpoint:

Login

RTK Network Status **Connection failed**

	Aircraft
Positioning	SINGLE

8. The *login success message* will appear if the base is successfully connected. RTK Network Status should change to the Connection successful state.



5.6.6 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 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*.

5.7.1 Setting up Reach RS2/RS2+

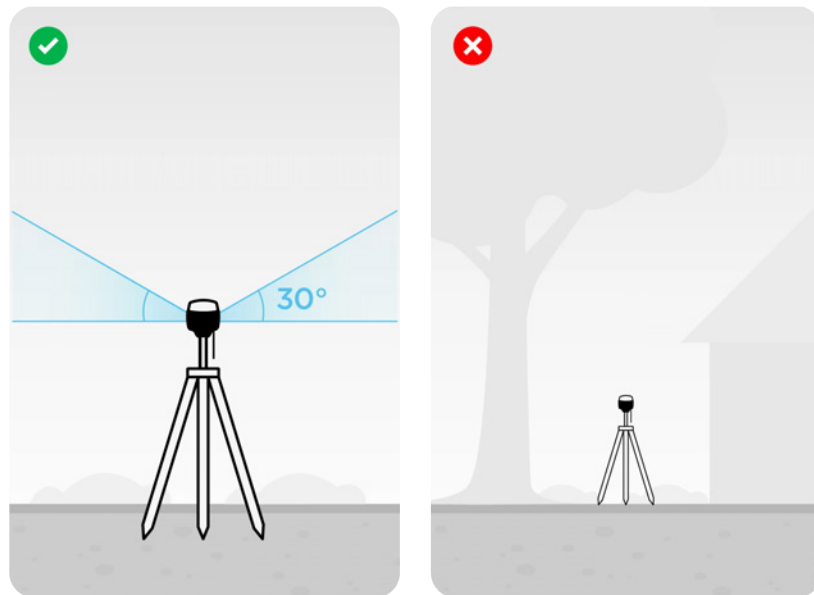
In this part, we will explain how to configure Reach RS2/RS2+ to transmit corrections to the PC via Bluetooth.

Placing the Reach RS2/RS2+ receiver

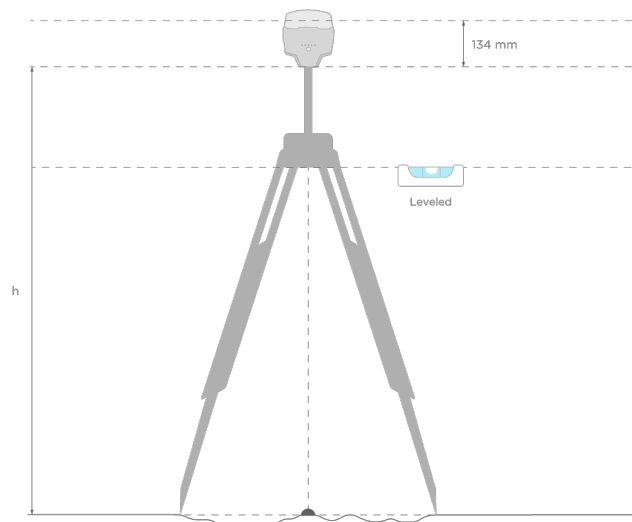
Tip: To find out other ways of placing the local base station, check the *Placing the base guide*.

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.

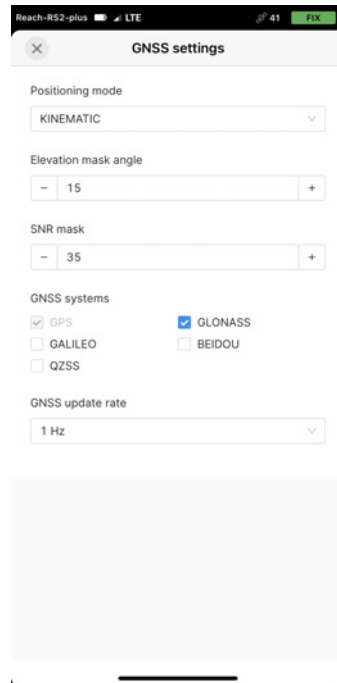
5.7.2 Pairing with PC

1. Open Emlid Flow and connect to your Reach.

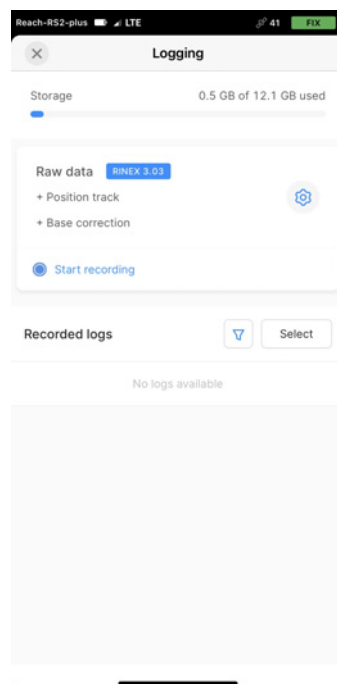
STEPS FOR CONNECTING VIA HOTSPOT: *To learn more, check the Connecting to Reach guide.*

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.*

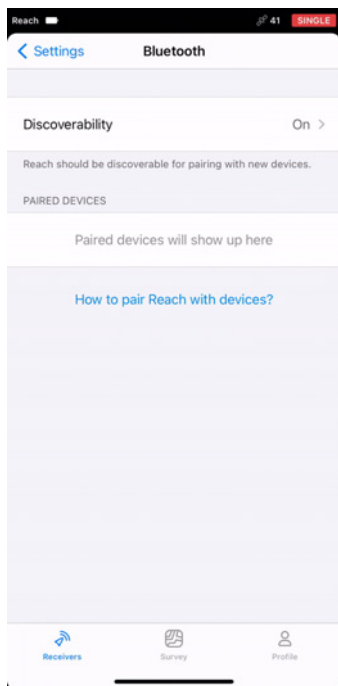


4. Go back to the *Receivers* screen and tap *Logging*.

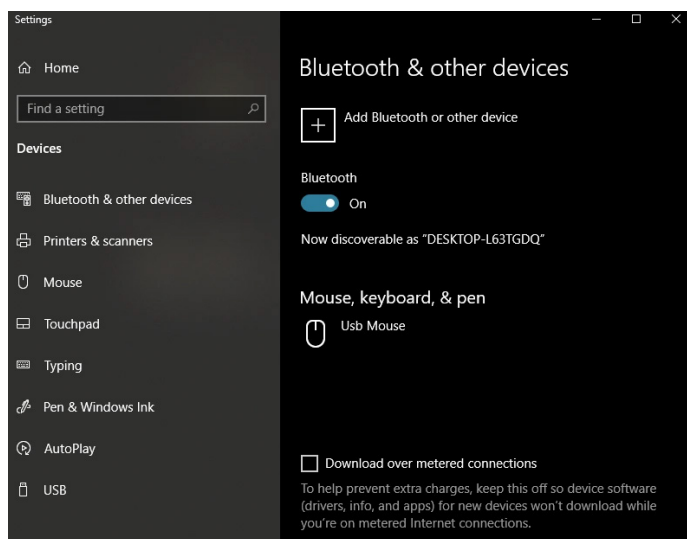


5. Tap the *Settings* button.
6. In the *Format* dropdown menu, choose *UBX*. Apply changes and close the *Logging* screen.

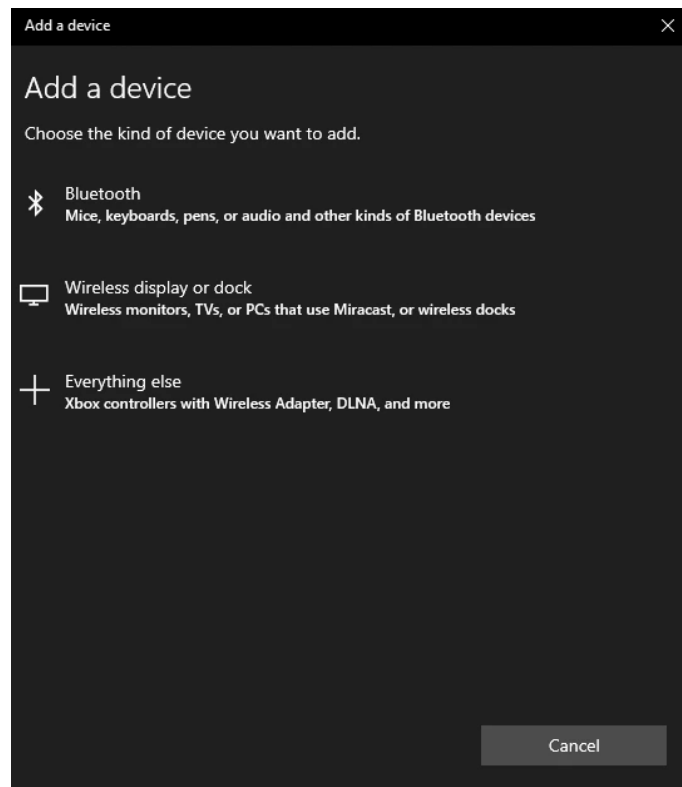
7. Go to *Settings* and tap *Bluetooth*.
8. Enable *Bluetooth* by tapping the *Turn on Bluetooth* button.
9. Tap *Discoverability* and turn on the *Discoverability* option. Tap *Save* to apply changes.



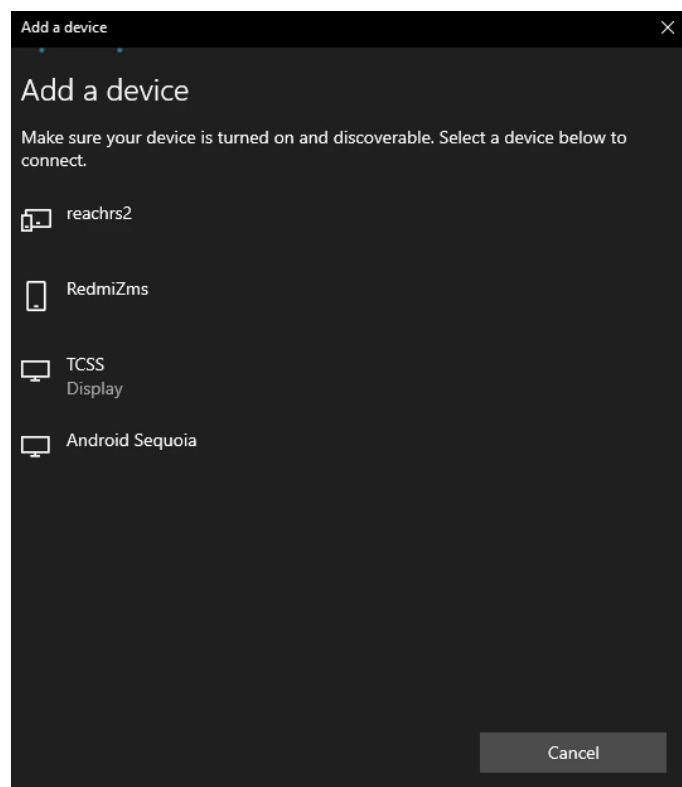
10. Enable Bluetooth on your PC.
11. Open Bluetooth settings.
12. Click on *Add Bluetooth or other device*.



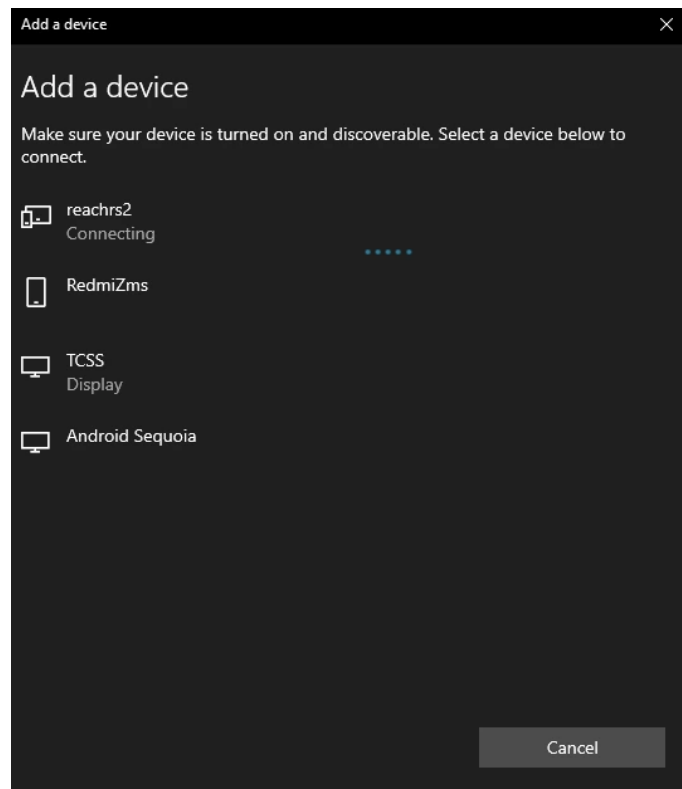
13. Choose the *Bluetooth* option in the *Add a device* window.



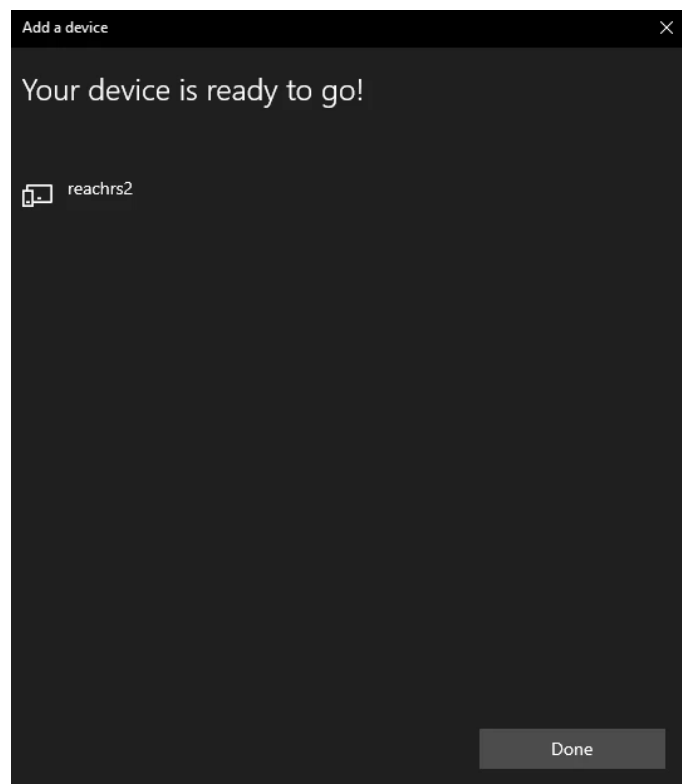
14. Make sure your Reach RS2/RS2+ is discoverable and can be seen in the list of devices.



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!"

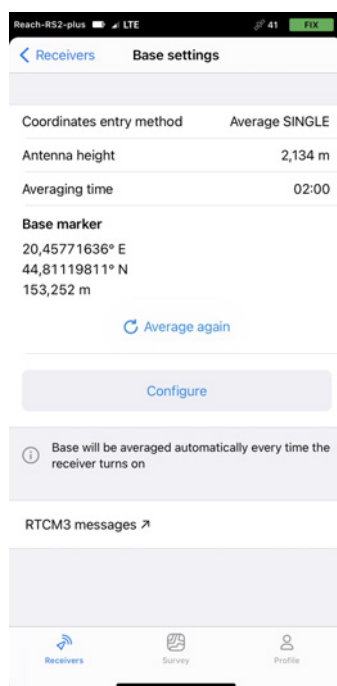


Now you can proceed to the next step.

5.7.3 Configuring base output

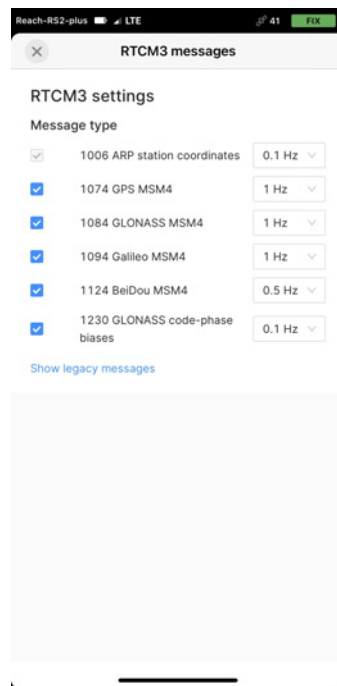
1. On the *Receivers* screen in Emlid Flow, tap *Base output*.

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.

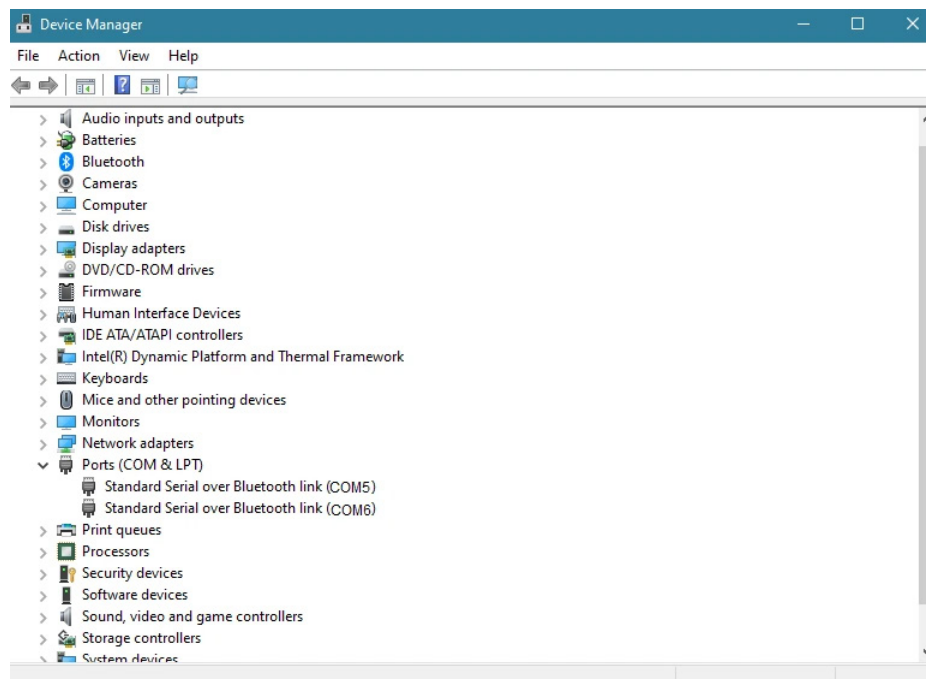
RTCM3 messages	Message type
	Minimal required messages
1006	ARP station coordinate
1074	GPS MSM4
	Optional messages for other GNSS
1084	GLONASS MSM4
1094	Galileo MSM4
1124	BeiDou MSM4



5.7.4 Checking connection

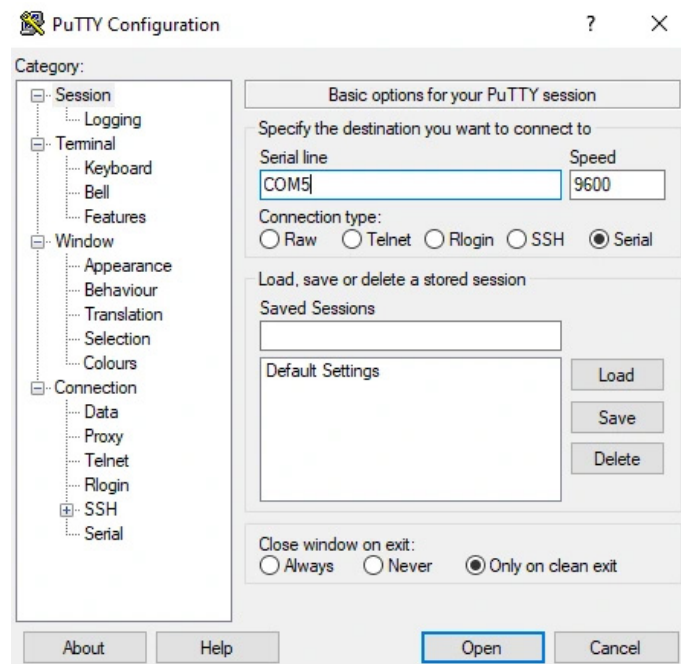
You will need to find out what COM port on your PC is used by Reach RS2/RS2+. For that, we recommend using the PuTTY client for Windows.

1. Download and install PuTTY.
2. Open Device Manager on your computer.
3. Check available Standard Serial over Bluetooth link ports.



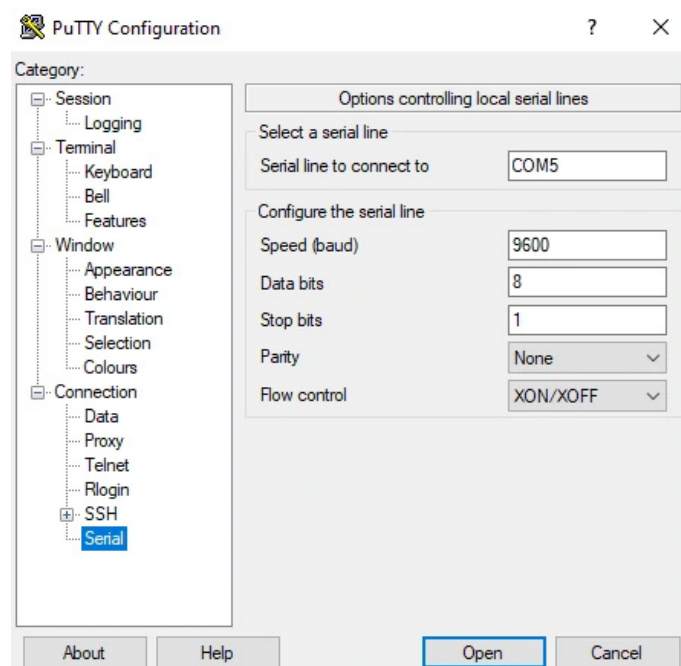
4. Open PuTTY.
5. Go to the *Session* tab.

6. Specify the COM port in the *Serial line*.
7. Choose speed at 9600.
8. Choose the connection type *Serial*.



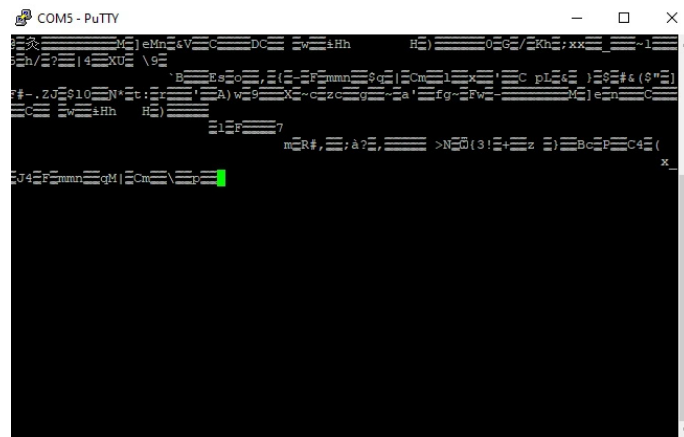
You can do the same in the *Serial* tab:

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*.

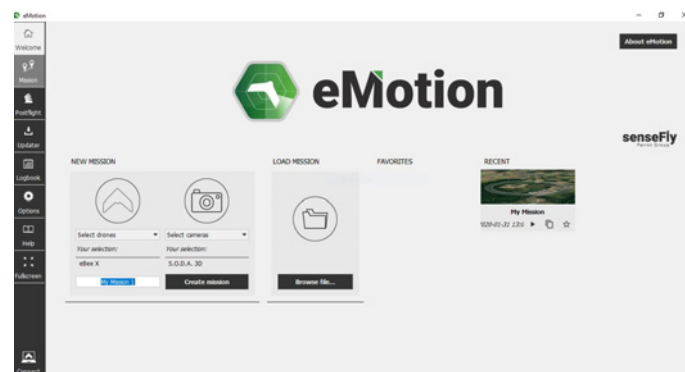


Now you are ready to configure the RTK link in eMotion3.

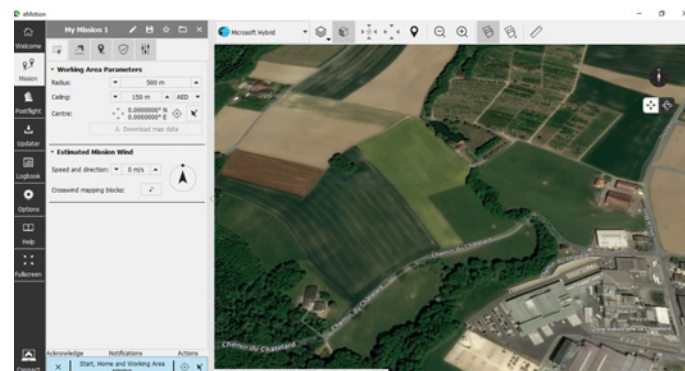
5.7.5 Connecting to eMotion3

Now we will show you how to establish an RTK link with Reach RS2/RS2+ base on your eBee drone.

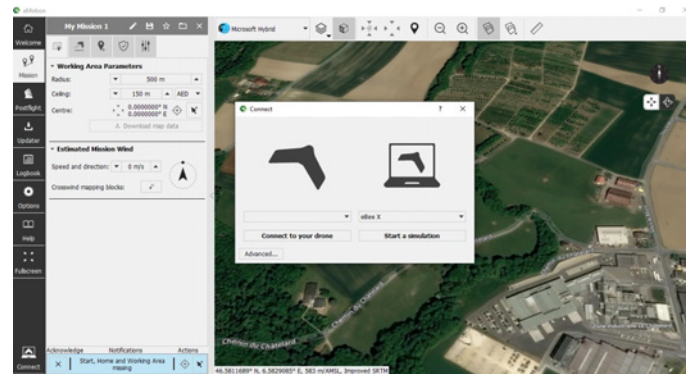
1. Launch eMotion3.



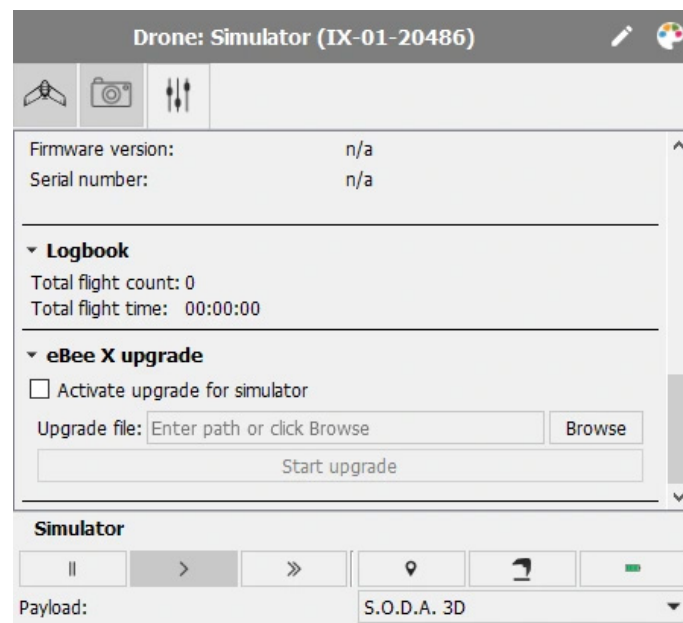
2. Create mission and go to the *Mission* tab.



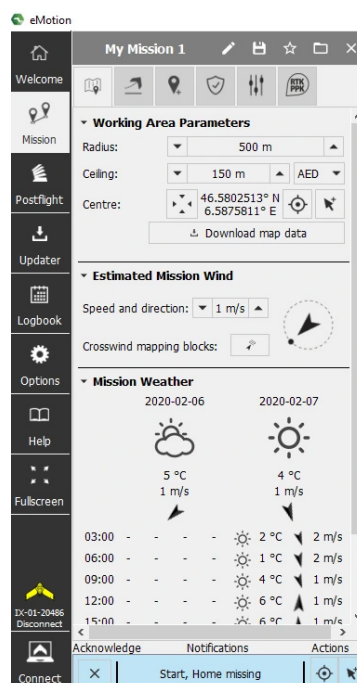
3. Press the *Connect* button. Connect to the drone by pressing *Connect to your drone* or simulate your flight by pressing *Start a simulation*.



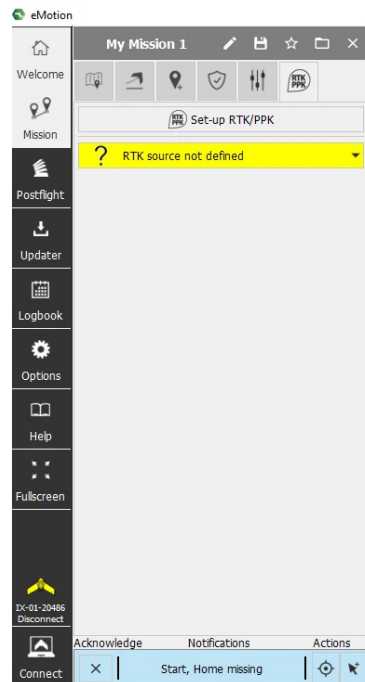
4. Activate your RTK/PPK license in the *theeBee plus upgrade* tab of the Drone's panel. To activate a license for simulation, tick an *Activate update for simulator* box.



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*.

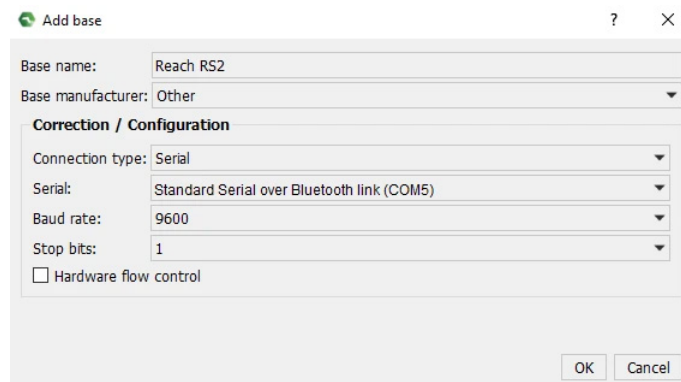
8. Set Reach RS2/RS2+ to a base name.

9. Set Other to a base manufacturer.

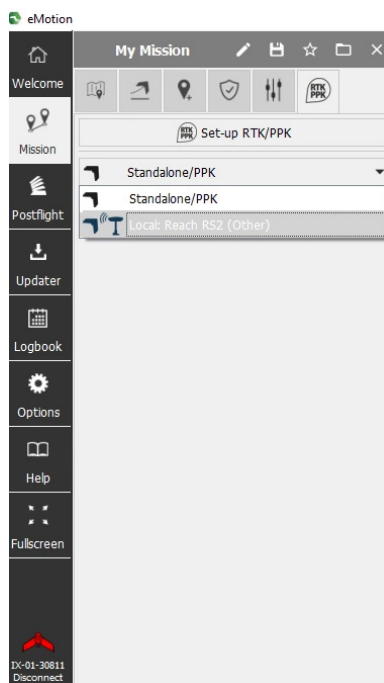
10. Set Connection type to Serial.

11. Choose the COM port that you checked on the previous step.

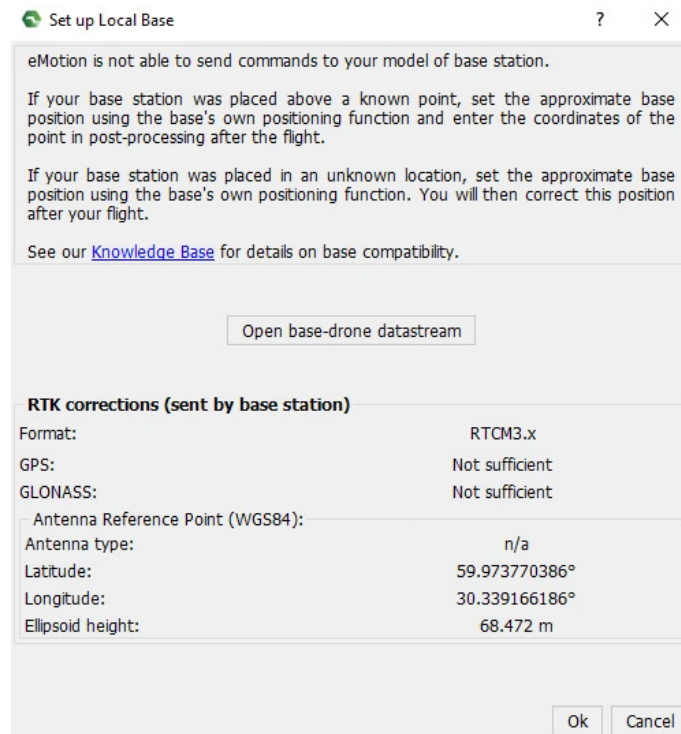
12. Set the same baud rate for all connected devices.
13. Press *OK*.



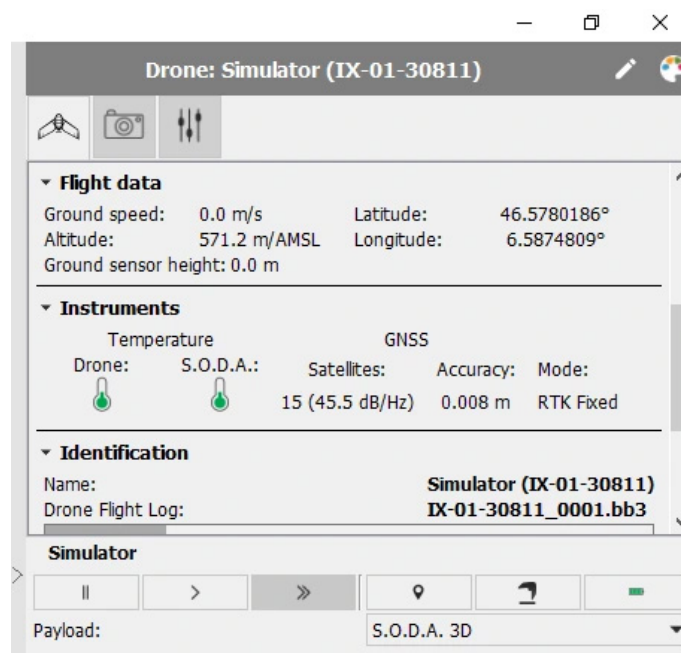
Once you configured the connection, you can choose the base station in the *RTK* tab.



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+.

5.8 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.

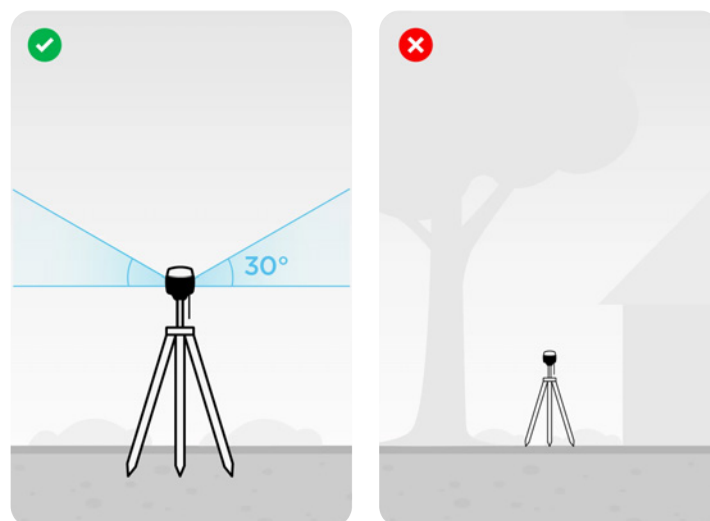
5.8.1 Preparing Reach RS2/RS2+ data

In this part, we will explain how to place Reach RS2/RS2+ to record logs for PPK.

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.

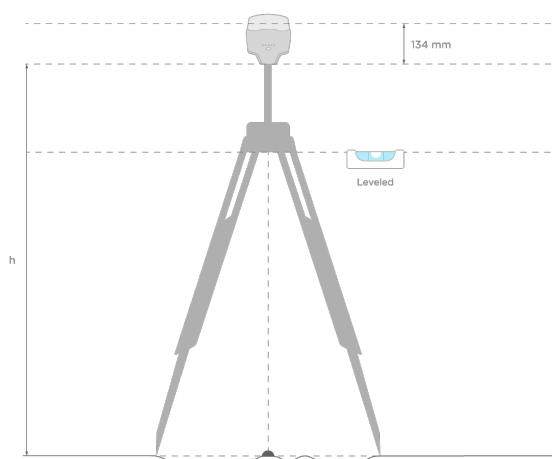
1. Make sure you choose an appropriate location to place Reach RS2/RS2+ base station. Take a look at 2 pictures below. The left picture demonstrates desirable conditions for the base location. The right one is an example of bad surrounding conditions such as the reduced view of the sky, possible obstructions 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.

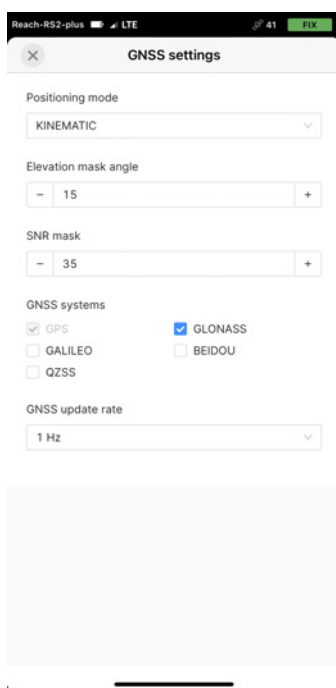


Note: Precise base coordinates will be needed for post-processing in eMotion.

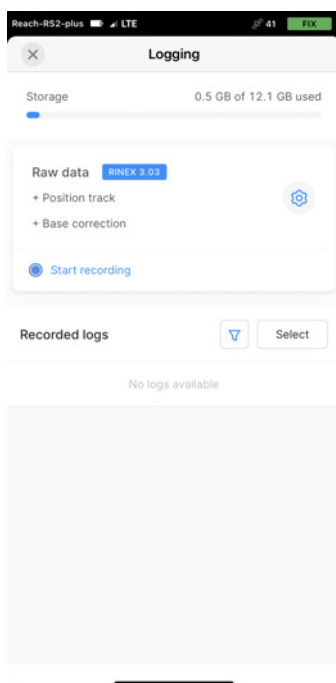
5.8.2 Raw data logging

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.

5.8.3 Converting raw data log

1. Download RTKLIB QT apps.

2. Download raw files from Reach to your PC.

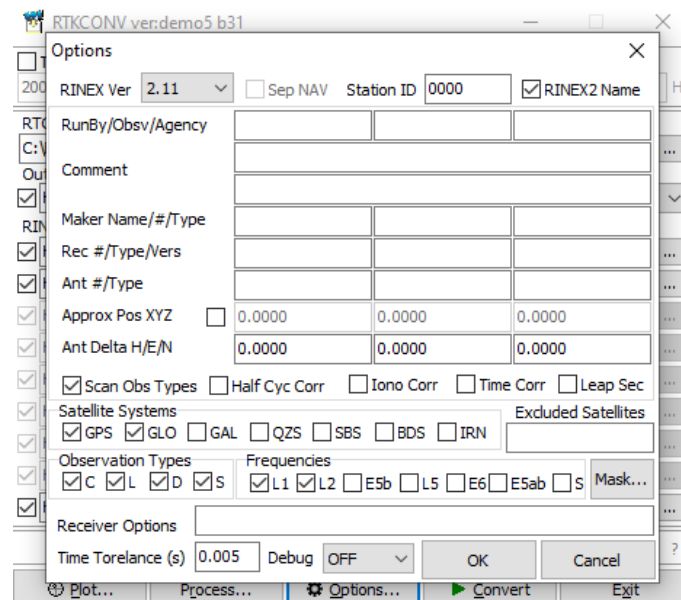
3. Start RTKLIB RTKConv.

4. Push *Options* button.

5. Choose *RINEX Version 2.11*.

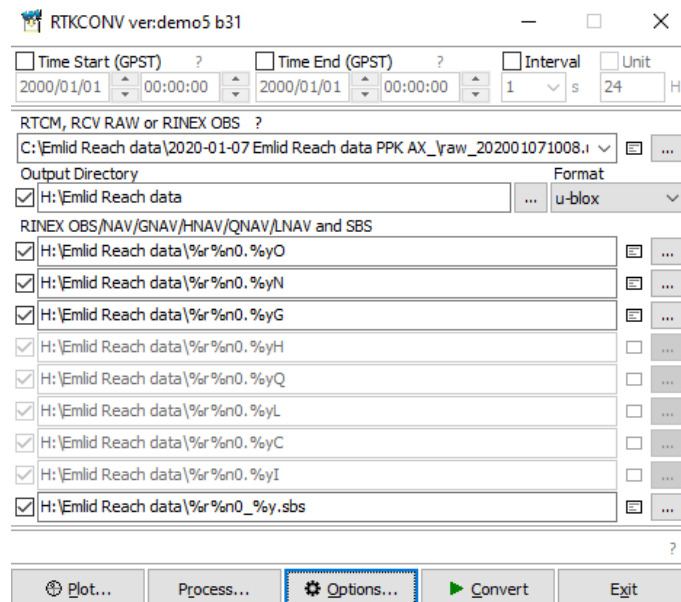
6. Turn on satellite systems you need.

7. Press *OK*.



8. Add your rover raw log in the first field and choose an output directory.

9. Choose format of your log in the pop-down menu. Set format to u-blox.

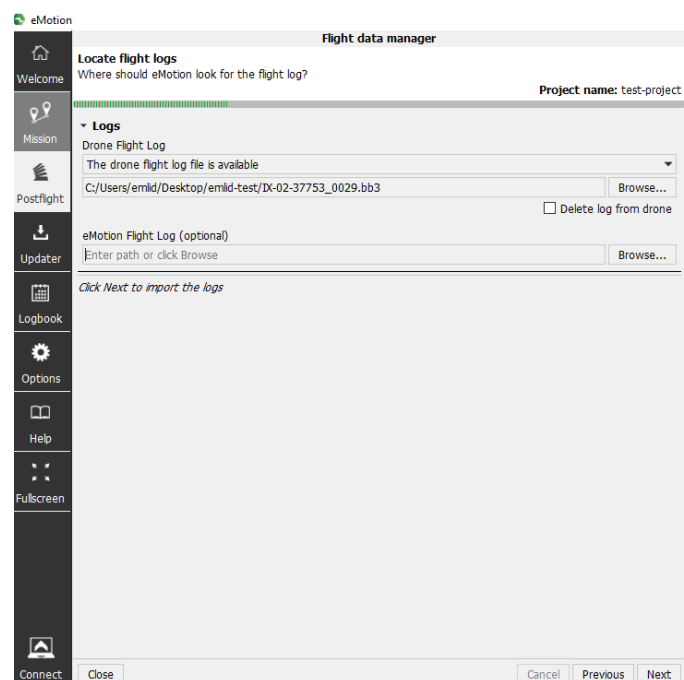


10. Press *Convert*.

Now you can proceed to post-processing your logs in eMotion3.

5.8.4 Post-processing with eMotion

1. Launch eMotion3 and select post flight FDM (Flight Device Manager).



2. Create a project and import the flight logs. Proceed to the *RTK/PPK workflow* tab.
3. 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 __Emild 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:/Emild Reach data/00000070.20D Browse

Navigation: H:/Emild Reach data/00000070.20n Browse

H:/Emild 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 __Emild 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/RS2+ and eBee drone.

6 Specifications

6.1 Performance specs

[Datasheet for Reach RS2 \[PDF, 6 MB\]](#) [Datasheet for Reach RS2+ \[PDF, 28.1 MB\]](#)

6.2 Ports overview

SIM card slot

Reach RS2 has a built-in 3.5G modem with 2G fallback and global coverage, 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](#).

RS-232 port

Reach RS2/RS2+ can be supplied with constant power over the bottom connector. It's useful when you want to set up RS2/RS2+ as a permanent base or integrate it with a tractor for precise agriculture. You can also configure the receiver to turn on and off in sync with an external battery. This feature is available in the [Emlid Flow settings overview](#).

To establish RTK communication with third-party devices, you can connect external radio via RS-232 port.

You can enable the Position Streaming to other devices or third-party apps via RS-232 port. You just need to turn on Position Streaming 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 [Base and rover setup 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.

6.3 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]

6.4 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 \[PDF, 852 KB\]](#)

6.5 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 Troubleshooting

7.1 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.

7.1.1 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.*

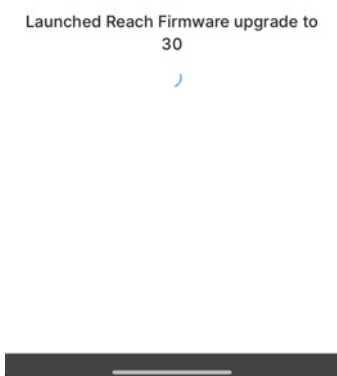
7.1.2 When to update your Reach

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:

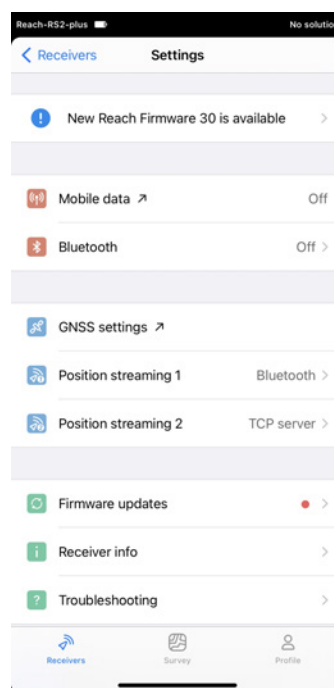
1. Install the Emlid Flow app.
2. Connect to the receiver.
3. Update the firmware following the on-screen instructions.



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.

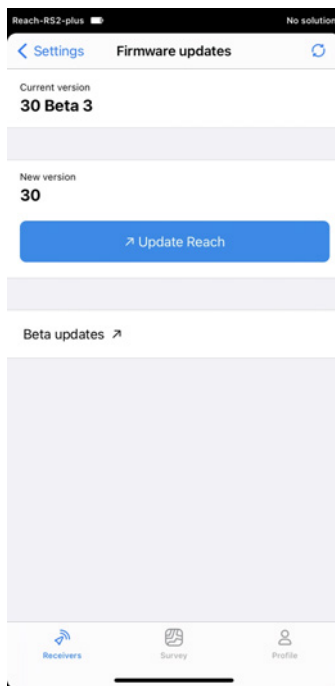


7.1.3 Update firmware

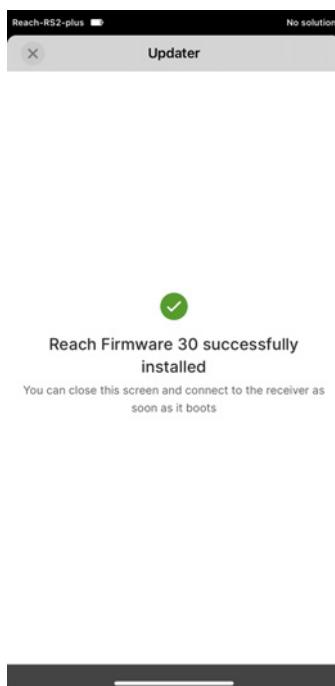
Note: You can allow using mobile data for updates by turning on the *Allow updates using mobile data* option on the *Mobile data* screen. However, we recommend updating your Reach using Wi-Fi network due to the large bulk of data.

To update the receiver, perform the following steps:

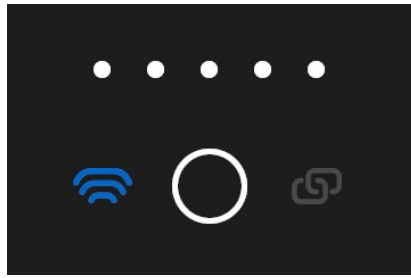
1. Tap the *Update Reach* button.



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.



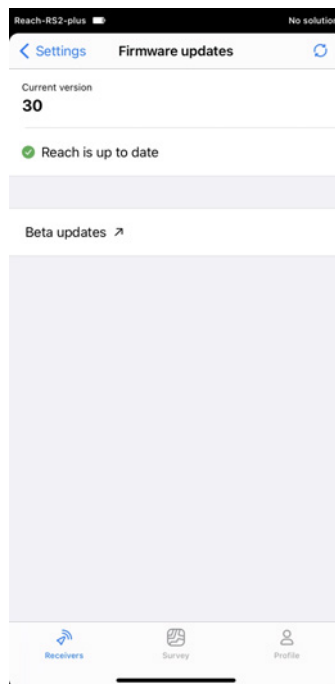
4. After reboot, wait for the Network LED to turn blue, showing that Reach RS2/RS2+ has joined your network again.



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.

7.2 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. You can find more information in the Settings overview section.*

7.2.1 Reach Firmware Flash Tool installation

To flash your Reach RX, 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.

7.2.2 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.

7.2.3 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.

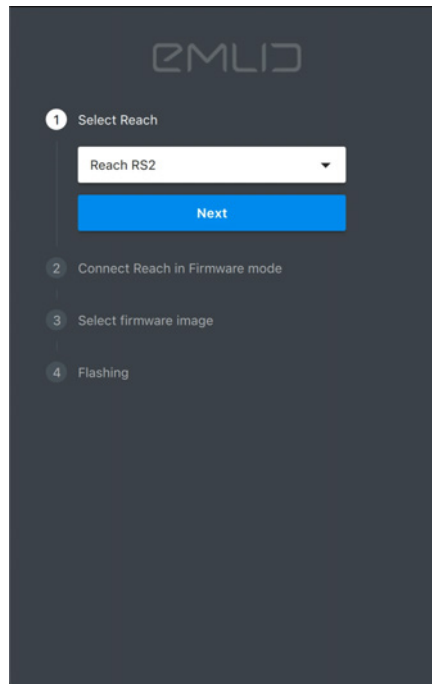
7.2.4 macOS installation

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.

7.2.5 Reflash your Reach RS2/RS2+

Reflash your Reach following the steps below:

1. Open Reach Firmware Flash Tool and choose Reach RS2/RS2+.



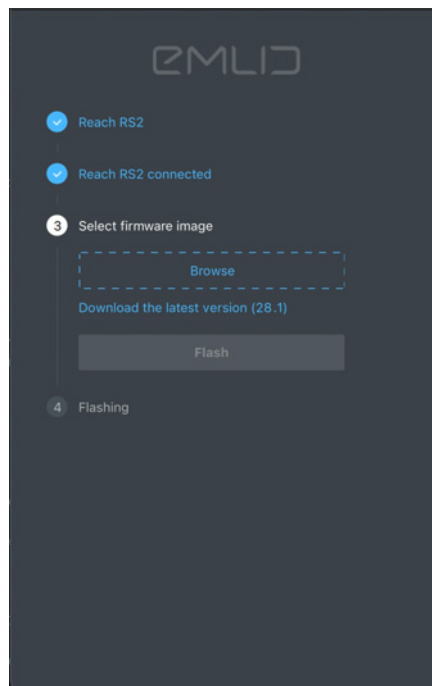
2. Connect your Reach in Firmware mode.

How to switch your Reach to firmware mode: *Make sure that Reach RS2/RS2+ is turned off and perform the following steps:*

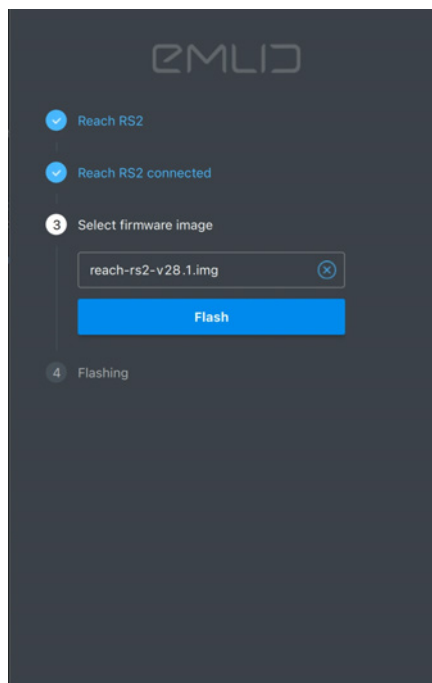
- (a) *Press and hold the power button.*
- (b) *Plug the USB cable into PC.*
- (c) *Release the power button.*
- (d) *All LEDs should blink several times simultaneously, and then start blinking one after another.*

3. Download the proposed Reach Firmware .zip file.

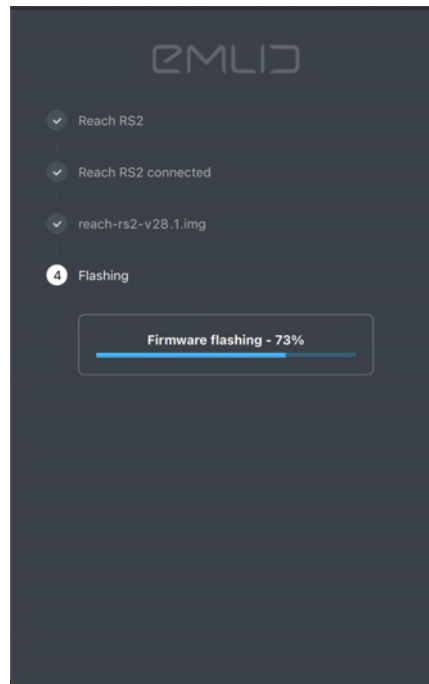
Note: *Make sure you have enough disk space. Reach Firmware Flash Tool creates 2 folders: one to download the image and another one to unpack it. Once you close the Flasher tool, the folder with the unpacked image will be deleted.*



4. Click *Flash*.

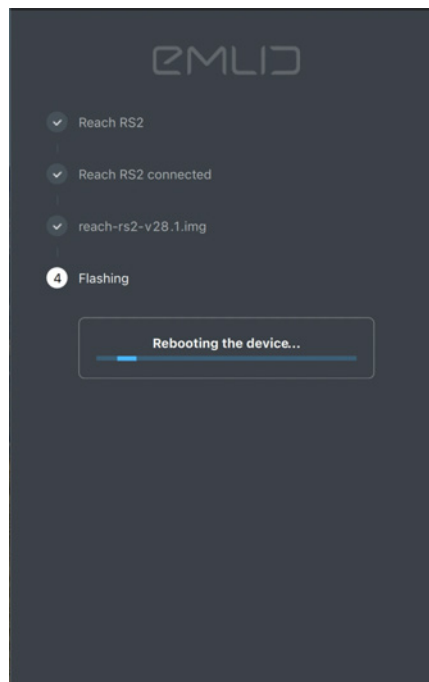


5. Wait until the end of the flashing process.



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.*

7.3 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.

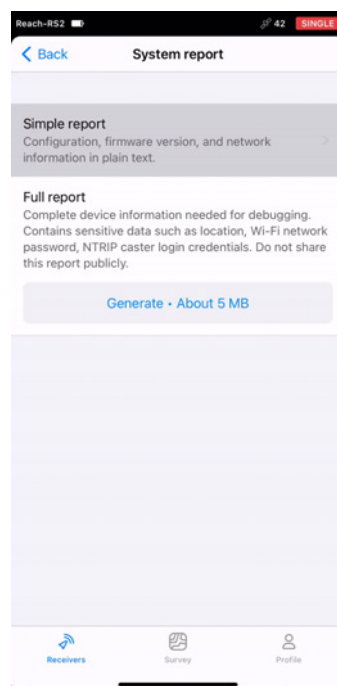
7.3.1 Overview

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.

7.3.2 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.

7.4 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.

7.4.1 Overview

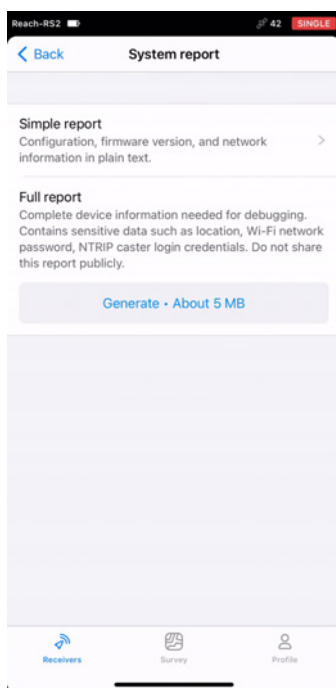
An FSR is a tool used to facilitate Reach troubleshooting. It comes in a ZIP archive and contains system logs and technical details of your Reach.

Caution: *We do not recommend sharing FSR publicly—it contains information such as your location, Wi-Fi network password, NTRIP caster login credentials.*

7.4.2 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.

7.5 How to find serial number

This guide explains how to find the serial number of your Reach.

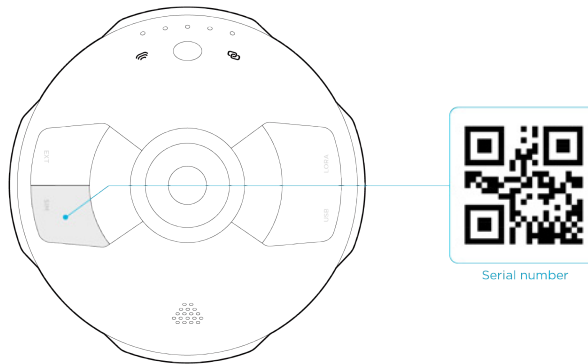
7.5.1 Overview

The serial number is assigned to your Reach unique string of numbers and letters.

7.5.2 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.

7.6 How to enable raw data debug option

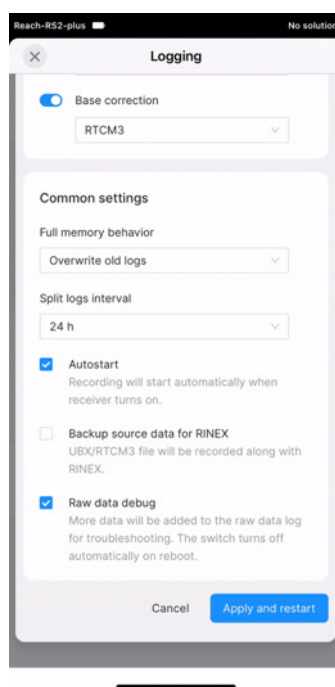
Caution: We recommend enabling the option only on the Support team request since the debug data adds extra weight to the logs.

This guide explains how to enable the raw data debug option on your Reach to facilitate troubleshooting in complicated cases.

7.6.1 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.

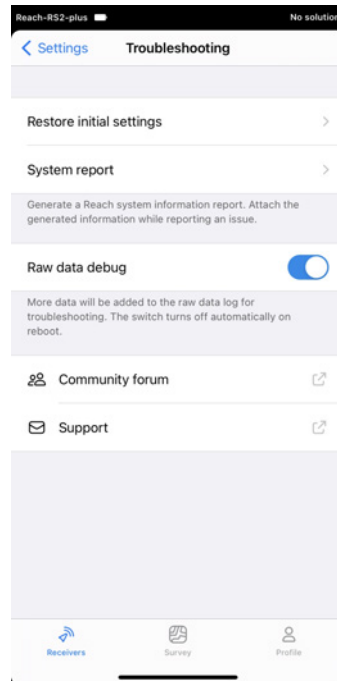
The raw data debug option adds additional internal information to the raw data logs in the UBX format. This feature provides more detailed information on the RTK calculation processes that can be used for debugging purposes in particular cases.



7.6.2 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.

7.6.3 How to restore initial settings

This guide explains how to restore the initial settings on your Reach RS2/RS2+.

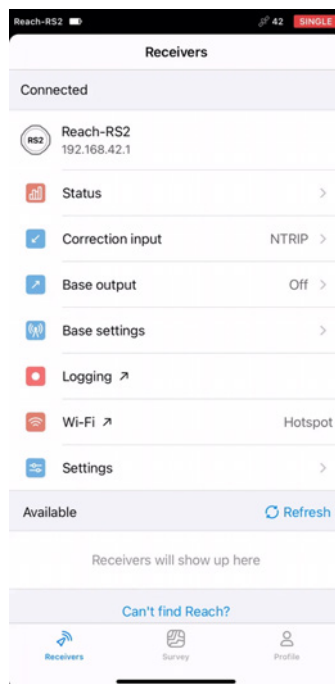
7.6.4 Overview

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.

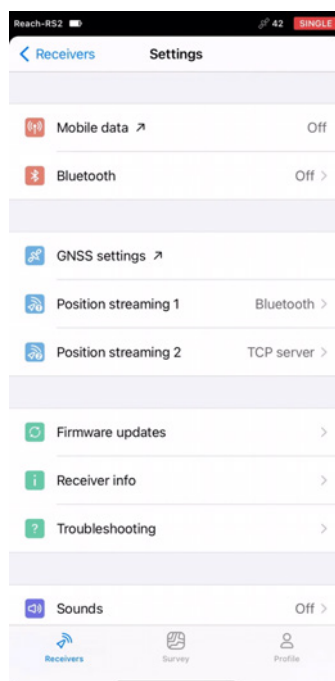
7.6.5 Workflow

To restore the initial settings on your receiver, follow the steps below:

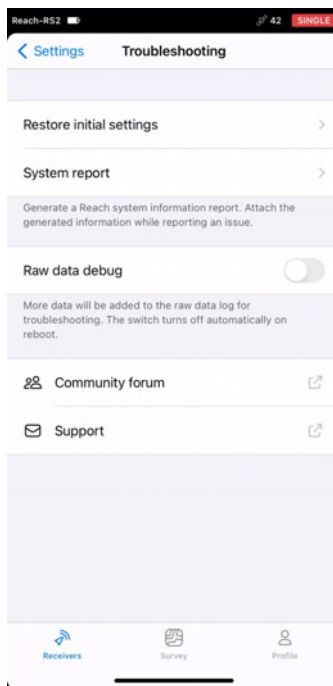
1. Connect to your Reach via Emlid Flow.



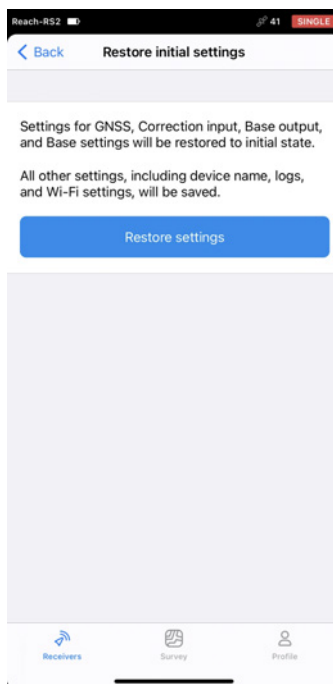
2. Tap *Settings* and go to the *Troubleshooting* section.



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.

8 Glossary

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.

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.

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.

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.

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.

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.

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.

LoRa radio

Long Range or LoRa radio is used for Reach receivers to send or receive corrections without an internet connection. Reach 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.

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.

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.

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.

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.

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.