



REACH RX

USER DOCUMENTATION

Firmware version **1.4**

Emlid Flow app version **8.4** or newer

June 15, 2023

Table of contents

1	Before you start	3
1.1	Power supply and operation	3
1.2	Connecting to Reach RX	4
1.3	Updating Reach RX firmware	5
1.4	Placement	5
2	Quickstart	6
2.1	How RTK works	6
2.2	Working with NTRIP service	7
2.3	Working with Reach RS2+ base	9
2.4	Working with third-party base	11
3	Tutorials	13
3.1	Preparing ground control points for PPK UAV mapping	13
3.2	Getting Reach coordinates on Android devices via Bluetooth	14
4	Reference	16
4.1	Firmware flashing	16
4.2	How to find serial number	16

1 Before you start

1.1 Power supply and operation

Overview

Reach RX has 2 LEDs—Battery LED and Status LED. The Battery LED indicates the battery charge level and is located above the power button. The Status LED indicates the operating states of the receiver. The power button is used to turn on and off the receiver and to check the battery charge level.



Checking battery charge level

You can check the battery charge level with a short press on the power button. Possible statuses of the Battery LED are the following:

RX is turned off	RX is turned on	RX is charging
31-100% Solid green	31-100% Solid green	100% Solid green
11-30% Solid yellow	11-30% Solid yellow	31-99% Blinking green
1-10% Solid red	0-10% Blinking red	11-30% Blinking yellow
0% Blinking red		1-10% Blinking red

Charging Reach RX

Reach RX has a built-in Li-Ion battery providing up to 16 hours of autonomous work when operating as an RTK network rover. You can power and charge Reach RX over the USB Type-C cable supplied with the receiver using power supplies like a power bank or USB wall adapter.

Operating receiver

You can check the operating state of the receiver by watching its Status LED. Possible statuses of the Status LED are the following:

Off Reach RX is turned off.

“Breathing” white Reach RX is loading.

Solid light Reach RX is operating. This state can be represented by 3 different colors: white, yellow, and green.

1.2 Connecting to Reach RX

Downloading Emlid Flow

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

Powering on Reach RX

To power up your Reach RX, follow the steps below:

1. Press the Power button once to display the current charge level. If it's low, charge the receiver from a USB wall charger or a power bank using the supplied USB Type-C cable.
2. Hold the power button for a couple of seconds to turn the unit on.
3. Wait until the loading is over, and the Status LED becomes solid white. Learn more about the Reach RX operating states in the [Power supply and operation guide](#).

Now you can connect to your Reach RX using Emlid Flow.

Connecting to Reach RX

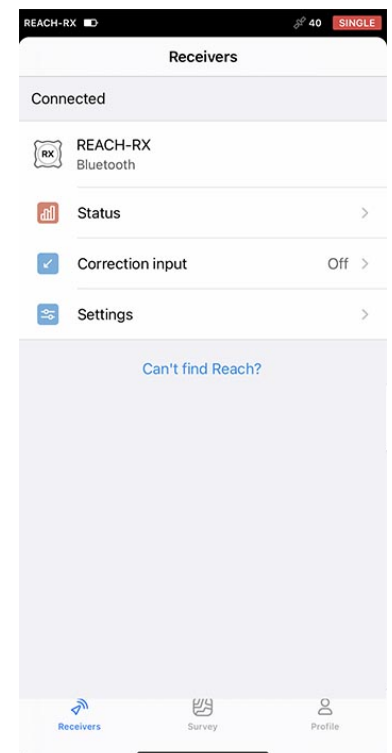
To connect to your Reach using Emlid Flow, follow the steps below:

1. Enable Bluetooth on your mobile device.
2. Open Emlid Flow and find your Reach from the list of available devices. Once you connect to the receiver, the Status LED will blink 2 times.

The app will automatically connect to your Reach if no other receivers are available in the list of devices.

Troubleshooting:

- If your Reach RX has not been detected, make sure that Bluetooth is turned on and all the permissions are enabled on your device.
- Some Android devices have the *Battery optimization* setting enabled by default. Make sure you disabled it for Emlid Flow to avoid disconnection.



1.3 Updating Reach RX firmware

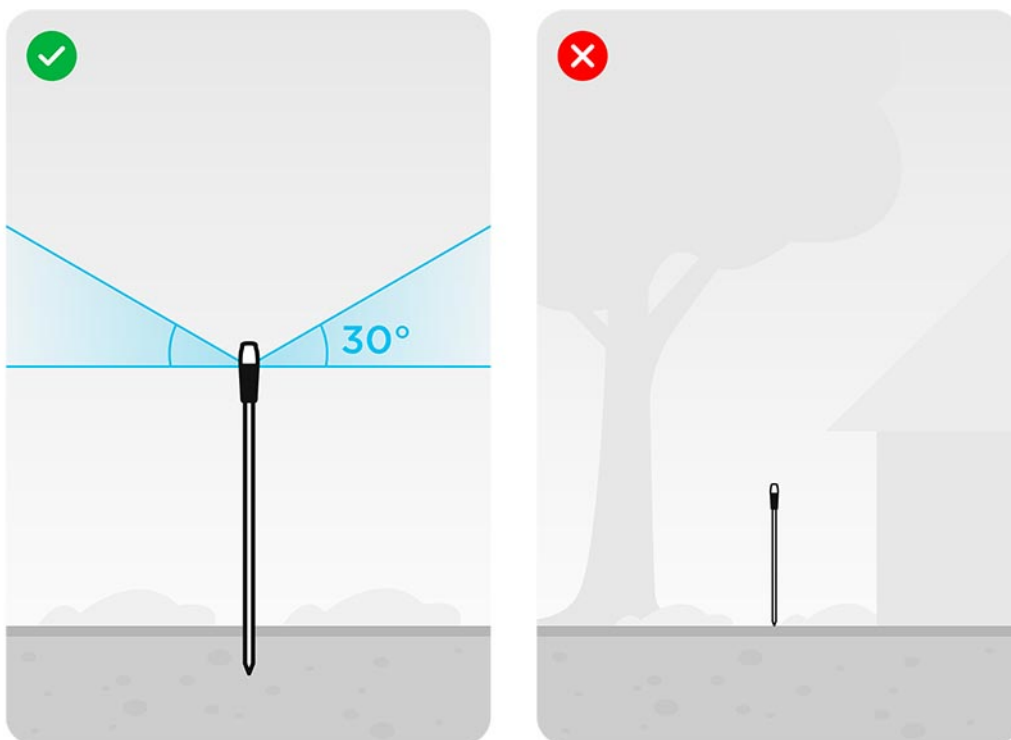
Updating Reach RX firmware requires a PC or Mac and uses Reach Firmware Flash Tool. Please, refer to [the guide](#) in our official online documentation.

1.4 Placement

Clear sky view without any obstacles

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

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



Examples of **good** environments for Reach placement: field, top of the hill, rooftop.

Examples of **bad** environments for Reach placement: indoors, urban area, forestry area.

No electronics nearby

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

2 Quickstart

2.1 How RTK works

Overview

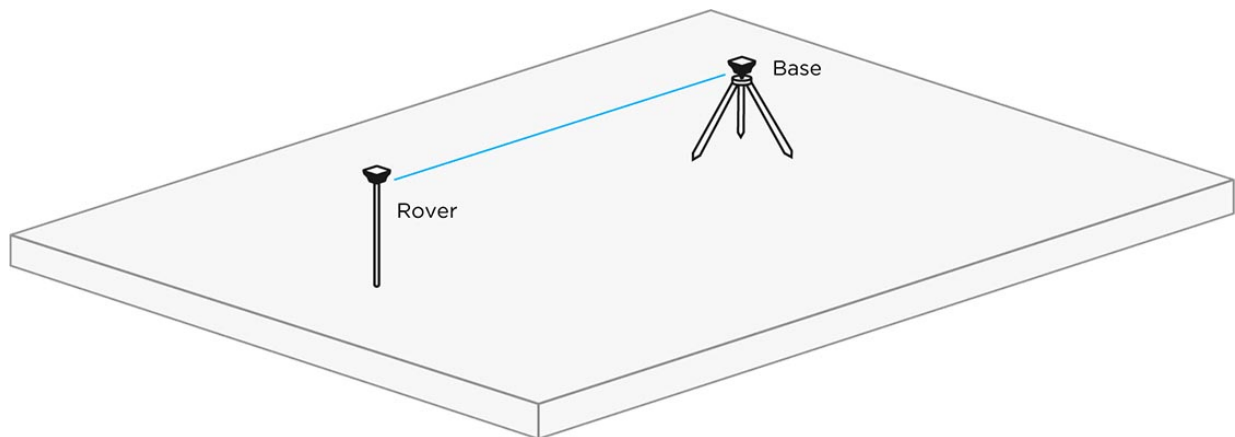
RTK is a technique used to improve the accuracy of a standalone GNSS receiver. Traditional GNSS receivers, like the one in a smartphone, could only determine the position with 2–4 meters (7–13 feet) accuracy. RTK can give you centimeter accuracy.

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.

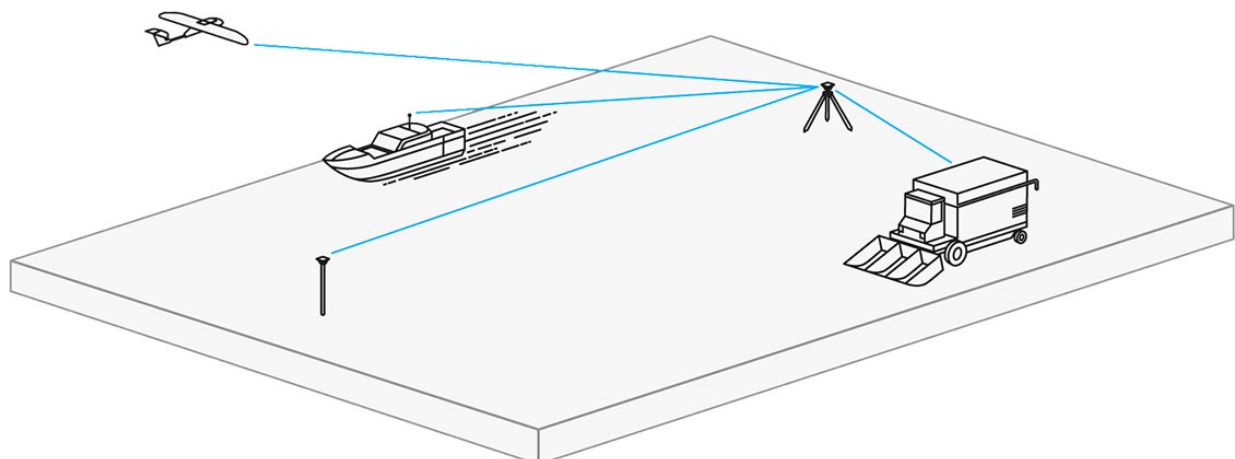
Our YouTube channel has [a video](#) that will show you how RTK technology works.

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.

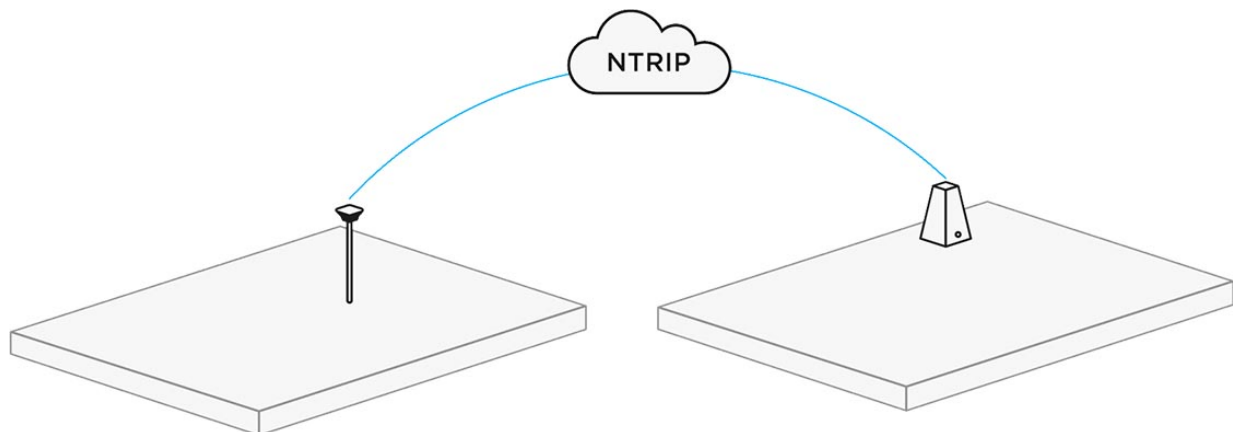


Corrections over NTRIP

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.



2.2 Working with NTRIP service

Overview

With the help of Emlid Flow, you can easily configure your Reach RX to receive corrections from an NTRIP service over Bluetooth. The app uses the internet connection on your phone or tablet to access network corrections and send them to Reach RX over Bluetooth.

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.

Workflow

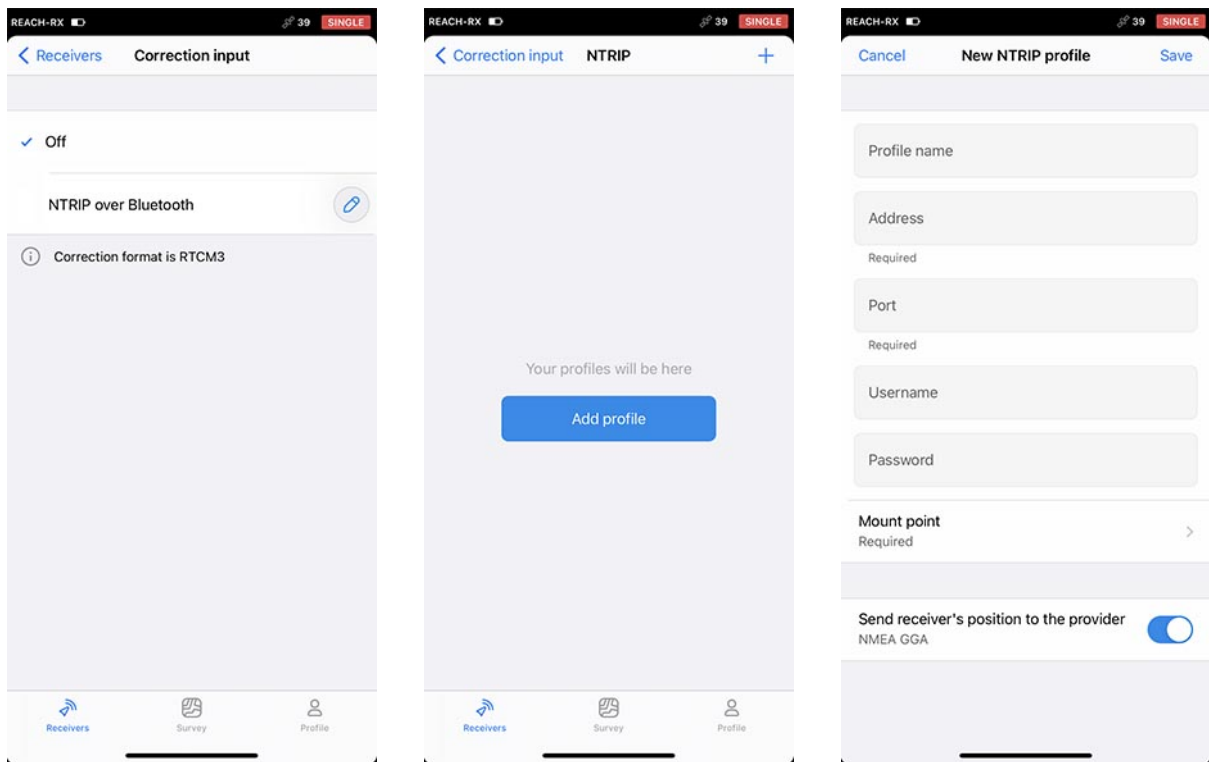
You can configure an NTRIP connection on your Reach before the survey. However, to make sure it receives RTK corrections, you need to provide it with a clear sky view.

Emlid Flow allows you to add an NTRIP profile and apply it for correction input at once. To configure correction input on your Reach RX, follow the steps below:

1. Connect to your receiver using Emlid Flow.
2. Tap *Correction input* and configure your Reach RX to receive network corrections over Bluetooth.
3. Tap *Add profile* and fill in the information from your NTRIP provider.

To find out which mount point suits you better, check the website of your NTRIP provider. Make sure that the baseline doesn't exceed 60 km (37 mi).

If your NTRIP provider requires information about receiver's position, such as VRS service, enable *Send receiver's position to the provider*.



4. Tap *Save*. In a few seconds, your Reach RX will start receiving corrections.

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

Before surveying, make sure your Reach has a clear sky view of at least 30° above the horizon. There should be no obstacles that could block the view like buildings, trees, cars, humans, laptops, etc. Learn more about Reach RX placement in the [Placement](#) guide.

Viewing results

When you completed your RTK setup, you can watch the current solution status in the top right corner of the Emlid Flow app or watch the Status LED on your Reach RX:

White SINGLE means that Reach has found a solution relying only on the satellite signals. In this case, the precision is usually at the meter level.

Yellow FLOAT means that Reach receives corrections from the base station but needs more time to calculate the solution. In this case, the precision is usually at the submeter level.

Green FIX means that Reach using the base corrections calculated a solution with a centimeter precision.

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

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

2.3 Working with Reach RS2+ base

Overview

With the help of Emlid NTRIP caster, you can combine Reach RS2+ as a base and Reach RX rover in one setup and pass corrections from Reach RS2+ to Reach RX over the internet.

Make sure that you can provide internet access for both receivers. You can learn more about [Emlid Caster](#) in our official online documentation.

Get access to NTRIP credentials

First, you need to get your NTRIP credentials for both Reach RS2+ base and Reach RX rover. Follow the steps below:

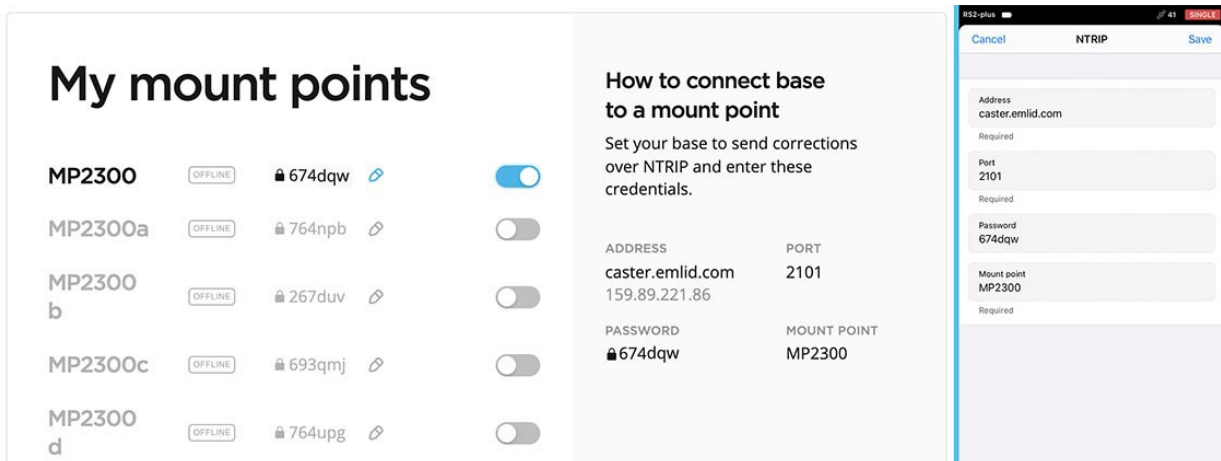
1. Go to caster.emlid.com.
2. Sign up or sign in using your Emlid account.

Once you sign up, you will access the page with NTRIP credentials for both base and rover, which are generated automatically. From this moment, you can use these credentials to connect your base and rover to a mount point.

Connect base to a mount point

To connect your Reach RS2+ base to a mount point, follow the steps below:

1. Activate the mount point you want to use by switching on the toggle.
2. Connect to your base via Emlid Flow, go to Base output, and set it up to send corrections over NTRIP using the obtained credentials (Address, Port, Password, Mount point).



Make sure you configured your base to output corrections via NTRIP. Once you successfully connect your base, you will see the *ONLINE* notification next to the mount point name.

My mount points

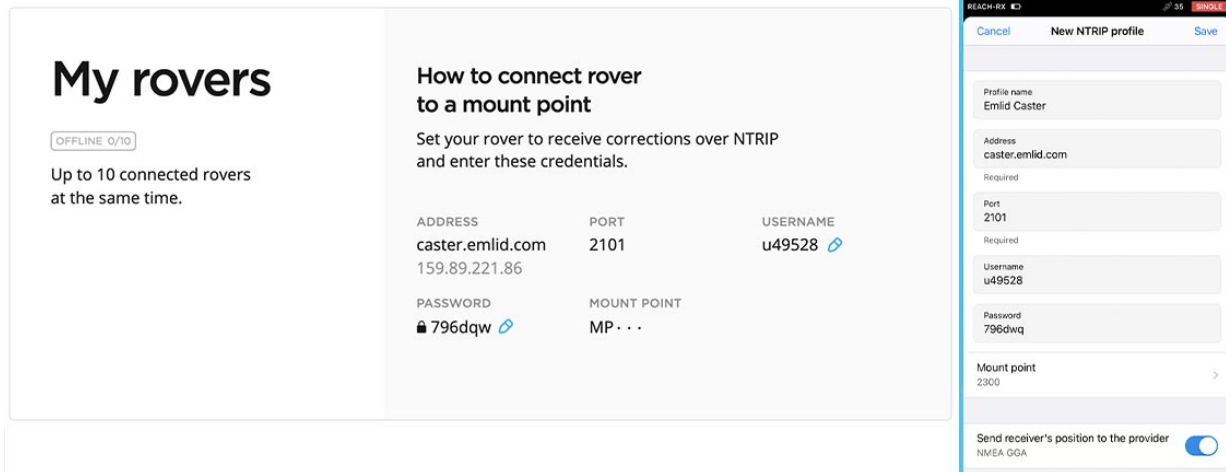
MP2300 ONLINE 674dqw 

How to connect base to a mount point

Set your base to send corrections over NTRIP and enter these credentials.

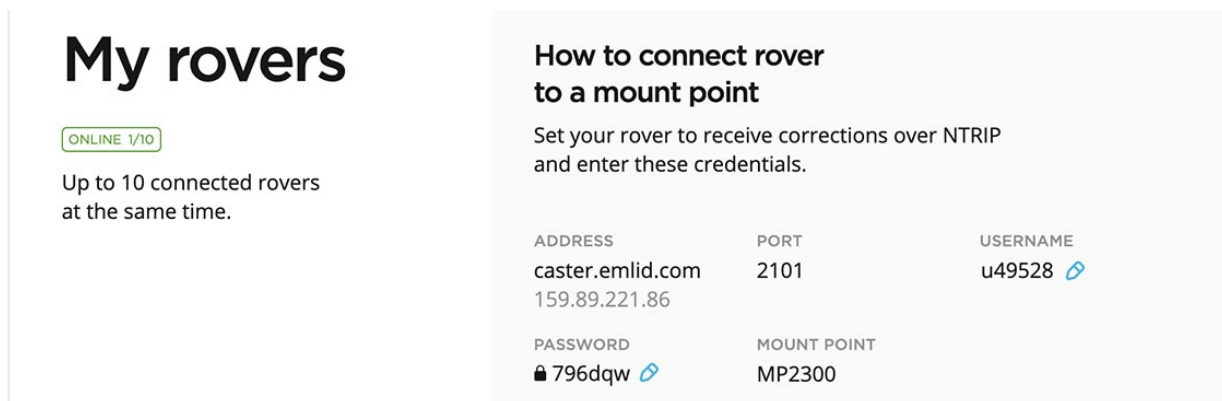
Connect your rover to a mount point

1. Access the rover's credentials. Once you activate the mount point for the base, you will see it in the rover's credentials.
2. Connect to your rover via Emlid Flow, go to Correction input, and set it up to get corrections over NTRIP using the obtained credentials for the rover (Address, Port, Username, Password, Mount point).



Make sure you configured your rover to receive corrections from the base via NTRIP. If you want to add more rovers, repeat the steps above.

Once you successfully connect your rover, you will see the *ONLINE* notification and the number of the connected rovers in the *My rovers* section.



To ensure successful corrections transmitting, double-check the credentials you entered on both base and rover. When you set up and connected both base and rover to the mount point, you are all set for the survey.

Before surveying, make sure your Reach has a clear sky view of at least 30° above the horizon. There should be no obstacles that could block the view like buildings, trees, cars, humans, laptops, etc. Learn more about Reach RX placement in the [Placement](#) guide.

When you completed your RTK setup, you can watch the current solution status in the top right corner of the Emlid Flow app or watch the Status LED on your Reach RX. Learn more about solution statuses in the [Viewing results](#) section.

2.4 Working with third-party base

Overview

With the help of Emlid NTRIP caster, you can combine a third-party base and Reach RX rover in one setup and pass corrections from the base to Reach RX over the internet.

Make sure that you can provide internet access for both receivers. You can learn more about [Emlid Caster](#) in our official online documentation.

Get access to NTRIP credentials

First, you need to get your NTRIP credentials for both Reach RS2+ base and Reach RX rover. Follow the steps below:

1. Go to caster.emlid.com.
2. Sign up or sign in using your Emlid account.

Once you sign up, you will access the page with NTRIP credentials for both base and rover, which are generated automatically. From this moment, you can use these credentials to connect your base and rover to a mount point.

Connect base to a mount point

To connect your third-party base to a mount point, follow the steps below:

1. Activate the mount point you want to use by switching on the toggle.
2. Set up your base to send corrections over NTRIP using the obtained credentials (Address, Port, Password, Mount point).

My mount points

MP2300	OFFLINE	674dqw		<input checked="" type="checkbox"/>
MP2300a	OFFLINE	764npb		<input type="checkbox"/>
MP2300b	OFFLINE	267duv		<input type="checkbox"/>
MP2300c	OFFLINE	693qmj		<input type="checkbox"/>
MP2300d	OFFLINE	764upg		<input type="checkbox"/>

How to connect base to a mount point

Set your base to send corrections over NTRIP and enter these credentials.

ADDRESS	PORT
caster.emlid.com	2101
159.89.221.86	
PASSWORD	MOUNT POINT
674dqw	MP2300

Make sure you configured your base to output corrections via NTRIP. Once you successfully connect your base, you will see the *ONLINE* notification next to the mount point name.

My mount points

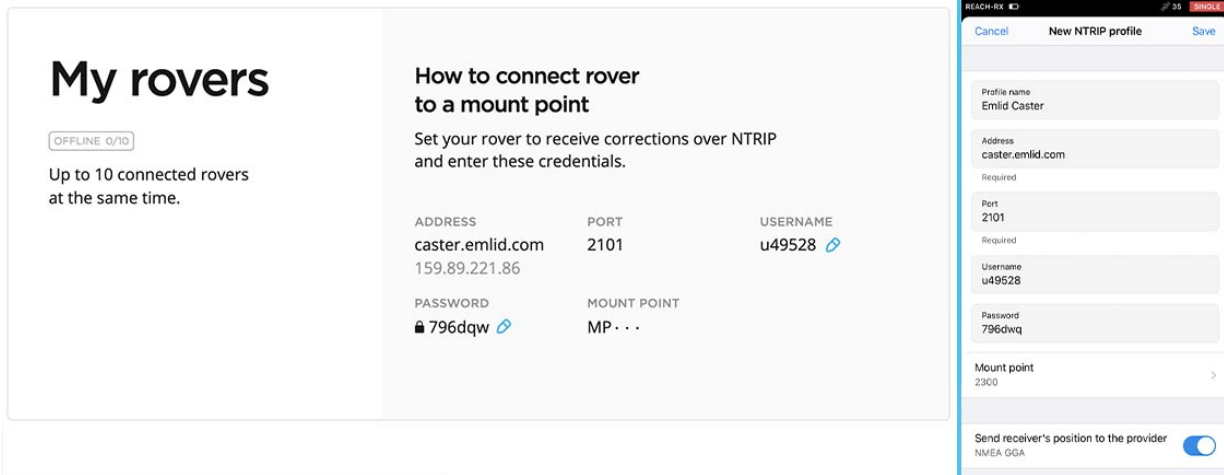
MP2300 ONLINE 674dqw

How to connect base to a mount point

Set your base to send corrections over NTRIP and enter these credentials.

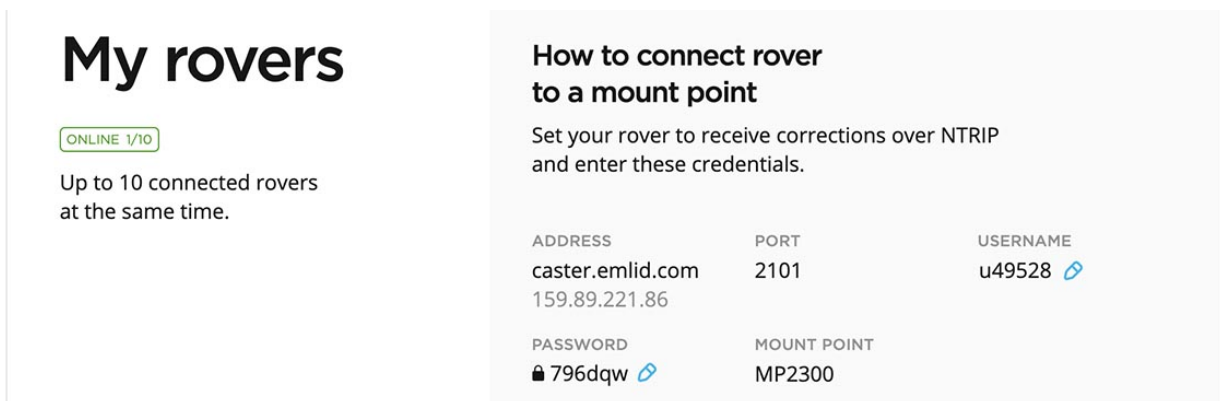
Connect your rover to a mount point

1. Access the rover's credentials. Once you activate the mount point for the base, you will see it in the rover's credentials.
2. Connect to your rover via Emlid Flow, go to Correction input, and set it up to get corrections over NTRIP using the obtained credentials for the rover (Address, Port, Username, Password, Mount point).



Make sure you configured your rover to receive corrections from the base via NTRIP. If you want to add more rovers, repeat the steps above.

Once you successfully connect your rover, you will see the *ONLINE* notification and the number of the connected rovers in the *My rovers* section.



To ensure successful corrections transmitting, double-check the credentials you entered on both base and rover. When you set up and connected both base and rover to the mount point, you are all set for the survey.

Before surveying, make sure your Reach has a clear sky view of at least 30° above the horizon. There should be no obstacles that could block the view like buildings, trees, cars, humans, laptops, etc. Learn more about Reach RX placement in the [Placement](#) guide.

When you completed your RTK setup, you can watch the current solution status in the top right corner of the Emlid Flow app or watch the Status LED on your Reach RX. Learn more about solution statuses in the [Viewing results](#) section.

3 Tutorials

3.1 Preparing ground control points for PPK UAV mapping

Overview

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

Use ground control points for any of the following purposes:

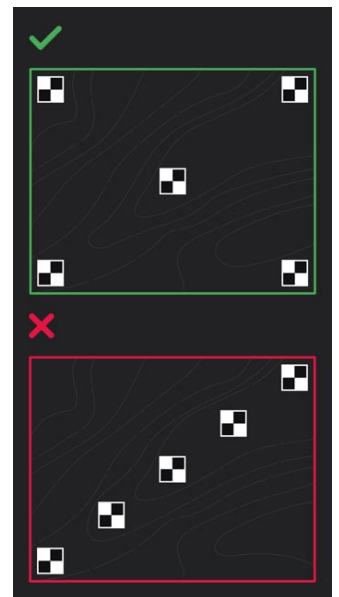
- To check and improve the accuracy of the map.
- To get the correct scale and orientation of the map.
- To ensure absolute positioning of the map.

To ensure precise drone mapping, you need to place and collect GCPs in RTK mode in the survey area. In most cases, GCPs are necessary to obtain absolute accuracy and georeference the map. In this case, you should place the base over a known point and manually enter its coordinates.

Placing GCPs

When placing GCPs, follow the requirements below:

- Make your GCPs clearly visible on the drone's images: they should be big enough and contrast with the surroundings.
- Provide enough GCPs depending on the survey area. Usually, you need 5–10 points.
- Place GCPs evenly in the survey area. For example, if you use 5 points, set one for each corner and the last one in the center of the area.
To ensure good area cover, avoid placing GCPs in single straight lines.
- Try to place GCPs at the highest and lowest points on the site. It will help perform the correct flat projection.



Measuring GCPs

After placing GCPs, you need to collect them. First, you need to configure your Reach RX to receive RTK corrections. To collect points using Emlid Flow, follow the steps below.

If you have trouble working with the mobile app, we recommend referring to our official [Emlid Flow documentation](#).

1. Go to the *Survey* tab and create a project.
2. Collect your ground control points.
3. Export the project once you collected GCPs.

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

3.2 Getting Reach coordinates on Android devices via Bluetooth

Overview

Mock location feature on Android devices allows using an external GNSS receiver as if it was a device's built-in GPS receiver. This way, you can stream position in the NMEA format from Reach RX to GIS apps on Android devices.

Below are some survey and GIS apps that can be used with Reach RX:

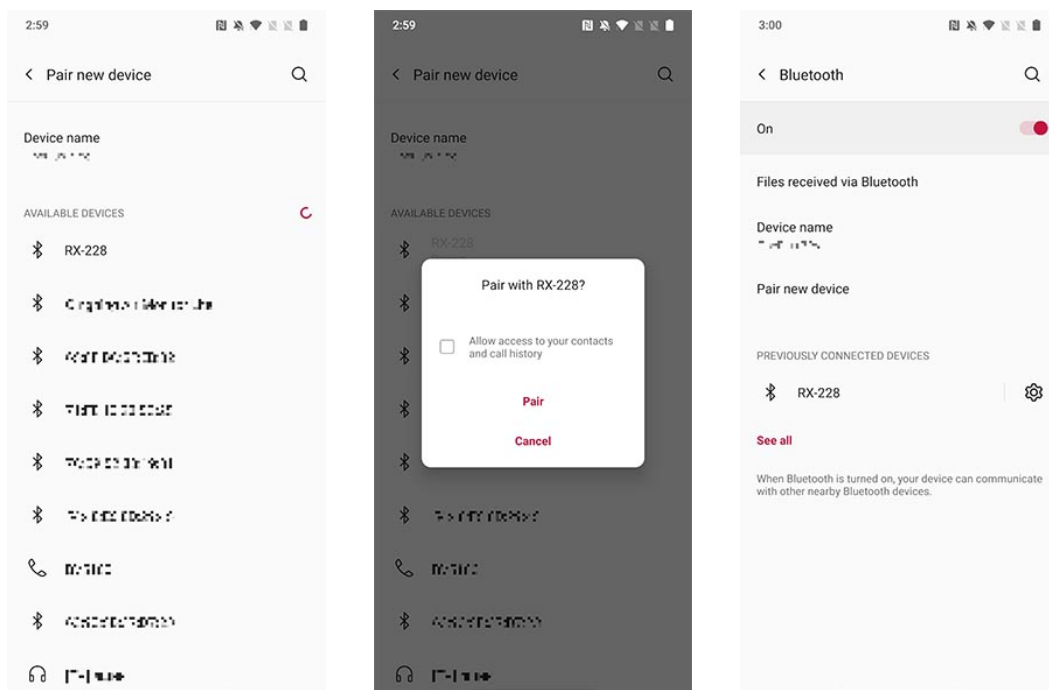
- Mobile Topographer Pro
- LandStar
- PointMan
- Autocad360
- Mapit GIS
- QField

Reach RX uses Bluetooth and streams its position in the NMEA format by default. No pre-configuration is needed. To configure mock location on Android devices with your Reach RX, you need to use an app that supports the mock location feature and allows NMEA data input via Bluetooth. We provide a guide on how to use Reach RX with [Lefebure NTRIP Client](#).

Pairing Android device

1. Navigate to the *Bluetooth* configuration screen on your Android device and enable Bluetooth.
2. Wait for your Reach RX to be listed as an available device. Keep Reach within a few meters from the device.
3. Tap the name of your Reach in the list of available devices on the Android device. If your device requires a PIN code, enter 0000.
4. Pair Reach with the Android device.

Once you paired your Reach with the Android device, you can configure mock location on the device.



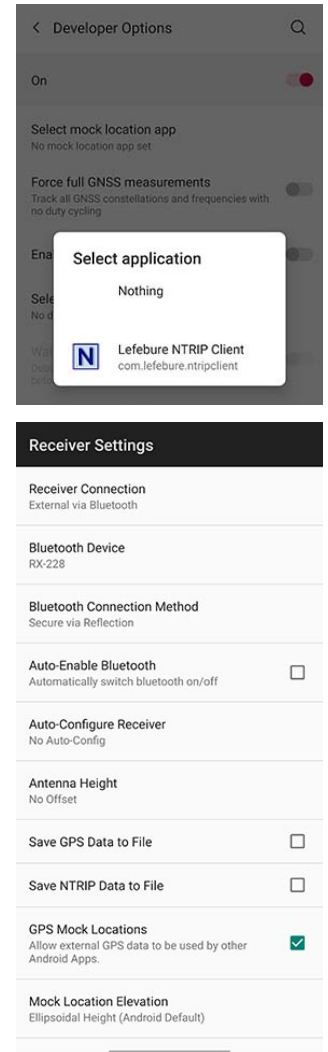
Configuring mock location on Android device using Lefebure NTRIP Client

To configure the mock location on the Android device, follow the steps below:

1. Download and install the [Lefebure NTRIP Client](#) app on your Android device.
2. Open *Developer Options* on your Android device. To learn more about accessing *Developer Options* on your device, check your Android device's instructions.

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

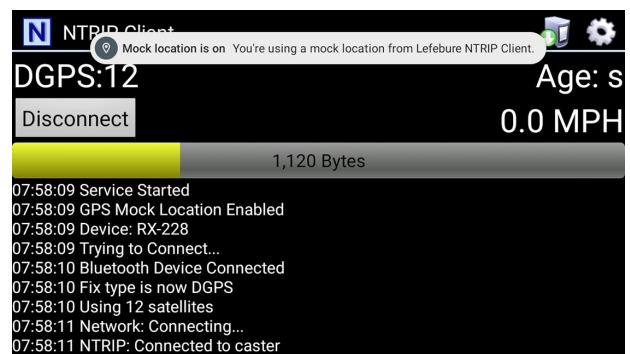
3. In the Select mock location app field, choose *Lefebure NTRIP Client*.
4. Launch the Lefebure NTRIP Client app and tap the *Settings* icon.
5. Go to *Receiver Settings*. Configure the following:
 - Receiver Connection: *External via Bluetooth*.
 - Bluetooth device: Reach RX, your device is paired with.
 - Bluetooth Connection Method: *Secure via Reflection*.
 - Enable *GPS Mock Locations*.



Configuring corrections input in Lefebure NTRIP Client

To configure your Reach RX to receive corrections from an NTRIP service in the Lefebure NTRIP Client app, follow the steps below:

1. In Lefebure NTRIP Client, go to *NTRIP Settings* and fill in the information from your NTRIP provider.
2. Save settings.
3. Go back to the main screen and tap the *Connect* button.
4. Check the log messages to make sure that corrections are coming and information about satellites is updated.



From this moment, all survey and GIS apps that use location services installed on your device will automatically have access to the positional data streamed from Reach RX.

4 Reference

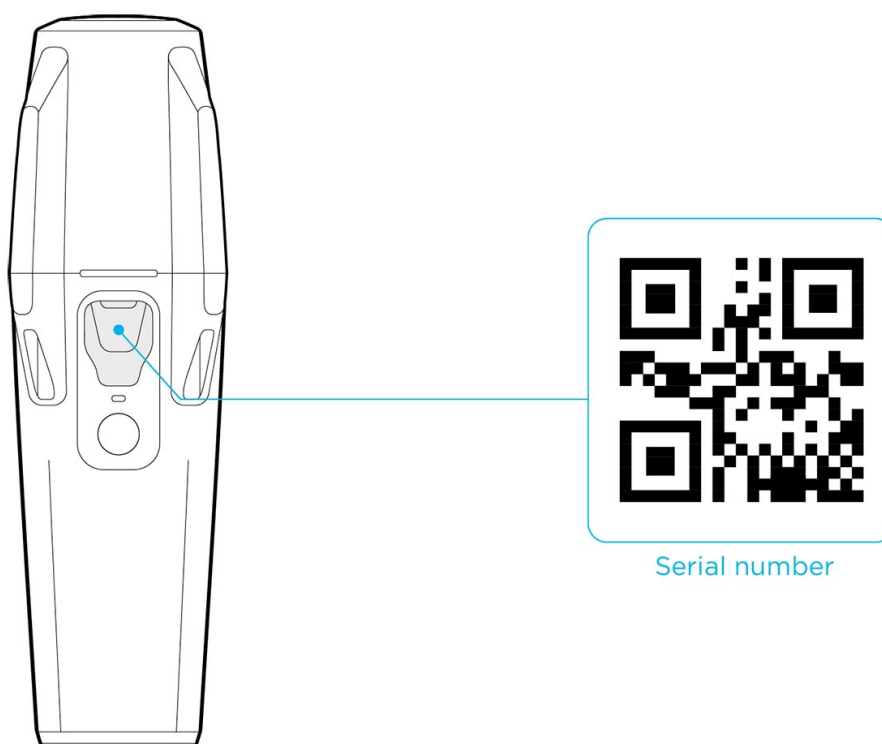
4.1 Firmware flashing

To flash your Reach RX, you'll need to download and install Reach Firmware Flash Tool on your computer. Please, refer to [the guide](#) in our official online documentation.

4.2 How to find serial number

To find the serial number of your Reach, perform the following steps:

1. Scan the QR code under the USB port 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.