

# User Guide: RTK Base Station

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## Product overview

The **ArduSimple RTK Base Station**, powered by the **Septentrio mosaic-X5 GNSS receiver module**, is designed to function as a **Continuously Operating Reference Station (CORS)** to provide high-precision RTK corrections over the internet. You can also use it as a local RTK base station via an optional radio link.

This product is compatible with, but does not include, a triple-band GNSS antenna, which is required for operation.

Initial configuration must be performed using a Windows computer. Once configured, the station can be accessed from other operating systems. Please contact us if you do not have access to a Windows computer for the setup.

## Package

The RTK Base Station includes the following components:

- **RTK Base Station.**
- **USB to USB-C cable.**



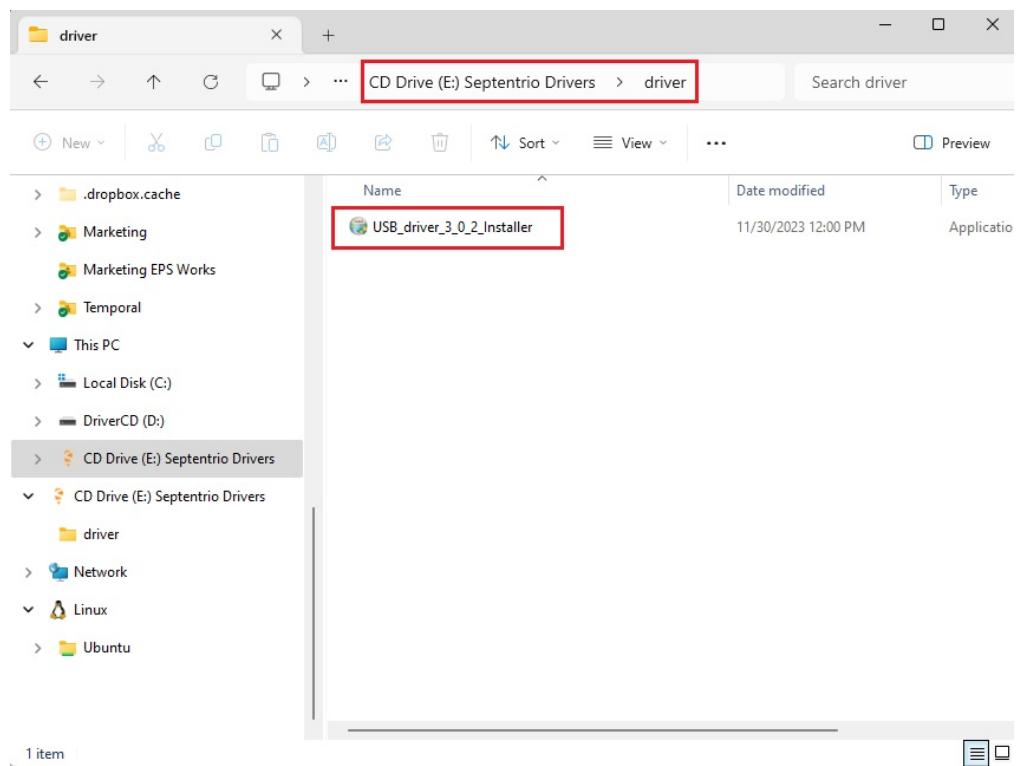
## Get started

### Step A: Connect the receiver to a PC

**IMPORTANT:** This Base Station kit uses a traditional RTK module and is designed for outdoor use only. It will not function properly if placed indoors near a window.

1. Screw the GNSS antenna onto the receiver module's antenna connector by hand; do not use any tools. Connect the RTK Base Station to your PC using the provided USB to USB-C cable.

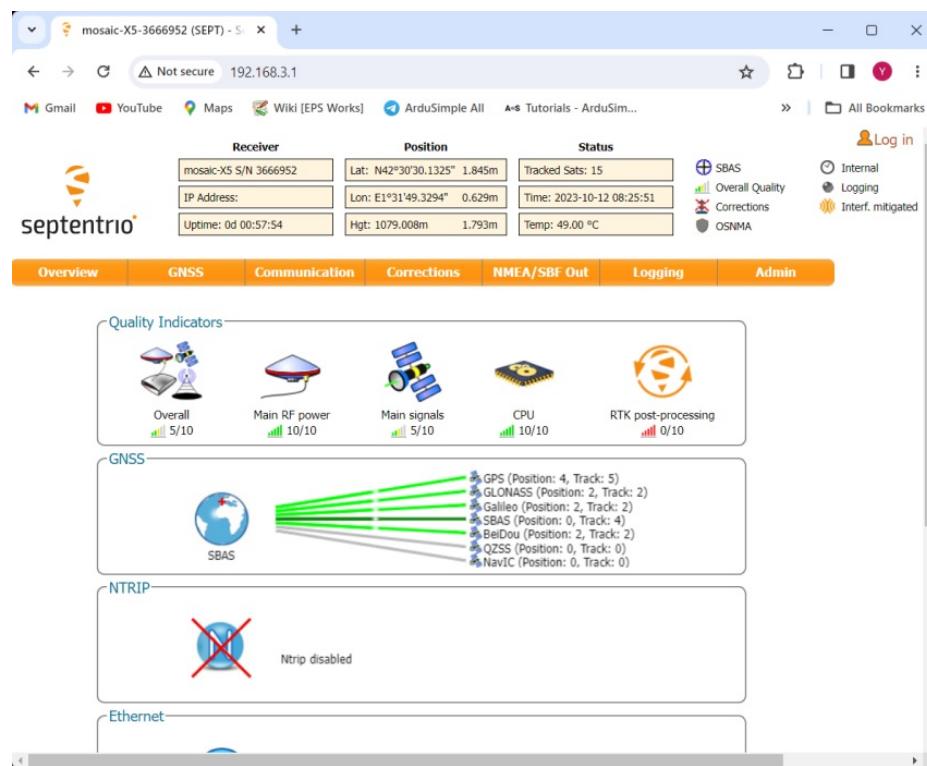
**Note on Initial Setup:** When you first connect the device to a PC, it may not be recognized. You will instead see a new hard drive appear on your computer. Open this drive and install the provided Septentrio driver. Once the installation is complete, disconnect and reconnect the USB cable. Your PC should now correctly recognize the receiver.



2. Open a web browser and input the address <http://192.168.3.1> to go to the Septentrio web interface. (192.168.3.1 is not the actual IP address of the RTK Base Station, just a virtual website accessed over the USB connection; you will learn how to activate and check your base station's IP address in a later section). The first time you connect to the web interface you might be asked to create and new user. Input your new **User Name** and **Password**, and the Septentrio Factory User Name **RxAdmin** and Password **S3pt3ntr10**.



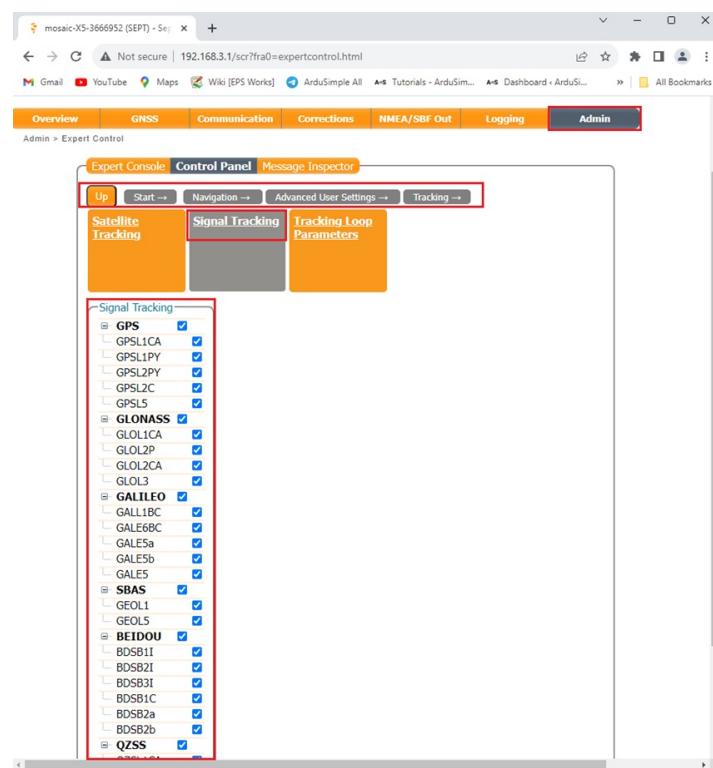
3. The web interface will open and show the general status of your Septentrio receiver module. You can use this interface to configure and monitor the internal RTK receiver.



4. L5 is disabled by default on the Septentrio mosaic-X5. Therefore, to enable it, navigate through the menu as follows:

**Menu Bar ? Admin ? Expert Control ? Control Panel ? Navigation ? Advanced User Settings ? Tracking ? Signal Tracking.**

Expand all satellite signal groups and select all bands.  
Click **OK** and **save configuration**.



## Step B: Configure the receiver as a static Base Station

To configure a base station, you can set its coordinates in two ways:

Auto  
Geodetic  
Auto

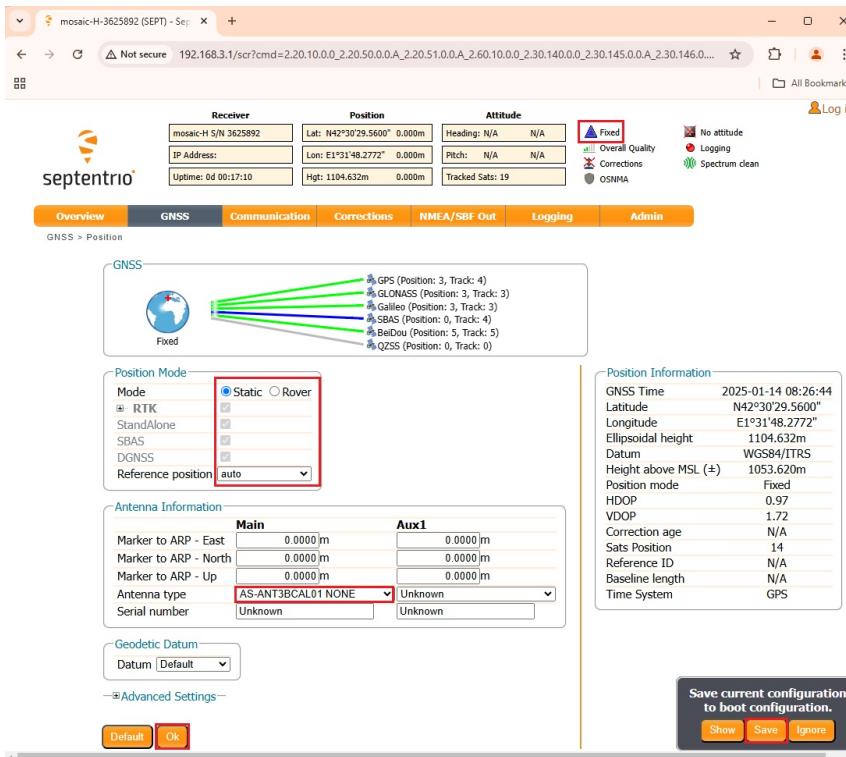
When the Base Station's coordinates are unknown, you can configure the receiver for automatic positioning. After collecting data for a specified period of time, it will calculate an average value to use as the base station coordinates (similar to the Survey-in mode of u-blox receivers).

The absolute accuracy for your Rover using this method will be approximately 1-2 meters, while the relative accuracy can reach 1 centimeter.

**Use Case for Auto Mode:** In land surveying, accurately measuring the distance between two ground points is often more critical than knowing their absolute global positions.

### Configuration Steps:

5. In the web interface, navigate to **GNSS ? Position**.  
Set Mode to **Static**.  
Set Reference position to **Auto**.
6. If using a [Calibrated Survey GNSS Tripleband + L-band antenna \(IP67\)](#), such as the **AS-ANT3BCAL01**, select it from the Antenna type menu. This will automatically upload the corresponding antenna Calibration file.
7. Press **Ok** and **Save Configuration**.
8. Within a few minutes, the Position Mode should change to **Fixed**.



## Geodetic

There are 3 ways to determine the coordinates of the base station.

You can refer to tutorial [How to determine the exact position of your base station](#).

The absolute accuracy of your rover can reach to 1cm.

Example where **Fixed position** is a good choice: In autonomous vehicle navigation, the vehicle needs to know its precise location within a global reference frame to navigate accurately.

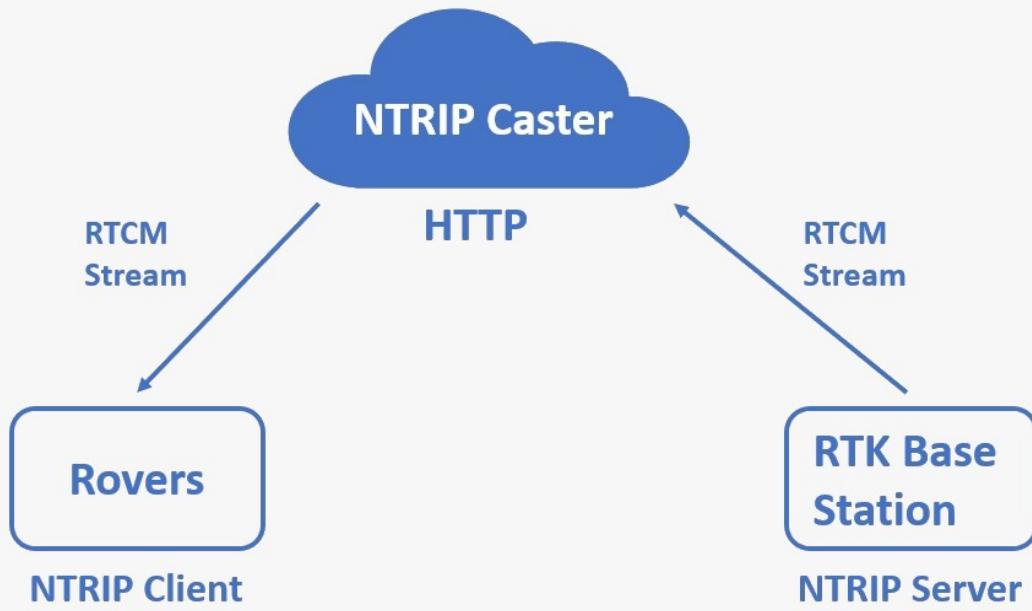
## Step C: Share the base station online, accessible from anywhere with an internet access

You can make your Base Station's RTK corrections available to anyone with an internet connection by adding it to an NTRIP service.

**NTRIP (Networked Transport of RTCM via Internet Protocol)** uses the internet to make correction data accessible from anywhere with a network connection, unaffected by terrain or physical obstructions. It supports multiple users simultaneously without requiring additional hardware or complex tuning. In contrast, traditional radio links are limited by range, require a clear line-of-sight, and involve higher initial setup costs.

**NTRIP caster** acts as a central server, efficiently managing and distributing GNSS correction data between an RTK Base Station and multiple rovers.

The caster uses standard internet protocols (HTTP/HTTPS), enabling rovers to connect over diverse networks, including cellular, Wi-Fi, or Ethernet. This approach overcomes common network challenges like NAT (Network Address Translation) and firewalls that can block direct peer-to-peer connections.



Several NTRIP caster services are available, each offering unique features to meet diverse needs. Services like **RTK2go** and **Onocoy** are free, but they make your base station publicly accessible.

To maintain privacy and restrict access to your base station, you can use software such as [SNIP](#) and [BKG](#), which provide secure, private connections. Note that some advanced features may require a paid subscription.

The following examples demonstrate how to share your base station with some of the most commonly used NTRIP caster services.

## RTK2GO (recommended for beginners)

RTK2go is a free, community-based NTRIP caster that enables users to publish and access GNSS correction streams globally. It is an ideal, cost-effective solution for real-time positioning.

9. Register using this [link](#). You will be prompted to enter your name, email address, and a mountpoint. Leave Message format set to **Auto Parse** and NTRIP Protocol set to **NTRIP Rev1**. All other fields are optional.

### Message format (optional)

Auto Parse (default) 

Leave set to 'Auto Parse' if not known. The Caster will auto-parse the data stream and if RTCM content is found, it will create suitable entries for you. If you are **not** sending some form of RTCM messages, please select the format. If your NTRIP Server SW provides a Caster Entry when connecting, that data will be used.

### NTRIP Protocol to Use (required)

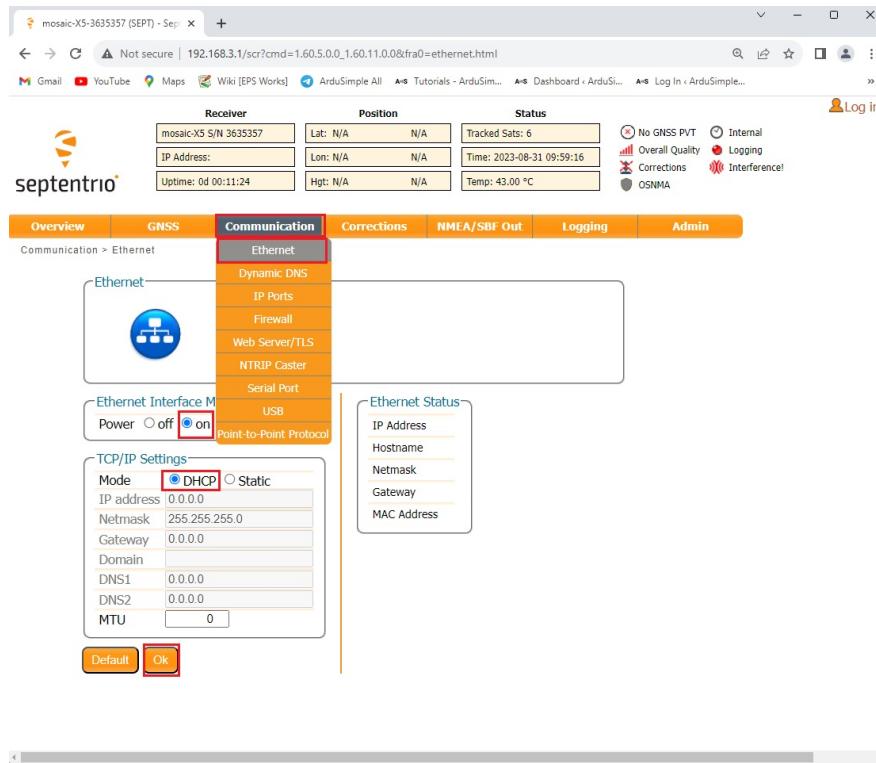
NTRIP Rev1  NTRIP Rev2

10. An automatic email will be sent. You must reply to the sender to confirm your registration.
11. A few hours after your reply, you will receive another email confirming that your mountpoint is active.
12. You now have the credentials (your mountpoint and password) to connect to RTK2go.
13. Connect the RTK base station to your router using an Ethernet cable.

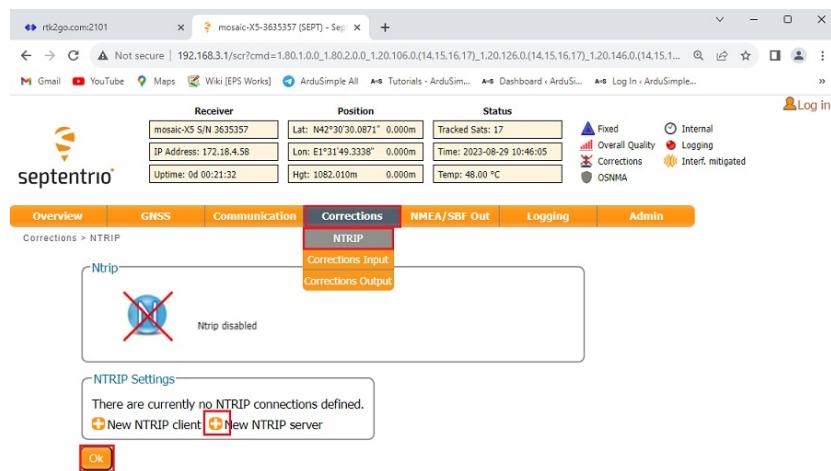


14. In the toolbar, navigate to **Communication ? Ethernet**. For the **Ethernet Interface Mode**, ensure **Power on** is checked. Most routers use an automatic IP configuration by default. To work with this standard setting, select **DHCP** from the menu. If you prefer to assign a static IP address manually, you can also configure this within the same menu.

Once configured, press **OK**.



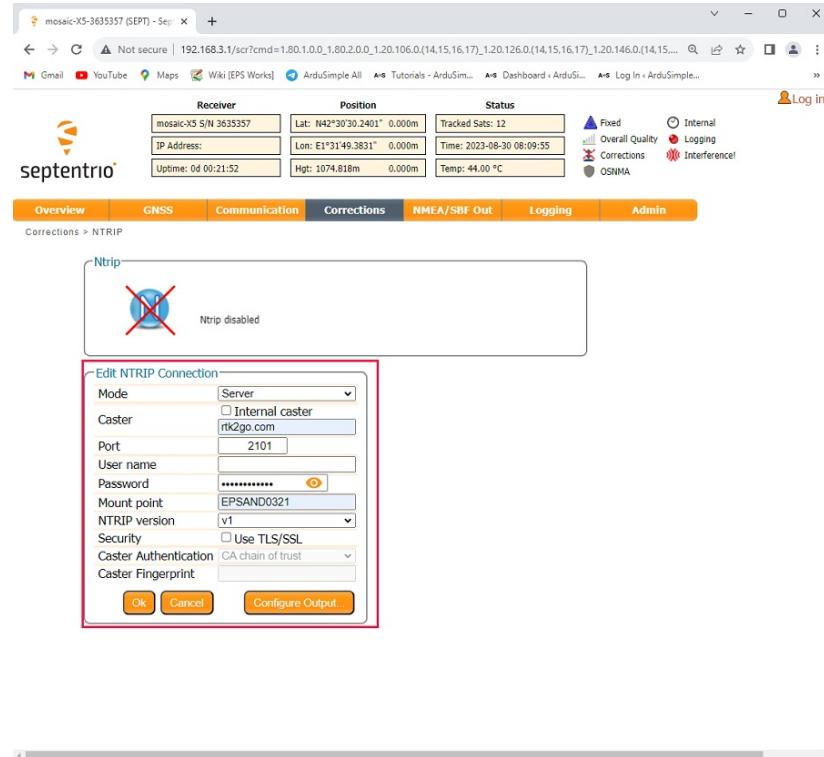
15. In the toolbar, navigate to **Corrections** ? **NTRIP**. Select **+New NTRIP Server** and click **OK**.



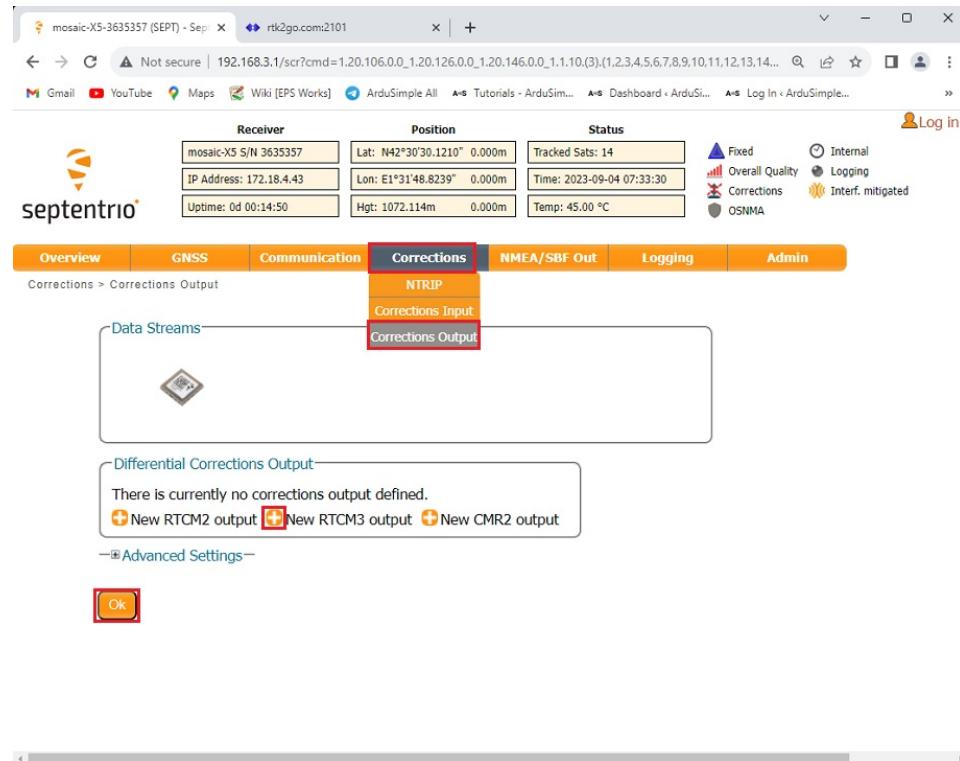
16. Configure the **NTRIP connection** as shown in the following image:

- Mode: **Server**
- Caster: **rtk2go.com**
- Port: **2101**
- Password: **(Enter your registered password at step 7)**
- Mount Point: **(Enter your registered mount point at step 7)**
- NTRIP Version: **v1**

Then, click **OK** and **Save Configuration**.



17. In the toolbar, navigate to **Corrections** ? **Corrections Output**. Select **+New RTCM3 Output** and click **OK**.



Receiver: mosaic-X5 S/N 3635357  
Position: Lat: N42°30'30.1210" 0.000m  
Status: Tracked Sats: 14  
IP Address: 172.18.4.43  
Uptime: 0d 00:14:50  
Lon: E1°31'48.8239" 0.000m  
Time: 2023-09-04 07:33:30  
Hgt: 1072.114m 0.000m  
Temp: 45.00 °C

Overall Quality: Fixed  
OSNMA: Internal  
Logging: Off  
Corrections: Off  
Interf. mitigated: Off

Overview | GNSS | Communication | **Corrections** | NMEA/SBF Out | Logging | Admin

Corrections > Corrections Output

NTRIP  
Corrections Input  
Corrections Output

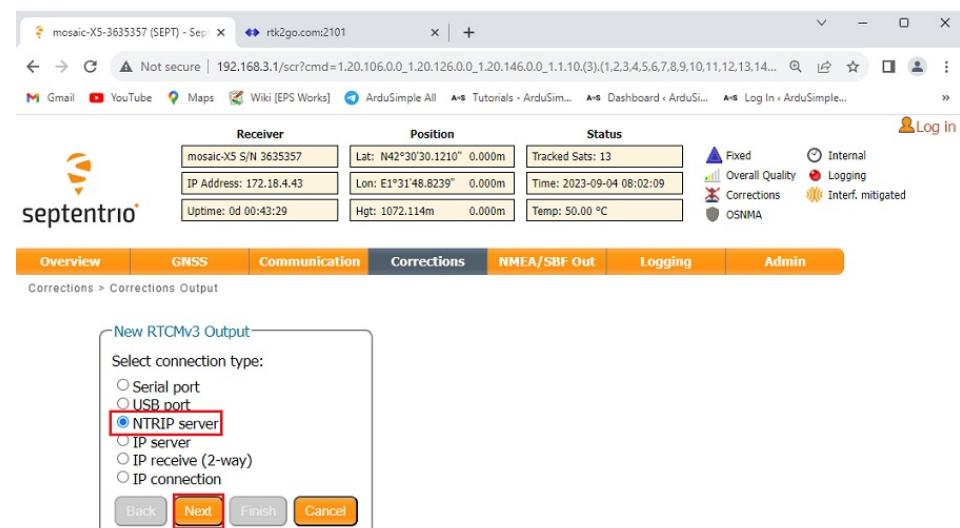
Data Streams

Differential Corrections Output  
There is currently no corrections output defined.  
+ New RTCM2 output + New RTCM3 output + New CMR2 output

Advanced Settings

Ok

## 18. Select NTRIP server. Press Next.



Receiver: mosaic-X5 S/N 3635357  
Position: Lat: N42°30'30.1210" 0.000m  
Status: Tracked Sats: 13  
IP Address: 172.18.4.43  
Uptime: 0d 00:43:29  
Lon: E1°31'48.8239" 0.000m  
Time: 2023-09-04 08:02:09  
Hgt: 1072.114m 0.000m  
Temp: 50.00 °C

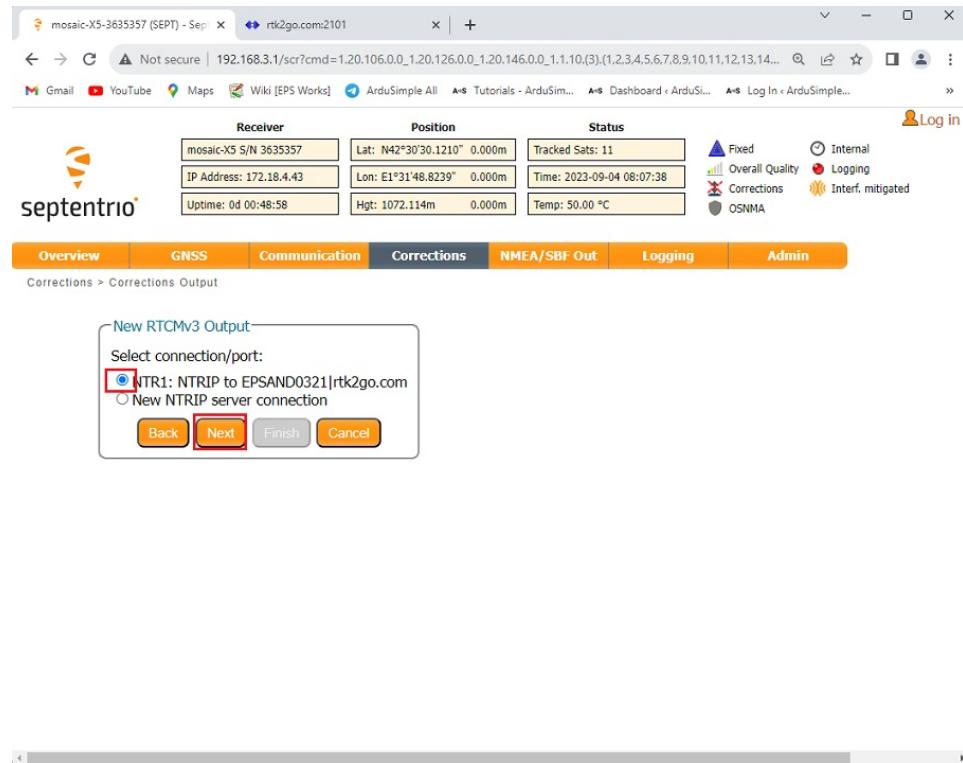
Overall Quality: Fixed  
OSNMA: Internal  
Logging: Off  
Corrections: Off  
Interf. mitigated: Off

Overview | GNSS | Communication | Corrections | NMEA/SBF Out | Logging | Admin

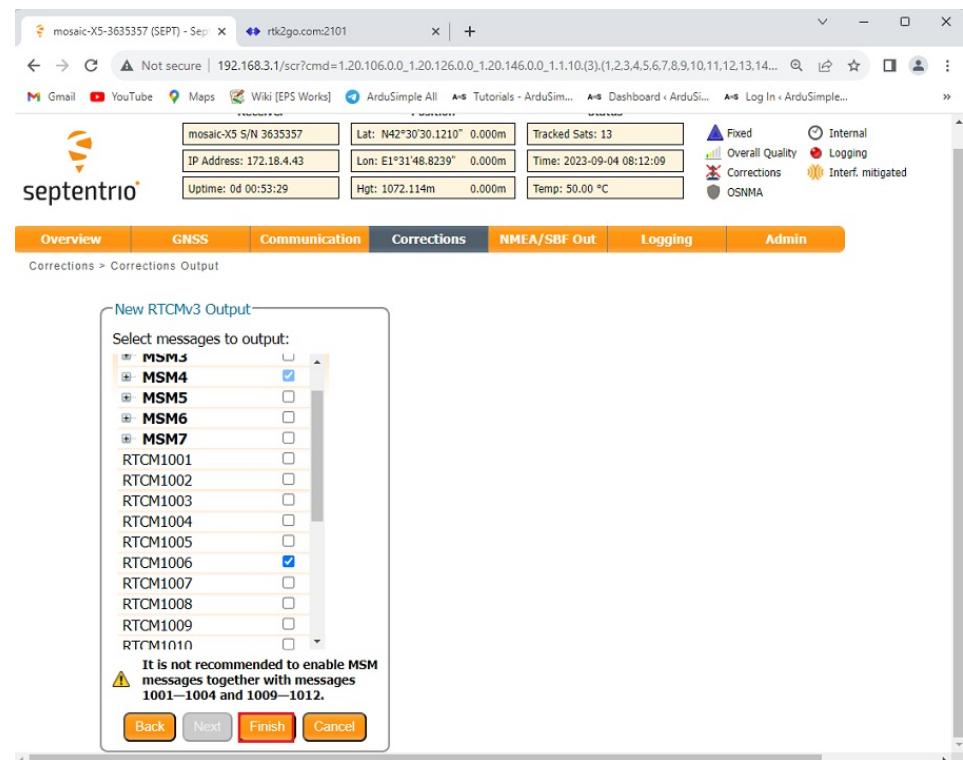
Corrections > Corrections Output

New RTCMv3 Output  
Select connection type:  
 Serial port  
 USB port  
 NTRIP server  
 IP server  
 IP receive (2-way)  
 IP connection  
Back Next Finish Cancel

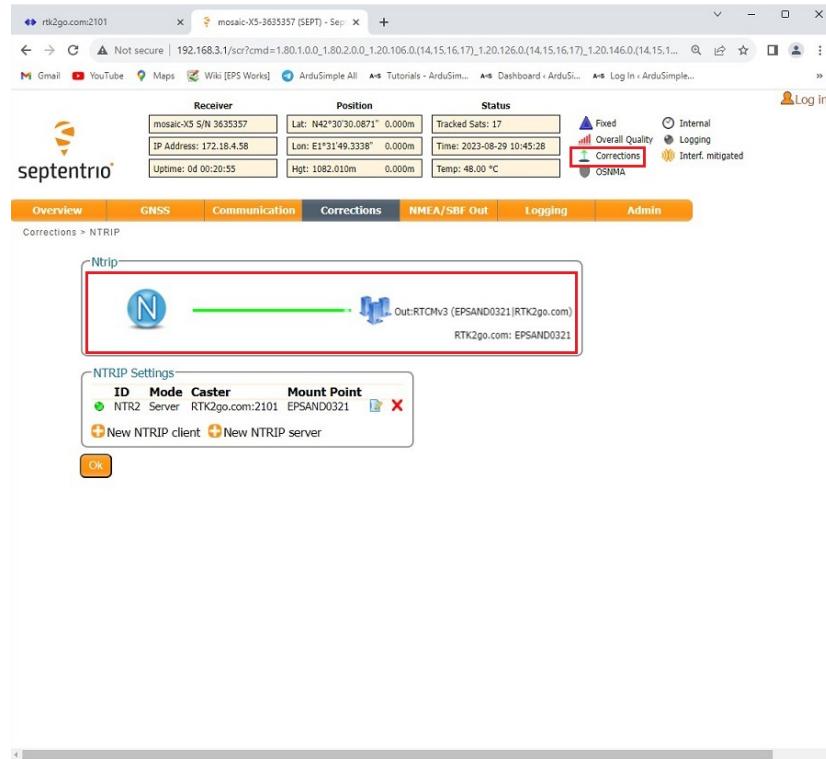
## 19. Choose NTRIP to *mount point* rtk2go.com.



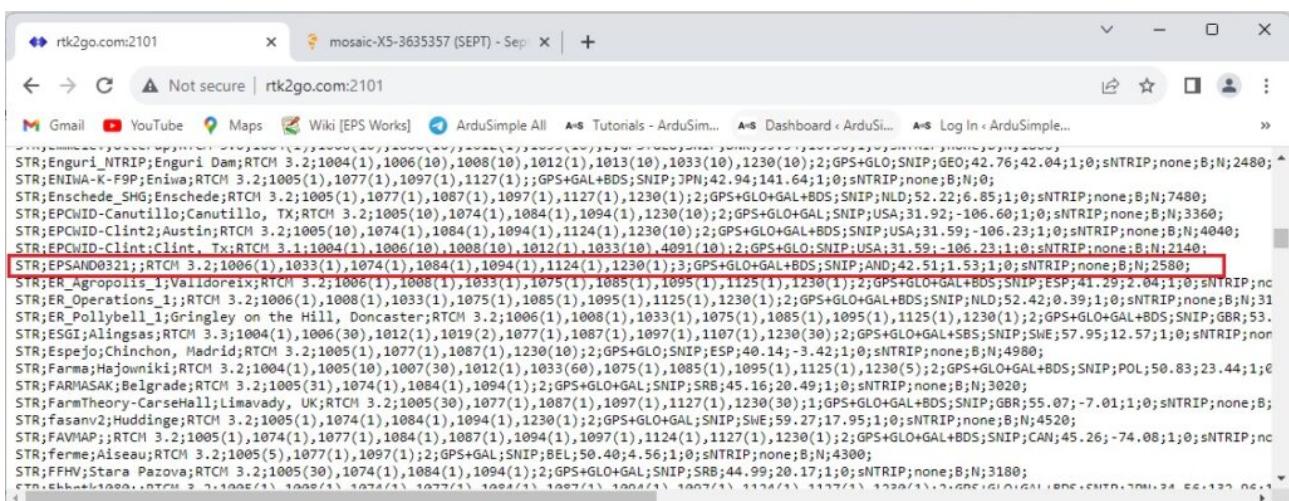
20. Select **RTCM v3 Output**. The default selection (including **MSM4, 1006, 1033, and 1230**) is generally optimal and compatible with most systems. You can customize these settings here if you have specific requirements. Click **Finish** and **Save Configuration**.



21. You can now see that it is sending RTCM messages to your mount point on RTK2go. In the upper-right corner of the screen, you will see a green arrow indicating an active data flow next to **Corrections**.



22. To verify that everything is working correctly, you can visit [rtk2go.com](http://rtk2go.com). You can now use any NTRIP client to connect to your mount point.



### Built-in NTRIP Caster (advanced users only).

The RTK Base Station includes an integrated NTRIP Caster that supports up to 10 simultaneous rovers, each with an individually configured username and password.

However, most internet service providers (ISPs) block incoming connections by default. Consequently, if a rover attempts to connect directly to your base station's public IP address, the connection will fail.

To use this mode, you must configure your ISP's router to open the necessary ports.

## Onocoy

Onocoy is a platform that enables users to share and access GNSS correction data. It features a reward system that provides cryptocurrency incentives for maintaining a well-calibrated and reliable base station. A key advantage is that Onocoy automatically calibrates your base station's position within its network, ensuring excellent pass-to-pass accuracy.

For a detailed setup guide, please refer to our tutorial: [How to get paid for installing and sharing your base station with Onocoy](#).

## Step D: Enable radio link (optional)

The kit does not include a radio module, but one can be added to transmit RTCM corrections wirelessly. If you are operating in an area with limited or no internet connectivity and the rover maintains a clear line of sight to the Base Station, a radio link is an effective solution for sending and receiving correction data.

To enable the radio link functionality, you will need to add one of the following components.



Plugins  
**Radio module**  
**Long Range**  
**(LR)**

Plugins  
**Radio module**  
**eXtra Long**  
**Range (XLR)**

Plugins  
**Radio Module**  
**Medium**  
**Range (MR)**

Please note that the dipole antenna for the Long Range and Extra Long Range radio modules must be ordered separately.



Accessories

[\*\*Dipole antenna for LR/XLR radio\*\*](#)



Accessories

[\*\*Vehicle Mount LR/XLR Antenna\*\*](#)

This section provides an integration guide for adding a radio interface to your RTK Base Station to transmit RTCM corrections over a radio link.

23. To open the case, pull the outer edge outward.



24. Use a knife or screwdriver to **remove the cover** from the pre-cut hole.

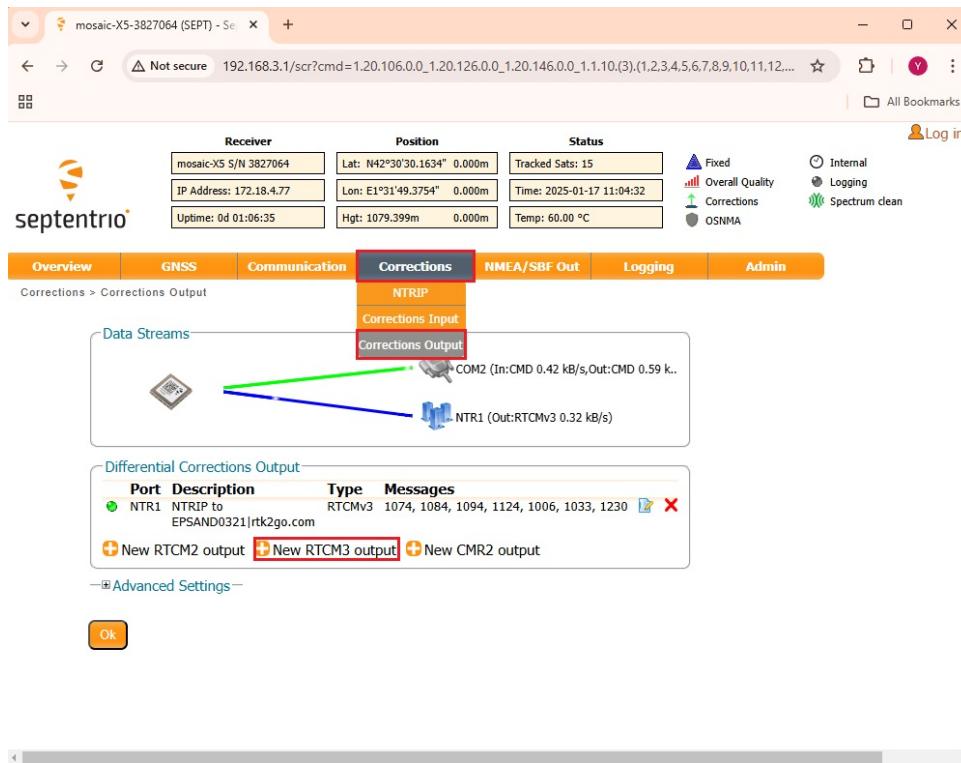


25. Mount the radio module on the **XBEE Socket** and connect the radio antenna.



26. Close the case and connect your RTK Base Station to a PC via USB.

27. In the Septentrio web interface, navigate to **Corrections ? Corrections Output** and create a **+New RTCM v3 Output**.



28. Select **Serial Port ? COM2**. The default message selection (**MSM4, 1006, 1033, and 1230**) is robust and compatible with most systems. Adjust these settings here if you have specific requirements.

29. Click **Finish** and **Save Configuration**. Your rover can now receive the RTCM corrections over this radio link.

## Hardware

The hookup guide in this section provides a detailed description of each hardware component and its function.

### Power



The RTK Base Station can be powered from two different sources:

- **USB-C port**
- **Pixhawk connector**

Only one power source is required, but both can be connected simultaneously without risk.

Power Supply Requirements:

- Use only high-quality USB-C cables no longer than 1 meter.
- If connected via a low-power USB hub or a PC with low-power USB ports, the Pixhawk connector must also be connected to a wall outlet or a high-capacity battery.

### GNSS Antenna



The RTK Base Station does not include, but requires a high-quality GPS/GNSS triple band (L1/L2/L5) antenna. In order to get the best performance we recommend using one of our [triple band antennas](#), as the [Budget Survey Tripleband GNSS Antenna \(IP66\)](#).

The board is compatible with both active antennas (maximum output is 150mA @ 3.3V) and passive antennas.

#### Installation Notes:

- **Always connect the antenna before powering the board.** This is very important as some board components could overheat if no antenna is connected.
- **Screw the antenna to the SMA connector by hand, never use any tools.** You could break the connectors if too much force is applied.
- **Install the antenna with the clearest possible view of the sky.** Use it outdoors and as far as possible from surrounding buildings, mountains, ...
- **For best results, install the antenna on top of a metallic flat plate** of at least 20cm side length (e.g. a car top surface).
- **Ensure the antenna is mounted on a stable pole, magnetic base, or structure** capable of withstanding heavy winds.

For more information on how antenna installation impacts performance, follow our [GPS/GNSS antenna installation guide](#) and [video](#).

## Interfaces

The following section explains the RTK Base Station's interfaces in detail.

## USB-C connector



This USB-C connector is used for the initial configuration of the Base Station. Its functions include:

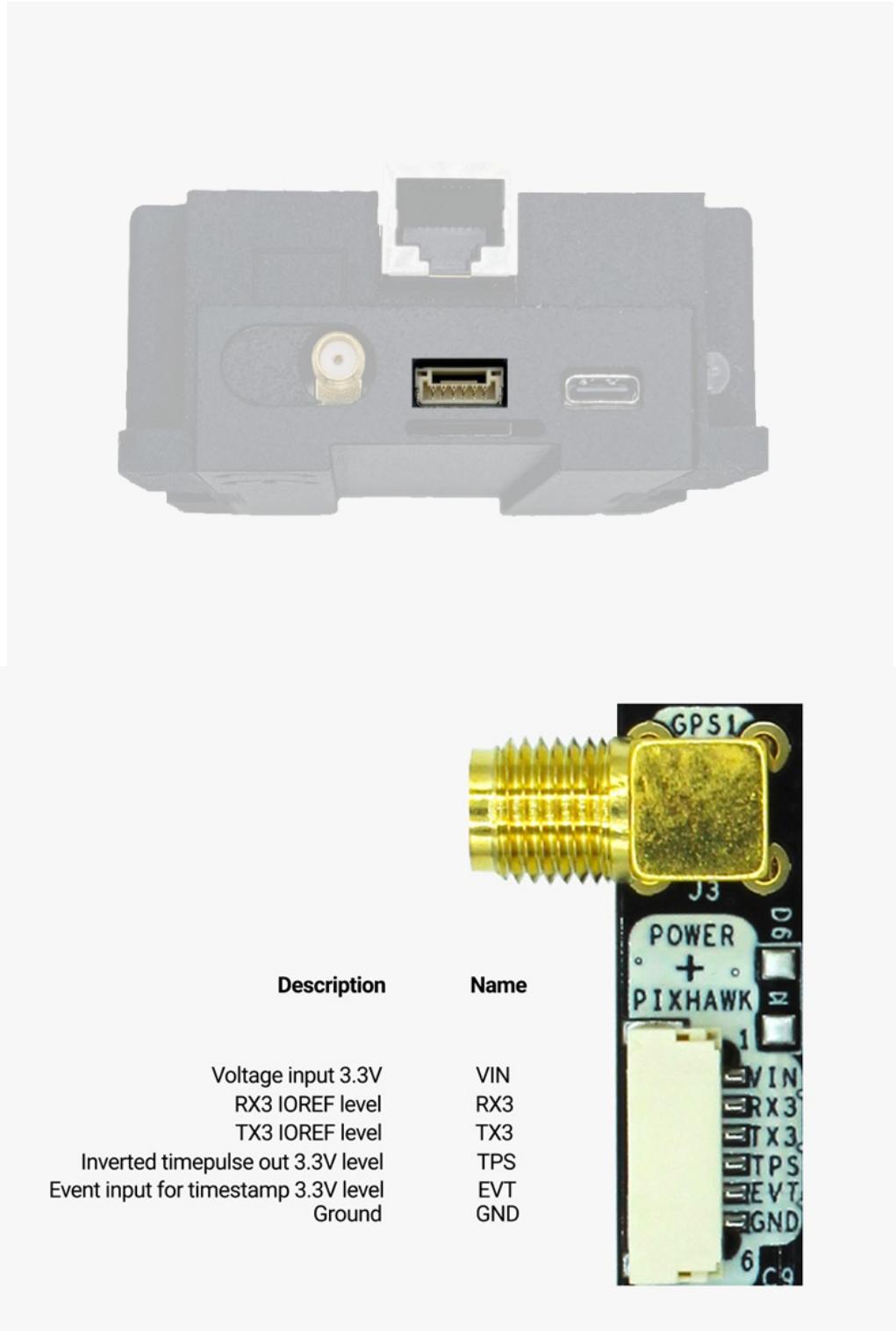
- Configuring the Base Station when connected to a PC.
- Powering the Base Station from a power bank or PC.

## Ethernet connector



Use this Ethernet connector to connect the receiver to a router. This provides internet access to the Base Station and, once configured, allows you to monitor and configure it from a remote computer.

## Pixhawk connector

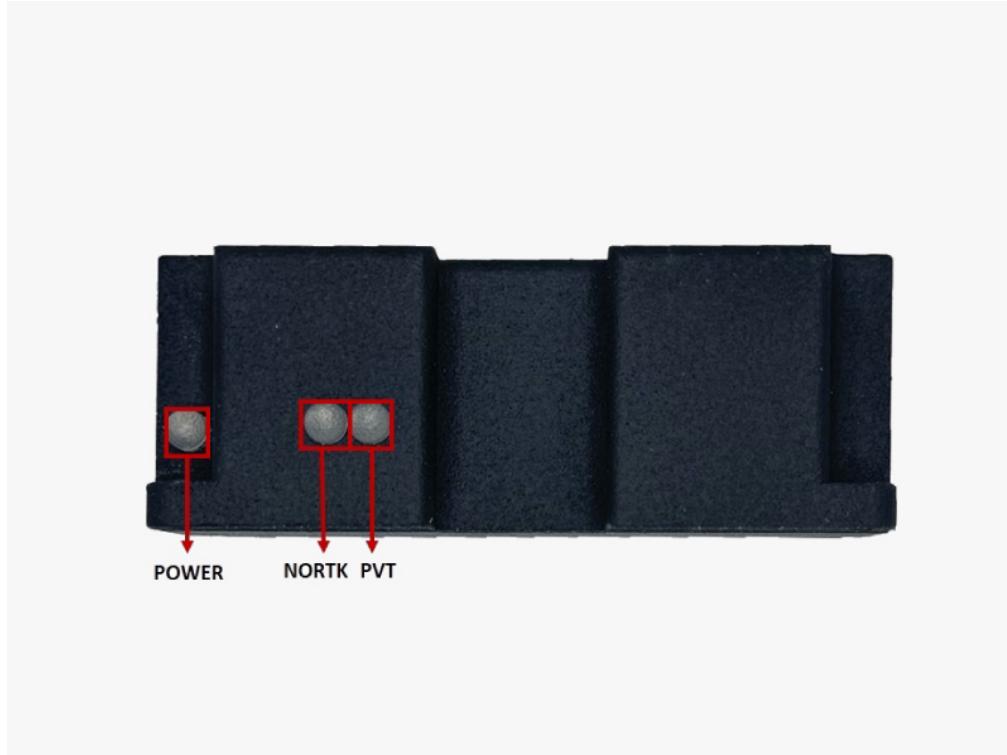


This connector is a standard JST GH 6-pin connector. If you will be connecting the receiver to different computers, you can use this connector as alternative permanent power source by using this cable: <https://www.ardusimple.com/product/usb-to-jst-gh-6-pin-cable/>

This connector also has a serial port (Serial Port 3 @ 3.3V TTL) that can be used to output correction data.

**??WARNING:** Do not connect RS232 cables to this connector, as it might burn the base station board. If in doubt you can always [contact us](#).

## LEDs



There are three status LEDs:

- **POWER:** Illuminates when the receiver is powered on.
- **PVT:** Illuminates when sufficient satellite data is available to calculate a position.
- **NORTK:** Blinking indicates that correction data is being received, while solid red indicates that the unit is in Base Station mode.

## Onboard datalogging (MicroSD card)



Insert a microSD card (not included in the package) here for data logging, and configure its parameters via the Septentrio's web interface. This function allows you to continuously log GNSS data for monitoring purposes or as a fallback in case of real-time RTK correction data interruptions.

For detailed steps, see the tutorial: [How to generate RINEX files with simpleRTK3B Pro.](#)

## Related tutorials

- [How to determine the exact position of your base station with simpleRTK3B Pro](#)
- [How to configure simpleRTK3B Pro as static base station](#)
- [How to share your triple-band Septentrio base station with RTK2go via Septentrio Native Ethernet](#)
- [How to get paid for installing and sharing your base station with Onocoy](#)

## Accessories



Antennas  
[\*\*Calibrated Survey Tripleband GNSS Antenna\*\*](#)



Antennas  
[\*\*Budget Survey Tripleband GNSS Antenna\*\*](#)



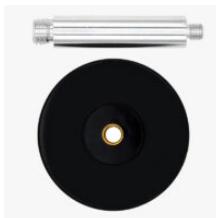
Plugins  
[\*\*Radio module Long Range \(LR\)\*\*](#)



Plugins  
[\*\*Radio module eXtra Long Range \(XLR\)\*\*](#)



Plugins  
[\*\*Radio Module Medium Range \(MR\)\*\*](#)



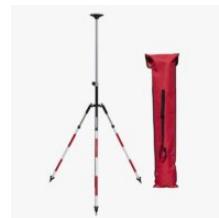
Accessories  
[\*\*Magnetic Stand for Survey GNSS Antenna\*\*](#)



Accessories  
[\*\*4 Section Pole for survey GNSS antenna\*\*](#)



Accessories  
[\*\*Pole for survey GNSS antenna\*\*](#)



Accessories  
[\*\*Tripod for surveying pole\*\*](#)



Accessories  
[\*\*Dipole antenna for LR/XLR radio\*\*](#)