PPP Service and how to operate with X-PAD

Version 1.1

This guide wants to be a complete reference for using the PPP service of the Zenith40 in combination of X-PAD.

Contents

GeoMax AG, Espenstrasse 135, CH-9443 Widnau, Switzerland, Tel: +41 71 447 1700

1. Step-by-step guide

In this first paragraph we will list the steps to activate and use the **PPP**. You can use these steps as reference.

TERRASTAR ORDER

How to order the license

1. Register to the Novatel e-shop sending a request to support@geomax-positioning.com
2. Login to Novatel e-shop
3. Request a 5 days demo license (max 3 for each receiver) or purchase a license

FIRST ACTIVATION IN X-PAD

First time PPP activation on the Zenith40 GNSS receiver

1. Open X-PAD and create a GNSS -> Zenith40 rover profile with PPP option enabled
2. Open the GNSS Status with this profile active and select PPP First Activation
3. Place the receiver in an open sky position for 3-4 hours for the PPP license activation
4. You can verify the successful activation in GNSS Receiver Info page

WORK WITH PPP ONLY

How to work with Zenith40 in PPP mode as a standalone solution, not in combination with a traditional RTK system (internet or UHF radio)

1. Open X-PAD and create a GNSS -> Zenith40 rover profile with PPP option enabled. Do not select any additional RTK data-link
2. Open an application
3. X-PAD proposes if you want to use to active the PPP and opens the PPP manager

3.1 If you want to work in a relative system in the PPP reference frame, select NO ADJUSTMENT and proceed

3.2 Wait for the PPP-Fixed status (the convergence time is approximately <18 min), when the accuracy meets the expectations, the measurements will start.

3.3 Coordinates will be measured in PPP mode in the PPP latitude-longitude reference frame

4. If you want to work in the same reference frame as an RTK system or the reference frame given by a known point, select from PPP manager an already created adjustment or, if not available, create a new position adjustment

4.1 If a position adjustment is created, select if proceed using a known point or an RTK point. Follow the step-by-step procedure to calculate the differences between the PPP reference frame and the RTK frame

4.2 If a position adjustment is already available, select it from the list

4.3 After the position adjustment is calculated or selected, we can use the PPP mode and work (if not already done in the position adjustment process, we must wait for the solution to converge to a cm accuracy)

WORK WITH PPP AND RTK CORRECTIONS

How to work with Zenith40 in PPP mode as backup for an RTK solution

1. Open X-PAD and create a GNSS -> Zenith40 rover profile with PPP option enabled. Select the additional RTK data-link also
2. Open an application
3. X-PAD proposes if you want to use to active the PPP and opens the PPP manager
4. Since we are mixing RTK measurements with PPP measurements a position adjustment is mandatory
5. Select from PPP manager an already created adjustment or, if not available, create a new position adjustment
6. If a position adjustment is created, select if proceed using a known point or an RTK point. Follow the step-by-step procedure to calculate the differences between the PPP and the RTK reference frame
7. If a position adjustment is already available, select it from the list
8. Note that we can also start with the RTK and select the PPP position adjustment also in a second time from the PPP menu
9. When the RTK datalink is down, the PPP position will be directly outputted (if the service is activated) in case the accuracy provided by the PPP solution is better than the RTK accuracy (Autonomous position if the RTK is down)
10. When RTK is available again, the RTK solution is again the source of coordinates, since in a standard case the RTK solution has better accuracy results than the PPP solution.
11. The Q-Lock Plus algorithm can choose between the solution service that provides better accuracy: PPP or RTK.

2. Introduction on PPP system

2.1 What is the PPP

PPP is a positioning technique that removes or models GNSS system errors to provide a high level of position accuracy from a single receiver, without the use of a GNSS base.

A PPP solution depends on GNSS satellite clock and orbit corrections, generated from a network of global reference stations. Once the corrections are calculated, they are delivered to the end user via satellite. These corrections are used by the receiver to obtain a **centimeter accuracy**, depending on the selected service without any GNSS local base station.

PPP solution requires a period to converge to desired accuracy to resolve any local biases such as the atmospheric conditions, multipath environment and satellite geometry. The actual accuracy achieved, and the convergence time required is dependent on the quality of the corrections and how they are applied in the receiver. Up to 3 cm accuracy is possible.

In Zenith40 PPP can be used standalone, to work with centimeter accuracy where a base or NTRIP is not available, or in combination with a standard RTK, to operate when the RTK data-link is down.

2.2 Terrastar service

Zenith40 uses the PPP service provided by **Terrastar**.

TerraStar, a Hexagon company, is a global leader in satellites-based correction services for land and near-shore applications and owns, operates, maintains and controls its global network.

- 24/7/365, all weather, correction services
- Various service levels at different performance levels are available. With its OEM7 Measurement Engine, Zenith40 classifies for “TerraStar C-Pro”, providing highest accuracy

Terrastar C-PRO	
Horizontal accuracy	2.5 cm (RMS) 3 cm (95%)
Vertical accuracy	5 cm (RMS)
Convergence Time	< 18 min
Supported GNSS	GPS/GLO/GAL/BDS

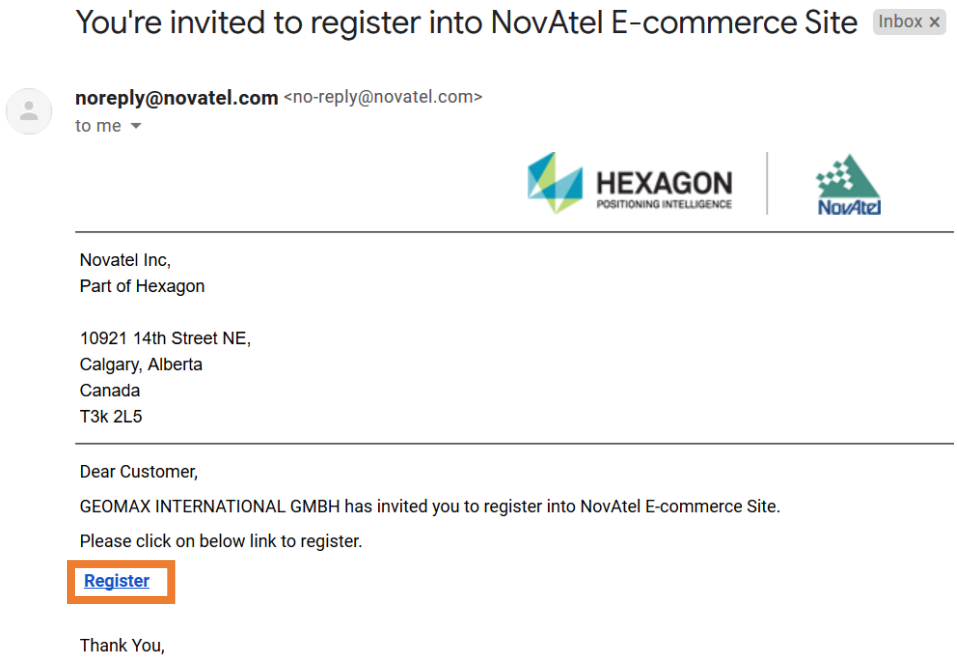
2.1 How to order Terrastar or request a demo

ACCESSING TO THE E-SHOP

To purchase a Terrastar license an invitation to the e-store of NovAtel is needed. To get your invitation please, contact the GeoMax support team on the email:

support@geomaxpositioning.com

You will receive the invitation on the email provided:


You're invited to register into NovAtel E-commerce Site Inbox ×

noreply@novatel.com <no-reply@novatel.com>
to me

HEXAGON POSITIONING INTELLIGENCE | NovAtel

Novatel Inc,
Part of Hexagon

10921 14th Street NE,
Calgary, Alberta
Canada
T3k 2L5

Dear Customer,

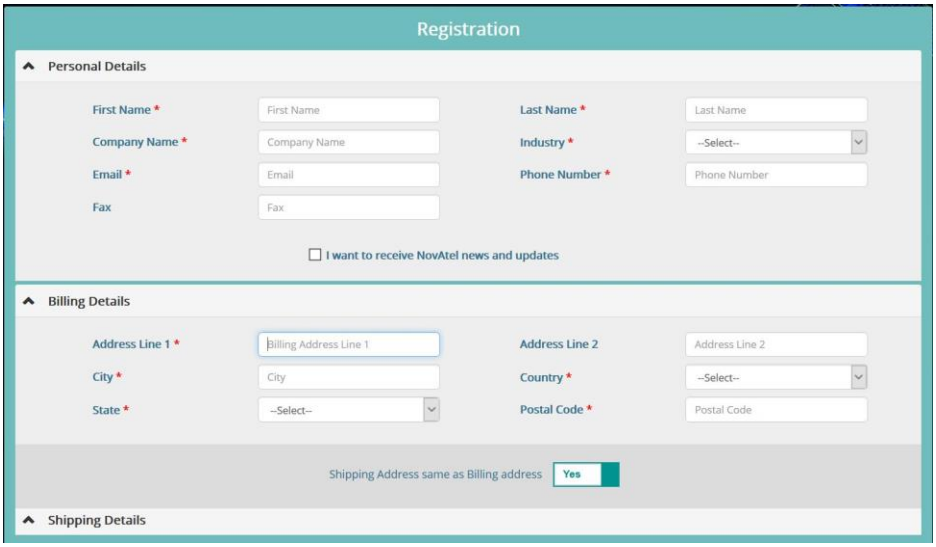
GEOMAX INTERNATIONAL GMBH has invited you to register into NovAtel E-commerce Site.

Please click on below link to register.

Register

Thank You,

Click **Register** on the invitation email, then on the Registration page insert your personal details, continue and check your email.



HEXAGON POSITIONING INTELLIGENCE | NovAtel

Novatel Inc,
Part of Hexagon

10921 14th Street NE,
Calgary, Alberta
Canada

T3K 2L5

Date: Fri Mar 29 09:43:49 GMT 2019 **Welcome!**

Amanda TRIAL

GeoMax

Thank you for registering with Novatel eCommerce, and Welcome to our community!

To finalize your registration, please click on the link below.

Link

If you believe you have received this email in error please contact our Support group at any of the contacts below.

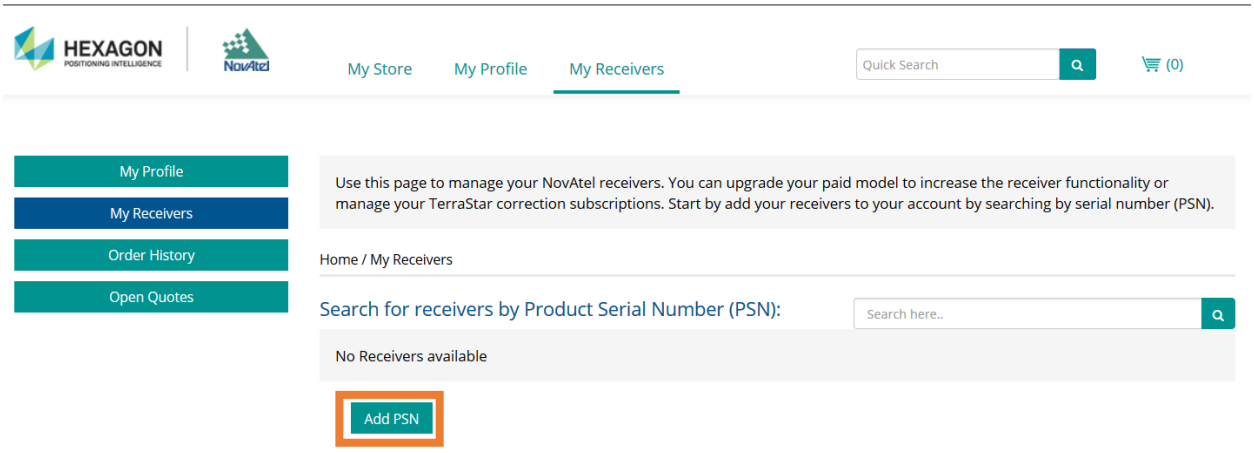
Click on the **Link** to enter the e-store and set up your password

You can also login from

https://store.novatel.com/

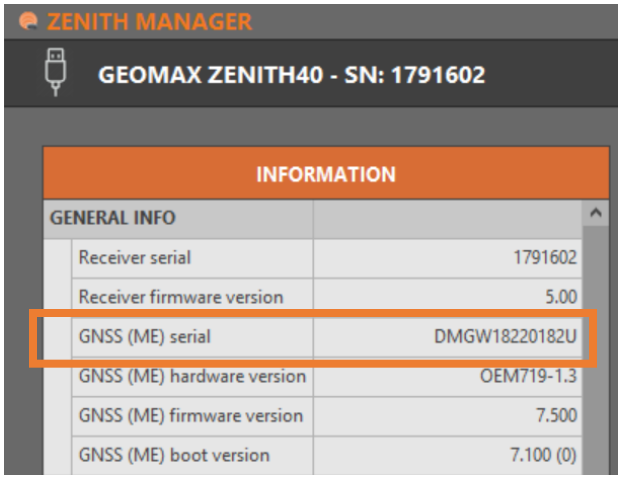
MY RECEIVERS

To manage your receivers, click on the **My Receivers** section in the top navigation after logging into NovAtel's online store

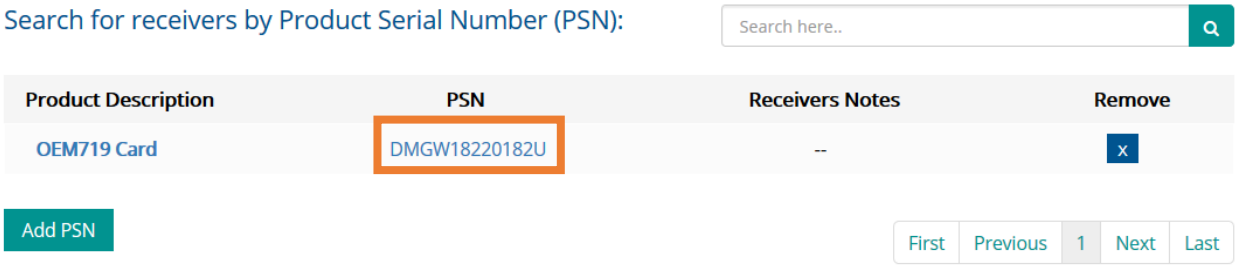


Click on ADD PSN to create a new receiver profile

The PSN of your receiver is the Serial Number of the ME board built in. You can find the information using the Zenith Manager app for PC or Tablet.



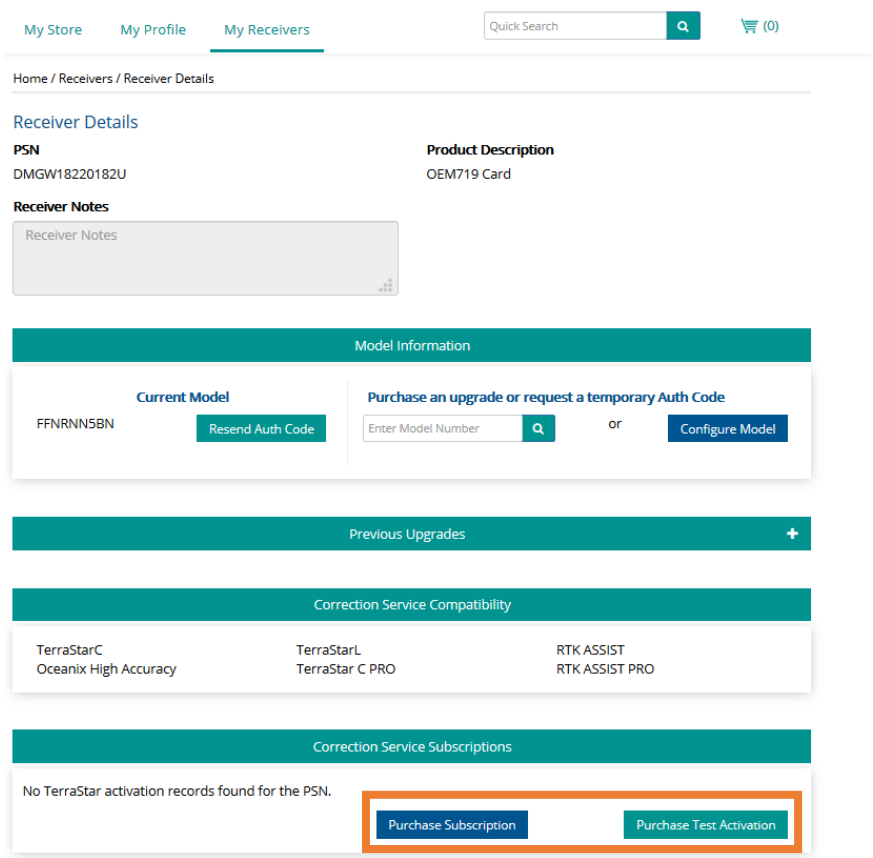
Enter the GNSS (ME) serial number



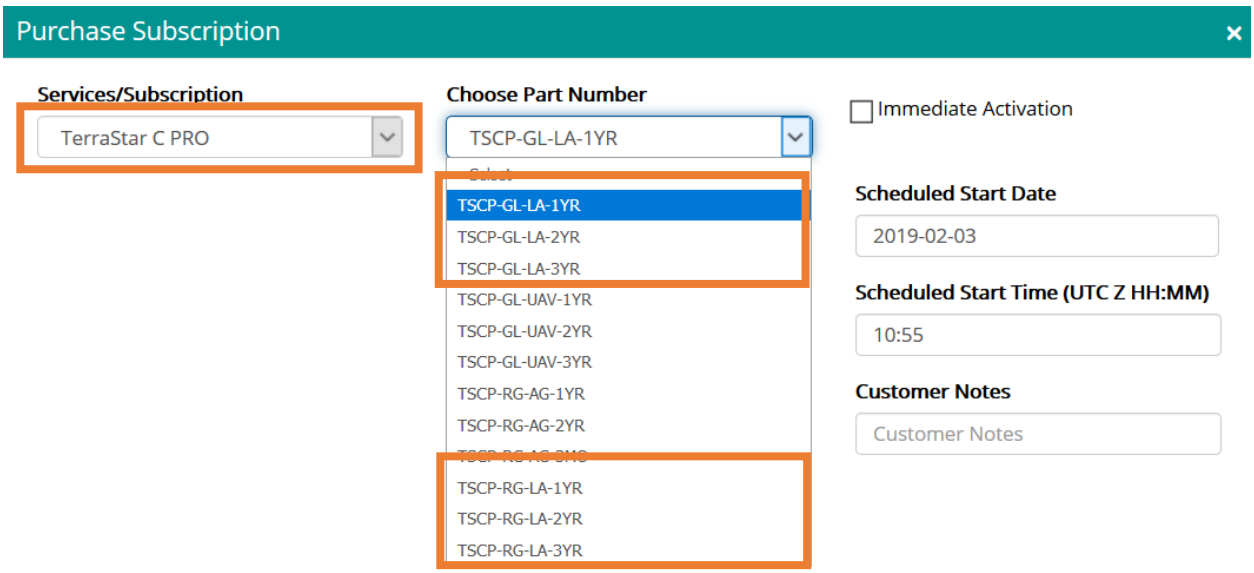
Click on the **PSN number** or Product description to access the receiver's details

SUBSCRIPTIONS

In this view you will see the receiver's details regarding current model and its correction service compatibilities and are able to perform various actions
Click on **PURCHASE SUBSCRIPTION** to purchase a new subscription



GeoMax AG, Espenstrasse 135, CH-9443 Widnau, Switzerland, Tel: +41 71 447 1700



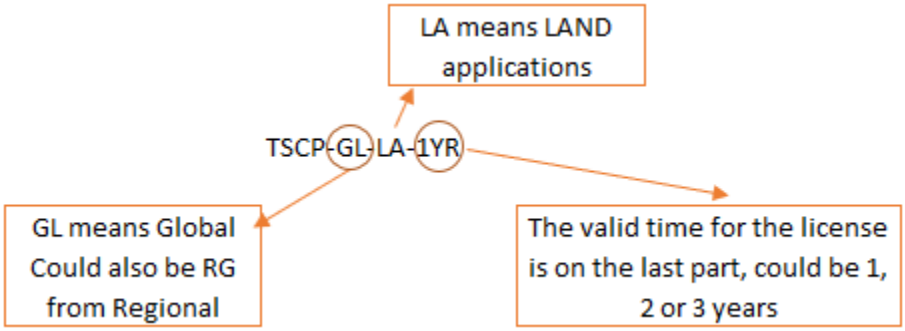
After clicking on “Purchase Subscription”, please select the Subscription Type and the part number you are looking to purchase from the available dropdown menus.

Service/Subscription: Select the service **TERRASTAR C PRO**

Choose Part Number: **TSCP-GL-LA-1YR /2YR /3YR** or **TSCP-RG-LA-1YR /2YR /3YR**

Then select the activation date

Part Number Description:



In case of choosing the REGIONAL license, the country of usage must be entered.

If for example you want to order a 1 year Terrastar license for Brazil, select TSCP-RG-LA-1YR and select Brazil as country.

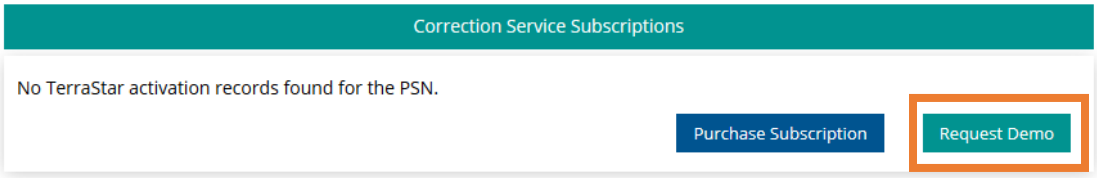
Then click on "**Next**" to start the checkout process and verify your order

SHOPPING CART/CHECKOUT

Proceed to pay via Credit Card, inserting the data and accepting the terms and conditions

TERRASTAR DEMO LICENSES

Each Zenith40 includes 3 x 5-days demo licenses.
To request the **demo license**, select the receiver from My Receiver page and click on the Request Demo button.



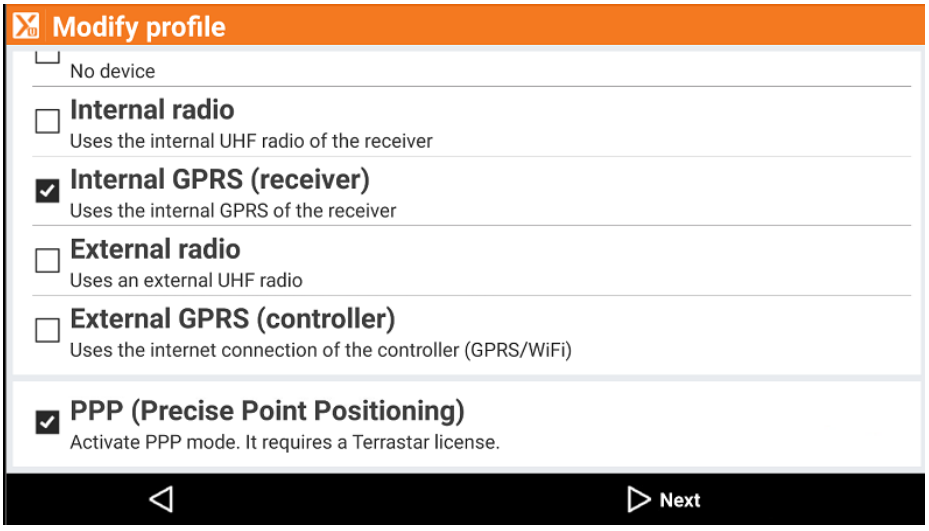
3. How to work with PPP and X-PAD Ultimate

In this section we will see how to operate using the field software X-PAD Ultimate

3.1 Configuration profile in X-PAD

To use the PPP in **X-PAD software** the first step is to create a profile. PPP can be used in 2 modes: as standalone system to obtain a cm accuracy, or as support to an RTK connection as backup.

In the 2 configuration it is necessary to activate the option PPP (Precise Point Positioning) in the GNSS Settings.



Open Settings -> GNSS & Total Station -> New Profile

Enter profile name -> Rover mode -> Geomax -> Zenith40

Connect the Bluetooth and in the RTK page select PPP (Precise Point Positioning)

If you want also to work with a standard RTK (GPRS or UHF) select also the additional RTK data-link, otherwise select only PPP.

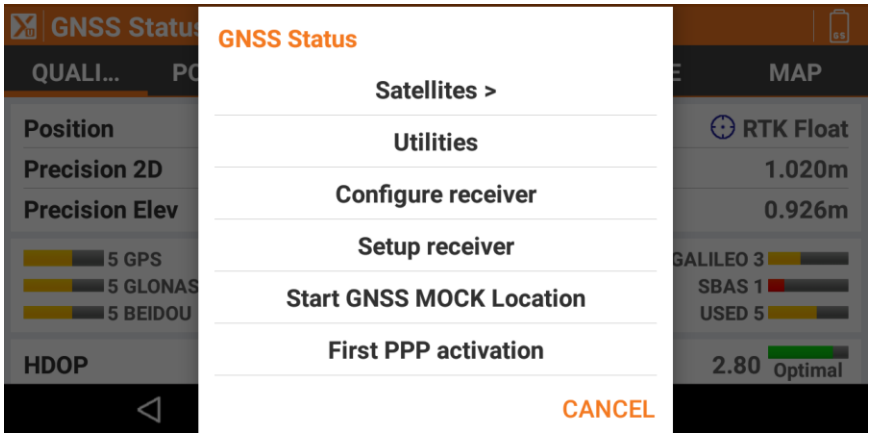
Complete the profile and configure the receiver.

3.2 First PPP activation

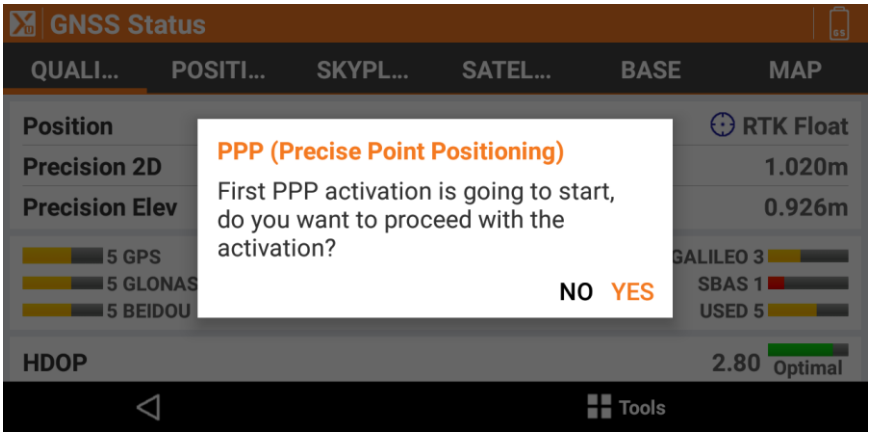
The authorization to use Terrastar is sent by the satellites to the receiver. To activate the PPP service, we must wait that the **authorization** is provided from the satellite to the unit. This requires **3-4 hours** of continuous satellite tracking by our unit.

To activate the first time the PPP:

- Open a GNSS page (the current profile must have PPP mode checked)
- Then open **GNSS Status** page, and from **TOOLS** list select **First PPP activation**

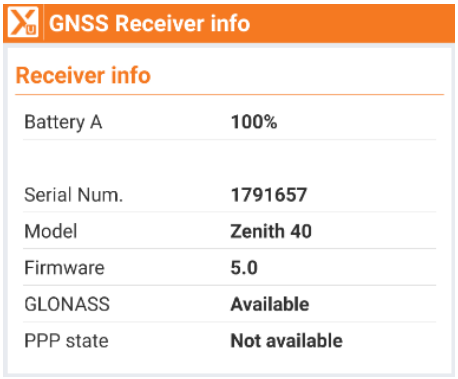


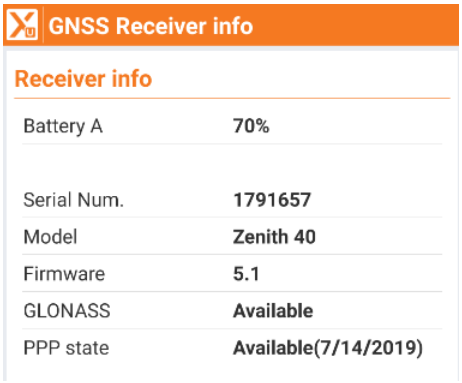
- A 3-4 hours open sky position is required to receive the Terrastar satellites signal. It is not necessary to have X-PAD connected in this step.



- From **GNSS info** page (clicking on the receiver battery icon on top right) is possible to check if the PPP service is available, in case the row **First PPP activation** will appear it means that the system is not ready yet.

Below on the left picture the GNSS Receiver info page shows the PPP service is not available (not activated yet) and on the right after PPP has been activated.





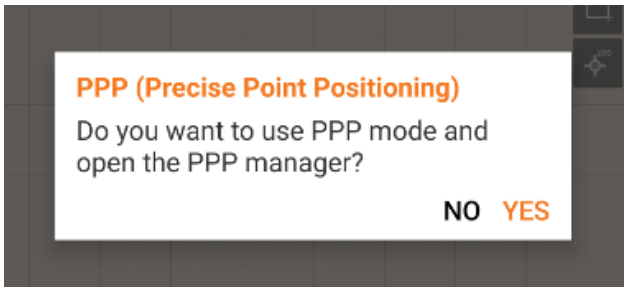
3.3 PPP Manager

The PPP works in a **different reference frame** compared to the RTK systems we are used to use. This means that the WGS84 latitude, longitude and height of the same point measured with RTK (for example the CORS network) and the latitude, longitude and height measured with PPP have a difference.

If we want to operate in the same reference frame, using PPP and a different reference frame, it is important that X-PAD calculate correctly the delta between the 2 frames.

To do this X-PAD has a step-by-step procedure to simplify all the process.

The first time you open an application, you will see a popup message informing if you want to do a system calibration.



If you press YES X-PAD will open the PPP manager where you can find the **position adjustments** between the PPP reference frame and the RTK frame.

A map following the list and can help the user on finding the best solution.

An adjustment it's valid when:

- the data of creation is no older than 2 months,

- the difference from the position where the calibration was done, and the current receiver position are less than 50km

Note: this validations for the position adjustment are not valid all around the globe. It may vary depending on the world position where the Zenith40 operates. If there is an area with high tectonic movements, the position adjustment should be calculated more often. It is advised to make a check on a known point with the position adjustment selected to verify the solution satisfies the needs, if not, a newer adjustment should be calculated.

This list includes all done position adjustments. The first time this will be empty.

Click on New to start a new position adjustment. This position adjustment will calculate the differences between the PPP system and the RTK system.

If instead we want to do a relative system, only with PPP, we don't need any position adjustment. In this case click on **NO POSITION ADJUSTMENT** and proceed with the PPP survey.

If an adjustment is activated, the PPP manager will be closed, the PPP shifting will load and apply to every measurement done with PPP service.
PPP manager it's now still accessible by "Tools" button of GNSS Status page, where, an option called "PPP" allow to open the PPP Manager or deactivate PPP positioning adjustment.

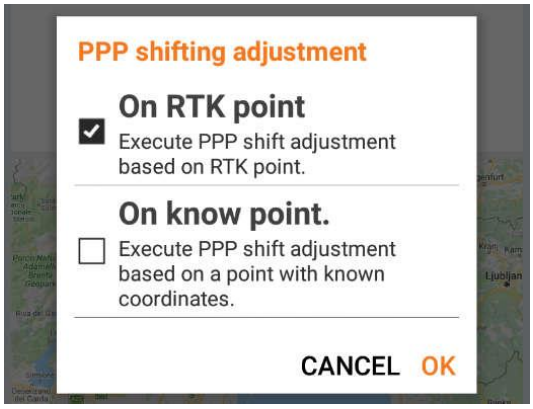
3.4 Create a new PPP Position Adjustment

If we want to have the PPP and the RTK in the same system, click on NEW to start the step-by-step procedure.

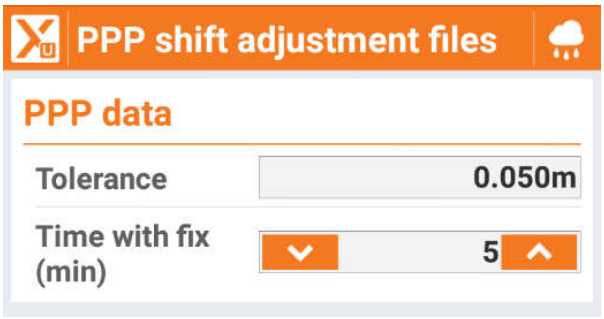
The calculation is based on:

- RTK position. The coordinates of the point are obtained from an average of a GNSS positions with the right accuracy (an RTK-Data page allows to insert accuracy information for position measuring).
  It's possible than the current instrument profile isn't an RTK profile. A message in this case appear and user can choose another profile with the same Bluetooth address and RTK.
- Known point, the coordinates of the point are inserted by the user.

IMPORTANT: in the adjustment procedure the receiver must be stable on the same position of the point measured in RTK or taken from the database, and to speed up the procedure must be on an open sky position.



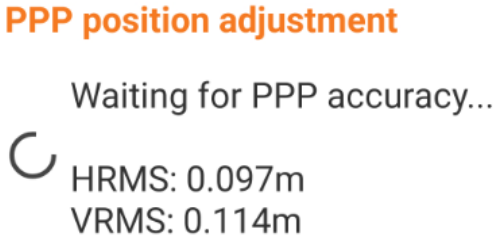
X-PAD will store a fixed position with an RTK profile or will select the one from the point database. After this step X-PAD has the WGS84 coordinate of the RTK.



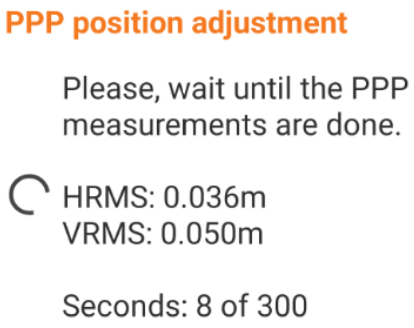
In the next step of the procedure X-PAD will store the same point with PPP, to calculate the shift.

First, X-PAD will wait to have the Terrastar convergence done: this usually takes around 15 minutes depending on satellite availability: when the status is PPP-Fixed the convergence is done.

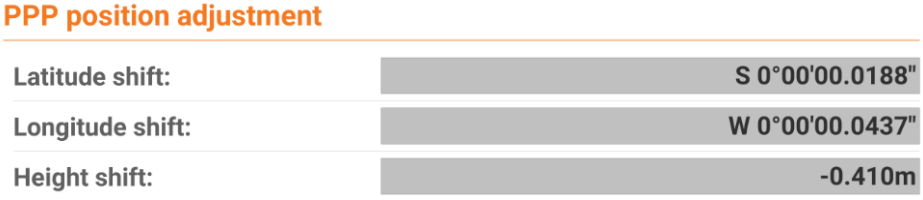
When the receiver status changes to PPP-Fixed X-PAD will wait to get the desired accuracy (for example 5cm, the value set in X-PAD in the step before).



When the RMS is smaller than the tolerance set, X-PAD will measure several times the same point in PPP (the number of times depends on the value in minutes set before).

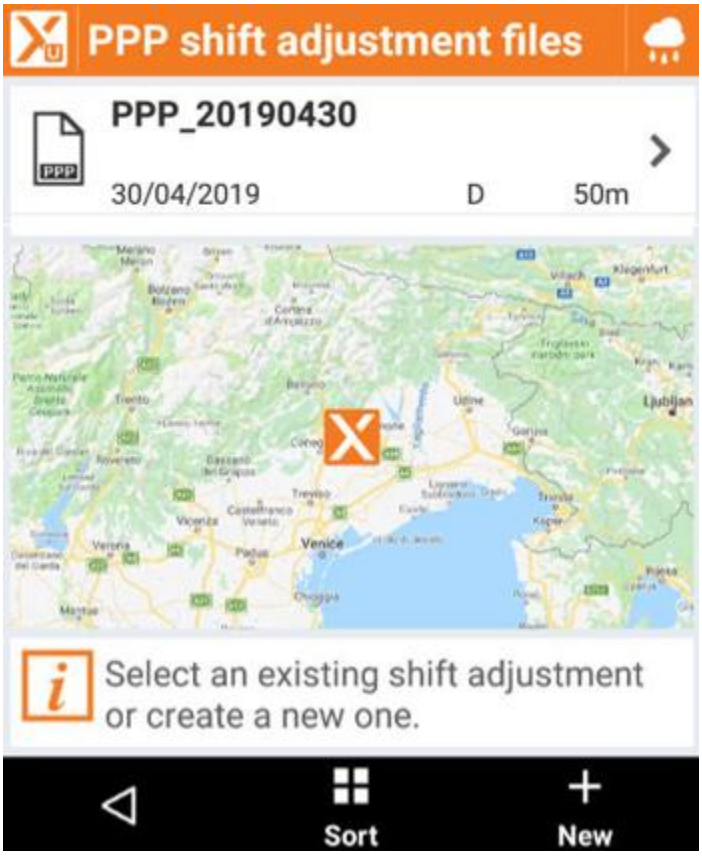


After the measurements, X-PAD will compare the Latitude-Longitude-Ellipsoid Elevation of the RTK point and the PPP point and calculates the delta.



These are the shifts that will be applied to the PPP measurements to be in the same reference frame than the RTK measurements.

Click Accept to save the calibration.



This calibration is stored in X-PAD, so it is not necessary to re-calibrate again if working in the same area. Note: the calibration can be shared with other instruments working on the same area -> share the file stored on the controller/tablet folder: XPAD/_Data/PPP and copy it on the desired controlled to be able to use it.

An adjustment it's valid when:

- the data of creation is no older than 2 months,
- the difference from the position where the calibration was done, and the current receiver position are less than 50km

If these 2 conditions are not valid, a warning message will pop up, the calibration can still be used BUT is advisable to perform a new adjustment.

3.5 Work with PPP without RTK

PPP can be used to operate in areas where the RTK is not available. In this case we can use PPP to obtain cm accuracy without a base.

After the GNSS profile has been created and the first activation completed, we are ready to use the receiver in this mode.

Open an application (for example Survey Point) and X-PAD will propose if we want to use a position adjustment.

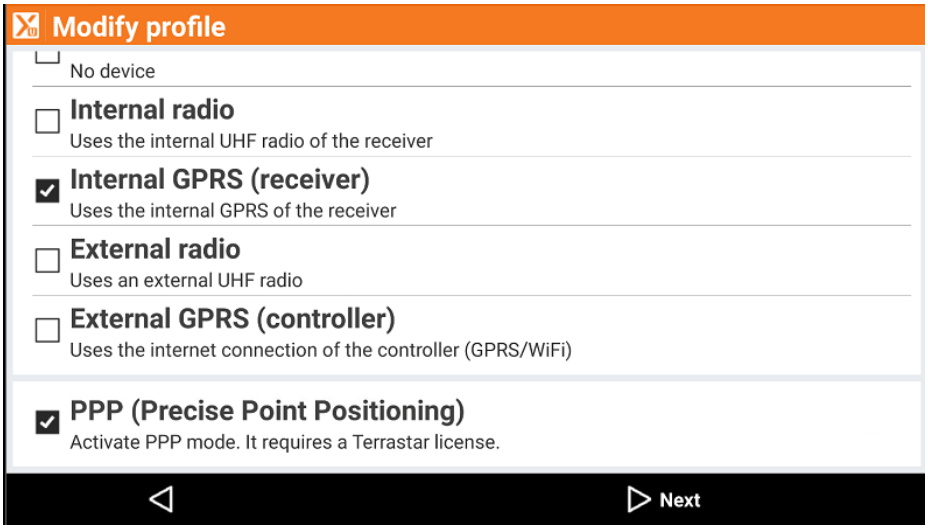
If we want to work in the same reference frame as a previous RTK system, select or create a position adjustment (refer to paragraph 6 and 7). Otherwise in the PPP manager select NO POSITION ADJUSTMENT.

When the system converges, we will be able to measure and store point in the PPP-Fixed status (approximately we must wait 15 minutes).

3.6 Work with PPP and RTK

PPP can also be used in combination with an RTK data-link to be a backup in case the RTK service is down. For example, if we use an RTK to a CORS network, we can use PPP to backup the RTK connection when internet is not available.

To work in this mode, we must create a Zenith40 RTK profile with enabled PPP and an RTK data-link, like in the picture below.



Open Settings -> GNSS & Total Station -> New Profile

Enter profile name -> Rover mode -> Geomax -> Zenith40

Connect the Bluetooth and in the RTK page select PPP (Precise Point Positioning)

Check also the additional RTK data-link.

Complete the profile and configure the receiver.

Then open a surveying application and X-PAD will propose if you want to work with PPP. In this case, since we are working with RTK and PPP, it is mandatory to select or perform a position adjustment, to be sure that PPP coordinates and RTK coordinates are referred on the same reference frame (means that same point measured in PPP and RTK must have same latitude and longitude).

Then start with the application. If the RTK position is available it will be used; as soon as the RTK is down, the PPP will be automatically used in case the PPP solution provides better accuracy then the RTK solution.

The positioning algorithm (Q-Lock Plus) will always output the coordinate with best accuracy. That means that the algorithm compares the accuracy of the PPP solution and the RTK solution, and automatically proposes the solution with the best accuracy.

When the RTK datalink is again available, and the RTK accuracy is better than the PPP, X-PAD automatically will switch again to RTK.