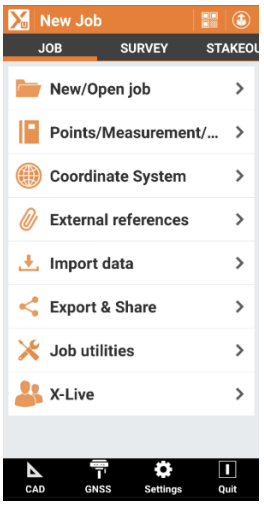
Getting Started Guide for



X-PAD Ultimate

used with

iGage GNSS RTK Receivers and GeoMax Zoom 70/75/90/95 Robotic Total Stations

This manual is for use with iG GNSS Receivers and GeoMax robots sold by iGage Mapping Corporation.

30 October 2021, X-PAD_GSG_R056.docx

How to use this Getting Started Guide

GNSS Receivers

If you purchased GNSS (GPS) equipment with X-PAD:

1. Follow the RED edged pages which detail how to install and configure X-PAD.
2. Follow the ORANGE edged pages which detail how to define instrument profiles for GNSS receivers.

Robotic Total Stations

If you purchased a Robotic Total Station with X-PAD:

1. Read the Common robot issues and questions section at the end of this manual with BLUE edge pages.
2. Follow the RED edged pages which detail how to install and configure X-PAD.
3. Follow the First Robotic Job section with PURPLE edged pages.

Table of Contents

The History of X-PAD

X-Pad was originally introduced in 2012 for use with GPS and Total Stations and was available for use on Windows Mobile devices.

The next 8-years produced significant upgrades:

2013	Zoom 80 Robotic Module, Road Module, Android devices
2014	Auto Measurements (Monitoring), 3D for Zoom3D, PicPoint, X-Pad Office
2015	X-Pad Construction, Zipp20, GIS Module, Bathymetry Module, Locators Module
2016	Zoom 90, X-Pole
2017	X-Pad Fusion, Masterplan
2018	X-Pad Survey Ultimate, X-Pad Build Ultimate
2019	Survey GO
2020	Extensive support for the USA: Bearings, US and International Feet

X-Pad has been translated to over 20 languages and has over 8,000 current deployments worldwide.

While X-Pad Ultimate is only targeted for the Android platform, X-Pad is still available for Windows Mobile and can be optionally included with every Zoom 95 robot.

Because both X-Pad and the Zoom 95 are from GeoMax, support for Zoom 95 Robots is unparalleled.

As support for the Windows Mobile operating system has been terminated, the Android OS presents a platform with a future, the majority of new handheld devices, faster operation, more memory, brighter screens, longer range Bluetooth, better battery life, better connectivity, better security and a well-defined forward path.

X-PAD Ultimate GNSS has the best Robotic Total Station support for GeoMax Zoom 90 and 95 Robots.

X-PAD Ultimate supports a variety of GNSS devices, Total Stations and Robots.

X-PAD Deployment: Which options will you need?

X-PAD Ultimate software can be installed on most Android phones and tablets eliminating the need for a dedicated data collector. The Android platform is significantly faster, enjoys continued development and is substantially more robust than Windows Mobile Devices providing you with a powerful field solution.

If you purchased a Robotic Total Station, you would need the TPS and Robotic options.

If you purchased an iGage GNSS receiver, you would need the GNSS and 'CHC Driver' options.

If you need to work with Volumes or stakeout Surfaces, you will want to purchase the 'Volume' option. If you plan on exchanging GIS data (Shapefiles) or collecting extensive GIS data with points you should purchase the GIS module.

Understanding licensing, maintenance, modules

X-PAD Ultimate GNSS field software is licensed as a main product including GNSS or TPS (Total Station) support:

(All prices 2022 Q4)

877734	X-PAD Ultimate Survey GNSS	$ 1,187.50
877735	X-PAD Ultimate Survey TPS Manual	$ 1,187.50
877736	X-PAD Ultimate Survey Auto Measuring (Monitoring) TPS	$ 1,150.00
877738	X-PAD Ultimate Survey Premium (GNSS, TPS and ROBOTIC)	$ 2,625.00

To these main products you can license additional task-oriented modules:

877740	X-PAD Ultimate Survey Volume Module:	$ 250.00

	Create and import 3D surfaces to be used for all stakeout operations. It includes functions for the calculation of the volumes according to different methods.	
877741	X-PAD Ultimate Survey Bathometry Module: Manage bathymetric surveys by acquiring depth data from echo sounder and GNSS positions. This includes a route control.	$ 1,025.00
877743	X-PAD Ultimate Survey Road Module: Import road design data from different formats, stakeout any element in the alignment with a variety of methods.	$ 432.00
877745	X-PAD Ultimate Survey PicPoint Module: Captures and photo processes allow you to place the measurement of points directly on the photos themselves.	$ 250.00
877746	X-PAD Ultimate Survey Robotic TPS Module: Extend the TPS main module with features that allow full control of motorized and robotic total stations.	$ 210.00
877747	X-PAD Ultimate Survey X-Pole (option): Flexibly work with TPS and GNSS at the same time, by using the best features of each system.	$ 625.00
877748	X-PAD Ultimate Survey GIS Module: Define GIS features and attributes to be assigned to measured points. It includes import and export functions of GIS data.	$ 62.50
877749	X-PAD Ultimate Survey Locator Module: Connect to utility locators and record depths at corresponding GNSS positions.	$ 62.50
877753	X-PAD Ultimate Survey BIM Module: Import BIM models, display, navigate and extract information (points, lines, surfaces) for checking and stakeout operations.	$ 250.00
877754	X-PAD Ultimate Survey Build Module: Extend the Survey version with all the features that are exclusively made for the Build version.	$ 462.50
902526	X-PAD Ultimate Survey: Set of commands designed for mechanical, electrical and plumbing, transfer heights, create parallel lines, on surfaces, and scan lines.	$ 250.00

Software maintenance

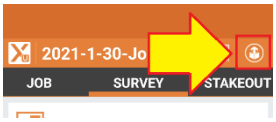
Your purchase of X-Pad Ultimate includes software updates and patches for 1-year.

This feature is called X-PERT. After the first year you can extend maintenance annually for a nominal fee.

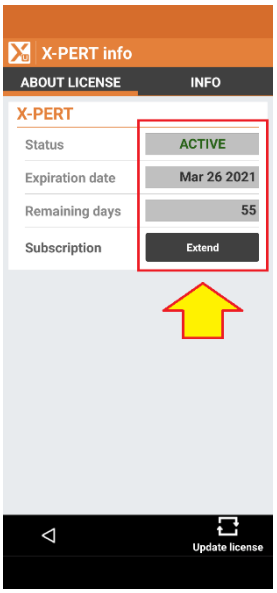
6015421	1-year X-PERT Option to receive Service Packs and have access to major updates for one year	$ 250.00

If maintenance has only expired for a few months, then reinstatement will retroactively be applied to the previous expiration date. If your license falls out of maintenance for more than 1-year, there is an additional $250 reinstatement charge, and the new expiration date will extend for 1-year from the time of reinstatement.

Once X-Pad is installed on a device, you can check the status of X-PERT:



Click on the X-PERT icon at the top of the main menu.



If you have recently extended X-PERT, you can click on Update license to synchronize your subscription.

Is X-PAD best with a phone or tablet?

X- PAD should work great with most modern Android phones and tablets. When deciding what device to use with X-PAD you might consider:

- Purchase a new device vs. using an existing device.
- Ability to ruggedize with an external case or protection system.
- Screen size and brightness
- Battery life
- Device memory
- Bluetooth range to Robotic Total Station

In addition to common consumer and prosumer devices, GeoMax (and other vendors) offer extremely rugged, field ready data Android based collectors like the 'Zenius800' ($1,800):

If you choose to use a phone, there are great lightweight pole mounting options:

Because it is easy to move your X-PAD Ultimate license to a new device, you can easily purchase a new data collector every year and preserve your field software investment.

Network Rover Applications

Because the Android device's internet connection can be used for Network Rover applications, *a phone or tablet that is activated with cellular data will be much easier to use with Network rover applications*.

While you can connect the collector to a Wi-Fi hotspot while in the field for access to server-based corrections, or you can put a SIM card in the GNSS receiver, using an Android device with an activated cellular modem enables data for job sharing and GNSS Network server access.

The phone/tablet data connection also assists in transferring files between the data collector and office with cloud accounts like Google Drive.

iGage mail lists

Please sign up for the X-PAD and Zoom90/95 mail lists so we can notify you of updates and changes.

We will automatically send you commonly asked questions and answers as we encounter them. **We will also send you firmware and software update notices. You can sign up here:** www.igage.com/ml **(that's slash M L for Mail List).**

Look for the 'X-PAD' mail list and if you purchased a robot, the 'Zoom 95/90 Robot' mail list.

Installing X-PAD on your Android device

Internet access is required to download, install and activate X-PAD on your device. Because the files are quite large, a Wi-Fi connection to an unmetered internet source will be better.

Update your Data Collector First

Before you install X-PAD, please **update your Android device**. Especially if the hardware has been newly acquired or has been sitting around unused for a while. X-PAD licensing may not survive an update from an older version of Android 10 all the way to the latest build of Android 11.

To update your device:

1. Plug device into external power.
2. Make sure device is attached to Wi-Fi internet. (It will not update via a cellular connection.)
3. Go to 'Settings: System: Advanced: System Update' (or search for Update in Settings.)
4. Click on 'Check for Update', choose to update if one is available.
5. Reboot your device if requested, wait for update to complete.

After the system update fully completes, go to the 'Play Store' and force update all your existing applications. From the 'Play Store' menu:

1. Click on the circle at the right side of the search box.
2. Click on 'Manage apps & device'
3. On the 'Overview' tab, click on 'update all'
4. Wait for any updates to fully complete.

If your device is new, there may be additional system updates after the first update. Consider checking for system updates a second time.

Get X-PAD from our website, not the 'Play Store'

On the Android device use the device's default browser and go to the web address:

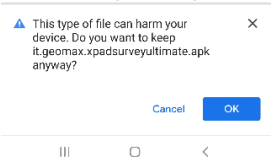
www.iGGPS.com

Look for the X-PAD logo near the bottom:

Find and click on the GeoMax X-PAD [Install Links]

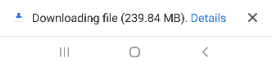
On the 'Links' page, find the X-PAD Ultimate Survey link and click on the large Download button:

A system warning message will be displayed:



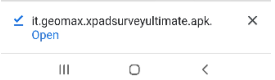
Click on OK.

The installer will be downloaded:



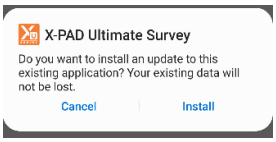
Wait for the download to complete.

Your device will offer to Open the installer:



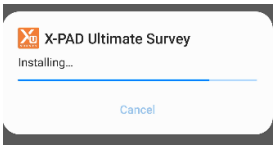
Click on 'Open'.

After a few seconds of staging this confirmation screen will be shown:



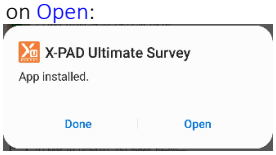
Click on Install.

It will take almost a minute to install X-PAD:



Wait for the installation to complete.

Click on Open:



During the installation process you will be asked to allow various permissions. You must allow these permissions or X-PAD will not be able to run:

Camera, Files, Location (GPS), Microphone, Phone, SMS

These permissions are needed to share data, add pictures to stored points, store jobs in device memory, use Voice commands, use the Android devices internal GPS to point a robot or do recon without an external receiver.

It is okay to deny permissions for Contacts.

The Activate license dialog is shown:

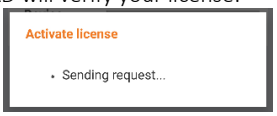
You should have *X-PAD License Certificate* or numbers on your invoice, find your unique **Equipment ID** and **Serial Number** on the certificate then enter them on the activation screen:

Click the Activate button 

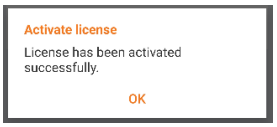
in the lower right-hand corner.

Your X-PAD license can only be installed on one device at a time.

X-PAD will verify your license:



After a few moments, a success message will be shown:



Click on OK.

The activated modules will be shown:

Only the options purchased will initially be active on your installation.

X-PAD has a great total station module for both manual and robotic total stations. It is likely that it will work with your existing equipment.

There are also many additional task-specific modules for saving time in the field.

Call us to add additional options to your license.

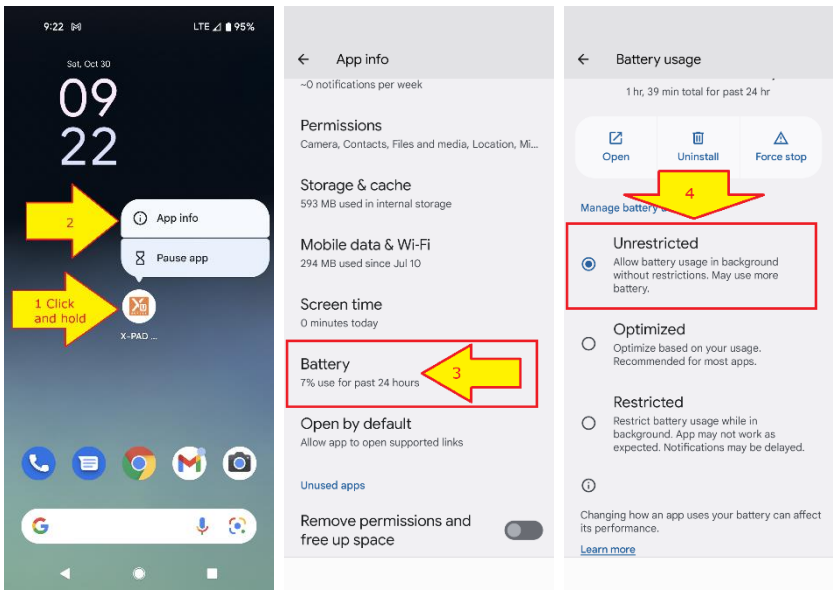
+1-801-412-0011

Immediately after installing and activating, download the USA Localization Pack as described on page 15.

Allow X-PAD to run in the background

By default, the Android OS may slow down X-PAD and break Bluetooth connections to survey devices when you task switch to use another application to extend battery life.

The power-saving option settings are slightly different on each version of Android. For Android 12: to allow X-PAD to run in the background: 1. Click and hold the screen top icon, 2. Click on App info, 3. Click on Battery settings, 4. Select Unrestricted battery use:



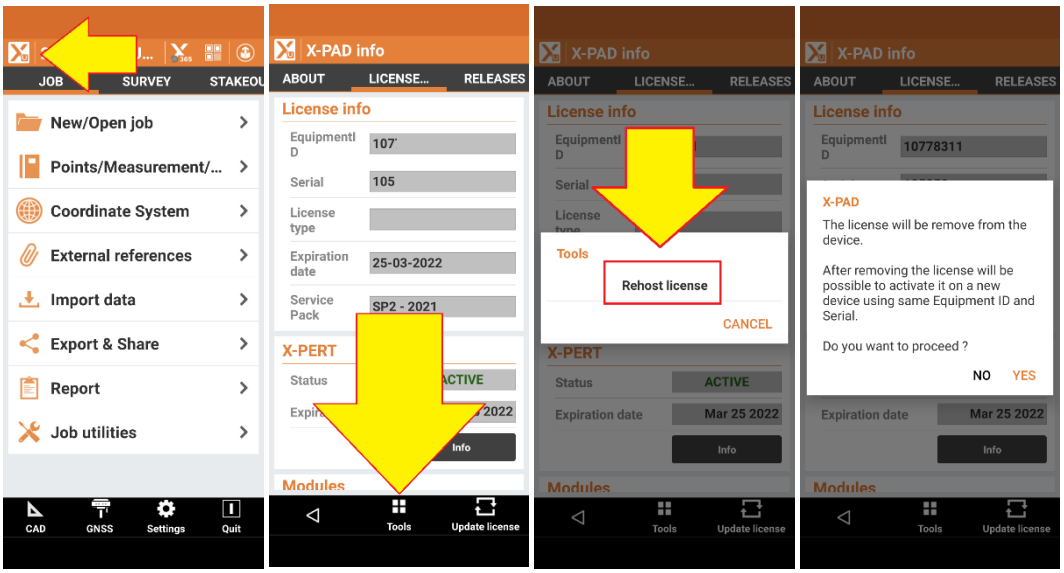
Rehosting (moving) X-PAD to a new device

If you have the device where your license is currently deployed, it is possible to move your X-PAD license from one device to a new device with no factory assistance.

From most any screen, click on the X in the upper left corner.

Select the LICENSE tab (at the top). Write down your EquipmentID and Serial. Do not lose them!

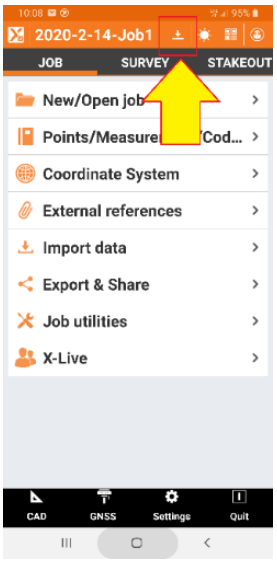
Click on Tools (bottom center), choose Rehost license and finally click on YES to confirm.



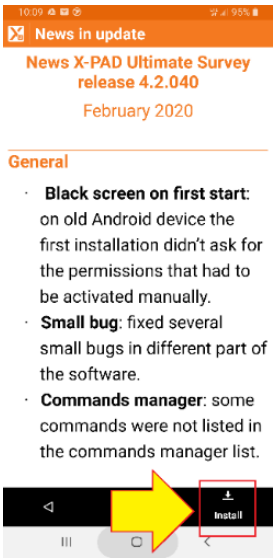
You may now install X-PAD on another device and re-use the original serial number.

Updating X-PAD to the Latest Version

On the main X-PAD screen:



If the  icon is displayed (as shown above) a new software version is available. Click on the down arrow to retrieve a description of the updates. After a few seconds the enhancements and bug fixes included in the new version will be shown:



Click on the Install button to download and then install the latest X-PAD version automatically.

If the update downloads but does not automatically install you may need to use the device's file 'Explorer' to manually run the .APK file. (This occurs on some devices with tightened security profiles.)

You will find the downloaded update in this system folder:

/Storage/emulated/0/X-PAD/_Data/Update

The file will be named in this fashion:

it.geomax.xpadsurveyultimate_X_X_XX.apk

Loading GEOIDS and local coordinate systems

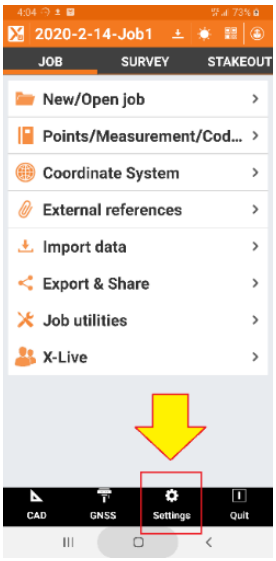
Immediately after installing X-PAD you should add the United States Localization Package to the base installation.

This will download and install USA specific GEOIDS and Coordinate Systems (like the US State Plane codes and Oregon and Iowa specific county systems) into the X-PAD program.

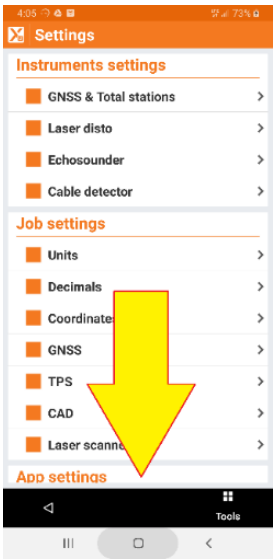
Loading the USA Localization Package

Internet access is required for this procedure.

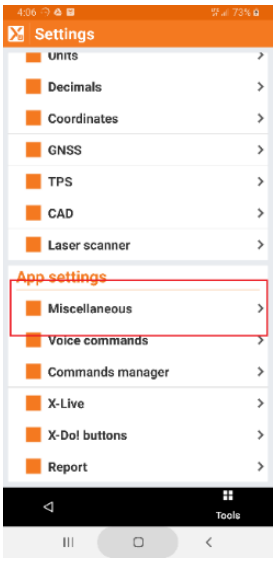
From the main menu click on Settings:



The Instrument settings dialog will be shown:

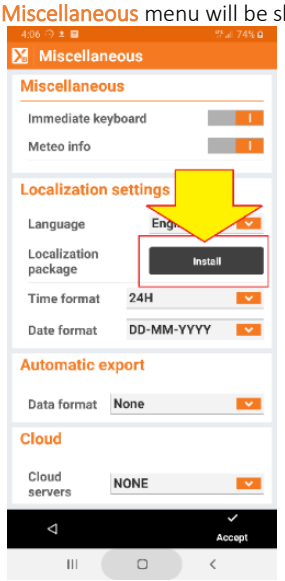


Drag the menu down up so that you can see the Miscellaneous item under App settings:



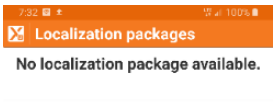
Click on Miscellaneous.

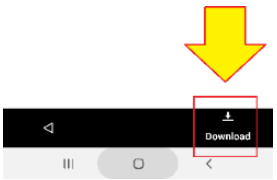
The Miscellaneous menu will be shown:



click on the Localization package Install button.

Previously downloaded / saved packages (if any) will be listed:

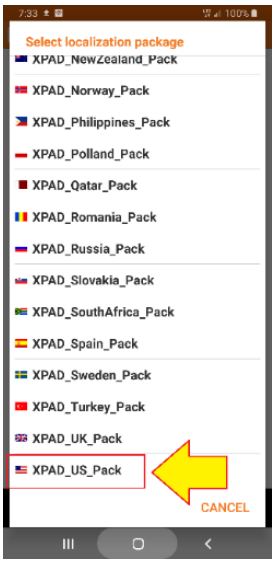




Click on the Download button to retrieve an updated list of all available packages.

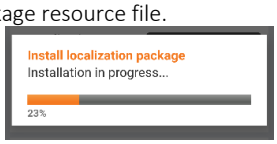
Wait while the list of packages is retrieved from the internet:

After a while a list of all localization packages will be shown:



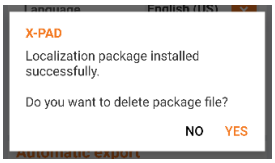
Scroll to the bottom of the list, then click on the XPAD_US_Pack package.

X-PAD will begin downloading and then installing the package resource file.



Wait for the package to download. Click on Yes if asked to install.

When complete:



If your device is low on memory click on YES to delete the package source. Otherwise keep the localization package source available by clicking NO.

Using Special County or State Projections

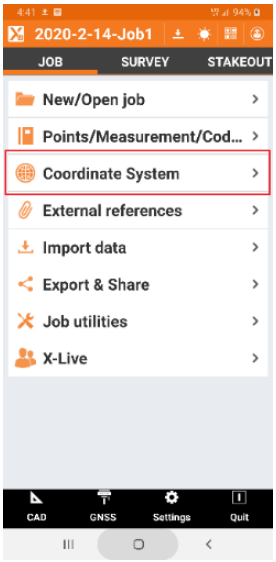
There are many State Plane Coordinate (SPC), State, County, Region specific projections in the United States.

These special projections are all available as predefined projections in the US localization pack:

NAD27 SPC	NAD83 SPC
Iowa County Projections	Las Vegas NV Projections
Kansas County Projections	Minnesota County Projections
Main Statewide Projections	Oregon Statewide Projections
Wisconsin WCCS Projections	Wisconsin WISCRS Projections

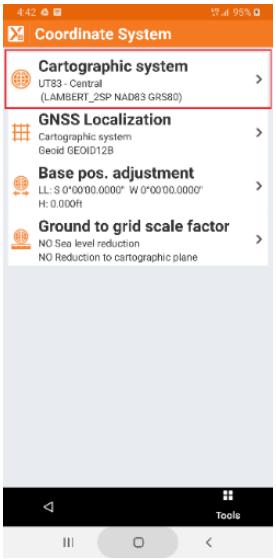
The following example shows the steps to load the Portland Oregon coordinate projection:

From the main ‘Job’ menu:



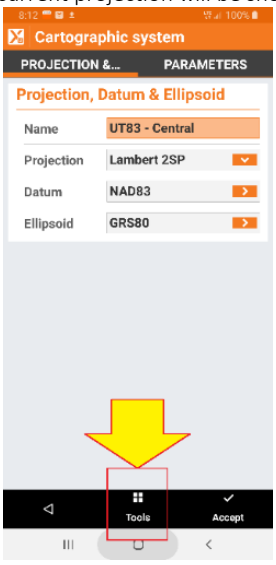
Click on Coordinate System.

The Coordinate System menu will be shown:



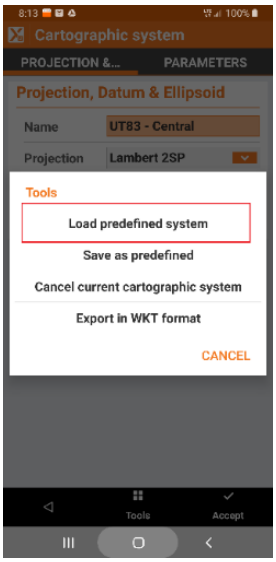
Click on Cartographic system.

The current projection will be shown:



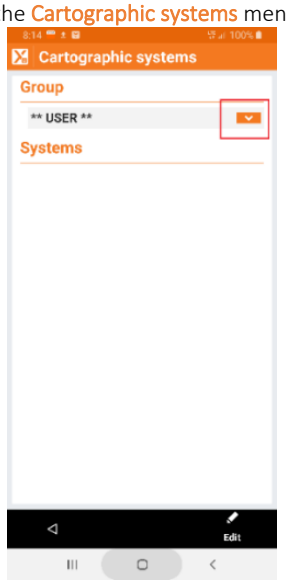
Click the Tools button at the bottom of the menu.

On this Tools menu:



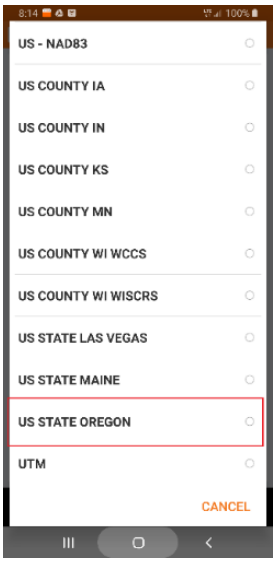
Click on Load predefined system.

On the Cartographic systems menu:



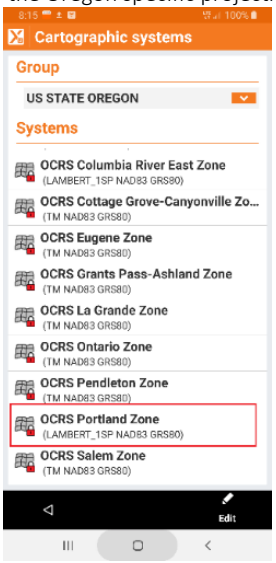
Click on the drop-down arrow for the USER group.

Scroll down to the bottom of the US list:



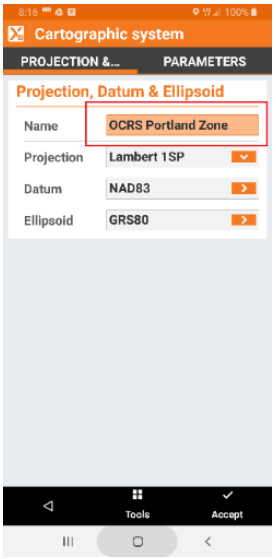
Then click on US STATE OREGON.

The Cartographic systems menu will be shown listing all of the Oregon specific projections:



Click on the OCRS Portland Zone option.

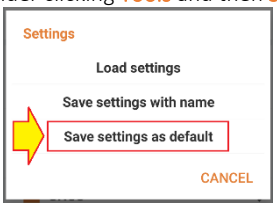
The Portland zone will be selected and activated:



Initial Job Setup

Important Tip: As you make changes to X-PAD settings it is very important to remember to click on the Accept button to save your changes. If you make changes, then click on the Back button, your changes will not be saved!

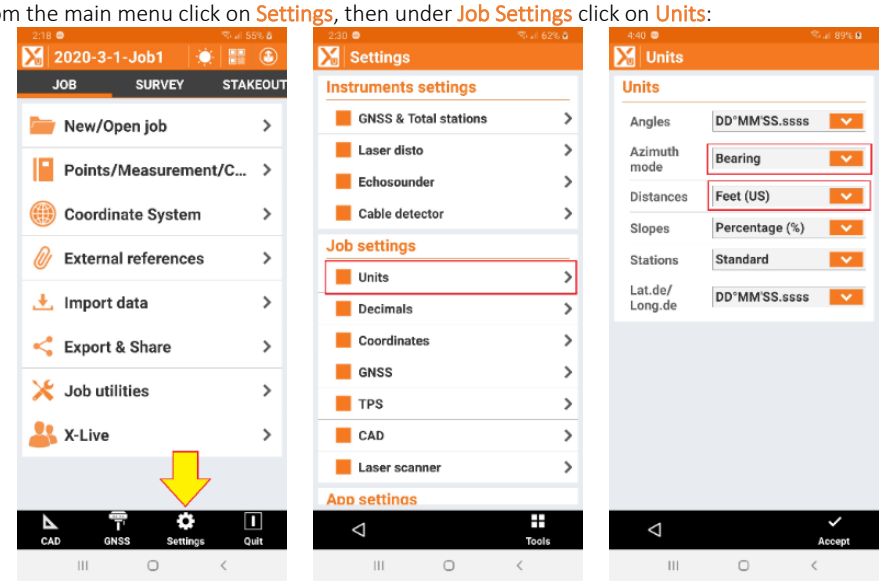
Important Tip: If you would like your settings to persist into new future jobs, immediately after making changes, consider clicking Tools and then Save settings as default so that new jobs will share the setting changes:



Settings can be stored as system wide defaults, named defaults or Site-specific defaults.

Settings: Units, distance and angles

From the main menu click on Settings, then under Job Settings click on Units:

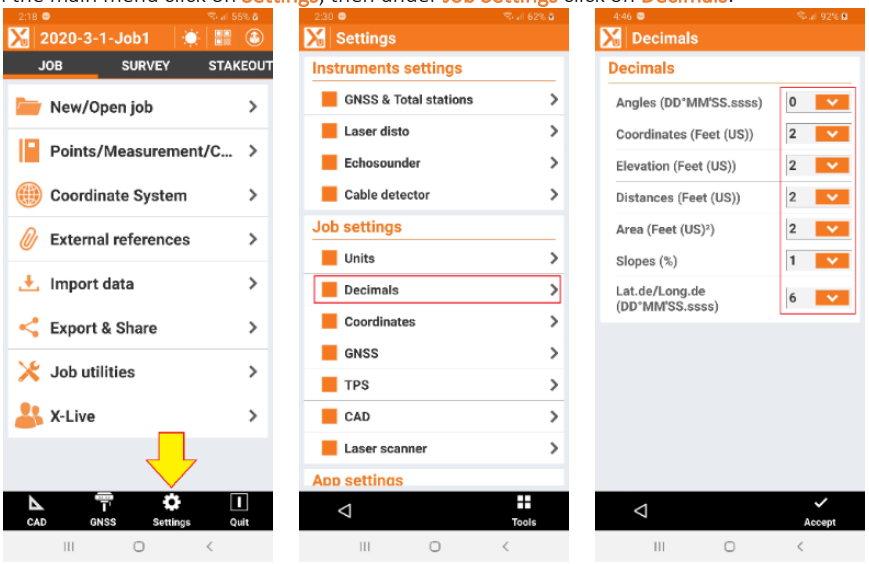


You will probably want to change Angles to DD MM SS.ss; Azimuth mode to Bearing and Distances to either Feet (US) or Feet (International). You can also select fractional feet (inches and fractional inches) for building / architectural units.

After changing any settings, click on Accept; then consider clicking on Tools and saving the changes as Defaults.

Settings: Decimals, Default Display Precision

From the main menu click on Settings, then under Job Settings click on Decimals:



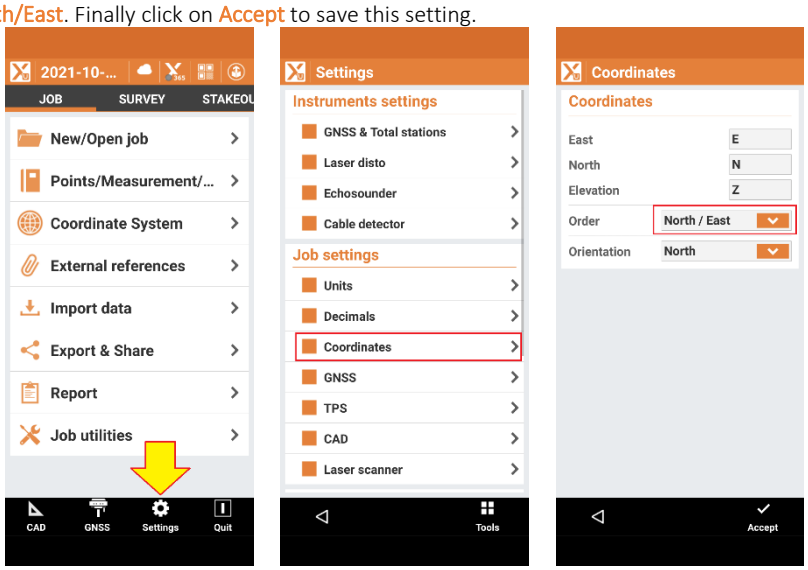
For GNSS/GPS and Robotic based jobs you will probably want to set:

Angles	0	N 45 12 34 W	even minutes
Coordinates	2	0.00	hundredths of a foot
Elevation	2	0.00	hundredths of a foot
Distance	2	0.00	hundredths of a foot
Lat/Lon	5	DDD MM SS.sssss	5-decimals of seconds

After changing settings, click on Accept; then consider clicking on Tools and saving the changes as Defaults.

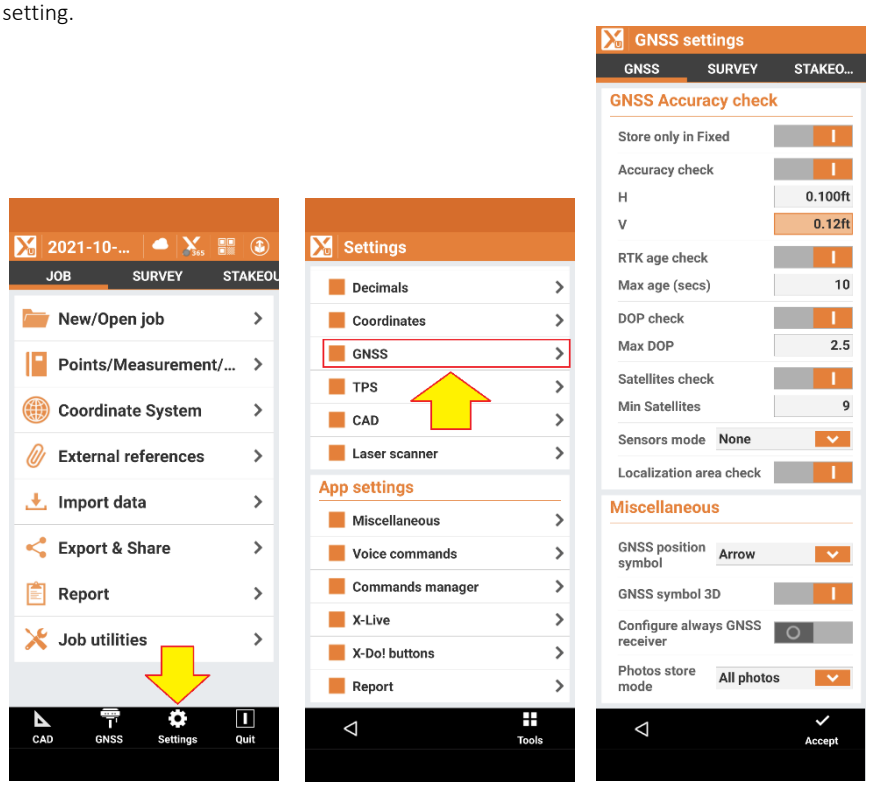
Settings: Coordinates

From the main menu click on Settings, then under Job Settings click on Coordinates, then set the Order to North/East. Finally click on Accept to save this setting.



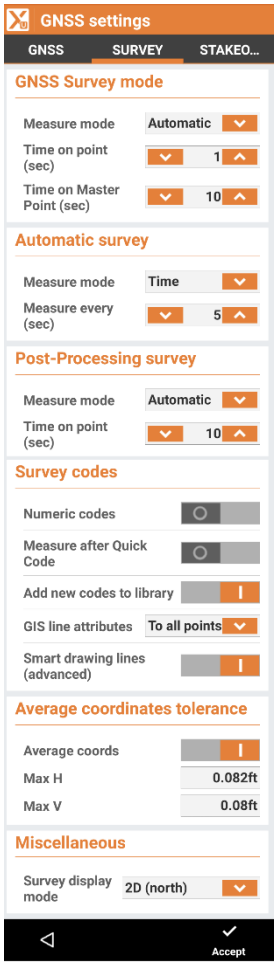
Settings: GNSS defaults

There are a few important GNSS defaults that you may want to look at. From the main menu click on Settings, then under Job Settings click on Coordinates, then set the Order to North/East. Finally click on Accept to save this setting.



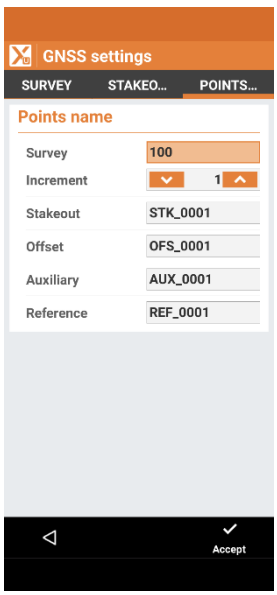
On the GNSS tab, we recommend these setting changes:

Store only in Fixed	ON	Only store FIXED measurements
Accuracy check	ON	Only store high quality fixes, without manual override
H	0.10 feet	
V	0.12 feet	
RTK age check	ON	Only store measurements with recent base corrections
Max age (secs)	10	a value from 4 to 10 is reasonable
DOP check	ON	DOP is a theoretical measure of constellation
Max DOP	2.5	normal constellations, in the open, may be as low as 1
Satellites Check	ON	
Min Satellites	9	if fewer than 9 SV's are in use, require override to store
Localization area check	ON	warn if an 'in-use' localization was defined at a distant location



On the SURVEY tab, we recommend these settings:

Time on point (sec)	1	5-epoch average for standard points
Time on Master Point	10	50-epoch average for control points
Average coordinates tolerance	ON	check the range of averages to make sure there are no wild points
Max H	0.10	
Max V	0.12	range limit for averages



On the POINTS tab:

The Points name is similar to Point ID or Point Number in other field tools.

However, the Points name can be numeric or alphanumeric. X-PAD defaults to pre-pending Stakeout, Offset, Auxiliary and Reference points with the designations shown.

In addition, Reference points (which you might consider to be Control Points) are kept in a separate list space.

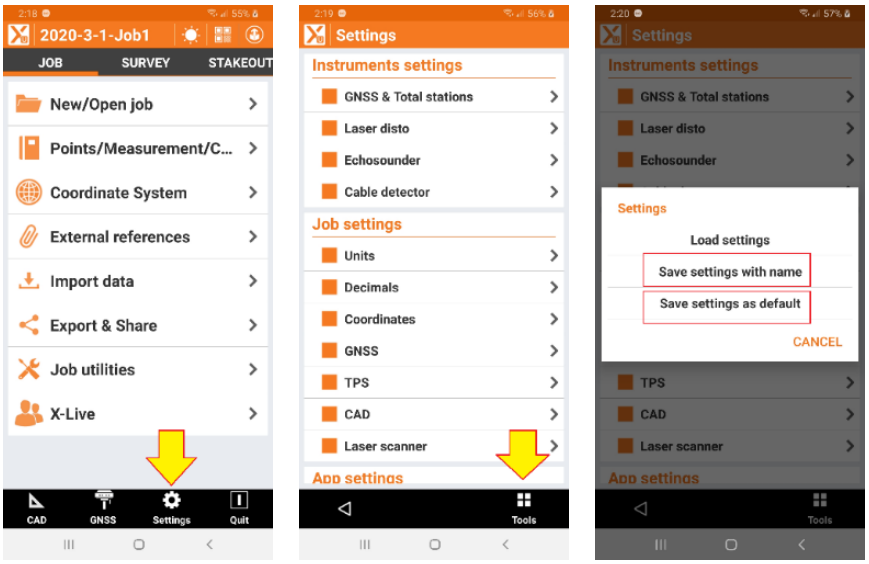
After configuring the GNSS settings be sure to click on the Accept button to save your changes. Then consider clicking on Tools and saving the changes as Defaults.

Saving Settings and Coordinate System Configurations

Both General Settings and Coordinate Systems can be saved. Coordinates can be saved on a Site-by-Site basis (see 'X-PAD: Sites' on page 24), and you can save both settings and coordinate systems to the default or to a named profile. Named setting profiles can be recalled or transferred to other devices to propagate settings.

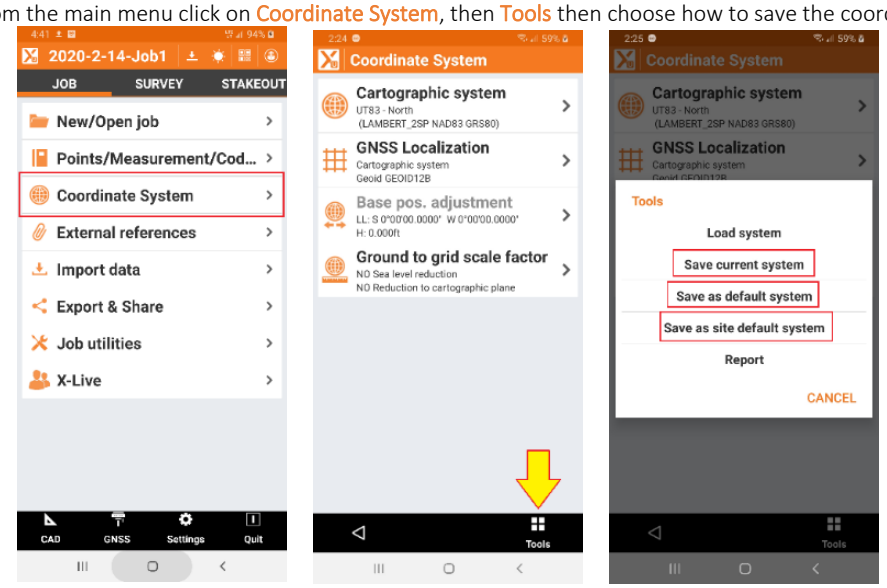
Storing 'Settings'

From the main menu click on Settings, then Tools, then Save settings with name or Save settings as default:



Storing 'Coordinate Systems' Defaults

From the main menu click on Coordinate System, then Tools then choose how to save the coordinate system:

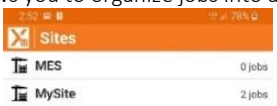


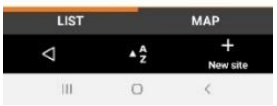
X-PAD: Sites

You can organize your jobs into Sites where multiple jobs are contained under defined profile groups.

This ‘site selection’ button, found under JOB: New/Open job:

Allows you to organize jobs into an unlimited number of Sites:





Each Site can have a unique default coordinate system and system defaults; so, Sites are useful if you regularly work in two State Plane zones.

Coordinate systems

X-PAD makes it very simple to setup jobs in a variety of common projection types. The USA specific localization package preloads most State Plane Zones and special County and State zones.

X-PAD supports nearly every possible coordinate system and localization style. This guide includes step-by-step instructions for these common systems:

For many applications you would like to survey with local Ground scaled coordinates, but also export accurate State Plane Coordinates. Switching an existing job between projection type is very simple and point-coordinates automatically recompute on the fly.

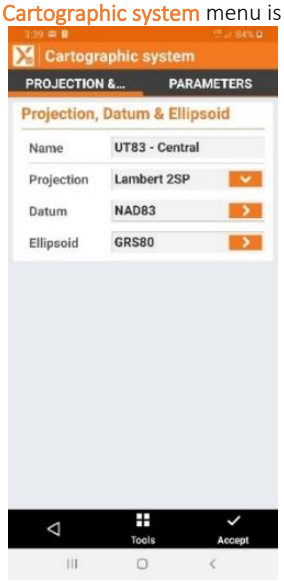
State Plane Coordinates at Grid

State Plane Coordinates at grid is a common coordinate system. This style includes UTM (both NAD83/WGS84 and NAD27) measurements and local specific coordinate systems like those used in Oregon and Iowa. It is also possible to define custom projections at a developed elevation using this style.

From the main menu, click on Coordinate System > to define the job projection:

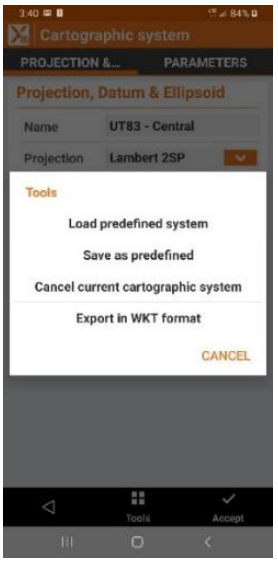
Click on Cartographic system >

The Cartographic system menu is shown:



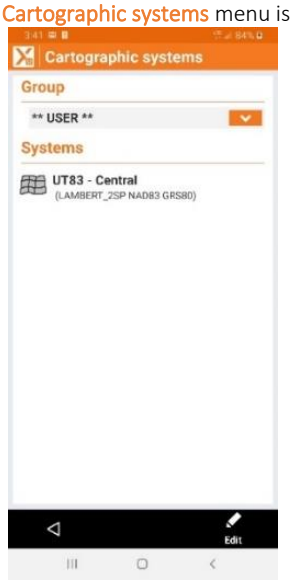
If the current projection is not correct, click on Tools at the bottom.

From this Tools menu:

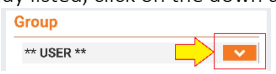


Click on Load predefined system.

The Cartographic systems menu is shown:

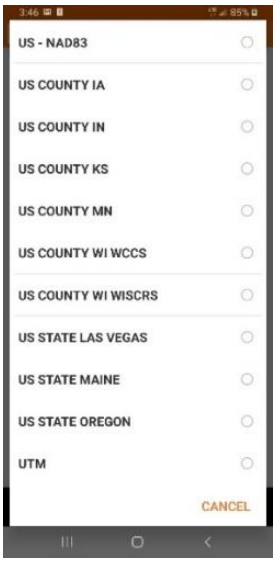


All of the previously used systems will be in the **USER** list, if the projection you need is not already listed, click on the down arrow:



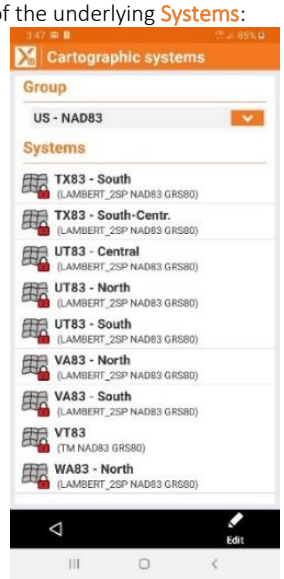
A list of all countries and US special projections will be shown.

Typically, you will want to choose 'US-NAD83', however if you are in Iowa, Indiana, Kansas, Minnesota, Wisconsin, Las Vegas Nevada or Oregon the local projections will be at the bottom of this list:



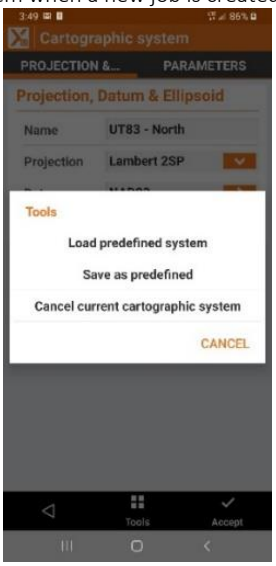
There are also entries for UTM and 'US-NAD27'.

After you select the correct Group, X-PAD will load all of the underlying Systems:



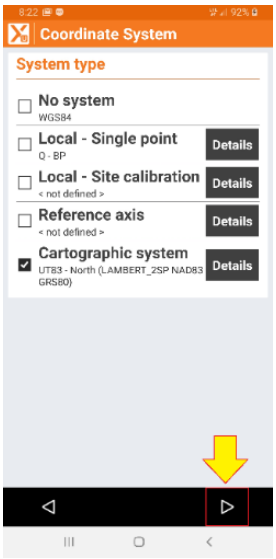
For this example, click on 'UT83 – North' loads the Utah North NAD83 SPC:

If you would like the new system to be the default system when a new job is created, click on Tools:



then Save as predefined. Future jobs will default to this projection.

Click the Accept button to return to the Coordinate System dialog:



Click the right-arrow at the bottom of the screen.

The Vertical system dialog will be shown:

Choose an appropriate GEOID (1), then click Accept (2) at the dialog bottom.

If USA specific GEOIDS are not available, follow the procedures in the chapter “Loading the USA Localization Package” on page 15 to download the USA Localization Package from the internet and install on your data collector.

Single-Point Localizations at Ground

X-PAD has two distinct scale factor mechanisms:

Ground to Grid

Used to convert Total Station Ground measurements down to Grid.

This is
NOT WHAT YOU WANT
for GPS / GNSS jobs!

This is for scaling
Ground Total Station
Measurements to Grid ➔

Grid to Ground

Available when a Local Single point system is selected.

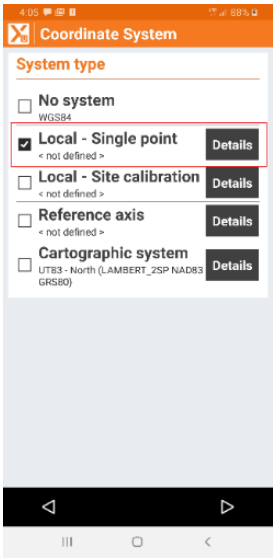
If you want to set local coordinates like:

10,000, 10,000

with a computed grid-to-ground scale factor that results in distances being Ground, then

This is the method that you want!

😊



This section describes how to configure a job with:

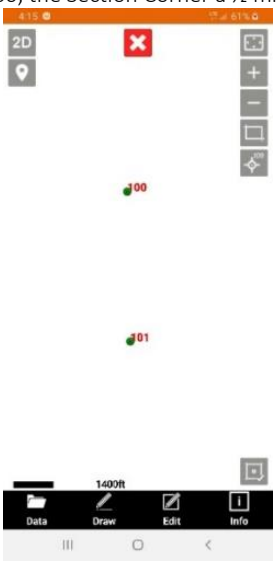
Local Coordinates like 10000, 10000, 5600

True / Geodetic North at a base point

Ground Distances: inversed distances will exactly match a total station

From a new job or an existing job, in State Plane or any other coordinate system store a point or setup a base at the location that you would like to be the local coordinate base.

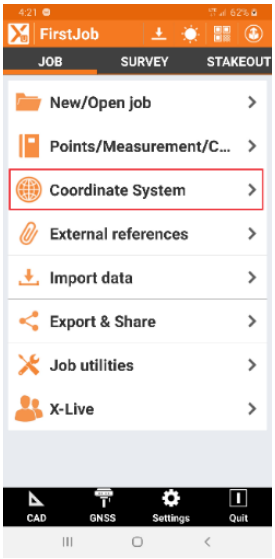
For this example, we will use an existing job with two points: Pt 101, the East Quarter of a section and Pt 100, the Section Corner a ½ mile to the North:



We want to assign the horizontal coordinates 10,000, 10,000 to point 100 where we have already set the base.

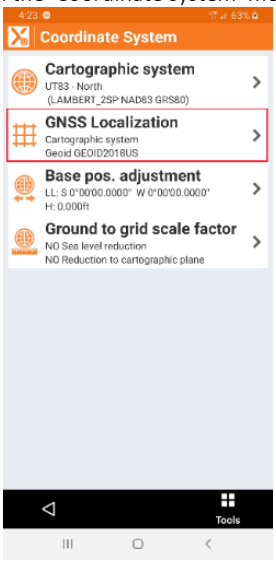
The UHF base was set with approximately the correct height so the elevation of point 100 is nearly correct, we will honor this measured height in our new projected system.

From the main JOB menu:



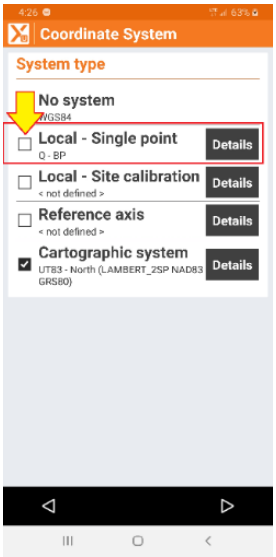
Click on Coordinate System.

From the 'Coordinate system' menu:



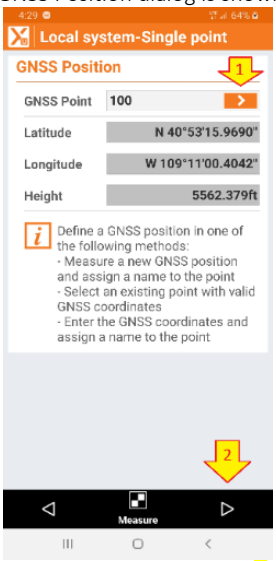
Click on 'GNSS Localization'.

The Coordinate System. System type selection menu is shown:



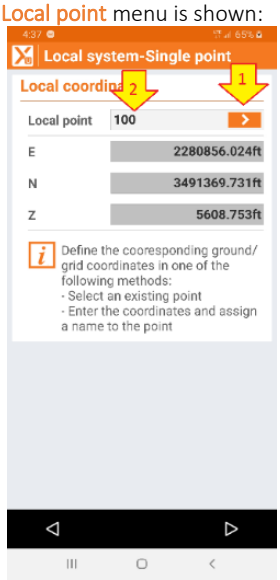
Check the 'Local – Single Point' checkbox, then click on the 'Details' button to the right.

The GNSS Position dialog is shown:

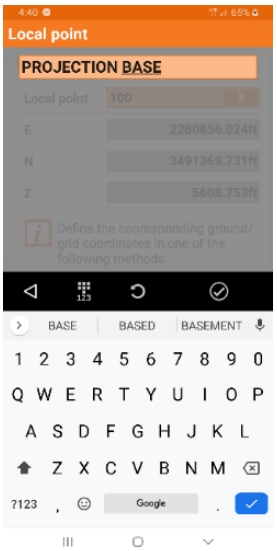


Click on the orange '>' button (1) and choose the measured point 100:
Then click on the right-arrow (2).

The Local point menu is shown:

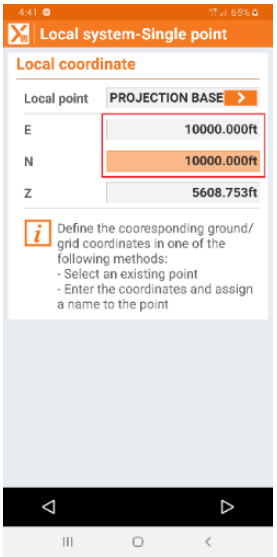


X-PAD asks for the Local point coordinates. We would like to reuse the existing height, so use the orange '>' button (1) to recall the State Plane coordinates for point 100.
Then click on the Local Point name (2) and enter a unique code:



Click the checkmark (blue or circled)

to return to the Local coordinate dialog:

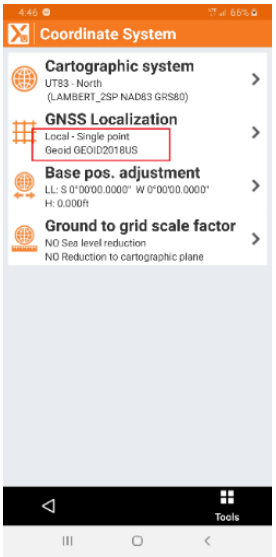


Now edit the Easting (E) and Northing (N) to be ’10,000’. Then click the Next button on lower right corner.

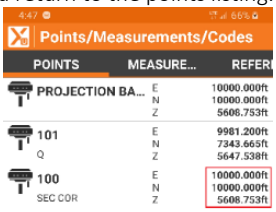
The Vertical system dialog is shown:

Choose an appropriate Geoid the latest GEOID (currently GEOID2018) is best, then click the Accept button lower-right.

The ‘Coordinate system’ screen is shown again with ‘Local – Single point; Geoid. The selection ‘GEOID2018US’ is shown under the localization type:



If you return to the points listing:



You will find new horizontal coordinates have been automatically computed for the existing points.

The job is now ready to survey additional points.

If you inverse distances between points, they will be Ground distance.

The basis of bearings will be True / Geodetic North at the projection base point.

Multiple-Point Site Calibrations

If you have two or more known coordinates on a job then you can match a coordinate system to best-fit your known coordinates.

The easiest way to build a multiple point site calibration is to

build a new job with a State Plane Coordinate system that matches your survey area

import the local coordinates that you will be calibrating to

survey/store the points that match the calibration coordinates

Typically, you will use: JOB: Import Data: Text File (ASCII) to import the known positions as REFERENCE POSITIONS. There are many other file formats available for direct import.

Once points are imported you can view them from JOB: Points/Measurement/Codes:

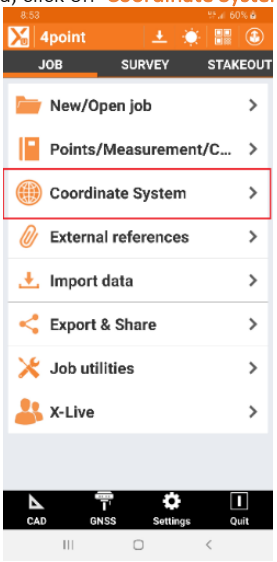
Either connect the rover to a network base, or setup your base at a known or unknown point. Once your rover has a FIXED position, store corresponding points for each of the measurement points using

SURVEY: Survey Points”:

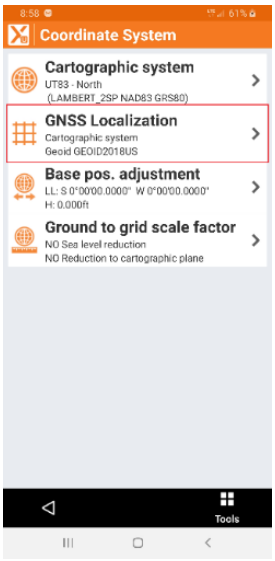
In this example the Reference points and Measured Points match this table:

Corner / Quarter	Reference Local Coordinates	GNSS Measured
Q 22-27	1	100
C 22-23-26-27	2	101
C 23-24-25-26	3	102
Q 23-26	4	103
Q 26-27	5	104

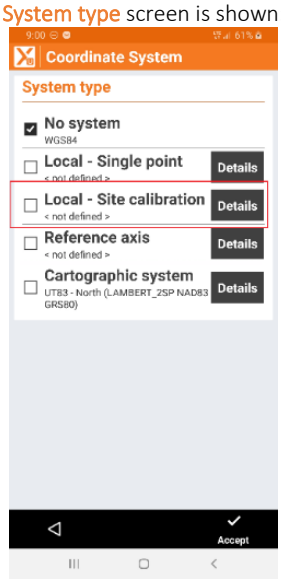
To build a multiple point calibration, from the JOB menu, click on ‘Coordinate System’:



The Coordinate System dialog is shown, click on ‘GNSS Localization’:

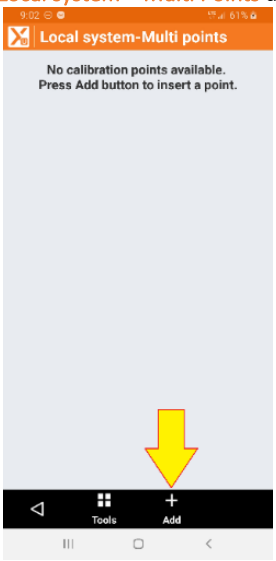


The System type screen is shown:



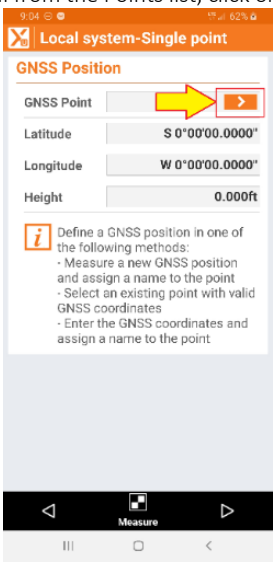
Click on Local – Site calibration, then click Details.

The Local system – Multi Points dialog is shown:

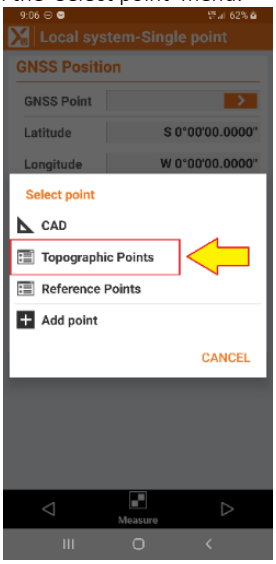


Click on + Add on the bottom.

X-PAD asks for the GNSS position which you can recall from the Points list, click on the '>' button:

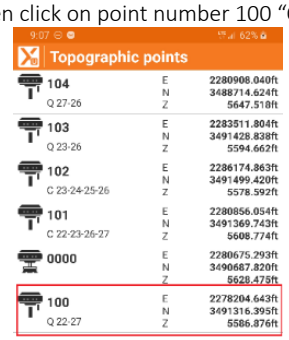


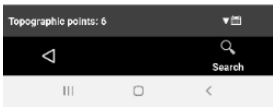
From the 'Select point' menu:



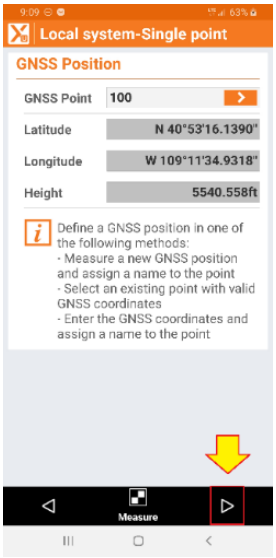
choose Topographic Points.

Then click on point number 100 "Q22-27":



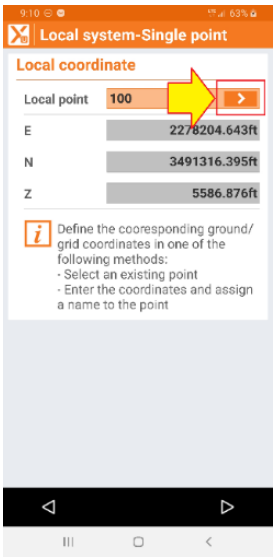


X-PAD confirms the GNSS Position:



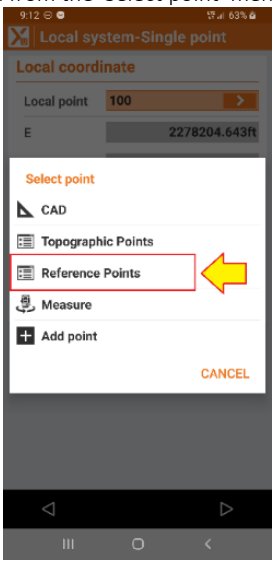
Confirm by clicking the right-arrow at the bottom.

X-PAD will ask for the Local coordinate:



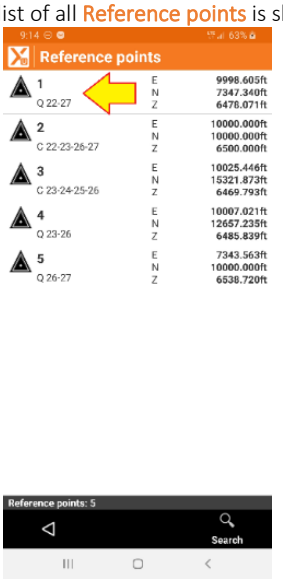
Click on the '>' button.

Then from the 'Select point' menu:



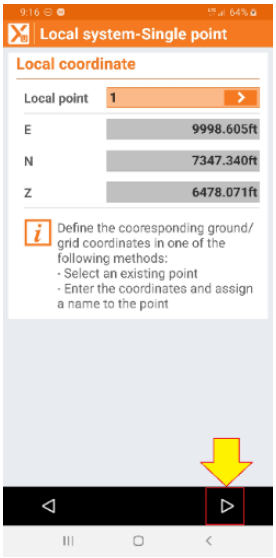
Choose Reference Points.

The list of all Reference points is shown:



Click on Reference point #1 which corresponds to GNSS point #100.

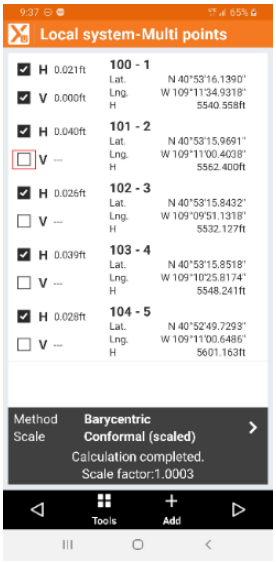
The Local coordinate menu is shown again:



Then verify the local coordinate by clicking the next button.

The first point pair has been successfully added. Click the 'Add' button and repeat this process for the remaining 4 points.

After adding all 5 point-pairs, the calibration will look similar to this:

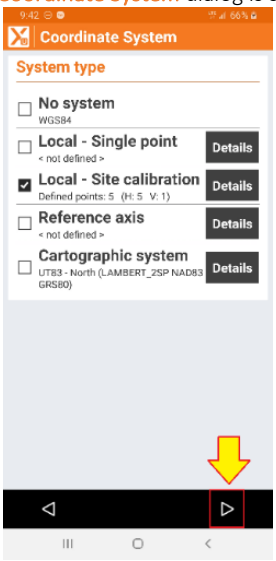


It is customary to only check one Vertical control box to avoid a tilted plane calibration unless the polygon formed by the control points completely encloses the entire job.

You can enable / disable horizontal checkboxes to narrow down any coordinate blunders.

Once the site calibration is acceptable, click on the Next button.

The Coordinate System dialog is shown again:



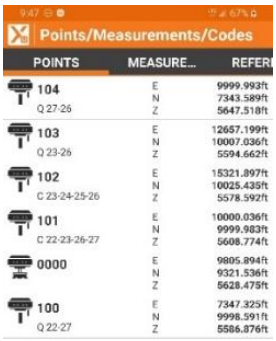
Click the Next button.

The Vertical system menu is shown:

Choose an appropriate GEOID for your project.

When you return to the Points list, you will find that your measured points have been adjusted based on

the new site calibration:



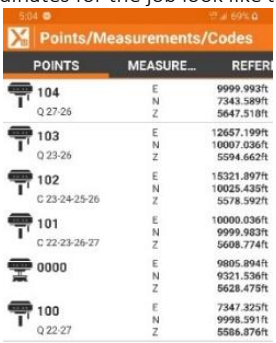
X-PAD will have computed a coordinate system that best matches your record (Local) data and applied it to all of the data.

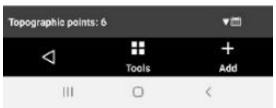
Switching between Coordinate Systems

Often when you configure a job for local ground coordinates, at the completion of the job you would like to also export out State Plane Coordinates (SPC) for the surveyed points to use as metadata for a plat. This allows distances and bearings to be in the local ground system, but still have coordinate annotations or tables that list the SPC grid coordinates.

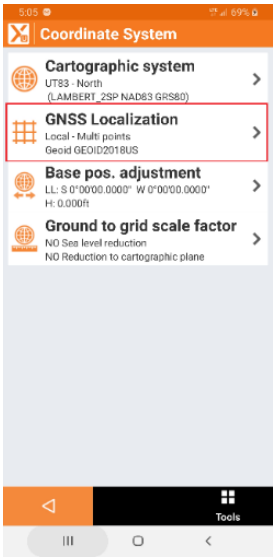
X-PAD makes it trivial to switch back to SPC, and then return to the local ground system if needed.

As an example, consider the Multiple-Point Site Calibration from the previous section. The local coordinates for the job look like this:



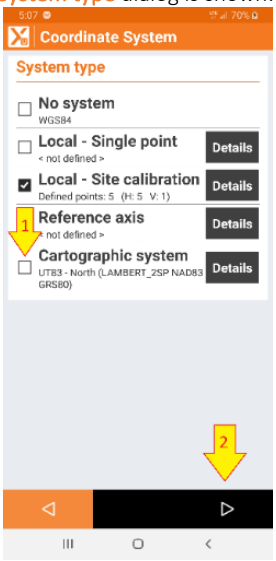


To switch back to SPC coordinates from the main JOB menu, click on Coordinate System:



Then click on GNSS Localization.

The System type dialog is shown:



Check the Cartographic system checkbox (1) and if the displayed system is correct click on the Next arrow (2).

Choose an appropriate 'Vertical system', then click the Accept button:

All of the coordinates are automatically recomputed.

Looking at the points list again:

The job is now State Plane projected.

After exporting these State Plane coordinates, it is just as easy to reselect the Multi Point GNSS Localization and return to Ground measurements.

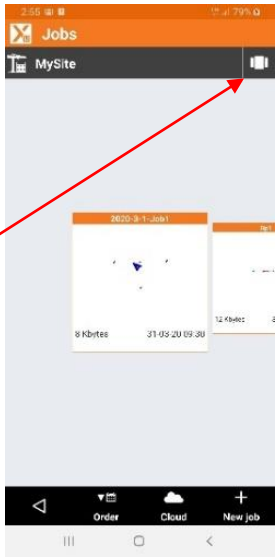
Picking an existing Job display style

The Job menu can display and select jobs four ways, selected by the icon in the right-hand corner of the top gray bar:

Gallery

Thumbnails of jobs contained in a Site are shown in a cascading carousel

Click here to change display method:



List

A list of jobs contained in a Site are shown with the Size and last edit date.

Map

A map showing the sites in a job is shown.

The plotted point is the location where the job was started.

You can change the background map using the Map Selection button:

Calendar

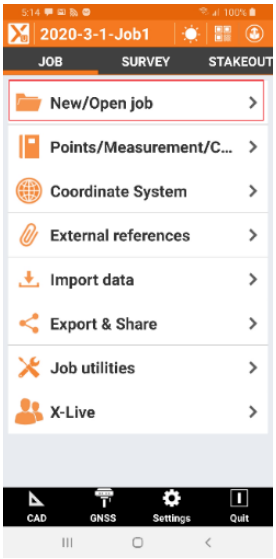
A calendar is shown with the last changed dates highlighted in orange.

Note that the calendar is organized with workdays left and weekends right:

MTWHFSS

Making a New Job

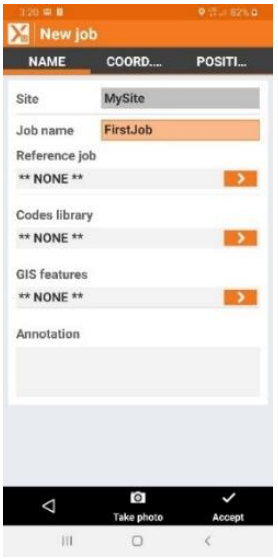
From the main menu:



Click on 'New/Open job', choose a different site if wanted,

Click on the 'New job' button in the lower right corner to make a new job in the selected site.

X-PAD will prompt for a job name (the default is the Year-Month-Day-Job X):



Give the new job a reasonable name ('FirstJob' above).

Take a Site Photo with the 'Take Photo' button at the bottom that represents the new job.

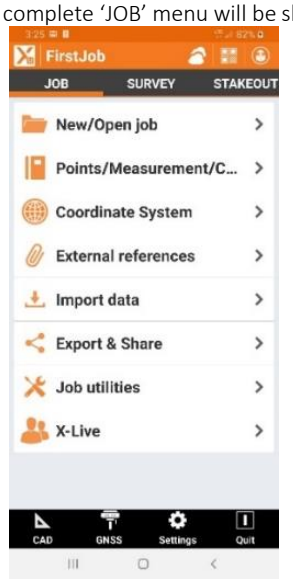
Select 'COORD...' at the top to display the default coordinate projection. This can be changed later.

Select 'POSITI...' to display the Address, job base Lat/Lon and job location on map.

Select 'PHOTO' to display the site photo.

After entering the initial metadata, click 'Accept' to create the new job.

The complete 'JOB' menu will be shown:

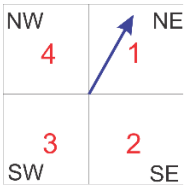


Using Quadrant Bearings

In the USA, for both rectangular and metes-and-bounds surveys it is common to describe courses by bearing angle and distance.

Because it is difficult to compute the reciprocal of azimuth angles in Deg-Min-Sec.sss we use Quadrant Bearings where the angle is described as an angle **East or West** of **North or South**. This has the benefit of just exchanging the N/S and E/W to describe a line 'going the other way.'

For example:



The blue vector above describes a course:

246.501 feet 60.700813 degrees
246.501 feet 60 d 42 m 03 s

In the United States this course is described as:

246.501 feet N 29 d 17 m 57 s W

Reversing the direction is simple:

246.501 feet S 29 d 17 m 57s E

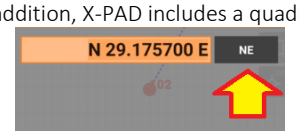
Most survey jobs begin with the entry of a parcel, described as a series of courses.

X-PAD automates the quadrant for a direction using the numbers in red in the diagram above:

1 NE **2** SE **3** SW **4** NW

So, to enter N 29 17 57 E you can use the shortcut: 129.1757. The reverse bearing would be 329.1757.

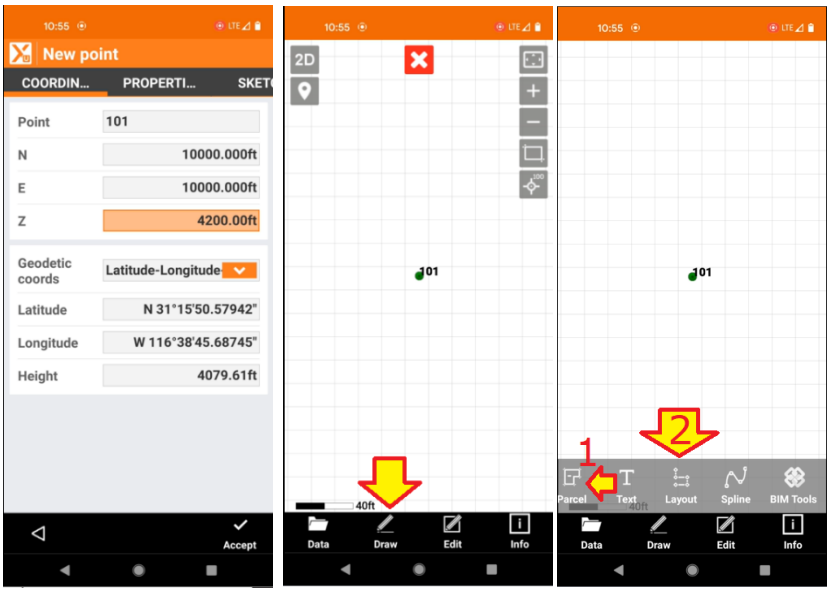
In addition, X-PAD includes a quadrant increment button:



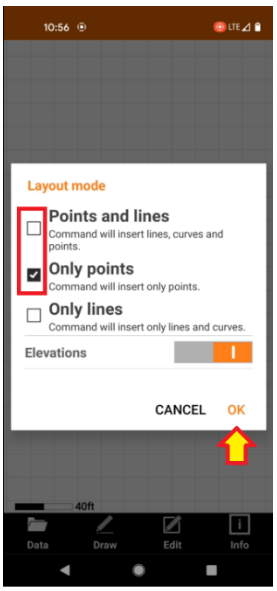
which when clicked changes the existing bearing through NE, SE, SW and NW.

Here is an example a 'straight line' course entry in X-PAD:

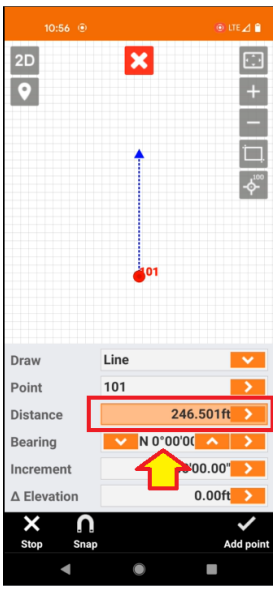
If you don't have an existing measured point to start at, use the JOB: Points/Measurements/Codes menu to add a new point at an arbitrary location like 10,000, 10,000.



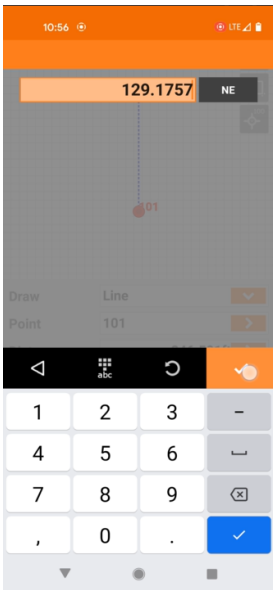
Make a new Starting Point 101, then go to CAD, then Draw, Drag left, then click on Layout



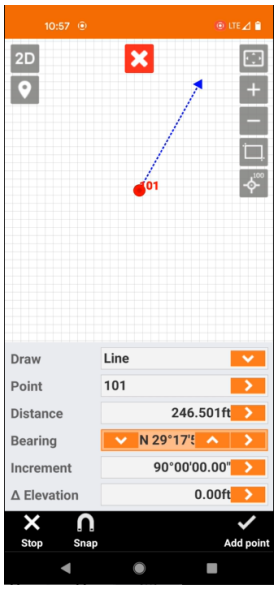
Choose Points, Lines or Both



Enter Distance, then click on the Bearing



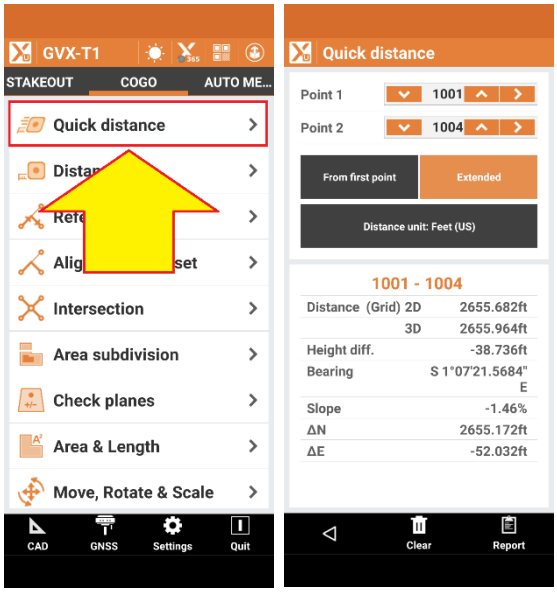
Enter the Quadrant "1" then the Bearing.
then click the ☑ mark.
129.1757 = N 29 17 57 E



Visually check the course, click on Add Point

COGO: Quick Distance

If you want to compute the distance between two points, COGO: Quick Distances will allow you to measure between points:



You can hold the first point and change the second point, or you can traverse around a series of points by toggling the From first point button.

Click the Distance Unit button to toggle through: Feet, Chains, Rods.

The results are displayed on a ticker-tape with the last measurement at the bottom. The entire tape can be exported in a variety of formats using the Report button.

The Quick Distance calculator is available from the COGO menu and via the Tools button in the Store Points and Stakeout Points menus.

CAD Screen Distance

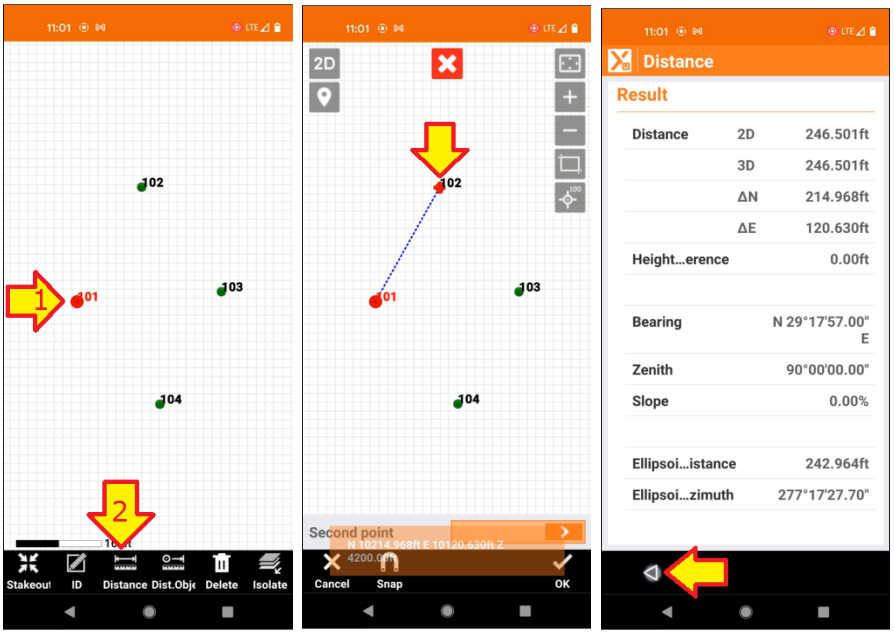
If you would like to compute the distance from an object, like a line or polyline, or a point click on CAD from the main menu.

There are two ways to Inverse:

1. From Object method: click on a point or object, then choose Distance. Subsequent point/object clicks will compute from the First object to each subsequent object holding the First object constant.
2. Traverse method: click on Info: Distance. Then select the First point, then the Second point. Subsequent point clicks will compute from the previously clicked point so you can traverse around a parcel checking each course in order.

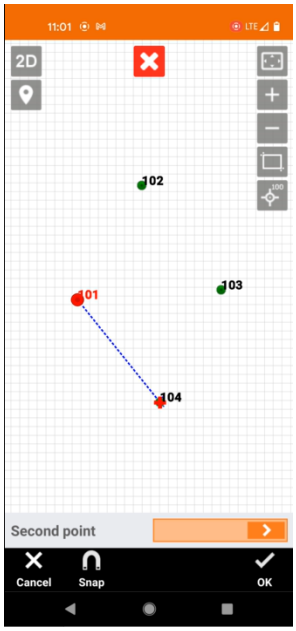
Inverse from a Point

First click on CAD from the main menu.



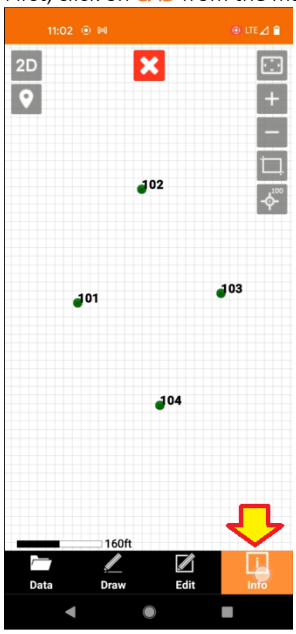
Click on a point (1), then click on Distance (2) Click on the Second point Check the course

You can then click on another point and inverse from the First point to another feature:

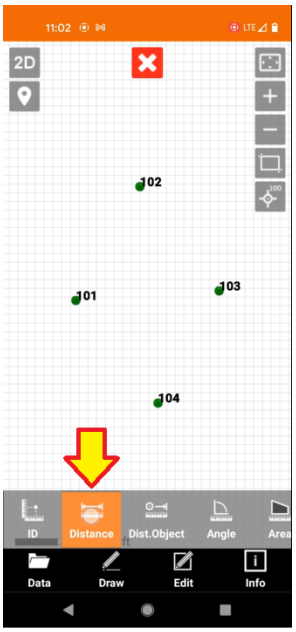


Inverse along a Traverse

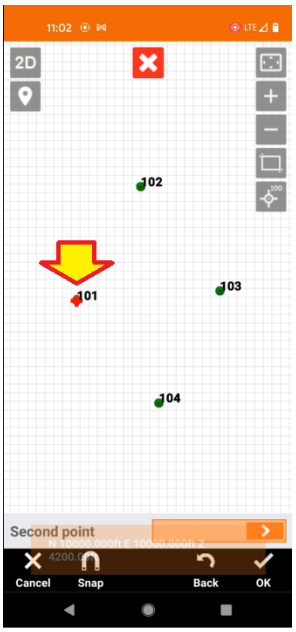
First, click on CAD from the main menu.



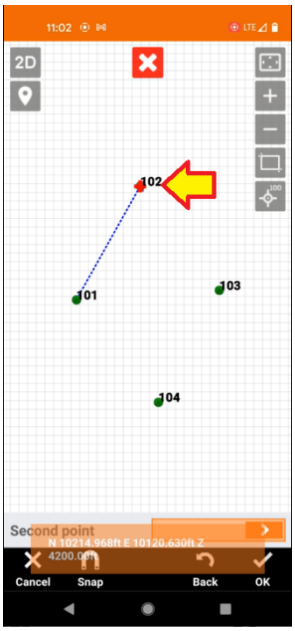
Click Info



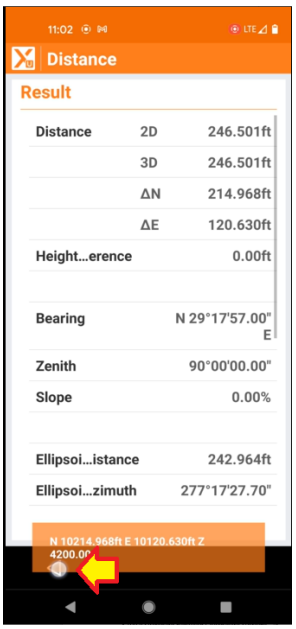
then Distance



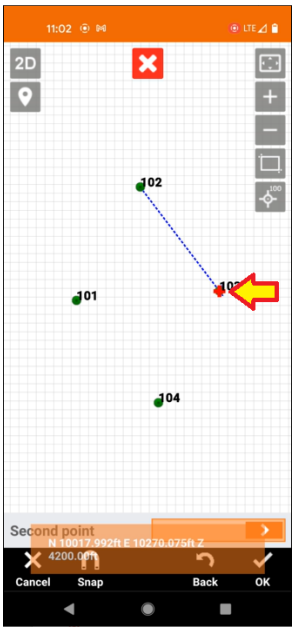
then click on the First Point



Then click on
Second point



Click back,



Click on the next
traverse leg endpoint to move ahead

GNSS instrument profiles

Each of your instruments will have one or more Instrument profiles in X-PAD.

A GNSS receiver might have both a UHF Rover profile, a UHF Base profile and a Network Rover profile.

Once you setup a profile, it can be reused over and over as needed for multiple jobs.

Profiles are added from 'Settings: Instrument Settings'.

This manual covers these instrument profile types:

Network Rover instrument profile

Your iGage receiver makes a great Network Rover coupled with X-PAD on a data connected device like a cell phone. Corrections are received by the Android device and passed through Bluetooth to the RTK head.

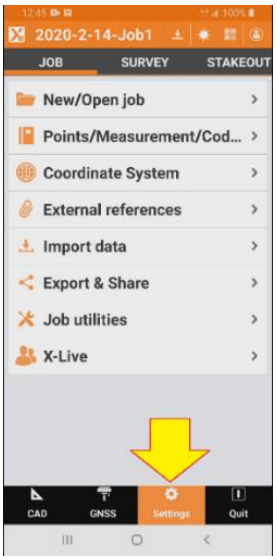
You can also provision a GSM card for your GNSS receiver and use its internal cell modem for the data connection.

Start a new job following the steps in the section 'X-PAD: New Job' on page 40.

Turn the receiver on and make a note of its 'Serial Number'.

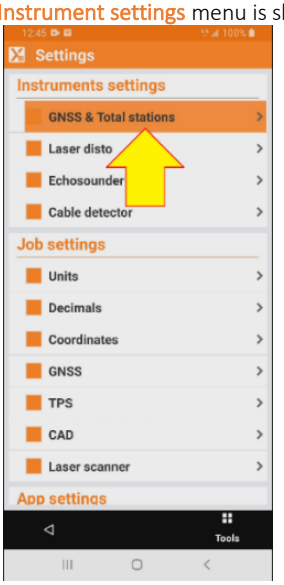
The first time you make a connection to a server, you need to create a new instrument configuration that includes the network settings.

In X-PAD from the main menu:



click on Settings.

The Instrument settings menu is shown:



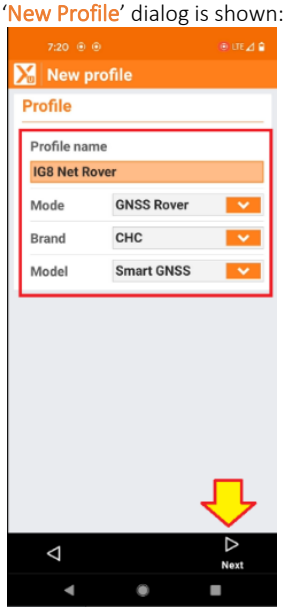
Click on GNSS & Total stations.

On the Instruments menu:

Click on 'Add' to configure a new instrument.

Choose GNSS Receiver (GNSS) as the instruments type.

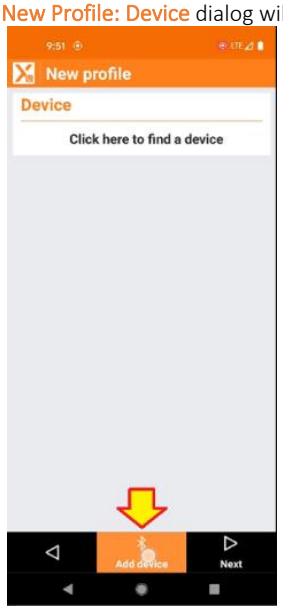
The 'New Profile' dialog is shown:



Enter a Profile Name, set the Mode to GNSS Rover, set the Brand to CHC.

Finally press Next.

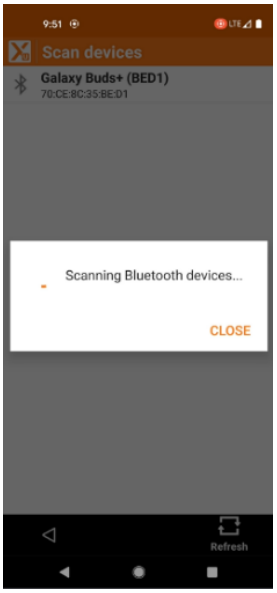
The New Profile: Device dialog will be shown:



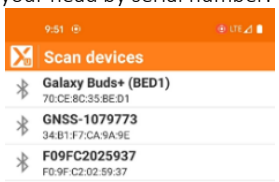
If you have already bonded to the Base receiver, use the drop-down button to select your device by serial number and proceed to the RTK- receive corrections section below.

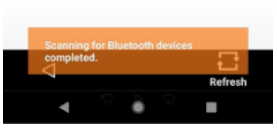
If your device is not listed (as shown above), click on the Add Device button at the bottom.

X-PAD will scan for Bluetooth devices:



After 15-seconds the available devices will be listed, find your head by serial number:



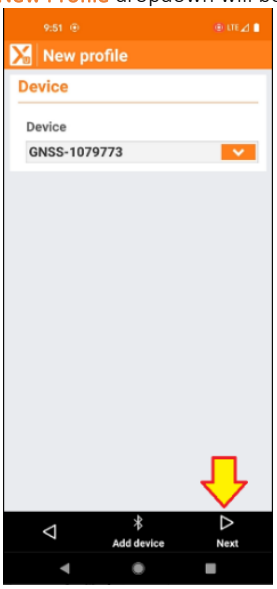


Click on the device.

The Bluetooth Manager will be shown again:

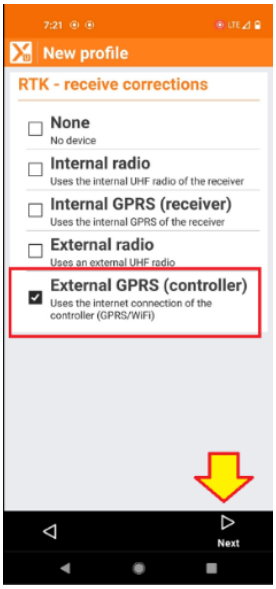
Click on Next.

The New Profile dropdown will be shown again:



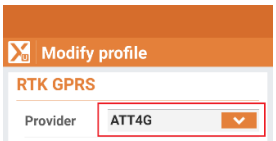
Verify that the correct Bluetooth device is selected. Then click 'Next'.

The 'New Profile Device' screen will be shown:



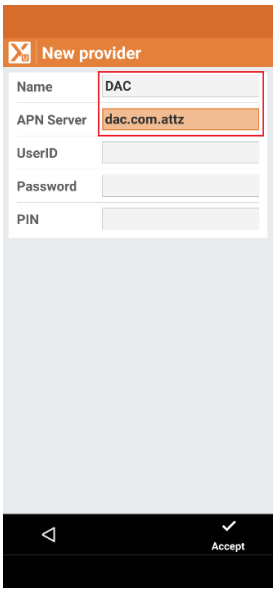
Select External GPRS (controller) to use the internet connection in the Android data collector or click on Internal GPRS (receiver) to use the GSM modem in the receiver.
Then click on Next.

If you choose Internal GPRS (receiver) you will need to set the cellular Provider which sets the APN in the receiver's internal GSM modem:



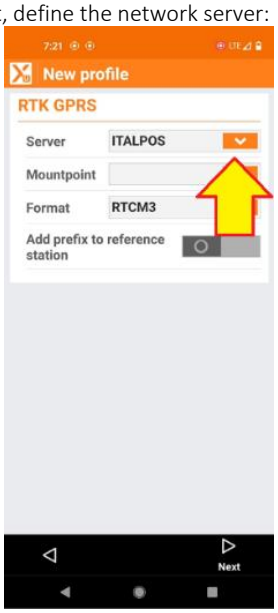
X-PAD includes common worldwide cellular providers:

for ATT 3G use AT&T (broadband)
for ATT4G use ATT4G (Broadband)
for iGage DAC supplied cards make a custom provider by clicking:
Providers...
then click +Add



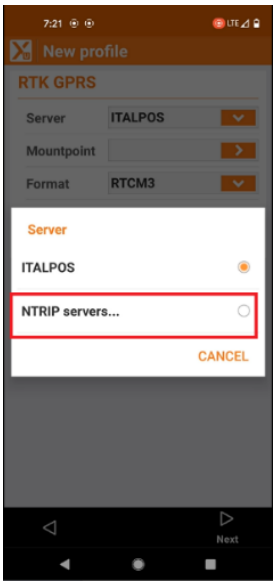
enter Name = DAC with the APN Server = dac.com.attz as shown above.
Click Accept to continue.

Next, define the network server:



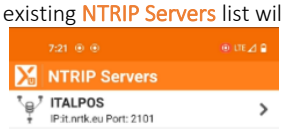
Click on the drop-down arrow in the Server selection.

The Server list is shown:



Click on NTRIP servers... to define a new network server.

The existing NTRIP Servers list will be shown:



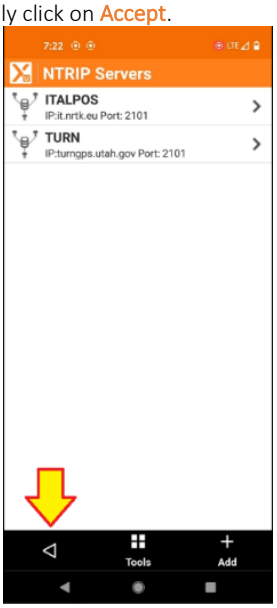
Click on + Add to add a new server.

The New NTRIP server dialog is shown:

Enter the server Name,
choose a mode: NTRIP or Point-to-Point,
enter the IP as either an internet address or dotted numerical address,
enter a Port number and if NTRIP enter the UserID and Password.

Before accepting, please **double-check** the IP address, Port and UserID and Password. The UserID and Password are case sensitive, a single transposed or missing digit will prevent the connection from succeeding.

Finally click on Accept.



Click on the Back arrow.

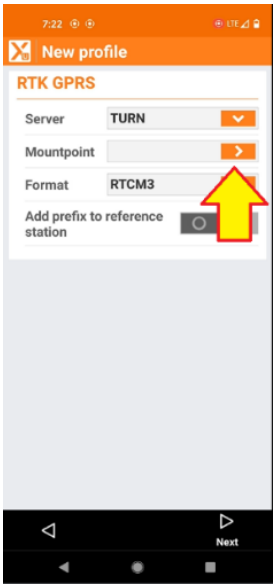
Returning to the RTK Profile screen:

Click on the Server drop down arrow again.

From the Server list:

Select the newly entered server.

And it will be listed as the Server:

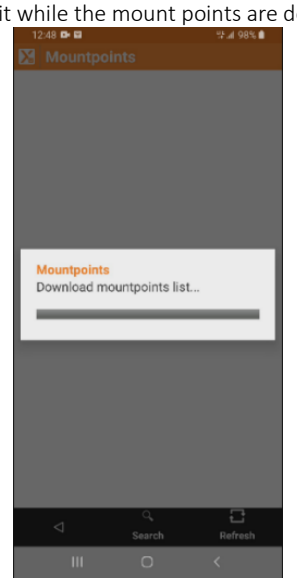


Click on the Mountpoint selection arrow >.

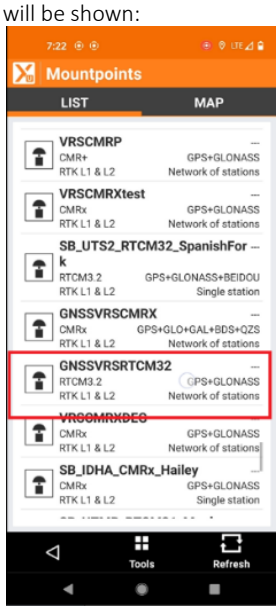
The empty Mountpoints list is shown:

Click on the Refresh button to connect to the network server and download the complete server mount table.

Wait while the mount points are downloaded:



After a moment the server's available Mountpoints: LIST will be shown:

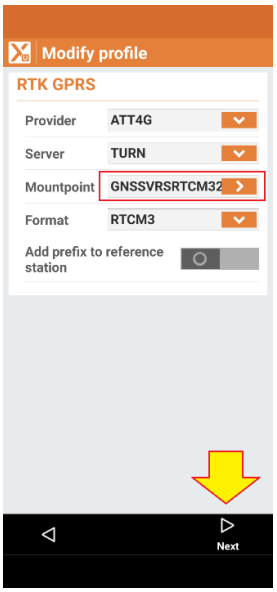


Scroll through the mount point list and click on the best correction source.

Typically, the best mount point will be a RTCM3.2 VRS selection which has the possibility of containing corrections for GPS + GLONASS + Galileo + BeiDou constellations with support for L2C, L3 and L5 signals.

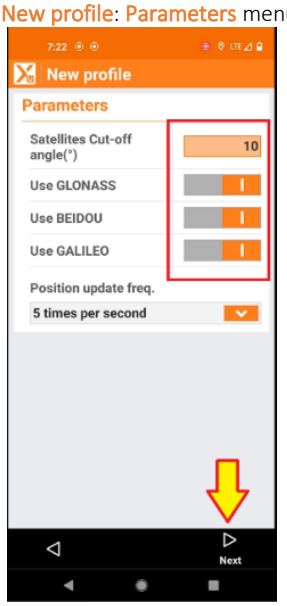
An RTCM2 or CMR+ mount point will typically only include corrections for GPS and GLONASS without the benefit of L2C, L3 and L5.

When you click on a mount point selection, you will return back to the RTK GPRS menu:



Click Next.

The New profile: Parameters menu will be shown:



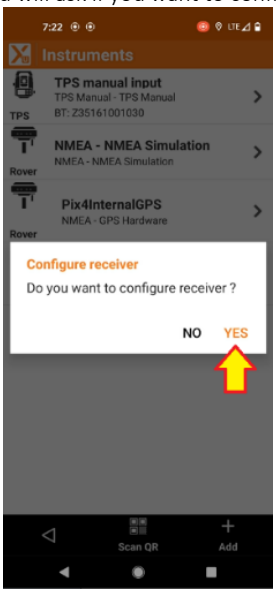
Set a reasonable Cut Off angle (10 or less), enable all the constellations, choose Position update freq. = 5 times per second, then click on Next.

The Antenna Height menu will be shown:

Enter the instrument Height in Meters or Feet. The Height is the distance from the bottom most part of the receiver to the point on the pole. If you have used a quick-connect, don't forget to add the adapter's height to the pole height.

Finally click on Accept.

X-Pad will ask if you want to configure the receiver:

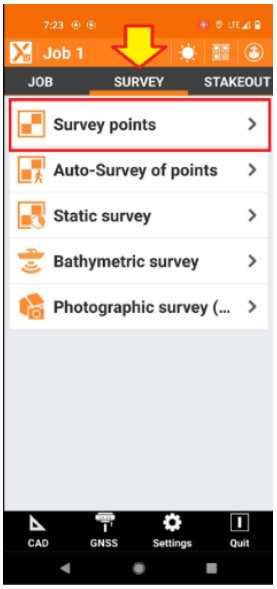


Click on Yes.

After a few moments the Instrument panel is shown with the new configuration selected:

Press the Back arrow,

to return to the main menu:



Select the SURVEY tab, then click on Survey points.

After a few moments the receiver should report a RTK FIXED solution:

If the Rover receiver is not FIXED, check the following items:

- Does the Android controller or receiver have internet access?
- Is the Server configuration exactly correct? (IP address, Port, UserID and Password must be exact.)
- Is the receiver outside and tracking satellites? Does it have a position?
- Is the receiver within the service area footprint for the network server?

X-PAD: UHF Base instrument profile

X-PAD has a variety of ways to configure a Base receiver broadcasting corrections over UHF.

The primary difference is how the initial coordinate for the base is obtained:

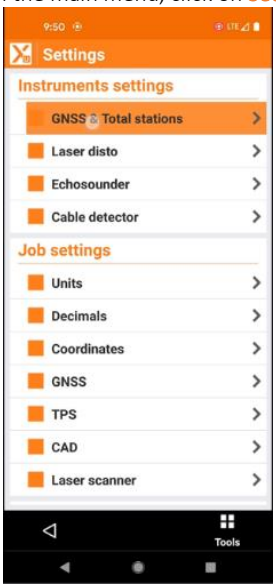
- Known Position: The position of the Ground Mark under the Base can be entered as a Geographic (Lat/Lon/Height), Projected Northing, Easting, Height or recalled from any of the Topographic or Reference points stored in the job.
- Current Position: The receiver's current position can be used to define the Base location. The receiver's Autonomous location can be used, or you can optionally connect the base receiver to a network server as a rover, get a network position for the base and then start the base with the network position.
- Last Setup: The last successful Base configuration, with possibly a new instrument height, will be used as the Base's broadcast coordinates.
- Automatic RTK Position: The Base receiver will be connected to a network using a matching Network Rover instrument profile and network corrections will be used to generate a FIXED solution which will then automatically be used as the Base's broadcast location.

Each of these Base configuration methods follows a similar configuration path.

Defining a Base profile

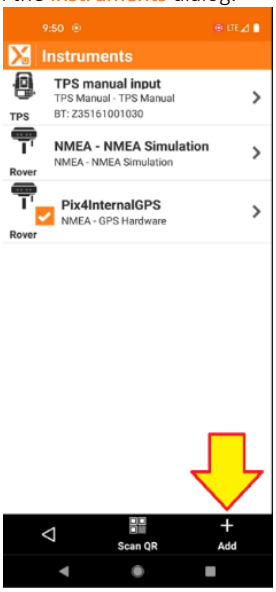
Start by opening an existing or new job.

From the main menu, click on Settings:



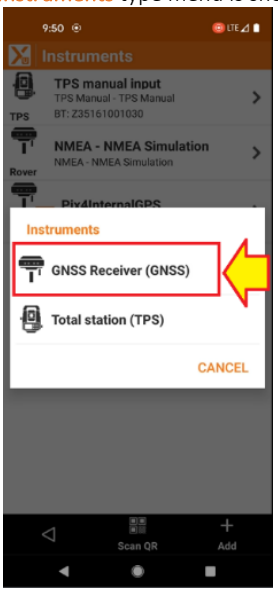
Then click on GNSS & Total Stations

From the Instruments dialog:



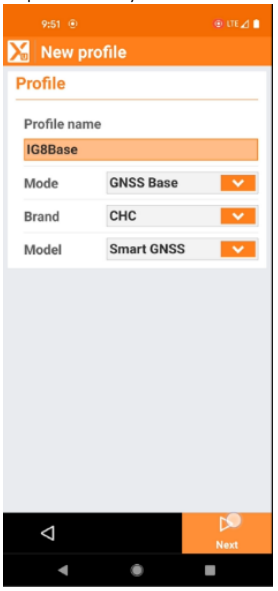
Click on the + Add button.

The Instruments type menu is shown



Choose GNSS Receiver (GNSS).

Build a profile for your receiver:



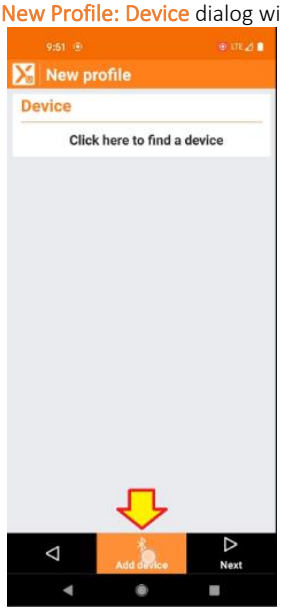
Set the 'Profile name' to reflect this will be a UHF Base.

Set the Mode to 'GNSS Base'.

Set the Brand to 'CHC'.

Then click Next.

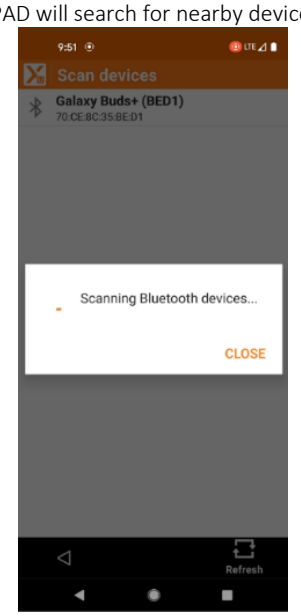
The New Profile: Device dialog will be shown:



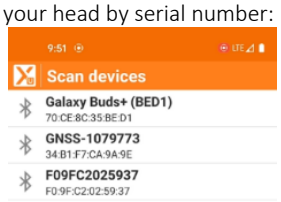
If you have already bonded to the Base receiver, use the drop-down button to select your device by serial number and proceed to the RTK- receive corrections section below.

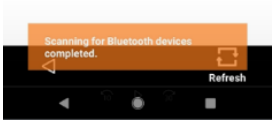
If your device is not listed (as shown above), click the Add Device button:

X-PAD will search for nearby devices:



After 15-seconds the available devices will be listed, find your head by serial number:

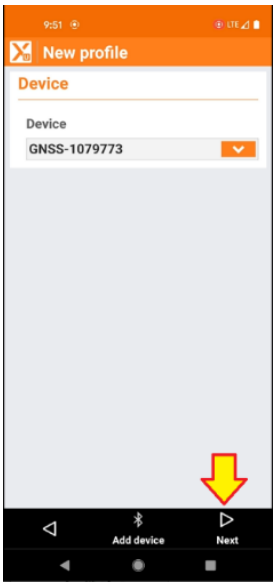




Click on the device, the Bluetooth Manager will be shown:

Click on Next:

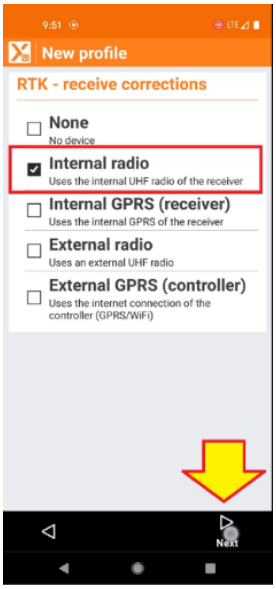
The Device selection is shown:



Verify that the correct receiver is selected.

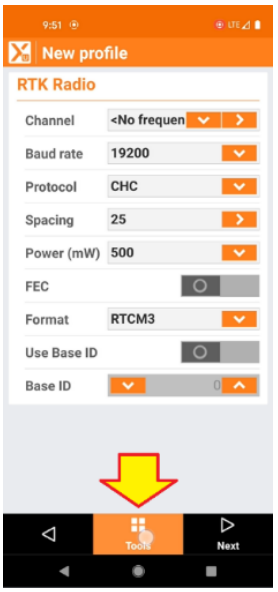
Then click Next.

The New Profile: RTK – receive corrections selection is shown:



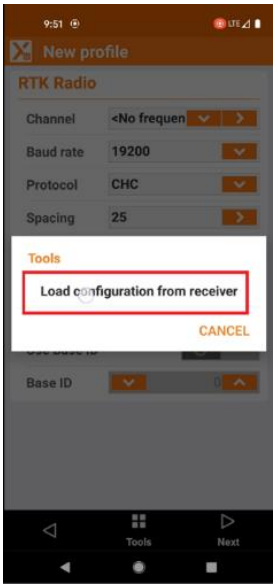
Select Internal radio, then click Next.

The New Profile: RTK Radio menu is shown:



Click the Tools button at the screen bottom

The Tools menu is shown:



Click on Import configuration from receiver.

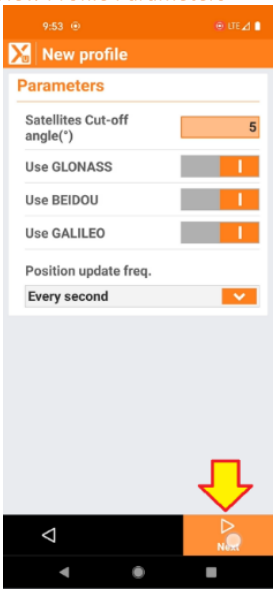
The existing radio profile will be recalled from the receiver's radio:

The Base and Rover settings must match exactly, except for Power which should be high on the Base and low on the Rover.

The settings shown above should be adequate for most applications. Setting FEC = ON for both the Base and Rover may double the radio range.

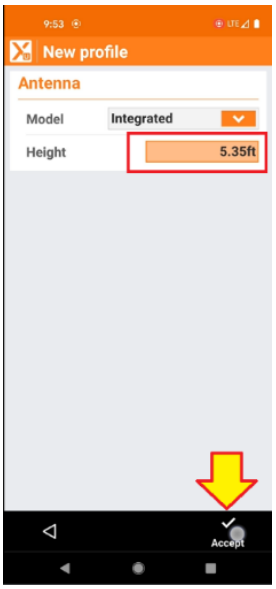
Click Next.

The New Profile Parameters dialog is shown:



Enable all the constellations and set the Satellites Cut off angle (Mask) to a value less than 8.

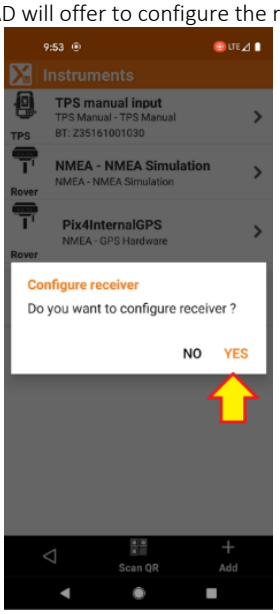
Click Next.



The HI (Height) is the default, you will be able to override it when you start the base.

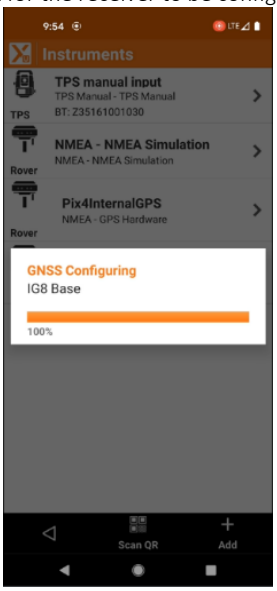
Click Accept.

X-PAD will offer to configure the receiver:



Click YES to apply the settings to the receiver.

Wait for the receiver to be configured:

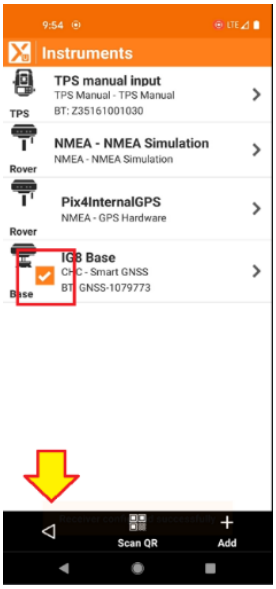


Click the Back arrow to return to the Settings menu.

Starting a UHF Base

Once you have setup a Base profile, you can use the profile to start a base.

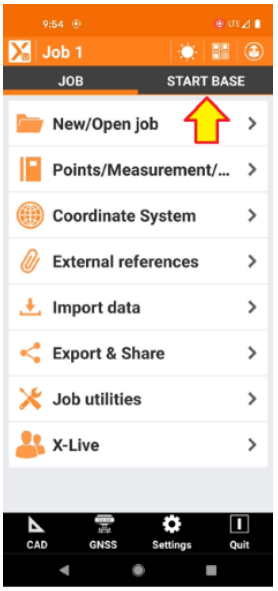
From the main menu click on Settings, then from the Instrument Settings menu click on GNSS and Total Stations, finally ensure that the correct Base profile is selected:



If it is not, click on the desired base profile and click on Current.

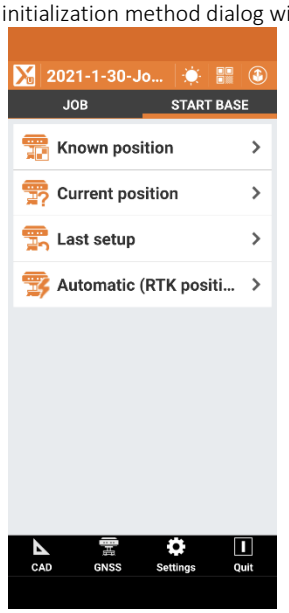
Click on the Back < arrow.

Return to the main menu:



The SURVEY menu item will be replaced with START BASE, click on it.

The initialization method dialog will be shown:



If you have a point in the current job that matches the base location, or you have the geographic (Latitude, Longitude, Height) or projected (Easting, Northing, Height) coordinates use the:

Base Initialization: Known position page 61

If you don't know where the base is and want to read the GPS to configure the base use the:

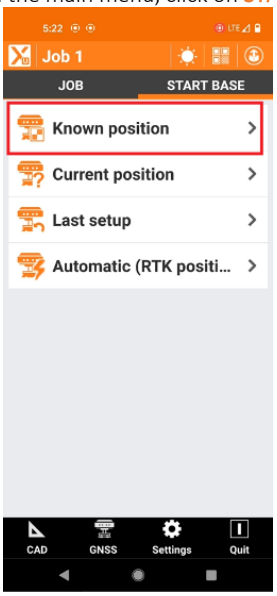
Base Initialization: Current position page 63

If you are starting at the last base position (perhaps on a subsequent day) use the:

Base Initialization: Last Setup page 65

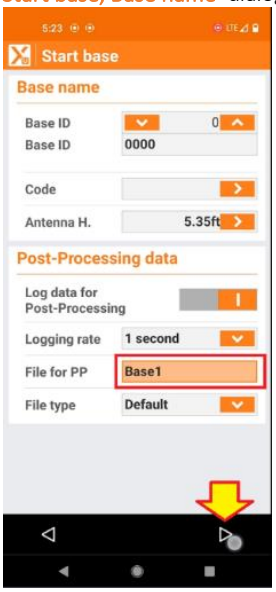
Base Initialization: Known position

If you know the coordinates for the base location, from the main menu, click on START BASE:



Then choose Known position

The 'Start base, Base name' dialog will be shown:



A Base ID of 0 is fine.

Enter the correct antenna height.

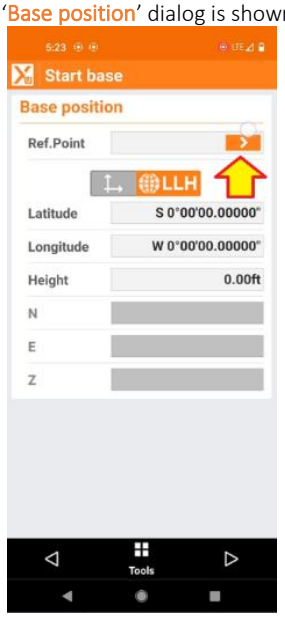
Always enable the 'Log data for Post-Processing' slider, then you will have the opportunity to process the base position in OPUS or against a rover if needed.

A logging rate of 1 or 5-seconds is appropriate. Enter a 'File for PP' filename that will be easy to identify.

Leave the File type set to Default.

Finally click on Next.

The 'Base position' dialog is shown:



You can select an existing point from the current job by clicking the '>' button or hand-enter the Latitude Longitude Height or hand-enter the Northing, Easting and Height.

If you choose to enter Latitude Longitude Height, the Height should be the 'Ellipsoid Height.'

If you enter the projected Easting, Northing, Height then the Height should be the 'Orthometric Height'.

If you have previously entered reference points into the current job, you can click the Tools button at the dialog bottom and automatically choose the nearest reference point.

When the Base position has been entered, click on the Next button.

The 'Create local system on base' option is displayed:

If you want to work at Grid leave the slider OFF. If you want to work at GROUND with a local coordinate, move the slider to the ON position:

If you choose to create a local system, enter the base position (typically 10,000, 10,000) or choose an existing point from the '>' on 'Local point'.

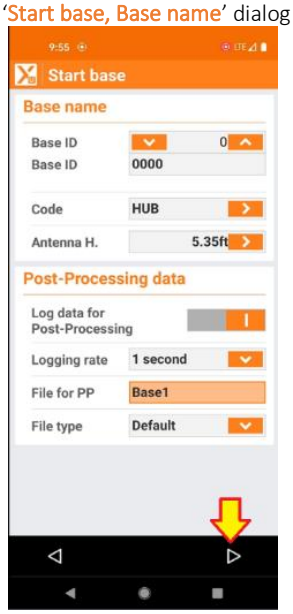
Finally click on 'Start Base'. After a few moments, the base configuration will be complete.

It usually takes 30-seconds for the receiver to begin transmitting corrections.

Base Initialization: Current position

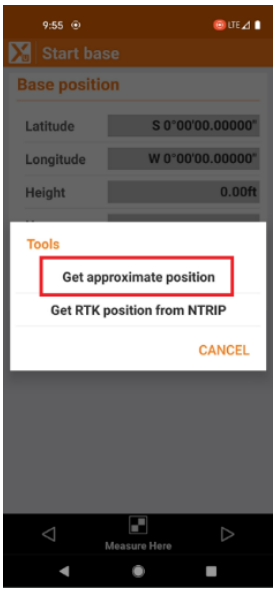
If you don't know the coordinates for the base location, choose 'Current position'.

The 'Start base, Base name' dialog will be shown:



Enter a code for the new base point, set the Antenna Height, move the slider to 'Log data for Post-Processing' so that a raw observation file will be collected to optionally send to NGS OPUS if you need to ground your survey later. Set the logging rate to '1 second', enter a reasonable filename for the observation file. Finally click on Next.

Click on the 'Measure Here' button on the screen bottom.



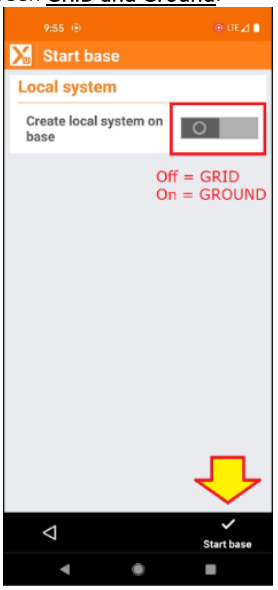
Click on 'Get approximate position' to read the current receiver position.

The approximate position will be shown:

If the receiver has been tracking satellites for longer than 10 minutes, the position will be within a couple feet of the ITRF receiver location (not NAD83.)

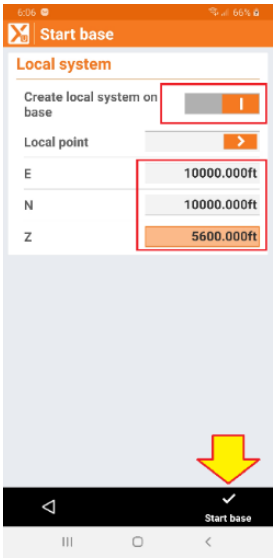
Click on the Next button.

The Local system dialog allows you to choose between GRID and Ground:



If you want to survey at GRID in the project coordinate system, leave the 'Create local system on base' slider off.

If you want to survey at GROUND, then move the slider to the ON position and enter the desired local coordinates for the base:



If the coordinate already exists in the job, you can recall it under 'Local Point', otherwise enter a new point code for the newly entered coordinate in Local Point.

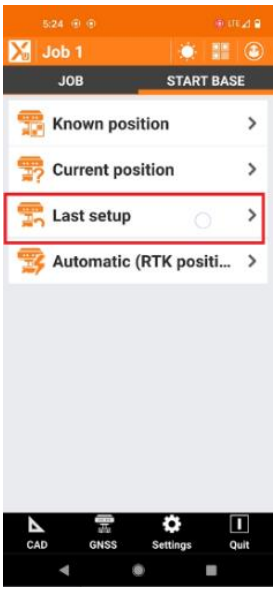
Finally click on the 'Start base' checkmark to compete the Base setup.

It usually takes 30-seconds for the receiver to begin transmitting corrections.

Base Initialization: Last Setup

Last Setup uses the previous Ground Mark location to initialize the base, this allows you to set the base on the previous position with a different instrument height.

Click on Last setup:



The 'Start base' dialog is shown:

Enter a Code for the position, the new Antenna Height, enable data logging, enter a reasonable name for the new day's observation files.

Finally click on the Next button:

The receiver will be loaded with the previous base configuration combined with the new instrument height.

The Create local system on base option is displayed:

If you want to work at **GRID** leave the slider OFF. If you want to work at **GROUND** with a local coordinate, move the slider to the ON position:

If you choose to create a local system, enter the base position or choose an existing point from the '>' on Local point.

Finally click on Start Base. After a few moments, the base configuration will be complete.

It usually takes 30-seconds for the receiver to begin transmitting corrections.

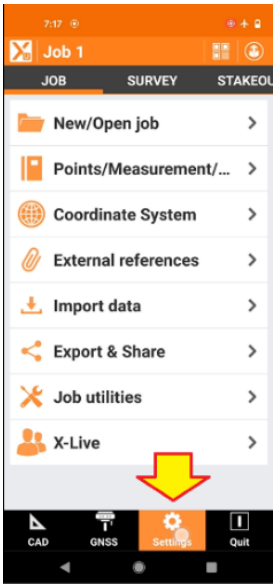
UHF Rover instrument profile

The UHF Rover configuration uses the internal UHF radio to receive corrections transmitted by the base. Corrections are transmitted by a UHF Base and received by the UHF radio in the Rover.

Start a new job following the steps in the section 'X-PAD: Starting a New Job'.

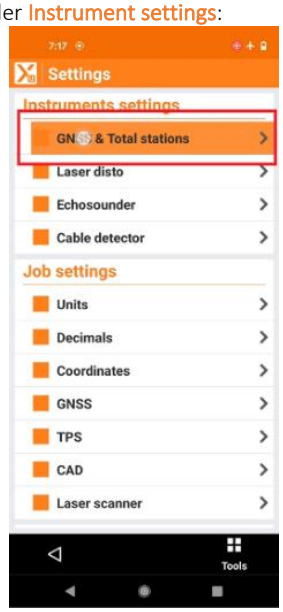
Turn the receiver on and make a note of its 'Serial Number'.

In X-PAD from the main menu:



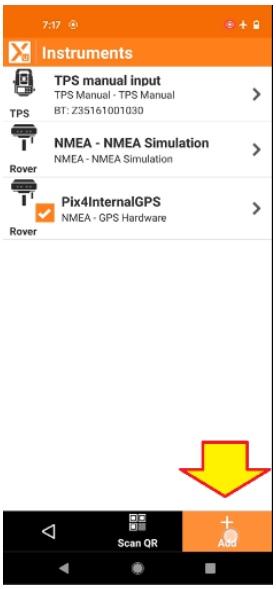
Click on 'Settings'

Under Instrument settings:



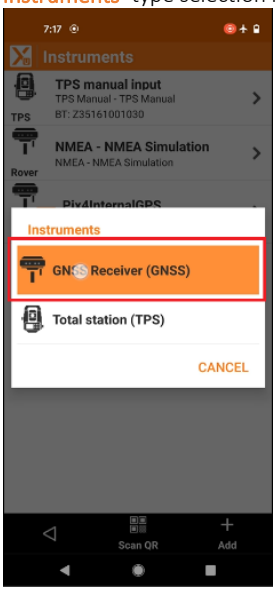
Click on GNSS & Total stations.

The Instruments list is shown:



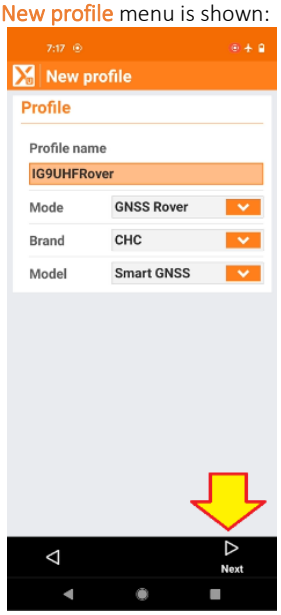
Click on 'Add' to configure a new instrument.

The 'Instruments' type selection is shown:



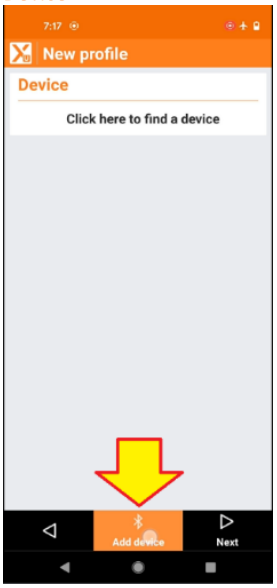
Click on GNSS Receiver (GNSS) to create a 'New profile'.

The New profile menu is shown:



Leave the Mode set to GNSS Rover.
Enter an appropriate 'Profile name' and change the 'Model' to 'CHC'.
Then click 'Next'.

The 'Device' list is shown:

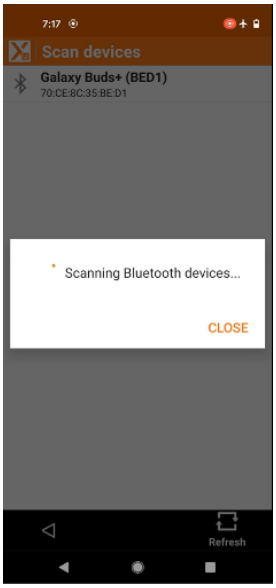


If your receiver is already available in the drop-down box then select it and click Next.

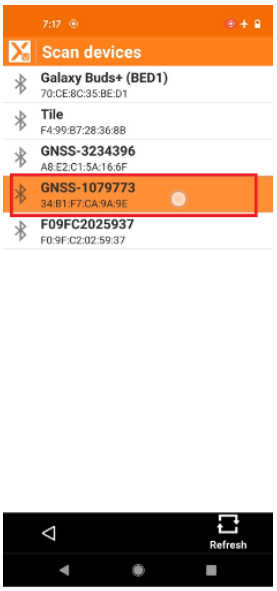
Otherwise, if your receiver is not already listed, use the 'Add device' button at the bottom to show the Bluetooth Manager:

In the Bluetooth Manager click on Search to find nearby devices.

Wait a while (about 15-seconds) for the Android device to search for and list all nearby Bluetooth devices:

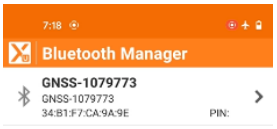


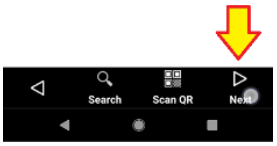
When the search is complete a list of nearby devices is shown:



Click on the correct device with the serial number that matches your receiver.

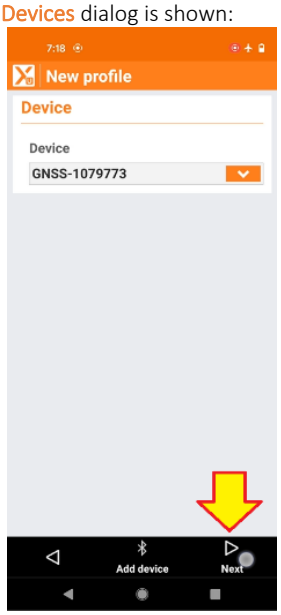
The Bluetooth Manager will be shown with the correct receiver listed:





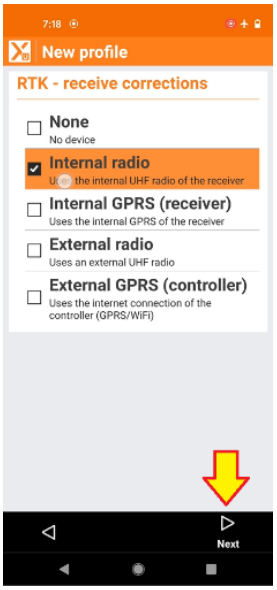
Click on Next.

The Devices dialog is shown:



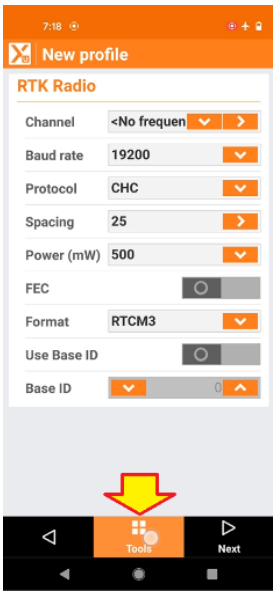
Verify that the correct device is shown, then click Next.

The RTK – receive corrections dialog is shown:



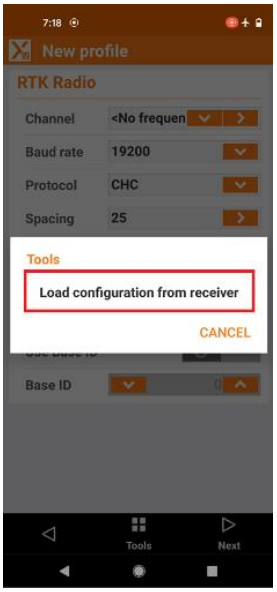
Select Internal radio then click on Next.

The RTK Radio selections are shown:



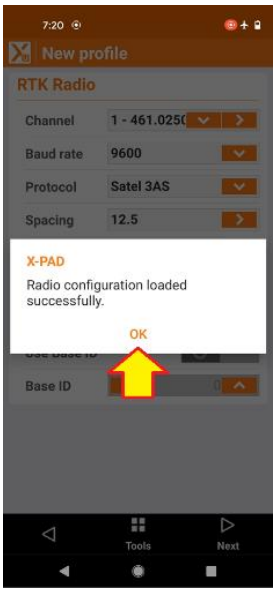
No frequencies will be available, click on the 'Tools' button at the screen bottom.

The Tools menu is shown:



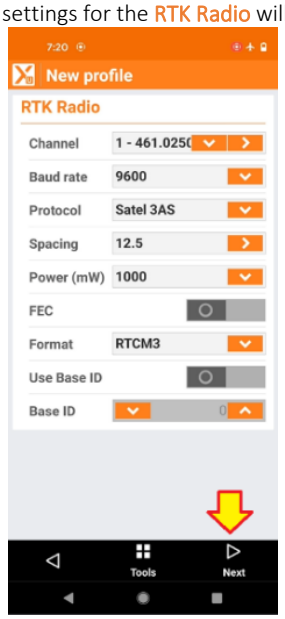
Click on the Load configuration from receiver button at the center of the screen.

Wait while X-PAD retrieves the licensed radio configuration from the receiver:



Click on OK.

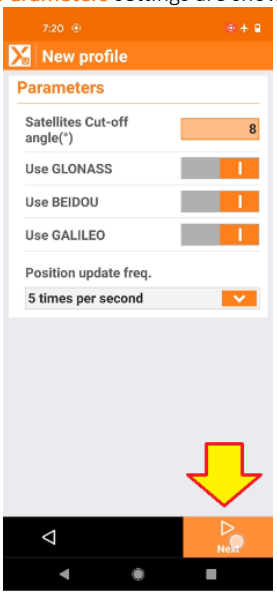
The settings for the RTK Radio will be displayed:



Make sure the RTK Radio settings match the base exactly.

Then click on Next.

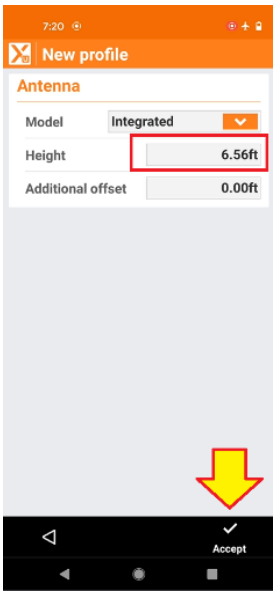
The Parameters settings are shown:



Set an appropriate Cut-off angle (the elevation mask). Enable all of the constellations you want to use.

Finally click on Next.

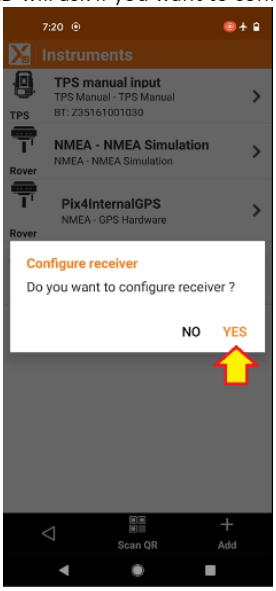
The New Profile: Antenna menu will be shown:



Verify the default / initial instrument Height.

Then click Accept.

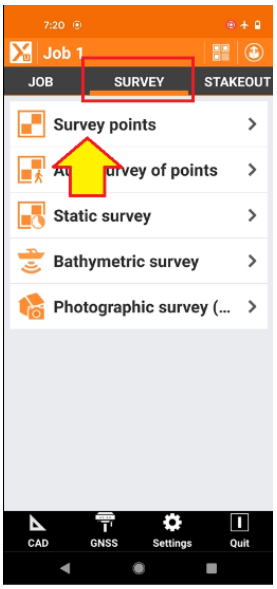
X-PAD will ask if you want to configure the receiver:



Click on YES.

This will configure the receiver and make the UHF Rover profile the default instrument.

Click the back button twice, then select the SURVEY tab:



Next click the Survey points line.

The GNSS Survey map screen is shown:

Wait for the receiver to report RTK Fixed and your programmed accuracy tolerance to be reached.

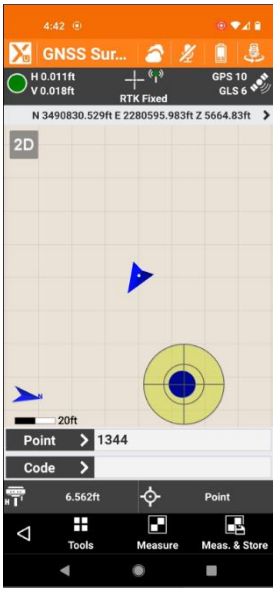
You are now ready to survey!

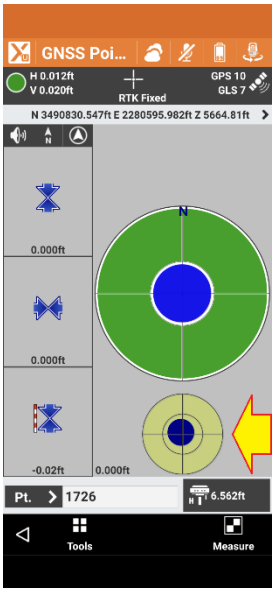
Using GNSS receivers with E-Bubble and IMU tilt compensation

The iG8 receiver has an internal E-Bubble (electronic bubble) to assist in leveling the pole. The E-Bubble operation is described immediately below.

The iG9 receiver has an internal IMU which allows for pole tilt compensation. See page 75 for IMU details.

iG8 / CHC i70 E-Bubble operation





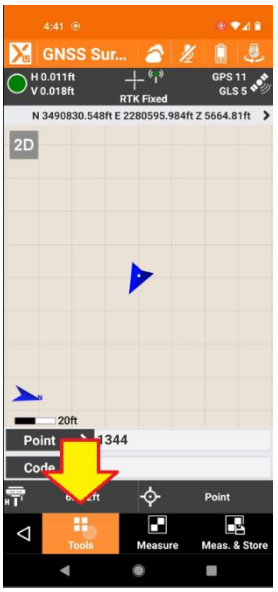
E-Bubble while storing eBubble while Staking

The E-Bubble is useful to keep unleveled shots from being stored and documenting that stored shots utilized a leveled rod. IMU tilt compensation corrects for pole tilt, allowing the operator to store building corners and obscured points.

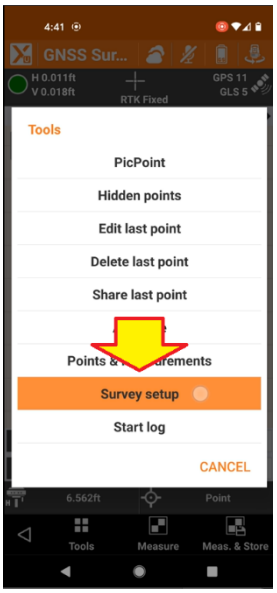
This chapter describes:

- How to enable the Tilt/IMU.
- How to set the maximum pole tilt tolerance.
- How to calibrate the electronic bubble.

To enable the E-Bubble from the Survey or Staking screens, click on the Tools button at the bottom of the screen:

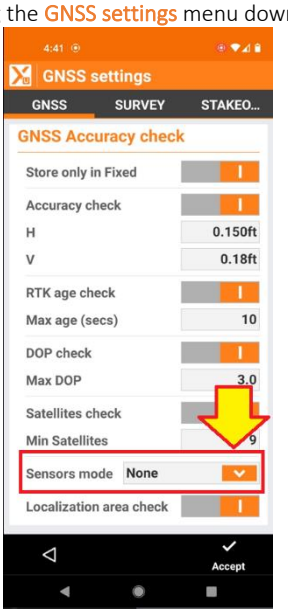


On the Tools menu:



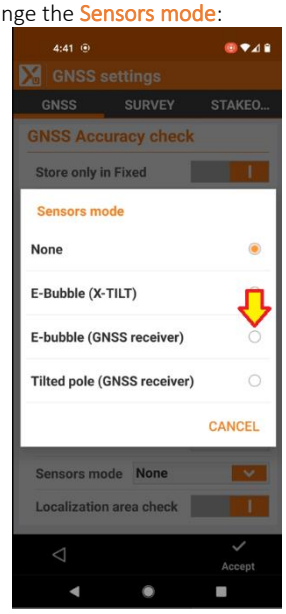
Click on Survey setup.

GNSS settings will be shown.
Drag the GNSS settings menu down to Sensors mode:

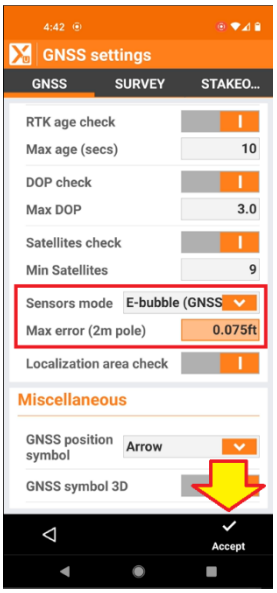


Click on the down button.

Change the Sensors mode:



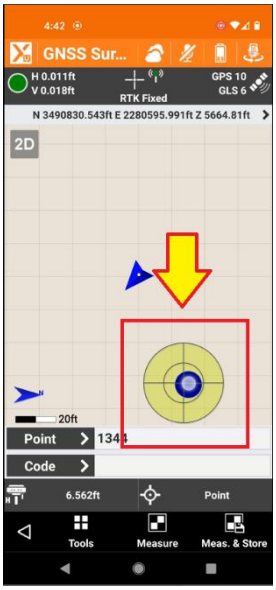
To E-bubble (GNSS receiver).
Next, set a reasonable Max error for the tilt-tolerance:



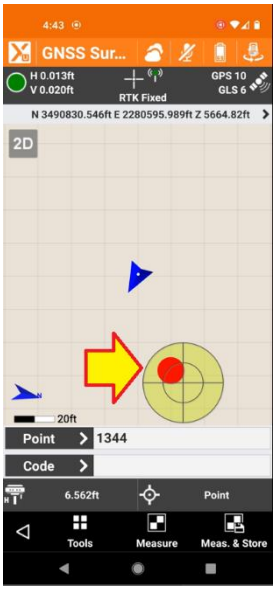
Max error is the horizontal distance from the measured receiver position to the pole tip and is computed based on the HI (Instrument/Pole Height). If you attempt to store a point when the tilt tolerance is exceeded, X-Pad will wait for you to level the pole and accumulate measurement epochs with tilt in tolerance as required by the averaging configuration (see Survey setup, SURVEY tab, Time on point and Time on Master point.

Finally click on Accept.
Note, if you click on the back arrow your changes will not be kept!

A translucent bubble will be shown:



If the pole tilt offset is less than the programmed tolerance the bubble will be shown as a blue-dot. If the tolerance is exceeded the E-Bubble will be shown as a red-dot:

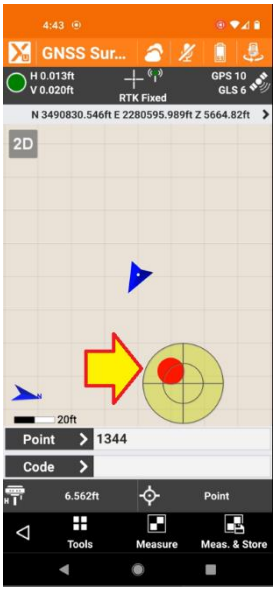


A red-dot will delay measurement epochs from being recorded until the pole is leveled.

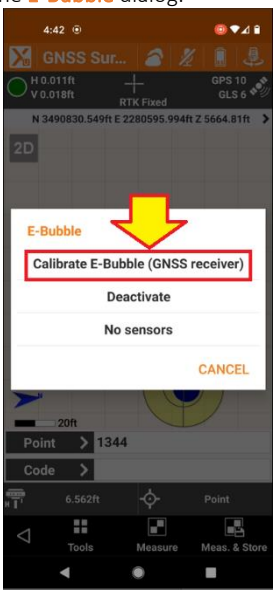
E-Bubble Calibration

The E-Bubble needs to be calibrated every few weeks, after shipping and after a large temperature swing.

Click-and-hold on the onscreen pole bubble to calibrate the bubble:

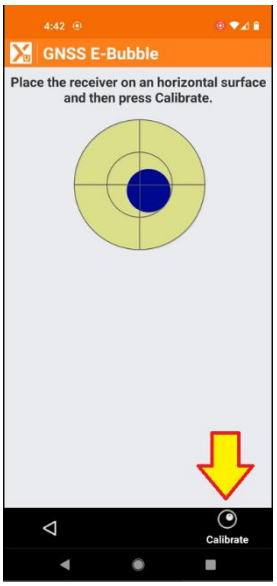


On the E-Bubble dialog:



Click on Calibrate E-Bubble (GNSS receiver).

The GNSS E-Bubble calibration screen will be shown:



Precisely level the head, then click the Calibrate button.

Wait 10-seconds for the calibration to complete:

The E-Bubble is now adjusted to match the instrument's current level.

iG9 / CHC i90 IMU Tilted Pole Compensation

Some receivers (iG9 and CHC i90) include an internal IMU (Inertial Measurement Unit) sensor that combines the RTK position solution with inertial movement to compute the position of the pole-point based on head position, receiver heading and receiver tilt.

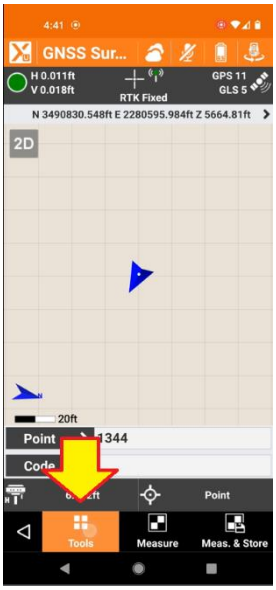
The IMU measurements do not include magnetic compass measurements so they will work near magnetized objects, metal buildings and under powerlines.

These tilted pole corrections happen at an extremely high rate.

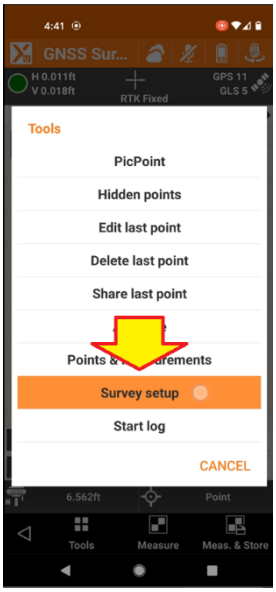
IMPORTANT NOTE: if you enable Tilt Compensation and the IMU is not initialized, a position will not be available in X-PAD until after you achieve initialization.

To enable the IMU Tilted Pole corrections from the Survey or Staking screens, click on the Tools button at

the bottom of the SURVY or STAKING screen:

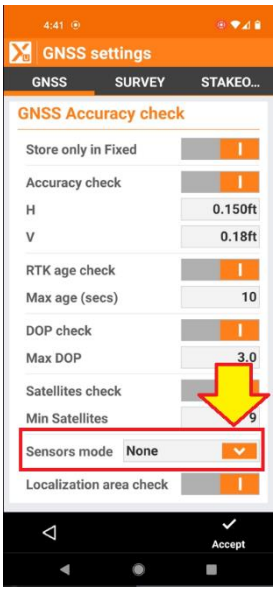


On the Tools menu:



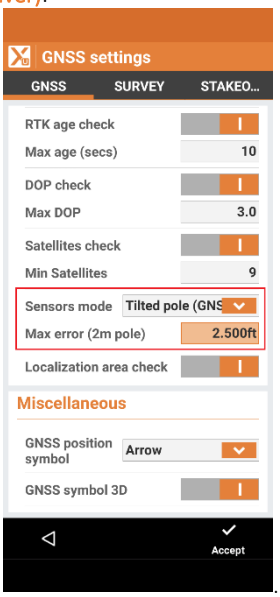
Click on Survey setup.

GNSS settings will be shown.
Drag the GNSS settings menu down to Sensors mode:



Click on the down button.

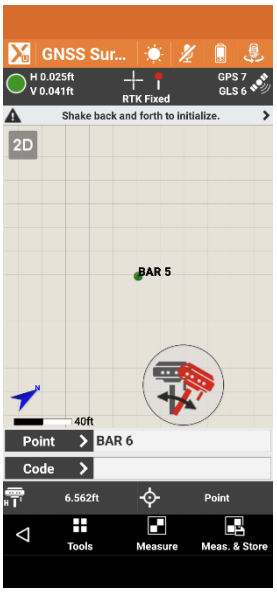
Change the Sensors mode to Tilted Pole (GNSS receiver):



Set the Max error (2m pole) to the maximum horizontal offset of a receiver at the top of the pole from the point on the ground. (A 20° tilt on a 2-meter pole is 2.25' offset.) Tilts that result in a higher offset will pause measurements.

Finally click Accept.

The SURVEY or STAKING screen will be shown:



A translucent tilt indicator will be displayed on the map bottom. As the IMU initializes several prompts are shown. The symbol above requests that you need to rock the receiver back-and-forth on a point.

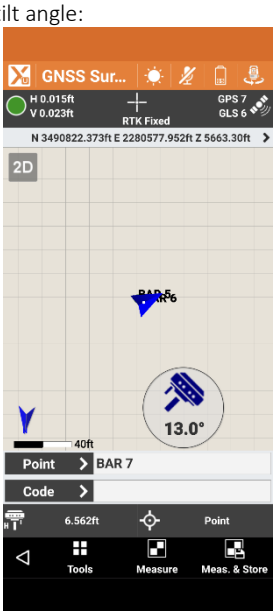
This icon:

requests that you hold the receiver nearly still and level.

Usually, the status goes back and forth between rocking and holding still.

The IMU will usually initialize in the process of moving between points if you ignore the initialization instructions.

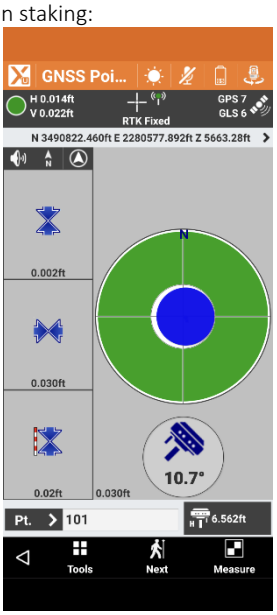
Once the IMU has initialized the screen will display the tilt angle:



When this icon is shown, the tilt compensation is active and you can store a measurement.

If you hold the receiver perfectly still (on a prism pole bipod) for more than 30-seconds, the IMU will lose fine initialization. X-PAD will request that you rock the receiver again. Typically, you only need to 'shake' the receiver 0.01' in one direction to reinitialize the IMU.

When staking:



the tilt angle is shown.

There is no calibration routine for the IMU other than the initialization sequence.

Adjusting a Base position to match an OPUS Solution

It is common to setup a Base at an autonomous/unknown position and immediately collect RTK shots on features.

These features will be correct relative to each other; however, they will have some offset from the desired reference frame; typically, in the USA: NAD83 2011 (2010.0).

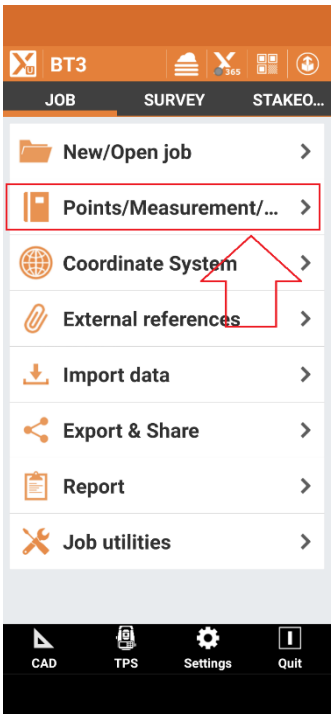
X-PAD fully automates the adjustment of the Rover shots to a qualified frame.

First, you might want to make a copy of your job data in a separate file for safety. From the JOB menu, click on Job utilities, then Save a copy of the job >. Enter a reasonable name for the new file like: 'JOB3_OPUSAdj.gfd4', click on Accept, then choose and Accept the folder location.

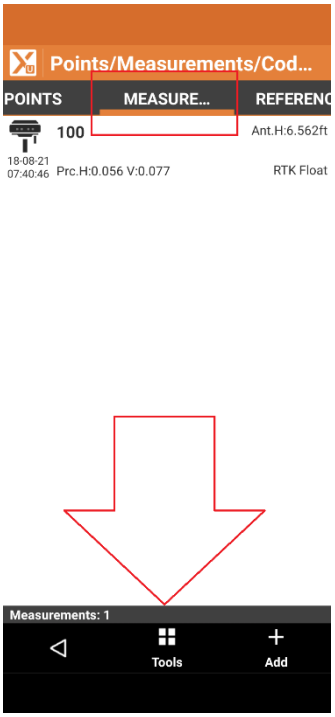
X-PAD will ask if you want to open the newly copied and saved job, click on Yes.

Your original file will be preserved and the adjusted points will end up in this new, separate job.

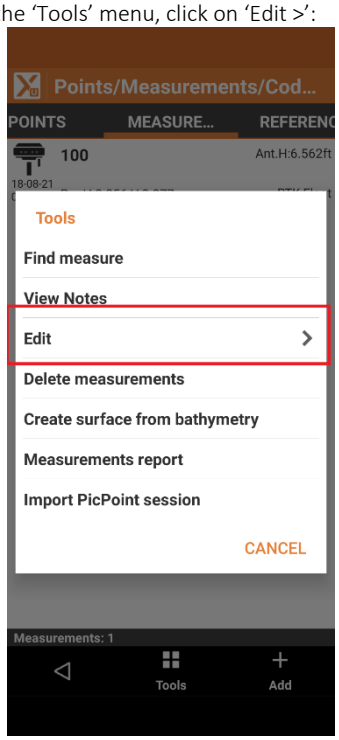
From the JOB menu, click on JOB: Points/Measurements/CODES:



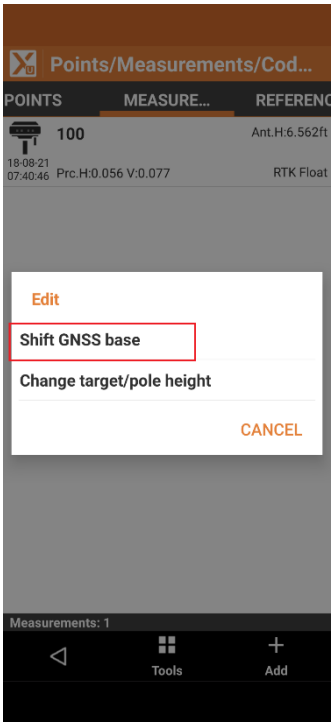
On the MEASURE tab, click on the Tools button at the bottom:



On the ‘Tools’ menu, click on ‘Edit >’:



Then on the Edit menu click on ‘Shift GNSS base’:

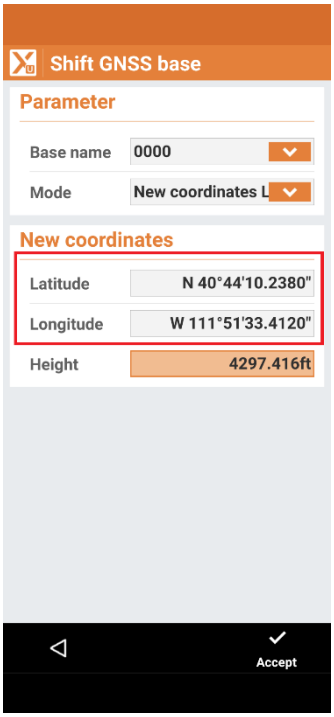


Enter the Latitude and Longitude from the OPUS positioning report:

```
REF FRAME: NAD_83(2011)(EPOCH:2010.0000)              ITRF2014 (EPOCH:2021.6261)

        X:      -1802350.582(m)    0.001(m)          -1802351.540(m)    0.001(m)
        Y:      -4492711.326(m)    0.002(m)          -4492710.040(m)    0.002(m)
        Z:       4141119.248(m)    0.005(m)           4141119.129(m)    0.005(m)

      LAT:    40 44 10.10238       0.004(m)        40 44 10.11718       0.004(m)
    E LON:   248  8 26.58804       0.000(m)       248  8 26.52976       0.000(m)
    W LON:   111 51 33.41196       0.000(m)       111 51 33.47024       0.000(m)
   EL HGT:          1309.855(m)    0.004(m)             1309.143(m)    0.004(m)
ORTHO HGT:          1326.571(m)    0.041(m) [NAVD88 (Computed using GEOID18)]
```



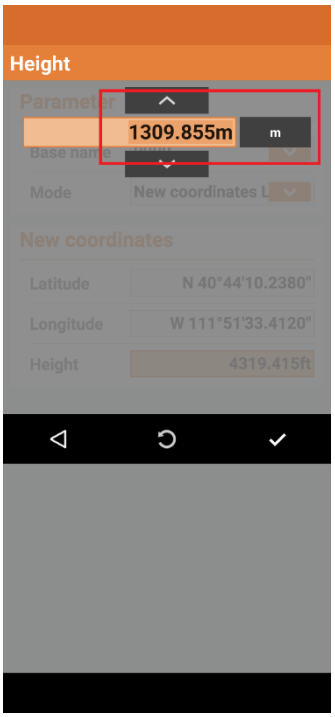
Even though the displayed elevation is in feet, and the OPUS return is in meters:

```
REF FRAME: NAD_83(2011)(EPOCH:2010.0000)              ITRF2014 (EPOCH:2021.6261)

        X:      -1802350.582(m)    0.001(m)          -1802351.540(m)    0.001(m)
        Y:      -4492711.326(m)    0.002(m)          -4492710.040(m)    0.002(m)
        Z:       4141119.248(m)    0.005(m)           4141119.129(m)    0.005(m)

      LAT:    40 44 10.10238       0.004(m)        40 44 10.11718       0.004(m)
    E LON:   248  8 26.58804       0.000(m)       248  8 26.52976       0.000(m)
    W LON:   111 51 33.41196       0.000(m)       111 51 33.47024       0.000(m)
   EL HGT:          1309.855(m)    0.004(m)             1309.143(m)    0.004(m)
ORTHO HGT:          1326.571(m)    0.041(m) [NAVD88 (Computed using GEOID18)]
```

you can enter the metric ellipsoid height directly by selecting meters on the entry box:



Finally click on the 'Accept' button to translate the Rover points.

You can now use these adjusted points as if they were collected from the correctly framed Base position.

Base Position Adjustment

For many surveys, you will have very accurate known coordinates for a control point on the job. However, this point won't be a great location to setup a Base.

Base Position Adjustment (BPA) allows you to set your base at any random location with an autonomous Current position. This might allow you to set your base at the top of a hill where radio corrections can reach an extended area and the Base will have a clear unobstructed view of the horizon in all directions.

BPA makes the required compensation on the Rover side that virtually moves the Base to exactly the correct location to allow your Rover to read the known coordinates at the control point.

It is important to note that BPA does not adjust the broadcast location **in** the Base. The Base continues to broadcast corrections with the autonomous position. All corrections / adjustments are performed on the Rover side.

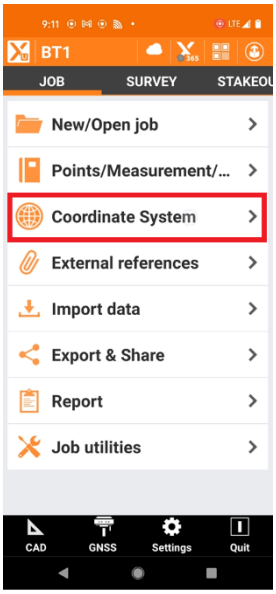
BPA, as implemented in X-PAD, does not require a previously surveyed point for calibration. You can use any point that you have Lat-Lon-Ellipsoid Height or State Plane Northing, Easting, Orthometric Height available for as the control point.

To use BPA, first configure your Base, reading the GPS for an autonomous position.

Connect to the Rover and make sure you have a FIXED position.

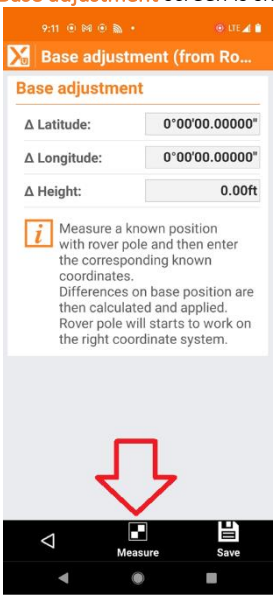
Go to the control point and set the Rover at the point, held with a bipod if available.

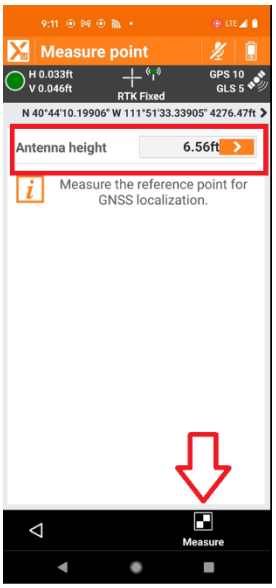
From the main JOB menu:



Click on Coordinate System, then click on Base position adjustment.

The Base adjustment screen is shown:

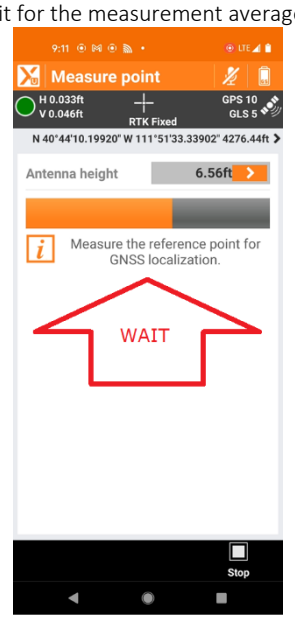


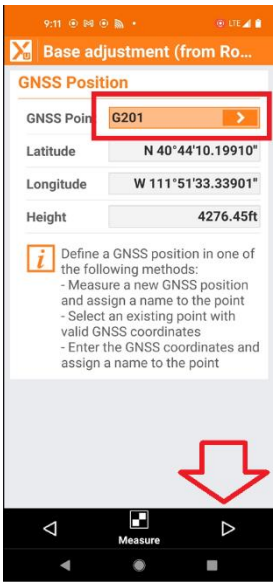


Click on the Measure button at the bottom.

Verify the rod height, level up the Rover, then click Measure to read the current FIXED GNSS Position from the receiver.

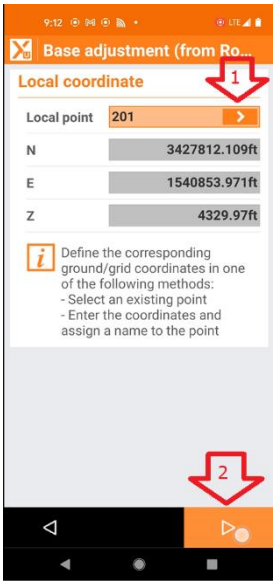
Wait for the measurement average to complete:

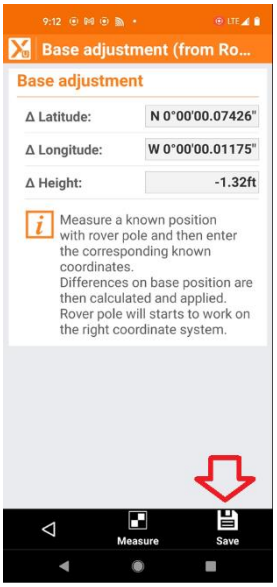




Name the GNSS point with a unique point name ('G201' above), then click the Next arrow on the bottom.

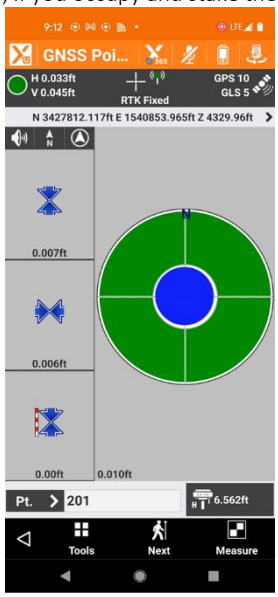
Now enter or select the Local coordinate (the value you would like the receiver to measure) at this point, then click the Next button:





X-PAD will compute the exact Base adjustment deltas required to make the Rover match the control point coordinates. Click the Save button to continue and put the BPA into play.

Now, if you occupy and stake the control point:



The rover will match the control coordinates.

GNSS Storing points: SURVEY: Survey points

If the current instrument is a GNSS Rover, then the main SURVEY: Survey points screen allows you to store GNSS measurements. Screens for optical measurements are shown in the Robotic Total Station section of this guide.

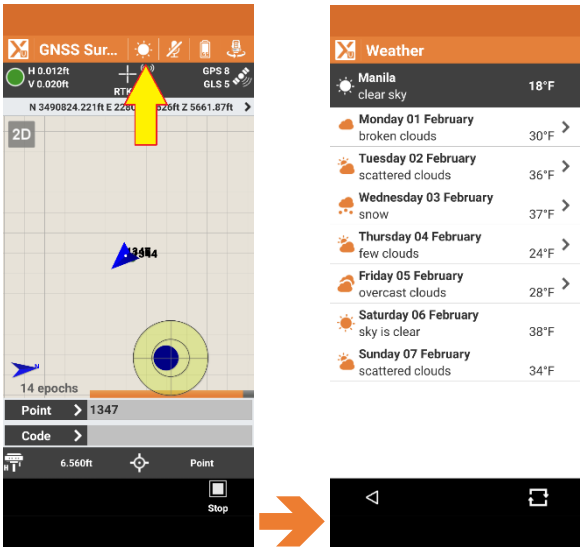
Let's take a tour of the Survey points screen.

X-PAD Info

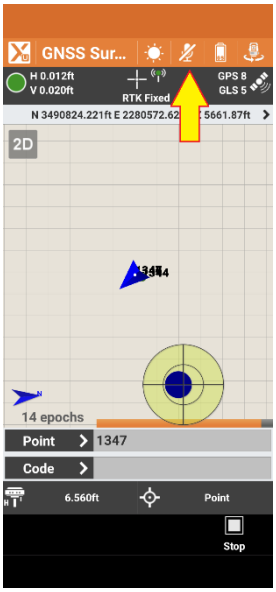
Clicking the X-PAD Ultimate icon in the upper left corner displays information about X-PAD, the current License activation, release notes and detailed information about the current device.

Weather

Clicking the weather icon displays the current and forecasted weather for your current location.



X-PAD Voice Commands



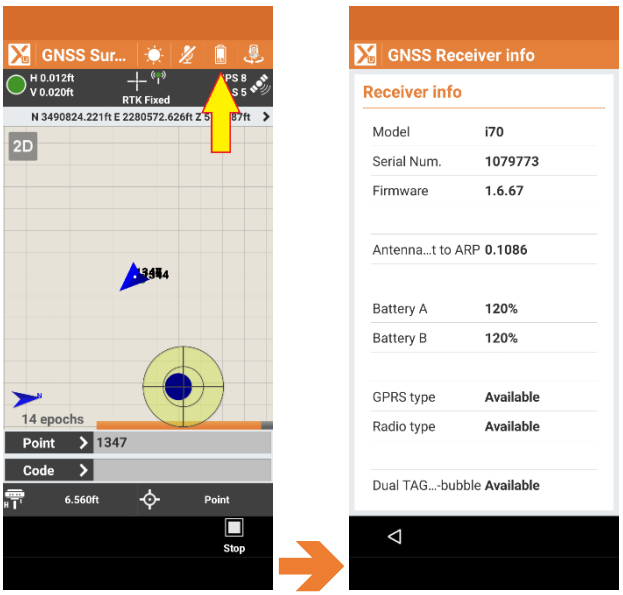
Enables X-PAD voice commands recognition.

Say 'OK X-PAD' to give verbal commands to X-PAD:

SURVEY: Store, Measure, Line, Arc, Stop, Code, XPole
STAKEOUT: Next
TPS/RTS: Prism, NoPrism (reflectorless), Tape, Lock, UnLock, Switch Target, Bubble, Target Height
GNSS/GPS: GNSS Status, Pole Height

You can have multiple words for one command. See Settings: Voice commands to configure and see a full list of voice actions.

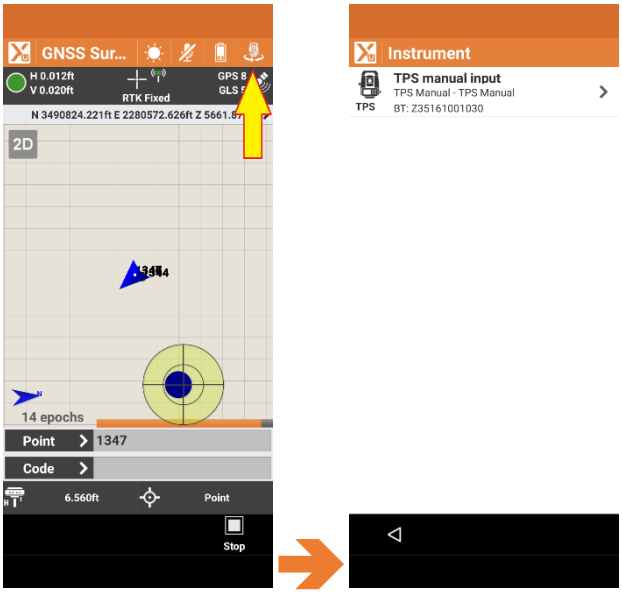
Receiver Battery and Instrument Status



Click to display detailed information about the current instrument including: Model, SN, Firmware, Battery status, Tilt & E-Bubble availability.

Click the < Back arrow to return to the SURVEY screen

Instrument Selection

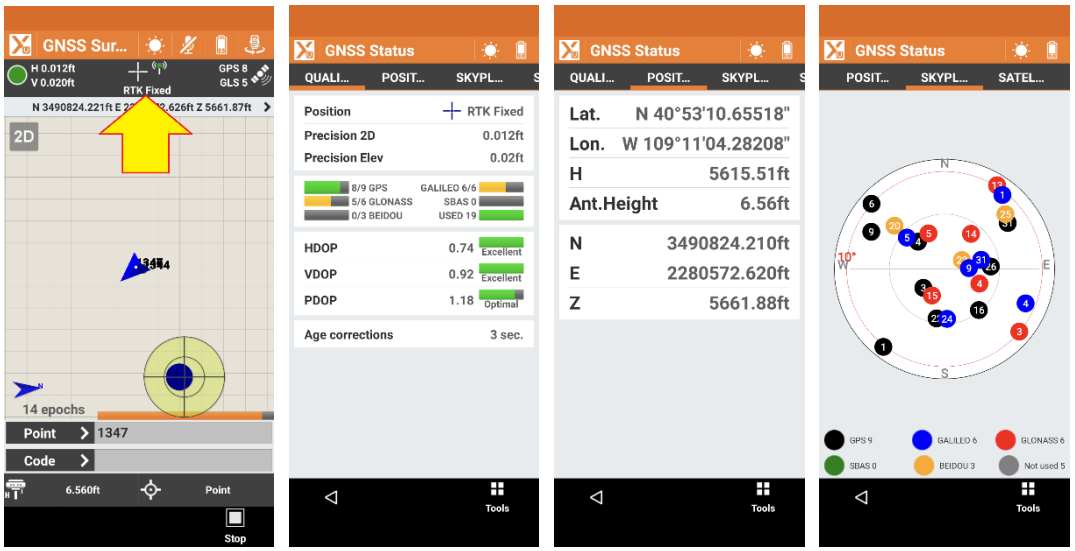


Allows you to quickly switch between instruments, from GNSS to Total Station.

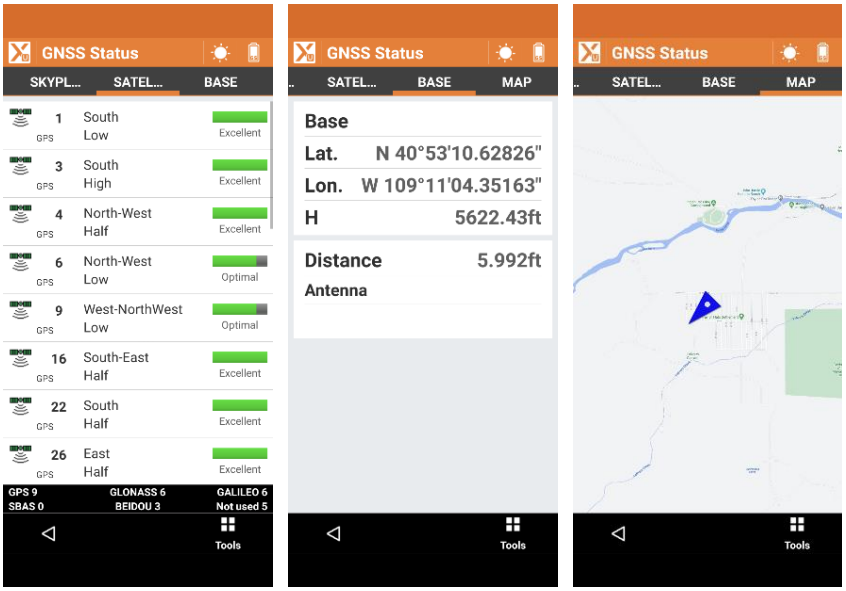
Click the < Back arrow to return to the SURVEY screen

Receiver Status

The receiver status panel shows: current measurement tolerance result (Green Dot); the estimated Horizontal and Vertical error; the current FIX, FLOAT, DGPS status; RTK Correction icon and the number and type of currently used satellites.



Click anywhere on the instrument status panel to move to the GNSS Status screens where you can move between the: QUALITY, POITION, SKYPLOT...



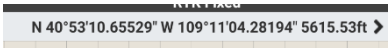
SATELLITE, BASE and general area MAP display screens.

Click the < Back arrow to return to the SURVEY screen

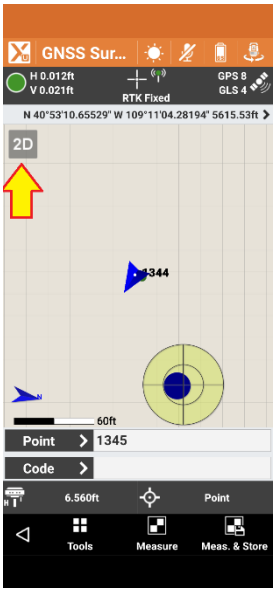
Current Position Display

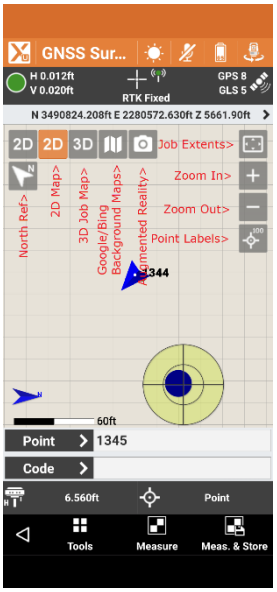
This coordinate line shows the current projected position:

If you click on the coordinate line, it will toggle to show the geographic coordinates:



Map Display Screen





You can pinch in and out on the map display to Zoom in and out. One finger will drag the map over the screen.

Clicking the Map button (2D above) displays the map controls:

Show a 2D representation

Show a 3D representation


Change background maps between Google, Bing, Custom, other custom Servers

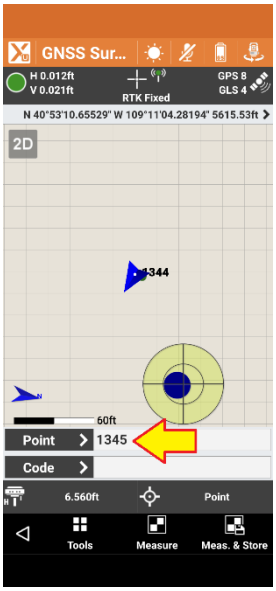

Switch to Augmented Reality mode: Superimpose your points and lines on the camera image:


Zoom to job extents


Zoom In, Out


Enable / Disable point information display

Point Name



Enter the Point name for the next stored measurement.

Clicking on the grey Point button:  will display the point and measurement list.

Clicking in the entry box:  will activate the onscreen point name editor.

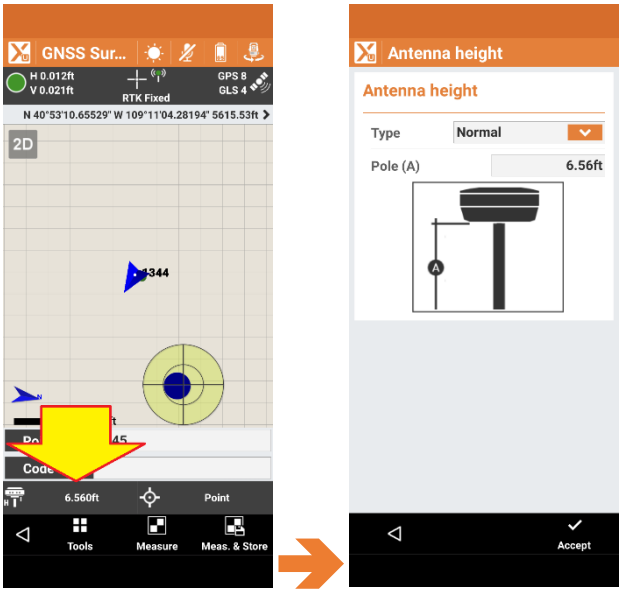
Point Code

Enter the Code for the next stored measurement.

Click on the grey Code button to pick the code from the library or add new codes. Coded points can also contain GIS Feature data, control drawing layers, symbols, colors. Click in the white area to directly enter a non-library code.

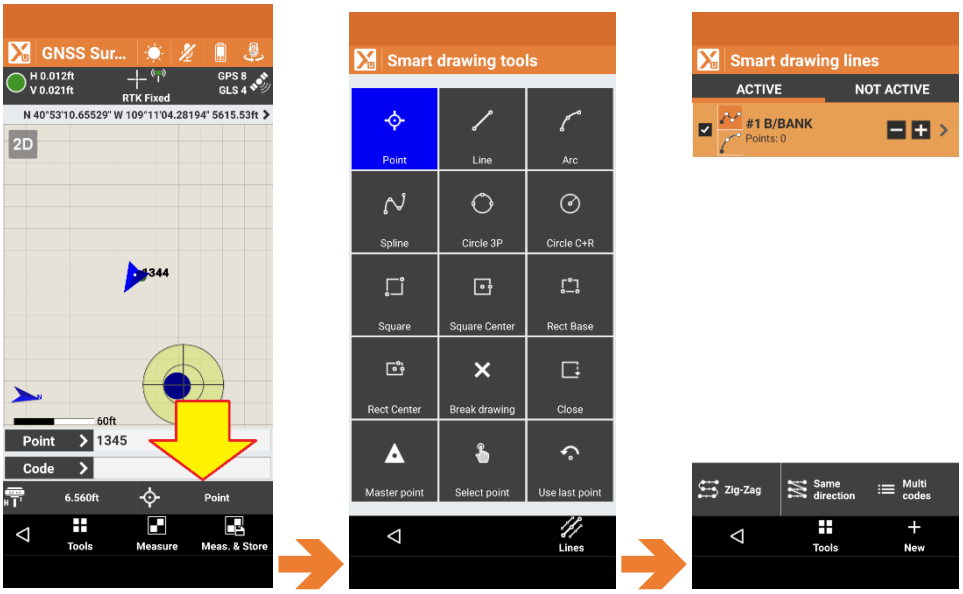
The X-PAD Ultimate User Manual has details about code operations.

Antenna Height



Click on the Antenna height button to edit the Instrument Height. This is the vertical distance from the bottom of the receiver to the tip of the point.

Smart Drawing Tools



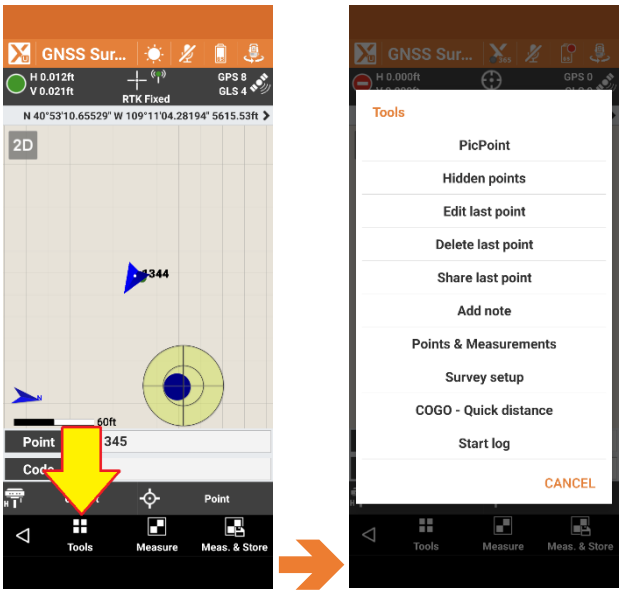
Smart drawing tools choose the measurement type and control line drawing in the field as measurements are taken. You can connect shots with straight Lines; Arcs; Splines; build Circles from 3-points on the circumference or the Center; set Squares and Rectangles. These field collections actions allow features to be collected on drawing layers, linework to be completed in the field and nearly complete drawings to be built as collected.

The /// Lines button launches the Smart drawing lines list that helps acquire multiple lines as you Zig-Zag or Z-Cross alignments. Detailed information on Smart drawing tools is presented in the X-PAD User Manual.

Point is used for Topo or quick side-shots, Master point uses a longer average.

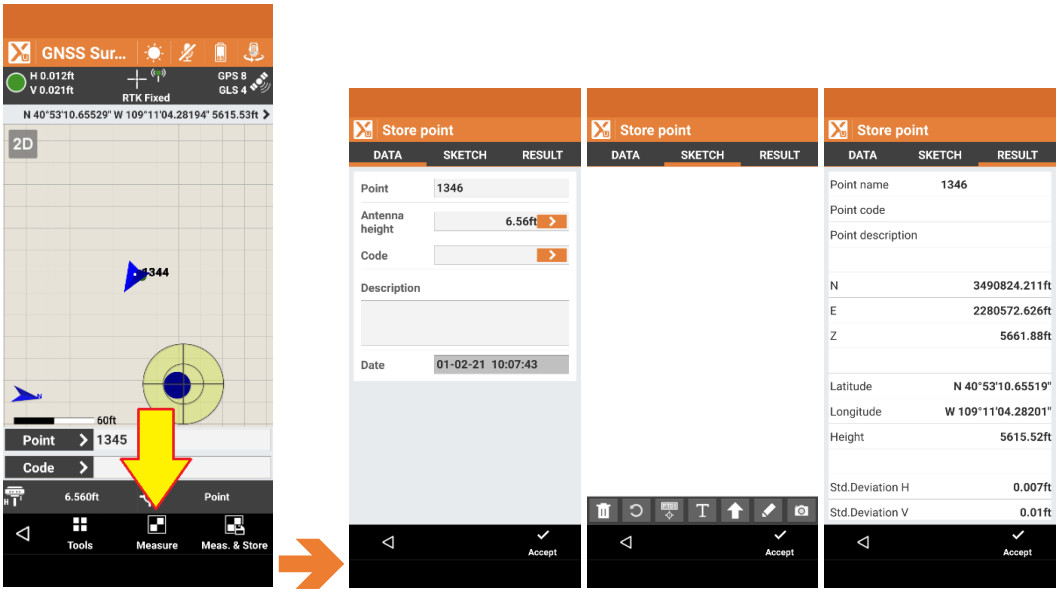
Continuous polygon and arc figures can be Closed to form shapes.

Tools



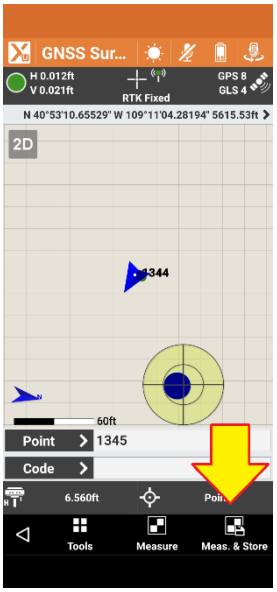
The Tools button allows quick access to PicPoint (pick a point from the map and add a point), Edit last point, Delete last point, Share last point, Add note to the survey with text and sketches, Points & Measurements brings up the point list, Survey setup allows you to edit the survey configuration for TPS, SURVEY, STAKEOUT and POINTS, COGO – Quick distance for inversing between points and Start log for recording receiver raw data.

Measure



The Measure button acquires a point as configured by the Smart Drawing Tool and Survey settings; after the point is collected you will have an opportunity to enter attributes for the stored point. You can change the point Name, edit the Antenna height, edit the Code, enter a detailed Description; you can also make a detailed SKETCH and include pictures; finally, all of the measurement data can be viewed on the RESULT tab.

Measure & Store



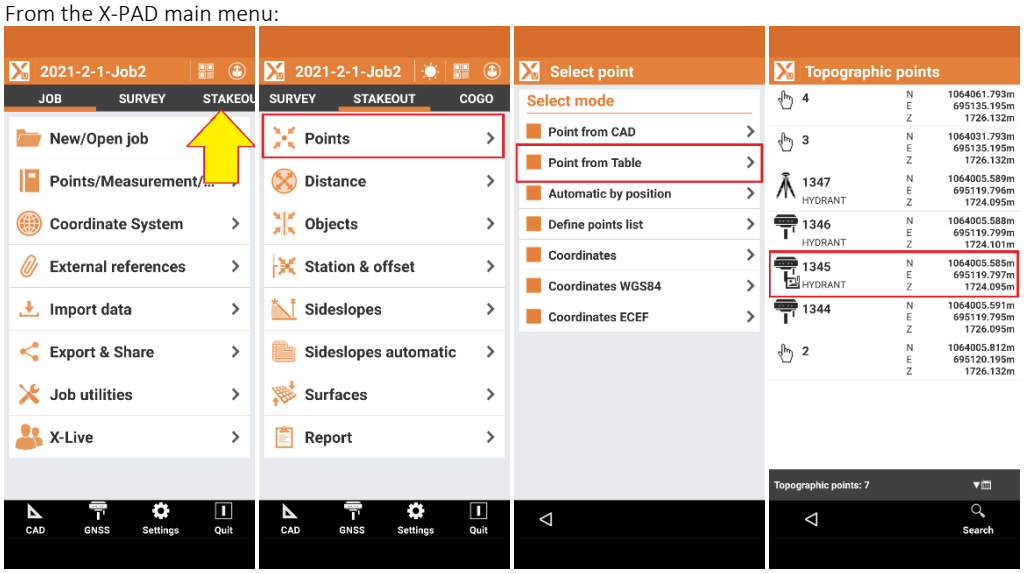
The Measure & Store button acquires a point as configured by the Smart Drawing Tool and Survey settings; after the point is collected it is immediately stored and X-PAD is ready to store another point.

If you decide you want to edit a point stored with Measure & Store, click on Tools and then Edit last point.

STAKE POINTS

Staking points is the process of navigating to a point or an offset from a point.

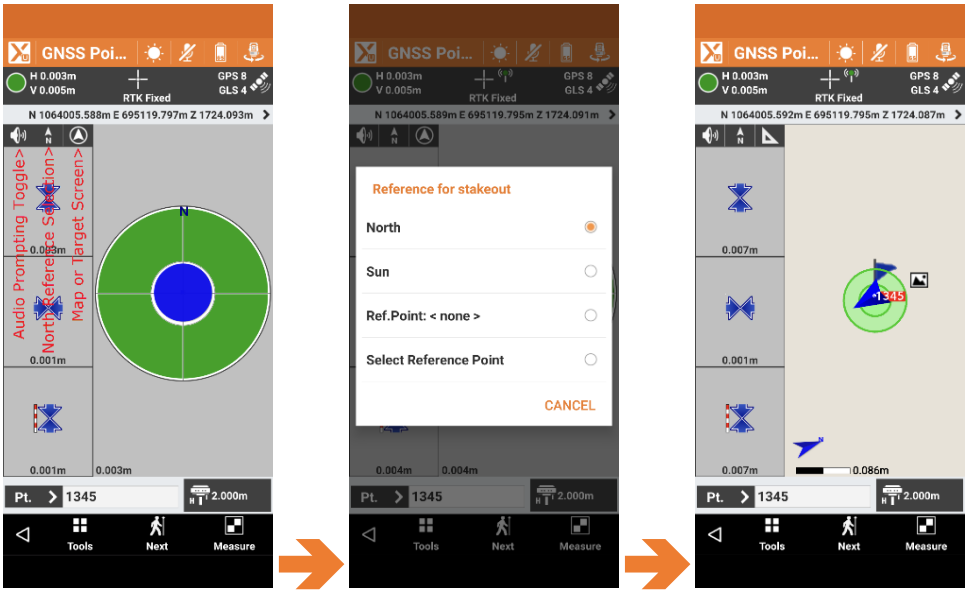
From the X-PAD main menu:



Click on the STAKEOUT tab, then POINTS, then Point from Table, finally choose a point to STAKEOUT.

Choosing Select point, Select mode: Define points list allows you to define an ordered list of points to stake, X-PAD will remember and display the points already staked and help you choose the nearest, un-staked point.

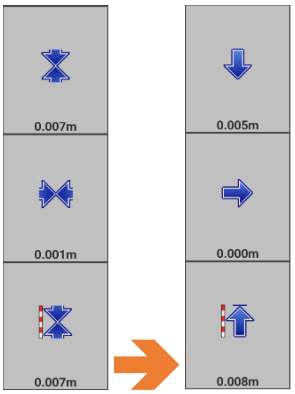
Stakeout Screen



If audio is enabled, X-PAD will prompt you with navigation instructions to lead you to the point.

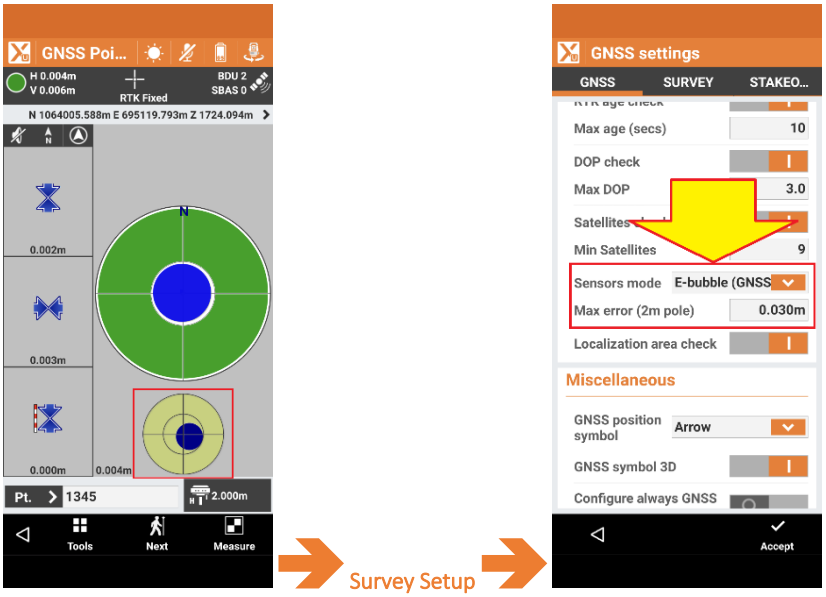
North Reference can be North Up, Sun Up or Reference Point up.

toggles to Map display; toggles to Target display.



Click on the side panel to toggle between visualization modes.

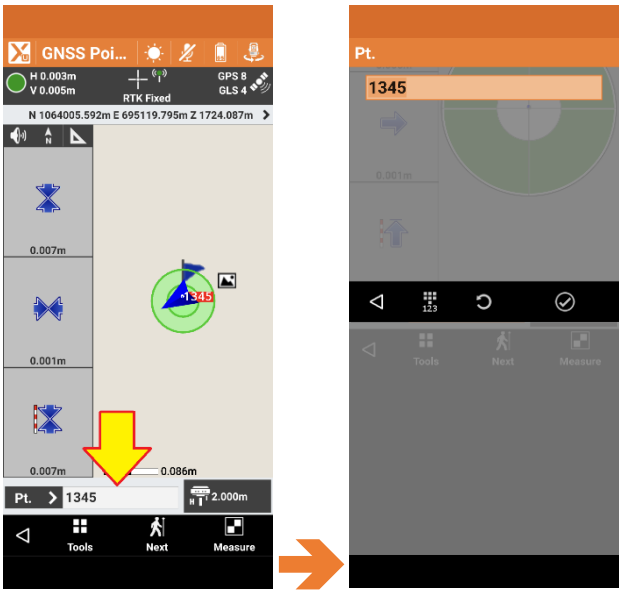
E-Bubble or IMU Tilt Compensation



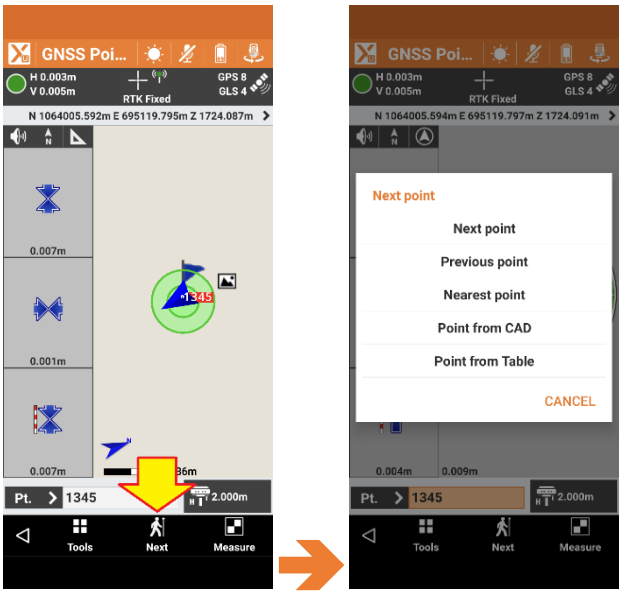
If your receiver has an E-Bubble or IMU Tilt Compensation you can enable the E-Bubble display or compensation by clicking on Next then Survey setup, selecting E-Bubble (GNSS receiver) or Tilted Pole (GNSS receiver).

Point Selection

Click on the Pt. > button to choose a new stake point from the current list.

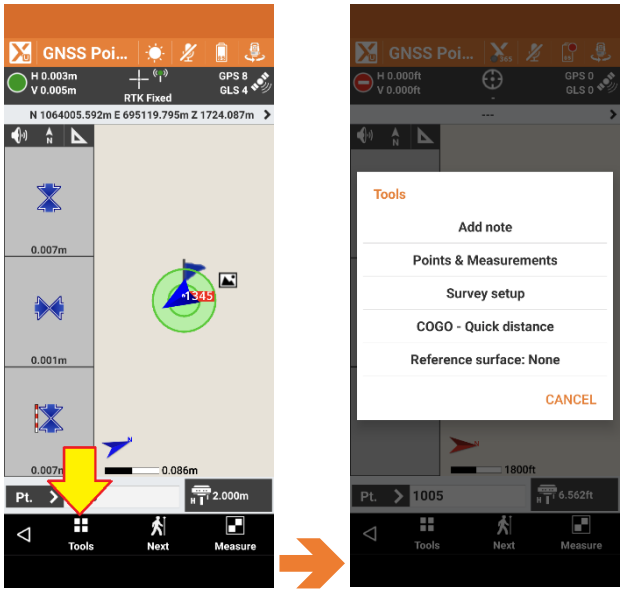


Click on the current point Name to directly enter a new Name to stake.



Click on the Next button to choose the Next, Previous, Nearest points or choose from CAD or the complete Table list.

Stakeout Tools (button)

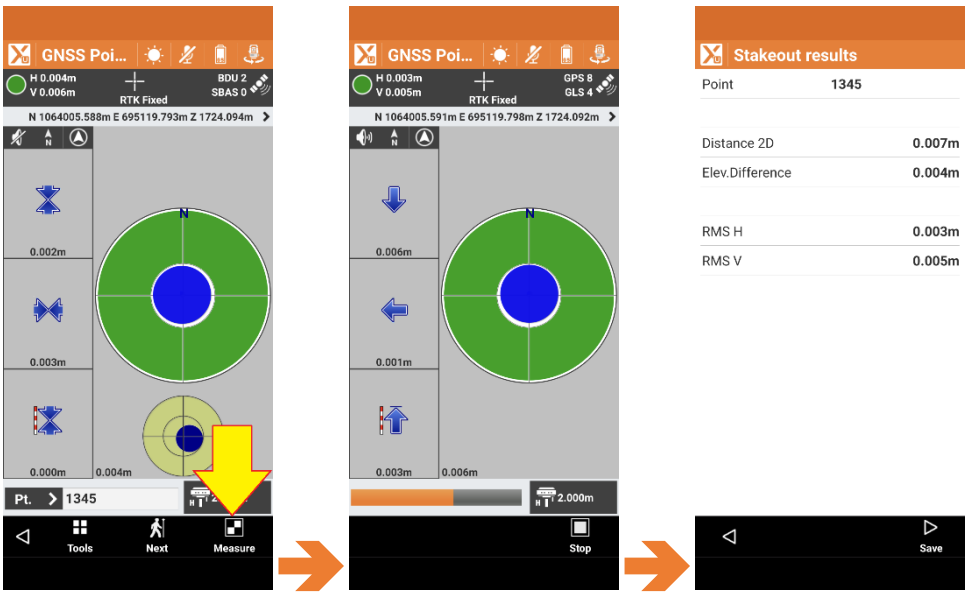


Click on Tools to:

- add a note to the survey record
- display the Points & Measurements list
- go to the Survey setup
- go to COGO-Quick distance to inverse between points
- add a Reference surface

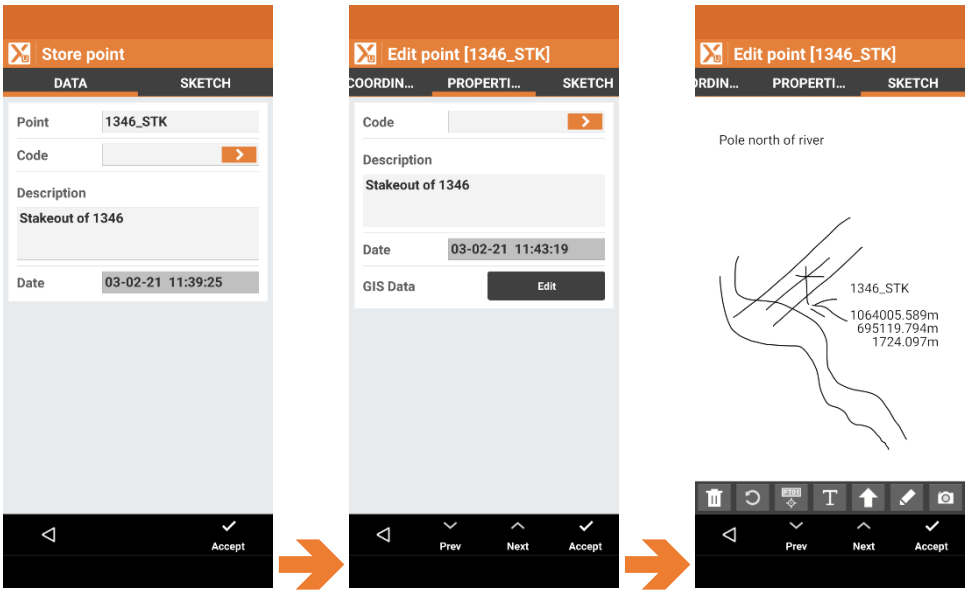
If you add a reference surface X-PAD will continuously display the elevation difference between the rod point and the design surface.

Measure



Clicking Measure begins measuring the staked point, then Stakeout results are shown with the option to Save the result.

Clicking on Save advances to the Store point dialog set:



Zoom 90 / 95 Robotic Total Station

Congratulations on the purchase of your new Robotic Total Station and t*hank you very much for purchasing your GeoMax robot and X-PAD field software from iGage!*

We know that your new robot will provide you with years of dependable service and we hope this Getting Started Guide we want to help you put it into service quickly.

X-Pad is the best Zoom 95 field software

Because X-Pad is developed by the robot manufacturer (Hexagon), X-PAD has the best Zoom 95 support of any field software tools.

While X-PAD has an amazing set of functions and options and might appear to be overwhelming at first, it is actually an easy tool to use with a Zoom 95 robot. Budget a few uninterrupted hours to work through the *First Job* section of this user manual.

The beginning of this guide includes detailed information on installing, configuring and using X-PAD. The following sections include basic guides for getting started with your robot using X-Pad.

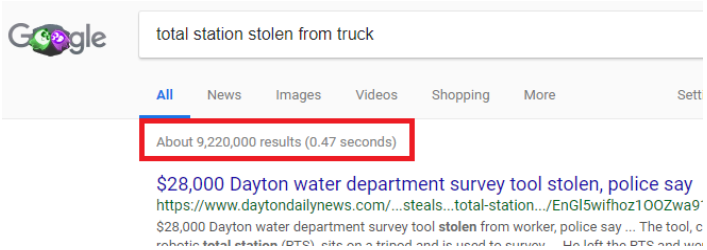
There is a very detailed X-PAD User Manual available that will help with more complicated tasks and there is a stand-alone Zoom 95 hardware User Manual.

Robot handling rules

First off, because Robotic Total Stations are so expensive, they deserve special handling and rules-of-use.

Let's cover some important suggestions for robotic total stations:

1. Robotic total stations have over one-million small mechanical, fragile parts in them. Robots are CRAZY expensive. Treat your robot like the very expensive, very fragile device that it is.
2. Do not leave your robot in the truck if it is hot or cold. Never put a wet or damp robot in the case for more than long enough to get back to the shop to warm it up and dry it out.
3. Use only top-quality tripods with dual-clamps:
   Both the TriMax 90553 (~$323) and the GeoMax 8248660 (~$175) tripods are reasonable
   Clean the sliding parts of the tripod. Adjust the top leg clamps and the lever clamp. Always lock both the Lever and the Screw clamps. Set the legs far enough apart to keep the instrument from blowing over. If it is windy, wire the tripod down. Remember that if the tripod blows over, it will cost you $15,000 + to replace the gun. Toppled robots are 'Never the Same.' Ever.
4. **Always keep one hand on the handle if the robot is not secured to a tripod or in the case**. As you loosen the tribrach nut, you must have the robot held in your other hand. If you loosen the nut, you must immediately put the robot in the case. The only place that a robot can be is on a secure tripod with the nut tightened, in your hand moving between the Tripod and case, or in the case.
5. **Never move an uncased robot**. If you need to traverse a robot, most companies require you to remove the robot from the tripod, put it in a latched case, move the case and tripod and then remount. Again, most companies will not allow you to move a robot mounted on a tripod because it endangers the robot and doing so may be cause for termination.
6. Always secure your robot, in the case, in your truck. Never place a robot case or robot on the tailgate or in the bed of a pickup. (I like to seat-belt the case in the center of my back seat.) Always lock your truck if it contains a robot:



Google says over **9 million robotic total stations have been stolen** out of vehicles!

7. Try to set the robot in a **safe place** on every site:
   a. away from frontages where a van can drive up and quickly steal the robot.
   b. away from vehicle traffic, especially places where vehicles are likely to back into the robot.
   c. away from heavy equipment paths.
8. If you drop or tip a robot onto the ground, the robot will NEVER-EVER be the same. **Ever**. The robot is essentially **bricked**. This - Damage - is - Never - Covered - by - Warranty.
9. Always keep your robot **insured** by 'Named Equipment Insurance' (sometimes called 'Inland Marine'). This will cover loss and damaged if the robot is stolen from your truck, from a job, from a hotel room or inadvertently damaged. The cost of this insurance is typically about 3% of the replacement cost when bundled with a business policy. If you cannot afford to replace your robot and pay cash, you cannot afford to not have insurance!
10. Every time you lift the robot by the top handle, make sure the handle is not partially released:

11. All Total Stations (Robotic or Manual) should be field calibrated if they are moved a significant distance, encounter rough handling or a large change is enviroment. Field calibration is described on page 47 of the GeoMax Zoom 95 User Manual and repeated in the Common Issues FAQ section of this guide.

Your first X-Pad robotic job: step-by-step

First use the instructions at the beginning of this guide to install, localize and configure X-PAD.

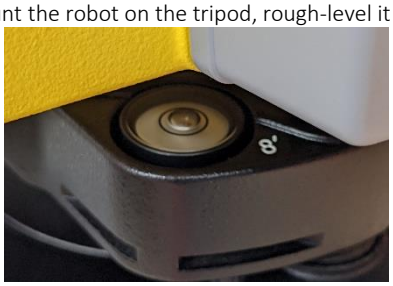
For our first job, let's assume that our robot is sitting on a hub, at a known State Plane coordinate location at our job:

3490820.322 N 2280573.301 E 5673.72 ortho

There are no other known points on our job however we have set a backsight at a random distance from the robot on a point with the same easting as the hub (so the backsight is North of the setup) and we want to set the azimuth circle to 0 on that backsight point.

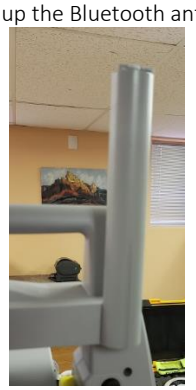
1. Setup a good tripod (use a Tri-Max or Heavy-Duty GeoMax.) Robots shake a lot and you will have horrible repeatability if you use an inexpensive, poorly adjusted or loose footed tripod.
   Make sure the leg slides are clean and the pivot bearings at the head are adjusted tight and solid.
   Make sure the foot-points are fully screwed in.
   Make sure the feet are tightened on the legs.
   Make sure the lever locks and the screw locks are firmly set.
   Make sure the tripod nut that holds the robot tribrach to the tripod head is really-tight.

2. Mount the robot on the tripod, rough-level it using the 8’ bubble on the tribrach:



3. Level the robot using the 6’ bubble on the instrument:

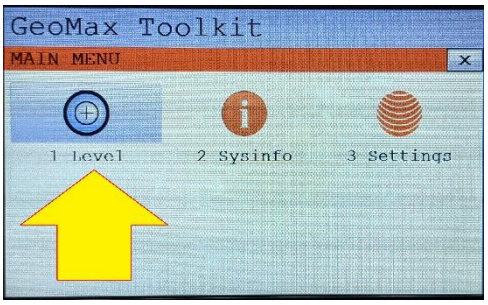
4. Flip up the Bluetooth antenna on the Long-Range Bluetooth handle:



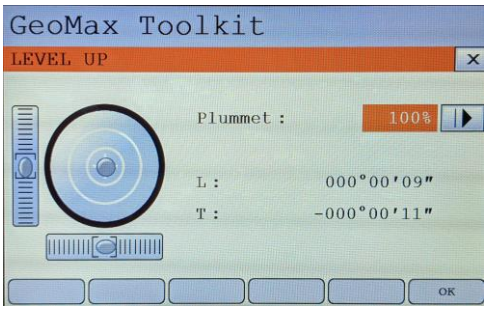
Check to make sure that the antenna is not partially pulled out from the handle. If it is pulled out, push/snap it back into place. The radio range will be reduced if the antenna is not firmly connected.

5. Put a fresh battery in the Zoom 90. Turn on the robot by pressing and holding the ON/OFF key for 5-seconds. Wait for the robot to boot.

6. From the GeoMax Toolket main menu:

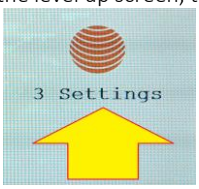


Click on the ‘Level’ icon or press the ‘1’ button:



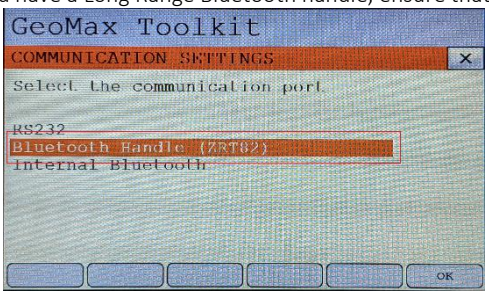
The laser plummet will turn on, slide the tribrach on the tripood head to center the robot over the Ground Mark (GM). You can decrease the laser intensity to reduce the spot size as small as possible while bright enough that you can still see it's location on the Ground Mark (GM).
Slide the robot to center the laser plummet over the GM, check the level again and tighten the instrument nut.
Finally, use the electronic bubble to 'fine' level the instrument.

7. Exit the level up screen, then click on 'Settings':

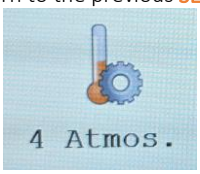


8. Click on 'Comm':

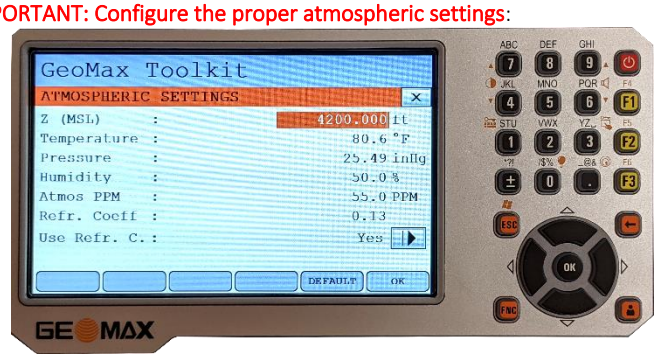
9. If you have a Long Range Bluetooth handle, ensure that the 'Bluetooth Handle (ZRT82)' is selected:



10. Return to the previous SETTINGS menu, click on '4. Atmos.'



11. IMPORTANT: Configure the proper atmospheric settings:



The elevation, temperature, pressure, and humidity are used to compute an 'Atmospheric PPM'.
You can either enter the:

Elevation, Temperature and Humidity

Or you can enter the:

Temperature, Pressure, and Humidity

Pressure is entered as a 'Station Pressure' or 'Absolute Pressure' not the 'Sea Level Pressure'. (See the 'Common Issues' document for a detailed discussion of pressure and the 'Atmospheric Settings' inputs.)

The Elevation and Pressure are interdependent. If you enter the Elevation, then the corresponding pressure will be computed. If you enter the Station Pressure, then the equivalent elevation (for the current conditions) will be computed.

It is usually easiest to enter:

Elevation, Temperature and Humidity

How important are these settings? Let's consider the common setting errors:
Elevation: Operator leaves Elevation set to 0, but at 4,200 ft. A 4,200-foot elevation error results in a 0.32' error per mile.
Temperature: Robot is set to 54 degrees; actual temperature is 94 degrees: 0.10' error per mile.
Pressure: Gun is set to 30.5 InHg, actual is 25.5 InHg: 0.23' error per mile.
Humidity: Gun is set to 30%, actual humidity is 5%: 0.003' error per mile.

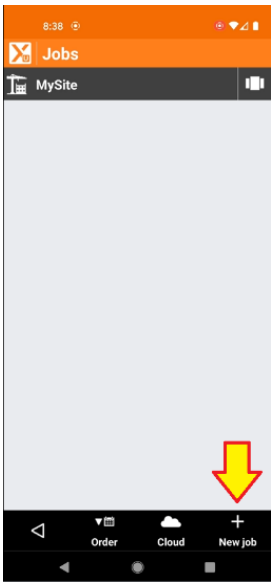
Conclusion: get the Temperature, Pressure or Elevation close. Adjust Temperature during the day. Don't worry much about the Humidity.

Finally click OK to store your settings and return to the main menu.

12. Measure-up and record the Instrument Height from the Ground Mark to the robot fiduciary mark:

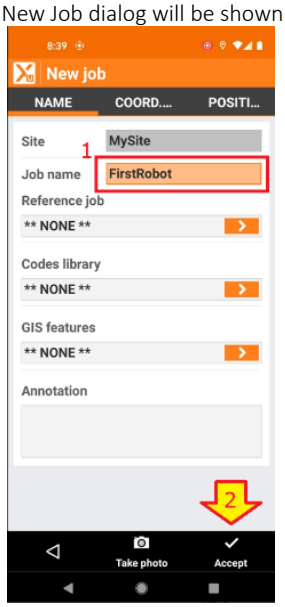
Start the survey

1. Start X-Pad:



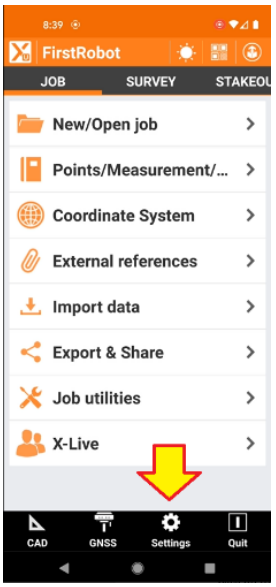
Click on New Job to make a new empty job.

2. The New Job dialog will be shown:



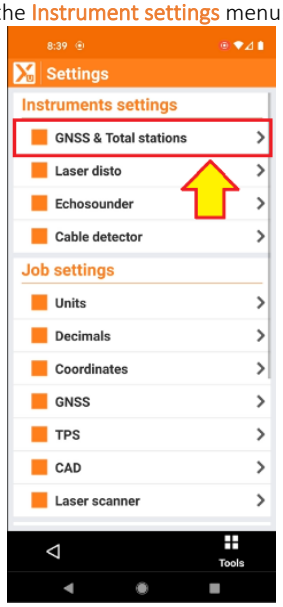
Enter a reasonable Job name then click on Accept.

3. From the main menu:



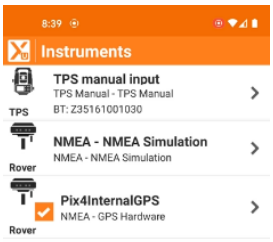
Click on the Settings button at the menu bottom.

4. On the Instrument settings menu:



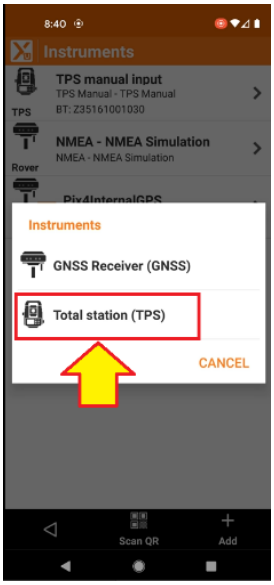
Click on GNSS & Total stations.

5. On the Instrument list screen:



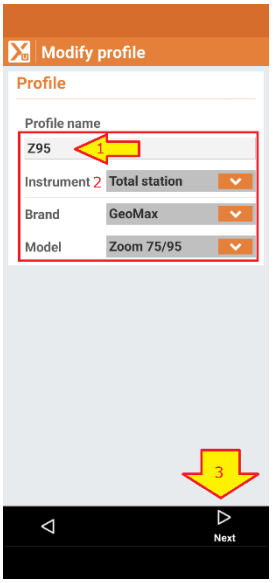
Click on the + Add button to add a new instrument.

6. The add Instruments menu is shown:



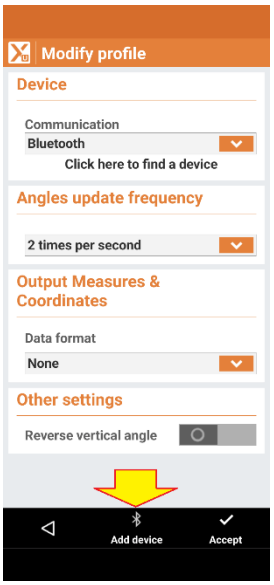
Click on Total stations (TPS).

7. On the New Profile: Profile menu:



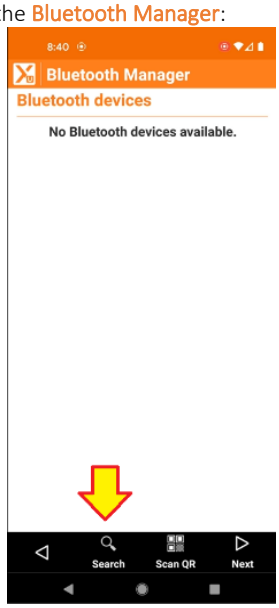
Enter a reasonable Profile name, select Brand = GeoMax, Model = Zoom 75/95 or Zoom 70/90 depending on your robot model.
Finally click on Next.

8. On the Device menu:



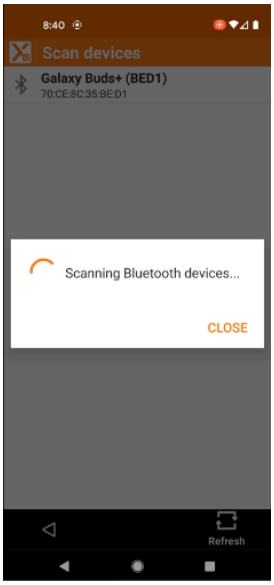
Make sure Communication is set to Bluetooth, then click on Add device.

9. On the Bluetooth Manager:



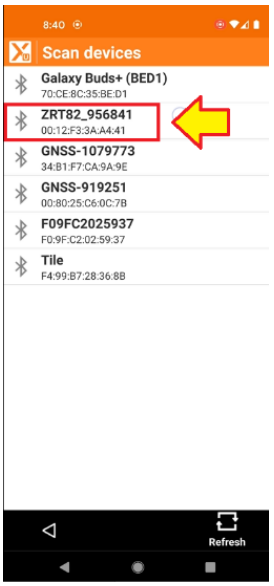
Click on the Search button.

10. X-Pad will search for all available devices:



Wait for the search to complete.

11. On the Scan Devices menu:

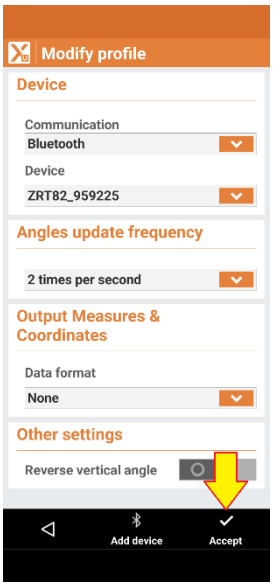


Click on the robot. If you have a Long-Range Bluetooth handle the name should begin with 'ZRTxxx'. If you are using the Robot's internal Bluetooth the name will include the serial number of the robot.

12. On the Bluetooth Manager:

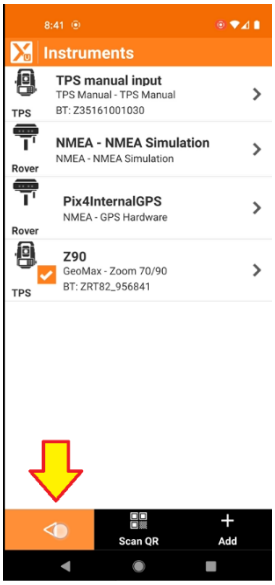
Click on Next.

13. Back on the Device menu:



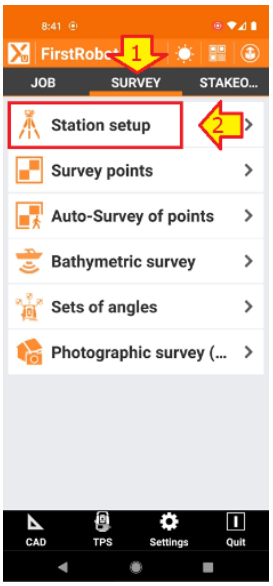
Verify the Device is correct.
Click on Accept to complete the robot setup.

14. On the Instruments list:



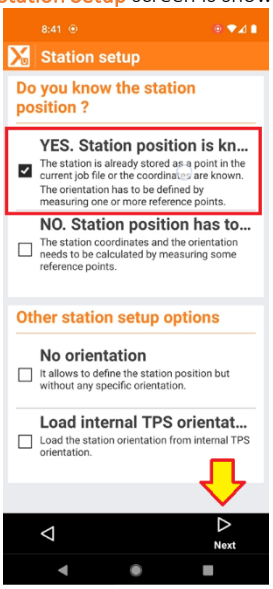
The robot profile will be the current profile.
Click on the Back button.

15. On the main menu:



Click on the Survey tab, then click on Station Setup.

16. The Station Setup screen is shown:

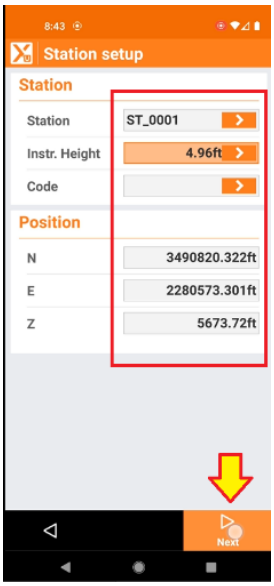


Since we know the coordinates for the robot position, click on YES. Station position is known.
Then click on Next.

17. The Orientation menu is shown:

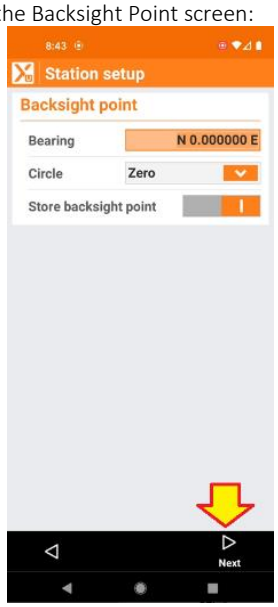
We don't know the coordinates for the backsight, however we do know that the azimuth is North, so click on Backsight by azimuth.
Then click on Next.

18. On the Station screen:



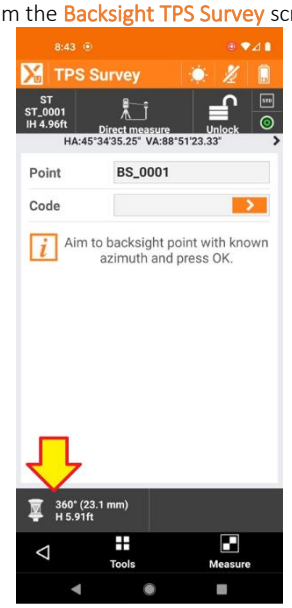
Enter a Station number/name, if the station is already in the job, you can recall it with the > button.
Enter the Instrument Height, measured from the ground mark to the height dot on the side of the robot.
Optionally enter a Code, either by typing or use the > to pull from the code list.
Enter the Northing, Easting and Z-Height (Ground Mark Height).
Finally click on Next.

19. On the Backsight Point screen:



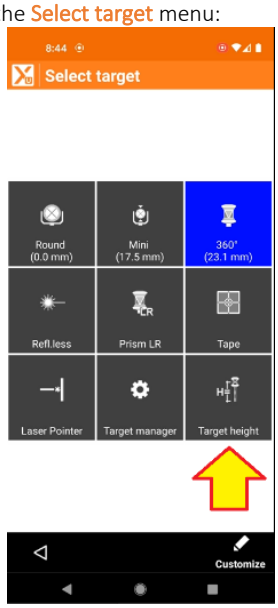
Set the Bearing to 0.
Choose to Zero the azimuth circle.
Store the backsight point.
Finally click on Next.

20. We now need to shoot the backsight.
Put the prism pole on the backsight point.
From the Backsight TPS Survey screen:



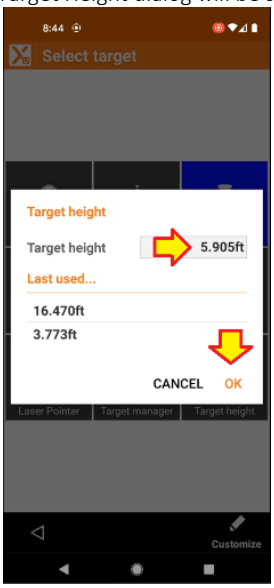
Make sure the correct prism and prism pole height are selected: if the prism height or type is incorrect, click the prism button.

21. On the Select target menu:



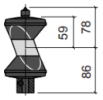
Click on the Target Height button to modify the prism height.

The Target Height dialog will be shown:



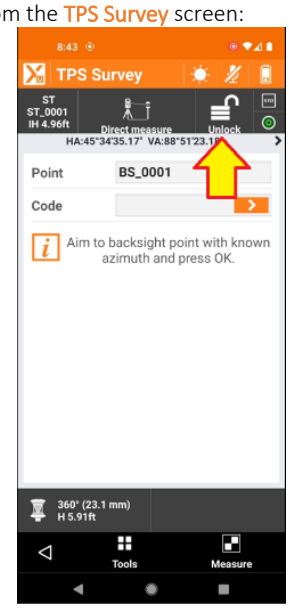
You can click on one of the Last used… heights or enter a new height.

Depending on your prism pole you may need to compute the height to the prism center. Remember the vertical center of the ZPR1 360 prism is 86 mm (0.2822') above the bottom of the prism:

360° prism GRZ4 ZPR1	GeoMax / Leica +23.1 Absolute - 11.3	
360° prism GRZ122	+23.1	

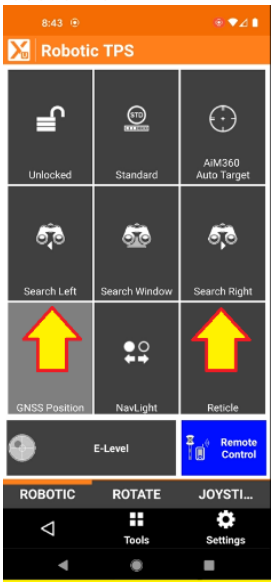
Once the height is correct, click OK.

22. From the TPS Survey screen:



Click on the Unlocked button.

23. The Robotic TPS screens is shown:

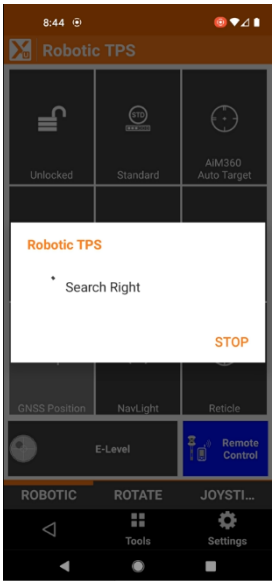


Click Search Left or Search Right to power search for the prism.

Note: if you are standing at the prism looking at

the robot the robot will turn the selected direction. If you are behind the robot looking towards the prism the directions will appear to be backwards.

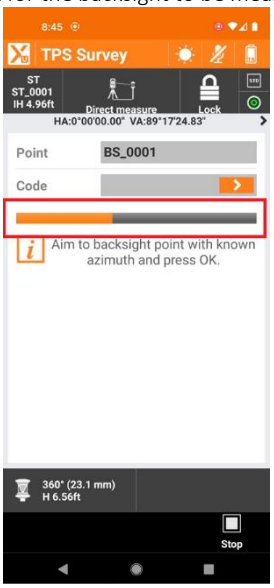
24. Wait for the robot to search and find the prism:



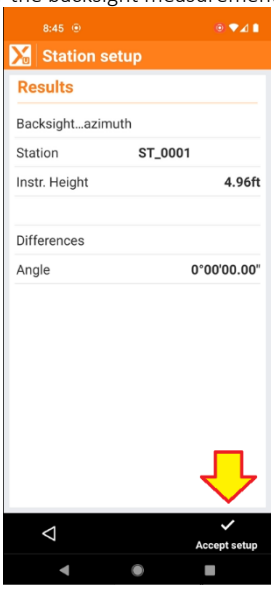
25. Once the robot locks:

1) the Lock symbol is displayed indicating prism is acquired.
2) Check the Instrument Height (IH).
3) Verify the correct prism and prism height H are entered.
4) Click Measure to fire the laser and measure the backsight.

26. Wait for the backsight to be measured:

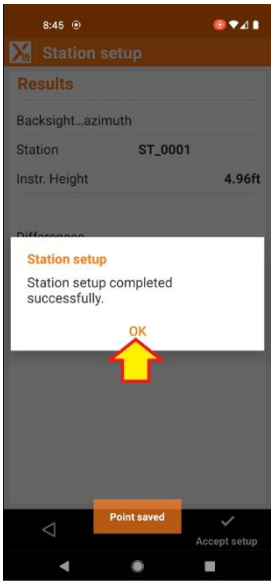


27. After the backsight measurement completes:



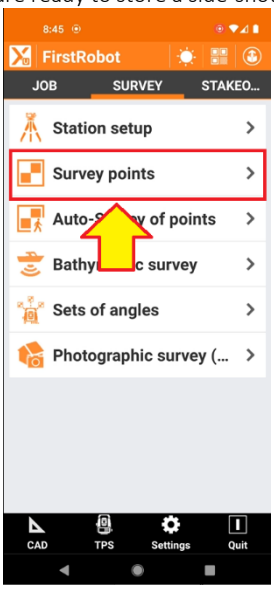
Verify that the station setup looks reasonable. Then click Accept setup to continue.

28. X-PAD will confirm the station setup:



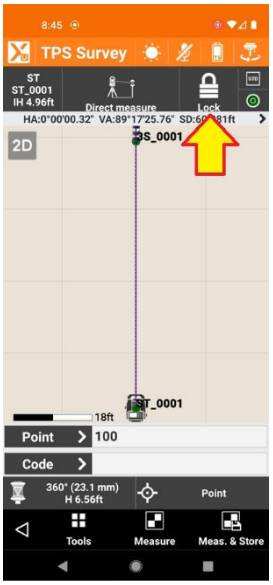
Click OK to continue.

29. We are ready to store a side-shot now.



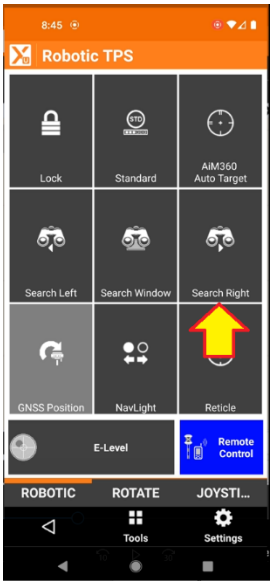
From the main SURVEY menu, click on Survey points.

30. If you need to motor to a different prism then



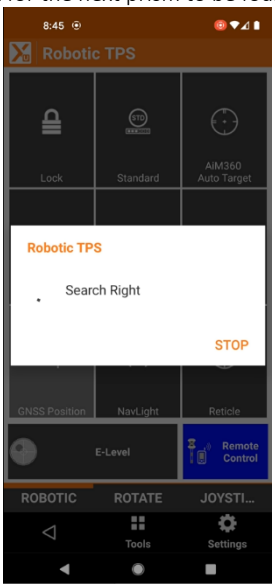
Click on the Lock button.

31. From the Robotic TPS screen:

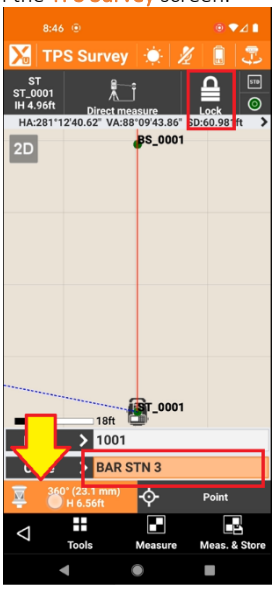


Click on the Search Right button.

32. Wait for the next prism to be found:

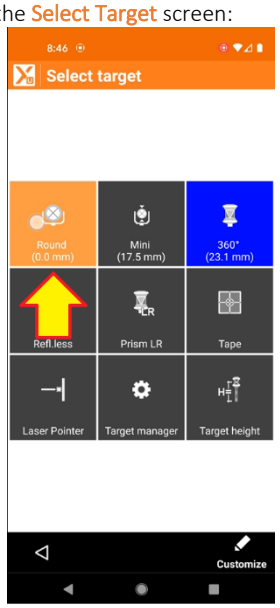


33. From the TPS Survey screen:



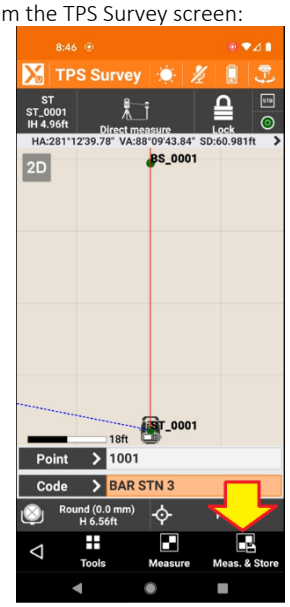
Verify that the robot is locked on the new target.
Verify the Point number is acceptable.
Enter an appropriate Code.
Verify that the correct prism type is selected. If not, click on the prism button to change the prism.

34. On the Select Target screen:



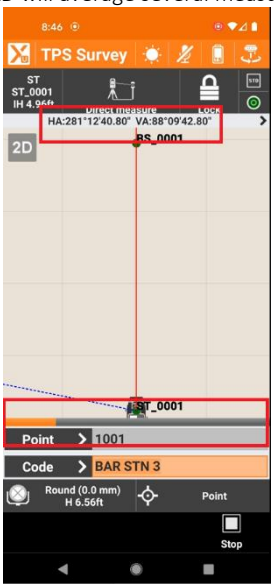
Click on the correct prism type. If the prism offset is confusing, read the FAQ in Common Questions: Prism Offsets.

35. From the TPS Survey screen:



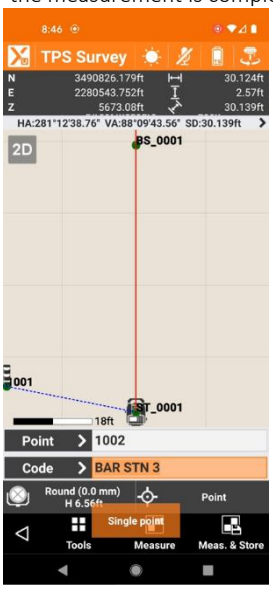
Click on the Meas & Store button to fire the laser.

36. X-PAD will average several measurements:



Wait for the shots to complete.

37. After the measurement is complete:



The horizontal angle, vertical angle and slope distance will be displayed at the top of the screen.

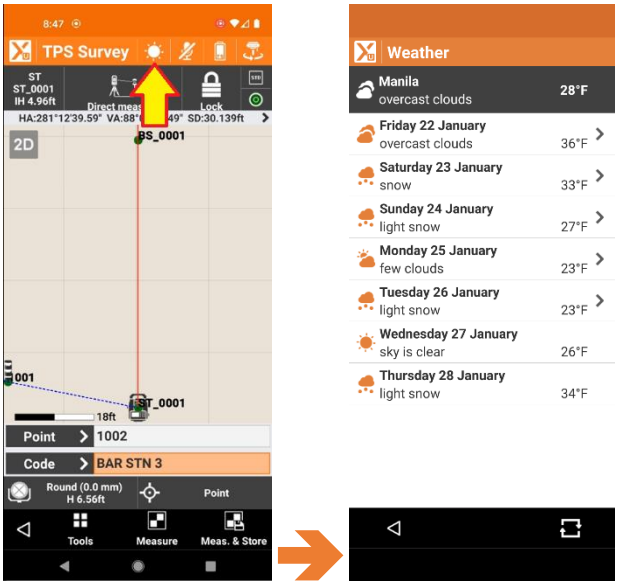
38. Additional measurements may be taken as needed.

Elements of the TPS survey screen

You can access most of the robot and X-PAD features directly from the TPS Survey screen.

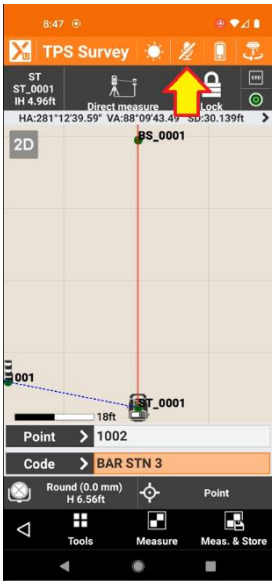
Here is a quick listing of actions.

Current weather



Displays current and forecasted weather.

X-PAD voice commands



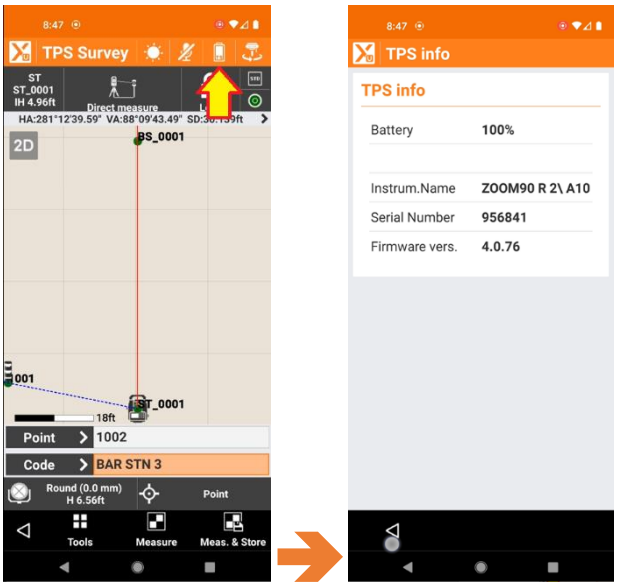
Say OK XPAD to give verbal commands to X-PAD:

SURVEY: Store, Measure, Line, Arc, Stop, Code, XPole

STAKEOUT: Next
TPS/RTS: Prism, NoPrism (reflectorless), Tape, Lock, UnLock, Switch Target, Bubble, Target Height
GNSS/GPS: GNSS Status, Pole Height

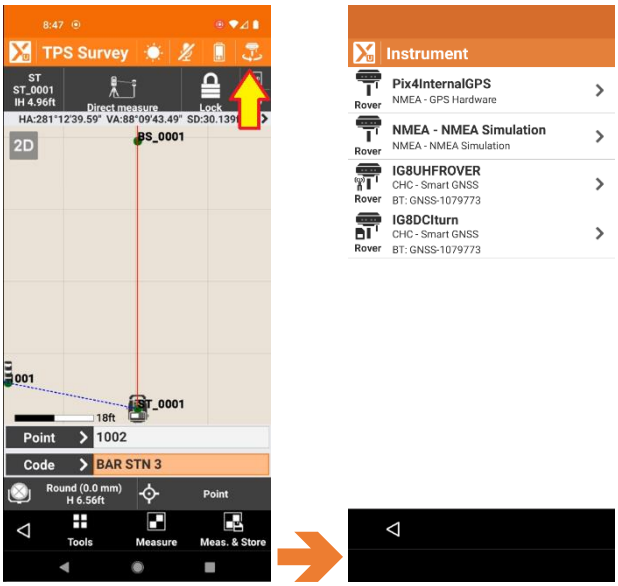
You can have multiple verbal commands for one action. See Settings: Voice commands to configure.

Robot battery status



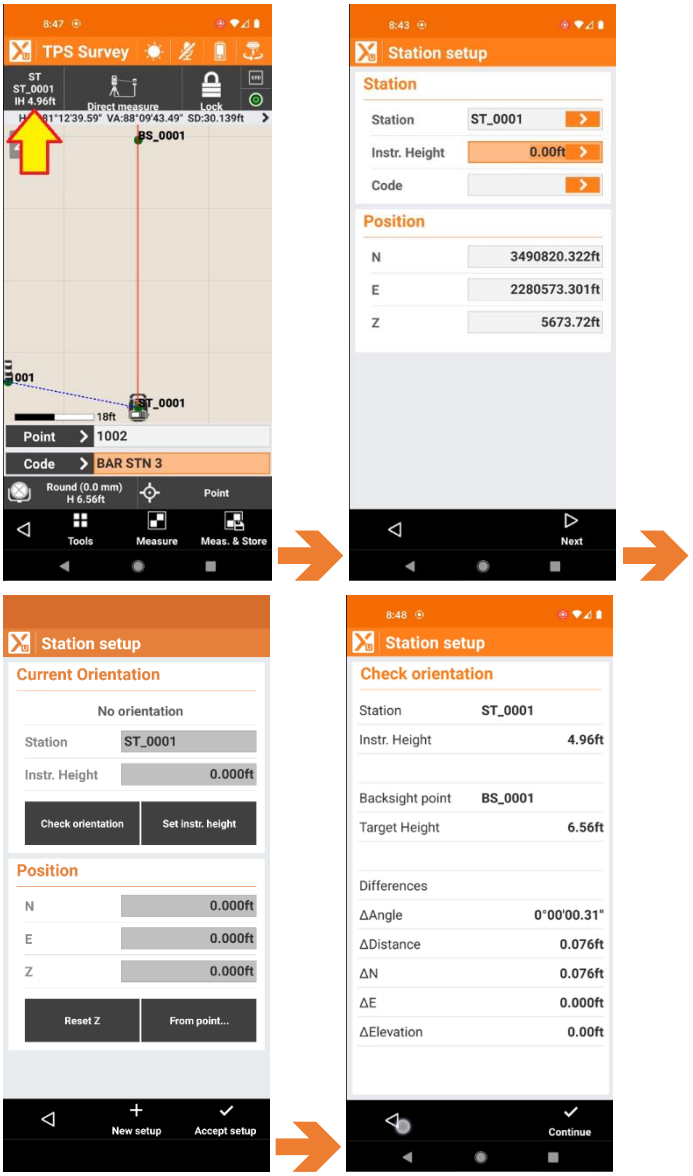
Displays the Battery status of the robot, with the Name, Serial Number and Firmware version.

Switch instruments



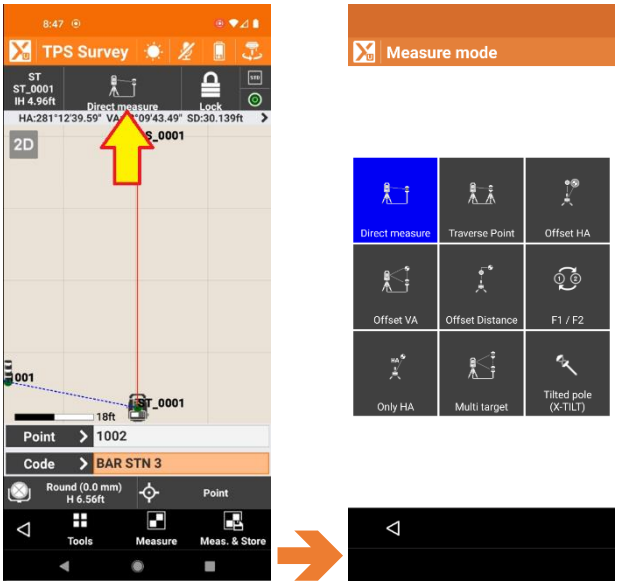
Allows you to quickly switch to another instrument (for example to store a GPS point to setup on.)

Station setup



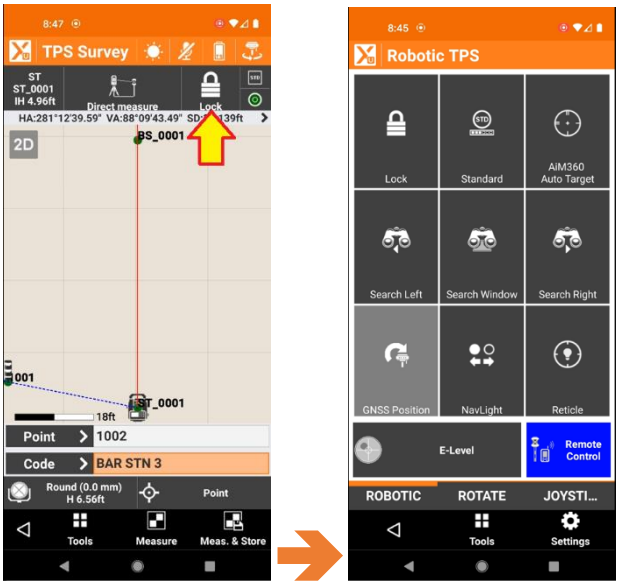
Use Station Setup to move to a new station, click Next and then Check orientation to check your backsight.

Measure mode



Select between Direct Measure, Traverse Point, Offset Horizontal, Offset Vertical, Offset Distance, Exchange instrument face F1-F2, Only measure Horizontal Angle, Multi-Target (two prisms on one pole) and Tilted pole (uses the inclinometer in the Android data collector.)

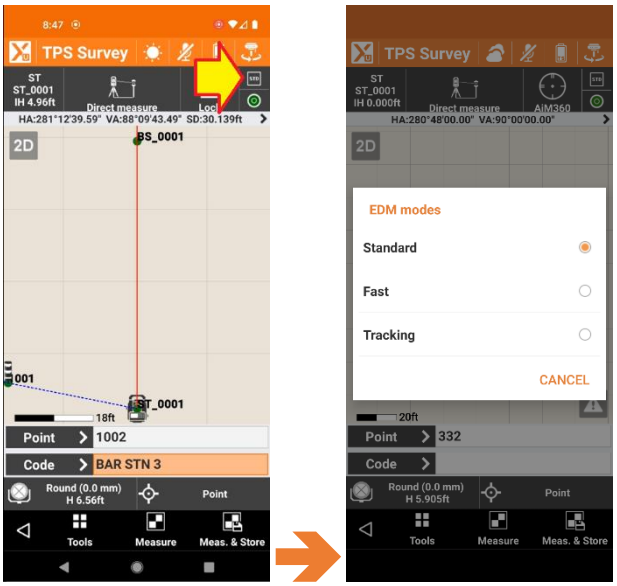
Robotic TPS



Lock/UnLock: Start and stop tracking. If not locked, will do a prism search.
EDM mode: Standard, Fast, Tracking
AiM360: AutoTarget automatically selects collimation mode by environment: normal, low visibility, high-reflectivity
Search: Left, Window, Right, by GNSS Position (uses GPS in Android device)
NavLights: Toggles the Nav lights on and off to assist with stakeout

There is a ROTATE tab and JOYSTICK tab at the bottom which have additional robot control functions.

Prism mode



Switches between Standard, Fast and Tracking EDM modes.

You should use Fast or Tracking for handheld prism shots closer than 30 feet. Standard should be fine for most other measurements.

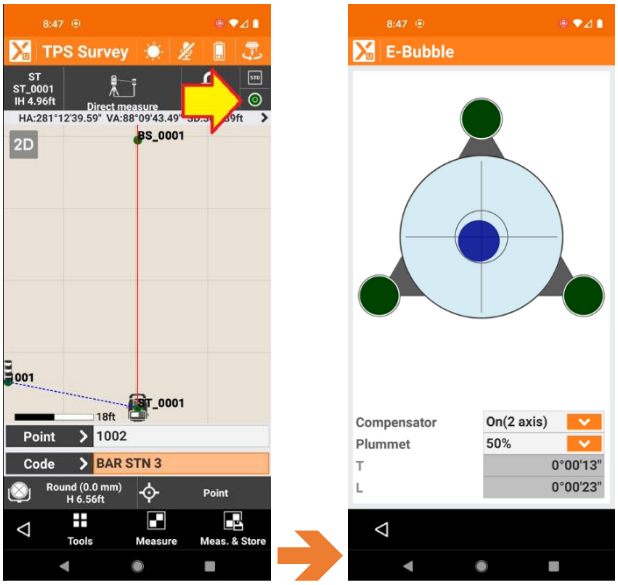
STANDARD: The robot stops tracking, then takes several angle and distance measurements computes an average and then begins tracking again.

FAST: When you press the Measure and store button, the robot takes a single reading of the angles and distance, XPAD calculates the coordinates

TRACKING: the instrument continuously read the angle and the distance. The angles are taking with a higher rate than the distance so the coordinate is estimated between distance readings.

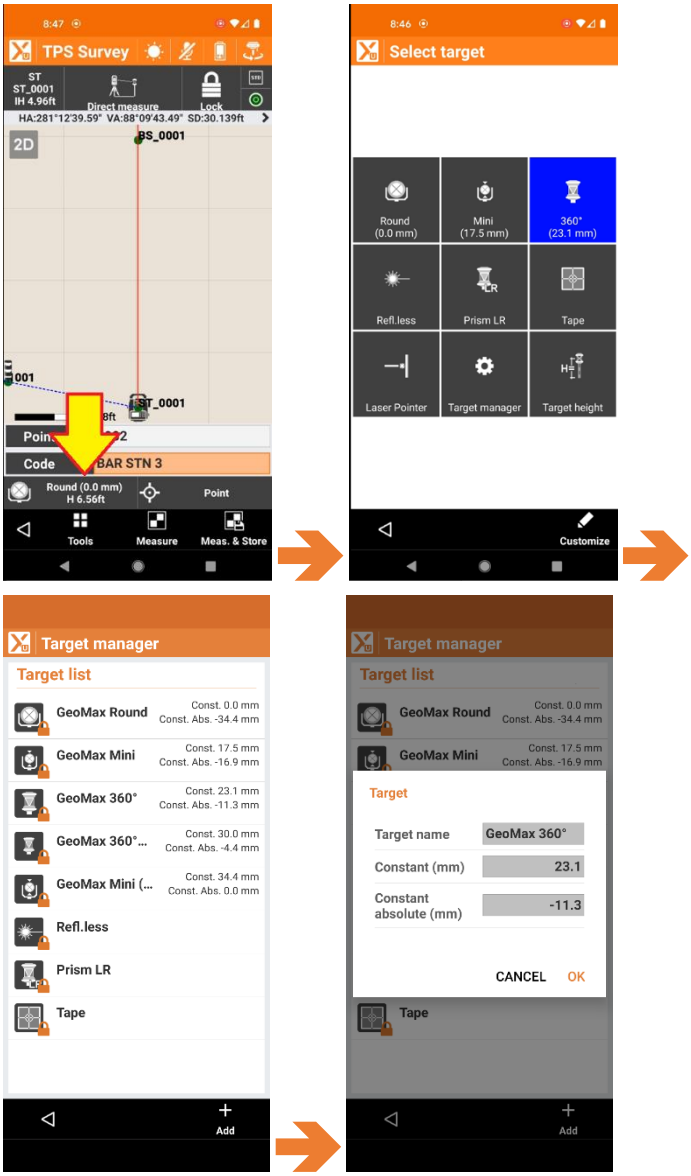
If the prism is moving, the distance may be incorrect and the computed distance may be incorrect. If the prism is stable and not moving, the coordinate will be correct since the distance matches the current prism position

E-bubble check



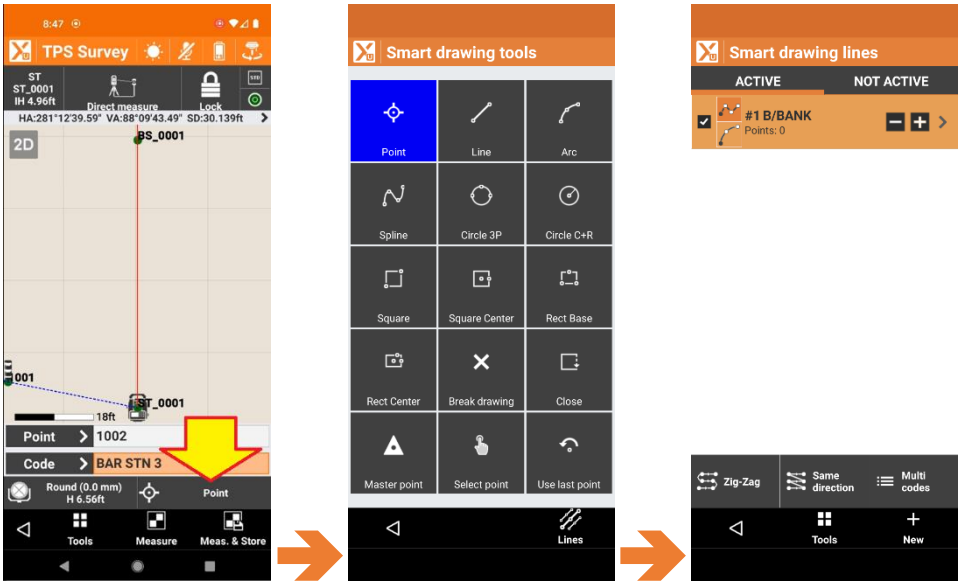
Check the E-Bubble, enables the Plummet laser and control the Compensator.

Prism selection, prism height, target manager



Select target, toggle to Reflectorless measurement, Long Range Prism (for taking very long-distance shots), Tape for reflective tape measurement, toggle the Laser Pointer, access the Target Manager, set the Target Height.

Smart drawing tools



Smart drawing tools choose the measurement type and control line drawing in the field as measurements are taken. You can connect shots with straight Lines; Arcs; Splines; build Circles from 3-points on the circumference or the Center; set Squares and Rectangles.

Point is used for Topo or quick side-shots, Master point uses a longer average.

Continuous polygon and arc figures can be Closed to form shapes.

The /// Lines button launches the Smart drawing lines list that helps acquire multiple lines as you Zig-Zag or Z-Cross alignments.

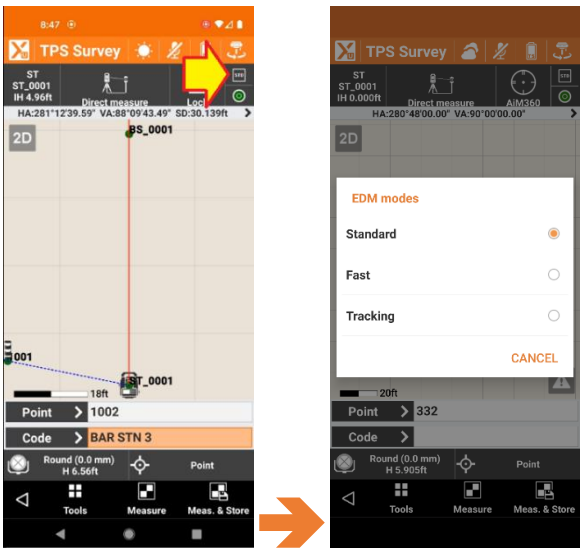
Common robot issues and questions

EDM mode

When the EDM mode is set to Standard, the robot stops tracking while a measurement is made and the EDM fires. If you are close to the robot, hand holding the prism, you may move the prism out of the robot's field of view while the measurement is performed.

You can either use a prism pole bipod to hold the prism steady or switch to Fast EDM mode.

In X-PAD on the TPS Survey or the TPS Stake screens:



Click the EDM Mode button (above the bubble button). Change the 'EDM Mode' to Fast if you are working at close range without a bi-pod.

The EDM Mode affects the EDM accuracy:

EDM measuring mode	std. dev. ISO 17123-4, standard prism	std. dev. ISO 17123-4, tape	Measurement time, typical [s]
Standard	1 mm + 1.5 ppm	3 mm + 2 ppm	2.4
Fast	2 mm + 1.5 ppm	3 mm + 2 ppm	0.8
Tracking	3 mm + 1.5 ppm	3 mm + 2 ppm	< 0.15

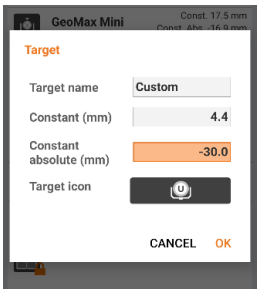
However, for hand-held shots the difference should be negligible.

The EDM should be enabled when staking

When staking, if Tracking is disabled X-PAD will 'Ding-Ding-Ding' when the prism is on-line regardless of the in-out distance. You should enable Tracking to fire the EDM to measure distance.

Leica (GeoMax) prism constants

X-PAD adheres to the Leica prism constant offset methodology and supports absolute constants simultaneously:



X-PAD Target manager

With X-PAD you can enter either the 'Leica' style offset (shown as Constant (mm)) or the Constant absolute (mm). X-Pad will compute the other value automatically.

If you enter an **absolute offset** X-PAD computes:

GeoMax/Leica Offset = **Absolute Offset** + 34.4 mm

If you enter the **GeoMax/Leica offset** then X-PAD computes the **absolute offset**:

Absolute Offset = **GeoMax/Leica Offset** + 34.4 mm

What is going on?

Prism offsets explained

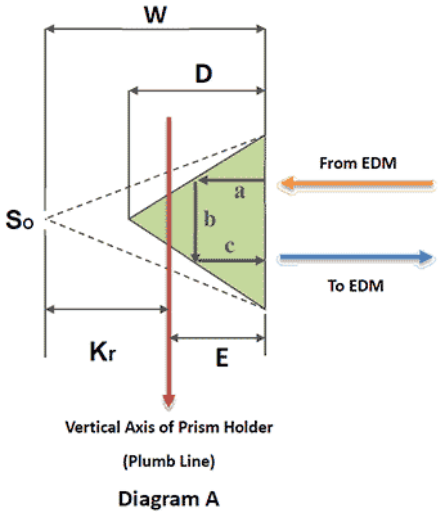


Diagram A

The distance that we want to measure is the distance from the instrument center (vertical axis) to the vertical axis (**Plumb Line**) of the prism holder. If the prism rod is held level, then the Plumb Line will align horizontally with the pole point at the Ground Mark. Thus we will measure the distance from the Ground Mark under the robot to the Ground Mark under the prism.

However, the path of the beam includes the distance the beam must travel through the prism (distance **a** + **b** + **c** above) and must be corrected for this "extra" distance and the change in the speed of light as the beam travels through glass instead of air.

Kr is the **absolute** offset (also known as the manufacturers offset) and most manufacturers print the **absolute** offset on the prism.

However, prism's manufactured by Leica Geosystems and 'some' GeoMax prisms use a prism offset that includes a 34.4 'standard' offset. The difference between a Leica prism quoted offset and all other prism offsets is the way the **Kr** value is handled. Leica's prism constant system is defined with reference to its standard prism sets (the GPH1 and GPR1) which have a **Kr** value equal to -34.4 mm.

The magnitude of the prism constant is determined by the distance between the vertical axis of the prism holder and target point (Diagram A) and the theoretical turning point (**So**) of the measuring beam, which is behind the glass.

If the vertical axis is situated right at the Plumb Line, then the absolute Prism Constant equals 0.

In some prisms, the vertical axis is always in front of the Plumb Line. The measured distance will then be too long and the corresponding prism constant (**Kr**), Diagram A) will be negative.

If the vertical axis runs through the center of the prism (commonly referred to as the nodal point), the prism distance won't change when tilted. Prism sets that follow these design principles are known as nodal prism sets.

Nikon Total Stations

Further complicating prism constants, some Nikon instruments have an implicit, un-entered minus sign in their onboard software. For these instruments, a -30 absolute prism (minus-thirty) is entered as '30' without the minus sign.

A Note of Caution

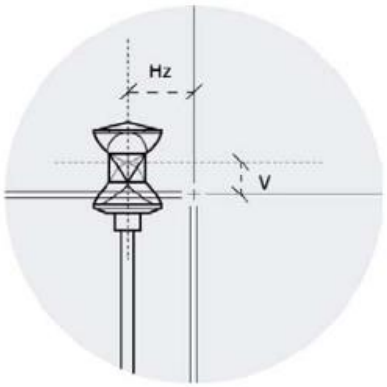
All Leica prisms have Leica constants on their labels.

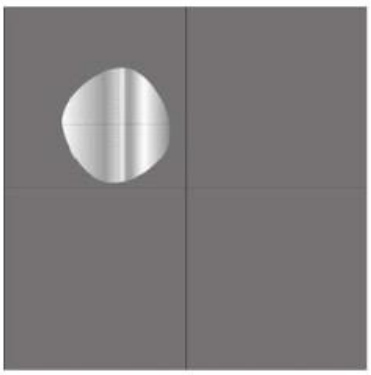
The GeoMax 360 prism has a Leica constant printed on the label. Some GeoMax branded prisms have Leica constants on their labels. Some GeoMax branded prisms have **both** Leica and absolute constants shown. Some GeoMax branded prisms have absolute printed on them. Be **very careful** with GeoMax branded prisms!

AiM

The GeoMax robots use 'AiM' technology to measure the prism position, adjust for prism tilt and prism skew without directly placing the robot crosshairs on the prism center. This method is MUCH more accurate than you could do by manually adjusting the crosshairs to center on prism glass so you should not try to out-smart AiM!

The robots have a high-resolution CCD (CMOS) array. A laser beam is transmitted through the telescope towards the prism and the reflected beam is visible on the CCD array. The computer uses the CCD image to compute the delta-Hz / delta-V of the prism center from the robot measurement center:



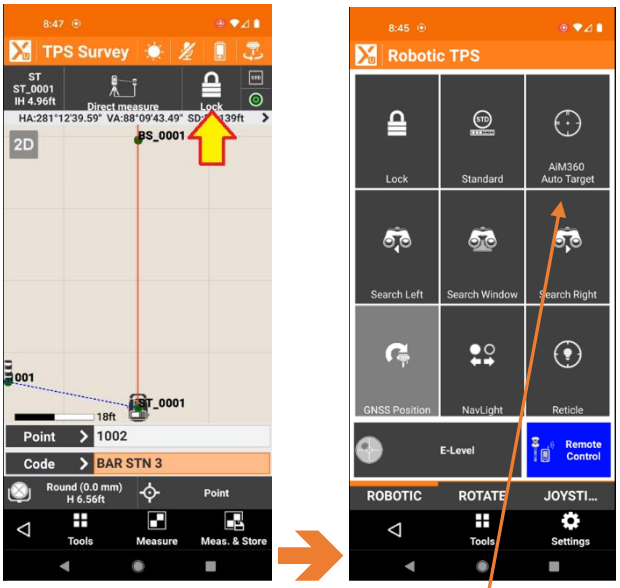


This saves positioning time, battery drive power, drive motor wear and results in a more accurate position than you can do by manual crosshair adjustment.

However, it also results in the crosshairs rarely aligning with the prism center when a robotic measurement is made. **Again, the robot will rarely align the prism with the telescope crosshairs** when targeting a prism closer than 1,000 meters. Do not be concerned, the **computed** prism center is within 1" (Hz and V).

AiM works to 3,280 feet.

AiM 360 auto target recognition



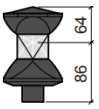
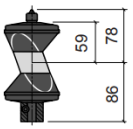
X-PAD: you can enable the Robot's AutoTarget mode.

The robot will automatically select the best collimation mode for the observed environment. This setting does not change the centering algorithm.

360 Prism (ZPR1) vertical height

The GeoMax ZPR1 prism is identical to the Leica GRZ4 prism.

The vertical center of the ZPR1 360 prism is 86 mm (0.2822') above the bottom of the prism:

360° prism GRZ4 ZPR1	GeoMax / Leica +23.1 Absolute - 11.3	
360° prism GRZ122	+23.1	

The lightweight GeoMax ZPC105 button-snap-lock pole is 1.965 m extended to the long position, 1.465 m extended to the bottom position. So, with the 360-prism:

1.965 m + 0.086 m = 2.051 m = 6.729 ' (nominally this would be 2.05 meters)

1.465 m + 0.086 m = 1.551 m = 5.089' (nominally this would be 1.55 meters)

The SECO 5501-11 pole includes a TLV adapter at the top which nominally allows the prism pole markings to direct read the prism center height.

Adjacent faces on ZPR1 360-Prism have a ~5mm vertical offset

There is a 0.005 meter (5 mm, 0.016 foot) vertical offset between adjacent prism faces on the ZPR1 360 prism.

If you are preforming an 'accurate' elevation survey, you should hold the prism so that a face with a 'Yellow Arrow' is always pointing back to the robot when you fire a shot.

If you are performing a 'very accurate' elevation survey, you should probably consider using a high-quality round prism instead of the 360-Prism:

765608	**ZPR100** Circular prism and holder (Constants - GeoMax 0.0; Absolute -34.4)	$288

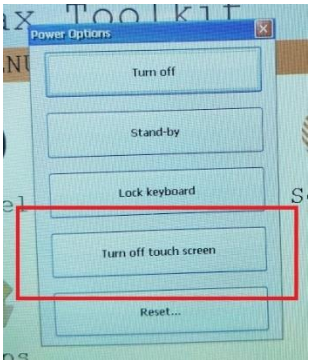
The GRZ122 High Accuracy 360 Prism:

754384	**GRZ122** High accuracy 360° Prism with 5/8" screw for GNSS antenna (Constants - GeoMax +23.1; Absolute -11.3)	$1,700

does not have this limitation, the GRZ122 is substantially more expensive than the ZPR1 360-Prism.

Zoom 90: Locking and unlocking the Touchscreen

Zoom 90 Only: You can lock and unlock the touchscreen. Usually, it is locked accidentally. To unlock, press and hold the ON/OFF button for 2 seconds:



The next-to-bottom button toggles the touchscreen on and off.

Display Backlight Warning

Do NOT set the display backlight to the lowest setting (which is off or nearly off). It is very difficult to reset the backlight to turn it on. (You must manually edit the device registry via a cable connected tool!)

So DO NOT turn off the backlight! Don't worry about saving power.

Long Distance Measurement Errors

We are often confronted with measurement error questions along the line of:

> *"I setup on a known benchmark and shoot the elevation of a remote benchmark 2,600 feet distant. The remote elevation is in error by around 7 hundredths of a foot!"*

Of course, if you are making a long measurement you want to make sure that:

The compensator is enabled

Instrument level is nearly perfect

The EDM mode is Standard

The pole bubble is adjusted correctly and a bi-pod is used to steady the pole

The elevation is nearly correct

The absolute pressure is correctly entered

Refraction Coefficient is enabled

However, the most important consideration is at 2,500 feet with a 5-second gun the estimated error is:

sin(5 / 3600) * 2500 feet = 0.061 feet

Because of the way the 5" and 2" guns are manufactured, it is statistically probable that a robot will NOT exceed its nameplate accuracy.

So, you should expect the robot to be as accurate as the nameplate and not much better. The expected error of a 5-second accuracy robot 0.06' is very close to 0.07'.

Do a Field Calibration at the first sign of trouble

In addition to the **factory recommended** situations where a field calibration is warranted:

- Before the first use
- Before every high precision survey
- After rough or long transportation
- After long working periods
- After long storage periods
- If the temperature difference between current environment and the temperature at the last calibration is more than 20°C (68°F)

If your robot is having a difficult time **Power-Searching** (it turns to prism, then can't find the prism when looking up and down and fails to lock), or your **robot won't shoot a prism even when locked** or **ANY OTHER pointing or measuring anomaly** then you should do a field calibration. Actually, you should do the field calibration twice: once to figure out how to do the calibration and a second time to really do it.

The instructions are in the User Manual on page 46. A summary of the User Manual follows:

To access the calibration, select: **MAIN MENU: Apps\Calib\Calibrate All** or **Calibrate without AiM**.

Calibration Step 1

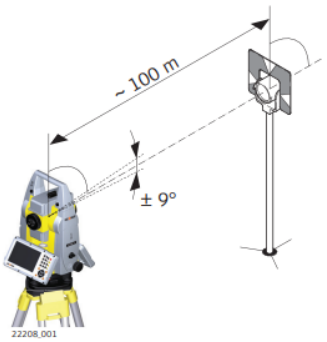
Step 1 of the calibration procedure determines the following instrument errors:

Error	Description
l, t	Compensator longitudinal and transversal index errors
i	Vertical index error, related to the standing axis
c	Horizontal collimation error, also called line of sight error
AiM Hz	AiM zero point error for horizontal angle
AiM V	AiM zero point error for vertical angle

☞ AiM Hz and AiM V are excluded from calibration if you choose the **Calibrate without AiM**. AiM Hz and AiM V are included to calibration if you choose **Calibrate All**.

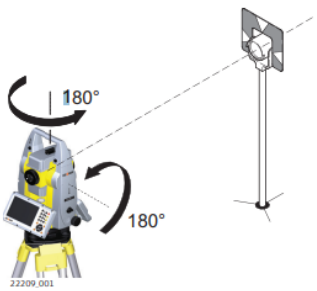
The following table explains the most common settings:

1. Level the instrument and press **OK**.

2. 

   Aim the telescope accurately at a target at about 100 m distance. The target must be positioned within ±9 °/±10 gon of the horizontal plane.

3. Press **OK** to measure and continue with the procedure or press **SKIP** to continue with Step 2 (Calibration Step 2) of the calibration procedure.

4. 

   Motorised instruments change automatically to the other face. It is recommended carefully fine-point to the target manually.

5. Press **OK** to measure and continue with the procedure or press **SKIP** to continue with Step 2 (Calibration Step 2) of the calibration procedure.

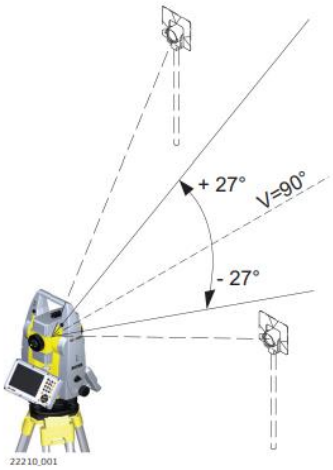
6. Repeat steps 3,4,5 and 6 for the second set. Continue with Step 2 (Calibration Step 2) of the calibration procedure.

Calibration Step 2

Step 2 of the calibration procedure determines the following instrument error:

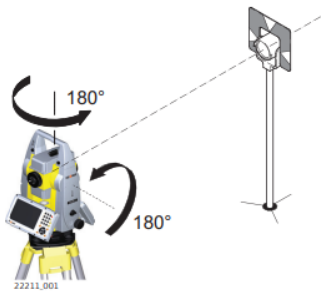
Error	Description
a	Tilting axis error

The following table explains the most common settings.

1. 

   Aim the telescope accurately at a visual target at about 100 m distance. If a 100 m distance is not possible it can be less than 100 m. No distance reading is taken during these steps so a prism target is not required. The visual target must be positioned at least 27°/30 gon above or beneath the horizontal plane

2. Press **OK** to measure and continue with the procedure or press **SKIP** to finish the calibration procedure.

3. 

   Motorised instruments change automatically to the other face. It is recommended carefully fine-point to the target manually.

4. Press **OK** to measure and continue with the procedure or press **SKIP** to finish the calibration procedure.
5. Repeat steps 1,2,3 and 4 for the second set.
6. The results are shown on the screen. If the values are okay, press **OK** to store or press **ESC** to decline.

Battery Charger LED Meanings

The battery charger comes with a small graphic instruction page. This page is written in 'Ikea' like icons that don't make any sense. The following summary is thought to be an accurate American translation of the instruction page:

Indoor Use Only. Don't get the charger wet.
If the charger is damaged, don't plug it into power.
Don't open the charger.
The fuse should be replaced with a 5 Amp fuse.
Use charger in moderate temperatures (32 deg F to 122 deg F).
It should take 2 to 4 hours to charge batteries from 20% to 80%.
Don't charge Ni-Cd or Ni-MH with this charger.
Only charge GeoMax Batteries with this charger.
Plug charger into power prior to inserting battery.

P	Power is applied to charger when the left LED is lit green.
L R	L solid when charging or fully charged.
L R	L sold and R solid when charging and battery is over 80% full.
L R	L flashes and R solid when battery is full.
L R	L solid red, R off, battery damaged.
L R	L and R solid red, charger is damaged.
L R	L off, R solid red, battery is too hot (or cold) to charge

Scout, TRack, AiM Range

Scout:	Power Search	985 feet
TRack:	Continuously track and follow prism	2,600 feet
AiM:	Compute the actual center of a prism	3,280 feet

Traverse Closing Issues

If you are having traverse closing issues, here are some things to consider:

1. Have you recently done a field calibration? The factory *basically* recommends doing one every **day**.
2. **Check your tripod**:
    a. are the legs loose?
    b. clean sliding surfaces?
    c. loose feet/shoes on the legs, make sure the foot points are screwed in tight.
    d. are you firmly setting the instrument screw?
    e. Are the feet firmly set in the ground?
    f. Is anyone touching the instrument or legs after setup?
    g. Is the station settling in asphalt?
    h. Is the robot level at the beginning and end of the observations?
3. Check the EDM mode: is it Standard, Fast or Tracking? (Standard is preferred) "Fast" means it won't update the angle with ATR after the first shot. Only the EDM distance is re-shot. With Fast you are not

really checking the centering process, just the distance. The "Fast" mode also has a slightly looser spec for distance. Setting the EDM mode to “Standard” will preclude the use of close handheld shots, however you really should not be using them to close traverses.

4. Check prism pole bubbles. Have the foresight and backsight tribrachs been checked/adjusted recently?
5. Check prism constants? (See the section “*Leica (GeoMax) Prism Constants*” above.)
6. Is the atmospheric temperature, pressure, elevation correctly entered? This is especially important if you have any long distance observations.
7. Are you allowing the robot to acclimate when pulling from truck to job? Direct heating can be a big issue. Heating the instrument unevenly, as in the case of the Sun hitting only one side can be a big issue. Consider setting up an umbrella.
8. The Robotic Total Station must be located at a location that does not vibrate as the compensators are very susceptible to vibration. Thus, bridges with active traffic are to be avoided.
9. Make sure the compensator is enabled.
10. If you are using the 360-prism, make sure you are using matching faces with arrows (or without arrows) exclusively. (See “*Adjacent Faces on ZPR1 360 Prism have a ~5mm vertical offset*” above.)
11. Are your backsight or foresight shots handheld or on high-stakes? (That won’t close well!)
12. Are your foresights and backsights balanced?
13. Are you inverting the scope? Doubling angles?
14. Long shots with heat waves / shimmer will have significant angular errors.

‘Atmospheric Corrections’

From the primary display face on the robot, you can click on ‘GeoMax Toolkit’ then ‘3 Settings’ and finally ‘4 Atmos.’ To reach the ‘ATMOSPHERIC SETTINGS’ page:

The purpose of this screen is to compute an Atmospheric PPM correction and enable/disable compensation for refraction.

Customers are often confused by this screen because if you enter an elevation, then the pressure is automatically modified; if you enter a pressure then the elevation is automatically modified. You cannot specify **both** elevation and pressure.

Determining an accurate ‘Absolute Station Pressure’ is difficult because devices that directly measure absolute pressure are highly temperature dependent. We recommend entering the robot Elevation, ambient Temperature and approximate Humidity.

The easiest method is to:

1. Enter the Elevation of the Robot within 20 feet.
2. Enter the Temperature.
3. Skip over the Pressure.
4. Enter the Humidity.

The robot will automatically compute the station pressure based on the values you enter.

If you choose to enter the 'Pressure' you need to enter the 'Absolute Station Pressure' not the 'Sea Level Corrected Pressure". The pressure published by the National Weather Service for Airports are very accurate, however they are '**Sea Level Compensated Pressures**' and that is not what you need!

This equation will approximately convert 'Sea Level Pressure' to 'Absolute Station Pressure':

$$StationPressure = SeaLevelPressure \cdot e^{-\frac{Elevation}{Temp*29.263}}$$

Where:

Elevation is in Meters ElevM = ElevF * 0.3048

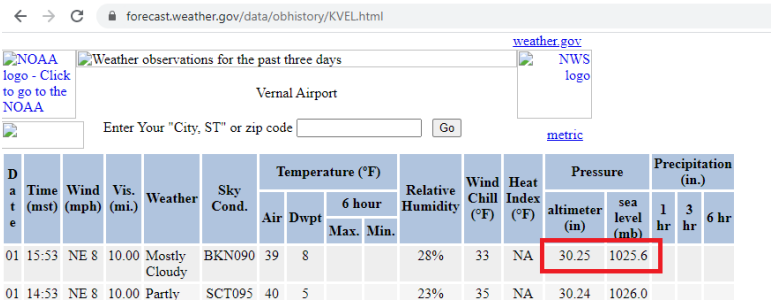
Temp is in degrees Kelvin degK = degC + 273.15

Warning: exactly converting is a very, very deep rabbit hole. It is not worth pursuing for this application.

Pressure Example

Many users prefer to use the pressure from the nearest airport to estimate 'Absolute Station Pressure' for a jobsite. Unless you are very close to an airport this may not be a reasonable method. For many rural applications where it is a long way to the nearest airport or there is any elevation difference this will be totally inappropriate.

For example, consider a location with where the elevation is 5653 ft and the temperature is 24 deg F. The nearest airport is 35 miles to the southeast. The elevation of the airport is 5280 feet (1609.3m). Using the current online weather forecast for the airport:


forecast.weather.gov/data/obhistory/KVEL.html

weather.gov

NOAA logo - Click to go to the NOAA

Weather observations for the past three days

Vernal Airport

NWS logo

Enter Your "City, ST" or zip code Go

metric

Date	Time (mst)	Wind (mph)	Vis. (mi.)	Weather	Sky Cond.	Temperature (°F)				Relative Humidity	Wind Chill (°F)	Heat Index (°F)	Pressure		Precipitation (in.)		
						Air	Dwpt	6 hour					altimeter (in)	sea level (mb)	1 hr	3 hr	6 hr
								Max.	Min.								
01	15:53	NE 8	10.00	Mostly Cloudy	BKN090	39	8			28%	33	NA	30.25	1025.6			
01	14:53	NE 8	10.00	Partly	SCT095	40	5			23%	35	NA	30.24	1026.0			

The current temperature at the airport is 39 degrees F (277.04K) and the 'Sea Level Adjusted Pressure' is 30.25 inHg.

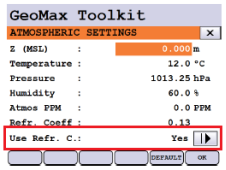
Convert to 'Absolute Station Pressure' = 24.80 inHg.

Entering 24.80 into the Settings page on the robot with the correct Temperature and Humidity results in a PPM of 34.2 PPM.

Using the Elevation (5653) results in a PPM of 41.2 PPM. The 7.0 PPM difference results in a measurement change of 0.04 feet per mile. Estimating the pressure is a lot of work with questionable value.

Enable ‘Use Refraction Coefficient’

Enable on the robot in the GeoMax Toolkit:



DEFAULT
To set all values to factory default.

Field	Description
Z(MSL)	Sets the elevation above mean sea level.
Temperature	Sets the temperature.
Pressure	Sets the pressure.
Humidity	Sets the humidity.
Atmos PPM	The atmospheric ppm is calculated from the values in the previous fields.
Refr. Coeff	Refraction coefficient to be used for calculation.
Use Refr.C.	If **YES**, refraction correction is applied to measurements.

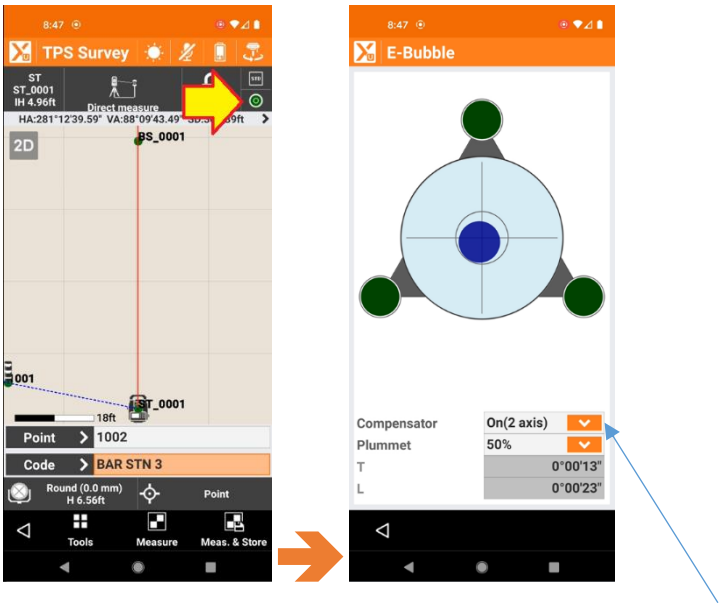
on the Robot. The default refraction coefficient is 0.13 and is appropriate for most jobs. Other common values are 0.142 and 0.2.

Enable the compensators

The compensators automatically adjust measurements to compensate for non-level instrument leveling. To enable the compensators:

From the survey screens, click on the E-Bubble indicator:

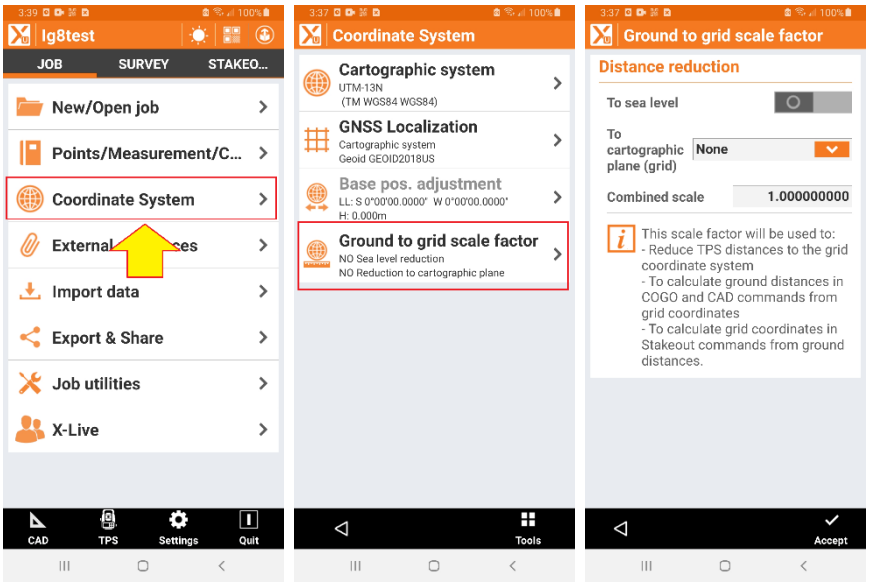
E-Bubble Check



Checks the E-Bubble, enables the Plummet laser and controls the Compensator.

Sea Level Correction

If you are using Grid coordinates, mixed with Ground Total Station measurements, use Sea Level adjustment to reduce optically measured ground distances to grid.



From the main JOB menu, click on Coordinate System, then Ground to grid scale factor.

Distance reduction reduces GROUND distances measured with the Total Station to GRID distances. This is only applicable if your current coordinate system is a GRID system.