Your First Zoom 90 X-Pad Job
Common Zoom 90 Issues & Questions

Thank You!

Thank you very much for purchasing a GeoMax robot and X-PAD field software from iGage!

We know that your new robot will provide you with years of dependable service.

X-Pad is a great field software tool.

Because X-Pad is developed by the robot manufacturer (Hexagon), it best supports the Zoom 90 hardware. While X-PAD has an amazing set of functions and options and might appear to be overwhelming at first, it is actually the easiest tool to use with a Zoom 90 robot. Budget a few uninterrupted hours to work through this *First Job* document.

We hope that this FAQ will help you ***install***, ***fully configure*** X-PAD and then do a ***simple station setup*** and store a ***side-shot***. Everything after that should be simple; however, there is a very detailed **X-PAD User Manual** available as a PDF or printed manual that will help with more complicated tasks.

Once you finish your first job, the **X-PAD User Manual** and **Common Zoom 90 Questions FAQ** should answer any questions that you might already have and will probably encounter in the future. We know from our extensive experience suppling GeoMax optical instruments that you will appreciate the answers to these always asked questions.

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Mail List

If you purchased a Zoom90 robot from iGage, **please sign up for the Zoom90 mail list**. 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 'Zoom90 Robot' group.

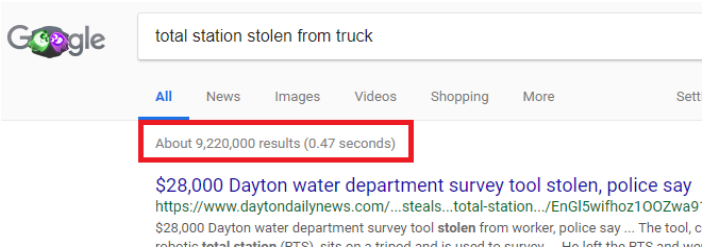
Robot Handling Rules

First off, let's cover some important rules 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 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. If the tribrach nut is loose, you must have the robot in hand. If you loosen the nut, you must immediately put the robot in the case. The only place that a robot can ever be is on a secure tripod with the nut tight, 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 in a latched case, move the case and remount. Again, most companies will not allow you to move a robot mounted on a tripod because it endangers the robot.

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 can not afford to replace your robot, you can not afford to not have insurance!
10. Every time you lift the robot by the top handle, make sure the handle is not partially released:

Oh Crap! 

11. All Total Stations (Robotic or Manual) should be field calibrated if they are moved a significant distance or encounter rough handling. Field calibration is described on page 39 of the **GeoMax Zoom 90 User Manual** and repeated in the **Common Issues FAQ**.

X-PAD: 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 faster and more reliable.

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

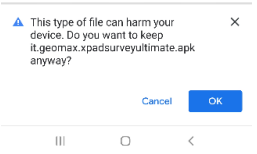
www.iGGPS.com

Look for the X-PAD logo near the bottom:

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

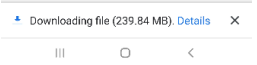
On the 'Links' page, find the 'X-PAD Ultimate Survey' link and click on the large 'Download' button:

A system warning message will be displayed:



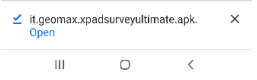
Click on OK.

The installer will be downloaded:



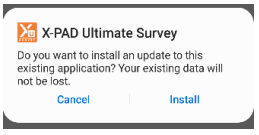
Wait for the download to complete.

Your device will offer to Open the installer:



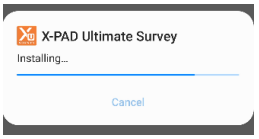
Click on 'Open'.

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



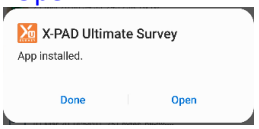
Click on 'Install'.

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



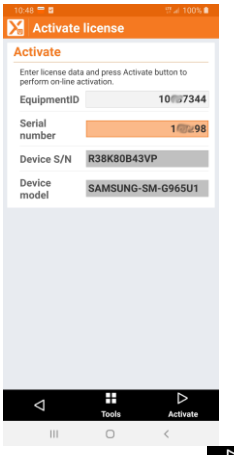
Wait for the installation to complete.

Click on 'Open':



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:

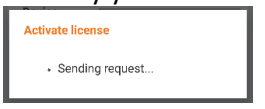


Click the Activate button 

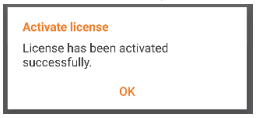
in the lower right-hand corner.

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

X-PAD will verify your license:

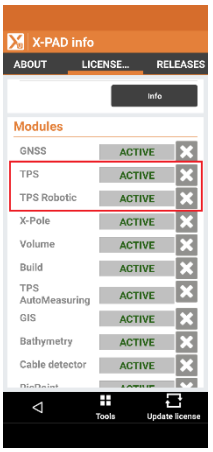


After a few moments, a success message will be shown:



Click on 'OK'.

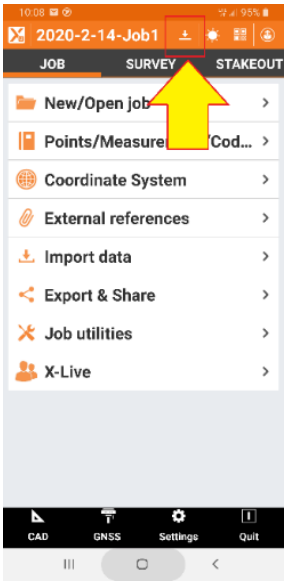
The activated modules will be shown:



Since you will be using a robotic total station, make sure that **TPS** and **TPS Robotic** are both active on your installed license.

X-PAD: Updating X-PAD to the Latest Version

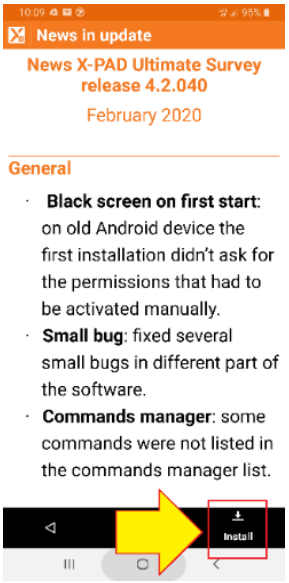
On the main X-PAD screen:



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 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

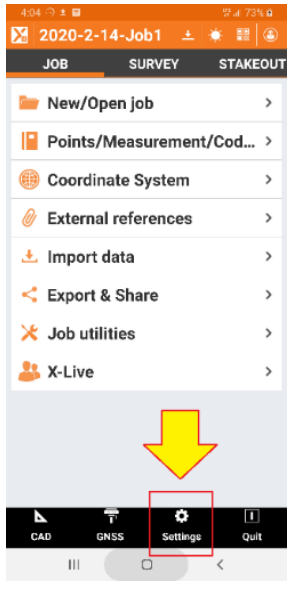
X-PAD: Loading GEOIDS and Local Coordinate Systems

Immediately after installing X-PAD you should add the United States Localization Package to the base installation. This will download and install location specific GEOIDS and Coordinate Systems (like the Oregon and Iowa specific county systems) into the X-PAD program.

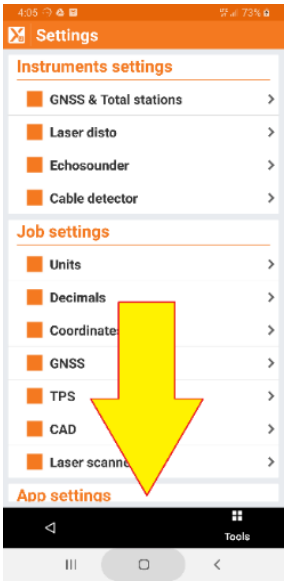
Loading the USA Localization Package

Internet access is required for this procedure.

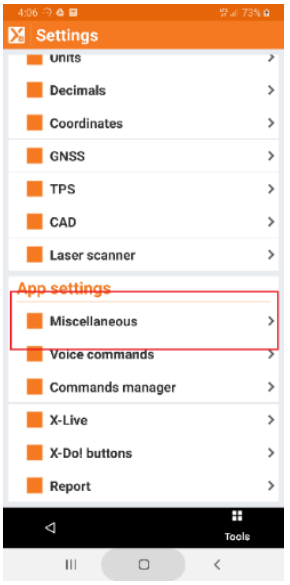
From the main menu click on '**Settings**':



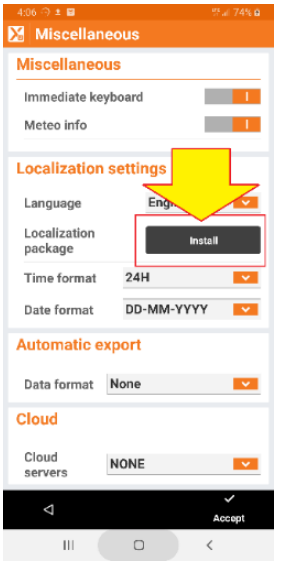
Drag the menu down up so that you can see the 'Miscellaneous' item under '**App settings**':



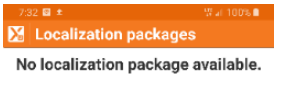
..roll down to the bottom..



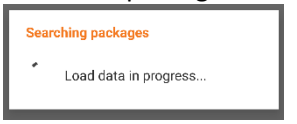
Click on '**Miscellaneous**', then click on the '**Localization package Install**' button:



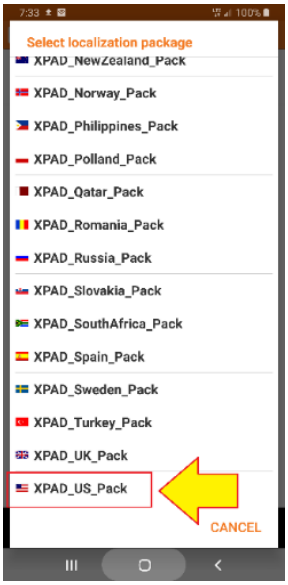
Previously downloaded / saved packages (if any) will be listed:



Click on the '**Download**' button to retrieve an updated list of all available packages:



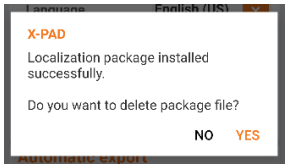
After a while a list of all localization packages will be shown:



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.

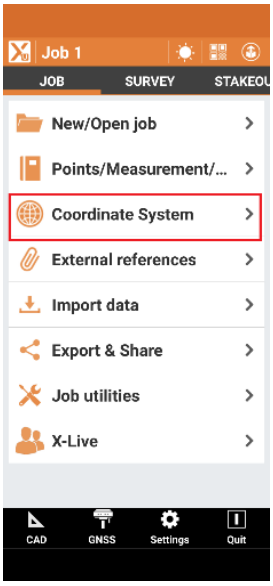
Wait for the package to download and install. When complete:



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**'.

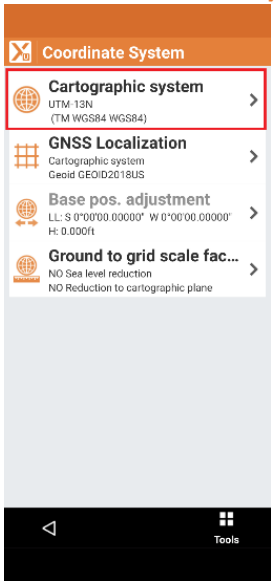
XPAD: Selecting a Coordinate System

1. From the main menu:



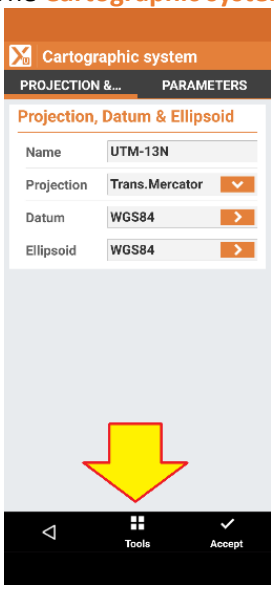
Click on **Coordinate System**.

2. From the **Coordinate System** menu:



Click on **Cartographic System**.

3. The **Cartographic system** menu is show:

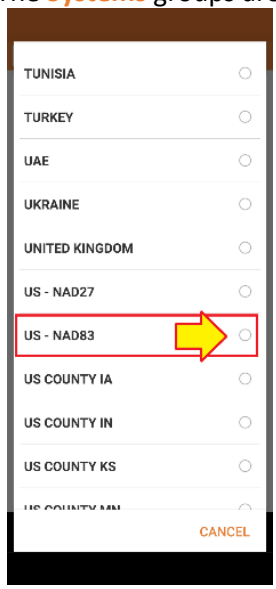


Click on the **Tools** button at the bottom.

4. The **Group** selector is shown:

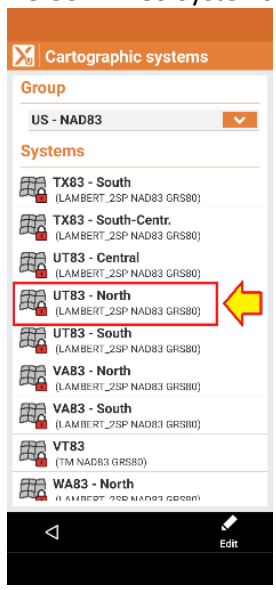
Click on the orange down arrow to the right of ****USER****.

5. The **Systems** groups are shown:



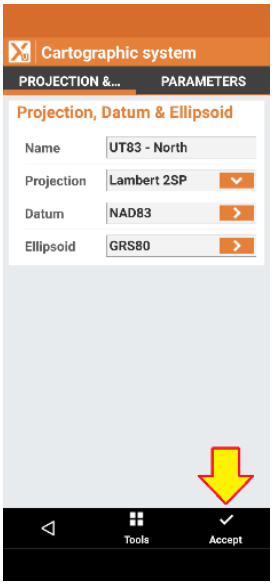
Scroll down and select **US – NAD83**

6. The US NAD83 Systems are shown:

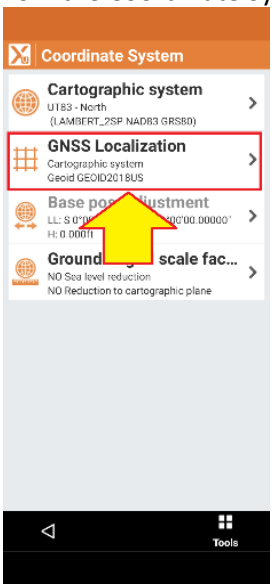


Scroll down and click on the appropriate State Plane Zone for your area.

7. The **Projection, Datum and Ellipsoid** selection is shown:

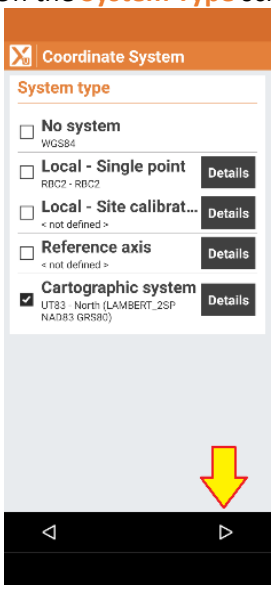


8. Click on the **Accept** button.
9. Next, load a GEOID in case we later want to use a GNSS receiver.
   From the Coordinate System screen:



   Click on **GNSS Localization**

10. On the **System Type** screen:



    Click on the **Next** arrow (bottom right).

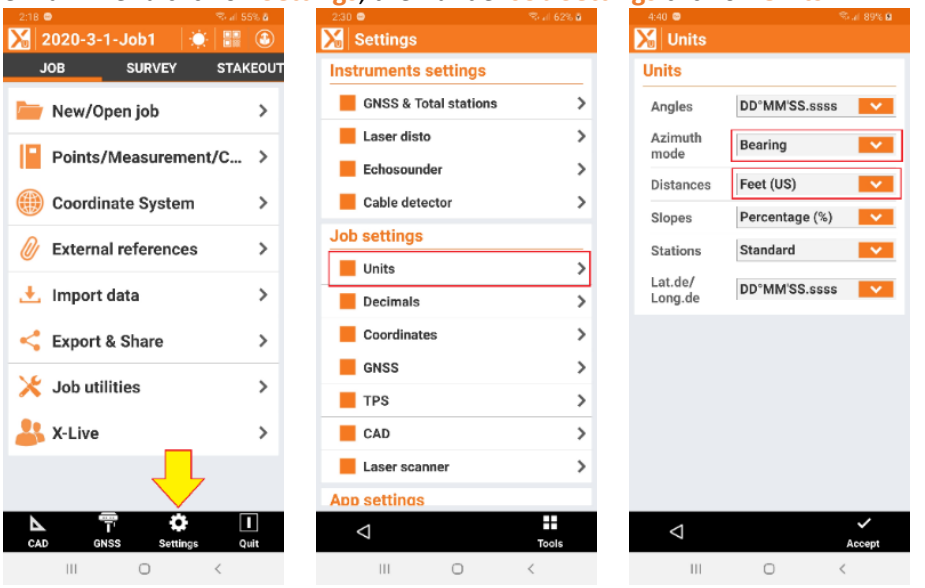
11. On the **Vertical system** menu:

    Select an appropriate GEOID, then click on Accept.

X-PAD: Configure Default Settings

US Survey Feet, International Feet, Meters; Bearing vs. Azimuth

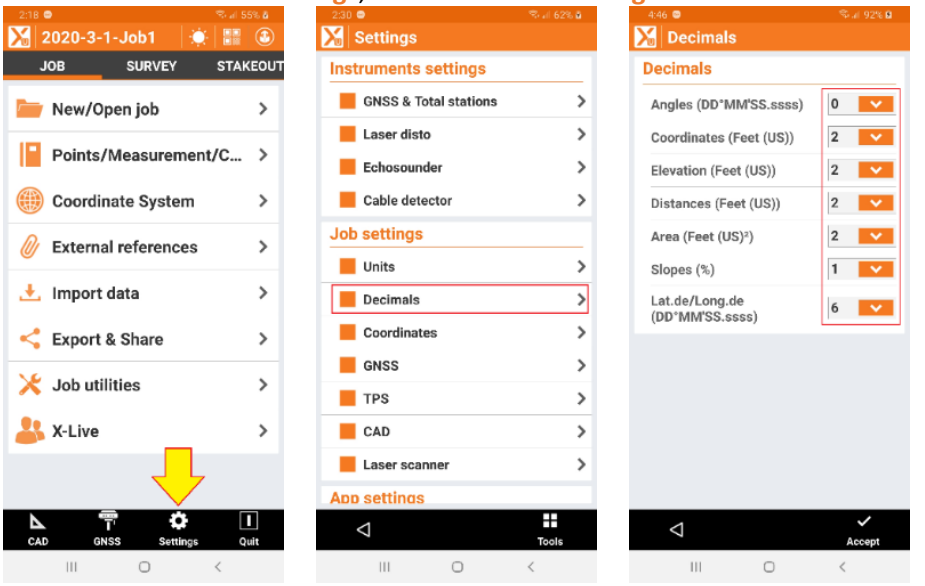
From the main menu click on **Settings**, then under **Job Settings** click on **Units**:



You will probably want to change the **Azimuth mode** to **Bearing** and the **Distances** to either '**Feet (US)**' or '**Feet (International)**'. You can also select fractional feet (inches and fractional inches).

Default Display Precision

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



For optical based jobs you will probably want to set:

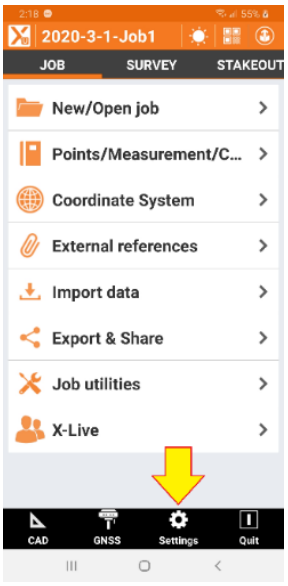
Angles	0	N 45 12 34 W	even minutes
Coordinates	3	0.000	hundredths of a foot
Elevation	3	0.000	hundredths of a foot
Distance	3	0.000	hundredths of a foot
Lat/Lon	5	DDD MM SS.sssss	5-decimals of seconds

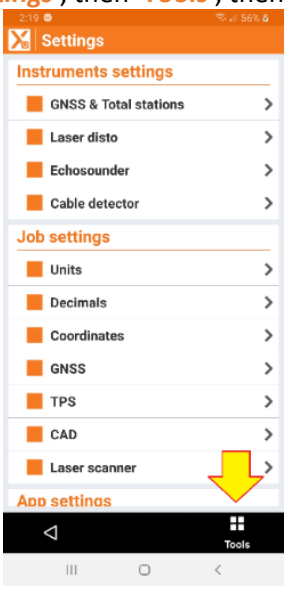
Saving Setting and Coordinate System Configurations

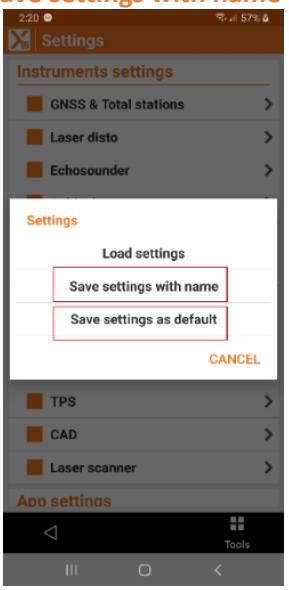
After configuring coordinate systems and settings in X-PAD store them as X-PAD defaults. Both 'General Settings' and 'Coordinate Systems' can be saved.

Storing 'Settings'

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

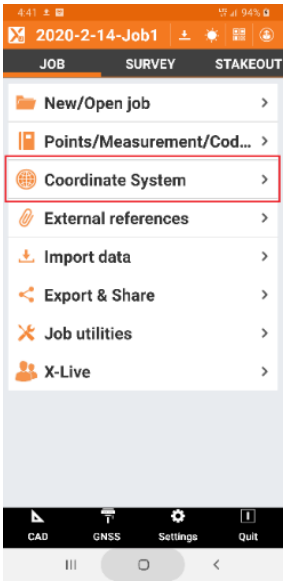


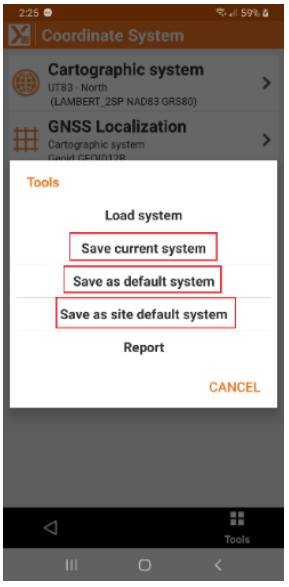




Storing 'Coordinate Systems'

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





Your First X-Pad Robotic Job: step-by-step

Now that X-Pad is Installed, Updated and Configured we can get to work.

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:

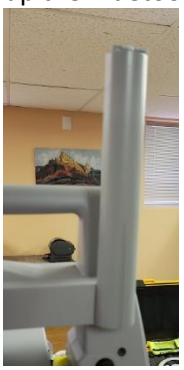
3490820.322 N 2280573.301 E 5673.72 ortho

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 and we want to set the azimuth circle to 0 on that backsight point.

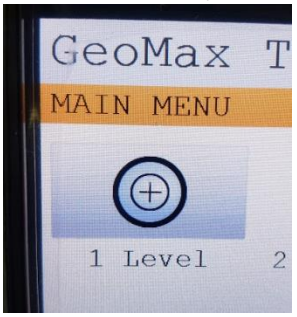
1. Setup a good tripod (use a Tri-Max or Heavy-Duty GeoMax.) Robots shake a lot and you will have horrible repeatability if you use an inexpensive, poorly adjusted or loose footed tripod.
   Make sure the leg slides are clean and the pivot bearings at the head are adjusted tight and solid.
   Make sure 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 set.
   Make sure the tripod nut that holds the tribrach is really-tight.
2. Mount the robot on the tripod, rough-level it using the 20' 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:

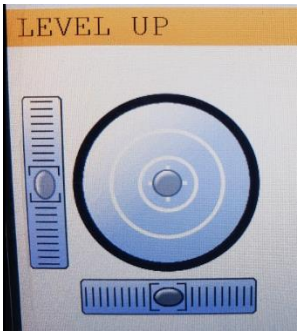


   Check to make sure that the antenna is not partially pulled out from the handle. If it is pulled out, push/snap it back into place. The radio range will be reduced if the antenna is not firmly connected.
5. Put a fresh battery in the Zoom 90. Turn on the robot by pressing and holding the ON/OFF key for 5-seconds. Wait for the robot to boot.
6. From the main menu, click on the 'Level' icon or press the '1' button:



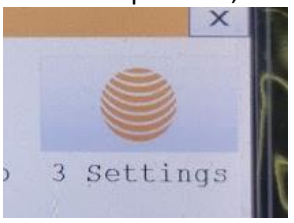
The laser plummet will turn on, slide the tribrach on the tripood head to center the robot over the ground mark. You can adjust the laser intensity to effectively reduce the spot size as small as possible while bright enough that you can still see it's location on the Ground Mark (GM).

7. Use the Electronic bubble:



to 'fine' level the instrument. If you adjust to perfection, then you will know if the tripod creeps during the day by checking the level at the end of the survey.

8. Slide the robot to center the laser plummet over the GM, check the level again and tighten the instrument nut.
9. Exit the level up screen, then click on 'Settings':

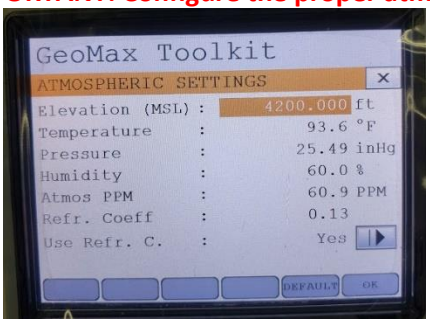


10. Click on 'Comm':

11. Ensure that the 'Bluetooth Handle (ZRT82)' is selected:

12. Return to the previous menu, then click on 'Atmos.'

13. **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:

Pressure, Temperature 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 that we encounter:

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**.

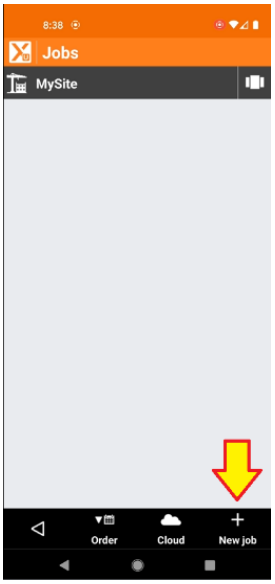
Conclusion: get the Temperature, Pressure or Elevation close. Adjust Temperature during the day. Don't worry much about the humidity.

14. From the 'ATMOSPHERIC SETTINGS' screen click OK to store your settings, then return to the main menu.

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

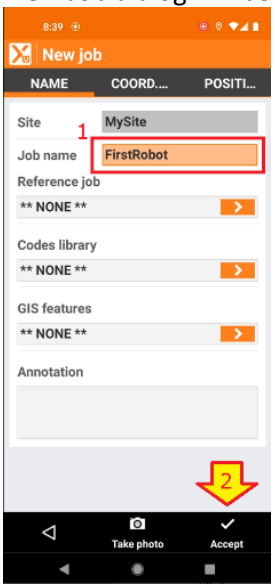
Start the Survey

1. Start X-Pad:



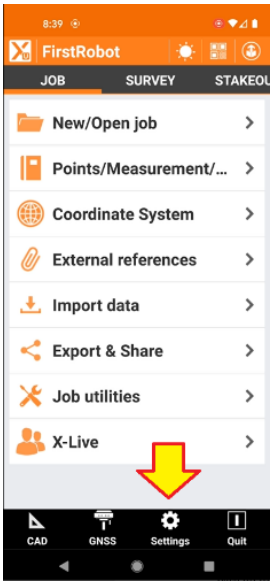
Click on **New Job** to make a new empty job.

2. The New Job dialog will be shown:



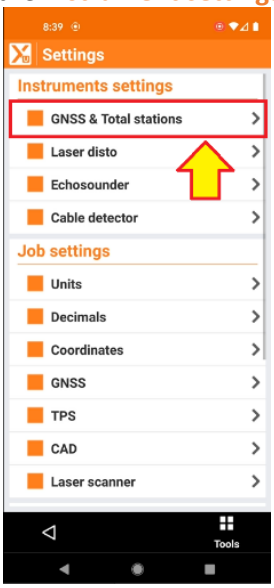
Enter a reasonable **Job name** then click on **Accept**.

3. From the main menu:



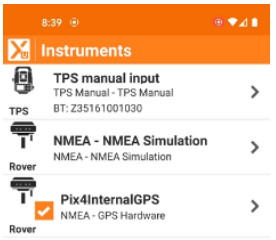
Click on the **Settings** button at the menu bottom.

4. On the **Instrument settings** menu:



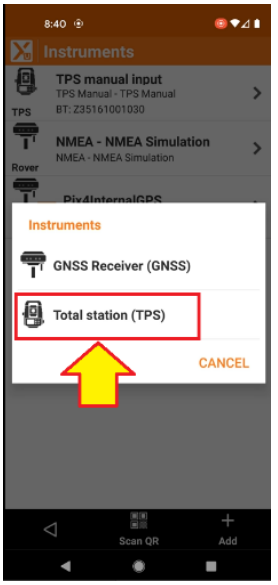
Click on **GNSS & Total stations**.

5. On the Instrument list screen:



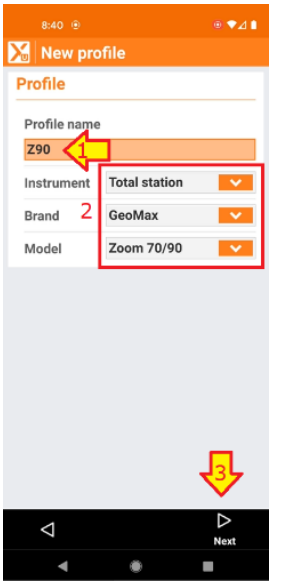
Click on the **+ Add** button to add a new instrument.

6. The add **Instruments** menu is shown:



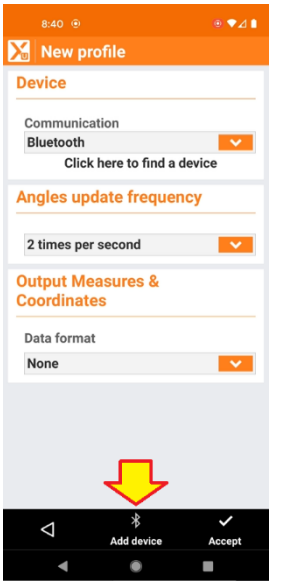
Click on **Total stations (TPS)**.

7. On the **New Profile: Profile** menu:



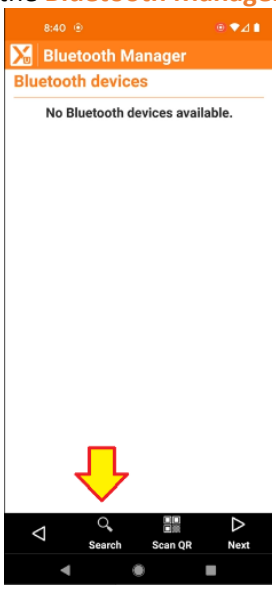
Enter a reasonable **Profile name**, select **Brand** = **GeoMax**, **Model** = **Zoom 70/90**.
Finally click on **Next**.

8. On the **Device** menu:



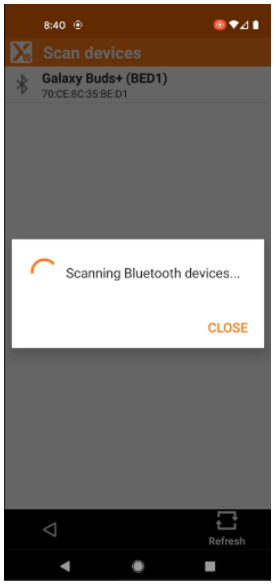
Make sure **Communication** is **Bluetooth**, then click on **Add device**.

9. On the **Bluetooth Manager**:



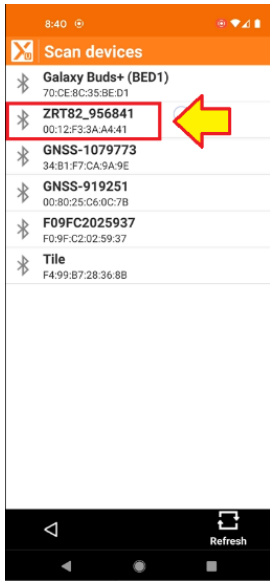
Click on the **Search** button.

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



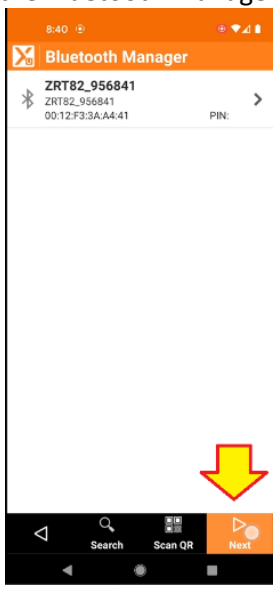
Wait for the search to complete.

11. On the **Scan Devices** menu:



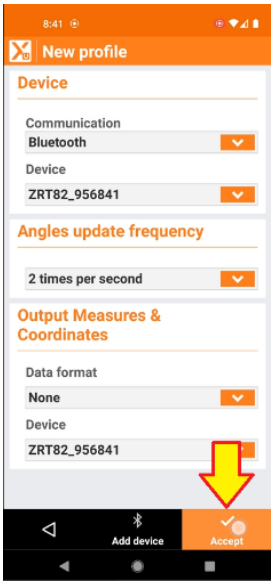
Click on the robot which should begin with '**ZRTxxx**'.

12. On the Bluetooth Manager:



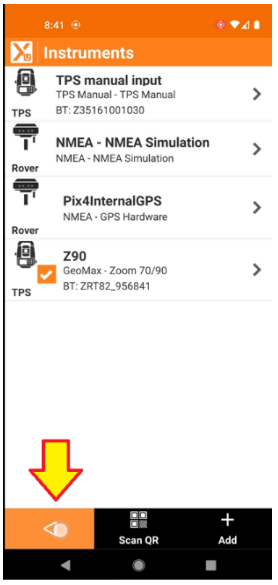
Click on **Next**.

13. Back on the Device menu:



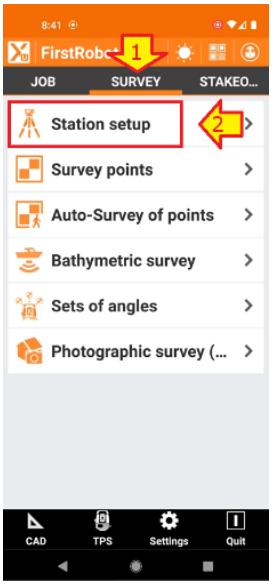
Verify the **Device** is correct.
Click on **Accept** to complete the robot setup.

14. On the Instruments list:



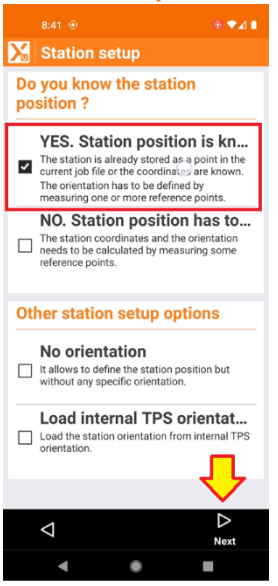
The robot profile will be the current profile.
Click on the Back button.

15. On the main menu:



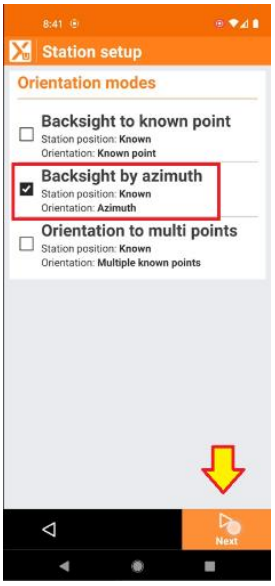
Click on the **Survey** tab, then click on **Station Setup**.

16. The **Station Setup** screen is shown:



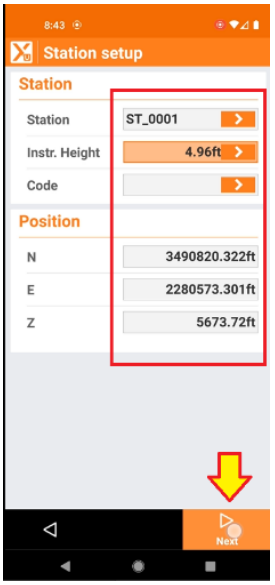
Since we know the coordinates for the robot position, click on **YES. Station position is known**.
Then click on **Next**.

17. The **Orientation** menu is shown:



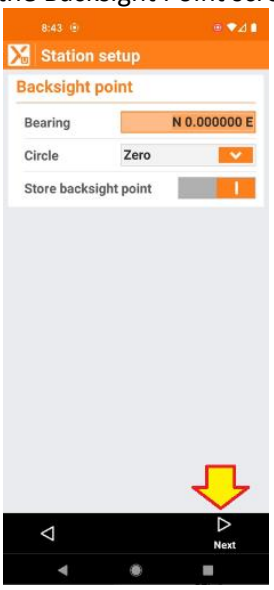
We don't know the coordinates for the backsight, however we do know that the azimuth is North, so click on **Backsight by azimuth**.
Then click on **Next**.

18. On the **Station** screen:



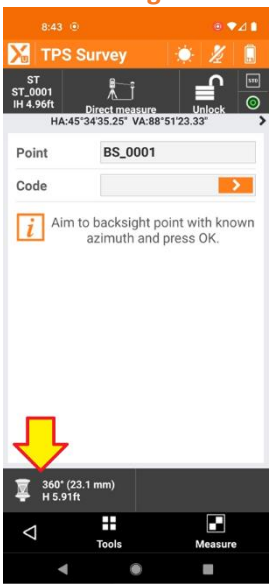
Enter a **Station** number/name, if the station is already in the job you can recall it with the **>** button.
Enter the **Instrument Height**, measured from the ground mark to the height dot on the side of the robot.
Optionally enter a **Code**, either by typing or use the **>** to pull from the code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

19. On the Backsight Point screen:



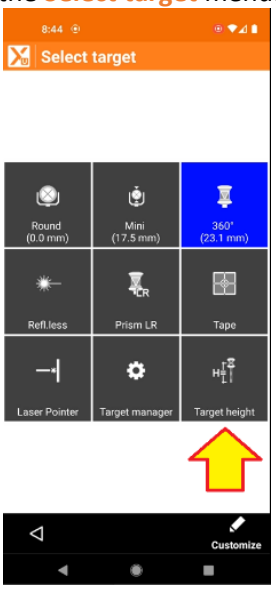
Set the **Bearing** to 0.
Choose to **Zero** the azimuth circle.
Store the **backsight point**.
Finally click on **Next**.

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



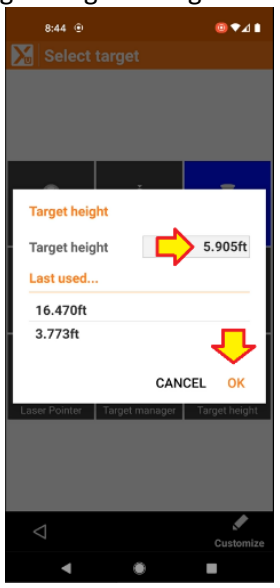
Make sure the correct prism and prism pole height are selected: if the prism height or type is incorrect, click the **prism** button.

21. On the **Select target** menu:



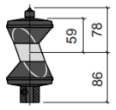
Click on the **Target Height** button to modify the prism height.

The Target Height dialog will be shown:



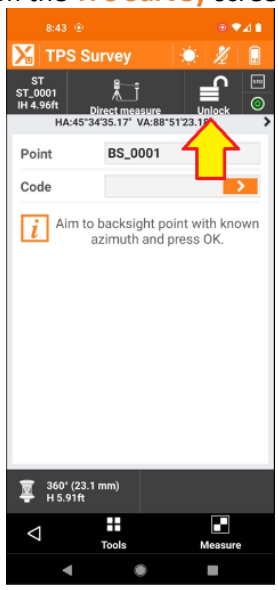
You can click on one of the **Last used…** heights or enter a new height.

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	

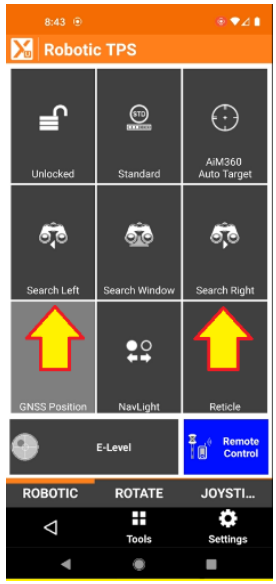
Once the height is correct, click **OK**.

22. From the **TPS Survey** screen:



Click on the **Unlocked** button.

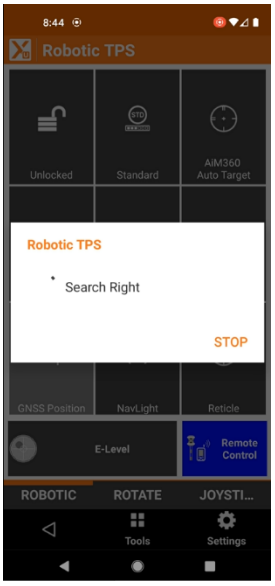
23. The **Robotic TPS** screens is shown:



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.

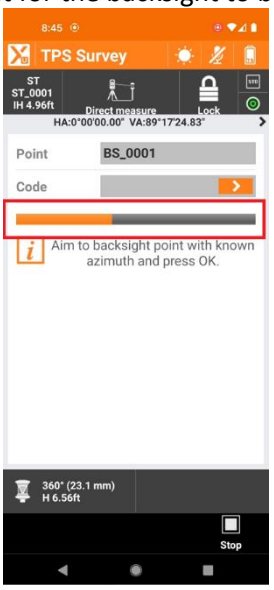
24. Wait for the robot to search and find the prism:



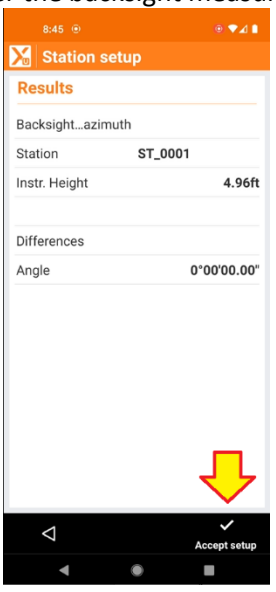
25. Once the robot locks:

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:

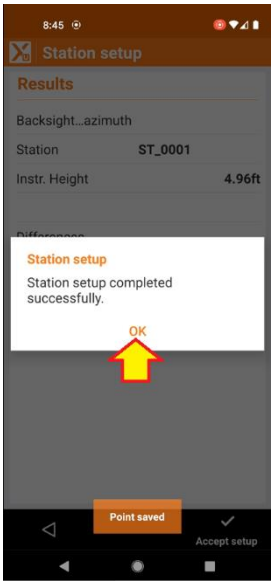


27. After the backsight measurement completes:



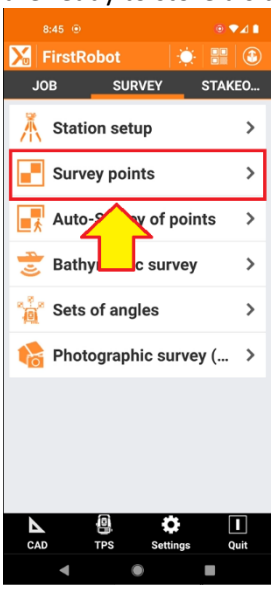
Verify that the station setup looks reasonable. Then click **Accept** setup to continue.

28. X-PAD will confirm the station setup:



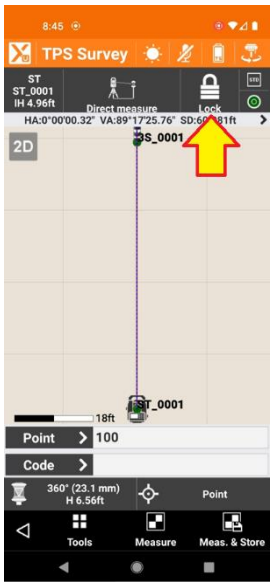
Click **OK** to continue.

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



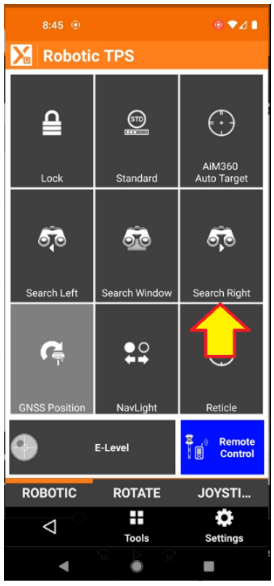
From the main **SURVEY** menu, click on **Survey points**.

30. I have a round can prism set to the left of the backsight (left when standing at the prism and looking back towards the robot):



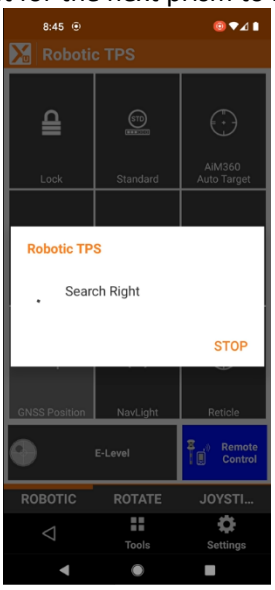
Click on the **Lock** button.

31. From the **Robotic TPS** screen:

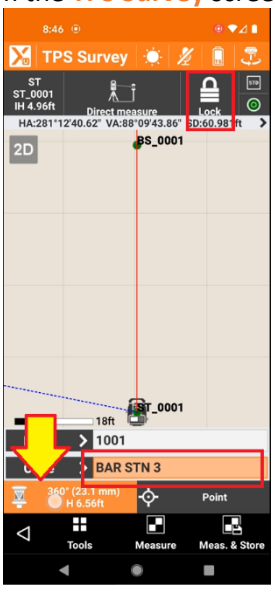


Click on the **Search Right** button.

32. Wait for the next prism to be found:

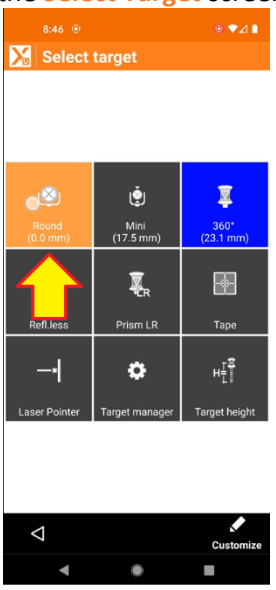


33. From the **TPS Survey** screen:



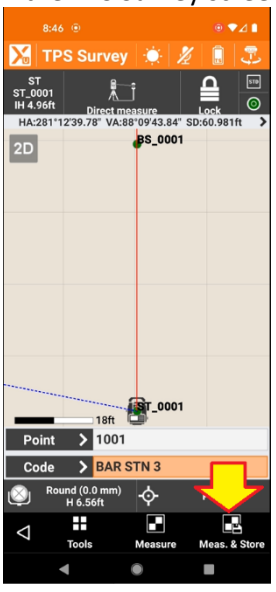
Verify that the robot is locked on the new target.
Verify the **Point** number is acceptable.
Enter an appropriate **Code**.
Click on the prism button to change the prism.

34. On the **Select Target** screen:



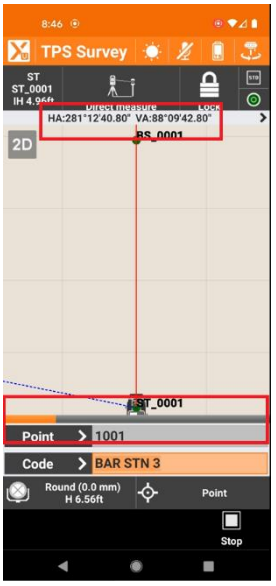
Click on the correct prism type: **Round (0.0mm)**.
If the prism offset is confusing, read the FAQ in Common Questions: Prism Offsets.

35. From the TPS Survey screen:



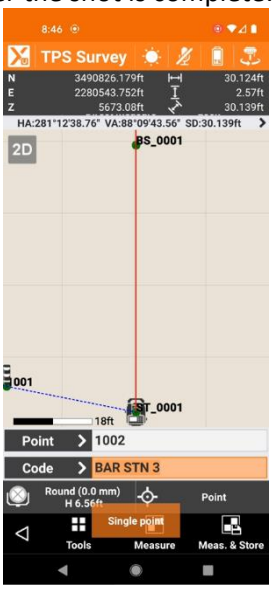
Click on the **Meas & Store** button to fire the laser.

36. X-PAD will make several measurements:



Wait for the shot to complete.

37. After the shot is complete:



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

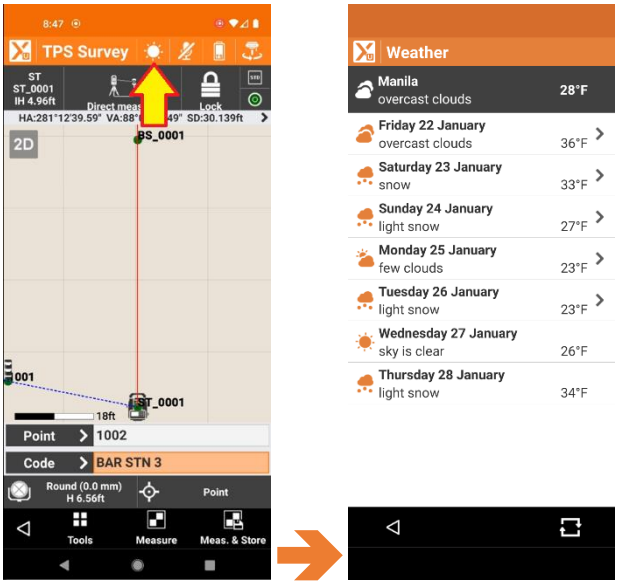
38. Additional shots may be taken as desired. When you complete this station, click the **Back** button to return to the **SURVEY** menu.

Elements of the TPS Survey Screen

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

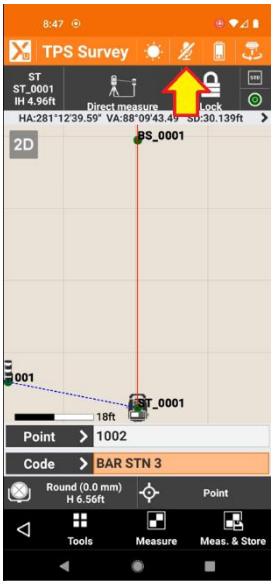
Here is a quick listing of actions.

Current Weather



Displays current and forecasted weather.

X-PAD Voice Commands

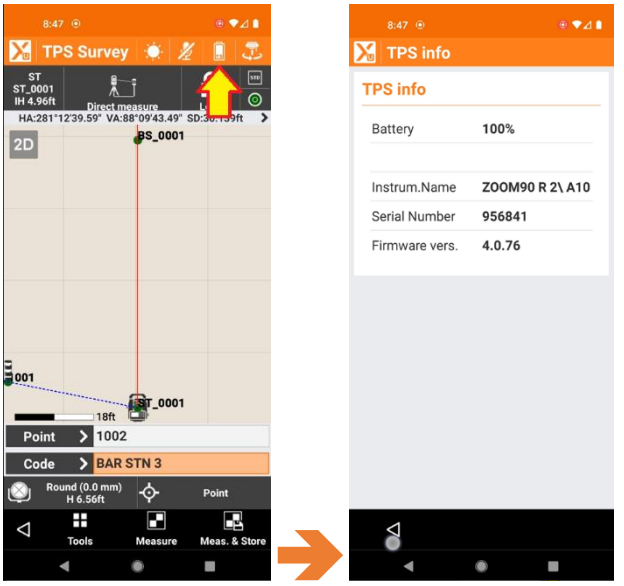


Say '**OK XPAD**' to give verbal commands to X-PAD:

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**

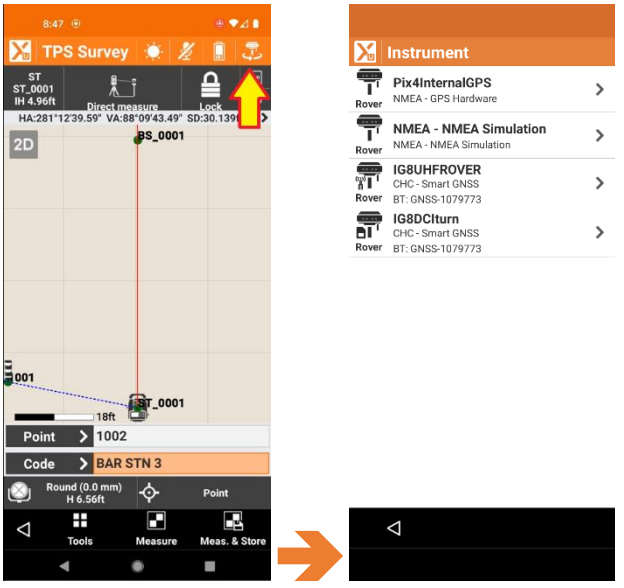
You can have multiple words for one command. See **Settings**: **Voice commands** to configure.

Robot Battery Status



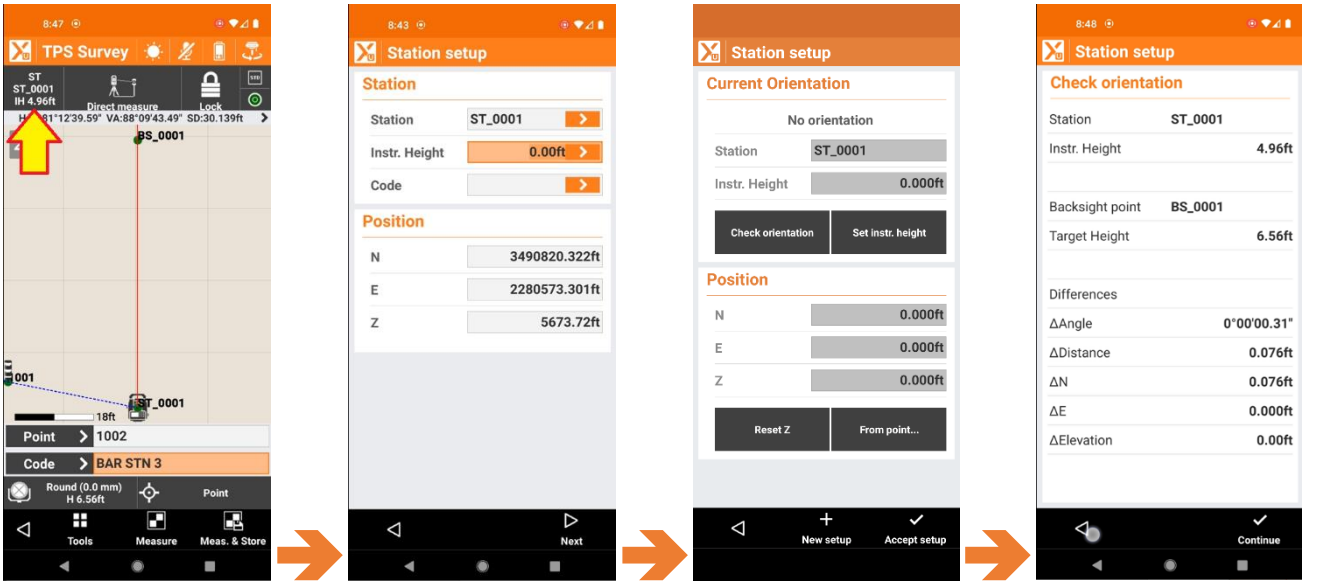
Displays the **Battery** status of the robot, its **Name**, **Serial Number** and **Firmware version**.

Switch Instruments



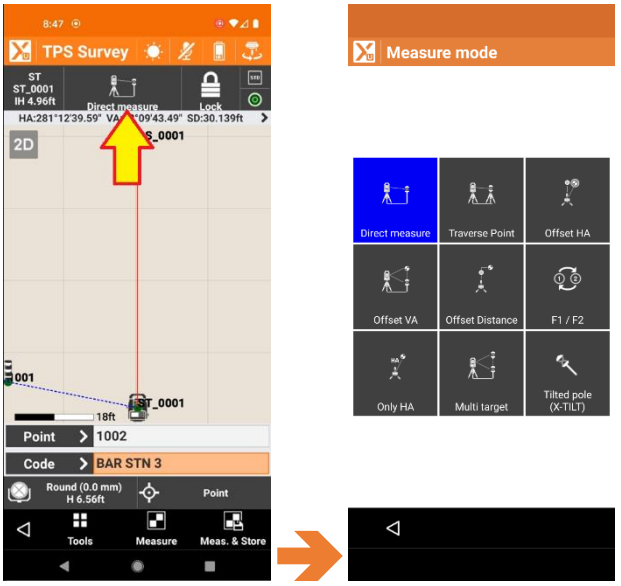
Allows you to quickly switch to another instrument (for example to store a GPS point to setup on.)

Station Setup



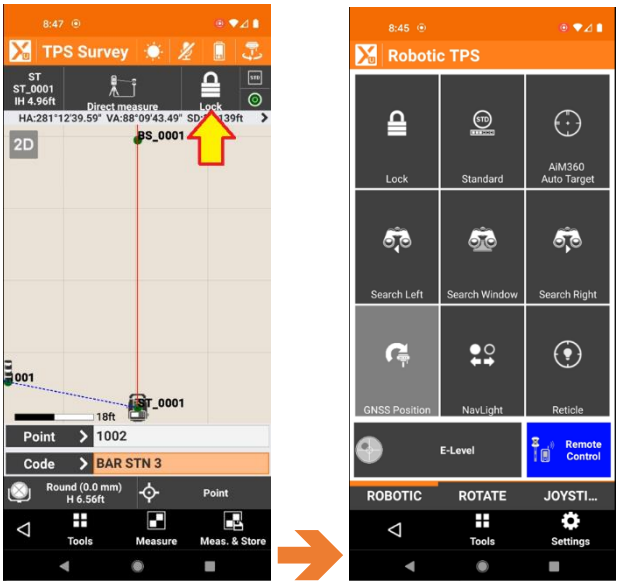
Use **Station Setup** to move to a new station, click **Next** and then **Check orientation** to check your backsight.

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 inclinometer in Android device.)

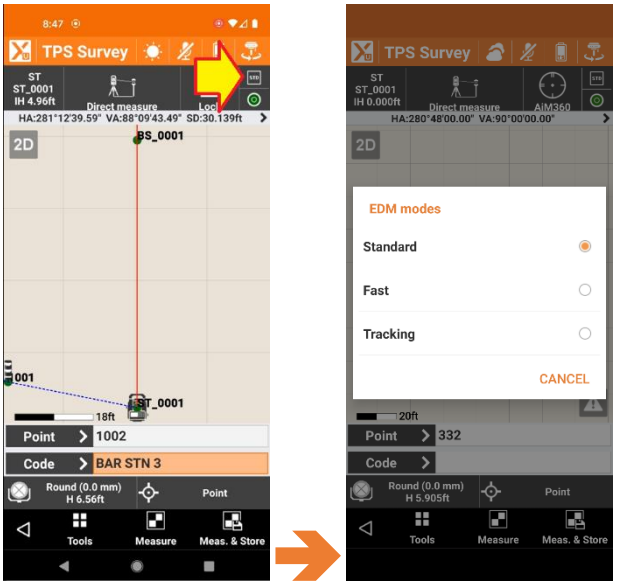
Robotic TPS



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 functions.

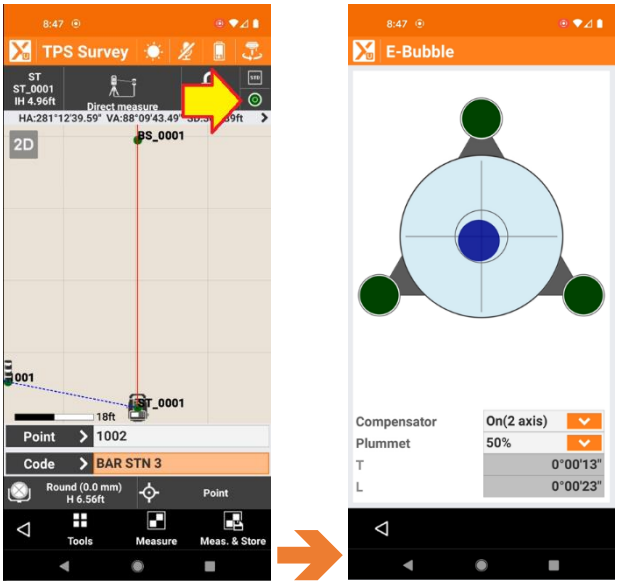
Prism Mode



Switches between **Standard**, **Fast** and **Tracking EDM modes**.

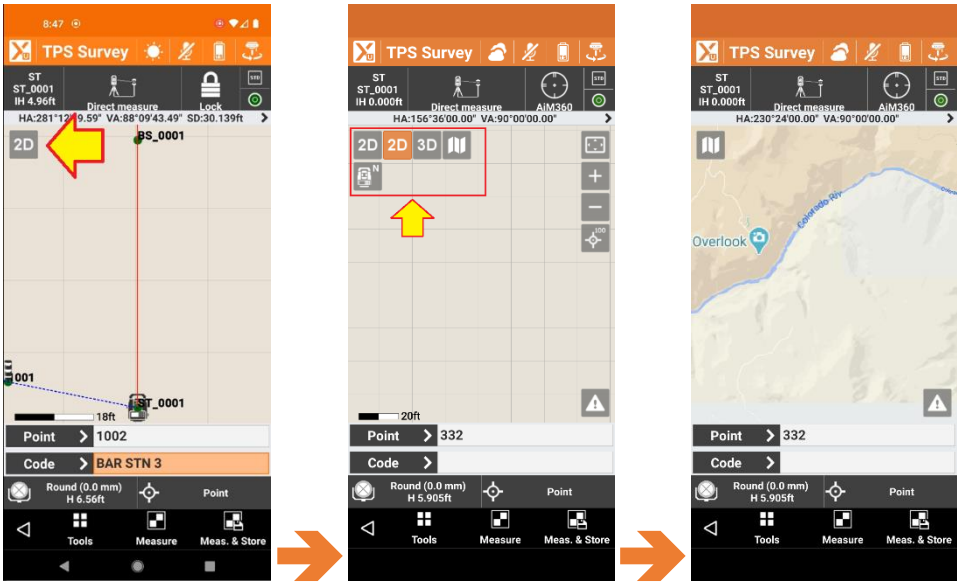
You should use **Tracking** for handheld prism shots closer than 30 feet. **Standard** should be fine for most other measurements.

E-Bubble Check



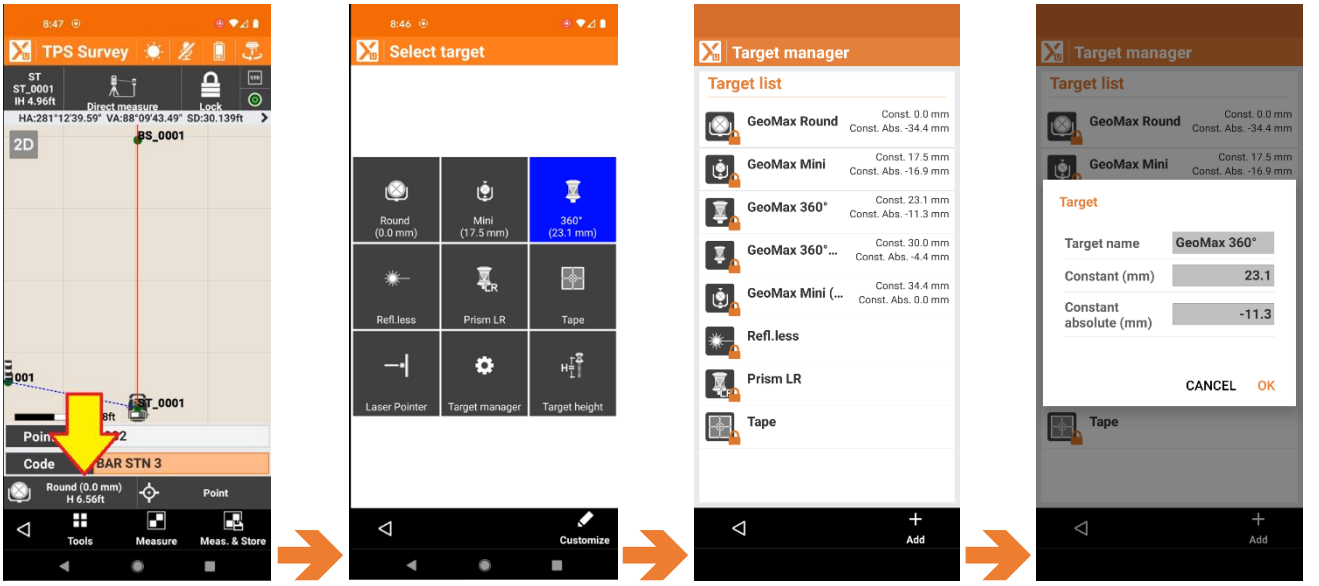
Check the **E-Bubble**, enables the **Plummet** laser and control the **Compensator**.

Map Control



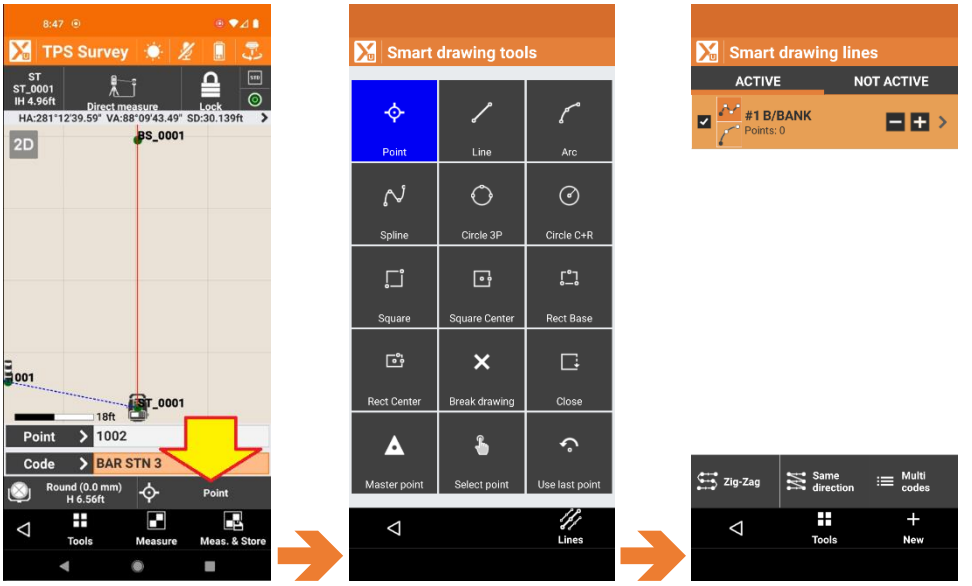
Switches between 2D, 3D maps with downloaded raster backgrounds. (Google image shown above.)
Switches between North up and robot direction up.

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



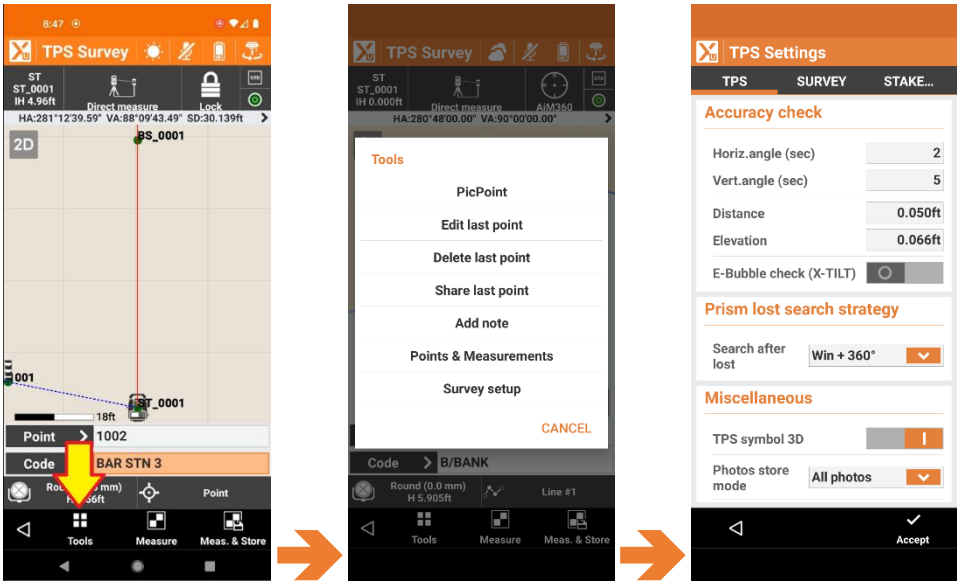
Smart drawing tools choose the measurement type and control line drawing in the field as measurements are taken. You can connect shots with straight **Lines**; **Arcs**; **Splines**; build **Circles** from **3-points** on the circumference or the **Center**; set **Squares** and **Rectangles**.

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.

Tools



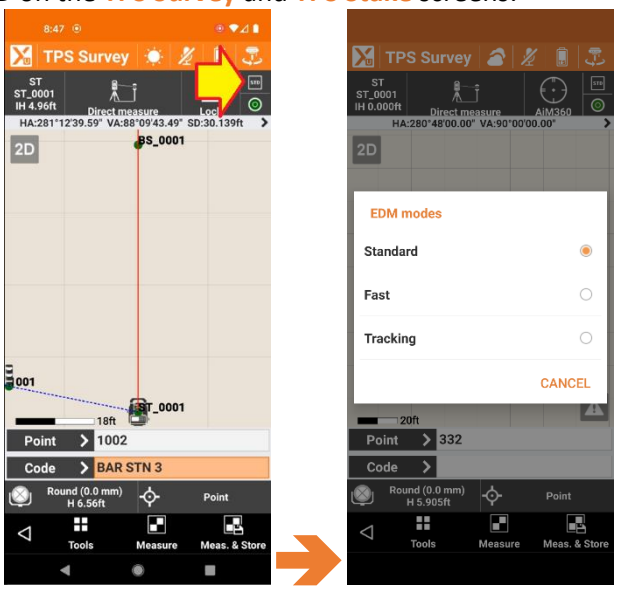
The **Tools** button allows quick access to **PicPoint** (pick a point from the map and add a point), **Edit last point**, **Delete last point**, **Share last point**, **Add note** to the survey with text and sketches, **Points & Measurements** brings up the point list and **Survey setup** allows you to edit the survey configuration for **TPS**, **SURVEY**, **STAKEOUT** and **POINTS**.

Common Zoom 90 Robot Issues and Questions

EDM Mode

Standard mode for short shots won't work:

In X-PAD on the **TPS Survey** and **TPS Stake** screens:



Click the **EDM Mode** button (above the bubble button).

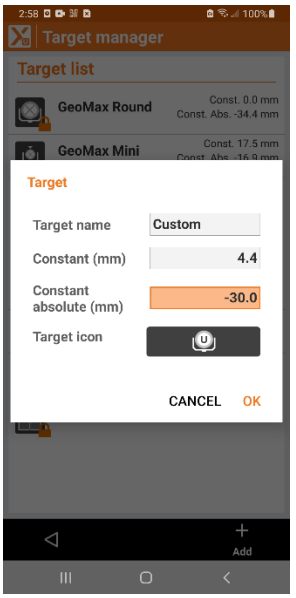
Change the 'EDM Mode' to **Fast** if you are working at close range without a bi-pod. The **EDM Mode** affects the EDM accuracy:

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.

Leica (GeoMax) Prism Constants

X-PAD makes prism constant entry simple, however you need to be aware that the Zoom 90 adheres to the Leica prism constant offset methodology.



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 = Standard Absolute Offset + 34.4 mm

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

Standard Absolute Offset = GeoMax/Leica Offset + 34.4 mm

What is going on?

Prism Offsets Explained

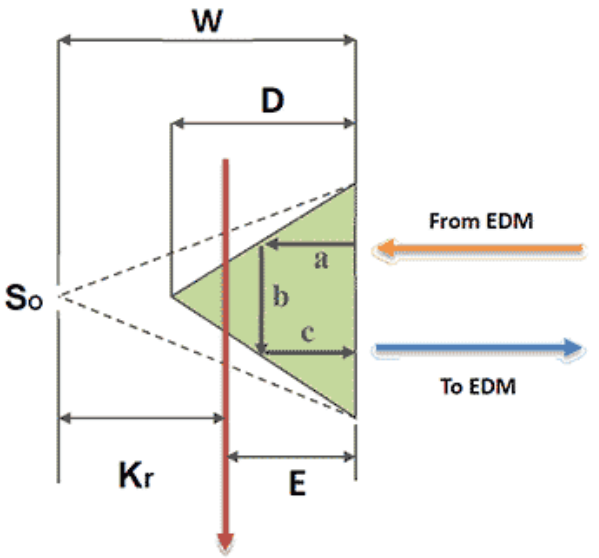


Diagram A

The distance that we want to measure is the distance from the instrument center (vertical axis) to the vertical axis (plumb line, Diagram A) of the prism holder.

However, the path of the beam includes the distance the beam must travel through the prism (distance a+b+c, Diagram A) and must be corrected for this “extra” distance and the effect on the speed of light when the beam travels through the glass instead of air.

This value is Kr: the absolute offset (also known as the manufacturers offset) and in most circumstances the absolute offset is what is printed on the prism.

Except for prism's manufactured by Leica Geosystems and some GeoMax prisms.

Every other manufacturer defines the prism constant as a correction that is directly applied to the measured distance.

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 point (So, Diagram A), then the Prism Constant equals 0. In other commercially available prisms the vertical axis is always in front of the point (So). The measured distance will then be too long and the corresponding correction (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. This minimizes errors due to misalignment. Prism sets that follow these design principles are known as nodal prism sets.

The GeoMax / Leica Prism Offset

GeoMax/Leica uses a different prism offset method than other manufacturers (and they are the only companies to do so). 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 + GPR1) which has a Kr value equal to -34.4 mm.

A Note of Caution

The GeoMax 360 prism has a Leica constant printed on the label.

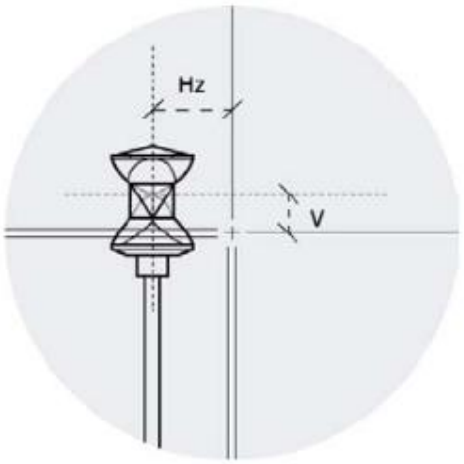
Some GeoMax branded prisms have Absolute embossed on them.

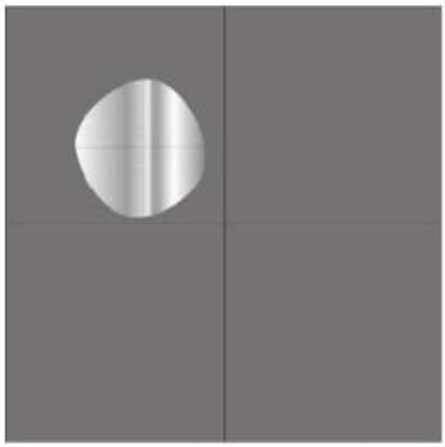
Be VERY careful with GeoMax branded prisms and the appropriate constant!

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 can do by manually adjusting the crosshairs so you should not try to out-smart it!

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 image to compute the delta-Hz / delta-V of the computed and adjusted prism center from the robot measurement center:



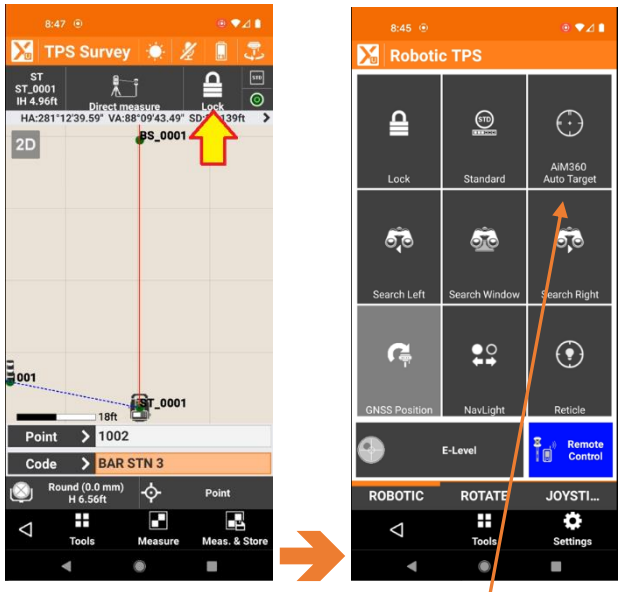


This saves positioning time, battery drive power, drive motor wear and results in a more accurate position than you could do by hand.

However, it also results in the crosshairs NOT 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 Target Recognition



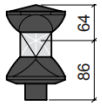
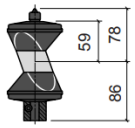
X-PAD Only: you can enable the Robot's **AutoTarget** mode.

The robot will automatically select the best collimation mode by the observed environment.

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 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:

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

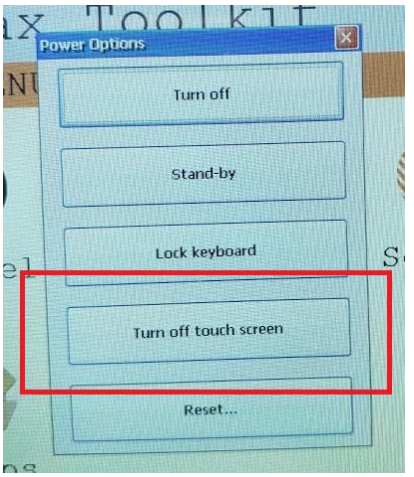
The GRZ122 High Accuracy 360 Prism:

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 prism.

Locking and Unlocking the Touchscreen on the Primary Face

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!

Long Distance Measurement Errors

For some reason, we often are confronted with elevation 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:

Compensator is enabled

Level is nearly perfect

EDM mode is Standard

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 statistically is probable that they will NOT exceed the nameplate accuracy. So, you should expect the robot to be as accurate as the nameplate and not much better.

Do a Field Calibration at the First Sign of Trouble

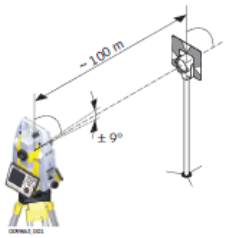
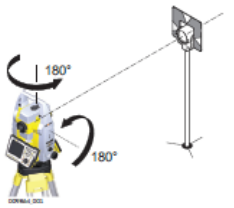
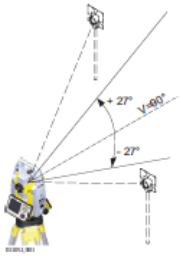
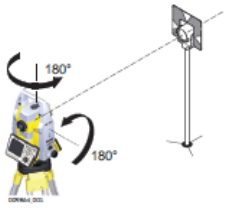
In addition to the **factory recommended** situations where a field calibration is warranted:

- 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

If your robot is having a difficult time **Power-Searching** (turns to prism, then can't find prism when looking up and down), 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.

The instructions are in the User Manual on page 38.

A summary of the User Manual follows:

Step	Description
1.	**MAIN MENU: Apps\Calib\Calibrate All** or **Calibrate without AiM.**
2.	Level the instrument and press **OK.**
3.	 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.
4.	Press **OK** to measure and continue to the next step.
5.	 Motorised instruments change automatically to the other face. It is recommended carefully fine-point to the target manually.
6.	Press OK to measure and continue to the next step.
7.	Repeat steps 3,4,5 and 6 for the second set. Continue with step 8.
8.	 Aim the telescope accurately at a target at about 100 m distance or less if not possible. The target must be positioned at least 27°/30gon above or beneath the horizontal plane.
9.	Press **OK** to measure and continue to the next step.
10.	 Motorised instruments change automatically to the other face. It is recommended carefully fine-point to the target manually.
11.	Press **OK** to measure and continue to the next step.

Step	Description
12.	Repeat steps 8,9,10 and 11 for the second set. Continue with step 13.
13.	The results are shown on the screen. If the values are okay, press **OK** to store or press **ESC** to decline.

On step 8, it is usually difficult to find a target 27 deg above the horizon, 100 meters distant (that would be > 150 feet tall at a distance of 350 feet.) It is okay to use a nut on the top of a power pole or a building corner.

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 English translation of the page:

Indoor Use Only. Don't get it 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 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" or "Fast"? (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 the 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 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 really 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 the 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 modified; if you enter a pressure then the elevation is 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 these values.

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'.

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

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

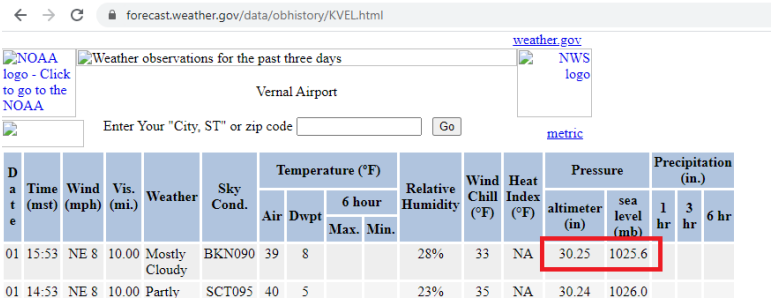
Where:

Elevation is in Meters	ElevM = ElevF * 0.3048
Temp is in degrees Kelvin	degK = degC + 273.15

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 this will be totally inappropriate.

For example, let's consider my current location. The elevation is 5653 ft and the temperature is 24 deg F. The nearest airport is Vernal Utah which is 35 miles to the southeast. The elevation of the Vernal 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 | NWS logo

Vernal Airport

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 Max.	6 hour Min.				altimeter (in)	sea level (mb)	1 hr	3 hr	6 hr
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.

Converting 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.

Because there is a significant difference in elevation and temperature between the airport and the robot's location, the Elevation method is much easier and less accident prone than the Pressure method.

Conclusion

Do a 'Field Calibration'

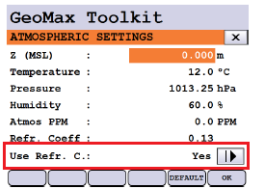
See the rules above. The beginning of the day is reasonable.

Set the Atmospheric settings

Use correct Elevation (not Pressure), Temperature and Humidity.

Enable ‘Use Refraction Coefficient’

Enable on the robot in the GeoMax Toolkit:



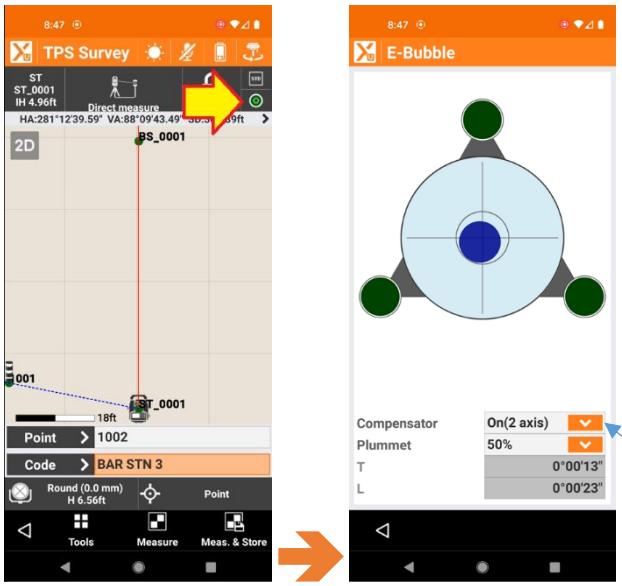
DEFAULT
To set all values to factory default.

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:

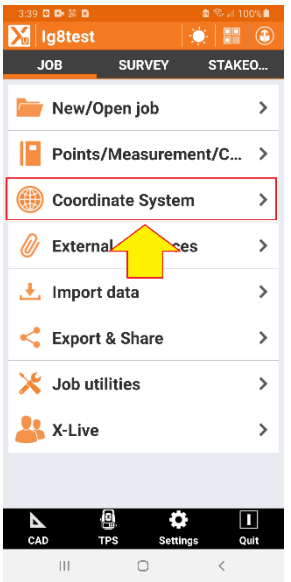
E-Bubble Check

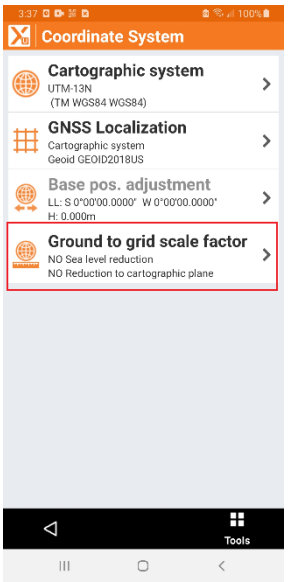


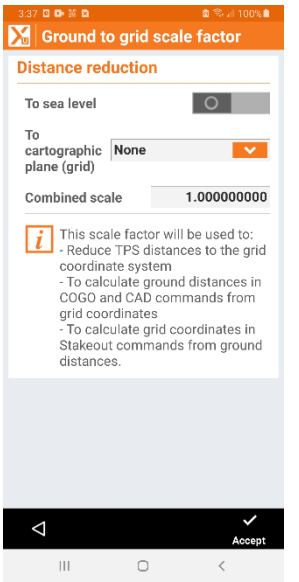
Checks the **E-Bubble**, enables the **Plummet** laser and controls the **Compensator**.

Sea Level Correction

If you are using Grid coordinates, mixed with Ground Total Station measurements, use Sea Level adjustment to reduce 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 you are surveying in a GRID system.