STONEX

Stonex Cube-a

Field Software

Quick Guide

cube-a

6.3

(December 2023) - Ver. 6.3

Summary

1. Introduction

Cube-a is the Stonex field software for professional surveying, designed and developed for the Android platform. With Cube-a is possible to perform a GNSS, GIS and Total Station survey. The software can be installed on any device equipped with Android operating system, starting from Android version 8.

This guide introduces the main functions available in Cube-a software.

1.1 Installation

I. Download the file with extension *.apk for installing the software and copy it into the internal memory of the Android device.
II. Click on the apk file from your Android device to start the installation, then click *Install*.

1.2 Registration of the user license

You need to know your personal license code, it looks like A06000000000000000. The software cannot be unlocked without entering the correct license code.

Follow the steps below to register your license.

I. Start the software.
II. Accept the end user license agreement.
III. Fill out the data form correctly and click *OK*.

If you have any problem activating the program, please contact the local dealer.

1.3 Cube-a first boot

The first time you open the software, you are prompted to create a project. Each time the user creates a new project in Cube-a, a folder with the same name is created in the device memory (File/StonexCube/Project) where there are all project data, the surveys, all photos associated to the points, etc.

Each time the user creates a new project, Cube-a automatically creates a file with extension *.PD, with the same name of the project, in the Data folder in the project folder (File/StonexCube/Project/Data); PD is the extension of the surveys created with Cube-a.

2. Main Interface

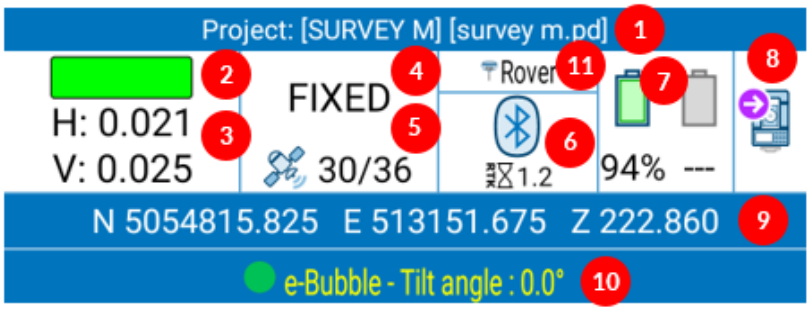
The main interface of the software consists of the Status Bar always visible at the top and the Menu Bar at the bottom.

The Status Bar is always visible, even switching menus, and is continuously updated in real time, based on the signal received and the location of the instrument you are connected to.

The menu bar, at the bottom of the screen, allows you to access the six main menus of the software.

2.1 Status Bar – GNSS Module

In the GPS mode, the status bar is as follows.

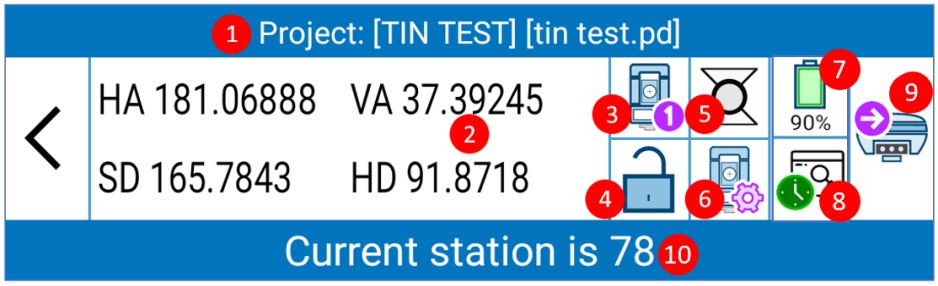


1. The name of the current Project and the PD file currently in use (see 3 Project).
2. Indicator of conformity to tolerances (see 7.2 Point type).
    a. Green: tolerances respected.
    b. Red: tolerances not respected.
    c. Yellow: tolerances respected only in part.
3. Horizontal and vertical root mean square (see 4.1 GNSS Status).
4. Type of solution (see 4.1 GNSS Status).
5. Number of satellites used/ number of satellites visible.
6. Data transmission mode (see 4.4 Datalink Settings) and age of differential corrections (see 4.1 GNSS Status).
7. GNSS receiver battery or batteries level.
8. Switch to Total Station mode.
9. Local or geodetic coordinates of the current position (click to switch between views).
10. Pole tilt angle (available only if connected to a receiver equipped with IMU sensor and with active tilt correction). Hold down to enable or disable the sensor.
11. Working Mode, The GNSS top bar shows the active working mode (rover, base, static). Clicking on the working mode area open the working mode settings page.

If the connected GNSS device has been enabled using a temporary license code, Cube-a will warn the user if the temporary license is going to expire in less than 30 days.

2.2 Status Bar – TS Module

In the Total station mode, the status bar changes in accordance with the type of total station connected to Cube-a. There are some common commands between the different TS models and some specifical options typical of motorized total stations. Here below their description:



1. The name of the current Project and the PD file currently in use (see 3 Project).
2. Total Station measurements:

   HA -> horizontal angle.

   VA -> vertical angle (by clicking on the angle you can view it as a percentage).

   SD -> slope distance.

   HD -> horizontal distance.
3. Face of the station in use. Click to rotate the total station (option available only for motorized TS)
   a. F1 face.
   b. F2 face.
4. Prism state (option available only for motorized TS). Click on this icon to access to the Prism Search Page (see 2.2.1 TS Control Panel) :


Prism is not locked.

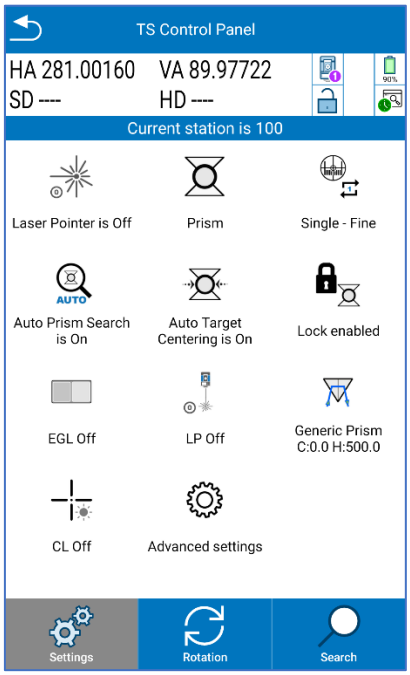

Prism is locked.


Prediction state. When the station loses the prism due to an obstacles, it predicts prism position by rotating with the same angular velocity as the movement of the prism to re-lock it easily, after passing the obstacles (option available only for motorized TS R180) (see 2.2.1 TS Control Panel for enabling/disabling procedure).

5. Select target type icon. Click to change the target type (see 2.2.1 TS Control Panel).
6. Click to access to TS control panel of the total station (see 2.2.1 TS Control Panel)
7. Total Station battery level.
8. Enter in the prediction configuration page (option available only for motorized TS R180) (see 2.2.1 TS Control Panel).
9. Switch to GNSS mode.
10. Name of the current station (click on the name to see the coordinates of the point).

2.2.1 TS Control Panel

The TS control panel contains three menus, *Settings*, *Rotation* and *Search*, depending on you are working with a motorized total Station, or you are working with a mechanical one.



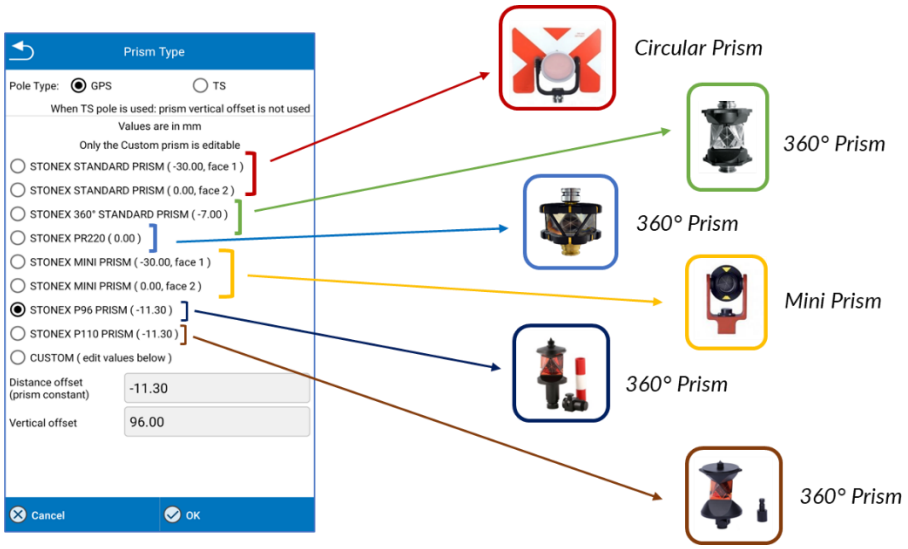
Total Station Settings

Define the total station settings. They can change depending on the total station model used.

- Laser pointer: click to turn off /on
- Target type. In this section the user can choose and change the survey target.
  - *No Prism* if you are surveying points without prism
  - *Tape* if you are measuring a point identified by a reflective sheet
  - *Prism* up to 2,500 meters
  - *Remote prism* between 2,500 and 5,000 meters
- Measuring mode. In this section the use can choose the measure mode (*Note*. The available measure modes depend on the model used).
  - *Single - Fine*: the station will measure a single and precise measurement point
  - *Single - Coarse*: the station will measure a single and fast measurement point
  - *Tracking - Fine*: The station will continue to make precise measurements point, until it is stopped
  - *Tracking - Coarse*: The station will continue to make fast point measurements point, until it is stopped
  - *Tracking - Coarse + Fine Shot*: The station will continue to make fast measurements until a precise measurement is made

- *Average (3)*: the station will survey 3 points measurements and Cube-a will average them.
- *Average (n)*: the station will *survey n* points measurements and Cube-a will average them. Press over the icon to enter as many measures as you want

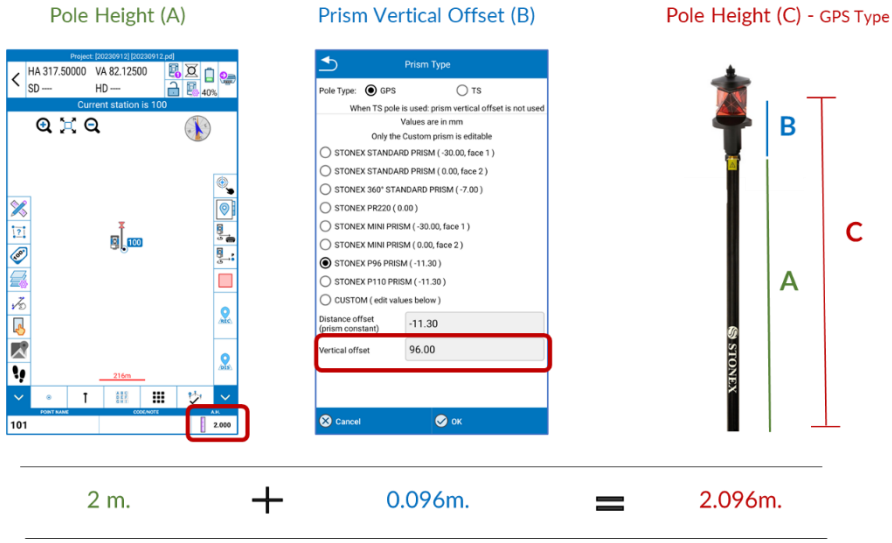
- Auto Prism Search: This option enables /disables the automatic prism search and centering (only available with robotic total station). In this way the user can use the robotic TS as a mechanical one.
- Auto Target: Can be enabled /disabled. If the Autotarget is enabled the total station centers automatically the prism center precisely before measuring. If Autotarget is enabled, the Lock is enabled and vice versa.
- Lock: Can be enabled / disabled. It makes sense to enable it if you are using a prism as a target. If enable the user can Lock and track the prism, after searching it.
- Electronic Guidelight: This option is useful to help the user to locate the prism in total station telescope direction. Can be enabled /disabled.
- PL (Laser Plummet): Can be enabled /disabled .
- Prism Type : In this section the user can insert the prism of the survey. it's possible to choose between some predefined prisms or add a custom one (clicking on CUSTOM). Click on ***OK*** to confirm your selection.
  - If the user selects one of the prisms from the list, the prism constant and the vertical offset are automatically associated to that prism type.
    In the image below, it's possible to see the photos of the different prisms already stored in Cube-a prism list.



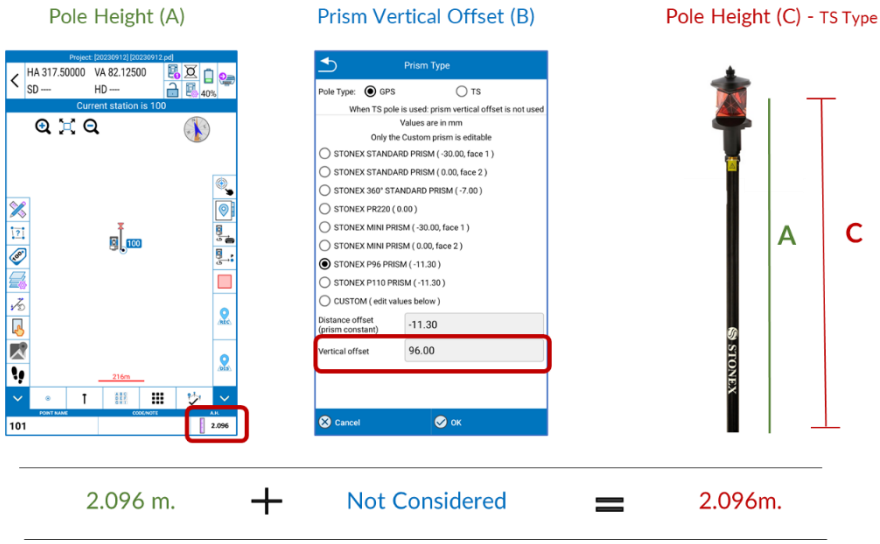
  - If the user selects CUSTOM.
    He must insert manually the prism constant (available on the prism datasheet) and the prism vertical offset.

In this section the user can also select the Pole Type, choosing between *GPS Pole* (consider the prism vertical offset) and the *TS Pole* (don't consider the prism vertical offset).

- If the user selects GPS Pole, the pole height will be calculated as the sum of the pole height inserted in Cube-a survey page (6 Survey) + prism vertical offset. In this case, the user has to select the right prism (B in the image below) and insert the height of the pole from the ground to the prism attachment (A in the image below). Cube-a automatically adds the prism vertical offset (B) to the pole height (A) to relate the measurements to the prism center (C in the image below).



- If the user selects TS Pole, Cube-a doesn't consider prism vertical offset (B) but only prism constant. In Cube-a survey page (6 Survey), the user has to insert the pole height as the height of the pole from the ground to prism center (A = C).



The choice between GPS and TS Pole depends on user needs. GPS pole type is selected by default.

- CL (Cross Light): Can be enabled CL On /disabled CL Off .

- Advanced Settings  . This section is available only for R180 Motorized total Station and can be used by the user to configure the station for the survey. In this page the user can:

  - Enable/Disable the *Quick Lock* function. If enabled the first lock is faster and the fine adjust is performed automatically during the centering and lock-in operation. If disabled, the first lock is slower, but the fine adjust is performed separately from the lock-in operation. We suggest disabling it only for monitoring operation. The *Quick Lock* function is enabled by default in Cube-a.

  - Configure the behavior of the station after losing the prism to re-lock the prism easily. Cube-a offers different solution giving the possibility to the user to choose the best configuration according to its needs and to the survey conditions.

    1. In this section the user can enable/disable the predicted position function (red square image below).

       - ☑ *If enable* -> when the station loses the prism due to an obstacle (tree, buildings, cars…), it continues searching for the prism using last known prism direction. If the prism returns in telescope field of view after passing the obstacle, the station re-locks it immediately and it's not necessary to restart the prism search routine.

       - ☐ *If disable* -> the station stops on the point where it loses the prism.
         If the prism returns in telescope field of view, the station re-locks it immediately and it's not necessary to restart the prism search routine.

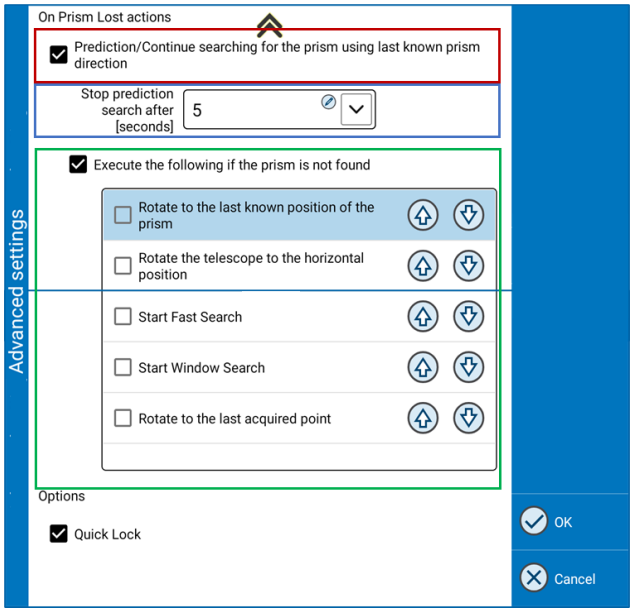
    2. In this section the user can set a prediction time, choosing between some predefined values (5, 10, 15, 20, 25, 30 seconds) or inserting a custom value (blue square image below).

    3. In this section the user can set a serie of operations to automatically re-lock the prism if prediction fails (green square image below).

       - ☑ *If enable* -> If the station doesn't re-lock the prism after the prediction time, it's possible to define a series of operations to be performed sequentially and automatically to lock the prism again.

       - ☐ *If disable* ->If the station doesn't re-lock the prism after the prediction time, the TS stops to rotate and it's necessary to re-start the prism search routine.

    Click on the check boxes to choose what actions you want the station performs automatically and click on the arrows to change the order of execution.



Total station rotation

From here the user can manage a motorized station. It's possible to rotate the TS up/down/left/right; pressing the arrows and using it like a joystick. Clicking on the arrow more than one times the user can increase the rotation speed (this option is available only for R180 motorized TS).

From this page the user can also change the face of the instrument (from face I to face II and vice versa). 

From this page the user can rotate the telescope of the station in horizontal position. 

Prism searching – R80

From here the user can manage the search for the prism with R80 total station. It's possible to start searching for the prism at the top  /bottom  /left  /right  or within larger and larger area  , starting from where the telescope is positioned.

The Search *Near GPS Location*  *and* Search Near *Point*  allow the user to rotate the telescope in the direction of the GNSS or the location of the point, respectively. They can be used during the survey, after the location of the station has been defined and its orientation. *Search near GPS location can* be used if you have the Cube-a GPS module and if the antenna has the *fixed* solution.

Press anywhere on the screen to stop the search. If the prism search is successful and lock settings are enabled, the prism will remain hooked.

Prism searching – R180

From here the user can manage the search for the prism with R180 total station. It's possible to start searching for the prism using FAST360° (search in every direction with clockwise 

and counterclockwise 

rotation of the instrument around its vertical axis) or within larger and larger area  , starting from where the telescope is positioned.

Press anywhere on the screen to stop the search. If the prism search is successful and lock settings are enabled, the prism will remain hooked.

Prism LOCK

To LOCK the prism with a robotic TS is necessary to configure the station as follow:

- *Measuring Mode* -> Tracking-coarse or Tracking - Coarse + Fine Shot (for R80); Tracking Coarse/Fine or Fine (for R180)
- *Lock Enabled*
- *Auto Target Centering is ON*

Search the prism following the indications in the paragraph above to find it and lock it.

3. Project

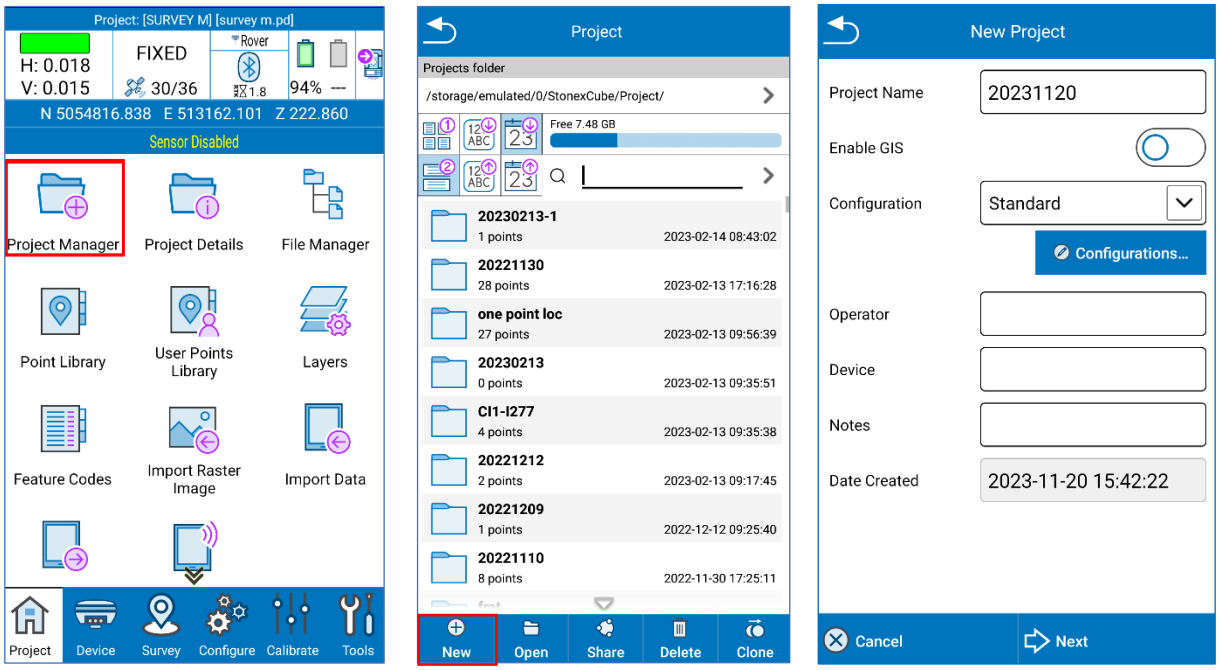
In this menu there is everything related to the project management, import and export of data, the current Fieldbook and the user points library and codes libraries.

Each project can contain more PD files, so more surveys; you can find all the projects in *project manager* and all the surveys, for the current project, in *file manager*. Once the program is launched, you are automatically in the last project and in the last used file; Cube-a always opens a project, whose name is always visible in the status bar at the top.

3.1 Project Manager – Create a new project

This page contains the list of the projects. At the top there is the path where you can find all projects visible below in the project list; you can sort these projects alphabetically or by last access date.

Click *New* to create a new project.



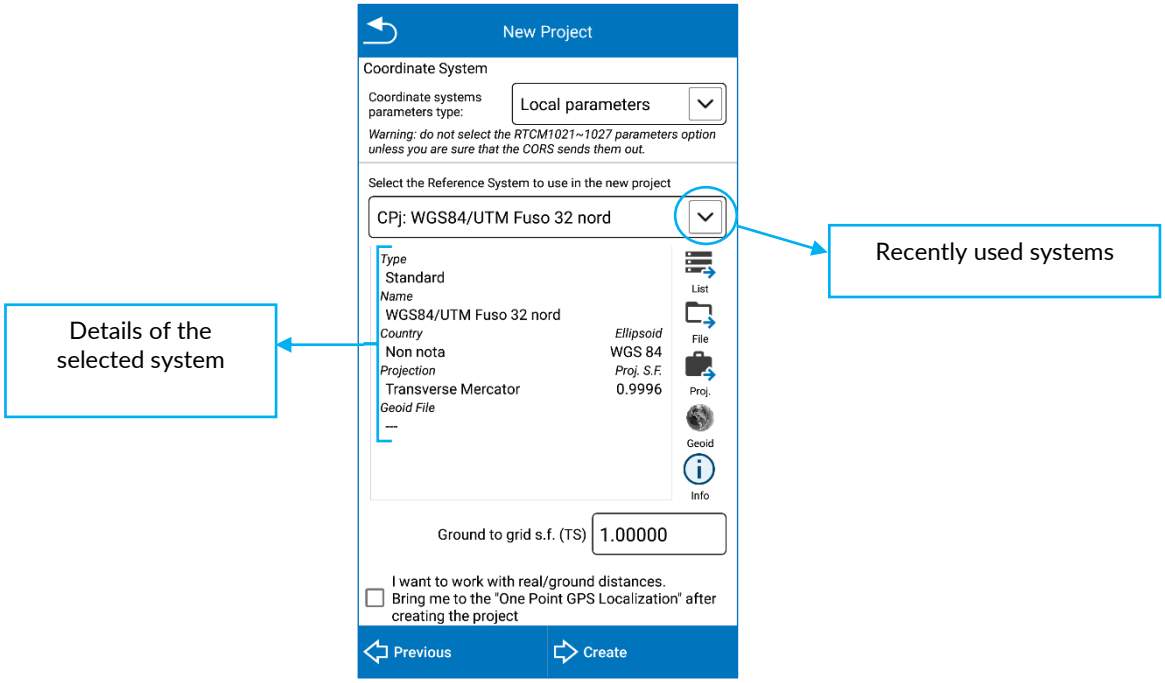
When you create a new project, the default project name is the project creation date, but you can change it by simply clicking on the name bar. In Cube-a, you can no longer change the name of the project; you can assign a different name to the export file only when you export. All other fields are optional.

The *Enable GIS* feature is visible only if you have the GIS module and is disabled by default; see section 3.1.2 GIS Project for more information.

In the drop-down menu *Configuration*, there are the standard configuration already included in the program and all the ones created by the user. Click on the blue key *Configuration* to create a new configuration.

Configuration means the symbol library and layers that can be used in the project. Example: if the user usually uses a dozen of layers defined in the same way each time, is not convenient to recreate them for each project, is instead very useful create a new configuration included these layers (defined just one time) and so recall that configuration for each project in which it is to be used.

By clicking *Cancel*, the project is not created. Click *Next* to continue the project creation.



In the *Coordinate System* section at the top, you can select RTCM 1021-1027 messages if the CORS you use sends them out.

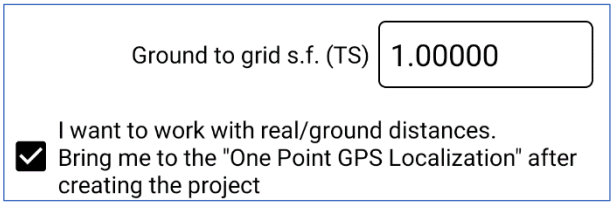
Select the coordinate system you want to use in the new project.

- Click *File* to import an external coordinate system: the compatible formats are *.SP, *.JXL.
- Click *Project* to take the coordinate system from an existing project.
- Click *List* to select the coordinate system from the list of predefined reference systems that you already find in Cube-a; you can search the system by country or key words.

The scale factor from ground to grid allows you to adapt the measurements made with total station to the active reference system. For example, if the projection adopted is UTM then the scale factor is 0.9996.

Note. If creating the project in total station module, Cube-a does not consider the reference system and the scale factor is assumed equal to 1.0000. The reference system will be defined during stationing operation 10 Calibrate – TS Module

Check the following option to perform a "one-point localization" as soon as you create the project. See 9.1 One Point Localization for more information.



Click *Previous* to back to the previous page (project name, configuration...).

Click *Create* to create the project.

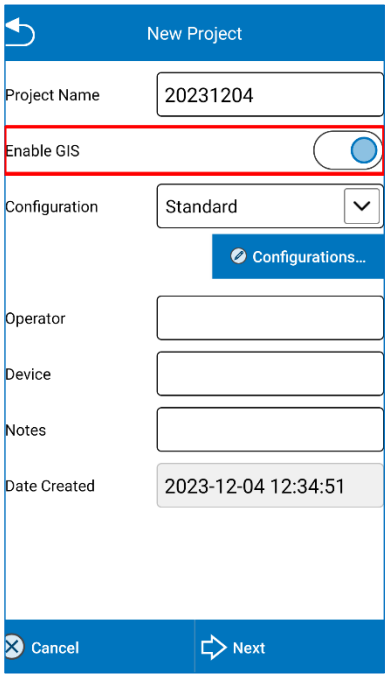
3.1.1 Import a Cube-a Project or a *.PD file

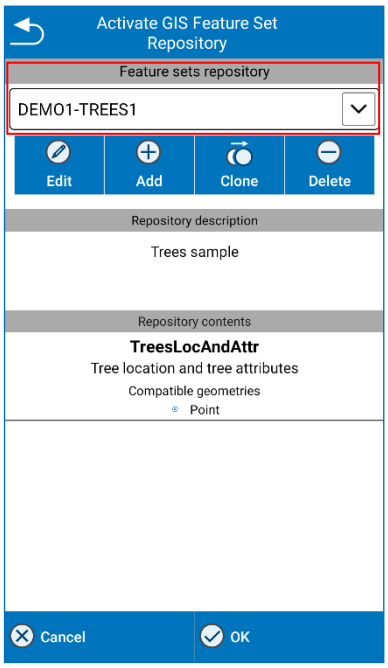
To import a project into your program, copy the project folder, as it appears, in the folder created by Cube-a, StonexCube → Project. The project will then be visible in the *Project Manager* menu in the *Project menu*.

To import a *.PD file within an existing project in Cube-a, copy the *.PD file in the path StonexCube → Project → (Existing Project folder) → **Data**. Attention, if you do not copy the *.PD file in the Data subfolder then it will not be visible in the program. Once copied, select it from the *File Manager* menu to open it in Cube-a.

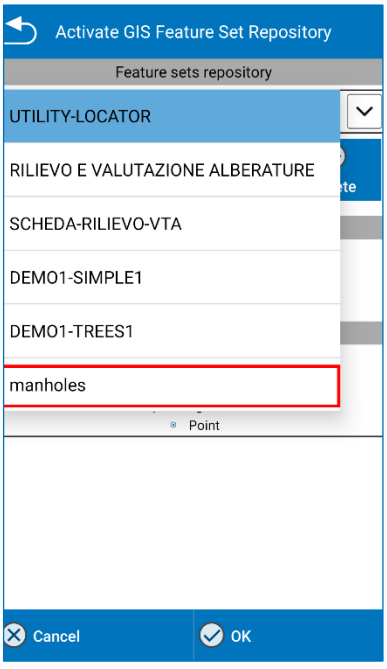
3.1.2 GIS Project

If you have the GIS module, you can enable the GIS option when you create a project, or later from the menu *Project Details*. If you enable the GIS option, the *Activate GIS Feature Set Repository* window appears. Here you can select a group of GIS attributes (Feature sets) from the drop-down menu to use it in the current project (select it and click *OK*), or to edit it (select it and click *Edit*), or to clone it (in this case you can edit the clone without changing the existing one) or delete it.



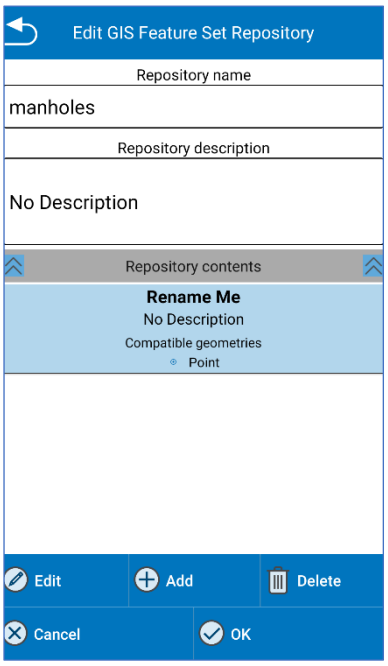


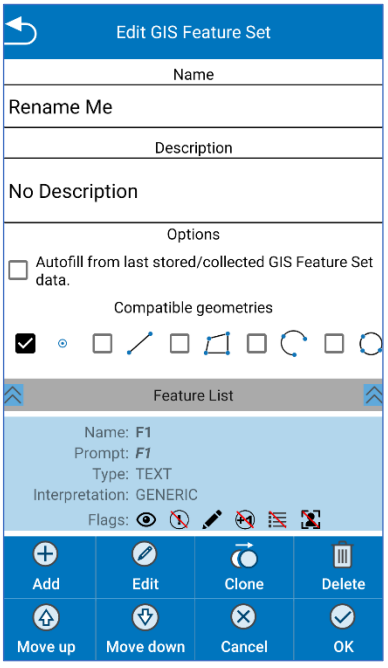
You can create a new group in Cube-a. Click *Add* and type the name you want. The new group appears in the drop-down menu, then select it and click *Edit* to create the group contents and GIS attributes.



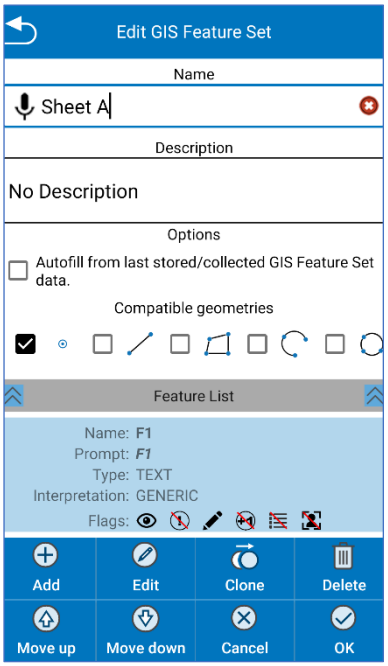
When you create a new group, a class is displayed by default, its name is "Rename me"; select this one and click *Edit* to change the name and create the list of attributes for this class.

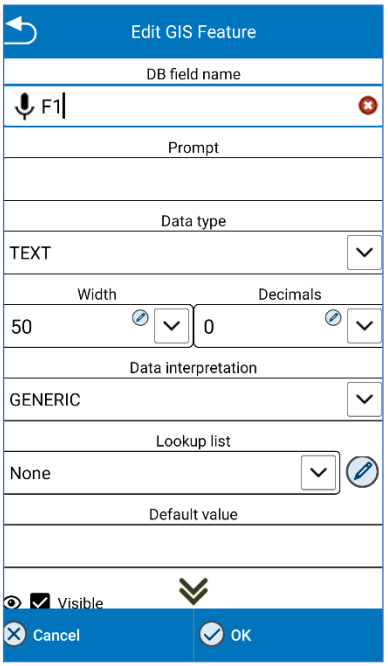
Click *Add* to add a new class. Click *Delete* to delete the selected class. Click *Cancel* to undo the changes. Click *OK* to confirm the changes.



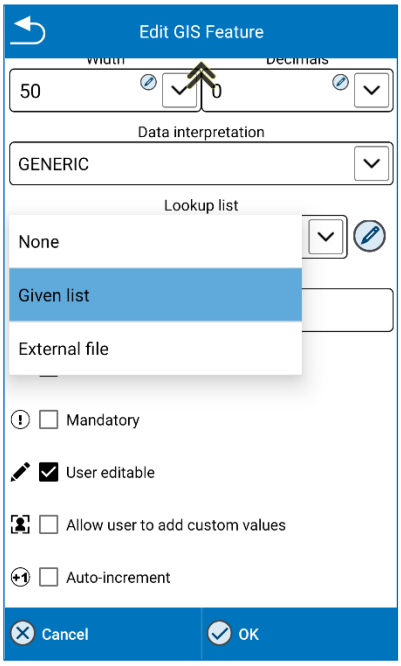


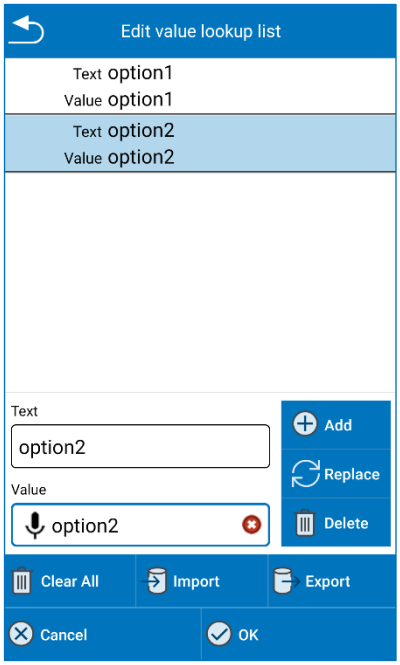
If you select a class from *Repository contents* and click *Edit*, the *Edit GIS Feature Set* window appears. Here you can change the name and description of the class, select compatible geometries, and create or edit the list of attributes, the *Feature List*. When you create a new class, an attribute appears by default, its name is "F1", then select this and click *Edit* to change the name and customize it. Click *Add* to add a new attribute to the current class. Click *Delete* to delete an attribute in the current class.





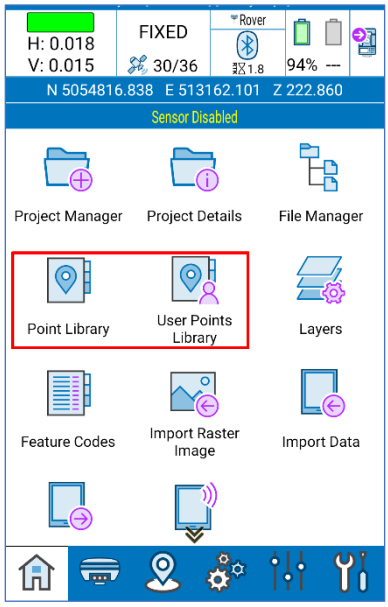
If you select an attribute from the attributes list (Feature List) and click *Edit*, the *Edit GIS Feature* window appears. Here you can change the name and the prompt for the attribute, data type, enter a list of possible values, and other options.





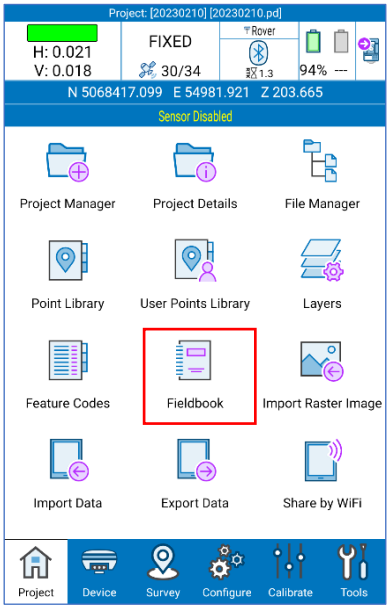
3.2 Point and User Points Library

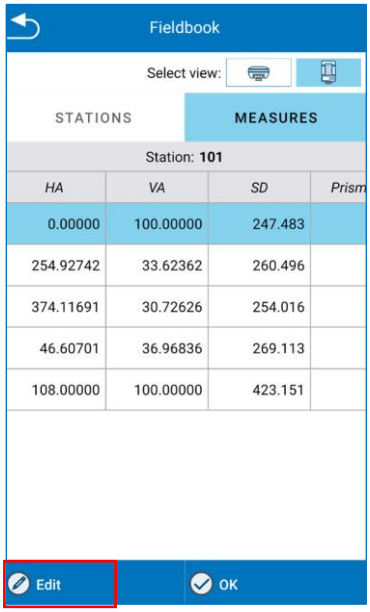
The *Point Library* contains all the imported and surveyed points in the current project; the *User Points Library* it's an archive of points created or imported accessible from all projects, so it's useful to store common points.

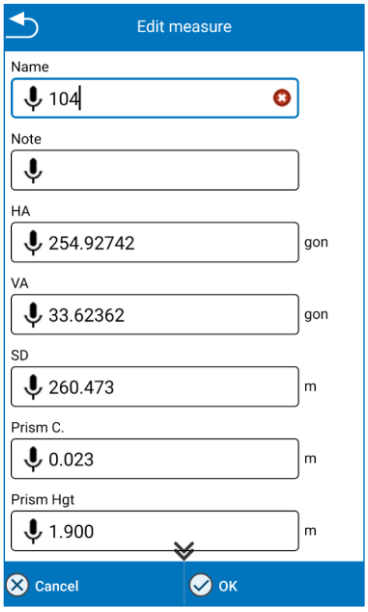


3.3 Fieldbook

The *Fieldbook* contains all the GPS and TS readings performed during the survey. The data included in the Fieldbook are editable. After the user changes some data, the Fieldbook is automatically recalculated by the software (*Note*. Free Stations can be edited using the Free Station/Resection command in *Calibrate* menu by clicking on the button *Existing*. Do not edit it from the Fieldbook).







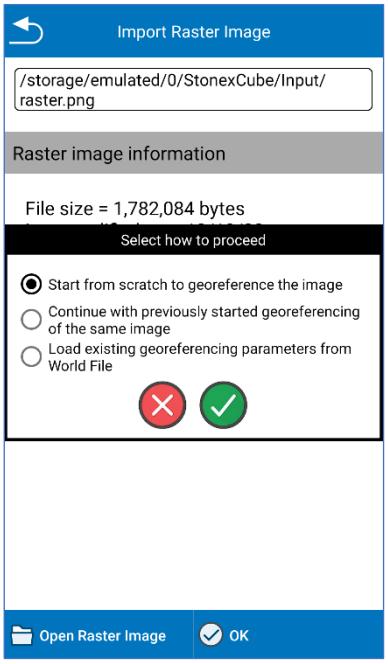
3.4 Raster Image georeferencing

The *Import Raster Image* menu allows you to import a raster image. By clicking "Open Raster Image", the default path is StonexCube → Input, but you can move to other folders.

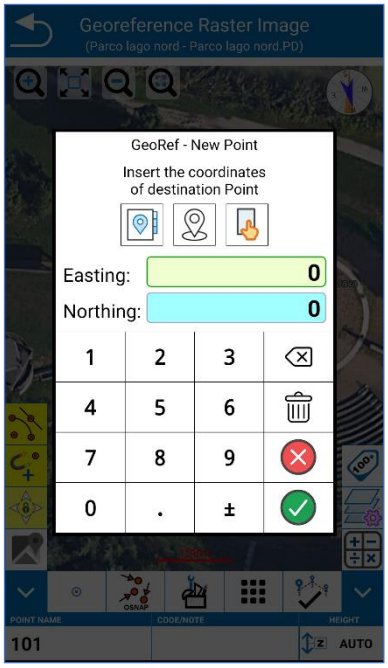
Cube-a supports raster images in the following formats:

- Portable Network Graphics (PNG) – lossless compression.
- JPG (Joint Photographic Experts Group) – non-leak-free compress.
- TIF (Tagged Image File Format)– usually compressed, usually without data loss.

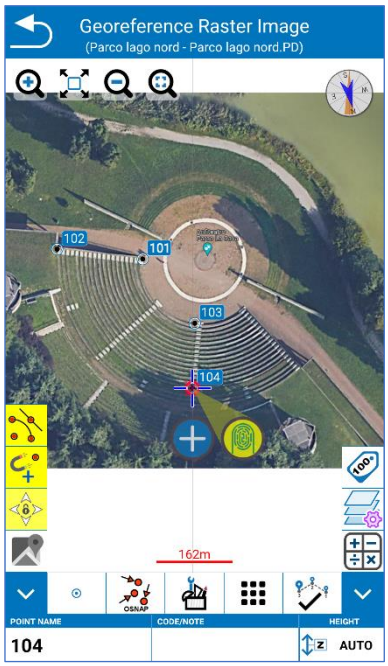
When you import a raster image, you can perform the georeferencing in Cube-a, by clicking on georeferencing option as in the following figure.

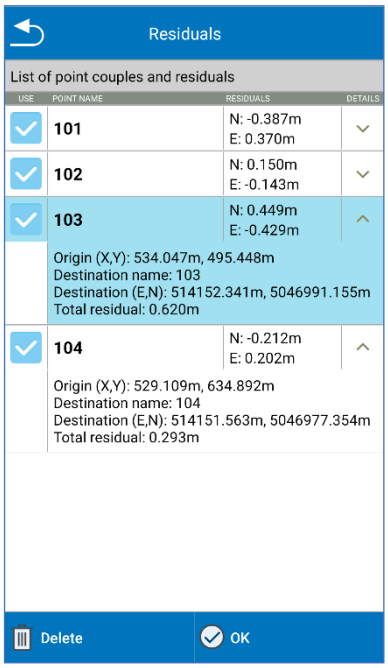


You need 4 points couples at least to perform the georeferencing. You need to associate the coordinates to 4 points not aligned at least in the raster image. You can take the coordinates from point library, from current GNSS position or from survey area.



Click *calculate* icon below on the right to see the list of point couples and residuals.





Click OK in the *Residuals* page to perform the georeferencing.

3.5 Export Data

Export Data menu is used to export the survey in a specific format, which is chosen by the user through the *File type* drop-down menu. You can export data in a default format or custom format. It is necessary to enter the name of the file you want to export, the survey (.PD file) and the format in which you want to export. Click *Export* to export the file to the export path shown at the top (click to edit the path if you want).

If you enable the *Share after exporting* option, before clicking *Export*, the file will also be shared in real time through the communication channel selected (e-mail for example).

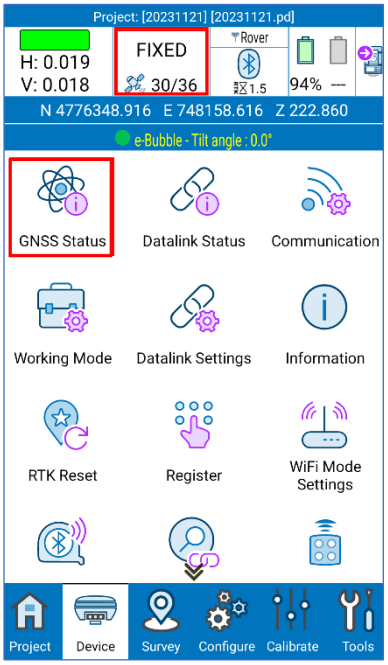
If you want to export the PD file, select the project in the page *project manger* and click *share*, or connect the controller via usb and copy the project folder from the device memory (File/StonexCube/Project).

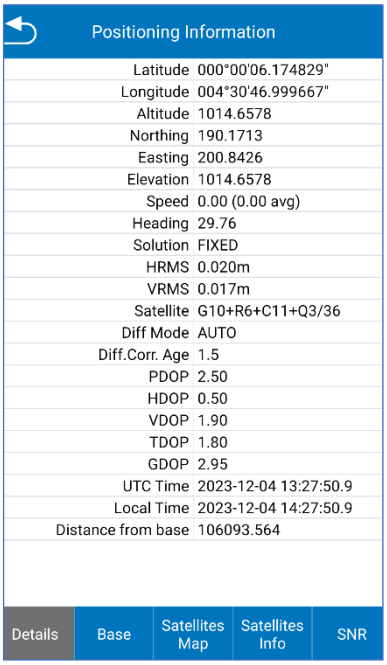
4. Device – GPS Module

The *Device* menu contains all the functions to connect and configure the external devices that can be the GNSS receiver and the Total Station, but also the distance meter and the utility locator,

4.1 GNSS Status

The *GNSS Status* page contains the GNSS positioning information. You can even access this page by clicking on solution/satellites on the status bar.





The **Solution** can be NO FIX, SINGLE, DGNSS, FLOAT, FIXED.

NO FIX: the GNSS position is not available (you are not connected to GNSS receiver, or the receiver does not see any satellites)

SINGLE: the GNSS is not receiving differential corrections from the base, so the accuracy is low.

DGNSS: the GNSS is receiving differential corrections from SBAS satellites, or from the base but it could not calculate a better solution; the causes can be various, e.g., a limited number of tracked satellites or slow data connection.

FLOAT: the GNSS is receiving differential corrections from the base, but the RTK algorithm has not been solved yet and it is always a less accurate position than a FIXED solution. It's a good solution for GIS surveys but not for measurements with expected centimetre accuracy. We suggest you wait to obtain a FIXED solution.

FIXED: the GNSS is receiving differential corrections from the base, it is the final and best solution for corrections with maximum possible accuracy, usually within 2 cm.

HRMS and **VRMS** stand for horizontal and vertical root mean square. They are in meters or feet (depending on system settings) and can be used to have an idea of accuracy level. They are the horizontal and vertical range within which 63% of positions can be, to be exact. Twice RMS is the distance within which 98% of positions can be found.

The **differential mode** is the format of differential messages (CMR, RTCM...). In Cube-a you always read AUTO because the decoding is made by GNSS receiver.

Differential correction age is the time (in seconds) required by the rover to receive corrections (e.g, 10 sec delay means that the base has sent a signal that the rover has received 10 seconds later). When RTK mode is running, the fix delay is low (less than 5 sec.), so the result is better.

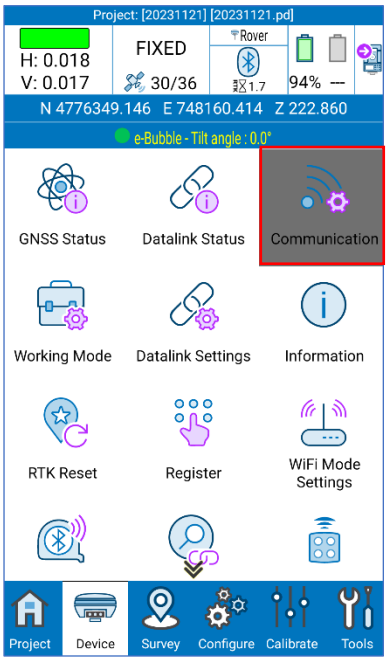
PDOP: Position dilution of precision. The lower PDOP value, the better satellite distribution; this makes easier the achievement of the FIXED solution.

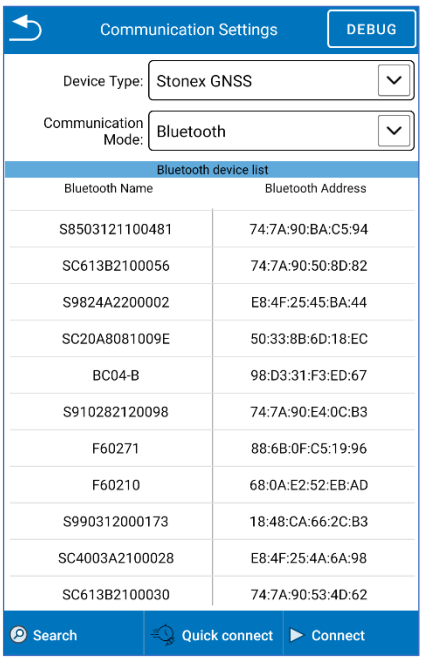
DOP Value	Description
1-2	Excellent
3-5	Good but it may not be enough good for some application
>6	The data should be discarded, unless they are used just to get some estimate of the point location

4.2 Communication – Connect the receiver

In the *Communication* page, you can establish the connection between the instrument and the controller. First, select the device type from the dropdown menu. Select:

- Stonex GNSS for all the latest generation Stonex GNSS receivers.
- Generic NMEA to connect a non-Stonex GNSS receiver.
- Internal GPS to use the GPS inside the controller.
- The remaining types according to the receiver model.





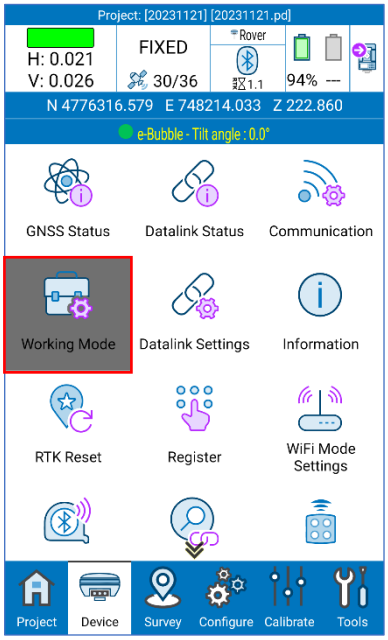
Set the communication mode (Bluetooth is suggested). Click *Search* to look for nearby devices and select the device; click *Connect* to establish the connection.

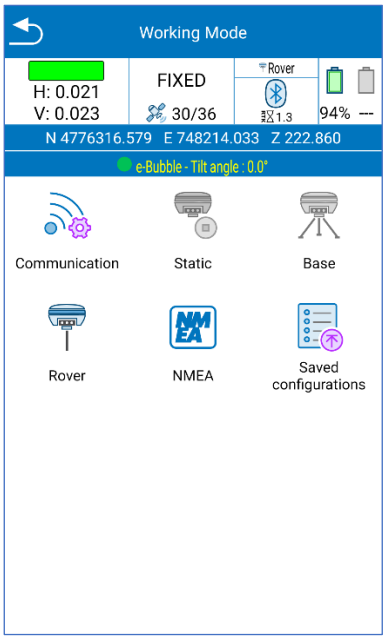
Demo mode

If you select *Demo* in the section *Communication mode*, then Cube-a simulates the connection to a receiver; this is a useful function to use the software without having a GNSS receiver connected. The location of the "fake" GNSS can be set by inserting the coordinates, or by picking from a point in the library or by clicking on the map; by pressing connect the simulation starts.

4.3 Working Mode

The *Working Mode* page allows you to configure the receiver as rover or base for RTK survey or for static survey. You can also launch configurations saved previously.



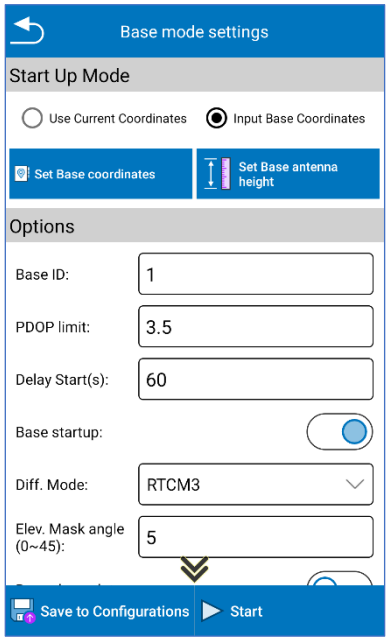


4.3.1 Base

There are two start up mode for base configuration.

Use Current Coordinates

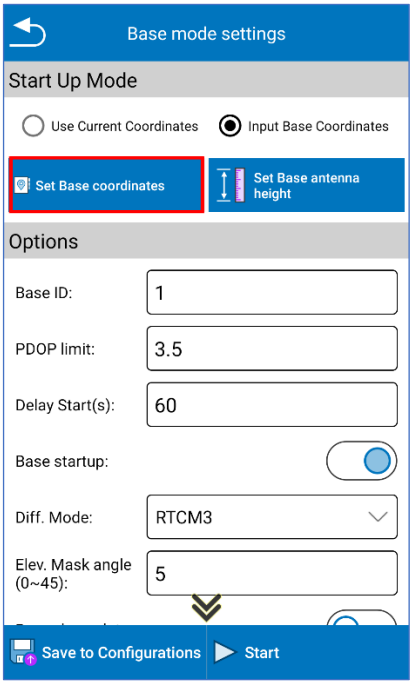
The program takes the current WGS-84 coordinates from the GNSS and sets them as base coordinates.

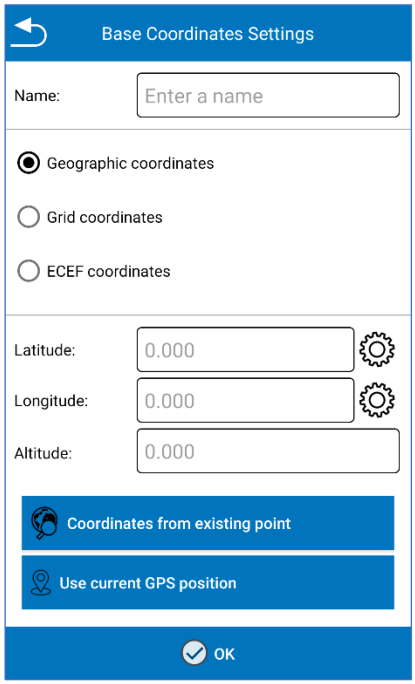


Input Base Coordinates

You can manually set base coordinates. This way you must insert even the antenna height.

Click *Set Base coordinates* to set them and the following page opens.



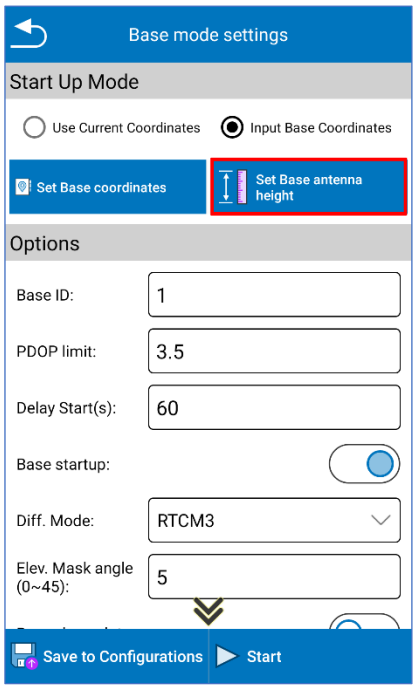


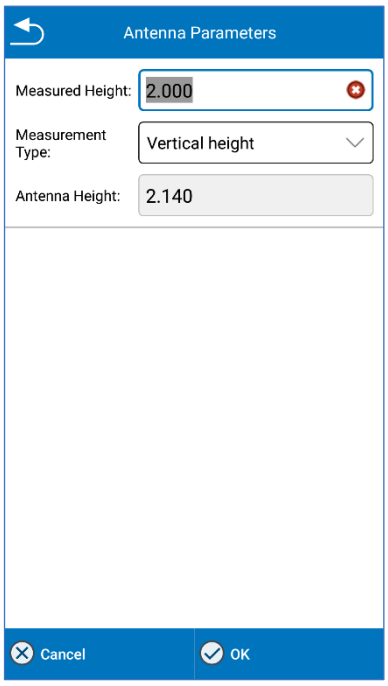
The coordinates sent by Cube-a to the base are always geodetic, but you can insert them in different formats. If you select "Geographic coordinates", then the coordinates will be sent as well as you insert them, so the altitude is the ellipsoidal height. Click on the gear icon to change angles format. If you select "Grid coordinates", then the coordinates you insert will be converted in geodetic coordinates by using the coordinate system set in Cube-a, and the geoid also if it's enabled. If you select "ECEF coordinates", then the coordinates you insert will be converted in geodetic coordinates on WGS-84 ellipsoid (the coordinates system and the geoid set are not considered).

You can manually insert the coordinates in the format chosen or taken from existing point (e.g., when you previously saved the base point in RTK mode or when you imported the known point in the library).

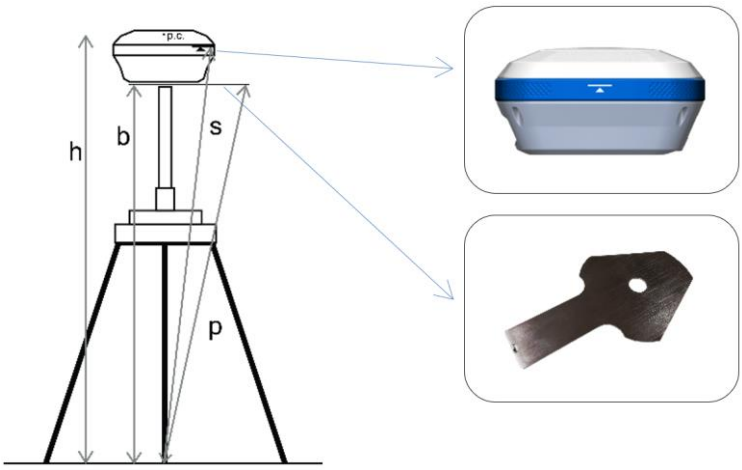
Click OK to confirm the base coordinates.

Click *Set Base antenna height* to set base height and the following page opens.





You can enter the measured height and set how the measurement is done. The antenna height value used in the survey will be calculated automatically by the program, depending on GNSS phase centre position, and visible in the text box Antenna Height.

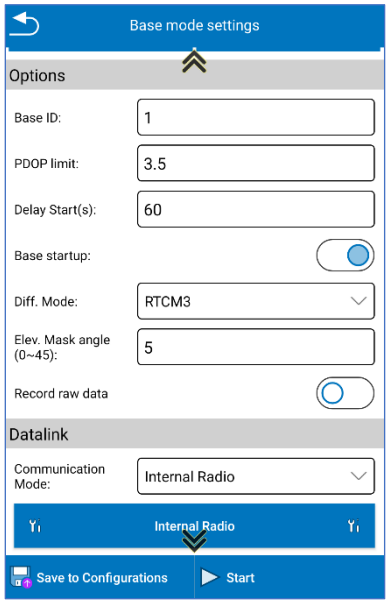


Measurement Type:

- Vertical height -> insert **b**
- Height to phase center -> insert **h**
- Slant height to altimetry line ->insert **s**
- Slant height to altimetry plate -> insert **p**

Options

In this section you can indicate the Base ID, the PDOP limit value, the base start delay, the differential data format, the elevation mask angle (satellites in this angle starting from horizon will not be considered) and the raw data recording.



Datalink

Select communication mode from the dropdown menu. See 4.4 Datalink Settings for details on each communication mode.

Satellite Systems

Satellite systems section includes seven systems: GPS, GLONASS, BEIDOU, GALILEO, NAVIC/IRNSS, QZSS and SBAS. Depending on your work needs, you can choose whether to use the signal from a constellation or not.

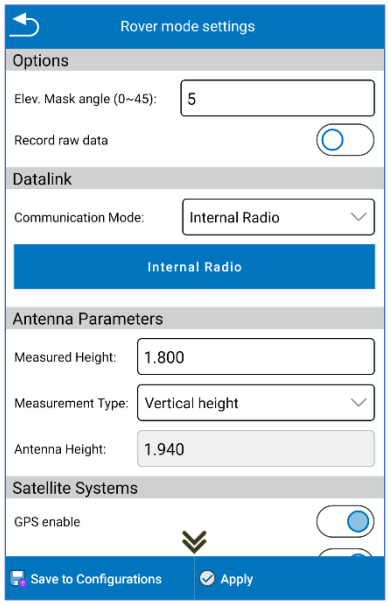
The Satellite Based Augmentation System (SBAS) is a large-scale differential improvement system (improvement system based on the quality of satellite signal). Navigation satellites are surveyed by many widely distributed different stations and the acquired raw data is sent to a computing center. Then from the calculation center, correction information is sent to geostationary satellites of the covered area, and finally, geostationary satellites send corrections to users, helping to improve positioning accuracy.

You can save the configuration by clicking on the corresponding button; this allows you to launch the same configuration later (or in a new project) without having to reinsert all parameters.

Click *Start* to start the receiver to base working mode.

4.3.2 Rover

Rover mode settings page is shown in the following figure.



Options

Elevation Mask angle: the cut off angle starting from horizon (satellites in this angle will not be considered).

Record raw data: you can enable the GNSS raw data recording if you need.

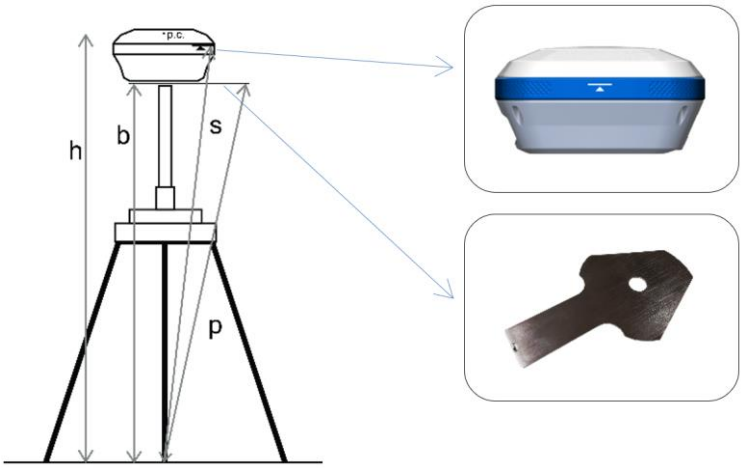
- Collection Interval: 1 Hz indicates the acquisition of one data per second, 5 HZ indicates the acquisition of five data per second, 5 s indicates that the receiver collects data every five seconds, and so on.
- The name of the raw data file is limited to 4 characters.

Datalink

Select communication mode from the dropdown menu. See 4.4 Datalink Settings for details on each communication mode.

Antenna parameters

You can enter the measured height and set how the measurement is done. The antenna height value used in the survey will be calculated automatically by the program, depending on GNSS phase center position, and visible in the text box Antenna Height.



Measurement Type:

- Vertical height -> insert **b**

Satellite Systems

This section includes seven systems: GPS, GLONASS, BEIDOU, GALILEO, NAVIC/IRNSS, QZSS and SBAS. Depending on your work needs, you can choose whether to receive the signal from a constellation or not.

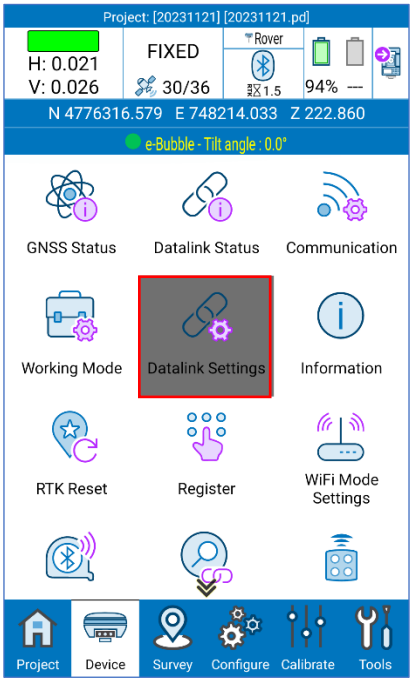
The Satellite Based Augmentation System (SBAS) is a large-scale differential improvement system (improvement system based on the quality of satellite signal). Navigation satellites are surveyed by many widely distributed different stations and the acquired raw data is sent to a computing center. Then from the calculation center, correction information is sent to geostationary satellites of the covered area, and finally, geostationary satellites send corrections to users, helping to improve positioning accuracy.

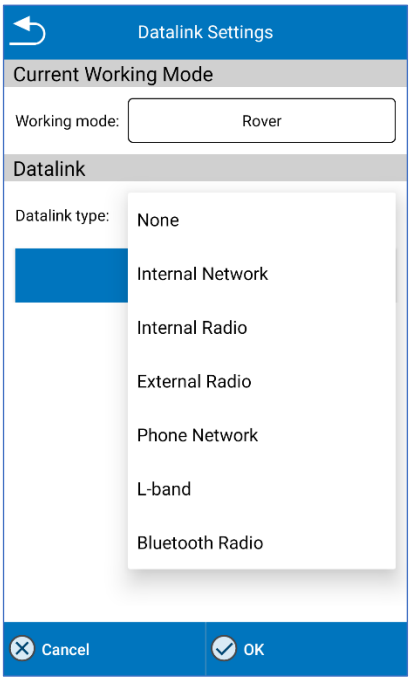
You can save the configuration by clicking on the corresponding button; this allows you to launch the same configuration later (or in a new project) without having to reinsert all parameters.

Click *Apply* to start the receiver to rover working mode.

4.4 Datalink Settings

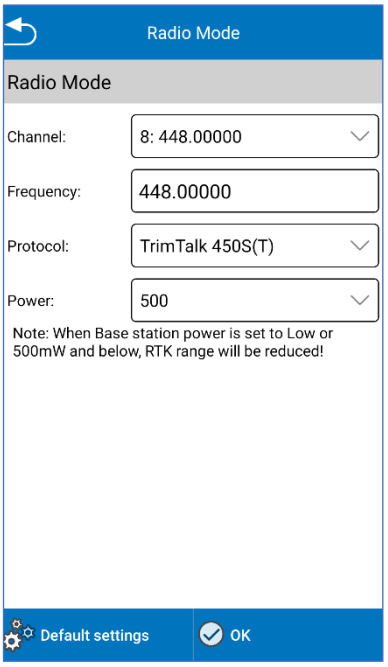
Different data transmission modes are available, and they depend on working mode (base or rover) and on GNSS you are connected. In the following paragraphs there is the description of all communication modes that you can select in datalink section when you configure the base or rover.

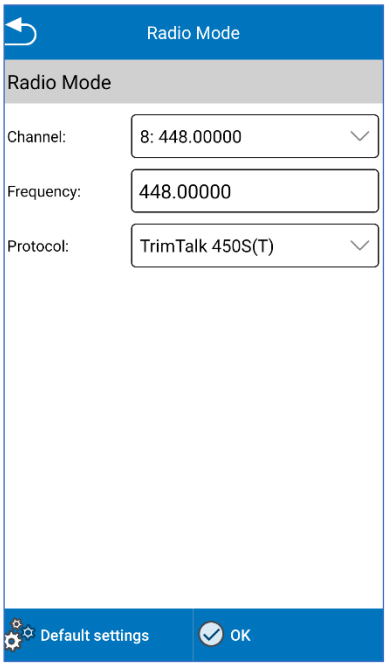




4.4.1 Internal Radio

Differential data is transmitted via GNSS internal radio. In the following figures is shown the internal network settings for base and rover.





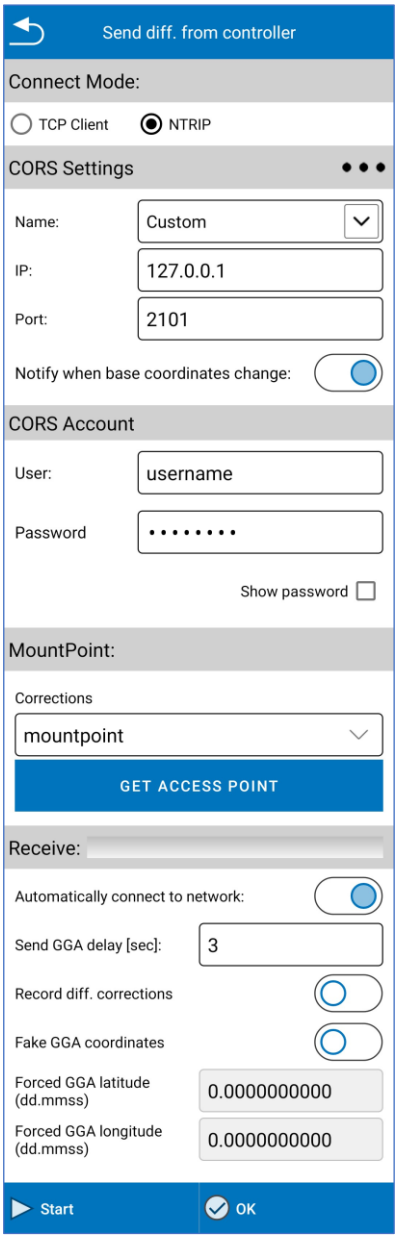
The list of available protocols depends on the connected GNSS receiver.

There are 8 channels, for each channel there is a preset frequency but if you choose channel 8 you can change the frequency. Click *Default Radio Settings* below to change the frequency of the channels.

The frequency and protocol of Base and Rover must be the same. In Basic mode, radio power affects the signal transmission distance. If the power is low, the energy consumption is also low, but the signal transmission distance is reduced; if instead the power is high, the energy consumption is high, but the signal transmission distance is extended.

4.4.2 Phone Network

Differential data is receiving through the controller network, so you must insert a SIM card with internet connection available inside the controller connected to GNSS or connect the controller to hotspot. This communication mode is only for rover.



Connect Mode

TCP: standard transmission control protocol, specific for network transmissions.

NTRIP: standard protocol used to transmit differential data over the CORS network.

CORS Settings

Rover CORS settings: you can search for a CORS by opening dropdown menu or add a new one by clicking on the search button (icon with three dots) or use a custom CORS by inserting parameters in the dedicated fields.

You can enable a warning message each time you change base coordinates.

CORS Account

Set the user and password to access the CORS

MountPoint

Click *Get Access Point* to download the list of mountpoints.

Select the mountpoint from dropdown menu.

Automatically connect to network: the connection starts or re-starts automatically if enabled.

Send GGA delay: interval (in seconds) to send position to NTRIP caster, to obtain the right corrections for that position.

Record diff. corrections: only for debug, to record all corrections received (and to send them to us) for test.

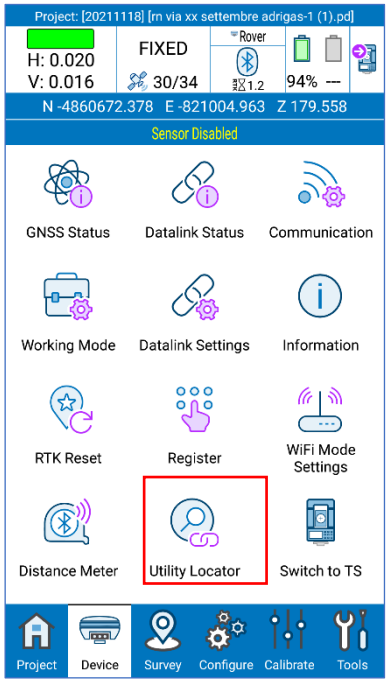
Fake GGA coordinates: send fake position to caster, only for test.

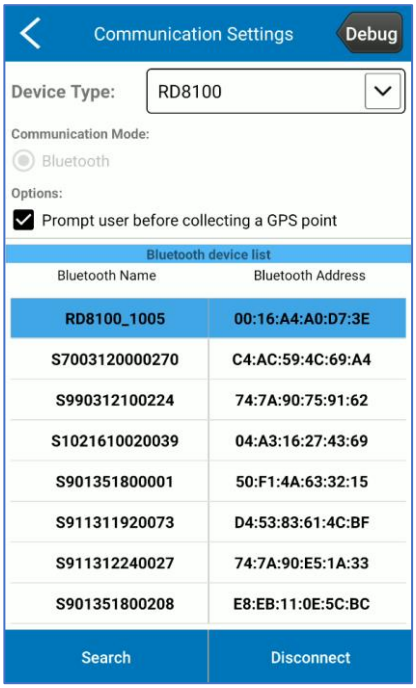
Forced GGA: set fake position to force it if the previous option is enabled.

Click *Start* to start receiving differential corrections.

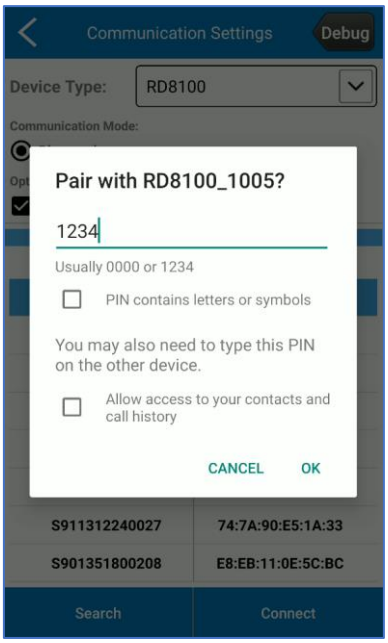
4.5 Utility Locator

You can connect the controller and use Cube-a with RD1800 Pipe Locator. This feature is available with the GIS module only. The page “Utility Locator” consists only in Bluetooth connection between the controller and the detector.



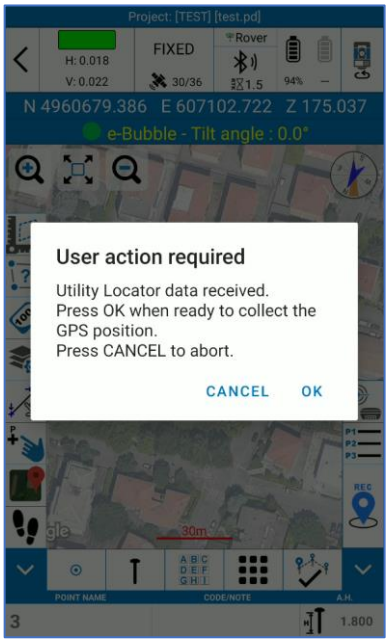


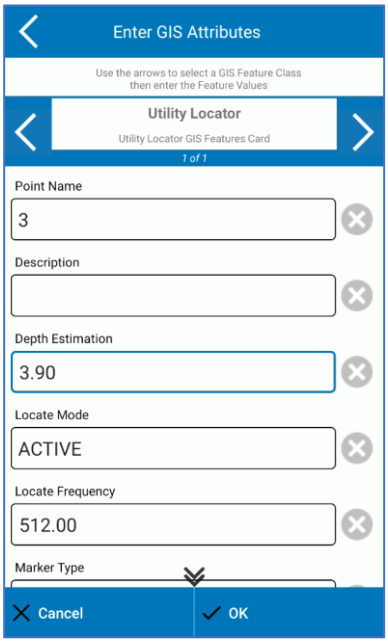
The first time you try to establish the connection, the pairing is required, and the password is 1234. Then, select the device and click *Connect*. See the detector user manual for more details on Bluetooth activation and locator settings.



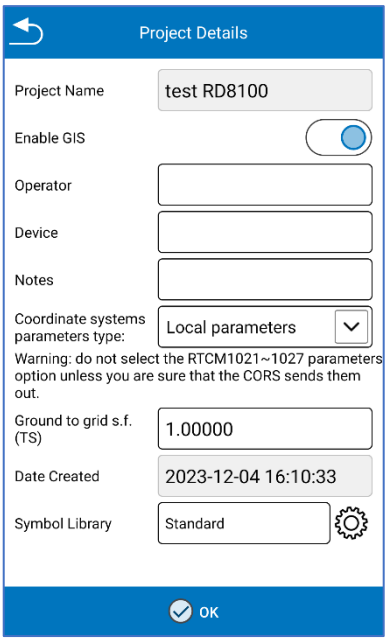
Once the connection is done, when you press the measure button on the instrument to take measurement of the found pipes, the following message automatically appears in Cube-a. This way, you can move the GNSS on the point where the locator is to collect GPS position.

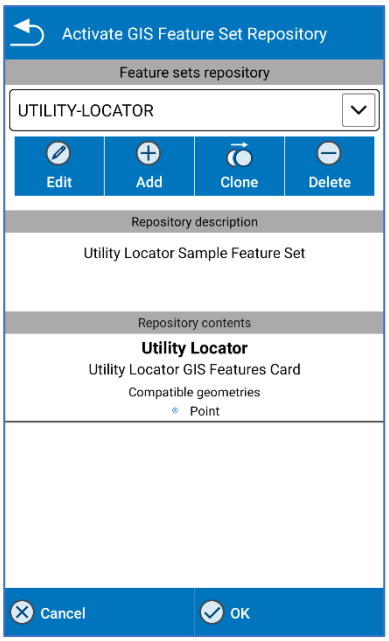
NB. If you disable the option “Prompt user before collecting GPS point” in Bluetooth connection page, then the following alert does not appear and the GPS position is taken as soon as you press the measure button on the detector.





Remind to enable the GIS option and select Utility Locator GIS group of attributes to automatically save the detector measures as GIS attributes when you save the GPS point. Cube-a automatically take information from detector and insert them in the related GIS field, as in the figure above.



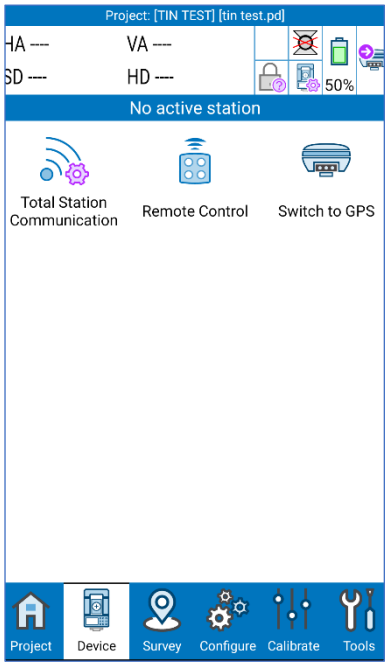


5. Device – TS Module

The *Device* menu contains all the functions concerning the communication and configuration of the GNSS receiver and the Total Station, in fact it looks different depending on the GPS or TS module.

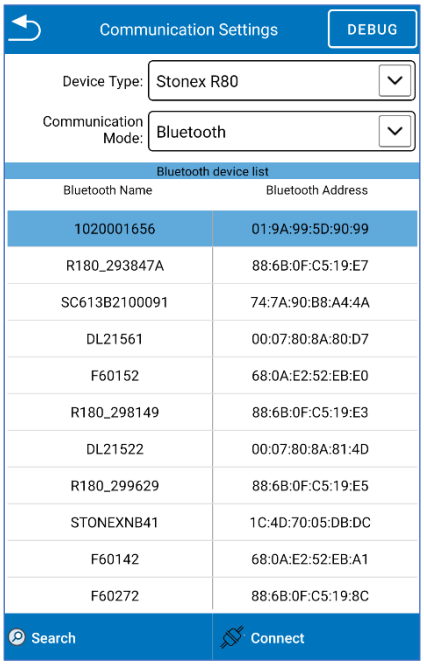
5.1 Communication – Connect the Total Station

There are currently seven supported total stations: Stonex R15, Stonex R25, Stonex R20, Stonex R35, Stonex R60, Stonex R80 and Stonex R180. The demo mode works only selecting Stonex R80.



5.1.1 Total Station Communication

Clicking on “Total Station Communication”, it’s possible to connect the instrument to Cube-a. Select the right *Device Type* and click *Search* to look for nearby devices; select the BT name of your instrument and click *Connect* to establish the connection.

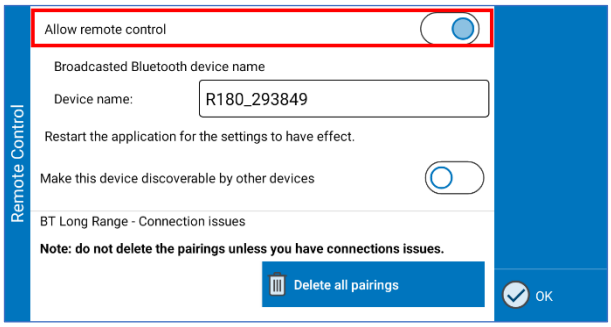


R15, R20, R25, R35, R80 works only in a remote way, using the internal BT module to establish the communication between Cube-a on the tablet and the total station.

R180 is instead characterized by two different configurations: on-board and remote. Select on-board if you are using Cube-a directly on the station and remote if you want to manage the instrument remotely using BT.

The remote configuration of R180 requires two Cube-a licenses (one activated on the Cube-a installed on the total station and the second one activated on the Cube-a installed on an external tablet).

In Cube-a installed on the total station, entering in Device -> Remote Control and enabling *Allow Remote Control*. In this page is also possible to change the *Device name* of the BT module of R180.



Enter in Cube-a installed on the tablet and click on Device->Total Station Communication. Select the *Device Type* (“Stonex R180 (remote)”) and click *Search* to look for nearby devices; select the BT name of R180 and click *Connect* to establish the connection.

Note. Cube-a TS on-board must be open also, to enable the remote connection with Cube-a on the tablet.

R60 is characterized only by on-board configuration. In Cube-a installed on the station, select as *Device Type* “Stonex R60 (on-board)” and click *Connect* to establish the connection.

6. Survey

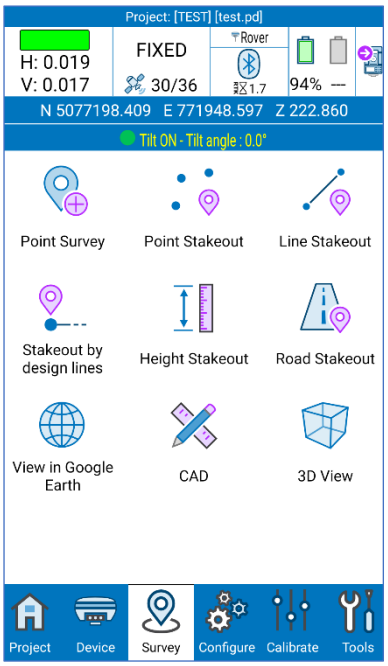
The *Survey* menu contains the survey area, the stakeout functions, and the CAD environment. In the total station mode, there is also the gridded scan function.

Click *Point Survey* to access the survey area. Here you can save points, see them on the background Google maps or DXF, draw while you are saving points and many other operations.

The survey page looks different depending on module (GPS or TS). The common functions are described in the following paragraph; see paragraphs 6.1.1 GPS Survey, 6.1.2 GIS Survey, 6.1.3 TS Survey, for specific functions in each mode.

6.1 Point Survey

Below there is the description of the icons in the survey area common for GPS and TS mode.



Zoom in

Zoom all

Zoom out

Compass (controller's compass)

Click to access the CAD environment (see 6.4 CAD)

Calculate distances and area between points on the map. Click on the icon to enable it then it turns yellow, and you can tap on the map to define the points. The distance between two segments is shown in green in the center of the segment, the progressive distances are shown in green on the points, and the area is in red in the center of the geometry.

Click to make visible or not the point labels. Hold down to access the display settings.

Click to access the layer settings.

Select line. Click on the icon to enable it then it turns yellow, and you can click directly on the line in the survey area to access the line staking out.

Select point. Click on the icon to enable it then it turns yellow, and you can click directly on the point in the survey area to access the point staking out.

Background map. Click to enable or change the map provider. Hold down to access the background map settings page.

Follow me function is enable: the center of the map is always the current position. Click to disable it then a red cross appears on the icon.

Hide the side column.

Select element to save. Click on the icon to choose the entity to draw while saving points or choose the point capture only (see 7.1 Draw during the survey).

Click to change the point type (see 7.2 Point type).

Save the point by clicking on the code you want to assign. Hold down to quickly access the code library.

Click to access the 7.3 Survey Tools.

Click to end the entity you are drawing.

Set the fake position, visible only in DEMO mode.

Click to open the point library.

The bottom bar has the following fields:

POINT NAME	CODE/NOTE	A.H.
6	ADR	2.000

- The name of the next point. Click to change it.
- Code for next point. Click to change it.
- Antenna height

6.1.1 GPS Survey

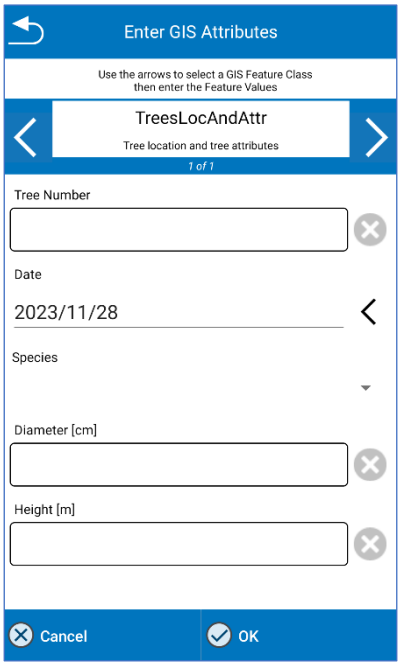
In GPS mode, the survey area looks like the following figure.

The only icon in addition to what has been described in the previous paragraph is the following.

Record GPS point

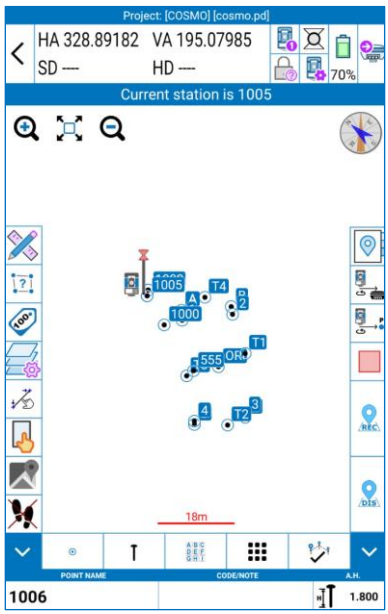
6.1.2 GIS Survey

In addition to 6 Survey and 6.1.1 GPS Survey, when the GIS option is enabled for the current project, the *Enter GIS Attributes* window appears after saving a point or an entity. Here you can choose the class by clicking on the right or left arrow and enter the GIS attributes. Click *OK* to confirm.

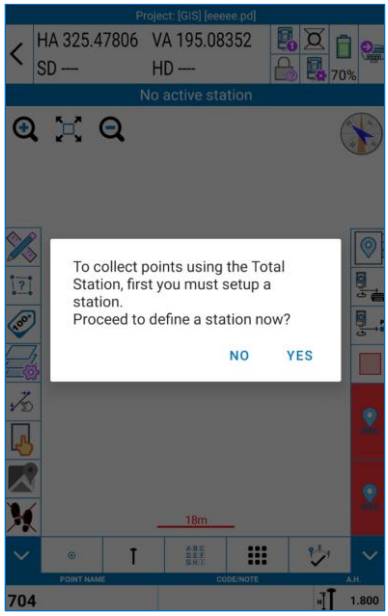


6.1.3 TS Survey

In Total Station mode, the survey area looks like the following figure.



The *DIS* and *REC* icons are red when the station has not yet been declared. Cube-a will not allow you to survey points as long as the keys remain red, but pressing on one of them, you will have the following message that leads directly to the station definition page. Click *OK* to declare the station (see 10.1 Station on point and 10.2 Resection/Free Station).



In the survey area, in addition to the icons described in 6.1 Point Survey, in TS mode there are the following functions:

Measure. Pressing and holding the icon is possible to perform a complete measurement or only measure the angles.

Save points if a measure has already been made, otherwise measure, and save the point.

Stop the measurement if you are in tracking mode or searching for the prism or to remove the prism lock (option available with robotic TS).

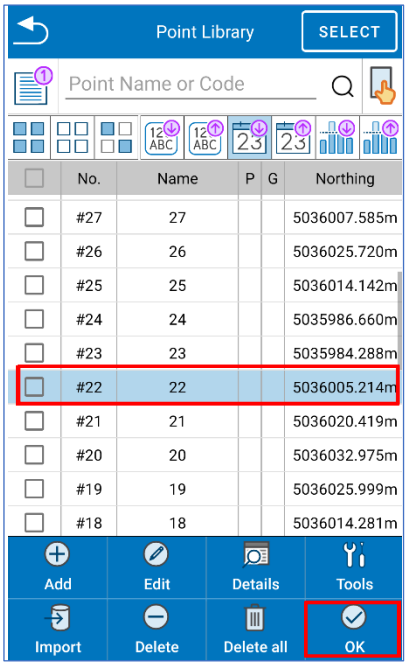
Rotate the telescope to a point. It can be used during measurement, after you have defined the station and its orientation.

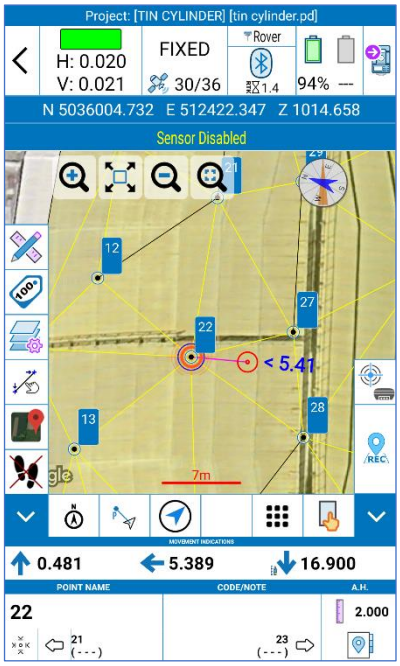
Rotate the telescope to the GPS location. It can be used during surveying, after you have defined the station and its orientation, it is enabled if you have the Cube-a GPS module and if the antenna is in a fixed solution.

Click on this icon and then on Topo Point to enable/disable the TS measure *Quick Mode*. If enabled the point is saved in the point library without displaying the resume page. Select the *Quick Mode* and click on *Save* to enable it.

6.2 Point Stakeout

The point stakeout interface is shown in the following figure. Your current position is the red circle (if you stand still) or the red arrow (if you move). The point you are staking out is highlighted with an orange circle. The pink line joins your position and the picket point.





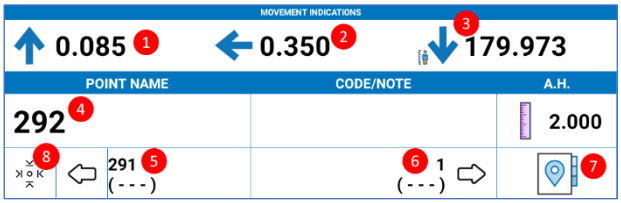
In addition to the functions described in #Point Survey, there are also the following features.

Zoom in on your position and the point you want to stakeout.

Define the orientation. The **indications** to reach the point **depend on this option**.

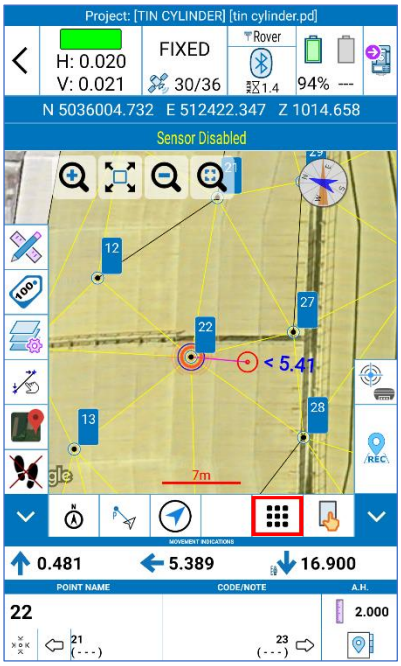
- *North*: rotate on yourself so that the North is in front of you.
- *South*: rotate on yourself so that the South is in front of you.
- *Sun*: rotate on yourself so that the Sun is in front of you.
- *Shadow*: rotate on yourself so that the Sun is behind you.
- *Point*: rotate on yourself so that the reference point is in front of you.
- *Line*: rotate on yourself to have the same orientation of the defined alignment. To define the alignment points, use the point selection tool (blue pointing hand).
- *Station (2-man)*: choose this option if there are two people at least in the field (only in TS mode). One stays at the total station and gives instructions to the second one who is close to prism.
- *Station (1-man)*: choose this option if you are alone in the field. It must refer to the location of the station and move by supporting the prism. This mode is to be used if you are working with a motorized/robotic station.

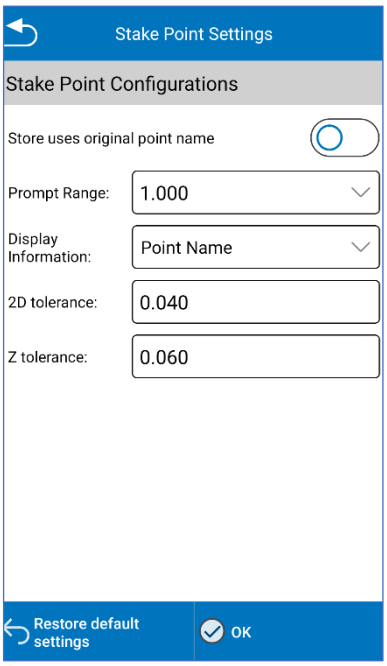
Shows the direction in which you must move, through a blue arrow, and the distance between the current position and the picket point. Press  to return to the map view.



1. Move back or forward.
2. Move left or right.
3. Move up or down.
4. Picket point.
5. Stakeout the previous point.
6. Stakeout the next point.
7. Access the points library to select another point to stakeout.
8. You can find nearest point modified to find first the "second nearest point", then if clicked again to find the "first nearest point". This allows to skip the just staked point.

Click the icon highlighted in red to access the *Survey Tools*. In addition to the functions described in 7.3 Survey Tools there are also the *Stake Point Settings*.

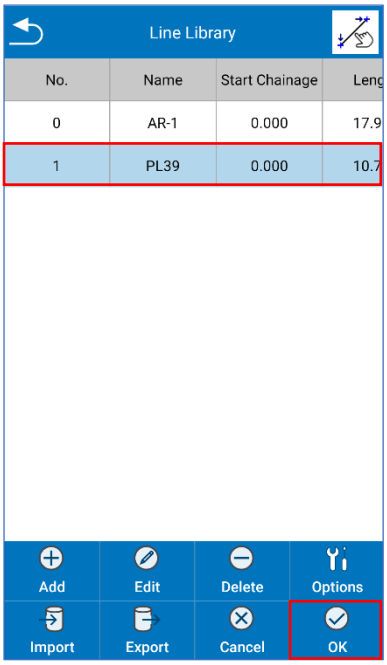


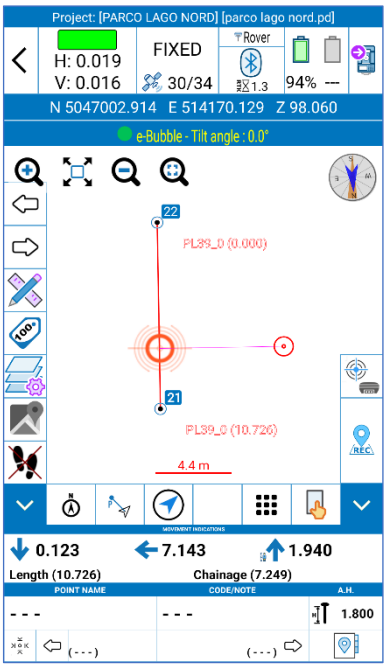


Prompt Range: three concentric circles can be displayed around the point; define the maximum distance from the picket point.

6.3 Line Stakeout

The line stakeout interface is shown in the following figure.





The icons are the same described in the previous paragraph 6.2 Point Stakeout. The line you are staking out is highlighted in red. The current position is shown with a red circle (if you hold still) or an arrow (if you move). The point you are staking out is shown with an orange circle.


Click here to access the line library and select another line to stakeout.

If you want to stakeout a line from a DXF file, remind that, if you import the file as external drawing then the DXF entities are not listed in the line library so you must select them from the map in the Survey Area select_line.

If you want to stakeout the circles and the arc that imported from the page “External drawing”, you can select the entity directly by activating this option  and clicking on the entity.

6.3.1 Line Stakeout Settings

The page *Stakeout settings* shown below appears as soon as you select a line to stakeout.

Offset distance

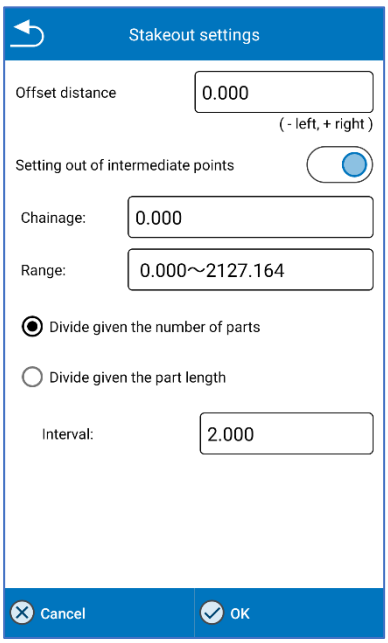
Stakeout the line selected shifted by value you insert.

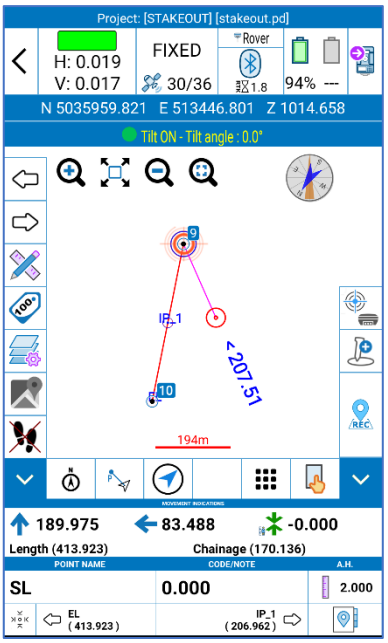
Setting out of intermediate points

Disabled: the indications are only for reach the line or the extensions of the line.

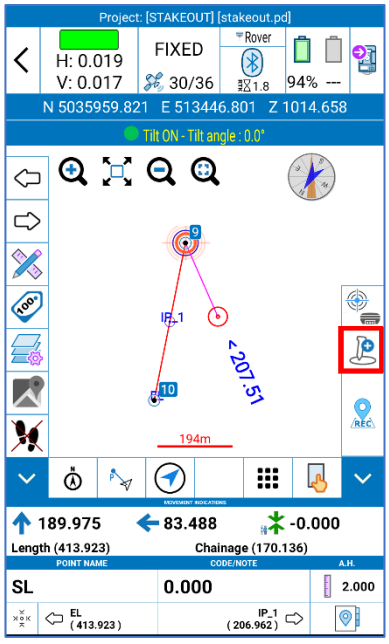
Enabled: the indications are for reach specific points on the line, on the extensions of the line or on the shifted line.

In the following example, setting out of intermediate points is enabled and the line has been divided in two (interval value) parts, so the indications are for reach specific points that are the first, the middle and the end point of the line.

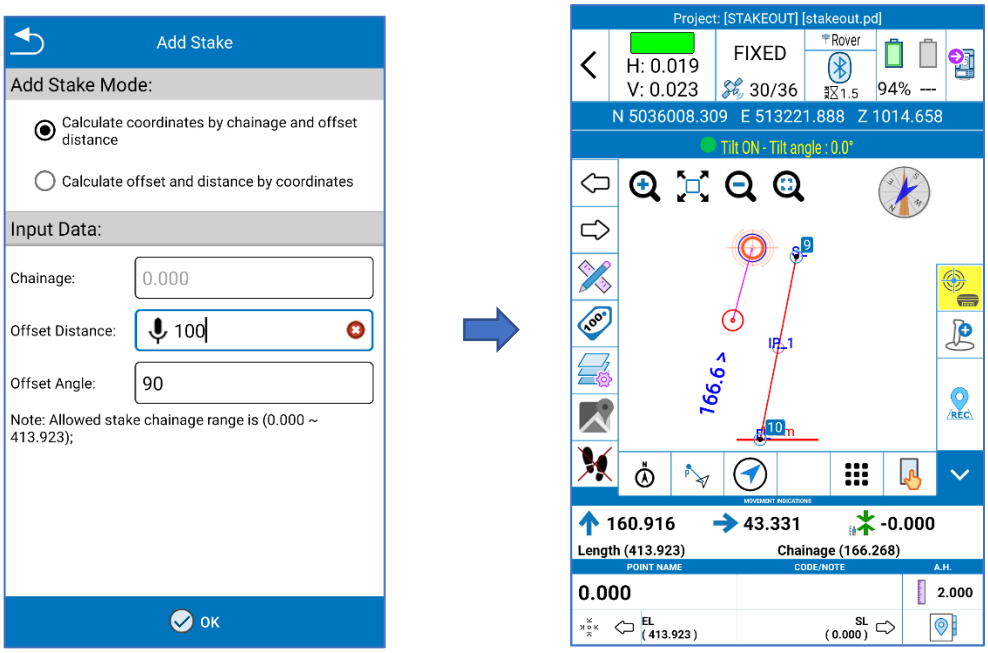




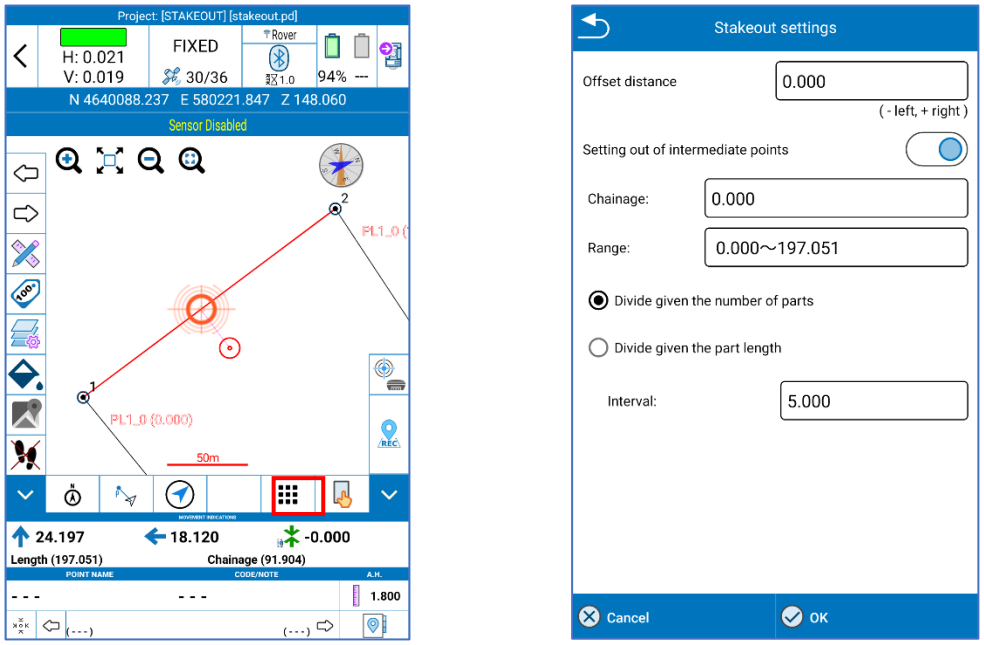
Click the icon in red in the following figure to stakeout specific points on the extensions of the line or on the shifted line.



In the following example, the indications are for reach the point at chainage 0, with an offset distance of 100 meters on the right with respect to the line.



Click the icon in red in the following figure to access the *Survey Tools*. In addition to the functions described in 7.3 Survey Tools there are also the *Stake Line Settings*.



Graphical aid indicators spacing: is the space between the reference lines added to the side of the line to be Staked out.

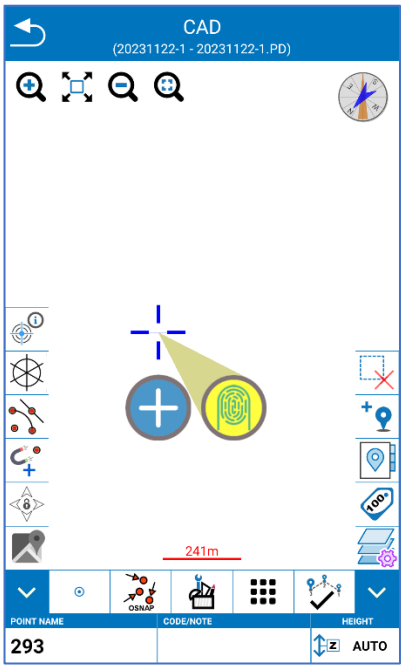
Chainage Prompt Step: it is the step to view the progressive on the line.

Warning Range: Warns you if you are approaching the destination point when you enter within the defined distance value. If you move away, you are warned that you are moving away from the destination point.

Display Track: "View" to see the points of the last positions (shows the scrap of the route executed).

6.4 CAD

In the CAD environment you can use various SNAPS to draw or edit existing entities. The main CAD function are available: move, rotate, trim, scale, align, mirror and many other features described below.



In the upper right there is the icon of a yellow question mark: hold down this icon to start a contextual help that allows you to remember, always, the meaning of the icons in the CAD area. Read the instructions that appear to use the help guide.

The icons in the vertical bar on the left are described below. They turn yellow when enabled.

 If enabled, displays the information for the selected entity.

 If enabled, hides the points symbol.

 If enabled, turn on all snaps you choose.

 If enabled, the cursor is automatically snapped to.

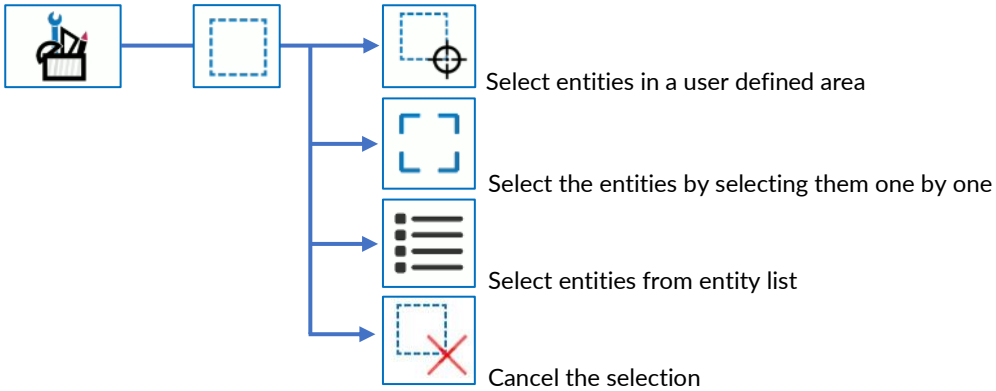
 If enabled, snap the pointer to the map.

 As in the survey area, enable a background map (e.g., Google).

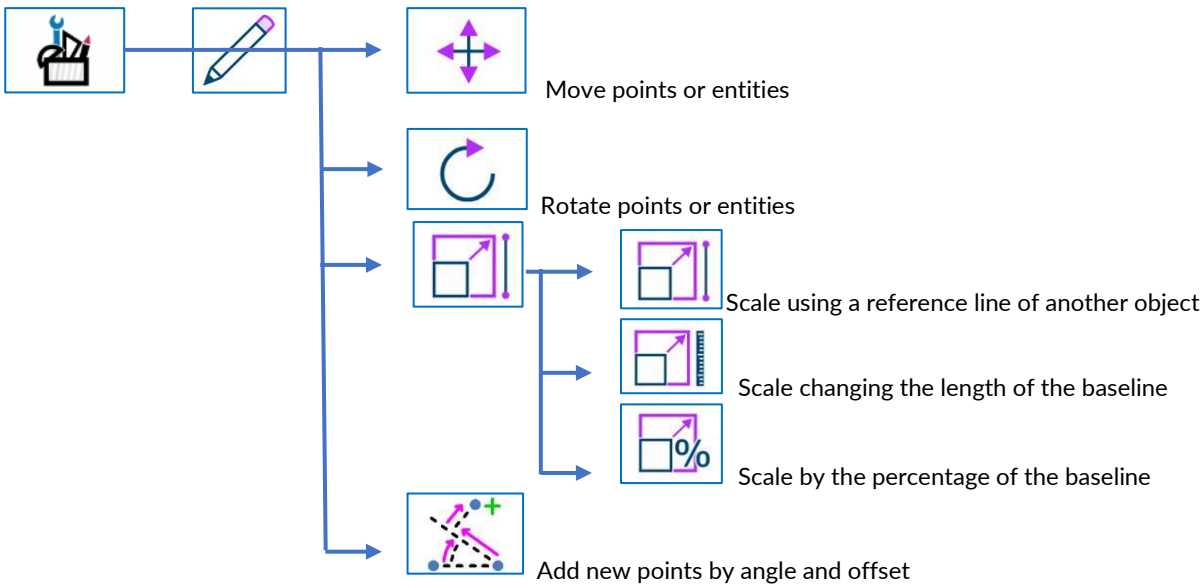
The icons in the horizontal bar are described below.

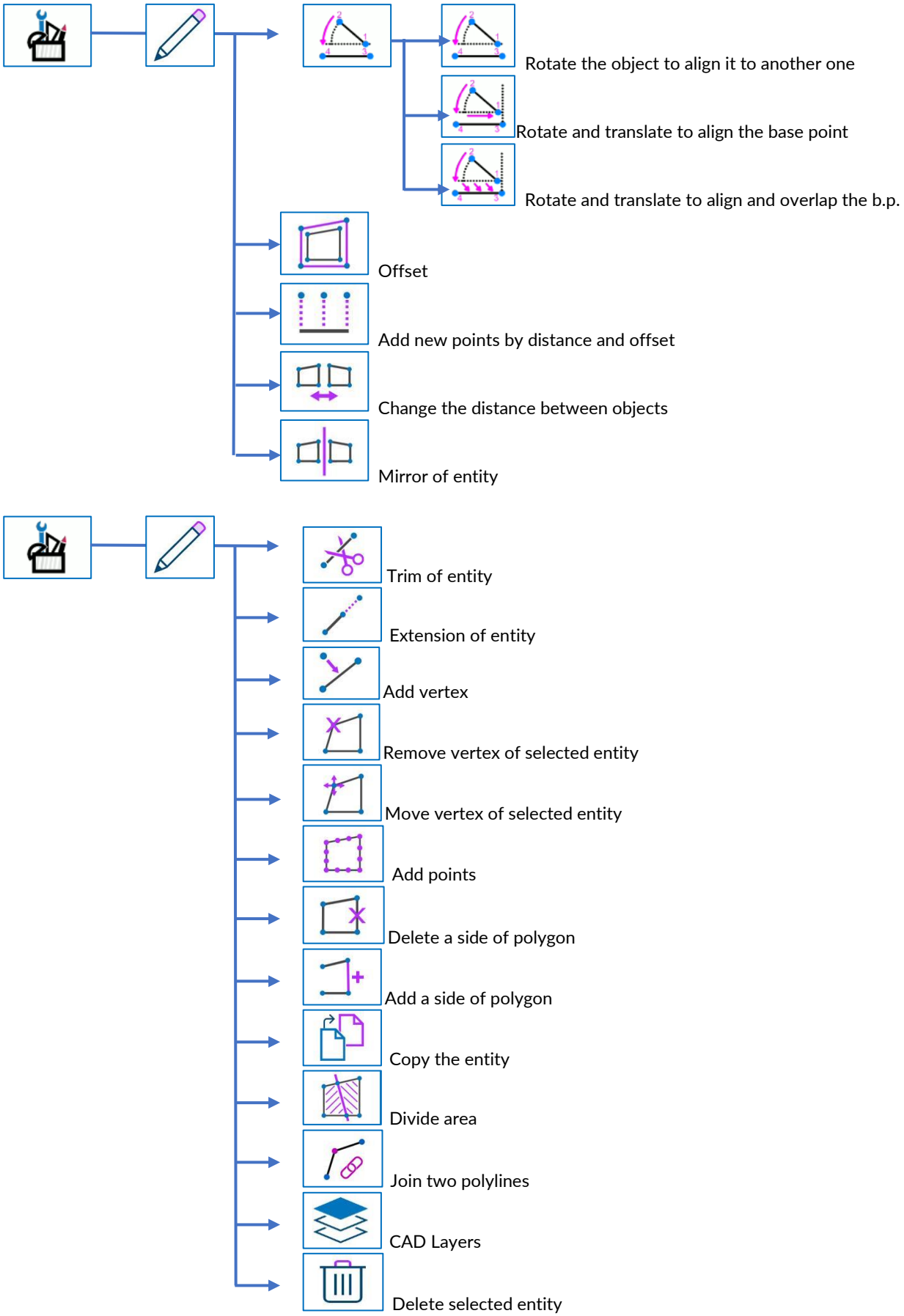
 Choose the entity you want to draw (see 7.1 Draw during the survey).

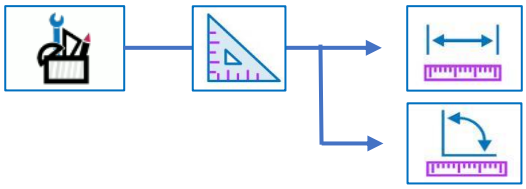
 Choose which SNAPs to activate.



Regarding the following functions, please read and follow the indications that appear in Cube-a while you are using the function, to select the right reference points or lines.




Rotate the object to align it to another one
Rotate and translate to align the base point
Rotate and translate to align and overlap the b.p.
Offset
Add new points by distance and offset
Change the distance between objects
Mirror of entity
Trim of entity
Extension of entity
Add vertex
Remove vertex of selected entity
Move vertex of selected entity
Add points
Delete a side of polygon
Add a side of polygon
Copy the entity
Divide area
Join two polylines
CAD Layers
Delete selected entity



Measure the distance between two points

Measure the angle between selected vertexes

View additional CAD tools

End drawing (see 7.1 Draw during the survey).

Set point elevation

The icons in the vertical bar on the right are described below.

Clear selection

If enabled, as you draw an entity, the vertices become points in the library.

Opens point library

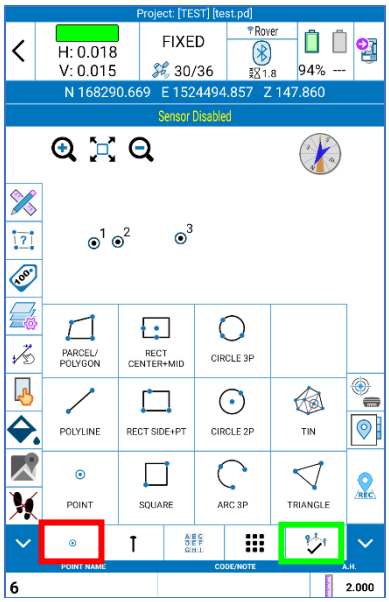
Click to make visible or not the point labels. Hold down to access to the display settings page.

Click to access to the Layers page.

7. Survey Options

7.1 Draw during the survey

CAD entities can be drawn during the points capturing. Click the icon highlighted in red below to choose the entity. Blue points are the points needed for drawing. You can stop the drawing by clicking on another entity or by clicking *end the entity* button highlighted in green below.



Point capturing. No CAD entities will be created during the point capturing. You can even draw after points capturing with Cad functions.

Polyline. Requires 2 points at least. While this function is active, Cube-a joins the points you are surveying in a polyline. If edges are more than one, when you click the *complete entity* button, the program asks if you want to connect the first and last vertices.

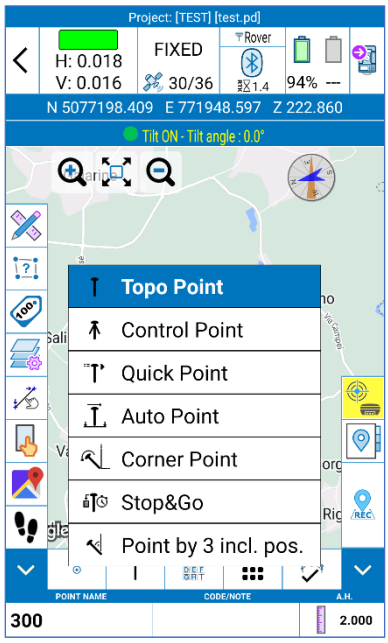
Polygon. Requires 3 points at least. While this function is active, Cube-a joins the points you are surveying in a polyline. When you click the *complete entity* button, the first and last vertices are automatically connected to draw the polygon.

TIN. Requires 3 points at least. Draw a TIN in the current layer with the points you are capturing.

End the entity. The action performed by this button depends on the type of active drawing function and how many points/vertices have been saved.

7.2 Point type

In the survey area there is the shortcut button for the point type.



This function allows to quickly choose the point type according to the needs, so the user does not need to change the parameters to save different types of point each time. Example: during the survey, the user wants to save boundary points with the best possible accuracy (which means to stay a few more seconds on the point). The user should change the point parameters to make the checks more stringent and, once saved these types of points, he should reset the starting parameters, otherwise it would mean to stay more time on all the other points as well. Thanks to this function it is enough to change the point type and choose the one with the parameters already inserted that meets user needs.

The following types of point have default parameters, but the user can always change them.

Topo Point: "classic" point. It is possible to set the following control parameters: minimum solution, maximum horizontal and vertical root mean square, PDOP limit, maximum differential correction age, readings to mediate and interval (interval between readings).

Control Point: point with stricter controls, recommended when you want to obtain the maximum reliability possible at the cost of stationing extra time on the point. It is possible to set the following control parameters: maximum horizontal and vertical root mean square, PDOP limit, maximum differential correction age, planimetric and altimetric limit, readings to mediate, average GPS range, number of readings repetition and interval. Example: if the number of readings is 10, the average GPS range is 2, the number of repetitions is 2, and the interval is 15s, then Cube-a performs 10 readings every 15s, the averages to 2 at a time and repeats the whole thing 2 times. When the saving is complete, you'll see the "report of generated control point."

Quick Point: quick points acquisition since the controls are fewer and, by default, less binding. It is possible to set the following control parameters: minimum solution, maximum horizontal and vertical root mean square, PDOP limit, maximum differential correction age.

Auto Point: this function allows you to automatically save points, so you do not need to click the rec button. It is possible to set the following control parameters: minimum solution, maximum horizontal and vertical root mean square, PDOP limit, maximum differential correction age. It is obviously necessary to choose the criteria for auto-saving; you can record according to step or time. If step is selected, it is related to meter or foot as per units' settings in Cube-a and the points are saved automatically depending on distance or height difference.

Corner Point: this function allows you to save a corner point (without resorting to geometric calculation by intersection) even if you do not have a GNSS receiver with tilt sensor. It is possible to set the following control parameters: maximum horizontal and vertical root mean square, PDOP limit, maximum differential correction age, readings to mediate. The acquisition consists in moving the pole drawing arcs around the edge holding the tip on the corner point; Cube-a makes average between these readings.

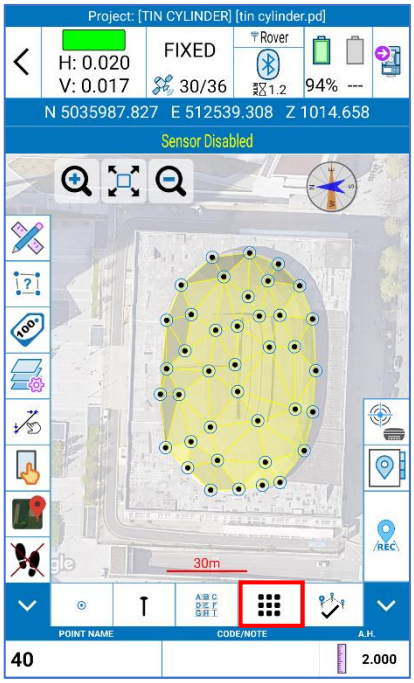
Stop&Go: point with no controls, to allow the user to save points even without differential corrections. You can enable the recording of raw data and set the number of epochs. This function is suitable for saving points in bad conditions to perform the post-processing in the office.

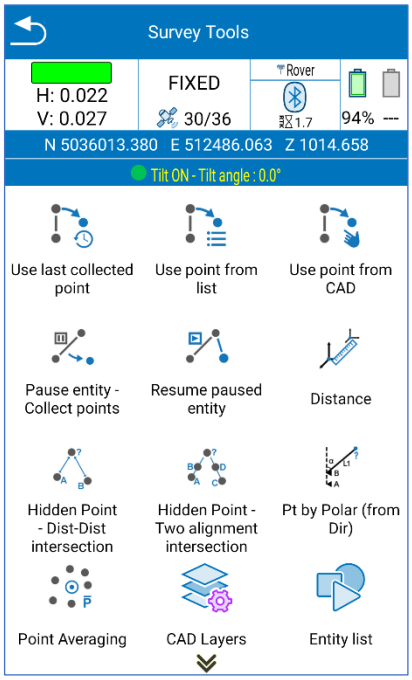
Point by 3 inclined pos.: this function allows you to save a corner point (without resorting to geometric calculation by intersection) even if you do not have a GNSS receiver with tilt sensor. Attention, you need a GNSS receiver with electronic bubble. It is possible to set the following control parameters: maximum horizontal and vertical root mean square, PDOP limit, maximum differential correction age, readings to mediate and interval (interval between readings). The acquisition consists of making three readings with the pole tilted in three different directions; Cube-a intersects the three spheres resulting from these three readings.

In some types of point you can enable quick mode. If you do not enable this option, after you click on rec, a window appears, which allows you to associate a photo to the point, change the code or height of the pole (you can also do these operations later from points library), check much information about the point and cancel the record. If you enable quick mode, the point is saved immediately, as soon as you click rec.

7.3 Survey Tools

Click on the icon with nine squares in the survey area to access to the *Survey Tools* page shown below.





The main survey tools are described below.

Distance

Calculate the distance between two given points. Points setting options available:

Typing coordinates

Select point from survey area

Take current coordinates from GPS

Select from point library

Hidden Point – Dist-Dist

Calculate the hidden point by two given points and the distances between the two points and the unknown point.

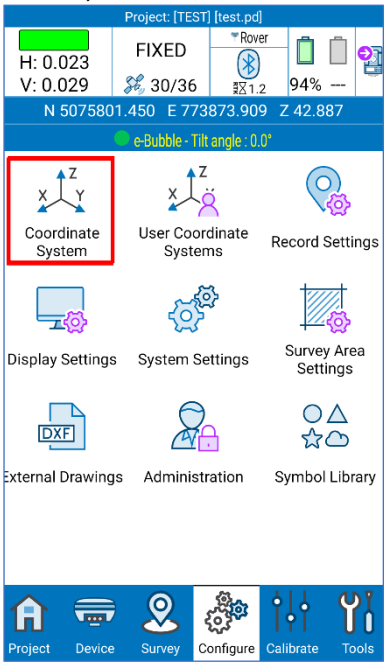
Within the command, at the top, there is a brief description of what you must insert to perform the calculation and what is the result.

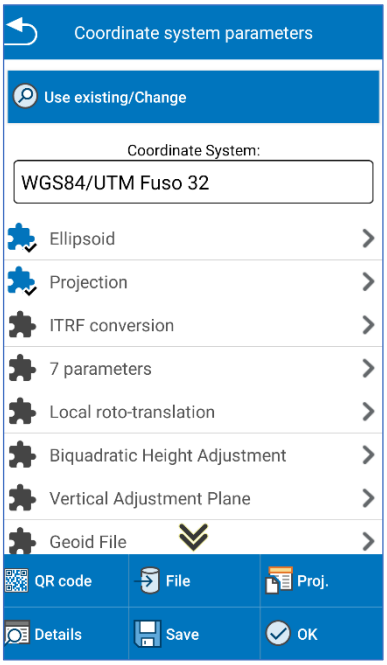
8. Configure

This menu contains all the functions to configure the Cube-a program, to configure some parameters of the current project, such as the reference system, and to import external drawings.

8.1 Coordinate System

It is not necessary to modify the parameters listed below (Ellipsoid, Projection, ...), except for specific needs that require the customization of these parameters, since the program defaults to the main reference systems in use worldwide. Click Existing Use/Change and then on Default Systems to access this list; you can search for the reference system by filtering by country or by word. By clicking on *Details*, you can read the parameters of the selected reference system. To choose and set up a reference system from the list of default systems, select it and click OK.





By clicking on "File" you can import a reference system saved on the device (*files are supported. SP and *. EP); by clicking instead on "QR code" you can scan the QR code and acquire the parameters of the coordinate system in this way.

The following are the parameters of your reference system listed on the Reference System Parameters page.

Ellipsoid: This command opens a page where you can choose the name of the ellipsoid that supports parameters that have already been defined or choose a customizable ellipsoid. In the latter case, you must choose Custom at the bottom of the "Ellipsoid Name" drop-down menu; you can then set semi-major axis and flattening ratio 1/f.

Projection: This command opens a page where you can choose the projection. Using gauss krüger projection, for example, you need to set the central meridian; this is automatically entered by the program if you are already connected to the GNSS receiver, using the position transmitted by it, otherwise it can be entered manually or, after connecting the GNSS receiver, the central meridian can be inserted by the program by clicking on the drop icon (icon to the right of the Central Meridian drop menu).

ITRF Conversion: This command opens a page where you can enable conversion between International Terrestrial Reference Frames (ITRF) with different reference eras. To enable ITRF conversion, you must choose the type of conversion, enter the reference era, and enable or disable speed entry; If you enable speed, you must insert the speed

components along the axes. X, Y, Z. Attention, this conversion is applied to all points in the current project, and not just from the moment you enable it.

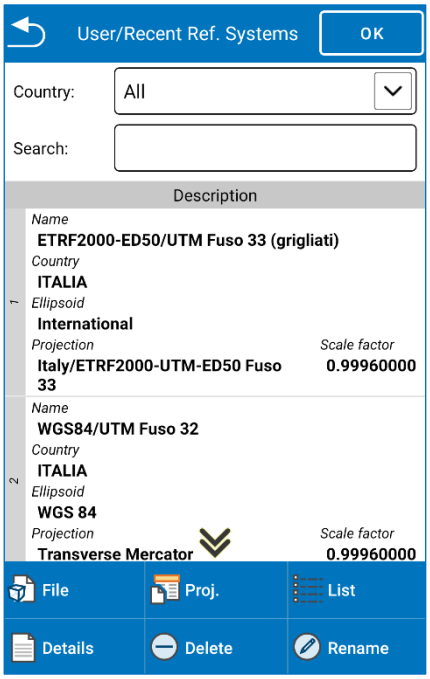
The **7 parameters**, **Local Rototranslation, Biquadratic Height Adjustment, Vertical Adjustment Plane, Local Offsets** commands contain translation, rotation, and scale factor values when expected from your localization.

Geoid files: This command opens a page where you can enable the use of the geoid. By clicking Open on the "Geoid Files" page leads to the list of preloaded geoids in the program. To add a geoid that is not in this list, copy the file to stonexcube -> Geoid; Cube-a supports all major standard geoid formats (*. GSF, *. GGF, *. UGF, *. BIN, ...).

Click OK to apply the chosen reference system. Click "Save" and choose "Local Disk" to save the system data to a file whose name and location you have defined. You can also encrypt the file by setting an Expiration Date, General Password (data cannot be displayed before expiration date), and Advanced Password (data can be displayed before expiration date). Click "Save" and choose "QR Code" to share the parameters of the current coordinate system via QR Code.

8.2 User Coordinate Systems

In the sub-menu *User Coordinate Systems* there are all the systems created by the users or chosen from the predefined and recently used ones.



8.3 External Drawings – Import DXF and SHP

This command allows you to import DXF or Shapefile files into your program in the form of layers. As a result, points will not be imported into the library, only in graphics. However, you can select points and entities from the graphics and use them for tracking. Click "Add" to select the file you want to import. The "Edit" command allows you to change/read the name of the imported external drawing, read the location of the file in the data store, enable/disable visibility, enable/disable the selection of items in the layer, such as lines and points ("Find" command), and set the unit of measure and scale factor.

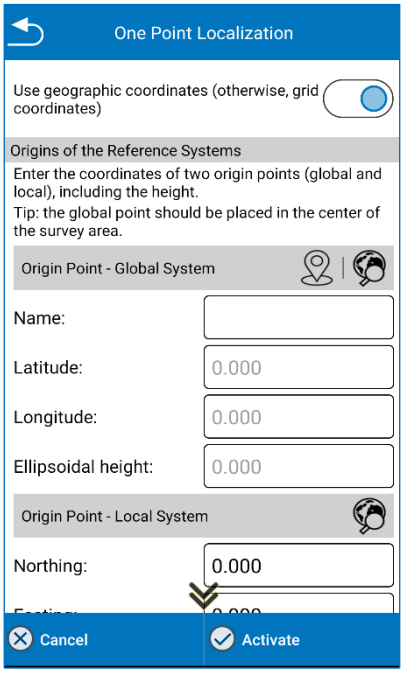
Warning: If the file is imported from the "Of curr. project" page, it will only be visible for the current project, while if it is imported to the "Global/Shared" page, it will be visible for all projects until you delete it or make it invisible.

9. Calibrate – GPS Module

The *Calibrate* menu, in the GPS mode, contains functions useful for calibrating the survey or the instrument.

9.1 One Point Localization

The function *one point localization* is useful when you want to work with the real distances between points, not affected by the deformation of the projection of the GPS reference system. This function is necessary when you want to compare the GPS survey with a total station survey.



The function consists in assigning to a point, preferably central to the survey, the local coordinates that will represent the origin of the new local system.

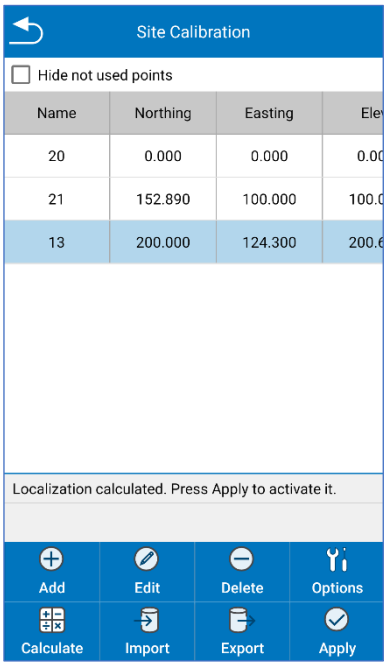
In the global system section, you can manually enter the coordinates of the origin point or detect them in real time from the GNSS receiver or select them from the point library. In the local system section, you can manually enter the coordinates of the origin point or select them from the point library.

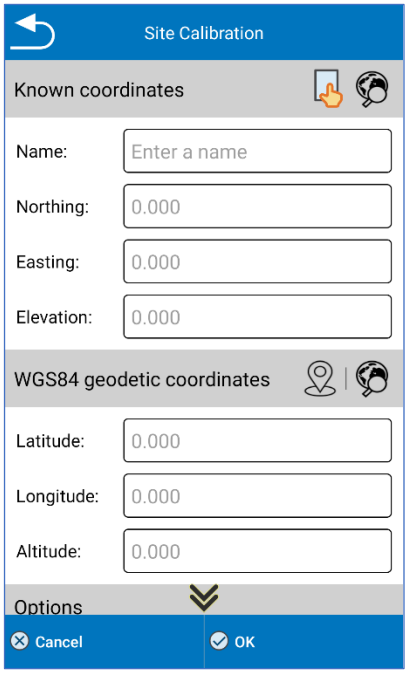
The orientation point is not mandatory; if you ignore this section then the local system will be oriented towards geographic north.

Click *Activate* at the bottom to create the new local system.

9.2 Site Calibration

You can perform a roto-translation with scale factor change; we suggest using at least 3 points not aligned.





Click *Add* to add a new point: associate the known (local) coordinates to the geodetic coordinates of the point, by inserting them in their respective sections.

Click *Calculate* and a report will appear with the calculation parameters.

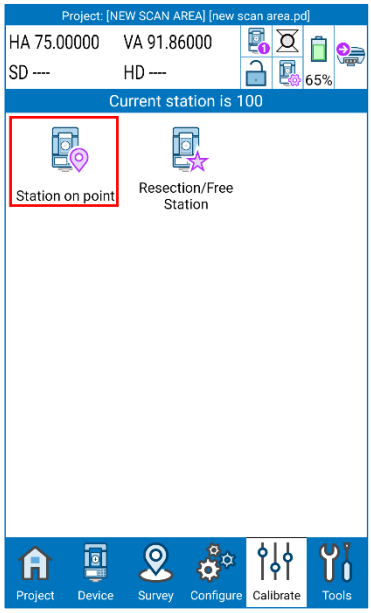
Click *Return* to back to the previous page; you can see the list of the points that will be used for calculation. Scroll horizontally to check the accuracy and delete the points with low accuracy if you can.

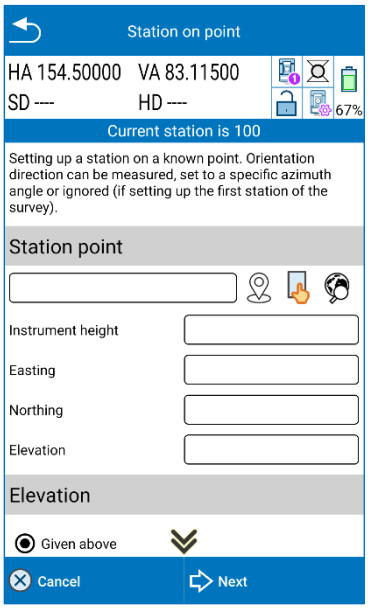
Click *Apply* to confirm and create the new local system or click the arrow up on the left to exit.

10. Calibrate – TS Module

The *Calibrate* menu, in the TS mode, contains the functions to set the station (*Station on a point* and *Free station*) and the tilt compensator page (only available for R180).

10.1 Station on point



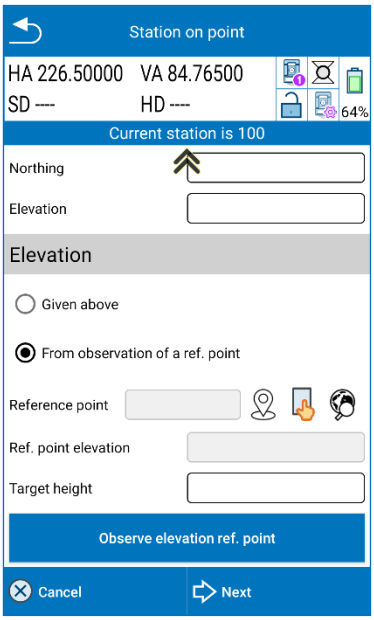


Station point coordinates can be entered manually by filling in the *Est Nord* and *Elevation* boxes, or by using the following keys:

-  to measure with GNSS antenna (if available). By clicking on it, Cube-a collects GPS coordinates directly using topographic point mode.
-  to select from the map including CAD entities
-  to select from the points list

If you want to change the name of the point, change the box to the left of these icons.

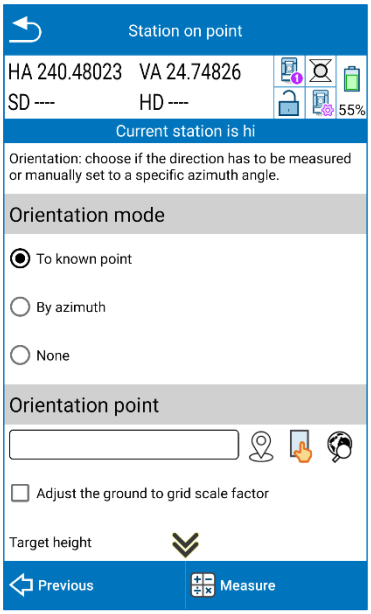
Enter the *Instrument Height* (Total Station Height).

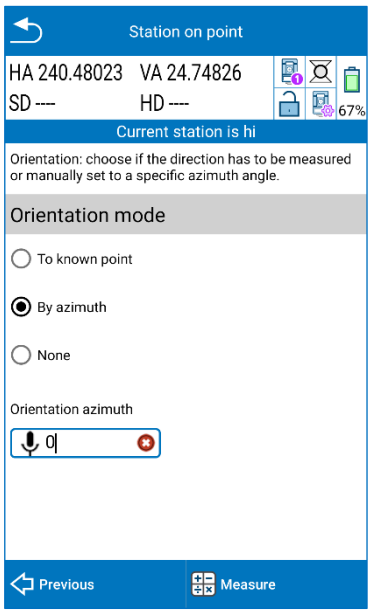


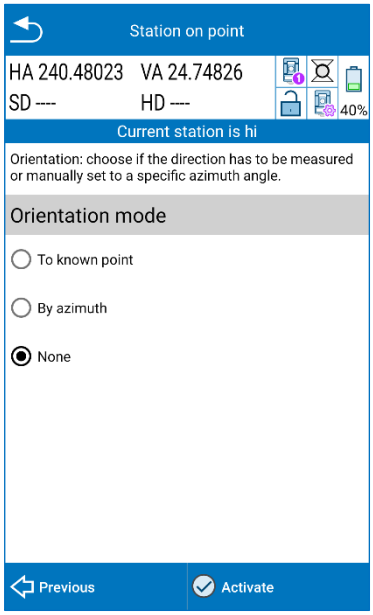
The elevation can also be inserted as a measure to a reference point. Define the reference point in the same way as it was done for the station point and insert the height of the target, then measure it and click *Next*.

On the next page, define which orientation mode you want to use:

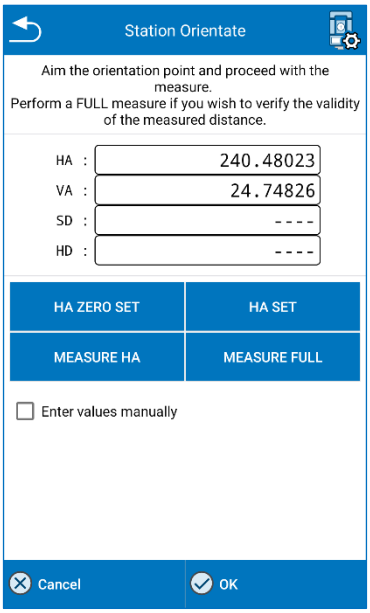
- *To a known point*: to orient the station to a point whose coordinates are known. Enter the coordinates of a point or measure or select it from the project (in the same way as defining the station point) and enter the height of the target.
- *By azimut*: allows the input of an orientation azimuth. Enter the reference angle with respect to North of the local system (not to be confused with the horizontal angle/azimuth read by the instrument).
- *No orientation*: does not consider the orientation. By default, Cube-a uses the horizontal angle of the station, without zeroing it or setting it to a certain value.







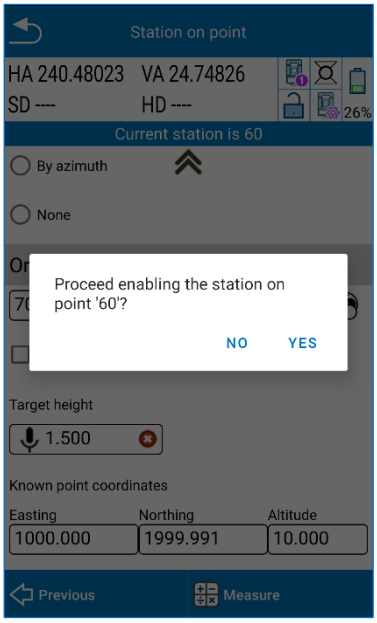
If you have selected *No Orientation*, you can click directly on *Activate* and you will complete the Station on Point procedure. Otherwise, in the other two cases, you must click *Measure* and collect the measurement of the orientation point, like visible in the image below.



1. *HA ZERO SET*: set the horizontal angle to 0 (the vertical angle will be automatically forced to 100 gon).
2. *HA SET*: Set the horizontal angle to a manually inserted value.
3. *MEASURE HA*: measure angles from the instrument
4. *MEASURE FULL*: measure the angles and distance from the instrument (option available only in orientation towards known point).

Click *OK*, after measuring.

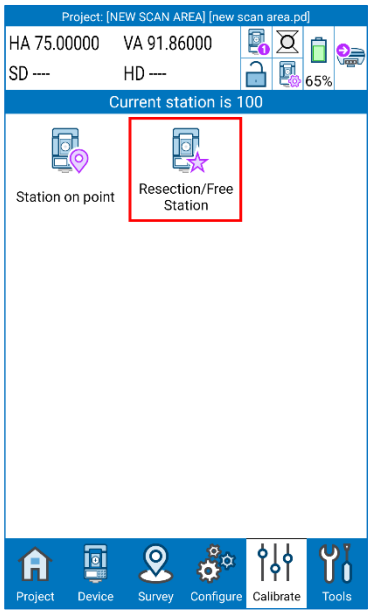
After the procedure, Cube-a asks for confirmation before activating the station on the defined point. Click *Yes* to proceed.

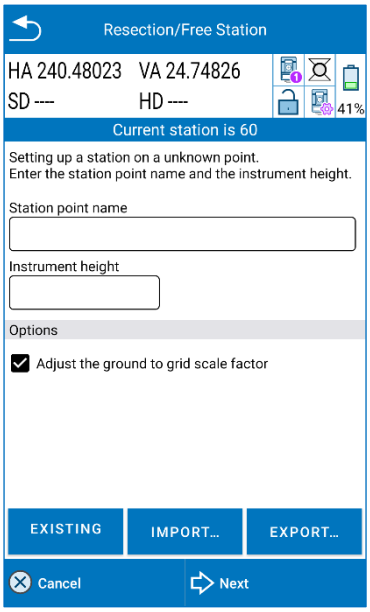


10.2 Resection/Free Station

Cube-a can calculate the position of a station located on an unknown point using the coordinates of some known points.

Please note that the orientation/reference points should cover and be all around the stationing site. The location of the reference points limits the area where subsequent measurements should be carried out, using the stationing. Point capture and/or stake out should never be performed outside this area. If measurements occur towards points outside the area, orientation errors will be extrapolated (maximized) rather than interpolated (reduced).





Enter *Station Point Name* and *instrument Height*.

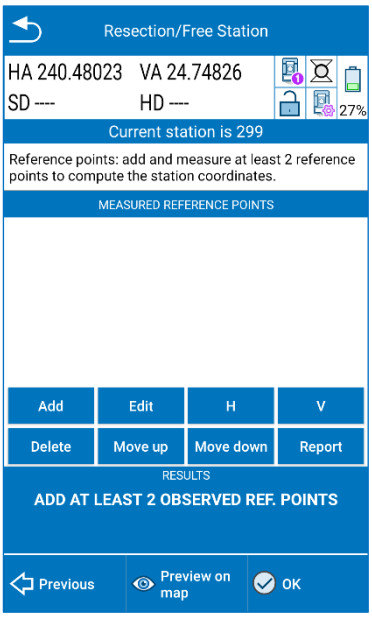
Choose to check with scale factor or not. Enabling Cube-a performs a check and applies an automatic factor over point distances so that the distances (at points) measured by the station are congruent. This option has to be enabled when using GNSS points for the free station calculation.

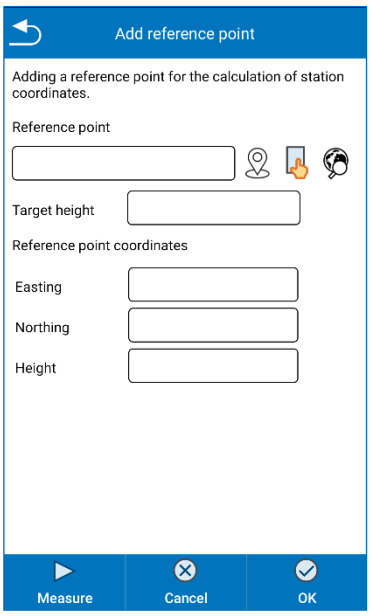
The *Import and Export* commands work with *.cr files, which store all stationing calculation, with the chosen points, station name, and each option entered performing this function.

Click *Next* to enter and measure the points for the least squares calculation. Cube-a requires you to satisfy one of the following cases:

- 3 or more angular readings.
- 2 or more complete readings (angles + distance).
- 2 or more mixed readings (angle + distance/ angles only).

Click *Add* to insert the first point.



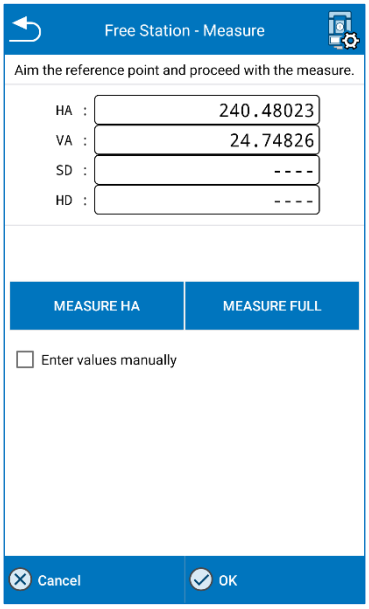


The coordinates of the point can be entered manually, either by filling in the *East*, *Nord* and *Elevation* box or by using the following keys:

-  to measure with GNSS antenna (if available). By clicking on it, Cube-a collects GPS coordinates directly using topographic point mode.
-  to select from the map, including CAD entities.
-  to select from the points list.

To change the name of the point, change the box to the left of the icons.

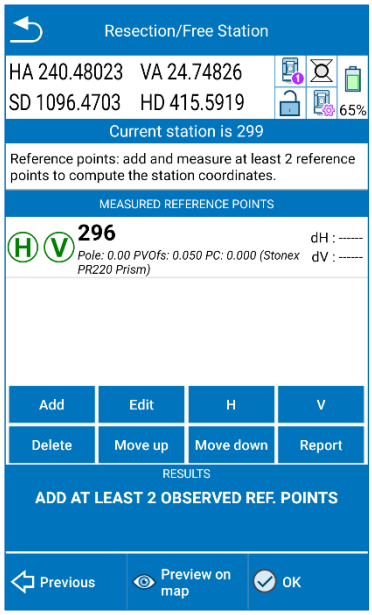
Insert the *Prism Height* (pole height) and click *Measure.*

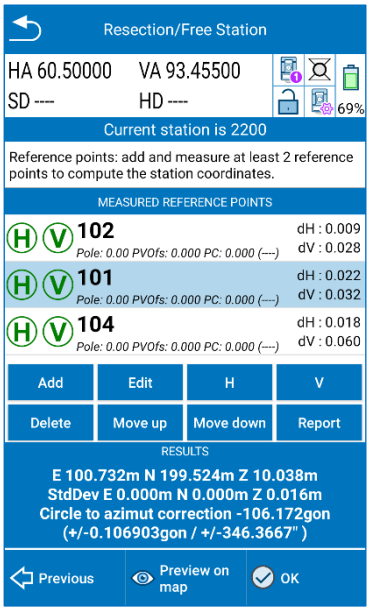


Aim the point and proceed with the measurement, which can be:

- *Angle measure*: only angular measurement.
- *Complete Measure*: angles and distance measurement.

Proceed by pressing *OK*. Continue with the addition of the next point(s), proceeding in the same way. Then, you will be able to view the result of the free station calculation.





In the image above on the right, there are the results of free station calculation (blue box):

- Calculated station coordinates E, N, Z.
- Standard deviations of E, N, Z, which define the estimation of the possible error on coordinates. They can be negative or positive values.
- *Scale factor* shows the calculated value (if enabled in the previous page).
- *Azimuth correction* is the horizontal angle correction that the free station program calculates relative to the horizontal circle of the total station.

Beside each point used for the free station calculation, it's possible to see the planimetric and vertical residuals on single measurements (Measured - Known). These are absolute values – values declared in meters:

- *dH* is the difference between calculated and known point in 2D.
- *dV* is the difference in altitude between calculated and known point.

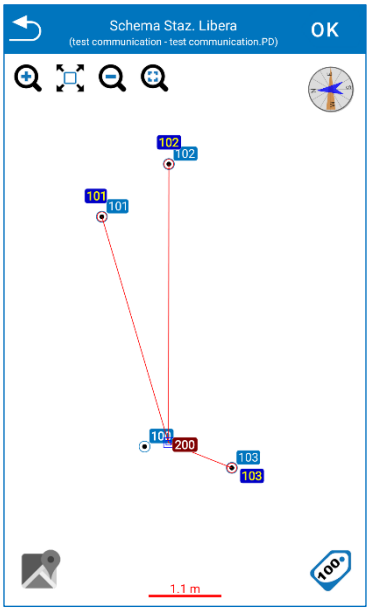
The user can press on Ⓗ and Ⓥ to turn off Horizontal and/or Vertical reading and check if the quality of the result increases. The same command is carried out by *H* and *V* in the blue icons.

You can click *Edit* to modify a point and re-measure it. Or you can press on *Delete* to remove a point.

Click on *Move up*/*Move down* to change the order of the points in free station calculation.

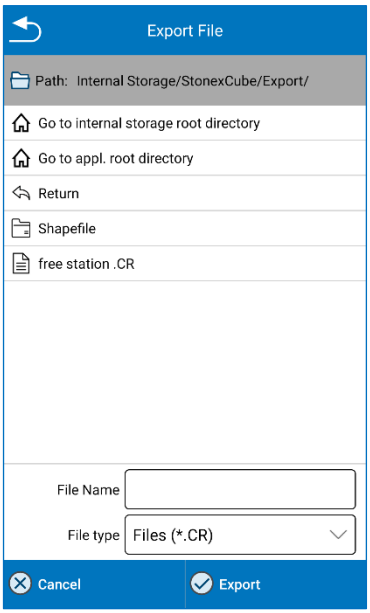
Click on *Report* to export a technical report about free station calculation, the report is saved in .txt format.

Click on *Preview on Map* to display a preview of the free station calculation on the survey area, like in the image below.



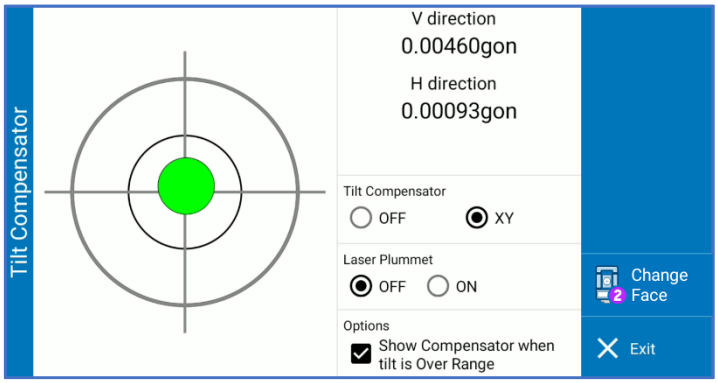
Before confirming with *OK*, you can press *Previous* to return to the screen where you can export the free station calculation.

The free station file is exported with a **.cr* extension.

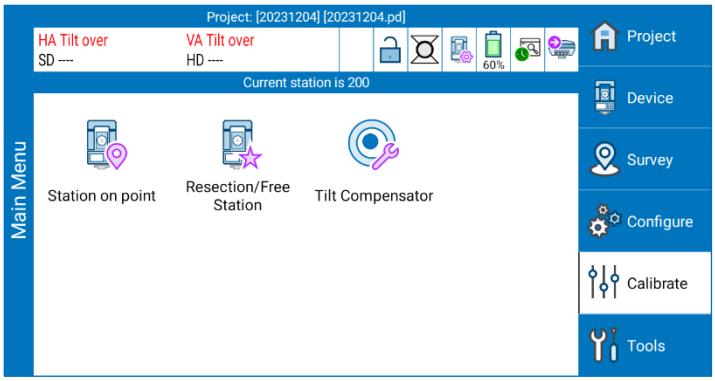


10.3 Tilt Compensator

Click on *Tilt Compensator* to enter in the tilt/electronical bubble page (function available only for R180 Robotic TS).



In this page, the user can visualize the instrument electronical bubble, activate/deactivate the Tilt Compensator and activate/deactivate the laser plummet. When the total station is not levelled and the option Tilt Compensator is *XY*, a message "*Tilt Over*" will appear in Cube-a upper bar as in the image below. Level the instrument the restore the angles reading visualization.

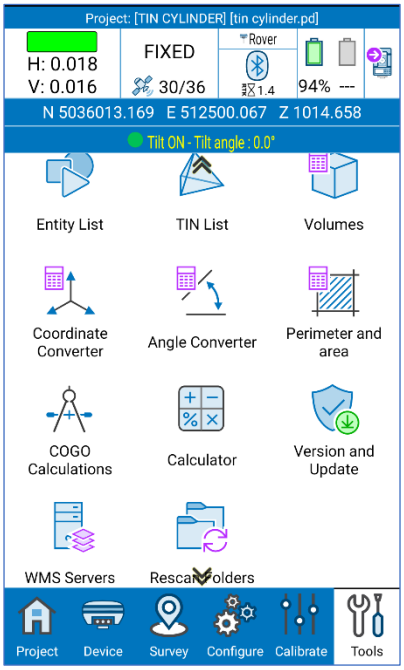


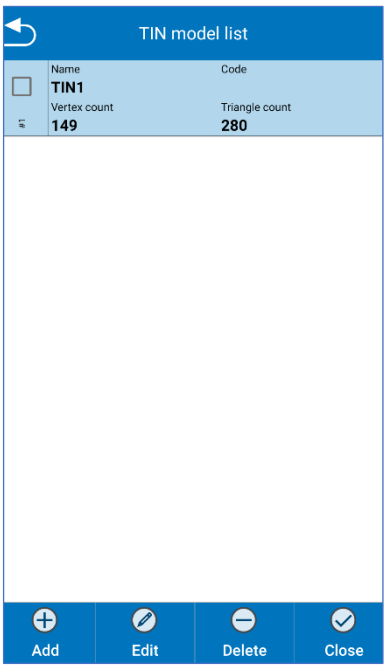
11. Tools

The *Tools* menu contains many useful functions such as volume and COGO calculations and information about the version and personal license of the Cube-a software.

11.1 TIN List

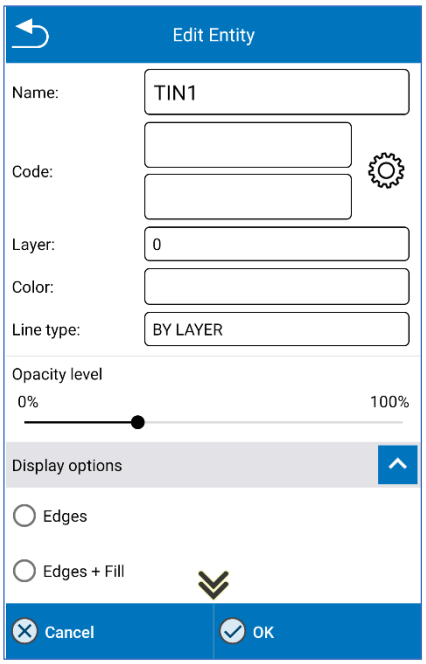
This page contains the list of the TIN (Triangulated Irregular Network). This feature is available with the module 3D only. Each TIN model in *TIN model list* corresponds to a TIN entity, that you can see in the survey area and in the entities list; if you delete the TIN entity then delete the TIN model also.

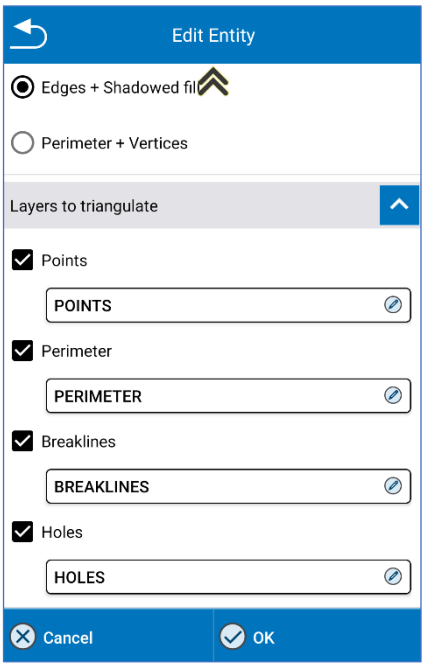




In the *TIN model list* page, you can select an existing TIN to edit its properties or to delete it.

Click *Add* to add a new TIN model; the *Edit Entity* page appears.



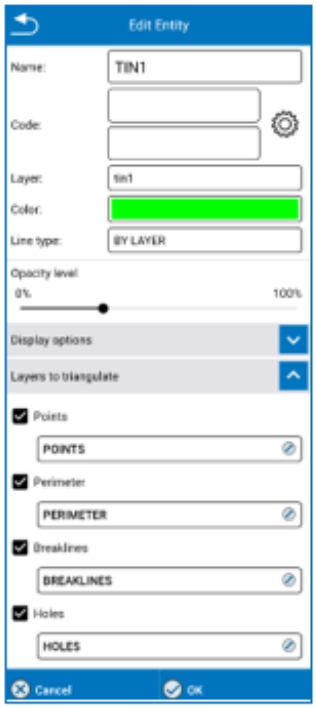


The TIN is dynamic so you can see, in the survey area, the changes in real time.

In the *Layers to triangulate* section, you can associate a layer to a TIN element (points, perimeter, breaklines, holes); this association is not mandatory, but if you enable them then the triangulation is automatic. If you did not enable them, the TIN will be drawing only when you select TIN entity in the Survey area. See the following examples.

Example 1: l*ayers to triangulate* enabled.

Example 2: l*ayers to triangulate* disabled.

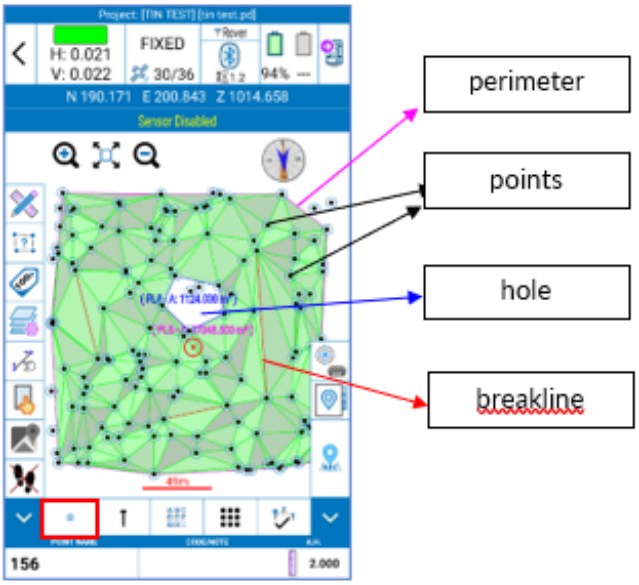


Example 1

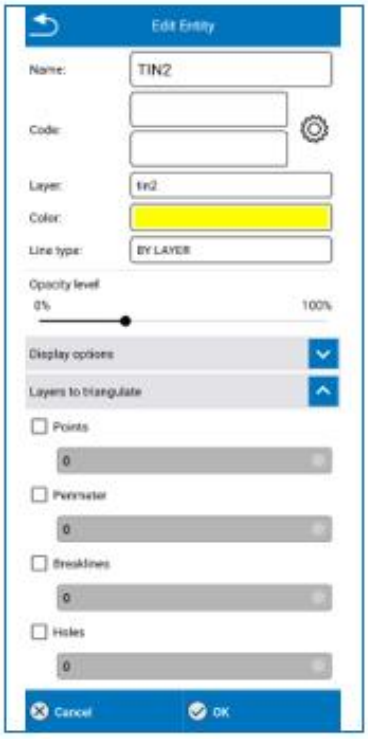
The TIN1 will be drawing in the layer tin1, green.

- All points in the layer POINTS1 will be automatically triangulated with TIN1 during the survey.
- All closed entities in the layer PERIMETER1 will be automatically used as perimeter for TIN1 during the survey.
- All lines in the layer BL1 will be automatically used as breaklines for TIN1 during the survey.
- All closed entities in the layer HOLES1 will be automatically used as exclusions for TIN1 during the survey.

Below the layers settings and the TIN entity.



You can collect points or entities and the software automatically creates the TIN when the points or entities belong to the layers you have chosen in *Layers to triangulate*.



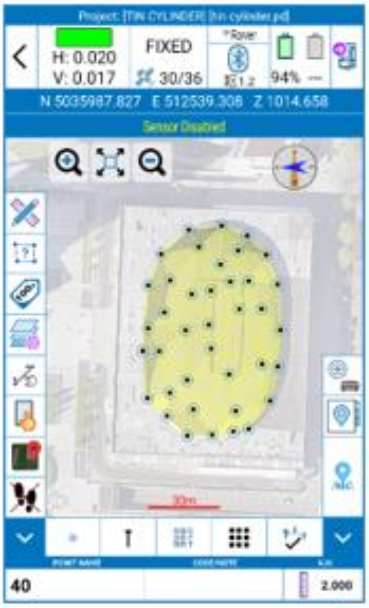
Example 2

The TIN2 will be drawing in the layer tin2, yellow.

The TIN2 will not be automatically drawing during the survey because there are not layers to triangulate enabled, in the *Layers to triangulate* section.

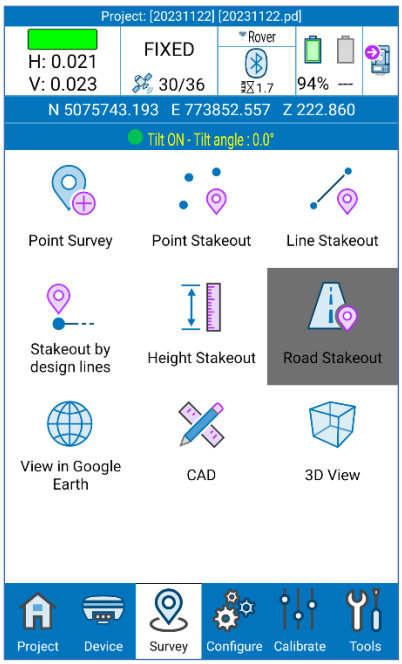
To draw the TIN2 you must select TIN entity in the Survey area. Only if the TIN entity drawing is enabled, the collected point will be triangulated.

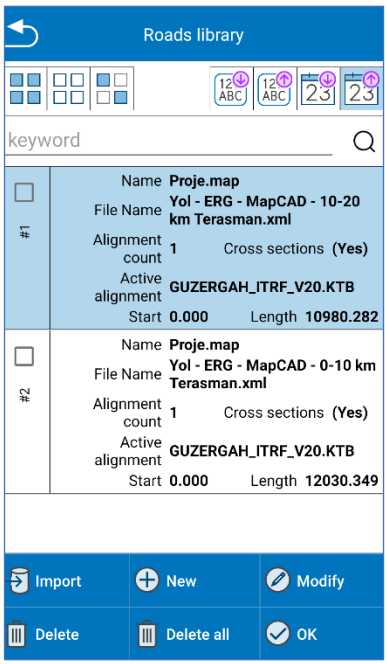
Below are shown
- TIN entity function enabled
- TIN2 with edges + shadowed fill
- TIN2 with only edges



12. Appendix – Road Stakeout

It's possible to stakeout roads and, in general, geometries composed of straights, arches, clothoids and parables, from Cube-a version 6.1. Click *Road Stakeout* to access the road library. If you have already selected a file from road library, then the road stakeout page will open as soon as you click *Road Stakeout* menu; in this case, click  to access the road library.





Click *Import* to import the road or road geometry to stakeout. The compatible formats are *.XML, *.DXF, *.CSV.

LandXML Import

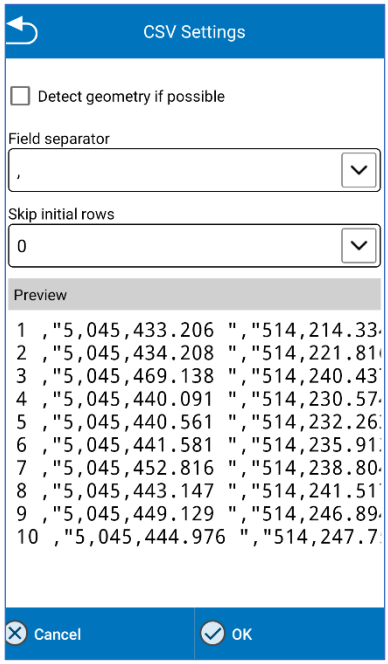
The most complete format is LandXML, it can contain the planimetric track, the cross sections, and the elevation profile and 3D models by TIN.

DXF Import

The DXF format allows to import tracks and cross sections by polyline or LWpolyline so lines and arches and 3D models by TIN.

CSV Import

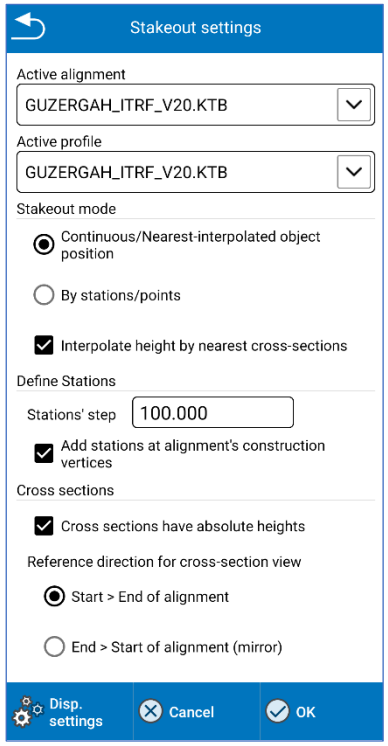
The CSV format allows to import just one geometry as sequence of points in axis. When you import a CSV file the following window appears.



It shows a preview, the first lines of the file to remind what's the field separator and if there is a header to correctly set the number of initial lines to skip. Enable the option "Detect geometry if possible" to recognize straights and arches; this function works properly if the points come from discretization of a complex geometry.

Stakeout settings

Select the road from list and click OK to stakeout.



- Active alignment

  Which alignment will be used for stakeout between the available ones.

- Active profile

  Which elevation profile will be used.

- Stakeout mode: Continuous/nearest interpolated object position

  The current gps position will be projected on the track to reach the nearest point.

- Stakeout mode: By stations/points

  Reach the defined stations/points along the track.

- Interpolate height by nearest cross-sections

  Calculate height by interpolation between the previous and next cross-sections.

- Stations step

  Set the distance between each station along the track.

- Add stations at alignment's construction vertices

  Add stations also on feature points of the track, like start and end of each junction of the track.

- Cross sections have absolute heights

  If enabled, cross sections heights are absolute; if disabled cross sections heights are relative to the elevation profile so it's important, in this case, select the right profile.

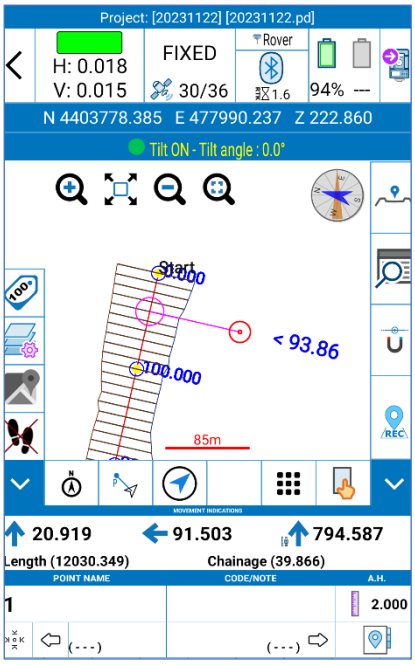
- Reference direction for cross-section view

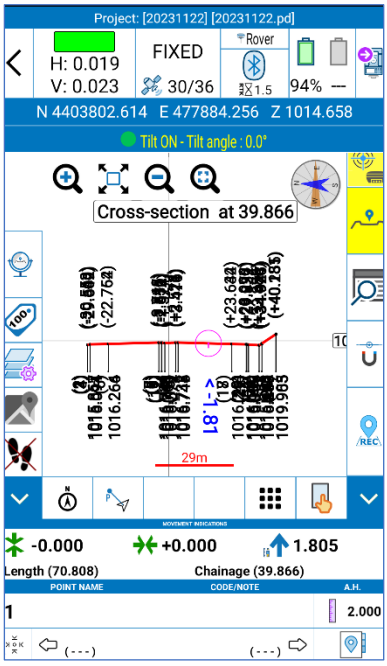
  Mirror the section if the walking direction it's not the same of the road project direction (start->end)

Road Stakeout Interface

If you have already selected a file from road library, then the road stakeout page will open as soon as you click *Road Stakeout* menu, otherwise, select the file and click OK to start the stakeout.

The interface is like the standard stakeout interface.





In the indication bar, in addition, there are the length and the chainage that is calculated from the projection of the current measure, and the following icons.

	Enable SNAP on the closest station point
	Go to section view (the closest available section) or back to profile view

STONEX® SRL

Via dell'Industria, 53 - 20037 Paderno Dugnano (MI)

Tel: +39 02 78619201

www.stonex.it