STONEX

Cube-a
Field Software
User Manual

cube·a

4.0

cube suite

www.stonexpositioning.com

Contents

Software Introduction

Cube-a is a GNSS surveying and mapping software which is developed by the Stonex srl company. Based on years of accumulating market experience, in combination with the international mainstream of surveying and mapping data acquisition function of the software, integrating RTK control, GIS data collection and road design and layout into one role. The main feature of the software is very outstanding graphic interaction, very powerful function and humanizes operation process. This manual mainly introduces all the menu functions and the field operation procedure of the **Cube-a** software.

The main interface window is divided into the main menu bar and sub-menu bar.

The main menu bar contains all the menu commands, content is divided into six parts: *Project*, *Device*, *Survey*, *Configure*, *Calibrate* and *Tools*. In this manual, we will introduce the functions of those menus in detail.

1. Cube-a installation and uninstallation

This chapter describes the installation and uninstallation instructions for **Cube-a** Software.

Cube-a Installation

1. Please download the Android **Cube-a** installation package (*.apk) and copy the installation package to your Android device.
2. Please find the **Cube-a** installation package (*.apk) in the "Files" of the Android device. Click the **Cube-a** installation package, there will pop-up the installation page. Then click "Install" to install the **Cube-a** software, after the installation successful, there will be the prompt page as shown in Figure 1-1.

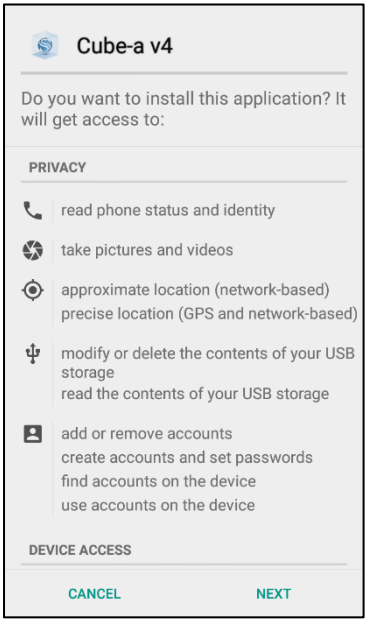


Figure 1-1

1.1 Cube-a First Run

The software must be registered and unlocked at its first run. To unlock it you need to know which is your personal and unique *Purchase Code ID*.

The Purchase Code ID is in a form similar to STX000000000ABC and you should have got it by e-mail or printed. The software cannot be unlocked without entering the correct Purchase Code.

This operation must be done while your device (tablet or phone) has an active Internet connection.

To register the software:

1. Launch the application as usual.
2. Read carefully the shown End User License Agreement (EULA).
3. Press the *Accept* button if you agree to be bound by the license agreement.
   Otherwise press the *Decline* button to terminate the application.
4. Fill out the Software Activation form.
5. Press *OK* to activate the software.

The above steps must be followed at each time the application is started and until the software has been successfully activated.

The Purchase Code, that must be entered in the first field of the form, is the proof of purchase required to identify and validate your software license.

To validate your software license and the authenticity of the Purchase Code itself the program will connect to our servers: at that time the Purchase Code is verified and, if all goes well, the program will get back the authorization to activate the software.

Notice that you cannot reuse the Purchase Code to unlock a copy of the program that has been installed onto another device. For that you will need to buy an additional license (thus, you will get another different Purchase Code).

In case of any problems during the activation of the program please contact us at cubesuite@stonex.it .

Figure 1.1-1

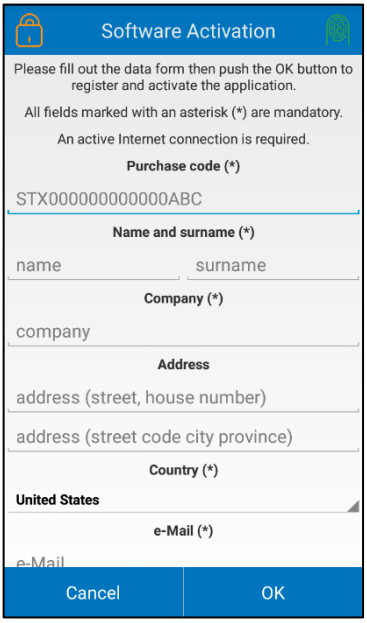


Figure 1.1-2

1.2 Cube-a Uninstallation

There are many ways to uninstall the software on the Android device. Here we mainly introduce two methods: press the Cube-a icon on the desktop and drag it to the "uninstall" option box, there will pop-up a dialog box "Uninstall Cube-a?" shown as the Figure 1.2-1. Then click "uninstall" to uninstall the Cube-a software.

Figure 1.2-1

Figure 1.2-2

Click the "Settings"—"Apps" to find the "**Cube-a**" in the submenu. Click the "**Cube-a**" as in figure 1.2-3, there will enter into the **Cube-a** information page shown as Figure 1.2-4. Then click the "uninstall" in Figure 1.2-4 to enter the **Cube-a** uninstallation page. Click the "uninstall" to uninstall the **Cube-a** software.

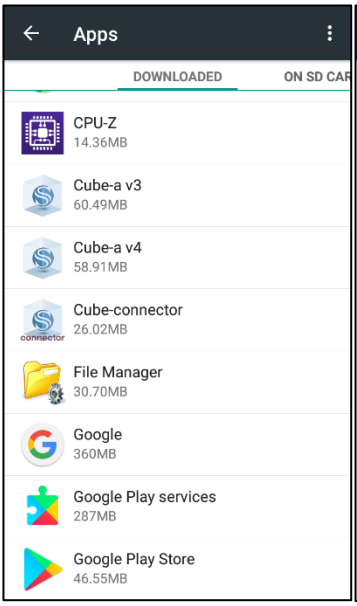


Figure 1.2-3

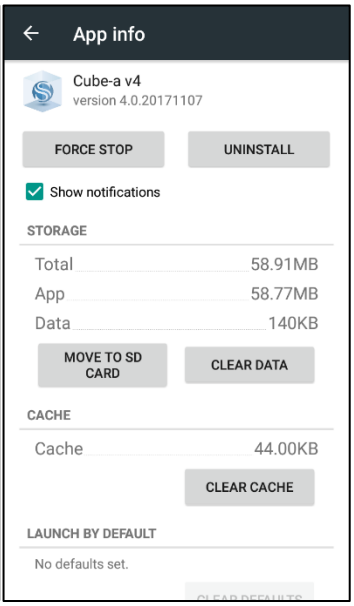


Figure 1.2-4

2. Software Introduction - Project

In the main interface of the software, click the "Project": the submenu shown in figure 2-1 will appear. The project submenu contains seven items, which are *Project Manager*, *View Data*, *File manager*, *Import Data*, *Import Raster Image*, *Backup File Import*, *Export Data*, *Project Details* and *Version and Updates*.

Figure 2-1

Cube-a stores all the data in the form of a set of files called *a project*. **Cube-a** remembers which was the last used project and it automatically reopens that project at the next run. Under normal circumstances, each time you begin to measure an area, you should create project file matched with the pre-construction engineering, and the file name should be "*.GSW". After the project has been created, the software will create a file in the device storage disk and the file name is same of the project, all data will be saved in this file.

2.1 Project Manage

Click “Project Manage” in the *Project* submenu: you will get to the “Current Project” page as shown in Figure 2.1-1.

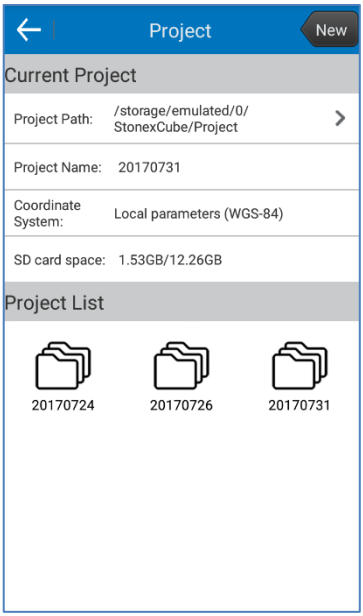


Figure 2.1-1

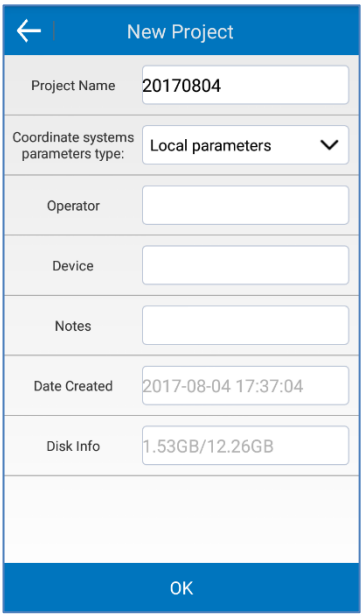


Figure 2.1-2

Click "New" in the upper right corner to create a new project. The page that create a project shown as Figure 2.1-2, please click “ok” after entering the project name (required), operator name, instrument and notes. Then there will pop-up a prompt “Apply current coordinate system transformation parameters?”. If you select "OK", then the coordinate system parameters of new project are same with the current project settings. If you select "Cancel", you can select the coordinate system parameters manually according to the engineering survey, or you can apply the local parameters. Click "OK", the new project will default to the current work of the project and return to the software main interface.

If you want to change the project file, please press and hold the project in the project list shown as Figure 2.1-3. Then if you click “Open”, this project will be open, and it will be also the default work open at program startup.

If you click “Delete”, this project will be deleted.

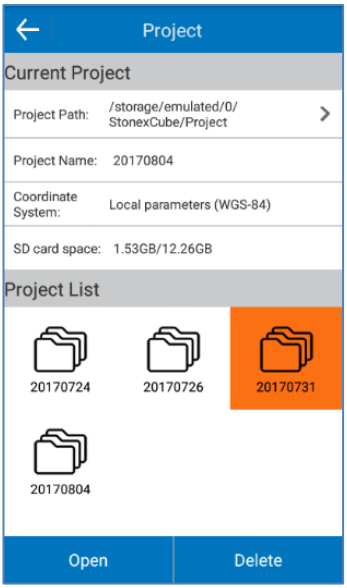


Figure 2.1-3

2.2 View Data

Click “Project” – “View Data”: the page shown in Figure 2.2-1 will appear. User could view the point data in the “Survey points library”, for example the plane coordinates (x, y, h), latitude and longitude coordinates, chainage, offset, code and other information. If there are many points saved in the “survey points library", users could enter the “point name” or the “code” to quickly find the target point shown as Figure 2.2-2.

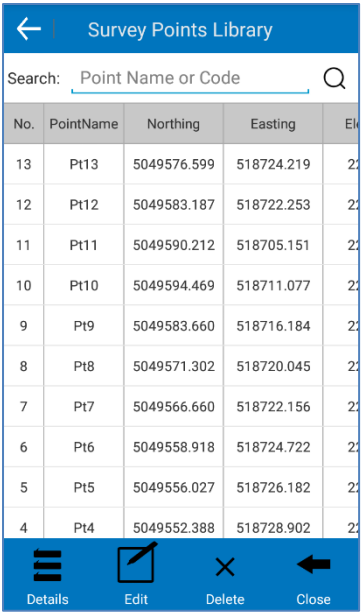


Figure 2.2-1

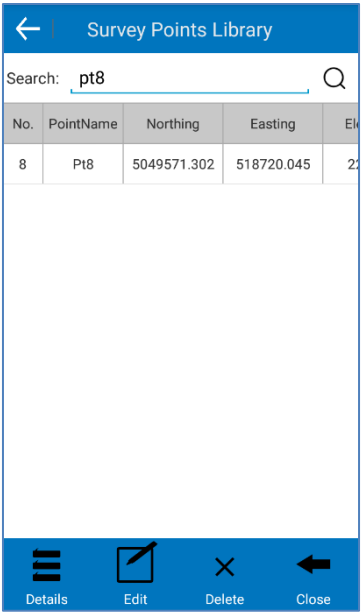


Figure 2.2-2

Select any point in the “survey points library” and click “Details”, then you can see the page shown in Figure 2.2-4. You can view the detailed information of this point, for example the plane coordinates, latitude and longitude coordinates, point type, storage mode, solution satellites number, HRMS, VRMS, PDOP, HDOP, VDOP, antenna height, base information and so on.

Select any point in the “survey points library” and click “Edit”, then you can see the page shown as Figure 2.2-3. You can edit the point name, code and antenna parameters (measure height, measure type, antenna height) of this point.

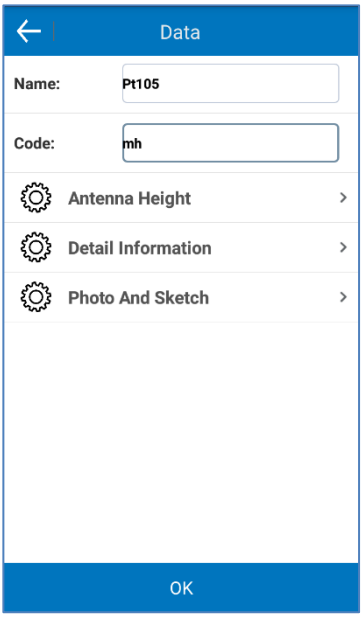


Figure 2.2-3

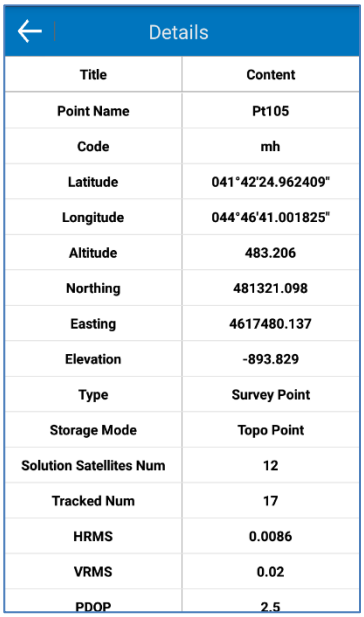


Figure 2.2-4

From the Data view (figure 2.2-3) you can start the *Photo And Sketch* feature to associate an image to the point. Find more about the *Photo And Sketch* feature in the *Point Survey* chapter.

If you click “Delete” after you select the point, then this point will be deleted from the “survey points library”.

2.3 File Manager

If the data of a project is too large, or if you want to divide the data into two different “survey points libraries”, please click “data manager”, then you can see the page shown as Figure 2.3-1. Click “New” on the upper right corner to create another file into which store the data: this new file will become the default file where to store new survey data.

The new data file is part of the current project.

If a project has multiple data files, select the data file in the data list, click "Open" to switch between different data files, and click "Delete" to delete the data file.

Figure 2.3-1

2.4 Backup File Import

The backup file is stored in the RTK receiver disk, and when the project stored in the mobile device is lost or damaged, you can restore the data through the Backup file.

Firstly, please connect the RTK receiver and PC using a 7-pin cable then copy the backup data to the PC. Next connect the mobile device with the PC and copy the backup data into the mobile device.

Finally, click “Backup file import” -> “Open backup file” to select the file which you want to import (Figure 2.4-1). Enter the data file name and click “OK” to open the data file.

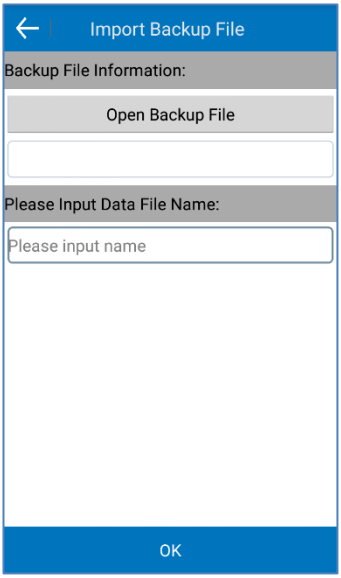


Figure 2.4-1

2.5 Export Data

Click “Project” -> “File Export”, you can see the page shown as Figure 2.5-1. Data file export is used to export the measurement data file into the format which the user makes maps.

You can export data to the specified format or a custom format. First fill in the (new) file name, select the export path, the source data file (*.PD) and the file format.

File formats include: RW5 (raw data), Custom file format (CSV), various AutoCAD™® file format (DXF) presets, Google Earth™® file format (KML), Cass format, Raw measurement data format (CSV), Pregeo DAT (Italy only), and so on. Click "Export" to export the file to the specified path.

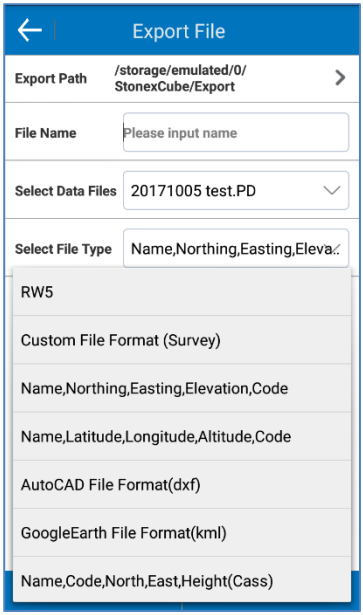


Figure 2.5-1

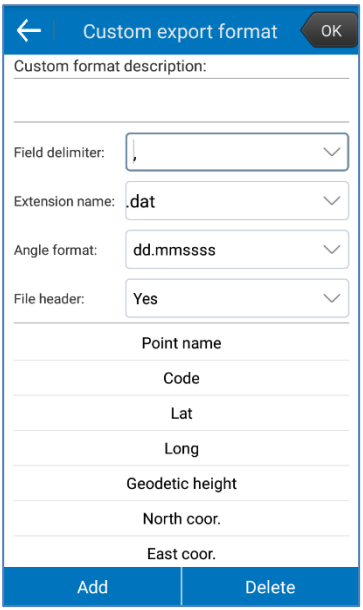


Figure 2.5-2

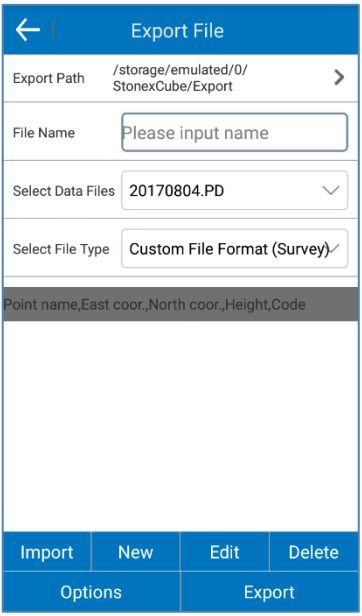


Figure 2.5-3

Custom file format settings

If you select "Custom File Format" and then click "New", you can create a new export template as shown in Figure 2.5-2. Set the field delimiter, extension name, angle format, whether to write the file header, and select the custom export format content. Select the content you want to export, click "Add" to add to the custom format description; click "Delete" to delete the contents of the custom format description one by one. Click "OK" to complete the custom export formatting shown as Figure 2.5-3.

You can also edit and delete the templates. To filter the points, click "Options" to select the class of points to export: tick the type of points that you want to export. The point classes include: auxiliary point, survey point, control point, input point, calculated point, stake out point and screen point.

RW5 format settings

When you export in RW5 format, you will be asked to specify/enter some additional settings as shown in figure 2.5-4.

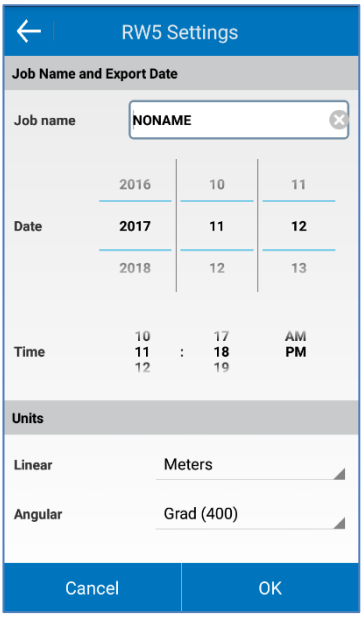


Figure 2.5-4

You must enter the *Job Name*, the *Date* and the *Time* of the job. If you need to work in feet, then you can change the unit of the exported coordinates/heights/distances from Meter to Feet (Imperial) or US Feet (Survey).

It is also possible to change the format of exported angles (but not for the geographic coordinates) between Degrees (360) and Grads/Gon (400).

Pregeo DAT format settings (Italy)

When you export in Pregeo (DAT) file format, which the official cadastral file format of Italy, you will be asked to specify/enter some additional settings as shown in figure 2.5-5.

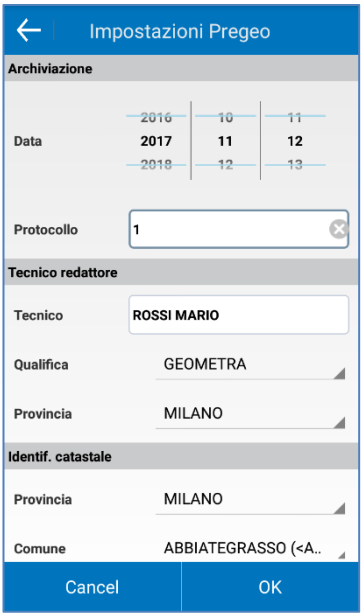


Figure 2.5-5

Enter:

- Survey date
- Protocol number
- Name of the surveyor
- Qualification of the surveyor
- Province (of living) of the surveyor
- Cadastral identifier (province, city, sheet and map numbers)
- Average elevation and easting
- Instrumental precisions (linear and angular)
- Type of update (of the map)
- Notes

The last option at the bottom of the page allows to “merge” the baselines referring to possibly multiple GNSS bases of reference so that they will all refer to a single (selectable) GNSS base of reference.

This option is useful to overcome some limitations of the Pregeo program in handling surveys with multiple bases of reference.

2.6 Import Data

Click “Project” -> “File Import” to start the import command. A page looking like the one shown if figure 2.6-1 will appear.

This command allows you to import points in coordinates (either grid coordinates or geographic/geocentric coordinates).

Choose the proper format from the File Format list then click the “Open Data File” button to choose the source file.

The path of the chosen file will be shown right below the open button and, more below, a preview of the contents of the file will be shown.

This preview allows you, if needed, to verify that the file contains compatible data.

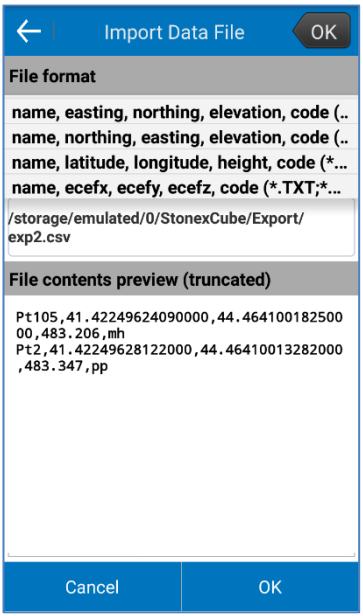


Figure 2.6-1

Click the “OK” button to proceed with the import or click the “Cancel” button to cancel.

The imported points will be of class “Input Point” so they will not show in the list of surveyed points (that is in the list shown by the “View Data” command). To see the points, you must open the “Points Library”: click “Tools” in the bottom part of the screen then select “Points Library”.

The imported points will be shown and possibly used when you start the stake out command.

2.7 Import Raster Image

Click "Project" -> "Import Raster Image" to import a georeferenced raster image. A page like the one shown in Image 2.7-1 with appear. Click the "Open Raster Image" button to choose a raster file to load (see Image 2.7-2).

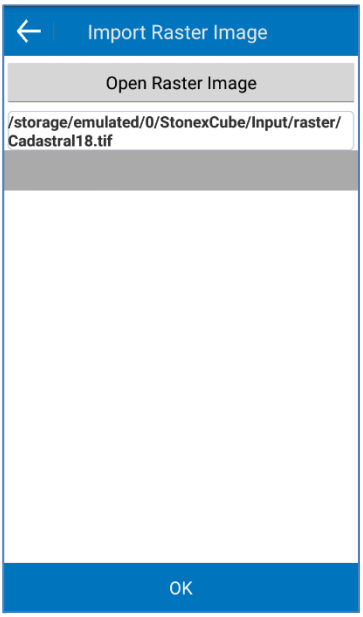


Figure 2.7-1

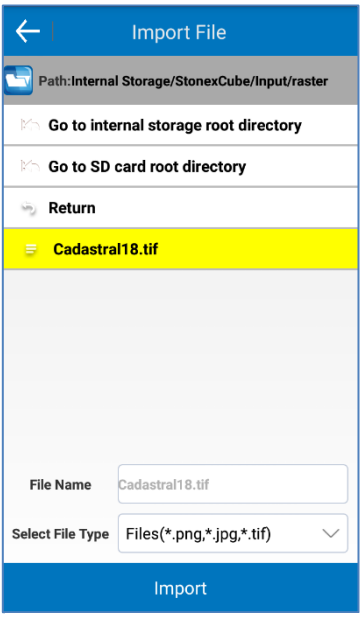


Figure 2.7-2

The program supports raster images that have been stored into files of the following formats:

- PNG (Portable Network Graphics) – compressed, lossless
- JPG (Joint Photographic Experts Group) – compressed, not lossless
- TIF (Tagged Image File Format) – usually compressed, usually lossless

Having a raster image is not sufficient: your raster image must come with a "twin" file that stores the georeferencing parameters. This file is called "*World*

File" and it must be created on a PC using a software that handles the image georeferentiation. In short, the following table shows which kind of World File you must store in the same folder that contains the raster image to import:

Raster Format	World File Format
*.PNG	*.PGW
*.JPG	*.JGW
*.TIF	*.TFW

Limits

Cube-a runs on Android and it must adhere to its limitations about memory allocation. One of such limitations is that any application should not allocate big blocks of memory and if an application does so then it must release that blocks of memory as soon as possible.

Taken from Android developer docs: "To allow multiple running processes, Android sets a hard limit on the heap size allotted for each app. The exact heap size limit varies between devices based on how much RAM the device has available overall. If your app has reached the heap capacity and tries to allocate more memory, the system throws an out of memory error".

All that means that you must be careful when trying to load raster images. Even if a raster image file seems to be of small dimensions (some megabytes) the same is not true for the image data it contains. Remember that usually raster image files are compressed, and that Cube-a has to decompress them before displaying them and this operation could need more memory than the Android OS is able to give.

As a rule: an image of W x H pixels in size (width x height) needs an amount of free memory equal to: W x H * 3 bytes.

Example: a photo of 5 mega pixels (2560 x 1920) occupies, after decompression, 14745600 bytes or 14 megabytes.

2.8 Project Details

Click “Project” -> “Project details” to view and to modify the relevant information of the current project. You can modify the operator, the instrument description and the notes as shown in Figure 2.8-1.

Click "OK" to save the modified information and return to the Project main interface.

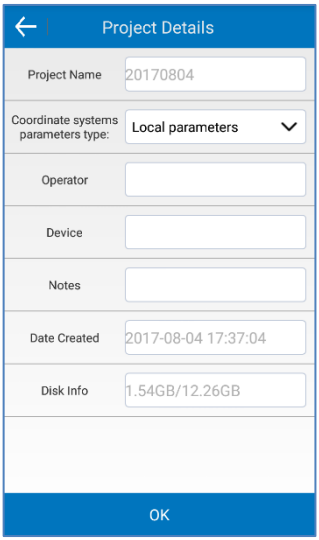


Figure 2.8-1

2.9 Version and Updates

Click “Project“ -> “Version and Updates” to view the installed software version and to check if an updated version of the software is available (Figure 2.9-1).

To check if an updated version of the software is available, click "Check Latest Version". If an update is available, you will be asked to download it (you can always choose to cancel the download and to postpone the update).

If at program startup your device is connected to the Internet, then the program will inform you (using Text to Speech) if an update is available. This will avoid you from opening the *Versions and Updates* page just to check if some update is available.

Figure 2.9-1

3. Software introduction - Device

Click "Device" in the main interface of the software, you will see the page shown in Figure 3-1. The Device submenu contains the *GPS Status*, *Data Link Status*, *Communication*, *Working Mode*, *Data Link Settings*, *Informations*, *RTK Reset*, *Register* commands.

The following sections will describe each of the commands in the submenu.

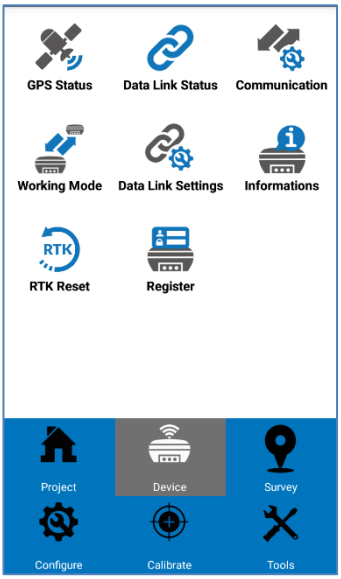


Figure 3-1

3.1 GPS State

Click “Device” -> “GPS status”, you can view the relevant information about GPS positioning. Click "detail", you can see the page as shown in Figure 3.1-2. The information includes the latitude and longitude coordinates of current GPS, plane coordinates, speed, heading, solution, differential mode, differential delay, satellite, PDOP, HDOP, HRMS, VRMS, UTC time, local time, and the distance to base.

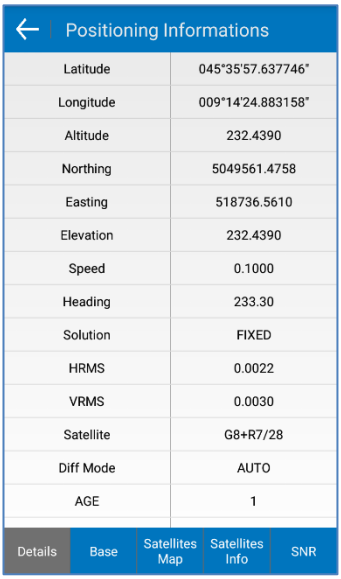


Figure 3.1-2

Solution state: including single solution, difference solution, float solution, fixed solution.

Single solution: it means that the receiver did not receive differential signal from the base, the accuracy is lowest.

Difference solution: it means that the receiver can receive differential signal from the base, but the data accuracy is low for various reasons, such as: mobile station location is too poor, too few satellites, and so on.

Float solution: it means that the receiver can receive differential signal from the base, it is the initial solution obtained by the carrier phase difference data solving, the accuracy is high, generally within 0.5 meters.

Fixed solution: It means that the receiver can receive differential signal from the base, it is the final solution obtained by the carrier phase difference data solving, with the highest accuracy, usually within 2 cm. With high-precision GPS measurement, it needs to achieve a fixed solution state to record data.

Differential mode: including CMR, RTCM and so on.

CMR: A type of differential message formats defined by Trimble.

RTCM: General differential transfer message format, including RTCM2.X, RTCM32 and so on.

Differential delay: it indicates the time at which a rover receives differentials (for example, a differential delay of 10 seconds indicates that the rover receives a differential signal from the base station sending before 10 seconds), the unit is seconds. When the RTK is working, the differential delay is smaller, the result is better, generally require less than 10 seconds, preferably 1 second or 2 seconds.

PDOP: Position dilution of precision. When it is less than 3, it is in the ideal state. The smaller the PDOP value is, the better the satellites distribute, it is helpful to reach the fixed solution state.

HDOP: Horizontal dilution of precision, which represents the component of PDOP in the horizontal direction.

VDOP: Vertical dilution of precision, which represents the component of VDOP in the vertical direction.

Base positioning information contains base ID, latitude and longitude, altitude, north coordinate, east coordinate, height, distance to the base, shown as Figure 3.1-3.

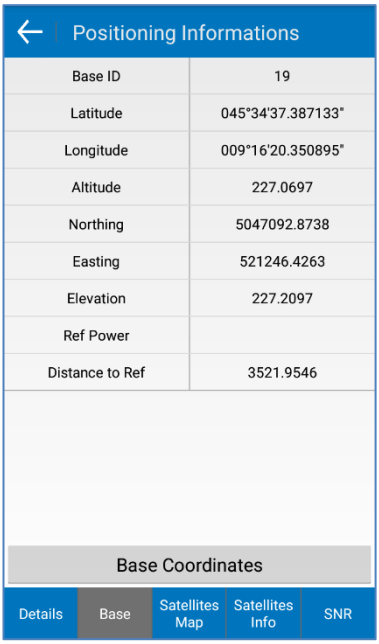


Figure 3.1-3

Satellite map indicates that the position of the satellites which receiver tracks, and it contains the azimuth angle and the height angle. The value on the circle represents the azimuth angle, and the value on the radius of

the circle represents the height angle, shown as Figure 3.1-4 (Blue for GPS, red for GLONASS, light green for BEIDOU, red for Glonass, magenta for Galileo, dark green for SBAS)

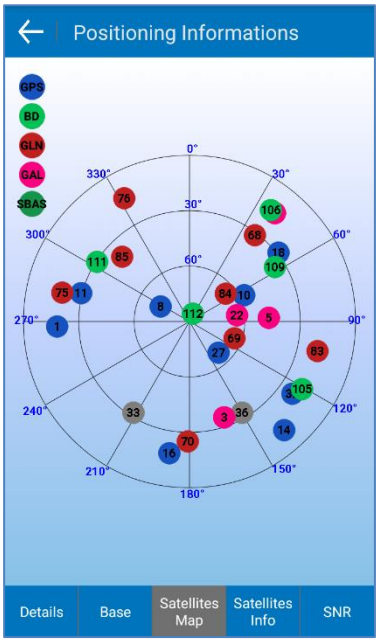


Figure 3.1-4

The satellite table contains the signal-to-noise ratio, the azimuth angle and the height angle of the six carrier signals of L1, L2, L5 in the GPS signal and B1, B2, B3 in Beidou signal, shown as in Figure 3.1-5.

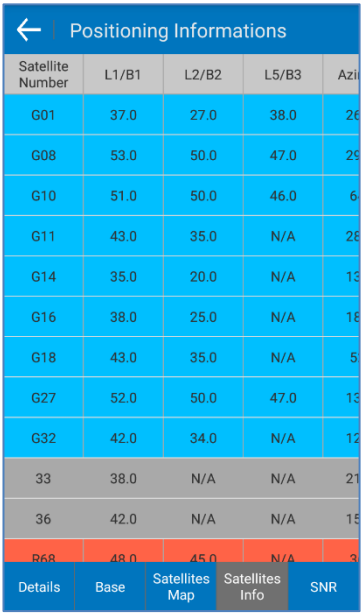


Figure 3.1-5

Ephemeris is a histogram represents the signal to noise ratio of L1, L2, L5 three carrier signals, shown as Figure 3.1-6.

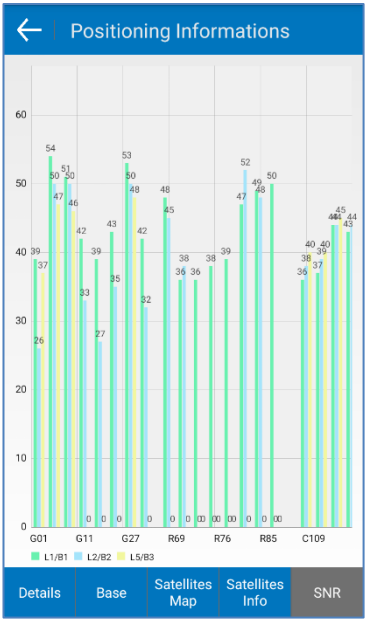


Figure 3.1-6

3.2 Data Link Status

Click “Device”-> “Data Link Status”, you can view the configuration and status of data link about the current receiver. When the data link is network, the data link status is shown in Figure 3.2-1.

There are four buttons (connect, disconnect, restart and refresh) in the bottom of the screen. Connect: click it to connect the data link. Disconnect: click it to disconnect the data link; Restart: click to re-initialize the network module; Refresh: click it to show the current data link status.

When the data link is internal radio, the data link status is shown in Figure 3.2-2. You can use the “restart” and “Refresh” buttons.

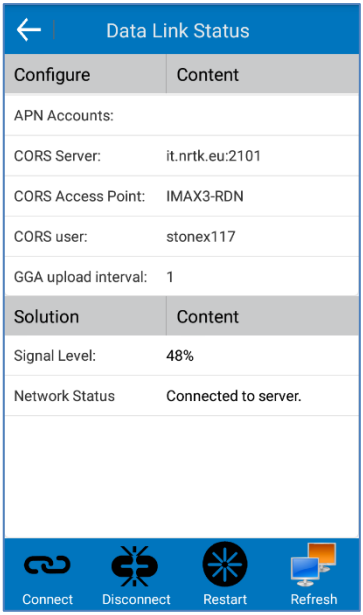


Figure 3.2-1

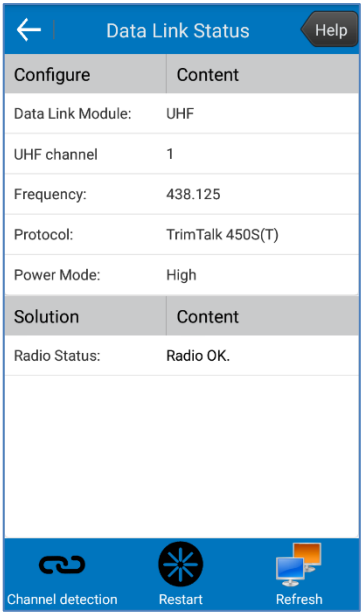


Figure 3.2-2

3.3 Communication Settings

Click “Device” -> “Communication”, there will be the page shown in Figure 3.3-1. Communication settings are mainly used to select the communication mode between receiver and **Cube-a** software. Communication settings need to be done in the two steps: Firstly, select the Device type from the options of RTK, M series and internal GPS. Secondly, set the communication mode, communication mode includes Bluetooth and WIFI. In the case of internal GPS opening, it can read its own GPS signal to achieve positioning.

1. *Bluetooth connection*

   Select "Bluetooth" communication mode in the communication settings interface, and then click "Search", you will see the page shown in Figure 3.3-2. If you already have a Bluetooth device in the list that you want to connect to, you can click "Stop" to stop searching, and select the name of the Bluetooth device to connect to the Device, click "Connect". When the Matching dialog box appears, please click “pair” and it could be connected successfully.

2. *WIFI connection*

   Select "WIFI" communication mode in the communication settings interface, then click "search" to find the WIFI names of corresponding receivers (the default WIFI name is the receiver number), at last click the WIFI name to connect it. After the connection is successful, return to the communication settings interface, and click "Connect" to complete the WIFI communication connection, shown in Figure 3.3-3.

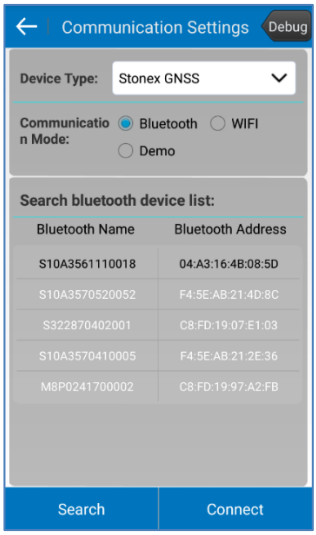


Figure 3.3-1

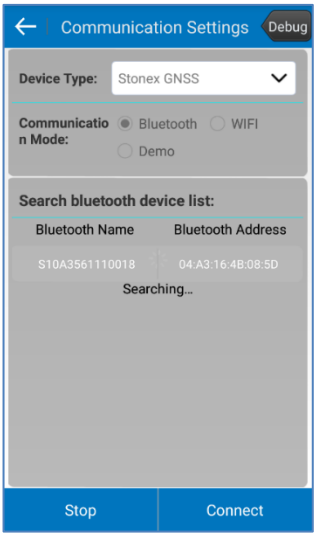


Figure 3.3-2

Figure 3.3-3

3. Demo Mode

When you select the communication mode as "Demo", then click "Connect" to enter the demo mode. You can try and view each function and don't need to connect the receiver.

3.4 Working mode

The working mode menu is mainly used to set the working mode of the receiver, click "Device" -> "working mode" to enter the working mode selection interface shown as Figure 3.4-1. In the working mode interface, there are five options including communication settings, static mode, base mode, rover mode, and Preset configurations.

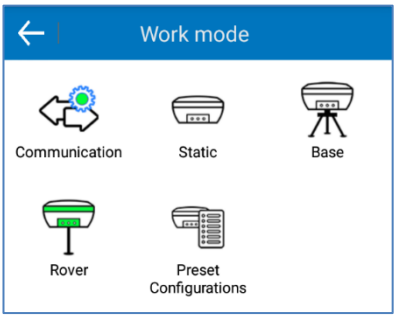


Figure 3.4-1

When doing static measurements, please set the working mode as static. When doing RTK measurements, please set the working mode as base or rover.

After connecting the Device and **Cube-a** software through communication settings, you can set the working mode, data link in the **Cube-a** software. The following sections describe the detailed settings in the working mode menu.

3.5 Communication

Click “Device” -> “Working Mode” -> “Communication”, you will enter the communication settings page same as the page in section 4.3. For the detailed description, please refer to section 4.3.

3.6 Static Mode

Click “Device” -> “Working Mode” -> “Static”, you will see the interface shown as Figure 3.6-1. The static setting contains three aspects: parameter settings, antenna parameters and satellite system. The following describes the various parameter settings in detail.

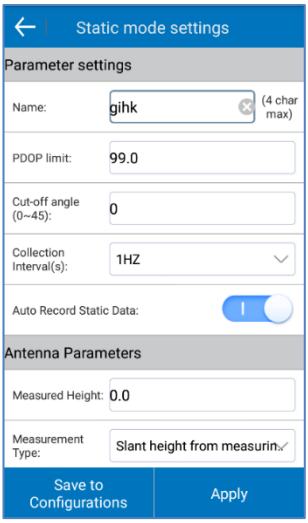


Figure 3.6-2

Name: The name of static data is limited to 4 digits.

PDOP limit: The geometric strength factor of the satellite distribution. The smaller the PDOP value is, the better the satellite distribution is. PDOP value less than 3 is the ideal state.

Cut-off angle: The angle between the connection between the satellite and the receiver and the horizon. The receiver does not receive satellite signals smaller than the cut-off angle. Value range: 0-45°.

Collection Interval: 1HZ said that the acquisition of a data per second, 5HZ said that the acquisition of five data per second, 5 seconds that five seconds to collect a data, and so on.

Auto record static data: If you select "Yes", receiver will start recording automatically when it is powered on and receiving satellites signal; If you select "No", you need to start recording static data manually after receiver is powered on.

Antenna height: Usually defined as vertical distance from the phase center of the antenna to the measurement point, because it cannot be directly measured, it is generally measured by other ways to calculate.

Satellites system: satellites system settings include five satellites systems, namely "GPS", "GLONASS", "BeiDou", "Galileo" and "SBAS" system. According to the needs of measurement work, you can choose whether to receive the corresponding satellites signal. (Note: only if the receiver supports the Galileo constellation then **Cube-a** will Galileo satellites in this page.)

SBAS: Wide-area differential augmentation system (satellite-based augmentation system). The navigation satellites are detected by a large

number of widely distributed differential stations and the acquired raw data is sent to the console. And then by the console through the calculation of the various satellite positioning correction information, and through the uplink injection station sent to the GEO satellites. Finally, GEO satellites will send the corrections to users, help to improve the positioning accuracy.

In the static mode settings, after all parameters have been set, please click "Save to Configurations" to store the static parameters. As shown in Figure 3.6-2, the static parameters of the current mode could be saved to the file, so that you can recall the configurations next time when you need. The configuration name could be set by users.

After the parameters in the static mode settings are set, click "Apply" to change the working mode of the receiver to static mode.

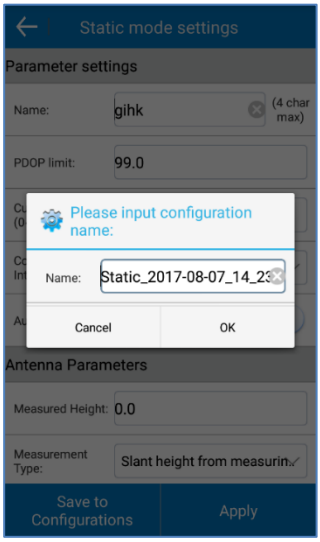


Figure 3.6-2

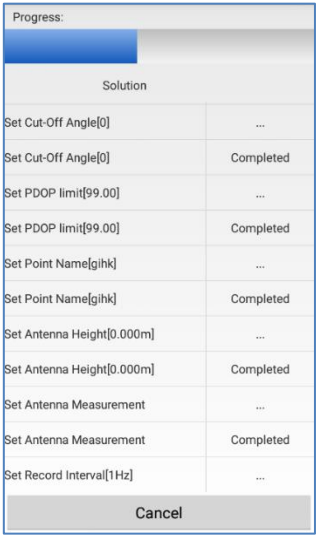


Figure 3.6-3

3.7 Base Mode

Click “Device – Working Mode - Base” to enter the “Base mode settings” page shown as figure 3.7-1. The base mode settings contain four aspects: startup mode, option settings, data link settings, and satellites system settings.

Start Up mode: There are two starting up modes, “use current coordinates” and “Input base coordinates”.

Use current coordinates: Base station takes the WGS-84 coordinates of current point as the base station coordinates.

Input base coordinates: The gap between input base coordinates and the accurate WGS-84 coordinates of current point shouldn’t be too large, otherwise the base station cannot work properly.

If you select “Input base coordinates”, Please click “Set base coordinates” to enter the base coordinates settings page shown as figure 3.7-2. There are three ways to input the base coordinates: search coordinates from library, get current GPS coordinates and input the coordinates manually. Then click “Set base antenna height” to set the antenna parameters.

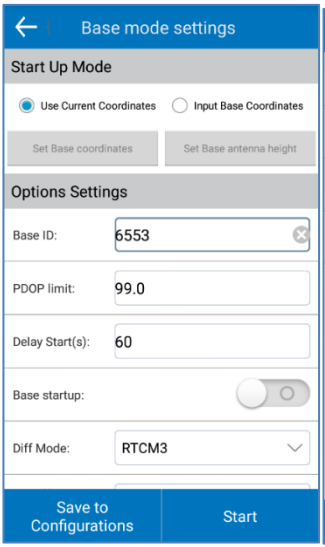


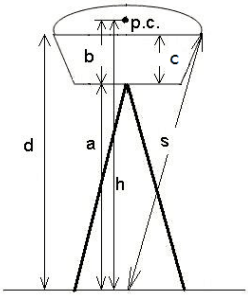
Figure 3.7-1

Figure 3.7-2

Figure 3.7-3

Measured height: The distance from the measured point to the ground.

Antenna height: Vertical height (h) from the antenna phase center to ground.



The known values which receiver provided are:

b: the height from the bottom of the device to the phase center (p.c.);

c: the height from the bottom of the device (ARP) to the rubber ring (SHMP);

R: the radius of the device rubber ring (R).

If the measured height is the vertical height (a) from the bottom of device to the ground, the measured mode is "Vertical height". And the antenna height: h = a + b.

If the measured height is the slant height (s) from the rubber ring to the ground, the measured mode is Slant height. Antenna height h = sqrt (s^2 - R^2) - c + b (sqrt means square root).

In option settings, you can set the Base ID, PDOP limit, Delay starts time, difference mode, cut-off angle and if to record raw data.

Data Link: There are four communication modes in datalink, including none data link, internal network, internal radio, external radio. Please refer to figure 3.7-4.

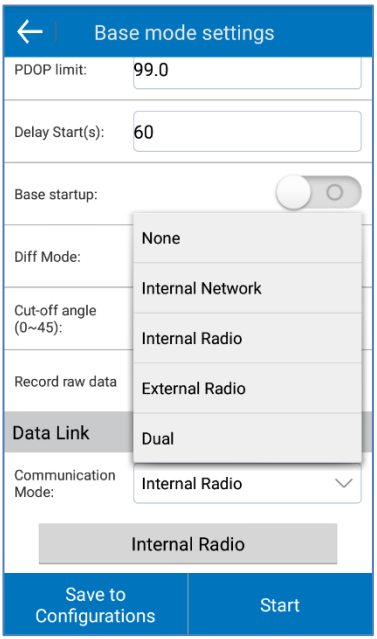


Figure 3.7-4

None: No differential data is sent.

Internal Network: Transmitting differential data through network, the receiver should be inserted in SIM card to transmit data.

Internal Radio: Transmitting differential data through internal radio. RTK base and rover are all with built-in radio, which could receive and transmit differential data. Base could transmit differential data through internal radio, and rover could receive differential data through internal radio.

External Radio: The receiver is connected to external radio, and transmitting differential data through the external radio.

After all parameters of base have been set, please click "Save to Configurations" to store the parameters. The base parameters of the current mode could be saved to the file, so that you can recall the configurations next time when you need. The configuration name could be set by users.

After the parameters in the base mode settings are set, click "Apply" to change the working mode of the receiver to base.

3.8 Rover Mode

Click “Device – Working Mode - Rover” to enter the “Rover mode settings” page shown as figure 3.8-1. The Rover mode settings contain four aspects: option settings, data link settings, antenna parameters settings and satellites system settings.

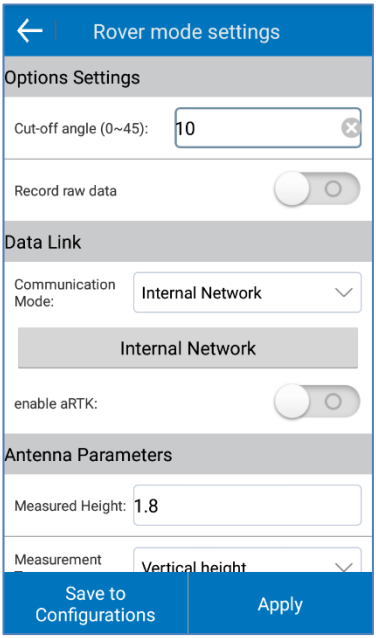


Figure 3.8-1

Options settings: If you enable the option “record raw data”, you can set the number of points name. Then you can collect the “Stop and go points” in point survey page.

Data Link: There are six communication modes in datalink, including no data link(none), internal network, internal radio, external radio, phone network and L-band. Please refer to figure 3.8-2.

The meaning of none, internal network, internal radio, external radio is same with which in base mode settings.

Phone Network: Transmitting differential data through the network of handheld. In this communication mode, the handheld should be inserted in SIM card or connected to Wi-Fi.

L-band: Using the Chinese precision satellite-based enhancement system, the geostationary communication satellite L-band broadcast differential signal, to achieve stand-alone 5-12 cm accuracy. Do not relies on ground base stations, CORS or network, in the non-differential signal area, desert, ocean, mountain, no differential signal area fast stand-alone positioning, easy to achieve high precision.

After the parameters have been set, please click “apply” to change the working mode to rover mode, then the rover could receive the differential data from the base. If the communication mode is radio, the frequency and protocol of base and rover should be the same.

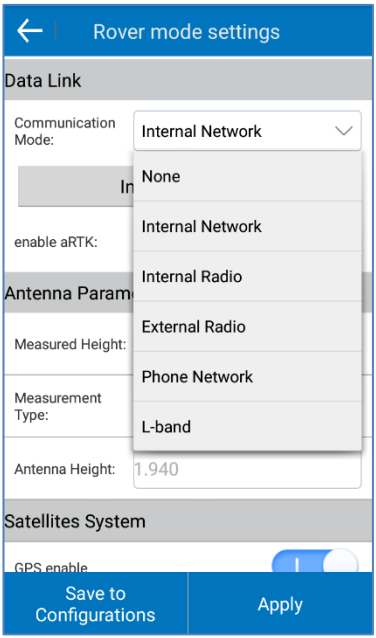

Rover mode settings
Data Link
Communication Mode:
Internal Network
None
Internal Network
Internal Radio
External Radio
Phone Network
L-band
enable aRTK:
Antenna Param
Measured Height:
Measurement Type:
Antenna Height:
1.940
Satellites System
GPS enable
Save to Configurations
Apply

Figure 3.8-2

3.9 Preset Configurations

Click “device – working mode – preset configurations” to enter the “preset configurations” interface shown as figure 3.9-1. If all configurations of various working mode of current project are saved, then these configurations can be viewed in this menu.

Figure 3.9-1

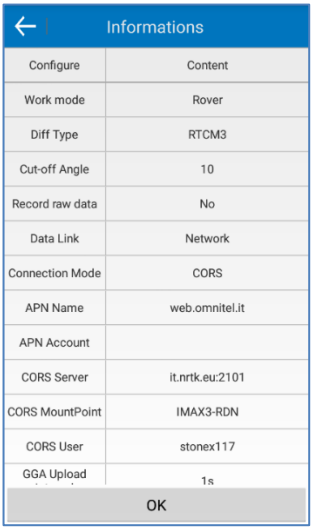


Figure 3.9-2

If you select one configuration and click “OK”, then device will work with the configuration which you selected.

If you select one configuration and click “details”, then all parameters of this configuration will be displayed.

If you select one configuration and click “delete”, then this configuration will be deleted.

3.10 Data Link Settings

Data link settings is mainly used to set the data transmission mode between the base and the rover. Click “device-> data link settings”, there are two options in the data link settings menu, current working mode and data link settings, please refer to figure 3.10-1. Depending on the different working mode, the data link settings are divided into two types, base data link settings and rover data link settings.

When current working mode is base, there are four data link modules, including None, internal network, internal radio, external radio. Please refer to figure 3.10-2.

When current working mode is rover, there are six data link modules, including None, internal network, internal radio, external radio, phone network and L-band. Please refer to figure 3.10-3.

After you select the data link module, you can click the button below the data link module to set corresponding parameters.

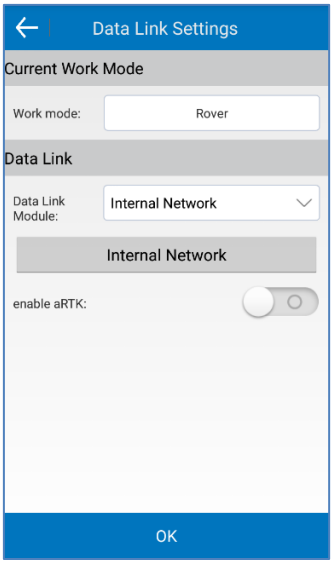


Figure 3.10-1

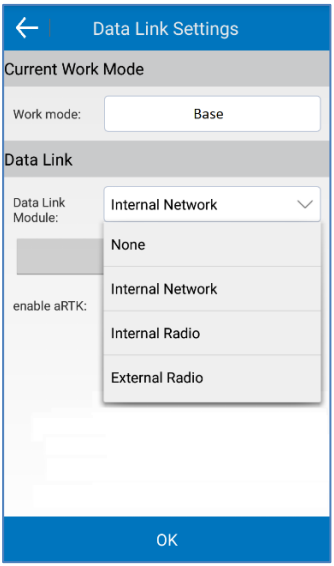


Figure 3.10-2

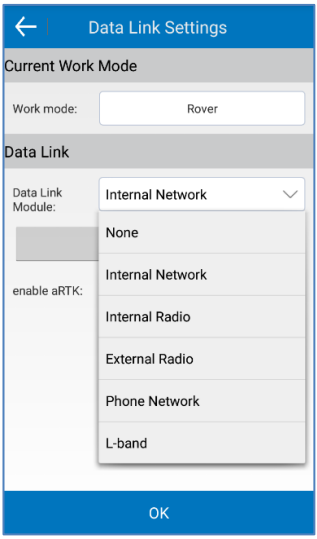


Figure 3.10-3

3.11 Internal Network

There are two kinds of network, internal network and phone network. When the working mode is base, the network only can be the internal network. When the working mode is rover, the network could be internal network and phone network.

When you select internal network in base mode, the content of settings includes connect mode, connect options, network mode, APN settings, CORS settings. When you select internal network in rover mode, the content of settings includes connect mode, connect options, network mode, APN settings, CORS settings, mountpoint settings, CORS account, get mountpoint settings. When you select phone network in rover mode, the content of settings includes connect mode, CORS settings, CORS account, and mountpoint.

Figure 3.11-1

TCP: Transmission control protocol, a communication protocol which is connection-oriented, reliable and byte-based.

NTRIP: Through internet protocol, a standard protocol used to transmit differential data via network, always used for CORS network.

Custom: User defined.

In "connect options" settings, the default value of GGA upload interval is 5s, and you can also set the GGA upload interval to other values. You can enable/disable the "Automatically connect to network". In rover mode, you can set the "network relay".

In "APN settings", you can set the operator/name/user/password of the SIM card in receiver. Some settings are preloaded as shown in figure 3.11-2. In addition, you can click the ••• on the right side to add or edit custom SIM card information.

Figure 3.11-2

Base network settings: Please set the IP, port, base access point (In general, the base access point is the device serial number of the base) and password in CORS settings. In addition, you can click the ••• on the right side to add or edit the parameters of the CORS server.

Rover network settings: Please set the IP and port in CORS settings, and you can also click ••• on the right side to add or edit the parameters of the CORS server. Some CORS settings have been preloaded in the software as shown in figure 3.11-3.

Then set the mountpoint, you can use "RTK network" or "mobile phone

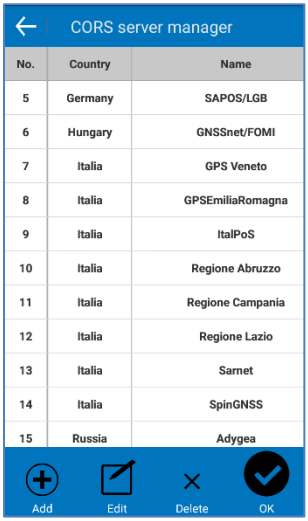


Figure 3.11-3

network" to get the mountpoint, and select a mountpoint in mountpoint settings. At last, set the user and password in CORS account. If the base is set up by yourself, the user and password could be entered as any characters. But if you are using someone else's CORS account, please enter the corresponding user and password.

Click "Ok", you will finish the base network settings or the rover network settings.

Note: The IP in base and rover network settings should be the same.

3.12 Internal Radio

Select the data link as “Internal Radio”, then click “internal radio” to set the parameters. The parameters in base and rover mode are the same, including channel, frequency and protocol. The channel 1-7 are the fixed channel, the frequency can’t be modified; the channel 8 is the customized channel, the frequency could be set as your actual need. Click “default radio settings”, you could set the frequency of 1-8 channel.

If the datalink of base and rover is internal radio, the frequency and protocol of base and rover should be the same. In base mode, the radio power will affect the transmission distance of the single. Low power, low power consumption, the signal transmission distance is close; High power, high power consumption, the signal transmission distance is far.

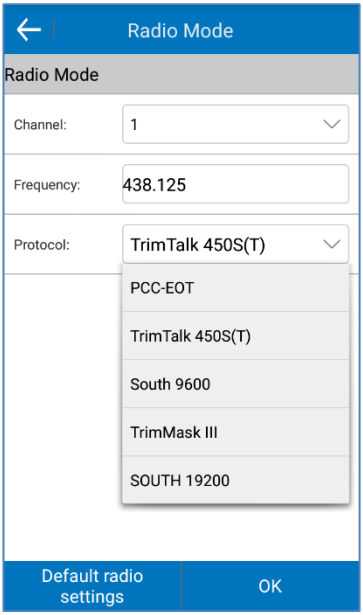


Figure 3.12-1

3.13 External Radio

Select the datalink as “external radio”, and click external radio to set the parameters. The external radio parameters of base and rover mode are the same, only need to set the baud rate. The default value of bard rate is 38400.

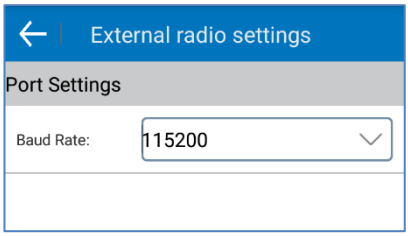


Figure 3.13-1

3.14 Phone Network

Phone network is only available in rover mode. Please select the datalink as "phone network" and click the phone network to set the parameters (figure 3.14-1), the parameters include CORS settings and mountpoint. If you click ••• on the right side of the CORS settings, you can add or edit the parameters of the CORS server.

These settings are the same as the internal network mode, except that network used in phone network mode is from the mobile device (handheld), which requires mobile devices to access the internet.

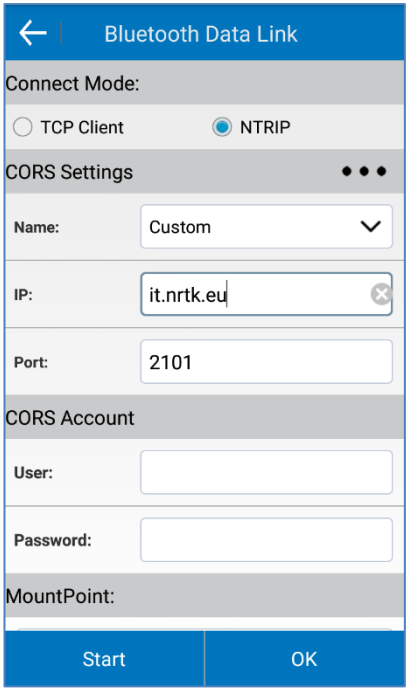


Figure 3.14-1

3.15 RTK Reset

Its function is to force an OEM board re-initialization, thus to force a complete recalculation of the location starting from fresh satellite signals. Click “Re_ position”, there will be the prompt dialog box shown as in figure 3.15-1, then click “Ok”, receiver will restart positioning.

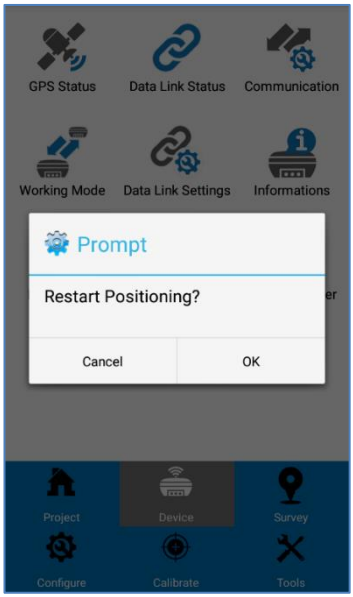


Figura 3.15-1

3.16 Informations

Contains the detailed parameters and status of device, antenna, network, radio and satellites systems. Please refer to figure 3.16-1.

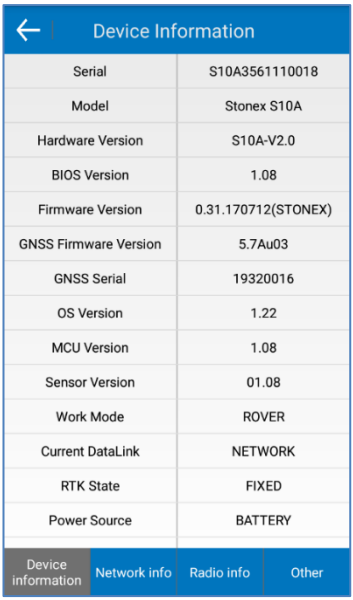


Figure 3.16-1

3.17 Register

You can view the device serial number and registration date in this interface. “Register” is to register the RTK, and when the receiver is connected with the **Cube-a,** then you can enter the activation code and click “registration” to register the RTK.

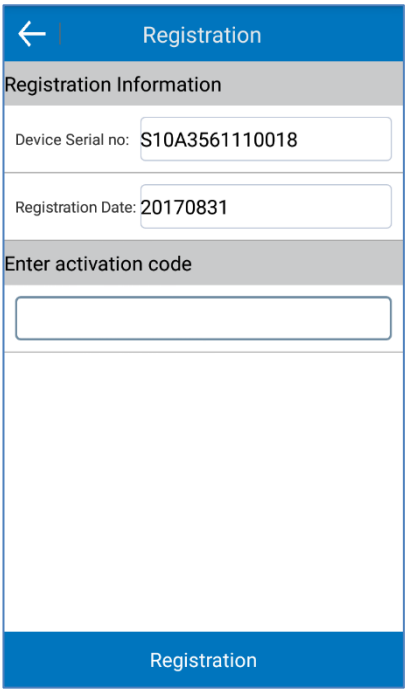


Figura 3.17-1

4 Software introduction - Survey

This chapter provides information on using the commands from the survey menu. You will see some submenus after you click "Survey", including *Point Survey*, *Point Stakeout* and *Line Stakeout*.

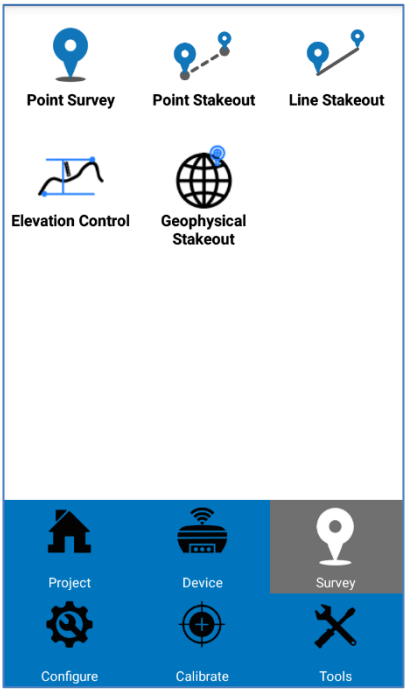
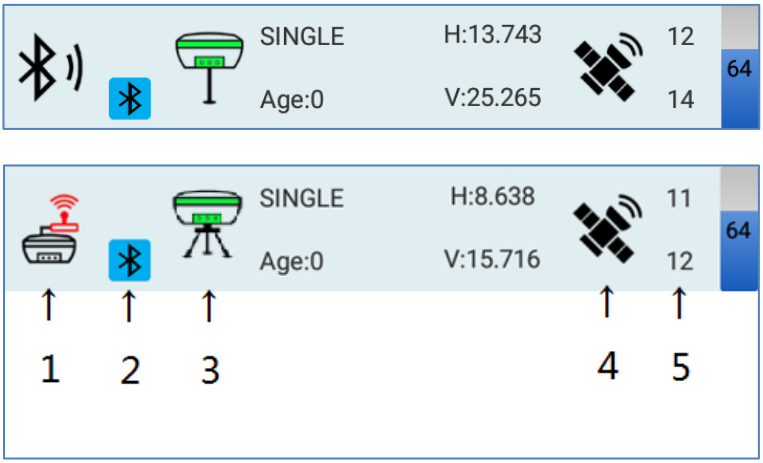


Figure 4-1

In the user interface of the submenu, you can click  on the upper right corner to set the point type and settings. Then click  to collect the point coordinates.



The icons in upper status bar description:

"1"—— Current datalink mode. In the above screenshot, it means the datalink is external radio, and you can click the icon to enter the interface to set the datalink.

"2"—— Current communication mode is Bluetooth. When the icon is blue, it means that **Cube-a** is connected with RTK. When the icon is gray, it means that **Cube-a** is not connected with RTK. You can click the icon to enter the communication settings interface.

"3"—— Current working mode, and you can click the icon to enter the working mode settings interface.

"4"—— Positioning information, and click the icon, you can see the detailed information about the positioning.

"5"—— Current number of satellites which used to solution, and the total tracked satellites number of receiver.

"Age: 0" —— It means that current age is 0.

"Single [0]" —— It means that current solution is single, and age is 0.

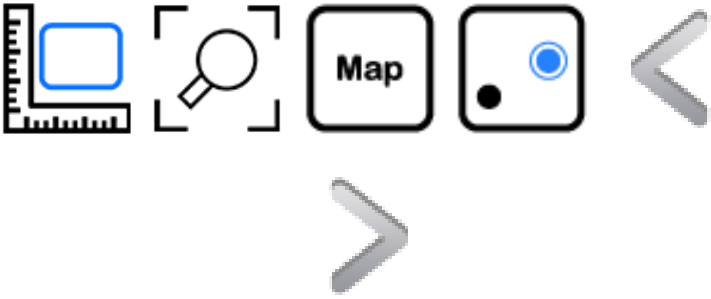
"Static, 0" —— "Static" means that the sensor is static status when the pole tilt survey is enabled, and "0" means that the tilt angle is 0.

"H"—— HRMS, the value represents the horizontal accuracy of current point.

"V"—— VRMS, the value represents the vertical accuracy of current point.

Solution status: Including single, float, differential and fixed.

Power level: Display the power level of the receiver.



The icons in left toolbar description:

: Screen measure. Measure the distance between any two points on the screen and the area of N (N> 2) points on the screen.

: Full map displayed. After you click this icon, all of the contents will be displayed in the screen which you can see.

: Collect screen point. When the icon is gray, it means the feature is disabled. When the icon turns green , it means the feature is enabled, and you can collect the screen points.

: Disable and enable map. When the icon is gray, it means the map is disabled. When the icon turns , it means the map is enabled.

: Position the current point in the middle of the screen.

: The previous line. It is available in line stakeout.

: The next line. It is available in line stakeout.

The icons in the right toolbar will be described in below chapter.

4.1 Point Survey

Click “Survey” -> “Point Survey” to enter the user interface of point survey shown as figure 4.1-1.

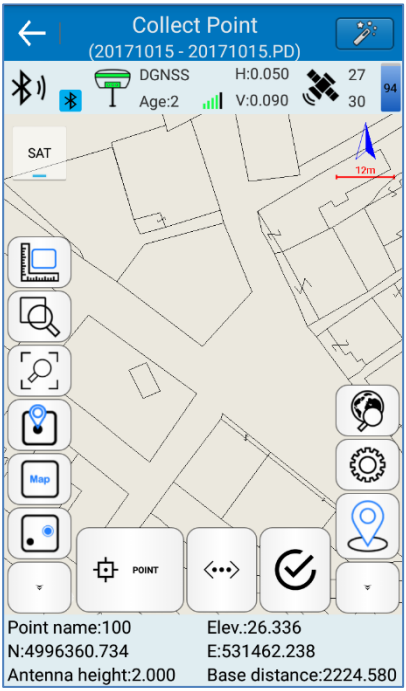


Figure 4.1-1

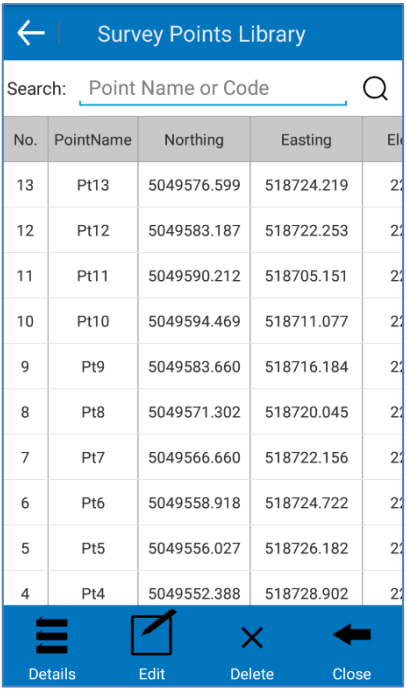


Figure 4.1-2

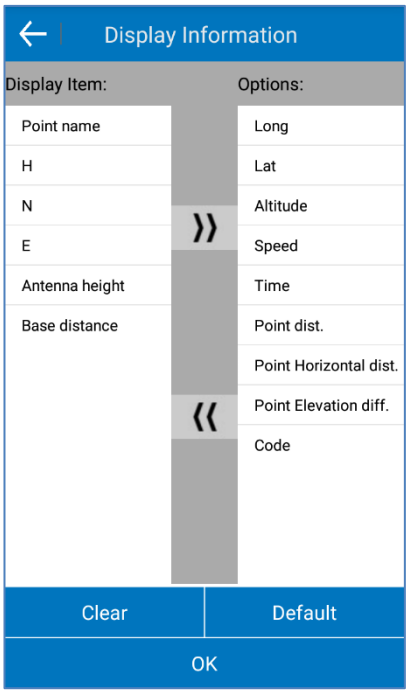


Figure 4.1-3

Description of the icons of point survey in right toolbar:

: Survey points library: the points which are collected by **Cube-a** are stored in the survey points library. After selected one point in the survey points library, you can click "details" to view the detailed information about this point, and you can also edit and delete this point which you selected.

: Display information settings: you can change the displayed information in the status bar at the bottom of the screen. Select an item in the "options" menu, then click to move this item to the "display item" menu. In the same way, select

an item on the “display item” menu, and click  to mode this item to the “options” menu. After you click “clear”, all the items in “display item” will be cleared. After you click “default”, the default items will be added to the “display item”, including point name, H, N, E, antenna height and base distance.

: Collect point coordinates: the default recording type will be same as the point type when you collected point last time. For example, if the point type was topo point when you collected last time, the recoding type is topo point when you collect point this time.

The items in status bar at the bottom of the screen description:

Point name: The point name of the collected point.

N, E, H: The plane coordinates (projection point) of the current point.

Long, Lat, Altitude: The geodetic coordinates of the current point.

Antenna height: The antenna height which you set when you do the measurement.

Speed: The moving speed of the receiver.

Base distance: The distance from current rover to the base.

Click  , you can set the type (topo point, control point, quick point, auto point and corner point) and saved conditions of recording points. And you can set the shortcut key in “Configure” -> “System Settings” -> “Shortcut Key”, then you can record the points through the shortcut keys. In general, you can record a point by pressing shortcut key once, and you can store the points by pressing shortcut key twice.

You can set the saved conditions and record option of the recorded points in "Configure" -> "Record Settings" -> "Topo point/Control point/Quick point/Auto point/Corner point".

Topo point: The "average GPS count" in record options refers to the number of points which could be consecutive recorded. Please refer to the Figure 4.1-4, it means that it could collect one point every time and this point should meet the saved conditions. When you click to record the topo point, if the RTK doesn't meet the saved conditions, there will be a prompt message. If the RTK meet the saved conditions, the measurement point info (HRMS, VRMS, delay, PDOP…) will be displayed in the screen. Then click OK to save the topo point.

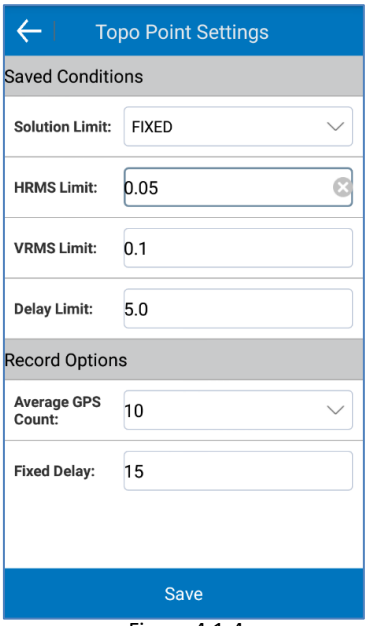


Figure 4.1-4

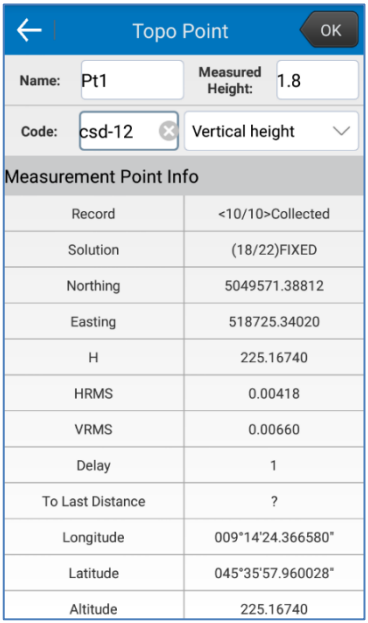


Figure 4.1-5

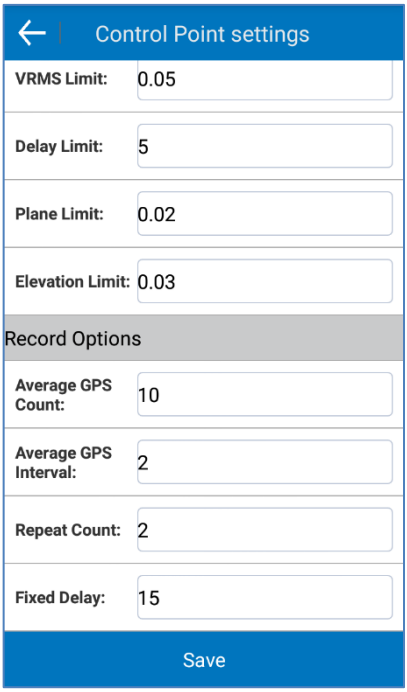


Figure 4.1-6

Control point: In the control point settings interface, you can set the saved conditions and record options of control point, please refer to Figure 4.1-6. In record options, we can set the parameters average GPS count, Average GPS interval, repeat count and fixed delay. If the fixed delay is 15, it means that it should wait for 15s after you click to record control point. If the average GPS interval is 2s and average GPS count is 10, it means that it could record a point every 2s and continuous record 10 points. If the repeat count is 2, it will collect 2 data sets. After the control points collection is finished, there will pop-up the prompt "The control

point report has been generated" when you click "OK". If you want to view the report, please click "OK".

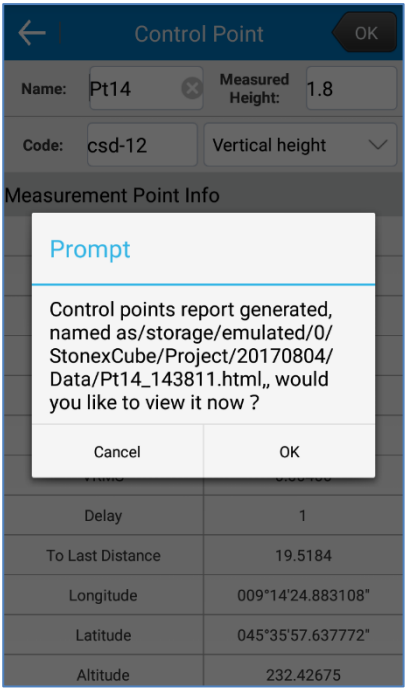
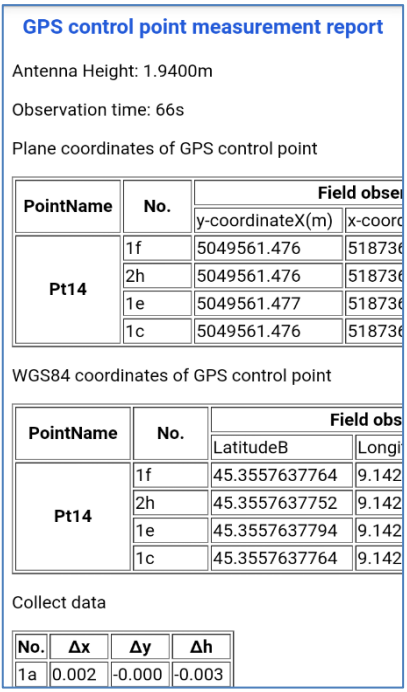


Figure 4.1-7



GPS control point measurement report

Antenna Height: 1.9400m

Observation time: 66s

Plane coordinates of GPS control point

PointName	No.	Field obse	
		y-coordinateX(m)	x-coord
Pt14	1f	5049561.476	51873
	2h	5049561.476	51873
	1e	5049561.477	51873
	1c	5049561.476	51873

WGS84 coordinates of GPS control point

PointName	No.	Field obs	
		LatitudeB	Longi
Pt14	1f	45.3557637764	9.142
	2h	45.3557637752	9.142
	1e	45.3557637794	9.142
	1c	45.3557637764	9.142

Collect data

No.	Δx	Δy	Δh
1a	0.002	-0.000	-0.003

Figure 4.1-8

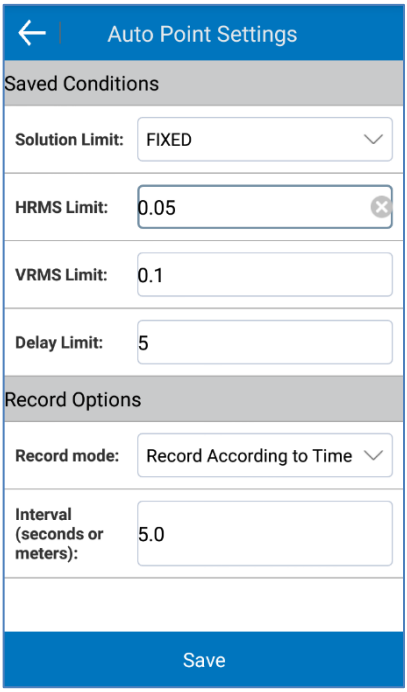


Figure 4.1-9

Quick point: When you collect the quick point, if the RTK meet the saved conditions, then the quick point will be collected after you click , and there will not pop-up the saved interface.

Auto point: When the record mode is "record according to time" and interval is 5s, it means that recording a point every 5s. Click to record the auto points, and if you want to pause the recording progress, please click "pause". Then if you want to start recording, please press "start". And you can click "close" to end the auto points recording.

Corner point: In corner point settings interface, you can set the saved conditions and average GPS count. Every time you record the corner point, you should record at least 15 points, and the distance between one point and another point should be greater than 1/10 of pole height. Then you can calculate the coordinates of the ball center by these corner points, the coordinates of the ball center are the corner point coordinates which you record.

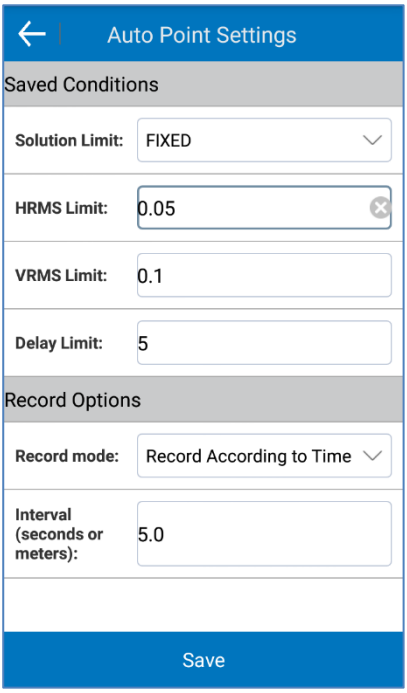


Figure 4.1-10

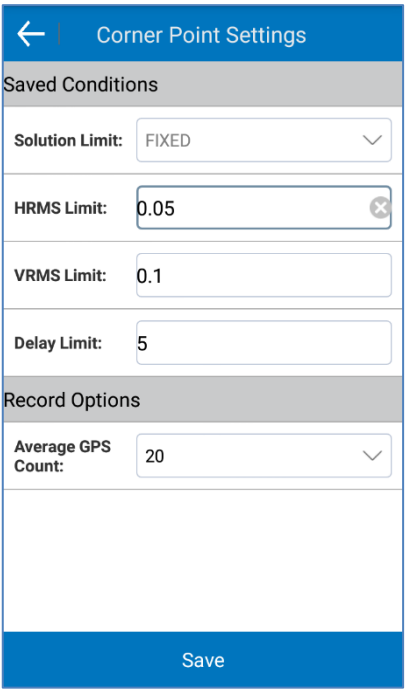


Figure 4.1-11

4.2 Drawing while acquiring points

From Cube-a v4 it is possible to draw vector CAD elements while surveying for points. The vertices of the vector CAD elements are the points acquired while a drawing tool is active.

To activate a drawing tool, refer to the “popup” tools grid as shown in figure 4.2-1.

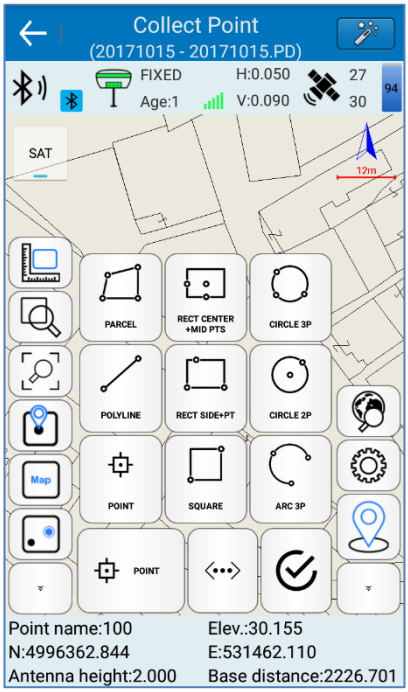
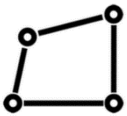
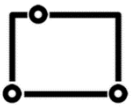
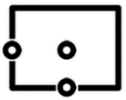
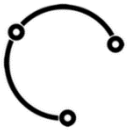
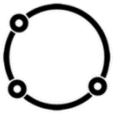


Figure 4.2-1

It is possible to draw vector CAD elements (meaning to "connect acquired points to form a particular vector shape") by activating one of the following drawing tools:

	***Point*** Enables the "standard acquisition", that is, simple point acquisition. No vector CAD entities will be created.
	***Polyline*** Enables the acquisition of polylines. While this tool is active, the program will connect all acquired points to form a polyline. Push the COMMIT button (see below) to end the acquisition of the polyline.
	***Parcel/Closed polyline*** Enables the acquisition of parcels/closed polylines. While this tool is active, the program will connect all acquired points to form a polyline. Push the COMMIT button (see below) to end the acquisition and to close the polyline.
	***Square by 2 pts*** Enables the acquisition of a square feature by means of two acquired points which are at the extremes of the diagonal of the square. The acquisition automatically ends as soon as the second point has been acquired.
	***Rectangle by base side + 3rd point on parallel side*** Enables the acquisition of a rectangular feature by means of two acquired points that defined the end points of one side plus one 3rd point that defines the distance of the opposite parallel side. The acquisition automatically ends as soon as the 3rd point has been acquired.

	***Rectangle by center point + 2 points on the mid point of 2 orthogonal sides*** Enables the acquisition of a rectangular feature by means of 3 acquired points: the first point defines the "center" of the rectangle, the second point defines the position of the mid point of one of the sides, the third point defines the position of the mid point of one of the two orthogonal sides to the previous side. The acquisition automatically ends as soon as the 3rd point has been acquired.
	***Arc of circle by 3 points*** Enables the acquisition of an arc of circle by means of the acquisition of 3 points that define (in order) the starting point of the arc, a constraint point for which the arc must pass through, the end point of the arc. The acquisition automatically ends as soon as the 3rd point has been acquired. The 3 points must not be aligned along a straight line.
	***Circle by 2 points*** Enables the acquisition of a circular feature by means of 2 acquired points: the first point defines the center of the circle, the second point defines the radius of the circle. The acquisition automatically ends as soon as the 2nd point has been acquired.
	***Circle by 3 points*** Enables the acquisition of a circular feature by means of 3 acquired points: the 3 points must be acquired in order, walking either in a clockwise or anti-clockwise direction along the circular feature to be acquired. The acquisition automatically ends as soon as the 3rd point has been acquired. The 3 points must not be aligned along a straight line.
	***COMMIT/CANCEL*** The action performed by this button depends on the kind of the active drawing tool and on how many points/vertices have been already stored. See the table 4.2-1.

	***COMMAND MENU*** Opens a menu with some helper commands. Commands include actions/settings for the CAD and COGO shortcuts. See table 4.2-2

Table 4.2-1

Drawing Tool	***# of vertices stored***	***COMMIT action***
Point	-	None
Polyline	< 2	Cancel acquisition
"	>= 2	Store & Restart
Parcel/Closed polyline	< 3	Cancel acquisition
"	>= 3	Store & Restart
Square by 2 pts	< 2	Cancel acquisition
Rectangle by base side + 3rd point on parallel side	< 3	Cancel acquisition
Rectangle by center point + 2 points on the mid point of 2 orthogonal sides	< 3	Cancel acquisition
Arc of circle by 3 points	< 3	Cancel acquisition
Circle by 2 points	< 2	Cancel acquisition
Circle by 3 points	< 3	Cancel acquisition

Table 4.2-2

USE LAST POINT	Instructs the program to insert/use the last collected point as a vertex for the current vector element being acquired.
HIDDEN POINT	Shortcut to the Hidden Point COGO function
CAD LAYERS	Opens the CAD's layer table

4.3 Photo And Sketch

The *Photo And Sketch* feature allows you to associate a photo to a point.

To launch *Photo And Sketch* command you must push the relative button that you can find in the bottom part of the screen while you are:

1. reviewing the details of point that you just collected;
2. editing the data of a point from the Survey Points Library.

The photo will be taken using the integrated camera of the handheld and it will be stored in a jpg file in the Photos folder of the active project.

The image file will have the name equal to the name of the collected point.

You can also draw over the image and insert:

- Text notes
- Point information (name, coordinates)
- Arrows
- Simple sketches (polylines drawn by hand).

Any of the above elements can be freely moved and rotated.

Images can also be re-shot or deleted.


Photo And Sketch
NAME = 130
NORTHING = 5049512.46
EASTING = 518729.22
Clear All
Add Note
Add Pt Info
Add Arrow
Draw
Undo Last
Move Item
Rotate Item
Take Photo
Rotate Photo
Cancel
OK

Figure 4.3-1

4.4 Point Stakeout

Click “survey- point stakeout” to enter the points library, then select one point and click “OK” to enter the stake point interface shown as figure 4.4-1.

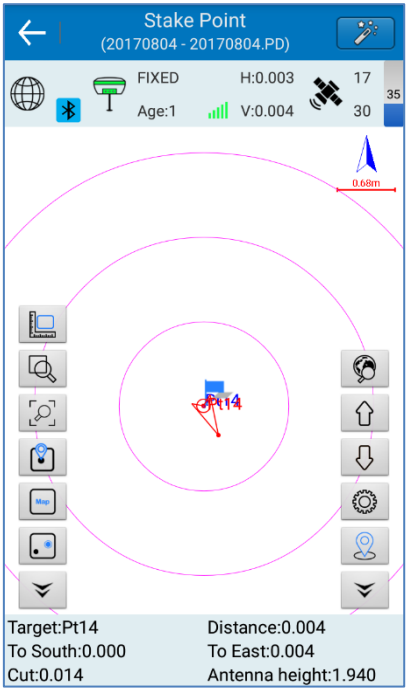


Figure 4.4-1

Figure 4.4-2

The icons of point stakeout in right toolbar description (figure 4.4-2):

: Points library. The coordinates of all points are stored in the points library. Please refer to chapter 8.1 for the operation of points library.

: Stake out the previous point.

: Stake out the next point.

: Stake point settings. You can set the stake point configurations in this interface, including prompt range, display track, display information (point name, point code) and collection scope. When you click "default configurations", the stake point configurations will be restored to default configurations. When you click "display information", you can select the displayed information in the status bar at the bottom of the screen.

Prompt Range: Set the stakeout point as center point, the I times/2 times /3 times of the prompt range as the radius to draw three concentric circles. Then the area of the three concentric circles is the prompt range.

Collection Scope: The distance between current point and the stakeout point, default value is 20 cm. When the collection point is in the collection scope, it doesn't prompt. When the collection point isn't in the collection scope, it will prompt.

: Collect topo point.

The items in the bottom status bar description:

Target: The name of the current stakeout point.

Distance: The distance from the RTK to the stakeout point.

North and South: The distance from the current RTK to the stakeout point needs to move southward or northward.

East and West: The distance from the current RTK to the stakeout point needs to move eastward or westward.

Cut and Fill: To cut or fill the location of stakeout point. When the current elevation is larger than the elevation of the stakeout point, please cut the location of the stakeout point. Otherwise, please fill the location of the stakeout point.

Antenna Height: The antenna height which you set when you measured.

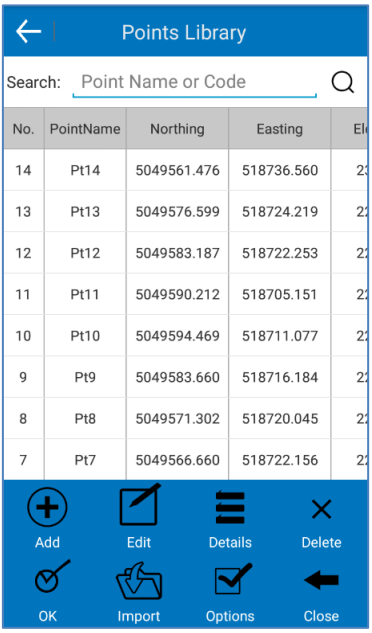


Figure 4.4-3

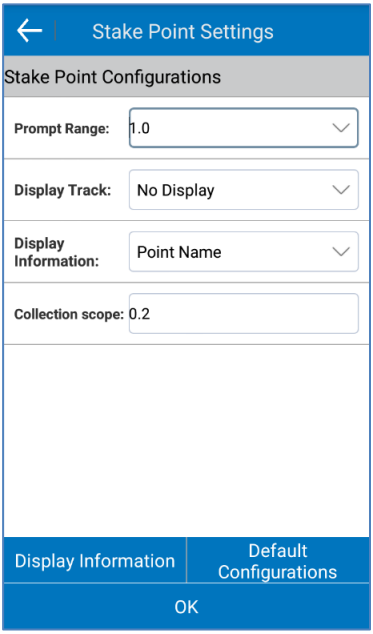


Figure 4.4-4

Point stakeout steps:

1. Select a point to stakeout in the points library, then click "OK" to enter the stake point interface. Please refer to the below Figure, red flag is the target stake point, the circle is the current position of the receiver, the arrow is the direction indicator, indicating the direction of current receiver. When the arrow direction is same with the direction to the

target point, please move in this direction, then you can reach the target point.

2. The items in the bottom status bar also indicate the direction and distance to the target stakeout point. If you want to reach the target point, you should move northward or southward, and you should move eastward or westward. And according to the elevation difference between current point and target point, it will suggest you to cut or fill.

3. When the current point is within the prompt range, there will be three concentric circles, it indicates that you are in precise staking.

4. The adjacent stakeout points in the points library can be switched automatically by ⇧ and ⇩ keys.

5. After you reach the stakeout point, please stake it.

4.5 Line Stakeout

Click “Survey” -> “Line Stakeout” to enter the lines library.

Select one line and click “OK” to set the parameters, then click “OK” again to enter the stake line interface.

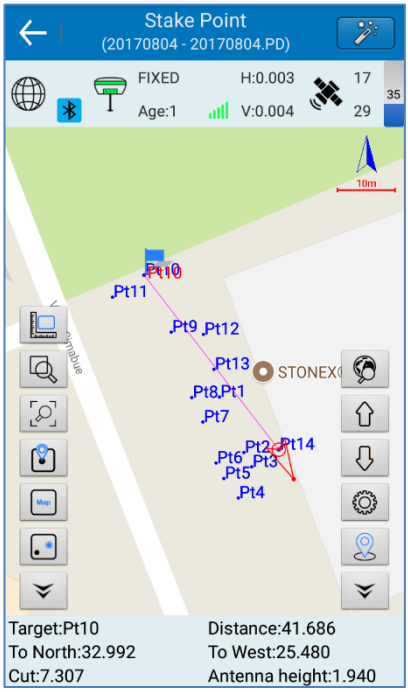


Figure 4.5-1

The icons of line stakeout in right toolbar description:

: Lines library. You can do eight operations in lines library, including *Add*, *Edit*, *Delete*, *Options*, *OK*, *Import*, *Export* and *Close*.

After you click "Add", it will enter the line parameters interface. You can add the line through two ways. The first way, input the road name, and set the start chainage, start point and end point, then the azimuth and line length will be calculated automatically, and you can click "OK" to add the line. The second way, set the road name, start point, start chainage, azimuth and line length, then click "OK" to add the line.

After selected one line in "lines library", then you can click edit to change the line parameters, click "Ok" to save the parameters which you changed. And if you click "delete" after you selected one line, the line you selected will be deleted.

Click "Options" to checked "the end chainage of last segment as the start chainage of next segment". If you checked it, it means that all lines are connected end to end, and spliced into a line.

Click "Import", there will pop-up the dialog box shown as Figure 4.5-2. If you select the import type as "import line library file", and set the start chainage (could be empty), then you can import the file which suffix is "*.SL". If you select the import type as "import coordinate file", and set the start chainage (could be empty), then you can import the file which suffix is "*.dat". The imported line file can be a line file in another project or a pre-edited line file, avoiding duplicate entries.

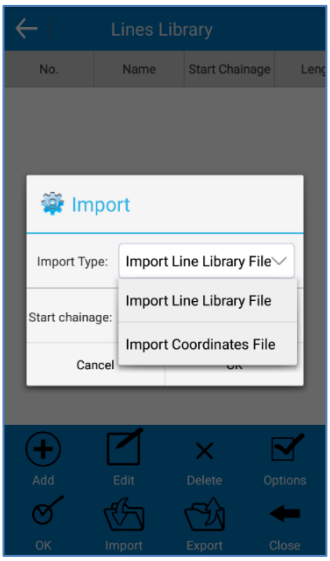


Figure 4.5-2

Click "Export", select the export path, and enter the file name. The line file ("*.SL") in the project can be exported to the specified path and used for other data processing or project import.

⇧ : Stake out the previous point in this line.

⇩ : Stake out the next point in this line.

: Add stake. When we stakeout line, we can add stake. There are two modes to add stake: first mode, calculate coordinates by chainage and offset distance, you need to input chainage, offset distance and offset angle. The second mode, calculate offset and distance by coordinates, you need to input name, northing, easting and elevation, or search coordinates from library, or get current GPS coordinates. After you set the parameters in add stake interface, please click "OK", and there will pop-up the prompt dialog box to display the calculate result. Then you can lick "stakeout" to stake and

store this point to points library. And you can also click “cancel”, it doesn’t to stakeout, and you can select to store this point to points library or not.

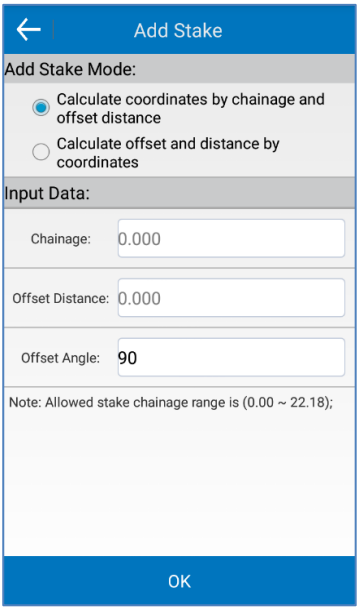


Figure 4.5-3

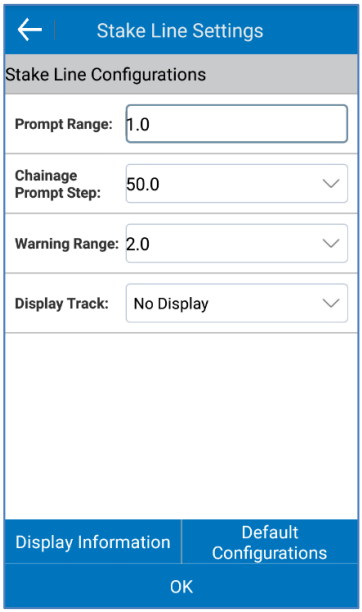


Figure 4.5-4

⚙ : Stake line settings. You can set the prompt range, chainage prompt step, warning range and display track in stake line settings interface shown as figure 4.5-4. When you click “default configurations”, the stake line configurations will be restored to default configurations. When you click “display information”, you can select the displayed information in the status bar at the bottom of the screen.

Prompt range: Taking the line as center, and taking “prompt range” as the spacing on both sides, generate six parallel lines. The area within the six parallel lines is the prompt range.

Chainage prompt step: The software will warn you when the current point is close to the integer multiple of chainage prompt step.

Warning range: The software will warn you when the current point is within the warning range.

 : Collect topo point.

The items in the bottom status bar description:

Target: The name of the stakeout line.

H: The height of current point.

Line chainage: Draw a vertical line from current point to stakeout line, line chainage is the distance from the vertical point to the start point.

Line offset: Draw a vertical line from current point to stakeout line, line offset is the distance from the vertical point to the current point. When the current point is on the left side of the line forward direction, the offset is negative; when the current point is on the right side of the line forward direction, the offset is positive.

Dis to start: The distance from current point to start point.

Dis to stop: The distance from current point to stop point.

Target peg: The name of the current stakeout peg.

To Big/Small: The distance from current point to target peg. "To big" means that if you want to reach the target peg, you should move to the direction of the large chainage, "to small" means that if you want to reach the target peg, you should move to the direction of the small chainage.

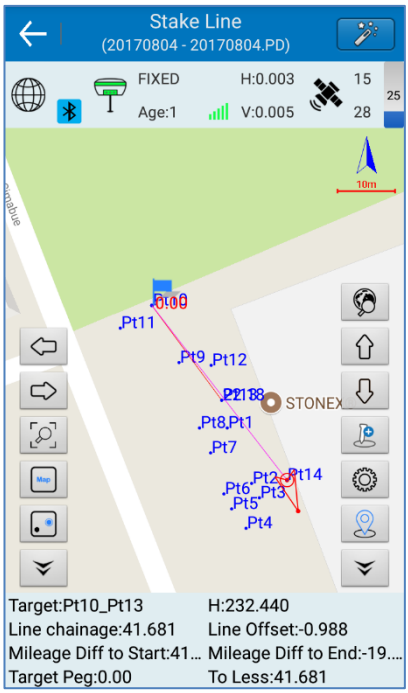


Figure 4.5-5

Line stakeout steps:

1. According to the engineering design, please edit the stakeout line in the line library or import line file in advance.
2. Select the Stakeout line, and click "OK" to enter the Stakeout line interface, the green flag indicates the start point, the red flag indicates the end point, the circle indicates the current point, and the arrow indicates the moving direction of the RTK. Please refer to Figure 4.5-5.
3. Moving direction: Move along the vertical line from current point to the stakeout line, you can return to the stakeout line. Or according to the prompt direction in the bottom status bar, you can

also find the correct direction to reach the stakeout line (You can change the items in the bottom of the status bar).

4. Please stakeout according to the prompt in the bottom status bar.
5. When the line offsets on both sides are within the prompt range, the parallel lines are generated on both sides of the stakeout line according to the setting of " prompt range". It indicates that you are in precise staking.
6. If you need to add a stake to the line during the staking process, click " " to set the stake mode and Position, then click "OK" to pop up the result dialog box. Click "Stakeout" to enter the stakeout interface, as shown in Figure 4.5-3. Then you can stake out according to the prompts in the bottom status bar, when the distance between stakeout point and current point is less than 3 meters, taking stake point as the center and generating prompt circles to get into the precise staking.
7. The adjacent stakeout lines in the lines library can be switched automatically by ⇧ and ⇩ keys.

5 Software introduction - Configure

Click "Configure". It consists of 6 submenus, namely Coordinate System, Record Settings, Display Settings, System Settings, Survey Settings and Layers Settings.

5.1 Coordinate System

Local coordinate parameters

Click "Configure"- "Coordinate System" as shown in Figure 5.1-1. All options can be clicked in to set up the parameter.

Click "Save" and choose "Local Disk" as shown in Figure 5.1-1 to save system data to the specified path as shown in Figure 5.1-2. It can also encrypt the file by setting up Expiry Date, General Password (data can't be viewed before expiry date) and Advance Password (data can be viewed before expiry date). Click "Save" and choose "QR Code" to share current coordinate system parameters.

Click "Predefined Projections" as shown in Figure 5.1-2 and choose "Local Disk" to import local-saved coordinate system parameters. It supports *.SP and *.EP files. Click "Predefined Projections" and choose "QR Code" to scan QR code to acquire coordinate system parameters.

Ellipsoid Parameter:

As shown in Figure 5.1-4, it can set up Target ellipsoid and enable/disable ITRF conversion. Target ellipsoid supports defined or custom parameters. With custom ellipsoid, it needs to set up Semimajor axis and Reciprocal of flattening 1/f, which should be consistent with the ellipsoid used for parameter calculation. To enable ITRF conversion, it needs to choose Conversion type, input Year of source coordinates and enable/disable Input velocity. If enabling Input velocity, it needs to input values for Vx, Vy and Vz as shown in Figure 5.1-5.

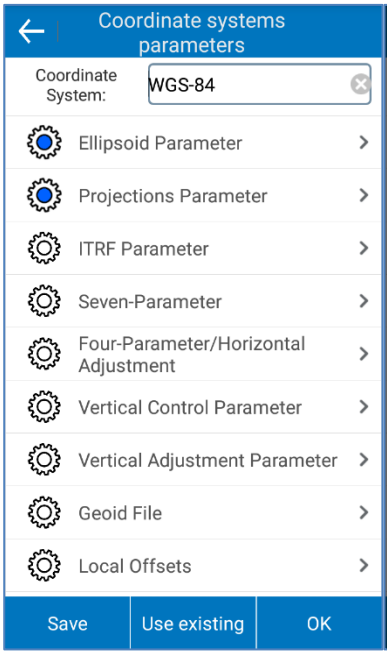


Figure 5.1-1

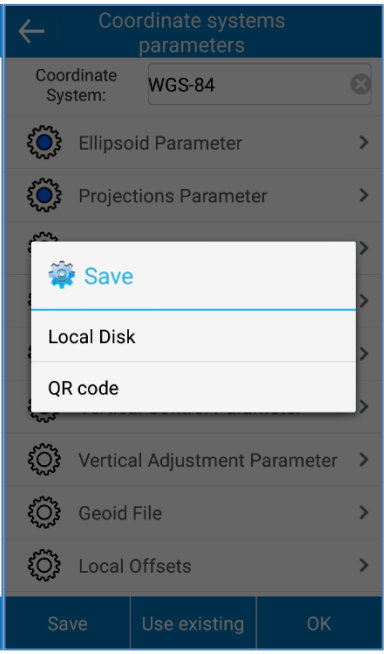


Figure 5.1-2

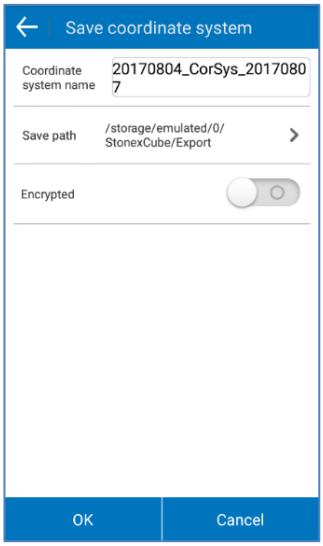


Figure 5.1-3

Figure 5.1-4

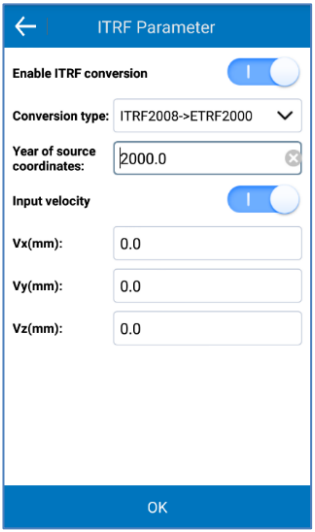


Figure 5.1-5

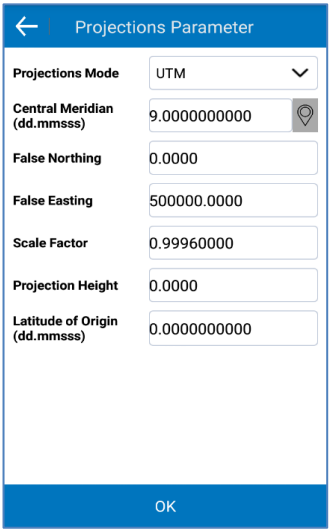


Figure 5.1-6

Projections Parameter

The frequently-used projections mode is Gauss Kruger, and after connecting to the device the Central Meridian can be acquired automatically via a click on  or manually via inputting the exact value. Common projections parameters are set up as followed: False Northing-0, False Easting-500000, Scale Factor-1, Projection Height-0 at low altitudes and change it as needed at high altitudes, Latitude of Origin-0.

Seven-parameter, Four-parameter/Horizontal Adjustment, Vertical Control Parameter, Vertical Adjustment Parameter and Local Offsets can be set up as needed.

1. RTCM1021~1027 Parameters

RTCM1021~1027 is a way to send coordinate system parameters via differential data. When coordinate system parameters type is set up as RTCM1021~1027 parameters in project creation, the software analyses coordinate parameters received with the differential data. In this mode, parameters cannot be set manually as shown in Figure 5.1-6.

5.2 Record Settings

Click "Configure"- "Record Settings" as shown in Figure 5.2-1. It can set up Saved Conditions and Record Options of Topo Point, Control Point, Quick Point, Auto Point and Corner Point. It can set up Code and choose Point Name Increment. It also supports Default Configurations.

Code: it can choose the same as last point, Mileage assignment code and Code is empty by default.

Point Name Increment: naming rule for saved points. For instance, Point Name Increment is 2, then the default point name of the first saved point is pt1, the second is pt3, and so on.

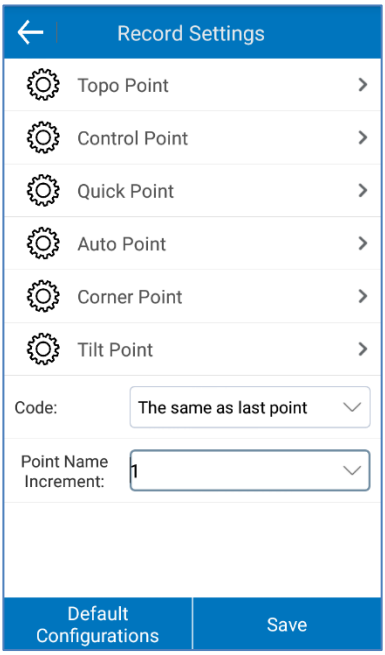


Figure 5.2-1

5.3 Display Settings

Click "Configure"- "Display Settings" as shown in Figure 5.3-1. Display Settings is for display set up on coordinates displayed in Survey interface. It can set up Display Content and Display Type as needed.

Display Content: Display Point Name, Display Code.

Display Type: Display All Points, Display Specified Point/Code, Display Last (0 to 100) Points.

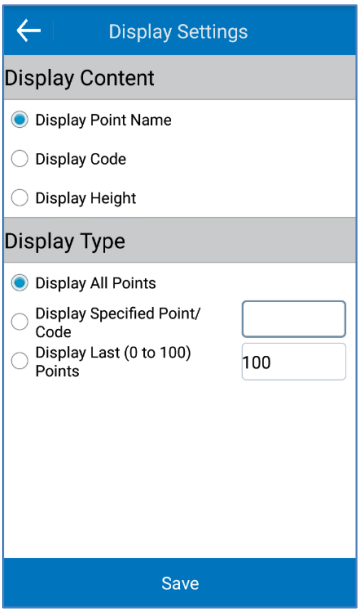


Figure 5.3-1

5.4 System Settings

Click "Configure"- "System Settings" as shown in Figure 5.4-1. It can set up Time Zone, Solution, Units, Stakeout Voice Prompt, Base Prompt, Tilt Survey, Device, Shortcut Key, Stakeout Shortcut Key and Map as needed.

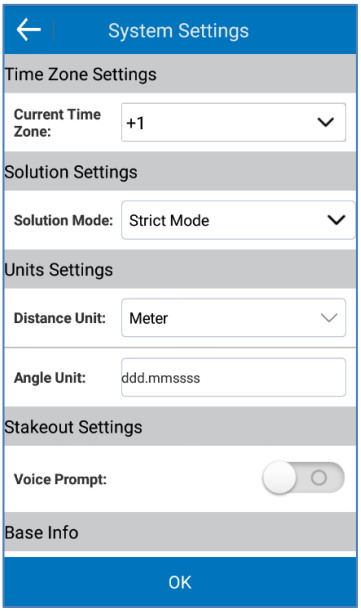


Figure 5.4-1

Time Zone Settings: set up device's Current Time Zone.

Solution Settings: for NovAtel board, solution mode can be set up as Normal Mode or Strict Mode. Strict Mode can improve solution reliability in special environment.

Units Settings: Distance Unit can be set up as Meter, US Survey Feet or International Feet. Angle Unit is ddd.mmssss. It can set up units according to different environment.

Stakeout Settings: it enables/disables voice prompt for stakeout.

Base Info: it enables/disables prompt for base coordinates change.

Tilt Survey: it enables/disables tilt survey, E-Bubble and Pole Tilt Correction.

Device: it enables/disables Voice function and WIFI function.

Shortcut Key: it sets up shortcut keys for Topo Point, Control Point, Quick Point, Auto Point and Corner Point. For P9A, default shortcut keys are respectively (1) for Topo Point, (2) for Control Point, (3) for Quick Point, (4) for Auto Point, and (5) for Corner Point. It also supports custom-defined.

Stakeout Shortcut Key: it sets up shortcut keys for Latest Point, Farthest Point, Last Point, Next Point and Survey Points Library.

Map: it enables/disables Google Map Display.

5.5 Survey Settings

Click “Configure”- “Survey Settings” as shown in Figure 5.5-1. Click “Add” to set up Point Coordinates or Search coordinates from library or Get current GPS coordinates. Generally, survey area set up needs at least three points. Points can be chosen to edit and delete. Click “Import” to import coordinates files (*.dat, *.txt, *.csv). Survey area shall display with red lines in measurement interface after survey area set up, as shown in Figure 5.5-2. It can check if the current point is in survey area when in survey.

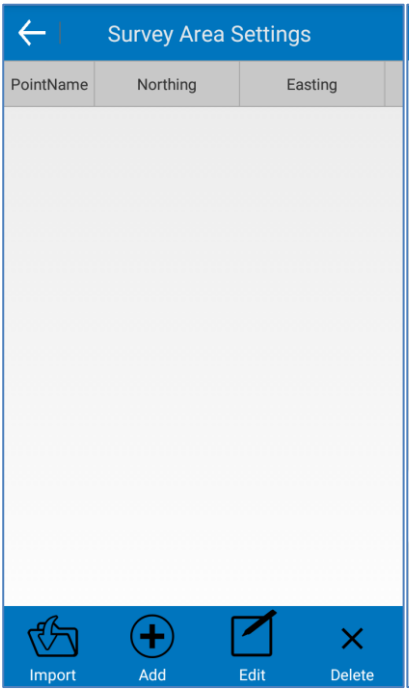


Figure 5.5-1

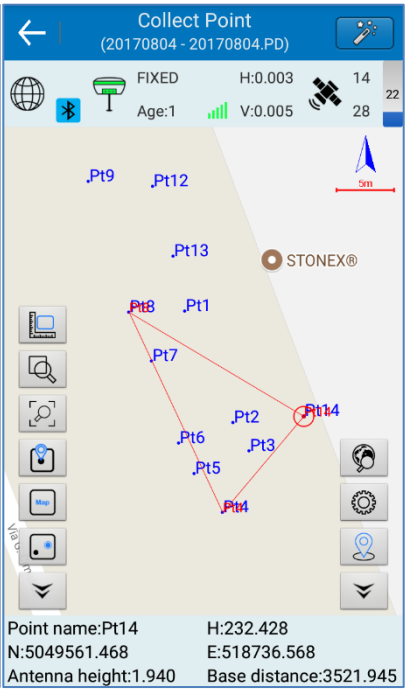


Figure 5.5-2

5.6 Layers Settings

Click "Configure"- "Layers Settings" as shown in Figure 5.6-1. Click "Add" to import layer. It supports *.shp (ArcGIS™ data type) and *.dxf (AutoCAD™® drawing exchange file) files. Choose layer and click "Edit" to edit Layer properties as shown in Figure 5.6-2. It can set up Contour Color and Fill Color, enable/disable layer properties display, choose which property to display and set up correspondent Text Color, choose if the layer visible and if selectable. Click "Boundary" to check the boundary of the layer as shown in Figure 5.6-3.

Multiple layers can be overlapped. Layers can edited, deleted, moved up and down. It can view imported layers in Survey interface after Layer settings, as shown in Figure 5.6-4.

In Survey, use  to choose layer and it shows Layer Element as shown in Figure 5.6-5. Click "Property" to check detailed layer element information. It can stakeout the chosen point on the layer via a click on "Stakeout". It can save the chosen point to coordinate library via a click on "Save".

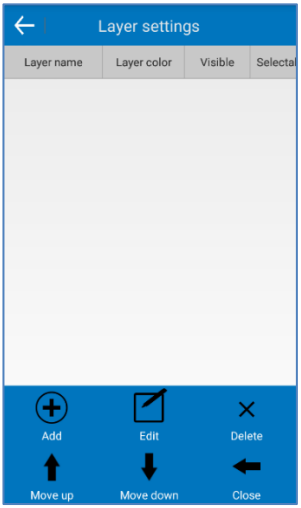


Figure 5.6-1

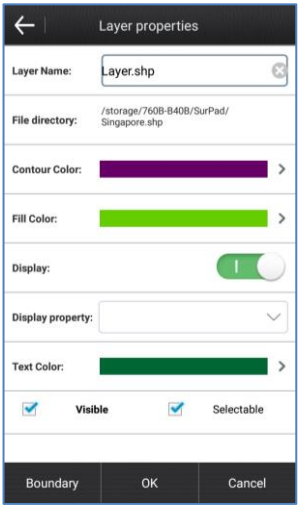


Figure 5.6-2

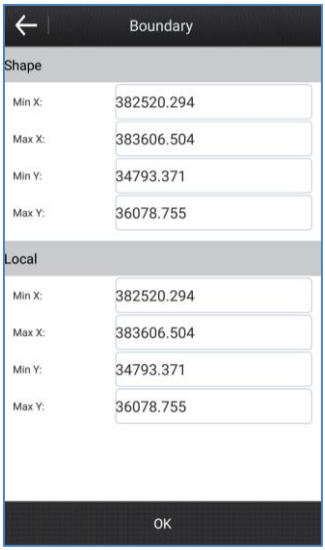


Figure 5.6-3

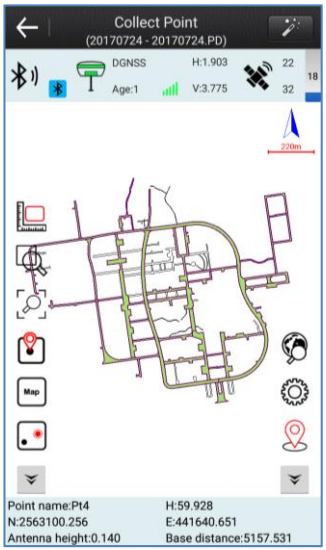


Figure 5.6-4

Figure 5.6-5

6 Software introduction - Calibrate

Click “Calibrate”, there will pop up the interface shown as Figure 6-1. There are three sub-menus, including Site calibration, calibration point and calibration sensor.

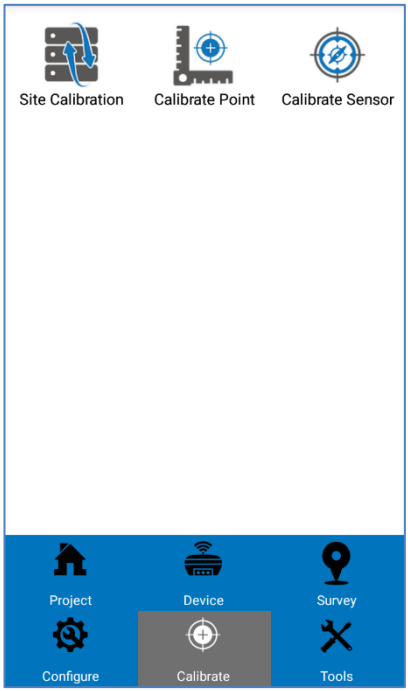


Figure 6-1

6.1 Site Calibration

In general, GPS receiver output data is WGS-84 latitude and longitude coordinates, the coordinates need to be converted to the construction measure coordinates, which requires coordinate conversion parameters are calculated and set the conversion parameters of software, it is the main tool to complete this work.

There are three coordinates convert methods, including “four parameters + elev. correction”, “seven parameters + four parameters + elev. correction” and “seven parameters”. The user need to consider which method should be used based on the known point.

Four parameters: At least two coordinates of control point should be known, which are in arbitrary coordinate system. It is the parameter that is used to perform a plane conversion between different coordinate systems within the same ellipsoid. Parameters include: four values (translate northing, translate easting, rotation and scale), the scale should be infinitely close to 1.

Seven parameters: At least three coordinates of control point should be known, which are in arbitrary coordinate system. It is the parameter that is used to perform space rectangular coordinate transformation within different ellipsoids. Parameters include 7 values (ΔX, ΔY, ΔZ, Δα, Δβ, Δγ, scale).

In general, the control point distribution directly determines the level of high and low and four parameters to control. Using four parameters for RTK measurement method can be in a small range (20-30 square kilometers), make the measurement point in plane coordinate and cooperate between the precision of elevation control net with known very well, as long as the coordinate point collection of two or more than two places, but in a wide range of measure (for example, dozens of hundreds of square kilometers), transformation parameters often can't play for increasing accuracy of plane and elevation in part of the scope, seven parameter method should be used at this moment.

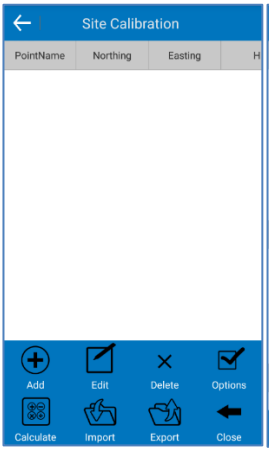
You first need to make measurements and leveling control, in the area known control point coordinates do static control, and then the network adjustment prior to the survey area is selected a control point A as static net adjustment WGS84 reference station. Use A static Device at A fixed point measure single point positioning of more than 24 hours (this step in the test zone is relatively small, relatively low accuracy of cases can be omitted), and then imported into the software in single point positioning point at which total recorded, the average as A point of WGS84 coordinate, as A result of long time observation, the absolute accuracy should be within 2 meters, and then to three dimensional control network adjustment, you need take point A WGS84 coordinate as known coordinate, to calculate other points of 3 d coordinates, but at least more than three group, after the input to calculate the seven parameters.

The four parameter is used to plane conversion, it also need to horizontal adjustment. When using horizontal adjustment, if there are less than three points elevations used to calculate, the parameter of horizontal adjustment is weighted average. If there are 4-6 points elevations used to calculate, the parameter of horizontal adjustment is plane fitting. If there are more than 7 points elevations used to calculate, the parameter of horizontal adjustment is surface fitting.

How to calculate the convert parameter?

In general, if we use three known points A, B, C to calculate the conversion parameters, then first we should know the GPS original record WGS-84 coordinates and local coordinates of A, B, C three points. There are two methods to get the GPS original record WGS-84 coordinates of A, B, C points. First method, set up static control network, then get the WGS 84 coordinates from the GPD recording of the post-processing software. Second method, GPS rover records the GPS original WGS-84 coordinates in a fixed solution when no correction parameters are active.

Click calibrate -> site calibrate, there will be the interface shown as Figure 6.1-1. You can do eight operations in this interface, including add, edit, delete, options, calculate, import, export and close.



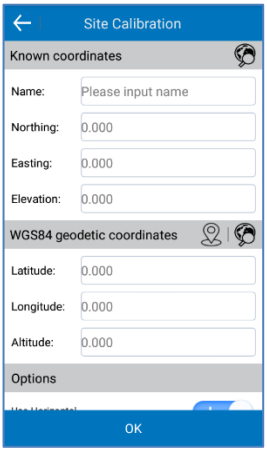


Figure 6.1-1 Figure 6.1-2

Click “Add”, there will pop-up the interface shown as Figure 6.1-2.

There are two methods to set the know point coordinates: first method, click ••• to get the coordinates from the points library; second method, input the name, northing, easting and elevation directly.

Then set the WGS84 geodetic coordinates, and click “OK” to add the first group of coordinates. The remaining coordinates can be added in this way, until you have added all the coordinates which are participated in the parameter calculation.

Select a coordinate in “Site calibration” and click “edit”, you can edit the parameters of this point, including known coordinates, WGS84 geodetic coordinates and options. Then click “OK” to save the changes.

Select a coordinate in “Site calibration” and click “delete”, then all the data about this point could be deleted from site calibration.

Click “Options”, there will pop up the site calibration settings shown as Figure 6.1-3. There are three coordinates convert methods, including “four parameters + elev. correction”, “seven parameter + four parameter + elev. correction” and “seven parameter”. The four parameters model includes “horizontal adjustment” and “four parameters”. Vertical control includes “weighted average”, “plane fitting”, “surface fitting”. The “horizontal accuracy limit” and “vertical accuracy limit” can be changed according to actual needs.

Click “Import”, you can import the “* .COT” file, which convenient coordinate input.

Click “export”, you can export and save the coordinates in site calibration to “* .COT” file. When you need to use these coordinates next time, you can import and don’t need to re-input.

After all the coordinates are entered, please click “calculate”, there will pop up the GPS parameter report shown as Figure 6.1-4. Click “return”, it will return to the site calibration interface, and when you click “Close”, there will pop up the prompt “are you sure to apply calculated parameter model to the current project?” shown as Figure 6.1-5. If you want to apply this parameter, please click “OK”. If you don’t like to apply this parameter, please click “cancel”.

After you apply the parameter, the original WGS-84 coordinates in the current project points library will be converted to the same coordinate system coordinates as the known points according to the parameters. Whether the calculation results are accurate or reliable, it can be checked by going to another known point.

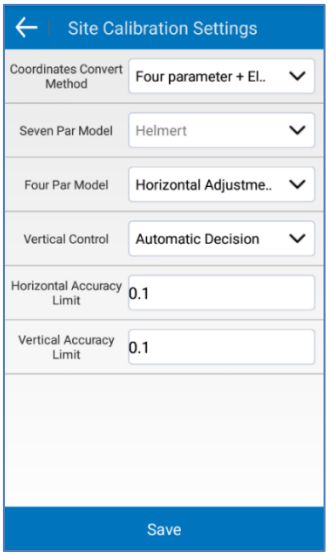


Figure 6.1-3

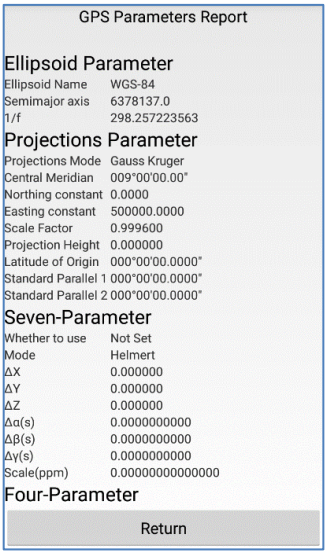


Figure 6.1-4

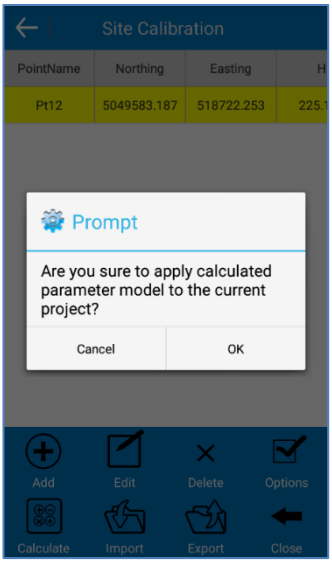


Figure 6.1-5

6.2 Calibrate Point

Click calibrate-> calibrate point, there will pop up the interface as shown in Figure 6.2-1. **Cube-a** has two kinds of calibrate point methods. Base point calibration, using the base coordinates before conversion and the current base coordinates to calibrate. Marker point calibration, using the coordinates of the points before conversion and the coordinates of the point after conversion to calculate.

Base point calibration steps:

1. Click "base point calibration" to enter the interface shown as Figure 6.2-2.
2. Please input the known point coordinates (the base coordinates before conversion). There are two methods to input the coordinates: Click  to get the coordinate from the points library. Or input the northing, easting and elevation directly. Click "current base coordinates" to set the antenna parameters, please refer to Figure 6.2-3.

Figure 6.2-1

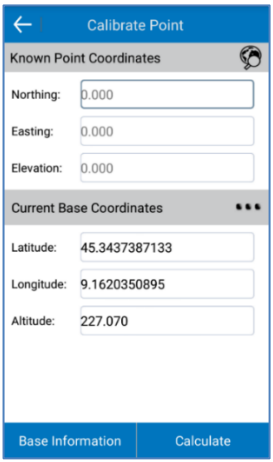


Figure 6.2-2

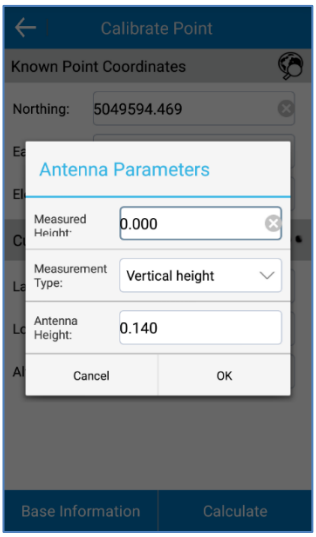


Figure 6.2-3

3. Input the measured height, and select the measurement type.
4. Click "Calculate" to pop up the result as shown in Figure 6.2-4. Then click "Ok" to return to the calibrate point interface.

   Note: The base point calibration should be used in a fixed solution.

Marker point calibration steps:

1. Click "marker point calibration" to enter the calibration point interface shown as Figure 6.2-5. Then input the known point coordinates, and click  to get the current WGS84 coordinates.
2. Click "OK" to pop up the result. Then click "OK" to return to the calibrate point interface.

Click "view local offsets" to view the local offsets, please refer to Figure 6.2-6.

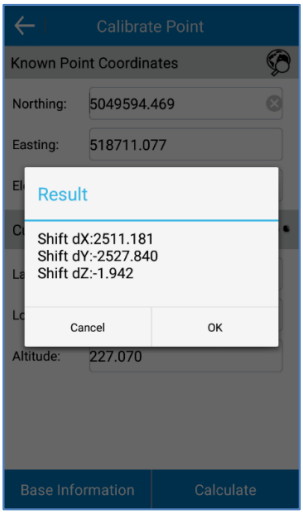


Figure 6.2-4

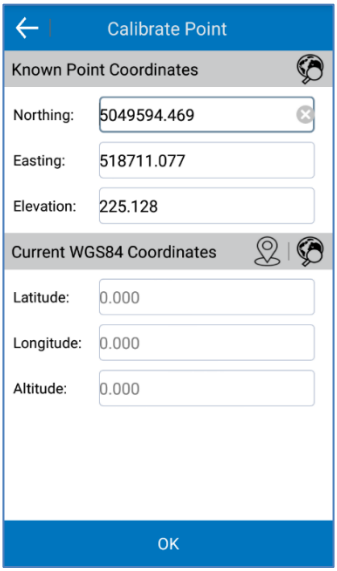


Figure 6.2-5

Figure 6.2-6

Calibrate point should be done on the basis of the already open transformation parameters. Local offsets are commonly used in the transformation parameters switch machine operations have been carried out and the base, or a work area of transformation parameters, can be directly input and local offsets parameters is, in fact, the use of a common point calculation of two different coordinates "three parameters", referred to as the local offsets in software.

The following is the case where the calibrate point is used.

1. In the startup mode parameters of base, the “use current coordinates” is selected, and the base have been restarted or the position has been moved, the rover should calibrate point.
2. When the user knows the conversion parameter of the work area, the base could be set up at any place. Please input the conversion parameter, and the rover should calibrate point.
3. In the startup mode parameters of base, the “input base coordinates” is selected, and the base has been moved, the rover should calibrate point.
4. In the startup mode parameters of base, the “input base coordinates” is selected. If the base hasn’t been moved, it just be restarted, the rover doesn’t need to calibrate point.

Note: The calibrate point parameters will not refresh the current point coordinates in the library. When display the current point coordinates, it will also display the calibrate point parameters, the subsequent measurement of the coordinates will be corrected by the calibrate point parameters. Transformation parameters by calculating the parameters of the library will refresh the current coordinates of the point. The WGS-84 coordinates of the measurement point are converted to local coordinates by conversion parameters.

6.3 Calibrate Sensor

Click "Calibrate"-> "Calibrate sensor" to enter the page shown as Figure 6.3-1. There are three function keys in this interface, including *e-bubble calibration*, *magnetic azimuth calibration* and *magnetic declination calibration*. There are four steps to perform sensor calibration, and the operation of these four steps will be described in detail below.

1. Enable pole-tilt correction

Click *Configure* -> *System settings*, select "*Pole – Tilt correction*" in tilt survey, then click "OK".

2. E-bubble calibration

① Click "calibrate -> calibrate sensor ->  " to enter the e-bubble calibration interface shown as Figure 6.3-1.

② After the bubble centered on the retractable pole, please click the "calibrate" button. At this time, the e-bubble in RTK and the bubble on the retractable pole are both centered, the bubble in **Cube-a** turns to green shown as Figure 6.3-2.

Note: The values displayed in the bottom of the screen.

Left——inclination angle

Right——Azimuth

3. Magnetic azimuth calibration

Click "  " to enter the interface shown as Figure 6.3-3.

① **Record vertical data** : follow the Figure 6.3-4 and 6.3-5 to install the calibration support pole, the limited block should be stuck in the groove of RTK. After you install the calibration support pole, please click "vertical", and do circular motion centered on the retractable pole, and the speed cannot more than 15 ° / s. The retractable pole rotated a circle, after finish the data record, the receiver will beep. The vertical data recording process shown as Figure 6.3-6. After the vertical data recording shown as Figure 6.3.7.

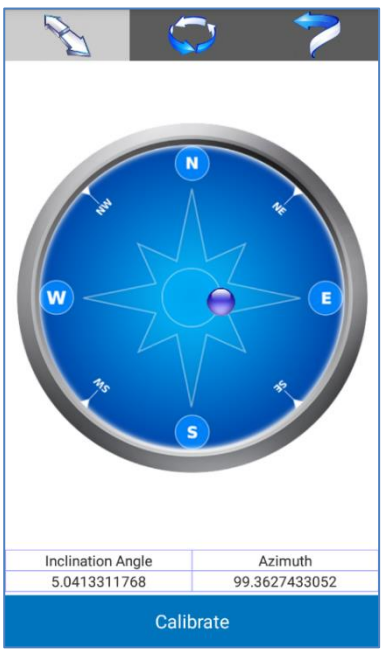


Figure 6.3-1

Figure 6.3-2

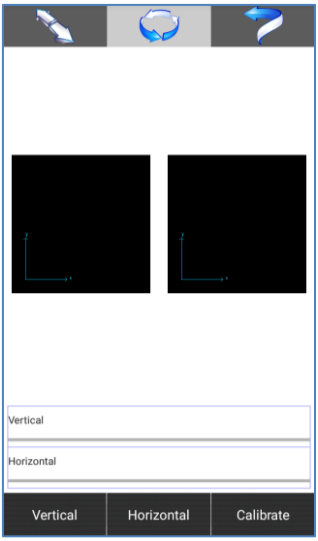


Figure 6.3-3

Figure 6.3-4

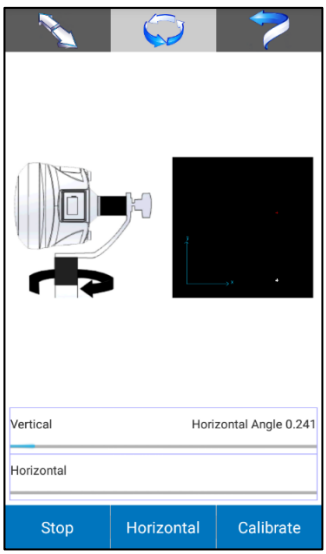


Figure 6.3-5

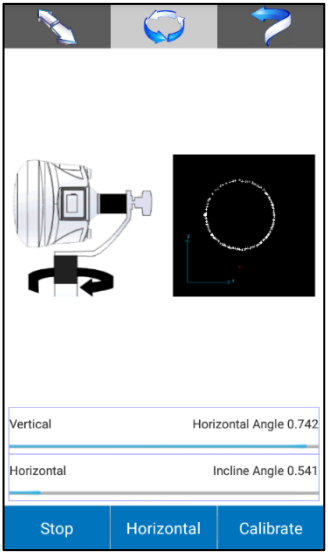


Figure 6.3-6

4. Record Horizontal data: Follow the Figure to install the calibration support pole. Click "horizontal", and do circular motion centered on the retractable pole while keeping an angular speed lower than 15°/s. When a complete rotation around then retractable pole has been completed, data recording will stop and the program will beep. The horizontal data recording process shown as Figure 6.3-8. After the horizontal data recording shown as Figure 6.3-9.

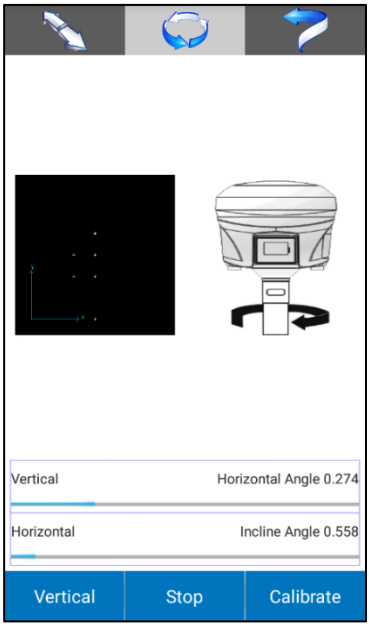


Figure 6.3-8

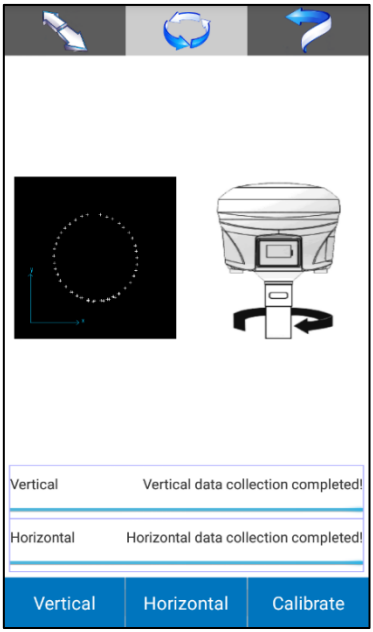


Figure 6.3-9

Note:

A. When rotated, the software will display the real-time status of the current data recording.

B. If the data of some locations is not recorded (too fast rotation will lead to data missed recorded), you need to rotate again to the location for the second recording.

C. When the recording is complete, there will be a beep and "Vertical Data recording is Complete" or "Horizontal data recording is complete!" displayed on the screen.

D. When recording horizontal data, the tilt angle must be less than 3 degrees.

③ **Calibrate parameter:** After the vertical and horizontal data recording is complete, click "Calibrate", there will pop up the dialog box of the calculating result of the parameters, as shown in Figure 6.3-10. Click "OK" to use this calibration parameter, as shown in Figure 6.3-11, to complete the "calibrate sensor".

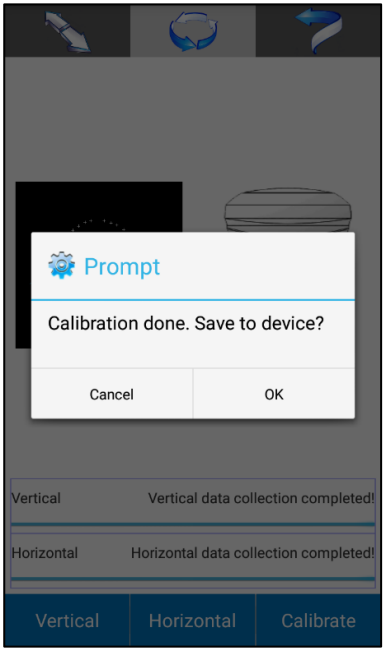


Figure 6.3-10

Figure 6.3-11

④.**Magnetic declination calibration**

Click "  " to enter the interface shown as Figure 6.3-12.

① **Record center points:** click "center point" to record center points, it need to record the coordinates of 10 static points. In the recording process and after the recording, please refer to the Figure 6.3-13 and 6.3-14.

Recording condition: a. relative static state b. inclination angle <0.3°

c. fixed solution d. recorded 10 points

Figure 6.3-12

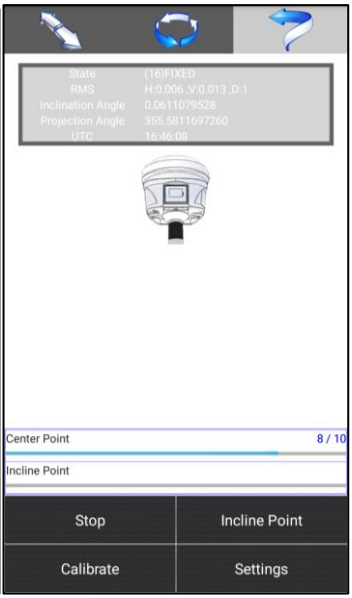


Figure 6.3-13

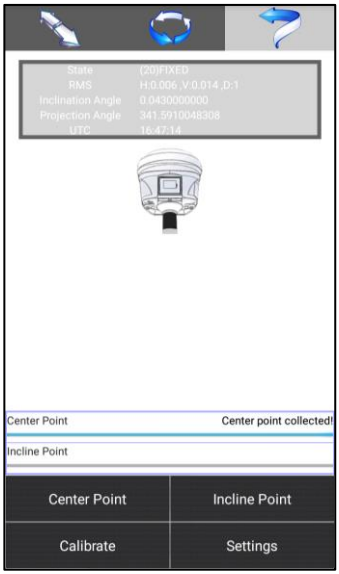


Figure 6.3-14

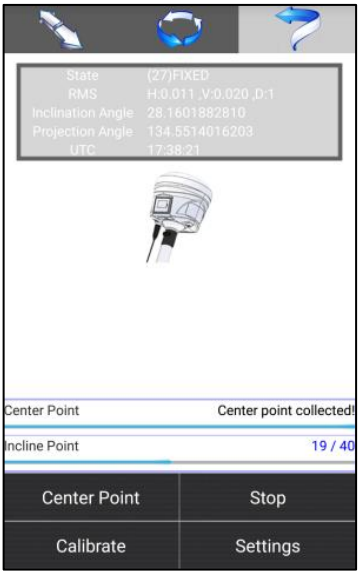


Figure 6.3-15

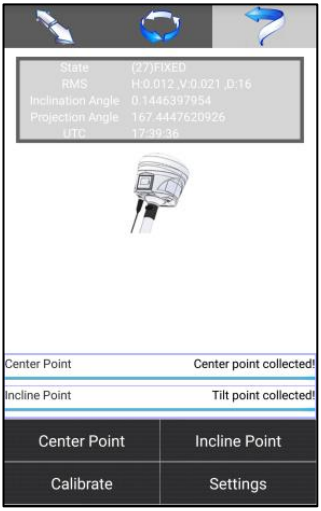


Figure 6.3-16

② **Record incline points:** Click “incline point” to record the incline points, it needs to be recorded in four directions (east, south, west and north), and should to record coordinates of 10 static points in every direction. In the recording process and after the recording, please refer to the Figure 6.3-15 and 6.3-16.

Recording condition:

a. relative static state

b. inclination angle 25°-35°

c. Fixed solution

d. Recorded data in every direction (east、south、west、north)

e. Recorded 10 points in every direction

Note:

A. When do the magnetic incline calibration, it is recommended that the retractable pole be extended to 2 m or more.

B. Keep the Device as smooth as possible when recording data.

③ **Calibrate parameter:** After the center point and the incline point have finished recorded, click “calibrate” to calculate Magnetic declination parameters, there will pop up the dialog box of antenna parameter settings, shown as Figure 6.3-17. After you input the antenna parameter, please click “OK”, then there will pop up the prompt about the projection correction. Please click “OK” to finish the sensor calibration.

④ After the sensor calibration, you can click "Settings" to view the magnetic declination. If you know the magnetic of the work area, you don't need to do the sensor calibration, please just input the magnetic declination in "settings".

Note: If there is a prompt that the error overrun, please check the antenna height is right or not. Then extend the retractable pole to redo the sensor calibration.

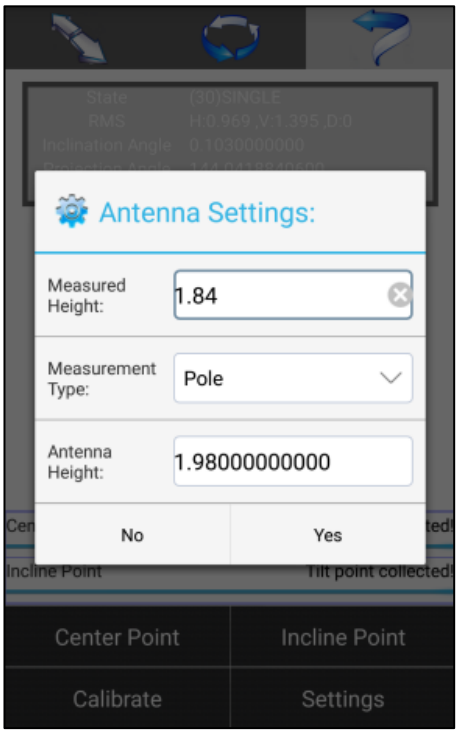


Figure 6.3-17

7 Software introduction – Tools

Click “Tools” as shown in Figure 7-1. It consists of 6 submenus, namely Points Library, Coordinates Converter, Angle Converter, Perimeter and area, COGO Calculation.

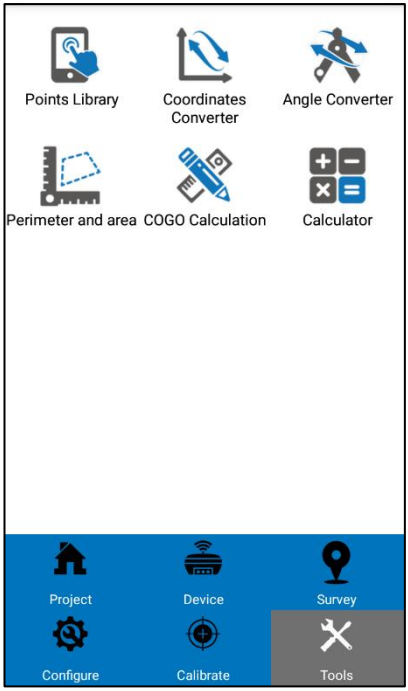


Figure 7-1

7.1 Points Library

Click “Tools”-”Points Library” as shown in Figure 7.1-1.

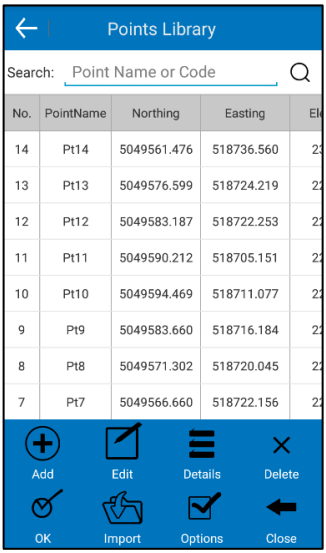


Figure 7.1-1

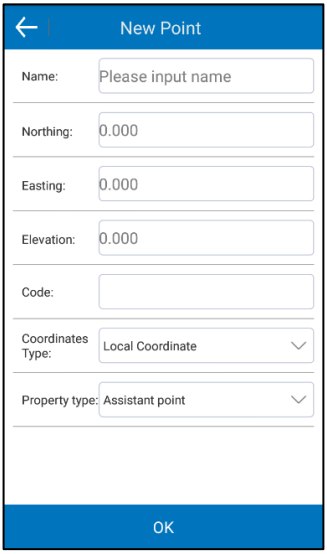


Figure 7.1-2

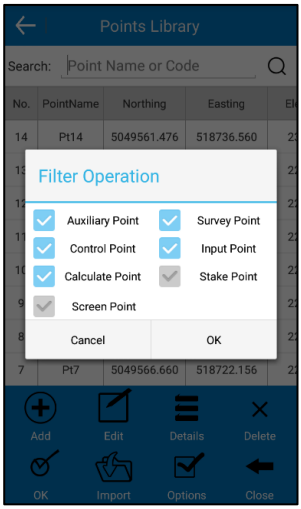


Figure 7.1-3

Points library is for unified management on all kinds of coordinates. It adds point coordinates used in operation, helping invoke them in point setting-out. It supports quick search on coordinate points through entering point name or point No. in the Search box. Points Library consists of 8 contents, namely Add, Edit, Details, Delete, OK, Import, Options and Close.

Click "Add" as shown in Figure 7.1-2. Coordinates type includes Local Coordinate and Geodetic Coordinate. Property type includes Assistant point, Control point, Input point and Stakeout point. Input point name, plane coordinates (x, y, h) or latitude/longitude coordinates and Code after setting up Coordinate type and Property type to accomplish parameter set up of new coordinates.

Choose any points in the Points Library. And click "Edit" to edit the Point name, plane coordinates (x, y, h) or latitude/longitude coordinates and

Code, which applies to all points but Survey points. Click "Details" to check the Point name, Code, latitude/longitude coordinates, plane coordinates (x, y, h) and Type. Click "Delete" to delete the chosen point from the Points Library.

Click "Import" and choose file format to import coordinates file, helping search and invoke coordinates in point setting-out. It supports Measurement data file(*.PD) and Custom format file(*.cvs, *.dat and *.txt).

Click "Option" as shown in Figure 7.1-3. Tick the point types to present as needed so as to filter other unwanted point types. It includes 7 options, namely Auxiliary Point, Survey Point, Control Point, Input Point, Calculate Point, Stake Point and Screen Point.

7.2 Coordinate Converter

Click "Tools"- "Coordinate Converter" as shown in Figure 7.2-1. Choose Conversion Mode, input coordinates, and click "Calculate" to accomplish coordinate conversion and check result as shown in Figure 7.2-2. If it needs to save the converted coordinates, click "OK" and input the point name to save it to the coordinate library.

There are two Conversion Modes: "*From WGS84 coordinates to current local coordinates*", and "*From current local coordinates to WGS84 coordinates*".

There are two ways to set up the converting coordinates: one is directly inputting the Latitude, Longitude and Altitude or plane coordinates (x, y, h); the other is extracting points from Points Library.

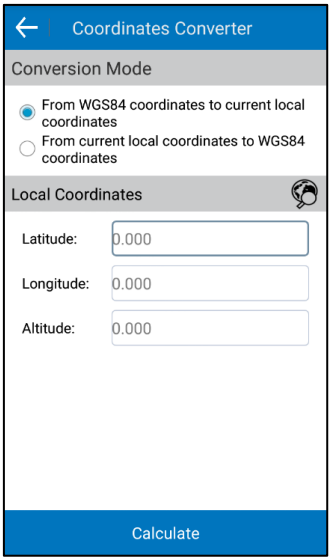


Figure 7.2-1

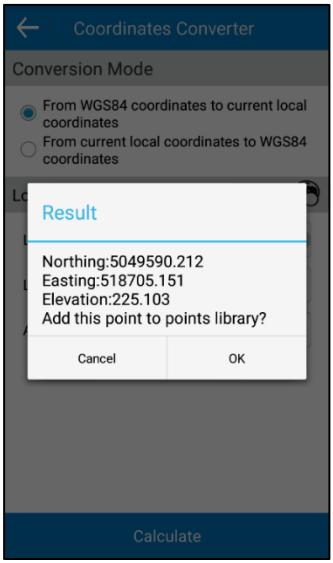


Figure 7.2-2

7.3 Angle Converter

Click “Tools”- “Angle Converter” as shown in Figure 7.3-1. It includes 6 angle formats, namely dd.mmssss, dd:mm:ss, dd°mm'ss, dd(Decimal), SS and Radian.

The conversion goes in the following sequences:1. choose input angle format; 2. input angle; 3. choose angle converted format; 4. angle conversion accomplished, converted result presented in the angle box.

For instance, input angle 23.25, convert it into dd(Decimal), and the result is as shown as in Figure 7.3-2.

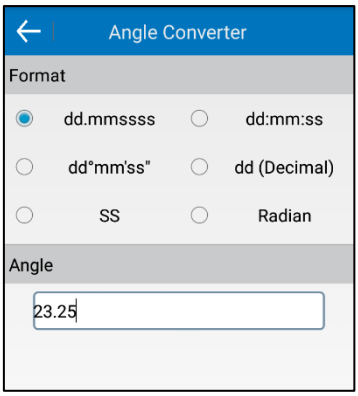


Figure 7.3-1

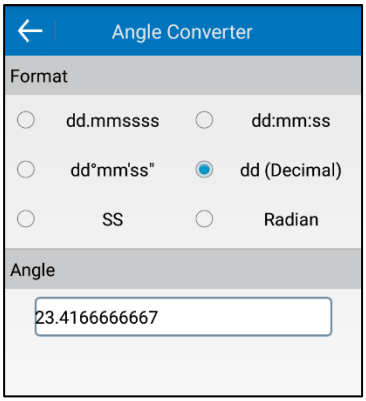


Figure 7.3-2

7.4 Perimeter and area

Click “Tools”- “Perimeter and area” as shown in Figure 7.4-1. Click “Add” to set up at least 3 coordinates and click “Calculate” to check the result, i.e., the Area and Perimeter of the graph composed by the set up points as shown in Figure 7.4-2. Points can be chosen to edit and delete. Click “Import” to choose import coordinates file(*.dat and *.txt) and enter into the Coordinate list selection as shown in Figure 7.4-3. The imported data can be filtered (through PointName or Code), searched and selected to determine the points used for Perimeter and Area calculation.

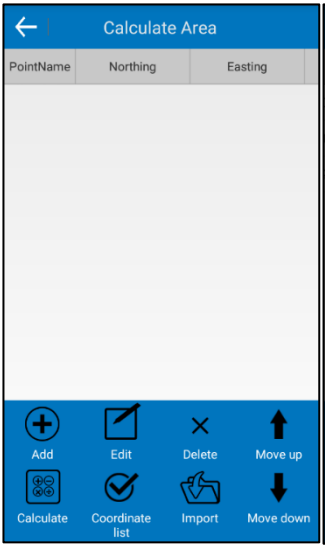


Figure 7.4-1

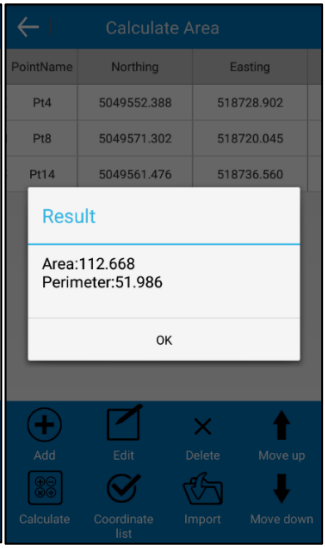


Figure 7.4-2


Coordinate list selection
Filter: PointName Code keyword
PointName Northing Easting
Pt1 5049571.388 518725.340
Pt2 5049560.887 518729.896
Pt3 5049558.176 518731.419
Pt4 5049552.388 518728.902
Pt5 5049556.027 518726.182
Pt6 5049558.918 518724.722
Pt7 5049566.660 518722.156
Pt8 5049571.302 518720.045
Pt9 5049583.660 518716.184
Pt10 5049594.469 518711.077
OK
Select All
Select None

Figure 7.4-3

8 COGO Calculations

Click “Tools”- “COGO Calculation” as shown in Figure 8-1. According to the known coordinates, it can Figure out position relations between point and point as well as between point and line. It includes Azimuth and Range, Angle offset, Vector, Two Lines Angle, Four known points, Two Points Two Lines, Two Points Two Angles, Two Points Lines Angles and One Point Line Angle.

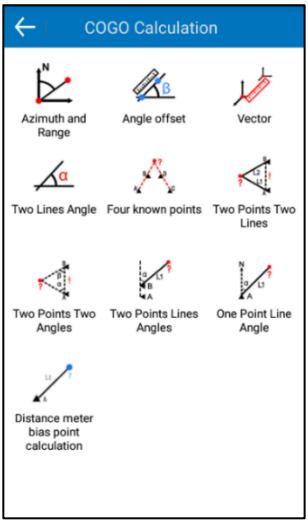


Figure 8-1

8.1 Azimuth and Range

Click "Tools"- "COGO Calculation"- "Azimuth and Range" as shown in Figure 8.1-1. Set Start Point and End Point and click "Calculate" to check the result of Plane distance, Azimuth, Elevation difference, Ratio of slope and Vector, as shown in Figure 8.1-2. There are three ways to set points: 1. extract coordinates from Points Library; 2. acquire current GPS coordinates; 3. directly input values of Northing, Easting and Elevation.

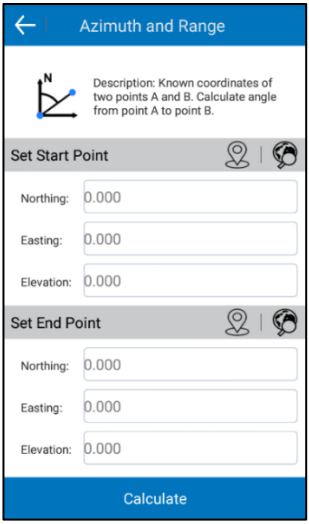


Figure 8.1-1

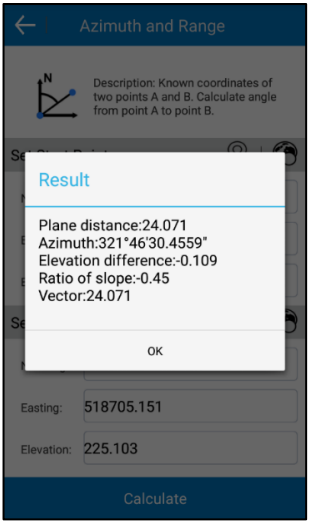


Figure 8.1-2

8.2 Angle offset

Click “Tools”- “COGO Calculation”- “Angle offset” as shown in Figure 8.2-1. Set Start Point, End Point and Offset Point, and then click “Calculate” to check the result of Start distance, End distance, Start Vertical Distance, End Vertical Distance, Offset Distance and Offset Angle as shown in Figure 8.2-2.

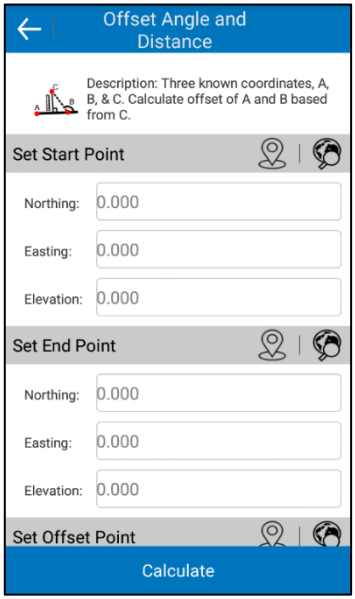


Figure 8.2-1

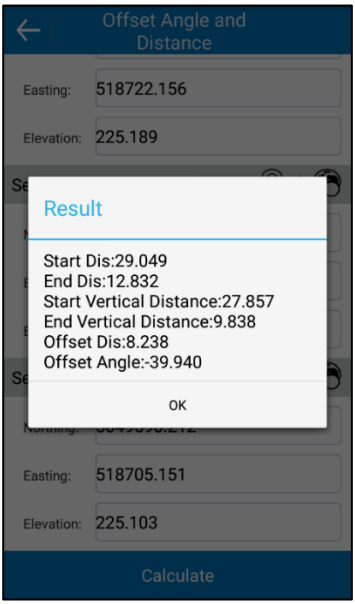


Figure 8.2-2

8.3 Vector

Click “Tools”- “COGO Calculation”- “Vector” as shown in Figure 8.3-1. Set Start Point and End Point, and then click “Calculate” to check the result as shown in Figure 8.3-2.

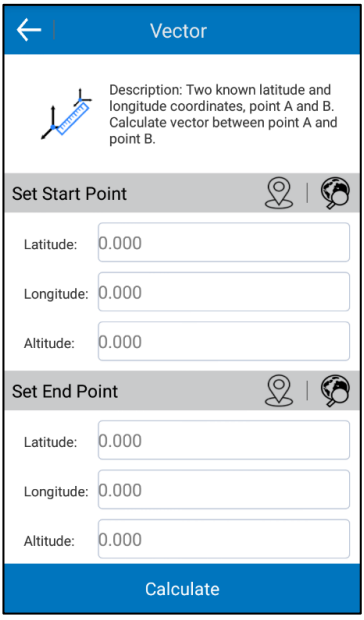


Figure 8.3-1

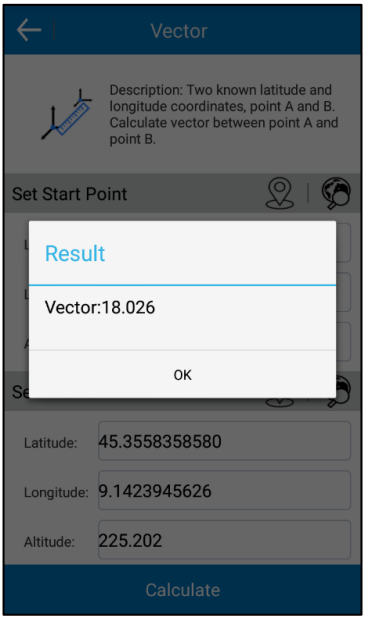


Figure 8.3-2

8.4 Two Lines Angle

Click “Tools”- “COGO Calculation”- “Two Lines Angle” as shown in Figure 8.4-1. Set Start Point A, End Point B, Start Point C and End Point D, and then click “Calculate” to check the result as shown in Figure 8.4-2.

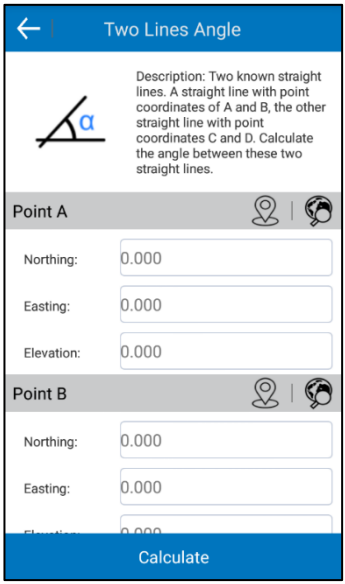


Figure 8.4-1

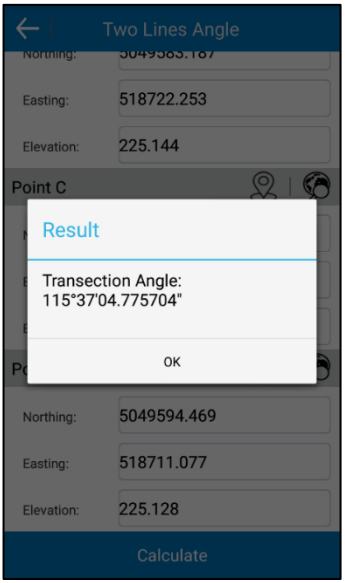


Figure 8.4-2

8.5 Four Known Points

Click “Tools”- “COGO Calculation”- “Four Known Points” as shown in Figure 8.5-1. Set Point A, Point B, Point C and Point D, and then click “Calculate” to obtain the point coordinates in chart as shown in Figure 8.5-2. If it needs to save the calculated point, click “OK” to save it to the coordinate library.

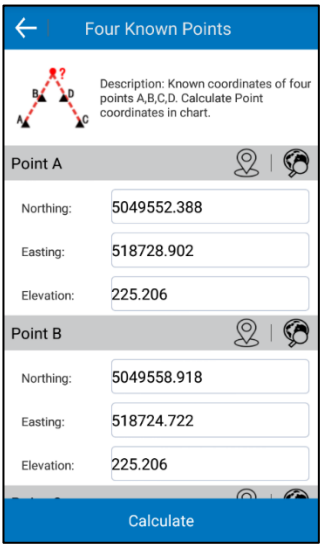


Figure 8.5-1

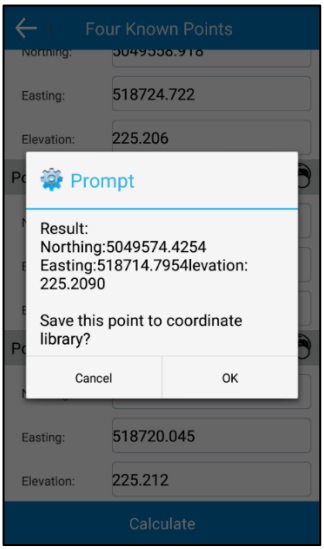


Figure 8.5-2

8.6 Two Points Two Lines

Click “Tools”- “COGO Calculation”- “Two Points Two Lines” as shown in Figure 8.6-1. Set Line L1, L2, Point A and Point B, and then click “Calculate” to obtain the point coordinates in chart as shown in Figure 8.6-2. If it needs to save the calculated point, click “OK” to save it to the coordinate library.

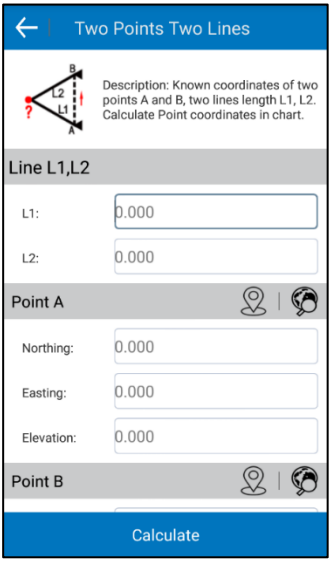


Figure 8.6-1

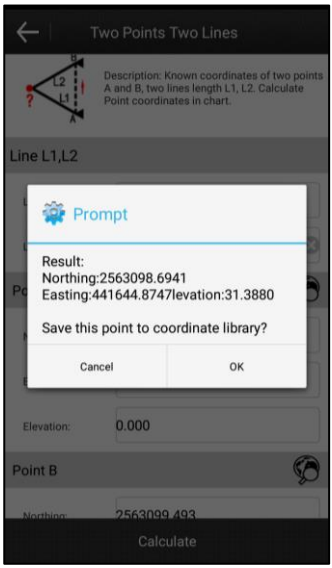


Figure 8.6-2

8.7 Two Points Two Angles

Click "Tools"- "COGO Calculation"- "Two Points Two Angles" as shown in Figure 8.7-1. Set Angle α, β, Point A and Point B, and then click "Calculate" to obtain the point coordinates in chart as shown in Figure 8.7-2. If it needs to save the calculated point, click "OK" to save it to the coordinate library.

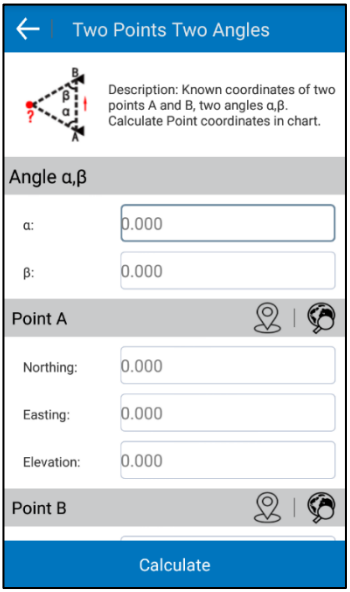


Figure 8.7-1

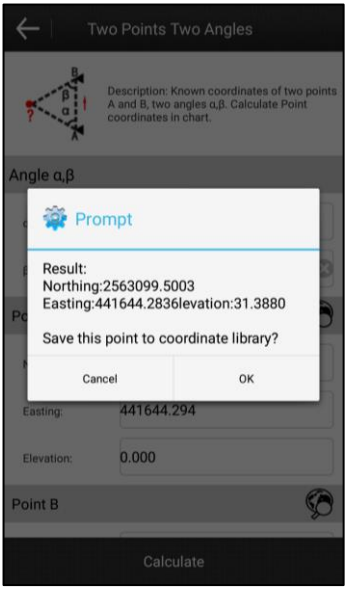


Figure 8.7-2

8.8 Two Points Lines Angles

Click “Tools”- “COGO Calculation”- “Two Points Lines Angles” as shown in Figure 8.8-1. Set Line L1, Angle α, Point A and Point B, and then click “Calculate” to obtain the point coordinates in chart as shown in Figure 8.8-2. If it needs to save the calculated point, click “OK” to save it to the coordinate library.

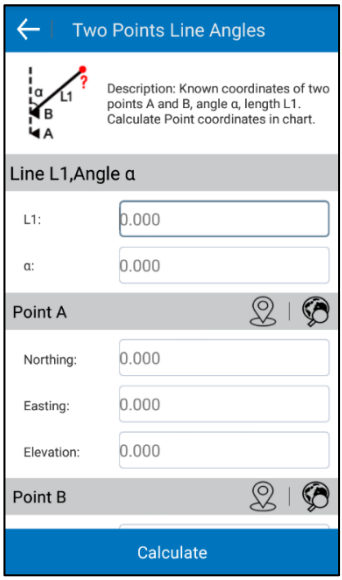


Figure 8.8-1

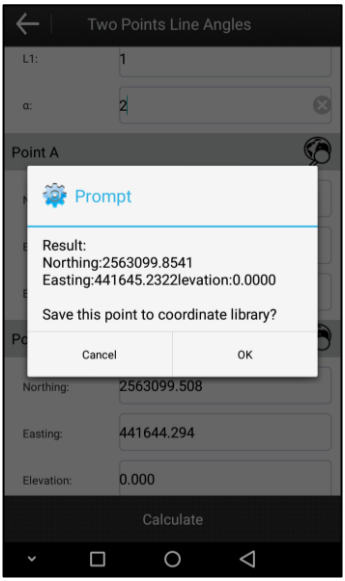


Figure 8.8-2

8.9 One Point Line Angles

Click “Tools”- “COGO Calculation”- “One Point Line Angles” as shown in Figure 8.9-1. Set Line L1, Angle α and Point A, and then click “Calculate” to obtain the point coordinates in chart as shown in Figure 8.9-2. If it needs to save the calculated point, click “OK” to save it to the coordinate library.

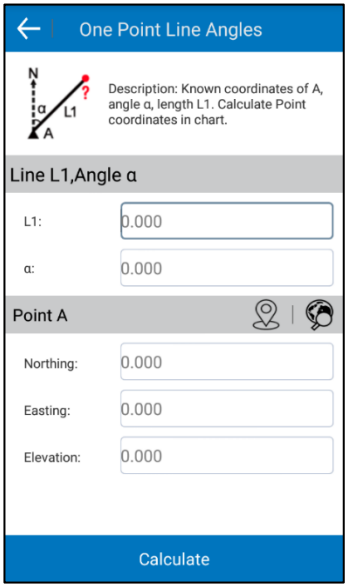


Figure 8.9-1

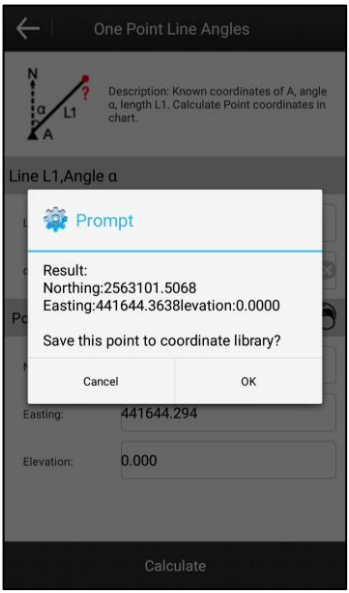


Figure 8.9-2

8.10 Calculator

This functionality directly invokes the calculator in handheld system, helping on data calculation.

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