Hi-Survey Road

User Manual

Manual Revision

Revision Date	Revision Level	Description
Dec. 2015	1	Hi-Survey Road User Manual B/6 Version
Sept. 2017	2	Hi-Survey Road User Manual B/7 Version
Mar. 2018	3	Hi-Survey Road User Manual B/8 Version
Dec. 2019	4	Hi-Survey Road User Manual B/13 Version
Feb. 2020	5	Hi-Survey Road User Manual B/14 Version

Hi-Survey Road

User Manual

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Preface

Introduction

Welcome to the Hi-Target Hi-Survey Road. This introduction describes how to use this product.

Experience Requirement

In order to help you use the Hi-Target series' products better, we suggest you carefully read the instructions. If you are unfamiliar with the products, please refer to http://www.hi-target.com.cn/

Tips for Safe Use

Notice: The contents here are special operations and need your special attention. Please read them carefully.

The contents here are very important. The wrong operation may damage the machine, lose data, break the system and endanger your safety.

Exclusions

Before using the product, please read these operating instructions carefully: they will help you to use it better. Hi-Target Surveying Instrument Co., Ltd will assume no responsibility if you fail to operate the product according to the instructions, or operate it wrongly due to misunderstanding the instructions.

Hi-Target is committed to constantly perfecting product functions and performance, improving service quality and we reserve the right to change these operating instructions without notice.

We have checked the contents of the instructions the software and hardware, without eliminating the possibility of error. The pictures in the operating instructions are for reference only. In the case of non-conformity with products, the products shall prevail.

Technology and Service

If you have any technical issues, please refer to Hi-Target's technology department for help

Relevant Information

You can obtain this introduction by:

1. Purchasing Hi-Target products: you will find this manual in the instrument container to guide you on operating the instrument.

2. Logging onto the Hi-Target official website, download the electronic version introduction at *Download center → Partners → Partner center*.

Advice

If you have any comments and suggestions for this product, please email info@hi-target.com.cn. Your feedback will help us to improve the product and service.

Chapter 1

Software Introduction

This chapter contains:

- Introduction
- Features
- Installation
- Quick Start
- General Collection

1.1 Introduction

Hi-Survey Road is a measurement software with a high degree of accuracy on the Android system of Hi-Target.

Hi-Survey Road should be run on Android 2.3.3 or above, it can be run on a Hi-Target professional measure controller, a general phone, tablet, and other Android devices. Just copy the Hi-Survey Road APK to the Android device.

1.1.1 Hi-Survey Road

Hi-Survey Road is designed for road surveying and staking with strong functions; it can be used for staking complex roads, combining road lines, and support three road algorithms (intersection, element, coordinate): cross-sections can be defined easily. The linear element method adopts the unified curve element model with rigorous theory, and the numerical integration algorithm is used to avoid the higher-order errors of traditional algorithms. Generally, the computing result can support all kinds of roads, common lines, and multi-type complex lines and connect receivers to measure online via Wi-Fi, Bluetooth, and networks.

1.1.2 Road Function

- Support for horizontal-section, vertical-section, cross-section, road-staking, slope-staking and visual cross-section collection.
- Calculate line-staking point in real-time, support for adding stake over any mileage, mileage-projecting in real-time, and displaying the mileage of staking points.
- Direct and convenient guidance method of staking, with line-staking and mid-level measurements working at the same time.
- The horizontal section line supports the common method (intersection, element, coordinate) and can freely define the line of any form. For example: interchange ramp.
- The cross-section earthwork provides two methods: Mean Area method and Prism method to calculate the amount of excavation.
- Supports multiple cross-section grade-change point-setting, the left and right slope can be edited into asymmetric type; it can also edit over-elevation and widening of a slope.
- Supports DTM surface design, DTM surface-staking, and DTM earthwork calculation.

1.2 Features

1) Easy to Use

- The more reasonable logic, clear and simple operation process and a friendly UI interface;

-Text and Graphic measuring interface in Detail Survey can be chosen by the user;
-Simple design to give a big mapping screen;
-Station option can be one-key set by configuration file;
-The defined coordinate system selected by region, convenient to set coordinate parameters;
-Supports many kinds of angle units, meets the operating habits and demands of business customers: good for globalization.
2) Supports Operating Big Data
-Supports big raster, vector data in .dxf, .td2, .shp format (geodetic coordinate and plan coordinate);
-Raw data and coordinate data saved independently to make sure the data primitiveness and realize post-processing kinematic, it is more flexible in data storing and processing, and the antenna type and height of raw data can be changed, to make sure the data can be recovered (by resetting the coordinate parameters, antenna type, and height);
-More complete antenna parameters management.
3) Fashionable
-The software and receiver firmware check the updates online automatically;
- Hi-Target and profession news is real-time pushed;
-Beautiful and fashionable interface;
-Wonderful and rich visual and touch experience, help make users enjoy working.

1.3 Installation

1.3.1 Installation

Copy the Hi-Survey Road program (.apk) to an Android device, click it to start installing, a Hi-Survey Road icon will appear on the desktop if the installation is successful.

Figure 1-3-1 Hi-Survey Road

1.3.2 Starting Interface

For the first time running the software, it will show the welcome pages of the software. Sliding left to enter the starting interface. The welcome pages will not be displayed in the next time (It can be viewed in the *About* interface).

Figure 1-3-2 Welcome Page (1) *Figure 1-3-3 Welcome Page (2)*

1.3.3 Start Instruction

The first time the Hi-Survey Road software is installed, it will prompt you to create a new project, set the coordinate system, and connect the device to start the measurement.

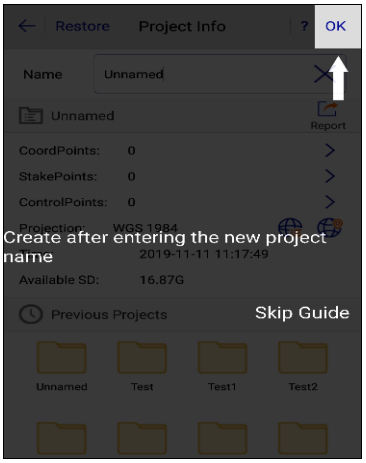


Figure 1-3-4 Start Instruction1 *Figure 1-3-5 Start Instruction2*

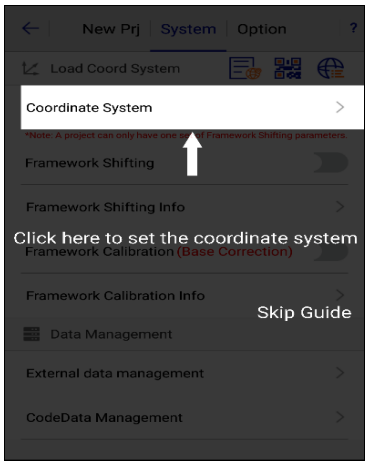


Figure 1-3-6 Start Instruction3

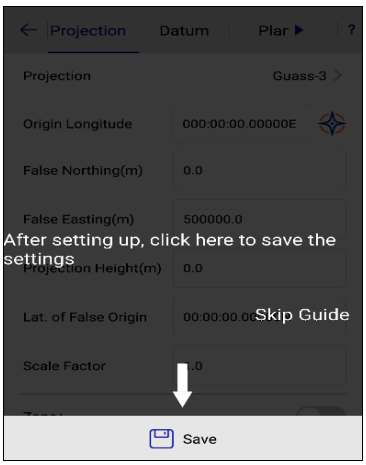


Figure 1-3-7 Start Instruction4

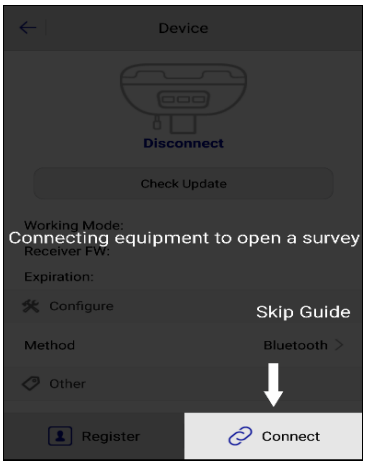


Figure 1-3-8 Start Instruction5

1.3.4 Main Interface

There are 4 pages on the main interface: *Project*, *Device*, *Survey*, *COGO* (slide or press the *Tab* button to change the page).

There are 3 themes of the main interface: *List, GridView* and *Simple*. The default theme of the UI interface is *GridView*.

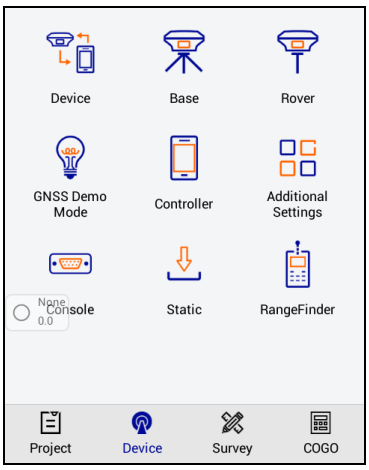


Figure 1-3-9 Device-Grid View

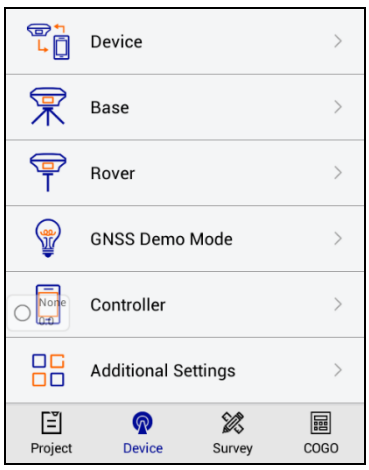


Figure 1-3-10 Device-List

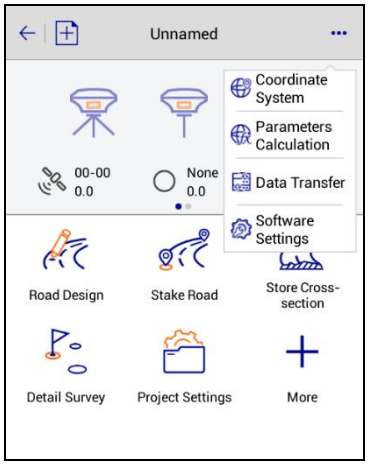


Figure 1-3-11 Device-Simple

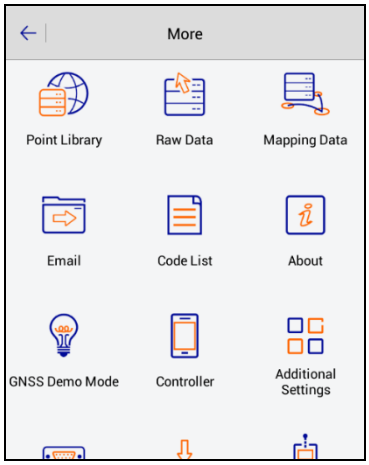


Figure 1-3-12 Device-More

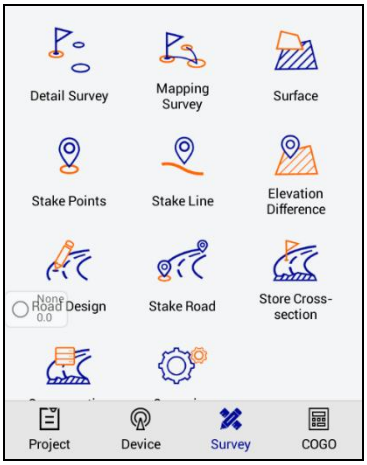


Figure 1-3-13 Survey-GridView

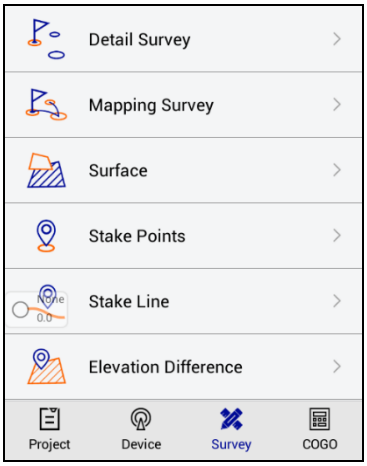


Figure 1-3-14 Survey-List

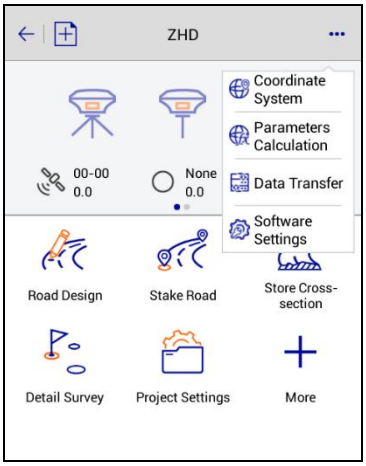


Figure 1-3-15 Survey-Simple

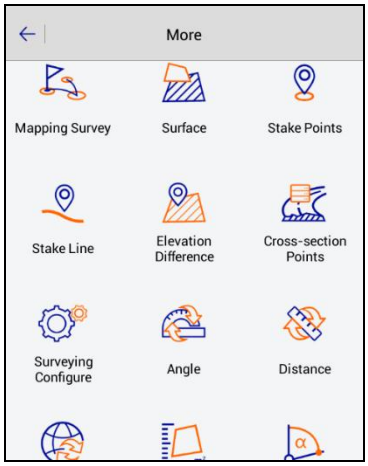


Figure 1-3-16 Survey-More

The module can be added and deleted in the simple theme. It also can be deleted and recovered in th e grid view and list theme. Long press the module to delete it, and the deleted module can be recover ed in *Project* → *Configure* → *Module* Recovery.

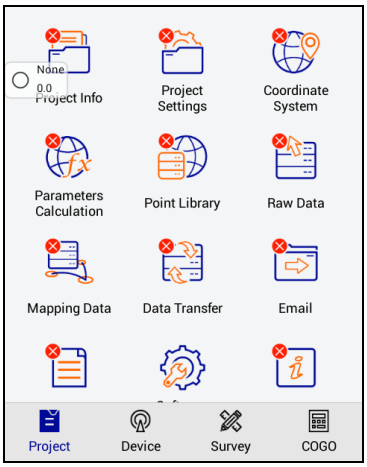
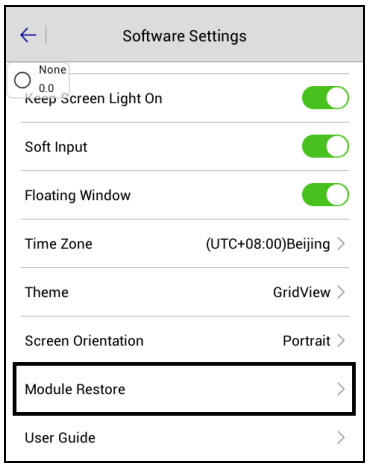


Figure 1-3-17 Delete



1-3-18 Module Restore

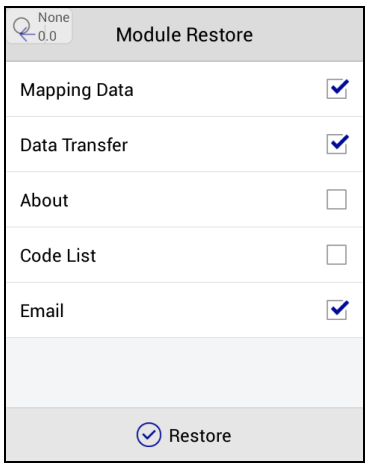


Figure 1-3-19 Select

The working directory path of Hi-Survey Road is the ZHD folder under the SD card. The project is under ZHD/Project/Road folder, and the specific sub-applications are stored in the corresponding projects.

Figure 1-3-20 Project

When starting a new measurement work, create a new project firstly, set the parameters - they are saved in the *.prj file; meanwhile, there will be a *.dam file with the same name of the project; the coordinate points, stake points, control points will be saved in the map folder. The structure of the new project (project name is *Unnamed*) is shown as the picture below.

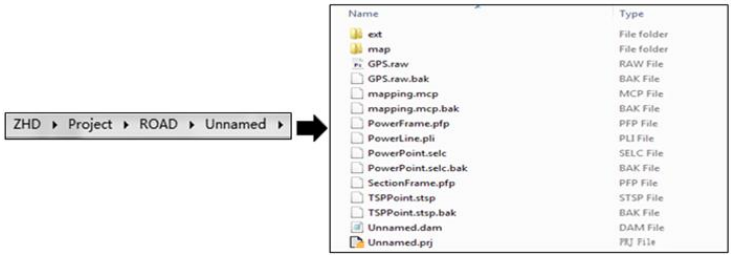


Figure 1-3-21 Road Work File

Notice:

1. If you create a new project when the controller does not have an external SD card, the project folder will automatically generate a * .bak back-up file
2. When the controller has the external SD card, the back-up data will be saved in the ZHD-Bak folder. The specific project data is stored in the corresponding project folder, as shown like the picture below.

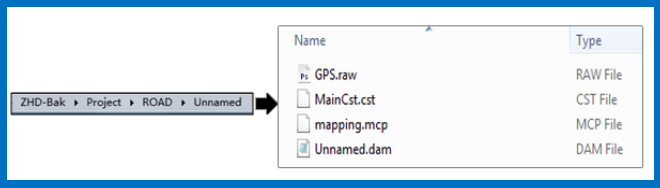


Figure 1-3-22 Road Back-up

1.4 Quick Start

This process is a simple solution that provides users who are the first time to use the software. The practiced users can ignore those steps.

1.4.1 Create a Project

1. Open Hi-Survey Road, the main interface of the software is as follows:

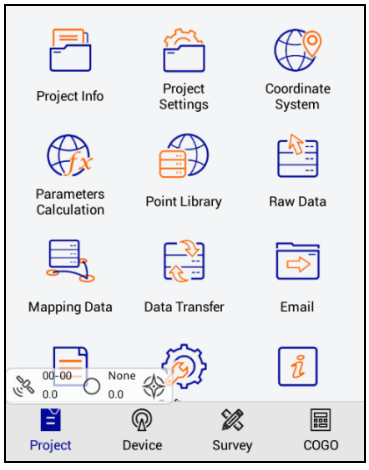


Figure 1-4-1 Main Interface

2. Create a new project. Click *Project* → *Project Info* to enter the project name and then click *OK*.

Select a code template. If you open the Auto Enter Project Settings switch (which is turned on by

default) in the *Project Settings* → *New Project*, it will automatically jump to the *Project Settings* → *System* interface. If you click the *Skip* button, the software will select the PRESET_EN template by default.

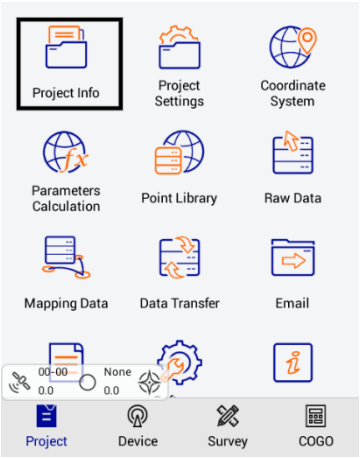


Figure 1-4-2 Project Info

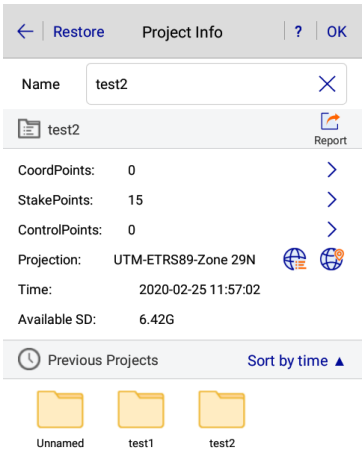


Figure 1-4-3 New Project

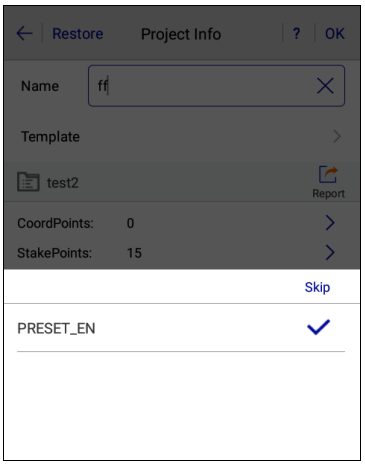


Figure 1-4-4 Project Code

3. You can also directly apply the Code List, Coordinate System (coordinate system is ticked by default) and Road File of the historical project after entering the project name.

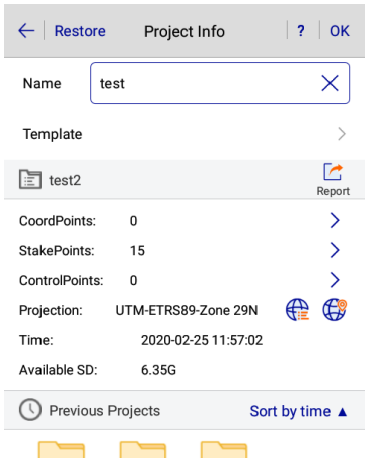


Figure 1-4-5 Template1

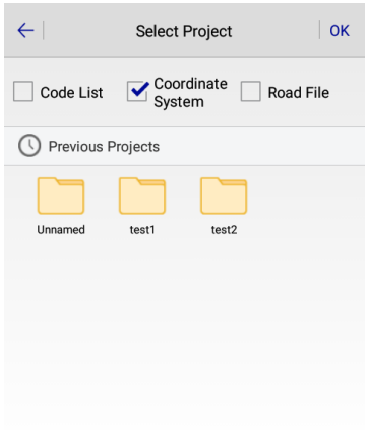


Figure 1-4-6 Template2

4. Project Settings: select the projection, set the source ellipsoid and projection parameters.

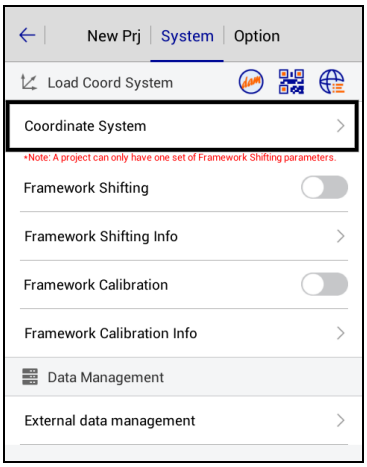


Figure 1-4-7 Coordinate System

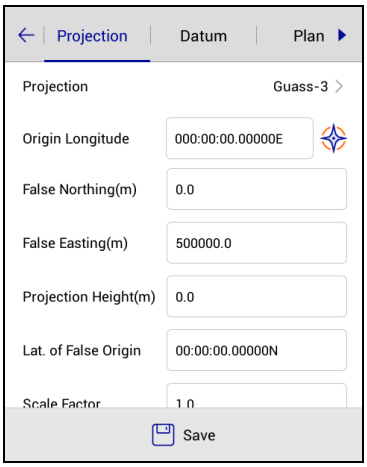


Figure 1-4-8 Projection

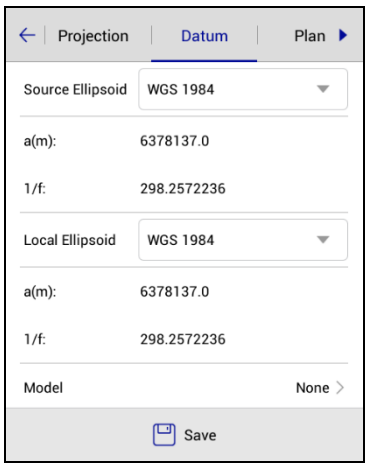


Figure 1-4-9 Datum

1.4.2 Set the Base

1. Connect the device, click *Device* → *Device Connection* → *Connect* to select the serial number of the base station for Bluetooth connection.

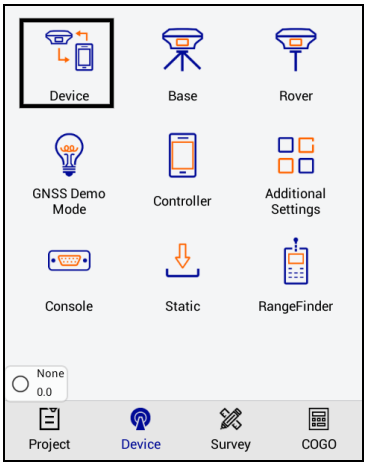


Figure 1-4-10 Device

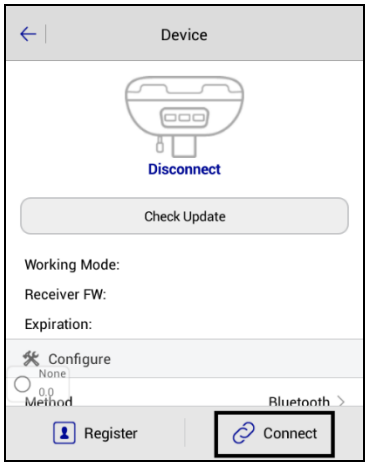
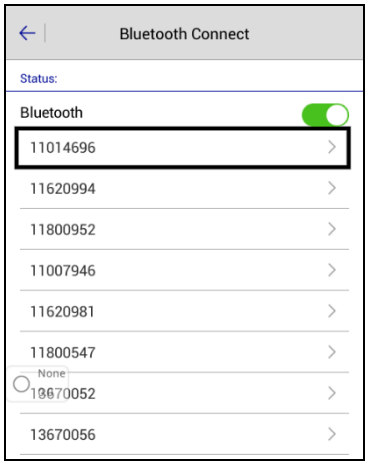


Figure 1-4-11 Connect



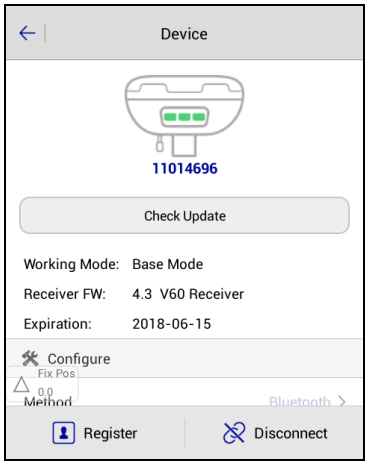
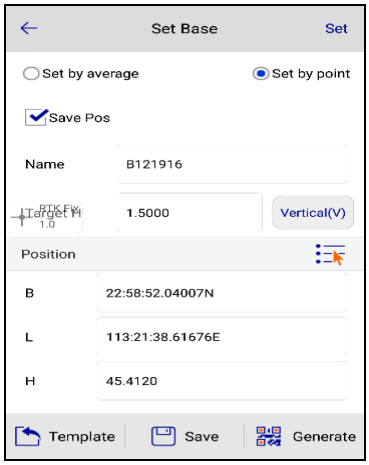


Figure 1-4-12 Device Number *Figure 1-4-13 Disconnect*

2. Set the base station and receiver position, before setting the *Datalink* and *Other*. Tick *Save Pos* to save the coordinates of the base station, and then set the *Correction Type, Elevation Mask, Data Link*. You can also set *Pos Frequency, Store GNSS Raw* and others by clicking *Advance Config*.

-Set the base location.

If the base station is located at a known point and the conversion parameters are known, you can choose Set by Point, directly input or select the WGS-84 BLH coordinates of the point from point library, or open the conversion parameters in advance, enter the local NEZ coordinates, so that the base station takes the WGS-84 BLH coordinates of the point as the reference transmitting the differential data.



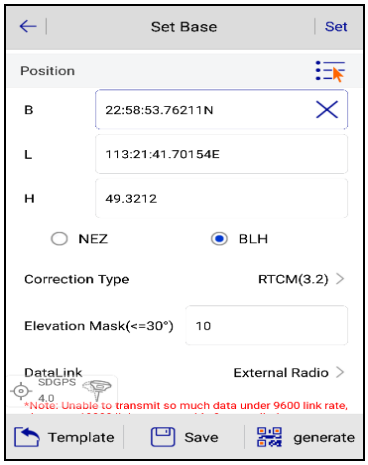
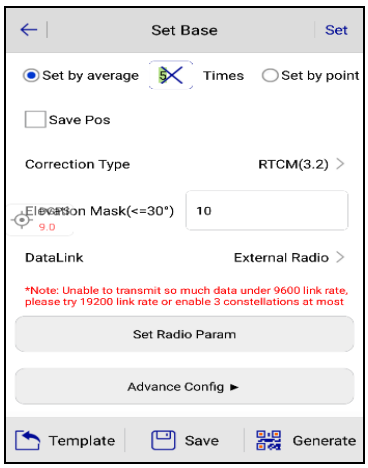


Figure 1-4-14 Set Base1 *Figure 1-4-15 Set Base2*

If the base station is set at an unknown point, choose Set by Average and set the average time. After

completing the data link and RTCM format settings, click Set in the upper right corner, the receiver will perform Average according to the set number of average times. Finally the average value will be the base station coordinates.

If you tick *Save Pos* when you choose Set by average, you also need to input the Target H, Measure-Type and Name.



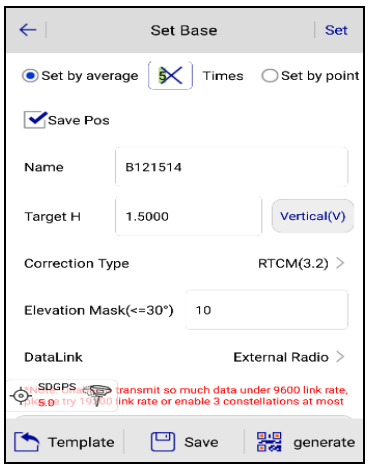


Figure 1-4-16 Set Base3 *Figure 1-4-17 Set Base4*

3. Click *Data Link*, select the data link type and enter the relevant parameters.

(for example, when transmitting data with the Hi-Target server, the relevant parameters need to be set. When the data link selects the Internal GSM, The *Group Type* can be selected *By City Number* or *By Base Station SN*. When the radio station is used for operation, the data link needs to select the *Internal UHF* or *External Radio* mode, and setting the radio channels.)

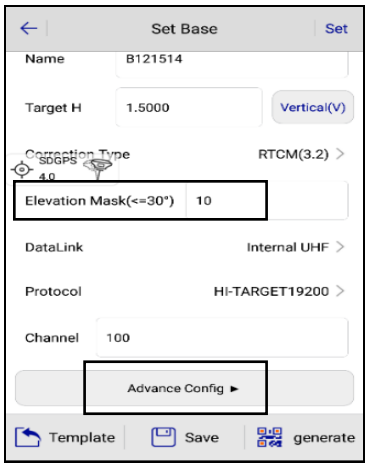


Figure 1-4-18 Set Base5 *Figure 1-4-19 Set Base6*

Click *Advanced Config* to set *Pos Frequency, Store GNSS Raw*, etc. Then click *Set* in the upper right corner, and the software will prompt that *the Base station is ready, do you want to set Rover now?*

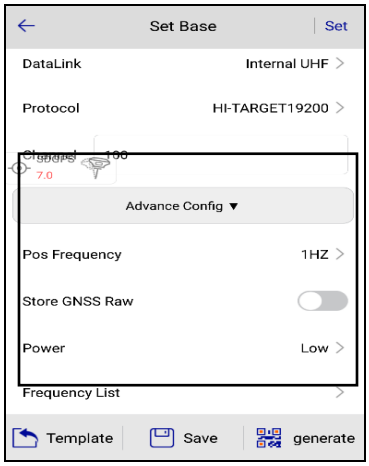


Figure 1-4-20 Set Base7

Check whether the differential light of the device is flashing regularly. When using the external radio station, the radio will flash once a second, if it is normal, it will prompt *Base station is ready, do you want to set Rover now?*

Base position

Datalink

Radio mode is the traditional data link mode, and the built-in radio mode is taken as an example, to illustrate the introduction of radio station mode using simple steps.

-*Internal UHF*: built-in radio.

-*Protocol:* The radio protocol and baud rate (for example, HI-TARGET19200) of the rover should be consistent with the base.

-*Channel*: 0 ~ 115 any number, but the rover station settings should be consistent with the base station.

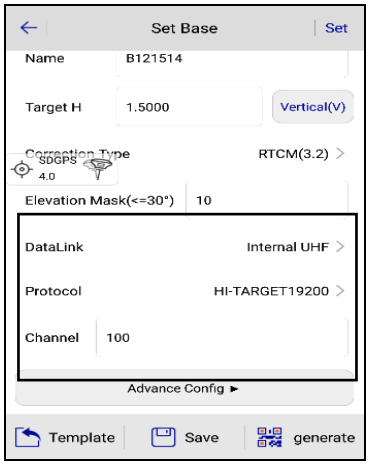
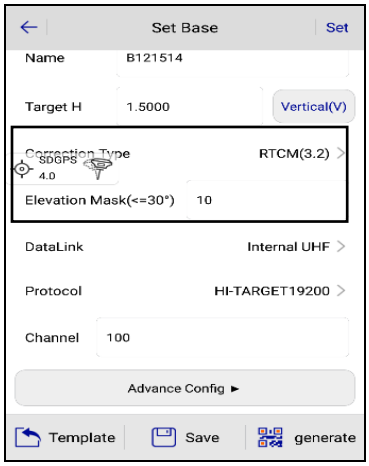


Figure 1-4-21 Settings of Base

(The data link parameters of the rover are consistent with the base, so the rover can receive the correction signal from the base.)

Parameter settings

After setting the relevant parameters of the datalink, you also need to set the *Correction Type, Elevation Mask,* and *Pos Frequency, Store GNSS Raw, Power (High/Middle/Low)*, and *Frequency List* in *Advance Config.*



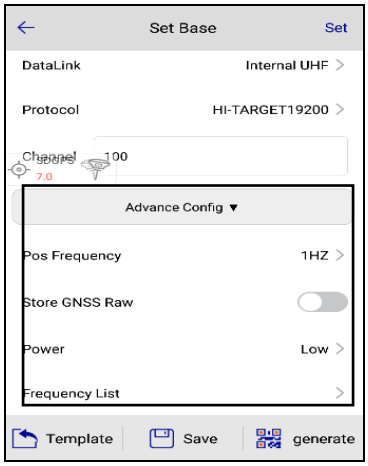


Figure 1-4-22 Set Base5 *Figure 1-4-23 Set Base6*

Notice:

The parameters of the base station must be consistent with the rover station settings.

After the parameter is set, click *Set* and the device will prompt *UHF Base* with voice, the device light will flash twice every second, indicating that the base station is set up successfully and sending the differential data.

When the green light flashes once every second (twice a second in power-saving mode) and the radio red light flashes once every second, indicating that the base station is successfully operating, and transmitting the signal. If the signal lights do not flash, you can restart the receiver device and re-operate once again.

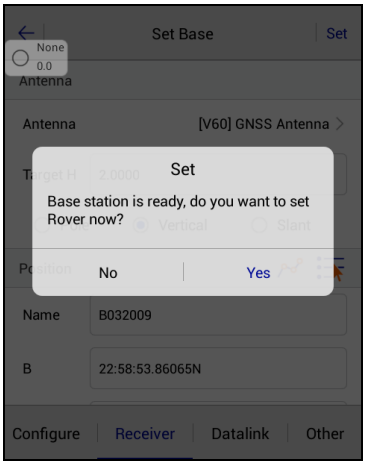


Figure 1-4-24 Set Prompt

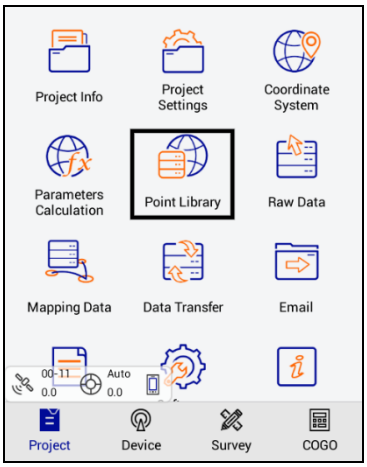
1.4.3 Set the Rover

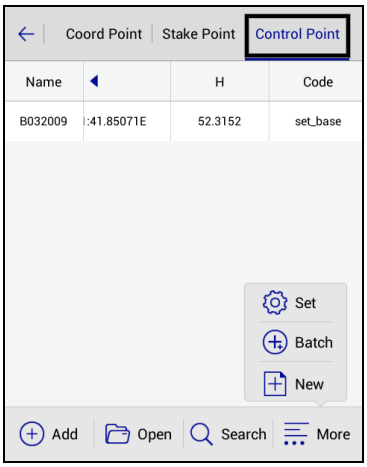
Connect to the rover by Bluetooth, and confirm that the rover data link and other parameters are consistent with the base station. The setting of the rover station is the same as that of the base station. The data link parameters of the rover station must be the same as the base station, to receive differential data. Then click *Set* and the device will do a voice prompt *UHF Rover*. Wait until it shows *RTK Fixed*, and then start the measurement.

Figure 1-4-25 Set Rover

1.4.4 Parameter Calculation

Firstly, set up the control point library in *Point Library* → *Control Point* to add control points, enter the name and the corresponding coordinates by manual input, Real-Time Collection, point library or map selection, and then click *OK*.





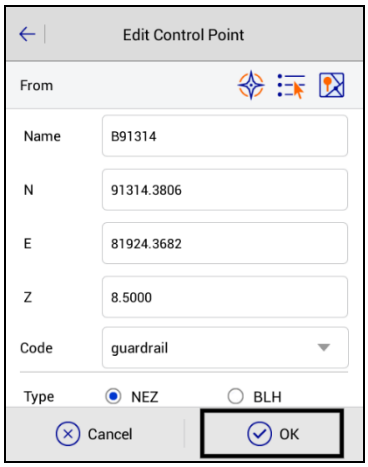
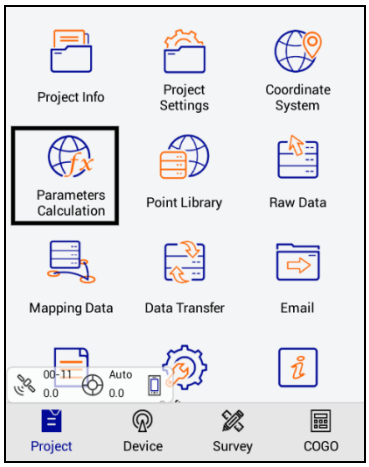


Figure 1-4-26 Point Library Figure 1-4-27 Control Point Figure 1-4-28 Edit Point

Click *Parameter Calculation*, select *Plane + Height Fitting* type and *Constant Vertical Offset* in *Height* (the *Height* can be selected as *Plane Fitting* when there are three points above), and then add point pairs, select the point as the source point, enter the corresponding control point coordinate in the target point, then click *Save*.



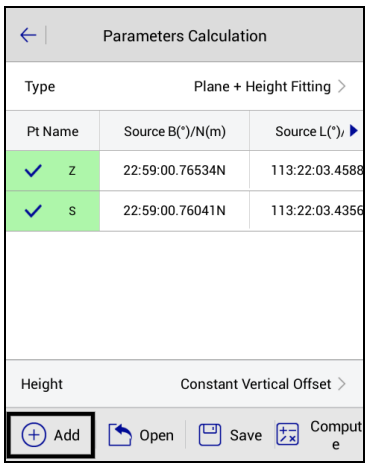
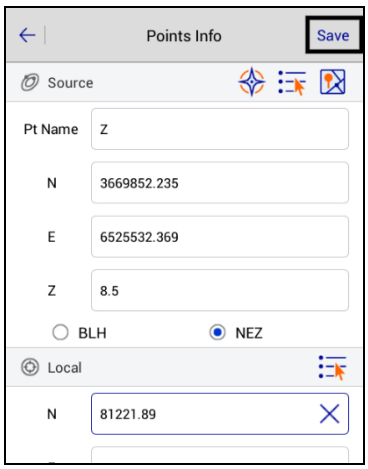


Figure 1-4-29 Parameters Calculation *Figure 1-4-30 Add Point*



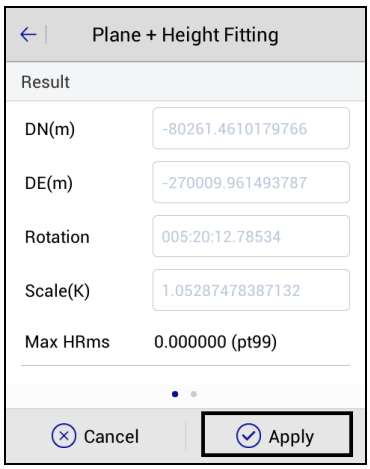
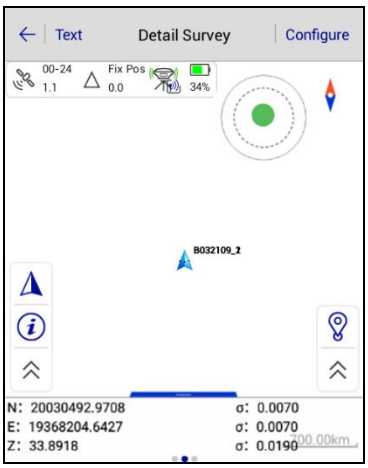


Figure 1-4-31 Save Point *Figure 1-4-32 Result*

After adding more than two points, click *Calculate*, it will display the calculated *Plane + Height Fitting* results, and mainly to check the rotation and scale. The result of the plane translation is generally smaller in the north and east, the rotation is about zero, the scale is between 0.9999 and 1.0000 (in general, the closer to 1, the better of the scale), the smaller the plane and elevation residual is, the better the result. Click *Apply* and the software will automatically use the new parameters to update the coordinate point library.

1.4.5 Detail Survey

In the *Detail Survey* interface, start the collection when getting fixed. After the rover station is set on the unknown point, you can press the collection icon and enter the *Name*, *Target H* and *Target-H type*. Then press *OK* to record the point.



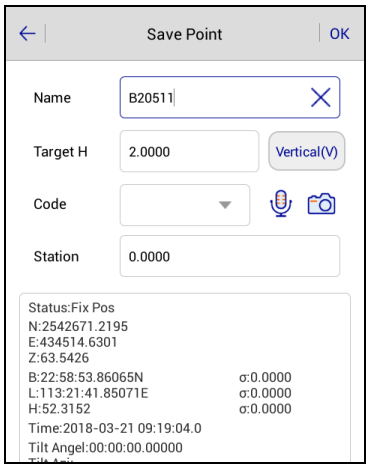
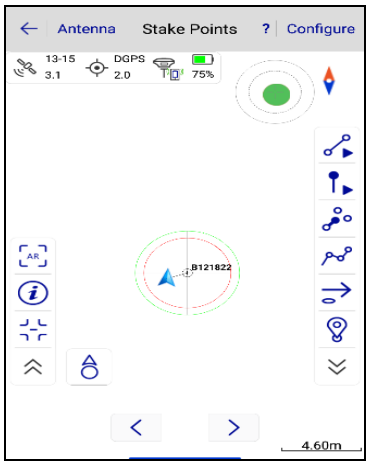


Figure 1-4-33 Detail Survey *Figure 1-4-34 Save Point*

1.4.6 Stake Out

Click *Stake Points* to enter the point staking-out interface and click the button to select the staked-out point, according to the direction, distance, and tips used to find the staked-out points. There is a process to get the current point (blue arrow) close to the target point (a circle with cross sign). The staking circle will then turn green, indicating that you are close to the staked point. The staking-out circle turns red when it is finished and meets the precision parameters. There is a small red flag for the staked points.

In the process of staking-out, you can also collect detail points, by the *Store* on the interface or store key on the controller.



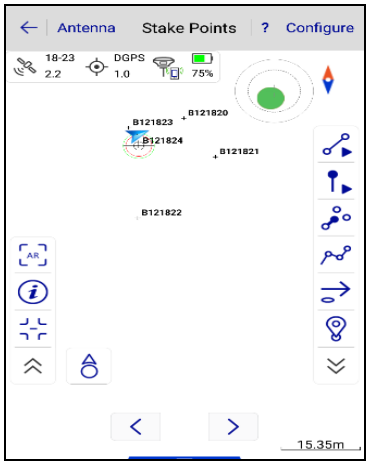


Figure 1-4-35 Stake Points1 *Figure 1-4-36 Stake Points2*

1.4.7 Data Transfer

In the *Data Transfer* interface, select *Raw Data*, and select the *Exchange Types* as *Export*, select the corresponding format export or *User-defined* export, input the file name, select the file save the path, and then click *OK* to export data. If it's *User-defined* export, after clicking *OK*, you can enter the custom format settings to select export content, then click *OK* to export the data. You can set and save the Name, Export Content, and Supported Fields when you choose to export User-defined (*.csv) and User-defined (*.txt).

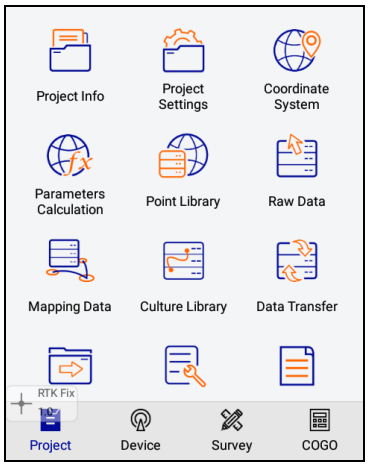


Figure1-4-37 Data Transfer

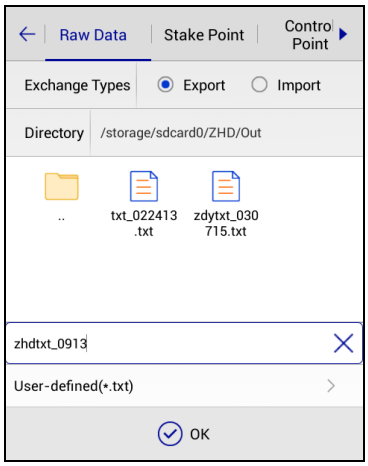
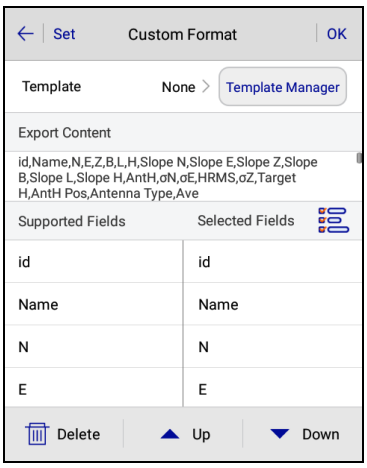


Figure 1-4-38 Export



1-4-39 Custom Format

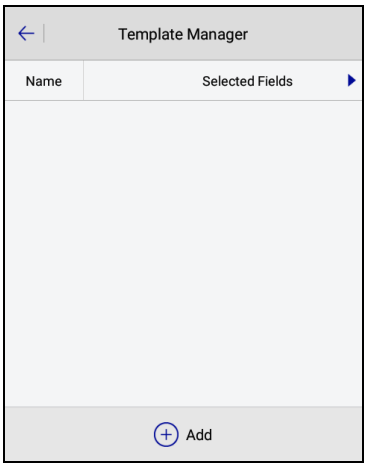


Figure 1-4-40 Template Manager

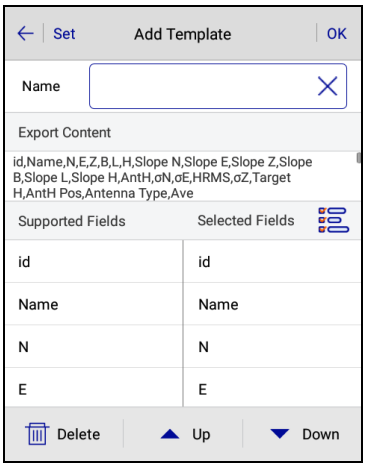


Figure 1-4-41 Add Template

1.4.8 Connect the Controller to Download Data

Connect the controller to the computer with the USB data cable. Pull down the hidden window of the controller to choose Media Device (MTP).

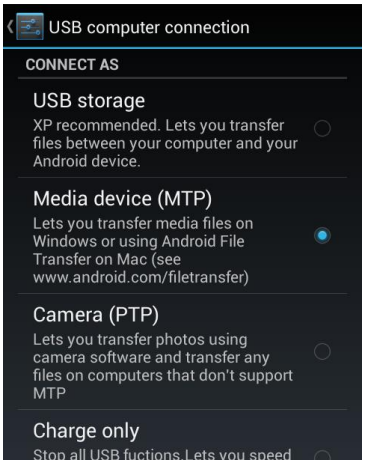


Figure 1-4-42 Transfer by USB

Find the path to export the data file on the controller (default: *ZHD\Out*), copy it to the computer, and then the RTK survey is finished.

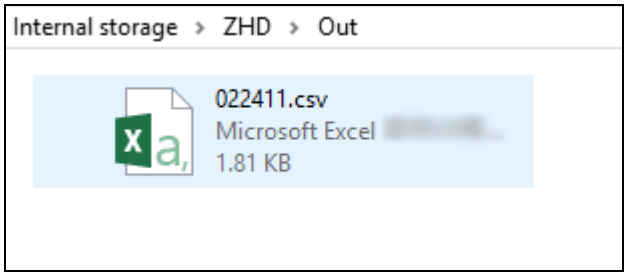


Figure 1-4-43 Result

1.5 General Collection

There are four common ways to get the *coordinates: Average, Select Point in Library, Select point on map, Real-time Collection.*

Notice: When using the controller for data collection, it supports shortcut key operation. The shortcut keys are only supported for detailed survey graphic collection. To avoid conflict, there are no shortcut keys in the text interface.

Button 1： Zoom In　　Button 2： Zoom Out

Button 3： Zoom center　　Button 4： Zoom All

Button 5： Culture Create　　Button 6： Auto Collection

Button 7： Average Survey　　Button 8： Indirect Survey

Button *： Open the configure　　Button Shift： text-map

1.5.1 Average

Get the coordinate in single status by average, 10 times by default, including *Average*, *Weighted average*, *Window average*, *Median filter*.

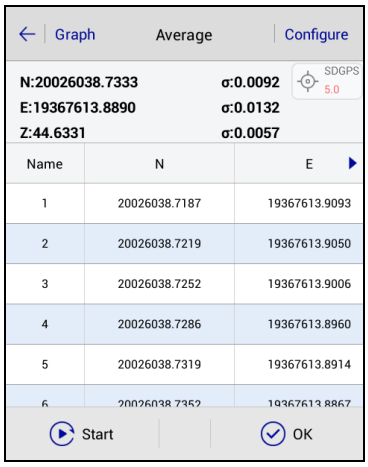


Figure 1-5-1 Average Text

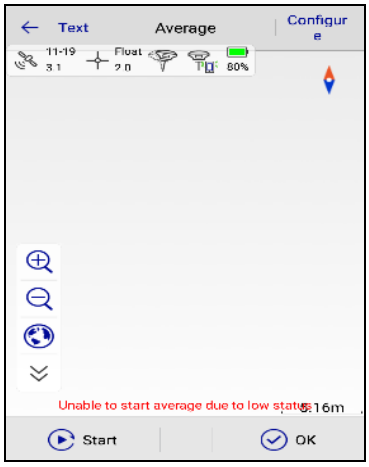


Figure 1-5-2 Average Graph

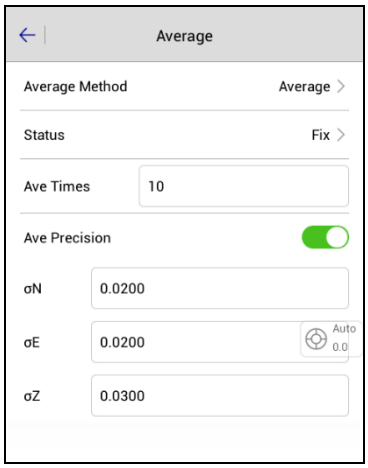


Figure 1-5-3 Average Parameters

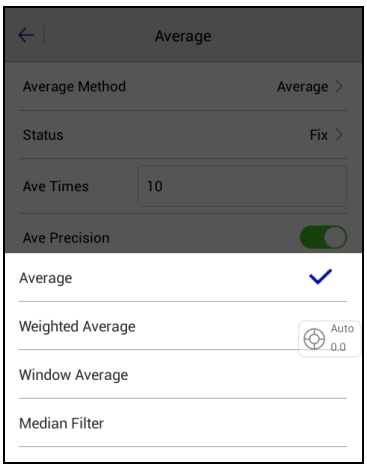


Figure 1-5-4 Average Method

1.5.2 Select Point from Library

The points with NEZ coord can be selected in *Coord Point*, *Stake Point*, *Control Point*, *Mapping Data,* and *Cross-section Point* library. The points with BLH coord can be selected in *Raw Data*, *Control Point* , *Mapping Data,* and *Cross-section Point* library.

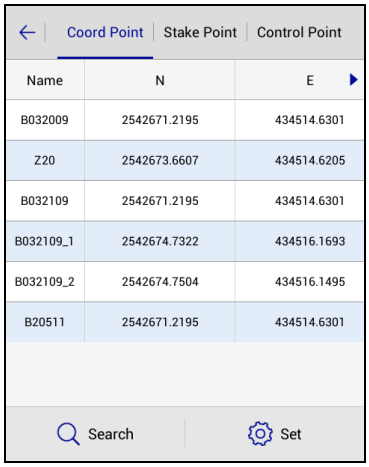
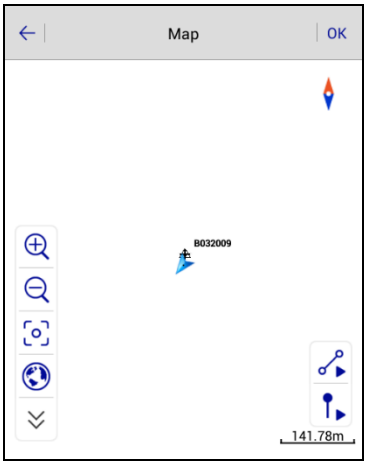
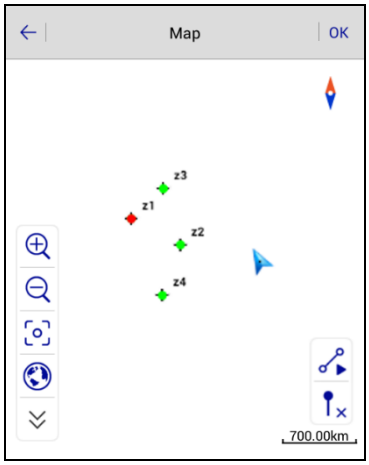


Figure 1-5-5 Coord Point

1.5.3 Select Point on Map

Click or to enter the select point on map mode, click to frame-to-select the points and click for staking points. Click again to exit the map selection. Click to click-to-select points, click again to exit the mode, then click OK to complete the selection.





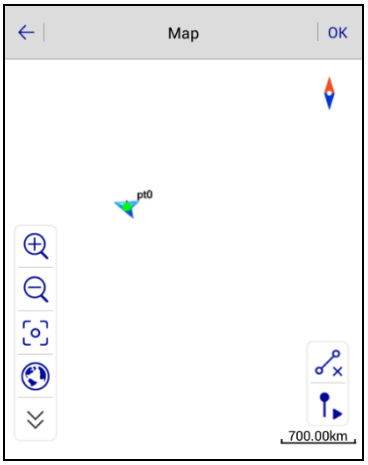


Figure 1-5-6 Select Point Figure 1-5-7 Map Selected Figure 1-5-8 Line Selected

1.5.4 Real-Time Collection

Real-Time Collection refers to real-time data collection through the receiver.

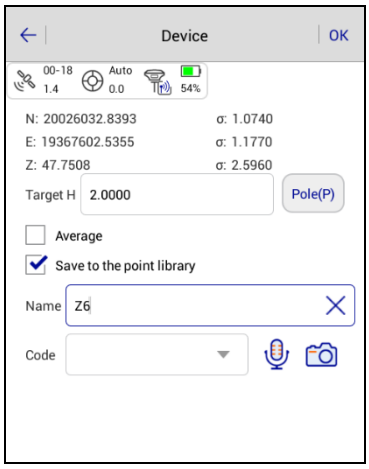


Figure 1-5-9 Real-Time Collection

Notice:

1. During real-time collection, select *Save to point library* (save to *Point Library* and *Raw Data* library), then click *OK* for collection.

2. Connect to devices supporting electronic bubble, they will display the electronic bubble view in the Device Collection interface, devices that do not support the electronic bubble will not display.

Chapter 2

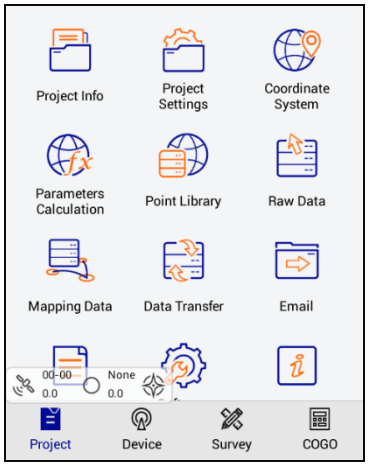
Project

This chapter contains:

- Project Info
- Project Settings
- Coordinate System
- Parameters Calculation
- Point Library
- Raw Data
- Mapping Data
- Data Transfer
- PPK
- Email
- Project Config
- Code list
- Culture Library
- Software Settings
- About

2.1 Project Info

Click *Project Info* on the main interface to manage the project, checking the project information, which includes name, points, stakeout points, projection, time, the available space of the storage and history project. You can make some operations with the project, including create, open, delete, recover, export, view, edit, and add attributes.



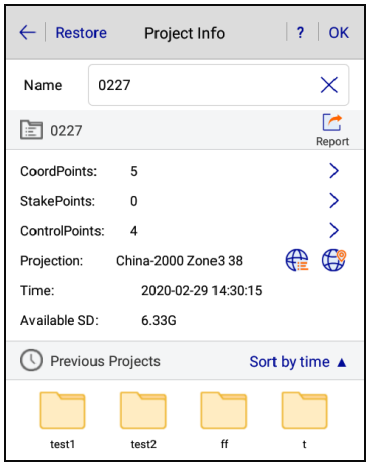
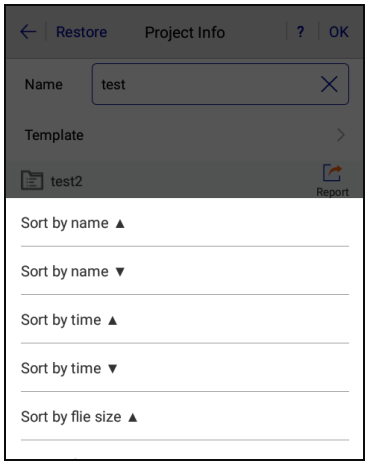


Figure 2-1-1 Main Interface *Figure 2-1-2 Project Info*

- OK: Enter a new project name, and the Template bar is displayed below. Click to select the *Code List, Coordinate System,* and *Road File* of other projects (if *Road File* is ticked, the new project will copy the road data in the selected item to the project's *Data/Roadfile*).

After inputting the project name, click *OK* to get a new project and automatically open it for the current project. If there is already a project with the same name, click *OK* to open it; or create a new project as the current project. The old project can be opened or deleted by long pressing.



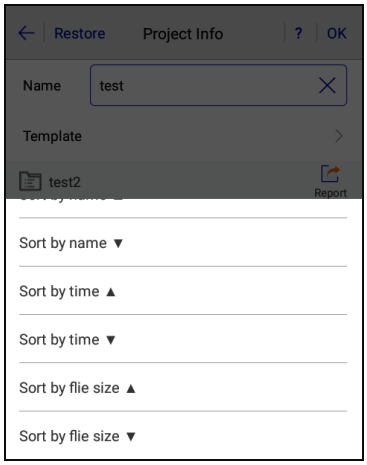
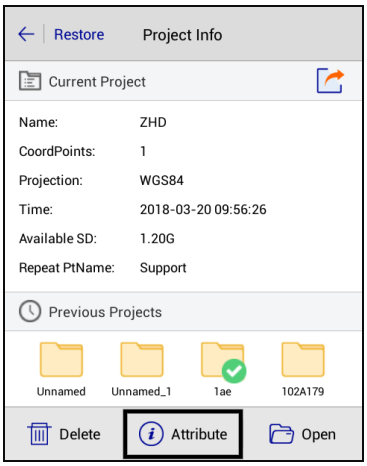
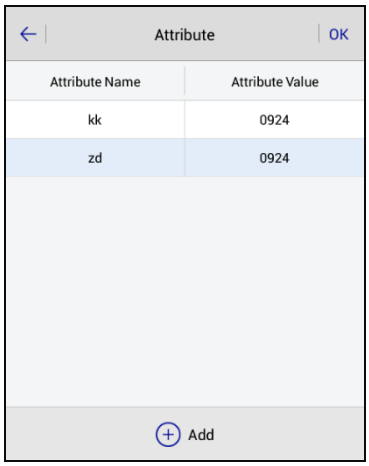


Figure 2-1-3 Project Sort1 *Figure 2-1-4 Project Sort2*

- Attribute: Save the title and content of the current project. Long press a project to select Properties in the toolbar. The attribute length is not limited, nor supported for writing and deleting in batches; attribute titles can be the same when adding attribute names, you can enter different values; the attribute name cannot be null, it needs to be digits, Chinese or English characters.





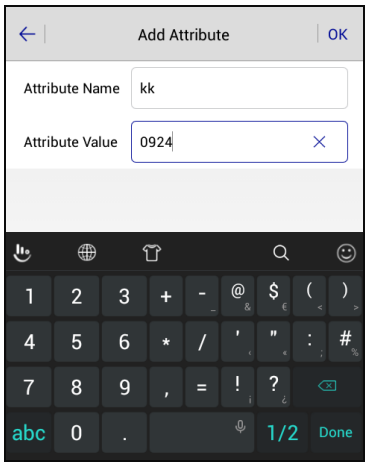
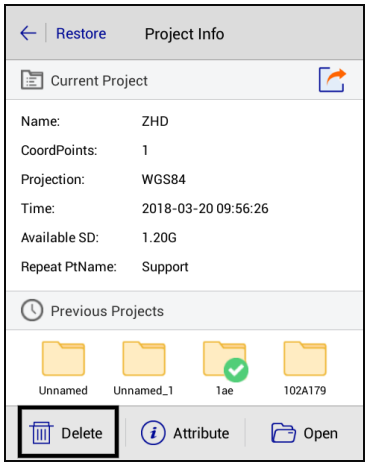


Figure 2-1-5 Enter Attribute *Figure 2-1-6 Edit* *Figure 2-1-7 Add Attribute*

- Delete: Delete the selected project. The project can be deleted directly or back-up delete (similar to recycle bin), providing the user with a remedial measure after mis-operation. (back-up delete is compressing project and then deleting the project). The compressed file is stored at *ZHD / Project / ROAD* directory).



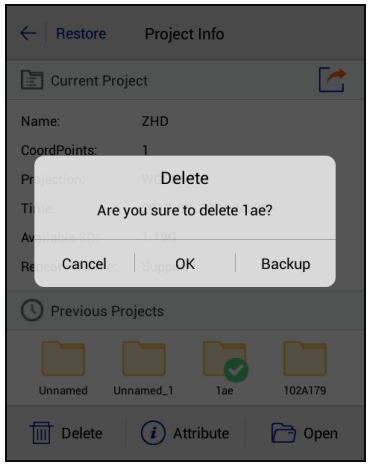


Figure 2-1-8 Delete *Figure 2-1-9 Prompt to Delete*

- Restore: The *Raw Data, Coordinate Parameters*, and *Project Info* can be restored from the *ZHD-Bak* folder of the external SD card of the work folder. When creating a project or collecting the points, the raw data file, dam or QR code coordinate parameters file, project information file, and cross-section points library in the same project name folder will be backed up on the external SD card *ZHD-Bak* folder. The Restore function can only be used when installing an external SD card.

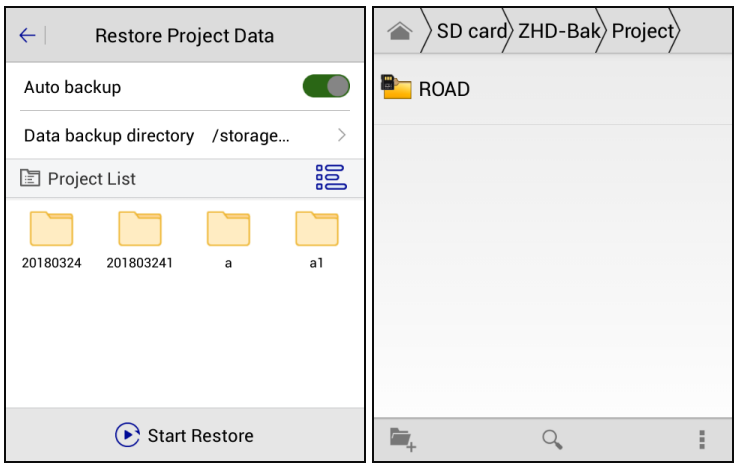


Figure 2-1-10 Restore List Figure 2-1-11 Back-up Folder

Notice:

1. If there is no external SD card, it will prompt every time you start the Hi-Survey Road.

2. The back-up function requires that the controller version must be in V1.0.2 and above.

When you restore the data, long press the project to select, press the selected project again to cancel. Click *Select All/Cancel All* to select all projects or cancel. After selecting, click *Start Restore* to recover.

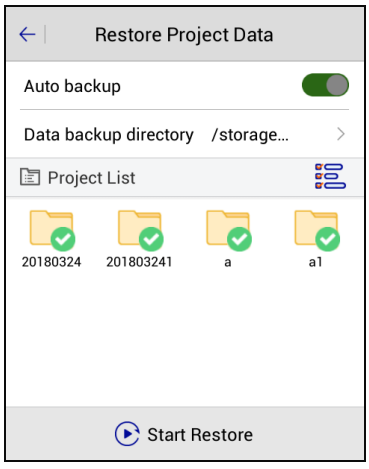
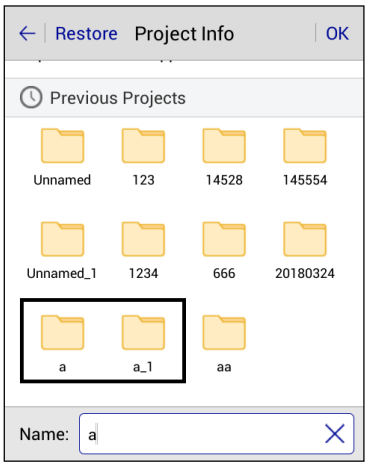


Figure 2-1-12 Select All or Cancel All

The recovered project will be saved at *Project Info* → *Previous Projects*. If there is a previous project with the same name as the restored project, it will add _1 at the end of the recovered project name.



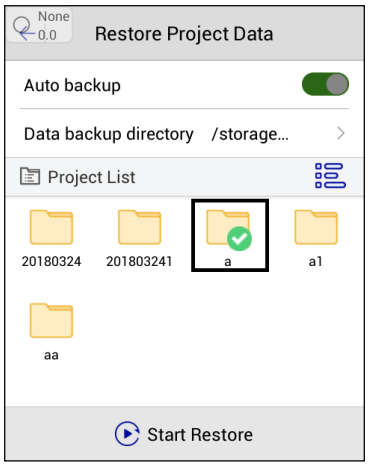
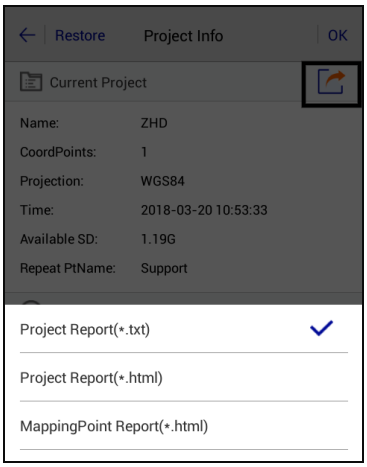


Figure 2-1-13 Same Name *Figure 2-1-14 the Recovered File*

-Export: Export the current project reports in *.txt format, *.html format of Project Report or Mapping Point Report in *.html format.



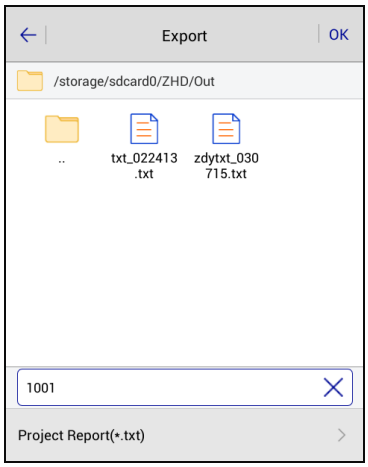


Figure 2-1-15 Export Format *Figure 2-1-16 Export*

2.2 Project Settings

2.2.1 New Project

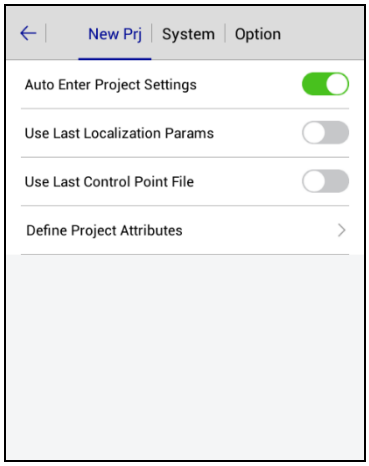


Figure 2-2-1 New Project

-Auto Enter Project Settings: After opening, it will automatically go to *Project Settings*, and show the *System* interface to set coordinates.
-Use Last Localization Params: After opening, the current project will use the same coordinate parameters as the last project (including the transformation model and parameters of plane conversion and elevation fitting).
-Use Last Control Point File: After opening, the control point of the last project will be copied to the current project.
-Define Project Attributes: Set the note of a new project. It will automatically go to the attribute-inputting interface to edit the corresponding attribute, after defining the project's attribute.

2.2.2 System

In *System* interface, coordinate system parameters can be set with the dam file, QR code or in *Coord Sys Management*. If coordinate parameters are changed, the coordinate point library will be updated too.
Project coordinate parameters include *Coordinate System, Framework Shifting, Framework Shifting Info, Framework Calibration,* and *Framework Calibration Info*. *Data Management* is used for external data management.

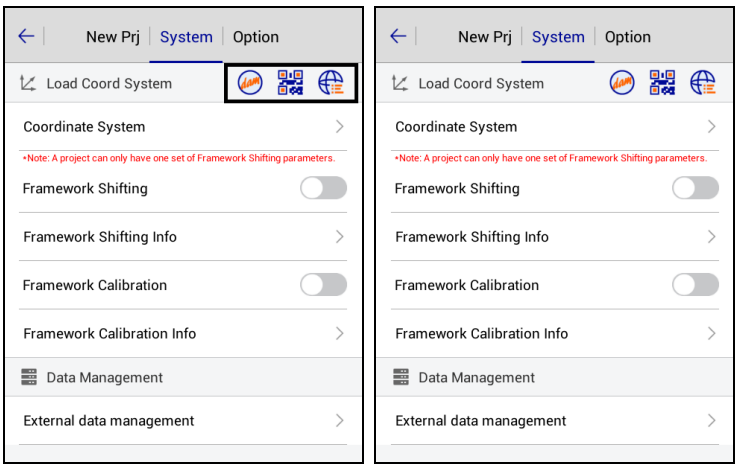


Figure 2-2-2 System Figure 2-2-3 System

1. Coordinate Parameters - Dam File Loading

Each software project corresponds to a separate *.dam file, there will be a new Dam file (the same name as the project) when you create a project. In the *Project Settings →System* interface, the user clicks to load a dam file, getting the coordinate parameter of the existing project applied to the current project: the coordinate point library will be updated at the same time.

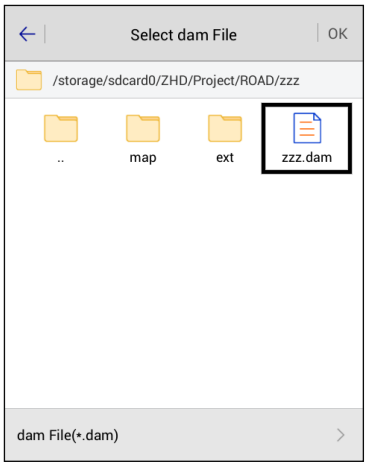


Figure 2-2-4 Add Dam File

2. Coordinate Parameters - QR Code

In the *Project Settings → System* interface, click to enter the QR code scanning interface, to get coordinate parameters from the QR code, and then create, Encrypt, share and Save the QR code.

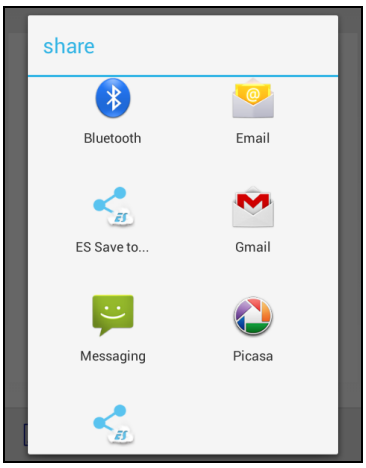
Figure 2-2-5 Scan QR Code

Click My QR Code and it will create a QR code of the current project coordinate parameters; the user can encrypt, share and save it. The scanned encrypted QR code only can be used, it cannot be viewed and edited.

- Encrypt: The user can choose to encrypt the coordinate parameters first, and then re-generate the QR code; the encrypted QR code can be shared and saved; encrypted parameters are not visible and cannot be edited, only called.
- Share: The QR code can be shared by third-party software to other customers;
- Save: The QR code can be saved as a picture in the controller. If there is a file with the same name under the save path, you can tick the coverage or enter a new filename.

Figure 2-2-6 QR Code

Figure 2-2-7 Encrypt



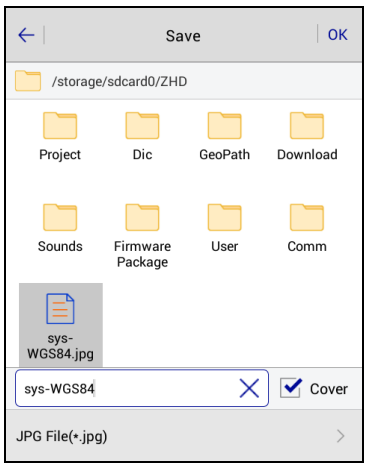
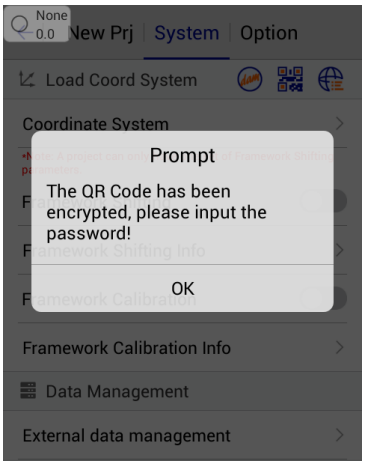


Figure 2-2-8 Share *Figure 2-2-9 Save*



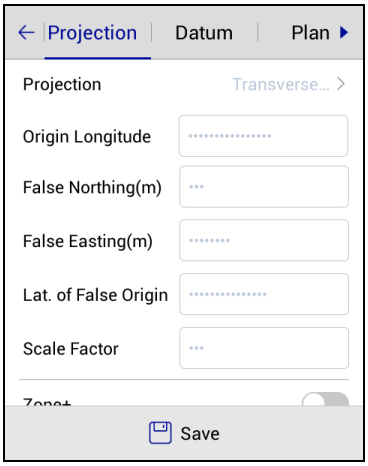


Figure 2-2-10 Encrypt Prompt *Figure 2-2-11 Encrypted Projection*

3. Coordinate Parameters - Coord Sys Management

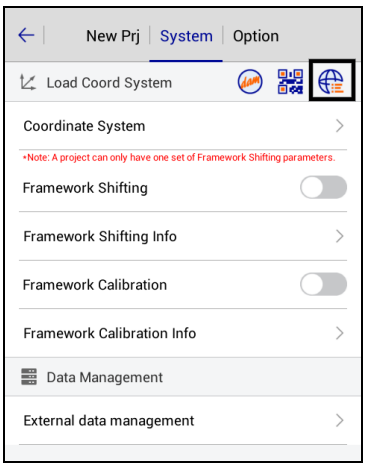
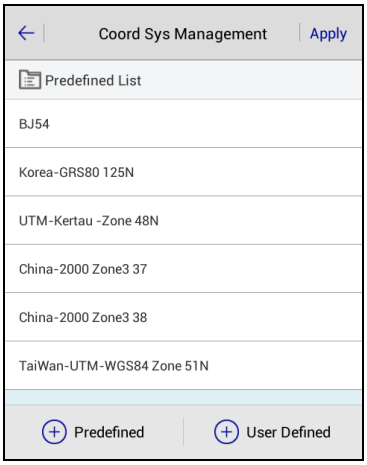


Figure 2-2-12 Coord Sys Management

The software coordinate transformation module is *CoordLib* module, which has been verified for many years and provides practical and full coordinate calculation ability. In Projection, it includes *Gaussian, Mercator, Lambert projection*, etc. In Datum conversion, it provides *Bursa-Wolf Transformation, Molodensky, Ten Params*, and others. In Plane conversion, it provides *2D Helbert, TGO, Planar Transformation Grid, FreeSurvey*, *Polynomial Fitting* and other conversion methods. In *Height Fitting conversion*, it provides *Mathematical Models, TGO, FreeSurvey* and *Geoid-Ellipsoid Separation Grid*.
In the *Project Settings* → *System* interface, users can click to enter the Coord Sys Management interface. Common coordinate systems can be added to system lists for easy use.



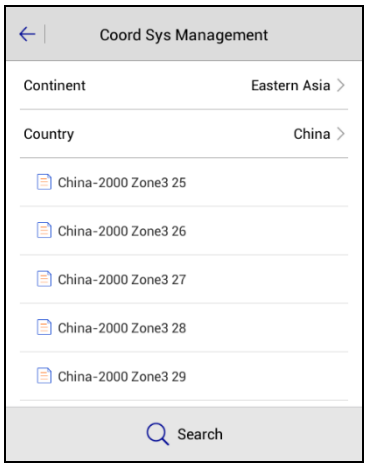
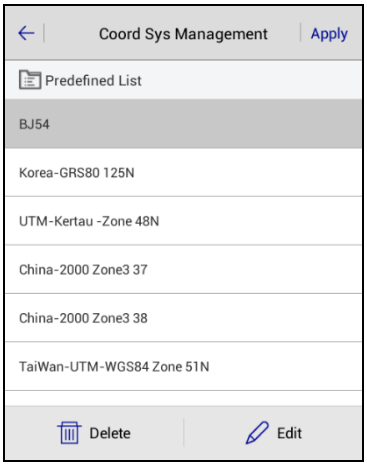


Figure 2-2-13 Pre-defined List *Figure 2-2-14 Pre-defined Coord*

- Pre-defined: Support for loading the Pre-defined coordinate systems, which are classified by continent and country, for convenient selection.
- User Defined: Add User Defined coordinate system according to the local situation.



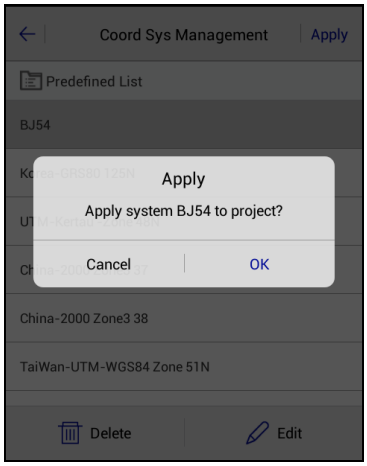


Figure 2-2-15 Select Coord *Figure 2-2-16 Apply Coord*

- Delete/Edit: Long press the coordinate system on a Pre-defined List to delete and edit. Editing coordinate system parameters in the system list do not affect the coordinate system parameters in the project unless you click the *Apply* after editing the coordinate system.

- Apply: Update the projection parameters used by the project. There will pop up a dialog to prompt whether the selected coordinate system should be applied to the current project. Click *OK* and the parameters are used successfully. The software converts the WGS84 geodetic coordinate BLH, measured by the receiver, to the plane coordinate NEZ of the selected coordinate system parameters.

4. Coordinate System

Click *Coordinate System* to go to the *Coord Sys Management* interface; you can edit the current project coordinate parameters and the created coordinate system is just used for the current project. Whether to update the parameters to the corresponding projection list can be chosen when saving. If OK, coordinate system parameters will be applied to the project according to current settings; if you select *Cancel*, coordinate system parameters will not be updated.

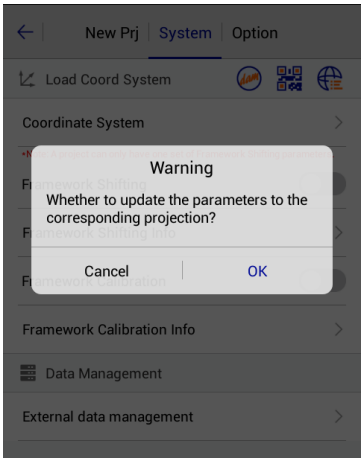


Figure 2-2-17 Warning

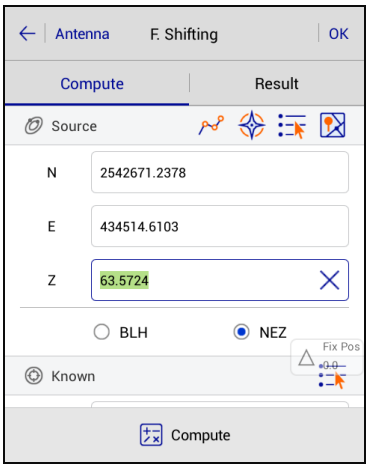
5. Framework Shifting

For computing the horizontal and vertical translation between two coordinate systems.
The user can transfer the collected GNSS coordinates to local NEZ by one point. For example, give the top-left point as (0, 0, 0), then other points are translated to an independent coordinate system, according to the point. Generally, the translation value is too large, if you translate BLH and NEZ, there will be a big projection error, so after framework-shifting, the saved BLH is still the original BLH, while the NEZ is the local one.

Compute

- Compute: Compute the dN, dE, dZ from the current point and known point.

First: Users need to obtain the source point (the current point) coordinates.
Second: and the coordinates of the known point first. The known point can be input directly or selected from the library.
The source point can be got from average collection, real-time collection , library , and map.



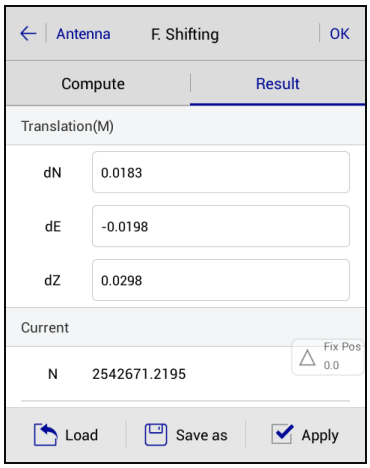


Figure 2-2-18 Compute *Figure 2-2-19 Result*

Result

- Apply: Check it to apply the correct value to the project.
- Load: Load the existing translation file.
- Save as: Save the translation parameters as a .txt file, so it can be used by other projects.
- OK: Save the translation parameters and update the project.

The calculated point translation parameter can be selected in the *Project Settings→ System* interface.

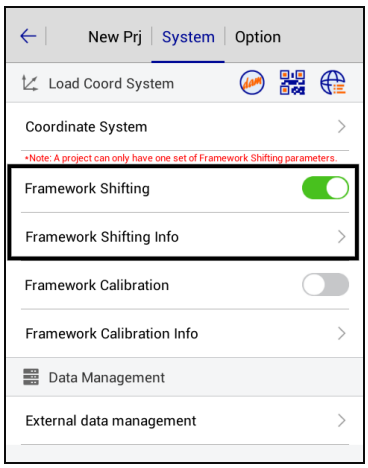


Figure 2-2-20 Framework Shifting

6. Framework Calibration

This is for computing the horizontal and vertical translation between two coordinate systems, generally used for situations as below:
Only one BJ-54, XIAN-80 point or only one point of a coordinate system which is a little rotated from WGS-84. Set the Base, then take the Rover to a known point, click *Framework Calibration* → *Compute*, collect the NEZ coordinate, input the known point, click Compute to get the Correction dN, dE, dZ of the known point and source point, press *Apply* to apply the parameters and the collected points will be corrected to the coordinate system of the known point.
You created a project, it worked, but you don't want to set the base at the same place, so now you can set the base at any place, by using the *Framework Calibration* function. Open the first-used project to a known point to correct the coordinates. The correction method is the same as the first situation.

- Compute: Calculate the coordinate correction dN, dE, dZ according to the current point and the known point. Users need to obtain the source point (the current point) coordinates and the coordinates of the known point first. The known points can be entered in three ways: select from the point library, select from the map or enter the coordinates directly. Select NEZ/BLH: the resulting known point coordinates will correspond to the NEZ/BLH format.

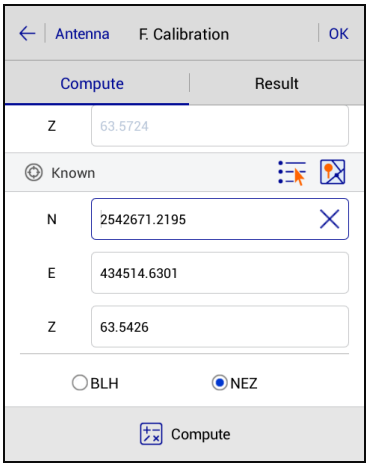


Figure 2-2-21 Compute

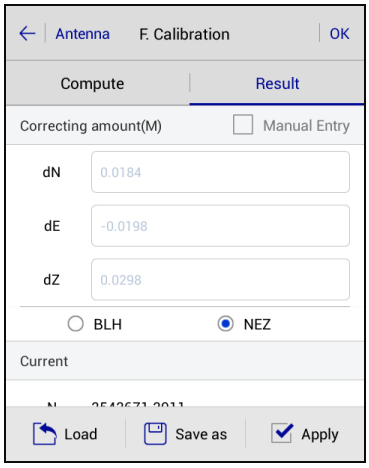


Figure 2-2-22 Result1

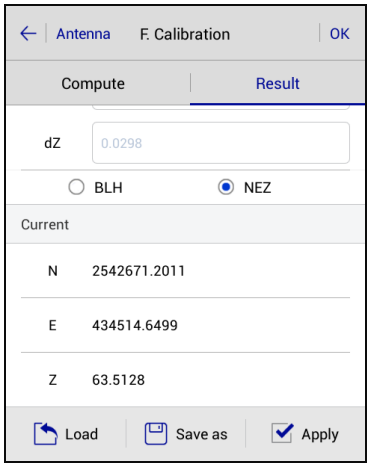


Figure 2-2-23 Result2

- Apply: Apply the calculated correction to the project.
- OK: Select Apply after computing, and click *OK* to apply the framework calculation parameters (notice: it is different from the OK that appears after pressing the return key).
- Cancel/OK: Select *Apply*, and click the return key to pop up the prompt dialog, click *Cancel* to return the framework calculation parameters; click *OK* to give up modifying the parameters.
- Load: Load the stored parameters.
- Save as: Store the calculated calibration parameters.

The calculated calibration parameters can be selected in the *Project Settings* → *System* interface.

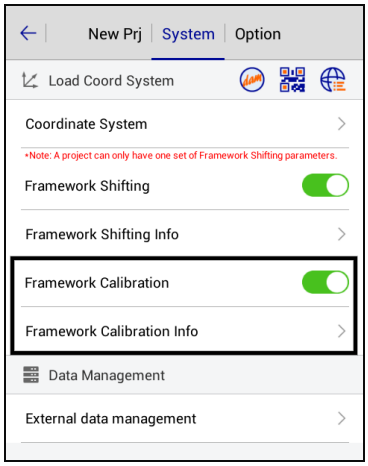
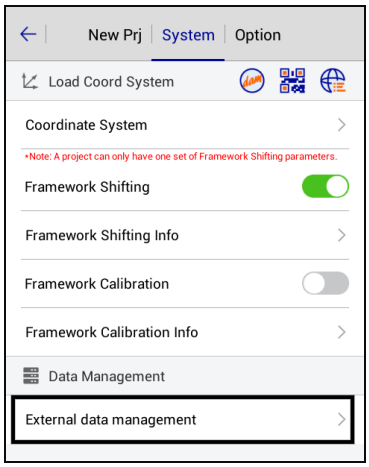


Figure 2-2-24 Framework Calibration

After using the framework calculation parameter to collect points, the parameters are automatically recorded in the raw data of each point, so that the geodetic coordinates of WGS-84 coordinates are restored when errors occur. In the *Raw Data* → *Edit RawData* interface, the framework calculation parameters of the original data can be viewed.

7. External Data Management

Enter External data management, click Add to load layer file *.td2, *.dxf and *.shp (when the external data format is incorrect, the file can't be imported) as the map background. Support for arc, circle and spiral curve. The imported DXF can be viewed on the map in colors. The color can be switched in *Configuration → Display → Display color*. Switch on to display all kinds of colors in *.dxf; switch off to display the default black. After loading point, line, and polygon in *.td2 format, the raster layer is always at the bottom, followed by polygon, line, and point.



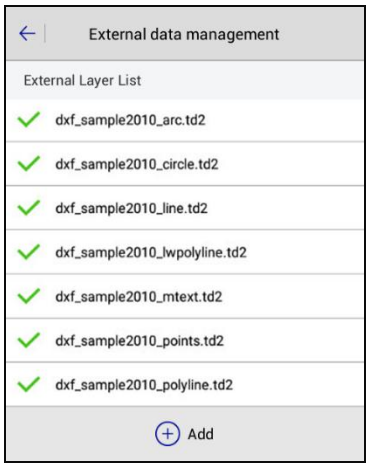


Figure 2-2-25 External Data Management *Figure 2-2-26 External data*

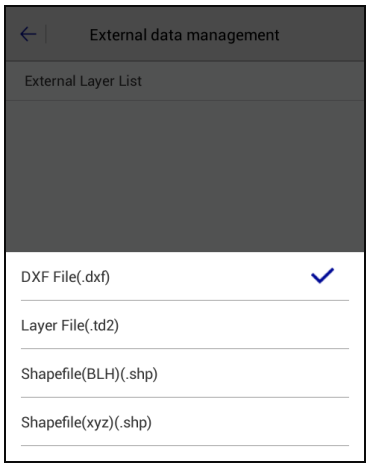


Figure 2-2-27 Add External Data *Figure 2-2-28 Edit External Data*

Notice:

External data management: opens all layers by default when adding the base map. Click the icon in front of the list, to switch layer visibility (on or off), which corresponds to that the base map of measurement interface display or not. Long press the added layer to open/close/delete the operation.

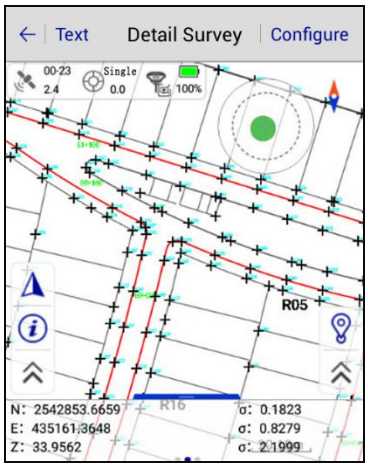
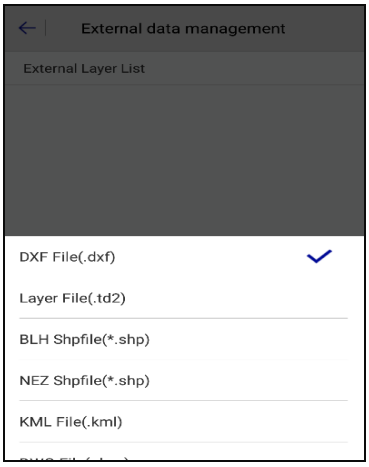


Figure 2-2-29 Display External Data

8. GIS Map Data Management

When the third map is the GIS map, the software will display *Layer Management* and *Network Map Service Manager*. The external data will then create the related layer and display the survey interface.

The user can add the file to the layer management. The supported file format contains DXF, SHP, GPX, KML, KMZ, MIF, DWG, TIF.



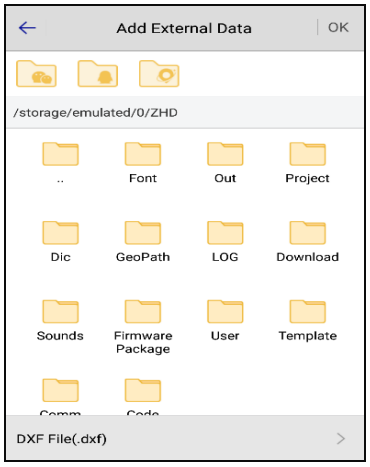
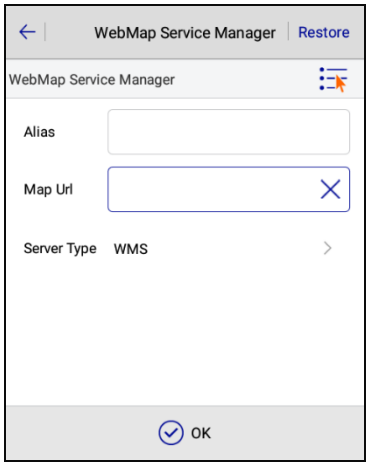


Figure 2-2-30 External Data Format Figure 2-2-31 External Data Path

The software can select the WMS /WMTS service to load the online map service in addition to the general files in the Network Map Service Management. You can do the overlay operation when the WMS and WMTS are both in the same coordinate system.



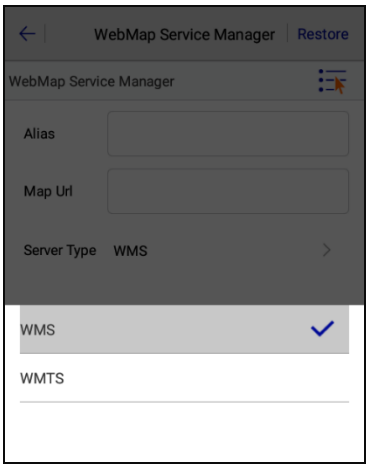
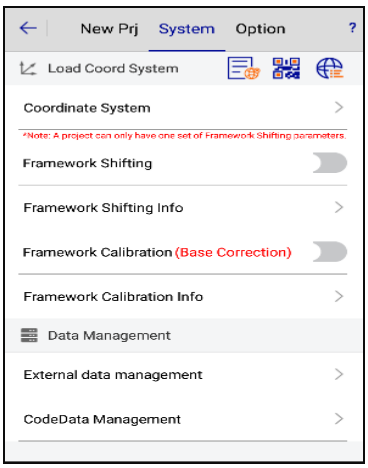


Figure 2-2-32 WMS Manager1 *Figure 2-2-33 WMS Manager2*

9. Code Data Management

Click *Code Data Management* to set the code template. The code contains the point, line, and polygon. You can create a *Group*, and *Add, Edit* and *Delete* them.



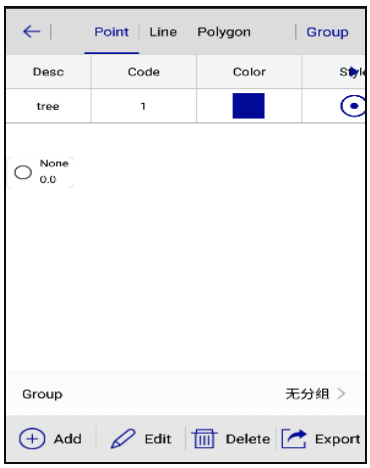


Figure 2-2-34 CodeData Management1 *Figure 2-2-35 CodeData Management2*

Before creating the code template, you should determine the type (point, line, and polygon), and then determine the group of the related type. Finally, add, edit and delete the operation of the name, code, color and style of this group.

-Add: Setting the name, code, group, color, and style. Click *OK* to create the new code.

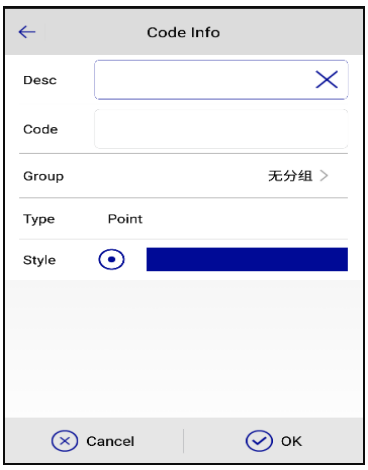


Figure 2-2-36 Code Info1

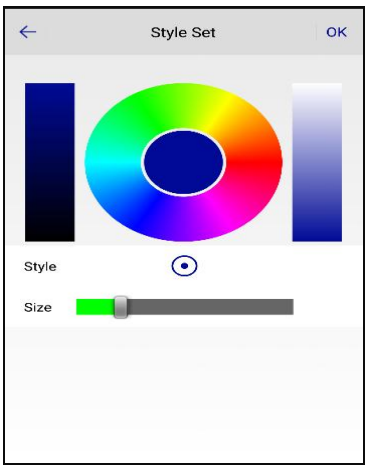


Figure 2-2-37 Code Info2

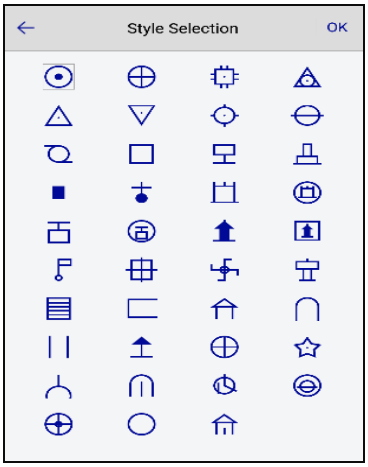


Figure 2-2-38 Code Style

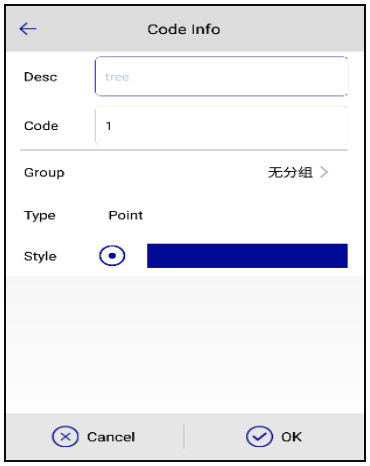


Figure 2-2-39 Code Info3

-Edit: Editing the existed code. It is similar to the Add function. But it can't edit the name of code.

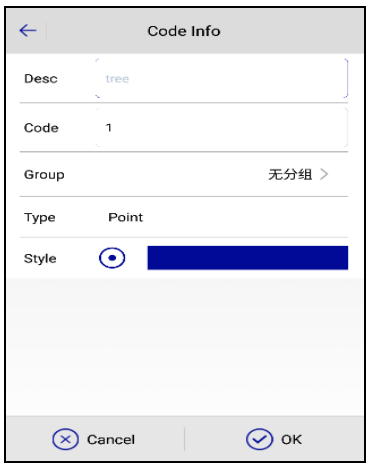


Figure 2-2-40 Code Info4

-Delete: Delete the selected code (It can be deleted by batches).

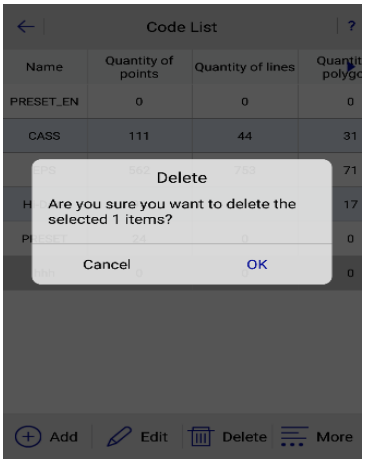


Figure 2-2-41 Code Delete

Click *Group* to *Add, Edit* and *Delete* the group.

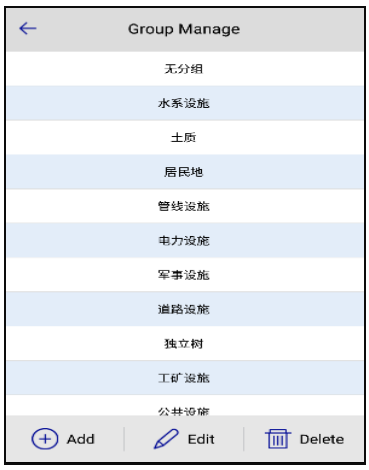


Figure 2-2-42 Group Manage1

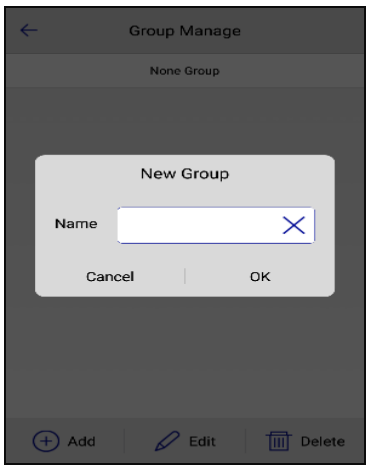


Figure 2-2-43 Group Manage2

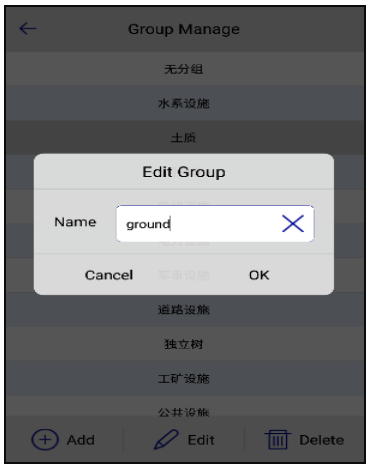


Figure 2-2-44 Group Manage3

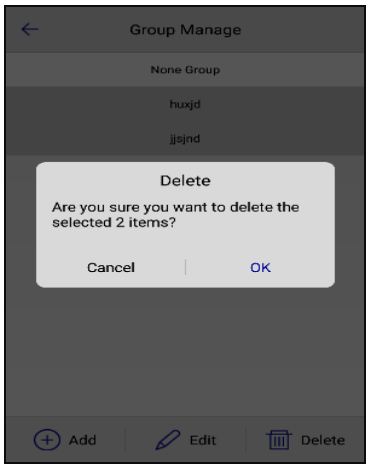


Figure 2-2-45 Group Manage4

2.2.3 Option

Do some other configurations, including *Angle, Distance, Apply Unit to Data Output, Time Stamp, Store GNSS Precision* and *Auto Load Last Road File.*

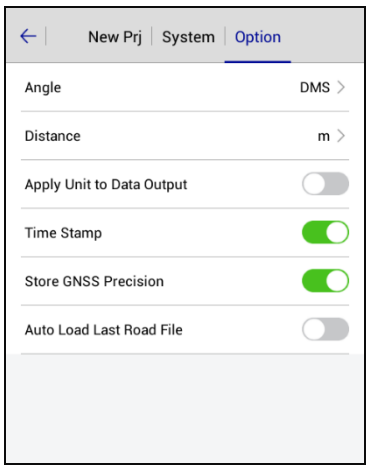


Figure 2-2-46 Option

- Angle: Confirm the angle unit, including DMS, Gons and mil.
- Distance: Confirm the distance unit, including m, Foot and U.S.Foot.
- Apply Unit to Data Output: Export data according to the set angle and distance format.
- Time Stamp: Record the real-time of each collecting point.
- Store GNSS Precision: Record the precision of each point collection.

2.3 Coordinate System

There are 3 methods to get into the coordinate system setting interface:
1. Main Interface *Project → Coordinate System;*
2. Main Interface *Project → Project Settings → System → Coordinate System*;
3. Main Interface *Project → Project Settings → System → Coord Sys Management*, long press the Coordinate system on the list to edit and enter the interface. Click Save after setting all the parameters, the system will prompt whether to update the parameters to the corresponding projection list, click OK to finish setting parameters.

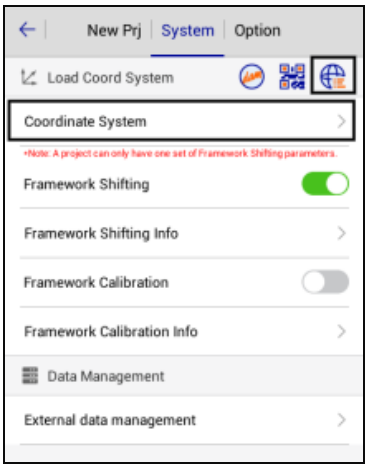


Figure 2-3-1 System

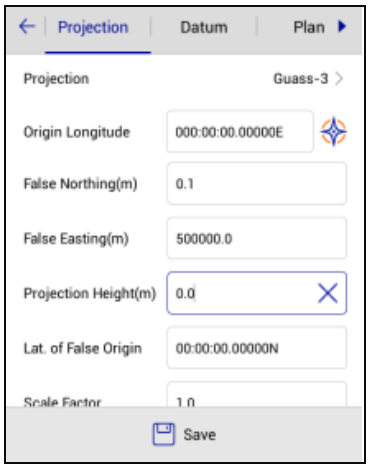


Figure 2-3-2 Projection

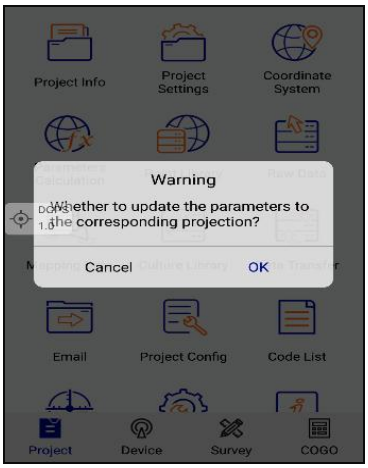


Figure 2-3-3 Save

Notice:

All the tabs in the software can be swiped by gestures, or click the tab page title bar to switch the page and make the tab page title bar automatically centered.

2.3.1 Projection

Frequently-used projections built-in: *Gauss, Mercator, Lambert*, etc. (notice: when using Gauss-3 or Gauss-6, the device can automatically compute the origin longitude after It is connected, other custom projections are not supported.

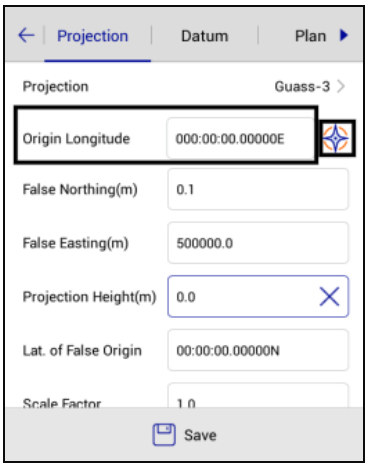


Figure 2-3-4 Obtain Origin Longitude

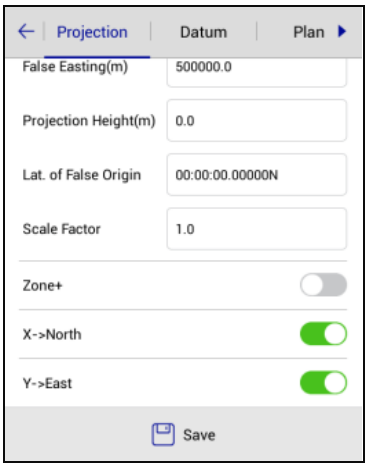


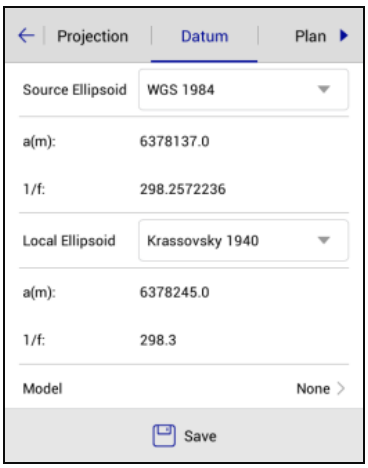
Figure 2-3-5 Other Parameters

Notice:

1. Coordinate system-Projection-Zone+ to set whether to add the number.
2. After opening Zone+, all coordinate E input boxes will be carried out with the number detection, if the number does not match, the input box will display the red font indicating that the number does not match the data confirmation.

2.3.2 Datum

Users can set source ellipsoid, local ellipsoid and datum transfer model (including *Bursa-Wolf Transformation, Molodensky, One-touch, Polynomial Regression* and *Ten Params*).



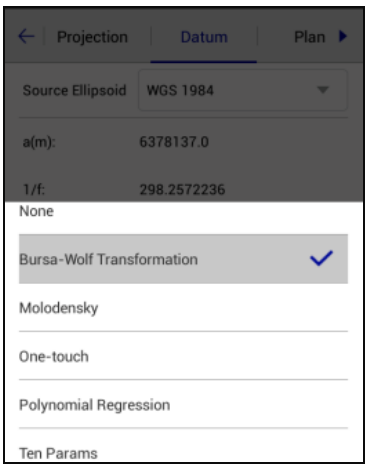


Figure 2-3-6 Datum Settings *Figure 2-3-7 Datum Model*

- *Save*: Click *Save* to save the parameters in a dam file after settings, the set parameters are invalid without clicking Save.

- *Source Ellipsoid*: Generally using *WGS-84*, *a* means semi-major axis, *1/f* means the inverse of flattening, and there are many frequently-used ellipsoids built-in.

- *Local Ellipsoid*: Local used ellipsoid.

Notice:

1. Customize the ellipsoid:

2. Edit the name of the source ellipsoid or target ellipsoid, long axis an (m) and the inverse of flattening (1/f) into the two lines to be input, the user input, the corresponding parameters and save it. Then the custom ellipsoid parameters will be saved in the file ZHD / Ellipse.csv.

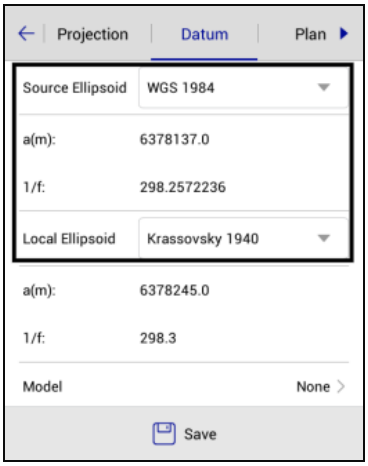


Figure 2-3-8 Datum-Source Ellipsoid

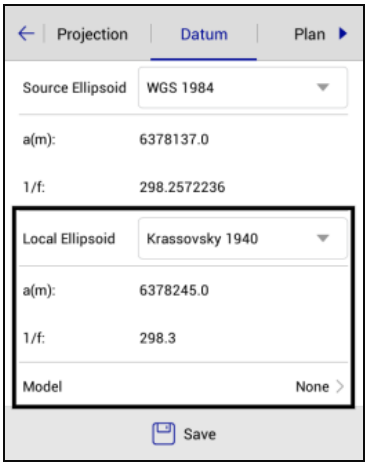


Figure 2-3-9 Datum-Local Ellipsoid

1. *Bursa-Wolf*

Including translation, rotation, scale parameters between two ellipsoids, the rotating angle should be very small. Bursa-Wolf needs at least three points to compute, it's suitable for conversion between different ellipsoidal coordinates.

2. *Molodensky*

A simplified model of Bursa-Wolf, only space translation parameters, it is a low accuracy mode and just needs one point to compute: suitable for the transformation of WGS-84 to a national coordinate system.

3. *Polynomial Regression*

Express the transfer relations of each space vector between two ellipsoids by a polynomial.

2.3.3 Plan

Include *2D Helmert, TGO, Planar Transformation Grid, FreeSurvey,* and *Polynomial Fitting*.

Figure 2-3-10 Plan Method

1. 2D Helmert
Includes translation, rotation, and scale parameters between two plane coordinate systems, it just needs two points in any coordinate system to compute.

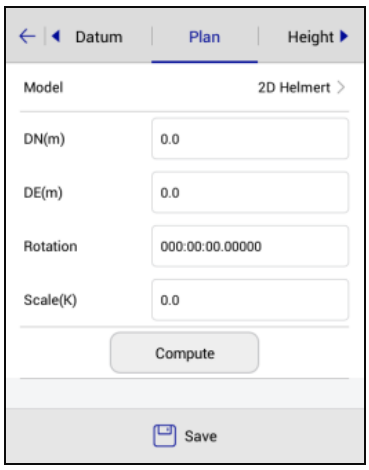


Figure 2-3-11 Plan Configure

2. *TGO*

A plane coordinate system transfer method of *TGO* software, more *North Origin, East Origin* than *2D Helmert*.

3. *Planar Transformation Grid*

Select an existing grid file to transfer *WGS-84* to the grid coordinate. The grid file (**.grd*) needs to be copied to the *GeoPath* folder in *ZHD*.

4. *FreeSurvey*

A transfer method of THALES Company, more *North Origin, East Origin* than *2D Helmert*.

5. *Polynomial Fitting*

Transfer the place by a polynomial model. In some projects, when the known points involved in calculating plane transformation and elevation fitting parameters are different points, use *2D Helmert* and *Height Fitting* to individually calculate parameters.

The *2D Helmert* is used in the calculation part of the plane, and the method is similar to the datum conversion model.

- When using four-parameters, the scale parameter is generally very close to 1, about 1.0000x or 0.9999x.

- When using three-parameters, the parameters generally need to be less than 120.

- When using seven-parameters, the parameters are required to be smaller, preferably less than 1000.

2.3.4 Height

Include *Mathematical Models, TGO, Geoid-Ellipsoid Separation Grid,* and *FreeSurvey*.

1. Mathematical Models

- *Constant Vertical Offset*: Translation needs one starting point at least.

- *Planar Fitting*: Needs three starting points at least.

- *Quadratic Surface*: Needs six starting points at least.

- *Zonal*: Needs three starting points at least.

2. *TGO*

A height transfer model includes five parameters: *H0 (constant adjustment), Kb (north slope), Kl (east slope), North Origin* and *East Origin*.

3. *Geoid-Ellipsoid Separation Grid*

Select an existing grid file to fit height. The grid file (**.grd*) needs to be copied to the *GeoPath* folder in the *ZHD* path.

4. *FreeSurvey*

A transfer method includes five parameters: *H0 (constant), Kb (north slope), Kl (east slope), B0 (origin latitude)* and *L0 (origin longitude)*.

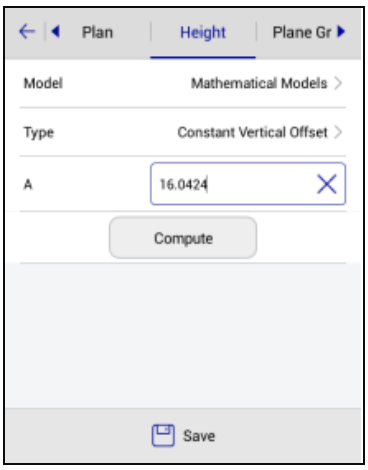


Figure 2-3-12 Height

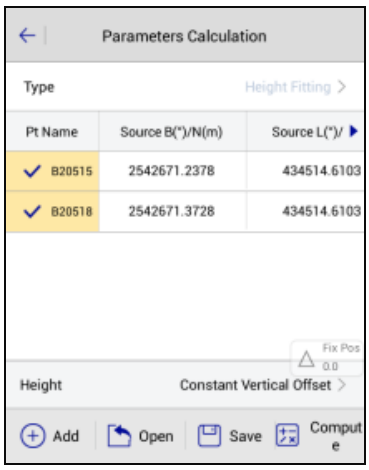


Figure 2-3-13 Parameters

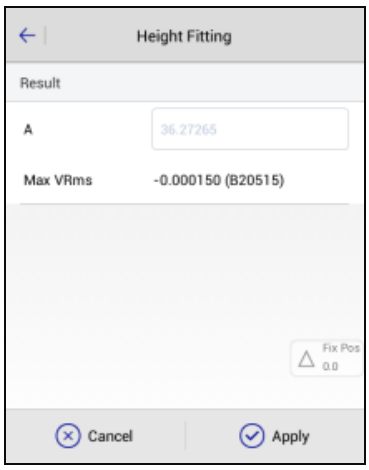


Figure 2-3-14 Result

The calculation of the individual height-fitting parameters includes *Constant Vertical Offset, Planar Fitting, Quadratic Surface,* and *Zonal,* which correspondingly require one, three, six and three starting points, at least, to be used. Enter the *Name*, *N, E*, the original *H* and the target *H* of the point involved in the height fitting parameter calculation, then click *Add*. After adding all points, click *Compute* to see the residual values, the maximum residual value is generally required to be less than 3 cm. If the value meets the requirements, click *Apply*. If not, click *Cancel*, remove the points with a big error and have a re-solution.

Set the height fitting mode:

- *Constant Vertical Offset* refers to the receiver measured height plus a fixed constant as the use of elevation: the constant can be negative.

- *Planar Fitting* refers to the height anomaly corresponding to multiple leveling points to produce an optimal fitting plane. When the plane is parallel to the horizontal plane, the planar fitting is equal to the constant vertical offset.

- *Quadratic Surface* refers to the height anomaly corresponding to multiple leveling points to produce an optimal fitting paraboloid. *Quadratic Surface* is relatively high for the starting data, and if the fitting is too poor, it may cause a height correction value divergence in the work area.

- *Zonal*: two known benchmarks to create a virtual mark, used to make the planar fitting.

- *Grid Fitting* needs to select the grid fitting file, it supports *Trimble (ggf), HI-Target (zgf)*, *Geoid99 (bin)* formats, compatible with the *egm-96* model. Grid fitting files are often large, the reading may take some time, please be patient. *Grid Fitting* is rarely used. If *Grid Fitting* and the other four kinds of elevation method are selected at the same time, *Grid Fitting* will be taken first, and then the other fittings.

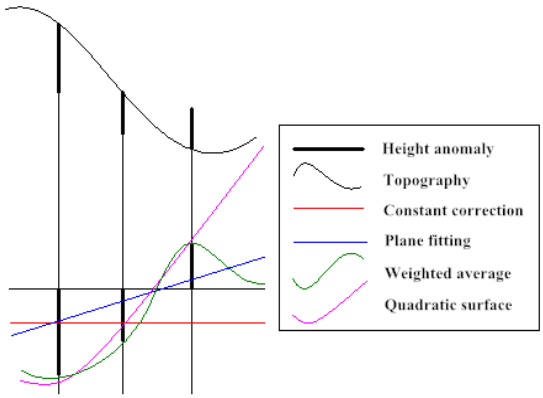


Figure 2-3-15 Height Fitting Plane Simulation

Notice: When importing parameters from the computer, the parameters can be edited into * .txt, parameter formats are as follows:

Table 2-3-1 Built-in Network Parameter Settings

Four-parameters	Seven-parameters
// The first line is skipped and just written DX:9847.12172733449 DY:-200265.017483647 R:0.0162640727776042 m:0.000162436743812444	// The first line is skipped and just written DX:511.755584317388 DY:-674.430387295999 DZ:-656.294939762613 RX:-0.000126577363609681 RY:-1.44916763174951E-05 RZ:0.0261524898234588 m:0.000168070284370492

2.3.5 Grid

Open the *Grid* needed and select the grid file. The grid file (**.grd*) needs to be copied to the *GeoPath* folder in *ZHD/GeoPath*.

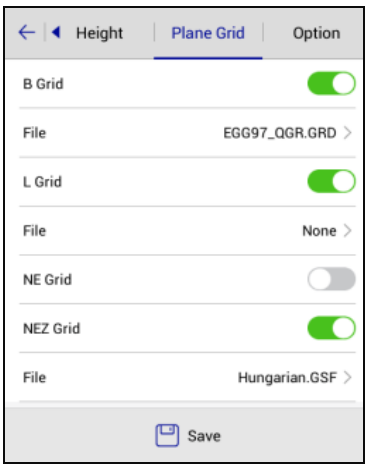


Figure 2-3-16 Plane Grid

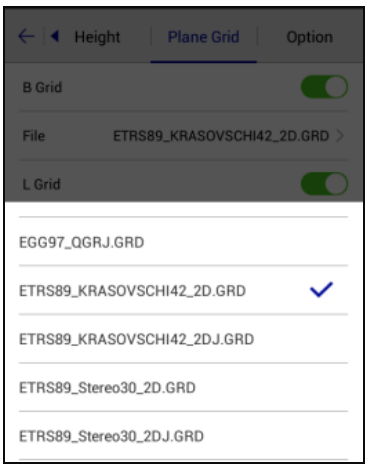


Figure 2-3-17 Plane Grid File

2.3.6 Option

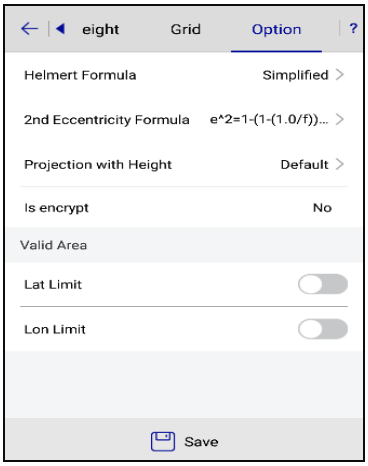
To apply the parameters computed by *HD-Power* to Hi-Survey Road, just input the parameters, select Simplified in *Helmert Formula* and the first in *2nd Eccentricity Formula*.

- *Encrypt*: To display the file encryption, the settings cannot be changed; if the *dam* parameter file is encrypted, you can see if the coordinate system date is expired.

- *Plane Correction Grid*: *Bilinear Interpolation/Dual-quadratic Spline Interpolation*. The default is dual-quadratic spline interpolation.

- *Plane Correction Grid*: It is hidden by default, and it can be seen only if the model in the *Plane* interface is either *Planar Transformation Grid* or the *NE Grid* or *NEZ Grid* in *Plane Grid* interface is opened.

- *Range:* You can set the working range of the coordinate system. It contains *Lat Limit* and *Lon Limit*. The default is closed. After changing the coordinate system or connecting the device, if the current position is not located in the range, there will be a prompt that *Current position is out of the valid area of the coordinate system*.



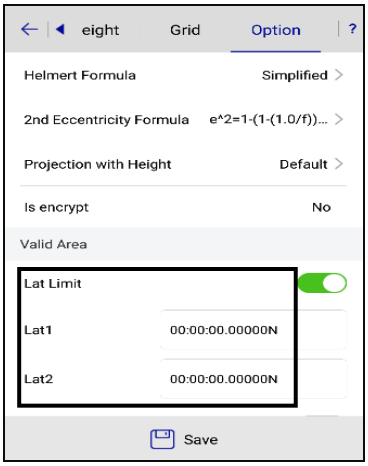
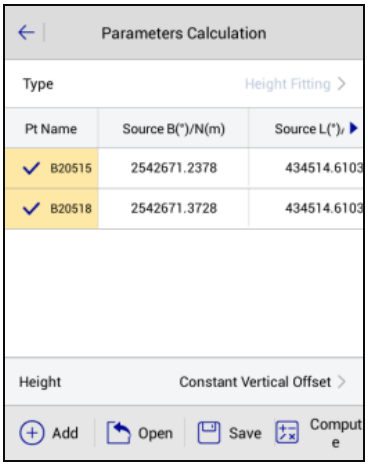


Figure 2-3-18 Range1 *Figure 2-3-19 Range2*

After modifying the values above, click Save, the software will modify the dam file under the current project, with the same name as the project; if the reference ellipsoid has been transformed, the coordinates will change.

2.4 Parameters Calculation

This function is for computing the transfer relation between two coordinate systems, including *Bursa-wolf Transformation, Modensky, Plane + Height Fitting, 2D Helmert Transformation, Height Fitting* and *One Touch*.



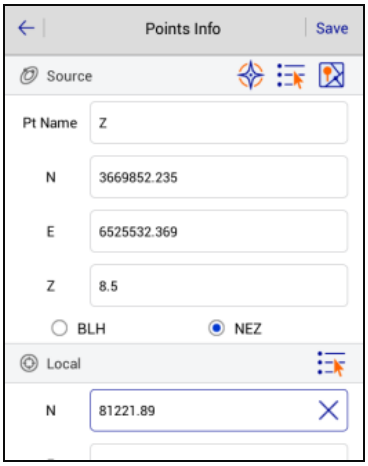


Figure 2-4-1 Parameters Calculation *Figure 2-4-2 Add Point*

- Add: Add the source point and local point; the source point can be input from manual, Real-Time Collection, library and selecting on map (BLH by default), the local point can be input from manual and library. The single or average collection is used for parameter calculation and data storage is supported (save to the *Coord Point* and *Raw Data*). After input, click *Save*. If you need to manipulate the existing point information long press it to edit or delete.

In addition, the points list will not display the point that has been added.

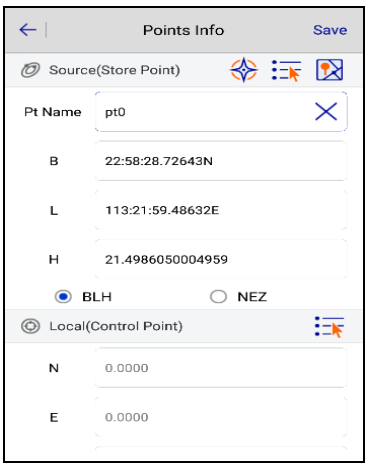


Figure 2-4-3 Add Points1

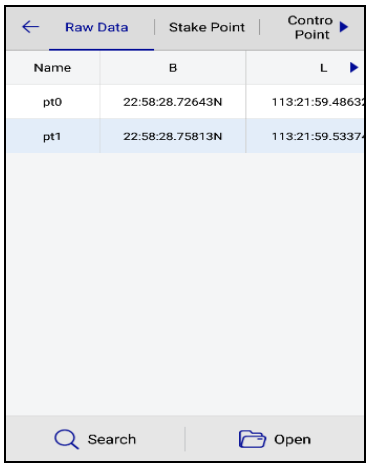


Figure 2-4-4 Add Points2

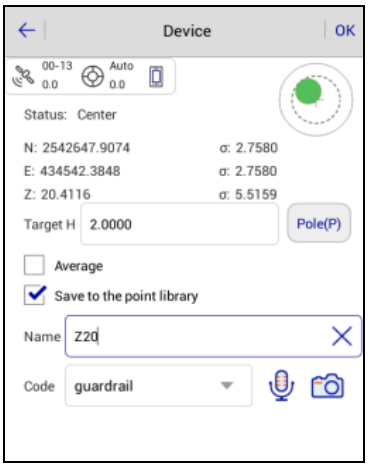


Figure 2-4-5 Add Points3

- Open: Support for Point pairs (*.txt), Carlson Loc File (*.loc), User-defined (*.txt).

- Save: Save the point pairs coordinate information, support for Point pairs (*.txt) and User-defined (*.txt). The angle format and exported file can be set in User-defined (*.txt)

- Compute: Compute the transfer parameters from source point to local point, it will compute the parameters and HRMS, VRMS of each point (HRMS: the horizontal RMS of the current point; VRMS: the vertical RMS of the current point).

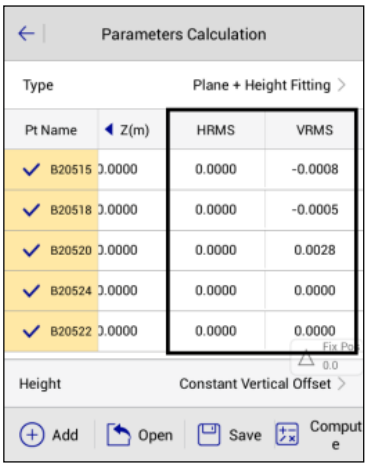


Figure 2-4-6 HRMS and VRMS

- Apply: Apply to corresponding coordinate parameters, and the result will be updated to the Coord point library.
- Cancel: Cancel the parameter computing result and go back to the calculation interface.

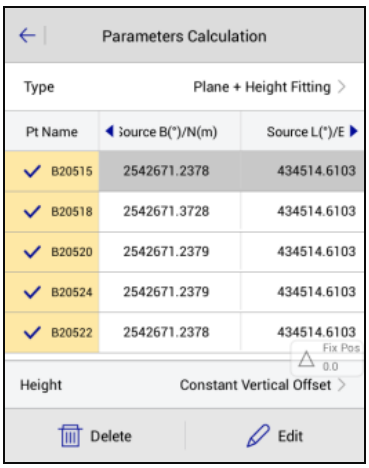


Figure 2-4-7 Edit Point

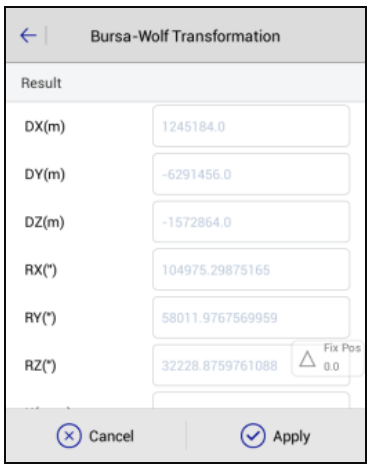


Figure 2-4-8 Result

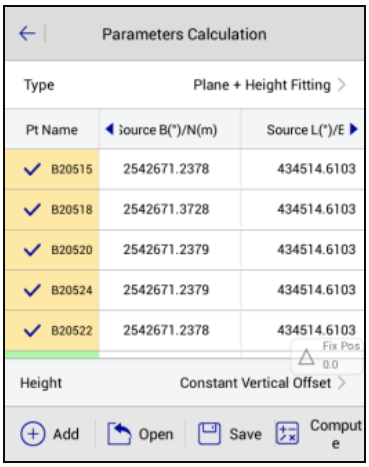


Figure 2-4-9 Plan + Height Fitting

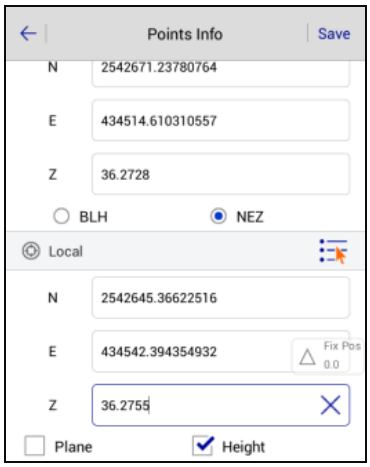


Figure 2-4-10 Add Point

The coordinate information input of point pairs by Plane + Height Fitting calculation can be set with specific types:

- Tick Plane: Use the plane coordinate NE of the point.

- Tick Height: Use the elevation coordinate Z of the point.

- Tick Plane and Height: Use the plane coordinate NE and elevation coordinate Z of the point, to compute plane and height fitting.

The color description of point pairs in Plane + Height Fitting:

- Blue: Use plane coordinate information of point pairs only.

- Yellow: Use elevation coordinate information of point pairs only.

- Green: Use plane and elevation coordinate information of point pairs.

Notice:

1. From the *Project Settings → System → Coord Sys Management,* enter the *Edit* or Define Project Attributes coordinate parameter interface to do the parameter calculation, which is the calculation for parameters' conversion corresponding to current custom or edited coordinate system type (you can't change the parameter calculation type);
2. From the *Project → Parameter calculation or Project → Coordinate system →Parameter calculation or Project → Project Setting → System → Parameter calculation* to calculate the current project coordinate conversion parameters. The parameters' calculation type can be selected independently, and the default is the Plane + Height Fitting. The height-fitting type is the currently selected type for parameter fitting by default.

2.5 Point Library

All of the coordinate point, stake point, and control point data will be saved here, including Name, N, E, Z, and Description. The list can be viewed by the left and right slipping. You can search and add points, or change the display settings. Long press to enter select mode, tick ☑ to select all/ cancel all; the selected points can be deleted or edited, you can delete many points, but only edit one point.

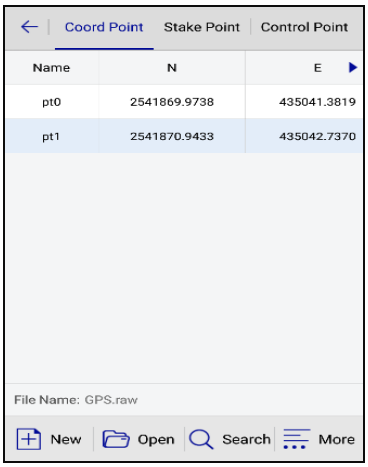


Figure 2-5-1 Coord Point

Figure 2-5-2 Coord Point

Notice:

1. In the Coord Point and Raw Data, the coordinate point list is a positive sequence display, the latest collection points shown in the last.
2. Coord Point - only for viewing, showing and editing the description, it does not allow add or delete.

- New: Create the new stakeout document in the same project. Click Stake Point, the current list will be cleared, at the same time, the file system will be in a fixed file directory (map folder under project) new a blank Stake Point as the current staking points file.

- Open: Open other stakeout documents at the same project; if you need to open the A project stakeout point, you must first copy the *.td2 and *.tdb file of A to the same project directory.

- Search: Search the corresponding point by name and description.

- Set: Set the NEZ display order of the coordinate points, the decimal number of the coordinates, and the number of coordinate points

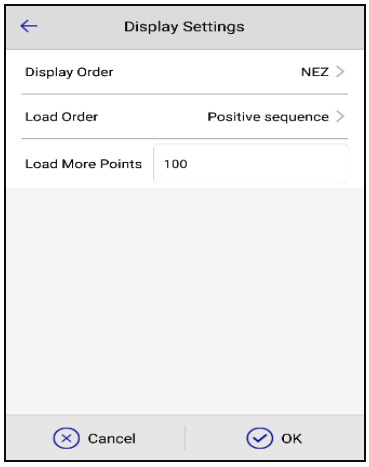


Figure 2-5-3 Display Settings

- Upload: Upload raw data to the private cloud.

- Process: Apply the current parameters to point library and get the result.

-Tick Use coordinate system of the current project, the project coord system is used by default, do not tick Use coordinate system of the current project if you need to update the coordinate system, just go to Coord Sys Management to set it.

- *Average points*: Long press the Average points, then click *Average Points* to check the selected data information. Reminder: if you need to save the average data, you will need to open the *Store Average Points* button in the *Configuration → Data*.

- Batch: Support to add numerous stake and control points from the point library.

- Add: Add coord point information, including name, coordinate and description; the coordinate can be from the real-time collection, select point and select on the map.

- Edit: Only edits description of coord points. All data of the stake point and control point can be edited. You can edit the point information. It contains Name, Groudcode, Station, Target H, H type and Antenna type, etc.

Notice:

1. Edit operations can only choose one edit at a time.
2. *Edit* and *Delete* will be displayed after long press the point.

- Delete: Delete the selected stake point and control point; points can be deleted en asse, or tick ☑ in front of a name to select all to delete.

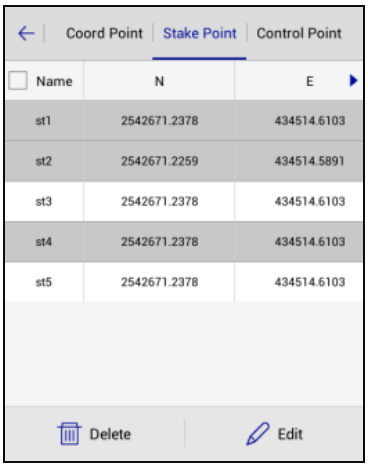


Figure 2-5-4 Delete

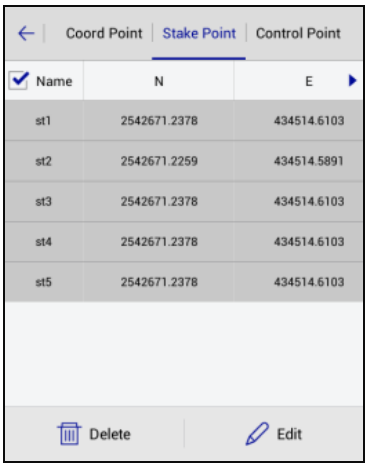


Figure 2-5-5 Delete All

Notice:

Long press to enter the selection mode, click to select multiple points, check the ☑ button to select the all / cancel all operation; you can delete one or more selected points, but each time only one point to edit.

2.6 Raw Data

Raw Data is to record BLH, Target H RMSE and description under WGS-84 ellipsoid collection, it can be transferred to get plane coordinates by using the coordinate transfer system.

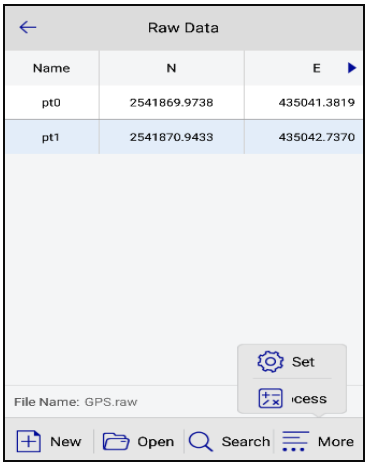


Figure 2-6-1 Coord Point

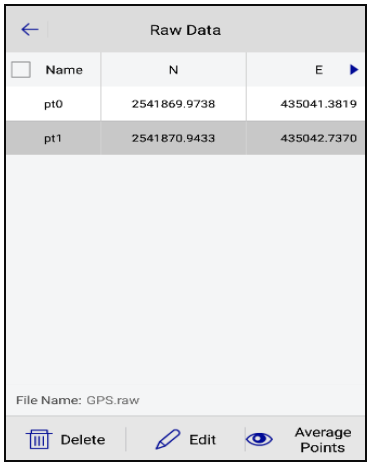


Figure 2-6-2 Coord Point

- New: Create a raw data file (*.raw).

- Open: Open an existing raw data file.

- Search: Search the coordinate point by name or description.

- Edit: Edit the raw data point name, code, station, target height, height type, and antenna type; it supports batch edit; the corresponding coordinate point name will be changed after editing raw data.

View other information of point, including solution type, coordinate information, number of average, difference ages, PDOP, satellite, the recording time, station coordinates, the vertical Angle, azimuth of tilt vector and points calibration information, etc..

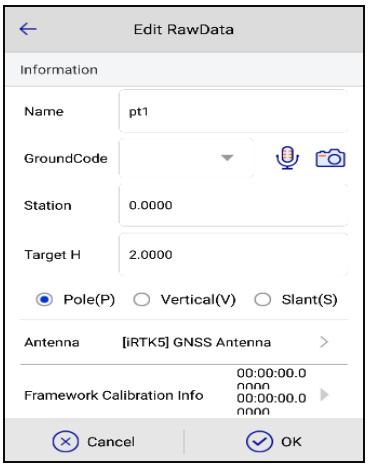


Figure 2-6-3 Edit Raw data

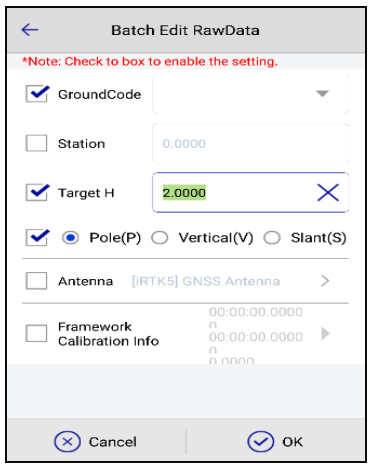


Figure 2-6-4 Batch Edit RawData

Notice:

1. Turn on *Surveying Configure → Data → Allow Same PtName function*, raw data supports the same name point collection. If you close it, the name of the re-entry will be prompted to repeat that Duplicate name: please enter it again.
2. In the *Edit RawData → Other Info* can check Framework Calibration information. If the project does not open using the Framework Calibration, the Framework Calibration value is 0.

-Average points: Long press the average points, then click *Average Points* to check the data information selected.

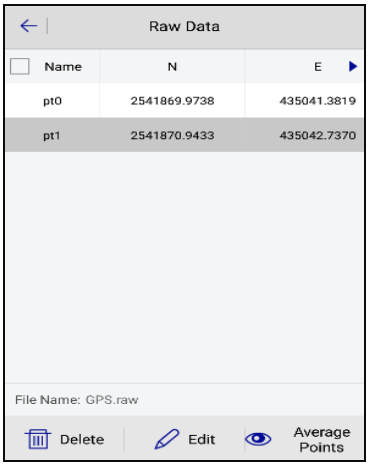


Figure 2-6-5 Raw Data

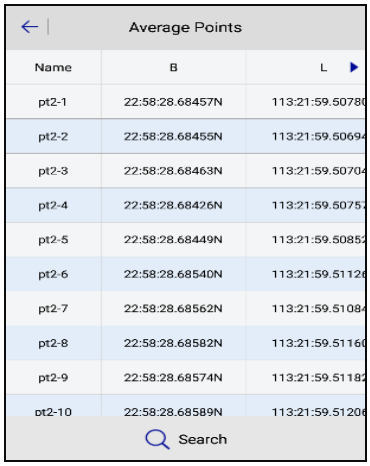


Figure 2-6-6 Average Points

Notice:

1. Slide to the right to read the BLH of the raw data.
2. All the geodetic coordinates are ground point geodetic coordinate.
3. Reminding, if you need to save the average data, then you have to open the Store Average Points button in the *Configuration → Data*.

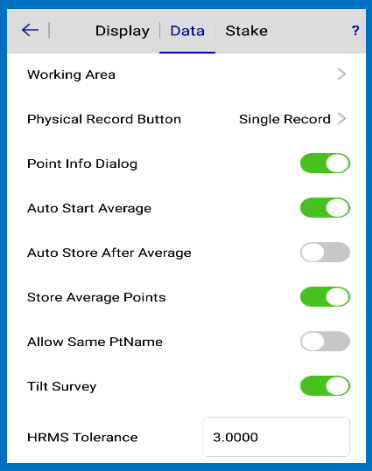


Figure 2-6-7 Average Points

- Upload: Upload raw data to the private cloud.

- Set: Set the loading sequence and display.

- Process: Apply the current parameters to point library and get the result.

Tick Use coordinate system of the current project, the project coord system is used by default, do not tick Use coordinate system of the current project if you need to update the coordinate system, just go to Coord Sys Management to set it.

Notice:

Data after the handle will update the coordinate point library by default, the measurement interface will display the new point coordinates after opening the new coordinates system.

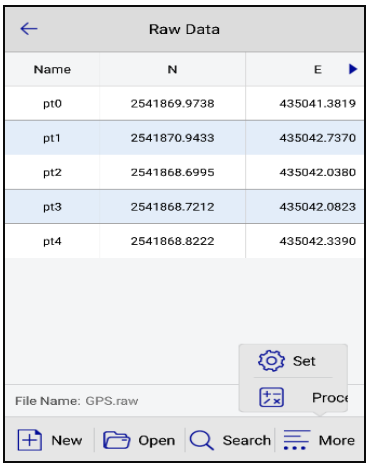


Figure 2-6-8 Average Points1

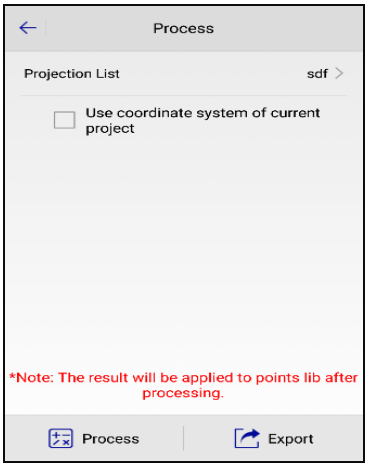


Figure 2-6-9 Average Points2

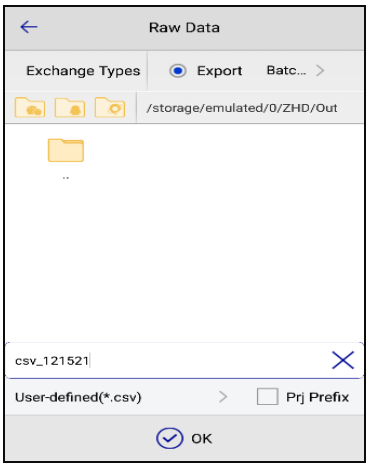


Figure 2-6-10 Average Points3

Figure 2-6-11 Average Points4

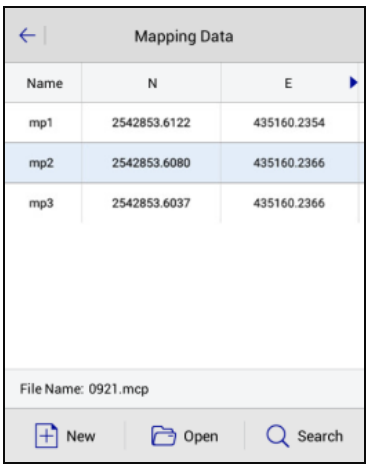
Processed data can be exported and export content can be selected in the optional field of the custom format setting. If there is the same file name, then it will prompt *The same file name already exists*, you can check to Cover the original data or enter a new file name, then click *OK* to export.

Optional fields include ID, Name, N, E, Z, B, L, H, Tilt N, Tilt E, Tilt Z, Tilt B, Tilt L, Tilt H,

Antenna H, σN, σE, Plane HRMS, σZ, Target H, Ave Times, Status, StartLocal time, EndLocal time, StartUTC time, EndUTC time, Desc, Latency, Sats, Shared Sats, PDOP, Elevation (°), VRS Name, Base B, Base L, Base H, Station, Tilt Angel, Tilt Azi, Tilt X, Tilt Y, TiltX Azi, Local B, Local L, Local H, Baseline Length, Azimuth, Offset, Audios, Images and Null.

2.7 Mapping Data

Mapping Data can show all mapping survey points and supports *New, Open, Search, Delete* and *Edit* via long-pressing one item.



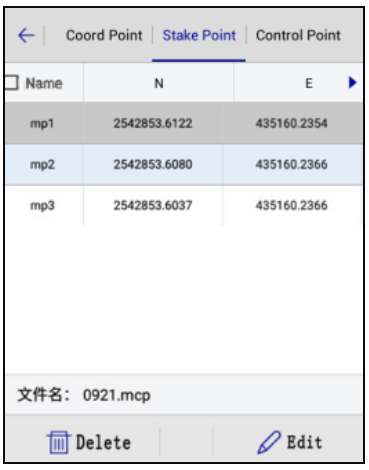
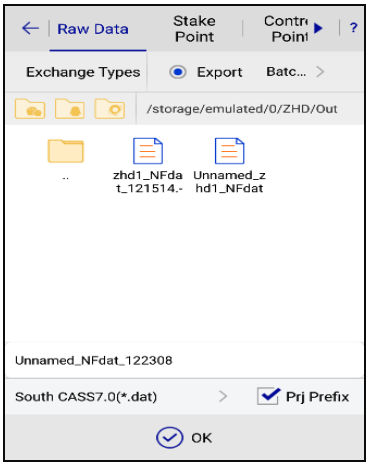


Figure 2-7-1 Mapping Data *Figure 2-7-2 Edit Mapping Data*

2.8 Data Transfer

Export or import *Raw Data, Stake Point, Control Point* and *Mapping Data* of the current project, for convenient searching and using. If there is a file with the same name as the exporting one, it will prompt *A file with the same name already exists*, tick *Cover* to export it, and it will not delete the old one.

Click the *Batches* button to enter the raw data select interface. Select the raw data, and then click *OK* to return to the main interface. The *OK* button can't be clicked if any raw data file is selected in the *raw data select* interface. In addition, if the *Batches* button isn't selected, the default exported data is the current data.



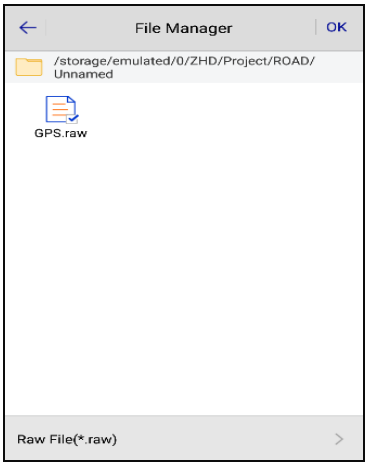


Figure 2-8-1 Raw Data export *Figure 2-8-2 Raw Data export*

Raw data export format includes:

User-defined (*.txt), User-defined (*.csv), DXF File(*.dxf), SHP File (*.shp), Excel File (*.csv), South cass7.0 (*.dat), Scsg2000 (*.dat), PREGEO (*.dat), ASC File (*.asc), KML (*.kml), NETCAD (*.NCN). GeoJSON (*.geojson),User Defined GIS (*.txt).

If you select the CASS model when creating a new project, select South CASS GIS (*dat). If you select the EPS model when creating a new project, select the EPS GIS (*txt). If you select Hi-Data model, select Hi-Data GIS (*hdx). If you select another template, select the User-Defined (*txt).

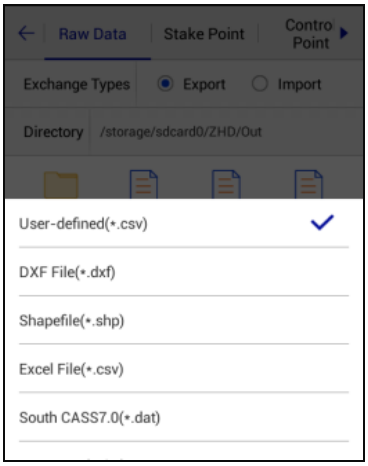


Figure 2-8-3 Format-CSV

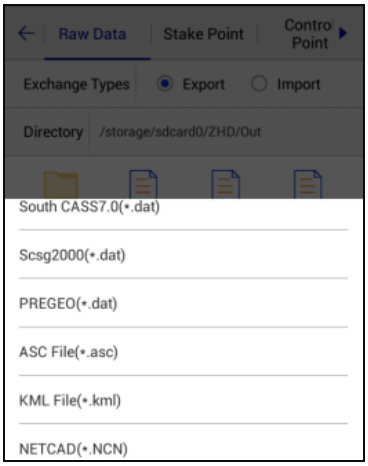


Figure 2-8-4 Format List

The coordinate point, stake point, and control point are saved as Survey.td2, Stake.td2, Control.td2 in the Map folder.

The import and export operation of custom format file method is:

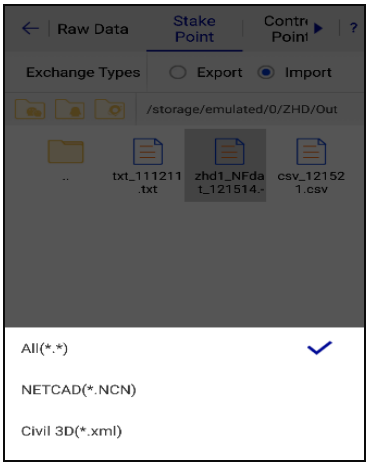


Figure 2-8-5 Data Import

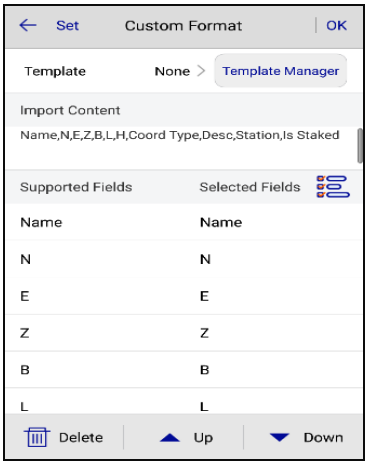


Figure 2-8-6 Custom Format

1. In the Supported Fields list, select the fields that need to be exported. The Selected Fields are automatically filled in the Selected Fields list click the button to select the full or full cancellation fields. The Export Contents will show the heads of the parts in proper order;

2. Select one item of Selected Field, clicking *Delete* will not export the field. If you move *Up* or *Down* to adjust the export order, the Export Contents field order will change altogether;

3. Click the *Template Manager* to define (*csv) export, you can select the template that you have configured. Template Manager can set and store name, Import content, etc.

4. Click the *Set* button to set the *Angle, Splitter* and *Format Header*, etc.

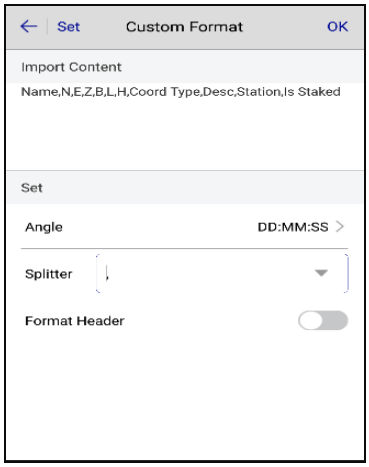
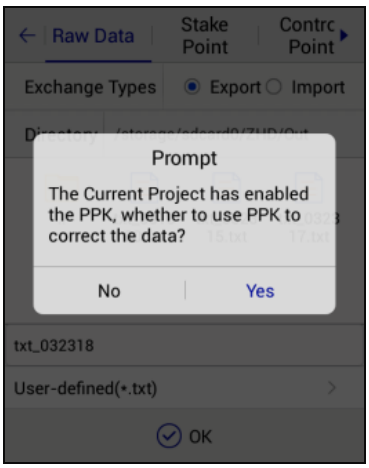


Figure 2-8-7 Custom Format

5. After setting, click *OK* to import or export the file; when the software is reintroduced into the staking point interface, the import format will default to be the data format of the last import, as long as the user does not do data cleaning or uninstall the software.

6. Project tilt measurement, *Data Transfer → Raw Data custom export*, supports the export of non-tilt correction of the plane coordinates.

7. If the item PPK function is ticked, when therover station is set, the PPK correction prompt box will pop up when the original data is exported in *Raw Data → Data Processing* or *Data Exchange*. Click *Yes* to enter the PPK correction file selection box, then select the file to correct the processing or exported point.



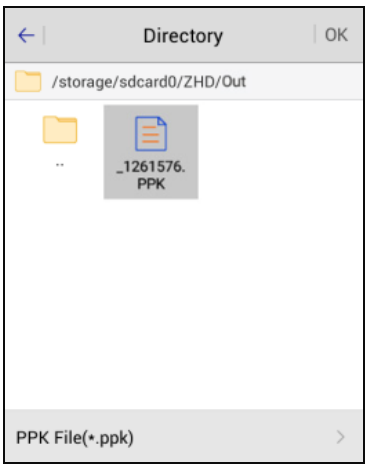


Figure 2-8-8 Prompt PPK *Figure 2-8-9 Select PPK File*

Notice:

1. All the import and export methods involved in the file custom format are the same as this step.
2. The file import data needs to do the number and coordinate range detection (including parameter Calculation Loading, *Data Exchange → Stake Point / Control Point* import, *Stake Line → Stake Line Library* loading, Road Stake/Cross-section Collection → Road Design File the choice of loading, Road Design → Plane → Section Design Line intersection, line element, coordinate method of loading. If the test data is not within the range of the value, or the E coordinate band number does not match, the Input import error prompt box is displayed.

When *Surveying Configure → Display →* Online Map → GIS Map, you can select to export GIS Map in the *Data Transfer*.

GIS map supports export format: DXF (*.dxf), SHP (*.shp), GPX (*.gpx), KML (*.kml), KMZ (*.kmz), MIF (*.mif), DWG (*.dwg). The shapefile has a point, line and polygon file. The other formats only have one file.

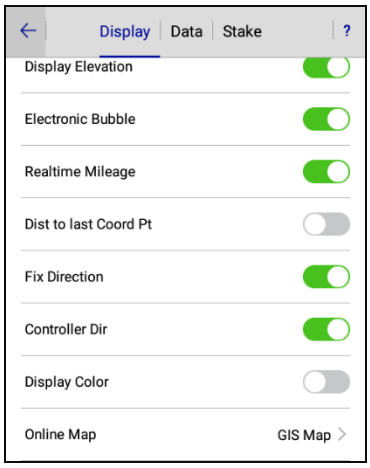


Figure 2-8-10 GIS Map1

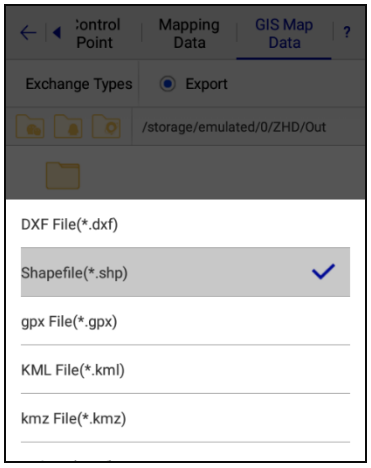


Figure 2-8-11 GIS Map2

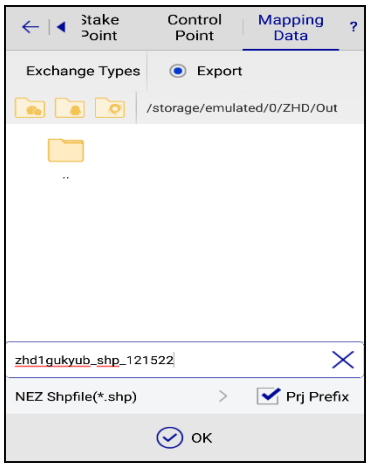


Figure 2-8-12 GIS Map3

2.9 PPK File

There is a PPK file when you do the PPK survey. You can check the PPK file information via the list. It contains the file name, device SN, device module, etc.

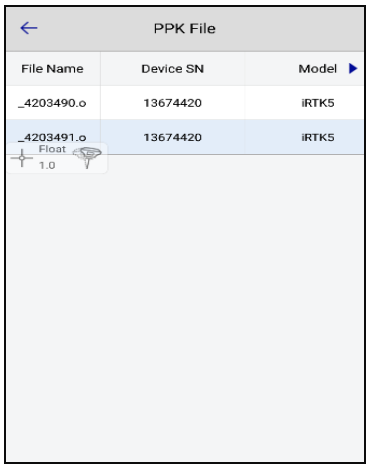


Figure 2-9-1 PPK File

If you long press the PPK file, it will show you the delete button. Click and delete the file. (Only delete the file in the software record file, do not delete the PPK file of the receiver.)

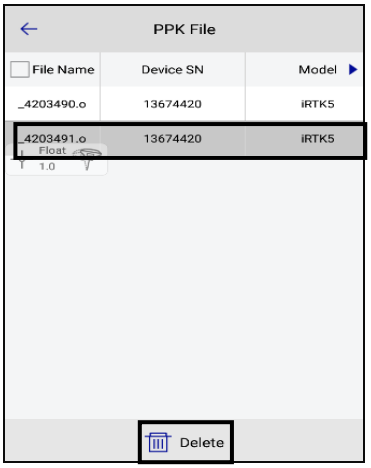


Figure 2-9-2 PPK File Delete1

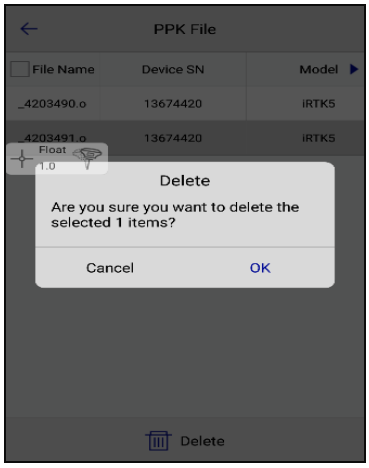


Figure 2-9-3 PPK File Delete2

Tick the ☐ ahead of the file name to delete batches.

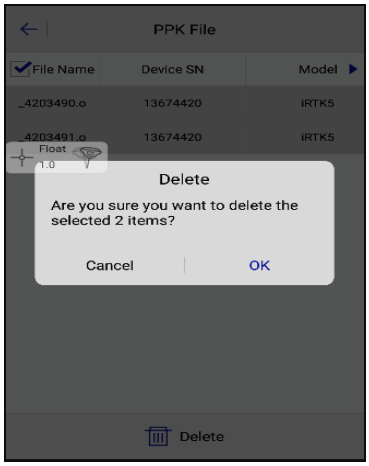


Figure 2-9-4 PPK File Delete3

2.10 Email

As an Android email client, the user can send project files by email to realize for remote uploading of data.

Figure 2-10-1 Email- From Hi-Survey Road

Tick *Email-From Hi-Survey Road* to make Hi-Target send mail as the sender.

Otherwise, users can switch to the mail type and enter the address, it supports most email systems.

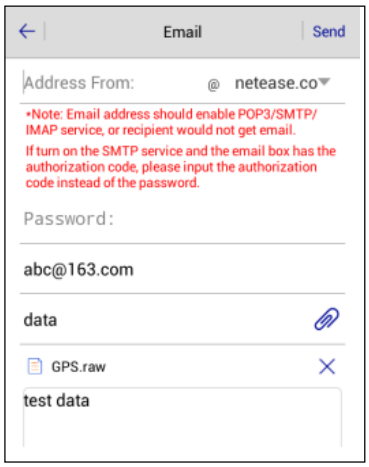


Figure 2-10-2 Email-Enter Address

Tick Feedback to give the feedback to Hi-Target - the default address is Hi-Target enterprise mail.

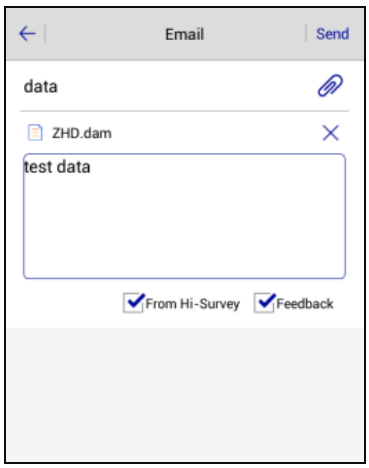


Figure 2-10-3 Feedback

File browser operation method (all operations involved in the file browsing options are applicable to this method in this software):

Press and hold an item; when the bottom right corner of the current item appears, put all items into selection mode, press the *BACK* button to exit the selection mode;

2. In the selection mode, you can select or deselect, or select multiple options;

3. In non-selection mode, click on each page, to return to the upper directory, until you reach the root directory of SD card;

4. Click OK to complete the file selection;

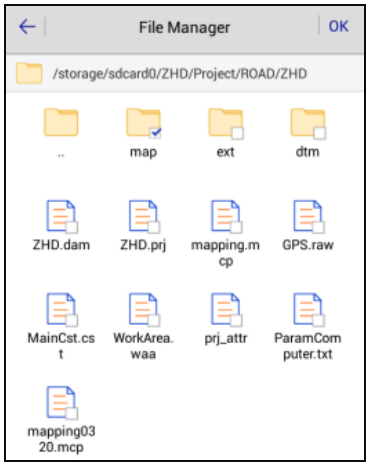


Figure 2-10-4 File Manager

File transfer network status test; enter the file transfer interface initially, without displaying the network status test button. When clicking Send and the message fails to send, it will show the Test Network button; click it to Test Network status, and display the test results.

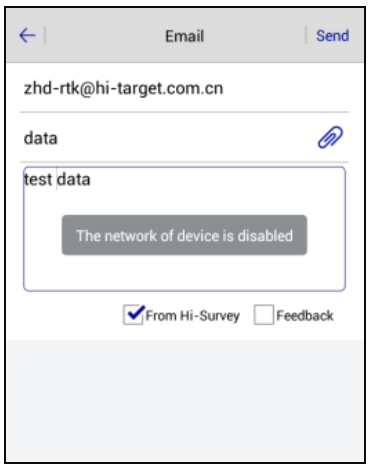


Figure 2-10-5 Check the Network

2.11 Project Config

This new function of the software is convenient to change the configuration parameters. It can define the parameter of the average survey, mapping survey, and survey precision. Click one touch to apply it after creating the new project. Click *New*, *Edit*, *Import* and *Export* to set the configuration parameter file. Project config manager is synced with (*.plc) of (ZHD/Template/config).

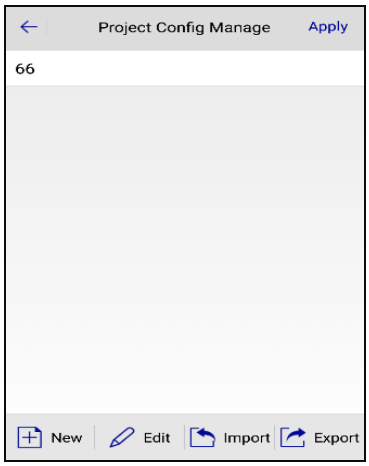


Figure 2-11-1 Check the Network

- *New*: Create a new project configuration template to change the parameters of the average survey, mapping survey, and survey precision. Click *New* to input the template name and enter the configuration interface. You can set the detailed content by adding, editing, deleting. After the project template has finished, click the *Return* button and you will get the prompt *Do you want to save data?*

Click *Yes* to finish the project configuration template.

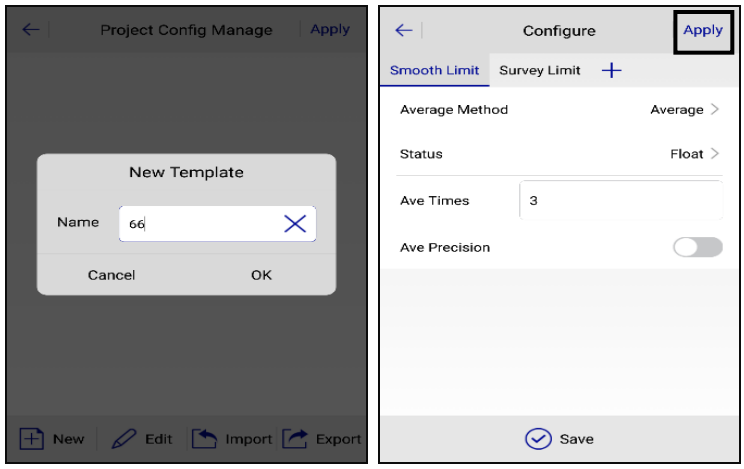


Figure 2-11-2 New Template Figure 2-11-3 New Template

-Edit: Select the template, then click the *Edit* button to change the project configuration interface. You can edit the detail content. Finally, click *Save*.

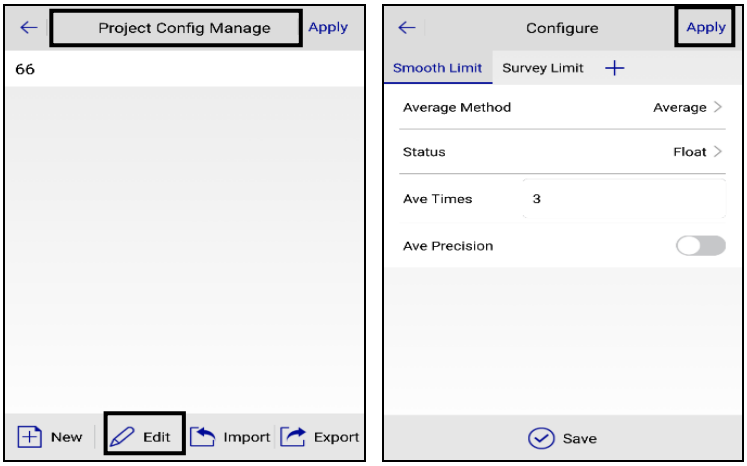


Figure 2-11-4 Project Config Manage Figure 2-11-5 Project Config Manage

-Import: Select the related project configuration file (*.plc) to import.

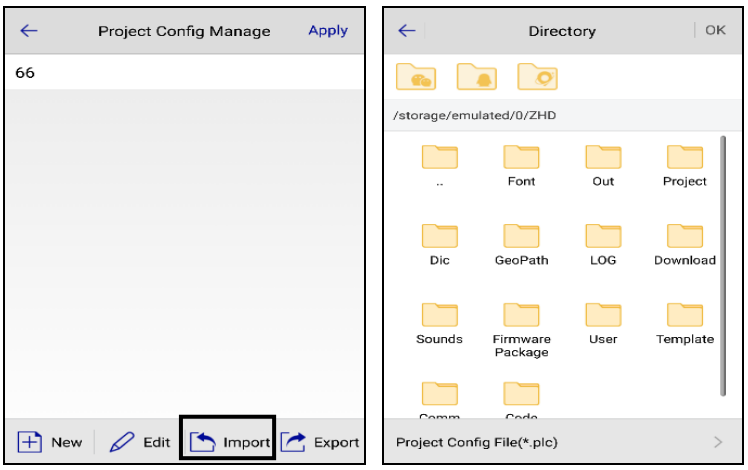


Figure 2-11-6 Import Figure 2-11-7 Import

-Export: Select the project configuration file in the list. Click Export and select the format (Project Config File(*.plc), then input the name to export the template.

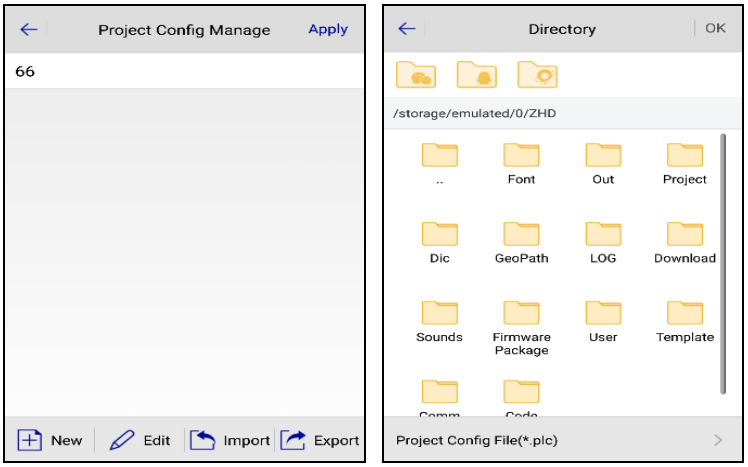


Figure 2-11-8 Export Figure 2-11-9 Export

-Delete: Long press the template, then click the delete button to delete the template.

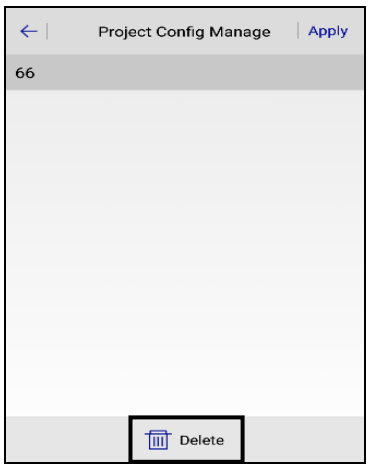


Figure 2-11-10 Template

2.12 Code List

This is a new function of the software. You can use the short letter to replace the complicated description. Import the points into the mapping software (such as CASS). This will create the polygon automatically. You can now enter the code list from the project, and then add, edit, delete, import and export. The code file is synced with (*.xml) of (ZHD/out).

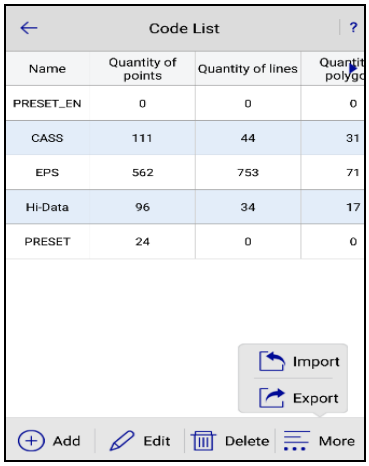


Figure 2-12-1 Code List

-*Add*: Setting the name, code, group, color, and style. Click *OK* to create the new code.

Figure 2-12-2 New Template

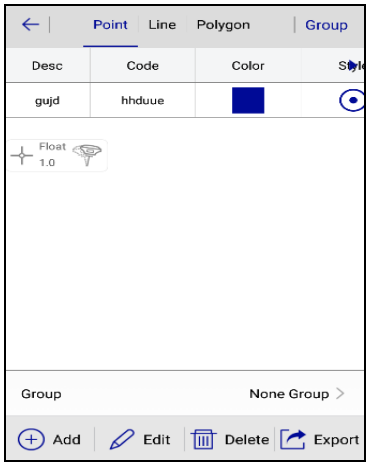


Figure 2-12-3 Add Point

Figure 2-12-4 Save

Before creating the code template, you should determine the type (point, line, and polygon), and then determine the group of the related type. Finally, do the adding, editing and deleting operation of the name, code, color, and style of this group.

-*Edit*: Editing the existing code. It is similar to the *Add* function. But it can't edit the name of code.

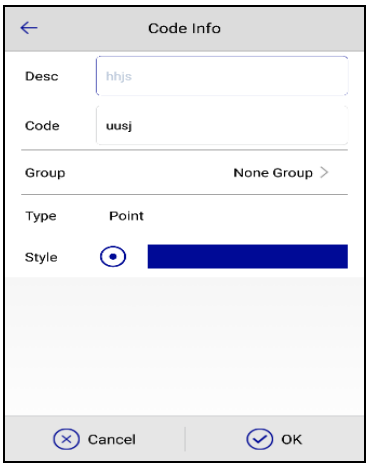


Figure 2-12-5 Add Template1

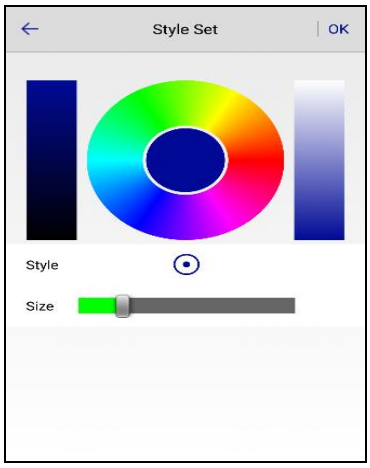
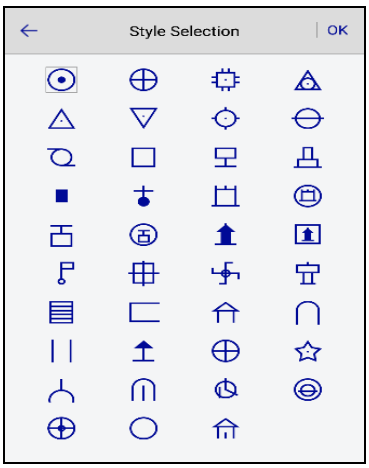


Figure 2-12-6 Add Template2



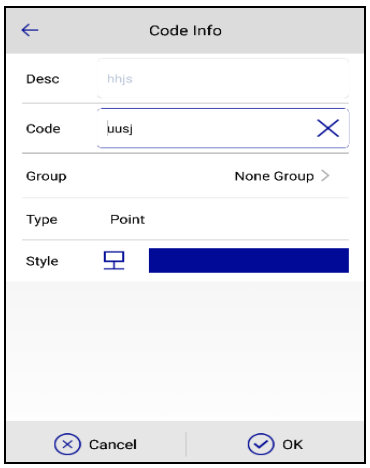


Figure 2-12-7 Add Template3 *Figure 2-12-8 Add Template4*

-Delete: Delete the selected code (You can delete it by batches).

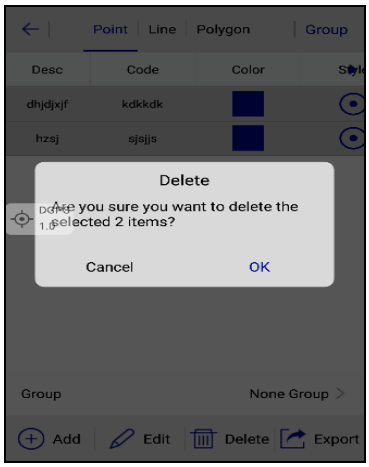


Figure 2-12-9 Delete Batches

Click *Group* to *Add, Edit* and *Delete* the group.

Figure 2-12-10 Group Manage1

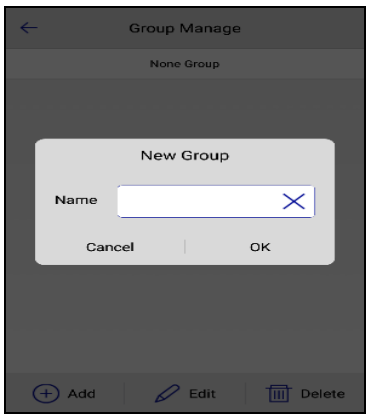


Figure 2-12-11 Group Manage2

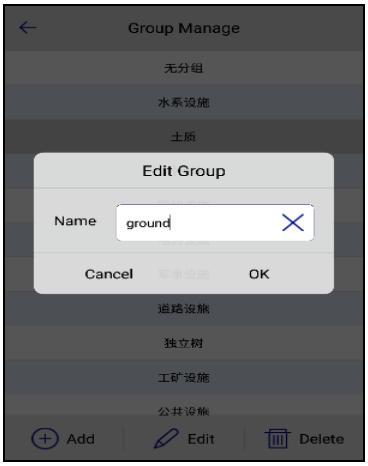


Figure 2-12-12 Group Manage3

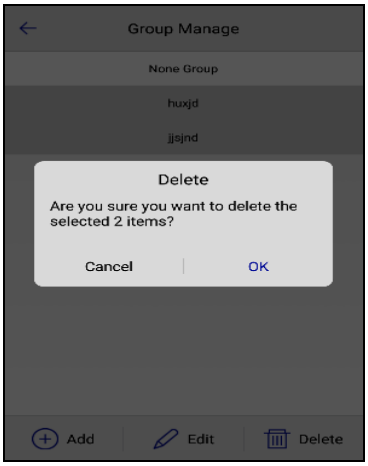


Figure 2-12-13 Group Manage4

CASS, EPS, and PRESET is the default template, and it cannot be deleted.

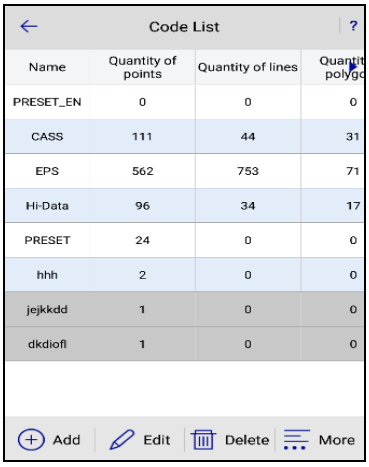


Figure 2-12-14 Group Manage5

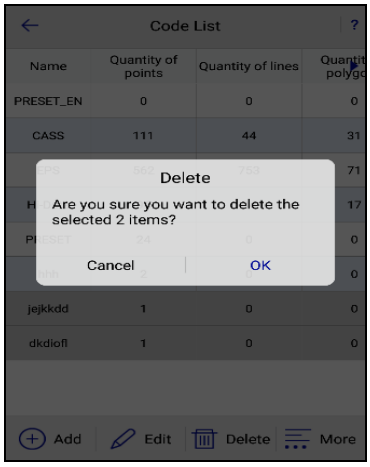
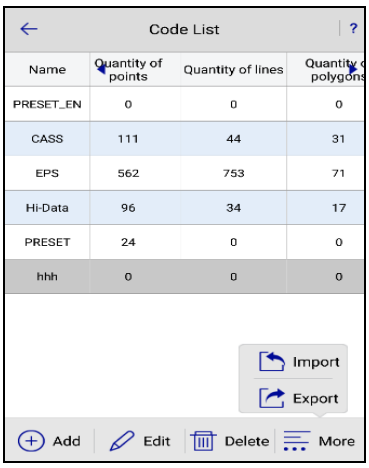
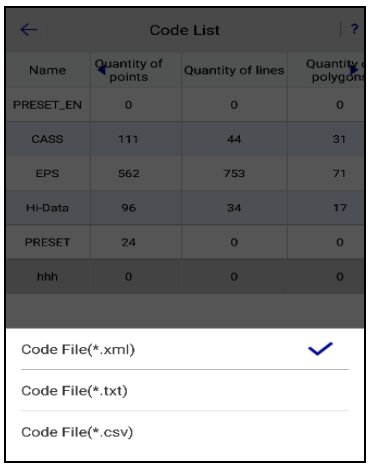


Figure 2-12-15 Group Manage6

-*Import:* Select the related the code file format (*xml), code template file(*txt), code template file (*,csc) to import.

-*Export*: Select the template in the list. Click *Export* and select the export format (*.xml, and .txt, *.csv). Then click *OK.*





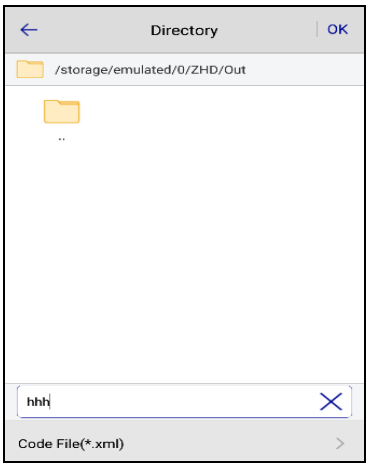


Figure 2-12-16 Export *Figure 2-12-17 Code List Format* *Figure 2-12-18 Export Directory*

2.13 Culture Library

You can check the line, polygon from the list. The line list will display the name, length, ground code information. Polygon will display *Surface Name*, *Perimeter*, *Max Area*, etc.

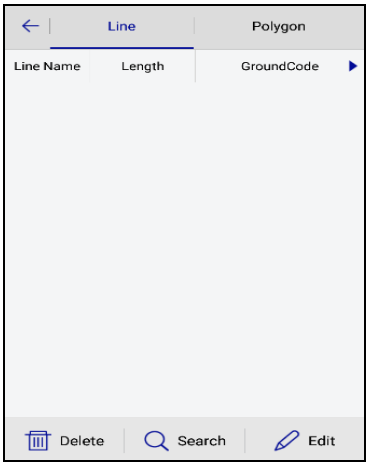


Figure 2-13-1 Culture Library Figure 2-13-2 Culture Library

-Delete: Select the line or polygon and click *Delete* to delete them (can delete them by batches).

-Search: Click *Search*, and input the name or the code description to find the line/polygon data.

-Edit: Select the line or polygon and click the *Edit* button to enter the attribute interface (no batches),

Check the selection information. Contain the line/polygon point coordinates. Meanwhile, and preview the line/polygon finished.

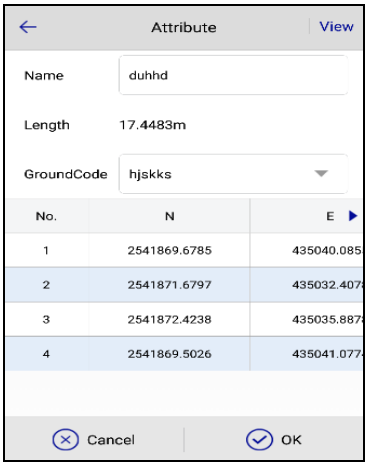


Figure 2-13-3 Culture Library 1

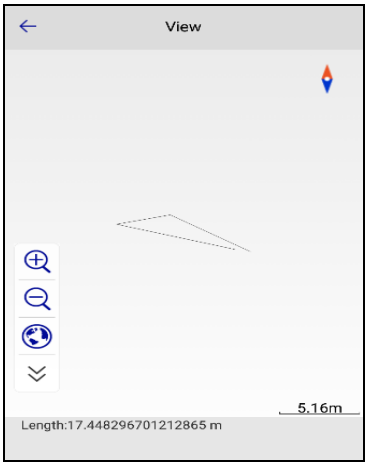


Figure 2-13-4 Culture Library2

Enter the attribute interface, long press the coordinate of the line and polygon to delete, up, down, insert and edit. Then add the coordinate information of the insert and edit by using the list selection, mapping selection, and real-time survey method.

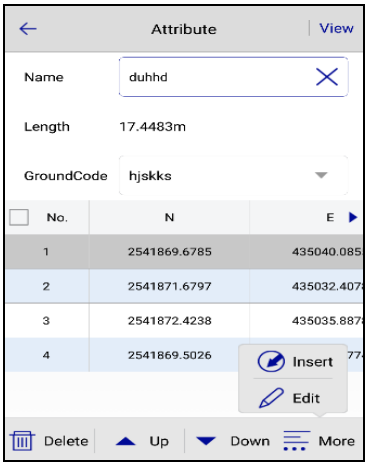


Figure 2-13-5 Edit Attribute1

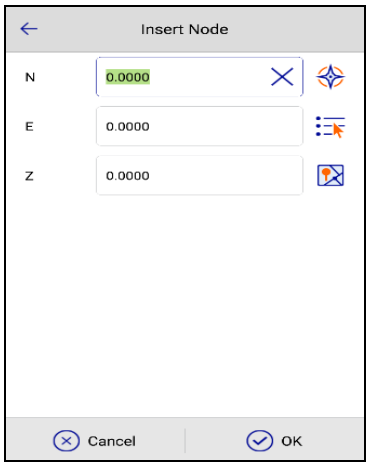


Figure 2-13-6 Edit Attribute2

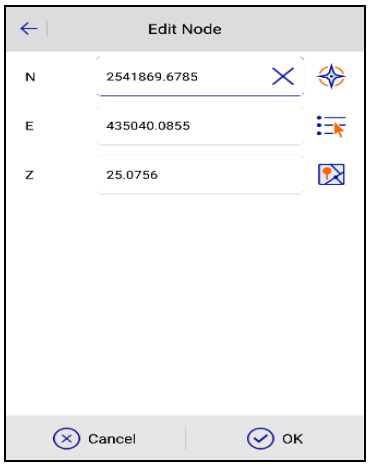


Figure 2-13-7 Edit Attribute3

2.14 Software Settings

- Auto Connect Device: Once opened, it will auto prompt whether to connect to the last device automatically when in the connecting, station setting and survey interface.

- Check Correction Transmitting: Once opened, it will check difference sending status in Base mode and check difference receiving status in Rover mode, and will show it in a floating window. : close check correction transmitting; : send no difference message; : sending difference message. When in the handle difference mode, there is a difference detection function, so there is no Check Correction Transmitting option.
- Check Network Status: Once opened, it can detect the network status of the device, or support iRTK5 series device. In the built-in network mode, open the software Settings → Check Network Status switch and open the floating window to view the current network signal strength directly.

- Check Base Position: Once opened, when the rover is first getting the difference, if the Base position is different from before, it will prompt whether to calculate a point. During operation, if a base station change is detected, it will prompt the user base station location to change, and the user can judge the problem according to the actual situation.

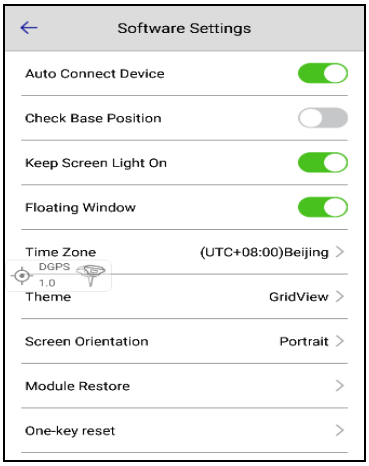


Figure 2-14-1 Software Settings1

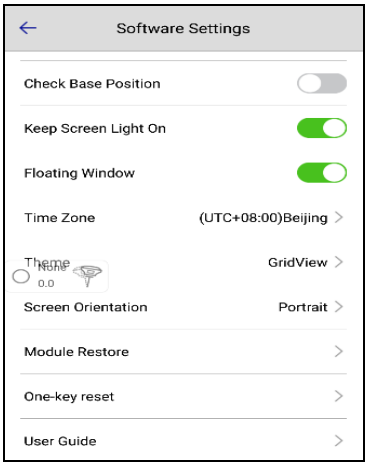


Figure 2-14-2 Software Settings2

- Keep Screen Light On: The shutdown status indicates that the power-saving mode is selected and the screen is not in light status.
- Soft Input: You can use soft input (screen input method) if opened; if closed, only via the keyboard.
- Floating Window: The floating window is set to display in the non-survey interface. The fixed position of the floating window in the survey interface shows no shrinkage; when in a non-survey interface, you can hold the floating window and drag it to any position in the screen, after 5 seconds, it automatically shrinks

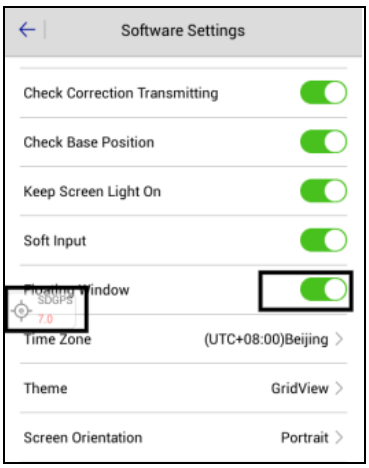


Figure 2-14-3 Floating Window 2-14-4 Floating Window Display

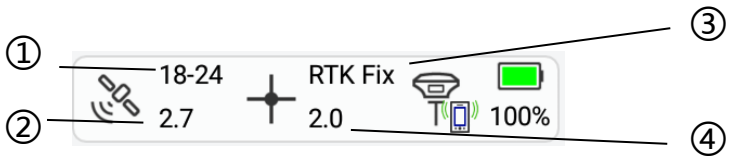


Figure 2-14-5 Floating Window

①. Public satellites and Visible satellites ②. PDOP

③. Solution state ④. Differential age

Description of working mode mark of the Floating Window:

Rover Station (close Check Correction Transmitting)
Rover Station (send no difference)
Rover Station (sending difference)
Base Station (close check correction transmitting)
Base Station (send no difference)
Base Station (sending difference)
Built-in GPS
Demo Mode
No Connection
Unknown Device
Static Mode

Description of the Floating Window data link:

No data link
With data link
Built-in network
External network (3G)
Built-in radio

External radio
Handle difference (sending difference)
Handle difference (no difference)
Handle difference (non-normal difference)
WIFI data link

When the data link is handled differently, click on the floating window to enter the *Data Collector Internet Status* interface and check the network status. Click *Connect* server to achieve the handle difference forwarding; if the user has connected to the receiver for the rover station difference, click Disconnect server to stop forwarding difference.

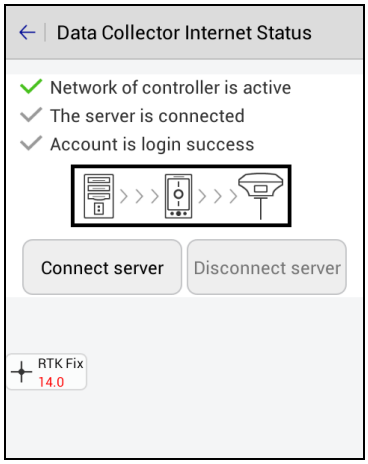
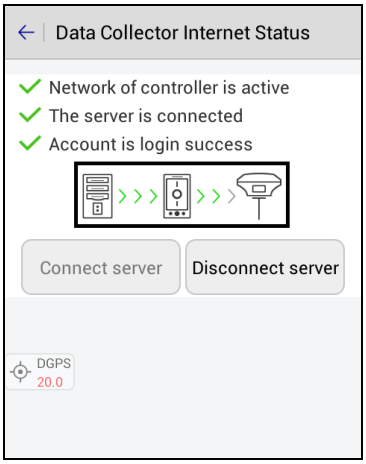


Figure 2-14-6 Connecting



2-14-7 Connected

- Solution state: mainly includes the following modes (except for the fixed coordinates, the precision ranges from high to low): the known points refer to the fixed (base station) △→ Fix Pos → RTK Fix → Float → DGPS → SDGPS → Auto ○→None (no GNSS Data).
- Differential Age: This refers to the time when a rover station receives a base station signal for a solution.
- PDOP: The spatial geometrical intensity factor of satellite distribution; the better the satellite distribution, the smaller the PDOP value; generally less than 3 is the ideal state.
- Visible satellites: The number of satellites received by the receiver, and 5 at least in RTK works.
- Public satellites: There is no public satellite in the Base station, only when the rover station receives the difference data. Public satellites refer to the calculated used satellites, when the base and rover station participate in whole cycles and search at the same time, generally, it needs more than 5 to work properly.
- Time Zone: Select the work time zone, correct the UTC time input by GNSS receiver to the local time in the user's area.

Notice:
For the iRTK5 device, after the time zone is selected, the handle is connected to the receiver, and the software pops up the waiting box to set the receiver time zone. The handle sets the time zone of the receiver each time the device is connected. After the software has set the time zone, the device needs to be restarted, which can be verified by static file creation time.

- Theme: Three themes, including List, Style Box and Simple.

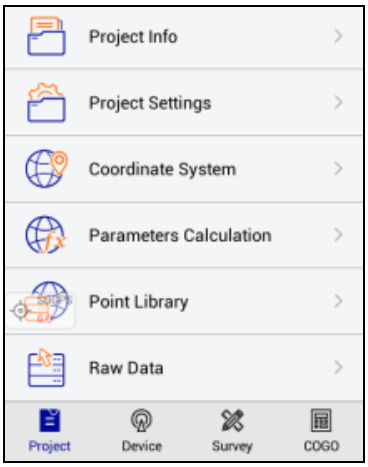


Figure 2-14-8 Simple *Figure 2-14-9 Gridview* *Figure 2-14-10 List*

- Screen Orientation: Can be either landscape or portrait. (the function applies to QpadX5).
- Module Restore: Long press to delete a module, press return key to exit delete mode, software settings module cannot be deleted. After deletion, module recovery can restore the deleted module to its original location.
- One-key reset: Select whether to reset the surveying configuration and software settings (note: unconnected and expired device will not be able to tick this option). Click OK when you get a prompt to reset the software settings and surveying configuration. If you click Cancel, it will keep the original configuration.
- User Guide: The user guide can be viewed through a third-party PDF reader. When viewing the user guide, you need to have a PDF document in the ZHD directory or the handle on the Internet, and a PDF reader installed.

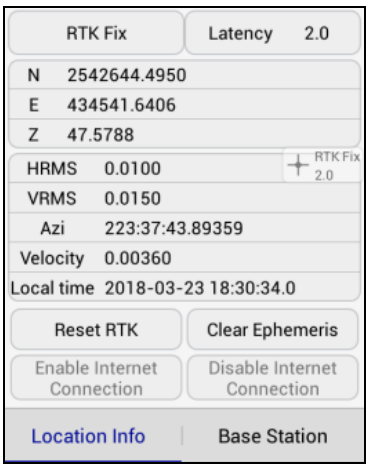
2.14.1 Location Information

Click the position icon on the floating window to quickly view the location details.

Figure 2-14-11 Floating Window - Location Information

Display the location information of the current point, including NEZ, Velocity, solution state,

Local time, and so on.



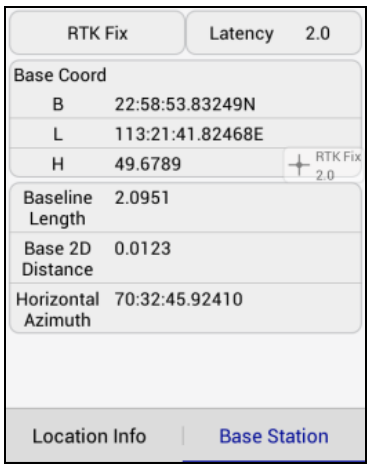


Figure 2-14-12 Location Info *Figure 2-14-13 Base Station*

- Reset RTK: Rover station will calculate the received difference from the base station again, usually under the condition of poor satellite status, you can calculate it many times, save the coordinates, to rule out an incorrect solution with multipath interference.

- Enable internet connection: Check whether the network is disconnected; after connecting, it is convenient to direct reconnect.

- Disable the internet connection: Disconnect the network after connecting.

- Clear Ephemeris: When the rover station is out of the lock, floating and unable to achieve the fixed location, and cannot find Beidou or GLONASS, then click the Clear the ephemeris button. Reset the main board after clearing.

- Base Station Information: Display base station coordinates, distance, horizontal distance, and azimuth.

2.14.2 Satellite Information

Click the satellite icon on the floating window to quickly view the satellite details.

Figure 2-14-14 Floating Window-Satellite Information

1. SATView

View the projected location of the satellite, the national flags represent their satellites, and the corresponding number below each satellite is the number of the locked satellites.

- GPS: The Prn range is 1-33

- GLONASS: The Prn range is 65-96

- SBAS: The Prn range is 120-151(EGNOS: Prm values: 120,124,126; SDCM: Prm values: 125,140,141; GAGAN: Prm values: 127,128; MSAS: Prm values: 129,137; WAAS: Prm values: 133,135,138)

- BDS: The Prn range is 161-195

- GALILEO: The Prn range is E1-E52

- QZSS: The Prn range is J191-J195

View and set GNSS satellite elevation mask, click Set to set the elevation mask.

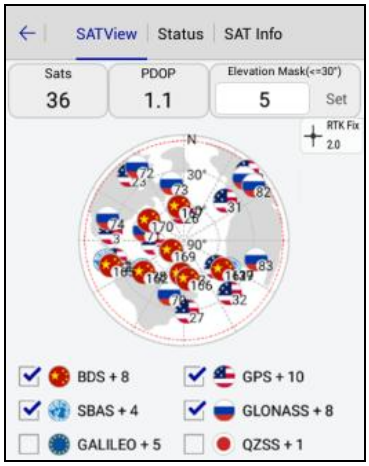


Figure 2-14-15 SATView

Set the color according to the L1 carrier signal-to-noise ratio of satellite, colour: red <= 31, 31 < orange <=41, green >41.

Figure 2-14-16 Status

2. Satellite Signal-to-Noise Ratio Map

PRN is the satellite number, Azi is the azimuth of the satellite, Ele is the elevation mask, L1 is the signal-to-noise ratio of the L1 band, L2 is the signal-to-noise ratio of L2 band, and Type is the satellite type.

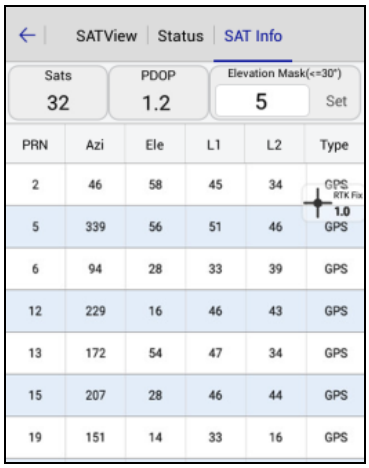


Figure 2-14-17 SAT Info

2.15 About

Here are the related instructions for the software version and upgrade.
Open the application in the networked state, and when a new version of the software is detected, the system will display the popup, according to the configuration information on the server. If the current link is a non-WIFI data link, the user will be prompted whether to download.

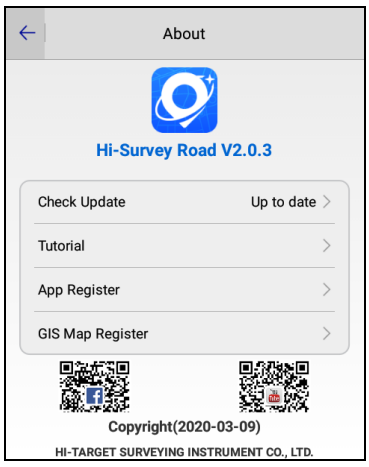


Figure 2-15-1 Update *Figure 2-15-2 QR Code*

The interface added the QR code of Hi-Target Facebook and Youtube, which can be accessed by scanning.

Notice:

The information above is virtual information, the factual operations are based on actual information.

Chapter 3

Device

This chapter contains:

- Device
- Base
- Rover
- GNSS Demo Mode
- Controller
- Additional Settings
- Console
- Static
- RangeFinder
- Device Check

3.1 Device

3.1.1 Device Connection

To connect the controller controller to GNSS receivers set the device connection method and antenna type (can be modified after connection), and then click Connect.

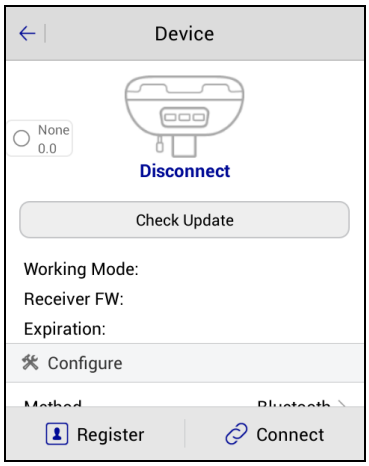


Figure 3-1-1 Device

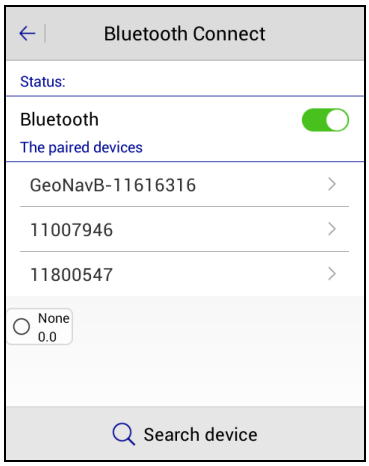


Figure 3-1-2 Bluetooth Connect

There are 4 methods of connection, Bluetooth, network, Wi-Fi, NMEA STREAM(Bluetooth). In addition, the built-in GPS and demo modes can be set independently with the controller controller.
In Bluetooth connection mode, it's necessary to turn on the Bluetooth function of the receiver and controller controller at the same time and click Connect to enter the Bluetooth connection interface. Click Search device to search for the device that needs to be connected, choose it in the list by the S/N and there will be a Bluetooth pairing prompt. Enter the pairing password (default password is 1234) to connect the device, and paired devices do not need to enter the pairing password again. If no device is found, please click Search device to search again.
In Network connection mode, click Connect to enter the network settings interface, and set the ID and password to connect the device (NB only supported on specific modes). If it's the first time of connection, please connect the receiver by Bluetooth first. Set the IP and port in *Additional Settings→ Receiver Settings → Remote Connection*, then use the network connection to do wireless remote operation easily.

The *Network* mode is for the specific device connection. You can use this mode when the device opens the remote connection. This mode can remotely operate the device easily.

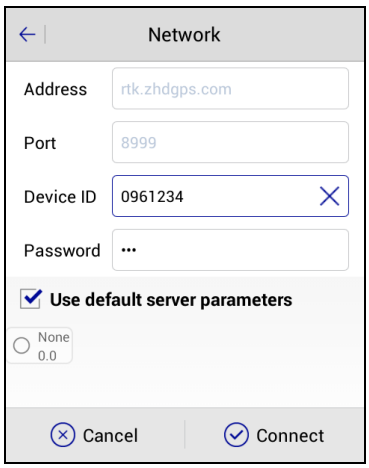
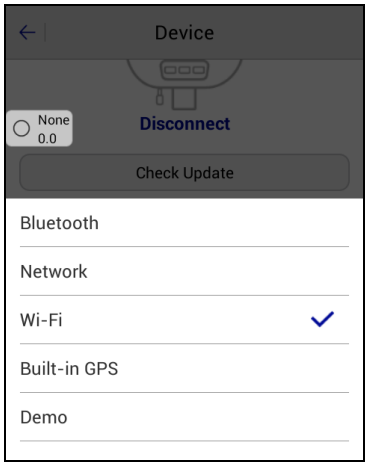


Figure 3-1-3 Network

1. In the *Wi-Fi* connection mode, if there is no Wi-Fi connection to the current controller, it will automatically enter the system Wi-Fi connection interface. Please choose the Wi-Fi that is needed, then click *Connect*. If it is already Wi-Fi-connected, users can choose *Cancel, Other* or *OK,* according to the situation. The method of making other Wi-Fi connections is the same as the above method. If you need to input the password for the first time, the password is 12345678. Once you have connected to the device, you don't need to enter the password again.



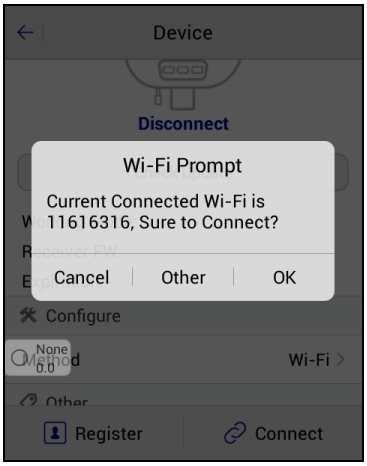
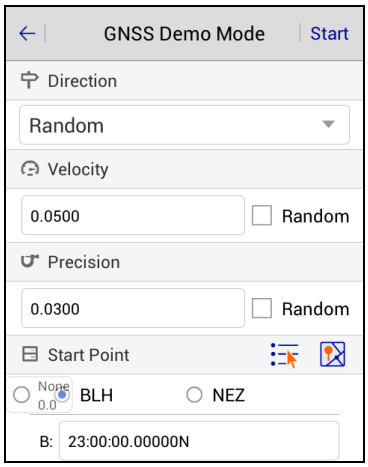


Figure 3-1-4 Wi-Fi *Figure 3-1-5 Wi-Fi Prompt*

2. In *Built-in GPS* connection mode, it will display the S/N of the controller, when using the Hi-Target controller, otherwise, it will be blank. Working mode, receiver FW and expiration will be blank too. The connection mode displays Built-in-GPS.

Figure 3-1-6 Built-in GPS

3. In Demo connection mode, the working mode, receiver FW and expiration will be blank too. S/N will display as a demo mode.



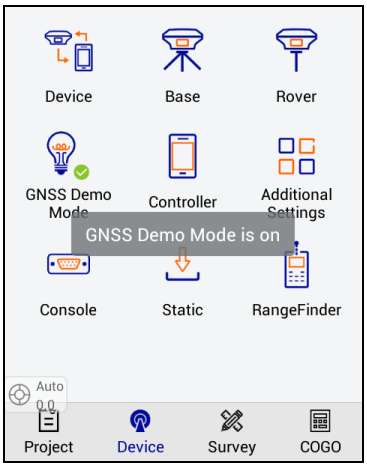


Figure 3-1-7 Demo Mode *Figure 3-1-8 Mode Prompt*

4. In the *NMEA STREAM (Bluetooth)* mode, the Bluetooth of the receiver and controller need to open. Click the *Connect* button to enter the *Bluetooth Connect* interface. Click *Search device* to search for the device. Select the device on the Bluetooth list. It will display the connection prompt. Input the password, which is 1234. You don't need to input the password if this device has been connected before. You don't need to input the password for V90Plus and IRTK5. If you can't find the device, please click the *Search device* again.
The current receiver's connection status will be displayed after the device is connected successfully, including the S/N, Check Update, Working Mode, Receiver FW, Expiration, Method and Antenna.

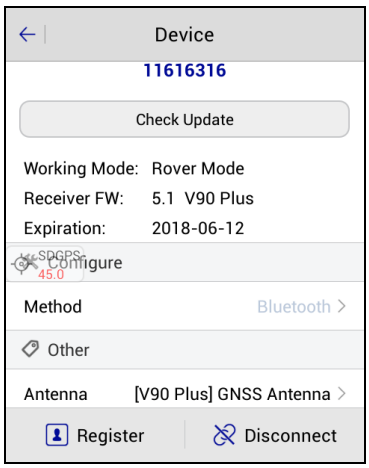


Figure 3-1-9 Device Info

- Check Update: Check and upgrade the connected device and motherboard firmware. After connecting the receiver by Bluetooth or Wi-Fi, click Check update to enter the firmware update interface. If there is a new firmware, there will be a prompt, and users can click the Update button to upgrade.

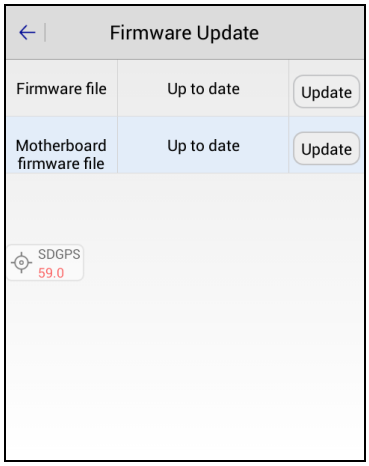


Figure 3-1-10 Firmware Update

- Working Mode: Display the current receiver's operating status, generally base mode, rover mode or static mode.
- Receiver FW: Receiver firmware version number and receiver type.
- Expiration: Deadline for registration code use.
- Antenna: Set the antenna type. Enter the antenna manage interface to choose it, according to the model; if there is no matching antenna type, you can click Add to add the custom antenna type by inputting the Model, Desc, Radius, L1 Phase Offset, L2 Phase Offset, and SHMP Offset in the Add Antenna interface.

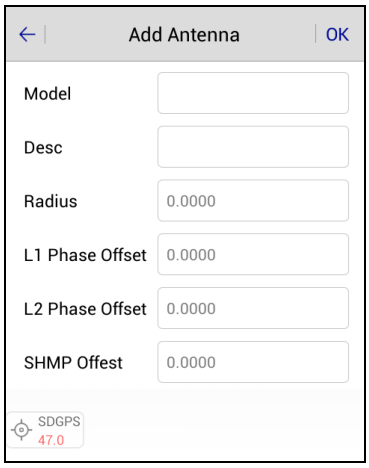


Figure 3-1-11 Antenna Manage *Figure 3-1-12 Add Antenna*

3.1.2 Register

Registering the receiver. Connect the GNSS receiver, input the receiver registration code, or scan the receiver QR code to register (please ask the Hi-Target service person for the registration code or QR code). The code for the 7-digit S/N receiver is 21-digits, with a 24-digit code for the 8-digit S/N receiver.

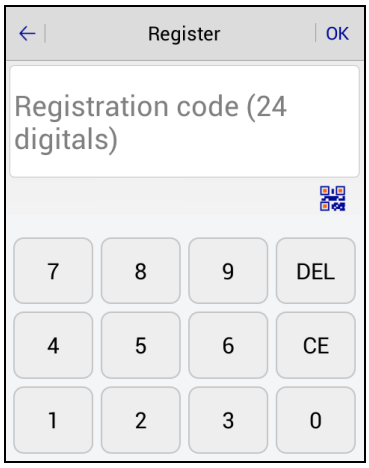


Figure 3-1-13 Register

3.1.3 NFC Connection

Users can scan the NFC-enabled receiver's NFC tag, with the NFC-enabled controller, to connect the device.

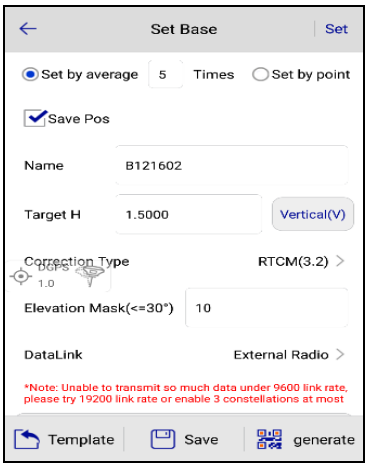
The current receiver's connection status will be displayed after the device is connected successfully, including *Working Mode, Receiver FW, Expiration, Method, Antenna,* etc.

3.2 Base

The base settings mainly set the working parameters of the base station, including the base coordinates, data link, and other parameters.

3.2.1 Base Configuration

Users can save all the parameters, set in the base station, as a configuration file, or load the parameters directly from the configuration file.



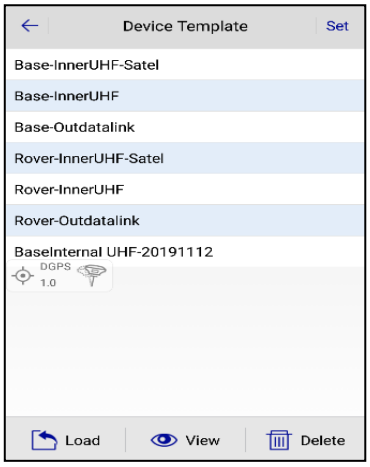


Figure 3-2-1 Configure *Figure 3-2-2 Delete or Load*

-Template: Click Template to enter the setting interface. The template information can be *Load, View* and *Delete.*

- Save: Input the configuration name and click to save the current set parameters.

- Delete: Delete the selected configuration file.

- Load: Load parameters of the selected configuration file.

- : Generate the parameters of the current settings as a QR code.

-View: View the parameters of the template.

-Delete: Delete the template selected.

3.2.2 Receiver Position

Set the coordinates of the base station to the latitude and longitude coordinates in the WGS-84 coordinate system (requires the GNSS to be measurable to get the height anomalous value, because the H of the base position is the ellipsoid height and the motherboard needs the geoidal height of the internal mode).

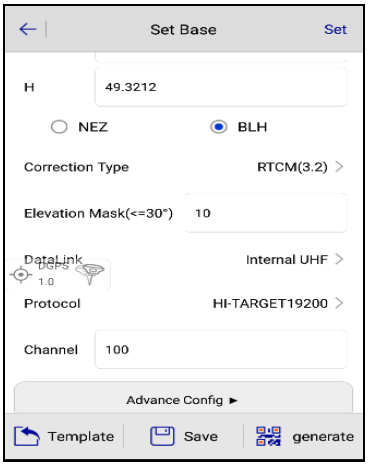


Figure 3-2-3 Set Base1

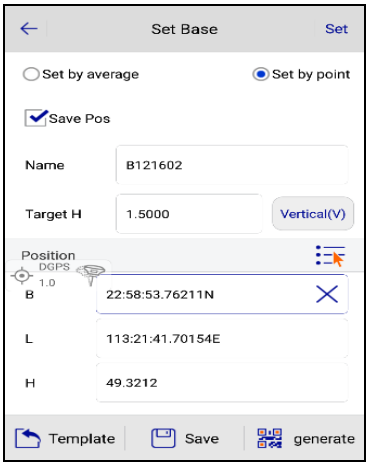


Figure 3-2-4 Set Base2

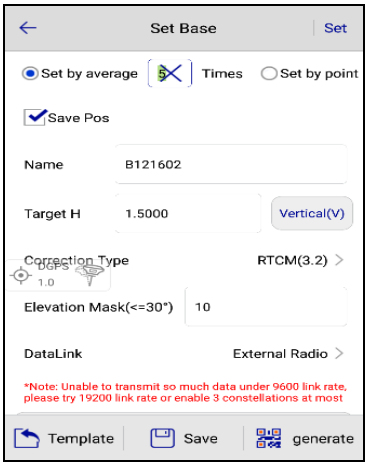


Figure 3-2-5 Set Base3

When setting up the base station at an unknown point, point coordinates can be obtained by average collection. (the more coordinates in the average collection, the higher the reliability).

When setting up the base station on a known point, users can input the coordinates directly, or select data from the point library by clicking the point library icon.

- : Average collection. To enter the average collection interface, the default number of smoothing is 10 times. This function will not display average information in the new version.

-Name: Set the base name.

- Target H: Input the instrument height and height type of the base station.

- Position: The ground reference point of the base station, it can be manually-set or obtained by average collection, or from the point library.

- : Point library. It is used to get points in the coordinate library to the current interface.

3.2.3 Datalink

Datalink settings are used to set the communication mode and parameters between the base and rover, including the Internal UHF, Internal GSM, External Radio, Wi-Fi （The device needs the Wi-Fi module）and Data Collector Internet.

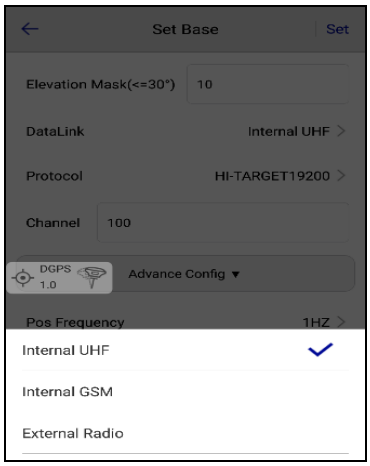


Figure 3-2-6 Set Base4

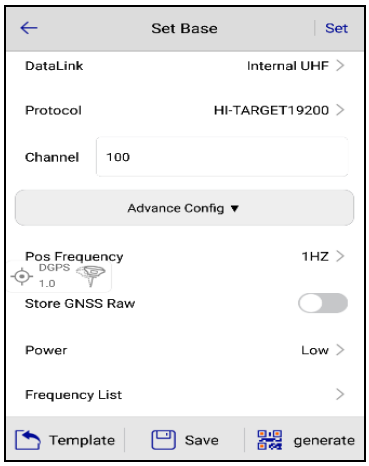


Figure 3-2-7 Set Base5

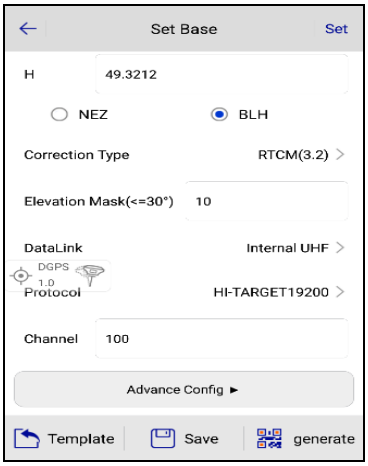


Figure 3-2-8 Set Base6

1. In the *Internal UHF* mode, users can set the *Channel, Power,* and *protocol*.

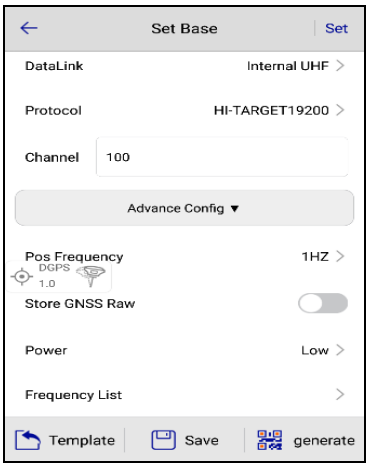


Figure 3-2-9 Set Base7

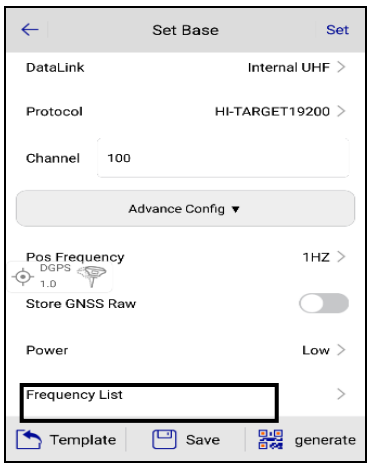
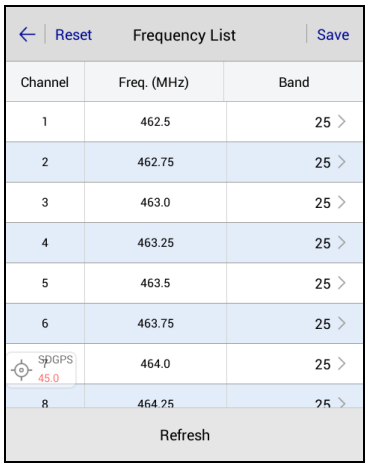


Figure 3-2-10 Set Base8

- *Power*: There are three options, including high, middle and low options.

- *Frequency:* Click to enter the interface to get the most suitable channel (for specific models).



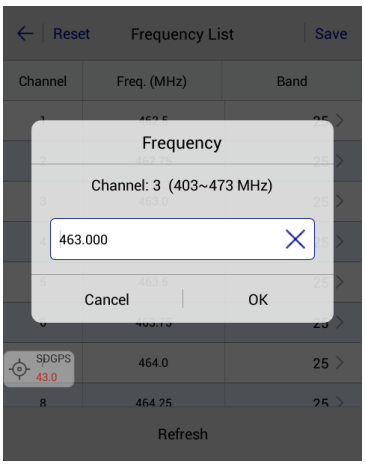


Figure 3-2-11 Channel List *Figure 3-2-12 Frequency*

Click the frequency of a channel to modify the frequency of the channel, within the frequency range specified by the channel.

- Refresh: If the result of the current search is not a suitable channel, users can change the starting channel to continue a new round of searches.

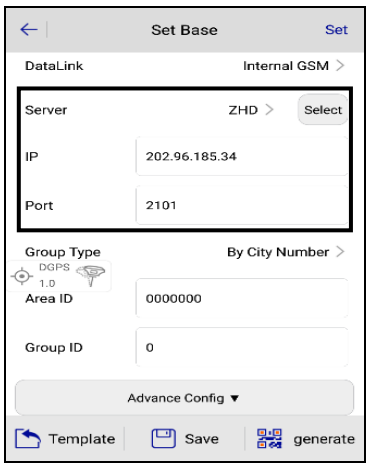
- Reset: Click to restore the list to the default state.

- Save: After modifying the frequency table, please click to complete the modification.

2. In *Internal GSM* mode, you need to set the data link as Internal GSM, Sever, IP, Port, Group type.

Figure 3-2-13 Internal GSM

-*Server/IP*: Select server, input IP and port or click *Select* to display the server address list.



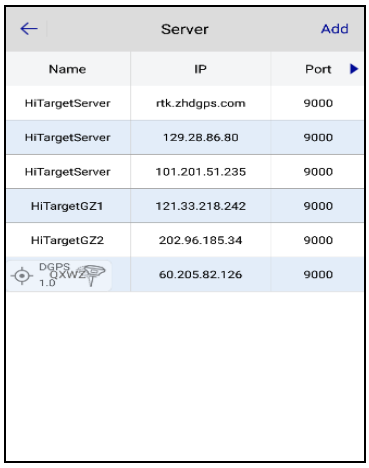


Figure 3-2-14 Server *Figure 3-2-15 Server List*

-*Group Type*: It contains *By City Number* and *By Base Station SN.*

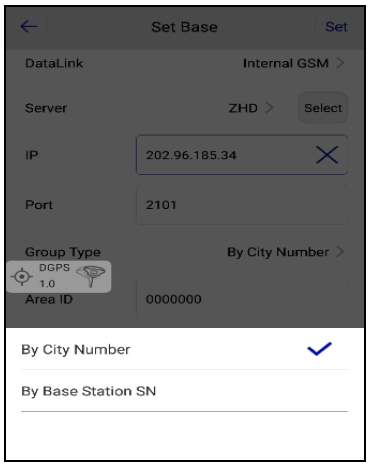


Figure 3-2-16 Type

- By City Number: The Area ID and Group ID are 7 and 3 digits respectively. The group ID needs to be less than 255. The base and rover need the same parameter settings to work properly.

- By Base Station SN: Input the base S/N, and set the same number in the same way with the rover.

When you use the CORS mode, please set the right IP, port, mount point, etc. Then click *Set* to save the settings. The username and password are SN and zhdgps, which can't be changed. When you set the rover, the username is 8 bits' number (it is suggested you use the SN to login), but it must not be the same as the base username. The other parameters are the same as the base.

2. In the *External Radio* mode, the device can connect to the external radio to transmit data. iRTK5 series allow setting the external radio parameters.

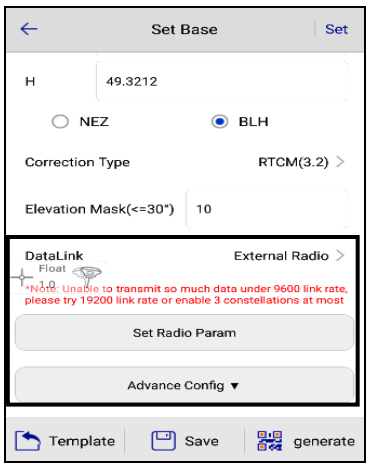
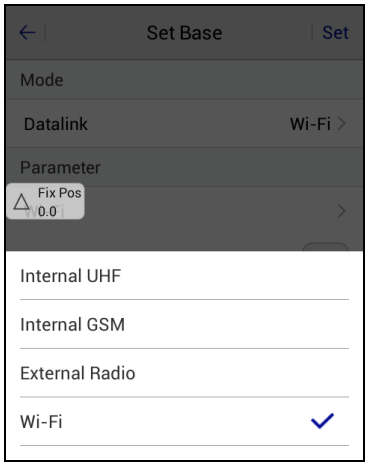


Figure 3-2-17 External Radio

3. For the Wi-Fi mode, after the controller is connected to a WiFi-enabled receiver, through a non-WiFi connection, the data link will add the Wi-Fi mode. In this mode, the receiver can be set to connect to a third-party Wi-Fi and send differential data.



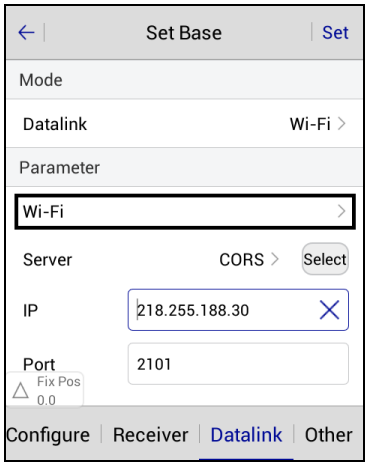


Figure 3-2-18 Wi-Fi Mode *Figure 3-2-19 Wi-Fi Mode Settings*

Click the Wi-Fi option to enter the Wi-Fi Parameter interface. When the Wi-Fi hotspot is turned on, the connection to the Wi-Fi of the controller is supported; otherwise, a third-party Wi-Fi hotspot will be connected.

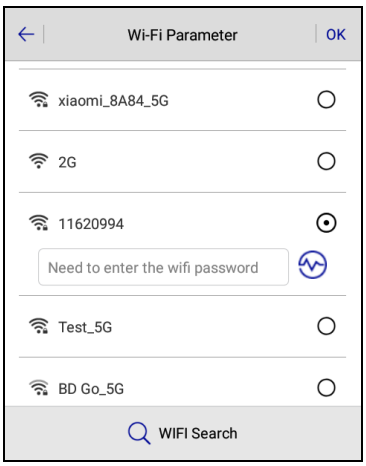
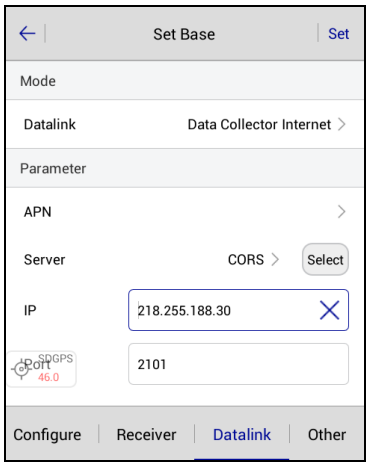


Figure 3-2-20 Wi-Fi Mode Settings

1. In *Data Collector Internet* mode, it supports ZHD and CORS mode to connect the server (for specific models).



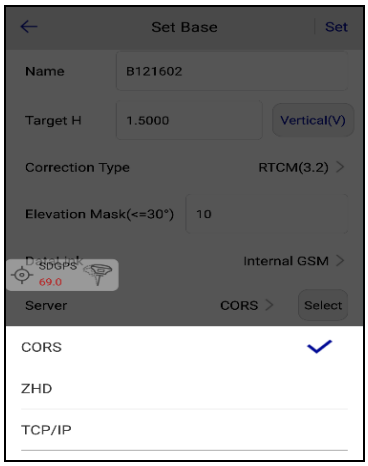
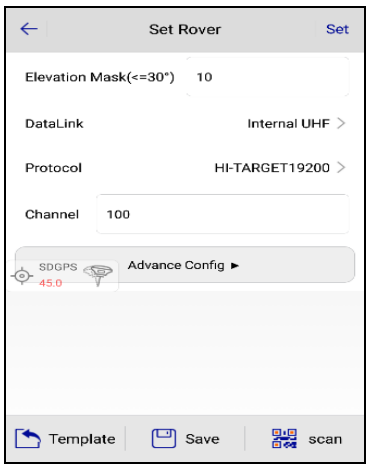


Figure 3-2-21 Data Collector Internet1 *Figure 3-2-22 Data Collector Internet2*

It uses the controller network to connect the server as the RTK, dial-up internet access by the network module of the controller. Send the received differential data to the device by Bluetooth after connecting to the server, so that the device can do network RTK without the SIM card.

3.2.4 Other Options

Set the Diff Mode, Correction Type, Elevation Mask, and other parameters.



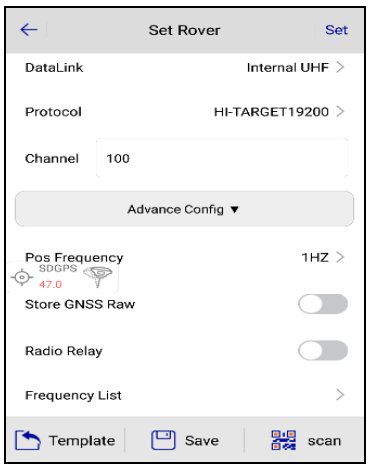


Figure 3-2-23 Other1 *Figure 3-2-24 Other2*

- Correction Type: Including RTCM(3.2), RTCM(3.0), CMR and RTCM(2.x).

Notice:
If use the receiver with 3 type satellites, the correction type is RTCM 3.2. It can support multiple brands' correction positioning and navigation.

- *Elevation Mask*: Adjustable from 0 to 30 degrees.

- *Pos Frequency*: Software update positioning data frequency, supports 1Hz and 2Hz.

- *PPK Mode*: Connect to a receiver that supports PPK function; the receiver will start a temporary static collection synchronously after the base turns on the PPK mode.

Click *Set* after all the base parameters are set, and there will be a prompt to indicate the success or failure of the settings. If the setting is successful, check the correction signal of the base to find out whether it has been sent. If it has failed, please check whether there has been a parameter error and try again several times.

3.3 Rover

The rover settings mainly set the working parameters of the rover, including Configure, Datalink, etc..

3.3.1 Rover Configuration

Users can save all the parameters set in the rover as a configuration file, or load the parameters directly from the configuration file.

In the configure interface, users can click the QR code icon to read the QR code shared by the base station, to obtain the configuration parameters quickly.

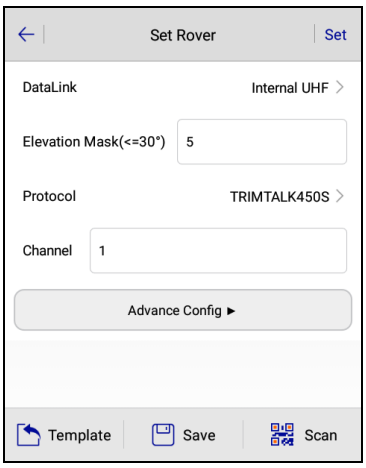


Figure 3-3-1 QR Code

3.3.2 Datalink

Rover data link settings are used to set communication types and parameters between the base and rover, including the Internal UHF, Internal GSM, External Radio, Data Collector Internet, External Network (3G), PPP Service (for specific models), etc. The Internal GSM and External GSM (3G) contain GPRS, GSM and CDMA.

In addition, the *External Network (3G*) can only be supported by English version software. *Data Collector Internet* is supported when the receiver connects the controller via Bluetooth or Wi-Fi. When the Qpad X5 connects the Build-in GPS, it can also use the Data Collector Internet. The PPP Service needs the special version receiver to support it.

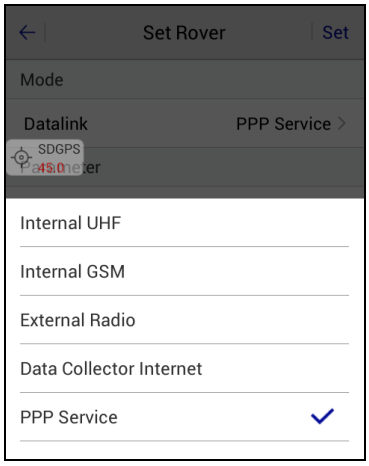


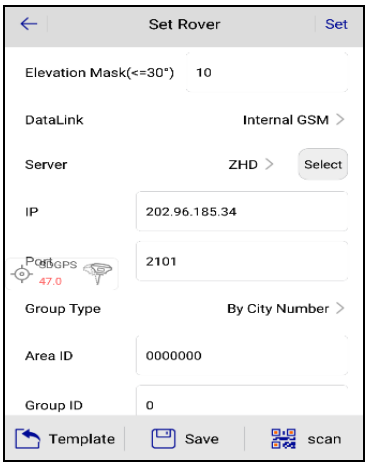
Figure 3-3-2 Datalink

1. In the *Internal UHF* mode, users can set the *Channel, Protocol,* etc.. The channel must be consistent with the channel of the base.

- *Radio Relay*: When you set the rover as the Internal UHF, you can use this function. (At present, only the IRTK5 series support this function, and the radio module is ZHD46005MD. The protocol is TRIMTALK450S, TRIMMARK 3, HI-TARGET 19200). After the channel and power are inputted, it can support the relay function for the other rovers.

2. In the *Internal GSM* mode, users can click *Network* to choose the network type (GPRS, GSM, CDMA).

Click the *Advance Config* set the network type and other parameters.



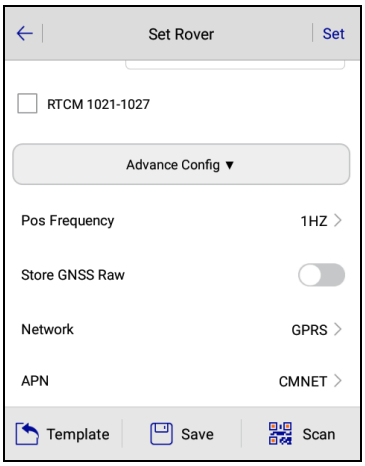
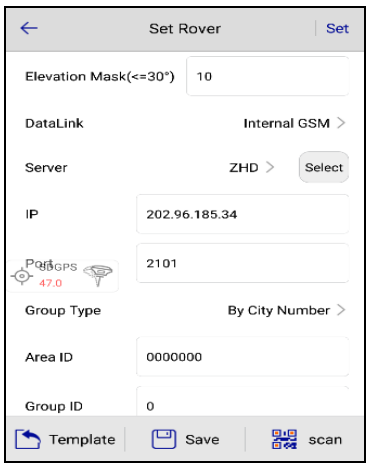


Figure 3-3-3 Advance Config1 *Figure 3-3-4 Advance Config2*

- *APN*: Different networks will have different settings. It's the parameters of the device SIM card.

- *Server*: Choose the model, including ZHD, CORS and TCP/IP. Input the IP and port manually, or click *Select* to enter the server list and choose a suitable server.

-*IP*: Input the server IP, port, or click select to select the server from the server list.



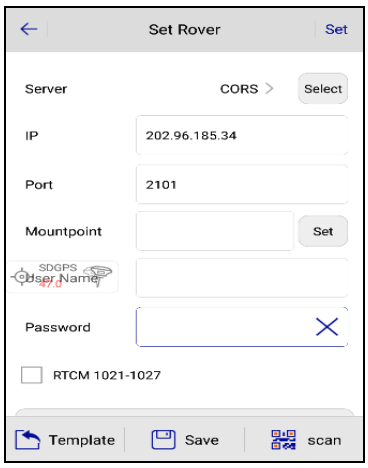


Figure 3-3-5 IP and Port1 *Figure 3-3-6 IP and Port2*

-*Group Type*: It can be selected *By City Number* or *By Base Station SN*.

- *By City Number*: The *Area ID* and *Group ID* are 7 and 3 digits respectively. The group ID needs to be less than 255. The base and rover need the same parameter settings to work properly.

-*APN*: When Network is GPRS, input CMNET. When Network is CDMA, Input *User Name* and *Password* as *card, card*.

- *Net Relay*: Click to open the net relay option (for specific models), and set the *Relay Channel*, Protocol, Power, etc. Then it can relay to other rovers while working.

When you use the *CORS* mode, please set the right IP, port, mount point, etc.

Click *Set* to enter the *CORS Parameters* interface, and click *Get Mountpoints* to choose the suitable Mountpoints and input the *User Name* and *Password* to finish the settings.

Notice:
In the CORS connection interface, you can compare the practical coordinate with the output coordinate to ensure the right correction by tick RTCM1021-RTCM1027.

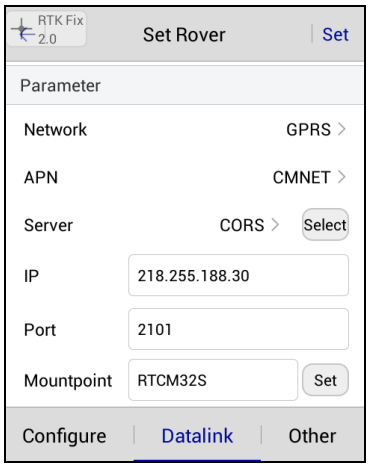


Figure 3-3-7 Set Rover

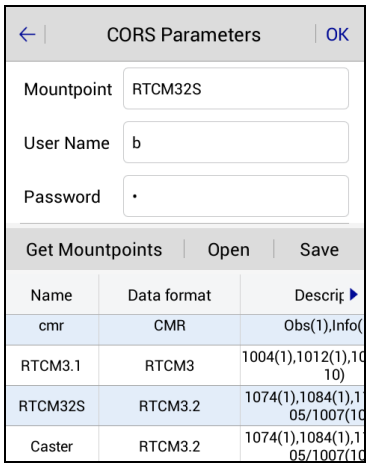


Figure 3-3-8 CORS Parameters

- *Open*: Load existing CORS parameters.
- *Save*: Save the current CORS parameters.
- *OK*: Complete the settings and return to the previous screen.

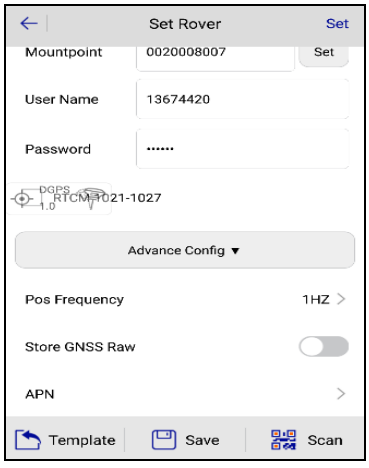
3. In the *External Radio* mode, the controller controller needs to be connected to a device that supports external radio.

4. In the *Data Collector Internet* mode, go to the rover setting interface, select *Data Collector Internet* of the data link, and select Sever, IP, Port, Group parameters, etc. Click *Set* to finish the station setting.

5. In the *PPP Service* mode, users can set the *Diff Mode* (satellite or network).

Notice:

1. When the data link is Internal GSM, the APN is SIM card parameters.
2. The APN of the data collector internet mode is the parameters of the controller. If the Wi-Fi is not connected, the controller must be installed with the SIM card to do APN settings, otherwise, there will be a prompt.
3. The controller APN parameter setting follows: controller and application → APN setting.



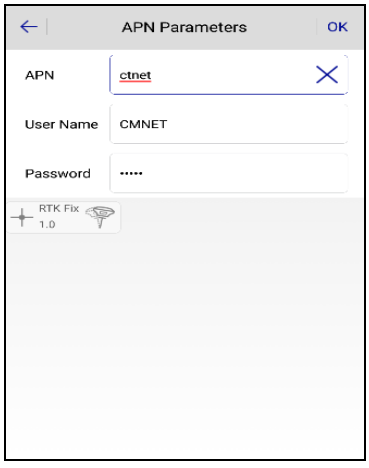


Figure 3-3-9 APN1 *Figure 3-3-10 APN Parameters*

3.3.3 Other Options

Set the *Pos Frequency, Elevation Mask* and PPK.

- *Elevation Mask*: Adjustable from 0 to 30 degrees.

- *Pos Frequency*: Software update positioning data frequency, supports 1Hz and 2Hz.

- *PPK Mode*: The receiver will start a temporary static collection synchronously after the rover turns on the PPK mode. It will record the RSP file in the *Detail Survey, Stake Points, Stake Line* when using the average collection. The file name will be consistent with the static collection file name.

- Click the Long baseline survey button. You can get a fixed solution when the baseline is 150 kilometers. (Notice, this function is only supported by OEM and the motherboard.)

- Click *Set* after all the base parameters are set, and there will be a prompt to indicate the success or failure of the settings. If the setting is successful, check the correction signal of the base to see whether it has been sent normally. If the signal has failed, check whether the parameter is right. If it isn't, then reset it again.

Notice:
If the project was turned on in PPK Mode, when setting up the rover, there will be a PPK correction prompt when the original data is exported.

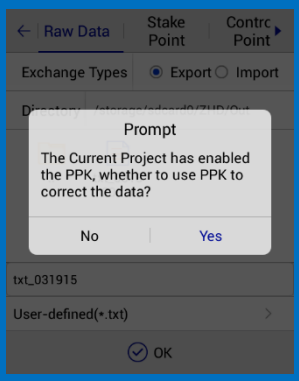


Figure 3-3-11 PPK

3.4 GNSS Demo Mode

The receiver can simulate measurement data in the demo mode to make it easy to learn the software.

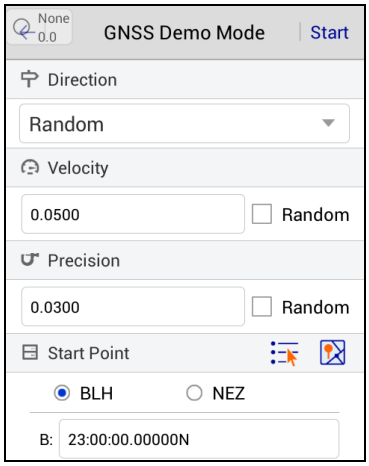


Figure 3-4-1 Demo Mode

-Choose the *Direction* according to demand, including *Random, Input, Map,* and *Line.*

- *Random*: The current point direction is displayed randomly.

- *Input*: Specify the traveling azimuth.

- *Map*: Specify the direction as the direction of the map. There are four options, East, South, West, and North.

- *Line*: Specify the line in the *Stake Line* or *Stake Road*.

-*Velocity* is the moving speed of the current point, it can be a specified speed or random.

-*Precision* is the precision limitation of the current point, it can be input or given randomly.

-*Start Point* can be specified with any coordinate. The coordinate can be input, or selected from the point library or map directly.

After completing the settings, click *Start* to start the demo mode. If the GNSS receiver or built-in GPS is connected, it will prompt whether to disconnect to start the demo mode. After the demo mode is started, the interface will automatically jump to the main software interface.

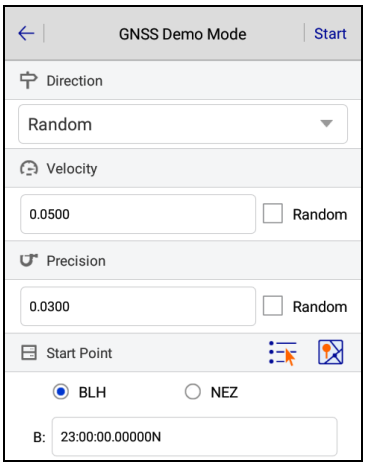


Figure 3-4-2 Demo Mode

3.5 Controller

In this interface, users can check the current controller type, Bluetooth support status, network, serial port, etc. It will display the corresponding mode with the Hi-Target controller, and display *General* for others (all non-Hi Target Android devices). The software only opens the encryption permission in the Hi-Target controller. If the controller is not a Hi-Target device, it will prompt *Non-certified device, don't support RTK survey*.

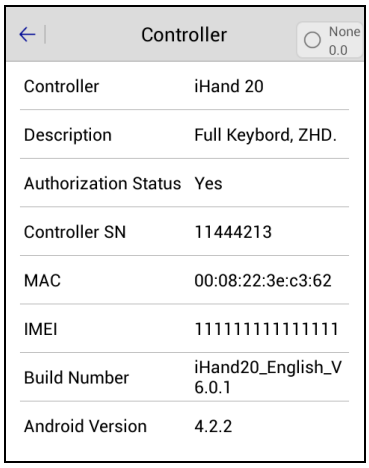


Figure 3-5-1 Controller

3.6 Additional Settings

The additional settings include module-info, registration info, 5-pin port data output, satellite tracking switch, receiver settings, service info, restore system, electronic bubble calibration, orientation sensor calibration, magnetic calibration, Wi-Fi hotspot password set, update firmware, network diagnostics.

Different types of devices or connections support different functions.

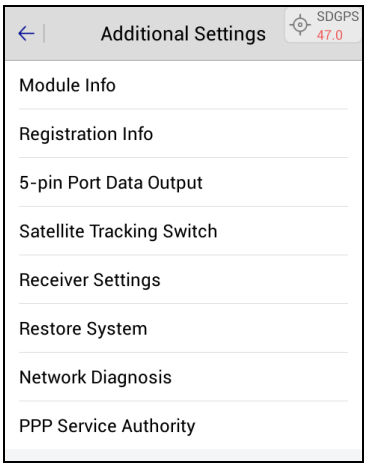


Figure 3-6-1 Additional Settings1

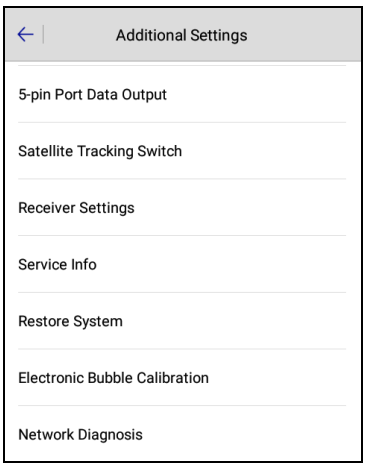


Figure 3-6-2 Additional Settings2

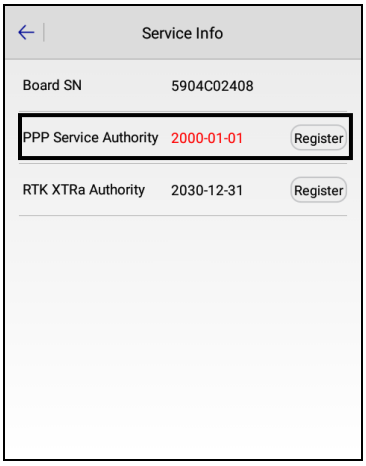


Figure 3-6-3 Additional Settings3

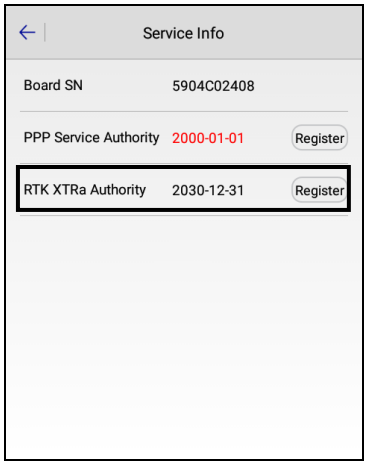


Figure 3-6-4 Additional Settings4

3.6.1 Module Info

Check the radio module type and network module type. The viewing of module information only supports some modes.

- *Radio Module Type*: Displays the type information of the device radio module.

- *Network Module Type*: Displays the type of information of the current network module.

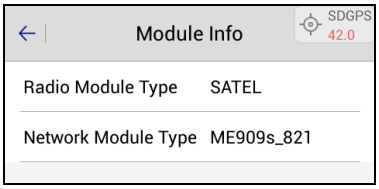


Figure 3-6-5 Module Info

3.6.2 Registration Info

In the registration info interface, check the device registration code and expiration time.

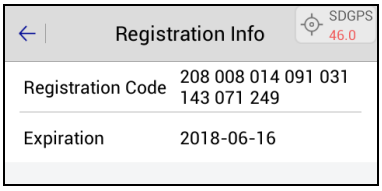


Figure 3-6-6 Registration Info

3.6.3 5-pin Port Data Output

Open 5-pin Port Data Output, users can select the corresponding port's baud rate, commands that need to be sent and the corresponding frequency (1Hz, 2Hz, and 5Hz).

After turning on the settings, the static collection will be stopped and it will not be allowed to open. If users try to open this option, when using the static collection or the base model, the software will prompt that the current mode does not support this operation.

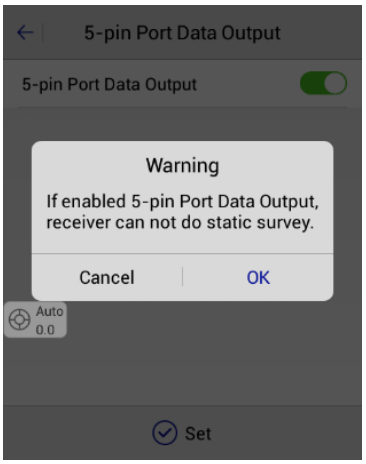


Figure 3-6-7 Warning

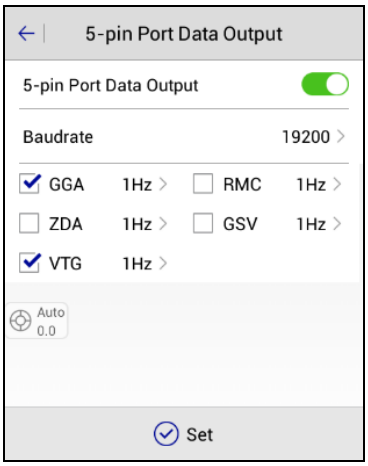


Figure 3-6-8 5-pin Port Data Output

Checking the static file and do the related operation.

-5-pin Port Data Output: ON/OFF

-Baud rate: 19200/115200.

GGA/RMC/ZDA/GSV/VTG/GSA/GLL/GST/GGK/VGK/HDT：Set output frequency of GGA/RMC/ZDA/GSV/VTG/GSA/GLL/GST/GGK/VGK/HDT, such as 1Hz, 2Hz, 5Hz, V90Plus with above 5.6 firmware or IRTK5 with V1.5 firmware can support 10Hz, 20Hz output.

3.6.4 Receiver Settings

Set the store RINEX data, stop and go, firmware upgrade prompt, remote connection, USB virtual serial port, store static data in receiver SD card, sound type, volume, one-step set station, quasi dynamic RTK, etc. Different devices have different settings.

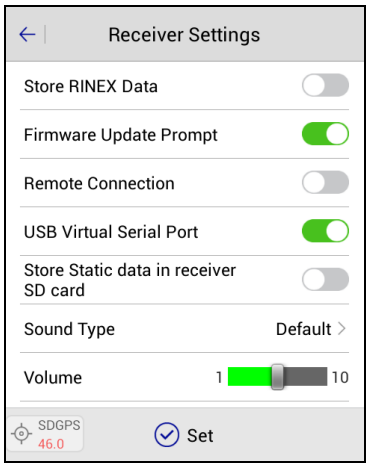


Figure 3-6-9 Receiver Settings

- *Store RINEX Data*: After turning on, the RINEX format data will be recorded synchronously with the static collection.

- *Stop and Go*: Support the function to collect temporary static data after turning on.

- *Firmware Upgrade Prompt*: After turning on, there will be a prompt when there is upgradeable firmware.

- *Remote Connection*: The device will automatically connect to the corresponding server after turning on. Remote connection IP and port do not need to be changed, the default value is OK.

- *USB Virtual Serial Port*: After turning on, users can connect the USB debugging virtual serial port.

- *Store Static Data in Receiver SD Card*: Set static files to save to SD card.

- *Sound Type*: Switch the voice announcement (None, default and user-defined).

- *One-step set a station*: After turning on, the base can be set automatically after power on.

- *Quasi dynamic RTK*: Users can star the Quasi-dynamic collection in the Detail survey after turning on.

Notice:
The remote connection address and port don't need to be changed and set the default setting (IP: rtk.zhdgps.com Port: 8999) to escape setting failure.

3.6.5 Service Info

The service info interface will display the current receiver version type and its corresponding function rights.

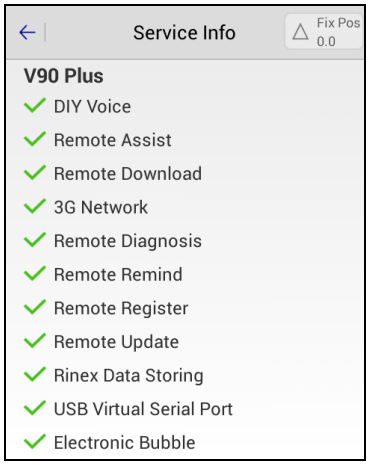


Figure 3-6-10 Service Info

-PPP Service Authority: Check the *PPP Service Authority* information. If the PPP Service Authority expired, it will display red. On the contrary, it will display black. You can click Register, and get the registration code or QR code from the technician. This function only supports the receiver that has the PPP Service Authority.

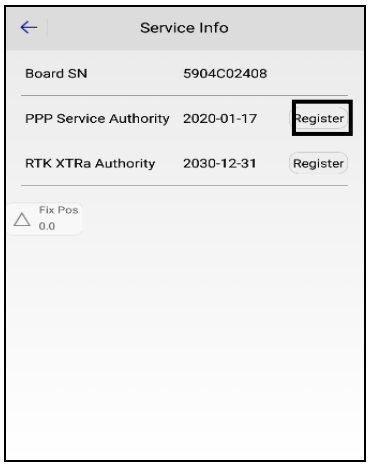


Figure 3-6-11 PPP Service Register1 *Figure 3-6-12 PPP Service Register2*

- RTK XTRa Authority: check the RTK XTRa Authority information. If the PPP Service Authority has expired, it will be displayed in red. Otherwise, it will be displayed in black. At present, only iRTK5 supports this function and the satellite type authority.

Figure 3-6-13 RTK XTRs Register1

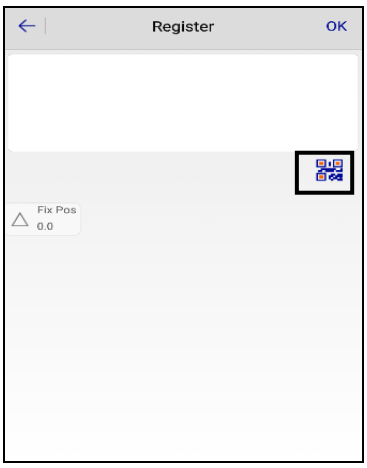


Figure 3-6-14 RTK XTRs Register2

3.6.6 Restore System

Restore the firmware to its original state.

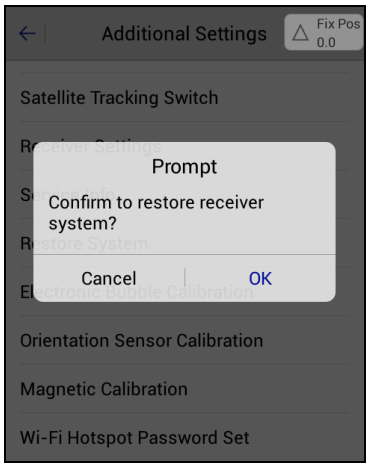


Figure 3-6-15 Restore

3.6.7 Electronic Bubble Calibration

Tilt survey → Electronic Bubble Calibration

3.6.8 Orientation Sensor Calibration

Tilt survey → Orientation Sensor Calibration

3.6.9 Magnetic Sensor Calibration

Tilt survey → Magnetic Sensor Calibration

3.6.10 Wi-Fi Hotspot Password Set

To modify the connection password for the receiver's Wi-Fi hotspot, please connect the receiver by Bluetooth first. Then enter the old password and new password twice correctly, and click *Set* to complete the operation.

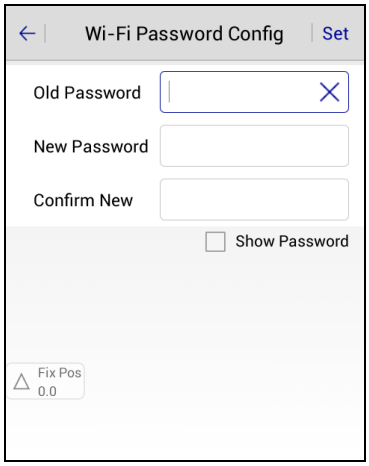


Figure 3-6-16 Wi-Fi Password Config

Notice:
1. The default Wi-Fi password is 12345678;
2. If you forgot the Wi-Fi password, you can use the *GNSS Receiver Manager → Wi-Fi Password Settings* to set a new password.

3.6.11 Update Firmware

Connect the receiver by Wi-Fi first, and choose the file to upgrade the firmware of the device and motherboard. The corresponding motherboard can only select the corresponding file to upgrade. If the wrong BRD file is imported, the device will prompt *upgrade failed* during the upgrade process. This function only works on some models.

3.6.12 Network Diagnosis

Check the state of the network module, SIM card, network signal, network registration, dial-up, and server connection. And this function only supports some specific models.

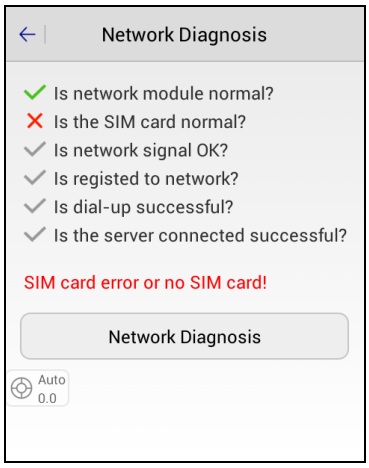


Figure 3-6-17 Network Diagnosis

- ✔: Normal.
- ✖: Abnormal.
- ✔: Not checked.

3.7 Console

It's mainly used to debug data and detect the GPRS signal strength. It can save the received debugging data as files.

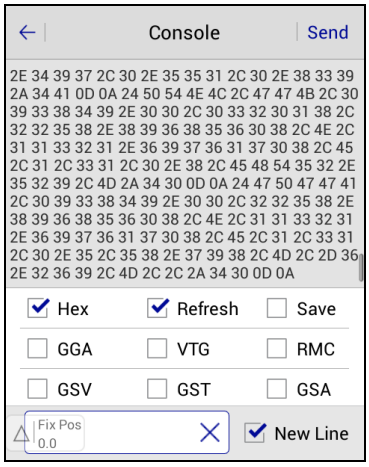


Figure 3-7-1 Console

- *Hex*: Select to display data in hexadecimal format.
- *Refresh*: Select to refresh the output.
- *Save*: Select to save the output data.

- *New Line*: Select to send the new line, select it when sending commands normally.

- *Send*: Click to send the command after entering the command.

- *GPRS Signal Test*: When using the internal GSM mode (for some specific models), select and click *OK* to enter the signal test. The current GPRS signal strength will be displayed in the text box in the pass-through mode. *+CSQ: 6,2* means that the signal strength is 6.

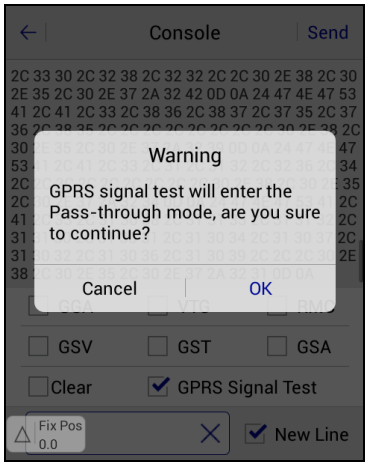


Figure 3-7-2 Warning

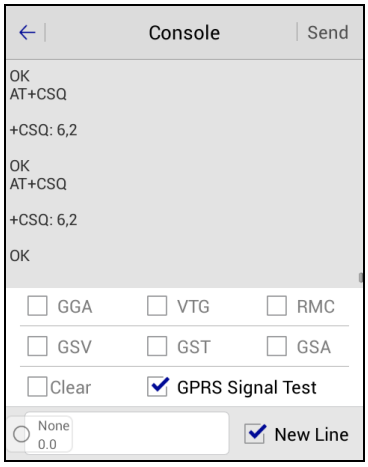


Figure 3-7-3 Pass-through Mode

Notice:
The two numbers behind the CSQ represent the GPRS signal strength value and the signal symbol error rate. The larger the previous value, the better the signal. The last value is 0 normally.

The software presets commonly-used data types and can receive data without selecting the command. Select data types, it supports multi-selection combination sending. Users can select *Clear* to clear the receiver's current data and request the selected data again and then click *Send* to send the data.

There will be sensor values output when using the demo mode or built-in GPS mode.

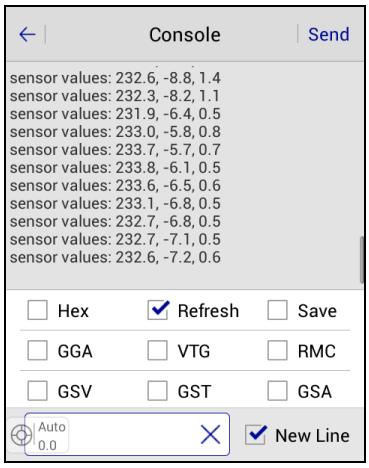
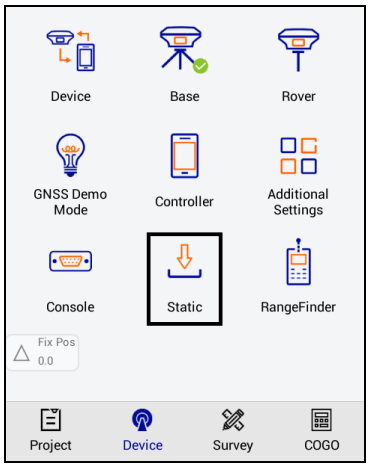


Figure 3-7-4 Sensor Values

3.8 Static

3.8.1 Static Settings



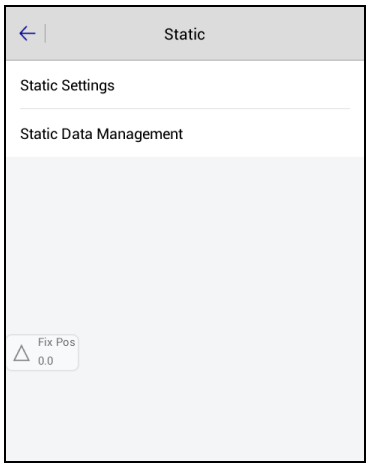
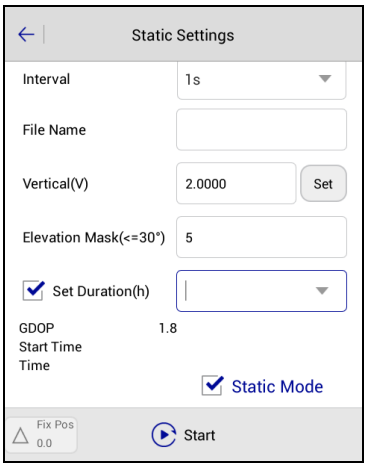


Figure 3-8-1 Device Interface *Figure 3-8-2 Static*

In RTK mode, if users need to do static collection at the same time, please click to enter the static settings interface to input the interval, file name, pole and elevation mask. Users can view the GDOP, start time and recording time. Click *Start* to start recording.



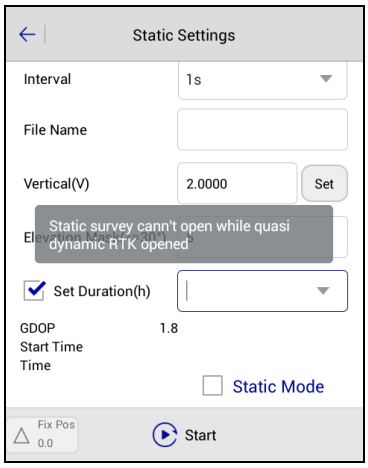


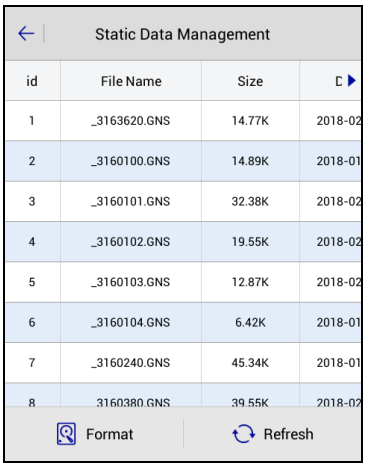
Figure 3-8-3 Set Duration *Figure 3-8-4 Static Mode*

The *Set Duration* function can be enabled only when the *Static Mode* option is selected (for some specific models). After the specified collection time is enabled, the current collection will stop and the receiver will automatically shut down.

Notice:
The height limit (antenna height) cannot be greater than 65m. If the height exceeds 65m, the HGO display antenna will be inconsistent. The software will fail and prompt when users input a value that exceeds 65m. The elevation mask limit must also not exceed 30 degrees.

3.8.2 Static Data Management

View static files in the current receiver and do some related operations.



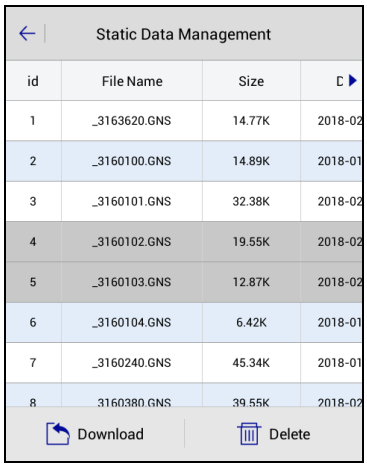


Figure 3-8-5 Static Data Management *Figure 3-8-6 Download or Delete*

- *Format*: Format static data, data is not recoverable.

- *Refresh*: Refresh the current file list interface.

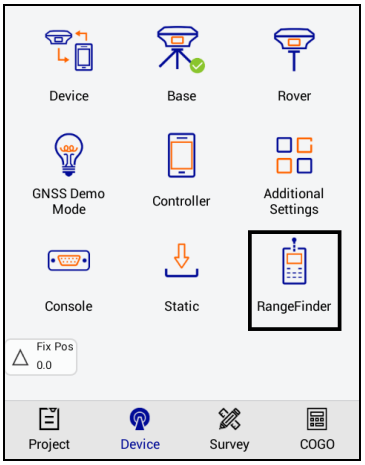
- *Download*: Connect the receiver by Wi-Fi, it supports the FTP static files download to the local store. Long press to choose files, and it will prompt the save path after the download is successful.

- *Delete*: Long press a record to delete the selected static data, allowing multiple files to be selected and deleted.

3.9 RangeFinder

3.9.1 RangeFinder Connection

Select the type of the rangefinder to be connected, including the Leica Disto D8/D5/D3 and Trupulse 360B, and click Connect to connect. The rangefinder choice is not available if already connected.



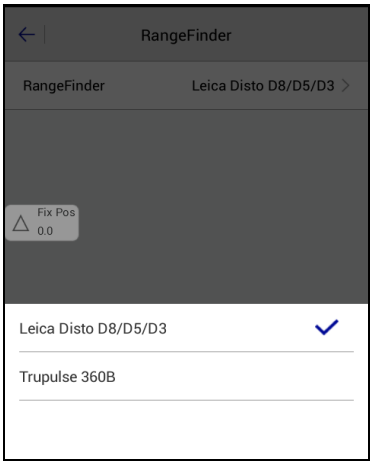
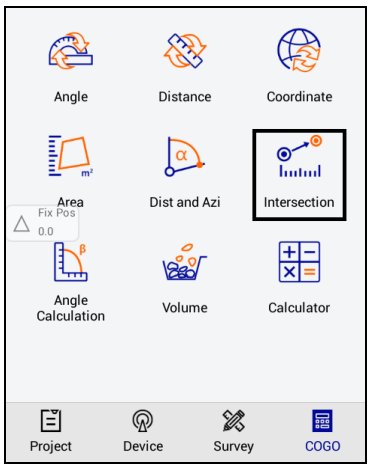


Figure 3-9-1 Device Interface Figure 3-9-2 Choose the RangeFinder

3.9.2 RangeFinder Intersection

Click *COGO→ Intersection* in the main interface to enter the intersection interface.



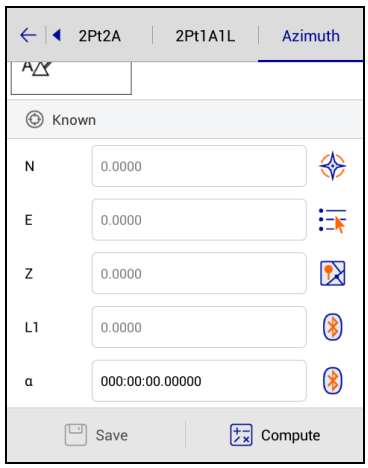


Figure 3-9-3 COGO Interface *Figure 3-9-4 Azimuth Interface*

When the rangefinder device is not connected, users can click the Bluetooth button in the *2Pt2L, 2Pt1L, 2Pt1A1L* and *Azimuth* interface to enter the rangefinder interface to connect the rangefinder.

After entering the rangefinder interface, click *Connect* to connect the rangefinder by Bluetooth and use the rangefinder to measure the corresponding value.

Notice:
The height limit (antenna height) cannot be greater than 65m. If the height exceeds When using the software to read the rangefinder ranging value, make sure that the rangefinder is in the initialized state and not in the waiting state.

3.10 Device Check

The Device Check is a new function that is used to check whether the coordinate is precise.

Click *Device Check* in the *Device* interface to enter this function. Users can input or select the corresponding points. It will then display its NEZ. Next, click the *Start Check* button to process the data and display the list. The content contains N, N Limit, E, E Limit, Z, Z Limit. If the check is a success, it will prompt *Current device meets inspection*.

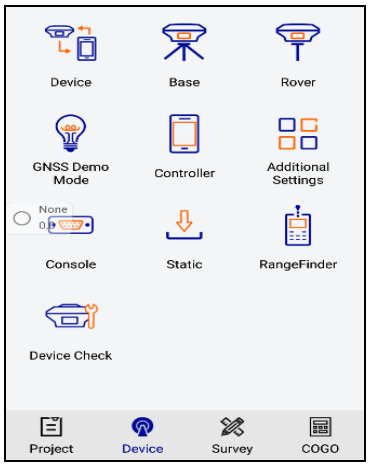


Figure 3-10-1Device Check1

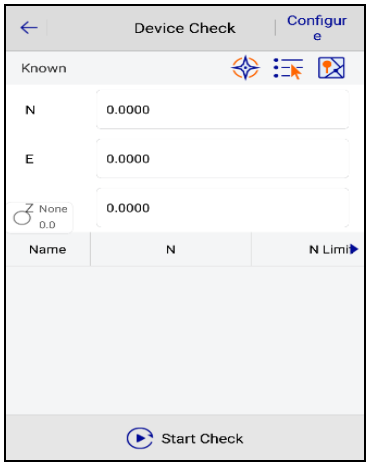


Figure 3-10-2 Device Check2

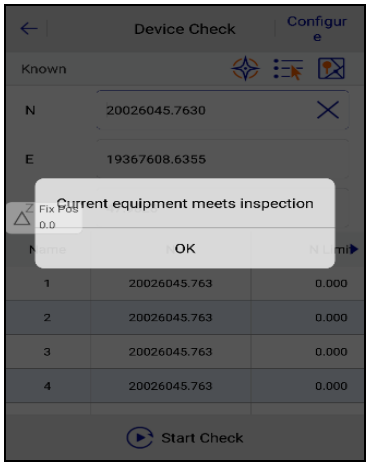


Figure 3-10-3 Device Check3

Chapter 4

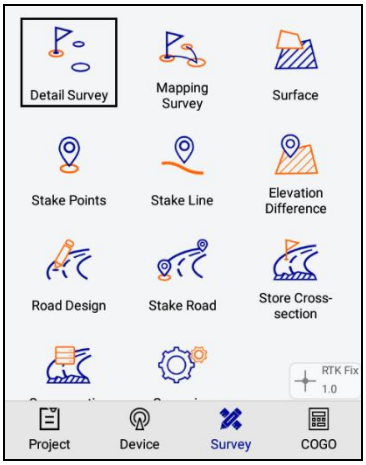
Survey

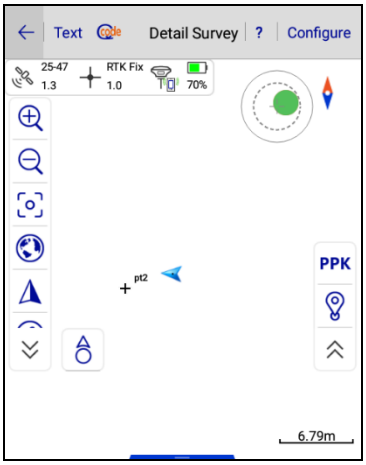
This chapter contains:

- Detail Survey
- Stake Points
- Stake Line
- Mapping Survey
- Menu

4.1 Detail Survey

Click the *Detail Survey* icon in the *Survey* interface to enter the Detail survey; text interface and the graphical interface can be switched via the *Text / Graph* button.





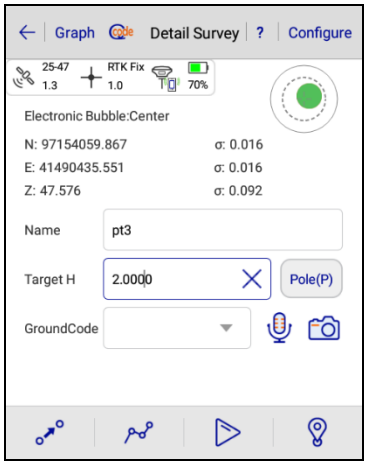
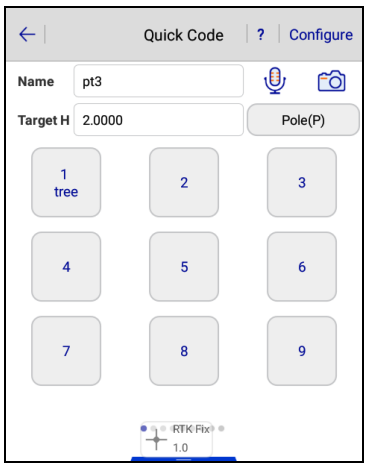


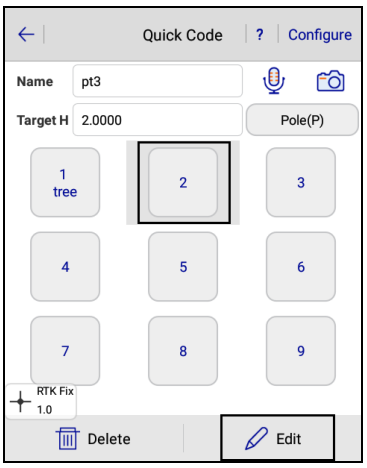
Figure 4-1-1 Detail Survey *Figure 4-1-2 Graph Interface* *Figure 4-1-3 Text Interface*

Navigation	Zoom in	Zoom out	PPK collection
Zoom center	Zoom All	Attribute Info	Select Point
Intersection	Auto Survey	Turn off Auto Survey	Average Survey
Store	Expand Tools	Hide Tools	Culture Create
Angle of View			

4.1.1 Quick code

In the *Detail Survey* interface, click the icon code in the upper left corner to enter the *Quick code* page. In the *Q-code* interface, you can set the point name, video, photo and target height, etc. Long press a code (1-9) to delete or edit the code information. For the edited code, you can directly collect and save the point with the corresponding quick code (1-9) by clicking the controller's physical button (1-9). Then the set quick code information will be automatically applied to the current collected point.





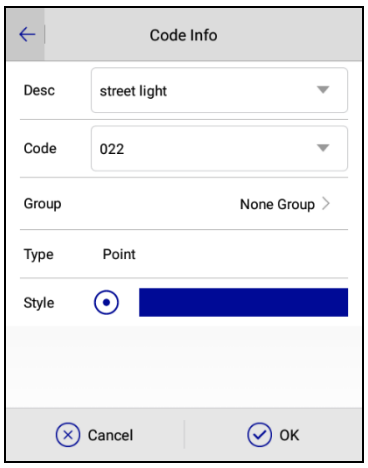
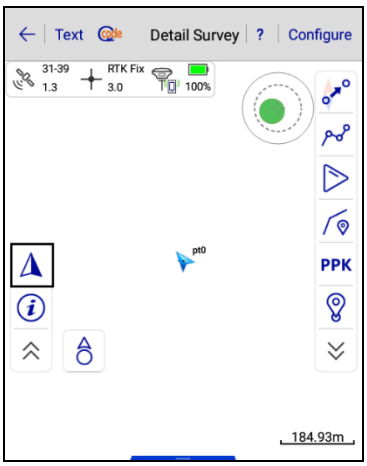


Figure 4-1-4 Quick Code *Figure 4-1-5 Edit* *Figure 4-1-6 Code Info*

4.1.2 Map Navigation

Enter the *Survey* interface; the map navigation is shown when the left toolbar is hidden. It allows users to view the current position, or search for a point position more intuitively, and the navigation tool provides three types of a *walk, driver and bus* for route searching.



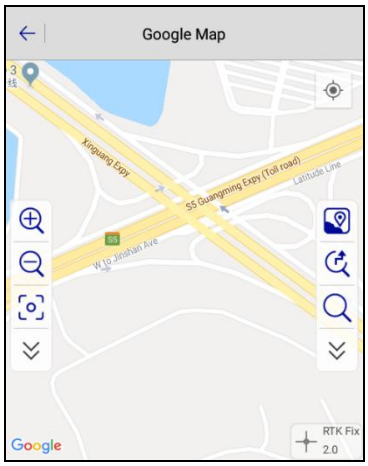


Figure 4-1-7 Navigation *Figure 4-1-8 Map Navigation*

Notice:

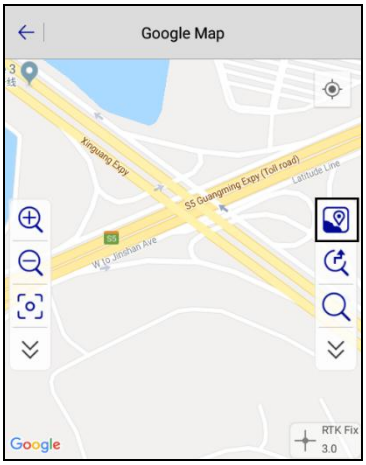
In the Survey interface, you can enter the map interface by clicking the icon.

Map navigation function doesn't display the points collected during measurement; the third party map in the configuration can display the points of the measurement.

After entering the *Map navigation* interface, the same tools as the survey interface will not repeat the introduction; add the following functions:

Satellite Imagery ：Layer General ：Route Search ：Point Search

Click and tools, the loaded map can be switched between satellite image and layer general.



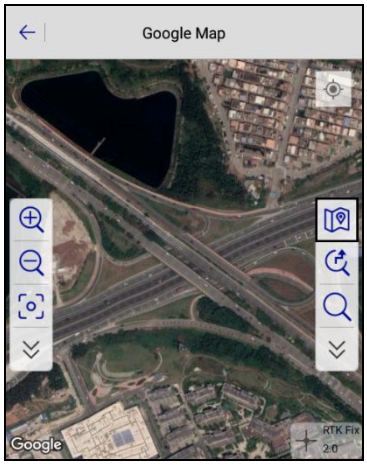
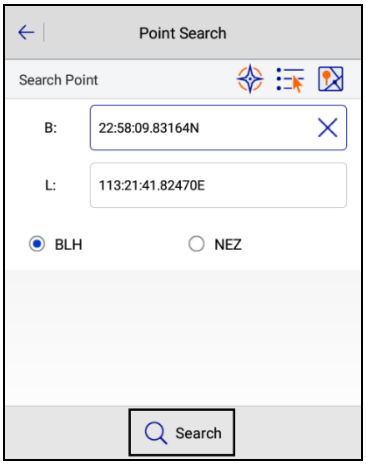


Figure 4-1-9 Map *Figure 4-1-10 Satellite*

During the survey, you can use the function point search if you search for the position of a point, used for route search. The coordinates of the search point can be obtained by real-time collection, point library, graphic selection, and manual input, and then clicking *Search*. Back to the map interface, the red icon on the map is the position of the search point. If you want to search the route to the point, click *Go Here*, then it will display route mileage at the bottom of the screen; you can select three methods of walking, driving, and bus. Click *Details* to view the detailed route of starting to endpoints.



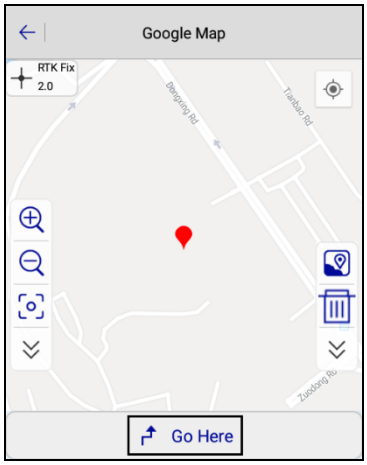
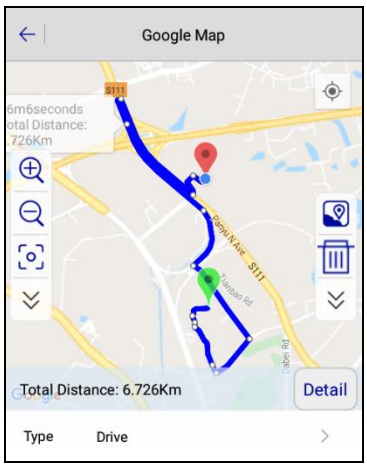


Figure 4-1-11 Search *Figure 4-1-12 Go Here*



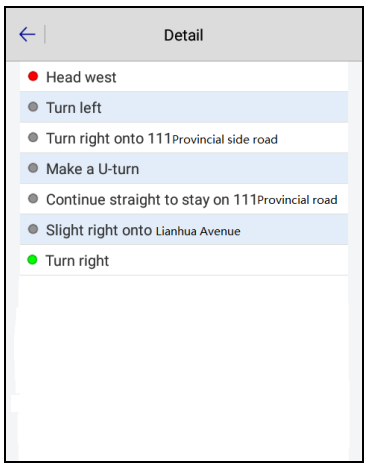


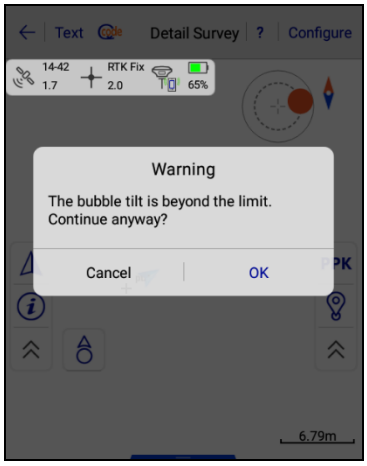
Figure 4-1-13 Route *Figure 4-1-14 Details*

If you know the start and endpoints, you can use the route search . After entering its interface, select the route type, input coordinates of the start point and endpoint, and then click Search.

4.1.3 Manual Collection

In general, you reach the measurement position, decide whether to collect points according to the survey coordinates, accuracy, and solution-state displayed on the interface. General RTK Fix solution; click for manual collection, the software checks the accuracy firstly (accuracy settings is in *Surveying Configure → Data*). If accuracy is not required, the software will be prompted.

It will pop up the *Save Point* interface before collection completed, you can check the reliability of the point; at the same time, the software automatically records data cumulatively according to the global point number and the prefix of point name is the one used last use. You can directly input *Target H*, and also click *Pole* for detailed settings of target height configuration and antenna type. Input mark information in *GroundCode* and you can also select commonly used types; then set *Station* in the *Save Point* interface.



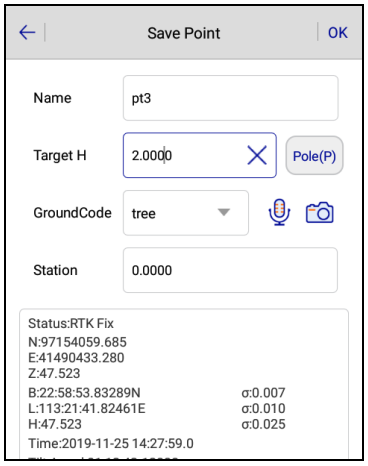


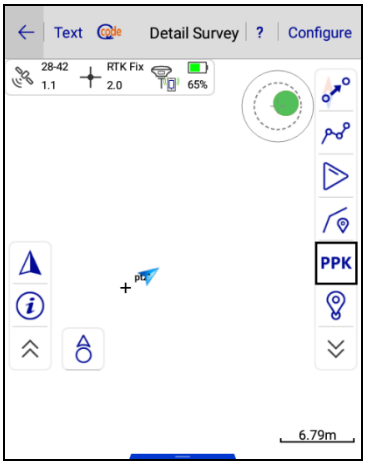
Figure 4-1-15 Bubble Prompt Figure 4-1-16 Point Info

4.1.4 PPK Collection

PPK (Post Processing Kinematic) technology was the earliest GPS dynamic differential technology. It is also known as the stop and go. The main difference between PPK and RTK technology is that it is not necessary to establish a real-time data transmission between the base and rover. After the positioning observation, the positioning data is collected by the two receivers. This is then jointly processed to calculate the coordinates of the rover at the corresponding position. The distance between the base and rover is not strictly limited.

The PPK function can be either used alone or in combination with RTK. When using the PPK function alone, the base station only needs to keep track of the satellites and record the static data. When used in combination with the RTK, the base station needs to send differential data while recording static data. Hi-Survey Road has the PPK switch in the setting interface of the base. When it is set to On, the base station can record static data and transmit the differential data.

After setting up the rover, click the *PPK button* on the right side of the graphic interface of the Detail survey for the PPK collection settings.



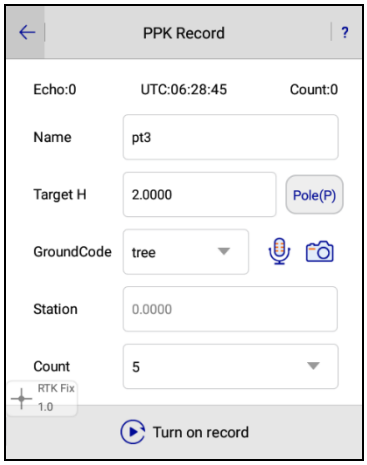
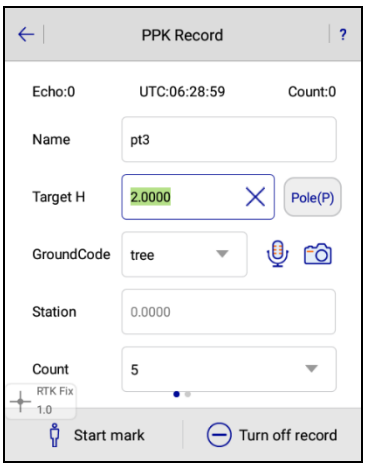


Figure 4-1-17 PPK Figure 4-1-18 PPK Record

Click *Turn on record*, the rover station starts to record static data. When you arrive endpoints measurement position, you can click *Start mark* to proceed collection after inputting the corresponding *Name, Target H, GroundCode*, select the average count (generally recommended more than 200 times).

Slide the screen to the left during the collection to view the coordinates of each average data. When the setting of the average times is reached or click *Finish mark*, the software automatically saves the coordinate points. Click *Turn off the record* and the rover will stop recording static data.



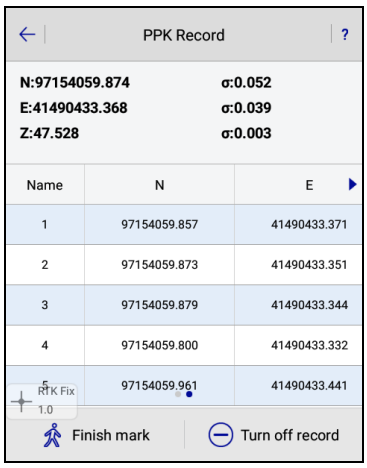


Figure 4-1-19 Start Mark *Figure 4-1-20 Mark Data*

Each time PPK collection is performed, a PPK file is recorded correspondingly, and you can view the file information and delete the file in the *Project → PPK File*.

Notice: The data and tag information of the PPK function of the rover are recorded in the Rinex folder of the receiver, and the Rinex file should be used for post-processing. For related operations on PPK post-processing, please refer to the HGO V2.0.0 Software User's Guide.

4.1.5 Culture Create

Click *Culture Create* and select the real-time collected points to create a line. After finishing *Culture Create*, the software will prompt a line collection in a pop-up window, which will display whether the culture should be closed or not. If not, it will create a line. If this is ticked, it will create the surface, marked on the map.

A hidden bar at the bottom displays WGS-84 BLH, local NEZ, and BLH coordinates, with left-right sliding to select to display coordinate types.

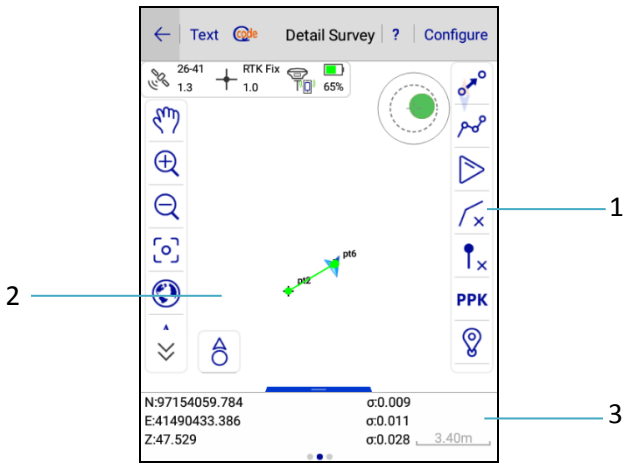
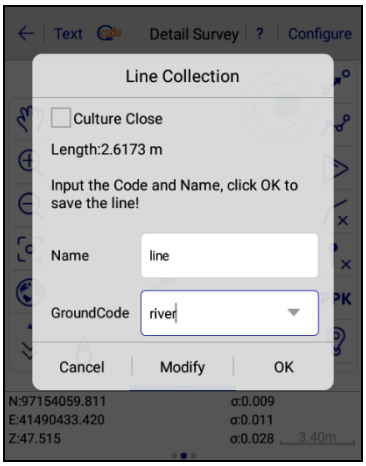


Figure 4-1-21 Culture Create

1-Culture create switch: off, on 2-Collected culture 3-Coordinate display



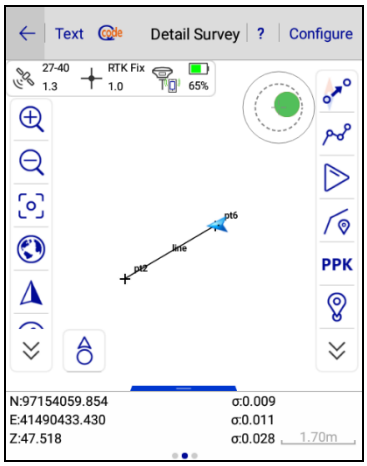


Figure 4-1-22 Line Collection *Figure 4-1-23 Collected Line*

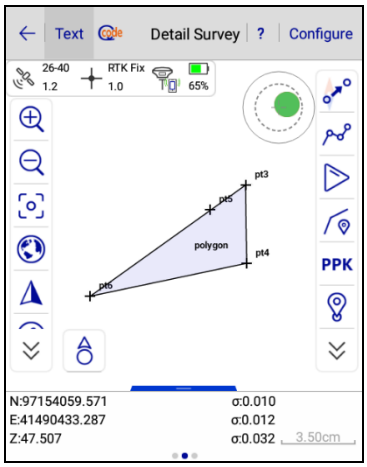


Figure 4-1-24 Polygon Collection *Figure 4-1-25 Collected Polygon*

4.1.6 Collect Input Method

In demo mode, built-in GPS or connecting device, Hi-Survey Road can support the electronic bubble survey. It will display the diagram of the electronic bubble position in the software interface, you can select *Auto → Bubble Is Centered* to collect points according to the state of the electronic bubble. The electronic bubble has the following states:

Center: Bubble is within the set limits, centered well.
Wait Center: Waiting for the user to adjust the pole to center the bubble.
Wait Survey: Waiting 2 seconds after center, enter the survey state, and collect points in this state.
Wait Move: After the last collection point is finished, it waits for you to move the pole; after moving a distance it will start the next survey.
Out of Range: In the set limits, the bubble deviates from the center position.

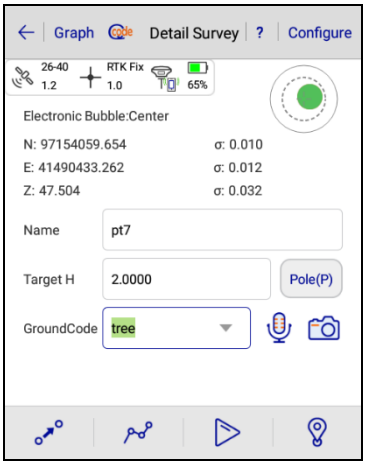
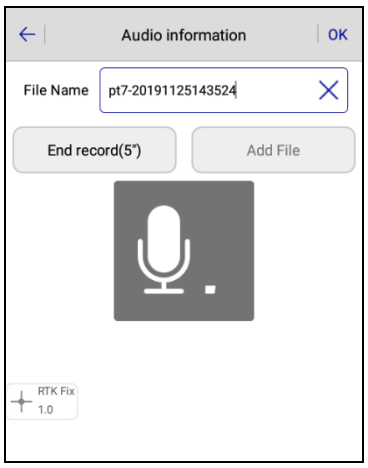
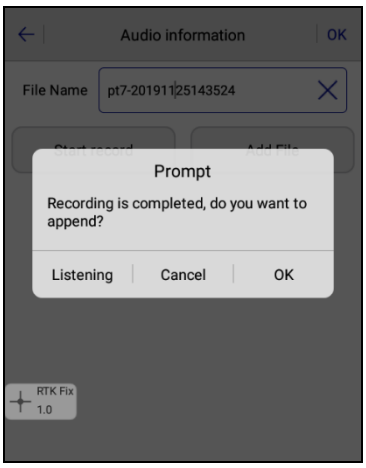


Figure 4-1-26 Bubble Center

When collecting coordinate points, it supports audio and photo attributes. In the Save Point or Text interface, click to input and view audio and photo information; the pictures displaying the current point coordinates and time in the upper right corner are saved in the file after point collection. It supports audio and photo file import by clicking Add File, audio file format can be *.amr, *.wav, *.mp3 and photo formats are *.jpg, *.png, *.bmp.





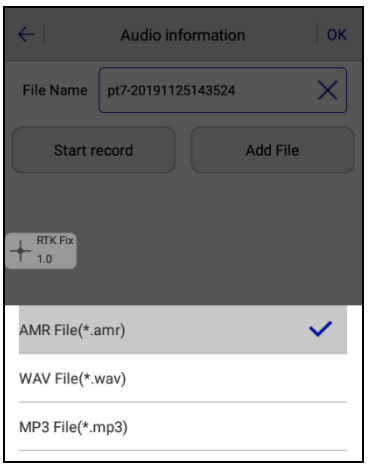
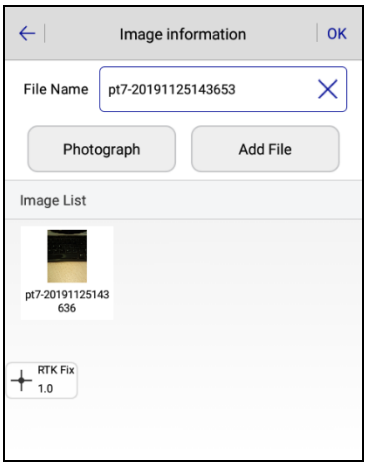


Figure 4-1-27 Audio Record *Figure 4-1-28 Audio Record Prompt* *Figure 4-1-29 Add Audio File*



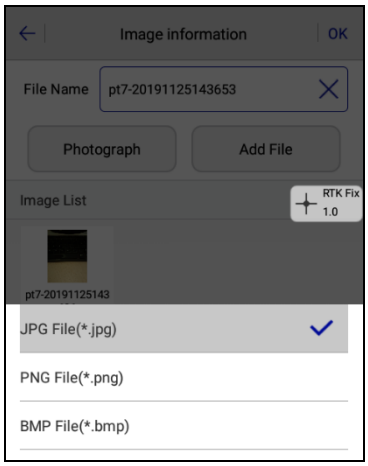


Figure 4-1-30 Photograph *Figure 4-1-31 Add Photo File*

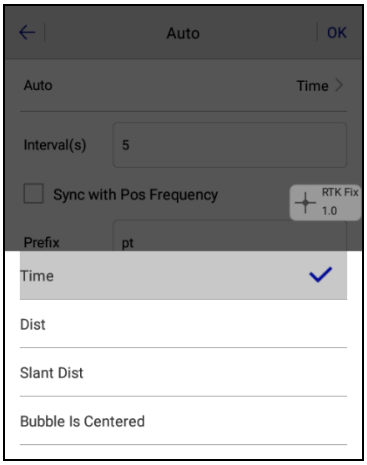
After returning to the parent interface, once the user has input audio or photo information, the interface icon is changed to .

When you select code information, you can directly select the common code, or manually edit the property.txt file (*SDcard/ZHD*) according to the actual work situation. The edited code information will be displayed in the list. Long press one file in the list to delete the file.

4.1.7 Automatic Collection

Click the Auto icon to enter automatic collection interface, select collection mode (including *Time Distance* (change value of N or E direction), *Slant Distance, Bubble Is centered*), input the *prefix, ID, GroundCode*, etc. Click *OK*, the software will enter automatic collection mode. Accuracy will be checked during automatic collection (accuracy is set in *Surveying Configure → Data* has a detailed description. If it meets the accuracy requirements, it will automatically collect and prompt to save points; if it does not meet the accuracy requirements, there will be no prompts until the accuracy

meets the requirements to continue to automatically collect and save), click ⏸ to finish automatic collection.



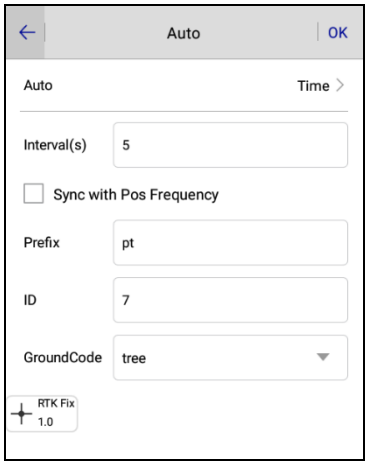


Figure 4-1-32 Auto Collection Method *Figure 4-1-33 Auto Collection by Time*

When the automatic collection mode is Time, the interval(s) value can be set, and it will start automatic collection according to the set time interval.
When the automatic collection mode is Distance, the interval(s) value can be set, and it will start automatic collection according to the set plane interval.
When the automatic collection mode is Slant Distance, the interval(s) value can be set, and it will start automatic collection according to the set slant interval.
When the automatic collection mode is Bubble is centered, hold it straight for automatic collection, and take away immediately after collection, with no further human intervention. Clicking on the upper-right corner of the interface *Configure → Data → Bubble Precision* to set the bubble precision.

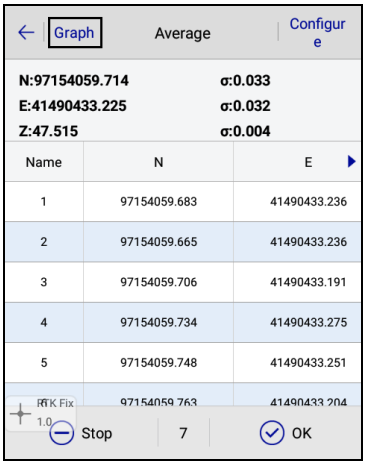
When the data quality is not good (the solution, precision, and the bubble do not meet the requirements), automatic collection stops, and a specific red font prompt will be given by the software, according to the current unsatisfied conditions.

4.1.8 Average Collection

Average Collection is a simple way to improve measurement accuracy; according to the error theory, the error occurs in any direction, so if there are a large number of observed quantities, accidental errors will be offset (but it's just theory, it doesn't mean that the more observed quantities, the higher the precision). In the *Average Collection* interface, click *Start*, the software will collect points, and display the current point position at the same time. The software automatically analyzes the quality of the data, then calculates and displays a standard deviation (root mean square error).

Average Collection supports text and graphic displays. After the average collection reaches the set number and stops, in the Text interface, you can delete some scattered points in the average list to improve the collection accuracy (long press average list, display Delete toolbar), and then the software

will automatically redo the average calculation. In the graphic display interface, click the average collection point to display the point coordinates.



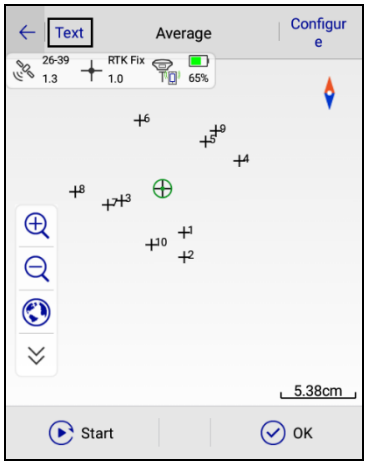
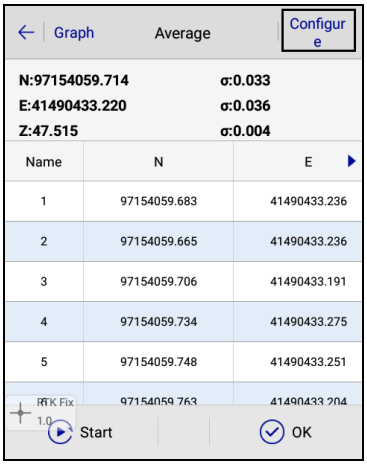


Figure 4-1-34 Average Text Interface *Figure 4-1-35 Average Graph Interface*

The calculated error is the same as the error of the measurement. However, because the average process is from a small quantities collection, the estimated error may be less than the actual measurement error.

Configuration can be done before average collection; click Configure in the upper right of the Average interface to set the *Average Method, Status, Ave Times and Ave Precision*. Each time you exit the software, the Status of the average collection configuration is set to the *Fix solution*. It cannot be configured during the average collection. If it fails to achieve the average accuracy, as well as configuration over-limit, it will prompt Unable to start average due to low precision. Then you need to re-configure the average precision.



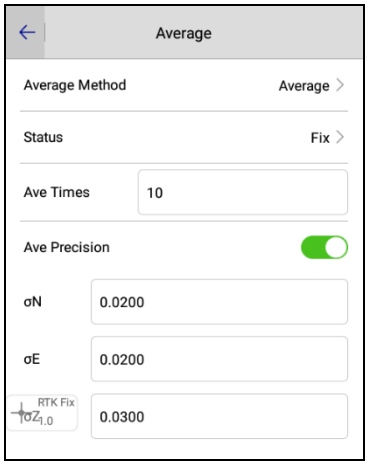


Figure 4-1-36 Configure *Figure 4-1-37 Configure Parameters*

4.1.9 Indirect Survey

Intersection collection is designed for places where we cannot reach or there is no GNSS signal. Usually, only plane coordinates can be obtained by intersection, and the elevation data should be obtained by other measurements. The principle of intersection is a simple graphical intersection calculation; there are many intersection ways, with different required quantity, you can choose according to your measurement tools (please refer to chapter 5 of this book for specific usage: *Tools → Intersection*).

Notice: The points calculated by intersection are saved in Coordinate Data and Raw Data.

4.1.10 Attribute Querying

Click to open Attribute Querying, to enter the Attribute Querying state.
It supports query point, line, and surface. Click and select point, line, and face on the map to show the attribute information, and you can delete, modify the attribute; click again to exit the attribute querying state.

To edit the selected data, you can also click the *Attribute Info → More* to jump to the *Edit RawData* interface. After editing, click *OK* to save the modified data and return to the *Detail Survey* interface. If you click *Cancel*, it will cancel saving the edited data and return to the Detail Survey interface.

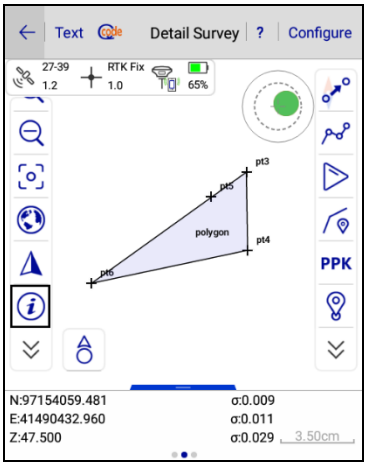


Figure 4-1-38 Attribute *Figure 4-1-39 Attribute Info*

4.2 Stake Points

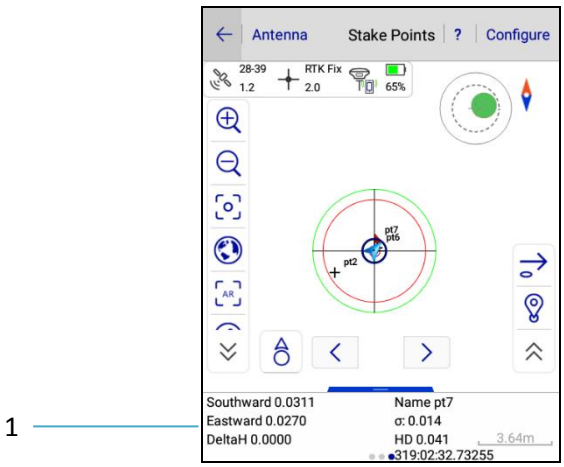


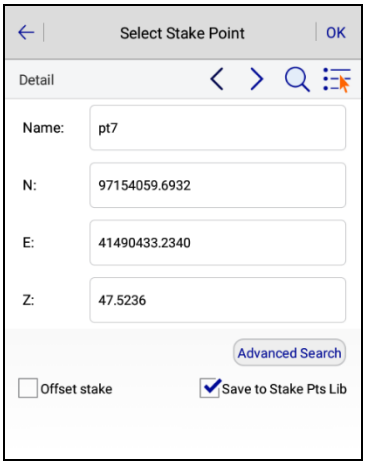
Figure 4-2-1 Stake Points interface

1- Stake instructions: Southward and Eastward to 0 mean it has reached the staked point. DeltaH represents the Verticals difference between the staked point and the current point.

Choose node on line | Select Point | Nearest Stake Point | Angle Of View
Average Collection | Select Stake Point | Single Collection | AR Stake

Select Stake Point: In the Stake Point interface, click to enter Select Stake Point interface; it provides three ways to define a point:

1) Manual input.
2) Select from the Coordinate Library.
Input the point name, click the search button to search from the Coordinate Point Library, Stake Point Library, and Control Point Library, Mapping Data Point Library, Cross-section Point Library. The searched results are displayed in the interface for user selection, and it will give a prompt if there is no result.



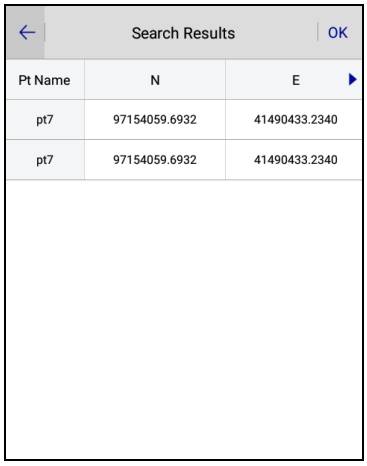
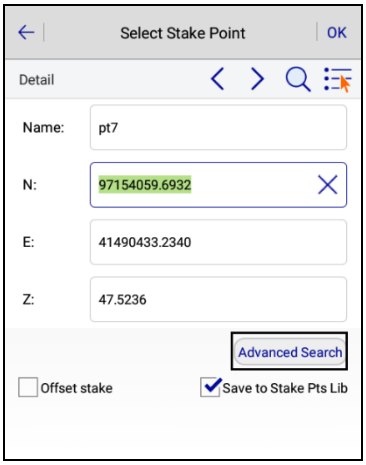


Figure 4-2-2 Search from Point Lib Figure 4-2-3 Search Results

3. Advanced Search

Click *Advanced Search* to enter the search interface. You can then search according to three conditions: *Name, GroundCode, and Code*, and search the points in the library (the code is only for coordinate points).



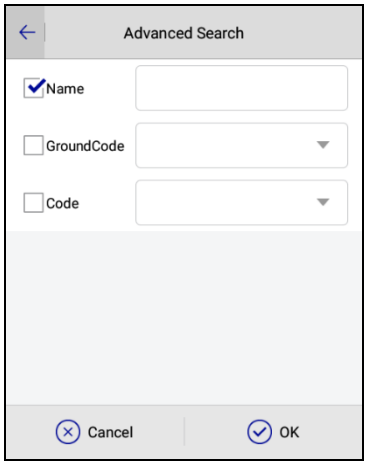


Figure 4-2-4 Advanced Search Figure 4-2-5 Advanced Search Interface

4. Select from the map (Choose node online and select a point on the map)

Choose node online: Click the icon to select line, then it will jump to the *Select Point From Line* interface, showing all nodes on the line. The map interface is displayed by default, and the map selection button is turned on .you can choose the node from the map or list. After selecting the node point, click *OK* in the upper right corner to perform staking points.

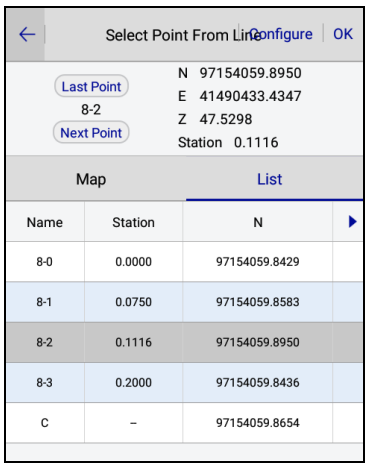
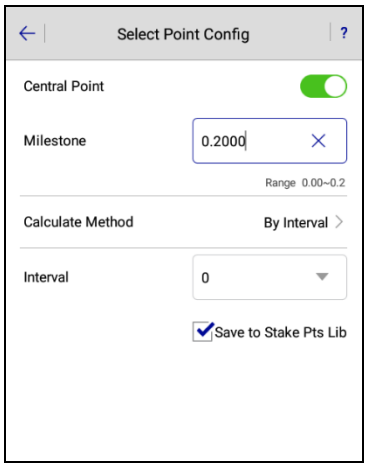


Figure 4-2-6 Map Interface *Figure 4-2-7 List Interface*

While choosing the node online, you can set the node through Configure.



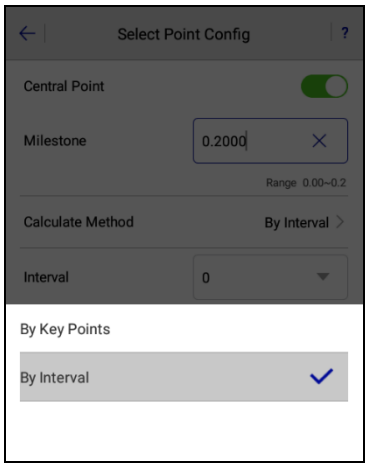


Figure 4-2-8 Select Point Config *Figure 4-2-9 Calculate Method* *Figure 4-2-10 Configure Result*

Central Point: The map interface will display a gravity point of the polygon named C.

Milestone: The default is 0. After setting the milestone value in the range, the starting point milestone in the map interface is the setting value.

Calculate Method: It includes *By Key Points* and *By Interval*. The default is *By Key Points*. When the calculation method is *By Interval*, the default interval value is 10, but the line range value should not be exceeded. After the calculation mode is set, the map interface generates the corresponding feature points and key nodes and displays them on the map and in the list.

When staking point, click < >, it will automatically extract the coordinates of *Stake Point Library*, according to the positive sequence or reverse order to stake out. In *Select Stake Point* interface, tick *Save to Stake Pts Lib*: corresponding points can be saved to the Stake Point Library.

Offset stake: After the user inputs HD(horizontal distance) and Azi (azimuth), click *OK*, the software calculates the offset point and uses it as the current staked point.

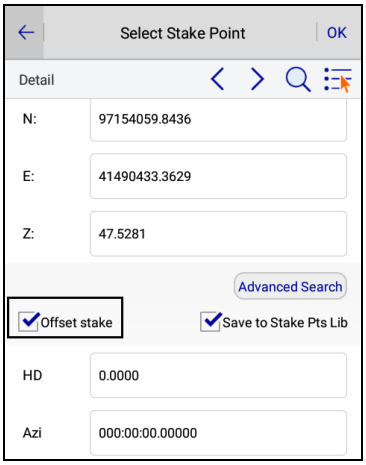
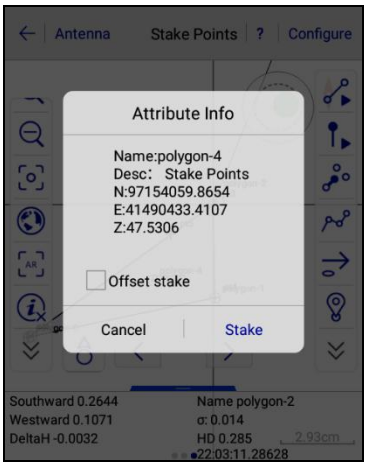


Figure 4-2-11 Offset Stake

Nearest Stake Point: End-users click icon, you can set the nearest point as the current stake point; in the process of approaching the nearest stake point, if you configure options such as voice prompts, precision, and prompt on approaching point, etc., the software will make a prompt, according to the distance, such as icons, voice, and words.

4.2.1 Attribute info

In the Stake Points interface, click the *Attribute Query* button and select a point on the map. The software prompts with a pop-up window, which displays the Name, Desc, NEZ, and other information. The selected point can then be used for the stakeout. If the current point is being staked out, the *Stake* button only shows when the *Offset Stake* switch is open. Set the HD and Azi to stakeout. If the current point is not being staked out, it will show the Stake button.



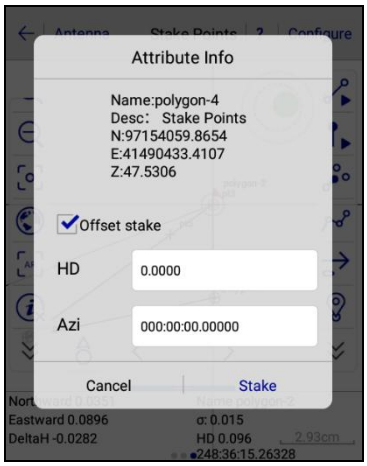


Figure 4-2-12 Attribute Info *Figure 4-2-13 Offset Stake Settings*

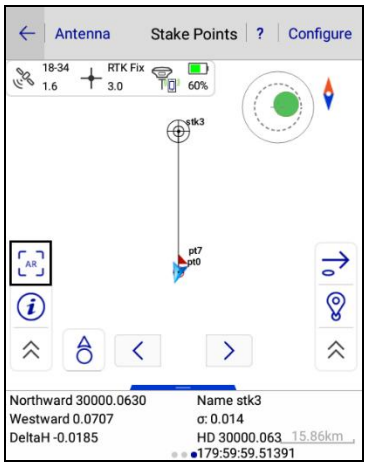
4.2.2 AR Stake

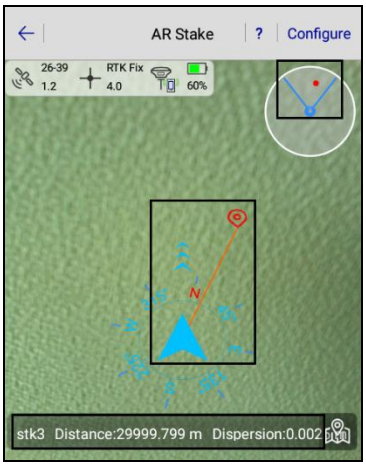
In the Stake Points interface, click the AR to enter the AR Stakeout interface. This function is only supported by iHand30 (firmware V1.1.0 or above) or other Android 5.0 or above devices.

The indication arrow on the *AR stakeout* interface shows the current stakeout direction, the distance, the height difference from the current point to the staked point, the Azimuth radar, 3D view, and 2D view.

When it is staked out to the prompt distance, the interface automatically jumps to the *Point stake (3D)* interface, providing you with a more accurate stakeout indication.

When the staked point exceeds the visible range of the stakeout, it will show a left, right, or backward prompt in the staking interface.





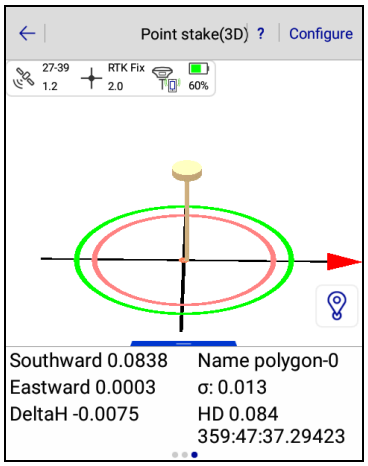
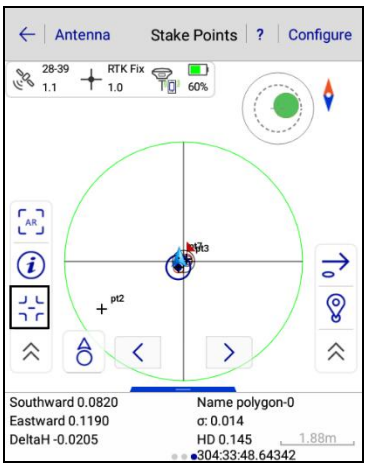


Figure 4-2-14 AR Stake *Figure 4-2-15 AR Stake Interface* *Figure 4-2-16 Point Stake(3D)*

4.2.3 Prompt of Closing to the Stakeout Point

When the distance from the current point to the staked point is less than the prompt distance you set, the stakeout area will be reduced to the range of the set cue distance, and the software will display the zoom button and center the staked point. The stakeout interface will now display two concentric circles with the center of the staked point. The larger radius indicates the prompt range that you set, and the smaller radius indicates the precision range you set.



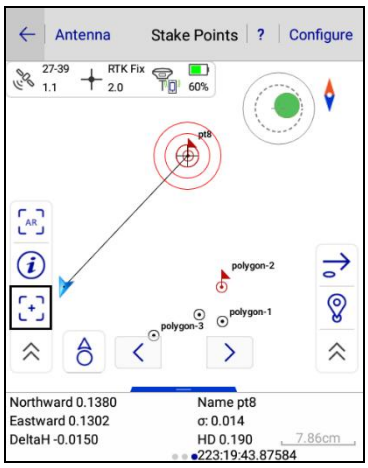
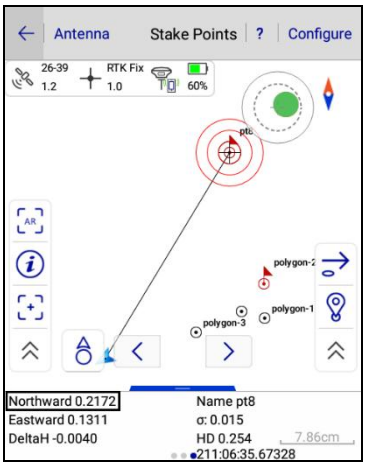


Figure 4-2-17 Zoom Prompt1 *Figure 4-2-18 Zoom Prompt2*

When you click , the map will revert to the size before the stakeout area is reduced, and the button changes to .

When the distance from the current position to the staked point is greater than the prompt distance +1, the map will revert to the size it was before the stakeout area was reduced, and the buttons or will disappear.



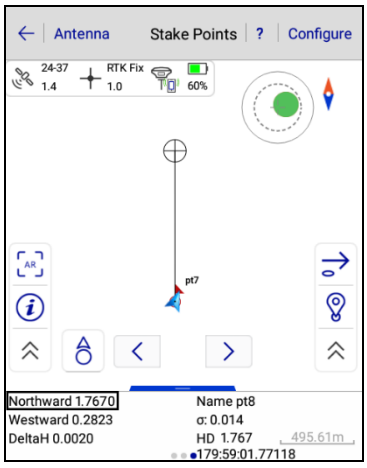


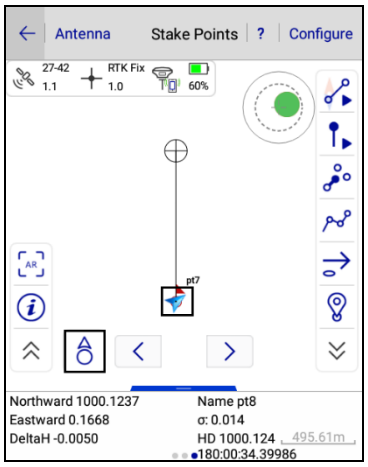
Figure 4-2-19 Prompt within Distance *Figure 4-2-20 Out of Prompt Distance*

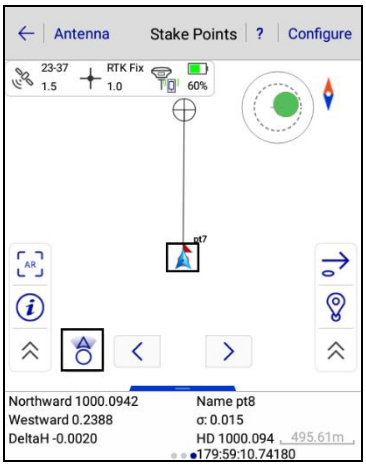
4.2.4 Angle of View

In the Stake Points interface, click *Configure* → *Display* → *Tool Display*, after adding the *Angle of View* function button. You can use the *Angle of View* function on the *Point Stakeout* interface.

When you click , it changes to (in the open status). The blue pointing arrow is fixed to the top of the screen. When you rotate the controller, the map rotates but the direction of the blue arrow

does not change. When you click , it will change to (in the off status), but the staked point does not change. The blue arrow changes according to the azimuth of the controller.





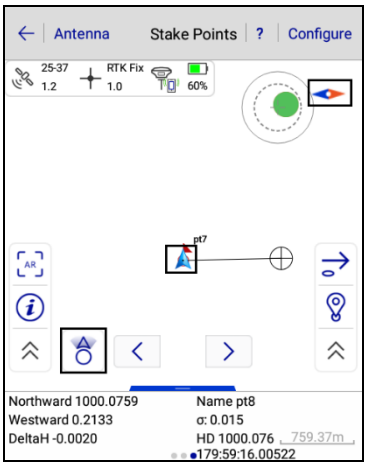
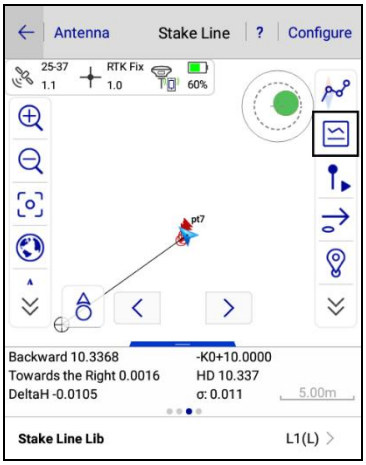


Figure 4-2-21 Angle of View1 *Figure 4-2-22 Angle of View2* *Figure 4-2-23 Angle of View3*

4.3 Stake Line

The Stake Line is a simple local staking tool for the local line. There are four basic lines: Line, Arc, Spiral curve and Circle. The line can be defined by *2 Points* and *Point+Azi* for the 2D-line or 3D-line. The arc can be defined by *2 Points* and a unified curve metamodel with *Point+Azi*, and the spiral curve can be defined by a unified curve metamodel with *Point+Azi*. The circle can be defined by the center and radius. (Note: in order to unify the concept, we consider that the staking of one line is the stake of a circuit for each staking point. Its position is only indexed by the mileage.)
Usually, the first step is to select the line type.

Click to enter Stake Line Library to define a line, including four types: *Line, Arc, Spiral Curve*, and *Circle*. You can add, edit, delete, create, load, save, save as, and open data for the data of *Stake Line Library*.



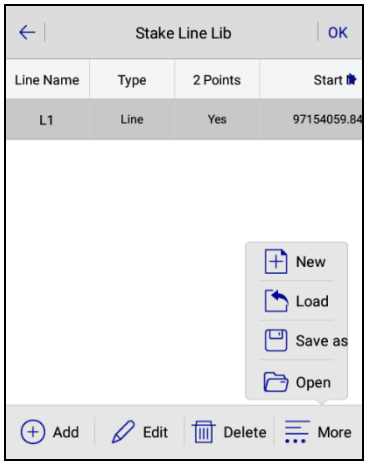
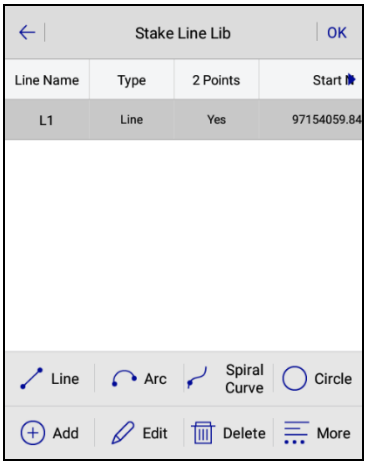


Figure 4-3-1 Stake Line Interface *Figure 4-3-2 Stake Line Lib*



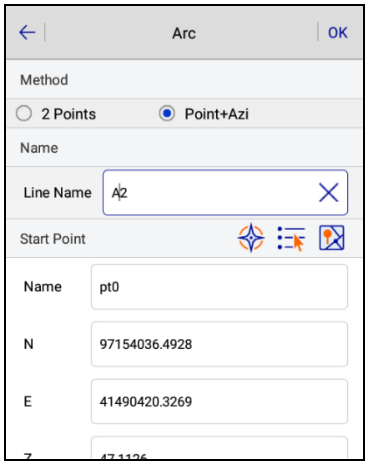


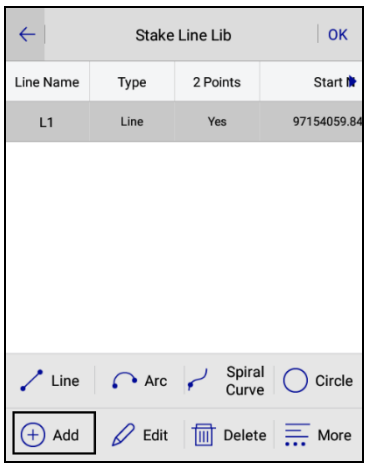
Figure 4-3-3 Four Line Types *Figure 4-3-4 Add Arc*

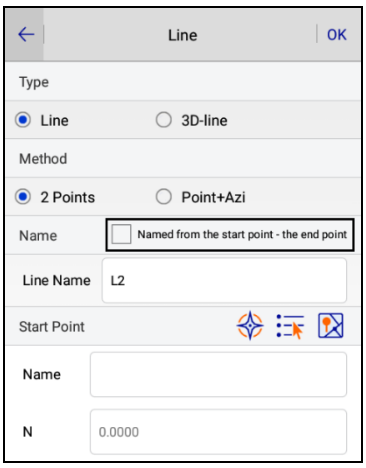
-Add: Add the relevant parameter information of *Line, Arc, Spiral Curve*, and *Circle* according to your requirement.
-Edit: Edit selected existing line elements.
-Delete: Delete the selected stake line.
-Create: New *.line file.
-Load: Accumulate line metafiles, the software will select the line element in the file and then switch to other projects and switch back. The loaded line element will be displayed in the Stake Line Library.

Line library file (*.line) is the internal format of the software; which is generated after added, edited and saved by software. *Two-point-line* file (*.2pt) is a public format, it can be edited by the user, choose to load *Two-point-line* to the Stake Library in the software.
-Save as: Save current line element information.
-Open: Open the *.line file saved in */ZHD/Project/ROAD/Unnamed*.
The following are the descriptions of each line type.

4.3.1 Define Line

Click *Add* → *Line* to select the line type, *Line* and *3D-line*. Two methods can be used to define the line: *2 Points* and *Point + Azi*. If you select the *2 Points* method, there will be an option Named from the start point-the endpoint. After ticking the option, the line will be automatically named after the start and endpoint. The users cannot edit the line name. When you cancel this option, the software stops automatically naming the line after the start and endpoint, without modifying the original line name.





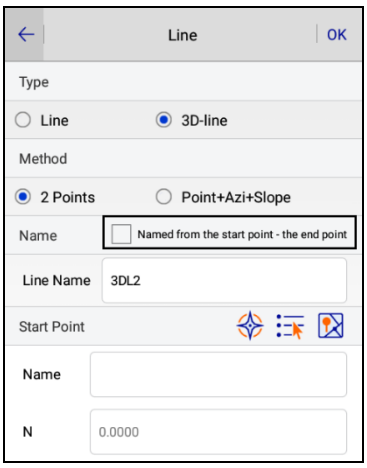


Figure 4-3-5 Add Line *Figure 4-3-6 Add 2D Line* *Figure 4-3-7 Add 3D Line*

Click *Sample Point*, input the mileage of point to be staked. Among them, the *Milestone* and *Offset* will automatically accumulate according to the *Step* value. You can also add, edit and import the *Station Offset* File. Click *OK* to enter the stake interface. (For example, if you are currently in the *Sample Point* interface, the point with the set milestone and offset that you input will be staked when you click *OK* in the upper right corner. If you are currently in the *Station Offset* file interface, the point with the mileage and offset of the *Station Offset File* will be staked when you click *OK*,)

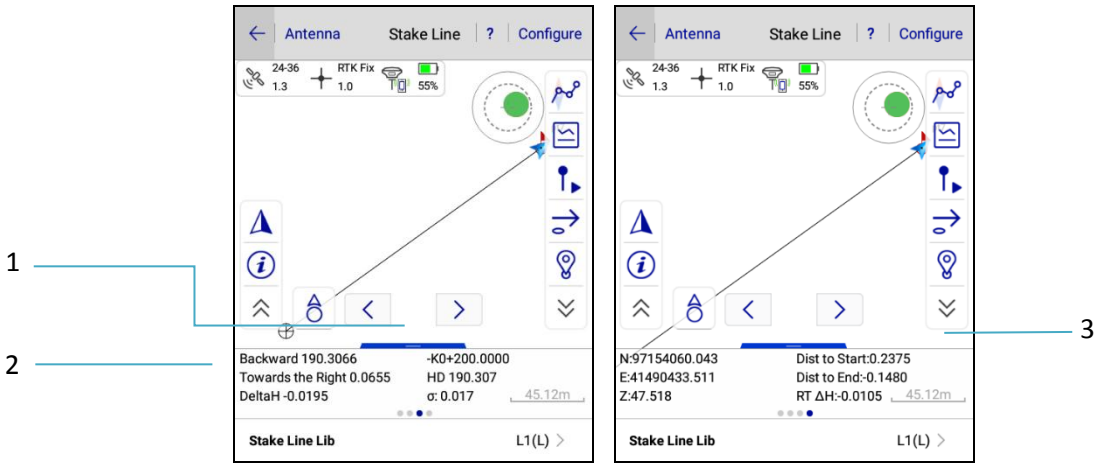


Figure 4-3-8 Instruction of Stake *Figure 4-3-9 Real-time Mileage*

1- Miles of current stake point K0+0.00

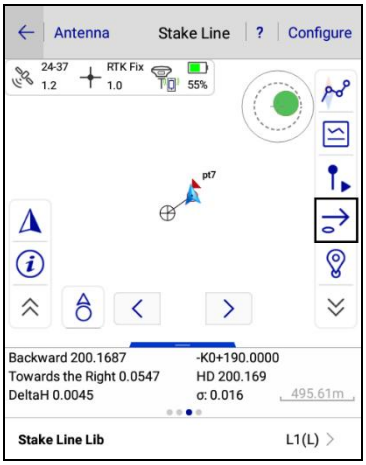
2- Stake tips

3- Display real-time mileage, real-time display the distance from the current point to the line segment

Sample Point

Calculate the position of the stake point and input mileage (if necessary, calculate the side pile), the Up and Down icons in the interface help to quickly adjust the mileage value, unit adjustments are the

steps, the data is recorded in global variables. So each time you enter the interface, the software automatically calculates a mileage/offset as the default value to save time. For example, to stake a pile every 10 meters set the step to 10, the mileage of the starting staked point is 1850. After the end of the first point to be staked, enter this interface again, the software will automatically calculate the mileage as 1860, click *OK* and continue to work.



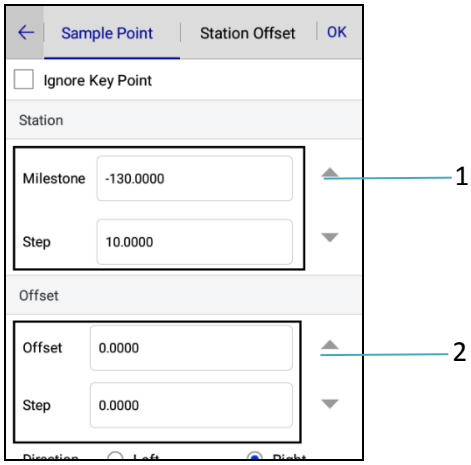


Figure 4-3-10 Sample Point *Figure 4-3-11 Set Sample Point*

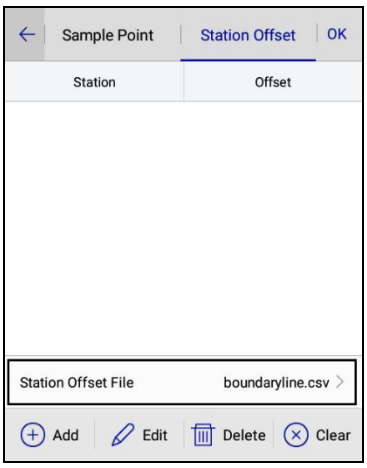
1- Manually increase the *Milestone*, automatically increase *Step* each time clicking *Mileage*.

2- Manually increase the *Offset*, automatically increase Step each time clicking *Offset*.

- Ignore the Key Point: When ticked, the feature points will be automatically skipped during the stakeout, and the stakeout will be performed according to the set mileage.
-Milestone: Mileage of current staked points.
-Offset: In the direction of increasing mileage, the distance from the current point to the vertical line of the defined line (left is negative and right is positive).
-Step: Each time you enter the interface, the added value of the mileage.
-Direction: Taking a defined line as the reference, set the direction to the left or to the right.
-Save to Stake Pts Lib: When ticked, the staked points will be automatically saved to the Stake Point Lib.

Station Offset

You can set the *Station* and *Offset* by manually adding or editing, or you can directly import the edited Station Offset File (*.csv) for stakeout by directly operating *Add, Edit, Delete* and *Clear* for the contents.
Add: Add mileage and offset under the current *Station Offset File* list.
Edit: Click to select a station offset point to modify the data.
Delete: Click to select a station offset point to delete the data.
Clear: Clear all content under the *Station Offset File* list.



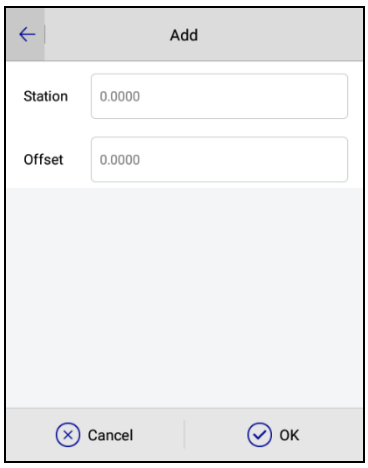


Figure 4-3-12 Import Offset File *Figure 4-3-13 Add Station Offset*

Stake the point in the specified milestone, according to the prompt. Place the current point (triangle) close to the target point (circle with cross).

Notice:

1. Offset is generally used when the roadside pile; Left or Right in Deflection represents the left and right of the line, respectively; input distance from the centerline to the edge line, in increments of zero, to stake a specific mileage.

2. When opening the real-time mileage function, the software will project the current position point on the line and display the mileage of the projection point, which is helpful to determine the walking direction.

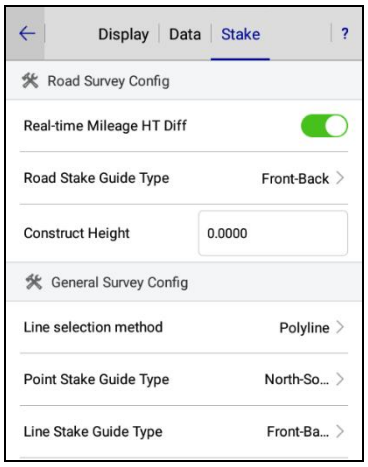
3. if currently in the *Sample Point* interface, after clicking *OK* in the upper right corner, the point with the set milestone and offset your input will be staked; if currently in the *Station Offset file* interface, click *OK*, the point with the mileage and offset of the *Station Offset File* will be staked

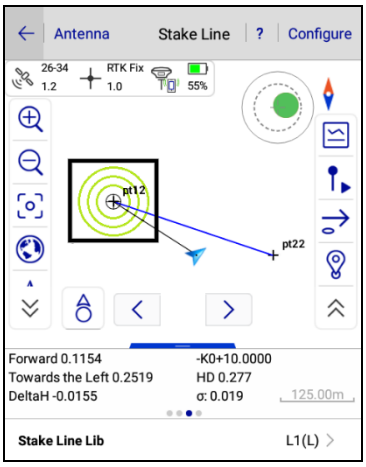
Select the *3D-line* to define a three-dimensional line, defined in two types: *2 Points* and *Point + Azi + Slope*.
When the *3D-line* is staked, the defined stake milestone is the 3D length, not the traditional 2D projected length.

In order to guide the destination, the software draws a connecting line, just make sure that the current walking direction coincides with the connecting line, the walking direction is correct. At the same time, there are some guidelines below, for some areas with a strong sense of direction and clear pointing, you can follow the instructions guide.

Notice: Blue arrow is the position and velocity direction of the current point, the circular icon is the target point, the dotted line is the line connecting the current point and the target point. As long as the walking direction coincides with the connecting line, it is possible to ensure that the stake direction is correct, so that the target point can be easily found. The following information box is the staking information, indicating the difference between the walking direction and the vertical direction.

Stake instructions can be selected in two types: *Front-Back, North-South*. You can set in *Configure* → *Stake* → *Line Stake Guide Type*.
If you turn on *Real-time Mileage HT Diff*, the current mileage will be displayed on the interface, and its connection with the current point will be drawn. Draw a small dot on the line to indicate the position of the projection; *Real-time Mileage* is also used to determine whether the direction of walking is correct (compare real-time mileage with stake point mileage, and increase direction).





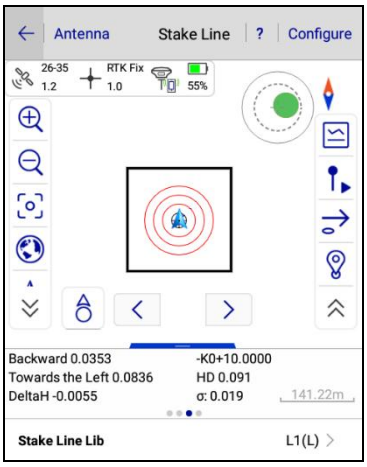


Figure 4-3-14 Stake Configure *Figure 4-3-15 Reach the prompt range* *Figure 4-3-16 Reach the set precision*

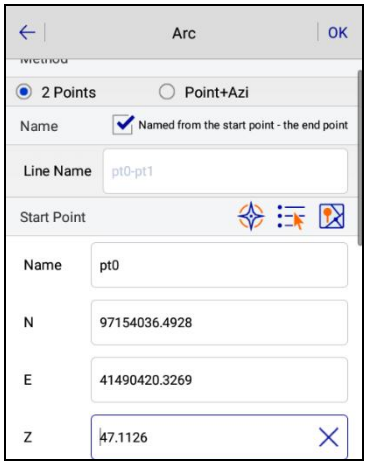
- Green: When close to the stake point it prompts *Reach the prompt range*.
- Red: Stake success prompts *Reach the set precision*.

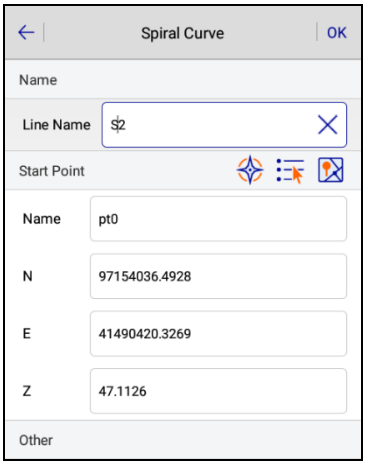
You can also turn on the staking voice prompt in *Configure* → *Stake* → *Voice Prompts*. When you reach the preset prompt range, and reach the lofting accuracy, the controller will give you different voice prompts.

4.3.2 Define Arcs and Spiral Curves

Click the *Arc* or *Spiral Curve* to define the line type; after defining the line style, the stakeout function will be similar to Line. You only need to click the *Stake Point* to input the mileage of point that is to

be staked. The *Milestone* and *Offset* will automatically accumulate according to the Step. Click *OK* to enter the stake interface.





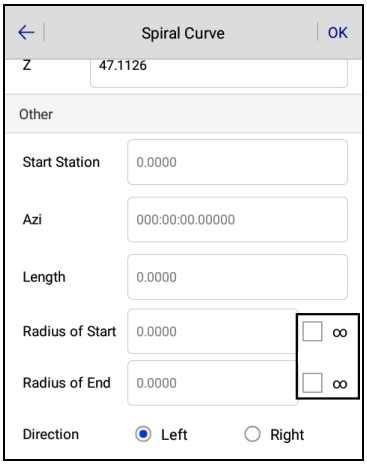


Figure 4-3-17 Add Arc *Figure 4-3-18 Add Spiral Curve* *Figure 4-3-19 Radius of Spiral Curve*

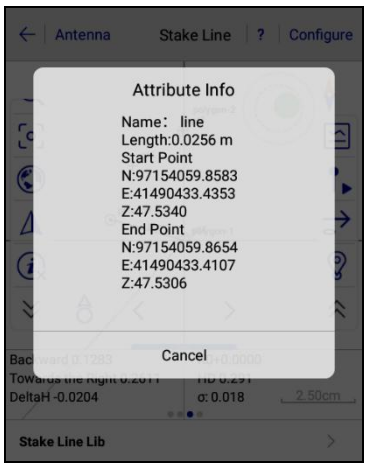
If you select the *2 Points* method to define *Arc*, there will be an option Named from the start point-the endpoint. After ticking the option, the line will be automatically named after the start and endpoint by the software. The user cannot edit the line name. When you cancel this option, the software stops naming the line after the start and endpoint automatically, without modifying the original line name.

-2 Points: Input Line Name, *Start and Endpoint coordinates, Start Station, Radius* and *Direction*;
-Point + Azi: Input *Line Name, Start Point coordinates, Start Station, Radius, Azi* and *Direction*.

-Radius of Start: Radius of the start point of the Spiral curve, tick ∞ to indicate straight line.
-Radius of End: Radius of the endpoint of the Spiral curve, tick ∞ to indicate straight line.

4.3.3 Attribute Info

In the *Stake Line* interface, click the attribute query icon ⓘ, select an existing line on the map, and the software will prompt with a pop-up window to display the *Name, Length, NEZ,* and other information. If the current line is being staked out, the *Stake* button will not be shown; if the current line is not now being staked out, it will show the *Stake* button directly.



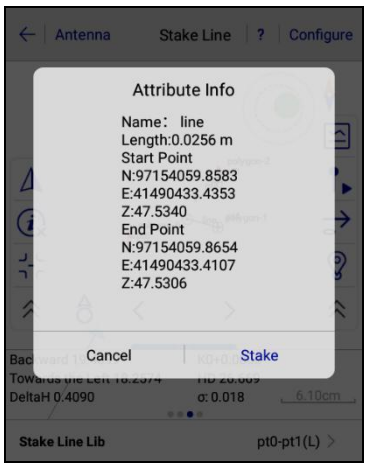


Figure 4-3-20 Current Stake Line Info *Figure 4-3-21 Line Info*

4.3.4 Prompt of Closing to the Stakeout Point

When the distance from the current point to the staked point on the line is less than the prompt distance that you set, the stakeout area will be reduced to the range of the set cue distance, and the software will display the zoom button and center the staked point. The stakeout interface will now display two concentric circles with the center of the staked point. The larger radius indicates the prompt range that you set, and the smaller radius indicates the precision range you set.

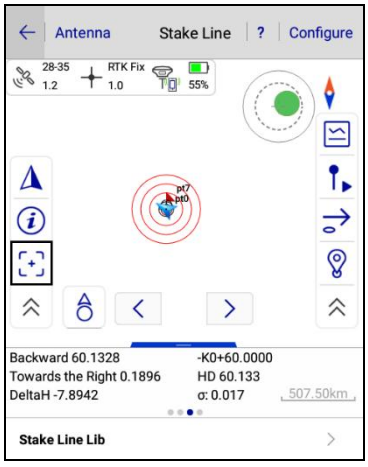
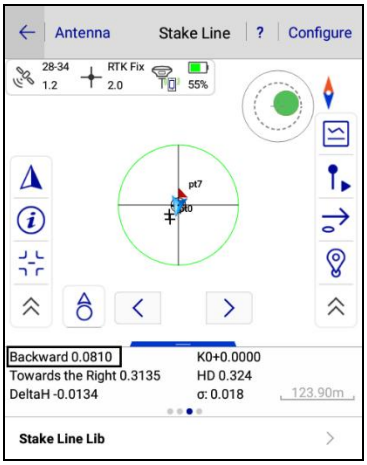


Figure 4-3-22 Zoom Prompt1 *Figure 4-3-23 Zoom Prompt2*

When you click , the map will revert to the size before the stakeout area is reduced, and the button changes to .

When the distance from the current position to the staked point is greater than the prompt distance +1,

the map will revert to the size before the stakeout area is reduced, and the buttons or will disappear.



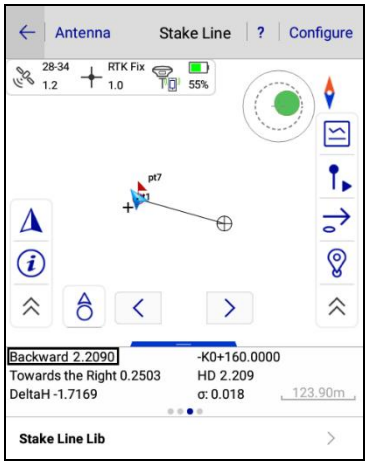


Figure 4-3-24 Prompt within distance *Figure 4-3-25 Out of Prompt distance*

4.4 Mapping Survey

Mapping Survey is the work of measuring the plane coordinates and elevation of the control points needed for the mapping.

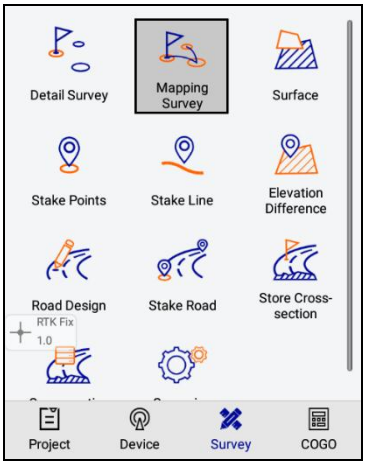


Figure 4-4-1 Mapping Survey

The accuracy of the mapping data, relative to the RMS of the adjacent level control point, should not be greater than 0.1mm on the mapping; the RMS of elevation should not be greater than 1/10 of the basic contour distance.

Enter the *Mapping Survey* interface to view the mapping survey progress, click *Configuration* setting parameters, the configuration page can automatically record the last input, and the name of the mapping point can be increased automatically.

-HRMS: The horizontal RMS of the current point;

-VRMS: The vertical RMS of the current point.

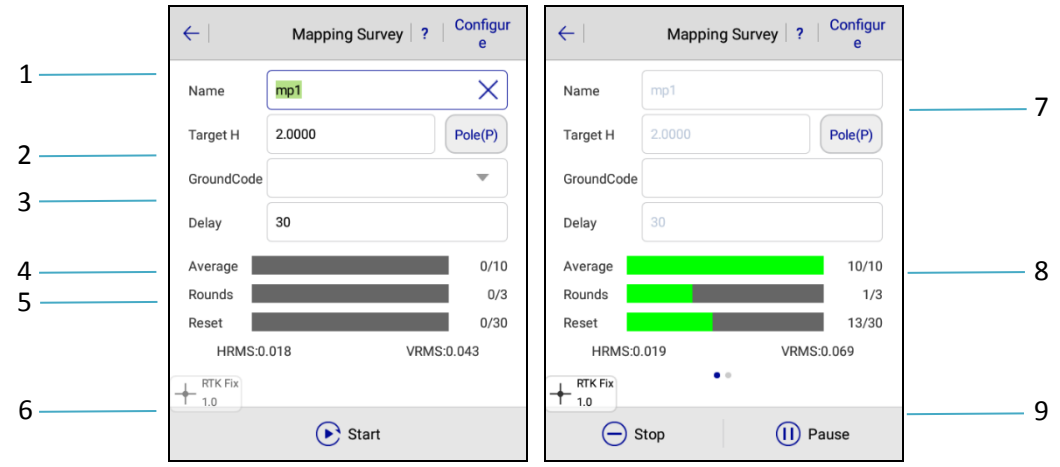


Figure 4-4-2 Mapping Survey Interface *Figure 4-4-3 Start Mapping Survey*

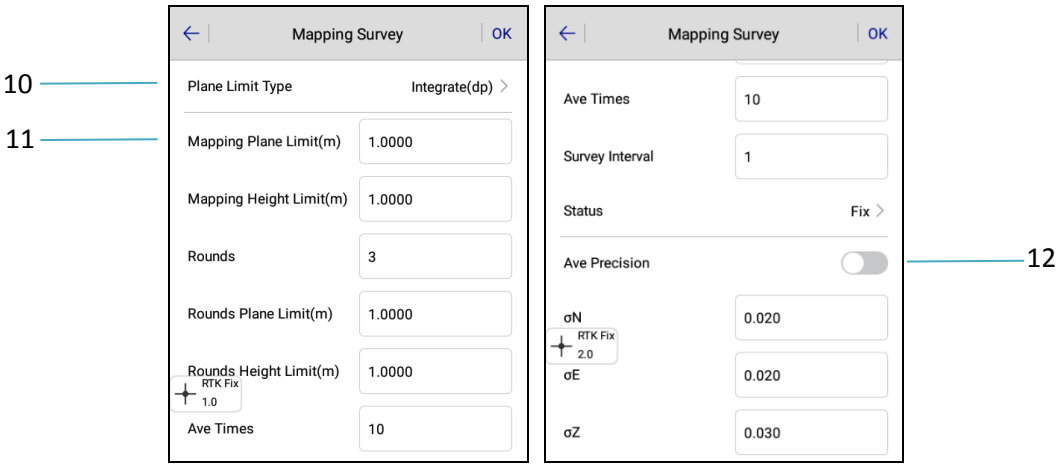


Figure 4-4-4 Mapping Survey Configure1 *Figure 4-4-5 Mapping Survey Configure2*

1-Edit point's name or it will automatically add by default

2-Input code of map point

3-Motherboard reset interval (s)

4-Average Progress per round

5-Motherboard reset progress

6-After the parameters are set, click Start

7-Click to select target high type, input target height

8-Measurement rounds and progress

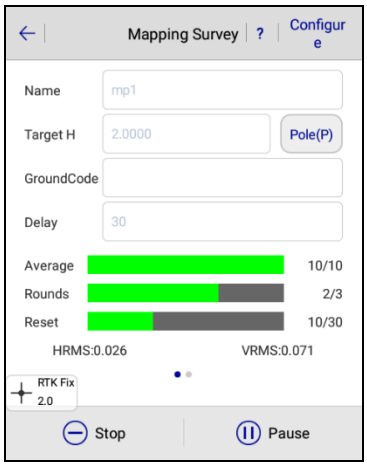
9-Stop or pause during mapping data collection

10-Select Plane Limit Type

11-When the plane limit typed is selected as the integrating, then the integrate is set here, conversely, it is each component

12-Press to open, you need to set Σn, σe, Σz precision.

During the collection process, swipe to the right in the *Mapping Survey* interface to view the detailed average data of the currently collected mapping data.



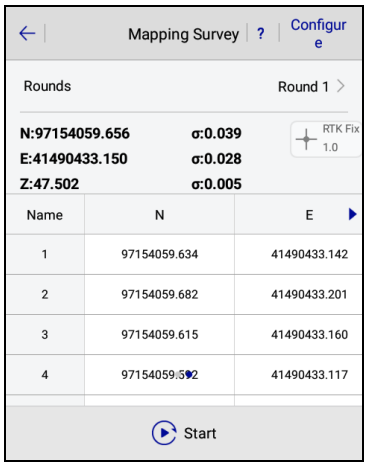
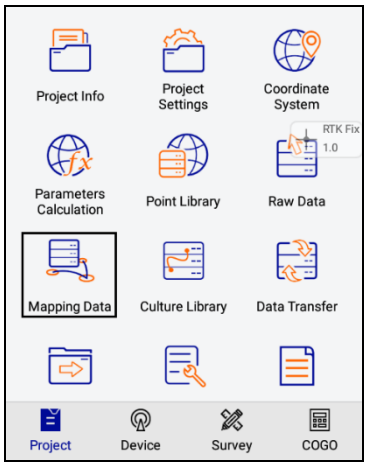
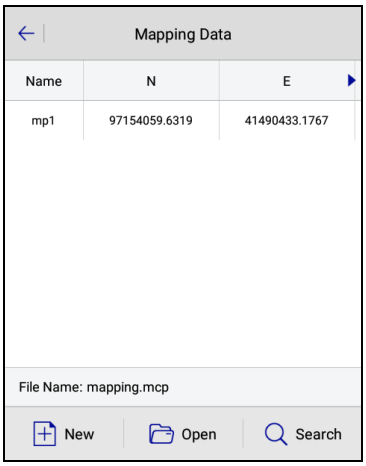


Figure 4-4-6 Stake Configure *Figure 4-4-7 Add Station Offset*

4.4.1 Mapping Data

Project interface → Mapping Data; you can view all mapping points, and you can also create, open, or search for data. Long press the mapping points to delete and edit.





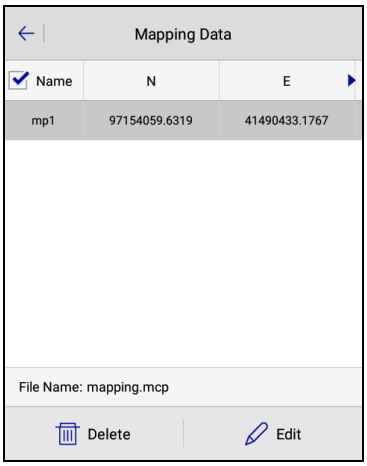


Figure 4-4-8 Mapping Data *Figure 4-4-9 Check Data* *Figure 4-4-10 Edit Data*

4.4.2 Mapping Survey Report export

Project interface → *Data Transfer*; click Mapping Data to export MappingPoint Report(*.html) or MappingPoint Report 2.0(*.html). The report shows Antenna HT, Storetime, and XYZ and BLH values the mapping point (the optimal value in 3 rounds, the optimal value of total data, and the average value of these 4 data), DX, DY, DH of each average point, Xrms, Yrms, Hrms, Dp-max, Dh-MAX, according to the Qualified rate(%) you can judge whether the point is available.

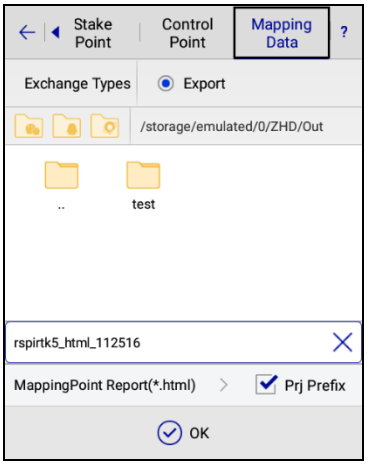


Figure 4-4-11 Mapping Data Export

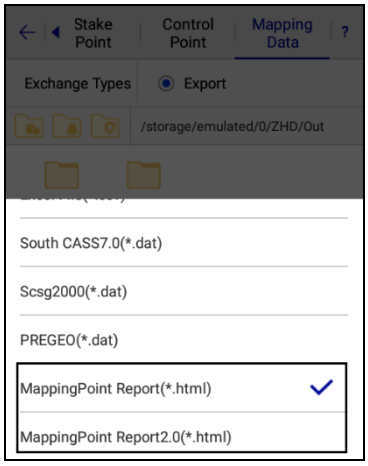


Figure 4-4-12 Mapping Point Report

Notice: Mapping Point Report is derived from the software's existing mapping survey calculation, and the result is consistent with the mapping data library. Mapping Point Report 2.0 is based on the averaging method and is inconsistent with the mapping data library.

4.5 Menu

Click the menu button of the controller in the *Detail Survey/Stake Point/Stake Line/Store Cross-section* interface; it will pop up a menu button for quickly jumping or data viewing between associated interfaces.

Figure 4-5-1 Connection Interface1 *Figure 4-5-2 Connection Interface2*

Click the menu button of the controller in the *Base/Rover* interface, to pop up the device icon to quickly jump to the device connection interface.

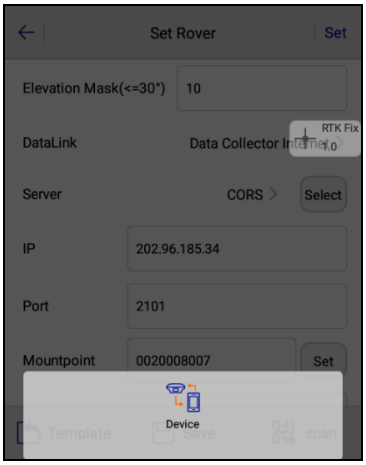


Figure 4-5-3 Connection Interface3

Road

This chapter contains:

- Operation procedure
- Stake road
- Road design
- Store cross-section
- Cross section Point
- Surface
- Elevation difference
- Surveying configure

5.1 Operation Procedure

The road engineering survey contains the route reconnaissance and design survey and road construction survey.

1. Route reconnaissance and design survey

Preliminary measurement: Control measurement. Measure the strip topographic map and profile diagram, collect geological hydrological data along the line, do the paper location or site location and make comparison plans to provide a basis for the preliminary design.

Decided measurement: Route centerline survey on the route of the selected design. Measure the profile diagram, cross-sectional profile, bridges and culverts, route crossing and facilities along the route to provide information for the construction design.

2. Road construction survey

Follow the design drawings to restore the road, measure the subgrade side piles and vertical curve, and do the project completion acceptance measurement.

5.2 Stake Road

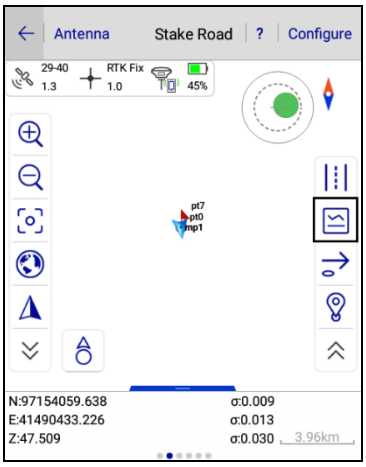
Stake road is the key function of Hi-Survey Road. The excellent working mode will make the surveying more efficient and systematic.

Stake roads and lines are mostly the same. The definition of the road is more complicated than the definition of the line, it will use the profile and cross-section to design the line, so the calculation is more complicated. But, relatively speaking, the difference between the stake road and stake line is only the operation of defining the line; point collection and staking-out operation are the same.

5.2.1 Load in the Road Data

The operation is as follows:

1. Click to enter the *Road Lib* interface. You can click *More* → *Import* to load the road or .xml file. You can also click *Add* to add the road manually.



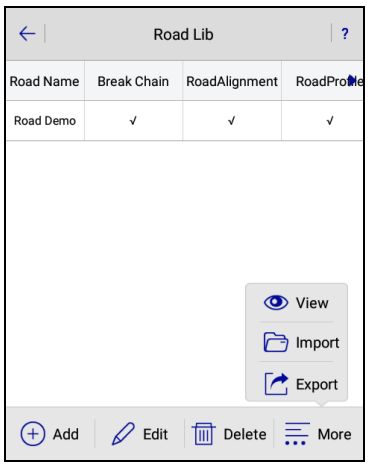
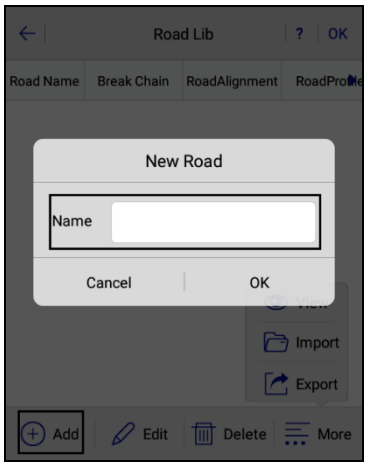
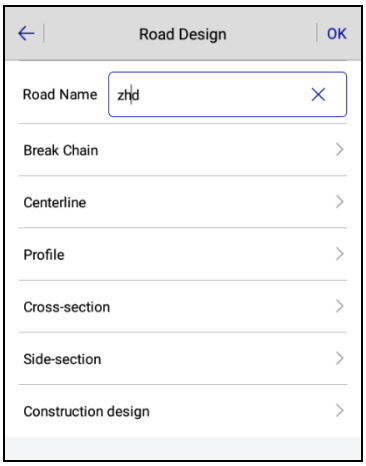


Figure 5-2-1 Stake Road *Figure 5-2-2 Road Lib*

2. When you add a new road, you can import the *Broken Chainage*, *Centerline, Profile, Cross-section*, *Side-section* or *Construction design* files. After each file has been imported, click *Apply* on the corresponding file interface.





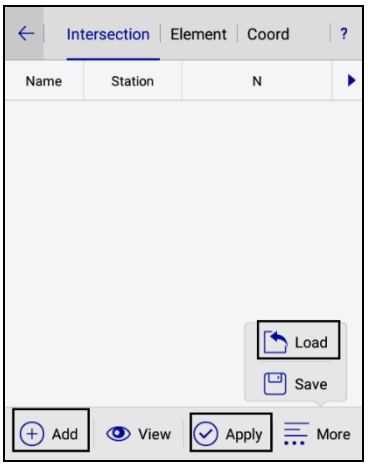
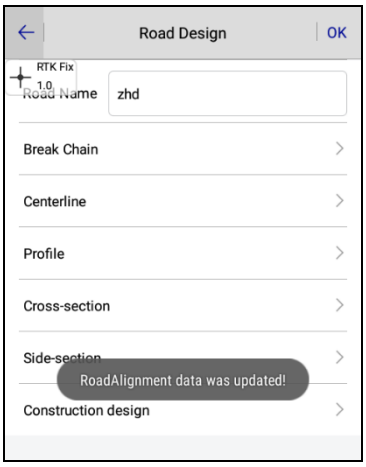


Figure 5-2-3 New Road *Figure 5-2-4 Road Design* *Figure 5-2-5 Intersection*

3. After successfully applying the design file, the interface will prompt that the *Road Alignment* data has been updated! Click *OK* to return to the *Road Lib* interface, which will prompt *Success*. To view whether the design file has been added click *Start Station, End Station* and *File Path* for easy verification.

4. Finally, select the road to be staked in the list, and click *OK* on the *Stake Road* interface for the stakeout.



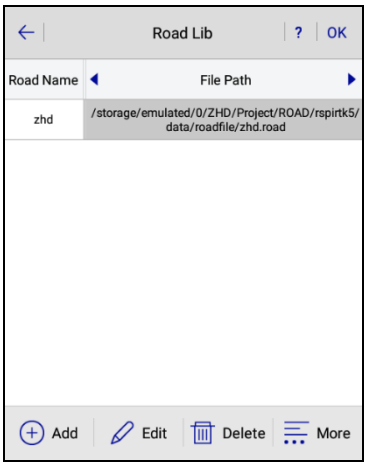
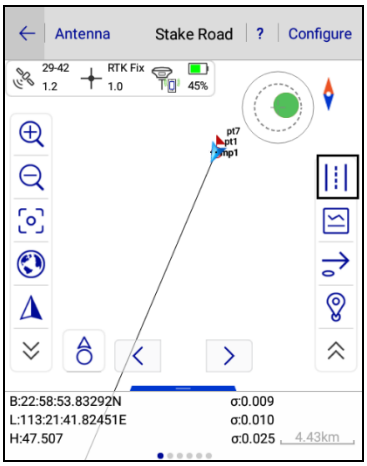


Figure 5-2-6 Road Alignment Updated *Figure 5-2-7 Road Information* *Figure 5-2-8 Road Path*

Click |⋮| to switch the perspective (top view or cross-section view of the road), and there will be the Side-section for users to choose if the side-section and cross-section are enabled. If there is no elevation for the profile, cross-section elevation collection and side-section staking-out can't be done. Because the elevation is unknown, it's impossible to get the height of filling and cutting.

In the cross-section view, the red dot indicates the corresponding position of the current position in the cross-section. In the upper left of the interface, the current real-time mileage and the offset from the centerline are displayed. At the bottom left of the interface, the height of filling and cutting is displayed.



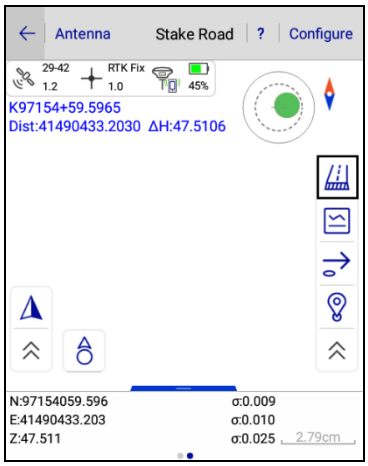
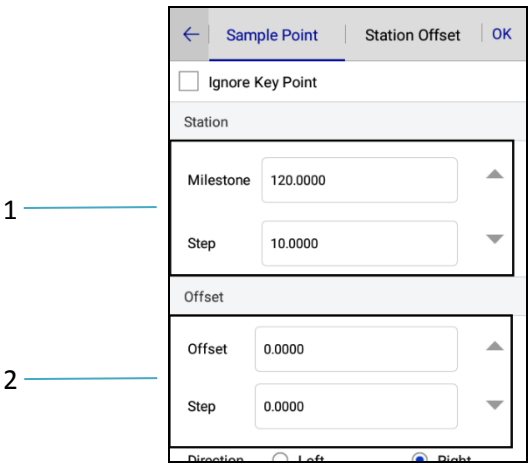


Figure 5-2-9 Top View *Figure 5-2-10 Cross-section View*

5.2.2 Confirm the location of Stakeout Points

Click *Sample Point* icon, input the mileage of point to be the staked. Among them, the *Milestone* and *Offset* will automatically accumulate according to the *Step*. Also, you can do the operation *Add, Edit* and *Import* for *Station Offset File*. Click *OK* to enter the stakeout interface. (For example, if you are currently in the *Sample Point* interface, the point with the set milestone and offset that you input will be staked when you click *OK* in the upper right corner. If you are currently in the *Station Offset* file interface, the point with the mileage and offset of the *Station Offset File* will be staked when you click *OK*.)



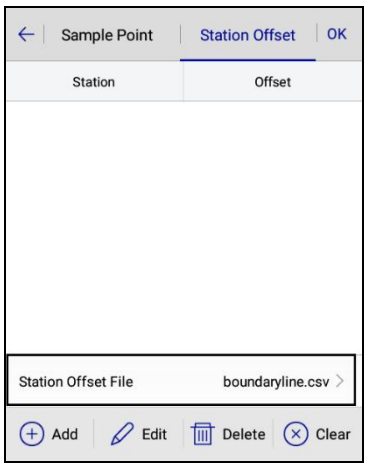


Figure 5-2-11 Sample Point *Figure 5-2-12 Station Offset*

1- Manually increase the *Milestone,* automatically increase *Step* each time clicking *Mileage*.

2- Manually increase the *Offset*, automatically increase *Step* each time clicking *Offset*.

Sample Point

Each time you enter this interface, the *Milestone* and *Offset* are automatically incremented by the *Step*. You only need to enter this interface to confirm the reduced data input negative value, and you can perform the stakeout work. If you need to make an adjustment, click the icon ▼ to reduce or click ▲ to increase it. Or you can manually input to complete the data input work.

Station Offset

You can set the *Station* and *Offset* by manually adding or editing, or you can directly import the edited *Station Offset File* (*.csv) for stakeout by directly operating *Add, Edit, Delete and Clear* for the contents.

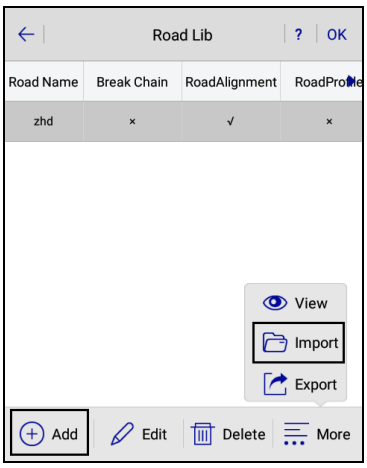
-Apply: Stake out the sample point; the *Stake Road* interface will display the dashed line connection between the current point and the staked point, as well as the stakeout indication.

5.2.3 Stakeout

This process is the same as the stake line operation.

5.3 Road Design

You can directly click the *Road Design* or *Road Designer File* in the *Stake Road* interface to enter the *Road Lib* interface, and then import, add or edit the road file (*.road). Each road file includes the *Road Name, Broken Chainage, Centerline, Profile, Cross-section, Side-section,* and *Construction design file*. You can load the corresponding design files according to your needs.



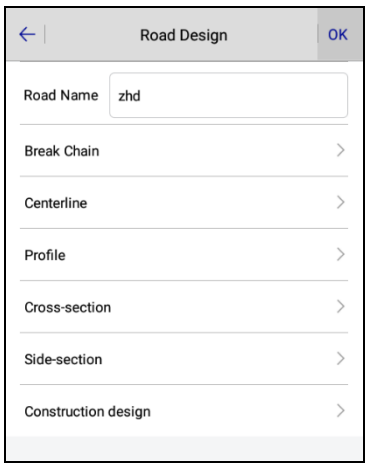


Figure 5-3-1 Import Road File *Figure 5-3-2 Road Design*

Broken Chainage: Only support *the Broken Chainage File*(*.BCP) file.

Centerline: Intersection method supports Point of intersection(*.PHI), Poling Data(*.CSV); Element methos supports Line Element File(*.sec), HDPM(*.pm), WDPM(*.pm), LandXML(*.xml) and Poling Data(*.CSV); Coord method supports Coord File(*.zline).
Profile: Support PVI file(*.PVI) and LandXML(*.xml).
Cross-section: Support Template File(*.TPL) and LandXML(*.xml).
Side section: Only support the BPI file(*.BPI).
Construction design file: Only support Construction File(*.BCI).
After the corresponding design file is loaded, click *More* → *View* to enter the line preview interface; click *Apply* to return to the *Road Design* interface and prompt that *RoadAlignment* data was updated! The *Profile* is taken as an example for the explanation below.

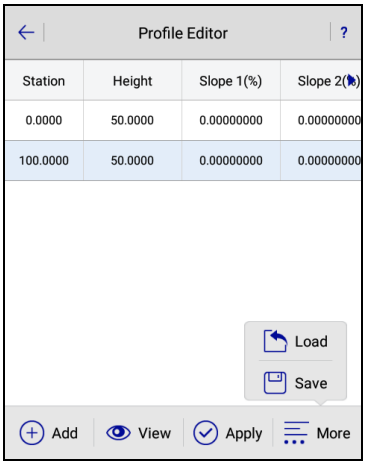


Figure 5-3-3 Profile Editor

Add: Input the *Station, Height, and Radius* manually to add the *Slope point data*.

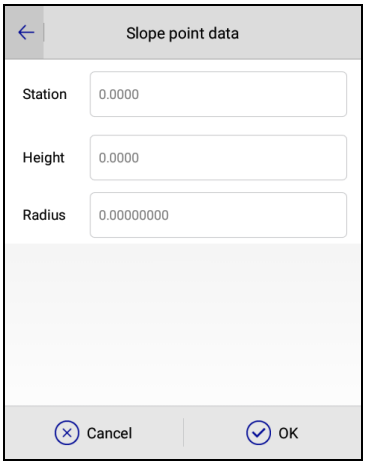


Figure 5-3-4 Slope Point Data

Load: Load the edited or saved slope point data.

View: View the slope point data in the list. Click the icon ⓘ on the right to display the detailed slope point information. Then input the mileage in the box below, and click *Check Station* to view the height value of the point which corresponds to the input mileage.

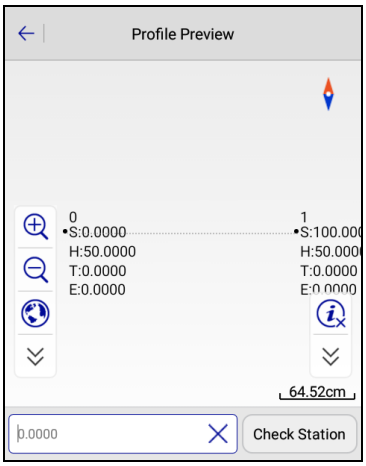


Figure 5-3-5 Profile Preview

Apply: After the profile design data has been loaded and edited, click *Apply* to update the latest current data. When the required design files are all completed, click *OK* to complete the design of the road file.

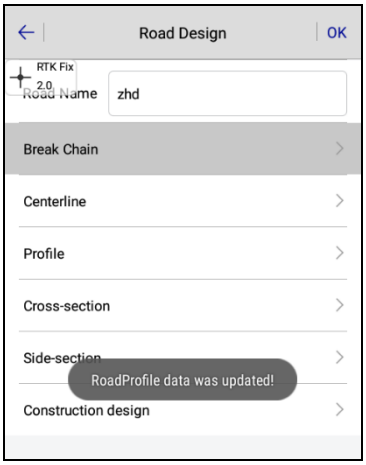


Figure 5-3-6 Profile updated

Save: After the profile design data has been loaded and edited, click *Save* to save the current data as a PVI file (*.PVI). The default save path is in the data/road profile folder under the current project file.

Long press data in the *Profile Editor* interface to *Delete, Insert* (insert a new slope point data before the point) or *Edit*.

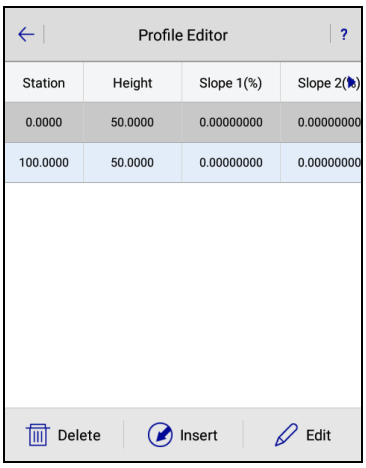


Figure 5-3-7 Profile Editor

Notice:

1.It's not possible to do the next mileage collection and stakeout without the centerline, and the slope cannot be staked out without the cross-section design line.

2.If there is no road when the user enter the road stake out interface from the main interface, the software will jump the road file list automatically. The user will can create or select road of the list to stake out. Meanwhile， it will prompt "Road data has not been defined, please set it first"

3.If the user return without any operation in the road files list, the software will return the road stake out interface and there is no road data to stake out.

5.3.1 Broken Chainage refers to when the station number is discontinuous due to local rerouting or segmentation measurement. The overlap of the stations is called a long chain, and the discontinuity of the station is called short-chain. Normally, the Broken Chainage will be marked directly on the Straight line, curve and corner table.

Click *Broken Chainage* to enter the *Broken Chainage Pile* interface. You can then add the Broken Chainage pile. Long press one date to delete and edit the pile. You can also *Load, Apply* and *Save* the *Broken Chainage File* (*.BCP).

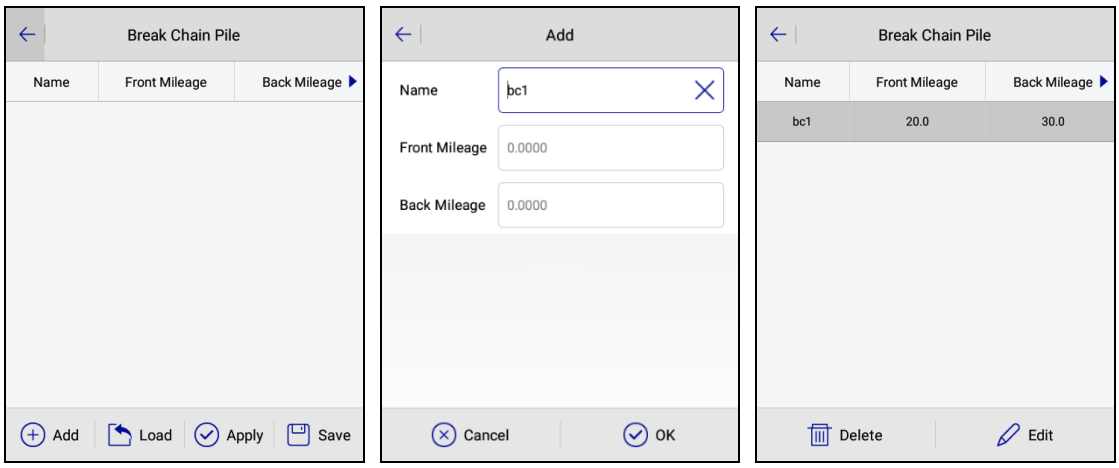


Figure 5-3-8 Broken Chainage Pile *Figure 5-3-9 Add Broken Chainage* *Figure 5-3-10 Edit Broken Chainage*

-Add: Click *Add* to add the Broken Chainage pile. Input the *Name*, *Front Mileage,* and *Back Mileage*, then click *OK*.
-Edit: Long press one data, click *Edit* to modify *Name, Front Mileage* and *Back Mileage* of the pile point, then click *OK*.
-Delete: Long press one data, click *Delete* to delete the selected Broken Chainage pile. The selected data can be deleted in batches.
-Load: Click *Load* to directly import an existing *Broken Chainage File* (*.BCP).
-Apply: After Broken Chainage pile has been loaded and edited, click Apply, it will return to the *Road Design* interface and prompt *Broken Chainage* data was updated!
-Save: Click *Save* to save the current Broken Chainage file in (*.BCP) format. The default saves path is *ZHD/Project/ROAD/Unnamed/data/road profile*.

5.3.2 Centerline

There are many methods for centerline, including *Intersection, Element,* and *Coordinate*. The intersection method is based on certain conventions (for example, a single intersection line defines the combination of line elements in the intersection point as *Spiral Curve→Arc→Spiral Curve*), which has certain restrictions on the type of lines. The element method can combine line shapes arbitrarily, supporting complex curves, including oval lines, multi-intersection curves, and imaginary intersection points, etc.. And it supports for polyline but .sec file will lose polyline corner information. The coordinate method is similar to the *Element* method, but the definition of each line element is determined by defining coordinates of the start and endpoint. The line element format (*.sec) files won't contain the polyline corner information, so if the polyline corner information is needed, please save the file as the Coord File (*.Zline) format.

Hi-Survey Road supports the *Intersection, Element* and *Coordinate* methods and the default line element combination within the intersection is the straight line → the first spiral curve → arc → the second spiral curve.
It supports the smooth spiral curve, and the non-smooth spiral curve supports the transverse import.

Notice:

1. Two spiral curves can be asymmetrical.

2. The reverse loop needs to be treated as a non-reverse loop, such as adding an intersection.

3. It supports the imaginary intersection point.

4. It supports the local curve, and the spiral curve length can be zero.

1. Intersection method

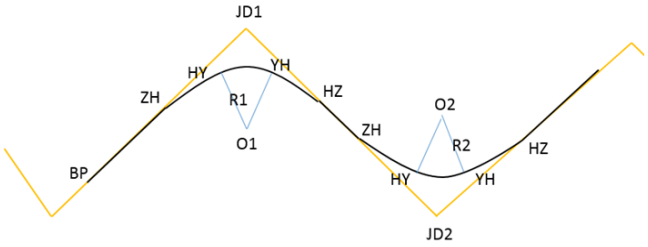


Figure 5-3-11 Intersection Graph

-Intersection JD1/JD2: The intersection of two adjacent lines.
-ZH: The point where the straight line intersects with the first spiral curve, that is, the start point of the first spiral curve.
-HY: The point where the first spiral curve intersects with the circular curve, that is, the endpoint of the first spiral curve.
-YH: The point where the circular curve intersects with the second spiral curve, that is, the start point of the second spiral curve.
-HZ: The point where the second spiral curve intersects with the straight line, that is, the endpoint of the second spiral curve.
-ZH-HY: The first spiral curve.
-YH-HZ: The second spiral curve.
-HZ-ZH: The straight line.
-HY-YH: The arc.

Click Intersection to enter the intersection table data-editing interface.

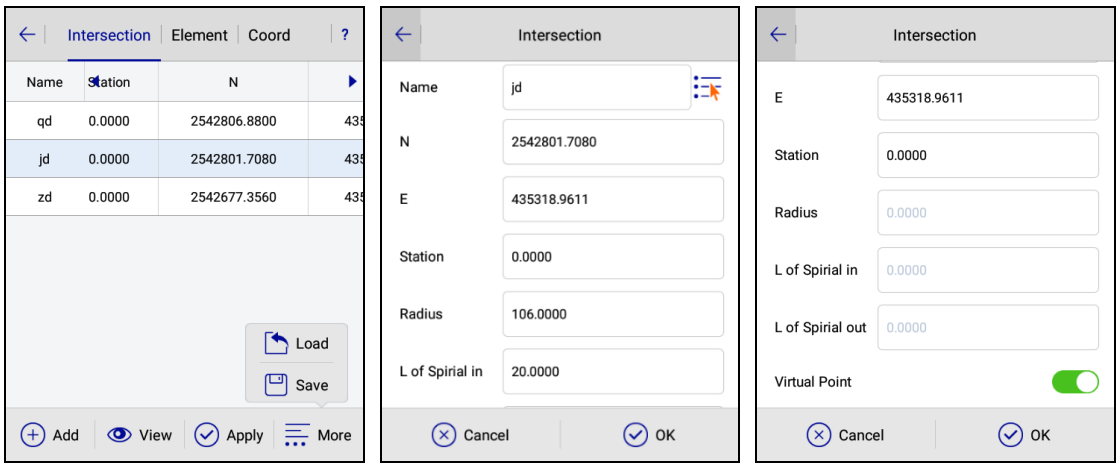


Figure 5-3-12 Intersection *Figure 5-3-13 Intersection Parameters* *Figure 5-3-14 Virtual Point*

-Add: Add intersection data, input the *Name, N, E, Station (only need to input the mileage of the first two points), Radius, L of Spiral in and L of Spiral out*, according to the Straight line, curve and corner table. If the radius and spiral length are known, input the value; if none, no need to input.
-Load: The user clicks “load” and selects the corresponding design data of the following format data Points of intersection(*.PHI), Poling Data(*.CSV), XY File (*. XY), HYDL File(*.hjd), Road design Table (*.xls, *.xlsx), Surveyor Table (*.xls, *.xlsx).
When select the intersection method, can load in Poling Data(*.CSV), Surveyor Table (*.xls, *.xlsx) to initialize intersection.
When select the element method, can load in the element file as Line Element File(*.sec), HDPM(*.pm), WDPM(*.pm), Poling Data(*.sec), Elcad(*.ICD), Road design Table (*.xls, *.xlsx), Surveyor Table (*.xls, *.xlsx).
-View: Check whether the centerline is right.
-Compute: Input Station and Offset; it can check the coordinates; input the coordinates, calculate the station and offset.
-Detail: Click to enter the interface to check the detail parameters, including the *Intersection Points, Line Element* and *Key Pts*.
-Input Limit Point: Click to input the limit point manually. Users can also select it from the point list or do a real-time collection to get the point.
-Change Line: Click to choose the point to be changed (start and endpoints are not selectable), and change it by Manual input or Select from map.
- Road Export Setting Transition Point: Click to view corresponding auxiliary points and auxiliary dashes in the figure.

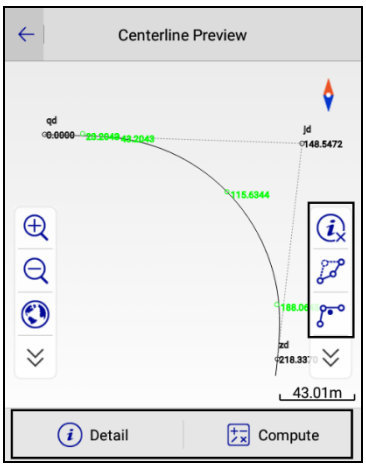
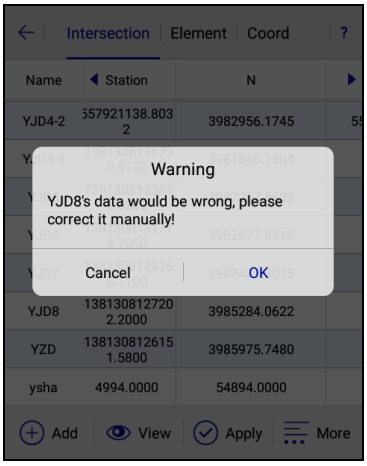


Figure 5-3-15 Centerline Preview

-Apply: The intersection file is saved in (*.PHI) format. The default save path is in the data/road profile folder under the current project file.
-Insert: Insert intersection data above the selected point.
-Edit: Edit the intersection data that has been entered

When the software encounters the data of the suspected oval curve, it will automatically recognize it. After manually changing the red marked data according to the prompt, click *OK* to apply the check.



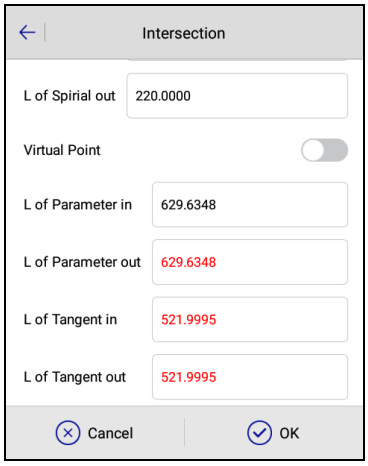
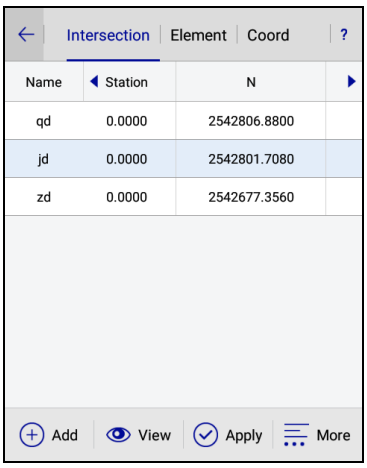


Figure 5-3-16 Warning *Figure 5-3-17 Modify Wrong Data in Red*

When involving the virtual intersection, return curve (turning over 180 degrees), the *Element* method can support, in addition, the Intersection method supports *Virtual Point* switch.
The first point of the virtual cross combination is normally entered, and after the second point is input, open the *Virtual Point* switch.



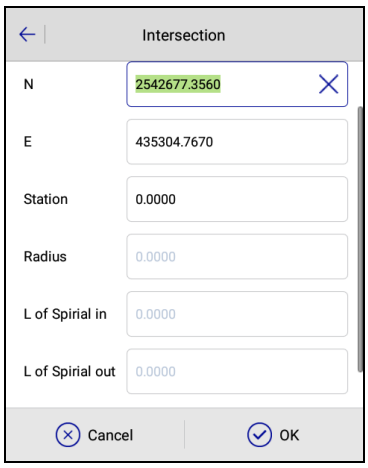


Figure 5-3-18 Intersection Points *Figure 5-3-19 Add Intersection Point*

-Delete: Delete the existing intersection point.

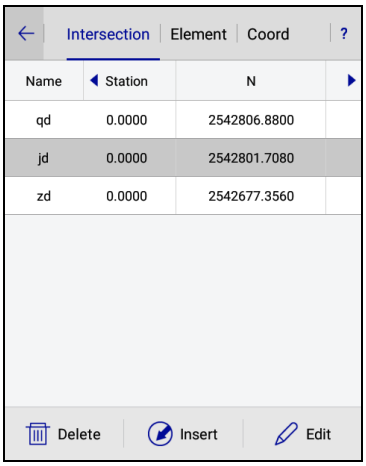


Figure 5-3-20 Edit Intersection Points

2. Element method

Element alignment decomposes the combination of complex route lines into several linear units. If there is information (coordinates, tangential direction, the radius of curvature, etc) about the starting point of the route plane curve, the unit that extends in any direction can be set from the start point, and the endpoint information of the unit can be calculated. Then the end of this unit can be used as the starting point for the next unit.

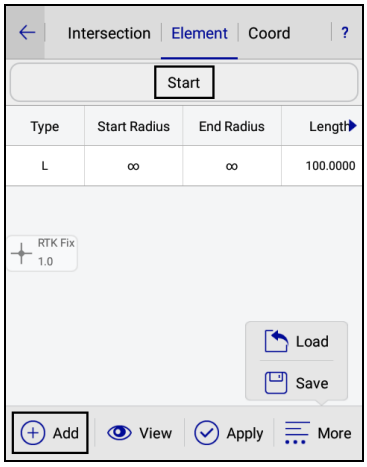
Common lines contain the straight line, arc and spiral curve. Users can input the line manually or load files directly, including the Line Element File (*.sec), HDPM (*.pm), WDPM (*.pm), LandXml File (*.xml) and Poling Data (*.CSV) formats.

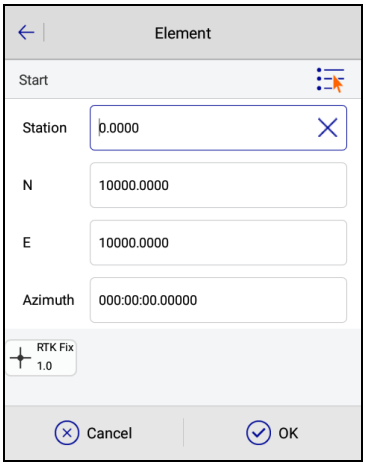
In the general working process, users need to input the coordinates of the starting point, *Station* and *Azimuth.* Click *Add* to choose the line type and input the information.

-Line: Expressed by L, input the *Length, Start Offset,* and *Start Azimuth*.

-Arc: Expressed by A, input the *Start Radius, Length, Direction, Start Offset, and Start Azimuth.*
-Spiral Curve: Expressed by S, input the *Start Radius, End Radius, Length, Direction*, etc..

In the online element method, the radius of the start and endpoint should be specially treated for the oval shape (the common palliative curve). To solve the correct radius of the start and the graph for incomplete gentle bending:
A×A÷[A×A÷R－Ls]
It is suggested that you use Poling Data (*.CSV) for fast-import. Just add two columns of slow bending parameters, A1 and A2, behind Poling Data (*.CSV), and click load to build the oval curve line.
Click *Start* to enter the element interface to edit the start point.





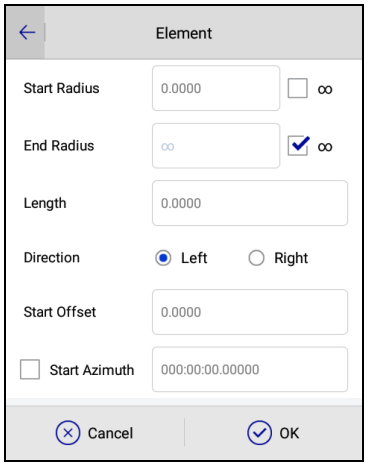
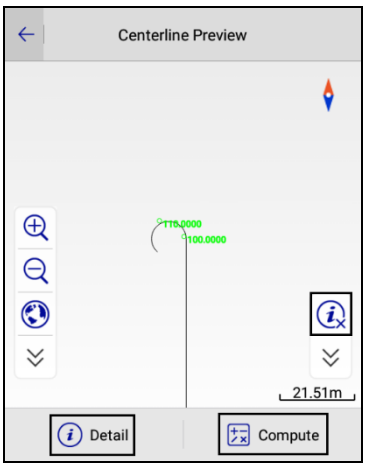


Figure 5-3-21 Start Point *Figure 5-3-22 Start Point Information* *Figure 5-3-23 Add Element*

Click *View* to preview and edit the centerline, enter the mileage in the box at the bottom right corner.
-Calculate: Input mileage and offset, check the coordinates; input coordinates, you can calculate back-projection distance and offset.
-Details: It can display detailed curve elements of the line, including line segment type, feature point coordinates, starting distance, starting position and other parameters.



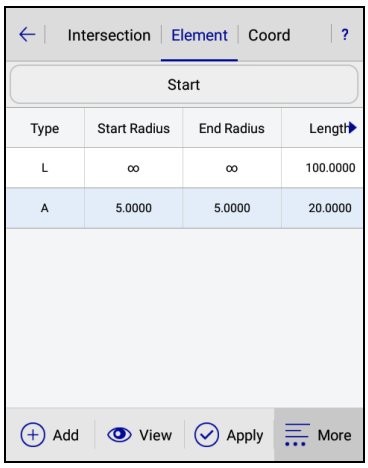
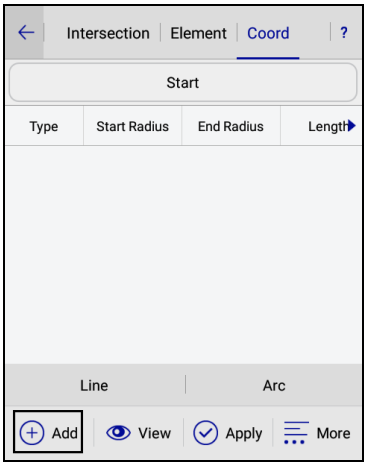


Figure 5-3-24 Centerline Preview *Figure 5-3-25 Element*

3. Coordinate method

The coordinate method is similar to the element method, but the definition of each line element is determined by defining coordinates of the start and endpoint. It can only load the *Coord File* (*.Zline) format.
In the general working process, users need to input coordinates of the start and endpoint.
Click *Start* to input the station and coordinate manually
Click *End* to input the station and coordinate manually, or select from the point list.
Click *Add* to choose the line type to input the line information.

-Line: Input the coordinates of the start and endpoint.
-Arc: Input coordinates of the start and endpoint, radius (∞ represents infinity, means Line), direction (the previous direction is the reference direction of deflection).



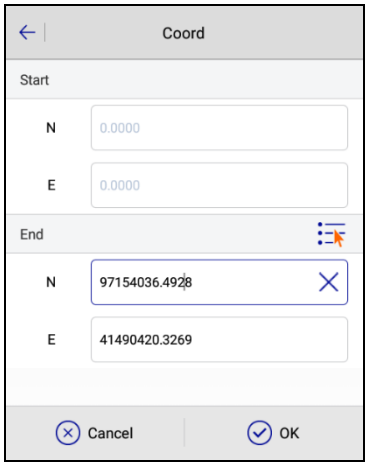
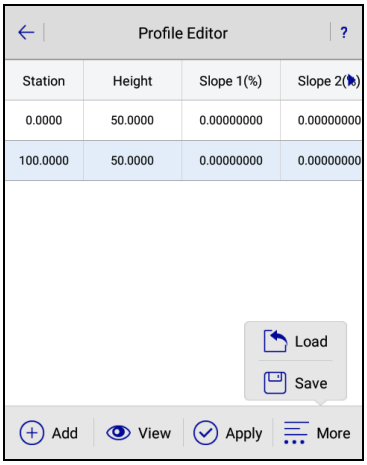


Figure 5-3-26 Add Coordinate Data *Figure 5-3-27 Input Coordinate*

5.3.3 Profile

The profile is an expression of the vertical movement of the road (the line fluctuates). It can be added manually, and users also can load the file in the PVI file (*.PVI) or LandXml File (*.xml) format.



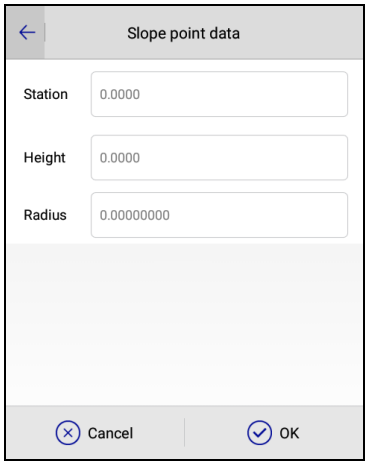


Figure 5-3-28 Profile Editor *Figure 5-3-29 Slope Point Data*

In the general working process, click add slope to change point data, including *Station, Height,* and *Radius* (radius of the vertical curve). All slope change point elements of the line are added in the sequence of mileage.
Click *Add* to add the slope point data and Long press the record to delete, insert or edit it. Click *View* to check the profile preview, and click *Check Station* to input the station value to check the height of the station.

5.3.4 Cross-section

The cross-section interface contains three options, including *Standard, SuperEle,* and *WidePlus*. Users can add, edit and delete the cross-section data. Here are two types of slope ratio inputs, percentage or ratio.
1. Standard

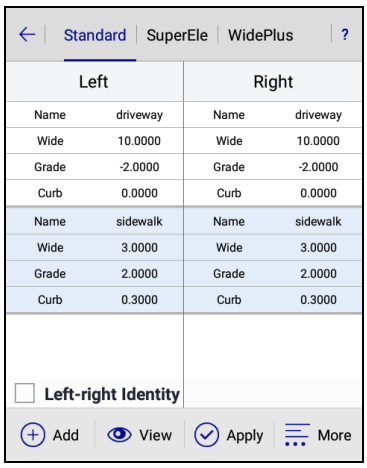


Figure 5-3-30 Standard *Figure 5-3-31 Template Editor*

-Name: The name of the current plate.
-Grade: From the middle of the road, uphill is positive and downhill is negative. The slope value is the ratio of the height difference between the two ends of the plate and the width of the plate.
-Wide: The width of the current plate.
-Curb: Click to input the height difference of the curb.
-Left-right Identity: The selection indicates that the left and right slopes are consistent, and the right slope data will be covered with data symmetrical to the left slope (the original right slope data will be covered and cannot be recovered).
In the general working process, click *Add* to define the cross-section, select slope ratio input mode, slope ratio, and width, and click display to check whether the graph is correct after editing.
-Check station: Enter station value to view the specified mileage profile
-Cross Line Info: Click ⓘ to view the detail cross line information.

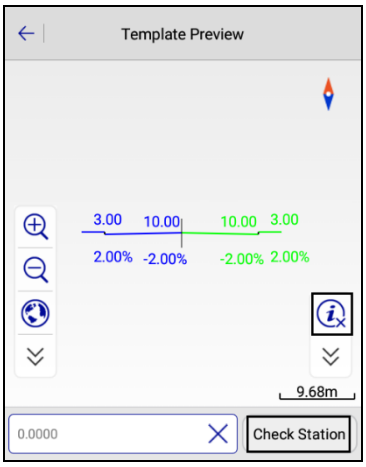
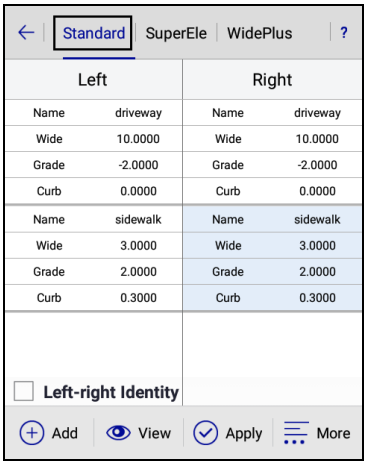


Figure 5-3-32 Template Preview

Notice: There is only one cross-section in memory. A road has different cross-sections at different road sections. Users can predefine several typical cross-sections according to their needs, and then transfer the cross-sections suitable for the terrain in different sections to stake out.

2. SuperEle

This is a way to make the road a lateral high-internal one-way cross slope in order to reduce the centrifugal force generated by a vehicle driving on the curve road.
Select the cross-sectional block corresponding to the SuperEle.



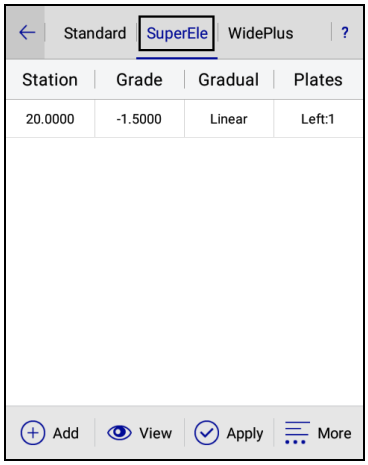
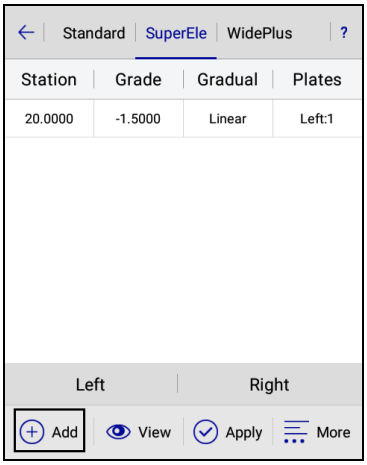


Figure 5-3-33 Standard *Figure 5-3-34 SuperEle*

The motor vehicle is set to be SuperEle as an example.



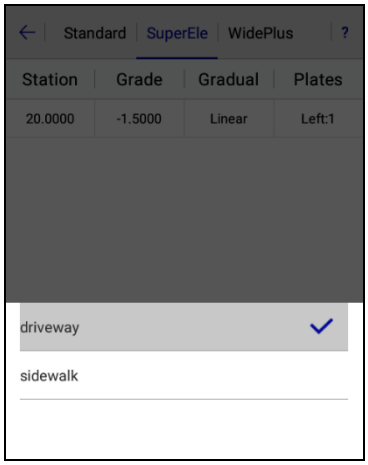
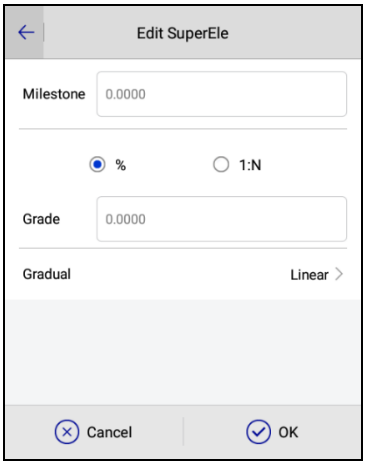


Figure 5-3-35 SuperEle *Figure 5-3-36 Add SuperEle*

If the SuperEle change points on the drawing are read as follows:

SuperEle change point 1: Milestone 20 Grade -1.5%
SuperEle change point 2: Milestone 30 Grade 2%
SuperEle change point 3: Milestone 40 Grade 2%
SuperEle change point 4: Milestone 50 Grade -1.5%



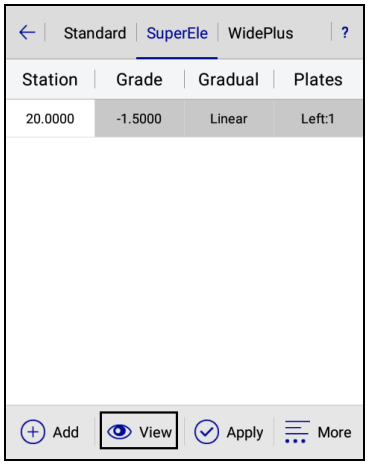
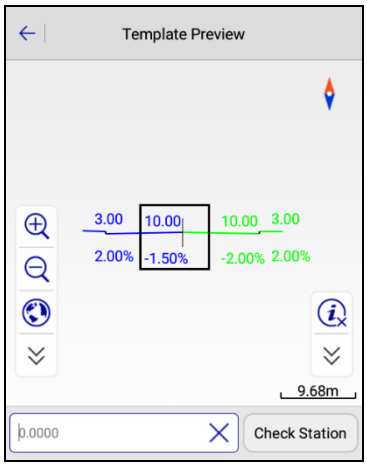


Figure 5-3-37 Edit SuperEle *Figure 5-3-38 View SuperEle*

Click View to check it after adding SuperEle points.
Enter the *Milestone* in the lower right box and click *Check Station* to view the cross-section in the corresponding milestone.



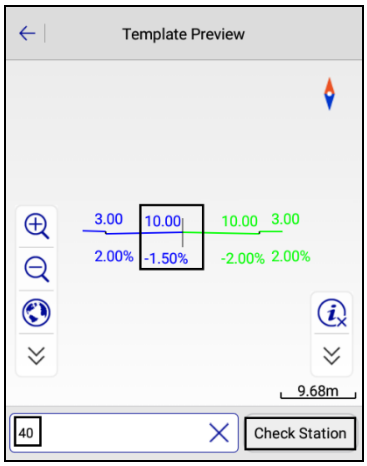
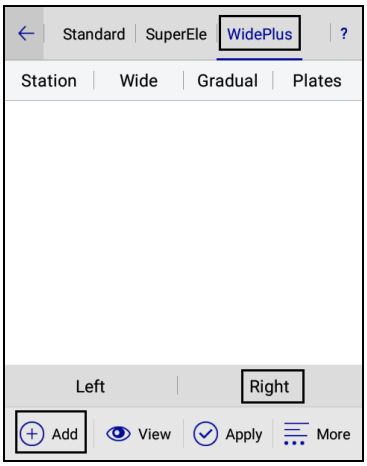


Figure 5-3-39 Template Preview *Figure 5-3-40 Check Station*

3. WidePlus

In order to change the road surface from the normal width to a curve, a widened width is set, so a transition zone of curve widening needs to be set. In the transition zone of curve widening, the road surface gradually varies in width. There are different setting methods of different road properties and levels.

In the *WidePlus* interface, users can input the widening change point information, according to the design drawings.
If the *WidePlus* change points on the drawing are read as follows:



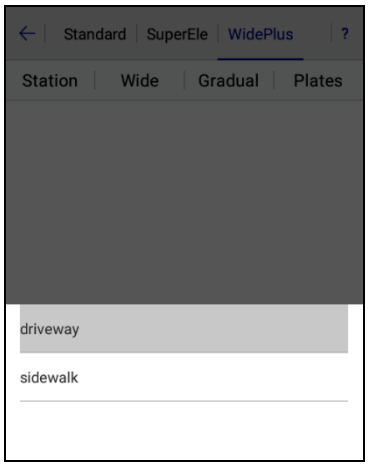
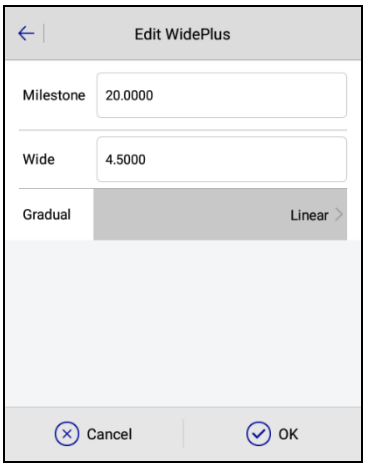


Figure 5-3-41 WidePlus *Figure 5-3-42 Add WidePlus*

WidePlus change point 1: Milestone 20 Wide 4.5
WidePlus change point 2: Milestone 30 Wide 5.2
WidePlus change point 3: Milestone 40 Wide 6
WidePlus change point 4: Milestone 50 Wide 5.2
WidePlus change point 5: Milestone 60 Wide 4.5



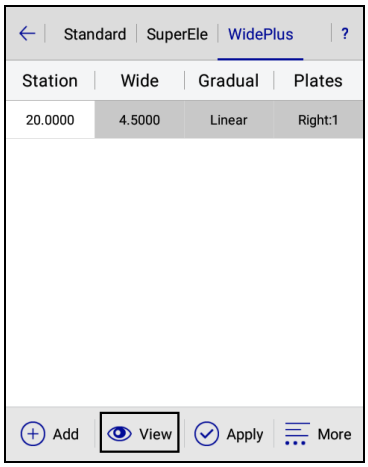
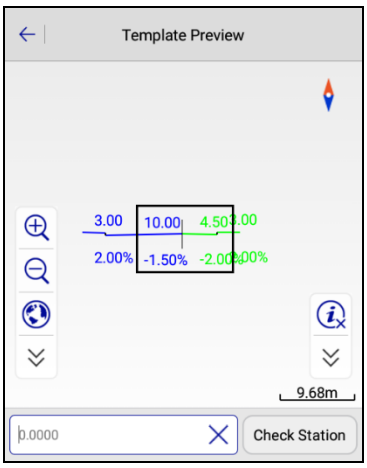


Figure 5-3-43 Edit WidePlus *Figure 5-3-44 View WidePlus*

Click *View* to check the template preview, and input the station value to check it.
Enter the mileage in the lower right box and click *Check Station* to view the cross-section in corresponding mileage.



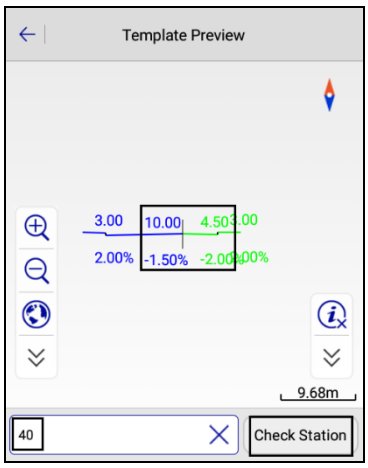


Figure 5-3-45 Template Preview *Figure 5-3-46 Check Station*

Notice: Users can switch *Standard, SuperEle and WidePlus* interfaces to view road data, and click *Apply* on any of the three interfaces to apply the current cross-section (*Standard* + *SuperEle* + *WidePlus*) to the road after confirmation. Users can also click *More* → *Save* to save it as the Template File (*.TPL) for subsequent loading and reuse.

5.3.5 Side-section

In the Side-section interface, users can add, load, apply, and save the side-section.
-Add: Click to choose and add the *Fill* or *Cut*. Input the side-section name, and edit the side-section features.

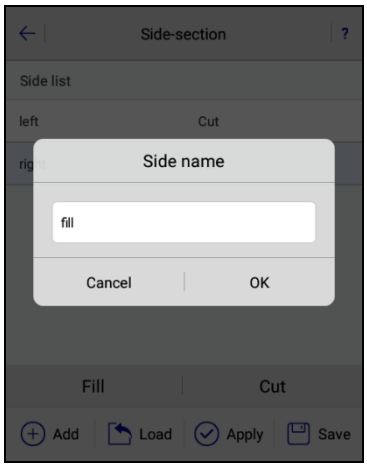


Figure 5-3-47 Side-section *Figure 5-3-48 Add Side-section*

-Load: Click to load the BPI File (*.BPI), and the side-section list will show all the section information in the current file.

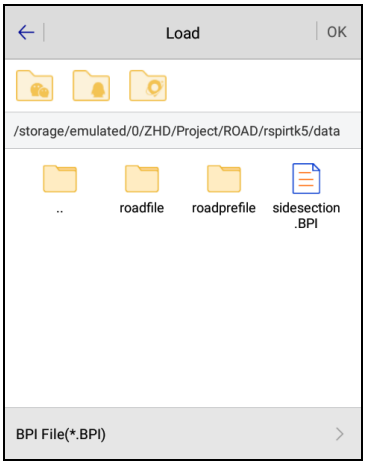
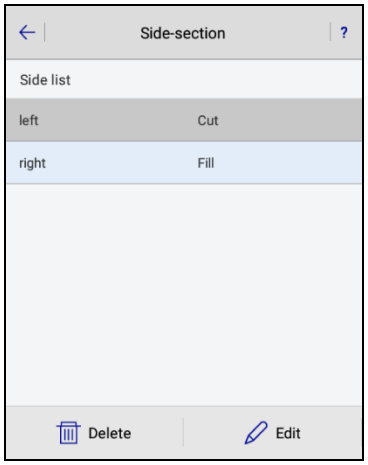
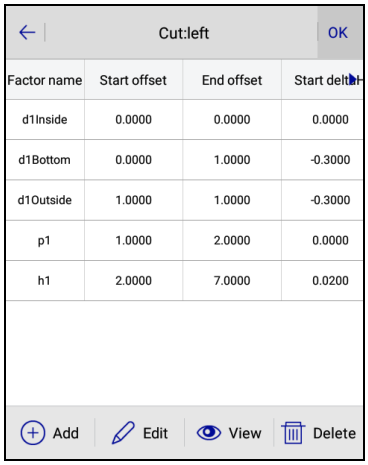


Figure 5-3-49 Load BPI File

-Apply: Click to apply the slope in the current side-section list to the current project road, and it will prompt Use data successfully.
-Save: Click to save the file in the BPI File (*.BPI) format. And the saved *.BPI file can be loaded successfully.

-Delete or Edit: Long press the record to delete or edit the side-section information. Click *Delete* to delete the selected side-section data. Click *Edit* to do the operation *Add, Edit, View* and *Delete* for the information such as *Factor name, Start deltaH* and so on. In the interface, click *Add* on the bottom, *Hillslope*, *Platform,* and *Ditch* will be displayed.





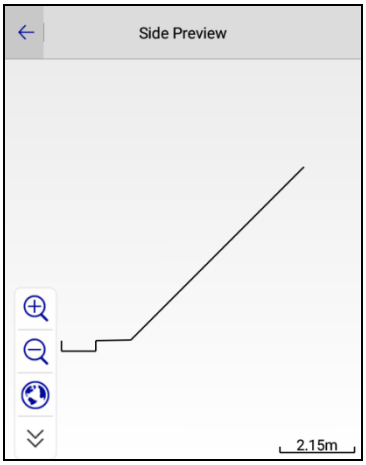
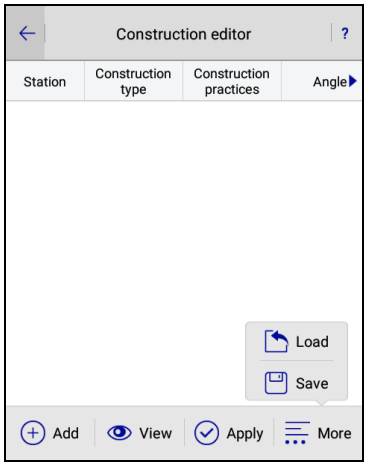
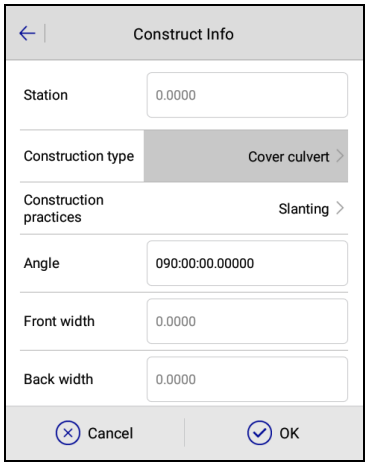


Figure 5-3-50 Side-section *Figure 5-3-51 Cut* *Figure 5-3-52 Side Preview*

5.3.6 Construction Design

Click Construction design to enter the editing interface. Hi-Survey Road supports four types of *Cover culverts, Circular culverts, Passageway* and *Footbridge*, and supports two methods: *Slanting* and *Straight*.





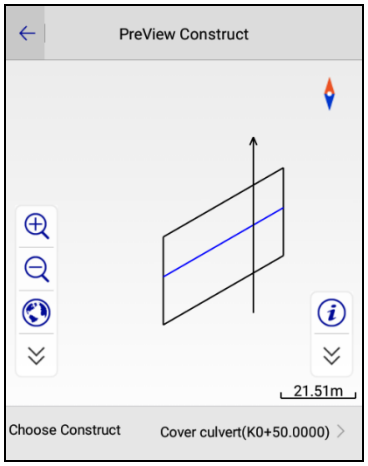


Figure 5-3-53 Construction Editor *Figure 5-3-54 Construct Info* *Figure 5-3-55 Preview Construct*

-Add: Click *Add* to select the construction type and construction practice on the *Construct Info* interface, input the *Station, Angle, Front width, Back width, Left length, Right length, Center height,* and *Slope*, click OK.
-View: Click *View* to enter the construction preview interface, you can view the designed construction graphic. Click the selection bar below to switch the multiple construction graphic display.
-Apply: Click *Apply* to refresh the data.
-More: Click *More* to load the construction design file or save the designed construction.

5.3.7 Road Data Export

The road data will export in the road library.
The steps as below:
(1) Select the road in the road list, click “more→export” to export the road file.

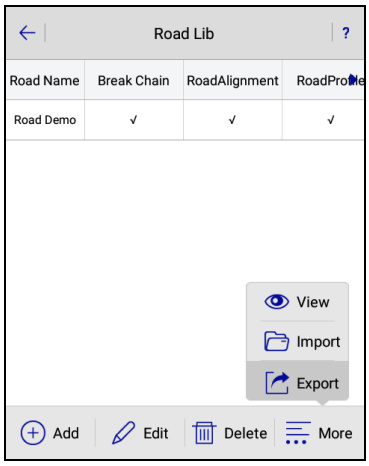


Figure 5-3-56 Export interface

(2) The default export format is Center Station File (*.csv). Click the Set button to enter the Road Export Setting interface and display the information of Start Sta, End Sta, Station Interval, Sequence Rule. Set and export the contents of each center station by customizing the relevant configuration. Then click OK to return to the Export interface, and export the data according to the settings.

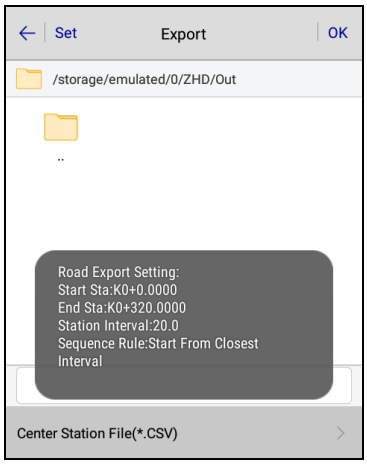


Figure 5-3-57 Center Station Data Export

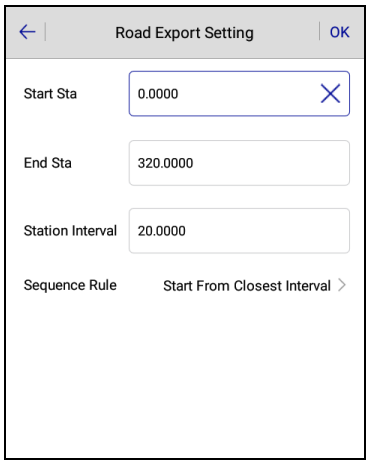


Figure 5-3-58 Road Export Setting

(3) Click the bottom enter the Line Element File(*.sec) export. The Set button of left corner will not be displayed.

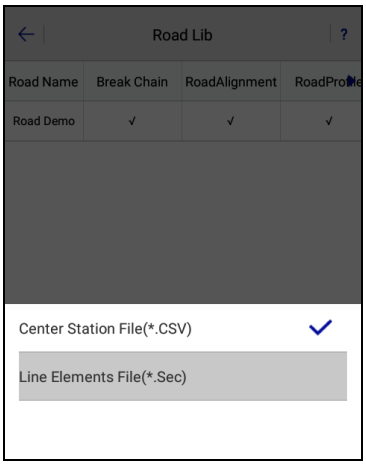


Figure 5-3-59 Line Elements Data Export

(4) Input the name of the data in the box and click “OK” to export the data.

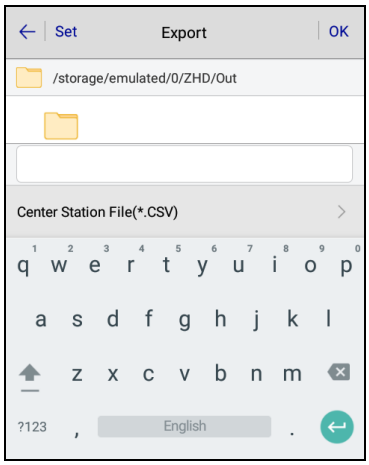


Figure 5-3-60 Name interface

5.4 Store Cross-section

Figure 5-4-1 Store Cross-section

Click Road Designer File to load existing files, then input the mileage, it will automatically calculate the cross-sectional position at that mileage, and display a dashed line as a reference line on the graph. When approaching this reference line, the software will calculate the distance between the current position and the reference line. If the distance is less than the setting value of the cross-sectional tolerance (the value can be set in *Configure* → *Data* → *Cross-section Precision*), users can do the cross-section point collection.

-Define: Click to define a specified mileage of the cross-section and input other settings. It will automatically calculate the cross-sectional position, at that distance, and display a dashed line as a reference line on the graph.

-Store: Click to collect points and input the cross-section information. If the *Center Point* is selected, the point will be used as the reference point of the cross-section. The cross-section point library will store the horizontal elevation of other points on the cross-section relative to the center point (each section must define a section mileage and collect the center point, otherwise the section points collected in this section will be invalid, or users need to add the center point manually afterward).
-Road Designer File: Click to load existing files
-Switch View: Click to switch to the cross-sectional view and check it.
-Intersection: Click to jump to intersection survey interface, please refer to *Tool Chapter*.

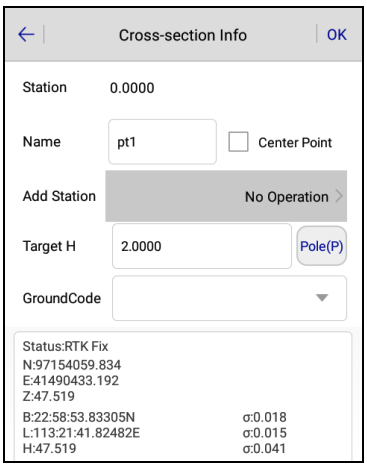


Figure 5-4-2 Cross-section Info1

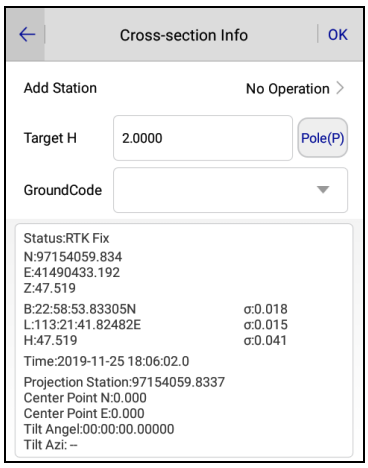


Figure 5-4-3 Cross-section Info2

When adding or subtracting mileage for the next sample point during cross-section collection, add feature point for judgments.

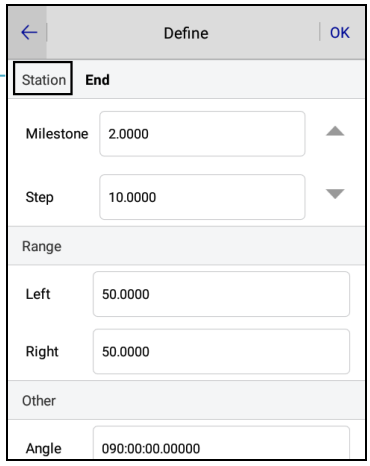


Figure 5-4-4 Define

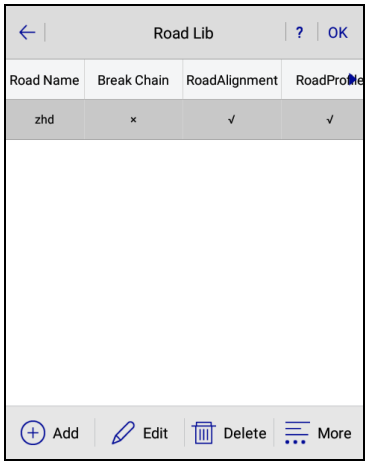


Figure 5-4-5 Road Lib

Figure 5-4-6 Top View

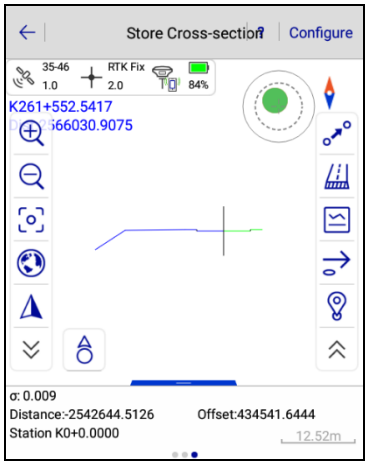
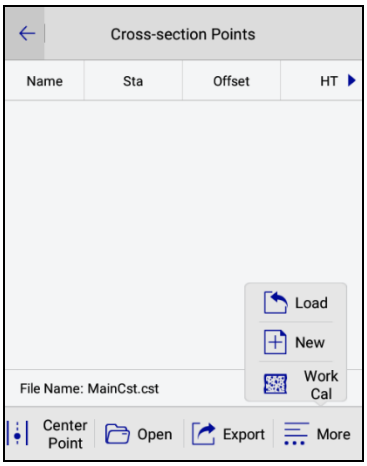


Figure 5-4-7 Cross-section View

Notice: The mileage prompt and feature point judgment function makes it easy for you to check whether the current section has been collected to prevent missed measurement when collected the current mileage section and entering the next mileage collection.

5.5 Cross-section Points

Cross-section data can be edited and managed in the *Cross-section Points* interface.



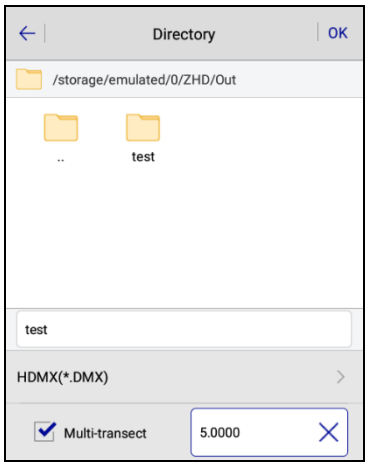
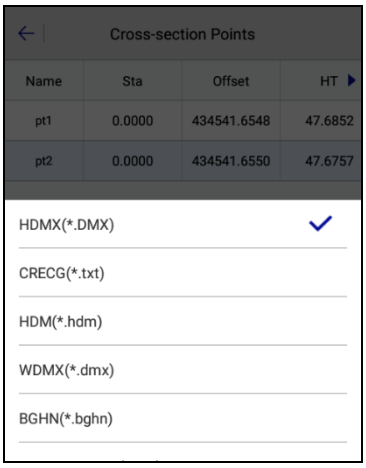


Figure 5-5-1 Cross-section Points *Figure 5-5-2 Output Directory*



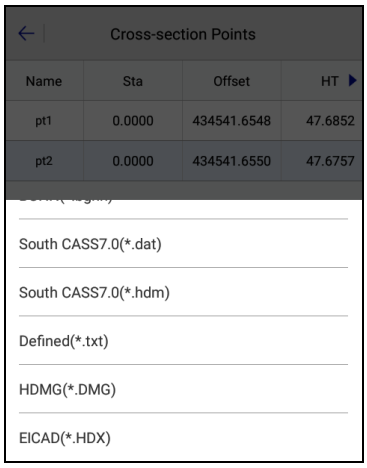


Figure 5-5-3 Format1 *Figure 5-5-4 Format2*

-Center Point: Click to add the center point.
-Open: Open other point files in the project.

-Export: Export files to other data formats, including HDMX (*.DMX), CRECG (*.txt), HDM (*.hdm), WDMX (*.dmx), BGHN (*bghn), HDMG (*.DMG), South CASS7.0 (*.dat), South CASS7.0 (*.hdm), Defined (*.txt) and EICAD (*.HDX).
-Load: Load and merge cross-section data in current or other projects.
-New: Create a new cross-section points file in the project.
-Work Cal: Click to enter the *Earthwork Calculation* interface.
In the *Earthwork Calculation* interface, it will load all the cross-section points by default to the calculation list.

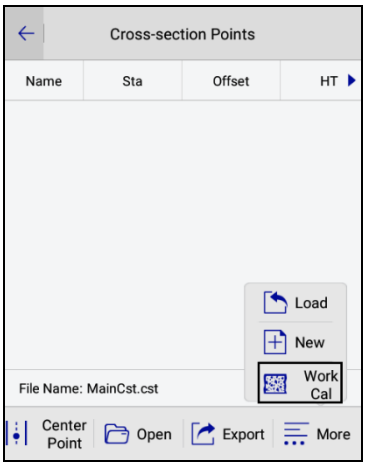
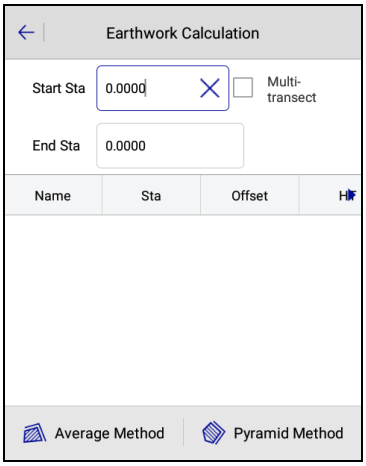


Figure 5-5-5 WorkCal

Click the point name to choose whether to participate in the calculation.

The earthwork calculation requires at least two cross-section points and corresponding center points within the range of start and end mileage. If the Multi-transect mode is selected, please input the projection distance limit in the input box. The result of the calculation is the amount of earthwork between the two cross-sections that are closest to the start and end mileage.



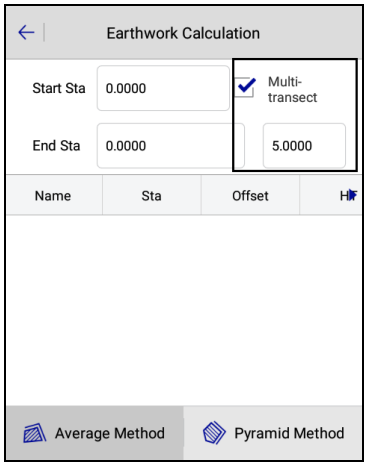


Figure 5-5-6 Earthwork Calculation *Figure 5-5-7 Multi-transect*

The earthwork calculation provides two methods, the *Average Method* and *Pyramid Method*.

The average method is simple and practical, but accuracy is not good. When the adjacent cross-sectional areas have a large difference, the pyramid method is more accurate.

5.6 Surface

This function is to design the DTM surface. Users can manage, add, delete, edit, import and preview the DTM surface.

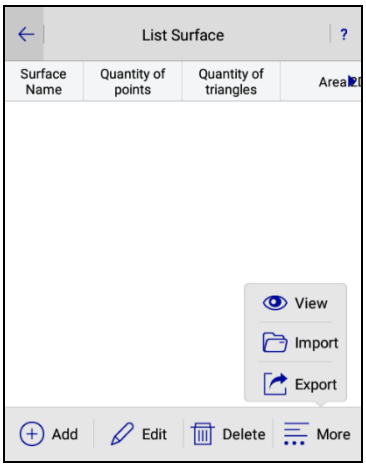
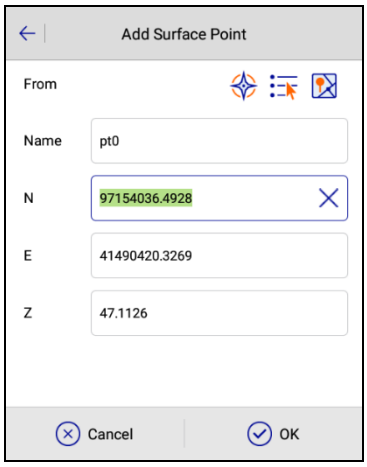
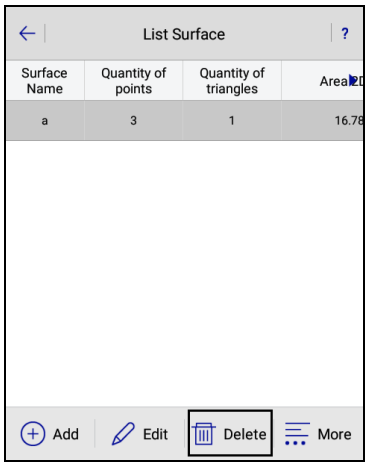


Figure 5-6-1 Surface

-Add: Click to add the surface. Set the surface name, point name and coordinate. The point information can be obtained from real-time acquisition, point library or map selection. A DTM surface should contain no less than three points.





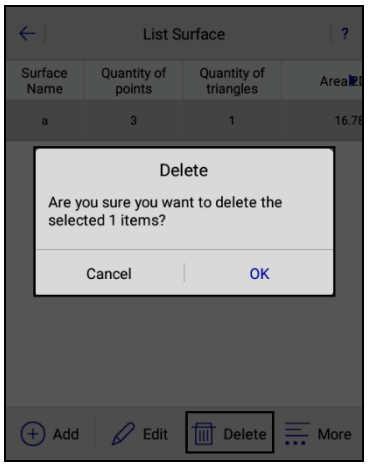
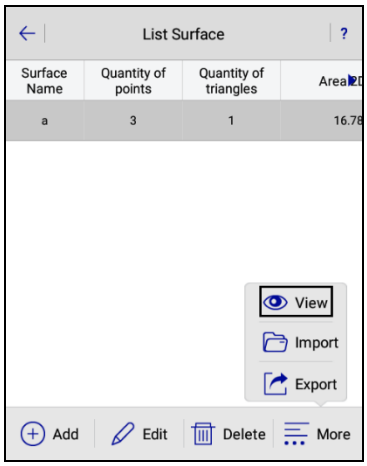
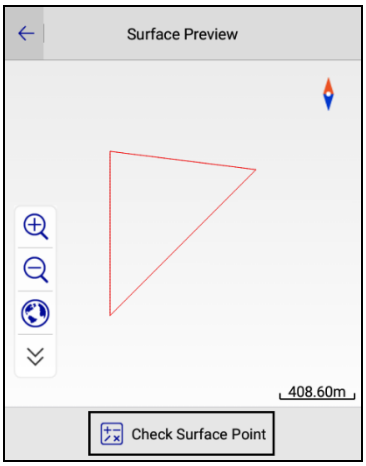


Figure 5-6-2 Add Surface Point *Figure 5-6-3 Delete* *Figure 5-6-4 Delete Prompt*

-Delete: Delete existing surfaces. Long press the surface in the library list to delete it. When the selected surface is being staked out, it cannot be deleted.
-Edit: Edit existing surfaces. Long press the selected surface point to delete or edit it.
-Import: Import the surface file which will be added to the list. You can import surface files across projects. The file format supports the Hi-Target file (*ttin), CASS file (*.sjw), and LandXml file (*.xml).
-Export: Click to export the surface file in the CASS Format (*.sjw) format saved in *ZHD/OUT* by default.
-View: Select or create a new surface, and then check it in the *Surface Preview*.
-Check Surface Point: Calculate the elevation of the input point. If the point is not on the surface, it can't be calculated. If the point is on the surface, click *OK*, the point will be saved in the Stake Point library and the *GroundCode* will be *Check Surface Point*.





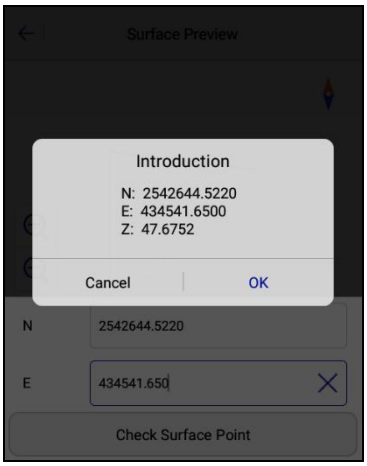
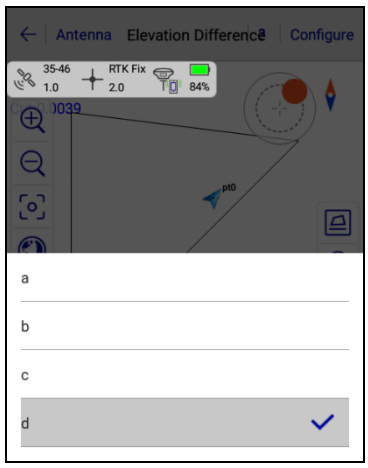


Figure 5-6-5 List Surface *Figure 5-6-6 Surface Preview* *Figure 5-6-7 Check Surface Point*

-Batch: Add points from the point library in batches, check the box in the front of the point name to select all the points.

5.7 Elevation Difference

This function is to calculate the elevation difference between the current point and the fitted point of the selected surface.
Click *Stake Surface Lib* to choose the surface to stake out, then it will display the TIN grid information in real-time. The *Fill* value will be displayed on the top left, and the coordinates and detailed height will be displayed on the bottom slide bar.



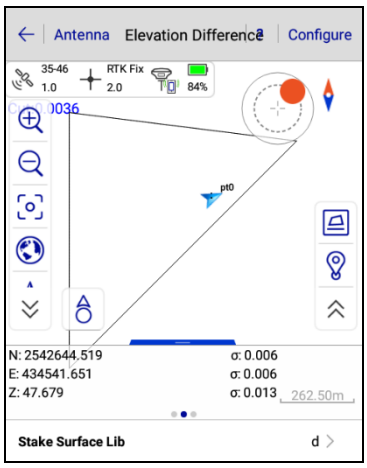
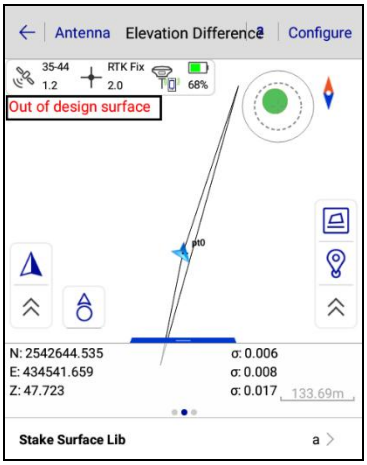


Figure 5-7-1 Choose Surface *Figure 5-7-2 Elevation Difference*

The upper left corner of the interface displays the *Real H* and *Design H* in real-time. If the current point is not in the selected surface range, it prompts *Out of design surface.*



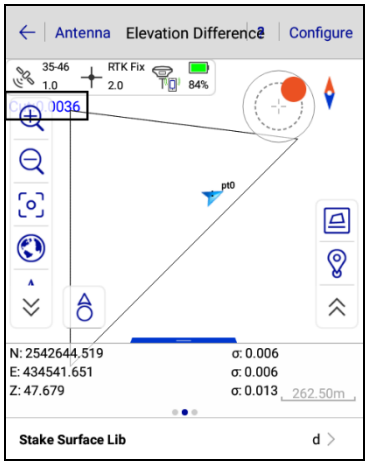
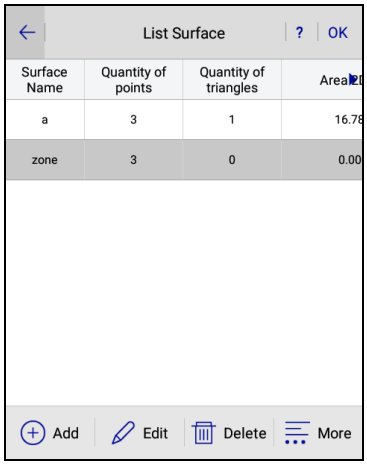
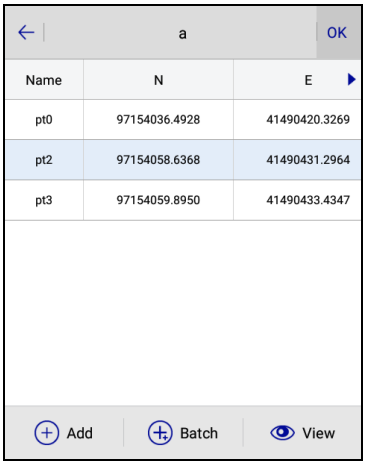


Figure 5-7-3 Out of Surface *Figure 5-7-4 Within Surface*

At the same time, you can click the *List Surface* to enter the surface library interface (you can also click the *Surface* module to enter the surface library interface), manually add surface or import known surface (support file import in specific directories), quickly edit the design surface information.





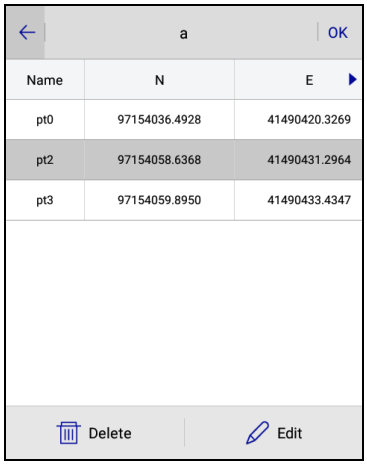
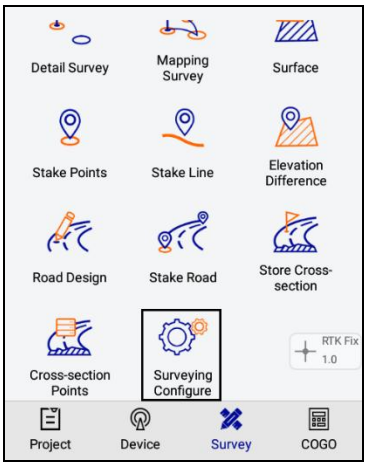


Figure 5-7-5 Surface List *Figure 5-7-6 Surface Point* *Figure 5-7-7 Edit Surface Point*

5.8 Surveying Configure

The surveying configuration is a common menu that is used to configure the graphical display of the work interface, including the road and general survey configuration of the *Detail Survey, Stake Points*, *Stake Line, Stake Road, Store Cross-section* and *Road Design*.
(Common functions also include: *Zoom In, Zoom Out, Zoom Center, Zoom All, Single Record, Average Record*, unified introduction in this chapter, other chapters will not be introduced).



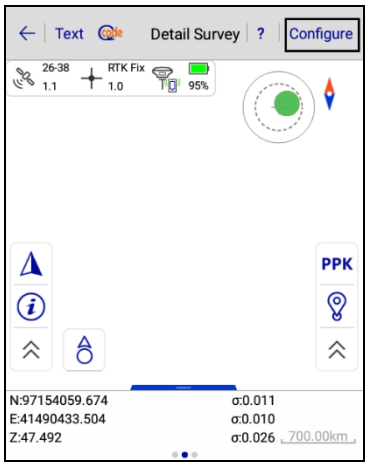


Figure 5-8-1 Surveying Configure *Figure 5-8-2 Configure*

5.8.1 Display

Surveying Configure → *Display*: set the display item of the general survey to turn on or off.
Store Cross-section interface → *Configure*: includes *Road Survey Config* and *General Survey Config*.
-Road Survey Config: includes *Cross-section Point* and *Roadline Transition Point*.

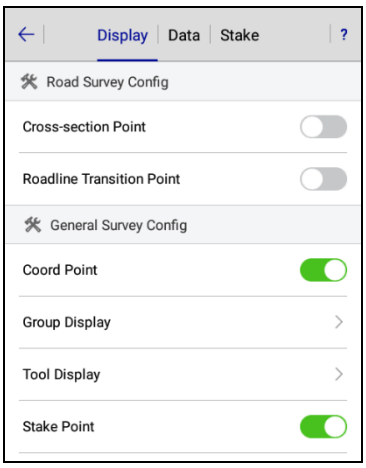
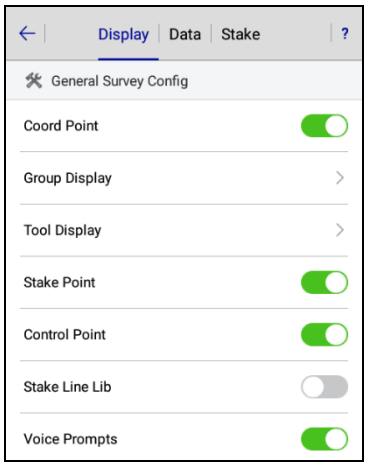
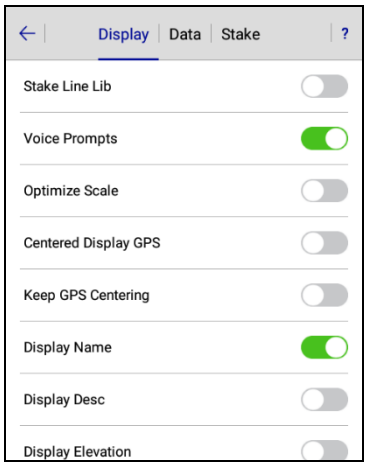


Figure 5-8-3 Display Configure of Cross-section

-Cross-section Point: Select whether to display the point name of the cross-section point during the road collection.
-Roadline Transition Point: Turn on this button, the Cross-section stakeout interface will display the slope and width information while the road stakeout interface will display the boundary line of road of the sample points combination. The positive offset points will connect to the right boundary line according to the mileage order while the negative offset points will connect to the left boundary line according to the mileage order. Otherwise, it will not display.

-General Survey Config: Coord Point, Stake Point, Control Point, Stake Line Lib, Voice Prompts, Optimize Scale, Centered Display GPS, Keep GPS Centering, Display Name, Electronic Bubble, Real-time Mileage, Dis to last Coord Pt, Fix Direction, Controller Dir, Display Color and Online Map.





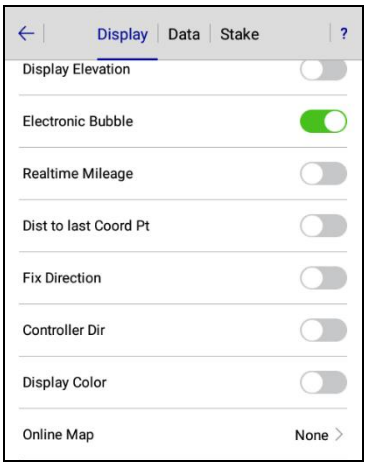


Figure 5-8-4 Display Configure1 *Figure 5-8-5 Display Configure2* *Figure 5-8-6 Display Configure3*

-Coord Point: Choose whether to display the coordinate point name.
-Group Display: The points with the same description code can be displayed with one group. There are many groups to display all the coordinates.

-Tool Display: The *Tool Display* can show or hide icons of the *Detail Survey, Stake Points, Stake Line, and Elevation Difference* in the left and right toolbar. Entering the *Tool Display* configuration, the user can select to display or hide the module and the location of the module.
The left side of the tool menu is an optional display, and the right side is the selected display. Click the icon on the left side to add the tool to the selected display on the right, and you can delete or move the selected display tool. If the resident box is checked, the tool will not be hidden by the shrink in the corresponding interface.

Click *Tool Reset* to restore the default display configuration of the software and click OK to complete the tool display configuration.

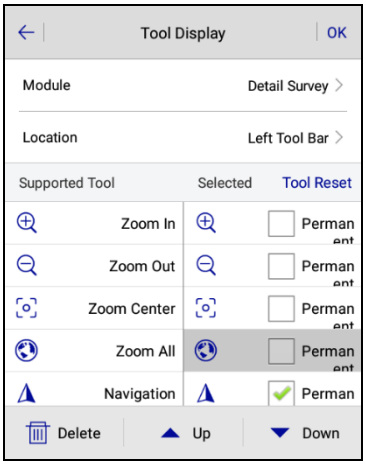
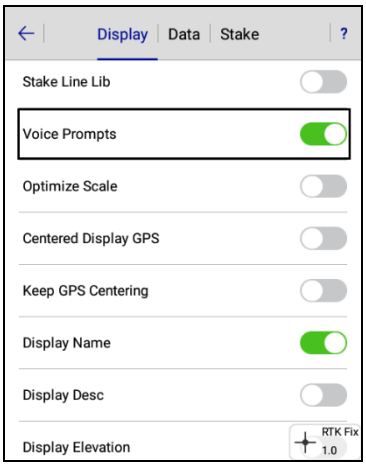


Figure 5-8-7 Tool Display

-Stake Point: Choose whether to display the stake point name.
-Control Point: Choose whether to display the control point name.
-Stake Line Lib: Choose whether to display the stake line library.
-Voice Prompts: Choose whether to open the voice prompts. Users can record user-defined voice prompts in the *.wav format: the file storage path is *ZHD/Sounds*.



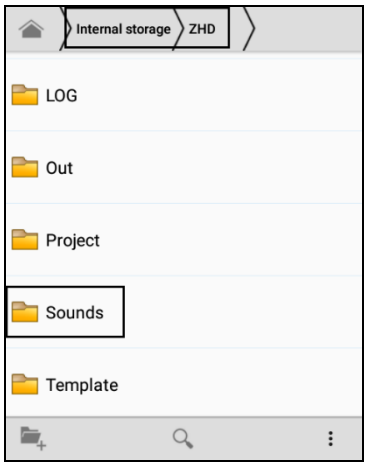


Figure 5-8-8 Voice Prompt *Figure 5-8-9 Sound File*

Customized file names have prescribed formats, including fixed.wav, losefix.wav, savedone.wav, stakereminder.wav and stakedone.wav.

-Optimize Scale: Choose whether to automatically adjust the scale to the right size. When enabled, it will automatically adjust the screen display based on the coordinate range in the coordinate data, and the Centered Display GPS and Keep GPS Centering will be invalid.
-Centered Display GPS: When the current point is not in the screen display range, the current point will be automatically centered.
-Keep GPS Centering: The current point is always in the middle of the screen.
-Display Name: Choose whether to display the point name.
-Display Desc: Choose whether to display the description code (name should be displayed first).

-Display Elevation: Choose whether display the elevation (name should be displayed first).

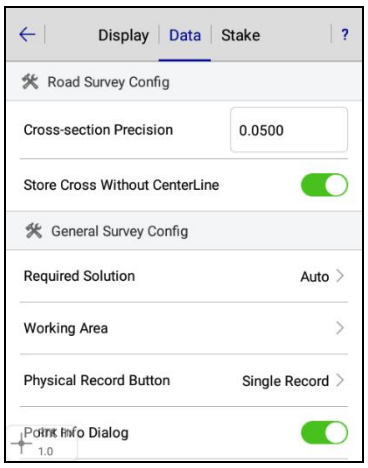
-Electronic Bubble: Choose whether to display the electronic bubble. When it's not displayed, the inclination won't participate in the acquisition accuracy judgment.
-Real-time Mileage: Select whether to display the current real-time mileage value in the Stake Line and Stake Road interface.
-Dis to last Coord Pt: Select whether to display the distance to the last point.

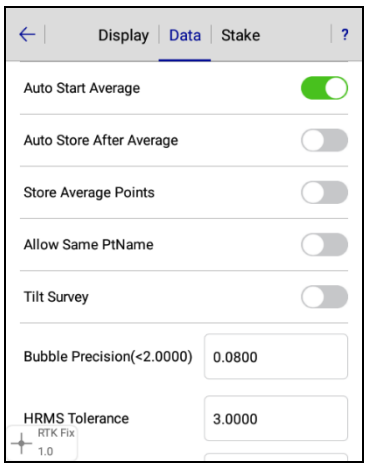
-Fix Direction: Smooth the sample over a period of time, and the calculated direction value will be relatively stable to reduce the irregular beats in direction.
-Controller Dir: After selecting, click *OK* as prompted to keep the controller screen upward, and move the controller according to the prompt to complete the calibration. Then return to the survey interface; the direction of the current point will be the direction of the controller.

-Display Color: Select whether the map is displayed in the feature color.
-Online Map: Select Google map as the base map for surveying or stakeout. Make sure the network is connected and it has updated to the latest Google service.

5.8.2 Data

The data configuration contains the *Road Survey Config* and *General Survey Config.*
-Road Survey Config: includes *Cross-section Precision* and *Store Cross Without Centerline*.
-Cross-section Precision: the default value is 0.0500m.
-Store Cross-section without centerline: Turn on the switch to directly capture the mid-pile and cross-section points in the cross-section without centerline file.
-General Survey Config: *Required Solution, Working Area, Physical Record Button, Point Info Dialog, Auto Start Average, Auto Store After Average, Store Average Points, Allow Same PtName, Tilt Survey, Bubble Precision (<2.0000), HRMS Tolerance, VRMS Tolerance, Stake Tolerance, Stake Prompt in, Mileage Tolerance, PtName Increasing by and No Fixed Prompt in(s).*





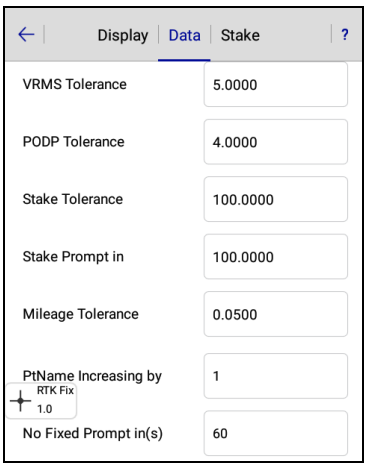


Figure 5-8-10 Data Configure1 *Figure 5-8-11 Data Configure2* *Figure 5-8-12 Data Configure3*

-Required Solution: Limit the solution type, including *the Auto, SDGPS, DGPS, Float,* and *Fix*. When the solution type is limited to the *Fix*, the accuracy prompt box will not pop up if the solution is acquired in the fixed solution state.
-Physical Record Button: Set the collection key on the physical keyboard as the *Single Record* or *Average Record* shortcut key.
-Point Info Dialog: Choose whether to display the point information confirmation box after collection.

-Working Area: Users can draw the range of the survey area and select over range tips.

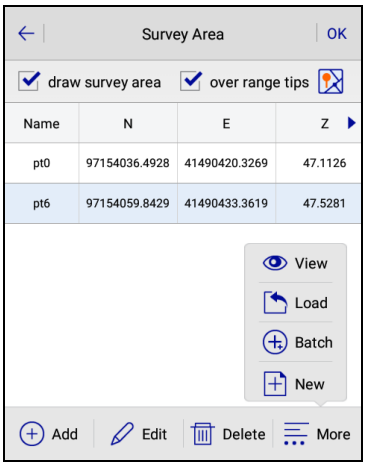


Figure 5-8-13 Working Area

-Auto Start Average: Check this option and click the average button, to enter the average collection interface, to automatically start smoothing. If this option is not checked, the smoothing won't start automatically, users need to click the start button in the average collection interface to start.
-Auto Store After Average: After it's turned on, click *OK* to do the average collection. When the number of smoothing reaches the set number, it will automatically exit the average interface and save points. Users can also click *OK* to end the average collection in advance.

-Store Average Points: Choose whether to save average data automatically.
-Allow the Same PtName: Choose whether users can collect points with the same name.
-Tilt Survey: Tilt survey can be done after turning on, and there will be tilt correction during data processing to get coordinates of points to be measured (only for specific models, and users can only start the tilt correction after completing calibration steps).
-Bubble Precision (<2.0000): Set the electronic bubble acquisition accuracy. The acceptable range of tilt distance when acquiring coordinates is recommended to be within 30 degrees.
-HRMS Tolerance: The horizontal RMSE of points, users can enter the maximum RMSE limit. When collecting points, there will be a prompt if it exceeds the limit value.
-VRMS Tolerance: The vertical RMSE of points; users can enter the maximum RMSE limit. When collecting points, there will be a prompt if it exceeds the limit value.
-Stake Tolerance: The precision limitation of stakeout points. Within the limit, the software will indicate that it has reached the accuracy range of the stakeout. If the sound prompt is enabled, an audio prompt will be given.
-Stake Prompt in: Set the prompt range of the stakeout. When the stakeout point is within the range, the range line will change color. If the sound prompt is enabled, an audio prompt will be given.
-Mileage Tolerance: Set the maximum error limit for real-time mileage.
-PtName Increasing by: The accumulation number value of the point name suffix. The default value is 1.
-No Fixed Prompt in (s): Voice prompt interval when the fixed solution is reached. The default value is 60s.

Notice: The default value of data collection accuracy of the fixed solution in the software is the value (m) shown in the figure below

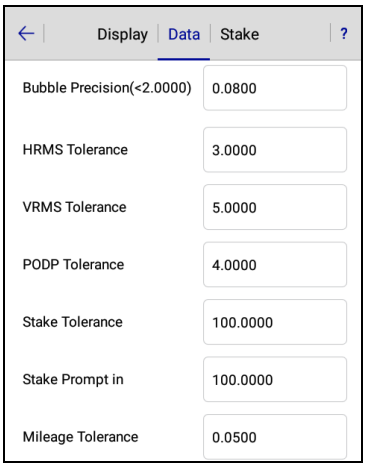


Figure 5-8-14 Data Configure

Notice:

1. Tilt Survey is only visible when connecting a receiver that supports tilt measurement (V90 plus/iRTK5).
2. If *Tilt Survey* is not turned on when the receiver is not level, the collection point and the saved point is the actual GPS location in the figure, not the point needs to be measured, so when Tilt Survey is not opened, please keep the receiver strictly level to collect the coordinates.
3. If *Tilt Survey* is turned on, when the receiver is not level, the software can automatically calculate the actual GPS location to the point that needs to be measured. At this time, the collection point and the saved point is the point to be measured.

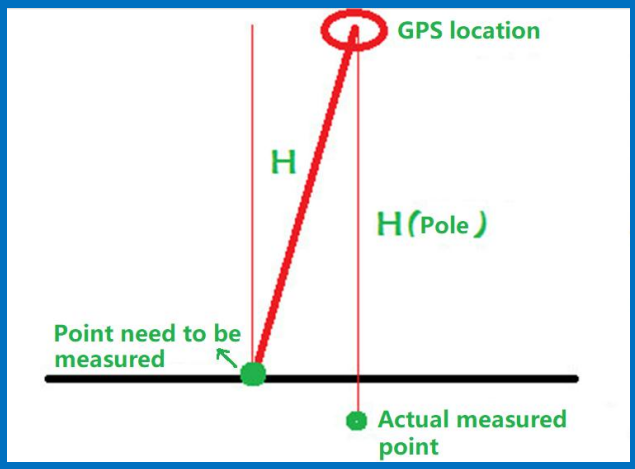


Figure 5-8-15 Tilt Survey

4. Tilt survey data processing, please refer to *Raw Data → Process*.

5.8.3 Stake

The stake configuration contains the *Road Survey Config* and *General Survey Config*.
-Road Survey Config: Includes *Real-time Mileage HT Diff, Road Stake Guide Type*.
-General Survey Config: Includes *Point Stake Guide Type, Line stake Guide Type, Stake Order, Mileage interval stake, Show Offset on Map, Check Move Direction, Map North Direction, Repeat Stake, StkName as PtName, Named by Station, Named by Real-time Station, Save Mileage* and *Save Real-time Mileage, Previous/Next Point Floating Button*.

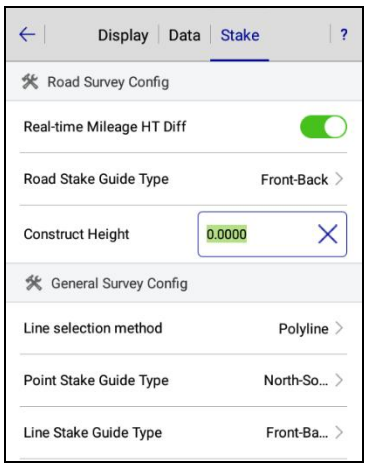


Figure 5-8-16 Stake Configure1

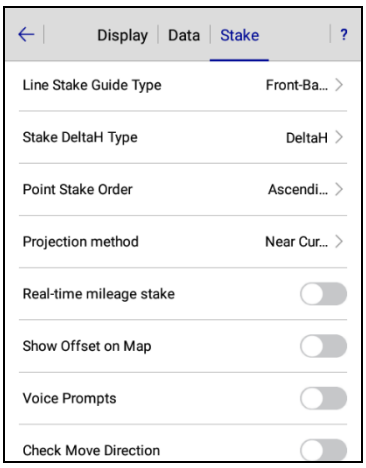


Figure 5-8-17 Stake Configure2

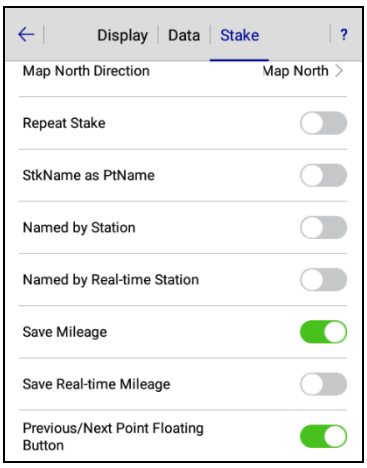


Figure 5-8-18 Stake Configure3

-Real-time Mileage HT Diff: After turning on, the height difference in the information bar of the *Stake Road* interface is the height difference between the current point projection on the line and the current point (make sure there is a road profile).

-Road Stake Guide Type: Select the stake guide type, including *Front-Back* and *North-South*.

-Line selection method：Includes *Polyline* and *Line Section*, the default is *Polyline*. When selecting *Polyline*, all the line section on the polyline will be selected when ***Stake Points*** → *Choose node online* or ***Stake Line*** → *Map*; when selecting *Line Section*, only the nearest line section will be selected.

-Point Stake Guide Type: Select the point stake guide type, and it contains *Front-Back* and *North-South*. In addition, when you use *Front-Back*, the software will open the *Reference Direction* option, and it contains *Sun Azimuth*, *Base Azimuth,* and *Custom Azimuth*.

-Line Stake Guide Type: Select the stake guide type, including *Front-Back* and *North-South.*

-Stake DeltaH Type: Set height difference as *DeltaH* or *Fill Or Cut*.

-Point Stake Order: Select stakeout points with ascending or descending order.

-Projection Method: It refers to the way in which the software places the receiver position onto the line during *Stake Line* or *Stake Road*. When the line is a retrograde curve, there may be multiple projection points on the line, and different projection positions may result in different real-time mileage and offset calculation results. The software set the default mileage projection method is *Near Current Pt*, and the customer can change it according to actual needs.

-Real-time mileage stake: It is turned off by default, the real-time mileage point is staked out; after turn on, it is staked at the specified mileage interval, and the previous mileage/next mileage stakeout is supported to freely switch.

-Show Offset on Map: When turned on, the stakeout prompt will be displayed on the map during the point stakeout process. If the *Check Move Direction* is turned on at the same time, and the distance from the current point to the stakeout point is greater than the stakeout distance, the horizontal

distance from the current point to the stakeout point will be displayed; otherwise, the front-back or south-north prompt will be displayed.

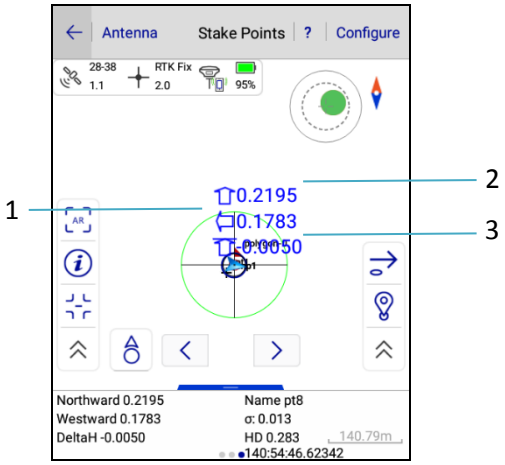


Figure 5-8-19 Offset

1-In the Front-Back mode, the left arrow indicates left, and the right arrow indicates right. In the North-South mode, the left arrow indicates the west, and the right arrow indicates the east.

2-In the Front-Back mode, the upward arrow indicates forward, and the downward arrow indicates backward. In the North-South mode, the upward arrow indicates the north, and the downward arrow indicates the south.

3-Heitht difference in Front-Back and North-South mode.

-Voice Prompt: When Stake Points, Stake Line, and Stake Road, it will give voice prompt according to the direction and distance. You can set the Prompt Interval(s).

-Check Move Direction: After turning on, when the distance from the current point to the stakeout point is not within the range of the stakeout distance, a large arrow will be displayed to indicate the deflection angle between the moving direction and the direction from the current point to the stakeout point. If it's approaching the stakeout point, it will be displayed in green. If it's moving away from the stakeout point, it will be displayed in red. If the moving direction is almost perpendicular to the direction from the current point to the stakeout point, it will be displayed in yellow.

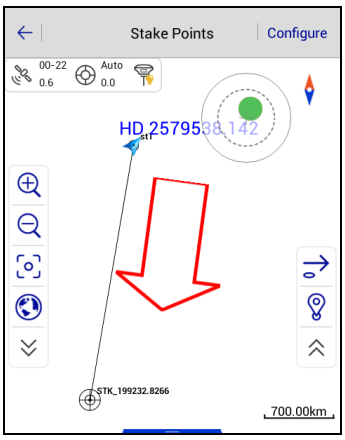


Figure 5-8-20 Moving Direction

-Map North Direction: Select the map direction, including the Map North or Forward.

-Repeat Stake: When turned on, it supports the repeat stake. Users can choose whether to skip the collected stakeout points automatically.

-StkName as PtName: Select whether to set the stakeout point name as the default point name.

-Named by Station: Select whether to set the station as the default point name.

-Named by Real-time Station: Select whether to set the real-time station as the default point name. This option can't be opened simultaneously with the Named by Station.

Notice: When turning on the *Named by Station* or *Named by Real-time Station* option, users need to select the *Allow Same PtName* option in the *Configure* → *Data* interface.

-Save Mileage: When collecting points, the mileage will be automatically filled as the staked point mileage.

-Save Real-time Mileage: When collecting points, the mileage will be automatically filled as the real-time projection mileage (the Save Mileage and Save Real-time Mileage must and can only be selected one at a time).

-Previous/Next Point Floating Button: When it is turned on, the Previous/Next icon will be displayed directly on the Staking interface, which is convenient for clicking and selecting the staking point.

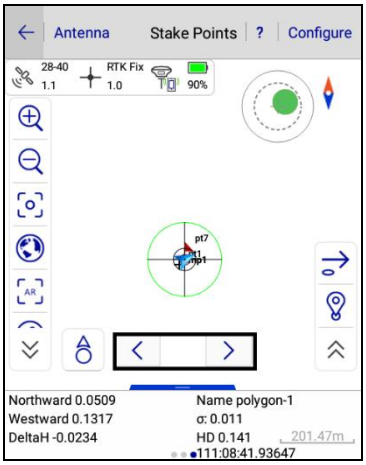


Figure 5-8-21 Previous/Next Point

Chapter 6

COGO

This chapter contains:

- Angle
- Distancen
- Coordinate
- Area
- Dist and Azi
- Intersection
- Angle Calculation
- Volume
- Point and Line
- Calculator
- Share
- FTP
- Compass

6.1 Angle

Support *Radian, Degree, DMS, Gon, Mil* angle units transforming mutually. After you input a value to any item, click *Compute*: other several values will be calculated.

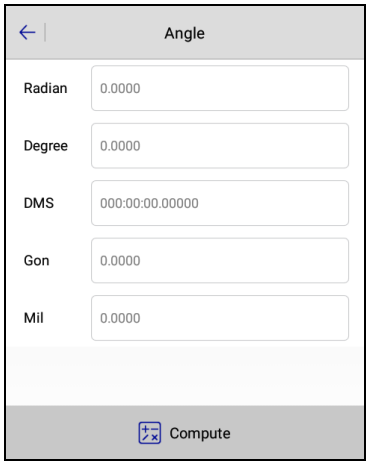


Figure 6-1-1 Angle Conversion

6.2 Distance

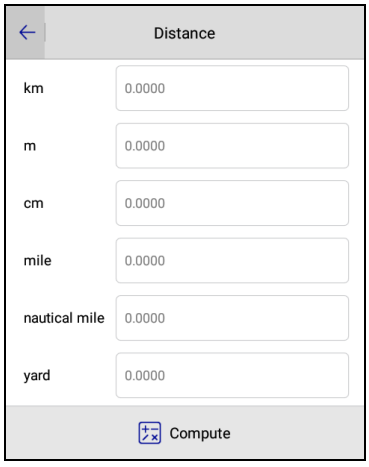


Figure 6-2-1 Distance Conversion

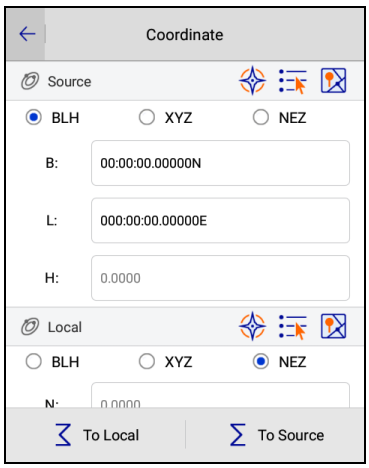
Support *km, m, cm, mile, nautical mile, yard, foot, inch* distance units transforming mutually. After inputting a value to any item, click *Compute*: other several values will be calculated.

6.3 Coordinate

Coordinate conversion supports tow conversion methods including Point and File.

6.3.1 Point

The data includes source ellipsoid and local ellipsoid. After inputting point information, you can switch between BLH, XYZ or NEZ. Click *To Local* or *To Source* to complete conversion between source ellipsoid and local ellipsoid. The coordinate of points can be selected from the real-time collection, coordinate library or map.



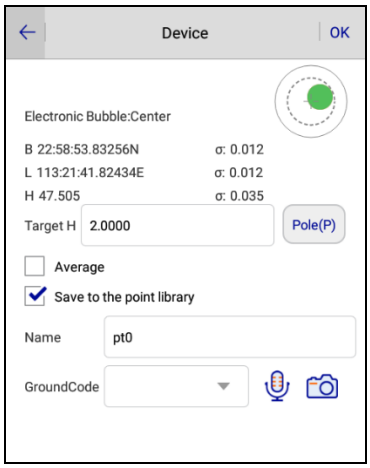
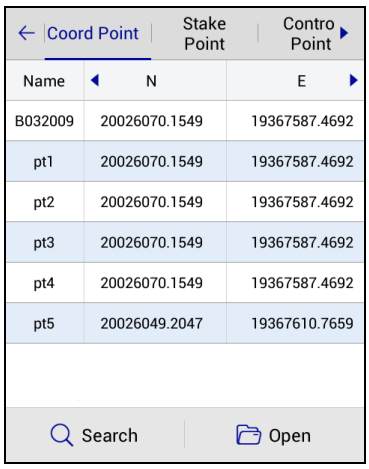


Figure 6-3-1 Coordinate Conversion *Figure 6-3-2 Receiver Collection*



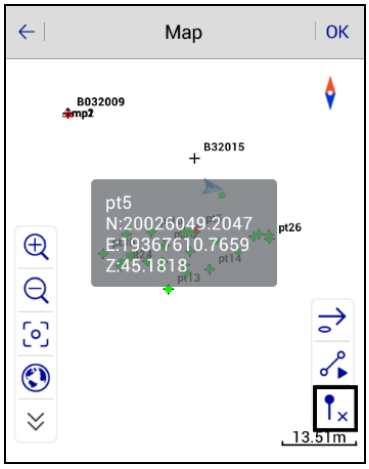


Figure 6-3-3 Point Library Selection *Figure 6-3-4 Select Point from Map*

6.3.2 File

The coordinate conversion operations of multi-point data by importing files, the conversion results of To Local or To Source will display in the interface.

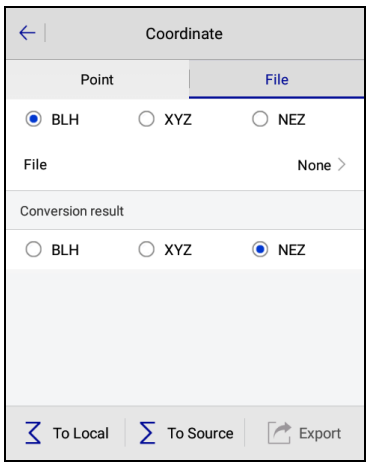


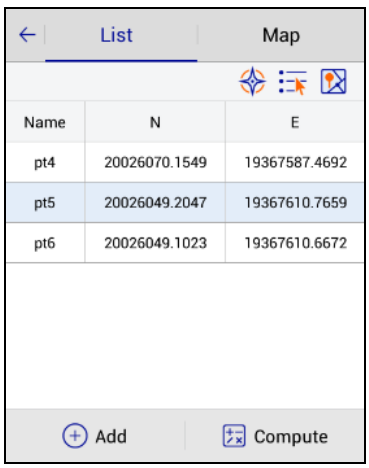
Figure 6-3-5 File

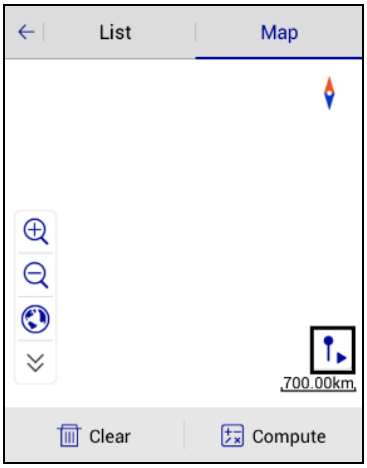
6.4 Area

Used for calculating area, circumference and some other parameters of graph. The area is indicated by *sq.m* or *mu* and circumference is indicated by *m*. The coordinate of point participated in calculation can be added manually, or real-time collected from the receiver or selected from a coordinate library or map.

Notice: *In the Map* interface of *Area, the Select Point* is not the same as the Map selection in the *List interface of Area.* In the former, the points on the map are selected by clicking on the point, and the latter by the way of selecting points in the circle and selecting the node on line.

The difference of map selection between *Area* and the other interface is: click to enter map selection mode. Frame select point on the map when the icon is in the state , when frame select multiple points, press but only one point in the box can be selected, click again to exit the map selection mode; Among them, when the icon is in the status , you can select multiple points in the box, click or again to exit the map selection mode, click *OK* to complete. Return to the list to view the selected points.





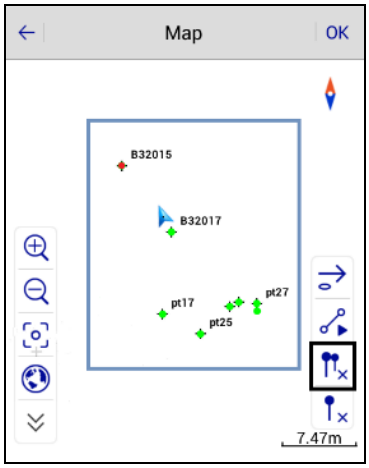


Figure 6-4-1 Area Calculation *Figure 6-4-2 Select Point* *Figure 6-4-3 Multiple Select*

- Add: The points can be added to the list by the way of real-time collection, point library, and graph selection.
- Compute: Calculates the area, mu, and length of the current point in order, and can view graphics and calculations in the result interface.

The results of the graphical will be displayed at the bottom left of the interface, which is divided into maximum area results and vector area results. The maximum area results will be displayed in green font, and the vector area results will be displayed in red font.

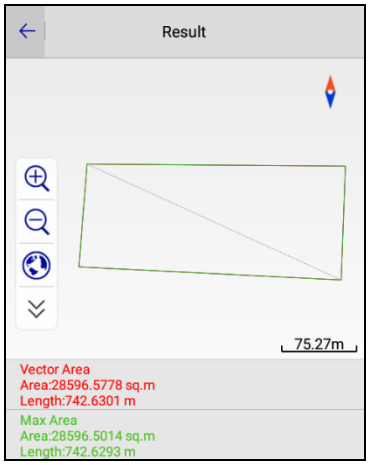
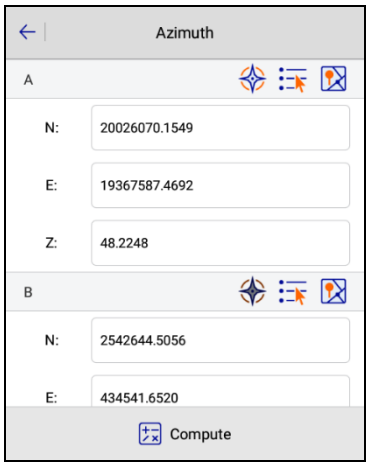


Figure 6-4-4 Results

6.5 Dist and Azi

Used for calculating distance and azimuth between two points. The coordinate of A and B points can be manually input, or read from receiver, coordinate library or map. After reading successfully, click *Compute* to calculate *Azimuth, Bank Angle, 2D-Distance, 3D-Distance, and H-Distance*.



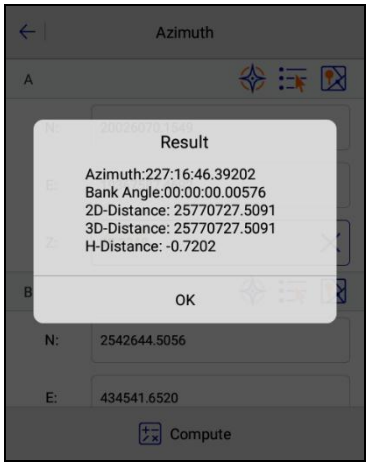
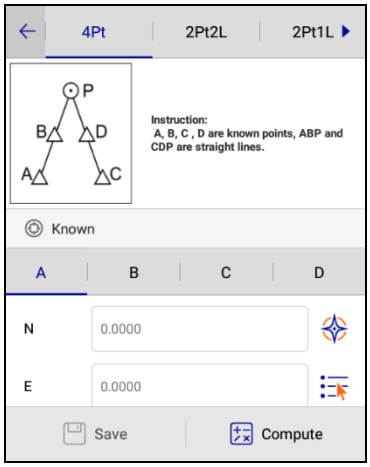
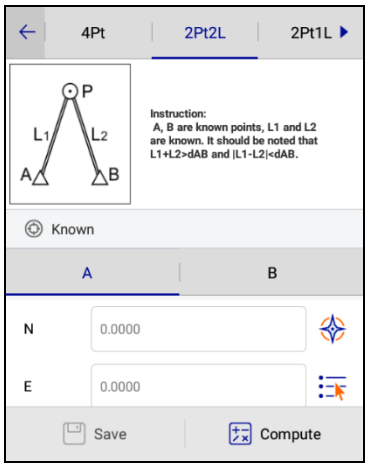


Figure 6-5-1 Distance and Azimuth *Figure 6-5-2 Result*

6.6 Intersection

In the case of a point needing measurement, but observation conditions are not ideal, calculate the needed point coordinate by measuring a nearby point. Click every icon to enter the corresponding measurement mode. The software supports nine measurement modes (*4Pt, 2Pt2L, 2Pt1L, 2Pt2A, 2Pt1A1L, Azimuth, 2C, 1L1C, 1RPt*).





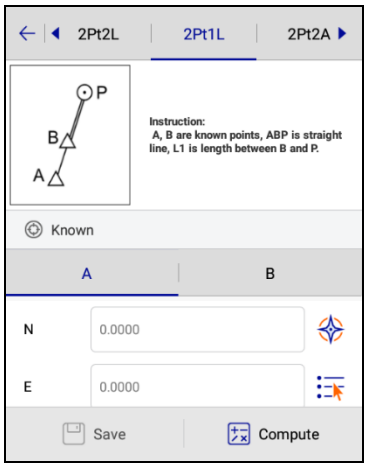
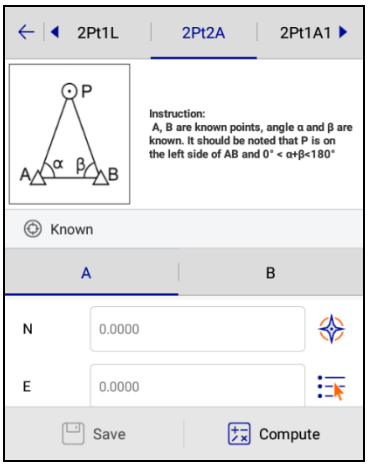
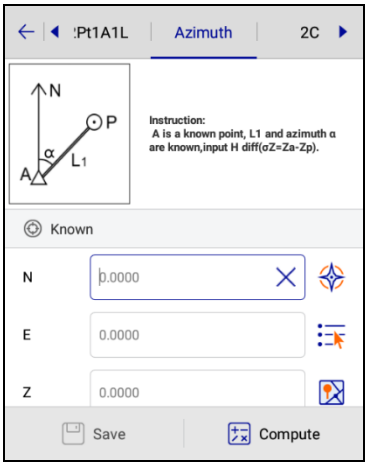


Figure 6-6-1 4Pt Interface *Figure 6-6-2 2Pt2L Interface* *Figure 6-6-3 2Pt1L Interface*





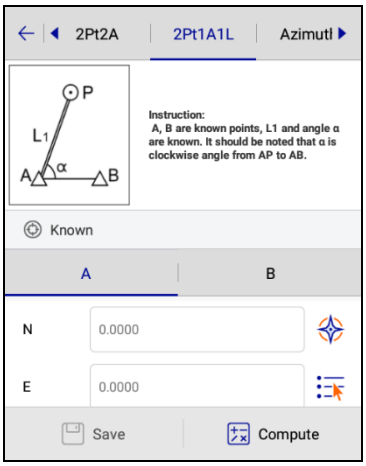
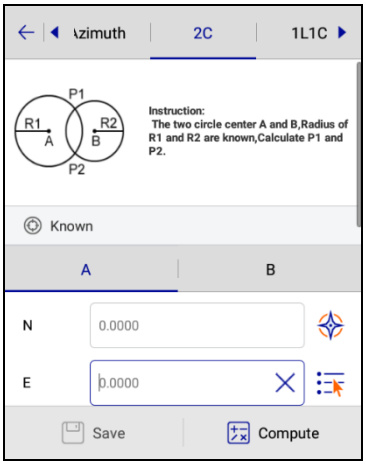
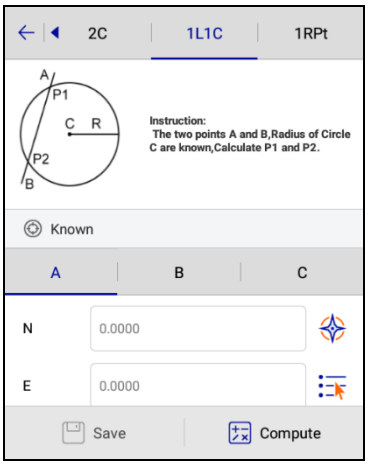


Figure 6-6-4 2Pt2A Interface *Figure 6-6-5 2Pt1A1L Interface* *Figure 6-6-6 Azimuth Interface*





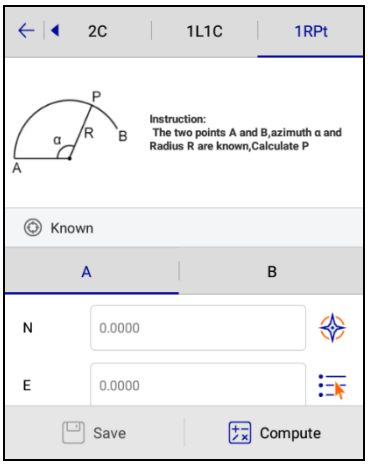


Figure 6-6-7 2C Interface *Figure 6-6-8 1L1C Interface* *Figure 6-6-9 1RPt Interface*

There are two positions of P according to the theory of 2Pt2L; 2Pt2A, 2Pt1A1L. If you input the coordinate of A first and then the coordinates of B, the position of P will be located above the AB line. Conversely, if you input the coordinate of B first, the position of P will be located under the AB line.

In the above intersection measurement methods, select known point ID, input the coordinate of the intersection measurement point (manual input, or read from receiver, coordinate library, map), input other known keys (such as L1, L2, etc..), click Compute, calculate the coordinate of unknown point P, click Save, input name, description and so on to save into the coordinate library.

In the Intersection, when you click GPS collection, prompting precision information (accuracy setting is performed in the Configuration) is easy for an understanding of real-time accuracy.

6.7 Angle Calculation

Used for calculating the angle of the three-point line.

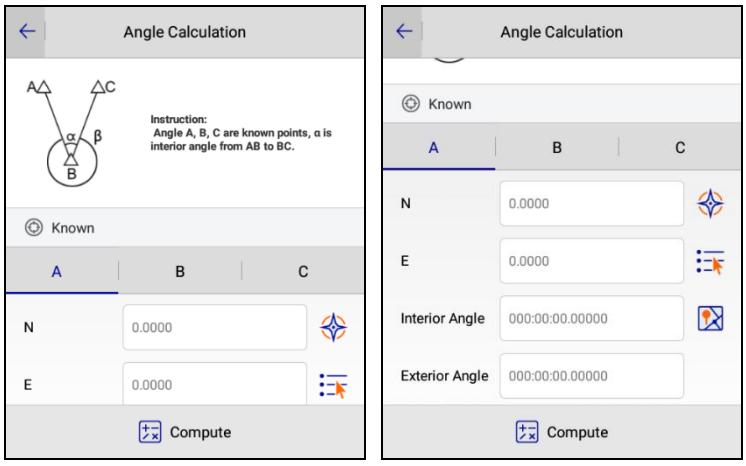


Figure 6-7-1 Angle Calculation Figure 6-7-2 Interior and Exterior

6.8 Volume

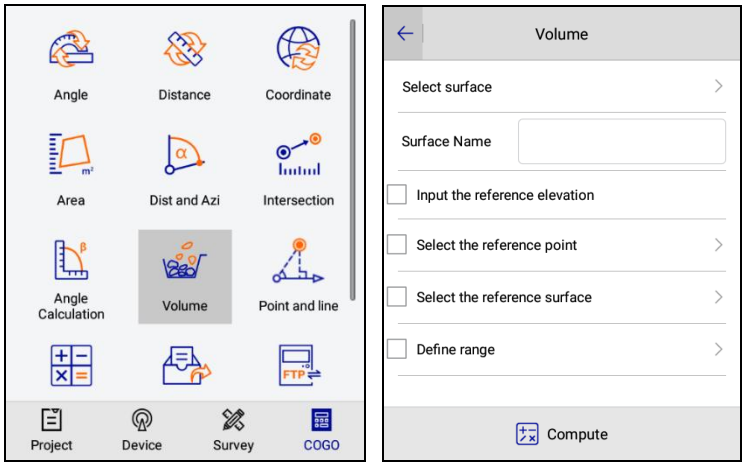
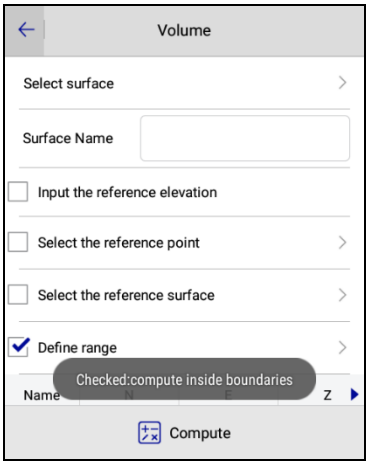
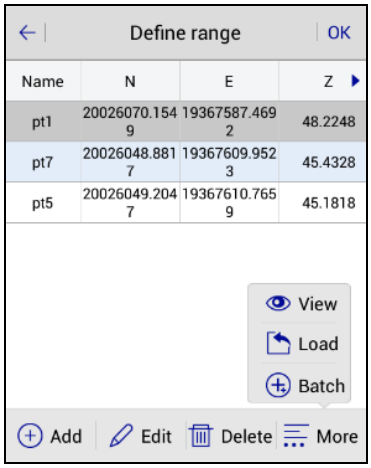


Figure 6-8-1 COGO interface Figure 6-8-2 Volume interface

Calculate the volume, 2D perimeter, 3D perimeter, and DTM area of two DTM surfaces, or between a DTM surface and a predetermined elevation.

- *Select surface*: Click extend icon , Select an actual surface from the *List Surface*.
- *Input the reference elevation*: Check it, the reference elevation and the surface are used for volume calculation. Click extend icon , input the target height needed to fill/dig.
- *Select the reference point*: Check it, the reference point and the surface are used for volume calculation. Click extend icon , Select a point as a reference point from the *Point Library*.
- *Define range*: Check it, calculate the volume inside boundary; conversely, without checking it, it will calculate the volume in the public area. Click extend icon , you can select the range points on the *Define range* interface, and add, edit, delete, load, and save the range points.





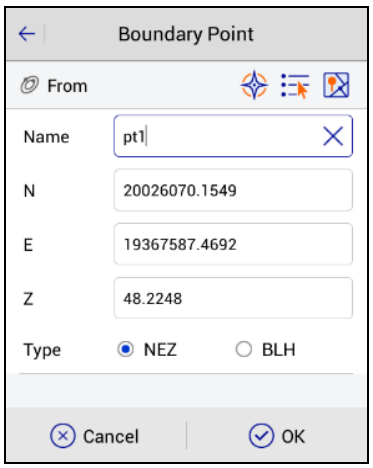


Figure 6-8-3 Checked Boundaries Figure 6-8-4 Define Range *Figure 6-8-5 Boundary Point*

- *Add*: Add a range point by manual input, real-time collection, point library selection or map selection, *Define Range* requires at least three points.
- *Edit*: Select the range point you want to edit: you can edit the coordinates of the point.
- *Delete*: Select a range point, click Delete to delete directly, no prompt.
- *Load*: Load an existing boundary file (*.waa), the load path is: *ZHD*\ *Project*\ *ROAD*\ *Project Name*\ *dtm* folder.
- *Save*: Save the re-add/edit volume boundary file: the save path and file format is consistent with that in *Load*. When the saved file name already exists, it cannot be saved, but check *Cover* to save the modified file. Also, click *OK* will also save re-add / edit volume boundary file.

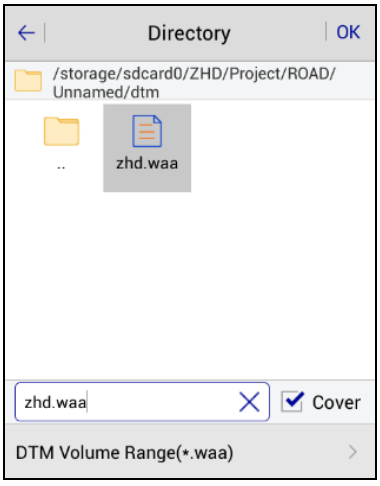
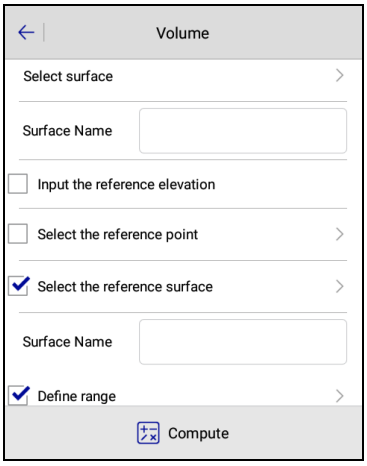
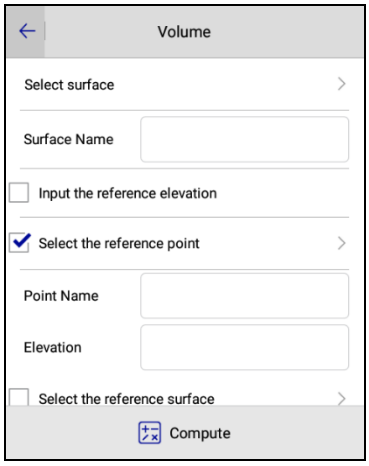


Figure 6-8-6 Save Directory

After selecting different calculation methods, click *Compute* and view the volume calculation, measurement surface, digging area, and fill area product information on the *Results* interface.





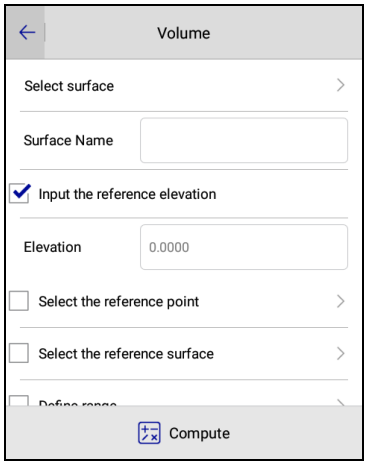
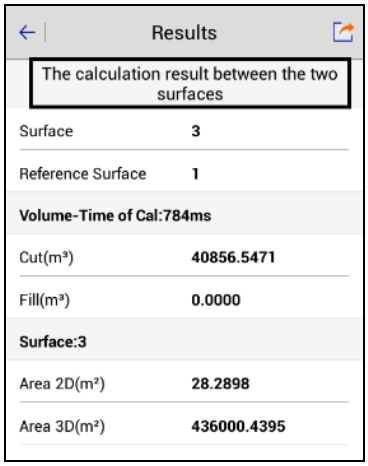


Figure 6-8-7 Two Surfaces Figure 6-8-8 Surface and Point Figure 6-8-9 Surface and Elevation



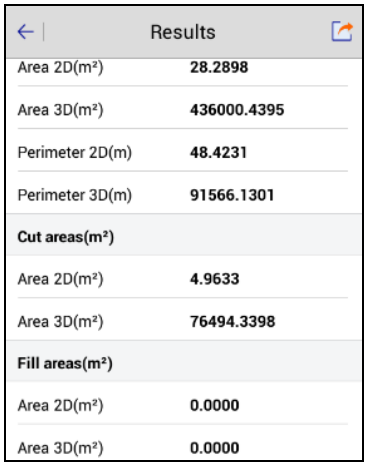
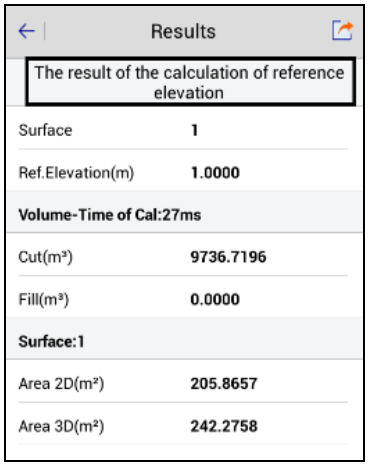


Figure 6-8-10 Result Above Figure 6-8-11 Result Below



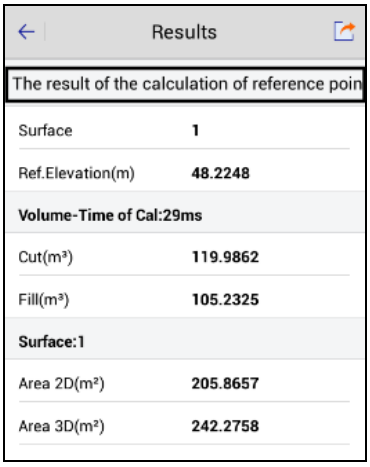
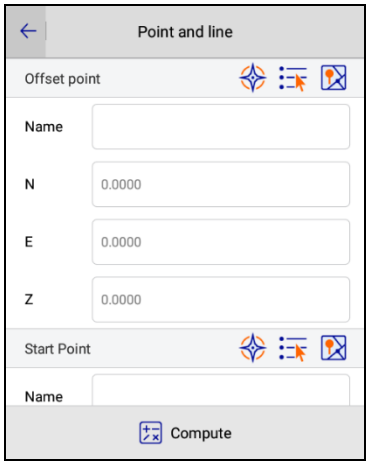


Figure 6-8-12 Elevation Result Figure 6-8-13 Point Result

- *Area (2D: m^2)*: The area projected onto the horizontal plane.
- *Area (3D: m^2)*: The area projected onto the slanted reference plane.
- *Perimeter (2D: m)*: The length of the polygon from the start point to the current measurement point in surface (2D).
- *Perimeter (3D: m)*: The length of the polygon from the start point to the current measurement point in surface (3D).

6.9 Point and Line

Used for calculating the relationship between points and lines.



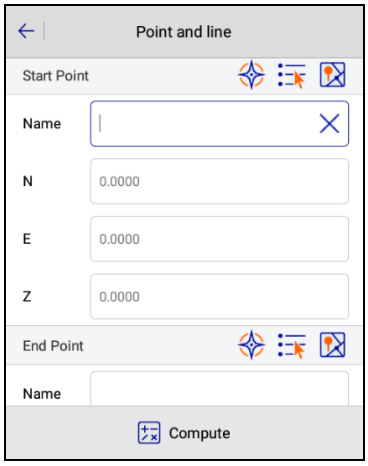
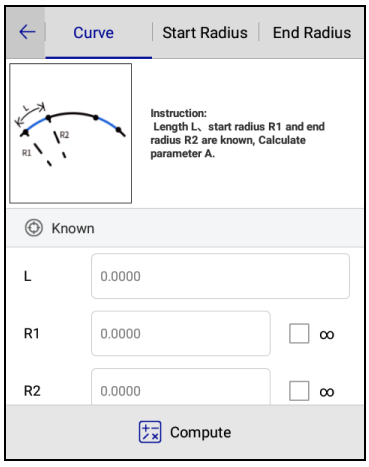
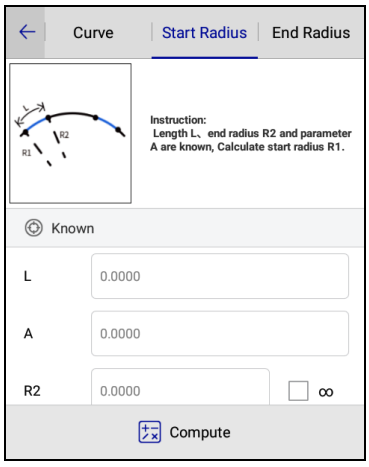


Figure 6-9-1 Point and line *Figure 6-9-2 Point and line*

6.10 Transition curve

Click the Transition curve icon in COGO interface, it supports to calculate the parameters of Curve, Start Radius, and End Radius.





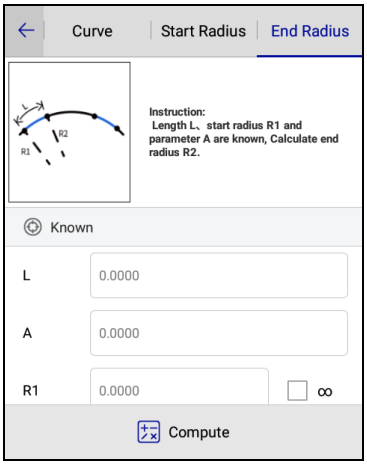
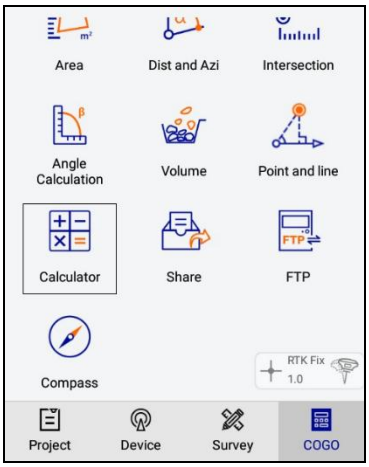


Figure 6-10-1 Curve *6-10-2 Start Radius* *6-10-3 End Radius*

6.11 Calculator

Used for simple mathematical calculations.



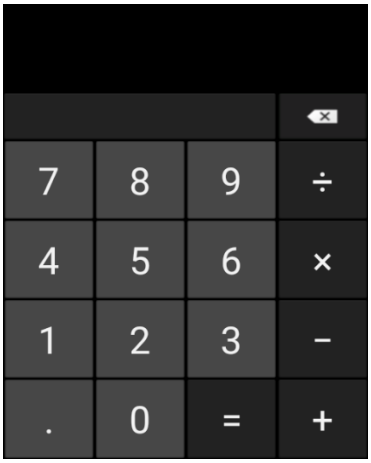
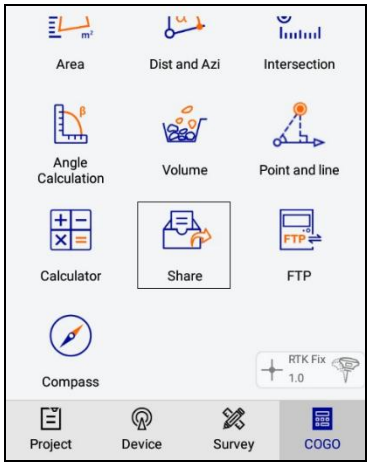


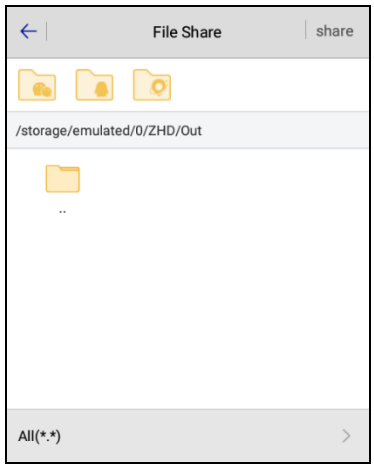
Figure 6-11-1 Calculator *Figure 6-11-2 Calculator*

6.12 Share

File transferring. The user clicks *Share* to enter the sharing interface, and the software displays the directory/storage/sdcard0/zhd/out by default.

- Select the file to be shared, click the *Share* button, and the software pop-up box will display the optional sharing method.
- Click the icon and jump to the corresponding software for file transfer.





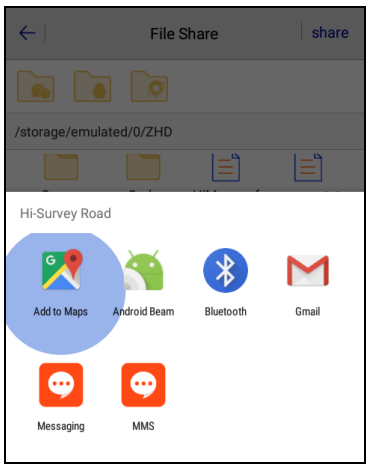


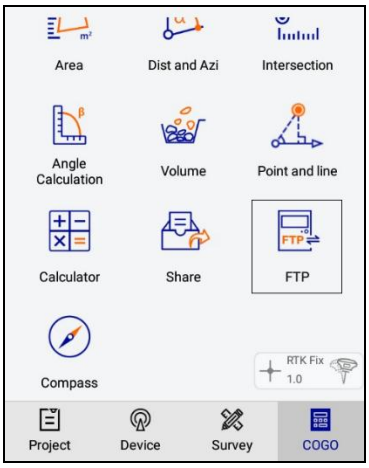
Figure 6-12-1 Calculator *Figure 6-12-2 Calculator* *Figure 6-12-3 Calculator*

6.13 FTP

For the FTP file transferring function, click FTP to enter the transmission function. The software will then display the default target path (/storage/simulated/0/zhd).

- Users need to enter the username, password, and port when the software does not check "password-free transmission".
- Check "password-free transmission". The software does not display the username and password input box, and the user only needs to configure the port.

When the device has connected to the Wi-Fi, the software automatically fills in the IP parameters and the port number defaults to 2121. After the user has configured all the parameters, click *Start*. According to the prompts, the user can input the corresponding path into the computer to download the FTP file.



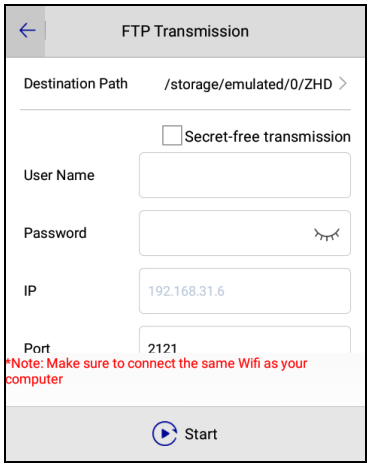


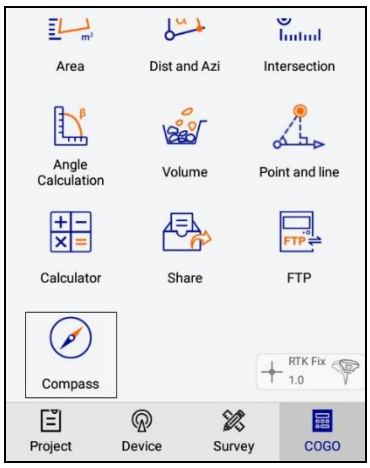
Figure 6-13-1 Calculator *Figure 6-13-2 Calculator*

6.14 Compass

Click Compass to enter the compass function.

Notice: When the manual compass is turned on, the visual angle orientation function will be turned off.

When you open the compass for the first time you will enter the calibration interface, and can confirm whether calibration is needed. If the calibration is successful, it will enter the calibration interface again after a period of 7 days.



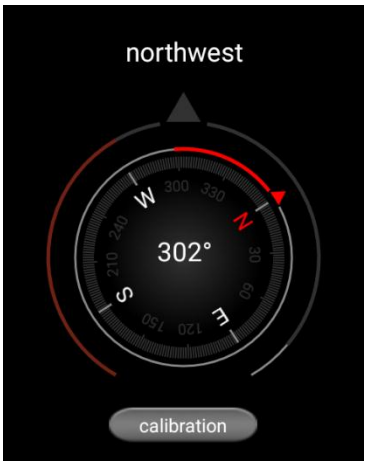


Figure 6-14-1 Calculator *Figure 6-14-2 Calculator*

Chapter 7

Tilt Survey

This chapter contains:

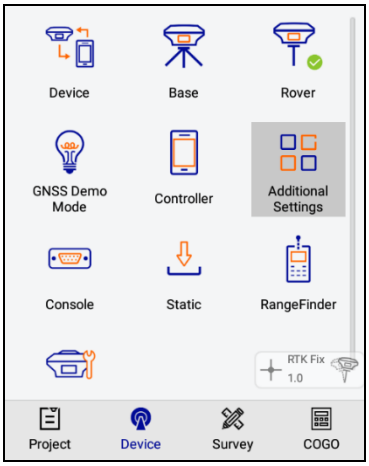
- Tilt Correction
- Tilt Survey 2.0
- Tilt Survey with Calibration-free

7.1Tilt Correction

The Tilt correction mainly includes three parts: electronic bubble calibration, Tilt Calibration and Verification, and Calibration verification.

7.1.1 Electronic Bubble Calibration

1. Connect to the receiver with the tilt survey function. In *Additional Settings*, click *Electronic Bubble Calibration* to enter the program.



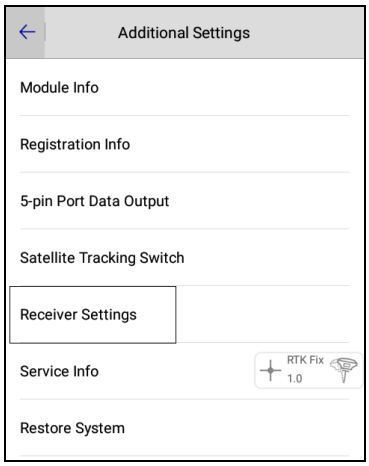


Figure 7-1-1 Additional Settings Figure 7-1-2 Receiver Settings

2. When the device had been perfectly leveled up, click *Start* for calibration, then click *OK*.

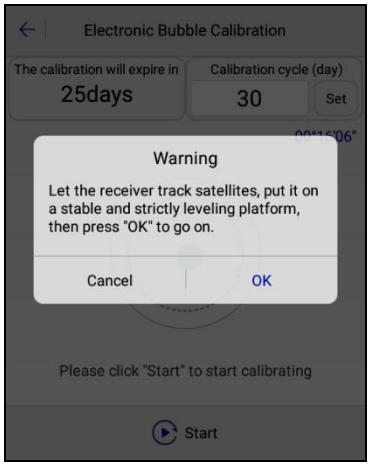


Figure 7-1-3 Bubble Center *Figure 7-1-4 Warning*

3. When success is prompted, the electronic bubble and horizontal bubble of the base will be centered at the same time.

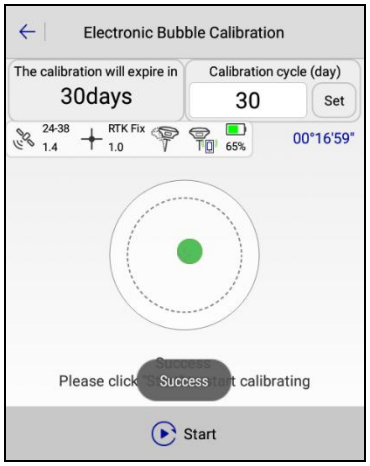


Figure 7-1-5 Calibrating *Figure 7-1-6 Calibration Success*

4. Calibration is finished. Notice: It is recommended to calibrate the device every 30 days, but the calibration cycle can be adjusted.

5. Auto collection. When the auto mode is set as *Bubble Is centered* the software will collect the points automatically when the electronic bubble is centered.

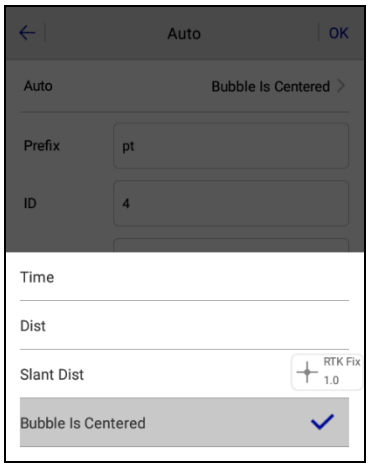


Figure 7-1-7 Auto Collection

Notice: When using the *Bubble Is Centered* for automatic collection, first set bubble precision. Connect a receiver with tilt measurement function, enter main interface → *Survey* → *Surveying Configure* → *Data (*or: enter survey interface → click *Configure* at the top right corner→ *Data)*, the *Bubble Precision* can set when tilt Survey is off.

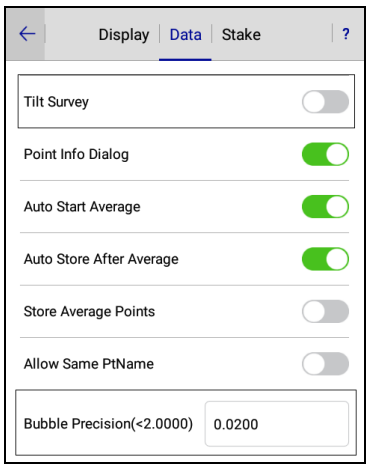


Figure 7-1-8 Tilt Survey And Bubble Precision

7.1.2 Tilt Calibration and Verification

Tilt Calibration

The whole tilt calibration has three steps:
1. Orientation sensor calibration;
2. Electronic bubble calibration;
3. Magnetic calibration.
The order of 1 and 2 steps can be reversed but must be performed before step 3.

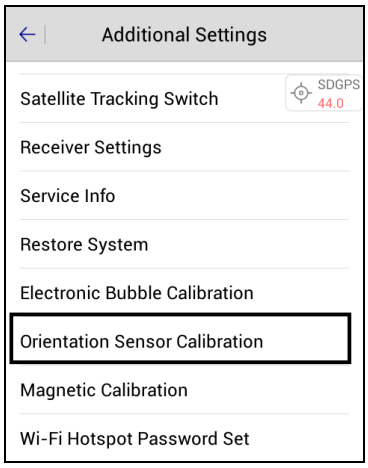
Notice:

1. The calibration should be done in a low magnetic interference area or an open field. Don't do calibration on the roof or top of a high building.

2. Calibration should be done in external station mode, don't use the internal UHF link to avoid magnetic interference.

3. Don't change battery and power off during all the calibration steps.

Here are the detailed operations below:
1. Orientation Sensor Calibration
Additional Settings → click Orientation sensor calibration to enter calibration interface.



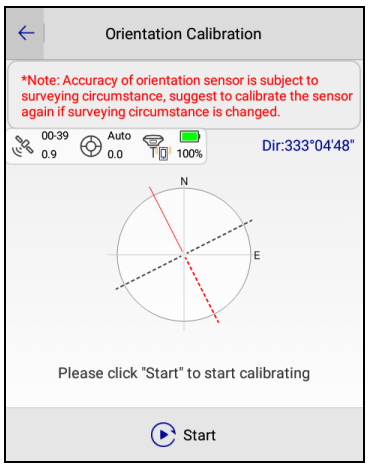
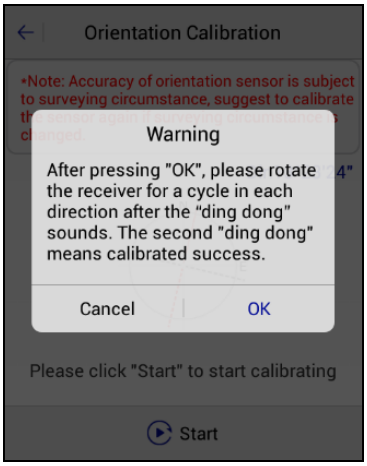


Figure 7-1-9 Sensor Calibration *Figure 7-1-10 Start Calibration*

Click *Start* to begin calibration, the calibration of the orientation sensor needs to be calibrated according to the demo.



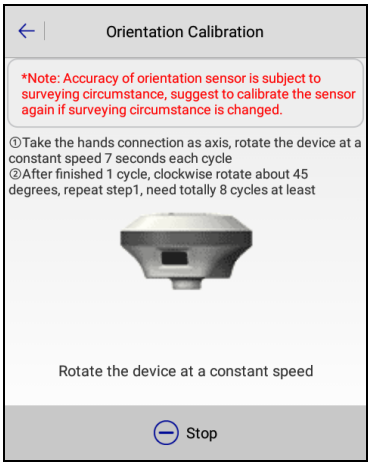


Figure 7-1-11 Warning *Figure 7-1-12 Rotate The Device*

Rotate at an average speed, approximately 7 seconds for a cycle.

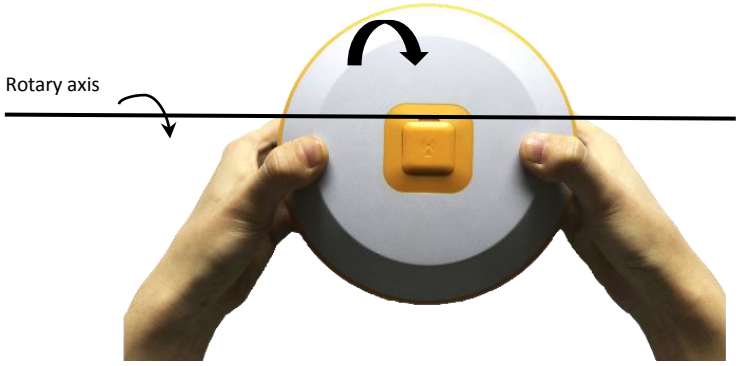


Figure 7-1-13 Rotary Axis

Clockwise rotate about 45 degrees, repeat step a, you need a total of 8 cycles at least.

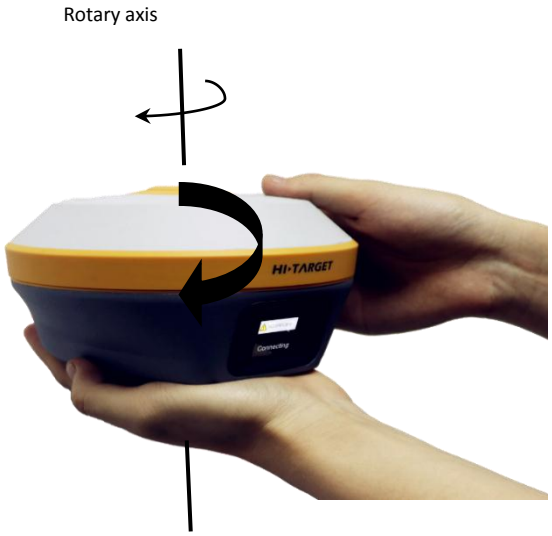
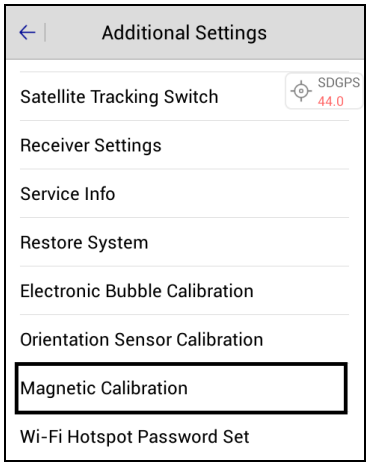


Figure 7-1-14 Clockwise Rotate

After the calibration is completed in each direction, the second *Ding-Dong* sound indicates *Success* from the device, which means calibration is finished. Conversely, prompting failure - do calibration again.



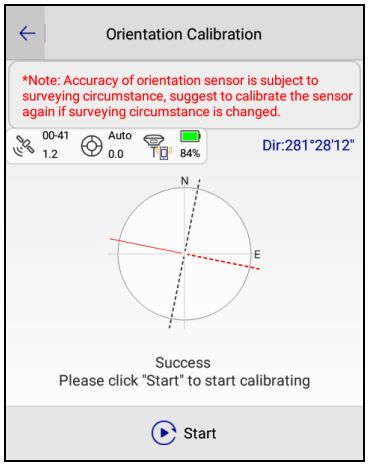


Figure 7-1-15 Calibration *Figure 7-1-16 Calibration Success*

2. Electronic Bubble Calibration

Please refer to Electronic Bubble Calibration.

3. Magnetic Calibration

This step can be done only after the calibration of the electronic bubble and orientation.

Additional Settings → click Magnetic calibration to enter calibration interface.

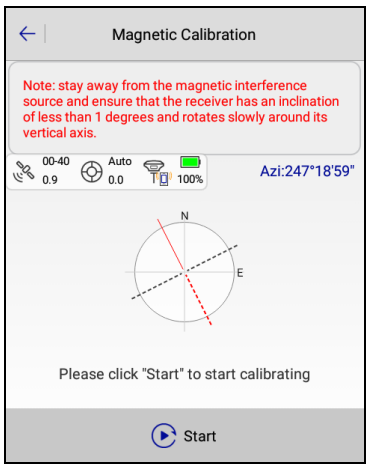
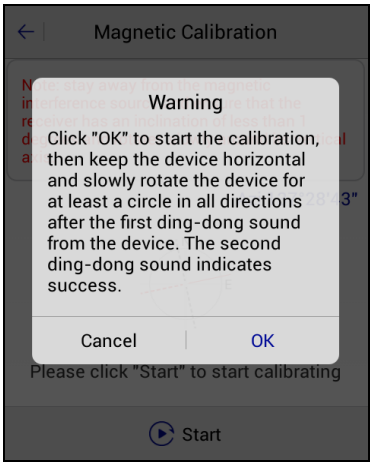


Figure 7-1-17 Start Calibration

Click *Start* to start calibration, magnetic calibration needs calibration in horizontal position.



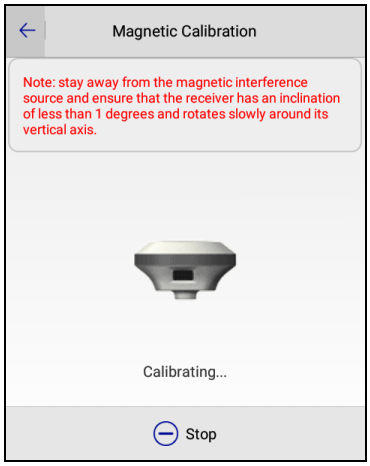


Figure 7-1-18 Warning *Figure 7-1-19 Calibrating*

Keep the device on horizontal and rotate it clockwise a week, slowly and evenly around the vertical axis. Rotation speed is recommended to be less than 20 degrees per second, ith slow uniform rotation and no pause during rotation.

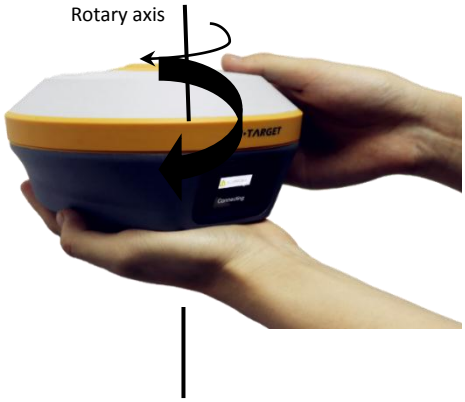


Figure 7-1-20 Horizontal Rotation

When horizontal calibration is complete, the second *Ding-Dong* sound from the device indicates *Success*. Conversely, prompting failure - do calibration again.

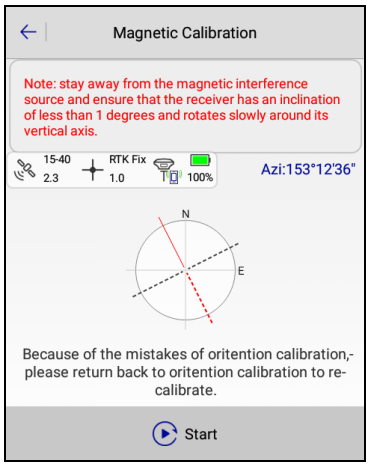


Figure 7-1-21 Failure

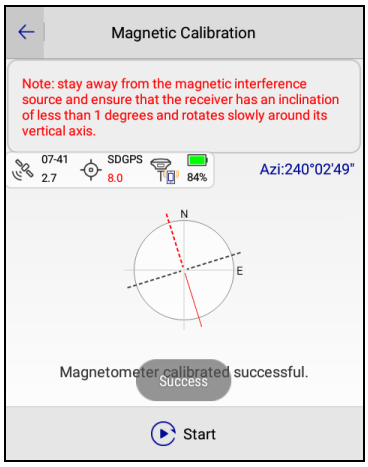


Figure 7-1-22 Successful

7.1.3 Calibration Verification

In order to make sure accuracy is not strongly interfered with by the environment and procedure, verification is necessary before starting the tilt survey.

Put the device at 30-degree tilt approximately, on the pole, and rotate it slowly clockwise for a week. View the azimuth changes, if the differences between maximum and minimum values are less than 5 degrees, it means the sensors are working well and you can do a tilt survey directly, otherwise module verification will be required.

Notice:

1. The pole shouldn't be moved.

2. Rotation speed should be 2 degrees per second and it takes about 3 minutes to rotate one week.

Unscrew the knob and hold the pole to rotate device clockwise slowly around pole.

Figure 7-1-23 Calibration Verification

Notice:

1. When replacing a new measurement area, or the terrain complex environment of the measurement area changes greatly, module verification is required before measurement.

2. When the new device first uses tilt measurement, it must be calibrated.

3. After the new battery is replaced, the device must be calibrated.

7.1.4 Tilt Correction Procedure

After electronic bubble calibration, orientation sensor calibration, magnetic calibration, and verification are successful, you can start a tilt surveying. If the device has not undergone calibration, users will be prompted when *Tilt Survey* is opened: you must complete all calibrations before you can open the *Tilt Survey*. Tilt Survey conditions are limited to static, within 20 degrees of tilt.

1. *Tilt Survey* must be opened when you start a tilt surveying, click *Surveying Configure→Data→Tilt Survey*.

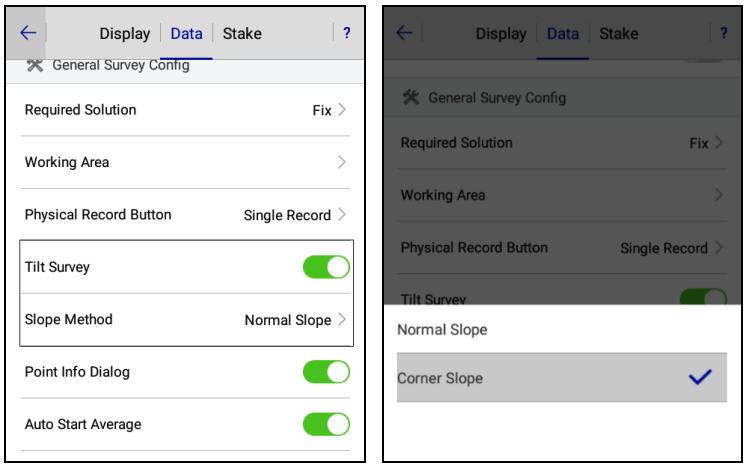


Figure 7-1-24 Tilt Survey *Figure 7-1-25 Slope Method*

2. When *Tilt Survey* is not opened，the software will not do a tilt survey, the software survey interface displays and records the coordinates of the tilt point to the point library. Conversely, when *Tilt Survey* is opened, the interface displays and records coordinate points to the point library: this coordinates point is the calculated ground coordinate point.

3. Collect Point

Enter survey interface to collect points, it supports two survey modes: *Corner Slope and Normal Slope.* The corner slope mode is accurate and reliable; the normal slope mode is simple to operate.

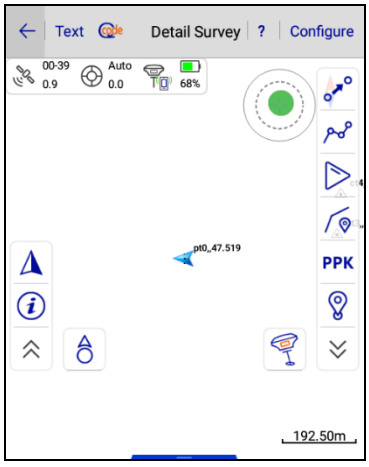


Figure 7-1-26Collection Point

Corner Slope

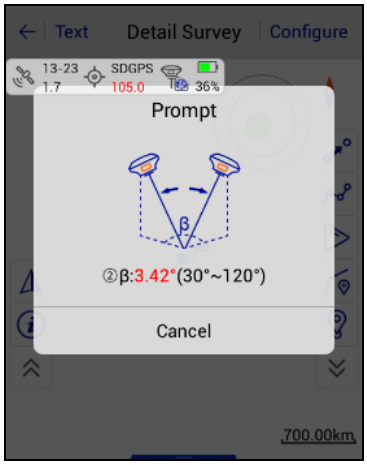
This mode is more precise, but it takes a little longer in the field. Orientation and magnetic calibration recommendations are prompted when interference is found by the device.

1. Please keep the receiver tilted and static, then click the collection icon. The best tilt angle is 10

degrees ~ 20 degrees: follow the prompts to operate.

Figure 7-1-27 Step One

2. Tilt in the other direction, with an azimuth span angle of 30 degrees to 120 degrees (*Azimuth Span Angle*: the angle formed by the vertical projection of the pole in two directions), and keep it static. There will be a sound prompts '*Di'* indicating that collection is complete.



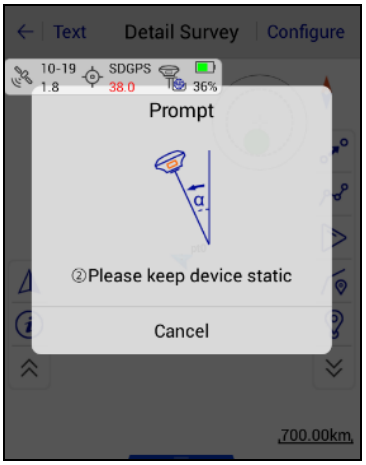


Figure 7-1-28 Step Two *Figure 7-1-29 Step Three*

3. In the *Save Point* interface, you can see the tilt angle and tilt azimuth of the point.

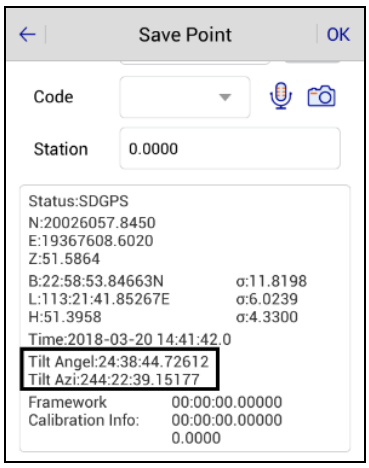
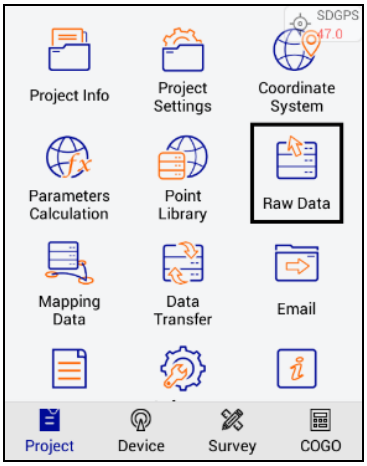


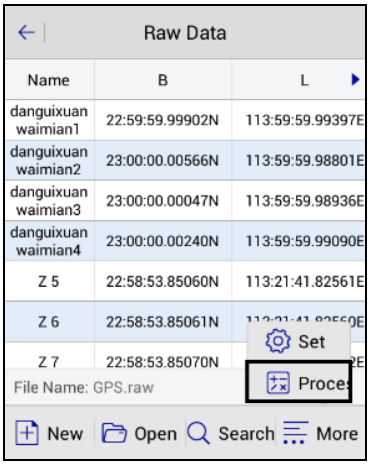
Figure 7-1-30 Save Point

Normal Slope

This method is much simpler, the receiver will collect points when it is still (function available in firmware version after v5.1 for V90 Plus and v1.1 for iRTK5). Orientation and magnetic calibration recommendations are prompted when interference is found by the device.

1. Enter process interface *Raw Data* → *More* → *Process*.





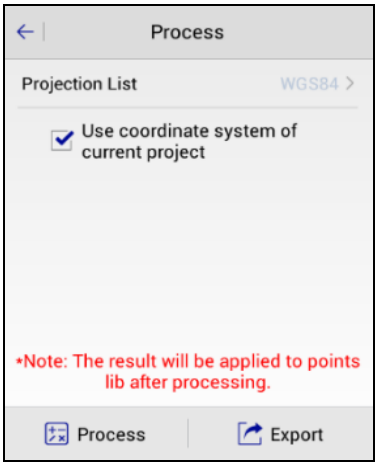
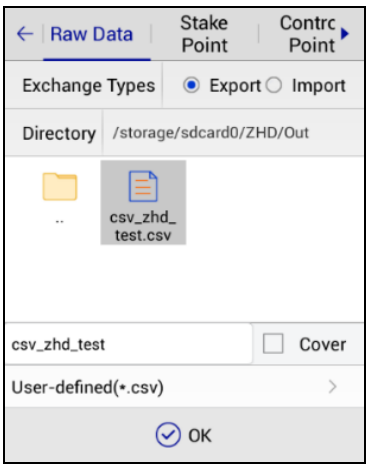


Figure 7-1-31 Raw Data *Figure 7-1-32 More* *Figure 7-1-33 Process*

2. *Data Transfer* is a raw data custom export. It supports export not an increase in plane coordinates for tilt correction (tilt N, tilt E, tilt Z is not tilted correction of plane coordinates). Select the export path and input the export file name and after completing the custom format settings, click *OK* to export.



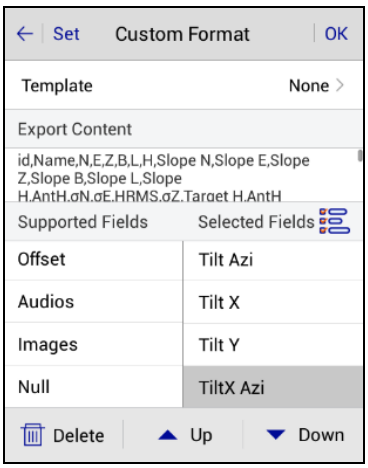


Figure 7-1-34 Save Raw Data *Figure 7-1-35 Custom Format*

Abnormal prompt

1. When you have finished following the prompts, if the prompt Corner Slope fails appears, the current point is not saved.

Figure 7-1-36 Prompt

2. When it prompts *The current low precision, whether to save data*, click *OK* to save the calibration ground point coordinates, click *Cancel* to not save the coordinate data.
3. When the collection point prompts *Magnetic is change,* so it is not collecting points and you need to do the three steps of tilt calibration.

7.2 Slope Method 2.0

7.2.1 Slope Method 2.0

When the *Hi-Survey Road* finishes connecting the device, open the "Slope method 2.0" switch in the Configuration - Data interface of the software, and then start the tilt survey.

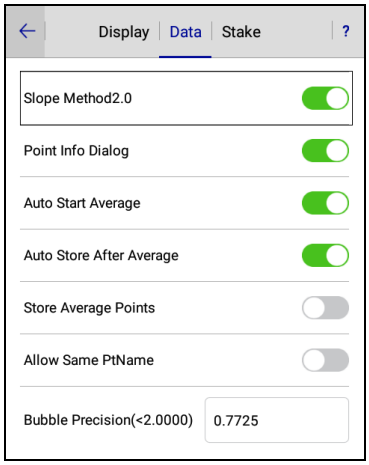


Figure 7-2-1 Slope method 2.0

In this mode, click the collection button in the *Detail survey* interface, and the software will prompt you to shake the device to start the measurement. Then shake the device at a constant speed and wait until the progress bar reaches 100% and finish collecting the point.

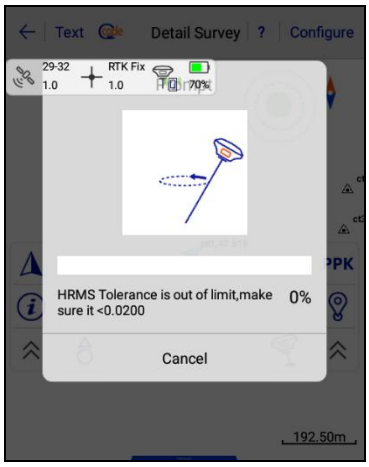


Figure 7-2-2 Shake

7.2.2 Prompt

If the "Slope method 2.0 fail" is prompted, the current point will not be saved.

Figure 7-2-3 Prompt

7.3 Tilt Survey with Calibration-free

7.3.1 Measuring Method

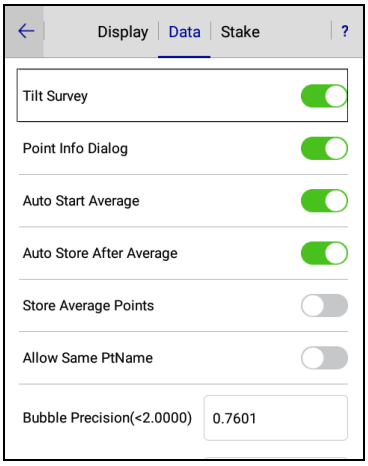
After connecting the receiver, open the *Tilt Survey* switch in the *Surveying configure-data* interface of the software, and after the receiver reaches RTK-Fix, the Tilt Survey can be initialized (click the *Tilt Survey* icon to view the initialization prompt).

Keeping the device in a static state

Keep the device in a static state for 1-3s when the device is in RTK-Fix.

Shaking

After the Tilt Survey initialization has finished, the receiver will be shaken back (once every second) for heading initialization.



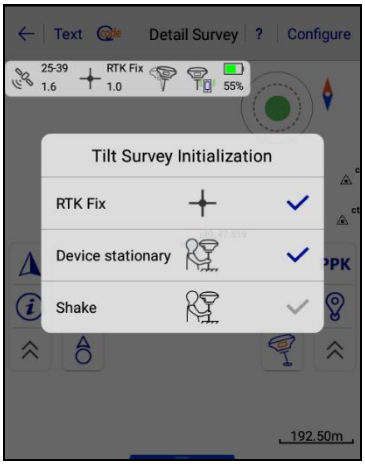


Figure 7-3-1 Tilt survey *Figure 7-3-2 Initialization interface*

When all the initialization items have been ticked, the receiver voice will broadcast "enter tilt measurement", and the Tilt Survey icon will light up. After the initialization of the Tilt Survey, the Tilt Survey operation can be performed on the device.

Notice:

1. The Tilt Survey must achieve the requirements of the RTK-Fix solution, attitude initialization and heading initialization before it can be used. Otherwise, it will prompt to complete the initialization operation.

2. The Uncorrected Tilt Survey function is only supported by the New iRTK5 GNSS RTK receiver.

3. When on the calibration-free tilt survey model, click on the tilt survey icon in the lower right corner of the interface to switch the current mode to the normal survey or tilt survey.

4. When on the calibration-free tilt survey model, the tilt azimuth, vertical inclination, and no tilt correction coordinates information can be viewed in the button box of the detail survey interface.

Chapter 8

Quasi-dynamic Survey

This chapter contains:

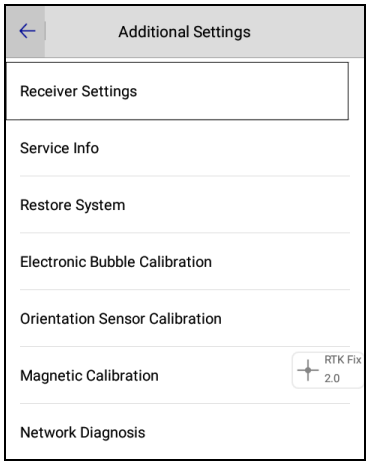
- Function Introduction
- Operation Procedure

8.1 Function Introduction

Quasi Dynamic RTK Survey was invented by Hi-Target, a new way to survey in tough areas where there is strong multi-path interference, signal blocking like standing beside big trees; the reliability is much better than the normal RTK survey in those conditions. It can offer precise coordinates in 20 – 40 seconds, with better fixing rate, accuracy, and reliability.

8.2 Operation Procedure

1. Activate the function.
Additional Settings → Receiver Settings → Quasi Dynamic RTK → Set.



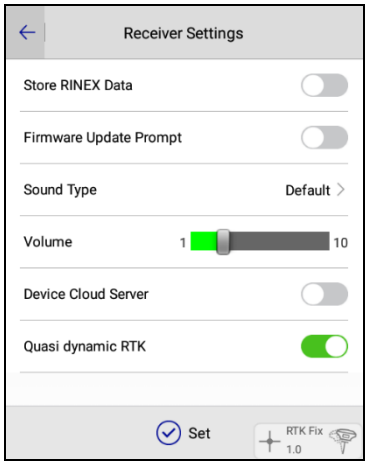
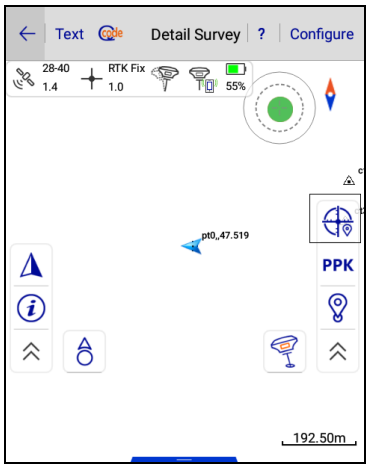
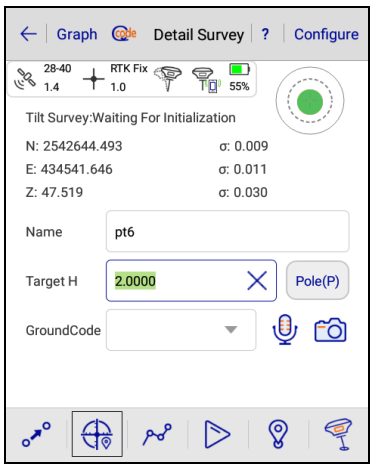


Figure 8-2-1 Receiver Settings Figure 8-2-2 Quasi dynamic RTK

2. After the RTK correction from the base receiver or CORS service had been received for more than 30 seconds, the quasi dynamic RTK survey is ready to work.

3. Go to *Detail Survey* interface, click button on the screen to start. If you get the feedback *QuasiDynamic engine is under preparation*, then please make sure the receiver is getting corrections.





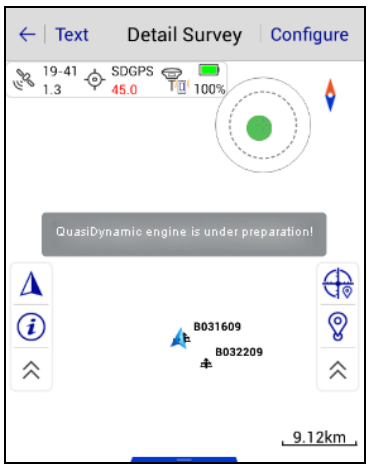


Figure 8-2-3 Button (1) *Figure 8-2-4 Button (2)* *Figure 8-2-5 Prompt*

4. It should take 20 – 40 seconds to finish collection, during the procedure please keep the receiver as steady as possible, rotating and shaking is not allowed.

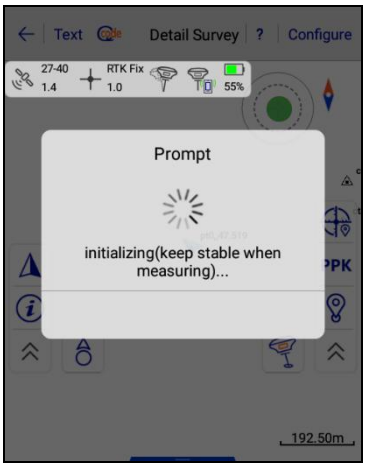


Figure 8-2-6 Prompt

5. After the dingdong sound is tweeted, the collection is done and the point is saved. In this mode, the normal detail survey RTK point collection is still available.

Chapter 9

iHand30 Controller

This chapter contains:

- Introduction
- Appearance
- Controller accessories
- Operation
- Download
- USB upgrading
- APN setting

9.1 Introduction

9.1.1 Foreword

The iHand30 controller is a professional data collector, based on the Android system. Using a combination of physical buttons and touch screen to operate, the default input languages are Chinese and English, and it supports multiple languages. The industrial-standard design can withstand 1.2 meters drop to a cement floor, is IP67 waterproof and dustproof standard to adapt to a complex operating environment. At the same time, the super capacity lithium battery can handle all weather requirements.

The iHand30 controller configures 3.7 inches 640 * 480 highlighted LCD; 1.5GHZ, quad-core 64-bit CPU; and 16GB ROM +2 GB RAM memory. It has a built-in Micro SD card slot, and maximum support 128GB expansion card (it only supports FAT32 format SD card, the NTFS format SD card cannot be supported); dual card dual standby, and supports the entire 4G network. With the Android 6.0 operating system, the interface is optimized and easy to use.

9.1.2 Features

1. Industrial-standard design, with IP67 it can withstand a 1.2 meters drop to a cement floor and adapt to a complex operating environment.

2. Highlighted LCD, the LCD screen is normally readable under strong sunlight.

3. Supports Bluetooth, Wi-Fi and 4G，which is convenient to carry out a variety of wireless data transmissions with the receiver. Wi-Fi and 4G can be used at the same time. Refer to the Hi-Survey Road Software User's Guide for more details.

4. Internal 8-million-pixel camera: for field collection of image information.

5. Internal removable large capacity lithium battery for more than 15 hours of work.

6. The internal NFC chip supports NFC data transmission for a rapid connection between the RTK and handheld controller.

7. Fast charge technology: for a rapid battery charge.

8. Full keyboard input method.

9. Local online upgrade to facilitate quick changes.

9.1.3 Caution

Although the iHand30 handheld controller is made with chemical and impact-resistant materials, it needs to be carefully used and maintained and should be kept in a dry environment. In order to improve the stability and usage cycle of the iHand30 handheld controller, please avoid exposing it to extreme environments, such as humidity, high temperatures, low temperatures, corrosive liquids or gases, etc.

Notice: The iHand30 handheld controller must be used within the temperature range from -20℃ to 55℃

9.2 Appearance

9.2.1 Front of The Controller

The front of the iHand30 controller includes a touch screen, keyboard microphone, and indicator light.

Figure 9-2-1 iHand30 controller

1- Indictor lights 2- Microphone 3- Touch screen 4- Keyboard

- Touch screen: multipoint capacitive touch screen with touch pen (open the touch pen function: Settings - Accessibility - Handwriting pen), which supports Chinese and English input.

- Keyboard: direction control, switch between Chinese and English, data collection, volume control, power on, power off and other functions.

- Microphone: the internal microphone can be used for field collection of voice messages.

- Indicator lights: from left to right: signal lamp, state lamp, power indicator.

9.2.2 Reverse Side of The Controller

There is a camera, battery cover, belt, NFC, trumpet, etc.. on the reverse of the controller.

Figure 9-2-2 the backside of the iHand30

1- Camera 2- Battery cover 3- Trumpet 4- NFC 5- Belt hole

- Camera: used for field collection of images.

- Battery cover: with an internal removable lithium battery.

- Belt hole: connect the belt to prevent it from sliding down.

- Trumpet: conduct real-time voice broadcasts for instrument operation and status.

- NFC: supports NFC data transmission to achieve a rapid connection between RTK and the handheld controller.

9.2.3 Side of The Controller

1- Waterproof and dustproof rubber cover 2- Audio port 3- USB port

Figure 9-2-3 the port of iHand30

- USB port: for connecting the USB data line and the controller.

- Audio port: for connecting the headphone cable and the controller.

Notice: When not using the audio port or Mini USB, please close the rubber cover to make it waterproof and dustproof.

9.3 Controller Accessories

9.3.1 Charger

Figure 9-3-1 Charger

Charger: 5V--3A/9V--2.7A/12V--2A

Type: A824A-120200U-CN2

9.3.2 Battery

Figure 9-3-2 Battery

Lithium battery: 3.7V /5200mAh

9.3.3 Data Cable

Figure 9-3-3 Data cable

USB data cable: connect to the USB port of a computer, for download of data; connect to the USB port of the charger for charging the controller.

9.3.4 Touch Pen

Figure 9-3-4 Touch pen

Touch pen: located on the strap of the controller.

9.4 Operation

9.4.1 Keyboard

Most settings and operations of the iHand30 handheld controller can be completed by the touch pen, and commonly used operations can be completed on the keyboard. The appearance and functions of the keyboard are as follows.

iHand30 keyboard includes: Back, OK, Power, APP, Fn, Collect, etc..

Figure 9-4-1 Keyboard

1- Home 2- Menu 3- APP 4- Fn 5- Power 6- Back

7- Collect 8- OK 9- Delete 10- Space 11- Enter 12- Shift

- Back: cancel or exit the operation of the current window.

- OK: confirmation.

- Power: press it for over 3secs to power on/off. Press it for 1sec to turn off /on the screen backlight in the power-on status.

- APP: quick start of the APP. The default is Hi-Survey Road software.

- Fn: when inputting, short press this key to cycle the input method (Chinese Pinyin/ English letter abc/ English association en/ number 123). In any interface long press this button to pop-up the selection box to switch the system input method.

- Collect button: collect data by manual operation.

- Shift: switch key of the input function.

- Fn + direction up/ down key: volume increase/ decrease.

- Screenshot function: pull down the screen at the top menu, select the screenshot options, and the screen capture will be kept in the folder of Mobile phone storage→Pictures→ Screenshots. (note: iHand30 does not set the shortcuts screenshot function).

Notice: When the iHand30 handheld controller is not used, please turn off the backlight to save electricity and prolong working time.

9.4.2 Battery Installation and Dis-assembly

1. Installation and disassembly of the battery

Installation:

Step1: the metal contact parts of the battery are placed upwards in the cell tank.

Figure 9-4-2 Installation of Battery

Step2: press the bottom of the battery.

Figure 9-4-3 Installation of the battery

Dis-assembly: pull up the bottom of battery

Figure 9-4-4 Dis-assembly of the battery

2. Installation and disassembly of the battery cover

Installation:

Step1: insert the two raised tabs of the battery cover into the corresponding slots.

Figure 9-4-5 Battery cover

Step2: press the battery cover tightly, press the black button.

Figure 9-4-6 Lock the battery cover

Dis-assembly: push up the black button of the battery cover, and pull up the battery cover.

Figure 9-4-7 Battery cover *Figure 9-4-8 Lock the battery cover*

9.4.3 Power System

1. The battery and charger model of the iHand30 handheld controller

Table 9-4-1 the battery and charger model

Name	Model
Lithium battery	BLP-5200S
Charger	A824A-120200U-CN2

2. Charge

The special charger should be within a certain temperature range when charging, and certain charge time is required. Specific use methods and requirements: use the special charger of the controller to charge in the temperature range of 10℃-40℃. There is a certain amount of electricity in the battery on first use, let the power completely run out from the first charge, then the first three times you will need to charge for 3 hours. After that, the iHand30 supports fast charging with the original charger and the charge time is then less than 3 hours. If the battery is not used often, it must be charged once every two months.

Notice:

1. Please use the configured battery and charger, do not put the battery into fire or metal short circuit electrode.
2. If the battery is hot, deformed, leaks, has an odor or any other abnormalities during use, charging or storage, please replace it
3. If the using time is obviously shortened, please stop using the battery. Please replace with a new battery

9.4.4 SIM Card Setting

The iHand30 handheld controller supports DSDS, the default card is SIM1. Both SIM1 and SIM2 support full network 4G.

1. Installation of the SIM card

Step1: remove the battery cover, remove the battery, and expose the SIM card slot. Slot 1: Micro SIM card; slot 2: standard SIM card.

Step2: put the SIM card into the slot with the front side (metal contact side) down.

Figure 9-4-9 Installation of SIM card

2. Network: Settings → Data usage.

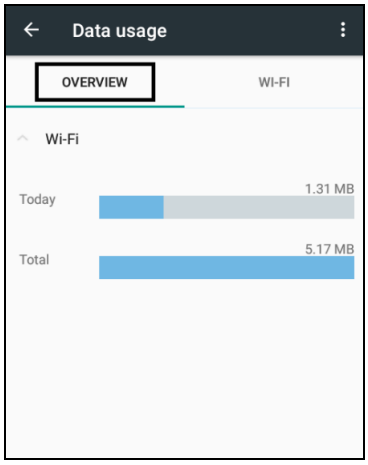


Figure 9-4-10 Data usage

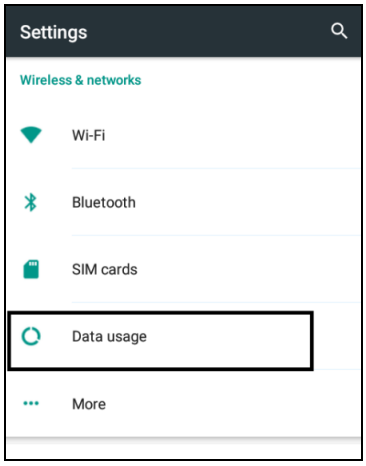


Figure 9-4-11 Overview of data

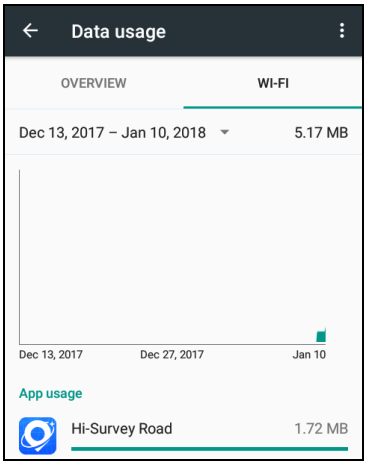


Figure 9-4-12 Cellular data network

9.4.5 Installation of The Micro SD Card

The Micro SD card can save collected data and program files.

Notice: Micro SD card（TF card）is an external storage card, usually used in mobile phones and PDAs. If you buy this, please note the difference to ordinary SD cards. The volume of the ordinary SD card is larger than the Micro SD card and is not suitable for the iHand30 handheld controller.

Step1: remove the battery cover, remove the battery, and expose the Micro SD card slot.

Step2: push down the metal sheet and open it.

Figure 9-4-13 Micro SD slot

Step3: Put Micro SD card into the slot (metal contact side down).

Figure 9-4-14 Installation of Micro SD card

Step4: push down the metal sheet and close it.

Figure 9-4-15 Installation of Micro SD card

9.4.6 Power On / Off

In the off state, Long press the power button for 3 seconds, it will power on.

Figure 9-4-16 The interface of the iHand30 screen

In the *power-on* state, Long press the power button for 3 seconds, it will prompt to shut down and to confirm, click Power off.

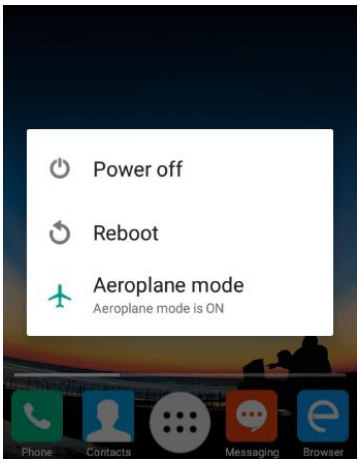
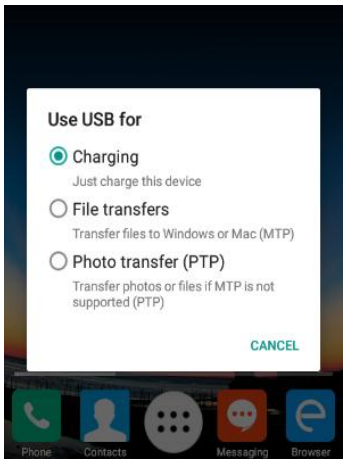


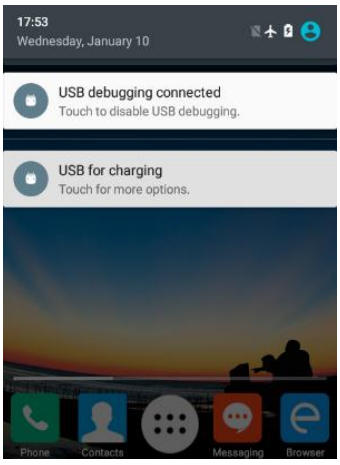
Figure 9-4-17 Power off

9.5 Download

1. Connect the controller to the computer via the USB data cable.

2. Transfer files: pull down the notice column and click USB for charging.





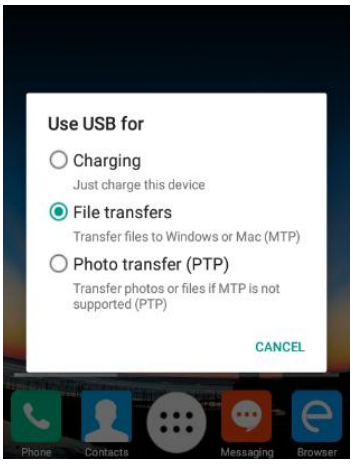
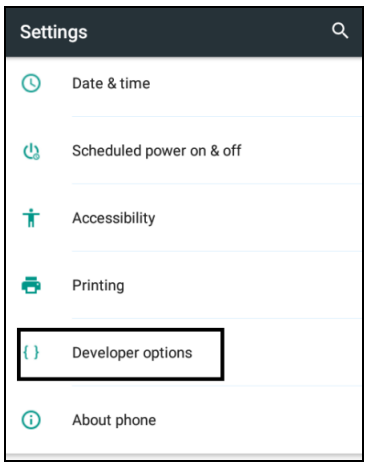
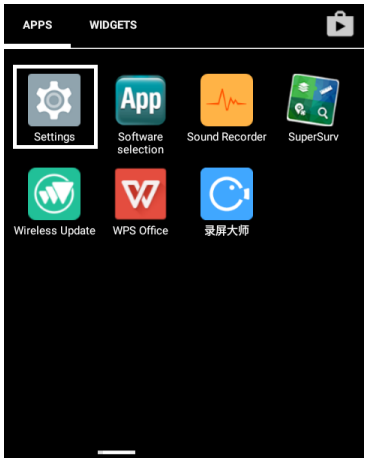


Figure 9-5-1 USB connected *Figure 9-5-2 Charging* *Figure 9-5-3 File transfers*

3. Connect the PC version mobile phone assistant: open the handheld controller, click Setting → Developer options → USB debugging.





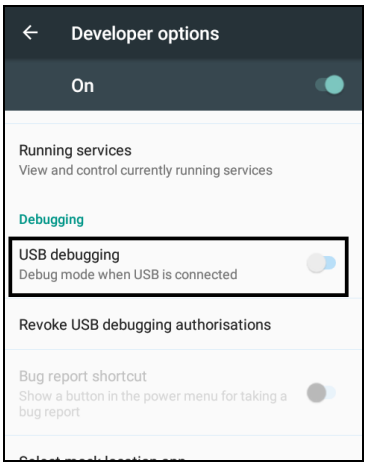


Figure 9-5-4 Settings *Figure 9-5-5 Developer options* *Figure 9-5-6 USB debugging*

9.6 USB Upgrading

iHand30 controller supports two methods for upgrading, local upgrade, and wireless upgrade.

1. Local upgrade of the iHand30 controller (download the firmware from the Hi-Target official website first).

Step1: Copy the upgrade firmware to the SD directory.

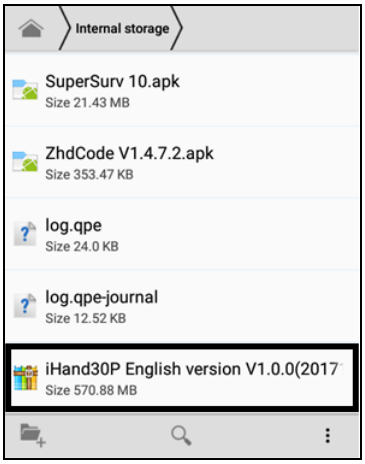


Figure 9-6-1 Upgrade patch

Step2: Choose the *Wireless Update* App.

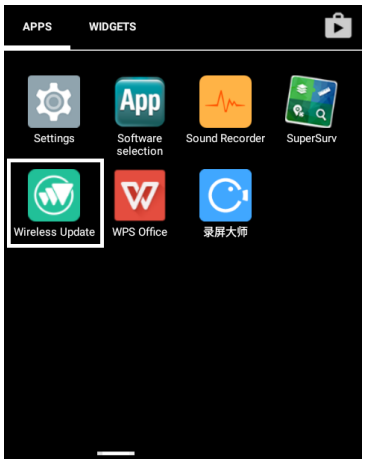


Figure 9-6-2 Update App

Step3: Open the *Wireless Update* App, as shown below.

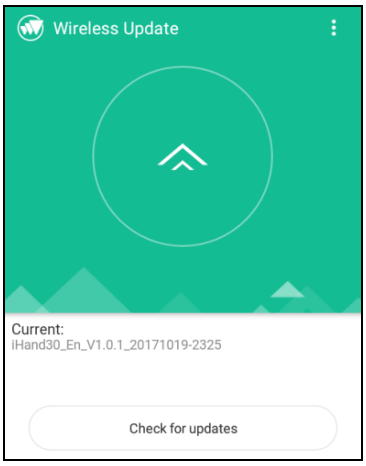


Figure 9-6-3 Interface of the update

Step4: Click the top-right menu selection in the interface, and choose *Local updates*.

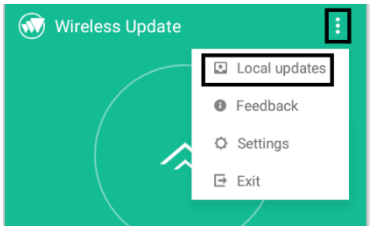


Figure 9-6-4 Local updates

Step5: Enter the interface.

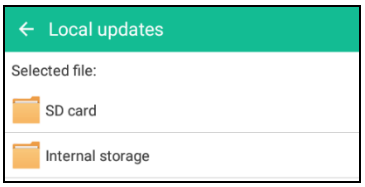


Figure 9-6-5 Local updates

Step6: Select the *Internal storage* file, then select the update firmware.

Figure 9-6-6 Choose the firmware

Step7: After selecting the upgrade firmware, click *Install Now*.

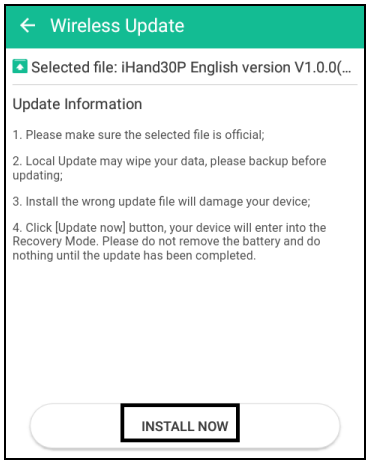


Figure 9-6-7 Install

Step8: The system will restart and begin to update.

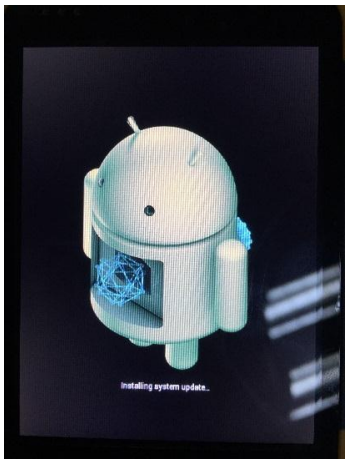


Figure 9-6-8 Interface of upgrade

2. Wireless update

Step1: Select the *Wireless Update* App.

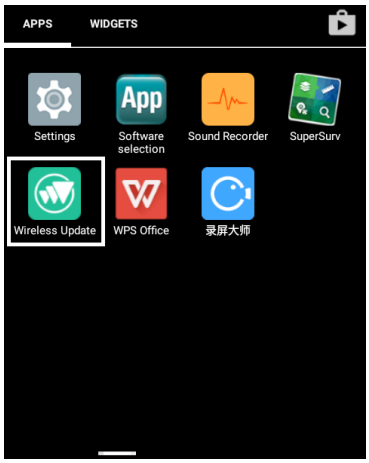


Figure 9-6-9 Update App

Step2: After entering the Wireless Update App, if there is a new version, the interface will show it and display the update. The complete update content will appear if you draw up the screen.

Step3: Click Download, the firmware update patch will be downloaded.

Step4: When the system upgrade package is downloaded, come out of the prompt window, and click Confirm. Special attention should be paid here. After clicking, it's forbidden to operate of the device.

Step5: After completing step 4, the device will enter the upgrade interface, waiting for the progress bar to reach the full grid that completes the system wireless upgrade.

Step6: when the upgrade is completed, the device will restart automatically, repeat steps 1 and 2 to check whether the update is complete, then finish it.

9.7 APN Setting

Please check whether the APN parameter is set correctly when the iHand 30 cannot access the Internet through the mobile network. In cases where the iHand 30 is not connected to Wi-Fi, the SIM card must be installed in the iHand 30 in order to set the APN.

The steps for the APN parameter setting of the iHand 30 system: Open *System Settings* > *More* > *Mobile network* > *Access point name (APN)* of the iHand 30, enter the iHand 30 SIM card network access point name (APN) selection and then set the APN related parameters.

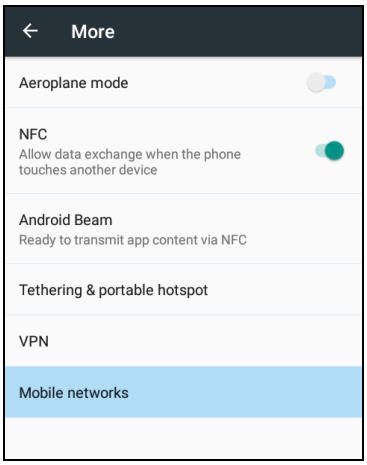


Figure 9-7-1 More interface

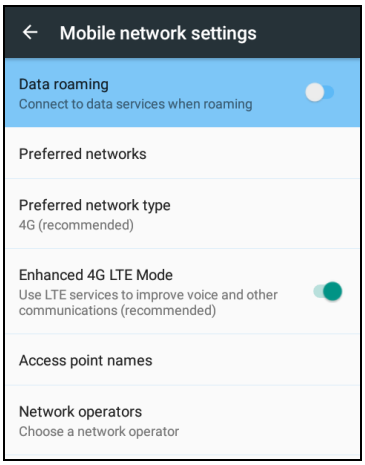


Figure 9-7-2 Mobile networks settings

When the data link mode of the Hi-Survey Road software is "Data Collector Internet", the APN parameters will be the iHand 30 system settings.
If the mobile card is a private network card provided by the CORS service provider, you need to set the APN parameter as a private network APN parameter in order to connect to the Internet. Follow the steps above to connect to the private network. After setting the name, APN, username, and password of the private card, login to the server to confirm the network connection.

Notice:

The "Data Collector Internet" is recommended for the software data link. This can

save the receiver's power, extend the operation time, and make the Mobile network more compatible with local networks.

The username and password of the private network card’s APN parameter setting are of the private network rather than CORS.

Chapter 10

Appendix

This chapter contains:

- Technical Terms
- Troubleshooting
- File Formats

10.1 Technical Terms

1. Global navigation satellite system（GNSS）

Global navigation satellite system (GNSS), is the standard generic term satellite navigation system, it provides global coverage of geographic spatial orientation, including the US GPS, Russian GLONASS, Chinese BDS, and the European Union's Galileo.

2. GPS time

The time measurement used by the NAVSTAR GPS system.

3. UTC

Universal Time Coordinated。Time standard for local daylight hours based on Greenwich meridian。See GPS time.

4. Multipath

Interference (similar to the heavy shadow on a television screen). GNSS signals arrive at multiple paths before they reach the antenna through different paths.

5. Degree of ambiguity

The number of weeks in the carrier phase pseudo space between GNSS satellite and GNSS receiver.

6. Ephemeris

Current satellite position prediction. It is transmitted in the data.

7. Epoch

Measurement interval of GNSS receiver. Variations of the calendar element with measurement type:
- For real-time measurement, it is set to one second.
- For post-processing measurements, set to one second and one minute.

8. Antenna height

The height of the receiver phase center to the center of the station.

9. Reference station（base station）

In a certain period of time, and if one or several receivers, on one or a few test sites, keep tracking an observation satellite, with the receiver in a certain range, the fixed station is called a reference station.

10. Mobile station

In a certain period of time, and if one or several receivers, on one or a few test sites, keep tracking an observation satellite, and the receiver is within a certain range, the fixed station is called a reference station。

11. Single reference station RTK measurement.

Only one base station is used, and the carrier phase difference correction parameter is measured by the data communication technology receiving base station.

12. Network RTK (CORS/VRS)

Refers to multiple reference stations in an area, network coverage to the region composition, and continuous tracking observation, through the sites of GPS observation network, covering the region and the time period for RTK correction parameters, in the region for RTK line RTK real-time correction way of positioning.

13. Cut-off height angle

In order to shield the effect of occluded objects (such as buildings, trees, etc..) and the multipath effect, the value of the angle threshold is lower than that of the satellite in the field of view,
which is usually set to 10 degrees.

14. Fixed solution

This indicates that the ambiguity has been solved and the measurement has been initialized. It is the most accurate type of solution.

15. Floating solution

This indicates that the ambiguity has been solved and the measurement has not been initialized.

16. DOP (dilution of precision)

Position Dilution of Precision (Dilution of Precision) is GNSS quality marks. It takes into account the position of each of the satellites, relative to the other satellites in the constellation, and their geometric position relative to the GNSS receiver. The smaller the DOP value, the higher the accuracy reliability. Standards applied by GNSS DOP value are: - the PDOP - position (3d coordinate) - RDOP relative (position), average time - HDOP - level (two-dimensional horizontal coordinates) - VDOP - vertical (only height) - TDOP - time (the clock offset only).

17. Spatial position dilution of precision (PDOP)

A unit number that represents the relationship between user position error and satellite position error. The factors reflecting the attenuation of positioning accuracy are related to the spatial geometric distribution of the measured satellite, and the larger the spatial distribution range, the smaller the PDOP value and the higher the positioning accuracy; conversely, the larger the PDOP value, the lower the positioning accuracy.

18. PDOP limit

The highest PDOP value for the receiver's computed position.

19. PPM

The measurement of the slanting distance of one-millionth is corrected for the impact of the earth's atmosphere. PPM is determined by the observed pressure and temperature as well as the specific instrument constants.

20. The RMS

The Root Mean Square is used to indicate the measurement accuracy of the point. It is the error circle radius at about 70% of the fixed point.

21. SNR

（Signal-to-Noise Ratio）。It is a measure of the strength of satellite signals. SNR ranges from 0 (no signal) to 99, of which 99 is the best, and 0 means the satellite is not available. The typical good value is 40. Normally, when SNR is above 25, GNSS systems begin to use satellites.

22. Weighted index

The weighted index is used in the neighborhood adjustment calculation. The calculated distance from each new point to the control point, in the station establishment, will be weighted according to the weighted index when the coordinate adjustment applied to the new point is calculated.

23. Pile distance/station distance.

The distance or interval along a line, arc, or path.

24. Projection

Projection is used to produce a plane map that represents the surface of the earth, or that part of the surface.

25. The ellipsoid

The earth's mathematical model of the rotation of an ellipse around a short axis.

26. Geodetic datum

A mathematical model designed to fit some or all of the geoid surface (physical earth surface).

27. Earth level

It's very close to the universal gravitation of the sea’s surface.

10.2 Troubleshooting

1. The receiver keeps tracking but failed to give coordinates.

Please try the possible solutions below:
(1) Set up the receiver again in another place with much less electromagnetic wave interference (like a power station, radar station, etc..)
(2) Set the working mode of the receiver to static, then collect static data for 3 – 5 min, then switch it back to the original model (base or rover)
(3) Long press function button to reset motherboard, or restart the device.
2. The base station failed to send correction signal.

Please try the possible solutions below:

(1) Replace the battery in case the battery power is too low (power LED will flash red)

(2) Abnormal LED display in base mode

a. Satellite LED flashing, means the receiver failed to track the satellites and the coordinates cannot be provided:

The place where the base was set might be blocked by buildings or shelters and the useful

Satellites were less than 4. Find a better place to set up the station again.

Coordinates provided by the base station are far from the actual coordinates; in this case, a re-averaging of base coordinates is required.

b. Satellite LED keeps on but the signal LED does not flash: this means the base does not transmit the correction signal. Please reset up the base.
(3) Central meridian might be set with a mistake, double-check this parameter.
(4) Reset motherboard, restart the device.
3. Rover cannot receive signals even if it is very close to the external radio of the base station:
(1) If the signal LED is not flashing, please refer to problem 2 (previous problem).
(2) Transmitting LED RX/TX does not flash (flashes once every second in normal conditions)

a. Check if the cable is connected firmly.

b. Check if the cable is broken, try to replace the cable.

c. Replace the power if the battery is too low.
(3) Everything is alright with the base part but the rover signal LED does not flash.

a. Make sure the radio channel and link rate are the same as the settings in the base.

b. Internal radio module in rover is abnormal, try to replace it, or grade the firmware or restart the device.
(4) Rover signal LED flashed but in the software, there is no common satellite number showing.

a. Make sure the message types between base and rover are the same.

b. Rover is severely interfered with and the common satellites‘ number is less than 4, so the number is not showing. On this occasion please go to an open-air area to set the rover.
4. Short-range radio communication in external radio base mode.

These are three possible reasons:

(1) External battery power is too low to supply enough power to transmit the signal. Replace the battery.

(2) The transmission method is not set to be external radio on the base station.
(3) External radio abnormal.

a. Power is set too low.

b. The transmission antenna is not installed properly.

c. The cable is not connected firmly.

d. The antenna on the rover is not installed firmly or broken.
(4) Strong interference in the base area. Try to change the channel or change the place to set up base
5. Failed to connect to internet in internal GSM mode.

How to solve:
(1) Cellular internet antenna is not installed or not installed firmly.

(2) Internet setting incorrect (check the IP address, port, telecom operator, APN, CORS ID, and password, etc..)
(3) SIM card problems

a. Not installed properly, or the position is not matched to the pins, either too shallow or too deep.

b. No balance in the SIM account.

c. The band of the SIM card is not matching the band in the cellular modem. Try to use another SIM card from other telecom operators.
(4) Cellular signal is weak in the region.
(5) CORS server is not working properly. Try to use another device to test it.

(6) Reset the device.
6. ZHD Server connection failed.

How to solve:
(1) Check the IP, port, Area ID, Group ID, the message type is the same between base and rover.
(2) Account or Group ID and Area ID occupied by other users. First come, first served.
(3) Server abnormal. Please contact CORS service center for help.
7. Rover failed to get signal from CORS.

How to solve:

(1) Signal LED flashing green, but failed to connect to server:

a. SIM card issues (no balance, SIM card slot lose, band incompatible)；

b. CORS parameters issues (IP, port, mount point, account ID and password, etc..)

c. Contact the CORS service center for help if the above are checked and are ok.

d. Internal cellular modem problem, try to reset or restart the device.

(2) Signal LED stays green but failed to receive a correction signal.

a. Check IP, port.

b. Contact the CORS service center for help if the things above are checked.
(3) Signal LED is green and flashes yellow every second, but no common satellites' number shows.

a. Check if the message type is correct

b. Check if the GNSS signal is severely blocked or interfered.
8. Bluetooth connection failed between controller and receiver

How to solve：

(1) Check if the working mode of receiver is static; if yes, switch it back to

base or rover mode; check if the 8-pin port of receiver is occupied or not.
(2) Clear the Bluetooth search result list, search again and connect the device.
(3) Either switch off and switch on the Bluetooth function or restart the device or controller.
(4) Update the firmware of controller, or the firmware of receiver.
9. Android controller cannot connect to PC (windows).

How to solve:
(1) Check if the driver was successfully installed or windows updated to the latest version.
(2) Check if the anti-virus software blocks the connection due to its security.
(3) Check if the *USB debug* function is activated.
(4) Check the USB cable is not broken.
10. Big coordinates difference after the Localization work (coordinate system parameters calculated)

Possible reasons:

(1) Accuracy is not good during the data sampling in the control point survey.

(2) The control point is not distributed properly in the restion③Abnormal control point coordinates.
How to solve:
(1) Check the parameters result, if the scale is far from 1, then the control points might not be correctly input.
(2) Check the distribution of the control points, they should not be so close to each other.
(3) Try to delete the points whose RMS are bigger, if there are more than 3 control points.

10.3 File Formats

10.3.1 Road File

[*. Dam] : parameter file.
[*.prj] : engineering documents.
[*.raw] : raw database file.
[maincst.cst] : cross-section point library file.
[*.mcp] : the graph root data file.
[*.bak] : the back-up file will be automatically generated by the new project software if there is no external SD card.
[ParamComputer] : apply the dot to the file.
[*.rsp] : PPK time file.
[*.ppk] : PPK post-processing file.
[*.txt] : custom TXT file.
[*.csv] : custom CSV file.
[*.dxf] : DXF file.
[*.shp] : SHP file.
[*.csv] : Excel file.
[*.dat] : Cass7.0, Scsg2000, and PREGEO data files.
[*.stl] : Hi-RTK record point library file.

[*.line] : line library file.
[*.sec] : line meta files.
[*.PHI] : intersection file.
[*.xy] : iron courtyard.
[*.csv] : five pile files.
[*.icd] : Elcad format.
[*.zline] : coordinate method file.
[*.pvi] : change the slope point file.
[*.tpl] : cross section design line file.

10.3.2 File Format Specification

1. Intersection of road plane design line [*.PHI]

PHI: Point of Horizontal Intersection.

PHI file is stored in a text format, separated by a comma, and the first line is the format description [when the program reads it], starting from the second line, and behavior of the internode information; the storage format is:

Intersection number, coordinate N, coordinate E, starting range, curve radius, forward detente curve, then detente curve

※The sample:

Intersection number, coordinate N, coordinate E, starting range, curve radius, forward detente curve, and then detente curve.

1, 3361410.701, 524798.9388, 200000, 0, 0, 0

2, 3361729.719, 516179.2477, 207750.218, 7000, 400, 400

3, 3362156.214, 514352.2852, 209804.108, 7000, 400, 400

4, 3363142.054, 511810.6419, 212590.856, 7000, 400, 400

5, 3365587.828, 502113.9878, 222784.866, 10000, 270, 270

2. Road plane line element file. [*.Sec]

Sec: short for Section.

Sec files are stored in text format, separated by commas.

The first line is: the starting information format specification [skip] when the program is read.

The second line is: the starting point of the line, including the starting point, starting distance, and starting point angle.

The third line is the line element format specification.

The fourth line is: the beginning line is a line element information.

Its storage format is: type, starting radius, end radius, line element length, deflection direction.

Note: *. Type: straight line, arc, detente curve

*. Radius: -1 represents infinity.

*. Deflection direction: left L; Turn right R

※The sample:

X0, Y0, S0, Azi0

3829469.058, 494798.067, 0, 1.67595677755068

[Type{L, A, S}, R1, R2{-1=infinity}, Length, Direction{L，R}]

L, -1, -1, 334.315, L

S, -1, 300, 145, R

A, 300, 300, 60, R

S, 300, 90, 60, R

A, 90, 90, 75, R

3. Road longitudinal section changes the slope point file [*.PVI]

PVI: short for Point of Vertical Intersection.

PVI files are stored in text format, separated by commas.

The first line is the format specification [skip] when the program is read.

From the second row, the row is a slope point information; its storage format is:

The slope of the slope is S, the elevation of the slope is H, the first slope is higher than i1, the second slope is i2, and the circle radius is R.

※The sample

S, H, i1, i2, R

19653.349, 794.963, 0, 0.049, 0

20070, 815.379, 0.049, 0.007, 12000

22180, 830.155, 0.007, -0.025, 30000

23880, 787.655, -0.025, -0.014, 17000

23974.007, 786.339, -0.014, 0, 0

4. Road cross-section design line document [*.tpl]

TPL: short for Template.

The TPL files are stored in text format, separated by commas.

The first line is the format specification [skip] when the program is read.

The second behavior left design line.

Third behavior right design line.

Its storage format is: the left design line [distance, slope ratio]\r right design line [distance, slope ratio].

※The sample:

Left design line [distance, slope ratio]\r right design line [distance, slope ratio]

10, -0.1, 1, 0, 10, 1, 1, 0, 10, 1

10, -0.1, 1, 0, 10, 1, 1, 0, 10, 1

The cross-section point library (*.cst) can be opened directly with notepad, and the coordinate points of data exchange module can be exported *.csv, sample points, control points can be exported or imported *.txt format, which facilitates data exchange with the computer.

(1) Export Excel file (*.csv)

Roll call, N, E, Z, describe information

4, 20.9919, 7.8963, -0.0147, Test

(2) Sample library import/export Txt file (*.txt)

Roll call, N, E, Z, description, set point range, whether it has been lifted (0: no, 1: yes)

1, 2542604.5095, 434458.4638, 47.5900, Lk pile 1, 10.0000, 0

22, 2542604.5062, 434458.4614, 45.4771, Street lamp, 30.0000, 1

(3) Control point library import/export Txt file. (*.txt)

Roll call, N, E, Z, description, coordinate type（0:blh，1:xyh）, B, L, H

t, 2542604.2867, 434459.2702, 47.9231, control points A, 1, 22:58:52.51358, 113:21:38.93873, 47.9231

uu, 2542604.5062, 434458.4614, 45.4771, Test, 1, 22:58:52.5206, 113:21:38.91030, 45.4771

(4) Cross section point library format （*.cst）

CrossSec points[Ver:1]

E, N roll call, north coordinates, east coordinates, elevation plane Z, WGS84 latitude raw measurement data, B WGS84 longitude L raw measurement data, WGS84 raw measurement data height H, high target, high target type, the antenna type [manufacturer: type], north coordinate RMS values, East coordinates the RMS value, surface elevation RMS value, type, number of smooth, recording time, satellite altitude Angle, visible satellite number, Shared satellite number, PDOP value difference ages, set over, mileage (cross-sectional defined mileage), by collecting the real-time mileage by inverse calculation of coordinate, defined when mileage in the section of the pile point collection N coordinates, acquisition defined when mileage in the section of the pile point coordinates, E acquisition defined when the tangent of the transverse section is in the center of the road.

pt0, 321.83562359172527, 75.99595486273756, -0.7214999980390115, 00:00:10.445790N, 109:30:49.422520E, 0.0, 0.6096000000000044, 0, Hi-Target: V30, 0.014002636, 0.011343374, 0.016180737, Single-point positioning, 1, 2013-10-08 15:07:16, 0, 19, 0, 1.7887421, 1.0, 6.263659450178594E-5, 30.0, 31.30462646484375, 321.0, 75.0, 0.8726646259971647.

Hi-Target
Surveying the World,Mapping the Future