

**HI▶TARGET**

# **Hi-RTK Road Software Manual**

**(For Road Construction)**

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# Content

<b>Chapter One Brief Introduction and Operation Process</b> .....	<b>2</b>
1.1 Software Brief Introduction .....	2
1.2 Brief Operation Direction .....	8
1.3 Menu Instruction.....	26
<b>Chapter Two Project</b> .....	<b>28</b>
2.1 Project Information .....	28
2.2 Coordinate System.....	29
2.3 Stored Points Database.....	29
2.4 Stake Point Library .....	31
2.5 Controlled Point Library .....	32
2.6 Upgrade Point Library .....	34
<b>Chapter Three GPS</b> .....	<b>35</b>
3.1 Connect GPS .....	35
3.2 Demonstration Mode .....	36
3.3 Navigation Information .....	37
3.4 Satellite Information.....	38
3.5 Antenna Setting.....	41
3.6 Base Station Setting .....	42
3.7 Rover Settings.....	47
3.8 Receiver Information .....	51
3.9 Console .....	52
<b>Chapter Four Parameter</b> .....	<b>54</b>
4.1 Coordinate System.....	54
4.2 Parameter Calculator .....	58
4.3 Use Checkpoint.....	60
<b>Chapter Five COGO</b> .....	<b>64</b>
5.1 Angle Calculation.....	64
5.2 Coordinate Conversion.....	64
5.3 Area Calculation .....	65
5.4 Distance&Azimuth between Two Point .....	66
5.5 Indirect Survey (Intersection).....	67

<b>Chapter Six Survey .....</b>	<b>69</b>
6.1 Detail Survey .....	69
6.2 Stake Points .....	77
6.3 Stake Line/Arc .....	79
<b>Chapter Seven Road .....</b>	<b>85</b>
7.1 Centerline Editor.....	85
7.2 Profile Editor.....	93
7.3 Template design and file edition .....	93
7.4 Stake Road.....	95
7.5 CrossSection Survey .....	98
<b>Chapter Eight Configuration .....</b>	<b>99</b>
8.1 Software Config.....	99
8.2 Color schemes .....	99
8.3 Select Controller.....	102
<b>Chapter Nine Icon Explanation .....</b>	<b>103</b>
<b>9.1general icons.....</b>	<b>103</b>
<b>9.2Button figure.....</b>	<b>104</b>
<b>9.3 Information bar of the current location.....</b>	<b>104</b>
<b>9.4 Power bar .....</b>	<b>105</b>
<b>9.5Solution status.....</b>	<b>106</b>
<b>Chapter ten The introduction of QminiM.....</b>	<b>107</b>
<b>10.1 keyboard.....</b>	<b>107</b>
<b>10.2Switch machine operation.....</b>	<b>108</b>
<b>10.3Data obtain.....</b>	<b>109</b>

# Chapter One Brief Introduction and Operation

## Process

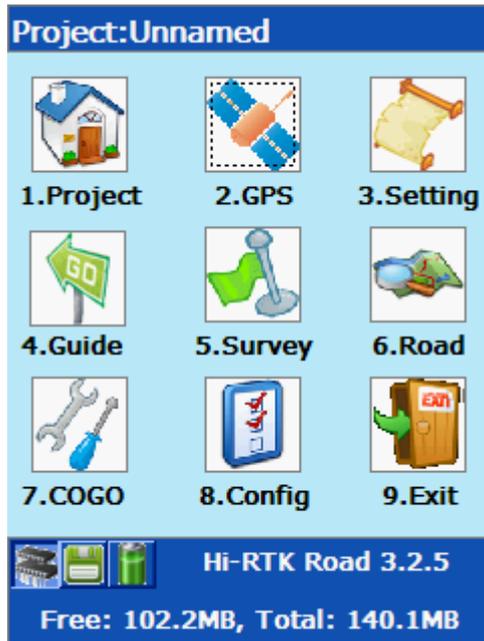
### 1.1 Software Brief Introduction

Hi-RTK Road software is the latest developed versatile handset software based on road construction survey. Following requirements of road construction survey and suggestions from all related customers, Hi-RTK road software which combines practical construction experience and GPS advantages is the wisdom from Hi-Target experts and all the customers.

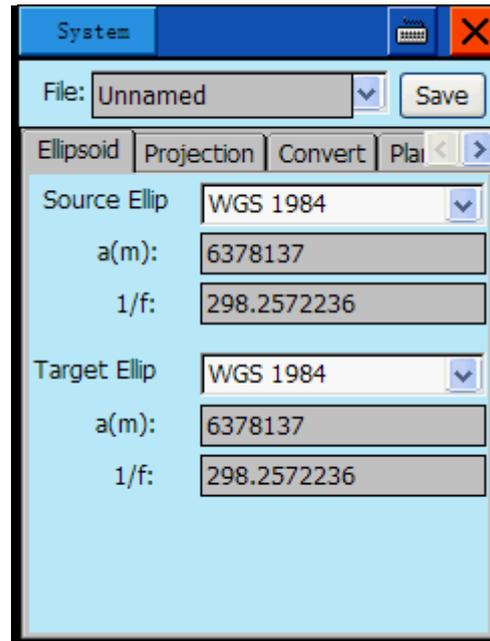
Hi-RTK's advantages are shown hereunder:

#### 1. Globalization

- (1) Switch function between Chinese and English Version.
- (2) Internal global common ellipsoid parameters and conversion benchmark.
- (3) Projection: involving international common projection such as: Gauss Projection, UTM Projection, Lam Bert Projection and Mercator projection.
- (4) Ellipsoid Conversion: Provide several practical methods conversion including three parameters, plane four parameters, seven parameters and one step method. Support Trimble and THALES formats.
- (5) Height Fitting: Support Trimble grid and height abnormalty correction.



1-1 DeskTop



1-2 Coordinate System

## 2. Parameter Calculation

- (1) Apply Coord software mode which has years of experience in support as coordinate system conversion mode, to provide users practical and comprehensive coordinate calculation function.
- (2) Available to get the points provided by GPS, from Map, Cooperate Points store file or input at site, convenient and practical.
- (3) Convenient parameter calculation function: maximally make survey parameter calculation be easy, more simple and convenient in operation.

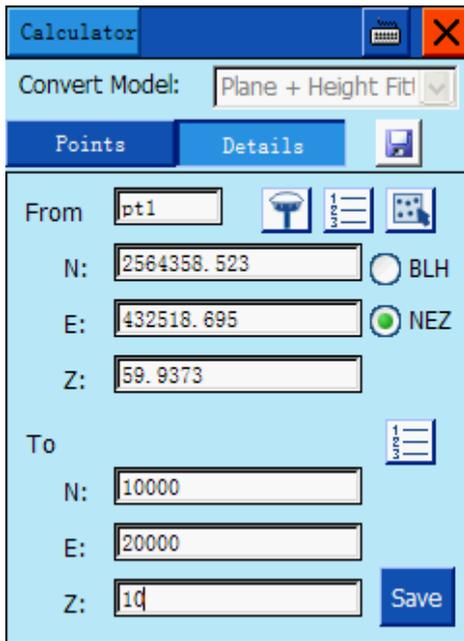


Figure 1-3 Add Coordinate

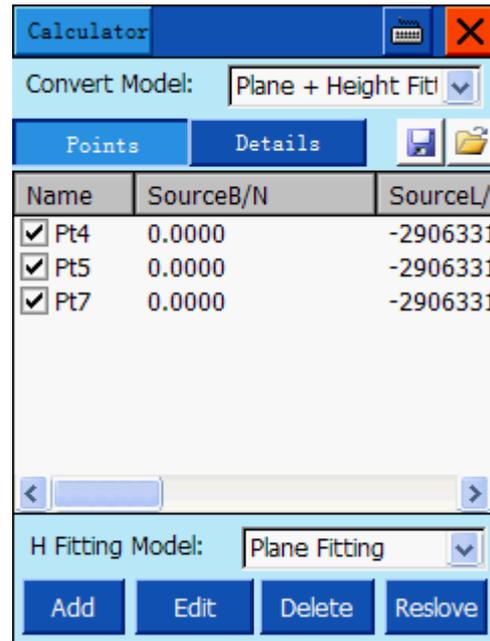
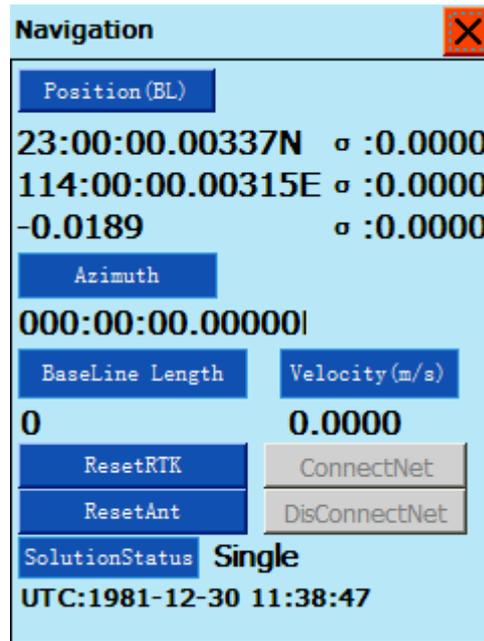


Figure 1-4 Parameter Calculation

### 3. Mapping

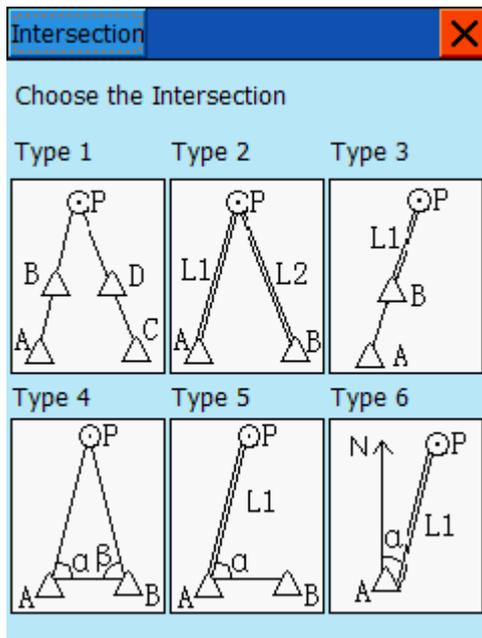
- (1) Point Aggregation Mapping: You can select point aggregations to proceed mapping, choose to input point name and description or not. Different symbol stand for corresponding kinds of points will help you to differentiate.
- (2) Efficiency: Lines and points aggregation mapping is applying the window cut algorithm improvements, to effectively improve the efficiency of graphics.
- (3) Scale: nonlinear-scale transition process, users feel more fluent
- (4) Orientation Indication: Choose to use reliable orientation estimation to optimize the correctness and stability of orientation.
- (5) Navigation Indication: You can appoint the upward side of the screen as your forward direction or Northward. The line connects lay out point and current point helps the user to estimate the moving direction.



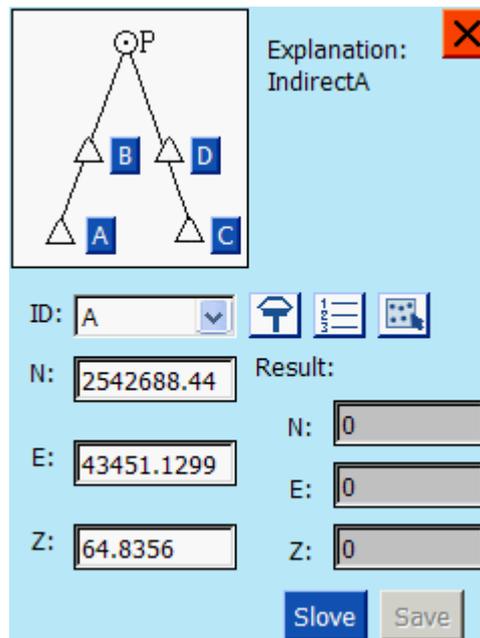
1-5 Navigation Information

#### 4. Assistant Functions

- (1) Support diverse modes of intersection survey, convenient to survey regions out to GPS signals.
- (2) Internal practical tools for distance calculation, area measurement, angles conversion and coordinate conversion.



1-6 Indirect Survey



1-7 Four Known Points

## 5. Road Function

- (1) Support Support editions of Centerline, Profile, Template, and 3 D stake road as well as visible CrossSection Survey. .
- (2) Real time calculation to lay out points on road. You can add stake points by any mileage, realtime mileage projection and show the layout point's mileage.
- (3) Direct instruction on laying out, you can proceed linear layout and plane layout at the same time.

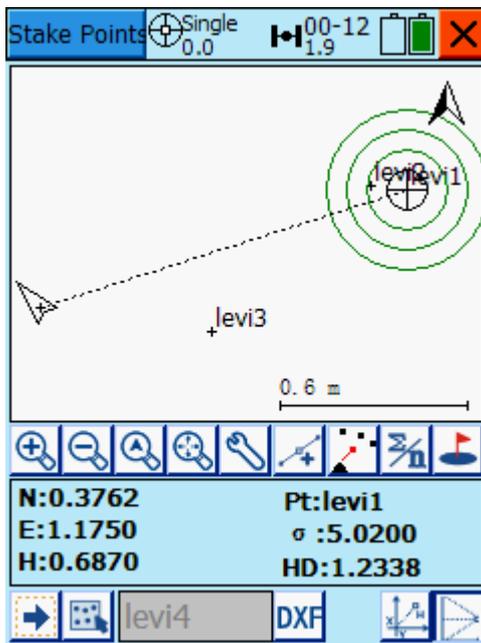


Figure 1-8

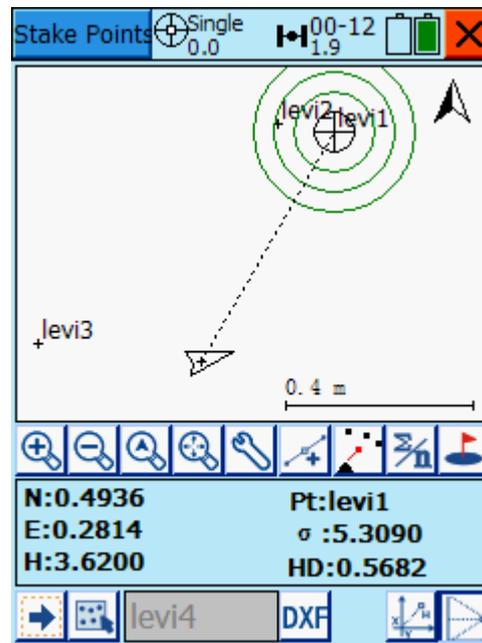


figure 1-9

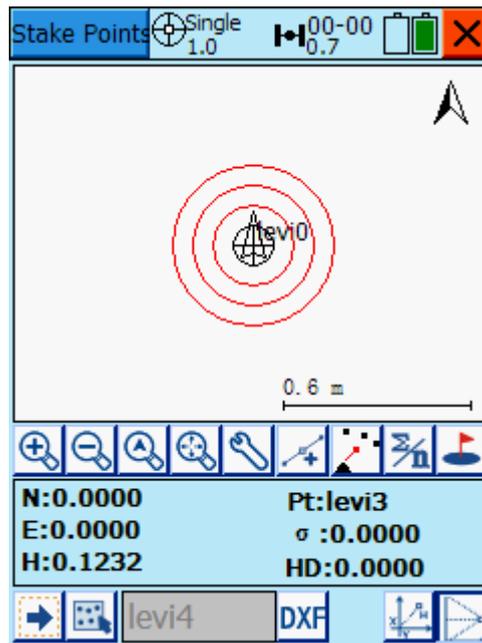
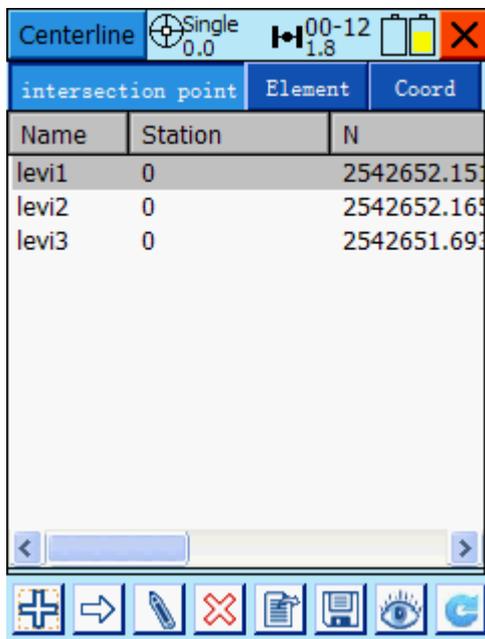
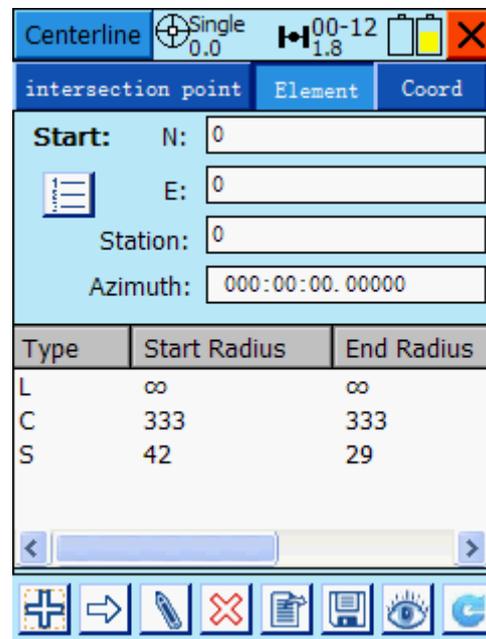


Figure1-10

- (4) Centerline section (horizontal section) editor supports the common-used intersection point method and element method; you can define lines in any shape freely. For example: Interchange Ramps



1-11 Intersection Points

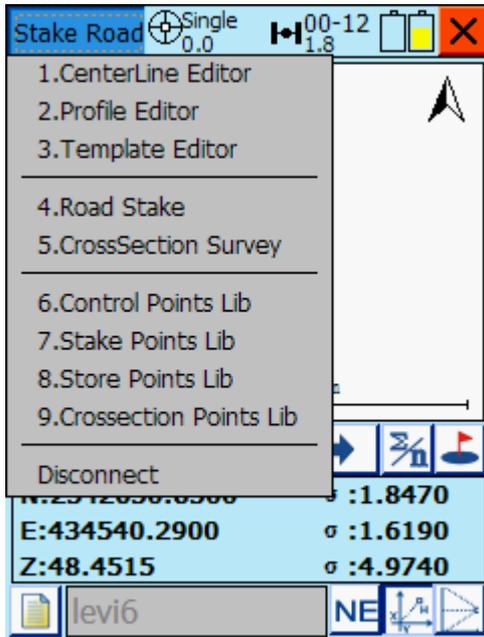


1-12 Element Lines

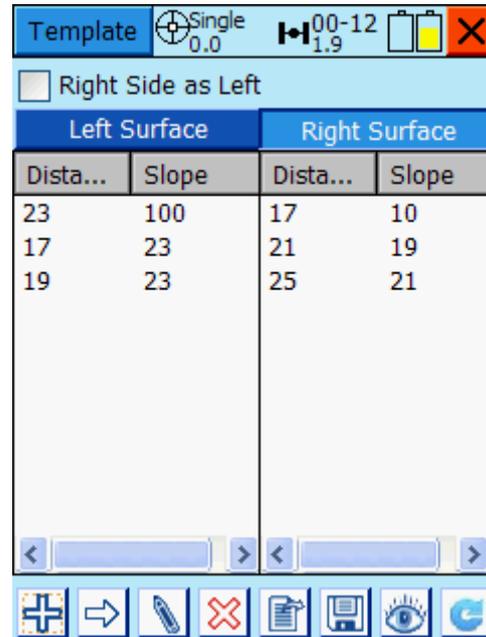
- (5) Accuracy: Adopt unified curve model in integral method to calculate coordinate, prevent truncation error from traditional multinomial calculation.
- (6) Support multiple cross-sectional change slope point set, left and right slope

can be compiled into a type of asymmetry.

(7) Visible cross-section collection.



1-13 Cross-section collection



1-14 Define Cross-section

## 6. Others

- (1) User-defined software menu color scheme.
- (2) Available to operate both on device and computer, easier to learn software operation.
- (3) Graphical operating interface, easy to memorize functional buttons.
- (4) Coordinate database indicated in different pages, improving display efficiency.
- (5) Powerful motherboard type identification ability and differential data types automatically correction with NovAtel board self-adapting differential data type ability
- (6) Standard navigation mode: Set the forward orientation to be line orientation, according with common visual thinking.

## 1.2 Brief Operation Direction

The brief operation direction is shown hereunder. Detail operation referenced to specifications in the coming chapters. The brief operation here is only one solution, you don't have to follow the steps after being familiarly with this software.

The common operation in your work can be:

- (1) Set up a base station, and finish setting working mode of GPS mainframe.  
(Detailed settings you can find from: Appendix~V8/V9 Brief Hardware Operation)
- (2) Open the PDA software, set up new projects, set coordinate system parameters, set base station parameters and launch differential signal from base station.
- (3) Set rovers to receive differential data from base station with narrowband fixed solution.
- (4) Set rovers on the known point to get origin coordinate under narrow fixed solution status.
- (5) Gain the conversion parameters between two coordinate systems according to origin coordinate and local coordinate of the known point.
- (6) Open coordinate conversion parameter and the origin coordinate provided by RTK survey will automatically change to be local coordinate.
- (7) Check the correctness of the local coordinate on another known point.
- (8) Gain the local coordinate data by surveying and laying out operation under local coordinate system.
- (9) Convert the coordinate data in PDA using coordinate format conversion to get coordinate data of the format you want.
- (10) Transfer data to PC through ActiveSync software to proceed follow-up mapping operation.

The main steps of RTK field operations are: set up base station, solve coordinate conversion parameter, point lay out and line lay out.

The coordinate system you're using is national coordinate system or local coordinate system in most cases, and the data that GPS received is under WGS-84 coordinate system, so coordinate system conversion is one of the most important parts in process of RTK operation.

In normal circumstances you can use diverse coordinate conversion method according to diverse conditions. The main conversion methods are: Plane four parameters conversion + height fitting, three parameters conversion, seven parameters conversion and one step conversion.

Even under the different parameter modes, the operations of sporadic

survey, point layout and line layout are the same.

Hereunder is the operation introduction of different conversions methods of RTK.

## **1. Plane four parameters conversions + height fitting (common method for engineering users)**

### **(1) Set up base station**

(Base station can be set on known point and unknown point. The location of the base station should be the same as the last time if you need to use the solved parameter. Open the project you establish last time, adjust the antenna height of base station and make sure differential signal transmission of the base station. Then the rover can launch work directly without resolving parameter again.

Requirements of setting point for base station:

- A. No large block and should be open over  $15^{\circ}$  elevation angle.
- B. Without hertzian waves interference (no microwave station, radar station and mobile phone station and so on within 200M distance, no high-voltage line within 50M distance.)
- C. Should be on high position when using UHF mode and no large block between rover and base station, otherwise, difference transmission distance will be badly shortened.
- D. At least two known points ( known points can be in any coordinates system, it is better to have three or more than three points in order to check the correctness of the known points)
- E. The method is applicable no matter the base station is on unknown point or known point and no matter the coordinate system is national coordinate or local construction coordinate.

Set up GPS base station and finish connection, set a needed working mode by using buttons on panel and wait for satellite fixing.(Detail settings reference: Appendix~V8/V9 Brief Hardware Operation)

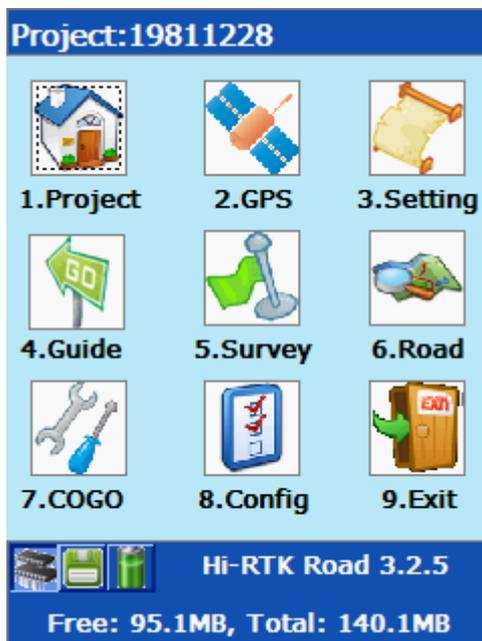
## (2) Open main program of controller

Click “Start” icon on desk-top of controller and click “Programs”--“FileExplorer”--“IPSM”--“HI-RTK Road”, “HI-RTK.exe” sequentially to open the program.

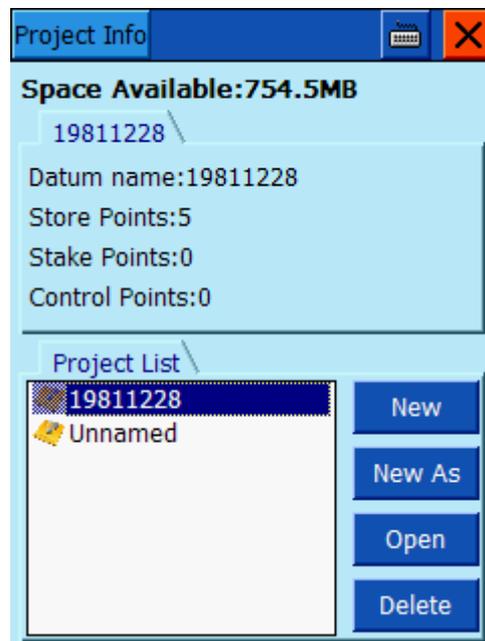
## (3) Establish new project

Generally, you should establish a new project for a new construction.

A. Click **【Project】** → **【New】** → Input project name → **【√】**



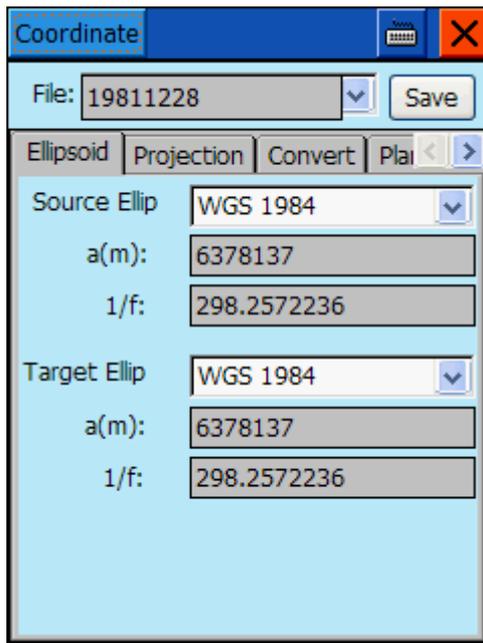
1-15



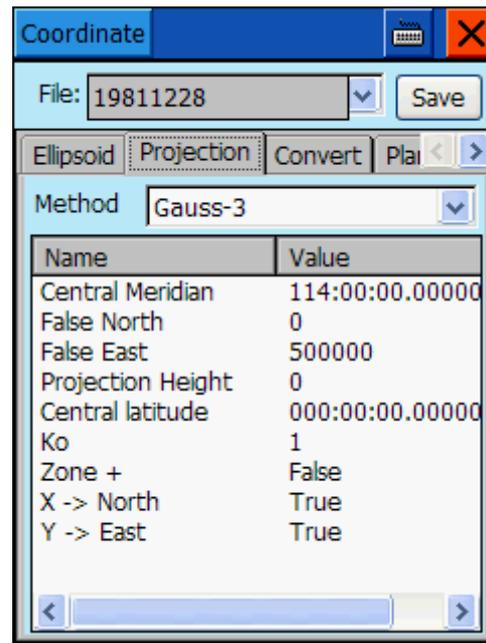
1-16

**Notice: Please save the new established project follow default path (IPSM/Project), or you will lose all data outside IPSM folder when the controller is out of battery or controller hard resetting.**

B. Click drop-down list **【Coordinate】** at upper left corner to set parameter of coordinate system.(As follow figure)



1-17



1-18

**“Ellipsoid”**: Select a country and input name of coordinate system. The format is “country-xxxx”. Origin ellipsoid generally is WGS-84 and objective ellipsoid is coinciding with known point. You don’t have to change the default selection “krassivsjt 1940” if the objective coordinate is user-defined.

**“Projection”**: Choose one projection and input projection parameter.

(If you are Chinese user, to operate projection generally you should choose “Gauss User-defined” and input “Central meridian longitude”. Usually central meridian longitude of known points is the only thing need to be changed; if you are user-defined coordinate system, input average longitude of the survey region. Usually error of the longitude should be less than 30”. Local longitude can be gained by using GPS in real time survey, when you connect PDA with GPS by bluetooth the information will be shown in **【GPS】**---**【Navigation Information】**).

**“Conversion”**: Do not input

**“Plane”**: Do not input

**“Height Fitting”**: Do not input

**“Save”**: Click **【Save】** at upper-right corner, to save parameter setting.

**Notice**: Remember to click **【Save】** , otherwise all setting will be invalid.

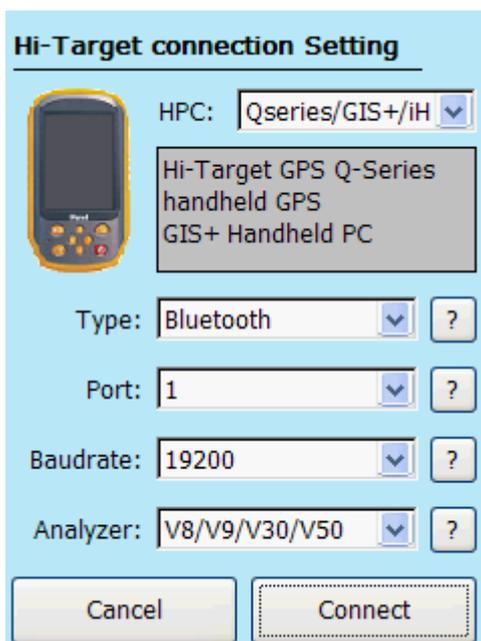
#### (4) GPS and base station mainframe connection.

**【GPS】** → “Upper-left drop-down menu” → Connect **【GPS】** , set

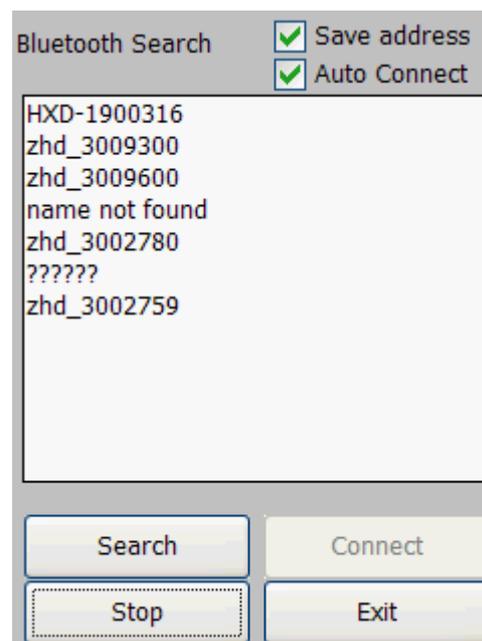
instrument type, connection mode, port, baud rate, click **【Connect】** , Click **【Search】** to choose an instrument number, click **【Connect】** again and if it's successful the number of connected GPS will be shown on receiver info window.

**Notices** on connection by Bluetooth:

- A. Click “Model” → “HPC Style” → Choose a HPC style
- B. The distance between controller and GPS mainframe should be within 10M.
- C. When selecting connecting port, there should not be a third Bluetooth instrument operating around your GPS instrument within 30m .( same other kinds of PDA and GPS mainframe should not open, either)
- D. Restart the receiver or PDA program in case failing in connection.



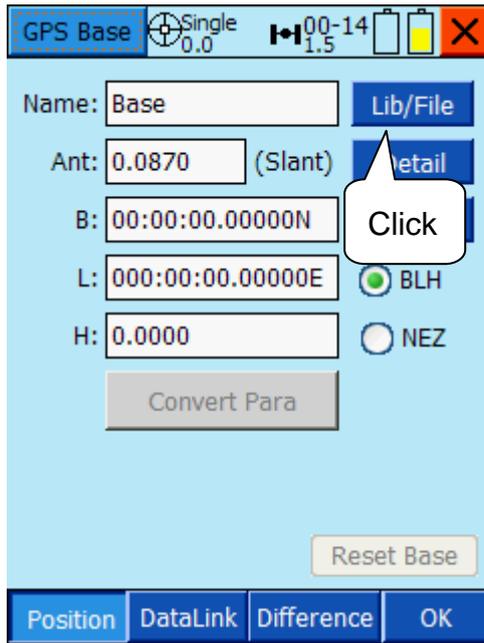
1-19



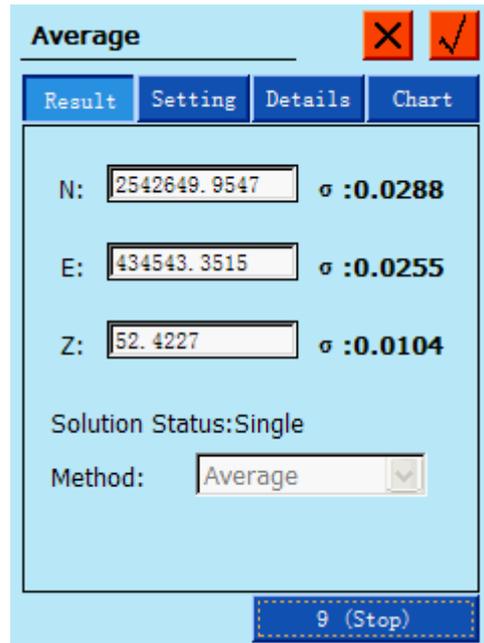
1-20

### (5) Base station setting

- A. Click drop-down menu at upper-left corner and click **【GPS Base】** .
- B. Click **【Average】** and then click **【√】** . (As Figure 1-21)



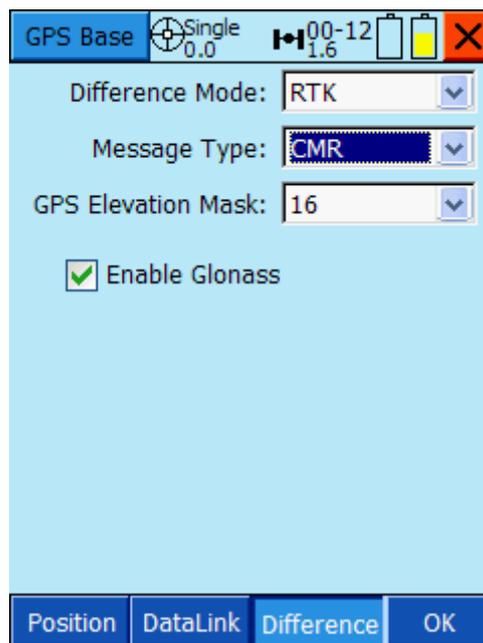
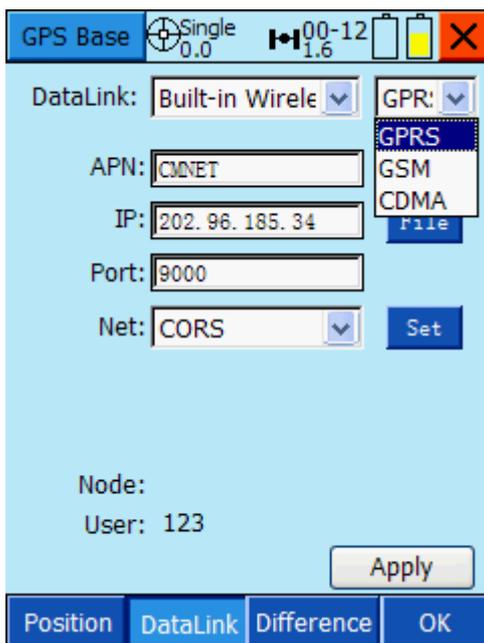
1-21



1-22

C. Click **【DataLink】** , choose the data link type and input corresponding parameter.

(For example: The parameter need to be set when operating under Hi-Target server data transmission. You can adjust Area ID and Group ID, Area ID should be seven digit and Group ID should be triple-digit less than 255.(choose internal radio as data link when you need to use the radio and select the UHF channel )



D. Click **【Difference】** (as upper-right figure) to choose differential mode and message mode. (It's default to be RTK, RTCA, you don't have to change it)

Click **【Antenna Height】** to select antenna type, input antenna height and confirm to return to upper-right interface.

Click **【OK】** at bottom-right corner, software will inform you successful setting.

E. Check the mainframe differential light to make sure yellow flash once per second. In case of using radio, the external radio light flashes once per second inform you successful setting on base station.

F. Click menu at upper-left corner, click **【Disconnect】** to disconnect PDA and GPS mainframe of base station.

## (6) Connection between GPS and rover.

**a. Connect PDA and GPS rover:** (install differential antenna to rover in case of applying UHF radio; and no need differential antenna when applying GPRS mode.)

Turn on rover and set the working mode, waiting for satellites tracked.

Click drop-down manu in upper-left corner → **【Connect】** to connect PDA and rover. When connection is successful, the connected GPS's number will be shown on "receiver information" interface which is similar as base station connection.

**b. Rover setting:** select **【Rover Setting】** to get a pop-up dialog **“Setting Rover”**.

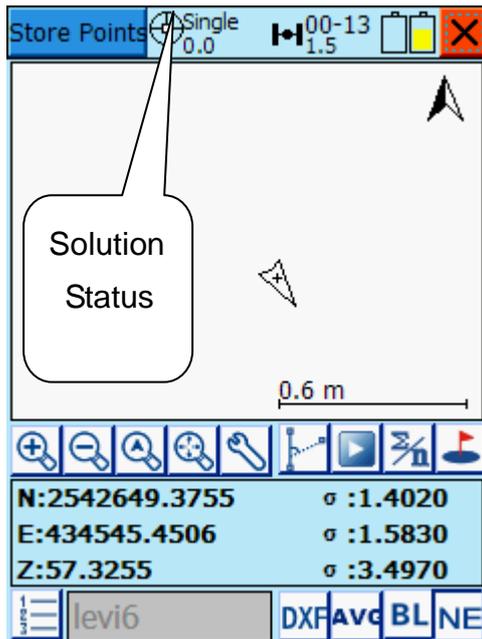
On **【Data Link】** interface select and input the same parameter as that for base station. (If you need to use CORS system, select CORS in network option, input CORS IP, input port number, click "setting" button ( on the right), input node name, user name and password)

Click **【Difference】** interface, select and input the same parameter as that for base station. And then adjust antenna height (IF you're CORS user, select "Send GGA" and set sending interval as 1 second)

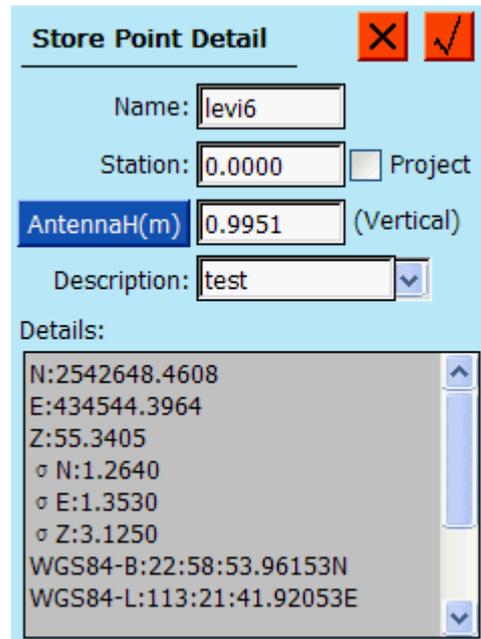
Click **【OK】** button, software inform you successful rover setting. click **【X】** button at upper-right corner to return software main menu.

### (7) Original Coordinates of Controlled Point Collection

Click **【Survey】** button on main menu to enter “Store Points”(sporadic survey) interface. (As low left figure shown):



1-25



1-26

- |   |  |
|---|--|
|  Fixed Coordinate (Base station) |  RTK Fixed Solution       |
|  RTK Float Solution              |  RTD Mode                 |
|  WAAS Mode                       |  Single Point Positioning |

Check solution status on top of screen, when it's “ RTK Fixed Solution”, center and level GPS antenna on the controlled point which need to be collected. Click “” or “SP” button on PDA keyboard to save coordinate.

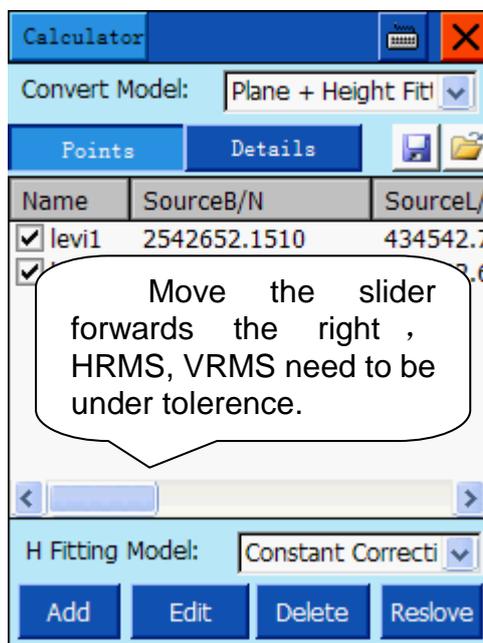
Pop-up “setting stored point attribute” dialog (As figure above). Input “Point Name” and “Antenna Height”, the number of point will be added automatically after you collect next point, and the height of antenna height will

be as same as the last point. Click “confirm”, to save the coordinate into coordinate database. Save origin coordinates into database for at least two known controlled points.

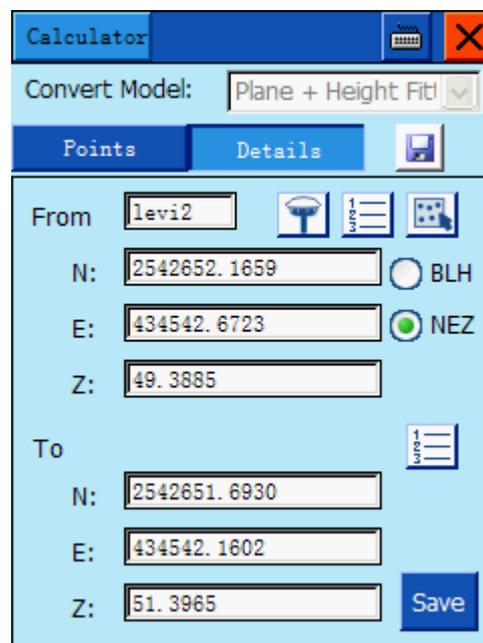
(8) Solve conversion parameter and height fixing parameter.

A. Solve conversion parameter.

In software main menu, click **【Setting】** →“drop-down list at upper-left corner” → **【Coordinate System】**→**【Coordinate Calculator】**, enter “Calculator” interface (As below-left figure shown):



1-27



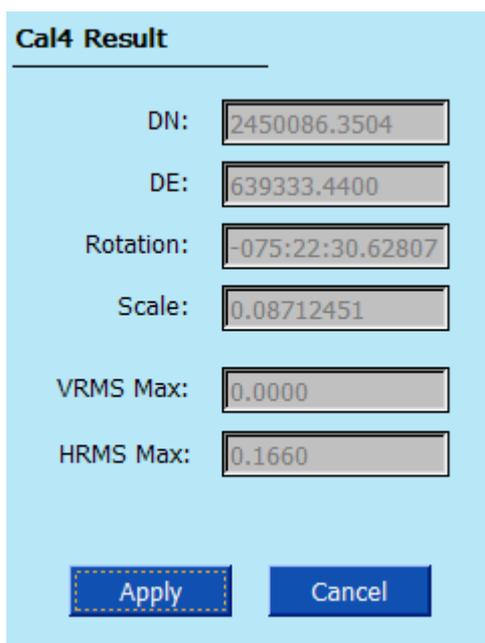
1-28

Click **【Add】** button, enter interface as upper-right figure, and input corresponding origin coordinate and objective coordinate. Click  to get coordinate from coordinate database and select origin coordinate of controlled points from database. Then input local coordinate of corresponding point TO objective coordinate and click **【Save】**. You repeat the operation to finish adding controlled points participated in solution.

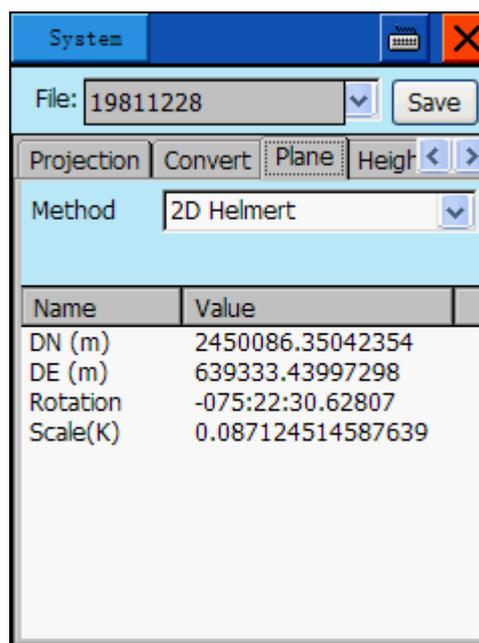
Click **【Solve】** at bottom right corner to get solved four parameters, then click **【Apply】**.

**Notice:** Scaling of four parameters is one number very approximating

“1” which will be more reliable with more approximate to “1”, usually it’s 0.999X or 1.000x. HRMA and VRMS show you the plane and vertical residual value. If this value exceeds the accuracy you need, it means the local coordinate and origin coordinate of certain survey point are not accurate. You can let the controlled points with high residual value not to join the solution by canceling to tick ahead of points in order to optimize the accuracy.



1-29



1-30

Check the application of “plane conversion” and “height fitting” in interface as upper-right figure. Click **【√】** to confirm and click **【x】** to return to main interface.

Notice: Height can only be corrected by fixed difference when there are less than 3 known points; you can use plane fitting when there more than 3 known points; you can precede curved plane fitting when there more than 6 known points. You should enter **【Setting】**→**【Height Fitting】** menu to do setting before getting conversed parameters when making plane fitting and curved plane fitting.

## (9) Sporadic Survey and Stake

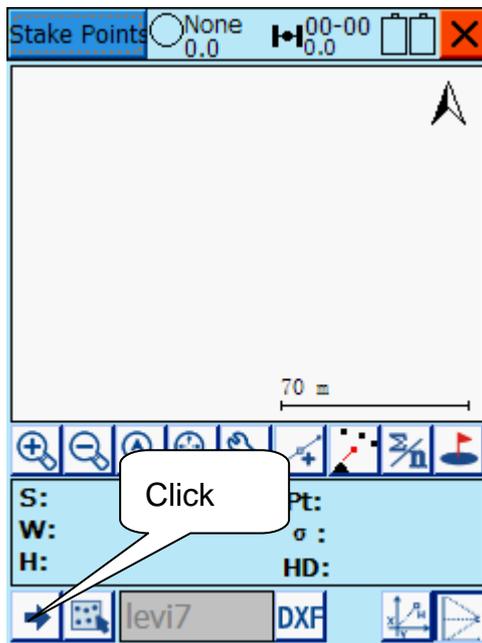
**A. Sporadic Survey:** Click **【Survey】** to enter “sporadic survey” interface,

center and level GPS antenna on collected points needed. Click  to save coordinate.

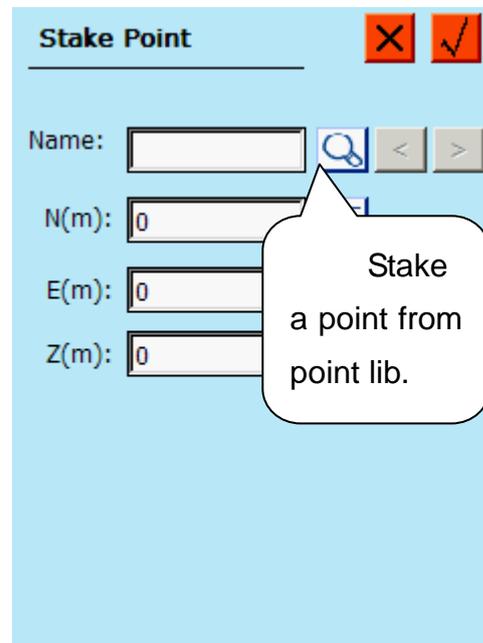
You can click  to enter the sporadic point database at the bottom left corner to view the collected points coordinate.

**B. Point Stake:** Click **【Stake Points】** on the drop-down menu at upper-left corner to enter interface as figure down-left.

Click  at bottom left corner (to stake next point) to enter interface as shown by below right figure, input stake points coordinate by clicking **【Lib】** to stake a point from the point library.

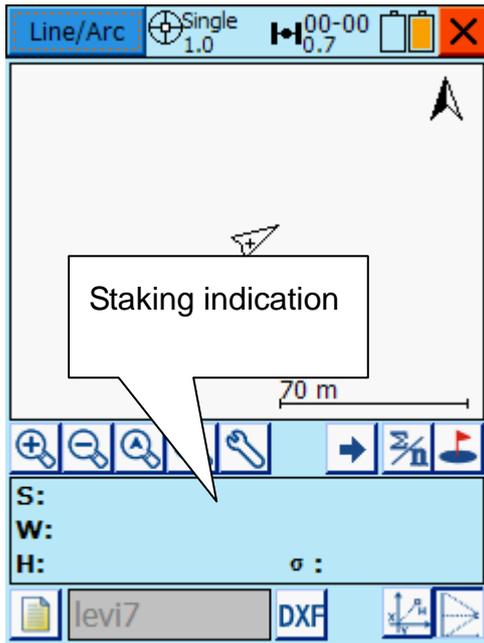


1-31

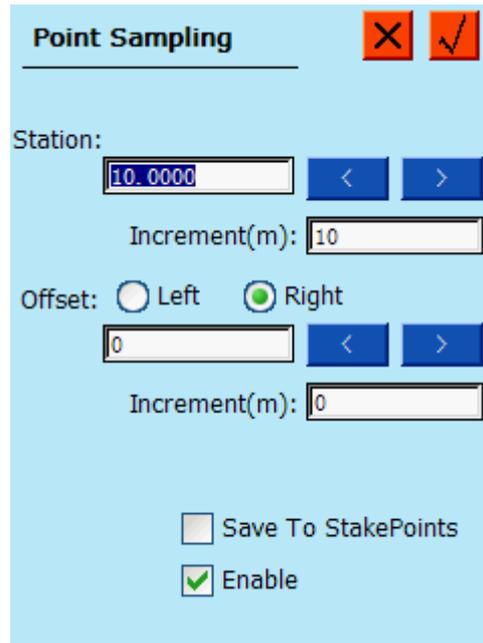


1-32

**C. Line Stake:** Click **【Line/Arc】** on the drop-down menu at upper-left corner.



1-33



1-34

Click  as shown on upper left figure, select one line type and input attribute of the line.

Click  next point and enter interface as shown on upper right figure. Define value of increment and confirm. Then follow the stake indication as figure upper left to proceede staking.

**Notice:** Generally, after getting solution of a group of parameters, it suggests to remark the base station, record the coordinate of base station, projection parameters and conversion parameters if you want to start a new work in the same survey region. When you start a new work at the same region, it is recommended to set up base station at the same positon, open project you used, finish base station setting, adjust antenna height of base station and check parameter correctness, then rover will find a correct coordinate.

## 2. Three Parameters Conversion

### (1) Base station set up

(Set up base station on a known point, if base station set on an unknown point, operation of PDA is similar as in four parameters solution except choosing three parameters for parameter calculation.)

Base set up should follow requirements hereunder:

- A. No large block and should be open over 15° elevation angle.
- B. Without hertzian waves interference (no microwave station, radar station and mobile phone station and so on within 200M distance, no high-voltage line within 50M distance.)
- C. Should be on high position when using UHF mode and no large block between rover and base station, otherwise difference transmission distance will be badly shortened.
- D. Need one known point (coordinate of known point can be in the national coordinate system or has very little rotation from WGS-84 coordinate system)
- E. This method is applicable for low coordinate accuracy requirement. The accuracy will be lower following the longer distance between base station and rover. Generally accuracy can be less than 5CM within 3KM distance.

Finish setting and connection of GPS base station. Set the working mode that you wanted from receiver panel, and wait for base station tracked satellite. (Details you can find from Appendix: V8/V9 Brief Hardware Operation)

### **(2) Open PDA main program:**

Click “Start” icon on desk top of PDA, click “Programs”--“File Explorer”, --“IPSM”,-- “HI-RTK Road”-- “HI-RTK.exe” sequentially to open handset program.

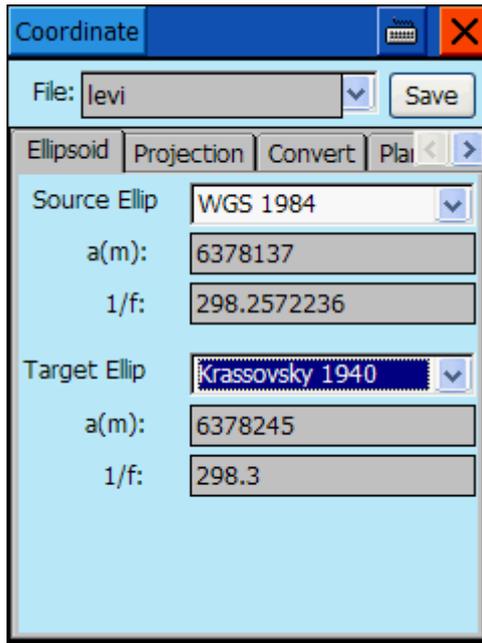
### **(3) Establish New Project:**

Generally, you should establish a new project for one new project.

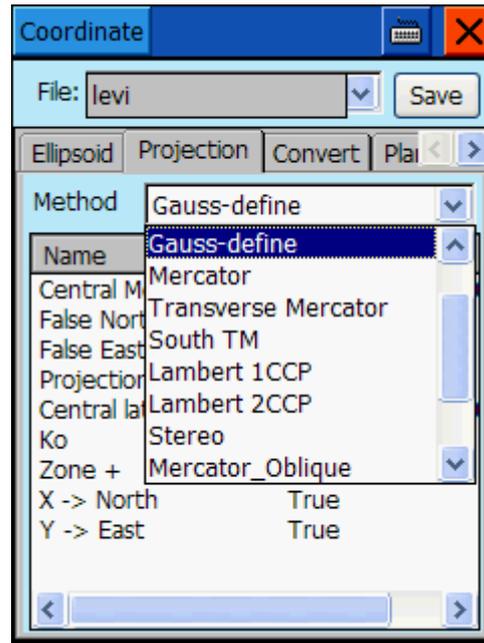
Click **【Project】** → **【New】** → Input project name → **【√】**

**Notice:** Please save the new established project following default path (IPSM/Project), otherwise you will lose all data which is not in IPSM folder when the controller is out of battery or controller hard reset.

B. Click drop-down list **【Coordinate】** at upper left corner to set parameter of coordinate system.(As follow figure)



1-35



1-36

**“Ellipsoid”**: Select a country and input name of coordinate system. The format is “country-xxxx”. Origin ellipsoid generally is WGS-84 and objective ellipsoid is coinciding with known point.

**“Projection”**: Choose one projection and input projection parameter.

(Take China for example, to operate projection generally you should choose “Gauss User-defined” and input “Central meridian longitude”. Usually central meridian longitude of known points is the only element need to be changed; if you are user-defined coordinate system and do not know your coordinate system, you can connect GPS first, and check from **【GPS】**---**【Navigation Information】**

**“Conversion”**: No input

**“Plane”**: No input

“Height Fitting”: No input

“Save”: Click **【Save】** at upper-right corner, to save parameter setting.

**Notice**: Remember to click the **【Save】** , otherwise all setting will be invalid.

#### (4) GPS and base station connection.

**【GPS】** → “Upper-left drop-down menu” → Connect **【GPS】** , set instrument model number, connection mode, port, baud rate, click **【Connect】**, Click **【Search】**to choose the instrument number, click **【Connect】**again and if it’s successful connection, the number of connected GPS receiver will be

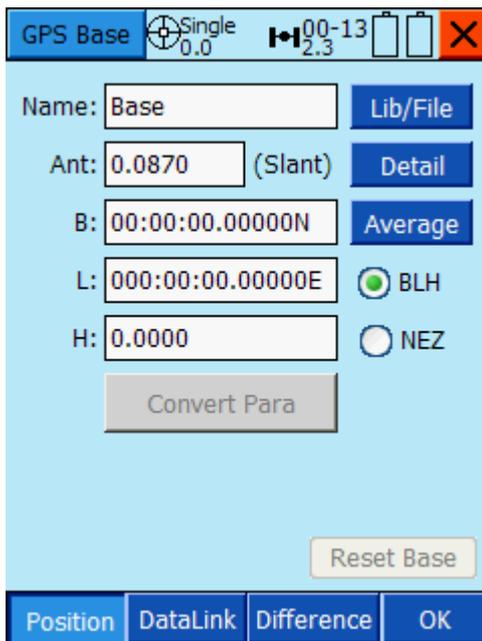
shown in the info. interface.

**Notice of connecting Bluetooth:**

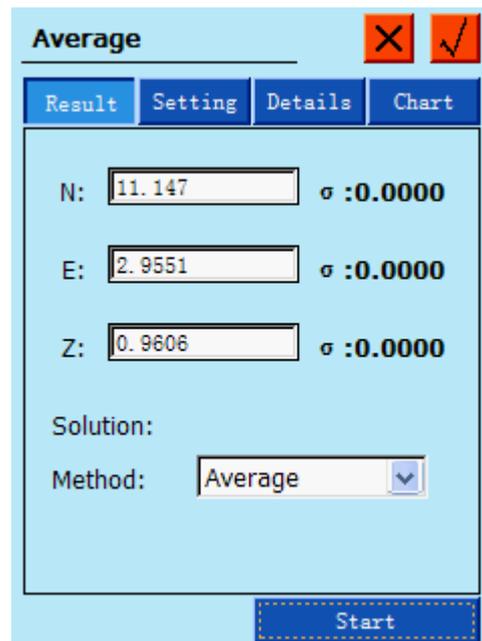
- A. Click “Config” →“HPC Select” → Choose the HPC style;
- B. The distance between PDA and GPS mainframe should be within 10M;
- C. Restart your receiver or PDA program when disconnect.

**(5) Base station setting**

- A. Click drop-down menu at upper-left corner and click **【GPS Base】** .
- B. Click **【Average】** and then click **【√】** . (As Figure 1-21)
- C. Input local coordinate x, y, z value of known point as below left figure **1-37**
- D. Click **【Convert Para】** to check if three parameters of “Ellipsoid Conversion” is applicable or not. (Generally: each of three parameters should be less than 120). Confirm by click  at upper right corner.



1-37

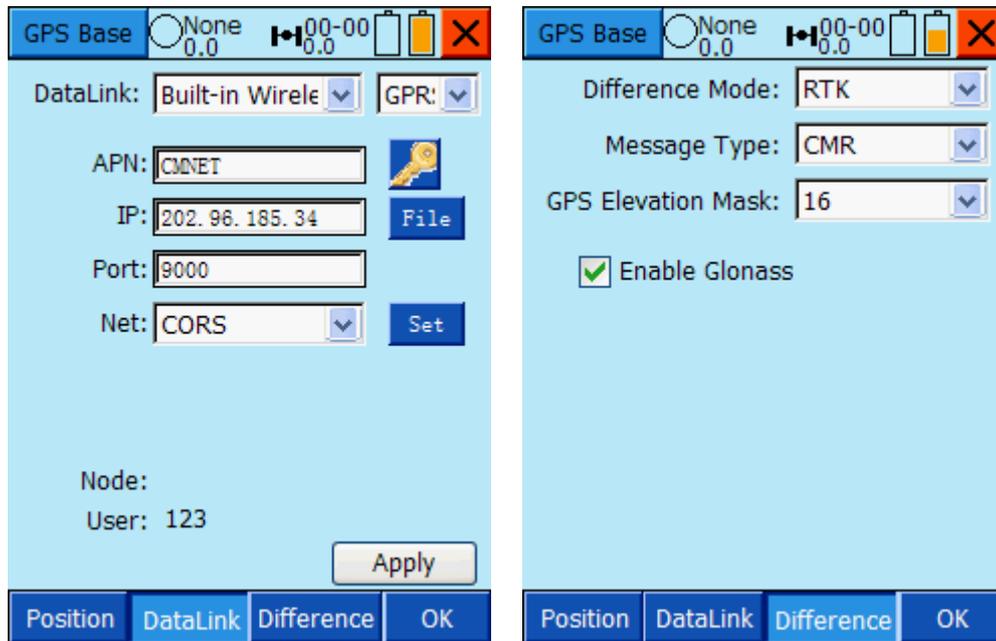


1-38

- E. Click **【DataLink】** , choose a data link type and input corresponding parameter.

(For example: The parameter need to be set when operating under Hi-Target server data transmission. You can adjust Area ID and Group ID, Area ID should be seven digits and Group ID should be triple-digit less than 255. Choose internal radio as data link when you need to use the radio and select

the UHF channel)



1-39

1-40

F. Click **【Difference】** (as upper-right figure) to choose differential mode and message mode. (It's default to be RTK, RTCA, you don't have to change it)

Click **【Antenna Height】** to select antenna type, input antenna height and confirm to return to upper-right interface.

Click **【OK】** at bottom-right corner, software will inform you successful setting.

G. Check the mainframe differential light to make sure the yellow flash per second. When you are using radio, the radio light flash each second informing you successful setting of base station.

### **(6) Rover Operation**

Operation is similar as four parameters. Please refer to chapter for four parameters operation.

## **3. Seven Parameter Conversion**

Requirements:

- A. At least 3 known coordinate points. (coordinate of known point can be in national coordinate system or has very little rotation from WGS-84 coordinate system. More than 3 known points are better to check

correctness of known points)

- B. Solution model of this method is precise. Precise accuracy of known points is necessary. It's generally used for operation in extensive region. We don't suggest you to use seven parameters when accuracy of known points is low.

#### **(4) One Step Conversion**

Requirement:

- A. At least three known coordinate point (coordinate of known point can be in national coordinate system. More than 3 known points are better to check correctness of known points)

One step conversion, seven parameters conversion, four parameters conversion and three parameters conversion (base station set on unknown point) are almost as same on receiver and PDA operation, but differences in required known point data and application field.

Generally:

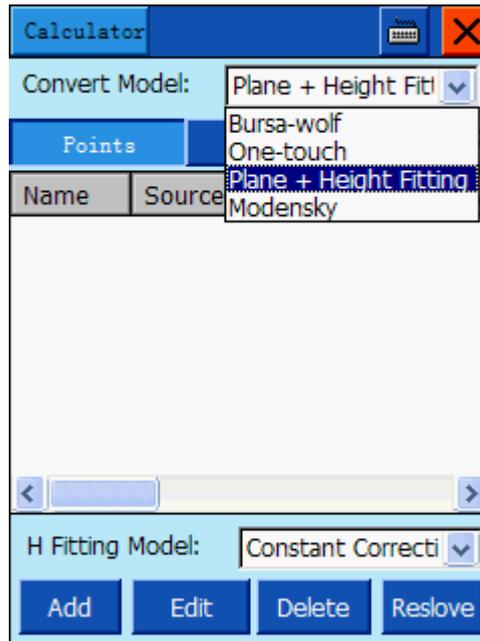
**Three Parameters:** Require one known national coordinate point and accuracy will reduce following working distance enlarged

**Four Parameters:** Require two random points with reliable accuracy in small scope

**Seven Parameters:** Require three known national coordinate points in high accuracy and strict requirements on known points

**One Step:** Three random coordinate points in reliable accuracy

There some more differences in solution process. All conversions can be selected in **【Parameter Calculation】** .



1-41

Specifications of PDAsoftware operation can be found in “Four parameters and height fitting conversion”.

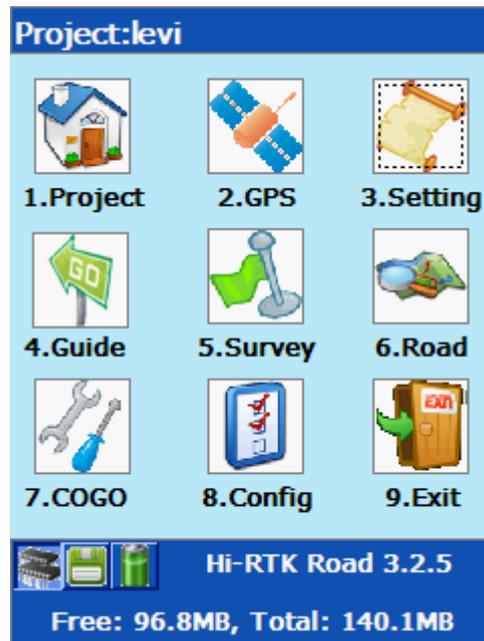
### 1.3 Menu Instruction

#### ◆ Software Main Interface

The software is related with nine sections, which are:

1. Project (files management, points library)
2. GPS (antenna height, base station and rover setting)
3. Parameter (coordinates conversion parameter, software config and so on)
4. Tools (common assistant tools for square calculation/parameter solution)
5. Survey (sporadic survey/point/line stake)
6. Road (road midline/longitudal section/cross section edition/road stake/cross section collection)
7. Configuration (configure software parameter)
8. About (view software edition)
9. Quit

Following is main interface of program:



1-42

# Chapter Two Project

## 2.1 Project Information

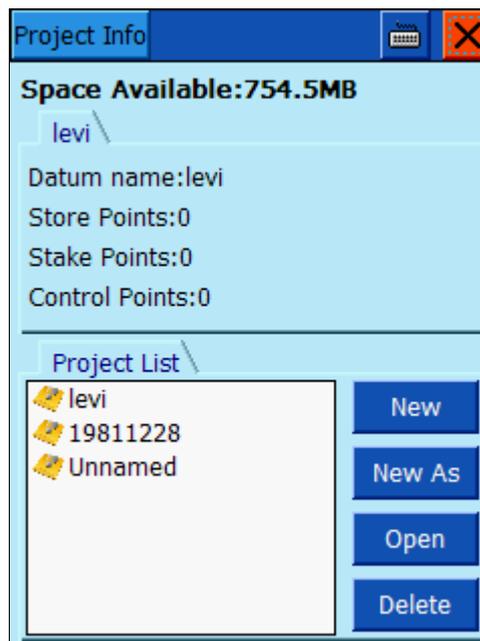
When you are in a new survey region, you should firstly establish a new project, save all the surveying parameters and data, then save all the settings into project files (\*.prj). Meanwhile, software will automatically establish a folder with the same name as project. Including stored points library, stake point database and controlled point database will be put into "Points" folder under coordinate database catalog.

\*.stl: Stored Point database    \*.skl: Stake Point database

\*.ctl: Controlled Point database

Main.Prj: Project Files, project name will be project folder's name

CC-PRJ.dam: backup for coordinate conversion parameter



2-1

**“Available Space”**: Indicate the current remain space of PDA. (Unit: M)

**【New】**: Establish a new project and a new folder. All files related to the project will be saved in this folder.

**【New As】**: Apply parameters from the old project to establish one new project.

**【Open】**: Open project (\*.project)

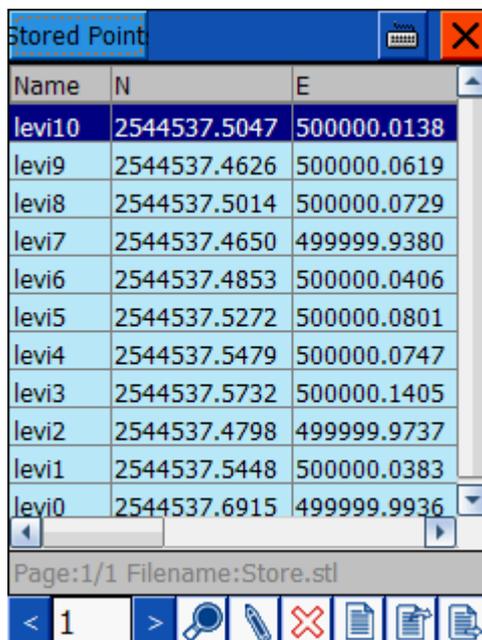
**【Delete】** : Delete selected project

## 2.2 Coordinate System

Automatically link to “Coordinate System”, specification you can find from Chapter Four. (Parameter→Coordinate system)

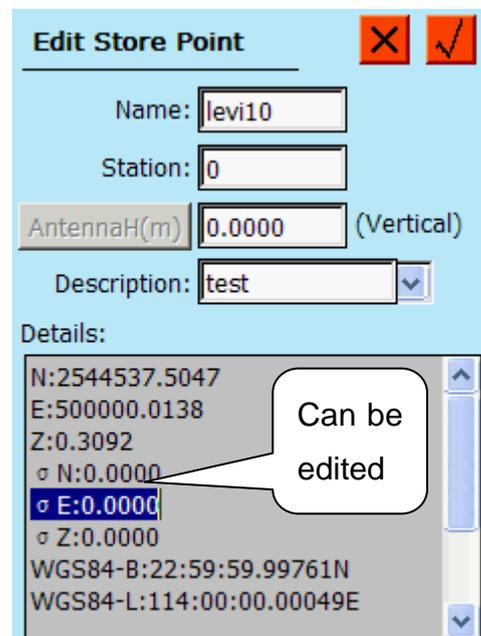
## 2.3 Stored Points Database

Save coordinate data of all the sporadic collected points, including: point name, X, Y H. You can precede operations including edit, filtrate, delete, export, establish new files and open points data library.



Name	N	E
levi10	2544537.5047	500000.0138
levi9	2544537.4626	500000.0619
levi8	2544537.5014	500000.0729
levi7	2544537.4650	499999.9380
levi6	2544537.4853	500000.0406
levi5	2544537.5272	500000.0801
levi4	2544537.5479	500000.0747
levi3	2544537.5732	500000.1405
levi2	2544537.4798	499999.9737
levi1	2544537.5448	500000.0383
levi0	2544537.6915	499999.9936

2-2 Stored Library



**Edit Store Point**

Name:

Station:

AntennaH(m):  (Vertical)

Description:

Details:

N:2544537.5047  
E:500000.0138  
Z:0.3092  
◦ N:0.0000  
◦ E:0.0000  
◦ Z:0.0000  
WGS84-B:22:59:59.99761N  
WGS84-L:114:00:00.00049E

2-3 Stored Points Edition



Edit Points: Edit sporadic collected point's name, remark, antenna height.

(Notice: Can not edit coordinate in Stored Library)



Delete Point: Delete selected point's coordinate data



Filtrate Point: Filtrate stored library and display stored points that meet Requirements.



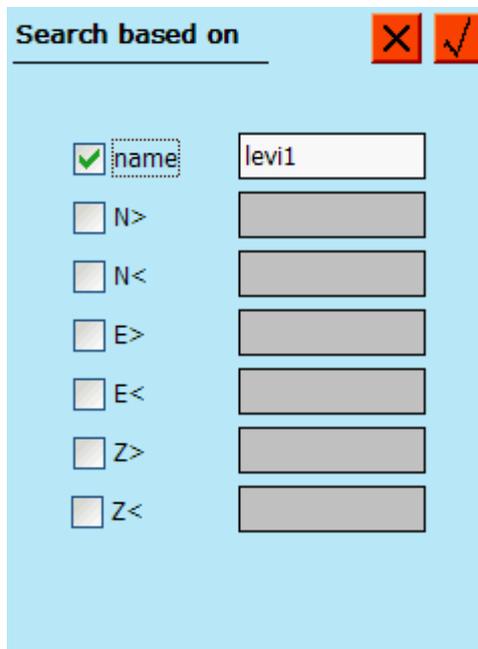
Files: Include new point database establishment, open point database, superadd to point database (Superadd record to origin point database without covering the origin database and new point database establishment), export point database, export format includes AUTOCAD(\*.dxf), Excel(\*.csv), SOUTH cass7.0(\*.dat).



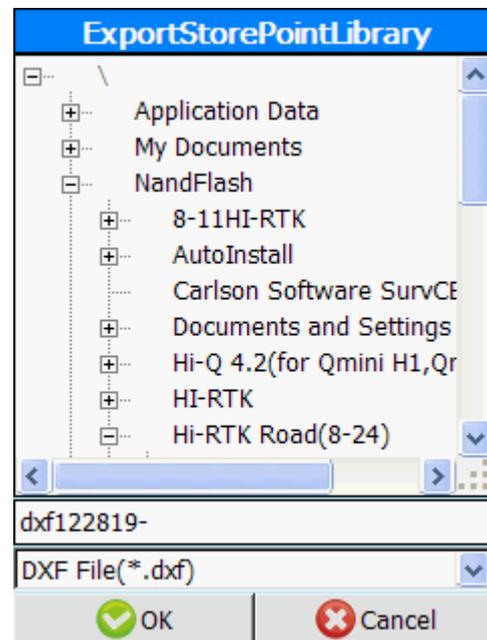
Save: Save edited point.



Export: Export the current stored point lib as “dxf.”, “csv.” and “dat.”. format.



2-4 Filtrate



2-5 Files Export

Stored point database (\*.stl) : you can open them by TXT directly. The format is:

● **Excel(\*.csv)、Stored library (\*.stl)**

Version : 1

Point Name,x,y,h,B,L,H,Antenna Height,X mean square error,Y mean square error,H mean square error, solution type,Correction parameter number,Start time,end time,description

Pt1,1000.2463,99.8287,-90.3146,22: 58: 53.86370,113: 21:

41.77038,47.5652,0.0000,1.564,1.533,4.376,6,0,08-6-26 3: 10: 09,,08-6-26 3:  
10: 09,,0

◆ **SOUTH Cass7.0(\*.dat)**

Point Name, Coding, Y, X, H

◆ P1, Y1, X1, H1

...

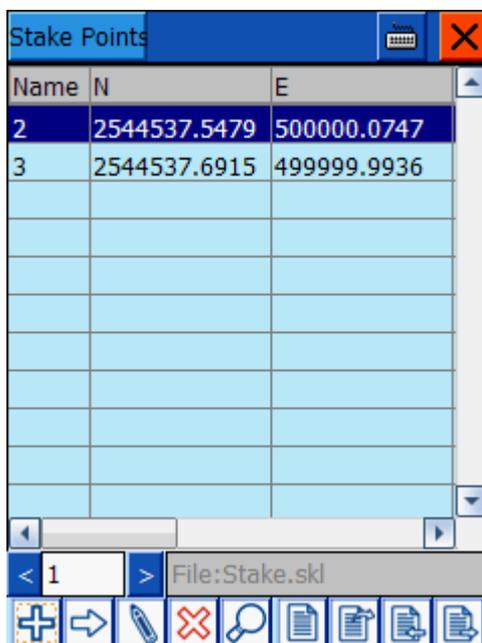
n, Pn, Yn, Xn, Hn

● **AUTOCAD(\*.dxf)**

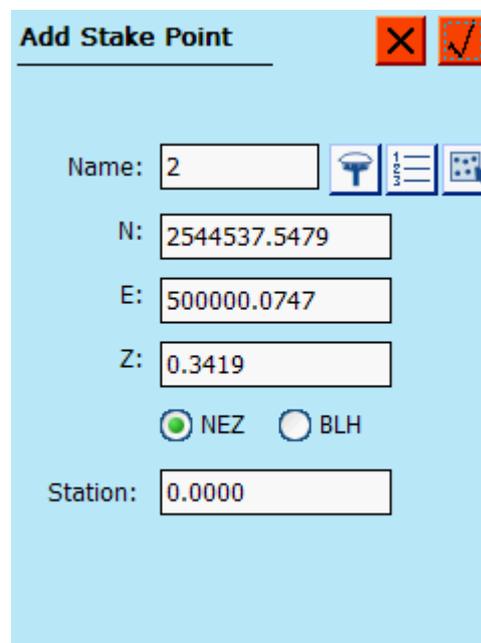
Specified format please refer to Auto CAD aid file.

## 2.4 Stake Point Library

Save coordinate data of all the stake points, including: point name, X, Y, H. You can proceed operations including edit, filtrate, delete, export, create new files and open points database.



2-6 Stake Point Library



2-7 Add New Stake Point



Add New Points: add coordinates of stake points, height, you can select points from drawing and coordinate database to add new points.



Add the next Stake Points.



Edit Points: Edit staked point's name, coordinate and distance (station)



Delete Point: Delete selected point's coordinate data



Filtrate Point: Filtrate stored library and display stored points that meet requirements.



Files: New point database creation, point database open, superadd to point database, export point database, export format includes AUTOCAD(\*.dxf), Excel(\*.csv), export format please refer to Appendix format introduction. You can open them by TXT directly or input (\*.csv) format from computer.



Save: Save edited point.



Export: export the current stake point lib as "dxf." and "csv." format.

## 2.5 Controlled Point Library

Save coordinate data of all the controlled points, including: point name, X,Y,H. You can precede operations including edit, filtrate, delete, export, create new files and open points database.

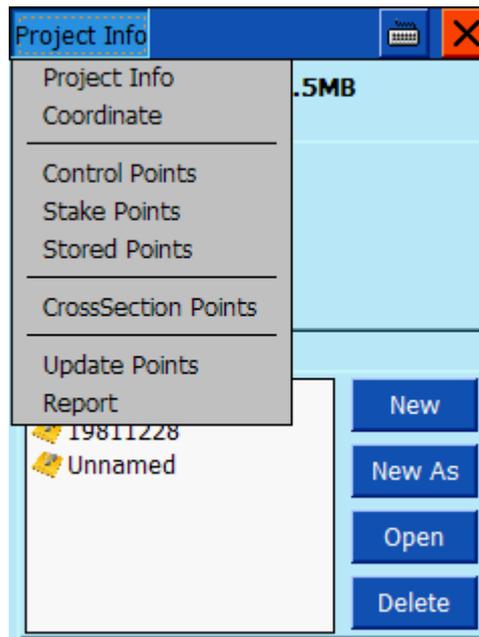




Export: export the current stake point lib as “dxf.” and “csv.” format.

## 2.6 Upgrade Point Library

Recalculate data in coordinates database using newly settings and get upgraded result after latest parameter conversion.

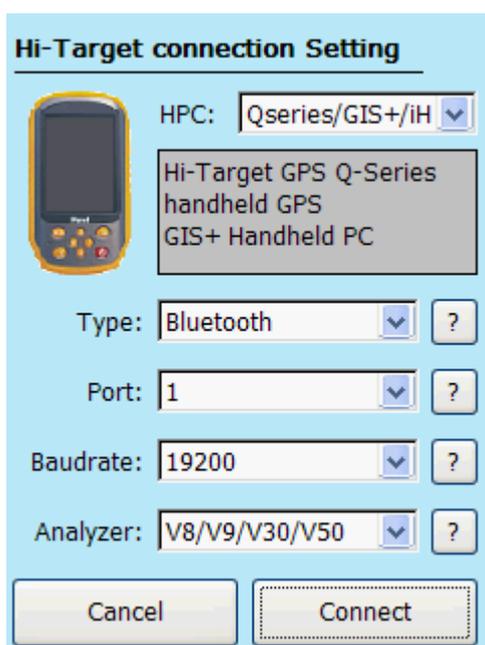


2-10 Upgrade Point Library

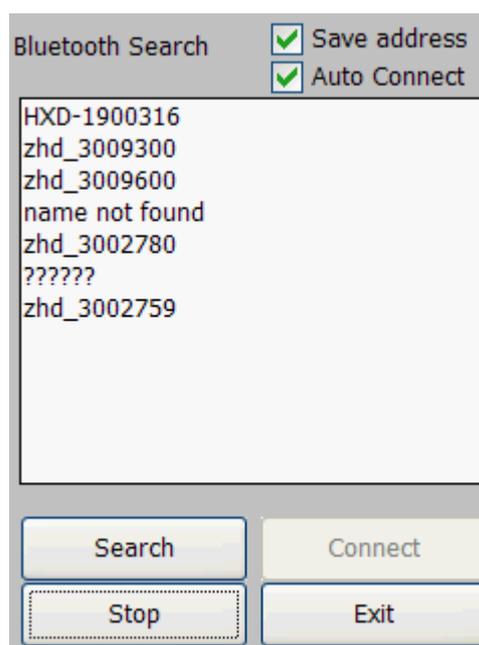
# Chapter Three GPS

## 3.1 Connect GPS

Use for Bluetooth connection between controller and GPS mainframe.



3-1



3-2

**Configuration Type:** Hi-Target type and motherboard type:

Hi-Target type: HD5800, HD6000, V8, V9.

Motherboard type: Novatel, CMC, CSI

**Model:** Choose according to receiver and motherboard type

**PDA Style:** It's grey and could not be changed. If you need to change PDA style please choose one PDA style following specification at **【configuration】 - 【controller selection】**

**Connection style:** Including: Bluetooth, port, Bluetooth CF card

**Port:** Port selection

**Baud Rate:** Choose one baud rate. Generally it's 19200 when connecting Hi-Target instruments

**Search:** Search one receiver number. You don't have to search number when the number is already shown in the screen

**Stop:** Click to stop searching when you get the number you want

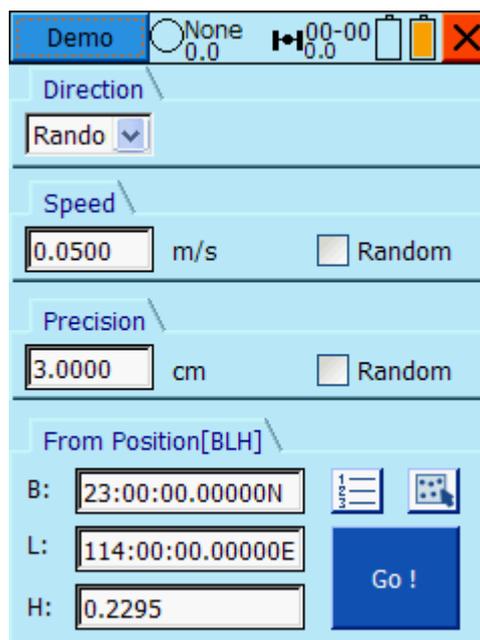
**Connect:** Click to connect the receiver that you want

**Quit:** Cancel Bluetooth searching interface

**Address Memory:** Memorize the receiver number from last search and you can use the number directly without search again.

### 3.2 Demonstration Mode

In demonstration mode, receivers can stimulate fieldwork data even without being tracked any satellite.



3-3

**Direction:** You can choose direction by line, map, appointment or random.

Line: You need to select one line during line stake operation.

**Map:** There are four options including: East, South, West and North for you to choose the walking orientation.

**Appointment:** Select one walking azimuth.

**Random:** Current point random display.

**Speed:** Current point walking speed, you can choose certain speed or set it

random.

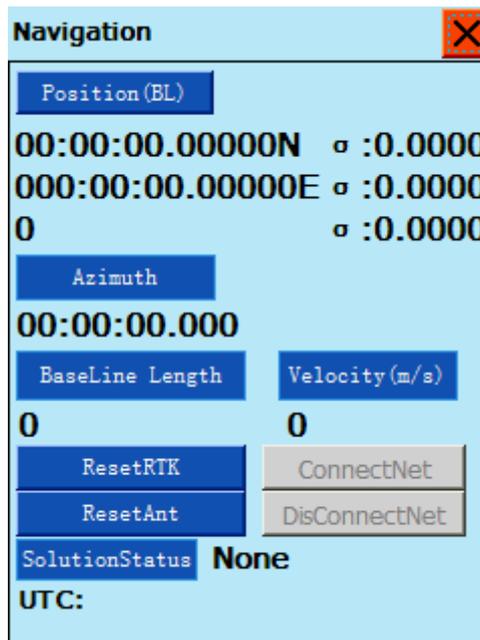
**Precision:** Accuracy restriction of current point during demonstration, you can choose accuracy or set it random.

**From Position:** You can select any coordinate to be start point coordinate for demonstration. The coordinate can be selected in coordinate library or on the map.

**Go:** You can click to enter demonstration when it's not connecting to GPS. It will return to software desktop automatically after you enter demonstration mode.

### 3.3 Navigation Information

Indicate navigation information of current point, including position, speed, solution status and time. (You can click "solution status" icon to enter)



3-4

**Position:** Indicate you current point longitude and latitude coordinates and plane coordinate. You can click position button to switch.

**Azimuth:** Indicate current point's moving azimuth.

**BaseLine Length:** Indicate distance between base station and rover in difference status.

**Velocity:** Indicate current point moving speed.

**SolutionStatus:** Indicate current point solution status. It will be single positioning if it's without difference

**Newly solution:** Rover will recalculate the received differential data from base station. When it's in worse satellite situation, you can recalculate several times and save coordinates to eliminate solution in multi-path interference.

**ResetAnt:** GPS will search satellites again for calculation.

**Time:** Indicate GPS standard time (8 hours less than Beijing hour)

**Notice:** Indicator of the software shows you the north direction. Only when you are moving, software can calculate the angle between North and screen direction by two coordinates. The direction shown by indicator will be random when you stay still.

### 3.4 Satellite Information

Use to view GPS satellites distribution (SkyPlot), satellite SNR, cut-off angle setting, received satellite signal type.



Quality SATView SATInfo X

Prn	Azi	Ele	L1	L2
4	326	82	55	50
11	211	57	46	40
14	83	66	49	46
19	179	38	37	32
20	218	18	28	26
24	204	51	40	39
25	160	83	57	50
26	358	17	28	26
28	306	77	54	49
29	74	26	29	29

GPS  SBAS  GLONASS  BD2

FileName: [ ] start

waiting for recording snr...

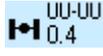
**Monitor/SkyPlot:**

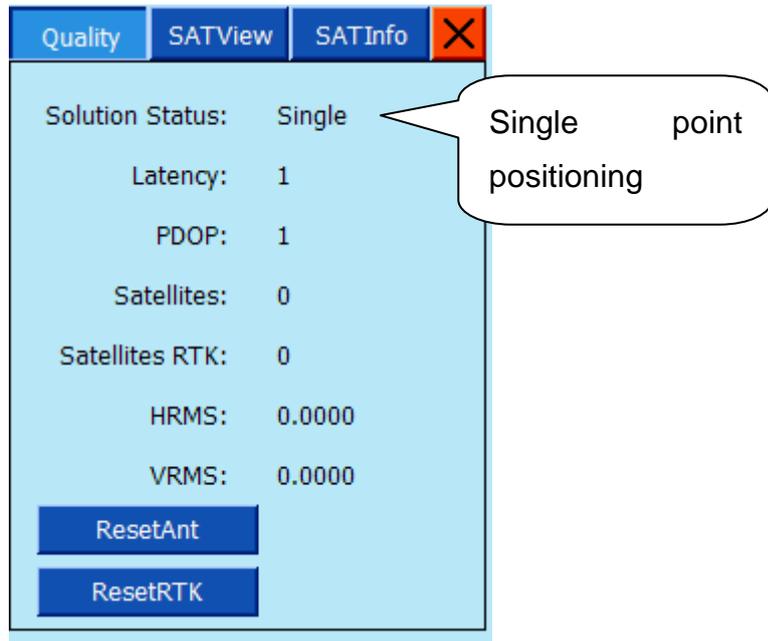
- ✚ You can view satellite projection and distribution.
- ✚ You can view GPS satellite height cut-off angle. By towing horizontal scroll bar and click **【OK】** you can set the satellite cut-off angle.
- ✚ Color is according to satellite L1 carrier phase SNR: Red:  $\leq 30$ , Orange:  $\leq 40$ , Olivine:  $\leq 50$ , Green:  $> 50$
- ✚ Click the square box at the bottom of the interface, you can choose the receiver to receive certain signal system or not.
- ✚ Rotundities indicate GPS and SBAS satellites, squares indicate GLONASS satellites.

**Satellite Signal-to-Noise Rate (SNR) Chart:**

- ✚ Satellite icons are used to identify which system satellites belong to: :  
GPS (small round) : SBAS (bigger round) : Glonass (square)
- ✚ Satellite Number: As picture shown, small numbers are GPS satellites, big numbers are GLONASS satellites.
- ✚ Prn indicates satellite number, Azi indicate satellite azimuth, Ele indicate Elevation angle, L1 show you L1 band SNR, L2 show you L2 band SNR.

Click  at the upper left corner of the interface, you can quickly enter navigation interface. (Details refer to previous section)

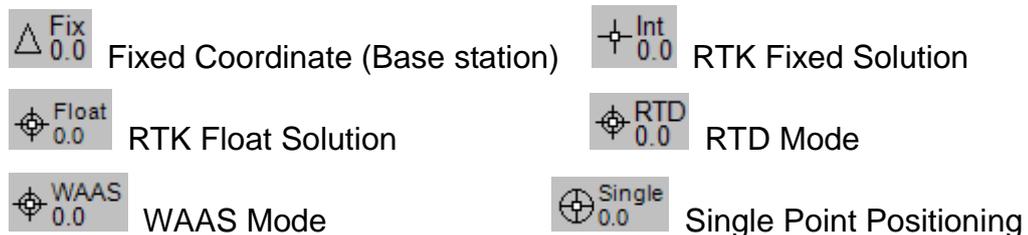
Click  at the upper right corner of the interface, you can quickly enter Satellite Information interface. The interface will show you information of Quality beside Satellite view and satellite information. As follow figure 3-7.



### 3-7

Specification of current point will be shown on the interface.

Solution Status: Mainly includes several modes hereunder: (Were arrayed from high accuracy to low, except fixed coordinates)



**Latency:** It means the time of solution after rover receiving the signal from base station. It's better to be 1 when you're using UHF mode and better to be 2 when you're using GPRS.

**PDOP Value:** Space Geometry intensity element of satellites distribution. PDOP value will be less with a better satellites distribution. It will be a ideal static when the value is less than 3.

**Visable Satellites Number:** The connected satellites number. You need at least 5 for a successful work.

**Public Satellites:** Only rover can get this information after receiving the differential data. It means the satellite numbers which

participate into solution when base station and rover take part in the integer ambiguity search. The number should be more than 5 for a successful work.

**HRMS:** mean square error of plane of current point

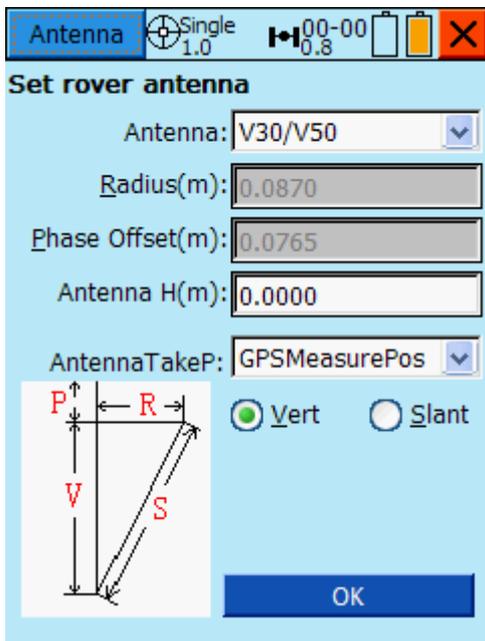
**VRMS:** mean square error of elevation of current point

**ResetRTK:** Rover solves the difference data which is received once again. When the satellite condition is not good enough, you can solve for several times and save coordinate to eliminate the incorrect solution because of multi-path interference.

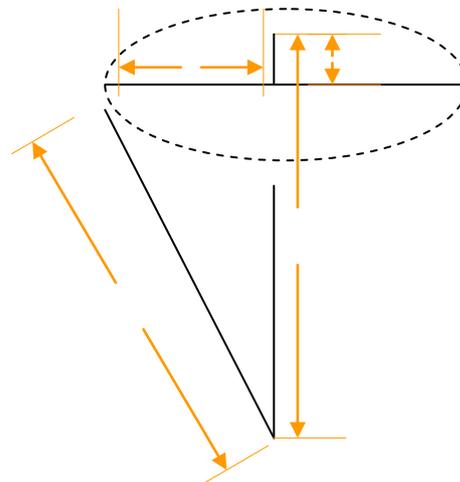
**ResetAnt:** Calculate again after GPS instrument search satellites again.

### 3.5 Antenna Setting

Setting parameters include satellite antenna type, radius of antenna and phase center setting.



3-8 Antenna Setting



3-9 Satellite antenna sketch map

Input antenna height correctly to get correct height of surveying point. In practical surveying, usually you can only get the slant height. (Distance between center point and rubber loop) You can get the vertical height by using

simple trigonometric function to calculation slant height, antenna radius and phase center height. Detail geometry relations are shown on the sketch map of the upper right illustration.

Letters on the sketch map indicate:

**S: Slant height** (Distance between surveying point and antenna rubber loop. Generally the antenna height you get during your survey process is slant height.),

**V:** Vertical Height

**R:** Antenna Radius

**P:** Antenna Phase Height

The common antenna radius and phase center height are stored in software.

You only need to: 1. Select one antenna type, 2. Input antenna height, 3. Click OK.

Software will calculate the vertical height automatically and correct it by point coordinates. You can also define the antenna type and only need to input antenna name, phase center and radius.

**Notice:** Correct antenna slant height measuring will greatly impact point accuracy. We recommend you to measure height several times to get average. Furthermore, you should upgrade setting in antenna setting interface of software if you move instrument tripod.

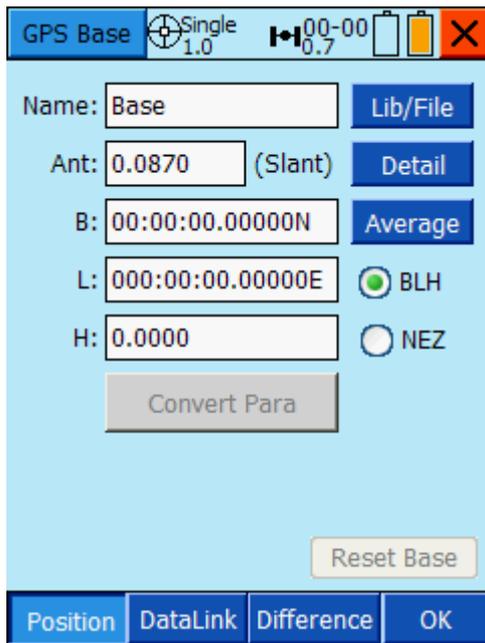
### 3.6 Base Station Setting

Setting base station you should mainly set the work parameters of base station including base station coordinate, data link of base station and so on.

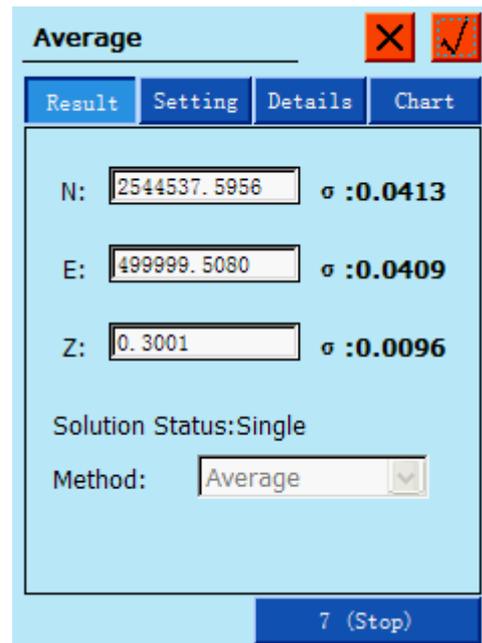
#### 1、 Position of Base Station:

Set the coordinate of base station to be longitude and latitude coordinates under WGS-84 coordinate system.

(Notice: H of base station coordinate is ellipsoid height. Because we need the level height of motherboard in internal model, we have to gain the height abnormal value of this level model. This requires GPS to be measurable when setting the base station.



3-10



3-11

When you're setting up base station, you can use "Average" for collection to gain relatively accurate WGS-84 coordinate.

(Notice: Base station setting up does not mean you can input any coordinates. You should set up the station after several times of "Average" operation. It will be more reliable when you click more times on "Average")

If the base station is set on the known point, you can input the plane coordinates of the known point and click "Apply to BLH" to convert to be WGS-84 coordinates.

(Notice: this conversion only applies to the national coordinate systems such as BJ-54 and GJ-80 ect, or the system in known conversed parameters relative to WGS-84.)

You can get local coordinates by clicking "Lib/File"to enter point library.

**【Average】** : Single positioning average, and average time is default to be 10.

**【Apply to BLH】** : Conversion between plane coordinate and coordinates of longitude and latitude.

**【Convert Para】** : It's used to calculate three parameters between local coordinates and WGS-84 coordinates. This function should be used only after average collection. Input know point's plane coordinate into X, Y, H part and click "Average" then

“Start”button to get the conversion between local coordinate and WGS-84.

**【Lib/File】** : You can enter Coordinate Library to select one point (all the Point Library button has the same function)

**【Base Station Point Name】**: It's automatically created according to current day and time. The format is (Base-Date Time), the time accuracy is second.

**【Stop】** : Click “Average”and the software will average automatically. You can click **【stop】** to end average. Software will show you times you already averaged and the button will change to be **【Start】** as finished averaging.

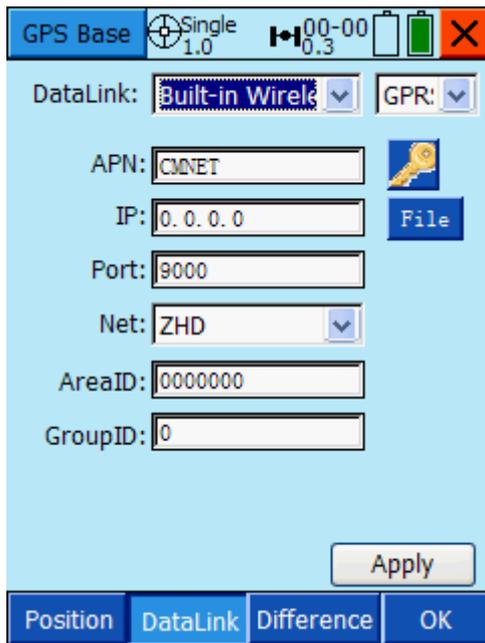
## 2. Base Station Data Link

Use to set the communication mode and parameter between base station and rover which including “internal radio”, “internal network”, “external data link”. The “internal network”comprises “GPRS”, “GSM”, “CDMA”. Usually we use radio and GPRS to communicate with rover. And when the base station is using internal network function, datalink should choose internal network. You can click network mode selection menu on the right side of the interface to choose one network type (One of GPRS, CDMA, GSM).

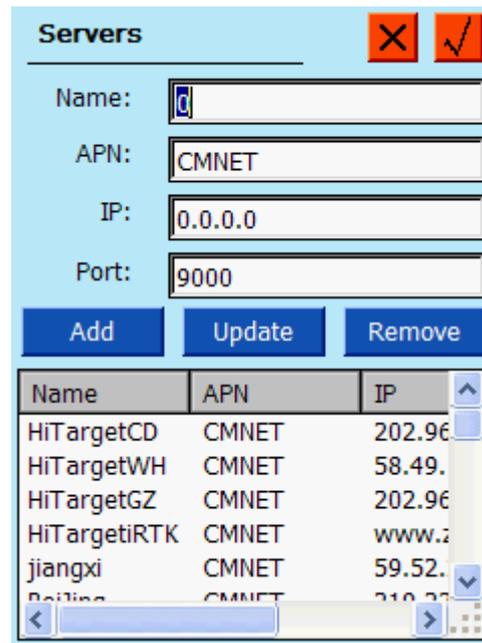
**“APN”**: Input “CMNET” when you use GPRS while input “card” when you use CDMA. For the Area out of China, you need to input the operator name for different certain SIM card after checking.

**“IP”**: Input server IP and port number. You can extract from “File”which is show as the below right figure to select one server you need. (Notice: Hi-Target network server address is 202.96.185.34, port number is 9000, if you use othe other server, need to input the right IP and Port after checking)

**“Area ID” and “Group ID”**: In case applying Hi-Target CORS, working by Hi-Target server, it needs toinput seven digit number and triple digit number. The Group Number is required to be less than 255. The number of base station and rover should be the same for a successful work.



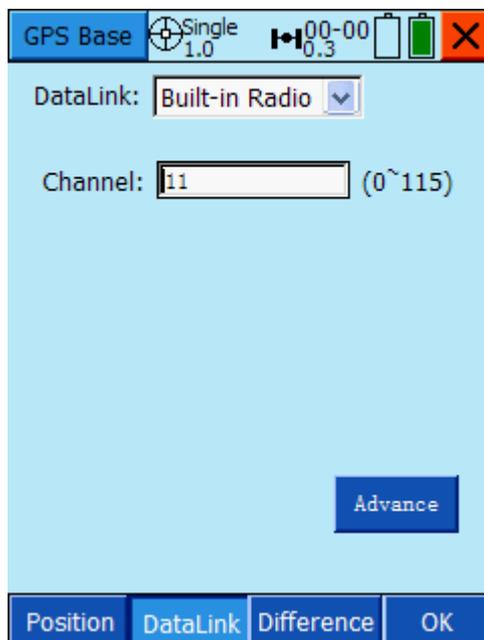
3-12 Internal Network



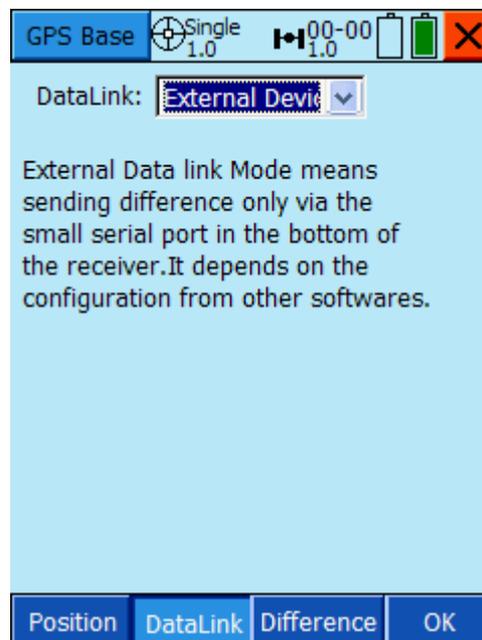
3-13 Server Address

When base station is using internal radio function: You only need to set the data link to be internal radio and choose one channel.

When the base is using external data link function: You should use external radio to proceed testing.



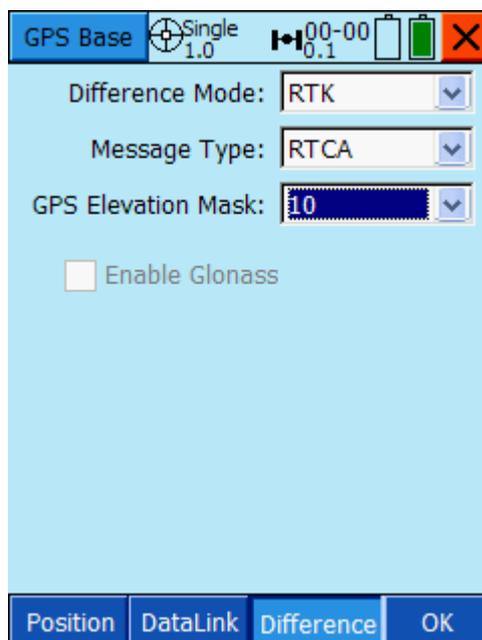
3-14 Internal Radio



3-15 External Radio

### 3. Other option of base station:

Set Difference Mode, Message Type, GPS Elevation Angle and Antenna Height.



3-16

**Difference Mode:** Including RTK, RTD and RT20. The default is RTK. RTD means Code difference, RT20 is single frequency RTK difference.

**Message Type:** Including RTCA, RTCM(2.X), RTCM(3.0), CMR and NovAtel , the default is RTCA. Hi-Target initiative base station support RTCA/CMR format and all the above format will be supported when connecting to VRS.

**GPS Elevation Mask:** Indicate GPS satellite receiving in certain cut-off angle which can be adjusted between 5 and 20 degree.

**【Antenna H(m)】 :** Click antenna height button you can set antenna type and antenna height for basestaion (Notice: Generally, the antenna height you measure is slant height. You might need a vertical height when you need to proceed forced centering. Don't forget to input it.)

**【OK】 :** Generally, click **【OK】** after finishing all base station setting. Software will inform you successful setting or setting fail. If it's successful, make sure mainframe of base station is sending difference signal. If it's failed, repeat the operation and exam parameter to correct wrong setting.

### 3.7 Rover Settings

Rover setting is mainly setting working parameters of rover, including rover data link and so on. Rover setting is as same as base station setting, only difference on information input.

#### (1) Rover Data Link

Data link is used to set the communication modes and parameters between rover and base station, including “internal radio”, “internal network”, and “external datalink”. The “external data link” comprises of “GPRS”, “GSM”, “CDMA”, we often use radio and GPRS wireless network to communicate with rovers.

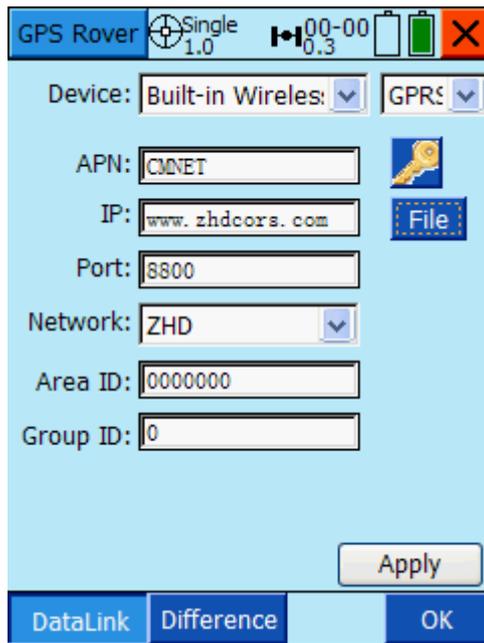
Rover using internal network function: Select internal website on data link and right click network modes menu to choose one network type (one of GPRS, CDMA, GSM).

**“APN”:** Input “CMNET” when using GPRS, input “card, card” when using CDMA.

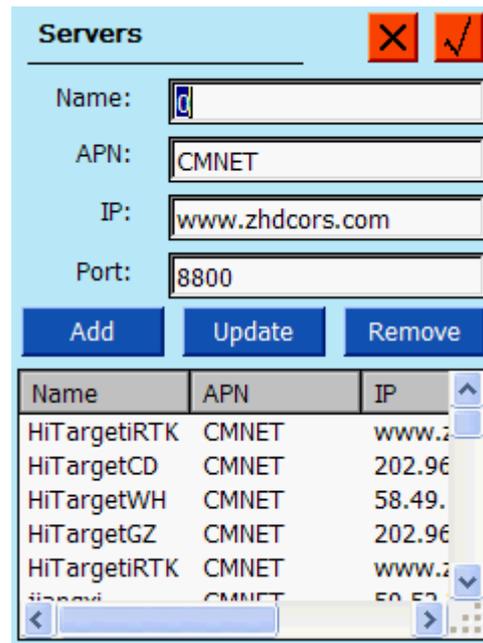
**“IP”:** Manually input server IP, port number or click “file” to choose one needed server on the list as below right figure.(Notice: Hi-Target network server address is 202.96.185.34, port number: 9000)

**“Area ID” and “Group ID”:** Respectively seven-digit and triple-digit, Area ID must less than 255 and should be the same on base station and rover for successful work.

**Network:** Including ZHD and CORS, choose ZHD if you’re using Hi-Target server and choose CORS when you connect to CORS system.



3-17 Network



3-18 server address

**Connect CORS:** select network as CORS. Input the IP and Port (Figure 3-19), or click “File” to select from. Click “Setting”, you will get to “CORS settings” surface (Figure 3-20), click “Nodes” to get source table. Select “source table” → input “user name” and “password” → test, you can check whether it receives CORS signal. If yes, click 【√】 in the up-right.

When **connect CORS**, users need to inform the center/main computer the location of the rover so as to do difference and collect data. If you are using this kind of network, please **select “Send Rover Position to Network” in need, and then set the sending interval is “1” second.**

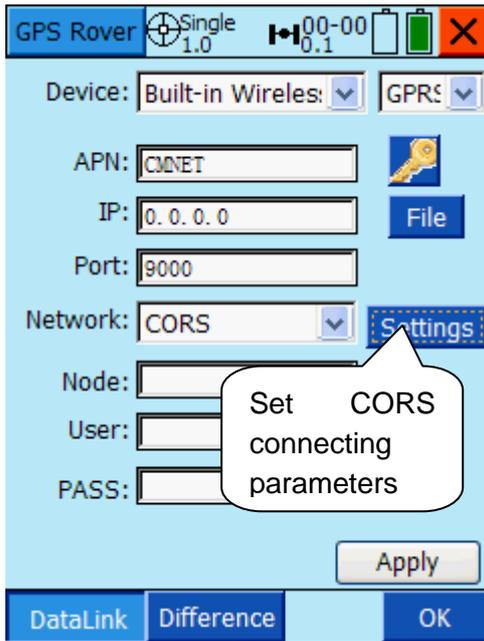
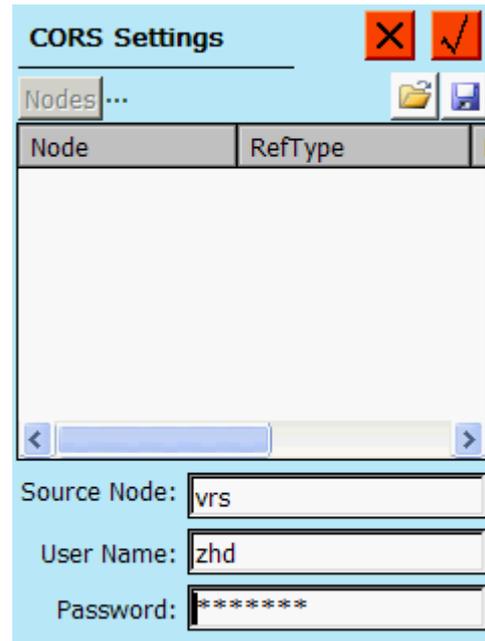


Figure 3-19 set CORS



3-20 set CORS

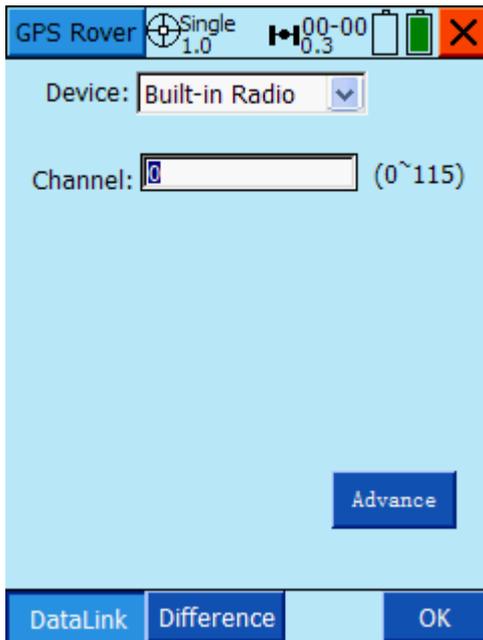
PS: generally used CORS which is in the format: CORS name, operator name, IP, Port

- Hi-Target: CMNET: 202.96.185.34: 9000
- Beijing: CMNET: 219.237.206.152: 2102
- Chengdu: CMNET: 218.89.201.169: 7777
- Chongqing: CMNET: 61.128.195.49: 950
- Dongwan: CMNET: 220.163.82.86: 9000
- Fujian: CMNET: 218.66.36.216.152: 8080
- Guiyang: card, card: 222.54.3.237: 6666
- Guangzhou: GZPIDW.GD: 10.88.2.3: 2102
- Hangzhou: CMNET: 122.224.128.59: 60886
- Jiangsu [outer-network]: CMNET: 58.213.159.132: 48665
- Jiangsu [inner-network]: jschgcy.js: 10.142.138.90: 48667
- Nanjing: CMNET : 218.94.36.185: 16571
- Nanning: CMNET: 124.227.12.20: 9527
- Qingdao: CMNET: 202.136.58.87: 9000
- Shanghai 1: CMNET: 202.136.208.106: 9901
- Shanghai 2: CMNET: 211.144.102.90: 9901
- Shenzhen: CMNET: 61.144.225.215: 8080
- Suzhou: card, card: 218.104.34.10: 6009
- Tianjing: CMNET: 202.99.107.125: 9800

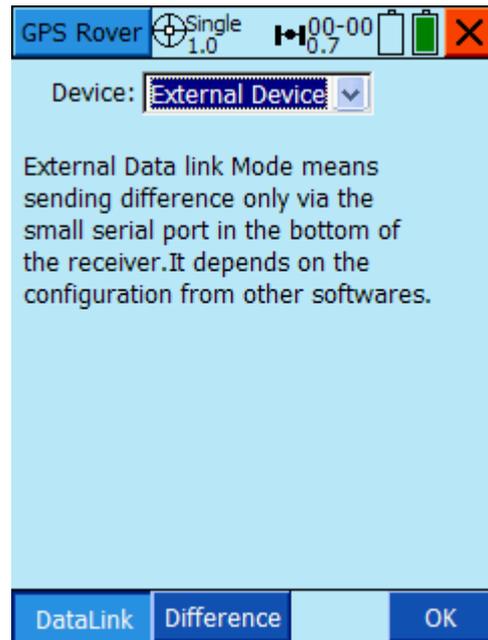
Wuhan city survey design institute: CMNET: 192.168.220.20: 9900

**Built-in Radio:** You only need to set the data link to be internal radio and adjust channel to make sure same channel between radio and base station.

**External Device:** You should use external radio to proceed testing of direct connection. (Specifications is shown on the below right figure)



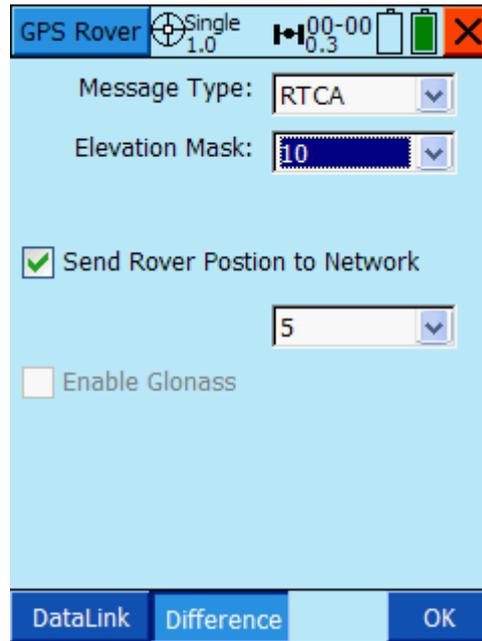
3-21 Internal Radio



3-22 External Datalink

## 2. Other option of rover station:

Set Message Type, GPS Elevation Mask, RTK Elevation Mask and Antenna Height.



3-23

**Message Type:** Including RTCA, RTCM (2.X), RTCM (3.0), CMR and NovAtel and the default is RTCA. Hi-Target initiative base station support RTCA/CMR format and all the above format is supported when connecting to CORS.

**GPS Elevation Mask:** Indicate cut-off angle for GPS receiving satellite, it is adjusted between 5 and 20 degree.

**Antenna H(m):** Click antenna height button you can set antenna type and antenna height for basestaion (Notice: Generally, the antenna height you measured is slant height. You might need the vertical height when you need to proceed forced centering. Don't forget to input it.)

**Send Rover Position to Network:** When connect to CORS system, the rover's location should be sent to host computer to get difference data. If you're using network like CORS system, click "Send GGA" and set the sending interval which default to be 1 second.

**OK:** Generall, click **OK** after finishing all base station setting. Software will inform you successful setting or setting fail. If it's successful, make sure mainframe of base station is sending difference signal. If it's failed, repeat the operation and exam parameter to correct wrong setting.

### 3.8 Receiver Information

Indicating current receiver connection status, including instrument number, mainboard information, voltage, work mode and register data.

**Sound Off:** Click to turn off or turn on receiver's voice

**Register:** Connect GPS and input receiver register code. (You can get the code from Hi-Target servicer)

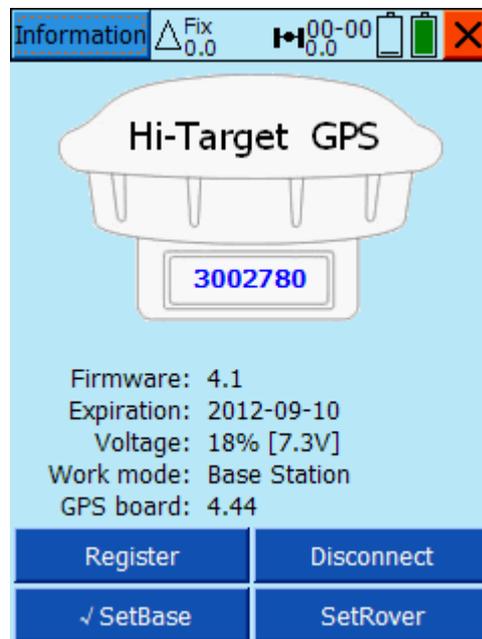
**Mainboard:** Indicate the receiver motherboard and its type.

**Firmware:** Receiver firmware edition number.

**GPS Voltage:** Indicate voltage of current receiver.

**Workstate:** Indicate the workstate of current receiver. Generally, it's BaseStation or RoverStation

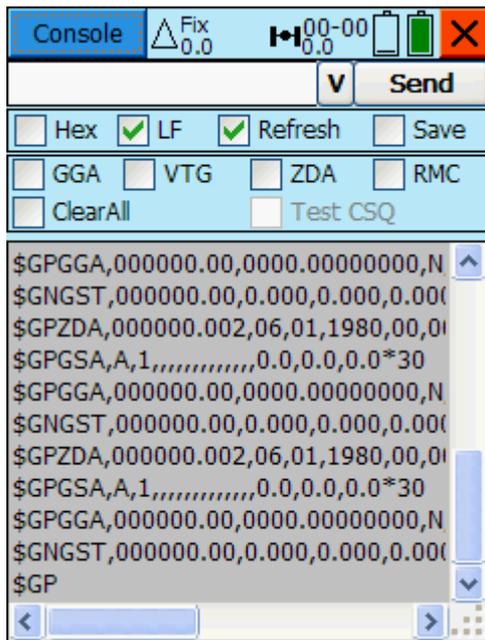
**Regist To:** The deadline of register code



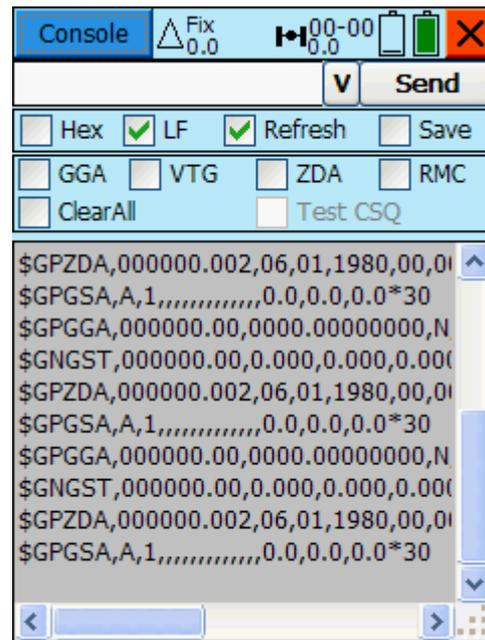
3-24

### 3.9 Console

Mainly use to debug port data. Built-in command in common use which can be save as files after adjustment.



3-25



3-26

**Binary System:** Select and output binary system

**Reflash:** select and reflash the output

**New line:** select one line and send it. Generally the send order must be deleted.

**Keyboard:** Display soft keyboard

**Save:** Save export files

**Files:** Select save path and input file name

**Send:** input the order and send

**Exit:** Close current interface.

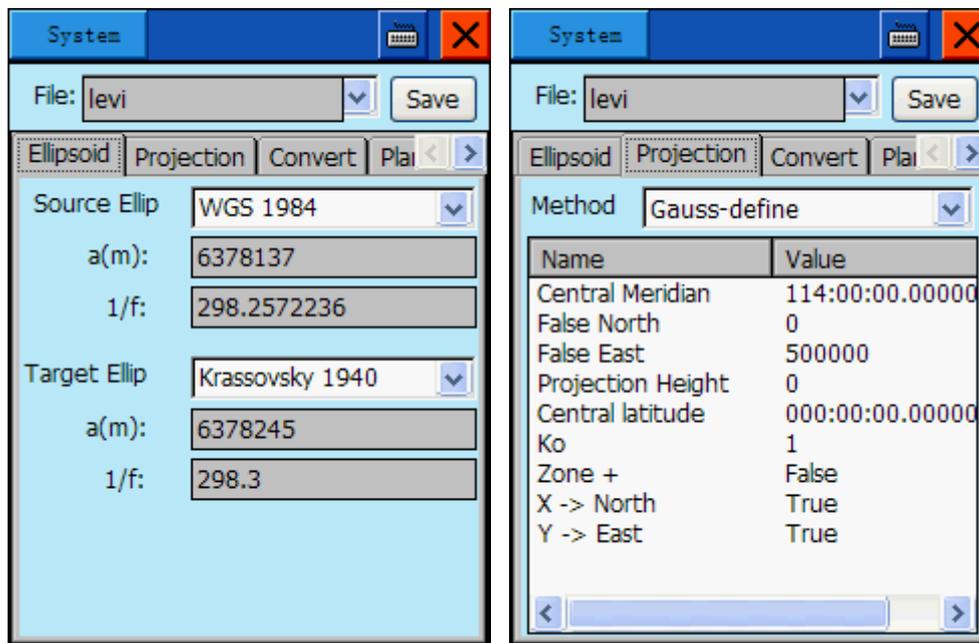
- Unlogall com1                      clean com1 output
- Log gpgga ontime 1                export data in standard format per second
- Log bestposb ontime 1            export data in binary system per second
- Log loglist                        export all LOG command which have been sent
- Log version                        export motherboard information and edition number  
(for checking motherboard)
- \$\$\$RST                             resume V8 baud rate command, and resume baud  
rate to be 19200
- Lockout 32                         do not receive NO.32 satellite signal
- rtkqualitylevel extra safe        receiver using save mode to calculate

# Chapter Four Parameter

## 4.1 Coordinate System

After enter parameter modes, you will see the coordinate system. And it defaults to be available for parameter calculation after select one coordinate system.

Software coordinates conversion module use the Coord software module which has been tested for many years, providing users with practical and comprehensive coordinate calculation ability. In projection part, includes Gauss projection, UTM projection, Lam Bert projection and so on. Conversion provides practical methods plane four parameters conversion, seven parameters conversion, one touch, Trimble and grid fitting. Height fitting provides abnormality correction including common height fitting, Trimble height fitting and grid height fitting.



4-1 Ellipsoid

4-2 Projection

**Country:** It contains global countries' name and default to be China. You can select one according to your location.

**Datum:** You can change it to be the datum you want. We suggest you to

use the project name as the datum name. Format is: country name-coordinate system name.

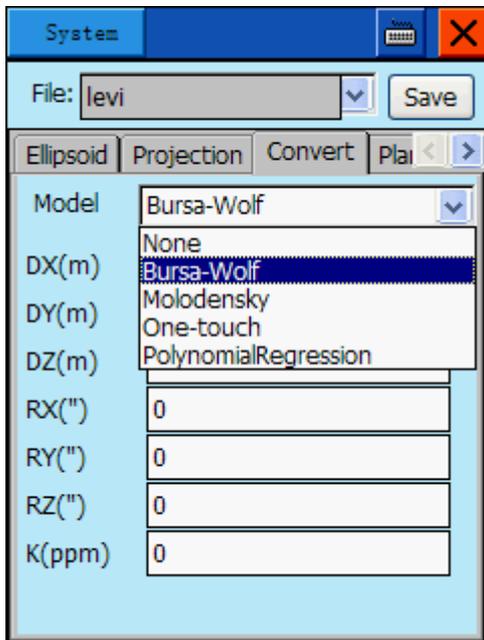
**Source Ellip:** Generally, it's WGS-84. Meaning of the parameter under Source Ellip: "a" stand for Semimajor and 1/f stand for Flattening.

**Local Ellip:** It contains ellipsoid parameters which are in common use in the world. It will show you the ellipsoid you're using under current coordinate system. If it's a user defined coordinate system (For example: X=10000, Y=5000, H=100), you can choose the default Beijing54 for current ellipsoid.

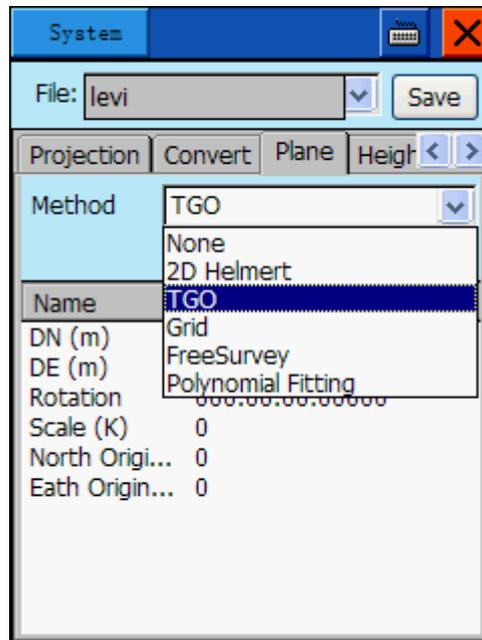
**Projection:** It contains projections which are in common use in the world, including Gauss projection, Mercator projection and Lam Bert projection.

(Notice: We suggest Chinese client choose user defined Gauss projection. You only need to adjust the Central Meridian Longitude. If you don't know the local longitude, you can check it on the navigation information after you connect GPS)

(The coordinate of BL can reach the accuracy of m in dms)



4-3 Convert



4-4 Plane

**Convert:** Bursa-Wolf seven parameters: Translation, rotation and scale between two ellipsoids on space vector. The rotation should be small and conversion model should be serious. You need three points to support the

calculation. This model is applicable for conversion between WGS-84 and national coordinate system.

**Molodensky three parameters:** It's simplification of Bursa-Wolf seven parameters which is a low accuracy conversion, only remains the translation parameter on space vector.

**One touch:** Translation, rotation and scale between two ellipsoids on space vector. You can set the rotation angle as will. You need three points to support the calculation. This model is applicable for conversion between WGS-84 and any other coordinate system.

**Plane:** Four parameters: Includes translation, rotation and scale parameter between two plane coordinate system which is practical for most of construction users. You only need known coordinate from two random coordinate systems to solve parameters.

**TGO:** Trimble TGO Software plane conversion method which need North origin and East origin parameters compare with four parameters.

**Grid:** insert grid files which has been edited and you can convert WGS-84 to be grid coordinate.

**FreeSurvey:** Thales corporation user defined plane conversion method which needs North origin and East origin parameter compare with four parameters.

### **Height Fitting:**

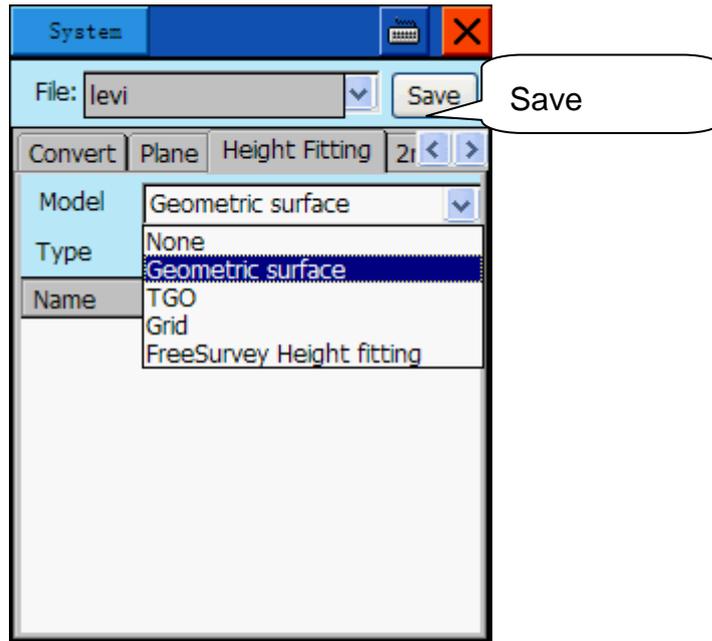
#### **Parameter Fitting:**

**Geometric Surface:** It's fixed difference correction and need at least one

**TGO:** Trimble TGO Software height fitting conversion model, including five parameters: Constant adjustment, North slope, East Slope, North origin point, East origin point.

**Geo Grid:** insert grid files which has been edited and you proceed height fitting.

**FreeSurvey Height Fitting:** Thales corporation height conversion model, including five parameters: Constant HO, North Slope, East Slope, Origin Latitude and Origin Longitude.



4-5

**【Save】** : Click **【Save】** to save all the coordinate system parameters and parameters will be saved into \*.dam files.ge

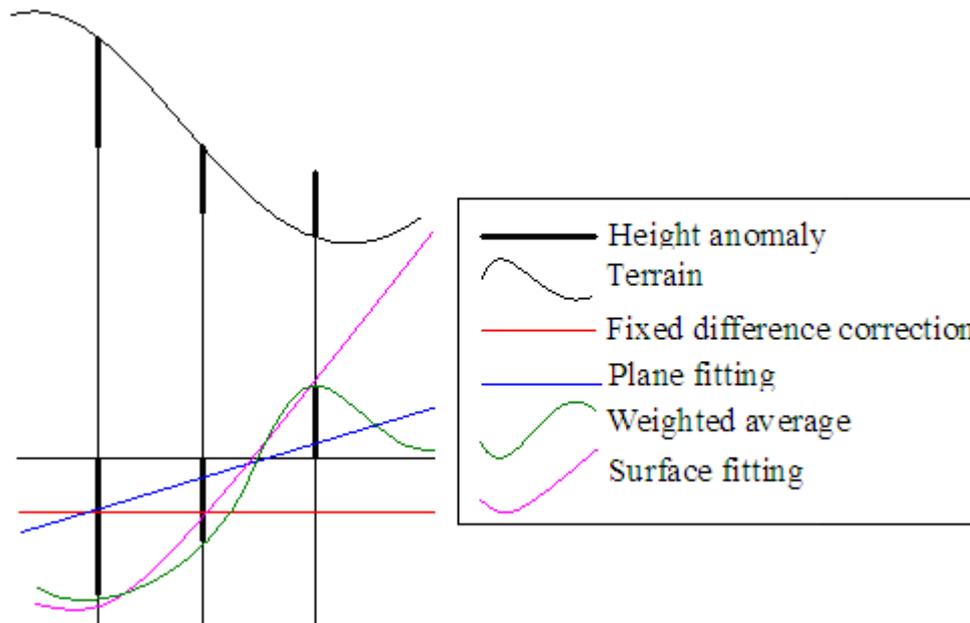
**Notice:** Click the Save button on the right side of interface or the parameter you set will be lost.

**Height Fitting Model Setting Specification:**

- a. Constant: Means the height which receivers get plus fixed constant as height for use. Fixed constant can be negative.
- b. Weighted Average: the inverse ratio weighted value of distance of level points. The height fitting value is close to height abnormality of the closest level point.
- c. Plane Fitting: Create one best fitting plane corresponding to several height abnormality of level points. The result will be same as fixed difference correction if the plane parallels water level.
- d. Plane fitting: corresponding to abnormality of several level points and create one best fitting paraboloid. The plane fitting has high requirement for start data. If the fitting is not good enough, it might cause the radiation of height fitting value of the work region.
- e. "Grid Fitting" need grid fitting files, supporting three formats Trimble(ggf), Hi-Target(zgf) and Geoid99(bin), and should be compatible with egm-96 model. The size of fitting files is usually big and need some time to read.

Please wait patiently. The grid fitting is seldom used in China. If you want to use grid fitting with other four height fittings, you should launch “grid fitting” first, then other fittings.

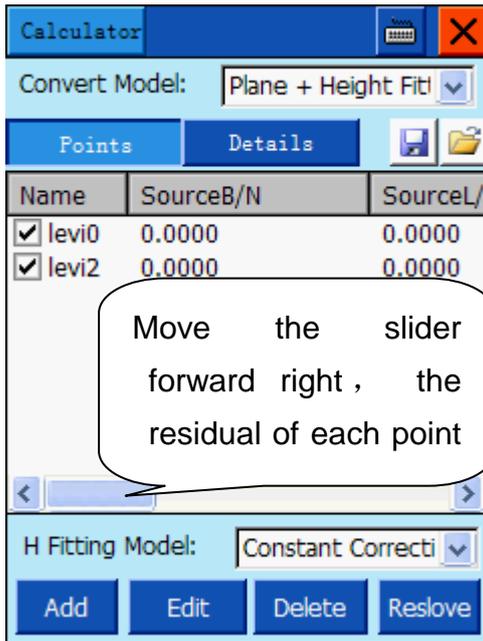
Height fitting plane simulation graphic as follow figure 4-6:



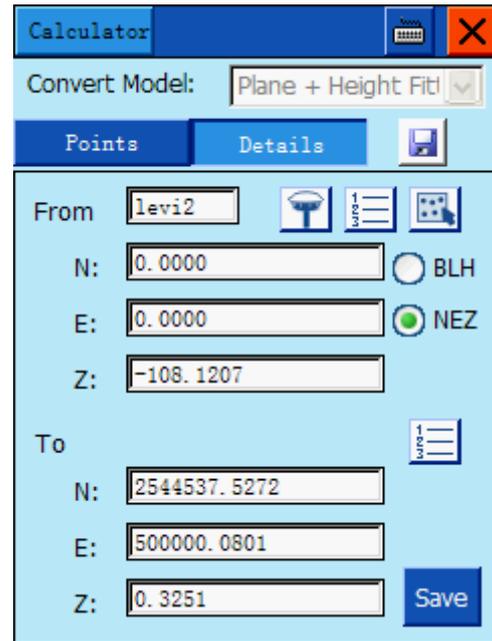
4-6

## 4.2 Parameter Calculator

Use to calculate the conversion relationship between two coordinate system, including “Bursa-wolf”, “One Touch”, “Plane + Height Fitting” and “Modensky”.



4-7 Calculator



4-8 Add Point

Select “Convert Model” and please choose “Plane+Height Fitting” if you want to use “conversion parameter+height fitting”

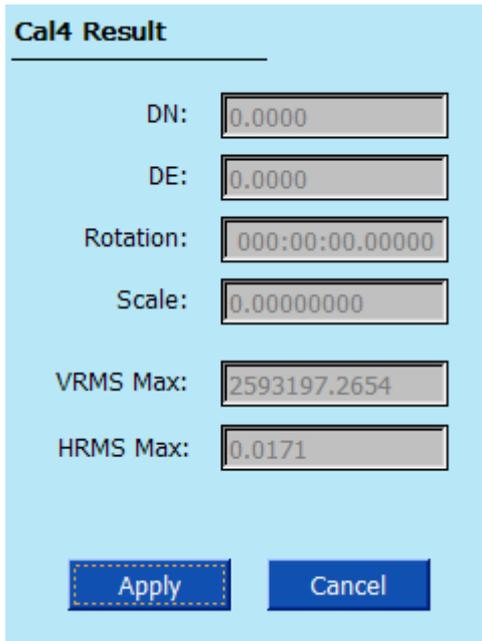
**【Add】** : You can add origin coordinate or target coordinate of the point. The origin coordinate can be manually input or you can extract from GPS, coordinate library and graphic. The objective coordinate can be manually input or you can also extract from point library. Click **【Save】** after input value.

**【Edit】** : You can edit the selected point coordinate

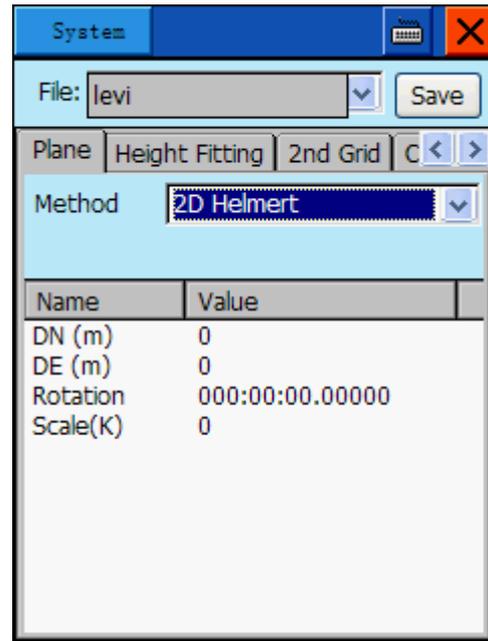
**【Delete】** : You can delete the selected point

**【Resolve】** : Click **【Resolve】** to solve the conversion parameter from origin coordinate to objective coordinate.(The pop-up interface as follow figure)

Software will solve the residual value of each point: HRMS and VRMS. Generally the point accuracy is reliable when the residual value is less than 3 centimeters.



4-9



4-10

**【Apply】** : It will save the current solution in the dam files and upgrade the current project parameter. Meanwhile, you will enter upgraded coordinate system interface and you can confirm the parameter as figure shown at the upper right corner. Click **【√】** to finish applying parameter and convert the coordinate you get on the rover to be local coordinate system.

When using four parameters: the scale parameter is always highly close to “1” and about 1.000X or .0999X.

When using three parameters: Three parameters are always required to be less than 120.

When using seven parameters: Seven parameters are better less than 1000.

**【Cancel】** : Cancel the calculation result and return to parameter calculation interface.

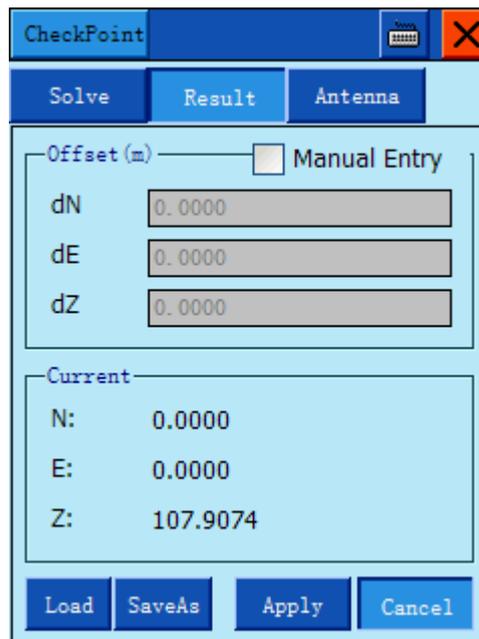
### 4.3 Use Checkpoint

This is used to calculate the plane and vertical conversion parameters

between two coordinate systems.

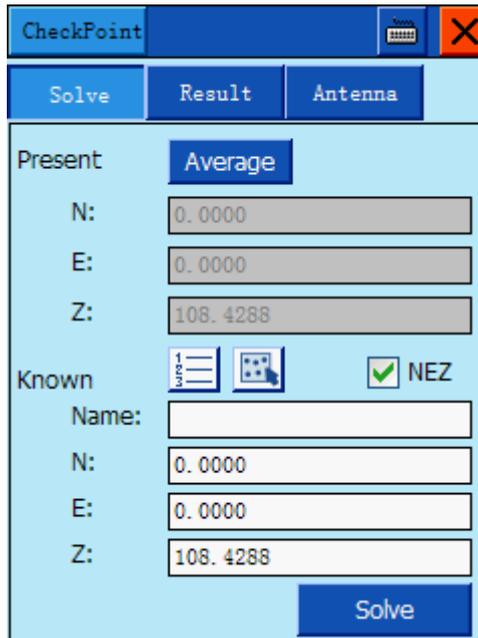
If you have done the current surveying work for a period of time after creating project and calculating parameters and when you continue with it you need to change the position of the base station for some external reason, you can achieve this work with “Checkpoint” function: you only need to set the base station at will while locate the rover in a known point, and click “Use Checkpoint”→”Solve”→”Average”→”Solve” in the right-down corner to collect the WGS84 coordinate of the current point and then input the known local coordinate. After this, click “Solve” in the right-down corner to get the differences dx, dy, dz between the known coordinate and the current collected coordinate. Finally, click “Apply” in “Result” to make these checking parameters applied in all later collected points so that all the points collected from then on will be transferred to the coordinate system of the known point.

### 1. Select



4-11

### 2. Solve



#### 4-12

【Average】 : get the WGS84 coordinate of the current point by averaging.

Three methods to input the coordinate of the known point:

- 1、  select from point lib;
- 2、  select on the map;
- 3、 Input the coordinate directly.

 Mark this xyh to input the xyh coordinate of the known point, or the BLH coordinate.

【Solve】 : Calculate the dx, dy, dz according to the coordinates of the known point and the current point.

### 3. Result

View the calculation result of the correction values.

The calculated correction values

The screenshot shows the 'Result' tab of the 'CheckPoint' software. The 'Offset (m)' section has a 'Manual Entry' checkbox that is unchecked. Below it, three input fields show the calculated values: dN is 0.0000, dE is 0.0000, and dZ is -1.0398. The 'Current' section displays the current values: N: 0.0000, E: 0.0000, and Z: 108.6626. At the bottom, there are four buttons: 'Load', 'SaveAs', 'Apply', and 'Cancel'.

Parameter	Value
dN	0.0000
dE	0.0000
dZ	-1.0398
N (Current)	0.0000
E (Current)	0.0000
Z (Current)	108.6626

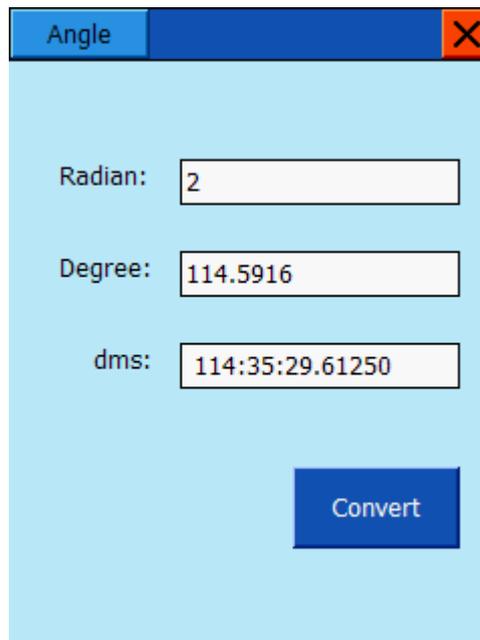
4-13

**【 Apply 】** : Apply the calculated correction values to the currentproject.

## Chapter Five COGO

### 5.1 Angle Calculation

Radian, Angle and Dms: After input the value of any of this three items and click you can get the other two.



The screenshot shows a software interface for angle conversion. At the top, there is a blue header bar with the word "Angle" on the left and a red "X" icon on the right. Below the header, there are three input fields, each with a label to its left: "Radian:" with the value "2", "Degree:" with the value "114.5916", and "dms:" with the value "114:35:29.61250". At the bottom right of the interface is a blue button labeled "Convert".

5-1

### 5.2 Coordinate Conversion

After you input the point information, you can click "BLH" or "XYH" for conversion. The solution will provide you immediately for you to view. "BLH" will use WGS-84 coordinate system and XYH will be local coordinate system. Both of them are plane coordinate and you can extract the coordinate point from GPS point library and graphic.

The image shows a 'Coordinate' dialog box with a blue header and a close button (X) in the top right corner. The dialog is divided into two sections: 'Source' and 'Local'. Each section contains three input fields for B, L, and H values, and three radio buttons for coordinate systems: BLH (selected), XYZ, and NEZ. There are also two buttons, 'To Local' and 'To Source', located between the two sections.

Section	B	L	H	BLH	XYZ	NEZ
Source	22:59:59.99631N	113:59:59.99783E	0.3252	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local	22:59:59.99833N	114:00:00.00282E	0.3251	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

5-2

### 5.3 Area Calculation

Use to calculate the Graphic area and perimeter. You can use square meter for indication. The coordinates for calculation can be manual input or extracted from GPS coordinate library and graphic.

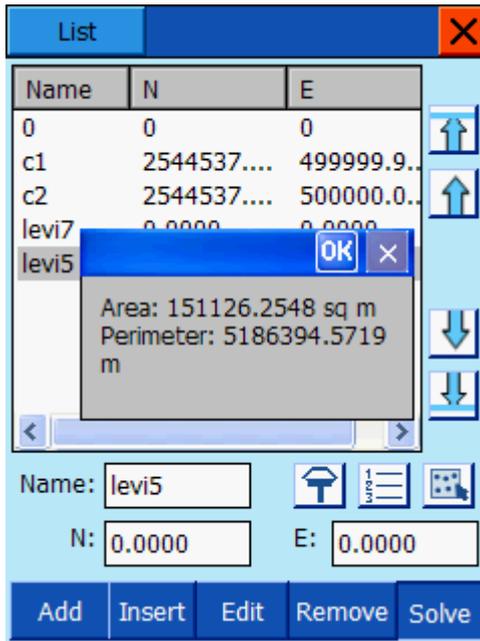
**【Add】** : You can add points to the list

**【Insert】** : You can insert one line above the current selected line.

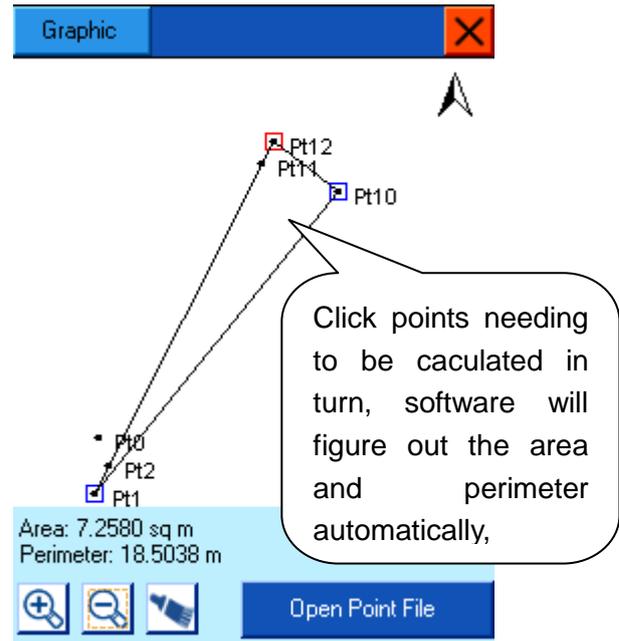
**【Edit】** : You can edit current selected project

**【Delete】** : Delete current point

**【Solve】** : Calculate the graphic area and perimeter which is circled by current points



5-3 List



5-4 Graphic



**Zoom in:** Enlarge scale



**Zoom out:** Reduce scale



**Clean:** Eliminate the connected graphic, area and perimeter solution.

10 m

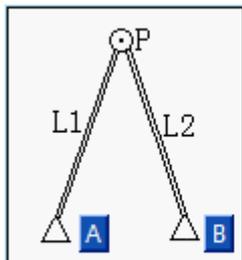
\_\_\_\_\_ : Current graphic scale

**【Open Point File】** : you can open the point library and draw the point to Graphic for your convenient aquare solution.

## 5.4 Distance&Azimuth between Two Point

Use to calculate the distance two points. You can manual input coordinates of A and B from the interface. Or you can extract from GPS, coordinate library and on Graphic. You can click “Solve” to get the “plane distance” and “space distance” between two points after finishing extraction.





Explanation: IndirectB

ID:    

N:  Result: N:

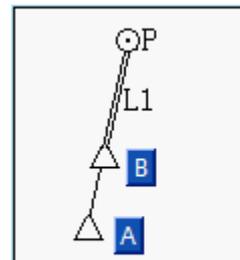
E:  E:

Z:  Z:

L1:

L2:

5-8 Two Points and Two Lines



Explanation: IndirectC

ID:    

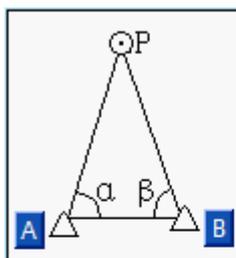
N:  Result: N:

E:  E:

Z:  Z:

L1:

5-9 Two Points and One line



Explanation: IndirectD

ID:    

N:  Result: N:

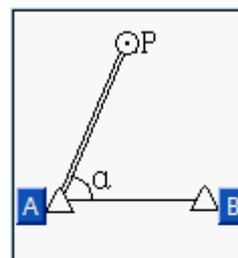
E:  E:

Z:  Z:

$\alpha$ :

$\beta$ :

5-10



Explanation: IndirectE

ID:    

N:  Result: N:

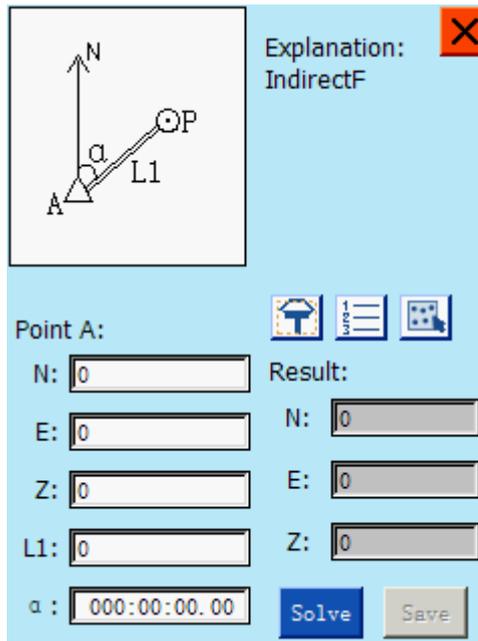
E:  E:

Z:  Z:

L1:

$\alpha$ :

5-11



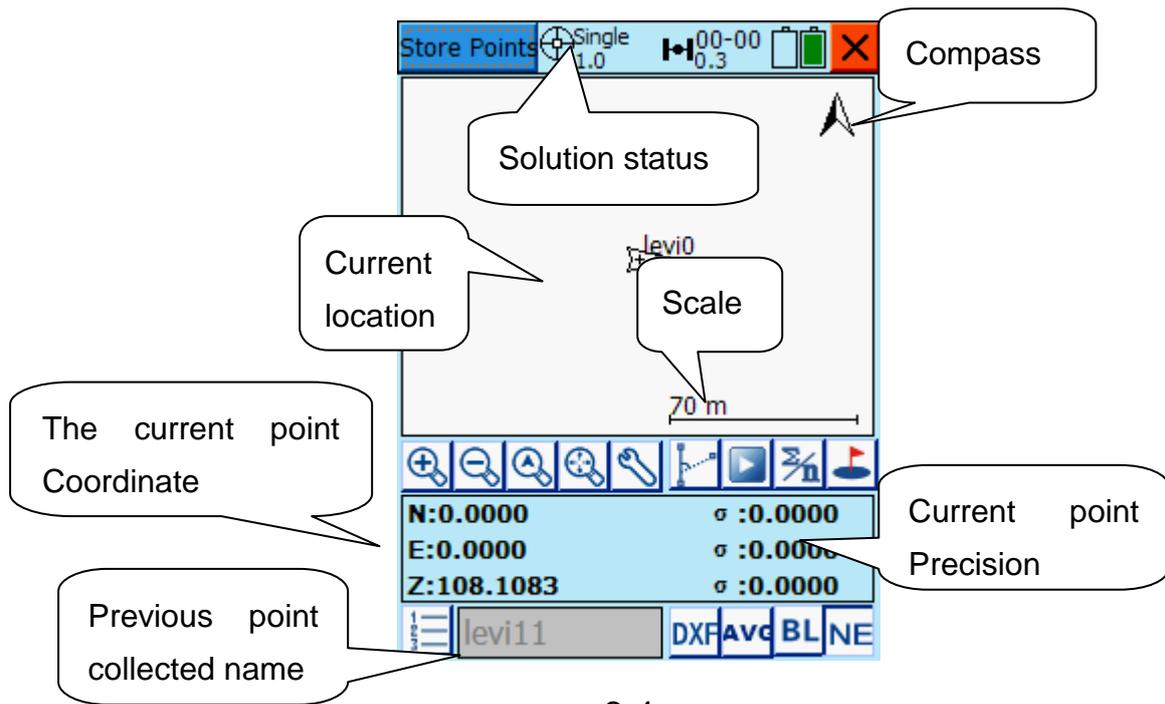
5-12 Two Points and Two Angles      5-13 Two Points with Line and Angle

When you doing the indirect survey as above, choose one “ID” of a known point and input indirect point coordinate (you can input manually or extract from GPS, coordinate library or graphic). Click **【Solve】** after you input other known elements (such as L1 and L2), then you can get to coordinates of the point “P” you want to get. Click **【Save】** and input point name, instrument height and Description to save the result into point library.

## Chapter Six Survey

### 6.1 Detail Survey

Click the **【Survey】** button on main menu and enter detail survey interface (as follow figure shown) (Notice: Detail information of all icon you can find in Chapter Nine: Icon Specification)



6-1



Zoom In



Zoom Out



Center Current Point



Full screen



Config



Intersection



Auto Record



Stop Auto Record



Average



Stord Point



Stored Point Library



Show Current Cordinate in BLH



Show Current Cordinate in xyh

Solve Status including:



Fixed Coordinate (Base station)



RTK Fixed Solution



RTK Float Solution



RTD Mode



WAAS Mode



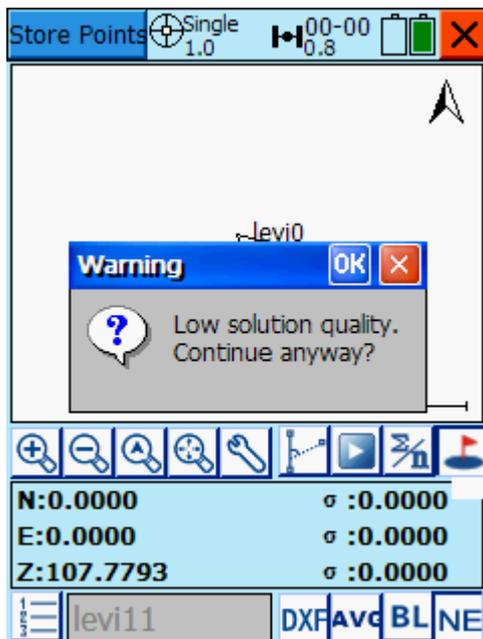
Single Point Positioning

Detail surveying is one common surveying, you have four methods to store point.

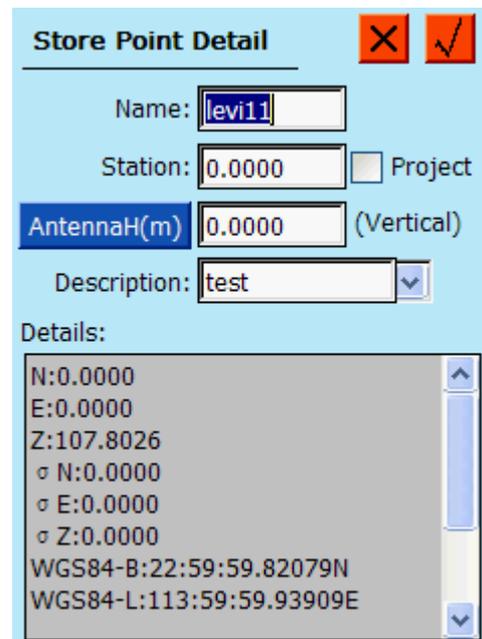
## 1. Manual Store Point

Generally, after you arrive at the surveying position, you can decide to launch the collection or not according to the coordinates, accuracy and solve status indicated on the interface. It's usually the RTK fixed solution if you are a RTK user. Click  to start the manual store point operation. Software will do accuracy inspection first. If the accuracy is not satisfied the system will ask you to continue or not (As low left figure shown). Click **【OK】** to save and **【Cancel】** to exit. There will be a pop-up interface with detail information (As low right figure shown) for you to recheck. And number of ID will automatically add one base on the former ID. Name of point is history last time. You can input "antenna height of click **【Antenna H(m)】** to finish detail setting of antenna type.

You can input description information at "Description" (Notice: If you are doing cross-section collection, please tick the "Staking Station", and you don't have to tick it when you are doing common detail surveying.



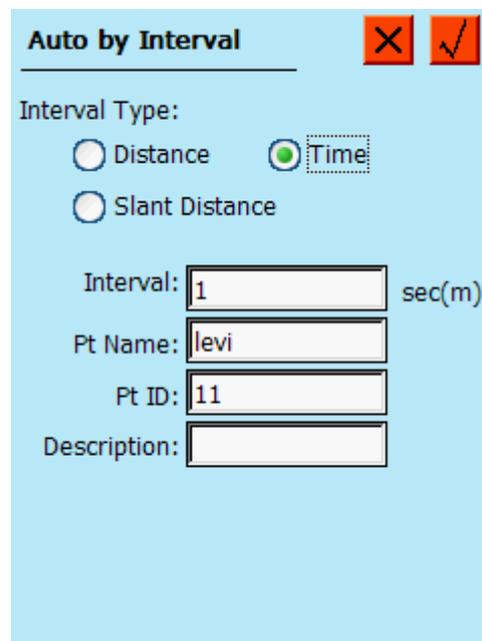
6-2 Manual Store Point



6-3 Store Point Information

## 2. Automatic Store (According to time/distance)

Click to enter Auto by Interval interface and you can input the auto type during auto store process (Including time interval, slant distance interval and plane interval such as X or Y orientation deviation) and also you can input the interval size, point name, point ID and description. After confirmation, the software will enter auto store modes. Software will do accuracy inspection first (It will store if the accuracy is satisfied and will be no information if the accuracy is not satisfied). You can click  to stop auto store.



**Auto by Interval**  

Interval Type:

Distance  Time  Slant Distance

Interval:  sec(m)

Pt Name:

Pt ID:

Description:

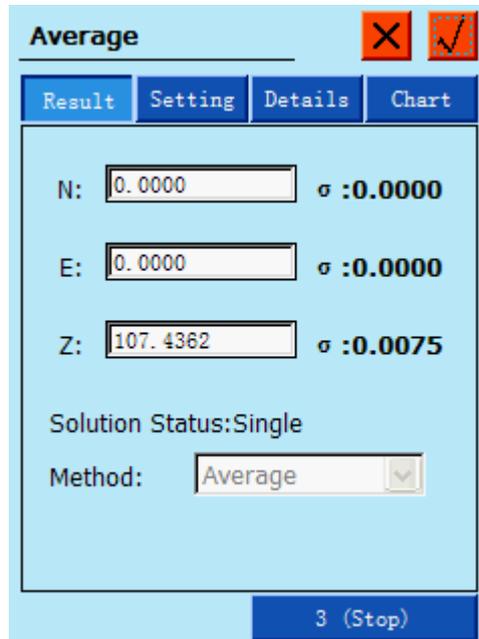
6-4

## 3. Average Store (Average of several epochs)

Average store is a simple way to improve the surveying accuracy. According to error theory, error should happen in random orientations. So we can eliminate the error when we take enough surveying operation. (This is only the theory and doesn't mean it will be a higher accuracy when there are more times of average) After you enter the interface of average, input the times of average and the overtime restriction. (You can also click "x", to manually stop it) The software will start storing after you click "start", and it will indicate the current point position. When you finish average, the software will analyse quality of data automatically and show you the standard deviation. (Root mean square

error)

**Notice:** The theory of standard deviation from calculation and root mean square error from survey is the same. But sometimes the root mean square error will be less than practical surveying error, because the average is a small



sample collection.

6-5

#### 4. Intersection Survey

Intersection survey is a kind of survey in case that some coordinates of points are not getable or without GPS signal, in which the plane location is usually got through intersection calculation while altitude data should be got through other survey method. The theory of intersection survey is graphics intersection calculation. As there are several methods of intersection and each one requires different types of value, you can choose one according to your survey tools. (See Figure 6-6, please refer to 5 Menu of Intersection Survey in Tools)

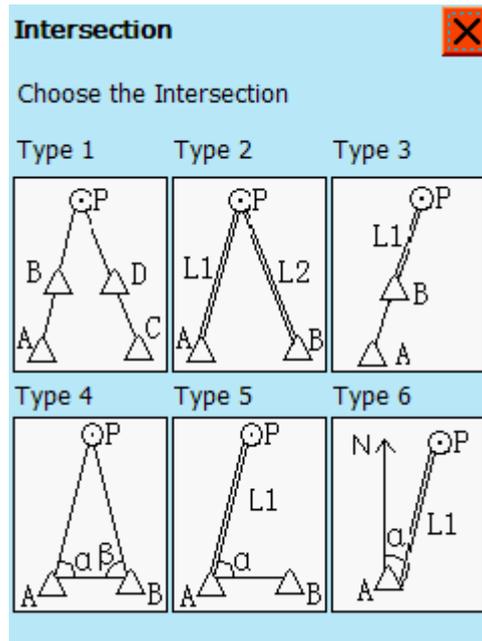


Figure 6-6

5.  **Config:**

The config menu is a shared menu by Survey, Stake and Road function to do the figure presentation in config work interface and tolerance setting, (notes: besides, enlarge, decrease, current location centering, record manually all belong to shared menu, which will be introduced one after one in this chapter and no introduction again in other chapters.)

Click  to enter config interface (Figure 6-7), click **“Tolerances”** to come to the interface as Figure 6-8, where you can set all the tolerances. The detailed introductions are as follows:

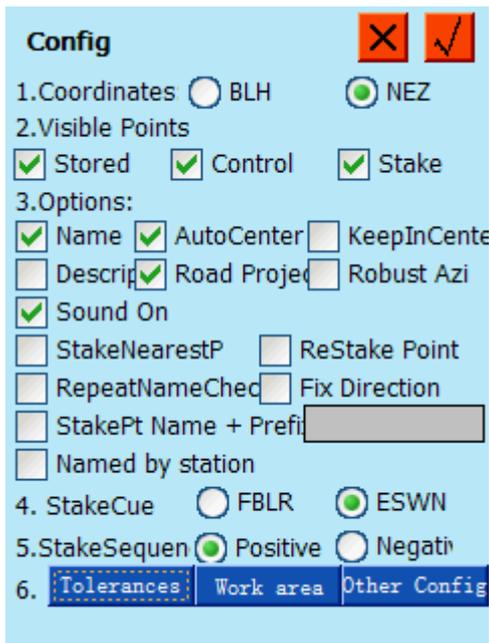


Figure 6-7

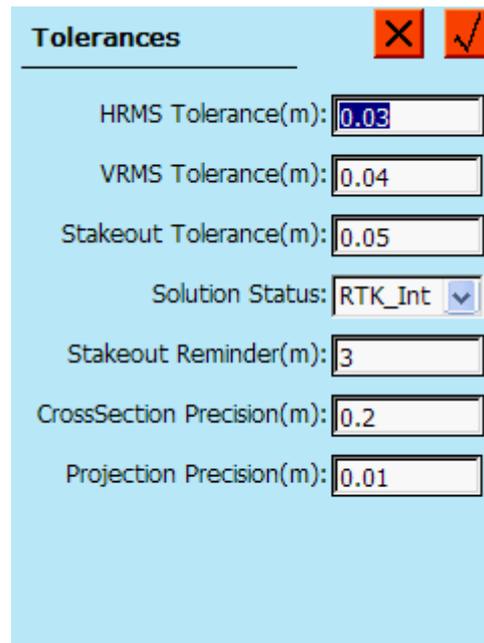


Figure 6-8

**Coordinates:** the types of the survey coordinate, containing BLH coordinate in WGS coordinate system and xyh in local coordinate system, showed in survey interface, the rectangular coordinate being the default one.

**Visible Points Lib:** choose whether map the coordinate in lib, marking for mapping.

**Name:** choose whether map points name, marking for mapping.

**Description:** choose whether map description, marking for mapping.

**Road Projection station:** choose whether map road projection, marking for mapping (only in line stake model) .

**Sound On:** choose whether open sound, marking for open.

**Key Stations:** show the key points in the curves in road survey, marking for enabling.

**FixAzimuth:** fix the azimuth to a certain angle while the background will adjust automatically in real time, marking for enabling.

**AutoCenter:** choose whether autocenter when the current points beyond the borderline, marking for enabling.

**KeepInCenter:** choose whether the current points locating always at the center of the screen, marking for enabling.

**Robust Azi:** the result azimuth of averaging samples of a period be stable,

without irregular skip.

**Fix Direction:** the upside of the screen is the fix direction, the background moving in real time, marking for enabling.

**AutoZoom:** adjust the scale automatically to show the map appropriately, marking for enabling.

### **【Tolerances】**

**HRMS Tolerance:** the mean square error of the survey plane. After input the limit value in the right box, the software will remind you “low tolerance, want to save?” when the survey results’ out of the limits.

**VRMS Tolerance:** the mean square error of the survey elevation, After input the limit value in the right box, the software will remind you “low tolerance, want to save?” when the survey results’ out of the limits.

**Stakeout Tolerance:** the limit of stake point tolerance, the software will remind you when you within the limit.

**Solution Status:** solution status limit, the precision from low to high is: single-point position, Wide Area Differential, code differential solution, RTK float solution, RTK fixed solution. When the limit as RTK fixed solution set, only collect data in RTK fixed solution state, the software will not remind you.

**Stakeout Reminder:** in stake model, when the distance between the current point location and the stake point reaches the set value, which can be input in the right box, the software will give you a sound and view reminder.

**CrossSection Precision:** in cross section stake model, when the vertical distance between the current point and the object section in within the set value, which can be input in the right box, the software takes the current point on the section

**Projection Precision:** if you enable Road Projection Display in line stake model, the software will control the error by calculation

according to your tolerance-setting, whose limit can be set in the right box.

## 6.2 Stake Points

Click pull-down menu in the left-up corner to enter stake points interface (Figure 6-7) (**notes:** please refer to 9 Icon Explanation to learn the detailed information of all the icons)

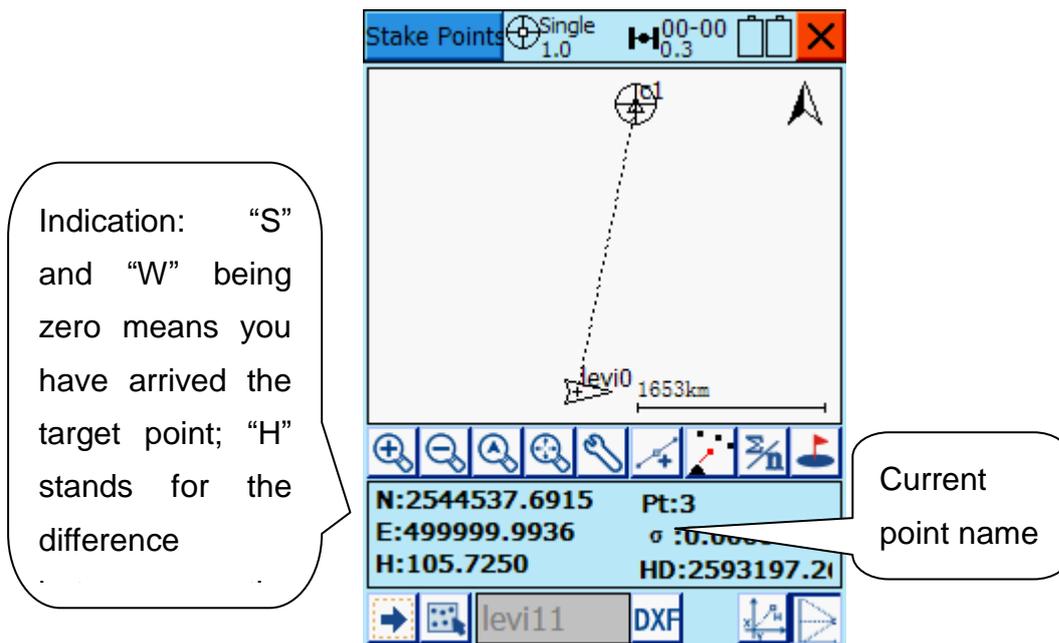


Figure 6-9

-  Next/Station/Transect
-  Select points from map to stake
-  Open reference line
-  Close reference line

Click directly  in stake point interface to enter stake point interface, three ways offered here to define points:

- 1、 input directly
- 2、 select from points lib
- 3、 select on the map (click  select on the map directly)

In the following Figure 6-11, Figure 6-12, you can impute the data from

the lib by click “File”, “Open Point File”:

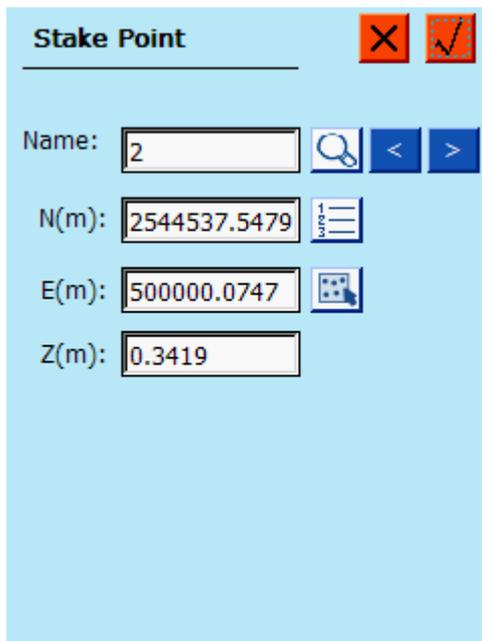


Figure 6-10 input directly

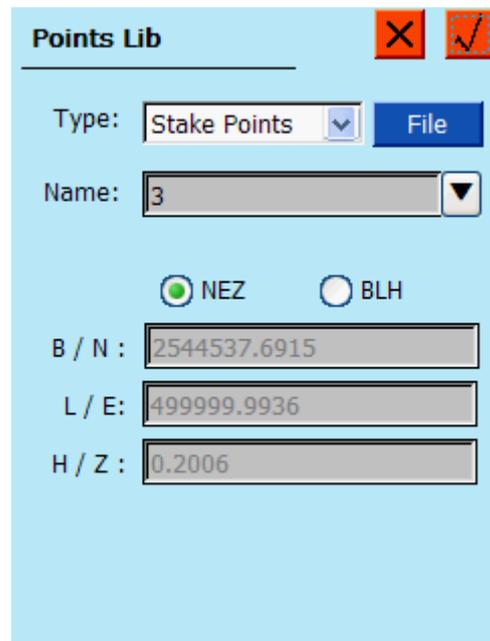


Figure 6-11 select from points lib

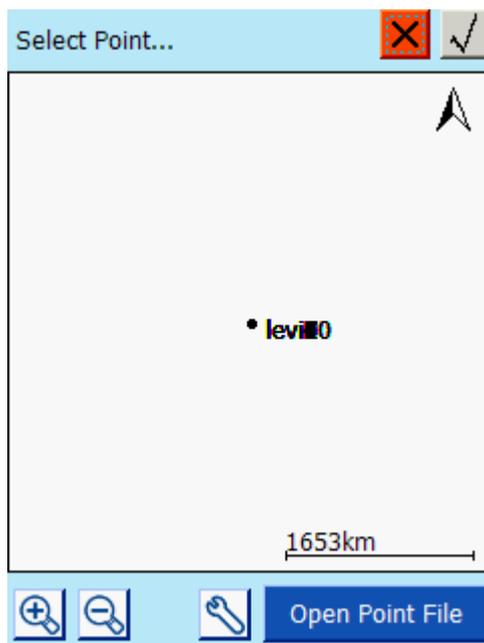


Figure 6-12 select on the map

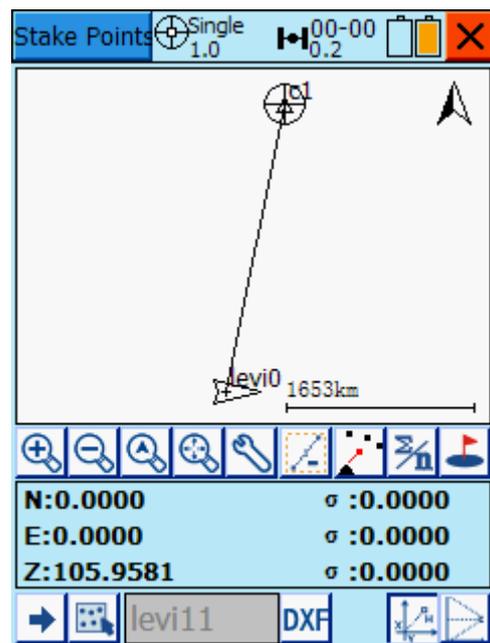


Figure 6-13  Open reference line

 Open reference line: (Figure 6-13) open reference line , the software will map a broken line automatically to connect the current point and the stake one as the reference line. After that, the distance between the current point and the stake point, elevation difference information, and the vertical

distance from the current point to the reference line will show in the bottom of the interface.

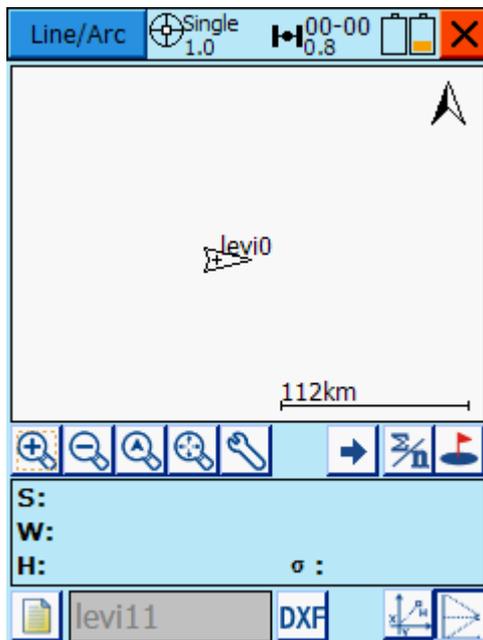
### 6.3 Stake Line/Arc

Stake line is a tool to layout part lines. This software offers three styles of stake lines: line, curve, spiral. The line can be defined by the points or one point and an azimuth; curve and spiral are defined by unified curve-element model.

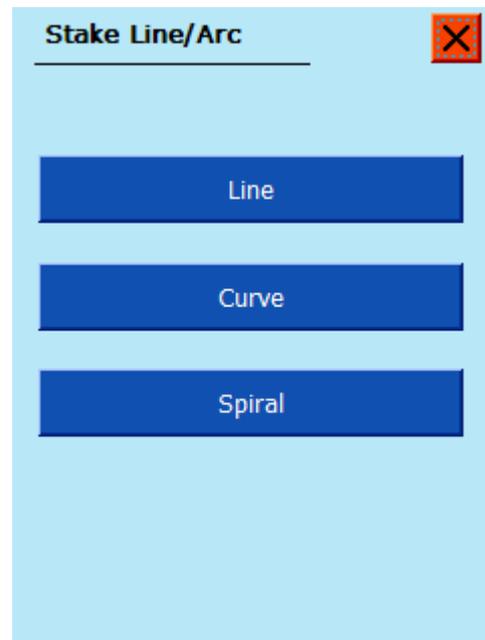
**Notes:** to get theory unified, stake line is taken as stake road, the position of every point staked is determined only by station.

The first set in stake line/arc: **select line style**

Click  define line data/impute road data file to enter the interface as Figure 6-15, where three styles of lines/arcs offered to select. The respective detailed information is introduced as follows:



6-14 stake line



6-15 define line/arc

#### **Define line/arc** (set line as example)

Click “Line” in Figure 6-15 to enter “Define Line” interface (Figure 6-16). The line can be defined by the points or one point and an azimuth. If you select the former method, click “Lib” to call coordinates of two points and input the

start station; if you select the latter one, call one point coordinate and input the azimuth of the line as well as the start station. then, click **【√】** to confirm.

Figure 6-16 define line

Click **➡** next /station to input the station of the required stake-point (Figure 6-17), in which interface the station and offset will accumulate automatically by increment. Click **✓** to enter stake interface.

Calculate the stake point coordinate, input station ( calculate offset when necessary); the “Left” and “Right” enable you to adjust station more smoothly, the unit adjusting amount being the increment; these data are all record in global variable, every time you enter this interface, the software will calculate a station/offset as default one automatically so as to save time. For example, if you stake a side piling every 10, then the increment should be 10. After this setting, when you start staking at the station“1850”, the next station will be “1860” defaulted by the software the next time you enter this interface. You only need confirm to continue stake.

**Station:** the station of the current point

**Offset:** Facing the orientation that station accumulating, vertical distance between the current line and the defined line.

**Increment:** the station-added value every time entering this interface

“Offset” is generally used in road-side spilling.

“Offset”: selecting “Left” and “Right” respectively stands for the left side and the right side of the road. Input the distance from midline to the

✕ ✔

**Point Sampling**

Station:  < >

Increment(m):

Offset:  Left  Right

< >

Increment(m):

Save To StakePoints  
 Enable

Increase station manually, one click adding one addition.

Increase offset manually, one click adding one increment.

Figure 6-17 point sampling

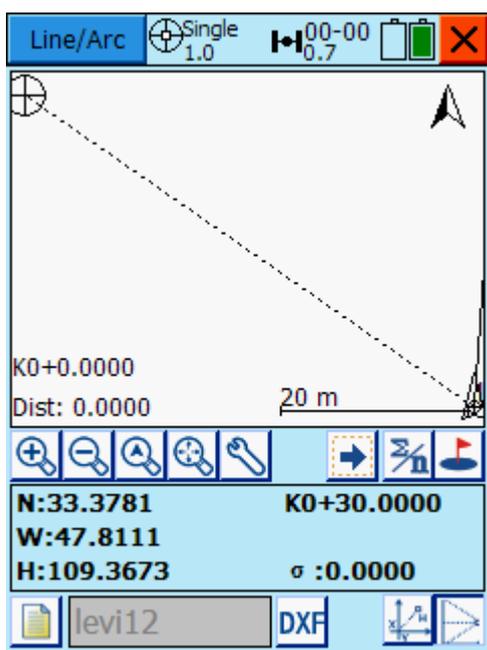


Figure 6-18 stake line/arc

(As Figure 6-16), stake the required point according to the hints on the map. The process of staking is actually a closing process from the current point (with triangle icon) to the object point (with cross-in-a-circle icon).

**Notes:** besides, you can also open real-time station function. Then the software will project the current point onto the roadline, displaying the station,

which will help you to get the moving direction.

To help you to arrive at the destination, the software map a connecting line. As long as you make sure that your moving direction coincident with the line, you will certainly move forward the right direction. Meanwhile, there are some indicators at the bottom. For some location with clear direction, you can use the staking indicator at the bottom to help you.

**Notes:** the triangle icon shows the current location and the speed orientation while the circle shows the objective point; the broken line connecting the current point and the objective line, As long as you make sure that your moving direction coincident with the line, you will certainly move forward the right direction so as to find the destination smoothly. There is staking indicator at the bottom information bar, which indicates you the difference value between your moving direction and the vertical direction.

If you open real-time station function, the current station will display at the left-up corner, and the connecting line to the current point, a round point will marked on the line for its project location; the real-time station is also used to judge whether you are in the right direction. (See whether the real-time station is the same as the staked point station, and the increment direction)

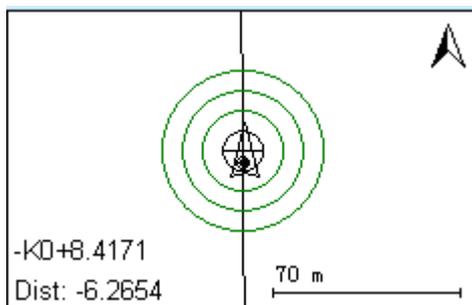


Figure 6-19 near the stake point hint

**[Reach your supposed range]**

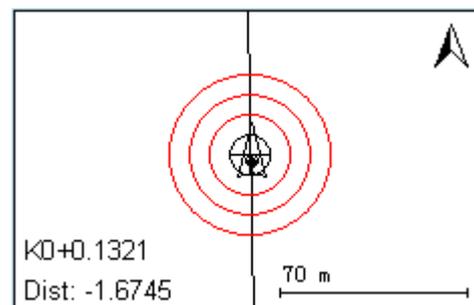


Figure 6-20 stake successfully hint

**[Reach your set stake tolerances]**

**Notes:** you can also open the sound reminder in config: when you reach the supposed reminding range and the set tolerance, the controller will hint in different sound.

### Define curve, spiral:

Click  define line data/impute road data file , select curve or spiral. Or define some style of line/arc only by clicking  next /station /transect, input stake point station (as figure 6-19), in which the station and the offset will accumulate automatically. Click  to enter stake interface. After you have define the arc style, the process of stake is more or less the same as that of line.

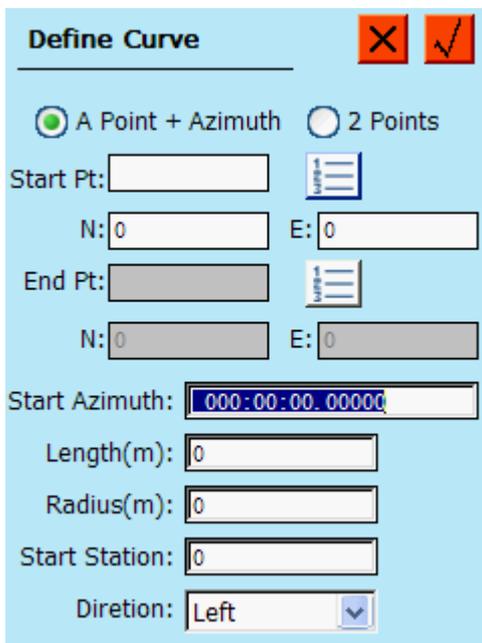


Figure 6-21

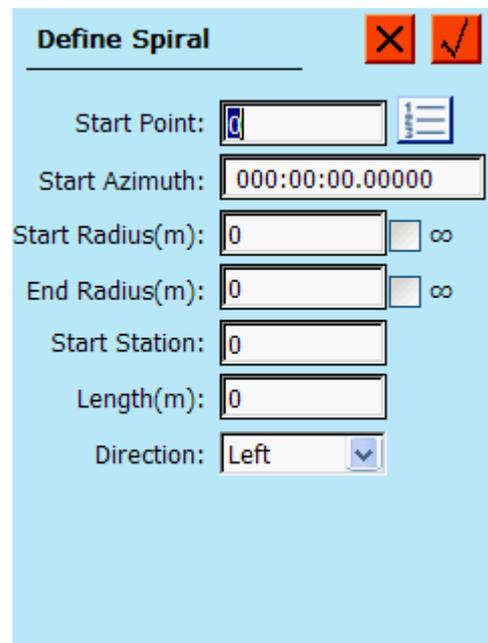


Figure 6-22

### Curve

**Start point:** call from point lib. Click “Pt Lib” to select points from lib.

**Start azimuth:** the orientation of the tangent on the start point

**Radius:** the radius of the curve

**Start station:** usually mathematical value. If there is “10+256.1” displayed on the construction drawing, the station of the start point should be 10256.1.

**Line element length:** the length of the curve

**Deflexion orientation:** in the direction that the curve forward, directing left stands for left deflexion while directing right stands for right deflexion.

## **Spiral**

**Start radius:** the radius of the start point, marking “∞” for line

**End radius:** the radius of the end point, marking “∞” for line

## Chapter Seven Road

Road function is the core of Hi-RTK Road software as well as the highlight, which is aimed at staking complex roads, enabling random combination of road lines. The two arithmetic “Point of intersection in centerline” and “Element” are the mainly-used methods in centerline-stake. In road-stake, the template is random. The inner calculation of “element” adopts unified curve-element model with rigorous theory, calculating in the method of value-integral, which eliminates errors of higher order terms. Consequently, the results calculated by the software can usually meet requirements of different-grade highways.

Three aspects of data which are plane data, vertical section data and transect data are used to define roads. Accordingly, three editors are designed to process the data of the three aspects respectively; or you can also process the different data on desk-top computer, then impute them into the controller software.

Finishing a road line, you can figure out the 3D coordinates of the points on the roads by mileages and the number of stakes so as to layout roads.

### 7.1 Centerline Editor

There are many ways to fix lines on plane, among which “Point of intersection” and “Element” (also called “Building Block Approach”) are the two main methods. As the “Point of intersection” is based on some conditions (for example, the definition of inner-element combination in single-point road is spiral-cure-spiral), this method can not “express” the road very well in some degree, while the method “Element” can construct any figures of roads. For other complex curves such as ovate curve, curve of multiintersection, false point of intersection and the like, you can transform those data to element-data so that you can use the method “Element” to do with.

This software offers the fixing defining line of point of intersection and the fixing defining line of element, meanwhile it defines the inner-element

combination inside points of intersection is Spiral in-Curve-Spiral out.

- Notes:**
1. the two spirals are not required symmetrical;
  2. Back-spiral should be changed into non- back-spiral by the way that, for example, adding a point of intersection.
  3. No Super-height or extra-width is supported.
  4. Disconnection is not supported, or it will be processed as actual station.
  5. False point of intersection is not supported, either, or it will be processed as real point of intersection.

The types of back-spiral: (distinguished mainly by where the point of the intersection on the curve is)

 non: not a back-spiral

 yes (false-to-false)

 yes (real-to-real)

 yes (real-to-false)

 yes (false-to real)

### **Fix line by Point of Intersection**

Click “Point of Intersection” to enter edition interface of point-of-intersection-table data (please refer to 9 icon explanation to check the detailed explanation of icons) :

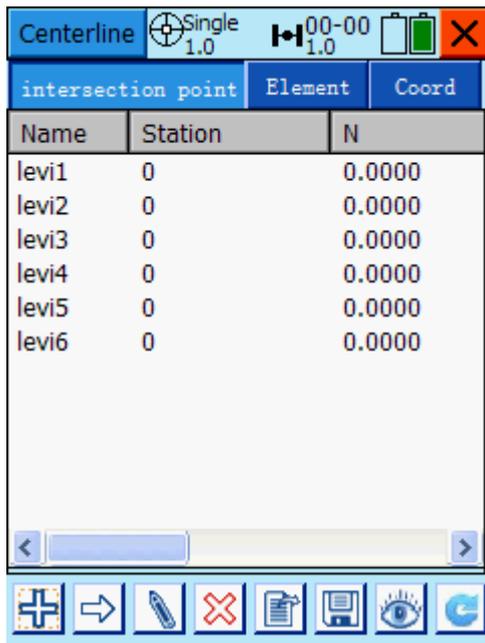


Figure 7-1 Point of Intersection

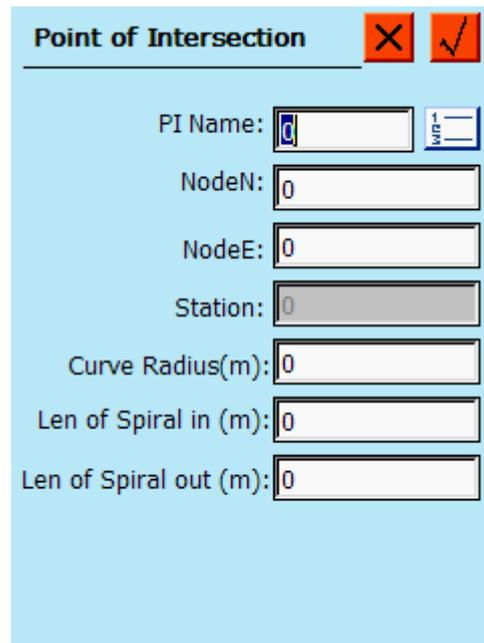


Figure 7-2 add point of intersection



add



insert



edit



delete



open



save



preview roadline figure: midline, vertical section, transect

Click  to add point of intersection, a interface as Figure 7-3 will show. You can add points of intersection, in turns of station, by inputting parameters containing the Name of point of intersection, X, Y, Station, Curve Radius, Length of Spiral in and Length of Spiral out until all points are added.

Click  Insert a PI

Click  Edit, to edit the input PI

Click  Delete, to delete a input PI

Click  Open an already-edit PI file (\*.PHI), you can input it manually or impute the data from some file, referring to 11.5 File format (point lib) and

#### 11.4 File format (Road format) .

Click  to save it as (\*.PHI) format.

As the above figures, you can create or edit PI file in this interface and then click  to check the map. (Figure 7-4 preview the plane) .

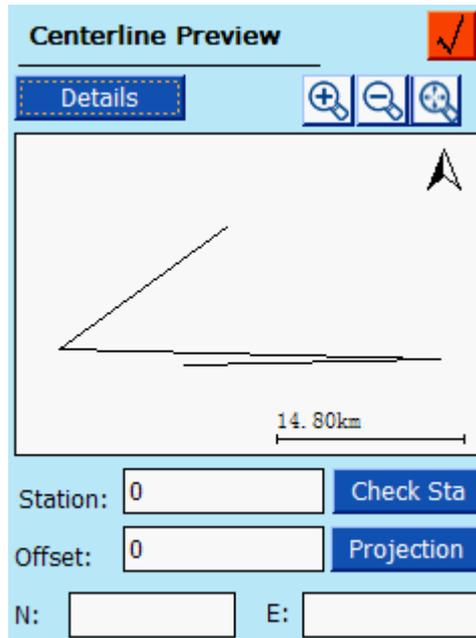


Figure 7-3 preview the plane

Input the mileage in the right-down box, click “Check Sta” to check the coordinate and the tangent orientation in a certain mileage (Figure 7-5) . Click “**Details**” to check the detailed information such as station, position, and azimuth.

Input xy of a known point then click Projection to get the result to check whether what you defined is correct.

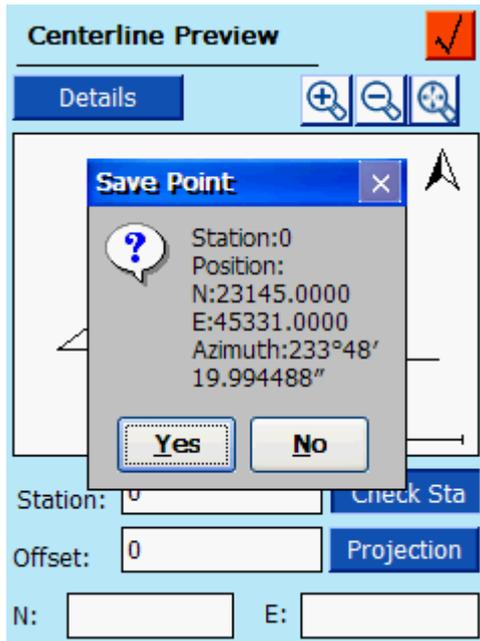


Figure 7-4 check the station

PIs			Elements		Key Pts	
Name	N	E				
levi7	23145.0000	45331.0000				
2	13467.0000	32105.0000				
3	12739.0000	62314.0000				
4	12307.0000	42105.0000				

Figure 7-5 Details

### Fix line by Element

“Element” is also called “Building Block Approach”. A complex line-element is usually combined by many simple line-elements connected end to end. Simple can be divided as line, curve, spiral. You can input line-element manually or impute the data from some file (\*.sec), referring to 11.5 File format (point lib) and 11.4 File format (Road format) .

Usually, you need only input the coordinate of the start point, station, and azimuth. Click  to add line-element data, select the style and input line-element.

**Line:** Input the length only.

**Curve:** Input start radius ( $\infty$  stands for infinitely large, that is as line) , the length, the direction (the heading direction being the referring deflexion) .

**Spiral:** Input start radius, end radius, the length, the direction.

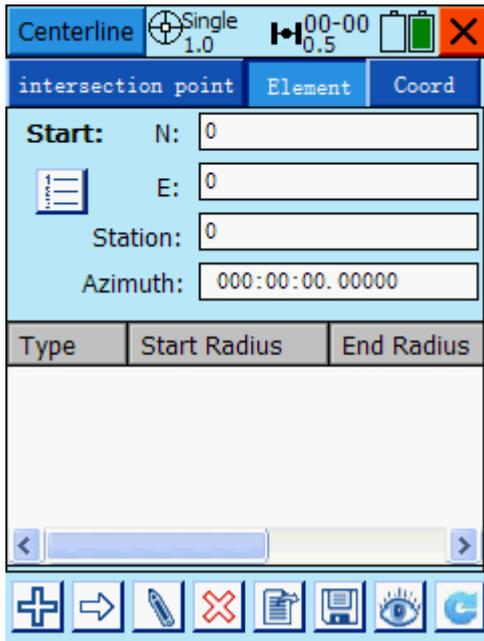


Figure 7-6 Element

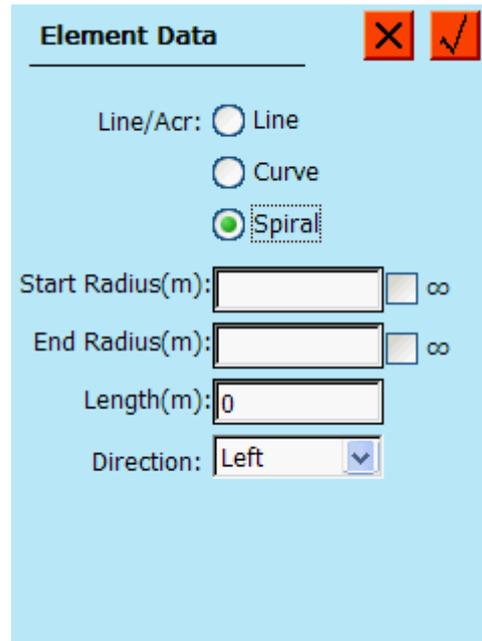


Figure 7-7 Pint of Intersection

As the above figures, you can create or edit PI file in this interface and then click  to check the map. (Figure 7-9 preview the plane ).

Input the mileage in the right-down box; click “**Check Sta**” to check the coordinate and the tangent orientation in a certain mileage.

Click “**Details**” to check the detailed information such as station, position, azimuth (Figure 7-10).

Besides, you can also check the key points in the “Key Pts” of “**Details**” (as Figure 7-11), which is what we mentioned of “**Key Stations**” in  **Config**.

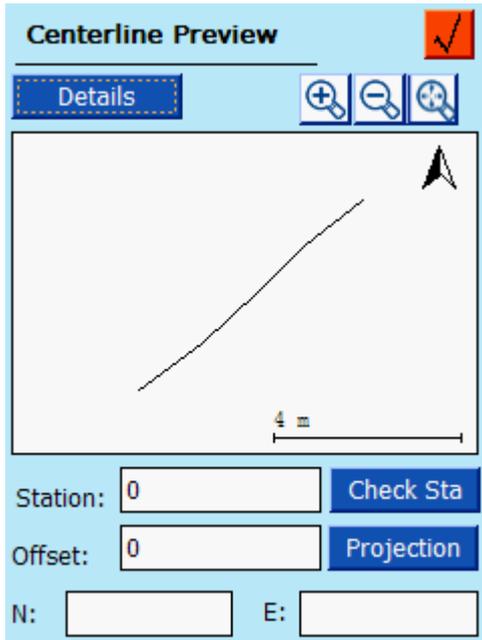


Figure 7-8 preview the plane

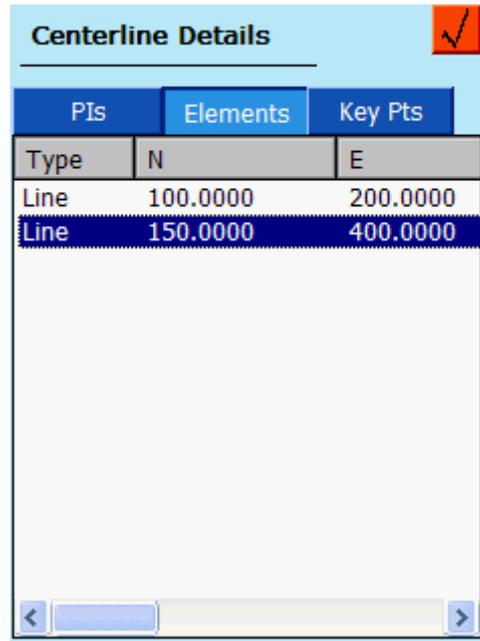


Figure 7-9 Details (Element)

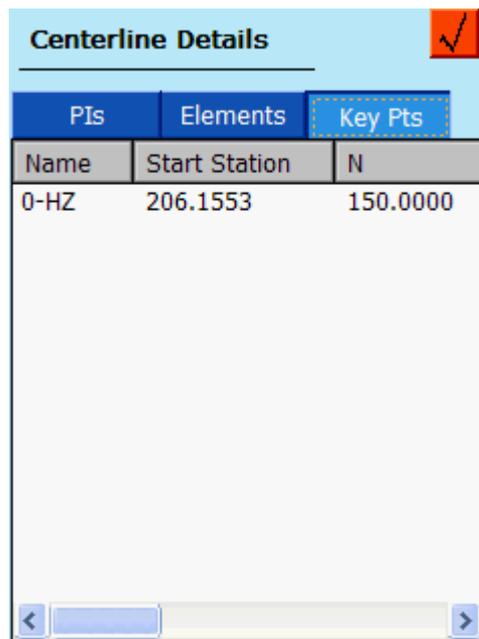


Figure 7-10 Details (Key Points)

Profile is a kind of expression of the heading direction of the road.

You can input road-line elements manually or impute the data from some file, referring to 11.5 File format (point lib) and 11.4 File format (Road format).

Usually, click  to add PVI data (as Figure 7-13), in turns of station, as

PVI station, elevation, slope1 (the slope of the former), slope2 slope1 (the slope of the latter), radius until all elements are added.

**Notes:** In common condition, slope1 is the same as slope2, slope1 being 0 while slope2 being 0.

Station	Elevation	Slope
19653.349	794.963	0
20070	815.379	0.049
22180	830.155	0.007
23880	787.655	-0.025
23974.007	786.339	0

Figure 7-11 Profile Editor

**PVI Data**

PVI Station(m):

Elevation(m):

Slope 1:  %

Slope 2:  %

Radius(m):

Figure 7-12 PVI Data

As the above figures, you can create or edit PI file in this interface and then click  to check the map.

Input the mileage in the right-down box, click “Check Sta” to check the elevation in a certain mileage (as Figure 7-14):

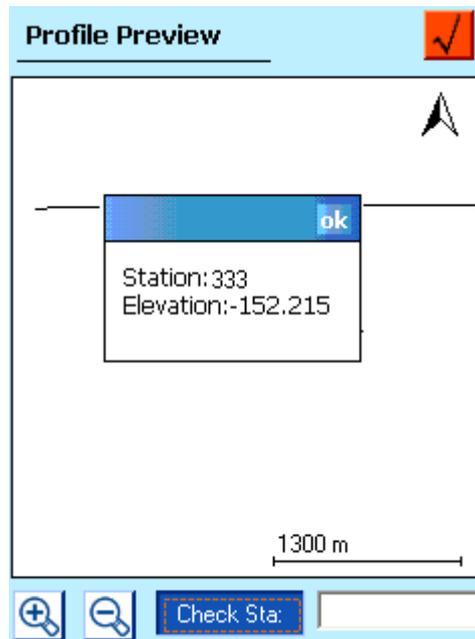


Figure 7-13

## 7.2 Profile Editor

Profile is a kind of description to the heading style of a road. You can define the road element manually or import \*.PVI file (please refer to the chapter appendix to see the detailed format of the import file).

Generally, click  to add PVI data: PVI Station, Elevation, Slope 1, Slope 2 and Radius. Add all the PVI data according to PVI station sequence.

Notes: generally speaking, the slope 1 equals to slope 2, which are both 0.

As the figures 7-12 and 7-13, you can create or edit PVI data and view the shape by clicking . Besides, you can also check the height of a certain station after inputting the station and clicking **【Check Sta】**.

## 7.3 Template design and file edition

Edition interface of the template:

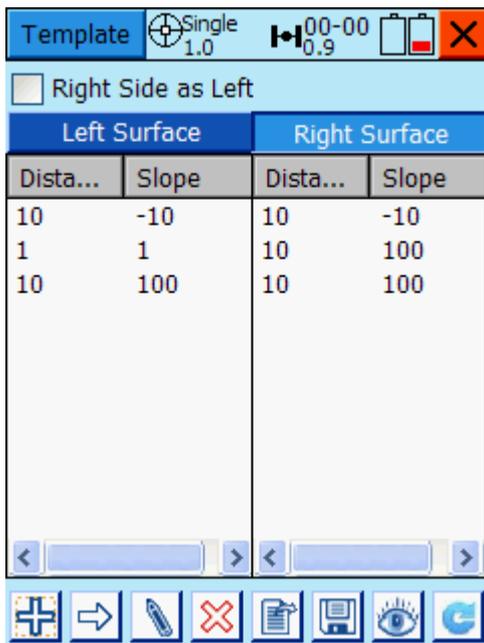


Figure 7-14 Template editor

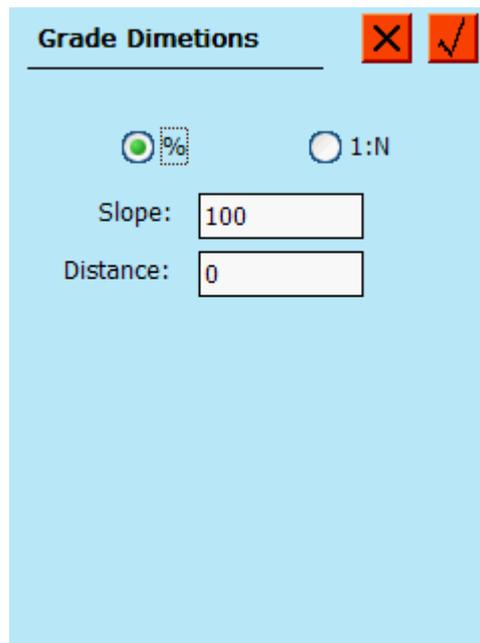


Figure 7-15 Grade Dimetions

As the above figures, you can create or edit template file by clicking “add” or “edit”. There are two ways to input the slope, percent and rate (Figure 7-15) .

**Distance:** the horizontal distance to the last PVI

**Slope:** the rate of (the height difference to the last PVI) to (the horizontal distance to the last PVI)

**Right side as left:** “mark” means the left side is the same as the right one.

Usually, click  to define template: select the way of inputting slope, inpute slope and distance (Figure 7-16). After edition, check the map (Figure 7-17) .

**Notes:** There is only one template in memory. As the same road has different templates in different road section, you can define several typical templates in advance, and inpute the appropriate one to layout.

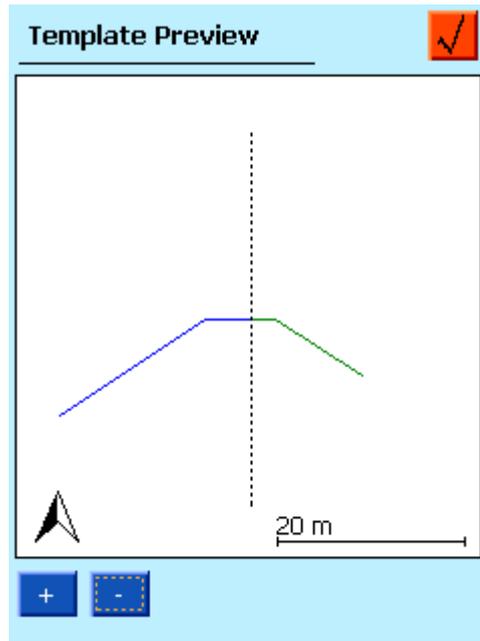


Figure 7-16

## 7.4 Stake Road

Road stake function is the core of this software, for which we have learnt and referred to many excellent software abroad and improved the define-first-stake-later work model of the traditional software so that the road stake became more flexible and smooth.

The working logic of road stake is the same as the one of line stake but more complex as the template and the profile design make the calculations more difficult. But with this software, the only difference lies in the operations in defining lines for the rest operations are all the same.

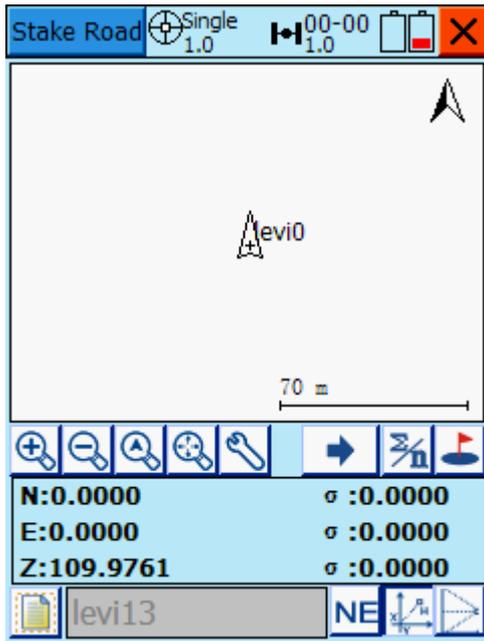


Figure 7-17

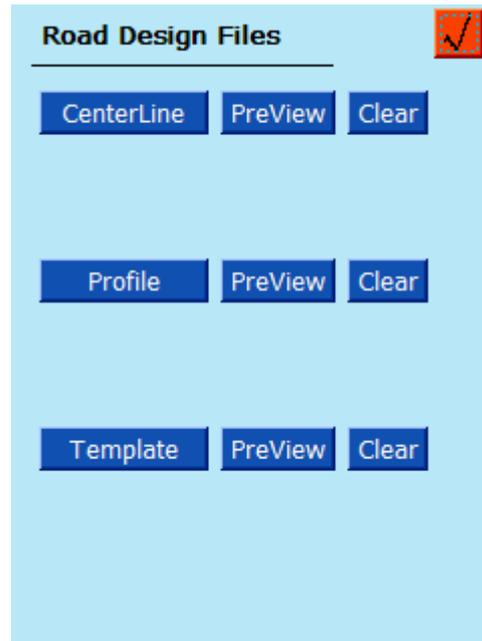


Figure 7-18

1、 Define road-line: click  define road data /impute road data file to impute the centerline, profile and template.

When every file has been imputed, you can check the data and the map by clicking the behind button. The catalog of the file imputed also presents behind for you to check.

Confirm the location: click  next/station, impute station, increment of the left/right offset, confirm it , then the software will calculate the coordinate of the location to be the coordinate of the stake point.

Notes: every time you enter this interface, the station and the increment will add automatically so as to reduce your burdens to input data again and again. The only thing you need to do is click “ok”. If you want to change, click **【<】** to reduce or click **【>】** to add, then confirm.

Figure 7-19 input station

◆ **Stake:** the same as line stake.

◆ **template collection**

While doing template collection, you can input the station to define a template position, and then collect data within this certain range. When you process data later, you only need to tell these stored points of the same template apart.

So, when you use this software, impute road data to define a plane file, and then input a station. After all these done, the software will calculate the template in the position of the given station and present a broken line being the reference. When you come near to the reference line, software calculates the distance between the current position and the reference. If the distance is smaller than a setting value, it will suggest you to do template collection. (to set the setting value, click  config->tolerances->define the range of the template)

Click  to record point. After output all the detailed points, do a simple procession on the data, then you can get the detailed point-group of the template in a certain station.

## 7.5 CrossSection Survey

In CrossSection Survey, you can define a cross section position by inputting a station. Then collect data within this range. When you process data later, you'd better tell these data defining the same cross section apart.

Import a road defining file (plane file) at first, and then input a station. Then the software will calculate the position of the cross section automatically and show a broken line as the reference. When you come close to the reference line, the software will calculate the distance between your current position and the reference line. If this distance is smaller than a set value, the software will inform you that you can collect the cross section data (you can set the informing value by config->tolerances).

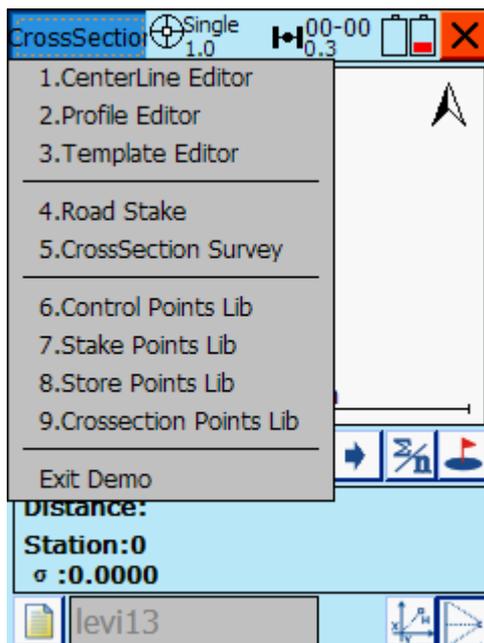


Figure 7-20 Cross Section Survey

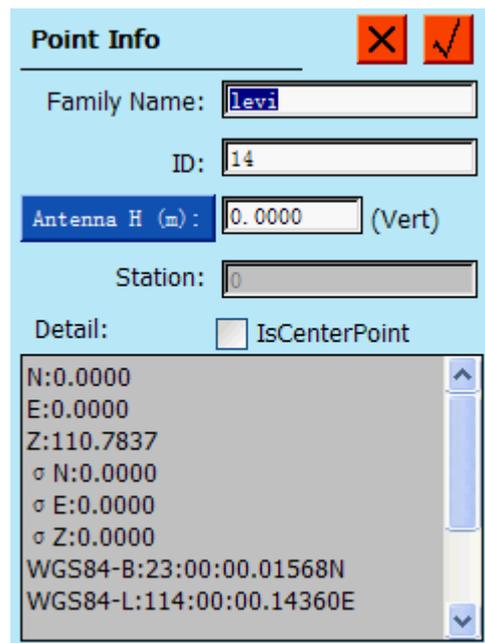


Figure 7-21 Point Info

You can record the point by . After you export all the detail points and process them, you will get the points collection of a certain station.

# Chapter Eight Configuration

## 8.1 Software Config

Configuring the overall software contains whether starting virtual keyboard or shortcut key. “√”stands for starting. See Figure 8-1:

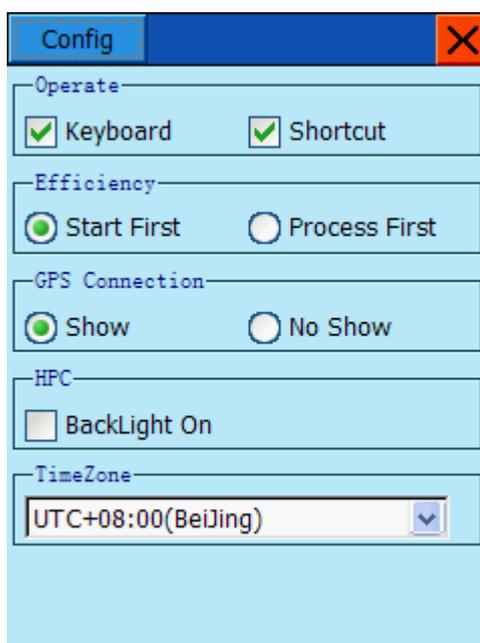


Figure 8-1

## 8.2 Color schemes

You can choose one of the presetting color schemes attached to the system, or modify the interface color element of any one to be what you like.

### 8.2.1 Select from the following list

Select and “Apply”. If you click “Restore”, it will come back to the previous setting.

Four presettings to select: “Ocean” for blue (default), “Nature” for green, “Passion” for red and “Mystery” for amethyst. See Figure 8-2 Select Color Scheme:

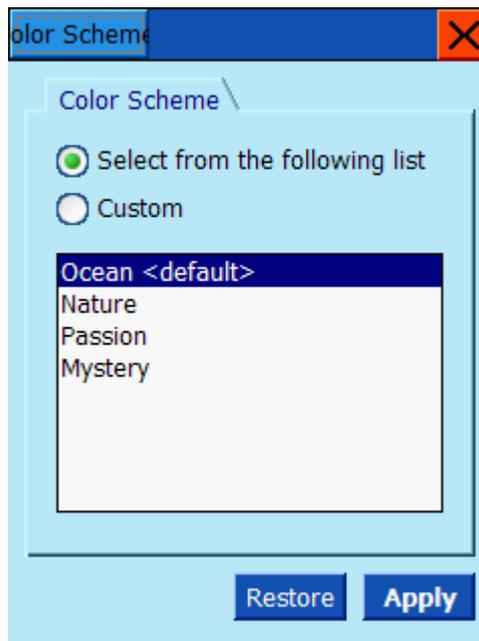


Figure 8-2 select color scheme

### 8.2.2 Custom

Customize your own color scheme.

If you select “Custom”, click “Change color...” to customize the color you want, while you can come back to the previous color scheme with a click on “Restore”. See Figure 8-3:

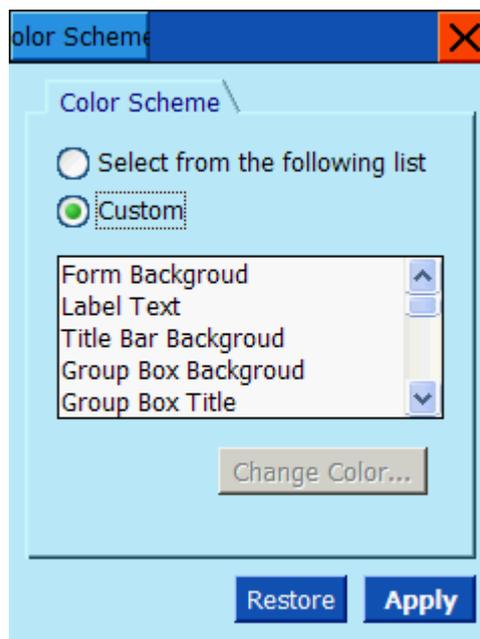


Figure 8-3 custom

When you choose the interface element that you want to modify in the list, the left-down grid will show the present color. See Figure 8-4:

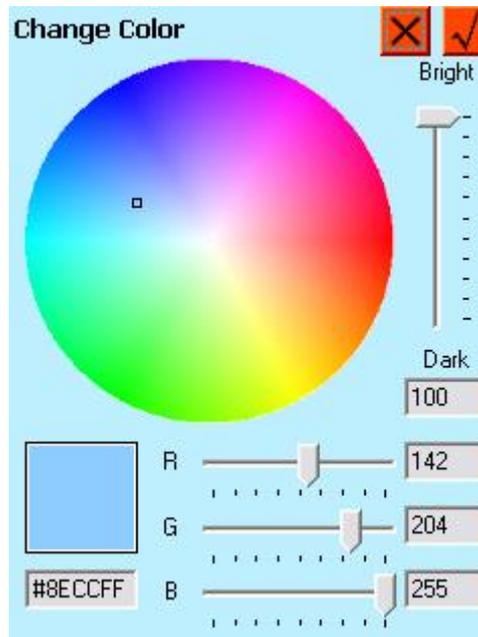


Figure 8-4 select color

The color you choose will show in the left-down grid in real time while its Hexadecimal code will show beside as the same.

When selection finished, confirm the color scheme with  or cancel with .

Attention: two ways to select color:

1. Click on the color wheel. The color in the center of the black grid on the color wheel stands for the color you select. Then change its brightness with the “Bright” slider right-sides of the color wheel. The present brightness shows in the first text box under the “Bright” slider..

**Tips:** The color becomes lighter and lighter till white while the black grid moves from edge to center on the color wheel; The color becomes darker and darker while the slider moves up to down.

2. If you know “RGB”, you can directly move the slider of “Red”, “Green”, “Blue” to create the color you like. The color value shows respectively on the right text box.

**Tips:** The two ways to select color are equivalent. You can see the color value of the “Red”, “Green”, “Blue” will varies with the movement of the

black grid on the color wheel.

### 8.3 Select Controller

Select the style of the controller. You are suggested to select the controller style when start the software, operating as follows:

Click “Apply” (Figure 8-6), and connect the controller and the receiver (Figure 8-7):

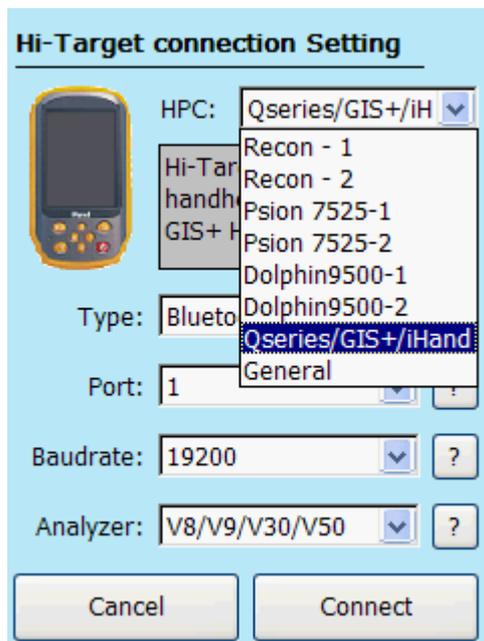


Figure 8-5 Qseries/GIS+iHand

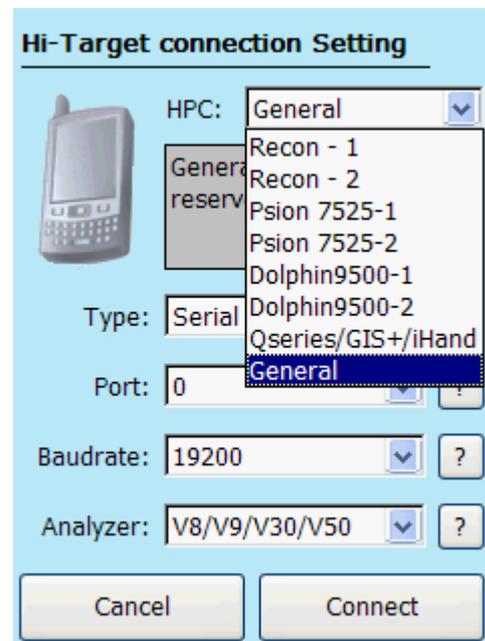


Figure 8-6 general style

#### “HPC Style”

- RECON-1:** Trimble controller (power key on the right side)
- RECON-2:** Trimble controller (power key on the left side)
- Psion 7525-1:** COM1 Bluetooth port, need no searching
- Psion 7525-2:** COM2 Bluetooth port, need searching
- Dolphin9500-1:** standard 9500 controller, connecting with COM5
- Dolphin9500-2:** handheld 9500 Bluetooth V1.1 (default), connecting with COM1 (tips: you can tell HPC style by the label on the back)
- General:** generally style, besides the above

“Apply”: confirm when selection finished

“About”: interface, version, update time

# Chapter Nine Icon Explanation

## 9.1 general icons

 coordinate system: arrowhead direct north; the white side stands for east.

 current location: the black point stands for the center of the current location while the arrowhead for the moving orientation

(PS: maybe the arrowhead's orientation not always keep consistent with the true one for the measuring errors. For the essentiality of orientation in layout measurement, developers have made stable estimation at orientation calculation so as to improve measuring stability. However, the arrowhead orientating will delay a little to show while a sudden turning which is ok.)

 **Scale:** The number on the line stands for the real distance, with meter as the unit, corresponding to the length of the line on the screen. You can get the real distance of any line on the map.

(PS: When click enlarge or decrease, the change of scale is a kind of complicated non-linear transformation, which is an improvement to actual needs made by developers so that you can enjoy viewing the map more smoothly.)

 **Stored points:** The center of the “+” stands for the center of the stored point with the point name upside consisted of prefix “Store” and auto-num “1” and the description downside.

(PS: Showing the point name and notation or not can be set when measuring, so as to improve mapping.)

 **Control point:** triangle



**Stake point:** circle

## 9.2 Button Figure



enlarge



decrease



current location



Full screen



config



point lib.



Intersection



average



record



Auto Record



Stop Auto Record



Show Current Cordinate in BLH



Show Current Cordinate in xyh



Next/Station/Transect



Select points from map to stake



open reference line



close reference line



Next/Station/Transect



Select points from map



collect point by GPS



add



insert



edit



delete



open



save



preview roadline figure: midline, vertical section, transect

## 9.3 Information bar of the current location

BLH model: the coordinate in BLH model is the longitude, latitude, ellipsoidal height and the mean square error of all orientation in the WGS84 coordinate system.

B:022:58:53.908524N	$\sigma$ :1.535
L:113:21:41.838594E	$\sigma$ :1.780
H:45.955	$\sigma$ :4.457

Xyh model: the coordinate in xyh model is the plane coordinate and level height transferred from local coordinate.

x:2542692.495	$\sigma$ :1.518
y:434539.739	$\sigma$ :1.799
h:-61.535	$\sigma$ :4.515

PS: 1.Each value is one time of the mean square error value in each orientation with meter as the unit;

2. You can enter the config interface select the model to show the current points information.

## 9.4 Power bar

Receiver power: the height of the black grid stands for the power status.



For the controller's device system could not get the power status precisely but a rude one as Full, Low, Critical, Charging generally, we express the four different power status with green, yellow, red and orange.



## 9.5 Satellite status bar

Satellite for calculation in satellite status bar



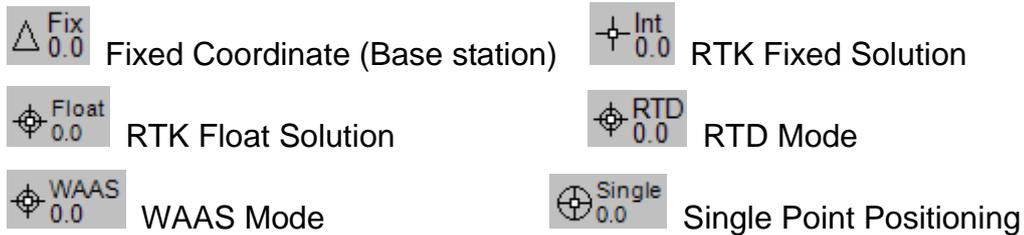
Upside "00-00": the former two figure stand for the number of satellites for calculation (which is the number of shared satellites in RTK model); the latter two stand for the number of the current

satellites.

Downside “0.0”: the PDOP value, to evaluate the influence on the solution quality by satellite distribution. The smaller the value (smaller than 3 stands for the good distribution) is, the better the distribution is.

## 9.5 Solution status/Quality bar

Signal explanation:



**PS:**

1、 in all kinds of mode with any survey technic, coordinate accuracy can be roughly defined as meter level, submeter level, decimeter level, centimeter level. Generally, the accuracy of single point positioning is on meter level; in short baseline positioning of RTK, the accuracy can reach centimeter level; the accuracy of RTD mode and all kinds of Wide Area Differential System (like WAAS/SBAS/DGPS) can be sunmeter or decimeter level; the accuracy of float solution in RTK mode is not good for the bad measurement conditions. So please pay more attention to the solution status (whether integer or not) in RTK difference mode. If the accuracy is always low for a long time, please try to reset antenna or resolve.

2、 Time is needed for the difference data transferred from base station to rover station through data-link. To calculate in real time, we can predict the difference data in some model with certain data. In the theory of mathematics, the extrapolation model always brings errors. And the wider the step of the extrapolation is, the larger the errors are, which is the concept of latency. In this way, **the smaller the latency is, the better the data is.**

## Chapter 10 The introduction of Qmini M

### 10.1 Keyboard

Qmini M series industrial GIS data collector keyboard. The keyboard keys contains: the confirmation button , exit key, F1 function keys, switch machine key and the direction key.



figure 10-1



Exit button: short press it on boot-up state, means to cancel or exit the the current window operation.



Confirm button: ok button.



Function button: function shortcut key. The function is defined by software, please refer to the relevant software instructions.



Switch machine button/backlight control button: long press it for more than 3 seconds to turns on/off it. On boot-up state, hold the button for 1 second, switch on or off the backlight .



Navigation button: move the cursor, to choice the options content.

## 10.2 Switch machine operation

### ◇Boot

In the shutdown state, long press  three seconds, it will boot.



Figure10-2

◇ shutdown

On state, long press  3 seconds, it will tip you to confirm shutdown, click on the "shut down" .



Figure10-3

## 10.3 Data obtain

### 1 install Microsoft ActiveSync

In the incidental CD (tool software \ connection program \ ActiveSync), double click MSASYNC45. exe file, please follow the instructions to complete installation. After the installation, find Microsoft ActiveSync and operate it in the "start menu" "program" .Set up "allows the USB connection" In the menu "connection Settings", as shown :



Figure10-4

## 2 The hardware connection

First, opened Qmini M series industrial GIS data collector, enter the Windows system, it is no need to open applications. Connect the USB port which with a smaller cable line with the industrial GIS plug with your PC. As shown :



Figure10-5

If you have connected them but the computer can't identify, please take the following method to solve:

a: close the USB charging in the power setting model  
 press  to the homepage, select "setting" → "power" → "USB charging", close the control switch of the USB charging.



Figure10-6

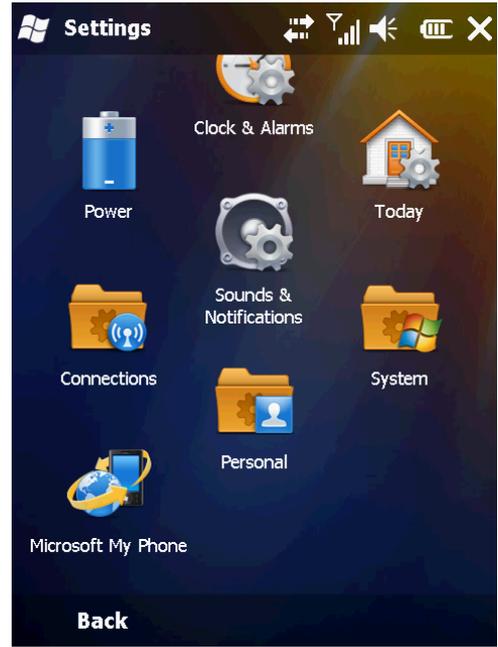


figure10-7



Figure 10-8

## B:To install the driver

Selects "computer" in the computer, choice "management" with the right button, open the "device manager"—" network Adapter ", right-click to uninstall "Microsoft Windows Mobile Remote Adapter". If your system is Windows 7, please don't check "delete this device driver software" .

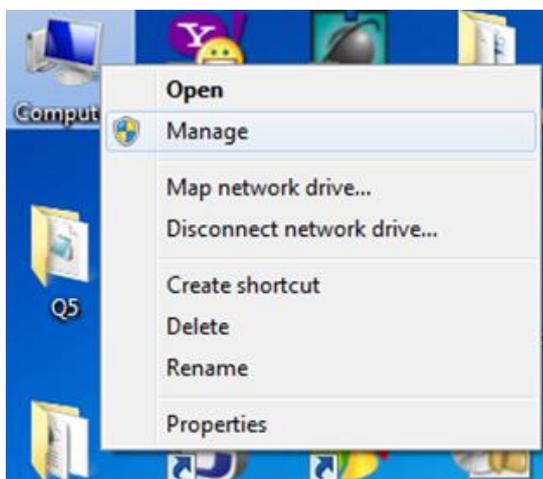


Figure10-9

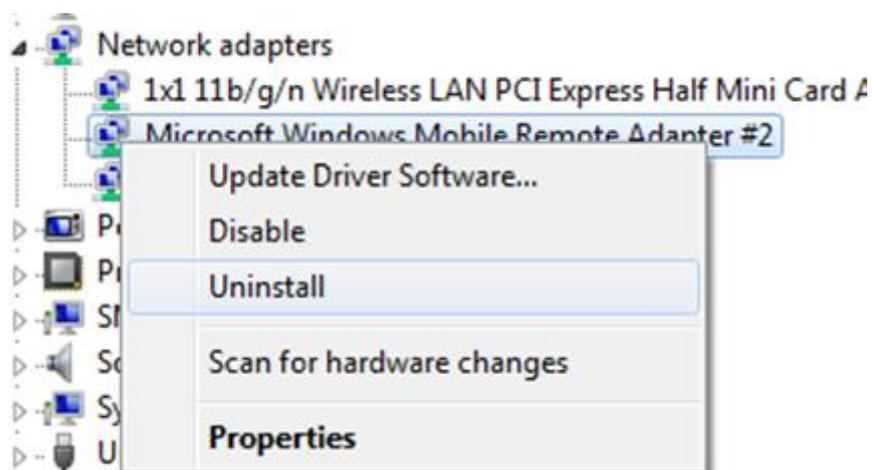


Figure10-10



Figure10-11

Connect the Qmini M series industrial GIS data collector with pc again, if there is a "Windows Mobile member center" registered tip ,please choose "not registered".

### 3 software connection

When the cable is connected ,the Microsoft ActiveSync in the computer will tips you "whether need to establish cooperation relationship," choose "cancel", Then Microsoft ActiveSync popup a hint, click "ok". Then it has been connected successfully. If it is the first connections, the computer will tips you to install the driver,just installed Windows compute driver according to guide,the driver is in " Incidental CD\ driver \ industrial GIS data collector drive " .

### 4 download data

Click on the " browse button" of the the Microsoft ActiveSync,open the resources browser of Qmini series industrial GIS data collector ,as figure 4-23 shows,you can enter the NandFlash index and copy data to the computer.

## Application functions

Qmini M series industrial GIS data collector is equipde with PPP technology (the technology used in Qmini MP model), built-in GPS navigation and positioning, digital camera, microphone, 3 G communications (this function is optional), and other functions, but it must be installed with the corresponding software. Qmini M series industrial GIS data collector is equipped with Hi-Q software,as to how to use Hi-Q software to operate of the application functions above, please refer to my company's "Hi-Q software operation instruction" content.