

## **Hi-Survey Road**

**User Manual** 



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# **Hi-Survey Road**

## **User Manual**



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## Preface

#### Introduction

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

#### **Experience Requirement**

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

#### **Tips for Safe Use**



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

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

#### **Exclusions**

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

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

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

#### **Technology and Service**

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



#### **Relevant Information**

You can obtain this introduction by:

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

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

#### **Advice**

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



## Chapter 1 Software Introduction

#### This chapter contains:

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



#### **1.1 Introduction**

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

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

#### 1.1.1 Hi-Survey Road

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

#### 1.1.2 Road Function

- Support for horizontal-section, vertical-section, cross-section, road-staking, slope-staking and visual cross-section collection.

- Calculate line-staking point in real-time, support for adding stake over any mileage, mileageprojecting in real-time, and displaying the mileage of staking points.

- Direct and convenient guidance method of staking, with line-staking and mid-level measurements working at the same time.

- The horizontal section line supports the common method (intersection, element, coordinate) and can freely define the line of any form. For example: interchange ramp.

- The cross-section earthwork provides two methods: Mean Area method and Prism method to calculate the amount of excavation.

- Supports multiple cross-section grade-change point-setting, the left and right slope can be edited into asymmetric type; it can also edit over-elevation and widening of a slope.

- Supports DTM surface design, DTM surface-staking, and DTM earthwork calculation.

#### **1.2 Features**

#### 1) Easy to Use

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



-Text and Graphic measuring interface in Detail Survey can be chosen by the user;

-Simple design to give a big mapping screen;

-Station option can be one-key set by configuration file;

-The defined coordinate system selected by region, convenient to set coordinate parameters;

-Supports many kinds of angle units, meets the operating habits and demands of business customers: good for globalization.

2) Supports Operating Big Data

-Supports big raster, vector data in .dxf, .td2, .shp format (geodetic coordinate and plan coordinate);

-Raw data and coordinate data saved independently to make sure the data primitiveness and realize post-processing kinematic, it is more flexible in data storing and processing, and the antenna type and height of raw data can be changed, to make sure the data can be recovered (by resetting the coordinate parameters, antenna type, and height);

-More complete antenna parameters management.

3) Fashionable

-The software and receiver firmware check the updates online automatically;

- Hi-Target and profession news is real-time pushed;

-Beautiful and fashionable interface;

-Wonderful and rich visual and touch experience, help make users enjoy working.

#### **1.3 Installation**

#### 1.3.1 Installation

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



Figure 1-3-1 Hi-Survey Road



#### 1.3.2 Starting Interface

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



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

#### **1.3.3 Start Instruction**

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



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



$\leftarrow$   New Prj   System	Option ?	$\leftarrow$  Projection D	atum 🕴 Plar 🕨	?	←   D	evice
Load Coord System		Projection	Guas	s-3 >		
Coordinate System	>					
*Note: A project can only have one set of Frames	work Shifting parameters.	Origin Longitude	000:00:00:00000E		Disc	connect
Framework Shifting		False Northing(m)	0.0		Chec	k Update
Framework Shifting Info	>	False Easting(m)	500000.0		Working Mode:	
Click here to set the coord Framework Calibration (Base Co	dinate system	After setting up, cli settings	ck here to save	the	Connecting equipr	nent to open a survey
Framework Calibration Info	>	Projection Height(m)			Expiration:	
Data Managament	Skip Guide	Lat. of False Origin	oo:oo:oo.ocSkip G	Guide	🛠 Configure	Skip Guide
		Scale Factor	- 0		Method	Bluetooth >
External data management	>					
CodeData Management	>		) Save		Register	🔗 Connect

Figure 1-3-6 Start Instruction3

Figure 1-3-7 Start Instruction4

Figure 1-3-8 Start Instruction5

#### 1.3.4 Main Interface

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

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



Figure 1-3-9 Device-Grid View

Figure 1-3-10 Device-List



←   ∓	Unnamed		←	More		Po	P	<b>D</b> A
(December 1)	Ţ	Coordinate System				O Detail Survey	Mapping Survey	Surface
$\wedge$		Real Calculation	Point Library	Raw Data	Mapping Data	0	0	0
00-00 0.0	O None 0.0	🔡 Data Transfer			8	Stake Points	Stake Line	Elevation
ATT	OTC	Software Settings	Email	Code List	About	1=		Kit
Road Design	Stake Road	Store Cross- section			,		Stake Road	Store Cross-
Po	<u>-</u>	+	Ŷ	Ē			15-10	section
O Detail Survey	Project Settings	More	GNSS Demo Mode	Controller	Additional Settings	Acres 1	Q.	_
				Д	r in the second s	Project	Device Surv	ey COGO

Figure 1-3-11 Device-Simple

Figure 1-3-12 Device-More

Figure 1-3-13 Survey-GridView



Figure 1-3-14 Survey-List

Figure 1-3-15 Survey-Simple

Figure 1-3-16 Survey-More

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



Ø=h	<b>8</b> 234	<u> </u>	← Software	Settings	Module Restore	
O None 0.0 Project Int	o Project Settings	Coordinate System	None 0.0 Keep Screen Light On		Mapping Data	
(Px			Soft Input		Data Transfer	
Paramete Calculatio	rs Point Library	Raw Data	Floating Window		About	
	<u>⊗ ⊙</u>	<mark>⊗</mark>	Time Zone	(UTC+08:00)Beijing >	Code List	
Mapping D	ata Data Transfer	Email	Theme	GridView >	Email	✓
<b>°</b> ⊒	(ā)	⊗ L	Screen Orientation	Portrait >		
			Module Restore	>		
Project	Device Survey	COGO	User Guide	>	✓ Restore	

Figure 1-3-17 Delete

1-3-18 Module Restore

Figure 1-3-19 Select

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

	Name	Туре
ZHD • Project •	🕌 ROAD	File folder

Figure 1-3-20 Project

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

Name	Туре
\mu ext	File folder
🕌 map	File folder
ri GPS.raw	RAW File
GPS.raw.bu	k BAK File
mapping.r	MCP File
C mapping.r	cp.bak BAK File
ZHD > Project > ROAD > Unnamed > PowerFran	e.pfp PFP File
PowerLine	pli PLI File
PowerPoin	selc SELC File
PowerPoin	selc.bak BAK File
SectionFra	ne.pfp PFP File
TSPPoint.s	sp STSP File
TSPPoint.s	sp.bak BAK File
Unnamed.	lam DAM File
Unnamed.	ri PRJ Pile

Figure 1-3-21 Road Work File



#### Notice:

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



Name	Туре
Ps GPS.raw	RAW Fil
MainCst.cst	CST File
mapping.mcp	MCP Fil
Unnamed dam	DAM Fil

#### **1.4 Quick Start**

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

#### 1.4.1 Create a Project

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



Figure 1-4-1 Main Interface

2. Create a new project. Click  $Project \rightarrow Project$  Info to enter the project name and then click OK. Select a code template. If you open the Auto Enter Project Settings switch (which is turned on by



default) in the *Project Settings*  $\rightarrow$  *New Project*, it will automatically jump to the *Project Settings*  $\rightarrow$  *System* interface. If you click the *Skip* button, the software will select the PRESET\_EN template by default.

	<u></u>		← Restore Project Info	? 🛛 ОК	← Restore Project Info	?   ОК
Project Info	Project Settings	Coordinate System	Name test2	×	Name [ff	×
		<b>⊑</b> &∋	test2	CC Report	Template	
Parameters			CoordPoints: 0	>	test2	Report
Calculation	Point Library	Raw Data	StakePoints: 15 ControlPoints: 0	>	CoordPoints: 0	>
			Projection: UTM-ETRS89-Zone 29N	2 🐨	StakePoints: 15	>
Mapping Data	Data Transfer	Email	Time: 2020-02-25 11:57:02 Available SD: 6.42G			Skip
₩ 00-00 No.	one ()	ů	Previous Projects     Sort by	time 🔺	PRESE I_EN	~
Project	Device Survey	cogo	Unnamed test1 test2			

Figure 1-4-2 Project Info

Figure 1-4-3 New Project

Figure 1-4-4 Project Code

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

← Restore Project Info ? OK	← Select Project OK
Name test X	Code List Coordinate Road File
Template >	C Previous Projects
E test2	
CoordPoints: 0	Linnamed test1 test2
StakePoints: 15	
ControlPoints: 0	
Projection: UTM-ETRS89-Zone 29N 🕀 🔀	
Time: 2020-02-25 11:57:02	
Available SD: 6.35G	
O Previous Projects Sort by time ▲	
Figure 1-4-5 Template1	Figure 1-4-6 Template2

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



← New Prj System Option		Datum Pla	an 🕨		Datum	Plan 🕨
🗠 Load Coord System 🧼 🔡 🕀	Projection	Guass	-3 >	Source Ellipsoid	WGS 1984	
Coordinate System >	Origin Longitude	000:00:00.00000E	<	a(m):	6378137.0	
Note: A project can only have one set of Framework Shifting      Framework Shifting	False Northing(m)	0.0		1/f:	298.2572236	
Framework Shifting Info	False Easting(m)	500000.0		Local Ellipsoid	WGS 1984	•
Framework Calibration	Projection Height(m)	0.0		a(m):	6378137.0	
Framework Calibration Info	Lat. of False Origin	00:00:00.00000N		1/f:	298.2572236	
🧱 Data Management	Scolo Factor	10		Model		None >
External data management >		3 Save			🖾 Save	

Figure 1-4-7 Coordinate System

Figure 1-4-8 Projection

Figure 1-4-9 Datum

#### 1.4.2 Set the Base

1. Connect the device, click  $Device \rightarrow Device Connection \rightarrow Connect$  to select the serial number of the base station for Bluetooth connection.



Figure 1-4-10 Device

Figure 1-4-11 Connect



← Bluetooth Connect	← Device
Status:	
Bluetooth	
11014696 >	
11620994 >	11014696
11800952	Check Update
11007946	Working Mode: Base Mode
11620981 >	Receiver FW: 4.3 V60 Receiver Expiration: 2018-06-15
11800547 >	🛠 Configure
018670052	A Diversion Anticest A Diversion Anticest A Diversion Anticest A Diversion A
13670056 >	Register      Disconnect

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

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

-Set the base location.

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

←	Set Base	Set	$\leftarrow \mid$	Set	Base	Set
◯ Set by	average	Set by point	Position			:==
Save	Pos		в	22:58:53.76	211 <b>N</b>	$\times$
Name	B121916		L	113:21:41.7	0154E	
_↓IaRJ&EM	1.5000	Vertical(V)	н	49.3212		
Position		<b>I</b>	() N	EZ	BLH	1
в	22:58:52.04007N		Correction	п Туре	R	TCM(3.2) >
L	113:21:38.61676E		Elevation	Mask(<=30°)	10	
н	45.4120		DataLink SDGPS 	le to transmit so	Exter	rnal Radio >
Temp	olate 💾 Save	Generate	Temp	late 🛄	Save	generate

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

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



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

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

←   Set	Base	Set	$\leftarrow$	Set E	Base	Set
● Set by average 🚺	Times OSet	by point	<ul> <li>Set by aver</li> </ul>	age 🏼 🗲	Times	O Set by point
Save Pos			Save Pos			
Correction Type	RTCM(	3.2) >	Name	B121514		
Electrision Mask(<=30°)	10		Target H	1.5000		Vertical(V)
DataLink	External Ra	adio >	Correction Ty	pe		RTCM(3.2) >
*Note: Unable to transmit so please try 19200 link rate or e	much data under 9600 l enable 3 constellations a	ink rate, at most	Elevation Mas	sk(<=30°)	10	
			DataLink		Ex	ernal Radio >
Advance	Config ►		Oles by 19700	transmit so n ink rate or en	nuch data ur able 3 const	der 9600 link rate, ellations at most
📩 Template 🔛	Save Ge	enerate	Template		Save	generate

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

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

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

$\leftarrow$	Set Base	Set	$\leftarrow$	Set B	ase Set
Name	B121514		Name	B121514	
Target H	1.5000	Vertical(V)	Target H	1.5000	Vertical(V)
	pe	RTCM(3.2) >		pe	RTCM(3.2) >
Elevation Ma	sk(<=30°) 10		Elevation Ma	isk(<=30°)	10
DataLink	h	nternal UHF $>$	DataLink		Internal UHF $\geq$
Protocol	HI-TAI	RGET19200 >	Protocol		HI-TARGET19200 >
Channel 1	00		Internal UHF		~
	Advance Config ►		Internal GSM	1	
Template	e 💾 Save	generate	External Rad	io	

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



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

$\leftarrow$	Set Base	Set
DataLink	Inter	nal UHF $>$
Protocol	HI-TARGE	T19200 >
	dvance Config ▼	
Pos Frequency		1HZ >
Store GNSS Raw		
Power		Low >
Frequency List		>
Template	Save	generate



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

#### **Base position**

#### Datalink

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

-Internal UHF: built-in radio.

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

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



÷	Set I	Base Set				
Name	B121514	J				
Target H	1.5000	Vertical(V)				
	pe	RTCM(3.2) >				
Elevation Mas	ik(<=30°)	10				
DataLink		Internal UHF >				
Protocol		HI-TARGET19200 >				
Channel 1	00	)				
Advance Config ►						
Template Save 🙀 generate						

Figure 1-4-21 Settings of Base

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

#### **Parameter settings**

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

←	Set Base	Set	÷	Set Base	Set
Name	B121514		DataLink	Inte	rnal UHF >
Target H	1.5000	Vertical(V)	Protocol	HI-TARGE	ET19200 >
Correstion ∲ 4.0	Type	RTCM(3.2) >	୍ର Chନ୍ତାର୍ଥ୍ୟର୍କ୍ତ ବ୍ୟୁ ପର୍ ତ୍ୟୁ - <mark>7.0</mark>	D	
Elevation	Mask(<=30°) 10			Advance Config 🔻	
DataLink		Internal UHF $>$	Pos Frequency		1HZ >
Protocol	HI-T	ARGET19200 >	Store GNSS Ray	w	
Channel	100		Power		Low >
	Advance Config ►		Frequency List		>
Templ	late 💾 Save	generate	Template	Save 🔤	generate

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





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

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



Figure 1-4-24 Set Prompt

#### 1.4.3 Set the Rover

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



$\leftarrow$	Set Rover Set
Elevation Ma	sk(<=30°) 10
DataLink	Internal UHF $\geq$
- @rstoccol	HI-TARGET19200 >
Channel	×
	Advance Config ►
Template	Save scan

Figure 1-4-25 Set Rover

#### **1.4.4 Parameter Calculation**

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

	<u></u>		←   co	oord Point	Stake Point	ontrol Point	$\leftarrow$	Edit Contro	l Point
Project Info	Project Settings	Coordinate System	Name	•	н	Code	From		🚸 🗐 🔞
		F A B	B032009	:41.85071E	52.3152	set_base	Name	B91314	
Parameters Calculation	Point Library	Raw Data					N	91314.3806	
							E	81924.3682	
Mapping Data	Data Transfer	Email				🔇 Set	Z	8.5000	
NA 00-11 Au	• <b>•</b>	ů			-	Batch	Code	guardrail	•
0.0 00 0.0							Туре	NEZ	O BLH
= Project	Device Survey	y COGO	+ Add	C Oper	n 📿 Search	More	$\otimes$	Cancel	🕢 ок

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

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





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

←	Points Info Save	←   Plan	e + Height Fitting
Ø Source	e 🚸 🔄 🕅	Result	
Pt Name	Z	DN(m)	-80261.4610179766
N	3669852.235	DE(m)	-270009.961493787
E	6525532.369	Rotation	005:20:12.78534
z	8.5	Scale(K)	1.05287478387132
ОВ	LH	Max HRms	0.000000 (pt99)
O Local	<b>E</b>		
N	81221.89	🛞 Cance	l 🕢 Apply

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

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

#### 1.4.5 Detail Survey

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





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

#### 1.4.6 Stake Out

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

In the process of staking-out, you can also collect detail points, by the *Store*  $\[mathbb{T}\]$  on the interface or store key on the controller.



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





#### 1.4.7 Data Transfer

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



Figure1-4-37 Data Transfer

Figure 1-4-38 Export

←   Set Custom	Format OK	$\leftarrow$	Template Manager	$\leftarrow \mid s$	Set Add Te	emplate	ок
Template No	ne > Template Manager	Name	Selected Fields	Name	•		X
Export Content				Export	t Content		
id,Name,N,E,Z,B,L,H,Slope N B,Slope L,Slope H,AntH,σN, H,AntH Pos,Antenna Type,A	N,Slope E,Slope Z,Slope ØE,HRMS,ØZ,Target Ave			id,Nam B,Slope H,AntH	e,N,E,Z,B,L,H,Slope N L,Slope H,AntH,σN,o Pos,Antenna Type,A	,Slope E,Slope Z,Sloj E,HRMS,σZ,Target ve	pe 🛙
Supported Fields Selected Fields				Suppo	orted Fields	Selected Fields	
id	id			id		id	
Name Name				Name		Name	
N	Ν			Ν		N	
E	E			Е		E	
🔟 Delete 🔺	Up 🔹 Down		(+) Add	1	Delete 🔺	Up 🔻	Down

1-4-39 Custom Format

Figure 1-4-40 Template Manager

Figure 1-4-41 Add Template



#### 1.4.8 Connect the Controller to Download Data

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



Figure 1-4-42 Transfer by USB

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



Figure 1-4-43 Result

#### **1.5 General Collection**

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



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

Button 1:	🔍 Zoom In	Button 2: 🤤 Zoom Out
Button 3:	Soom center	Button 4: 🕙 Zoom All
Button 5:	Culture Create	Button 6: 🖻 Auto Collection
Button 7:	Rverage Survey	Button 8: 🌌 Indirect Survey
Button *:	Open the configure	Button Shift: text-map

#### 1.5.1 Average

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

←   Gra	oh Average	Configure	Text Average Configur     e
N:200260 E:193676 Z:44.6331	38.7333 σ: 13.8890 σ: I σ:	0.0092	
Name	Ν	E	
1	20026038.7187	19367613.9093	
2	20026038.7219	19367613.9050	æ
3	20026038.7252	19367613.9006	Q
4	20026038.7286	19367613.8960	
5	20026038.7319	19367613.8914	*
6	20026038 7352	19367613 8867	Unable to start average due to low status 16m
€	Start	🕢 ок	Start OK

Figure 1-5-1 Average Text

Figure 1-5-2 Average Graph



$\leftarrow$	Average		$\leftarrow$	Average
Average	e Method	Average $>$	Average Method	Average >
Status		Fix >	Status	Fix >
Ave Tim	nes 10		Ave Times	10
Ave Pre	cision		Ave Precision	
σN	0.0200		Average	×
σE	0.0200	Auto 0.0	Weighted Averag	e O Auto
σZ	0.0300		Window Average	
			Median Filter	

Figure 1-5-3 Average Parameters

Figure 1-5-4 Average Method

#### 1.5.2 Select Point from Library

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

←   Coord Point   Stake Point   Control Point						
Name	Ν	E 🕨				
B032009	2542671.2195	434514.6301				
Z20	2542673.6607	434514.6205				
B032109	2542671.2195	434514.6301				
B032109_1	2542674.7322	434516.1693				
B032109_2	2542674.7504	434516.1495				
B20511	2542671.2195	434514.6301				
Q Search 🔯 Set						

Figure 1-5-5 Coord Point

#### 1.5.3 Select Point on Map

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





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

#### 1.5.4 Real-Time Collection

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

←∣	Device	ок
00-1 1.4	<sup>8</sup> $\bigoplus$ <sup>Auto</sup> $\bigoplus$ $\underbrace{\blacksquare}_{54\%}$	
N: 200	26032.8393	σ: 1.0740
E: 1930	57602.5355	σ: 1.1770
Z: 47.7	508	σ: 2.5960
Target	H 2.0000	Pole(P)
A	/erage	
🗹 Sa	ave to the point library	
Name	Z6	×
Code		- 🔮 🙆

Figure 1-5-9 Real-Time Collection

#### Notice:



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

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





## **Project**

#### This chapter contains:

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


# 2.1 Project Info

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

	<u></u>		←   Restore Project Info   ?   OK
Project Info	Project Settings	Coordinate System	Name 0227 X
$(\mathcal{P})$			D227
HTX'			CoordPoints: 5
Parameters Calculation	Point Library	Raw Data	StakePoints: 0 >
			ControlPoints: 4
			Projection: China-2000 Zone3 38 🕀 😭
Manaina Data	Dete Transfer	[mail	Time: 2020-02-29 14:30:15
Mapping Data	Data Transfer	Email	Available SD: 6.33G
No No	ne (2)	ĩ	Orevious Projects     Sort by time ▲
Ĕ	® X		
Project	Device Survey	COGO	test1 test2 ff t

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

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

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

←   Restore Project Info   ?   0	$\leftarrow \mid \text{Restore} \qquad \text{Project Info} \qquad \mid ? \mid \text{OK}$
Name test X	Name test X
Template	Template
test2	rt test2
Sort by name	Sort by name ▼
Sort by name ▼	Sort by time A
Sort by time 🔺	
Sort by time 🔻	Sort by time V
Sort by flie size ▲	_ Sort by flie size ▲
	Sort by flie size ▼

Figure 2-1-3 Project Sort1

Figure 2-1-4 Project Sort2



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

←   Restore	Project Info	← Attr	ibute OK	$\leftarrow$		Å	Add At	tribut	e		ОК
🔚 Current Project		Attribute Name	Attribute Value	Attri	bute Na	me l	ĸk				
Name:	ZHD	kk	0924				1				
CoordPoints:	1	zd	0924	Attri	bute Va	lue	0924				×
Projection:	WGS84										
Time:	2018-03-20 09:56:26										
Available SD:	1.20G			Jı.	Æ		ናጉ			0	$\odot$
Repeat PtName:	Support			0			U			~	0
() Previous Pro	ojects			1	2	3	+		@ 。	\$ €	( )
				4	5	6		/			: , # ,
Unnamed Un	named_1 1ae 102A179			7	8	9			!	?	
🔟 Delete 🥡 Attribute 🏱 Open		÷	Add	abc	0				Ŷ	1/2	Done

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

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

← Restore Project Info	← Restore Project Info
🔄 Current Project 🔀	🔚 Current Project
Name: ZHD CoordPoints: 1	Name: ZHD CoordPoints: 1
Projection: WGS84 Time: 2018-03-20 09:56:26 Available SD: 1.20G	Providence of Delete Think Are you sure to delete 1ae? Available
Repeat PtName: Support	Previous Projects
Unnamed Unnamed_1 1ae 102A179	Unnamed Unnamed_1 lae 102A179
🔟 Delete 🪺 Attribute 🏳 Open	Delete (i) Attribute 🗁 Open

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

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





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



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

← Restore Project Data				
Auto backup				
Data backup directory /storage	>			
E Project List				
20180324 201803241 a	al			
Start Restore				

Figure 2-1-12 Select All or Cancel All

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



← Restore Project Info 0	K Restore Project Data
C Previous Projects	Auto backup
	Data backup directory /storage >
Unnamed 123 14528 145554	🖹 Project List
Unnamed_1 1234 666 20180324	20180324 201803241 a a1
a a_1 aa	aa
Name: a	Start Restore

Figure 2-1-13 Same Name

Figure 2-1-14 the Recovered File

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

$\leftarrow \mid$ Restore	Project Info	ОК	$\leftarrow  $	Export	ОК
Current Proj	ect		/stora	ge/sdcard0/ZHD/Out	
Name: CoordPoints: Projection: Time: Available SD: Repeat PtName:	ZHD 1 WGS84 2018-03-20 10:53:33 1.19G Support			txt_022413 zdytxt_030 .txt 715.txt	
Project Report(*.	txt)	~			
Project Report(*.	html)		1001		X
MappingPoint Re	eport(*.html)		Project Rep	port(*.txt)	>

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





# 2.2 Project Settings

#### 2.2.1 New Project



Figure 2-2-1 New Project

-Auto Enter Project Settings: After opening, it will automatically go to *Project Settings*, and show the *System* interface to set coordinates.

-Use Last Localization Params: After opening, the current project will use the same coordinate parameters as the last project (including the transformation model and parameters of plane conversion and elevation fitting).

-Use Last Control Point File: After opening, the control point of the last project will be copied to the current project.

-Define Project Attributes: Set the note of a new project. It will automatically go to the attributeinputting interface to edit the corresponding attribute, after defining the project's attribute.

## 2.2.2 System

In *System* interface, coordinate system parameters can be set with the dam file, QR code or in *Coord Sys Management*. If coordinate parameters are changed, the coordinate point library will be updated too.

Project coordinate parameters include *Coordinate System, Framework Shifting, Framework Shifting Info, Framework Calibration,* and *Framework Calibration Info. Data Management* is used for external data management.



← New Prj   System   Option	←   New Prj   System   Option			
🖄 Load Coord System	🗠 Load Coord System			
Coordinate System	Coordinate System			
*Note: A project can only have one set of Framework Shifting parameters.	*Note: A project can only have one set of Framework Shifting parameters.			
Framework Shifting	Framework Shifting			
Framework Shifting Info	Framework Shifting Info			
Framework Calibration	Framework Calibration			
Framework Calibration Info >	Framework Calibration Info			
🧱 Data Management	🧱 Data Management			
External data management >	External data management			

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

#### 1. Coordinate Parameters - Dam File Loading

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

←	Select o	lam File	ОК
/storage/	/sdcard0/ZHI	D/Project/RO	AD/zzz
	map	ext	zzz.dam
dam File(*.dar	n)		>

Figure 2-2-4 Add Dam File

#### 2. Coordinate Parameters - QR Code

In the *Project Settings*  $\rightarrow$  *System* interface, click  $\frac{1}{20}$  to enter the QR code scanning interface, to get coordinate parameters from the QR code, and then create, Encrypt, share and Save the QR code.





Figure 2-2-5 Scan QR Code

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

- Encrypt: The user can choose to encrypt the coordinate parameters first, and then re-generate the QR code; the encrypted QR code can be shared and saved; encrypted parameters are not visible and cannot be edited, only called.

- Share: The QR code can be shared by third-party software to other customers;

- Save: The QR code can be saved as a picture in the controller. If there is a file with the same name under the save path, you can tick the coverage or enter a new filename.



Figure 2-2-6 QR Code Figure 2-2-7 Encrypt





Figure 2-2-8 Share



Quert None 0.0 New Prj   System   Option	← Projection   Datum   Plan ►
🖄 Load Coord System 🛛 🐼 🔛	Projection Transverse >
Coordinate System	Origin Longitude
F The QR Code has been	False Northing(m)
password!	False Easting(m)
Framework Calibration	Lat. of False Origin
Framework Calibration Info	Scale Factor
📰 Data Management	Zopat
External data management	💾 Save

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

## 3. Coordinate Parameters - Coord Sys Management



←   New Prj   System   Option			
🗠 Load Coord System 🧼 🞇 🤅			
Coordinate System	>		
*Note: A project can only have one set of Framework Shifting parameter	rs.		
Framework Shifting			
Framework Shifting Info			
Framework Calibration			
Framework Calibration Info	>		
Data Management			
External data management	>		

Figure 2-2-12 Coord Sys Management

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

← Coord Sys Management Apply	← Coord Sys Management
E Predefined List	Continent Eastern Asia >
BJ54	Country China >
Korea-GRS80 125N	🗐 China-2000 Zone3 25
UTM-Kertau -Zone 48N	🖹 China-2000 Zone3 26
China-2000 Zone3 37	🖹 China-2000 Zone3 27
China-2000 Zone3 38	E) China-2000 Zone3 28
TaiWan-UTM-WGS84 Zone 51N	🖹 China-2000 Zone3 29
+ Predefined + User Defined	Q Search

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

- Pre-defined: Support for loading the Pre-defined coordinate systems, which are classified by continent and country, for convenient selection.

- User Defined: Add User Defined coordinate system according to the local situation.



← Coord Sys Management Apply	$\leftarrow$ Coord Sys Management Apply
E Predefined List	Predefined List
BJ54	BJ54
Korea-GRS80 125N	Koree-ORS80 125N Apply
UTM-Kertau -Zone 48N	Apply system BJ54 to project?
China-2000 Zone3 37	China-200 Cancel 37 OK
China-2000 Zone3 38	China-2000 Zone3 38
TaiWan-UTM-WGS84 Zone 51N	TaiWan-UTM-WGS84 Zone 51N
🔟 Delete 🖉 Edit	Edit

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

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

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

#### 4. Coordinate System

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

$\leftarrow$   New Prj   System	Option
Load Coord System	🔎 🔡 🕀
Coordinate System	
Fi Whether to update the para corresponding projection?	meters to the
Cancel	ок
Framework Calibration Info	
📰 Data Management	
External data management	

Figure 2-2-17 Warning



## 5. Framework Shifting

For computing the horizontal and vertical translation between two coordinate systems.

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

#### Compute

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

First: Users need to obtain the source point (the current point) coordinates.

Second: and the coordinates of the known point first. The known point can be input directly or selected from the library.

The source point can be got from average collection  $\mathbb{M}$ , real-time collection  $\circledast$ , library  $\mathbb{H}$ , and map  $\mathbb{N}$ .

←   Ante	nna F. Shi	ifting	ОК	←   Ante	nna F. Shi	ifting OK
Cor	npute	Result		Cor	npute	Result
Ø Sour	ce	r 🚸 🗐		Translatio	n(M)	
Ν	2542671.2378			dN	0.0183	
E	434514.6103			dE	-0.0198	
z	63.5724		×	dZ	0.0298	
	O BLH	NEZ	Fix Pos	Current		Fix Pos
💮 Know	'n	Ζ		N	2542671.2195	
	, , , , , Co	ompute		📩 Loa	ad 🛄 S	ave as 🗹 Apply

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

#### Result

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

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



← New Prj System	Optic	'n	
t∠ Load Coord System	$\swarrow$		€
Coordinate System			>
*Note: A project can only have one set of Frame	work Shift	ing param	eters.
Framework Shifting			
Framework Shifting Info			>
Framework Calibration		(	
Framework Calibration Info			>
🧱 Data Management			
External data management			>

Figure 2-2-20 Framework Shifting

#### 6. Framework Calibration

This is for computing the horizontal and vertical translation between two coordinate systems, generally used for situations as below:

Only one BJ-54, XIAN-80 point or only one point of a coordinate system which is a little rotated from WGS-84. Set the Base, then take the Rover to a known point, click *Framework Calibration*  $\rightarrow$  *Compute*, collect the NEZ coordinate, input the known point, click Compute to get the Correction dN, dE, dZ of the known point and source point, press *Apply* to apply the parameters and the collected points will be corrected to the coordinate system of the known point.

You created a project, it worked, but you don't want to set the base at the same place, so now you can set the base at any place, by using the *Framework Calibration* function. Open the first-used project to a known point to correct the coordinates. The correction method is the same as the first situation.

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



←   Anten	nna F. Calibration OK	K ( $\leftarrow$   Antenna F. Calibration   OK ( $\leftarrow$   Antenna F. Calibration   OK			
Com	apute Result	Compute	Result	Compute Result	
Z	63.5724	Correcting amount(M)	Manual Entry	dZ 0.0298	
N	2542671.2195	dE -0.0198		O BLH O NEZ	
E	434514.6301	dZ 0.0298		N 2542671.2011	
z	63.5426	O BLH	NEZ	E 434514.6499	
0	BLH	Current	,	Z 63.5128	
	Compute Load Save as Apply Load Save as			📩 Load 🖾 Save as 🗹 Apply	

Figure 2-2-21 Compute



Figure 2-2-23 Result2

- Apply: Apply the calculated correction to the project.

- OK: Select Apply after computing, and click *OK* to apply the framework calculation parameters (notice: it is different from the OK that appears after pressing the return key).

- Cancel/OK: Select *Apply*, and click the return key to pop up the prompt dialog, click *Cancel* to return the framework calculation parameters; click *OK* to give up modifying the parameters.

- Load: Load the stored parameters.

- Save as: Store the calculated calibration parameters.

The calculated calibration parameters can be selected in the *Project Settings*  $\rightarrow$  *System* interface.

← New Prj System	Optio	n	
🗠 Load Coord System			€
Coordinate System			>
*Note: A project can only have one set of Frame	work Shift	ing param	eters.
Framework Shifting			
Framework Shifting Info			>
Framework Calibration			
Framework Calibration Info			>
Data Management			
External data management			>

Figure 2-2-24 Framework Calibration

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



#### 7. External Data Management

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

← New Prj System Option	← External data management
🗠 Load Coord System 🥢 🔡 😭	External Layer List
Coordinate System >	V dxf_sample2010_arc.td2
•Note: A project can only have one set of Framework Shifting parameters.	<pre>dxf_sample2010_circle.td2</pre>
Framework Shifting	V dxf_sample2010_line.td2
Framework Shifting Info	<pre>dxf_sample2010_lwpolyline.td2</pre>
Framework Calibration	<pre>dxf_sample2010_mtext.td2</pre>
Framework Calibration Info	<pre>dxf_sample2010_points.td2</pre>
🧱 Data Management	<pre>dxf_sample2010_polyline.td2</pre>
External data management >	(+) Add

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



Figure 2-2-27 Add External Data

Figure 2-2-28 Edit External Data



## Notice:



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



Figure 2-2-29 Display External Data

#### 8. GIS Map Data Management

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

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

$\leftarrow$ External data management		<del>~</del>	Add Exter	nal Data	ОК
External Layer List					
		/storage/emula	ated/0/ZHD		
			Font	Out	Project
DXF File(.dxf)		Dic	GeoPath	LOG	Download
Layer File(.td2)	_	Sounds	Firmware	llser	Template
NEZ Shpfile(*.shp)			Package	000	Template
KML File(.kml)	_	DXF File(.dxf)	Code		>
1					

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



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

←   v	VebMap Service Manager	Restore	$\leftarrow  $	WebMap Service Manager
WebMap Servi	ce Manager	=	WebMap Serv	ice Manager
Alias			Alias	
Map Url		×	Map Url	
Server Type	WMS	>	Server Type	WMS
			WMS	_
			WMTS	
	🕢 ок			

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

#### 9. Code Data Management

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

← New Prj System Option	?	←	Point Line	Polygon	Group
🗠 Load Coord System 🔤 🖁		Desc	Code	Color	Style
Coordinate System	>	tree	1		$\odot$
"Note: A project can only have one set of Framework Shifting	g parameters.				
Framework Shifting		O None 0.0			
Framework Shifting Info	>				
Framework Calibration (Base Correction					
Framework Calibration Info	>				
🧱 Data Management					
External data management					
External Gata Management		Group		无	;分组 >
CodeData Management	>	(+) Add	i 🖉 Edit	🔟 Delete 🔽	SExport

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

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

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



ок

← Code Info	← Style Set
Desc	
Code	
Group 无分组 >	
Type Point	
Style 💿	Style 💿
	Size
🗙 Cancel 🔗 OK	
Figure 2-2-36 Code Info1	Figure 2-2-37 Code Info2
← Style Selection 0	Code Info
⊙ ⊕ ☺ ▲	Desc tree
$\land \nabla \diamond \Theta$	



Figure 2-2-38 Code Style

Figure 2-2-39 Code Info3

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



$\leftarrow$	Code Info	
Desc	tree	]
Code	1	]
Group		无分组 >
Туре	Point	
Style	$\odot$	
$\otimes$	Cancel	🕗 ок

Figure 2-2-40 Code Info4

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



Figure 2-2-41 Code Delete

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



 $\times$ 

III Delete

ж

← Group Mana	ige	$\leftarrow$	Group Manage
无分组			None Group
水系设施			
土质			
居民地			New Group
管线设施		Nomo	
电力设施		Name	·
军事设施		Car	ncel
道路设施			
独立树			
工矿设施			
公井设施			
+ Add 🖉 Edit	Delete	(+) Add	🖉 Edit

Figure 2-2-42 Group Manage1





Figure 2-2-44 Group Manage3

Figure 2-2-45 Group Manage4

#### 2.2.3 Option

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



Angle     DMS >       Distance     m >       Apply Unit to Data Output     Image: Comparison of the comp	n
Distance     m >       Apply Unit to Data Output     □       Time Stamp     □       Store GNSS Precision     □       Auto Load Last Road File     □	DMS >
Apply Unit to Data Output       Time Stamp       Store GNSS Precision       Auto Load Last Road File	m >
Time Stamp       Store GNSS Precision       Auto Load Last Road File	
Store GNSS Precision	
Auto Load Last Road File	

Figure 2-2-46 Option

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

## 2.3 Coordinate System

There are 3 methods to get into the coordinate system setting interface:

- 1. Main Interface Project → Coordinate System;
- 2. Main Interface Project  $\rightarrow$  Project Settings  $\rightarrow$  System  $\rightarrow$  Coordinate System;

3. Main Interface  $Project \rightarrow Project$  Settings  $\rightarrow$  System  $\rightarrow$  Coord Sys Management, long press the Coordinate system on the list to edit and enter the interface. Click Save after setting all the parameters, the system will prompt whether to update the parameters to the corresponding projection list, click OK to finish setting parameters.

←   New Prj   System   Option	$\leftarrow$   Projection	Datum F	Plan 🕨		<u></u>	
🗠 Load Coord System 🧼 🎇 🕀	Projection	Gua	ss-3 >	Project Info	Project Settings	Coordinate System
Coordinate System >	Origin Longitude	000:00:00.00000E	<		Ð	
Framework Shifting	False Northing(m)	0.1		Calculation	Warning	Raw Data
Framework Shifting Info	False Easting(m)	500000.0			to update the para esponding projection	on?
Framework Calibration	Projection Height(m)	0.¢	×	Norphic Car		ок
Framework Calibration Info	Lat. of False Origin	00:00:00.00000N		Email	Project Config	Code List
🧱 Data Management	Scale Faster	10				Code Liat
External data management >	acare ractor	Save		Project	P X Device Surv	ey COGO

Figure 2-3-1 System

Figure 2-3-2 Projection

Figure 2-3-3 Save





## Notice:

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

## 2.3.1 Projection

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

←   Projection	Datum Plan 🕨		Datum Plan 🕨
Projection	Guass-3 >	False Easting(m)	500000.0
Origin Longitude	000:00:00.00000E	Projection Height(m)	0.0
False Northing(m)	0.1	Lat. of False Origin	00:00:00.00000N
False Easting(m)	500000.0	Scale Factor	1.0
Projection Height(m)	0.0 🗙	Zone+	
Lat. of False Origin	00:00:00.00000N	X->North	
Scale Factor	1.0	Y->East	
E	Save	e	3 Save

Figure 2-3-4 Obtain Origin Longitude

Figure 2-3-5 Other Parameters



## Notice:

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

## 2.3.2 Datum

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



←   Projection	Datum	Plan 🕨	←   Projection   Datum   Plan ►
Source Ellipsoid	WGS 1984	Ψ.	Source Ellipsoid WGS 1984 👻
a(m):	6378137.0		a(m): 6378137.0
1/f:	298.2572236		1/f: 298.2572236
Local Ellipsoid	Krassovsky 1940	*	Bursa-Wolf Transformation
a(m):	6378245.0		Molodensky
1/f:	298.3		One-touch
Model		None >	Polynomial Regression
	Save		Ten Params

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

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

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

- Local Ellipsoid: Local used ellipsoid.



### Notice:

1. Customize the ellipsoid:

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



←   Projection	Datum	Plan 🕨	←   Projection	Datum	Plan 🕨
Source Ellipsoid	WGS 1984	*	Source Ellipsoid	WGS 1984	•
a(m):	6378137.0		a(m):	6378137.0	
1/f:	298.2572236		1/f:	298.2572236	
Local Ellipsoid	Krassovsky 1940	~	Local Ellipsoid	Krassovsky 1940	•
a(m):	6378245.0		a(m):	6378245.0	
1/f:	298.3		1/f:	298.3	
Model		None >	Model		None >
	Save Save			Save Save	

Figure 2-3-8 Datum-Source Ellipsoid Figure 2-3-9 Datum-Local Ellipsoid

#### 1. Bursa-Wolf

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

#### 2. Molodensky

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

#### 3. Polynomial Regression

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

## 2.3.3 Plan

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



← I ◀ Datum	Plan	Height 🕨				
Model		TGO >				
DN(m)	0.0					
DE(m)	0.0					
None						
2D Helmert						
TGO	тбо 🗸					
Planar Transformation Grid						
FreeSurvey						
Polynomial Fittin	g					

Figure 2-3-10 Plan Method

#### 1. 2D Helmert

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

← I ◀ Datum	Plan	Height 🕨
Model		2D Helmert >
DN(m)	0.0	
DE(m)	0.0	
Rotation	000:00:00.0000	J
Scale(K)	0.0	
	Compute	
	🕒 Save	

Figure 2-3-11 Plan Configure

#### 2. TGO

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

#### 3. Planar Transformation Grid

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

#### 4. FreeSurvey

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



#### 5. Polynomial Fitting

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

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

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

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

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

#### 2.3.4 Height

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

- 1. Mathematical Models
- Constant Vertical Offset: Translation needs one starting point at least.
- Planar Fitting: Needs three starting points at least.
- Quadratic Surface: Needs six starting points at least.
- Zonal: Needs three starting points at least.
- 2. TGO

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

3. Geoid-Ellipsoid Separation Grid

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

4. FreeSurvey

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



← 🔍 Plar	n Height Plane Gr 🕨	$\leftarrow$	Parameters Calcula	tion	$\leftarrow$	Height Fitting
Model	Mathematical Models >	Туре		Height Fitting >	Result	
Туре	Constant Vertical Offset >	Pt Name	Source B(*)/N(m)	Source L(")/ 🕨	A	36.27265
A	16.0424	✓ B20515	2542671.2378	434514.6103	Max VRms	-0.000150 (B20515)
	Compute	✓ B20518	2542671.3728	434514.6103		Fix Pos 00
		Height	Constant	Vertical Offset >		
	Save	(+) Add	🎦 Open 💾 Sa	ave 😥 Comput e	× Cano	el 🕢 Apply

Figure 2-3-12 Height

Figure 2-3-13 Parameters

Figure 2-3-14 Result

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

#### Set the height fitting mode:

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

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

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

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

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





Figure 2-3-15 Height Fitting Plane Simulation

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

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

Four-parameters	Seven-parameters
	// The first line is skipped and just written
// The first line is skipped and just written	DX:511.755584317388
DX:9847 12172733449	DY:-674.430387295999
DV:_200265_017483647	DZ:-656.294939762613
D:0.0162640727776042	RX:-0.000126577363609681
R.0.0102040727770042	RY:-1.44916763174951E-05
m:0.000162436743812444	RZ:0.0261524898234588
	m:0.000168070284370492

#### 2.3.5 Grid

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



← I ◀ Height	Plane Grid Option	$\leftarrow$   $\blacktriangleleft$ Height   Plane Grid   Option
B Grid		) B Grid
File	EGG97_QGR.GRD >	File ETRS89_KRASOVSCHI42_2D.GRD >
L Grid		L Grid
File	None >	EGG97_QGRJ.GRD
NE Grid		ETRS89_KRASOVSCHI42_2D.GRD
NEZ Grid		) ETRS89_KRASOVSCHI42_2DJ.GRD
File	Hungarian.GSF >	ETRS89_Stereo30_2D.GRD
	Save	ETRS89_Stereo30_2DJ.GRD

Figure 2-3-16 Plane Grid Figure 2-3-17 Plane Grid File

## 2.3.6 Option

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

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

- Plane Correction Grid: Bilinear Interpolation/Dual-guadratic Spline Interpolation. The default is dualquadratic spline interpolation.

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

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



Figure 2-3-18 Range1

Figure 2-3-19 Range2

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

## **2.4 Parameters Calculation**

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

$\leftarrow$	Parameters Calculat	ion	$\leftarrow$	Points Info	Save
Туре		Height Fitting >	Ø Source	e 😽	👍 🕅
Pt Name	Source B(°)/N(m)	Source L(*)/ >	Pt Name	z	
✓ B20515	2542671.2378	434514.6103	N	3669852.235	
✓ B20518	2542671.3728	434514.6103	F	6525532 369	
			c	0520052.005	
			Z	8.5	
			ОВ	LH	
Height	Constant	Vertical Offset >	O Local		*
	<b>F</b>	Comput	N	81221.89	×
(+) Add	🞦 Open 💾 Sa	e e			

Figure 2-4-1 Parameters Calculation

Figure 2-4-2 Add Point

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



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

$\leftarrow$	Points Info	Save	← Raw	Data Stake Point	Contro Point	←   1	Device OK
Ø Source	e(Store Point) 🛛 🚸 🏣		Name	в	L 🕨	00-13 ⊕ Auto	
Pt Name	pt0	X	pt0	22:58:28.72643N	113:21:59.4863	Status: Center	· ( <b>ج</b> ))
в	22:58:28.72643N		pt1	22:58:28.75813N	113:21:59.53374	N: 2542647.9074	σ: 2.7580
						E: 434542.3848 Z: 20.4116	σ: 2.7580 σ: 5.5159
L	113:21:59.48632E					Target H 2.0000	Pole(P)
н	21.4986050004959					Average	
	BLH O NEZ					Save to the point li	brary
💮 Local(	Control Point)	*				Name Z20	×
N	0.0000					Code guardrail	- U fõi
E	0.0000						
			Q s	earch (	📑 Open		

Figure 2-4-3 Add Points1

Figure 2-4-4 Add Points2

Figure 2-4-5 Add Points3

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

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

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

← Parameters Calculation					
Type Plane + Height Fitting >					
Pt Name	◀ Z(m)	HRMS	VRMS		
✓ B20515	0.0000	0.0000	-0.0008		
✓ B20518	0.0000	0.0000	-0.0005		
✓ B20520	0.0000	0.0000	0.0028		
✓ B20524	0.0000	0.0000	0.0000		
✓ B20522	0.0000	0.0000	0.0000		
Height Constant Vertical Offset >					
🕂 Add 🚺 Open 🖾 Save 😥 Comput					

Figure 2-4-6 HRMS and VRMS

- Apply: Apply to corresponding coordinate parameters, and the result will be updated to the Coord point library.

- Cancel: Cancel the parameter computing result and go back to the calculation interface.



←	Parameters Calcula	ation	←   Burs	sa-Wolf Transformation
Туре	Plane 4	+ Height Fitting >	Result	
Pt Name	✓ Source B(°)/N(m)	Source L(*)/E 🕨	DX(m)	1245184.0
✓ B20515	2542671.2378	434514.6103	DY(m)	-6291456.0
✓ B20518	2542671.3728	434514.6103	DZ(m)	-1572864.0
✓ B20520	2542671.2379	434514.6103	RX(")	
✓ B20524	2542671.2379	434514.6103		
✓ B20522	2542671.2378	434514.6103	RY(*)	58011.9767569959
Height	Constant	Vertical Offset >	RZ(*)	32228.8759761088 A 0.0
鼠	Delete	C Edit	(×) Can	cel 📿 Apply



Figure 2-4-8 Result

$\leftarrow$	Parameters Calculation		$\leftarrow$	Points Info	Save
Туре	Plane +	Height Fitting >	N	2542671.23780764	
Pt Name	▲ Source B(°)/N(m)	Source L(*)/E >	E	434514.610310557	
✓ B20515	2542671.2378	434514.6103	z	36.2728	
✓ B20518	2542671.3728	434514.6103	0	BLH	z
✓ B20520	2542671.2379	434514.6103	© Loca	I	*
✓ B20524	2542671.2379	434514.6103	N	2542645.36622516	
✓ B20522	2542671.2378	434514.6103 A Fix Pos 0.0	E	434542.394354932	
Height	Constant	Vertical Offset >	z	36.2755	×
+ Add	🎦 Open 💾 S	ave 茾 Comput e	Plar	ne 🗹 Heigh	it

Figure 2-4-9 Plan + Height Fitting

Figure 2-4-10 Add Point

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

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

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

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

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



### Notice:

1. From the *Project Settings*  $\rightarrow$  *System*  $\rightarrow$  *Coord Sys Management,* enter the *Edit* or Define Project Attributes coordinate parameter interface to do the parameter calculation, which is the calculation for parameters' conversion corresponding to current custom or edited coordinate system type (you can't change the parameter calculation type);



calculation type); 2. From the Project  $\rightarrow$  Parameter calculation or Project  $\rightarrow$  Coordinate system  $\rightarrow$ Parameter calculation or Project  $\rightarrow$  Project Setting  $\rightarrow$  System  $\rightarrow$  Parameter calculation to calculate the current project coordinate conversion parameters. The parameters' calculation type can be selected independently, and the default is the Plane + Height Fitting. The height-fitting type is the currently selected type for parameter fitting by default.

## **2.5 Point Library**

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

←   Coor	d Point Stake Point	Control Point	←   Coor	d Point Stake Point	Control Point
Name	N	E 🕨	Name	N	E
pt0	2541869.9738	435041.3819	pt0	2541869.9738	435041.3819
pt1	2541870.9433	435042.7370	pt1	2541870.9433	435042.7370
File Name: G	PS.raw		File Name: GF	PS.raw	
+ New	Den Q Sea	arch More	III Delete	e 🖉 Edit	Average Points



Figure 2-5-2 Coord Point



## Notice:

1. In the Coord Point and Raw Data, the coordinate point list is a positive sequence display, the latest collection points shown in the last.

2. Coord Point - only for viewing, showing and editing the description, it does not allow add or delete.





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

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

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

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

← Display Settings						
Display Order	NEZ >					
Load Order	Positive sequence >					
Load More Points	100					
🚫 Cancel	🐼 ок					

Figure 2-5-3 Display Settings

- Upload: Upload raw data to the private cloud.
- Process: Apply the current parameters to point library and get the result.

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

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

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

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

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





# Notice:

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

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

←   Co	ord Point Stake Poin	t Control Point	←   Coo	ord Point Stake Point	Control Point
Name	N	E	🗹 Name	Ν	E
st1	2542671.2378	434514.6103	st1	2542671.2378	434514.6103
st2	2542671.2259	434514.5891	st2	2542671.2259	434514.5891
st3	2542671.2378	434514.6103	st3	2542671.2378	434514.6103
st4	2542671.2378	434514.6103	st4	2542671.2378	434514.6103
st5	2542671.2378	434514.6103	st5	2542671.2378	434514.6103
1	Delete	🖉 Edit	Ī	Delete	🖉 Edit

Figure 2-5-4 Delete

Figure 2-5-5 Delete All

Notice:

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

## 2.6 Raw Data

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



~	Raw Data		<i>←</i>	•	Raw	Data	
Name	N	E 🕨		Name	N		E
pt0	2541869.9738	435041.3819		pt0	2541869.	9738	435041.381
pt1	2541870.9433	435042.7370		pt1	2541870.	9433	435042.737
		🐼 Set					
File Name: Gi	PS.raw	tess	File	Name: GP	S.raw		
+ New	🗁 Open 📿 Sea	arch 🗮 More	ť	II Delete	Ø	Edit	Average Points

Figure 2-6-1 Coord Point

Figure 2-6-2 Coord Point

- New: Create a raw data file (\*.raw).
- Open: Open an existing raw data file.
- Search: Search the coordinate point by name or description.

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

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

<i>←</i>	Edit RawData	<del>~</del>	Batch Edit	RawData	
Information		*Note: Che	eck to box to enab	ble the setting.	
Name	pt1	🗹 Grou	IndCode		•
GroundCode	- Ū 🖻	Stati	ion 0.00	00	
Station	0.0000	🗹 Targ	et H 2.00	00	$\times$
Target H	2.0000		Pole(P) O Ve	ertical(V) O Sla	nt(S)
Pole(P)	O Vertical(V) O Slant(S)				
Antenna	[IRTK5] GNSS Antenna >	Calib	nework pration Info	00:00:00.0000	▶
Framework Ca	00:00:00.0 00:00:00.0 00:00:00.0 00:00				
🗙 Can	сеі 📀 ОК	$\otimes$	Cancel	📀 ок	

Figure 2-6-3 Edit Raw data

Figure 2-6-4 Batch Edit RawData





## Notice:

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

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

←	Raw Data		$\leftarrow \mid$	Average Points	
Name	N	E 🕨	Name	В	L 🕨
ptO	2541869.9738	435041.3819	pt2-1	22:58:28.68457N	113:21:59.5078
pt1	2541870.9433	435042.7370	pt2-2	22:58:28.68455N	113:21:59.5069
			pt2-3	22:58:28.68463N	113:21:59.5070
			pt2-4	22:58:28.68426N	113:21:59.5075
			pt2-5	22:58:28.68449N	113:21:59.5085
			pt2-6	22:58:28.68540N	113:21:59.5112
			pt2-7	22:58:28.68562N	113:21:59.5108
			pt2-8	22:58:28.68582N	113:21:59.5116
			pt2-9	22:58:28.68574N	113:21:59.5118
File Name: G	PS.raw		pt2-10	22:58:28.68589N	113:21:59.5120
🔟 Delet	e 🖉 Edit	Average Points		Q Search	

Figure 2-6-5 Raw Data

Figure 2-6-6 Average Points




## Notice:

- 1. Slide to the right to read the BLH of the raw data.
- 2. All the geodetic coordinates are ground point geodetic coordinate.
- 3. Reminding, if you need to save the average data, then you have to open the Store

Average Points button in the Configuration  $\rightarrow$  Data.

$\leftarrow \mid$	Display Dat	a Stake	?
Working	g Area		>
Physica	I Record Button	Single	e Record >
Point In	fo Dialog		
Auto St	art Average		
Auto St	ore After Average		
Store A	verage Points		
Allow S	ame PtName		
Tilt Sur	vey		
HRMS <sup>-</sup>	Folerance	3.0000	
Fi	gure 2-6-7 A	verage F	Points

- Upload: Upload raw data to the private cloud.
- Set: Set the loading sequence and display.
- Process: Apply the current parameters to point library and get the result.

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



#### Notice:

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



←	Raw Data	
Name	Ν	E
pt0	2541869.9738	435041.3819
pt1	2541870.9433	435042.7370
pt2	2541868.6995	435042.0380
pt3	2541868.7212	435042.0823
pt4	2541868.8222	435042.3390
		63 cm
		Cy Set
File Name: GI	PS.raw	Proce
+ New	🎦 Open 📿 Sea	arch 🗮 More

#### Figure 2-6-8 Average Points1

#### Figure 2-6-9 Average Points2

← Raw Data	← Set Custom Format   OK
Exchange Types   Export Batc >	Template None > Template Manager
/storage/emulated/0/ZHD/Out	Export Content
	id,Name,N,E,Z,B,L,H,Slope N,Slope E,Slope Z,Slope B,Slope L,Slope H,AntH,-σ-N,-σ-E,HRM- S,σZ,Target H,AntH Pos,Antenna Type,Ave
	Supported Fields Selected Fields
	id id
	Name Name
	N N
	E E
csv_121521	z z
User-defined(*.csv) > Prj Prefix	в в
⊘ ок	Till Delete 🔺 Up 🔽 Down

Figure 2-6-10 Average Points3

Figure 2-6-11 Average Points4

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

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

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

#### 2.7 Mapping Data

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



$\leftarrow$	Mapping Da	ta		•	←   Co	oord Point Stake Poi	nt Control Point
Name	N	E	۲		Name	N	E
mp1	2542853.6122	435160.2354			mp1	2542853.6122	435160.2354
mp2	2542853.6080	435160.2366			mp2	2542853.6080	435160.2366
mp3	2542853.6037	435160.2366			mp3	2542853.6037	435160.2366
File Name	: 0921.mcp			3	文件名:	0921.mcp	
+ N	ew 🦻 Open	Q Search				Delete	🖉 Edit

Figure 2-7-1 Mapping Data

Figure 2-7-2 Edit Mapping Data

## 2.8 Data Transfer

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

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



Figure 2-8-1 Raw Data export

Figure 2-8-2 Raw Data export

Raw data export format includes:



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

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

←   Raw Data   Stake Point   Contro Point ►	← Raw Data Stake Point Control Point
Exchange Types   Export  Import	Exchange Types   Export  Import
Directory /storage/sdcard0/ZHD/Out	Directory /storage/sdcard0/ZHD/Out
User-defined(*.csv)	South CASS7.0(*.dat)
DXF File(*.dxf)	Scsg2000(*.dat)
Shapefile(*.shp)	PREGEO(*.dat)
Evcel File(+ csv)	ASC File(*.asc)
	KML File(*.kml)
South CASS7.0(*.dat)	NETCAD(*.NCN)

Figure 2-8-3 Format-CSV

Figure 2-8-4 Format List

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

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

←   Raw Data Stake Point	Contre ?	← Set C	ustom Format	ОК
Exchange Types O Expor	rt 💿 Import	Template	None > Template M	anager
/storage/emul	ated/0/ZHD/Out	Import Content		
		Name,N,E,Z,B,L,H,C	Coord Type,Desc,Station,Is	Staked
txt_111211 zhd1_1 .txt t_1211	NFda csv_12152 514 1.csv	Supported Fields	Selected Fields	
		Name	Name	
		N	Ν	
		E	E	
All(*.*)	~	z	Z	
	-	в	в	
NETCAD(*.NCN)		L	L	
Civil 3D(*.xml)		Delete	🔺 Up 🔍 🔻	Down

Figure 2-8-5 Data Import

Figure 2-8-6 Custom Format



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

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

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

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

← Set	Custom Format	ок
Import Conten	t	
Name,N,E,Z,B,L,	H,Coord Type,Desc,Station	n,Is Staked
Set		
Angle	DD	:MM:SS >
Splitter		•
Format Heade	er	

Figure 2-8-7 Custom Format

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

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

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



ОK



Figure 2-8-8 Prompt PPK Figure 2-8-8 Prompt PPK





1. All the import and export methods involved in the file custom format are the same as this step.

2. The file import data needs to do the number and coordinate range detection (including parameter Calculation Loading, *Data Exchange*  $\rightarrow$  *Stake Point* / *Control Point* import, *Stake Line*  $\rightarrow$  *Stake Line Library* loading, Road Stake/Cross-section Collection  $\rightarrow$  Road Design File the choice of loading, Road Design  $\rightarrow$  Plane  $\rightarrow$ Section Design Line intersection, line element, coordinate method of loading. If the test data is not within the range of the value, or the E coordinate band number does not match, the Input import error prompt box is displayed.

When Surveying Configure  $\rightarrow$  Display  $\rightarrow$  Online Map  $\rightarrow$  GIS Map, you can select to export GIS Map in the Data Transfer.

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



Display Data Stake	?	← I ◀ Control   Mapping   GIS Map   ?	← I ◀ Stake Control Point Data
Display Elevation		Exchange Types   Export	Exchange Types   Export
Electronic Bubble		/storage/emulated/0/ZHD/Out	/storage/emulated/0/ZHD/Out
Realtime Mileage			
Dist to last Coord Pt		DXF File(*.dxf)	
Fix Direction		Shapefile(*.shp)	
Controller Dir		gpx File(*.gpx)	
Display Color		KML File(*.kml)	zhd1gukyub_shp_121522
Online Map (	SIS Map	kmz File(*.kmz)	NEZ Shpfile(*.shp) >

Figure 2-8-10 GIS Map1

Figure 2-8-11 GIS Map2

Figure 2-8-12 GIS Map3

## 2.9 PPK File

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

~	PPK File	
File Name	Device SN	Model 🕨
_4203490.0	13674420	iRTK5
_4203491.o	13674420	iRTK5

Figure 2-9-1 PPK File

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





Figure 2-9-2 PPK File Delete1

Figure 2-9-3 PPK File Delete2

Tick the  $\square$  ahead of the file name to delete batches.



Figure 2-9-4 PPK File Delete3

## **2.10 Email**

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



$\leftarrow$	Email	Send
abc@163.c	om	
data		Ø
📄 GPS.raw		×
test data		
	From Hi-Survey	Feedback

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

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

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

Address From:	@ n	etease.co*
<ul> <li>Note: Email address IMAP service, or recip If turn on the SMTP sauthorization code, p code instead of the p</li> </ul>	s should enable F pient would not g ervice and the er please input the a assword.	POP3/SMTP/ jet email. nail box has the outhorization
Password:		
abc@163.com		
data		61

Figure 2-10-2 Email-Enter Address

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



$\leftarrow$	Email	Send
data		Ø
ZHD.dam		×
test data		
	From Hi-Survey	Feedback

Figure 2-10-3 Feedback

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

Press and hold an item; when the bottom right corner of the current item right rig

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

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

4. Click OK to complete the file selection;



Figure 2-10-4 File Manager

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



$\leftarrow$	Email	Send
zhd-rtk@	)hi-target.com.cn	
data		Ø
test data		
Т	e network of device is disab	bled
	From Hi-Survey	Feedback

Figure 2-10-5 Check the Network

## 2.11 Project Config

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

$\leftarrow$	Project Config Manage	Apply
66		
+ New	🖉 Edit [ Import	<b>Export</b>

Figure 2-11-1 Check the Network

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



Project Config Manage  $\leftarrow$ Apply Configure Smooth Limit Survey Limit + Average Method Average > Status Float > New Template Ave Times з Name 66  $\times$ Ave Precision ок Cancel Save 🕂 New 🖉 Edit [ 📩 Import 🛃 Exp

Click Yes to finish the project configuration template.

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

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

← Project Config Manage Ap	oply ←	Configure	Apply
66	Smooth Limi	t Survey Limit +	-
	Average Me	ethod	Average >
	Status		Float >
	Ave Times	3	
	Ave Precisi	on	
🕂 New 🖉 Edit 🎦 Import 🚰 E	xport	Save Save	

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

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



÷	Project Config Manage	Apply	÷	Direc	tory	OK
66						
			/storage/emu	lated/0/ZHD		
				Font	Out	Project
			Dic	GeoPath	LOG	Download
			Sounds	Firmware Package	User	Template
			Comm	Code		
+ New	Edit 🥂 Import	t 🛃 Export	Project Conf	ig File(*.plc)		>

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

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

÷	Project Config Manage	Apply	~	-	Direc	tory	OK
66				<b>*</b>			
			/s	torage/emu	lated/0/ZHD		
					Font	Out	Project
				Dic	GeoPath	LOG	Download
				Sounds	Firmware Package	User	Template
				Comm	Code		I
+ New	🖉 Edit [ Import	📥 Export	P	roject Conf	ig File(*.plc)		>

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

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





Figure 2-11-10 Template

## 2.12 Code List

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

<b>←</b>	Code List ?								
Name	Quantity of points	Quantity of lines	Quantit polygo						
PRESET_EN	0	O	0						
CASS	111	44	31						
EPS	562	753	71						
Hi-Data	96	34	17						
PRESET	24	0	0						
			mport						
		_ <b>_</b> =	xport						
+ Add	🖉 Edit	🔟 Delete 📑	More						

Figure 2-12-1 Code List

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



~	Code	List	?	$\leftarrow \mid$	Point Line	Polygon	Group	$\leftarrow \mid$	Point Line	Polygon	Group
Name	Quantity of points	Quantity of lines	Quantit polygo	Desc	Code	Color	Style	Desc	Code	Color	Siyle
PRESET_EN	0	0	0	gujd	hhduue		$\odot$				
CASS	111	44	31	Float e	8						
EPS	New Ter	mplate	71	1.0	T				Ba	ck	
H Name	e gjn	×	0						Do you want t	to save data?	
C	Cancel	ок							No	Yes	
	/	1									
				Group		None	e Group >	Group		None	Group >
+ Add	C Edit	TIII Delete	More	+ Add	🖉 Edit	Delete	Export	+ Add	6 Edit	Delete	Export

Figure 2-12-2 New Template

Figure 2-12-3 Add Point

Figure 2-12-4 Save

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

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



Figure 2-12-5 Add Template1 Figure 2-12-6 Add Template2





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

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



Figure 2-12-9 Delete Batches

Click Group to Add, Edit and Delete the group.



← (	← Group Manage
	无分组
	水系设施
	土质
	居民地
Norma	管线设施
Name	电力设施
Cancel	军事设施
	道路设施
	独立树
	工矿设施
	公共设施
+ Add	+ Add 🖉 Edit 🔟 Delete

#### Figure 2-12-10 Group Manage1



oup Manage

New Group

 $\times$ 

ок



Figure 2-12-12 Group Manage3

Figure 2-12-13 Group Manage4

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

←	Code	List	?	~		Code	List	1.
Name	Quantity of points	Quantity of lines	Quantit polygo	N	ame	Quantity of points	Quantity of lines	Quan poly
PRESET_EN	0	0	0	PRE	SET_EN	0	0	
CASS	111	44	31	c	ASS	111	44	3
EPS	562	753	71		EPS	<sup>562</sup> Dele	te <sup>753</sup>	7
Hi-Data	96	34	17	н	Are	you sure you wa	nt to delete the	1
PRESET	24	0	0	PI	RESET	24		
hhh	2	O	0		hhh	Cancel	ОК	
jejkkdd	1	D	0	je	jkkdd	1	0	
dkdiofl	1	0	0	d	kdiofl	1	0	
+ Add	6 Edit	III Delete	More	(+	Add	C Edit	Delete	More

Figure 2-12-14 Group Manage5

Figure 2-12-15 Group Manage6



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

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

÷	Cod	le List	?	$\leftarrow$	Code List ?		÷	Directory	ок	
Name	Quantity of points	Quantity of lines	Quantity of polygons	Name	Quantity of points	Quantity of lines	Quantity of polygon:	/storage/emu	llated/0/ZHD/Out	
PRESET_EN	0	0	0	PRESET_EN	0	0	0			
CASS	111	44	31	CASS	111	44	31			
EPS	562	753	71	EPS	562	753	71			
Hi-Data	96	34	17	Hi-Data	96	34	17			
PRESET	24	0	0	PRESET	24	0	о			
hhh	0	0	o	hhh	0	0	o			
		<b></b>	Import	Code File	(*.xml)		$\checkmark$			
			Export	Code File	(*.txt)			hbh		×
+ Add	🖉 Edit	Delete	More	Code File	(*.csv)			Code File(*.xml)		>

Figure 2-12-16 Export

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

## 2.13 Culture Library

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

←	Line	Polygon		$\leftarrow$	Line		Polygon
Line Name	Length	GroundCode	•	Surface Name	Perimet	er	Max Araa
<b>—</b>				<b>A</b>			0 - 11
III Dele	te 🛛 📿 Se	earch 🖉 Edi	t	🔟 Dele	ete 📿 S	earch	🖌 Edit

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

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

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



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

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

Figure 2-13-3 Culture Library 1

Figure 2-13-4 Culture Library2

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

<del>~</del>	Attribute	View	~	Insert	Node		←	Edit Node		
Name	duhhd	×	N	0.0000	$\times$	} ♦	N	2541869.6785	<b>X</b>	�
Length	17.4483m		Е	0.0000		) <b>:</b>	Е	435040.0855		Ŧ
GroundCo	ode hjskks	•	z	0.0000			z	25.0756		•
No.	N	E 🕨								
1	2541869.6785	435040.085								
2	2541871.6797	435032.407								
з	2541872.4238	435035.887								
4	2541869.5026	Insert 77.								
		6 Edit								
Delete	e 🔺 Up 🔻 Do	wn More	$\overline{\mathbf{x}}$	) Cancel	🕢 ок	(	$\otimes$	Cancel	⊘ ок	



Figure 2-13-6 Edit Attribute2

Figure 2-13-7 Edit Attribute3

## 2.14 Software Settings

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



- Check Correction Transmitting: Once opened, it will check difference sending status in Base mode and check difference receiving status in Rover mode, and will show it in a floating window. %: close check correction transmitting; %: send no difference message; %: sending difference message. When in the handle difference mode, there is a difference detection function, so there is no Check Correction Transmitting option.

- Check Network Status: Once opened, it can detect the network status of the device, or support iRTK5 series device. In the built-in network mode, open the software Settings  $\rightarrow$  Check Network Status switch and open the floating window to view the current network signal strength directly.

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

← Software Settings	← Software Settings
Auto Connect Device	Check Base Position
Check Base Position	Keep Screen Light On
Keep Screen Light On	Floating Window
Floating Window	Time Zone (UTC+08:00)Beijing >
Time Zone (UTC+08:00)Beijing >	GridView >
Theme GridView >	Screen Orientation Portrait >
Screen Orientation Portrait >	Module Restore >
Module Restore >	One-key reset
One-key reset >	User Guide >

Figure 2-14-1 Software Settings1

Figure 2-14-2 Software Settings2

- Keep Screen Light On: The shutdown status indicates that the power-saving mode is selected and the screen is not in light status.

- Soft Input: You can use soft input (screen input method) if opened; if closed, only via the keyboard.

- Floating Window: The floating window is set to display in the non-survey interface. The fixed position of the floating window in the survey interface shows no shrinkage; when in a non-survey interface, you can hold the floating window and drag it to any position in the screen, after 5 seconds, it automatically shrinks



← Software Settings	←   Text Detail Survey Configure
Check Correction Transmitting	<sup>8</sup> <sup>00-18</sup> △ <sup>Fix</sup> <sup>Pos</sup> <sup>Pos</sup> <sup>SUB</sup> <sup>33%</sup>
Check Base Position	
Keep Screen Light On	
Soft Input	+ pr3450 + pr3515
Floating Window	▲ + <sup>1,001</sup> ++++ + <sup>1,001</sup> +++ + <sup>1,001</sup> ++++ + <sup>1,001</sup> ++++
Time Zone (UTC+08:00)Beijing >	
Theme GridView >	*
Screen Orientation Portrait >	_700.00km_

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



Figure 2-14-5 Floating Window

①. Public satellites and Visible satellites ②. PDOP

3. Solution state

④. Differential age

Description of working mode mark of the Floating Window:

- P Rover Station (close Check Correction Transmitting)
- Rover Station (send no difference)
- Rover Station (sending difference)
- Rease Station (close check correction transmitting)
- Rease Station (send no difference)
- R Base Station (sending difference)
- Built-in GPS
- Demo Mode
- No Connection
- When the second second
- 冤 Static Mode

Description of the Floating Window data link:

No data link

Nith data link

Built-in network

∃cExternal network (3G)

🖻 Built-in radio



External radio

<sup>(II)</sup>Handle difference (sending difference)

Handle difference (no difference)

<sup>(II)</sup>Handle difference (non-normal difference)

#### ♥IFI data link

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



Figure 2-14-6 Connecting

2-14-7 Connected

- Solution state: mainly includes the following modes (except for the fixed coordinates, the precision ranges from high to low): the known points refer to the fixed (base station)  $\triangle \rightarrow$  Fix Pos +  $\rightarrow$  RTK Fix +  $\rightarrow$  Float  $\Leftrightarrow \rightarrow$  DGPS  $\Leftrightarrow \rightarrow$  SDGPS  $\otimes \rightarrow$  Auto  $\supset \rightarrow$ None (no GNSS Data).

- Differential Age: This refers to the time when a rover station receives a base station signal for a solution.

- PDOP: The spatial geometrical intensity factor of satellite distribution; the better the satellite distribution, the smaller the PDOP value; generally less than 3 is the ideal state.

- Visible satellites: The number of satellites received by the receiver, and 5 at least in RTK works.

- Public satellites: There is no public satellite in the Base station, only when the rover station receives the difference data. Public satellites refer to the calculated used satellites, when the base and rover station participate in whole cycles and search at the same time, generally, it needs more than 5 to work properly.

- Time Zone: Select the work time zone, correct the UTC time input by GNSS receiver to the local time in the user's area.



#### Notice:

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





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

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

- Screen Orientation: Can be either landscape or portrait. (the function applies to QpadX5).

- Module Restore: Long press to delete a module, press return key to exit delete mode, software settings module cannot be deleted. After deletion, module recovery can restore the deleted module to its original location.

- One-key reset: Select whether to reset the surveying configuration and software settings (note: unconnected and expired device will not be able to tick this option). Click OK when you get a prompt to reset the software settings and surveying configuration. If you click Cancel, it will keep the original configuration.

- User Guide: The user guide can be viewed through a third-party PDF reader. When viewing the user guide, you need to have a PDF document in the ZHD directory or the handle on the Internet, and a PDF reader installed.

#### 2.14.1 Location Information

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



Figure 2-14-11 Floating Window - Location Information

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

Local time, and so on.



RTK	Fix	Latency	2.0	RTK	Fix	Latency	2.0
N 254	2644.4950			Base Coord			
E 434	541.6406			В	22:58:53	.83249N	
Z 47.5	5788			L	113:21:4	1.82468E	
HRMS	0.0100		+ RTK Fix	н	49.6789		+ RTK Fix
VRMS	0.0150			Baseline	2.0951		
Azi	223:37:43.	89359		Length			
Velocity	0.00360			Base 2D Distance	0.0123		
Local time	2018-03-2	3 18:30:34.0	0	Horizontal	70:32:45	.92410	
Reset	t RTK	Clear Ephe	emeris	Azimuth			
Enable I Conne	Internet ection	Disable In Connec	ternet tion				
Locatio	n Info	Base Sta	ation	Location	Info	Base S	tation

Figure 2-14-12 Location Info

Figure 2-14-13 Base Station

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

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

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

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

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

#### 2.14.2 Satellite Information

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



Figure 2-14-14 Floating Window-Satellite Information

#### 1. SATView

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

- GPS: The Prn range is 1-33



- GLONASS: The Prn range is 65-96

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

- BDS: The Prn range is 161-195
- GALILEO: The Prn range is E1-E52
- QZSS: The Prn range is J191-J195

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



Figure 2-14-15 SATView

Set the color according to the L1 carrier signal-to-noise ratio of satellite, colour: red  $\leq 31$ , 31 < 0 orange  $\leq 41$ , green >41.



Figure 2-14-16 Status



#### 2. Satellite Signal-to-Noise Ratio Map

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

$\leftarrow$	SATVie	w Stat	tus SA	T Info		
Sat	s	PDOP	Ele	Elevation Mask(<=30*)		
32	2	1.2		5	Set	
PRN	Azi	Ele	L1	L2	Туре	
2	46	58	45	34	GPS RTK Fb	
5	339	56	51	46	T 1.0 GPS	
6	94	28	33	39	GPS	
12	229	16	46	43	GPS	
13	172	54	47	34	GPS	
15	207	28	46	44	GPS	
19	151	14	33	16	GPS	

Figure 2-14-17 SAT Info

### 2.15 About

Here are the related instructions for the software version and upgrade.

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



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

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





## Notice:

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





# **Chapter 3**

## Device

## This chapter contains:

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



## 3.1 Device

#### **3.1.1 Device Connection**

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

$\leftarrow \mid$	Device	← Bluetooth Connect		
		Status:		
O None 0.0		Bluetooth The paired devices		
	Disconnect	GeoNavB-11616316 >		
	Check Update	11007946 >		
Working Mode:		11800547 >		
Receiver FW: Expiration:		O None 0.0		
🛠 Config	ure			
Mathad	Divotooth			
💶 Re	gister 🔗 Connect	Q Search device		

Figure 3-1-1 Device

Figure 3-1-2 Bluetooth Connect

There are 4 methods of connection, Bluetooth, network, Wi-Fi, NMEA STREAM(Bluetooth). In addition, the built-in GPS and demo modes can be set independently with the controller controller.

In Bluetooth connection mode, it's necessary to turn on the Bluetooth function of the receiver and controller controller at the same time and click Connect to enter the Bluetooth connection interface. Click Search device to search for the device that needs to be connected, choose it in the list by the S/N and there will be a Bluetooth pairing prompt. Enter the pairing password (default password is 1234) to connect the device, and paired devices do not need to enter the pairing password again. If no device is found, please click Search device to search again.

In Network connection mode, click Connect to enter the network settings interface, and set the ID and password to connect the device (NB only supported on specific modes). If it's the first time of connection, please connect the receiver by Bluetooth first. Set the IP and port in *Additional Settings* $\rightarrow$  *Receiver Settings*  $\rightarrow$  *Remote Connection*, then use the network connection to do wireless remote operation easily.

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



$\leftarrow$	Network						
Address	rtk.zhdgps.com						
Port	8999						
Device ID	0961234						
Password	•••						
🗹 Use def	ault server parameters						
O None 0.0	O None 0.0						
🛞 Cancel 🥥 Connect							

Figure 3-1-3 Network

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

$\leftarrow$	Device	$\leftarrow$	De	evice	
O None 0.0	Disconnect		Disc	onnect	
	Check Update		Wi-Fi	Prompt	
Bluetooth		Cur V 116	rrent Connec 616316, Sure	ted Wi-Fi i to Conne	s ct?
Network		E Ca	ancel O	ther	ОК
Wi-Fi	~	🛠 Cor	nfigure		
Built-in GPS			d		Wi-Fi >
Demo		⑦ ∩th	or		
		2	Register	Ó	Connect

Figure 3-1-4 Wi-Fi

Figure 3-1-5 Wi-Fi Prompt

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





Figure 3-1-6 Built-in GPS

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

$\leftarrow   \qquad GNSS  Demo  Mode    \; Start$		Ţ
➡ Direction		l Bover
Random		
Velocity	¥.	
0.0500 Random	GNSS Demo Controller Ad Mode S GNSS Demo Mode is on	lditional ettings
U" Precision		
0.0300 Random	Console Static Ran	igeFinder
🗄 Start Point 🙀 🕅		
	Auto	
B: 23:00:00.00000N	E 😡 💥 Project Device Survey	E COGO

Figure 3-1-7 Demo Mode

Figure 3-1-8 Mode Prompt

4. In the *NMEA STREAM (Bluetooth)* mode, the Bluetooth of the receiver and controller need to open. Click the *Connect* button to enter the *Bluetooth Connect* interface. Click *Search device* to search for the device. Select the device on the Bluetooth list. It will display the connection prompt. Input the password, which is 1234. You don't need to input the password if this device has been connected before. You don't need to input the password for V90Plus and IRTK5. If you can't find the device, please click the *Search device* again.

The current receiver's connection status will be displayed after the device is connected successfully, including the S/N, Check Update, Working Mode, Receiver FW, Expiration, Method and Antenna.



$\leftarrow$	Device							
	11616316							
C	Check Update							
Working Mode:	Rover Mode							
Receiver FW:	5.1 V90 Plus							
Expiration:	2018-06-12							
- KSDGPS Configure								
Method	Bluetooth >							
Other								
Antenna [\	/90 Plus] GNSS Antenna >							
Register	🔀 Disconnect							

Figure 3-1-9 Device Info

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

← Firmware Update							
Firmware file Up to date Updat							
Motherboard firmware file	Up to date	Update					
・							

Figure 3-1-10 Firmware Update

- Working Mode: Display the current receiver's operating status, generally base mode, rover mode or static mode.

- Receiver FW: Receiver firmware version number and receiver type.
- Expiration: Deadline for registration code use.

- Antenna: Set the antenna type. Enter the antenna manage interface to choose it, according to the model; if there is no matching antenna type, you can click Add to add the custom antenna type by inputting the Model, Desc, Radius, L1 Phase Offset, L2 Phase Offset, and SHMP Offset in the Add Antenna interface.



← Add Antenna	Manage OK	←   Ade	d Antenna	ОК
Manufacturer	Hi-Target >	Model		
Model	V90 Plus >	Desc		
Desc	GNSS Antenna	Radius	0.0000	
Radius	0.13000	L1 Phase Offset	0.0000	
L1 Phase Offset	0.09450	L 2 Phase Offset	0.0000	
L2 Phase Offset	0.08980	LZ Flidse Oliset	0.0000	
SHMP Offest	0.00000	SHMP Offest	0.0000	
⇒ SDGPS 69.0		- Constant SDGPS 47.0		

Figure 3-1-11 Antenna Manage

Figure 3-1-12 Add Antenna

#### 3.1.2 Register

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

$\leftarrow \mid$	Regi	ister	ОК
Regist digital	ration c s)	code (2	4
7	8	9	DEL
4	5	6	CE
1	2	3	0

Figure 3-1-13 Register

#### **3.1.3 NFC Connection**

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

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



## 3.2 Base

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

#### 3.2.1 Base Configuration

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

÷	Set Base	Set
Set by av	verage 5 Times	O Set by point
_		<u> </u>
Save Po	DS .	
Name	B121602	
Target H	1.5000	Vertical(V)
Correction	Туре	RTCM(3.2) >
Elevation N	fask(<=30°) 10	torral Darlia 🔪
*Note: Unable please try 192	to transmit so much data u 00 link rate or enable 3 cons	nder 9600 link rate, stellations at most
Templa	ate 🛄 Save	generate

Figure 3-2-1 Configure

Figure 3-2-2 Delete or Load

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

- Save: Input the configuration name and click to save the current set parameters.
- Delete: Delete the selected configuration file.
- Load: Load parameters of the selected configuration file.
- 128: Generate the parameters of the current settings as a QR code.
- -View: View the parameters of the template.
- -Delete: Delete the template selected.

#### 3.2.2 Receiver Position

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



←	Set Base	Set ←	Set Base	Set	←	Set Base	Set
н	49.3212	⊖Set	by average	Set by point	Set by av	erage 🚺 Time	s OSet by point
() N	EZ 💿 BLH	Sa	ve Pos		Save Po	s	
Correction	n Type RTC	M(3.2) > Name	B121602		Name	B121602	]
Elevation	Mask(<=30°) 10	Target	H 1.5000	Vertical(V)	Target H	1.5000	Vertical(V)
DataLink	Intern	al UHF > Positio	n 3	:	Correction	Гуре	RTCM(3.2) >
Protocol	HI-TARGET	F19200 >	22:58:53.76211N	×	Elevation M	ask(<=30°) 10	)
Channel	100	L	113:21:41.70154E		DataLink	E	External Radio >
	Advance Config ►	н	49.3212	,	*Note: Unable please try 1920	to transmit so much data 00 link rate or enable 3 co	under 9600 link rate, nstellations at most
Temp	late 📑 Save	generate 🎦 Te	mplate 🕒 Save	generate	Templa	te 💾 Save	generate

Figure 3-2-3 Set Base1

Figure 3-2-4 Set Base2

Figure 3-2-5 Set Base3

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

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

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

-Name: Set the base name.

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

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

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

#### 3.2.3 Datalink

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



← Set Base Set	÷ ←	Set Base	Set	←	Set Base	Set
Elevation Mask(<=30°) 10	DataLink		Internal UHF >	н	49.3212	
DataLink Internal UHF >	Protocol	HI-TA	ARGET19200 >	() N	ez 💿	BLH
Protocol HI-TARGET19200 >	Channel	100		Correction	Туре	RTCM(3.2) >
Channel 100		Advance Config 🔻		Elevation	Mask(<=30°) 10	
Advance Config V	Pos Freque	ency ≥	1HZ >	DataLink		Internal UHF $\geq$
	Store GNS	S Raw		Protocol	HI-	FARGET19200 >
Internal UHF	Power		Low >	Channel	100	
Internal GSM	Frequency	List	>		Advance Config 🕨	
External Radio	Templa	ate 🛄 Save	generate	Templ	ate 💾 Save	generate

Figure 3-2-6 Set Base4

Figure 3-2-7 Set Base5

Figure 3-2-8 Set Base6

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

<u>,</u>	Set Base	Set	<del>~</del>	Set Base
DataLink	Intern	al UHF >	DataLink	Interr
Protocol	HI-TARGET	19200 >	Protocol	HI-TARGE
Channel 100			Channel	100
Adv	vance Config 🔻			Advance Config 🔻
Pos Frequency		1HZ >	Pos Freque	ency ∋
Store GNSS Raw			Store GNS	S Raw
Power		Low >	Power	
Frequency List		>	Frequency	List
🔨 Template	🛄 Save	generate	Templa	ate 🛄 Save

Figure 3-2-9 Set Base7

Figure 3-2-10 Set Base8

- Power: There are three options, including high, middle and low options.
- Frequency: Click to enter the interface to get the most suitable channel (for specific models).


←   Rese	et Frequency Li	st Save	$\leftarrow \mid$ Rese	t Frequency Li	st Save
Channel	Freq. (MHz)	Band	Channel	Freq. (MHz)	Band
1	462.5	25 >		462.5	25 >
2	462.75	25 >	2	Frequency	-25->
3	463.0	25 >	3	Channel: 3 (403~4	73 MHz) 25 >
4	463.25	25 >	a <b>463</b> .	000	× 25 >
5	463.5	25 >	5	463.5	25>
6	463.75	25 >	Ģ.	403.75	25
	464.0	25 >		464.0	25 >
8	464.25	25 >	8	464.25	25 >
	Refresh			Refresh	

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

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

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

- Reset: Click to restore the list to the default state.
- Save: After modifying the frequency table, please click to complete the modification.
- 2. In Internal GSM mode, you need to set the data link as Internal GSM, Sever, IP, Port, Group type.

$\leftarrow$	Set Base	Set
DataLink	Interr	al GSM $>$
Server	ZHD >	Select
IP	202.96.185.34	
Port	2101	
Group Type	By City I	Number >
Area ID	000000	
Group ID	0	
A	dvance Config ▼	
Template	💾 Save	generate

Figure 3-2-13 Internal GSM

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



$\leftarrow$	Set Base	Set	$\leftarrow$	Server	Add
DataLink	Interna	al GSM >	Name	IP	Port
Server	zhd >	Select	HiTargetServer	rtk.zhdgps.com	9000
	000.05.105.04		HiTargetServer	129.28.86.80	9000
IP	202.96.185.34		HiTargetServer	101.201.51.235	9000
Port	2101		HiTargetGZ1	121.33.218.242	9000
Group Type	By City N	umber >	HiTargetGZ2	202.96.185.34	9000
• DGPS			-O- DGPS 0XWZ	60.205.82.126	9000
Area ID	000000				
Group ID	0				
	Advence Config =				
	Advance Coning +				
Template	🛄 Save 🚆	generate			

Figure 3-2-14 Server

Figure 3-2-15 Server List

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





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

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

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

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



÷	Set Base Set					
н	49.3212		j			
() N	EZ	<ul> <li>BLH</li> </ul>				
Correction	Correction Type		1(3.2) >			
Elevation	Elevation Mask(<=30*) 10					
DataLink External Radio > Float NGA: Unable to transmit so much data under 9600 link rate, please try 19200 link rate or enable 3 constellations at most						
DataLink Float *Note: Unabl please try 19	e to transmit so n 200 link rate or er	External nuch data under 960 nable 3 constellation	Radio > 0 link rate, s at most			
DataLink Float *Note: Unabl please try 19	e to transmit so n 200 link rate or er Set Radi	External nuch data under 960 nable 3 constellation o Param	Radio > 0 link rate, s at most			
DataLink Float *Note: Unabl please try 19	e to transmit so n 200 link rate or er Set Radi Advance	External nuch data under 960 abble 3 constellation o Param Config 🔻	Radio > 0 link rate, s at most			

Figure 3-2-17 External Radio

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

$\leftarrow$	Set Base	Set	$\leftarrow$	Set Base	Set
Mode			Mode		
Datalink		Wi-Fi >	Datalink		Wi-Fi >
Parameter			Parameter		
		>	Wi-Fi		>
Internal UHF			Server	CORS >	Select
Internal GSM			IP	218.255.188.30	×
External Radio			Port	2101	
Wi-Fi		~	Configure   F	Receiver   Datalink	Other

Figure 3-2-18 Wi-Fi Mode

Figure 3-2-19 Wi-Fi Mode Settings

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



← Wi-Fi Parameter	ок
🗟 xiaomi_8A84_5G	0
<b>奈</b> 2G	0
11620994 Need to enter the wifi password	⊙ ⊗
🛜 Test_5G	0
🛜 BD Go_5G	0
Q WIFI Search	

Figure 3-2-20 Wi-Fi Mode Settings

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

$\leftarrow$	Set Base	Set	~	Set Ba	se Set
Mode			Name	B121602	
Datalink	Data Collector Internet	>	Target H	1.5000	Vertical(V)
Parameter			Correction Ty	pe	RTCM(3.2) >
APN		>	Elevation Mas	sk(<=30°) 1	o
Server	CORS > Sele	ct		1	Internal GSM $>$
IP	218.255.188.30	<	Server		CORS > Select
- Port GPS	2101		CORS		~
Y 46.0			ZHD		
Configure F	Receiver Datalink Oth	er	TCP/IP		

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

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

#### 3.2.4 Other Options

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



$\leftarrow$	Set Rover	Set	÷	Set Rover	Set
Elevation Mask(	<=30°) 10		DataLink	In	ternal UHF $>$
DataLink	Internal	UHF >	Protocol	HI-TAR	GET19200 >
Protocol	HI-TARGET1	9200 >	Channel	100	
Channel 100				Advance Config 🔻	
	Advance Config ►		Pos Freque	ency	1HZ >
			Store GNS	S Raw	
			Radio Rela	y .	
			Frequency	List	>
Template	Save	scan	Templ	ate 🛄 Save	scan

Figure 3-2-23 Other1

Figure 3-2-24 Other2

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



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

- Elevation Mask: Adjustable from 0 to 30 degrees.
- Pos Frequency: Software update positioning data frequency, supports 1Hz and 2Hz.

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

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

#### 3.3 Rover

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

#### 3.3.1 Rover Configuration

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

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



← Set	Rover Set			
DataLink	Internal UHF $\geq$			
Elevation Mask(<=30°)	5			
Protocol	TRIMTALK450S >			
Channel 1				
Advance Config ►				
Template Save Scan				

Figure 3-3-1 QR Code

#### 3.3.2 Datalink

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

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

$\leftarrow$	Set Rover	I	Set
Mode			
Datalink SDGPS atsimeter		PPP Servi	ce >
Internal UHF			
Internal GSM			
External Radio			
Data Collector	Internet		
PPP Service			~

Figure 3-3-2 Datalink



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

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

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

← Set Rover Set  $\leftarrow$ Set Rover Set Elevation Mask(<=30°) 10 RTCM 1021-1027 DataLink Internal GSM > Select Advance Config V Server ZHD > IP 202 96 185 34 Pos Frequency 1HZ > Postigers 2101 Store GNSS Raw By City Number > Group Type GPRS > Network Area ID 0000000 APN CMNET > Group ID 0 Save Template Scan 💾 Save 🔨 Template scan

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

Figure 3-3-3 Advance Config1

Figure 3-3-4 Advance Config2

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

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

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



÷	Set Rover	Set ←	Set Rover
Elevation Mask(	<=30°) 10	Serve	er CORS > s
DataLink	Interr	nal GSM >	202.96.185.34
Server	ZHD >	Select	2101
IP	202.96.185.34	Mou	ntpoint
- 0- 47.0	2101	-duser	Name
Group Type	By City	Number > Pass	word
Area ID	000000	F	RTCM 1021-1027
Group ID	0		
Template	Save	🚼 scan 🎦 T	emplate 🛄 Save

Figure 3-3-5 IP and Port1

Figure 3-3-6 IP and Port2

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

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

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

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

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

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



Notice:

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



RTK Fix	Set Rover S	Set	$\leftarrow$	CORS Paramet	ers Ok
Parameter			Mountpoir	nt RTCM32S	
Network	GPRS	; >	User Nam	e b	
APN	CMNET	>	Password	•	
Server	CORS > Sele	ect			
			Get Mour	ntpoints Ope	en Save
IP	218.255.188.30		Name	Data format	Descrip
Port	2101		cmr	CMR	Obs(1),In
Mountpoint	BTCM32S Se	et	RTCM3.1	RTCM3	1004(1),1012(1) 10)
			RTCM32S	RTCM3.2	1074(1),1084(1 05/1007
Configure	Datalink Othe	r	Caster	RTCM3.2	1074(1),1084(1 05/1007

Figure 3-3-7 Set Rover

Figure 3-3-8 CORS Parameters

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

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

4. In the *Data Collector Internet* mode, go to the rover setting interface, select *Data Collector Internet* of the data link, and select Sever, IP, Port, Group parameters, etc. Click *Set* to finish the station setting.
5. In the *PPP Service* mode, users can set the *Diff Mode* (satellite or network).



#### Notice:

1. When the data link is Internal GSM, the APN is SIM card parameters.

2. The APN of the data collector internet mode is the parameters of the controller. If the Wi-Fi is not connected, the controller must be installed with the SIM card to do APN settings, otherwise, there will be a prompt.

3. The controller APN parameter setting follows: controller and application  $\rightarrow$  APN setting.

$\leftarrow$	Set Rover	Set	$\leftarrow$	APN Parameters	Ok
Mountpoint	0020008007	Set	APN	ctnet	×
User Name	13674420				
Password			User Name	CMNET	
Popp			Password		
	-1027		+ RTK Fix		
	Advance Config 🔻				
Pos Frequency		1HZ >			
Store GNSS Ra	w				
APN		>			
Template	Save Save	Scan			



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

#### 3.3.3 Other Options

Set the Pos Frequency, Elevation Mask and PPK.

- Elevation Mask: Adjustable from 0 to 30 degrees.

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

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

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

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





Notice:



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

← Raw Data	Stake Point	Contrc Point
Exchange Types	Expo	rt O Import
D The Current Pr the PPK, wheth correct the dat	rompt oject has e her to use l a?	enabled PPK to
No		Yes
txt_031915		
User-defined(*.txt)		
6	🔊 ок	
Figure 3	3-3-11	PPK

# 3.4 GNSS Demo Mode

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

GNSS Demo Mo	de Start
Random	•
O Velocity	
0.0500	Random
U" Precision	
0.0300	Random
🗄 Start Point	<b>i</b>
• BLH O NEZ	
B: 23:00:00.00000N	

Figure 3-4-1 Demo Mode

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

- Random: The current point direction is displayed randomly.
- Input: Specify the traveling azimuth.



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

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

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

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

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

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

$\leftarrow$	GNSS Demo Mode	Start
➡ Direction		
Random		-
C Velocity		
0.0500		Random
UT Precision		
0.0300		Random
E Start Point		<b>I</b>
BLH	○ NEZ	
B: 23:00:00	00000N	

Figure 3-4-2 Demo Mode

# **3.5 Controller**

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



← Contr	oller O None
Controller	iHand 20
Description	Full Keybord, ZHD.
Authorization Status	Yes
Controller SN	11444213
MAC	00:08:22:3e:c3:62
IMEI	1111111111111111
Build Number	iHand20_English_V 6.0.1
Android Version	4.2.2

Figure 3-5-1 Controller

# **3.6 Additional Settings**

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

Different types of devices or connections support different functions.

← Additional Settings	← Additional Settings	
Module Info	5-pin Port Data Output	
Registration Info	Satellite Tracking Switch	
5-pin Port Data Output	Receiver Settings	
Satellite Tracking Switch	Service Info	
Receiver Settings		
Restore System	Restore System	
Network Diagnosis	Electronic Bubble Calibration	
PPP Service Authority	Network Diagnosis	

Figure 3-6-1 Additional Settings1

Figure 3-6-2 Additional Settings2



← Ser	rvice Info		← Ser	rvice Info	
Board SN	5904C02408		Board SN	5904C02408	
PPP Service Authority	2000-01-01	Register	PPP Service Authority	2000-01-01	Registe
RTK XTRa Authority	2030-12-31	Register	RTK XTRa Authority	2030-12-31	Registe

Figure 3-6-3 Additional Settings3

Figure 3-6-4 Additional Settings4

#### 3.6.1 Module Info

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

- Radio Module Type: Displays the type information of the device radio module.
- Network Module Type: Displays the type of information of the current network module.

$\leftarrow$	Module	e Info	-\$	SDGPS 42.0
Radio Moo	dule Type	SATEL		
Network M	lodule Type	ME909s_8	21	

Figure 3-6-5 Module Info

#### 3.6.2 Registration Info

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

← Regist	ration Info	-\$ SDGPS 46.0
Registration Code	208 008 014 0 143 071 249	91 031
Expiration	2018-06-16	

Figure 3-6-6 Registration Info



## 3.6.3 5-pin Port Data Output

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

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

$\leftarrow$   5-pin Port Data Output	← 5-pin Port Data Output
5-pin Port Data Output	5-pin Port Data Output
	Baudrate 19200 >
Warning	GGA 1Hz > RMC 1Hz >
receiver can not do static survey.	□ ZDA 1Hz > □ GSV 1Hz >
Cancel OK	VTG 1Hz >
Auto	Auto 0.0
⊘ Set	⊘ Set

Figure 3-6-7 Warning

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

Checking the static file and do the related operation.

-5-pin Port Data Output: ON/OFF

-Baud rate: 19200/115200.

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

#### 3.6.4 Receiver Settings

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



← Receiver Settings	5
Store RINEX Data	
Firmware Update Prompt	
Remote Connection	
USB Virtual Serial Port	
Store Static data in receiver SD card	
Sound Type	Default >
Volume 1	10
$- \begin{array}{c} & \\ & \\ \hline & \\ & \\ \hline & \\ & \\ \hline & \\ & \\ &$	

Figure 3-6-9 Receiver Settings

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

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

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

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

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

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

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

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

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



Notice:

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



## 3.6.5 Service Info

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

$\leftarrow$	Service Info	$\triangle _{0.0}^{\text{Fix Pos}}$		
V90 Plus				
🗸 DIY Vo	ice			
🗸 Remot	e Assist			
🗸 Remot	e Download			
🗸 3G Net	✓ 3G Network			
✓ Remote Diagnosis				
✓ Remote Remind				
✓ Remote Register				
✓ Remote Update				
<ul> <li>Rinex Data Storing</li> </ul>				
🗸 USB Virtual Serial Port				
🗸 Electro	onic Bubble			

Figure 3-6-10 Service Info

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

← Servi	ice Info		$\leftarrow$	Registe	r OK
Board SN	5904C02408				
PPP Service Authority	2020-01-17	Register			
RTK XTRa Authority	2030-12-31	Register			
Fix Pos 0.0			Fix F	205	

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

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



ок



Figure 3-6-13 RTK XTRs Register1



#### 3.6.6 Restore System

Restore the firmware to its original state.



Figure 3-6-15 Restore

#### 3.6.7 Electronic Bubble Calibration

Tilt survey  $\rightarrow$  Electronic Bubble Calibration

#### 3.6.8 Orientation Sensor Calibration

Tilt survey → Orientation Sensor Calibration

#### 3.6.9 Magnetic Sensor Calibration

Tilt survey  $\rightarrow$  Magnetic Sensor Calibration



#### 3.6.10 Wi-Fi Hotspot Password Set

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

←   Wi-Fi Pa	ssword Config Set
Old Password	
New Password	
Confirm New	
	Show Password
$\Delta_{0.0}^{\rm Fix  Pos}$	

Figure 3-6-16 Wi-Fi Password Config



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

#### 3.6.11 Update Firmware

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

#### 3.6.12 Network Diagnosis

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





Figure 3-6-17 Network Diagnosis



# 3.7 Console

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

$\leftarrow$	Console	Send
$\begin{array}{c} 2E \ 34 \ 39 \ 37 \ 2\\ 2A \ 34 \ 41 \ 0D \ 0\\ 39 \ 33 \ 38 \ 34 \ 3\\ 32 \ 32 \ 53 \ 82 \ 2\\ 31 \ 31 \ 33 \ 32 \ 3\\ 2C \ 31 \ 2C \ 31 \ 20 \ 33 \ 3\\ 35 \ 32 \ 39 \ 2C \ 4\\ 2C \ 30 \ 39 \ 33 \ 3\\ 38 \ 39 \ 36 \ 38 \ 3\\ 2E \ 36 \ 39 \ 37 \ 3\\ 2E \ 36 \ 39 \ 37 \ 3\\ 2C \ 30 \ 25 \ 32 \ 39 \ 22 \ 3\\ 2E \ 36 \ 39 \ 37 \ 3\\ 3E \ 39 \ 38 \ 39 \ 38 \ 38 \ 39 \ 38 \ 38$	$\begin{array}{c} \text{C 30 } \text{2E 35 } \text{35 } \text{31 } \text{2C } \text{3} \\ \text{A 24 } \text{50 } \text{54 } \text{4E 4C 2C} \\ \text{9 2E 30 } \text{30 } \text{2C 30 } \text{33 } \text{5} \\ \text{12 E 36 } \text{39 } \text{37 } \text{36 } \text{31 } \text{5} \\ \text{12 E 36 } \text{39 } \text{37 } \text{36 } \text{31 } \text{5} \\ \text{12 C 30 } \text{2E 38 } \text{2C 45 } \\ \text{D 2A 34 } \text{30 } \text{0 D 0A 24} \\ \text{8 34 } \text{39 } \text{2E 30 } \text{30 } \text{2C 5} \\ \text{5 36 } \text{30 } \text{38 } \text{2C 4E 2C} \\ \text{5 36 } \text{30 } \text{38 } \text{2C 45 } \text{2} \\ \text{5 } \text{31 } \text{37 } \text{30 } \text{38 } \text{2C 45 } \text{2} \\ \text{5 } \text{31 } \text{37 } \text{30 } \text{38 } \text{2C 45 } \text{5} \\ \text{5 } \text{31 } \text{37 } \text{30 } \text{38 } \text{2C 45 } \text{5} \\ \text{5 } \text{31 } \text{37 } \text{30 } \text{38 } \text{2C 45 } \text{5} \\ \text{5 } \text{31 } \text{37 } \text{30 } \text{38 } \text{2C 45 } \text{5} \\ \text{5 } \text{31 } \text{37 } \text{30 } \text{38 } \text{2C 45 } \text{5} \\ \text{5 } \text{31 } \text{37 } \text{30 } \text{38 } \text{2C 45 } \text{5} \\ \text{5 } \text{31 } \text{37 } \text{30 } \text{38 } \text{2C 45 } \text{37 } \text{39 } \text{38} \\ \text{C 4D 2C 2C 2A 34 } \text{30 } \end{array} $	00 2E 38 33 39 47 47 4B 2C 30 22 30 31 38 2C 00 38 2C 4E 2C 47 30 38 2C 45 48 54 35 32 2E 47 50 47 47 41 22 32 35 38 2E 31 31 33 32 31 2C 41 2C 33 31 2C 4D 2C 2D 36 0D 0A
🗹 Hex	🗹 Refresh	Save
GGA	VTG	RMC
GSV	GST	GSA
A Fix Pos	×	🖌 New Line

Figure 3-7-1 Console

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



- New Line: Select to send the new line, select it when sending commands normally.
- Send: Click to send the command after entering the command.

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

$\leftarrow \mid$	Console	Send	$\leftarrow  $	Console	Send
2C 33 30 2C 2E 35 2C 30 41 2C 41 2C	32 38 2C 32 32 2C 2C 3 2E 37 2A 32 42 0D 0A 2 33 2C 38 36 2C 38 37 20	0 2E 38 2C 30 4 47 4E 47 53 C 37 35 2C 37	OK AT+CSQ		
36 2 <u>C 38 35</u> 30 2E 35 2C 53 41 2C 41	Warning	C 30 2E 38 2C A 24 47 4E 47 C 32 36 2C 34	+CSQ: 6,2 OK		
2C 2C 41 Pass-	signal test will enter through mode, are ye	the 35 pu sure 2C 2C	AT+CSQ +CSQ: 6,2		
31 to con 31 38		20 20 20 30 1 00 0A	ок		
			GGA	VTG	RMC
GSV	GST	GSA	GSV	GST	GSA
Clear	🗹 GPRS Sign	al Test	Clear	🗹 GPRS Sig	gnal Test
Fix Pos 0.0	×	New Line	O None 0.0		🖌 New Line

Figure 3-7-2 Warning

Figure 3-7-3 Pass-through Mode



#### Notice:

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

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

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



$\leftarrow$	Console	Send
sensor values: sensor values: sensor values: sensor values: sensor values: sensor values: sensor values: sensor values: sensor values: sensor values:	232, 6, -8, 8, 1, 4 232, 3, -8, 2, 1, 1 231, 9, -6, 4, 0, 5 233, 0, -5, 8, 0, 8 233, 7, -5, 7, 0, 7 233, 8, -6, 1, 0, 5 233, 1, -6, 8, 0, 5 232, 7, -6, 8, 0, 5 232, 7, -6, 8, 0, 5 232, 7, -7, 1, 0, 5 232, 6, -7, 2, 0, 6	
Hex	🗹 Refresh	Save
GGA	VTG	RMC
GSV	GST	GSA
Ol Auto	× [	🗹 New Line



# 3.8 Static

#### 3.8.1 Static Settings



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

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



← Static	Settings		← Static	Settings
Interval	1s	•	Interval	1s 💌
File Name			File Name	
Vertical(V)	2.0000	Set	Vertical(V)	2.0000 Set
Elevation Mask(<=30°)	5		Static survey cann' El <sup>ev</sup> dynamic RTK open	t open while quasi ed <sup>°</sup>
Set Duration(h)		•	Set Duration(h)	
GDOP 1.8 Start Time Time	Static M	ode	GDOP 1.4 Start Time Time	3 Static Mode
∆ Fix Pos	Start			Start

Figure 3-8-3 Set Duration

Figure 3-8-4 Static Mode

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



Notice:

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

#### 3.8.2 Static Data Management

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

$\leftarrow$	Static Data Ma	nagement		$\leftarrow$	Static Data Ma	nagement	
id	File Name	Size	C 🕨	id	File Name	Size	
1	_3163620.GNS	14.77K	2018-02	1	_3163620.GNS	14.77K	20
2	_3160100.GNS	14.89K	2018-01	2	_3160100.GNS	14.89K	20
3	_3160101.GNS	32.38K	2018-02	3	_3160101.GNS	32.38K	20
4	_3160102.GNS	19.55K	2018-02	4	_3160102.GNS	19.55K	20
5	_3160103.GNS	12.87K	2018-02	5	_3160103.GNS	12.87K	20
6	_3160104.GNS	6.42K	2018-01	6	_3160104.GNS	6.42K	20
7	_3160240.GNS	45.34K	2018-01	7	_3160240.GNS	45.34K	20
8	3160380.GNS	39.55K	2018-02	8	3160380.GNS	39.55K	20
[	Format	🕂 Refre	sh	•	Download	🔟 Dele	te

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



- Format: Format static data, data is not recoverable.
- Refresh: Refresh the current file list interface.

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

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

# 3.9 RangeFinder

#### 3.9.1 RangeFinder Connection

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



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

#### 3.9.2 RangeFinder Intersection

Click  $COGO \rightarrow$  Intersection in the main interface to enter the intersection interface.



Angle	Distance	Co	pordinate	+ 	-   ◀ 2 ∠> Know	Pt2A 2Pt1A	1L Azi	muth
	a		o∕* <sup>©</sup> Imtud	N		0.0000		<
Area	Dist and Az	zi Int	tersection	E		0.0000		: <u>-</u>
	1200		+- ×=	z		0.0000		
Calculation	Volume	C	alculator	L	1	0.0000		8
				α		000:00:00.00000		8
Project	@ Device	Survey	COGO			Save	茾 Compu	ıte

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

When the rangefinder device is not connected, users can click the Bluetooth button 8 in the 2Pt2L, 2Pt1L, 2Pt1A1L and Azimuth interface to enter the rangefinder interface to connect the rangefinder.

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



# **3.10 Device Check**

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

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



Device

**P** 

GNSS Demo Mode

Console

(T)

Device Check

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Project

O None

#### 



**Hi-Survey Road User Manual** 

Figure 3-10-1Device Check1

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Device

Survey

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Base

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Controller

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Static

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Rover

Additional Settings

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RangeFinder

==

COGO

Figure 3-10-2 Device Check2

Figure 3-10-3 Device Check3

# Copfigur



# **Chapter 4**

# Survey

# This chapter contains:

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



**PPK** PPK collection

Culture Create

Select Point



# 4.1 Detail Survey

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



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

Q Zoom out

℅ Hide Tools

Attribute Info

**II** Turn off Auto Survey

- A Navigation
- Soom center Soom All

🕀 Zoom in

Auto Survey

☆ Expand Tools

- Intersection
- Store
- Angle of View

#### 4.1.1 Quick code

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





Figure 4-1-4 Quick Code Figure 4-1-5 Edit



#### 4.1.2 Map Navigation

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



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

# Notice:



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

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



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

Satellite Imagery 1 : Layer General 🤄 Route Search Q. Point Search

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



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

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



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





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

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

#### 4.1.3 Manual Collection

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

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





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

#### 4.1.4 PPK Collection

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

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

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



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

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

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



<del>(</del>	PPK Record	?	$\leftarrow$	PPK Record	
Echo:0	UTC:06:28:59	Count:0	N:9715405 E:4149043	9.874 d	5:0.052 5:0.039
Name	pt3		Z:47.528	c	<del>5</del> :0.003
Target H	2.0000	Pole(P)	Name	Ν	
			1	97154059.857	
GroundCode	tree 💌	y 🖻	2	97154059.873	
Station	0.0000		3	97154059.879	
			4	97154059.800	4
Count	5	•	RTK Fix	97154059.961	4
1.0 P Start n	nark 😑 Tu	Irn off record	1 1.0	ish mark	Turn

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

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



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

#### 4.1.5 Culture Create

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

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





Figure 4-1-21 Culture Create

1-Culture create switch:  $\overline{1}$  off,  $\overline{1}$  on 2-Collected culture 3-Coordinate display



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



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



### 4.1.6 Collect Input Method

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

Center: Bubble is within the set limits, centered well.

Wait Center: Waiting for the user to adjust the pole to center the bubble.

Wait Survey: Waiting 2 seconds after center, enter the survey state, and collect points in this state.

Wait Move: After the last collection point is finished, it waits for you to move the pole; after moving a distance it will start the next survey.

Out of Range: In the set limits, the bubble deviates from the center position.



Figure 4-1-26 Bubble Center

When collecting coordinate points, it supports audio and photo attributes. In the Save Point or Text interface, click  $\frac{1}{2}$  to input and view audio and photo information; the pictures displaying the current point coordinates and time in the upper right corner are saved in the file after point collection. It supports audio and photo file import by clicking Add File, audio file format can be \*.amr, \*.wav, \*.mp3 and photo formats are \*.jpg, \*.png, \*.bmp.



← Audio information OK	← Audio information OK	← Audio information OK
File Name pt7-20191125143524	File Name pt7-201911/25143524	File Name pt7-20191125143524
End record(5") Add File	Other second     Add File       Prompt     Recording is completed, do you want to append?       Listening     Cancel	Start record Add File
HTK Fix	HTK Fix	AMR File(*.amr)

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

← Image information OK	← Image information OK
File Name pt7-20191125143653	File Name pt7-20191125143653
Photograph Add File	Photograph Add File
Image List	Image List
pt7-20191125143	pt7-20191125143
636	JPG File(*.jpg)
	PNG File(*.png)
	BMP File(*.bmp)

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

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

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

#### 4.1.7 Automatic Collection

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


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

$\leftarrow$	Auto	ок	<del>(</del>	Auto	ок
Auto		Time >	Auto		Time >
Interval(s)	5		Interval(s)	5	
Sync with F	Pos Frequency	+ RTK Fix	Sync wit	h Pos Frequency	
Prefix	pt		Prefix	pt	
Time Dist		~	ID	7	
Slant Dist			GroundCode	tree	•
Bubble Is Cente	red		+ RTK Fix		

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

When the automatic collection mode is Time, the interval(s) value can be set, and it will start automatic collection according to the set time interval.

When the automatic collection mode is Distance, the interval(s) value can be set, and it will start automatic collection according to the set plane interval.

When the automatic collection mode is Slant Distance, the interval(s) value can be set, and it will start automatic collection according to the set slant interval.

When the automatic collection mode is Bubble is centered, hold it straight for automatic collection, and take away immediately after collection, with no further human intervention. Clicking on the upper-right corner of the interface *Configure*  $\rightarrow$  *Data*  $\rightarrow$  *Bubble Precision* to set the bubble precision.

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

# 4.1.8 Average Collection

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

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



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

Grap	h Average	Configur e	← Text Average e
N:971540 E:4149043 Z:47.515	59.714 a: 33.225 a: a:	0.033 0.032 0.004	<sup>26-39</sup> + <sup>KIKHX</sup> <sup>26</sup> 65 <sup>8</sup> + <sup>6</sup> ⊥ <sup>49</sup>
Name	Ν	E 🕨	+4
1	97154059.683	41490433.236	+* + <sup>2+3</sup> ⊕
2	97154059.665	41490433.236	
3	97154059.706	41490433.191	D .
4	97154059.734	41490433.275	
5	97154059.748	41490433.251	$\geq$
RTK Fix	97154059 763	41490433 204	<u>5.38cm</u>
+ 1.0 	Stop 7	🕢 ок	💽 Start 🧭 OK

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

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

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

$\leftarrow \mid$ Grap	oh Average	Configur e
N:971540	59.714 σ: 33.220 σ:	0.033 0.036
Z:47.515	σ:	0.004
Name 1	N 97154059.683	E •
2	97154059.665	41490433.236
3	97154059.706	41490433.191
4	97154059.734	41490433.275
5	97154059.748	41490433.251
	97154059 763 Start	41490433 204

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



# 4.1.9 Indirect Survey

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



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

## 4.1.10 Attribute Querying

Click (*i*) to open Attribute Querying, to enter the Attribute Querying state.

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

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



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





# 4.2 Stake Points



Figure 4-2-1 Stake Points interface

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

🖧 Choose node on line	e 🍾 Select Point	🍰 Nearest Stake Point	Angle Of View
Average Collection	Select Stake Poir	nt 💡 Single Collection	AR Stake

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

#### 1) Manual input.

2) Select from the Coordinate Library.

1

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



$\leftarrow$	Select Stake Point	ок ←	Search Res	sults OK
Detail	< > Q	Pt Nar	ne N	E
Name:	pt7	pt7	97154059.6932	41490433.2340
N:	97154059.6932	pt7	97154059.6932	41490433.2340
E:	41490433.2340			
Z:	47.5236			
Offset	Advanced Se stake Save to Stake P	arch ts Lib		

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

#### 3. Advanced Search

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

$\leftarrow$	Select Stake Point OK	<b>←</b>	Advanc	ed Search
Detail	< > Q 🔙	Name	e	
Name:	pt7	Grour	ndCode	
N:	97154059.6932	Code		
E:	41490433.2340			
Z:	47.5236			
Offset s	Advanced Search			
		$\otimes$	Cancel	🕢 ок

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

4. Select from the map (Choose node online  $\mathcal{A}$  and select a point on the map  $\mathbf{1}$ )

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



← Select F	Point From Lineonfigure	ок ←	Select Poir	nt From Linconfigure	ок
Last Point 8-2 Next Point	N 97154059.8950 E 41490433.4347 Z 47.5298 Station 0.1116	Las	8-2 kt Point	N 97154059.8950 E 41490433.4347 Z 47.5298 Station 0.1116	
Мар	List	1	Мар	List	
		Name	Station	N	►
		8-0	0.0000	97154059.8429	
⊕ (	0.11	8-1	0.0750	97154059.8583	
Q	C 0.07	8-2	0.1116	97154059.8950	
()	•	8-3	0.2000	97154059.8436	
$\approx$		× c	-	97154059.8654	
	<u>5.38cr</u>	<u>m_</u>	1		

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

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

← Select P	oint Config ?	$\leftarrow$	Select Point Config	2	<del>\</del>	Select Poin	t From Lineonfig	ure OK
Central Point		Central Point			Las	t Point E	97154059.844 41490433.371	19 7
Milestone	0.2000 ×	Milestone	0.2000	×	Nex	t Point s	Station 0.0100	
	Range 0.00~0.2		Ri	ange 0.00~0.2	N	lap	List	
Calculate Method	By Interval $\geq$	Calculate Met	hod B	y Interval >				\$
Interval	0 •	Interval	0	•	Ð		0.11	
	Save to Stake Pts Lib	By Key Points	1		Q		C 0.07	
		By Interval		~	<ul><li>♥</li><li>♥</li></ul>	400.01		<b>↑</b> ×
							L	5.38cm

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

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

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

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

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



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

÷	Select Stake Point OK
Detail	< > Q 🐺
N:	97154059.8436
E:	41490433.3629
Z:	47.5281
✓Offset st	Advanced Search
HD	0.0000
Azi	000:00:00.00000

Figure 4-2-11 Offset Stake

Nearest Stake Point: End-users click  $2^{\circ}$  icon, you can set the nearest point as the current stake point; in the process of approaching the nearest stake point, if you configure options such as voice prompts, precision, and prompt on approaching point, etc., the software will make a prompt, according to the distance, such as icons, voice, and words.

## 4.2.1 Attribute info

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



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



# 4.2.2 AR Stake

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

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

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

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



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

# 4.2.3 Prompt of Closing to the Stakeout Point

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





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

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

When the distance from the current position to the staked point is greater than the prompt distance +1, the map will revert to the size it was before the stakeout area was reduced, and the buttons  $\begin{bmatrix} + \\ - \end{bmatrix}$  or  $\begin{bmatrix} - \\ - \end{bmatrix}$  will disappear.



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

## 4.2.4 Angle of View

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

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



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



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

# 4.3 Stake Line

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

Usually, the first step is to select the line type.

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

← Antenna Stake L	ine ? Configure	$\leftarrow$	Stake	e Line Lib	ОК
		Line Name	Туре	2 Points	Start 🕅
Ð		L1	Line	Yes	97154059.84
Q	•				
[0]	$\rightarrow$				
۲	0				+ New
÷ 6 <	> *				Load
Backward 10 3368	0+10 0000				Save as
Towards the Right 0.0016 HI DeltaH -0.0105 o:	D 10.337 0.011 <u>5.00m</u>				C Open
Stake Line Lib	L1(L) >	+ Add	🖉 Edit	Delet	te 📃 More



$\leftarrow$	Stake	e Line Lib	ок	$\leftarrow$	Arc
Line Name	Туре	2 Points	Start 陀	Method	
L1	Line	Yes	97154059.84	O 2 Points	s 💿 Point+Azi
				Name	
				Line Name	Alz
				Start Point	*
				Name	pt0
				N	97154036.4928
🖍 Line	Arc	Spira Curve	e Circle	5	41400420 2260
(+) Add	🖉 Edit	Delet	e 📃 More	L	+1+90+20.3209
U Add		Delet		7	47 1126

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

-Add: Add the relevant parameter information of *Line, Arc, Spiral Curve*, and *Circle* according to your requirement.

-Edit: Edit selected existing line elements.

-Delete: Delete the selected stake line.

-Create: New \*.line file.

-Load: Accumulate line metafiles, the software will select the line element in the file and then switch to other projects and switch back. The loaded line element will be displayed in the Stake Line Library.

Line library file (\*.line) is the internal format of the software; which is generated after added, edited and saved by software. *Two-point-line* file (\*.2pt) is a public format, it can be edited by the user, choose to load *Two-point-line* to the Stake Library in the software.

-Save as: Save current line element information.

-Open: Open the \*.line file saved in /ZHD/Project/ROAD/Unnamed.

The following are the descriptions of each line type.

## 4.3.1 Define Line

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



÷	Stake	Line Lib	ок	$\leftarrow$	Line	ок	<b>←</b>	Line OK
Line Name	Туре	2 Points	Start 🍺	Туре			Туре	
L1	Line	Yes	97154059.84	<ul> <li>Line</li> </ul>	O 3D-line		○ Line	<ul><li>3D-line</li></ul>
				Method			Method	
				2 Points	s 🔿 Point+Azi		2 Point	s O Point+Azi+Slope
				Name	Named from the start point	- the end point	Name	Named from the start point - the end point
				Line Name	L2		Line Name	e 3DL2
				Start Point	*	<b>i</b> 🔁	Start Point	🚸 📻 🖸
🖍 Line	Arc	Curve	e Circle	Name			Name	
+ Add	🖉 Edit	Delet	e 🧮 More	Ν	0.0000		N	0.0000

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

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



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

1- Miles of current stake point K0+0.00

#### 2- Stake tips

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

#### **Sample Point**

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



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



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

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

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

- Ignore the Key Point: When ticked, the feature points will be automatically skipped during the stakeout, and the stakeout will be performed according to the set mileage.

-Milestone: Mileage of current staked points.

-Offset: In the direction of increasing mileage, the distance from the current point to the vertical line of the defined line (left is negative and right is positive).

-Step: Each time you enter the interface, the added value of the mileage.

-Direction: Taking a defined line as the reference, set the direction to the left or to the right.

-Save to Stake Pts Lib: When ticked, the staked points will be automatically saved to the Stake Point Lib.

## **Station Offset**

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

Add: Add mileage and offset under the current Station Offset File list.

Edit: Click to select a station offset point to modify the data.

Delete: Click to select a station offset point to delete the data.

Clear: Clear all content under the Station Offset File list.



← Sample Point	Station Offset OK	$\leftarrow$	Add	
Station	Offset	Station	0.0000	
		Offset	0.0000	
Station Official File				
Station Offset File	boundaryIme.csv /			
🕂 Add 🖉 Edit	Delete 🗙 Clear	$\otimes$	Cancel	🕢 ок

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

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

# Notice:

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



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

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

Select the *3D-line* to define a three-dimensional line, defined in two types: 2 Points and Point + Azi + Slope.

When the *3D-line* is staked, the defined stake milestone is the 3D length, not the traditional 2D projected length.

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





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

Stake instructions can be selected in two types: *Front-Back, North-South.* You can set in *Configure*  $\rightarrow$  *Stake*  $\rightarrow$  *Line Stake Guide Type.* 

If you turn on *Real-time Mileage HT Diff*, the current mileage will be displayed on the interface, and its connection with the current point will be drawn. Draw a small dot on the line to indicate the position of the projection; *Real-time Mileage* is also used to determine whether the direction of walking is correct (compare real-time mileage with stake point mileage, and increase direction).



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

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

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

## 4.3.2 Define Arcs and Spiral Curves

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



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

←	Arc OK	$\leftarrow  $	Spiral Curve	ок	$\leftarrow  $	Spiral Curve OK
<ul><li>2 Poin</li></ul>	nts O Point+Azi	Name			Z 47.1	126
Name	Named from the start point - the end point	Line Name	\$2	×	Other	
Line Nam	pt0-pt1	Start Point	* :*		Start Station	0.0000
Start Point	t 🚸 🚉 🕅	Name	pt0		Azi	000:00:00.00000
Name	pt0	N	97154036.4928		Length	0.0000
N	97154036.4928	E	41490420.3269		Radius of Start	0.0000
E	41490420.3269	z	47.1126		Radius of End	0.0000
z	47.1126 ×	Other			Direction	● Left ○ Right

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

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

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

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

## 4.3.3 Attribute Info

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





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

# 4.3.4 Prompt of Closing to the Stakeout Point

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



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

When you click  $\int_{-c}^{L}$ , the map will revert to the size before the stakeout area is reduced, and the button changes to  $\begin{bmatrix} - \\ + \end{bmatrix}$ .

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



the map will revert to the size before the stakeout area is reduced, and the buttons [+] or  $\frac{1}{2}$  will disappear.



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

# 4.4 Mapping Survey

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



Figure 4-4-1 Mapping Survey

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

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

-HRMS: The horizontal RMS of the current point;



-VRMS: The vertical RMS of the current point.



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



Figure 4-4-4 Mapping Survey Configure 1 Figure 4-4-5 Mapping Survey Configure 2

- 1-Edit point's name or it will automatically add by default
- 2-Input code of map point
- 3-Motherboard reset interval (s)
- 4-Average Progress per round
- 5-Motherboard reset progress
- 6-After the parameters are set, click Start
- 7-Click to select target high type, input target height
- 8-Measurement rounds and progress



9-Stop or pause during mapping data collection

10-Select Plane Limit Type

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

12-Press to open, you need to set  $\Sigma n$ ,  $\sigma e$ ,  $\Sigma z$  precision.

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

$\leftarrow$	Mapping Survey ?	Configur e	$\leftarrow$	Mapping Surve	y   ?   <sup>Configur</sup> e
Name	mp1		Rounds		Round 1 $>$
Target H	2.0000	Pole(P)	N:9715405 E:4149043	i9.656 σ:0.03 3.150 σ:0.02	9 + RTK Fix 1.0
GroundCode			Z:47.502	σ:0.00	5
Delay			Name	Ν	E 🕨
Average		10/10	1	97154059.634	41490433.142
Rounds		2/3	2	97154059.682	41490433.201
Reset	026 VBMS:0	10/30	3	97154059.615	41490433.160
	• •		4	97154059.592	41490433.117
() () ()	Stop 🕕 Pa	use		● Start	

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

## 4.4.1 Mapping Data

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

	<u>ŕ</u>		$\leftarrow \mid$	Mapping Da	ta	$\leftarrow$	Mapping Da	ata
Project Info	Project	Coordinate	Name	Ν	E	🗹 Nam	e N	E
Parameters	Point Library	Raw Data	mp1	97154059.6319	41490433.1767	mp1	97154059.6319	41490433.1767
		Data Transfer						
			File Name	: mapping.mcp		File Nar	ne: mapping.mcp	
Project	Device Surve	ey COGO	+ N	ew 🔁 Open	Q Search	ť	Delete	6 Edit

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



# 4.4.2 Mapping Survey Report export

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

← I ◀ Stake Point Control Mapping Data ?	← I ◀ Stake   Control   Mapping   ?					
Exchange Types   Export	Exchange Types   Export					
/storage/emulated/0/ZHD/Out	/storage/emulated/0/ZHD/Out					
testSouth CASS7.0(*.dat)						
	Scsg2000(*.dat)					
rspirtk5_html_112516	PREGEO(*.dat)					
MappingPoint Report(*.html) > Yrj Prefix	MappingPoint Report(*.html)					
⊘ ок	MappingPoint Report2.0(*.html)					

Figure 4-4-11 Mapping Data Export Figure 4-4-12 Mapping Point Report



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

# 4.5 Menu

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





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

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



Figure 4-5-3 Connection Interface3



# Road

# This chapter contains:

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



# **5.1 Operation Procedure**

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

1. Route reconnaissance and design survey

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

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

2. Road construction survey

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

# 5.2 Stake Road

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

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

## 5.2.1 Load in the Road Data

The operation is as follows:

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

← Antenna	Stake Roa	ad ? Configure	$\leftarrow$	Roa	ıd Lib	?
29-40 1.3 + RTK 1.0	Fix 😴 🛄 TO 45%		Road Name	Break Chain	RoadAlignment	RoadPro
Ð			Road Demo	~	√	~
Q						
<b>[</b> 0]	pt7 pt0 mp1	$\square$				
۲		$\rightarrow$				
Δ		8			0	View
≈ 8		*				Import
N:97154059.638	_	σ:0.009				Export
E:41490433.226 Z:47.509		σ:0.013 σ:0.030 <u>3.96km</u> ,	+ Add	🖉 Edit	Delete	More

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



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

$\leftarrow$	Roa	ad Lib	?   ОК	$\leftarrow \mid$	Road Design	ок	÷	Intersection	Element Coord	?
Road Name	Break Chain	RoadAlignment	RoadPro	Road Name	zhļd	×	Name	Station	N	•
	New	r Road		Break Chain		>				
Nam	e			Centerline		>				
	Osnasl	OK	-	Profile		>				
	Cancel	OK	. View	Cross-section	n	>				_
			Fxport	Side-section		>				Load
Add	Edit	Delete		Construction	design	>	(+) Ad	d 💿 View		More
									U 467	

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

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

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

← Road Design OK	$\leftarrow \mid$	Roa	d Lib	?   ОК	$\leftarrow$	Road Lib	? OK
RTK Fix	Road Name	Break Chain	RoadAlignment	RoadProme	Road Name	<ul> <li>File Path</li> </ul>	•
	zhd	×	~	×	zhd	/storage/emulated/0/ZHD/Projec data/roadfile/zhd.ru	t/ROAD/rspirtk5/ bad
Break Chain >							
Centerline >							
Profile >							
Cross-section >							
Side-section > CRoadAlignment data was updated!							
Construction design >	+ Add	6 Edit	Delete	More	+ Add	🖉 Edit 🔟 Delete	More

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

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



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



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

# 5.2.2 Confirm the location of Stakeout Points

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



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

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



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

#### **Sample Point**

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

#### **Station Offset**

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

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

## 5.2.3 Stakeout

This process is the same as the stake line operation.

# 5.3 Road Design

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

$\leftarrow$	Roa	d Lib	<b>?</b>   OK	$\leftarrow$	Road Design	ок
Road Name	Break Chain	RoadAlignment	RoadProme	Road Name	zhd	
zhd	×	~	×			
				Break Chain		>
				Centerline		>
				Profile		>
		0	View	Cross-section	1	>
			Import  Export	Side-section		>
+ Add	6 Edit	Delete	More	Construction	design	>

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

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



Centerline: Intersection method supports Point of intersection(\*.PHI), Poling Data(\*.CSV); Element methos supports Line Element File(\*.sec), HDPM(\*.pm), WDPM(\*.pm), LandXML(\*.xml) and Poling Data(\*.CSV); Coord method supports Coord File(\*.zline).

Profile: Support PVI file(\*.PVI) and LandXML(\*.xml).

Cross-section: Support Template File(\*.TPL) and LandXML(\*.xml).

Side section: Only support the BPI file(\*.BPI).

Construction design file: Only support Construction File(\*.BCI).

After the corresponding design file is loaded, click  $More \rightarrow View$  to enter the line preview interface; click *Apply* to return to the *Road Design* interface and prompt that *RoadAlignment* data was updated! The *Profile* is taken as an example for the explanation below.

$\leftarrow \mid$	Profile	e Editor	?
Station	Height	Slope 1(%)	Slope 2(🏷)
0.0000	50.0000	0.0000000	0.00000000
100.0000	50.0000	0.0000000	0.00000000
			Load Save
+ Add	🕐 View	Apply	More

Figure 5-3-3 Profile Editor

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

$\leftarrow$	Slope point data
Station	0.0000
Height	0.0000
Radius	0.0000000
$\otimes$	Cancel OK

Figure 5-3-4 Slope Point Data

Load: Load the edited or saved slope point data.



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

$\leftarrow$	Profile F	Preview
		\$
€ 0 © >	0 •S:0.0000 H:50.0000 T:0.0000 E:0.0000	1 •S:100.000 H:50.000 E:0.0000 E:0.0000 €:0.0000 €:0.0000 €:0.0000
þ.0000	1	Check Station

Figure 5-3-5 Profile Preview

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

←	Road Design	ОК
RTK Fix 2.0 Road Name	zhd	
Break Chain		>
Centerline		>
Profile		>
Cross-section		>
Side-section Roa	dProfile data was updated!	>
Construction d	esign	>

Figure 5-3-6 Profile updated

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

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





Figure 5-3-7 Profile Editor



# Notice:

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

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

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

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

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



← Break Chain Pile			$\leftarrow$	Add		$\leftarrow$	Break Ch	nain Pile
Name	Front Mileage	Back Mileage 🕨	Name	bc1	×	Name	Front Mile	age Back Mileage 🕨
			Front Mileage	0.0000		bc1	20.0	30.0
			Back Mileage	0.0000				
(+) Add	🗅 Load 🥑 A	pply 💾 Save	🗙 Cano	el	🕢 ок	tī	Delete	D Edit

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

-Add: Click *Add* to add the Broken Chainage pile. Input the *Name*, *Front Mileage*, and *Back Mileage*, then click *OK*.

-Edit: Long press one data, click *Edit* to modify *Name, Front Mileage* and *Back Mileage* of the pile point, then click *OK*.

-Delete: Long press one data, click *Delete* to delete the selected Broken Chainage pile. The selected data can be deleted in batches.

-Load: Click Load to directly import an existing Broken Chainage File (\*.BCP).

-Apply: After Broken Chainage pile has been loaded and edited, click Apply, it will return to the *Road Design* interface and prompt *Broken Chainage* data was updated!

-Save: Click *Save* to save the current Broken Chainage file in (\*.BCP) format. The default saves path is *ZHD/Project/ROAD/Unnamed/data/road profile*.

# 5.3.2 Centerline

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

Hi-Survey Road supports the *Intersection, Element* and *Coordinate* methods and the default line element combination within the intersection is the straight line  $\rightarrow$  the first spiral curve  $\rightarrow$  arc  $\rightarrow$  the second spiral curve.

It supports the smooth spiral curve, and the non-smooth spiral curve supports the transverse import.





# Notice:

1. Two spiral curves can be asymmetrical.

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

- 3. It supports the imaginary intersection point.
- 4. It supports the local curve, and the spiral curve length can be zero.
- 1. Intersection method



Figure 5-3-11 Intersection Graph

-Intersection JD1/JD2: The intersection of two adjacent lines.

-ZH: The point where the straight line intersects with the first spiral curve, that is, the start point of the first spiral curve.

-HY: The point where the first spiral curve intersects with the circular curve, that is, the endpoint of the first spiral curve.

-YH: The point where the circular curve intersects with the second spiral curve, that is, the start point of the second spiral curve.

-HZ: The point where the second spiral curve intersects with the straight line, that is, the endpoint of the second spiral curve.

-ZH-HY: The first spiral curve.

-YH-HZ: The second spiral curve.

-HZ-ZH: The straight line.

-HY-YH: The arc.

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



←∣ Ir	ntersection	Element Coord	2	←	Intersection		÷	Intersection
Name	Station	N	•	Name	jd	F	E	435318.9611
qd	0.0000	2542806.8800	435	N	2542801 7080			
jd	0.0000	2542801.7080	435	, , , , , , , , , , , , , , , , , , ,	2042001.7000		Station	0.0000
zd	0.0000	2542677.3560	435	Е	435318.9611		Radius	0.0000
				Station	0,0000			
				otation			L of Spirial in	0.0000
				Radius	106.0000		L of Spirial out	0.0000
			ave	L of Spirial in	20.0000		Virtual Point	
+ Add	l 🕐 Vie	ew 🕢 Apply 🗮	More	🗙 Canc	el 📀 OK		🗙 Canc	el 📀 OK

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

-Add: Add intersection data, input the *Name, N, E, Station (only need to input the mileage of the first two points), Radius, L of Spiral in and L of Spiral out*, according to the Straight line, curve and corner table. If the radius and spiral length are known, input the value; if none, no need to input.

-Load: The user clicks "load" and selects the corresponding design data of the following format data Points of intersection(\*.PHI), Poling Data(\*.CSV), XY File (\*. XY), HYDL File(\*.hjd), Road design Table (\*.xls, \*.xlsx), Surveyor Table (\*.xls, \*.xlsx).

When select the intersection method, can load in Poling Data(\*.CSV), Surveyor Table (\*.xls, \*.xlsx) to initialize intersection.

When select the element method, can load in the element file as Line Element File(\*.sec), HDPM(\*.pm), WDPM(\*.pm), Poling Data(\*.sec), Elcad(\*.ICD), Road design Table (\*.xls, \*.xlsx), Surveyor Table (\*.xls, \*.xlsx).

-View: Check whether the centerline is right.

-Compute: Input Station and Offset; it can check the coordinates; input the coordinates, calculate the station and offset.

-Detail: Click to enter the interface to check the detail parameters, including the *Intersection Points, Line Element* and *Key Pts*.

-Input Limit Point: Click r to input the limit point manually. Users can also select it from the point list or do a real-time collection to get the point.

-Change Line: Click  $\mathbb{P}^2$  to choose the point to be changed (start and endpoints are not selectable), and change it by Manual input or Select from map.

- Road Export Setting Transition Point: Click *(i)* to view corresponding auxiliary points and auxiliary dashes in the figure.





Figure 5-3-15 Centerline Preview

-Apply: The intersection file is saved in (\*.PHI) format. The default save path is in the data/road profile folder under the current project file.

-Insert: Insert intersection data above the selected point.

-Edit: Edit the intersection data that has been entered

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

$\leftarrow  $ Ir	ntersection E	lement Coord	?	$\leftarrow$	Intersection
Name	<ul> <li>Station</li> </ul>	Ν	•	L of Spirial out	220.0000
YJD4-2	557921138.803 2	3982956.1745	55		
YJD4-3	War	ning		Virtual Point	
YJD	8's data would b ect it manually!	e wrong, please		L of Parameter in	629.6348
YJD6				L of Parameter out	620 6249
JD7	Cancel	39834 <b>OK</b> 1075			029.0340
YJD8	138130812720 2.2000	3985284.0622		L of Tangent in	521.9995
YZD	138130812615 1.5800	3985975.7480			
ysha	4994.0000	54894.0000		L of Tangent out	521.9995
+ Add	View		More	× Cancel	⊘ ок

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

When involving the virtual intersection, return curve (turning over 180 degrees), the *Element* method can support, in addition, the Intersection method supports *Virtual Point* switch.

The first point of the virtual cross combination is normally entered, and after the second point is input, open the *Virtual Point* switch.



← Ir	ntersection	Element Coord		$\leftarrow$	Intersection			
Name	<ul> <li>Station</li> </ul>	Ν	•		N	2542677.3560		
qd	0.0000	2542806.8800			E	425204 7670		
jd	0.0000	2542801.7080		E		435304.7670		
zd	0.0000	2542677.3560			Station	0.0000		
					Radius	0.0000		
					L of Spirial in	0.0000		
					L of Spirial out	0.0000		
+ Add	View		/lore		🗙 Cance	еі 📀 ок		

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

-Delete: Delete the existing intersection point.

$\leftarrow$	Int	tersection	E	Element	Coo	rd	?
Name	9	<ul> <li>Station</li> </ul>			Ν		•
qd		0.0000		2543	2806.8	800	
jd		0.0000		254	2801.70	080	
zd		0.0000		254	2677.3	560	
	Dele	ete (		Insert		🖉 Edi	it

Figure 5-3-20 Edit Intersection Points

#### 2. Element method

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

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

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

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



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

In the online element method, the radius of the start and endpoint should be specially treated for the oval shape (the common palliative curve). To solve the correct radius of the start and the graph for incomplete gentle bending:

# $A \times A \div [A \times A \div R - Ls]$

It is suggested that you use Poling Data (\*.CSV) for fast-import. Just add two columns of slow bending parameters, A1 and A2, behind Poling Data (\*.CSV), and click load to build the oval curve line. Click *Start* to enter the element interface to edit the start point.

← Int	ersection	ement Coor	d ?	$\leftarrow$	Element		÷	Element
Start				Start	:		Start Radius	0.0000 🖸 🗴
Туре	Start Radius	End Radius	Length	Station	þ.0000 ×	)	End Radius	∞ ∞ ∞
L	œ	œ	100.0000	N	10000.0000		Longth	
I RTK Fix				Е	10000.0000		Lengui	0.000
1.0				Arimuth		)	Direction	Left      Right
		<b>■</b>	Load	Azimuun	000.00.00000	J	Start Offset	0.0000
			Save				Start Azimuth	000:00:00.00000
+ Add	💿 View	Apply	More	$\otimes$	Cancel 🔗 OK		× Cancel	🐼 ок

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

Click *View* to preview and edit the centerline, enter the mileage in the box at the bottom right corner. -Calculate: Input mileage and offset, check the coordinates; input coordinates, you can calculate back-projection distance and offset.

-Details: It can display detailed curve elements of the line, including line segment type, feature point coordinates, starting distance, starting position and other parameters.


Centerline Preview	←   In	tersection E	lement Coo	rd ?
\$		St	art	
	Туре	Start Radius	End Radius	Length
	L	00	00	100.0000
2115,0000	А	5.0000	5.0000	20.0000
Q         Q           Q         Q           S         Q           ≥         21.51m				
(i) Detail	(+) Add	View	Apply	E More

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

#### 3. Coordinate method

The coordinate method is similar to the element method, but the definition of each line element is determined by defining coordinates of the start and endpoint. It can only load the *Coord File* (\*.Zline) format.

In the general working process, users need to input coordinates of the start and endpoint.

Click Start to input the station and coordinate manually

Click End to input the station and coordinate manually, or select from the point list.

Click Add to choose the line type to input the line information.

-Line: Input the coordinates of the start and endpoint.

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

← Intersection   Element   Coord   ?				$\leftarrow$	Coord	
	Start			Start		
Туре	Start Radius	End Radius	Length	N		
				E		
				End		₹
				Ν	97154036.4928	×
				Е	41490420.3269	
	Line	Ar	с			
+ Add	View	Apply	More	$\otimes$	Cancel (	🕑 ок

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



### 5.3.3 Profile

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

$\leftarrow \mid$	Profile Editor		?	$\leftarrow$	Slope point data
Station	Height	Slope 1(%)	Slope 2(🏷)	Station	0.0000
0.0000	50.0000	0.0000000	0.00000000		
100.0000	50.0000	0.0000000	0.00000000	Height	0.0000
				Radius	0.00000000
			J Save		
+ Add	View	Apply	More	$\otimes$	Cancel 📀 OK

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

In the general working process, click add slope to change point data, including *Station, Height,* and *Radius* (radius of the vertical curve). All slope change point elements of the line are added in the sequence of mileage.

Click *Add* to add the slope point data and Long press the record to delete, insert or edit it. Click *View* to check the profile preview, and click *Check Station* to input the station value to check the height of the station.

#### 5.3.4 Cross-section

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

1. Standard



←   Star	ndard Supe	rEle WideF	Plus ?	$\leftarrow$	Template Editor
L	eft	Ri	ght	Name	sidewalk
Name	driveway	Name	driveway		
Wide	10.0000	Wide	10.0000		
Grade	-2.0000	Grade	-2.0000		• % U I.N
Curb	0.0000	Curb	0.0000	0	
Name	sidewalk	Name	sidewalk	Grade	2.0000
Wide	3.0000	Wide	3.0000		
Grade	2.0000	Grade	2.0000	Wide	3.0000
Curb	0.3000	Curb	0.3000		
				Curb	0.3000
Left-ri	ight Identity				
+ Add	View	Apply	— More	$\otimes$	) Cancel 🔗 OK

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

-Name: The name of the current plate.

-Grade: From the middle of the road, uphill is positive and downhill is negative. The slope value is the ratio of the height difference between the two ends of the plate and the width of the plate.

-Wide: The width of the current plate.

-Curb: Click to input the height difference of the curb.

-Left-right Identity: The selection indicates that the left and right slopes are consistent, and the right slope data will be covered with data symmetrical to the left slope (the original right slope data will be covered and cannot be recovered).

In the general working process, click *Add* to define the cross-section, select slope ratio input mode, slope ratio, and width, and click display to check whether the graph is correct after editing.

-Check station: Enter station value to view the specified mileage profile

-Cross Line Info: Click (i) to view the detail cross line information.

$\leftarrow$	Template Preview							
	\$							
Ð	3.00 10.00 10.00 3.00							
Q	2.00% -2.00% -2.00% 2.00%							
*	×							
0.0000	Check Station							

Figure 5-3-32 Template Preview





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

#### 2. SuperEle

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

← Star	ndard Supe	rEle WideP	'lus ?		← Stan	idard Supe	erEle WideP	'lus ?
L	Left		Right		Station	Grade	Gradual	Plates
Name	driveway	Name	driveway		20.0000	-1.5000	Linear	Left:1
Wide	10.0000	Wide	10.0000					
Grade	-2.0000	Grade	-2.0000					
Curb	0.0000	Curb	0.0000					
Name	sidewalk	Name	sidewalk					
Wide	3.0000	Wide	3.0000					
Grade	2.0000	Grade	2.0000					
Curb	0.3000	Curb	0.3000					
Left-ri	ight Identity							
+ Add	View	Apply	More		+ Add	View	Apply	More

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

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

←   Standard   SuperEle   WidePlus   ?			$\leftarrow$	Stand	dard Supe	rEle WideP	lus ?	
Station	Grade	Gradual	Plates	Stati	ion	Grade	Gradual	Plates
20.0000	-1.5000	Linear	Left:1	20.00	000	-1.5000	Linear	Left:1
				drive	way			~
Le	ft	Rig	Iht	sidew	alk			
+ Add	View	Apply	More					

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

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



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

← Edit SuperEle	←   Standard   SuperEle   WidePlus   ?
Milestone 0.0000	Station Grade Gradual Plates
	20.0000 -1.5000 Linear Left:1
● % ○ 1:N	
Grade 0.0000	
Gradual Linear >	
Cancel OK	+ Add View Apply To More

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

Click View to check it after adding SuperEle points.

Enter the *Milestone* in the lower right box and click *Check Station* to view the cross-section in the corresponding milestone.

← Template Preview	← Template Preview
\$	\$
⊕       3.00       10.00       10.00       3.00         ♀       2.00%       -1.50%       -2.00%       2.00%         ♥       ♀       ♀       ♀       9.68m         ♥       ♀       ♀       ♀         ↓       Check Station       ♦	€       3.00       10.00       10.00       3.00         €       2.00%       -2.00%       2.00%         €

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

#### 3. WidePlus

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



In the *WidePlus* interface, users can input the widening change point information, according to the design drawings.

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

← Standard SuperEle WidePlus ?	$\leftarrow$   Standard   SuperEle   WidePlus   ?
Station Wide Gradual Plates	Station Wide Gradual Plates
	driveway
	anony
Left Right	sidewalk
+ Add View Apply _ More	

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

WidePlus change point 1: Milestone 20 Wide 4.5

WidePlus change point 2: Milestone 30 Wide 5.2

WidePlus change point 3: Milestone 40 Wide 6

WidePlus change point 4: Milestone 50 Wide 5.2

WidePlus change point 5: Milestone 60 Wide 4.5

$\leftarrow$	Edit WidePlus	;	←   Stan	dard Supe	rEle WideP	'lus ?
Milestone	20.0000		Station	Wide	Gradual	Plates
			20.0000	4.5000	Linear	Right:1
Wide	4.5000					
Gradual		Linear $\geq$				
$\otimes$ (	Cancel	🕢 ок	+ Add	View	Apply	More

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

Click *View* to check the template preview, and input the station value to check it.

Enter the mileage in the lower right box and click *Check Station* to view the cross-section in corresponding mileage.



$\leftarrow$	Template Preview	$\leftarrow$	Template Preview	
	\$		\$	
Ð	3.00 10.00 4.503.00 2.00% -1.50% -2.00%	Ð	3.00 10.00 4.503.00 2.00% -1.50% -2.00%	
D ()	(i)			D
*	*	*	*	/
	9.68m		<u>9.68n</u>	<u>n</u>
þ.0000	Check Station	40	Check Statio	on

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



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

#### 5.3.5 Side-section

In the Side-section interface, users can add, load, apply, and save the side-section.

-Add: Click to choose and add the Fill or Cut. Input the side-section name, and edit the side-section features.

$\leftarrow$	Side-section	?	$\leftarrow$	Side	-section	?
Side list			Side list			
left	Cut		left		Cut	
right	Fill		right	Side	e name	
			fill	Cancel		ок
Fill		Cut		Fill		Cut
+ Add	📩 Load 🕢 Apply	y 💾 Save	+ Add	📩 Load	🕢 App	oly 🏼 💾 Save

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



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

$\leftarrow$	Load					
	Ø					
/storage/emulat	ed/0/ZHD/F	Project/ROAD/	rspirtk5/data			
	roadfile	roadprefile	sidesection .BPI			
BPI File(*.BPI)			>			

Figure 5-3-49 Load BPI File

-Apply: Click to apply the slope in the current side-section list to the current project road, and it will prompt Use data successfully.

-Save: Click to save the file in the BPI File (\*.BPI) format. And the saved \*.BPI file can be loaded successfully.

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

$\leftarrow$	Side-section	2	$\leftarrow$	← Cut:le		ок	$\leftarrow$	Side Preview
Side list			Factor name	Start offset	End offset	Start delt		
left	Cut		d1Inside	0.0000	0.0000	0.0000		
right	Fill		d1Bottom	0.0000	1.0000	-0.3000		/
			d10utside	1.0000	1.0000	-0.3000		
			p1	1.0000	2.0000	0.0000		
			h1	2.0000	7.0000	0.0200		
						·	Ð	
							Q	
_						_	۲	
Delet	te 🖉 Edi	t	(+) Add	Edit	🕚 View	Delete	$\approx$	2.15m

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



#### **5.3.6 Construction Design**

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

$\leftarrow$	Construct	tion editor	2	←   c	onstruct Info	← P	reView Construct
Station	Construction type	Construction practices	Angle	Station	0.0000		\$
				Construction type	Cover culvert $\geq$		
				Construction practices	Slanting $>$	Ð	
				Angle	090:00:00.00000	Q	
		<b>F</b>	Load	Front width	0.0000		
		Ē	] Save	Back width	0.0000	~	≥
+ Add	View	Apply	More	× Cancel	🐼 ок	Choose Construct	Cover culvert(K0+50.0000) >

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

-Add: Click Add to select the construction type and construction practice on the Construct Info interface, input the Station, Angle, Front width, Back width, Left length, Right length, Center height, and Slope, click OK.

-View: Click *View* to enter the construction preview interface, you can view the designed construction graphic. Click the selection bar below to switch the multiple construction graphic display.

-Apply: Click Apply to refresh the data.

-More: Click *More* to load the construction design file or save the designed construction.

#### 5.3.7 Road Data Export

The road data will export in the road library.

The steps as below:

(1) Select the road in the road list, click "more-> export" to export the road file.



$\leftarrow$	Roa	?	
Road Name	Break Chain	RoadAlignment	RoadPro
Road Demo	~	~	~
			View
			) Import
			Export
	2 Edit		<u> </u>

Figure 5-3-56 Export interface

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

←   Set Export	ок	←   R	oad Export Setting	ОК
/storage/emulated/0/ZHD/Out		Start Sta	0.0000	×
		End Sta	320.0000	
		Station Interval	20.0000	
Road Export Setting: Start Sta:K0+0.0000 End Sta:K0+320.0000 Station Interval:20.0 Sequence Rule:Start From Closest Interval		Sequence Rule	Start From Closest I	nterval >
Center Station File(*.CSV)	>			

Figure 5-3-57 Center Station Data Export Figure 5-3-58 Road Export Setting

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



← Road Lib ?									
Road Name	Name Break Chain RoadAlignment								
Road Demo	~	~	V						
Center Sta	ation File(*.CS <sup>v</sup>	√)	~						
Line Elements File(*.Sec)									

Figure 5-3-59 Line Elements Data Export

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

$\leftarrow \mid :$	Set		E		ок						
<u> </u>	/storage/emulated/0/ZHD/Out										
Center	Statio	n File	(*.CS'	<b>v</b> )				>			
q <sup>1</sup> v	v <sup>2</sup> e	° i	• 1	5 }	/ L	7 1	i <sup>®</sup> c	° p			
а	s	d	f	g	h	j	k	L			
<b>±</b>	z	х	С	V	b	n	m	×			
?123	,		E	Englisł	١			e			

Figure 5-3-60 Name interface



# 5.4 Store Cross-section



Figure 5-4-1 Store Cross-section

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

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

-Store: Click 😵 to collect points and input the cross-section information. If the *Center Point* is selected, the point will be used as the reference point of the cross-section. The cross-section point library will store the horizontal elevation of other points on the cross-section relative to the center point (each section must define a section mileage and collect the center point, otherwise the section points collected in this section will be invalid, or users need to add the center point manually afterward). -Road Designer File: Click 🔄 to load existing files

-Switch View: Click ||| to switch to the cross-sectional view and check it.

-Intersection: Click *s* to jump to intersection survey interface, please refer to *Tool Chapter*.



$\leftarrow \mid$	Cross-section I	nfo OK	$\leftarrow$	Cross-section In	fo
Station	0.0000		Add Station		No Operation
Name	pt1	Center Point	Target H	2.0000	Pole(
Add Station		No Operation $\geq$	GroundCode		~
Target H	2.0000	Pole(P)	Status:RTK Fix N:97154059.83 E:41490433.19 Z:47.519	34 02	
GroundCode		•	B:22:58:53.833 L:113:21:41.82 H:47 519	305N 2482E	σ:0.018 σ:0.015 σ:0.041
Status:RTK Fi	x 834		Time:2019-11-	25 18:06:02.0	
E:41490433.1 Z:47.519	92		Projection Stat Center Point N	tion:97154059.8337 :0.000	
B:22:58:53.83 L:113:21:41.8 H:47.519	305N 2482E	σ:0.018 σ:0.015 σ:0.041	Center Point E Tilt Angel:00:0 Tilt Azi:	:0.000 0:00.00000	

Figure 5-4-2 Cross-section Info1



When adding or subtracting mileage for the next sample point during crosssection collection, add feature point for judaments.

$\leftarrow$	Define	ок	~
Station E	nd		Roa
Milestone	2.0000		
Step	10.0000	•	
Range			
Left	50.0000		
Right	50.0000		
Other			
Angle	090.00.00		9



Figure 5-4-4 Define Figure 5-4-5 Road Lib



Figure 5-4-6 Top View Figure 5-4-7 Cross-section View





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

# 5.5 Cross-section Points

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

<del>~</del>	Cross-sec	tion Points		← Directory 0	ĸ
Name	Sta	Offset	нт 🕨	/storage/emulated/0/ZHD/Out	
		ſ	Load	test	
		E	New	test	
File Name	: MainCst.cst	8	Work Cal	HDMX(*.DMX)	>
Cente	er 🗁 Open	Export	More	Multi-transect 5.0000	

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

$\leftarrow$	Cross-see	ction Points		$\leftarrow \mid$	Cross-se	ction Points	
Name	Sta	Offset	нт 🕨	Name	Sta	Offset	нт І
pt1	0.0000	434541.6548	47.6852	pt1	0.0000	434541.6548	47.6852
pt2	0.0000	434541.6550	47.6757	pt2	0.0000	434541.6550	47.675
HDMX(*.E CRECG(*. HDM(*.hd	DMX) txt) Im)		~	South CA	SS7.0(*.dat) SS7.0(*.hdm)		
WDMX(*.dmx)				Defined(* HDMG(*.[	.txt) DMG)		
BGHN(*.b	ighn)			EICAD(*.H	IDX)		

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

-Center Point: Click to add the center point.

-Open: Open other point files in the project.



-Export: Export files to other data formats, including HDMX (\*.DMX), CRECG (\*.txt), HDM (\*.hdm), WDMX (\*.dmx), BGHN (\*bghn), HDMG (\*.DMG), South CASS7.0 (\*.dat), South CASS7.0 (\*.hdm), Defined (\*.txt) and EICAD (\*.HDX).

-Load: Load and merge cross-section data in current or other projects.

-New: Create a new cross-section points file in the project.

-Work Cal: Click to enter the Earthwork Calculation interface.

In the *Earthwork Calculation* interface, it will load all the cross-section points by default to the calculation list.



Figure 5-5-5 WorkCal

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

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

Earthwork Calculation			$\leftarrow \mid$	Earthwork C	alcula	ation		
Start Sta	0.0000	X Mult	i- sect	Start Sta	0.0000		Multi- transe	ect
End Sta	0.0000			End Sta	0.0000		5.000	ο
Name	Sta	Offset	HÌF	Name	Sta		Offset	HÌF
🔊 Avera	ge Method	🛞 Pyramid I	Method	🔊 Avera	ge Method		Pyramid N	/lethod

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



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

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

# 5.6 Surface

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

÷	List S	urface	?
Surface Name	Quantity of points	Quantity of triangles	Area
			View
		C	) Import
			Export
+ Add	🖉 Edit	Delete	More

Figure 5-6-1 Surface

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



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



-Delete: Delete existing surfaces. Long press the surface in the library list to delete it. When the selected surface is being staked out, it cannot be deleted.

-Edit: Edit existing surfaces. Long press the selected surface point to delete or edit it.

-Import: Import the surface file which will be added to the list. You can import surface files across projects. The file format supports the Hi-Target file (\*ttin), CASS file (\*.sjw), and LandXml file (\*.xml).

-Export: Click to export the surface file in the CASS Format (\*.sjw) format saved in *ZHD/OUT* by default.

-View: Select or create a new surface, and then check it in the Surface Preview.

-Check Surface Point: Calculate the elevation of the input point. If the point is not on the surface, it can't be calculated. If the point is on the surface, click *OK*, the point will be saved in the Stake Point library and the *GroundCode* will be *Check Surface Point*.



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

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

# **5.7 Elevation Difference**

This function is to calculate the elevation difference between the current point and the fitted point of the selected surface.

Click *Stake Surface Lib* to choose the surface to stake out, then it will display the TIN grid information in real-time. The *Fill* value will be displayed on the top left, and the coordinates and detailed height will be displayed on the bottom slide bar.





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

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



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

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



$\leftarrow$	List S	urface	?   ОК	$\leftarrow$	а	ок	$\leftarrow$	а	ОК
Surface Name	Quantity of points	Quantity of triangles	Area⊉I	Name	N	E	Name	N	E
а	3	1	16.78	pt0	97154036.4928	41490420.3269	pt0	97154036.4928	41490420.3269
zone	3	0	0.00	pt2	97154058.6368	41490431.2964	pt2	97154058.6368	41490431.2964
				pt3	97154059.8950	41490433.4347	pt3	97154059.8950	41490433.4347
+ Add	6 Edit	Delete	More	(+) Ad	dd 🕂 Batch	View	Ī	Delete	6 Edit

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

# 5.8 Surveying Configure

The surveying configuration is a common menu that is used to configure the graphical display of the work interface, including the road and general survey configuration of the *Detail Survey, Stake Points, Stake Line, Stake Road, Store Cross-section* and *Road Design*.

(Common functions also include: *Zoom In, Zoom Out, Zoom Center, Zoom All, Single Record, Average Record*, unified introduction in this chapter, other chapters will not be introduced).



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

#### 5.8.1 Display

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



← Display Data Stake	2
🛠 Road Survey Config	
Cross-section Point	
Roadline Transition Point	
🛠 General Survey Config	
Coord Point	
Group Display	>
Tool Display	>
Stake Point	

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

-Cross-section Point: Select whether to display the point name of the cross-section point during the road collection.

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

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

←   Display   Data   Stake   ?	←   Display   Data   Stake	?  Cisplay Data Stake ?
🛠 General Survey Config	Stake Line Lib	Display Elevation
Coord Point	Voice Prompts	Electronic Bubble
Group Display >	Optimize Scale	Realtime Mileage
Tool Display	Centered Display GPS	Dist to last Coord Pt
Stake Point	Keep GPS Centering	Fix Direction
Control Point	Display Name	Controller Dir
Stake Line Lib	Display Desc	Display Color
Voice Prompts	Display Elevation	Online Map None >

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

-Coord Point: Choose whether to display the coordinate point name.

-Group Display: The points with the same description code can be displayed with one group. There are many groups to display all the coordinates.



-Tool Display: The *Tool Display* can show or hide icons of the *Detail Survey, Stake Points, Stake Line, and Elevation Difference* in the left and right toolbar. Entering the *Tool Display* configuration, the user can select to display or hide the module and the location of the module.

The left side of the tool menu is an optional display, and the right side is the selected display. Click the icon on the left side to add the tool to the selected display on the right, and you can delete or move the selected display tool. If the resident box is checked, the tool will not be hidden by the shrink in the corresponding interface.

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

$\leftarrow$	Tool D	isplay	ОК
Module	•	De	tail Survey $>$
Locatio	n	Le	ft Tool Bar $>$
Support	ed Tool	Selected	Tool Reset
Ð	Zoom In	Ð	Perman
Q	Zoom Out	Q	Perman
<b>[</b> 0]	Zoom Center	<b>(</b> )	Perman
۲	Zoom All	٢	Perman
Δ	Navigation	Δ	< Perman
D 🕅	elete 🔺	Up	<ul> <li>Down</li> </ul>

Figure 5-8-7 Tool Display

-Stake Point: Choose whether to display the stake point name.

-Control Point: Choose whether to display the control point name.

-Stake Line Lib: Choose whether to display the stake line library.

-Voice Prompts: Choose whether to open the voice prompts. Users can record user-defined voice prompts in the \*.wav format: the file storage path is *ZHD/Sounds*.

←   Display   Data   Stake	?	Internal storage ZHD
Stake Line Lib		E LOG
Voice Prompts		
Optimize Scale		Cut
Centered Display GPS		Project
Keep GPS Centering		Sounds
Display Name		
Display Desc		Template
Display Elevation	+ RTK Fix	<b>□</b> , · · ·

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



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

-Optimize Scale: Choose whether to automatically adjust the scale to the right size. When enabled, it will automatically adjust the screen display based on the coordinate range in the coordinate data, and the Centered Display GPS and Keep GPS Centering will be invalid.

-Centered Display GPS: When the current point is not in the screen display range, the current point will be automatically centered.

-Keep GPS Centering: The current point is always in the middle of the screen.

-Display Name: Choose whether to display the point name.

-Display Desc: Choose whether to display the description code (name should be displayed first).

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

-Electronic Bubble: Choose whether to display the electronic bubble. When it's not displayed, the inclination won't participate in the acquisition accuracy judgment.

-Real-time Mileage: Select whether to display the current real-time mileage value in the Stake Line and Stake Road interface.

-Dis to last Coord Pt: Select whether to display the distance to the last point.

-Fix Direction: Smooth the sample over a period of time, and the calculated direction value will be relatively stable to reduce the irregular beats in direction.

-Controller Dir: After selecting, click *OK* as prompted to keep the controller screen upward, and move the controller according to the prompt to complete the calibration. Then return to the survey interface; the direction of the current point will be the direction of the controller.

-Display Color: Select whether the map is displayed in the feature color.

-Online Map: Select Google map as the base map for surveying or stakeout. Make sure the network is connected and it has updated to the latest Google service.

#### 5.8.2 Data

The data configuration contains the Road Survey Config and General Survey Config.

-Road Survey Config: includes Cross-section Precision and Store Cross Without Centerline.

-Cross-section Precision: the default value is 0.0500m.

-Store Cross-section without centerline: Turn on the switch to directly capture the mid-pile and crosssection points in the cross-section without centerline file.

-General Survey Config: Required Solution, Working Area, Physical Record Button, Point Info Dialog, Auto Start Average, Auto Store After Average, Store Average Points, Allow Same PtName, Tilt Survey, Bubble Precision (<2.0000), HRMS Tolerance, VRMS Tolerance, Stake Tolerance, Stake Prompt in, Mileage Tolerance, PtName Increasing by and No Fixed Prompt in(s).



← Display Data S	take ?	← Display Data	Stake	?	←   Display   Da	ata Stake
🛠 Road Survey Config		Auto Start Average			VRMS Tolerance	5.0000
Cross-section Precision	0.0500	Auto Store After Average	(		PODP Tolerance	4.0000
Store Cross Without CenterLine		Store Average Points	(		Stake Tolerance	100.0000
🛠 General Survey Config		Allow Same PtName	(		Stake Prompt in	100.0000
Required Solution	Auto >	Tilt Survey	(			
Working Area	>	Dubble Developer (+0.0000)	0.0000		Mileage Iolerance	0.0500
Physical Record Button	Single Record $\geq$	Bubble Precision(<2.0000)	0.0800		PtName Increasing by	1
Point Info Dialog		HRMS Tolerance	3.0000		No Fixed Prompt in(s)	60

Figure 5-8-10 Data Configure 1 Figure 5-8-11 Data Configure 2 Figure 5-8-12 Data Configure 3

-Required Solution: Limit the solution type, including *the Auto, SDGPS, DGPS, Float,* and *Fix*. When the solution type is limited to the *Fix*, the accuracy prompt box will not pop up if the solution is acquired in the fixed solution state.

-Physical Record Button: Set the collection key **equivalent** on the physical keyboard as the *Single Record* or *Average Record* shortcut key.

-Point Info Dialog: Choose whether to display the point information confirmation box after collection.

-Working Area: Users can draw the range of the survey area and select over range tips.

$\leftarrow$	← Survey Area				
🗹 draw	/ survey area	🗹 over range	e tips <u> </u>		
Name	N	E	z 🕨		
pt0	97154036.4928	41490420.3269	47.1126		
pt6	97154059.8429	41490433.3619	47.5281		
			View Load Batch		
+ Add	🖉 Edit	Delete	More		

Figure 5-8-13 Working Area

-Auto Start Average: Check this option and click the average button, to enter the average collection interface, to automatically start smoothing. If this option is not checked, the smoothing won't start automatically, users need to click the start button in the average collection interface to start. -Auto Store After Average: After it's turned on, click *OK* to do the average collection. When the

number of smoothing reaches the set number, it will automatically exit the average interface and save points. Users can also click *OK* to end the average collection in advance.



-Store Average Points: Choose whether to save average data automatically.

-Allow the Same PtName: Choose whether users can collect points with the same name.

-Tilt Survey: Tilt survey can be done after turning on, and there will be tilt correction during data processing to get coordinates of points to be measured (only for specific models, and users can only start the tilt correction after completing calibration steps).

-Bubble Precision (<2.0000): Set the electronic bubble acquisition accuracy. The acceptable range of tilt distance when acquiring coordinates is recommended to be within 30 degrees.

-HRMS Tolerance: The horizontal RMSE of points, users can enter the maximum RMSE limit. When collecting points, there will be a prompt if it exceeds the limit value.

-VRMS Tolerance: The vertical RMSE of points; users can enter the maximum RMSE limit. When collecting points, there will be a prompt if it exceeds the limit value.

-Stake Tolerance: The precision limitation of stakeout points. Within the limit, the software will indicate that it has reached the accuracy range of the stakeout. If the sound prompt is enabled, an audio prompt will be given.

-Stake Prompt in: Set the prompt range of the stakeout. When the stakeout point is within the range, the range line will change color. If the sound prompt is enabled, an audio prompt will be given.

-Mileage Tolerance: Set the maximum error limit for real-time mileage.

-PtName Increasing by: The accumulation number value of the point name suffix. The default value is 1.

-No Fixed Prompt in (s): Voice prompt interval when the fixed solution is reached. The default value is 60s.



**Notice:** The default value of data collection accuracy of the fixed solution in the software is the value (m) shown in the figure below

← Display Data	Stake ?
Bubble Precision(<2.0000)	0.0800
HRMS Tolerance	3.0000
VRMS Tolerance	5.0000
PODP Tolerance	4.0000
Stake Tolerance	100.0000
Stake Prompt in	100.0000
Mileage Tolerance	0.0500

Figure 5-8-14 Data Configure



#### Notice:

1. Tilt Survey is only visible when connecting a receiver that supports tilt measurement (V90 plus/iRTK5).

2. If *Tilt Survey* is not turned on when the receiver is not level, the collection point and the saved point is the actual GPS location in the figure, not the point needs to be measured, so when Tilt Survey is not opened, please keep the receiver strictly level to collect the coordinates.

3. If *Tilt Survey* is turned on, when the receiver is not level, the software can automatically calculate the actual GPS location to the point that needs to be measured. At this time, the collection point and the saved point is the point to be measured.



#### 5.8.3 Stake

The stake configuration contains the Road Survey Config and General Survey Config.

-Road Survey Config: Includes Real-time Mileage HT Diff, Road Stake Guide Type.

-General Survey Config: Includes Point Stake Guide Type, Line stake Guide Type, Stake Order, Mileage interval stake, Show Offset on Map, Check Move Direction, Map North Direction, Repeat Stake, StkName as PtName, Named by Station, Named by Real-time Station, Save Mileage and Save Real-time Mileage, Previous/Next Point Floating Button.



← Display Data	Stake ?	←   Display   Data	Stake ?	← Display Data St	ake ?
🛠 Road Survey Config		Line Stake Guide Type	Front-Ba >	Map North Direction	Map North >
Real-time Mileage HT Diff		Stake DeltaH Type	DeltaH >	Repeat Stake	
Road Stake Guide Type	Front-Back $>$	Point Stake Order	Ascendi >	StkName as PtName	
Construct Height	.0000 ×	Projection method	Near Cur >	Named by Station	
🛠 General Survey Config		Real-time mileage stake		Named by Real-time Station	
Line selection method	Polyline >	Show Offset on Map		Save Mileage	
Point Stake Guide Type	North-So >	Voice Prompts		Save Real-time Mileage	
Line Stake Guide Type	Front-Ba >	Check Move Direction		Previous/Next Point Floating Button	

Figure 5-8-16 Stake Configure1 Figure 5-8-17 Stake Configure2 Figure 5-

Figure 5-8-18 Stake Configure3

-Real-time Mileage HT Diff: After turning on, the height difference in the information bar of the *Stake Road* interface is the height difference between the current point projection on the line and the current point (make sure there is a road profile).

-Road Stake Guide Type: Select the stake guide type, including *Front-Back* and *North-South*.

-Line selection method : Includes *Polyline* and *Line Section*, the default is *Polyline*. When selecting *Polyline*, all the line section on the polyline will be selected when *Stake Points*  $\rightarrow$  *Choose node online* or *Stake Line*  $\rightarrow$  *Map*; when selecting *Line Section*, only the nearest line section will be selected.

-Point Stake Guide Type: Select the point stake guide type, and it contains *Front-Back* and *North-South*. In addition, when you use *Front-Back*, the software will open the *Reference Direction* option, and it contains *Sun Azimuth*, *Base Azimuth*, and *Custom Azimuth*.

-Line Stake Guide Type: Select the stake guide type, including Front-Back and North-South.

-Stake DeltaH Type: Set height difference as DeltaH or Fill Or Cut.

-Point Stake Order: Select stakeout points with ascending or descending order.

-Projection Method: It refers to the way in which the software places the receiver position onto the line during *Stake Line* or *Stake Road*. When the line is a retrograde curve, there may be multiple projection points on the line, and different projection positions may result in different real-time mileage and offset calculation results. The software set the default mileage projection method is *Near Current Pt*, and the customer can change it according to actual needs.

-Real-time mileage stake: It is turned off by default, the real-time mileage point is staked out; after turn on, it is staked at the specified mileage interval, and the previous mileage/next mileage stakeout is supported to freely switch.

-Show Offset on Map: When turned on, the stakeout prompt will be displayed on the map during the point stakeout process. If the *Check Move Direction* is turned on at the same time, and the distance from the current point to the stakeout point is greater than the stakeout distance, the horizontal



distance from the current point to the stakeout point will be displayed; otherwise, the front-back or south-north prompt will be displayed.



Figure 5-8-19 Offset

1-In the Front-Back mode, the left arrow indicates left, and the right arrow indicates right. In the North-South mode, the left arrow indicates the west, and the right arrow indicates the east.

2-In the Front-Back mode, the upward arrow indicates forward, and the downward arrow indicates backward. In the North-South mode, the upward arrow indicates the north, and the downward arrow indicates the south.

3-Heitht difference in Front-Back and North-South mode.

-Voice Prompt: When Stake Points, Stake Line, and Stake Road, it will give voice prompt according to the direction and distance. You can set the Prompt Interval(s).

-Check Move Direction: After turning on, when the distance from the current point to the stakeout point is not within the range of the stakeout distance, a large arrow will be displayed to indicate the deflection angle between the moving direction and the direction from the current point to the stakeout point. If it's approaching the stakeout point, it will be displayed in green. If it's moving away from the stakeout point, it will be displayed in red. If the moving direction is almost perpendicular to the direction from the current point to the stakeout point, it will be displayed in yellow.







Figure 5-8-20 Moving Direction

-Map North Direction: Select the map direction, including the Map North or Forward.

-Repeat Stake: When turned on, it supports the repeat stake. Users can choose whether to skip the collected stakeout points automatically.

-StkName as PtName: Select whether to set the stakeout point name as the default point name.

-Named by Station: Select whether to set the station as the default point name.

-Named by Real-time Station: Select whether to set the real-time station as the default point name. This option can't be opened simultaneously with the Named by Station.



**Notice:** When turning on the Named by Station or Named by Real-time Station option, users need to select the Allow Same PtName option in the Configure  $\rightarrow$  Data interface.



-Save Mileage: When collecting points, the mileage will be automatically filled as the staked point mileage.

-Save Real-time Mileage: When collecting points, the mileage will be automatically filled as the realtime projection mileage (the Save Mileage and Save Real-time Mileage must and can only be selected one at a time).

-Previous/Next Point Floating Button: When it is turned on, the Previous/Next icon will be displayed directly on the Staking interface, which is convenient for clicking and selecting the staking point.



Figure 5-8-21 Previous/Next Point



# **Chapter 6**

# COGO

# This chapter contains:

- Angle
- Distancen
- Coordinate
- Area
- Dist and Azi
- Intersection
- Angle Calculation
- Volume
- Point and Line
- Calculator
- Share
- FTP
- Compass





# 6.1 Angle

Support *Radian, Degree, DMS, Gon, Mil* angle units transforming mutually. After you input a value to any item, click *Compute*: other several values will be calculated.

$\leftarrow$	Angle			
Radian	0.0000			
Degree	0.0000			
DMS	000:00:00.00000			
Gon	0.0000			
Mil	0.0000			
Compute				

Figure 6-1-1 Angle Conversion

# 6.2 Distance

÷	Distance		
km	0.0000		
m	0.0000		
cm	0.0000		
mile	0.0000		
nautical mile	0.0000		
yard	0.0000		
	Compute		

Figure 6-2-1 Distance Conversion

Support *km, m, cm, mile, nautical mile, yard, foot, inch* distance units transforming mutually. After inputting a value to any item, click *Compute*: other several values will be calculated.

#### 6.3 Coordinate

Coordinate conversion supports tow conversion methods including Point and File.



#### 6.3.1 Point

The data includes source ellipsoid and local ellipsoid. After inputting point information, you can switch between BLH, XYZ or NEZ. Click *To Local* or *To Source* to complete conversion between source ellipsoid and local ellipsoid. The coordinate of points can be selected from the real-time collection, coordinate library or map.

$\leftarrow$	Coordinate	9	~		Devic	e	ОК
Ø Source	3	🚸 📻 😥					
BLH	⊖ xyz		E	ectronic Bubl	ble:Center		
B:	00:00:00.00000N		B	22:58:53.832 113:21:41.82	256N 2434E	σ: 0.012 σ: 0.012	
L:	000:00:00.00000E		H Ta	47.505 rget H 2.00	000	σ: 0.035	Pole(P)
H:	0.0000			Average	ne point library		
Ø Local		🚸 🗐 🕅	N	ime	pt0		
⊖ BLH		• NEZ	GI	oundCode		<b>▼</b> (	0
ت ک	To Local	> To Source					

Figure 6-3-1 Coordinate Conversion Figure 6-3-2 Receiver Collection

←  Coor	d Point Stake Point	Contro Point	←   Мар	ОК
Name	< N	E 🕨	<b>D</b> 000000	8
B032009	20026070.1549	19367587.4692	amp2	
pt1	20026070.1549	19367587.4692	+ 832015	
pt2	20026070.1549	19367587.4692	pt5	
pt3	20026070.1549	19367587.4692	€ N:20026049:2047 pt2	5
pt4	20026070.1549	19367587.4692	Q	
pt5	20026049.2047	19367610.7659	[0]	$\rightarrow$
				ℯ
				<b>1</b> √
Q	Search	🖻 Open	Ľ _	3.51m

Figure 6-3-3 Point Library Selection Figure 6-3-4 Select Point from Map

#### 6.3.2 File

The coordinate conversion operations of multi-point data by importing files, the conversion results of To Local or To Source will display in the interface.



$\leftarrow$	Coordinate		
Point		File	
BLH	⊖ xyz	○ NEZ	
File		None $\geq$	
Conversion result			
	⊖ xyz	NEZ	
	∑ To Source	Export	

Figure 6-3-5 File

# 6.4 Area

Used for calculating area, circumference and some other parameters of graph. The area is indicated by *sq.m* or *mu* and circumference is indicated by *m*. The coordinate of point participated in calculation can be added manually, or real-time collected from the receiver or selected from a coordinate library or map.



**Notice:** In the Map interface of Area, the Select Point  $\stackrel{\uparrow}{\downarrow}$  is not the same as the Map selection  $\stackrel{\textcircled{}}{\boxtimes}$  in the List interface of Area. In the former, the points on the map are selected by clicking on the point, and the latter by the way of selecting points in the circle and selecting the node on line.

The difference of map selection between *Area* and the other interface is: click  $\mathbb{N}$  to enter map selection mode. Frame select point on the map when the icon is in the state  $\frac{1}{4}$ , when frame select multiple points, press  $\Rightarrow$  but only one point in the box can be selected, click  $\frac{1}{4}$  again to exit the map selection mode; Among them, when the icon is in the status  $\frac{1}{4}$ , you can select multiple points in the box, click  $\frac{1}{4}$  again to exit the map selection mode, click  $\frac{1}{4}$  or  $\frac{1}{4}$  again to exit the map selection mode, click OK to complete. Return to the list to view the selected points.





Figure 6-4-1 Area Calculation Figure 6-4-2 Select Point Figure 6-4-3 Multiple Select

- Add: The points can be added to the list by the way of real-time collection, point library, and graph selection.

- Compute: Calculates the area, mu, and length of the current point in order, and can view graphics and calculations in the result interface.

The results of the graphical will be displayed at the bottom left of the interface, which is divided into maximum area results and vector area results. The maximum area results will be displayed in green font, and the vector area results will be displayed in red font.

<del>\</del>	Result
	¢
€ Q	
<ul><li></li><li></li><li></li></ul>	
	<u>75.27m</u>
Vector Area:20 Length	Area 8596.5778 sq.m :742.6301 m
Max Ar Area:20 Length	rea 3596.5014 sq.m :742.6293 m

Figure 6-4-4 Results

# 6.5 Dist and Azi

Used for calculating distance and azimuth between two points. The coordinate of A and B points can be manually input, or read from receiver, coordinate library or map. After reading successfully, click *Compute* to calculate *Azimuth, Bank Angle, 2D-Distance, 3D-Distance, and H-Distance*.



$\leftarrow$	Azimuth	←	Azimuth
А	🚸 🗐 🕅	А	🗞 🕂 🕅
N:	20026070.1549	N	Result
E:	19367587.4692	(E);	Azimuth:227:16:46.39202 Bank Angle:00:00:00.00576 2D.Distance: 25770727 5001
Z:	48.2248	23	3D-Distance: 25770727.5091 H-Distance: -0.7202
В	* 🗐 🕅	в	ок 😚 🗟 🛛
N:	2542644.5056	N:	2542644.5056
E:	434541.6520	E:	434541.6520
	Compute		Compute

Figure 6-5-1 Distance and Azimuth

#### Figure 6-5-2 Result

#### **6.6 Intersection**

In the case of a point needing measurement, but observation conditions are not ideal, calculate the needed point coordinate by measuring a nearby point. Click every icon to enter the corresponding measurement mode. The software supports nine measurement modes (*4Pt, 2Pt2L, 2Pt1L, 2Pt2A, 2Pt1A1L, Azimuth, 2C, 1L1C, 1RPt*).



Figure 6-6-1 4Pt Interface

Figure 6-6-2 2Pt2L Interface Figure 6-6-3 2Pt1L Interface





Figure 6-6-4 2Pt2A Interface Figure 6-6-5 2Pt1A1L Interface Figure 6-6-6 Azimuth Interface



Figure 6-6-7 2C Interface Figure 6-6-8 1L1C Interface Figure 6-6-9 1RPt Interface

There are two positions of P according to the theory of 2Pt2L; 2Pt2A, 2Pt1A1L. If you input the coordinate of A first and then the coordinates of B, the position of P will be located above the AB line. Conversely, if you input the coordinate of B first, the position of P will be located under the AB line. In the above intersection measurement methods, select known point ID, input the coordinate of the intersection measurement point (manual input, or read from receiver, coordinate library, map), input

other known keys (such as L1, L2, etc..), click Compute, calculate the coordinate of unknown point P, click Save, input name, description and so on to save into the coordinate library.

In the Intersection, when you click GPS collection, prompting precision information (accuracy setting is performed in the Configuration) is easy for an understanding of real-time accuracy.

# 6.7 Angle Calculation

Used for calculating the angle of the three-point line.




Figure 6-7-1 Angle Calculation Figure 6-7-2 Interior and Exterior

## 6.8 Volume

	ES.		← Volume
Angle	Distance	Coordinate	Select surface
	a	<b>00</b>	Surface Name
Area	Dist and Azi	Intersection	Input the reference elevation
Ľ	Val	2	Select the reference point
Angle Calculation	Volume	Point and line	Select the reference surface
+- ×=		FTP ==	Define range >
Project	Device Surv	ey COGO	📩 Compute

Figure 6-8-1 COGO interface Figure 6-8-2 Volume interface

Calculate the volume, 2D perimeter, 3D perimeter, and DTM area of two DTM surfaces, or between a DTM surface and a predetermined elevation.

- Select surface: Click extend icon  $^{>}$  , Select an actual surface from the List Surface.

- *Input the reference elevation*: Check it, the reference elevation and the surface are used for volume calculation. Click extend icon  $\ge$ , input the target height needed to fill/dig.

- Select the reference point. Check it, the reference point and the surface are used for volume calculation. Click extend icon >, Select a point as a reference point from the *Point Library*.

- *Define range*: Check it, calculate the volume inside boundary; conversely, without checking it, it will calculate the volume in the public area. Click extend icon  $\ge$ , you can select the range points on the *Define range* interface, and add, edit, delete, load, and save the range points.



← Volume		$\leftarrow$	Define	e range	ОК	$\leftarrow$	Boundary Point
Select surface	>	Name	Ν	E	Z 🕨	Ø From	🚸 🏣 🔞
Surface Name		pt1	20026070.154 9	19367587.469 2	48.2248	Name	
		pt7	20026048.881 7	19367609.952 3	45.4328		
Input the reference elevation		pt5	20026049.204 7	19367610.765 9	45.1818	N	20026070.1549
Select the reference point	>					Е	19367587.4692
Select the reference surface	>				View	z	48.2248
C Define range	>			Ľ	Load	Туре	• NEZ O BLH
Checked:compute inside boundaries	z 🕨			(	Batch		
Compute		(+) Ad	d 🖉 Edit	🔟 Delete	More	🚫 Ca	ncel 📀 OK

Figure 6-8-3 Checked Boundaries Figure 6-8-4 Define Range Figure 6-8-5 Boundary Point

- *Add*: Add a range point by manual input, real-time collection, point library selection or map selection, *Define Range* requires at least three points.

- Edit: Select the range point you want to edit: you can edit the coordinates of the point.

- Delete: Select a range point, click Delete to delete directly, no prompt.

- Load: Load an existing boundary file (\*.waa), the load path is: ZHD\ Project\ ROAD\ Project Name\ dtm folder.

- *Save*: Save the re-add/edit volume boundary file: the save path and file format is consistent with that in *Load*. When the saved file name already exists, it cannot be saved, but check *Cover* to save the modified file. Also, click *OK* will also save re-add / edit volume boundary file.

$\leftarrow$	Directory	ОК
/storag	ge/sdcard0/ZHD/F ned/dtm	Project/ROAD/
	zhd.waa	
zhd.waa		X Cover
DTM Volum	ne Range(*.waa)	>

Figure 6-8-6 Save Directory

After selecting different calculation methods, click *Compute* and view the volume calculation, measurement surface, digging area, and fill area product information on the *Results* interface.



←   Volume	← Volume	← Volume
Select surface >	Select surface >	Select surface >
Surface Name	Surface Name	Surface Name
Input the reference elevation	Input the reference elevation	✓ Input the reference elevation
Select the reference point	Select the reference point	Elevation 0.0000
Select the reference surface	Point Name	Select the reference point
Surface Name	Elevation	Select the reference surface
Define range	Select the reference surface	
Compute	t ⊂ Compute	t ⊂ Compute

Figure 6-8-7 Two Surfaces Figure 6-8-8 Surface and Point Figure 6-8-9 Surface and Elevation

←   Re	esults			Results	
The calculation	result between the urfaces	Are	a 2D(m²)	28.2898	
Surface	3	Are	a 3D(m²)	436000.4395	
	-	Per	rimeter 2D(m)	48.4231	
Reference Surface	1	Per	rimeter 3D(m)	91566.1301	
Volume-Time of Cal:	784ms	Cut	tareas(m²)		
Cut(m <sup>3</sup> )	40856.5471	Cut	areas(III )		
Fill(m <sup>3</sup> )	0 0000	Are	a 2D(m²)	4.9633	
	0.0000	Are	a 3D(m²)	76494.3398	
Surface:3		Fill	areas(m <sup>2</sup> )		
Area 2D(m <sup>2</sup> )	28.2898				
Area 3D(m²)	436000.4395	Are	a 2D(m²)	0.0000	
		Are	a 3D(m²)	0.0000	

Figure 6-8-10 Result Above Figure 6-8-11 Result Below

←	Results 🛃	$\leftarrow$	Results 🗠
The result of the	e calculation of reference elevation	The result of the o	calculation of reference poin
Surface	1	Surface	1
Ref.Elevation(m)	1.0000	Ref.Elevation(m)	48.2248
Volume-Time of Ca	l:27ms	Volume-Time of C	al:29ms
Cut(m <sup>3</sup> )	9736.7196	Cut(m <sup>3</sup> )	119.9862
Fill(m³)	0.0000	Fill(m <sup>a</sup> )	105.2325
Surface:1		Surface:1	
Area 2D(m²)	205.8657	Area 2D(m <sup>2</sup> )	205.8657
Area 3D(m²)	242.2758	Area 3D(m²)	242.2758
		11	

Figure 6-8-12 Elevation Result Figure 6-8-13 Point Result



- Area (2D:  $m^2$ ): The area projected onto the horizontal plane.

- Area (3D:  $m^2$ ): The area projected onto the slanted reference plane.

- Perimeter (2D: m): The length of the polygon from the start point to the current measurement point in surface (2D).

- Perimeter (3D: m): The length of the polygon from the start point to the current measurement point in surface (3D).

## 6.9 Point and Line

Used for calculating the relationship between points and lines.

$\leftarrow$	Point and line	e	$\leftarrow  $	Point and line
Offset poi	nt	🚸 🔄 😥	Start Point	🚸 🗐 🔞
Name			Name	I X
Ν	0.0000		N	0.0000
E	0.0000		Е	0.0000
z	0.0000		z	0.0000
Start Point	t	🚸 🔄 🔞	End Point	🚸 🗐 🔞
Name			Name	
	Compute	9		Compute

Figure 6-9-1 Point and line Figure 6-9-2 Point and line

## 6.10 Transition curve

Click the Transition curve icon in COGO interface, it supports to calculate the parameters of Curve, Start Radius, and End Radius.

← c	Curve Start Radius	End Radius	←	Curve Start Radius End Rad	us ←	Curve	Start Radius End Radius
R1 R2	Instruction: Length L. start radius radius R2 are known, Ca parameter A.	R1 and end Ilculate	RI	Instruction: Length L. end radius R2 and param A are known, Calculate start radius I	eter 21. Ri	182	Instruction: Length L, start radius R1 and parameter A are known, Calculate end radius R2.
💮 Know	vn		💮 Kr	nown	(	🛈 Known	
L	0.0000		L	0.0000		L 0.0	0000
R1	0.0000	_ ∞	А	0.0000	A	<b>A</b> 0.0	0000
R2	0.0000	□ ∞	R2	0.0000	R	R1 0.0	0000 🗌 👁
	Compute			Compute			Compute

Figure 6-10-1 Curve





## 6.11 Calculator

Used for simple mathematical calculations.



Figure 6-11-1 Calculator Figure 6-11-2 Calculator

## 6.12 Share

File transferring. The user clicks *Share* to enter the sharing interface, and the software displays the directory/storage/sdcard0/zhd/out by default.

- Select the file to be shared, click the *Share* button, and the software pop-up box will display the optional sharing method.

- Click the icon and jump to the corresponding software for file transfer.



Figure 6-12-1 Calculator

Figure 6-12-2 Calculator

Figure 6-12-3 Calculator



## 6.13 FTP

For the FTP file transferring function, click FTP to enter the transmission function. The software will then display the default target path (/storage/simulated/0/zhd).

- Users need to enter the username, password, and port when the software does not check "password-free transmission".

- Check "password-free transmission". The software does not display the username and password input box, and the user only needs to configure the port.

When the device has connected to the Wi-Fi, the software automatically fills in the IP parameters and the port number defaults to 2121. After the user has configured all the parameters, click *Start*. According to the prompts, the user can input the corresponding path into the computer to download the FTP file.



Figure 6-13-1 Calculator

Figure 6-13-2 Calculator

## 6.14 Compass

Click Compass to enter the compass function.



**Notice:** When the manual compass is turned on, the visual angle orientation function will be turned off.

When you open the compass for the first time you will enter the calibration interface, and can confirm whether calibration is needed. If the calibration is successful, it will enter the calibration interface again after a period of 7 days.





Figure 6-14-1 Calculator

Figure 6-14-2 Calculator



# **Chapter 7**

## **Tilt Survey**

This chapter contains:

- Tilt Correction
- Tilt Survey 2.0
- Tilt Survey with Calibration-free



## 7.1Tilt Correction

The Tilt correction mainly includes three parts: electronic bubble calibration, Tilt Calibration and Verification, and Calibration verification.

## 7.1.1 Electronic Bubble Calibration

1. Connect to the receiver with the tilt survey function. In *Additional Settings*, click *Electronic Bubble Calibration* to enter the program.



Figure 7-1-1 Additional Settings Figure 7-1-2 Receiver Settings

2. When the device had been perfectly leveled up, click Start for calibration, then click OK.



Figure 7-1-3 Bubble Center

Figure 7-1-4 Warning

3. When success is prompted, the electronic bubble and horizontal bubble of the base will be centered at the same time.



← Electronic Bubb	ole Calibration	← Electronic Bubb	le Calibration
The calibration will expire in	Calibration cycle (day)	The calibration will expire in	Calibration cycle (day)
25days	30 Set	30days	30 Set
		₹ <sup>24-38</sup> + <sup>RTK Fix</sup> ?	00°16'59"
	7		
Calibra	ting	Please click Succe	ess tort calibrating
⊖ :	Stop	💽 s	Start

Figure 7-1-5 Calibrating Figure 7-1-6 Calibration Success

4. Calibration is finished. Notice: It is recommended to calibrate the device every 30 days, but the calibration cycle can be adjusted.

5. Auto collection. When the auto mode is set as *Bubble Is centered* the software will collect the points automatically when the electronic bubble is centered.

$\leftarrow$	Auto	ок
Auto	Bubbl	le Is Centered >
Prefix	pt	
ID	4	
Time		
line		
Dist		
Slant Dist		+ RTK Fix
Bubble Is Cer	tered	~





**Notice:** When using the *Bubble Is Centered* for automatic collection, first set bubble precision. Connect a receiver with tilt measurement function, enter main interface  $\rightarrow$  *Survey*  $\rightarrow$  *Surveying Configure*  $\rightarrow$  *Data* (or: enter survey interface  $\rightarrow$  click *Configure* at the top right corner  $\rightarrow$  *Data*), the *Bubble Precision* can set when tilt Survey is off.



÷	Display Data St	ake ?
Tilt	Survey	
Poir	nt Info Dialog	
Auto	o Start Average	
Auto	o Store After Average	
Stor	re Average Points	
Allo	w Same PtName	
Bub	ble Precision(<2.0000) 0.02	200

Figure 7-1-8 Tilt Survey And Bubble Precision

## 7.1.2 Tilt Calibration and Verification

## **Tilt Calibration**

The whole tilt calibration has three steps:

- 1. Orientation sensor calibration;
- 2. Electronic bubble calibration;
- 3. Magnetic calibration.

The order of 1 and 2 steps can be reversed but must be performed before step 3.



## Notice:

1. The calibration should be done in a low magnetic interference area or an open field. Don't do calibration on the roof or top of a high building.

2. Calibration should be done in external station mode, don't use the internal UHF link to avoid magnetic interference.

3. Don't change battery and power off during all the calibration steps.

Here are the detailed operations below:

1. Orientation Sensor Calibration

Additional Settings  $\rightarrow$  click Orientation sensor calibration to enter calibration interface.



Additional Settings	
Satellite Tracking Switch SDGPS 44.0 *Note: Accuracy of orientation sensor is subject surveying circumstance, suggest to calibrate t again if surveying circumstance is changed.	et to he sensor
Receiver Settings	33°04'48"
Service Info	
Restore System	
Electronic Bubble Calibration	
Orientation Sensor Calibration	
Magnetic Calibration Please click "Start" to start calibrati	ng
Wi-Fi Hotspot Password Set   Start	

Figure 7-1-9 Sensor Calibration Figure 7-1-10 Start Calibration

Click Start to begin calibration, the calibration of the orientation sensor needs to be calibrated according to the demo.

$\leftarrow$ Orientation Calibration	← Orientation Calibration
<ul> <li>Note: Accuracy of orientation sensor is subject to surveying circumstance, suggest to calibrate the warning</li> <li>After pressing "OK", please rotate the receiver for a cycle in each direction after the "ding dong" sounds. The second "ding dong" means calibrated success.</li> <li>Cancel OK</li> </ul>	*Note: Accuracy of orientation sensor is subject to surveying circumstance, suggest to calibrate the sensor again if surveying circumstance is changed. Take the hands connection as axis, rotate the device at a constant speed 7 seconds each cycle @After finished 1 cycle, clockwise rotate about 45 degrees, repeat step1, need totally 8 cycles at least
Please click "Start" to start calibrating	Rotate the device at a constant speed
Start	🕞 Stop

Figure 7-1-11 Warning

Figure 7-1-12 Rotate The Device

Rotate at an average speed, approximately 7 seconds for a cycle.



Figure 7-1-13 Rotary Axis



Clockwise rotate about 45 degrees, repeat step a, you need a total of 8 cycles at least.



Figure 7-1-14 Clockwise Rotate

After the calibration is completed in each direction, the second *Ding-Dong* sound indicates *Success* from the device, which means calibration is finished. Conversely, prompting failure - do calibration again.

← Additional Settings	← Orientation Calibration		
Satellite Tracking Switch	*Note: Accuracy of orientation sensor is subject to surveying circumstance, suggest to calibrate the sensor again if surveying circumstance is changed.		
Receiver Settings	№         00-41         ●         Auto         ●         ●         ●         Dir:281°28'12"		
Service Info	Ni		
Restore System	E		
Electronic Bubble Calibration			
Orientation Sensor Calibration	-		
Magnetic Calibration	Success Please click "Start" to start calibrating		
Wi-Fi Hotspot Password Set	E Start		

Figure 7-1-15 Calibration Figure 7-1-16 Calibration Success

#### 2. Electronic Bubble Calibration

Please refer to Electronic Bubble Calibration.

3. Magnetic Calibration

This step can be done only after the calibration of the electronic bubble and orientation. Additional Settings  $\rightarrow$  click Magnetic calibration to enter calibration interface.





Figure 7-1-17 Start Calibration

Click Start to start calibration, magnetic calibration needs calibration in horizontal position.



Figure 7-1-18 Warning

Figure 7-1-19 Calibrating

Keep the device on horizontal and rotate it clockwise a week, slowly and evenly around the vertical axis. Rotation speed is recommended to be less than 20 degrees per second, ith slow uniform rotation and no pause during rotation.





Figure 7-1-20 Horizontal Rotation

When horizontal calibration is complete, the second *Ding-Dong* sound from the device indicates *Success*. Conversely, prompting failure - do calibration again.



Figure 7-1-21 Failure Figure 7-1-22 Successful

## 7.1.3 Calibration Verification

In order to make sure accuracy is not strongly interfered with by the environment and procedure, verification is necessary before starting the tilt survey.

Put the device at 30-degree tilt approximately, on the pole, and rotate it slowly clockwise for a week. View the azimuth changes, if the differences between maximum and minimum values are less than 5 degrees, it means the sensors are working well and you can do a tilt survey directly, otherwise module verification will be required.





## Notice:

1. The pole shouldn't be moved.

2. Rotation speed should be 2 degrees per second and it takes about 3 minutes to rotate one week.



Unscrew the knob and hold the pole to rotate device clockwise slowly around pole.

Figure 7-1-23 Calibration Verification

## Notice:



1. When replacing a new measurement area, or the terrain complex environment of the measurement area changes greatly, module verification is required before measurement.

- 2. When the new device first uses tilt measurement, it must be calibrated.
- 3. After the new battery is replaced, the device must be calibrated.

## 7.1.4 Tilt Correction Procedure

After electronic bubble calibration, orientation sensor calibration, magnetic calibration, and verification are successful, you can start a tilt surveying. If the device has not undergone calibration, users will be prompted when *Tilt Survey* is opened: you must complete all calibrations before you can open the *Tilt Survey*. Tilt Survey conditions are limited to static, within 20 degrees of tilt.

1. *Tilt Survey* must be opened when you start a tilt surveying, click *Surveying Configure* $\rightarrow$ *Data* $\rightarrow$ *Tilt Survey*.



← Display Data ★ General Survey Config	Stake ?
Required Solution	Fix $\geq$
Working Area	>
Physical Record Button	Single Record >
Tilt Survey	
Clana Mathad	Namel Olana
Slope метлоа	Normal Slope >
Point Info Dialog	
Auto Start Average	

Figure 7-1-24 Tilt Survey Figure 7-1-25 Slope Method

2. When *Tilt Survey* is not opened, the software will not do a tilt survey, the software survey interface displays and records the coordinates of the tilt point to the point library. Conversely, when *Tilt Survey* is opened, the interface displays and records coordinate points to the point library: this coordinates point is the calculated ground coordinate point.

#### 3. Collect Point

Enter survey interface to collect points, it supports two survey modes: *Corner Slope and Normal Slope*. The corner slope mode is accurate and reliable; the normal slope mode is simple to operate.

← Text @	Detail Survey ? Configure
€ 00-39 0.9 ⊕ Auto	68%
	/@.
Δ	PPK
<i>(i)</i>	8
\$ ₿	₽ >
	<u>192.50m</u>

Figure 7-1-26Collection Point

#### **Corner Slope**

This mode is more precise, but it takes a little longer in the field. Orientation and magnetic calibration recommendations are prompted when interference is found by the device.

1. Please keep the receiver tilted and static, then click the collection icon. The best tilt angle is 10



degrees ~ 20 degrees: follow the prompts to operate.



Figure 7-1-27 Step One

2. Tilt in the other direction, with an azimuth span angle of 30 degrees to 120 degrees (*Azimuth Span Angle*: the angle formed by the vertical projection of the pole in two directions), and keep it static. There will be a sound prompts '*Di*' indicating that collection is complete.



Figure 7-1-28 Step Two

Figure 7-1-29 Step Three

3. In the Save Point interface, you can see the tilt angle and tilt azimuth of the point.





Figure 7-1-30 Save Point

## **Normal Slope**

This method is much simpler, the receiver will collect points when it is still (function available in firmware version after v5.1 for V90 Plus and v1.1 for iRTK5). Orientation and magnetic calibration recommendations are prompted when interference is found by the device.

1. Enter process interface Raw Data  $\rightarrow$  More  $\rightarrow$  Process.



Figure 7-1-31 Raw Data Figure 7-1-32 More Figure 7-1-33 Process

2. *Data Transfer* is a raw data custom export. It supports export not an increase in plane coordinates for tilt correction (tilt N, tilt E, tilt Z is not tilted correction of plane coordinates). Select the export path and input the export file name and after completing the custom format settings, click *OK* to export.



← Raw Data Stake Point Contrc	$\leftarrow \mid$ Set	Custom Format	ОК	
Exchange Types	Template	N N	one >	
Directory /storage/sdcard0/ZHD/Out	Export Co	Export Content		
csv_zhd_ test.csv	id,Name,N, Z,Slope B,S H.AntH.σN. Supportec	id,Name,N,E,Z,B,L,H,Slope N,Slope E,Slope Z,Slope B,Slope L,Slope H.AntH.oN.oE.HRMS.oZ.Taraet H.AntH Supported Fields Selected Fields		
	Offset	Tilt Azi		
	Audios	Tilt X		
csv_zhd_test  Cover	Images	Tilt Y		
User-defined(*.csv)	Null	TiltX Azi		
⊘ ок	🔟 Delet	te 🔺 Up 🔻 [	Down	

Figure 7-1-34 Save Raw Data Figure 7-1-35 Custom Format

## **Abnormal prompt**

1. When you have finished following the prompts, if the prompt Corner Slope fails appears, the current point is not saved.





2. When it prompts *The current low precision, whether to save data*, click *OK* to save the calibration ground point coordinates, click *Cancel* to not save the coordinate data.

3. When the collection point prompts *Magnetic is change,* so it is not collecting points and you need to do the three steps of tilt calibration.

## 7.2 Slope Method 2.0

## 7.2.1 Slope Method 2.0



When the *Hi-Survey Road* finishes connecting the device, open the "Slope method 2.0" switch in the Configuration - Data interface of the software, and then start the tilt survey.

← Display Data Stake	?
Slope Method2.0	
Point Info Dialog	
Auto Start Average	
Auto Store After Average	
Store Average Points	
Allow Same PtName	
Bubble Precision(<2.0000) 0.7725	

Figure 7-2-1 Slope method 2.0

In this mode, click the collection button in the *Detail survey* interface, and the software will prompt you to shake the device to start the measurement. Then shake the device at a constant speed and wait until the progress bar reaches 100% and finish collecting the point.



Figure 7-2-2 Shake

## 7.2.2 Prompt

If the "Slope method 2.0 fail" is prompted, the current point will not be saved.





Figure 7-2-3 Prompt

## 7.3 Tilt Survey with Calibration-free

## 7.3.1 Measuring Method

After connecting the receiver, open the *Tilt Survey* switch in the *Surveying configure-data* interface of the software, and after the receiver reaches RTK-Fix, the Tilt Survey can be initialized (click the *Tilt Survey* icon to view the initialization prompt).

#### Keeping the device in a static state

Keep the device in a static state for 1-3s when the device is in RTK-Fix.

#### Shaking

After the Tilt Survey initialization has finished, the receiver will be shaken back (once every second) for heading initialization.



← Display Data Stake	?	~	Text @ De	tail Survey	? Configure
Tilt Survey		20	25-39 1.6 + 1.0		
Point Info Dialog			Tilt Surve	y Initializati	on
Auto Start Average			RTK Fix	+	<ul> <li>✓</li> <li>▲</li> </ul>
Auto Store After Average		Δ	Device stationary	R	🗸 РК
Store Average Points		i	Shake	RT	~ 8
Allow Same PtName		~	â		?
Bubble Precision(<2.0000) 0.7601					<u>, 192.50m</u> ,

Figure 7-3-1 Tilt survey Figure 7-3-2 Initialization interface

When all the initialization items have been ticked, the receiver voice will broadcast "enter tilt measurement", and the Tilt Survey icon will light up. After the initialization of the Tilt Survey, the Tilt Survey operation can be performed on the device.



## Notice:

1. The Tilt Survey must achieve the requirements of the RTK-Fix solution, attitude initialization and heading initialization before it can be used. Otherwise, it will prompt to complete the initialization operation.

2. The Uncorrected Tilt Survey function is only supported by the New iRTK5 GNSS RTK receiver.

3. When on the calibration-free tilt survey model, click on the tilt survey icon in the lower right corner of the interface to switch the current mode to the normal survey or tilt survey.

4. When on the calibration-free tilt survey model, the tilt azimuth, vertical inclination, and no tilt correction coordinates information can be viewed in the button box of the detail survey interface.



# Chapter 8

## **Quasi-dynamic Survey**

## This chapter contains:

- Function Introduction
- Operation Procedure



## **8.1 Function Introduction**

Quasi Dynamic RTK Survey was invented by Hi-Target, a new way to survey in tough areas where there is strong multi-path interference, signal blocking like standing beside big trees; the reliability is much better than the normal RTK survey in those conditions. It can offer precise coordinates in 20 – 40 seconds, with better fixing rate, accuracy, and reliability.

## **8.2 Operation Procedure**

1. Activate the function.

Additional Settings  $\rightarrow$  Receiver Settings  $\rightarrow$  Quasi Dynamic RTK  $\rightarrow$  Set.

← Additional Settings	← Receiver Settings
Receiver Settings	Store RINEX Data
Service Info	Firmware Update Prompt
Restore System	Sound Type Default >
Electronic Bubble Calibration	Volume 1 10
Orientation Sensor Calibration	Device Cloud Server
Magnetic Calibration	Quasi dynamic RTK
Network Diagnosis	Set

Figure 8-2-1 Receiver Settings Figure 8-2-2 Quasi dynamic RTK

2. After the RTK correction from the base receiver or CORS service had been received for more than 30 seconds, the quasi dynamic RTK survey is ready to work.

3. Go to *Detail Survey* interface, click the button on the screen to start. If you get the feedback *QuasiDynamic engine is under preparation*, then please make sure the receiver is getting corrections.



← Text @ Detail Survey ? Configure	←   Graph @ Detail Survey   ?   Configure	$\leftarrow \mid Text \qquad Detail Survey  \mid Configure$
28-40 + RTK Fix ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥	28:40       +       RTK Fix       ************************************	QuasiDynamic engine is under preparation!
▲ ② ☆ ☆ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲	Target H 20000 Pole(P) GroundCode	▲ (i) ★ B031609 ★ B032209 ★ Comparison (Comparison (Compariso
<u>, 192.50m</u>	<ul> <li>✓</li> <li>✓</li></ul>	<u>9.12km</u> ,

Figure 8-2-3 Button (1) Figure 8-2-4 Button (2) Figure 8-2-5 Prompt

4. It should take 20 – 40 seconds to finish collection, during the procedure please keep the receiver as steady as possible, rotating and shaking is not allowed.



Figure 8-2-6 Prompt

5. After the dingdong sound is tweeted, the collection is done and the point is saved. In this mode, the normal detail survey RTK point collection is still available.





# **Chapter 9**

## iHand30 Controller

## This chapter contains:

- Introduction
- Appearance
- Controller accessories
- Operation
- Download
- USB upgrading
- APN setting



## **9.1 Introduction**

## 9.1.1 Foreword

The iHand30 controller is a professional data collector, based on the Android system. Using a combination of physical buttons and touch screen to operate, the default input languages are Chinese and English, and it supports multiple languages. The industrial-standard design can withstand 1.2 meters drop to a cement floor, is IP67 waterproof and dustproof standard to adapt to a complex operating environment. At the same time, the super capacity lithium battery can handle all weather requirements.

The iHand30 controller configures 3.7 inches 640 \* 480 highlighted LCD; 1.5GHZ, quadcore 64-bit CPU; and 16GB ROM +2 GB RAM memory. It has a built-in Micro SD card slot, and maximum support 128GB expansion card (it only supports FAT32 format SD card, the NTFS format SD card cannot be supported); dual card dual standby, and supports the entire 4G network. With the Android 6.0 operating system, the interface is optimized and easy to use.

#### 9.1.2 Features

1. Industrial-standard design, with IP67 it can withstand a 1.2 meters drop to a cement floor and adapt to a complex operating environment.

2. Highlighted LCD, the LCD screen is normally readable under strong sunlight.

3. Supports Bluetooth, Wi-Fi and 4G, which is convenient to carry out a variety of wireless data transmissions with the receiver. Wi-Fi and 4G can be used at the same time. Refer to the Hi-Survey Road Software User's Guide for more details.

4. Internal 8-million-pixel camera: for field collection of image information.

5. Internal removable large capacity lithium battery for more than 15 hours of work.

6. The internal NFC chip supports NFC data transmission for a rapid connection between the RTK and handheld controller.

7. Fast charge technology: for a rapid battery charge.

- 8. Full keyboard input method.
- 9. Local online upgrade to facilitate quick changes.



## 9.1.3 Caution

Although the iHand30 handheld controller is made with chemical and impact-resistant materials, it needs to be carefully used and maintained and should be kept in a dry environment. In order to improve the stability and usage cycle of the iHand30 handheld controller, please avoid exposing it to extreme environments, such as humidity, high temperatures, low temperatures, corrosive liquids or gases, etc.



**Notice:** The iHand30 handheld controller must be used within the temperature range from -20  $^{\circ}$  to 55  $^{\circ}$ 

## 9.2 Appearance

## 9.2.1 Front of The Controller

The front of the iHand30 controller includes a touch screen, keyboard microphone, and indicator light.



Figure 9-2-1 iHand30 controller

1- Indictor lights 2- Microphone 3- Touch screen 4- Keyboard



- Touch screen: multipoint capacitive touch screen with touch pen (open the touch pen function: Settings - Accessibility - Handwriting pen), which supports Chinese and English input.

- Keyboard: direction control, switch between Chinese and English, data collection, volume control, power on, power off and other functions.

- Microphone: the internal microphone can be used for field collection of voice messages.
- Indicator lights: from left to right: signal lamp, state lamp, power indicator.

## 9.2.2 Reverse Side of The Controller

There is a camera, battery cover, belt, NFC, trumpet, etc.. on the reverse of the controller.



Figure 9-2-2 the backside of the iHand30

1- Camera 2- Battery cover 3- Trumpet 4- NFC 5- Belt hole

- Camera: used for field collection of images.
- Battery cover: with an internal removable lithium battery.
- Belt hole: connect the belt to prevent it from sliding down.



- Trumpet: conduct real-time voice broadcasts for instrument operation and status.

- NFC: supports NFC data transmission to achieve a rapid connection between RTK and the handheld controller.

## 9.2.3 Side of The Controller



1- Waterproof and dustproof rubber cover 2- Audio port 3- USB port Figure 9-2-3 the port of iHand30

- USB port: for connecting the USB data line and the controller.
- Audio port: for connecting the headphone cable and the controller.



**Notice:** When not using the audio port or Mini USB, please close the rubber cover to make it waterproof and dustproof.



## **9.3 Controller Accessories**

## 9.3.1 Charger



Figure 9-3-1 Charger

Charger: 5V--3A/9V--2.7A/12V--2A

Type: A824A-120200U-CN2

## 9.3.2 Battery



Figure 9-3-2 Battery

Lithium battery: 3.7V /5200mAh



## 9.3.3 Data Cable



Figure 9-3-3 Data cable

USB data cable: connect to the USB port of a computer, for download of data; connect to the USB port of the charger for charging the controller.

## 9.3.4 Touch Pen



Figure 9-3-4 Touch pen

Touch pen: located on the strap of the controller.

## 9.4 Operation

#### 9.4.1 Keyboard

Most settings and operations of the iHand30 handheld controller can be completed by the touch pen, and commonly used operations can be completed on the keyboard. The appearance and functions of the keyboard are as follows.

iHand30 keyboard includes: Back, OK, Power, APP, Fn, Collect, etc..





Figure 9-4-1 Keyboard

1- Home	2- Menu	3- APP	4- Fn	5- Power	6- Back
7- Collect	8- OK	9- Delete	10- Space	e 11- Ente	r 12- Shift

- Back: cancel or exit the operation of the current window.

- OK: confirmation.

- Power: press it for over 3secs to power on/off. Press it for 1sec to turn off /on the screen backlight in the power-on status.

- APP: quick start of the APP. The default is Hi-Survey Road software.

- Fn: when inputting, short press this key to cycle the input method (Chinese Pinyin/ English letter abc/ English association en/ number 123). In any interface long press this button to pop-up the selection box to switch the system input method.

- Collect button: collect data by manual operation.



- Shift: switch key of the input function.

- Fn + direction up/ down key: volume increase/ decrease.

- Screenshot function: pull down the screen at the top menu, select the screenshot options, and the screen capture will be kept in the folder of Mobile phone storage → Pictures → Screenshots. (note: iHand30 does not set the shortcuts screenshot function).



**Notice:** When the iHand30 handheld controller is not used, please turn off the backlight to save electricity and prolong working time.

## 9.4.2 Battery Installation and Dis-assembly

1. Installation and disassembly of the battery

Installation:

Step1: the metal contact parts of the battery are placed upwards in the cell tank.



Figure 9-4-2 Installation of Battery

Step2: press the bottom of the battery.





Figure 9-4-3 Installation of the battery

Dis-assembly: pull up the bottom of battery



Figure 9-4-4 Dis-assembly of the battery

2. Installation and disassembly of the battery cover

Installation:

Step1: insert the two raised tabs of the battery cover into the corresponding slots.




Figure 9-4-5 Battery cover

Step2: press the battery cover tightly, press the black button.



Figure 9-4-6 Lock the battery cover

Dis-assembly: push up the black button of the battery cover, and pull up the battery cover.



Figure 9-4-7 Battery cover Figure 9-4-8 Lock the battery cover

## 9.4.3 Power System

1. The battery and charger model of the iHand30 handheld controller



## Table 9-4-1 the battery and charger model

Name	Model
Lithium battery	BLP-5200S
Charger	A824A-120200U-CN2

## 2. Charge

The special charger should be within a certain temperature range when charging, and certain charge time is required. Specific use methods and requirements: use the special charger of the controller to charge in the temperature range of  $10^{\circ}C-40^{\circ}C$ . There is a certain amount of electricity in the battery on first use, let the power completely run out from the first charge, then the first three times you will need to charge for 3 hours. After that, the iHand30 supports fast charging with the original charger and the charge time is then less than 3 hours. If the battery is not used often, it must be charged once every two months.

#### Notice:

- 1. Please use the configured battery and charger, do not put the battery into fire or metal short circuit electrode.
- 2. If the battery is hot, deformed, leaks, has an odor or any other abnormalities during use, charging or storage, please replace it
- **3.** If the using time is obviously shortened, please stop using the battery. Please replace with a new battery

## 9.4.4 SIM Card Setting

The iHand30 handheld controller supports DSDS, the default card is SIM1. Both SIM1 and SIM2 support full network 4G.

1. Installation of the SIM card

Step1: remove the battery cover, remove the battery, and expose the SIM card slot. Slot 1: Micro SIM card; slot 2: standard SIM card.

Step2: put the SIM card into the slot with the front side (metal contact side) down.





Figure 9-4-9 Installation of SIM card

2. Network: Settings  $\rightarrow$  Data usage.

← [	Data usage	:	Sett	Settings Q		÷	Data usage		:
ov	ERVIEW	WI-FI	Wirel	ess & networks			OVERVIEW	WI-F	1
∽ Wi-Fi			•	Wi-Fi		Dec 1	3, 2017 – Jan 10, 2018	Ŧ	5.17 MB
Today		1.31 MB	*	Bluetooth					
Total		5.17 MB		SIM cards					
			0	Data usage		Dec 13	, 2017 Dec 27, 2017		Jan 10
				More		App u	sage Hi-Survey Road		1.72 MB

Figure 9-4-10 Data usage

Figure 9-4-11 Overview of data Figure 9-4-12 Cellular data network

## 9.4.5 Installation of The Micro SD Card

The Micro SD card can save collected data and program files.





**Notice:** Micro SD card (TF card) is an external storage card, usually used in mobile phones and PDAs. If you buy this, please note the difference to ordinary SD cards. The volume of the ordinary SD card is larger than the Micro SD card and is not suitable for the iHand30 handheld controller.

Step1: remove the battery cover, remove the battery, and expose the Micro SD card slot.

Step2: push down the metal sheet and open it.



Figure 9-4-13 Micro SD slot

Step3: Put Micro SD card into the slot (metal contact side down).



Figure 9-4-14 Installation of Micro SD card

Step4: push down the metal sheet and close it.





Figure 9-4-15 Installation of Micro SD card

## 9.4.6 Power On / Off

In the off state, Long press the power button for 3 seconds, it will power on.



Figure 9-4-16 The interface of the iHand30 screen

In the *power-on* state, Long press the power button for 3 seconds, it will prompt to shut down and to confirm, click Power off.





Figure 9-4-17 Power off

## 9.5 Download

- 1. Connect the controller to the computer via the USB data cable.
- 2. Transfer files: pull down the notice column and click USB for charging.



Figure 9-5-1 USB connected

Figure 9-5-2 Charging

Figure 9-5-3 File transfers

3. Connect the PC version mobile phone assistant: open the handheld controller, click Setting  $\rightarrow$  Developer options  $\rightarrow$  USB debugging.





Figure 9-5-4 Settings Figure 9-5-5 Developer options Figure 9-5-6 USB debugging

## 9.6 USB Upgrading

iHand30 controller supports two methods for upgrading, local upgrade, and wireless upgrade.

1. Local upgrade of the iHand30 controller (download the firmware from the Hi-Target official website first).

Step1: Copy the upgrade firmware to the SD directory.



Figure 9-6-1 Upgrade patch

Step2: Choose the Wireless Update App.





Figure 9-6-2 Update App

Step3: Open the *Wireless Update* App, as shown below.





Step4: Click the top-right menu selection in the interface, and choose Local updates.



Figure 9-6-4 Local updates

Step5: Enter the interface.



← Local updates		
Selected file:		
SD card		
Internal storage		

Figure 9-6-5 Local updates

Step6: Select the Internal storage file, then select the update firmware.

÷	Local updates
Inter	nal storage
	.UTSystemConfig
	.DataStorage
	backups
	tmp
	360Log
	360
	iHand30P English version V1.0.0(20171222)
	documents

Figure 9-6-6 Choose the firmware

Step7: After selecting the upgrade firmware, click Install Now.



Figure 9-6-7 Install

Step8: The system will restart and begin to update.





Figure 9-6-8 Interface of upgrade

- 2. Wireless update
- Step1: Select the Wireless Update App.



Figure 9-6-9 Update App

Step2: After entering the Wireless Update App, if there is a new version, the interface will show it and display the update. The complete update content will appear if you draw up the screen.

Step3: Click Download, the firmware update patch will be downloaded.

Step4: When the system upgrade package is downloaded, come out of the prompt window, and click Confirm. Special attention should be paid here. After clicking, it's forbidden to operate of the device.



Step5: After completing step 4, the device will enter the upgrade interface, waiting for the progress bar to reach the full grid that completes the system wireless upgrade.

Step6: when the upgrade is completed, the device will restart automatically, repeat steps 1 and 2 to check whether the update is complete, then finish it.

## 9.7 APN Setting

Please check whether the APN parameter is set correctly when the iHand 30 cannot access the Internet through the mobile network. In cases where the iHand 30 is not connected to Wi-Fi, the SIM card must be installed in the iHand 30 in order to set the APN.

The steps for the APN parameter setting of the iHand 30 system: Open *System Settings > More > Mobile network > Access point name (APN)* of the iHand 30, enter the iHand 30 SIM card network access point name (APN) selection and then set the APN related parameters.

← More	← Mobile network settings			
Aeroplane mode	Data roaming Connect to data services when roaming			
NFC Allow data exchange when the phone touches another device	Preferred networks			
Android Beam Ready to transmit app content via NFC	Preferred network type 4G (recommended)			
Tethering & portable hotspot	Enhanced 4G LTE Mode Use LTE services to improve voice and other communications (recommended)			
VPN	Access point names			
Mobile networks	Network operators			
	Choose a network operator			

Figure 9-7-1 More interface Figure 9-7-2 Mobile networks settings

When the data link mode of the Hi-Survey Road software is "Data Collector Internet", the APN parameters will be the iHand 30 system settings.

If the mobile card is a private network card provided by the CORS service provider, you need to set the APN parameter as a private network APN parameter in order to connect to the Internet. Follow the steps above to connect to the private network. After setting the name, APN, username, and password of the private card, login to the server to confirm the network connection.

## Notice:

The "Data Collector Internet" is recommended for the software data link. This can



save the receiver's power, extend the operation time, and make the Mobile network more compatible with local networks.

The username and password of the private network card's APN parameter setting are of the private network rather than CORS.





# Chapter 10

## Appendix

## This chapter contains:

- Technical Terms
- Troubleshooting
- File Formats



## **10.1 Technical Terms**

1. Global navigation satellite system (GNSS)

Global navigation satellite system (GNSS), is the standard generic term satellite navigation system, it provides global coverage of geographic spatial orientation, including the US GPS, Russian GLONASS, Chinese BDS, and the European Union's Galileo.

## 2. GPS time

The time measurement used by the NAVSTAR GPS system.

#### 3. UTC

Universal Time Coordinated . Time standard for local daylight hours based on Greenwich meridian. See GPS time.

4. Multipath

Interference (similar to the heavy shadow on a television screen). GNSS signals arrive at multiple paths before they reach the antenna through different paths.

5. Degree of ambiguity

The number of weeks in the carrier phase pseudo space between GNSS satellite and GNSS receiver.

6. Ephemeris

Current satellite position prediction. It is transmitted in the data.

7. Epoch

Measurement interval of GNSS receiver. Variations of the calendar element with measurement type:

- For real-time measurement, it is set to one second.
- For post-processing measurements, set to one second and one minute.
- 8. Antenna height

The height of the receiver phase center to the center of the station.

9. Reference station (base station)

In a certain period of time, and if one or several receivers, on one or a few test sites, keep tracking an observation satellite, with the receiver in a certain range, the fixed station is called a reference station.

10. Mobile station

In a certain period of time, and if one or several receivers, on one or a few test sites, keep tracking an observation satellite, and the receiver is within a certain range, the fixed station is called a reference station.

11. Single reference station RTK measurement.



Only one base station is used, and the carrier phase difference correction parameter is measured by the data communication technology receiving base station.

## 12. Network RTK (CORS/VRS)

Refers to multiple reference stations in an area, network coverage to the region composition, and continuous tracking observation, through the sites of GPS observation network, covering the region and the time period for RTK correction parameters, in the region for RTK line RTK real-time correction way of positioning.

## 13. Cut-off height angle

In order to shield the effect of occluded objects (such as buildings, trees, etc..) and the multipath effect, the value of the angle threshold is lower than that of the satellite in the field of view, which is usually set to 10 degrees.

## 14. Fixed solution

This indicates that the ambiguity has been solved and the measurement has been initialized. It is the most accurate type of solution.

## 15. Floating solution

This indicates that the ambiguity has been solved and the measurement has not been initialized.

## 16. DOP (dilution of precision)

Position Dilution of Precision (Dilution of Precision) is GNSS quality marks. It takes into account the position of each of the satellites, relative to the other satellites in the constellation, and their geometric position relative to the GNSS receiver. The smaller the DOP value, the higher the accuracy reliability. Standards applied by GNSS DOP value are: - the PDOP - position (3d coordinate) - RDOP relative (position), average time - HDOP - level (two-dimensional horizontal coordinates) - VDOP - vertical (only height) - TDOP - time (the clock offset only).

## 17. Spatial position dilution of precision (PDOP)

A unit number that represents the relationship between user position error and satellite position error. The factors reflecting the attenuation of positioning accuracy are related to the spatial geometric distribution of the measured satellite, and the larger the spatial distribution range, the smaller the PDOP value and the higher the positioning accuracy; conversely, the larger the PDOP value, the lower the positioning accuracy.

## 18. PDOP limit

The highest PDOP value for the receiver's computed position.

## 19. PPM

The measurement of the slanting distance of one-millionth is corrected for the impact of the earth's atmosphere. PPM is determined by the observed pressure and temperature as well as the specific instrument constants.

## 20. The RMS

The Root Mean Square is used to indicate the measurement accuracy of the point. It is the error circle radius at about 70% of the fixed point.



## 21. SNR

(Signal-to-Noise Ratio) . It is a measure of the strength of satellite signals. SNR ranges from 0 (no signal) to 99, of which 99 is the best, and 0 means the satellite is not available. The typical good value is 40. Normally, when SNR is above 25, GNSS systems begin to use satellites.

22. Weighted index

The weighted index is used in the neighborhood adjustment calculation. The calculated distance from each new point to the control point, in the station establishment, will be weighted according to the weighted index when the coordinate adjustment applied to the new point is calculated.

23. Pile distance/station distance.

The distance or interval along a line, arc, or path.

24. Projection

Projection is used to produce a plane map that represents the surface of the earth, or that part of the surface.

25. The ellipsoid

The earth's mathematical model of the rotation of an ellipse around a short axis.

26. Geodetic datum

A mathematical model designed to fit some or all of the geoid surface (physical earth surface).

27. Earth level

It's very close to the universal gravitation of the sea's surface.

## **10.2 Troubleshooting**

1. The receiver keeps tracking but failed to give coordinates.

Please try the possible solutions below:

(1) Set up the receiver again in another place with much less electromagnetic wave interference (like a power station, radar station, etc..)

(2) Set the working mode of the receiver to static, then collect static data for 3 - 5 min, then switch it back to the original model (base or rover)

(3) Long press function button to reset motherboard, or restart the device.

2. The base station failed to send correction signal.

Please try the possible solutions below:

(1) Replace the battery in case the battery power is too low (power LED will flash red)

(2) Abnormal LED display in base mode

a. Satellite LED flashing, means the receiver failed to track the satellites and the coordinates cannot be provided:

The place where the base was set might be blocked by buildings or shelters and the useful



Satellites were less than 4. Find a better place to set up the station again.

Coordinates provided by the base station are far from the actual coordinates; in this case, a reaveraging of base coordinates is required.

b. Satellite LED keeps on but the signal LED does not flash: this means the base does not transmit the correction signal. Please reset up the base.

(3) Central meridian might be set with a mistake, double-check this parameter.

(4) Reset motherboard, restart the device.

3. Rover cannot receive signals even if it is very close to the external radio of the base station:

(1) If the signal LED is not flashing, please refer to problem 2 (previous problem).

(2) Transmitting LED RX/TX does not flash (flashes once every second in normal conditions)

a. Check if the cable is connected firmly.

b. Check if the cable is broken, try to replace the cable.

c. Replace the power if the battery is too low.

(3) Everything is alright with the base part but the rover signal LED does not flash.

a. Make sure the radio channel and link rate are the same as the settings in the base.

b. Internal radio module in rover is abnormal, try to replace it, or grade the firmware or restart the device.

(4) Rover signal LED flashed but in the software, there is no common satellite number showing.

a. Make sure the message types between base and rover are the same.

b. Rover is severely interfered with and the common satellites' number is less than 4, so the number is not showing. On this occasion please go to an open-air area to set the rover.

4. Short-range radio communication in external radio base mode.

These are three possible reasons:

(1) External battery power is too low to supply enough power to transmit the signal. Replace the battery.

(2) The transmission method is not set to be external radio on the base station.

(3) External radio abnormal.

a. Power is set too low.

b. The transmission antenna is not installed properly.

c. The cable is not connected firmly.

d. The antenna on the rover is not installed firmly or broken.

(4) Strong interference in the base area. Try to change the channel or change the place to set up base

5. Failed to connect to internet in internal GSM mode.





How to solve:

(1) Cellular internet antenna is not installed or not installed firmly.

(2) Internet setting incorrect (check the IP address, port, telecom operator, APN, CORS ID, and password, etc..)

(3) SIM card problems

a. Not installed properly, or the position is not matched to the pins, either too shallow or too deep.

b. No balance in the SIM account.

c. The band of the SIM card is not matching the band in the cellular modem. Try to use another SIM card from other telecom operators.

(4) Cellular signal is weak in the region.

(5) CORS server is not working properly. Try to use another device to test it.

(6) Reset the device.

6. ZHD Server connection failed.

How to solve:

(1) Check the IP, port, Area ID, Group ID, the message type is the same between base and rover.

(2) Account or Group ID and Area ID occupied by other users. First come, first served.

(3) Server abnormal. Please contact CORS service center for help.

7. Rover failed to get signal from CORS.

How to solve:

(1) Signal LED flashing green, but failed to connect to server:

a. SIM card issues (no balance, SIM card slot lose, band incompatible);

b. CORS parameters issues (IP, port, mount point, account ID and password, etc..)

c. Contact the CORS service center for help if the above are checked and are ok.

d. Internal cellular modem problem, try to reset or restart the device.

(2) Signal LED stays green but failed to receive a correction signal.

a. Check IP, port.

b. Contact the CORS service center for help if the things above are checked.

(3) Signal LED is green and flashes yellow every second, but no common satellites' number shows.

a. Check if the message type is correct

b. Check if the GNSS signal is severely blocked or interfered.

8. Bluetooth connection failed between controller and receiver

How to solve:



(1) Check if the working mode of receiver is static; if yes, switch it back to

base or rover mode; check if the 8-pin port of receiver is occupied or not.

- (2) Clear the Bluetooth search result list, search again and connect the device.
- (3) Either switch off and switch on the Bluetooth function or restart the device or controller.
- (4) Update the firmware of controller, or the firmware of receiver.

9. Android controller cannot connect to PC (windows).

How to solve:

- (1) Check if the driver was successfully installed or windows updated to the latest version.
- (2) Check if the anti-virus software blocks the connection due to its security.
- (3) Check if the USB debug function is activated.
- (4) Check the USB cable is not broken.
- 10. Big coordinates difference after the Localization work (coordinate system parameters calculated)

Possible reasons:

(1) Accuracy is not good during the data sampling in the control point survey.

(2) The control point is not distributed properly in the restion<sup>3</sup>Abnormal control point coordinates. How to solve:

(1) Check the parameters result, if the scale is far from 1, then the control points might not be correctly input.

(2) Check the distribution of the control points, they should not be so close to each other.

(3) Try to delete the points whose RMS are bigger, if there are more than 3 control points.

## **10.3 File Formats**

## 10.3.1 Road File

[\*. Dam] : parameter file.

[\*.prj] : engineering documents.

[\*.raw] : raw database file.

[maincst.cst] : cross-section point library file.

[\*.mcp] : the graph root data file.

[\*.bak] : the back-up file will be automatically generated by the new project software if there is no external SD card.

[ParamComputer] : apply the dot to the file.

[\*.rsp] : PPK time file.

[\*.ppk] : PPK post-processing file.

[\*.txt] : custom TXT file.

[\*.csv] : custom CSV file.

[\*.dxf] : DXF file.

[\*.shp] : SHP file.

[\*.csv] : Excel file.

[\*.dat] : Cass7.0, Scsg2000, and PREGEO data files.

[\*.stl] : Hi-RTK record point library file.



[\*.line] : line library file.
[\*.sec] : line meta files.
[\*.PHI] : intersection file.
[\*.xy] : iron courtyard.
[\*.csv] : five pile files.
[\*.icd] : Elcad format.
[\*.zline] : coordinate method file.
[\*.pvi] : change the slope point file.
[\*.tpl] : cross section design line file.

## **10.3.2 File Format Specification**

1. Intersection of road plane design line [\*.PHI]

PHI: Point of Horizontal Intersection.

PHI file is stored in a text format, separated by a comma, and the first line is the format description [when the program reads it], starting from the second line, and behavior of the internode information; the storage format is:

Intersection number, coordinate N, coordinate E, starting range, curve radius, forward detente curve, then detente curve

XThe sample:

Intersection number, coordinate N, coordinate E, starting range, curve radius, forward detente curve, and then detente curve.

- 1, 3361410.701, 524798.9388, 200000, 0, 0, 0
- 2, 3361729.719, 516179.2477, 207750.218, 7000, 400, 400
- 3, 3362156.214, 514352.2852, 209804.108, 7000, 400, 400
- 4, 3363142.054, 511810.6419, 212590.856, 7000, 400, 400
- 5, 3365587.828, 502113.9878, 222784.866, 10000, 270, 270
- 2. Road plane line element file. [\*.Sec]

Sec: short for Section.

Sec files are stored in text format, separated by commas.

The first line is: the starting information format specification [skip] when the program is read.

The second line is: the starting point of the line, including the starting point, starting distance, and starting point angle.



The third line is the line element format specification.

The fourth line is: the beginning line is a line element information. Its storage format is: type, starting radius, end radius, line element length, deflection direction. Note: \*. Type: straight line, arc, detente curve \*. Radius: -1 represents infinity. \*. Deflection direction: left L; Turn right R \*\*The sample: X0, Y0, S0, Azi0 3829469.058, 494798.067, 0, 1.67595677755068 [Type{L, A, S}, R1, R2{-1=infinity}, Length, Direction{L, R}] L, -1, -1, 334.315, L S, -1, 300, 145, R A, 300, 300, 60, R

- S, 300, 90, 60, R
- A, 90, 90, 75, R
- 3. Road longitudinal section changes the slope point file [\*.PVI]

PVI: short for Point of Vertical Intersection.

PVI files are stored in text format, separated by commas.

The first line is the format specification [skip] when the program is read.

From the second row, the row is a slope point information; its storage format is:

The slope of the slope is S, the elevation of the slope is H, the first slope is higher than i1, the second slope is i2, and the circle radius is R.

XThe sample

S, H, i1, i2, R

19653.349, 794.963, 0, 0.049, 0

20070, 815.379, 0.049, 0.007, 12000

22180, 830.155, 0.007, -0.025, 30000



23880, 787.655, -0.025, -0.014, 17000

23974.007, 786.339, -0.014, 0, 0

4. Road cross-section design line document [\*.tpl]

TPL: short for Template.

The TPL files are stored in text format, separated by commas.

The first line is the format specification [skip] when the program is read.

The second behavior left design line.

Third behavior right design line.

Its storage format is: the left design line [distance, slope ratio]\r right design line [distance, slope ratio].

XThe sample:

Left design line [distance, slope ratio]\r right design line [distance, slope ratio]

10, -0.1, 1, 0, 10, 1, 1, 0, 10, 1

10, -0.1, 1, 0, 10, 1, 1, 0, 10, 1

The cross-section point library (\*.cst) can be opened directly with notepad, and the coordinate points of data exchange module can be exported \*.csv, sample points, control points can be exported or imported \*.txt format, which facilitates data exchange with the computer.

(1) Export Excel file (\*.csv)

Roll call, N, E, Z, describe information

4, 20.9919, 7.8963, -0.0147, Test

(2) Sample library import/export Txt file (\*.txt)

Roll call, N, E, Z, description, set point range, whether it has been lifted (0: no, 1: yes)

1, 2542604.5095, 434458.4638, 47.5900, Lk pile 1, 10.0000, 0

22, 2542604.5062, 434458.4614, 45.4771, Street lamp, 30.0000, 1

(3) Control point library import/export Txt file. (\*.txt)

Roll call, N, E, Z, description, coordinate type (0:blh, 1:xyh) , B, L, H

t, 2542604.2867, 434459.2702, 47.9231, control points A, 1, 22:58:52.51358, 113:21:38.93873, 47.9231



uu, 2542604.5062, 434458.4614, 45.4771, Test, 1, 22:58:52.5206, 113:21:38.91030, 45.4771

(4) Cross section point library format (\*.cst)

CrossSec points[Ver:1]

E, N roll call, north coordinates, east coordinates, elevation plane Z, WGS84 latitude raw measurement data, B WGS84 longitude L raw measurement data, WGS84 raw measurement data height H, high target, high target type, the antenna type [manufacturer: type], north coordinate RMS values, East coordinates the RMS value, surface elevation RMS value, type, number of smooth, recording time, satellite altitude Angle, visible satellite number, Shared satellite number, PDOP value difference ages, set over, mileage (cross-sectional defined mileage), by collecting the real-time mileage by inverse calculation of coordinate, defined when mileage in the section of the pile point collection N coordinates, acquisition defined when mileage in the section of the pile point coordinates, E acquisition defined when the tangent of the transverse section is in the center of the road.

pt0, 321.83562359172527, 75.99595486273756, -0.7214999980390115, 00:00:10.445790N, 109:30:49.422520E, 0.0, 0.60960000000044, 0, Hi-Target: V30, 0.014002636, 0.011343374, 0.016180737, Single-point positioning, 1, 2013-10-08 15:07:16, 0, 19, 0, 1.7887421, 1.0, 6.263659450178594E-5, 30.0, 31.30462646484375, 321.0, 75.0, 0.8726646259971647.



