

# SURPAD 4.2 USER GUIDE

For Android Platform

V1.1

Shanghai eSurvey GNSS Co., Ltd.



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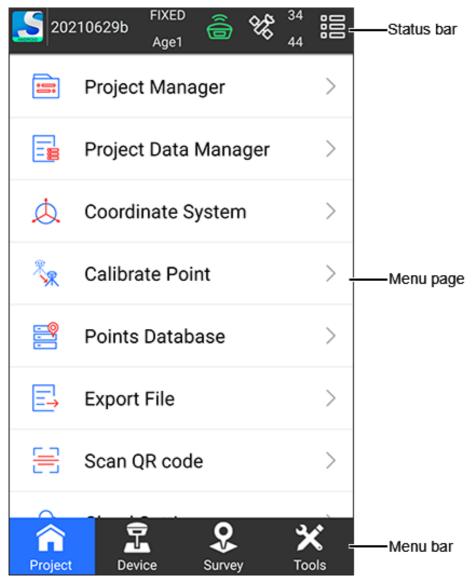
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# 1 SurPad at a Glance

Based on the Android platform, SurPad is a GNSS surveying and mapping software, developed by e-Survey. Combining with the international mainstream of surveying and mapping data acquisition function, it integrates RTK control, GIS data collection and road design and layout into one role.

With graphic interaction, SurPad is very powerful but easy-to-use. Its interface layout is as follows:







# 1.1 Status Bar

This part gives information about SurPad and the receiver:

Stat	tus icon	What it does
AMDROID	About software	To submit your feedback about the software, activate the software, and update the software.
20210629b	Project name	To show the name of the current project.
FIXED Age1	Solution status and delay	To show the solution status (including single, float, differential and fixed) and the differential delay in real- time.
Ô	Communicatio n	To show the connection status between the receiver and device. Green: connection succeeds. White: connection fails.
628	Positioning information	To check the current positioning information.
34 44	Satellites count	To show the used satellites number (e.g. 34) and the observed satellite number (e.g. 44).
	Main interface setting	To set the interface style to <b>List</b> or <b>Grid</b> , and set whether to enable general function, road function, electric function and other function which are enabled by default.

# 1.2 Menu Bar

This part gives access to the software functions:

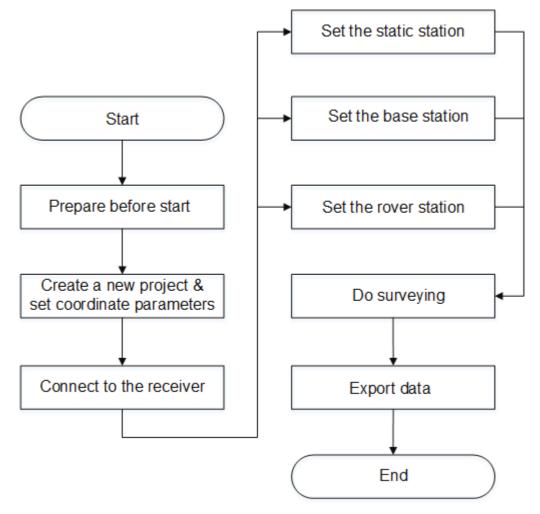
Menu		What it does	
Project	Project menu	To manage project operations. See <u>3</u> Project for details.	
Device	Device menu	To set operation mode and check information of the receiver after connecting to the receiver. See <u>4</u> Device for details.	
Survey	Survey menu	To start your survey work. See <u>5</u> Survey for details.	
X Tools	Tools menu	To select various calculation methods. See <u>6</u> Tools for details.	

# Our servey

# 2 Quick Start

To learn how to get your SurPad software up and running.

The process of quick start is as follows:



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# 2.1 Prepare before Start

It is used to make sure that your SurPad can work and run normally.

To prepare before start, do the following:

- 1. Prepare the following:
  - Two GNSS receivers (one base station and one rover station)
  - An Android device with network connected.
- 2. Install the SurPad.
- 3. Activate the SurPad.

# 2.1.1 Install the SurPad

It is used to make sure the SurPad can be correctly installed in your Android device.

To install the SurPad, do the following:

- 1. Download the Android SurPad installation package (\*.apk), and copy it to an Android device.
- 2. Find the installation package in File Manager in Android device.
- 3. Press the installation package, and press **INSTALL** in the following prompt:



- 4. After a prompt *App installed* shows, press one of the following:
  - **DONE**: to return to the path where the installation packages puts.
  - **OPEN**: to open SurPad software.

After installing the SurPad, to uninstall it, do one of the following:

- Long press the software icon on the desktop and drag it to **Uninstall** box.
- Press Settings  $\rightarrow$  APPs, find SurPad, and press SurPad and Uninstall.



# 2.1.2 Activate the SurPad

When you start SurPad at the first time, registering your license of the software is required. Otherwise, you cannot use SurPad normally.

To activate the SurPad, do the following:

1. To enter **Software Activation** interface, in the status bar, press **Software activation**:

← so	oftware activation					
Activation information						
Activation ID	667D32F9667D36AC	Сору				
Expiry date	2021-7-28					
Activation option	IS					
Manual	Manual code activation (requires internet)					
Online activation (requires internet)						
Offline activation						
Transfer activation code (requires internet)						

Alternatively, press main menu  $Project \rightarrow About Software$ , and press Software Activation.

- 2. Select one of the following methods to activate your SurPad:
  - Manual code activation: internet is required.
  - **Online activation**: internet is required.
  - Offline activation: internet is not required.
  - **Transfer activation code**: internet is required. With this code, you can use SurPad on different devices.



# 2.2 Create a New Project and Set Coordinate Parameters

In general, when you begin to measure an area at the first time, you need to create a project file matched with the current project coordinates.

After the project has been created, a file folder whose name is the same with the project will be created to save all data under directory *SurPad/Project* in your Android device.

To create a new project and set coordinate parameters, run SurPad, and do the following:

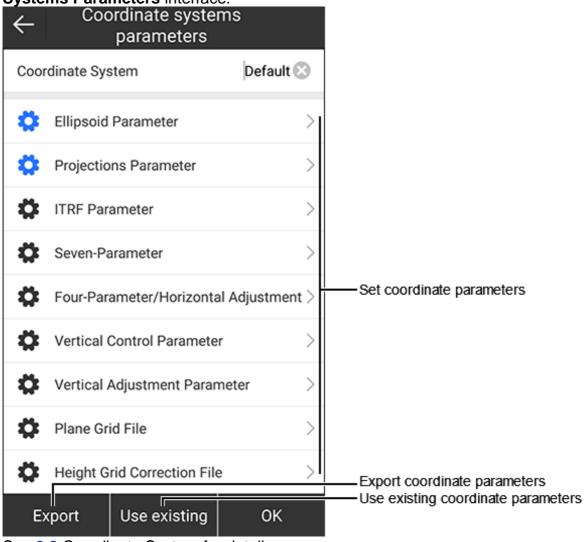
1. To enter **Create Project** interface, press main menu **Project** → **Project Manager**, and press **New**:

← Cre	eate Project
Project Name	20210630 😒
Coordinate systems parameters type	Parameters of last project $>$
Operator	
Device	
Notes	
Date Created	2021-06-30 17:45:39
Disk Info	1.26 GB/54.48 GB
	ок

- 2. Set the following required parameters:
  - **Project Name**: the created date by default.
  - Coordinate systems parameters type: including parameter of last project, local parameters, RTCM1021~1027 parameters, and CORS encrypted parameters.
- 3. Optional: Set the following additional parameters based on your need:
  - Operator
  - Device
  - Notes
- 4. Press OK.

# -survey

5. Optional: If Coordinate systems parameter type is set to Parameter of last project or Local parameters, set the coordinate system parameters in Coordinate Systems Parameters interface:



See <u>3.3</u> Coordinate System for details.

# **O-survey**

# 2.3 Connect to the Receiver

It is used to establish the communication between the receiver and the SurPad.

To connect to the receiver, do the following:

1. To enter **Communication** interface, press main menu **Device**  $\rightarrow$  **Communication**:

← c	ommu	nicatio	n	
Device manufacturer			eSur	vey $>$
Device Type	rtk $>$			
Communicatio Mode	on		Blueto	oth >
Bluetooth Device	List		Ex	<u>[]</u>
E30P3A1900043	7	D4:53:8	83:5F:8F:F1	
E30P3A2000089		D4:53:83:61:04:FE		
E5003A2000022	23	74:7A:90:3B:05:66		
Search		ection	Conn	lect

- 2. Select the device manufacturer and the device type.
- 3. Select one of the following communication modes:
  - **Bluetooth**: to connect the receiver by Buletooth. Its operation is the same with WIFI operation.
  - **WIFI**: to connect the receiver by WIFI. Its operation is the same with Bluetooth operation.
  - **Serial port**: to connect the receiver with a data cable by setting port and baud.
  - **Demo**: to check and try out various functions of SurPad in demo mode by setting coordinates of the start point.





- 4. Taking the communication mode **Bluetooth** as an example, to set the communication mode, do the following:
  - a. To find receivers in Bluetooth Device List, press Search.
  - b. When the receiver you need to connect shows in the device list, press Stop.
  - c. Press the target Bluetooth, and press Connect.

**CAUTION: Fast Connection** is to search the signal around and automatically connect to the strongest one.

d. **Optional**: Press **Pair** in the pairing prompt if it is the first time to connect to the receiver.

## 2.4 Set the Static Station

It is used to set the static, including configuration, option settings, antenna parameters, etc.

See 4.4 Static for details.

To set the base station, do the following:

1. To enter Static Mode Settings interface, press main menu Device  $\rightarrow$  Static:

← Static mode setti	ngs				
Configurations	>				
Options Settings					
Point name	0089				
PDOP limit	3.5 >				
Cut-off angle	5 >				
Collection Interval	1нг >				
Auto Record Static Data	•				
Antenna Parameters					
Antenna Measured Height	1.8				
Antenna Measurement Type	Vertical height $>$				
Antenna Height	1 872				
Advanced Save&Apply	Apply				

2. Press **Configurations** to select the configuration.



- 3. In **Options Setting** area, set point name, PDOP limit, cut-off angle, collection interval, and automatic static data recording.
- 4. In **Antenna Parameters** area, set antenna measured height, antenna measurement type and antenna height.
- 5. Press Apply.

# 2.5 Set the Base Station

It is used to set the base, including configuration, base ID, start up mode, differential mode, base startup, raw data recording, data link, etc.

See <u>4.3</u> Base for details.

To set the base station, do the following:

1. To enter **Base Mode Settings** interface, press main menu **Device**  $\rightarrow$  **Base**:

← Bas	e mode settii	ngs
Configurations		>
Base ID		
Start Up Mode		Single Point $>$
Diff Mode		RTCM3.2 >
Base startup		•
Record raw dat	ta	$\bigcirc \circ$
Data Link	1	Device Internet $>$
Connect Options		
Connect Mode		NTRIP $>$
Auto connect t	o network	
Advanced	Save&Apply	Apply

- 2. Press **Configurations** to select a saved configuration.
- 3. Set Base ID.
- 4. Press Start Up Mode to set a start up mode.
- 5. Select whether to enable base startup and record raw data.
- 6. Press **Datalink** to select a way to transmit differential signals.
- 7. Press Apply.



# 2.6 Set the Rover Station

It is used to set the rover, including configuration, cut-off angle, raw data recording, aRTK, aRTK age limit, data link, etc.

See <u>4.2</u> Rover for details.

To set the rover station, do the following:

1. To Rover mode settings interface, press main menu  $Device \rightarrow Rover$ :

$\leftarrow$	Rover mod	e settings	
Configurat	tions		>
Cut-off an	gle		5 >
Record ray	w data		•
Enable aR	ТК		$\bigcirc \circ$
aRTK Age	Limit		1200
Data Link		Phon	e Internet $>$
Connect N	lada		
	Noue		NTRIP
CORS Setting			NTRIP
CORS Setting			NTRIP ••• eSurvey

- 2. Press **Configurations** to select a saved configuration.
- 3. Set or select the cut-off angle.
- 4. Select whether to record raw data and enable aRTK. With raw data recorded, you can input point name and collect post-differential point.
- 5. Set the aRTK age limit.
- 6. Press **Data Link** to select a way to transmit differential signals.
- 7. Press Apply.



Return to the main interface to see if the status is fixed solution Age1 in the status bar.

# 2.7 Do Surveying

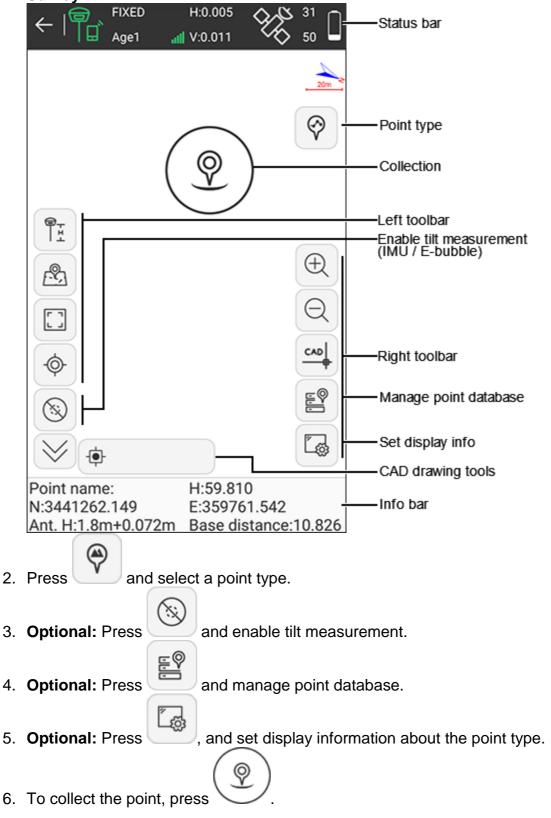
It is used to start your surveying work.

**O-survey** 

See <u>5.1</u> Point Survey for details.

To do surveying, do the following:

1. To enter the main interface of point survey, press main menu  $Survey \rightarrow Point$ Survey:



# **O-survey**

# 2.8 Export Data

It is used to export measurement data file into your needed data format for later use.

See <u>3.6</u> Export File for details.

To export data, do the following:

- 1. Copy the data file that needs to import to SurPad folder.
- 2. Press main menu **Project**  $\rightarrow$  **Export File**.
- 3. Select the target data file, enable whether to export road cross-section, file format, and angle format.
- 4. Press Export.
- 5. Select the target file storage (internal storage root directory or program storage directory).
- 6. **Optional:** Modify the file name.
- The default one consists of the current data and time.
- 7. Press Export again.

A prompt Export file succeeded pops up.



# 3 Project

SurPad manages data in the form of engineering documents, that is, all operations are controlled in a project. Every time you start SurPad, the software will automatically invoke engineering documents used last time.

# 3.1 Project Manager

Press main menu  $Project \rightarrow Project Manager$  to enter Project Manager interface:

Project Path	Internal Storage/SurPad/ Project >	Modify project directory
Disk Info	1.25 GB/54.48 GB	Check disk memory
Input project name	0	
Project List	11	
🚞 20210629b	20210629 08:38	
20210628	20210628 14:10	Select existed porject
<b>20210628</b> a	20210628 15:46	
<b>20210629a</b>	20210629 08:38	
		Create a new project
		Export target project Check/modify project info
New Import	Export Details	



# 3.1.1 Modify the Project Directory

It is used to change the storage directory of the current project.

To modify the project directory, do the following:

1. Press Project Path. File Directory interface shows:

2. Select the target directory.

**CAUTION:** If the workload is large in survey, please make sure the memory of the target directory is sufficient to save the project.



## 3.1.2 Create a New Project

To create a new project, see <u>2.2</u> Create a New Project and Set Coordinate Parameters for details.

#### 3.1.3 Select a Existed Project

It is used to select a project as the current project if you have created projects before.

To select an existed project, do one of the following:

- To find a project in the local by its project name, input the project name, and press
- To find a project in the local by the project list, in the **Project List** area, select a file folder.

If there are too many file folders, to quickly find the target one, you can press and select a sorting method.

• To import a project in other directories, press **Import**, select the target file directory and project.

## 3.1.4 Export a Project

To export a project, do the following:

- 1. In the **Project List** area, select the target project.
- 2. Press **Export** and select the target file directory.



# 3.1.5 Check / Modify Project Information

To check / modify the project information, do the following:

1. Press Details. Project Details interface shows:

$\leftarrow$	← Project Details	
Project Nam	<b>e</b> 20210629b	
Coordinate systems parameters	Local parameters $>$ type	
Operator	test 😒	
Device	e-Survey	
Notes	test	
Date Create	d 2021-06-29 08:38:56	
Disk Info	1.25 GB/54.48 GB	
ОК		

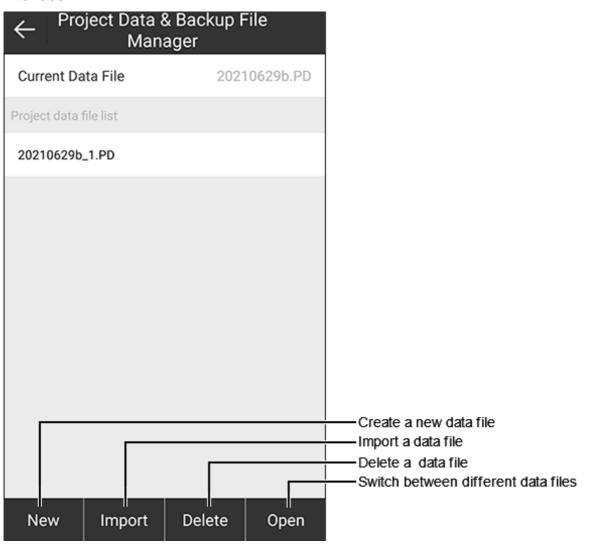
- 2. **Optional:** Modify the following information based on your needs:
  - Coordinate systems parameters type
  - Operator
  - Device
  - o Notes



# 3.2 Project Data Manager

It is used in a project where there is too much data or when you want to distinguish between two different coordinate point libraries.

Press main menu  $\textbf{Project} \rightarrow \textbf{Project Data Manager}$  to enter Project Data Manager interface:



#### 3.2.1 Create a New Data File

It is used to create a new data file with PD format to save the recorded survey data. The new data file is the data file for the storage record of the current project, and it belongs to the current project.



To create a new data file, do the following:

1. Press New. A prompt Create new project data file shows:

Create new project data file		
Name	20210629b_	3 🐼
	Cancel	ок

2. Set a name for the created data file. Default: the current data file name\_1/2/3... (accumulating)

## 3.2.2 Import a Data File

It is used to import a data file with RTK format.

To import a data file, do the following:

- 1. Select the target data file in **Project data file list** area.
- 2. Press Import. Import Backup File interface shows:

← Import Backup File		
Open Backup file(.RTK)		
File Path		>
Please input data file name		
File Name	20210629b_3 🛞	.PD
(	ок	

- 3. Press File Path and select the file path.
- 4. Set a name for the imported data file.



Default: the current data file name\_1/2/3... (accumulating)

## 3.2.3 Delete a Data File

To delete a data file, do the following:

- 1. In Project data file list area, select the target file.
- 2. Press **Delete**. A prompt for confirmation shows.
- 3. Press OK.

## 3.2.4 Switch between Different Data Files

It is used to switch between different data files when a project owns multiple data files.

To switch between different data files, do the following:

- 1. In **Project data file list** area, select the target file.
- 2. Press Open.

# 3.3 Coordinate System

It is used to set coordinate system parameters.

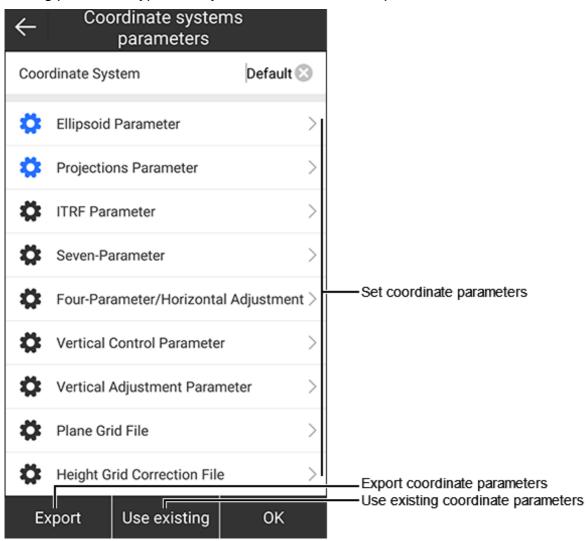
# Press main menu $\textbf{Project} \rightarrow \textbf{Coordinate System}$ to enter Coordinate Systems Parameters interface.

The interface differs in the coordinate system parameter type when a project is created:

- Local parameters
- RTCM1021~1027 parameters: a way to send coordinate system parameter via differential data. In this way, the software analyses coordinate parameters from received differential data.
  - The **Coordinate Systems Parameters** interface is unchangeable.
- CORS encrypted parameters: it is mainly used by CORS merchants when they would like to keep coordinate parameters secret. The Coordinate Systems Parameters interface is unchangeable.



Taking parameter type local parameters as an example, the interface is as follows:



## 3.3.1 Set Coordinate Parameters

To set coordinate parameters, do the following:

- 1. Set a name for the coordinate system.
- 2. Set the following parameters according to the actual situation:
  - Ellipsoid parameter: to select the target ellipsoid or customize the ellipsoid. With the customized ellipsoid, please set the semimajor axis and reciprocal of flattening 1/f, which should be the same with the ellipsoid used for parameter calculation.
  - Projection parameter: it contains most of the frequently-used projection modes, such as UTM, Gauss Kruger, Transverse Mercator, Lambert Conic Conformal, etc.

During setting projection parameters, when the central meridian is not the

same with the actual situation, you can press *or* manually input the current central meridian.

- o **ITRF parameter**: ITRF refers to International Terrestrial Reference Frame.
- **Seven parameter**: to perform Space rectangular coordinate transformation within two different ellipsoids.

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- Four-parameter/horizontal adjustment: in general at least two known points and four pairs of XY coordinate values in two different space rectangular coordinate systems are required to calculate the four unknown parameters.
- Vertical control parameter: to use some known points to calculate the vertical control parameters, in order to match the elevation of receivers with the local height system.
- **Vertical adjustment parameter**: the elevation transformation model of Trimble TGO software.
- Grid file: to match the horizontal difference (North and East) between the local and universal coordinate system, and import the grid file (\*.GDS, \*.GSB, \*.GFS).
- Geoid file: to match the earth height (ellipsoid height used in GPS elevation system) with the normal height (used in elevation system in survey), and import the geoid file (\*.GGF, \*.SGF, \*.UGF, \*.GSF).
- Local offsets: to calculate local offsets based on a known point.

# 3.3.2 Use Existing Coordinate Parameters

It is used to apply coordinate system parameters stored before.

To use existing coordinate parameters, do the following:

- 1. Press Use existing.
- 2. Select one of the following methods to apply coordinate parameters:
  - Local disk: to apply them in the local. SP and EP formats are supported.
    - **QR code**: to apply them by scanning the QR code.
    - **Cloud server**: to apply them from the cloud server. See <u>3.8</u> Cloud Settings for details.
    - **Predefined projections**: to apply predefined parameters saved before.

#### 3.3.3 Export Coordinate Parameters

To export coordinate parameters, do the following:

- 1. Press Export.
- 2. Select one of the following methods to export the set coordinate parameters:
  - Local Disk: to save them in the SurPad files in the local.
    - **QR Code**: to save them as a QR code.
    - Cloud Server: to upload them to the cloud server.



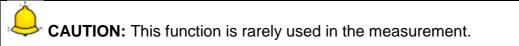
# 3.4 Calibrate a Point

#### Press main menu **Project** → **Calibrate Point** to enter **Calibrate Point** interface:

← Calibrat	e Point	
Base Point Calibration	>-	Do base point calibration
Marker Point Calibratio	n >-	Do marker point calibration
dX	0	
dY	0	Result of point calibration
dH	0	
Clear	ОК	

There are the following ways to calibrate a point:

• Base point calibration: the base station is set up at known control points and has been leveled and centered.



• Marker point calibration: the base station is not set up at a known control point when it has been turned on / off or its position has been changed, and the rover station is set up at known control points.



## 3.4.1 Do Base Point Calibration

By inputting coordinates of a known point and WGS84 coordinate automatically obtained when the base station is started, SurPad will calculate calibration parameters of the base station.

To do base point calibration, do the following:

1. To enter Calibrate Point interface, press main menu Project  $\rightarrow$  Calibrate Point, and press Base Point Calibration:

← Calibrate Point		
Known Point Coo	rdinates	
Northing		0
Easting 0		0
Elevation	Elevation 0	
Current Base Coo	rdinates	
Latitude	ľ	V31°05'03.893"
Longitude	E	121°31'49.372"
Altitude	61.76	
Antenna Parar	neters <sup>0m,H</sup>	eight to phase center >
Result		
Shift dX		
Base Information	Calculate	Apply

- 2. To input a known point, do one of the following:
  - To select a point from the point database, press S and select the target point.
  - To manually input coordinates, set values of **Northing**, **Easting** and **Elevation**.



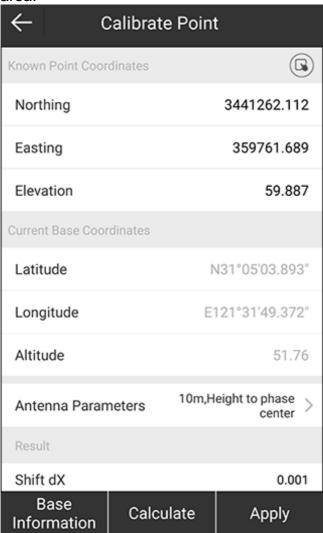
3. To enter Base Antenna Parameter interface, press Antenna Parameters:

← Base Antenna Parameter			
Antenna Measured Height(m) 10 😒			
Antenna Measurement Type		Height to phase	center >
Antenna Height 10			10
Antenna Parame	Antenna Parameters		
Antenna Type ESVE300P		00PRO >	
R(mm)	78.5	H(mm)	39.8
HL1(mm)	31.7	HL2(mm)	22.5
ОК			

- 4. Set the following antenna parameters, and press **OK** to return to **Calibrate Point** interface:
  - Antenna Measured Height
  - Antenna Measured Type: including pole height, height to phase center, slant height, slant height to altimetry.
  - **Antenna Type**: it is automatically set according to the current connected receiver.



5. To check the calculation result, press **Calculate**. The result is shown in **Result** area:



If the calculation result is in red font in **Result** area, it indicates the translation parameter is out of range (the longitude difference or latitude difference over 1°, or the height difference over 1000°).

6. To directly apply the calculation result, press Apply.



## 3.4.2 Do Marker Point Calibration

By inputting coordinates of a known point and the generated WGS84 coordinate, SurPad will calculate calibration parameters of the rover station.

To do marker point calibration, do the following:

1. To enter Calibrate Point interface, press main menu Project  $\rightarrow$  Calibrate Point, and press Marker Point Calibration:

Calibrate Point		
Known Point Coordinates		
Northing	3441262.112	
Easting	359761.689	
Elevation	59.887	
Current WGS84 Coordinates		
Latitude	dd.mmssssss	
Longitude	dd.mmssssss	
Altitude		
Antenna Parameters	1.8m,Pole Height $>$	
Result		
Shift dX		
Measure	Apply	

- 2. To input a known point, do one of the following:
  - To select a point from the point database, press is and select the target point.
  - To manually input coordinates, set values of **Northing**, **Easting** and **Elevation**.



3. Press Measure. Record Point interface shows:

← Recor	← Record point	
Antenna Parameters	1.8m,Pole Height $>$	
Name	Pt6 😒	
Code		
Progress	<1/1>Collected	
Solution Status	<35/47>FIXED	
HRMS	0.005	
VRMS	0.01	
Northing	3441262.111	
Easting	359761.69	
Elevation	59.887	
Latitude	N31°05′03.893"	
Longitude	E121°31'49.3721"	
Settings Restart	Save&Appl y OK	

4. Set a name and code.

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5. To set saved conditions, press **Setting**, and set related parameters in **Saved Conditions** interface, and press **OK** to return to **Record point** interface:

← Saved Co	onditions
Solution Limit	SINGLE $>$
HRMS Limit	0.1 >
VRMS Limit	0.2 >
Default Point Name	Pt1 >
Point Name Increment	1 >
Default Code	same as last point $>$
Average GPS Count	1 >
Default Configurations	ок

- 6. Press Antenna Parameters, and set antenna parameters.
- 7. Press OK to return to Calibrate Point interface. The result shows in Result area.
- 8. To directly apply the calculation result, press **Apply**.

# **O-survey**

### 3.5 Point Database

It is used to manage all types of coordinate points.

Press main menu **Project**  $\rightarrow$  **Points Database** to enter **Points Database** interface:

<		Points	Database	9		
Co	ount 5	Input name or	code		0	Find a existed point
	Name	Northing	Easting	Elevation	L	
Ŷ	Pt5	3441262.112	359761.689	59.887	N31°(	
Ŷ	Pt4	3441262.110	359761.689	59.899	N31°(	Directly select a point
Ŷ	Pt3	3441262.112	359761.691	59.885	N31°(	
Ŷ	Pt2	3441262.111	359761.688	59.887	N31°(	
Ŷ	Pt1	3441262.111	359761.692	59.890	N31°(	
	Add	Edit	Details	Import		Add a new point Edit a point Check point info Import a point Do the following: Delete a point Filter points Recover points Share a point

#### 3.5.1 Find the Existed Point

To find the existed point, do the following:

- 1. Input a name or a code of the existed point in input box of **Count n**.
- 2. Press Q.



#### 3.5.2 Add a New Point

To add a new point, do the following:

1. Press Add. New Point interface shows:

۲ <del>ک</del>	New point
Name	Pt6 😒
Northing	
Easting	
Elevation	
Code	
Coordinates Type	Local Coordinate $>$
Property type	Input point $>$
	ок

- 2. Input a name.
- 3. Select a coordinate type:
  - Local Coordinate
  - Geodetic Coordinate
- 4. Set one of the following coordinates:
  - If the coordinate type is set to **Local Coordinate**, set northing, easting and elevation.
  - If the coordinate type is set to **Geodetic Coordinate**, set latitude, longitude and altitude.



- 5. To set a code, do one of the following:
  - Directly input a code name.
  - To select a code from the code database manager, press

÷	← Code Library Manager				
No.	Name		Full Pat	h	
1	a1	Internal St	orage/SurPa	ad/Config/a	1.txt
2	a2	Internal St	orage/SurPa	ad/Config/a	2.txt
3	a3	Internal St	orage/SurPa	ad/Config/a	3.txt
N	ew	Edit	Delete	Import	ок
		typo:			

- 6. Select a property type:
  - Assistant point
  - Control point
  - Input point
  - Stakeout point





#### 3.5.3 Edit a Point

To edit a point, do the following:

- 1. Select a point.
- 2. Press Edit. Edit Point interface shows:

÷	Edit Point	
Name		Pt1 😒
Northing		10
Easting		10
Elevation		10
Code		
Coordinates Typ	pe	Local Coordinate
Property type		Input point
	ок	

- 3. Modify the following based on your needs:
  - ∘ Name
  - **Coordinate**: including northing, easting and elevation. It is only for input points. For measured points, this is unavailable.
  - Code



#### 3.5.4 Check Point Information

It is used to check the point name, code, latitude, longitude, altitude, northing, easting, elevation, coordinates of X, Y and Z, and property type.

To check point information, do the following:

- 1. Select a point.
- 2. Press Details. Point Details interface shows:

← Point Details				
Title	Content			
Point Name	Pt4			
Code				
Latitude	N31°05'03.893"			
Longitude	E121°31'49.372"			
Altitude	59.899			
Northing	3441262.11			
Easting	359761.689			
Elevation	59.899			
×	-2859084.051			
Y	4660052.802			
z	3273943.182			
Photo And Sketch				



#### 3.5.5 Import a Point

To import a point, do the following:

1. Press Import. Import File interface shows:

← Impo	rt File
File Format	Local coordinates format(.csv dat txt)
[Point Name],[Northing],[E	asting],[Elevation],[Code]
Property type	Control Point $>$
Preview	
Format Manager	ок



Optional: To add a user-defined format, do the following:
 a. Press Format Manager:

	← User-defined format					
No.	Format name	Extension name				
1	test	dat				
2	test1	dat				
3	test2	txt				
4	test3	csv				
5	test4	xIs				
I	New	Edit Imp	ort	Delete		



b. Press New:

← Custom format			
Custom format de	scription		
Format name		Point N	lame
		Code	
Field delimiter	Latitud	le	
	Longitu	ude	
Extension name	~	Altitude	
dat File header	•	Northing	
Yes	~	Easting	
		Elevation	
		x	
Add	Del	ete	ОК

- c. Set format name, field delimiter, extension name and add format description.
- d. Press **OK**. The add user-definded format shows in the existed file formats.
- 3. Press File Format, and select one of the following existed file formats:
  - Measurement data file (.PD): preview is not supported.
  - Geodetic coordinates format (.csv / .dat / .txt)
  - Local coordinates format (.csv / .dat / .txt)
  - COT format (.cot)
  - Cass format (.dat)
  - AutoCAD format (.dxf)
  - GoogleEarth kmz file format (.kmz)
  - NETCAD format (.ncn)
  - PXY file (.pxy)
  - Carlson coorinate file (.crd)
  - Spatial coordinate (.csv / .dat / .txt)
  - User-defined formats
- 4. Select a property type.
- 5. Optional: To preview the point, enable Preview.
- 6. Press OK.
- 7. Select the target file directory and the target file.
- 8. Preview the data, and press **OK** to import coordinates if the data is correct.



#### 3.5.6 Delete a Point

To delete a point, one of the following:

- 1. Do one of the following:
  - Long press the target point in **Points Database**.
  - Press  $\dots \rightarrow$  Delete.

<ul> <li>← Points Database</li> </ul>						
Count 0	Count 0/5 Input name or code					
0	Name	Northing	Easting	Elevation		
$\bigcirc $	Pt5	3441262.112	359761.689	9 59.887 1		
$\bigcirc $	Pt4	3441262.110	359761.689	59.899		
$\bigcirc $	Pt3	3441262.112	359761.691	59.885		
0 🤗	Pt2	3441262.111	359761.688	3 59.887 I		
0 🤗	Pt1	3441262.111	359761.692	2 59.890		
Cance	Cancel Select All Delete Ant. H					

- 2. To select the target point, do one of the following:
  - Input the name or code of the target point, and press .
  - To select the target point in the point list, check it.



#### 3.5.7 Filter Points

To filter points, do the following:

1. Press  $\dots \rightarrow$  **Options**. The **Filter Operation** interface shows:

←	Filter Operation	
P	Assistant Point	
<b>P</b>	Survey Point	
Ø	Control Point	
$\heartsuit$	Input Point	
<b>%</b>	Calculate Point	
P	Stake Point	
Ģ	Screen Point	
<b>R</b>	Base Point	
	ОК	

2. Enable or disable the target point type.



#### 3.5.8 Recover Points

It is used to recover points you deleted.

To recover points, do the following:

1. Press  $\dots \rightarrow$  **Recover**. The **Deleted Points** interface shows:

← Deleted points						
$\bigcirc$	Name	Northing	Easting	Elevation		
0 🖗	Pt4	3441262.11	359761.689	59.899		
0 🖗	Pt5	3441262.112	359761.689	59.887		
Can		Select /	All Re	ecover		

- 2. Do one of the following:
  - Check the target point(s).
  - To select all points, press Select All.
- 3. Press Recover.

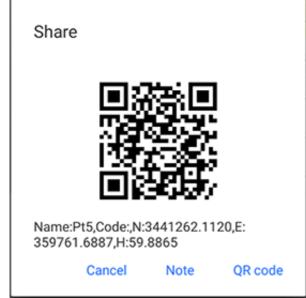
The target point(s) show(s) in **Point Database** interface again.



#### 3.5.9 Share a Point

To share a point, do the following:

- 1. Select the target point in **Points Database** interface.
- 2. Press ...  $\rightarrow$  Share. A QR code of the target point is automatically generated:



3. Press **QR Code**, and select the target app on your device.





#### 3.5.10 Modify Antenna Parameters

It is used to modify antenna parameters of points except screen points, so as to adjust the coordinates of points.

To modify antenna parameters, do the following:

1. Long press the target point in **Points Database** interface:

Points Database					
Count 1,	Count 1/5 Input name or code				
0	Name	Northing	Easting	Elevation	
<b>ම</b>	Pt2	3449427.285	369854.219	0.800	
$\bigcirc $	Pt1	3449427.285	369854.380	0.800	
$\bigcirc $	Pt3	3449437.656	369844.801	0.000	
$\bigcirc $	Pt2	3449437.681	369844.822	0.000	
$\bigcirc $	Pt1	3449437.585	369844.798	0.000	
Cance	Cancel Select All Delete Ant. H				

- 2. Optional: Check all target points.
- 3. Press Ant.H. Antenna Parameters interface shows.
- 4. Set antenna measure height and antenna measurement type.

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### 3.6 Export File

It is used to export measurement data file into the data format that you need.

Press main menu  $Project \rightarrow Export File$  to enter Export File interface:

← Export	File	
Select data file	20210629b.PD 🗦	
Export Road Cross-sectio	n 🕥 -	Export road cross-section
File Format	Survey point data format(.csv)	—Export files in a specified format
[Point Name].[Code].[Original Longitude].[Original Altitude]. x].[Station Correction y].[Station [Latitude].[Longitude].[Altitude] [Northing].[Easting].[Elevation [Used satellites].[Tracked sate [VRMS].[AGE].[Local date].[Lo [Base Latitude].[Base Longitu [Distance to Ref].[Inclination of angle].[Projected angle].[Corre [Correction h].[Target].[Station diff.].[Dist to start].[Tower Nat	Station Correction on Correction h], e][Antenna Height], ][Solution Status], ellites][PDOP][HRMS], cal time][Base ID], de][Base Altitude], correction][Inclined action x][Correction y], h.][Offset].[Elevation	—Vary with file format
Angle format	dd*mm'ss.ssss* $>$	
Export by acquisition time		
Format Manager	Export	

#### 3.6.1 Export a File in a Specified Format

To export files in a specified format, do the following:

- 1. Select a data file.
- 2. Select one of the following file formats:
  - Survey point data format (.csv)
  - Survey point data format (.xls)
  - TPS Survey point data format (.csv)
  - Cass format (.dat)
  - o KS Scsg2000 (.dat)
  - Local coordinates format (.dat)
  - Geodetic coordinates format (.dat)
  - o Name, North, East, Elevation, Station, Offset (.dat)
  - AutoCAD format (.dxf)
  - GoogleEarth kml file format (.kml)
  - GoogleEarth kmz file format (.kmz)



- SW electric file format (.swd)
- Track file format (.gpx)
- DOL file format (.csv)
- DOL file format (.html)
- LSS file format (.001)
- Photo and Skethc (.jpg)
- NETCAD format (.ncn)
- PXY file (.pxy)
- Carlson coordinate file (.crd)
- Cadastral surveying data format (.PD)
- GNSS Survey Report (.xls)
- 3. Press Export.

#### 3.6.2 Export a File in a User-defined Format

To export a file in a user-defined format, do the following:

1. Press Format Manager. User-defined format interface shows:

← User-defined format			
No.	Format name	Extension name	
1	test	dat	
2	test1	dat	
3	test2	txt	
4	test3	csv	
5	test4	xIs	
l	New	Edit Imp	oort Delete
1		-	oort Delete

• **New**: to create a new customized file format.

- Edit: to edit the created file format.
- **Import**: to import a customized file format.
- Delete: to delete the created customized file format.



2. Press New. Custom format interface shows:

← Custom format			
Custom format de	scription		
Format name		Point N	lame
		Code	
Field delimiter		Latitud	e
	<b>`</b>	Longitude	
Extension name       dat          ✓            File header          ✓            Yes          ✓		Altitude	e
		Northir	ng
		Easting	)
		Elevati	on
		x	
Add	Del	ete	ОК

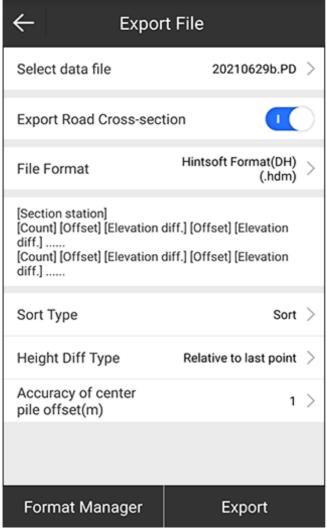
- 3. Set the following:
  - o Format name
  - Field delimiter: , @ Space Tab Enter
  - Extension name: dat, csv, txt, xls
  - $\circ$  File header
- 4. Select the exported format content, and press **Add** to add the content to the input box of **Custom format description**.
- 5. **Optional:** To delete the content of the custom format description one by one, press **Delete**.
- 6. Press **OK**. The interface returns to **User-defined format**.
- 7. Go back to **Export File** interface, and select a data file.
- 8. Select the customized file format.
- 9. Press Export.



#### 3.6.3 Export Road Cross-section

To export road cross-section, do the following:

1. Enable Export Road Cross-section. The following interface shows:



The interface varies with the file format.

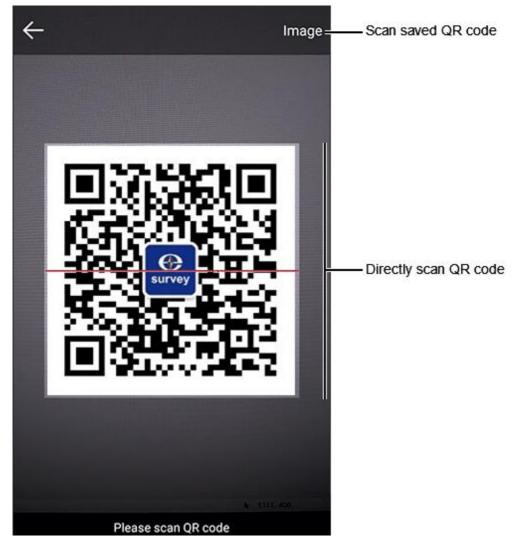
- 2. Select a data file.
- 3. Select a file format:
  - Hintsoft format (DH)(.hdm)
  - TianZhen format (H) (.hdm)
  - SOUTH CASS Cross-section file format (.hdm)
  - Haiti (.hdm)
  - Section measurement data (.csv)
- 4. Do related settings.
- 5. Press Export.

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### 3.7 Scan QR Code

It is mainly used to scan the QR code of coordinate system and configuration set.

Press main menu **Project**  $\rightarrow$  **Scan QR Code** to enter **Scan QR Code** interface:



After scanning the QR code, you can view detail information and apply the data in the current project.



### 3.8 Cloud Settings

It is a customized function. Please contact us if necessary.

Press main menu  $\textbf{Project} \rightarrow \textbf{Cloud Settings},$  and turn Use switch to ON status to enter Cloud Settings interface:

← Cloud	Settings
Use	
Cloud Settings	
IP	5
Port	0
Connect Status	Device not connected!
Cloud User Information	
User Group	test .
Password	test
Upload Data Settings	
Upload Survey Point	<u> </u>
Upload Track Interval	5 >
(	ок

You can use existing coordinate parameters through cloud server by pressing main menu **Project**  $\rightarrow$  **Coordinate System**.

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### 3.9 Software Settings

It is used to set the following:

- General settings: including shortcuts, software update notification, and voice prompt.
- Record settings: including topo point, control point, quick point, auto point, corner point, stop & go point, and tilt point.
- System settings: including distance unit, distance decimal, angle format, angle decimal, station format, language, text encoding, survey point data backup, change alert of base coordinates, location services, and auto start at boot.
- Display settings: including CAD background color, display content, coordinate order habit, display type, last (0 ~ 100) points, screen orientation, full screen display, and map display.

To do software settings, press main menu **Project**  $\rightarrow$  **Software Settings** to enter **Software Settings** interface, and modify related settings based on your needs.

### 3.10 About Software

It is used to check feedback, activate the software and check the latest version.

Press main menu  $Project \rightarrow About Software$  to enter About Software interface:

← About Software		
SurPad For Android V4.2.210625.105857		
Feedback	>-	Write feedback
Software activation	>-	Activate SurPad4.2
Check Latest Version	>-	Check latest version
Copyright © 2016-2018 Geoelectron Co., Ltd. All Rights Reserved.		





#### 3.10.1 Write Feedback

To write feedback, do the following:

1. Press Feedback. Feedback interface shows:

← Feedback		
Do you have any questions or suggestions?		
Subject		
Feedback content(required)		
Contact		
E-mail(required)		
Appendix:		
Add attachments		
Submit		

- 2. Write your feedback. Attachments are available.
- 3. Press Submit.

#### 3.10.2 Activate the SurPad

See 2.1.2 Activate the SurPad for details.

#### 3.10.3 Check the Latest Version

It is used to check if the current software is the latest version.

#### To check the latest version, press Check Latest Version:

- If it is the latest version, the interface shows Latest version.
- If not, a prompt *New version found. Update now?* shows to remind you to update the software.

# Our servey

### 4 Device

### 4.1 Communication

Press main menu **Device**  $\rightarrow$  **Communication** to enter **Communication** interface:

← Commu	nication	
Device manufacturer	eSurvey >-	Select a device manufacturer
Device Type	rtk >-	Select a device type
Communication Mode	Bluetooth >-	Select a communication mode
Bluetooth Device List	토문	
E30P3A1900047	D4:53:83:5F:8F:F1	
E30P3A2000089	D4:53:83:61:04:FE	
E5003A20000223	74:7A:90:3B:05:66	
		Search target device
Search	ection Connect =	Connect target device

The device type differs in the device manufacturer. Connection to a total station is supported.

See 2.3 Connect to the Receiver for details.

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#### 4.2 Rover

It is used to set the receiver as the rover station.

Press main menu **Device**  $\rightarrow$  **Rover** to enter **Rover mode settings** interface:

← Rover mode set	ttings	
Configurations	>	
Cut-off angle	5 >	
Record raw data	•	
Enable aRTK	•	
aRTK Age Limit	1200	
Data Link	Phone Internet >	
Connect Mode	NTRIP -	Set data link
CORS Settings	$\bigcirc$	
Name	eSurvey	
User	gdfkk	
Stop   Auvanceu	&Appl Apply	oot uuvunood oottingo

- **Cut-off angle**: the minimum vertical angle that is allowed to receive satellite signals. Signals below the angle will be ignored.
- **Record raw data**: to select whether to record raw data. With raw data recorded, you can set point name and collect post-differential point.
- Enable aRTK: to select whether to enable aRTK. With it enabled, the receiver is able to generate RTK positions even if the RTK correction source becomes unavailable within the set aRTK age limit.
- Data link: to select a way to transmit differential signals:
  - **None**: no differential signals is transmitted.
  - **Device Internet**: through the internal network in the receiver via a SIM card.
  - External Radio: through an external radio connected with the receiver.
  - **Phone Internet**: through the network of the used device.
  - Internal Radio: through the internal radio.

#### 4.2.1 Set the Data Link

It is used to set the current data link.



To set the data link, do one of the following:

- If the data link is set to **Device Internet**, set the following:
  - In **Connect Mode** area, set the following:
    - Connect mode
      - **NTRIP**: the standard network transmission differential mode, commonly used in CORS networks.
      - **CSD**: the original form of data transmission developed for the time-division multiple access (TDMA)-based mobile phone systems.
      - **TCP client**: one of the main protocols of the Internet protocol suite. It can be used to transfer differential data.
      - **Custom**: the user defined mode.
      - **GGA upload interval (s)**: default value: 5.
      - Auto connect to network: to select whether the receiver automatically connects to the internet once it is powered on.
      - **Network mode**: including GPRS and WIFI (the receiver should equip with WIFI function).
      - **Network system**: including auto, GSM, and CDMA1x.
      - **Network relay**: to select whether to use network relay.
  - In APN Settings area, select whether to automatically connect to APN, or set operator, name, user and password.

In addition, you can press 💬 after **APN Settings** to add an APN.

• In CORS Settings area, set name, user and password.

In addition, you can press after **CORS Settings** to customize information about the CORS server.

- In **MountPoint Settings** area, set mount point, select whether to enable phone internet access, and press **Get Mount Point**.
- If the data link is set to External Radio, set baud rate. Default baud rate: 38400
- If the data link is set to **Phone Internet**, set the following:
  - In CORS Settings area, set name, user and password.

In addition, you can press after CORS Settings to customize information about the CORS server.

- In MountPoint Settings area, set mount point, and press Get Access Point.
- In **Receive Data** area, select whether the receiver automatically connects to the internet once it is powered on.
- If the data link is set to Internal Radio, set the following:
  - Channel and frequency: channel 1~7 is fixed whose frequency is unchangeable; channel 8 is user-defined whose frequency can be set as needed.

**CAUTION:** With this data link, the frequency and protocol settings of the rover and base should be the same.



 Protocol: including Satel, PCC-4FSK, PCC-GMSK, TrimTalk 450S, HiTarget(9600), HiTarget(19200), South 9600, Trimmari III, South 19200, TrimTalk(4800), PCC-GMSK(4800), GEOTALK, GEOMARK, etc.

#### 4.2.2 Set Advanced Settings

To set advanced settings, do the following:

1. Press Advanced. Advanced Settings interface shows:

$\leftarrow$	Advanced settings	
GPS		
GLONASS	3	
BEIDOU		
GALILEO		
SBAS		$\bigcirc \circ$
QZSS		$\bigcirc \circ$
	ОК	

- 2. Select whether to receive signals from the following systems:
  - o GPS
  - o **GLONASS**
  - o **BEIDOU**
  - $\circ$  GALILEO
  - **SBAS**: the wide-area differential augmentation system (satellite-based augmentation system).
  - $\circ$  QZSS

# **O-survey**

#### 4.3 Base

It is used to set the receiver as the base station.

Press main menu **Device**  $\rightarrow$  **Base** to enter **Base mode settings** interface:

← Base mode sett	ings	
Configurations	>	
Base ID		
Start Up Mode	Single Point $>$	Set startup mode
Diff Mode	RTCM3.2 >	
Base startup	$\bigcirc \circ$	
Record raw data	$\bigcirc \circ$	
Data Link	Device Internet >	Set data link
Connect Options		
Connect Mode	NTRIP $>$	
Auto connect to network	Set advanced settings	
Advanced Save&Apply	Apply	

**CAUTION:** If the receiver is not in the base mode, you can directly modify its base parameters and set the receiver as the base station; if it is, you need to stop the base station before modifying its base parameters.

- Base ID: ID of the base station.
- Startup mode: including single point and input base coordinates.
- **Diff mode**: including RTCM3, CMR, CMR+, DGPS and RTCM32.
- **Base startup**: to select whether the base station automatically sends data after it is restarted.
- **Record raw data**: to select whether to record raw data. With raw data recorded, you can set point name and collect post-differential point.
- Data link: to select a way to transmit differential signals:
  - **Device internet**: through the internal network via a SIM card or WIFI.
  - External radio: through an external radio connected with the receiver.
  - Internal radio: through the internal radio.
  - **Dual**: through the device internet and external radio.

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#### 4.3.1 Set the Startup Mode

The supported startup modes include the following:

• **Single point**: to directly use WGS-84 coordinates of the current point as the base coordinates.

In this mode, point calibration for the rover station is required. See 3.4 Calibrate a Point for details.

• **Input base coordinates**: to manually input the base coordinates.

**CAUTION:** If the current position differs significantly from the input coordinates, please check the coordinate system or use single point mode to start base.

To set the startup mode by inputting base coordinates, do the following:

1. Select Start up mode as Input base coordinates. Base Coordinates Settings shows:

← Base Coordin	ates Settings
Input Base Coordinates	
Coordinates Type	Local Coordinate $>$
Northing	0
Easting	0
Elevation	0
Antenna Parameters	10m,Height to phase center >
Save	ок

2. To get the base coordinates, do one of the following:

🕀-survey

○ To use the current GPS coordinates, press

- To select a point from the point database, press and select the target point.
- To manually input coordinates, select a coordinate type (geodetic coordinate or local coordinate), and set values of base coordinate.
- 3. To get antenna height, press **Antenna Parameters**, and set antenna measured height and antenna measurement type in **Base Antenna Parameter** interface:

← Base Antenna Parameter				
Antenna Measured Height(m) 10 🛞				10 🐼
Antenna Measurement Type			Height to phase center $>$	
Antenna Height				10
Antenna Parameters				$\bigcirc$
Antenna Type			esve300pro $>$	
R(mr	n)	78.5	H(mm)	39.8
HL1(	(mm)	31.7	HL2(mm)	22.5
ОК				

The antenna type will be automatically recognized.

- 4. **Optional:** To save coordinates to the point database, press **Save** in **Base Coordinates Settings** interface.
- 5. To apply the base coordinate settings, press **OK**.



#### 4.3.2 Set the Data Link

It is used to set the current data link.

To set the data link, do one of the following:

- If the data link is set to **Device internet**, set the following:
  - In **Connect options** area, set the following :
    - Connect mode
      - **NTRIP**: the standard network transmission differential mode, commonly used in CORS networks.
      - **Custom**: the user defined mode.
      - **ZHD**: the differential transmission mode of HI-TARGET network, which needs to set group number and subgroup number.
      - **CHC**: the differential transmission mode of CHC network.
      - Auto connect to network: to set whether the receiver automatically connects to the internet once it is powered on.
      - **Network mode**: including GPRS and WIFI (the receiver should equip with WIFI function).
      - Network system: including auto, GSM, and CDMA1x.
  - In APN Settings area, select whether to automatically connect to APN, or set operator, name, user and password.

In addition, you can press 🖤 after **APN Settings** to add an APN.

 In CORS settings area, set NTRIP/CORS IP, port, base access point and server password.

For base access point, it is generally set to the device serial number.

In addition, you can press after **CORS Settings** to customize information about the CORS server.

- If the data link is set to **External radio**, set baud rate. Default baud rate: 38400.
- If the data link is set to Internal radio, set the following:
  - **Channel and frequency**: channel 1~7 is fixed whose frequency is unchangeable; channel 8 is user-defined whose frequency can be set as needed.

**CAUTION:** With this data link, the frequency and protocol settings of the rover and base should be the same.

- Protocol: including Satel, PCC-GMSK, TrimTalk 450S, South 9600, HiTarget(9600), HiTarget(19200), TrimTalk(4800), GEOTALK, GEOMARK, HZSZ, etc.
- **Power**: the power level of the base will affect the operating distance of the radio:
  - Low power and low power consumption lead to short operating distance.
  - High power and high power consumption lead to long operating distance.
- If the data link is set to **Dual**, see settings when the data link is set to **Device** internet and External radio.





#### 4.3.3 Set Advanced Settings

To set advanced settings, do the following:

1. Press Advanced. Advanced Settings interface shows:

← Advanced settings	3
Cut-off angle	5 >
PDOP limit	3.5 >
Delay Start(s)	60 >
GPS	
GLONASS	
BEIDOU	
GALILEO	
SBAS	•
QZSS	•
ОК	

- 2. Set the following parameters:
  - **Cut-off angle**: the minimum vertical angle that is allowed to receive satellite signals. Signals below the angle will be ignored.
  - **PDOP limit**: the geometric strength factor of the satellite distribution. The smaller the PDOP value is, the better the satellite distribution is. When it is less than 3, it is the ideal state.
  - **Delay start (s)**: it will give time to get better signal tracking and provide stable correction data especially when the base station is just powered on and the signal tracking is not good.
- 3. Set whether to receive signals from related systems: See <u>4.2.2</u> Set Advanced Settings for details.

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#### 4.4 Static

It is used to set the receiver as the static station.

Press main menu  $Device \rightarrow Static$  to enter Static mode settings interface:

← Static mode sett	ings	
Configurations	>	
Options Settings		
Point name	0089	
PDOP limit	3.5 >	Set option settings
Cut-off angle	5 >	jj-
Collection Interval	1нд >	
Auto Record Static Data		
Antenna Parameters		
Antenna Measured Height	1.8	Set antenna parameters
Antenna Measurement Type	Vertical height $>$	
Antenna Height	1 872	Set advanced settings
Advanced Save&Apply	Apply	

#### 4.4.1 Set Option Settings

To set option settings, in **Options Settings** area, set the following:

- **Point name**: the point name of static data. It should be within 4 characters.
- **PDOP limit**: the geometric strength factor of the satellite distribution. The smaller the PDOP value is, the better the satellite distribution is. When it is less than 3, it is the ideal state.
- **Cut-off angle**: the minimum vertical angle that is allowed to receive satellite signals. Signals below the angle will be ignored.
- **Collection interval**: nHZ represents that the acquisition of data group(s) per second; ns represents that the acquisition of a group of data within second(s). The maximum interval depends on the receiver GNSS activation status.
- Auto record static data: to select whether the receiver automatically starts recording when it is powered on.



#### 4.4.2 Set Antenna Parameters

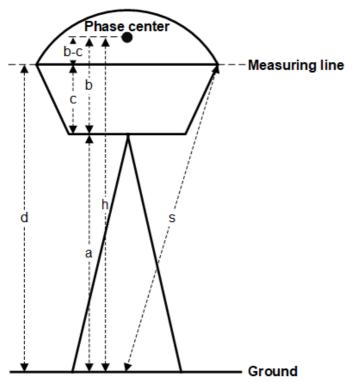
Since the antenna height cannot be directly measured, it is automatically calculated by SurPad based on the measured height you input and measurement type you select.

CAUTION: No matter what the value of measured height you input and what kind of measurement type you select, the value of antenna height is unique.

To set antenna parameters, in Antenna Parameters area, set the following:

- Antenna measured height: its meaning depends on the antenna measurement type.
  - Antenna measurement type
    - Height from phase center
    - Slant height form measuring line
    - Vertical height from measuring line
    - Slant height form altimetry
    - Vertical height
- Antenna height: the vertical height from the phase center of the antenna to the ground.

#### Principle



Among them:

- **a**: the vertical height form the bottom of the receiver to the ground.
- **b**: the vertical height from the bottom of the receiver to the phase center.
- **c**: the vertical height from the bottom of the receiver to the measuring line.
- **b-c**: the vertical height from the phrase center to the measuring line.
- **d**: the vertical height from the measuring line to the ground.
- h: the antenna height.



- **s**: the slant height form the measuring line to the ground.
- **R**: the radius of the rubber ring.
- S: the slant height from the altimetry piece to the ground with the known radius (Rc) of the alitimetry piece.

There are the following ways to calculate the antenna height:

Measured height	antenna measurement type	Antenna height
h	Height from phase center	h = h
S	Slant height form measuring line	$h = sqrt (s^2 - R^2) + (b - c)$
d	Vertical height from measuring line	h = a + c + (b - c) = a + b
S	Slant height from altimetry	$h = sqrt (S^2 - Rc^2) + b$
а	Vertical height	h = a + b

#### 4.4.3 Set Advanced Settings

It is used to set whether to receive signals from the corresponding systems.

To set advanced settings, do the following:

1. Press Advanced. Advanced Settings interface shows:

$\leftarrow$	Advanced settings	
GPS		
GLONASS	3	
BEIDOU		
GALILEO		
SBAS		$\bigcirc \circ$
QZSS		$\bigcirc \circ$
	ок	



- 2. Set whether to receive signals from the following systems:
  - o GPS
  - GLONASS
  - BEIDOU
  - o **GALILEO**
  - **SBAS**: wide-area differential augmentation system (satellite-based augmentation system).
  - o QZSS

#### 4.5 Work Mode Status

It is used to check working information and work mode status.

Press **Device**  $\rightarrow$  **Work Mode Status** to enter the following interface (taking rover station and data link is set to phone internet as an example):

← Rover-Pho	Rover-Phone Internet	
Working Information	Work Mode Status	Check working inf     Check work mode
Connect Mode	NTRIP	
CORS Settings		
Name	eSurvey	
User	gdfkk	
Password		
MountPoint Settings		
MountPoint	SH_5th-floor	
Get Acc	ess Point	
Receive data		
Stop	ок	

- Working information: including cut-off angle, whether record raw data is enabled, whether aRTK is enabled, and whether GPS, BEIDOU, GLONASS, GALILEO, SBAS, or QZSS is enabled.
- Working mode status: see <u>4.2</u> Rover / <u>4.3</u> Base / <u>4.4</u> Static for details.



### 4.6 Configurations

It is used to check all configuration set which includes all work mode settings for the receiver.

In general, default settings can satisfy daily use.

Press main menu **Device**  $\rightarrow$  **Configurations** to enter **Configurations** interface:

← Config	gurations	
Default:Base_Externa Work mode:Base Base ID:1	Il_Radio_38400 Data Link:External Radio Baud Rate:38400	
Default:Rover_Interna Work mode:Rover Channel:8 Protocol:Trimmark III	al_Radio_8 Data Link:Internal Radio Frequency:447.125	
<b>Default:Base_Interna</b> Work mode:Base Base ID:1 Frequency:447.125	I_Radio_8 Data Link:Internal Radio Channel:8 Protocol:Trimmark III	Configuration set
Static_20210629 Work mode:Static PDOP limit:99.0 Collection Interval:1Hz	Name:0665 Cut-off Angle:10 Auto Record Static Data:Yes	
Static_20210629_1 Work mode:Static PDOP limit:99.0 Collection Interval:1Hz	Name:0665 Cut-off Angle:10 Auto Record Static Data:Yes	
New D	etails Apply	Create a new configuration file Check details Apply the configuration file



## 4.6.1 Create a New Configuration File

To create a new configuration file, do the following:

1. Press New. Save to Configurations interface shows:

← Save to Configurations				
File Name	Please input name			
Work mode	Rover $>$			
Cut-off angle	10 >			
Record raw data	0			
Enable aRTK	0			
aRTK Age Limit	>			
Data Link	Phone Internet $>$			
Connect Mode	NTRIP $>$			
CORS Settings	$\bigcirc$			
Name	>			
QR code	ОК			

- Set related information. The setting differs in the setting of work mode and data link. See <u>4.2</u> Rover / <u>4.3</u> Base / <u>4.4</u> Static for details.
- 3. **Optional:** To save the configuration file as a QR code and share it to others, do the following:
  - a. Press **QR code**. The QR code is automatically generated.
  - b. Press **Save**, and select the target path.
    - The QR code will save in JPG format.
- 4. Press OK.

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## 4.6.2 Check Details

To check details of a configuration file, do the following:

- 1. Select the target configuration file.
- 2. Press Details. Details interface shows:

← Details		
Title	Content	
Work mode	Base	
Start Up Mode	Single Point	
Base ID	1	
PDOP Limit	3.50	
Delay Start	60s	
Auto start after pow	Yes	
Diff Type	RTCM3.2	
Cut-off Angle	5	
Record raw data	No	
Data Link	External Radio	
External Serial Port	38400	
QR code	ОК	

- 3. **Optional:** To save the configuration file as a QR code and share it to others, do the following:
  - a. Press **QR code**. The QR code is automatically generated.
  - b. Press **Save**, and select the target path.

The QR code will save in JPG format.

4. Press OK.

## 4.6.3 Apply the Configuration File

To apply the configuration file, do the following:

- 1. Select the target configuration file.
- 2. Press Apply.





## 4.7 Device Information

Press main menu **Device**  $\rightarrow$  **Device Information** to enter **Device Information** interface:

← Device Info	· Device Information	
Serial	E30P3A1900047	
Model	E300 Pro	
Hardware Version	V1.1	
BIOS Version	1.05	
Firmware Version	0.22.200922	
GNSS Firmware Ver	6.0Aa03x2	
GNSS Serial	21800417	
OS Version	1.08	
MCU Version	2.61	
Sensor Version	1.3.3	
Work Mode	Rover	Check device info
Current DataLink	Phone Internet	Check radio info
Device information Network info	Radio info Other	



## 4.8 Inspection Accuracy

It is used to calibrate the pole and check accuracy of the IMU. And it is required when tilt measurement is enabled and the IMU is used.

Press main menu  $\textbf{Device} \rightarrow \textbf{Inspection Accuracy}$  to enter Inspection Accuracy interface:

← Inspection a	ccuracy
Antenna Parameters	1.8m,Pole Height $>$
Average GPS Count	20 >
Average GPS Interval	1 >
Exclusion abnormal point ratio(%)	0 >
Record number(0°~90°)	
Record number(90°~180°)	)
Record number(180°~270	)°)
Record number(270°~360	)°)
Start	Pole calibration
Start	Pole calibration

For how to enable IMU tilt measurement, see 5.1.1 Enable IMU Tilt Measurement for details.

4.8.1 Inspect Accuracy of Tilt Measurement

It is used to check if pole calibration is required.

To inspect accuracy of tilt measurement, do the following:

- 1. Set the following parameters:
  - Antenna parameters
  - Average GPS count
  - Average GPS count
  - Average GPS interval
  - Exclusion abnormal point ratios (%)
- 2. Press Start.

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- 3. Move the pole  $0^{\circ} \sim 90^{\circ}$ , and wait the value of **Record number(0°~90°)** turns to **5/5**.
- 4. Move the pole 90° ~ 180°, and wait the value of **Record number(90°~180°)** turns to **5/5**.
- 5. Move the pole 180° ~ 270°, and wait the value of **Record number(180°~270°)** turns to **5/5**.
- 6. Move the pole 270° ~ 360°, and wait the value of **Record number(270°~360°)** turns to **5/5**.

The result shows as follows:

$\leftarrow$	Inspection	accurac	у	$\leftarrow$	Inspection	accurac	у
Exclusion point ratio			0 >	Exclusion point rate	n abnormal io(%)		0 >
FIXED				FIXED			
Record nu	mber(0°~90°	)	5/5	Record r	number(0°~90°	)	5/5
Record nu	mber(90°~18	:0°)	5/5	Record r	number(90°~18	30°)	5/5
Record nu	mber(180°~2	270°)	5/5	Record	number(180°~2	270°)	5/5
Record nu	mber(270°~3	60°)	5/5	Record r	number(270°~3	360°)	5/5
Test results				Test result	s		
∆plane ma	ax(mm)		29.827	∆plane i	max(mm)		60.33
∆height m	ax(mm)		6.63	∆height	max(mm)		43.961
Maximum	tilt angle	2	0°16'15.2767°	Maximu	m tilt angle	2	9°21'59.7194"
Min(N)	3439879.1	Max(N)	3439879.1	Min(N)	3439871.2	Max(N)	3439871.3
Min(E)	359818.998	Max(E)	359819.047	Min(E)	359721.779	Max(E)	359721.884
Min(H)	59.997	Max(H)	60.008	Min(H)	515.538	Max(H)	515.615
Res	tart	Pole c	alibration	R	estart	Pole c	alibration

- If the result shows in red, the accuracy is not enough, calibrating the pole is required.
- If not, calibrating the pole is not required.

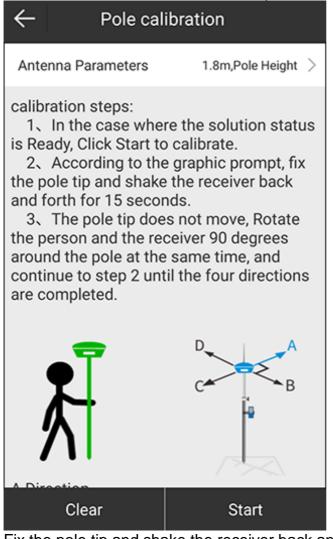


### 4.8.2 Calibrate the Pole

It is required when tilt measurement is not accurate due to the wear of pole tip or change of the pole.

To calibrate the pole, do the following:

1. To enter Pole Calibration interface, press Pole Calibration:



- 2. Fix the pole tip and shake the receiver back and forth for 15 s.
- 3. Rotate 90° without moving the pole, and shake the receiver back and forth for 15 s.
- 4. Repeat step 3 until you rotate 360°.

After calibrating the pole, a prompt *Calibrated successfully* shows at the bottom of the interface.

If calibrating the pole fails, find a new area to do calibrating again.

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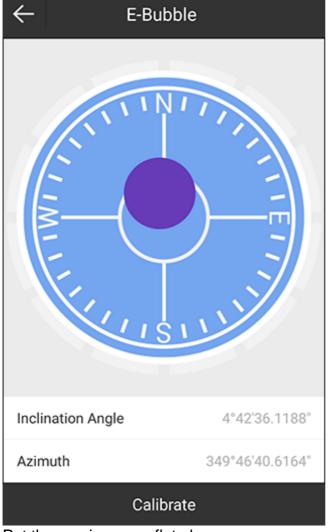
## 4.9 Calibrate Sensor

It is required when tilt measurement is used and E-bubble is used.

Before calibrating the sensor, to enable E-bubble tilt measurement, press main menu **Device**  $\rightarrow$  **Device Setting**, set tilt survey to **E-Bubble**, and press **OK**.

To calibrate the sensor, do the following:

1. <u>To enter E-Bubble interface, press main menu</u> **Device**  $\rightarrow$  **Calibrate Sensor**:



- 2. Put the receiver on a flat place.
- 3. Press Calibrate. The E-bubble turns to green.



## 4.10 Device Settings

Press main menu **Device**  $\rightarrow$  **Device Settings** to enter **Device Settings** interface:

	Settings
Solution Mode	Normal Mode $>$
Tilt Survey	Pole Tilt Correction $>$
Tilt Survey parameters	Strict Mode $>$
Sensor output frequency	5нг 🗦
Positioning data output frequency	1нz 🗦
Enable Voice	•
Base station alarm	•
Enable WIFI	•
Long-term open netwo	rk o
Default	ок

- **Solution mode**: including normal mode, survey mode and strict mode (in this mode, reliability of solution can be improved.)
- **Tilt survey**: to enable pole tilt correction (IMU or E-bubble).
- Tilt survey parameters: including normal mode, strict mode or user-defined mode.
- **Positioning data output frequency**: to set the output frequency of the positioning data.
- Enable voice: to select whether to enable receiver voice broadcast function.
- **Base station alarm**: to select whether to remind you when the base station is moved. With it enabled, the rover receiver will broadcast *Base is moved*.
- Enable WIFI: to select whether to enable receiver WIFI.
- Long-term open network: to select whether to enable long-term open network. With it enabled, the network initialization will be faster. It is suggested to enable it when a SIM card is used.
- **WIFI share network**: to select whether to share network through WiFi when a SIM card is inserted on the receiver.
- **Base coordinate change alert**: to select whether to remind you when coordinates of the base station changes.

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## 4.11 Default Radio Settings

To set default radio settings, do the following:

1. Press main menu **Device** → **Default Radio Settings** to enter **Default Radio** Settings interface:

$\leftarrow$	Default radio settings	
Factory	UniStrong >	Radio factory
1	441.0	Radio channels
2	442.0	
3	443.0	
4	444.0	Radio frequency
5	445.0	
6	446.0	
7	447.0	
8	448.0	
	ОК	

- 2. To set radio frequency, do one of the following:
  - To use radio frequency of the target factory, press **Factory**, and select the target factory.
  - $\circ~$  To customize radio frequency, press value of the radio frequency, and input a value.
- 3. Press **OK** for confirmation.

## 4.12 Restart Positioning

It is used to control the receiver to clear the current ephemeris information, so as to initialize OEM board and receive satellites signals again for positioning.

To restart positioning, do the following:

- 1. Press main menu **Device** → **Restart Positioning**. A prompt *Restart positioning*? shows.
- 2. Press **OK** for confirmation.



## 4.13 Device Activation

## Press main menu **Device** $\rightarrow$ **Device** Activation to enter **Device** Activation interface:

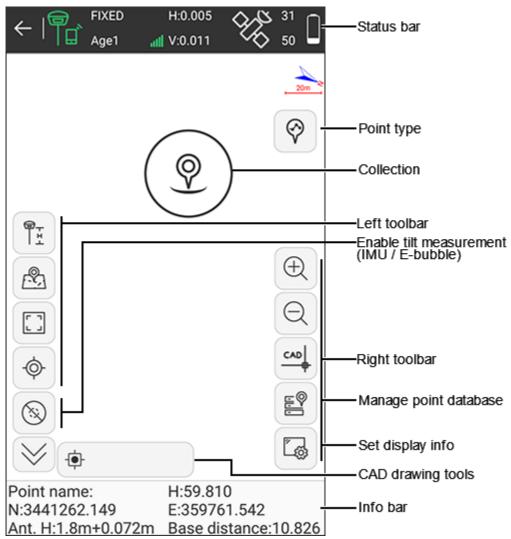
← Device Activation					
Activation	Information				
Device S	Serial no		E30P3A	1900047	Check device serial number
Registra	tion Date		2	0210730	and expired date
Enter activ	ation code				
1	2	3	А	В	Enter activation code:
4	5	6	С	D	- Manually input activation code - Scan QR code
7	8	9	E	F	
	0		Backsp	ace	
	4	Activatio	n		For confirmation

# Our survey

# 5 Survey

## 5.1 Point Survey

Press main menu  $\textbf{Survey} \rightarrow \textbf{Point Survey}.$ 



## Status bar

Status icon	What it does
$\leftarrow$	To exit point survey interface.
	To show the operation mode of the receiver. You can press it to enter <b>Rover / Base / Static mode settings</b> interface. See <u>4.2</u> Rover / <u>4.3</u> Base / <u>4.4</u> Static for details.
FIXED Age1	To show the solution status (including single, float, differential and fixed) and the differential delay in real-time.



Status icon	What it does
att	To show the differential signal of the receiver.
H:0.005 V:0.01	H: to show the horizontal accuracy. V: to show the vertical accuracy.
678	To check the current positioning information.
35 43	35: to show the number of used satellites. 45: to show the number of observed satellites.
	To show the battery level of the receiver.

## Point type

Icons	What it does
	Topo point
Ø	Control point
Ø	Quick point
Ø	Automatic point
•	Corner point (only when E-bubble is used)
$\bigcirc$	Tilt point (only when E-bubble is used)



## Collection

Icons	What it does
9	To collect coordinates of the current point with tilt survey disabled.
	To start IMU tilt measurement with tilt survey enabled and IMU used. See <u>5.1.1 Enable IMU Tilt Measurement</u> for details.
٢	To start E-bubble tilt measurement with tilt survey enabled and E-bubble used.

You can freely drag the collection icon to any position.

## Left toolbar

lcons	What it means
Ċ	Redraw (to refresh the current displayed data.)
	Antenna parameters
E S	Switch map
	Full map
-\$-	Jump map center
$\bigotimes$	Tilt survey is disabled.
¢	IMU tilt survey is enabled. See <u>5.1.1 Enable IMU Tilt Measurement</u> for details.
	E-bubble tilt survey is enabled.
$\bowtie$	To collapse icons in the left toolbar.
$\langle \rangle$	To expand icons in the left toolbar.



Icons	cons What it means			
P.	Display content			
BG	CAD background color			
Ø	Compass			
A B	Offset point calculation			
n jan Jan	Equal point calculation			
Ĵ€¢™	Coordinate positive calculation			
x - by	Forward intersection			
\$\$	Resection			
and the second	Intersection calculation			
gage a	Two lines angle			
	Great-circle distance			
A.	Point line calculation			
n − − − − − − − − − − − − − − − − − − −	Coordinate inverse calculation			
	Calculator			
( <b>@</b> 5	Restart positioning			



\_\_\_\_

lcons	What it means			
<b>%</b>	Static and collect points			
	Perimeter and area			
XY BL	Coordinates converter			
	Screen measurement			
<u></u>	CAD text			
ZA	Automatic scaling			
	Auto jump map center			
8	Take screen point			
Right toolbar				

### Right toolbar

Icons What it does	
Q	To zoom out the graphic.
Ð	To zoom in the graphic.
	To enter <b>Points Database</b> interface. See <u>3.5</u> Point Database_for details.
	To set display information. See <u>5.1.3</u> Set Display Information for details.



# CAD drawing tools

Icons	What it does	
square	To draw a square.	
line	To draw a line.	
polyline	To draw a polyline.	
rect	To draw a rectangle.	
rect center	To draw the center of a rectangle.	
polygon	To draw a polygon.	
Circle 2p	To draw a circle by two points.	
Circle 3p	To draw a circle by three points.	
arc	To draw an arc.	
-••- point	To draw a point.	
Spline	To draw a spline.	
Default	To enter Layer Settings interface.	



### Information bar

interface:

• **Point name**: the point name of collected point.

To enable IMU tilt measurement, in left toolbar, press

- N, E, H: the horizontal coordinates (projection point) of the current point.
- Ant. H: the antenna height in survey.
- **Base distance**: the distance from the current rover station to the base station.

## 5.1.1 Enable IMU Tilt Measurement



, and do as the prompt in the

Status	What it means	What to do
Finit  MagEnvChange	Magnetic calibration is required.	Take the pole and draw a circle towards the ground.
Finit	Initialization is required.	Shake the pole or walk around.
Inaccurate	The accuracy of tilt measurement is not enough.	Wait.
Inaccurate TiltReject	The tilt angle exceeds 60°.	Make sure the tilt angle is within 0° ~ 60°.
Ready	Tilt measurement is successfully enabled.	Start survey.

## 5.1.2 Manage Point Database

The operation is the same with operation in main menu **Project**. See 3.5 Point Database for details.

## 5.1.3 Set Display Information

It is used to customize display information, including topo point, information bar, and toolbars.

# **O-survey**

To set display information, do the following:

1. In the main interface of line stakeout, press shows:

**1**33

. Display Information interface

shows: ← Display Ini	formation
	AATION TOOLBARS
HRMS Limit	0.05 >
VRMS Limit	0.1 >
PDOP Limit	3.0 >
AGE Limit	5 >
Allow same point name	• •
Keep last input focus	
Default Point Name	Pt1 >
Point Name Increment	1 >
Default Code	same as last point $>$
DEFAULT	ок

- 2. To set point limit, do the following:
  - a. Set recording limit, including solution limit, HRMS limit, VRMS limit, PDOP limit, and AGE limit.
  - b. Select whether to allow the same point name and keep the last input focus.
  - c. Set or select the default point name, and set the increment of the point name, and default code.
  - d. Set or select the average GPS count.





- 3. To customize the information bar / toolbars, do the following:
  - a. To switch to INFORMATION BAR / TOOLBARS page, press INFORMATION BAR / TOOL BARS

← Disp	olay Info	rmation	← Disp	olay Infor	mation
TOPO POINT	INFORMAT BAR	TOOLBARS	TOPO POINT	INFORMATI BAR	ON TOOLBARS
Display Item		Options	Display Item		Options
Point name		Code	🚫 Tilt Survey		Auto jump map
н		Long	Jump map center		Automatic A scaling
N	»	Lat	🗍 Full Map	»	Take screen point
E		Altitude	🖧 Switch map		CAD Text
Ant. H		Forward azimuth	@ Antenna 그 Parameters		Screen measurement
Base distance	«	Speed	🖉 ReDraw	<b>«</b>	Coordinates Converter
		Time			Perimeter and Area
		Point dist.			Static and collect
					o Dootort
DEFAULT		ок	DEFAULT		ок

b. To remove information from **Display Item** list, select the target information in

Display Item list, and press

c. To add information to **Display Item** list, select the target information in

## Options list, and press

- 4. **Optional:** To restore settings to default settings, press **Default**.
- 5. To save settings, press **OK**.



### 5.1.4 Start Point Survey

## 5.1.4.1 Start Survey for a Topo Point

To start survey for a topo point, do the following:

hows: - Topo P	oint	
Name	Pt1 😒	
Code		
Antenna Parameters	1.8m,Pole Height $>$	
Detail Information		
Record	<1/1>Collected	
Solution	(37/47)FIXED	
Northing	3441262.149	
Easting	359761.538	
Elevation	59.806	
HRMS	0.005	
VRMS	0.008	
AGE	1	
Photo And Sketch	ОК	

2. Set point name, code, and antenna parameters, and check detail information.



3. **Optional:** Press **Photo and Sketch** and make an information note on the collected points, including documents, pictures, graphs in **Photo and Sketch** interface:

$\leftarrow$		And Sketch		
Point Name: Pt8 Code: Northing: 3441262.15 Easting: 359761.539 Elevation: 59.796 Latitude: 31°05'03.8942" Longitude: 121°31'49.3664" Altitude: 59.796				
5	T 💬			
undo Note Point info Arrow Drawing Photo				
	Cancel	ОК		
	lcons	What it does		
S	Undo	To undo and return to the previous step.		
Т	Note	To add a note with the customized font size and color.		
ı.	Point info	To add point information, including name, code, northing, easting, height, etc. with the customized font size and color.		
	Arrow	To add arrows with the customized color and style.		
Ø	Drawing	It is similar to the pencil function in Windows Paint. You can customize the color and thickness.		
0	Photo	To directly invoke camera to take a picture to add into information.		
$\phi^{0}_{ij}\phi$	Move	To move any added information.		

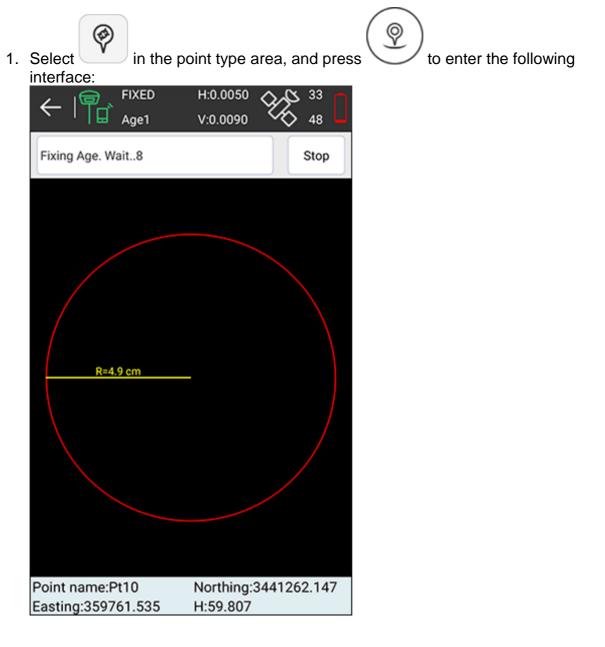


lcons		What it does	
Ċ	Rotate	To rotate any added information.	
	Zoom	To zoom in or out any added information.	
Ê	Clear	To clear all information.	

4. To save the topo point, press OK.

## 5.1.4.2 Start Survey for Control Points

To start survey for control points, do the following:





SurPad automatically starts to collect points every set interval and enters **Control Point** interface until it finishes the set total number:

← Contro	l Point		
Name	Pt4 😒		
Code			
Antenna Parameters	1.8m,Pole Height $>$		
Detail Information			
Record	<6/20>Collected		
Solution	(35/48)FIXED		
Northing	3441262.147		
Easting	359761.538		
Elevation	59.804		
HRMS	0.005		
VRMS	0.008		
AGE	1		
Photo And Sketch	ок		

2. Set point name, code and antenna height. A prompt *Control point report generated, named as xxx, would like to view it now?* shows.

# -survey

3. **Optional:** To save the control point, press **OK**. The control point report is generated:

enerated: GPS control p	oint measu	rement report			
Ba	Basic Information				
Project ame		(202c10630 - 202c10630.PD)			
Operator					
Report Time	2021-07-05	2021-07-05 15:44:10			
Antenna Height	1.87150000	1.871500000000002			
Observation Time	63	63			
Coordinat					
Coordinate Coordinate system name	e systems p Default	arameters			
Coordinate system name		arameters WGS-84			
Coordinate	Default Ellipsoid				
Coordinate system name Ellipsoid	Default Ellipsoid Name Semimajor	WGS-84			
Coordinate system name Ellipsoid	Default Ellipsoid Name Semimajor axis	WGS-84 6378137.0			

5.1.4.3 Start Survey for a Quick Point

To start survey a quick point, do the following:

- 1. Select in the point type area.
- 2. Set a point name behind icon
- 3. Do one of the following:
  - To set a code, directly input a code behind icon
  - $\circ$  To select a code that already exists, press , and select a code.

(2)

4. Press . SurPad automatically starts collection after prompt voice and saves the quick point.

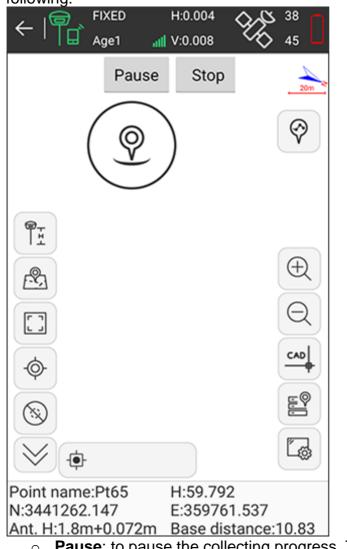


### 5.1.4.4 Collect Automatic Points

To collect automatic points, do the following:

Select in the p	oint type area, and pres	Auto Point interface
← Auto	Point	
Name	Pt45 😒	
Code		
Antenna Parameters	1.8m,Pole Height $>$	
Detail Information		
Record	<1/1>Collected	
Solution	(33/45)FIXED	
Northing	3441262.147	
Easting	359761.539	
Elevation	59.795	
HRMS	0.005	
VRMS	0.008	
AGE	1	
Photo And Sketch	ОК	

2. Set point name, code and antenna height, and click **OK**. SurPad automatically starts to collect point until you interrupt the progress by pressing one of the following:



🕀-survey

- **Pause**: to pause the collecting progress. To resume the collecting, you can press **Start**.
- **Stop**: to stop the collecting progress.

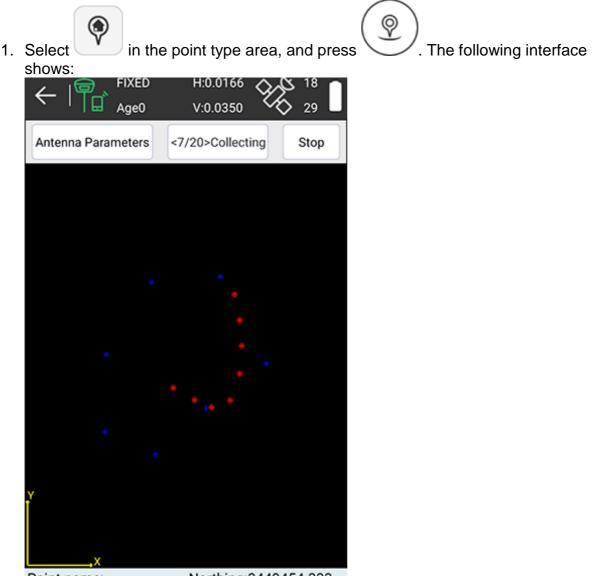
## 5.1.4.5 Start Survey for a Corner Point

SurPad will automatically calculate coordinates of the pole tip according to the automatically collected 20 points.

It is available only when E-bubble is used.



To start survey for a corner point, do the following:

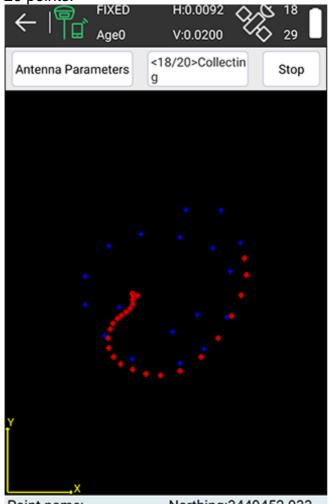


Point name: Northing:3449454.333 Easting:369873.474 H:6450434.902

2. **Optional:** To modify antenna parameters, press **Antenna Parameters**, and set antenna parameters.



3. Draw circles with the pole without moving the pole tip. SurPad automatically collects 20 points:



 Point name:
 Northing:3449452.933

 Easting:369862.601
 H:6450414.233



4. After 20 points are collected, press **OK** in **Corner Point** interface:

← Corner Point				
Name	Pt1 😒			
Code				
Antenna Parameters	1.8m,Pole Height $>$			
Detail Information	Detail Information			
Record	<20/20>Collected			
Solution	(16/24)FIXED			
Northing	3449454.448			
Easting	369873.863			
Elevation	6450435.803			
HRMS	0.232			
VRMS	0.232			
AGE	0			
Photo And Sketch	ОК			



#### 5.1.4.6 Start Survey for a Tilt Point

It is available only when E-bubble is used.

Before starting survey for a tilt point, press

To start survey for a tilt point, do the following:

to enable tilt measurement.

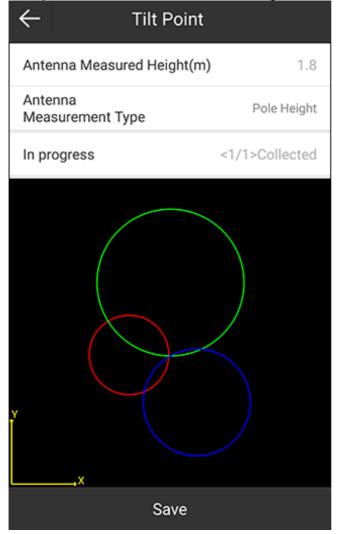
9 Tilt Point interface shows: 1. Select in the point type area, and press  $\leftarrow$ Tilt Point 1.8 🖸 Antenna Measured Height(m) Antenna Pole Height > Measurement Type In progress Start

- 2. Optional: To modify antenna parameters, press Antenna Parameters, and set antenna parameters.
- 3. To start collecting tilt points, press Start.
- 4. Incline the pole with the inclined angle greater than 5°. SurPad automatically collects the first tilt point.





5. Change the inclined direction and repeat step **4** until 3 tilt points are collected. After <u>3 tilt points are collected</u>, the following interface shows:





6. To save the result, press **Save**. The following interface shows:

← Tilt Point				
Name	Pt1 😒			
Code				
Antenna Parameters	1.8m,Pole Height $>$			
Detail Information				
Record	<1/1>Collected			
Solution	(17/28)FIXED			
Northing	3449452.989			
Easting	369863.035			
Elevation	6450415.183			
HRMS	0.018			
VRMS	0.046			
AGE	1			
Photo And Sketch	ОК			

7. Press OK.

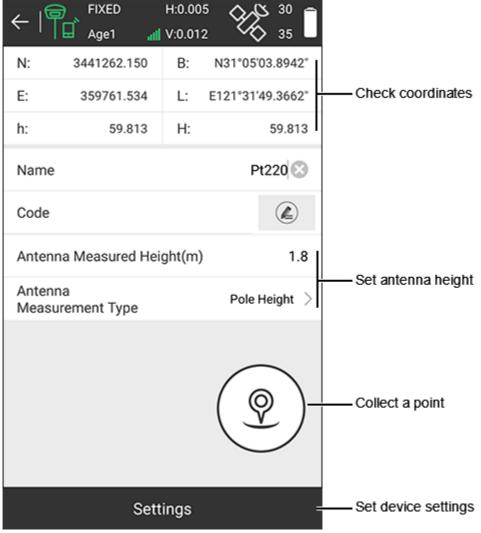
# **O-survey**

## 5.2 Detail Survey

It is a simplified mode of point survey for rapid and continuous survey.

To start detail survey, do the following:

1. Press main menu **Survey**  $\rightarrow$  **Point Survey** to enter the following interface:



2. Set point name, code and antenna height.



## 3. **Optional:** Set device settings:

a. Press Settings. Device Settings interface shows:

Certified Settings: Device Set		
Tilt Survey	Disable	>
Solution Limit	FIXED	>
HRMS Limit	0.05	>
VRMS Limit	0.1	>
PDOP Limit	3.0	>
AGE Limit	5	>
Allow same point name	$\bigcirc$ c	
Point Name Increment	1	>
Default Code	same as last point	>
Average GPS Count	1	>
Default Configurations	ОК	

- b. Select whether to enable tilt survey.
- c. Set recording limit, including solution limit, HRMS limit, VRMS limit, PDOP limit, and AGE limit.
- d. Select whether to allow the same point name, and set the increment of the point name, and default code.
- e. Select the average GPS count.
- f. Press OK.
- 4. To collect a point by detail survey, press

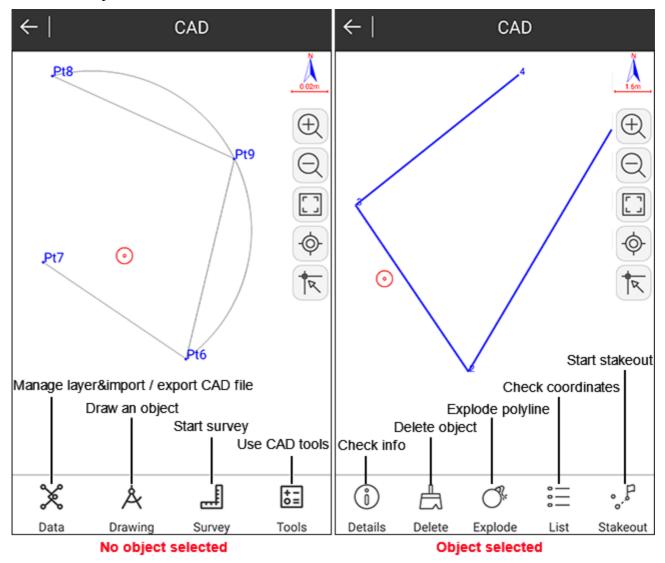




## 5.3 CAD

It is mainly used to import and edit the existing CAD graphics and stakeout in the existing CAD graphics.

Press Survey  $\rightarrow$  CAD to enter CAD interface:





## 5.3.1 Manage the Layer

To manage the layer, do the following:

- 1. To add a new layer, do the following:
  - a. To enter New Layer interface, press Data  $\rightarrow$  Layer, and press NEW LAYER:

$\leftarrow$	New I	ayer		
Layer Name				
Color				>
As work layer				•
Visiblity				
Lock Layer				0
Cancel			ок	

- b. Input the layer name and set the layer color.
- c. Select the following:
  - Whether to set the layer as the work layer.
  - Whether the layer is visible.
  - Whether to lock the layer.



2. Press OK. The interface returns to Laver Settings interface:

$\leftarrow$		iyer setti	ngs		
DI	RAW LAYER		CAD LAYER		
$\oslash$	•	layer1			
0	Ø 6	layer2			
0	•	layer3			
		NEW LAY	R		
Icons			What	t it	
$\oslash$	The lay	er is the w	ork layer.		
Ο	The lay	er is not th	ne work layer.		
٢	The layer is visible.				
Ø	The layer is not visible.				
⋳	The lay locked l		ed. In the lock st	tati	
6	The lay	er is unloc	ked.		



- 3. **Optional:** Do the following based on your needs:
  - To rename the target layer, select the target layer, long press it, select **Rename**, and set the layer name.
  - To hide all layers, long press any layer, select **Hide all**. Icon shows. All layers become invisible.

 $_{\circ}$  To modify the current work layer, press  $\bigcirc$  .  $\bigotimes$  shows.

• To modify the lock status, press to unlock the target layer, and press

to lock the target layer.

• To modify the layer color, press the color of the target layer, and select a color again.

# -survey

# 5.3.2 Import / Export a CAD File

CAD files refer to DXF and DWG files.

To import / export a CAD file, do one of the following:

- To import a CAD file, do the following:
  - a. Press **Data**  $\rightarrow$  **Open**.
  - b. Select the target file path.
- To export a CAD file, do the following:
  - a. Press Data  $\rightarrow$  DXF export. DXF export interface shows:

← DXF export	
CAD layer	
Points Database	
Layer color	>
Point Name	
Color[Point Name]	>
Elevation	$\bigcirc \circ$
Code	$\bigcirc \circ$
Auto connect by code	0
Polyline use 3D type	
Elevation digit	з >
Export	

- b. Select the information that you would like to export.
- c. Press Export.



## 5.3.3 Draw an Object

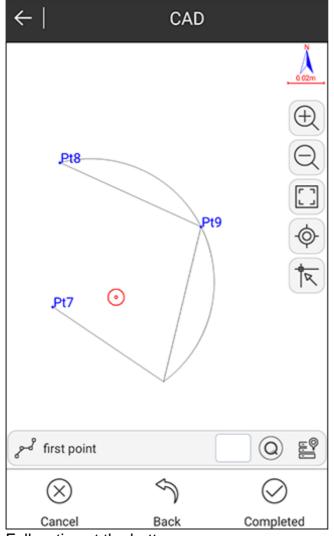
To draw an object, do the following:

1. Press Drawing. The following interface shows:

←			CAD		
					N
					€ O E ¢ k
-•	/	s-s	Ņ	ſ	Ľ
point	line	polyline	Spline	arc	polygon
×		Å			+ - o =
Data	(	Drawing	Surve	v	Tools



2. Select a shape. The following interface shows:



- 3. Follow tips at the bottom.
- 4. After finishing, press **Completed**.

## 5.3.4 Start Survey

It is used to find the intersection point, perform distance offset, division, intersection, lengthening, etc.

Т	ools	What it does
$\bigcirc$	Int 2 dist	To define an intersection by two point and two distance.
$\times$	Int 4 point	To define an intersection by two intersecting lines drawn by four points.
$\mathcal{A}$	Int entity	To define an intersection from object(s).



Т	ools	What it does
1	Point offset	To define an offset point by a point on the object and offset distance.
11	Dist offset	To copy the object to the set distance.
ď, n	Divide	To divide the object by the input number of partitions.
a <sup>a</sup> .	Measure	To divide the object by the input fractional length.
₽₽	Invert	To invert the order of target point names on an object.
×	Lengthen	To lengthen the object from the endpoint.

To start survey, do the following:

1. Press **Survey**, and select a survey mode. The following interface shows (taking **Dist offset** as an example):



- 2. Follow tips at the bottom.
- 3. After finishing, press **Completed**.

### 5.3.5 Use CAD Tools

With CAD tools, you can achieve the following:

Tools		What it does
	Delete	To delete the target object.
$\triangle$	Angle	To calculate angle.
a a a a	Distance	To calculate points by distance.



1	<b>Fools</b>	What it does	
	Area	To calculate area.	
BG	CAD backgroun d color	To modify CAD background color.	
Ċ	Redraw	To refresh the current displayed data.	
-\$-	Current position	To show coordinates of the current position.	

To use CAD tools, do the following:

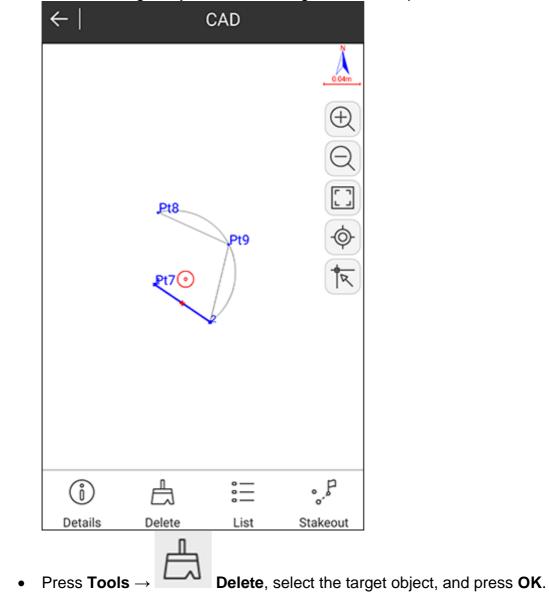
- 1. Press **Tools**, and select the target tool.
- Follow tips at the bottom.
   Press OK.



## 5.3.6 Delete CAD Data

To delete CAD data, do one of the following:

• Select the target object in the drawing window, and press **Delete**:





# 5.3.7 Check Object Information

To check object information, do the following:

1. Select the target object in the drawing window, and press **Details**. **Object Info** interface shows:

← Ob	ject Info
Entity	line
Layer	0
Color	>
closed	open
Total Length 2D	2331.018m
Total Length 3D	2331.018m
Vertexes	2
center point	
Northing	4093.875
Easting	5180.75
Elevation	0

2. **Optional:** To modify the color of the target object, press **Color**, and select the target color:



- 3. Check the following information:
  - o Entity
  - o Layer
  - Color



- Object type: open or closed
- Total length 2D and 3D
- Vertexes
- Coordinates of the center point

### 5.3.8 Explode a Polyline

It is used to explode a polyline into several lines.

To explode polylines, select the target polyline in the drawing window, and press **Explode**.

#### 5.3.9 Check Coordinates

It is used to check coordinates of the target object, and modify the point name, or start stakeout.

To check coordinates, do the following:

1. Select the target object in the drawing window, and press **List**. The following interface shows:

÷	← Object Info					
Er	Entity line					
La	ayer			Def	ault	
No.	Name	Northing	Easting	Elevation	Code	
0	с	3441262.121	359761.534	0		
1	N1	3441262.142	359761.503	0		
2	N2	3441262.1	359761.565	0		
	Save	e M	odify	Stakeo	ut	

- 2. **Optional:** To modify point name, select the target point, press **Modify**, and modify the name.
- 3. **Optional:** To start stakeout, select the target point, and press **Stakeout**.
- 4. Check coordinates of the target object (including center point).





## 5.3.10 Start Stakeout

To start stakeout, do the following:

1. <u>Select the target object, and press Stakeout.</u> Stakeout Settings interface shows:

← Stakeout Settings	
Start Station	
Offset Distance	0
Setting out by pile by coordinate	$\bigcirc \circ$
ОК	

- 2. Set the start station and offset distance, and select whether to set out by pile by coordinate.
- 3. Press **OK**, and perform stakeout. See <u>5.4</u> Point Stakeout for details.

# **O-survey**

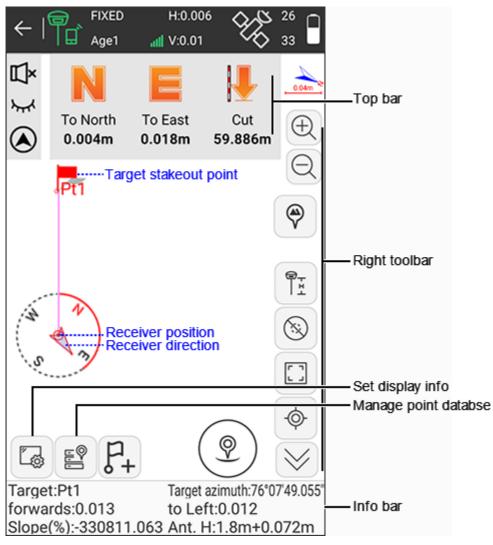
Alternatively, you can start stakeout for points by pressing **List**, select the target point and press **Stakeout** in **Object Info** interface:

← Object Info							
Entity line						line	
La	ayer					Def	ault
No.	Name	Nor	thing	Easting	E	levation	Code
0	с	34412	62.121	359761.53	4	0	
1	N1	34412	62.142	359761.503	3	0	
2	N2	3441	262.1	359761.56	5	0	
	Save	;	М	odify		Stakeo	ut



# 5.4 Point Stakeout

To enter the main interface of point stakeout, press  $Survey \rightarrow Point Stakeout$ , select a target point or add a new point, and press **OK**:



## Top bar

lcons	What it does
N / S	To indicate the distance that the receiver needs to move north / south from the current position to the stakeout point.
E / W	To indicate the distance that the receiver needs to move west / east from the current position to the stakeout point.
$\downarrow$ / $\uparrow$	If the current height is higher than the stakeout point, $\downarrow$ shows; if not, $\uparrow$ shows.
Ľ×	To close the voice prompt of stakeout.
	To open the voice prompt of stakeout.



lcons	What it does
$\sim$	To hide the top bar.
٩	To show the top bar.
۲	To switch to the compass mode.
Δ	To switch to the distance mode.

## Toolbars

Here only icons different from **Point Survey** main interface are listed. About the same icons, please see 5.1 Point Survey for details.

lcons	What it does
₽+	To add a new stakeout point.
$\diamond$	To select the last point for stakeout.
°	To select the next point for stakeout.
°.°.	To select the point closest to the stakeout point.

#### Information bar

- Target: the name of the stakeout point.
- **Target Azimuth**: the azimuth from the current point to the target position.
- **Forwards** / **Back**: the distance that the receiver needs to move forwards / back from the current position to the stakeout point.
- **To Left / To Right**: the distance that the receiver needs to move left / right from the current position to the stakeout point.
- **To North** / **To South**: the distance that the receiver needs to move south / north from the current position to the stakeout point.
- **To East** / **To West**: the distance that the receiver needs to move east / west from the current position to the stakeout point.
- **Slope(%)**: the ratio of the vertical length to the horizontal length.
- Ant.H: the antenna height in survey.

# **O-survey**

0

### 5.4.1 Manage Stakeout Point Database

To manage stakeout point database, do the following:

- 1. To enter **Stake Point** interface, do one of the following:
  - $\circ$  Press main menu **Survey**  $\rightarrow$  **Point Stakeout**.

Count 4 Input name or code					0
	Name	Northing	Easting	Elevation	Latit
P	Pt4	10000.000	10000.000	10000.000	N0°05'2
P	Pt3	1000.000	1000.000	1000.000	N0°00'3
P	Pt2	100.000	100.000	100.000	N0°00'0
P	Pt1	10.000 10.000 10.000		10.000	N0°00'0

- 2. Do the following:
  - Add a new stakeout point.
  - Edit a stakeout point.
  - Check stakeout point information.
  - Import a stakeout point.
  - Delete a stakeout point.
  - Filter a stakeout point.
  - Recover stakeout points.
  - Share a stakeout point.
  - Mark a stakeout point as staked.

The operations are almost the same with operations in **Points Database** interface. See 3.5 Point Database for details.



#### 5.4.2 Set Display Information

It is used to customize display information, including stakeout settings, topo point, information bar and toolbars.

To set display information, do the following:

1. In the main interface of line stakeout, press shows:

$\leftarrow$	Display In	formation	
STAKEOUT SETTINGS	TOPO POINT	INFORM ATION BAR	TOOLBARS
Name		Stakeout poin par	t(Without > enthesis)
Code		Stake	eout point $>$
Prompt Ra	inge(m)		0.42 >
Automatic	scaling		$\bigcirc \circ$
Automatic	Stakeout La	test Point	$\bigcirc \circ$
Automatic points	ally marked a	as staked	
Stakeout r error(m)	ange		0.05 >
Display Inf	formation	Po	int Name $>$
Stakeout r	eference	North	(E,W,N,S) >
DEF	AULT	o	к

- 2. Set the following stakeout settings:
  - **Name**: the name of the stakeout point.
  - Code: to select a code for the stakeout point.
  - **Prompt range**: to set the target distance triggering precise stakeout.
  - **Automatic scaling**: to select whether to make the figure automatically display in full screen. Once it is enabled, you cannot zoom in / out the figure.
  - **Automatic stakeout latest point**: to select whether to automatically stake out the latest point.
  - Automatically marked as staked points: to select whether to automatically mark the selected point as the staked point when the current target distance is less than tolerance.

. Display Information interface



- **Stakeout reference**: to change the display in the top bar (North (E, W, N, S) or forward direction (front, back, left, right)).
- Voice broadcast: to select whether to enable voice broadcast.
- 3. Set point limit, information bar and toolbars. See 5.1.3 Set Display Information in point survey for details.

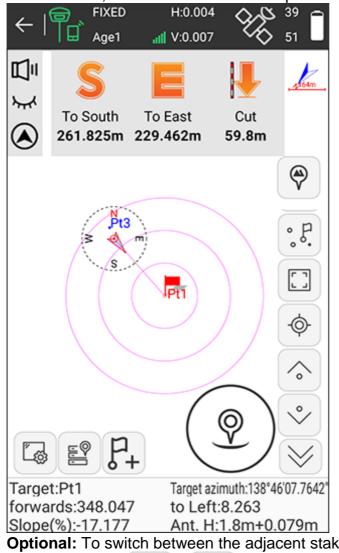
## 5.4.3 Start Point Stakeout

To start point stakeout, do the following:

1. To select a point for stakeout, do the following:



- b. Select the target point.
- c. Press **OK** to enter stakeout interface.
- 2. Move towards the indicated direction according to information in the information bar. When the target distance is within 3 times of the prompt range, three concentric circles shows, which indicates it enters precise stakeout:



database, press

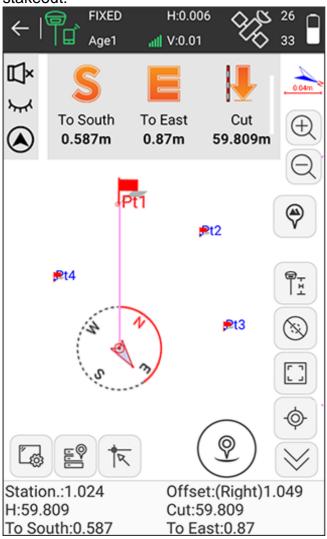
0



4. After reaching the stakeout point, stake it.

-0
₩Ÿ

5. Press to enter point stakeout database, and select the stakeout point, press ... → Marked as Staked. The target point in point stakeout database turns to blue, and a small red flag shows in the staked point in the main interface of point stakeout:



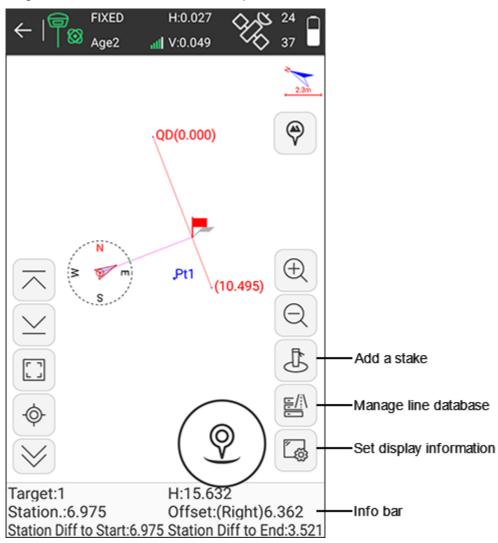
Alternatively, you can enable **Automatically marked as staked points** in display information.



# 5.5 Line Stakeout

It is the stakeout of the designed line, including line station, left and right offset and elevation control within line.

To enter the main interface of line stakeout, press  $Survey \rightarrow Line Stakeout$ , select the target line or add a new line, and press **OK**:



### Information bar

- **Target**: the name of the stakeout line.
- H: the height of the current point.
- **Station**: making a perpendicular to the stakeout line through the current receiver position, the start station plus the distance between the foot of perpendicular and the start point.
- Offset: the perpendicular distance from the current position to the target line.
- Station Diff to Start: making a perpendicular to the stakeout line through the current receiver position, the distance from the foot of perpendicular to the start point.
- **Station Diff to End**: making a perpendicular to the stakeout line through the current receiver position, the distance from the foot of perpendicular to the end point.



#### 5.5.1 Manage Line Database

To manage line database, do the following:

- 1. To enter Lines Database interface, do one of the following:
  - $\circ$  Press main menu **Survey**  $\rightarrow$  **Line Stakeout**.

<ul> <li>In the main interface of line stakeout, press</li> </ul>								
← Lines Database								
No.	Name	Start Station	Length	Azimuth				
1	line1	1.000	0.038	257°47'58.313"				
2	line2	1.038	0.062	43°41'52.9706"				
3	line 3	1.100	0.204	346°06'00.0453"				
	Ad -	Edit _	Dolet					
	Add	Edit	Delet	e OK				

- 2. Do the following:
  - $\circ~$  Add a new line.
  - Edit a line.
  - $\circ$  Delete a line.
  - Import a line.
  - Export a line.

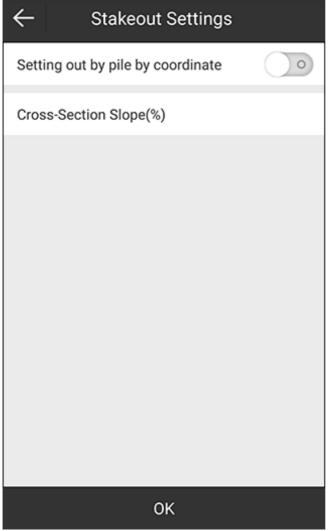
The operations are almost the same with operations in **Points Database** interface. See 3.5 Point Database for details.



#### 5.5.2 Set Stakeout Settings

To set stakeout settings, do the following:

1. To enter Stakeout Settings interface, select the target line in line database:



- 2. Select whether to set out by pile by coordinate.
- 3. Do one of the following according to your selection that **Setting out by pile by coordinate** is enabled or not:
  - If it is enabled, select whether to automatically stake the latest point, set station, select a calculation mode, and set interval: Calculation mode:
    - Stakeout by station number: use the start point as the start distance.
    - Stakeout by station distance: use the node as the start distance.
      - Custom mileage offset
  - If it is not enabled, set cross-section slope (%).
- 4. Press OK.



#### 5.5.3 Set Display Information

It is used to customize display information, including stakeout settings, topo point, information bar and toolbars.

<u></u>

To set display information, do the following:

1. In the main interface of line stakeout, press shows:

← Disp	lay Inf	formation	)			
	)PO INT	INFORM ATION BAR	TOOLBARS			
Prompt Range(n	Prompt Range(m) 0.5					
Automatic scalir	ng					
Display all lines			$\bigcirc \circ$			
Stakeout referen	ce Fo	rward directio	on(front,ba k,left,right)			
Voice broadcast			>			
DEFAULT		(	эк			

2. Set the stakeout settings, topo point, information bar and toolbars. See <u>Set Display Information</u> in point stakeout for details.

. Display Information interface

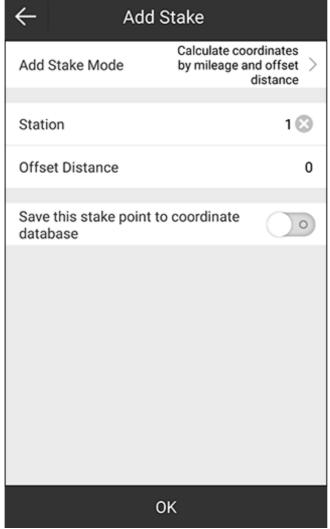


#### 5.5.4 Add a Stake

To add a stake, do the following:



- 1. In the main interface of line stakeout, press
- 2. Select one of the following modes to add stake:
  - o Calculate coordinates by mileage and offset distance



 Calculate offset and distance by coordinates (inputting northing, easting and elevation, search coordinates from the database, or get the current GPS coordinates)

← Add	Stake
Add Stake Mode	Calculate offset and $\ >$ distance by coordinates $\ >$
Please set coordinate poir	nt 😧   😱
Northing	
Easting	
Elevation	
(	ок

- 3. Set related parameters.
- 4. Press **OK**. A prompt about the calculation result shows:

Prompt		
	ooint correspond offset distance	
	Cancel	Stakeout

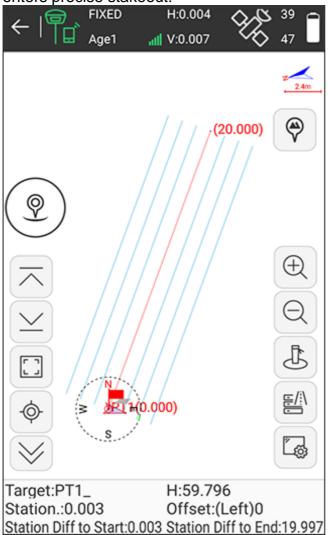
5. Press **Stakeout** to start line stakeout.



## 5.5.5 Start Line Stakeout

To start line stakeout, do the following:

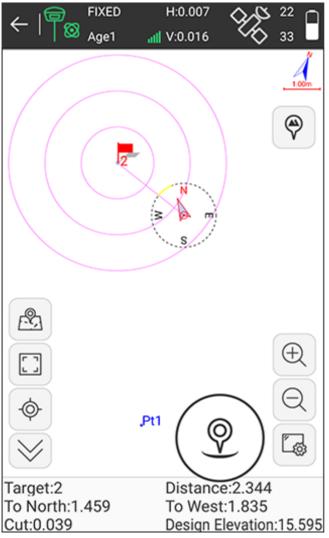
- 1. According to the engineering design, edit the stakeout line in the line database or import a line file.
- 2. Select the target stakeout line and press **OK** to enter line stakeout interface.
- 3. Move towards the indicated direction according to information in the information bar. When the line offsets on both sides are within 3 times of the prompt range, three parallel lines are generated on both sides of the stakeout line, which indicate it enters precise stakeout:





4. **Optional:** To add a stake to the line during stakeout process, see <u>5.5.4</u> Add a Stake for details.

When the target distance is less than 3 times of the prompt range, the system will tale the stake point as center and generate prompt circles to get into precise stakeout:



5. **Optional:** To switch the adjacent stakeout lines in line database, press

or

6. After reaching the stakeout line, stake it.

# 5.6 GIS Data Collection

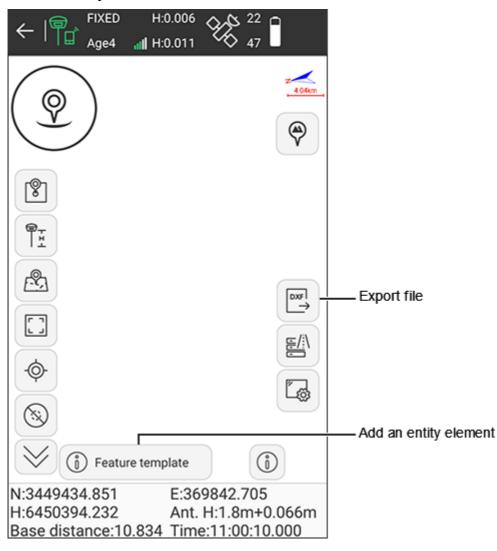
It is used to mark surface features and add labels to them.

The type of a mark surface includes the following:

- Point
- Polyline
- Polygon



Press Survey  $\rightarrow$  GIS Data Collection to enter the main interface of GIS data collection:





() Feature template

## 5.6.1 Add an Entity Element

To add an entity element, do the following:

_	_	_	Count	manager	nent
	Name	Type			
1	tree	polyline	0		

# 1. To enter Entity Element Management interface, press



2. To enter Entity Edit interface, press Add:

← Entity edit							
Name							
Ту	Type polyline >			Style		>	
La	Label1 label1 > Label2 label2				el2 >		
No.	Name	Туре	Alias	Default	Input limit		
1	label2	Date		Empty	Normal		
2	label1	Text value		Empty	Normal		
	Add	Edit	:	Delet	e C	Ж	

- 3. Set an entity name.
- 4. Select a type of the surface feature, and select a style.



- 5. To set label 1 and label 2, do the following:
  - a. To enter Field Edit interface, press Add:

$\leftarrow$	Field	edit	
Name			
Remark			
Field type			Text value $>$
Scan barco	de or QR co	de	•
Input limit			Normal >
Effective ler	ngth of text		50
Default valu	e type		Empty $>$
NEX	т		ок

- b. Set a label name, remark.
- c. Select a field type (including integer value, double value, text value, dropdown menu, check box, date, time and file).
- d. Select whether to scan barcode or QR code.
- e. Select a input limit:
  - **Normal**: when the label name is deleted, name will default to 0.
  - **Required**: name is required.
  - **Disabled**: name is unchangeable.
  - Hide: the label is hidden in the main interface of GIS Data Collection.
- f. Select the default value type.
- g. Select the target filed for label 1 and label 2.

The interface returns to Entity Element Management interface.

6. Select the target entity element, and press  $\leftarrow$  to return to the main interface.



## 5.6.2 Start GIS Data Collection

To start GIS data collection, do the following:

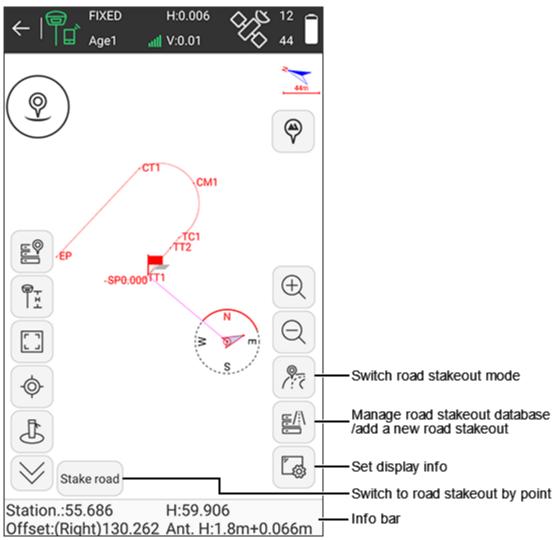
- 1. In the main interface of GIS data collection, select a point type, select the target surface feature and draw it.
- 2. To set label details, do one of the following:
  - Press , set the property and press Save.
    Press , set the property and press Save.

In this way, you cannot edit label details once you have saved them.

# 5.7 Stake Road

It is used for stakeout of road, hydraulic engineering, and slope construction.

To enter the main interface of road stakeout, press  $Survey \rightarrow Stake Road$ , and add a new road stakeout:





### Information bar

- **Station**: making a perpendicular to the stakeout line through the current receiver position, the start station plus the distance between the foot of perpendicular and the start point.
- **H**: the height of the current point.
- **Offset**: the perpendicular distance from the current position to the target line.
- Ant.H: the antenna height in survey.

## 5.7.1 Add a New Road Stakeout

To add a new road stakeout, do the following:

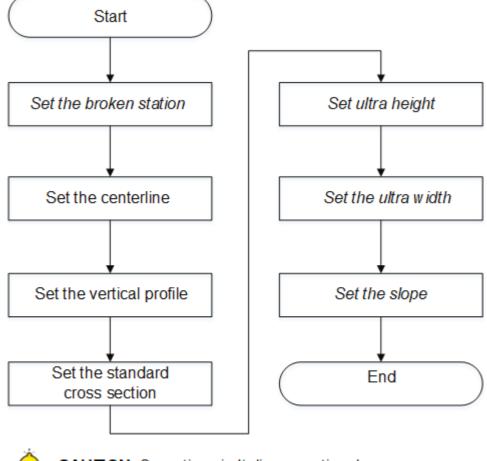
1. Press New. Road Design interface shows:

←		Road Design					
Road Name							
\$	Broken station >						
\$	Centerline >						
\$	Vertical Profile >						
\$	Standard Cross Section >			>			
\$	Slope		>				
Мар		Check	ОК				

2. Set the road name.



## 3. Do the following:



- **CAUTION**: Operations in Italic are optional.
- 4. **Optional:** To preview the road design, press **Map**.



5. **Optional:** To check the road design, press **Check**, and do the following:

← Road Check				
Calculation mode	Input Station and offset $ ightarrow$			
Station	100 😒			
Offset Distance	0			
Note: Allowed stake st 200.000; Result	tation range is100.000 ~			
C	alculate			
a. Select a calc	culation mode:			

- Input station and offset
- Input coordinate
- Batch export
- Batch counter calculation
- b. Set station and offset distance.



c. Press Calculate. The result shows in Result area:

← Road Check					
Calculation mode	Input Station and offset $>$				
Station	100				
Offset Distance	30 😒				
Note: Allowed stake station range is100.000 ~ 200.000;					
Result					
Northing	100				
Easting	130				
Design Elevation	60				
Road Design Elevation	n 60				
Azimuth	0°00'00"				
Width(Left section)	20				
Cal	culate				



# 5.7.1.1 Set the Broken Station

It is used to allow broken station without changing all stations when measurement is incorrect or the design changes. That is, you can use new station in the changing place and still old station in other places.

To set the broken station, do the following:

# 1. To enter Broken Station, press Broken station:

← Broken station							
No.	Туре	Length	Before station	After station			
1	Long	0	0.000	0.000			
2	Short	9	1.000	10.000			
	Add		Edit De		ок		

- 2. To add a broken station, press Add.
- 3. Set the following:
  - **Before station**: the original station of the target point.
  - After station: the modified station of the target point.
- 4. Optional: To set another broken station, press Next, and repeat step 3.
- 5. Press OK.

## -survey

## 5.7.1.2 Set the Centerline

It is used to define the centerline on the design to the actual road.

To set the centerline, do the following:

1. To enter Centerline interface, press Centerline:

← Centerline									
De	Design Method Line Element method >								
No.	Line Type	Deviation	Start Radius	End Radius	Ler				
1	Start Point								
2	Line								
3	Line				e				
4	Curve	Left	50	50	1				
5	Line				1				
6	Line				7				
7	Spiral	Left	00	50	1				
8	Curve	Left	50	50	e				
9	Spiral	Left	50	œ	1				
10	Line				4				
ļ	٨dd	Edit	Delete C	alculate					

- 2. Select a design method:
  - Line element method
  - $\circ$  Intersection method
  - Coordinate element method



3. To add a centerline, press **Add**. Taking the design method **Line element method** as an example, the interface is as follows:

← Set start o	coordinate
Start coordinates paramete	rs 💽
Northing	
Easting	
Start Station	
Azimuth	0°00'00"
Next	ок

- 4. To set a start coordinate, do one of the following:
  - To manually input coordinates, set values of **Northing** and **Easting**.
  - To select a point from the point database, press (S) and select the target point.
- 5. Set the start station and azimuth.
- 6. To set end point, press **Next**, or press **OK**  $\rightarrow$  **Add**, and do the following:
  - a. Select a line type:
    - Line
    - Curve
    - Spiral
  - b. Set element parameters.
  - c. Press OK.

7. To get coordinates of all set points, press **Calculate**. **Coordinates List** interface shows:

←	Coordinates List						
Name	Station	Northing	Easting	Elevation			
SP	0.000	3441262.113	359761.687	0			
TT1	5.000	3441262.462	359766.675	0			
20.00	20.000	3441273.952	359776.317	0			
40.00	40.000	3441289.273	359789.172	0			
60.00	60.000	3441304.594	359802.028	0			
TC1	72.000	3441313.787	359809.742	0			
80.00	80.000	3441320.3	359814.373	0			
100.00	100.000	3441339.041	359820.963	0			
120.00	120.000	3441358.87	359819.735	0			
140.00	140.000	3441376.656	359810.882	0			
CM1	150.500	3441384.203	359803.609	0			
160.00	160.000	3441389.59	359795.801	0			

**O-survey** 

8. To return to **Road Design** interface, press  $\leftarrow$  twice in the upper left corner.

# -survey

## 5.7.1.3 Set the Vertical Profile

To set the vertical profile, do the following:

1. To enter Vertical Profile Database interface, press Vertical Profile:

← Vertical Profile Database								
Са	Calculate Mode Circular curve >							
No.	Slope point station	Slope point elevation	Radius					
1	0.000	60	100					
2	200.000	50	801.165					
3	400.000	65	100					
A	dd Edit	Delete Import	ок					
	dd Edit		ОК					

- 2. Select a calculation mode:
  - Circular curve
  - o Parabola



3. To add a vertical profile, press Add:

$\leftarrow$	Vertical	Profile		
Station				
Elevation				
Input Type			Radius	>
Radius				
Nex	¢t		ОК	

- 4. Set the station and elevation.
- 5. Select an input type (radius and spiral length), and set radius or spiral length.
- 6. Optional: To set another vertical profile, press Next, and repeat step 4 and 5.
- 7. Press OK.



#### 5.7.1.4 Set the Standard Cross Section

To set the standard cross section, do the following:

1. <u>To enter Standard Cross Section interface</u>, press Standard Cross Section:

← Standard Cross Section							
	Left section Right section						
No.	Name	Width	Slope	Elevation Diff			
L-1	Sidewalk	10	0	0.2			
L-2		20	50	2			
L-3		10	0	2			
	Add	Ed	it	Delete	ОК		

2. Select setting left section or right section.



3. To add a left or right section, press Add.

← Standar	d Cro	ss Section
Name		>
Width		
Slope(%)	Stan	dard Slope, 2% Input 2
Elevation Elevation	differ	ence from previous pl
Next		ОК

- 4. Set a name.
- 5. Set the following:
  - Width: the horizontal length.
  - **Slope** (%): the ratio of vertical length to horizontal length.
  - Elevation: the distance between the road and curb.
- 6. **Optional:** To set copy setting to right-section / left-section, switch to related page, and press **Symmetry**.
- 7. Press OK.

## 5.7.1.5 Set the Ultra Height

It is used to change the slope of the cross section.

To set the ultra height, do the following:

1. To enter Ultra Height interface, press Ultra Height:

4	← Ultra Height						
Cr	oss-sect	ion				-Left2	>
No.	Station	Slope	Gradua	il mode			
0	100.000	60.0	Linear	change			
	Add	Ec	dit	Dele	te	ОК	

2. Select the cross-section.



3. Press Add. The following interface shows:

← Ultra ⊦	
Gradual mode	Linear change $>$
Station	
Slope(%)	
Next	ок

- 4. Select a gradual mode:
  - Linear change:
  - Three parabola:
- 5. Set the station and slope.
- 6. Optional: To set another ultra height, press Next, and repeat step 4 and 5.
- 7. Press OK.



#### 5.7.1.6 Set the Ultra Width

It is used to change the length of the cross section.

To set the ultra width, do the following:

1. To enter Ultra Width interface, press Ultra Width:

4	← Ultra Width						
Cr	oss-sec	ction			Sidew	alk-Left1	>
No.	Station	Width	Gradual	mode			
0	15.000	100	Linear c	hange			
		_					
	Add	E	dit	Dele	ete	ОК	

2. Select the cross-section.



3. Press Add. The following interface shows:

← Ultra \	
Gradual mode	Linear change $>$
Station	
Width	
Next	ок

- 4. Select a gradual mode:
  - Linear change:
  - Three parabola:
  - Four parabola:
- 5. Set the station and width.
- 6. Optional: To set another ultra width, press Next, and repeat step 4 and 5.
- 7. Press OK.



#### 5.7.1.7 Set the Slope

To set the slope, do the following:

1. To enter **Slope** interface, press **Slope**:

← Slope								
Ту	Type Left-Cut >							
No.	Station	Level Count	Horizontal distance	e				
1	100.000	0	0.0					
	Add	Edit	Delete	ОК				

- 2. Select a slope type:
  - o Left-cut
  - o Left-fill
  - o Right-cut
  - Right-fill



#### 3. Press Add. Add Slope interface shows:

← Add Slope									
St	Station								
No.	Io. Type Height/Width Ratio/Slope Width								
1	Slope	10	1:10	100					
2	Platform	19	5%	19					
		E dia	Delete						
	Add Edit Delete OK								



4. Set the station, and press Add:

Туре	Slope $>$
Elevation	
Ratio(1:N)	
Next	ок

- 5. Select a type (slope or platform).
- 6. Set elevation and ratio(1:N).
- 7. **Optional:** To set another slope, press **Next**, and set related items. The interface returns to **Add Slope** interface.
- 8. Select the target type, and press **OK**. The interface returns to **Slope** interface.
- 9. Select the target slope, and press OK.



#### 5.7.2 Manage Road Stakeout Database

To manage road stakeout database, do the following:

- 1. To enter Stake Road interface, do one of the following:
  - If it is your first time to start road stakeout, press main menu Survey → Stake Road.

			interface		takeout,	oress		
← Stake road								
No.	Name			Full Path				
1	44	Internal S	torage/SurPa	ad/Project/2	20210720/1			
N	ew	Edit	Delete	Import	ок			
Do	the fol	lowina:						

- 2. Do the following:
  - o Add a new road stakeout.
  - Edit a road stakeout.
  - Delete a road stakeout.
  - Import a road stakeout.

#### 5.7.3 Switch the Road Stakeout Mode

Road stakeout mode includes the following:

- Centerline stakeout
- Cross-station stakeout: it is to stake out the designed road on the drawing to the corresponding ground by marking the excavation line and filling line for construction.



To switch the road stakeout mode, do one of the following in the main interface of road stakeout:

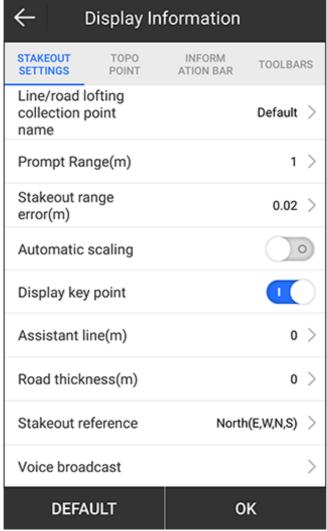
- To switch to centerline stakeout, press ٠
- To switch to cross-station stakeout, press •

#### 5.7.4 Set Display Information

It is used to customize display information, including stakeout settings, topo point, information bar, and toolbars.

To set display information, do the following:

1. In the main interface of road stakeout, press shows:



2. Set stakeout settings, topo point, information bar and toolbars. See 5.4.2 Set Display Information in point stakeout for details.

. Display Information interface



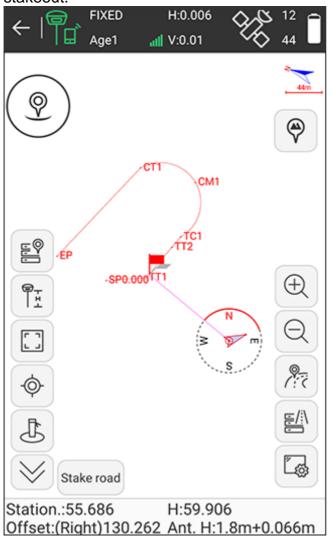




#### 5.7.5 Start Road Stakeout

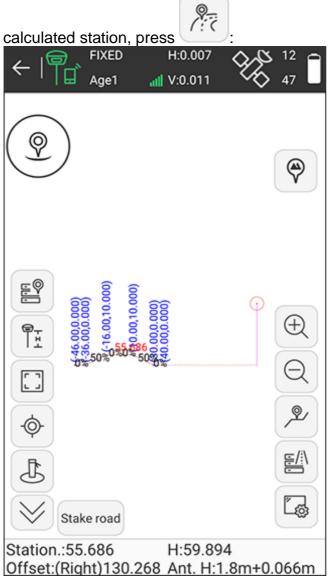
To start road stakeout, do the following:

- 1. According to the engineering design, edit the stakeout road in road stakeout database.
- 2. Select the target stakeout road and press **OK** to enter the main interface of road stakeout.





3. **Optional:** To view slope graph in the range of the current station based on the



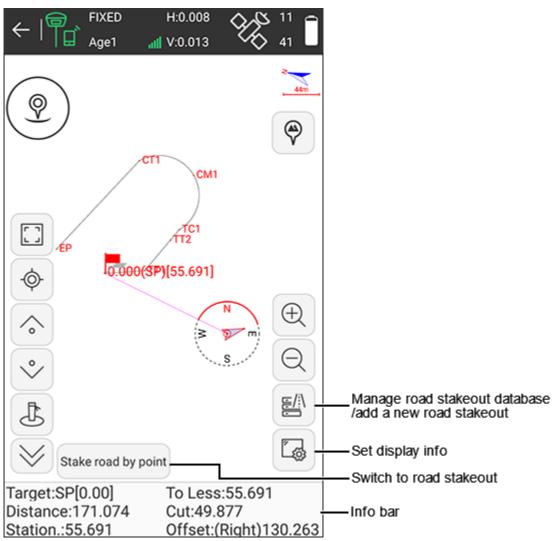
- 4. Move towards the indicated direction according to information in the information bar.
- 5. After reaching the stakeout road, stake it.



## 5.8 Stake Road by Point

It is used for continuous stakeout of specific stakes with fixed stake distance like 20 / 50 / 100 or with specific stake number as construction required.

To enter the main interface of road stakeout by point, press **Survey**  $\rightarrow$  **Stake Road by Point**, add a new road stakeout / select a road stakeout, press **OK**, set stakeout settings, and press **OK**:



#### Information bar

- Target: the name of the stakeout road.
- To More / To Less: the distance from the current point to target peg. To More means the station of the target point is greater than the station of the current point.
   To Less means the station of the target point is less than the station of the current point.
- **Distance**: the distance between the receiver and the stakeout point.
- **Cut** / **Fill**: if **Cut** shows, the current position is higher than target point; if **Fill** shows, the current position is lower than target positions.
- **Station**: making a perpendicular to the stakeout line through the current receiver position, the start station plus the distance between the foot of perpendicular and the start point.



• Offset: the perpendicular distance from the current position to the target line.

## 5.8.1 Set Stakeout Settings

To set stakeout settings, do the following:

1. To enter **Stakeout Settings** interface, press **Survey** → **Stake Road by Point**, add a new road stakeout / select a road stakeout, press **OK**:

← Stakeout S	ettings
Automatic Stakeout Late	st Point
Station	0
Offset Distance	0
Range	0.000~10.000
Calculation mode	$\begin{array}{c} {\rm Stakeout~by~station} \\ {\rm distance} \end{array} >$
Interval	20 >
Left peg offset	o >
Right peg offset	o >
ОК	

- 2. Select whether to automatically stake out the latest point.
- 3. Set station, offset distance and range.
- 4. Select a calculation mode:
  - Stakeout by station number
  - Stakeout by station distance
- 5. Set interval.
- 6. Set left peg offset and right peg offset.
- 7. Press OK.

#### 5.8.2 Add a New Road Stakeout

To add a new stakeout road, see 5.7.1 Add a New Road Stakeout for details.

#### 5.8.3 Manage Road Stakeout Database

To manage road stakeout database, see <u>5.7.2</u> Manage Road Stakeout Database for details.

## -survey

#### 5.8.4 Set Display Information

To set display information, see <u>5.4.2</u> Set Display Information in point stakeout for details.

#### 5.8.5 Start Road Stakeout by Point

To start road stakeout by point, do the following:

- 1. Select the target stakeout road and press **OK**.
- 2. Set stakeout settings, and press **OK** to enter the main interface of road stakeout by point.

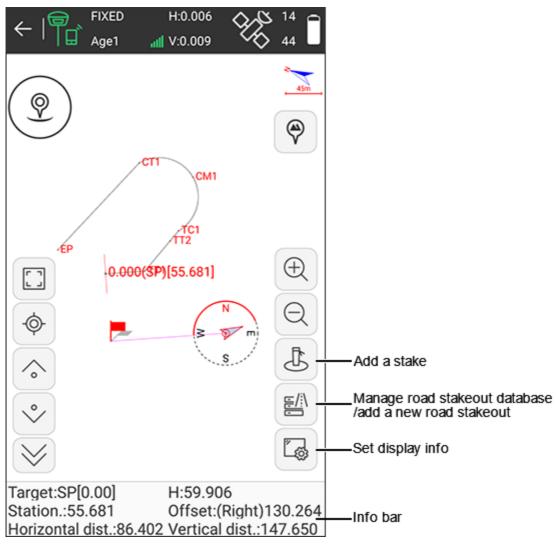
See <u>5.8.1</u> Set Stakeout Settings for details.

- 3. Move towards the indicated direction according to information in the information bar.
- 4. After reaching the stakeout point of the road, stake it.

## 5.9 Cross Section Measurement

Cutting a road into slices creates many parallel cross sections. This operation is used to mark the position of cross sections for line engineering and hydraulic engineering.

To enter the main interface of cross section measurement, press **Survey**  $\rightarrow$  **Cross Section Measurement**, add a new road stakeout / select a road stakeout, press OK, set stakeout settings, and press **OK**:





#### Information bar

- **Target**: the name of the current stakeout road.
- **H**: the elevation of the current receiver position.
- **Station**: making a perpendicular to the stakeout line through the current receiver position, the start station plus the distance between the foot of perpendicular and the start point.
- Offset: the perpendicular distance from the current position to the target line.
- **Horizontal dist.**: making a perpendicular to the cross section through the current receiver position, the distance from the foot of perpendicular to the intersection point of the cross section and stakeout line.
- Vertical dist.: making a perpendicular to the cross section through the current receiver position, the distance from the foot of perpendicular to the current position of the receiver.

#### 5.9.1 Set Stakeout Settings

To set stakeout settings, do the following:

 To enter Stakeout Settings interface, press Survey → Cross Section Measurement, add a new road stakeout / select a road stakeout, press OK:

← Stakeout S	ettings
Auto select stakeout sect	tion
Station	0
Range	0.000~10.000
Calculation mode	Stakeout by station distance >
Interval	20 >
Normal	25 >
OK	

- 2. Select whether to automatically stake out the latest point.
- 3. Set station.



- 4. Select a calculation mode:
  - Stakeout by station number
  - Stakeout by station distance
- 5. Set interval.
- 6. Set the length of normal (the distance between the centerline and the ends of cross section).
- 7. Press OK.
- 5.9.2 Add a New Stakeout Road

To add a new stakeout road, see <u>5.7.1</u> Add a New Road Stakeout for details.

5.9.3 Manage Road Stakeout Database

To manage road stakeout database, see <u>5.7.2</u> Manage Road Stakeout Database for details.

#### 5.9.4 Set Display Information

To set display information, see <u>5.4.2</u> Set Display Information in point stakeout for details.

#### 5.9.5 Start Cross Section Measurement

To start cross section measurement, do the following:

- 1. According to the engineering design, edit the stakeout road in road stakeout database.
- 2. Select the target stakeout road and press OK.
- 3. Set stakeout settings, and press **OK** to enter the main interface of cross section stakeout.

See <u>5.9.1</u> Set Stakeout Settings for details.

- 4. Move towards the indicated direction according to information in the information bar.
- 5. **Optional:** To add a stake to the cross section during stakeout process, see 5.5.4 Add a Stake in line stakeout for details.
- 6. After reaching the stakeout road, stake it.



## 5.10 Layers Settings

The main interface is as follows:

	ver settings	
DRAW LAYER	BACKGROUND LAYER	
0 👁 6	Default	
	NEW LAYER	Add a new layer

5.10.1 Set Drawing Layer

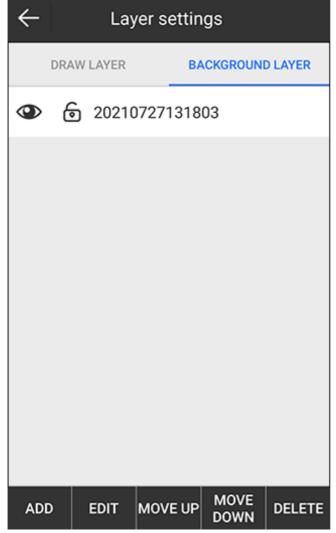
See 5.3.1 Manage the Layer for details.



#### 5.10.2 Set Background Layer

To set background layer, do the following:

1. Switch to **BACKGROUND LAYER** page:





2. Press **ADD**, and select the target format and file. **Layer Properties** interface shows:

← Layer pr	operties
Layer Name	20210727131803 🐼
File Path	/storage/emulated/ 0/SurPad/ 20210727131803.dxf
Visible	
Selectable	
Boundary	ок

Supported file format:

- AutoCAD file: \*.dxf, \*.dwg
- Shape file: \*.shp
- LandXML: \*.xml
- 3. Edit properties of the target layer.
- 4. Optional: To check the layer boundary, press Boundary.
- 5. Do the following in **BACKGROUND LAYER** page based on your needs:
  - To edit the target layer, select the target layer, and press EDIT.
    - To move the target layer down, select the target layer, and press **MOVE UP**.
    - To move the target layer up, select the target layer, and press **MOVE DOWN**.
    - To delete the target layer, select the target layer, and press **DELETE**.



## 5.11 Survey Range Settings

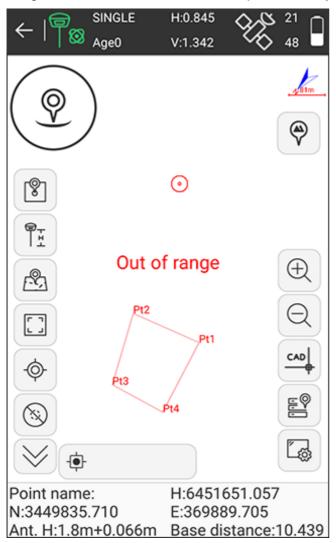
It is used to set the survey range and make sure all measured points are within the range. When the current point exceeds the range, a prompt shows.

Press main menu Survey  $\rightarrow$  Survey Range Settings. Survey Range Settings interface shows:

← Survey Range Settings							
	List			Previev	w Map –		Preview range / draw a survey range by CAD
Name	Northing	Easting	Elevation	Code			
pt1	99918	96679	109900				
pt3	948573	88869	19790				
pt4	302368	582183	854306				
pt4	49438	39883	50967				
							Add a survey range
Ad	d Se	elect	Edit	(	ЭК		



After adding or drawing a survey range, to check if the current point exceeds the set range, enter the main interface of point survey:





#### 5.11.1 Add a Survey Range

To add a survey range, do the following:

- 1. In **List** page, do one of the following:
  - Press Add, and do one of the following to set coordinates of a point:

$\leftarrow$	Point Coordi	inates		
Please set co	ordinate point		9	
Name				
Northing				
Easting				
Elevation				
	ОК			
To use the operation of the second seco	current GPS co	oordina	ates, pr	ress

- To select a point from the point database, press is and select the target point.
- To manually input coordinates, set values of **Northing**, **Easting** and **Elevation**.
- To select points in batch mode, press Select, and select the target points.
   Press OK.

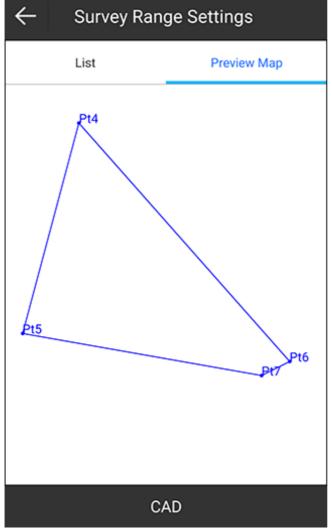
Alternatively, you can press **Select** in **List** page, and select points from the point database.



### 5.11.2 Draw a Survey Range by CAD

To draw a survey range by CAD, do the following:

1. In Preview Map page, press CAD:



- 2. Do one of the following:
  - Select to load the last CAD drawing.
  - Draw a range by CAD drawing tools.
- 3. Select the drawing, and press **OK** to exit CAD. The interface returns to **Preview Map** page.

**CAUTION:** Selecting the drawing is required. Otherwise, drawing a survey range by CAD will fail.

4. Switch to List page, press OK.



## 6 Tools

## 6.1 Localization

In general, the output data of the receiver is WGS-84 latitude and longitude coordinates. The coordinates need to be converted to local coordinates, which requires SurPad to calculate and configure coordinate conversion parameters. Localization is the main tool to achieve this.

Press main menu **Tools**  $\rightarrow$  **Localization** to enter **Localization** interface:





#### 6.1.1 Add a Localization Point

To add a localization point, do the following:

1. Press Add. The following interface shows:

← Localization						
Known Coordinates	ß					
Point name	Pt2					
Northing	3441262.148					
Easting	359761.537					
Elevation	59.801					
Geodetic Coordinates	<b>9</b>   <b>G</b>					
Coordinates Type	Geodetic Coordinate $>$					
Latitude	N31°05'03.8941"					
Longitude	E121°31'49.3663"					
Altitude	59.801					
Options						
(	ок					

- 2. To set coordinates of a known point, do one of the following in **Known Coordinates** area:
  - To select a point from the point database, press (S) and select the target point.
  - To manually input coordinates, set point name and values of **Northing**, **Easting** and **Elevation**.



- 3. To set WGS84 geodetic coordinates, do one of the following in **Geodetic Coordinates** area:
  - To use the current GPS coordinates, press (2), set antenna parameters, and a point name.
  - To select a point from the point database, press (S) and select the target point.
  - To manually input the coordinates, select one of the following coordinate types and set coordinates:
    - **Geodetic coordinate**: including latitude, longitude and altitude.
    - Local coordinate: including northing, easting and elevation.
- 4. Select whether to enable the horizontal control and vertical control.
- 5. Press OK.

### 6.1.2 Edit a Localization Point

To edit a localization point, do the following:

- 1. Select the target point, and press Edit.
- 2. Edit parameters of this point. See 6.1.1 Add a Localization Point for details.

#### 6.1.3 Delete a Localization Point

To delete a localization point, do the following:

- 1. Select the target point, and press **Delete**. A prompt *Are you sure to delete this record?* shows.
- 2. Press OK.

All data about this point is deleted from the point database.



#### 6.1.4 Set Localization Settings

To set localization settings, do the following:

1. To enter Localization Settings, press  $\dots \rightarrow$  Options:

← Localization Settings						
Convert Method	Horizontal correction + Elev_correction	>				
Horizontal correction Model	Four Parameter	>				
Vertical Control	Vertical Adjustment	>				
Horizontal Accuracy Limit	0.1	>				
Vertical Accuracy Limit	0.1	>				
	ОК					

- 2. Select a conversion method:
  - Horizontal correction + Elev\_correction
  - Horizontal + Vertical Adjustment
  - Seven parameter + Horizontal correction + Elev\_correction
  - Seven Parameter
- 3. Optional: If the conversion method is set as Horizontal correction + Elev\_correction or Seven parameter + Horizontal correction + Elev\_correction, select a horizontal correction model:
  - Horizontal Adjustment
  - Four Parameter
- 4. Optional: If the conversion method is set as Horizontal correction + Elev\_correction or Seven parameter + Horizontal correction + Elev\_correction, select a vertical control mode:
  - Automatic Selection
  - Weighted Average
  - Plane Fitting
  - Surface Fitting



## • Vertical Adjustment

5. Set horizontal accuracy limit and vertical accuracy limit.

If points in the coordinate point database exceed the set horizontal accuracy limit, information about these points turns red:

~	← Localization									
No.	Name	Northing	Easting	н	Latitude					
0	Pt1	0	0	0						
1	Pt2	2	2	2						
2	3	2	2	1						
Add		Edit	Delete	Calculat	е					

#### 6.1.5 Get the GPS Parameter Report

After all points participated in the parameter calculation have been add, you can get the GPS parameter report.

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To get the GPS parameter report, do the following:

1. Press Calculate. GPS Parameters Report interface shows:

← GPS Parameters Report	
Ellipsoid Parameter	
Ellipsoid Name	WGS 84
Semimajor axis	6378137
1/f	298.257
Projections Parameter	
Projections Mode	UTM
Central Meridian	E123°00'00"
Northing constant	0
Easting constant	500000
Scale Factor	0.9996
Projection Height	0
Latitude of Origin	N0°00'00"
Save	Apply

2. **Optional:** To export the report, press **Save** and select the target storage path.

3. To refresh data in the coordinate point database, press **Apply**. To check whether the calculation results are accurate or reliable, find known points to check the coordinate accuracy. See <u>5.1</u> Point Survey for details.

## 6.1.6 Import Localization Points

It is used to import localization points in \*.cot, \*.loc, \*.fou, \*.tfou. formats.

To import a localization point, do the following:

- 1. Press ...  $\rightarrow$  Import.
- 2. Select the target storage path, and press **OK**.

## 6.1.7 Export Localization Points

It is used to export localization points in \*.cot format for later use.

To export a localization point, do the following:

- 1. Press  $\dots \rightarrow \text{Export}$ .
- 2. Select the target storage path, and press **Export**.



### 6.2 Coordinates Converter

#### Press main menu Tools $\rightarrow$ Coordinates Converter to enter Coordinates Converter:

← Coordinates Converter			Convert a single point	
Single point Co	nversion	File Con	version	Convert a file
Source Coordina	te	(	<b>Q</b>   <b>G</b>	
Туре	🔘 BLH	⊖ xyz		
Latitude			N0°00'00"	
Longitude			E0°00'00"	
Altitude				
Target Coordinat	te			
Туре		⊖ xyz	🔘 NEZ	
Northing				
Easting				
Elevation				
Transfo	rm	Sa	ve	

#### 6.2.1 Convert a Single Point

To convert a single point, do the following:

- 1. Select a type of the source coordinate:
  - **BLH**: including latitude, longitude and altitude.
  - **XYZ**: the geocentric coordinate, including X, Y, and Z.
  - **NEZ**: including northing, easting and elevation.
- 2. To set the source coordinate, do one of the following:
  - To use the current GPS coordinates, press (2), set antenna parameters and a point name.
  - To select a point from the point database, press is and select the target point.
  - To manually input coordinates, set values of coordinates.



- 3. To select a type of the target coordinate:
  - BLH
  - **XYZ**
  - **NEZ**
- 4. Press Transform. The result automatically shows in Target Coordinate area.
- 5. **Optional:** To save the converted coordinates as a new point to the point database, press **Save**, and input a point name.

### 6.2.2 Convert a File

To convert a file, do the following:

- 1. Select a type of the source coordinate:
  - BLH
  - **XYZ**
  - **NEZ**
- 2. To select the format for the file to import, press **File**, do one of the following, and press **OK**:
  - Set file format, angle format and select whether to preview the file.
  - Press Format Manager and customize a file format.
- 3. Select the target storage path.
- 4. select a type of the target coordinate:
  - BLH
  - **XYZ**
  - **NEZ**
- 5. Press Transform.
- 6. To select a format for the file to export, do one of the following:
  - Check the file format, and press **OK**.
  - Press Format Manager and customize a file format.
- 7. Select the target storage path.



### 6.3 Angle Converter

To start angle conversion, do the following:

1. To enter Angle Converter interface, press main menu Tools  $\rightarrow$  Angle Converter:

← Angle Converter					
Format	dd°mm'ss.ssss" $>$				
dd°mm'ss.ssss"	dd.mmssssss				
Result					
dd (Decimal)	0				
dd.mmssss	0				
dd:mm:ss.ssss	0:00:00				
Radian	0				
Calcu	late				

- 2. To select an angle format, press **Format**, and select one of the following:
  - dd(Decimal)
  - o dd.mmssss
  - o dd:mm:ss.ssss
  - $\circ$  dd:mm:ss.ssss"
  - $\circ$  Radian
- 3. Input an angle.
- 4. Press Calculate. The result shows in Result area.

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# 6.4 Perimeter and Area

It is used to calculate perimeter and area of the graph formed by added points. At least 3 points that are not in a line are required.

To enter **Calculate Area** interface, press main menu **Tools**  $\rightarrow$  **Perimeter and Area**:

÷	← Calculate Area					
		List	Prev	view Map		
No.	Name	Northing	Easting	Elevation		
0	PT1	449434	369842	650394		
1	PT2	14856	719842	4958996		
2	РТЗ	66908	5892	7699369		
				Г		
ļ	٩dd	Select	Edit C	alculate		



#### 6.4.1 Add a New Point

To add a new point, do the following:

1. Press Add. Point Coordinates interface shows:

← Point C	coordinates
Please set coordinate po	oint <b>()</b>   <b>(</b>
Name	
Northing	
Easting	
Elevation	
	ОК

- 2. To set coordinates of the point, do one of the following:
  - To use the current GPS coordinates, press (2), set antenna parameters and a point name.
  - To select a point from the point database, press is and select the target point.

Alternatively, you can press **Select** in **Calculate Area** interface, and select a point from the point database.

- To manually input coordinates, set values of **Northing**, **Easting** and **Elevation**.
- 3. Press OK.

#### 6.4.2 Edit a Point

To edit a point, do the following:

- 1. Select the target point, and press Edit.
- 2. Edit name and coordinates of this point.



### 6.4.3 Calculate Perimeter and Area

To calculate perimeter and area, press **Calculate**. The result shows:

Result	
Area:146024381550.000000m² Area:14602438.155000ha Perimeter:1801841.273m	
	ок

### 6.5 COGO Calculation

It is used to calculate distances, azimuths, point positions and other coordinate geometry (COGO) functions by the following methods:

Method		Known information	Calculate	
Coordinate inverse calculation	A	А, В	AB(2D), azimuth $A \rightarrow B(\alpha)$ , elevation difference, ratio of slope, slope angle, and AB (3D)	
Point line calculation	P B A	A, B, C	AC(2D), BC(2D), AP(2D), BP(2D), PC(2D), α, β	
Great-circle distance		Latitude, longitude and altitude for point A and B	Great-circle distance of AB	
Two lines angle	o B	А, В, О	Clockwise angle α	
Intersection calculation	A C	A and B (on 1st straight line), C and D (on 2nd straight line)	P and angle of the two lines	
Resection	L1 A	A, B, L1, L2	Ρ	
Forward intersection	A A B B	Α, Β, α, β	Р	



Method		Known information	Calculate
Coordinate positive calculation	B A L1	Α, Β, L1, α	Ρ
Offset point calculation	A L1 P B	A, B, L1, L2	С
Equal point calculation	A	A, B (AB is divided into multiple parts by certain distance.)	Each divided points

To start COGO calculation, do the following:

- 1. To enter COGO Calculation interface, press main menu Tools  $\rightarrow$  COGO Calculation.
- 2. Select the target method.
- 3. To set coordinates of points, do one of the following:
  - To use the current GPS coordinates, press (2), set antenna parameters and a point name.
  - To select a point from the point database, press in and select the target point.
  - To manually input coordinates, set values of **Northing**, **Easting** and **Elevation**.
- 4. Press **Calculate**. The result shows in **Result** area.



# 6.6 Calculator

It is used for the convenience of some simple data calculation.

To use the calculator, press main menu **Tools**  $\rightarrow$  **Calculator** to enter **Calculator** interface:

$\leftarrow$	← Calculator				
					0
√	(	() C DEL			
	π	7	8	9	÷
tan-1	tan	4	5	6	*
cos-1	cos	1	2	3	-
sin-1	sin	0	•	=	+

# 6.7 External Radio Configuration

Before setting external radio configuration, make sure the receiver is disconnected.

To set external radio configuration, do the following:

1. To enter **Radio Mode** interface, press main menu **Tools** → **External Radio Configuration**:

← Radio Mode						
Radio type	Geoelectron $>$					
Connection mode	Bluetooth $>$					
Search bluetooth device list						
E600351800033	0C:AE:7D:C8:2D:0C					
E5003A20000217	74:7A:90:38:8E:0B					
E30P3A2000089	D4:53:83:61:04:FE					
E5003A20000223	74:7A:90:3B:05:66					
TRU3038100006	BF:18:18:11:5F:CC					
E30P3A1900047	D4:53:83:5F:8F:F1					
E5003A20000038	74:7A:90:37:EF:67					
Search	Connect					

- 2. Select a radio type, and connection mode.
- 3. Press Search. SurPad automatically searches all devices with Bluetooth on.
- 4. Select the target device, and press **Connect**. **Search** button turns into **Settings** button when the connection succeeds.



# 5. Press Settings. Functional Selection interface shows:

← Functional selection				
Parameter setting	>			
Channel detection	>			
Equipment information	>			
Temperature control	>			
Radio control				
Firmware update >				



- 6. To finish parameter settings, do the following:
  - a. Press Parameter setting. Parameter setting interface shows:

	er setting
Parameter setting	
Receiving channel frequency	Custom
Transmitting channel frequency	Custom
Current channel	>
Radio Protocol	>
Transmistting baud rate	>
Emissive power	>
Relay	>
Relay receiving channel	>
Relay transmistting channel	>
Get	Settings



b. To obtain parameters of the current connected external radio, press Get:

← Parameter setting						
Parame	Parameter setting					
	Receiving channel Custom					
1:	441.000000	2:	442.000000			
3:	443.000000	4:	444.000000			
5:	445.000000	6:	446.000000			
7:	447.000000	447.000000 8: 445.000000				
	smitting nel frequency		Custom >			
1:	441.000000	2:	442.000000			
3:	443.000000	4:	444.000000			
5:	445.000000	6:	446.000000			
7:	447.000000	8:	445.000000			
	Quantization of the second sec					
	Get		Settings			

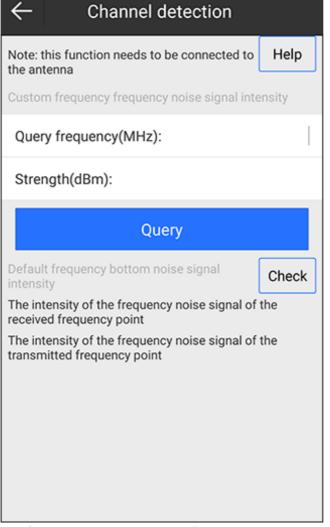
- c. After the configuration is set, press Settings.
- d. **Optional:** Customize parameters of the current external radio.



7. To start a channel test, do the following:

**CAUTION:** an external radio antenna is required.

a. Press Channel detection. Channel Detection interface shows:



- b. Optional: To check help information, press Help.
  - Signal is stronger: ≥ -95 dBm
  - Signal is weak: -105 dBm ~ -95 dBm
  - Signal is very weak (no signal): ≤ -105dBm

Signal is stronger indicates that the channel is in use. It is suggested to skip the channel and use channels that are in range Signal is very weak (no signal).

c. Input the query frequency, and press **Query**.

If the strength shows weak, it indicates that the channel is accessible.

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d. To acquire the intensity of the frequency noise signal of the received and transmitted frequency point, press **Check**:

← Cha	nnel detection	
Default frequency bo intensity	ottom noise signal	Check
The intensity of the f received frequency p	requency noise signal point	of the
1 [463.125 MHz] :	Very weak(-117.5	dBm)
2 [464.125 MHz] :	Very weak(-117.37	5 dBm)
3 [465.125 MHz] :	Very weak(-117.12	5 dBm)
4 [466.125 MHz] :	Very weak(-116.5	dBm)
5 [463.625 MHz] :	Very weak(-117.37	5 dBm)
6 [464.625 MHz] :	Very weak(-117.5	dBm)
7 [465.625 MHz] :	Very weak(-117.25	dBm)
8 [466.625 MHz] :	Very weak(-116.87	5 dBm)
The intensity of the f transmitted frequence	requency noise signal cy point	of the
1 [441.0 MHz] :	Very weak(-116.625	dBm)
2 [442.0 MHz] :	Very weak(-116.125	dBm)

# -survey

8. To check the equipment information, press **Equipment information** in **Functional Selection** interface, and press **Get** in **Equipment Information** interface. SurPad automatically gets equipment information:

$\leftarrow$ Equipment information		
Equipment information		
Device serial number	TRU3038100006	
BOOT version	v1.13	
APP firmware version	1.1.0	
Board	TRU35_MB	
Board version	V1.1	
Radio module	TRM100	
Bluetooth	B102	
Temperature(°C)	32.2	
Voltage(V)	9.74	
Data of manufactura Get	2010-00-05	



- 9. To set temperature control, do the following:
  - a. Press **Temperature control** in **Functional Selection** interface. **Temperature Control** interface shows:

← Temperatu	re control		
First order temperature contr	rol		
Temperature threshold			
Power gain(dB)			
Two stage temperature cont	rol		
Temperature threshold			
Power gain(dB)			
Note: 1, temperature threshold range [-100~1000] degrees Celsius; 2, power gain range [-60~60]dB; 3, the first order temperature threshold value must be less than the second class temperature threshold value.			
Get	Settings		

- b. To view temperature control of the current connected external radio, press **Get**.
- c. **Optional:** Customize temperature control of the current external radio.
  - Temperature threshold range: -100 °C ~1000 °C.
  - Power gain: -60 dB ~ 60 dB.

**WARNING:** The temperature threshold of the first order should be smaller than that of two stage.

d. Press Settings for saving temperature control.



10. To set radio control, do the following:

a. Press Radio control in Functional Selection interface. Radio Control interface shows:

÷	Radio conti	rol	
Serial port baud rate:	38400	~	Modify
Power-on mode:	OFF	~	Modify
	Restart		
Power off			
Restore to default frequencies			
Restore to factory settings			

- b. To change the serial port baud rate, select baud and press **Modify**.
- c. To select whether to enable power-on mode, select a selection and press **Modify**.
- d. Do one of the following based on your own needs:
  - To restart the external radio, press **Restart**.
  - To power off the external radio, press **Power off**.
  - To restore the changed frequency to its default settings, press **Restore to default frequencies**.
  - To eliminate all user-defined information for the external radio, press Restore to factory settings.





11. To update firmware, press **Firmware update** in **Functional Selection** interface, and select a firmware file with \*.bin format in **Firmware Update** interface:

← Firmware update
Upgrade file:
File information:
Note: 1, in the process of upgrading, do not leave the current page; 2, after the success of the upgrade, the radio equipment will restart. Please restart this software and radio equipment to connect.



## 6.8 Volume Calculation

It is used for land levelling, roadbed excavation, excavation for civil air defense projects, ground filling, roadbed filling and pit backfilling with small-scale, high-precision landform.

To start volume calculation, do the following:

1. To enter Volume Calculation interface, press main menu Tools  $\rightarrow$  Volume Calculation:

← Volume Calculation	
Calculation mode Triangulation mo	de >
Calculating area	>
Calculating parameter	
Reference height	
O Reference polygon	
Result	
Calculate	





2. To enter Polygon Database interface, press Calculating area:

4	-	Polyg	jon Data	base	
No.	Name			Full Path	
1	test	Internal St	orage/SurPa	ad/Project/2	20210720/0
N	ew	Edit	Delete	Import	ОК



3. To add a new area, press New:

← Calculate Area					
Fi	le Narr	ie			
	List Preview Map				
No.	Name	Northing	Easting	Elevatio	n
0	Pt2	3449434.856	369842.71	6450394.	245
1	Pt2	3441292.44	359857.818	60	
2	Pt1	3449434.821	369842.861	6450394.521	
A	٨dd	Select	Edit	ОК	

- 4. Set a file name.
- 5. To get coordinates of points, do one of the following, and press OK:
  - To obtain the current GPS data, select from the point database, or manually set coordinates, press **Add**, and do related operations.
  - To select points from the point database in batch mode, press **Select**, and select the target points.
  - To directly import a file (\*.dat, \*.csv, \*.txt), press ... → Import and select the target file.

The interface returns to **Polygon Database** interface.

- 6. Select the target polygon, and press **OK**. The interface returns to **Volume Calculation** interface.
- 7. To select a way to calculate the set area, do one of the following:
  - Set the reference height, and press **Calculate**.
  - Press **Reference polygon**, and select the target polygon in polygon database, and press **Calculate**.



### The result shows in **Result** area:

← Volume Calculation		
Calculation mode	Triangulation mode $>$	
Calculating area	test.csv $>$	
Calculating parameter		
Reference height	50 🐼	
O Reference polygon		
Result		
Fill	0.0000m³	
Cut	3409614315.2036m <sup>3</sup>	
Surface area	499583.6625m²	
Calculate		



### 6.9 Add Offsets to Points at Specified Period

It is usually used when data is collected without localization and it needs to calibrate data of a certain period after collection.

To add offsets to points at specified period, do the following:

- 1. To enter Add Offsets to Points at Specified Period interface, press main menu Tools → Add Offsets to Points at Specified Period.
- 2. To calculate the localization parameters, press **Marker Point Calibration**, set coordinates of the known point and the current WGS84 coordinates, and press **Calculate**. The result shows:

	to points at d period
Marker Point Calibratic	n >
dX	-0.032
dY	0.151
dH	0.088
Clear	Update



3. Press **Update**. The following interface shows:

Add offsets to points at specified period			
Base ID	Start Time	Base_B	
1003	2021-07-20 15:26:48.000	N31°05'03.893"	E12
	Update		



4. Select the target data, and press **Update**. The following interface shows:

Add offsets to po specified peri		
Date to update	2021-07-20	>
Start Time	15:26:48	>
End Time	16:41:49	>
Note: Allowable update duration is:1 16:41:49(+1).	5:26:48(-1) ~	
Update		

5. To calibrate date of a certain period, set the data to update, start time and end time, and press **Update**.

# 🕀-survey

# 6.10 FTP Shared Data

It is used to share data between SurPad and your PC in real time through FTP.

Before sharing data through FTP, make sure SurPad and your PC are in the same local area network.

To share data through FTP, do the following:

1. To enter **FTP Shared Data** interface, press main menu **Tools**  $\rightarrow$  **FTP Shared Data**:

Target Path	Internal Storage/SurPad >
User Name	admin 🛞
Password	
IP	192.168.50.150
Port	2222
FTP Address	FTP://192.168.50.150:2222
network 2. Open my comput enter the FTP addres	d computer are in the same WiFi ter / computer / this computer and ss in the address bar me and password in the pop-up logir
	Open

- 5. To save settings, press **Open**.
- 6. Input the FTP address into the address bar of your PC:

> Internet > 192.168.50.150 9



7. Input the set user name and password to access:

Log On	As	$\times$	
?	Either the server does not allow anonymous logins or the e-mail address was not accepted.		
	FTP server: 192.168.109.169		
	User name:		
	Password:		
	After you log on, you can add this server to your Favorites and return to it easily.		
≙	FTP does not encrypt or encode passwords or data before sending them to the server. To protect the security of your passwords and data, use WebDAV instead.		
	□Log on <u>a</u> nonymously □ <u>S</u> ave password		
	Log On Cancel		

8. Start sharing files.

### 6.11 Share

It is used to share files in both device memory and SurPad memory to other Apps in your device.

The Apps that can be shared depend on the software you have installed, and SurPad 4. 2 is only responsible for calling the Android interface.

To share files, do the following:

- 1. Press main menu **Tools**  $\rightarrow$  **Share**.
- 2. Select the target file in the target directory, and press OK.
- 3. Select the target App in your device.



### 6.12 Grid to Ground

It is used to calculate the scale factor between the total station and RTK in high attitude area, so as to achieve coordinate conversion.

To start grid to ground, do the following:

1. To enter **Grid to Ground** interface, press main menu **Tools**  $\rightarrow$  **Grid to Ground**:

$\leftarrow$	Grid To Grou	ind	
Calculate Origin	n Point		
Туре	🔘 BLH		
Latitude		N0°00'00"	
Longitude		E0°00'00"	
Altitude			
Result			
Elevation scale factor			
Grid scale factor			
Combined scale factor			
Calcul	ate	Apply	

- 2. Select a type of the source coordinate:
  - **BLH**: including latitude, longitude and altitude.
  - **NEZ**: including northing, easting and elevation.
- 3. To set coordinates of a point, do one of the following:
  - To use the current GPS coordinates, press (IV), set antenna parameters and a point name.
  - To select a point from the point database, press is and select the target point.
  - To manually input coordinates, set values of Latitude, Longitude and Altitude, or Northing, Easting and Elevation.



4. Press Calculate. The result shows in Result area:

÷	← Grid To Ground	
Calculate Origin	Point	<b>?</b>   <b>.</b>
Туре	🔘 BLH	
Latitude		N31°05'03.8823"
Longitude		E121°31'49.4195"
Altitude		59.321
Result		
Elevation scale factor		0.999990689
Grid scale fac	ctor	1.0002424883
Combined sc	ale factor	1.000233175
Calcula	te	Apply

5. To apply the result, press **Apply**.

# -survey

To view the calculated ground coordinates, press main menu  $Project \rightarrow Points$ Database, and select the target point, and press Details:

← Point Details		
Title	Content	
Easting	369854.219	
Elevation	0.8	
x	-2859097.112	
Y	4660052.211	
Z	3273938.437	
Туре	Survey Point	
Combined Factor	1.0002330914	
Ground N	3449427.287	
Ground E	369854.217	
Ground H	0.8	
Record Mode	Topo Point	
Photo And Sketch		



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