SingularXYZ®

E1

GNSS RECEIVER

User Manual

SingularXYZ Intelligent Technology Ltd.

Dear Users,

Thank you for choosing SingularXYZ E1 GNSS Receiver. We recommend that you spend some time reading this User Manual in order to have a full understand of this product and get started easily.

Please read the following important factors carefully.

• RTK rover (Network Rover mode): The E1 can be used as a GNSS RTK rover. In this mode, you need to get the RTK corrections via internet (3/4G) in NTRIP protocol.

• RTK rover (UHF/radio rover mode): The E1 can be used as a RTK rover with the UHF mode suppose you have the existing base which can work with the radio protocols that the E1 supports.

• RTK Base station mode: You can setup the E1 as the base and stream the correction data via UHF. The E1 supports most common UHF/radio protocols in the market.

• Static mode: The E1 can be used as static mode to collect GNSS raw data for post processing.

Related Regulations

The receiver contains integrated Bluetooth wireless technology and UHF. Regulations regarding the use of the datalink vary greatly from country to country. In some countries, the unit can be used without obtaining an end-user license. But in some countries the administrative permissions are required. For license information, please consult your local dealer.

Technical Assistant

If you have any questions and can't find the answer in this manual, please contact your local dealer from which you purchased the E1 receiver. Alternatively, request technical support from SingularXYZ .

You can also scan the following QR code to access to SingularXYZ Product User Manual folder and download the E1-Series User Manual.

Website www.singularxyz.com
Email support@singularxyz.com
WhatsApp +8618055477026

User Manual Folder

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Trademark notice

SingularXYZ® E1 GNSS receivers comply with the limits for a Class B digital device, pursuant to the Part 15 of the FCC rules when it is used in the Portable Mode. Operation is subject to the following two conditions:
(1)This device may not cause harmful interference;
(2)It must accept any interference received, including interference that may cause undesired operation.

Copyright Notice

The receiver can withstand the rough treatment that typically occurs in the field. However, the receiver is high-precision electronic equipment and should be treated with reasonable care.

Safety Information

Before using the receiver, please make sure that you have read and understood this User Guide, as well as the safety requirements.

- Connect your devices strictly based on this User Guide
- Install the GNSS receiver in a location that minimizes vibration and moisture
- Avoid falling to ground, or colliding with other items
- Do not rotate 7-pin Lemo port
- Do not cover the radio, keep a sound ventilation environment
- To reduce radiation, please keep above 2 meters away from the radio station
- Take lighting protection measures when installing antennas
- Change the cable if damaged

CONTENTS

1 INTRODUCTION

The SingularXYZ E1 GNSS Receiver(hereinafter E1) User Guide is aimed to help you get familiar with the E1 receiver and start your project effectively. We highly recommend you to read this manual before surveying, even you have used other GNSS RTK receivers before.

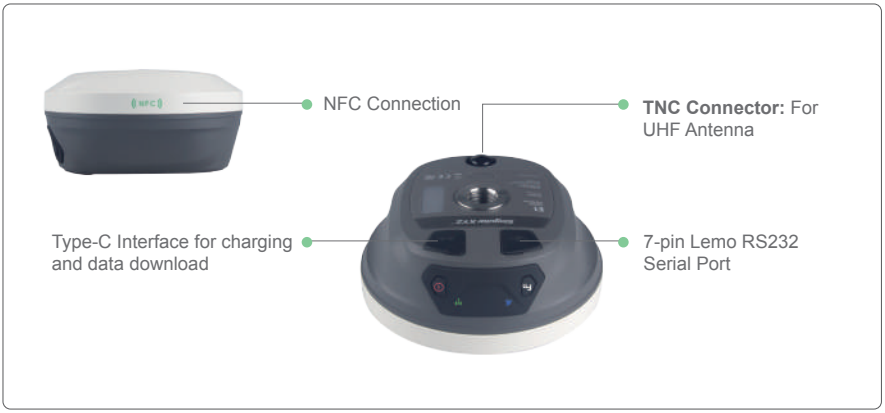
1.1 About the Receiver

With high precision GNSS module inside, E1 GNSS receiver can be applied in RTK mode with all GNSS constellations. E1 receiver has ultra-small size and strong anti-interference ability to make it possible to work even in harsh environments. It is the ideal RTK/GNSS product for surveyors.

1.2 Lower housing

Receiver lower housing contains a serial port, a USB port and a TNC connector for UHF whip antenna connection.

Interfaces



1.3 Front panel

Receiver front panel contains 4 indicator LEDs, Function button and Power button.

Front Panel

Indicators	Description	
	Satellite Tracking Indicator	Flash N times every 5s N: Number of tracking satellites
Fn	**Static & Network Indicator**	Yellow light flashes: recording static data
	Function Button	Press twice in succession to start/stop static data recording
	Correction Data Indicator	Flash when TX/RX correction data
	Power Indicator	Red light on: receiver on Red light flashes: power < 10% Green light flashes: charging Green light on: fully charged
	Power Button	Long press to turn on/off the receiver

2 RTK WORKFLOW

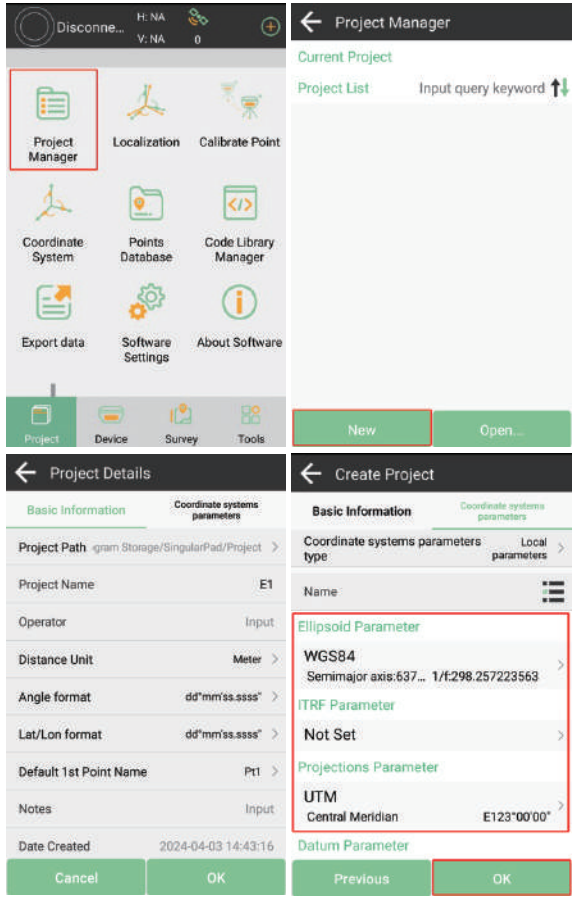
This chapter introduces how to conduct RTK Survey with SingularPad Software. SingularPad is professional Android-based surveying software developed by SingularXYZ team. SingularPad is fully functional as a field surveying software, equipped with complete work modes and necessary functions for surveyors.

2.1 Installation of SingularPad

SingularPad has been pre-installed on SingularXYZ data collector before shipping, if you want to download on your own device, please contact us.

2.2 Create a New Project

Click **Project Manager**, click the **New** to create a new project file and input project name, set coordinates systems parameters and click **OK** to save the project.

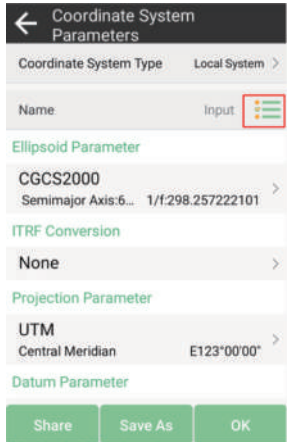


NOTE

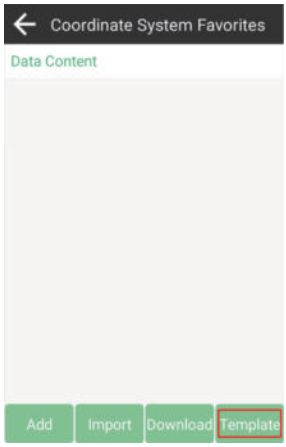
Our software has added coordinate systems for most countries. You can find the coordinate system you need by filtering the country name or searching the coordinate system name.

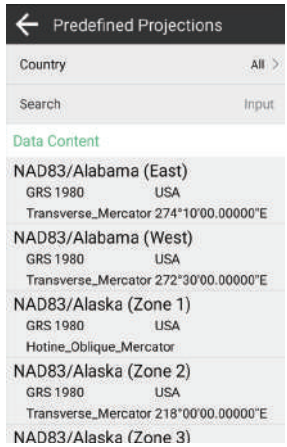
The following steps give an example of how to find the predefined coordinate system you need in SingularPad software.

Click the button located after **Name** in Coordinate System Parameters interface.

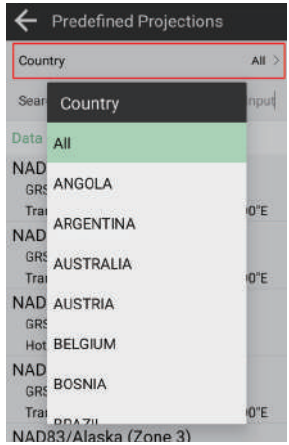


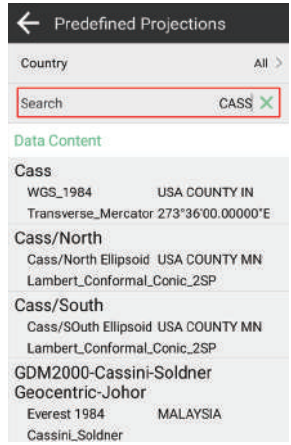
In the Coordinate System Favorites interface, click the **Template** below to enter the Predefined Projections interface.



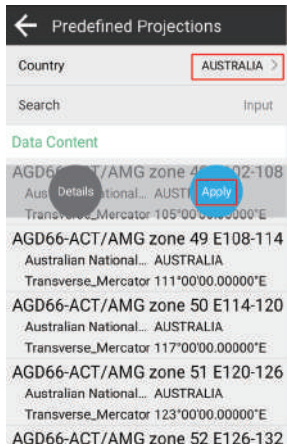


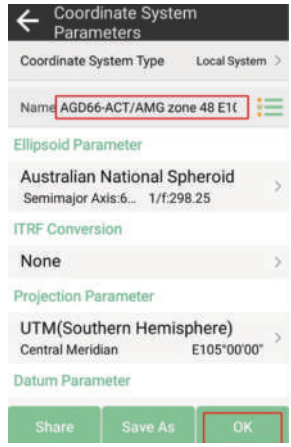
Click **Country** to select the country name or enter a keyword after **Search** to find it.



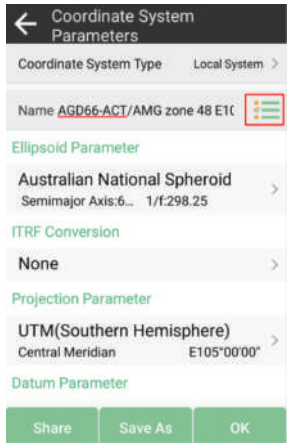


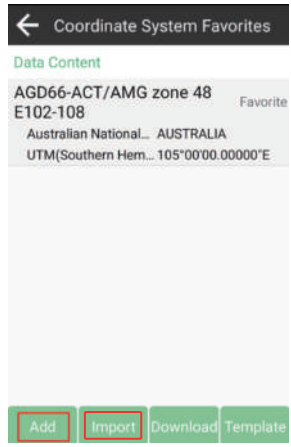
After finding the required coordinate system, click Apply to add it to coordinate system parameters, click OK to apply it to the current project.





If you can't find what you need in Predefined Projections, you can click **Add** or **Import** to create new coordinate system.





2.3 Device connection

2.3.1 NFC connection

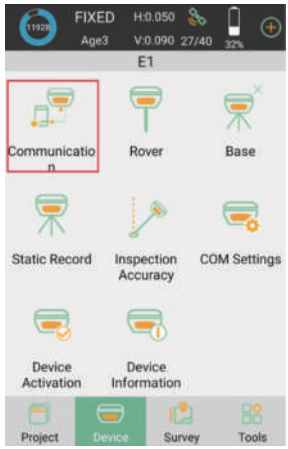
Equipped with an NFC chip, users can easily connect the E1 receiver to the data collector with just one touch, as shown in the figure on the right.

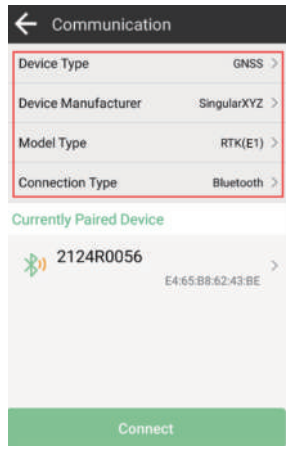
2.3.2 Bluetooth connection

After creating a new project, switch to **Device** interface, click **Communication.**

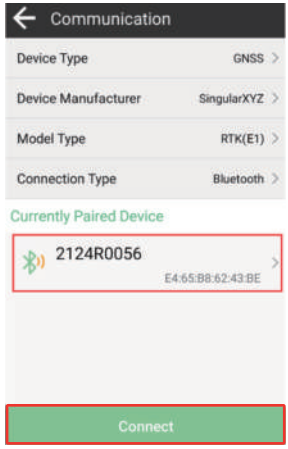
Select the corresponding parameters according to the following requirements

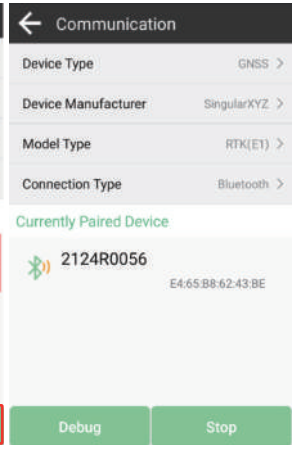
Device Type: GNSS
Device Manufacturer: SingularXYZ
Mode Type: RTK(E1)
Connection Type: Bluetooth



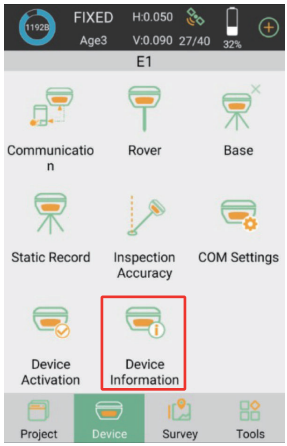


Make sure the controller Bluetooth is turned on, click Current Paired Devices below to find the SN of the E1 receiver. Click **Connect.**





After connecting E1 receiver, you can check the information of the receiver (like firmware version) in **Device Information**.



TIP

If you fail to connect with receiver through SingularPad, you can follow the prompts to enter the system Bluetooth settings interface of the PDA/data collector to ensure that the Bluetooth pairing is successful.

Sometimes you need to cancel the device Bluetooth pairing, restart the receiver or SingularPad software and pair again.

2.4 Quick setup of E1 receiver

Please follow the instructions below to quickly set up your E1 receiver according to the kit type you purchased.

For E1 Base & Rover Kit
Refer to Section 2.4.1 Internal Radio Mode for detailed setup instructions.

For E1 Rover Kit
Refer to Section 2.4.2 PDA CORS Mode for detailed setup instructions.

Ensure that you follow the appropriate section based on your kit to achieve optimal performance of your E1 receiver.

2.4.1 Mode 1 – Internal Radio Mode (E1 Base + E1 Rover)

If you've purchased 2 units of E1 GNSS receiver, please select one E1 as base and the other as rover. During configuration, you need to connect your PDA device or data collector to the base and rover respectively.

When work as a Base station, SingularPad supports transmit the correction data in Internal Radio mode.

Internal Radio: This mode uses internal radio to transmit the correction data from Base to Rover. You need to set Base and Rover with the same protocol and frequency.

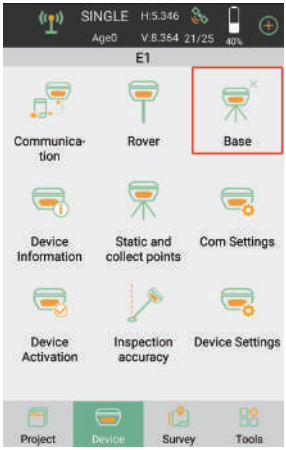
- Protocol: Supports TRIMTALK, TRIMMK3, TT450S, TRANSEOT and SATEL.
- Frequency: select a channel or customize a frequency, the range of frequency is 410-470MHz
- Baud rate: 9600
- Power: High and low (low power will reduce the transmission range)

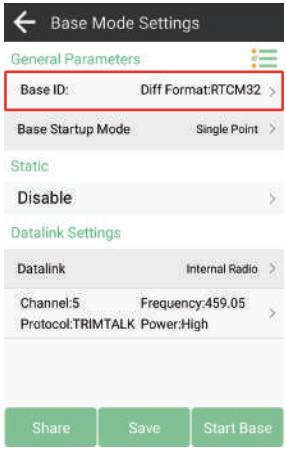
> **TIP** **Where to Set Up the Base Station?**
>
> **Ideal Environment:**
> - Clear outdoor sky view, free from obstructions
> - Place GPS and radio antennas as high as possible to reduce signal interference and increase range
>
> **Avoid:**
> - Obstacles: buildings, vehicles, towers, trees, etc.
> - Interference: high-power radar, TV, cellular towers, power lines or electrical facilities

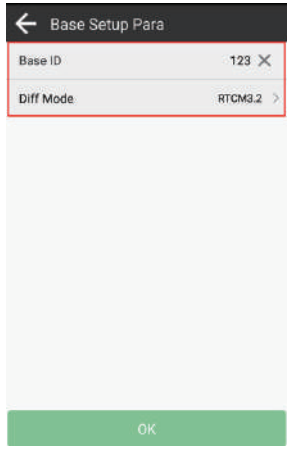
The following steps give an example of how to configure internal radio base mode.

> **NOTE**
> Set Internal Radio Work Mode: Connect the whip antenna to both your base station and rover.

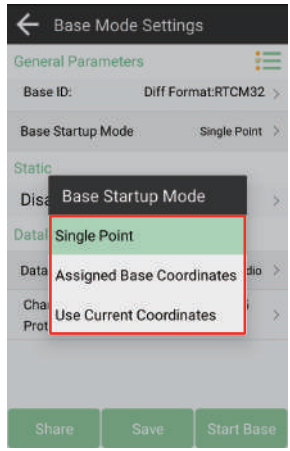
1.Go to **Device** >> **Base**. Set **Base ID** and choose the **Diff Mode** firstly.







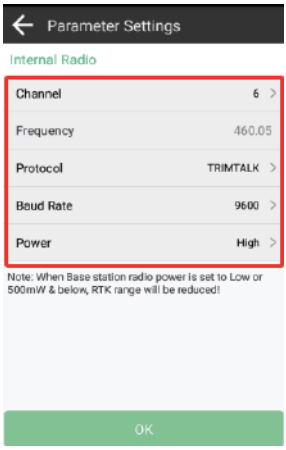
2.Click Base Startup Mode to select the base startup way.



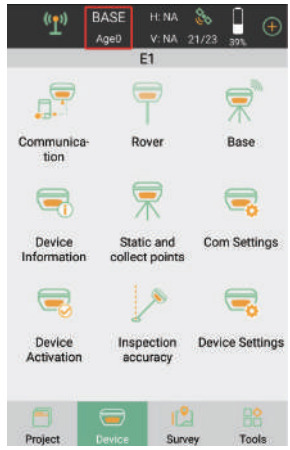
Single Point: Start the base station at unknown coordinates
Assigned Base Coordinates: Start the base station at known coordinates, and you need to enter the latitude, longitude and the height
Use Current Coordinates: Automatically start the base station at the current coordinates

> **NOTE**
> Please setup the base station at a known point. Select **Base Startup Mode** as **Assigned Base Coordinates** and input the known point coordinates. Make sure the current coordinates of the instrument is within 50 meters of the known point coordinates.
> Otherwise, you will need to conduct **3.3 Calibrate Point** after or before surveying.

3.Set **Data Link** as **Internal Radio**. Set parameter settings, Channel, Frequency, Protocol, Baud Rate and Power.



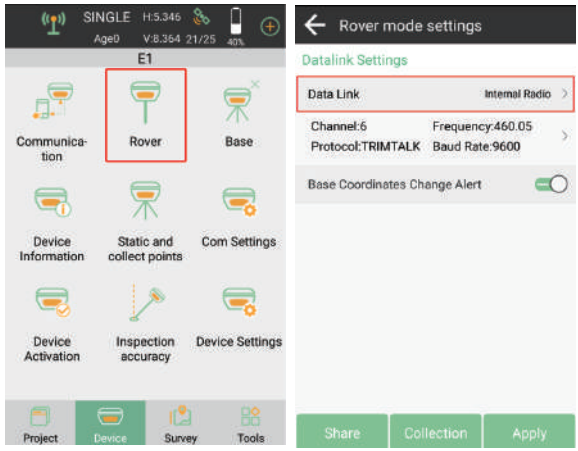
4.When start Base succeed, it will show as below in SingularPad.



After base settings, please disconnect the base device and then search for the SN of rover to connect and configure the rover device.Select the same protocol and frequency with the Base.

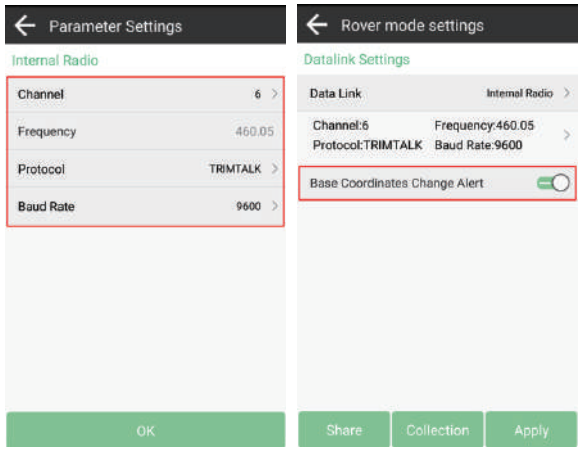
The following steps give an example of how to configure internal radio rover mode.

1.Go to **Device** >> **Rover**. Set **Data Link** as **Internal Radio**.



2.**Parameter Settings**. Set Channel, Frequency and Protocol the same as the Base.

3.**Base Coordinates Change Alert**: SingularPad will alert when the base station coordinates change while you are working. This may be because the rover is mistakenly connected to another base station or the base station has been moved.



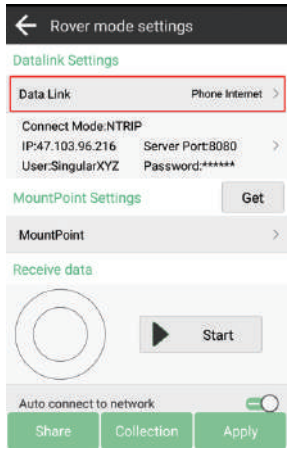
4.Click **Apply** to start the Rover mode.

After completing the configuration, please check the RTK status in the top status bar. Once the status changes to **"FIXED"** and the differential delay **"age"** is within the range of 1-2 seconds, you have obtained reliable centimeter-level RTK positioning. Now you can proceed to **Section 3: RTK Survey - Field Data Collection** to start surveying.

2.4.2 Mode 2 – PDA CORS Mode (Single E1 Rover)

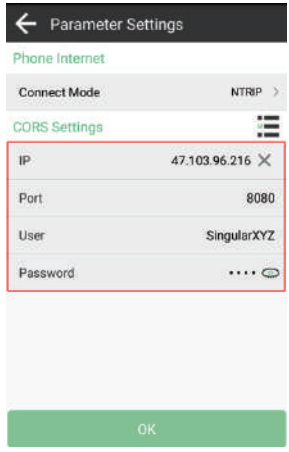
When work as a Rover, SingularPad supports receive the correction data in Phone Internet Mode.

Phone Internet: This mode uses the phone internet to transmit the correction data from Base to Rover. Please make sure the PDA device is in good network conditions, such as 4G(SC200 data collector can obtain a 4G network signal by inserting a SIM card), WiFi or hot spot.



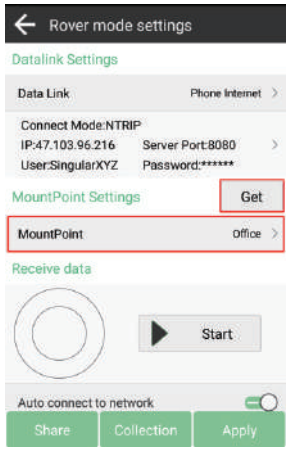
1.Go to **Device** >> **Rover**. Set **Data Link** as **Phone Internet**.

2.Set **Connect Mode**, for E1 receiver supports NTRIP and TCP Client.
CORS Settings: Input the server IP, Port, User and Password in the CORS Settings.



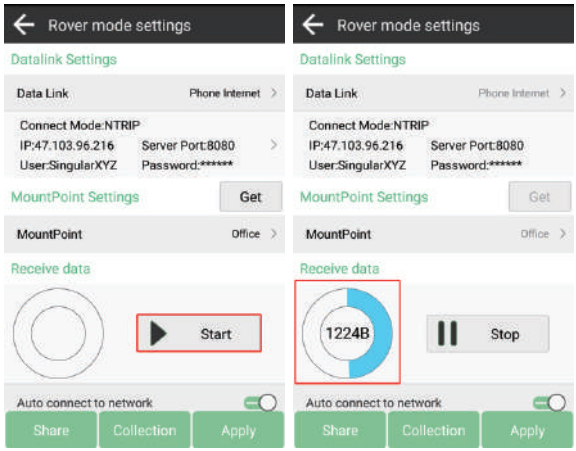
> **NOTE**
>
> The IP & port in the picture is only for example, please enter your local CORS account instead.
>
> You can purchase a third party RTK corrections service account in your local area to obtain an RTK FIX solution.

3.Click **Get** button on the right to get the mountpoint list and choose the mountpoint.

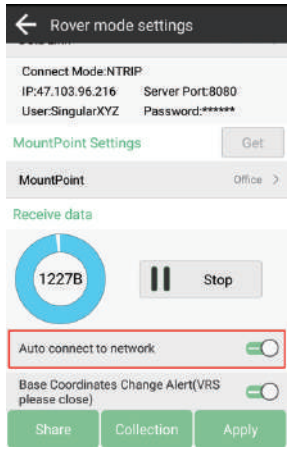


> **NOTE**
>
> The mount point "Office" in the figure is an example. Please find out the appropriate mount point via the website of your local NTRIP/CORS provider. Make sure that the baseline doesn't exceed 50km.

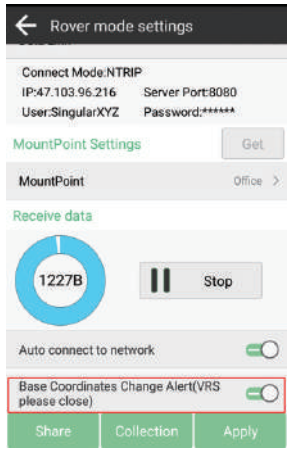
4.Click **Start** button on the right to receive data from CORS/RTK correction service. Then you can see the rover is receiving data.



5.**Auto connect to network**: When this option is opened, SingularPad will connect to network automatically so that user don't need to click start to connect network.



6.**Base Coordinates Change Alert**: Singular-Pad will alert when you connect with different base station. When you are using VRS, please do not turn this on.



7.Click **Apply** to start the Rover mode.

After completing the configuration, please check the RTK status in the top status bar. Once the status changes to **"FIXED"** and the differential delay **"age"** is within the range of 1-2 seconds, you have obtained reliable centimeter-level RTK positioning. Now you can proceed to **Section 3: RTK Survey - Field Data Collection** to start surveying.

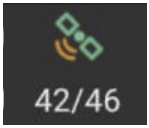
3 RTK SURVEY – FIELD DATA COLLECT

This section describes the basic survey functions of SingularPad, including Point Survey, Detail Survey, Control Point Survey, Point Stakeout, CAD Mapping and etc. Before RTK survey, you need to connect to the receiver and get a fixed solution.

3.1 SingularPad Top Status Bar Introduction

After completing your E1 RTK setup, check current RTK solution status at the top of the SingularPad software.

RTK solution status	Description
FIXED	E1 is receiving RTK corrections stably and obtaining a Fixed RTK solution with centimeter-level accuracy.
SINGLE	Single-point satellite positioning without receiving RTK correction data. The accuracy is around meter-level.
DGNSS	E1 received corrections from the base/CORS, but it needs more time to calculate due to environmental interference or correction data quality. The accuracy is around decimeter-level.
FLOAT	E1 receives corrections from the base/CORS, but due to obstructions or magnetic field interference the signal reception is not very stable and the accuracy is sub-meter level.



The satellite icon shows calculated satellites number/tracked satellites number. You can click it to check satellite map and more information.

Age means the time since the last differential data was received.

When connecting to a CORS account for measurement work, please ensure the “age” is within the range of 1-2.

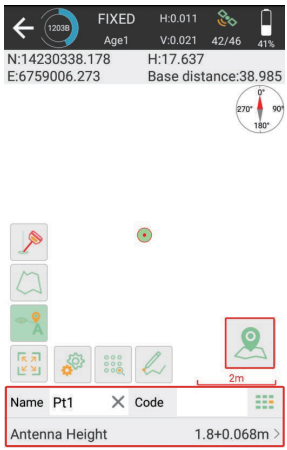
When using the radio mode for measurement work, please ensure the “age” is within the range of 2-5.

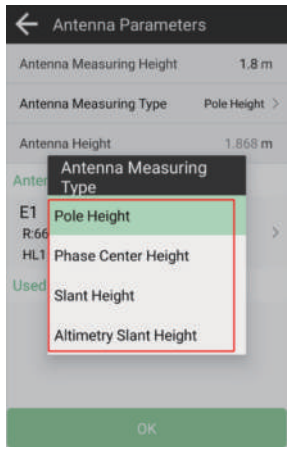
A high “age” will result in poor measurement point accuracy.

There are HRMS and VRMS on the top of the interface, click it you can check more details.

3.2 Point Survey

In the Survey interface, click **Point Survey** and enter point name, code and antenna height, then click  to start or stop collecting data.

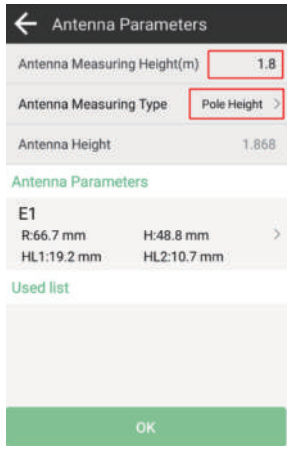




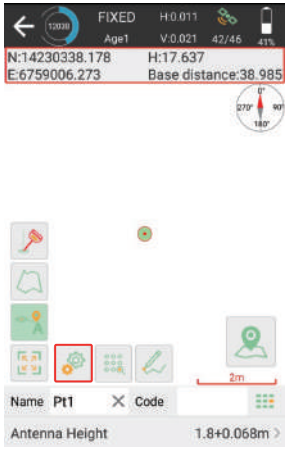
NOTE

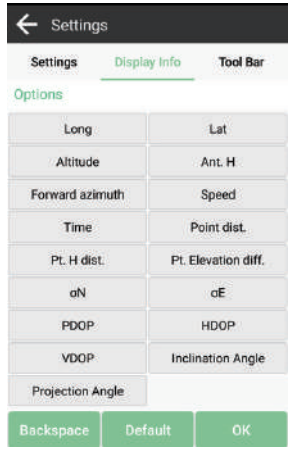
Our software supports 4 antenna measuring types.

Pole Height: Typically, select the Antenna Measuring Type as Pole Height and enter the height of your centering pole.

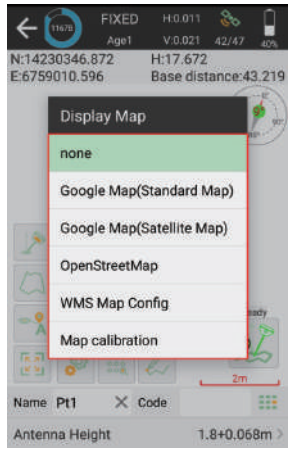


In the floating window of the survey interface, you can see the display information. The default display information is NEH and Base distance, and click the floating window you can set them as you need. You can also click  to enter the display information settings interface and select the information you need to display. Except default display information, SingularPad supports Longitude, Latitude, Altitude, etc.





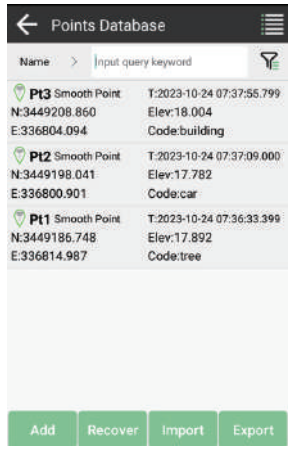
• Click to select different map types or do map calibration. SingularPad supports Google Map (Standard Map/Satellite Map), OpenStreetMap and WMS Map.



• Click to jump to map center.

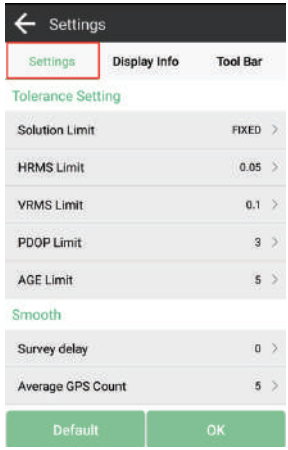
• Click to show the all points on the interface.

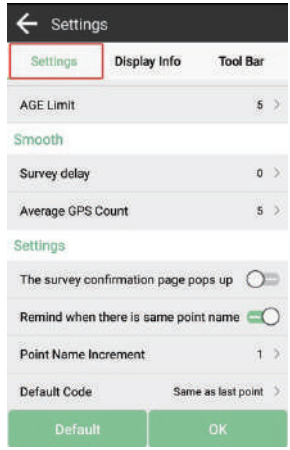
• Click to enter the point database and view the coordinates of the measured points. You can add, recover, import and export data. After selecting a point, you can view the details and take notes or take photos.



• Click  to enter Settings interface

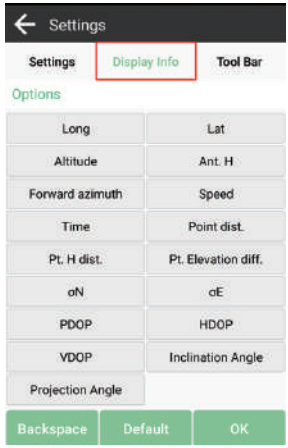
In **Settings** interface, you can modify **Tolerance Setting** such as solution limit, HRMS limit, VRMS limit and etc. and modify **Smooth** parameters and other **Settings** options.

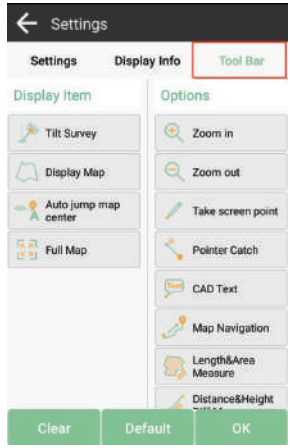




In **Display Info** interface, you can set the display information to the floating window, such as longitude, latitude, altitude,etc.

In **Tool Bar** interface, you can add or delete options that displayed on the point survey interface. You can customize the interface layout to suit your usage habits.

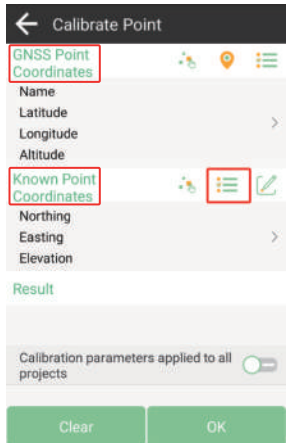


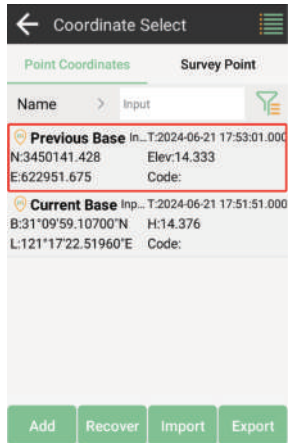


3.3 Calibrate Point

When changing the position of the base station, there will be offsets between surveying points under different base stations. Users can use the Calibrate Point to calibrate the offset.

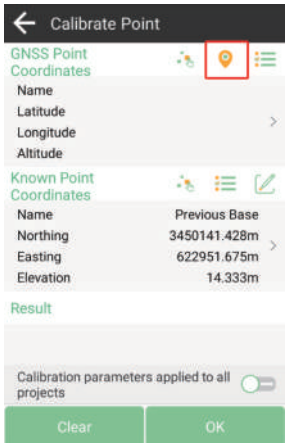
Go to **Project** > **Calibrate Point**. Add a point measured under the previous base station as **Known Point Coordinates**, and measure the same point under current base station as **GNSS Point Coordinates**.

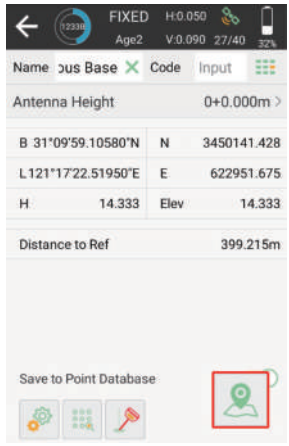




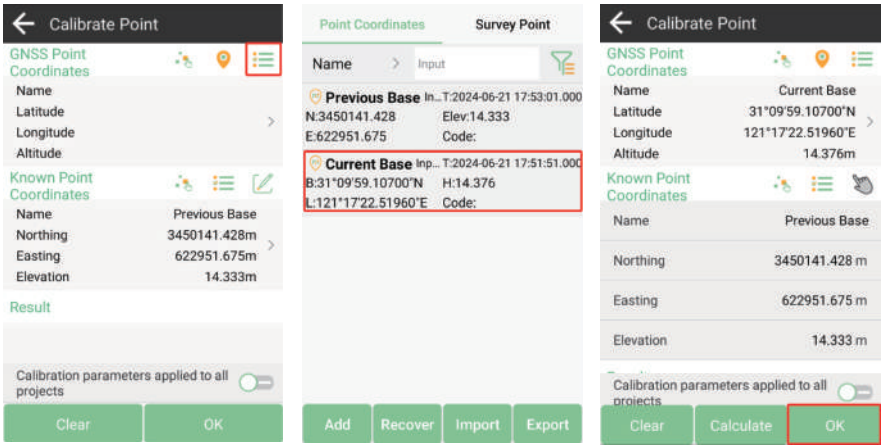
For the GNSS Point Coordinates, you can click the surveying icon to measure under the current base directly.

> **NOTE** Please confirm the RTK status is FIXED.





Or measure the GNSS point under the current base station in advance and click to select from the point database.

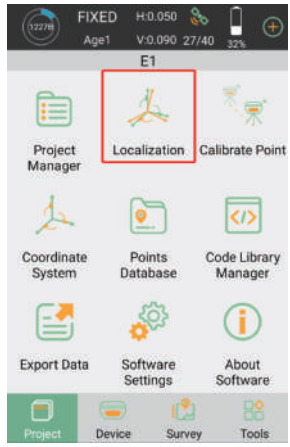


Then click **Calculate** and **OK** to complete the Calibrate Point.

3.4 Localization

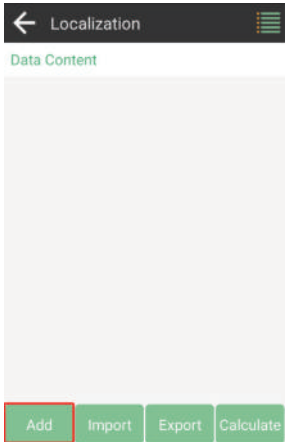
When starting a new project, if you are using the local small-scale coordinate system, you can use this function to transform the geodetic coordinates system to your local system.

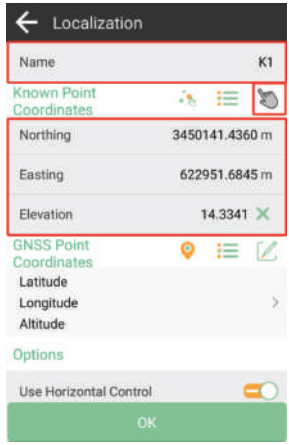
Go to **Project** > **Localization**, add at least 3 pairs of points for the Localization.



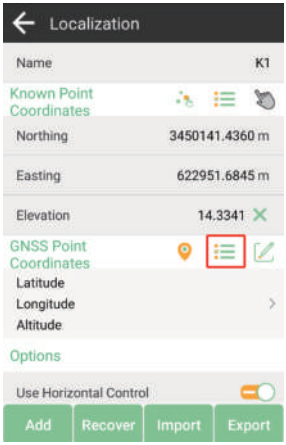
> **NOTE**
>
> A pair of points are the known local coordinates and the surveying coordinates of the same point.

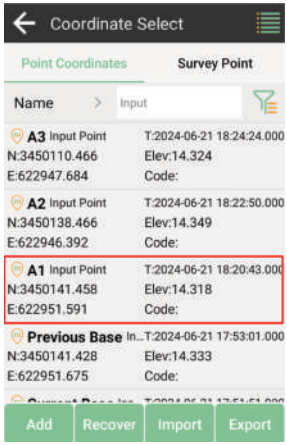
Click **Add** to add the corresponding pairs. Firstly, input the Known Point Coordinates. ▶

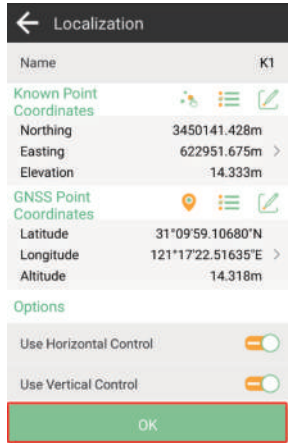




Then select the corresponding GNSS coordinates of the known point. ▼

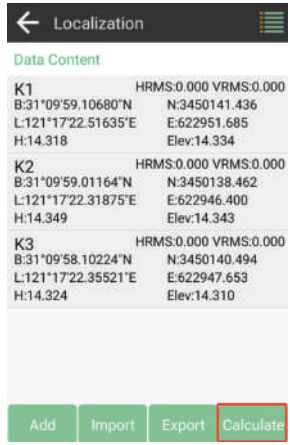




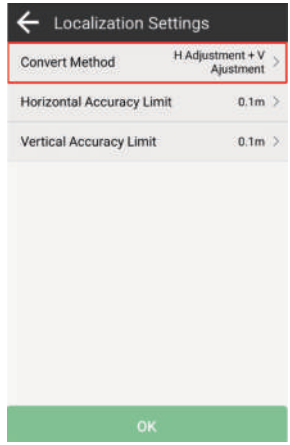


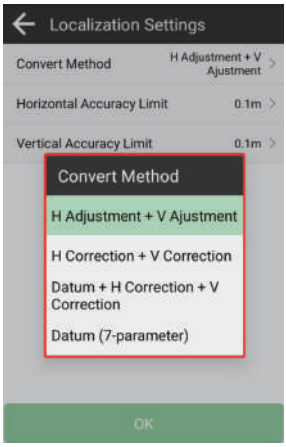
Add the remaining point pairs in sequence. You can also enter the known point in point database in advance and select the input points.

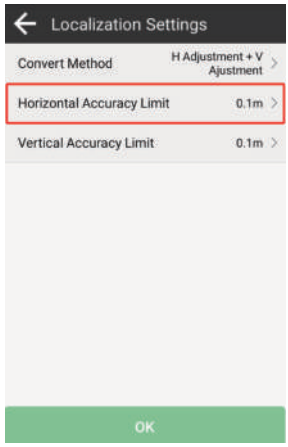
After adding all the point pairs, click **Calculate**.

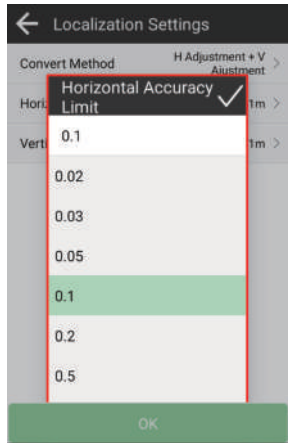


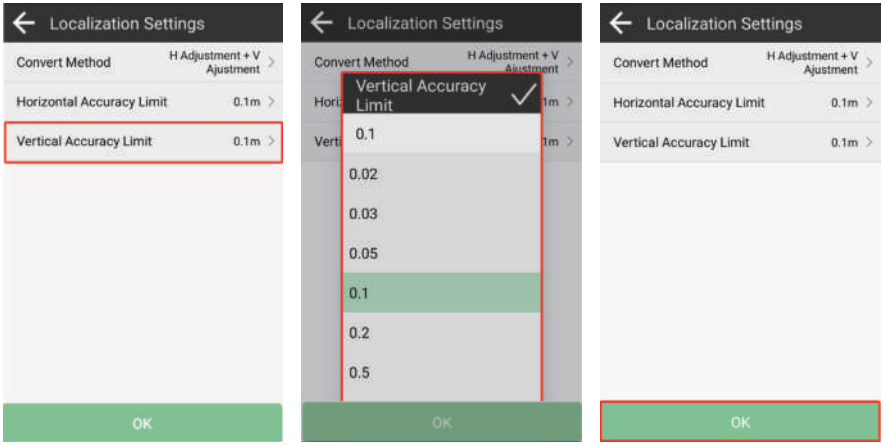
Select the convert method and the accuracy limit according to your project requirements.



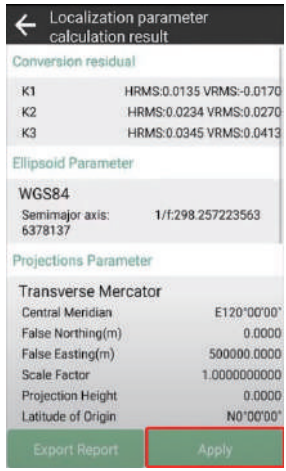








You can click Export Report to save the projected coordinate system parameters. Click **Apply** to apply the localization.

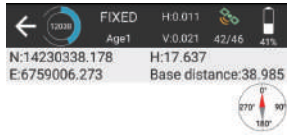


3.5 Tilt survey

The E1 GNSS receiver has a built-in IMU module that supports tilt surveying up to 60°. The system will accurately calculate the actual offset based on the tilt angle, reducing the user's burden on centering pole at each measurement.

The tilt function option will appear in each survey/stakeout function interface. You can click to turn this function on/off.

Tilt initialization is required when using it for the first time or when its calibration expires.



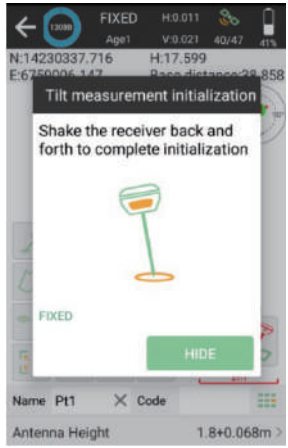
The following steps give an example of how to use tilt survey.

1.Open IMU: Go to survey >> Point Survey >> click the button to open.

After clicking the tilt IMU button, the system will prompt you to check the antenna information, please check whether the antenna height is correct.

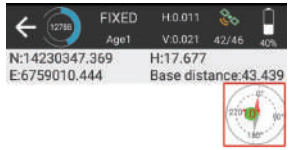
2. Initialization

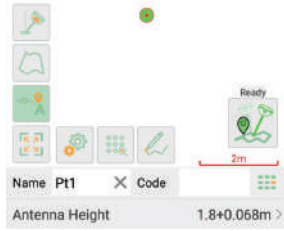
After clicking the IMU button, you can follow the guidance on the interface to complete it. During operation, ensure that the receiver can search for satellites and obtain a fixed RTK solution.



> **NOTE**
>
> If the receiver is powered off or reset, it will need to be reinitialized.

In survey interface, you can find the bubble and angle value showing how you tilt the pole in real time. To ensure the accuracy, please keep the tilt angle less than 60°. When the pole tilts within 60°, the built-in IMU precisely calculates the actual offset, the accuracy of which can be accurate to ±2.5cm.



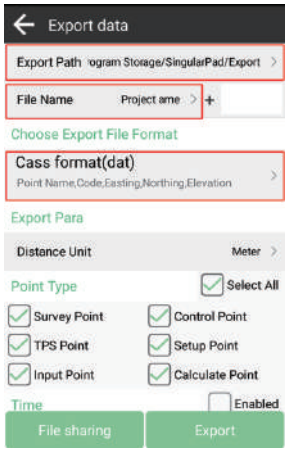


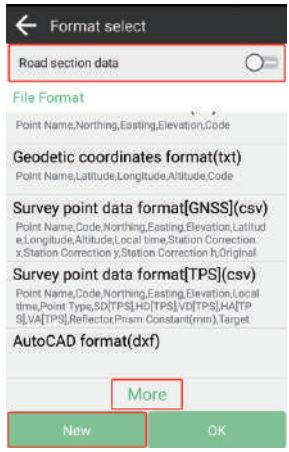
TIP

Do not shake or rotate the receiver violently, otherwise you need to re-initialize.

3.6 Export points data

Tap Export in Project interface to export point data. Also, click More formats to export the survey points in various formats like stake points/ lines, DXF, SHP, KML, RAW, RW5, HTML, CASS feature result.

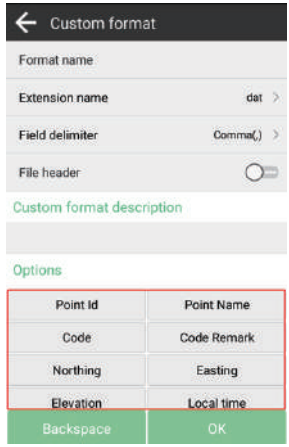




• Export Path: the default export path is internal storage/SingularPad/export; you can also change to any other path where the file is
• File Name: support project name, operator,data, data time
• Export File Format: support *.csv, *.dat, *.txt, *.kml, etc.
• Distance Unit: support meter, US survey feet and international feet
• Road section data: open to export road section data

Besides, you can click New to create a user defined type. The elements include: id, name , code, latitude, longitude, altitude, northing, easting, elevation, N, E, Z, type, local time, UTC time, solution status, AGE, max delay, min delay, use satellites, tracked satellites, cut-off angle, mount point, measurement method, repeat, start data, end time, RMS, HRMS, VRMS, PDOP, VDOP, speed, heading, antenna type, measuring type, measuring height, antenna height, base id, base latitude, base longitude, base altitude, distance to ref, original latitude, original longitude, original altitude, undulation height, station correction h, inclination correction, pitch, roll, yaw, inclined angle, projected angle, stakeout type, target, station, offset, north diff, east diff, elevation diff.

For the points, lines and polygons you surveyed in point survey, you can export dxf file, then you can edit them in third party CAD software, or import to base map to check, or import to CAD to stake. Choose the data that you want to export including survey point, input point, control point, stake point, line and polygon, and the layer properties include name, code and height.



4 STATIC SURVEY

This chapter describes how to conduct static survey through E1 receiver and to use SingularXYZ Converter software to convert data format. For static survey, E1 supports 3 data formats: binary XYZ, Rinex 3.02 and Rinex 3.04. SingularXYZ binary format (*.XYZ) is a raw observation data format and you can convert it to RINEX format via SingularXYZ Converter Software. (Contact SingularXYZ support team for the tool).

If you need post-processing software, please contact the support email at <support@singularxyz.com> for assistance.

4.1 Static Data Collection

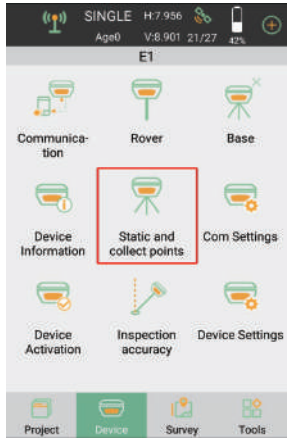
Static survey is mainly used for the control point survey. To reach millimeter accuracy, follow as below:

- At least 3 GNSS receivers are required to form a stable triangulation network.
- It is better to collect static data on the known point.
- Power off the receiver before moving to other observation site.
- For the convenience of post-process static observation raw data, record the station name, receiver SN, antenna height, start and end time for each observation site.

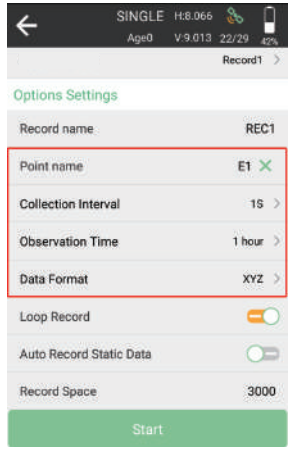
> **TIP**
> You can start recording static data in the front panel by double-pressing the function button, it's convenient for you.

The following steps give an example of static survey.

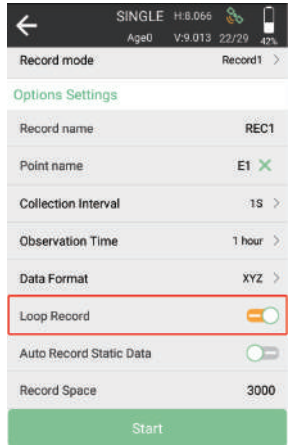
1.Go to **Device** >> **Static and collect points**. Choose the Record mode, there are two record modes and they can record static data at the same time.



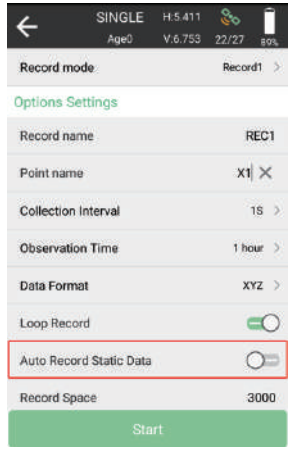
2.Options Settings interface: Input Record name and Point name. Set the Collection Interval, Observation Time and Data Format.



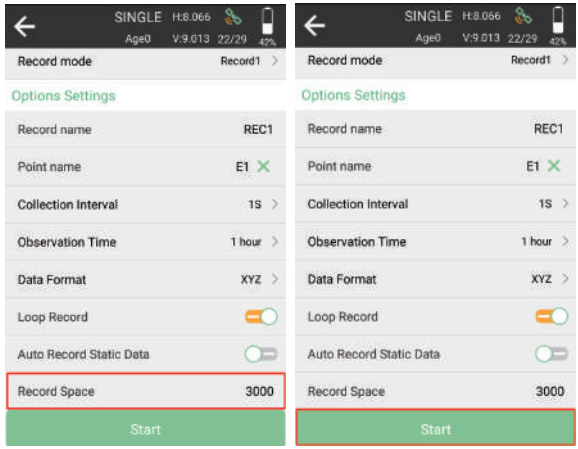
3.Turn on/off the **Loop Record** according to your needs. If this option is turned on, the receiver will delete the earliest recorded data to keep recording when the record space is full.



4.Turn on/off the **Auto Record Static** according to your needs. If this option is turned on, the receiver automatically records static data after it is power on.



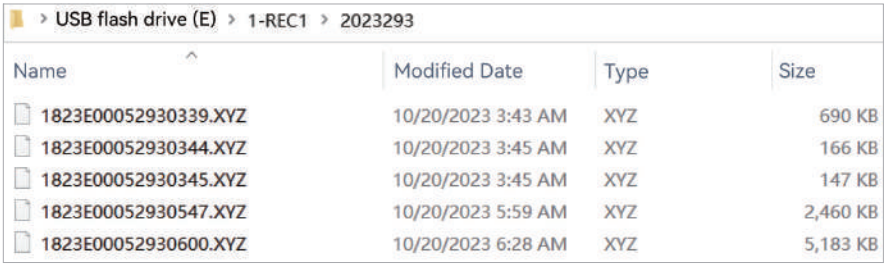
5.Set the **Record Space** in the end (unit: MB). It will limit the amount of data that receiver record.



6.Click **start** to start static survey.

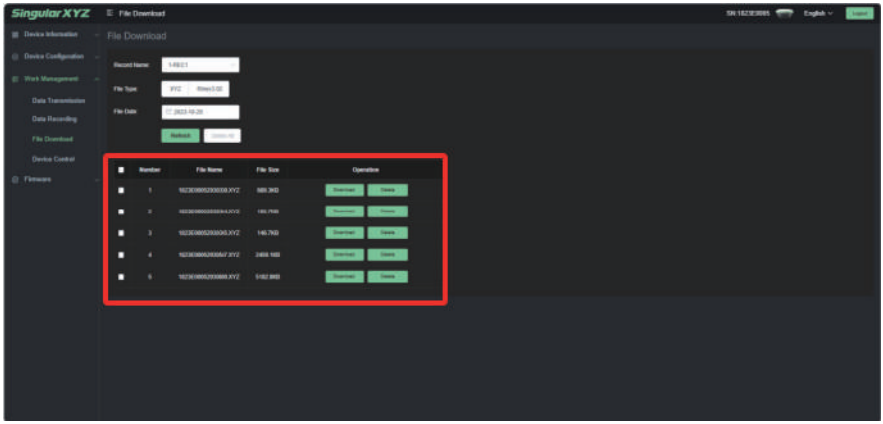
4.2 Static Data Download

The raw observation data is saved in internal memory of E1 receiver, when connected with PC via TYPE-C cable, the E1 receiver can work as a USB Flash Disk SingularXYZ_DISK, which means you can copy the static data to PC directly.



In addition, you can download the static data via Web UI, connect your PC or phone to the WiFi of the E1 receiver(WLAN name: the SN of E1) and log in the web page in browser via IP **192.168.10.12** (Username: **admin**, Passwords: **admin**).

Go to **Work management** >> **File Download**, select the corresponding record name, file type and date to filter and download the static data.

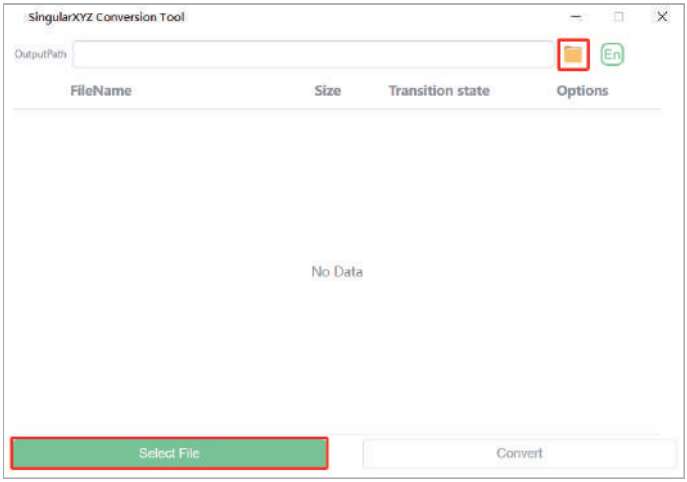


4.3 RINEX Convert

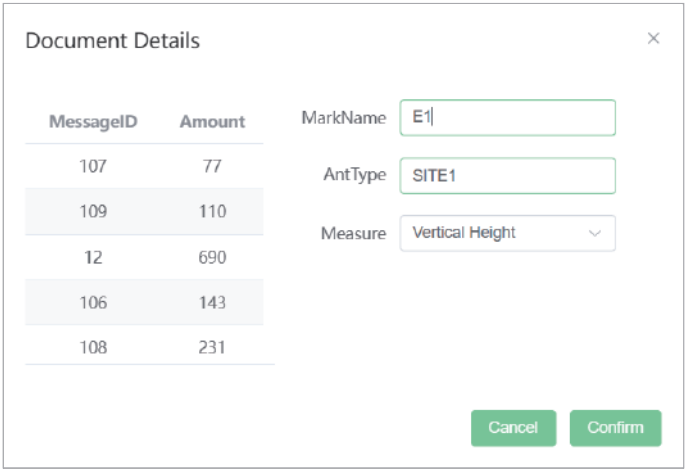
After copy raw observation data to PC, you can convert the data from SingularXYZ binary format (*.XYZ) to Rinex in SingularXYZ Converter software.

The following steps give an example of Rinex convert.

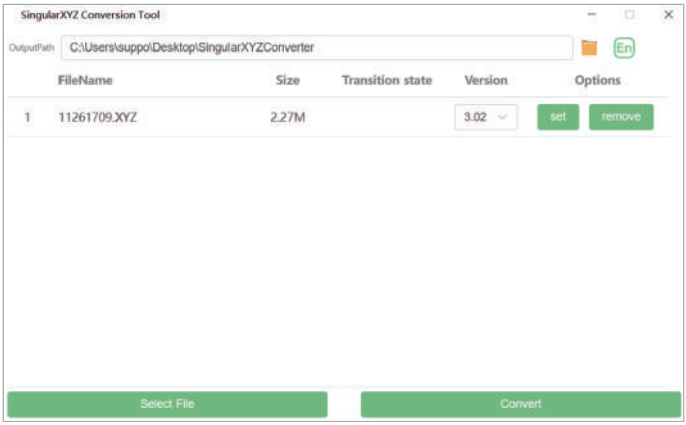
- Start SingularXYZ Converter software;
- Set the output path and select to import the binary file;



• After import the binary file, click set then input the marker name and choose the measure type of antenna height, and the antenna type is automatically identified as SITE 1 for E1 receiver;



• Click **convert** to start convert XYZ to Rinex, and the Rinex files will be output to the output file path.



NOTE

The output path of the conversion software and the storage path of the files to be converted can only contain English letters and numbers.

WARRANTY CARD

In order to provide more efficient service, please submit your product maintenance request synchronously on SingularXYZ official website Support>> Registration & Maintenance

Product Model: _____

Serial Number: _____

Date of Shipment: _____

Customer Name: _____

Address: _____

Address: _____

Note: Before returning for repair, please contact SingularXYZ support team or your local SingularXYZ distributor partner for debugging.

Warning and Caution

An absence of specific alerts does not mean that there are no safety risks involved. A Warning or Caution information is intended to minimize the risk of personal injury and/or damage to the equipment.

WARNING – A Warning alerts you to a potential risk of serious injury to your person and/or damage to the equipment, because of improper operations or wrong settings of the equipment.
CAUTION – A Caution alerts you to a possible risk of damage to the equipment and/or data loss.

Warranty Notice

SingularXYZ does not warranty devices damage because of force majeure (lighting, high voltage or collision).
SingularXYZ does not warranty the disassembled devices.

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