USER GUIDE

SPHEREFIX

SP10

SPHEREFIX

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SP10

GNSS RECEIVER USER GUIDE

Guangzhou Spherefix Navigation Technology Co., Ltd.

Preface

Introduction

This section explains the purpose of the manual and the basic use of the SP10 GNSS Receiver.

User qualifications

To obtain the best results from the SP10, read this manual in full before operation. If you are unfamiliar with any function, visit https://www.spherefixgnss.com/ for supplementary material.

Safety information

Note: Highlights a procedure or condition that requires extra attention.

Warning: Identifies an operating step whose incorrect execution may damage the equipment, cause data loss, or create a safety hazard.

Limitation of liability

Guangzhou Spherefix Navigation Technology Co., Ltd. accepts no responsibility for damage or injury resulting from failure to follow the instructions or from misinterpretation of the contents.

We reserve the right to revise this manual without notice as part of our continuous product-improvement policy.

Although every effort has been made to ensure accuracy, discrepancies between the manual and the actual hardware or software may occur; in such cases the physical product takes precedence.

Technical support & service

Should you encounter any technical issues, please call the Spherefix Technical Support Department; we will respond promptly.

Feedback

Send any suggestions about the product or manual to: contact@spherefixgnss.com. Your comments will help us improve both the product and service.

Contents

1、SP10 At A Glance 01
1.1 Appearance 01
1.2 Battery Indicator 02
1.3 Power On And Off 03
1.4 Insert A SIM Card 03
1.5 Charge The Battery 04
1.6 Abnoraml State 04

2、Web UI 06
2.1 System View 07
2.2 Device Firmware 07
2.3 Skyplot 09
2.4 Data Stream 11
2.5 Mode Config 13
2.6 Others Config 15
2.7 Remote Assistance 16
2.8 File 17
2.9 Log 17
2.10 Message Text 18
2.11 Data Config 20

3、SphereFix Basic Operations 26
3.1 Installation 26
3.2 Project Manager 26
3.3 Communication 28
3.4 Rover 30
3.5 Base 34
3.6 Static 36
3.7 Point Survey 37
3.8 Tilt Measurement 42
3.9 Point Stakeout 43
3.10 Localization 46
3.11 Point Calibration 49
3.12 Points Database 52
3.13 Export 54
3.14 Device Information 55

4、Device and Software Activation 56
4.1 Device Activation 56
4.2 Software Activation 57

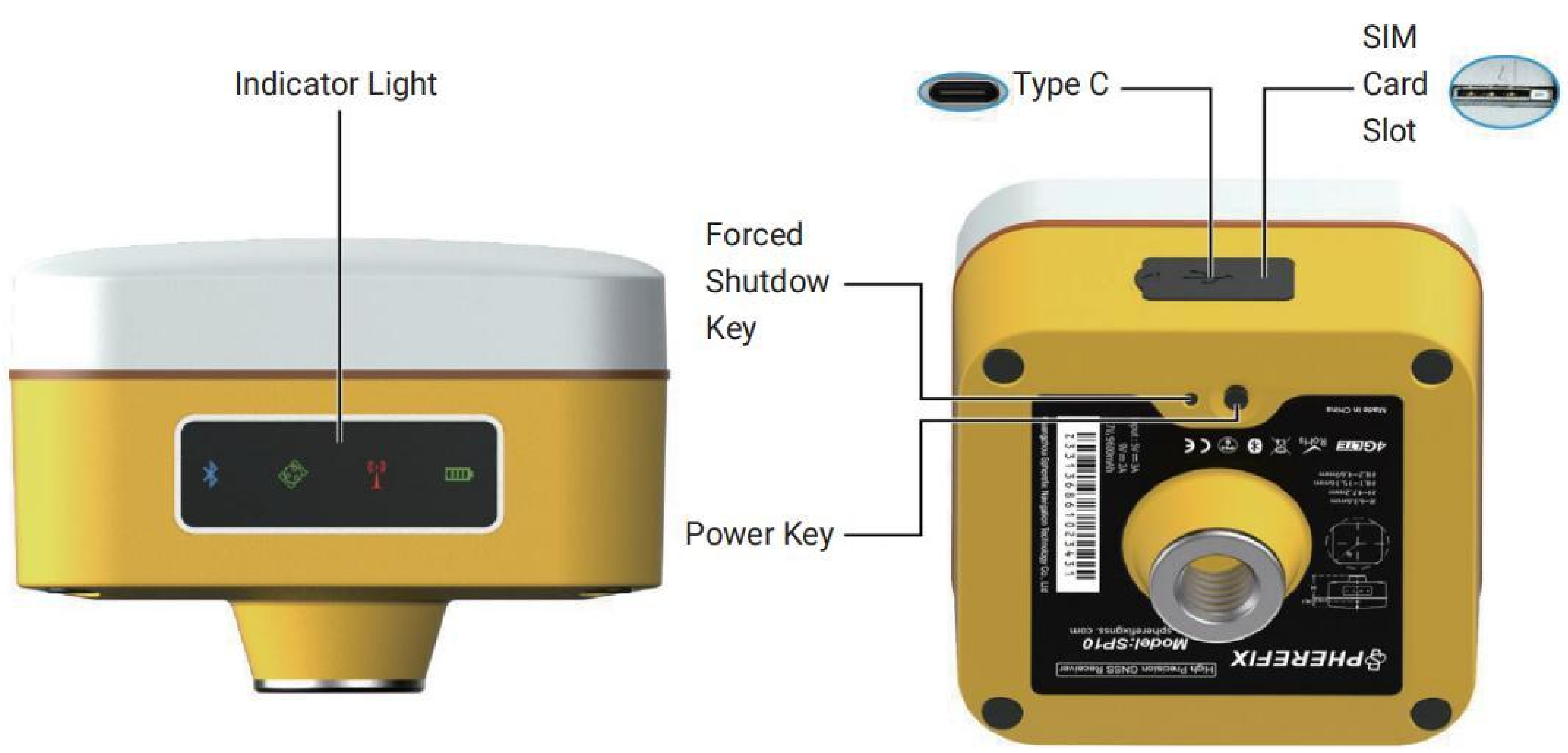
5、Specifications 59

1. SP10 At A Glance

SP10 is a mini portable multifunctional GNSS receiver developed based on Beidou high-precision positioning technology. It has a magnesium alloy body, meets the IP65 protection level, weighs less than 510g, is easy to carry around, has ultra-low power consumption, and is equipped with a 9600mAh lithium battery, with a full battery life of more than 16 hours.

1.1 Appearance

The main body of SP10 is as follows:

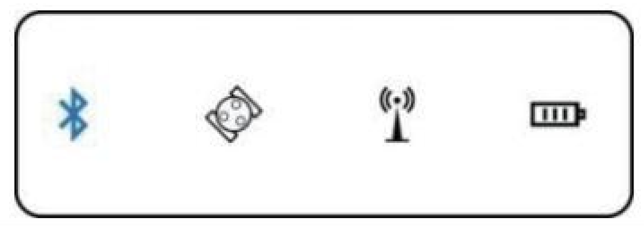
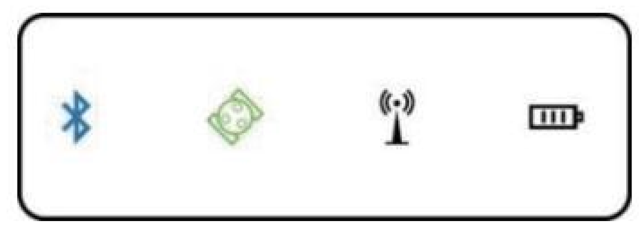
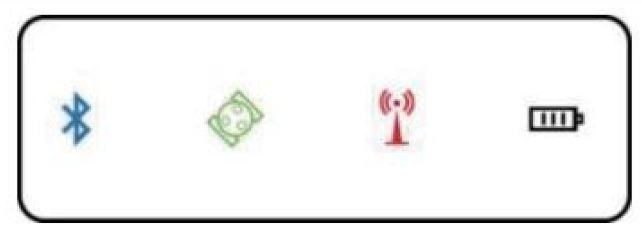
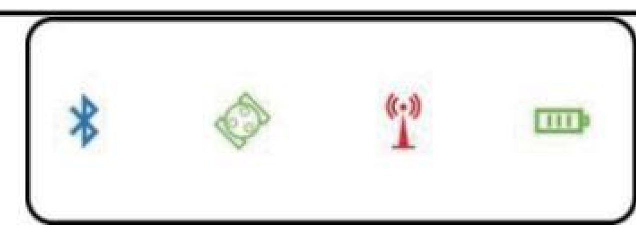


Projects	Function	Roleor status
	Power Key	Short press for 1s to check the battery level; Long press for 3s to turn on the device when it is off; Long press for 3s to turn off the device when it is on.
	Forced Shutdown Key	Short press to force the mainframe to power down immediately, for accidental death of the mainframe, this operation does not restore the factory settings.
	Type C	Type-C interface, supports 5V3A charging.

	SIM Card Slot	External SIM card, supporting 4G full network conne-ctivity.
	Power Indicator Light	Green light always on during normal operation; Red light flashes when power is low; Red light always on during charging; Green light always on when charging is complete.
	Bluetooth Indicator Light	Blue light always on for Bluetooth connected; Blue light off for Bluetooth disconnected; Blink for abnormal condition.
	Differential Data Indicator Light	Red light blink when receiving differential data; Red light off when no differential data receiving.
	Satallite Indicator Light	Green light flashing 1s interval in the positioning state; Green light off when out of the positioning state.

1.2 Battery Indicator

Short press the power key for 1s when the device is off, through the indicator light, you can know the battery level:

Indicator Light	Battery Level
	0%-25%
	26%-50%
	51%-75%
	76%-100%

1.3 Power On And Off

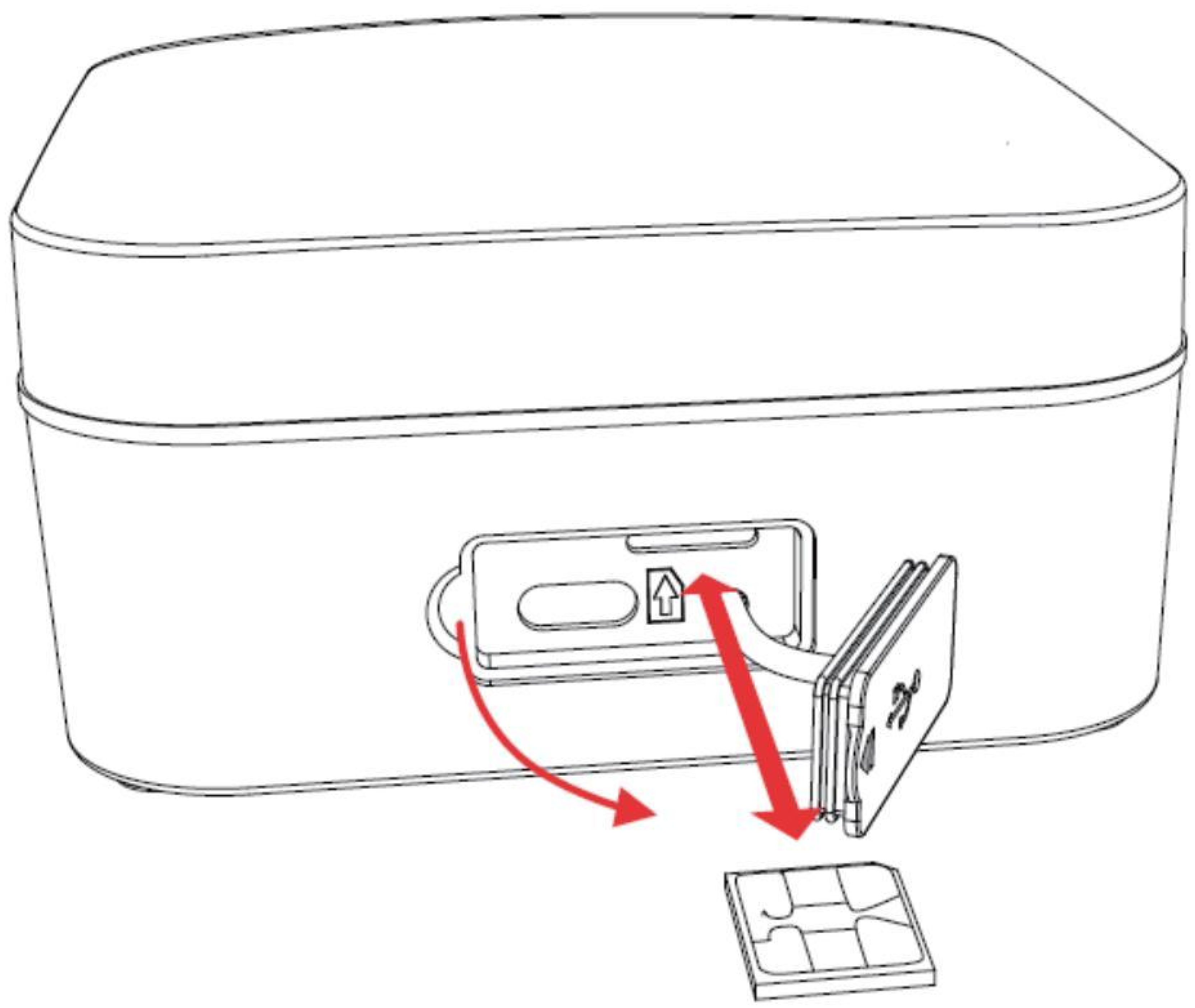
Power on: Press and hold the power key for 3 seconds until the buzzer "beeps". Release the button, the device starts to power on, and the panel light flashes. The device will not start until the buzzer emits a "beep" for 3 times.

Shutdown: Press and hold the power key for 3 seconds until the buzzer "beeps". Release the button and the device starts to shut down. The unit will power off until all panel lights go out.

Forced shutdown: In case of unexpected failure, press the forced shutdown key, and the device will automatically shut down.

1.4 Insert A SIM Card

The device supports network working mode.



Insert SIM card:

1. Open the rubber cover;
2. Insert the SIM card slot according to the instructions (the chip faces the set-top and the notch faces the card slot);
3. Cover the rubber sleeve.

1.5 Charge The Battery

The device is equipped with a Type-C charger that supports 5V3A. It takes 3 hours to fully charge the battery.

1. Red light: The battery is charging.
2. Green indicator light: The battery is fully charged.

To charge the battery, open the type-C cover, connect one end of the data cable to the type-C interface, and the other end to the charger.

Note: For the safety of your device, please use the standard adapter in the package or a 3C-certified brand adapter to charge the device.

1.6 Abnoraml State

When the device experiences abnormal situations such as expired registration code, restricted area, failed location configuration, and network errors, the buzzer will emit a beep sound.

Registration code expiration: First, provide the device ID to the dealer to obtain a new registration code, and then refer to section 4.1 for registration.

Positioning configuration failure: Attempt to restart the device to recover. If unable, please contact the dealer for resolution.

Network error:

1. Check if a SIM card is inserted;
2. Check if the SIM card can access the internet normally;
3. Check if the APN parameters are filled in correctly.

2. Web UI

The device WIFI can be used as a hotspot, and a PC, smartphone or tablet can be connected to the hotspot. After connecting to the hotspot, you can manage the working status, change the working mode, configure basic settings, download raw data, update firmware and register devices, etc. Take the interface of your PC as an example, enter the Web UI, and perform the following operations:

1. Use the computer to find the WIFI hotspot of the device. Hotspot name: device serial number, default password is empty.
2. Open a web browser and enter the IP address 10.10.10.10. The following interface displays:

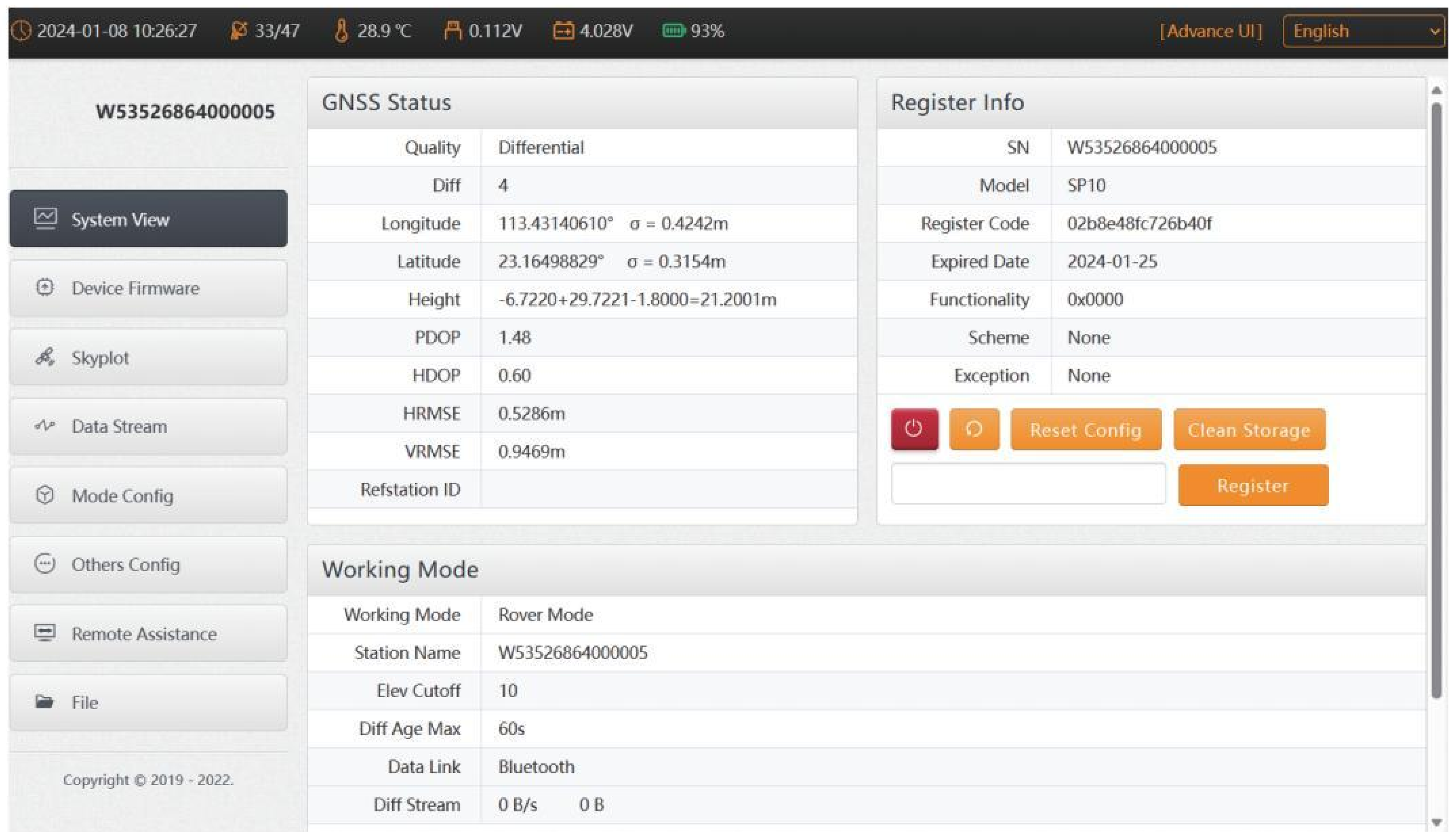


Figure 2-1

Meaning of icons arranged horizontally above the interface:

2024-01-08 11:04:31	34/47	29.5 ℃	0.061V	4.001V	89%
Time	Satellite Used/Tracked	Temperature	Supply Voltage	Battery Voltage	Battery Info

2.1 System View

1. GNSS Status: Quality, Latitude, Longitude, Height, Satellite, Refstation ID;

2. Register Info: SN, Expired Date, Scheme, Exception;

The registration code is a valid time code that authorizes the location function of the device. When it is found that the registration code has expired and the device positioning function is unavailable, we can obtain a new registration code from the supplier by providing the device SN, and enter it on this page and click [Register] to register.

3. Working Mode: Working Mode, Elev Cutoff, Data Link.

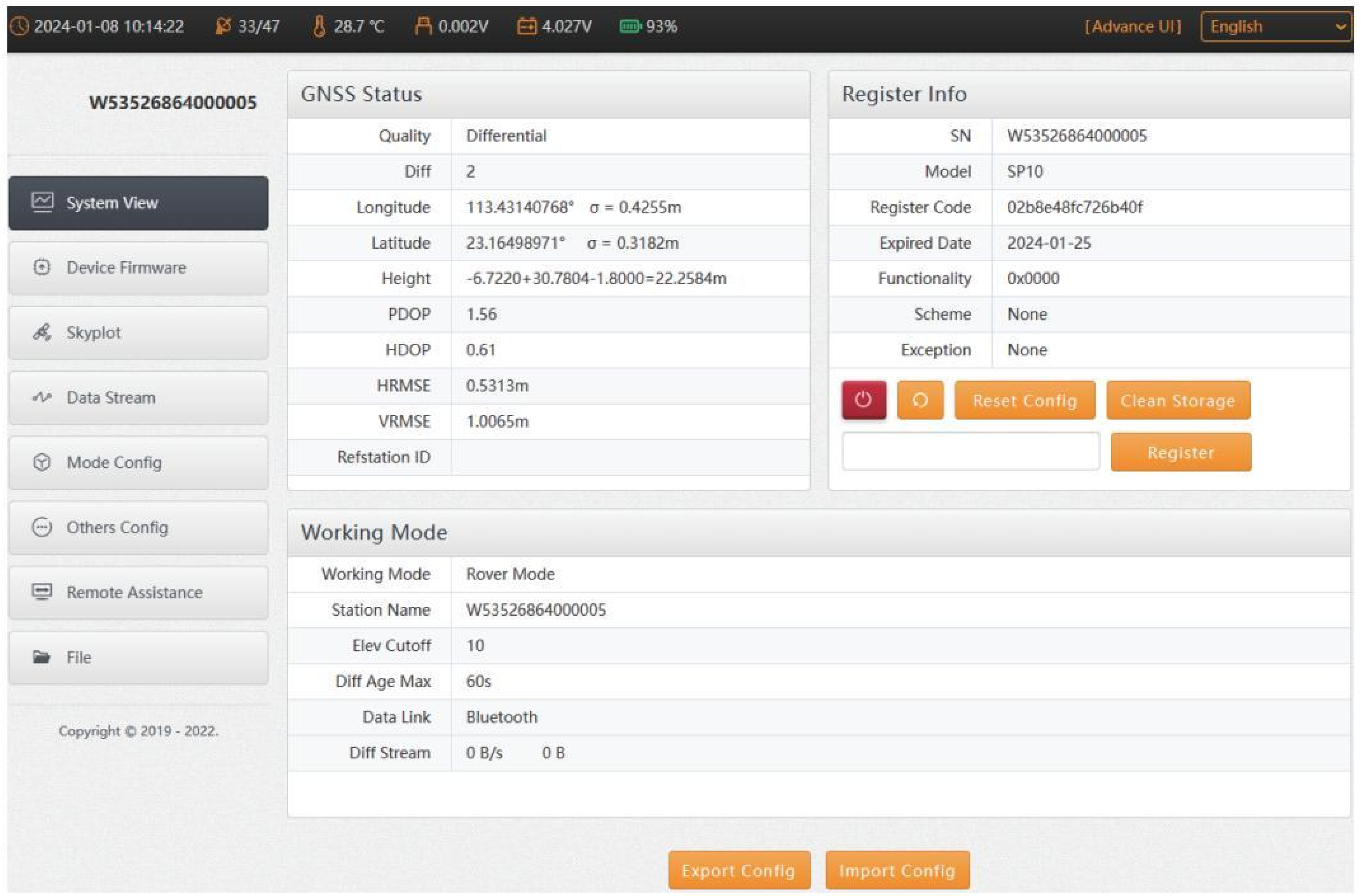


Figure 2.1

2.2 Device Firmware

1. Device Info: SN, Hardware, GNSS Type, GNSS Hardware;

2. System Version: System, GNSS Firmware, INS Firmware, Firmware.

Click Upgrade Firmware below to automatically identify and upgrade the positioning board firmware, tilt module firmware, and device firmware. There will be a prompt below during the upgrade process, and the device will restart after the upgrade is complete.

The operation steps are as follows:

a. Click [Local Upgrade];

b. Select the correct device firmware in the pop-up window, flash the firmware and wait for the device to restart;

c. After the restart is complete, the firmware upgrade is completed;

d. Reconnect the device WiFi, enter the webui, and check whether the firmware has been upgraded successfully.

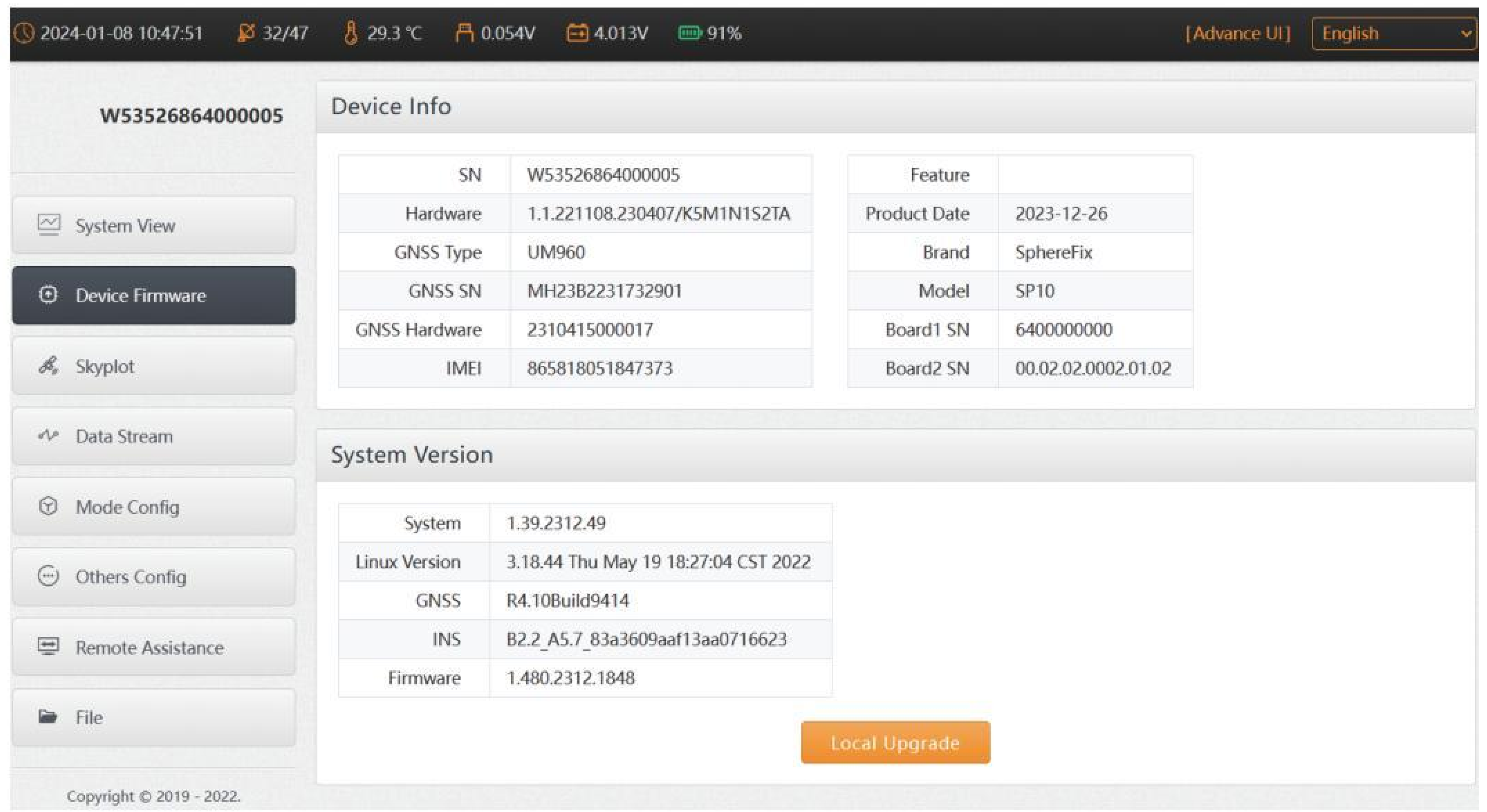


Figure 2.2

2.3 Skyplot

1. Skyplot: Trace, Name, Health, Elev, Azim;

Figure 2.3-1

2.GNSS System: Elev Cutoff, System, Table, Chart.

If it is found that the device receives fewer satellites under normal environment, you can enter this page to check whether all satellite systems have been turned on.

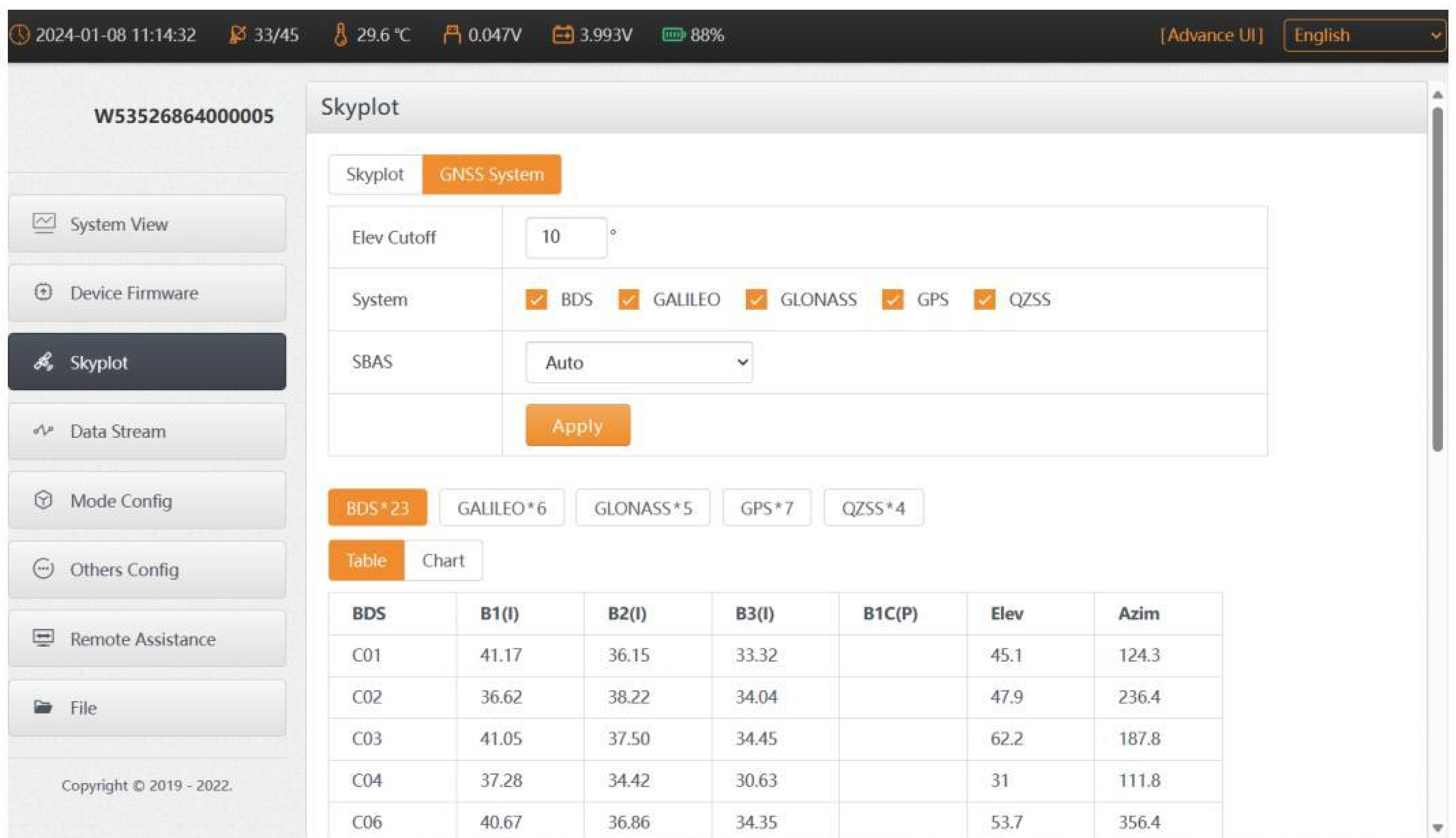


Figure 2.3-2

BDS*23 | GALILEO*6 | GLONASS*5 | GPS*7 | QZSS*4

Table | Chart

BDS	B1(I)	B2(I)	B3(I)	B1C(P)	Elev	Azim
C01	40.62	36.40	33.02		45.1	124.3
C02	36.20	38.64	33.92		47.9	236.4
C03	40.73	37.87	34.20		62.2	187.8
C04	36.87	34.63	30.01		31	111.8
C06	40.86	36.64	34.22		53.7	356.4
C07	38.17	37.97	34.72		43.3	182.3
C08	34.34	32.31	28.97		26.9	205.3
C09	38.95	35.51	32.06		46.9	328
C10	37.27	34.44	31.48		35.4	190.6
C13	36.97	32.09	29.96		31.6	217.6
C16	42.98	36.80	32.82		52.8	357.3
C21	46.30		39.40	47.11	63.6	300.1
C22	43.42		39.73	43.40	54.3	165.5

Figure 2.3-3

Figure 2.3-4

2.4 Data Stream

The data stream is mainly used to debug data information; you can view the current data status, as shown in the following below:

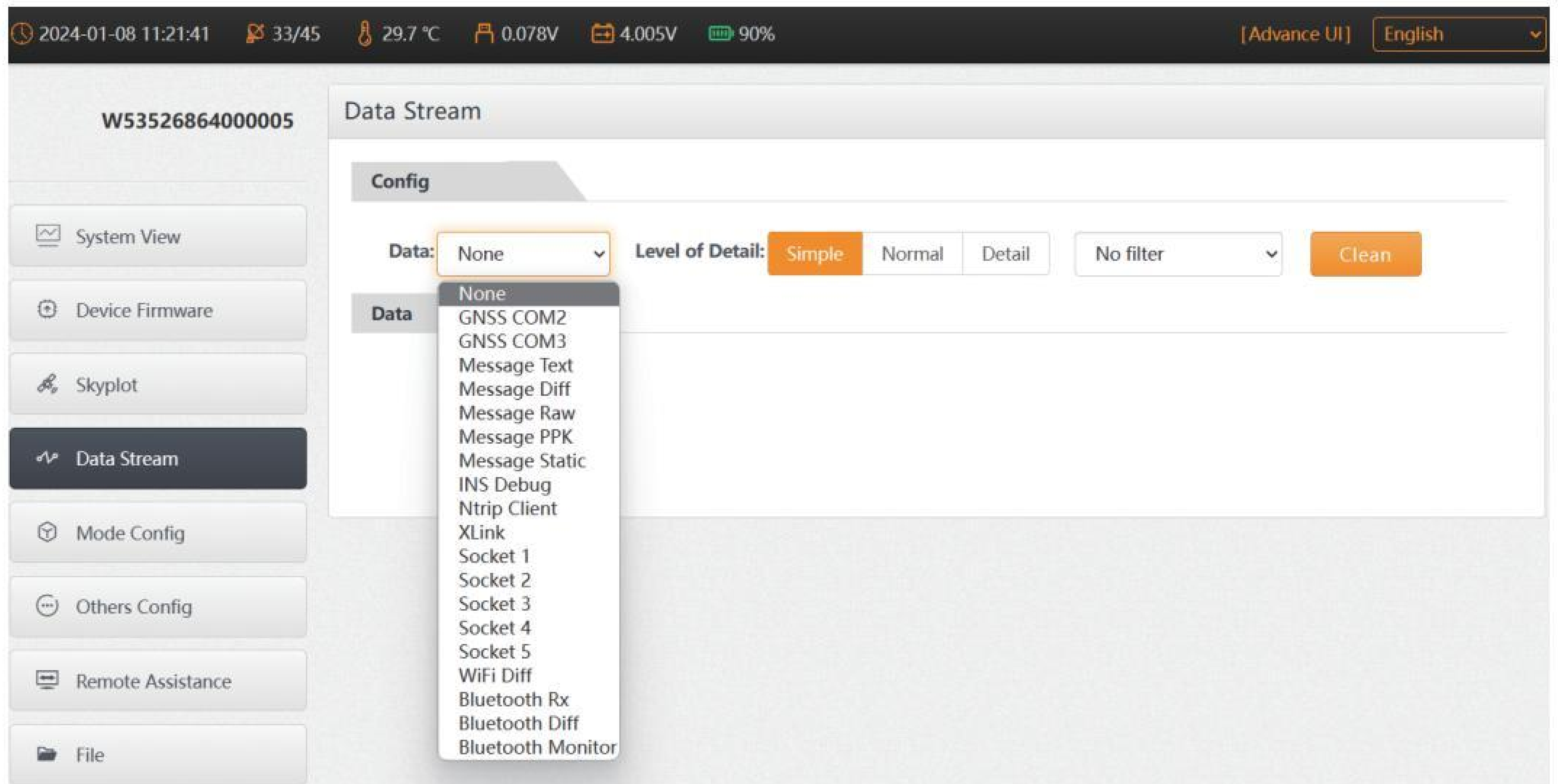


Figure 2.4-1

For example:

1. Message Text: see 3.9 in this section for the configuration of text data.

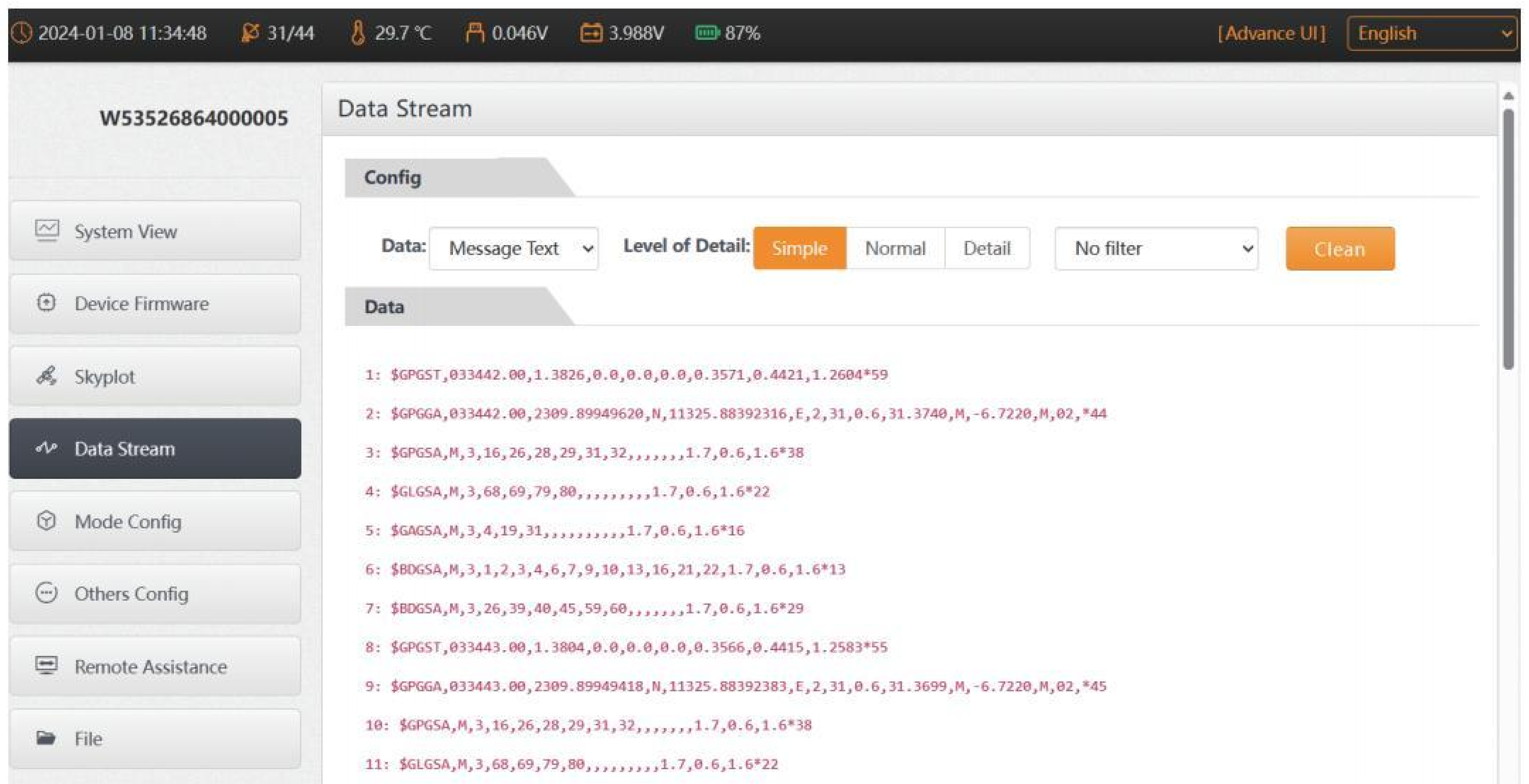


Figure 2.4-2

2. Message Raw

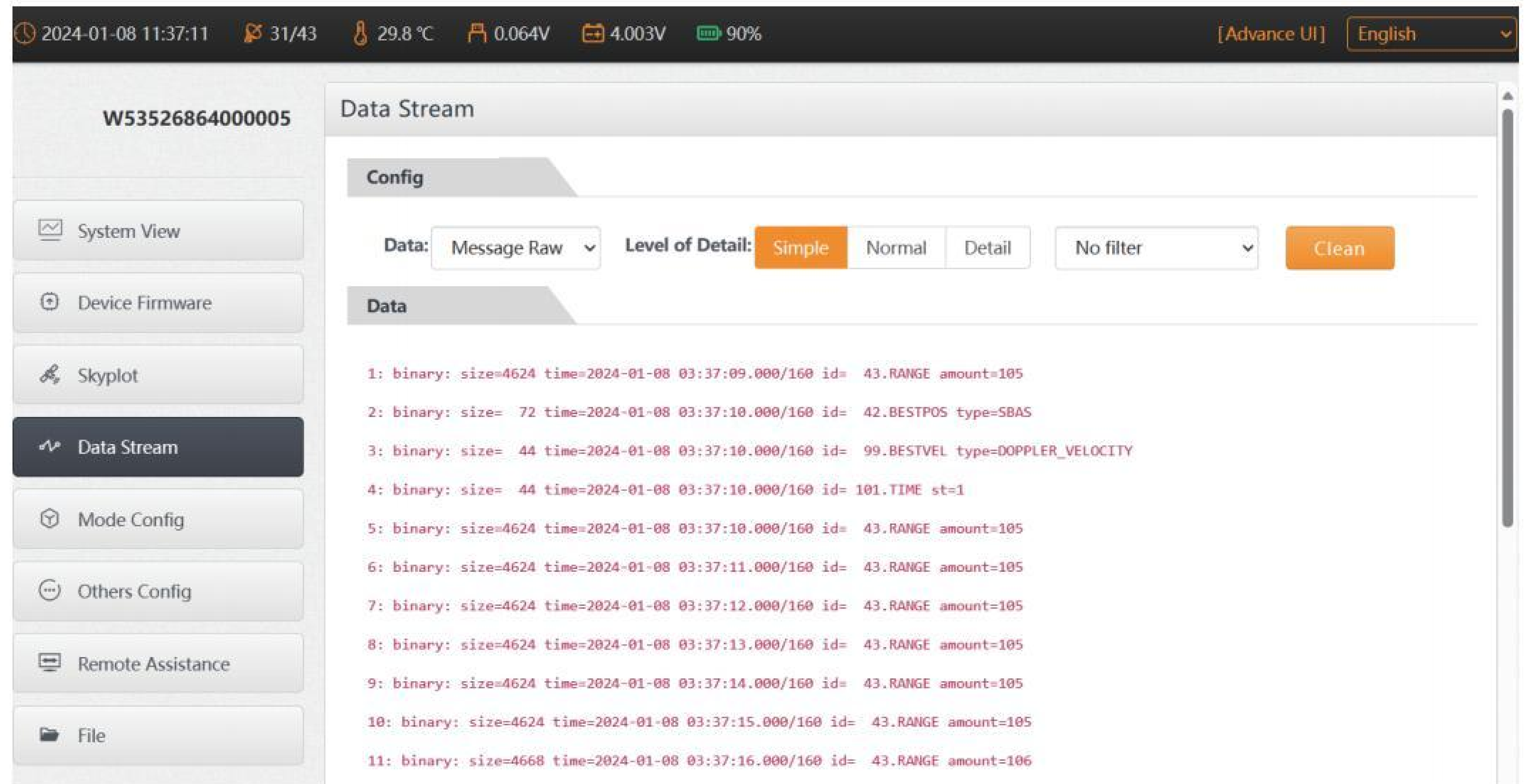


Figure 2.4-3

3. Message Diff: when the device is the base station, you can check whether there is differential data output here.

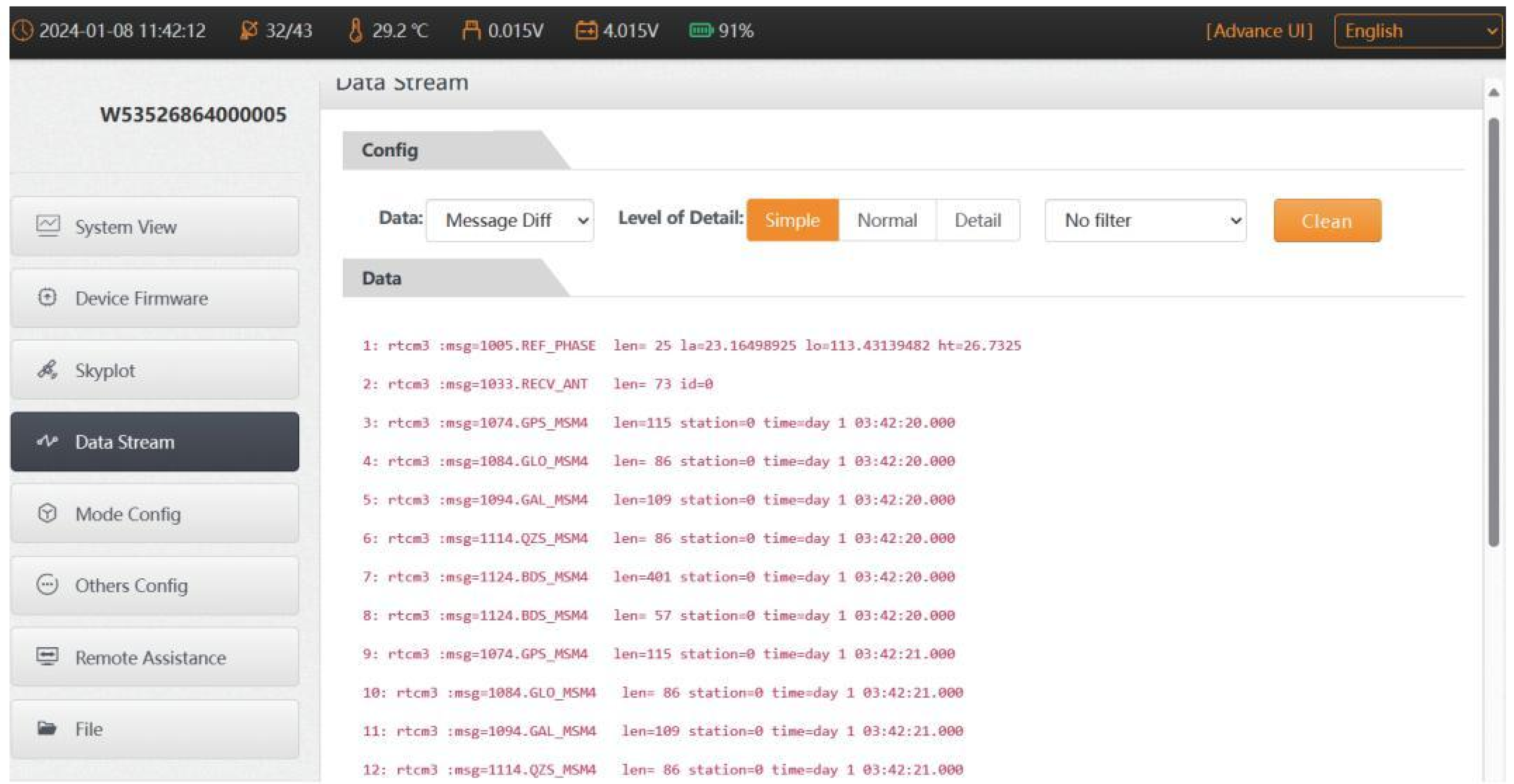


Figure 2.4-4

4. Message Static: When the device is static mode, you can check whether there is static data output here.

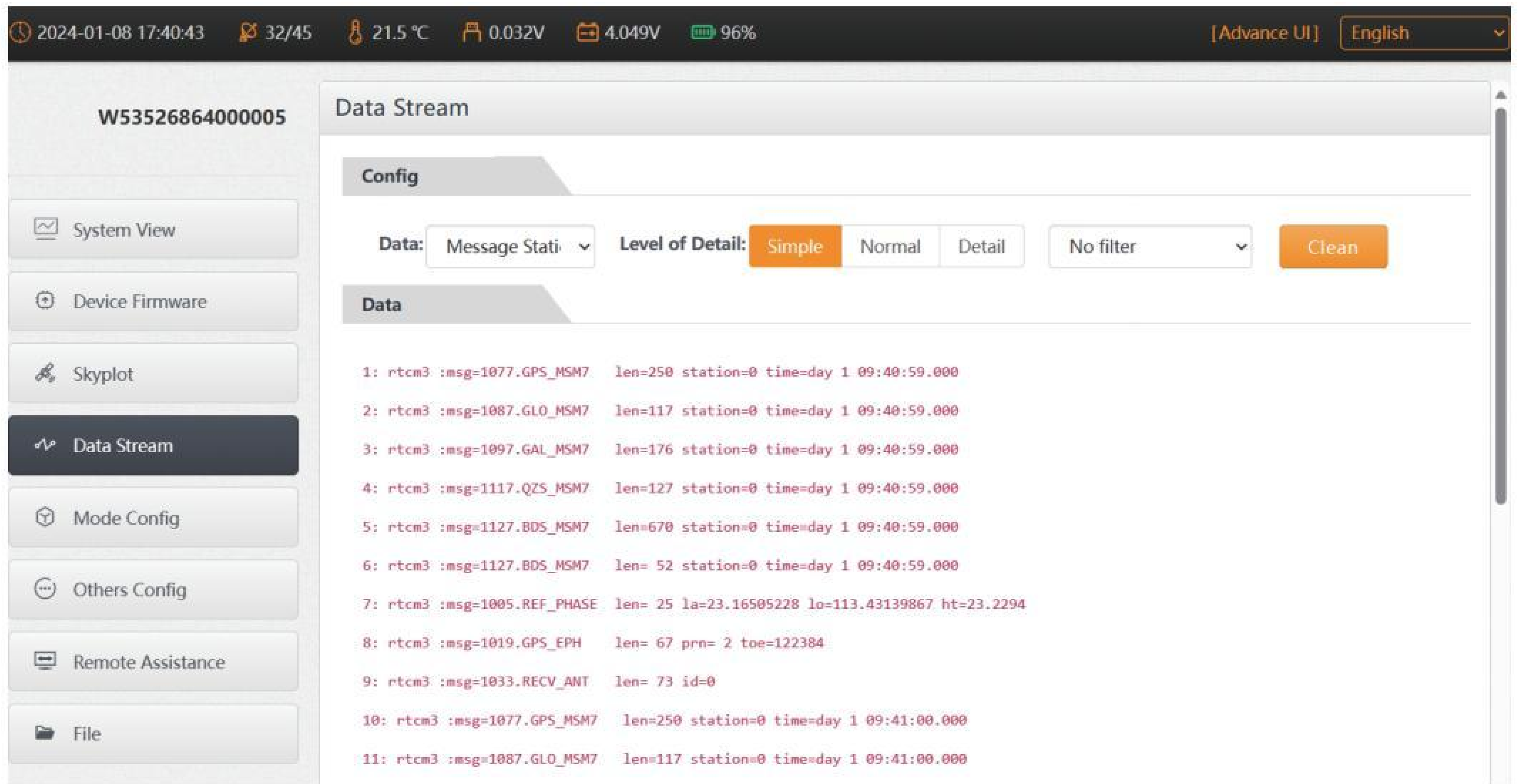


Figure 2.4-5

2.5 Mode Config

1. Working Mode: You can choose Rover Mode/ Base Mode/ Static Mode, and select the Elev Cutoff at the same time;

a. Rover Mode: the following parameters (Station Name, Elev Cutoff, Diff Age Max, Height Type, Antenna Height, Record, PPK) can be configured.

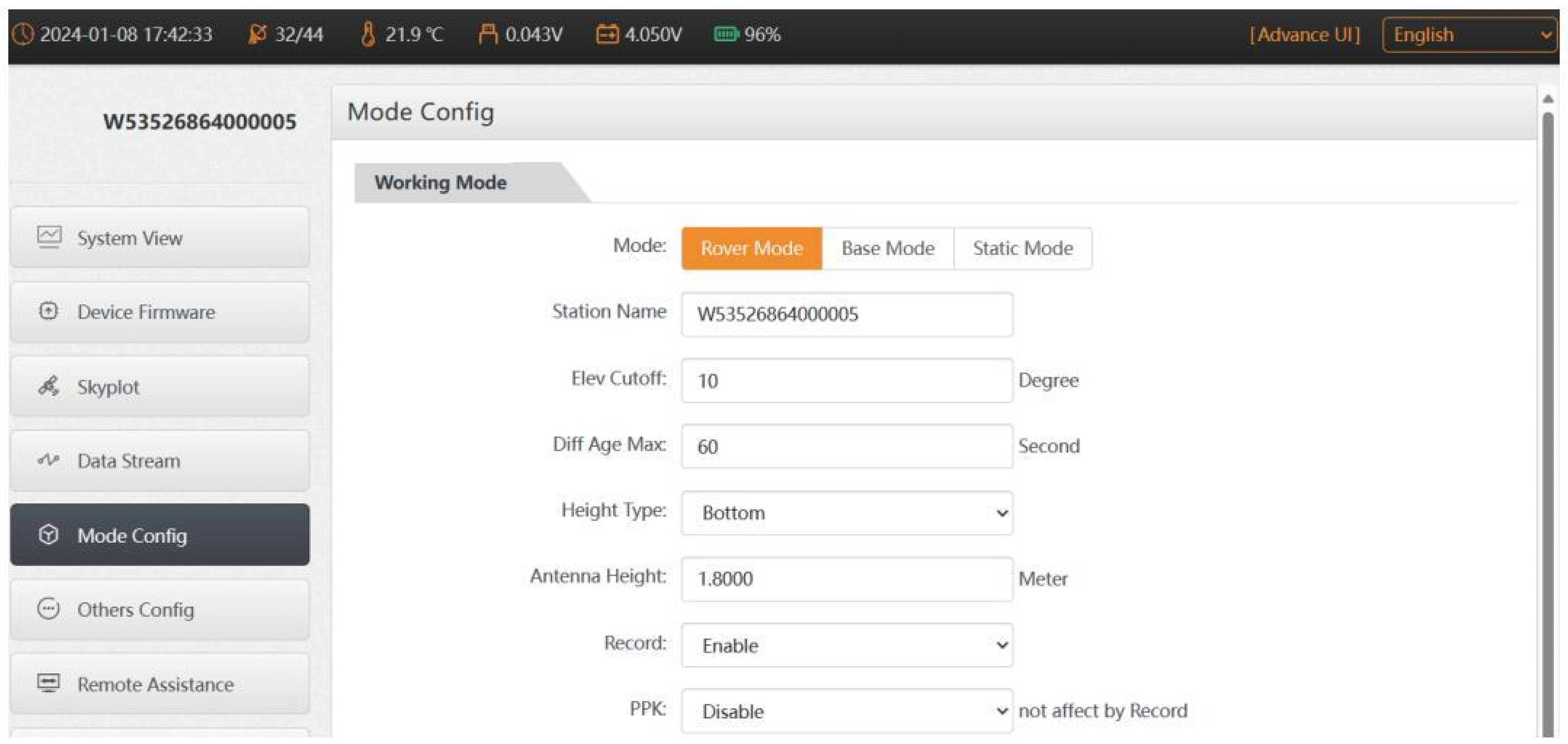


Figure 2.5-1

b. Base Mode: the following parameters (Station Name, Elev Cutoff, Station ID, PDOP Threshold, Diff Type, Base Mode, Height Type, Antenna Height, Record) can be configured.

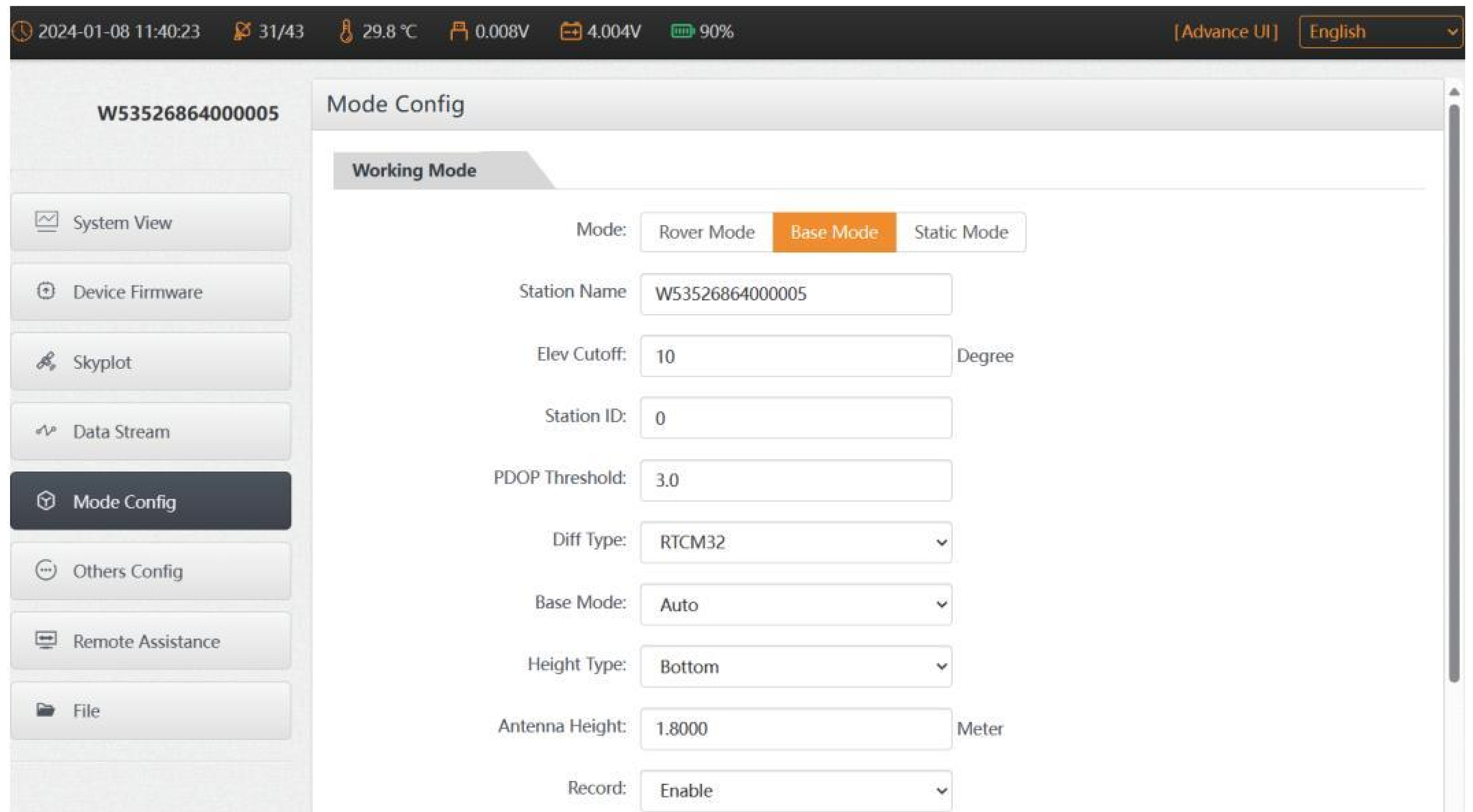


Figure 2.5-2

c. Static Mode: the following parameters (Station Name, Elev Cutoff, PDOP Threshold, Sample Interval, Height Type, Antenna Height, Record) can be configured.

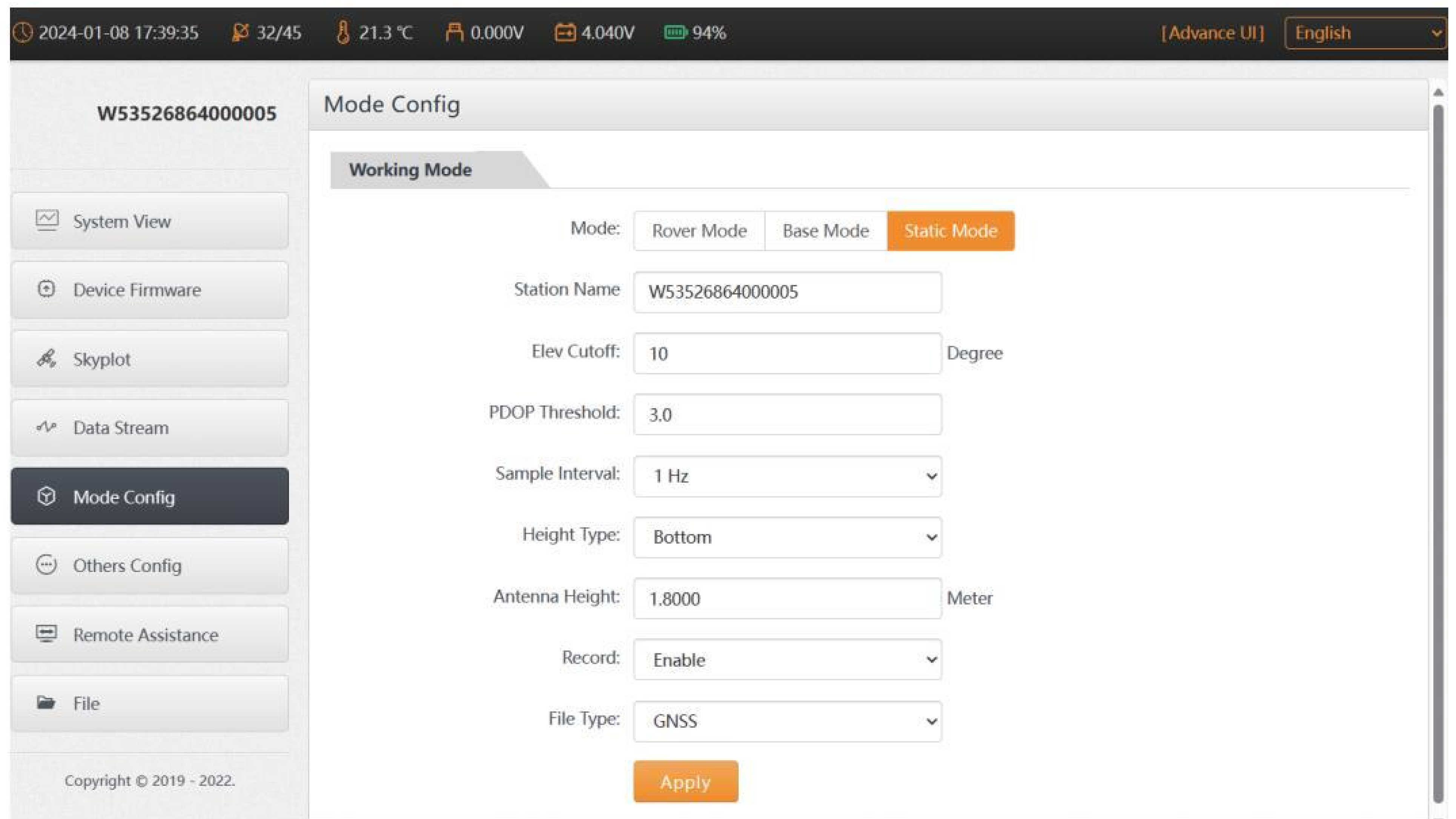


Figure 2.5-3

2.Data link: You can choose No Data link/ Bluetooth/ Wifi/ Built-in Network/ XLink.

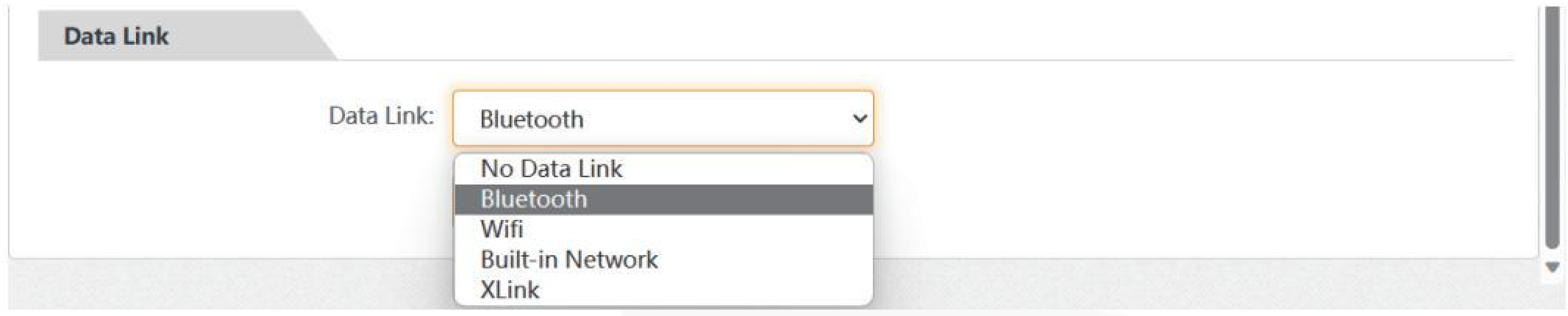


Figure 2.5-4

a. Bluetooth: the device obtains the differential data of SphereFix software accessed by the manual network through Bluetooth connection to the manual;

b. Built-in Network: the device receives or sends data through the built-in network. To select this data link, first insert the SIM card into the device;

2.6 Others Config

1.GNSS System: The small box behind a single point can turn on or off the corresponding satellite system;

2.WiFi: You can choose three types of Disable/AP/Station, and you can set the WiFi name and password by yourself;

Note: when the device WiFi is used as the Station, you can access the network by entering the name and password of the external hotspot.

3.Others: Time Zone.

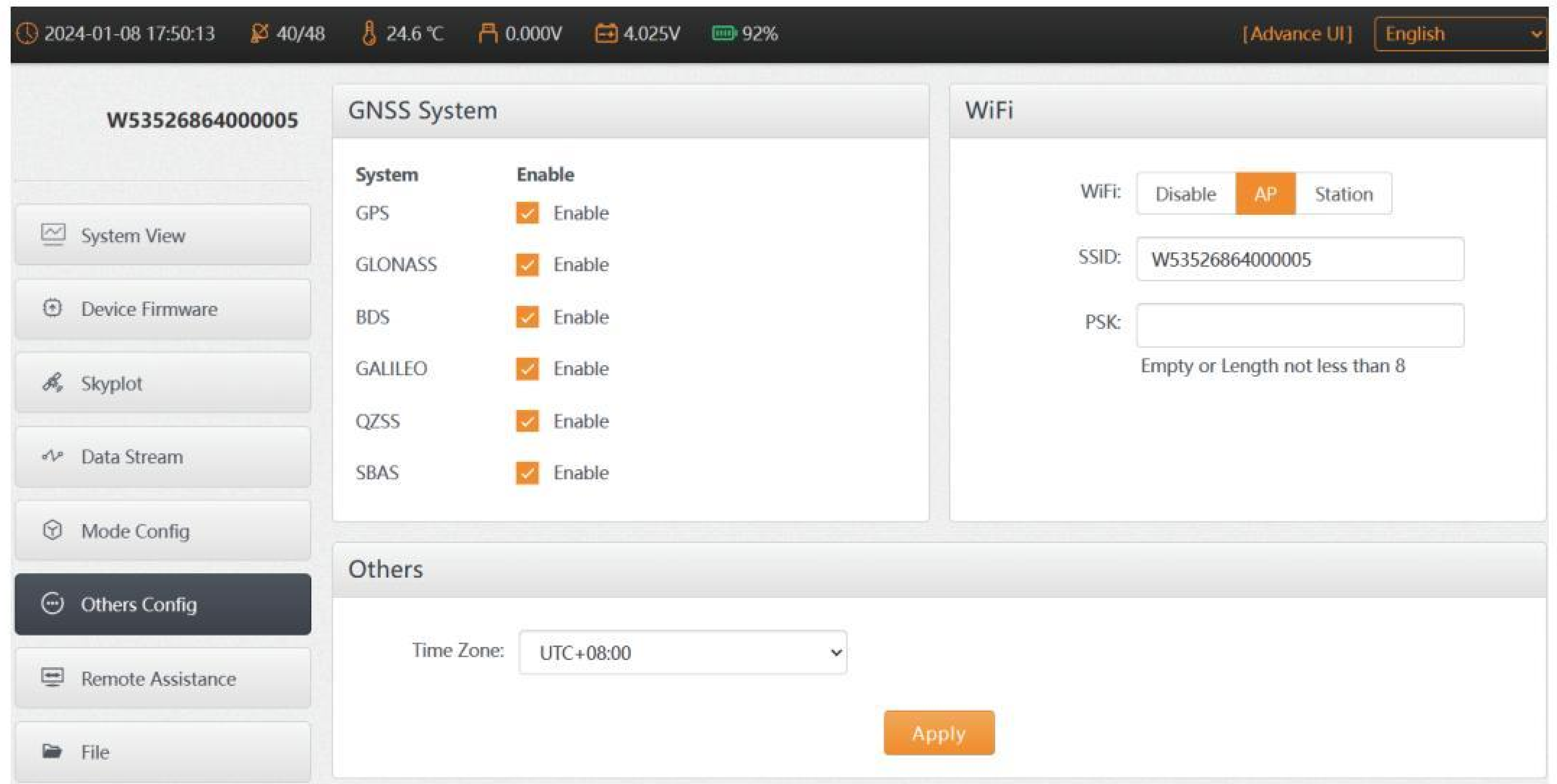


Figure 2.6-1

2.7 Remote Assistance

ZXVPN can provide a virtual LAN, connect the device to the server, and conduct WEBUI access in the background to provide corresponding remote technical support and services.The operation steps are as follows:

1. Insert the mobile network card into the device;
2. Open the mobile network and confirm that the mobile network is online;
3. Click [Use Default Value] to apply.

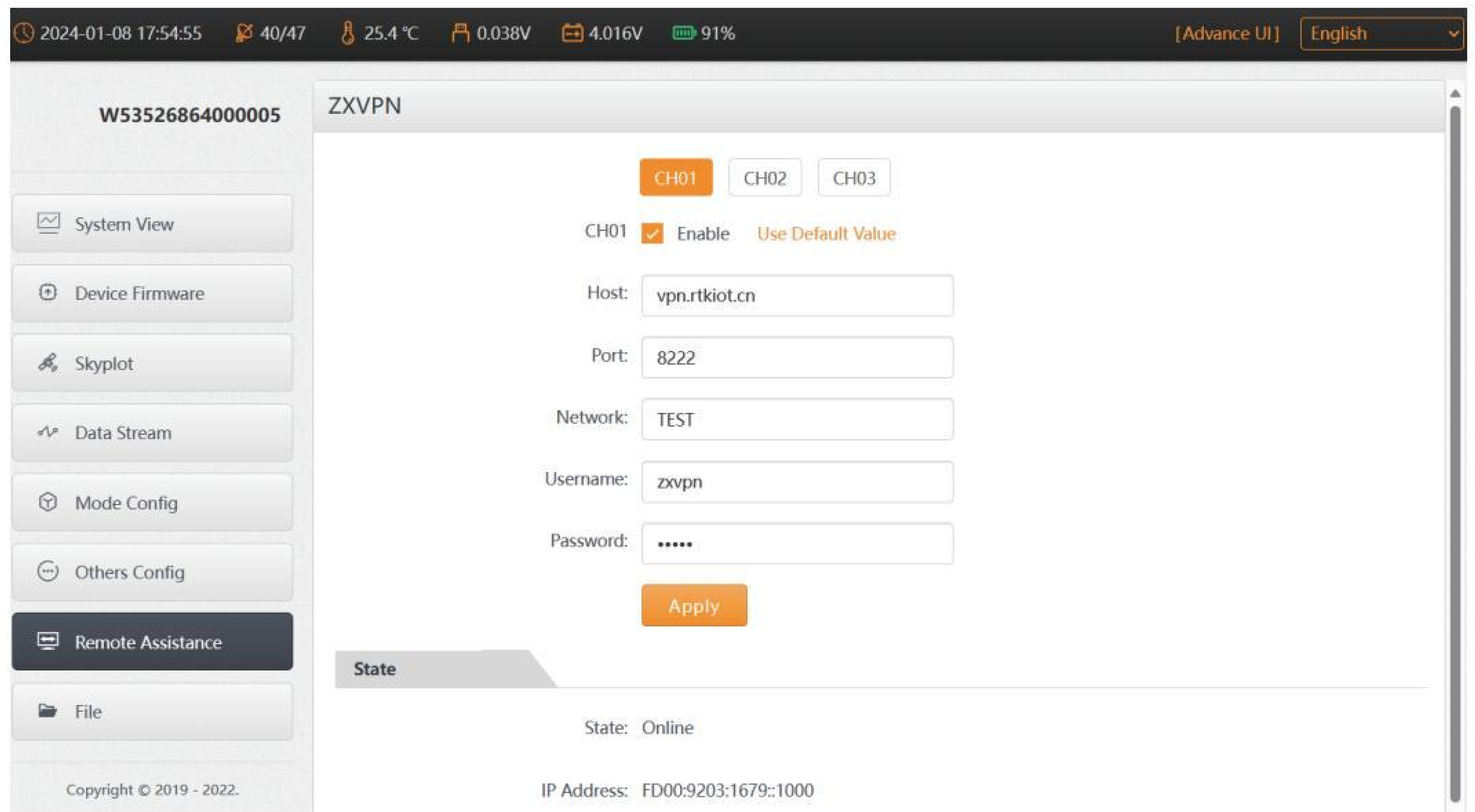


Figure 2.7-1

2.8 File

File management can delete and download data of each channel in batches , as shown below:

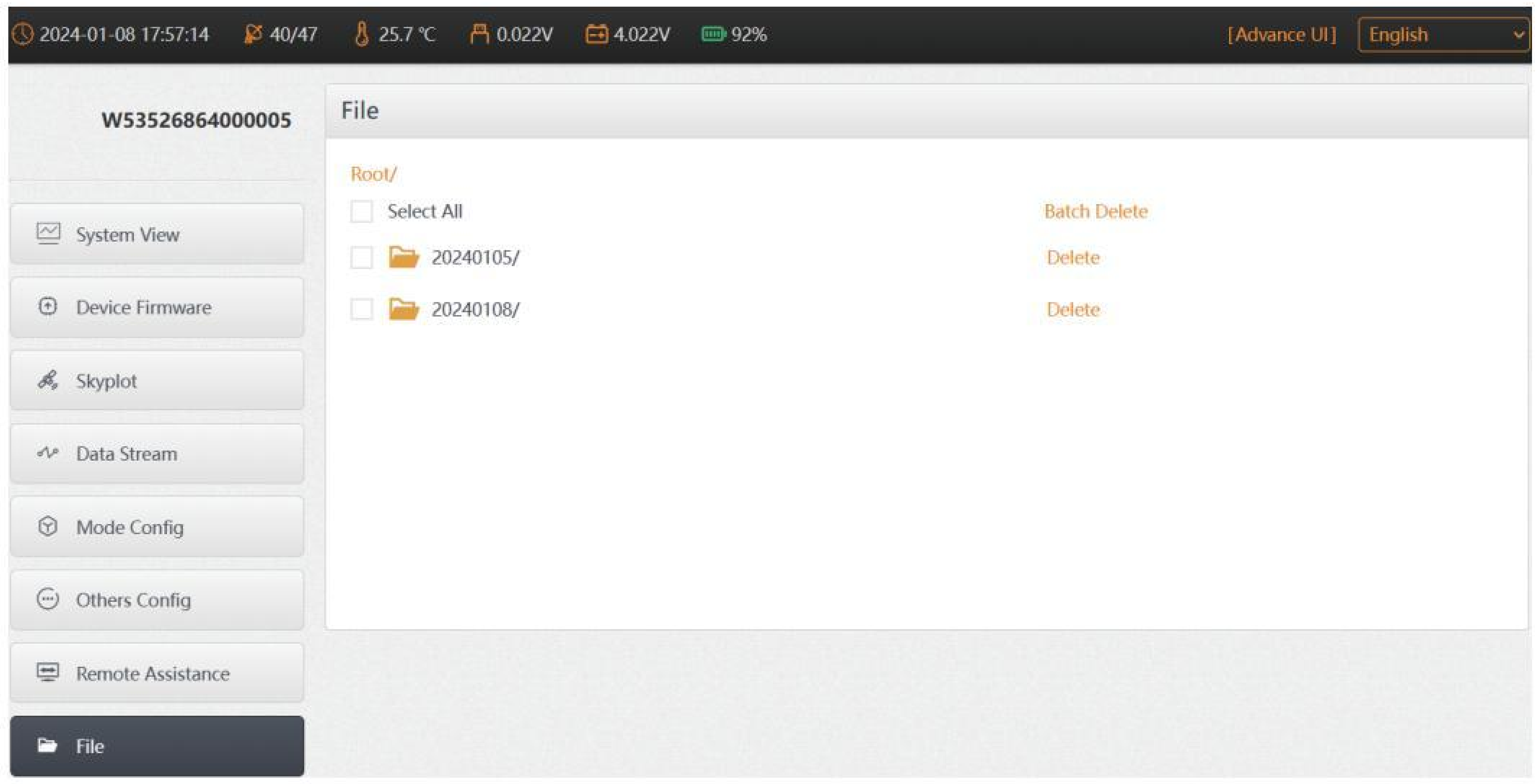


Figure 2.8-1

2.9 Log

It provides the download of the operation log of the device. When the device is abnormal during use, you can download the log generated at the corresponding time here to the supplier for troubleshooting. As shown below:

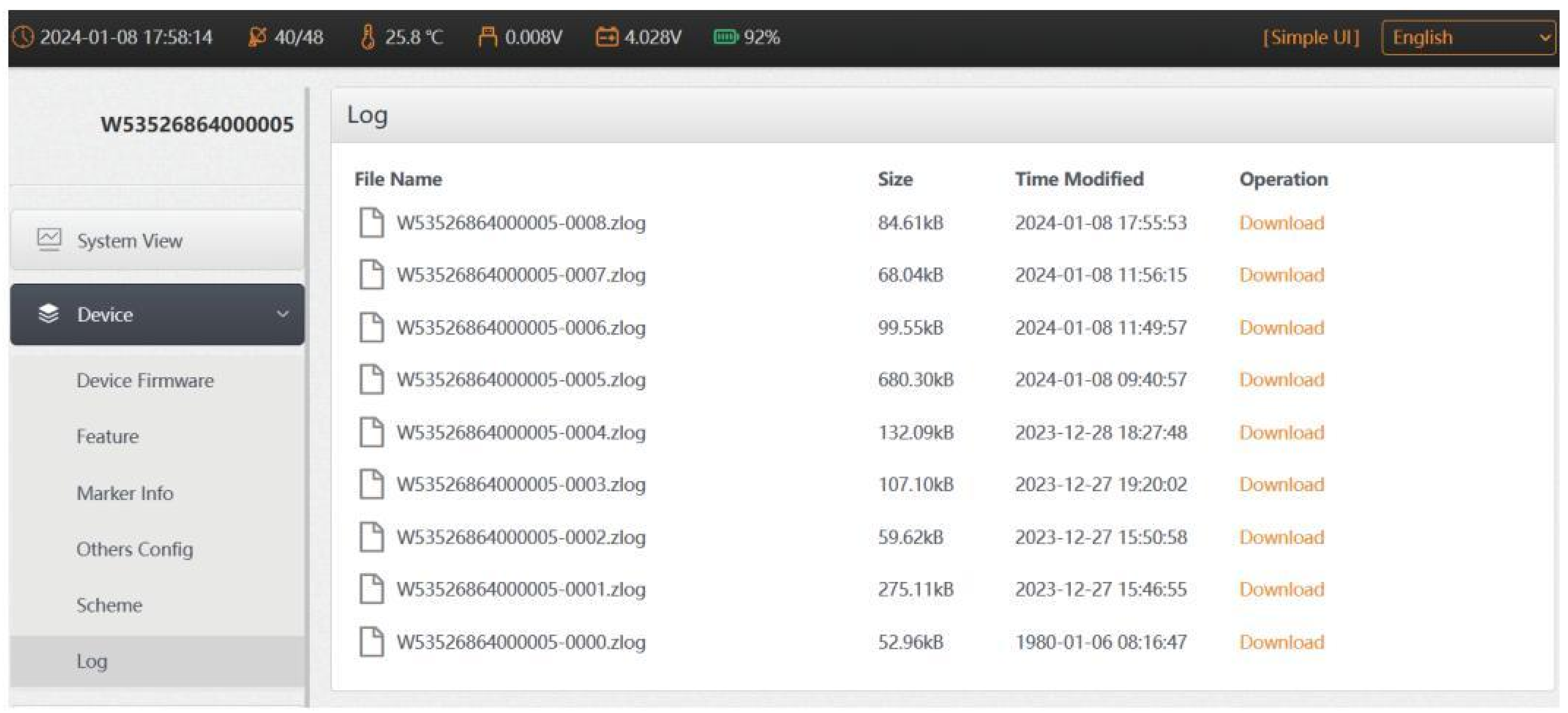


Figure 2.9-1

2.10 Message Text

You can set the type and frequency of output data in text format, as shown below. After configuration, you can check whether there is corresponding text data output in 3.4 of this section.

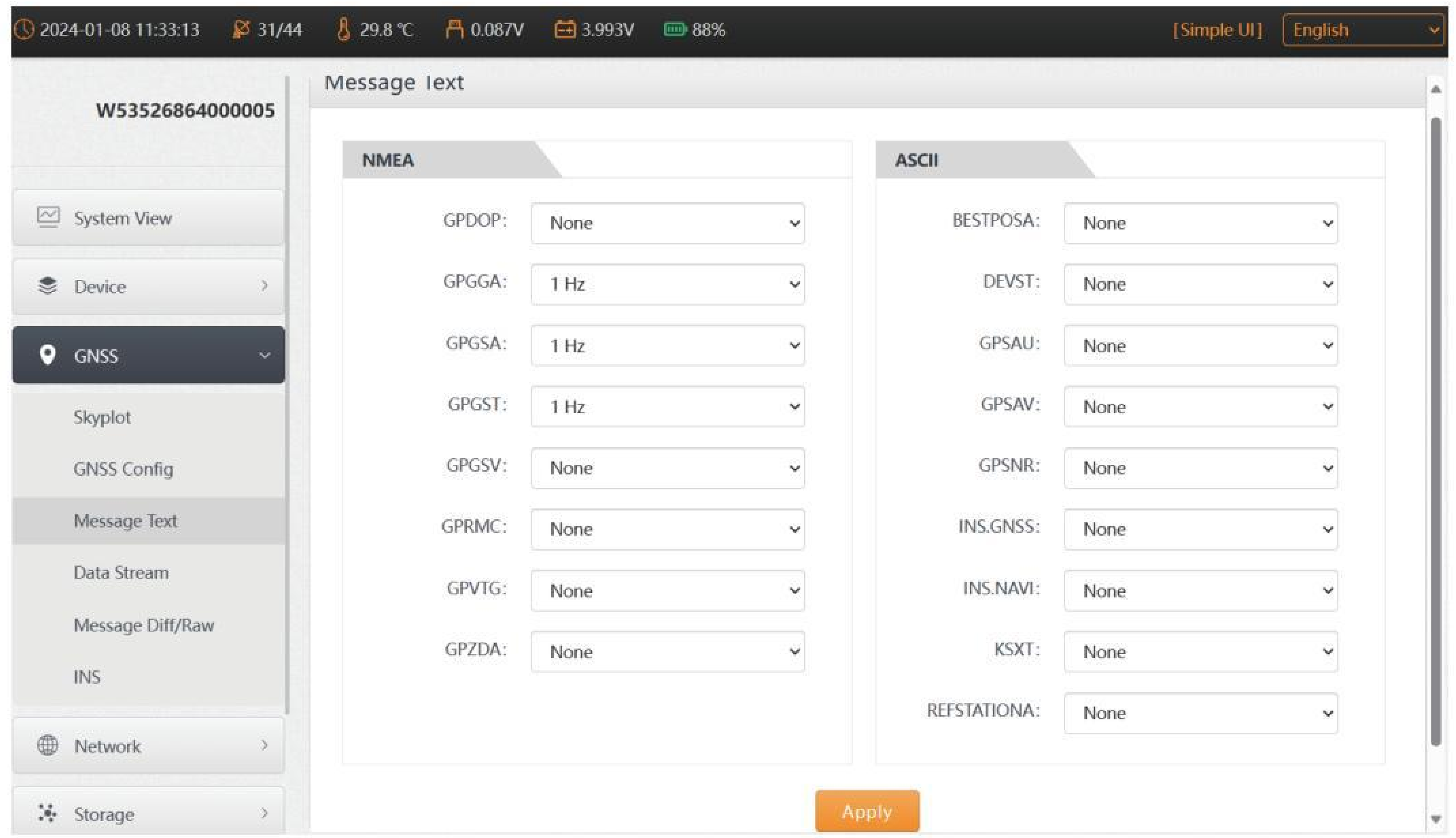


Figure 2.10-1

The following are the formats of several common message text:

GPGGA	$GPGGA,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,M,<10>,M,<11>,<12>*hh
<1>	UTC time, hhmmss (hour minute second) format, 8 hours different from Beijing time
<2>	Latitude ddmm.mmmm (degrees and minutes) format (the previous 0 will also be transmitted)
<3>	Latitude Hemisphere N (Northern Hemisphere) or S (Southern Hemisphere)
<4>	Longitude dddmm.mmmm (degrees and minutes) format (the previous 0 will also be transmitted)
<5>	Longitude Hemisphere E (East Longitude) or W (West Longitude)
<6>	GPS status: 0=no positioning, 1=single point positioning, 2=SBAS differential positioning, 4=RTK fixed solution, 5=RTK floating point solution, 6=inertial navigation positioning

<7>	The number of satellites (00~12) using the solution position (the previous 0 will also be transmitted)
<8>	HDOP horizontal precision factor (0.5~99.9)
<9>	Altitude (- 9999.9~99999.9)
<10>	Height of earth ellipsoid relative to geoid
<11>	Differential time (the number of seconds since the last differential signal was received. If it is not differential positioning, it will be null)
<12>	Differential station ID No. 0000~4095 (the previous 0 will also be transmitted, otherwise it will be null)

GPGSA	$GPGSA,<1>,<2>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<4>,<5>,<6>*hh
<1>	Mode, M=manual, A=automatic
<2>	Positioning type, 1=no positioning, 2=2D positioning, 3=3D positioning
<3>	PRN code (pseudo-random noise code), the satellite number (01~32, the previous 0 will also be transmitted) being used to calculate the position.
<4>	PDOP position precision factor (0.5~99.9). The spatial geometric intensity factor of satellite distribution. Generally, the better the satellite distribution is, the smaller the PDOP value is, which is generally less than 3.
<5>	HDOP horizontal precision factor (0.5~99.9)
<6>	VDOP vertical precision factor (0.5~99.9)

GPGSV	$GPGSV,<1>,<2>,<3>,<4>,<5>,<6>,<7>,...<4>,<5>,<6>,<7>*hh
<1>	Total number of GSV statements
<2>	Number of GSV in this sentence
<3>	Total number of visible satellites (00~12, the previous 0 will also be transmitted)
<4>	PRN code (pseudo-random noise code) (01~32, the previous 0 will also be transmitted), which can be understood as satellite number.
<5>	Satellite elevation (00~90 degrees, the front 0 will also be transmitted)
<6>	Satellite azimuth (000~359 degrees, the front 0 will also be transmitted)
<7>	Signal to noise ratio (00~99dB, empty when no satellite is tracked, and the previous 0 will also be transmitted), 50 is better.
Note: <4>,<5>,<6>,<7>information will be displayed circularly according to each satellite, and each GSV statement can display information of up to 4 satellites. Other satellite information will be output in the next sequence of NMEA0183 statements.	

2.11 Data Config

The device has 24G storage space (recyclable storage) and supports five channels (CH01/CH02/CH03/CH04/CH05) to save various files, as shown in the figure below. We can configure the data source, file period, file name and file format of each channel for storage as required.

Note: Do not change the mode after the device data configuration is completed, or the default storage configuration will be restored.

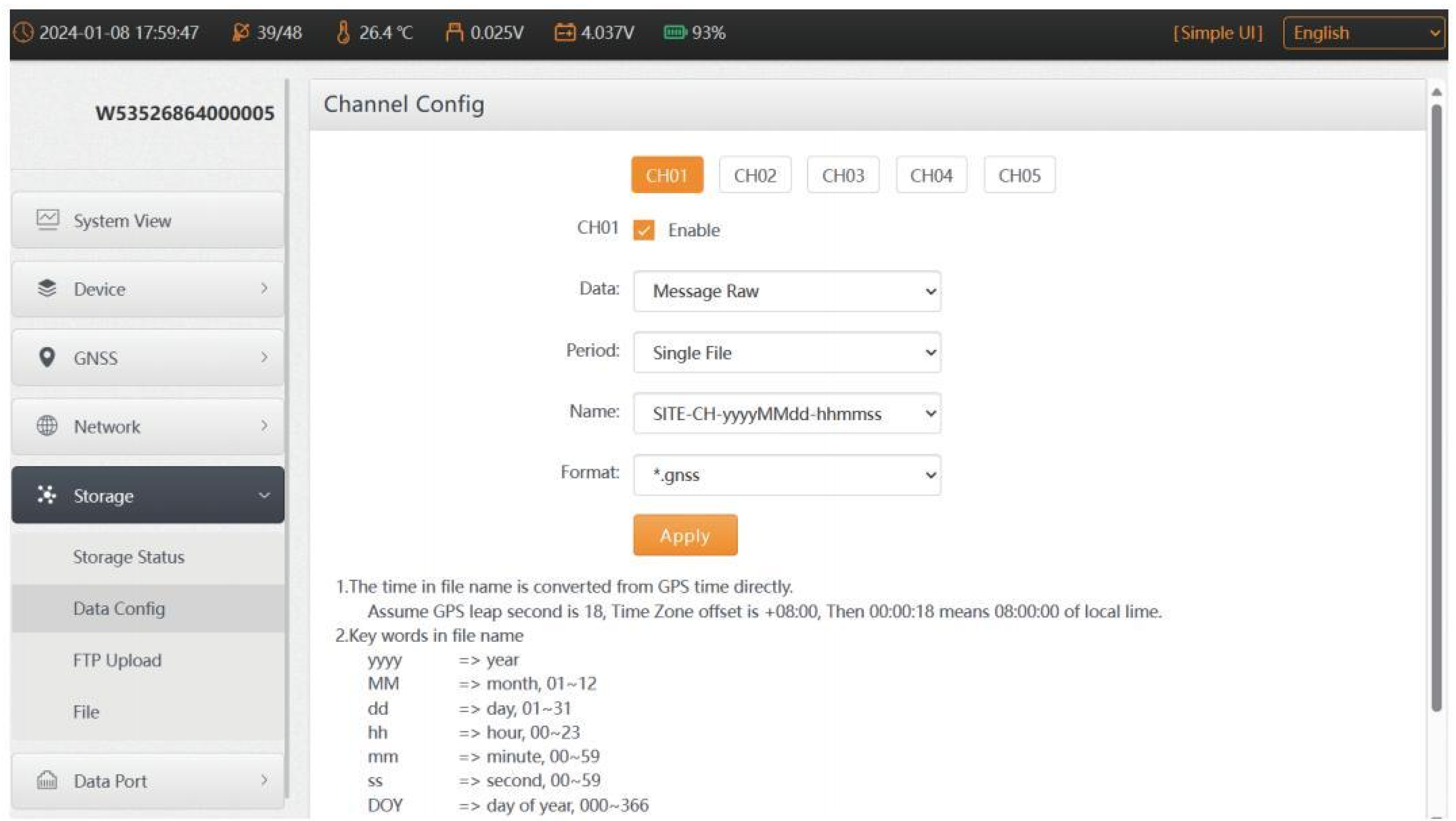


Figure 2.11-1

Data:

- None
- GNSS COM2
- Message Text
- Message Diff
- Message Raw
- Message PPK
- Message Static
- INS Debug
- Ntrip Client
- XLink
- Socket 1
- Socket 2
- Socket 3
- Socket 4
- Socket 5
- WiFi Diff
- Bluetooth Rx
- Bluetooth Diff
- Bluetooth Monitor

Period:

- Single File
- 1 hour
- 2 hours
- 3 hours
- 4 hours
- 6 hours
- 8 hours
- 12 hours
- 24 hours

Name:

- SN-CH-yyyyMMdd-hhmmss
- SN-yyyyMMdd-hhmmss
- SITE-SSSS-yyyyMMdd-hhmmss
- yyyyMMddhhmmss
- SSSSDOYX
- SITEDOYhhmm
- SITEDOYX
- SITEDOYXmm
- SITEDOYhh
- SITE-CH-yyyyMMdd-hhmmss

Format:

- *.gnss
- *.data
- *.txt
- *.dev
- RINEX2.10
- RINEX2.11
- RINEX3.02
- RINEX3.03
- RINEX3.04
- RINEX3.05
- RINEX3.05 (.D)
- RINEX3.05 (.gz)

File name naming rules :

1.The time in file name is converted from GPS time directly.	Assume GPS leap second is 18, Time Zone offset is +08:00, Then 00:00:18 means 08:00:00 of local lime.
2.Key words in file name	
yyyy	=> year
MM	=> month，01~12
dd	=> day，01~31
hh	=> hour，00~23
mm	=> minute，00~59
ss	=> second，00~59
DOY	=> day of year, 000~366
X	=> hour, a~x, 0 when one file per day
SN	=> Serial Number
SITE	=> Marker Name
SSSS	=> Marker Number

When the device is set to rover station, base station or static mode through the SphereFix software, the device will automatically configure the corresponding channel for data storage by default.

1. Rover (CH01)

When the device is set as a rover station through the SphereFix software, the device will automatically configure CH01 to store and locate the original data by default. If ppk is enabled, CH05 will also be automatically configured by default to store post positioning data, as shown in the following figure.

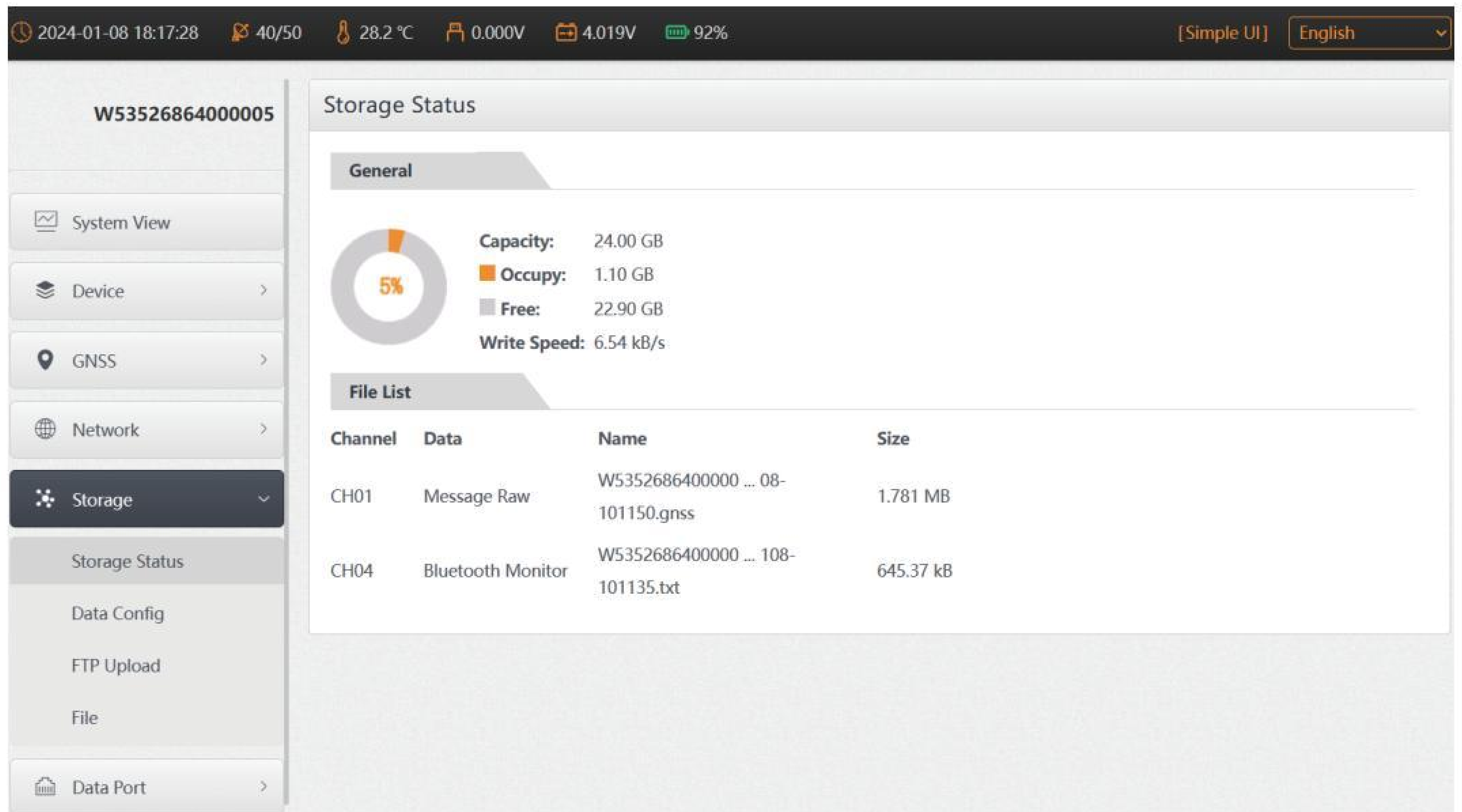


Figure 2.11-2

2. Base (CH02)

When the device is set as the reference station through the SphereFix software, the device will automatically configure CH02 to store and locate the original data by default. If ppk is enabled, CH05 will also be automatically configured by default to store location post-processing data, as shown in the following figure.

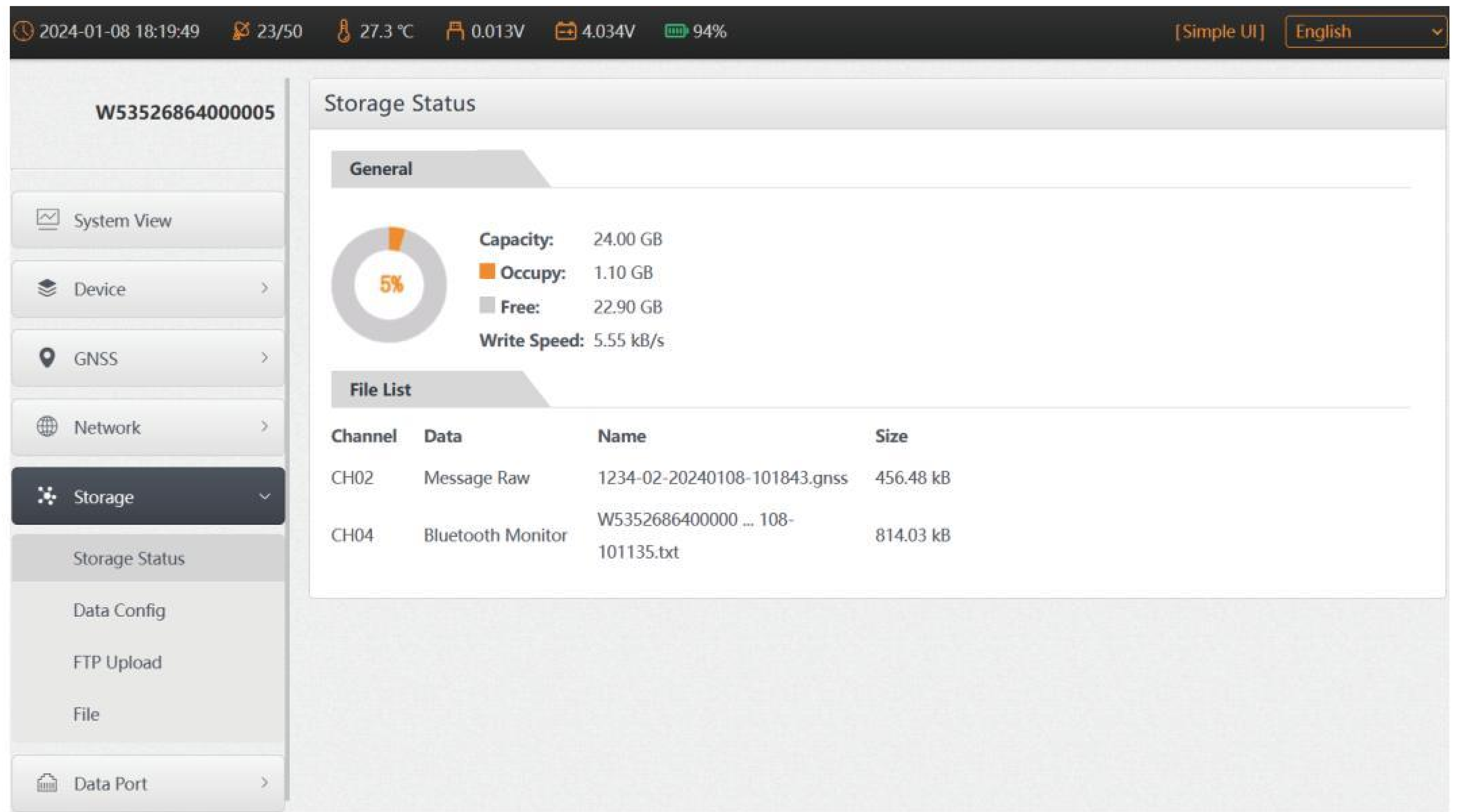


Figure 2.11-3

3. Static (CH03)

When the device is set to the static mode through the SphereFix software, the device will automatically configure CH03 to store static positioning data by default, as shown in the following figure.

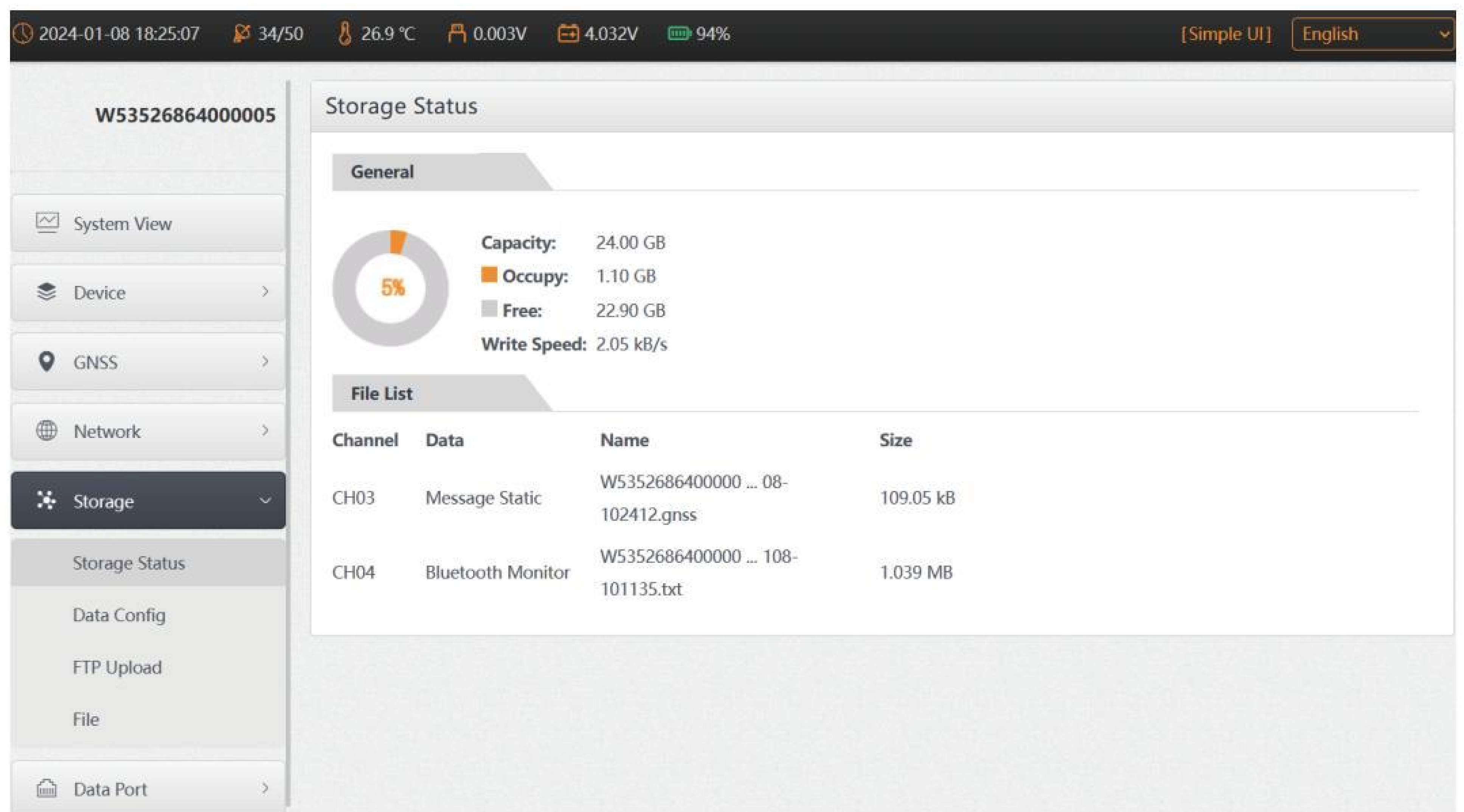


Figure 2.11-4

Note: Whenever the SphereFix software connects to the device through Bluetooth, the device will automatically configure CH04 to store Bluetooth monitor data. If there is any problem with the settings of the Bluetooth connection device, you can download the recorded Bluetooth monitor data for troubleshooting.

3. SphereFix Basic Operations

3.1 Installation

Installation:

1.Download the SphereFix software installation package (*.apk).

2.Copy the SphereFix apk to your mobile device (controller). In the file manager of the controller, locate the apk and click it to install. (Subsequent version updates support online upgrades; refer to the "About Software" section for details.)

3.Click the SphereFix on the desktop to launch the software. (For the first time, you need to create a project; subsequently, the software will automatically open the last used project each time it starts.)

3.2 Project Manager

Click "Project" -> "Project Manager", as shown in Figure 3.2-1. Project Manager includes functions such as creating a new project, importing a project, exporting a project, deleting a project, and opening a project.

Click "Project Path" to modify the project's path. The default path is in Internal Storage -> SphereFix -> Project directory.

Click "Details", as shown in Figure 3.2-2, to modify the project's basic information, coordinate system parameters, code management, and other essential attributes.

Click on "New", as illustrated in Figure 3.2-3. When creating a new project, fill in details such as the project name, whether to apply a template, and choose a code template. Click "OK." Then, input or modify the coordinate system parameters for the project, as shown in Figure 3.2-4, and click "OK" to complete the project creation.

Clicking other projects in the list will provide an option to open them, as seen in Figure 3.2-5. Long-pressing on a project in the list will reveal a delete option, as shown in Figure 3.2-6 (Note: You cannot delete a project that is currently in use).

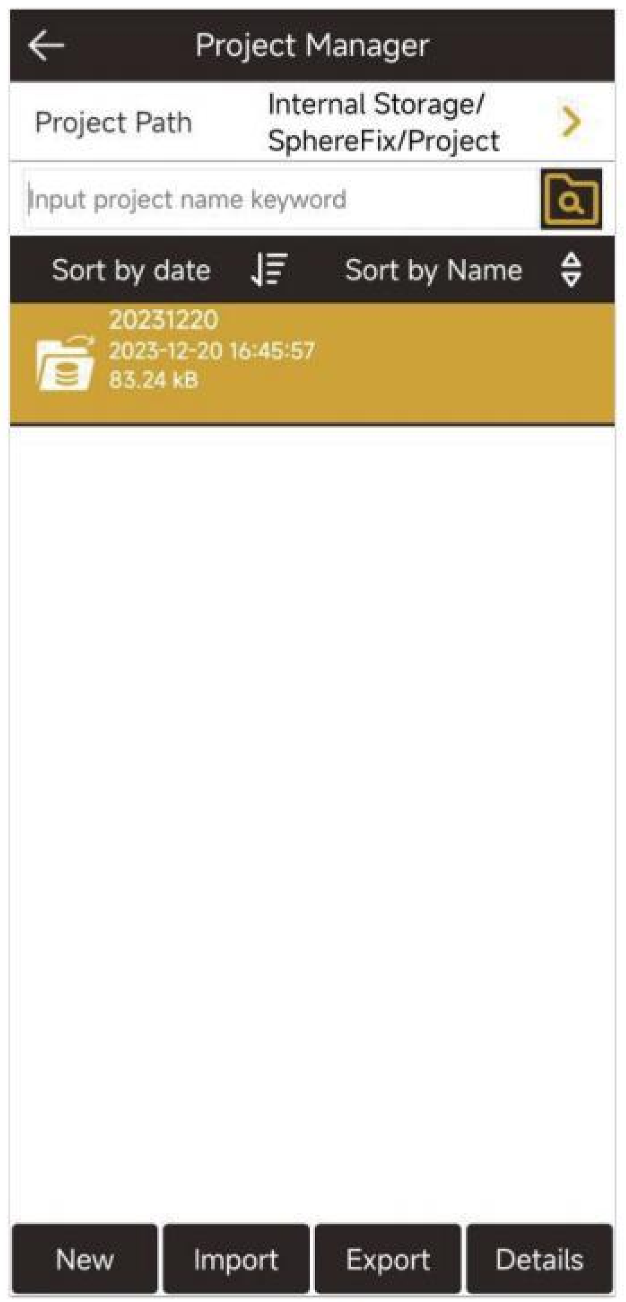


Figure 3.2-1

Figure 3.2-2

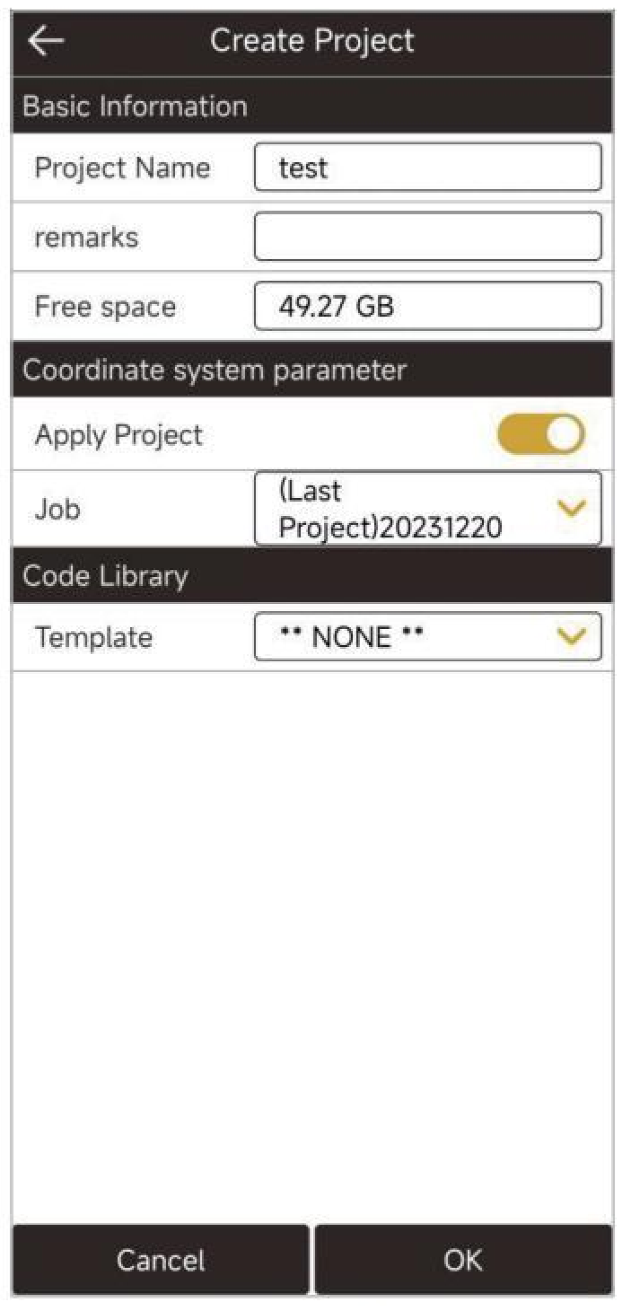


Figure 3.2-3

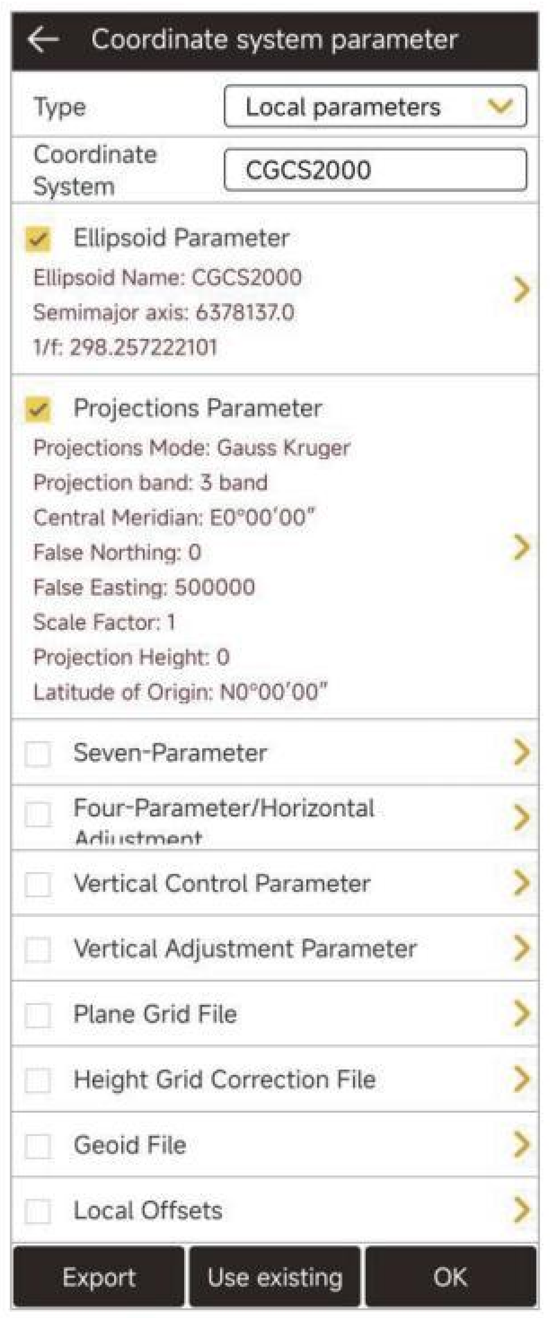


Figure 3.2-4

Figure 3.2-5

Figure 3.2-6

3.3 Communication

Click "Device" -> "Communication" to enter the communication settings, as shown in Figure 3.3-1. Select the instrument type ("SP10"), communication mode ("Bluetooth"), then click "Search," as shown in Figure 3.3-2, to view the Bluetooth device list. Select the corresponding device serial number, click "Connect" to complete the device connection, as shown in Figure 3.3-3 After successfully connecting the device, it will directly return to the menu, as shown in Figure 3.3-4. To re-enter communication settings, as shown in Figure 3.3-5, clicking "Stop" will disconnect the device connection. Clicking "Debug" allows you to view the data communication between the software and the device, as shown in Figure 3.3-6.

1. Communication modes include Bluetooth, Port, TCP client, etc；

2. Click "Search" to enter Bluetooth search and selection. Click on the corresponding device serial number to choose the device you want to connect to;

3. After successfully connecting the device, click "Debug" to view the data communication between the software and the device. You can also send debug commands to the device to troubleshoot and analyze location-related issues.

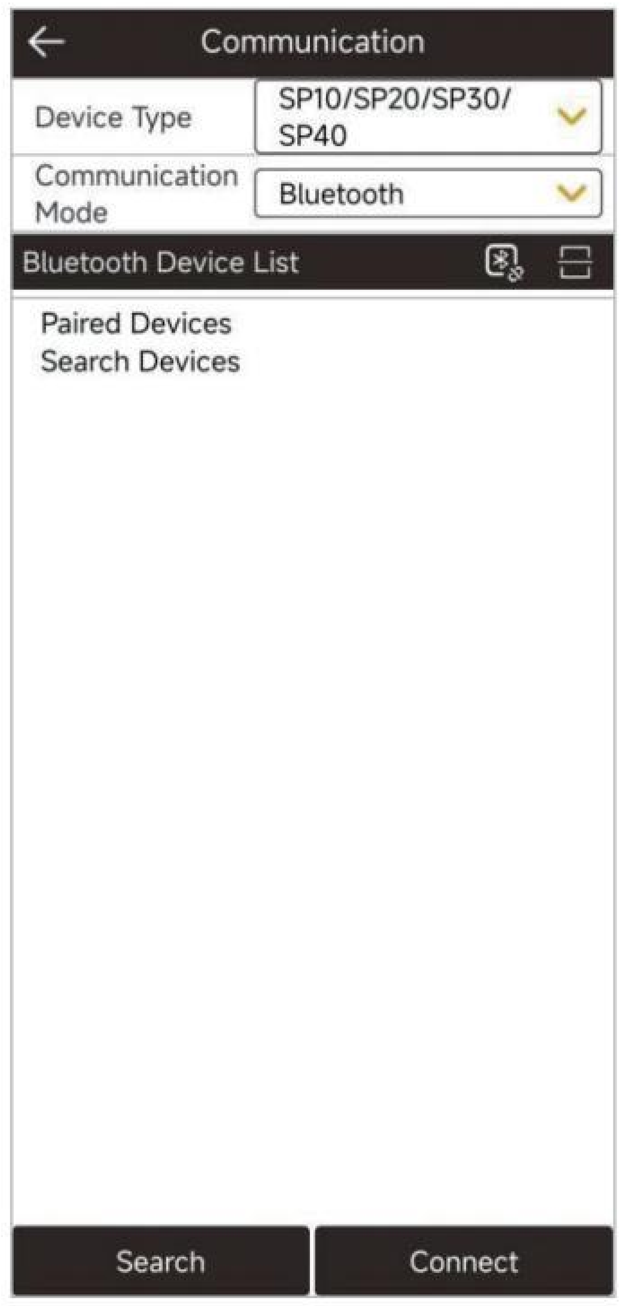


Figure 3.3-1

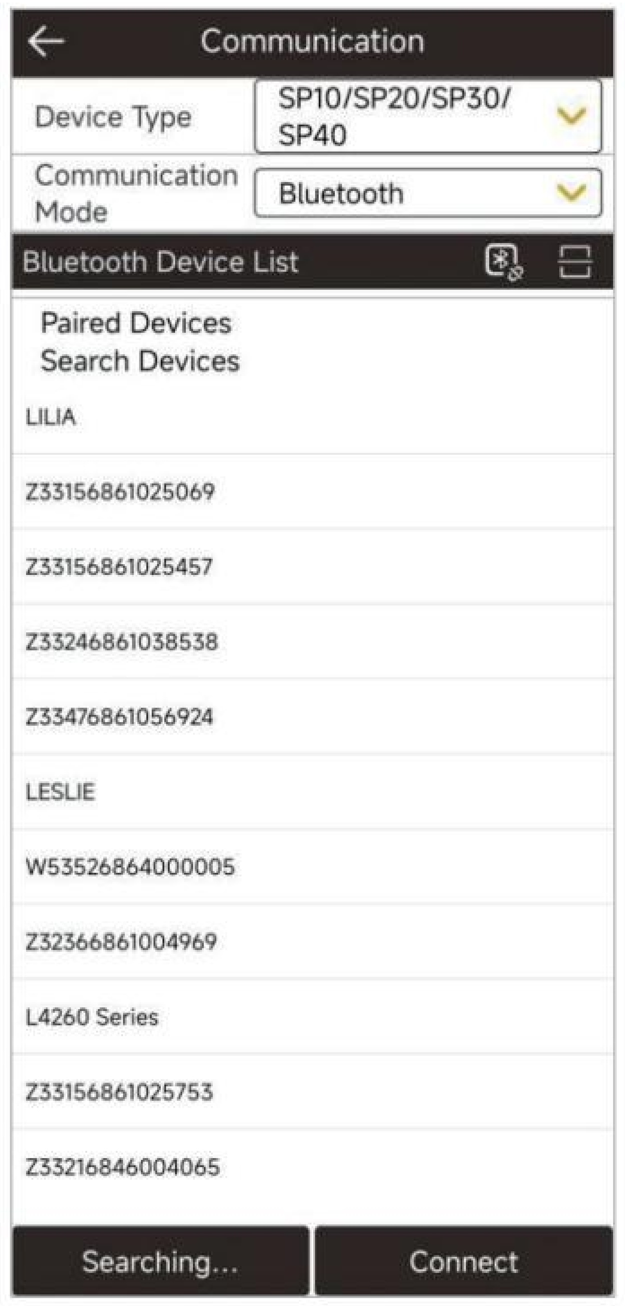


Figure 3.3-2

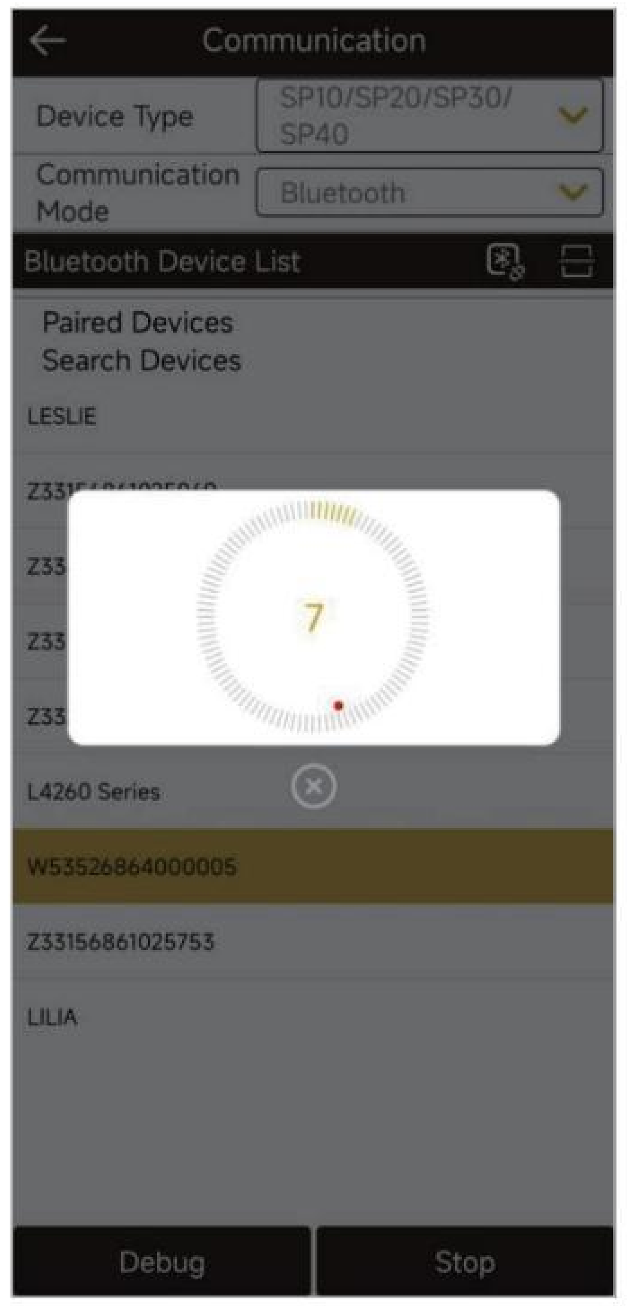


Figure 3.3-3

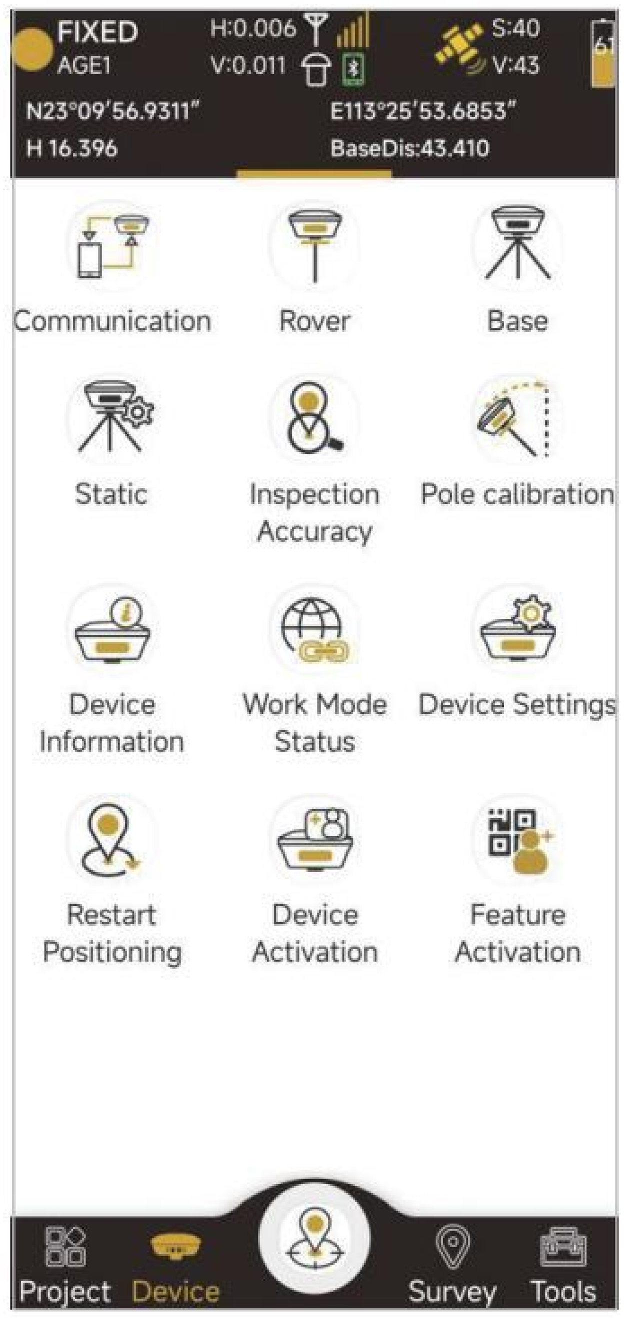


Figure 3.3-4

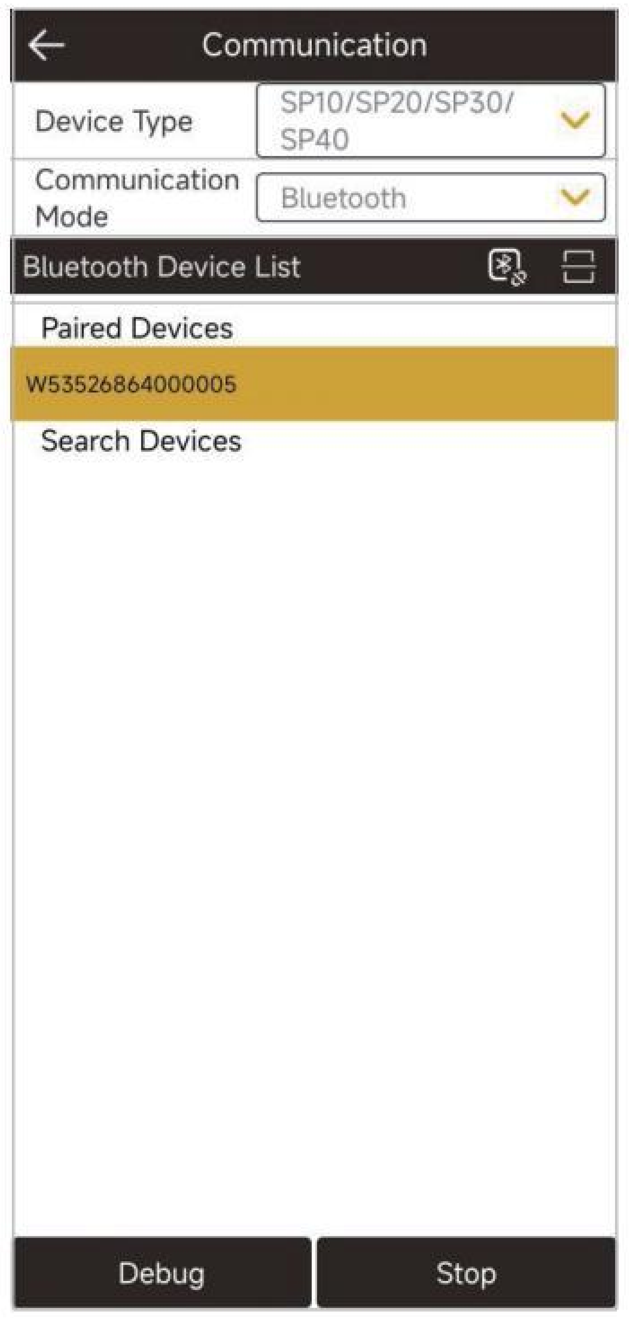


Figure 3.3-5

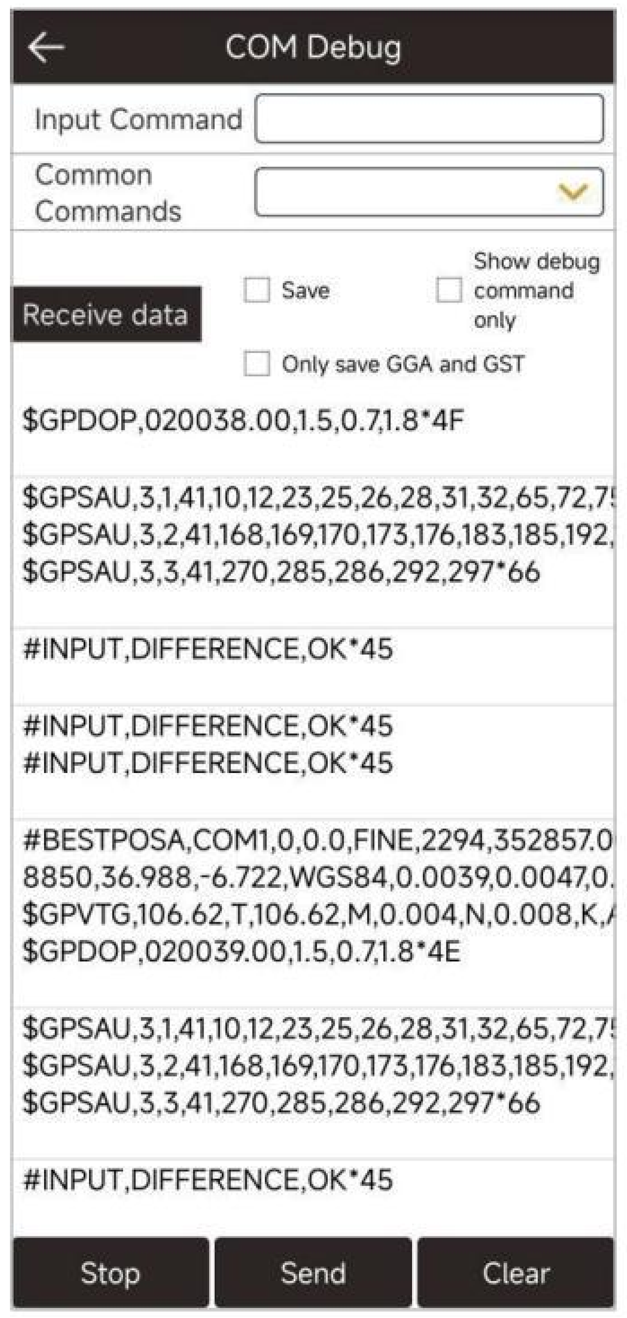


Figure 3.3-6

3.4 Rover

Click "Device" -> "Rover", as shown in Figure 3.4-1. GNSS positioning devices can calculate the position coordinates by receiving satellite signals, normally, due to atmospheric effects on signals, the positioning device can only obtain coordinates with a single-point solution, resulting in low accuracy. To ensure high-precision positioning with GNSS, in addition to the GNSS device itself receiving and calculating positions from satellite signals, it also needs to receive signals from another nearby fixed-position GNSS device. This second device's signal serves as the reference signal. Since the atmospheric effects on signals are generally consistent within a certain area, with the known coordinates of the reference signal, the two sets of GNSS can calculate high-precision positions. The GNSS device with a fixed position is called the reference station, while the one with a variable position is called the mobile station. The data transmitted from the reference station to the mobile station is referred to as differential data, and the data transmission method is known as a data link. The Mobile Station Mode setting configures the GNSS device as a mobile station, establishing certain parameters to transmit the reference station's GNSS satellite signals to the GNSS device through a specific method, allowing the GNSS device to achieve high-precision positioning.

In addition to configuring the differential data transmission, you can also set basic information for GNSS, such as the elevation cutoff angle, differential delay, and whether to enable PPK (Post-Processed Kinematics), as shown in Figure 3.4-1. Setting the elevation angle below a certain value will exclude the reception of satellite signals at low angles. In situations with poor signal quality at low angles, this can be beneficial for precision calculation. PPK parameters involve recording raw observational data from GNSS receivers and using post-processing algorithms to calculate high-precision coordinates.

Differential data parameter settings are primarily for configuring the transmission of differential data from the reference station to the current device through a specific method. This provides necessary conditions for the device to calculate high-precision coordinates. Data transmission methods mainly include Phone Internet, Device Internet and other options:

1. Phone Internet: As shown in Figure 3.4-1, it refers to obtaining differential data through the network of the device where the software is located. The data is acquired from a specified server address according to a certain protocol, and then transmitted to the device through the software's communication connection for high-precision calculation. Click the at the right of CORS setting to enter CORS settings, as indicated in Figure 3.4-2. Here, you can directly select, edit, or delete existing CORS servers, or manually add CORS server, as shown in Figure 3.4-3.

After correctly configuring the server address, retrieve the mount point list, as shown in Figure 3.4-4, and select the corresponding Mount point to obtain differential data. Click "Start," and if the configuration is correct, the data reception progress bar will start moving. If the progress bar shows no data, check whether the configuration is correct.

2. Device Internet: As shown in Figure 3.4-5, it refers to obtaining differential data through the SIM card network of the GNSS device. This is done according to a certain protocol from a specified server address for high-precision calculation. The connection mode involves the transfer protocol for differential data, typically using NRTIP, TCP client, etc. Enter server IP, port, username, and password. The SIM network is a dedicated network, and APN parameters need to be configured, as shown in Figure 3.4-6. CORS settings are similar to Phone Internet settings. After correctly configuring the server address, retrieve the mount point list and select the corresponding mount point to obtain differential data. Mount points can be obtained through the device network, or if a mobile phone has a network, it can also be obtained through the corresponding network of the mobile phone.

Note: Every data link has the baseline coordinate change prompt enabled by default. This is because receiving incorrect base station signals may lead to inaccurate coordinates, and it is recommended to check and confirm.

Figure 3.4-1

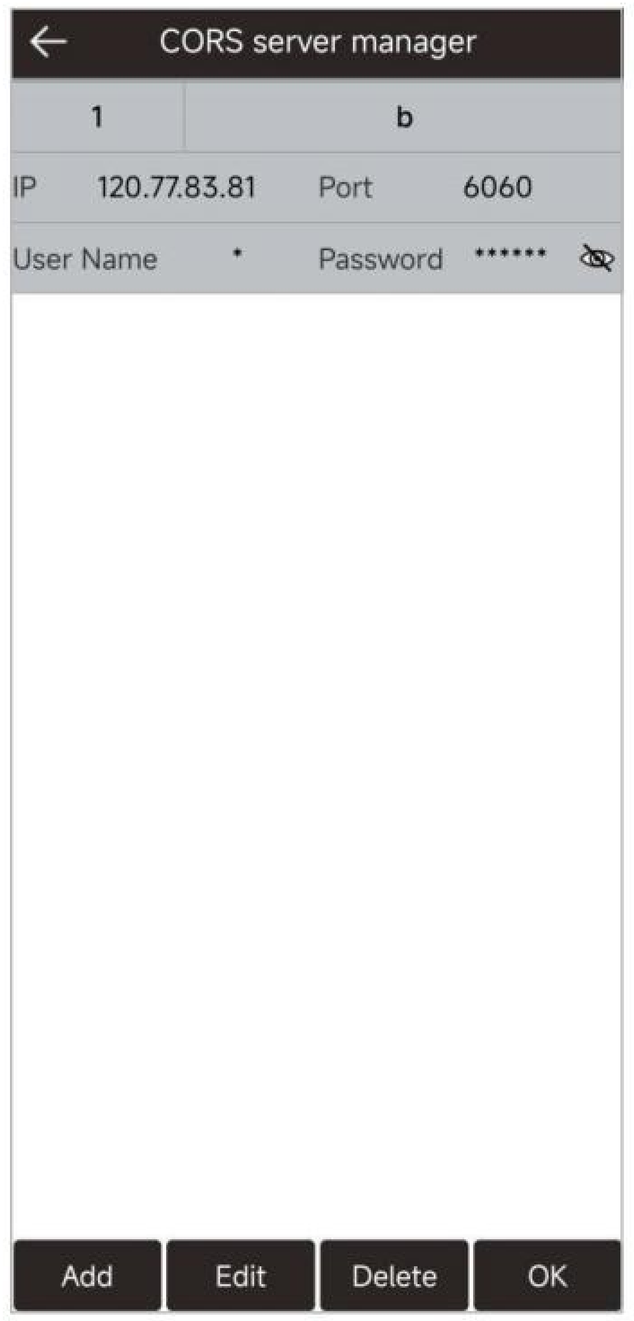


Figure 3.4-2

Figure 3.4-3

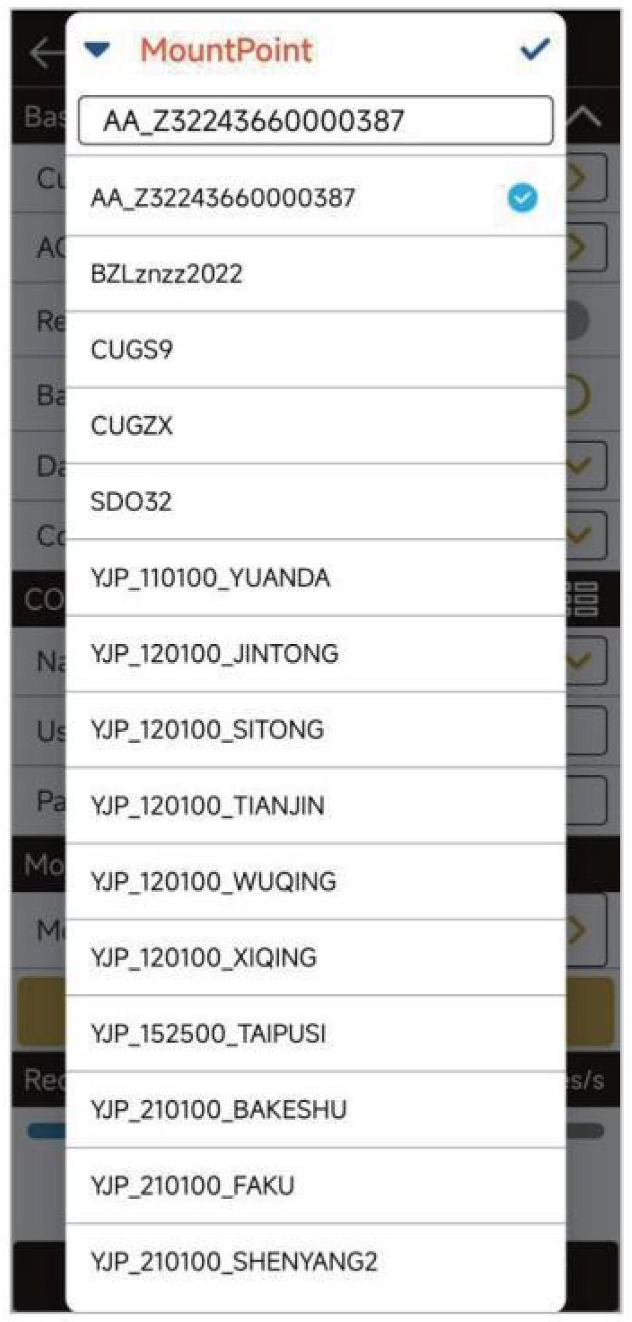


Figure 3.4-4

Figure 3.4-5

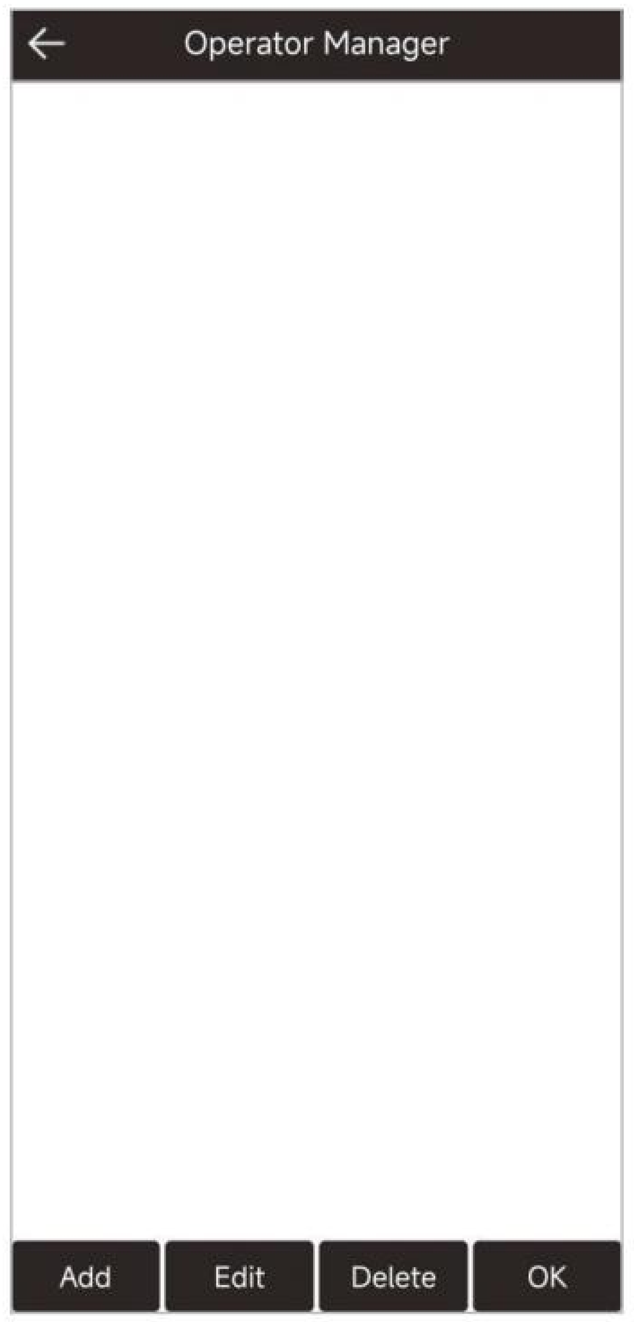


Figure 3.4-6

3.5 Base

Click "Device" -> "Base", as shown in Figure 3.5-1. This function allows the GNSS device to act as a base station, sending satellite information data in a certain way to provide high-precision calculation conditions for the receiving rover station. The main station as a base station needs to set parameters such as startup conditions, startup mode, and data broadcast parameters.

Note: During the base station startup period, the device is not allowed to move; otherwise, it may cause errors in the coordinates calculated by the rover station.

Startup conditions include parameters such as base station ID, differential data format, elevation mask angle, PDOP limit, etc. Click "Advanced," as shown in Figure 3.5-2, to configure parameters such as elevation mask angle and PDOP limit. The differential data formats include commonly used formats such as CMR, RTD, RTCM23, RTCM30, RTCM32, RTCM33;

The startup mode includes using a single-point coordinate and specifying the base station coordinate:

1. Using a single-point coordinate: This means that the GNSS device outputs differential broadcast data based on the current position (with low accuracy) as the startup coordinate;

2. Specifying the base station coordinate: This involves the user specifying the coordinates based on the location where the device is set up. The user pre-knows the coordinates of this position, and these coordinates are used as the startup coordinates for outputting differential broadcast data. Please click to measure a point, or click to measure a point in real-time or select a coordinate value from the coordinate point library, as shown in Figure 3.5-3.

Data broadcast mainly involve how the base station, after startup, outputs the differential data for the mobile station to receive and use. The main methods include the Device Internet, Internal Radio, external radio, etc. Settings are similar to those for the rover station, with the following differences:

1. For the Device Internet NTRIP protocol, the base station sets the starting transmission base station access point, as shown in Figure 3.5-1, while the rover station obtains a list of mount points and selects the corresponding base station mount point for connection;

2. CORS settings refer to the corresponding configuration of the rover station's data link

Figure 3.5-1

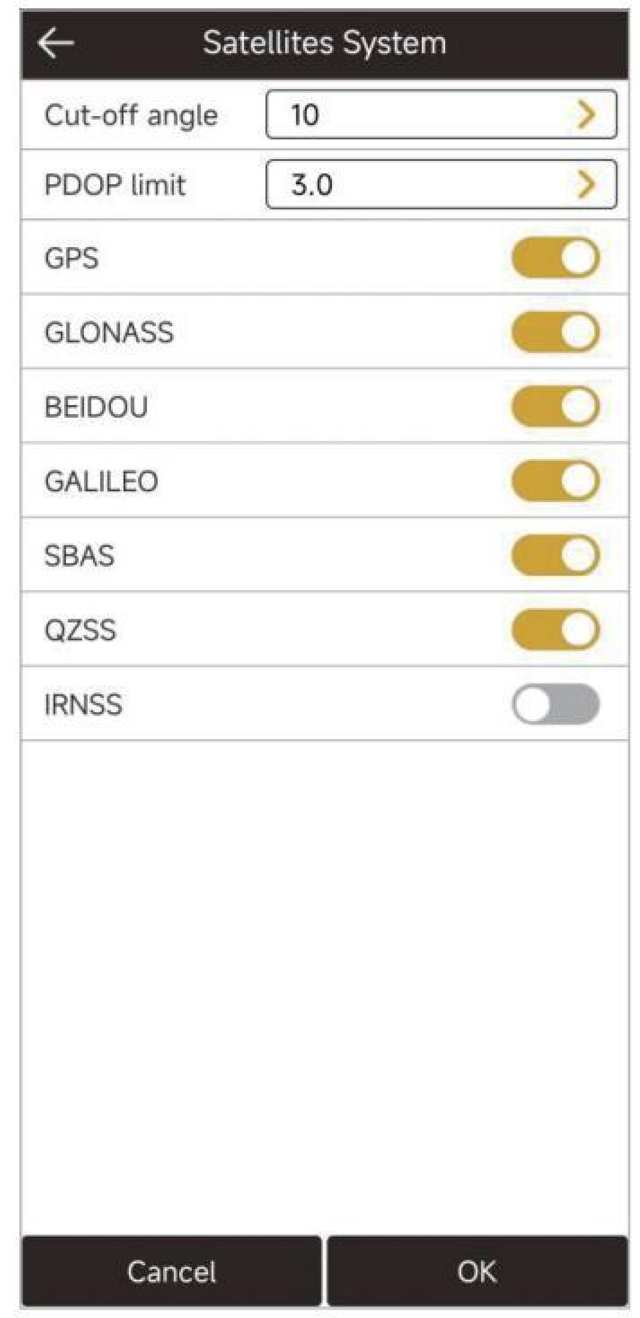


Figure 3.5-2

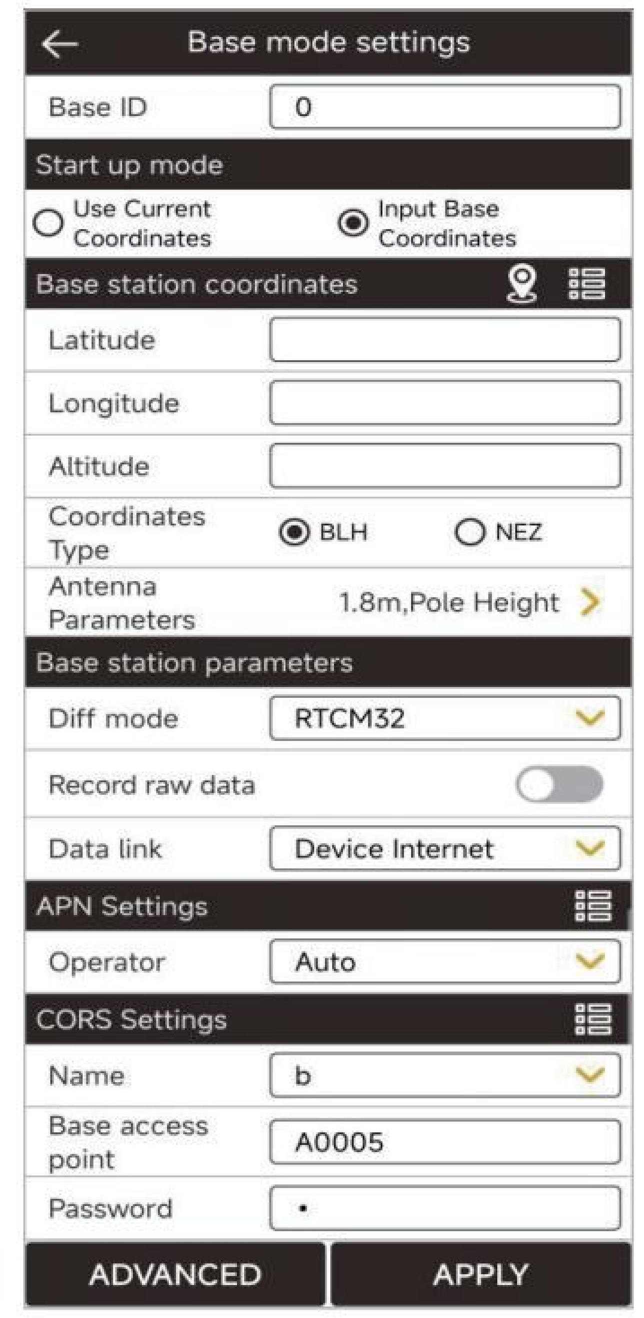


Figure 3.5-3

3.6 Static

Click "Instruments" -> "Static", as shown in Figure 3.6-1. This feature is designed to store the satellite's raw observation data from the GNSS device into a designated disk file, recording observational data over a period for later use with static post-processing software to calculate high-precision coordinates. It is typically used for control point collection. To initiate static mode, you need to set the point name for the static file, as well as conditions for recording such as PDOP limit, elevation cutoff angle, collection interval, antenna parameters, and file format, etc, as shown in Figure 3.6-2.

Click "Start" to start static collection, as shown in Figure 3.6-3, and click "Stop" to end static collection. In the status, information such as record status, start time, number of epochs, and record file name is displayed.

Note: During static recording, device movement is not allowed, as it may result in inaccuracies in the coordinates calculated during post-processing.

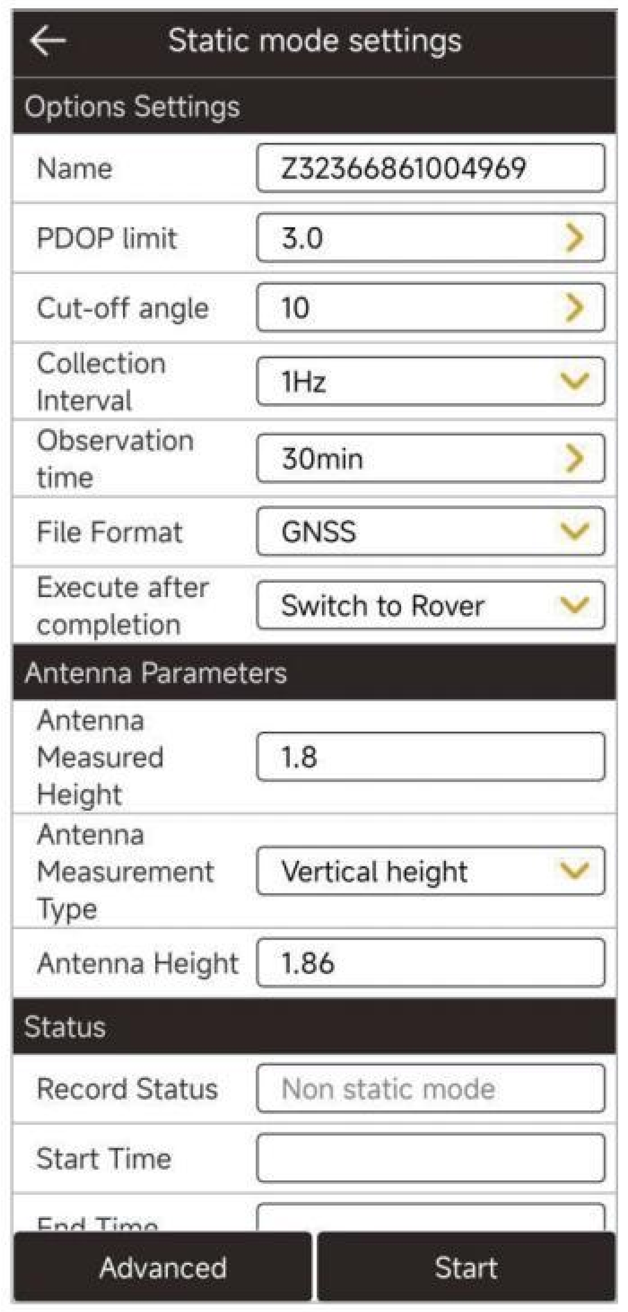


Figure 3.6-1

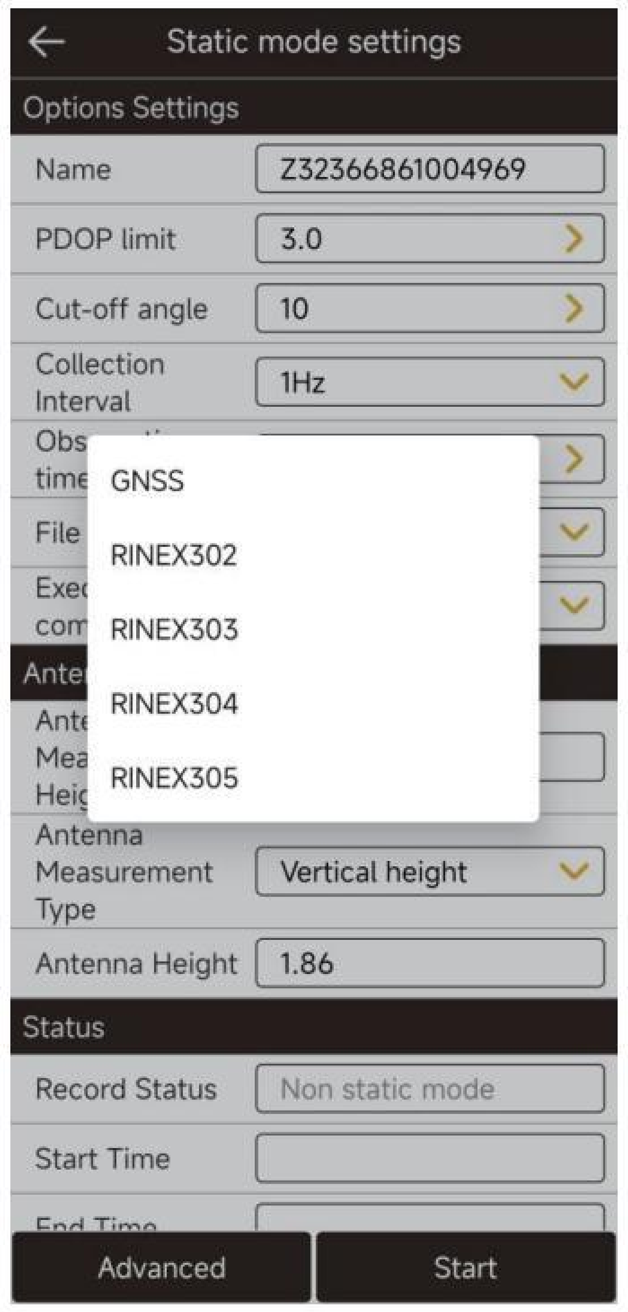


Figure 3.6-2

Figure 3.6-3

3.7 Point Survey

Click "Survey" -> "Point Survey", as shown in Figure 3.7-1. Measure and store the location output by the GNSS device into the point database according to certain precision limiting conditions. In the Point Survey menu, the top title bar displays basic information about the current location output by the GNSS device, including the current solution status, differential delay, HRMS, VRMS, and the number of received satellites. Below the title bar is the status bar displaying other important information, and the displayed content can be set according to user preferences in the settings. In the Point Survey, it defaults to displaying North, East, Height coordinates, and base station information. The middle area shows measurement data plotting information, and you can also set to display online maps.

In the upper-left corner of the plotting area, the represents the map orientation, making it convenient for users to determine direction when needed. In the lower-left corner of the plotting area, the scale of the drawing is displayed, and you can click the or on the right to zoom in or out on the drawing scale. Below the plotting area are the displays of the functionality collected, and these functional menus can also be customized in the settings according to the user's needs to quickly operate certain functions here.

In the lower-right corner of the plotting area, the is the trigger button for initiating measurement and collection. This button can be moved to a more convenient location based on the user's habits. Clicking the button initiates the measurement function, as shown in Figure 3.7-2. You can input a point name and code, and by clicking the , you can choose a preset code from the code library, facilitating quick filling of attributes for the feature. If there are many codes in the code library, the codes used more frequently will be displayed at the beginning for the user's quick selection

Below the plotting area are the measurement type selection, entrance to the coordinate point library, antenna height settings, and the tools menu.

Clicking "Topo Point," as shown in Figure 3.7-3, will display four types: Topo Point, Control Point, Quick Point, and Auto Point. You can choose the corresponding point type for measurement based on your actual needs.

Click on "Points Database" to enter the point library, as shown in Figure 3.7-4. Here, you can view information about the measured points.

Click the to edit antenna height, as shown in Figure 3.7-5. Antenna height settings are used to subtract the antenna height from the phase center coordinates of GNSS to obtain the actual location of the ground measurement target. If the antenna information is incorrect, you can click antenna parameters to select the correct antenna type(used when GNSS devices do not output antenna information or when using an external antenna).

Click "Tools," as shown in Figure 3.7-6, to quickly operate certain functions from the menu based on your needs. You can also add or remove functions from the toolbar in the settings according to your preferences.

Click the , as shown in Figure 3.7-7, to enter the measurement settings. Here, you can set the limiting conditions for measurement collection, such as status limits, HRMS limits, VRMS limits, PDOP limits, delay limits, etc. You can adjust these limitations based on the accuracy requirements of your tasks. Setting the smoothing point count averages multiple positioning points to improve accuracy.

Additionally, you can set default point names and default codes. The information bar allows you to customize the display of status information, focusing on the details you find most important, as shown in Figure 3.7-8. The toolbar allows you to display commonly used functions for quick and easy access during operations. This includes features such as automatic centering of measurement points, toggling the map, compass mode, screen point selection, CAD text, coordinate transformation, perimeter and area calculation, CAD background color, and more. Clicking the icons in the toolbar triggers the corresponding functions, as shown in Figure 3.7-9.

Click the to automatically center the current location on the screen. Click to display all current measurement points on the screen.

Click , as shown in Figure 3.7-10, to toggle the tilt measurement on/off.

Click , as shown in Figures 3.7-11 and 3.7-12, to choose the desired online map for display.

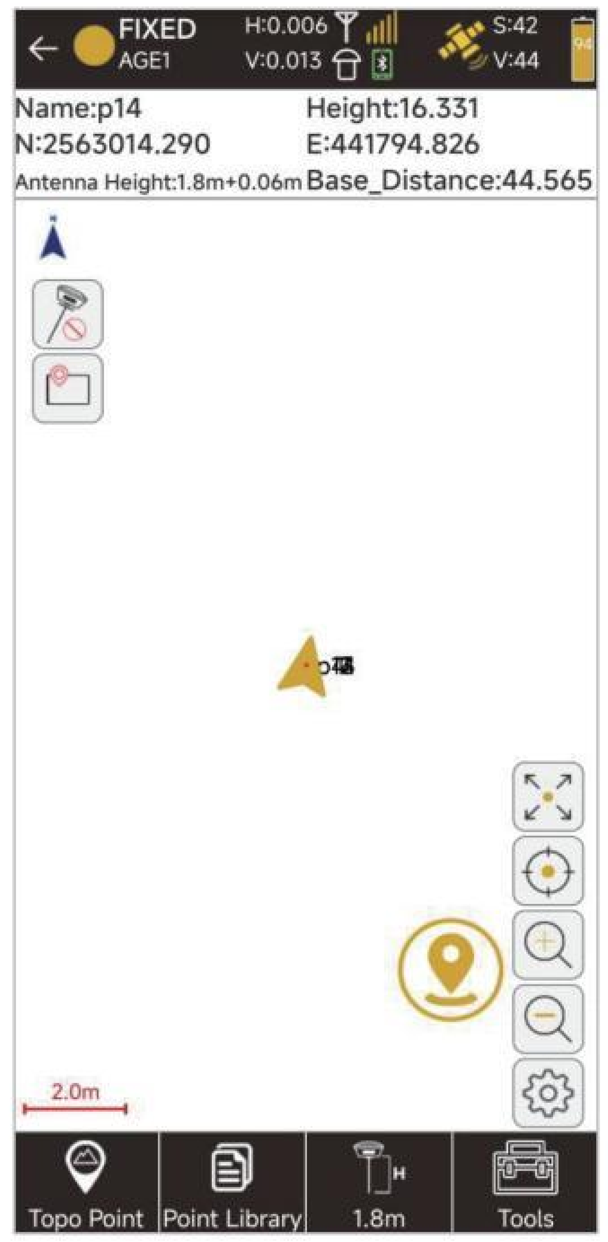


Figure 3.7-1

Figure 3.7-2

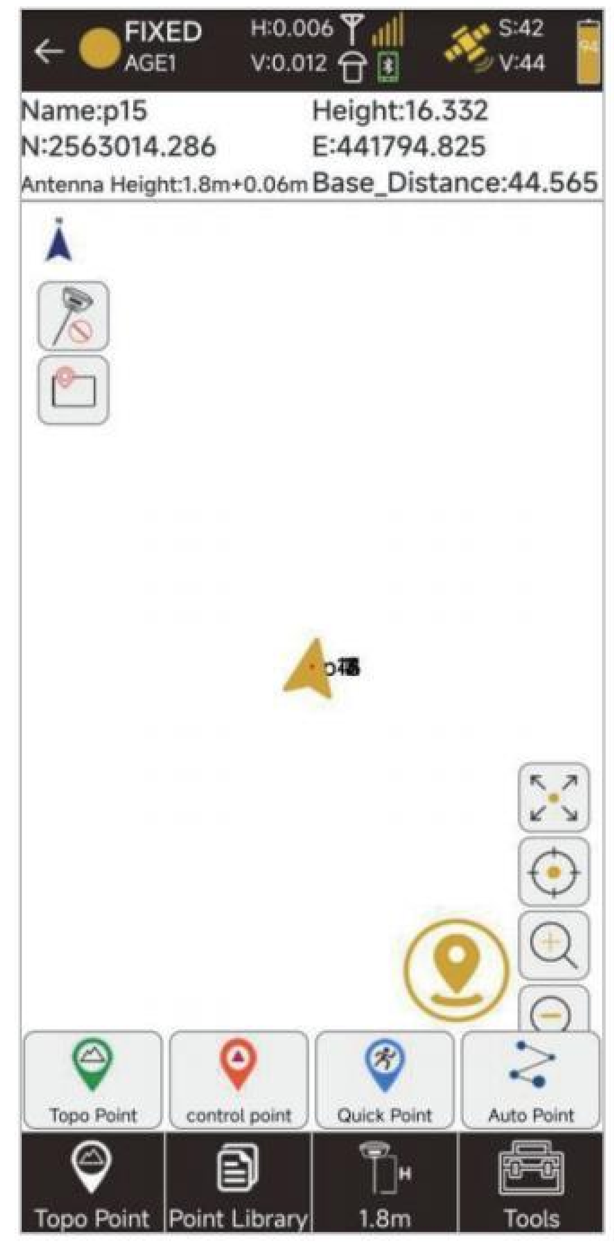


Figure 3.7-3

Figure 3.7-4

Figure 3.7-5

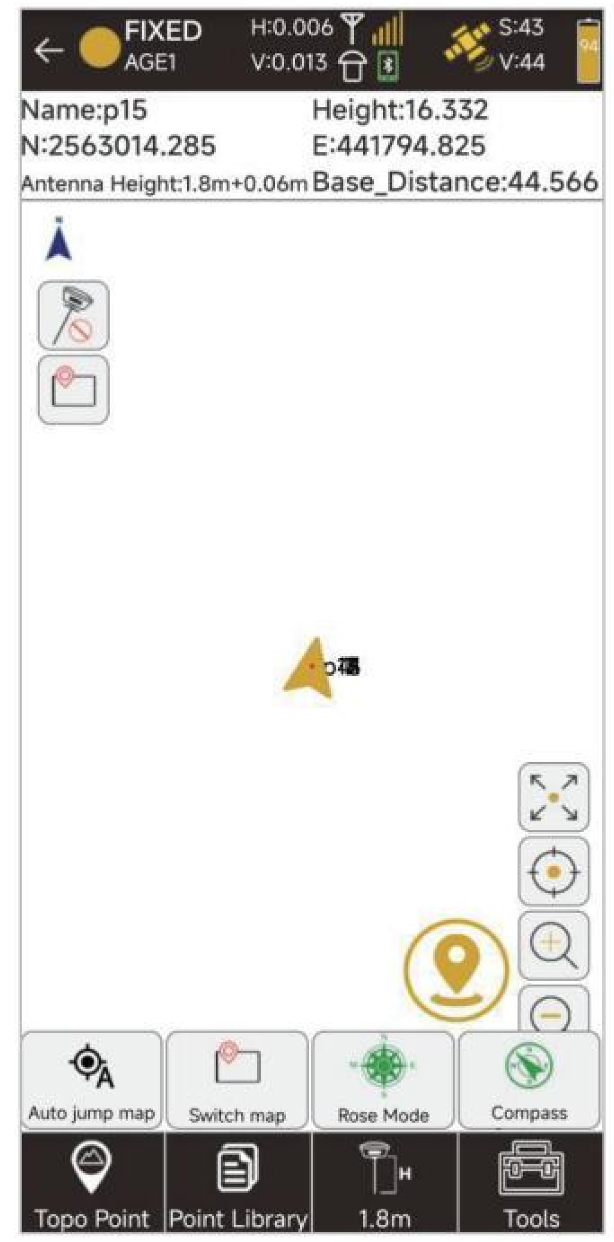


Figure 3.7-6

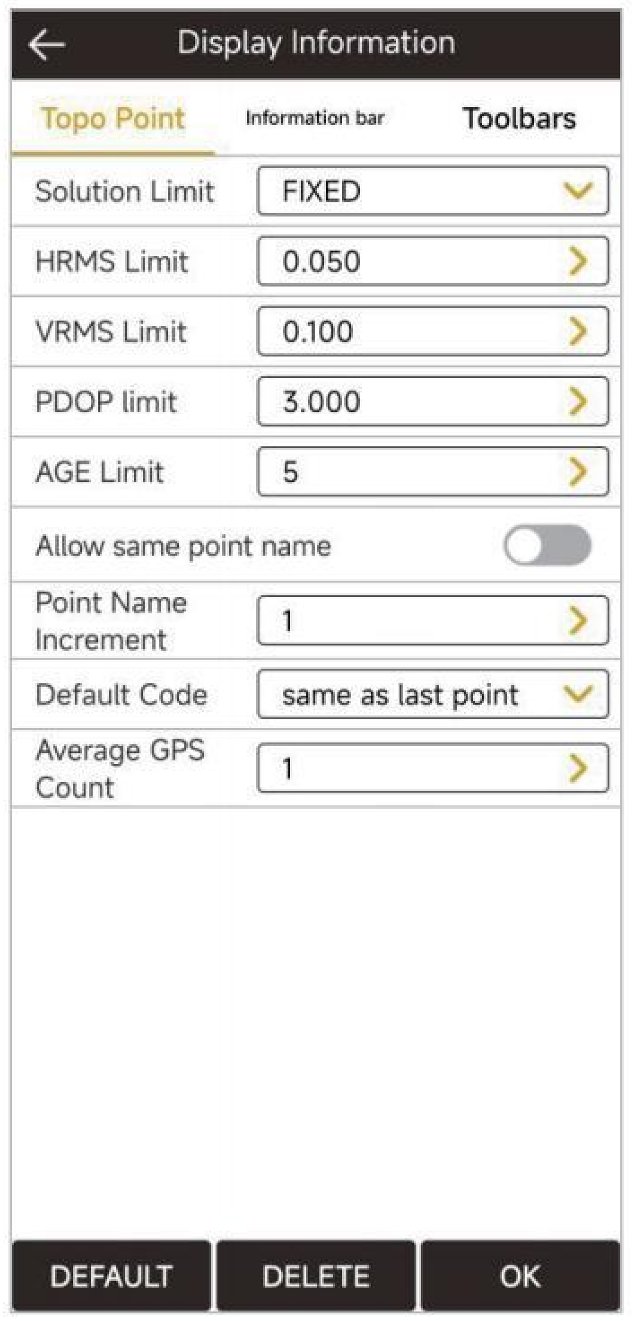


Figure 3.7-7

Figure 3.7-8

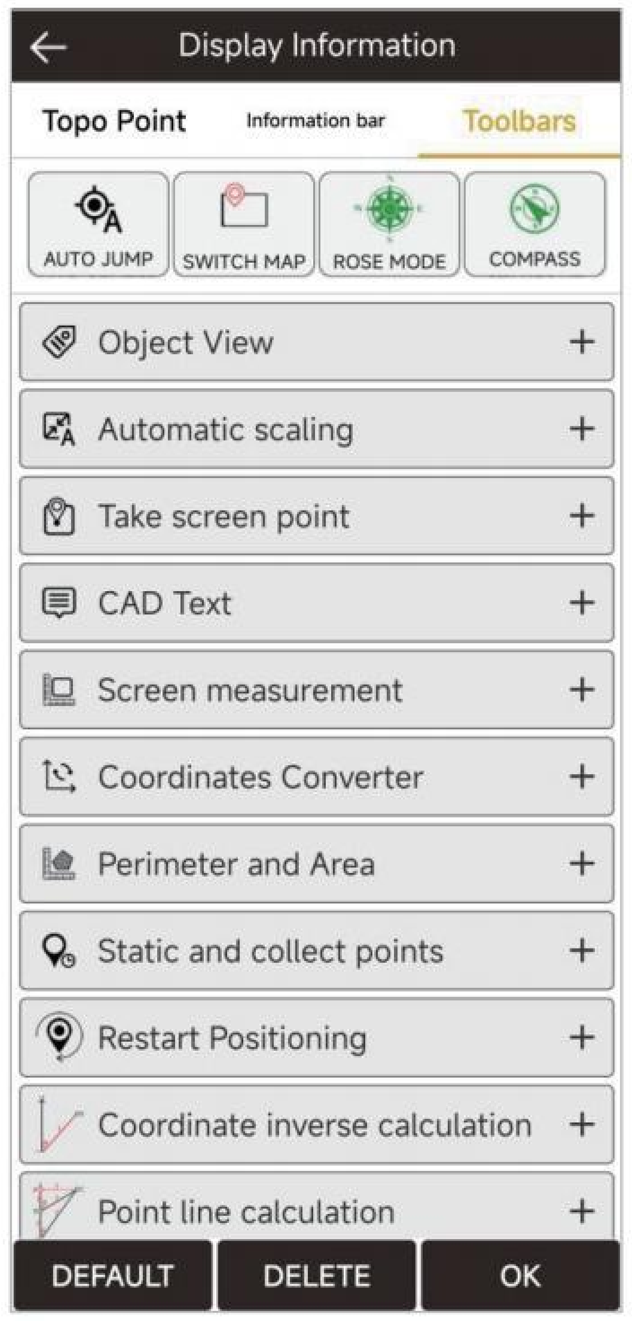


Figure 3.7-9

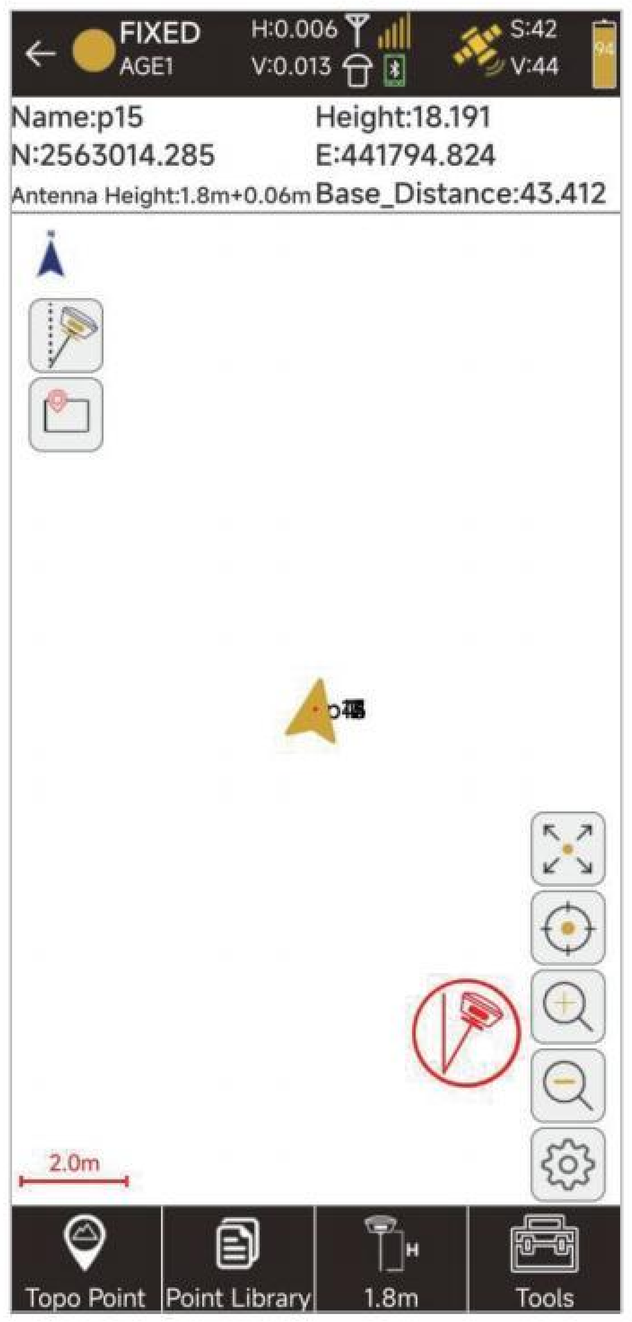


Figure 3.7-10

Figure 3.7-11

Figure 3.7-12

3.8 Tilt Measurement

The IMU function requires the device to have a tilt module. Devices equipped with this function can achieve:

1. Ensuring accuracy within 2cm in a tilt range of up to 60 degrees;

2. The calibration process is straightforward, requiring only shaking the pole back and forth in place;

3. Supports pole calibration to eliminate measurement errors caused by pole curvature, as explained in Section 3.6.

Click "Survey" -> "Point Survey" to enter the point survey page. Click the top-left corner  for turning on tilt measurement. When it is turned on, the icon appears as . Follow the prompts that appear, as shown in Figure 3.8-1, and enter the antenna height (height of the pole) based on the actual situation.

At this point, the device needs to be in a fixed solution. Refer to the animated guide that appears, as shown in Figure 3.8-2. Shake the pole back and forth for 5-10 seconds, then rotate it 90 ° , and continue shaking it back and forth. Repeat this process until the icon changes to , as shown in Figure 3.8-3. Now you can proceed with tilt measurement.

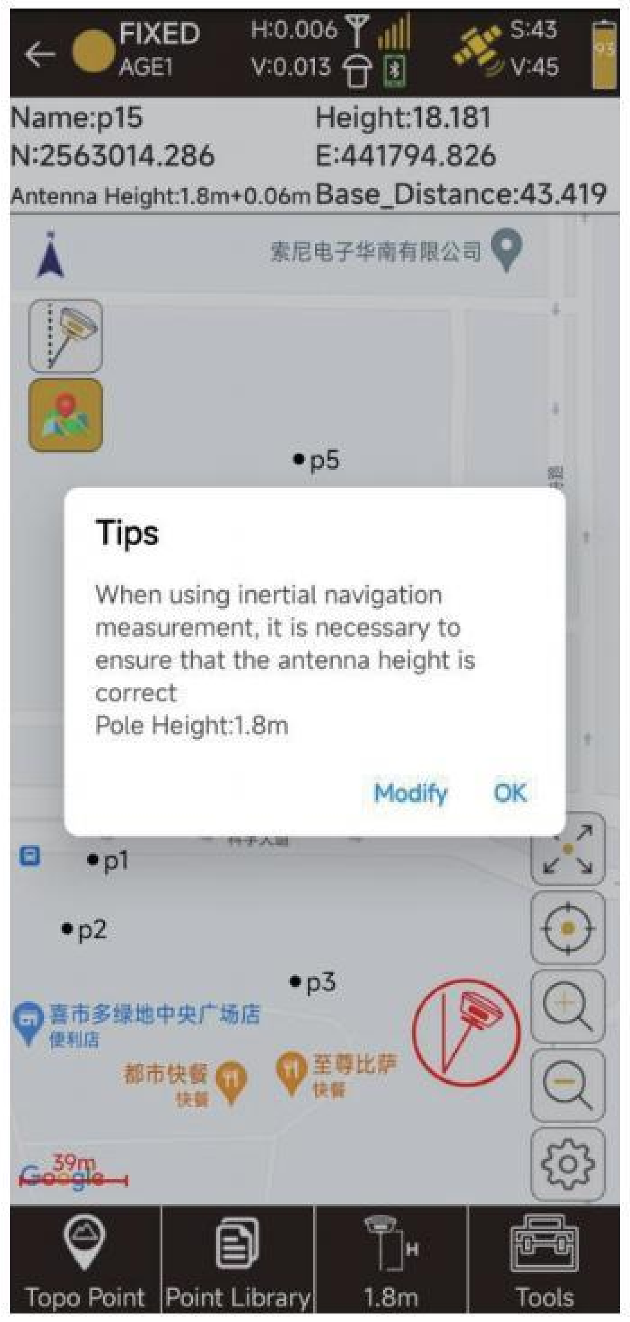


Figure 3.8-1

Figure 3.8-2

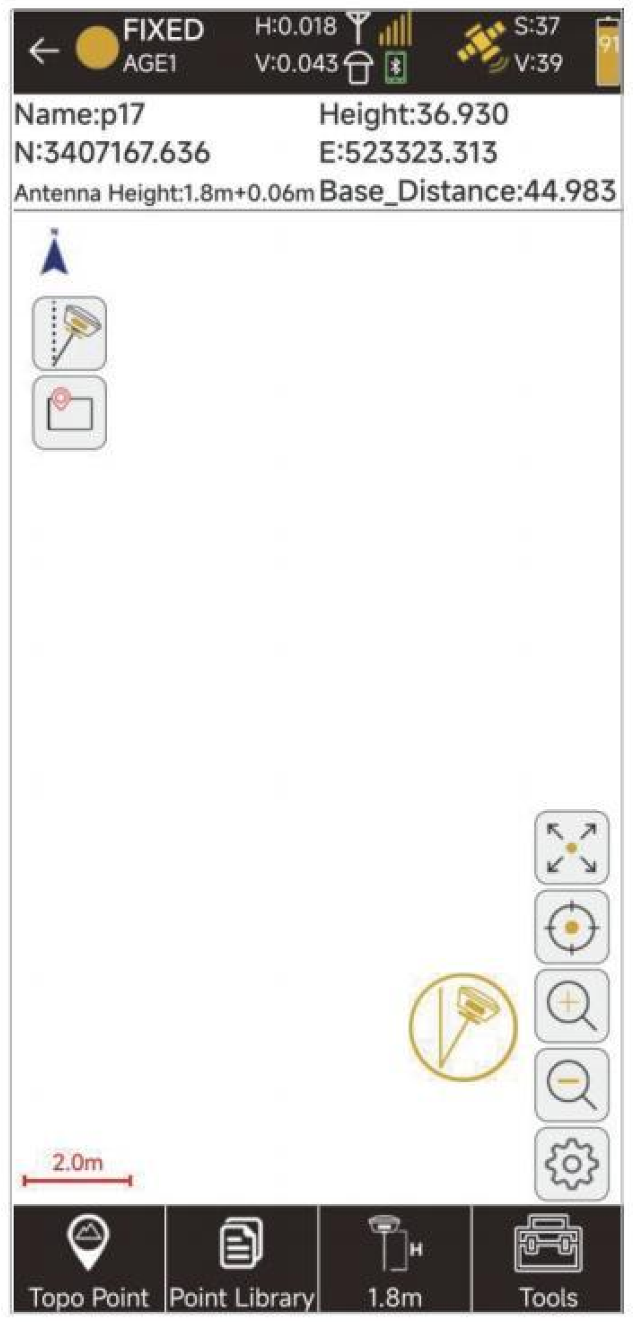


Figure 3.8-3

3.9 Point Stakeout

Click "Survey" -> "Point Stakeout" entering the stakeout point library, as shown in Figure 3.9-1. Stakeout refers to finding the location of a point on-site when the coordinates of the point are known. The pending stakeout points display both unstaked and staked points. Clicking a staked point allows for editing, viewing details, stakeout, and deletion, as shown in Figure 3.9-2. The pending stakeout points are part of the point library, and the addition, removal, import, and export operations for staked points are the same as for points library. Removing a point from pending stakeout does not actually delete the point in the point library. Stakeout can also be performed by selecting points from the coordinate points (all points in the coordinate point library). After selecting points for stakeout, enter the stakeout interface, as shown in Figure 3.9-3.

Click to enter the stakeout setting, as shown in Figure 3.9-4. Here, you can set parameters such as the alert range, stakeout tolerance, and choose the reference azimuth according to the cardinal directions (east, south, west, north) or relative directions (front, back, left, right). Additionally, you can configure voice prompts.

The layout of the stakeout menu is similar to the point survey menu, with some differences. The status bar displays the deviation values in the east, south, west, and north directions from the target. The compass is aligned with the current position. In addition to the measurement type, coordinate point library, antenna height, and tools at the bottom of the drawing area, there are also functions such as stakeout the nearest point, stakeout the previous point, and stakeout the next point.

Click "Nearest," as shown in Figure 3.9-5, to stakeout the nearest point.

Click , as shown in Figure 3.9-6, to manually add stakeout points at any time.

If you want to reach the target point more quickly:

For users with a good sense of direction who can distinguish between east, south, west, and north in real-time fieldwork, you can directly observe the continuous connection between the current location point and the target point in the stakeout compass display. Walk in the direction indicated to reach the target point. Refer to Figure 3.9-3, where walking southwest will lead to the target point Pt4.

If the user has difficulty distinguishing between east, south, west, and north, you can rely on the orientation arrow at the current location. The arrow points in the same direction as the controller when it is flat. As shown in Figure 3.9-3, if the controller points south, rotate the controller until its direction aligns with the line connecting the current point and the target point. Once aligned, follow the direction indicated by the controller to reach the target point.

Figure 3.9-1

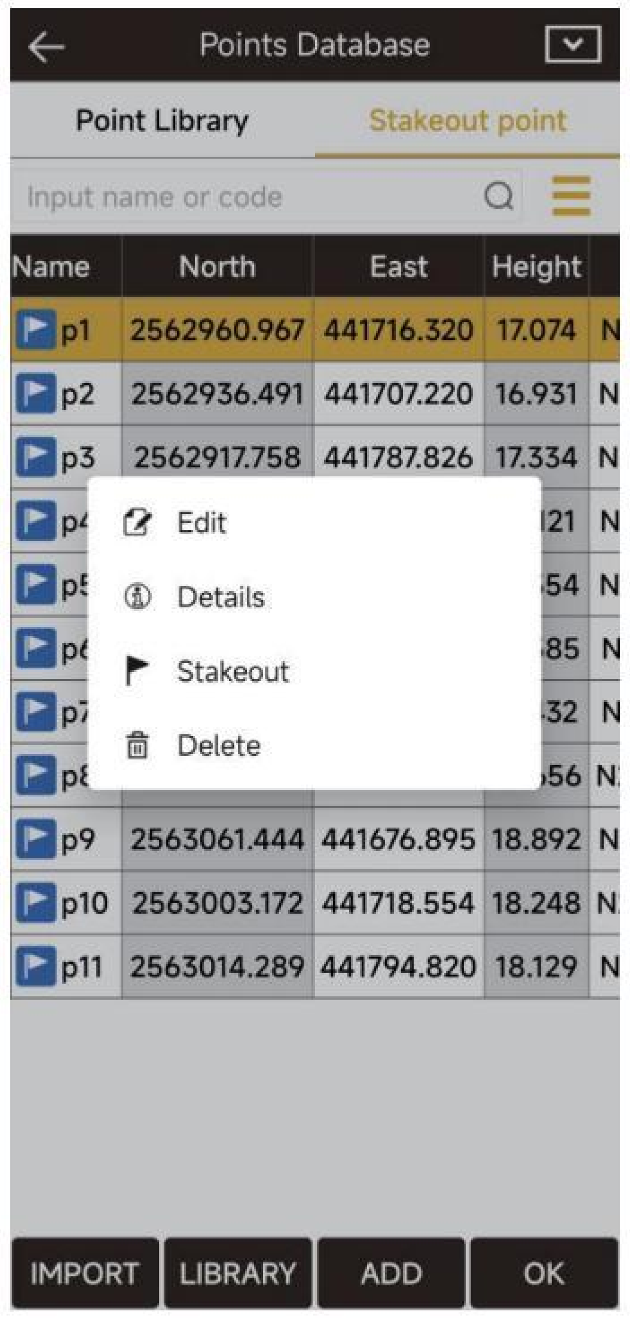


Figure 3.9-2

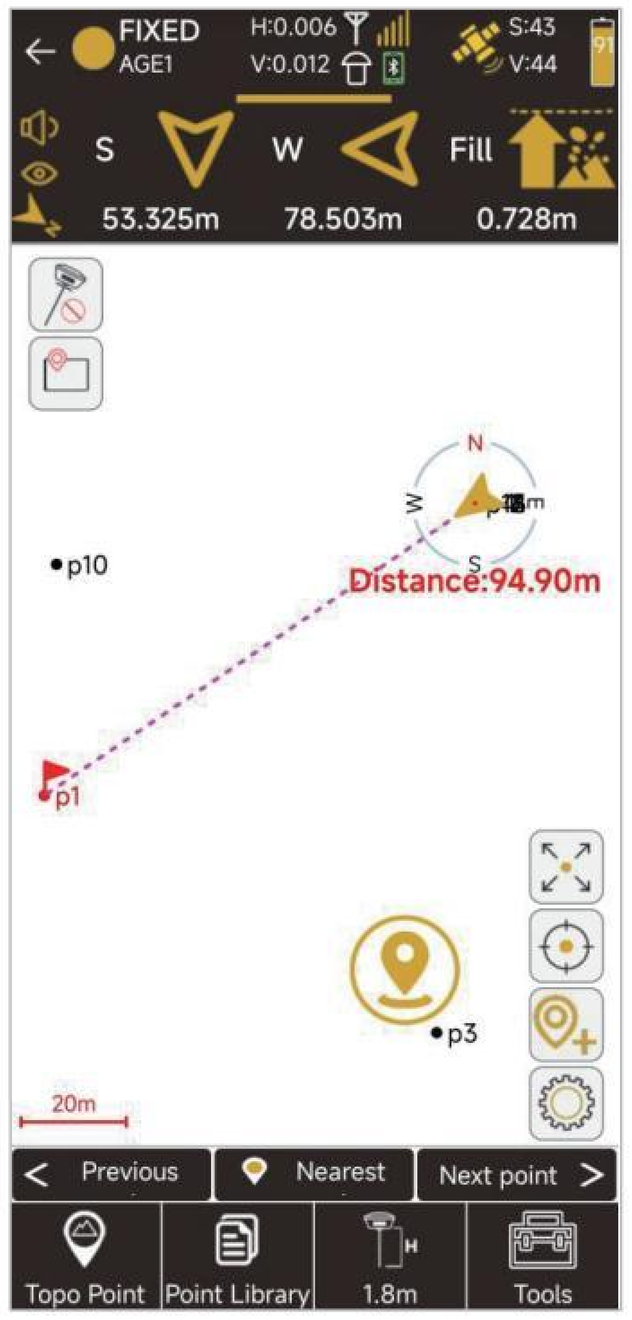


Figure 3.9-3

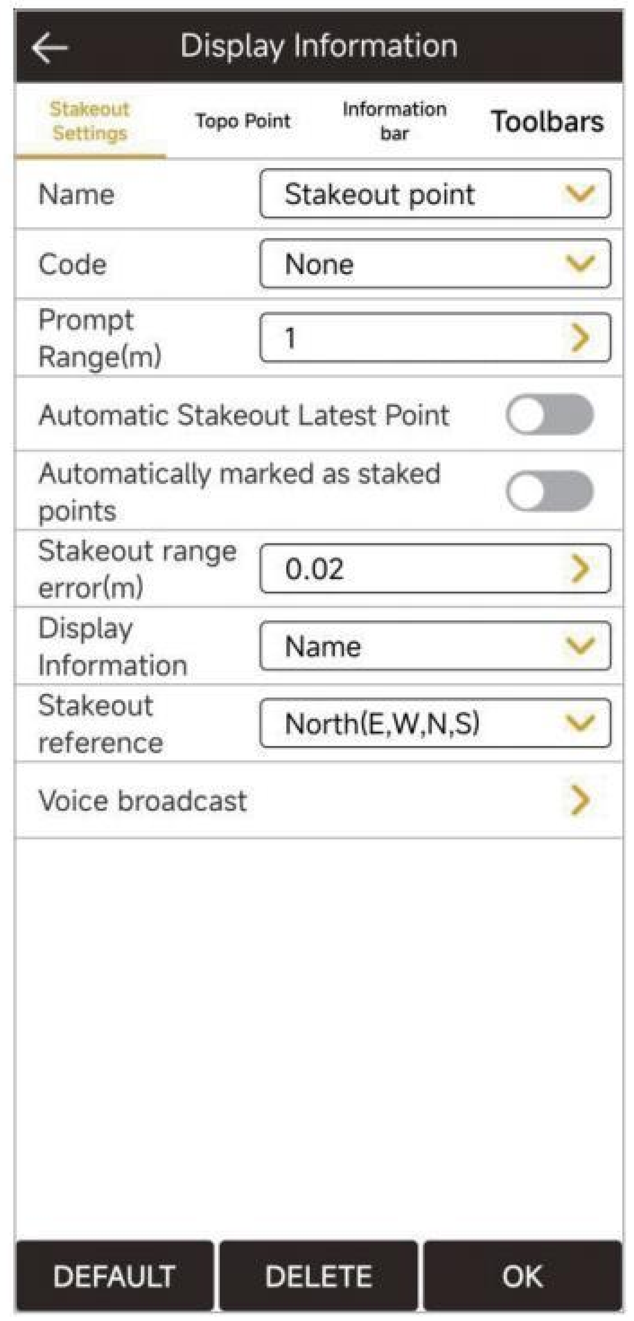


Figure 3.9-4

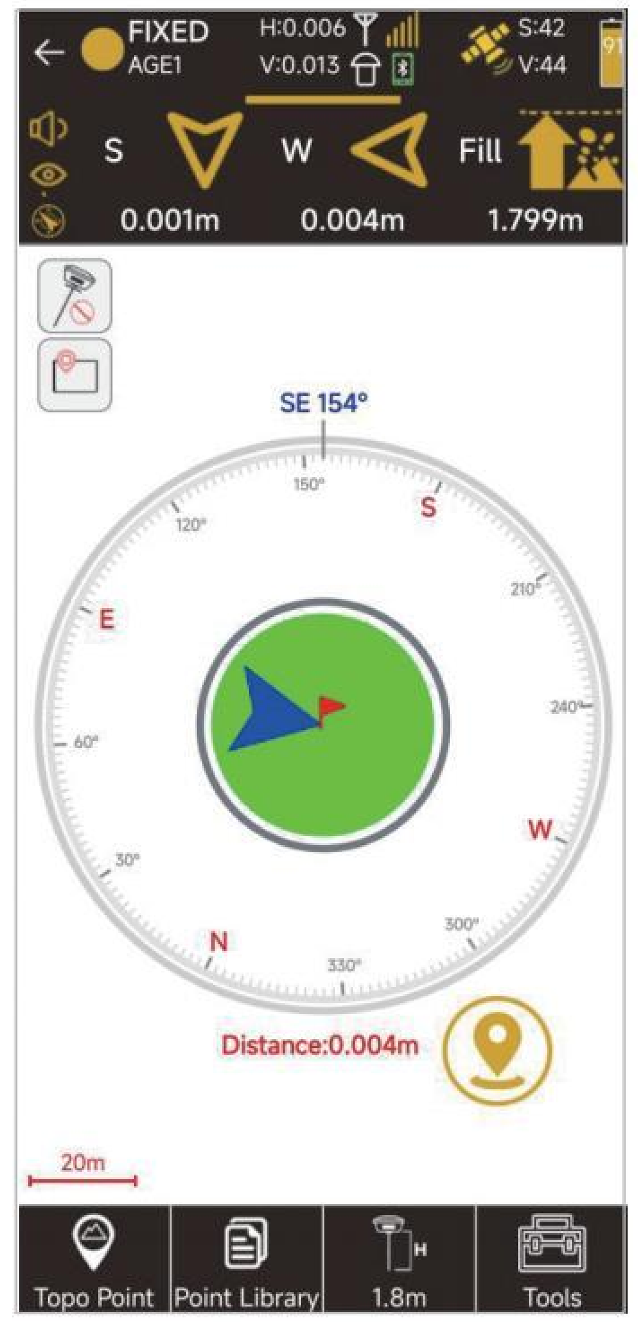


Figure 3.9-5

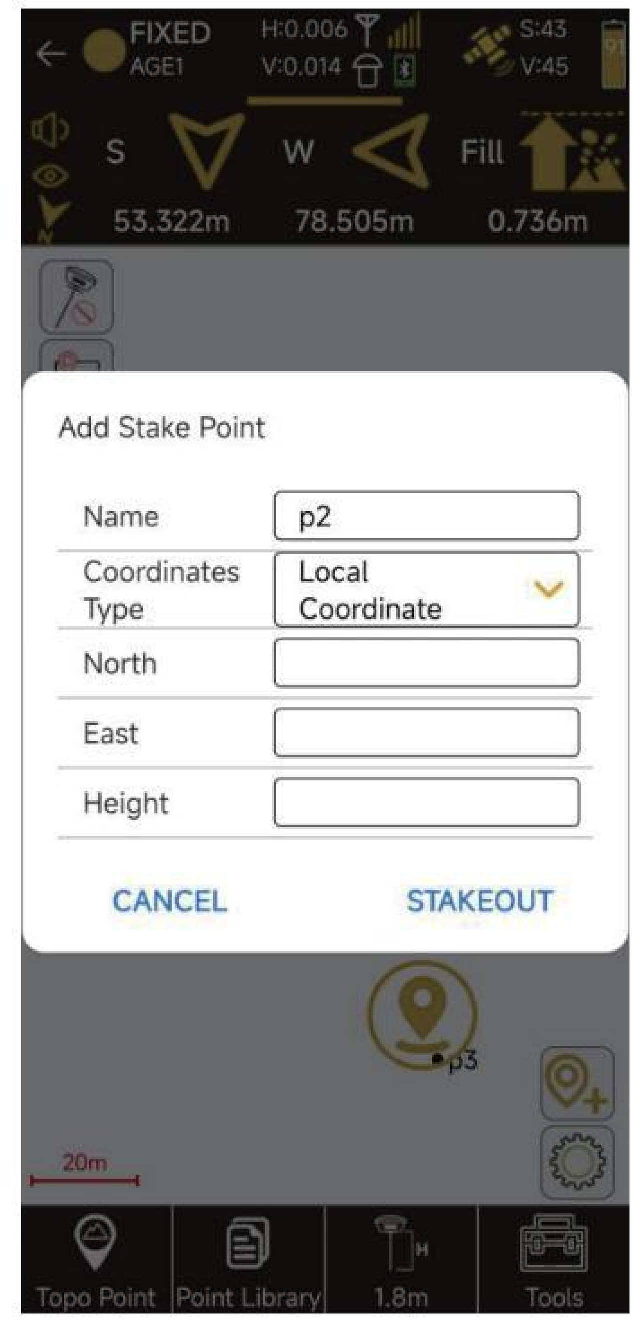


Figure 3.9-6

3.10 Localization

Click "Project" -> "Localization", as shown in Figure 3.10-1. You can import control point parameters in various formats and export control point data as files for use by third-party software. The high-precision position obtained from GNSS devices is in satellite positioning latitude and longitude coordinates. However, in actual project operations, ground plane coordinates are ultimately needed for measurement applications. If you have coordinated transformation parameters, they can directly set the coordinate system parameter values in the coordinate system section (refer to Section 2.3). If you do not have specific coordinate system parameters but have corresponding latitude and longitude coordinates and plane coordinate values, referred to as control points, this feature can be used to calculate the transformation parameters when control point data is available and apply them to project operations.

Click "Add," as shown in Figure 3.10-2. You can enter control points manually or choose to import them from the point database, as illustrated in Figure 3.10-3. In the control point list, selecting a data item allows you to modify, edit, and delete control point parameters, as shown in Figure 3.10-4.

After editing the control point parameters, calculate the transformation parameters for the control points by clicking "Convert Method," which will bring up the transformation parameter conditions setting, as shown in Figure 3.10-5. Coordinate transformation methods include plane correction, vertical correction, elevation fitting, and seven parameters. These methods can be used individually or in combination, and the calculated transformation parameters are considered usable as long as they fall within the permitted accuracy range. The plane correction model includes four parameters and horizontal adjustment, while the elevation fitting method includes weighted average, plane fitting, surface fitting, and vertical adjustment. Typically, if the working range is extensive, using the seven parameters may be necessary to meet the accuracy requirements for all control points. If the working range is relatively small, plane correction alone may achieve the required accuracy.

After configuring the calculation conditions, click on "Calculate." The results of the transformation parameter calculation and the residuals for each control point will be displayed, as shown in Figure 3.10-6. Once the transformation parameters are calculated, you can export a calculation report for project review. If the transformation parameters are qualified, you can apply them to the engineering project, enabling normal measurement operations.

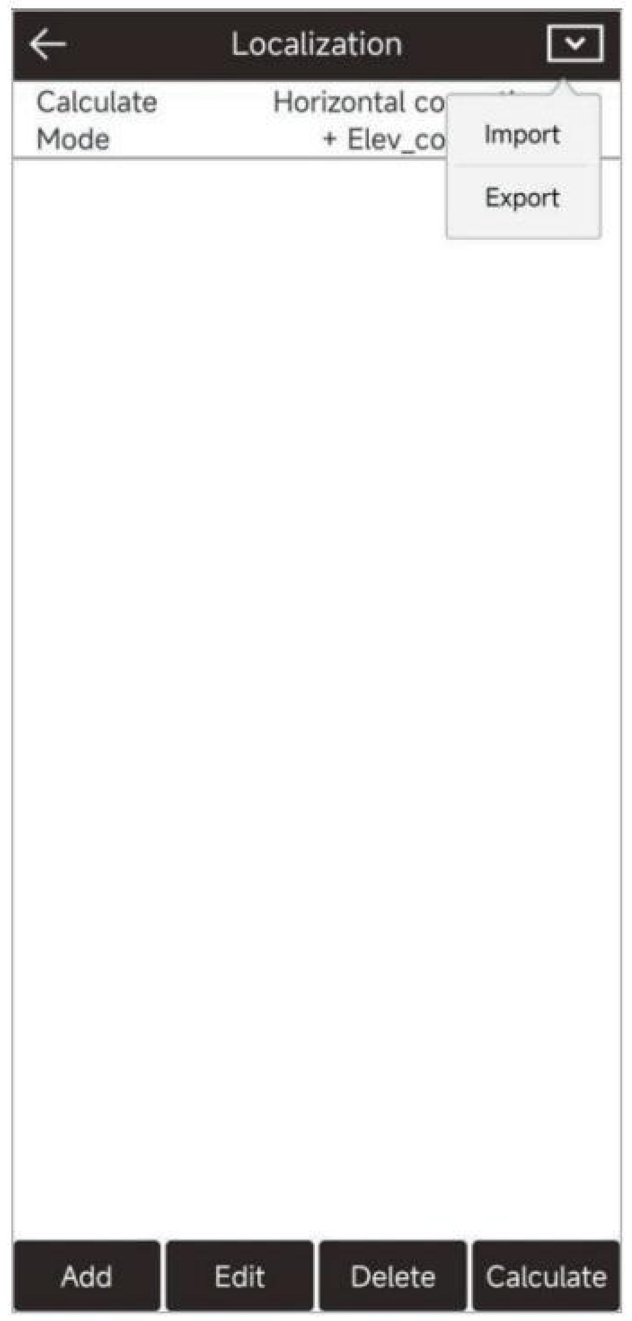


Figure 3.10-1

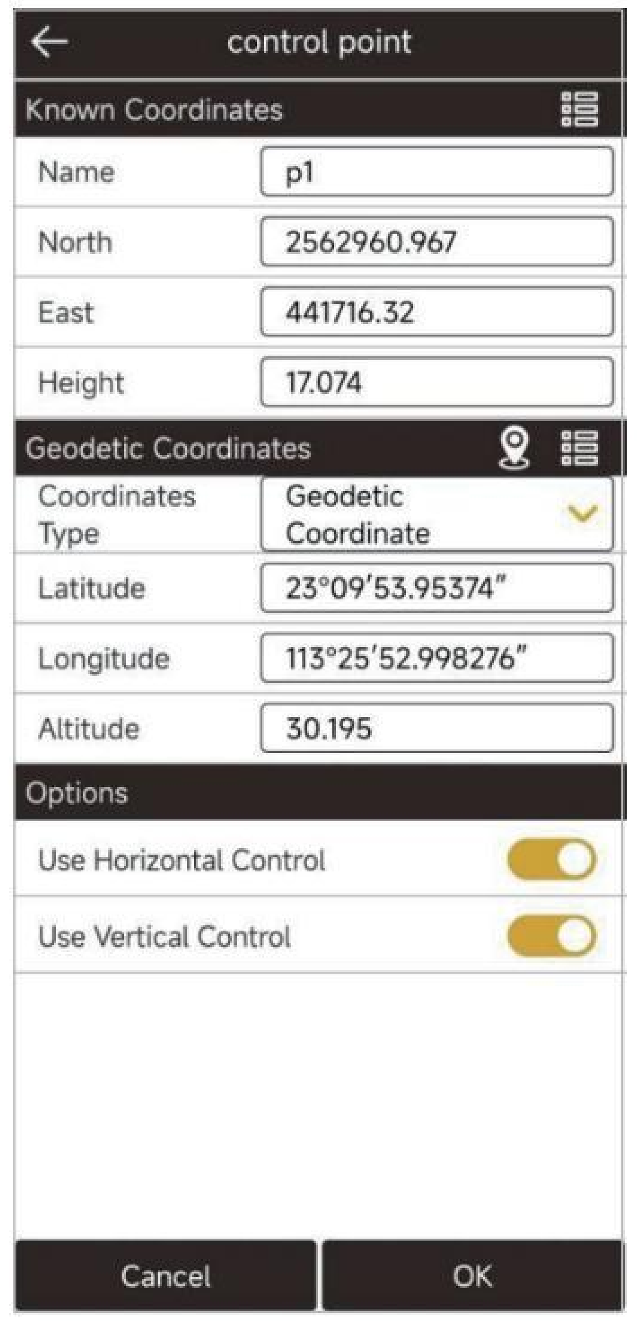


Figure 3.10-2

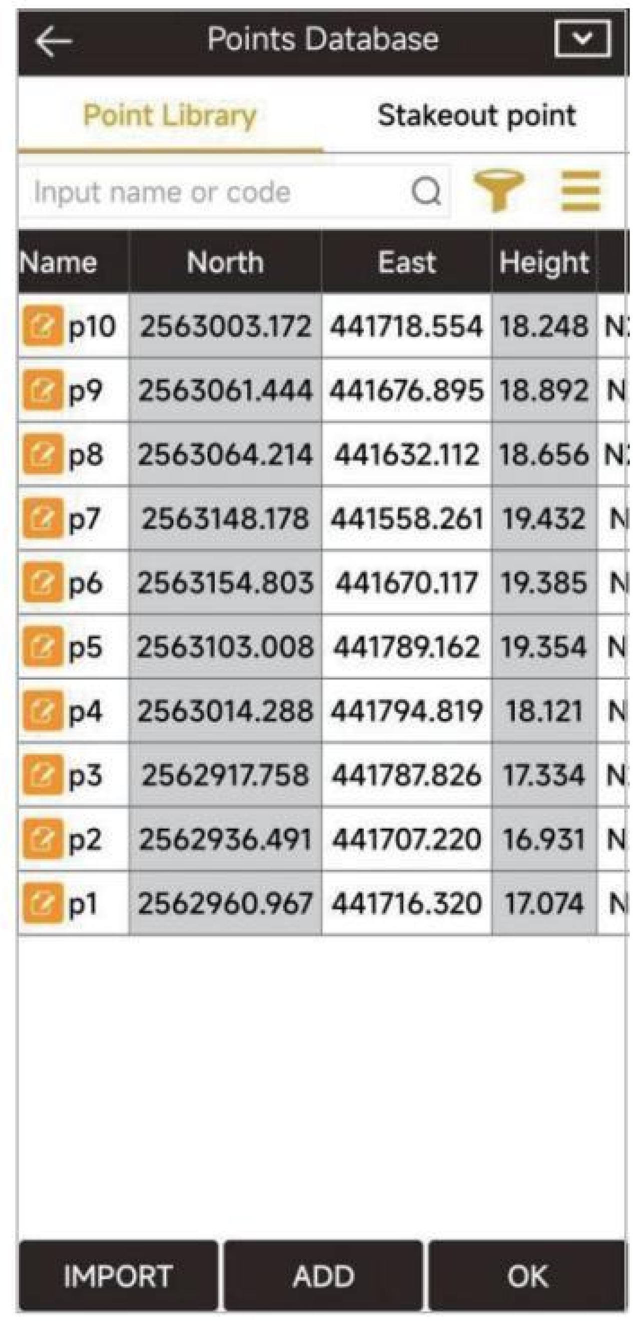


Figure 3.10-3

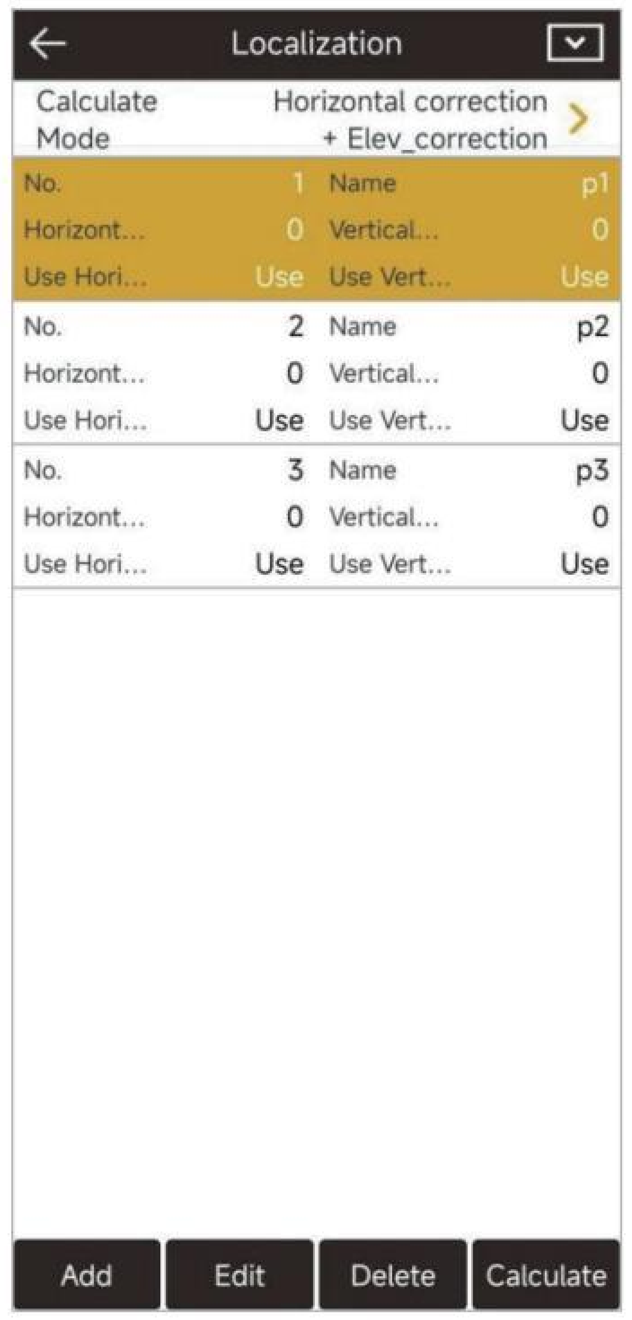


Figure 3.10-4

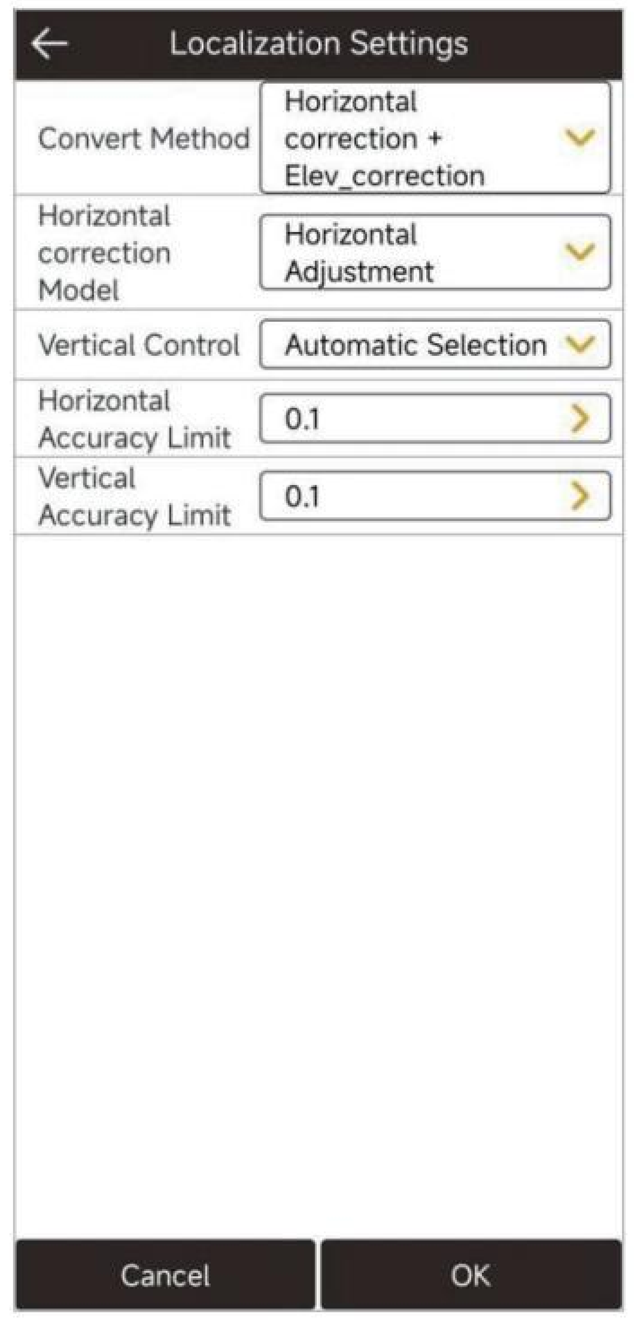


Figure 3.10-5

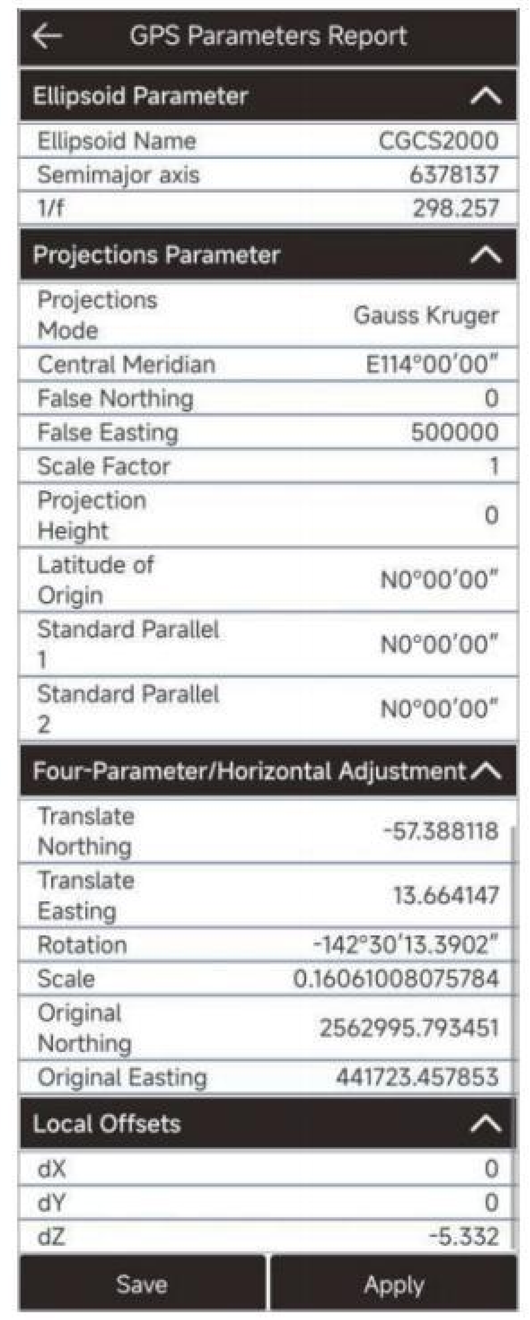


Figure 3.10-6

3.11 Point Calibration

Click "Project" -> "Calibrate Point", as shown in Figure 3.11-1. In the actual application process, the GNSS device obtains high-precision positioning through differential data from reference stations. Here, we recognize that the coordinates of the reference station are known. In reality, the high-precision position output by the GNSS device is the relative position of the reference station. In practical applications, in addition to some users using differential data from CORS reference stations, a considerable number of users use differential data transmitted by their own GNSS devices.

When using the self-established base station to transmit differential data, a project may involve multiple starts of the reference station. During the startup of the reference station, the startup position and coordinates of the base station may change, and the startup coordinates may not be correct. Without calibration, the coordinates obtained using the differential data from these base stations may be incorrect. Therefore, when the mobile station receives new differential data from the base station for measurement operations, translation calibration is needed to ensure that the coordinates obtained by the software match the coordinates obtained from the last connected base station. After the startup coordinates or position of the base station change, it is necessary to use a known position to calibrate the coordinates correctly.

Click "Base Point Calibration," as shown in Figure 3.11-2. Click and select a known point from the point database (using the coordinates measured by the last base station at a specific location), then click "Calculate" and apply to complete the calibration process.

Click "Marker Point Calibration," as shown in Figure 3.11-3. Click and select a known point from the point database (using the coordinates measured by the last base station at a specific location). Then, place the device at the location of the known point, click to measure a new point," and calculate the deviation value. Click "Apply," and the coordinates received by the software will now match the coordinates measured in the last session.

If there is a notification about changes in base station coordinates and you are receiving differential signals from a self-established base station, it indicates the need for base station translation recalibration. In such cases, it is advisable to perform the base station translation calibration again to ensure accurate coordination between the received coordinates and the actual ground coordinates.

Note: CORS stations are Continuously Operating Reference Stations where both the position and startup coordinates remain unchanged. If using differential data from CORS stations, even if the received coordinates may change, the obtained coordinates are still correct, and there is no need for translation calibration.

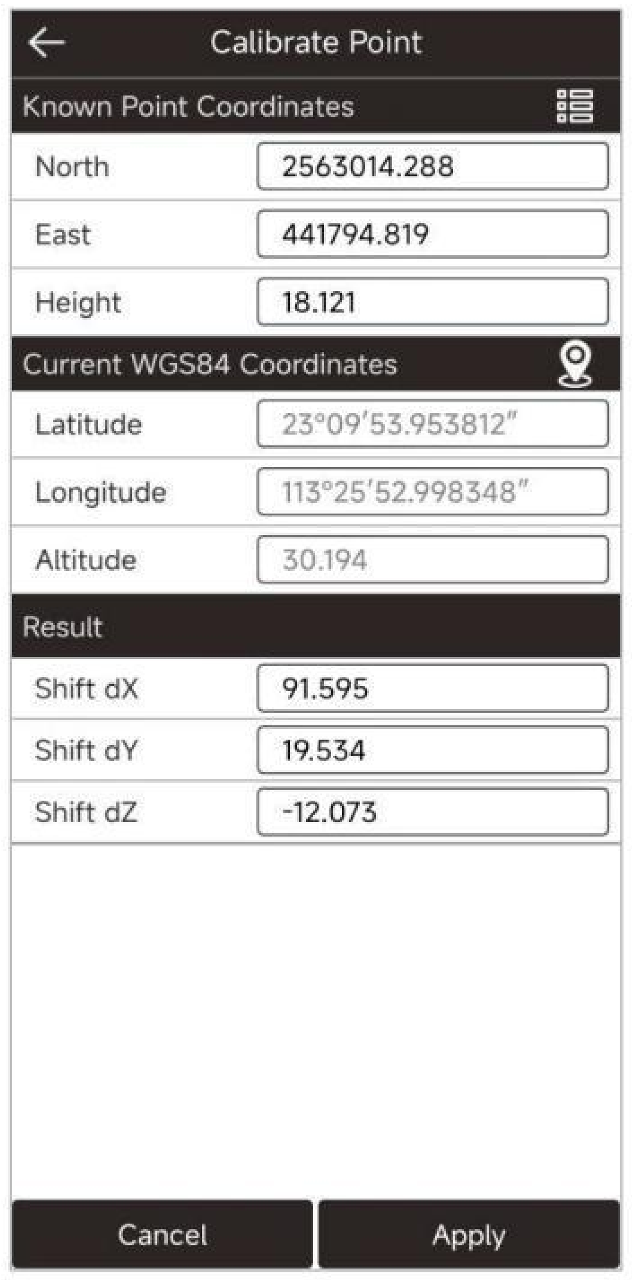


Figure 3.11-1

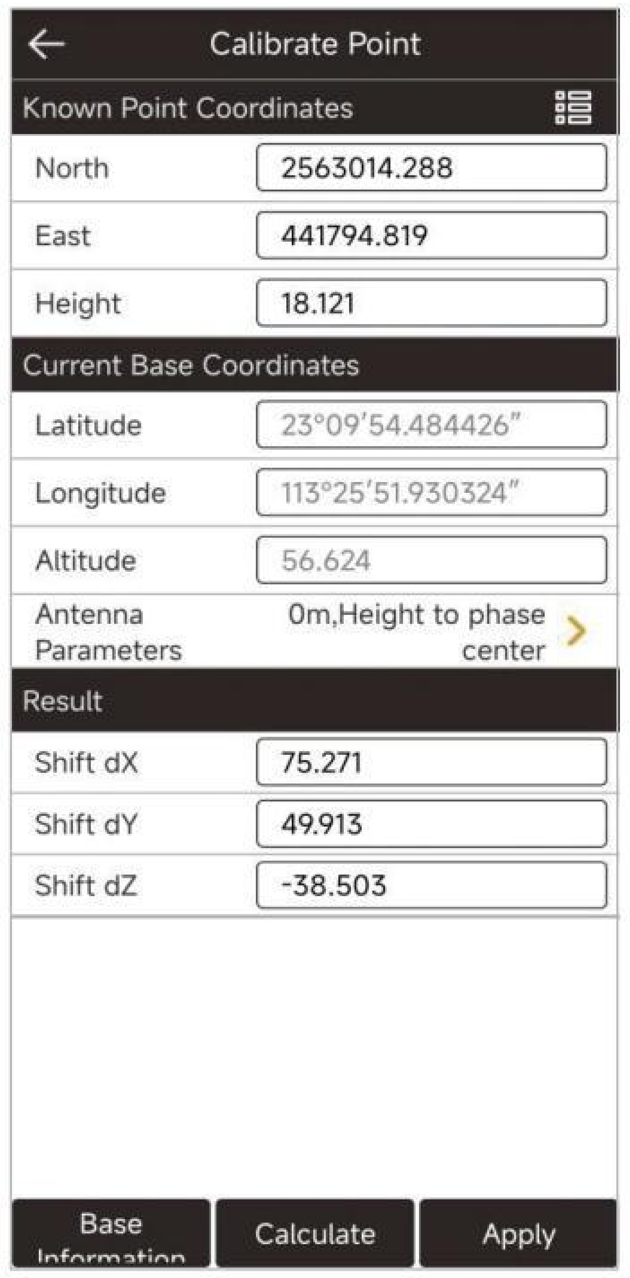


Figure 3.11-2

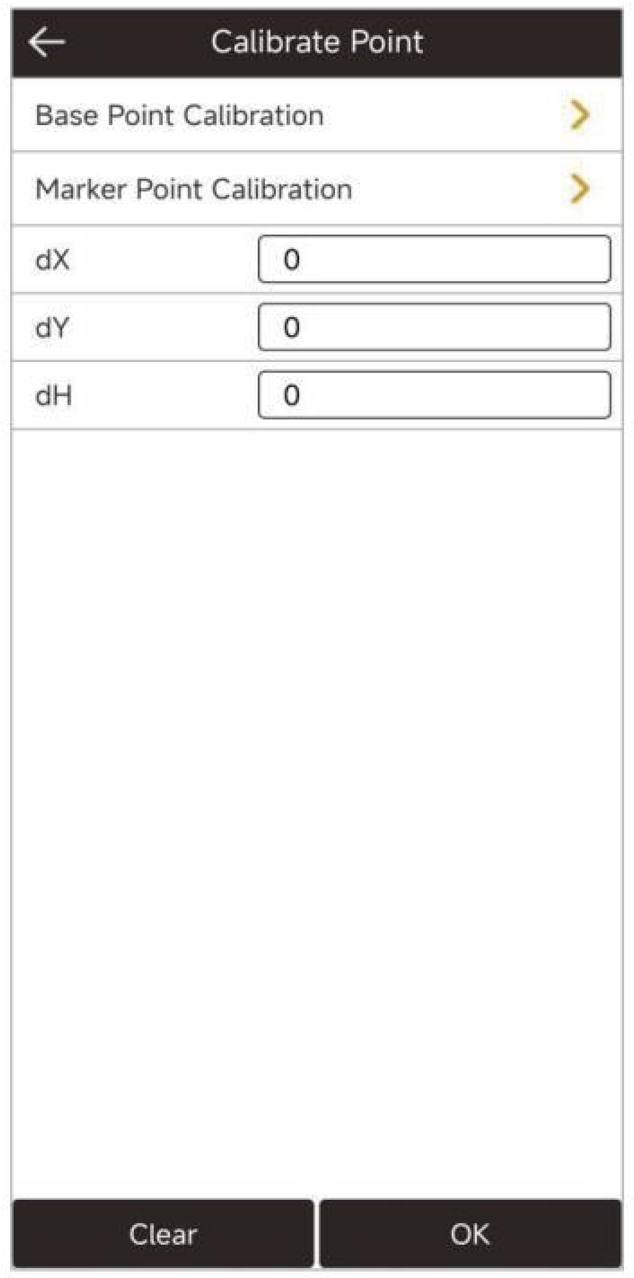


Figure 3.11-3

3.12 Points Database

Click "Project" -> "Points Database", as shown in Figure 3.12-1. Here, you can view and manage point data in the project, including functions such as adding, editing, deleting, importing, etc.

Click , as shown in Figure 3.12-2, to switch the display style of point information.

Click "Add," as shown in Figure 3.12-3. You can manually enter the point name, code, and corresponding coordinates;

Click "Import," as shown in Figure 3.12-4. Choose the file format for importing point data, then proceed to select the data file to complete the data import process;

Select the point, click "Edit," as shown in Figure 3.12-5, and you can edit and modify the name and code of the point;

Click , as shown in Figure 3.12-6, to perform point type filtering.

Clicking will pop up operations, as shown in Figure 3.12-1, where you can perform batch deletion, data statistics, sorting, and other functions as needed;

Figure 3.12-1

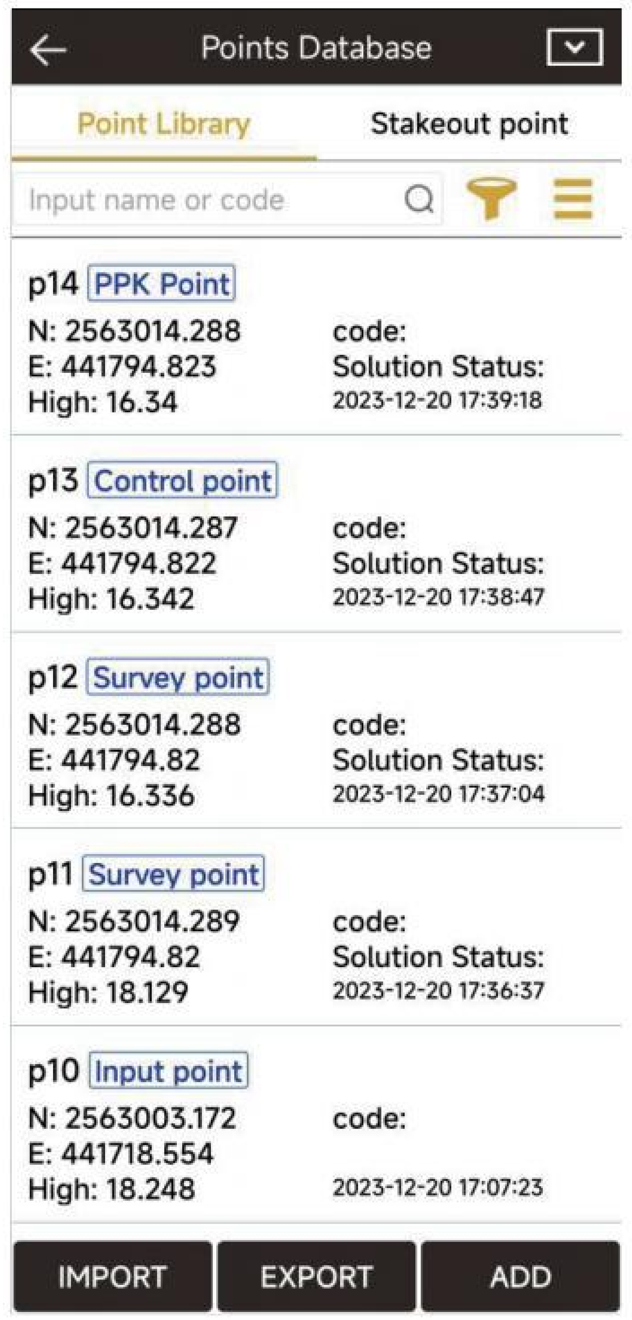


Figure 3.12-2

Figure 3.12-3

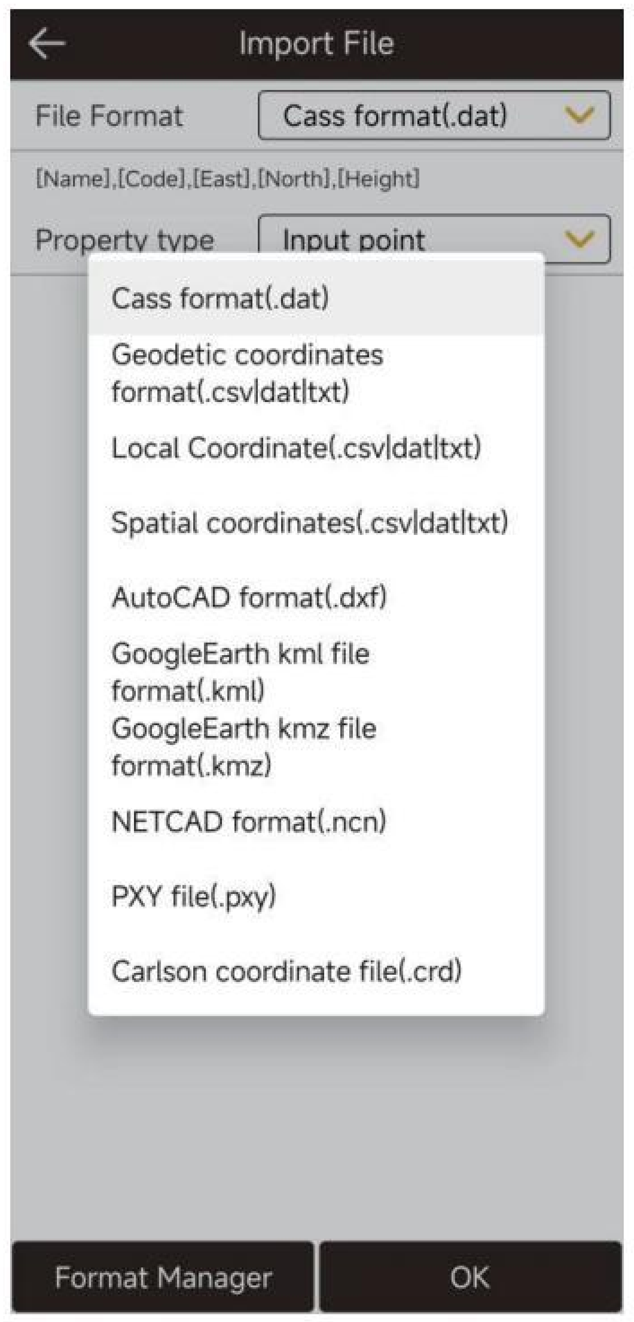


Figure 3.12-4

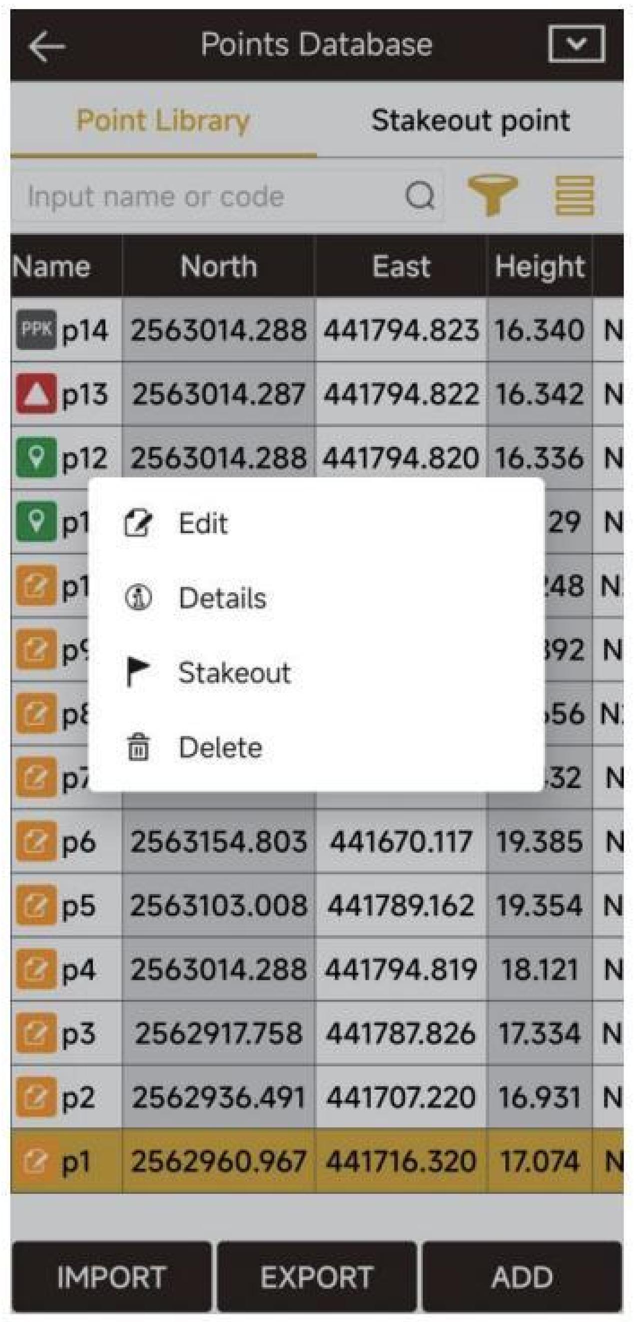


Figure 3.12-5

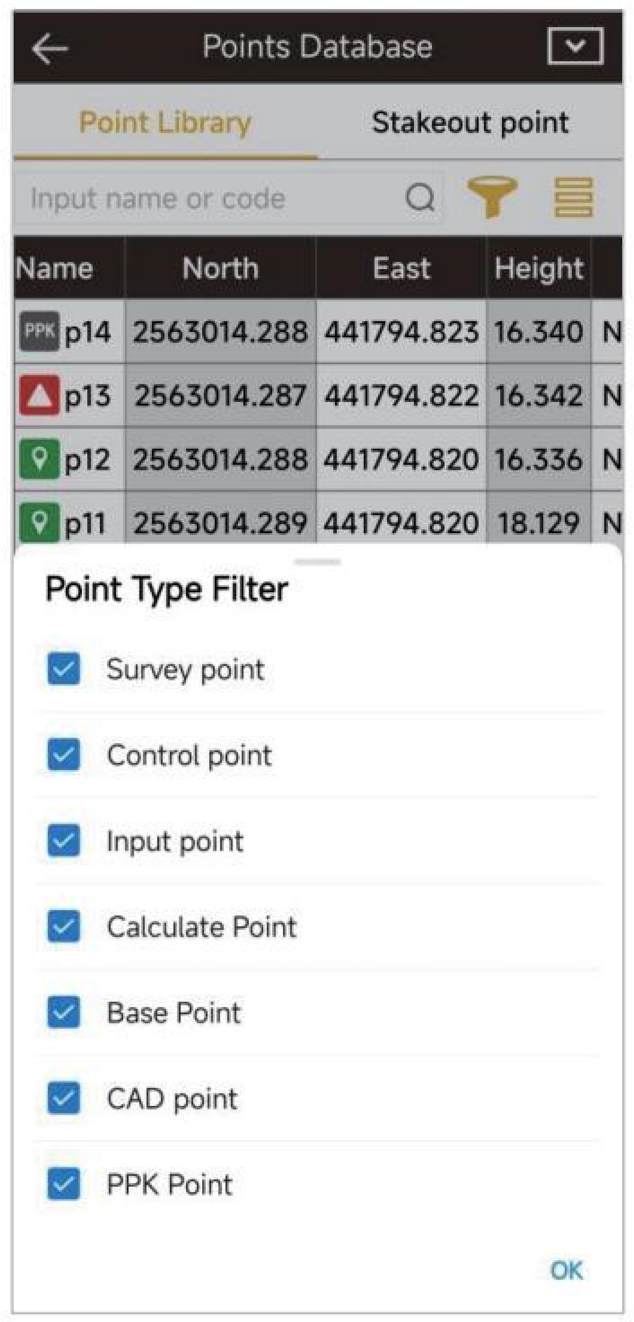


Figure 3.12-6

3.13 Export

Click "Project" -> "Export File", as shown in Figure 3.13-1. Choose the type, file format, and angle format for exporting data as needed. Click on "Export File Manage," as shown in Figure 3.13-2, choose the file format for exporting data, and click "OK." Click on "User-Defined Format," as shown in Figure 3.13-3, to manually create and edit the file format for exporting data.

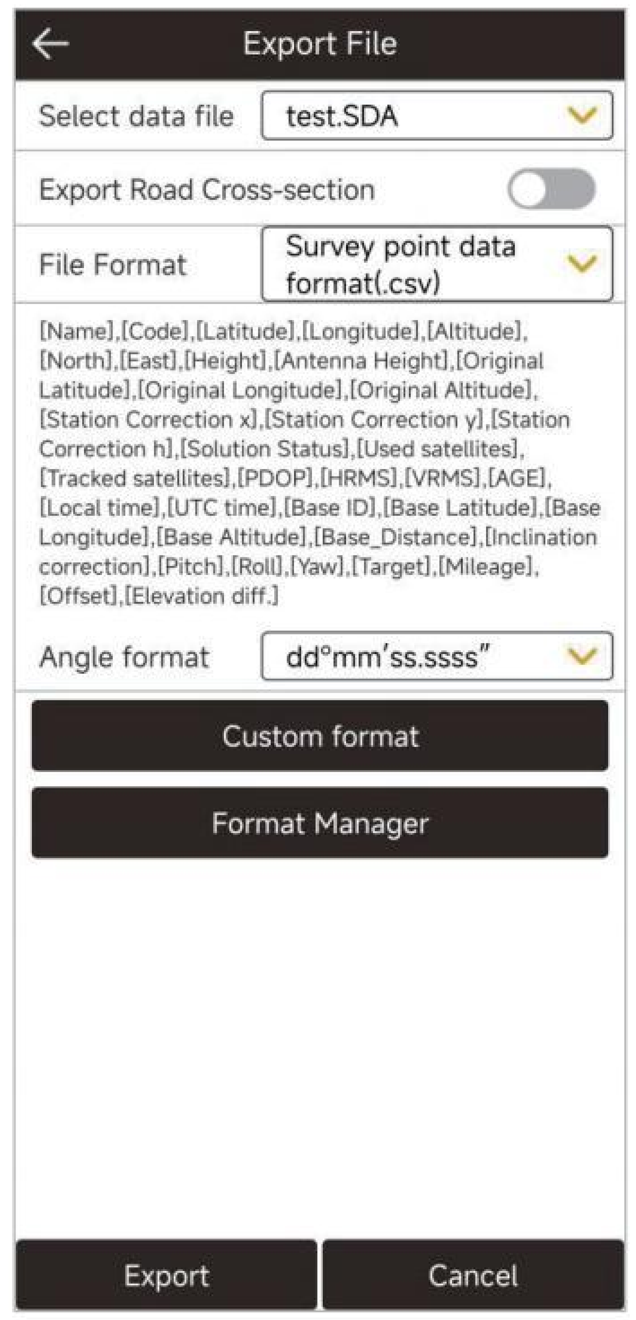


Figure 3.13-1

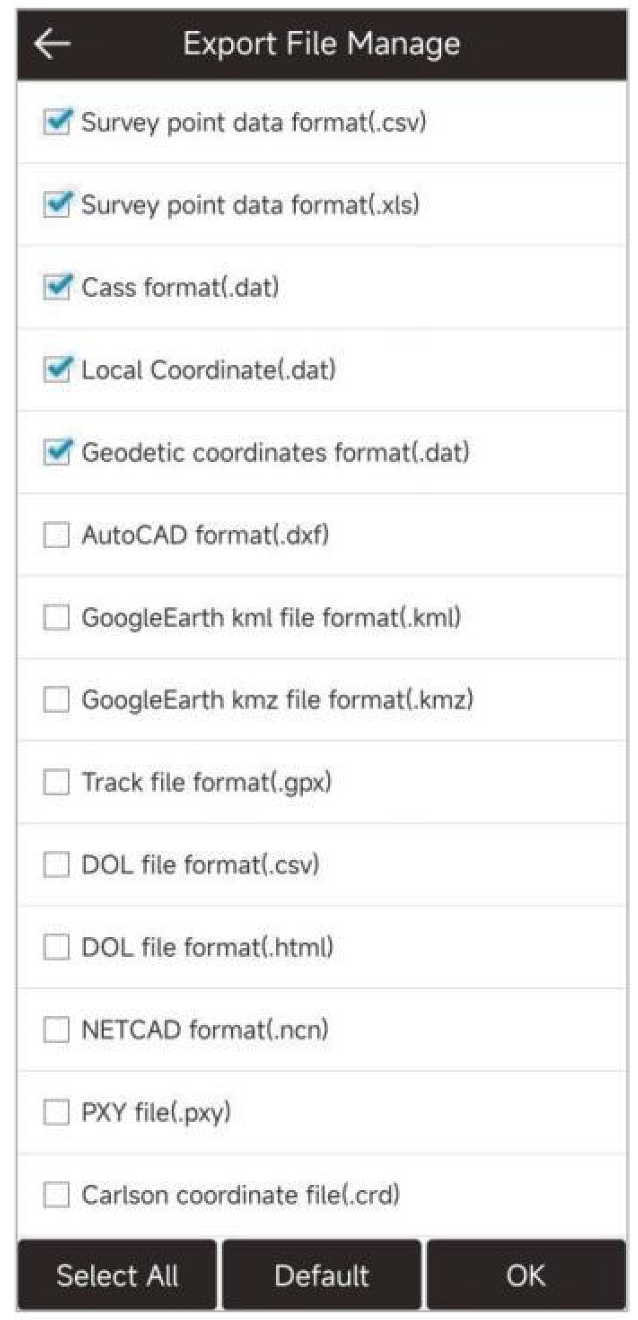


Figure 3.13-2

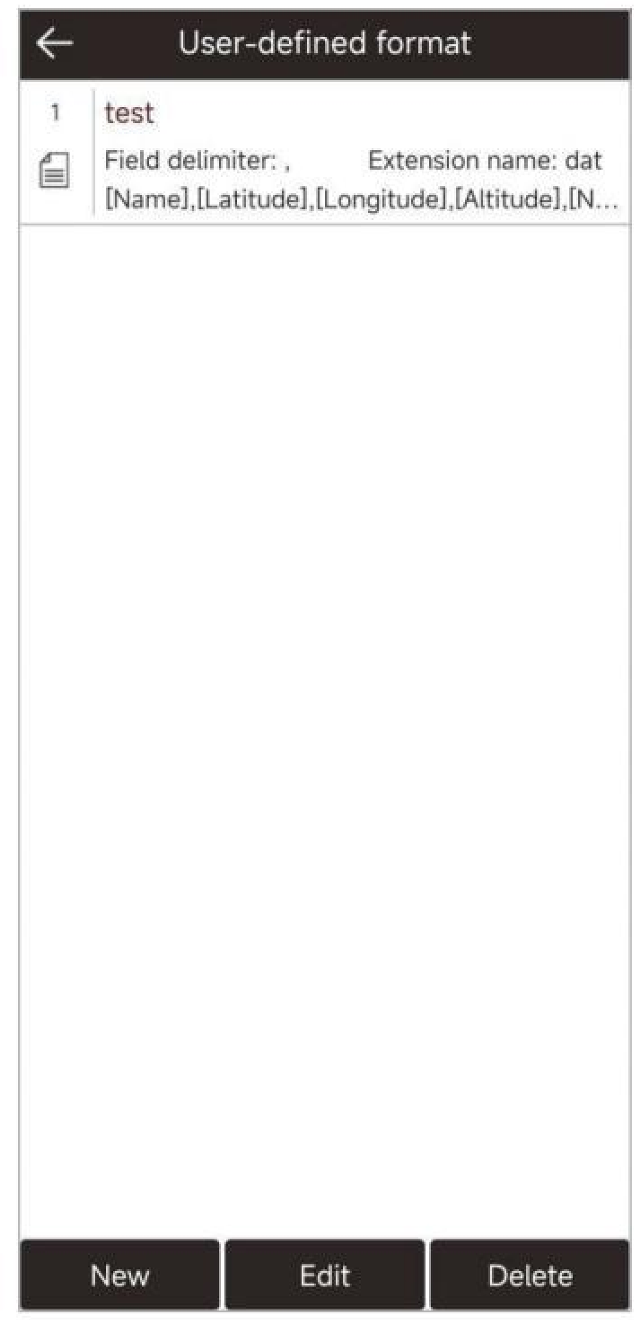


Figure 3.13-3

3.14 Device Information

Click "Device" -> "Device Information", as shown in Figure 3.14. Here, you can view basic information about the GNSS device, including its operating mode, device serial number, firmware version, battery status, expiration time, satellite systems, antenna parameters, and more.

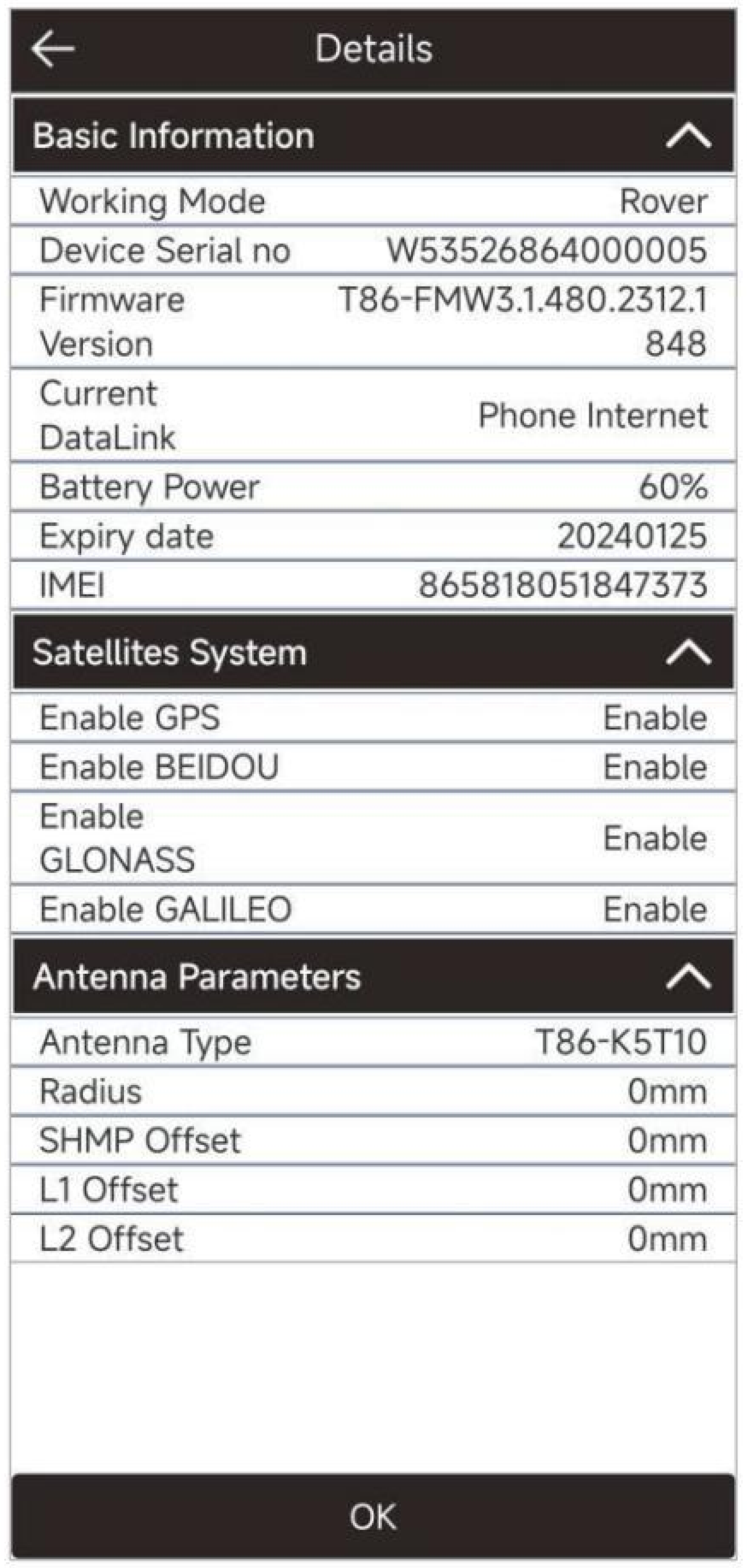


Figure 3.14

4. Device and Software Activation

4.1 Device Activation

Click "Device" -> "Device Activation", as shown in Figure 4.1, to view the device serial number and expiration date. If the GNSS device has expired, you can obtain the registration code from the dealer and authorize the device registration here.

Figure 4.1

4.2 Software Activation

Click "Project" -> "About Software", as shown in Figure 4.2-1, to view the software's version information and registration authorization details.

Click "Check for New Versions". If there is a new version, a popup with information about the update will appear. Click "Update" to install the latest version of the software. If there is no new version, a message will indicate that the software is already up to date.

Click "Software Registration", and it will take you to the software registration interface, as shown in Figure 4.2-2. Here, you can view the activation ID and expiration date.

For the first-time software installation, click on "Online Activation." This allows you to activate the software for free for one month directly.

Click on "Manual Code Activation", as shown in Figure 4.2-3. Here, you can input the authorization code or scan the QR code to activate the software.

If you need to change to a new controller, you can click "Transfer Registration Code" in the old controller. After that, enter the transferred activation code in the software registration of the new controller to activate the software.

Figure 4.2-1

Figure 4.2-2

Figure 4.2-3

5.Specifications

ITEM		SPECIFICATIONS	REMARKS
Hardware system OS		Qualcomm Cortex-A7 Linux	
GNSS	GPS	L1 C/A, L2P, L5	
	GLONASS	L1, L2	
	BDS	B1I, B2I, B3I, B1C, B2a	
	GALILEO	E1, E5a, E5b	
	QZSS	L1, L2, L5	
	Channel	1408	
	Data format	NMEA-0183	
	Correction I / O Protocol	RTCM3.X	
	Data update frequency	5Hz(max)	
	Recapture Time	<1s	
	Cold Boot	<40s	
POSITIONING ACCURACY	Single (RMS)	Horizontal : 1.5m vertical : 2.5m	
	DGPS (RMS)	Horizontal : 0.4m vertical : 0.8m	
	RTK (RMS)	Horizontal : ±(8mm+1ppm) Vertical : ±(15mm+1ppm)	
	Time Accuracy (RMS)	10ns	
	Static Accuracy(RMS)	Horizontal : ±(2.5mm+0.5ppm) Vertical : ±(5mm+0.5ppm)	
	Speed Accuracy(RMS)	0.2m/s	
	Tilt compensation Accuracy(within 60°)	<2cm	
SYSTEM	Bluetooth	BR+EDR+BLE	
	WIFI	802.11 b/g/n	
	Network	LTE FDD: B1/2/3/5/8 LTE TDD: B38/39/40/41 GSM: 900/1800MHz	
	Storage	32GB	
INDICATOR	Power Indicator	Show power status	
	Satellite Indicator	Show position status	
	Data link Indicator	Show differential signal status	
	Bluetooth Indicator	Show Bluetooth status	
BATTERY	Battery	3.7V, 9600mAh	
	Work time	More than 16 hours(Typical, Rover, GSM)	The static working mode supports continuous data collection for 24 hours under full power
	Charge	MTK PE+ 1.1/2.0 9V/2A USB PD 12V/1.25A 5V/3A	Support fast charging adapter and adaptively and dynamically adjust charging current

ENVIRONMENTAL	Work Temperature	-20℃~+60℃	
	Storage Temperature	-40℃~+85℃	
	Shock	Withstand 1.5M pole drop	
	Protection	IP65	
PHYSICAL	Material	Magnesium alloy main body, ABS/PC top cover	
	Dimension	100.5mm*100.5mm*69mm	
	Weight(g)	<510g	

REVISE

Revision	Revision History	Revision date
V1.0	Initial	2024-01-10

Frequencies and Emission Power for the GPS/ Bluetooth/Wi-Fi/LTE/GSM

GPS

The requirement for the following technical information of the EUT was tested in this report:

	GNSS	GNSS Signal Designations	RNSS Frequency Band (MHz)
Supported GNSS, GNSS signals and RNSS frequency bands	BDS	B1I	1 559 to 1 610
		B1C	1 559 to 1 610
	Galileo	E1	1 559 to 1 610
		E5a	1 164 to 1 215
		E5b	1 164 to 1 215
	GLONASS	G1	1 559 to 1 610
		G2	1 215 to 1 300
	GPS	L1 C/A	1 559 to 1 610
		L1C	1 559 to 1 610
		L2C	1 215 to 1 300
		L5	1 164 to 1 215
Antenna Type	Integrated Antenna		

Equation 4-1: Maximum degradation in C/N_0

$$\Delta\ C/N_0 \leqslant 1\ dB$$

GNSS	GNSS Signal Designations	RNSS Frequency Band (MHz)
BDS	B1I	1 559 to 1 610
	B1C	1 559 to 1 610
Galileo	E1	1 559 to 1 610
	E5a	1 164 to 1 215
	E5b	1 164 to 1 215
	E6	1 215 to 1 300
GLONASS	G1	1 559 to 1 610
	G2	1 215 to 1 300
GPS	L1 C/A	1 559 to 1 610
	L1C	1 559 to 1 610
	L2C	1 215 to 1 300
	L5	1 164 to 1 215
SBAS	L1	1 559 to 1 610
	L5	1 164 to 1 215

Table 1: GNSS, GNSS signals and RNSS frequency bands

Frequency band (MHz)	Test point centre frequency (MHz)	Blocking signal power level (dBm)	Comments
1 518 to 1 525	1 524	-65	MSS (space-to-Earth) band
1 525 to 1 549	1 548	-95	MSS (space-to-Earth) band
1 549 to 1 559	1 554	-105	MSS (space-to-Earth) band
1 559 to 1 610	GUE RNSS band under test		
1 610 to 1 626	1 615	-105	MSS (Earth-to-space) band
1 626 to 1 640	1 627	-85	MSS (Earth-to-space) band

Frequency band (MHz)	Test point centre frequency (MHz)	Blocking signal power level (dBm)	Comments
960 to 1 164	1 154	-75	AM(R)S, ARNS band
1 164 to 1 215	GUE RNSS band under test		
1 215 to 1 260	GUE RNSS band under test		
1 260 to 1 300	GUE RNSS band under test		
1 300 to 1 350	1 310	-85	Radiolocation, ARNS, RNSS (Earth-to-space) band

Wi-Fi

The requirement for the following technical information of the EUT was tested in this report:

Frequency Range	802.11b/g/n(20 MHz): 2.412 GHz - 2.472 GHz f_c = 2412 MHz + (N-1)*5 MHz, where - f_c = "Operating Frequency" in MHz, - N = "Channel Number" with the range from 1 to 13. 802.11n(40 MHz): 2.422 GHz - 2.462 GHz f_c = 2412 MHz + (N-1)*5 MHz, where - f_c = "Operating Frequency" in MHz, - N = "Channel Number" with the range from 3 to 11. The frequency block is 2.4GHz-2.4835GHz
Modulation Type	DSSS, OFDM
Equipment Type (LBT / non- LBT)	LBT based Detect and Avoid
Adaptive or non-adaptive	Adaptive
LBT Based	Yes (Load Based)
Antenna System (eg., MIMO, Smart Antenna)	N/A
Categorization as Correlated or Completely Uncorrelated	N/A
Antenna Type	Integrated Antenna
Antenna Gain	1.0 dBi (In test items related to antenna gain, the final results reflect this figure. This value is provided by the applicant.)
Beamforming Gain	N/A
The Max RF Output power	16.0 dBm
Receiver Category	1

Bluetooth

The requirement for the following technical information of the EUT was tested in this report:

Modulation Technology	Bluetooth(For Classic): FHSS Bluetooth Low Energy: Wide band modulations other than FHSS
Modulation Type	Bluetooth(For Classic): GFSK, π/4-DQPSK, 8-DPSK Bluetooth Low Energy: GFSK
Transfer Rate	DH5: 1 Mbps 2DH5: 2 Mbps 3DH5: 3 Mbps BLE: 1 Mbps

Frequency Range	The frequency range used is 2402 MHz – 2480 MHz; The frequency block is 2400 MHz to 2483.5 MHz.
Number of channel	Bluetooth(For Classic): 79 (at intervals of 1 MHz) Bluetooth Low Energy: 40 (at intervals of 2 MHz)
Tested Channel	Bluetooth(For Classic): 0 (2402 MHz), 39 (2441 MHz), 78 (2480 MHz) Bluetooth Low Energy: 1 Mbps: 0 (2402 MHz), 19 (2440 MHz), 39 (2480 MHz)
Nominal Channel Bandwidth	1 MHz
Antenna Type	Integrated Antenna
Antenna Gain	1.0 dBi (In test items related to antenna gain, the final results reflect this figure. This value is provided by the applicant.)
Beamforming Gain	N/A
Adaptive or Non-Adaptive	Adaptive
LBT Based	Non-LBT
The Max RF Output power	Bluetooth (For Classic): 8.9 dBm Bluetooth Low Energy: 0.3 dBm
Receiver Category	Bluetooth (For Classic): 2 Bluetooth Low Energy: 2

Description	Modulation Type (BT for Classic)	Modulation Type (BLE)	Transfer Rate (BT for Classic)	Transfer Rate (BLE)
Transmitter Parameters				
RF output power	GFSK, π/4-DQPSK, 8-DPSK	GFSK	DH5: 1 Mbps 2DH5: 2 Mbps 3DH5: 3 Mbps	1 Mbps
Power Spectral Density	N/A	GFSK	N/A	1 Mbps
Duty Cycle, Tx-sequence, Tx-gap	N/A	N/A	N/A	N/A
Accumulated Transmit Time, Frequency Occupation and Hopping Sequence	GFSK, 8-DPSK	N/A	DH5: 1 Mbps 3DH5: 3 Mbps	N/A
Hopping Frequency Separation	GFSK, 8-DPSK	N/A	DH5: 1 Mbps 3DH5: 3 Mbps	N/A
Medium Utilization (MU) factor	N/A	N/A	N/A	N/A
Adaptivity	--	--	N/A	N/A
Occupied Channel Bandwidth	GFSK, 8-DPSK	GFSK	DH5: 1 Mbps 3DH5: 3 Mbps	1 Mbps
Transmitter unwanted emissions in the out-of-band domain	GFSK, 8-DPSK	GFSK	DH5: 1 Mbps 3DH5: 3 Mbps	1 Mbps
Transmitter unwanted emissions in the spurious domain	GFSK, 8-DPSK	GFSK	DH5: 1 Mbps 3DH5: 3 Mbps	1 Mbps
Receiver Parameters				
Receiver spurious emissions	GFSK, 8-DPSK	GFSK	DH5: 1 Mbps 3DH5: 3 Mbps	1 Mbps
Receiver Blocking	GFSK	GFSK	DH1: 1 Mbps	1 Mbps
Other Parameters				
Geo-location capability	N/A	N/A	N/A	N/A

GSM

The EUT in this report supports GPRS and EGPRS with 8PSK uplink:

Operating Bands	GSM 900/1800			
Modulation Type	GPRS: GMSK EGPRS: 8PSK			
Channel Spacing	200kHz			
Number Of Channel	GSM 900 MHz: 975-1023&1-124 GSM 1800 MHz: 512-885			
The Max RF Conducted Power	GPRS900: 27.94 dBm GPRS1800: 26.12 dBm			
Multislot Class	GPRS: Class 33 EGPRS: Class 33 Max Downlink Timeslot: 5 Max Uplink Timeslot: 4 Max Active Timeslot: 6			
Band	Power Class GMSK	Power Class 8PSK	Tx Frequency Range	Rx Frequency Range
900	4	E2	880 MHz ~ 915 MHz	925 MHz ~ 960 MHz
1800	1	E2	1710 MHz ~ 1785 MHz	1805 MHz ~ 1880 MHz

LTE

The following is the technical information of the EUT tested frequency bands in this report.

E-UTRA Operating Bands	FDD LTE Band 1/3/5/8 TDD LTE Band 38/39/40/41		
E-UTRA Capabilities	Single Carrier		
Modulation Type	QPSK/16QAM		
The Max RF Conducted Power	Band 1: 21.64 dBm Band 3: 21.97 dBm Band 5: 21.97 dBm Band 8: 22.16 dBm Band 38: 22.28 dBm Band 39: 21.77 dBm Band 40: 21.66 dBm Band 41: 22.51 dBm		
Release Version	Rel.10		
UE Category	4		
Channel Bandwidths for Single Carrier	Band 1: 5 MHz, 10 MHz, 15 MHz, 20 MHz Band 3: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz Band 5: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz Band 8: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz Band 38: 5 MHz, 10 MHz, 15 MHz, 20 MHz Band 39: 5 MHz, 10 MHz, 15 MHz, 20 MHz Band 40: 5 MHz, 10 MHz, 15 MHz, 20 MHz Band 41: 5 MHz, 10 MHz, 15 MHz, 20 MHz		
Band	Power Class	Tx Frequency Range	Rx Frequency Range
1	3	1920 MHz ~ 1980 MHz	2110 MHz ~ 2170 MHz
3	3	1710 MHz ~ 1785 MHz	1805 MHz ~ 1880 MHz
5	3	824 MHz ~ 849 MHz	869 MHz ~ 894 MHz
8	3	880 MHz ~ 915 MHz	925 MHz ~ 960 MHz
38	3	2570 MHz ~ 2620 MHz	2570 MHz ~ 2620 MHz
39	3	1880 MHz ~ 1920 MHz	1880 MHz ~ 1920 MHz
40	3	2300 MHz ~ 2400 MHz	2300 MHz ~ 2400 MHz
41	3	2555 MHz ~ 2655 MHz	2555 MHz ~ 2655 MHz