Freyja GNSS RTK System

User Manual

Manual Revision

Revision Date	Revision Level	Description
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Freyja

GNSS RTK System User Manual

Preface

Introduction

Welcome to the Satlab Freyja receiver. This introduction describes how to use this product.

Experience requirement

To help you use the Satlab series products better, Satlab suggests that you read the instructions carefully. If you are unfamiliar with the products, please refer to *www.satlab.com.se*

Tips for safe use

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

Warning: The contents here are generally very important as the wrong operation may damage the machine. This can lead to the loss of data, or even break the system and endanger your safety.

Exclusions

Before using the product, please read these operating instructions carefully, as they will help you to use it better. Satlab Geosolutions AB. assumes no responsibility if you fail to operate the product according to the instructions, or operate it wrongly because you have misunderstood them.

Satlab is committed to constantly perfecting the product's functions and performance, improving its service quality, and reserves the right to change these operating instructions without notice.

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

Technology and service

If you have any technical issues, please call the Satlab technology department for help, and we will answer your question.

Relevant information

You can obtain this introduction by:

Purchasing Satlab products: this manual is found in the instrument container and will help you to operate the instrument.

Logging on to the Satlab official website and downloading the electronic version of this introduction from *Partner Center*: *http://members.satlab.com.se//*

Advice

If you have any suggestions for this product, please email them to: *info@satlab.com.se* Your feedback information will help us to improve the product and service.

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Chapter 1

Overview

This chapter contains:

- Foreword
- Features
- Use and precautions

1.1 Foreword

Freyja GNSS RTK receiver brings superior performance and high efficiency that will support your fieldwork with reliable solutions. Its deployment of the advanced RTK engine and new-generation IMU guarantees a 25% performance improvement even in the most demanding environments. Thus you can count on Satlab Freyja to provide you with better productivity.

1.2 Features

1. Its more durable and portable with an ultra-light EPP material instrument case.

2. It can bring accurate and reliable results and boost efficient fieldwork with a self-developed built-in IMU and core algorithm.

3. Equipped with the High-performance Patch Antenna, it both enhances the low elevation angle tracking capabilities and maintains a high gain for higher elevation satellites.

4. It does not provide overly optimistic coordinate quality and guarantees the high reliability of RTK fixed positions, improving accuracy better than 8 cm by 20 %.

5. Hi-Fix technology enables both continuous connectivity and quality results.

1.3 Use and precautions

The Freyja GNSS receiver is designed to have chemical and impact resistance, but precision instruments require careful use and maintenance.

Notice:

1. The receiver must be within the specified temperature range when it is used and stored. For detailed requirements, please refer to Chapter 3: Technical specification.

2. Recommend a separation distance of 1m or more should be maintained between this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended.

3. The product shall not be permanently installed outdoor because protection against water and dust is not guaranteed Please bring back to indoors in rainy weather.

4. This device needs a license from the national regulatory authority before can be put into service.

Notice:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

In order to ensure the continuous tracking observation of the satellite and quality of the satellite signal, the space above the station should be as wide as possible, with no obstacles above the 15° elevation angle. To reduce the interference of various electromagnetic waves on the GNSS satellite signal, there should be no strong electromagnetic interference within a range of about 200m around the station, such as TV towers, microwave stations, and high-voltage transmission lines. To avoid or reduce the occurrence of multipath effects, the station should be away from terrain and features with strong reflectors, such as high-rise buildings, water, etc.

Chapter 2

Product introduction

This chapter contains:

- Overall appearance
- Button & LED
- WEB management system
- Static survey
- Tilt survey
- Firmware upgrade

2.1 Overall appearance

The product's appearance is divided into three parts, including the upper cover, bottom cover and control panel.

Figure 2-1-1

2.1.1 Upper cover

Figure 2-1-2

2.1.2 Bottom cover

The bottom cover includes the SMA antenna interface, Type-C USB interface.

Figure 2-1-3

1. SMA antenna interface 2. Connection screw 3. Speaker 4. Type-C USB interface

◇ SMA antenna interface: Connect the radio antenna while using the *Internal UHF* mode.

◇ Type-C USB interface: To upgrade the firmware and download static data.

◇ Protective plug: Used for dustproof and waterproof sockets.

Notice:

1. If you don't use the SMA antenna interface and USB interface, please cover the rubber plug to protect them from dust and water.
2. When the speaker is flooded, the sound may be silent or hoarse, but it will return to normal after it has dried.

2.1.3

Control cover

The control panel includes a satellite light, power button and data light.

Figure 2-1-3

1. Satellite LED 2. Data LED 3. Power button

2.2 Button & LED

2.2.1 Button function

Table 2-2-1 Button function description

Function	Description
Power-on	Long press the power button for 1 second.
Power-off	In the power-on state, long press the power button for more than 3 seconds but less than 6 seconds.
Forced shutdown（use when the device crashes）	Press the power button for at least 12 seconds.
Query current status	Press the power button once to voice the product's current working status.
Reset motherboard	When the device is powered on, long press the power button for 6 seconds and release it after hearing the second "dingdong" sound.
Switch working mode	Double-click the power button to enter the mode switch. After each double-click, switch to a working mode, and click the power button to confirm it.
One-key setting station	When the device is powered off, long press the power button for 6s to turn it on.

2.2.2 LED

Table 2-2-2 LED function description

Function	Status	Description
Power LED(red)	Long-term lighting	When the device is powered off, it is for charging the device.
	OFF	It is not charging or fully charged.
Power LED(green)	Flash	The power ≤10%.
	Long-term lighting	1. RTK mode: No correction data. 2. Static mode: Sampling has not started.
	Flash	1. RTK mode: Flashes at the frequency of the correction transmit and receives. 2. Static mode:

Function	Status	Description
Data LED		Sampling interval >1s: Flashes at the sampling interval. Sampling interval ≤1s: Flashes once per second.
	Off	1. RTK mode: No correction data. 2. Static mode: Sampling has not started.
 Satellite LED	Long-term lighting	Satellite is tracked.
	Flash	Satellite is not tracked.

2.3 WEB management system

Freyja has a built-in web management system that can be used to set the receiver's working mode, data output, as well as view receiver information and satellite information. The receiver's Wi-Fi name is its S/N. You can connect it to a controller or phone (the default password is: 12345678) and then input the IP address *192.168.20.1* into the browser to log onto the web management system.

Note: The web management system can only be visited when the receiver's Bluetooth isn't connected.

2.3.1 Main menu

After logging into the web management system, you can click Start to enter the main menu interface. Each option of the main menu contains drop-down menus.

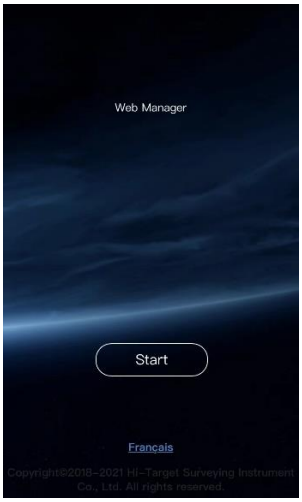


Figure 2-3-1 Home

Figure 2-3-2 Main menu

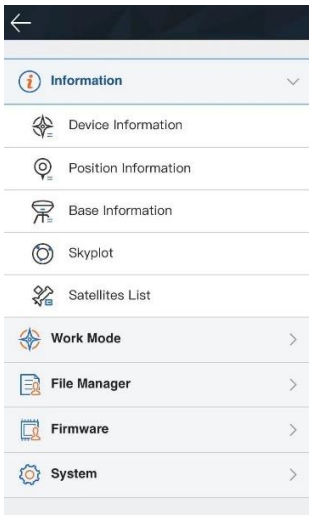


Figure 2-3-3 Information

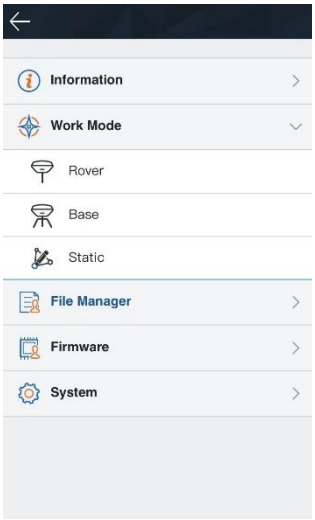


Figure 2-3-4 Work mode

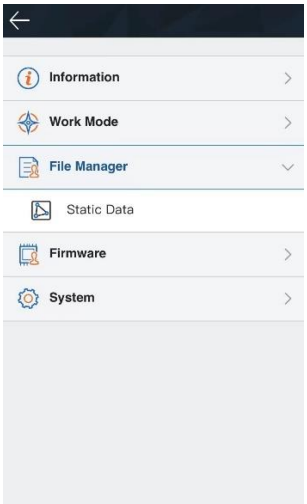


Figure 2-3-5 File manager

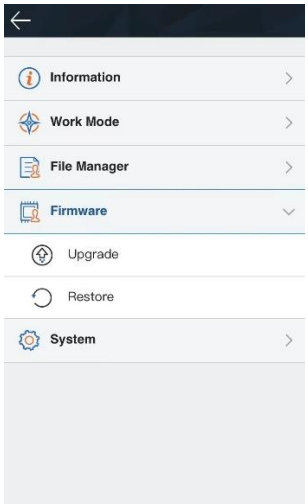


Figure 2-3-6 Firmware

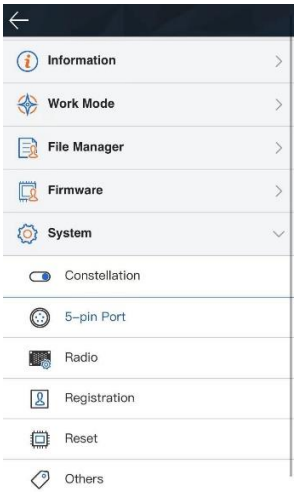


Figure 2-3-7 System

Table 2-3-1 Menu description

Main menu	Sub-menu	Description
Information	Device info	Device model, version, registration info, etc.
	Position info	Coordinates, satellite tracking, solution state, etc.
	Base info	Coordinates and distance to the base
	Sky plot	Check the sky plot
	Satellites list	Satellite tracking information
Work mode	Rover	Data link and parameter settings of the rover
	Base	Data link and parameter settings of the base
	Static	Static measurement parameter settings
File manager	Static data	Download, delete and format static data
Firmware	Upgrade	Select and upgrade the firmware
	Restore	Restore the system
System	Constellation	The satellite tracking switches
	Five-pin port	Output settings of the five-pin
	Radio	Radio frequency list
	Reset	Reset the motherboard
	Registration	Device registration and information
	Others	Switch of the static RINEX and volume control, etc

2.3.2 Information

1. Device information

Includes the main information about the device: device model, S/N, firmware version, OEM info, battery power, work mode, configuration parameters, etc.

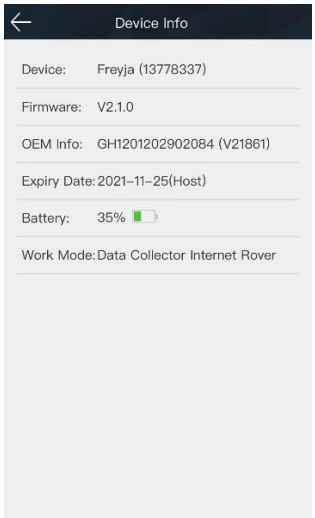


Figure 2-3-8 Device information

2. Position information

Includes the device's position, satellites, solution state, latency, PDOP and time, etc.

Figure 2-3-9 Position information

3. Base information

Includes the coordinates and distance of the base in the rover mode.

Figure 2-3-10 Base information

4. Sky plot

Displays the visual satellites of the device and the switches of each constellation.

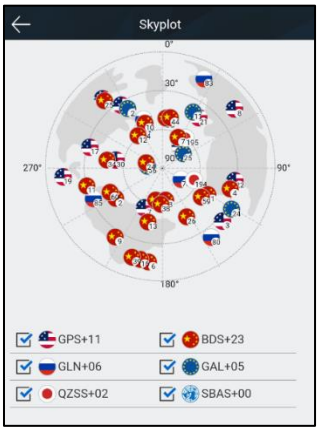
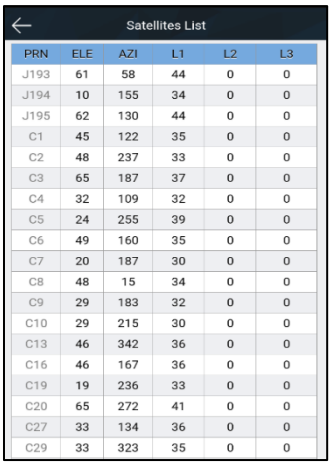


Figure 2-3-11 Sky plot

5. Satellites list

Shows the satellite's tracked information.



PRN	ELE	AZI	L1	L2	L3
J193	61	58	44	0	0
J194	10	155	34	0	0
J195	62	130	44	0	0
C1	45	122	35	0	0
C2	48	237	33	0	0
C3	65	187	37	0	0
C4	32	109	32	0	0
C5	24	255	39	0	0
C6	49	160	35	0	0
C7	20	187	30	0	0
C8	48	15	34	0	0
C9	29	183	32	0	0
C10	29	215	30	0	0
C13	46	342	36	0	0
C16	46	167	36	0	0
C19	19	236	33	0	0
C20	65	272	41	0	0
C27	33	134	36	0	0
C29	33	323	35	0	0

Figure 2-3-12 Satellites list

2.3.3 Work mode

1. Rover

Set up the rover's data link and parameters. The rover station data link includes: *Internal UHF.*

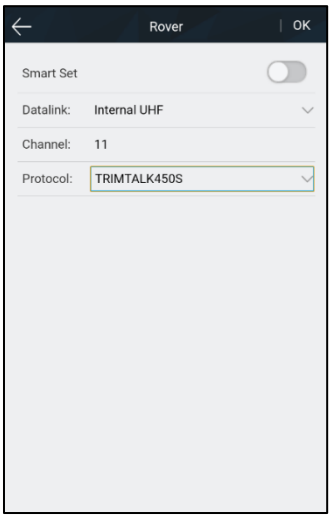


Figure 2-3-13 Rover

2. Base

Set up the data link and parameters of the base and get the point coordinates by averaging. The base station data link mode includes: *Internal UHF.*

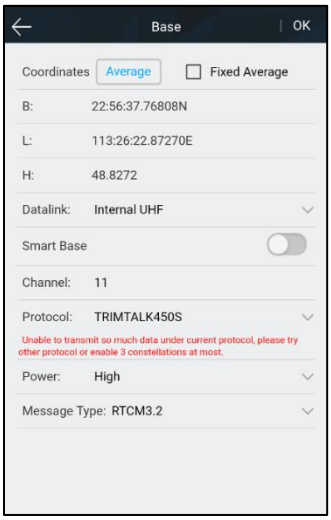


Figure 2-3-14 Base

3. Static

Set up the file name and parameters of the static collection.

Note: After ticking *Static Mode*, you can only cancel it in the base rover setting interface.

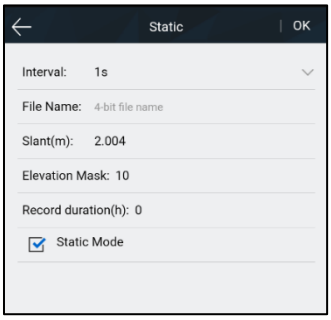


Figure 2-3-15 Static

2.3.4 File manager

1. Static data

Display the static data files, which supports the Download, Delete and Format options.

Note: After checking the "Static Mode", you can only uncheck the "Static Mode" in the base station mode or rover mode.

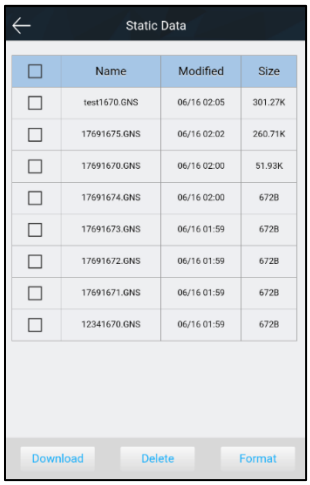


Figure 2-3-16 Static data

2.3.5 Firmware

1. Upgrade

Display specific device version information. Click Select, choose the upgrade package and then click Start. The receiver will automatically detect it and upgrade the firmware.

Figure 2-3-17 Upgrade

2. Restore

You can restore the system to its state after the last firmware upgrade.

Figure 2-3-18 Restore

2.3.6 System

1. Constellation

Switches of the satellite tracking.

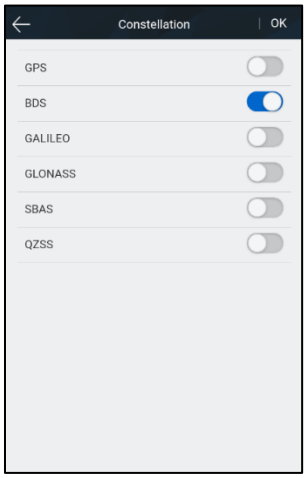


Figure 2-3-19 Constellation

2. Radio

You can select the radio modulation protocol (HI-TARGET19200, HI-TARGET9600, TRIMTALK450S, TRIMTALK III, SATEL-3AS, SOUTH19200, SOUTH9600, CHC19200, CHC9600, TRANSEOT).

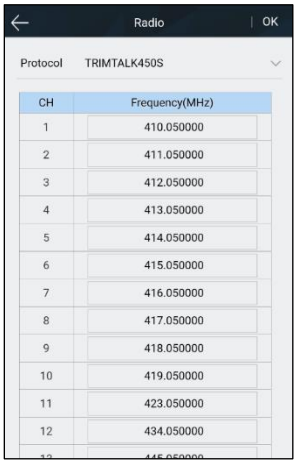


Figure 2-3-20 Radio

3. Registration

Display the registration information of the receiver. You can select the registration type, and then enter the corresponding code to register online.

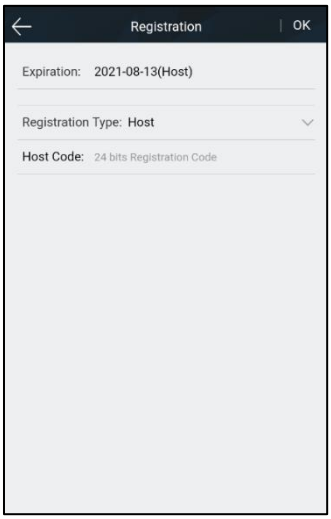


Figure 2-3-21 Registration

4. Reset

Reset the motherboard.

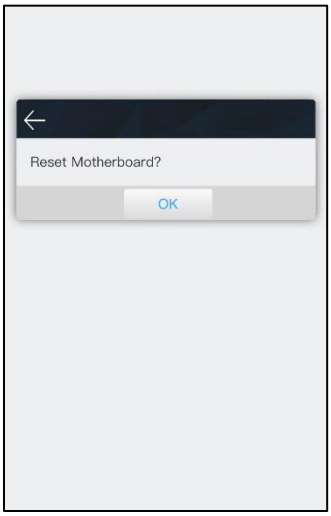


Figure 2-3-22 Reset

5. Others

You can set the switches of the Store RINEX Data and Check Base Position, select the RINEX version, and adjust the voice volume of the receiver.

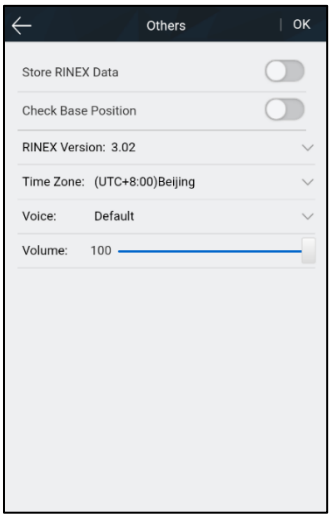


Figure 2-3-23 Others

2.4 Static survey

Static survey is a kind of positioning survey, which is mainly used to establish various control networks.

2.4.1 Static settings

There are two ways to set up the device to work in the static mode:

1. Hi-Survey Road software – static interface – to set up the static or temporary static mode.

2. Web interface – work mode – to set up the static or temporary static mode.

Users can download the static data file to the computer, if necessary, and then use the static post-processing software (HBC data processing software package) to process the data.

2.4.2 Static data collection steps

1. Set up the receiver on a control point with a tripod, making sure the tripod is strictly centered and leveled. The benchmark must be installed.

2. Measure the slant height of the receiver three times in three directions, ensuring that the difference of each measurement is less than 3mm, and then take the average value as the final height. The slant height of the receiver is measured from the center of the measuring point to the upper part of the top of the benchmark.

(Note: The radius of the benchmark is 0.130m, and the benchmark's distance from the phase center of the receiver is 0.0848m.)

3. Record the point name, S/N, receiver height and beginning time.

4. Press the power button to power-on and set up the static collecting mode.

5. Turn off the receiver after the static data is collected and record the turn-off time.

6. Download and post-process the static collection data.

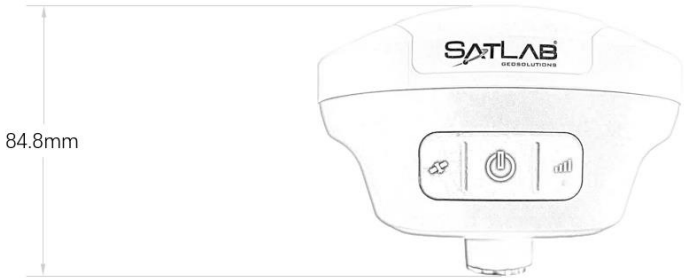


Figure 2-4-1

Notice: Don't move the tripod or change the collecting set while the receiver is collecting data.

2.4.3 Static data download

1. Download by USB cable

Connect the receiver to a computer with the Type-C USB cable and copy the static data to the computer. The static data is in the GNSS folder of the static drive.

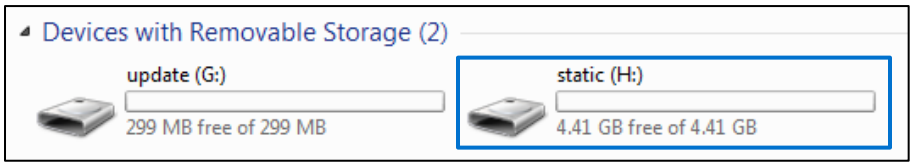


Figure 2-4-2

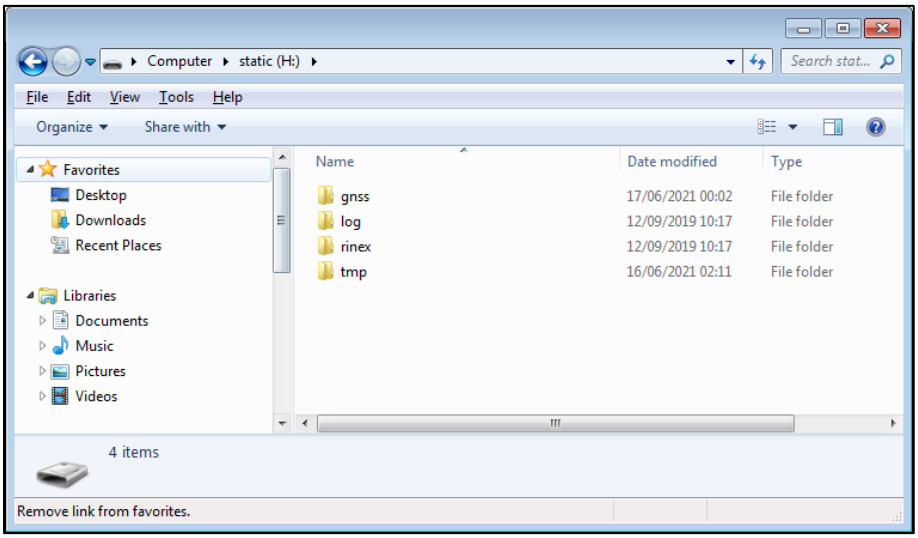


Figure 2-4-3

2. Download in the web management system

The Wi-Fi name of the receiver is its S/N. You can connect it to a controller or phone (the default password is: 12345678) and then input the IP address 192.168.20.1 into the browser to log into the WEB management system. Now, open the file manager interface and select the static file that needs to be exported. Click Download and the file can be downloaded to the controller or phone.

The default save path of the static data to be downloaded from the website is: device internal storage > MyFavorite. You can customize the save path according to your needs.

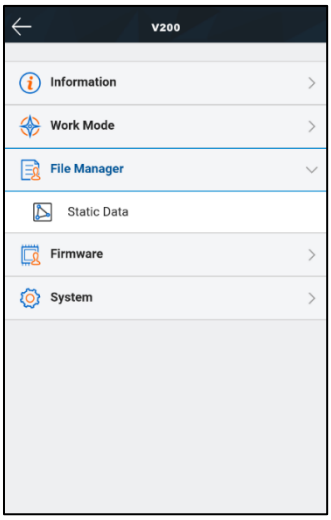


Figure 2-4-4

Figure 2-4-5

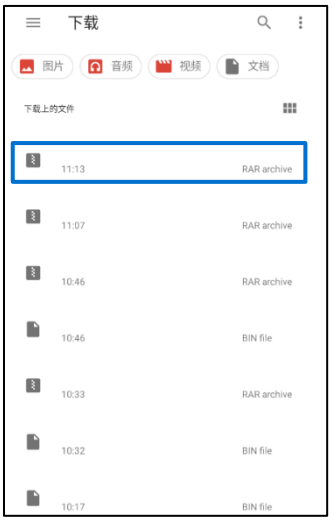


Figure 2-4-6

2.5 Tilt survey

2.5.1 Calibration-free tilt survey

Connect the receiver in the Satsurv software to open the Tilt Survey in the Survey → Surveying Configure → Data interface. Click the Tilt Survey icon and follow the prompt on the Hi-Survey Road interface to finish the initialization.

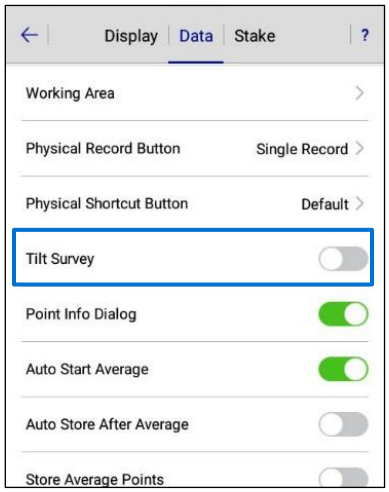


Figure 2-5-1

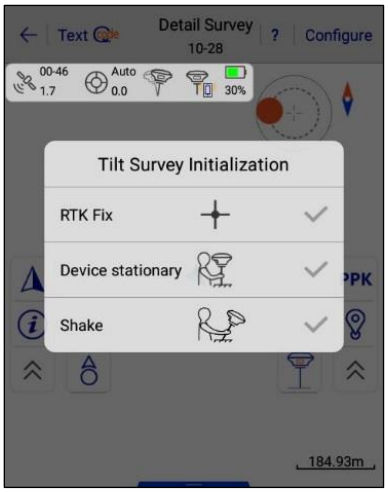


Figure 2-5-2

1. Device stationary

When the receiver gets the fixed solution, keep the receiver static until Device stationary is marked with ✓

2. Shake

After Device stationary is finished, shake the receiver back and forth (once every second) for initialization until Shake is marked with ✓

When all of the initialization items are ticked, the receiver prompts “Tilt compensation started” and the tilt survey icon becomes illuminated. This means that the tilt survey initialization is now complete and you can perform the tilt survey on the receiver.

Notice:

1. Make sure the actual pole height is consistent with the set pole height before the tilt survey.

2. When turning on the Tilt Survey switch, you will need the initialization operation before normal use.

3. To meet most the users' operational needs, the maximum measurement angle of the tilt survey is 70°.

4. To ensure the measurement accuracy, do not turn the device quickly during the measurement process.

5. The data quality is not good in the occluded environment. If the accuracy requirements are high, please try to use this function in an open environment.

6. When you enter the tilt survey for the first time every 7 days, you need to complete the static calibration according to the prompts. Just let the device stand for about 10s to complete this.

2.6 Firmware upgrade

You can upgrade the firmware of the receiver, motherboard and module by using a USB cable, the web management system and remote online.

2.6.1 Upgrade by USB cable

Steps to using a USB cable in order to upgrade the firmware:

1. Turn on the receiver and connect the receiver and the computer with the cable attached. This will show the update drive.

2. Copy the firmware (which can be downloaded from our official website or the technical team) to the update drive. Disconnect the computer and receiver and restart the receiver, which automatically recognizes the firmware and starts upgrading the firmware.

3. There will be different prompt voices for the success or failure of the upgrade. If it fails, please contact our technical team.

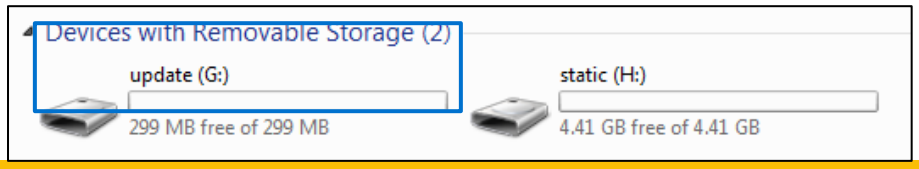


Figure 2-6-1

2.6.2 Upgrade by using the web management system

Copy the firmware to the controller or phone and use Wi-Fi to connect it to the receiver. The name of the Wi-Fi is the device's S/N. Now, input 192.168.20.1 to log in, click Firmware upgrade - Select - File to choose the firmware, and then click start to upgrade it.

Notice:

1. When the download fails, it will resume downloading if the network recovers within two minutes; otherwise, it will exit the firmware upgrade detection.

2. It will not forcibly power-off during the upgrade. If the power is forcibly cut off, the instrument may be damaged and become abnormal.

Chapter 3

Technical specification

This chapter contains:

- Technical specification

3.1 Technical parameters

Table 3-1-1 Technical parameters

Configuration		Detailed Indicators
GNSS configuration	Satellite signals tracked simultaneously	BDS: B1, B2, B3
		GPS: L1, L2, L5
		GLONASS: L1, L2
		GALILEO: E1, E5a, E5b
		QZSS: L1, L2, L5
	Output format	ASCII: NMEA-0183, Binary data
	Positioning output	1~20Hz
	Static data format	GNS and RINEX
	Message type	CMR, RTCM3.0, RTCM3.2
System configuration	Operating system	Linux system and Soc processor
	Data storage	8G internal storage
Accuracy and reliability[1]	RTK position precision	Horizontal: ± (8+1×10-6D) mm (D is the distance between measurement points)
		Vertical: ± (15+1×10-6D) mm (D is the distance between measurement points)
	Static measurement precision	Horizontal: ± (2.5+0.5×10-6D) mm (D is the distance between measurement points)
		Vertical: ± (5+0.5×10-6D) mm (D is the distance between measurement points)
Tilt survey	Accuracy	Horizontal: 8mm+1ppm+0.8mm/°
	Static keep time	＞40 seconds
	Start method	Rotated shake
Data communication	Wi-Fi	802.11 b/g/n Wi-Fi frequency is 2412-2472MHz, max output power: 15.42dBm e.i.r.p
	Bluetooth	Bluetooth® 4.1, frequency 2402-2480Mhz, max output power: 8.54dBm e.i.r.p
	Internal UHF	Power: High, middle, low
		Frequency: 410MHz~470MHz
		Protocol: HI-TARGET, TRIMTALK450S, TRIMMARK III, TRANSEOT, SATEL-3AS, CHC, SOUTH
		Channels: 116 totally, 100~115 configurable

Configuration		Detailed Indicators
User interface	Button	Power button*1
	LED prompt light	3 LED lights, Satellite light, Data light, Power button
WEB UI	WEB website	Internal WEB, Receiver settings, Status checking
Output Port	Radio antenna port	1, SMA port, connect the antenna
	USB port	1, Type-C USB port, firmware upgrade and static data download
Physical	Internal battery	Capacity：6800mAh/7.4V, Rover >10 hours [2]
	Charge time	≤7.0 hours
	Size	132mm*67mm（without battery cover）
	Weight	≤0.82kg
	Power consumption	4.2 W
Environment	Water/dustproof	IP68
	Drop test	1.2m free drop & 2m centering rod drop
	Salt mist	Alternating salt fog 96 hours
	Operation temperature	-30°C ~ +70°C
	Storage temperature	-40°C ~ +80°C

Notice:

1. The device's precision is down to many factors, as it contains number of satellite, geometric distribution, observation time, atmosphere and multipath effect etc.

2. Battery working time is related to the work environment, working temperature and battery life.

Chapter 4

Accessories and interfaces

This chapter contains:

- Data cable
- Antenna
- Battery & charger

4.1 Data cable

Type-C cable: To connect the receiver to the PC for upgrading the firmware and downloading static data.

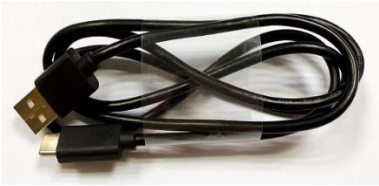


Figure 4-1-1 Type-C cable

4.2 Antenna

The UHF radio antenna is used in the Internal UHF mode.

Figure 4-2-1 UHF radio antenna

4.3 Battery

1. Battery: The receiver has a built-in 6800mAh/7.4V battery.

Notice:

If the battery needs to be stored for a long time, it should be charged to about 70% and then placed in a dry, low temperature environment. It is recommended that you charge and discharge the battery every 3 months. If you do not have the conditions that are needed for charging and discharging, take out the battery after 3 months and charge it to about 70% before storing it once more.

2. Charger: To charge the receiver, use the standard charger. When it is in charge, the power button light will turn red.

Figure 4-3-1 Cable and charger

Notice: Please use this product's standard charger to charge the receiver. We will not be responsible for any accidents that occur during the charging process or any damage to the instrument if you use other chargers instead.

§ 15.19 Labelling requirements.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

§ 15.21 Information to user.
Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

§ 15.105 Information to the user.
Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
-Reorient or relocate the receiving antenna.
-Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help.