SATLAB®
GEOSOLUTIONS

SL900 GNSS RTK System
User Manual

CE IP67

2018

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Manual Revision

SATLAB SL900 GNSS RECEIVER

Revision Date	Revision No.	Description
Dec. 2018	1	SL900 GNSS RTK System User Manual

SL900

GNSS RTK SYSTEM

Table of Contents

Introduction

Welcome to the SatLab SL900 GNSS receiver. This manual describes how to use this product.

Recommendation

SatLab recommends that you read this manual carefully to make better use of the SatLab SL900 receiver. If you still need further information, please visit SatLab's official website: www.satlab.com.se

Safety Tips

Note: The note content is to help you with those parts of the general operation of the receiver that require special attention. Please read carefully.

Warning: The warning content generally provides very important information. If the receiver is not operated in accordance with the warnings, it could cause damage, loss of data, or even endanger your personal safety.

Limitation of Liability

Please be sure to read the instruction manual before use, as it will help you to make better use of this product. If you do not follow the instructions when operating the receiver, or fail to understand the specification's requirements and the proper use of this product, any loss or damage resulting from the misuse will be limited to the terms of SatLab's International Warranty 'Limitation of Liability' clause.

SatLab is committed to the continuous improvement of product functionality and performance, and accordingly, reserves the right to make changes to the product and the contents of this manual without prior notice.

We have reviewed the contents of this publication in conjunction with the hardware and software in order to ensure consistency. However, this does not exclude the possibility of errors. The User's Guide is for reference only. If it deviates from the actual product, then the actual product version prevails.

Your suggestions

If you have any suggestions and comments relating to the SatLab SL900 GNSS receiver, please email them to us at info@satlabgps.com. Your feedback on the quality of our products will be greatly appreciated.

Chapter 1

Overview

This Section Describes

- **Foreword**
- **Features**
- **Precautions**

Foreword

The SL900 is a high-precision GNSS receiver that performs even under the most demanding conditions. It is capable of delivering highly accurate data in real-time to any devices via Bluetooth. With its features of compact size and light weight, this GNSS receiver is one of the most flexible solutions that promises positioning reliability.

SL900 Features

- New design and magnesium alloy structure – so it is smaller size, lighter in weight and higher in quality.
- It has a Linux operating system that is more powerful and reliable.
- The transceiver UHF radio enables you to switch your working modes between the base and the rover.
- The built-in 16G storage space provides support for the insertion of an external SD card.
- The product supports a long-distance Bluetooth and Wi-Fi connection for remote data transmission.
- The accuracy is more guaranteed with gravity acceleration sensor (electronic bubble).
- The product supports the tilt survey with a maximum tilt angle of 30 degrees.
- The new generation controller SHC30 is rugged, long-lasting, and accessible in various environments.
- Based on Android system – uses intelligent measurement Satsurv software to improve work efficiency.
- Multifunctional, by using one key, with a simple and convenient NFC operation that is quick and easy.
- Provides double format storage of static data (*.GNS / RINEX).

Precautions

(1) The product should be operated and stored within the specified ambient temperature range.

(2) Do not place the receiver in a humid, corrosive environment.

(3) To ensure the signal quality of the satellites tracked, the SL900 should be operated clear of obstacles and with a clear sky, where possible.

(4) Avoid, where possible, environments with strong electromagnetic interference, such as TV towers, microwave stations, high voltage transmission lines and other equipment.

(5) In order to avoid or reduce the occurrence of multipath, the receiver should be operated away from electromagnetic 'reflective' features, such as high-rise buildings, water surfaces, etc.

Chapter 2

Product Introduction

This Section Describes

- **Overall Appearance**
- **Button & LED**
- **Static Mode**
- **Firmware Upgrade**

Overall Appearance

The SL900 consists of three parts: the upper cover, the bottom cover and the control panel.

Figure 2-1 Control panel

The control panel contains a power button and three LED lights, which are, respectively, the satellite indicator LED, power LED and communication status LED.

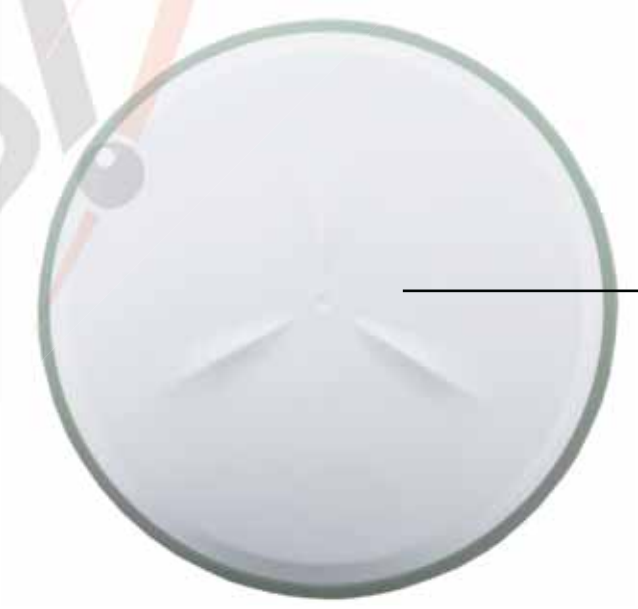

Figure 2-2 Upper cover

- Anti-wear buffer: Wear prevention points can enable the host to avoid scratches.

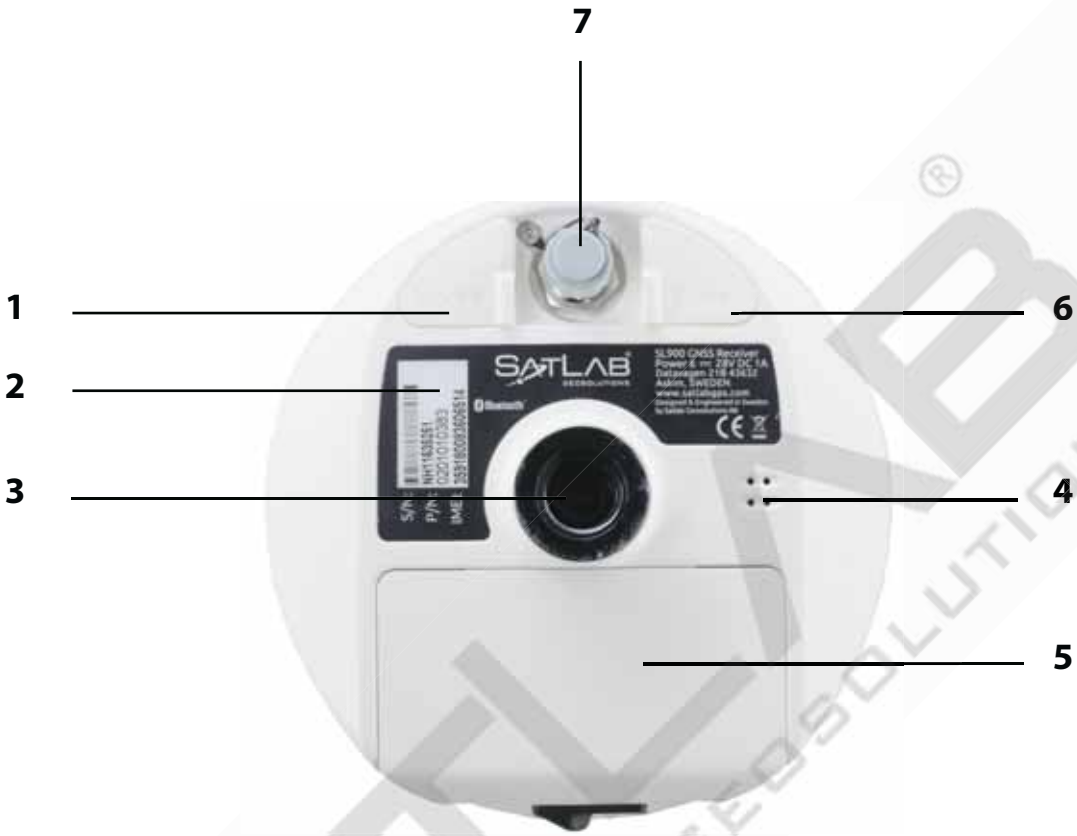

Figure 2-3 Bottom cover

1. Five-pin socket **2.** Host label **3.** Connection screw **4.** Speaker
5. Battery compartment **6.** USB socket **7.** Network/radio antenna interface

- Five-pin socket: For external data linking and external power supply.
- Connection screw: For fixing the instrument to the base or a pole
- Speaker: For the quick operation of the instrument and to broadcast its status with the voice.
- Battery compartment: Used to place the battery.
- USB socket: To connect the host with external devices, upgrade firmware and download static data. It can also be used as the USB to the serial port in special working modes (you will need to install the driver).
- Network/Radio antenna interface: The network antenna is used when using the network and the radio antenna when using the radio.
- Battery cover: The battery cover protects it from dust and water.
- Protective plug: This is used for dustproof and waterproof sockets.

Button & LED

Table 2-1 Button function

Function	Description
Power-on	Long press the button for 1 second.
Power-off	In the power-on state, long press the button for more than 3 seconds and less than 6 seconds. Release the button for a normal shutdown when the speaker makes the first ding-dong sound.
Auto-set base	In the power-off state, long press the power button for 6s to automatically set the base station, and then release it. The receiver will now automatically set the base mode.
Working mode switch	Double-click the power button to enter working mode; every double-click will switch to another working mode.
Working mode	Single click to confirm the current working mode.
Reset motherboard	In the power-on state, long press the power button for more than 6s when you hear the second ding-dong, and then release it.
Mandatory power off	In the power-on state, long press the power button for more than 8s.

Table 2-2 LED function

Item	Status	Description
Power lamp (yellow)	Always on	In normal voltage Battery remaining≥60%
Power lamp (red)	Always on	Battery remaining: 10%~60%
	Slow flash	Low voltage：battery remaining < 10%
Signal lamp（green）	Off	No GSM/Wi-Fi connection
	Always on	GSM/Wi-Fi module has connected to the server successfully.
	Slow flash	GSM/WiFi module has connected to the internet successfully.
	Fast flash	GSM/WiFi module is connecting to the internet server.
Signal lamp (red)	Slow flash	1. The data link sends and receives data (the rover station only prompts to receive, and the base station only prompts to transmit). 2. Static data is being collected – static acquisition flashes at the sampling frequency.
	Off	Communication failure, no data output
Satellite lamp (green)	Always on	Satellites are being tracked successfully.
	Slow flash	Satellites have been lost. Try and retrack them.
	Off	1. Mother board error resulting in no data output while resetting receiver 2. Mother board error resulting in no data output while in static mode
All three of the LEDs are illuminated		Reset the mainboard or there has been a static collecting error (insufficient storage space).

Static Mode

The SL900 receiver can be used for static measurements. Double-click the power key to enter the mode switching process. Every double-click will then switch you from one mode of operation to another. In the mode switching process, click the power key to confirm the working mode. The red signal light flashes every few seconds (according to the sampling interval) and then collects one epoch. The collected static measurement data is stored in static/gnss files. The static data files need to be downloaded to the computer and then processed with static post-proceed software.

Note: You can also use the controller to switch working modes. For its specific operation, please refer to the Satsurv software instructions.

(1) Set up the receiver on a control point, ensuring that it is both centered and level.
(2) Measure the height of the receiver three times. Ensure the difference of each measurement is less than 3mm and the final height of the receiver is the average height. The instrument height should be measured from the control point to the upper part of the measurement benchmark. The radius of the SL900 receiver benchmark is 0.130m, and the phase center is 0.1018m high.
(3) Record the station name, instrument number, instrument height, date and start of the observation time.
(4) Power on the receiver and set it to static mode. The satellite light will flash to indicate that the receiver is searching. This will turn to constant green when the satellites are locked. The red signal light will then start to flash, according to the set sampling interval.
(5) Power down the receiver after the measurement has been completed and record the shutdown time.
(6) Download the processing data.

Note: Don't move the tribrach or change the collecting set while the receiver is collecting data.

The collected GNSS static data is stored in the 'static' drive of the 16GB internal storage in the SL900 receiver. There are three folders: log, gnss and rinex. The log folder stores the log information. The data format stored in the gnss folder is *.gns; The data format stored in the rinex folder is a standard RINEX format data file. You can connect it to your computer by using a USB cable and find the drive to copy the static data to your computer.

Note: When the storage space of the receiver is less than 2MB, the red signal lamp will flash quickly and stop recording. Meanwhile, the existing data files will not be overwritten.

The SL900 receiver file management uses U-Disk storage, plug-and-play, and direct drag-and-drop downloading. You do not need to download the management software. The SL900 receiver can only download static data by using the U-Disk mode. It cannot write to the SL900 receiver.

Users can download data through the U-Disk. Use the Mini USB cable when downloading. Connect the receiver with the computer by using the Mini USB data cable. After the connection, a static drive will appear on the computer. You can then copy the collected static files by opening the disk.

After downloading, edit the point name and antenna height:

1. Select *.GNS static files and double-click the mouse.
2. The Document Edit dialog box will pop up. Edit the point name and input the antenna height, then click OK.

Note: Static files in the removable disks cannot be deleted directly. You can use the controller software to do this.

Firmware Upgrade

The receiver uses a 3G network, and the host firmware can be automatically upgraded through the network (please refer to the Satsurv software guide). The user can also choose to manually upgrade by using the U-Disk.

The two steps to upgrading the firmware by USB cable are：

1. Turn on the receiver and connect it to the computer with the cable attached. It will show the update drive when you click on the computer.
2. Copy the firmware (you can download it from our official website or get it from the technical team) to the update drive. Disconnect the computer and receiver, and then restart the receiver.

Figure 2-4 Update drive

Chapter 3

Operation of SL900 Using Satsurv

This Section Describes

- **Create a Project**
- **Set the Base**
- **Set the Rover**
- **Parameter Calculation**
- **Detail Survey**
- **Stake Out**
- **Data Transfer**
- **Connect the Controller to Download Data**

This section provides a Quick Start guide to operating the SL900 with Satsurv.

Create a Project

1. Open the Satsurv software. The software main interface is as follows:

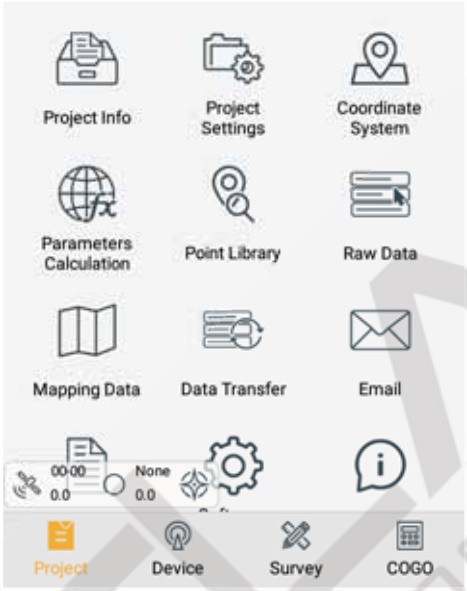

Figure 3-1 Main interface

2. Create a new project, and then click Project→Project Info to enter the project name and click OK.

Figure 3-2 Project info

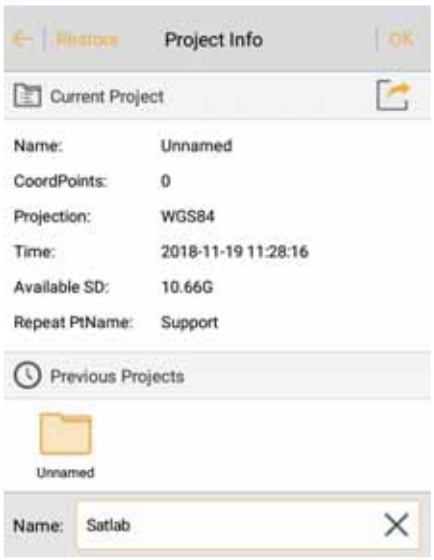

Figure 3-3 New project

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

Figure 3-4 Project settings

Figure 3-5 Coordinate system

Figure 3-6 Projection

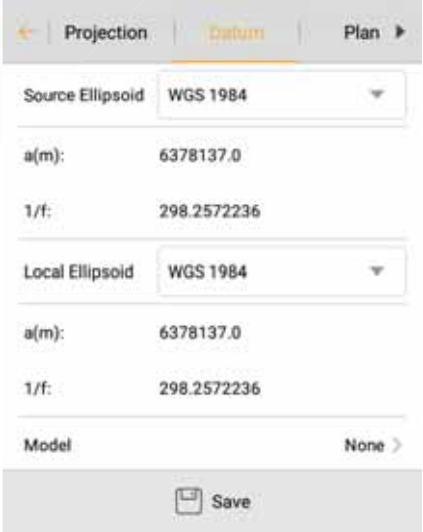

Figure 3-7 Datum

Set the Base

Connect the device, click Device→Connect to select the serial number of the base station for the Bluetooth pair connection.

Figure 3-8 Device

Figure 3-9 Connect

Figure 3-10 Device number

Figure 3-11 Disconnect

Set both the base station and receiver position, and then set the Datalink and Other.

1. Select the antenna type and enter both the height and the type.

2. Set the base location.

- If the base station is located at a known point and you know the conversion parameters, do not select the Average. Directly input or select the point of the WGS-84 BLH coordinates from the point library or open the conversion parameters in advance and enter the local NEZ coordinates, so that the base station uses the point of the WGS-84 BLH coordinates as a reference and transmits the differential data.

- If the base station is located at an unknown point, click Average , and click OK after the average to complete the coordinates of the base station.

Figure 3-12 Set base

Figure 3-13 Average

3. Click Data Link, select the data link type and then enter the relevant parameters (e.g. when you use the SATLAB server to transfer the data operation, you will need to set the parameters and then select the Internal GSM mode, where the Area ID and Group ID can be changed. The Area ID is seven digits, the Group ID is three digits less than 255. When you choose to use the Internal UHF to work, you should set the radio channel).

Radio mode is the traditional data link mode. The Internal UHF mode is taken as an example to show how the radio station mode can be introduced by taking simple steps.

- Internal UHF: built-in radio

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

- Power: High/Middle/Low

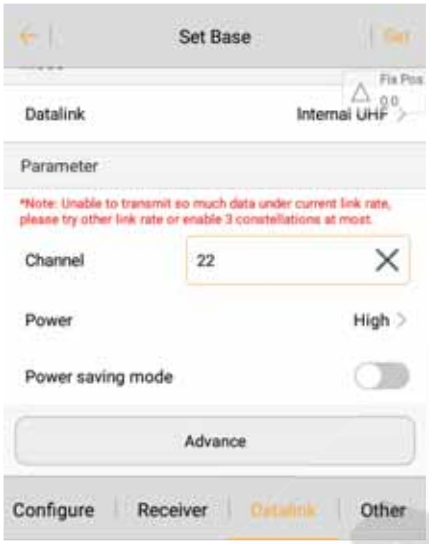

Figure 3-14 Datalink settings of base

4. Click Other and select the Diff Mode, Correction Type. Then click Set and it will promptly set up successfully. The parameters of the base station must be consistent with the rover station settings.

Figure 3-15 Other base settings

5. Check whether the differential signal lamp of the receiver is flashing once every second (2 seconds in the power-saving mode). When using the external radio, the lamp will flash once every second, if it is normal. It will then prompt you with the message: Base station is ready, do you want to set Rover now?

After the parameter is set, click Set and the receiver will give a voice prompt. The signal lamp will then flash twice a second, indicating that the base station has been set up successfully and is sending the differential data.

Wait until the green signal lamp flashes once every second (2 seconds in power-saving mode) and the radio red lamp flashes once every second, indicating that the base station is successfully operating and transmitting the signal. If the signal lamp does not blink, you can restart the receiver and operate it once again.

Figure 3-16 Set base success

Set the Rover

Connect to the rover through Bluetooth, making sure that the rover data link and other parameters are consistent with the base station. The setting of the rover station is the same as that of the base station. To receive differential data, the data link parameters of the rover station must be the same as the base station. Then click Set and the receiver will do a voice prompt for UHF Rover. Wait until it shows RTK Fix, and then start the measurement.

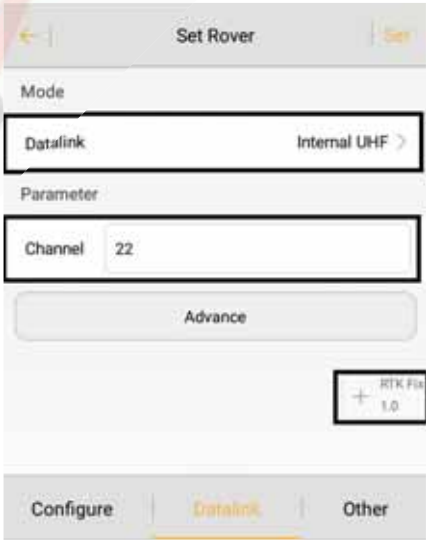

Figure 3-17 Set rover

Parameter Calculation

First set the control point library in Point Library→ Control Point to add the control points. Enter the name and the corresponding coordinates by using manual input, real-time collecting, the point library or map selection, and then click OK.

Figure 3-18 Point library

Figure 3-19 Control point

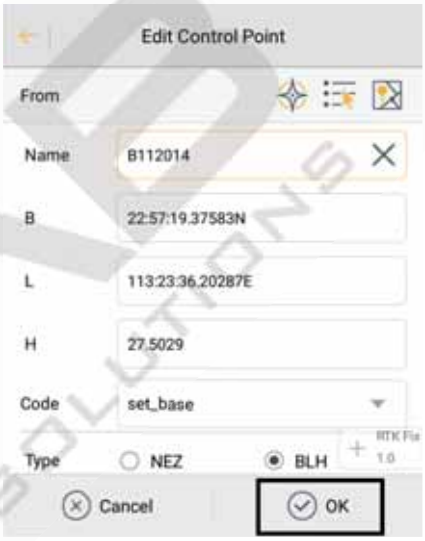

Figure 3-20 Edit point

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

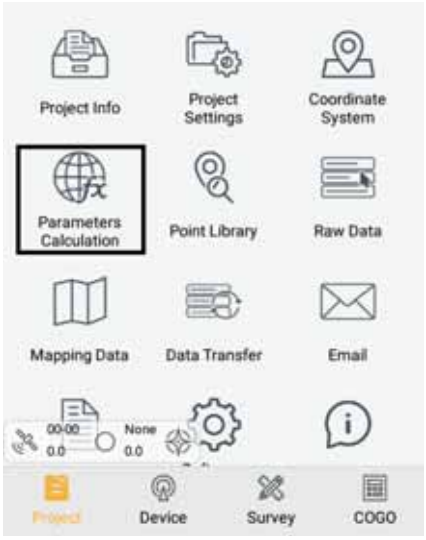

Figure 3-21 Parameters calculation

Figure 3-22 Add point

Figure 3-23 Save point

Figure 3-24 Result

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

Detail Survey

Start the coordinates collection work in the Detail Survey interface when RTK Fix is displayed. After the rover station is on the unknown point and centered, you can press the collection key and enter the Name, Target H and Target-H type. Then press OK to record the point.

Figure 3-25 Detail survey

Figure 3-26 Save point

Stake Out

Click Stake Points to enter the staking point interface and click the → button to select the staking point.

Then, find the staking point according to the direction and distance tips. There is a process used to make the current point (blue arrow) close to the target point (round plus cross sign). When the staking circle turns red, the staking point is successful and meets the precision parameters.

In the process of point staking, you can also collect detail points by using the Store on the interface or keying store on the controller.

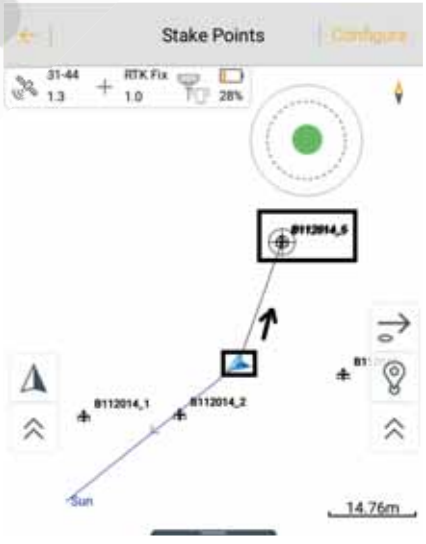

Figure 3-27 Staking point

Figure 3-28 Stake success

Data Transfer

In the Data Transfer interface, select Raw Data, and then select the Exchange Types as Export. Select the corresponding format export or User-defined export, then input the file name, select the Directory to save file, and click OK to export the data. If it's a User-defined export, you can enter the custom format settings (after clicking OK) to select export content. Then click OK to export the data.

Figure 3-29 Data transfer

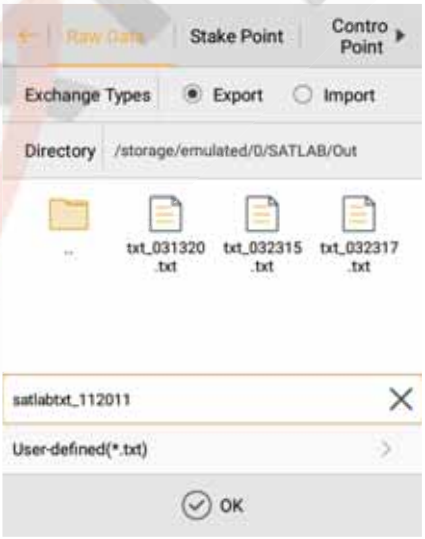

Figure 3-30 Export

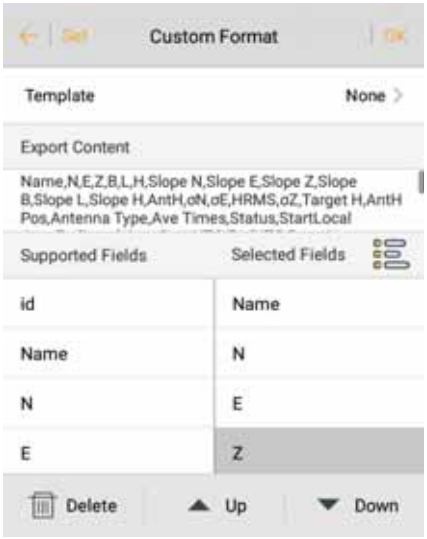

Figure 3-31 Custom format

Connect the Controller to Download Data

Use the USB data cable to connect the controller to the computer. Open the hidden drop-down window of the controller. Where it says Use USB for, you will see a list of options. Select File transfers.

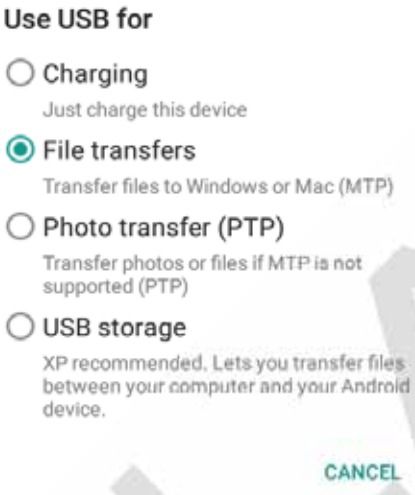

Figure 3-32 Transfer by USB

Find the path that is used to export the data file on the controller (default: SATLAB\Out) and copy it to the computer. The RTK measure is then finished.

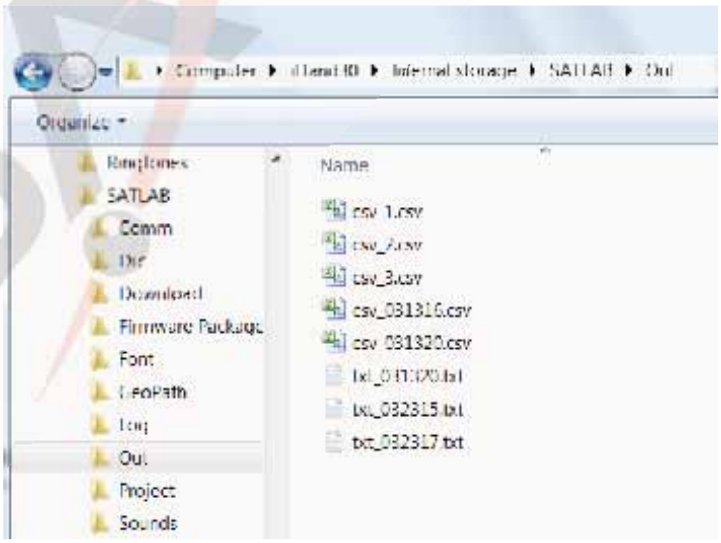

Figure 3-33 Exported data

Chapter 4

Technical Specification

This Section Describes

- **GNSS Parameters**
- **Measurement Performance**
- **Communications**
- **System**
- **Data Management**
- **General**

Technical Parameters

GNSS Parameters

Signal Tracking

GPS (L1C/A, L1C, L2C, L2P, L5)

GLONASS[1] (L1C/A, L2C, L2P, L3, L5)

BeiDou[2] (B1, B2, B3)

Galileo[3] (E1, E5 AltBOC, E5a, E5b, E6)

IRNSS (L5)

QZSS (L1C/A, L1C, L2C, L5, L6)

SBAS (L1, L5)

L-Band (Up to 5 Channels) TerraStar®

No. of Channels: 555

Measurement Performance

Real-time Kinematic

H: 8mm + 1ppm RMS/ V: 15mm + 1ppm RMS

Network RTK

H: 8mm + 0.5ppm RMS/ V: 15mm + 0.5ppm RMS

High-precision Static

H: 2.5mm + 0.1ppm RMS/ V: 3.5mm + 0.4ppm RMS

Static and Fast Static

H: 2.5mm + 0.5ppm RMS/ V: 5mm + 0.5ppm RMS

DGPS Position Accuracy

H: 25cm RMS / V: 50cm RMS

SBAS Position Accuracy

H: 50cm RMS / V: 85cm RMS

Code Differential: DGPS/RTCM

Initializing Time: 2-10s

Initializing Reliability: 99.9%

Communications

UTMS/WCDMA/GPRS/GSM

Internal 3G Mobile Network

Bluetooth V2.1 + EDR, NFC

Wi-Fi: 2.4G, 802.11 b/g/n

Internal Radio: Satel Radio for Tx/Rx

System

Operation System: Linux

Start-up Time: 3s

Data Storage: 16GB internal storage; supports 32G SD card

Data Management

5 Hz Update (up to 100 100 Hz[4])

CMR, RTCM2.X, RTCM3.0, RTCM3.2

GNS, Rinex

TerraStar® and RTK Assist Service

General

Environmental

IP67 environmental protection

Waterproof to 1m (3.28ft) depth

Temporary Submersion

Shock resistant body to 2m (6.5ft) pole drop

Temperature:

-40°C to 65°C Operating

-40°C to 85°C Storage

Physical Properties

Size: 170mm x 95mm

Weight: 1.2kg including battery

Battery: 5,000mAh Lithium-Ion Battery

Battery Life: 10 hours (RTK Rover)

Note

[1] Hardware ready for L3 and L5

[2] Designed for BeiDou phase 2 and 3, B1 and B2 compatibility. B3 conditionally supported and subject to change.

[3] E1bc support only. Hardware ready for E6bc

[4] Optional

Chapter 5

Accessories & Interfaces

This Section Describes

- **5-pin Lemo Interface**
- **Data Cable**
- **Antenna**
- **Benchmark**
- **Battery & Charger**

Five-pin Lemo Interface

The five-pin lemo connector is used for the connection of the receiver with an external data link and/or an external power supply.

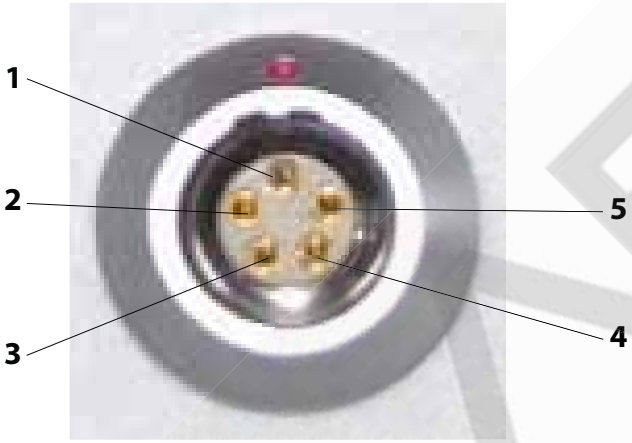

Figure 5-1 Five-pin lemo connector

1. It is also known as COM, which used to connect the host and external radio to transmit differential data. Description:

- 1 to GND
- 2 to GND
- 3 power into Vin
- 4 data into RXD
- 5 data out TXD

2. All the round sockets start to count the stitches counterclockwise on the front side; the round plugs start to number the stitches counterclockwise with the welding surface.

3. All the above data out (TXD) and in (RXD) signals are described by the receiver. TXD is the receiver data transmission signal line and RXD is the receiver data reception line.

4. In addition, the serial port DB9 pin connector signal of the computer is: 2 (RXD computer data receiving signal line), 3 (TXD computer data transmitting signal line), 5 (GND signal ground). Referred to as "2 received & 3 rounds."

Note: All of the above are for the host and the front interface of the host's bottom is shown (the interface soldering surface).

Figure 5-2 Installation

Data Cable

1. The Mini USB cable has a standard USB interface on one end and a Mini USB interface on the other. It is used to connect the host and external devices for data transmission.

Figure 5-2 Mini USB data cable

2. Five-pin data cable (DG-3): to connect the host and external radio to transmit differential data.

Figure 5-3 Five-pin data cable

Figure 5-4 Five-pin plug

Note: 1. When connecting the various plugs, make sure the red point in the line joint at the red point in the receiver socket is aligned or it will damage the receiver socket and plugs.

2. Directly grasp the sliding collar when you pull out the plug, and pull hard. This will not rotate the plug.

3. After using the cable, it should be put in a place where it cannot be squeezed to prevent damage to the plug.

Antenna

There is both a UHF internal radio antenna and a 3G/GPRS antenna. You can select the appropriate antenna, according to the operation mode you prefer. The UHF radio antenna is used in the UHF mode, and the external 3G/GPRS antenna is used in the internal GSM mode.

Figure 5-5 3G/GPRS antenna (above) & radio antenna (below)

Benchmark

The benchmark is used to measure the height of the instrument.

Figure 5-6 Benchmark

Battery & Charger

Steps to install and unload the battery:

1. Installation: Press the battery cover button gently and then press down. The battery cover can be lifted upwards. The battery cover and battery are then removed, as shown in the figure. Push to the right to unlock it and to the left to lock it.

Figure 5-8 Unload

Gently push the battery in the direction that is marked 'Close' and complete the installation.

Figure 5-8 Installed battery

2. Unload: Gently press and then push in the direction that is marked 'Open', pull out the battery and complete the unloading.

Table 5-1 Battery and charger model

Name	Model
Lithium-ion battery	BL-5000
Battery charger	CL-8410

Table 5-2 Power supply mode

Power Supply	Power supply mode	Lithium battery; 5-pin socket external power supply
	Power supply range	6V min and 28V max

You can also connect the receiver to an external power source through the 5-pin socket.
The external voltage range for GSM operation mode and UHF rover station is DC 6-28V and the current should be more than 3000mA. If there is an external power supply, the receiver will choose the higher voltage between the lithium and external power supplies. When an external power supply is required, the specified dedicated power supply must be used.

Note: 1. The service time of the lithium battery will decrease when there is a reduction in temperature and this will increase both the charging and discharging times. Generally, one new 5000 mAh lithium battery can be used for 10 hours for static data collection, or 8 hours for the GPRS rover, or 7 hours for the 2W internal transceiver transmitting station.

2. In order to extend the life of the battery, please charge it as soon as possible – within 24 hours of the battery going flat; otherwise, the battery's life will be shortened.

3. If the battery is not going to be used for a long time, please charge the battery once per month in order to prolong its service time.

A caution about charging: the BL-5000 lithium battery must be charged by using a CL-8410/CL-4400 lithium battery charger. The charging time is about 7 hours. CL-8410 chargers have charging lamps that turn red during the charging period, and green after charging. They then continue charging for 1~1.5 hours, until the battery is fully charged.

Figure 5-10 Charger

Operation of charging:

1. Gently push the battery in the direction that is marked 'Close' and complete the installation.
2. When the power is connected, the charge indicator will be displayed in red to start charging.

Note: 1. Only use a battery and charger that is configured by the manufacturer. Do not throw them into the fire or use the metallic short-circuit electrode.

2. If there is overheating, deformation, liquid leakage, the emission of a smell or another anomaly during the use, charging or storage period of the battery, please stop using it and replace it with a new one.

3. If the battery's service time is clearly shortened, please stop using the battery, as it indicates that the battery is old. Please replace it with a new one.


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