V.1612EN

GNSS POSITIONING SYSTEM

NOVA R6

with MicroSurvey FIELDGenius

USER MANUAL

RUIDE

MENU

1. A BRIEF INTRODCTION

RUIDE dedicates to offer the most advanced and reliable GNSS positioning solutions to surveyors.

RTK surveying technology, as a cutting-edged and efficient surveying technology, has been playing a more and more important role in surveying work. RUIDE NOVA R6, the new generation integrated RTK system with smaller size and innovative design, provides high efficiency and intelligent surveying experience to surveyors, which is suited for nowadays demands of precision, reliability and user-friendliness.

This manual is to explain how to install, set up and use RTK system with NOVA R6 receiver, as well as the use of the accessories. We recommend you to read this manual carefully before or during using the system.

1.1 APPLICATOINS

Control Survey
Dual-band (dual-frequency) system static measurements can accurately complete the high-precision deformation observation, photo-control point measurement.
Highway Survey
Quickly completes the encryption of the control points, road topographic mapping, cross-section measurement, profile measurement.
CORS
Provides stable and convenient data link for field operations. It is seamlessly compatible with all types of CORS applications.
Data Collect
Perfectly matches various field software to realize quick and easy data acquisition.
Stakeout Shot
Large-scale point, line, plane lofting.
Electric Power Measurement
Power line measurement orientation, ranging, angle calculation.
Marine Application
Oceanographic research, dredging, piling, inserted row, making the marine operations more convenient and easy.

1.2 FEATURES

State-of-the-art Design
Smallest size in industry and innovative design with 12.9cm X 11.2cm. Using aeronautical

material Magnesium alloy with sophisticated industrial design, providing a unique advantage compared to other materials: light weight, resistance to external impact and shock absorption, and good electromagnetic shielding.

Dual Module Bluetooth

NOVA R6 is equipped with Bluetooth 4.0 module, which is first to adopt this technology to support communication with smartphone, tablet PC etc. from Bluetooth 2.1 to 4.0, making communication faster and more stable.

Tilt & E-Bubble Sensor

The internal tilt sensor helps to survey without leveling the receiver, in order to improve survey efficiency. Tilt angle is allowed up to 30°. Tilt compensator corrects the coordinates according to the direction and tilt angle.
The internal E-Bubble sensor can display the leveling status of the receiver on the controller in real time. You don't even need a leveling bubble on the pole anymore.

*NFC

Internal NFC module can make the Bluetooth communication easier and simpler.

Full Constellation Support

Pacific Crest BD970 mainboard is a compact multi-constellation receiver designed to deliver centimeter accuracy to a variety of applications. That enables NOVA R6 to support a wide range of satellite signals, including GPS L2C and L5, GLONASS L1/L2 signals, and also Galileo and BEIDOU signals for improving accuracy and speed of positioning.

Smart and Open

Intelligent platform provides an excellent solution for the interaction between the receiver and surveyor, such as power management, voice broadcast, and self-inspection.

Advanced Data Link

Integrated with powerful data link system, NOVA R6 is compatible with current radio protocols in the market from 410-470MHz, supporting all kinds of network types to access CORS seamlessly. The protocol can switch between TrimTalk and SOUTH as needed.

*WiFi

NOVA R6 employs a WiFi module, which enables PC and cell phone to connect to the receiver and read the survey data directly through the software.

*Might not available in different models.

1.3 ITEM LIST

Standard Configuration of Rover

Standard Configuration of Base

1. UHF Antennas
2. GSM Antenna
3. Charger
4. Batteries for Receiver
5. Rover Receiver
6. Measuring Tape
7. Controller
8. Multi-function Data cable
9. Bracket for Controller
10. Carbon Fiber Pole
11. Supporting Pole
12. External Radio
13. Multi-communication cable
14. Frequency-Changing Cable
15. Transmission Antenna

OP. Optional: Tribrach & Adapter

2. CONFIGURATION OF GNSS SYSTEM

1. Rover Receiver
2. UHF Antenna
3. Controller
4. Base Receiver
5. External Radio
6. Power Supply for Radio
7. Transmission Antenna

2.1 INTRODUCTION OF RECEIVER

2.1.1 Appearance

The receiver is a flat cylindrical, 112mm in height, 129mm in diameter, the height from the rubber seal ring to the bottom is 60mm. The front side is the button and indicator panel. The bottom of the instrument is the radio and network interface, as well as the battery house.

1. Top Cover
2. Rubber Ring
3. Indicator Lights
4. Power Button
5. Battery House
6. UHF/GPRS Antenna Socket
7. 5-pin Power Cable Socket
8. 7-pin Data Cable Socket
9. Beeper of Voice Broadcast

2.1.2 Indicator Lights

NOVA R6 indicator lights refer to 2 meanings:
Indicator for ***switching working mode***, and,
Indicator for ***self-check***.

NOVA R6 indicator light panel has 3 LED indicators, clearly indicates various status.

Indicator	Status	Meaning
Power	On	Normal voltage.
	Flash	Low battery.
Satellite	Flash	Number of satellite locked, indicating every 5s.
Bluetooth	Off	Controller disconnected.
	On	Controller connected.
Signal/Data	Flash	Static mode: Flashing in accordance with the setting sampling interval when recording data.
	On	Base or rover mode: Receiving strong signal.
	Flash	Base or rover mode: Receiving weak signal.
	Off	Base or rover mode: Receiving no signal.

2.1.3 Mode Checking & Switching

Mode Checking

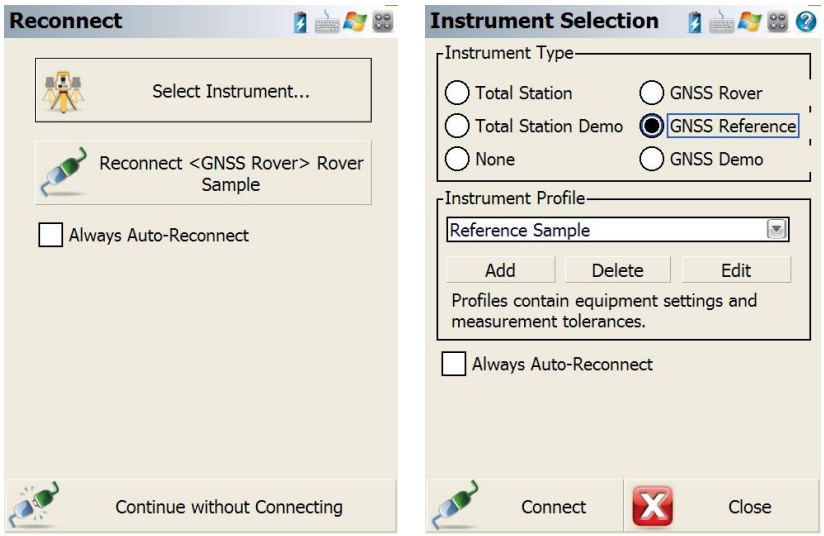
Press ⓘ once, there is a voice broadcast reminding current working mode.

Mode Switching

You can switch the mode either on the receiver or FieldGenius on the controller.

After the receiver is turned on, wait for a while for its initialization, then hold ⓘ button. You will hear the voice saying each mode with the indicator lights switching. Release your finger from the button after you hear the voice of the mode you want to switch to.

Or, after receiver is turned on, use controller to connect to the receiver, then configure the working mode and data link mode. This part will be described with more detail later.



2.1.4 Self-inspection

If the receiver is working properly, you can use the self-inspection function.

Power on the receiver, hold ⓘ for 8s until the ᛒ light turns on again along with the beeping. Then release the button, the receiver starts performing self-inspection.

After all the parts undergone the inspection, there is a voice broadcast. Wait a few seconds, the instrument will turn off automatically.

If the self-inspection doesn't pass, there is a voice broadcast. The receiver will stay in the status of the self-inspection, which implies you to identify the problem.

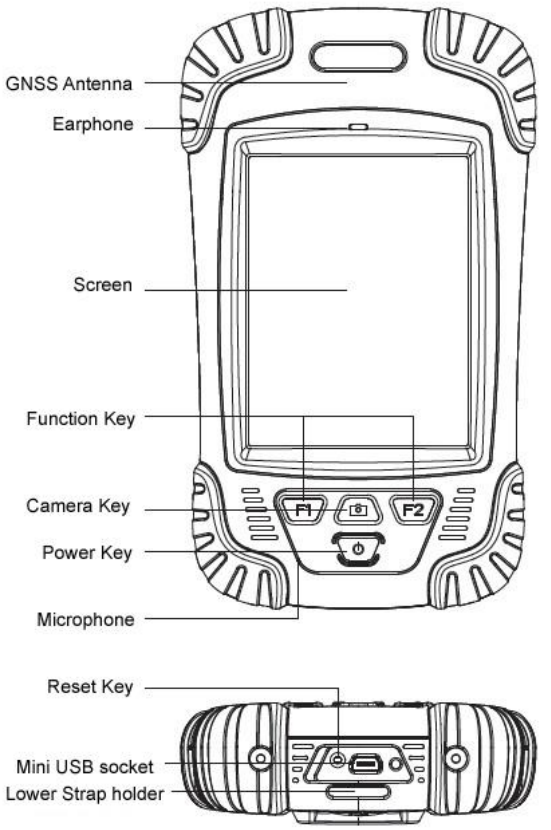
The meaning of the lights during self-check.

Indicator	Status	Meaning
	On	Receiver is performing the self-inspection.
	On	Inspection on OEM board is passed.
	Off	Inspection on OEM board is not passed.
	On	Inspection on GPRS/GSM module is passed.
	Off	Inspection on GPRS/GSM module is not passed.
	On	Inspection on internal radio module is passed.
	Off	Inspection on internal radio module is not passed.

2.2 HANDHELD CONTROLLER

2.2.1 Basic Introduction

Takes S10 for example.



Standard Configuration	Description
Li-ion Battery	3.7V/3000 mA/h

Strap	Black, 180*12mm
Touch Pen	Black, 12.7mm
USB data cable	1.5m
USB Charger	5V/1A

a. Charging

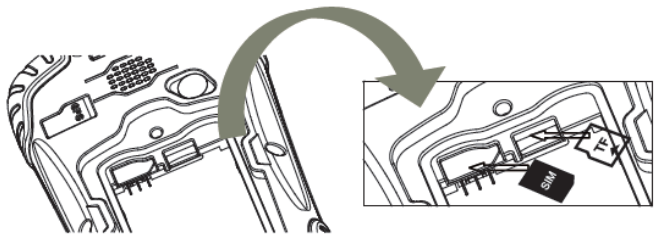
Connect the charger with collector by the USB Link cable to recharge.

Main screen will show the charging icon in power off (on) status (If you connect controller with PC to recharge, the time will be longer).

b. Installing Battery, SIM card and storage card

Turn the lock up straight and rotate it anticlockwise, you can take off the battery cover.

There are two sockets upon the battery position, left is for SIM Card and right is for Storage Card.



Installing the battery, turn the lock clockwise to the end (SIM card: The missing angle corner of SIM card will be at the lower right corner).

c. Power on/off

Make sure that the battery is fully charged or you can connect the controller to PC via the USB cable (Controller should be with battery.).

Press Power key for 3-5 seconds to power on/off.

(If there is no any response from controller or other unusual situations happen, press Reset key besides the USB socket in the bottom of controller with the stylus pen).

d. Connect to PC

Below is the desktop software you need to install when you want to manage or install programs on Windows Mobile device.

Windows XP: *Microsoft ActiveSync 4.5* or higher version.

Windows Vista, Windows 7, Windows 8, Windows 10: *Windows Mobile Device Center*.

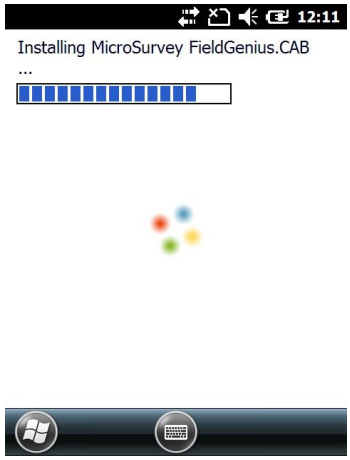
Connect the controller to PC via the mini USB data cable.

Connection will be preceded automatically. icon will turn green and an interface of Setting will come out. Click Cancel. After this, you can manage and edit the data in the controller.

e. Installing Program

Make sure that controller is synchronized with PC. Run the Installation file on PC.

If the installation program is also suitable for the controller, you can copy the installation program into the controller to install. You can just copy the folder into collector when you need.

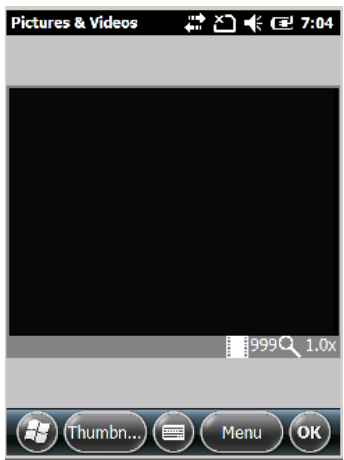


We suggest you install programs into Flash Memory and save the data into storage card.

f. Camera

Go to the Camera Mode by pressing Camera key for 3 or more seconds.

Press Camera key to take a photo and click OK on the screen to save.



2.3 EXTERNAL RADIO

2.3.1 Features

HX-U202 is a classified UHF radio modem with a switchable power (5/35W) transmitter and wide tuning range (410-470 MHz). It is designed for easy mobile use in demanding field conditions.

In addition, the channel spacing is also selectable from 12.5 or 25 kHz. And the protocol can be changed between TrimTalk and South. HX-U202 is equipped with a digital tube, 4 LED and three keys, which are used to indicate the current operating status, as well as changing the operating channel and remaining battery.

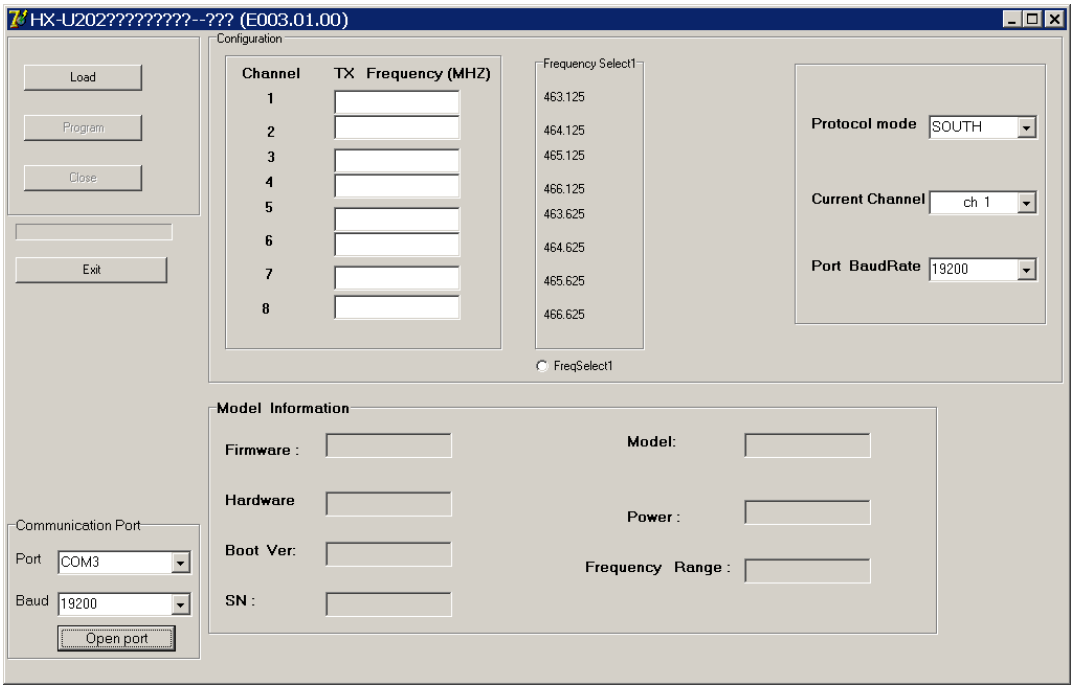
2.3.2 Interface Introduction

1. Channel Switch Button
2. Output Switch Button
3. Power Button
4. Channel Screen
5. Low-output Indicator
6. High-output Indicator
7. Power Indicator
8. Transmitting Indicator

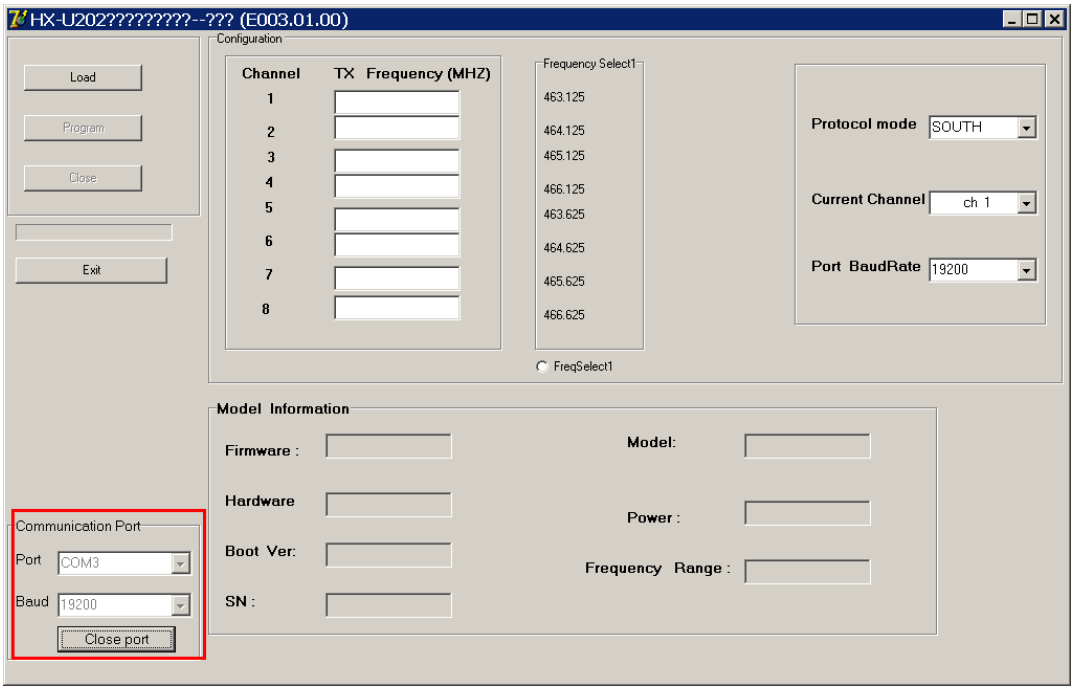
2.3.3 How to Set the Radio

a. Connect the radio to PC with the frequency changing cable F9440.

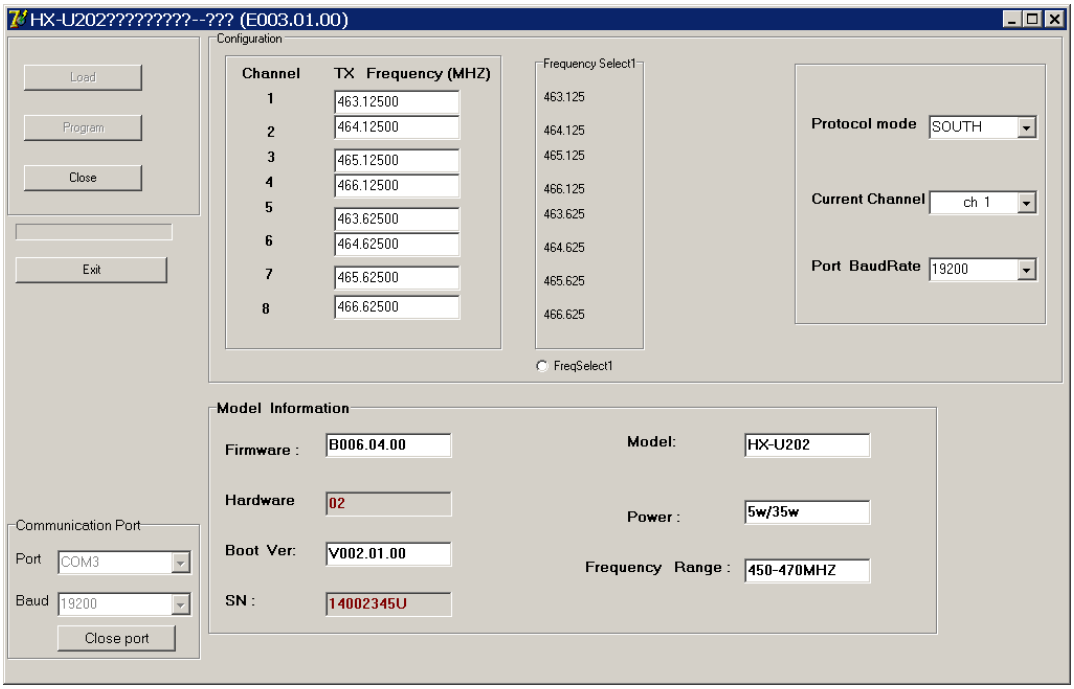
b. Run configuration software.



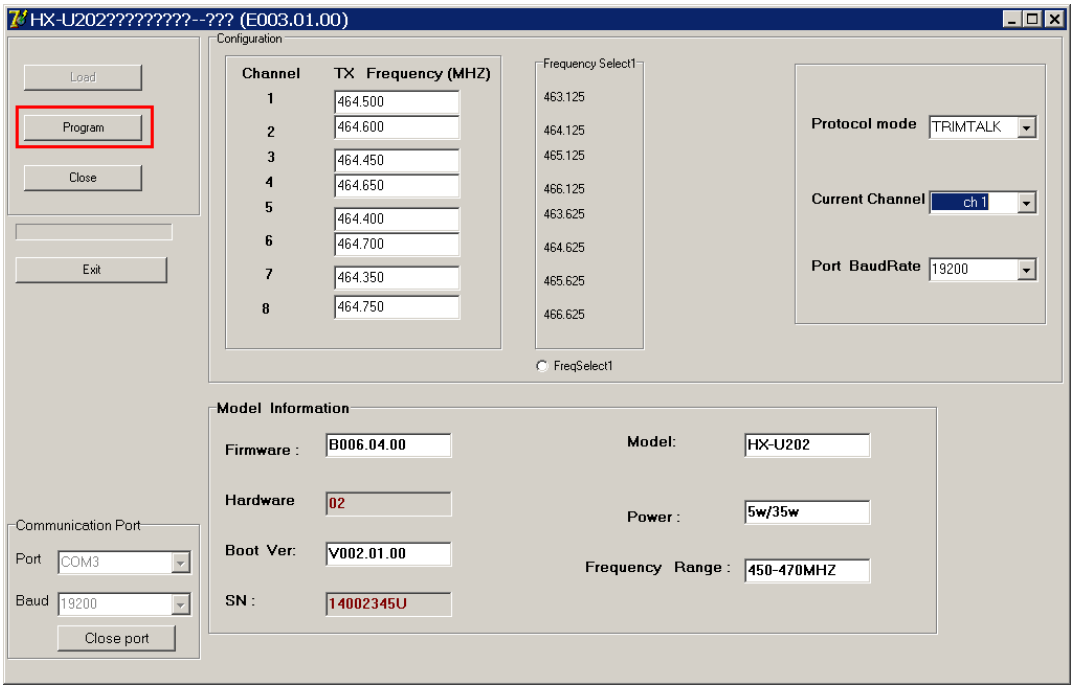
c. Select the right port and baud rate as 19200, click open.



d. Power on the radio and click load ASAP, and then the software will get the radio parameters



e. In the interface, we can change the protocol, SOUTH\TRIMTALK (TrimTalk 450S) and frequencies, after that, click program to confirm.



After configuration, click exit to exit the software.

2.3.4 Radio Transmitting Antenna

The UHF transmitting antenna is particularly suitable for field use, the receiving antenna is

Omni-directional antenna.

2.3.5 Application Notice

Low Power: When the power indicator flashing, it means lower power. Replace the external battery in time, otherwise the data link would be data link unstable or unable to launch.

Radio Transmitting Output: It is based on the voltage of the power supply. Check the voltage before use.

High and low Output: Use low-output transmitter when low-output can satisfy the operation because high-output transmitter will consume extra battery power. Excessive use will reduce battery life.

Install the radio station as high as possible.

Power Corrugated Coefficient: Power ripple coefficient must be less than 40mV. The smaller the ripple factor is, the smaller will be the beam spectrum and the higher communication quality.

Power Connection: Positive and negative should be connected correctly.

Electromagnetic Environment: Before using the radio, it is better to perform electromagnetic environment measurement, to avoid the communications blackout.

Suitable Antenna: The fundamental parameters to select the antenna refer to the band width, frequency, gain, directivity, impedance, VSWR and other factors. Usually the effective bandwidth of the antenna is 3-5MHz. It should be based on the frequency bands used by the channel to be defined. For the long-distance transmission, it is better to use a directional antenna and high-gain antenna.

We recommend:

Use battery which is more than 12/36Ah, and maintain a regular current of 10A during

operation.
Charge it in time. Do not overuse the battery, otherwise it will reduce battery life.
Replace the batteries after 6-12 months, to ensure the radio working performance.

2.4 ACCESSORIES

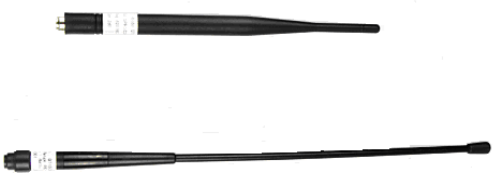
2.4.1 Instrument Case

The carrying case of NOVA R6 is ideal for surveyors. It has strong abrasive resistance and waterproof. Meanwhile the unique backpack design reduces the heavy burden.
The inner layer of the black soft bag is filled with anti-collision foam. The receiver and other accessories can be dispersed and embedded.

2.4.2 Battery & Charger

The standard configuration includes 2 batteries and 1 charger:
On the charger, the indicator CHARGE turns red when the battery is being charged. The indicator FULL turns green when charging is completed.

2.4.3 Antennas



UHF differential antenna is needed in UHF built-in radio base station mode and UHF built-in radio rover station mode.

2.4.4 Multi-function Data Cable

Multi-function cable is a "Y" shaped cable used to connect the base receiver (5-pin red jack),

transmitting stations (black jack) and external battery (red and black clip) for power supply and data transmission.

Multi-function Data Cable: Connect the receiver to the computer, for the transmission of static data and the receiver firmware upgrade.

Note: The models and types of instrument accessories will vary with the instrument upgrade.

3. OPERATIONS

GNSS measurement modes refers to the operating modes used to determine the relative position between the stations with the help of GNSS technology. Point coordinates precision obtained is not the same. Its operating methods and observation time are also different, thus having different range of applications. GNSS receiver operating program is divided into two types: static measurement and RTK dynamic measurement (including the base station and rover station).

Environmental Requirements

a. Observation stations (ie, the receiving antenna settlements) should be away from high-power radio transmitters and high voltage transmission lines in order to avoid the magnetic field interfering the GNSS satellite signal. Receiver antenna and its distance shall not be less than 200m.

b. Observation station should not be near to large waters or objects which can strongly affect (or absorb) electromagnetic wave to weaken the effects of multi-path.

c. Observation station should be located in places where the receiving device can be installed easily with good vision. Elevation angle of obstacles in view should generally be greater than 10° - 15°, in order to weaken the effects of troposphere refraction.

d. Observation station should be put in a convenient place, and easy to use other means of measuring, joint measurement and expansion.

e. For the long baseline GPS network, you should also consider the good communication facilities nearby (telephone and telegraph, post and telecommunications) and power supply.

3.1 STATIC MODE

3.1.1 About Static Measurement

Definition

GNSS positioning measurement is realized by installing three (or more) GNSS receivers to perform simultaneous observation and determine the relative position between the stations.

Applications

a. The establishment of a national geodetic control network.
b. The establishment of precise engineering control network, such as bridge measurement, tunnel measurement, etc.
c. The establishment of a variety of encryption control networks, such as city measurement, Drawing Point measurement, road survey, demarcation measurement.
d. For the GNSS measurement of small and medium-sized city, town, as well as mapping,

cadastral, land information, real estate, geophysical exploration, surveying, construction and other control measurements.

3.1.2 GPS Net Design

a. GPS net generally constitutes a closed figure by independent observation edge, such as a triangle, polygon or annexed line, to optimize the checking conditions, and improve the reliability of the network.
b. The points of the GPS network should coincide as close as possible with that of the original ground control network. Coincidence point generally should not be less than 3 (performs leveling conjunction when not enough) and should be evenly distributed in the network in order to reliably determine the transformation parameters between the GPS and ground networks.
c. The points of the GPS network coinciding with the leveling points should be considered. Non-coincidence point should generally perform leveling conjunction method (or methods of equivalent accuracy), or set a certain density leveling conjunction point in the network, to provide information for the study of the geoid.
d. In order to facilitate the observation and perform leveling conjunction, GPS outlets should generally be located in unobscured and easy -to -reach places.
e. In order to facilitate the classical leveling conjunction or extension, emplace near the outlet a good view orientation point, to establish leveling conjunction direction. The distance between the point and the station should generally be greater than 300 meters.
f. According to the different purpose of GPS measurements, the independent observations edge of GPS network should be certain geometry. The basic forms of the graph are as follows: triangular network, ring network, stellate network.

3.1.3 Operation

Step 1: Setting Up

Set the receiver on the tripod.

Step 2: Setting Working Mode

Power on the receiver. Wait until hearing the voice broadcasting the current working mode. Hold the Power button until hearing the voice saying “Rover, Base, Static” with the LED indicator shifting. After the word “Static”, release the button. At this moment the receiver will be turned off. Turn it on again and you will hear the voice confirming the mode of Static.

Step 3: Data Collecting

Notice: Static Mode does not require a controller to work with.

3.2 BASE + ROVER MODE (RTK MODE)

3.2.1 Definition

Real-time Dynamic Measurements, referred to as RTK.

RTK technology is the real-time dynamic differential carrier phase positioning technology, combining global satellite navigation and positioning technology with data communication technology which includes base station and rover station. Base station transmits the data by radio or network to the rover station, which will perform differential analysis, thus providing real-time coordinates of the measurement point in the specified coordinate system. Depending on the modes of transmission of the differential signal, RTK is divided into the radio mode and network mode. Here we introduce radio mode first.

3.2.2 Operation

3.2.2.1 Base Setup

Step 1

Set the base and the tripod.

Step 2 (please refer to 2 different data link modes you will use.)

<Using External radio>

Set the high gain antenna *(e.g. QC450A-T(B))* on a tripod, and connect it to the external radio *(e.g. HX-U202) on another tripod*, which should have been connected with the external power supply via the multi-functional cable *(e.g. LE52X-00-01)*.

Note: Place the 2 tripods at least 2m away from each other to avoid signal interference.

<Using internal UHF radio>

Install the transmitting antenna *(e.g. QT450AS-1)* on the UHF interface under the receiver. The 30cm pole support *(e.g. CFFMG)* is recommended in order to realize a higher position.

Step 3

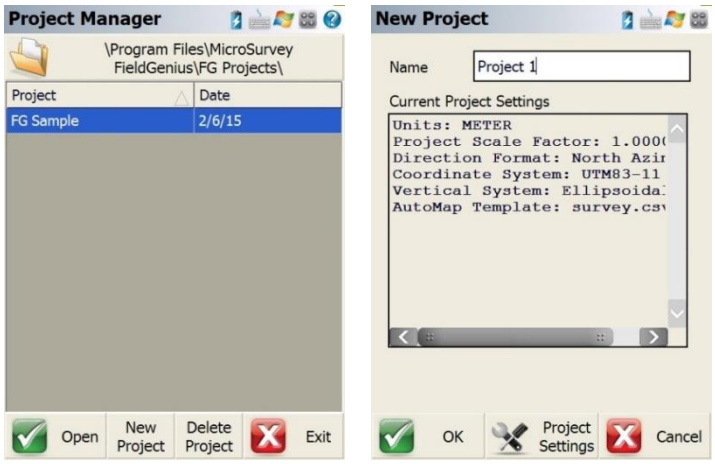
Make sure all connections are correct, then power on the base receiver and the external radio.

3.2.2.2 Setting the Base

Step 1: Selecting Project

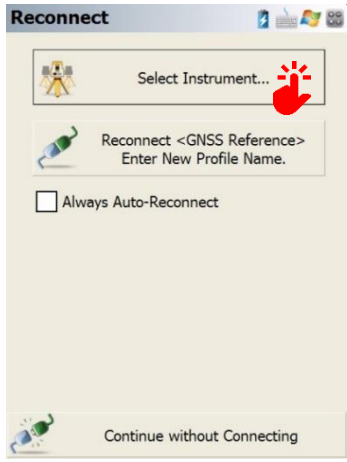
Run FieldGenius.

Select an existed project, or create a project. Edit the Project Settings if necessary.



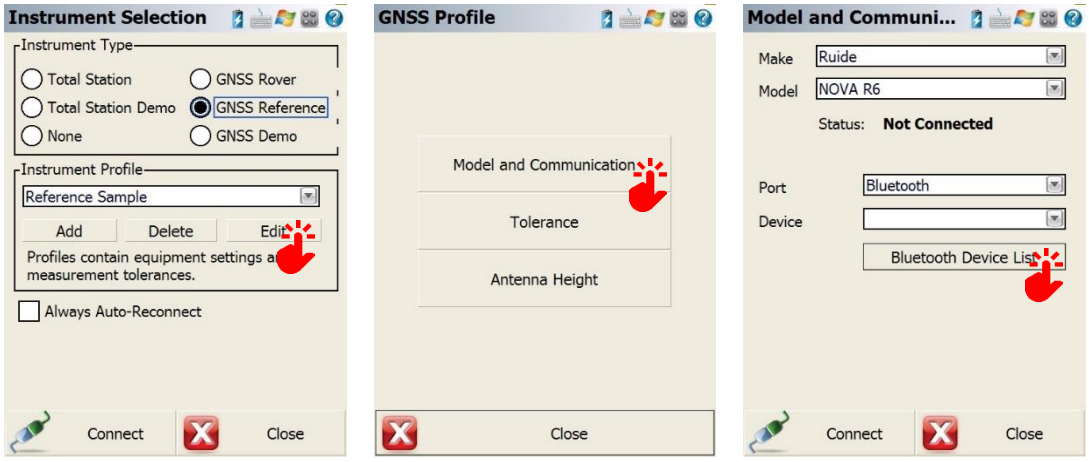
Step 2: Selecting Model and Connecting Bluetooth

Click Select Instrument... .



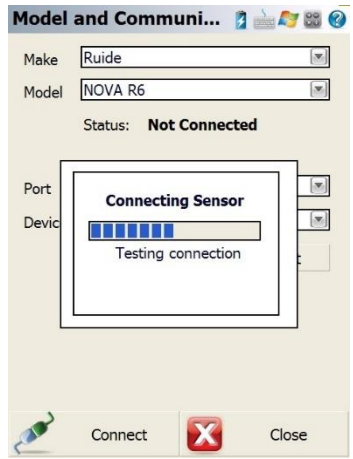
Choose *GNSS Reference* as the *Instrument Type*, which means this receiver will be defined as Base.

Press Edit → Model and Communication. Select the brand, model name, and select *Bluetooth* as the *Port*. Then press Bluetooth Device List to browse the list.



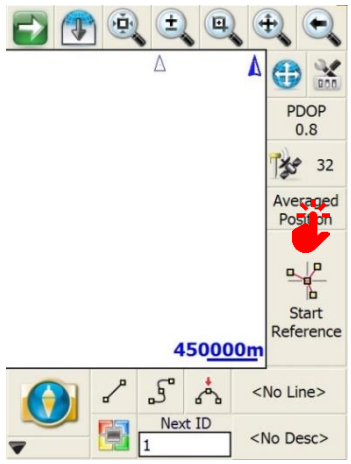
Press Search and choose select the correct serial number on the list.

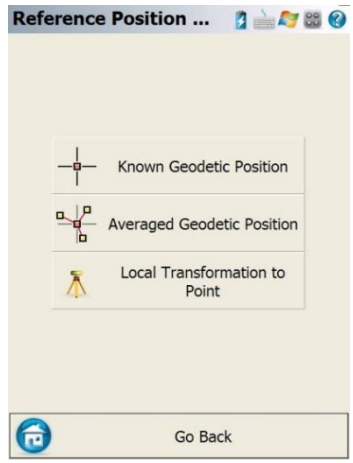
Press Connect.



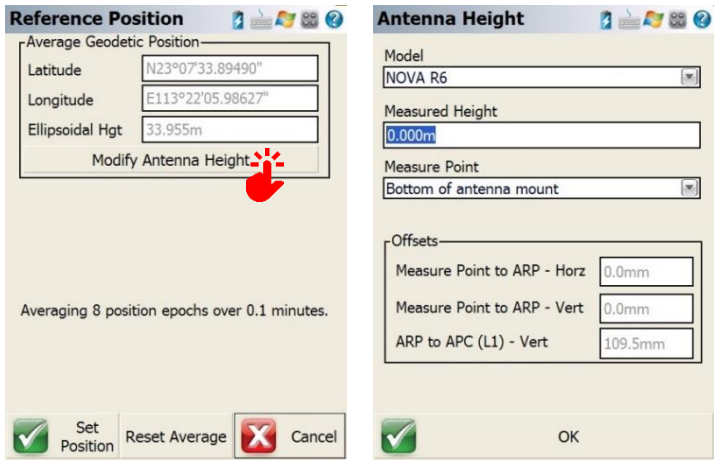
Step 3: Start Reference

Click Averaged Position. Choose the different ways of reference position.





Click Start Reference after that. Enter to *Average Position* screen. Click Modify Antenna Height to input the height of antenna.

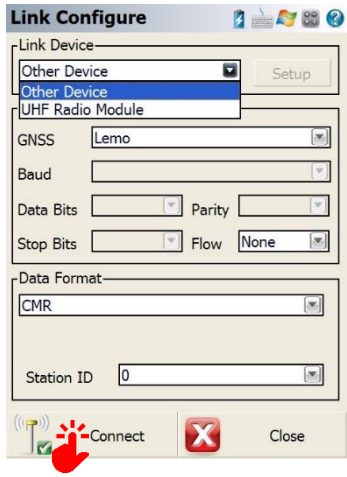


Click Set Position to finish the setting of reference position, and select whether to save the reference point to the point database according to your need. Then you will enter to the interface of *Link Configure*.

Step 4: Select data link.

<Using External radio>

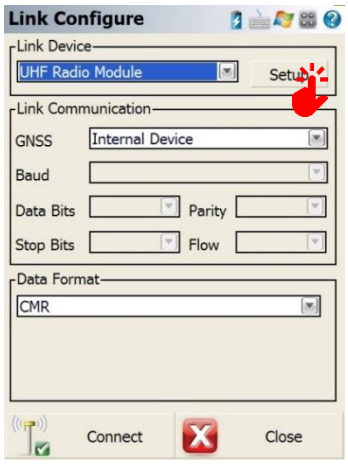
Choose *Other Device* in *Link Device* and click Connect to start the base.

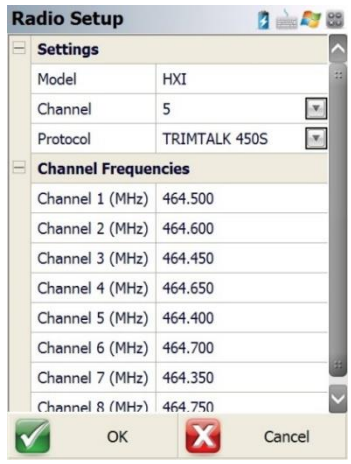


Make sure all connections are all right, then power on the radio by pressing ⏻.
Press ▲ to define the channel. Keep in mind the channel number that is selected to match the settings in controller late.
Note: Radio starts to transmit when TX light is flashing.

<Using Internal UHF radio>

Choose *UHF Radio Module* in *Link Device.*
Click Setup to set Channel and Protocol.
Click Connect to start the base.





3.2.2.3 Setting the Rover

Step 1 Rover Setup

Install the rover receiver and the bracket on pole, and fix the controller into the bracket.

Step 2

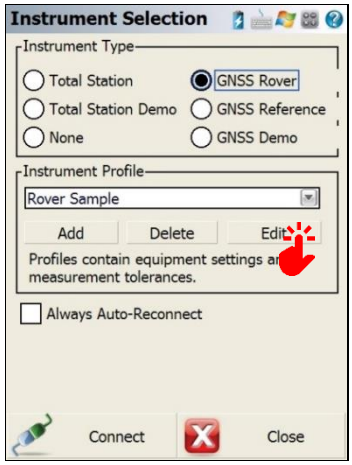
Install the UHF antenna *(e.g. QT450AS-1)* on the UHF interface under the rover. Power on the receiver.

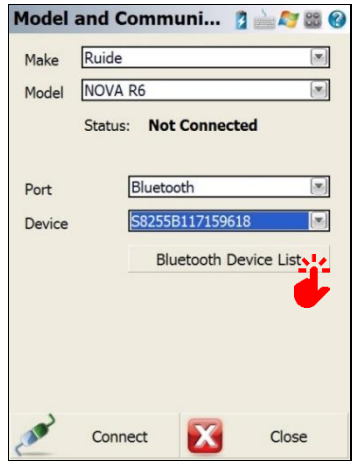
Step 3: Selecting working mode, model name and Bluetooth connection.

The procedure is similar to setting the Base, except the *Instrument Type*. Select *GNSS Rover* as *Instrument Type*.

From Edit, Select the correct brand and model.

Connect to the right serial number from the *Bluetooth Device List*.





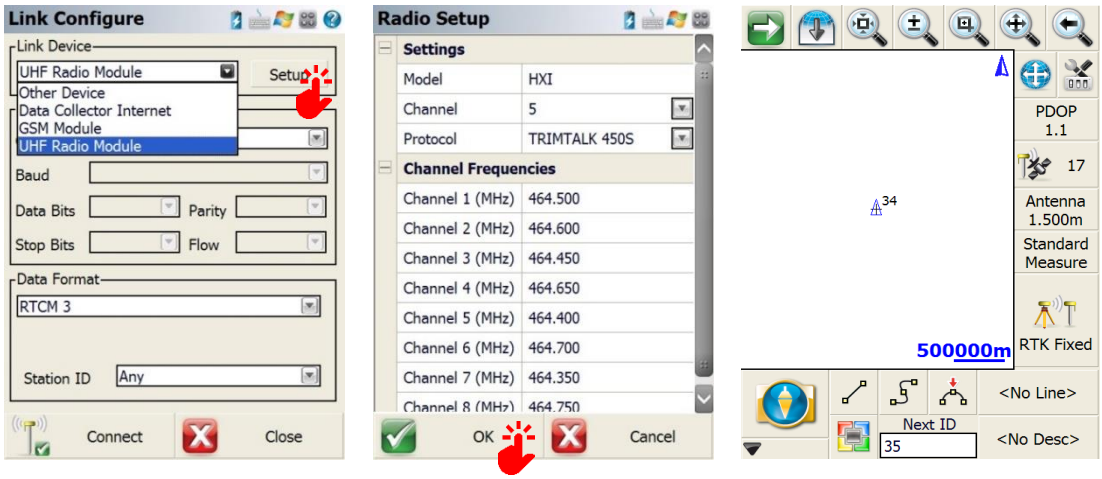
Step 4: Select the data link.

Select *UHF Radio Module* in the *Link Device*.

Click Setup to choose the Channel and Protocol same as the settings in Base (GNSS Reference).

Click OK to apply this channel setting in *Radio Setup* interface.

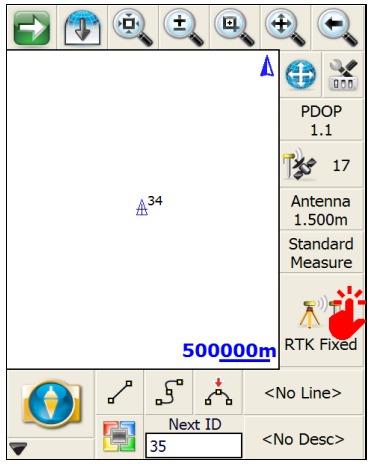
Finally, click Connect to go to the main interface.



Step 5: Get fixed solution and start collecting.

After you get the status RTK Fixed, you can start to survey.

Collect any points by clicking RTK Fixed.



3.3 NETWORK MODE

3.3.1 Definition

The main difference between Base+Rover mode and Network mode is the network transmission of differential data. Therefore the erection is similar to the radio mode, the setting of EGstar is different.

3.3.2 Operation

3.3.2.1 Rover Setup

Step 1

Insert a SIM card to the SIM card slot beneath the battery compartment, and install the battery.

Step 2

Install the bracket onto the carbon fiber pole, and fix the controller onto the bracket, then power on the controller.

Step 3

Install the GPRS antenna *(e.g. QT0822D-S)* on the GPRS interface under the rover, and screw the receiver into the carbon fiber pole, then power on the receiver.

3.3.2.2 Setting the Rover

Step 1: Setting working mode and connect the Bluetooth.

Refer to Session XXXXXXX.

Step 2: Select GSM Module as data link.

Choose GSM Module in Link Configure.

Click Setup.

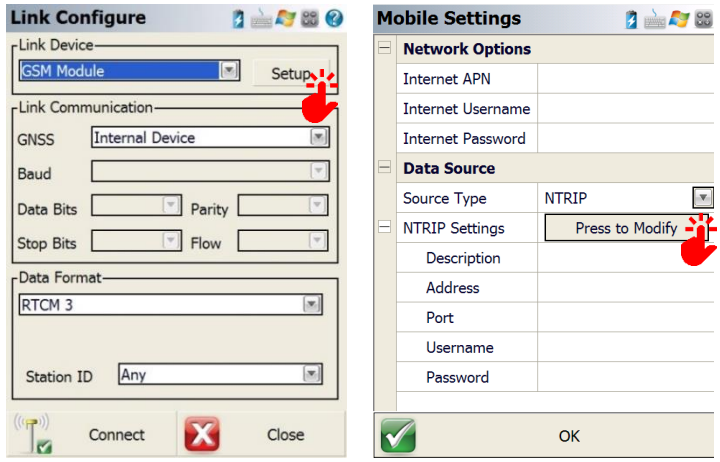
<Internet APN>: Check with our SIM card telecom provider.

<Internet Username>: If necessary.

<Internet Password>: If necessary.

Press to Modify, Add to add a new CORS server information.

(Or select the existed CORS information to re-edit/use directly.)



Step 3: Add CORS information.

<Description >: Input a name for this CORS.

<Address>: Check with the CORS operator.

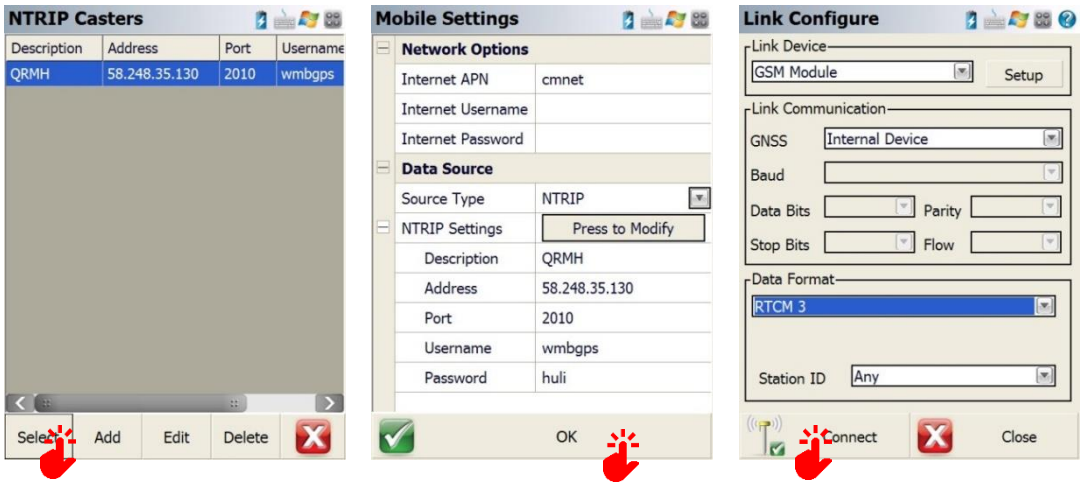
<Port>: Check with the CORS operator.

<Username>: Check with the CORS operator.

<Password>: Check with the CORS operator.

After adding new CORS information, return to *Link Configure* interface.

Click Connect again to start NTRIP connection.



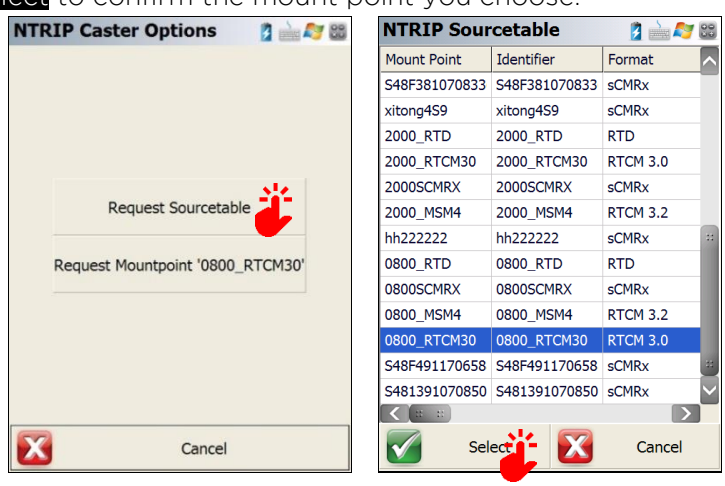
Step 4: Select mount point.

If the receiver has connected to a mount point before, reconnect directly this mount point which has been stored.

Or request the whole sourcetable if you connect this NTRIP broadcaster for the first time.

Click Request Sourcetable to select the available mount point from the NTRIP Sourcetable.

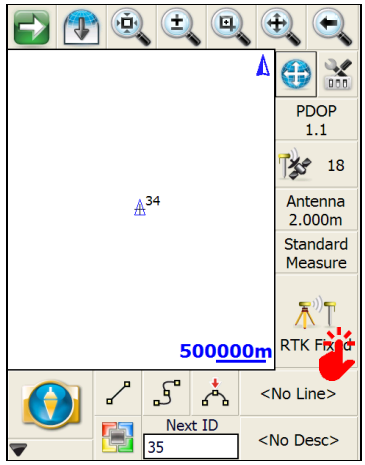
Click Select to confirm the mount point you choose.



Step 5: Get fixed solution.

The receiver will get a fixed status if it receives differential signals successfully from CORS station.

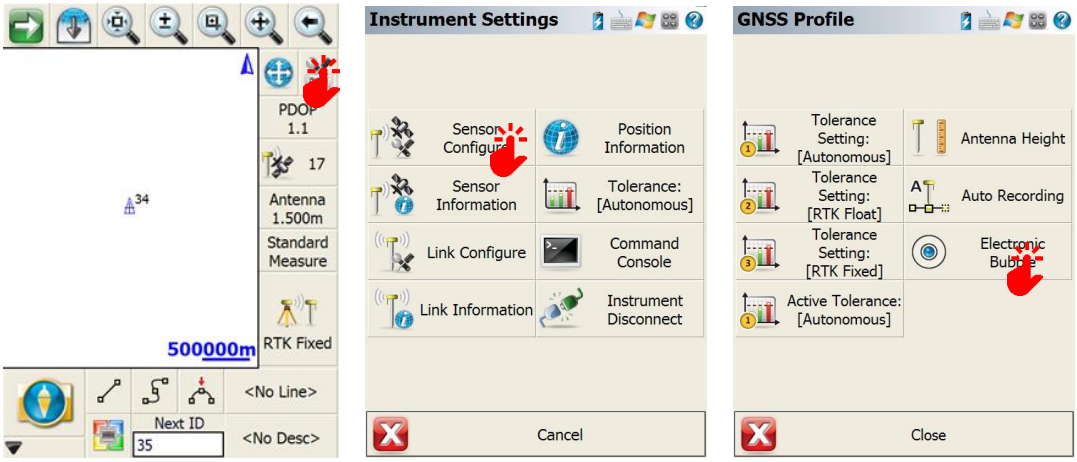
Click RTK Fixed to start to collect points.



3.4 TILT SURVEY

Step 1: Enter to Electronic Bubble.

After the receiver gets fixed, click , Sensor Configure, Electronic Bubble.



Step 2: Setting.

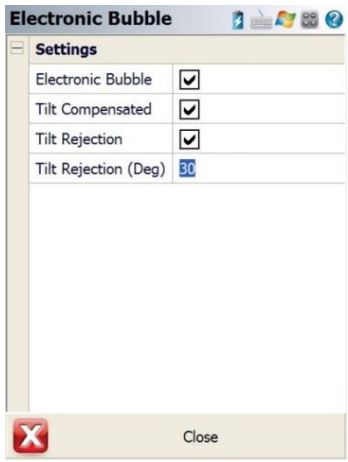
There are four options you can choose in *Setting* interface.

<Electronic Bubble>: to display the graph of the electronic bubble graph on the page of storing points.

<Tilt Compensated>: Eliminate error from pole inclination.

<Tilt Rejection>: Refuse storing a point if the tilt is over.

<Tilt Rejection (Deg)>: Set the maximum tolerance of tilt angle, usually less than 30°.

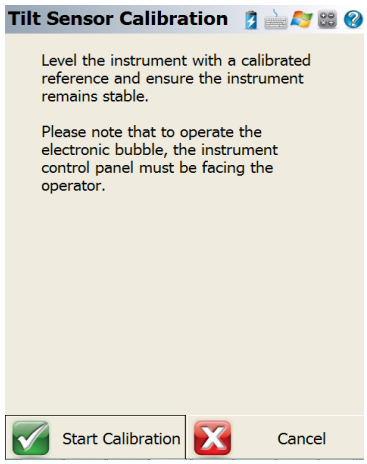


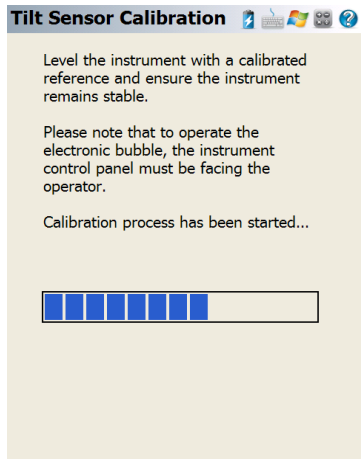
Step 3: Calibrate tilt sensor.

This process is to calibrate the internal tilt sensor, and reset the vertical angle to zero.

a. Click Calibrate Tilt Sensor to start.
b. Perfectly level the receiver with a calibrated reference such as a bipod or tripod.
c. Make sure the receiver is in a stable plumb position.
d. Click Start Calibration button to start the tilt sensor calibration.

Note: the control panel of the receiver must be facing to the operator during calibration.

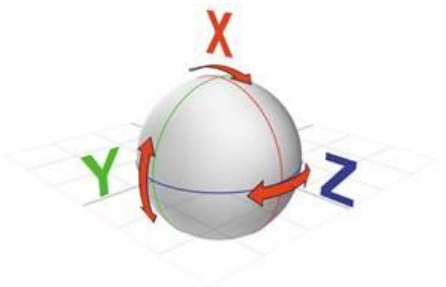




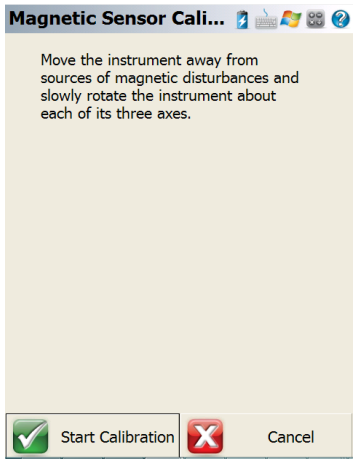
Step 4: Calibrate Magnetic Sensor

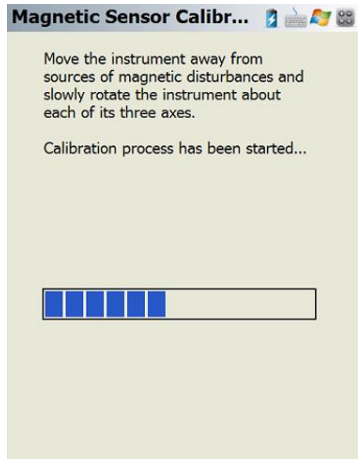
This procedure is to calibrate the internal magnetic sensor.

a. Click Calibrate Magnetic Sensors to start.
b. Make sure the receiver is away from any artificial magnetic sources.
c. Slowly rotate the receiver on 3 axes.
   Longitudinal Axis (Roll)
   Lateral Axis (Pitch)
   Vertical Axis (Yaw)



d. Click Start Calibration to start the process.





Now you can collect the points with tilt corrected.
Notice: It is recommended to calibrate the electronic bubble every time you start to work.

3.5 MEASURING ANTENNA HEIGHT

The antenna height is related to static operations and RTK operations, the following is the introduction separately.

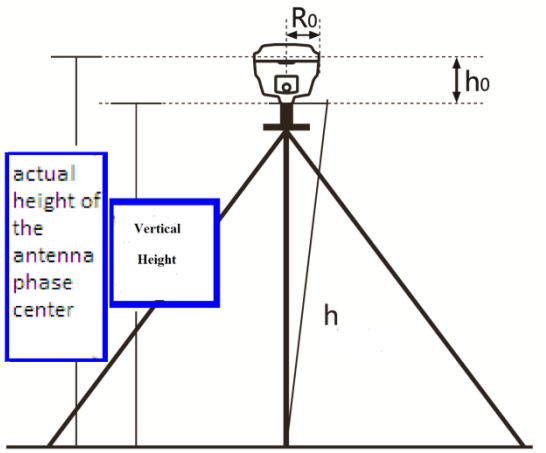
Antenna height is actually the vertical height of the phase center to ground measurement point, measurement methods of antenna height in dynamic mode includes pole height, vertical height and slant height.

- Pole Height: the height of the centering pole, which can be read from the pole scale;
- Vertical Height: the vertical height from the ground to the bottom of the main mainframe + antenna phase center to the bottom of the mainframe.
- Slant Height: measure to the middle of the rubber ring. In the hand-held software, select the antenna height mode to the slant height, then input the value.

Antenna Height Measurement in Static Mode

Measures from the ground to the middle of the receiver rubber ring. Select the appropriate

type of antenna in the post-processing software.



4. CONNECTING TO PC

4.1 DATA TRANSFER

The receiver document management of NOVA R6 uses U disc storage, plug and play, which does not need to download any program, and directly drag and download. The multi-function data cable is used to download, connect one end to USB, the other end to the 7-pin socket at the bottom of the mainframe. After connected, there will be a new drive on the computer, like a flash disk, which enables copying files directly.

STH file is the data file acquired from NOVA R6. The modification time is the time of data collection. The original files can be copied directly to the PC. You can use the software INStar to copy the data to PC, and to modify the file name and the antenna height.

Please refer to the user guide of INstar for more information.

APPENDIX A: TECHNICAL SPECIFICATION

Performance No. of Channel		220
Configuration		Dual frequency for GPS, GLONASS, BEIDOU & SBAS.
Single Tracked	GPS	L1C/A, L1C, L2C, L2E, L5
	GLONASS	L1C/A,L1P,L2C/A,L2P, L3
	BEIDOU	B1, B2, B3
	SBAS	L1C/A, L5 (only for the satellites supporting L5)
	Galileo	GIOVE-A, GIOVE-B, E1, E5A, E5B
		QZSS, WAAS, MSAS, EGNOS, GAGAN, SBAS
Position Accuracy Code Differential	Horizontal	25cm+1ppm RMS
	Vertical	50cm+1ppm RMS
	SBAS	Typically <5m 3DRMS
Real-time Kinematic	Horizontal	8.0mm+1.0ppm RMS
	Vertical	15.0mm+1.0ppm RMS
	Time to Work	2-8s
Static & Fast Static	Horizontal	2.5mm+0.5ppm RMS
	Vertical	5.0mm+0.5ppm RMS
Network RTK	Horizontal	8.0mm+0.5ppm RMS
	Vertical	15.0mm+0.5ppm RMS
Communication	I/O	Network/radio data link antenna port
		7-pin LEMO RS232 + USB
		5-pin LEMO external radio power port +RS232
		SIM cars slot
Wireless Modem		Integrated internal radio receiver & transmitter
	Frequency	410-470MHz
	Protocol	TrimTalk450s, TrimMark3, PCC EOT, SOUTH
	Output Power	0.5W/1W
GSM/GPRS Modem		WCDMA 3.5G module, GPRS/EDGE compatible, CDMA2000/EVDO 3G optional
Double Module Bluetooth		BLEBluetooth 4.0 standard, supports connection with Android & iOS
		Bluetooth 2.1 + EDR standard
WiFi		802.11b/g

NFC		Close range (<10cm) automatic pair between R6 & controller (equipped with NDFC wireless module)
Data Storage/Transmission		4GB internal storage, more than 3 years' raw observation data based on recording from 14 satellites plug & play mode of USB data transmission.
Data Format	Differential	CMR+, CMRx, RTCM 2.1, RTCM 2.3, RTCM 3.0, RTCM 3.1, RTCM 3.2
	GPS Output	NMEA 0183, PJK plane coordinates, binary code
	Network Model	VRS, FKP, MAC, supporting NTRIP protocol
Internal Sensor	Tilt Survey	Built-in tilt compensator, correcting coordinates automatically according to the tilt direction & angle of the centering rod.
	E-Bubble	Controller software displays electronic bubble, checking leveling status of the centering rod real time.
Physical	Dimension	12.9cm X 11.2cm
	Weight	970g (including battery)
	Material	Magnesium aluminum alloy shell
Environmental	Operating Temp.	-45°C to 60°C
	Storage Temp.	-55°C to 85°C
	Humidity	Non-condensing
	Water Proof	IP67 standard, protecting from long time immersion of depth of 1m
	Dust Proof	IP67 standard, fully protecting against blowing dust
	Shock	OFF status: Withstands 2m pole drop onto cement ground naturally.
	Vibration	ON status: Withstands 40G 10 milliseconds sawtooth wave impact.
Electrical	Power Consumption	2W
	Battery	Rechargeable, removable Lithium-ion battery
	Battery Life	Single battery: 7h (static mode) 5h (internal UHF base mode) 6h (rover mode)

APPENDIX B: TECHNICAL TERMS

Ambiguity: unknown quantity is the integer number of cycles of the carrier phase measured from the satellite to the receiver.

Baseline: The connection line of the two measurement points, on which to receive GPS signals and collect observation data simultaneously.

Broadcast ephemeris: message released by the satellite demodulator satellite orbit parameters.

SNR (Signal-to-noise ratio): an endpoint signal power to noise power ratio.

Cycle skipping: interfere loop skips a few cycles from a balanced point, and stabilize in the new equilibrium point, this make the phase integer number of cycles to generate an error.

Carrier: As the carrier, Frequency, amplitude or phase modulation of the modulated wave by a known reference value.

C / A code: GPS coarse / acquisition code, modulate the pseudo-random binary code for the 1023 bit duplex, the bit rate of which is 023MHz, and code repetition period of 1ms.

Difference measurement: GPS measurements employ cross-satellite cross-receiver and cross-epoch.

Difference Positioning: the method of determining the relative coordinates between two or more receiver by tracking the same GPS signal.

Geometric dilution of precision: Describe the contribution of satellite geometry errors factor in dynamic positioning.

Eccentricity: $e = \sqrt{\frac{a^2-b^2}{b^2}}$ where a, b of the semi-major axis and semi-minor axis.

Ellipsoid: mathematical graphics formed when an ellipse moves around the minor axis of rotation in Geodetic Survey.

Ephemeris: the position of celestial bodies over time parameters.

Flattening: $f = \frac{1}{a}(a-b) = 1 - \sqrt{(1-e^2)}$

a is the semi-major axis, b is the semi-minor axis, e is the eccentricity.

Geoid: similar to the mean sea level and extends to the mainland special planes. Geoid everywhere perpendicular to the direction of gravity.

Ionosphere delay: delay of radio waves through the ionosphere (non-uniform dispersion medium)

L-band: The radio frequency range of 390-1550MHz.

Multipath error: the positioning error caused by the interference between two or more radio signal propagation path.

Observing session: the use of two or more receivers at the same time to collect GPS data period.

Pseudo Range: GPS receiver in the time required to copy the code aligned with the received GPS code offset and multiplied by the speed of light to calculate the distance. This time offset is the difference between the signal reception time (time series of the receiver) and the signal emission time (satellite time series).

Receiver channel: GPS receiver RF mixer and IF channel, can receive and track satellites two carrier signals.

Satellite configuration: the configuration status of the satellite with respect to a specific user or a group of users within a specific time.

Static position: do not consider the point of measurement of the movement of the receiver.

FCC STATEMENT

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.

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.

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

This equipment is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

Use the GNSS RECEIVER in the environment with the temperature between -45°C and 60°C.

CAUTION: RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS.

The device complies with RF specifications when the device used at 0cm from the user's body

CE0700