

Galaxy G6 Measuring System

User Manual

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Chapter Ⅰ Brief Introduction

Read this chapter, and you will have a brief knowledge of South Company and Galaxy G6 measurement system.

§1.1 Introduction

Welcome to South Surveying&Mapping Instruments Co., Ltd, which is China's leading GPS RTK instrument production and sales enterprises, has been committed to spread the international advanced GPS mapping survey techniques and products to the users. To know more information about SOUTH, please visit our official website http://www.southinstrument.com/

This manual takes Galaxy G6 measuring system for example, to explain how to install, set up and uses the RTK system as well as the use of the accessories. We recommend that you read these instructions carefully before using the instrument.

§1.2 Applications

Control Survey: dual-band (dual-frequency) system static measurements can accurately complete the high-precision deformation observation, photo-control point measurement.
Highway Survey: quickly complete the encryption of the control points, road topographic mapping, cross-section measurement, profile measurement with EGStar.
CORS Application: provide more stable and convenient data link for field operations. It is seamlessly compatible with all types of domestic CORS applications.
Data acquisition measurement: perfect match South's various measurement software to do 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.

§1.3 Main Features

Intelligent Platform

Combine embedded Linux operating system with SOUTH smart cloud, Galaxy G6 will no

longer be a separate hardware device, but a complete intelligent system, with the aid of the SOUTH powerful cloud service platform, users are able to register the receiver, upgrade firmware and diagnosis in real-time by remote control service. Never leave home you can enjoy the star service from SOUTH.

This product is a MID.
The EUT received DC 3.7V power from a li-ion battery (2800mAh), and the charge voltage is D C 5V/1.5A.
The EUT Support Radios Application: Bluetooth/WIFI
The EUT is working base on the MCU A33(Crystal: 24MHz, 32.768KHz). The power supply is controlled by the IC AXP223.
The EUT equipped with RF module RTL8723BS (WIFI+BT) (Crystal: 40MHz).

The WiFi, BT could not transmit simultaneously

Bluetooth

Bluetooth V4.0:

Works in the 2.4GHz (2402MHz~2480MHz) ISM band

79 channels for Bluetooth V4.0

1MHz channel spacing

Modulation type: GFSK, π/4-DQPSK, 8-DPSK

40 channels for Bluetooth V4.0

2MHz channel spacing

Modulation type: GFSK

WiFi

Works in the 2.4GHz(2412MHz~2462MHz), Modulation: DSSS and OFDM on IEEE 802.11 protocols and support 802.11b/g/n(HT20&HT40).

Channel spacing: 5MHz

11 channels for 20MHz bandwidth and 7 channels for 40MHz bandwidth

One integral antenna for WIFI, BT(1.5dBi)

Advanced InBuilt UHF module

Galaxy G6 adopts new and excellent datalink system, which is compatible with current radio protocols in the market, also supports all kinds of network types to access CORS seamlessly

Speed Dial

Based on Linux platform and PPP dial-up technology, which ensures the stability of network connection for Galaxy G6 in the process of measuring.

Intelligent Interaction

Support to access the internal web UI manage page of receiver with WiFi and USB connection, monitor host state real-time, configure receiver freely.

Attractive OLED Display

Galaxy G6 is installed with a more attractive OLED display that mode settings and status are intuitive and easy to know from the screen

Smart Voice Guide

The customizable iVoice technology is allowed to customize your local language. Multi-lingual and clear-tone messages enable users to understand the critical information and status of receiver such as network connection, solution status, working mode and more, which definitely helps to improve work efficiency by being acknowledged.

Full Constellations Tracking

Equipped with most advanced GNSS boards, Galaxy G1 system can track most signal from all kinds of running satellite constellation, especially support B1,B2 and B3 signal from COMPASS, also get position result with only COMPASS signal

Electronic Bubble & Tilt Compensation

The internal tilt compensator and electronic bubble can correct the coordinate result automatically at the points with tile angel and tile direction

Large capacity power support

Galaxy G6 is equipped with 2 large capacity (7.4V, 6800mAh), removable and rechargeable Li-ion batteries, they are checked the remaining power real-time.

The portable power source package can last up to 24 hours continuous work, which provides almost 2-3 working days. Plus the pioneered power saving mode, the battery package ensures G6 can complete the measurement under static mode and base mode.

Intelligent Storage

Galaxy G6 supports variety of raw data storage including STH, Rinex2.01 and Rinex3.02. The

internal 8G SSD (Solid State Drive) ensures long time data collection. And as an OTG host, G6 also allows to extend an external USB device for the storage.

The configurable sample frequency is really up to 50Hz.

The one-key intelligent copy function enables users download static data from receiver by inserting an USB storage to receiver directly without bringing the unit back to office, that extremely improves the efficiency and the demanding of static fieldwork.

Amazing Housing

Galaxy G6, with and innovative design, built with magnesium alloy materials. And the top edge is design to decrease harm for receiver in case of fall down to ground

NFC Function

The internal NFC module can make the complicated Bluetooth communication more easy and simple

Cloud Service

The function enable realize online upgrade and register, remote diagnosis in real-time

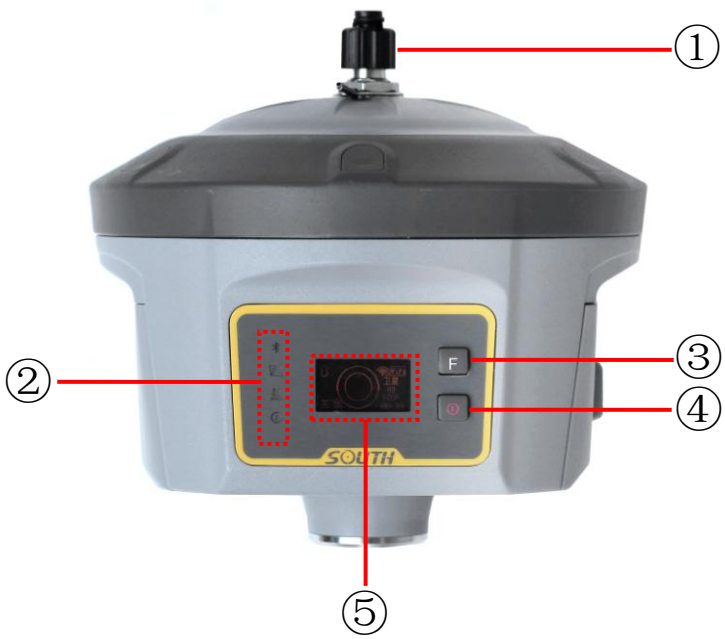
Chapter Ⅱ Hardware Component

Reading this chapter, you can grasp the components, installation and the function of Galaxy G1 measuring system

§2.1 Mainframe

The mainframe is a flat cylindrical, 137mm in height, 152mm in diameter, the height from the rubber seal ring to the bottom is 60mm. the body is made up of magnesium alloy material, it makes overall the G6 be more rugged and durable. Galaxy G6 adopts LCD and buttons combination design, install with an attractive OLED display that mode settings and status are intuitive to know, easy to operate. At the side and the bottom of receiver there are the frequency used interfaces.

§2.1.1 Front Components



Ref	Component	Description
①	**UHF antenna interface**	Install UHF receiving/transmitting antenna
②	**Indicators**	Indicates the working status for receiver

③	**F Key**	Page up/down, selection button
④	**Power Key**	Power on/off receiver, confirm button
⑤	**OLED Display**	Display the working mode and status of receiver

Indicators

The indicators are located at the left side of front component, details meaning please check the table below.

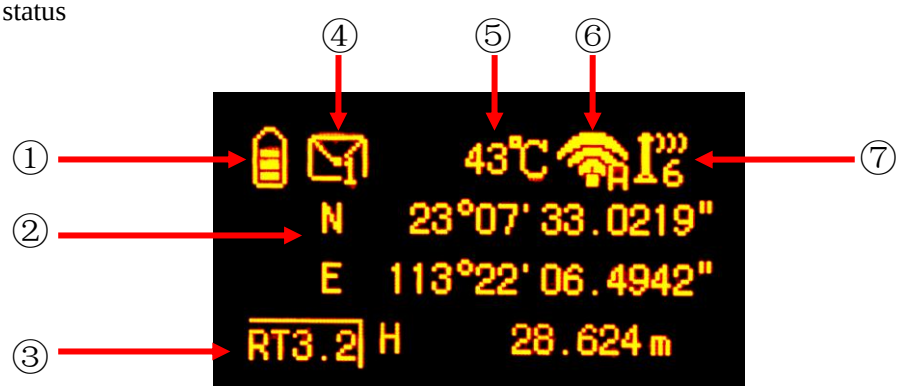


Ref	Component	Description
①		Glows in red to indicate that Bluetooth connection has established
②		Flashes in red to indicate that the static data is storing with the sample interval
③		**UHF mode:** Flashes in red to indicate that the signal is receiving/transmitting with the interval **GPRS mode:** 1) Fast flashes in red to indicate that the receiver is dialing; 2) Flashes in red with the signal receiving/transmitting interval when successful dial **WiFi mode:** 1) Fast flashes in red to indicate that the receiver is establishing WiFi connection; 2) Flashes in red with the signal receiving/transmitting interval when successful connection
④		Glows in red if there is enough power in battery Flashes in red to inform you the battery is going to run out and 5 minutes left when it starts blinking

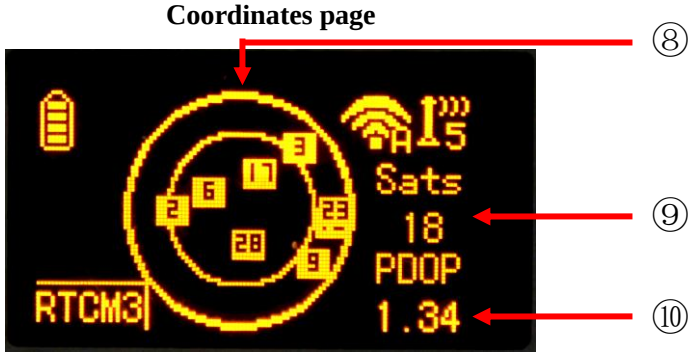
Display and main interface

Power on G6 and after initializing, it will get into the main interface and begin to search the satellite like a radar on skyplot, then you will get a voice saying the working mode, 10 seconds later the screen will automatically switch to display the coordinates and other information.

The satellite information will display on this interface such skyplot, the number of satellite and PDOP status



Coordinates page

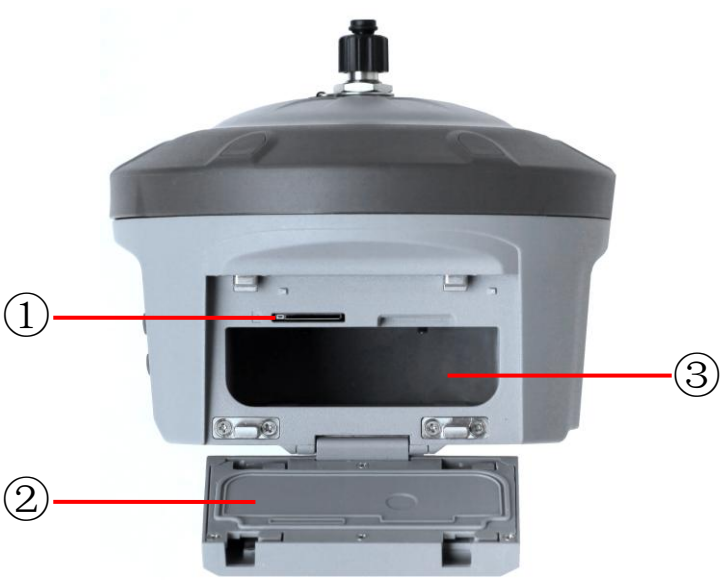


Skyplot page

Ref	Component	Description
①	**Battery symbol**	Display the electricity quantity in real-time
②	**Coordinates**	Display the coordinates of base or rover
③	**Solution/Message type**	It will display the message type transmitted when the receiver is set as base; and it will display the solution type when the receiver works as rover
④	**Message symbol**	The message symbol will appear automatically if receiver gets something error, such as error message. Press F key to read the message and press F key again to cancel
⑤	**Temperature**	Display the temperature of receiver in real-time
⑥	**WiFi symbol**	Display the WiFi status, when it shows , that

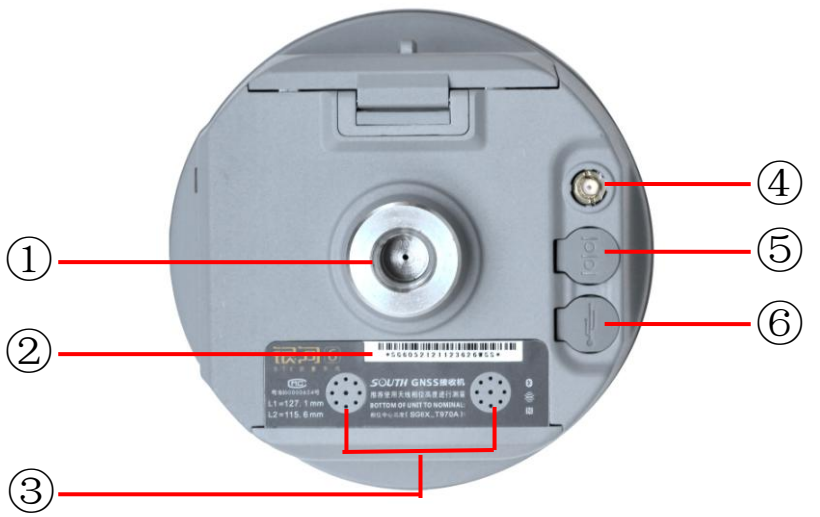
		means the receiver is establishing WiFi connection as WIFI client, and if the WIFI successfully connected the symbol will change to be ; when it shows , that means the receiver is broadcasting its WIFI hotspot (We recommend to turn it off while unused.)
⑦	**Data link symbol**	G6 will indicate the current used datalink at this location. means internal UHF mode and the current channel, means the GPRS mode, means dual-emitting mode, means externl device mode
⑧	**Skyplot**	Display the satellites distribution
⑨	**Satellites**	The value under Sats indicates the number of satellites
⑩	**PDOP**	Display current PDOP value

§2.1.2 Side Components



Ref	Component	Description
①	**SIM card slot**	Where we can insert a SIM card when the receiver is set in GPRS mode
②	**Battery cover**	Restore the cover after installing the battery to avoid the battery slips off
③	**Battery housing**	Installing the battery

§2.1.2 Bottom Components



Ref	Component	Description
①	Screw hole	Fix the mainframe to the tribrach or the pole
②	SN label	Apply for a registration code, Bluetooth ID
③	Speaker	Mode setting and working status prompt
④	GPRS antenna interface	Install GPRS antenna
⑤	5-pin port	As a power port connected with an external power supply device; as a differential transmission port connected with an external radio; as a serial port to check data output and debug
⑥	7-pin port	USB port, OTG interface and Ethernet port

§2.2 Operation on receiver

§2.2.1 Main configuration page

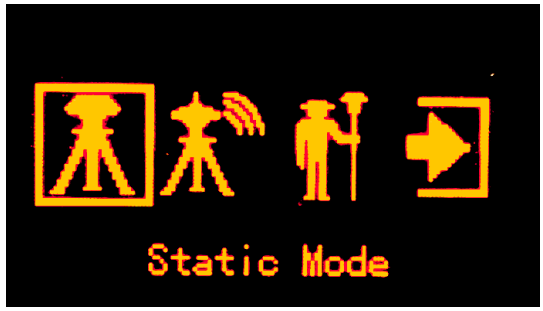
Press once on F key after power on receiver to get into the configuration interface, then you will have Mode Select, Set Datalink, System Option, WIF Config, UHF Info, Config Mode, Power Off and Quit.

Press F key to move the box to the option which you need to configure, and then press Power key to confirm your selection.



§2.2.2 Mode Select

Power on receiver and press F key to get into main configuration interface, move the select box to Mode Select option, press Power key to confirm and enter Mode Select page, there you will have Static Mode, Base Mode and Rover mode.



Static Mode Setting

To make a static job with Galaxy G6, first you have to set the receiver in Static mode.

Get into the Mode Select page and place the select box at the Static Mode (first item), then press Power key to confirm and return to Coordinate/Skyplot page



What we should do in the next is setup all the parameters for static mode. Press power key once and enter Record Option page, all the parameter items are displayed here including point name, antenna height, sample interval, record mode and data type.

Site: this is point ID for static, and it is the last 4 digits from serial number, but you can edit it if you choose this item, there are 0-9 and A-Z for each digit.

Ant.Hgt: This is the antenna height measure from ground point to measurement tape

Interval: This is the sample rate for raw data storage

Rec.Mode: This is used to configure receiver to store raw data automatically or manually if achieve sampling condition

DataType: This is used to choose the data format for raw data storage, such as STH, Rinex2.01 and Rinex3.02

Press F key to move to **Edit** option and press power key to confirm, here you can select the item to edit by pressing F key. For example, press F key to move to Datatype item and press power key to setup what kind of data format we are going to record, press F key to move to Rinex2.x or Rinex3.x and press power key to confirm, after that, press F key to move to OK option and press Power key to finish setting and return to the coordinate/skyplot page.

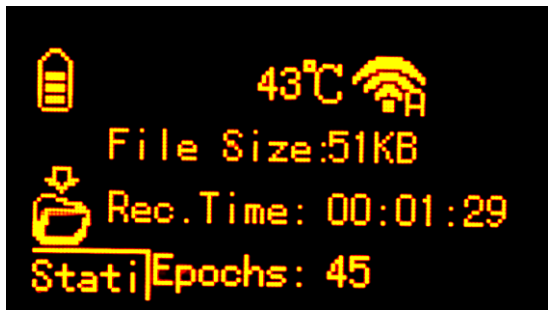


The receiver will start to record the data if achieve the sampling conditions, at this moment, recording information will be shown on the screen such as file size, recording time and the epochs.

File Size: Real-time display the size of data file

Rec.Time: Real-time display the recording time

Epochs: Real-time display the quantity of epochs receiver already obtained



NOTE: Please ensure the parameter values static mode are the same if there are more than 2 pcs units work at the same time.

Base Mode Setting

Press F key after initialization to get into configuration interface, then move select box to Mode Select option and press Power key to enter Mode Select page, move the select box to Base Mode (second item) and press Power key to confirm. Once return to coordinate/skyplot page, press power key to enter Base configuration page. Start Base Option, Record Option and Quit option are displayed in this page.



Start Base Option

This option is to control and setup the parameters for the transmission when base station achieves the transmitting conditions.



Base Mode: Manual, Repeat and AutoBase for optional to start the base station.

Diff Type: This is the correction format which base support to transmit, there are RTD, RTCM23, RTCM30, RTCM32,CMR, SCMRX for optional.

Mask Angle: It is a altitude restricted angle which is an angle defined from horizontal level to the sky direction, it is mainly used to control satellite view for GPS receiver. 10-15 degree is the default setting.



Record Option

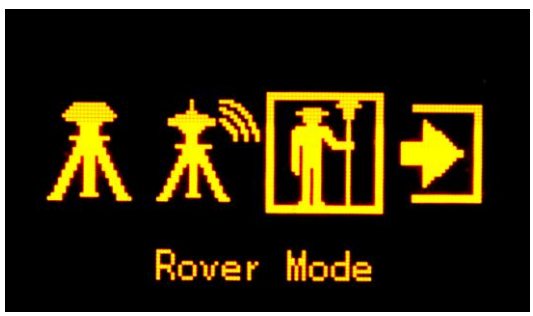
That is used to control and setup the parameters for base station to record raw data or not





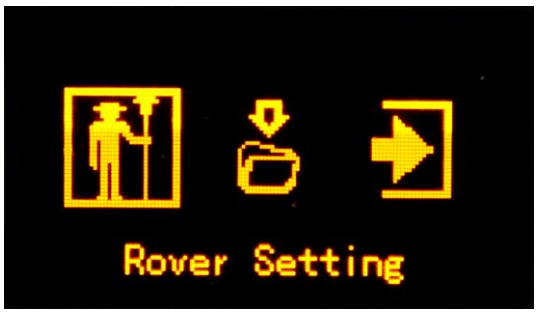
Rover Mode Setting

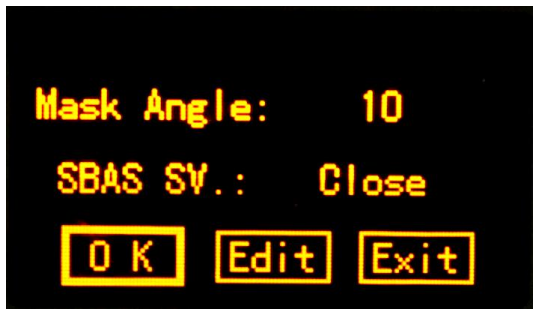
Press F key after initialization to get into configuration interface, then move select box to Mode Select option and press Power key to enter Mode Select page, move the select box to Rover Mode (third item) and press Power key to confirm. Once return to coordinate/skyplot page, press power key to enter Rover configuration page. Rover Setting, Record Option and Quit option are displayed in this page.



Rover Setting

This is used to configure the mask angle and SBAS satellite view for rover receiver





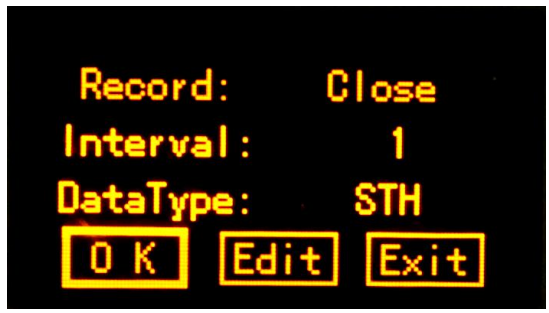
Mask Angle: It is a altitude restricted angle which is an angle defined from horizontal level to the sky direction, it is mainly used to control satellite view for GPS receiver. 10-15 degree is the default setting.

SBAS SV: This is used to control the rover receiver to track the SBAS system or not.

Record Option

That is used to control and setup the parameters for rover station to record raw data or not, it is similar to the base station.



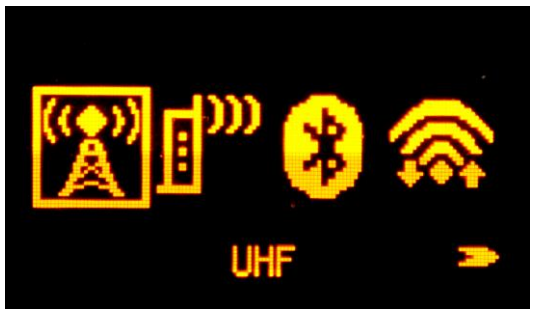


§2.2.3 Datalink Setting

Galaxy G6 is integrated with a series of excellent and advanced datalink modules make it be an extremely powerful system that includes built-in radio module, cellular module, Bluetooth and WIFI, G6 is not only able to connect with the external module, but also can close the datalink if it is not the necessary use.



Press F key to get into main configuration interface after the initialization or the working mode has been setup, then move the select box to Set Data Link option by pressing F key, and press power key to confirm and enter the interface, there are UHF, Cellular Net, Bluetooth, Dual Transmitting, WIFI Datalink, External, Close Datalink and Main menu options displayed on this interface.



UHF Setting

Select UHF option and then get into its configuration interface, then you can setup the channel, air baud rate, communication protocol and power for internal UHF.



Channel: This is the communication channels for internal UHF, the value of the channel must be the same both in Base and Rover.

Air Baud: This represents the radio transmission rate of data, the higher value, the bigger of data size transmitted per second, in this page, there are 9600 and 19200 for selection. The default setting is recommended to use, Base and Rover must have the same rate if it is changed.



Protocol: This is radio communication protocol for data transmission, SOUTH and TRIMTALK are optional in this page and SOUTH is the default setting, if it is changed, Base and Rover must use the same protocol for communication.



Power: This appears only in Base mode, the radio transmitting power is allowed to define in High, Middle or Low power.

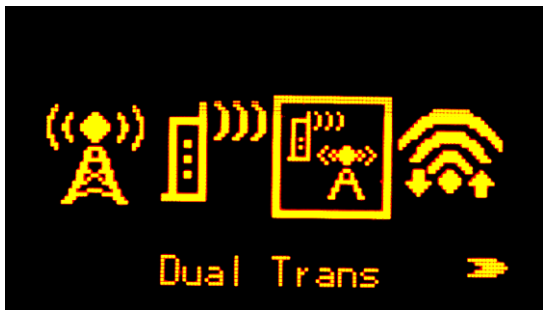
Cellular Net Setting

This mode is using the internal cellular module that connect to internet and access to reference station for the corrections.



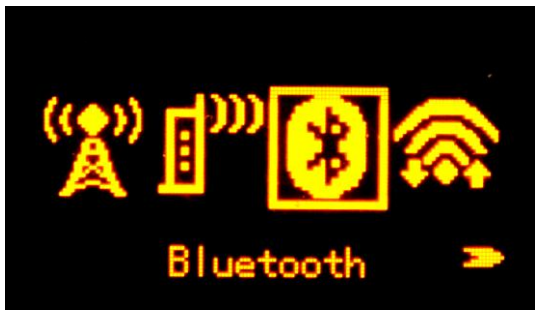
Dual Transmitting Mode

This mode is used for the Base station that it is able to transmit the corrections by both internal UHF and cellular net.



Bluetooth Mode Setting

This mode is used on Rover that access the reference station for corrections by using data collector internet that transfer the corrections to receiver through Bluetooth.



WIFI Datalink Setting

This is the pioneer to use WIFI as the datalink that connect to the internet and access to reference station for corrections. (detail settings please refer to ….)



External Device

Setup this mode to connect the external datalink such as external radio module or external GPRS module.



Close Datalink

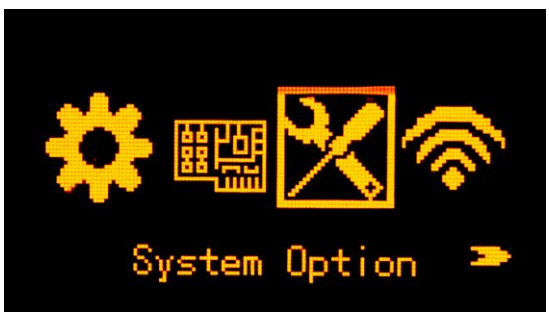
This option is used to turn off all of the transmission method for development and customization, usually keep all the datalink activated.



§2.2.4 System Setting

In System Setting, you will have more configurations for Galaxy G6 that includes Language setting, Voice option, selfcheck, online service and so on.

Move the select box to System Option and then enter the configuration page, there you will have Language, Voice Option, System Info, Self Check, Online Option, Other Option and Copy Static File items displayed on this page.





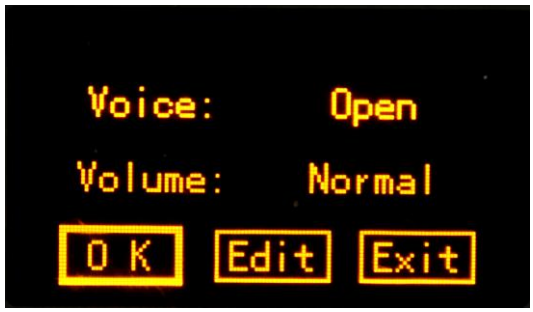
Language

The Language page contains Chinese, English, Russian, Korean, Spanish and Portuguese, users can setup to show their local language on G6.



Voice Option

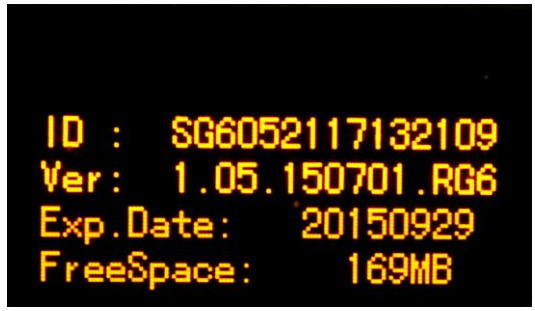
Users can turn on/off the voice prompt and turn up/down the volume in Voice Option page.



Sytem Info

Get into System Info page, more detail information about the receiver is displayed here including receiver ID (the serial number), firmware version, expired date and remaining memory

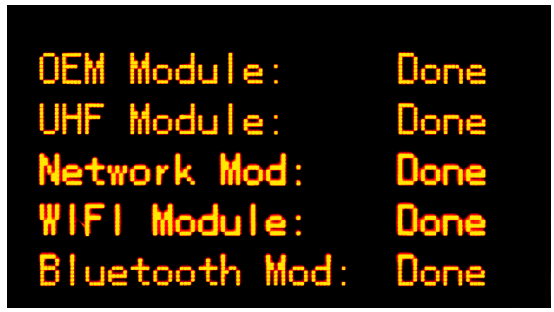




Self Check

This is used to check whether there is something wrong with the internal modules such as OEM board, internal UHF, cellular module and Bluetooth module.





Online Option

This online service option is used for registration and upgrade firmware online for Galaxy G6, it is very convenient that you don't need any more PC software to do this.

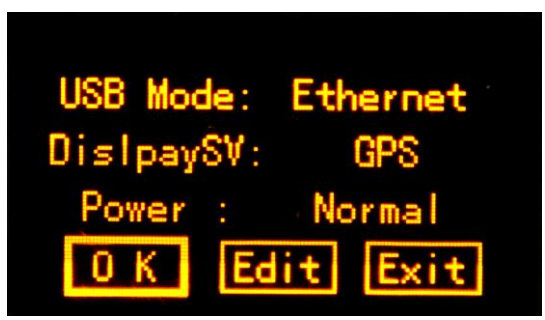




Other Option

In this page, there are USB mode, Display SV and Power items displayed.





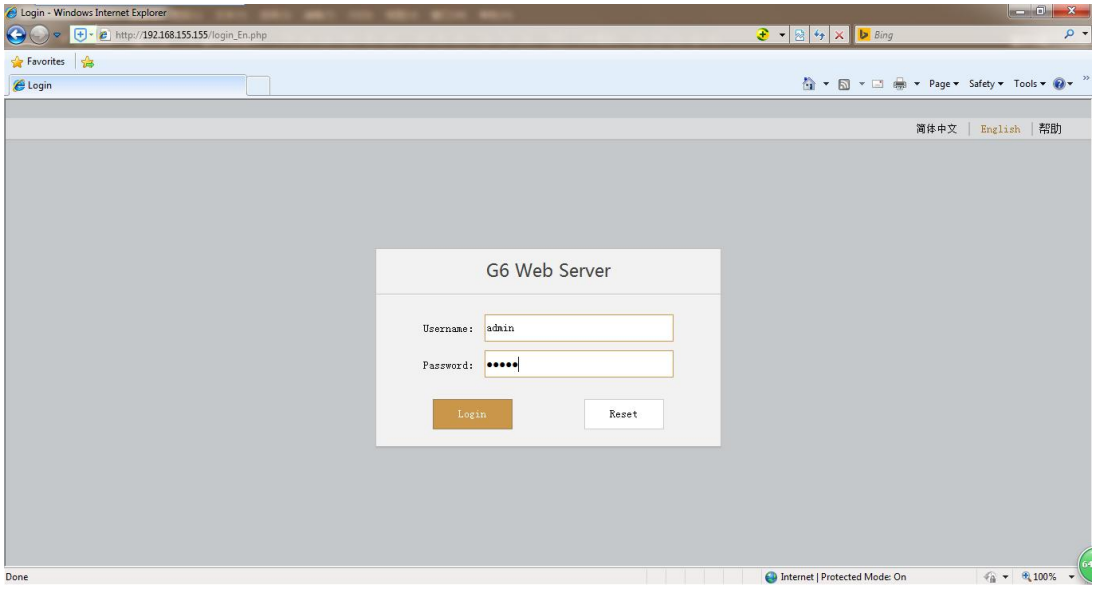
USB Mode: This is used to configure G6 what kind of mode output from 7-pin port when connect the receiver with computer via USB cable.



If **USB Disk** option is selected, then Galaxy G6 will be detected as a flash disk when connects to computer via USB cable, in this case, you can copy the static data from G6's memory folder.

If **Ethernet** option is selected, G6 is equivalent to a network adapter that you can access to the internal web ui page of G6 through USB cable when connect G6 with computer. Run the IE explorer and type IP 192.168.155.155 into IP address bar, then input the default username (admin) and password (admin) for login.

NOTE: A corresponding driver is required to intall on computer to activate this function, the driver can be downloaded from official website, or contact with SOUTH technician for more supports.



DisplaySV: This is Display Satellite View, that means G6 is configured what kind of satellite constellation displays at skyplot page on screen, usually, GPS constellation is the default setting.



Power: This is the power saving mode that the corresponding unused items and the screen will be turned off when the receiver enters normal work status if Saving option is selected. Press any button to exit power saving mode.



Copy Static Files

Galaxy G6 is able to work as a USB OTG host that it can be connected a USB flash disk directly via an OTG cable, then users can copy the static data to USB flash disk. Set the USB mode as USB disk.



§2.2.5 WIFI Config

Move the select box to WIFI config option and press power key to get into the WIFI configuration page, WIFI Info and WIFI Option are contained in this page.



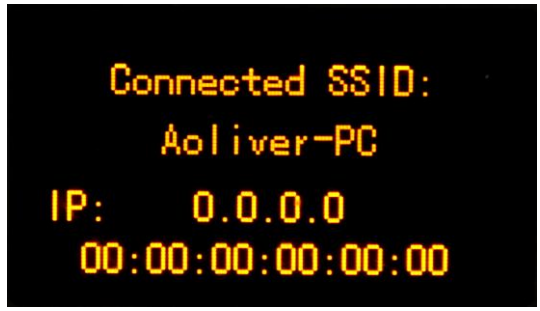
WIFI Info

If the WIFI working mode is selected to be "**Client**", the connected WIFI information will be displayed at WIFI Info page.

Connected SSID: This is the connected WIFI SSID which connects to internet.

IP: G6 will generate an LAN IP address for accessing its internal web UI page after connecting to the WIFI.

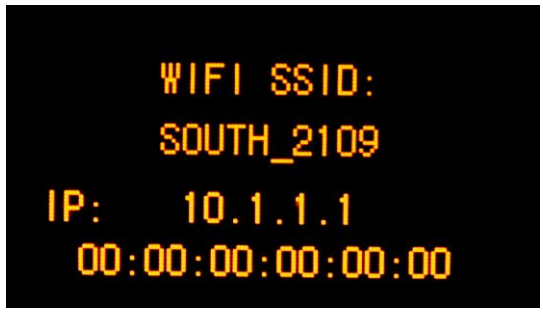




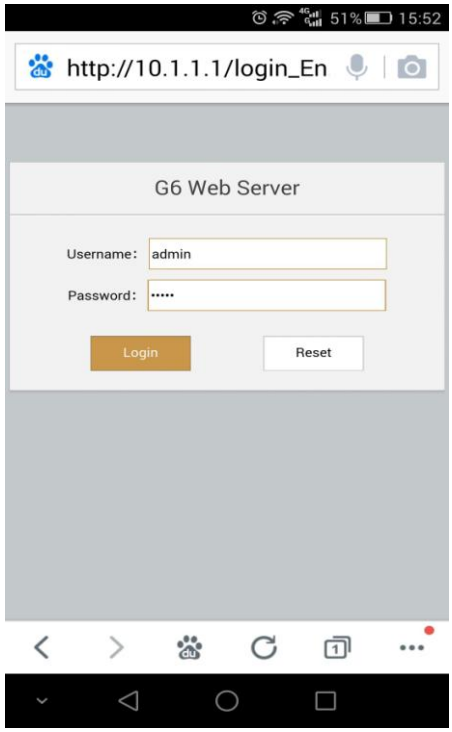
If the WIFI working mode is selected to be "AP", the WIFI hotspot information will be displayed at WIFI Info page.

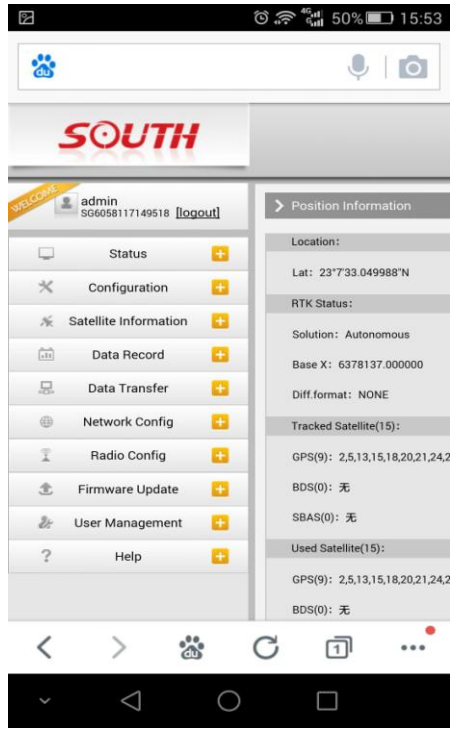
WIFI SSID: This is the WIFI hotspot SSID which broadcasted by G6, it is named with SOUTH_xxxx (xxxx is the last 4 digits of SN).

IP: This is the default IP address which is used for the internal web UI access.



Search the WIFI SSID broadcasted by G6 with smartphone or laptop and connect it, then input the IP address 10.1.1.1 into the address bar of explorer and access to the web UI of G6.

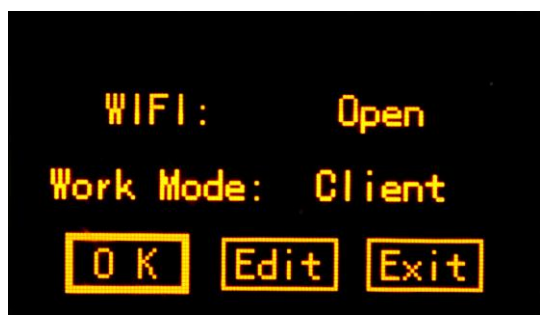




WIFI Option

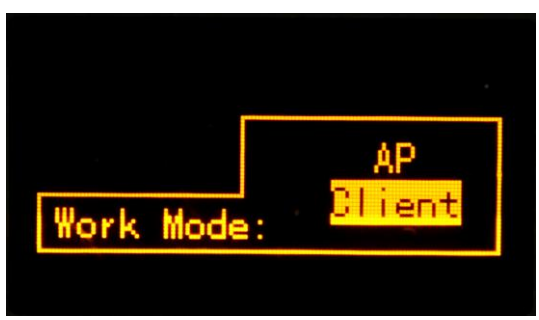
This is used to turn on/off the WIFI and setup what working mode of WIFI, such as AP (WIFI hotspot) and Client.





WIFI working mode setting

For the WIFI working mode, it is not only to be the hotspot, but also to be a datalink that help Galaxy G6 to connect to internet and obtain corrections from reference station.



AP: This item means the WIFI hotspot broadcasted by G6 for mobile terminals such as smartphone or tablet to connect and access the Web UI.

Client: If this item is selected, G6 will connect to the internet via WIFI connection and then download the corrections from reference station.

REMINDING: Turn off the WIFI is recommended if it is unused.

§2.2.6 Datalink Info (only for Base/Rover)

Under Base or Rover mode, there will be an additional option to view the information of current used datalink.

UHF Info

If the internal UHF mode is setup for Base or Rover, the **UHF Info** item will be displayed at main configuration page, move the select box to this item and press power key to view the information.

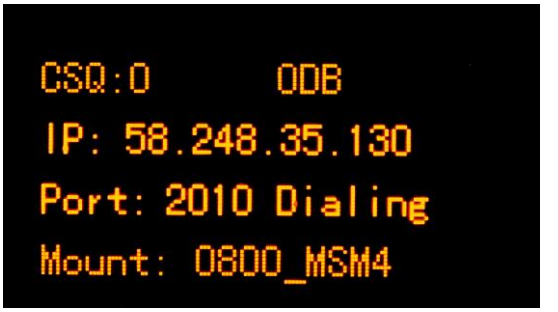




Network Info

If the Cellular Net mode or Dual Trans mode is selected as current datalink for Base or Rover, the **Network Info** item will be displayed at the main configuration page, choose this item and get into its page to view more information.

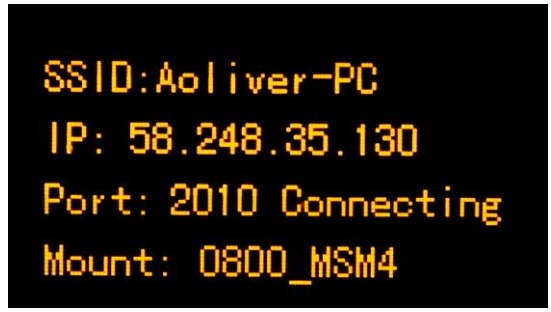




WIFI Status

If the WIFI is selected to be current datalink for Base or Rover, the **WIFI Status** item will be displayed at the main configuration page, press F key to move the select box to this item and then press Power key to enter its page to view more information.

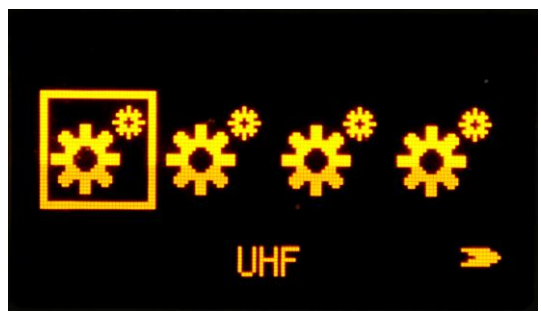




§2.2.7 Config Mode

This option is mainly used to configure the modem direct connect mode for receiver debugging or problem diagnosis. UHF, Cellular Net, Sensor Config and GNSS OEM are contained in this mode.





§2.2.8 Power Off

To power off the receiver, move the select box to Power Off item or press power button and hold for 3 seconds, the reminding page appears with the options of Exit, OFF and RESET, select OFF button to power off the receiver or move to RESET to restart receiver.





ChapterⅢ Web UI Configuration

§3.1 Overview

Because of using the smart embedded Linux operating system and SOUTH intelligent cloud technology, Galaxy G6 is allowed to configure and monitor the status of itself in real-time on web UI. G6 supports to access its web UI via its broadcasted WIFI hotspot and USB mode.

WIFI mode

First of all, get into WIFI Config option to open the WIFI hotspot by choosing AP option in WIFI Option.

Then use smartphone, tablet or laptop to connect the WIFI hotspot (SOUTH_xxxx) and input the default IP (10.1.1.1) into explorer, input the default username and password for login.

USB mode

First of all, choose the Ethernet option in “System Option—Other option—USB Mode” to make the 7-pin port be an ethernet port, then connect G6 with computer via USB cable. Run the IE explorer and type IP 192.168.155.155 into IP address bar, then input the default username (admin) and password (admin) for login.

NOTE: install the corresponding driver to activate this function, the driver can be downloaded from official website.

Remote Login

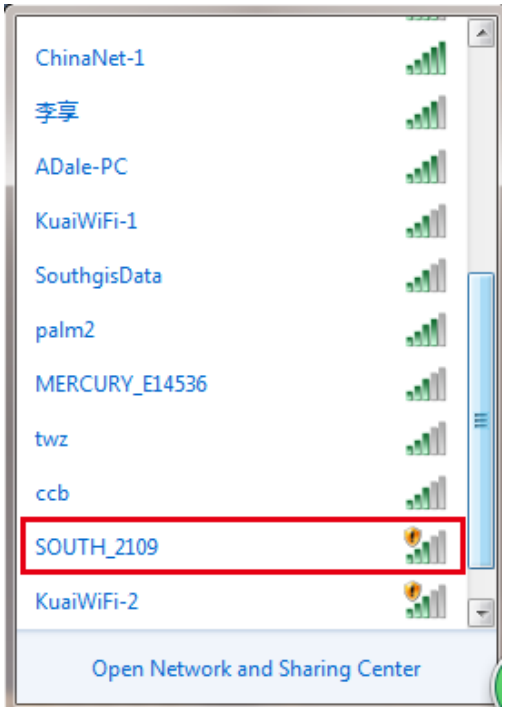
If users would like to remote login the web UI of G6, then G6 has to connect to the internet and forward its 80 port to the public network. For example, if the IP address 222.196.35.76 is the public network IP which G6 has connected, and the 80 port of G6 has been bounded with 8000 in public network, then users can input the public network IP address into IE explorer along with the forwarding port for login. (http:// 222.196.35.76:8000)



NOTE: please use the IE explorer for the Web UI login.

In this chapter, we will take using the WIFI hotsopt to login the Web UI for example.

Open the WIFI hotspot of G6 then search the SSID with computer. Then connect the WIFI hotspot from G6.



§3.2 Web UI main interface

After connecting to the WIFI, input IP 10.1.1.1 into the IP address bar of IE explorer and the login page will appear.

Input admin for both username and password, click Login button then all the items are displayed on Web UI home page. As shown at figure





In the Web UI home page, Status, Configuration, Satellite Information, Data Record, Data Transfer, Network Config, Radio Config, Firmware Update, User Management and Help are listed at left side. And the positioning informaiton including positioning information and satellites are diplayed at right side.

Ref	Component	Description
	Status	Positioning information, satellite tracking and the others will be displayed in this page
	Configuration	It contains registration for receiver, base configuration, antenna configuration, satellite configuration, receiver configuration and system configuration.
	Satellite Information	Display and control the satellites are used or not
	Data Record	Configure the parameters for static mode and raw data download
	Data Transfer	Contains NTRIP configuration, TCP/IP configuration and data transferring with PC
	Network Config	Contains network parameters configuration, WIFI configuration and the other functions
	Radio Config	Configure the parameters and frequency for radio modem
	Firmware Update	It is used to upgrade the firmware for receiver and each modem
	User Management	Add and manage the Web UI users

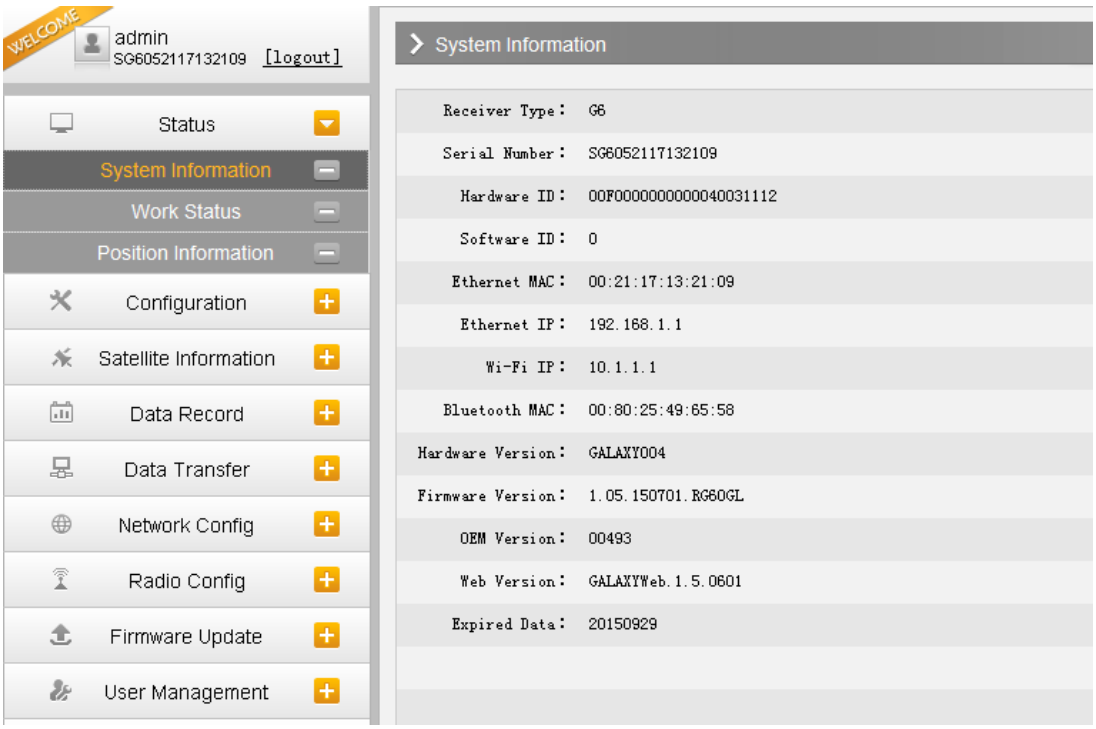
	Help	Offers solutions

§3.2.1 Status

System Information, Work Status and Position Information are listed under Status menu.

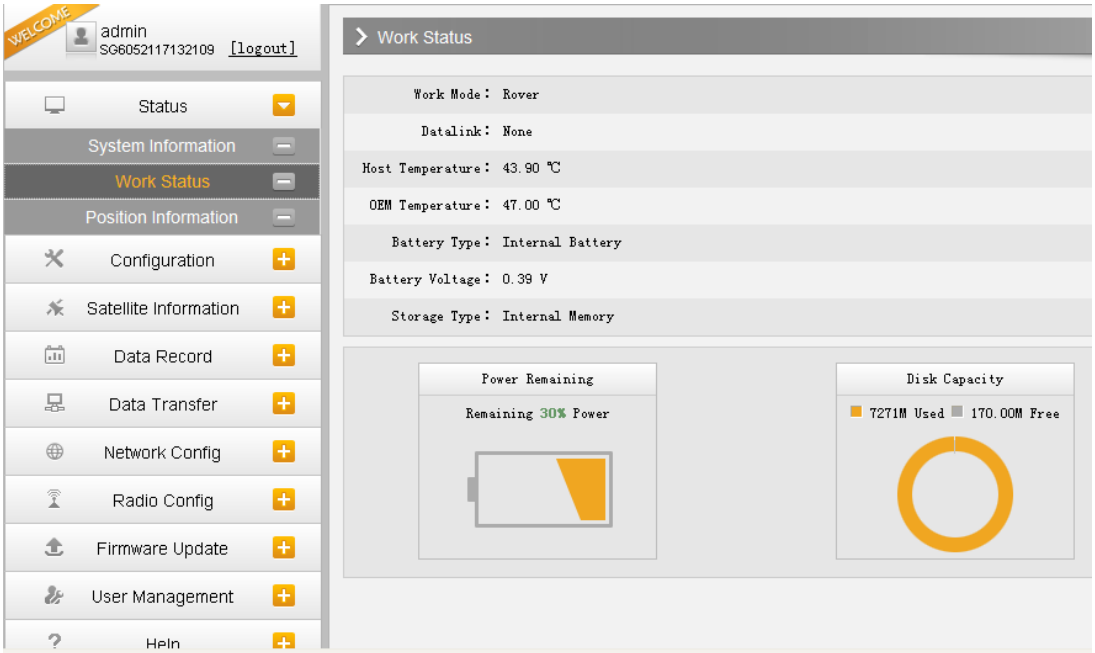
System Information

In this page, all the information of G6 is diplayed such as serial number, hardware ID, MAC address, firmware version and so on.



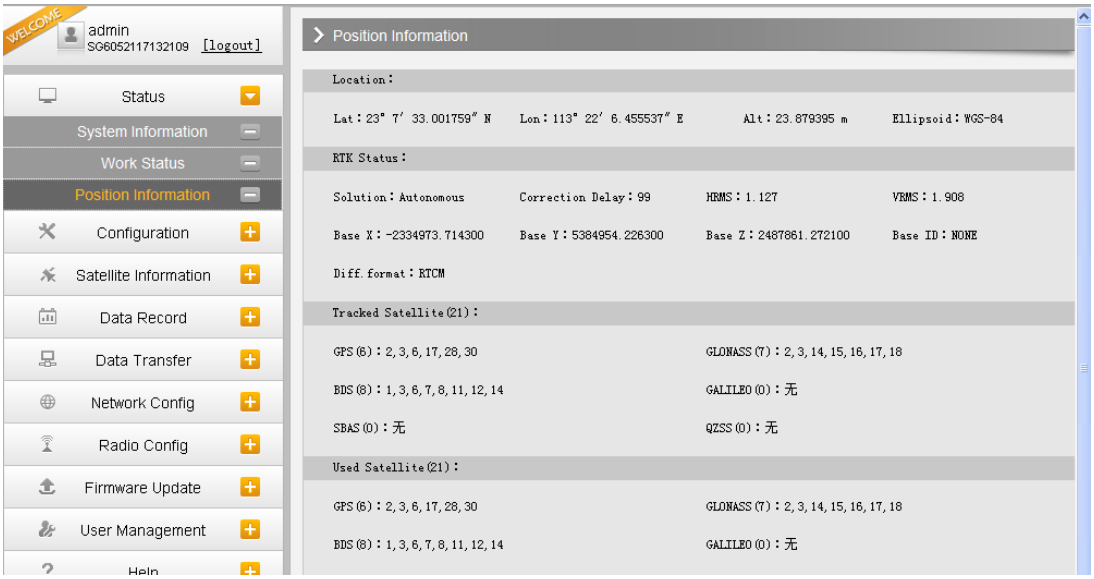
Work Status

The physical state of G6 such as working mode, datalink, host temperature, remaining power and the free memory is obtained from this page



Position Information

In this page, users can be clear at a glance on current position information and satellite information



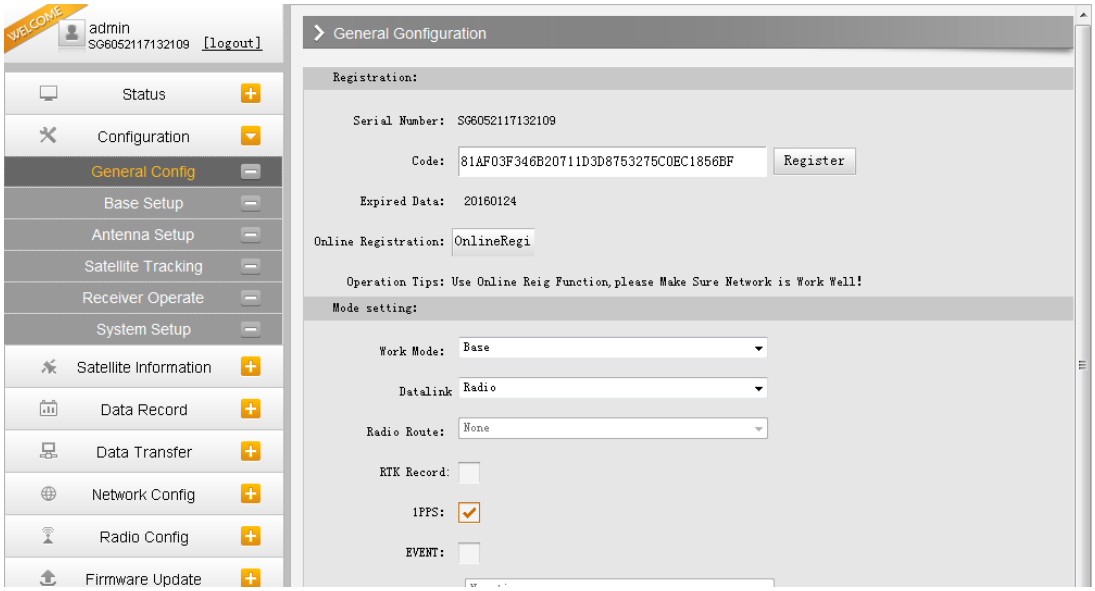
§3.2.2 Configuration

General Config, Base Setup, Antenna Setup, Satellite Tracking, Receiver Operate and Default Language are contained under Configuration menu. Users are able to configure all kinds of parameters for Galaxy G6 under Configuration menu, and all the settings are immediate effect

after saving.

General Config

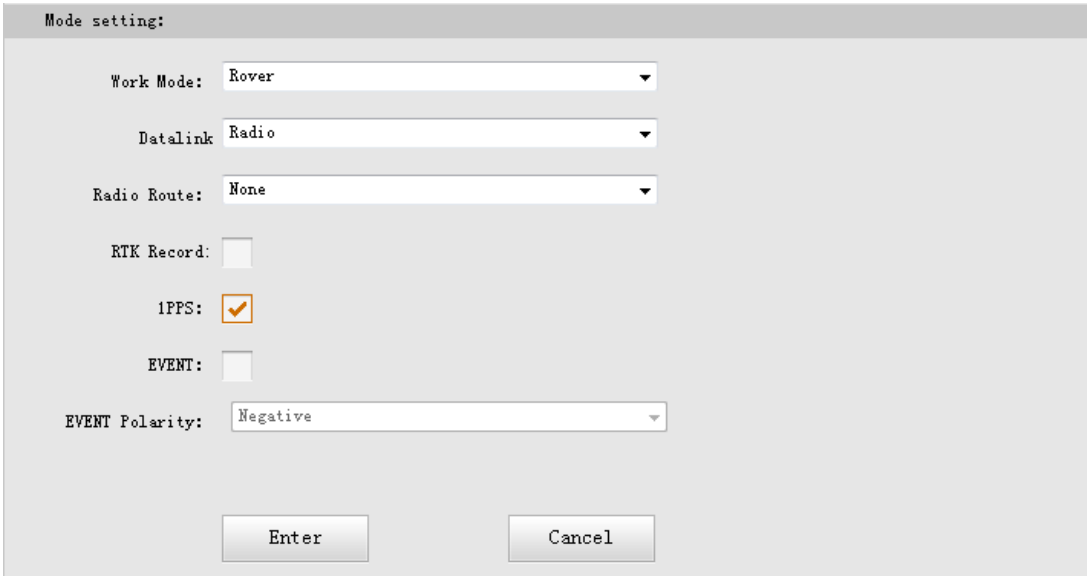
The registration for receiver working mode setting can be completed in this general configuration page.



If the code of G6 has expired or is going to be run out, please provide the serial number of your G6 for us to apply for another available code, then input the code into the blank or register the receiver online.



Galaxy G6 is allowed to setup the working mode and datalink from this Web UI that only need the mobile phone or tablet PC is able to connect the wifi hotspot of G6.

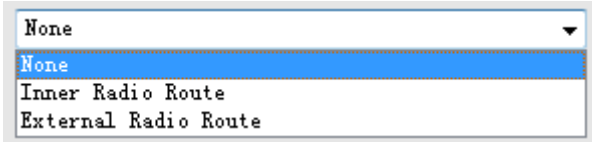


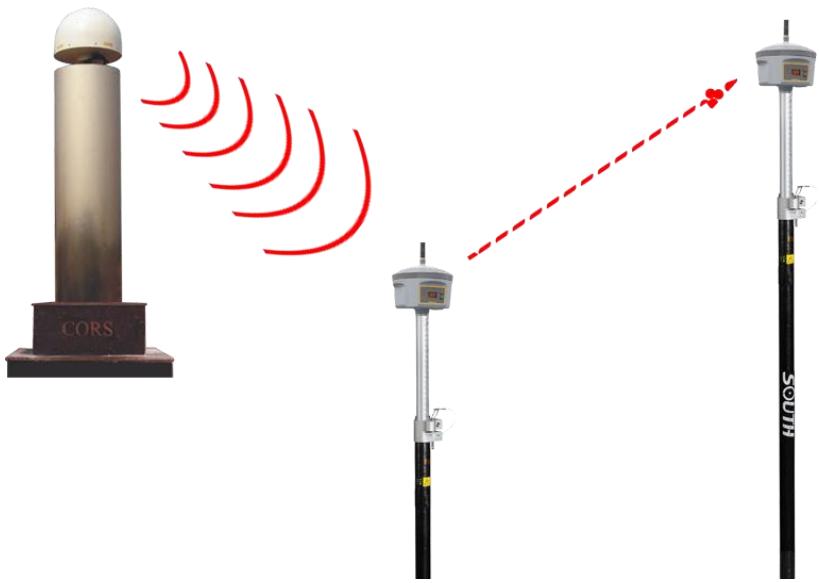
Work Mode: There are Rover, Base and Static contained in this dropdown list

Datalink: Pull down the list, there will be all kinds of options for datalink, such as radio, Network, External, Bluetooth, WIFI and CSD.



Radio Route: This feature is used to transfer the correction which from the reference station for the other rover by radio, the rovers will have the same coordindates from the reference station. It is able to use internal radio or connect an external radio to transfer the correction. This is very convenient for user that there is only a SIM card for a few rovers. This is only used in Rover mode.





RTK Record: This is used to enable raw data recording in base mode or rover mode for post-processing

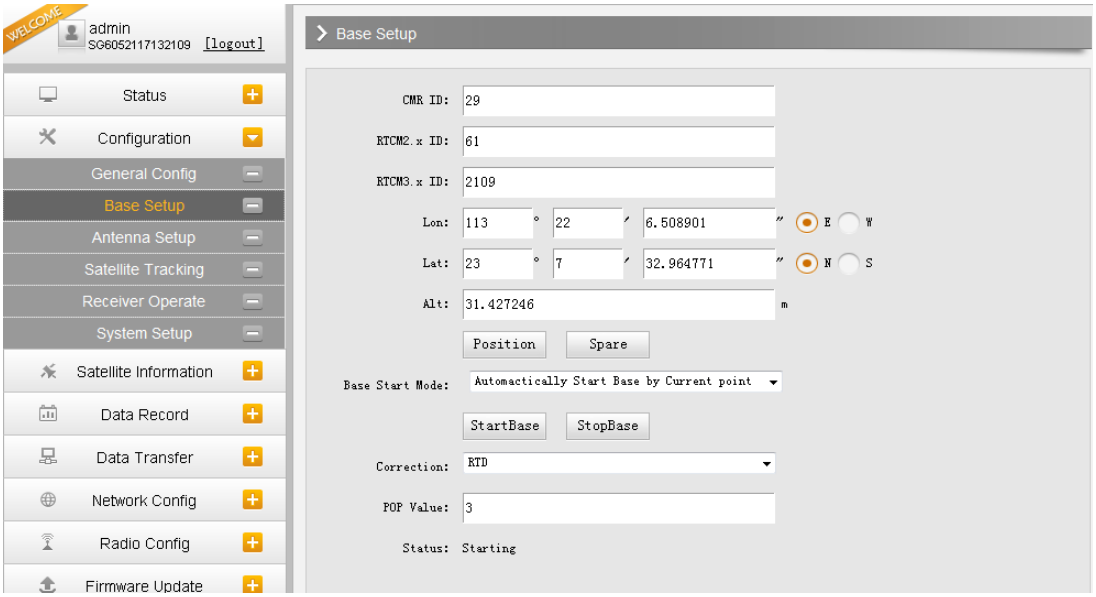
1 PPS: This option is for the 1 pulse per second output

EVENT: This option is for the EVENT marker input

EVENT Polarity: EVENT input method.

Base Setup

When G6 works as a base, the basic configuration for base can be setup in this page. Users can input the correct coordinates or capture a current position for the base. Also users can define what kind of correction format is transmitted.



CMR ID/RTCM2.X ID/RTCM3.X ID: Users can specify the ID for transmitting correction.

Position: Click this button to capture the coordinates for current position

Spare: This is used to the repeat station

Base Start Mode: Here contains 3 methods to start the Base, manually start base, automatically start base by fixed point, automatically start base by current point.

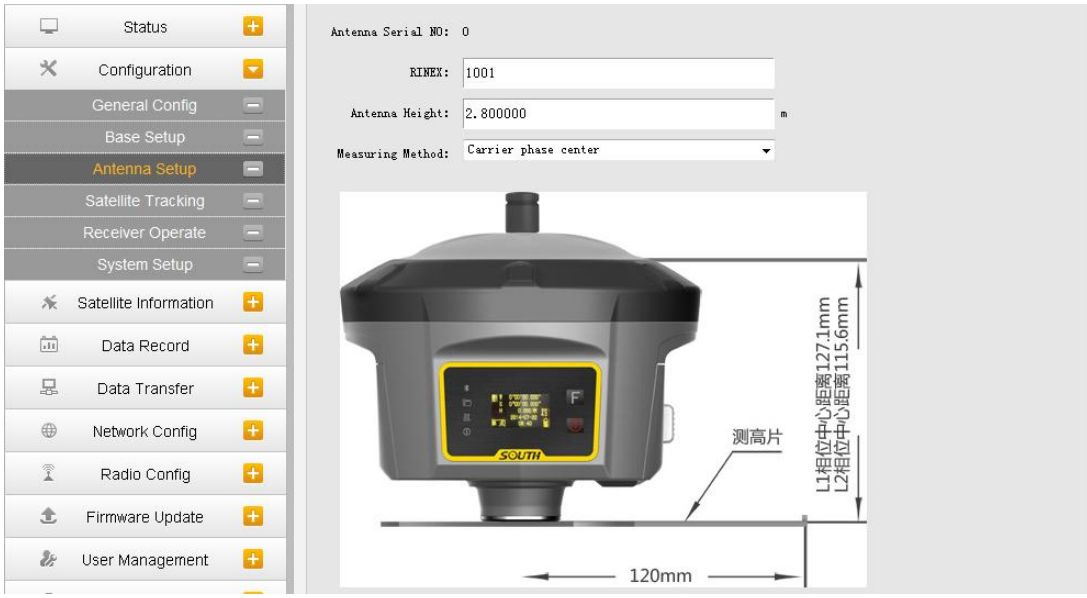
Correction: Here contains the global general used correction formats including RTD,RTCM23, RTCM30, RTCM32, CMR and SCMRx

POP Value: This value is setup for the PDOP limitation.

Status: Here will display the status for base in real-time.

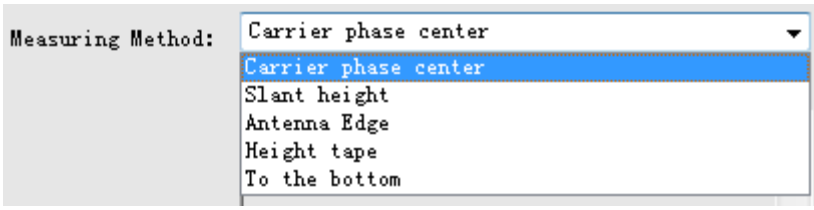
Antenna Setup

The antenna parameters are configured in this page including the antenna height, measuring method.



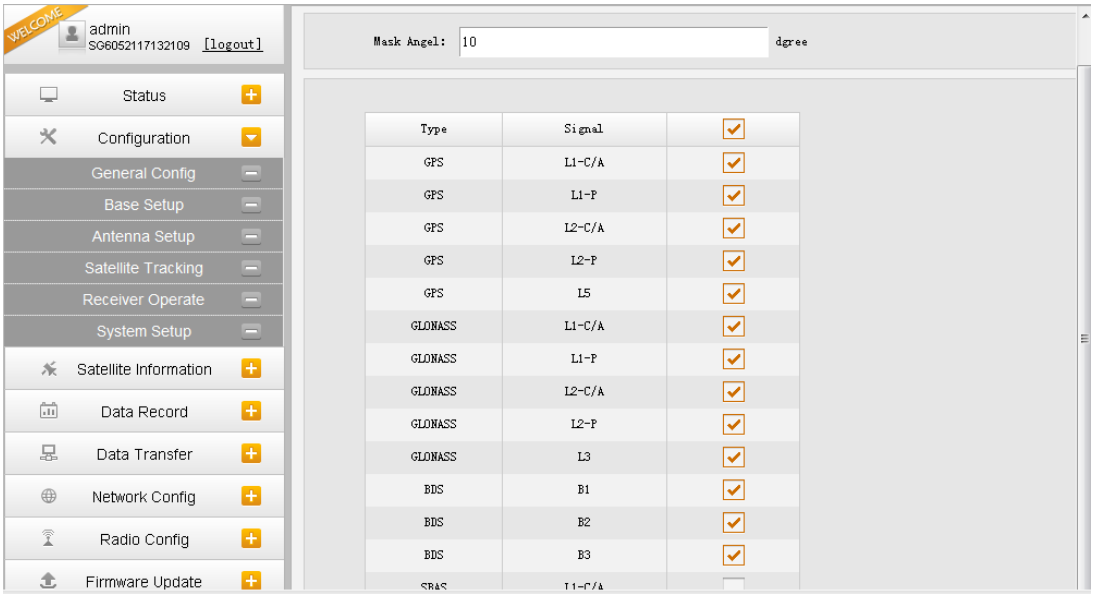
Antenna Height: This is the value for height of antenna while surveying.

Measuring Method: Here provides several methods for measuring the antenna height such as carrier phase center, slant height, antenna edge, height plate and to the bottom.



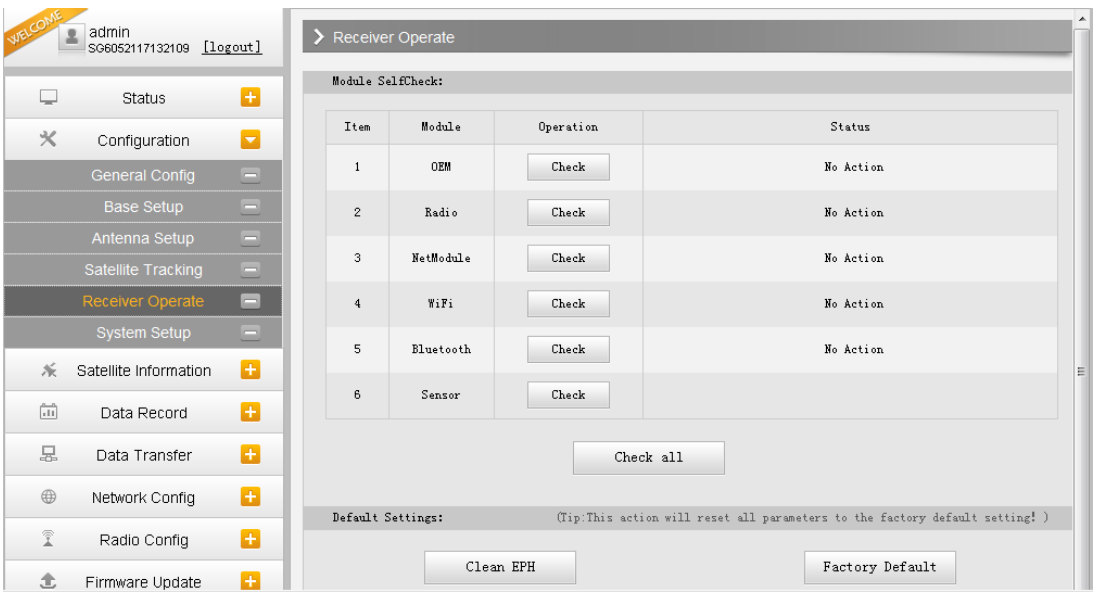
Satellite Tracking

In this page, users can define the mask angle for satellite tracking, and check on the box of corresponding band from the constellation that to use this band or not



Receiver Operate

The page provides all kinds of operations to control the receiver such as self-check operation, clean epochs, factory reset, reboot and power off.



Self-check: Users can also do the self-check from this configuration page, click on the Check all button to check all the modems or click on the check button corresponding to the modem to check one by one.

Clean EPH: Click this button to clear the remaining epochs to let recever track the satellites better.

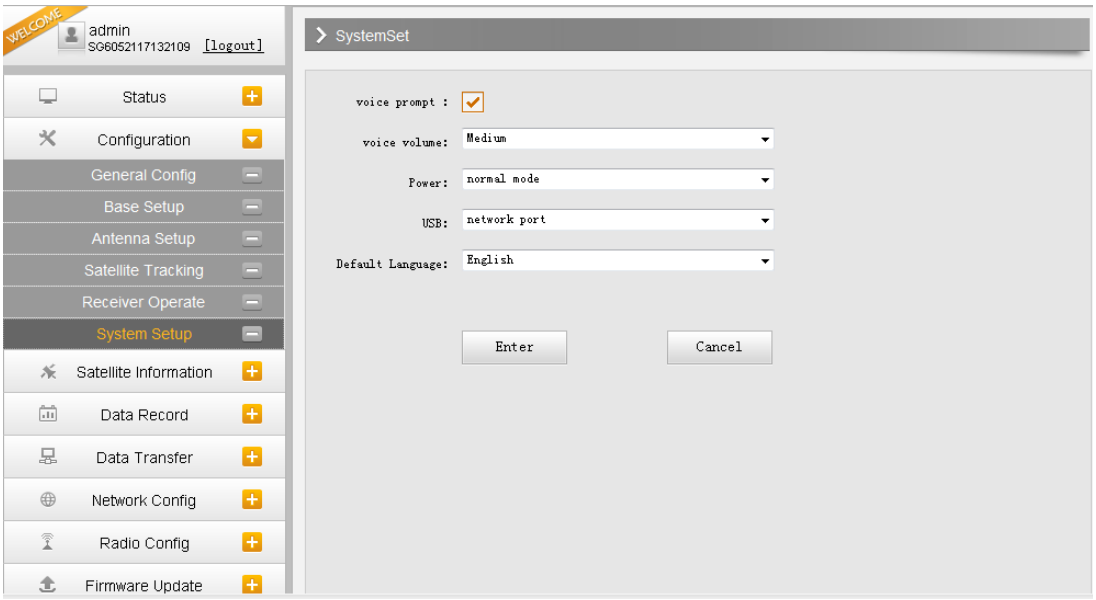
Factory Default: Click this button to bring the receiver back to factory default setting.

Reboot: Click this button to restart the receiver.

Power Off: Click this button to power off the receiver.

System Setup

This page is used to control Voice prompt, volume of voice, power saving, USB mode and the default language for receiver.



Voice Prompt: Check on this box to turn on the voice guide for G6, cancel it to turn off the voice guid.

V**oice Volume:** Define the voice volume for G6's speaker.

Power: Configure the receiver to use the power saving mode or not.

USB: This is used to configure G6 what kind of mode output from 7-pin port when connect the receiver with computer via USB cable. USB and network port for optional.

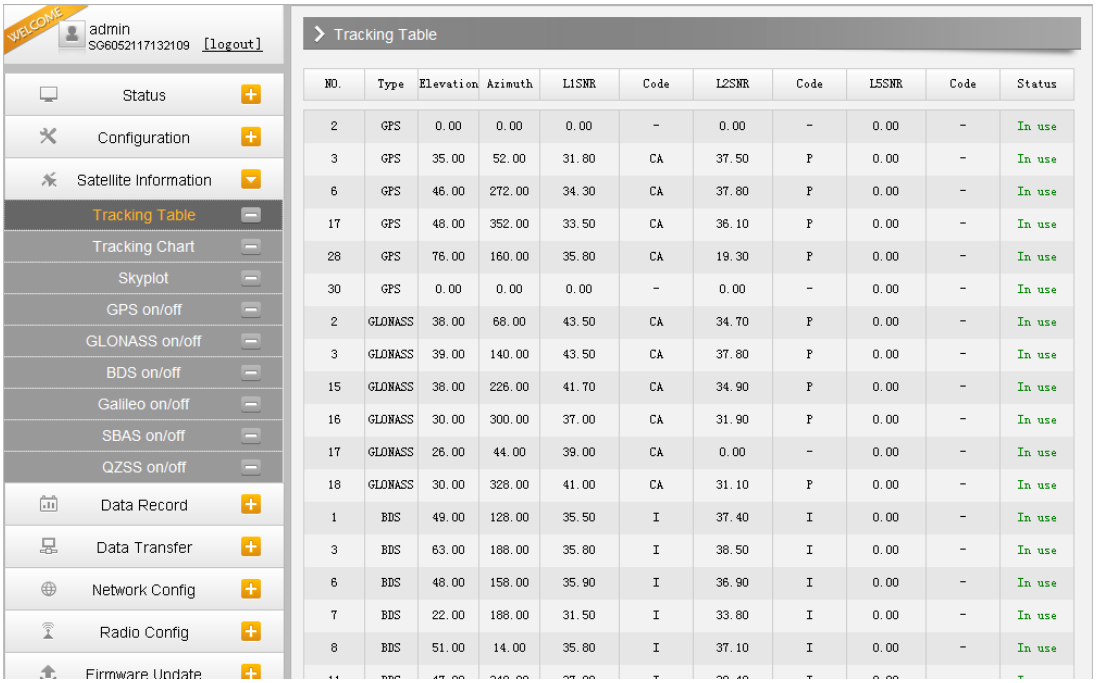
Default Language: Configure the default language for Galaxy G6.

§3.2.3 Satellite Information

The "Satellite Information" provides all kinds of tables, graph and the skyplot to view the information of tracking satellites. And it is allowed to configure to use which satellite in constellation on/off page by checking on the corresponding box.

Tacking Table

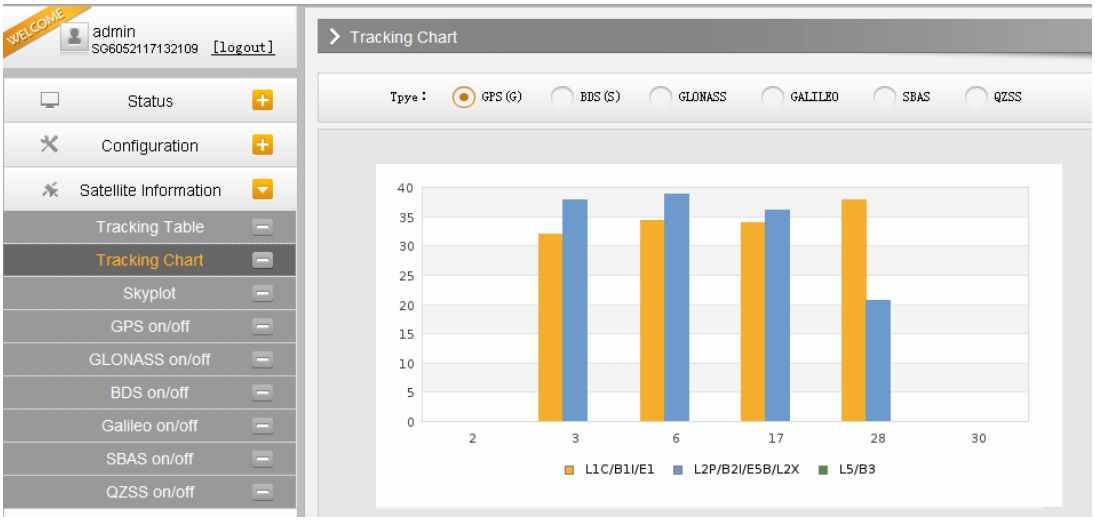
Here is the table to list all current used satellites and the other information for these satellites.



NO.	Type	Elevation	Azimuth	L1SNR	Code	L2SNR	Code	L5SNR	Code	Status
2	GPS	0.00	0.00	0.00	-	0.00	-	0.00	-	In use
3	GPS	35.00	52.00	31.80	CA	37.50	P	0.00	-	In use
6	GPS	46.00	272.00	34.30	CA	37.80	P	0.00	-	In use
17	GPS	48.00	352.00	33.50	CA	36.10	P	0.00	-	In use
28	GPS	76.00	160.00	35.80	CA	19.30	P	0.00	-	In use
30	GPS	0.00	0.00	0.00	-	0.00	-	0.00	-	In use
2	GLONASS	38.00	68.00	43.50	CA	34.70	P	0.00	-	In use
3	GLONASS	39.00	140.00	43.50	CA	37.80	P	0.00	-	In use
15	GLONASS	38.00	226.00	41.70	CA	34.90	P	0.00	-	In use
16	GLONASS	30.00	300.00	37.00	CA	31.90	P	0.00	-	In use
17	GLONASS	26.00	44.00	39.00	CA	0.00	-	0.00	-	In use
18	GLONASS	30.00	328.00	41.00	CA	31.10	P	0.00	-	In use
1	BDS	49.00	128.00	35.50	I	37.40	I	0.00	-	In use
3	BDS	63.00	188.00	35.80	I	38.50	I	0.00	-	In use
6	BDS	48.00	158.00	35.90	I	36.90	I	0.00	-	In use
7	BDS	22.00	188.00	31.50	I	33.80	I	0.00	-	In use
8	BDS	51.00	14.00	35.80	I	37.10	I	0.00	-	In use

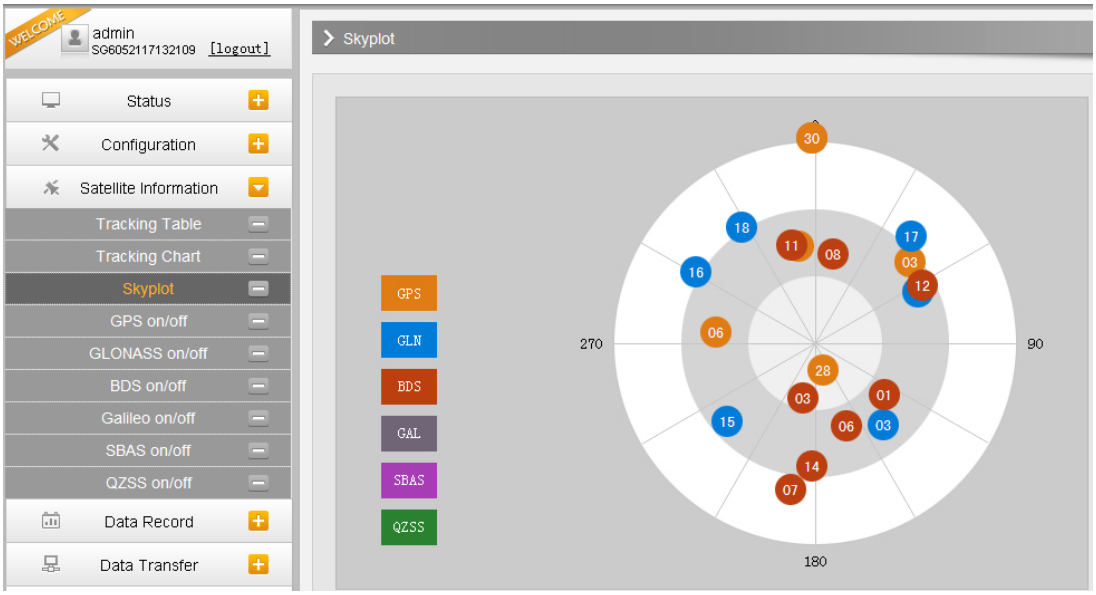
Tracking Chart

In this page, the histogram will indicate the signals from those used satellites, and allow to check each constellation separately.



Skyplot

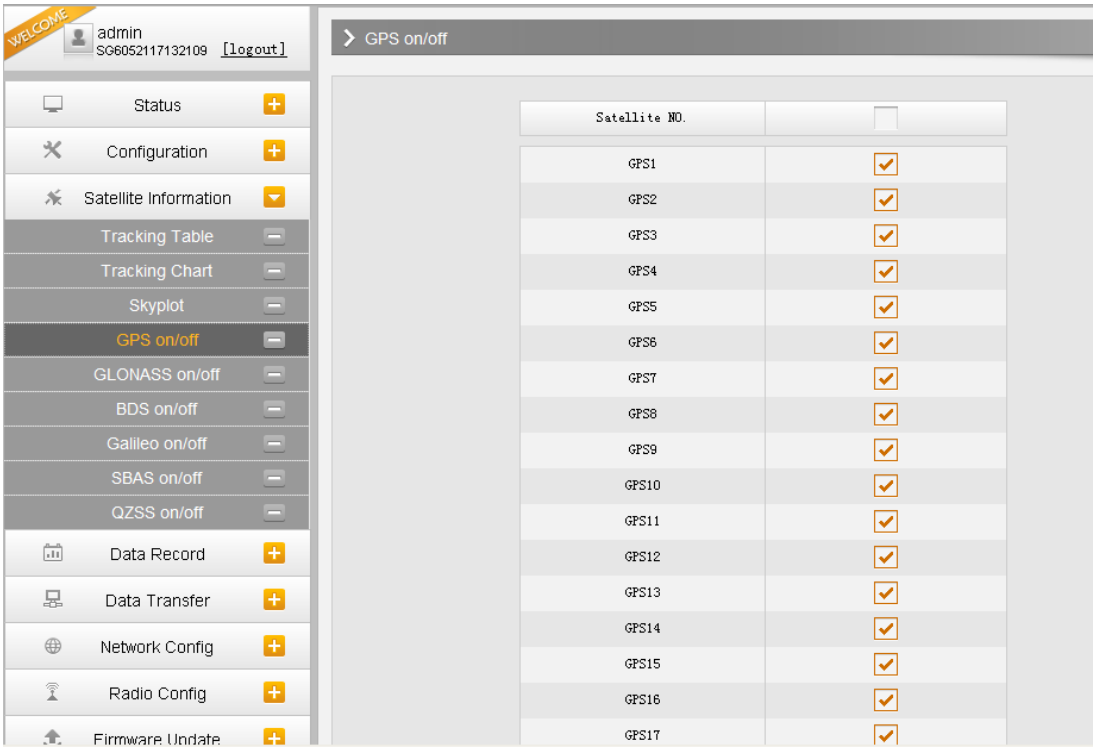
In this page, all the tracking satellires are shown on the skypolt, this let users intuitively view and know where the current position of satellite is.



GPS on/off

For all the running GNSS constellations or the augmentation system, G6 allows to configure to use which satellite or not.

In gnss on/off page, all the running satellites are listed, and unselect the box corresponding to the satellite to not use it.



§3.2.4 Data Record

The “Data Record” performance is mainly used to configure all the parameters for receiver in static mode. Much more operations can be done on Galaxy G6 such as storage path, interval, data format and data files download.

Recording Config

The page provides more practical operations for raw data storage.



Storage Option: Here are the options to be selected for where the raw data will be stored, internal memory or external memory.

Interval: This is the sampling interval for data storage, 50Hz(0.02s) sampling interval now is available for G6.

File Interval: This is used to defined the data storage time for the static file.

Data Format: Here are 3 options to selected for G6 to store what kind of format data, STH, Rinex2.0 and Rinex3.0.

Point Name: A point name is required, the last 4 digits of SN is default setting for the point name.

Auto Delete: This is used to configured G6 to delete the previous data files automatically if the memory is full.

Format: Click this button to format the internal memory for G6.

Recording Mode: Here are 2 options to configure G6 to record raw data automatically or not if it achieves the sampling conditions.

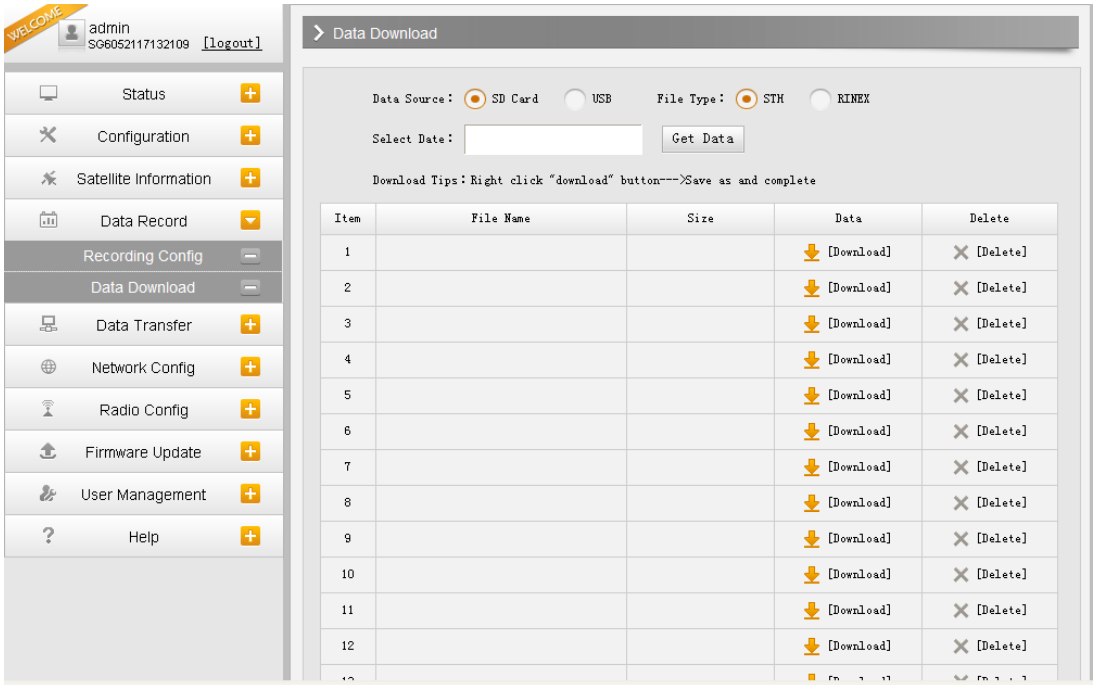
Start/Stop: Click these buttons to start recording or strop recording the raw data.

Recording Status: Here shows the status of static data storage.

Data Download

This page provides the data files to download

Choose the storage where the static data recorded, and file type, then click on the blank of "Select Date" to choose what date the data was recorded and click "Get Data" button, all the files recorded in the date you choose will show in the table, tap download button to download the data files.

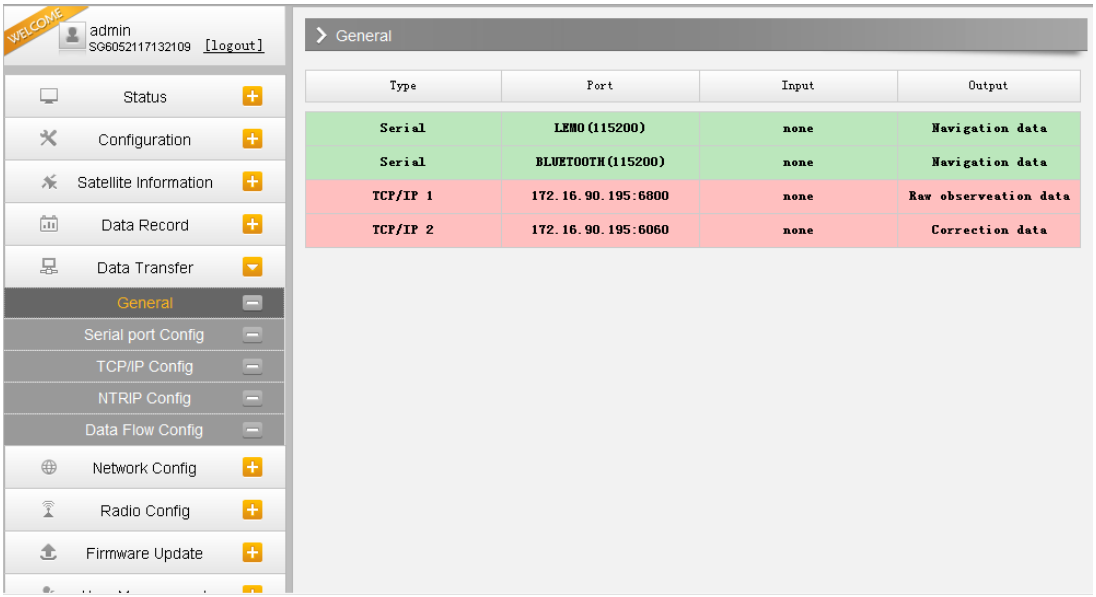


§3.2.5 Data Transfer

This performance contains General, Serial Port Config, TCP/IP Config, NTRIP Config and Data Flow Config. The "Data Transfer" allows to configure the output mode for raw observation data and differential data, as well as to the NTRIP performance configuration.

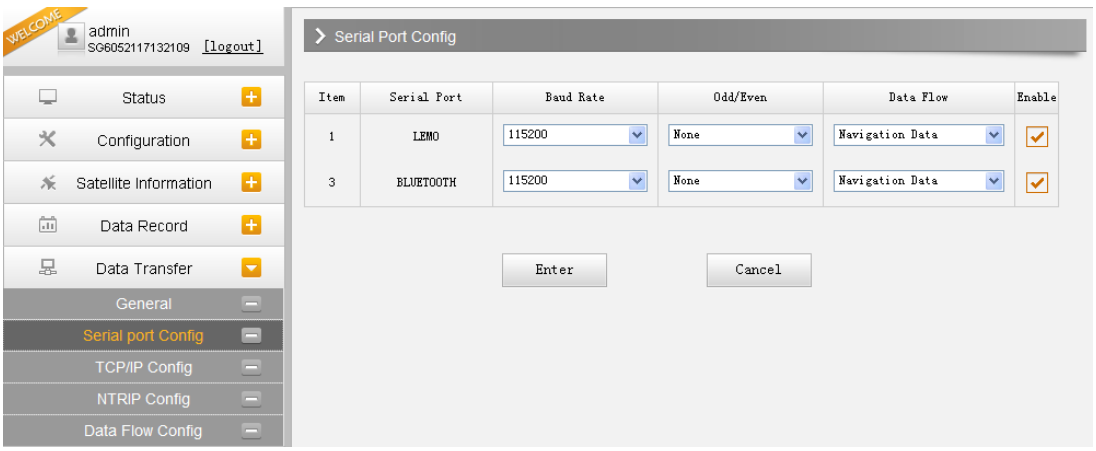
General

This page shows the service condition and the output contents of the ports, if the port item display in green, that means the port is being used, and the port is not used while the item display in red.



Serial port Config

This page is allowed to configure the baud rate, odd-even check and the data flow for serial port (5-pin port) and Bluetooth.



CAUTION: do not change the default value in this page for each item, if you want to change the settings, please contact with SOUTH technician for further support.

In the dropdown list of data flow, there shows 4 items for selection.

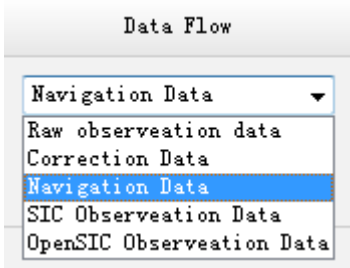
Raw observation data: This is the raw observation data straight from OEM board.

Correction Data: This is the correction data straight from OEM board.

Navigation Data: This is the navigation data output from receiver such as NMEA-0183, GSV, AVR, RMC and so on. It is configured in Data Flow Config page.

SIC Observation Data: This is the user-defined format observation data from SOUTH.

OpenSIC Observation Data: This is the open version of SOUTH user-defined format observation data for secondary development.

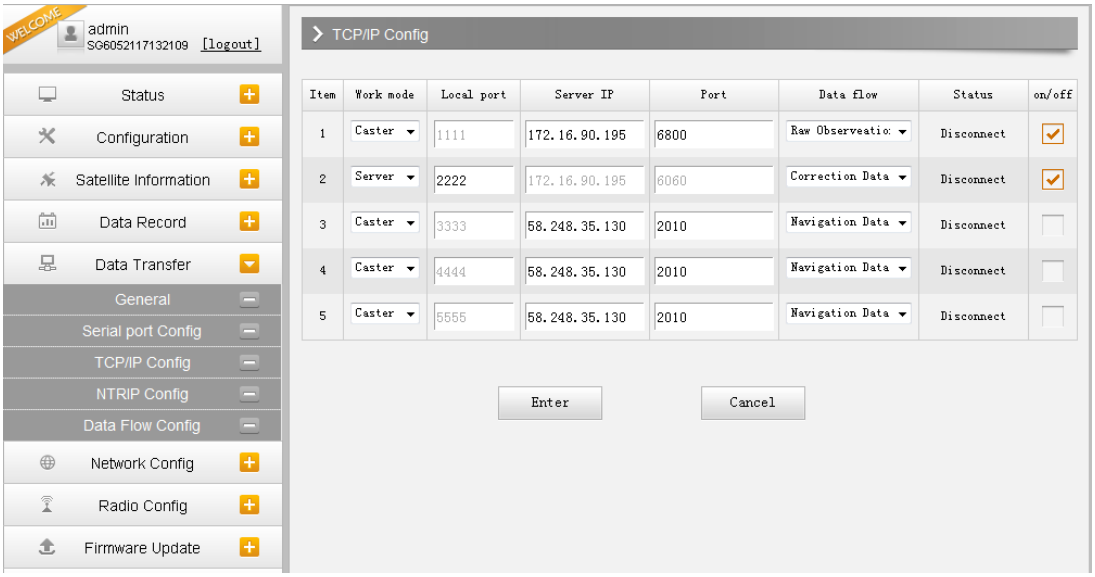


TCP/IP Config

This is used to configured the raw data or navigation data to be uploaded or transferred to a server. And there are Caster and Server working mode for this performance.

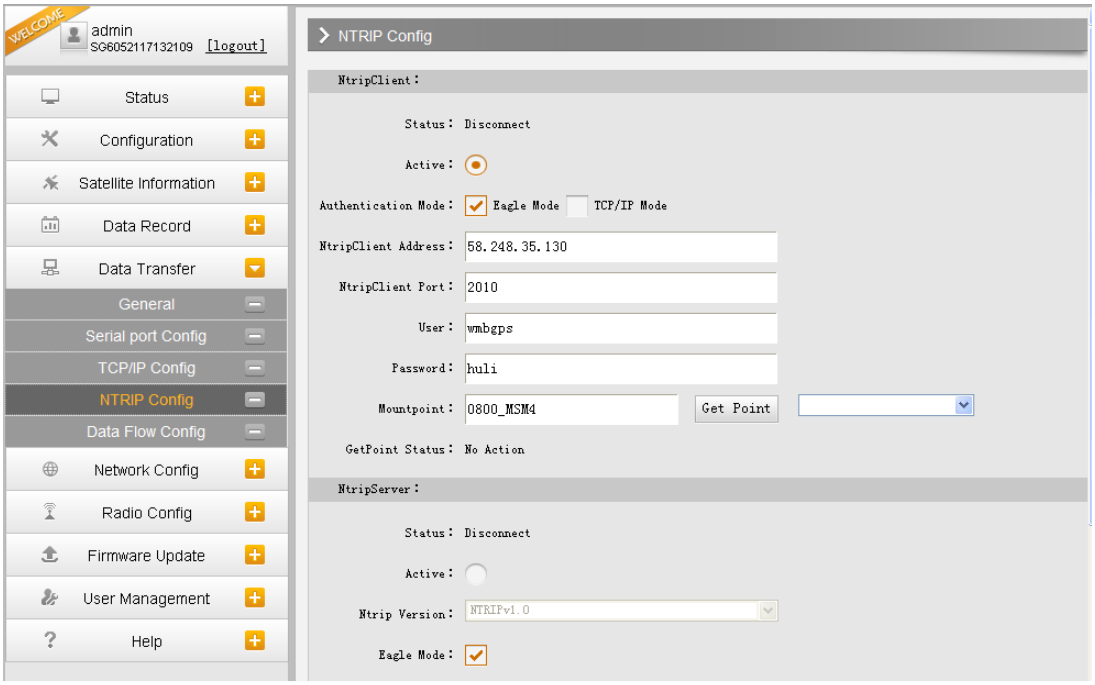
Caster: If this working mode is selected, G6 will be a client to upload the data to a specify server if it connects to the internet by WIFI or GPRS connection with SIM card inserted. Input the specified IP and port for server, and the data format what is uploaded. Then users are able to see the uploaded data on server.

Server: Galaxy G6 will upload the data onto internet by the static WIFI if server is selected, then users are able to obtain its dynamic data by accessing to G6 through the IP from receiver.



NTRIP Config

This is used to configure the NTRIP performance while receiver is going to connect to internet. Galaxy G6 supports complete NTRIP performance including NTRIP Client, NTRIP Server and NTRIP Caster.



NtripClient

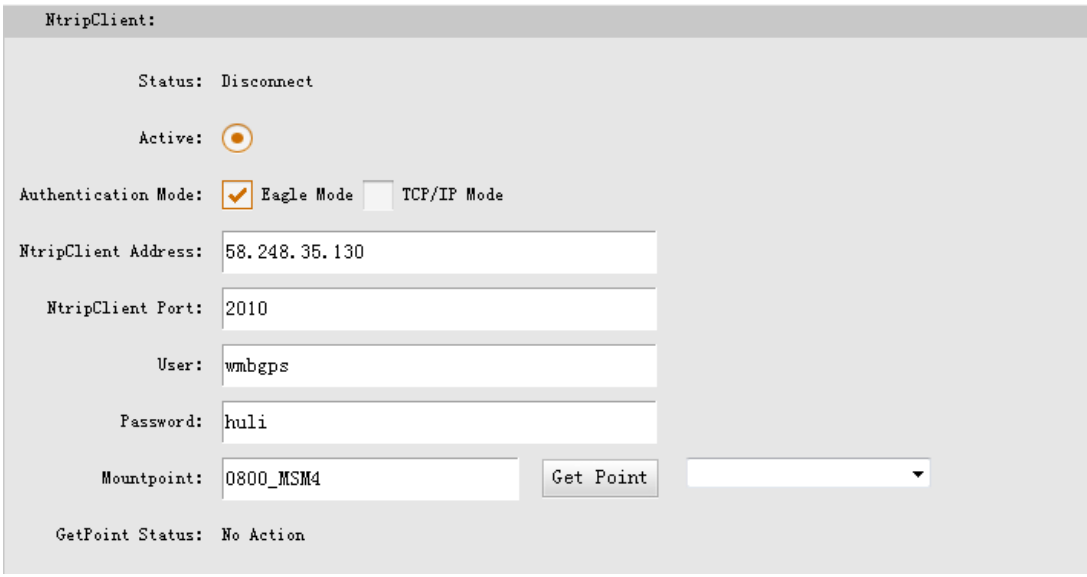
This is the general used function for rover set in GPRS mode. At the field of NtripClient, the specify IP address, access port of reference station, as well as the assigned username and password shall be input for the NTRIP connection.

Status: This field will display the status of NTRIP connection, connect or disconnect.

Active: Check on this circle to activate this function.

Authentication Mode: These two modes use different protocol standard for the connection, Eagle Mode is SOUTH standard mode, and TCP/IP Mode is for private network use, usually, choose the Eagle mode for the default setting.

The next fields are the standard configuration for NTRIP connection, IP, port, username and password, after these information is input into the corresponding field, click on Get Point button to download the source table from server, then choose a proper mountpoint to access.

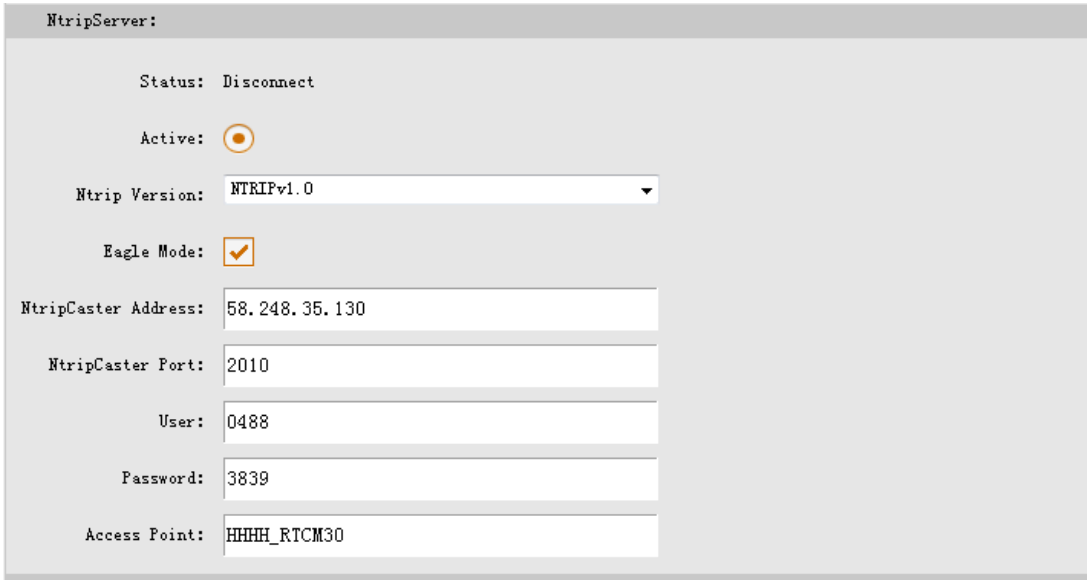


NtripServer

This configuration is used in Base+GPRS mode that Base station will transfer its correction onto the server as long as it connects to internet, then Rover can download the base's correction from server for use.

Ntrip Version: This field provides NTRIPv1.0 and NTRIPv2.0 for optional.

Access Point: This field is allowed to user-defined the correction format which base will transfer to the server, such as HHHH_RTCM30

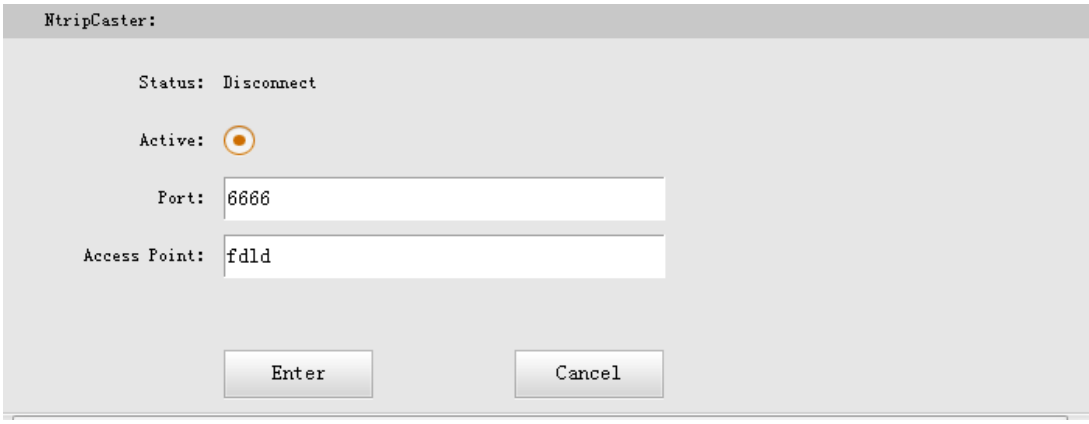


NtripCaster

This feature is finally realized on Galaxy G6, the receiver is equivalent to a CORS system that it generates and broadcasts the user-defined correction for rover if G6 connects a static IP address.

Port: This is the specify port for the access.

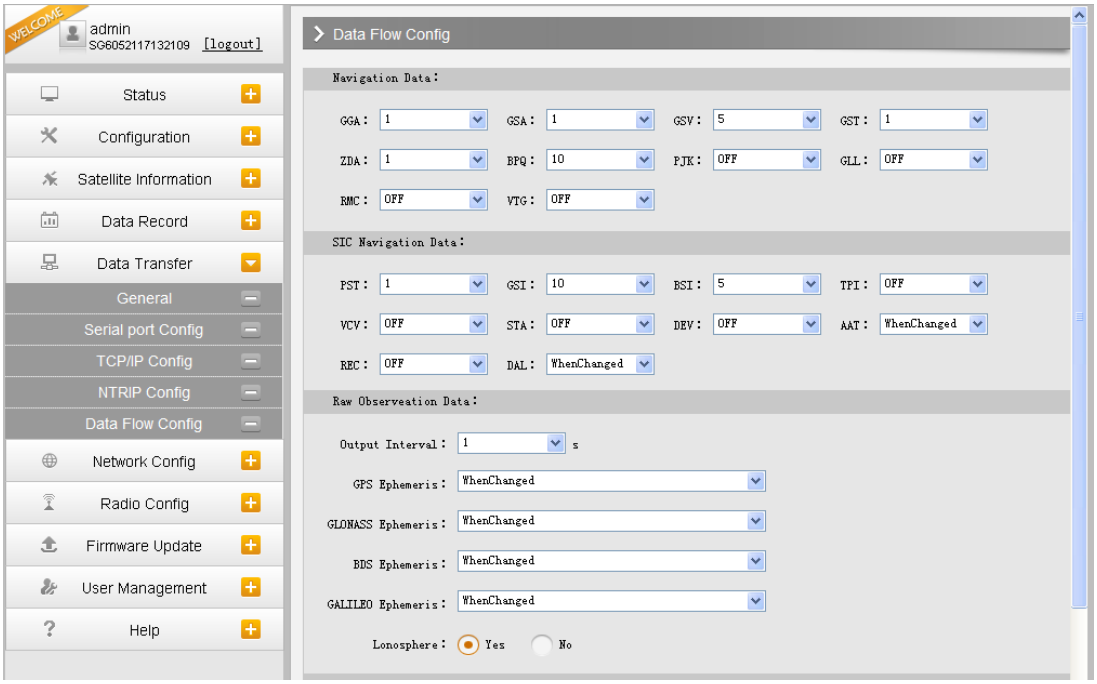
Access Point: This is mountpoint which can be user-defined.



Data Flow Config

In this page, users can freely to configure the content and the update rate of data flow that to output or not to output what kind of data format.

Click on the dropdown list for each data format to define the update rate



§3.2.6 Network Config

The “Network Config” is able to configure the ways and the contents for internet access of G6. GSM/GPRS Config, CSD Config, WIFI Config, Bluetooth Config, Port Forwarding, Router and Network Testing are under the list of Network Config.

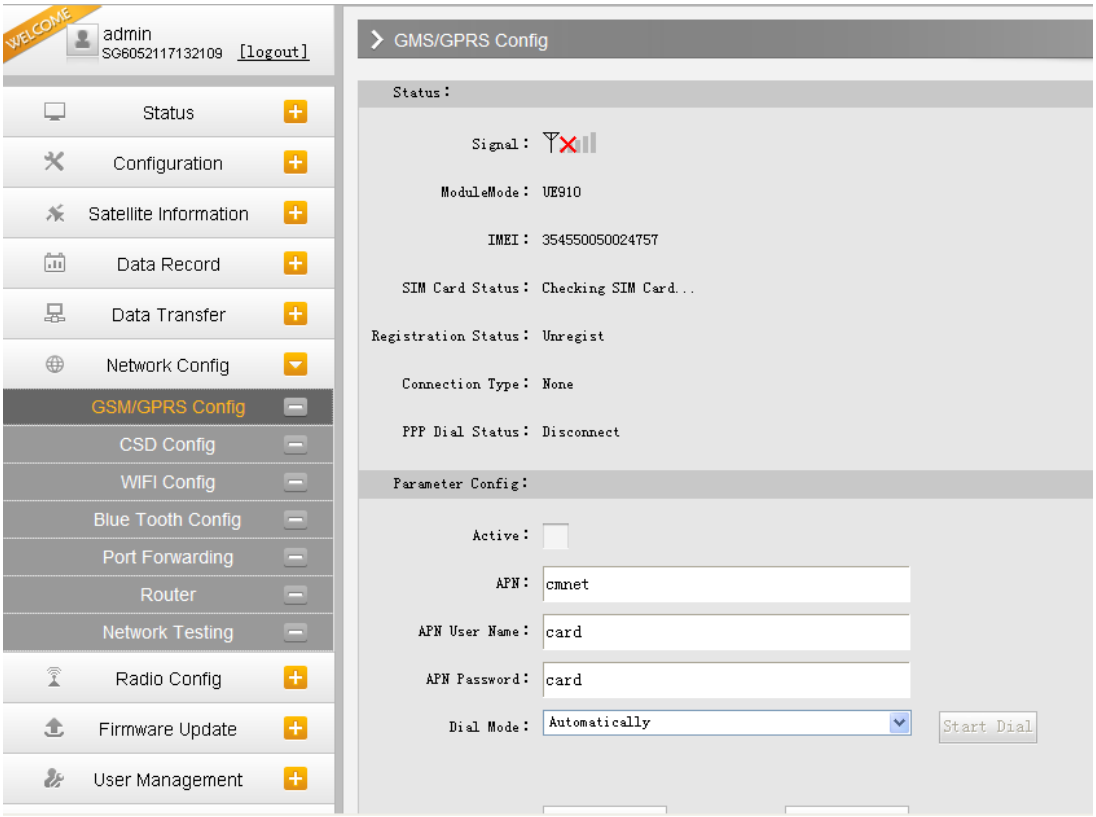
GSM/GPRS Config

In this page, all the information of receiver under Rover+GPRS mode will be displayed

including the hardware information and dialing status.

Status: The dialing status and hardware information are displayed in this field that users can intuitively to view the signal of network, module model and the IMEI number of the module.

Parameter Config: The parameters of SIM card are input in this field including APN, assigned username and password, dial mode.



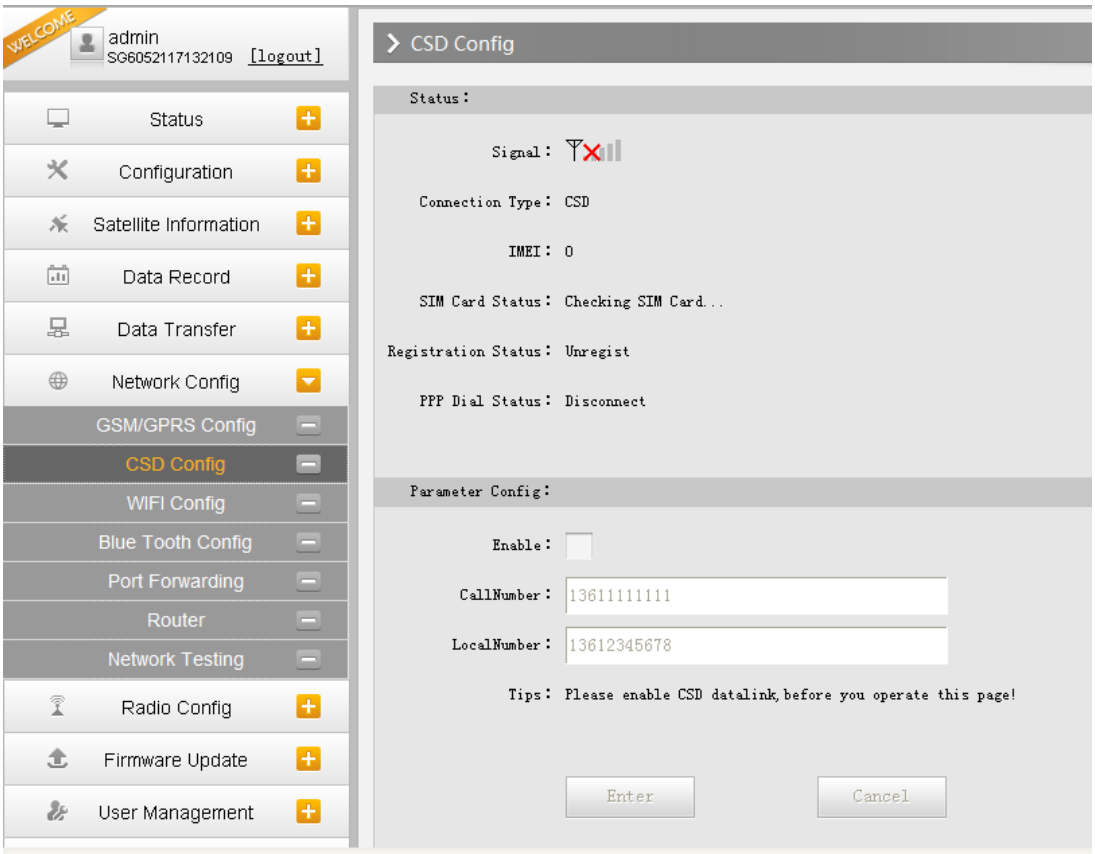
CSD Config

CSD is the meaning of direct dial between Base and Rover with SIM card inserted (the CSD function should be activated on local SIM card), this function is mainly used in the area where there is very poor internet signal coverage.

Status: This field displays the dialing status when CSD is used on G6.

Parameter Config: To enable the CSD function with checking the box of Enable option in this field, then input the phone number for Rover and Base in CallNumber and LocalNumber.

Tips: please choose CSD as datalink for receiver in General Config.



WIFI Config

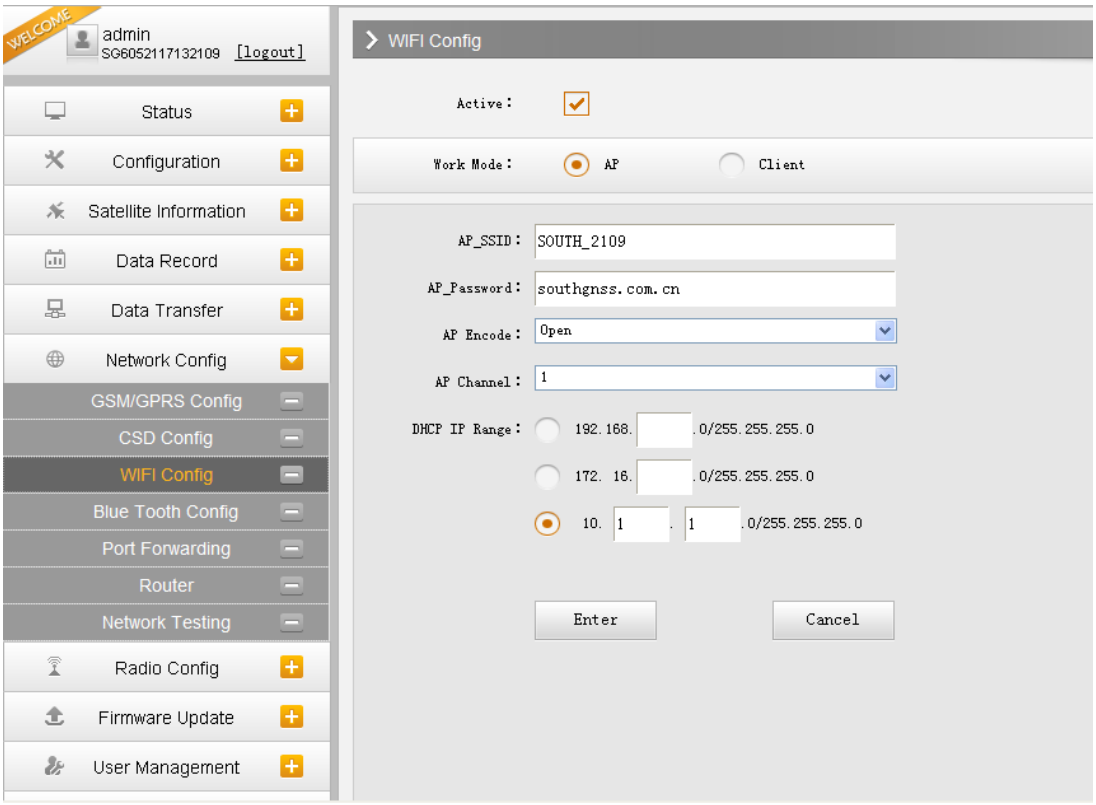
This is mainly used on the WIFI configuration for Galaxy G6, there are AP mode and Client mode for optional.

AP:

This is used to enable the WIFI hotspot for G6 to broadcast for mobile terminals such as smartphone or tablet to connect and access the Web UI.

Check the box of AP in Work Mode to enable the WIFI hotspot for G6, and define the SSID, password, encryption method and broadcasting channel for WIFI connection.

DHCP IP Range: This is allowed to user-defined the IP for Web UI login.



Client:

This option enables Galaxy G6 to search and connect the other WIFI hotspot which connects to the internet, the receiver is able to download and use the mountpoint from reference station.

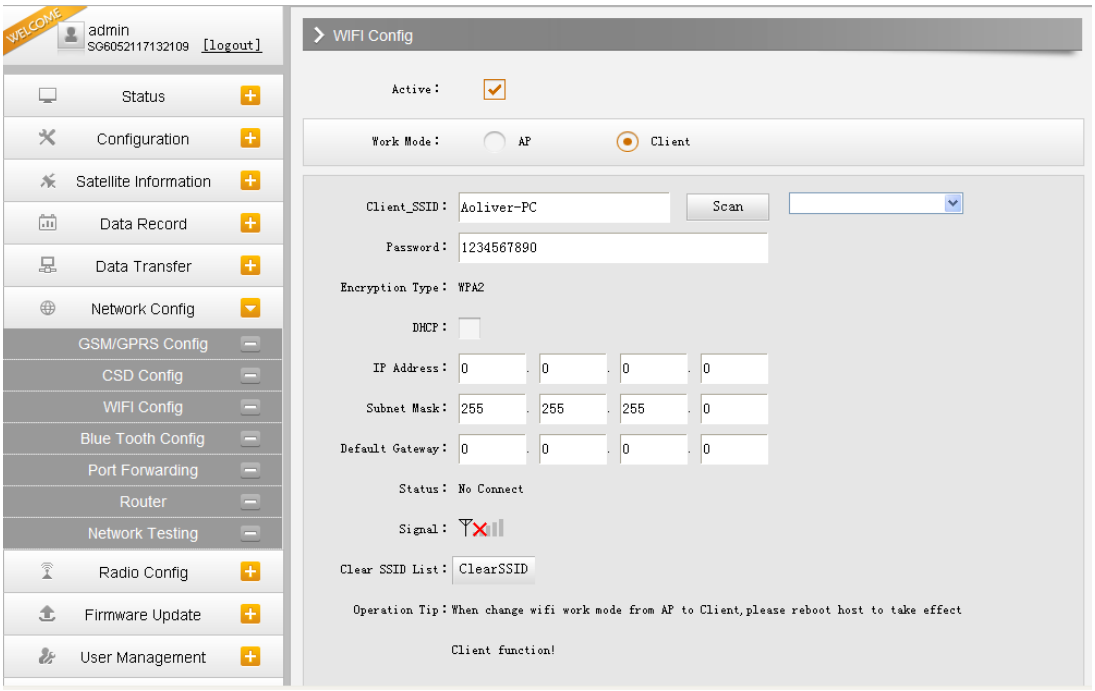
Client_SSID: This is the WIFI hotspot which G6 is going to connect

Scan: Click this button to search the surrounding available WIFI hotspot.

Password: This is the password which the WIFI hotspot requires.

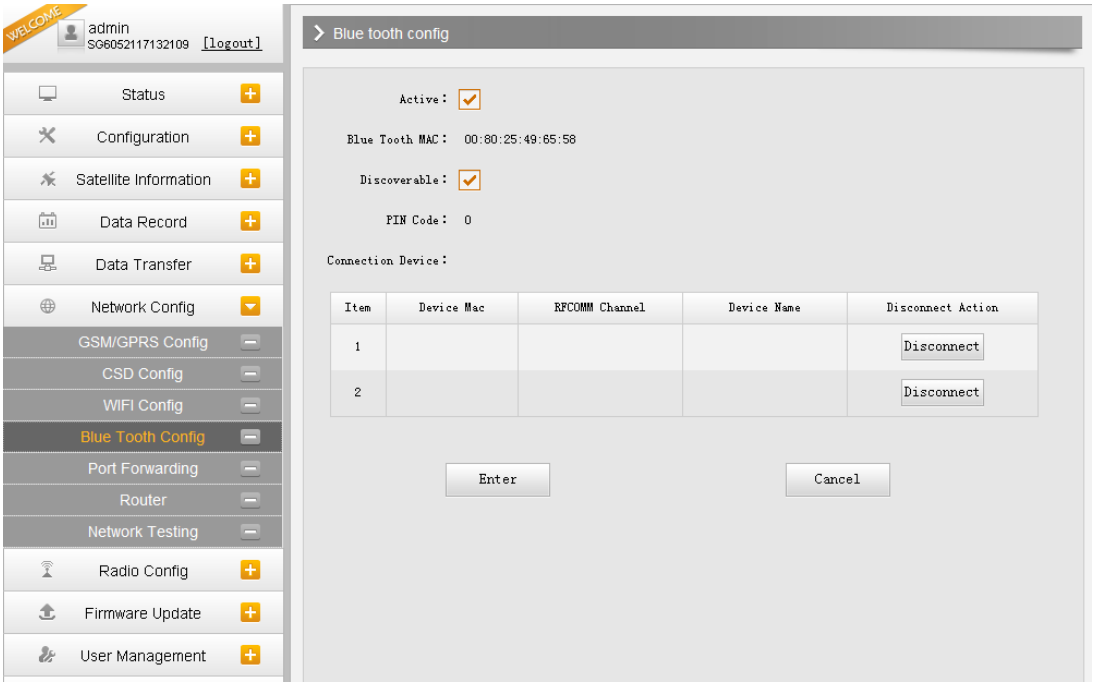
IP fields: If G6 successfully connects to the WIFI, there will be an LAN IP address generated by G6.

ClearSSID: Click this button to clear the SSID list.



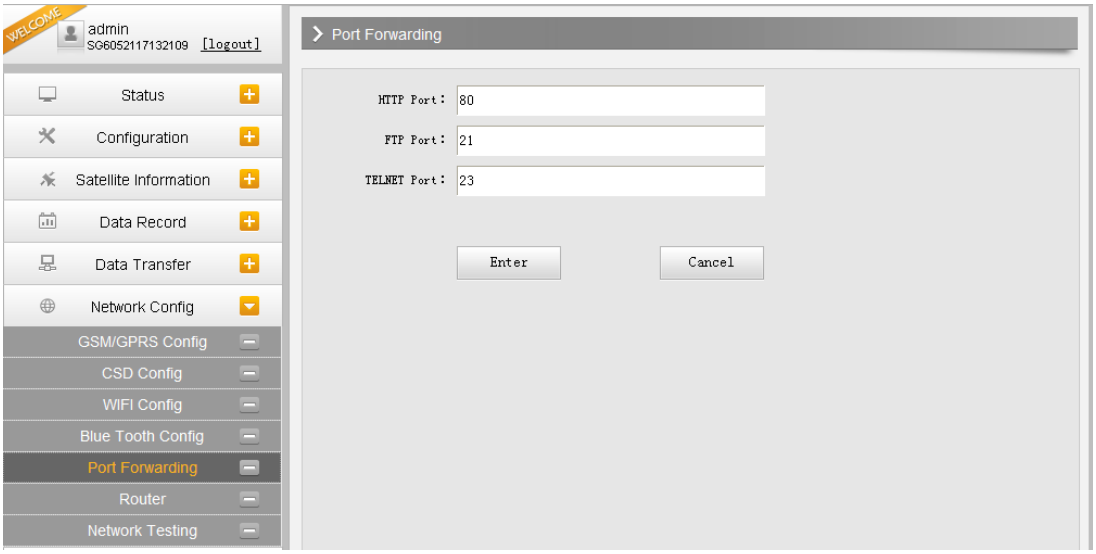
Bluetooth Config

In this page, users can view the information and connection status of Bluetooth, such the MAC of Bluetooth, discoverable or not, the PIN code, and the connection devices in following table.



Port Forwarding

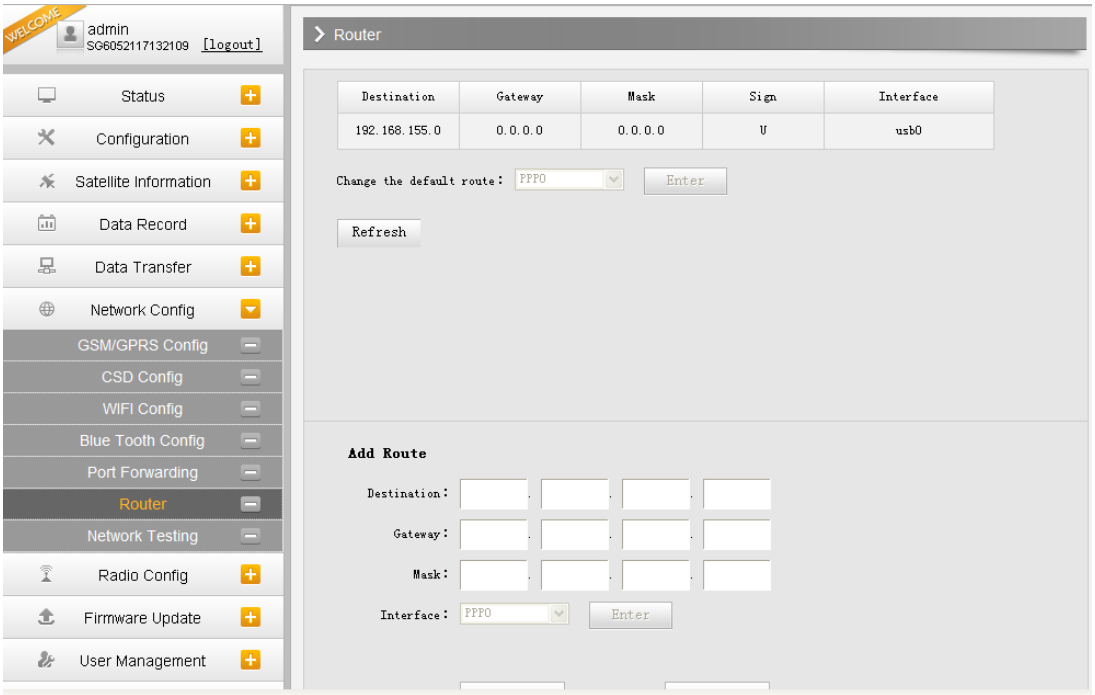
This page is mainly used to view and configure the internet transmission port for G6, customize and debug receiver.



NOTE: Usually we will keep the default setting in this page, if you would like to modify it, please contact with SOUTH technician for more supports.

Router

This is mainly used to view and configure the parameters for router, only under the condition of customize and debug receiver.



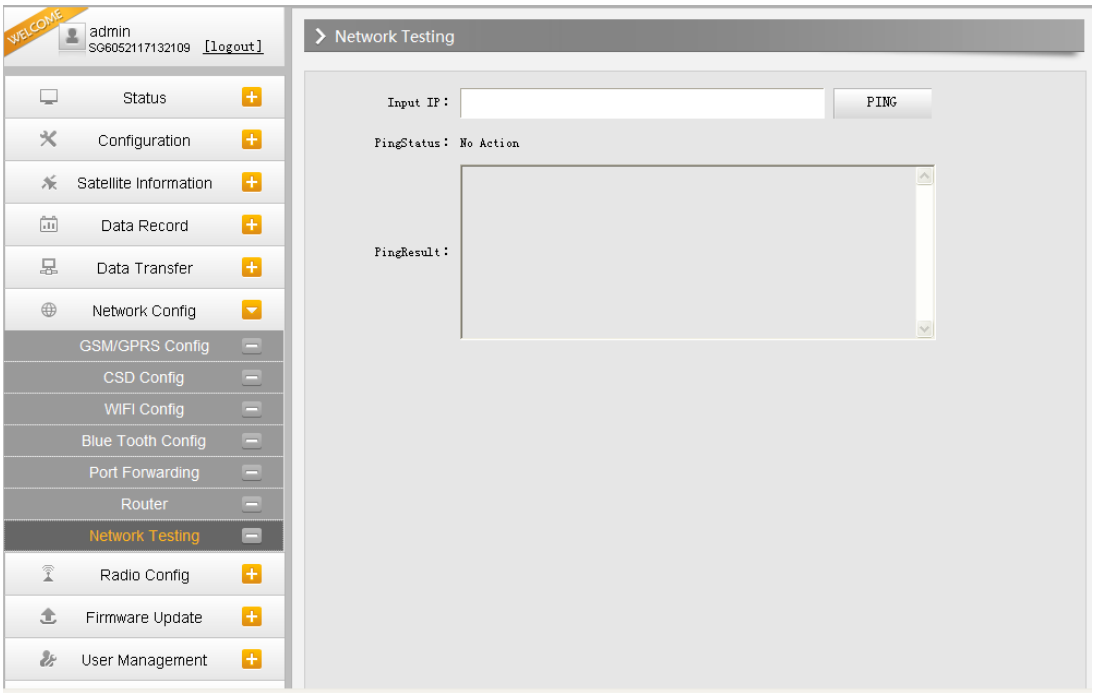
NOTE: Usually we will keep the default setting in this page, if you would like to modify it, please contact with SOUTH technician for more supports.

Network Testing

This function is mainly used to test network status for G6 after logging on the internet.

How to do:

Input the IP address which G6 already connected, then click PING button, the testing information will be displayed in the following window.

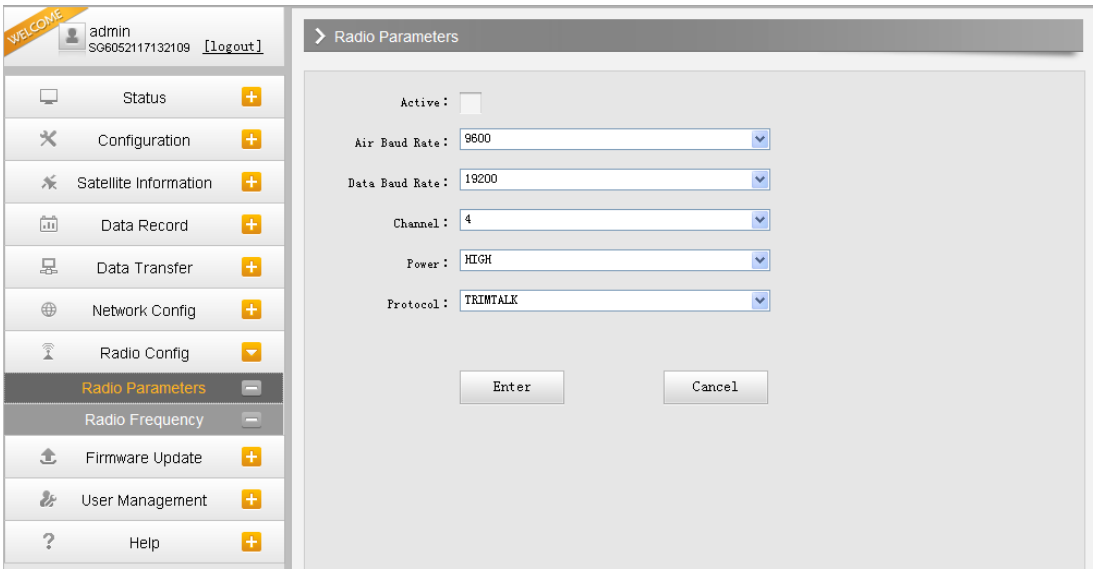


§3.2.7 Radio Config

As the name implies, the parameters of radio can be done in “Radio Config”, it is divided into Radio Parameter and Radio Frequency.

Radio Parameter

This page is mainly used to configure the parameters for internal radio module of Galaxy G6.



Air Baud Rate: This represents the data transmission rate in the air of internal radio, the higher value, the bigger of data size transmitted per second, usually keep the default setting.

Data Baud Rate: This represents the rate of data transmission port of internal radio, this rate should be the same in both Base and Rover. In general, the data baud rate of SOUTH radio module has been unified to be 19200, keep it as default.

Channel: This is the communication channels for internal UHF, the value of the channel must be the same both in Base and Rover.

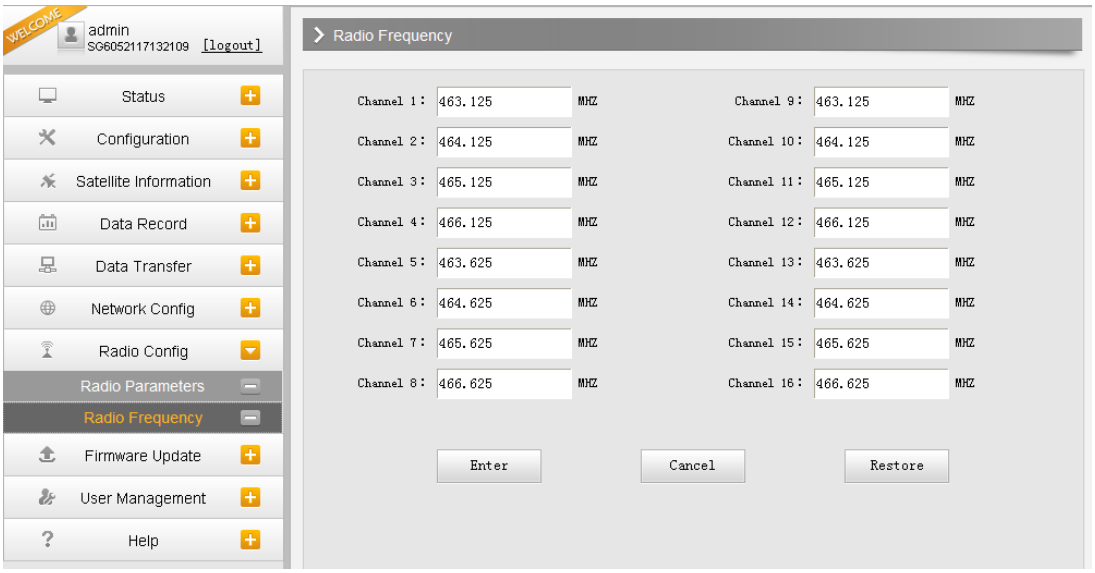
Power: This appears only in Base mode, the radio transmitting power is allowed to define in High, Middle or Low power.

Protocol: This is radio communication protocol for data transmission, SOUTH and TRIMTALK are optional in this page and SOUTH is the default setting, if it is changed, Base and Rover must use the same protocol for communication.

Radio Frequency

For Galaxy G6, the powerful internal radio module supports much more radio channels apply to the legal frequency in different countries or areas.

There are 16 radio channels listed in this page after clicking on radio frequency. Users are able to change the frequency freely in the channel spacing, click Restore button to bring the frequency of each channel back to default setting.



§3.2.8 Firmware Update

Update the latest firmware for receiver or for corresponding modems can be done in "Firmware Update".

Firmware Update

This page displays all the information of the firmware which current installed on G6, and allows to update the latest version firmware for receiver. To get latest version firmware please contact with SOUTH technician.



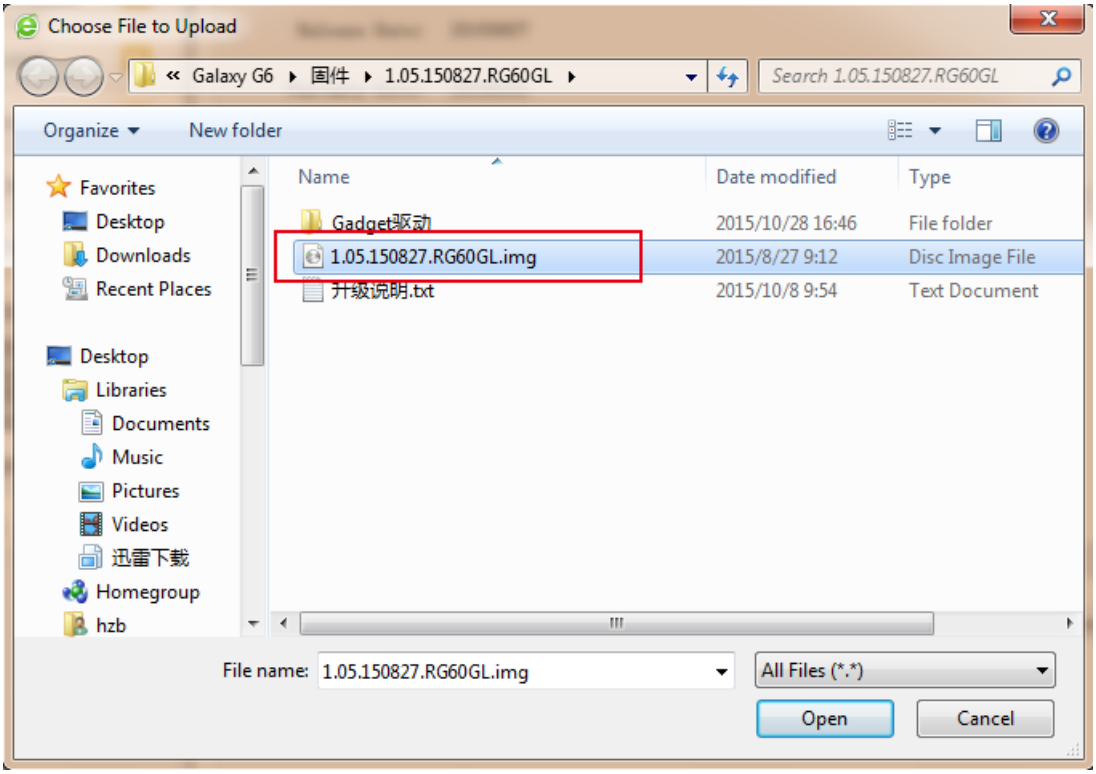
Online Update: Galaxy G6 supports to update the firmware online anytime if there is something

update or optimized.

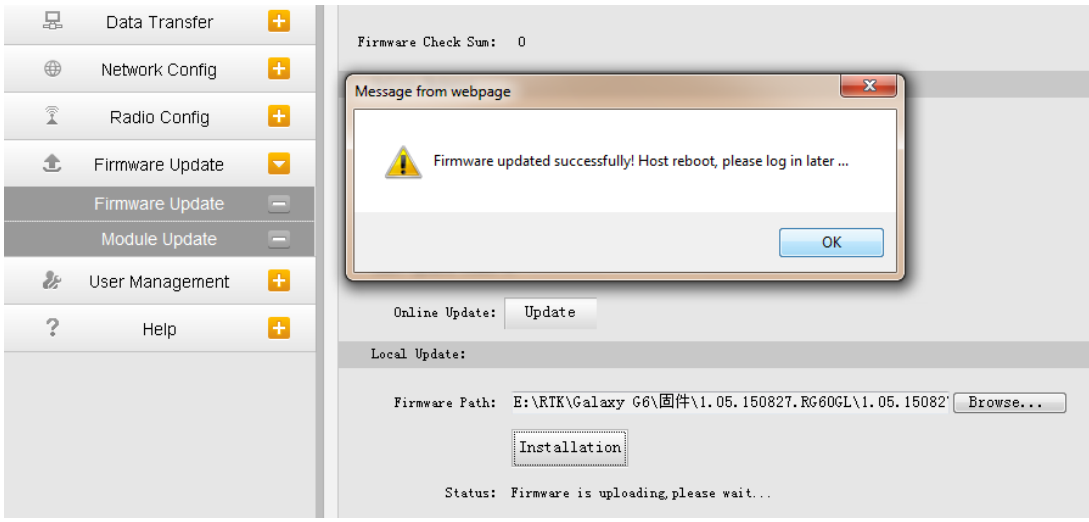
Local Update: Update the latest firmware by using a firmware file.

How to upgrade the firmware with Local Update

a) Click on "Browse" button to load firmware file (Please take in mind that the firmware is ended with .img as the extension name).

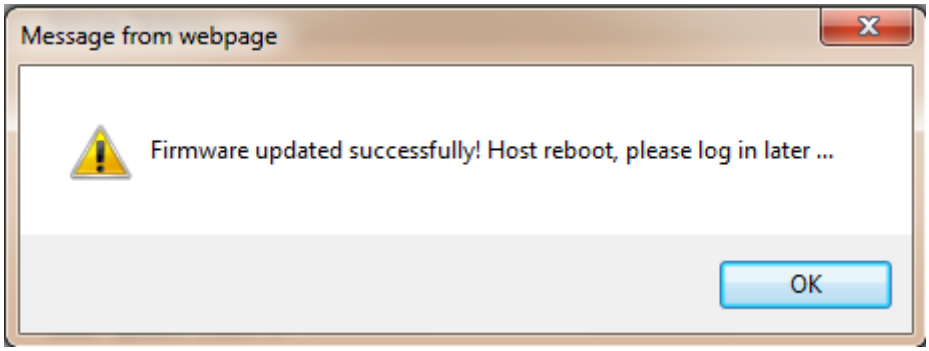


b) And then click "Installation" button to start upgrading.



c) After the firmware is completed upgrading, a dialog will appear saying "Firmware updated

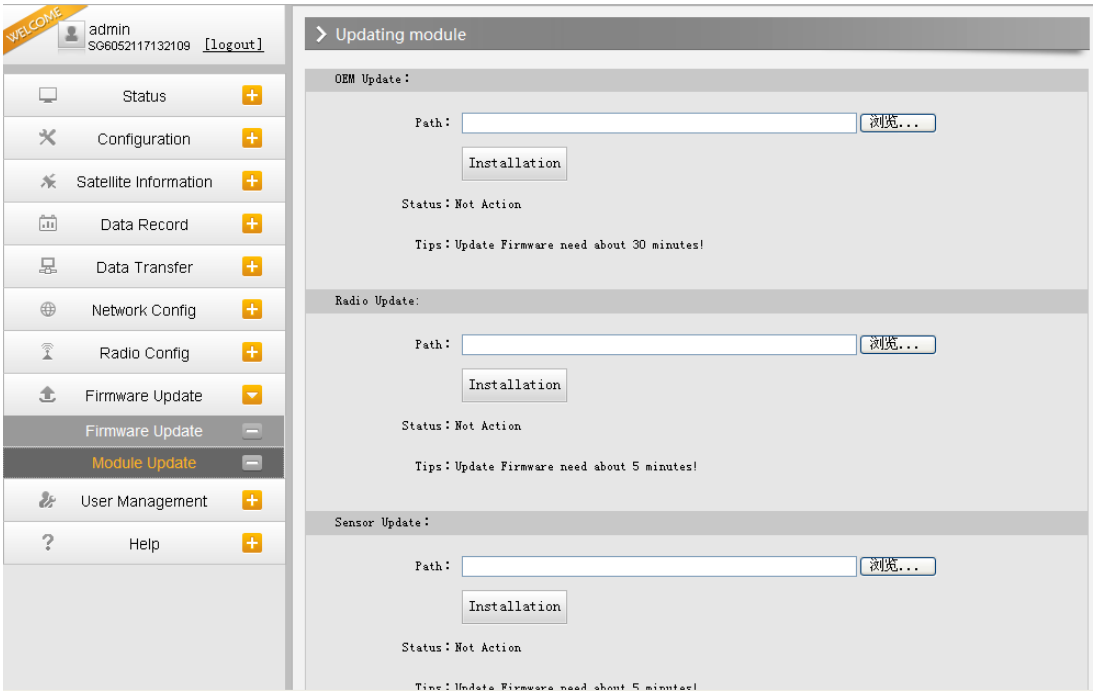
successfully! Host reboot, please log in later…", then the receiver will restart automatically.



SPECIAL REMIND: Galaxy G6 doesn't support to update the firmware with the help of INstar program any more, in the future, update the firmware for Galaxy G6 shall be done through the Web UI.

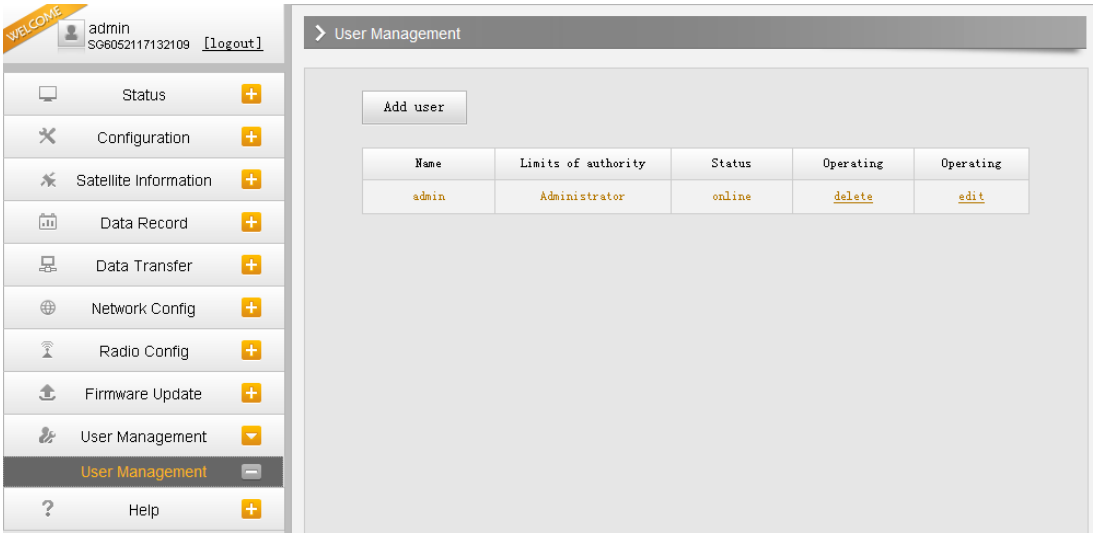
Module Update

This page is used to update the firmware for corresponding modem such as OEM board, radio module and sensor.



§3.2.9 User Management

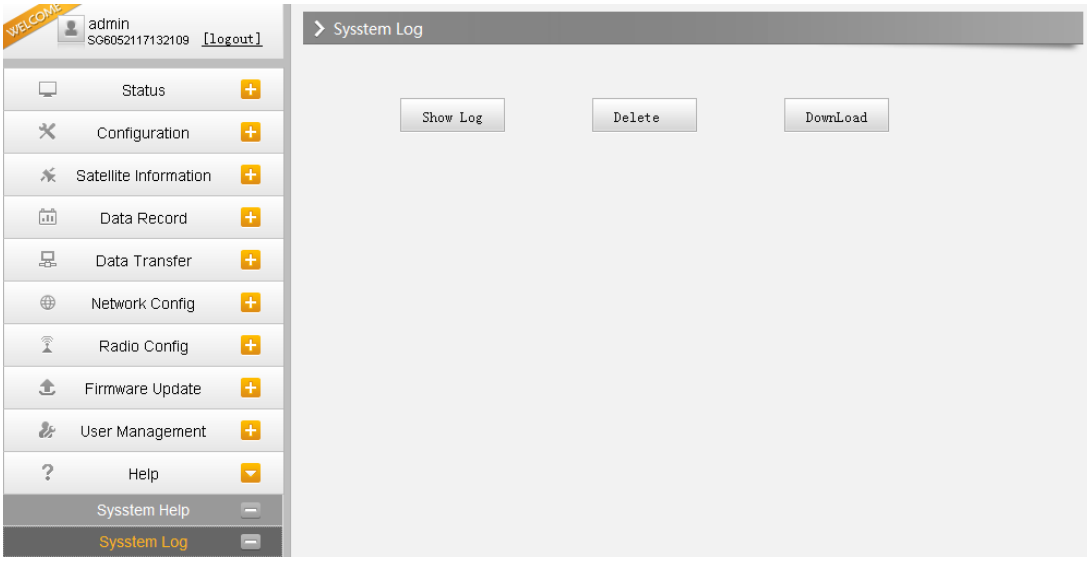
This page is used to manage the authority of login Web UI for users, including the username, password and add users.



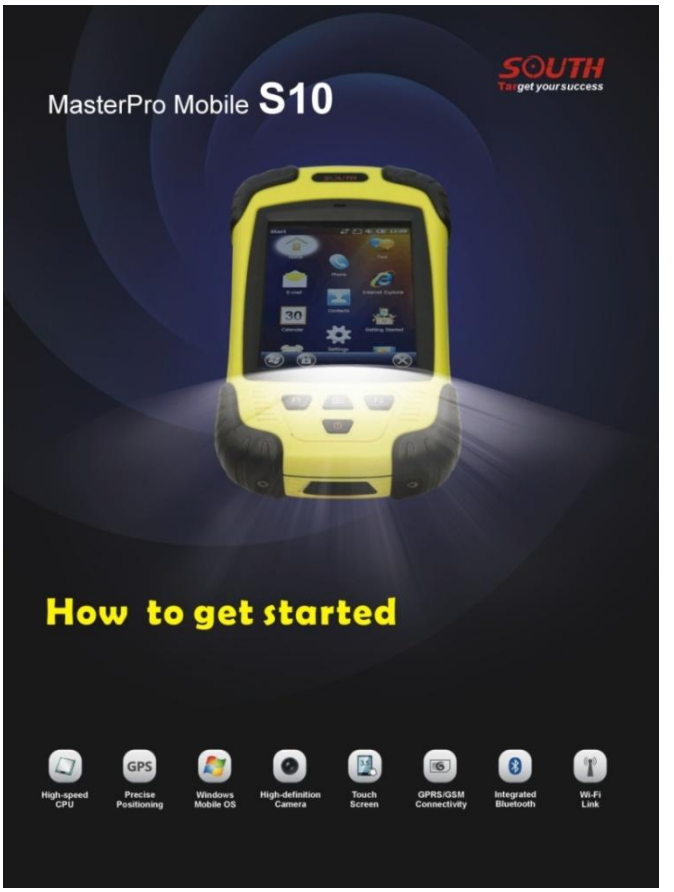
§3.2.10 Help

In this page, users can get help and check the log book of receiver (the log book can help to backtrack the working status of receiver).

NOTE: Only the administrator can modify any parameters for receiver and manage users, and the ordinary users only have the right to view the relative parameters.

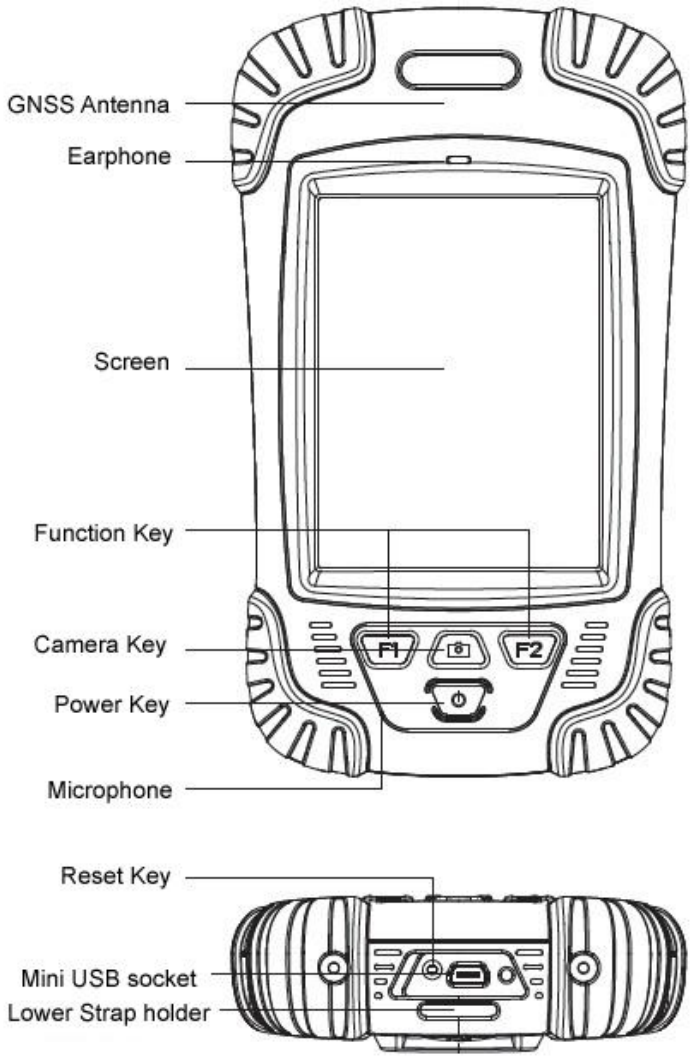


ChapterⅣ Data Collector S10



§4.1 Basic introduction to the handheld

Here takes S10 for example (If you want to know more about Psion controller, please refer to the manual for Psion controller), appearance of S10:



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
Disc	

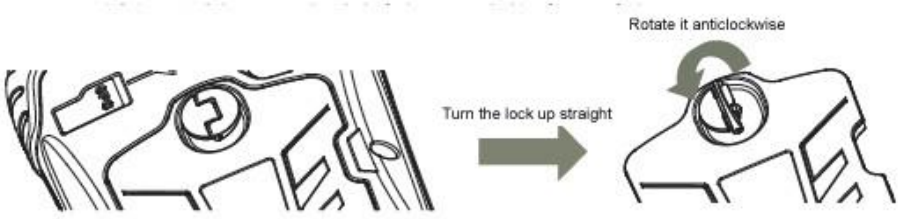
1. Charging

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

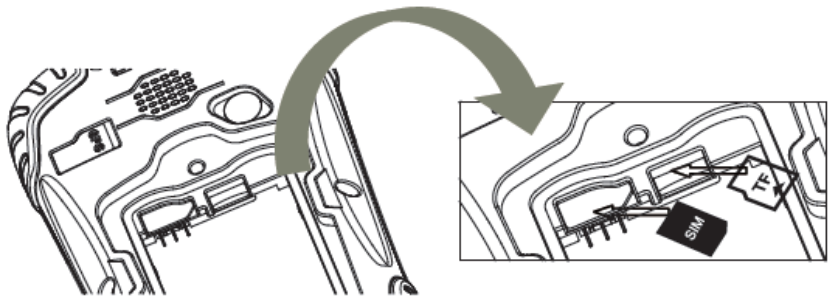
Main Screen (Upper right corner) will show the Charging Icon in power off (on) status.(Once you connect Collector with PC to recharge; the charging time will be longer).

2. 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)

3. Power on/off

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

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

(If there is no any response from Collector or other unusual situations happened, press the Reset Key besides the USB socket in the bottom of Collector with the Touch Screen Pen).

4. Connect to PC

Make sure that you've installed **Microsoft ActiveSync 4.5** or higher version, if your computer equipped with win7 or win8 system, please make sure that you have installed **Windows Mobile Device Center** program.

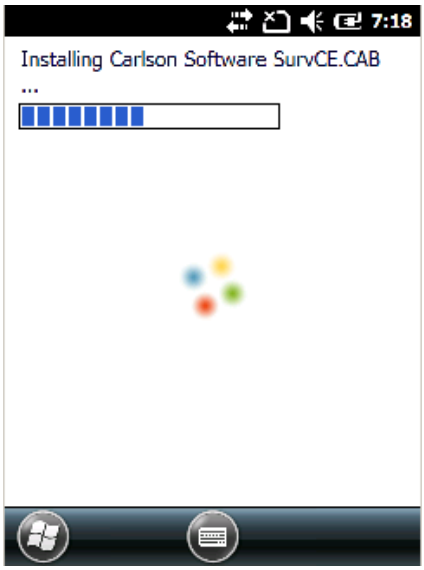
Connect the Collector to PC via the Mini USB Data Cable.

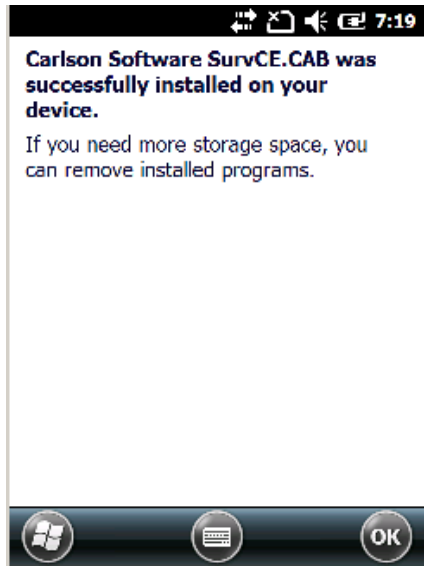
Connection will be preceded automatically by Microsoft ActiveSync. Icon will turn green and an interface of Setting will come out, you can just click "Cancel". After this, you can manage and edit the data in Collector.

5. Installing Program

Make sure that collector is synchronized with PC. Run the Installation file at PC side.

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

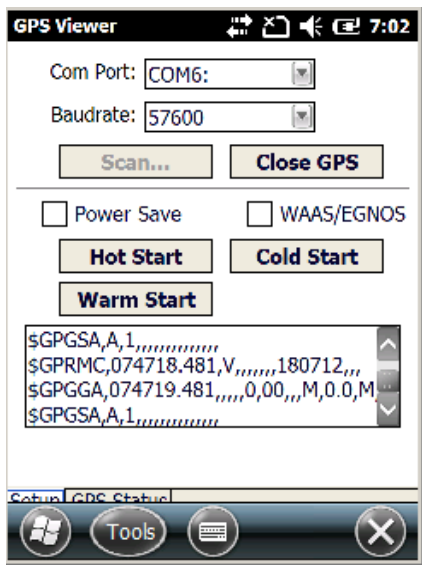




We suggest you installing programs into Flash Memory and save data into Storage Card.

6. How to use GPS

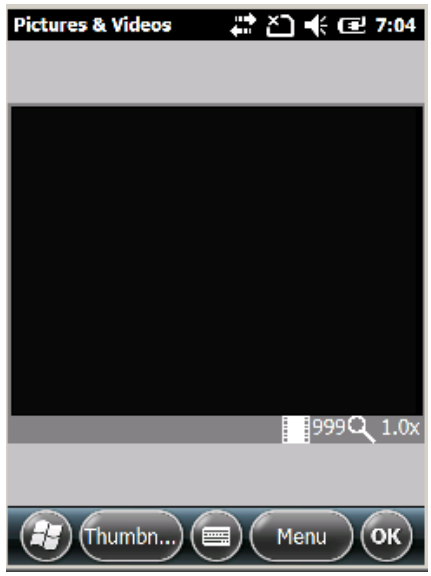
If you want to check the working status of GPS via checking or collecting software, please set the COM port to COM6 and the baud rate to 57600.



7. Camera

Get into the Camera Mode by pressing the Camera Key for 3 or more seconds.

Press Camera Key to take a photo and click “OK” on the screen to save.

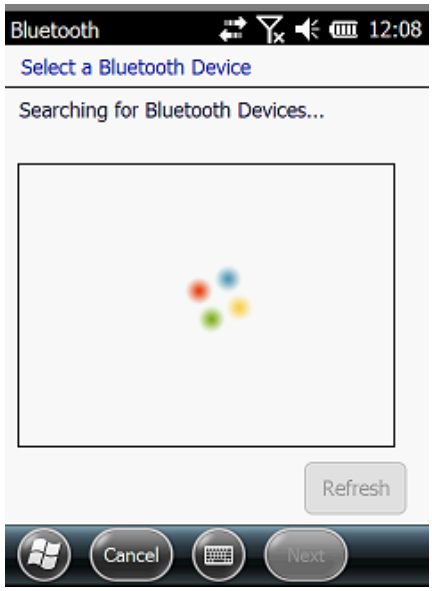


Note: If you want to know more information about S10, Please refer to S10 manual.

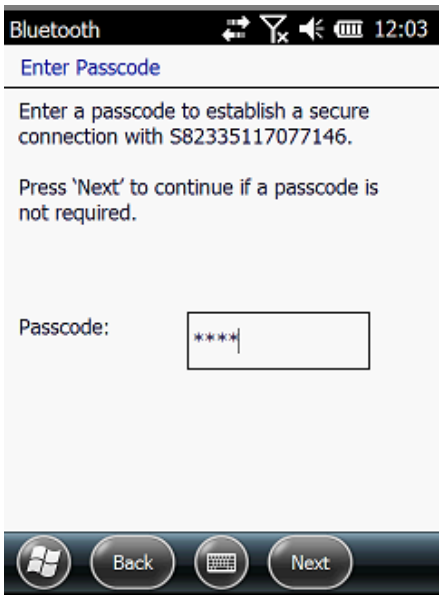
§4.2 Bluetooth Connection

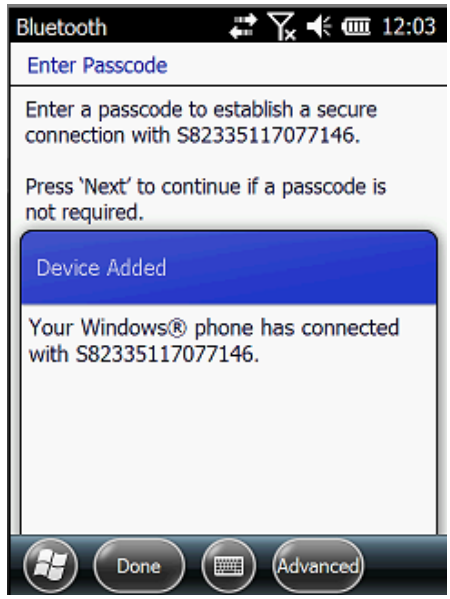
The short-range wireless Bluetooth communication facilities are for the wireless exchange of information among a variety of Bluetooth-enabled devices.

Tap on the Start menu (Settings) → (control panel) to open (Bluetooth Device Manager). tap on the(scanning device) after setting the Bluetooth device, and the surrounding Bluetooth devices will be listed in the search list. And then input the passcode 1234 to have pair between controller and receiver. As shown below:

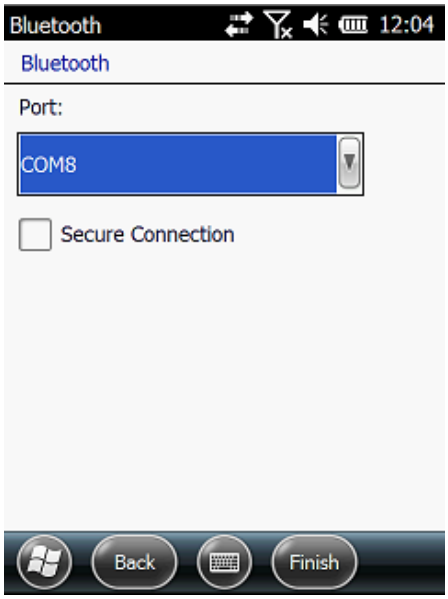


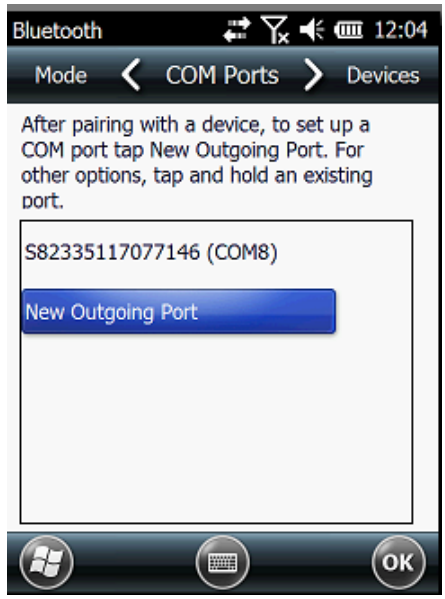






After the pair, select an available com port for the receiver (usually COM 8 and COM 5 are OK). As shown below:





After the establishment of the virtual serial port, other applications can use the serial port for data communication with a Bluetooth device.

§4.3 Software installation and connecting

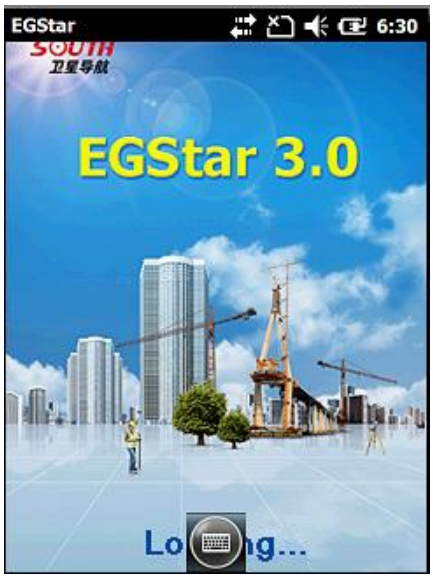
Professional surveying and mapping software are made for measurement applications for different industry:"EGStar", "Power Star", "Mapping Star", "Navigation Star" and so on. Here

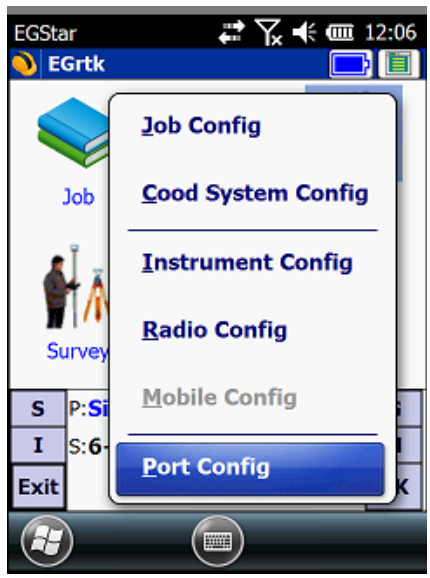
takes EGStar for example:

EGStar is the specific software for G1 measuring system, mainly for the collection and calculation of the measuring points.

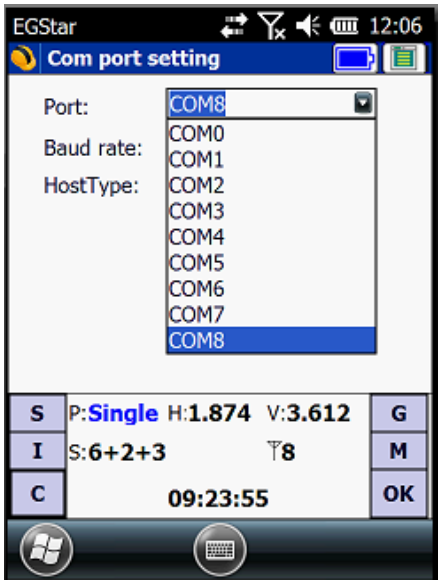
Before installing of EGStar, you need to install Microsoft Active Sync. After installing it on your computer, connect handheld to computer with a cable, and install EGStar into the handheld, at the same time, keep the mainframe power on, then set as follows:

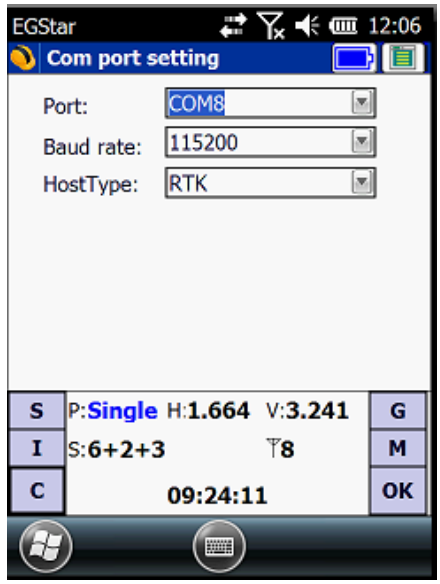
Open EGStar software and enter the main interface. Click “OK” on the "prompt" window.



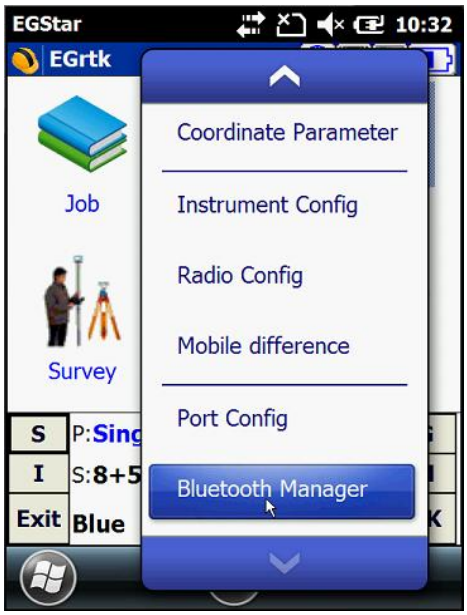


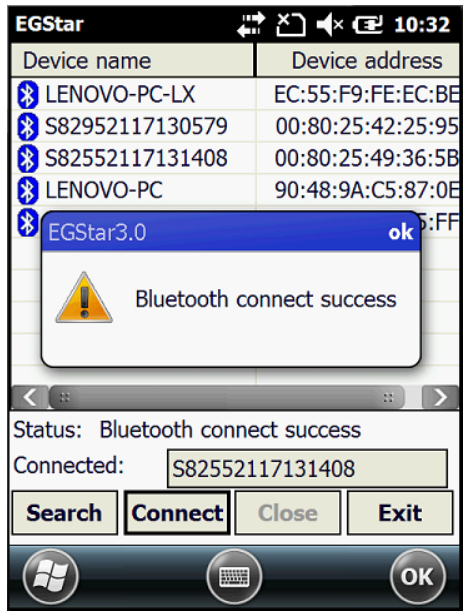
1. "Configure" → "Port Config", in the "Port Configuration “dialog box, select the port “COM8 ", with the same serial number which you use to connect the Bluetooth serial port service. Click "OK." If the connection is successful, the status bar will display related data. If there is barrier, exit EGStar to reconnect (If the above settings are correct, then link directly). Handheld connecting with the host PC can do the follow-up measurement.





2. Or go to “Bluetooth Manager”, in this interface tap on “Search” button and the controller will search the surrounding Bluetooth devices, select the correct serial number from the list and click on “Connect” button, controller will connect to receiver without setting any COM port. If the prompt message “Bluetooth connect success” appears, that means that controller has successfully connected with receiver, then please check the Bluetooth indicator on receiver.





Chapter Ⅴ External Radio

§5.1 Overview

The radio GDL20 is a high-speed semi-manual wireless data transmission radio, whose air transfer rate can be up to 19200 bps and the RF transmitter power is larger, used in Southern RTK measurement system.

Radio GDL20 adopts GMSK modulation, 19200bps transfer rate, low bit error rate. RF frequency can cover 450-470MHz band. Data transmission mode of GDL20 is transparent mode, that is, the received data is sent to the RTK GPS system unchanged.

Radio GDL20 data interface is a standard RS-232 interface, which can be connected to any RS-232 terminal equipment for data exchange.

GDL20 digital radio research employs advanced radio frequency technology, digital signal processing technology and baseband processing technology, carefully selected high quality components to organize production, to ensure the long-term stable and reliable operation;

Have a forward error correction control, digital error correction function.

It has eight transmitting and receiving channels. Can be changed according to the actual use of the channel frequency, transmit power adjustable interval is 0.5MHz.

§5.2 Frequency Table

Channel number	Frequency（450-470MHz）
Channel 1	463.125
Channel 2	464.125
Channel 3	465.125
Channel 4	466.125
Channel 5	463.625
Channel 6	464.625
Channel 7	465.625
Channel 8	466.625

§5.3 Radio Appearance



① Control panel ②SN number

Control Panel

Control panel lights display the status of the radio, the key operation is simple and convenient, one-to-one interface can effectively prevent connection errors.



① Channel indicator light.

② Power indicator light,

③ ON / OFF power key: This key controls the unit's power switch. The red light on the left indicates the power status of the machine.

④ TX red light indicator: This indicator flashes once per second means that the radio is transmitting data with the transmitting interval in 1 second;

⑤ AMP PWR indicator: Indicates the level of radio power, light on indicates low-power, light off indicates high-power

⑥ CHANNEL button: By pressing this switch, you can switch channels 1-8.

§5.4 Radio Interfaces

Mainframe Interface: 5-pin jack for connecting a GPS receiver and power supply



Antenna interface：For connecting the transmitter antenna

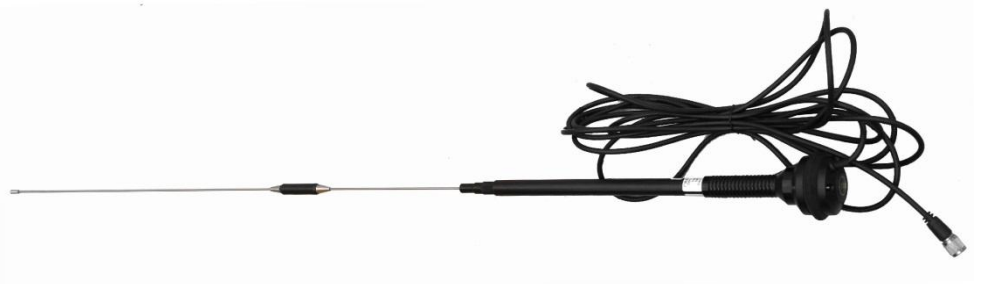


Power switch (Shown in picture below): switch to adjust the radio power, AMP PWR lights on the panel indicate the radio power level, light on indicates low power, lights off high power.



§5.5 Transmitting Antenna

The UHF transmitting antenna is particularly suitable for field use, the receiving antenna is 450MHz Omni-directional antenna, light and durable.



§5.6 Application Notice

The battery power is too low: When the flashing channel indicator appears on the control panel, which means the lack of battery power, replace the battery in time, otherwise there would be

data link unstable or unable to launch.

GDL20 radio power supply: voltage 12-15V (typical 13.8V) RF transmitter power 25W, current 7.0A.

Radio transmits power: radio transmits power based on the voltage of the power supply, check the voltage before use.

High and low power use: use low-power transmitter when low power can satisfy the operation as high-power transmitter will exponentially consume 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 the beam spectrum be and the higher communication quality will be.

Power Connection: Power of positive and negative connected correctly.

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

Radio match antenna: the basic parameters of the antenna selection are the band width, frequency, gain, directivity, impedance, VSWR and other indexes .Usually the effective bandwidth of the antenna is 3-5MHz,antenna selecting should be based on the frequency bands used by the to be selected channel. For the long-distance transmission, it is better to use a directional antenna and high-gain antenna, and pay attention to the impedance of the antenna and feeder to match with the Radio GDL20 antenna interface (50 ohms).

We recommend:

Recommend that you use plug-in battery which is more than 12/36Ah,the use of maintain a regulated current of 10A during the operation.

Recommend that you charge it in time, do not overuse the battery, otherwise it will reduce battery life.

Recommend that you replace the batteries after six months to a year, to ensure the radio distance.

ChapterⅥ Accessories

§6.1 Instrument Case



The instrument case for Galaxy G6 contains two layers of packing: the inner layer is filled with anti-collision foam, the host and other accessories can be dispersed and embedded; the outer layer is a hard instrument case, sealing-strong, wear-resistant anti-wrestling. Compact, durable, can effectively prevent the impact, easy to clean

§6.2 Batteries & Portable Power Package

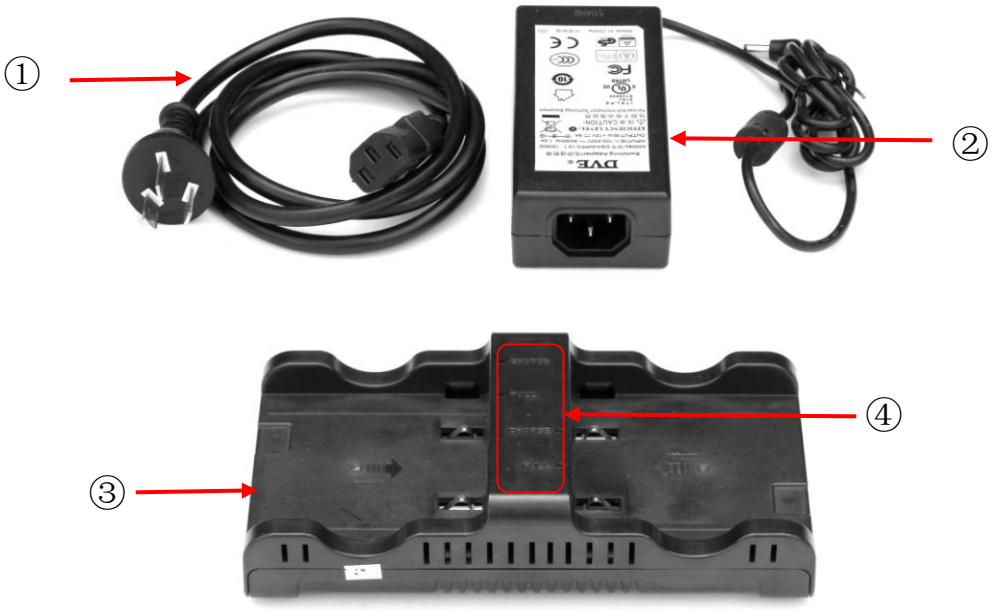
§6.2.1 Batteries

2 pcs large capacity (6800mAh/per) Li-ion batteries are the standard configuration for Galaxy G6 that to make sure G6 has enough power for whole day work.

The battery is allowed to check how much power left by pressing the power button on battery.



Charger



①——adapter connection cable

②——adapter

③——charger

④——charging indicators (FULL/CHARGE)



Ⅰ. Install batteries onto the charger
Ⅱ. Plug connector of the adapter to charger
Ⅲ. Plug the connection cable to adapter
Ⅳ. Plug the jack into socket

NOTE: If CHARGE indicator glows in red, it indicates the battery is being charged, If FULL indicator glows in green, it indicates the battery is full charged.

§6.2.2 Portable power package

Galaxy G6 is equipped with a professional battery package that ensures a long time continuous work.





①——Indicators, the indicators indicates how much power remain by pressing the power button.

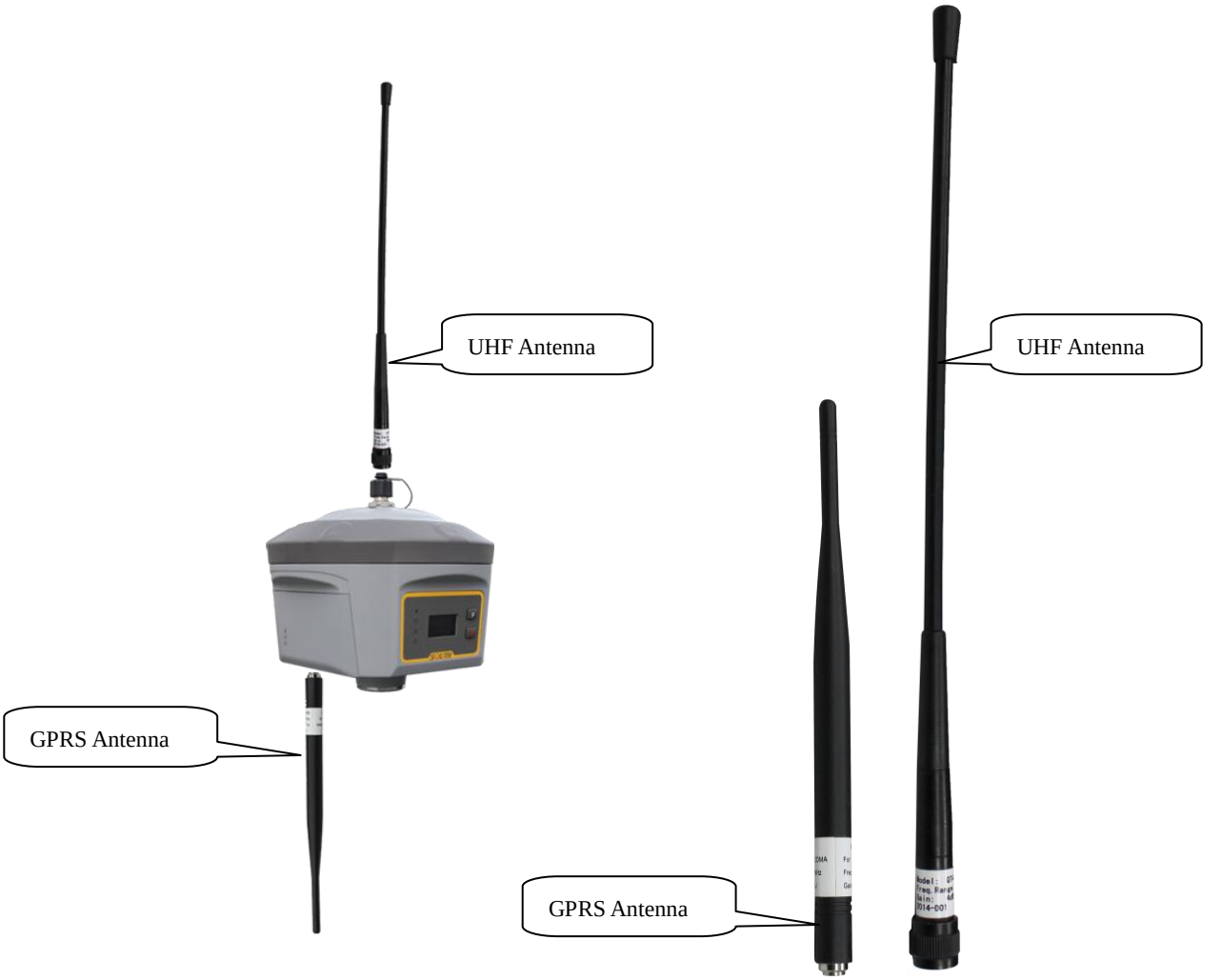
②——The combination batteries installed into the portable power source

③—— Hang buckle, hang the battery package onto tripod

④—— 7-pin port, connect the cable with receiver for power supply.

⑤—— Power supply cable, this cable is used to connect the power source to receiver.

§6.3 Differential Antennas



The differential antennas are as shown above;

The UHF differential antenna is required to install to the interface at the top of receiver if Galaxy G6 is set up into internal UHF mode.

If the receiver is set up to use GPRS mode, the GPRS antenna is required to install to the interface at the bottom of the receiver.

§6.4 Cables

7-pin to USB cable

This cable is used to connect the receiver with computer for static data transmission, Web UI accessing and firmware update.



7-pin to OTG cable

This cable is used to connect an external storage directly to Galaxy G6 for static data storage and copy.



Communication cable

This cable is used to connect the receiver to computer for receiver debugging, differential data checking and firmware update.



§6.5 Other Accessories

Other accessories include rover station centering rod, handheld bracket, base point, connectors, measuring plate and measuring tape.



Tribrach & connector



Measuring tape



Support pole



Bracket for controllers



Carbon fiber pole

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

Chapter Ⅶ Measuring Operation

Reading this chapter, you can grasp in detail how to use the G1 measurement to do system static, RTK operations.

GPS measurement operation scheme refers to the operating scheme used to determine the relative position between the stations with the help of GPS technology. Point coordinate 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).

Test environment requirements:

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

(2) Observation stations should not be near to the large area waters or objects which can strongly reflect (or absorb) electromagnetic wave to weaken the effects of multi-path;

(3) Observation stations should be located in places where the receiving device can be installed easily, and good vision available. Elevation angle of obstacles in view should generally be greater than 10 °to 15 °, in order to weaken the effects of troposphere refraction;

(4)Observation stations should be selected in a convenient place, and easy to use other means of measuring, joint measurement and expansion;

(5) For the long baseline GPS network, should also consider the vicinity good communication facilities (telephone and telegraph, post and telecommunications) and power supply, for power between the stations and equipments.

§7.1 Static Operation

§7.1.1 Static Measurements Profile

Static measurements

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

Scope

The establishment of a national geodetic control network (second or less);

The establishment of precision engineering control network, such as bridge measurement, tunnel measurements, etc;

The establishment of a variety of encryption control network, such as city measurements, Drawing Point measurement, road surveying, demarcation measurements.

For the GPS measurements of small and medium-sized cities, towns, as well as mapping, cadastral, land information, real estate, geophysical exploration, surveying, construction and other control measurement, should meet the accuracy requirements of the D, E grade GPS measurements.

§7.1.2 Operating Procedures

Pre-measurement

Project approval

Program design

Construction design

Surveying and mapping data collection and arrangement

Instrument test, test

Reconnaissance, choice of site, buried stone

Measurement

Operating team stationed in

Satellite status Forecast

Observation planning

Dispatch of operation and field work observation

After the measurement

Data transmission, dump, backup,

Baseline Solution and quality control

Network adjustment (data processing, analysis) and quality control

Finishing results, technical summary

Project acceptance

§7.1.3 Field Operation Notes

1)Static mode of Galaxy G1 receiver only to set in EGStar software or other software (Such as Field Genius or SurvCE), please refer to the EGStar manual for more information.

2)Set up a tripod on the control point, leveling and centering strictly on the measuring point.

3)Measure the instrument height three times, the difference of the results shall not be more than 3 mm, and average the results. The instrument height should be measured from the center of the control point to the mark line on the instrument.(Refer to §3.4)

4)Record instrument number, point name, instrument height, and start time.

5)Power on, confirm the static mode, the mainframe begins to search satellites and satellite lights begin to flash. Recording condition reached, the status light flashes in accordance with the set sampling interval, flashing once indicates the acquisition of an epoch.

6)After the test, the mainframe shut down, and then begins data transmission and data processing (data transmission sees Chapter IV, data processing, please read another manual GPS data processing software operation manual).

§7.1.4 GPS Net Design

The net design mainly subject to the users' requirement, but outlay, time interval of observation, type of receiver and the receiver amount, etc also relate to the net design.

In order to satisfy the users' requirement, we should keep the principle as follows:

1. GPS net normally forms closed graph by independent observation borders, such as triangle, polygon or connecting traverse, etc, to add checking conditions and to improve the net consistency.

2. When designing the net, the net point should be superposition with the original ground net points. The superposition points are generally no less than three and distribute evenly on the net in order to ensure the changing parameters between GPS net and local net.

3. GPS net point should be superposition with the level points, and the other points are normally united—surveyed with level surveying way or the equivalent way. You can also set some level united—surveying points in order to offer geoid's information.

4. In order to observe and level united survey, we often set GPS net points at a clear and easy arriving field.

5. We often distribute some well eyeshot azimuth points around GPS net to ensure united survey direction. The distance from azimuth to observation station should be more than 300 meters.

According to different purpose of GPS surveying, independent observation borders of GPS net should compose definite geometry graph. The basic graphs are as follows:

Triangle net

The triangle in GPS net is composed of independent observation borders, it has strong geometry structure and well self-checking ability, it can also find out the coarse difference of result and to share the difference to each baseline with adjustment.

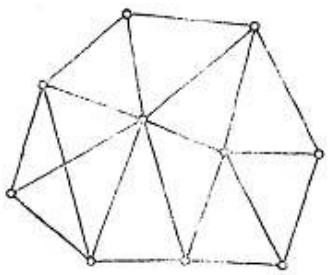
But this net need a lot of observation, especially when receivers are lacking it will greatly prolong the observation time. So only when accuracy and security are required very high, and receivers are more than three, we can use this graph, see fig 5-3.

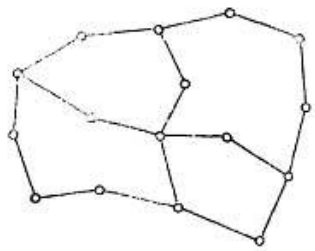
Circle net

Circle net is composed of many loops which are formed of many independent observation borders. This net is similar with one of the classical surveying-- lead net. Its structure is a little worse than triangle net. The amount of baselines in closed loop decides the self--checking ability

and consistency. General speaking, the amount of baselines has such limit as follows:

The advantage of circle net is the small workload, good self-checking and consistency. But the main disadvantage is that the accuracy of indirect-observed border is lower than that of direct-observed border, and the baseline accuracy of neighbor points distributes unevenly. In field surveying, we usually use annexed traverse as special example according to practical situation and the net usage. This requirement for this traverse is the high accuracy for the known vectors between two point ends. Furthermore, the amount of annexed traverses cannot exceed the limits.

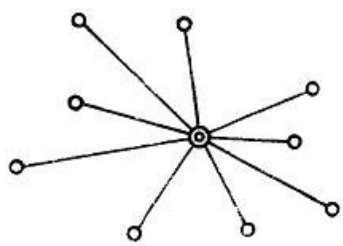




Star shape net

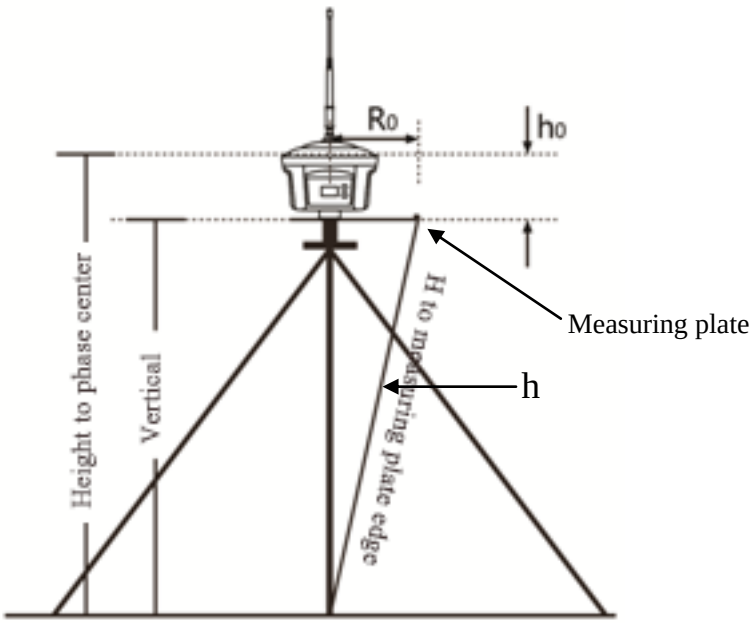
Star net has simple geometry graph, but the baselines of it mostly don't compose a closed graph, so it has a bad checking ability and consistency.

The advantage of this net is that it only needs two receivers, the work is very simple, so it is mostly used in the quick surveying as quick static orientation and kinematical orientation. This working mode is widely used in project layout, border surveying and GIS surveying, etc.



§7.1.5 Antenna Height Measurement

After fixed the instrument, user should measure antenna height at the beginning and the end of every period of time to ensure the accuracy "mm" level. We usually measure from the center point on the ground to the center waterproof loop of antenna. That is an inclined height. Please refer to the following figure.



We use a formula to calculate antenna height.

$$H = \sqrt{h^2 - R_0^2} + h_0$$

"h" is the inclined height that measure from point on the ground to the measuring plate edge.

R_0 is the distance from middle of antenna to the edge of measuring plate.

h_0 is the distance from antenna phase center to the bottom of receiver (measuring plate).

H is the calculation result. We usually measure antenna height twice and adopt the average.

Attention: *We input the inclined height as the antenna height, which is the inclined distance from point on the ground to the waterproof loop of antenna.*

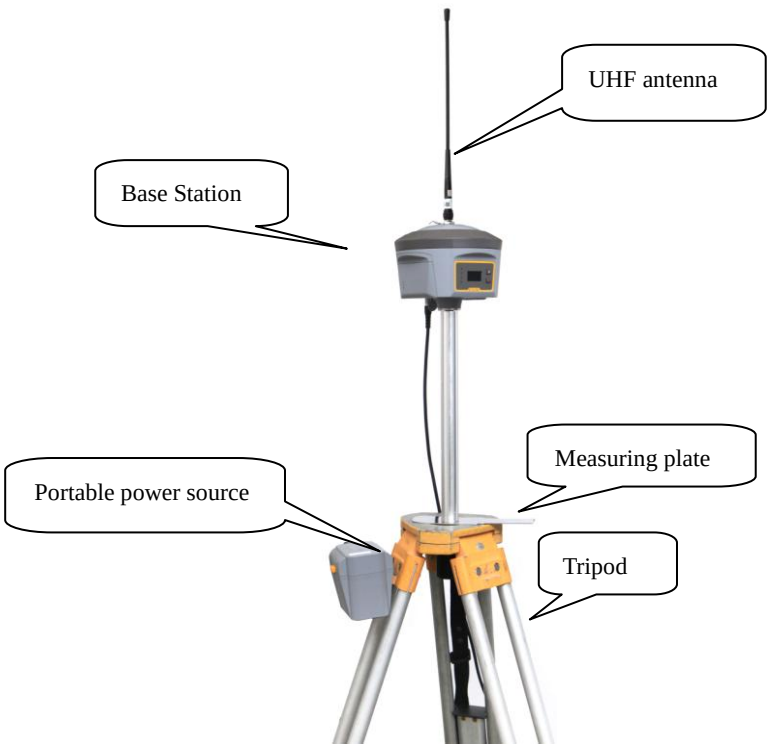
§7.2 RTK measurement

RTK is the abbreviation of Real-Time Kinematic measurements.

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 different ways of differential signals transmission, there are two methods for RTK operation by using the radio and internet (GPRS).

§7.2.1 By using radio (Internal radio)



§7.2.1.1 Base Station Set up

Base station shall be set up in the broad view, unobscured and higher places; avoid the vicinity of the high-voltage power transmission equipment and the transmitting and receiving antennas of

radio communication equipment, the shade of trees, and the sides of waters, all of which will produce different degrees of impact on the GPS signal reception and emission of radio signals

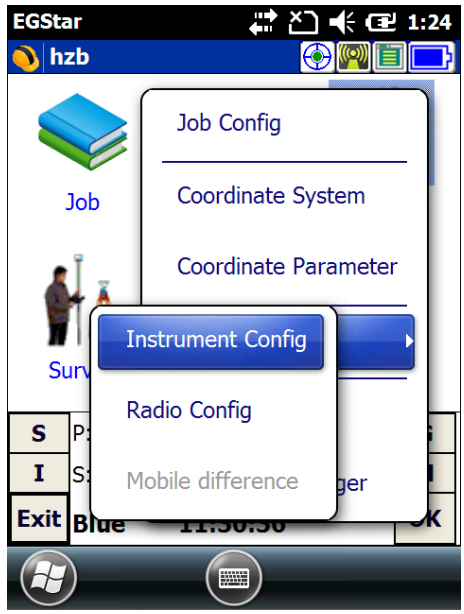
1) Set a tripod to the location with known coordinates (or unknown), attach base receiver to the tribrach adapter set (the measuring plate is recommended to install under base receiver).
2) Install the transmitting antenna onto the receiver.
3) Make sure all connections are alright, then power on receiver.
4) The receiver is set as base with internal radio mode. (set on the control panel, or on internal Web UI or on the software installed on data collector).

§7.2.1.2 Start the Base station

First time to start the base station, all the relative parameters are completely configured before starting.

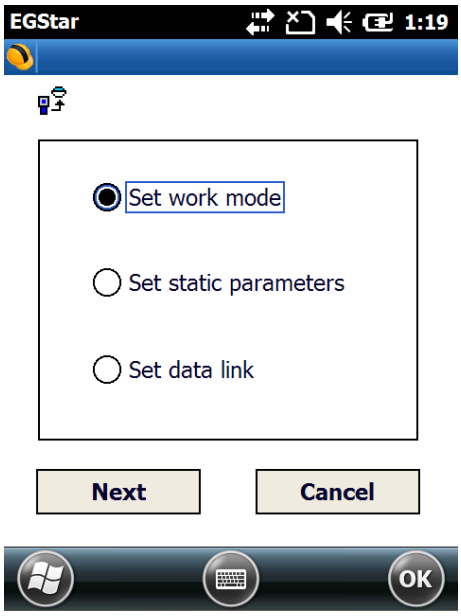
Using EGStar3.0

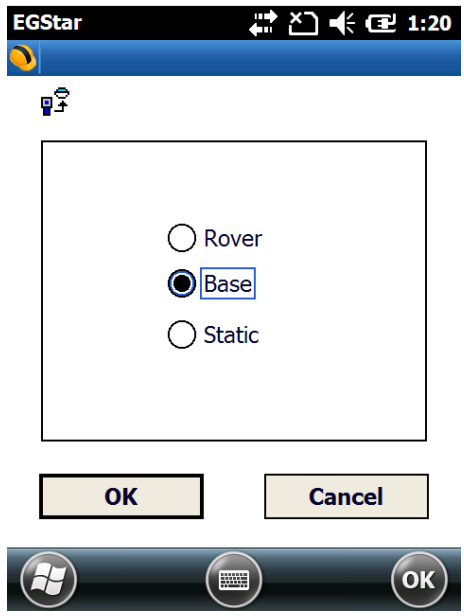
1) Run EGStar3.0 program on data collector;
2) Go to "Config—Device Config—Instrument Config" page to configure the working mode and datalink for base receiver.



3) Tap on "Work mode setting" and then check the box of "Set work mode", then click on "Next" to continue;

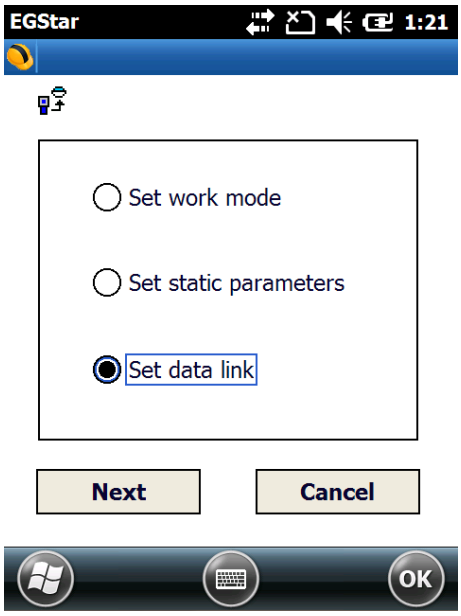
4) Check the box of "Base" option and click "OK" and return to Instrument setting page. At this moment, Galaxy G6 prompts the correct working mode with voice guide.

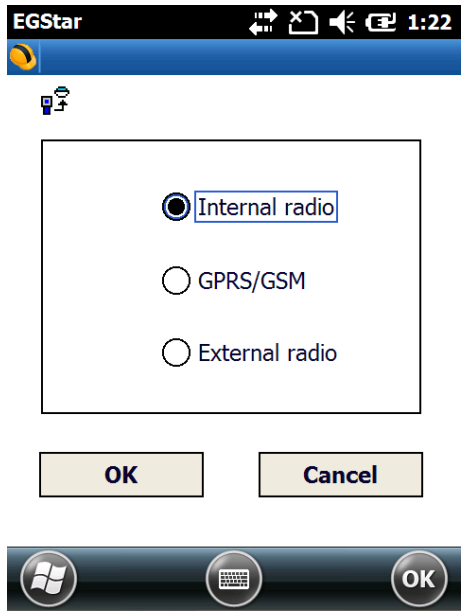




5) Then tap on "Work mode setting" and then check the box of "Set data link", then click on "Next" to continue;

6) Check the box of "Internal radio" option and click "OK" to complete the settings.





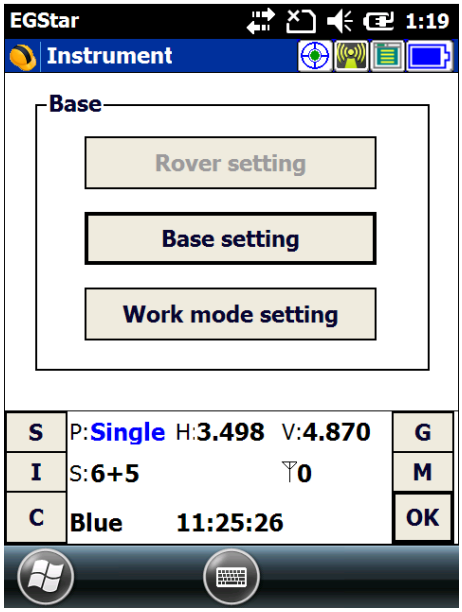
7) Return to the main interface and again get into instrument config page, tap on "Base setting" to get into Base configuration page.

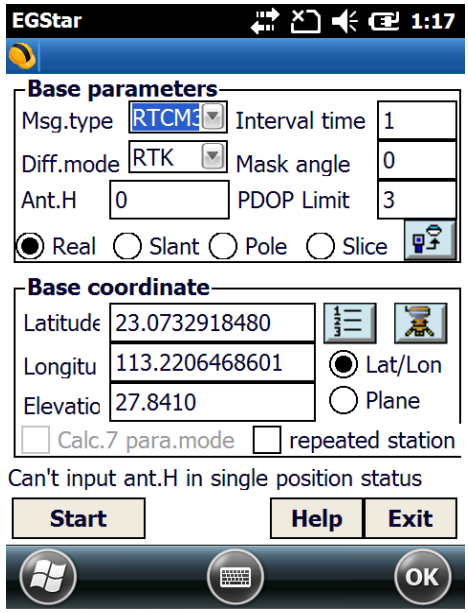
8) Choose the correction format in Msg,Type, choose the antenna measuring method and input correct antenna height in Ant,H, input the proper value for Interval time, Mask angle and PDOP limit.

9) Then tap on the symbol  to save and complete the parameters.

10) Input the coordinates for base location or tap on the symbol  to obtain a single position for base.

11) After all the parameters are completely set, click on "Start" button to start the base station.



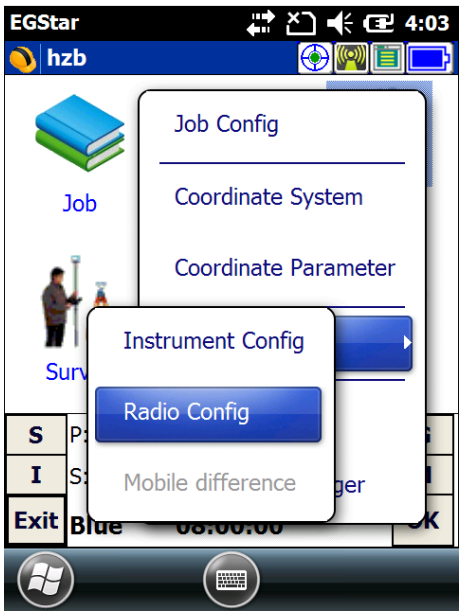


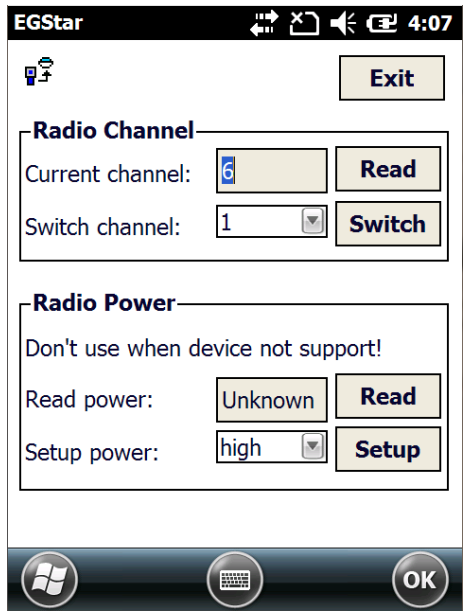


REMIND: If the base station is still set up on the same position next time, check the box of "repeated station" option and the base station will start automatically with known coordinates.

Radio channels setting

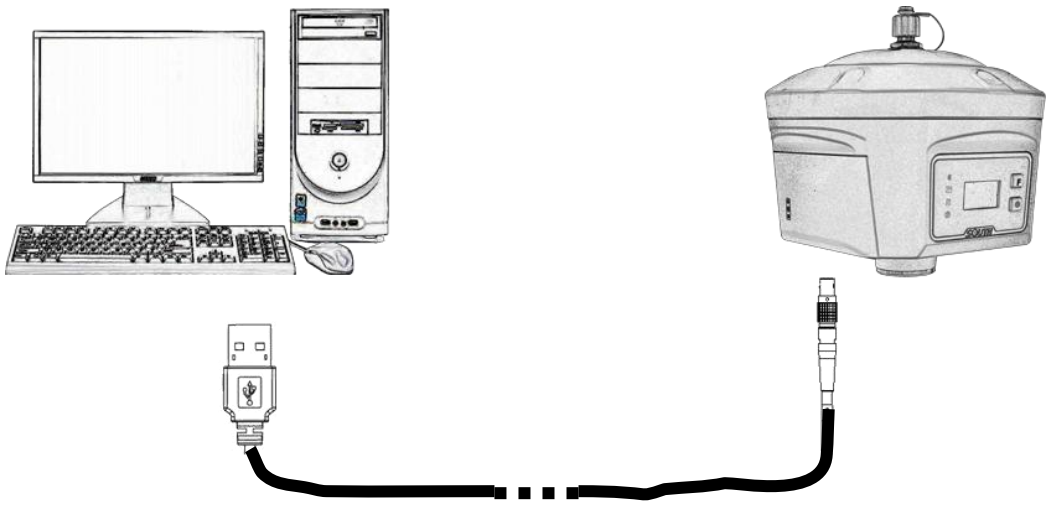
1) Go to "Config—Device Config—Radio Config" page.
2) In radio channel field, click on "Read" button to read the current channel value, or select a radio channel from the list and click on "Switch" button to change the radio channel.
3) In radio power field, click on "Read" button to read the current radio power, or select high/low from the list and click on "Setup" button to apply power for radio.



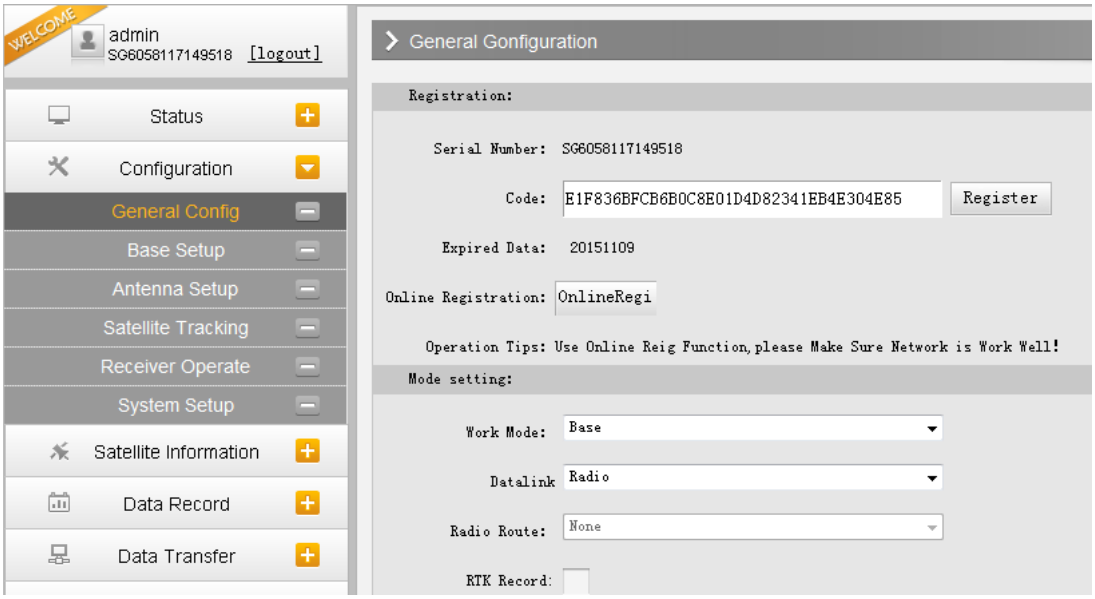


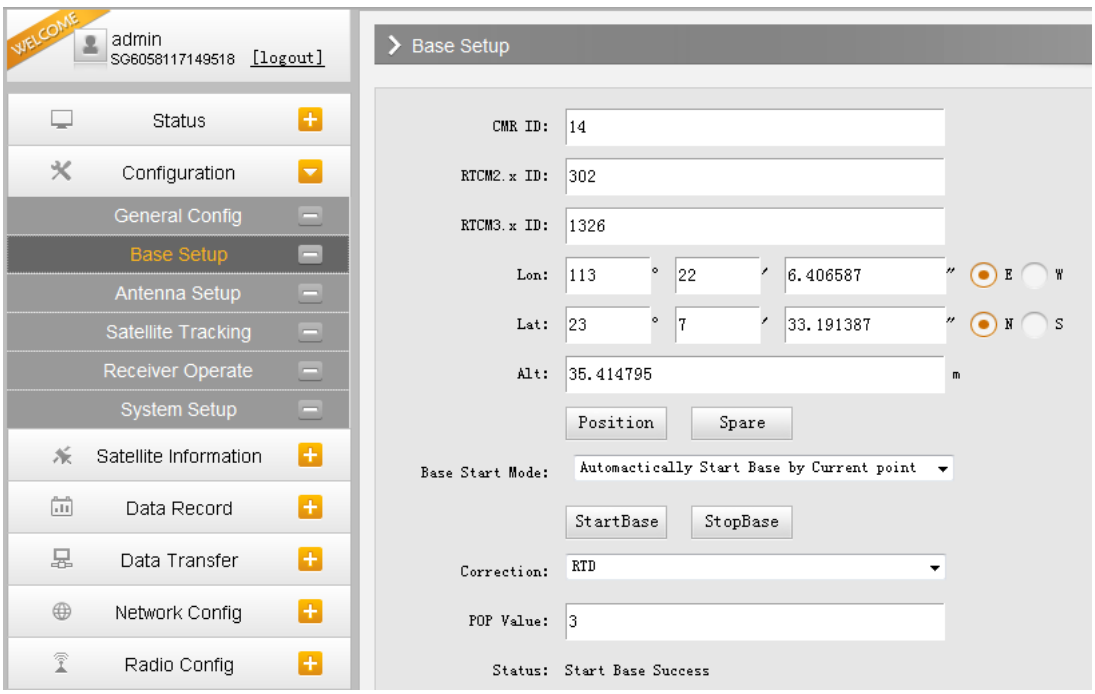
Using internal Web UI

1) Connect Galaxy G6 with computer via 7-pin to USB cable and set the USB port to output as Ethernet on G6. (a driver is required to installed on computer to enable this function).

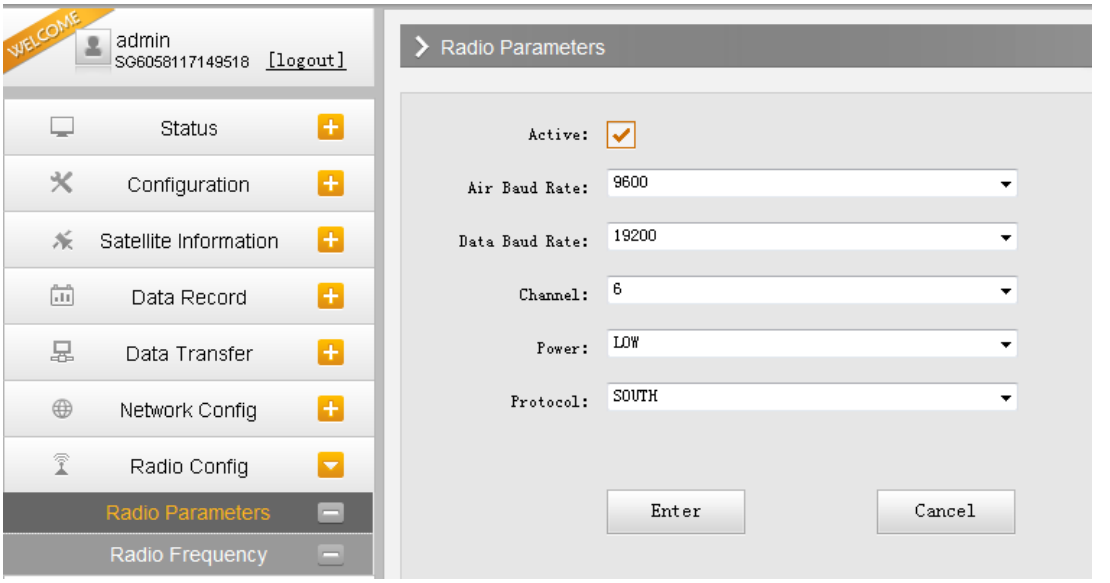


2) Login the internal Web UI of G6 with the default username and password (admin/admin).
3) Get into “General Config” interface under “Configuration”;
4) Choose “Base” in “Work Mode” and “Radio” for “Datalink”, then click “Enter” button to save configurations;
5) Get into “Base Setup” interface, and input known coordinates or click “Position” button to obtain a single coordinates for base station;
6) Choose the correction format in “Corrections”, then click “StartBase” button to start the base station.





7) Get into “Radio Parameters” interface under “Radio Config”, configure the radio parameters for base station such air baud rate, channel value, power and protocol.



§7.2.1.3 Rover station set up

After verifying the successful transmitting of the Base station, the rover station shall be set up at this moment.

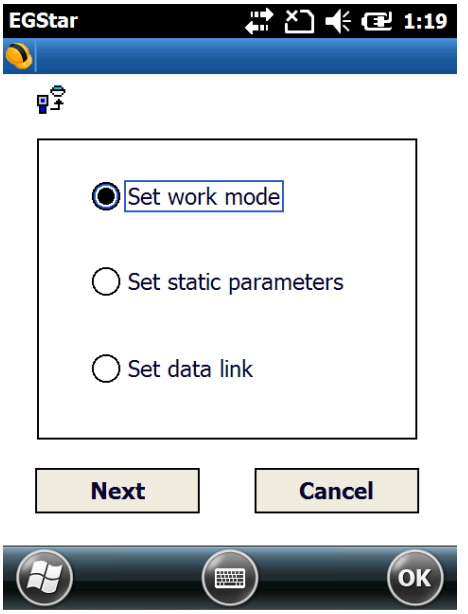
1) Install the bracket holder onto the carbon fiber pole, and fix the controller into the bracket, then power on the controller.
2) Install the receiving antenna onto the rover receiver, and screw the receiver into the carbon fiber pole, then power on the receiver.
3) Set the receiver as rover with internal radio mode. (set on the control panel, or on internal Web UI or on the software installed on data collector).

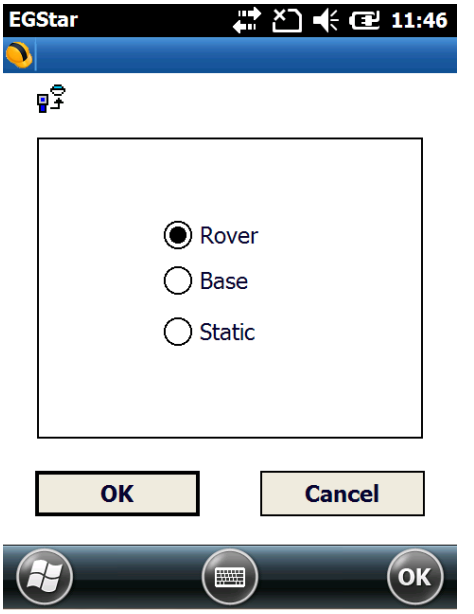

Rover receiver
UHF receiving antenna
Carbon fiber pole
Bracket
Data collector
GPRS receiving antenna
SOUTH
SOUTH

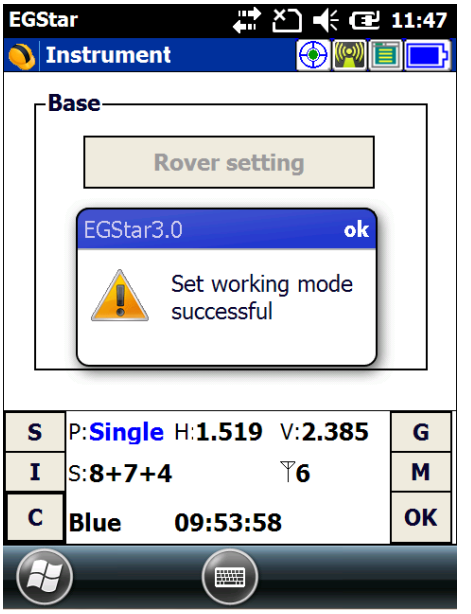
§7.2.1.4 Rover settings

Using EGStar3.0

1) Run EGStar3.0 program on data collector;
2) Go to "Config—Device Config—Instrument Config" page to configure the working mode and datalink for rover receiver.
3) Tap on "Work mode setting" and then check the box of "Set work mode", then click on "Next" to continue;
4) Check the box of "Rover" option and click "OK" and return to Instrument setting page. At this moment, Galaxy G6 prompts the correct working mode with voice guide.

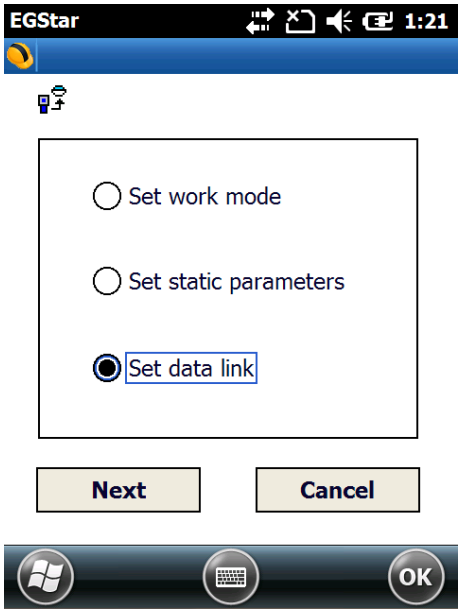


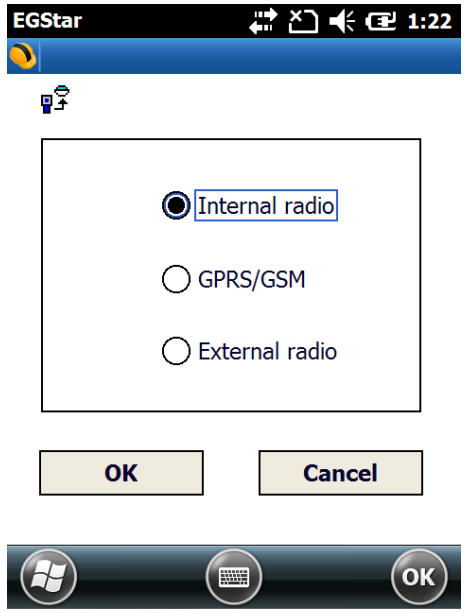




5) Then tap on “Work mode setting” and then check the box of “Set data link”, then click on “Next” to continue;

6) Check the box of “Internal radio” option and click “OK” to complete the settings.



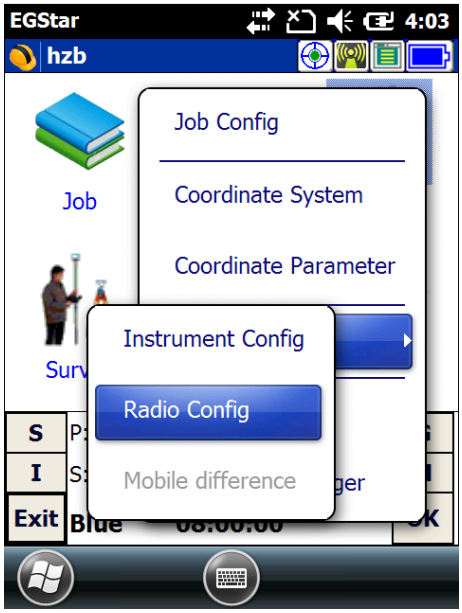


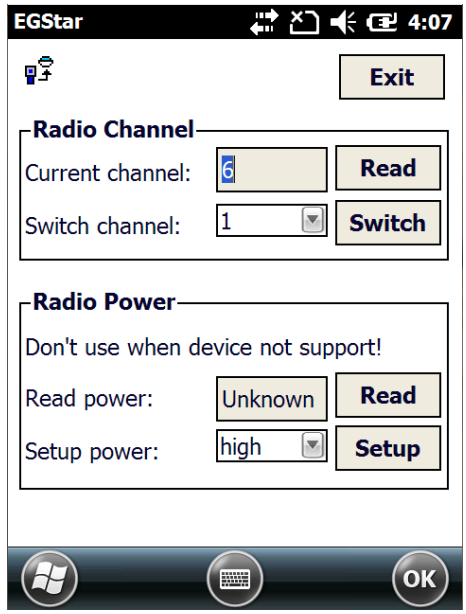
7) Radio channels setting

8) Go to “Config—Device Config—Radio Config” page.

9) In radio channel field, click on “Read” button to read the current channel value;

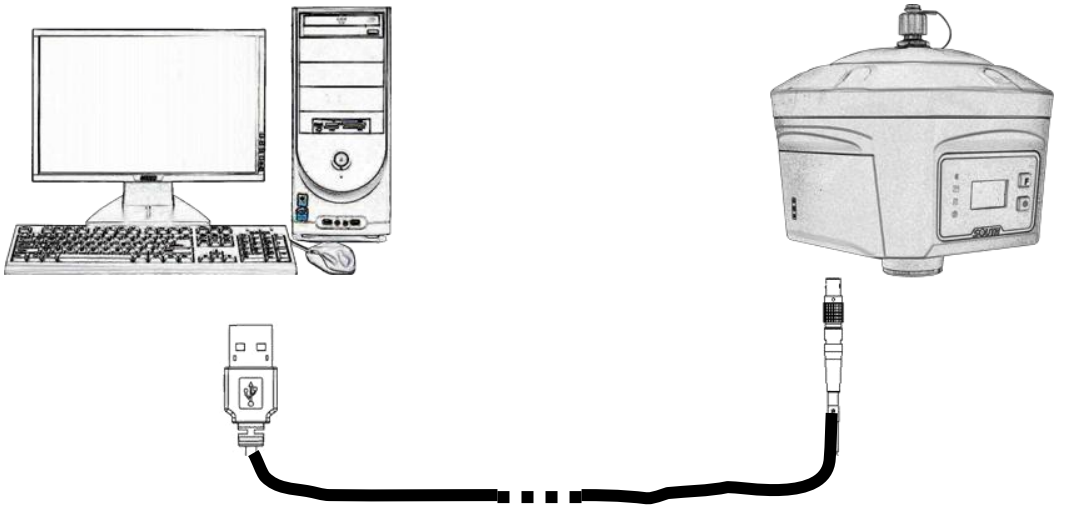
10) Select the same radio channel value as set on base station from the list and click on “Switch” button to apply this channel value.



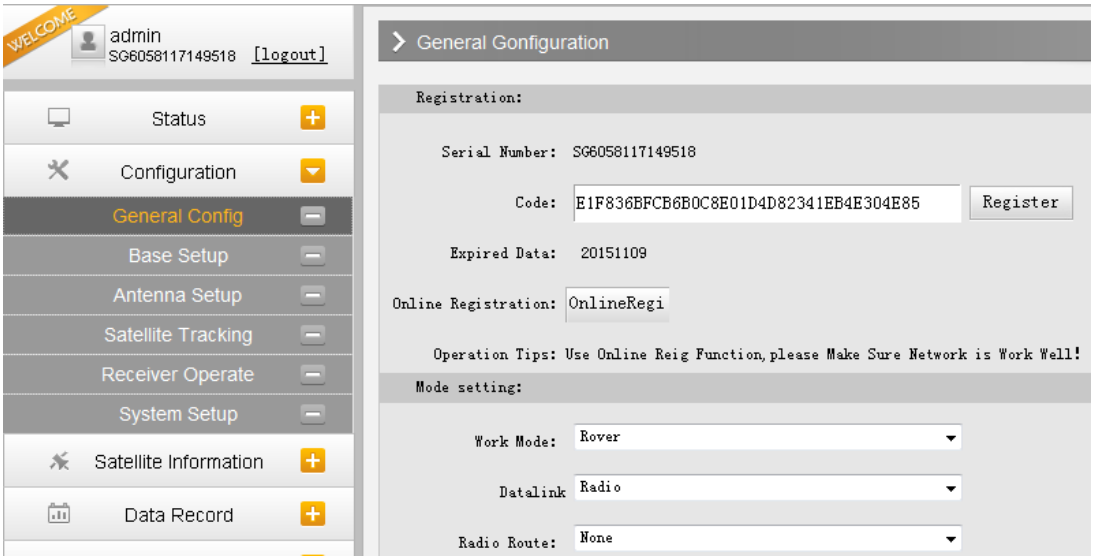


Using Web UI

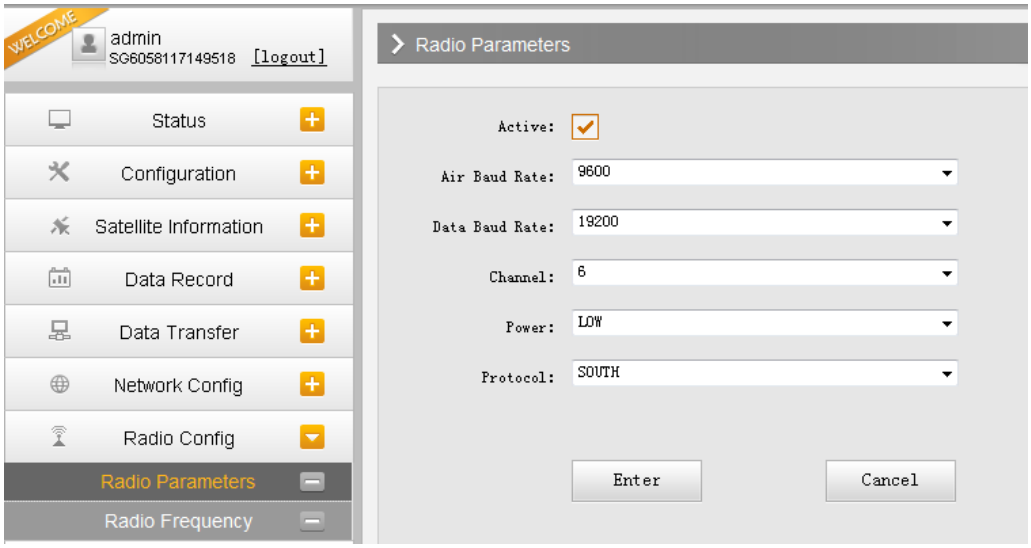
1) Connect Galaxy G6 with computer via 7-pin to USB cable and set the USB port to output as Ethernet on G6. (a driver is required to installed on computer to enable this function).

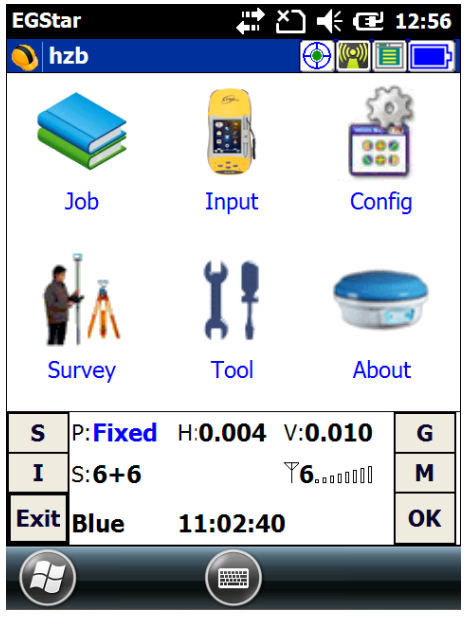


2) Login the internal Web UI of G6 with the default username and password (admin/admin).
3) Get into “General Config” interface under “Configuration”;
4) Choose “Rover” in “Work Mode” and “Radio” for “Datalink”, then click “Enter” button to save configurations;



5) Get into “Radio Parameters” interface under “Radio Config”, configure the same radio parameters as set on base station for rover station such air baud rate, channel value, power and protocol

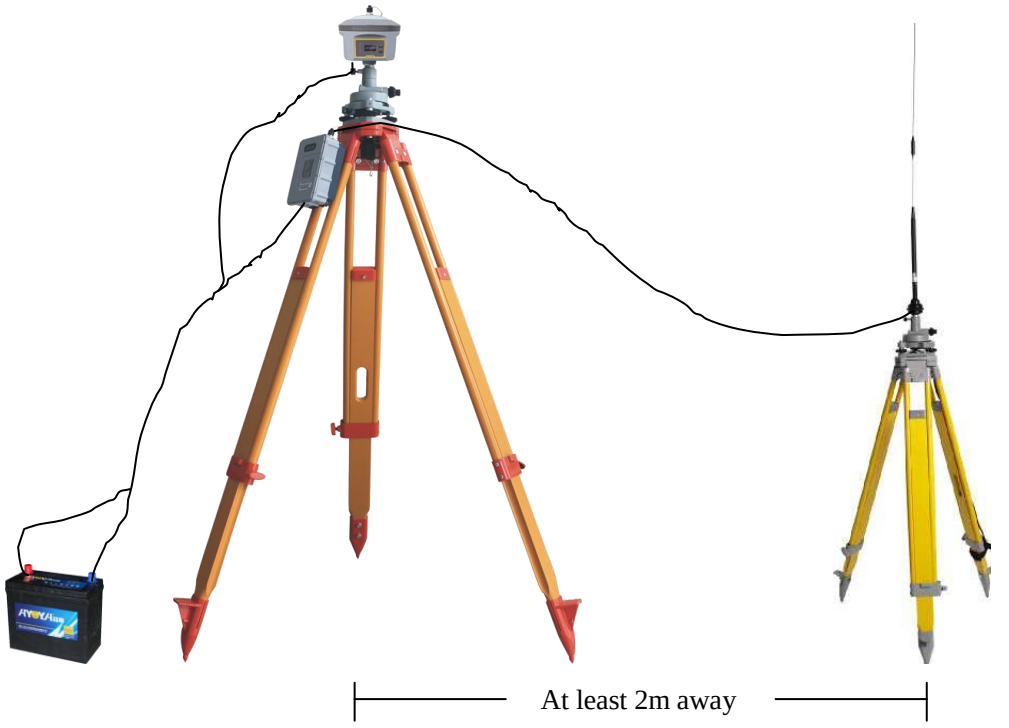




§7.2.2 By using radio (external radio)

§7.2.2.1 Base station setup

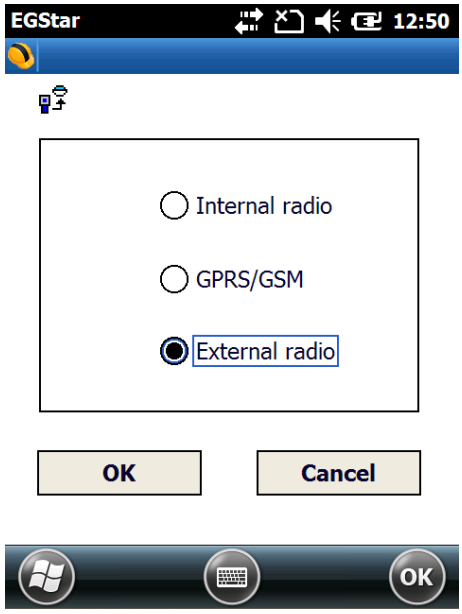
1) Set a tripod to the location with known coordinates (or unknown), attach base receiver to the tribrach adapter set (the measuring plate is recommended to install under base receiver).
2) Mount the UHF antenna set onto a tripod, and connect it to the external radio which is linked with the external power supply via the multi-function cable.
3) Power on the base receiver and set the receiver as base with external radio mode. (set on the control panel, or on internal Web UI or on the software installed on data collector).



NOTE: place the 2 tripods at least 2m away from each other against signal interference.

Using EGStar3.0

Set the base receiver as base working mode from "Config—Device Config—Instrument Config—Work mode setting—Set work mode--Base", choose the External option in "Set data link".



§7.2.2.2 Radio settings

1) Make sure all connections are alright, then power on the radio by pressing power button, and then press "C" button to define the channel for data transmission.
2) Please keep in mind the channel is selected to match the settings in controller later on.
3) Radio starts to transmit when TX LED is flashing.



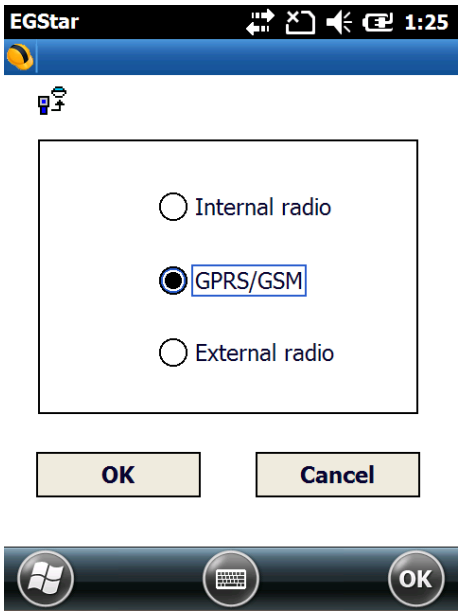
§7.2.2.3 Start Base Station (Please refer to 7.2.1.2)

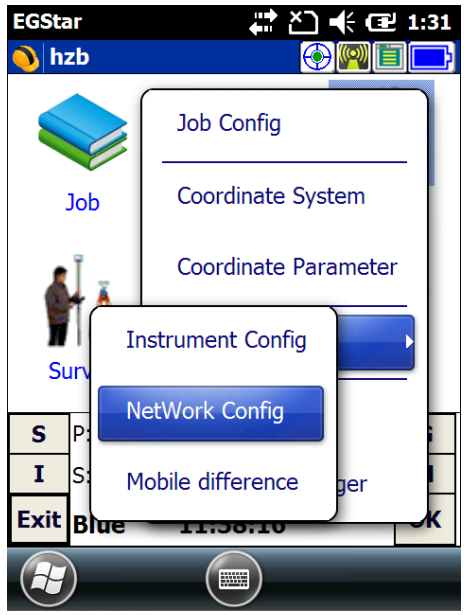
§7.2.3 By using internet (GPRS)

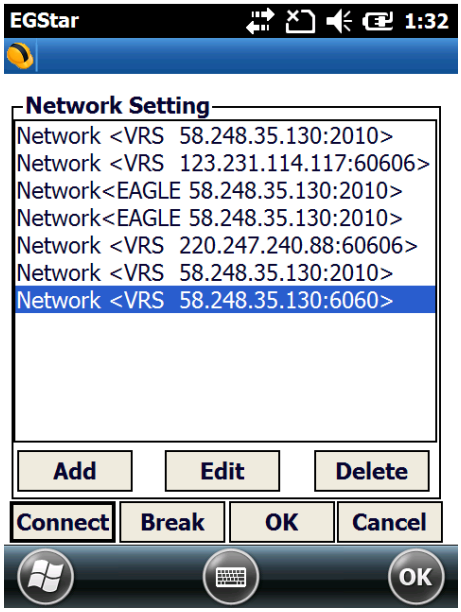
1) In this mode, base station is no longer to set up as CORS is permanently installed.
2) Insert a SIM card into the SIM card slot in battery component.
3) Power on the rover receiver and connect with controller via Bluetooth.

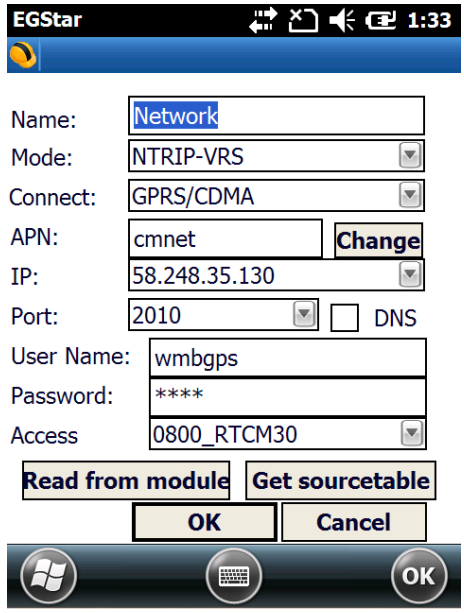
EGStar3.0 settings

1) Go to "Config—Device Config—Instrument Config—Work mode setting—Set data link" interface to choose "GPRS/GSM" option for rover station.
2) Then return to main interface and go to "Config—Device Config—Network Config" page.
3) Add a new NTRIP connection in this page or select the existed one to re-edit/use directly.



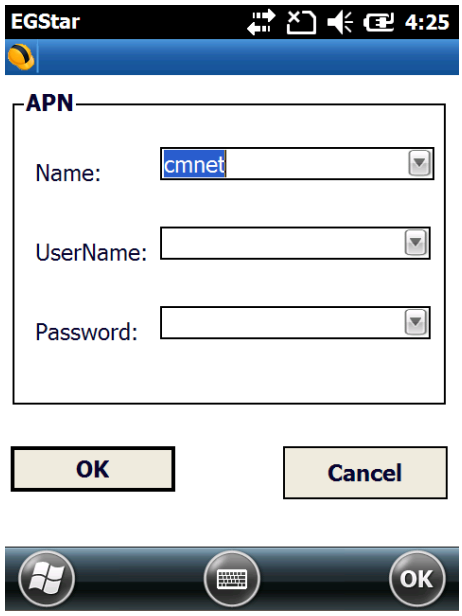






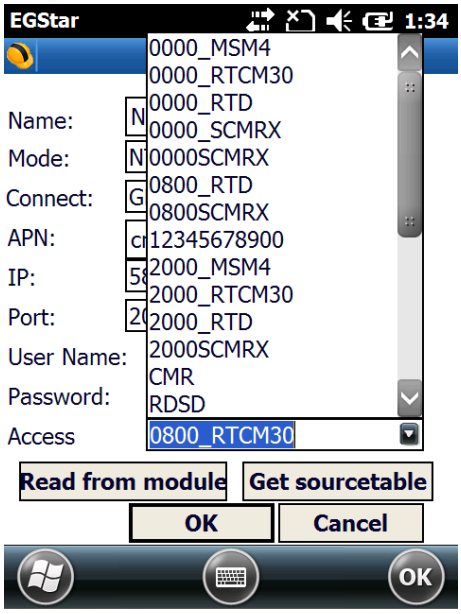
4) Input a name for NTRIP connection and choose “NTRIP-VRS” for “Mode” and choose “GPRS/CDMA” for Connect.

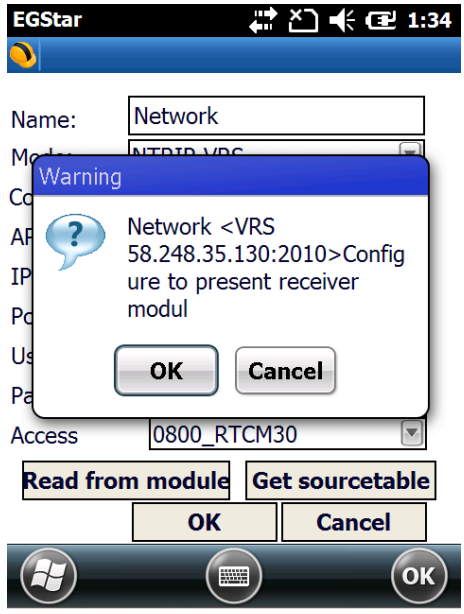
5) Then click on “Change” button to define the ANP for your local SIM card.



6) Input the IP address and port, then input the assigned username and password for your NTRIP connection.

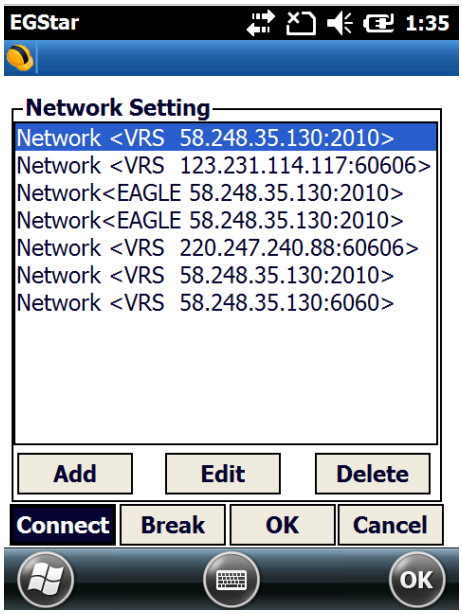
7) Press “Get Sourcetable” button to obtain mountpoint list, then select the appropriate one from the list in Access option, press “OK” button to confirm and return to Network Setting interface.

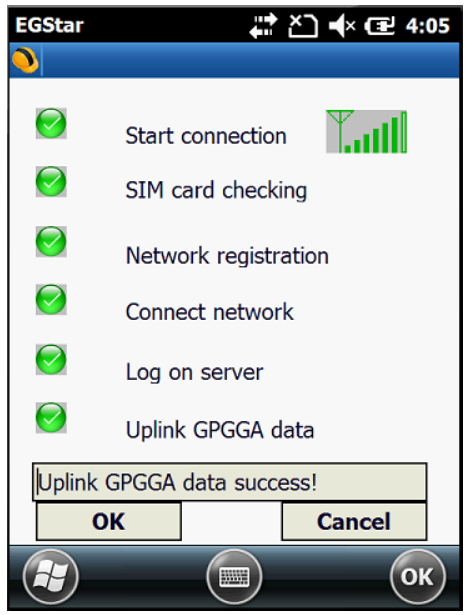




8) Press “Connect” button to access CORS network and obtain corrections from selected mountpoint.

9) After the message “Uplink GPGGA data success” appears in the status bar, click “OK” button to return to main interface, and check the general info at the bottom.

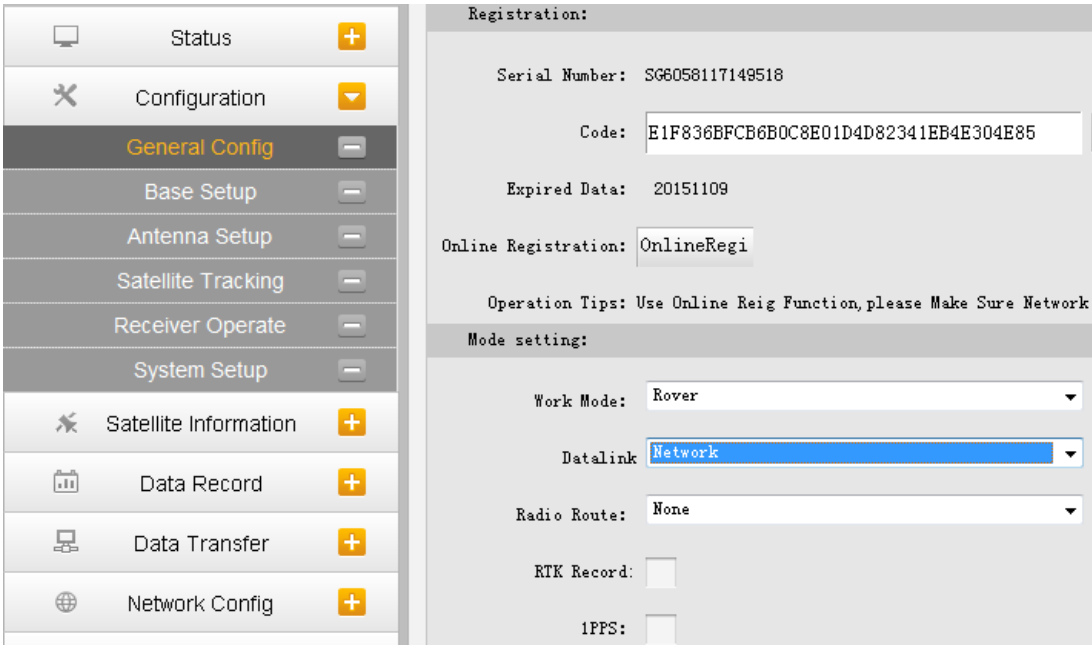


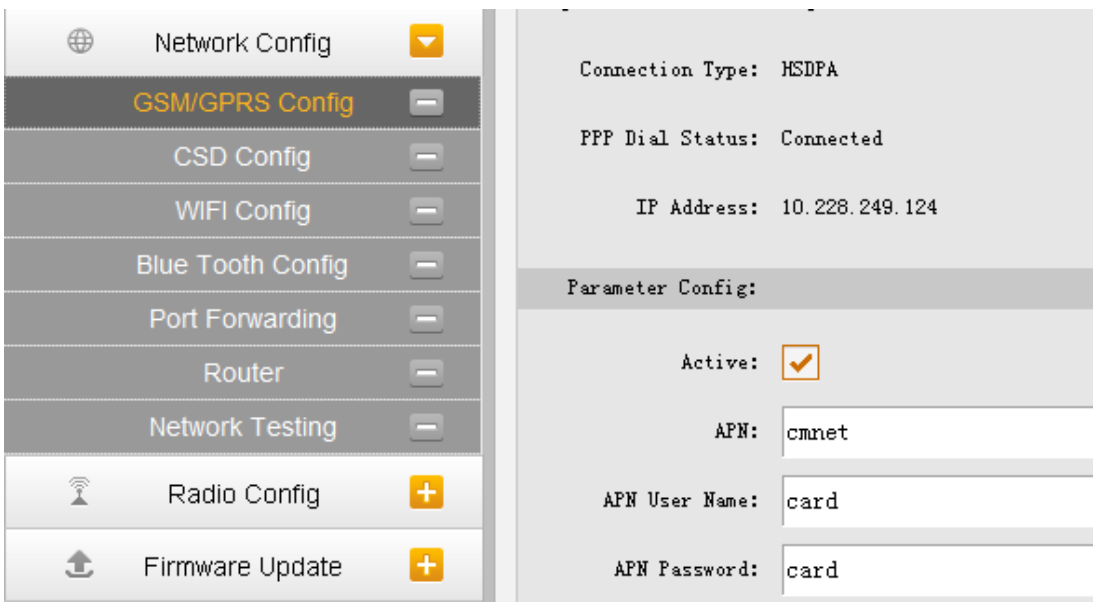


NOTE; the parameters would be automatically saved up once input, the receiver would track the CORS info most recently input and connect when it gets started next time.

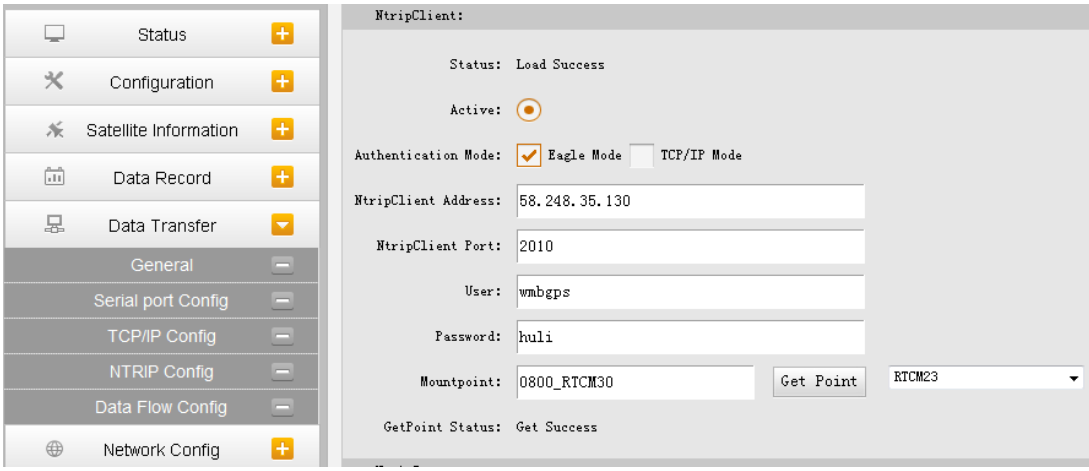
Web UI settings

1) Login the web UI of G6 and go to "General Config" interface, then choose "Network" in "Datalink" option, click on "Enter" button to confirm and save the settings.
2) Then go to "GSM/GPRS Config" interface under "Network Config" to check if the SIM card is detected, and input the APN information at the bottom.





3) Go to "NTRIP Config" interface under "Data Transfer", and input the CORS server information including IP, Port, User and password, then click "Get Point" button to download mountpoint list from server. Then select the appropriate one from the list and click on "Enter" button at the bottom to access.



§7.2.4 By using internet (WIFI)

WiFi datalink is a new feature and new technology adopted on Galaxy G6, it is more faster and stable in network RTK job.

Set the receiver as rover with WIFI mode on the control panel or on Web UI.

Instrument settings

1) After choosing the rover mode for receiver, then press F button and get into the “Set Data Link” configure page, then move the select box to “WIFI Datalink” option and press power button to confirm.

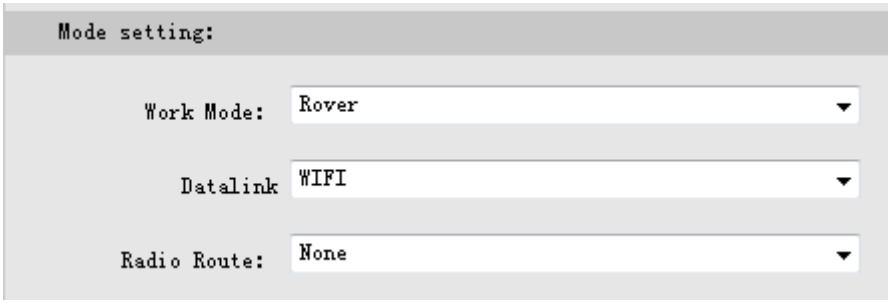


2) Then get into the “WIFI Config” configure page to check if the WIFI connection is already established.

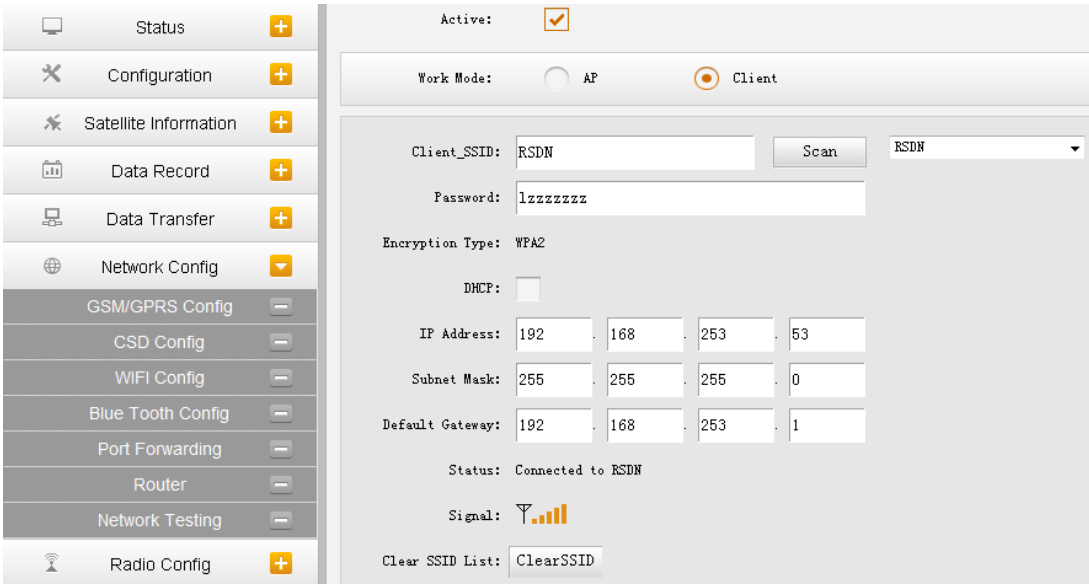


Web UI settings

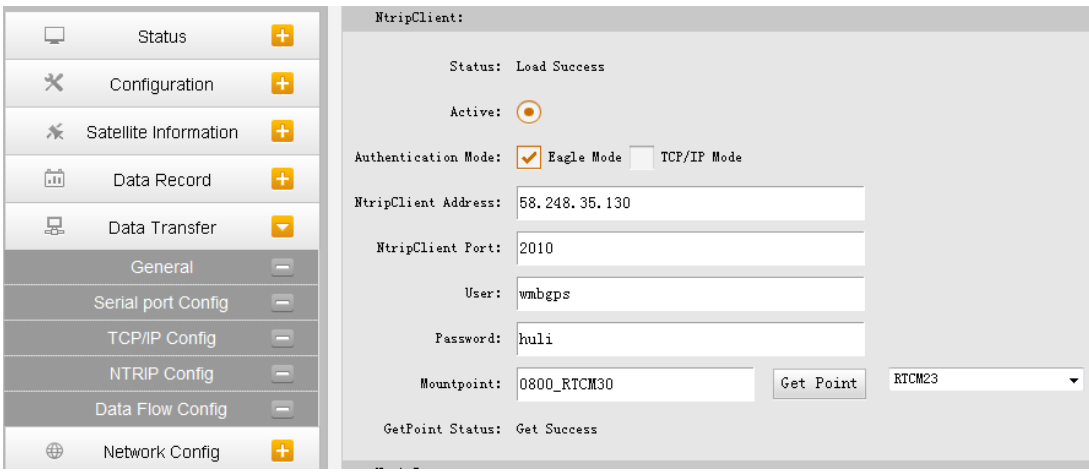
1) Login the web UI of G6 and go to “General Config” interface, then choose “WIFI” in “Datalink” option, click on “Enter” button to confirm and save the settings.



2) Then go to “WIFI Config” interface under “Network Config”, there the option of “Client” is activated if WIFI used as datalink.
3) Click on the “Scan” button to search the surrounding available WIFI hotspot, then select a proper one and input the password, click the “Enter” button at the bottom to confirm and access



4) If the WIFI connection is successfully connected, go to "NTRIP Config" interface under "Data Transfer", and input the CORS server information including IP, Port, User and password, then click "Get Point" button to download mountpoint list from server. Then select the appropriate one from the list and click on "Enter" button at the bottom to access.



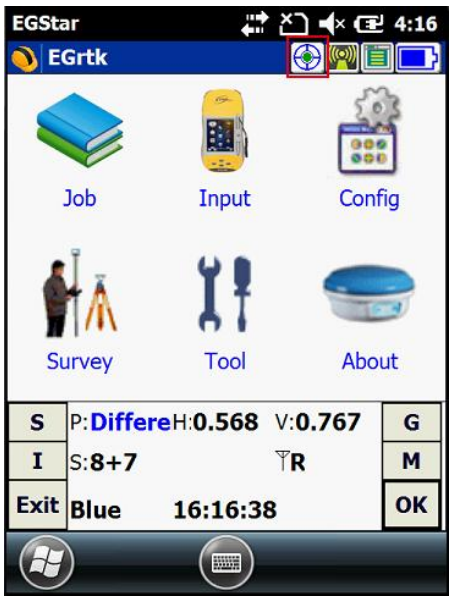
§7.2.5 Tilt Survey

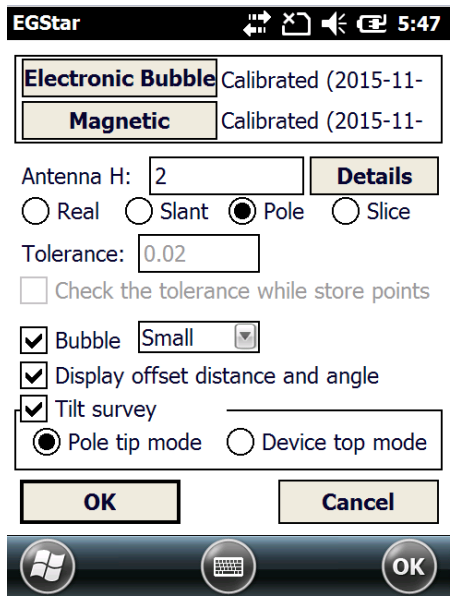
Electronic Bubble

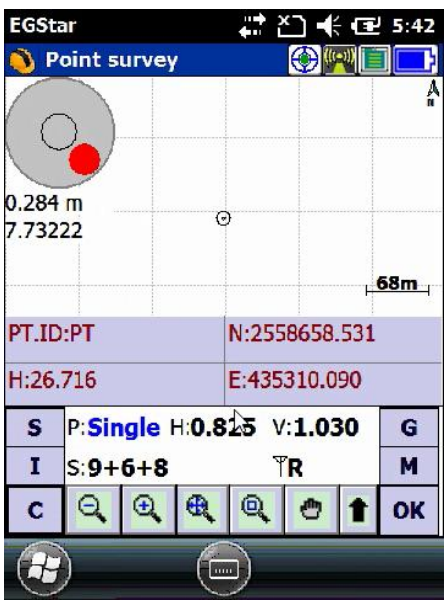
Start electronic bubble

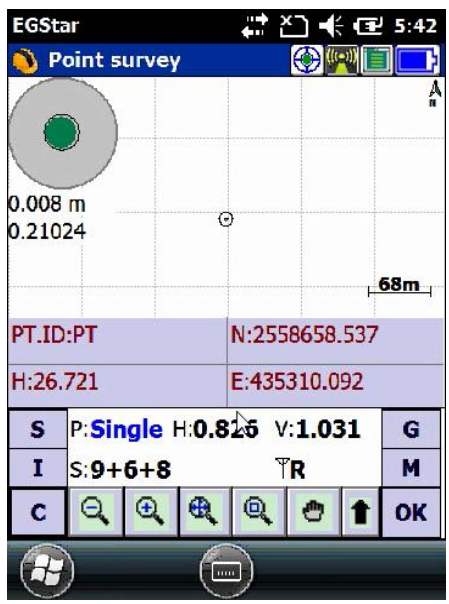
a) In the main interface, click the calibration setting button on the top of the interface, then get into the setting interface.

b) Mark on the checkbox of "Bubble" option in the setting interface, click 'OK' return to Point survey interface, there appears the electronic bubble on the upper left of the screen.







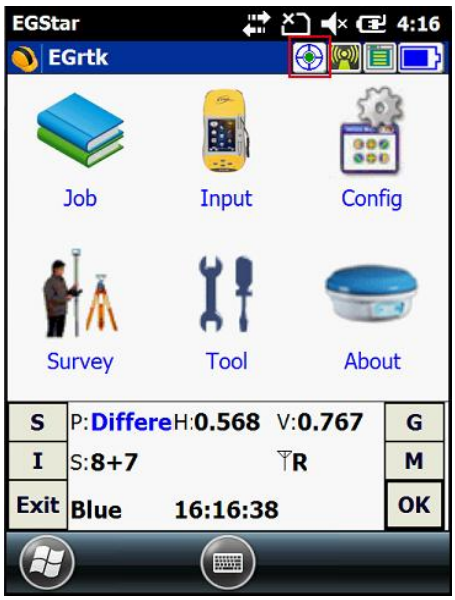


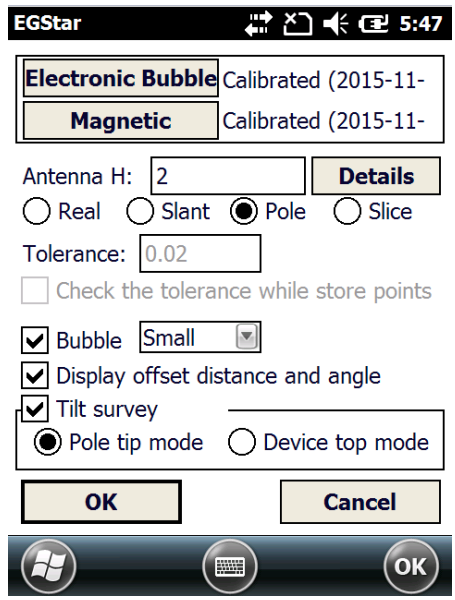
Sensors Calibration

Galaxy G6 supports tilt survey function, but before doing the tilt surveying on Galaxy G6, the sensors calibration shall be done.

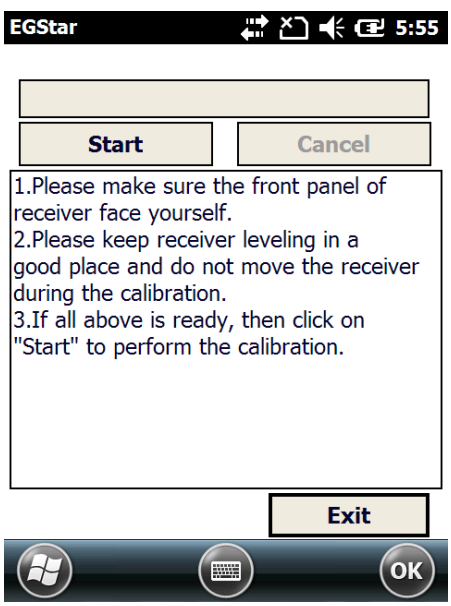
1. Electronic Bubble calibration

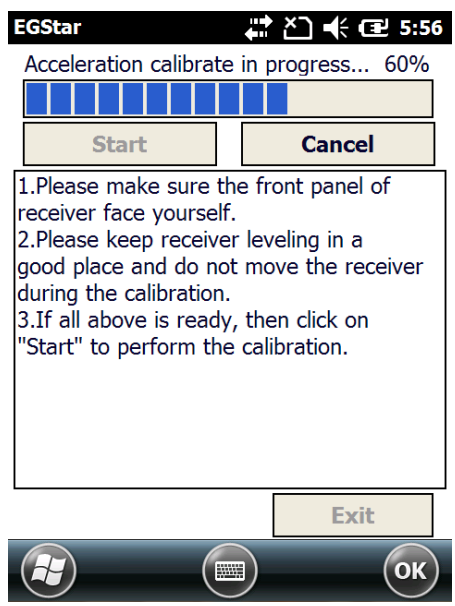
Get into calibration interface by clicking on calibration setting button on the top of the screen. Click “Electronic Bubble” in the calibration setting interface,





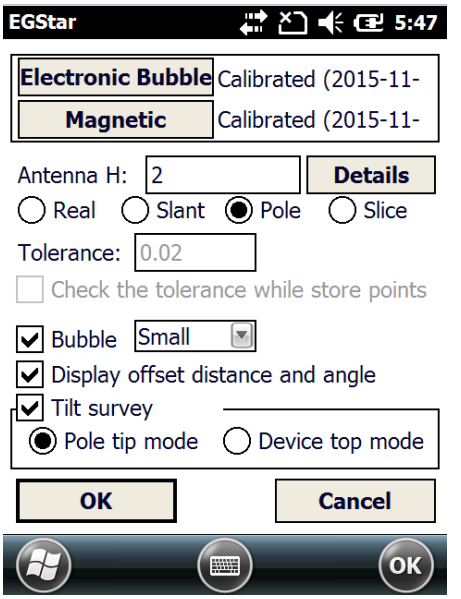
In the acceleration calibration interface, make sure the device is level, hold and click “Start” button to start the calibration, until it’s finished.



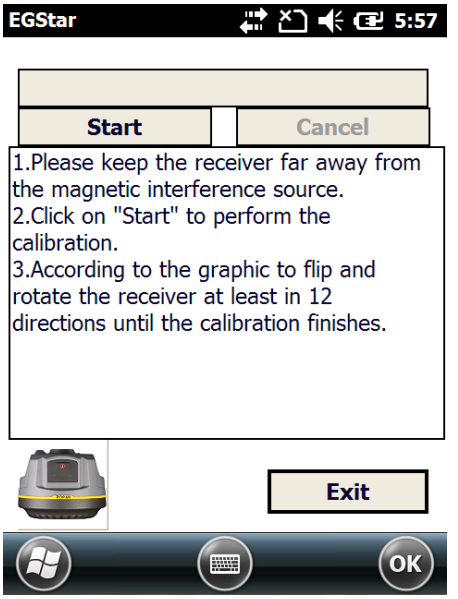


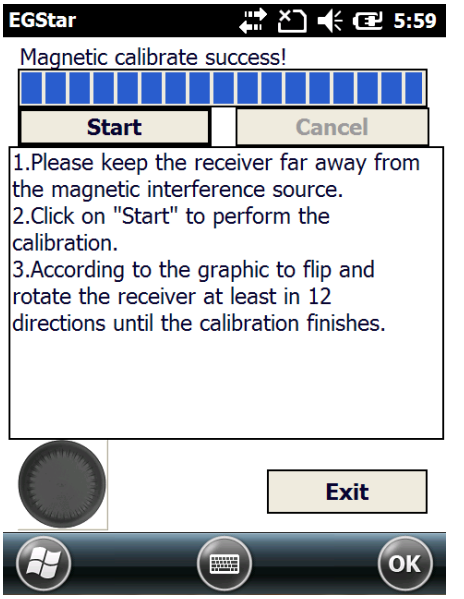
2. Magnetic calibration

In the calibration setting interface, click “Magnetic” to enter the magnetic calibration interface.



In the megnetic calibration interface, click “Start” to start the calibration, then flip and rotate the G6 according to the sketch map on the left bottom of the screen (you can also draw “∞” after G6 is connected to the carbon fiber pole), until the calibration is finished 100%.





Tilt Surveying

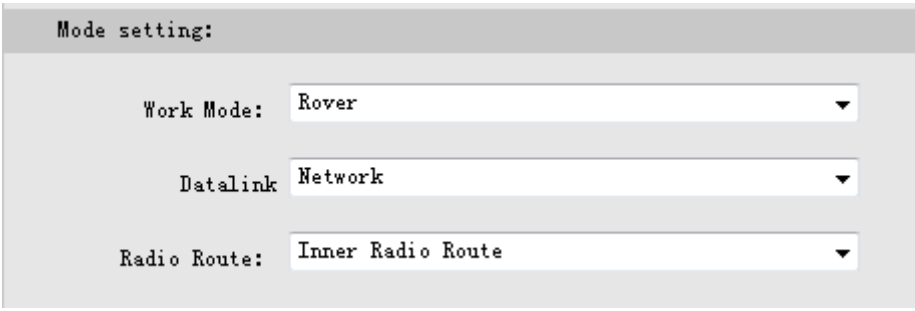
After finishing the calibration for sensors, you can start tilt survey with Galaxy G6 in the tough conditions such as under the eave or around the wall, this function can correct the slant coordinates to the normal coordinates within 30 °angle of inclination.

SPECIAL REMIND: We recommend you to do the measurement in usual way with the pole centering in the open air area, the tilt survey function is not the mainly measuring method for the normal fieldwork.

§7.2.6 Radio Router

This feature is used to transfer the correction which from the reference station for the other rover by radio, the rovers will have the same coordindates from the reference station.
NOTE: This function should be used under Rover+Network mode.

Before configuring on this function, go to “Radio Parameters” interface to check which radio channel value and what kind of protocol are being applied, please keep in mind on this channel value and protocol that are selected to match on rovers later on.
Then choose “Network” for Datalink option and choose “internal radio” for Router option in “General Config” page, click on “Enter” button to confirm the settings.



At this moment, configure the parameters for rover to access to the CORS server for corrections. (Please refer to 7.2.3)
Then the other rovers are able to connect the rover router via internal radio with the same channel value, after rovers have fixed solution, the base coordinates are same as CORS station.

Appendix A Galaxy G6 technical specifications

Signals Tracked Simultaneously	
Channels	220 Channels
BDS	B1, B2, B3
GPS	L1C/A, L1C, L2C, L2E, L5
GLONASS	L1C/A, L1P, L2C/A, L2P, L3
SBAS	L1C/A, L5 (Just for the satellites supporting L5)
GALILEO	GIOVE-A, GIOVE-B, E1, E5A, E5B
	QZSS, WAAS, MSAS, EGNOS, GAGAN, SBAS
GNSS Features	
Positioning output rate	1Hz~50Hz
Initialization time	< 10s
Initialization reliability	>99.99%
Positioning Precision	
Code Differential GNSS Positioning	Horizontal: ±0.25 m + 1 ppm
	Vertical: ±0.50 m + 1 ppm
SBAS positioning accuracy	typically<5m 3DRMS
Static GNSS Surveying	Horizontal: ±2.5 mm + 0.5 ppm
	Vertical: ±5 mm + 0.5 ppm
Real-Time Kinematic Surveying	Horizontal: ±8 mm + 1 ppm
(Baseline<30km)	Vertical: ±15 mm + 1 ppm
Network RTK	Horizontal: ±8 mm + 0.5 ppm
	Vertical: ±15 mm + 0.5 ppm
RTK initialization time	2~8s
Physical	
Dimension	15.2cm(Diameter)×13.7cm(Height)
Weight	1.44kg (battery included)
Material	Magnesium aluminum alloy shell
Environmental	
Operating	-45℃~+60℃
Storage	-55℃~+85℃
Humidity	100% Non-condensing
Waterproof/Dustproof	IP67 standard, protected from long time immersion to depth of 1m
	IP67 standard, fully protected against blowing dust
Shock and Vibration	Withstand 3 meters pole drop onto the cement ground naturally
	Withstand 40G 10 milliseconds sawtooth wave impact test

Electrical	
Power Consumption	2W
Power Supply	9-25V DC, overvoltage protection
Battery	Rechargeable, removable Lithium-ion battery, allow to check remaining electricity quantity
Battery Life	Single battery: 30h (static mode)
	10h (internal UHF base mode)
	15h (rover mode)
Communications and Data Storage	
I/O Port	5PIN LEMO external power port + RS232
	7PIN LEMO RS232+external USB(OTG)+Ethernet
	1 network antenna interface
	1 radio antenna interface
	SIM card slot
Wireless Modem	Integrated internal radio receiver and transmitter, 0.5W/2W/3W optional
	External radio transmitter 5W/25W
Frequency Range	410-470MHz
Communication Protocol	TrimTalk450s, TrimMark3, PCC EOT, SOUTH
Cellular Mobile Network	WCDMA3.5G network communication module, downward compatible with GPRS/EDGE
	customized CDMA2000/EVDO 3G and TDD-LTE/FDD-LTE 4G module
Double Module Bluetooth	BLEBluetooth 4.0 standard, support for android, ios cellphone connection
	Bluetooth 2.1 + EDR standard
NFC Communication	Realizing close range (shorter than 10cm) automatic pair between Galaxy G6 and controller (controller equipped NFC wireless communication module needed)
External Devices	Optional external GPRS/EDGE dual-mode communication module, switchable; allow to connect external WLAN card
WIFI	
Modem	802.11 b/g standard
WIFI hotspot	The WIFI hotspot allows any mobile terminal to connect and access to the internal webserver for the control and moditor receiver
WIFI Client	To work as the datalink that receiver is able to broadcast and receive differential data through WIFI
Data Storage/Transmission	
Storare	8GB SSD internal storage
	Automatical cycle storage (The earliest data files will be removed while the memory is not enough)

	Support external USB storage
	The customizable sample internal is up to 50Hz
Data Transmission	Plug and play mode of USB data transmission
	Support FTP/HTTP data download
Data Format	Differential data format: CMR+, CMRx, RTCM 2.1, RTCM 2.3, RTCM 3.0, RTCM 3.1, RTCM 3.2
	GPS output data format: NMEA 0183, PJK plane coordinates, Binary code, Trimble GSOF
	Network model support: VRS, FKP, MAC, fully support NTRIP protocol
Inertial Sensing System	
Tilt Survey	Built-in tilt compensator, correcting coordinates automatically according to the tilt direction and angle of the centering rod
Electronic Bubble	Controller software display electronic bubble, checking leveling status of the centering rod real time
User Interaction	
Operaing system	Linux
Buttons	Two-button operation, visual operation, convenien t and efficient
Display	0.96 inch HD OLED display, 128×64 resolution
Indicators	Convenient to view and understand mode settings and status
Webserver	Allows to control and moditor the receiver in webserver through WIFI or Bluetooth, freely to configure receiver
Voice guide	Status and operation voice guide, support to customize local language, Chinese/English/Korean/Spanish/Portuguese/Russian/Turkish supported
Open platform	The OpenSIC observation data format and interative interface support secondary development

Appendix B GDL-20 radio technical specifications

General specifications	
Frequency bands	450-470MHz
Channel interval	0.5MHz
Channel transfer rate	19200bps
Channel number	8
Frequency Stability	±2.0ppm
Modulation mode	GMSK

Antenna impedance	50Ω
Ambient temperature	-25 ℃～60 ℃
Humidity	10-90% relative humidity, non-condensing
Receiver Specifications	
Receiver sensitivity	≤0.25μV(12dB SINAD)
Adjacent Channel Selectivity	≥65dB
Modulation signal frequency deviation	≤±5.1KHz
Intermodulation Rejection Ratio	≥65dB
Audio distortion	≤3%
Transmitter indicators	
RF output power	10W/25W Switchable
Adjacent Channel Rejection Ratio	≥65dB
Spurious frequency components	≤4μW
Residual FM	≤-35dB
Remaining AM	≤2%
Carrier frequency modulation mode	TWO PIN
RS-232 interface	
rate	19200bps can be set
Data stream	1 start bit, 8 data bits, no parity (parity bit can be set), 1 stop bit
power	DC power supply
voltage	12-15V, the typical of 13.8V, the voltage of the power supply will affect the size of the RF power of the transmitter
Power consumption	
Receiver standby current	≤100mA
The machine operating current of the transmitter	8A
voltage	13.8V
power	15W/25W

Appendix C 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.

Caution: Any changes or modifications to this device not explicitly approved by manufacturer could void your authority to operate this equipment.

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.