



STONEX S990A
GNSS Receiver
User Manual



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Introduction

This document is the user guide for S990A and it is intended to introduce how to use the receiver correctly.

S990A GNSS receiver is a multiple-frequency receiver and designed for GNSS surveying applications. It is available as a base station, or as a standalone rover, which can be switched freely whenever and wherever, offering maximum versatility in the system configuration to meet your specific requirements. At the same time, S990A receiver can upgrade easily to continually meet your new demand.

The integrated design of the receiver makes the S990A only 1.40 kg, which is light and portable. The internal antenna supports the all satellite system signals like GPS, GLONASS, Galileo, Beidou, QZSS. The users no longer have to worry about upgrading RTK hardware to support other satellite systems.

The internal use of the latest Sensor Fusion system allows the field to take the tilt measurement without calibration, and the field surveying is more convenient.

An important feature inside S990A is **Atlas** reception: Atlas is a differential corrections systems broadcasted on L-Band, allowing increase in position accuracy in area not covered by conventional CORS working under Ntrip Technology (lack of reference stations, lack of GPRS signals, etc). Atlas is broadcasted by satellite systems, so the reception is nearly ensured all over the world. Atlas uses similar technology compared to SBAS, but providing better positioning accuracy.

The new S990A has the new GSM modem. Worldwide LTE, UMTS/HSPA+ and GSM/GPRS/EDGE coverage Multi-constellation GNSS receiver available for applications requiring fast and accurate fixes in any environment. EG25-G is backward-compatible with existing EDGE and GSM/GPRS networks, ensuring that it can be connected even in remote areas devoid of 4G or 3G coverage.

The Stonex S990A has the new TRM 121 Radio module that support radio trasmission on 2 different band frequencies. It can work with 410/470 Mhz frequency and also with 900 Mhz hopping frequencies. The device supports the most used radio protocols such as Trimtalk 450(S), Satel, PCC-EOT and more others.

The S990A is also equipped with a colored display full touch where the user can check the status of the receiver, position, quality of the solution and other important information. The user thought the display touch can also start a base using the radio technology or start a base in communication with an external device like an external radio. Through the display touch it is possible start a static session.

This chapter provides basic information to help you get familiar with your GNSS receiver.

Key Features:

- Rugged housing
- Support full constellation satellites
- 4G LTE and Bluetooth / WLAN datalink support
- UHF datalink with internal 1 W radio module
- Atlas&aRTK support
- Easy configuration from Web UI and remote server
- Display touch menu
- 1PPS output support
- Support New Sensor for Tilt measure
- Intelligent connection
- IP67

1. Receiver appearance

1.1 Front view



The following table contains the description of the receiver front view.

ITEM	DESCRIPTION
1. Satellite indicator	- Off: no satellite tracked - Flashing red: satellites tracked but not positioned - Flashing green: satellites positioned but not fixed - Green: fixed solution - Flashing green and red alternately: GNSS board abnormal

2. Datalink indicator	• Green: datalink setting succeeds • Flashing green: data in normal transmission/reception • Flashing green/blue: in rover mode, data in normal transmission/reception and record raw data active • Blue: working mode static but not recording • Flashing blue: in static mode, flashing blue according to static sampling interval
3. Power indicator	• Green: the power supply in 30%-100% • Flashing green: power in 10%-30% • Flashing red: power<10% with warning beep
4. Bluetooth indicator	• Blue: Bluetooth has connected • Off: No connection
5. PPS indicator	• Green: 1 PPS output enabled but no output • Flashing Green: 1PPS output enabled and data outputs • Off: 1 PPS output disabled
6 Sensor Fusion indicator	• Green: Sensor fusion is enabled and could be output without any problems • Off: Sensor fusion is disabled
7. LCD Display touch	• 1.45 inches touch LCD screen for interface display and operation settings
8. Power button	• Switch ON/OFF the receiver. • Short press to broadcast the current operation mode and status

1.2 Bottom view



The following table contains the description of the receiver bottom view.

ITEM	DESCRIPTION
1. 1PPS	For pulse signal output
2. 5-pin LEMO	Connects external power and the external radio
3. Type-C	- Receiver Power Supply - Data transfer
4. UHF	Connects to the UHF antenna for the internal radio module
5. SIM	Nano SIM card slot

1.3 Top View



1.4 Back-side view



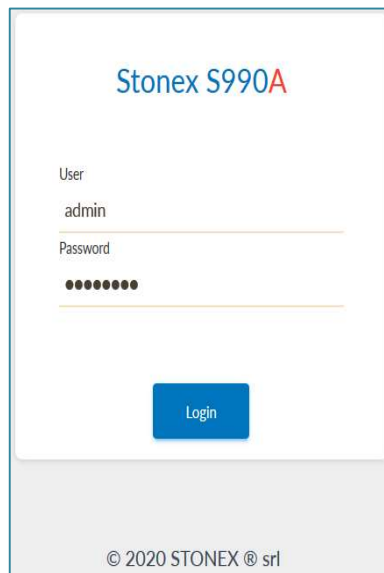
2. Web Interface

The Stonex S990A receiver has Web UI functionality. By getting access to its internal hotspot, you can easily manage it on the Web UI. As long as you have a smart phone, PC or handheld with WIFI functionality, you can easily connect to the S990A receiver to view status, download data and configure the receiver.

The S990A receiver is default to open WIFI automatically when it's powered on. Use smart phone/PC/handheld to search the receiver hotspot, whose name is its serial number, and connect it. Receiver WIFI only supports getting access to Web UI to check status and set up mode, not for Internet connection.

The WIFI hotspot name is the serial number of the receiver.

Enter the IP address: 192.168.10.1. A window will pop up when the user log in, which need to fill in the user, that is "admin", and password that is "password".



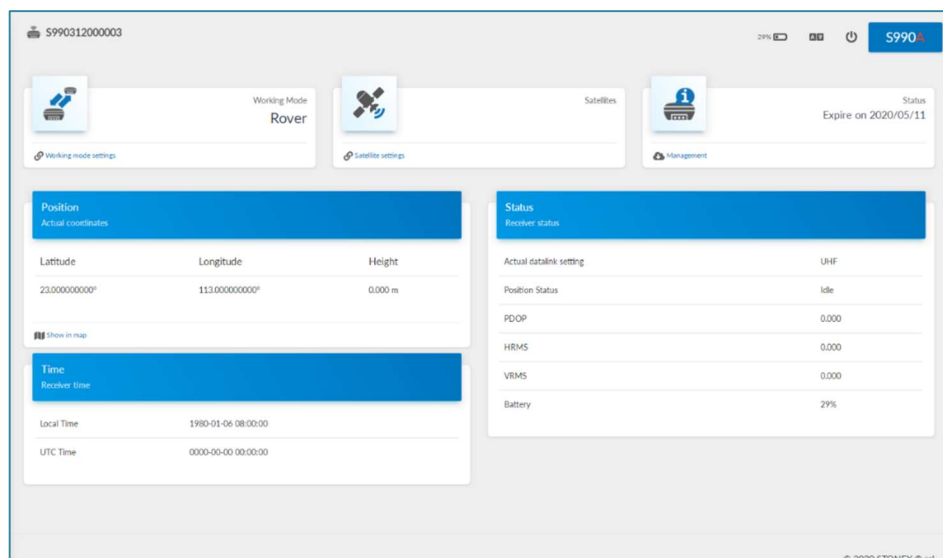
The image shows a web browser window displaying the login page for the Stonex S990A receiver. The page has a white background with a blue border. At the top, the text "Stonex S990A" is displayed in blue and red. Below this, there are two input fields: "User" with the text "admin" entered, and "Password" with a series of black dots. A blue "Login" button is positioned below the password field. At the bottom of the page, the copyright notice "© 2020 STONEX ® srl" is visible.

2.1 Dashboard

In the Dashboard page, you can see the device serial number, power level, language and device name in the top of page.

And you can also see the current working mode, satellites, expire date. Position information, time and status.

Inside the Dashboard is visible the status of the license of the receiver. If it is unlocked there will be PERMANENT, if not it will appear the expire date.



*The position showed in map is available only if the device used to access at the web UI is connected in internet after the access of it.

2.2 Satellites

In this page, you can view satellites Sky plot and satellites table.

Always in this page you can set the cutoff angle (in DEG) up to 45°.

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29%   

S990A

Satellites Used / Satellites Tracked

Total	8 / 13
GPS	5 / 5
BeiDou	2 / 3
GLONASS	1 / 3
GALILEO	0 / 2
SBAS	0 / 1

Settings

Cutoff Angle [0-45°]

5

Save

Satellites Skyplot

Satellites Table

Type	Satellite number	Elev. [Deg]	Azim. [Deg]	L1 / B1 [dBHz]	L2 / B2 [dBHz]	L5 / B3 [dBHz]
GPS	G10	15	288	43	31	37
GPS	G12	52	242	32	26	
GPS	G24	79	326	33	21	37
GPS	G25	18	242	39	20	36
GPS	G32	10	320	38	20	33
BeiDou	C14	12	324	35	35	39
BeiDou	C21	29	244	40	35	
BeiDou	C26	26	282	29	33	36
GLONASS	R7	38	306	0	40	
GLONASS	R8	5	344	0	35	
GLONASS	R9	23	278	33	35	
GALILEO	E1	49	266	29	39	
GALILEO	E4	43	290	0	41	
SBAS	S123	32	150	35	0	

2.3 Static Survey

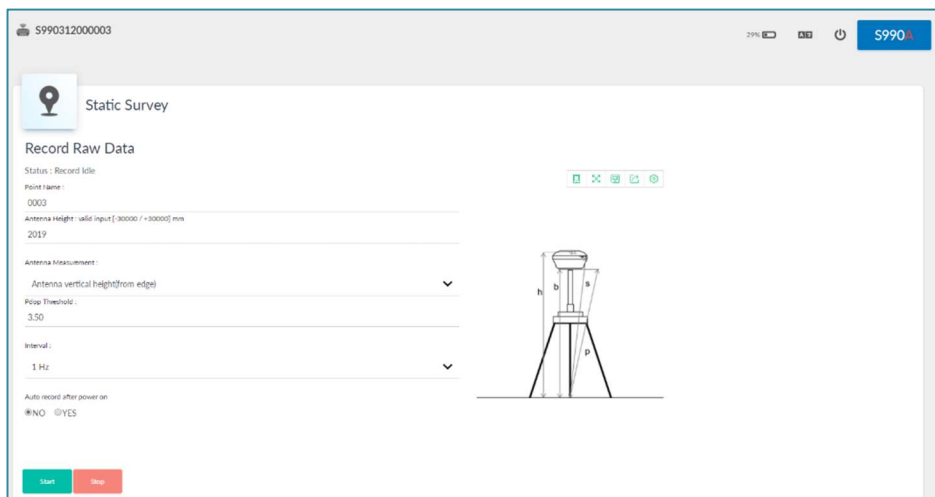
As the pictures shows, in static survey, the user can input the point name, antenna height, PDOP threshold. And the antenna measurement and collect interval. These are all the parameters can be used in static collection.

Antenna height options available are:

- Antenna phase center
- Antenna slant height mode
- Antenna vertical height (from edge)
- Altimeter pieces
- Antenna vertical height (from bottom)

The picture shows with accuracy the type of heights.

At last, there are two record options. If you activate auto record, it will collect data automatic when you power on the receiver.



5990312000003 20% S990A

Static Survey

Record Raw Data

Status : Record Idle

Point Name : 0000

Antenna Height : valid input [30000 / +30000] mm
2019

Antenna Measurements :

Antenna vertical height from edge

PDOP Threshold : 3.50

Interval : 1 Hz

Auto record after power on
YES NO YES

Start Stop

Diagram labels: A, B, P

2.4 Download the Raw Data

In this page, you can download, delete and edit the observation files and ephemeris.

It is possible convert directly the raw data in rinex select Convert.

For every raw data file is showed the start time and the end time, the name, the size of the file and the Antenna heigh set.

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S990A

Download Raw Data

Select	Name	Size (MB)	Antenna Height (m)	Start Time	End Time	Operation
☐	00410921.dat	0.039	0.000	2020-04-01 17:25:13	2020-04-01 17:25:28	Convert Download Delete Edit
☐	00410922.dat	7.6	0.000	2020-04-01 17:29:06	2020-04-01	Convert Download Delete Edit

2.5 Working Mode

You can select different work mode to configure, rover and base. In different mode, there are different configuration you can make.

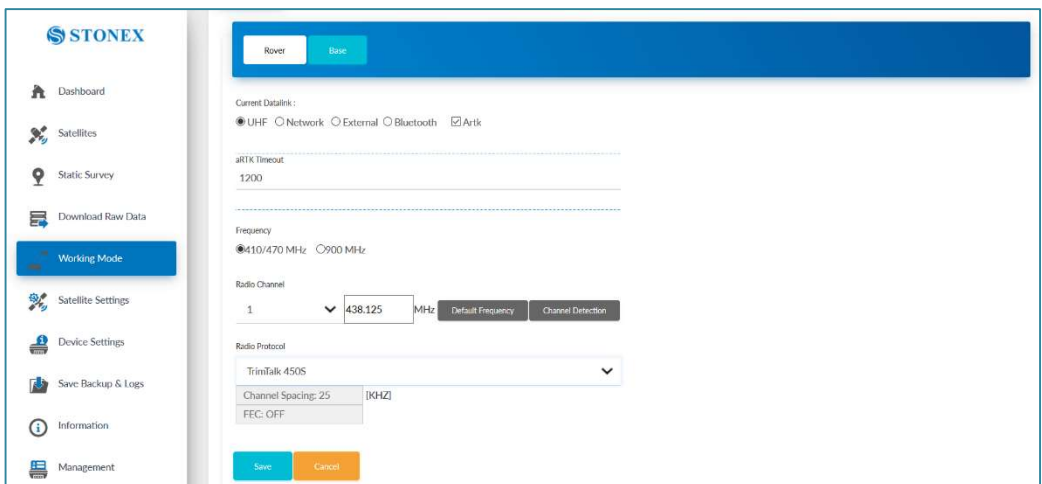
2.5.1 Rover

In rover mode, you can select different datalinks. Different datalink also has different options that can be edited. The datalink includes UHF, Network, External and Bluetooth.

If you select UHF mode, you can select radio channel and radio protocol as you want. You also can select if record the raw data during the session or not.

The frequencies of channel 1 to 8 for 410/470 Mhz interval are editable.

Obviously, the channel frequency inserted must respect the frequency range 410/470Mhz and the frequency range of the UHF antenna used. The interface is as follow:

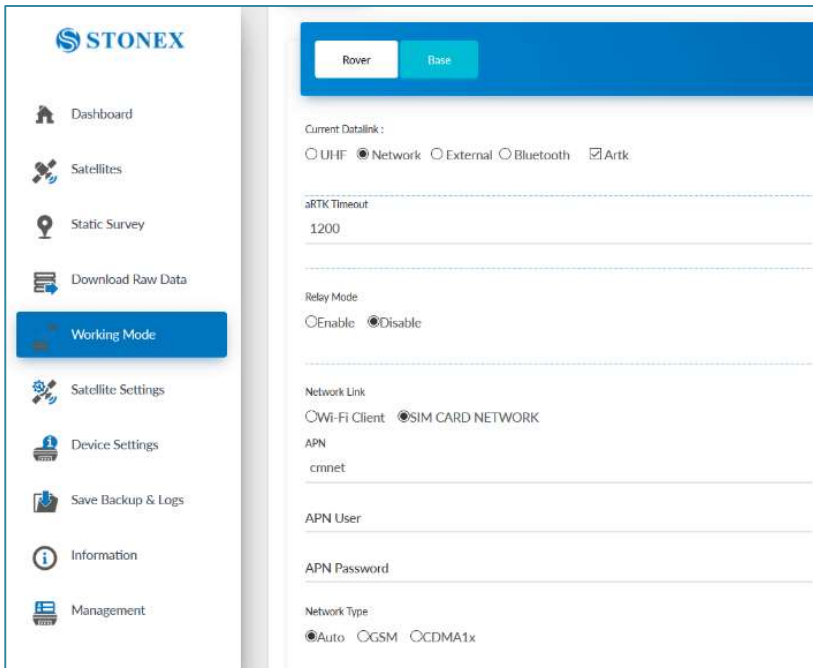


The screenshot shows the STONEX web interface for configuring a Rover. On the left is a sidebar menu with options: Dashboard, Satellites, Static Survey, Download Raw Data, Working Mode (highlighted), Satellite Settings, Device Settings, Save Backup & Logs, Information, and Management. The main content area has a top bar with 'Rover' and 'Base' tabs. Below this, the 'Current Datalink' section has radio buttons for UHF (selected), Network, External, Bluetooth, and Artik. The 'uRTK Timeout' is set to 1200. The 'Frequency' section has radio buttons for 410/470 MHz (selected) and 900 MHz. The 'Radio Channel' section shows a dropdown set to '1' and a text input field containing '438.125' with a unit of 'MHz'. There are buttons for 'Default Frequency' and 'Channel Detection'. The 'Radio Protocol' dropdown is set to 'TrimTalk 450S'. Below that, 'Channel Spacing' is set to '25' and 'FEC' is set to 'OFF'. At the bottom are 'Save' and 'Cancel' buttons.

If you select Network, it appears the specific options of the network configuration. The user can insert and set the parameter of the Caster Service and the respective User and Password if he is setting an NTRIP profile. Through the Web UI is possible to download the list of the mountpoints, the user after the download can choose the mountpoint he prefers and then start the connection with it.

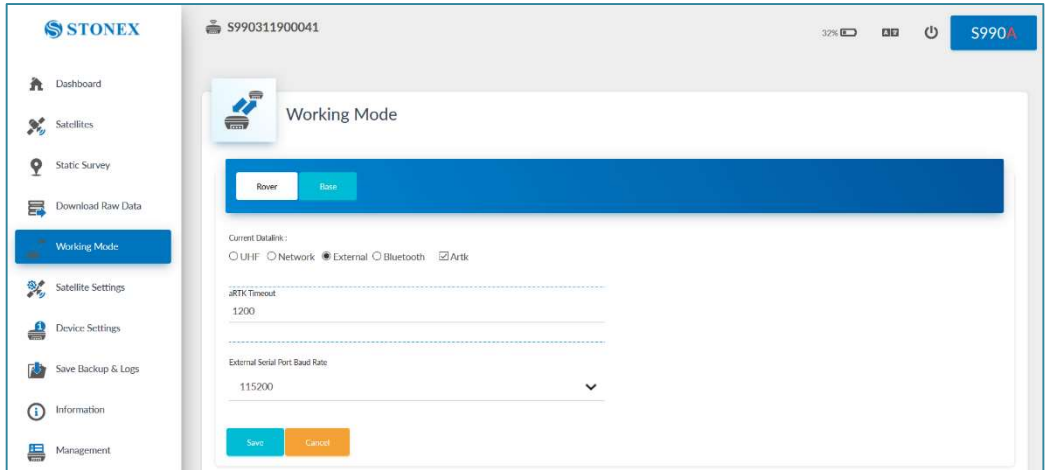
If the user uses a SIM card, it is necessary to insert the APN and eventually the user and password.

If the user wants to use a SIM card inside the receiver, it is suggested to remove the PIN card of it before the application.

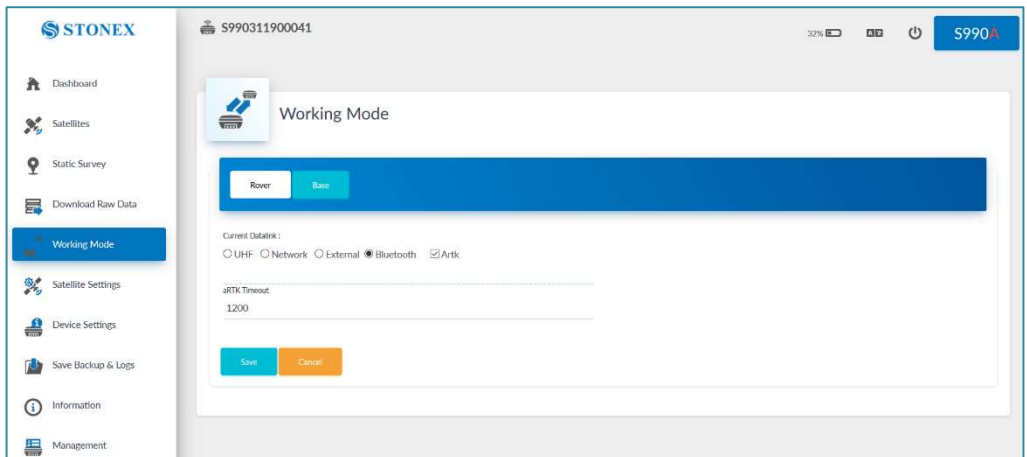


The screenshot displays the STONEX web interface. On the left is a sidebar menu with the following items: Dashboard, Satellites, Static Survey, Download Raw Data, Working Mode (highlighted in blue), Satellite Settings, Device Settings, Save Backup & Logs, Information, and Management. The main content area has a blue header with 'Rover' and 'Base' tabs. Below the header, the 'Current Datalink' section shows radio buttons for UHF, Network (selected), External, Bluetooth, and a checked checkbox for Artk. The 'aRTK Timeout' is set to 1200. The 'Relay Mode' section has radio buttons for Enable and Disable (selected). The 'Network Link' section shows radio buttons for Wi-Fi Client and SIM CARD NETWORK (selected). The 'APN' field contains 'cmnet'. The 'APN User' and 'APN Password' fields are empty. The 'Network Type' section has radio buttons for Auto (selected), GSM, and CDMA1x.

If you select External, then it can connect to external radio. The external serial port baud rate should be same of the external radio.



If the user uses a controller, and establish a Bluetooth connection, it appears Bluetooth.



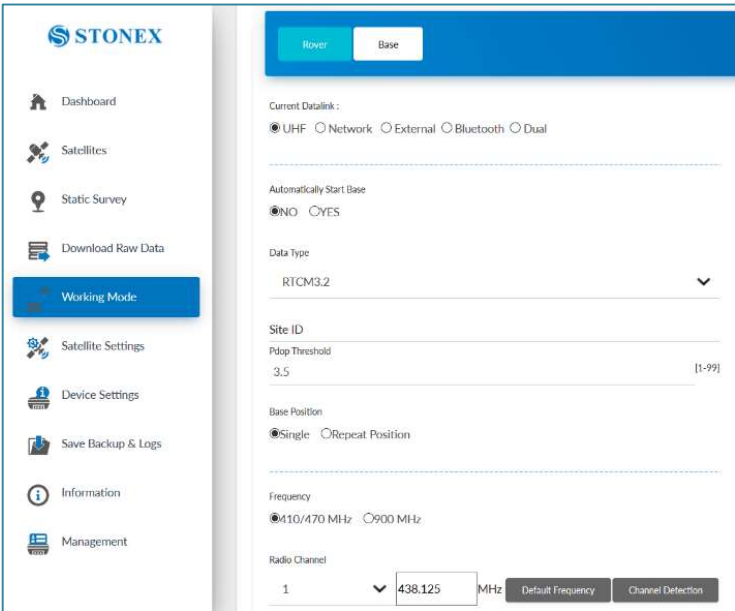
2.5.2 Base

Base mode in plus respect the rover has the specific parameters of the base. For example you can set the base data type, start base and base position and so on.

Important parameters are the position of the base. User can set as Base position Single if the position of the base is unknown or insert directly the coordinates of the base point selecting Repeat Position.

If you select UHF mode, most of the settings are same as rover. But you can set the radio power. To obtain best performance it is necessary set HIGH. The protocols are divided in 2 groups in base of the frequency range: 410/470 Mhz or 900 Mhz.

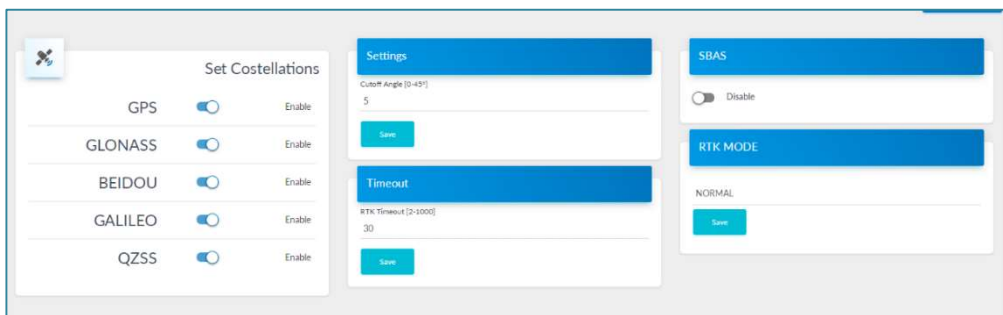
If you select Network, as the rover it's possible set the data type, site ID, base position and record raw data, the most important is you can input APN account, APN user and password, connect mode, caster address and port. In plus there are always the parameter of the coordinate of the base.



2.6 Satellite settings

In this page, you can set information of satellite systems and the cutoff angle.

In satellite settings is possible set the RTK mode between NORMAL or SureFix. Normal mode for normal survey, SureFix to enable the algorit that provide more severe to the position calculation.



The screenshot displays the satellite settings interface of the Stonex S990A GNSS Receiver. It is organized into four main sections:

- Set Constellations:** A list of satellite systems with toggle switches and 'Enable' labels.

Satellite System	Status	Action
GPS	Enabled	Enable
GLONASS	Enabled	Enable
BEIDOU	Enabled	Enable
GALILEO	Enabled	Enable
QZSS	Enabled	Enable
- Settings:** A section for the Cutoff Angle.

Cutoff Angle [0-45°]: 5

Save
- Timeout:** A section for the RTK Timeout.

RTK Timeout [2-1000]: 30

Save
- SBAS:** A section for SBAS settings.

SBAS: Disable
- RTK MODE:** A section for RTK Mode.

RTK MODE: NORMAL

Save

2.7 Device settings

In this page, you can set the time zone, direct link mode, sensor, serial port baud rate, Speaker, Power on/off automatically when connected 5-pin cable, network enable and WIFI hotspot share network, and the NMEA configurations.

The user can set the NMEA output rate message per message in base of the necessities. In example the GGA can set on 1 Hz and the GSA at 5 Hz.

General configuration

Time Zone	GMT+8:00	▼
Direct Link Mode	Disable	▼
Sensor	Disable	▼
5-pin Serial Port Baud Rate	115200	▼

Save

Hardware configuration

Speaker	☒
Power on automatically when connected 5-pin cable	☐
Power off automatically when disconnected 5-pin cable	☐
Network Enable	☐
Wi-Fi Hotspot Share Network	☐

Save

NMEA configuration

GGA:	1HZ	ZDA:	1HZ	GEDOP:	Off
GSA:	1HZ	GSV:	55	GEREF:	55
GST:	1HZ	VTG:	1HZ	GESNR:	55
RMC:	Off	GLL:	Off	GEVCV:	1HZ

Auto output GNSS PPP message ☒

External Port Output NMEA ☒

Save

2.8 Save Backup & Logs

On this page, you can download the backup data, and download the logs.

S990312000003

20%

S990

Backup RTK data

Select	Name	Size (MB)	Operation

Configuration Set

Name	Create Time	Operation
Save Current Settings		
Upload Configuration 选择文件 未选择任何文件 Submit		

Logs

APP log	Clean Download
OS log	Clean Download

2.9 Information

In this page, it displays the receiver specific info such as device model, serial number, firmware version and hardware version. And also displays the antenna info, GNSS board info, Network module info and the UHF module info.

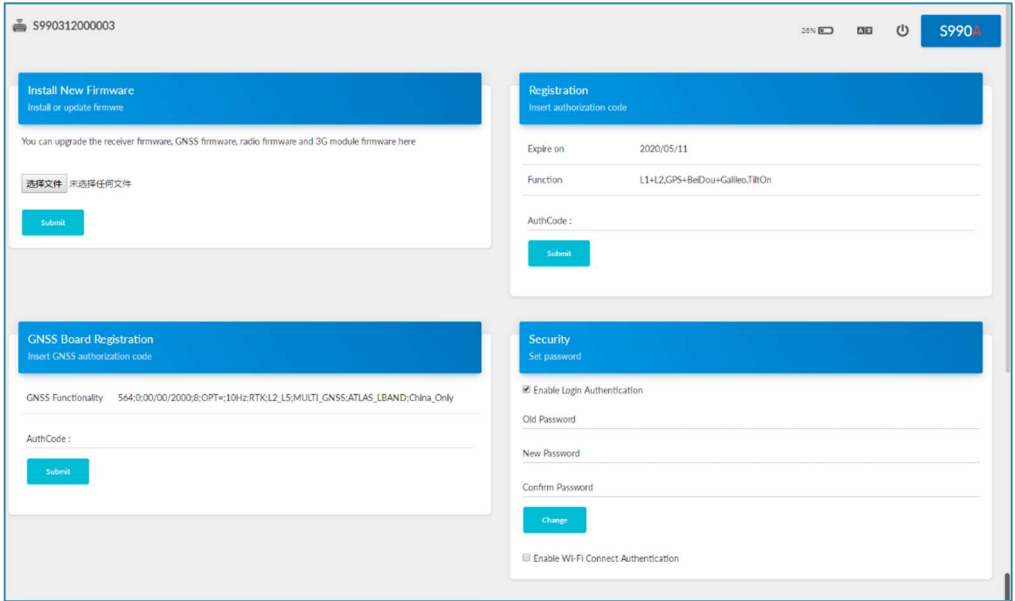
Very important information are the firmware versions. It is necessary check them in case the availability of a new firmware update.

S990312000003

28%

2.10 Management

In this page you can upgrade firmware, register device and GNSS board, set the passwords. And you can also do the self-test, format internal disk and restore to factory settings.



The screenshot displays the management web interface for the Stonex S990A receiver. The interface is divided into four main sections, each with a blue header and a white content area.

- Install New Firmware:** The header says "Install New Firmware" and "Install or update firmware". The text below states, "You can upgrade the receiver firmware, GNSS firmware, radio firmware and 3G module firmware here". There is a file selection button labeled "选择文件" (Select File) with the text "未选择任何文件" (No file selected) next to it. Below this is a "Submit" button.
- Registration:** The header says "Registration" and "Insert authorization code". It contains fields for "Expire on" (2020/05/11), "Function" (L1+L2GPS+BeiDou+Galileo+TiltOn), and "AuthCode:". There is a "Submit" button at the bottom.
- GNSS Board Registration:** The header says "GNSS Board Registration" and "Insert GNSS authorization code". It shows "GNSS Functionality" as "564;0.00/00/2000;8:OPT+;10Hz;RTK;L2_L5;MULTI_GNSS;ATLAS_LBAND;China_Only". There is an "AuthCode:" field and a "Submit" button.
- Security:** The header says "Security" and "Set password". It includes a checkbox for "Enable Login Authentication" (checked), fields for "Old Password", "New Password", and "Confirm Password", and a "Change" button. At the bottom, there is a checkbox for "Enable Wi-Fi Connect Authentication".

The top of the interface shows the device ID "S990312000003", battery status "28%", signal strength, and a power icon. The top right corner displays "S990A".

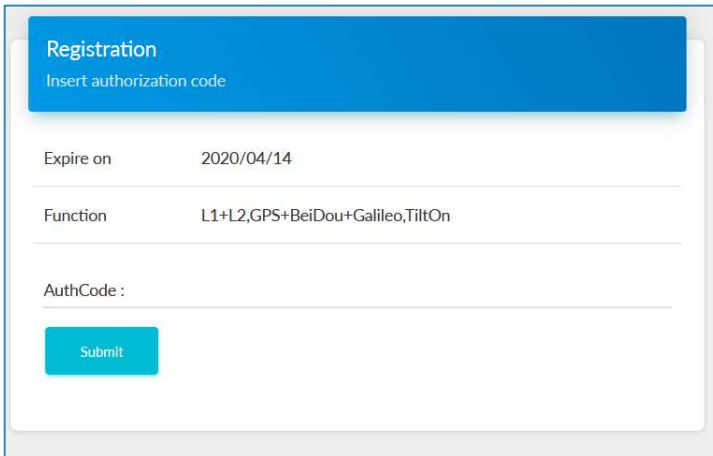
2.10.1 Install new firmware

In the management of the WEB UI page, you can see that "online update", click "browse", select the required to upgrade the firmware, click the "upload document", system will restart to upgrade. After the upgrade, you can view the current "firmware version" on the "instrument information" page.

2.10.2 Device register

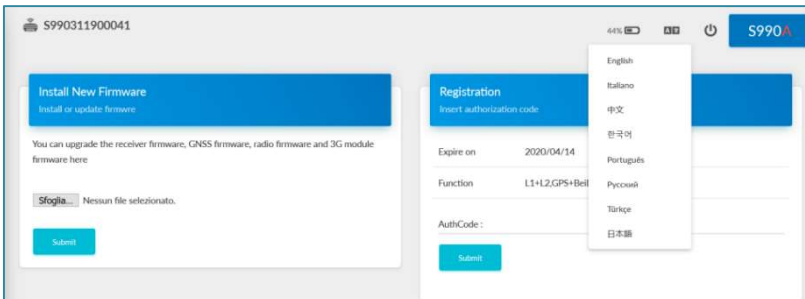
The register code consists of 32 digits and letters. You can register the device via WEB UI. The detailed steps are shown as followed.

In management page, you can see “registration”. Input register code and click submit, and then registration is done. After registration, you can check the expiration time of current registration in the page.



2.11 Set the language

As you can see, there is language button in the right-up side of WebUI. And the S990A has 8 languages to set up. They are Italian, Chinese, English, Korean, Portuguese, Russian, Turkish and Japanese.



3. Basic operation

3.1 Power on receiver

Short-Press the power button, the power indicator will light on and you will hear one beep, then S990A will be powered on.

Wait up to the next 3 beeps to use the device.

After the 3 beeps the initialization can be considered complete.

3.2 Power off receiver

Long press the power button, all indicators interval flashing and the voice prompted "power off". Then short-press the power button to confirm power off.

3.3 Check & Switch of the current working mode

Check

When receiver is powered on, short press the power button and then it will voice broadcast the current working mode and data link.

Model

When the receiver is powered on, connect it with handheld or other controllers so as to set up and switch the working mode of receiver.

3.4 Receiver self-check

Self-check functionality is to check whether every module works normally. When S990A receiver has indicators off or module doesn't work normally, you can use self-check to inspect the receiver. S990A self-check consists of six parts, namely GNSS, radio, network, WIFI, Bluetooth, and sensor. The self-

check results will be voice broadcasted in the process. Self-check operation and result broadcast are as followed:

When receiver is powered on, press power button and hold it until the receiver voice broadcasts "power off". Press it again until the receiver sounds a beep and voice broadcasts "self-check", which means the receiver starts to operate self-check. New receiver is recommended to operate self-check at least once.

In the process of self-check, each module inspection is followed by its inspection result. If the module inspection passes, it will voice broadcast "OK" and module led keeps on until the whole self-check finishes. If the module inspection fails, it will voice broadcast current module inspection fail, keep module led flashing and buzzer sounding until you restart the receiver. Self-check lasts for about 1 minute. If there is self-check failure, please contact local dealer.

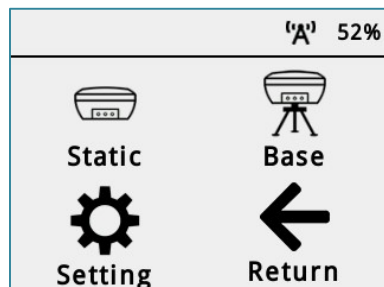
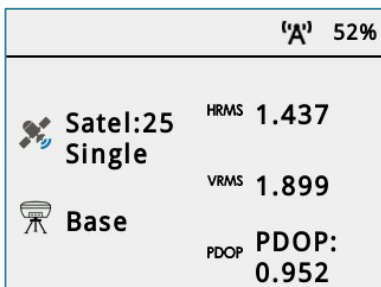
If every module indicator is lit with no flashing, and voice broadcast says every module work normally (such as "GPS self-check. OK."), it means all the modules work normally. Receiver starts to work after the whole self-check finishes

3.4.1 Receiver selfcheck with Display touch

With the new Stonex S990A, through the display the user can do the selfcheck.

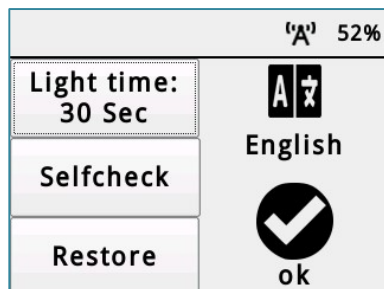
To start a selfcheck follow the steps here below:

From the **Status** windows scroll to the left to open the **Working Mode** menu.



Then select **Setting** option.

Inside the Setting menu click **SelfCheck** to start the feature.



The selfcheck will start automatically.

Wait the end of the selfcheck, after that it will be possible continue to work normally with the device.

3.5 Insert SIM card

If you need to use the SIM card, you should insert the SIM card before you power on the S990A.

Procedure to insert the SIM card:

1. Open the slot on the bottom of the receiver
2. Move the SIM card slot to the left to unlock it
3. Insert the SIM card as showed on the cover slot
4. Close the SIM card slot and move it to the right to block it.
5. Once it is blocked, close the cover slot
6. Turn on the receiver



7. Display Touch Menu

The Stonex S990A is equipped with a Display touch.

Through the touch screen the user can check the status of the receiver, start a static session, start a base via UHF and start a base using an external device (in example the external radio).

7.1 Status of the receiver

As default on the display it appears the status of the receiver.

There, it showed the HRMS, VRMS, PDOP of the current solution.

It showed the status, and the current working mode.

It is also showed the level of the battery.

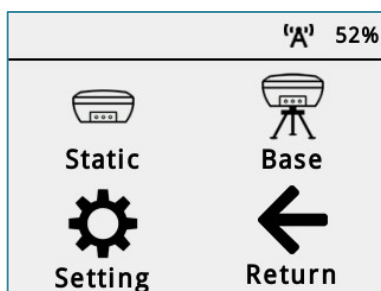
		'A'	52%
	Satel:25 Single	HRMS	1.437
		VRMS	1.899
	Base	PDOP	PDOP: 0.952

*To go back on the previous page inside the menu scroll to the right.

7.2 Working mode

Scrolling to the right, the user will have the working mode menu.

There, the user can choose between Static, Base, Settings or come back on the status window.

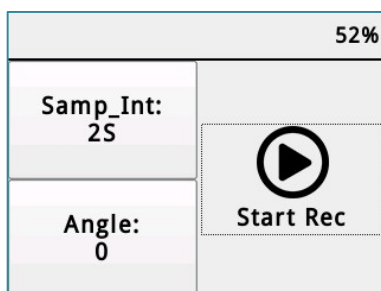


7.3 Static working mode

The user to go inside the static menu has to press Static.

Inside it's possible the Interval sample and the cut off angle.

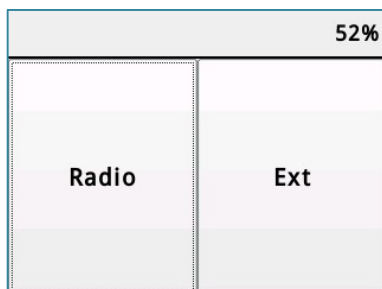
To start/stop the session it's necessary press Start/Stop Rec.



7.4 Base

Inside the working mode menu, if the user wants to set and start a base has to choice Base.

Inside it will have 2 options, Radio and External



7.4.1 Radio Base

Pressing Radio the user can set:

- Base ID
- PDOP Threshold
- Data Type
- Channel number
- Power intensity of the radio module
- Protocol type

When the user has set all the parameters, to start the base it's necessary press Start.

Then to Stop it, it necessary press Stop

52%	
3 441.125Mhz	Power:Low
Protocol: TrimMark III	➔

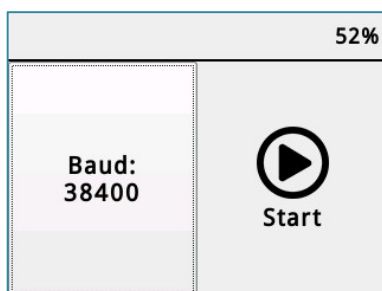
52%	
Base_ID: 1	Data Type: RTCM32
PDOP-Limit: 3.5	▶ Start

7.4.2 External Base

The user has also the possibility to start a base with external device.

To do that, in radio mode menu, it necessary select Ext

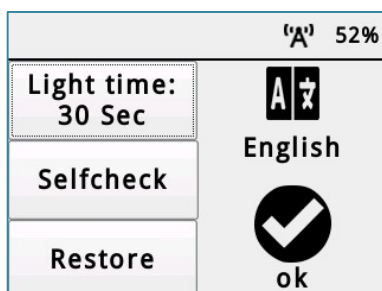
Inside Ext menu the user can choose the Baud Rate to communicate to the external device via 5-Pin LEMO cable.



7.5 Settings

Inside Settings, the user can change the light time of the screen, start a self-check, start a Restore Factory Settings or change the Display touch language.

After every change, to confirm it, it is necessary press OK.



8. New IMU Technology

The New S990A series receivers are equipped with the new IMU¹ System that allows tilted measurement (TILT).

It has the following advantages:

- The initialization process is much simpler.

You can use *Stonex Cube-a* field software to calibrate the sensor; Cube-a will ask to initialize the IMU when needed and it will show how to do it. The process is very fast, usually a few seconds for IMU initialization.

- The receiver with integrated inertial navigation module ensures the real-time interference-free tilt compensation.

It is not affected by any geomagnetic and external metal structures and other environmental influences. It adopts "satellite and inertial navigation" dual inspection.

- Fast and precise survey.

It is possible survey and store points with just one measure with slant pole up to 60° (2 cm accuracy up to 30°, 5 cm accuracy up to 60°).



1.Optional activation

8.1 IMU with Stonex Cube-a

8.1.1 Sensor Activation and Configuration

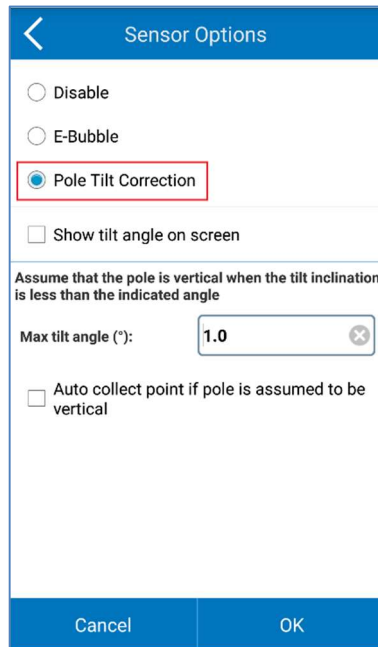
To use the S990A with new IMU technology it's necessary to enable the feature in the specific options menu.

Before using the receiver to collect points with the slanted pole, check if the pole tilt correction functionality has been enabled.

With Stonex Cube-a, follow this path to find the configuration menu:

Configure → System Settings → Sensor Options.

There, enable the **Pole Tilt Correction**.



Sensor Options

☐ Disable

☐ E-Bubble

☒ Pole Tilt Correction

☐ Show tilt angle on screen

Assume that the pole is vertical when the tilt inclination is less than the indicated angle

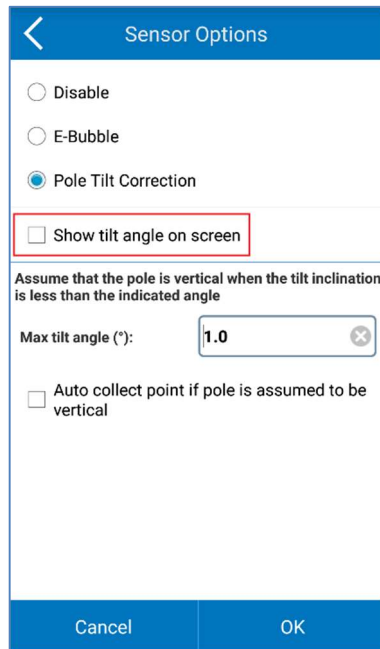
Max tilt angle (°):

☐ Auto collect point if pole is assumed to be vertical

Cancel OK

In the same screen, it is possible to ask the software to show on screen the angle of the tilt angle (in decimal degrees, 0° = true vertical).

To show this information, mark the relative check inside the Sensor Option menu.



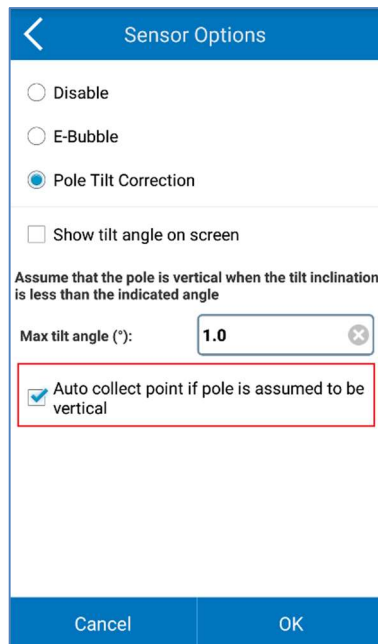
The user can also define the verticality tolerance of the instrument.

That is, the maximum value of the (sensor) tilt angle that the software shall accept when checking for the pole verticality.

The value is in decimal degrees.

Example: 0.3 means $\pm 0.3^\circ$ from true (local) verticality.

Finally, there is also the possibility of automatically starting the measurement of the point when the pole is considered vertical.



< Sensor Options

☐ Disable

☐ E-Bubble

☒ Pole Tilt Correction

☐ Show tilt angle on screen

Assume that the pole is vertical when the tilt inclination is less than the indicated angle

Max tilt angle (°):

☒ Auto collect point if pole is assumed to be vertical

Cancel OK

8.1.2 Initialization

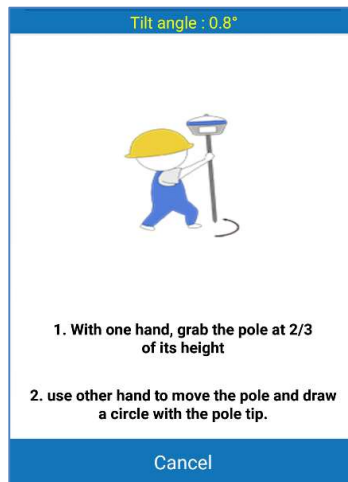
After the activation of the sensor, go in Survey mode.

If the sensor is not ready to work yet, Cube-a will show you which operations are necessary to perform its initialization.

There is a necessary pre-requisite to use the IMU: the status of the GNSS solution must be **Fixed** (Fixed, aRTK Fixed, Surefixed or ExtraSafe Fixed).

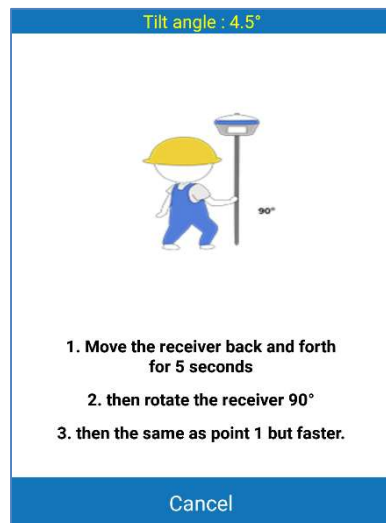
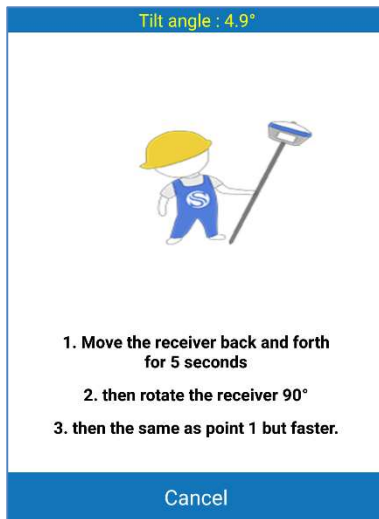
When, and only when, the receiver is in Fixed, and if the sensor needs to be initialized, two different popup screens could show up.

The first screen shows up seldomly: it lets the sensor adjust for the local magnetic field. Just rotate the pole with the device as shown in the picture below.



The second screen lets the sensor adjust the calibration parameters based on the local GNSS position and accuracy.

Move the receiver back and forth for a few seconds in a direction. Then rotate the system about 90 degrees and repeat the movements, in the same direction as before, as shown in the picture below.



If the screen does not disappear, try changing position to get lower RMS values and then repeat the two steps.

It could happen that during the survey, the screens show up: this means that the IMU accuracy has degraded and it's necessary to adjust it: shake the receiver for a few seconds and it will be ready to continue to work.

8.1.3 RMS Study and Sensor Calibration

You can check the accuracy of the tilt compensation through the RMS quality check.

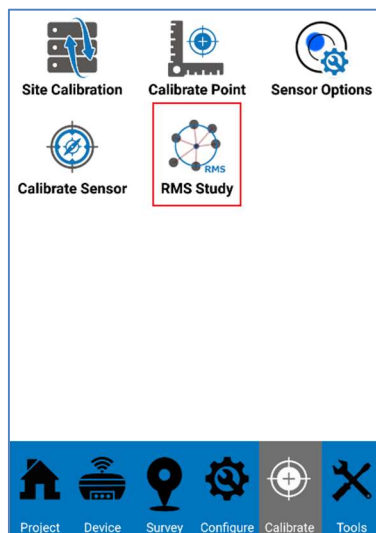
If the accuracy (RMS) is good, then you can continue working. If the accuracy (RMS) is not good, then calibrate the sensor using the Calibrate Sensor tool.

The RMS Study performs the study of the quality/accuracy of repeated measures (keep the pole tip at the same exact position on the ground).

How to use it?

Open the **Calibrate** menu, then select the **RMS Study** command.

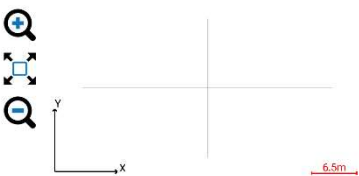
When inside the RMS Study screen, click **Start** to collect the measures.



The application will collect measures/positions at an average frequency of 1Hz. Collected positions will be averaged and RMS values will be computed.

The RMS values let the user to verify if the accuracy of the device falls within some required accuracy upper limit. If the RMS values are not satisfactory then the user can, and he should, proceed with the calibration.

Tilt angle : 0.5°

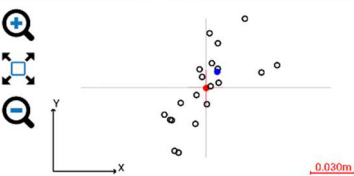


☒ Use the first point as the reference point

Number of points	0
Easting StdDev	-
Northing StdDev	-
Height StdDev	-
Average Easting	-
Average Northing	-

Clear	Delete last	Add
Start	Cancel	Save

Tilt angle : 4.9°



☒ Use the first point as the reference point

Number of points	21
Easting StdDev	0.019
Northing StdDev	0.023
Height StdDev	0.017
Average Easting	514247.961
Average Northing	5045444.463

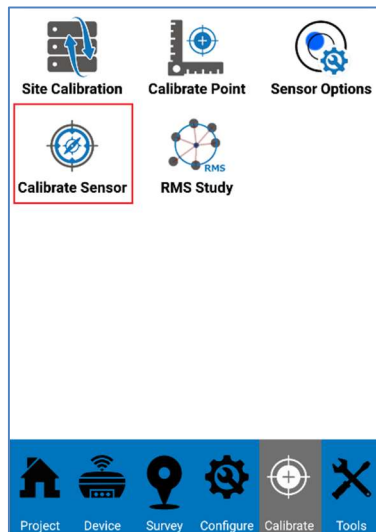
Clear	Delete last	Add
Start	Cancel	Save

The user has the control of the number of sample positions used in the RMS calculation. When the user decides to complete the check, he can press **Stop** to stop the automatic position acquisition.

As said, if the RMS values are not satisfactory then the user can, and he should, proceed with the sensor calibration.

This operation is also suggested when the user changes the pole height and/or the pole type (there could be a change in the straightness of the pole).

To calibrate the sensor, select the **Calibrate** page and then click on the **Calibrate Sensor** command.

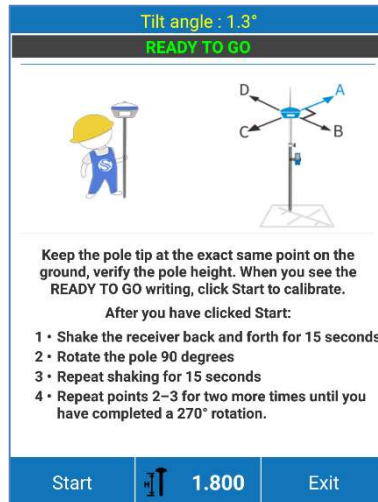


Follow the shown instructions to perform the calibration.

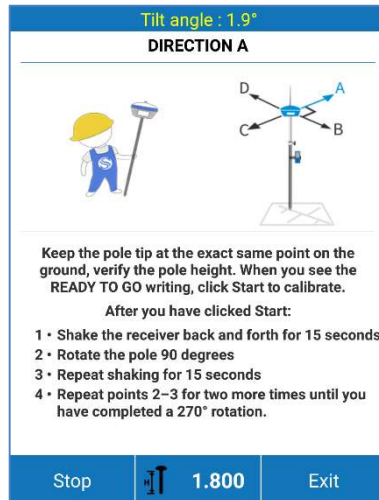
A **Fixed** GNSS solution is mandatory.

Check the antenna height: a wrong antenna height will make the calibration not accurate.

Wait for the message **Ready to Go**, start the calibration by clicking on the **Start** button.



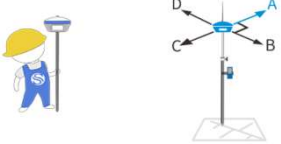
As shown in the picture below, to correctly calibrate the sensor, it's necessary to choose an arbitrary first direction as a reference (direction A), then start to move the receiver back and forth along that direction and until a message asking to change the direction appears.



Rotate the receiver 90 degrees clockwise, reaching the direction $A + 90^\circ = B$, and continue to move back and forth the device.

Tilt angle : 1.5°

ROTATE OF 90° - A → B



Keep the pole tip at the exact same point on the ground, verify the pole height. When you see the **READY TO GO** writing, click Start to calibrate.

After you have clicked Start:

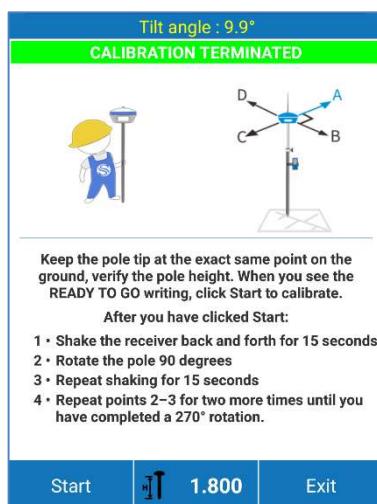
- 1 • Shake the receiver back and forth for 15 seconds
- 2 • Rotate the pole 90 degrees
- 3 • Repeat shaking for 15 seconds
- 4 • Repeat points 2~3 for two more times until you have completed a 270° rotation.

Stop
 **1.800**
Exit

This operation must be repeated for 3 times, thus every 90 degrees up to a total of 270° clockwise.

After moving the device back and forth along the direction D, the message **Calibration Terminated** will appear.

If the calibration fails, an error message will be shown. In this case, repeat the calibration procedure.



9. Accessories

9.1 Carrying case

The external appearance of the transport container is shown in the picture here below.



9.2 Standard accessories

P/N	Description
30-350292	Power adapter with 4 plugs
30-350293	Charging Cable USB type C
30-350300	USB A to USB C
30-350063	Measuring tape 3m (MT-300)
30-350336	Carrying case for S990A (CC-990)
n/a	SW Cube-link
n/a	Pen Drive set 8Gb with Manual & Video Tutorial

10. Technical specification

RECEIVER

Signal Tracked	GPS: L1 C/A, L1C, L1P, L2C, L2P, L5
	GLONASS: L1C/A, L1P, L2C/A, L2P, L3
	BEIDOU: B1, B2, B3, ACEBOC
	GALILEO: E1, E5A, E5B, ALTEBOC, E6
	QZSS: L1 C/A, L1C, L2C, L5, L6
	IRNSS: L5
	SBAS: L1, L5
L-Band	Atlas H10 / H30 / Basic (optional) ⁵
Bridging of RTK outages	aRTK - Works up to 20 minutes
Channels	800
Position Rate	10 Hz (optional 20-50Hz) ⁵
Signal Reacquisition	< 1 s
RTK Signal Initialization	Typically < 10 s
Hot Start	Typically < 15 s
Initialization Reliability	> 99.9 %
Internal Memory	32 GB
Tilt sensor	E-Bubble IMU

POSITIONING¹

HIGH PRECISION STATIC SURVEYING	
Horizontal	2.5 mm + 0.1 ppm RMS
Vertical	3.5 mm + 0.4 ppm RMS
CODE DIFFERENTIAL POSITIONING	
Accuracy	0.40 m RMS
SBAS POSITIONING ²	
Accuracy	0.60 m RMS
REAL TIME KINEMATIC (< 30 Km) – NETWORK RTK ³	
Fixed RTK Horizontal	5 mm + 0.5 ppm RMS
Fixed RTK Vertical	10 mm + 0.5 ppm RMS

INTEGRATED GNSS ANTENNA

High accuracy four constellation micro-strip antenna, zero phase center, with internal multipath suppressive board

INTERNAL RADIO (optional)⁵

Model	TRM 121 1 W
Type	Tx - Rx
Frequency range	410 – 470 MHz 902.4 – 928 MHz
Channel Spacing	12.5 KHz / 25 KHz
Range	3 – 4 Km in urban environment Up to 10 Km with optimal conditions ⁴

INTERNAL MODEM

GSM integrated	EG25-G
Band	LTE FDD: B1/B2/B3/B4/B5/B7/B8/B12/ B13/B18/B19/B20/B25/B26/B28 LTE TDD: B38/B39/B40/B41 UMTS: B1/B2/B4/B5/B6/B8/B19 GSM: B2/B3/B5/B8 Nano SIM card

COMMUNICATION

I/O Connectors	5 pins Lemo, connect the external power supply and external radio Type-C, for receiver power supply and data transfer 1PPS port
Bluetooth	2.1 + EDR, V4.1
Wi-Fi	802.11 b/g/n
Web UI	To upgrade the software, manage the status and settings, data download, etc. via Smartphone, tablet or other electronic device with WI-FI capability
Reference outputs	RTCM 3.0, 3.2 CMR, CMR+, DGPS
Navigation outputs	NMEA 0183

POWER SUPPLY

Battery	Internal Rechargeable 7.2 V – 10.200 mAh
Voltage	9 to 28 V DC external power input with over-voltage protection (5 pins Lemo)
Working Time	Up to 10 hours
Charge Time	Typically 4 hours

PHYSICAL SPECIFICATION

Dimensions	φ 151 mm x 94.5 mm
Weight	1.40 Kg
Operating Temperature	-40°C to 65°C (-40°F to 149°F)
Storage Temperature	-40°C to 80°C (-40°F to 176°F)
Waterproof/Dustproof	IP67
MIL- STD	MIL-STD-810H
Shock Resistance	Designed to endure to a 2 m pole drop on concrete floor with no damage
Vibration	Vibration resistant

Specifications are subject to change without notice

1. Accuracy and reliability are generally subject to satellite geometry DOPs), multipath, atmospheric conditions and obstructions. In static mode they are subject even to occupation times, the longer is the baseline, the longer must be the occupation time.
2. Depends on SBAS system performance.
3. Network RTK precision depends on the network performances and are referenced to the closest physical base station.
4. Varies with the operating environment and with electromagnetic pollution.
5. Optional, it can be activated via activation code.

Appendix 1: Default Radio configuration

The internal radio TRM121 can transmit on the 410-470MHz and 902.4-928 MHz band; users can choose radio channel and radio protocol through the handheld software or WEB interface. The default frequencies of each channel is in the following table.

Channel	Frequency
1	438.125 MHz
2	440.125 MHz
3	441.125 MHz
4	442.125 MHz
5	443.125 MHz
6	444.125 MHz
7	446.125 MHz
8	447.125 MHz

Main features and general performance of the internal radio are summarized below.

General performance	
Frequency range	Fixed frequency: 410-470 MHz
	Hopping frequency: 410-470 MHz and 902.4-928 MHz
Band width	Fixed frequency: 12.5 KHz, 25 KHz
	Hopping frequency: 280 KHz
Modulation scheme	Hopping frequency: GMSK
	Fixed Frequency: GMSK, 4FSK
Transmitter	
RF output power	High power (1.0 W)
Modem	
Rate	Fixed frequency: 9600bp, 19200bps
	Hopping frequency: 115200bps
Modulation	GMSK

Appendix 2: Copyrights, warranty and environmental recycling

Copyrights and trademarks

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STONEX®, the STONEX® logo, and S990A GNSS receiver are trademarks of STONEX® Limited.

STONEX® *Cube-a* and *Stonex® Cube Link* are trademarks of STONEX® Limited.

Bluetooth is a trademark owned by Bluetooth SIG, Inc. and licensed to Trimble Navigation Limited. All other trademarks are the property of their respective owners.

Release Notice

This is the April 2020 release of the STONEX® S990A GNSS new model receiver user guide.

The following limited warranties give you specific legal rights. You may have others, which vary from state/jurisdiction to state/jurisdiction.

Standard Limited Warranty

Version 2020

The terms and conditions of this Limited Warranty constitute the complete and exclusive warranty agreement between The Customer or Dealer and STONEX® for the Product and supersedes any prior agreement or representation made in any STONEX® sales document or advice that may be provided to Customer by any STONEX® representative in connection with Customer's purchase of the Product. No change to the conditions of this Limited Warranty is valid unless it is made in written form and signed by an authorized STONEX® supervisor.

STONEX® warrants that its Products:

(1) are free from defects in materials or workmanship for generally 1 years (accessories or specific parts for which different limited warranty period shall apply).

(2) have been tested/calibrated in proper working status prior to shipment.

The warranty period starts from date of first sale of the instruments. At its sole discretion, under the warranty period, STONEX® will repair the product or send parts for replacement at its expense. STONEX® agrees to repair or replace the defected instrument within thirty (30) days only if STONEX® Europe recognizes that the defects of the instrument are not caused by human factors or no obvious damage to its surface is visible. STONEX® warrants any new replaced parts or products are warranted to be free from defects in materials and workmanship for thirty (30) days or for the remainder of the Limited Warranty Period of the Product in which they are installed, whichever is longer. Faulty Parts or Products replaced under this Limited Warranty shall become property of STONEX®. All products that have to be repaired have to be returned to our technical representative office location via any delivery company the customer prefers, nevertheless STONEX® is not accountable for the unlikely event that the Products gets lost in transit. Any damage inflicted by the customer or by third party after the products has been delivered to the customer is excluded from the limited warranty as well any damage arising from an improper use, from any action or use not provided for in the enclosed user guides and/or manuals.

Shipping policy

The Customer or the dealer is required to pay for the charges for shipping of fault parts or instruments to STONEX® representative office and STONEX® is providing the shipping for return. Dealers need to follow STONEX® repair/service procedure to achieve a better and prompt service result.

Return policy Dead On Arrival instruments

All returned products have to be shipped to STONEX® representative office.

The original Purchaser has a period of seven (7) days starting from date of purchasing to signal the existence of a defect in the instrument for a full refund

(less shipping and handling), provided the merchandise is in new, resalable condition and returned in the original, undamaged packaging. Customer has to pay for both the return and the original freight fees, regardless of the original freight paid by the Company. All warranty books, instruction manuals, parts and accessories must be included as well as the original box in which the item was shipped. We recommend placing the original carton inside another box, to avoid any additional damage to the carton itself. In some cases, returns of special items will require a re-stock fee. Acceptance of returned merchandise is final only after inspection by STONEX®.

Above terms and policies shall apply as for hardware. Dealers need to follow STONEX® repair/service procedure to achieve a better and prompt service result.

Firmware/Software warranty

Stonex doesn't warrant that operation of Firmware/Software on any instruments will be uninterrupted or error-free, or that functions contained in Firmware/Software will operate to meet your requirements.

Stonex will forward the Software/Firmware Fix to the dealer or customer. Firmware/software Fix means an error correction or other update created to fix a previous firmware version that substantially doesn't conform to the instruments specification.

Over Warranty repair(s) policy

Customer shall pay the standard repair fees for any service (whether part replacement or repairs) and performed by STONEX® under request and explicit authorization of the customer itself. In this case the customer is charged for return shipment's fees as well.

Disclaimer and Limitation of Remedy

All other express and implied warranties for this product, including the implied warranties of merchantability and fitness for a particular purpose and/or non-infringement of any third party's rights, are hereby disclaimed. Stonex® expressly disclaims all warranties not stated in this limited warranty. Any implied warranties that may be imposed by law are limited in duration to the

term of this limited warranty. Some jurisdictions do not allow the exclusion of implied warranties or limitations on how long an implied warranty lasts, so the above exclusions or limitations may not apply to customer. Customer must read and follow all set-up and usage instructions in the applicable user guides and/or manuals enclosed. If customer fails to do so, this product may not function properly and may be damaged. Customer may lose data or sustain personal injuries. Stonex®, its affiliates and suppliers do not warrant that operation of this product will be uninterrupted or error free; as do all electronics at times. If this product fails to work as warranted above, customer's sole and exclusive remedy shall be repair or replacement. In no event will Stonex®, its affiliates or suppliers be liable to customer or any third party for any damage in excess of the purchase price of the product. This limitation applies to damages of any kind whatsoever including (1) damage to, or loss or corruption of, customer's records, programs, data or removable storage media, or (2) any direct or indirect damages, lost profits, lost savings or other special, incidental, exemplary or consequential damages, whether for breach of warranty, contract, tort or otherwise, or whether arising out of the use of or inability to use the product and/or the enclosed user guides and/or manuals, even if Stonex, or an authorized Stonex® representative, authorized service provider or reseller has been advised of the possibility of such damages or of any claim by any other party. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages for some products, so the exclusions or limitations may not apply to customer. This limited warranty gives customer specific legal rights, and customer may also have other rights which vary from country/state/jurisdiction to country/state.

Instruments

STONEX® Products:

- Stonex S990A GNSS receiver: 2 years

Accessories

Accessories and specific parts warranty

For accessories provided by Stonex with the instruments S990A GNSS the following general warranty time is for reference:

- Accessories: 1 year.

Environmental recycling

The cardboard box, the plastic in the package and the various parts of this product have to be recycled and disposed of in accordance with the current legislation of your Country.

For countries in the European Union (EU)

The disposal of electric and electronic device as solid urban waste is strictly prohibited: they must be collected separately.

Contact Local Authorities to obtain practical information about correct handling of the waste, location and times of waste collection centre. When you buy a new device of ours, you can give back to our dealer a used similar device.

The dumping of these devices at unequipped or unauthorized places may have hazardous effects on health and environment.

The crossed-out dustbin symbol means that the device must be disposed of in authorized collection centers and must be managed separately from solid urban waste.



For countries outside European Union (EU)

The treatment, recycling, collection and disposal of electric and electronic devices may vary in accordance with the laws in force in the Country in question.

Appendix 3: Safety Recommendations

Warnings and Cautions

An absence of specific alerts does not mean that there are no safety risks involved in the use of this equipment.

Always follow the instructions that accompany a Warning or Caution, reported in this.

This information is intended to minimize the risk of personal injury and/or damage to propriety. In particular, observe safety instructions that are presented in the following form:

WARNING - A Warning alerts about risk for health and/or damage to the propriety. A warning identifies the nature of the risk and the extent the possible injury and/or damage. It also describes how to protect yourself and/or the equipment from this risk.

CAUTION - A Caution alerts about a possible risk of damage to the equipment and/or loss of data, but no risk for human safety.

Wireless Module Approval

The receivers use internal wireless modules or can be connected to an external data communications UHF radio. Regulations regarding the use of the radio-modems vary greatly from country to country. In some countries, the unit can be used without obtaining an approval license. Other countries require specific approval or auto certification by the set maker.

Before using this instrument, check if authorization to operate the receiver is required in your country. It is the responsibility of the importer to verify if it is necessary a certification or license for the equipment in the country of use.

Instrument Approval

Covers technical features of the equipment relatives to electromagnetic emissions that can cause interference and disturbances to other instruments (note like EMC compatibility) or generate not correct functionalities of the instrument itself. Approval is granted by the manufacturer of the equipment. Some countries have unique technical requirements for operation in particular frequency bands. To comply with those requirements, Stonex srl may modified the equipment to be subjected to grant.

Unauthorized modification of the units voids already got approvals, the warranty time and the operational licenses of the instrument.

UHF 410-470 MHz / 902.4-928 MHz Data transceiver

General Antenna Installation Warning

1. All antenna installation and servicing are to be performed by qualified technical personnel only. When servicing the antenna, or working at distances closer than those listed below, ensure the transmitter has been disabled.
2. Typically, the antenna connected to the transmitter is a directional (high gain) antenna, fixed-mounted on the side or top of a building, or on a tower. Depending upon the application and the gain of the antenna, the total composite power could exceed 90 watts ERP. The antenna location should be such that only qualified technical personnel can access it, and that under normal operating conditions no other person can touch the antenna or approach within 0.6 meters of the antenna.

You can see below a table showing the Antenna Gain versus Recommended Safety Distance:

Antenna Gain	0-5 dBi	5-10 dBi	10-16.5 dBi
Minimum RF safety distance	0.6 meters	1.06 meters	2.3 meters

For USA

The FCC has adopted a safety standard for human exposure to radio frequency electromagnetic energy. Proper use of this radio modem results in exposure below government limits. The following precautions are recommended:

DO NOT operate the transmitter when someone is located less than 20 cm (7.8 inches) of the antenna.

DO NOT collocate (place within 20 cm) the radio antenna with any other transmitting instruments.

DO NOT operate the transmitter unless all RF connectors are secure, and any open connectors are properly terminated.

DO NOT operate the equipment near electrical blasting caps or in an explosive atmosphere.

All equipment must be properly used according to the installation instructions for safe operation.

All equipment should be repaired and calibrated only by a qualified technician

For Europe

The European Community provides some Directives for the electronic equipments introduced on the market.

All the relevant information's are available on the European Community website:

<https://ec.europa.eu/growth/sectors/electrical-engineering/>

From this link you can download the Directive 2014/53 / UE RED relating to telecommunication equipment, the LVD Low voltage directive and the EMC directive for electromagnetic compatibility.

Bluetooth/WiFi radio Module

The radiated output power of the internal Bluetooth module of this equipment is far below the FCC and EU radio frequency exposure limits. In any case, be sure to use the equipment with the radio far at least 20 cm from the human body. The Bluetooth module match the guidelines found in radio frequency "safety standards and recommendations "published by Scientific organizations.

Stonex srl therefore believes the internal wireless radio is safe for use by end users. The level of energy emitted is far less than the electromagnetic energy emitted by wireless devices such as UMTS phones. However, the use of Bluetooth/WiFi may be restricted in some special situations or place, like aircraft , hospital ,etc. If you are unsure of existence of restrictions, you should ask for authorization before switching on the Bluetooth radio.

Raccomandation for installing antennas for internal radios

An absence of specific alerts does not mean that there are no safety risks involved in the use of this equipment.

Always follow the instructions that accompany a Warning or Caution, reported in this. This information are intended to minimize the risk of personal injury and/or damage to propriety. In particular, observe safety instructions that are presented in the following form:

CAUTION

For your own safety, and to match the RF Exposure requirements of the FCC, always observe these precautions:

Always maintain a minimum separation distance of 20 cm (7.8 inches) between yourself and the radiating antenna.

Do not collocate (place within 20cm) the radio antenna with any other transmitting device.

Do not switch on the GSM or UHF module without the antenna mounted to the external connector.

UHF Antennas having a gain greater than 5 dBi, are strictly prohibited for use with this device. The required antenna impedance must be 50 ohms.

Rechargeable Lithium-ion batteries

These receivers use a rechargeable Lithium-ion battery.

WARNING

- Avoid direct contact with the rechargeable Lithium-ion battery if it appears damaged. Battery liquids are corrosive and, contact with it can result in personal injury or damage to properties.

To prevent injury or damage:

- If the battery leaks, avoid contact with the battery fluid.
- If battery fluid gets into your eyes, immediately rinse your eyes with clean water and seek medical attention. Do not rub your eyes!
- If battery fluid gets onto your skin or clothing, immediately use clean water to wash off the battery fluid.

WARNING

- Do not create damage at the rechargeable Lithium-ion battery.

A damaged battery can cause an explosion, with risk of fire, and can result in personal injury and/or property damage.

To prevent injury or damage:

- Do not use or charge the battery if it appears to be damaged. Signs of damage are discoloration, warping, leaks of liquids.
- Do not expose the battery to fire, high temperature, or direct strong sunlight.
- Do not introduce the battery in water or liquid substance, in general.
- Do not use or store the battery in very hot ambient.
- Do not drop or puncture the battery.
- Do not open the battery and do not put in short-circuit its electrical contacts.



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