SinoGNSS®
By ComNav Technology Ltd.

Venus Laser RTK

User Guide

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Trademark notice

FCC Notice

SinoGNSS Venus comply with the limits for a Class B digital device, pursuant to the Part 15 of the FCC rules when it is used in the Portable Mode.
Operation is subject to the following two conditions:
(1) This device may not cause harmful interference;
(2) It must accept any interference received, including interference that may cause undesired operation.

Copyright Notice

Technical Assistance

If you have any question and can't find the answer in this manual, please contact your local dealer from which you purchased the Venus. Alternatively, request technical support from ComNav Technology Website: www.comnavtech.com or technical support email: support@comnavtech.com. Your feedback about this Guide will help us to improve it with future revisions.

Safety Information

Before using the receiver, please make sure that you have read and understood this User Guide, as well as the safety requirements.

- Connect your devices strictly based on this User Guide
- Install the GNSS receiver in a location that minimizes vibration and moisture
- Avoid falling to ground, or colliding with other items

- Keep a sound ventilation environment
- Change the cable if damaged

Related Regulations

The receiver contains integral Bluetooth® wireless technology. Regulations regarding the use of the datalink vary greatly from country to country. In some countries, the unit can be used without obtaining an end-user license. But in some countries the administrative permissions are required. For license information, please consult your local dealer.

Use and Care

The receiver can withstand the rough treatment that typically occurs in the field. However, the receiver is high-precision electronic equipment and should be treated with reasonable care.

Warning and Caution

An absence of specific alerts does not mean that there are no safety risks involved. A Warning or Caution information is intended to minimize the risk of personal injury and/or damage to the equipment.

WARNING- A Warning alerts you to a potential risk of serious injury to your person and/or damage to the equipment, because of improper operations or wrong settings of the equipment.
CAUTION- A Caution alerts you to a possible risk of damage to the equipment and/or data loss.

Warranty Notice

ComNav Technology does not warranty devices damage because of force majeure (lighting, high voltage or collision).
ComNav Technology does not warranty the disassembled devices.

Contents

1 Introduction

The SinoGNSS Venus User Guide is aimed to help you get familiar with the Venus and start your project effectively. We highly recommend you to read this manual before surveying, even you have used other GNSS receivers before.

1.1 About the receiver

With SinoGNSS® Quantum™ algorithm, Venus can be applied in RTK mode with all GNSS constellations. Venus has ultra-small size and strong anti-interference ability to make it possible to work even in harsh environments. It is the ideal RTK/GNSS product for surveyors.

1.2 Receiver features

The SinoGNSS® Venus key features:

- Utra small and super light
  - Size: 80±1mm(L), 70±1mm(W), 150±1mm(H)
  - Weight: 380g
- 1590 channels of simultaneously tracked satellite signals
- Increased measurement traceability with SinoGNSS® Quantum™ algorithm technology
- able-free Bluetooth wireless technology
- 3 indicator LEDs for battery power, diff, satellite, and 1 function button for power
- IP67 waterproof
- Integrated IMU sensor
- Integrated Laser sensor
- Support SBAS PPP service
- Support NFC Fast Connection
- Support long baseline E-RTK™ (Beidou B3 signal is included in RTK calculate engine)

1.3 Venus parts list

This section provides overall Venus parts list, including basic supplies and customized kits based on your requirements.

1.3.1 Basic Supply kit

SinoGNSS® Venus Basic Supply kit contains one receivers and related accessories.

Item	Picture
1* Kits Venus	
1*Charger adapter (EU/USA/UK)	
1*USB—Type-C cable	
1*2m-Range Pole with yellow bag	
R60 Controller	
Controller Battery, Charger and Cable	
Controller Bracket	

2 Setting up the receiver

This chapter provides general information on environmental requirements, setup, power supply and connection of the Venus.

2.1 Environmental requirements

To keep the receiver with a reliable performance, it is better to use the receiver in safe environmental conditions:

- Operating temperature: -20°C to +60°C
- Storage temperature: -30°C to +70°C
- Out of corrosive fluids and gases
- With a clear view of sky

2.2 Laser Specification

To keep the laser with a reliable performance, It is better to use Venus in the conditions that meet the laser specifications:

- Range: 15m
- Accuracy(room temperature): (3-5)mm + 1ppm
- Measuring Frequency: Classic Value: 3Hz
- Maximum Value: 5Hz
- Laser Injection Power: 0.9mW to 1.5mW
- Working Temperature: -20°C to +50°C
- Storage Temperature: -30°C to +60°C

2.3 Front panel

Receiver front panel contains 3 indicator LEDs, Power button. The indicator LEDs show the status of differential, satellite tracking and battery power. For detailed information, see *chapter 3.3*.

2.4 Lower housing

Receiver lower housing contains a M8 Thread and Millimeter-level Laser.

2.5 Power supply

Venus supports internal batteries and external power input.

2.5.1 Internal batteries

The receiver is equipped with Lithium-ion batteries, which cannot be disassembled at will. The Venus adopts the internal battery design that provides you an effective survey workflow. The internal batteries typically provide about 20-hour operating time as a rover. However, this operating time varies based on environmental conditions.

● Battery Safety Charge and use the battery only in strict accordance with the instructions below: – Do not use or charge the battery if it appears to be damaged. Signs of damage include, but are not limited to, discoloration, warping, and leaking battery fluid. – Do not expose the battery to fire, high temperature, or direct sunlight. – Do not immerse the battery in water. – Do not use or store the battery inside a vehicle during hot weather. – Do not drop or puncture the battery. – Do not open the battery or short-circuit its contacts.
● Charging the Lithium-ion Battery Please charge the internal battery via type-c cable
● Storage of the Lithium-ion Battery – Keep batteries in dry conditions.
● Dispose of the Lithium-ion Battery – Discharge a Lithium-ion battery before dispose of it. – Dispose of batteries is an environmentally sensitive manner, and adhere to any local and national regulations concerning battery disposing or recycling.

WARNING – Do not damage the rechargeable Lithium-ion battery. A damaged battery can cause an explosion or fire, and can result in personal injury and/or property damage.

2.5.2 External Power Supply

The receiver is connected to an external power supply through a Type-C cable, and make sure that use an external power supply with the correct voltage of Venus, such as a 5-9V power pack. Over-voltage function cannot protect your Venus if reverse connection.

2.5.3 Charge Battery via Venus

The battery of the receiver cannot be disassembled at will. However, the Type-c interface makes its charging mode more flexible. Venus supports adaptive charger for fast charging protocol. The standard voltage is 9V. The portable mobile power supply can charge and power it anytime and anywhere.

1. Power off Venus receiver and enter charging mode;
2. Connect Venus receiver to Adaptive charger with type-c cable;
3. The LED light on the front panel of the receiver will flash according to the battery percentage, and the green light will be on when it is fully charged.

2.6 Pole-mounted setup

To mount the receiver on a range pole as the figure shown below:

- Thread the receiver onto the range pole
- Mount the controller bracket to the pole
- Install the controller into the bracket

Tip: Do not tightly clamp the controller on the Range Pole.

3 General Operation

This chapter introduces all controls for the general operation, including button functions and all LED behaviors on the front panel.

3.1 Button functions

There is a power button on the front panel.
Press the power button for about 1 second to turn on the receiver;
To turn off the receiver, long press the button for 3-4 seconds until all LEDs off.

3.2 LED behavior

The LEDs on the front panel indicate receiver working status. Generally, a lit or slowly flashing indicates normal operation, and an unlit LED indicates that no operation is occurring. The following table define each possible LED state:

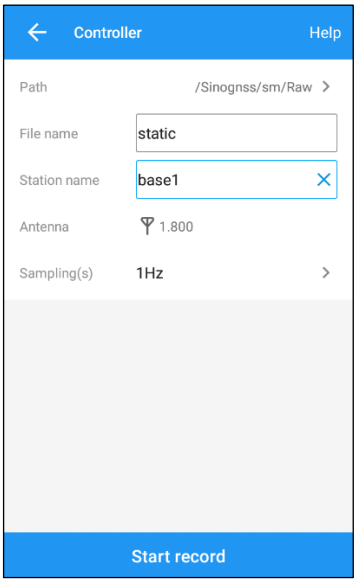
LEDs Description	States	
Power	Green	Battery is above 30%
	Yellow	Battery is below 30%
Differential Data	Flashes once per second	Receiving/transmitting differential data
Satellite Tracking	Fast flashing/ Flashes 1 time every 5 seconds	No satellite received
	Flashes N times every 5 seconds	Received N satellite signals
	Flashes according to the selected sample interval	1) Sample interval varies from 20Hz to 60s. 2) Flashing 1/s simultaneously with differential light if internal memory is run off

Power LED:
When battery is below 30%, power LED light is yellow; when battery is above 30%, power LED light is green.

4 Static survey

Static survey is commonly applied for control points, which requires millimeter accuracy. After connecting with Bluetooth, you can record static data to your controller directly.

For record static data in controller, you can configure it and change sampling interval via Survey Master. Its sample frequency supports 0.1s, 0.2s, 0.5s, 1s, 2s, 5s, 10s, 15s, 30s, 60s.



- You can enter File name, Station name, Antenna height, Sampling -> Click ***Start record***, the recorded raw data will be saved in the corresponding path.
- The raw data is in .cnb format, you can transfer to RINXE format through CRU software.

5 Real-Time Kinematic Survey (RTK)

This chapter introduces how to conduct RTK Survey with Survey Master Software, including software installation, start a new project, receiver connection and RTK working modes (CORS).

5.1 Installation of Survey Master

Survey Master is available on Google play, you can download for free and install the software to SinoGNSS controller R60.

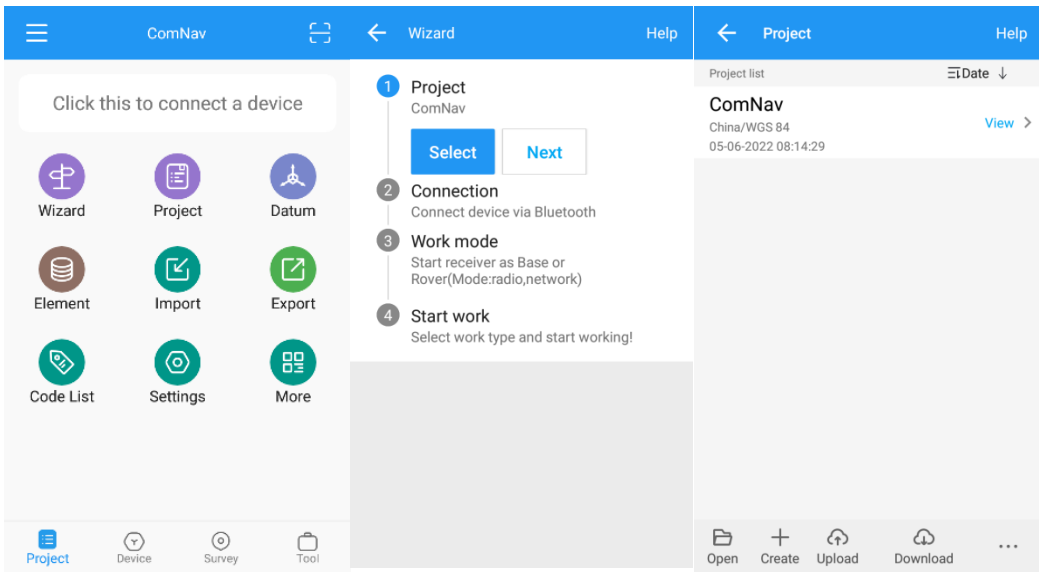
Also you can download the latest version from our website:
Software Download ComNav Technology Ltd.

5.2 Wizard function in Survey Master

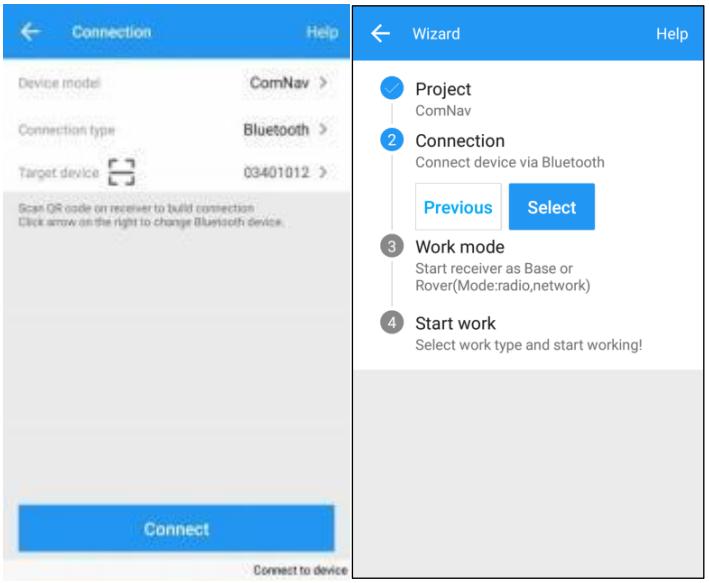
Follow the Wizard, you can quickly learn the general workflow of Survey Master, also you can quick start your survey by this function no matter you are experienced one or new user.

In Project menu, tap Wizard.

1. ***Project***: Click ***Select*** to go into Project interface to create or select a project. For detailed information, you can refer to chapter 5.3.

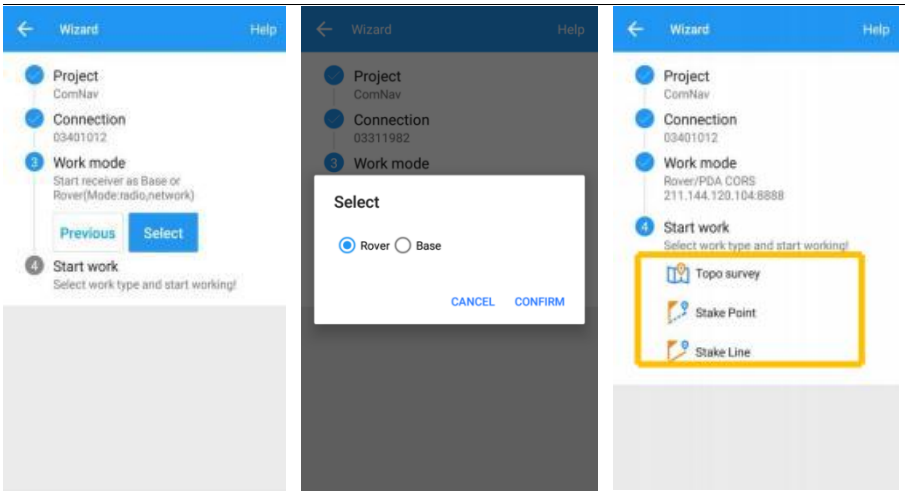


2. ***Connection***: Click ***Select*** to go into Bluetooth connection interface. For detailed information, you can refer to chapter 5.4.



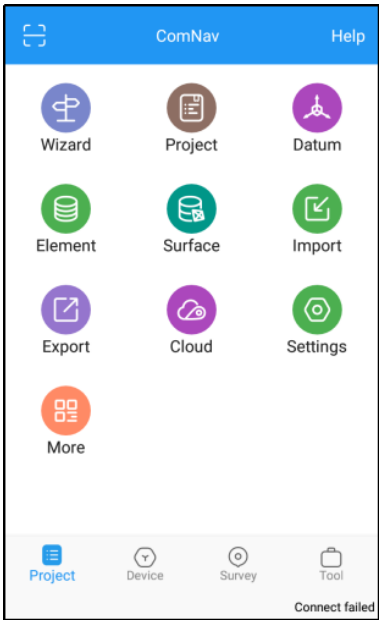
3. ***Work mode***: Click ***Select*** to go into Quick Setup interface to start your receiver as Rover. For detailed information, you can refer from chapter 5.5.

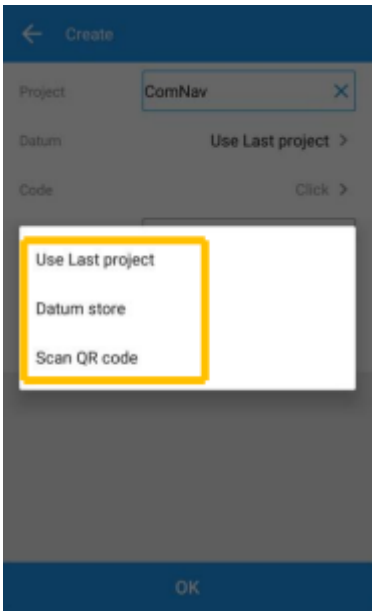
You start your receiver as Rover, then you can start work directly of topo survey or stakeout



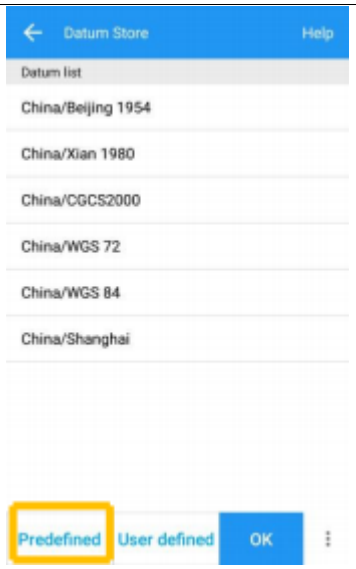
5.3 Start a New Project

Click ***Project***, you can use the same Datum with last project, choose a datum in store and scan QR code from other controller to add Datum, even sharing project with cloud.

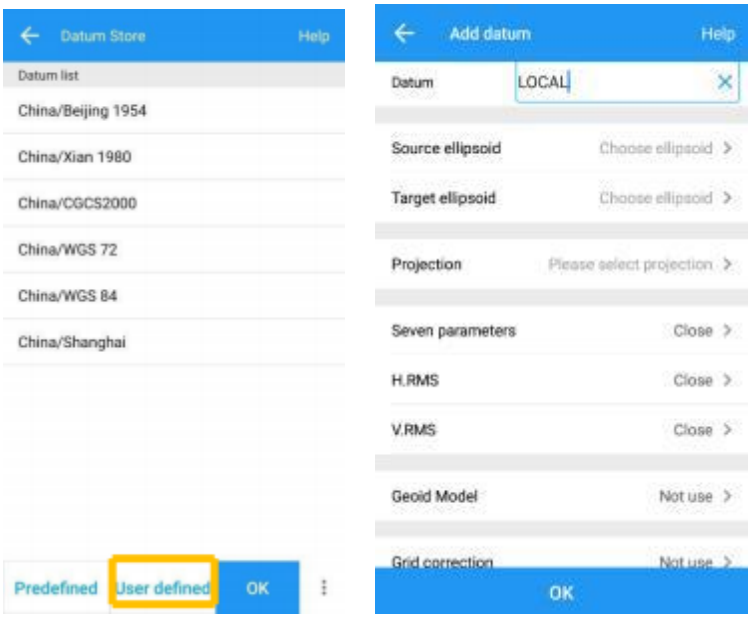




- Select a Predefined datum: You can select datum directly from the list. Survey Master currently has 49 countries datum and will add more afterwards.



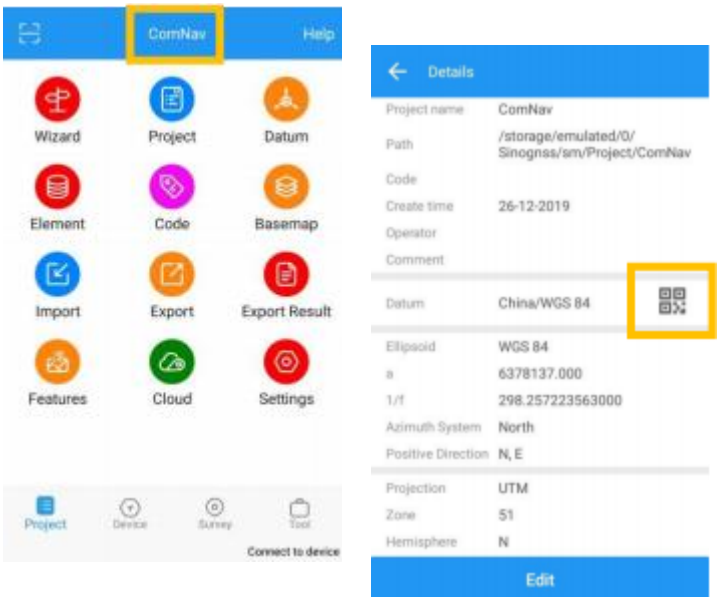
- Create a User defined datum: If you cannot find datum you want in the list, follow instructions below to add one: select Ellipsoid, Projection for your datum, and even seven parameters, geoid model based on your request.



Tip1: if asked username and password for seven parameters, enter admin admin

Tip2: For H.RMS and V.RMS, it will show if do ***Site Calibration****.*

- Share Datum via QR code.
- After you build a project, press the project name, it will generate a QR code. Users can use the Scan function in the main interface to access the coordinate system.

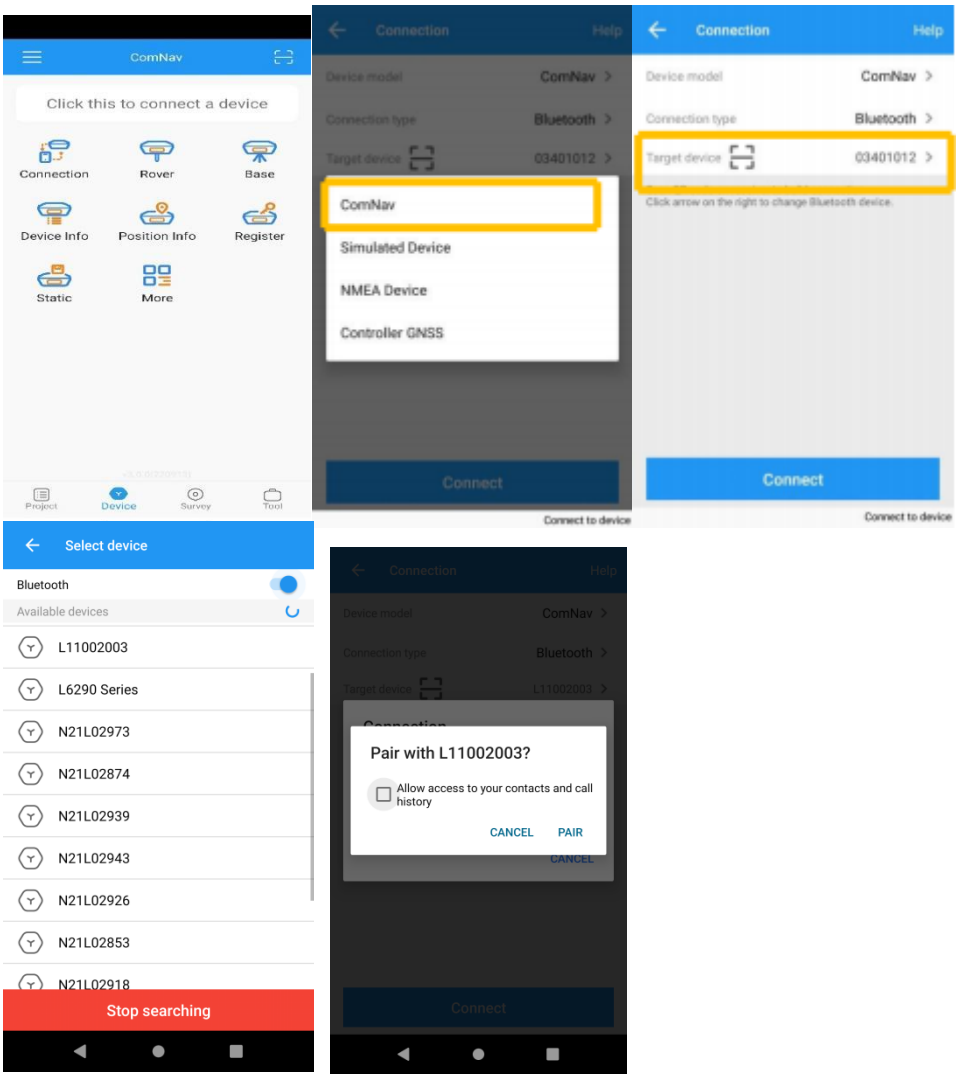


5.4 Bluetooth connection

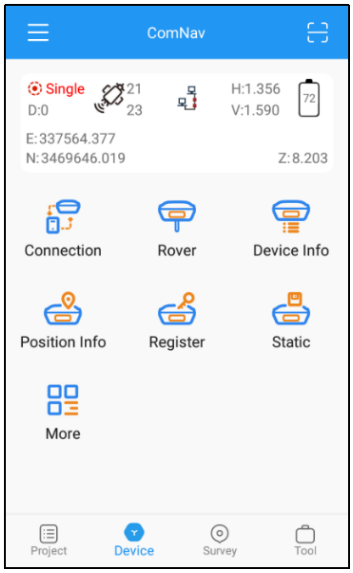
To connect Survey Master with Venus, switch to ***Device*** interface, tap ***Connection*** to go into Bluetooth connection interface.

- Make sure device Bluetooth turned on;
- Click ***Find device***—select SN of your Venus —allow pair

After connect ComNav receiver, you can check the device version in ***Device Info***.



After connected successfully, the top will show the positioning status.



Tip: If you are failed to connect with receiver through Survey Master, you can just follow prompt info to go into the device Bluetooth setting interface to make sure Bluetooth paired successfully. Sometimes you need restart the receiver or Survey Master Software.

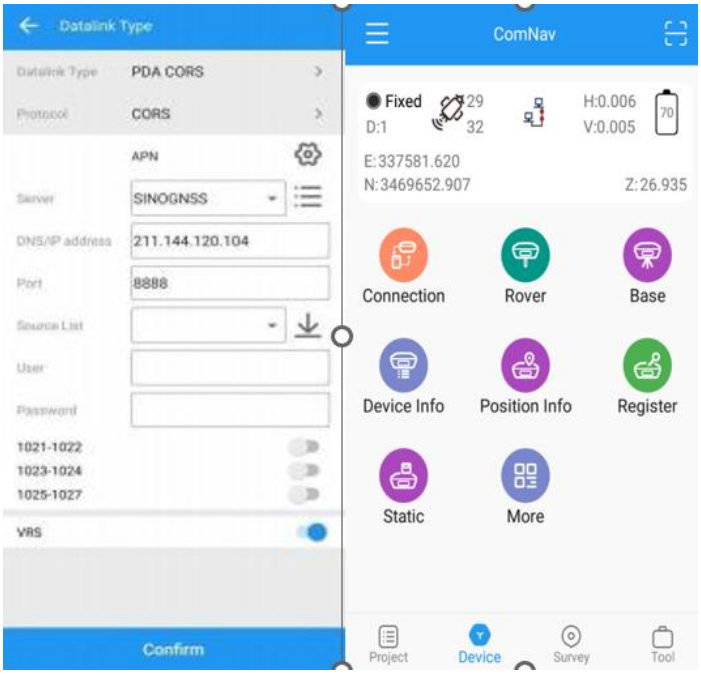
5.6 PDA CORS Mode

Without setting up your own base stations, the Venus can receive correction data transmitted from continuously operating reference station via PDA's GPRS. To do RTK survey in PDA CORS mode, it requires:

1. A Venus
2. A controller with SIM card and software

Configure the Rover as below:

- Make sure your controller can access to internet via SIM card or Wi-Fi, then run Survey Master Software.
- Build Bluetooth connection as shown in chapter 5.4, Click ***Device*** -> ***Rover*** -> PDA CORS.



- Enter CORS DNS/IP address and port-> Click Source List and select the proper source -> enter User and password.
- After Confirm succeed, the diff LED on receiver will flash, and software can get a fixed result.
- It also provides TCP protocol.

http://www.hw-group.com/products/HWg-Ares/HWg-Ares_GSM_APN_en.html#top

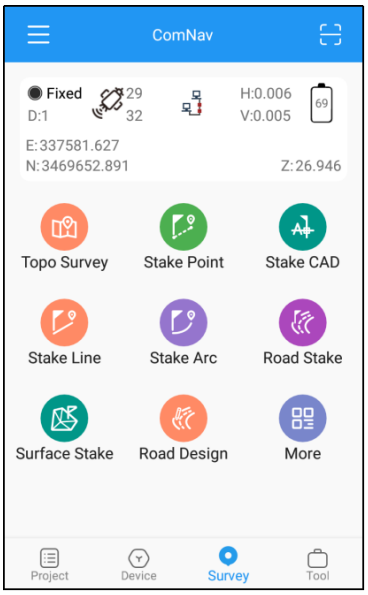
6 Basic Survey Functions

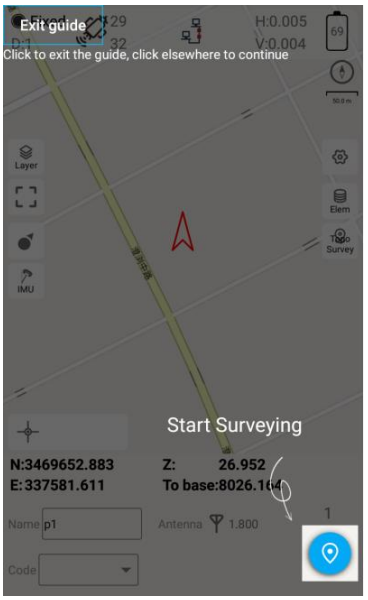
This section describes the basic survey functions of Survey Master, including point measurement, Topo survey, Auto survey, Area survey, Static, PPK, staking, site calibration, import and export measured points.

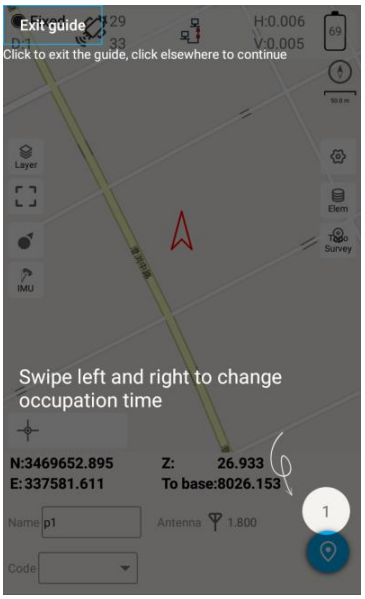
6.1 Topo survey

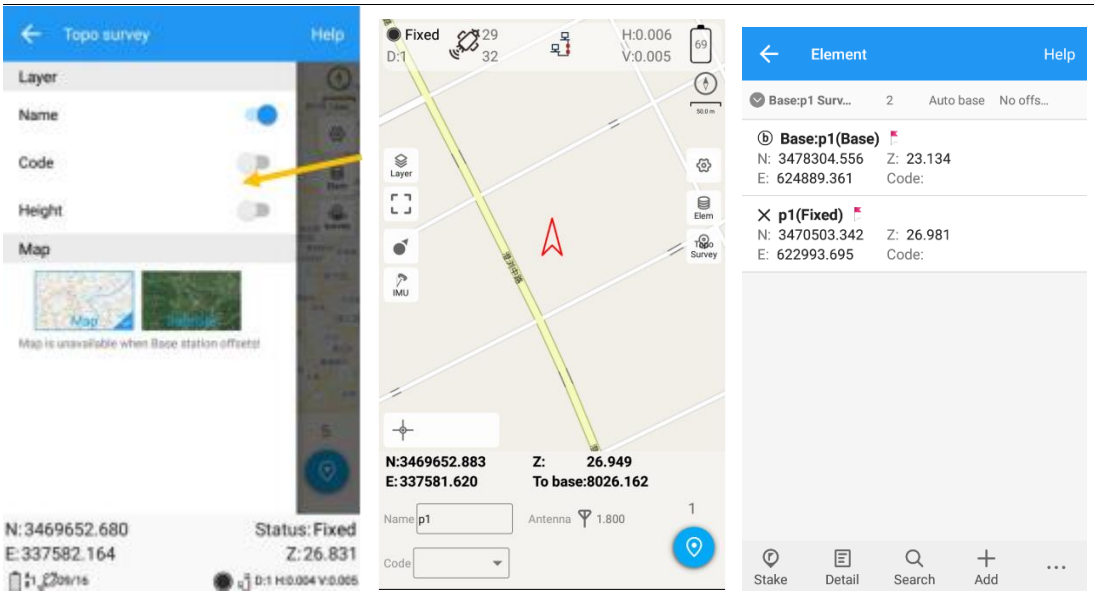
Click Topo Survey-> enter point name, ->click  to start or stop collecting data.

- You can quickly change antenna height in the survey interface.
- Tap Elem to check point coordinates.
- Tap Layer to show the layers you want display on map





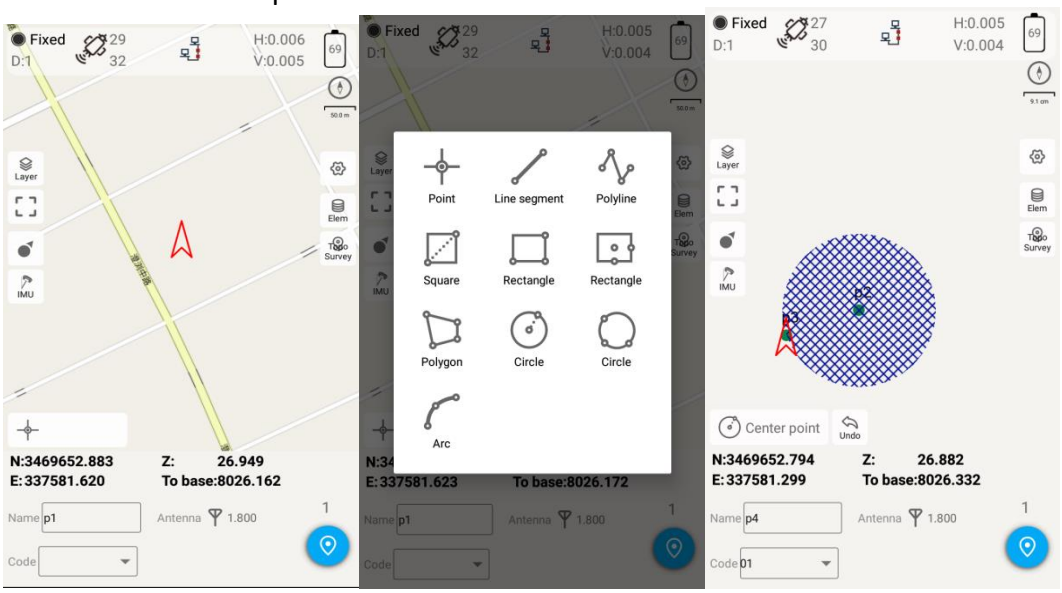




: Click this to show the whole points on the interface.

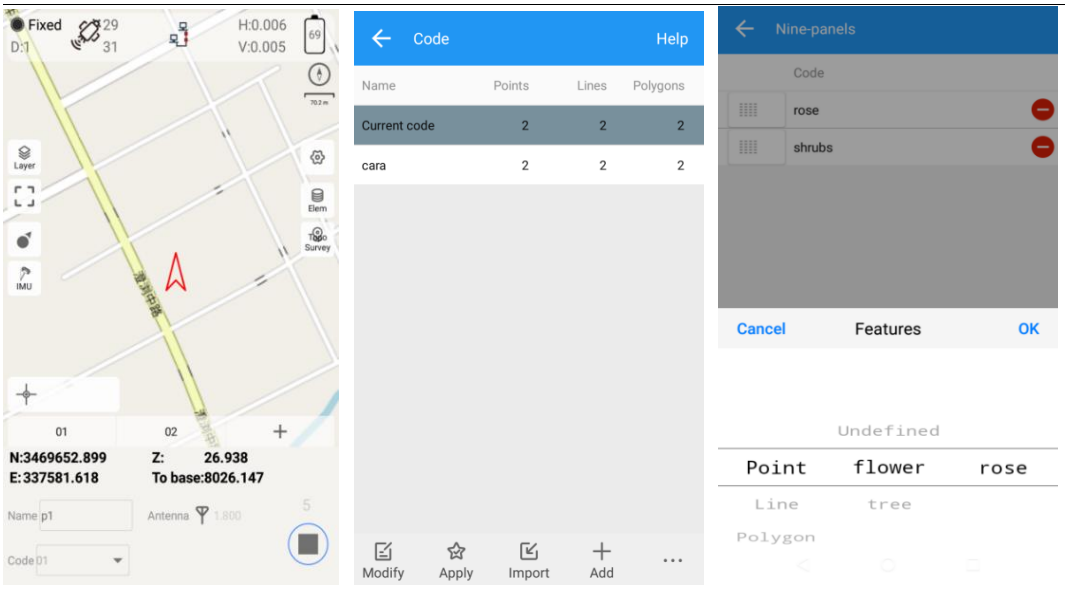
: If the arrow is out of sight on the interface, you can click this to locate the receiver position, then the arrow will be shown on the interface.

- Graphic survey: Tap the graphic button, after completing survey, will directly show the graphic on the map, you can export the graphic survey results as *.dxf format in Export interface.

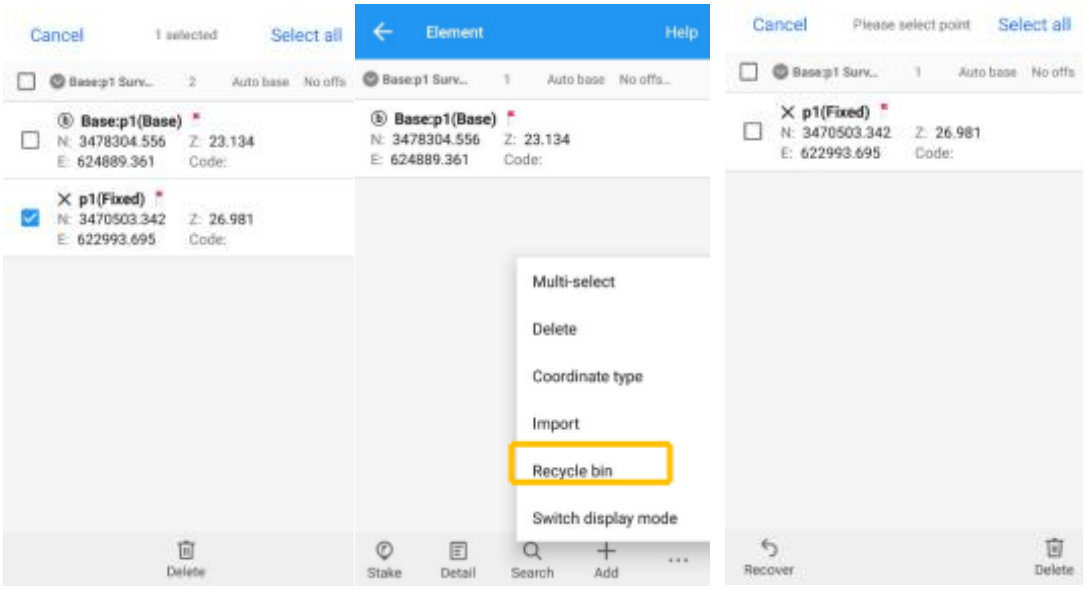


- Fast survey by pressing Code: Tap the code in nine panels, will survey the point directly.

Go into code management interface to modify code list, then you can choose code to use in nine panels.

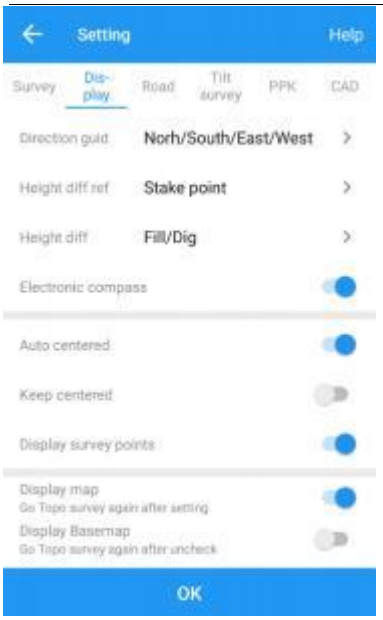


- Recover deleted points in Recycle Bin.



6.1.1 Survey settings

- Fixed: only fixed result can be saved;
- Duplicate name: allow point name same;
- RMS: point accuracy need higher than the value;
- Offset radius: point cannot offset bigger than the value during measure;
- Occupation time: measure times for one point;
- Point stepsize: for point name;
- Stake range: show circle when close to target point;

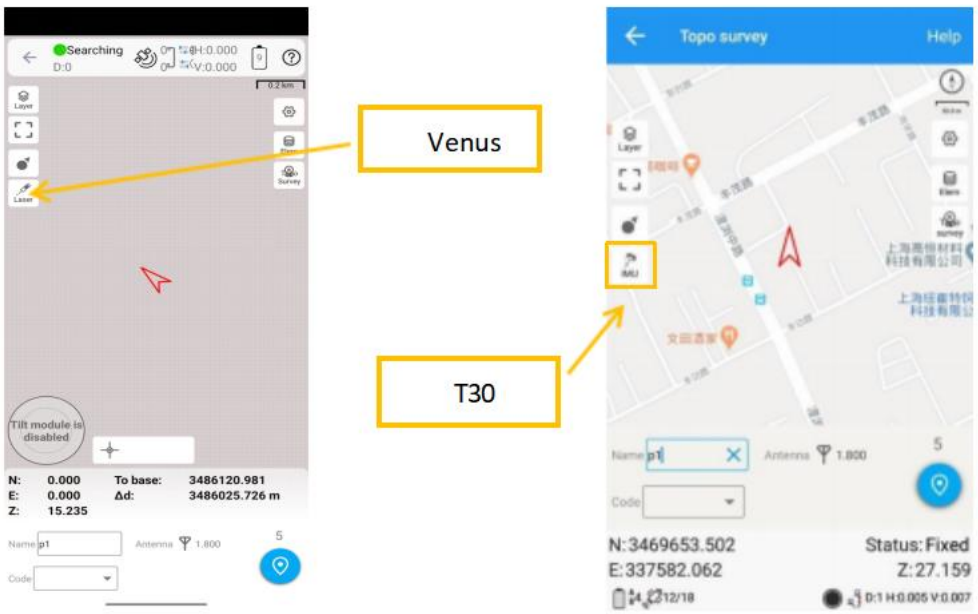


- Direction guide: 3 methods showing guide for stake out;
- Electronic compass: Use controller compass during stake out;
- Auto centered: Map will go to current location after 5 seconds;
- Keep centered: Map will go to current location after 1 second;
- Display survey points: will show all survey points on map;
- Display Basemap: for showing DXF/SHP file on map

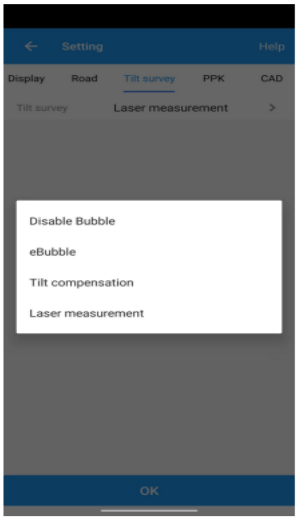
6.1.2 Tilt survey

Tilt survey option will appear when receiver supports for tilt survey, it is available for ComNav Technology Venus Laser RTK, use IMU sensor.

According to the IMU sensor, can meets the requirement of high precision measurement. When the tilts within 60° , the built-in sensor based IMU precisely calculates the actual offset, which accuracy can up to 5.5 cm.

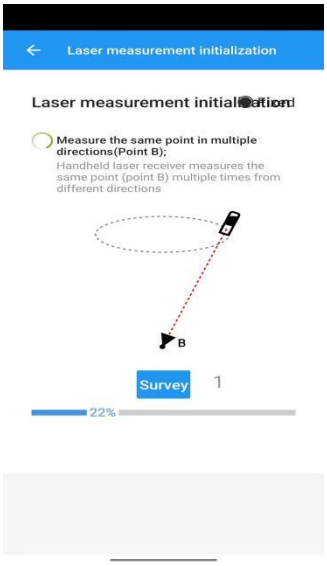


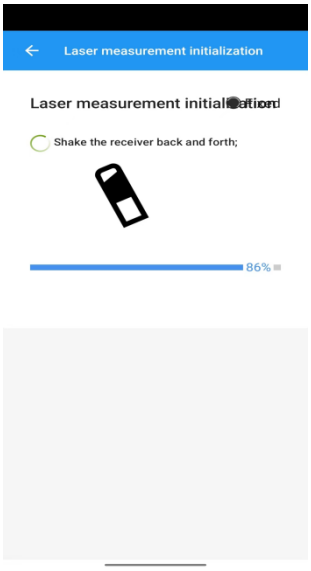
1. Open Laser measurement from Tilt survey in setting



2. Initialization

If you power off the receiver or freset it, need to initialize again. After open IMU button, you can follow the guidance in interface to complete it. During operation, make receiver can search the satellites and get a fixed solution



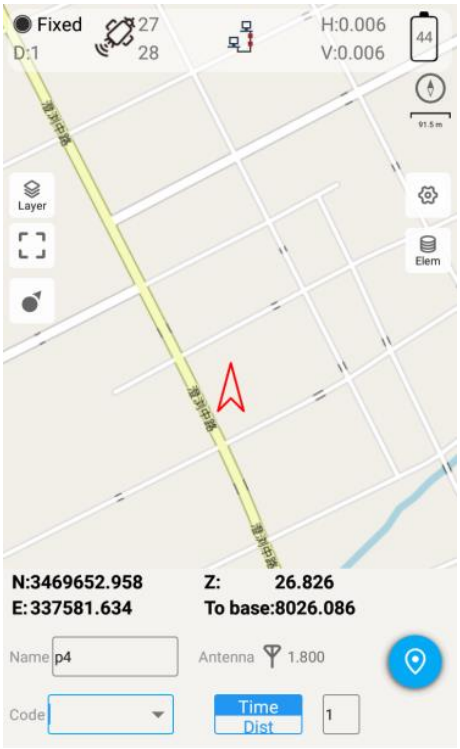


In survey interface, you can find the bubble and angle value shows the pole you tilt. For more accuracy, angle less than 60° will be better.

Tip: Do not shake or rotate the receiver violently, otherwise you need to re-initialize.

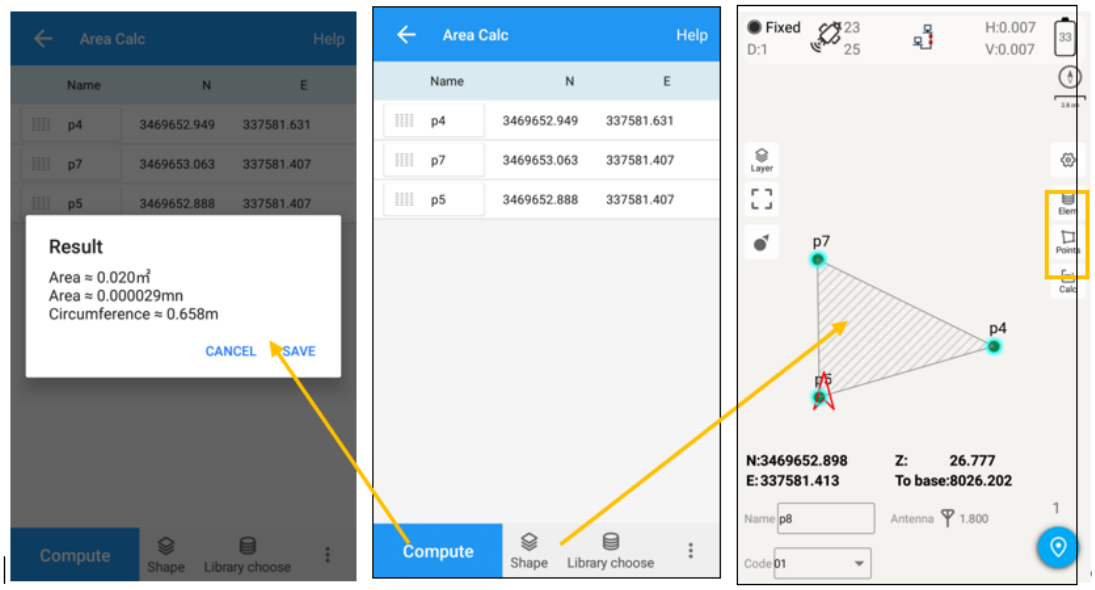
6.2 Auto survey/Area survey

For Auto survey, it supports automatic and continuous survey according to Time or Distance.



For Area survey, it can compute area directly after getting points.

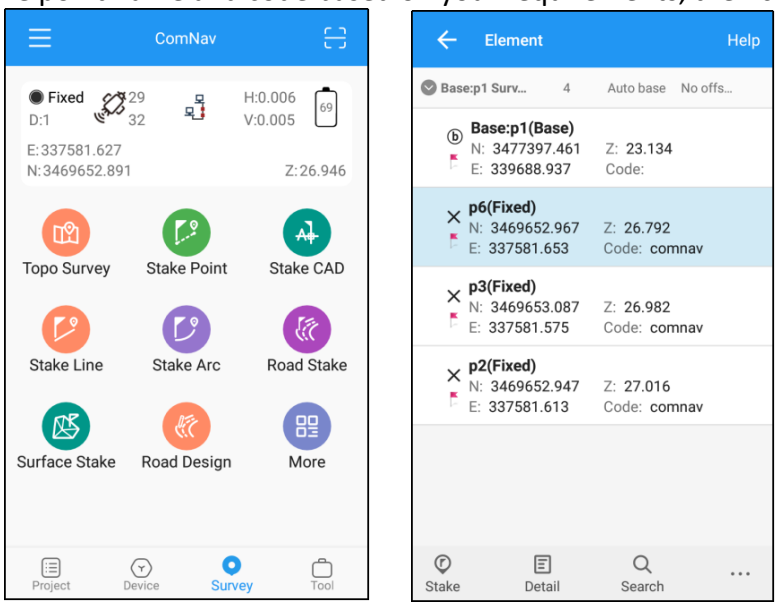
Press , it will show the coordinate information, press , it will show the area result, press , it will show the shape on map.

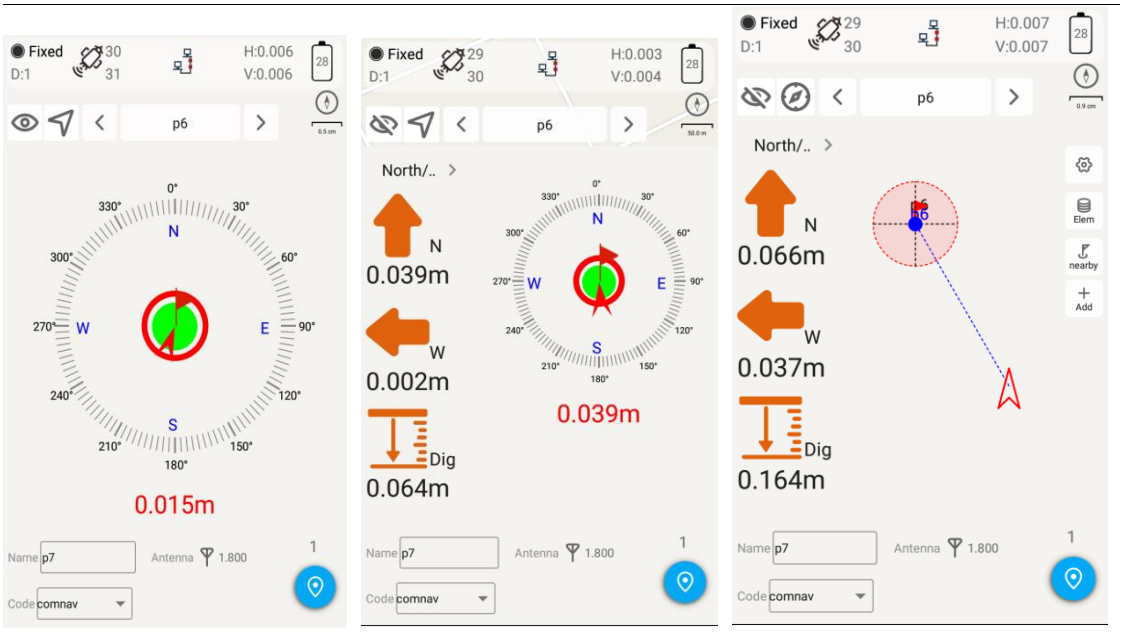


6.3 Stake points/lines

Go into ***Stake point*** interface, click to choose a point and tap ***Stake***. Survey Master provides a navigation map when staking points/lines. If you are close to the target point enough, it will alarm you based on the alarm range you set.

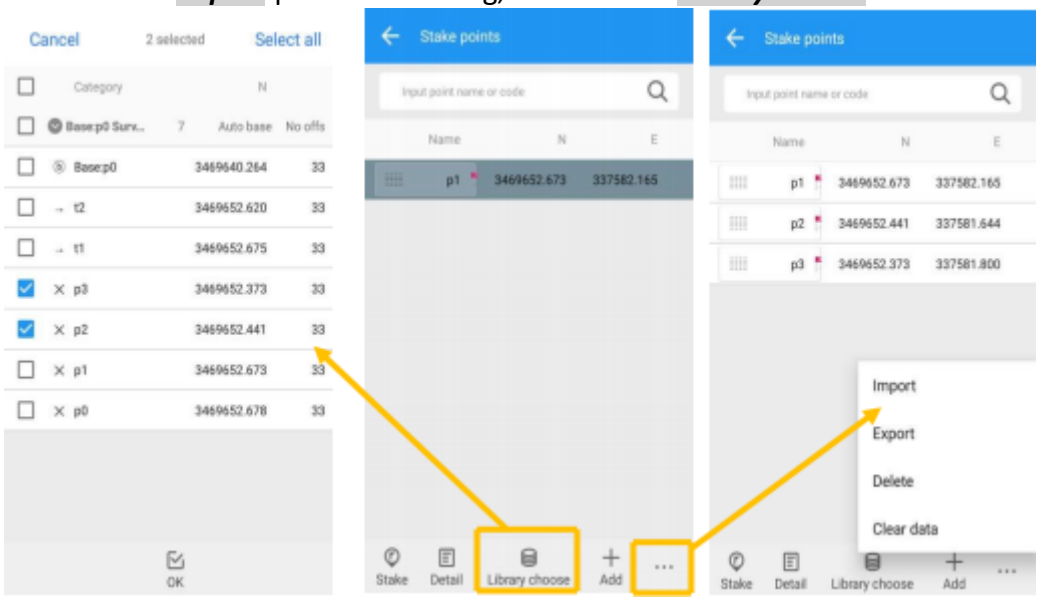
Enter the point name and code based on your requirements, then click





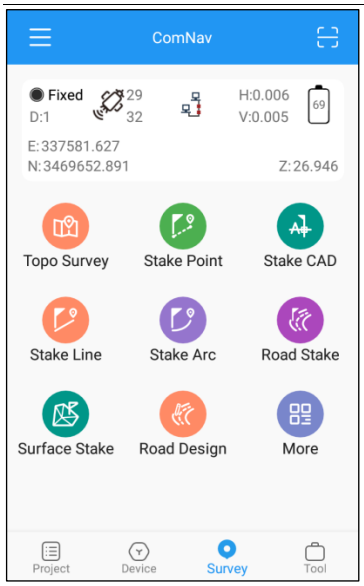
Various navigation info choices

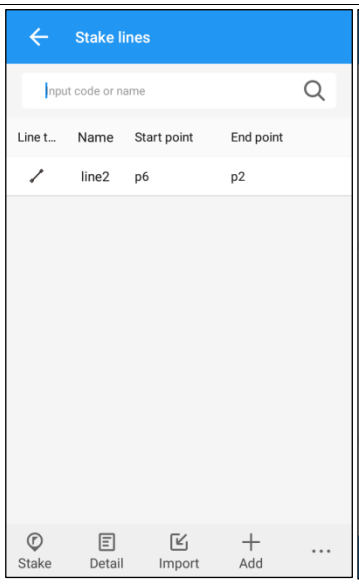
You can also ***Import*** points for staking, or add from ***Library choose.***

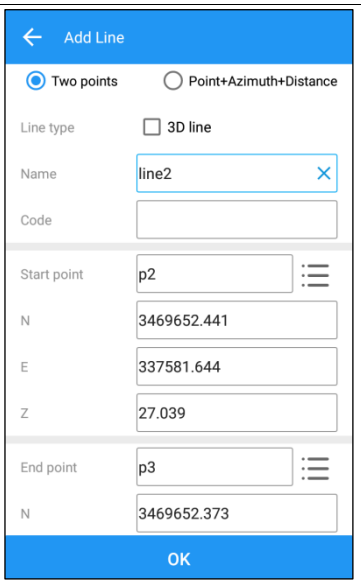


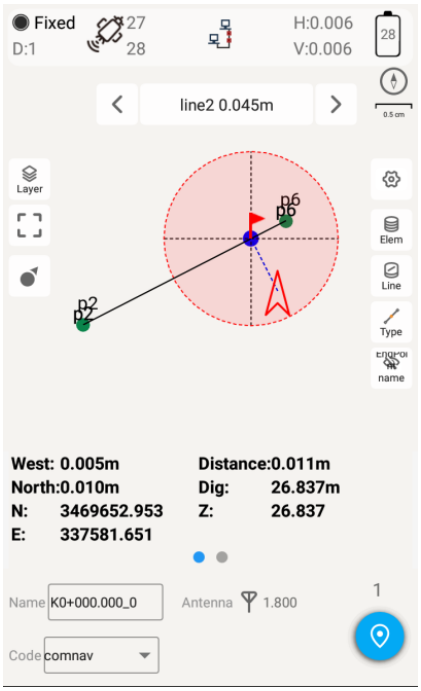
Tip: keep your receiver vertical to the ground.

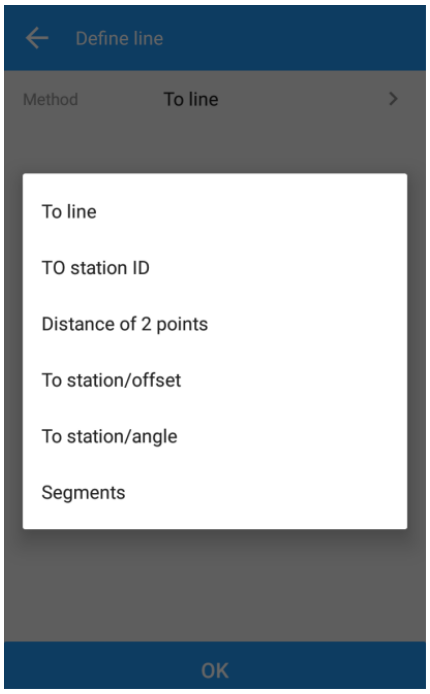
For staking lines, click Add -> add line (Two points or Point + Azimuth + Distance) -> click OK -> Choose one line and click Stake. The default method to stake is “To line”, press method to choose a method you want.











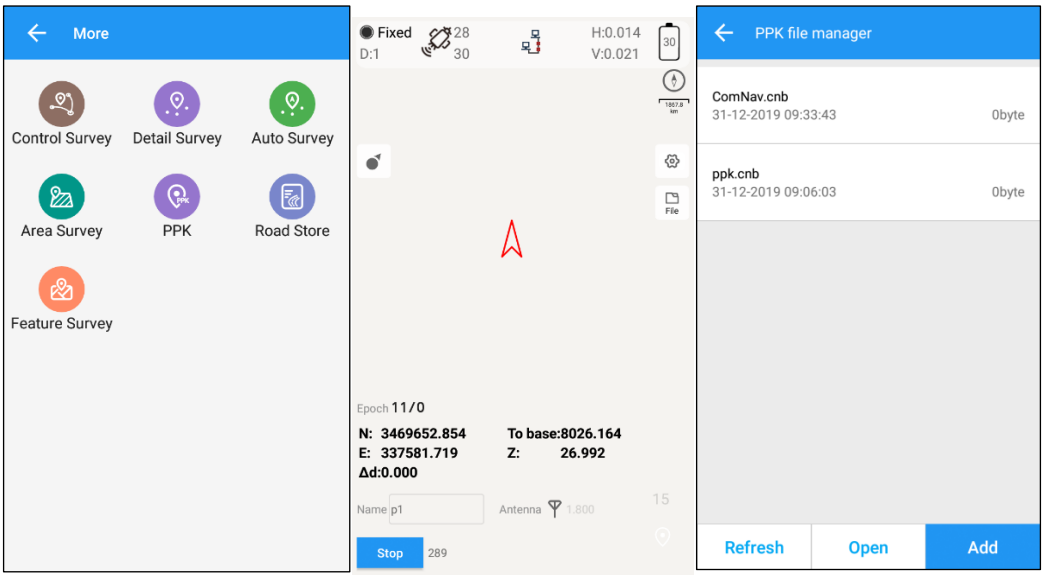
- To line: show shortest way to find a point on line;
- To station ID: stake points on line by defined interval;
- Distance of 2 points: show distance of current location to the line's start point and end point;
- Segment: Stake on line by defined segment value.

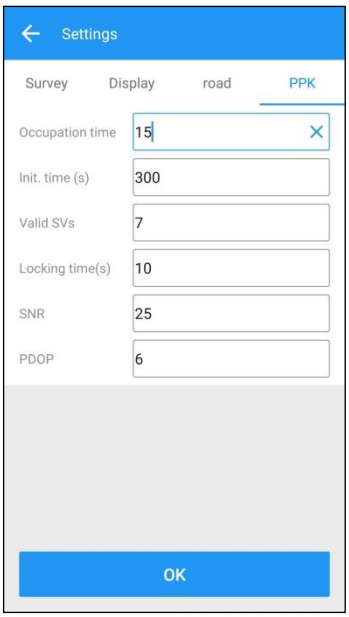
6.4 PPK

PPK (post processing kinetic) is the unique function of survey master, which is used for post-processing dynamic measurements.

It also needs two receivers to work together, one work as Base to record static data, and Venus work as Rover as shown below.

1. Click PPK in survey interface -> choose or create a PPK file.
2. Go to settings, configure PPK settings based on your requirements.
3. To get stable epoch, click Init to initialize -> to start PPK survey.



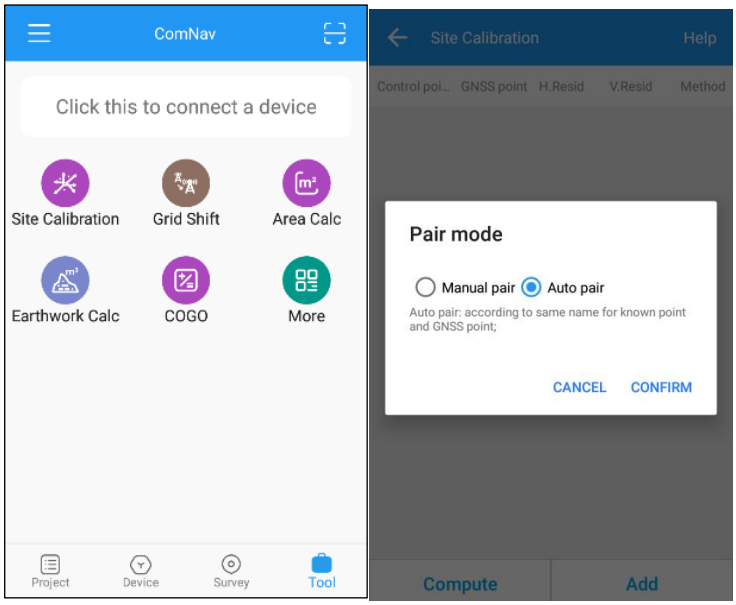


6.5 Site calibration/Grid Shift

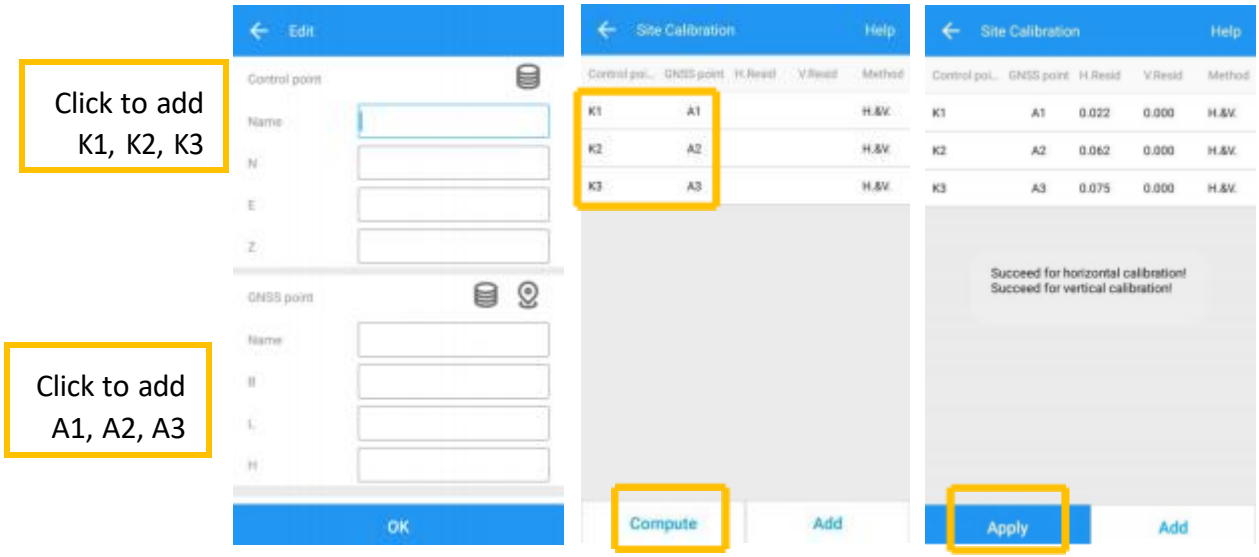
6.5.1 Site calibration

Site calibration is commonly needed once in one project, and all the points will be collected based on calibrated datum system.

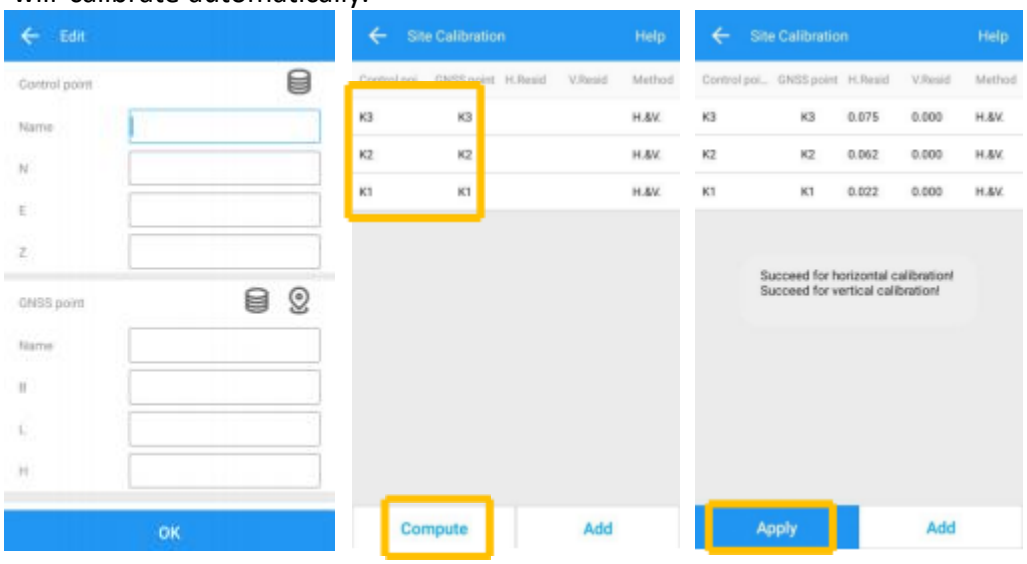
1. Choose manual pair or auto pair.



2. If you choose manual pair, you can directly enter at least three groups' point to compute. (for example, take K1,K2,K3 as known points, take A1,A2,A3 as measured points) After click Compute to calculate, the software will calibrate automatically.



3. If you choose auto pair, it will auto compute according to the same name for known point and measured point. After click ***Compute*** to calculate, the software will calibrate automatically.

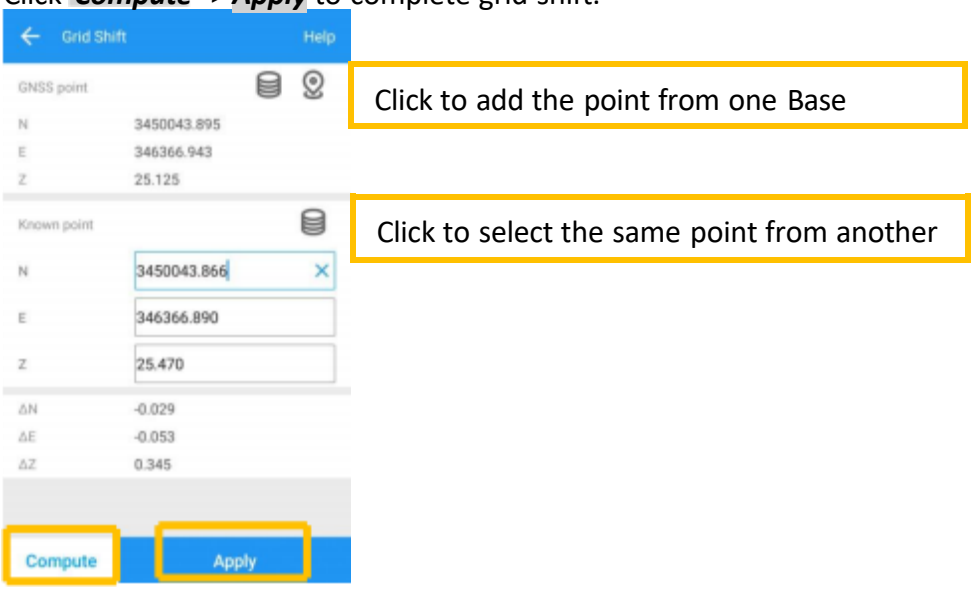


4. Click ***Apply*** to confirm to replace datum. The value of H.Resid and V.Resid should meet the requirement (H.Resid ⩽ 0.015m, and V.Resid ⩽ 0.02m).

6.5.2 Grid Shift

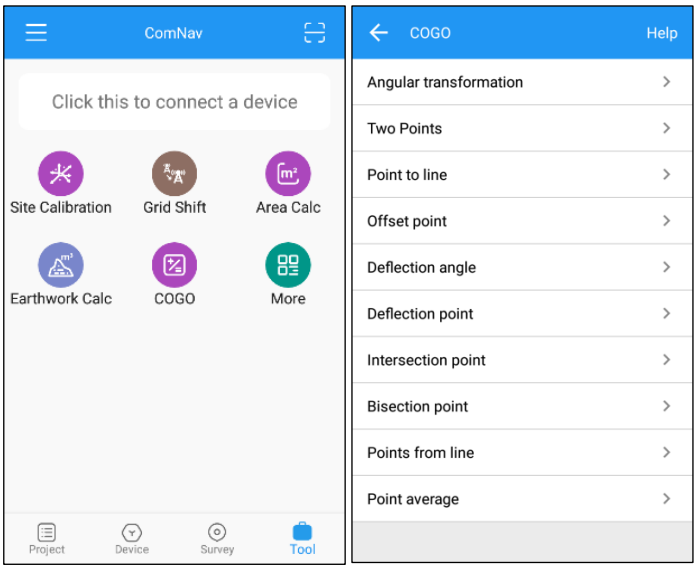
Grid reset function is applied when you need to change the position of Base station in the same project.

Click ***Grid Shift*** in Survey interface -> add current Base point and target Base point -> Click ***Compute*** -> ***Apply*** to complete grid shift.



6.6 COGO

With COGO function, you can calculate points/lines/angle directly on field.



- Angular transformation: Angular type transform;
- Two points: Calculate two points distance;
- Point to line: Distance from point to one line;
- Offset point: Calculate point with azimuth and distance;
- Deflection angle: Calculate angle of two lines;
- Deflection point: Calculate point with angle and distance;
- Intersection point: Calculate intersection points from two lines;
- Bisection point: Calculate point from angle bisector;
- Points from line: Calculate points on line by distance or segment;
- Point average: Calculate average from points;

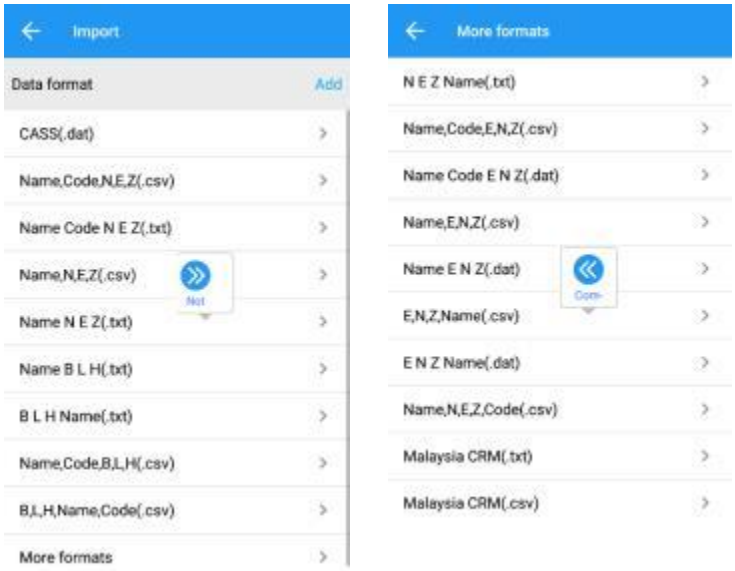
7 Data Export/Import

Survey Master supports to import/export data including grid coordinate, Lat/Lon coordinate with various data format, support import DXF/DWG file and export result of DXF/KML, etc.

7.1 Import

Tap ***Import*** in project interface, there are some predefined data formats, click ***More formats*** to get more predefined formats. Besides, you can click ***Add*** to create a User-defined type.

Long press the predefined data format that you don't use often, you can move this format to the More formats page; also, you can move the data format of More formats page to the previous page where stored the formats you usually use.



- Name: Enter the name for the format
- Delimiter: support Comma(,), Space( ), Semicolon(;)
- File format: support *.csv, *.dat, *.txt format

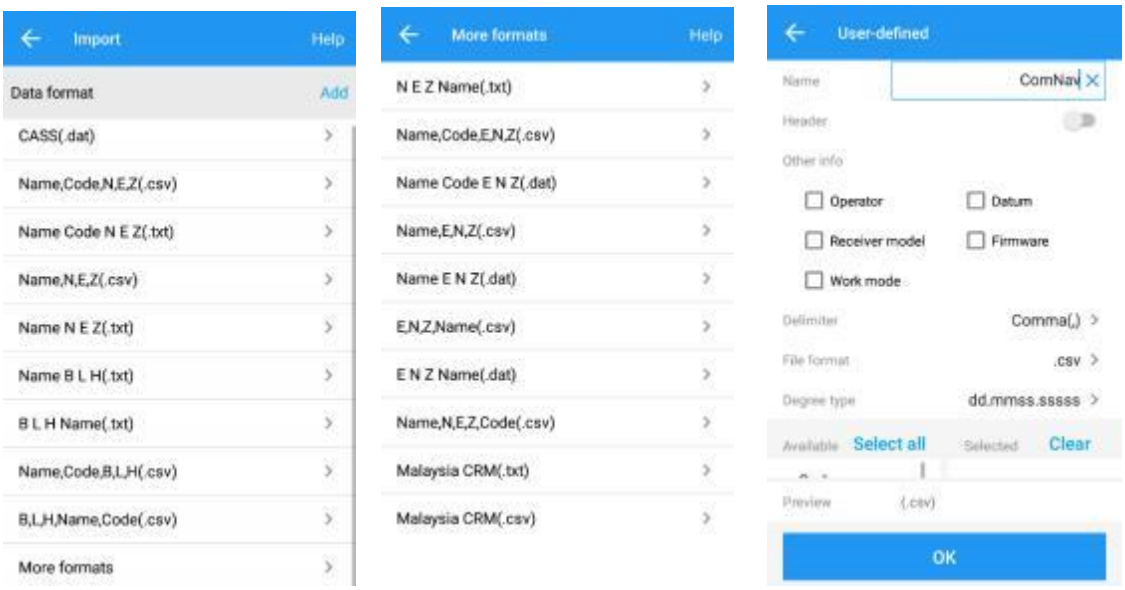
Click ***Select all*** to choose all elements, Click ***Clear*** to eliminate all elements selected.

The elements include: code, name, N, E, Z, B, L, H, X RMS, Y RMS, V.RMS, status, start time, occupation time, diff age, base ID, total AntHgt, Antenna height, measure type, antenna name, ending time, comment, RMS, PDOP, HDOP, VDOP, TDOP, GDOP, total SV, used SV, elevation, tilt offset, tilt angle, tilt distance

Tip: The format you defined will also be saved to Export interface.

Choose one format to import data.

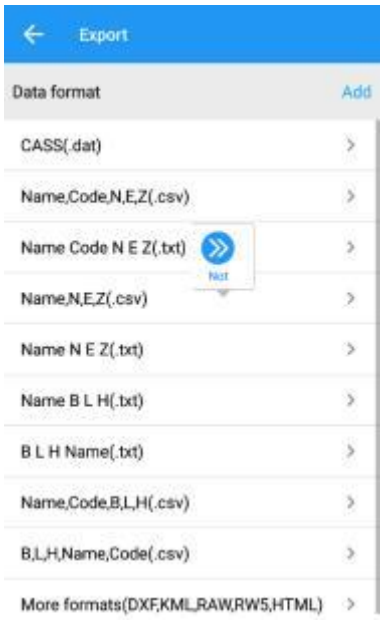
- The default export path is …*/Sinognss/sm/data,* you can also click ***Upperfolder*** to change to any other path where the file is.
- Point type: support Input point, Control point, Stake point

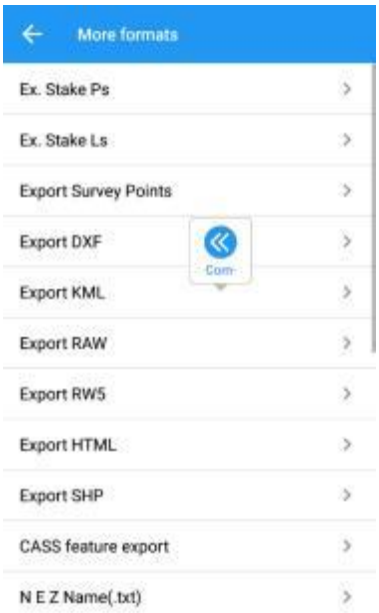


7.2 Export

Tap ***Export*** in Project interface to export simple data of survey points. Also, click ***More formats*** to export the survey points with detailed information or other formats like stake points/lines, DXF, SHP, KML, RAW, RW5, HTML, CASS feature result.

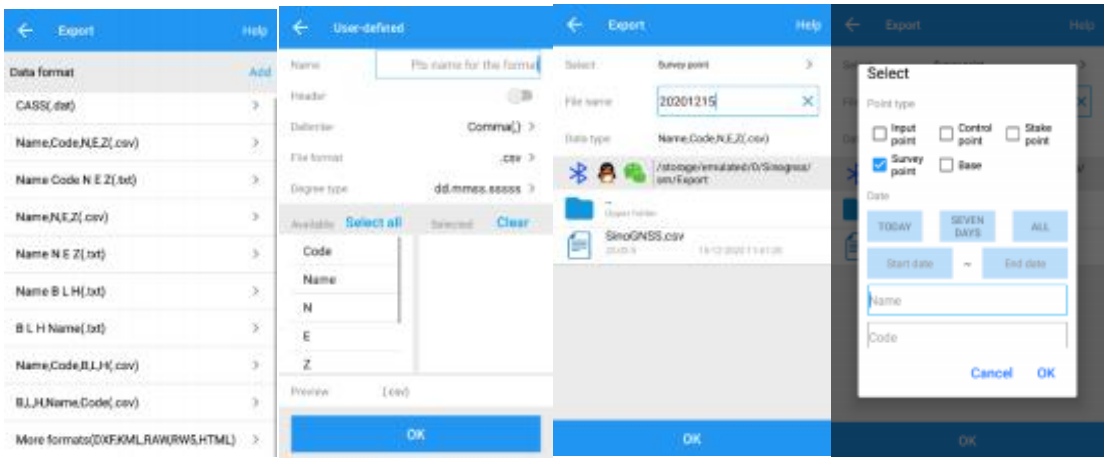
Same with Import result, long press the predefined data format to select the interface you want to place.





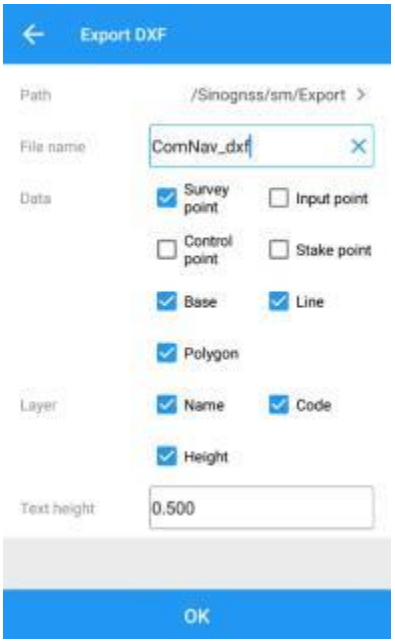
- File format: support *.csv, *.dat, *.txt format choose one format to export data.
- Select: support Survey point, Control point, Input point, Stake point, Base, also,you can set the data, name, code of data to specific export.

The default export path is …*/Sinognss/sm/export*, and the previous saved file will be shown below, you can also click ***Upper folder*** to change to any other path.



For the points, lines and polygons you surveyed in Topo survey and Feature survey, you can click ***Export DXF*** to export dxf file, then you can edit them in third party CAD software, or import to ***Basemap*** to check, or import to ***Stake CAD*** to stake.

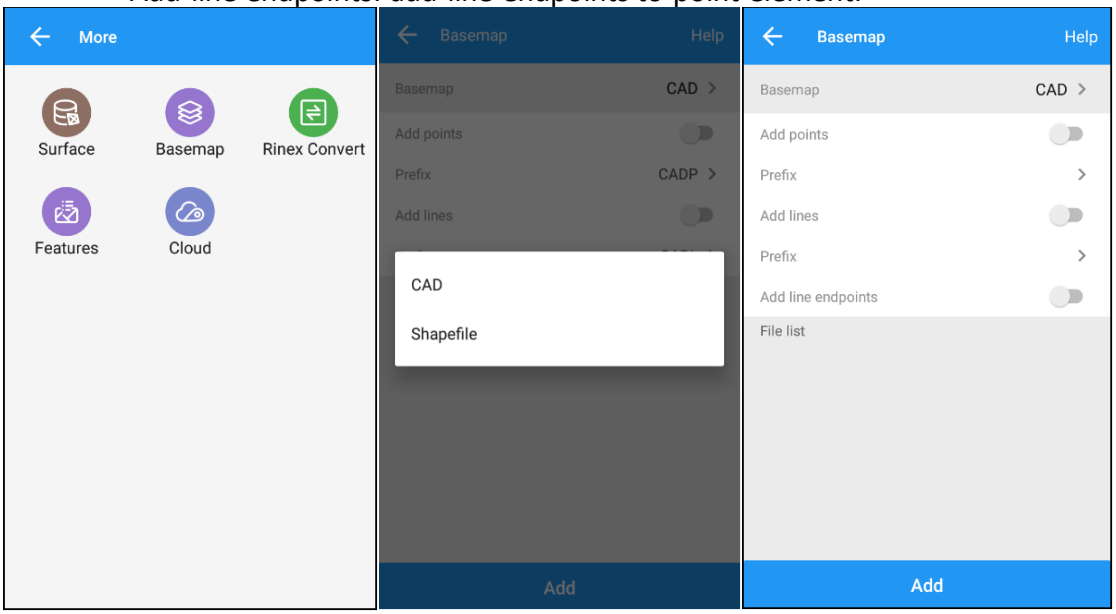
Choose the data that you want to export including survey point, input point, control point, stake point, base, line and polygon, and the layer properties includes name, code and height, the default text height is 0.5.



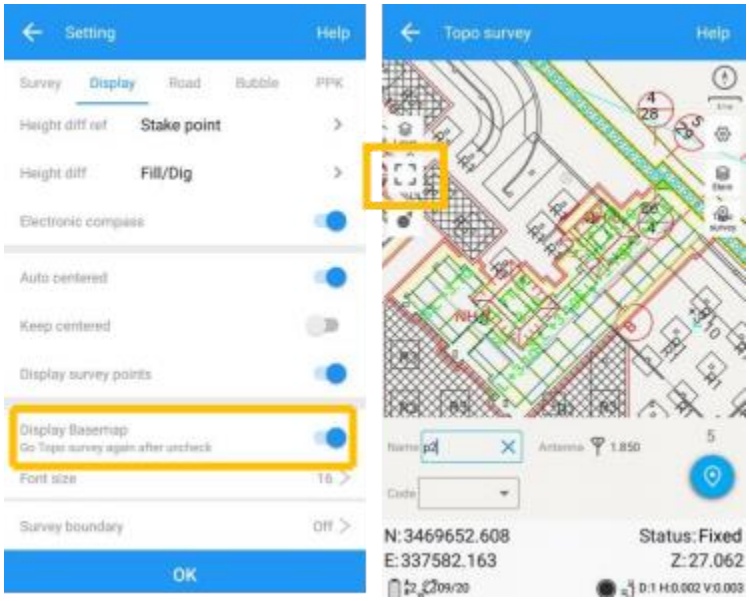
7.3 Import Basemap

Tap ***Basemap*** to import DXF/DWG/SHP file into Survey Master.

- Add points: Save points from the dxf/dwg/shp file to element.
- Add lines: Save lines from the dxf/dwg/shp file to element.
- Prefix: Support add prefix name for points/lines saved to Elements.
- Add line endpoints: add line endpoints to point element.



Remember go survey settings to check on display basemap, click zoom button to auto show basemap.

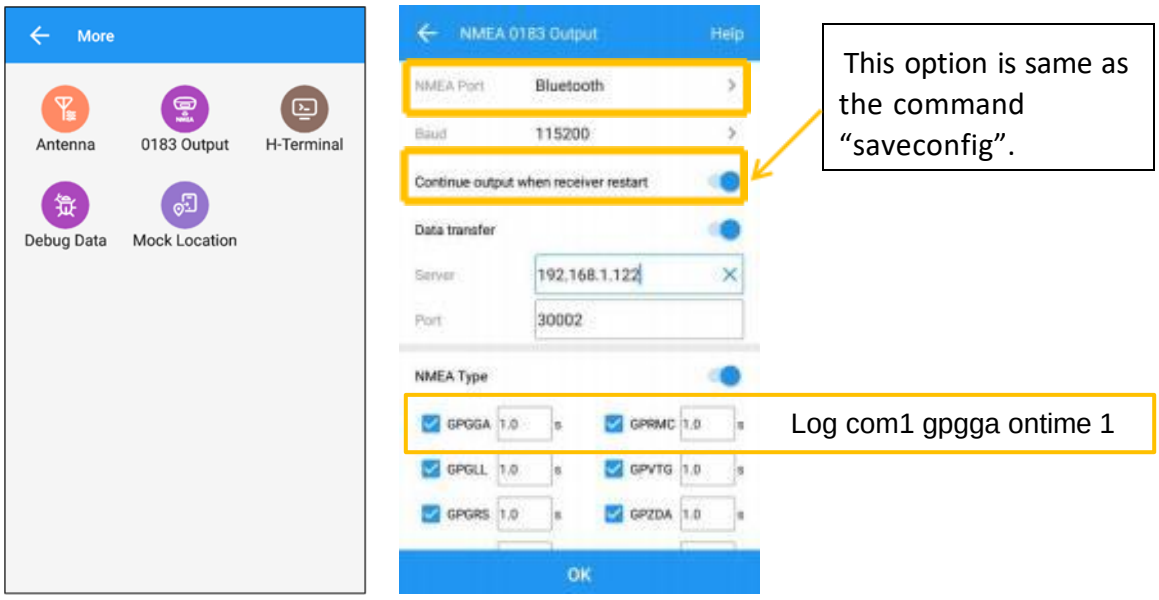


8 Export Result

8.1 NMEA 0183 output

With ***NMEA 0183*** function, you can quickly set to output NMEA data from lemo port or Bluetooth. In fact, this function is same as enter commands "log comX gpXXX ontime X".

Choose NMEA Port -> Baud -> check commands you want to output.



Data transfer: for transmit all the BT output to the address.

8.2 Register Venus via Survey Master

Normally, the register code is like this:

ID:03401012 $$:49-0B-79-23-00-00-00-95-85

FUNCTIONREG:2207453726-3851620954-0949162572-0697504466-0613618189-0027539229

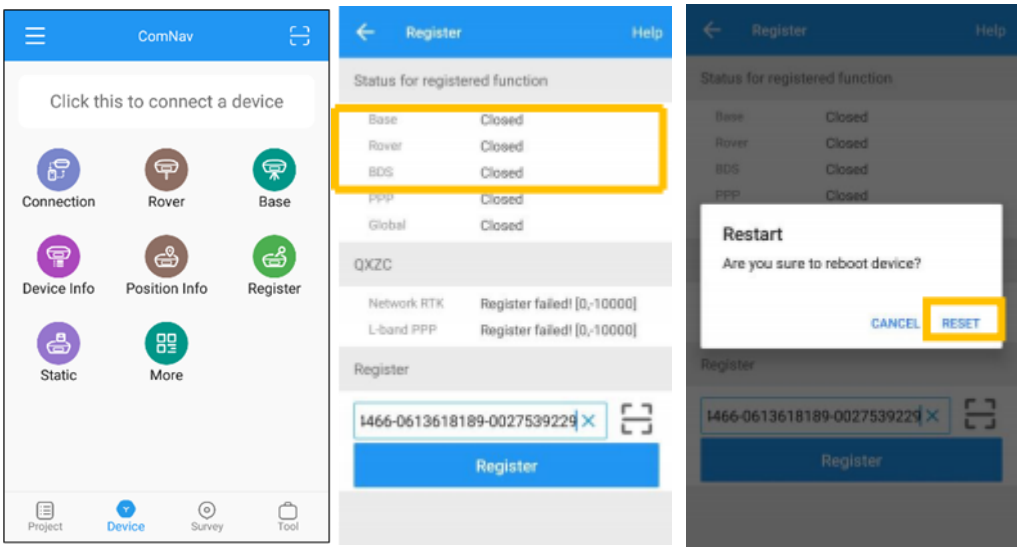
Note: The length of code may different according to different requirements.

Following shows two methods to register the receiver.

➢ **Register function**

For Register function, you need only enter the number:

2207453726-3851620954-0949162572-0697504466-0613618189-0027539229

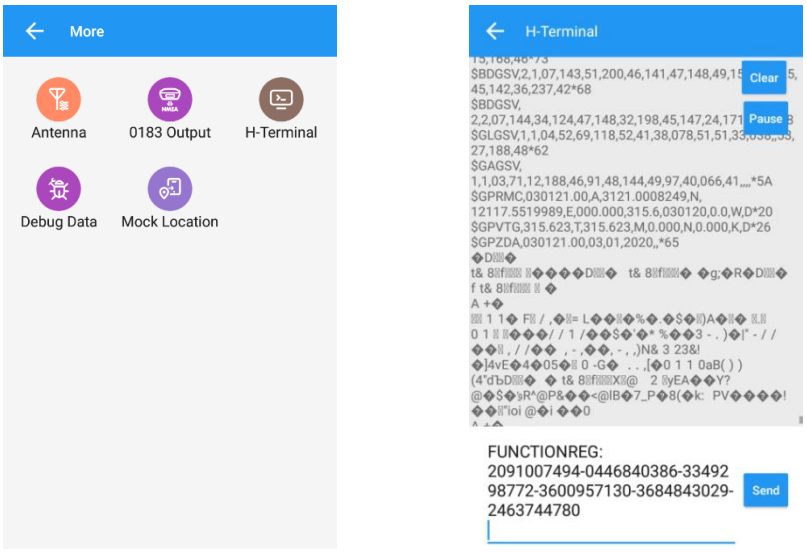


➢ **Register via commands**

You need copy the whole code, include the word 'FUNCTIONREG:'

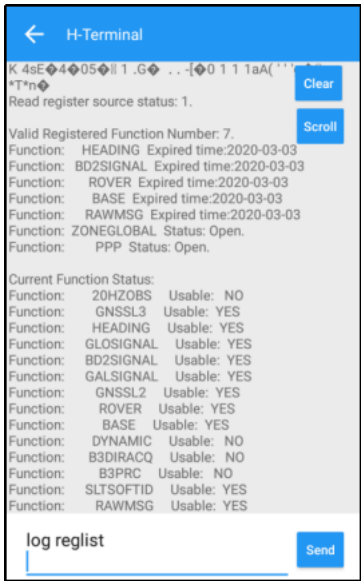
FUNCTIONREG:2207453726-3851620954-0949162572-0697504466-0613618189-0027539229

Copy the whole code, and enter the cursor to next ine, then send.



Send command: LOG REGLIST

To check receiver register status.



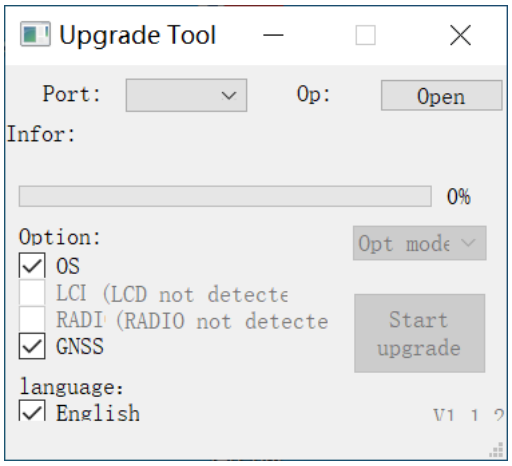
9 Firmware Upgrade

Prepare a USB-TypeC cable. And download a Driver of USB recongnition. It' s important.

Venus adopts the latest chip, integrated system and board, which shall be distinguished during upgrading. The latest version of the system is 1.1.0, and the board is 610QR

1. Copy the firmware software to your PC, connect Veuns to your PC via type-c cable and turn on the receiver.

2. Open the firmware program, select ***proper port*** to connect with receiver, click "***Open***", **only** choose" ***OS" and "GNSS"*** and then click "***Start***". Wait for a minute, it will be successful. It means that the system has been upgraded to 1.1.0, 610QR



When the progress bar is full, and "***Completed!***" appear below, it seems the update has been completed and then you can disconnect it and wait for 1 minute to finish the update

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.

RF Exposure Information

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.