USER GUIDE

SMC20

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PHEREFIX

SMC20

EXCAVATOR GUIDANCE SYSTEM USER GUIDE

Guangzhou Spherefix Navigation Technology Co., Ltd.

User Guidelines

1. Prior to utilizing this product, kindly review all the accompanying documents thoroughly to grasp its usage procedures and safety considerations.
2. Avoid disconnecting any system cables while the device is still powered.
3. When setting up connections, adhere strictly to the manual's instructions. Refrain from tugging, twisting, or sharply bending the data cables, as these actions could result in broken pins or wires, potentially causing weak connections or system failures.
4. To power the system, make sure the power supply is adequate(voltage: 12–24V, rated current ≥5A).
5. Avoid using cables that are damaged. Replace them immediately to prevent operational problems or further damage.
6. Damage resulting from unforeseen circumstances (e.g., lightning, high-voltage spikes, impacts) is excluded from the company's complimentary warranty coverage.
7. Avoid opening the product's casing; tampering with it will invalidate the warranty.

Pre-Use Instructions

1. Fundamental Guidelines
(1) Get to know the product and its operational needs prior to use. Adhere to both the manual instructions and the standard health and safety rules in your area.
(2) Follow measures to prevent accidents, safety procedures, workplace safety standards, medical advice, and traffic regulations.
(3) Consult with professionals for guidance on operating the product to prevent malfunctions or accidents.
(4) Upon receiving the product, make sure you have the inventory list and user manual, and follow the company’ s technical advice for setup and use.
2. Personnel Qualifications
(1) Operators should be skilled in operating an excavator and able to manage emergencies when using the system.
(2) Operators need to have a thorough understanding of excavator tasks and be able to adaptably utilize system features across various situations.
(3) Operators should be knowledgeable about the installation and operation of hardware and software, and be able to safely address common problems.
(4) Individuals under 18 years of age and individuals with physical or mental disabilities that impede safe operation are not allowed to use the machinery.
3. Pre-Operation Preparation
(1) Check the area around the excavator for any obstructions or dangers. Make sure the working space is free from unauthorized individuals.
(2) Carry out daily checks for any loose, missing, or worn parts, and for any dirt buildup.
(3) Operators should know the controls and functions of the product well.
4. Safety Considerations for Installation
(1) Make sure to properly connect the GNSS antenna and IMU cables. Use cable ties to secure them and prevent damage from pulling or crushing.

Contents

1. Product Overview

1.1. Manual Overview

This guide offers full instructions for setting up and using the SMC20 System. It covers:

- A full inventory of necessary parts.
- In-depth explanations of what each part does.
- Easy-to-follow steps for using the software.
- Technical details and performance metrics.

1.2. Product Overview

The SMC20 Excavator Guidance System, crafted by Spherefix, is a top-notch, precise tool for smart excavation.

It's made up of:

- A GNSS super-accurate positioning antenna
- A bright 10.1-inch display screen
- An Attitude sensor(IMU)

1.3. Product Features

This system is versatile and fits different excavators, guiding them accurately for efficient work. It helps overcome visibility issues. It's great for tasks like leveling ground, digging trenches, shaping slopes, and cleaning ponds.

1.3.1. System Features

(1) The RTK system has an accuracy of ±2.5 cm and can handle high-precision positioning and orientation across multiple frequencies.

(2) The system comes with a built-in global communication module that maintains internet connectivity and ensures data recovery even in the event of power loss.

(3) It's designed with industrial-grade standards, meeting IP67 specifications, making it ideal for tough outdoor conditions.

(4) The advanced IMU includes a high-performance microprocessor and filtering algorithms for reliable and accurate measurements.

(5) It offers real-time display capabilities, showing any deviation of the bucket from the planned values to provide precise guidance.

(6) The multi-view display feature provides top, side, and front views to help overcome blind spots during excavation.

(7) It supports various operation modes including leveling, trenching, slope grading, dike construction, and other tasks.

(8) It provides both visual and audio alerts for immediate feedback on operational mistakes.

1.3.2. System Benefits

(1) Greater efficiency

This system helps operators finish digging jobs faster and more precisely. With live positioning and guidance, they can exactly control where and how deep the excavator goes, stopping mistakes that happen when doing it by hand. It also cuts down on damage and the need to redo work from messing up.

(2) Cost savings

It leads to savings on labor and fuel. Operators can finish tasks faster, cutting down on the time needed for construction, which in turn cuts labor costs. Plus, accurate navigation helps to minimize material waste, saving even more money.

(3) Improved Safety

It assists operators in steering clear of hazardous situations, delineating safe operating zones, keeping excavators out of perilous regions, and offering instant alerts to prompt operators to act swiftly, ensuring construction safety.

(4) Versatile Compatibility

In tricky construction spots, like digging trenches or cleaning out ponds, it's hard to see what you're doing. This system uses live positioning and guidance to help operators handle these tough jobs, making sure the work gets done right.

(5) Data logging

It typically captures important construction data, like how deep and where the digging happens. Users can use this info to manage the job better and analyze it later to make construction work smoother and faster.

2. Equipment List

2.1. Onboard Components

No.	Name	Quantity	Picture
1	Tablet	1	
2	Radio Antenna	1	
3	GNSS Antenna	2	
4	Satellite Antenna Cable 1	1	

No.	Name	Quantity	Picture
5	Satellite Antenna Cable 2	1	
6	Satellite Antenna Extension	1	
7	Controller	1	
8	Main Cable	1	
9	Gyroscope 1	1	
10	Gyroscope 2	1	
11	Gyroscope Extension Cable 1	1	
12	Gyroscope Extension Cable 2	1	
13	RAM Mount	1	
14	Installation Kit	1	

2.1. Onboard Components

No.	Name	Quantity	Picture
1	Receiver	1	
2	Radio Antenna	1	
3	Power Cable	1	
4	Extension Pole	1	
5	Mounting Plate	1	

3. Essential Components

3.1. Tablet Kit

The tablet serves as the central unit of the system, managing data processing, executing algorithms, and facilitating user interaction.

Includes:

No.	Name	Quantity	Picture
1	Tablet	1	
2	Tablet bracket	1	

3.2. Controller Kit

It gathers information from the IMU and base station to perform RTK positioning and motion calculations.

Includes:

No.	Name	Quantity	Picture
1	Controller	1	
2	Radio Antenna	1	

3.3. Satellite Antenna Kit

Receive satellite signals and sends this data to the tablet's motherboard for calculations related to positioning and orientation.

Includes:

No.	Name	Quantity	Picture
1	GNSS Antenna	2	
2	Satellite Antenna Cable 1	1	
3	Satellite Antenna Cable 2	1	
4	Satellite Antenna Extension	1	

3.4. IMU Kit

Collect attitude changes during the excavator's operation.

Includes:

No.	Name	Quantity	Picture
1	Gyroscope 1	1	
2	Gyroscope 2	1	
3	Gyroscope Extension Cable 1	1	
4	Gyroscope Extension Cable 2	1	

4. Installation Instructions

4.1. Tablet Installation

Attach the tablet to the cab using a RAM mount for convenient access by the operator.

4.2. GNSS Antenna Installation

Attach the antenna mounting plates to the left side of the boom and arm.

Link the boom antenna to ANT1 and the arm antenna to ANT2.

Notes:

(1) Both antennas should be mounted on the left side of the excavator to ensure clear visibility.

(2) The boom antenna is typically positioned horizontally in the center of the boom.

(3) Extra cable length is provided to avoid equipment damage during stick rotation. The antenna installation point and the two rotation points on the stick should be aligned in a straight line.

(4) The accompanying illustration depicts the antenna mounting plate, antenna securing bolts, and other associated components.

4.3. Gyroscope Installation

The gyroscope mounting plate is attached to the junction between the stick and the bucket rotation via welding, and the gyroscope is secured to the mounting plate using a screw.

Gyroscope 1 is mounted on the stick, while the other gyroscope is positioned at the connection point between the stick and the bucket rotation.

Notes:

(1) Extra length of the gyroscope cable is provided to prevent damage to the hardware during stick and bucket rotation.

(2) The connector of Gyroscope 2 is oriented towards the stick position to facilitate cable installation.

(3) The gyroscope is installed in a position that does not interfere with the excavator's operation, preferably in the middle of the stick.

(4) Gyroscope mounting plate and fixing screws, etc.

4.4. Other Notes

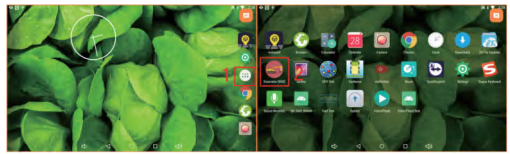
(1) The controller can be positioned on the right side of the cab, in a location that does not hinder the driver's work.
(2) The radio antenna can be mounted on the roof of the cab.
(3) Equipment connection diagram.

5. Software Introduction

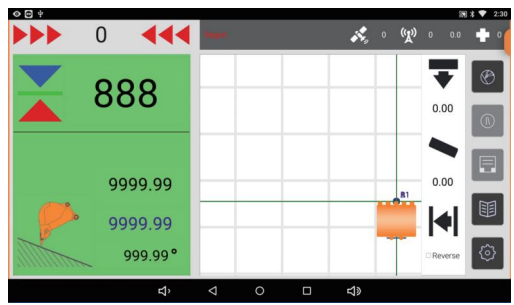
5.1. Starting the Software

Method 1: Tap the Excavator GNSS icon on the desktop.

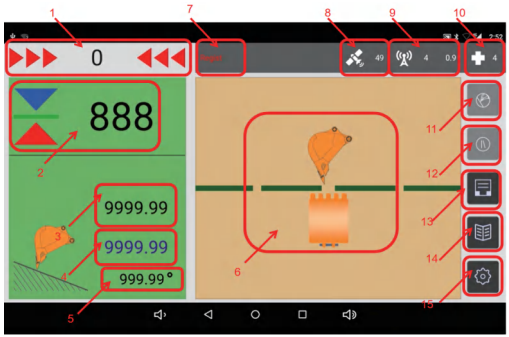
Method 2: Open the Android menu → Select Excavator GNSS.



Upon launching the software, you will be directed to the main interface, which is depicted in the figure. Note that the appearance of the main interface may vary slightly due to different settings and operations.



5.2.Main Interface Icons



(1) Bucket Lateral Deviation
(2) Fill/Dig volume
(3) Current Bucket Height
(4) Reference Plane Height
(5) Bucket Angle
(6) Navigation Display
(7) Registration Notification
(8) Satellite Count (tap to access base station settings)
(9) RTK Status (Normal Status: 4; Age ≤ 3 seconds)
(10) Heading Status (Usually 4 or 5)
(11) Slop Cutting mode
(12) Slope Trench Mode
(13) Planar & Fill and Dig Mode
(14) Real-time Parameters
(15) Calibration Settings

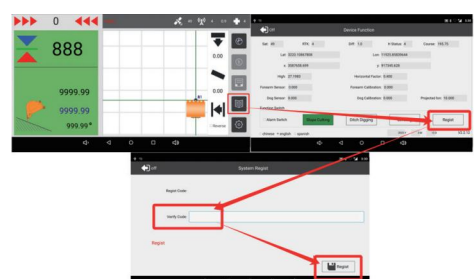
Additional Icons for Special Modes:
(16) Design Fill/Dig Volume
(17) Design Slope
(18) Lateral Offset Toggle

6. Software Operation

6.1. Registration

(1) Go to Real-Time Parameters → Registration.
(2) Input the registration code (provided by sales/support).
(3) Click the “Register” button.

Note: The registration code can be obtained from sales or technical personnel.



6.2. Base Station Setup

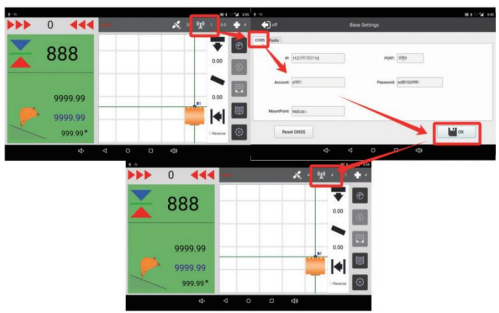
The system supports two types of base station setups.

Option 1: CORS Mode

(1) Tap the RTK status icon → Select CORS.

(2) Enter IP, port, account, password, and mount point.

(3) Click OK. Status “4” indicates success.

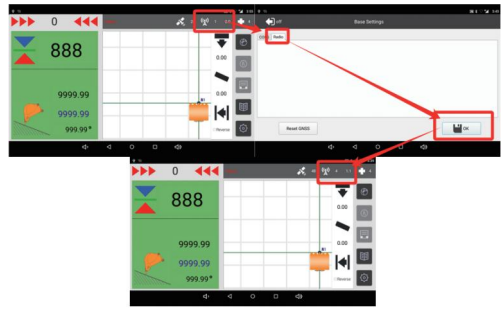


Note: The value X.X displayed next to the Differential Status indicates the number of seconds since the last reception of differential data from the base station.

Option 2: Radio Mode

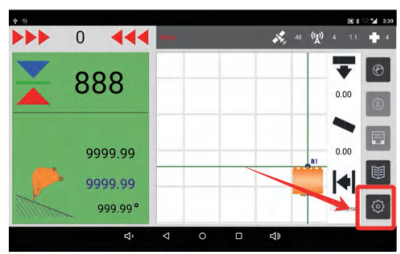
(1) Tap the RTK status icon → Select Radio.

(2) Click OK. Status “4” indicates success.

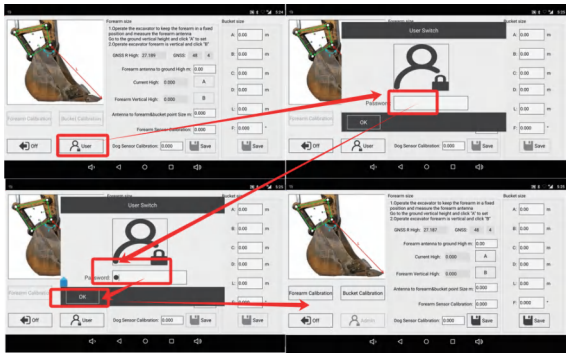


6.3.Device Calibration

Prerequisite: Park the excavator on level ground.

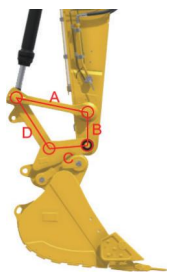


Click the User button, then enter the password: 1, in the password box, click Confirm to unlock the calibration content in the interface.

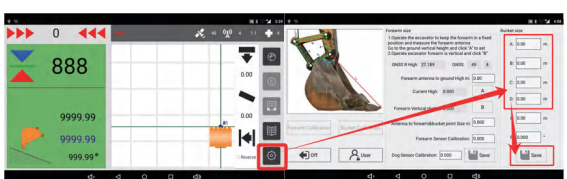


(1) Bucket Settings

Measure lengths A, B, C, D as shown.



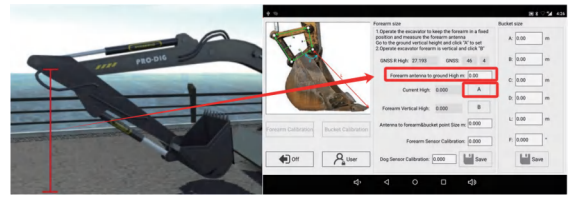
Enter the measured values into the settings and save them.



(2) Stick Settings

① Measure the vertical distance from the stick antenna to the ground.

② Click A to record the antenna elevation.



③ Then position the stick vertically (90°) and click B → Save.

(3) Stick Calibration

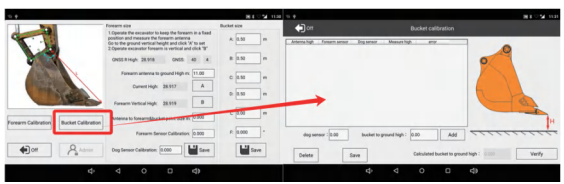
① Click the Stick Calibration button to access the calibration interface.

② Technicians need to measure the vertical distance from the ground to the connection point between the stick and the bucket, as depicted in the figure.

③ Technicians should enter the measured height into the calibration interface each time, and then proceed to measure the next height. This process should be repeated at least four times before clicking the Save button to complete the stick calibration.

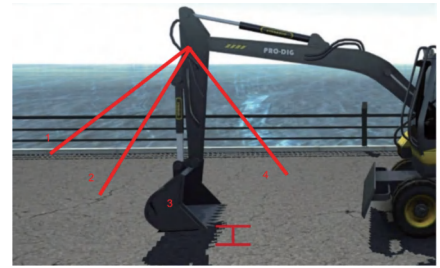
(4) Bucket Calibration

① Click the Bucket Calibration button to enter the calibration interface.

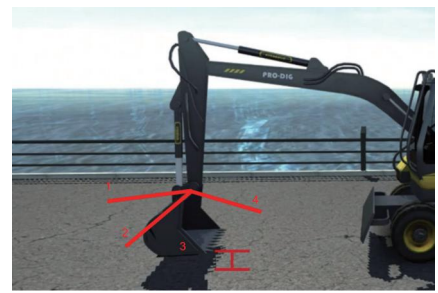


② Technicians are required to measure four sets of data, with each set consisting of four measurement results, totaling 16 results.

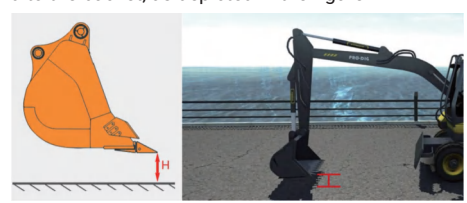
The four sets of data are measurements when the stick is in different positions:



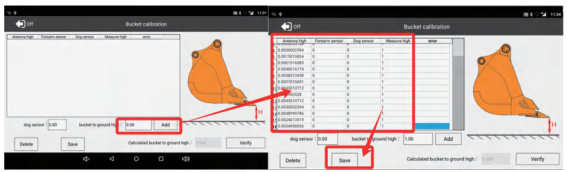
Each set of data requires measuring the distance from the bucket to the ground four times at different bucket angles.



Technicians need to measure the vertical distance from the ground to the bucket, as depicted in the figure.



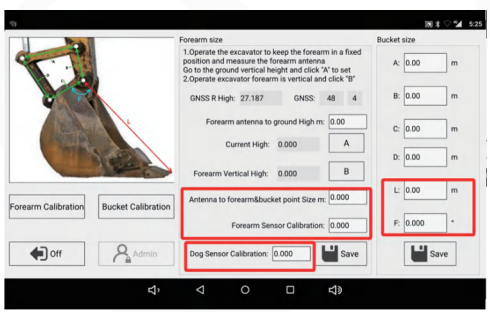
Technicians should enter the measured height into the calibration interface each time, and then proceed to measure the next height. After measuring all 16 parameters, click the Save button to complete the bucket calibration.



Note: When the stick is in different positions, ensure that the bucket does not touch the ground during rotation.

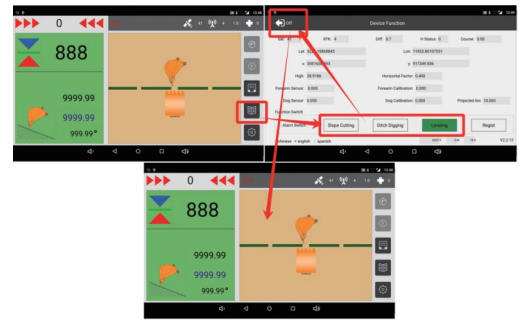
(5) Parameter Calculation

① After finishing the calibration, contact the technician to obtain these five values.



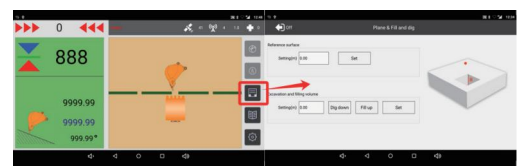
6.4. Excavator Operation

Click the Real-Time Parameters button to access the function settings interface, select the appropriate operation mode, and then click the "Off" button to configure the corresponding operation mode functions.



6.4.1. Plane & Fill and Dig

Click the Plane & Fill and Dig button to enter the settings interface.



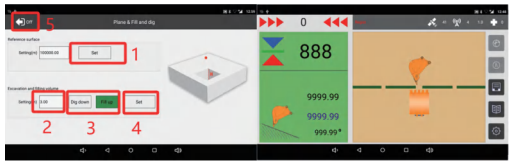
Step 1: Position the bucket appropriately and click the Reference Surface Setup button.

Step 2: Adjust the elevation for filling and excavation.

Step 3: Choose the suitable working mode, either excavating downward or filling upward.

Step 4: Set the volume for digging down or filling up.

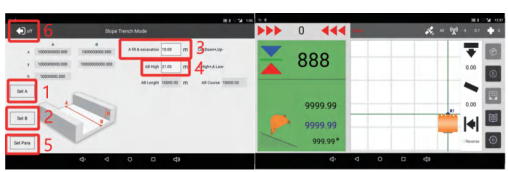
Step 5: Click the “Off” button to start operation following the guidance in plane mode.



6.4.2. Slope Trench Mode

Click the Slope Trench Mode button to enter the settings interface.

Step 1: Position the bucket appropriately and set A.
Step 2: Drive the excavator to the B area, place the bucket at point B, and set B.
Step 3: Set the fill/dig volume at point A.
Step 4: Set the height difference between points A and B.
Step 5: Click the Set Para button.
Step 6: Click the “Off” button to start operation following the guidance in slope trench mode.



Note:

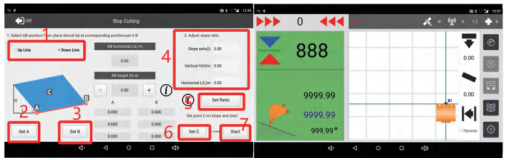
When setting the fill & excavation volume for point A, a positive value indicates digging down, while a negative value indicates filling up.

When setting the height difference between points A and B, a positive value means point A is higher than point B, and a negative value means point A is lower than point B.

6.4.3. Slop Cutting Mode

Click the Slop Cutting Mode button to enter the settings interface.

Step 1: Select the collection location for slope opening line.
Step 2: Drive the excavator to the A area, position the bucket at point A, and click the “Set A” button.
Step 3: Drive the excavator to the B area, position the bucket at point B, and click the “Set B” button.
Step 4: Enter the slope ratio, H, and L values.
Step 5: Click the “Set Ratio” button.
Step 6: Position the bucket at any point on the slope, as shown in the figure, and click the “Set C” button.
Step 7: Click the “Start” button to begin operation following the guidance in Slope Cutting Mode.



Note:

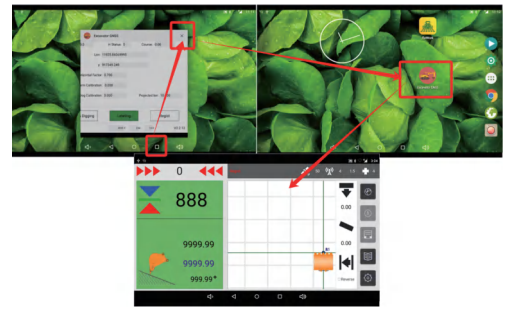
The slope ratio is calculated as H/L, and should be rounded to two decimal places.

The AB height adjustment is used to set the height difference between points A and B.

7. Other Functions

7.1. Language Switching

Step 1: Click the Real-Time Parameters button to access the device function interface, select the desired language, and then click the “Off” button.



7.2. Real-Time Parameters

The first part displays the real-time parameters of the equipment's satellites and gyroscopes, primarily for R&D personnel to diagnose issues.

The second part is the alarm switch, which is on by default.