USER GUIDE

PHEREFIX

SAG20

AGRICULTURAL SATELLITE
LAND LEVELING SYSTEM USER GUIDE

SAG20

PHEREFIX

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Guangzhou Spherefix Navigation Technology Co., Ltd.

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1. Foreword

SPHEREFIX is a brand under Guangzhou Spherefix Information Technology Co., Ltd. Guided by the philosophy of “Smart Efficiency,” Spherefix is dedicated to delivering affordable, high-precision engineering surveying equipment tailored for users in emerging markets.

Today, Spherefix products—including RTK receivers, CORS stations, GIS data collectors, surveying controllers, and engineering software—are distributed in over 50 countries and regions worldwide. Beyond hardware, Spherefix offers full-scale technical support to surveying professionals, while also ensuring an intuitive and efficient experience for users new to GNSS technology.

For inquiries or assistance, please reach out to our sales or technical support team.

2. About safety

2.1. General considerations

General considerations: You are responsible for checking carefully before installing the equipment.

Most accidents are caused by misconduct to safety rules. Read the steps and and get familiar with it and also the methods described in the manual. This manual is not recommended for use may cause personal injury or damage to equipment.

1. Read and get familiar with the operation manual before installing and using the system. Get instructions from the mechanic or operating manual provided by the equipment manufacturer.

2. All the work was done around heavy machinery. Please pay special attention to safety construction site.
3. The system is installed outside or inside the machine. Cannot install or remove the system when the machine is running.
4. The system components’ installation should not affect operator’s vision and action.
5. When the machine is running,keep clothes and body parts away from it.
6. Pay attention to protect the eye and wear safety glasses when cutting, welding.
7. Even if the machine is turned off, the hydraulic pipe may be under high pressure. Please pay attention to protect your body and your clothes.
8. Use appropriate methods of welding and protective measures during welding. Then rust dampers began on all affected areas during decontamination.
9. To prevent damage or theft, you have to remove the movable parts at night to safe places.

Attention:

1. Make sure to disconnect all machine power during deceleration.
2. Do not flatten around hydraulic pipes or certain components during mechanical operation.
3. All support brackets should be firm and stable to prevent detachment from the device vibration.
4. Please make sure the the container is dry. Humidity can hurt some parts.

3. SAG20 System Overview

3.1. SAG20 Product Specification

The SAG20 Agricultural Satellite Land Leveling System utilizes satellite receivers, which are also compatible with Beidou, GPS, GLONASS, and other satellite systems, ensuring 24/7 operational capability. The base station provides an extensive coverage range, with a maximum radius of 30 kilometers, eliminating the need for frequent station relocations (such as with traditional base stations or laser generators). Moreover, the base station is capable of supporting multiple devices simultaneously. As shown below, the System remains unregistered.

3.2. System Benefits

The SAG20 System combines satellite positioning with intelligent control software, enabling fully automated 3D grade control. Utilizing GNSS RTK technology, the system tracks the grader’ s real-time position and orientation, comparing this data with digital design models to provide visual, numerical, and audio feedback, ensuring millimeter-level accuracy without the need for survey stakes.

This innovative solution operates continuously in complex terrains, requiring minimal operator expertise and eliminating the need for rework. Its modular design integrates project management, equipment monitoring, and real-time earthwork calculations, enhancing overall productivity.

By automating grade control, the system increases efficiency by over 30%, significantly boosting profitability for earthmoving contractors. This technology offers a cost-effective solution for precision grading in construction, mining, and agriculture.

3.3. Operating Principles

The SAG20 System relies on satellite positioning data sent from base stations to controllers, which process the data in real time to calculate the grader blade's position in relation to a reference plane. Based on this , the system automatically adjusts the hydraulic cylinders—retracting to lower the blade for cutting when it's above the plane, or extending to lift it for filling when it's below. This continuous adjustment allows for precise grading, transforming uneven ground into a smooth, level surface through repeated cutting and filling.

4. Setup of Equipment

4.1. GNSS Antenna Setup

For optimal performance in satellite-guided leveling, it’ s crucial to install the GNSS antenna correctly. Ideally, the antenna should be positioned directly above the center of the grader blade for the best results.

While magnetic mounts are easy to use, we recommend opting for elevated flange mounts as they offer superior stability and more accurate leveling.

The installation site can vary based on the grader's model and setup, so its important to carefully evaluate the specific requirements of each machine before determining the ideal location.

4.2. Radio Antenna Setup

The radio antenna receives signals transmitted by base stations. During installation, it can be mounted on the vehicle roof and secured using the suction cup located at the bottom of the antenna, as demonstrated in the image below.

4.3. Cable Setup

Follow the diagram for installing the vehicle-mounted mobile terminal. The solenoid valve control line regulates the lifting and lowering of the grader's hydraulic cylinder. To prevent the movement being reversed during installation, you can use an external lifting switch for testing. If the movement is reversed, simply swap the two control line ports and secure them.

Attention:

1. Select an appropriate path for routing;

2. Route the solenoid valve control line and antenna cable separately to prevent them from getting tangled.

4.4. Base Station Setup(Optional)

Power the base station with a 12V battery and place it in an open area.

Ensure the antenna height is at least 1.5m, with an unobstructed 360° view.

Monitor the indicators: When the base station is functioning correctly, the POW and SA indicators will remain steady, and the LINK indicator will blink.

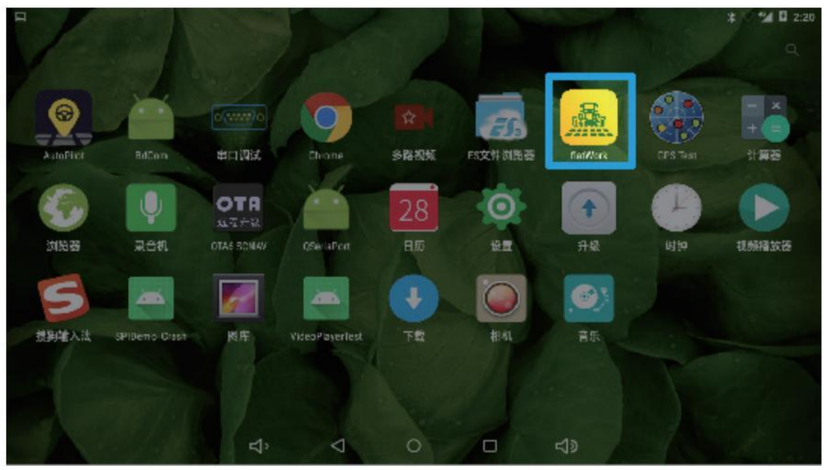
The base station has a radio coverage range of 2-3km. During operation, ensure that the distance between the vehicle terminal and the base station does not exceed its coverage range. The actual range depends on the height of the base station's antenna and the surrounding environment.

Be mindful of battery power loss. If the base station's voltage drops below 6V, it will not function properly, and the POW indicator will flash to signal low power.

5. Software Functionality

5.1. Software Interface Introduction

5.1.1. Start flatWork



5.1.2. Main Interface

Key Features:

1.Fine Adjustment: Adjust by ±1cm with each click.

2.Blade Control: Manually raise or lower the blade.

3.Settings: Configure base station and satellite parameters.

4.Reference Plane: Define the horizontal plane.

5.Auxiliary Tools: Measure terrain elevation.

6.Start/Stop Operation: Begin or halt the process.

5.2. Base Station Setup

Figure 1: The system settings menu includes four essential configuration modules: Base Station Setup, Satellite Positioning Data, Mode Selection, and System Settings.

Figure 2: The base station configuration offers three connection options. To use the network differential mode:

1. Go to Settings > Network Differential from the main menu.
2. Tap Refresh to scan for nearby base stations.
3. Choose an available station and confirm the selection.

Attention:

Only qualified professionals should adjust the website settings. If an error occurs, select "Exit" to cancel the changes.

Figure 3: Select one of the three base station options (radio base station): Access via the main interface by navigating to Settings > Radio Base Station

Attention:

This feature requires the radio module to be installed at the factory.

Figure 4: Select one of the three base station options (CORS) from the main interface by navigating to Settings > CORS. This step requires reaching out to the dealer, who will then contact the company's remote specialist.

Figure 5: Satellite Positioning: Track real-time parameters such as satellite count, longitude/latitude, elevation, and speed.

5.3. Mode Settings

Figure 6: Available Modes

Plane Mode (Flat Terrain)**:**

1.Click on "plane Mode".

2. Click "OK".

Single Slope Mode Setup(One-Way Slope)**:**

1.Calibrate Point A at the highest point in the field.

2. Calibrate Point B at the lowest point in the field.

3.Input the elevation difference (e.g., 20 cm if Point A is higher than Point B) → Set Elevation → Exit.

Dual Slope Mode Setup(Two-Way Slope)**:**

Follow the same process as Single Slope Mode, but also calibrate Point C to measure the elevation difference between Points A and C.

Figure 7: System Settings (Default Values):

1. Sensitivity: 1.8
2. Dead Zone: 2 cm
3. ECU Connection: ON
4. Mapping Threshold: 50 cm**

图7

Attention:

Modifications to system settings must be carried out under the supervision of qualified professionals. Unauthorized changes could lead to performance issues and pose risks to operational safety.

6. Establishing a New Reference Plane

6.1. Mode Overview

After completing the "Machine Dimensions" and "Coordinate Conversion Parameters" settings, you can define the working plane by:

Tapping the "Reference Plane" button located at the bottom right of the main interface.

Choosing one of the two available options:

1. Plane Mode — for creating a horizontal surface
2. Slope Mode — for setting an inclined plane

See Figure 6 for details.

Plane Mode Setup

1. Press the "Set Plane" button.
2. Change the working mode to Plane Mode.

3. For initial setups, ensure the "Offset" value is set to 0.
4. After clicking "Set Plane," the system will gather sensor and GNSS data to determine the elevation baseline.
5. Depending on measurement accuracy, success or failure notifications will be displayed. (If the deviation exceeds the allowable range, the system will notify the user of the failure and automatically retry data collection until it meets precision standards.)
6. To further improve accuracy: Select "Analyze Elevation" and follow the on-screen instructions to collect multiple ground points.
7. After completing the point collection, tap "End" — the system will automatically generate the most accurate reference plane.

Slope Mode Setup

1. Enter Slope Mode and tap "Set".
2. Calibrate reference points according to the diagram (Points A and B for single slope; Points A, B, and C for dual slope).
3. Fill in the height difference values between the points.

Attention:

Slope Mode is restricted to operations from high to low, or low to high elevations.

7. System Exit

Exit Methods:

Option 1: Quickly exit by double-clicking the red triangle symbol.

Option 2: Open the taskbar, locate the application, and select "Remove" to close it.

8. Workflow Overview

8.1. Steps Before Leveling

Starting the System

1. Start the tractor and allow the gauge readings to stabilize before ignition.
2. Activate the PTO (Power Take-Off) at a low speed.
3. Power up the controller and launch the satellite leveling software.
4. Raise the grader blade to a safety height of 5–10 cm, either using the controller or manual switch.
5. Turn off the controller to avoid accidental operations.

Base Station Setup (Radio Mode Only)

1. Position the tripod in an open area within the designated work zone.
2. Connect the necessary cables, power on the base station, and configure the frequency settings.

Grader Adjustment

1.Start the tractor, engage the PTO shaft, and power on the controller.
2.Lower the grader blade to a height of 5–10 cm above the ground for initial leveling.

8.2. Leveling Operation

Work Direction:

1.Always perform grading from higher to lower areas, making multiple passes to ensure even leveling.
2.If the tractor becomes overloaded with excessive soil, immediately raise the blade through the control interface or external switch to unload the material, then return to automatic mode. Conversely, if insufficient soil is being removed, lower the reference plane gradually.

8.3. Post-Leveling Procedures

Maintenance:

1.Clean the blade regularly to prevent rust buildup.
2.Store the grader in a dry, well-ventilated location, shielded from rain and direct sunlight.

Inspection:

Inspect all connections and components for any damage or signs of looseness.

Attention:

While all equipment is weather-resistant, proper storage is essential for maintaining optimal performance over time.