SMAJAYU
PRECISION AGRICULTURE

JYL20
Operation Manual

SMAJAYU(SHENZHEN)CO.LTD

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User Notice

1. Before using this product, please read all the user information provided with it carefully to understand the usage and precautions of this product.

2. Do not disassemble or assemble the relevant cables in the satellite flat ground navigation system equipment when the power is on.

3. Please connect your device strictly according to the requirements in the manual. For data cables and other cables, do not pull, rotate, or squeeze excessively, otherwise it will easily cause broken needles and lead to poor contact.

4. When supplying power to this product (system), please pay attention to the power supply requirements of the equipment (the power supply voltage must be 12V, and the rated current must not be less than 5A).

5. Do not continue to use the cables after they are damaged. Please purchase and replace them in time to avoid affecting the use effect.

6. The equipment is damaged due to force major (lightning strike, high pressure, collision, scratching), which does not belong to the free maintenance scope of our company.

7. Please do not disassemble the product shell by yourself, otherwise the warranty will not be given.

Notice before Use

1. The Basic Principle

（1） Fully understands the product and its operating requirements before use and comply with the "common-sense health and safety operating regulations" of the country and region while following the instructions in use!

（2） Accident prevention measures and common-sense safety technology, labor protection, medical and traffic regulations must also be followed.

（3） Listening to suggestions for product operation can help avoid malfunctions and accidents.

（4） When the product is delivered, you should get the receipt list and instruction manual and follow our company's technical guidance for installation and operation.

2. Personnel requirements

（1） Terminal users need to operate the system while driving the tractor. Operators are required to be proficient in driving the tractor and could deal with emergencies during driving.

（2） The operator needs to have a certain understanding of the land leveling work, and clearly know that the various functions of the system will be used flexibly when leveling different terrain; the operator understands the installation and operation principles of related software and hardware, and has the ability to safely handle common faults.

（3） Persons under the age of 18 and those with disabilities that hinder safe operations should not participate in agricultural machinery operations.

3. Preparation before Working

（1） Check whether there are obstacles around the shovel and other factors that endanger safe operations, and let irrelevant personnel leave the work area.

（2） According to the requirements of daily maintenance, carefully check the leveling shovel for loose parts, missing parts, excessive wear, and sediment accumulation.

（3） Operators must be familiar with the operating devices of the product and their functions.

4. Precautions During Installation

（1） The solenoid valve cable is correctly connected to the GNSS antenna cable. After the connection, it should be allowed to sag naturally and cannot be dragged and squeezed to prevent the normal operation of the system from being cut off.

（2） A protection chain must be hung between the front end of the tractor and the shovel to ensure the safe use of the system.

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1. Introduction

1.1 Abstract

Smajayu GNSS Land Leveling System is an important innovation in the field of GNSS high-precision positioning applied to precision agriculture. The system is composed of high-precision GNSS positioning equipment, controllers, data communication equipment and high-brightness display equipment. It uses base station + mobile vehicle terminal or connects to network base stations for operation.

1.1.1 Features

1. The motor grader can be controlled through manual and automatic modes, and tablet display datum plane and height information reference datum plane in real-time.
2. In the automatic mode, the field can be leveled automatically according to the height of the set datum plane, and it supports the leveling of slope and horizontal field.
3. The terrain information is displayed in different colors, which greatly improves the work efficiency. It can understand the height and leveling of the entire field in real time. It can make accurate judgments during operation, improve work efficiency by more than 40%, and greatly save time and cost. It has a great working advantage compared with conventional laser land leveling systems and ordinary satellite leveling systems.
4. The on-board terminal is compatible with our Autopilot system, intelligent spray system, driving assistance system, etc., which can greatly reduce the purchase cost of various equipment. For specific operation items, please refer to the following detailed description.

1.1.2 Benefits after Land Leveling

1. Increase Yield

   Using GNSS Land Leveling System to accurately leveling the land can increase production by 20-30% compared with traditional leveling technology, which is 50% of the unleveled land. These impressive results are obtained by applying the appropriate amount of water to the plants for their growth. The even distribution of water improves the environment for germination and plant growth and increases the yield of crops.

2. Save Irrigation Water

   After the field is leveled, the water used for irrigation can be fully utilized, so that the water can be evenly distributed throughout the field, so that the uneven flow of water will not cause the irrigation water cost to increase.

3. Save measurement cost

   There is no need to hire a survey team to measure the elevation of the land, with just a few minutes of training, anyone can accurately and quickly measure the elevation of the land after using GNSS Land Leveling System.

4. Reduce Fertilizer Loss

   After the field is precisely leveled, not only the water can be accurately used, but the fertilizer can also be stored in the roots of the plants, which can greatly reduce the loss of fertilizer during irrigation and drainage.

5. Control High Location Soil

   The high ground can be accurately leveled to obtain a uniform height, which reduces the erosion of the high soil by water and prevents the high soil from gathering in the low place.

1.2 Datasheet and Composition

1.2.1 R26 Mobile Base Station Device List

Table 1 R26 Device List

R26 Mobile Base Station Device List			
Name	**Mode**	**Quantity**	**Figure**
R26 GNSS Receiver	R26	1	
Terminal Antenna		1	
Disk		1	
RTK Extension Rod		1	
Nine-core setting line		1	
Power Adapter		1	
Nine-core to DC cable		1	

1.2.2 JYL20 Land Leveling System Device List

Table 2 JYL20 Device List

JYL20 Land Leveling System Device List			
Name	**Mode**	**Quantity**	**Figure**
Tablet	T100	1	
RAM Bracket		1	
U Type Clip		2	
Camera		1	
Camera extension line		1	
Controller	W20	1	
GNSS Antenna	A10	1	
GNSS Antenna Cable		1	
GNSS Antenna Sucker		1	
CAN one to two cable		1	
Tractor main cable		1	
External Lift Switch		1	
Solenoid Valve Control Cable		1	
Vehicle Radio Antenna		1	
Radio antenna		1	
Power line		1	
4G antenna		1	

1.3 Working Principle

The satellite provides the base station with positioning reference information, and the base station transmits the radio signal to the controller and through internal calculation, so that the controller can obtain more precise position information. The controller calculates the reference datum plane by real-time sampling, compares the position of the scraper body with the reference datum plane, and combines the corresponding algorithm to obtain the expansion and contraction amount of the limit cylinder. When the scraper body position is higher than the reference datum level, the limit cylinder automatically shortens, the scraper body descends, the scraper body remove the soil and drives the soil forward; when the scraper body is lower than the reference datum level, the limit cylinder automatically extends and the scraper body rises, and the soil in the scraper fills up to the lower ground. When leveling the ground, the limit cylinder is constantly expanding and contracting according to the terrain, and the scraper body continuously remove and fill the soil. After leveling for a period, the field can form a plane on the same terrain to achieve fine leveling.

2. System Installation

2.1 Device Installation

2.1.1 GNSS Antenna Installation

The installation of GNSS antennas in the entire GNSS Land Leveling System is particularly important. Choosing a suitable installation location is the prerequisite for ensuring the leveling effect; due to the difference in the model and appearance of the leveler, the installation location must also be installed according to the actual situation; Please note that the GNSS antenna must be placed directly above the center of the grader scraper, as shown in the figure below(Figure1); when installing the GNSS antenna, you can choose the antenna suction cup for fixed installation; it is recommended that the clients increase the antenna installation position and use a flange fixed and the leveling effect could be better.

Figure 1 GNSS Antenna Installation

2.1.2 Radio Antenna Installation

The vehicle-mounted radio antenna is used to receive the radio signal from the mobile base station. It can be placed on the roof of the vehicle when installed, and can be fixed

on the roof of the suction cup at the bottom of the vehicle-mounted radio antenna, as shown in the following figure (Figure2):

Figure 2 Radio Antenna Installation

2.1.3 Cables Connection

Install according to the schematic diagram of the on-board mobile terminal(Figure3), and the solenoid valve control cables respectively control the lifting of the hydraulic cylinder of the leveler; during installation, in order to prevent the lifting from being contrary to the actual situation, an external lifting switch can be used for debugging. If it is contrary to the actual situation, the control line Change the positions of the two ports and then fix them.

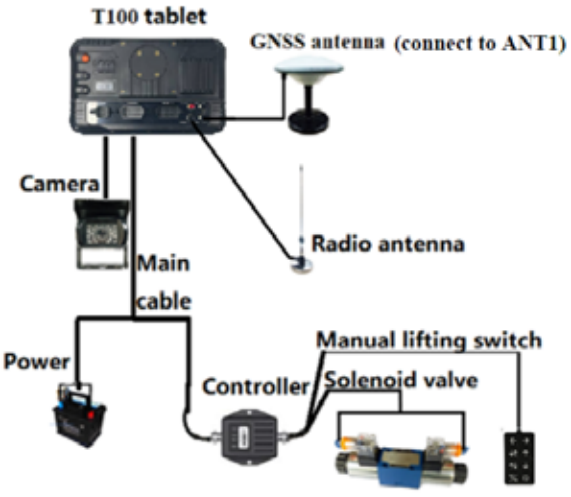


Figure 3 Cables Connection

Figure 3 Cables Connection (with D10)

Note:

1. Choose the correct cable layout location.
2. The solenoid valve control cable and the antenna cable are arranged separately, try to avoid the two entangled together.

2.1.4 Installation of Display and Controller

The display is the main equipment for the system to interact with the driver. Its installation position should be in the cab that is convenient for the driver to operate, such as the right or front of the cab seat. There is a tractor's own wire hole inside the cab. Fix the mounting bracket, if it is not possible to drill holes in a suitable position for fixing, then fix the monitor on the bracket.

2.2 Base Station Installation

2.2.1 Mobile Base Station Installation

Please reference figure below. (Figure5)

Figure 5 Mobile Base Station Installation

2.2.2 Installation Notes

1. When installing a mobile base station, pay attention to the surrounding environment and place it in a relatively open place to prevent interference

with satellite signals.

2. The GNSS antenna must be erected on a tripod or the height must be higher than 1.5 meters, and there must be no obstruction within the 360-degree range.

3. When the base station is working, observe whether it can work normally through the indicator light. During the normal working status, Power light are always on, the Satellite light flash,and the Differential light indicator flashes every second.

4. The coverage diameter of the mobile base station radio is about 2km. It should be noted that the distance between the vehicle-mounted terminal and the base station should not exceed its operating coverage during work. The specific coverage is related to the height of the base station radio antenna and the surrounding environment. The actual operating range shall prevail.

5. Mind the loss of battery power

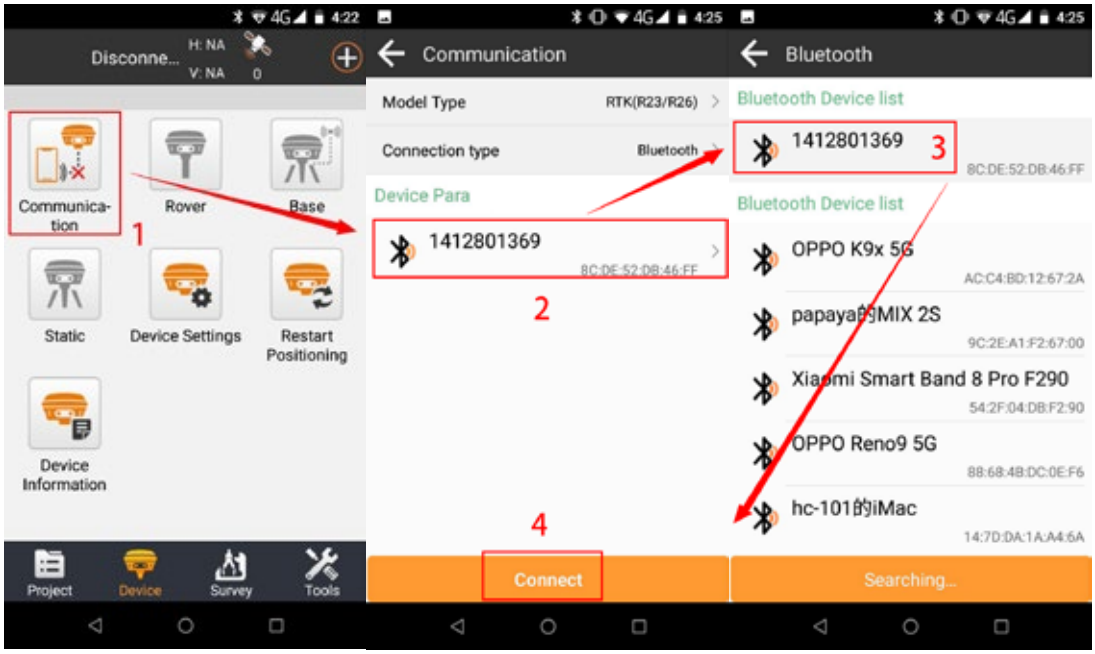
Set R26 as base station

(1) Install SMAJAYU Survey software(Allypad.apk) on your Android device.

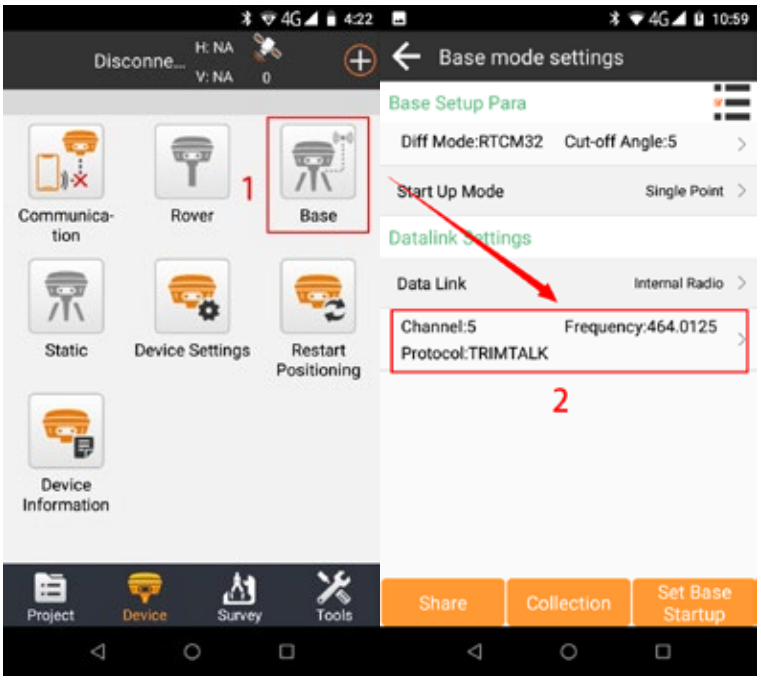
Download link:
https://www.dropbox.com/sh/w3s22r374bz4mhg/AAAwaiRbSi_odzfEM3Vj7FkFa?dl=0

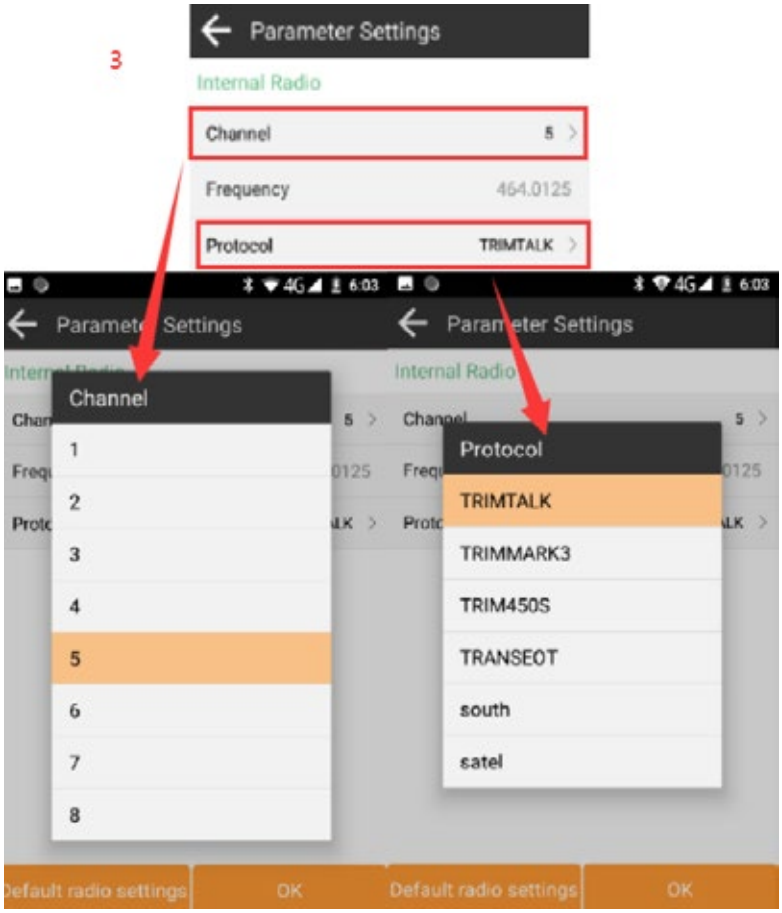
(2) Set up and start R26, open the Allypad app (make sure the device where the software is located has turned on Bluetooth): Device --> Communication --> Device Para --> Select your device number (same as SN) --> Connnect.

Set R26 base station : https://youtu.be/b2jBVYX_yNE



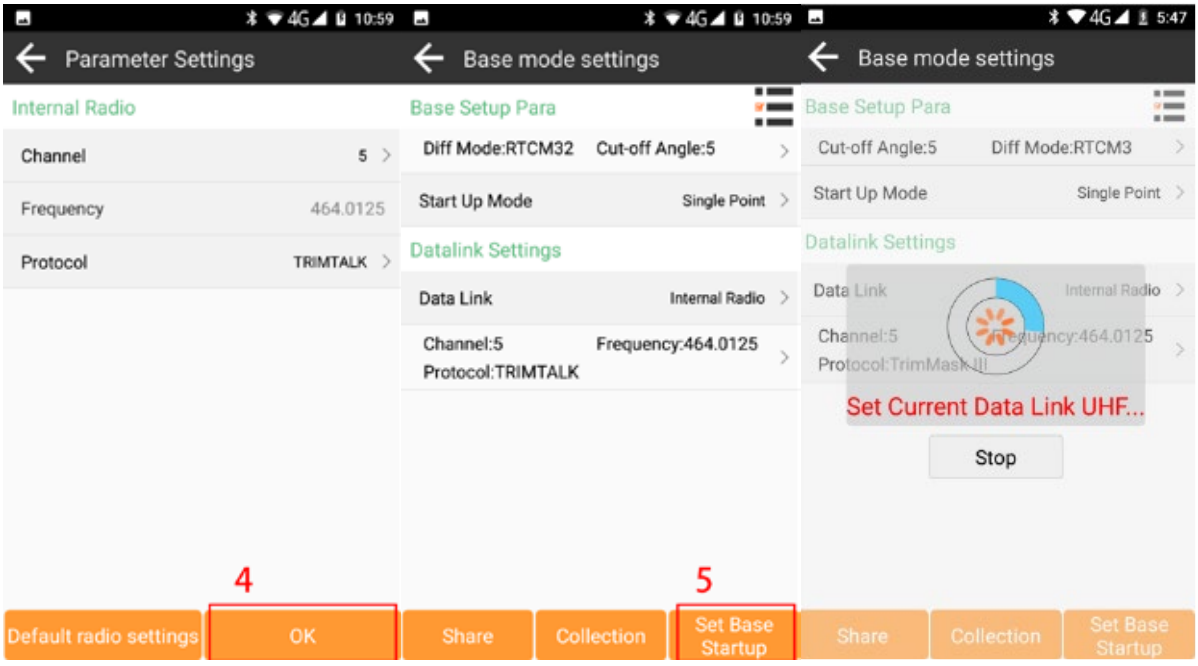
(3) Device --> Base --> Select the channel and frequency --> Set Base Startup





Tip:

1. **If your base station is R26 V2, the protocol selection is CSS.**
2. **If there is no protocol option in the software, please try to set the base station with default parameters first. After successful reset, you can see the options of the protocol.**



3. Features

3.1 Land Leveling System Software

Land Leveling System Software

As shown in the figure (Figure6), it is the icon of Land Leveling System software, click to enter the main interface.

3.2 Software Button Features

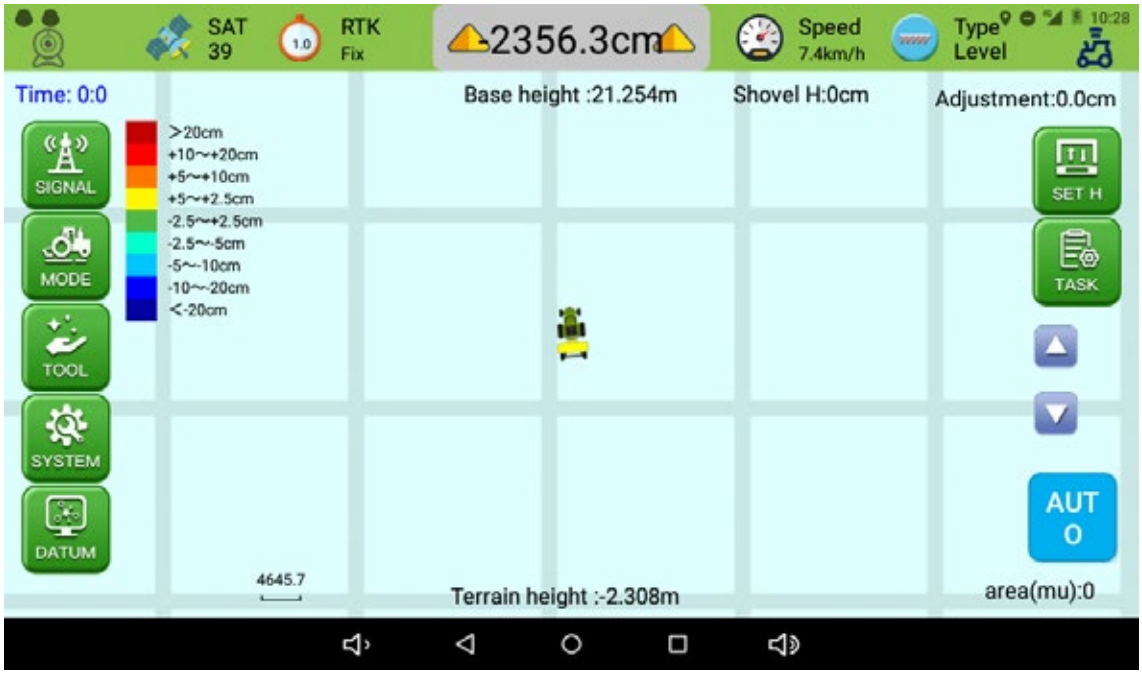


Figure 7 Software Button Features

As shown in the figure (Figure7), the main interface of the Land Leveling software is displayed on this interface: "Satellite", "RTK", "High Difference", "Speed", "Operation Mode", "Base Station", "Leveling Mode", "Auxiliary Function", "System Settings", "Information", "Datum Plane Fine-Turning", "One-key Height Setting", "Start Leveling/Auto Leveling", "Fine-Turning Value", "Total Earthwork" , "Map Scale" and other information can facilitate the information interaction between the software and the driver.

The function and role of each button will be explained in detail below.

3.2.1 Display at The Top of The Main Interface

1. Satellite: Shows the number of satellites found in real time. (Figure8)

Figure 8 Satellite

2. RTK: RTK status and data delay, fixed as available status. (Figure9)

Figure 9 RTK

3. High Difference: The value displayed in the top middle position is the height difference between the real-time plane and the datum plane，It is marked as when higher than datum plane and flash (default 0.5S flash once)，positive value，for instance：+15cm；It is marked as when lower than datum plane and flash (default 0.5S flash once)，negative value，for instance：-15cm；It is marked as when within datum plane accuracy range and flash (default 0.5S flash once)，for instance：-1cm (That is within the accuracy range, the range can be set by yourself). (Figure10)

Figure 10 High Difference

4. Speed：Real-time working speed（For reference tractor speed）.(Figure11)

Figure 11 Speed

5. Leveling Mode：Current leveling mode, horizontal or slope mode. (Figure12)

Figure 12 Leveling Mode

6. Camera：Real-time image data,  click to open the camera, half of the image and half of the leveling interface. (Figure13)

Figure 13 Camera

7. Reset：Click to work with a fixed perspective of the tractor icon. (Figure14)

Figure 14 Reset

3.2.2 Display on The Left Side of The Main Interface

1. Base Station: Base station mode selection and connection, there are three modes: Radio, CORS, and Smajayu Network. You can choose one of them according to local conditions during operation, as shown in the figure below (Figure15).

Figure 15 Base Station Connection

2. Leveling Mode：After click button, there will be horizontal mode, slope mode, and control mode. The current horizontal mode and slope mode are available. You can choose according to the work situation during operation. After selection, there will be a detailed operation introduction, as shown in the following figure (Figure16, 17, 18, 19, 20, 21).

Figure 16 Leveling Mode

Figure 17 Control Mode

Figure 18 Manual height setting in horizontal mode.

Figure 19 Auto height setting in horizontal mode

Figure 20 Two-point fixed height in slope mode

Figure 21 Directional height setting in slope mode

3. Accessibility: After operation the accessibility, there are area measurement, working hours, and briefing modes. After operation the area measurement and working hours, there are detailed introduction and operation instructions; Briefing mode: the simple interface is the same as the data called by the advanced interface, but the interface and operation are simplified , Which is convenient for operators with different usage habits and different requirements. This function is not yet open. (Figure 22, 23, 24)

Figure 22 Accessibility

Figure 23 Area Measurement

Figure 24 Working Hours

4. System Setting: After opening the system settings, there are three items: precision setting, threshold setting, and other settings. The specific operations are described in detail after opening the corresponding items, as shown in the figure. (Figure25, 26, 27, 28)

Figure 25 System Setting

Figure 26 Precision Setting

Figure 27 Threshold setting

Figure 28 Other Setting

3.2.3 Display on The Right Side of The Main Interface

1. Fine-tuning value: The fine-turning value means the value to move the input datum plane up or down. A positive value means a move up by “n” cm, and a negative value means a move down by “n” cm. Click the up/down arrow to increase/decrease 0.5 cm.

2. Datum plane fine-tuning: Open the datum plane fine-tuning, click the up arrow, the datum plane will move up, and adjust in 0.5cm units, and click the down arrow to move the datum plane down, as shown in the figure below (Figure29):

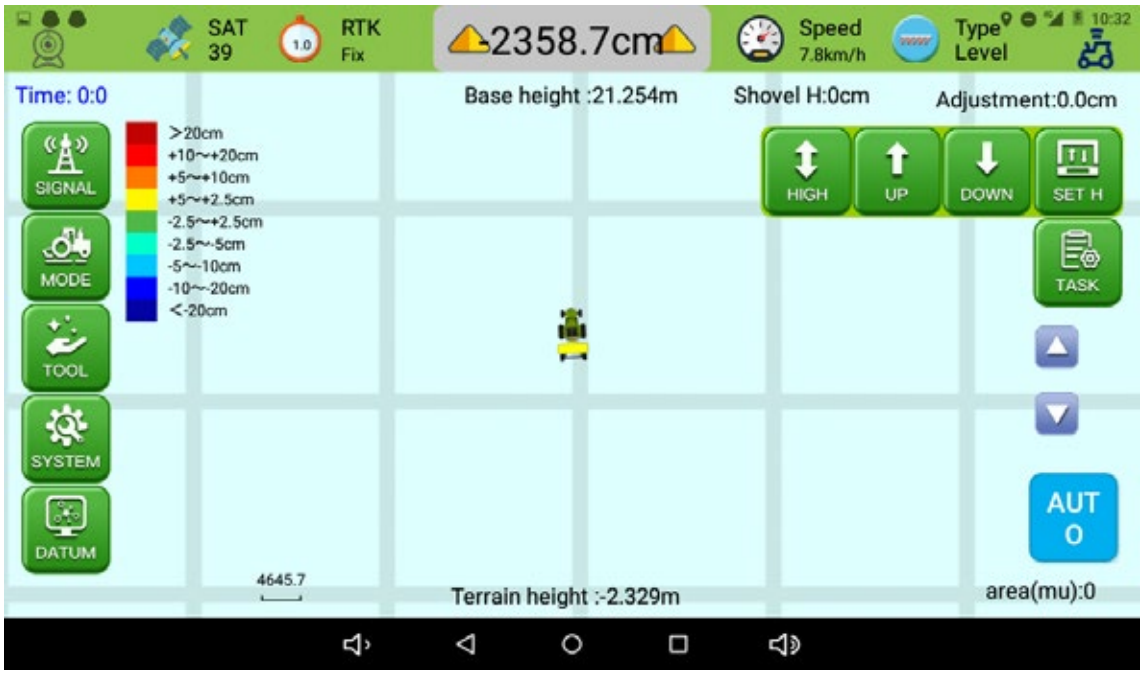


Figure 29 Datum Plane Fine-turning

3. One key to set height: Click "One-key height fix", click "Height fix", then a confirmation dialog box pops up. Click "Confirm". Datum plane is reset successfully, and the datum plane is the current GNSS antenna height position. As shown below (Figure30).

Figure 30 One Key to Set Height

4. Start Leveling / Automatic Leveling: Green button is manual control mode, red button is automatic control mode; the default is manual (green button) when the machine is turned on, click to change to automatic status display, and the system enters automatic control lifting operation mode.

3.2.4 The Main Interface Bottom Display

Map Scale: Use two fingers to zoom in and zoom out of the map and display the corresponding value according to the zoom in and zoom out ratio, unit in m (meters). （Figure31）

Figure 31 Map Scale

3.3 Working Flow

3.3.1 Connect to R26 base station

Method 1:

1. Make sure R26 is successfully set as base and D10 is properly connected to the tablet. Start Software, Click SIGNAL --> RADIO --> 2029D
2. If your radio base station is R26 V1, please select Narrowband Mode. Manually select the R26 protocol, enter the frequency and click SET, see Figure 32.1. If your power tower base station is R26 V2, please select Lora Mode. Enter the SN of R26, and then click SET, see Figure 32.2.
3. Wait 1~2 minutes until RTK gets the Fix solution. See Figure 32.3. RTK is displayed as Fix, which means it is successfully connected to R26.

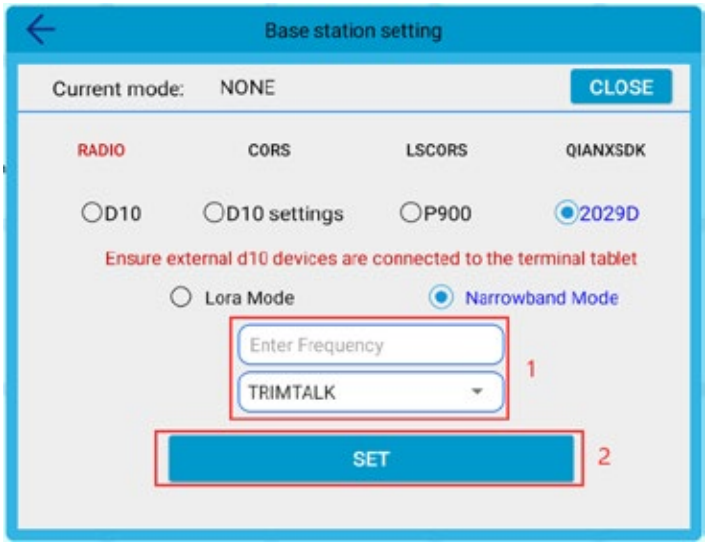


Figure 32.1 Connect to R26 V1

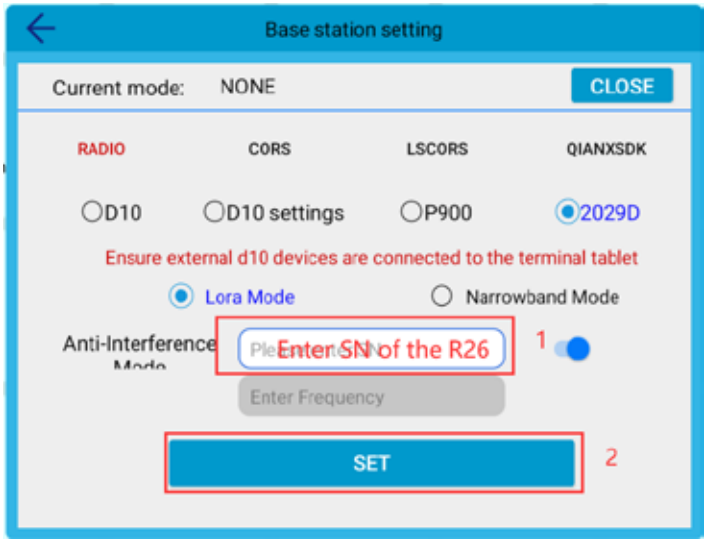


Figure 32.2 Connect to R26 V2

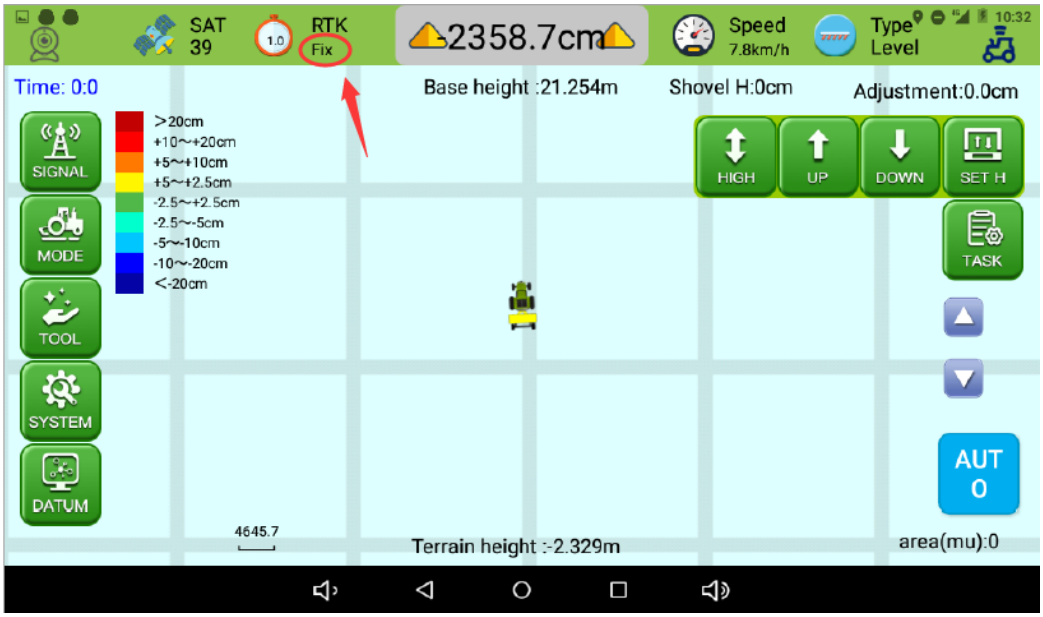


Figure 32.3 Fix solution

Method 2 (If you have obtained the fixed solution through method 1, please skip this method. If you can't , try method 2):

1. Start Software, set the same channel and protocol as R26 base station on 'D10 setting', or click OBTAIN to automatically obtain the base frequency and protocol and then click SET.
2. Click SURE in 'D10' to save the radio settings (Figure30), wait 1~2 minute until the RTK get fix solution.

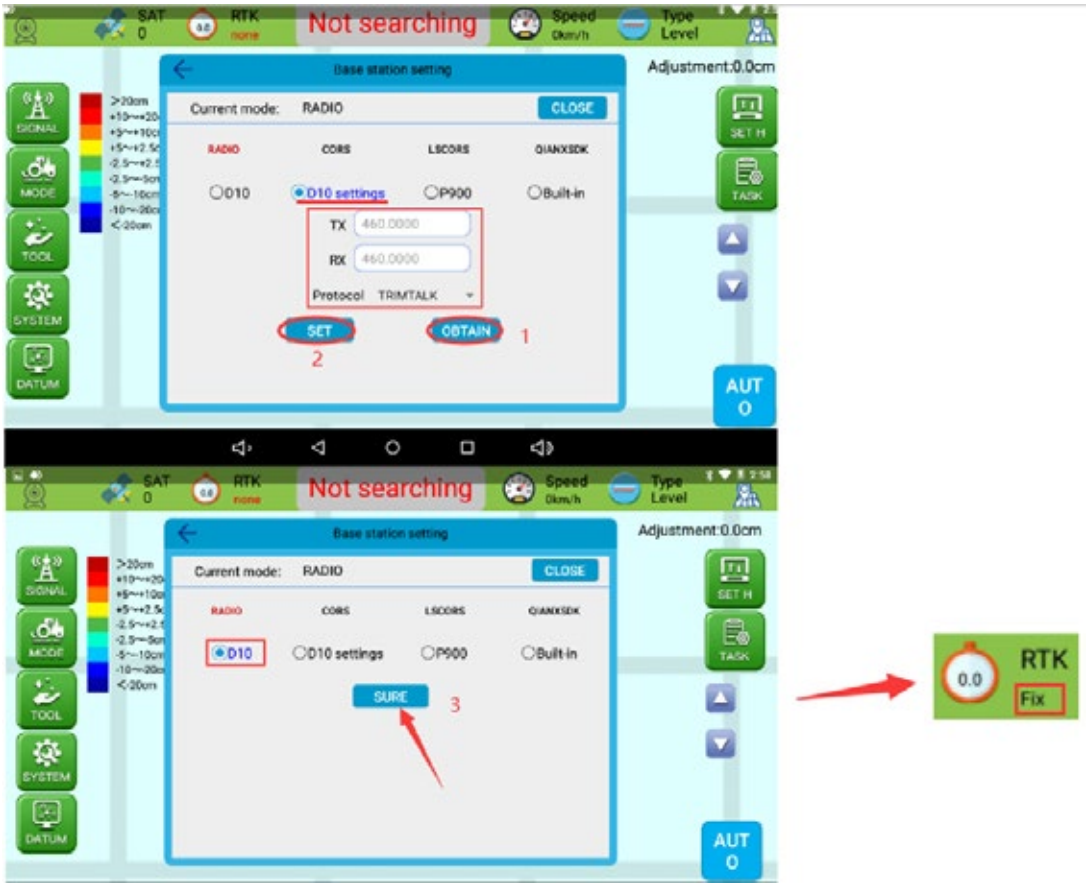


Figure 32.4 Base Station Setting

3.3.2 Create a new job

1. The base station is connected well, check whether the search star is normally, whether the RTK is fixed, whether the elevation and other displays are normally.
2. Enter the corresponding job information after creating a new job. (Figure33)

Figure 33 Create a New Job

3. Click system setting – other setting to setting width. (Figure34)

Figure 34 Width Setting

5. Datum plane setting: Open the horizontal mode in the leveling mode, and you can set the datum plane by manual or automatic height setting. The specific operations are as follows:

   （1） Manual height setting: start the power output, manually lift the blade of the scraper, adjust the blade of the scraper to a suitable height from the ground, enter the leveling mode, click manual height setting to complete the benchmark setting.

   （2） Automatic height setting: Manually control the leveling scraper to the ground, click the ground height button, and manually control the leveling scraper to raise about 15cm (the tractor does not scrape the soil during driving), click to start measuring, and run a figure 8 in the work area. After driving, click Finish to complete the benchmark setting.

   Note:

   1. When setting the datum plane manually, you must choose a location with a moderate topography for setting.
   2. When setting the datum plane, mind the position of the hydraulic cylinder. It cannot be set at the limit position of the hydraulic cylinder, preferably half of the hydraulic cylinder.

6. Click to start Automatic Leveling. (Figure35)

Figure 35 Start Automatic Leveling

Appendix A: Q&A

Q1: Base Station Satellite light does not light up

Analysis: The base station does not receive satellite signals or the RTK is not fixed.

Solution: (Checking by step, go to next step if signal cannot be restored after check.)

- Power cable connect, check equipment powered normally;
- Check whether the substrate erection position is reasonable, whether it is blocked by tall trees or buildings, whether there is high-voltage line influence;
- Reconnect the cables and restart the device;
- Reconfigure R26 with Allypad software.

Q2：The base station does not transmit radio signals

1. Analysis: Base station RTK is not fixed

   Solution：Reference Q1.

2. Analysis: Base station is not working in radio mode.

   Solution:

   - Change base station channel.
   - Reconfigure R26 with Allypad software.

3. Analysis: Receiver internal damage.

   Solution: Send back to company for repair.

Q3: Abnormal state of mobile vehicle terminal

1. Analysis：The number of satellites is less than 12.

   Solution:

   - Power cable connect, check equipment powered normally；
   - Check whether the substrate erection position is reasonable, whether it is blocked by tall trees or buildings, whether there is high-voltage line influence；
   - Reconnect the cables and restart the device；

2. Analysis：Radio signal reception is abnormal.

   Solution：

   - Change base station channel.
   - Reconfigure R26 with Allypad software.

Q4. Scraper lifts slowly

Analysis: Lack pressure.

Solution:

- Enter the software interface to adjust the threshold setting to increase the lifting speed ratio.

Figure 37 Adjust Lifting Ratio

- Adjust the speed of the output shaft and switch to the high-speed output gear.

Q5: Waves appear during leveling

1. Analysis: System signal reception abnormal.

   Solution: Check whether the signal reception is normal. If it is abnormal, reference Q3.

2. Analysis: Uneven plowing, local plots are too hard.

   Solution ：

   - Plow again
   - Perform leveling operations perpendicular to the direction of the wave mark or leveling the waves several times.

3. Analysis: The scraper shakes frequently

   Solution:

- Enter the accuracy adjustment under the system settings of the software interface and adjust the accuracy to 1.5—2.5cm；(Figure38)

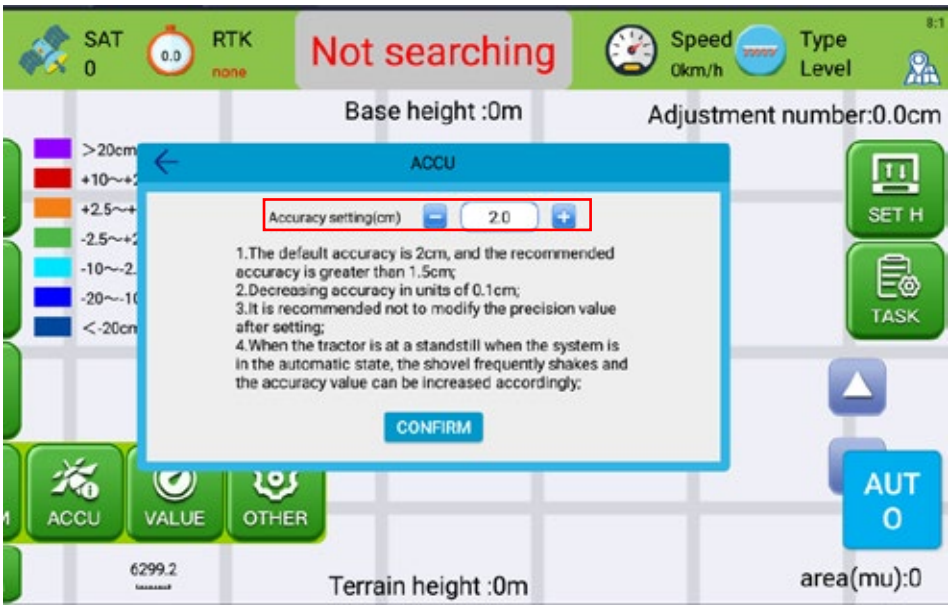


Figure 38 Adjust Accuracy Setting

- Enter the sensitivity adjustment under the system settings of the software interface and adjust the sensitivity value to 60-100. (Figure39)

Figure 39 Adjust Lifting Speed

Q6: Scraper reactions slow during leveling

Analysis: Sensitivity value is too low

Solution: Enter the software settings to increase the sensitivity value, generally set to 60-100.

Figure 40 Adjust Sensitivity Value

Appendix B Datasheet

1. T100 Display

Table 3 T100 Datasheet

T100 Display Datasheet	
Name	**Value**
Operating Voltage	12V
Screen Size	10 Inch
Brightness	800nits
Operating Temperature	-10 ~ +70℃

2. W20 Controller

Table 4 W20 Datasheet

W20 Controller Datasheet	
Name	**Value**
Operating Voltage	12V
Protection Level	IP65
Operating Temperature	-35 ~ +65℃

3. R26 Receiver

Table 5 R26 Datasheet

R26 Receiver Datasheet	
Static Accuracy	Flat: ±（2.5+0.5×10-6D）mm Elevation: ±（5+0.5×10-6D）mm （D is the distance between measured points）
RTK Accuracy	Flat: 1cm+1ppm Elevation: 1.5cm+1ppm

4. D10 External Radio

Table 6 D10 Datasheet

D10 External Radio Datasheet	
Name	**Value**
Operating Voltage	DC8-32V
Protection	IP67， Waterproof, Dustproof, Strong Shock Resistance
Storage Temperature	-40 ~ +85℃
Operating Temperature	-40 ~ +70℃

SMAJAYU
PRECISION AGRICULTURE

About Us

SMAJAYU was built in 2009, 10years+ experienced the technology changes from traditional devices to smart equipments. Intelligent agriculture empowered SMAJAYU new mission to support Agriculture development.

High-precision and affordable RTK GNSS system boosts the farming technology adoption across all-size farms. Integrated with GPS accuracy technology, SMAJAYU agriculture guidance and auto-steer ensure centimeters precision farming.

The main goals of SMAJAYU intelligent agriculture is optimizing farmer's work, reducing input costs and increasing farm income, promoting farm environment, increasing farm production.

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