Installation and Calibration Instructions for the PWL Parallel Guidance Kit.

Notice

The products, services, and features purchased are specified in the agreement between PWL

the Customer. All or part of the products, services, and features described in this document may not be

included in the scope of purchase or use.

The information contained in this document is subject to change without notice. We have made every effort to prepare this

document with the aim of ensuring the accuracy of its content, but all statements, information, and recommendations

contained herein do not constitute any warranty, express or implied.

Contents

1 Before you begin

Dear Customers,

Thank you for purchasing our product. Before starting work, please read the following information carefully and make sure your operator reads it carefully; if you are not the operator:

- **This user manual applies exclusively to the product. If the actual situation does not correspond to the situation described in the manual, please contact us. In accordance with the user manual, the actual situation takes precedence.**
- **To ensure safety and familiarize yourself with the instructions for using this system, please carefully read the safety precautions, operating instructions, disclaimers, and instructions contained in this user manual.**
- **The information contained in this user manual is subject to change without notice. We reserve the right to modify or improve the device, as well as the content of the user manual, without any obligation to notify you. If you have questions, please contact us.**

1.1 A Word to the Operator

This Nano Steer 210 automatic steering system is designed to assist the operator in precision farming applications. IT IS NOT A REPLACEMENT. Remember that YOU are fully responsible for the safe operation of the vehicle.

Carefully read and always follow the safety precautions and instructions for proper use of the system contained in this manual.

This user manual is intended exclusively for the FAG210. If the actual situation differs from the one described in this user manual, the actual situation shall prevail.

The information contained in this user manual is subject to change without notice. We reserve the right to redesign, modify, or improve the system, as well as the content of this user manual, as necessary, without notice.

1.2

The precautions listed in this section are intended to minimize the risk of personal injury and/or property damage.

Improper use of the system may result in death or injury to persons, damage to property, and/or system malfunction. Please make safety a priority in your daily work.

Before starting work, carefully read and understand the safety section, familiarize yourself with the locations and test all controls, and check all controls in an area free of people and obstacles.

Remember that YOU are the key to safety. Good safety practices protect not only you, but also the people around you.

1.3 Disclaimer

We assume no liability for property damage, personal injury, or death resulting from the following conditions, including: the Nano Steer 210 system and any of its components:

- **Any damage or loss resulting from installation or use that does not comply with the precautions and instructions contained in this user manual, or resulting from intentional destruction or damage to the system.**
- **Any property damage and/or system malfunction resulting from failure to perform maintenance by service centers authorized by Nano Steer 210.**
- **Any natural disasters, such as earthquakes, storms, floods, etc.**
- **Data alteration, data loss, etc.**
- **Improper transport.**
- **Use of non-genuine parts.**
- **The method of use was not explained in the user manual.**
- **Use of the GNSS system or signal for any purpose other than its intended use.**

We cannot guarantee the accuracy, integrity, continuity, or availability of the GNSS signal. When using the system, you are responsible for exercising common sense and your own navigational skills.

2 Nano Steer 210 at at a glance

The Nano Steer 210 is an integrated navigation device designed specifically for agricultural machinery autopilots, providing reliable positioning and guidance to enhance the precision of agricultural work and operational efficiency.

The FAG210 is equipped with a large 10-inch screen and advanced software supporting complex functions. The device integrates seamlessly with agricultural machinery, providing intuitive operation and stable performance tailored to the diverse needs of small and large-scale farms.

- **Accuracy:**
- **Dry land: 2.5 cm @RMS (≤ 10 km/h)**
- **Rice paddy: 5 cm @RMS (≤6 km/h)**
- **Line reception distance: < 7 m**
- **Vehicle speed range: 0.2–18 km/h**
- **Correction data source: CORS, radio and satellite corrections**
- **NMEA output: GGA, GSV, VTG, GSA, ZDA, RMC, and GST**
- **Data format: RTCM3.X**
- **Optional sensors: angle sensor, GNSS auxiliary antenna, and camera**

The system consists of the following components:

- **Computer hardware**
- **Software**

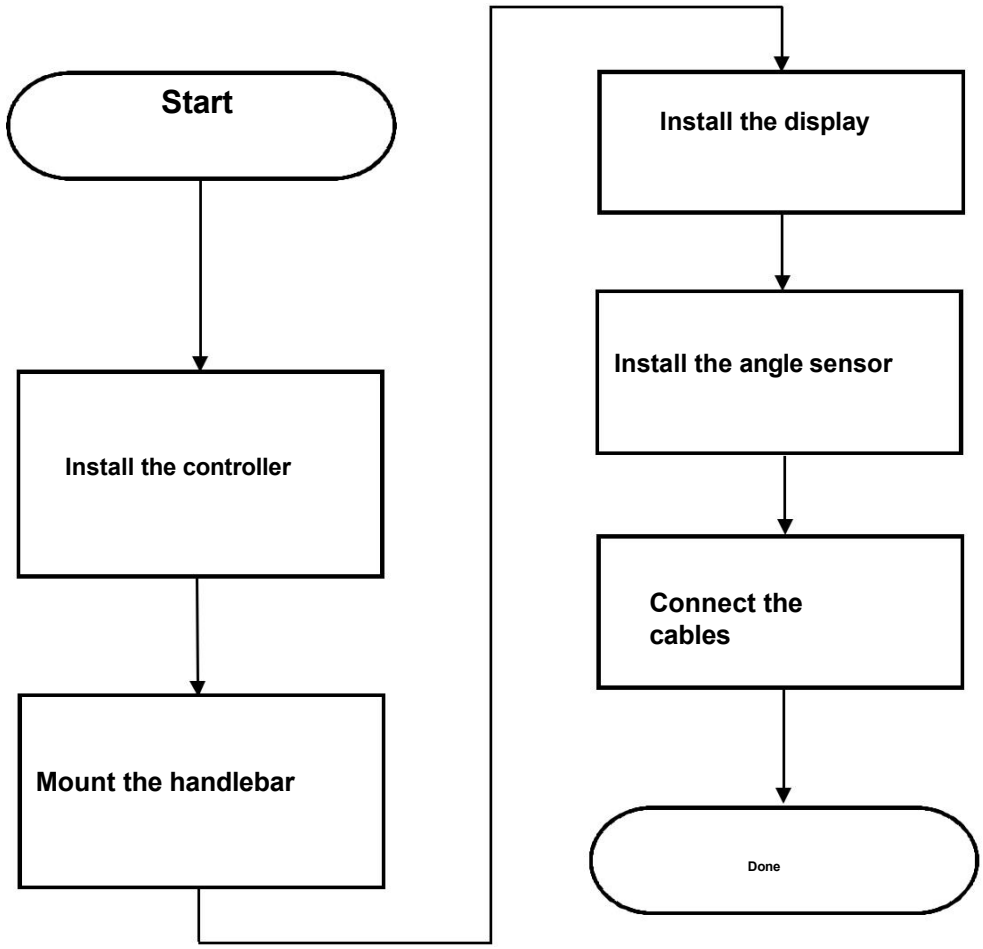
3 Hardware

3.1 Overview

The Nano Steer 210 hardware consists of the following components:

Computer hardware	Photo	Where to install
FC3 controller		It should be mounted in a location that is aligned with the centerline of the vehicle's roof. Before installation, check that screws and brackets are secure.
DP10 Display		It should be installed in a location where it is easily visible and be visible to the driver.
FM5 Electric Steering Wheel		It should be mounted directly on the steering shaft.
Angle J100 Sensor (optional)		It should be mounted on the right side of the vehicle's front axle. vehicle.
System cables	-	See the Wiring section for details.

A typical installation process is as follows:



3.2 Before installation

3.2.1 Check

Before installation, make sure that the vehicle to be installed meets the following basic conditions:

- **The vehicle is parked on a clean, level surface.**
- **There is enough space to work around the vehicle.**
- **The parking brake is engaged, and the wheels are blocked.**
- **All tools and headers are lowered to the ground.**
- **The front tires have sufficient pressure.**
- **If the pressure is too low, inflate the tires to the required level.**
- **The space between the connecting rods that control the front tires is not very large.**
- **If the size is too large, adjust it.**
- **The vibrations generated by the engine are not very strong when the vehicle starts.**
- **The battery voltage is normal.**
- **The voltage is 12 V (off) and 12–16 V (on).**
- **The steering wheel feels light during operation, and there is no play between the steering shaft and the steering wheel.**
- **There is sufficient space for mounting the steering wheel, the Y-shaped handle, and the C-shaped handle.**

3.2.2 Preparation

Before installation, prepare the following tools:

Name	Specification
Screwdriver	1
Allen wrench	1
Flat wrench	1
Diagonal pliers	1
Three-jaw sprocket puller	1
Tape	1
Knife	1
Electric drill	1
Socket wrench	1

3.3 FC3 controller

The FC3 controller is a specialized controller designed to power agricultural navigation systems, with each model optimized for specific installation needs and functional requirements.

The FC3 is an all-in-one design—integrating an IMU module, antenna, and circuit board—tailored for roof-mounted installation on agricultural equipment, ensuring stable operation and reliable navigation in agriculture.

3.3.1 Interface

9-pin port*1 (232*2, CAN*1);

RF interface, for the TNC interface of a GNSS secondary antenna;

SIM card slot*1.

3.3.2 Indicator light

Once all the cables are connected, you can press the power button to start up the FC3 controller. After it starts up, you can check its status by observing the color of the indicator light:

Flashing red light: update mode

Red light on: device self-check Green light on: device self-test complete

Flashing green light: RTK solution established

3.3.3 Installation

The controller should be mounted on the roof of the vehicle, and the mounting bracket should b e installed on the underside.

It can be secured with screws or adhesive tape. After completing the preparatory work, mount the controller on the tractor's central axle.

3.4 FM5 Electric steering wheel

3.4.1 Packing List

Name	Quantity	Photo
FM5 Electric Steering Wheel	1	
T-bracket	1	
T-bracket extension	1	
Y-shaped bracket and bracket shaped like C-shaped bracket	1	
M5*12 M6*40	8 3	

Name	Quantity	Photo
Handball on the steering wheel	1	

3.4.2 Installation

1. First, align the motor and handlebar, then tighten the screws to secure them (they were already connected when you received them)

This step does not require installing the handlebar cover.

If the cover has been installed previously, please remove it for later installation.

2. Next, install the shaft adapter.

Turn the motor over and secure the shaft adapter with screws.

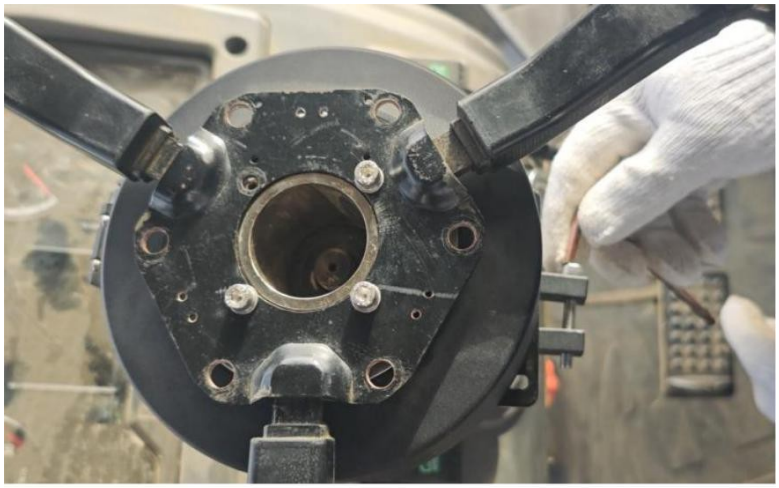
3. Third, mount the T-shaped bracket at the bottom of the motor.

Installation is also done using screws; there is no need to tighten them for later installation and position adjustment.

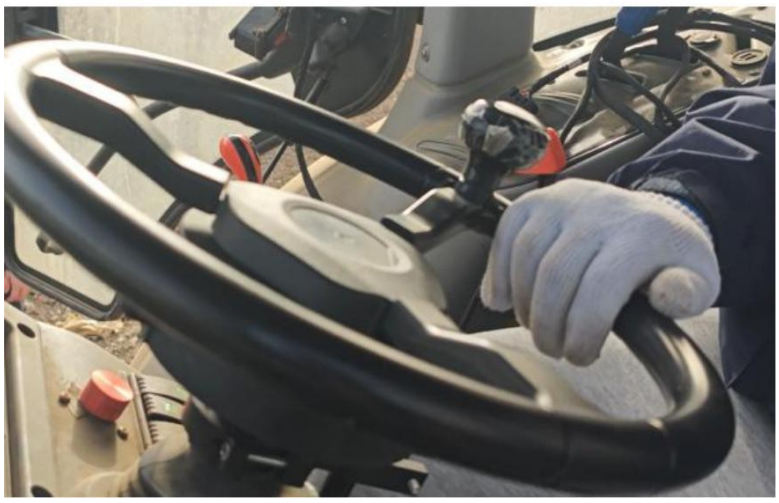
4. Fourth, mount and secure the Y and C brackets at the end of the control rod.

These do not need to be fully tightened so that their position can be easily adjusted.

5. Next, insert the motor into the steering gear and secure all mounting brackets with screws.



6. Finally, insert the shaft bolt into the motor hole, tighten it with a socket wrench, and then close the steering wheel cover to complete the steering motor installation.



3.5 DP10 Display

3.5.1 Packing List

Name	Quantity	Photo
DP10 Display	1	
Mounting kit RAM	1	

3.5.2 Installation

The smart display should be installed in a location where it is easy to view and operate. This is usually the armrest on the right door.

1. First, mount the rectangular ball head using U-bolts and secure it in the appropriate location inside the cab.

2. Next, attach the RAM mount to the ball head.

3. Finally, attach the tablet to the RAM mount, tighten, and secure. Installation complete.

3.6 J100 Angle Sensor Installation

In the case of the angle sensor, the sensor itself has already been integrated into the mounting plate bracket;

simply choose the appropriate location, mount it, and secure it flat on the right side of the front wheel (make sure it is the right front

wheel).

3.7 Cable

3.7.1 Introduction

The system typically comes with only one integrated harness.

If you purchase the optional angle sensor, you will also receive an extension cable for the angle sensor.

The integrated wiring harness and main head serve as the controller connector.

Following the controller connector downward, you will reach a splitter port with a total of five branch lines.

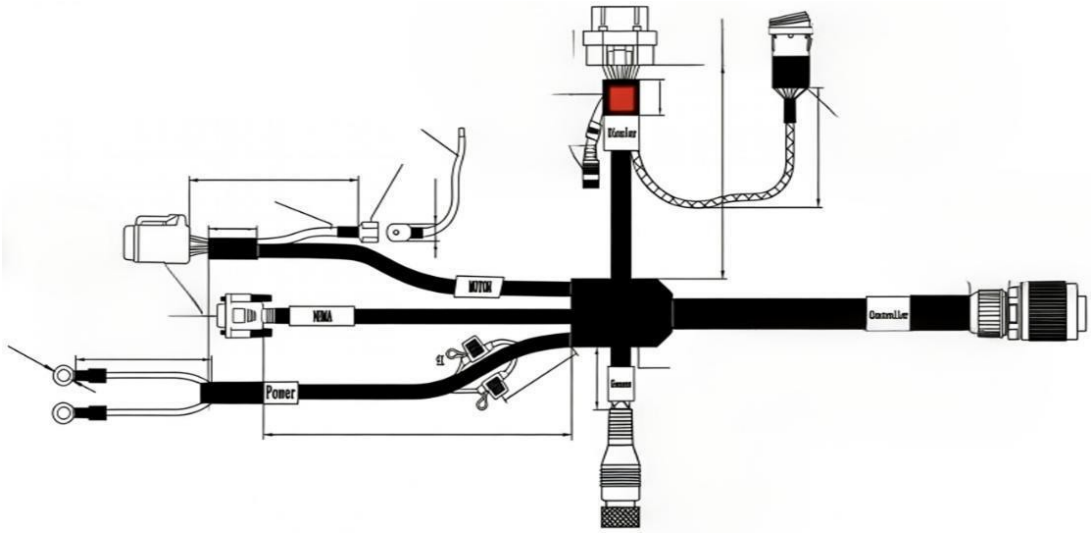
One of the branch ports is very short and serves as an interface for the angle sensor, which can be used with the extension cable;

In the next branch port, you will first see a fuse, followed by interfaces for the positive and negative terminals Power supply terminals;

One of the remaining three branches is the interface for the motor, as well as the switch and horn wire.
If the original steering wheel is equipped with a horn, you can connect it to this harness to keep it;

The next branch port is a DB9 connector, which can be used to output NMEA data. The final branch is an interface for the display screen and an interface for an external camera.

The wiring harness diagrams are shown below—each connector is labeled and easily identifiable.

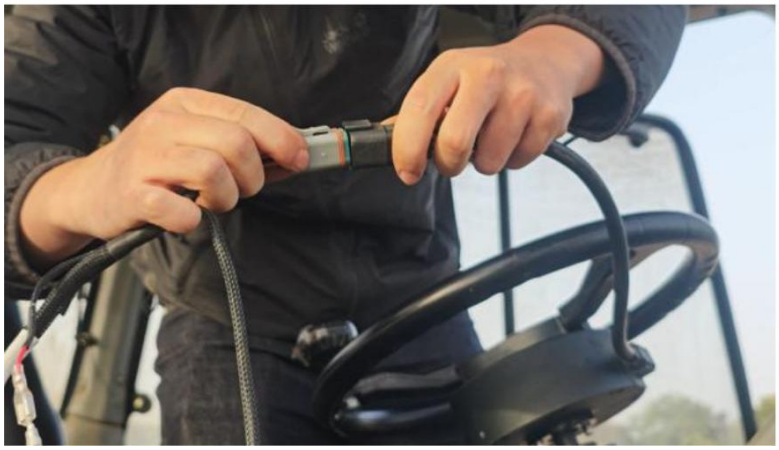


3.7.2 Connection

1. First, connect the power interface.

To use the battery, first remove the positive terminal, then the negative terminal. After disassembly, connect the negative port first, then the positive port.

2. Once the connection is complete, connect the four branch ports in sequence (display screen + motor + controller + angle sensor), where the angle sensor is optional.



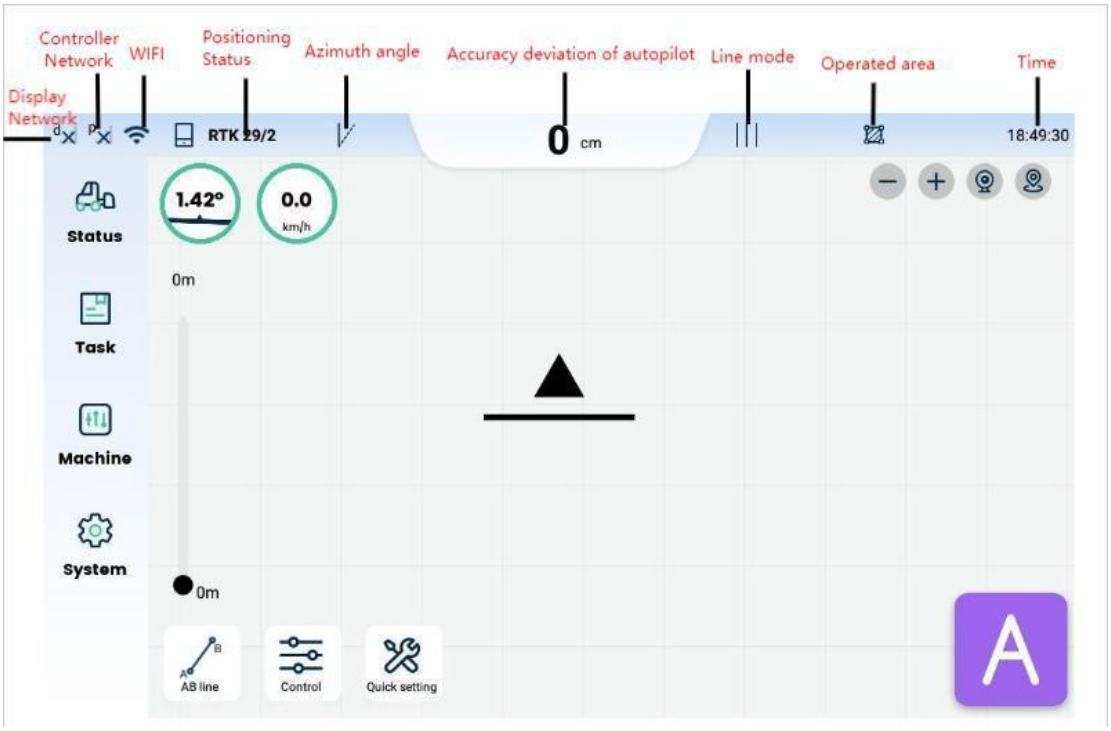
3. When connecting the angle sensor, make sure the wiring harness is long enough to prevent the wire from breaking when the tire rotates.

After connecting the wiring harness, you can secure any loose wires with cable ties and attach them to the body.

4 Software

4.1 Overview

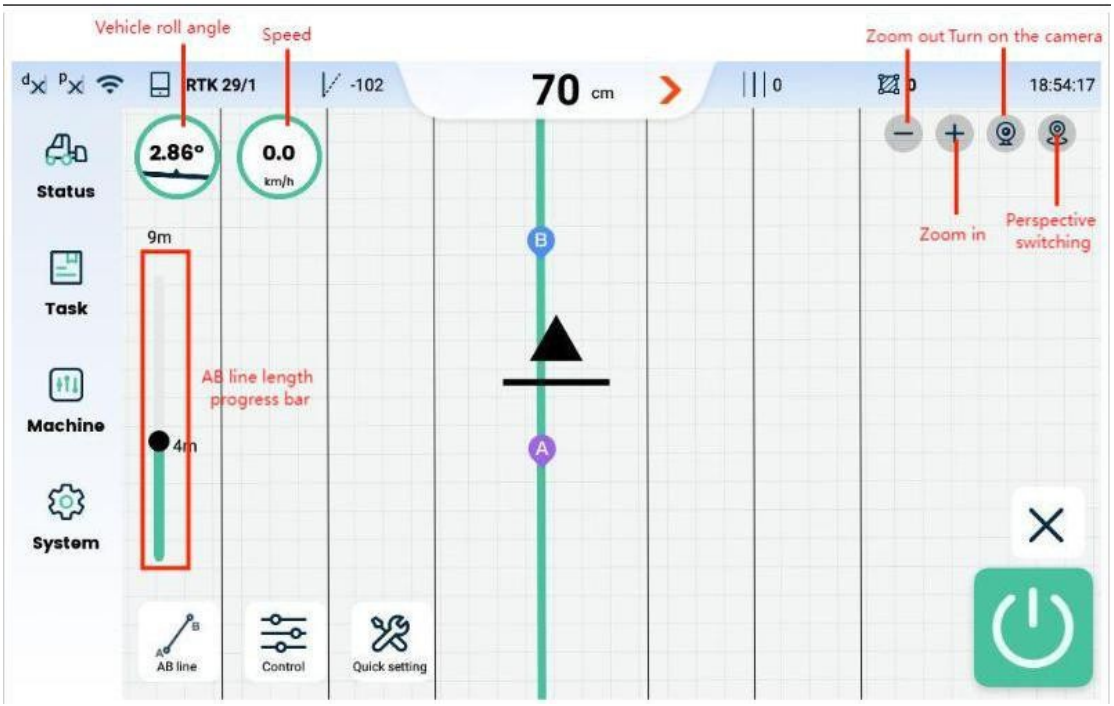
The main software interface looks as follows:



Satellite positioning status information:

- **NO** No satellite signal.
- **AUT** Single-point solution.
- **FLT** Floating-point solution.
- **DIFFERENCE SBAS (Satellite-Based Augmentation System) status.**
- **RTK Fixed solution. The number after RTK, the number before the "/" sign indicates the number of available satellites, and the number after the "/" sign indicates the age difference.**

  Please begin work after determining the RTK solution status.
- **PPP: A state of improved satellite positioning while simultaneously achieving a fixed solution.**
- **PPP-S Star pattern; the system is in a convergent state.**



• 9m **:This number represents the straight-line distance between point A and point B after the guide line has been set.**

• 0m **:Distance already traveled.**

• **: The symbol represents the vehicle.**

• A **:The symbol represents point A. (After a successful click, it is used to create a new task)**

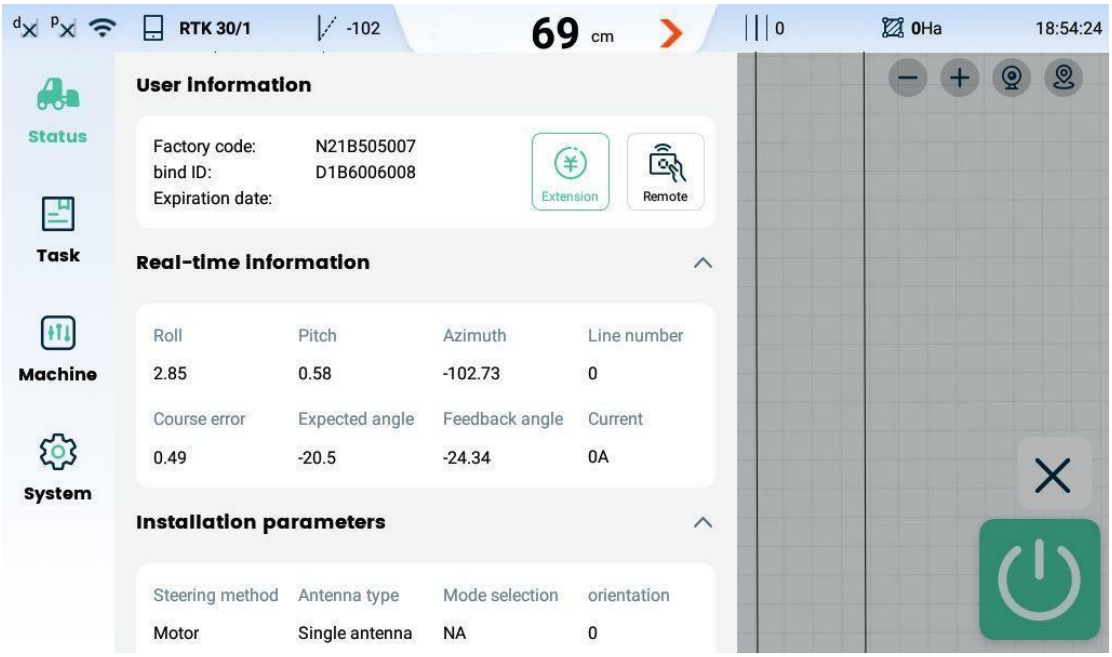
Point A of the guide line, which will become point B. Once the line is created, **Click to autopilot will be activated.)**

4.2 Status

• User information — users can view the serial number, pairing ID, and other information;

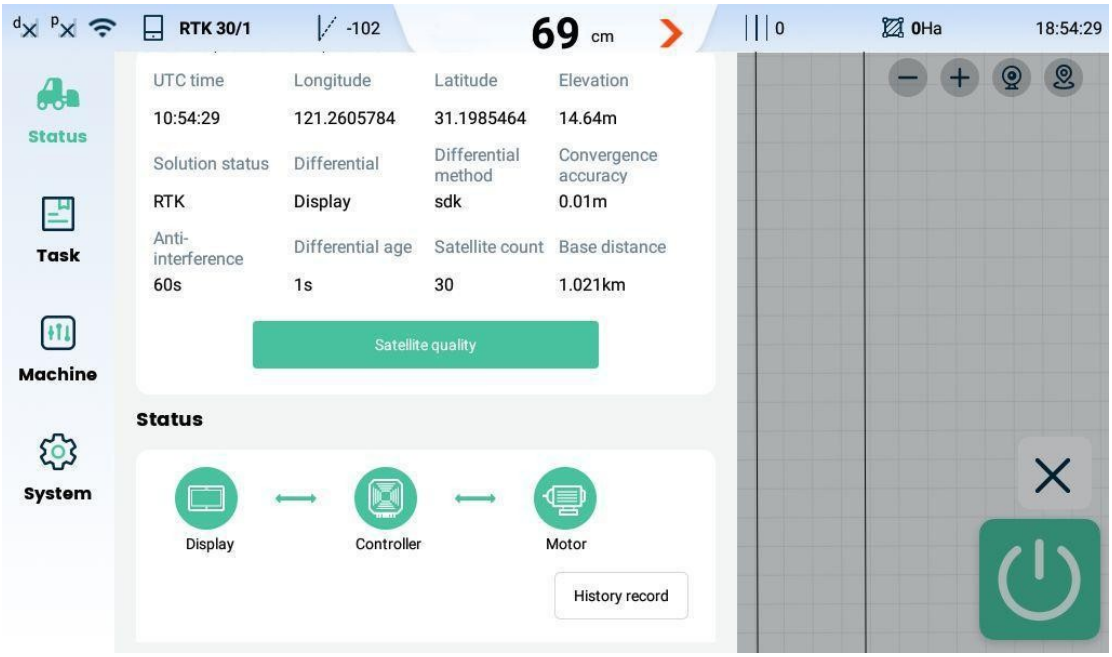
• Real-time information — users can view the current device status in real time, such as roll and pitch values, reference line numbers, and other information;

• Installation parameters — users can view the installation parameters of the current device, such as method (motor/hydraulic), antenna type (dual antenna/single antenna), configuration selection, and other information;



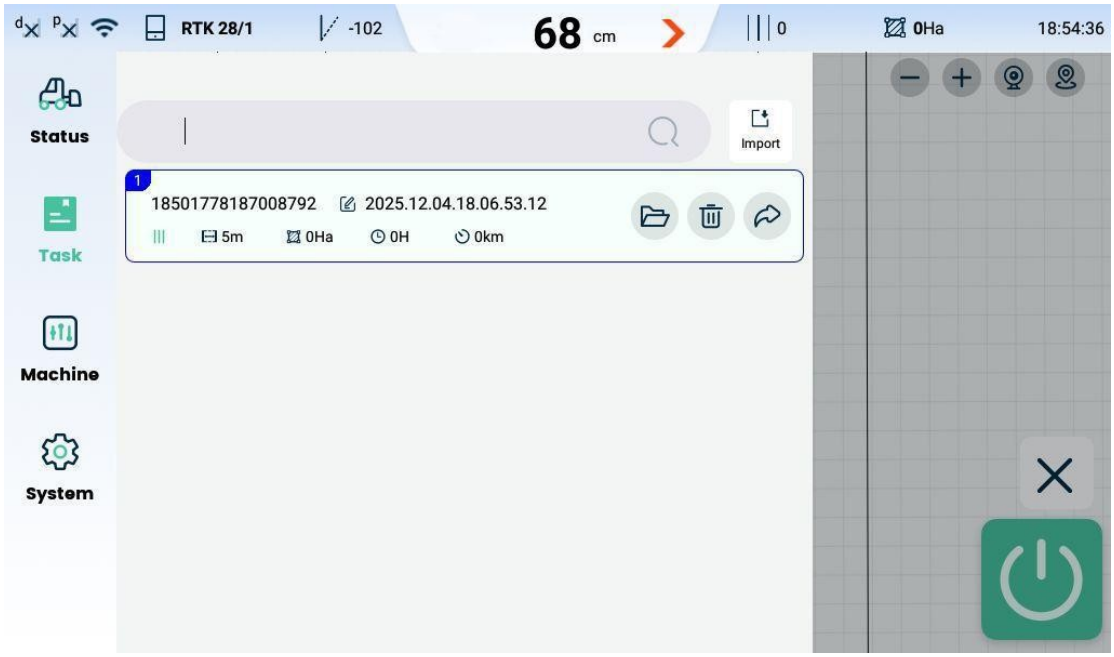
• Satellite status — users can view the satellite status of the device's current location, e.g., latitude and longitude, differential mode, accuracy, differential age, number of satellites, and other information;

• Device Status

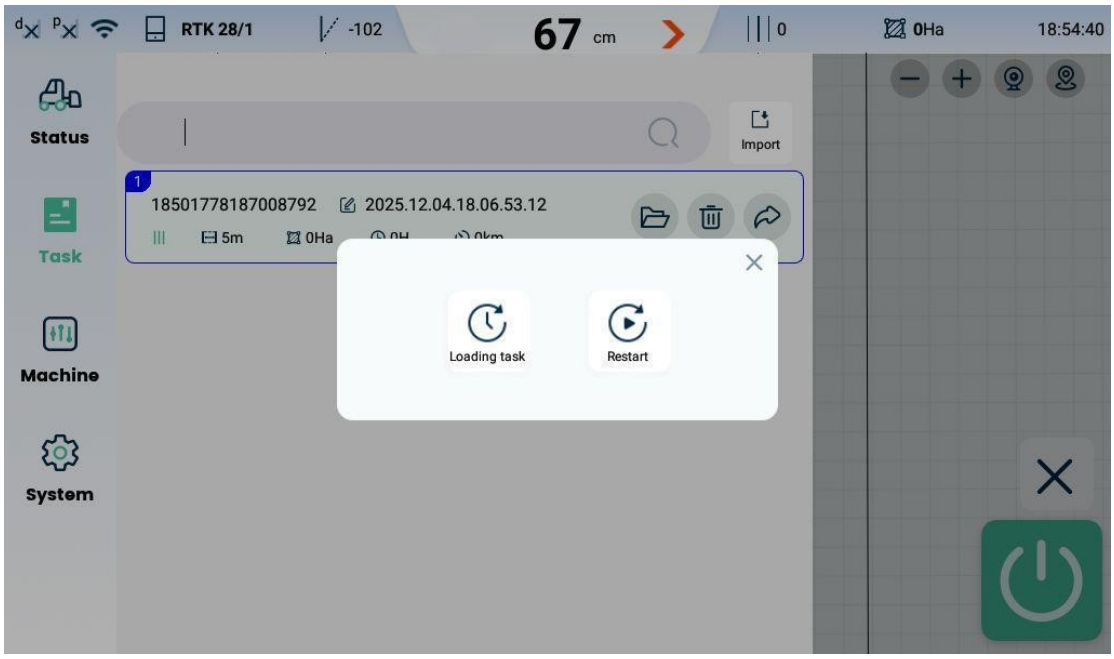


Users can use this feature to view the connection status of the controller, motor, and display. If the device malfunctions, the LED will turn red, indicating a problem with the circuit or hardware connection.

4.3 Task



- : Click the icon to open the task file, then click Load Task to continue the task based on the previous task result; Click "Restart" to cancel the set offset and start the task trajectory.

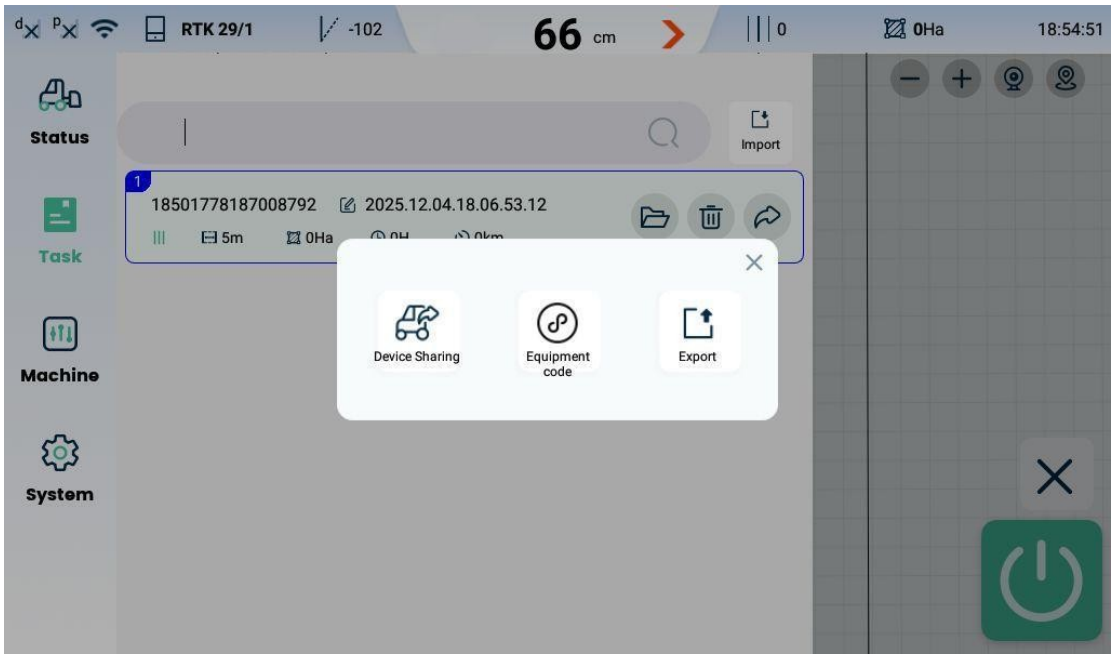


- : Click the icon to delete the corresponding task file.

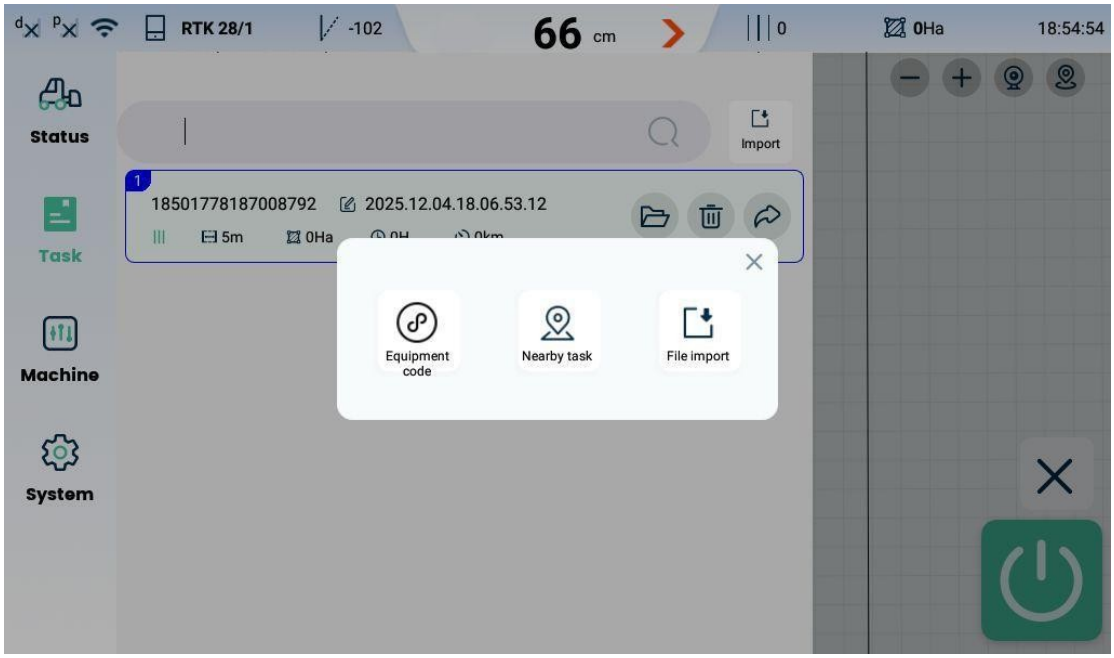
- : **Click this icon to share or export the corresponding job file. Click "Share Device" and enter the device's serial number to share the job with the corresponding device; Click**

  Generate Device Code to generate a random device code. At this point, another device can enter the generated device code to import the task file;

Click Export to export the job file to a storage device.



- Import : **Click this icon to import a job file.**



- 

:Click the hardware code and enter the job sharing code to import job files associated with the sharing code.

- 

:Not expanded.

- 

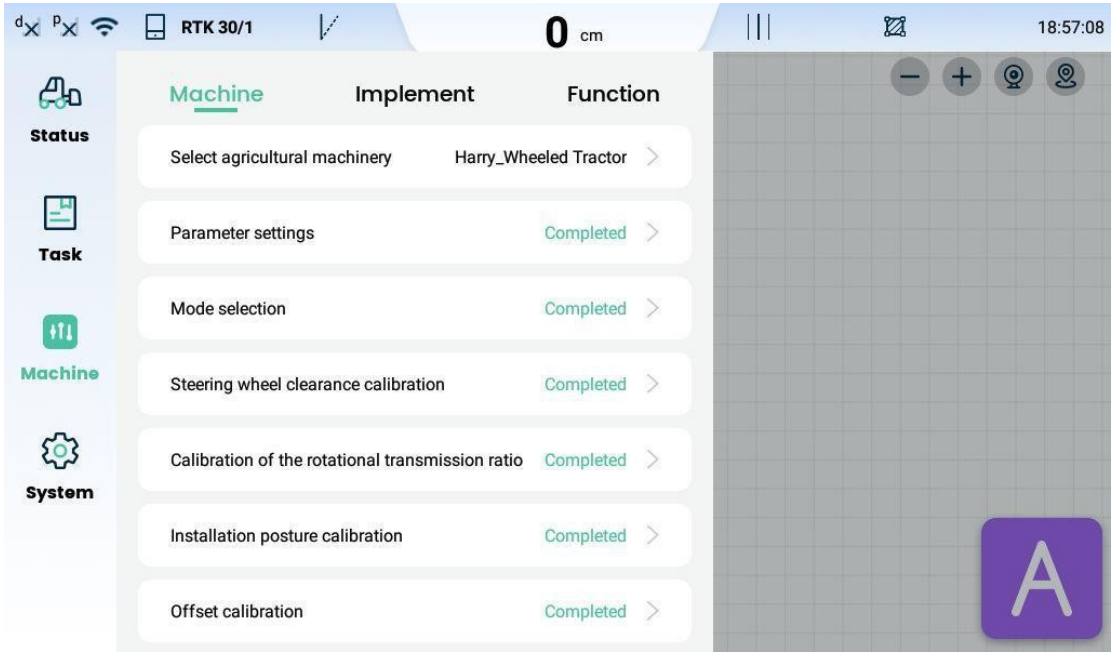
：Click to import task files from local storage.

- 

：You can monitor the task completion time, the surface area, and the tool width through this small window.

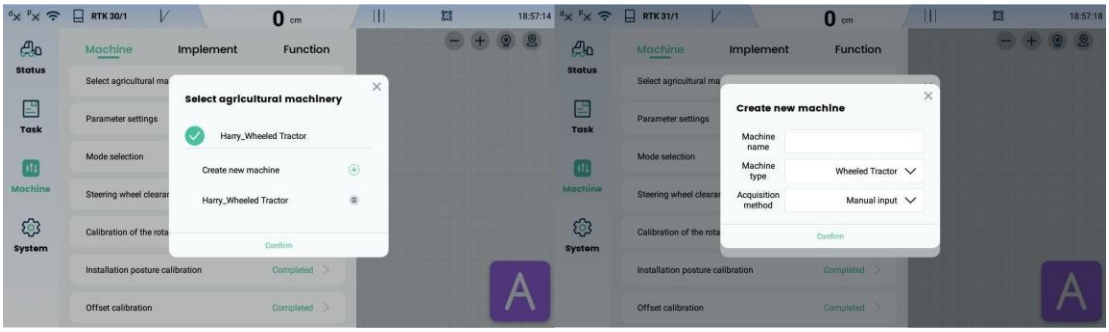
4.4 Machine

4.4.1 Machine



4.4.1.1 Select agricultural machinery

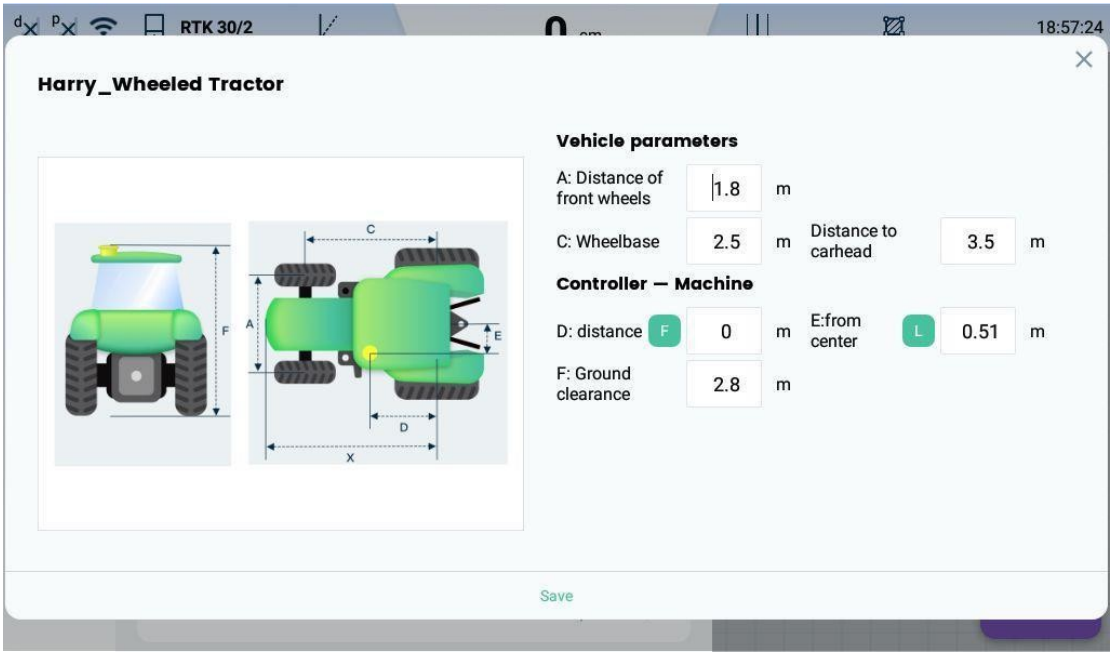
Click this option to create and select an agricultural machine object.



4.4.1.2 Parameter Settings

Click on parameter settings, enter the various measurement parameters of the vehicle model, and fill in the parameters accurately as shown in the figure. Refer to A \ C \ D \ E \ F \ X in the figure, measure the actual data

using a ruler and fill in the corresponding data field (Note that the unit is “meters”)



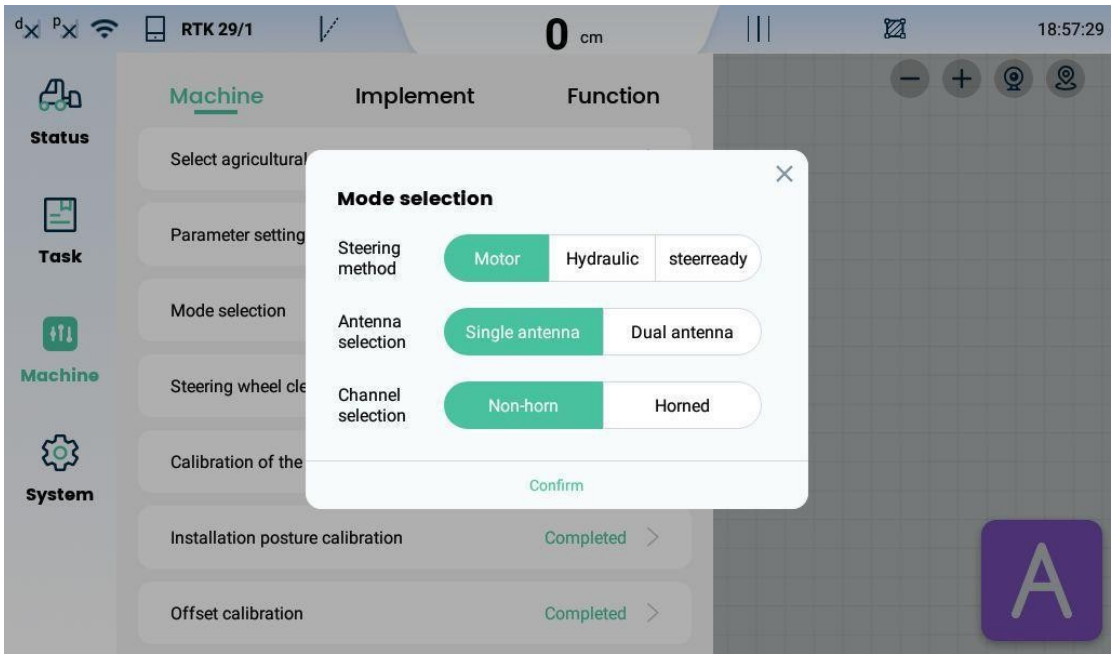
Please try to keep measurement errors within 5 cm and remember to save your data.

4.4.1.3 Mode Selection

Select Control Method, Antenna Selection, and Channel Selection.

No beep: Channel in angle-free detection mode.

The selected options in the diagram are: motor-controlled steering, single antenna, and free-angle detection mode.



4.4.1.4 Steering play calibration

Steering play, in layman's terms, refers to the maximum angle/travel that the steering wheel can achieve.

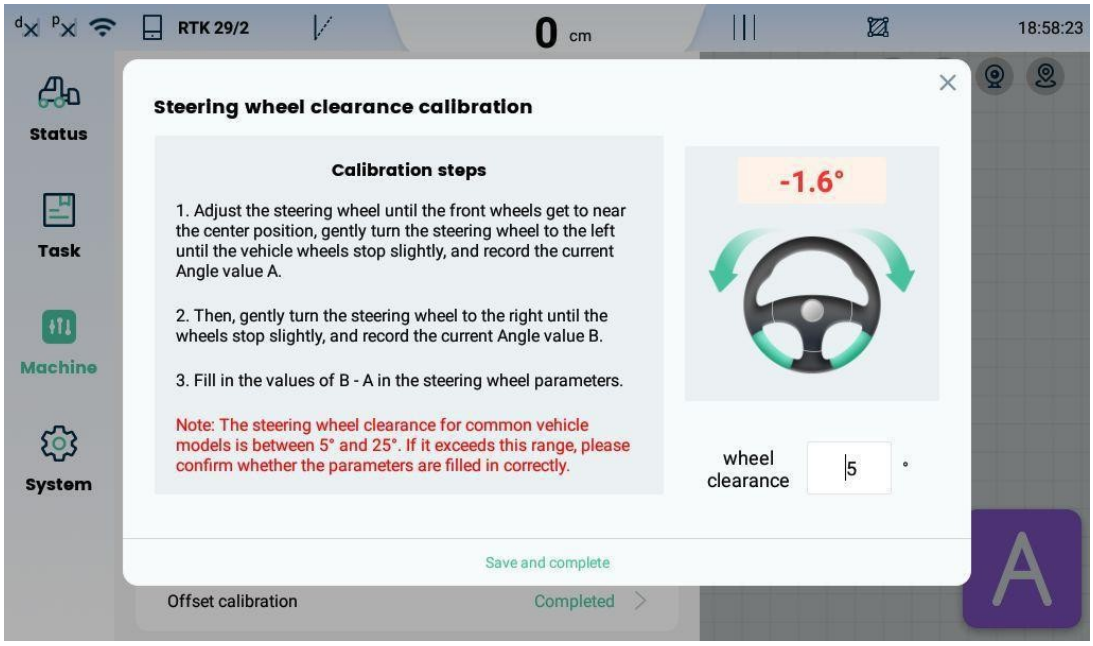
Turning left and right without turning the wheels. Simply put, this is the range of "idle play, without resistance and without

"wheel response" when turning the steering wheel. This is commonly known as "free play."

"play" in the industry.

Calibrate according to the interface instructions. Turn the steering wheel left and right; subtracting

the angle value gives you the steering play value.



4.4.1.5 Steering ratio calibration

Steering ratio, simply put, is the ratio of the “steering wheel rotation angle”

to the “actual steering angle of the vehicle’s wheels”—essentially the fundamental parameter measuring “how much

"how much the steering wheel turns determines how much the wheels will turn," directly influencing the "responsiveness of the steering system"

and the "feel" of the steering wheel. This

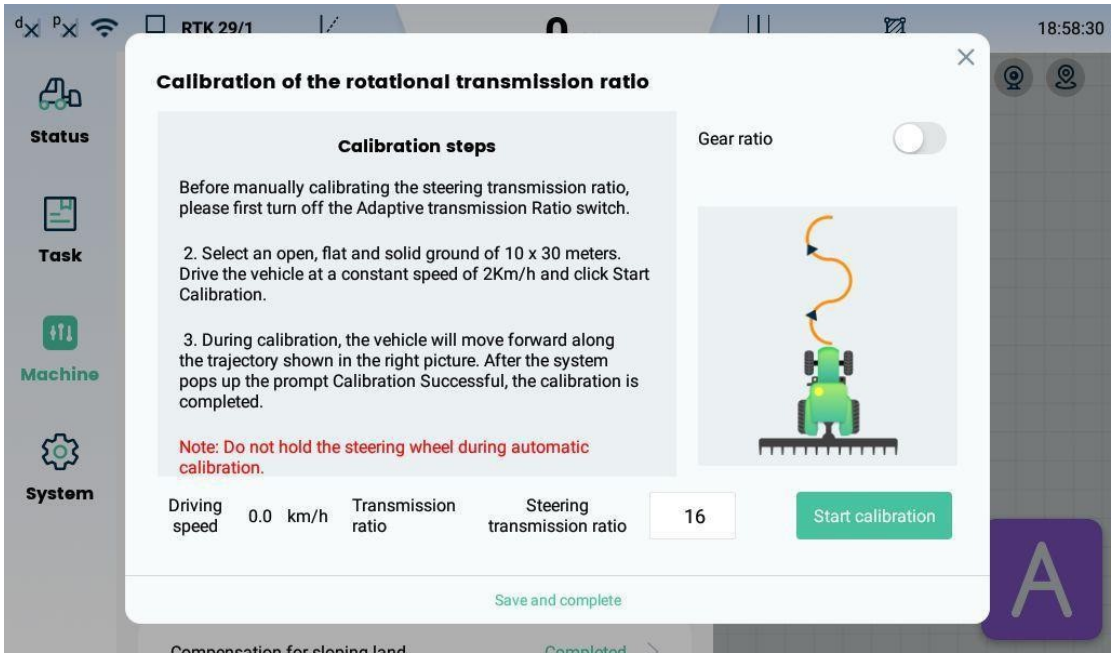
formula can be understood intuitively:

Gear ratio = Steering wheel rotation angle (°) ÷ Vehicle wheel turning angle (°)

Once calibration begins, the vehicle will automatically move forward along an S-shaped path. Please

ensure there is sufficient space in front of the vehicle. By automatically driving along the S-shaped path,

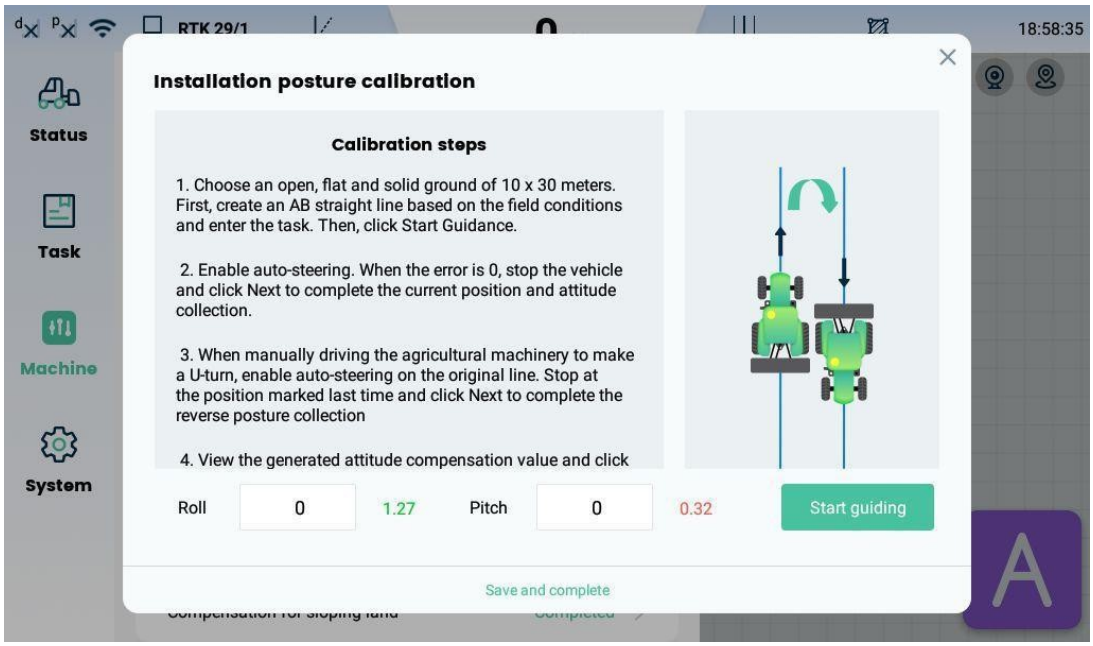
the vehicle can automatically calibrate the gear ratio.



4.4.1.6 Installation Alignment Calibration

The roll angle and pitch angle of a vehicle are two key angles describing the vehicle's position in three-dimensional space, corresponding respectively to "left-to-right tilt" and "front-to-back tilt" degrees (°), defined based on the ISO 8855 vehicle coordinate system (X-axis forward, Y-axis to the left, Z-axis up).

First, create a straight guide line and follow the interface instructions; autonomous driving in both directions to calibrate the vehicle's roll and pitch values. Be sure to save and complete the process.



4.4.1.7 Offset Calibration

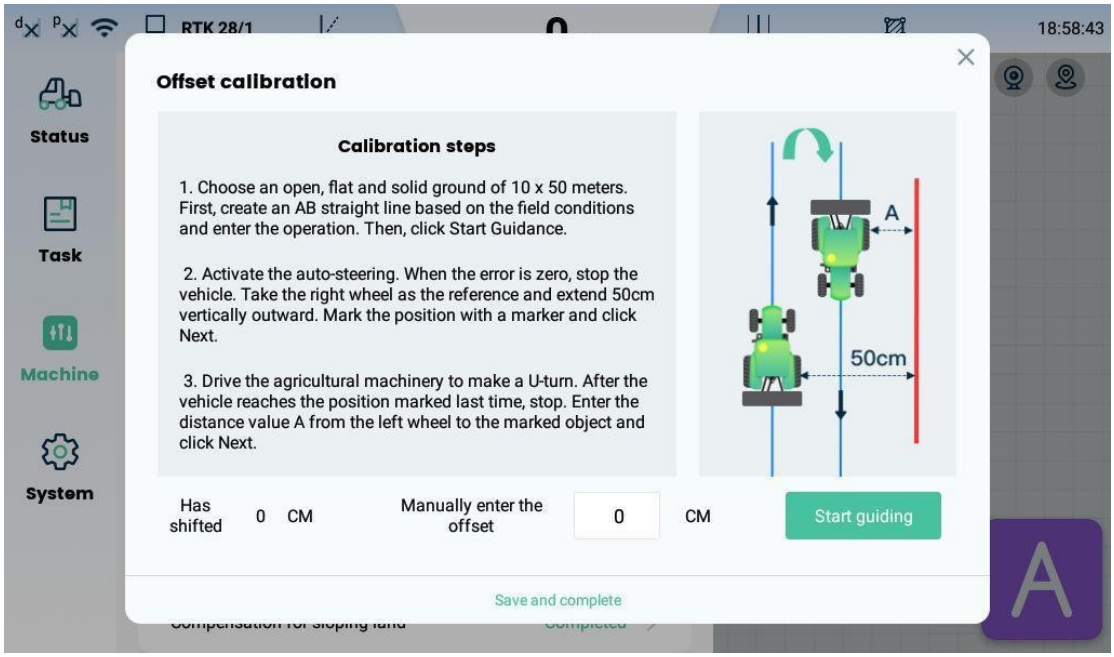
"Offset" calibration is a key step in correcting GNSS antenna offset, controller installation error,

and mechanical steering deviation by “driving back and forth along the same AB line + marking measurement,” so that the convergence of the trajectories in both directions is ≤ ± 1 cm. The core is to ensure that the “outbound”

and “return” trajectories are consistent and eliminate missed/re-cultivated areas during crossing.

Perform the calibration procedure according to the interface instructions, enter the measurement

values, and complete the calibration.



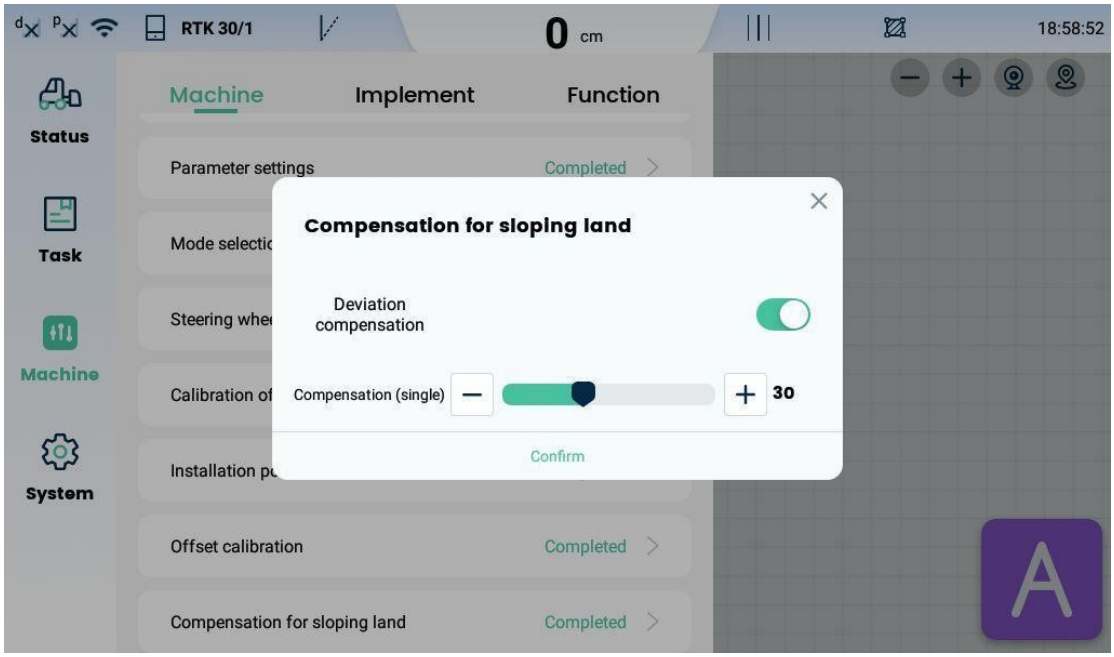
4.4.1.8 Terrain Slope Compensation

Slope calibration is a process that uses IMU position compensation, slope baseline calibration, and trajectory correction on sloped terrain to eliminate positional deviations caused by tilt/slope, enabling the machine to operate machines to operate stably along a given AB line with a positioning accuracy of ±1.5 cm to ±2.5 cm, avoiding the risk of missed plowing/re-plowing and sideways slippage.

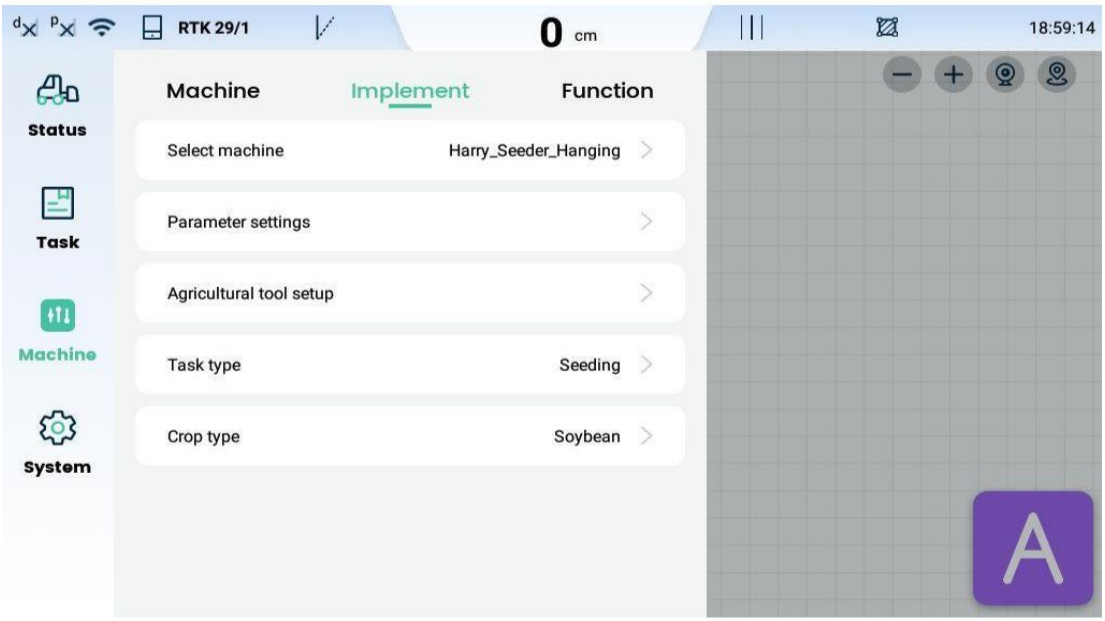
The greater the constant deviation when driving on a slope, the higher the corresponding compensation value should be set.

If the value is set too low, compensation may not occur or may be slow; if it is set too high, the limit may be exceeded, which could result in overcompensation.

It is usually sufficient to leave the switch on and set to the default value.

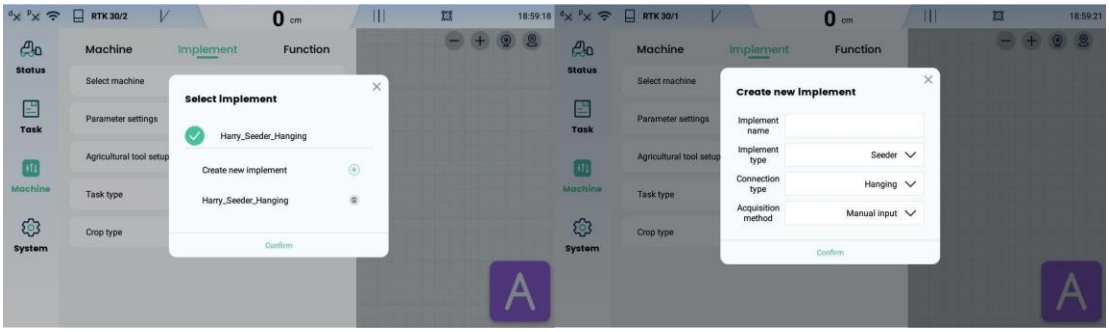


4.4.2 Tool



4.4.2.1 Select the Apply option

Click this option to create and select a tool object.



4.4.2.2 Parameter Settings

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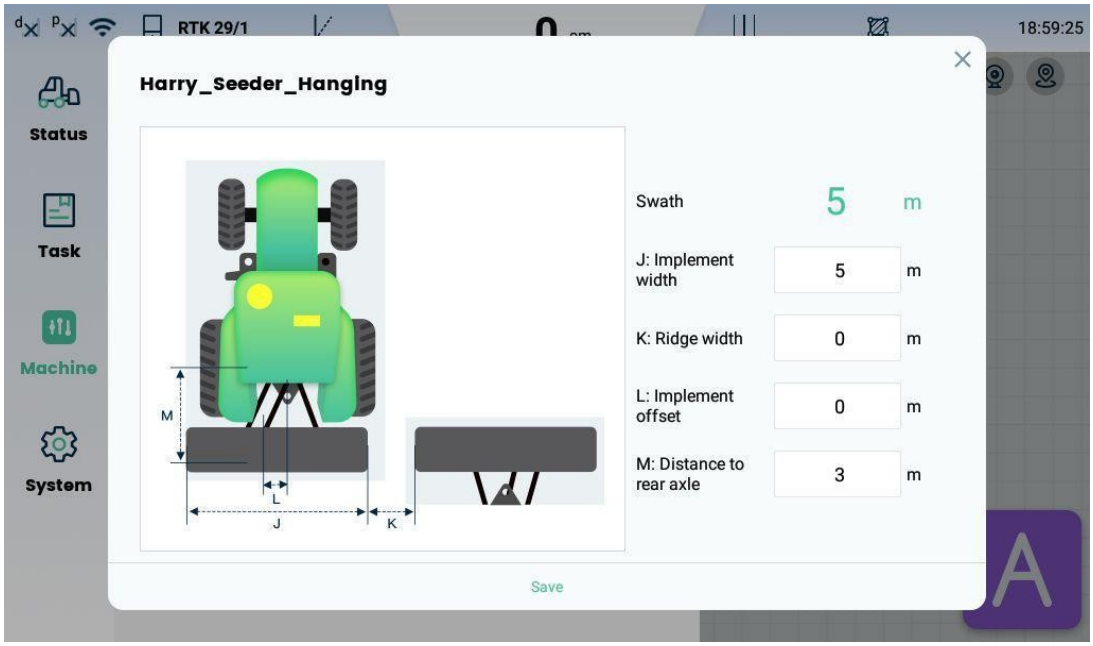
Click Parameter Settings and enter various tool measurement parameters, including tool width, ridge width, tool offset, etc.

Swath = Tool width + Ridge width



4.4.2.3 Implementing the configuration

Combined ridge calibration (also known as “cross-calibration”) is a key step in achieving accuracy

± 1 cm – ± 2 cm by measuring the overlap/gap between adjacent working widths, adjusting the offset and tool width parameters on the display terminal, and ensuring that the combined ridge (the so-called transition zone between adjacent working passes) has a uniform width, with no skipped plowing passes or double plowing.

The steps are as follows:

Set line AB: Display and control terminal → create line AB with a distance of ≥ 10 m between points A/B, activate the

autopilot.

Work three times: Work continuously along line AB three times, creating two connected ridges (left and right).

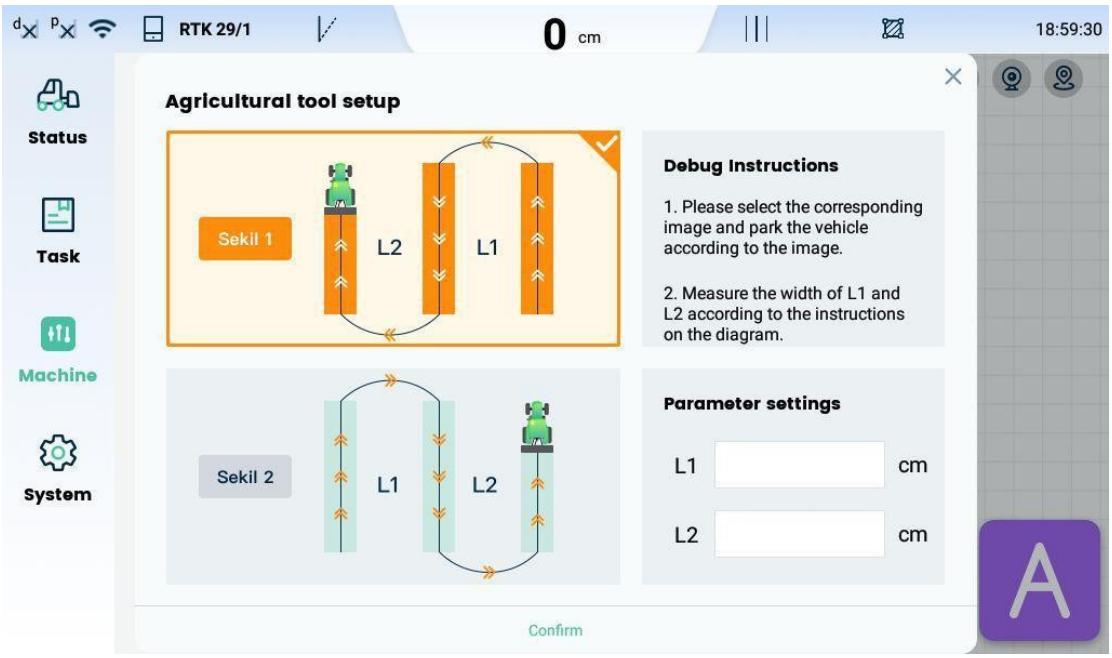
Measurement deviation: Use a measuring tape to measure the width of the left and right ridges,

and record the difference from the standard value (e.g., standard 50 cm, measured 52 cm on the left side, 48 cm on the right side).

Correction parameters: Terminal → Machine → Tool configuration → Input offset (left 52 cm, right 48 cm)

→ Confirm → Automatically calculate and save the calibration results.

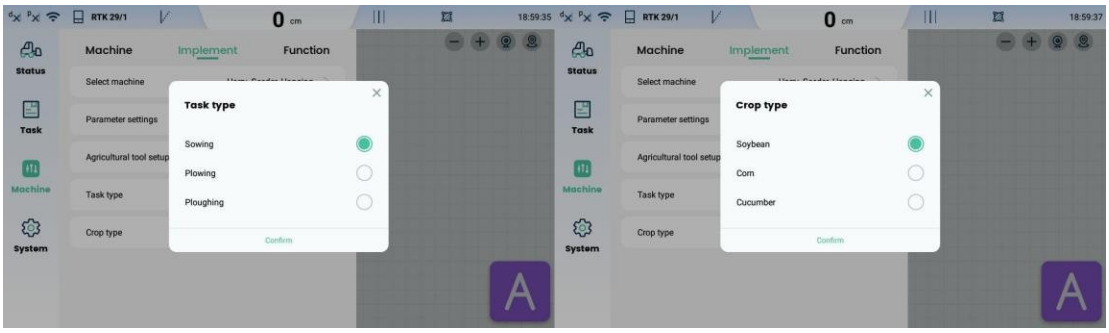
Verification: Perform 2 more operations, ensure a uniform spine width (deviation ≤± 1 cm), and save the parameters.



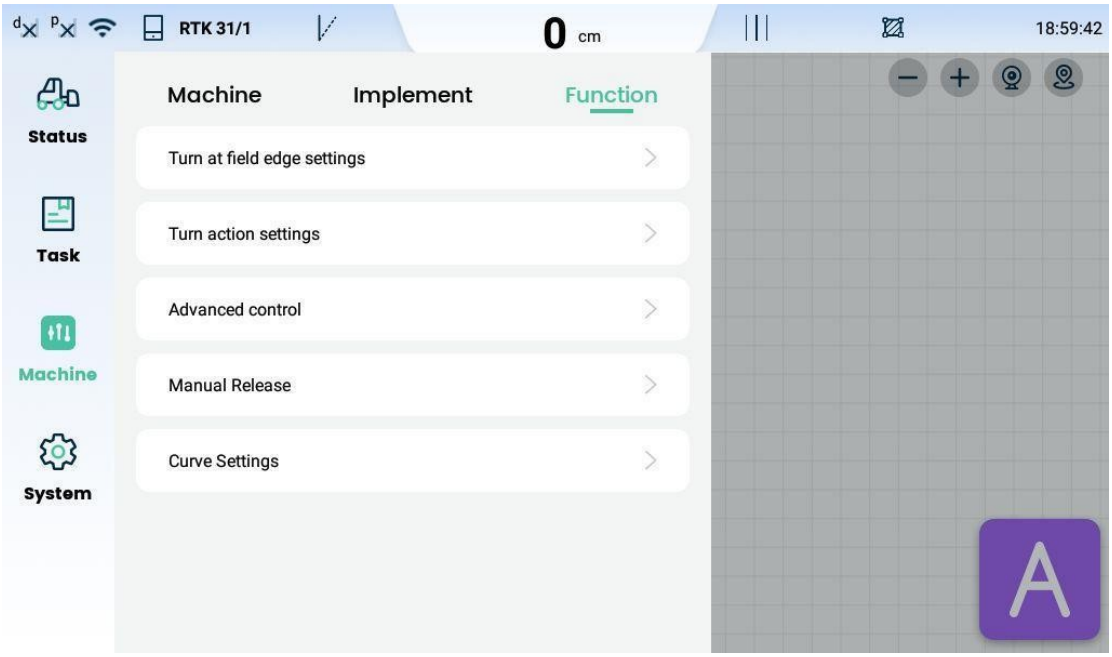
4.4.2.4 Task/Trimming Type

Select job types to distinguish between job types related to tools. Select crop types

to distinguish between crop types applied to tools.



4.4.3 Function

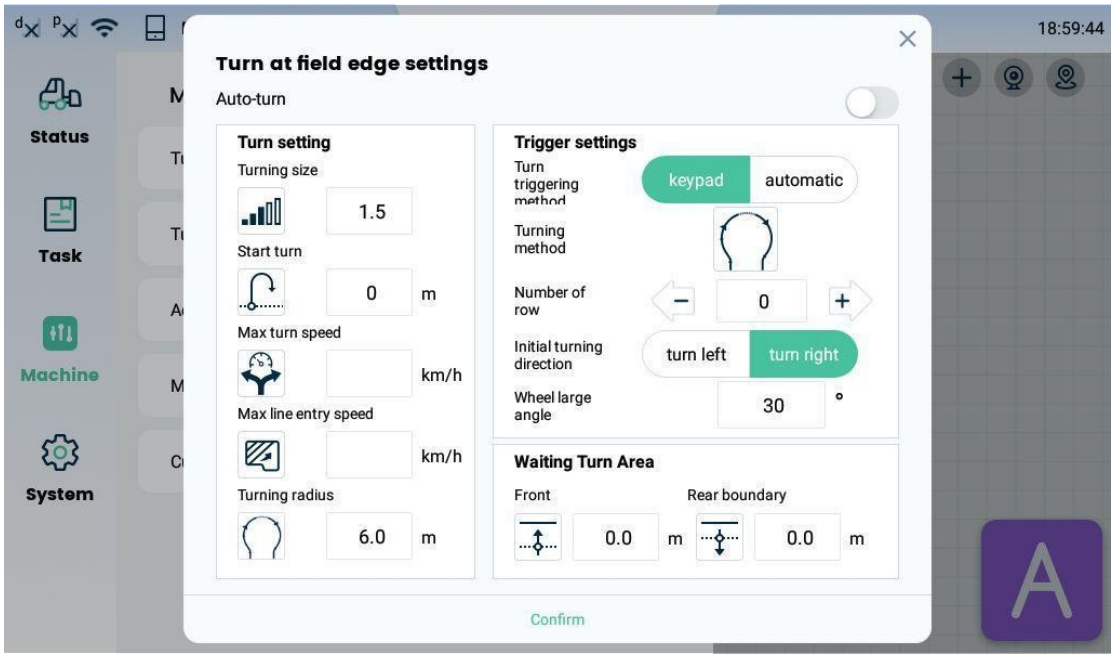


4.4.3.1 Field Edge Turn Settings

The button in the upper right corner allows you to enable or disable the automatic turning function.

Turn setting

- **Turning radius: Set a proportional turning radius value between 1 and 2.**
- **Start turn: Set the distance to maintain after entering the waiting lane to perform the turning maneuver.**
- **Maximum turning speed: Set the maximum vehicle speed during a turn.**
- **Maximum line entry speed: Set the maximum speed for entering the lane after completing the turn.**
- **Turning radius: Set the minimum turning radius of the vehicle.**



Trigger Settings

The trigger method can be set to key trigger or automatic trigger.

Rolling method: Automatic adaptation. Depending on the turning radius, it automatically adjusts between a U-shape and a bulb shape.

Number of rows: You can set the number of rows to skip.

Initial turning direction: The initial turning direction can be set to left/right turn. High-angle wheel: The maximum turning angle of the wheels can be set as a limit during turning.

Waiting Zone

Front boundary: Set the distance from the approaching boundary to start the turning action.

Rear boundary: Set the distance from the boundary that has already been crossed to start the turning action.

4.4.3.2 Manual release

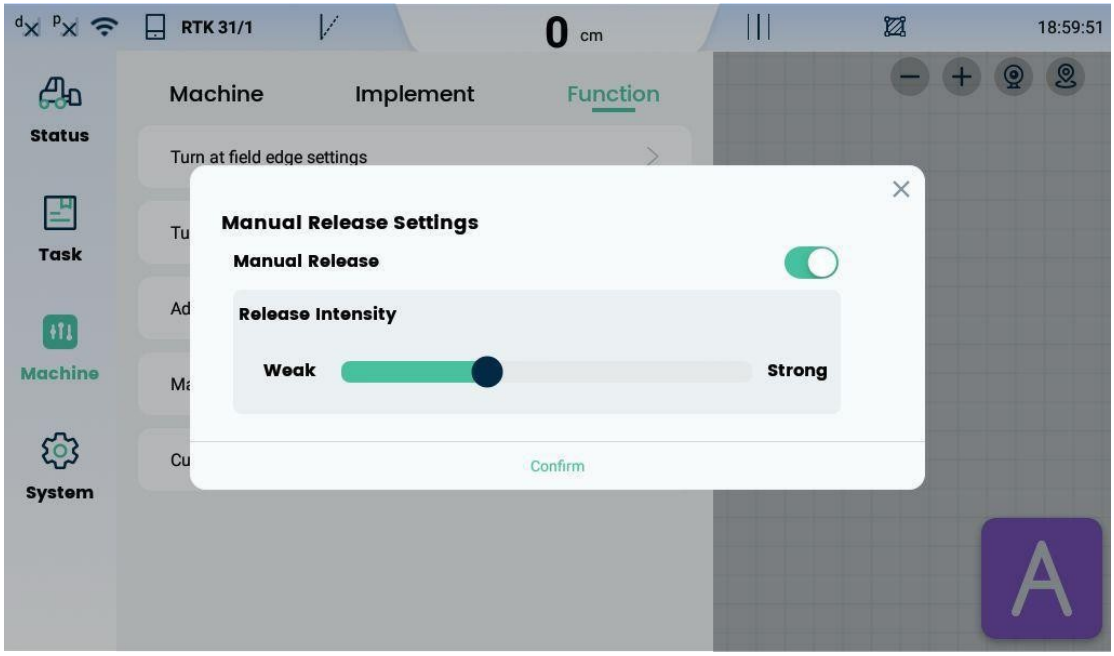
Click the top-right corner to enable manual disengagement of the autopilot. Drag the

progress bar

The closer the 'strong' indicator is to the black circle, the more force is required to manually disable the autopilot.

The closer the 'weak' indicator is to the black circle, the less force is required to manually disable the autopilot.

Click Confirm to save



4.4.3.3 Curve Settings

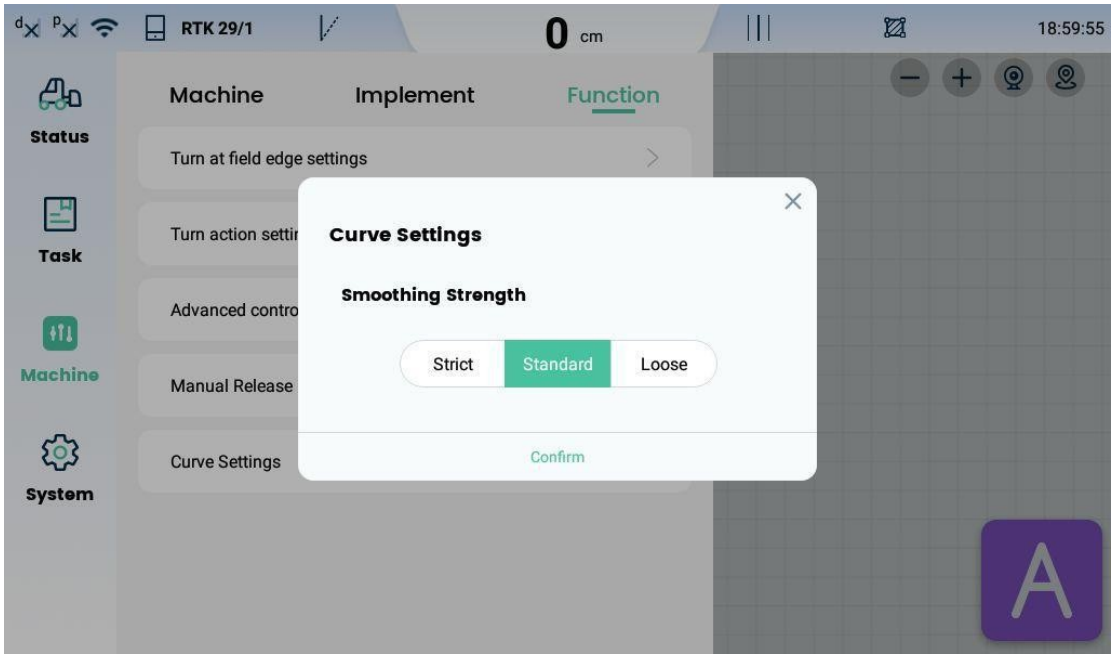
Smoothness strength determines the smoothness of the line after

the curve is created. Loose: Represents maximum line

smoothness.

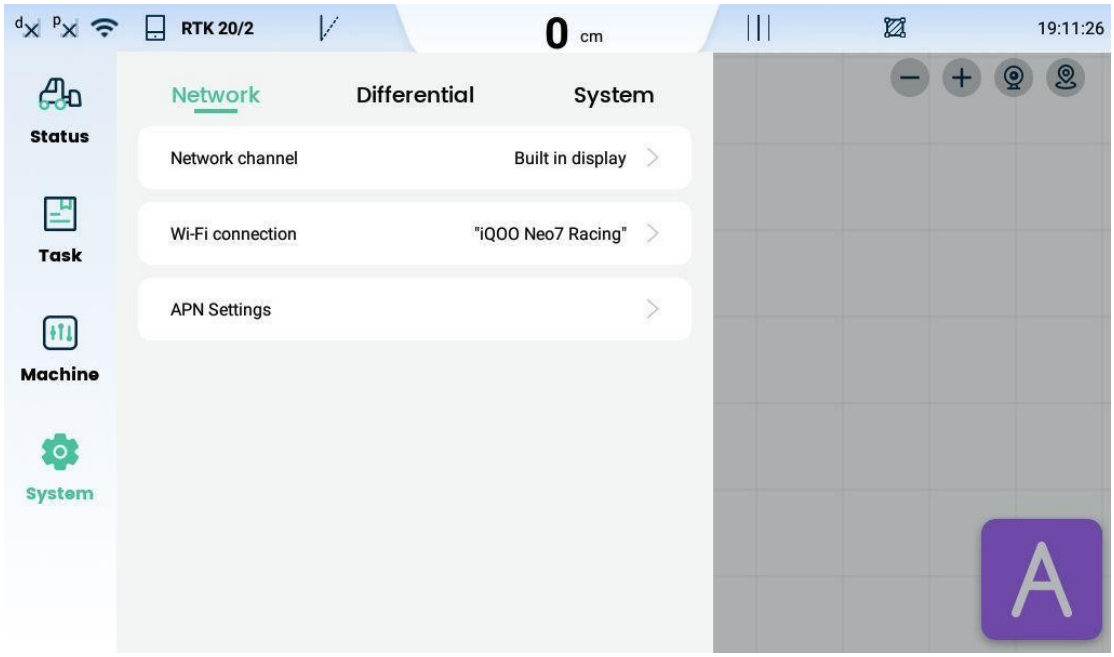
Standard: Represents a smoothness level between Loose and Tight for the line

Tight: Represents the minimum smoothness of the line, preserving its actual state.



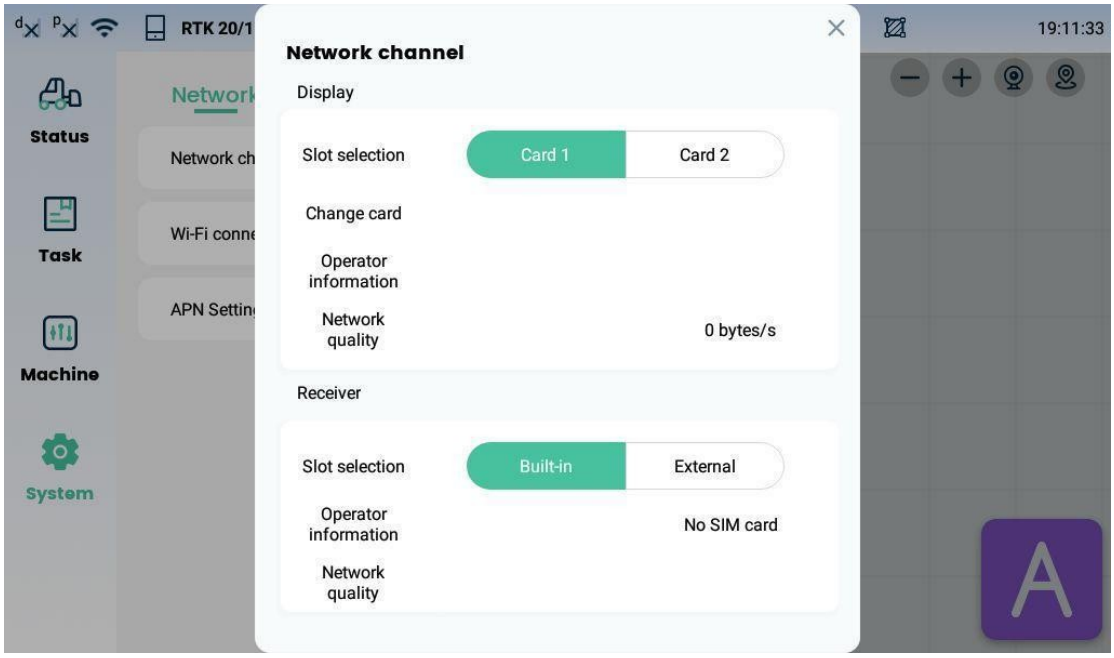
4.5 System

4.5.1 Network



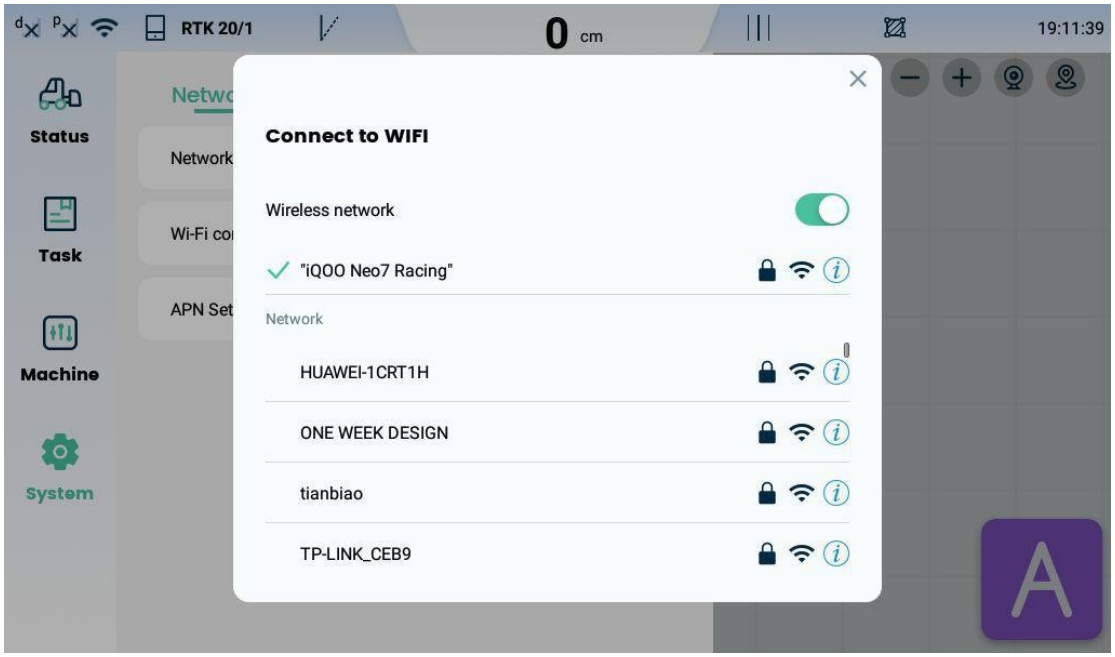
4.5.1.1 Network Channel

Click on "Network Channel," select the SIM card's network channel, and choose between the SIM card in the display unit or the SIM card in the controller.



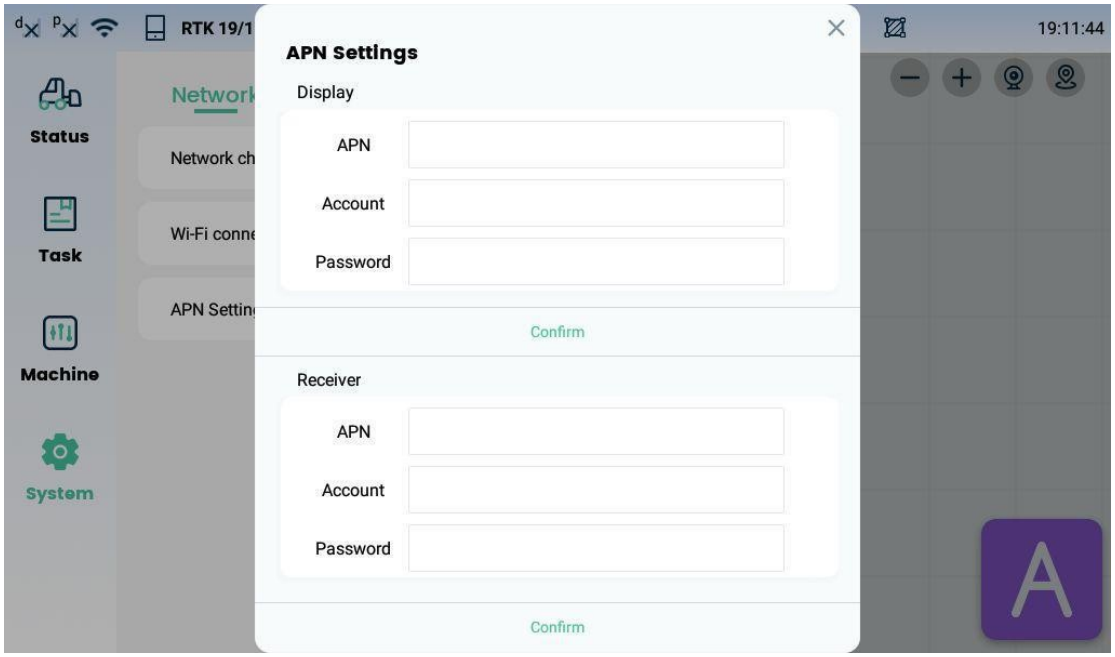
4.5.1.2 Wi-Fi Connection

Connect to a Wi-Fi network here.

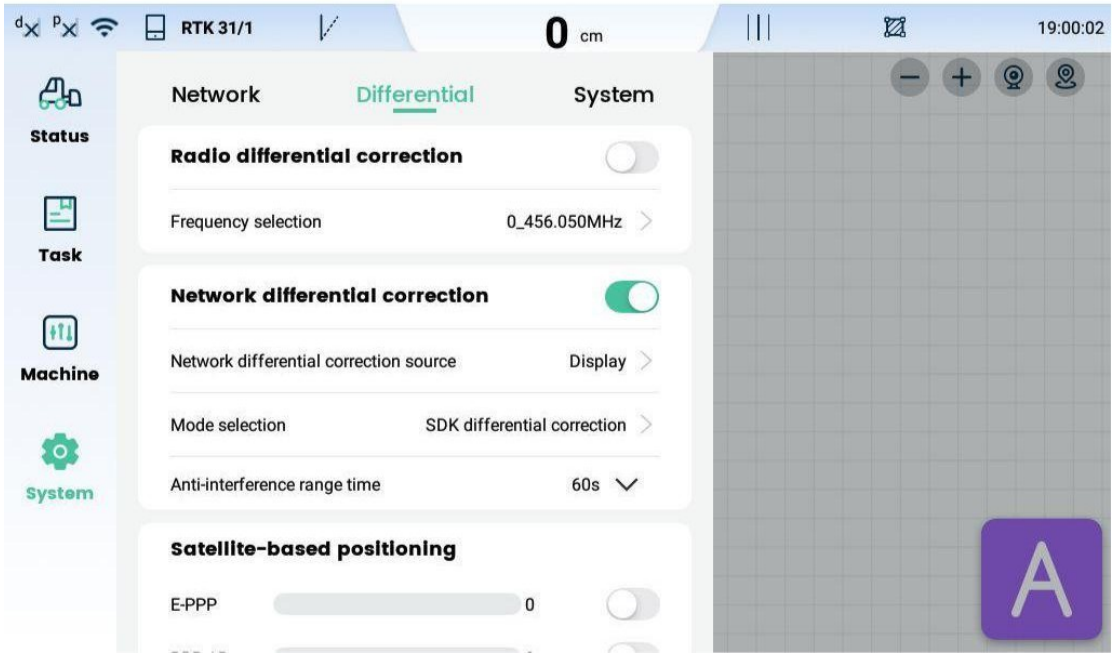


4.5.1.3 APN Settings

Enter the SIM card APN configuration parameters on the display screen or controller.

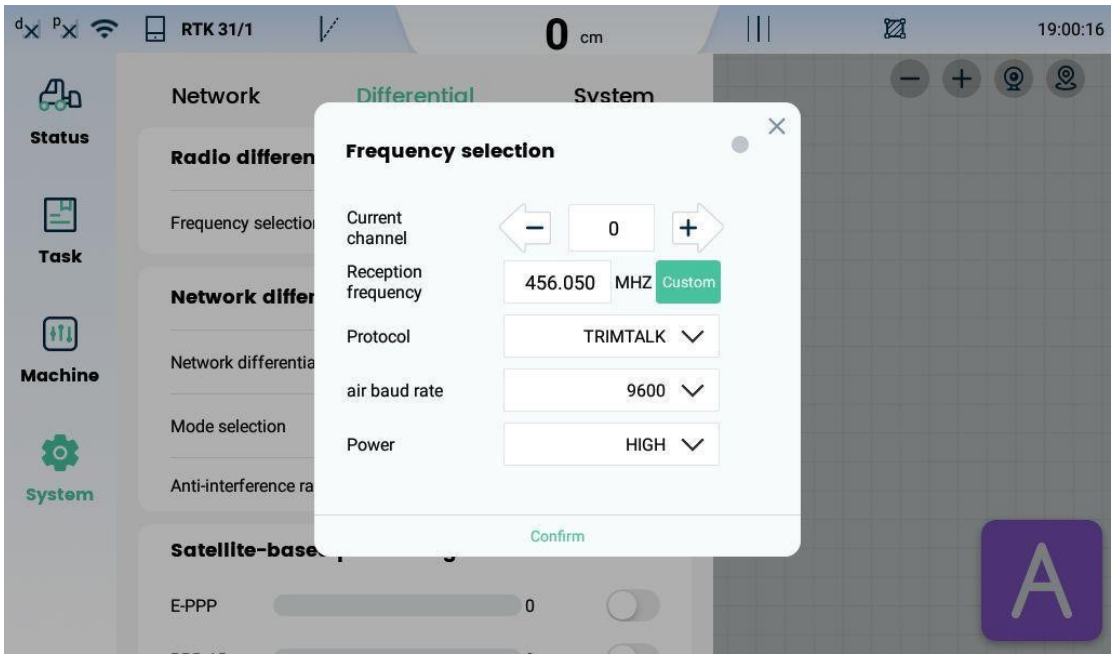


4.5.2 Differential



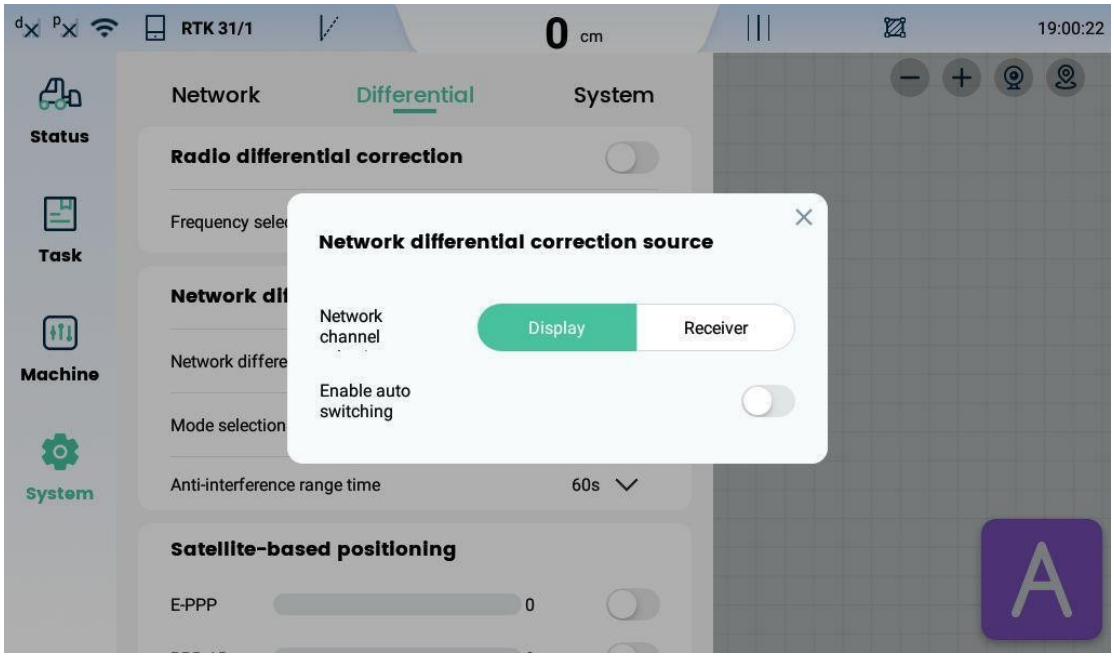
4.5.2.1 Radio Differential Correction

Select the differential radio signal, connect to the base station, enter the appropriate frequency, protocol, baud rate, etc., click Confirm, and check the connection status.

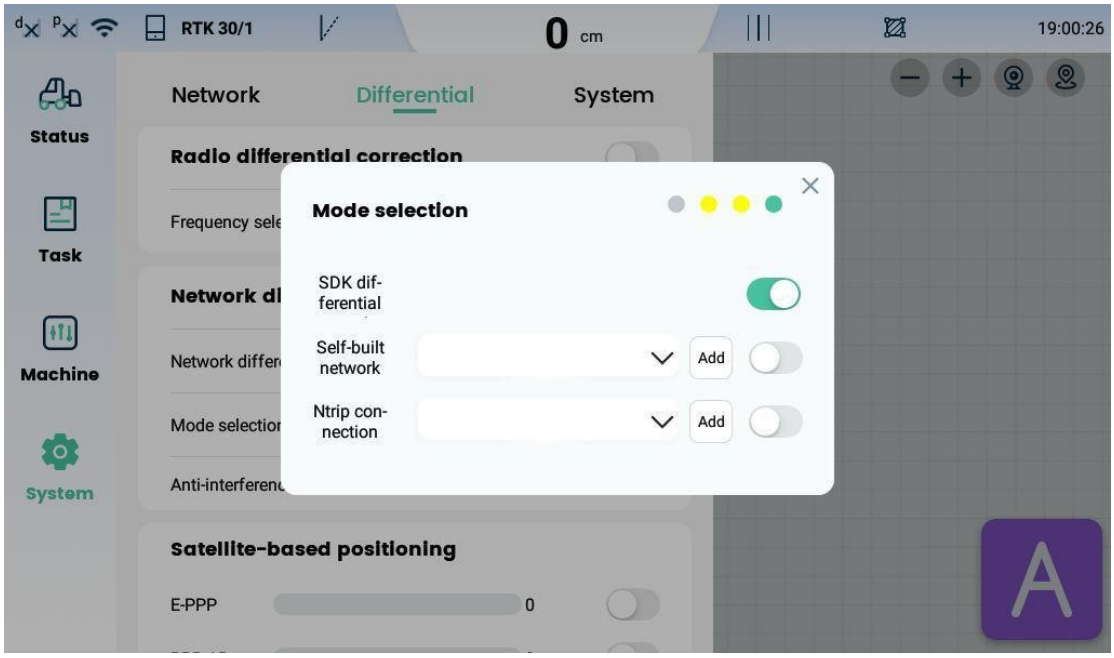


4.5.2.2 Network Differential Correction

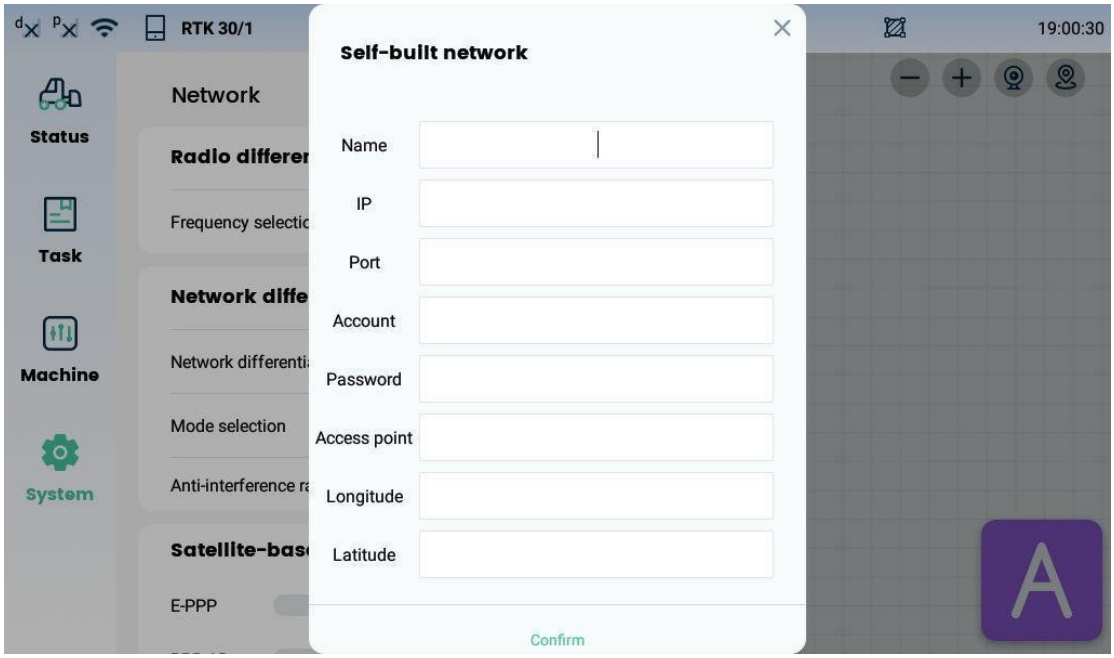
Users can select the source of the network differential correction as a receiver or a display, or select automatic switching to automatically read the network page as the differential source.



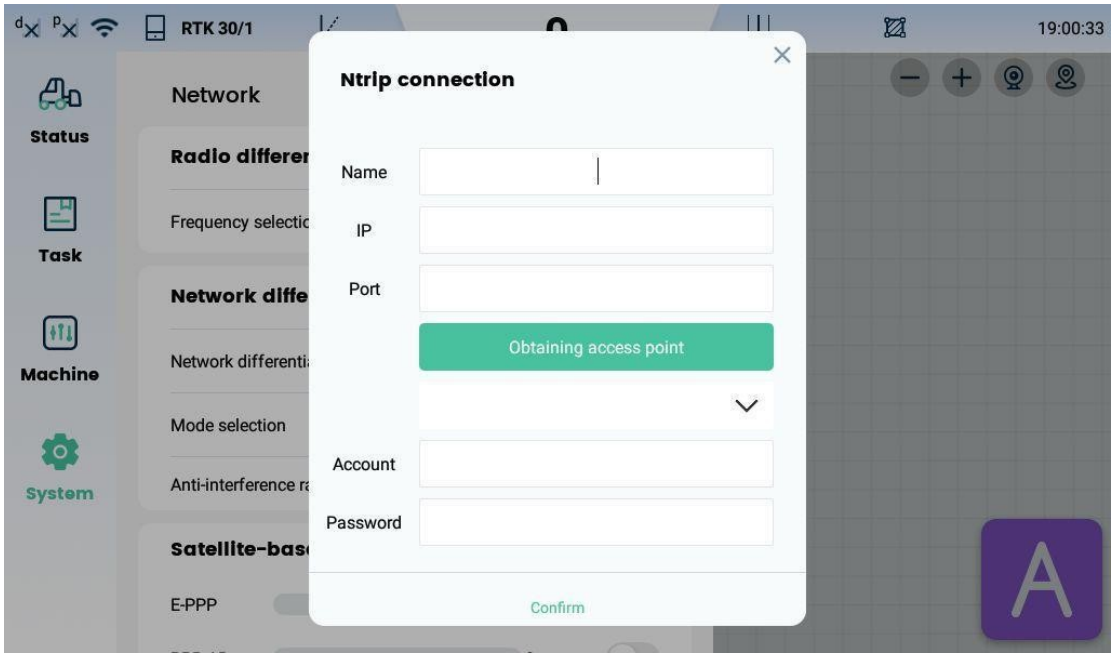
Differentiation SDK: Open the SDK method for differentiation (Device SDK authorization required)



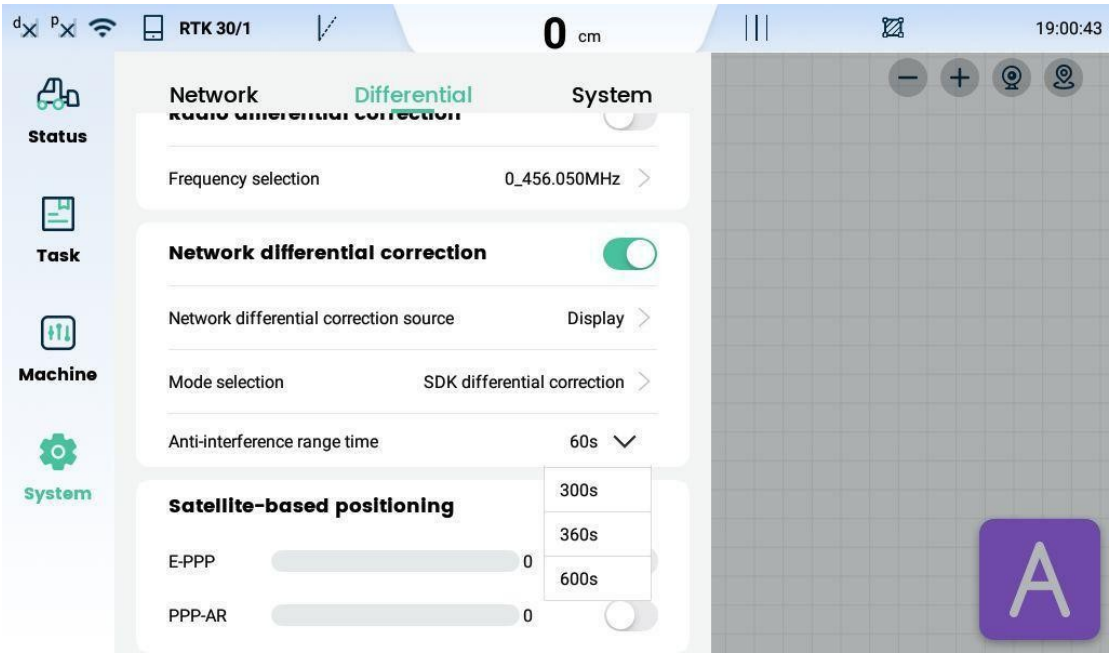
Self-built network: Enter the name, IP address, port, account password, access points, etc.



Ntrip connection: Enter the IP address, port, account password, and access point.



The anti-interface coverage time can be set. In the event of loss of the differential signal, a timeout can be set to maintain precise satellite positioning within this range so as not to enter AUT mode. It can be set to a maximum of 600 seconds. As the differential age increases, the accuracy of satellite positioning will gradually deteriorate.

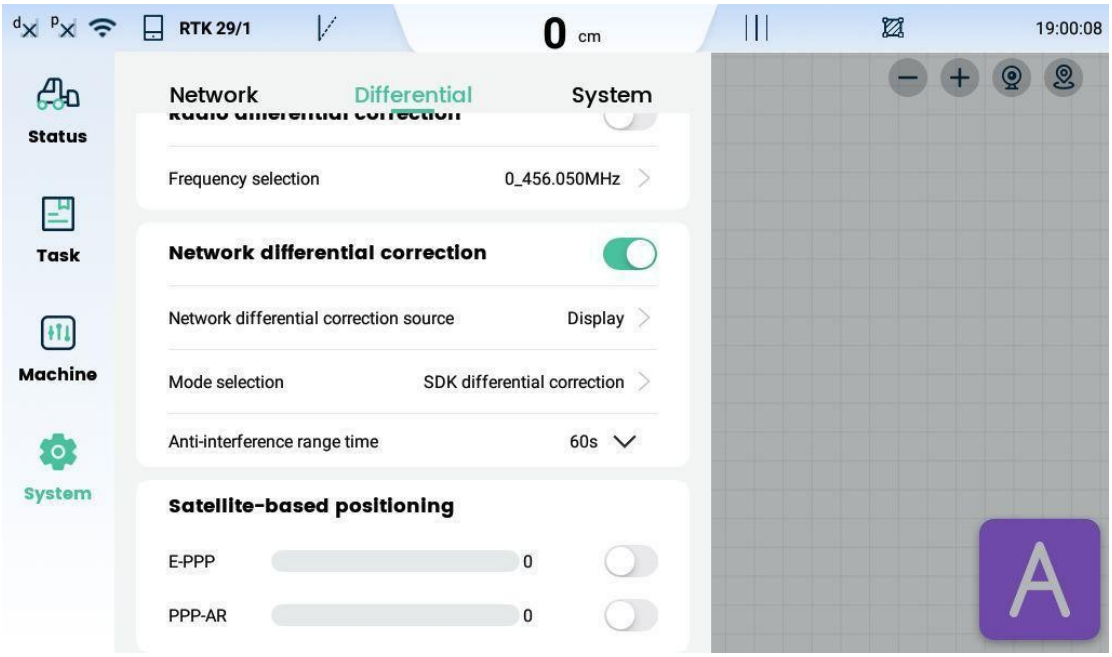


4.5.2.3 Satellite Positioning

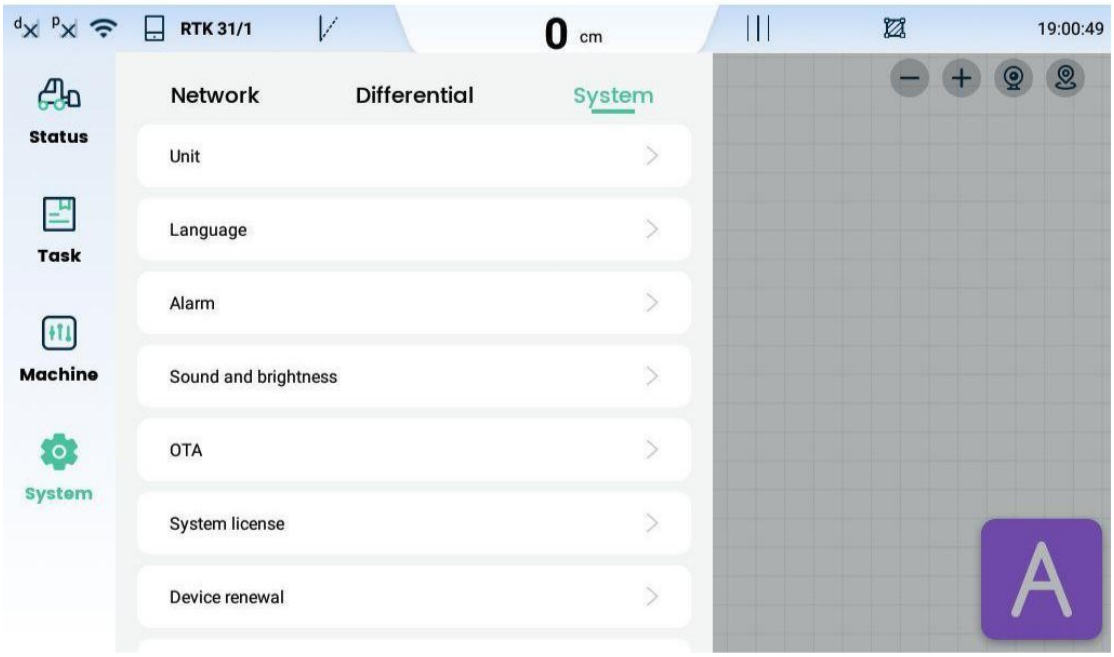
E-PPP: E6-HAS (Free)

PPP-AR: Paid Satellite reference signal

The progress bar shows the progress of convergence.

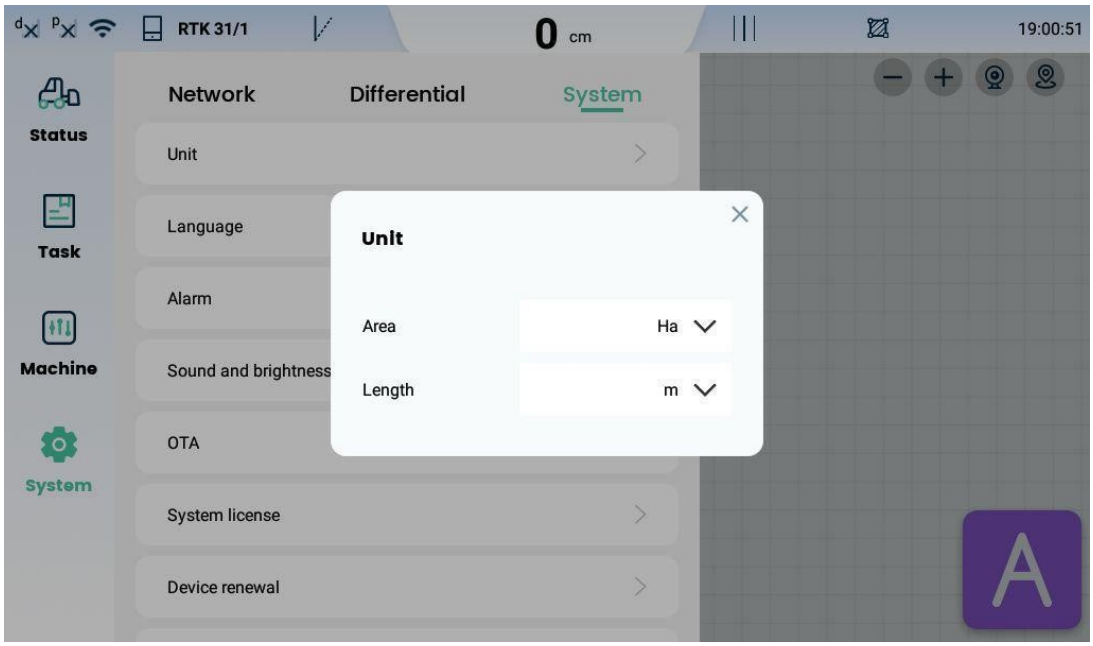


4.5.3 System



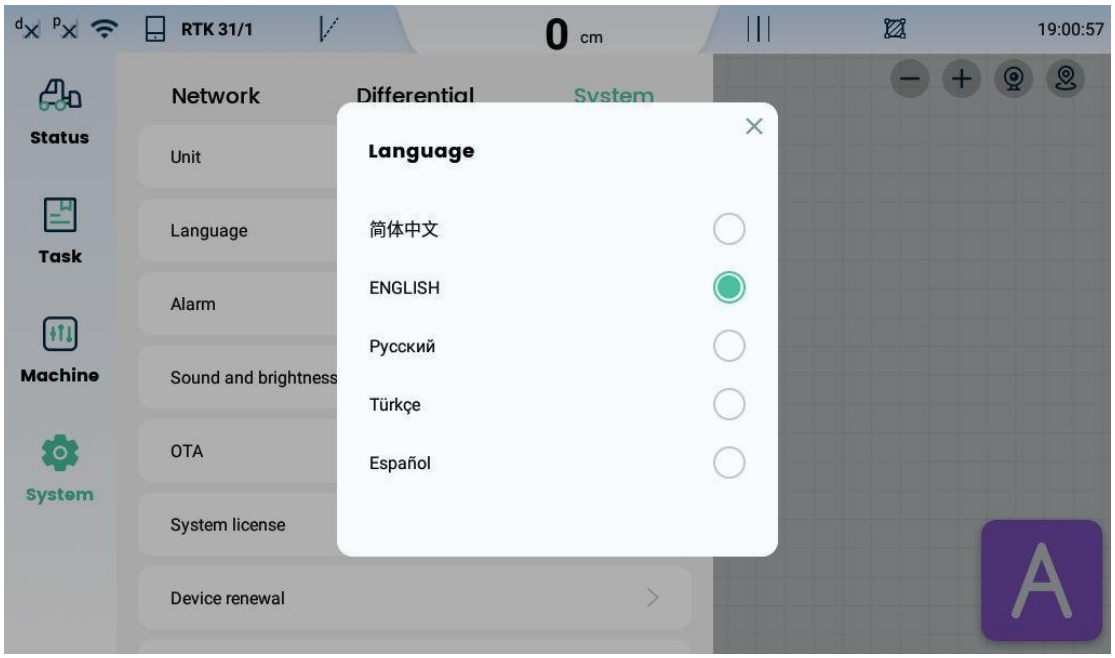
4.5.3.1 Unit

Users can select units of area and length.



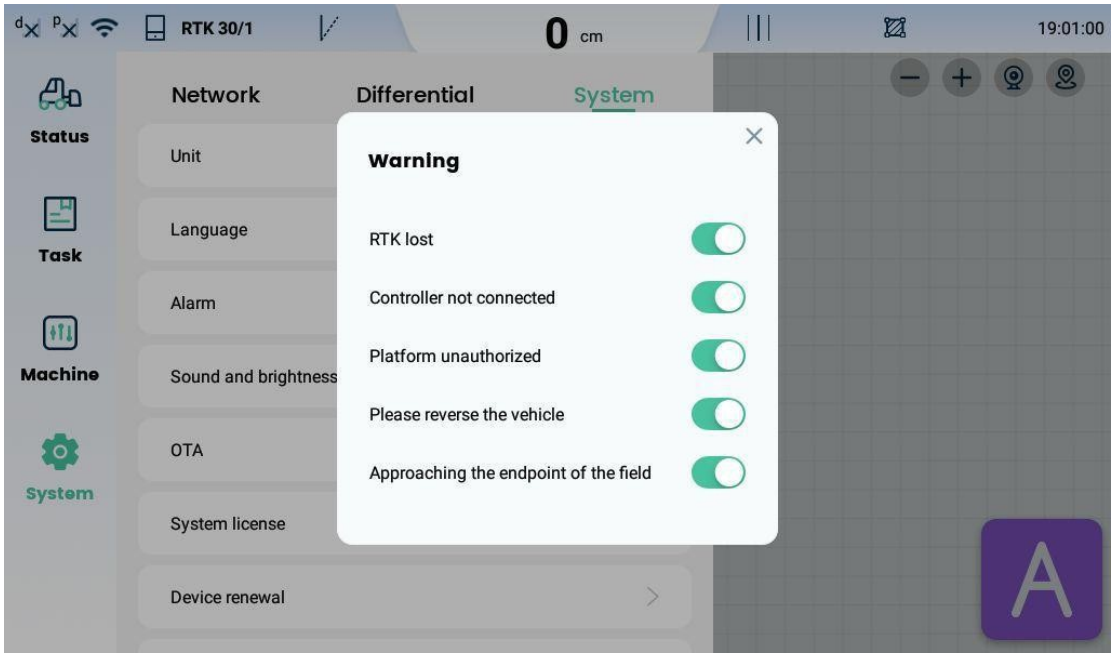
4.5.3.2 Language

Users can select different interface languages.



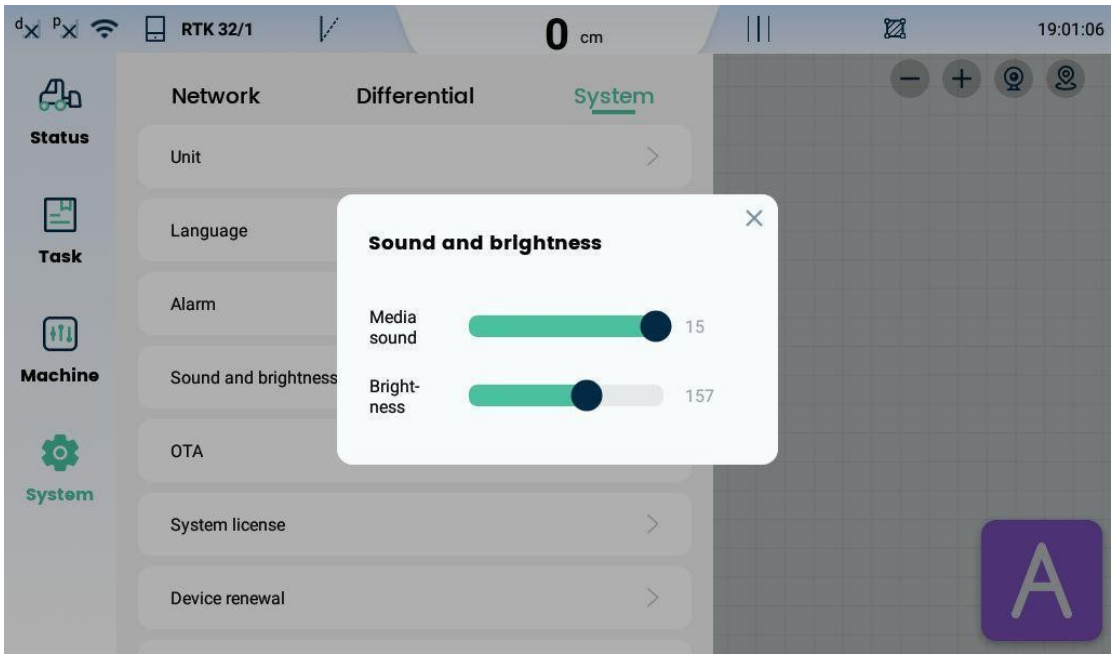
4.5.3.3 Alarm

When a system function requires a reminder or alarm, a voice message will be played to remind the user, and users can choose whether to enable a voice reminder for a specific function.



4.5.3.4 Sound and Brightness

Users can adjust the volume of multimedia audio and the screen brightness.

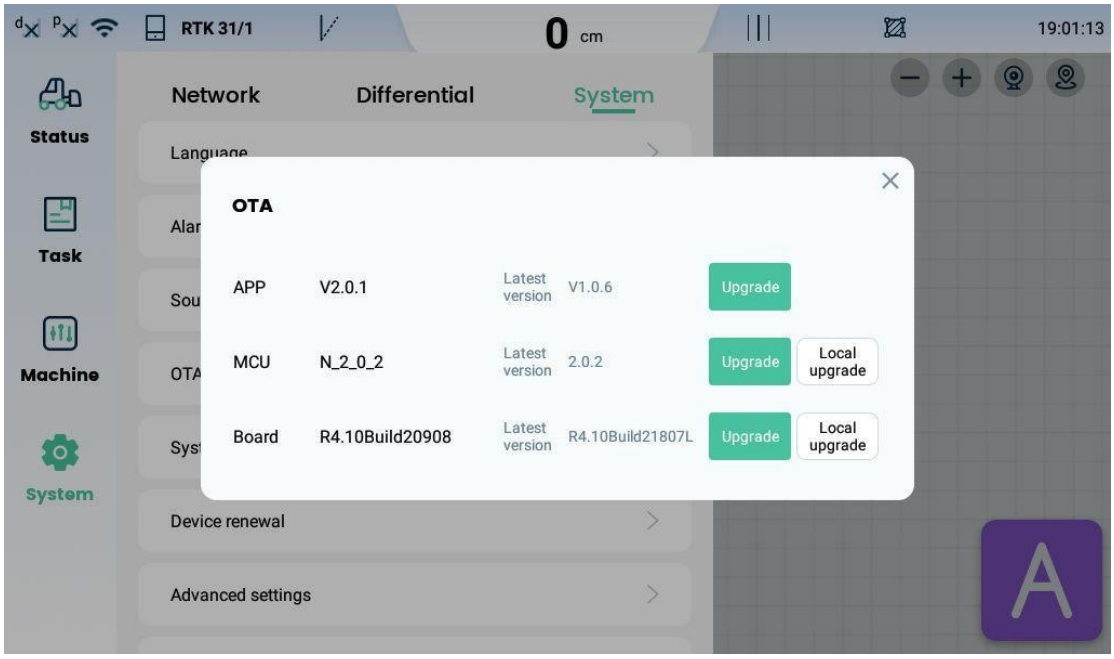


4.5.3.5 OTA

Users can perform version updates in this window, both online (in a network environment) and locally.

You can copy the version file to local storage using a USB drive, then locate and update the file.

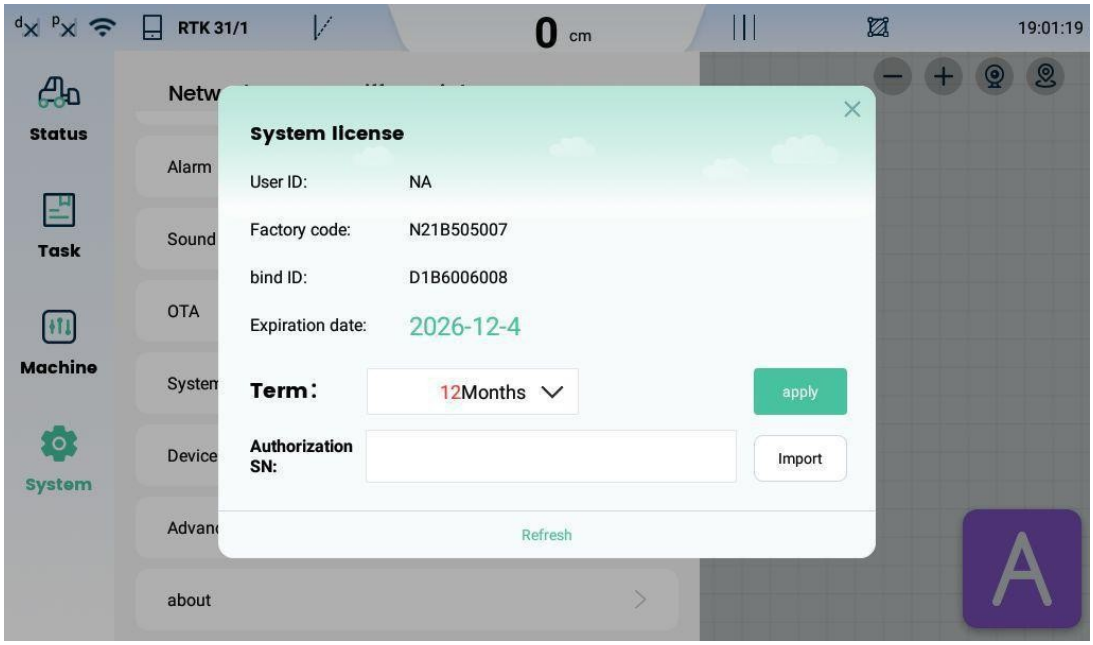
locally.



4.5.3.6 System License

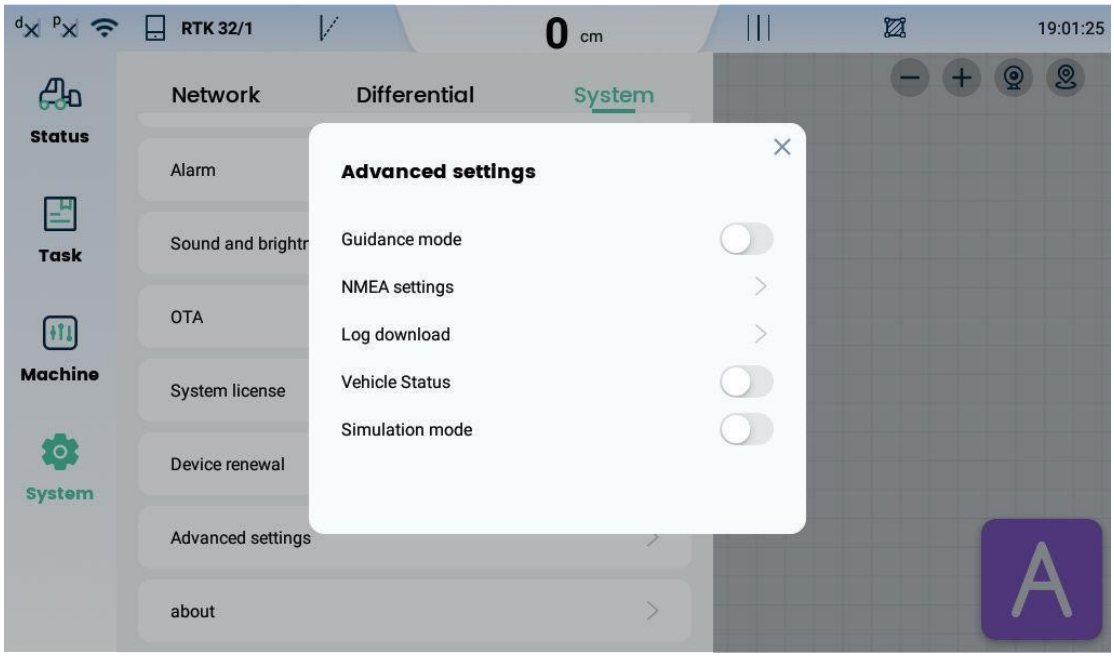
Users can authorize the use of the device in this interface. Users can apply online via the platform, and Nano Steer 210 technicians will issue a device activation code upon receiving the application. Once issued, the device will automatically receive an authorization activation period;

The authorization status can also be obtained by entering the activation code, which must be obtained from technical staff.



4.5.3.7 Advanced Settings

In the advanced settings, you can enable boot mode, configure NMEA data export, download logs, view vehicle status, and enable simulator mode.



4.5.3.8 Information

In the Information interface, you can view various details about device numbers, including key information such as: model, device number, IMEI, etc.

4.6 Function

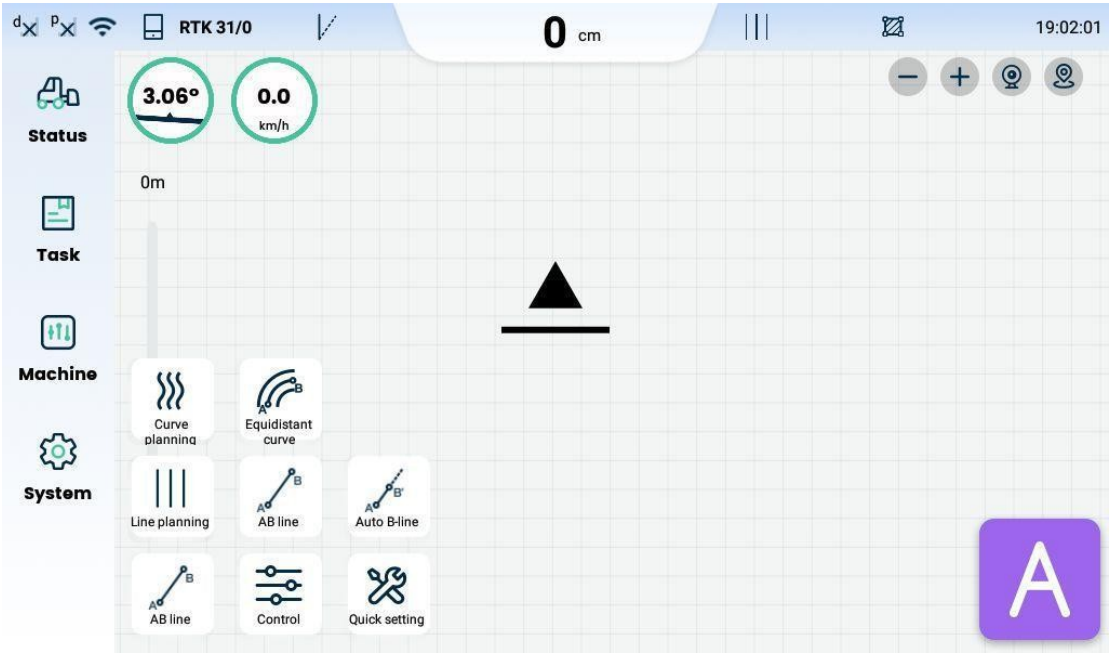
4.6.1 Explanation of the key icon

Select Line Mode——Line

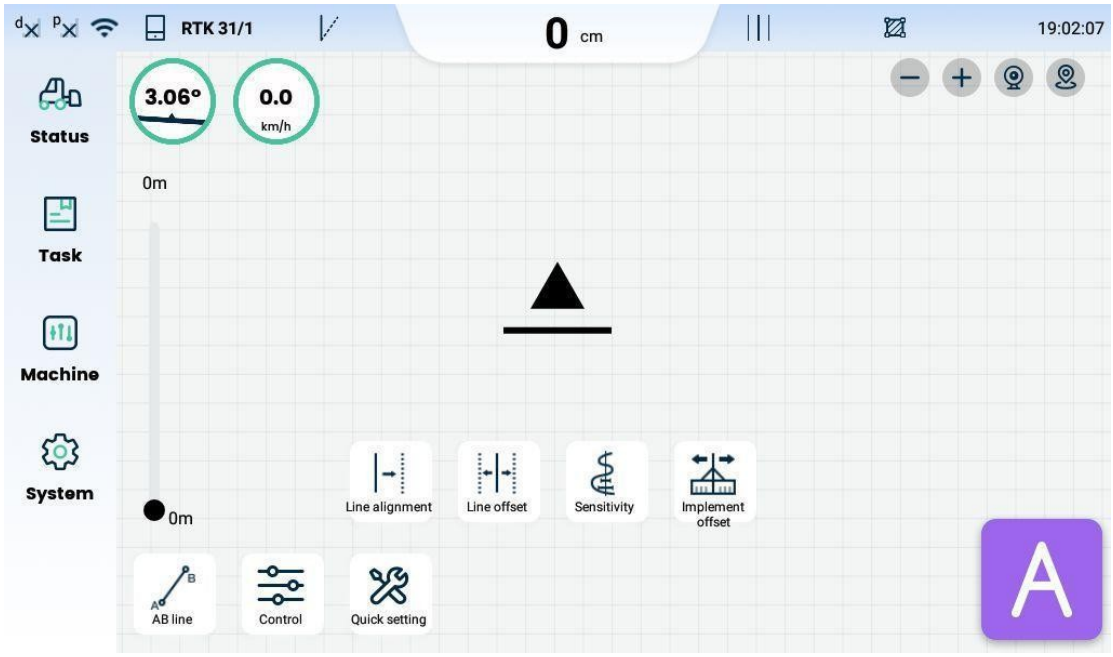
AB: Straight Line AB

Automatic Line B: After passing through point A, the vehicle will automatically generate a guide line 50 meters away from point A.

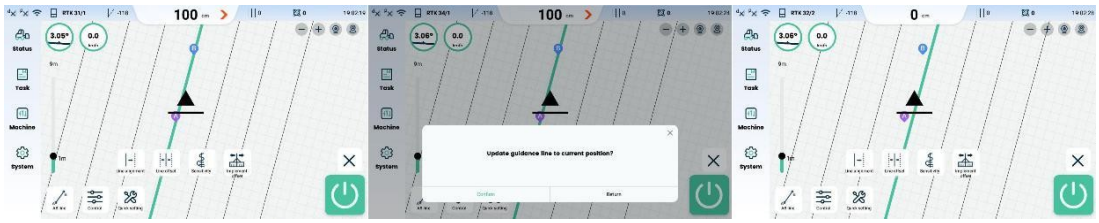
Constant-distance curve: Curve line mode



Control--



Line Alignment: If there is a guide line task in the current interface, pressing this button will drag the guide line to align it with the vehicle.



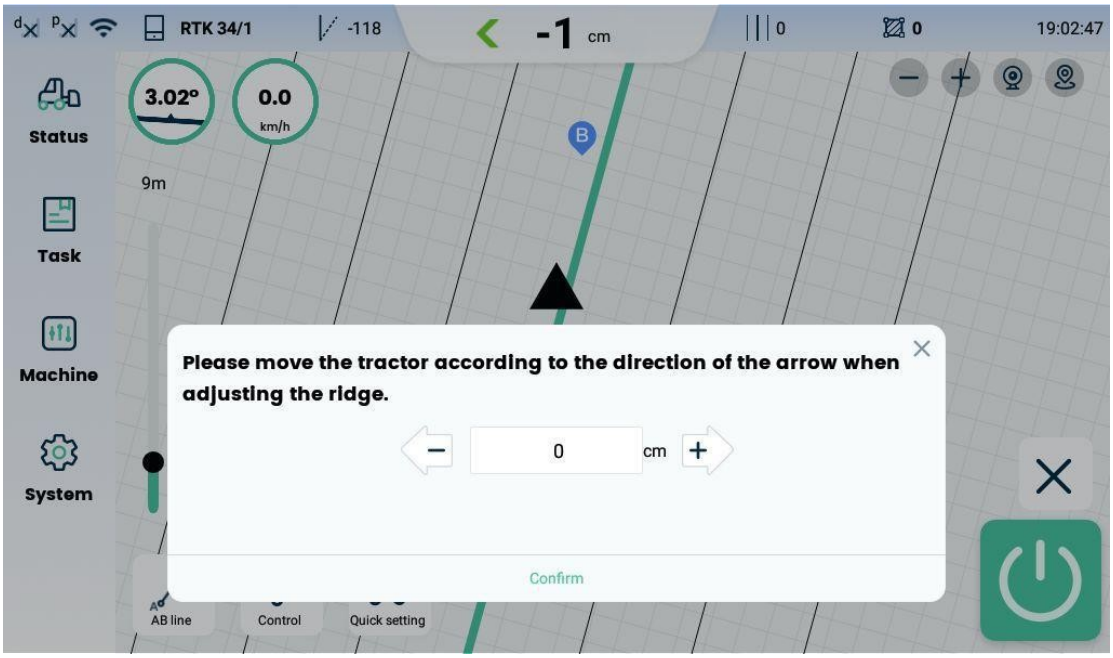
Line Shift: Users can manually move the guide line left and right.

Sensitivity--

Amplitude: The higher the motor's operating value, the greater the motor's rotation.

Sensitivity: Motor response speed—the lower the value, the faster the response.

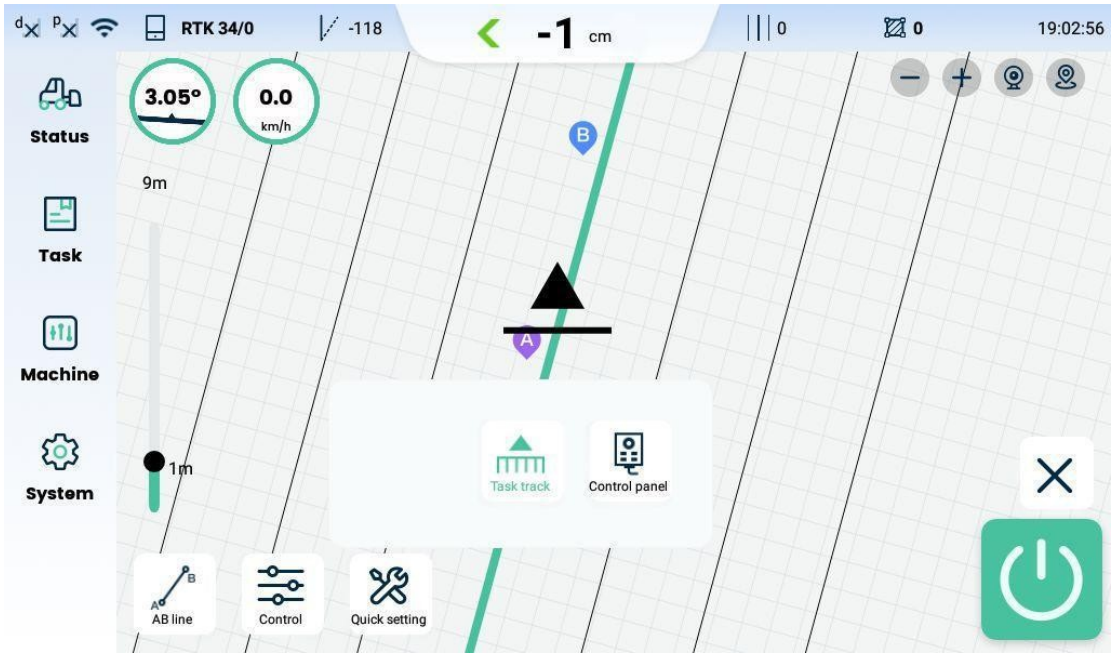
Offset Implementation: Provides the main interface window for manually adjusting the tool offset to customize the ridge combination.



Quick Setup——

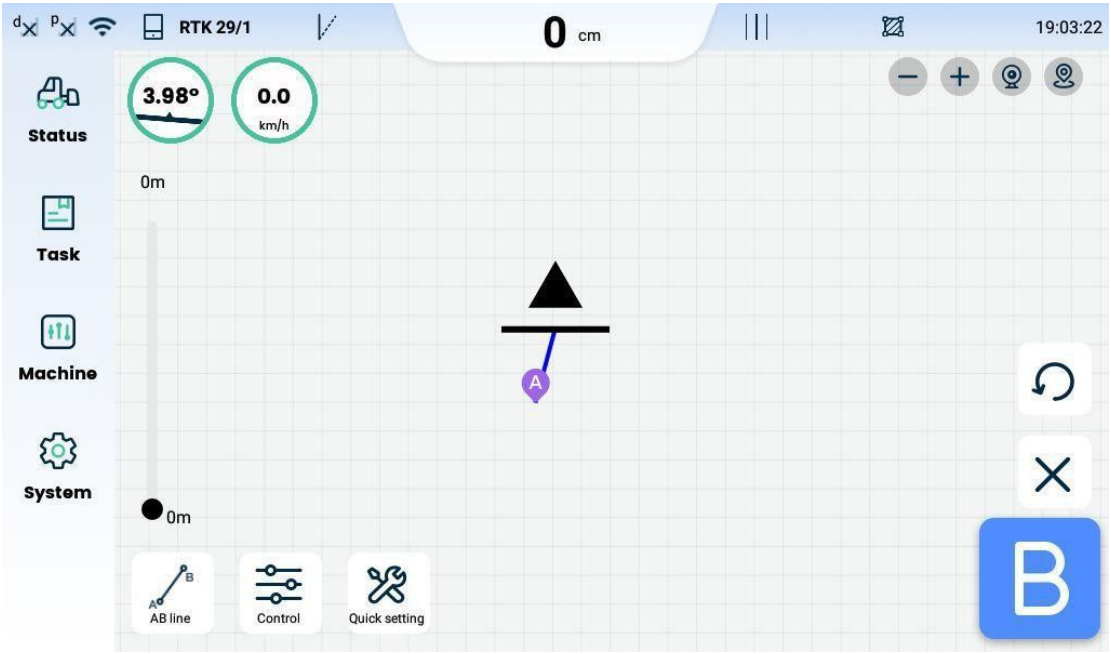
Task path: Users can open and close the trajectory recording status. Control panel:

Collapsed.

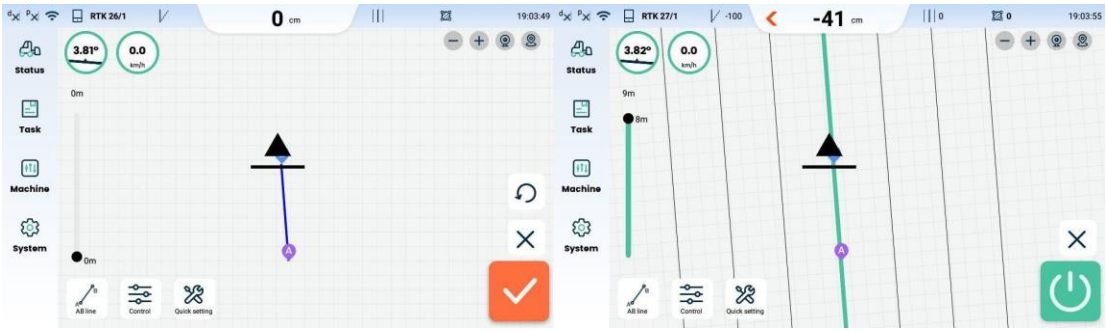


4.6.2 Draw a line to start the task

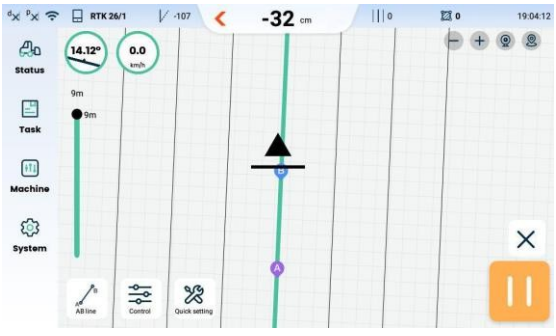
Press “A” and drive forward.



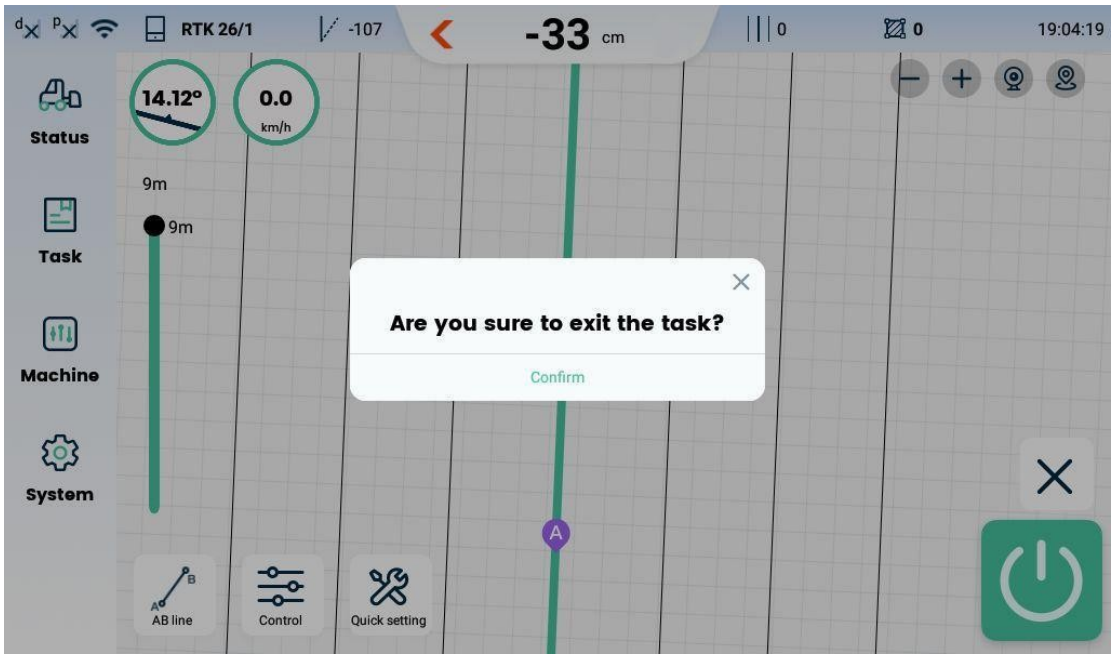
After traveling a specified distance, press “B.” Then press “√” to finish creating the line.



Press  **to turn on autopilot; press**  **to turn off autopilot.**



Press ✕ **to exit the task.**



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Tax ID: 9930691316, REGON: 523485892