

■ **AF305**
AUTOMATED STEERING SYSTEM



 **ALLYNAV**

NEW AGRICULTURE · NEW FUTURE

AF305

CATALOG

PRODUCT INTRODUCTION AND APPLICATION SCENARIOS

High-Precision Automatic Steering System for Multi-Scenario Applications

INTELLIGENT TECHNOLOGY

Independently developed, employing industry-leading technology
Ultra-high positioning accuracy and performance

WORKING MODE

AF305 High-Precision Operation Mode Based on RTK Base Stations
The AF305 can operate in two modes when connected to an RTK system
AF305's High-Precision Operation Mode Based on SBAS Without a Base Station

PRODUCT COMPETITIVENESS&ADVANTAGES

The AF305's Terrain Compensation Algorithm
Description of the adaptive PID control algorithm and its benefits for automatic steering.
ISOBUS Intelligent Integrated Control Module

THE MAIN COMPONENTS

T101 MTK Smart Display and Control Terminal
R70 Vehicle-mounted Receiver
Electronic Control Motor
Steering Wheel
IMU (Inertial Measurement Unit)
High-definition Camera

SPECIFICATIONS

This brochure provides an in-depth look at the AF305's features and capabilities. From intelligent planning and control to advanced component specifications and precision algorithms, the AF305 stands out as a high-performance solution for modern agriculture. Its integration of advanced technologies not only improves efficiency and productivity on the farm but also supports sustainable farming practices.



High-Precision Automatic Steering System for Multi-Scenario Applications

■ High-Precision Automated Navigation

The AllyNav AF305 employs the latest satellite positioning system and a high-precision algorithm for its automatic steering system. Utilizing a combination of Global Navigation Satellite System (GNSS) positioning and an IMU (Inertial Measurement Unit) for integrated navigation, it adjusts the front wheel angle in real-time during operations. This ensures the driving route closely aligns with the desired and preset paths, achieving a control precision within a 2.5 cm error margin.

■ Intelligent Planning and Operational Efficiency

The product, designed with customer experience and actual economic benefits in mind, has undergone multiple iterations to differentiate from traditional offerings. It features GIS-based intelligent plot management and customization of operation paths, operation records, data sharing, and support for file import and export. It allows for simultaneous collaborative operations across multiple machines and plots. With high system integration, strong scalability, better adaptability, and a richer product line, it delivers higher value to customers.

■ Global Navigation Technology

The system achieves full operational status without the need for any ground stations through integrated navigation (GNSS+IMU) and Satellite-Based Augmentation System (SBAS) technology, supporting all global SBAS features including WAAS, EGNOS, MSAS, GAGAN, etc. Additionally, it can achieve up to 50 kilometers of signal coverage in the highest performance expectations when used with AllyNav's proprietary RTK base station, allowing for base station-dependent operations.



The AF305 Automatic Steering System is designed for agricultural production tasks such as seeding, trenching, spraying, transplanting, plant protection, and harvesting. It ensures uniform row spacing and even plant distribution, enhancing crop ventilation and light penetration, reducing crop diseases and pests, increasing crop yield, decreasing operator fatigue, improving operational efficiency, and enhancing land utilization.

Automatic steering technology significantly boosts on-site work efficiency and reduces driver fatigue. It enhances work quality while lowering operational and input costs. By eliminating overlaps and skips, it maximizes coverage to increase yield. This technology enhances productivity and maximizes economic benefits, allowing farmers to cover more land in less time with the automatic steering system. This frees up time for other critical tasks; it aids in the intelligent management of farms, enabling better decision-making, maximizing inputs, and increasing yields. Additionally, the automatic steering system contributes to soil health by reducing unnecessary soil compaction, promoting healthier crops and higher yields.





Independently developed, employing industry-leading technology

The AllyNav AF305 achieves centimeter-level accuracy by integrating technologies such as RTK (Real-Time Kinematic), PPP-RTK (Precise Point Positioning-Real Time Kinematic), and SBAS (Satellite-Based Augmentation System). It is compatible with the following full-constellation, full-frequency global navigation satellite systems:

	BeiDou	GLONASS	Galileo	GPS	QZSS
Owner	China	Russia	European Union	United States	Japan
Coverage	Global	Global	Global	Global	Regional
Frequency	B1I/B2I/B3I	G1/G2	E1/E5a/b	L1C/A/L2P(Y) L2C/L5	L1,L2,L5

A Optimal Estimation Algorithm

Integrated navigation is achieved through real-time data fusion of GNSS + IMU positioning information using optimal estimation algorithms, based on Bayesian estimation theory. This process involves the fusion of various measurements' Gaussian distributions, accomplishing the optimal estimation of parameters to be estimated, thereby obtaining high-precision location, speed, and attitude of the machine, and it also has the capability to output covariance. Non-holonomic constraints (NHC), zero-speed correction, zero integral drift rate, and other methods are used to suppress and correct errors from pure inertial navigation based on the dynamic and static characteristics of the vehicle.



B Ultra-high operational stability

The Error State Kalman Filter (ESKF) algorithm is utilized to solve real-time optimal path estimation problems, using the estimated parameter errors as state variables. Under the assumption of small errors, the error model and observation model are linearized, with the optimization criterion being the minimization of the variance of the estimated states. In real-time positioning, the integrated navigation Kalman filter algorithm boasts high computational efficiency, reliability, and rapid convergence capability, providing precise positioning and attitude data for downstream output.

The quality of data collection by the Kalman filter is crucial for overall directional positioning performance. Therefore, before feeding measurements into the Kalman filter, a fault detection and isolation mechanism identifies unusable measurements to prevent invalid data from adversely affecting the filter. The basis for fault detection and isolation includes positioning status (single point, pseudorange differential, float solution, fixed solution), DOP values, the number of satellites tracked, signal-to-noise ratio, standard deviation, signal interference location, and signal interruption duration.



C Ultra-high positioning accuracy and performance

	RTK Radio Transmission	RTK VRS	SBAS	PPP-RTK
Pass to Pass Accuracy	2.5cm	2.5cm	20cm	2.5cm~20cm
Year to Year Accuracy	2.5cm	2.5cm	90cm	2.5cm~20cm
Required	Base Station	CORS/SIM	/	/
Reliability	General	High	High	High
Cover	35km	No limit	No limit	No limit

*Pass to pass accuracy refers to the precision in transitioning from the current driving row to the next driving row in the intermediary area, with an accuracy of 2.5 cm meaning the error in the set width of the pass is less than 2.5 cm.

*Year to year accuracy is referred to as repeatability accuracy.

1 AF305 High-Precision Operation Mode Based on RTK Base Stations

To achieve the best performance and ultra-high precision operation with the AF305, it is recommended to use it in conjunction with Allynnav's technology:

RTK (Real Time Kinematic) technology uses a base station as a differential source to further enhance positioning accuracy. The location of the base station and data such as satellite signals are usually well-known. It receives the same satellite data as the rover (mobile station) and calculates the errors by comparing the real-time position information received from the satellites with the known actual data. This differential data is then transmitted in real-time to the rover via shortwave radio. The rover on the machinery uses this differential data to correct the real-time position information received from the satellites, reducing errors and thus improving accuracy.

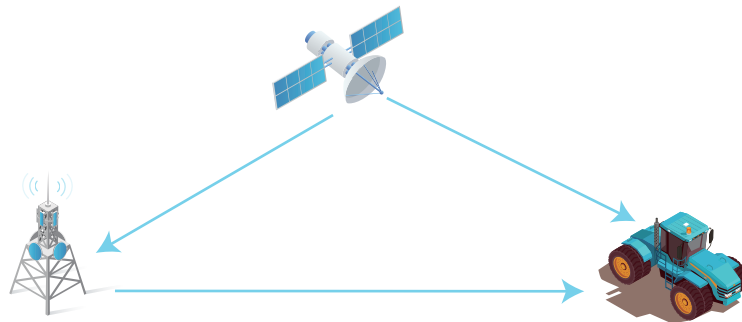
2 The AF305 can operate in two modes when connected to an RTK system

4G/Radio Base Station RTK (Radio Transmission):

The base station transmits differential information to the rover (mobile station) in the form of electromagnetic waves via a network or radio. It is necessary for the base station and rover to ensure that the radio channel, protocol, and frequency points are consistent to enable communication.

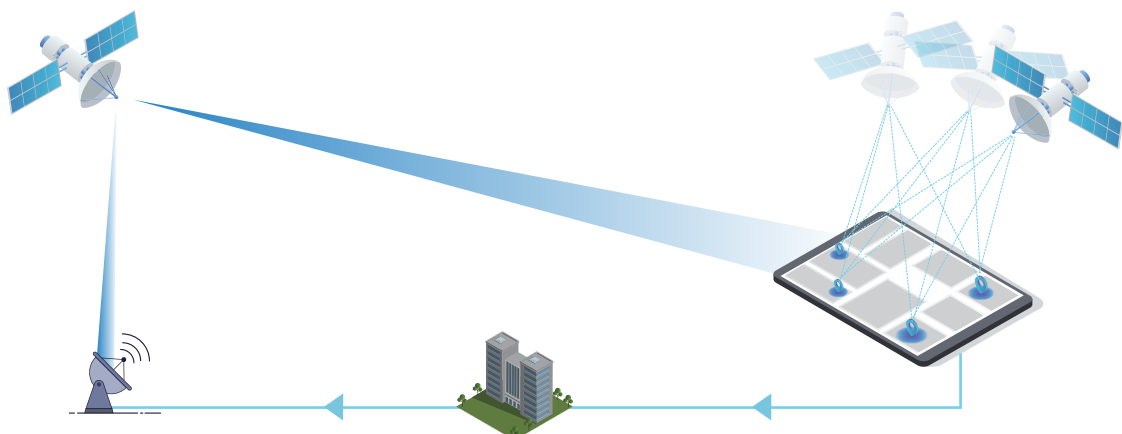
Network Virtual Reference Station RTK (VRS):

By connecting to CORS (Continuously Operating Reference Stations) or inserting a SIM card into the mobile terminal, the rover (mobile station) receives differential data via the CORS network or GPRS mobile phone network. Access to the CORS service is typically through the NTRIP (Networked Transport of RTCM via Internet Protocol) protocol. The use of a network virtual reference station requires a stable network connection.



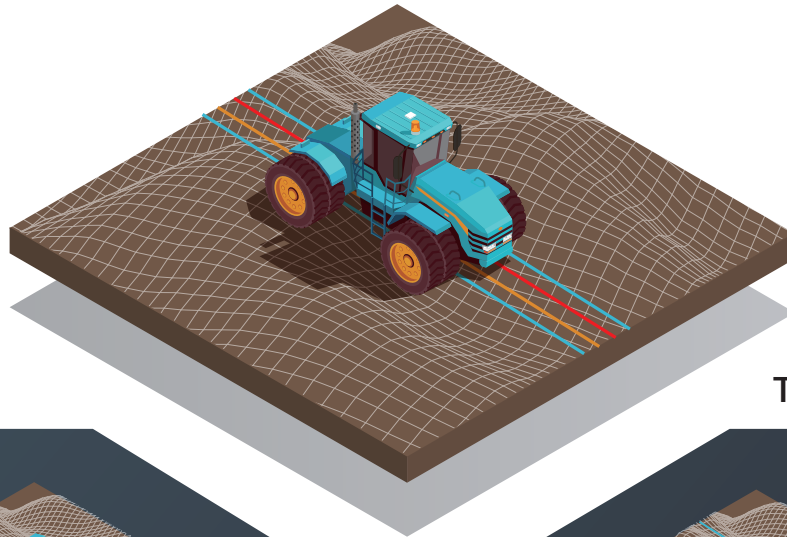
3 AF305's High-Precision Operation Mode Based on SBAS Without a Base Station

Supports all global SBAS (Satellite-Based Augmentation Systems) functions, including WAAS, EGNOS, MSAS, GAGAN, etc., eliminating the need for ground-based stations for SBAS correction of the Global Positioning System. Vehicles equipped with GNSS antennas receive signals from the Global Positioning System satellite constellation. The SBAS service has several ground-based GNSS receivers distributed across the area they correct, receiving the same GNSS information as the vehicles. They can calculate real-time position errors and send this information to a control station, which then uploads the information to a geostationary satellite. The geosynchronous satellite receives the correction information and retransmits it back to the receiver on the vehicle. The positioning accuracy of the SBAS system is typically around 20 cm.

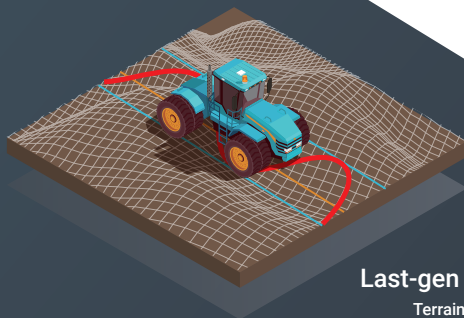


Product Competitiveness & Advantages

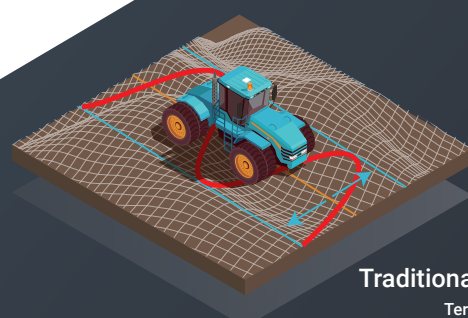
AF305's terrain compensation algorithm utilizes real-time measurements of roll, pitch, and yaw data from sensors installed on wheels and body to minimize overlap and skip rows, enhancing row accuracy. It achieves leading straight-line performance in the industry.



AF305 T3
Terrain Compensation



Last-gen Terrain T2
Terrain Compensation



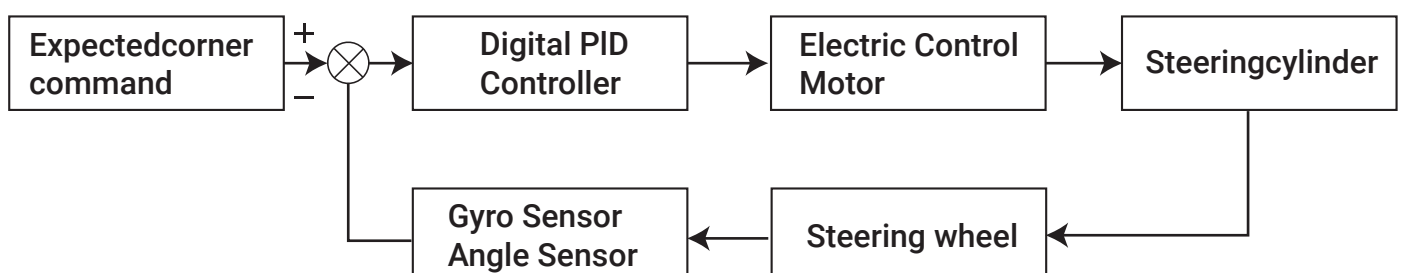
Traditional agriculture
Terrain Compensation

A Intelligent Planning

Intelligent Planning GIS: A technical system for the collection, storage, management, computation, analysis, display, and description of geographically distributed data. Custom path support allows for the customization and import/export of path files.

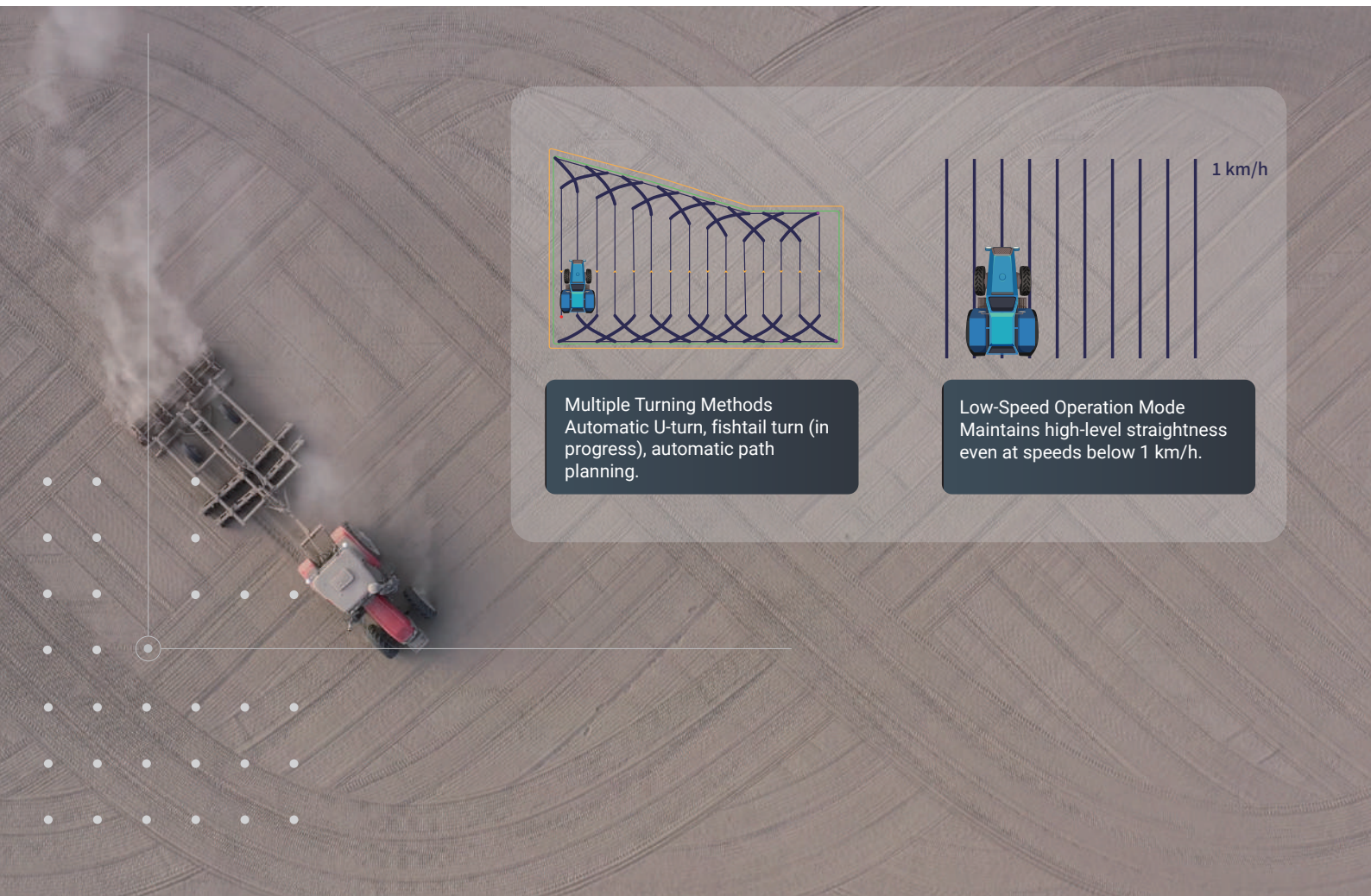
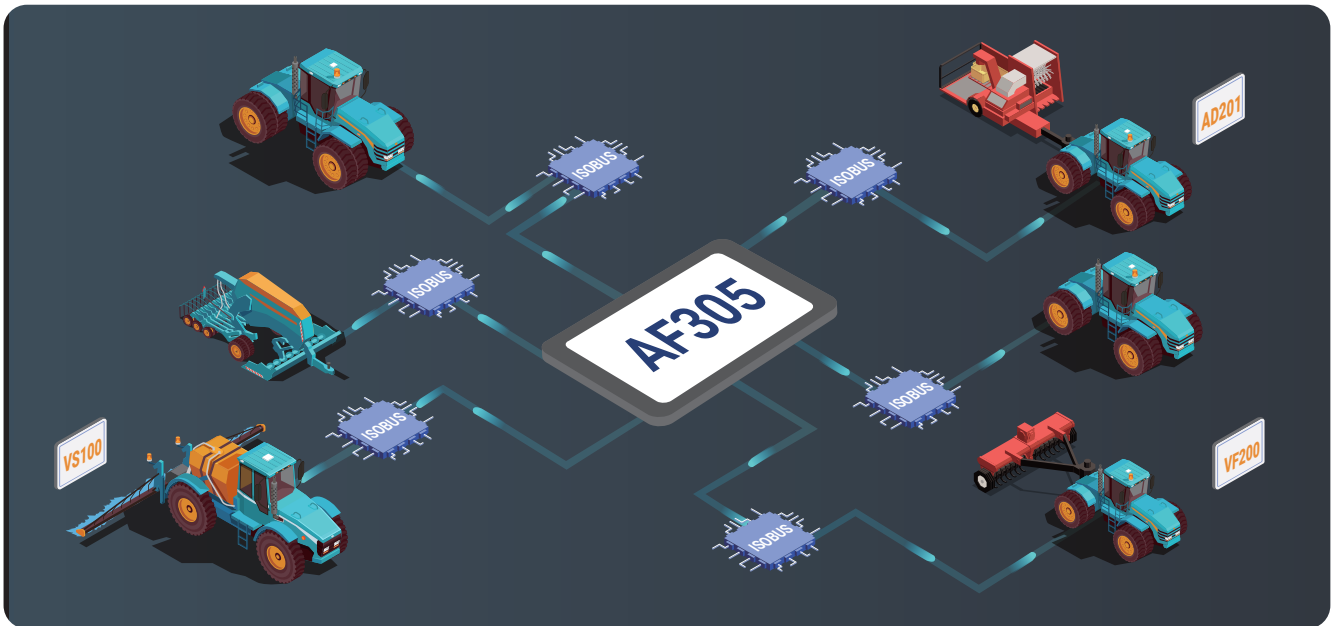
B Intelligent Control

Adaptive PID Control Algorithm: The adaptive PID control method and front wheel angle feedback control method achieve precise control of automatic steering by adjusting the controller's proportional, integral, and differential parameters. This approach offers quick response, accuracy, and is stable and reliable.



ISOBUS INTELLIGENT INTEGRATED CONTROL MODULE (UNDER DEVELOPMENT)

ISOBUS standardized communication protocol allows our automated steering system to serve as a common platform for various agricultural machinery and implements. Using our own products as an example, including the intelligent sprayer VS100, seeder VF200, data monitoring platform AD201&101, harvester, and other agricultural machinery, our system will be compatible with different manufacturers. This compatibility enables seamless communication and collaboration, promoting interoperability and efficiency in agricultural operations. This standardization helps optimize resource utilization, enhance production efficiency, and reduce the complexity of managing different agricultural equipment in the field.



The main components of the AF305



T101 MTK Smart Display and Control Terminal

Unleash the full potential of smart farming with the T101 MTK Tablet Terminal – not just a display, but the central hub of data processing on your agricultural machinery. Embedded with a car-grade MT8768CA CPU, this powerhouse goes beyond simple tasks to drive complex calculations and precision control, essential for modern farming.

The T101 MTK does more than just show data; it's the brain behind the brawn, processing inputs from both external and built-in sensors. Leveraging the tablet's robust 8-core processor, 2GB RAM, and up to 32GB storage, it seamlessly runs advanced algorithms that guide the steering wheel for exact navigational maneuvers across diverse terrains.

Outfitted with a vibrant 10.1-inch capacitive touch screen, the T101 delivers outstanding visibility and responsiveness, ensuring status information is clear and control is intuitive, even with the tap or swipe of ten fingers simultaneously. All this, built into a device that braves the elements, certified with IP67 for water and dust resistance.

Connectivity is a breeze, with comprehensive options from Wi-Fi and multi-band LTE to Bluetooth V4.0, ensuring that your tablet is as connected as you need it to be. It doesn't just handle data; it communicates it effectively, making sure that you stay at the forefront of agricultural technology.

Lightweight, rugged, and engineered to perform in a temperature range from a frigid -20°C to a blistering +60°C, the T101 MTK is the reliable workhorse that epitomizes the essence of precision farming. Choose this tablet to be at the helm of your farm's future, steering towards efficiency and accuracy with every turn.

The main components of the AF305



Steering Wheel

Steer your agricultural operations towards success with our versatile and user-friendly steering wheel, the perfect companion for almost any wheel-steered farm machinery. This steering solution brings universal compatibility to the table, supporting multi-use functionality with easy transferability between machines – a testament to flexibility in modern farming.

Opt for our time-saving and effort-reducing handball steering wheel design, or upgrade to the multifunction steering wheel, complete with convenient buttons. These features allow you to control essential functions of the automatic driving system – like setting A and B points, starting and ending navigation, and resetting navigation lines – all without the need to touch a screen.

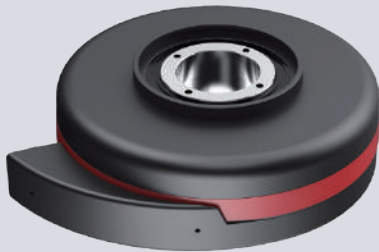
This tactile approach means you can adjust your navigation trajectory on the fly, without taking your eyes off the field. With a simple press of a button, engage in precision navigation, keeping your focus where it matters most: on your crop and the task at hand. Experience seamless operation and effortless trajectory management, designed to enhance your productivity and elevate your farm's efficiency.

Our steering wheel isn't just a tool; it's a revolution in agricultural maneuverability. Embrace the ease of operation, minimize downtime, and get ready to transform how you navigate your agriculture with precision.



R70 Vehicle-mounted Receiver

- Stable operation with high accuracy and NMEA data output: outputs the positioning data received from the GNSS (Global Navigation Satellite System).
- Built-in BeiDou/GNSS full-frequency antenna, full-system multi-frequency high-precision positioning oriented board card, radio, inertial navigation module, 4G module (optional), etc. It can continue to operate for ten minutes even if the network is disconnected. The integrated design, with 3M adhesive installation, makes it very easy to dismantle; it offers stable performance, fast positioning speed, and high accuracy. Built-in high-precision six-axis gyroscope for high-precision attitude measurement.
- Reliable triple protection with a standard IP67 waterproof and dustproof rating.



Electronic Control Motor

- Superior performance with the EMS series integrating the motor and ECU into a robust device capable of delivering stable high torque. Easy to install and maintain, suitable for old vehicles, transplinters, and other high-resistance applications, featuring low noise, low heat generation, high precision.
- The EMS series motor supports long-term operation with minimal heating, protecting components and extending working life. It has an IP67 waterproof and dustproof rating, suitable for outdoor harsh working environments in agriculture.
- Two speed control/position control modes to suit different working scenarios. The integrated design of the drive and control can be widely used in precision agriculture and other vehicle automatic steering applications.



IMU

- A six-axis Inertial Measurement Unit capable of real-time measurement of the device's Roll, Yaw, and Pitch angles during motion, providing data to the tablet system. This, combined with the global satellite navigation system, forms integrated navigation, offering the necessary support for centimeter-level precision in operations.

T101 MTK TABLET TERMINAL MAIN SPECIFICATIONS

SYSTEM

1. Powerful, stable and reliable car-grade processor, **CPU: MT8768CA**
2. Conforms to IP67 technical specification
3. Equipped with super **8-core** processor, main frequency **2GHz**, onboard **2GB** memory, **16or32GB** storage
4. CANBus, Serial, LTE; USB
5. Wide voltage input, 6-36VDC
6. Dual SIM
7. 10.1-inch capacitive touch screen, support 10-finger touch, resolution 1280*800P, brightness 750nits
8. The system uses Android 12.0
9. Optical target design, status information at a glance

COMMUNICATIONS

- Wi-Fi: 2.4GHz IEEE 802.11 b/g/n
- Cellular: FDD-LTE800 / 1800 / 2100 / 2600MHz
TD-LTE1900 / 2300 / 2500 / 2600MHz
NCDMA850 / 900 / 1900 / 2100MHz
GSM850 / 900 / 1800 / 1900MHz

- Bluetooth: V4.0
- USB: USB 2.0 * 1
- Audio: 3.5mm Audio Jack for Audio
- Serial Port: RS232 * 2, RS485 * 1
- CAN Port: CAN * 2
- Digital input: DI * 2
- Digital output: DO * 2
- Analog camera input * 4

ELECTRICAL

- Consumption: $\leq 12.0W$
- Power Input: DC 6V~36V
- Power failure detection: supported
- Power output: 12V DC * 1

PHYSICAL

- Dustproof Waterproof: IP-67
- Dimension: 280mmx180mmx45mm
- Weight: 1.36kg
- Operating Temperature: -20C~+60°C
- Storage Temperature: -40C~+70C

R70 RECEIVER MAIN SPECIFICATIONS

SATELLITES TRACKING

BDS: B1I, B2I, B3I

GPS: L1C/A/L2P (Y) /L2C/L5

GLONASS: G1, G2

Galileo: E1, E5a, E5b

QZSS: L1, L2, L5

Cold start: <30s

Initialization: <5s (Representative)

RTK initialization reliability: >99.9%

Re-acquisition: <1s

ENVIRONMENTAL

Working temperature: -45°C~+75°C

Storage temperature: -55°C~+85°C

Humidity: 100% non-condensing

Waterproof & dustproof: IP67

Drop: Survive from 2m-drop

PHYSICAL

Size: 181.4mm×181.1mm×70mm

Weight: 1.05Kg

ACCURACY

Standalone: 1.5m Horizontally

2.5m Vertically

RTK: 8mm+1ppm Horizontally

15mm+1ppm Vertically

Velocity: 0.03m/s

GNSS + INS heading: 0.5°

Accelerometer range: ±8g

COMMUNICATIONS

Baud rate: 9600~460800

UHF: Support

Deutsch connector: Power supply * 1, Rs232 * 2, CAN * 1

Radio interface: one

GNSS antenna interface: one

DATA FORMAT

Data output format: NMEA-0183, binary

GNSS Data update rate: 1~20Hz selectable

INS Data update rate: 1~100Hz selectable

Correction data format: RTCM3.0/3.2

ELECTRICAL

Power consumption: ≤4W

Power supply voltage: 9~36V DC

Indicator: 3 LEDs indicating power, correction data and satellite tracking

ELECTRONIC CONTROL MOTOR MAIN SPECIFICATIONS

MOTOR PARAMETER

Rated speed: 100rpm

Rated torque: 4 N * M

Maximum torque: 9 N * M

Maximum empty travel error: without reducer, no empty travel error

COMMUNICATIONS

Interface: RS232, CANBUS, AD (Analog to Digital) conversion

Protocol: ModBUS, CAN

Encoder resolution: 53248 line, 4000 pulses per circle

Encoder interface: Parallel communication, no protocol

Feedback element: Incremental encoder 53248PPR

Encoder output frequency: 200Khz maximum

Max backlash error (degrees): No reducer, no backlash error

ELECTRICAL

Rated voltage: DC 12V

Limit Short-time working voltage range: DC 6 ~ 35V

Rated current: 10A

peak current: 40A

Stall current: 25A

PHYSICAL

Hight: 61mm

Diameter: 182mm

Weight: 2.9 kg

Material: Aluminum alloy

ENVIRONMENTAL

Operating temperature: -40 °C to + 70 °C

Storage temperature: -45 °C to + 80 °C

Environmentally: IP67 dustproof and waterproof

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