User Manual

Version V2.0-20220706

User Manual
For SMAJAYU JY302

GNSS Auto-Steering System

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Revision History

Version	Revision Date	Change Summary
1.0	16/04/2019	Initial Release
2.0	21/08/2020	Upgrade Product Figure

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*****When you need to enter the registration code, an interface will pop up with the machine code on it. Please enter the corresponding registration code according to the machine code.**

Please click the link to check the registration code：

https://drive.google.com/drive/folders/1hoZ0AU8wWquh_YHr8y_I6hujdSRlwawu?usp=sharing

1. Introduction

This chapter mainly introduces the overview, system component and package list of the SMAJAYU JY302 GNSS Auto-Steering System.

1.1 Overview

The SMAJAYU JY302 Auto-Steering System is an automatic steering system which uses high-torque motor control steering wheel. It integrates the advantages of convenient installation, large torque, high precision, low noise, low heat, and quick debugging. It is suitable for various applications of tractors, harvesting machines, plant protection machinery, rice transplants and other agricultural vehicles.

The system consists of a base station and a vehicle control part. The vehicle control part includes a control tablet integrated with a high-precision GNSS board, a steering wheel motor with a built-in controller, and an angle sensor. It can be widely used for sowing, cultivating, trenching, ridging, spraying pesticide, transplanting, land consolidation, harvesting and other work scenarios.

1.2 System Composition

The whole system includes one T100 Control Tablet, one EMS2 Motor Wheel, two A10 GNSS antennas, one Angle Sensor, and other accessory cables. They need external power source to power them up, from vehicle or independent power supply. The two antennas are installed on the top the vehicle, the angle sensor is installed on wheel of the vehicle, the motor wheel is installed to replace the original steering wheel, and the tablet is installed beside the motor wheel for monitoring purpose.

Figure 1.1 Major parts in JY302 Auto-Steering System

Figure 1.2 JY302 auto-steering system structure

1.3 Main Devices in the package

1.3.1 T100 Control Tablet

T100 Control Tablet is a portable, robust android tablet which is equipped with a built-in high-precision GNSS board offering centimeter level accuracy positioning and heading.

T100 Control Tablet provides RS232, RS485, USB2.0, CAN etc. interfaces to connect with other equipment, and supports Wi-Fi, 3G/4G LTE wireless communication. The detailed specification refers to section 3.1 T100 Control Tablet. The outlook of T100 Control Tablet is shown as below.

Figure 1.3 T100 Control Tablet

1.3.2 A10 GNSS antenna

A10 GNSS antenna is used to receive the RF signal from the satellites.

There are two antennas in the package. The detailed specification of this antenna refers to section 3.2 A10 GNSS Antenna.

Figure 1.4 A10 GNSS Antenna

If an antenna from other companies is used, contact SMAJAYU to obtain permission, or the system may not work as expected.

1.3.3 EMS2 Motor Wheel

The EMS2 Motor Wheel is an electric motor steering wheel. It is designed for easy-to-install operation. With high-torque, direct-drive electric motor, EMS2 can provide up to 2.5cm RTK accuracy. The detailed specification of this motor wheel refers to section 3.3 EMS2 Motor Wheel.

Figure 1.5 EMS2 Motor Wheel

1.3.4 Angle Sensor

Angle sensor is an auxiliary part which provides higher accuracy and stability. It is used to detect the angle change of the steering tire.

Figure 1.6 Angle sensor

2. General Operations

This chapter introduces how to set up the system and make it start working properly.

2.1 Assembly and Installation

2.1.1 EMS2 installation

The EMS2 Motor Wheel is an electric motor steering wheel. The most important part is the **spline sleeve**, which is based on the selection of the vehicle model refer to the table in Appendix. Please indicate your vehicle model before placing order of this system. The other components include Loge cover, steering wheel, flange, bracket and screws which are shown as below.

Figure 2.1 Assembly diagram of EMS2 motor wheel

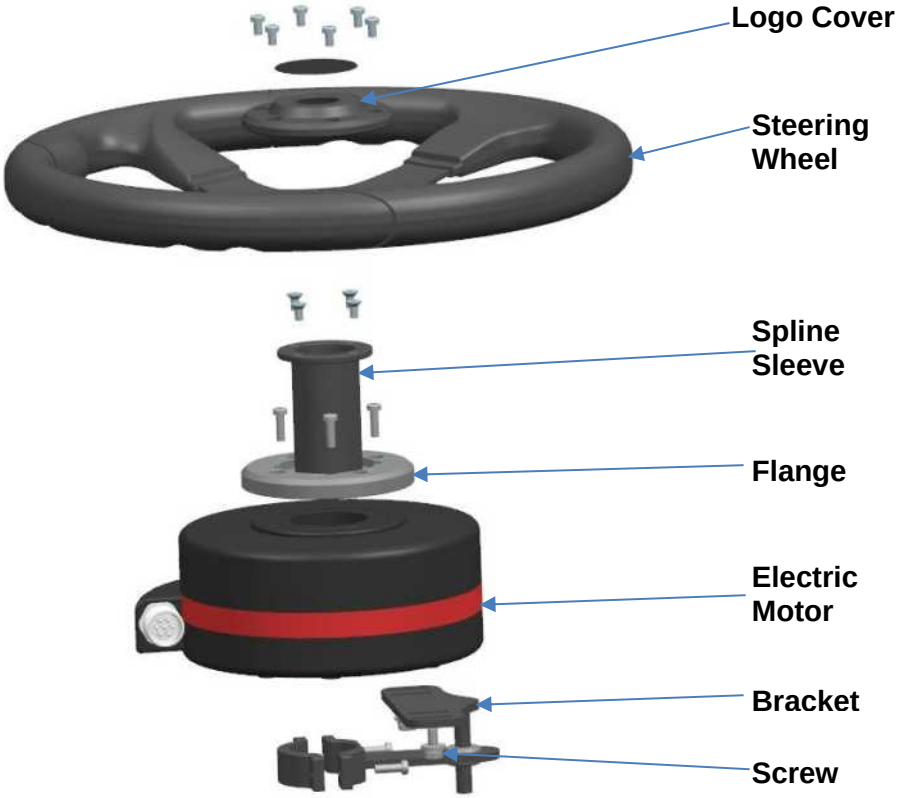


Figure 2.2 Descriptions of the EMS2 assembly components

The detailed steps of installing EMS2 Motor Wheel are shown as below.

1) Prepare the components needed for EMS2 Electric Motor.

Figure 2.3 Components needed for electric motor

2) Use the corresponding screws in the package to fixate

the bracket and motor on the vehicle to replace the original steering wheel.

Figure 2.4 Installation example of electric motor

Figure 2.5 Installation example of bracket for fixating EMS2 Motor Wheel

3) Use screws to install the steering wheel and Loge cover.

Figure 2.6 Installation example of EMS2 Motor Wheel

4) Now the installation of EMS2 Motor Wheel is completed. It should be connected to the main cable after all parts are assembled properly. The cables connection refers to section 2.1.4 Cables Connection.

2.1.2 Angle Sensor installation

The detailed steps of installing Angle Sensor are shown as below.

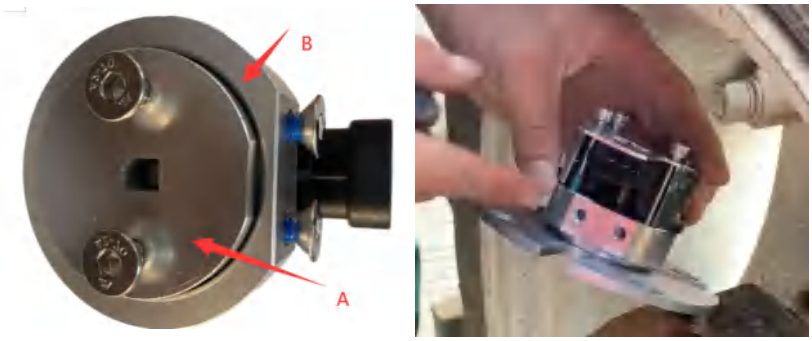
1) Prepare the components needed for installing Angle Sensor.

Figure 2.7 Components needed to install angle sensor

2) Install angle sensor on left front wheel. Take off screw on left front wheel and install angel sensor board, notes plane with screw holes on angel should face to vehicle body when installation.

Figure 2.8 Install the parts to fixate angle sensor

Mind turn angel sensor in right position before install on board. Please make sure plane A and plane B keep parallel and face to vehicle body when installation.



3) Adjust the position of angle sensor to be properly installed. Find the best position and make sure angle sensor could turn in normally. Then, use screw fix angle sensor bracket.

Figure 2.9 Possible position of angle sensor – 1

Figure 2.10 Fix angle sensor – 2

4) Extend board could be used if this part do not have a screw could use for fix angel sensor bracket.

Figure 2.11 Installation example of angle sensor

5) Now the installation of Angle Sensor is completed. It should be connected to the main cable after all parts are assembled properly. The cables connection refers to section 2.1.4 Cables Connection.

2.1.3 Dual-antenna installation

Two GNSS antennas are fixed on the roof of the vehicle. The line between the two antennas should be perpendicular to the direction of the vehicle's route. Normally the left antenna is the primary antenna, and the right antenna is the secondary antenna.

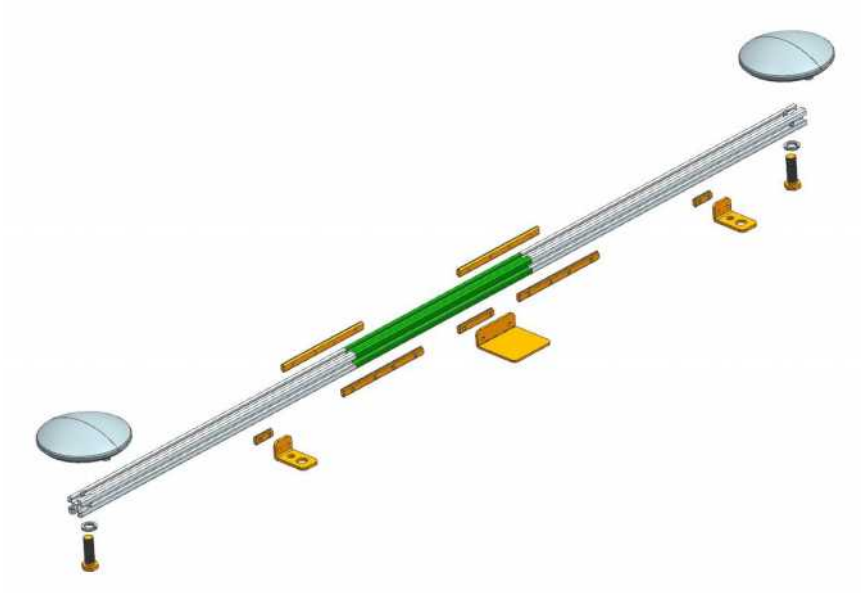


Figure 2.12 Assembly diagram of dual antenna

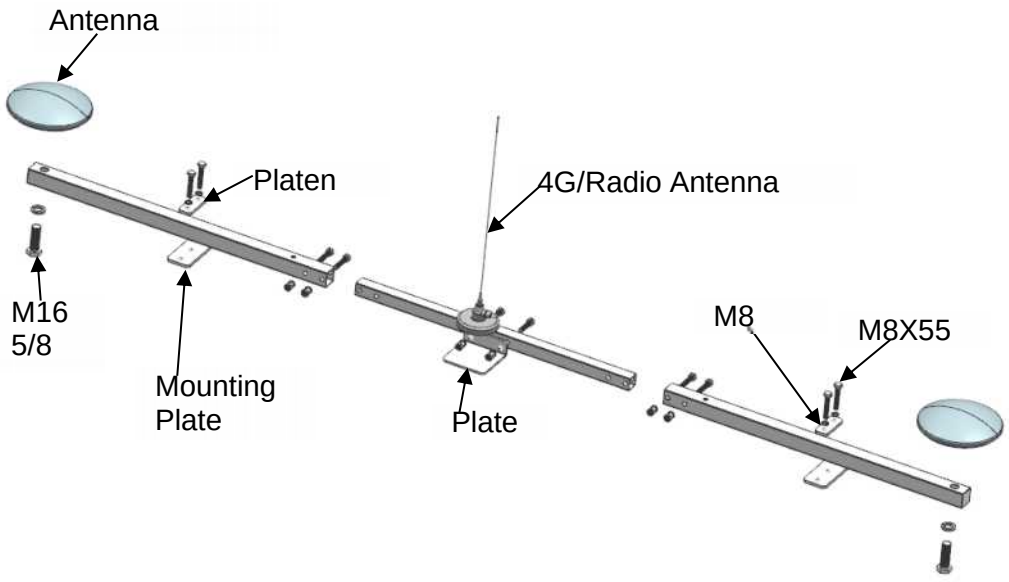


Figure 2.13 Descriptions of dual-antenna components

Figure 2.14 Installation example of dual-antenna – 1

Figure 2.15 Installation example of dual-antenna – 2

2.1.4 Cables Connection

The cables connection should be paid much attention during assembly as there are various connectors on the main cable which is shown below.

Figure 2.16 Main Cable with multiple connectors

The current hardware supports 12V and 24V power supplies

Figure 2.17 Power extension cable with two wires

Figure 2.18 Angle Sensor

The Attitude Sensor (IMU) is optional. It is only required when the angle sensor is not able to be installed on the vehicle.

Figure 2.19 Cable for AttitudeSensor (IMU)

Figure 2.20 Attitude Sensor (IMU)

Figure 2.21 Power Switch with cable

Figure 2.22 Main Cable connects to EMS2 Motor Wheel

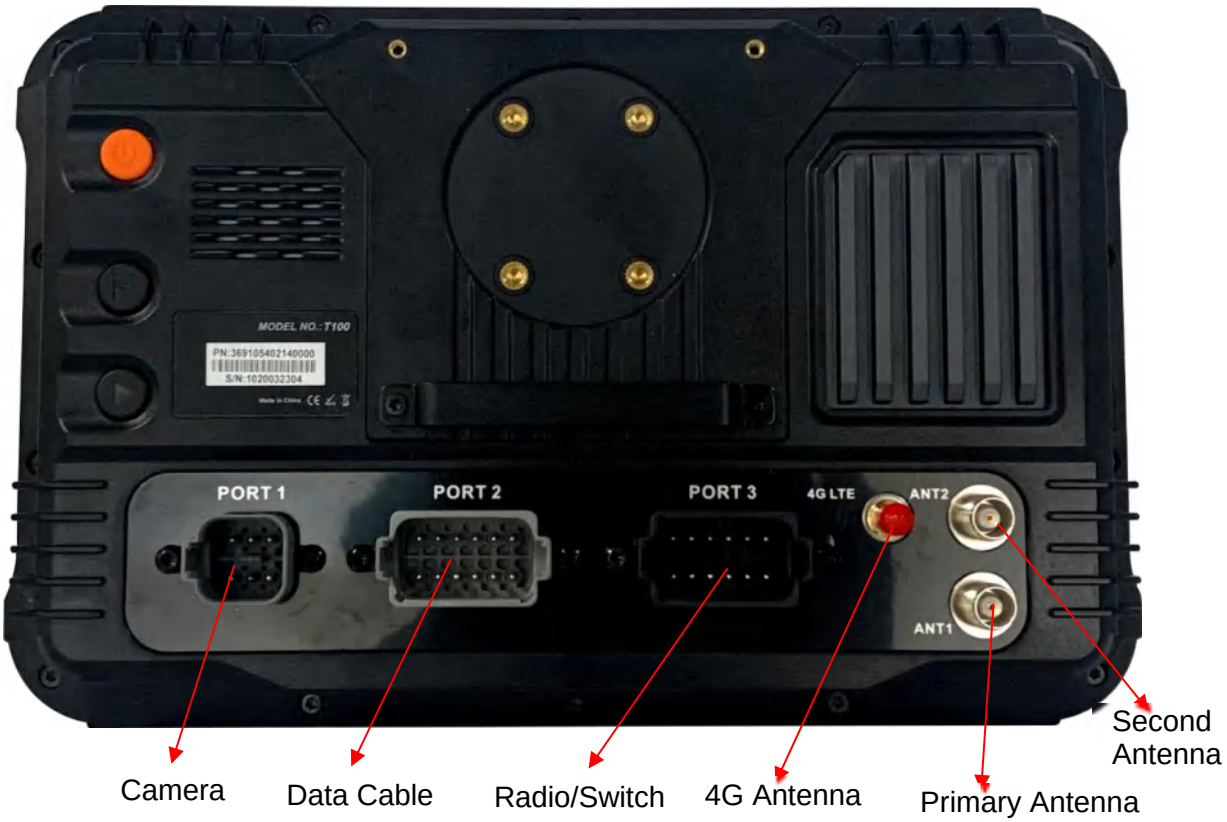


Figure 2.23 T100 Control Tablet connects to main cable and two antennas

Normally the T100 Control Tablet is installed in the control room of the vehicle using the bracket which is shown as below.

Figure 2.24 Bracket for T100 Control Tablet

2.2 Software Operations

The software pre-installed in the T100 Control Tablet is called **Autosteer**.

2.2.1 Software Installation

Power on the T100 Control Tablet by turning on the power switch after all cables and parts are assembled properly. The home screen is shown as below.

Figure 2.25 Home screen of T100 Control Tablet

If Autosteer application should be re-installed for any reason, copy the .apk file into a USB drive and insert it to the USB port of the T100 Control Tablet.

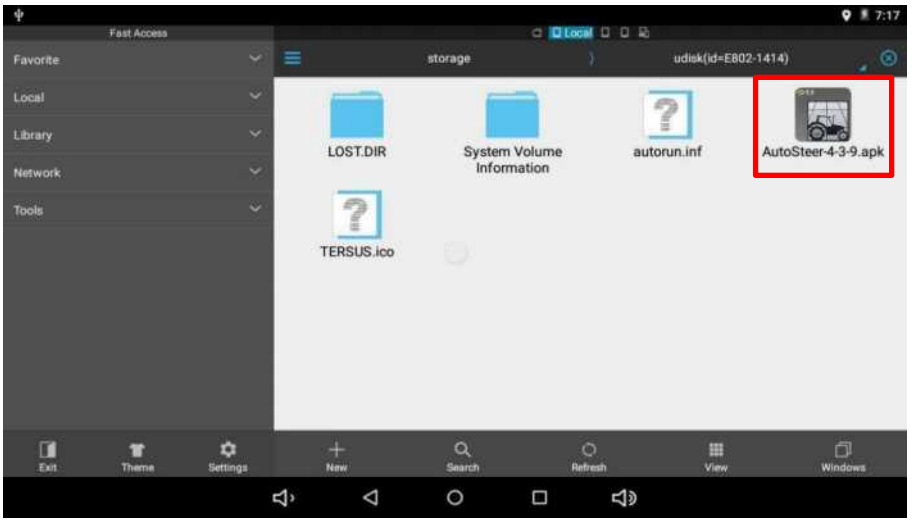


Figure 2.26 Installation file of Autosteer

Click the installation file (.apk file) of Autosteer to install the software to the tablet. The icon will be on the home screen which is shown in Figure 2.25 Home screen of T100 Control Tablet.

Click the Autosteer app on the home screen to enter the software, users should accept the public liability disclaimer notice to enter the main interface of the software.

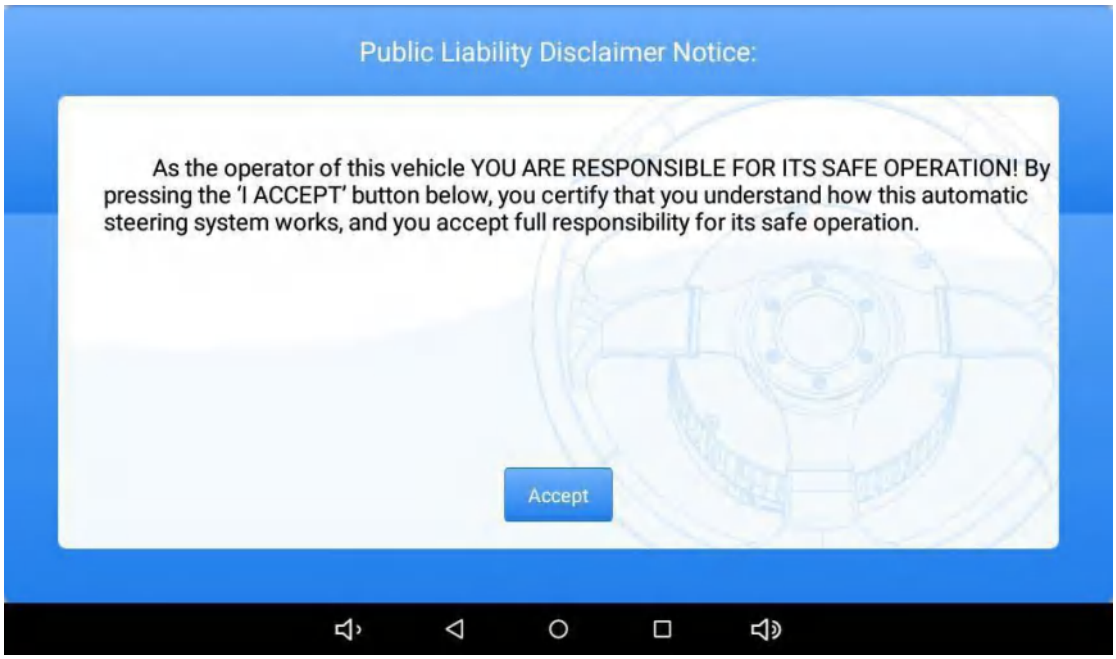


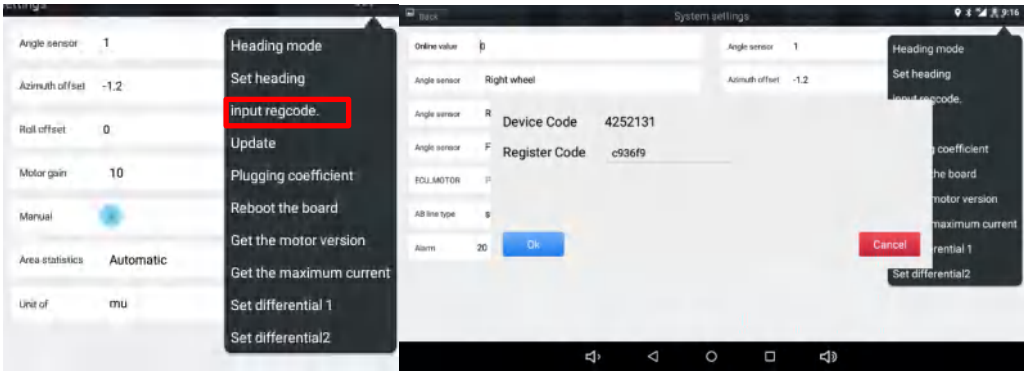
Figure 2.27 Public liability disclaimer notice

2.2.2 Registration.

Please ask SMAJAYU engineer support to complete registration.

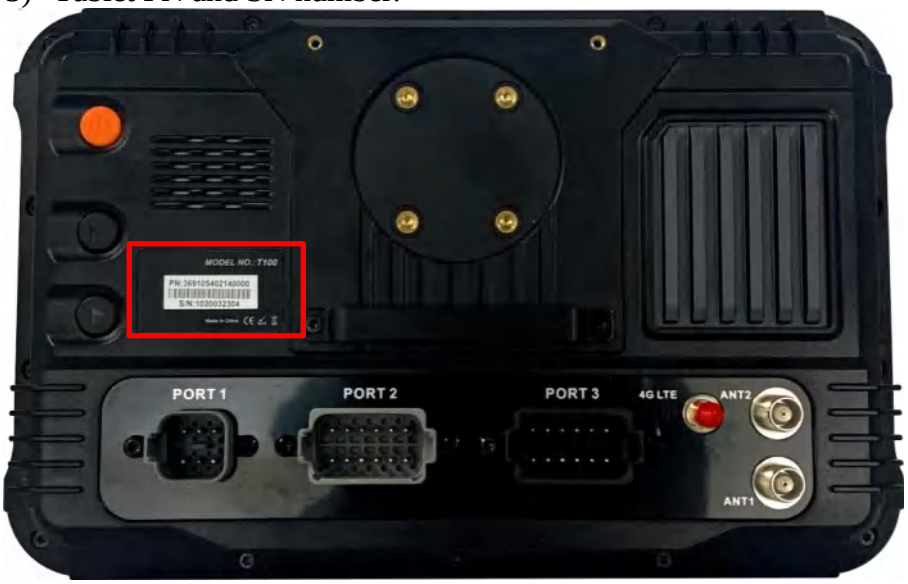
Also, please supply follow information to SMAJAYU Support.

1) Device Code. "System Setting" >> "More" >> "…"



2) Motor SN，PN and device code number.

3) Tablet PN and SN number.



4) Gyro PN and SN number. (If in use)

5) Upload JY302 device parts installation figures.

2.2.3 Software Activation

The software Autosteer is activated before shipping out to customer. If users encounter any situation which needs activate this software or any other questions on the software or firmware, please contact SMAJAYU technical support by email android.development@smajayu.com for guidance.

2.2.4 Configurations

The main interface of Autosteer software is shown as below.

Figure 2.28 Autosteer software main interface

RTK configuration steps are:

1) Select [Base station] in the main interface.
2) Select CORS or External Datalink mode, the external datalink can be a Ntrip Modem or a radio module.

4) Back to the main interface, RTK status becomes Fix.

3) Edit the information as below for example:

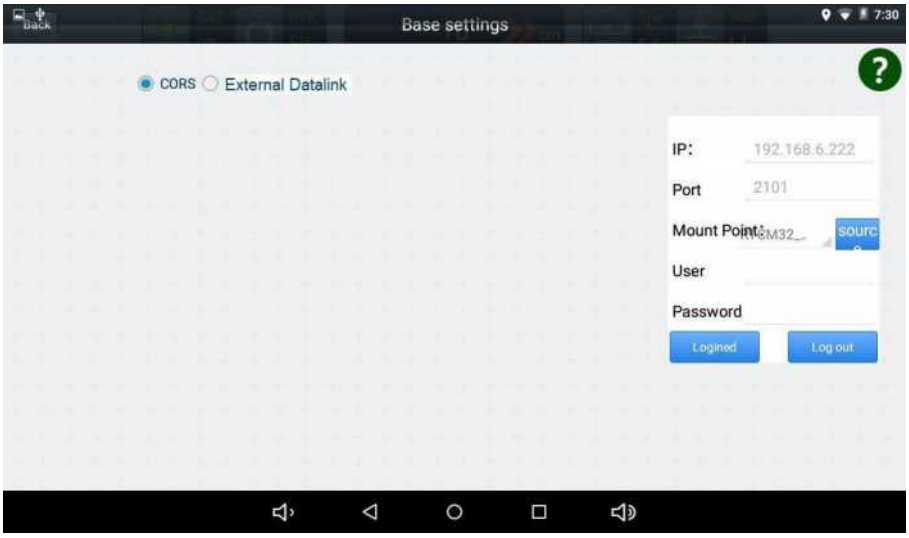


Figure 2.29 RTK base configuration

Vehicle configuration steps are:

1) Select [Vehicle Parameter] in the main interface.

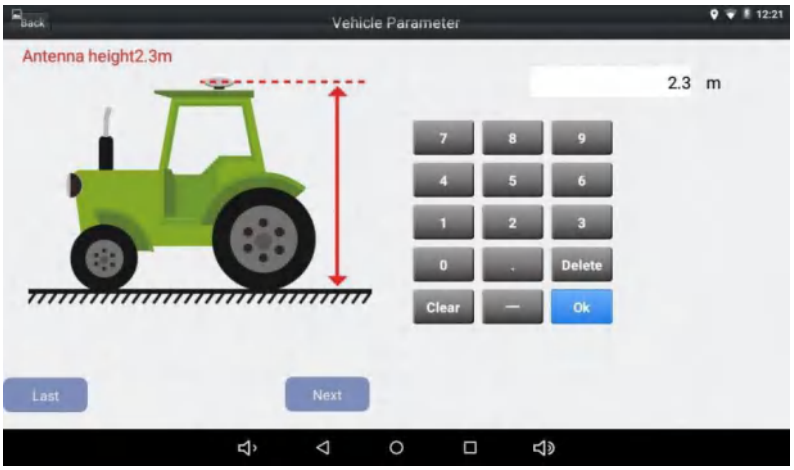


Figure 2.30 Vehicle parameter configuration – antenna height

2) Fill the parameter and select [Next]. （0.8 m in normally）

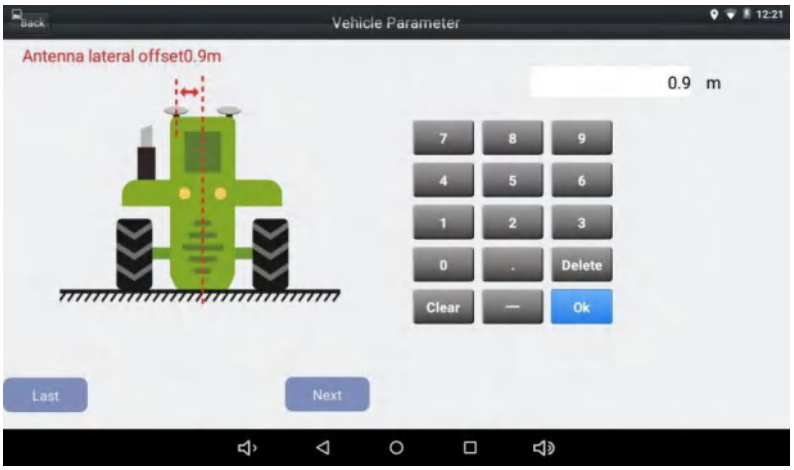


Figure 2.31 Vehicle parameter configuration – antenna lateral offset

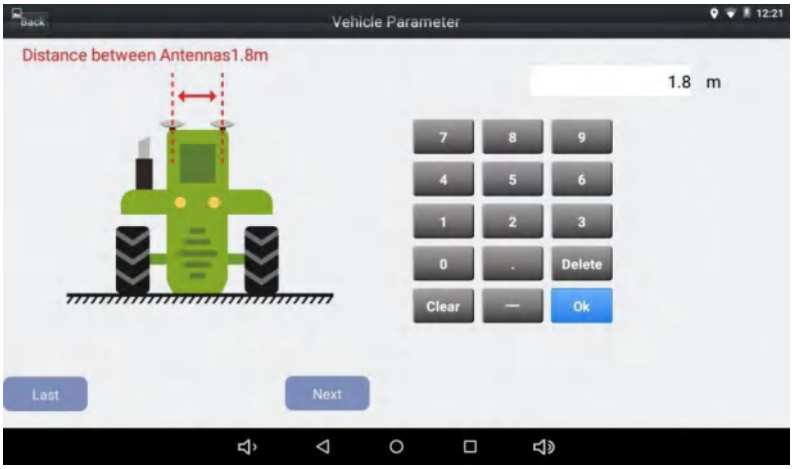


Figure 2.32 Vehicle parameter configuration – antenna distance

Figure 2.33 Vehicle parameter configuration – antenna fore

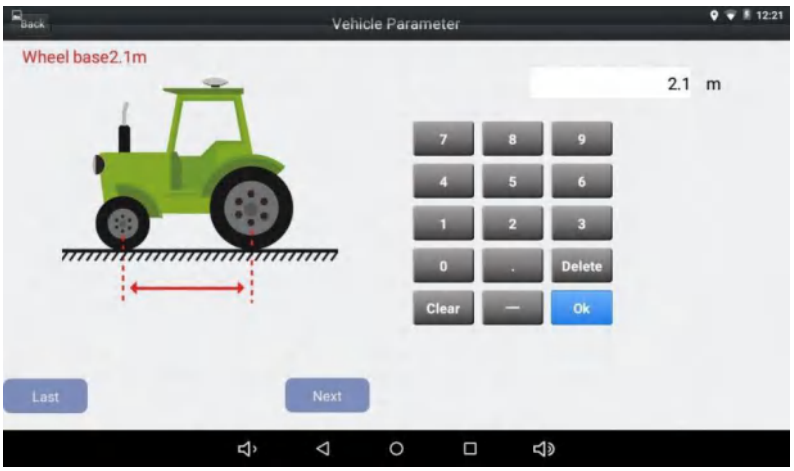


Figure 2.34 Vehicle parameter configuration – wheelbase

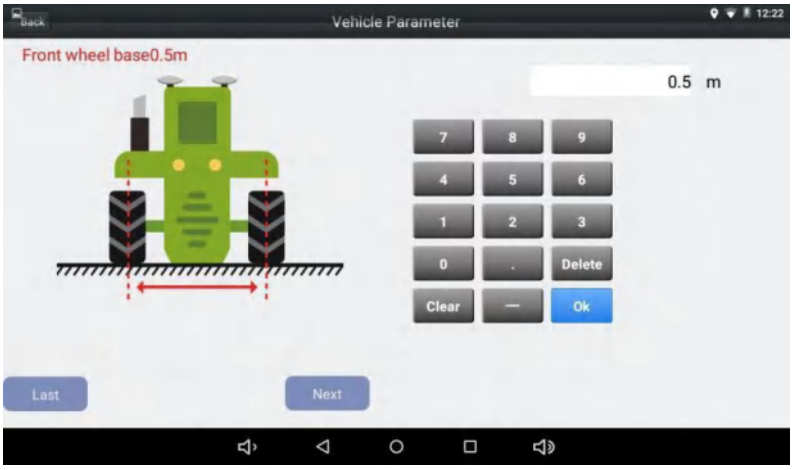


Figure 2.35 Vehicle parameter configuration – front wheel

3) After all the parameters are set, click [Back] on the upper left corner to return to the main interface.

2.2.5 Calibration

Before the JY302 Auto-Steering system is enabled for the field work, it is recommended to perform the calibration for specific vehicle following below steps.

1) Select [System settings] in the main interface.

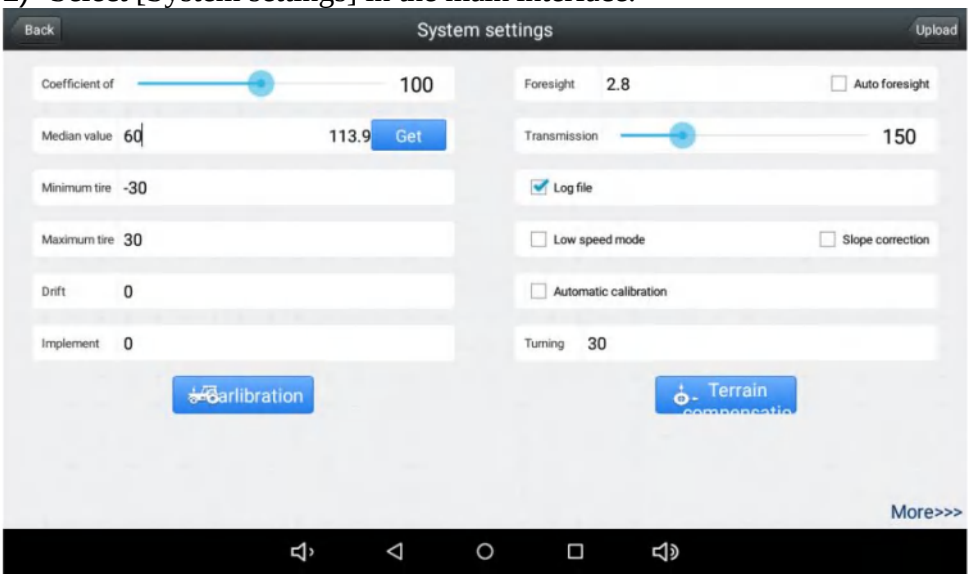
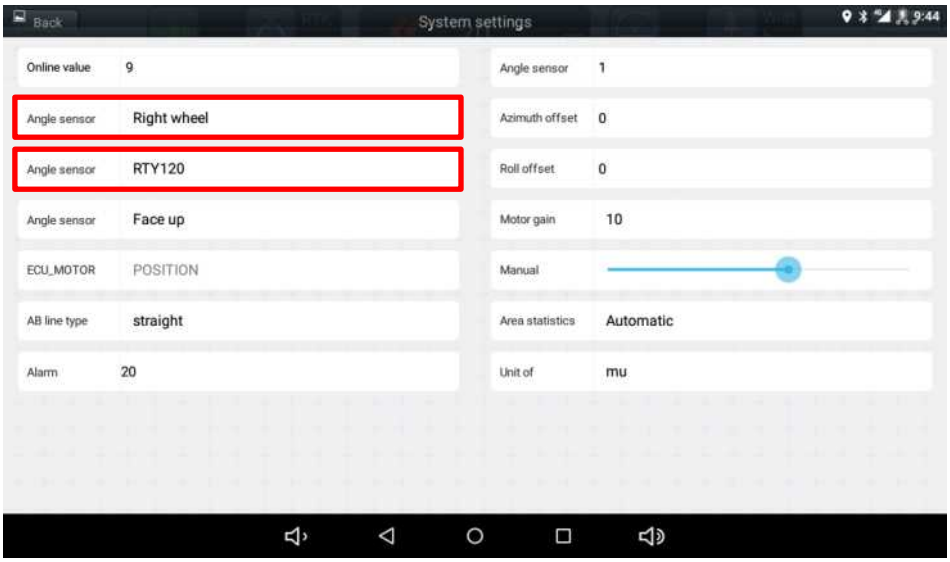


Figure 2.36 System setting interface

2) Select [more] in the lower right corner and select [Angle sensor



position] correctly. The angel sensor position chosen of “Right Wheel” or “Left Wheel" is depend on the position of angel sensor installation. Angel sensor choose “RTY 90”.

3) Select [Middle], and then click [Get] to obtain the centering angle. The number should between 50-70. Please adjust angel sensor if the data is not in the range.

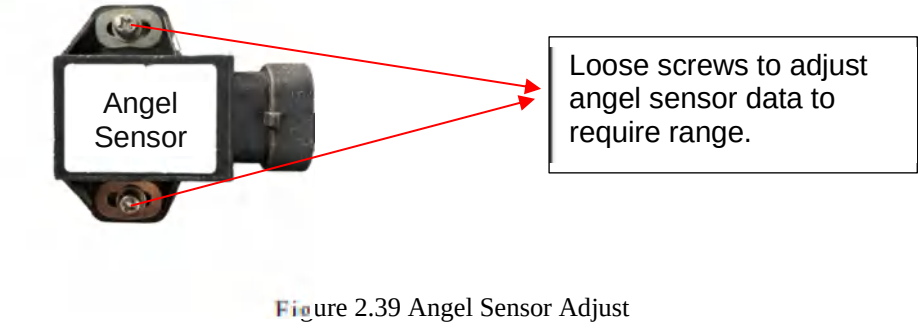


Figure 2.39 Angel Sensor Adjust

Note: Before clicking [Get], ensure the front wheel of the vehicle is in the middle.

4) Select [Turn left] and [Turn right]. Click [Turn left] and [Turn right] respectively, and the front wheel will rotate 5 degrees in the corresponding direction, respectively. The minimum tire angle and maximum tire angle should be in the range from -20 to +120 degrees.

Note: Power up the vehicle before clicking the buttons.

5) Select [Terrain Compensation] and do the calibration according to the screen wizard.

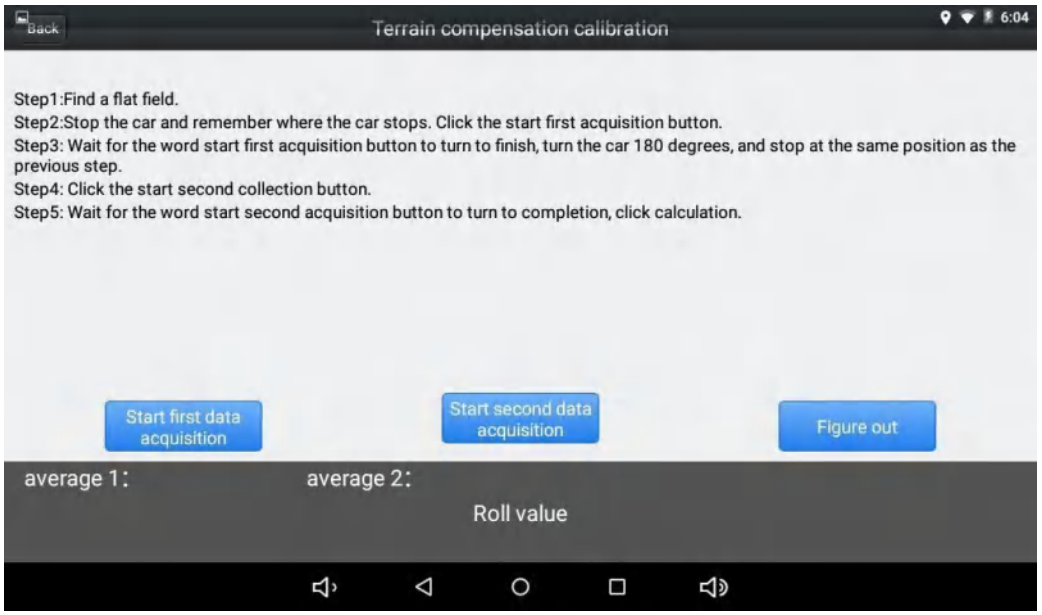


Figure 2.40 Terrain compensation wizard

Note: If the ground is not flat, roll debugging needs to be opened, and roll adjustment is needed after the roll adjustment is opened

6) Select [Calibration] and do the calibration according to the screen wizard.

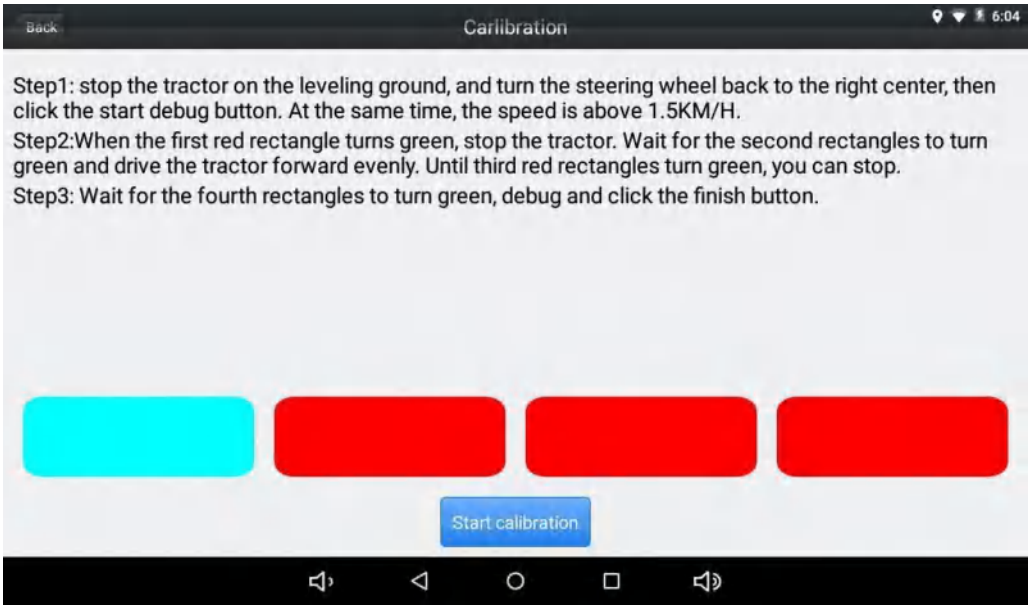


Figure 2.41 Calibration wizard

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2.2.6 Navigation line setting

Here takes the AB line for example of the navigationline.

1) Select [Width] in the main interface, set the width and offset of thetask.

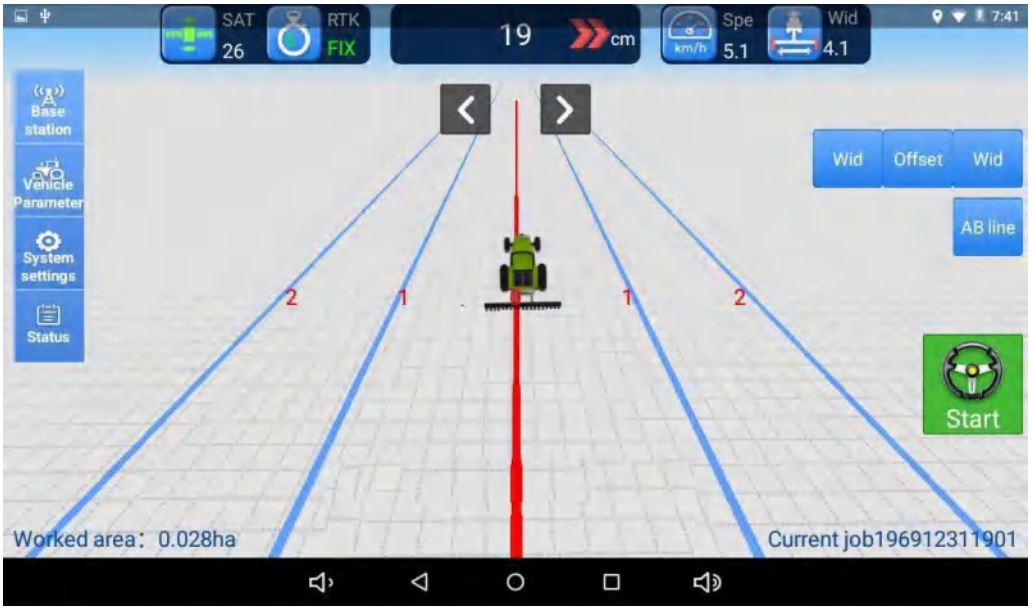


Figure 2.42 Set width and junction

2) Select [AB line], set A and B when creating a new navigation job.

Or import the AB line if there is already an AB line data in thetablet.

Note: set up the AB line first, or the tractor cannot work.

Figure 2.43 Import AB line

3) Return to the home screen. Click [Start] to start the system.

Figure 2.44 Agricultural operation in progress

3. Gyro Calibration

3.1 Single Gyro

Step 1: Select Single Gyro.
"System Setting">> "More"

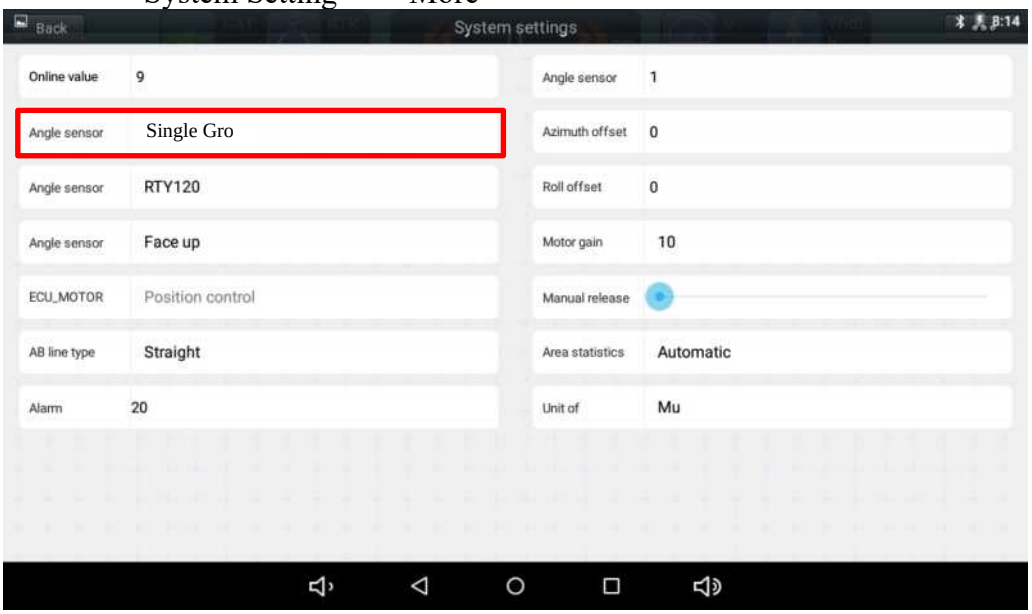


Figure 3.1 Single Gyro

Step2: Check "Automatic Calibration"

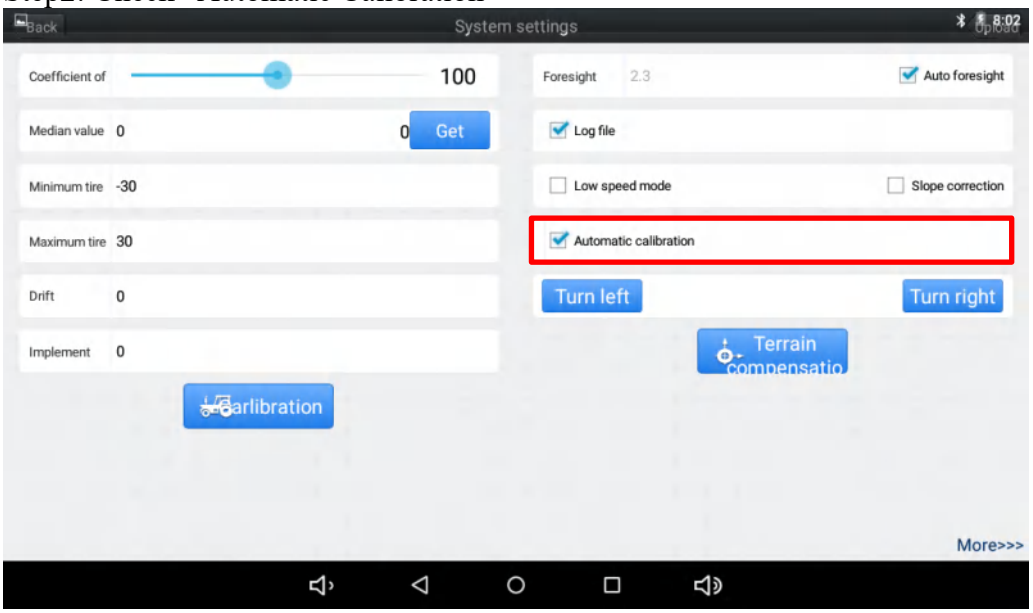


Figure 3.2 Single Gyro Calibration

Step 3: "Carlibration">> "Single gyro debugging"

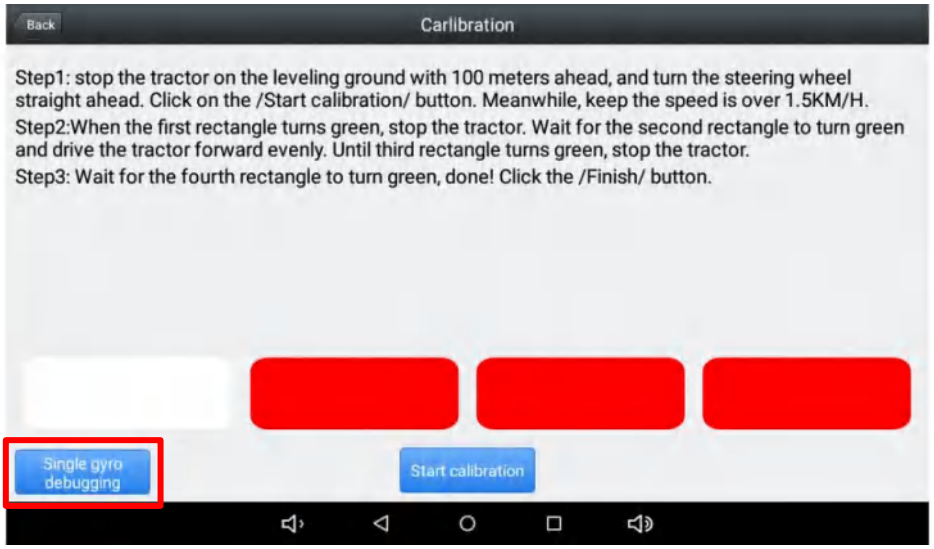


Figure 3.3 Single Gyro Calibration

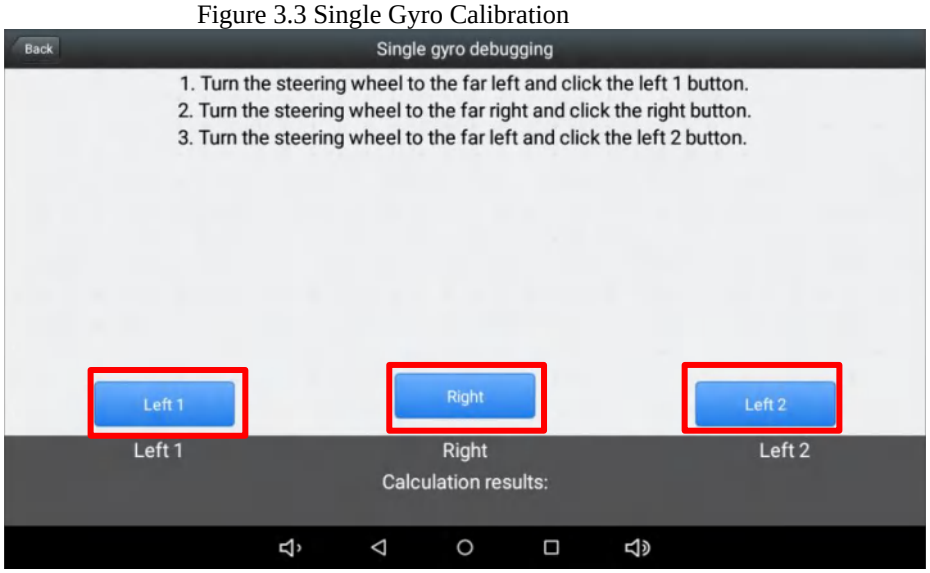


Figure 3.4 Single Gyro Calibration

Adjust Azimuth Offset if there are deviation when using Auto-Steering.
Always left deviation decrease “Azimuth Offset” value and always right deviation increase “Azimuth Offset” value.

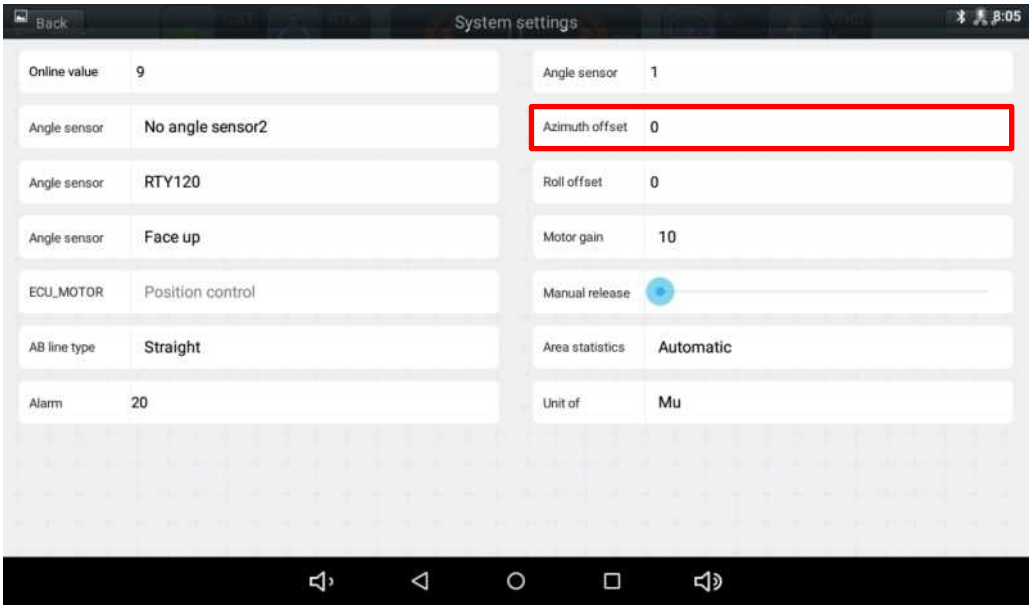


Figure 3.7 Azimuth Offset for Auto-Steering Deviation

4. Specifications

This chapter includes the specifications of T100 Control Tablet,

A10 GNSS Antenna and EMS2 Motor Wheel.

4.1 T100 Control Tablet

Table 3.1 T100 Control Tablet Specifications

GNSS Performance		
Signal Tracking	GPS L1, L2 GLONASS L1, L2 BeiDou B1, B2 GALILEO E1, E5b QZSS L1, L2 SBAS L1	
GNSS Channels	432	
Position Accuracy	Single Point Positioning	1.5m RMS (Horizontal)
		2.5m RMC (Vertical)
	DGPS Positioning	0.4m (Horizontal)
		0.8 (Vertical)
	RTK Positioning	10mm+1ppm (Horizontal)
		15mm+1ppm (Vertical)
Heading Accuracy	0.1 RMS @ 1m baseline	
Time Accuracy	20ns RMS	
Velocity Accuracy	0.03m/s RMS	
Reacquisition	< 1s	
Correction	RTCM 2.3/3.0/3.2	
Date Output	NMEA-0183	

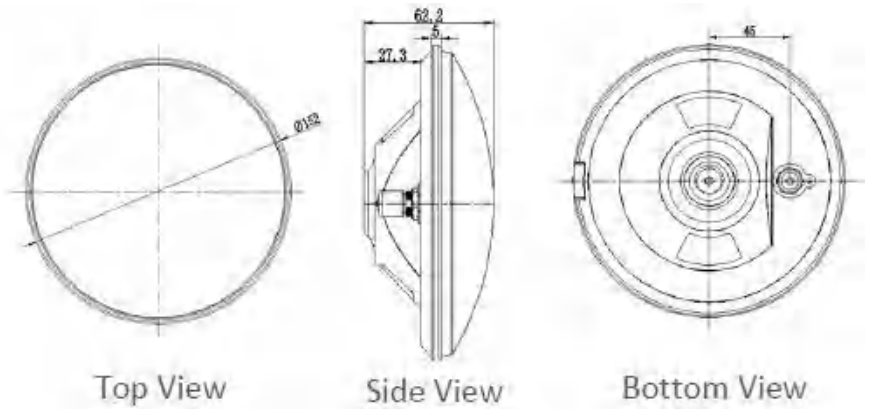
Heading and RTK update rate	20Hz
Network Protocol	NTRIP, TCP/IP
System Performance	
Operating System	Android 6.0
CPU	Quad-Core 1.5GHz
Memory	2GB RAM + 16GB ROM
LCD	10.1“Capacitive Touch Screen
Resolution	1024x600 pixels
Communications	
Wi-Fi	2.4GHz IEEE 802.11 b/g/n
Cellular	FDD-LTE 800 / 1800 / 2100 / 2600MHz TD-LTE 1900 / 2300 / 2500 / 2600MHz WCDMA 850 / 900 / 1900 / 2100MHz GSM 850 / 900 / 1800 / 1900MHz
Bluetooth	V4.0
USB	USB 2.0 (host & debug) x1
Audio	3.5mm Audio Jack for Audio
Serial Port	RS232 x2, RS485 x1
CAN Port	CAN x2 (J1939, CANOpen, ISO15765)
Ethernet	RJ45 (100M Ethernet) x1
Electrical	
Power Input	9V~36V DC
Power failure detection	supported
Power output	12V DC x2
Physical	
Dimension	281mmx181mmx42mm
Weight	1.5kg

Environmental	
Operating Temperature	-20 C to +70 C
Storage Temperature	-40 C to +85 C
Water & Dust proof	IP65
Vibration	MIL-STD-810G
Road Vehicle Standards	ISO16750
Humidity	0%~90%RH @ -20℃~+70℃ 30%~95%RH @ -40℃~+85℃

4.2 A10 GNSS Antenna

Table 3.2 A10 GNSS Antenna

Antenna Specification	
Tracking signals	GPS L1/L2; BDS B1/B2/B3. GLONASS L1/L2
Impedance	50 Ohm
Polarization	RHCP
Axial Ratio	≤ 3dB
Azimuth Coverage	360°
Output VSWR	≤ 2.0
Peak Gain	5.5dBi
Phase Center Error	± 2mm
LNA Specification	
LNA Gain	40±2dB
Noise Figure	≤ 2.0dB
VSWR	≤ 2.0
Input Voltage	3.3~12V DC

Operating Current	≤ 45mA
Ripple	± 2dB
Physical	
Dimension	Φ152*62.2mm
Weight	374g
Signal Connector	TNC Female
Installation connector	5/8’’ x 11 UNC Female
Environmental	
Operating temperature	-45 C - +85 C
Storage temperature	-45 C - +85 C
Damp	45% - 95%
Mechanical Drawing	
	

4.3 EMS2 Motor Wheel

Table 3.3 EMS2 Motor Wheel

Motor Performance	
Rated speed	100 rpm
Rated torque	10 N·m

Guaranteed continuous operation speed	100 rpm
Maximum freewheel error	0 (without reducer)
Supply voltage	8V~16V DC
Rated current	10A
Stall current	25A
Rated voltage	12V
Communication	
Communication protocol	ModBUS
Encoder resolution	1000 lines, 4000 pulses / circle
Encoder interface(protocol)	parallel, no protocol
Encoder maximum output rate	200KHz
Communication interface	RS232
Physical	
Dimension	Φ187x100.2mm (motor) Φ410x32mm (steering wheel)
Weight	6.35kg (motor only)
Material	Aluminum alloy
Environmental	
Operating temperature	-40 C - +105 C (motor)
Storage temperature	-45 C - +150 C (motor)

5. Typical Applications

5.1 Base Station example

It is recommended using AllyNet system as the base station to cooperate with JY302 auto-steering system. With SMAJAYU Ntrip Caster Service, Ntrip Modem and Base Receiver, the AllyNet opens the possibility for users to transmit Real Time Kinematic (RTK) corrections via Internet (Ethernet or 2G/3G/4G) in a simple, user-friendly way, just using a SIM card or Ethernet cable without any need of a static IP.

Figure 5.1 AllyNet System Structure

There are various applications that JY302 GNSS Auto-Steering System can be used. Here list three working scenarios.

5.2 Spraying Pesticide

Figure 5.2 Spraying pesticide using JY302 auto-steering system

5.3 Transplanting

Figure 5.3 Transplanting using JY302 auto-steering system

5.4 Other tractor work

Figure 5.4 Other tractor works using JY302 auto-steering system

6. Appendix-1

Here list current available spline shafts, new spline shaft can be customized if your vehicle is not including in the table below. Contact SMAJAYU Technical Support via email android.development@smajayu.com for more details.

Table 5.1 List of Available Spine Shafts

No.	Mark	Matched Vehicles
1	A	**John Deere** models (350, 720, 754, 804, 850, 854, 904, 954, 7830, 2204, 8295, 1204, 1404, 1354, 6605 and 5-754, 5-850, 5-854, 5-900, 5-904, N754, 6B954) **East Red** models 954 and 1204 **RENOMAN** models 2204 and 1404 **ZOOMLION** PL2604 **Case New Holland** Puma 2304
2	A1	**John Deere** model 5-754
3	B	**LOVOL** models 900, 1004, 1654 **East Red** models 700, 750, 754, LX800, 90, 904, LF904, 1204 **John Deere** 484, KAT2804 **DFAM** models 704, 904, 1204, 1504
4	N	**Case New Holland** model 535 **CLAAS** model 2204
5	KN	**Case New Holland** model T1654
6	NH40	**Case New Holland** model 904 (φ17.4mm 40 teeth) **Case New Holland Shanghai** model SNH904
7	D	**DEUTZ FAHR** models (φ20.4mm)
8	D1	**DEUTZ FAHR** models 1804, 2604 (φ20.6mm)
9	E	**CHERY** model RC954

10	JG	**DFISEKI** models PZ60, T954
11	W	**LOVOL** models 654, 800, 900, 904, 1204, 1304, 1504 **DFAM** model 750 **East Red** model 2004
12	T	**KUBOTA** models M704K, 954 **YANMAR** rice trans planters

7. Terminology

BDS	BeiDou Navigation Satellite System
DC	Direct Current
DGPS	Differential Global Positioning System
GLONASS	GLObal Navigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
PC	Personal Computer
RMS	Root Mean Squares
RTK	Real-Time Kinematic
RTCM	Radio Technical Commission for Maritime Services
USB	Universal Serial BUS

If you encounter difficulties during use, you can email our technical support team and we will solve any problems for you.

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Email: support@smajayu.com & tech@smajayu.com

8. Set Imple and Joint width

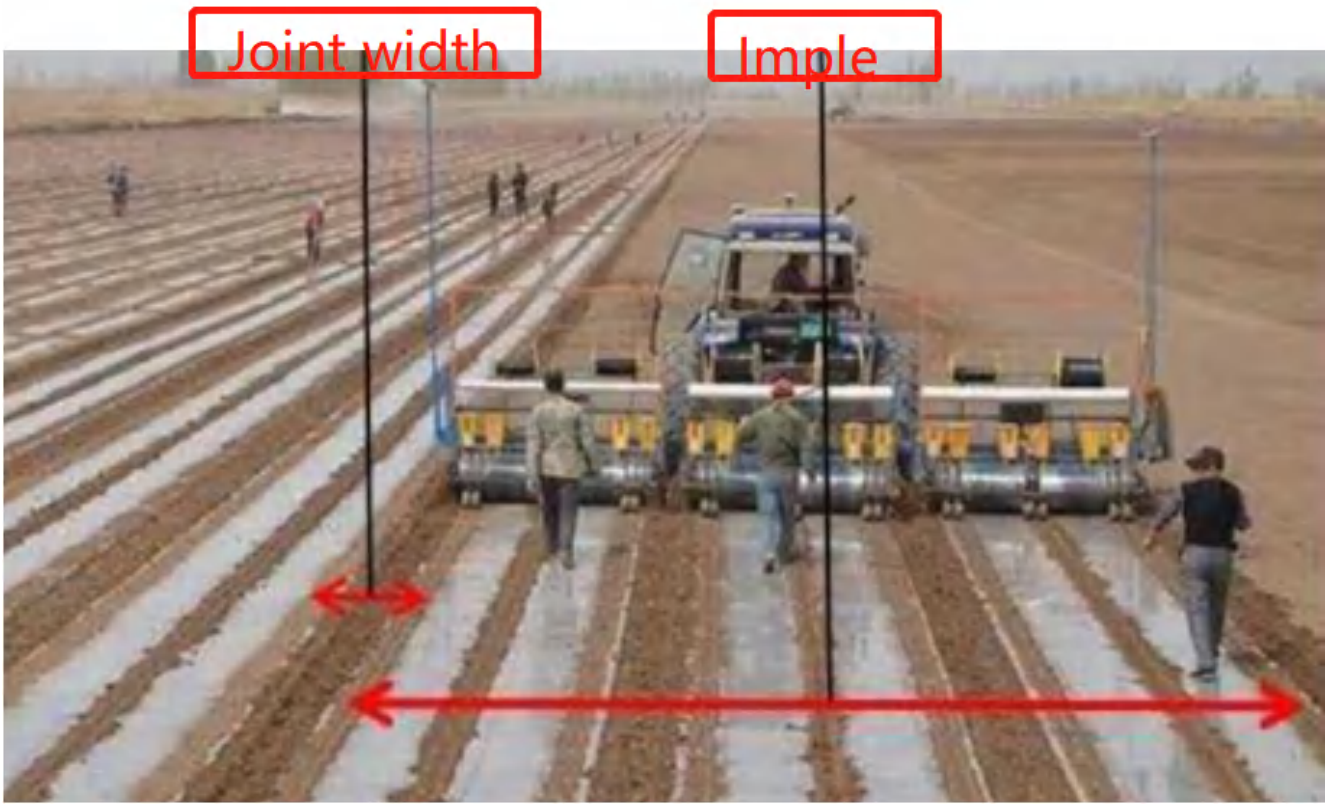
8.1 Abstract

This paper mainly introduces how to set the specific operation of farm tool distance and handover line distance, and how to correctly set these two values in different operation scenarios.

8.2 Specific operation process

8.2.1 Before setting these two values, we first need to understand their specific meaning. As shown below:

Imple (implement width, the distance between the two most seed rows)
Joint width (distance between two adjacent seed rows)



8.2.2 There are three possible situations when setting these two data.

（1） When working in the field, it is necessary to measure and set the width and joint distance.

（2） When working in the field, the width needs to be measured and set, but the joint distance is 0.

（3） If the width distance to be input is less than the measured distance of agricultural tools, the input width shall be measured according to the actual situation

8.2.3. After determining the width and joint data to be input, we can input these data on the software. The specific operations are as follows:

（1） Click the width button as shown in the figure.

（2） Click the Width button as shown in the figure.

（3）Enter the Imple and Joint width data in the places shown in the figure, and then click OK to operate normally.