SingularXYZ

SL100
Land Leveling System
User Manual

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Chapter 1	**Introduction**

1.1   Overview

The SL100 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 leveling system can be controlled manually and automatically, and the tablet displays the height of the reference plane and the real-time height information.

2. In the automatic mode, the site can be automatically leveled according to the set height, and two modes of slope and level site are supported.

3. The terrain information is displayed in different colors, which greatly improves work efficiency. It can help users understand the height and level of the entire site in real time, and make accurate judgments during operation, which largely improves work efficiency by more than 40%, and greatly saves time and cost. Compared with the traditional laser land leveling system and ordinary satellite leveling system, it has great working advantages.

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

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 SL100 Packing List

Table 1: SL100 Packing List

SL100 Land Leveling System Device List			
Name	Mode	Quantity	Figure
Tablet	T10	1	
RAM Bracket	/	1	
GNSS Antenna	SA100	1	
GNSS Antenna Mount	/	1	
Controller	/	1	
GNSS Antenna Cable	/	1	
Power Supply Cable	/	1	
Communication Main Cable	/	1	
External Lift Switch	/	1	
4G Antenna	/	1	
Solenoid Valve Control Cable	/	1	
Camera	/	Option	
Camera Cable	/	Option	

Accessary	/	1	

1.3   Work 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.

Chapter 2	System Installation

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

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 leveling machine, the installation location should also be determined according to the actual situation. Please note that the GNSS antenna must be placed directly above the center of the scraper, as shown in the figure below (Figure2.1).

When installing the GNSS antenna, please find the appropriate screws to fix the antenna mount.

Figure 2.1 GNSS antenna installation

2.1.2 Cables Connection

Install according to the schematic diagram of the on-board mobile terminal (Figure2.3), 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.
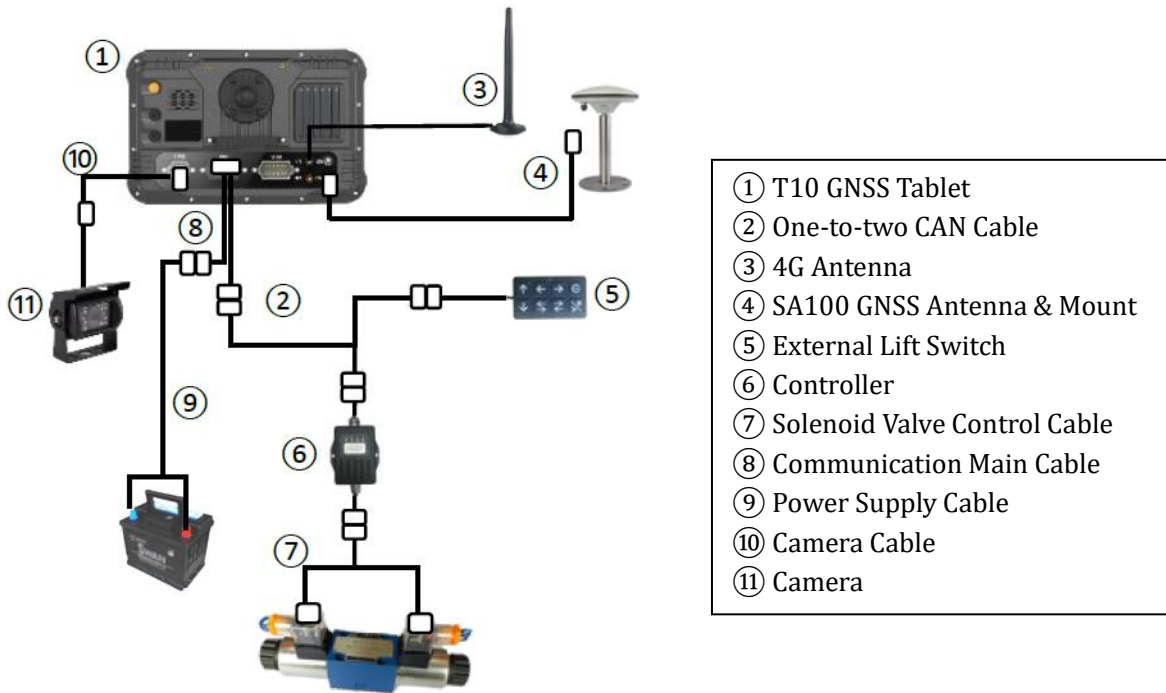
Figure 2.2 Cables connection

Note:

1. Choose the correct cable layout location.

2. The One-to-two CAN Cable is connected to the Communication Main Cable.

3. The solenoid valve control cable and the antenna cable should be arranged separately, avoiding them entangled together.

2.1.3   Display and Controller Installation

The tablet is the main equipment for the system to interact with the driver. It should be installed in the cab where 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 viable to drill holes in a suitable position for fixing, then fix the tablet on the bracket.

Figure 2.4 Tablet installation

This chapter will introduce the main features of SingularXYZ field leveling software and operations.

Figure 3.1 Software icon

3.1 Software Button Features

The main interface of the land leveling software is shown in figure 3.2, including function buttons and status bar, which can facilitate the information interaction between the software and the driver. The detailed instructions will be described in the following content.

Figure 3.2 Software Main Interface

3.1.1 Top Status Bar

1. Satellite: Shows the number of tracking satellites in real time.

2. RTK: RTK solution status and correction data delay. The available status is Fixed.

3. Height Difference: The value displayed in the top middle position refers to the distance between the real-time plane elevation and the target plane elevation, which flashes once every 0.5s by default.

It is marked as ▼ when the real-time elevation is higher than target elevation, and the value is positive.

It is marked as △ when the real-time elevation is lower than target elevation, and the value is negative.

It is marked as ▬ when the height difference between the real-time elevation and the target elevation is within the accuracy range, which can be set by yourself.

4. Speed: Real-time speed of working tractor.

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

6. Camera: Real-time image data. Click to open the camera, it will display the real-time image of the half interface and the model leveling interface of the other half interface, as shown in Figure 3.3.

Figure 3.3 Camera Interface

7. Viewing angle: Click to fix the angle of view as the center of the model, click to fix the angle of view as the leveling interface.

3.1.2   Left Toolbar

1. SIGNAL: The SIGNAL button is used to configure the base station signal, which provides Radio and CORS two work modes. You can choose one of them and enter the corresponding information according to your local conditions.

Figure 3.4 SIGNAL – Base Configuration Interface

2. MODE: The MODE button is used to select the leveling modes. After click the button, there are 2 leveling modes for your use (Figure 3.5), including the flat mode (LEVEL) and slope mode (SLOPE).
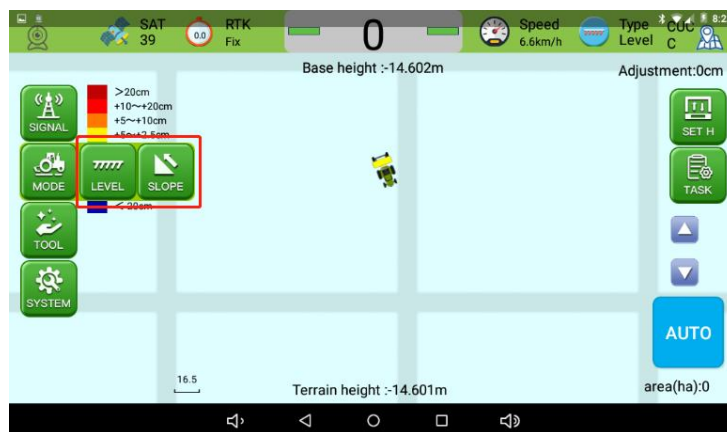

Figure 3.5 Leveling Modes

You can choose the work mode according to the work situation during operation. After selection, there will be a detailed operation instruction on the software interface, as shown in Figure 3.6 & 3.7.

Figure 3.6 & 3.7 Configuration of flat mode (left: Manual height, right: Auto height)

Figure 3.8 – 3.10 Configuration of slope mode

3. TOOL: The TOOL function includes area measurement, working time and survey mode. The detailed operation instructions are shown in Figure 3.12 – 3.14.

Figure 3.11 TOOL
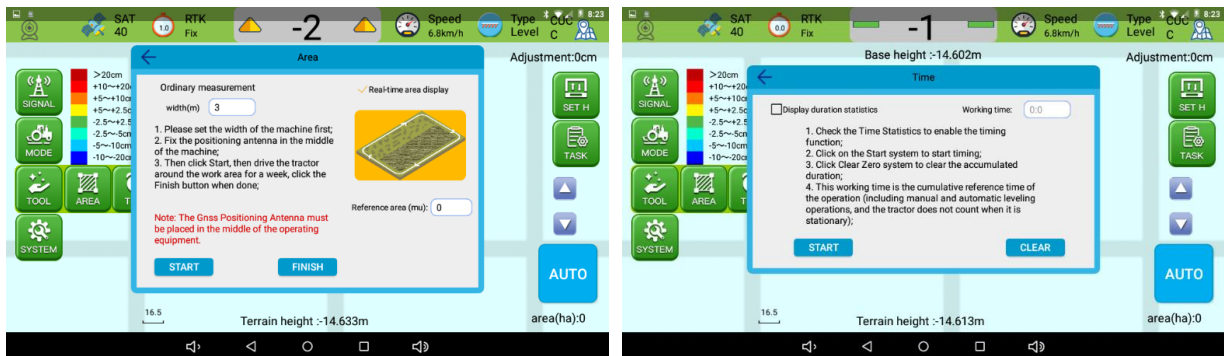
Figure 3.12 & 3.13 Area measurement(left) & Working time(right)
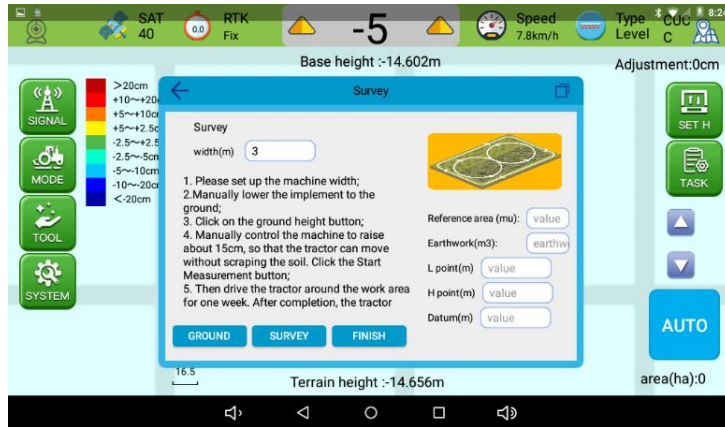
Figure 3.14 Survey tool

4. SYSTEM: From system button, you can configure the accuracy setting (ACCU), threshold setting (VALUE) and other settings (OTHER).
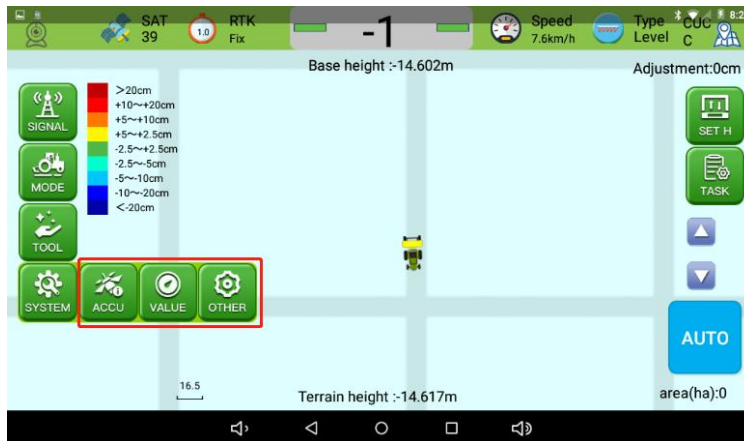
Figure 3.11 System Setting

The specific operations are described in the corresponding prompt window of each option, as shown in the following figures (Figure 3.12 – 3.14).

Figure 3.12 Accuracy Setting

Figure 3.13 Threshold setting

Figure 3.14 Other Setting

3.1.3   Right Toolbar

1. SET H: The SET H is used to set the target leveling elevation. Click BASE to enter the constant elevation directly. Users can also fine-tune the target elevation by click the UP/DOWN buttons, the blue arrow buttons or directly through the external lift switch. The target elevation will increase/decrease 0.5 cm by click these buttons once.

Figure 3.15 Set elevation

2. TASK: Users can create a new working task or manage the exist tasks via the TASK tool.

Figure 3.15 Elevation setting

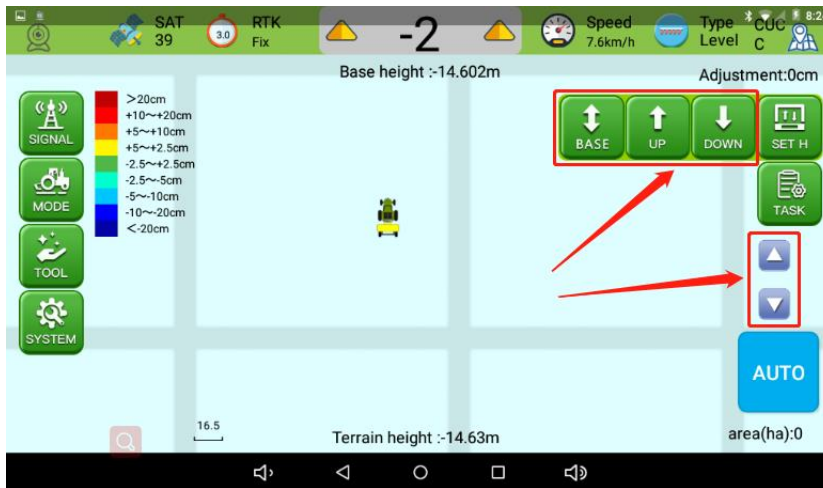3. Manual Leveling/Automatic Leveling Switch: When the interface shows blue button AUTO, the system in under manual control mode, which is the defaut status when powering on.

Click AUTO button to turn to antomatic leveling mode, and the button will turn red. Click MAN button to return to manual mode.
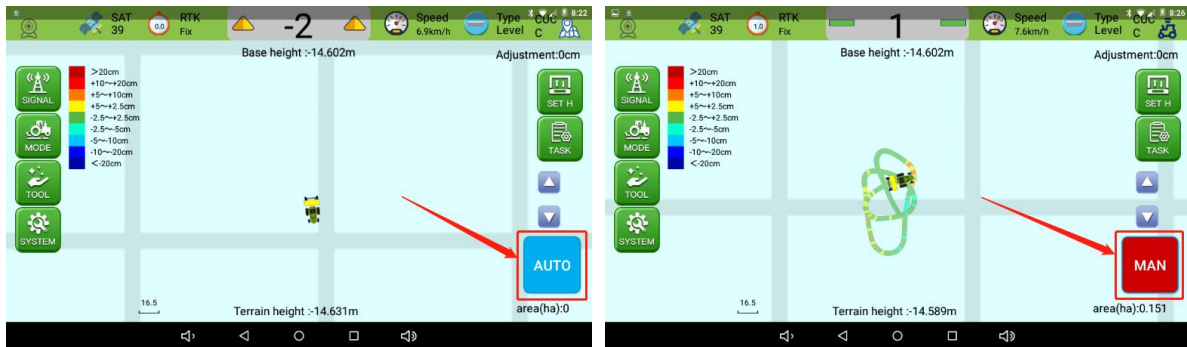
Figure 3.15 Elevation setting

3.2 Work Flow

3.2.1 Base Station Connection

Start Software and set the base station connection in SINGAL button.

- For radio mode, please set the same frequency as the base station and click SURE.

- For CORS mode, please enter the APN, IP, port, mountpoint, username and passwords according to your conditions.

Figure 3.16 Base Station Setting

After base station connection, check whether the related status is normal, including the satellite tracking, RTK solution, elevation display and other status.

3.2.2 Create A New Job

Enter the corresponding job information when creating a new job, TASK>>NEW.

Figure 3.17 Create a New Job

Click SYSTEM >> OTHER to set the pass width.

Figure 3.18 Width Setting

3.2.3　Datum Plane Setting

Open MODE >> LEVEL to set the datum plane of flat mode by manual or automatically. The specific operations are as follows:
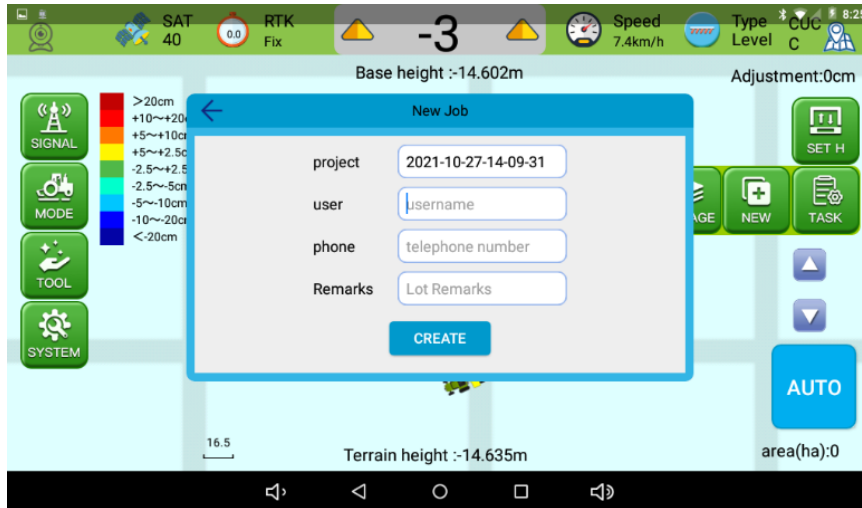
1) Manual height setting: Start the power output, manually lift the blade of the scraper, adjust the blade of the scraper to a suitable height from the ground, enter the leveling mode, click manual height setting to complete the benchmark setting.

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 in the work area. After driving, click Finish to complete the benchmark setting.

Note:

1. When setting the datum plane manually, please choose a location with a moderate topography for setting.

2. When setting the reference level, pay attention to the position of the hydraulic cylinder. It cannot be set at the extreme position of the hydraulic cylinder, preferably half of the hydraulic cylinder.

3.2.4   Start Leveling

Click the AUTO button to start automatic leveling.

Figure 33 Start Automatic Leveling

4.1 Appendix A: Q&A

Q1: Abnormal state of mobile vehicle terminal

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

Solution:

- Power cable connection, check if the equipment is powered normally.
- Check if the antenna cable is intact and connected well.
- Check whether the substrate erection position of antenna 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.

Q2. Scraper lifts slowly

Analysis: Lack pressure.

Solution:

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

Figure 4.1 Adjust Lifting Ratio

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

Q3: Wavy land appear during leveling

1. Analysis: System signal reception abnormal.

   Solution: Check whether the signal reception is normal. If it is abnormal, reference Q1.

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

   Solution:

   - Plow again.
   - Perform leveling operations perpendicular to the direction of the wavy land or leveling the wavy land 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.

Figure 4.2 Adjust Accuracy Setting

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

Figure 4.3 Adjust Lifting Speed

Q4: Scraper reactions slow during leveling

Analysis: Sensitivity value is too low

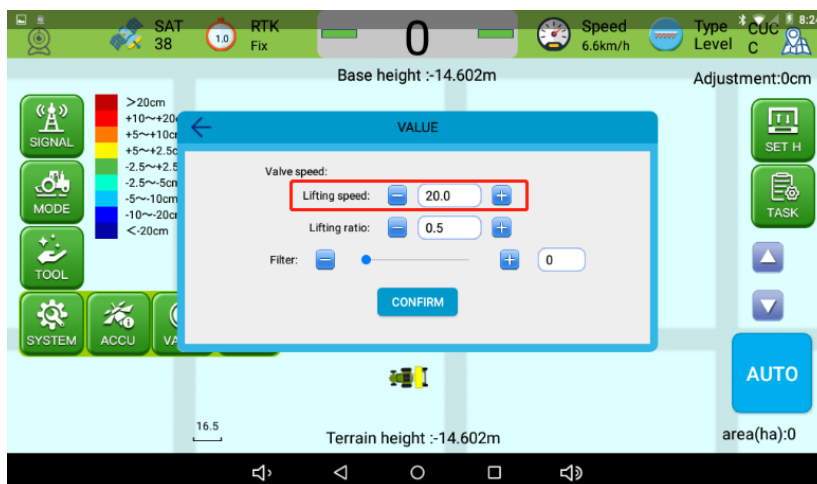Solution: Enter the software settings to increase the sensitivity value, generally set to 60-100.

Figure 4.4 Adjust Sensitivity Value

4.2 Appendix B: Datasheet

4.2.1   T10 GNSS Tablet

Table 2: T10 Datasheet

System	
Operation System	Android 6.0
CPU	Quad-Core 1.5GHZ
RAM	2GB
ROM	16GB
Flash	T flash, up to 64GB
Display	
LCD	10.1" HD
Brightness	750Nits, sunlight readable
Resolution	1024×600 pixels
Touch Panel	Capacitive screen
GNSS Specifications	
GPS	L1, L2
GLONASS	L1, L2
BDS	B1, B2
Galileo	E1, E5b
QZSS	L1, L5
SBAS	WAAS, EGNOS, MSAS, GAGAN
RTK Accuracy	H: 10mm+1ppm, V: 15mm+1ppm
Heading Accuracy	0.1°
Timing Accuracy	20ns
Velocity Accuracy	0.03m/s
Data Format	RTCM 2.3/3.0/3.2, NMEA0183
Data Update Rate	Maximum 20Hz
Electrical & Physical	
Input voltage	9-36 VDC
Power consumption	≤4.5W
Size	281×181×42mm
Weight	1.5 Kg

Environmental	
Waterproof & dustproof	IP65
Shock	Designed to survive a 2m drop onto concrete
Operating temperature	-20 ℃ to + 70 ℃ (-4 °F to 158 °F)
Storage temperature	-40 ℃ to + 85 ℃ (-40 °F to 185 °F)
fHumidity	100% non-condensing

4.2.2   Controller

Table 3: Controller Datasheet

Specification	Value
Operating Voltage	12V
Protection Level	IP65
Operating Temperature	-35 ~ +65℃