

# TMC20 Operating Instruction

## *Excavator Guidance System*



# Content

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- 1. Notice before use** ····· 01
  - 1.1 Basic principles ····· 01
  - 1.2 Personnel requirements ····· 01
  - 1.3 Preparation before operation ····· 01
  - 1.4 Precautions for installation ····· 01
- 2. Product Introduction** ····· 02
  - 2.1 Product Overview ····· 02
  - 2.2 Product Advantage ····· 02
  - 2.3 Product Advantage ····· 04
  - 2.4 How the product works ····· 04
- 3. System Installation** ····· 05
  - 3.1 Double antennas +2 IMUs ····· 05
  - 3.2 Installation of the slab ····· 06
- 4. Function Description** ····· 07
  - 4.1 Software Registration ····· 07
  - 4.2 Device information and function Settings ····· 08
- 5. Other Functions** ····· 09
- 6. Equipment maintenance** ····· 10
- 7. Common problems and solutions** ····· 11

# 1. Notice before use

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## 1.1 Basic principles

- (1) Fully know the product and its operation requirements before use, and comply with the "common sense health and safety operation regulations" of the country and region in accordance with the instruction manual.
- (2) Accident prevention measures and common-sense safety technology, labor protection, medical and traffic regulations must also be observed.
- (3) Taking advice on the operation of the product will help to avoid failures and accidents.
- (4) When the product is delivered, you should get the receiving list and the instruction manual and follow the technical guidance of our company for installation and operation.

## 1.2 Personnel requirements

- (1) The end user needs to operate the system while driving the excavator, requiring the operator to be skilled in driving the excavator and have the ability to deal with emergencies during the driving process.
- (2) The operator has a full understanding of the operation of the excavator and clearly knows how to flexibly use the functions of the system in different scenarios.
- (3) The operator understands the installation and operation principles of relevant hardware and software, and has the ability to safely deal with common faults.
- (4) Personnel under the age of 18 and those with diseases and disabilities that hinder safe operation should not participate in relevant mechanical operations.

## 1.3 Preparation before operation

- (1) Check whether there are obstacles and other factors endangering the safety operation around the excavator, And let irrelevant personnel leave the operation area.
- (2) According to the requirements of daily maintenance, carefully check whether the excavator guidance system is loose, lost, excessive wear, sediment accumulation and other phenomena.
- (3) The operator must be familiar with the operating device of the product and its own function.

## 1.4 Precautions for installation

The GNSS antenna cable and IMU cable are connected correctly. After connection, cable ties should be used to arrange the cable. Do not drag and squeeze the cable to prevent the cable from being torn and affecting the normal operation of the system.

## 2. Product Introduction

### 2.1 Product Overview

Beidou Intelligent excavator guidance system is an intelligent mining guidance solution with high precision, high performance and visual operation independently developed by TOKNAV. The system is mainly composed of GNSS high-precision positioning antenna, 10.1 inch highlight display terminal and IMU module.

### 2.2 Product Advantage

The system can be adapted to a variety of mining machinery, to achieve the accurate guidance of the excavator operation, to achieve the purpose of efficient operation, and to solve the problem of limited vision, is a common site leveling, trenching, slope brushing and pond dredging excavator operations such as auxiliary sharps.

#### 1.2.1 Features of the system

- RTK dynamic accuracy  $\pm 2.5\text{cm}$ , support multi-frequency high-precision positioning and orientation;
- Built-in dual card single to the full netcom module, to maintain terminal communication with the Internet, with power off continuous transmission function;
- Products in accordance with the industrial rules of product design, in line with IP67 specifications, adapt to the field harsh working environment;
- IMU internal integration of high-performance microprocessor and advanced filtering algorithm, high measurement accuracy, The data is stable;
- Display terminal real-time display bucket distance benchmark deviation value, accurate guide excavator into Row operation;
- Multi-dimensional display of job information, including the main view, side view and top view, to solve the digging, The problem of limited vision of digging machine;
- The whole plane/digging canal/brushing a variety of operation modes can be selected to adapt to different work scenes;
- Graphics, voice real-time ultra prompt, error can not be missed.

#### 1.2.2 Benefits of the system

##### (1) Improve construction efficiency

The system assists the operator to complete the excavation task more quickly and accurately. Through real-time positioning and navigation, the operator is able to accurately control the position and depth of the excavator, avoiding errors that may exist in traditional manual operation, while reducing damage and repetitive work caused by misoperation.

##### (2) Reduce operating costs

The use of the system can reduce labor costs and energy consumption. Operators can complete tasks more quickly, reducing construction cycles and thus reducing labor costs during construction. In addition, with precise navigation and operation, waste and wastage of materials can be reduced, further reducing costs.

##### (3) Improve safety

The system can help the operator avoid some potentially dangerous situations and set the work area. After that, to prevent the excavator from straying into dangerous areas, the system can provide real-time warnings and reminders to help the operator take timely measures to ensure safety in the construction process.

## 2. Product Introduction

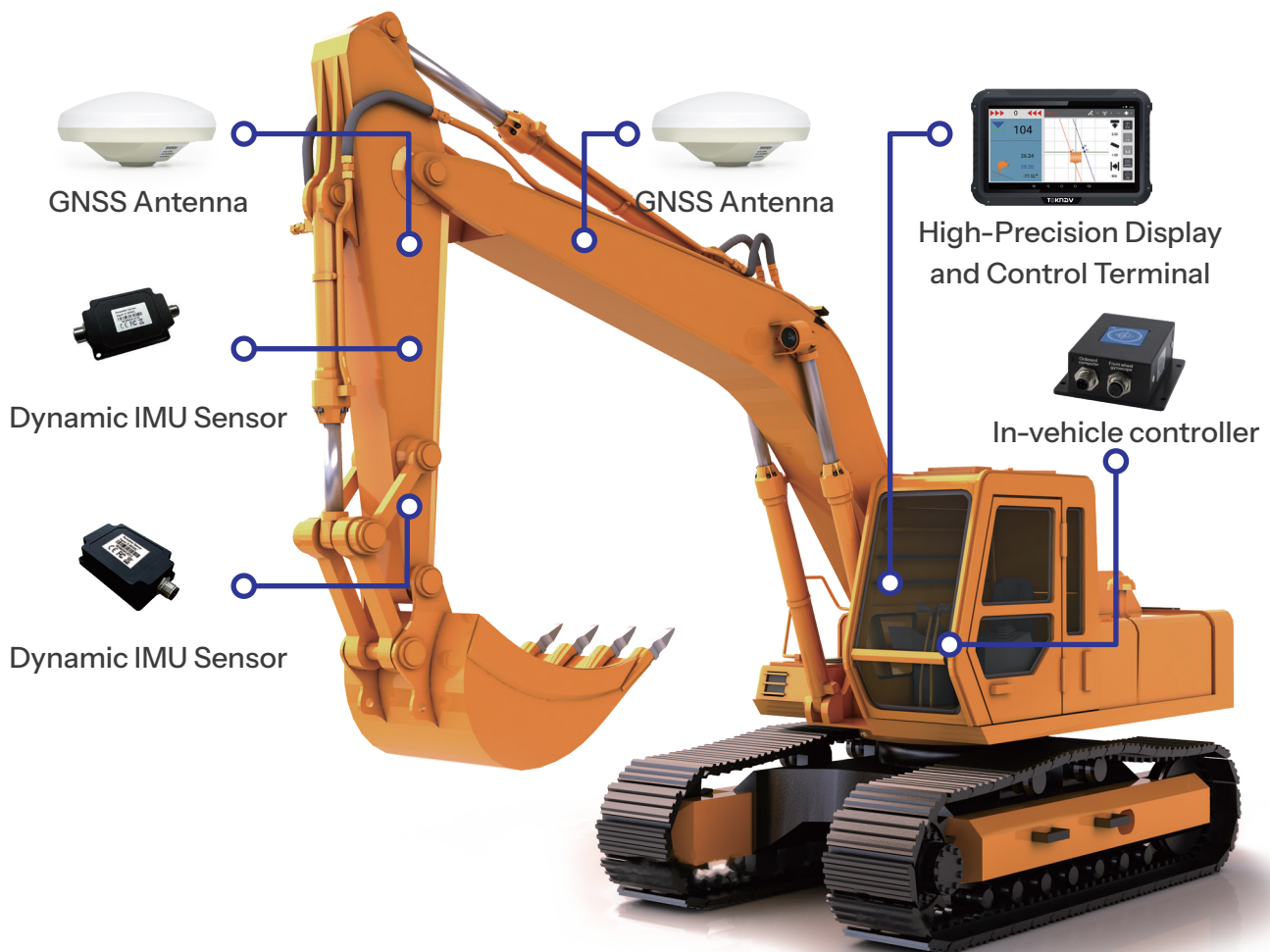
### (4) Adapt to the complex environment

In complex construction environments, such as ditching and dredging of rivers and ponds, operating excavators may be more difficult due to visual obstacles. Through real-time positioning and navigation, the system can help operators better cope with these complex situations and ensure the smooth completion of construction tasks.

### (5) Data recording and analysis

The system usually records the relevant data in the construction process, such as mining depth, location information, etc. These data can be used for the control and management of the construction process, and can also be used as the basis for subsequent construction analysis to help optimize the construction process and improve efficiency.

Product configuration scheme: Dual antenna +2 IMUs



**Note:** In any state, the digging bucket can be fixed with elevation.

## 2. Product Introduction

### 2.3 Product Advantage

Tablet main technical parameters	
Parameter name	value
Operating voltage	5~32VDC
Screen size	10.1"
Brightness	750nits
Operating temperature	-20°C ~ +60°C
Water and dust resistant	IP67

Main technical parameters of attitude sensor	
Parameter name	value
Operating voltage	9~36VDC
Resolution	0.01°
Update rate	100hz
Operating temperature	-40 °C~ +85 °C
Water and dust resistant	IP67

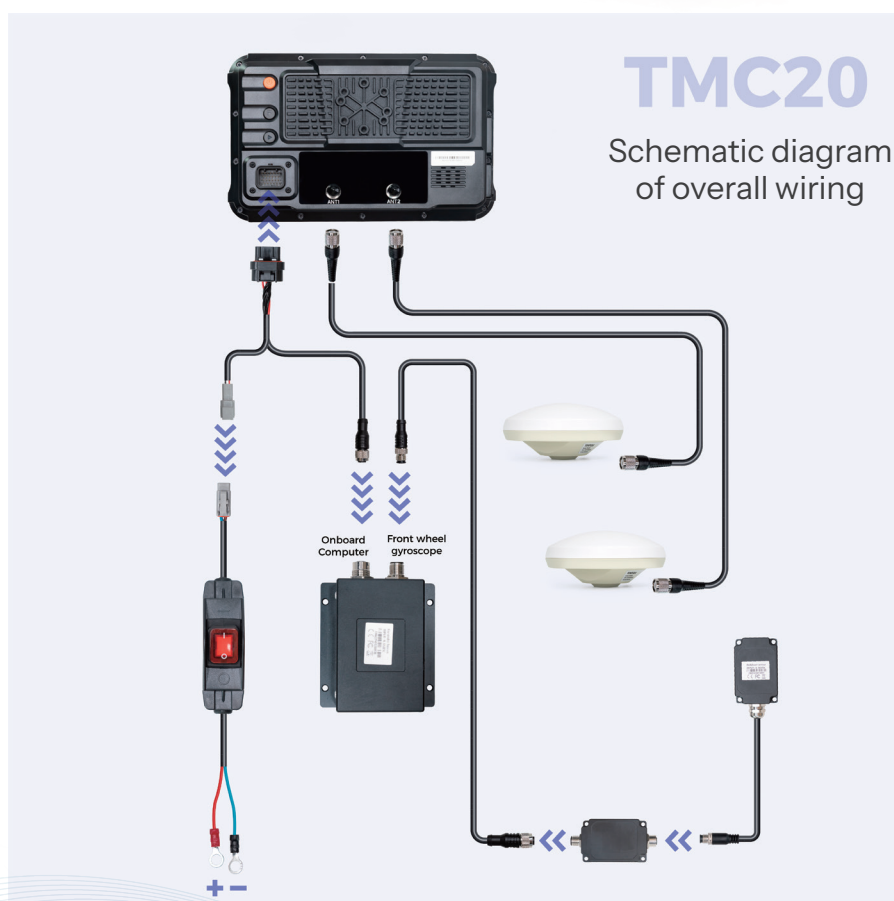
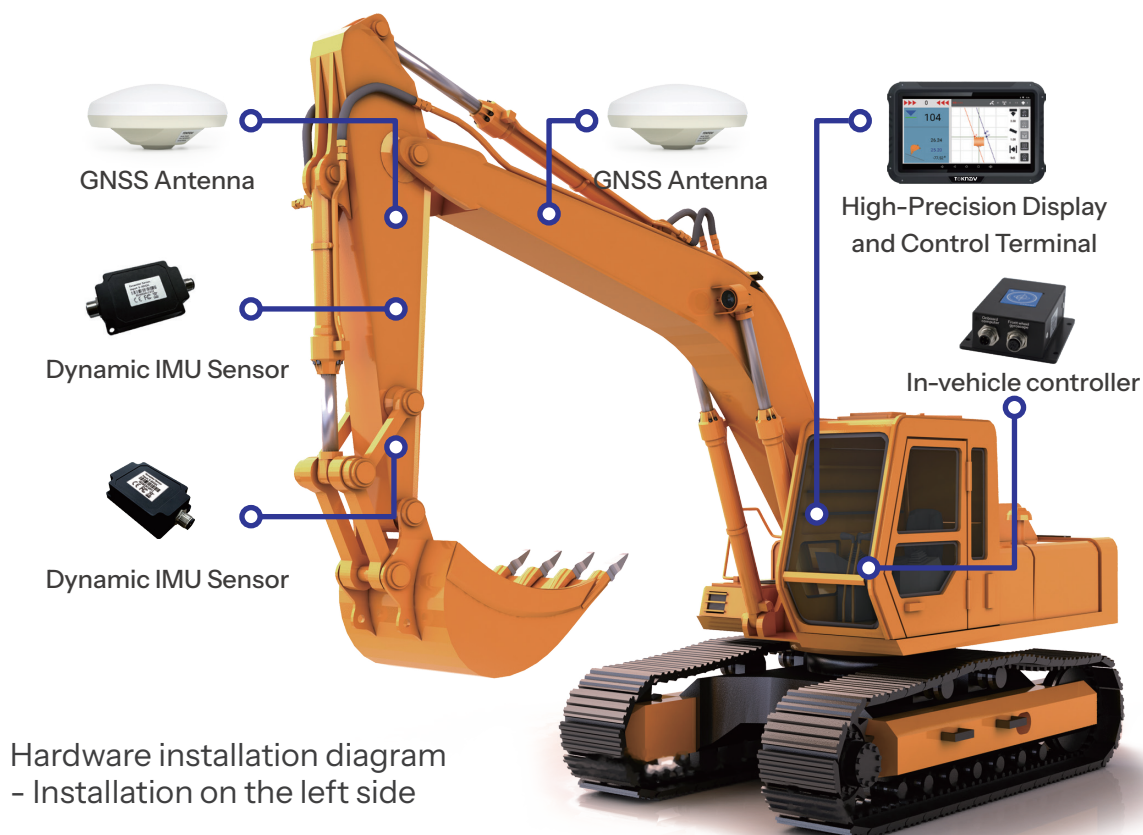
Antenna main technical parameters	
Parameter name	value
Operating voltage	3.3 ~ 12 VDC
Impedance	50 ohms
Mode of polarization	Right-handed circular polarization
Operating temperature	-40°C ~ +85°C
Water and dust resistant	IP67

### 2.4 How the product works

Based on the Beidou RTK positioning technology, the system obtains the 3D position information of the positioning antenna in real time, reads the values of various Angle sensors installed on the excavator, and calculates the calibrated dimensions of the main pivot, analyzes and processes the data through comprehensive calculation, and generates the operation information of the excavator. The display terminal displays the position, attitude and speed of the excavator in real time through the guidance of graphics, numerical values and sound, assists the operator to control the running track and working Angle of the excavator more accurately, and carries out the earth filling and digging operation according to the set working mode, eliminating the construction lofting work, improving work efficiency and ensuring construction quality.

# 3. System Installation

## 3.1 Double antennas +2 IMUs



# 3. System Installation

## 3.2 Installation of the slab

The plate should be installed in a position that is convenient for the driver to operate and observe, and fixed with RAM bracket and suction cup bracket. After determining the position of the plate, the suction cup should be locked to prevent falling off due to mechanical shaking during the operation.



The main communication cable connector is connected to the plate plug (the cable connector should be firmly inserted), the TNC connector of the main antenna cable is connected to the ANT1 port of the plate, and the TNC connector of the secondary antenna cable is connected to the ANT2 port of the plate.

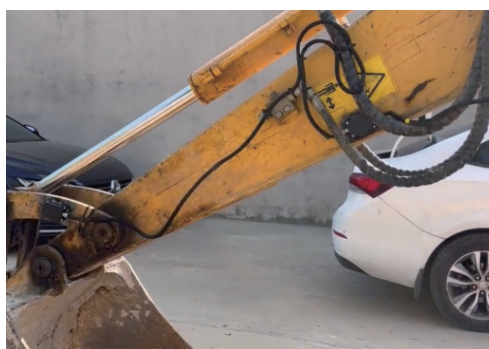


The "power supply" on the main communication cable is connected to the power supply cable connector, which can be powered directly from the cab using the cigarette lighter, or connected to the Deutsch power supply cable from the excavator battery. When the system power supply, pay attention to the equipment power supply requirements (DC9-36V), the power line and the battery are directly connected, pay attention to the positive and negative poles of the power supply to prevent reverse connection.

The GNSS antenna is installed on the left side of the forearm and the big arm of the excavator, the main antenna is on the left side of the forearm, the second antenna is on the left side of the big arm, and the antenna is tightened on the fixed support, and the support is welded to the left side of the excavator's forearm and the big arm respectively. During installation, ensure that the bottom edge of the main antenna support, the bottom edge of the second antenna support and the axis of the forearm are in a straight line, and the distance between the main and secondary antennas must be more than 1 meter. The antennas should not be moved after installation.



Installation of the antenna

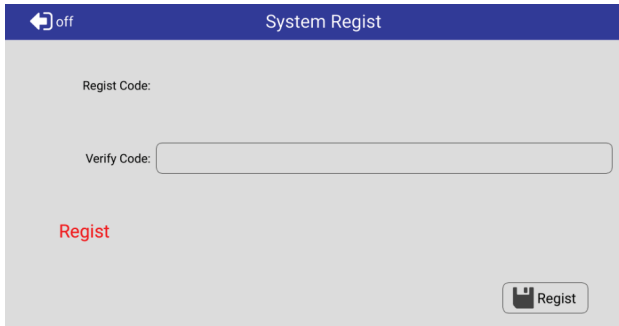


Installation of IMU module

# 4. Function Description

## 4.1 Software Registration

After installing the device, you need to register the system.

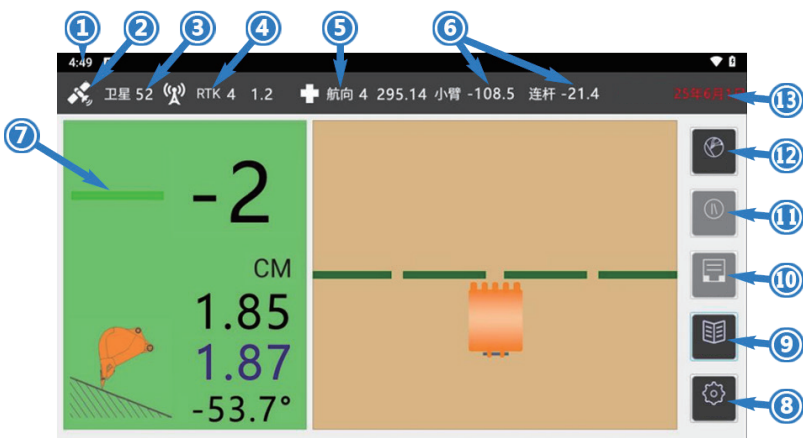


Device Registration

After entering the registration code, clicking "Register" will prompt the system expiration time, and the system registration is complete.

After completing the information registration, enter the main interface of the software, the displayed content is as shown in the following picture. On this interface are displayed: "Number of satellites", "RTK status", "IMU status", "low arm sensor value", "bucket link sensor value", "system registration information", "tip height difference", "system setting" and other information, after the system parameter setting is completed, it will also display "bucket elevation" and "benchmark elevation". Facilitate the information interaction between the driver and the system.

The status bar of the software main interface is introduced:



1.System time: Displays the time of the system, i.e. the time of the satellite.

2. Satellite icon: Click to enter satellite signal Settings,

3. Number of satellites: Display the number of satellites found by GNSS antennas in realtime (under normal circumstances, the number of satellites can be connected to the base station normally when the number is more than 28), click the icon to enter the satellite sky map and SNR display interface.

4. RTK status: display RTK status and differential delay data, RTK display "fixed", and differential delay data does not exceed 5 for the available state, click the icon to set the base station.

## 4. Function Description

5. Heading status: Normal is 4 and 0 is abnormal
6. IMU status: forearm sensor value, bucket connecting rod sensor value, IMU display connection status value, when the value is abnormal, pop-up window reminder.
7. Light target guide bar: Shows the deviation of the bucket tip elevation from the reference elevation. The greater the value above the reference elevation, the more red fill above the light target bar; The higher the value below the reference elevation, the more red fill below the light target bar.
8. Settings: Tap the icon to access the calibration screen.
9. Device information: Click the icon to enter the function status and function switch interface
10. Whole plane: Click on the icon to make a leveling data change.
11. Ditching: Click on the icon to make ditching data changes.
12. Brush slope: Click on the icon to make changes to the brush slope data.
13. Time: System expiration time.

"Save" button: Used to save the calibration Settings you have made to the excavator's control system. Click this button to save the Settings after you have completed all calibration operations and confirmed that you have done nothing wrong.

The Machine Settings screen displays various calibration parameters for the excavator's sensors. It includes a 'Save' button at the bottom right. The parameters are organized into sections: Forearm Sensor Calibration (A, B, C, D, L, F) and Bucket Calibration (A, B, C, D, L, F). A diagram of the excavator's arm and bucket is shown on the right side of the screen.

Parameter	Value	Unit
A	0.00	m
B	0.00	m
C	0.00	m
D	0.00	m
L	0.00	m
F	0.000	*

Forearm Calibration: 0.000

Bucket Calibration: 0.000

Save

Data calibration Settings screen

### 4.2 Device information and function Settings

This page is the real-time parameters of the equipment's satellites and gyroscopes, mainly provided for R&D personnel to check problems. Alarm Switch is on by default. Switch language at the bottom.

The Device Function screen displays real-time parameters for the excavator's satellites and gyroscopes. It includes a 'Function Switch' section at the bottom with an 'Alarm Switch' and a 'Regist' button. The parameters are organized into sections: Sat, RTK, Diff, H Status, Course, Lat, Lon, x, y, High, Horizontal Factor, Forearm Sensor, Forearm Calibration, Forearm SensorX, Dog Sensor, Dog Calibration, and Projected Ion.

Parameter	Value
Sat	0
RTK	0
Diff	0.0
H Status	0
Course	0.00
Lat	0.00000000
Lon	0.00000000
x	0.000
y	0.000
High	0.0000
Horizontal Factor	0.000
Forearm Sensor	0.000
Forearm Calibration	0.000
Forearm SensorX	0.000
Dog Sensor	0.000
Dog Calibration	0.000
Projected Ion	10.000

Function Switch

Alarm Switch Regist

chinese english spanish Turkish Polish Korean

0Y 0M 0D V2.6.09

Function Status Settings

## 5. Other Functions

### Brush slope mode:

When demarcating the brush slope mode, it is necessary to set AB flat distance, and the position of the opening line can be switched to the upper opening line by default. According to the requirements of the operation, find the position of point A and point B in turn, collect the coordinates of the two points, get the direction of the bottom or top edge of the slope, and get the distance between the two points L AB, height difference h, according to the requirements of the operation, can directly edit the slope ratio, vertical height, horizontal distance and other data, so that the demarcated hypotenuse data reach the target slope ratio and target slope Angle. After confirming that the above information is correct, click the "Start operation" button to complete the calibration of the operation model in the brush slope mode.

Parameter setting of slope brushing

### Whole plane mode:

Control the excavator to place the tip of the bucket at the appropriate height from the ground, click the "Set reference plane" button, collect the elevation of the current tip, refer to the obtained tip coordinate value, you can directly set the parameters in the text box of filling and digging amount, after the target benchmark data is confirmed, click the "Close" button to complete the calibration of the operation model in leveling mode.

### Bevel plane and digging channel mode:

Mark the positions of point A and point B successively, collect the coordinates of these two points, get the direction of digging canal, and set the parameters in the text box of digging depth under point A according to the operation requirements. If there is A height difference in AB, the parameters need to be set in the AB height difference text box, the default A and B two points are the same height. The obtained plane formed by two points A and B is the ground elevation of the trench; After confirming the above information, click the "Close" button to complete the calibration of the operation model in the digging mode.

	A	B
x	10.000	10.000
y	10.000	10.000
h	0.000	

## 6. Equipment maintenance

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All the instruments and equipment produced by the company support all-weather operation, the protection level is IP65 and above, with the function of waterproof and dustproof, but in order to ensure that the instruments maintain better performance, after the use of excavator operations, it is necessary to maintain and maintain the system equipment.

### Daily maintenance

- (1) In the process of using the system, frequent disassembly of the equipment should be avoided as far as possible to reduce the probability of damage to parts caused by mistakes in the operation process.
- (2) After the use of the guidance system, ensure that the antenna and attitude sensor are placed in a light place that is not soaked by rain, extend the service life of the hardware, and also make the equipment maintain better working performance.
- (3) After the use of the guiding system, it should be checked whether the connection is loose, whether the connected equipment is damaged, if there is an abnormal situation, it should be handled in time.

### Parts preservation

When the equipment is not used for a long time, the various equipment of the system should be disassembled and stored in a dry and ventilated place with flat ground to avoid sun and rain.

- (1) When storing the cable, ensure that the interface is intact, it is strictly prohibited to drop the cable from a height (especially at a low temperature), it is strictly prohibited to contact with acid, alkali and mineral oil, to be isolated from these corrosive substances, and there should be no harmful gases that destroy insulation and corrode metal in the storage warehouse of the cable.
- (2) The dust on the surface of the plate needs to be cleaned before storage, and the foam pad or other items should be used to separate it to prevent scratching or impact damage to the plate.

# 7. Common problems and solutions

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## **Problem 1:** Show that the number of search stars is 0

Cause analysis: The cable connection is loose or broken/The TNC interface voltage is abnormal (corresponding to the antenna at the lower arm/in front of the upper arm, ANT1 port on the plate)

Solution:

- (1) Check the GNSS cable connected to ANT1, fix the cable again if the cable connection is loose, and replace the cable if the cable is broken;
- (2) Measure the ANT1 interface voltage and replace the plate if it is abnormal.

## **Problem 2:** Secondary antenna floating

Cause analysis: The cable connection is loose or broken/The TNC interface voltage is abnormal (corresponding to the antenna at the body/behind the big arm, ANT2 port of the plate)

Solution:

- (1) Check the GNSS cable connected to ANT2, fix the cable again if the cable connection is loose, and replace the cable if the cable is broken;
- (2) Measure the ANT2 interface voltage and replace the plate if it is abnormal.

## **Problem 3:** RTK single point

Cause analysis: No connection base station/working place affects signal reception

Solution:

- (1) Look at the search star, usually 28, no connection base station: base station setting - Beidou base station 1/ Beidou base station 2 - login, you can also choose a closer network base station connection;
- (2) Check whether the antenna is firm, and can not receive signals normally when the antenna is tilted;
- (3) Observe whether there are tall trees or buildings or high-voltage lines in the vicinity that affect signal reception, and contact technical personnel to open the Beidou base station if necessary.

## **Problem 4:** RTK pseudo-distance/float

Cause analysis: base station signal quality is poor

Solution:

- (1) Replace the network base station connection with a close distance;
- (2) Contact technical personnel to open the Beidou base station 3 or upgrade the board card.

## **Problem 5:** Attitude sensor data cannot be received

Cause analysis: The cable connection is loose or broken/The plate is abnormal

Solution:

- (1) Check the cable connected to the attitude sensor. If the cable is loose, fix the cable again. If the cable is broken, replace the cable.
- (2) Restart the panel and check whether the external power supply is connected.