blicube

G-RTK User Manual

Revision History:

Version	Data	Author	Describe
V1.0	2021/05/04	Qingchuan	Original version
V1.1	2021/07/08	Qingchuan	Modify pictures of GRTK shell
V1.2	2021/07/14	Qingchuan	Add several mode of Base
V2.0	2021/10/28	Alan	Add English version

Statement:

The user using the G-RTK centimeter-level positioning module is deemed to have automatically accepted this statement.

Please read this manual carefully before using the G-RTK centimeter-level positioning module. If you have any questions you don't understand, please contact our technical support email *blicube.sp@gmail.com*.

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Part 1 System Introduction

1.1 Introduction

G-RTK is a dual-antenna high-precision differential positioning and directional module (Real Time Kinematics) independently developed by *Blicube*. A complete RTK system can be formed through two G-RTK modules (one mobile terminal and one base station terminal).

The module is based on a new generation of high-performance GNSS SoC chip design,supports multi-system multi-frequency RTK positioning, supports dual-antenna high-precision orientation, and supports GPS&GLONASS&Beidou&Galileo&QZSS navigation and positioning. It is mainly for high-precision positioning and orientation requirements such as drones, robots and intelligent driving.

Figure 1.1 Physical image of GRTK centimeter-level positioning and orientation system

1.2 Parameters

● **Performance**

Frequencies	BDS B1I/B2I1
	GPS L1/L2
	GLONASS L1/L2
	Galileo E1/E5b
	QZSS L1/L2
Single Point Positioning (RMS)	Horizontal：1.5m
	Vertical：2.5m
DGPS (RMS)	Horizontal：0.4m
	Vertical：0.8m
RTK (RMS)	Horizontal：1cm+1ppm
	Vertical：1.5cm+1ppm
Heading Accuracy (RMS)	0.2 degree/1 m baseline
Velocity Accuracy (RMS)	0.03 m/s
Time Accuracy (RMS)	20 ns
Time to First Fix (TTFF)	Cold start < 25 s
Initialization Time	< 5s (typical)
Reacquisition	< 1 s
Correction	RTCM v2.3/3.0/3.2
Data Output	NMEA-0183
Update Rate	20 Hz
Inertial Navigation Accuracy	< 5% of distance travelled during GPS denied conditions
Working Temperature	-20°C to +85°C
Power Supply	5v to 55v

⚫ **Physical size**

Figure 1.2 Schematic diagram of physical size
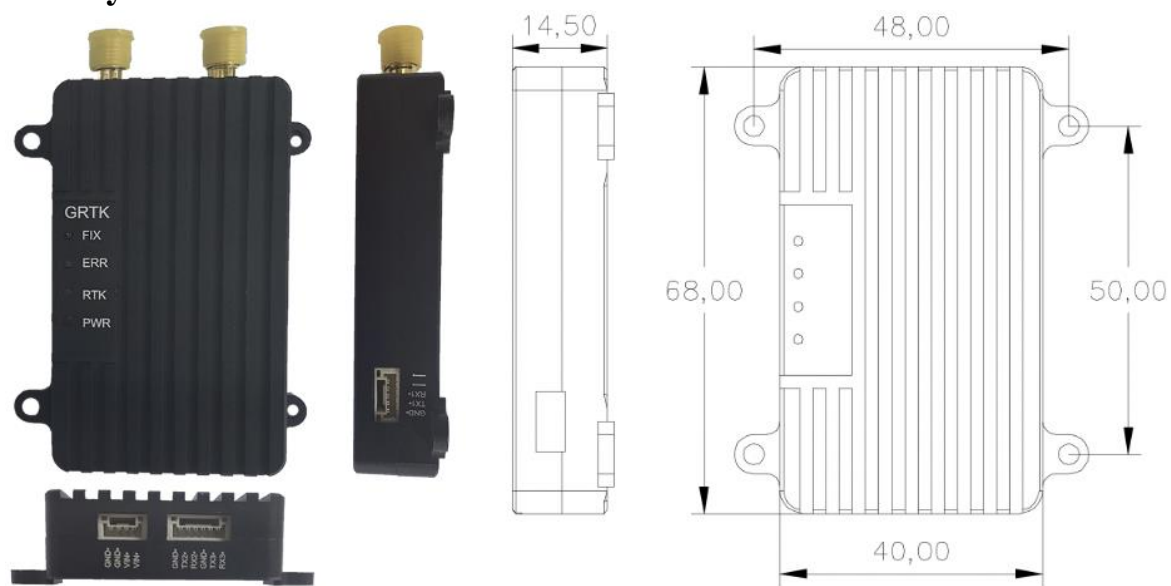
Part 2 Usage

2.1 Interfaces

The G-RTK module can be used as a base station or as a mobile station. There are three interfaces in total, as shown in Figure 2.1. They are the Power port for powering the device, the com1 port for communication between the mobile station and the base station, and the com2 port for communicating with the flight controller to transmit positioning information. The com2 port includes uart2 and uart3, and the default use of uart2 is the serial port of flight control communication.

❶ Master antenna   ❷ Slave antenna

❸ Power   ❹ com1   ❺ com2

Figure 2.1 G-RTK module interfaces diagram

In addition, there are four LED indicators on the front of the module. The three on the left display the module's operating status, which are 3D Fix positioning status, operating error,

and RTK positioning status; a single indicator on the right is used to display the power supply status.

The G-RTK module supports dual antenna direction finding, where the left antenna is the master antenna, the right antenna is the slave antenna, and the single antenna needs to be connected to the master antenna.

2.2 Hardware connection

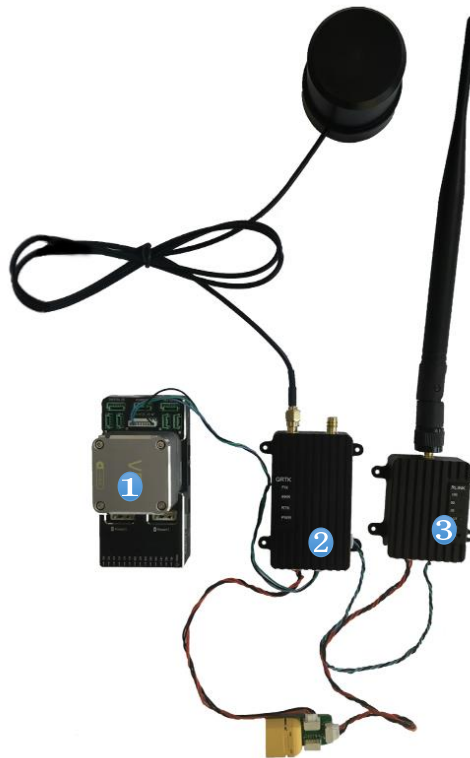- **Base station connection**
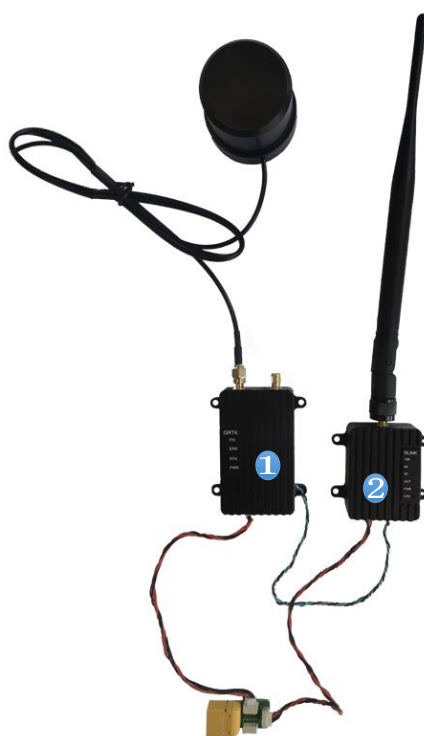
❶ Base station ❷ Radio

Figure 2.2 Base station connection diagram

Figure 2.3 Schematic diagram of base station tripod installation

- 30s to quickly enter *RTK FIXED.*
- Base station supports independent link forwarding.
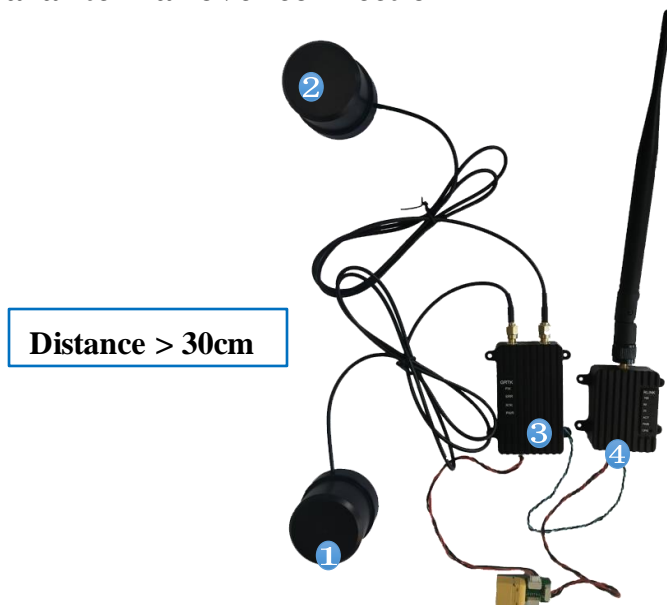
● **Rover connection**

❶ Flight Controller   ❷ Rover   ❸ Radio
Figure 2.3 Rover connection diagram

● **Dual antenna rover connection**

Distance > 30cm

❶ Master antenna   ❷ Slave antenna   ❸ Rover   ❹ Radio
Figure 2.3   Dual antenna rover connection diagram

When the base station is not used, only the rover can be used as a conventional positioning device for positioning. The connection is shown in Figure 2.3.

The base station and the rover can be used together to form an RTK centimeter-level positioning system, and the base station supports plug and play.

The dual-antenna direction finding of the rover needs to keep the master-slave antenna consistent with the heading in accordance with the master-back-and-forward. The distance between the master-slave antennas should be greater than 30cm to ensure the direction finding accuracy.

2.3 Indicator light & Positioning status

There are 4 indicators on the G-RTK module, the specific meanings are shown in the table below:

Light	Status	Describe
FIX	On	Enter 3D Fixed state.
	Off	Not in 3D Fixed state.
ERR	On	Error! The module does not work properly.
	Off	No error has occurred and is working properly.
RTK	On	Enter RTK Fixed state.
	Off	Not in RTK Fixed state.
PWR	On	The power supply is OK.
	Off	The power supply is abnormal.

➢ **When the Base is working properly, the status light changes：**
   PWR and FIX are on，the other lights are off.
➢ **When the Rover is working properly, there are two conditions in which the status light changes:**
1. PWR and FIX are on，the other lights are off, that means Rover has been in 3D Fixed state.
2. PWR, FIX and RTK are on, the other lights are off, that means Rover has been in RTK Fixed state.

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2.4 Positioning data description

The G-RTK module outputs NMEA protocol positioning data by default, connects computer with G-RTK module's Tx2 and Rx2 by USB-to-TTL module, then you can use the serial assistant to read or configure the output message.

G-RTK Rover and Base are factory configured, non-professionals do not configure equipment at will.

2.4.1 Rover with a single antenna

➢ **Output messages at 10Hz by factory default:**
● $GPGGA: Global positioning system fix data
● $GPGSA: GNSS DOP and active satellites
● $GPRMC: Recommended minimum data
➢ **Other message**
   If needed, you can send ASCII syntax by serial port to configurate it：
● Configuration Format: GPXXX COMX XX （message + output port + output rate）
● SAVECONFIG（Save configuration）
➢ **Reset**
   If output message is inconsistent with the factory during use, the output can be reset
   by following commands:
● FRESET   (Do factory reset)
● GPGGA COM2 0.2   (Output GPGGA message at 5Hz from COM2)
● GPRMC COM2 0.2   (Output GPRMC message at 5Hz from COM2)
● KSXT COM2 0.2   (Output KSXT message at 5Hz from COM2)
● SAVECONFIG   (Save configuration)

2.4.2 Rover with dual antennas for heading

➢ **Output messages at 10Hz by factory default:**
● $GPGGA: Global positioning system fix data
● $GPGSA: GNSS DOP and active satellites
● $GPRMC: Recommended minimum data
● $GPHDT: Output current heading information
➢ **Other message**

If needed, you can send ASCII syntax by serial port to configurate it：

- Configuration Format: GPXXX COMX XX （message + output port + output rate）
- SAVECONFIG（Save configuration）

➢ **Reset**

If output message is inconsistent with the factory during use, the output can be reset by following commands:

- FRESET (Do factory reset)
- GPGGA COM2 0.2 (Output GPGGA message at 5Hz from COM2)
- GPRMC COM2 0.2 (Output GPRMC message at 5Hz from COM2)
- KSXT COM2 0.2 (Output KSXT message at 5Hz from COM2)
- SAVECONFIG (Save configuration)

Part 3 Guidance for Use

The current version of the G-RTK cm positioning system supports the output of NMEA protocol positioning data, the following guidance is based on the Ardupilot firmware using the Mission Planer ground station.

3.1 Connection for modules

- Have the hardware, including Pixhawk controller, G-RTK, radio, battery, etc, shown in Figure 3.1 ready for connection before wiring:

Figure 3.1 Hardware physical diagram

- Connect the com2 port of G-RTK Rover to the GPS port of pixhawk, and the com1 port connects to the digital transmission device that communicates with the Base side.
- Connect the G-RTK Base to the antenna and battery, and connect the com1 port to the radio that communicates with the Rover side
- Rover, Base stations and Radio need to be power supplied separately.

3.2 Mission Planner settings

G-RTK Base supports plug-and-play and does not require additional setup at the ground station. However, before actually using RTK, you need to set the parameters for flight control in MP, and the necessary parameter settings are given below, which can be referred to as follows:

https://ardupilot.org/copter/docs/common-gps-for-yaw.html

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➢ Configure the GPS protocol as NMEA and set the GPS data refresh rate to10Hz.

The list of parameters：

● **GPS_TYPE** is set to **5** to configure the GPS protocol as NMEA.

● **GPS_RATE_MS** is set to **100ms** which means the GPS data refresh rate is 10Hz.

➢ GPS direction needs to be enabled using dual antenna direction measurement.

The list of parameters：

● **AHRS_EKF_TYPE** is set to **3** to choose EKF3.

● **EK2_ENABLE** is set to **0** to disable EKF2.

● **EK3_ENABLE** is set to **1** to enable EKF3.

● **EK3_MAG_CAL** is set to **5** to enable GPS direction.

3.3 Positioning testing

➢ Use Rover to draw a basketball court line by following the real line.
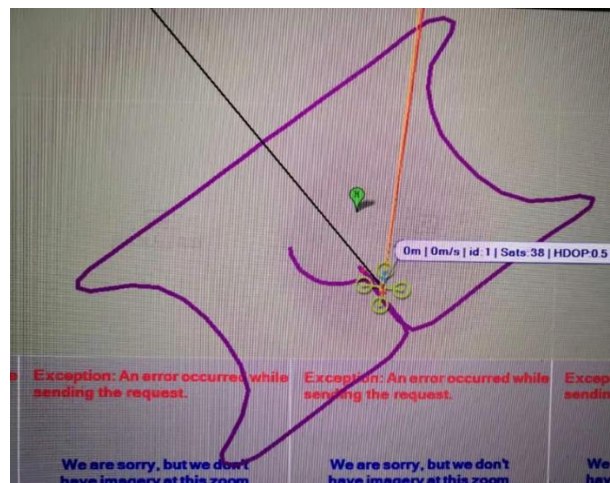

Figure 3.4 G-RTK test result

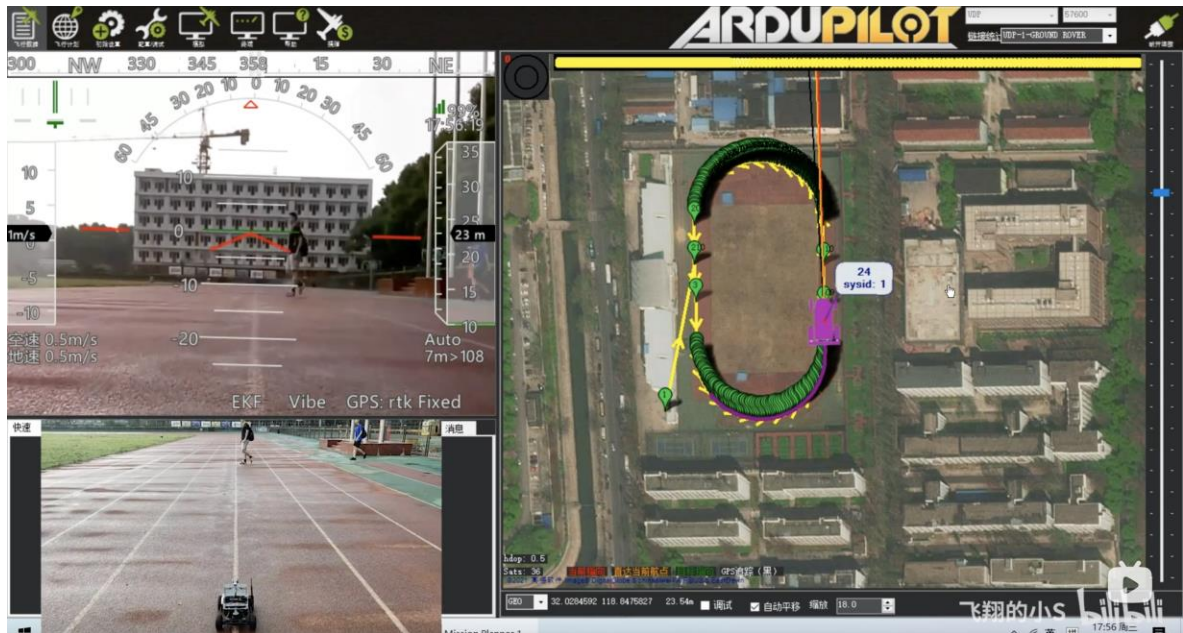● Unmanned vehicle automatic route mission measurement.

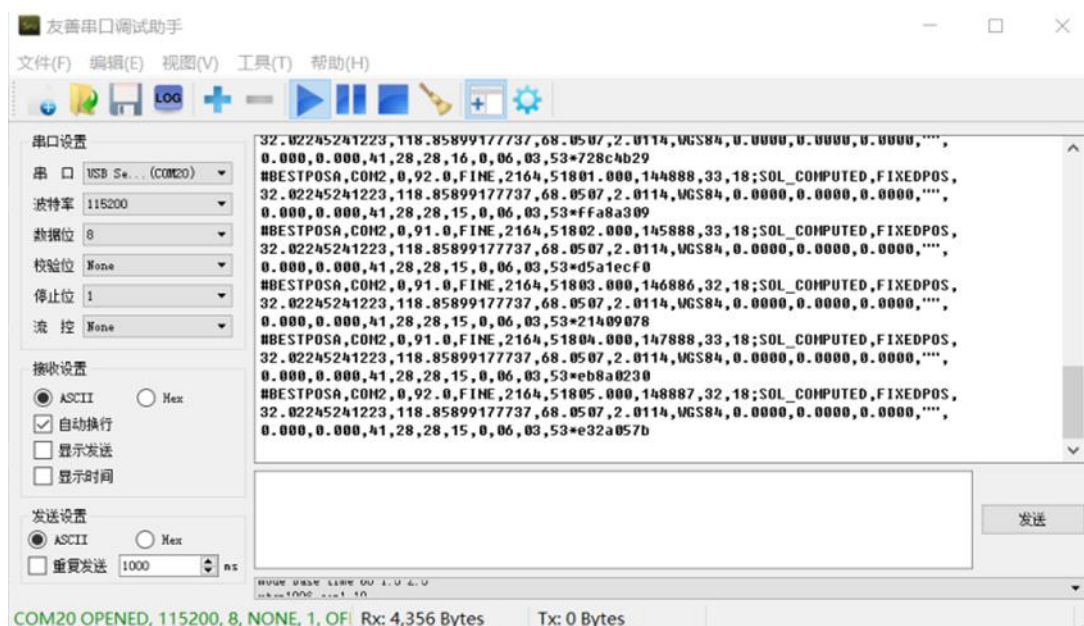Figure 3.5 G-RTK auto-mission control test result

Part 4 Modes of Base Station

GRTK Base has two modes of operation，self-optimizing base station and fixed base station.
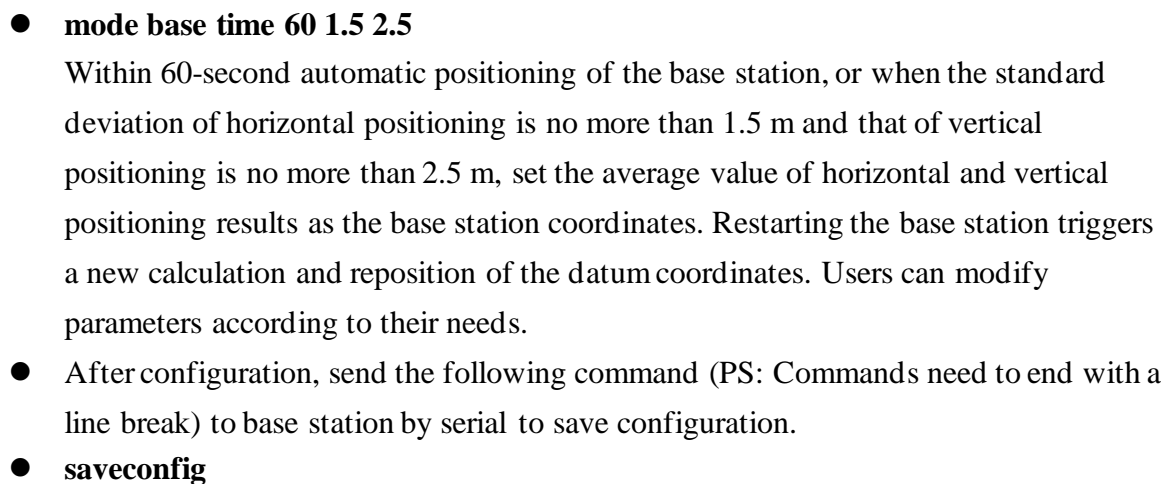
- **Self-optimizing base station：**When it is not clear exactly where the base station will be located，Base will position itself and average itself for a certain period of time after installation as the coordinates of the base station.

- **Fixed base station:** When know the exact coordinates of the base station location will be set up, you need to enter that exact coordinate into the base station.

4.1 Self-optimizing base station

- Base station default operating mode is self-optimizing base station. Using USB to TTL module to connect the base station serial 2 (Rx2&Tx2) to the computer, the computer runs serial debugging assistant, open the corresponding serial port with the baud rate of 115200. The base station returns the current location information.

- Send the following command (PS: Commands need to end with a line break) to base station by serial to complete configuration.

- **mode base time 60 1.5 2.5**

  Within 60-second automatic positioning of the base station, or when the standard deviation of horizontal positioning is no more than 1.5 m and that of vertical positioning is no more than 2.5 m, set the average value of horizontal and vertical positioning results as the base station coordinates. Restarting the base station triggers a new calculation and reposition of the datum coordinates. Users can modify parameters according to their needs.

- After configuration, send the following command (PS: Commands need to end with a line break) to base station by serial to save configuration.

- **saveconfig**

4.2 Fixed base station

Fixed base station mode configuration is divided into two steps, the first step is to obtain the current exact coordinates, the second step is to enter the base station's precise coordinates into the base station.

Step1: Get the current exact coordinates

Using the USB-to-TTL module to connect the base station serial 2 to the computer, the computer runs the serial debugging assistant, open the corresponding serial port, Baud rate of 115200. The base station returns the current location information.
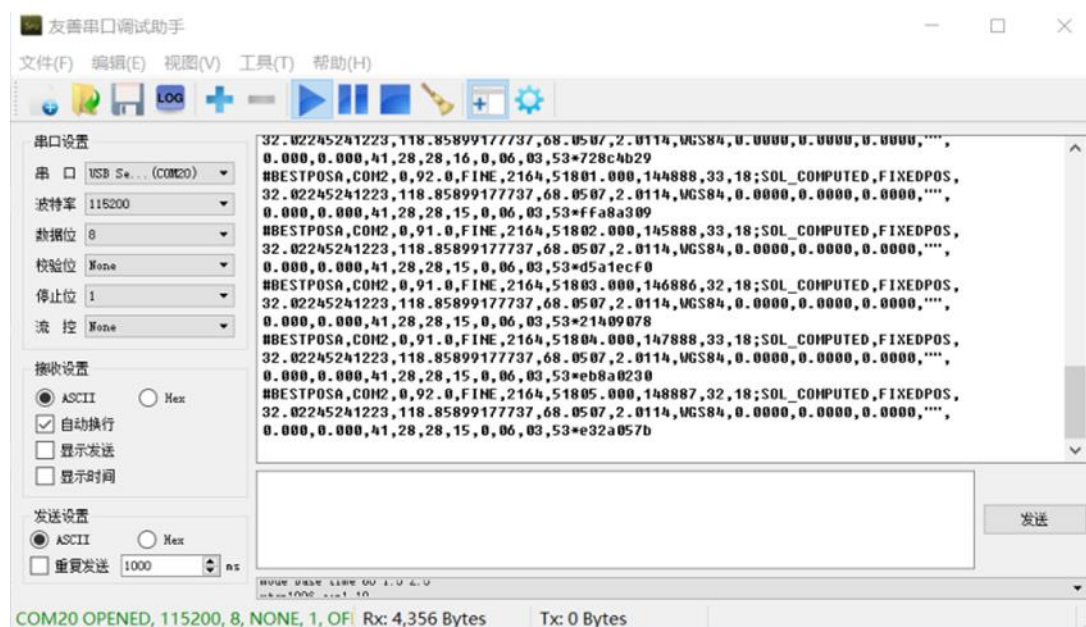
➢ Send the following command (PS: Commands need to end with a line break) to base station by serial to complete configuration.

➢ **mode base time 60 1.5 2.5**

Within 60-second automatic positioning of the base station, or when the standard deviation of horizontal positioning is no more than 1.5 m and that of vertical positioning is no more than 2.5 m, set the average value of horizontal and vertical positioning results as the base station coordinates. Restarting the base station triggers a new calculation and reposition of the datum coordinates. Users can modify parameters according to their needs.

● Note that the obtained WGS84 coordinates indicate that the base station initialization is complete when the data is stable.

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Longitude, latitude and elevation data are stable.
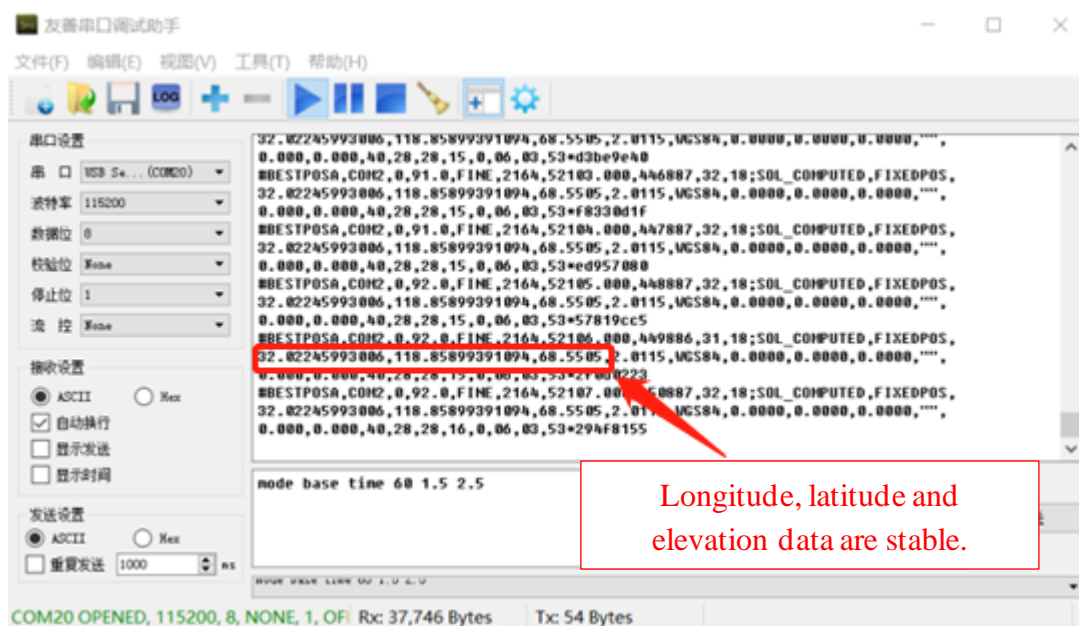
Step2: Enter the exact coordinates of the base station into the base station

● Copy the location information of the base station output

#BESTPOSA,COM2,0,91.0,FINE,2164,52077.000,420887,32,18;SOL_COMPUTED,FIXEDPOS,32.02245993006,118.85899391094,68.5505,2.0115,WGS84,0.0000,0.0000,0.0000,"",0.000,0.000,40,28,28,16,0,06,03,53*17b29c25 **(Sample data)**

● Analyze and get longitude, latitude and elevation data

32.02245993006,118.85899391094,68.5505（**Please replace it based on the actual measurement data**）

● The configuration command is generated based on the exact coordinates of the base station

mode base 32.02245993006 118.85899391094 68.5505

Send the configuration command (note that the command needs to end with a line break) to the base station through a serial port.
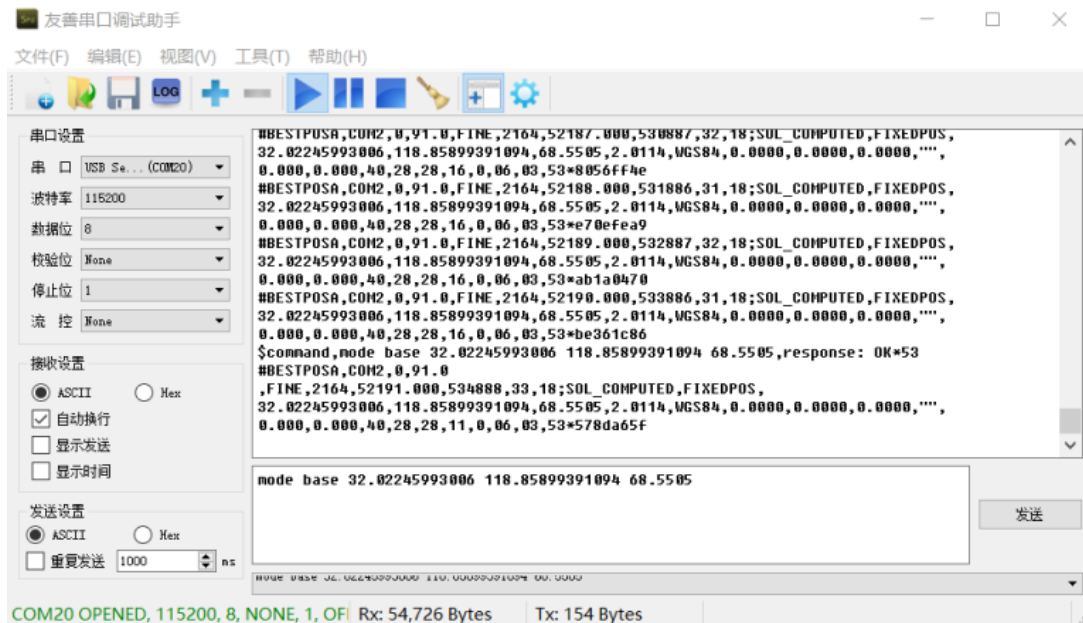
- When the configuration is complete, the following command (note that they need to end with a line break) is sent to the base station through a serial port to save the configuration.
- **saveconfig**
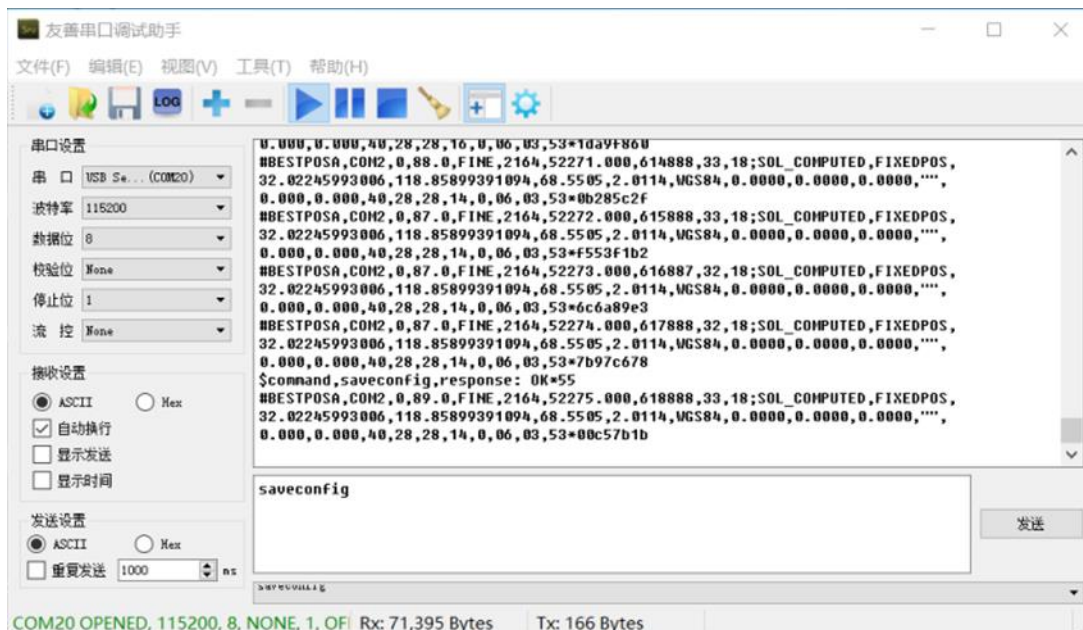
Part 5 Precautions

➢ With our G-RTK Kit, the base station side supports plug-and-play. If only Rover is purchased, the use of other companies' base station end requires additional RTK base station configuration at the ground station, which does not guarantee compatibility and positioning accuracy.

➢ This product is positioning equipment, which needs to search for satellite positioning, try to test it in the open and undisturbed site.

➢ The positioning status of G-RTK should be mainly decided by the ground station.

Part 6 Purchase

6.1 Link for purchase

AliExpress: G-RTK (BLI Store)

6.2 List

GRTK Kit

Item	Model	Quantity
GRTK	As BASE	1
GRTK	As ROVER	1
Antenna	BL-320（Multi-star & multi-frequency & GNSS）	3
Power distribution board	Standard	2
Power cord	GH1.25 4P-GH1.25 4P（for Power distribution board）	2
Data Cable for BASE	GH1.25 5P-GH1.25 5P（for Radio）	1
Data Cable for Rover	GH1.25 5P-GH1.25 5P（for Radio）	1
	GH1.25 6P-GH1.25 10P（for Controller）	1
Transfer line	GH1.25 6P to DuPont（for configuration of GRTK）	1

6.3 Express delivery

Appropriate logistics methods need to be adopted according to the actual situation.

6.4 Wholesale

Wholesale prices vary depending on the quantity of the wholesale, please contact customer service for more details.

6.5 Test videos

a) Centimeter-level positioning accuracy test.
b) The base station is quickly deployed within 30s.
c) Stationary positioning test & drone light painting with GRTK.