SIYI

SIYI RTK Positioning and Orientation Module User Manual

SIYI Technology (Shenzhen) Co., Ltd.

siyi.biz/en

SIYI

Thank you for purchasing SIYI Technology products.

The SIYI RTK family proudly introduces the new dual-antenna high-precision full-system all-frequency positioning and orientation module. With advanced performance and top-notch accuracy, it is compact in size and boasts extremely low power consumption. Equipped with the RM3100 industrial-grade magnetometer, this module supports single-module dual-antenna direction finding and maintains excellent anti-interference performance even in complex electromagnetic environments. It provides high-precision control responses and enables precise operations for unmanned systems, supporting flight control systems and empowering the intelligent robotics ecosystem with high-precision positioning, orientation, and autonomous navigation control.

To ensure you have a great product experience, please carefully read the user manual before installation. This manual will help you resolve most of your usage questions. For additional assistance, you can visit SIYI Technology's official website (www.siyi.biz), call SIYI Technology's official after-sales service center at 400-838-2918, or email support@siyi.biz to consult with SIYI

SIYI

Technology engineers about product-related knowledge and to provide feedback on product issues.

Contact Us：**SIYI Official Website** *(https://siyi.biz/en)*

SIYI User Group - Facebook	
Facebook	
LinkedIn	
YouTube	

SIYI

User Manual Version Update History

Version	Update Date	Update Content
1.0	2024.8	Initial release
1.1	2024.11	Add content to section 3.2.

Content

Read Tips

Icons

Please pay more attention to content indicated with the following marks:

DANGER Dangerous manipulation probably leads to human injuries.

WARNING Warnings on manipulation possibly leads to human injuries.

CAUTION Cautions on what manipulation may lead to property loss.

Prohibited **Mandatory** **Mark**

Safety

The SIYI RTK Positioning and Orientation Module is designed and manufactured for professional application scenarios. Necessary adjustments have been completed before leaving the factory; please do not disassemble or modify its structure. The F9P RTK system is highly precise, and operators must possess certain basic

skills to handle it. Please use the module with caution. SIYI Technology will not be held responsible for any unnecessary damage to the product, economic loss, or even personal injury caused by improper or irresponsible use of this product. Minors must use this product under the supervision and guidance of professionals.

SIYI products are designed for commercial applications and are strictly prohibited from being used for military purposes. Unauthorized disassembly or modification of this product without the consent of SIYI Technology is forbidden.

Storage / Carrying / Recycling

When your SIYI product is left unused, or you are bringing it outdoors, or the product life has expired, please do read the below precautions.

Danger

Always place your SIYI products at places where babies or kids do not reach.

SIYI products should be placed in places which are too hot (above 60℃) or too cold (under -20℃).

Caution

SIYI products should not be placed in places under direct sunshine or too dusty or too wet.

Carrying or transporting SIYI products should avoid vibration or shatter by which components may break.

Chapter 1: Product Overview

1.1 Product Features

Full-System, Full-Frequency RTK Positioning

SIYI's RTK positioning and orientation module supports full-system, full-frequency high-precision positioning, including BeiDou, GPS, GLONASS, Galileo, and QZSS. This significantly enhances positioning accuracy and reliability.

RM3100 Industrial-Grade Magnetometer

Equipped with the RM3100 magnetometer, SIYI's RTK positioning and orientation module greatly improves magnetic field measurement resolution, reduces noise levels, and expands measurement range, providing the positioning system with excellent anti-interference capability.

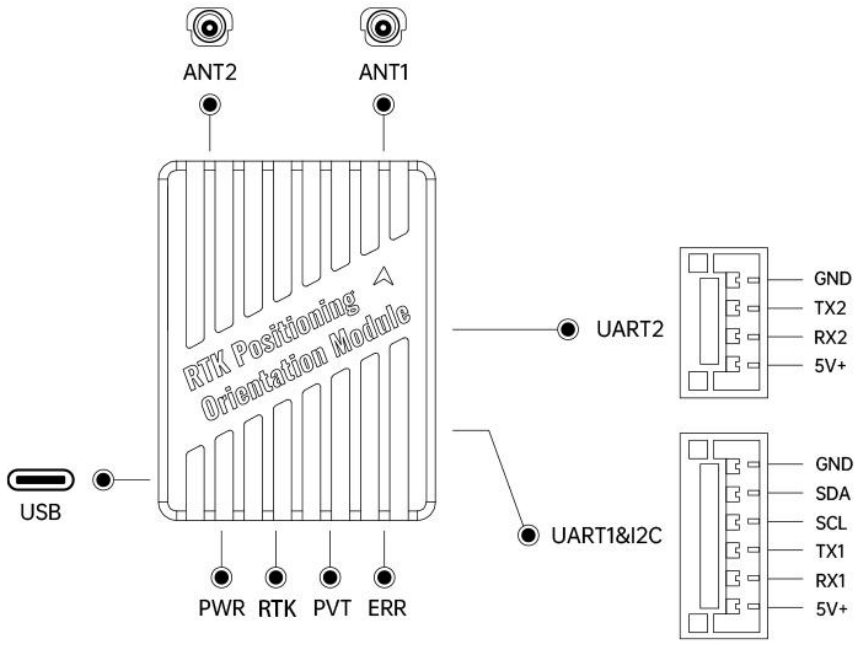
Single Module with Dual-Antenna Orientation

The system enables orientation determination using just one module connected to two antennas, replacing the traditional magnetometer and ensuring stable operation in complex electromagnetic environments.

Compact and Lightweight Design

Engineered specifically for the intelligent robotics ecosystem, the module embodies minimalist design, achieving millimeter-level precision and ultralight weight.

1.2 Interfaces and Definitions



UART1&I2C: Autopilot Communication
UART 2: Autopilot Communication
ANT1/2: Antenna Connector
USB (Type-C): PC Configuration

PWR: Power Indicator
RTK: RTK Status Indicator
PVT: PVT Status Indicator
ERR: ERR Status Indicator

1.3 Technical Specifications

Hardware Specifications

GNSS Receiver	Unicore UM982
Electronic Compass	PNI RM3100
Satellite Navigation System	GPS GLONASS BeiDou Galileo QZSS
Satellite Frequency Band	**Antenna 1：** BDS:B1I、B2I、B3I GPS:L1C/A、L2P（Y）/L2C、L5 GLONOSS:L1、L2 Galileo: E1、E5a、E5b QZSS:L1、L2、L5 **Antenna 2：** BDS:B1I、B2I、B3I GPS:L1C/A、L2C GLONOSS:L1、L2 Galileo: E1、E5b QZSS:L1、L2

Overall Performance

Positioning Accuracy	**Single Point Positioning：** Horizontal 1.5M/ Elevation 2.5m **GPS (Differential GPS)：** Horizontal： 0.4M+1PPM/ Elevation：0.8m+1PPM **RTK:**

	Horizontal 0.8cm+1PPM Elevation：1.5cm+1PPM
Directional Accuracy (Dual-Module Measurement)	Baseline: 1m, Directional Accuracy: 0.2 degrees
Maximum Number of Satellites	Single : 28 + RTK:50 +
Differential Data Format	RTCM3.X
Time to First Fix (TTFF)	Cold Start: <30s, Hot Start
Antenna Gain	Mobile End: 2 dBi Base Station End: 5.5 dBi
Data Refresh Rate	5Hz (default); Maximum 20Hz
Interface Type	2 x UART 1 x USB (Type-C)
Antenna Interface Type	MMCX
Operating Voltage	4.5 ~ 5.5 V
Power Consumption	1 W
Operating Temperature	–30 ~ 75 °C
Product Dimensions	40mmx30.5mmx15mm
Product Weight	22.8g（excluding antenna）

1.4 Item List

1 x SIYI RTK Positioning and Orientation Module

2 x Quadruple Helix Antennas

2 x Quadruple Helix Antenna Feedlines (SMA female to MMCX right-angle male, feedline length: 550mm)

1 x Type-C to USB Data Cable

1 x UART1 to GPS Module Connection Cable

(for connecting the UART1 interface of the RTK mobile module to the flight controller GPS module)

1 x UART1 to TELEM4 Connection Cable

(for connecting the UART1 interface of the RTK mobile module to the flight controller TELEM4 interface)

1.5 Status Indicator Definitions

Power Indicator Light

🔴 Red Light On: Module is powered normally

○ Red Light Off: Module has no power

RTK Status Indicator Light

🔵 Blue Light On: Entered RTK status

○ Blue Light Off: Not in RTK status

PVT Status Indicator Light

🟢 Green Light On: Positioning successful

○ Green Light Off: Not positioned

ERR Status Indicator Light

🔴 Red Light On: Module error

○ Red Light Off: Module is normal

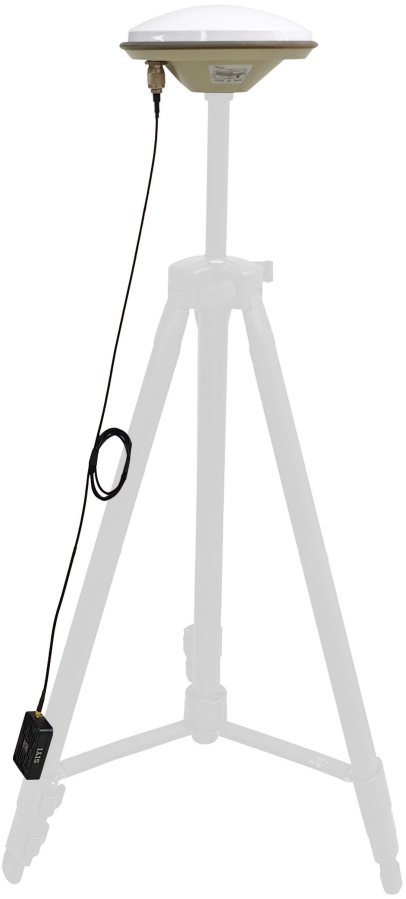
Note

The RTK status indicator light is only active on the mobile end when the system enters RTK status. The RTK status indicator light on the base station end will not light up.

Chapter 2: Before Use

2.1 Installation and Fixing

2.1.1 F9P RTK Base Station



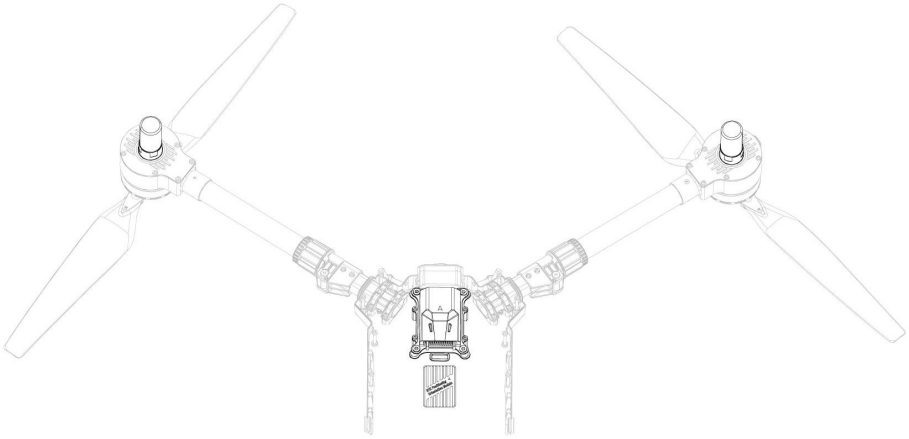
Refer to the image above to securely mount the RTK base station and the mushroom antenna on a tripod, ensuring that the antenna feed line is properly connected.

Note

The tripod should be provided by the user.

Please ensure that there are no obstacles or sources of interference around the RTK antenna to avoid affecting the convergence time and positioning accuracy.

2.1.2 Mobile End (SIYI RTK Positioning and Orientation Module)



Refer to the image above to securely mount the RTK mobile end on the aircraft body, ensuring it does not wobble. The arrow on the RTK module should align with the installation direction of the

flight controller (the aircraft's nose direction).

Note

The SIYI RTK Positioning and Orientation Module is equipped with a built-in RM3100 compass. To ensure stable operation of the device, the module should be installed away from sources of magnetic interference.

Installation of Mobile End Antenna Bracket

If the frame design does not allow for the RTK mobile end antenna to be installed in the specified position, refer to the image below. Use a mounting bracket to securely fix the four-arm spiral antenna to the aircraft body, ensuring it does not wobble. The arrow on the RTK module should align with the installation direction of the flight controller (the aircraft's nose direction).

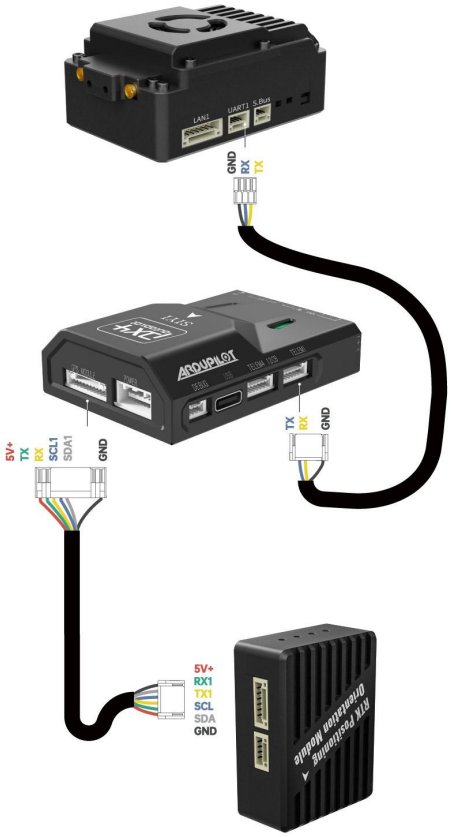
Note

Please avoid obstructing the RTK antenna, as this may affect positioning performance.

Chapter 3: Dual-Antenna Orientation (Compass Replacement)

When dual RTK antennas are installed, they can replace the device's compass and enable dual-antenna orientation functionality.

3.1 Instructions for Use



Refer to the diagram above to connect the RTK mobile module to the flight controller, while the flight controller is connected to the airborne data link.

ArduPilot firmware version 4.4.0 or above is required.

The relevant parameter configuration for the flight controller and the RTK mobile module is as follows:

Using Serial Port 3 as an example:

Set SERIAL3_PROTOCOL = 5 (GPS)

Set GPS1_TYPE = 25 (Unicore Moving Baseline)

If only using the main antenna for positioning and not utilizing the orientation function, set GPS1_TYPE = 24 (Unicore Master)

Set the position of the main and secondary antennas for the SIYI RTK Positioning and Orientation Module:

GPS_MB1_TYPE = 1 (The offset of the mobile baseline main antenna relative to the secondary antenna. After modification, restart to display the next parameter.)

GPS_MB1_OFS_X: The X-axis offset of the main antenna relative to the secondary antenna (distance in meters). If the main antenna is in front of the secondary antenna, the value is positive; otherwise, it is negative.

GPS_MB1_OFS_Y: The Y-axis offset of the main antenna relative to the secondary antenna (distance in meters). If the main antenna is to the right of the secondary antenna, the value is positive; otherwise, it is negative.

GPS_MB1_OFS_Z: The Z-axis offset of the main antenna relative to the secondary antenna (distance in meters). If the main antenna is lower than the secondary antenna, the value is positive; otherwise, it is negative.

Main Antenna Positioning Offsets

GPS_POS1_X: The X-axis offset of the main antenna relative to the flight controller (distance in meters). If the main antenna is in front of the flight controller, the value is positive; otherwise, it is negative.

GPS_POS1_Y: The Y-axis offset of the main antenna relative to the flight controller (distance in meters). If the main antenna is to the right of the flight controller, the value is positive; otherwise, it is negative.

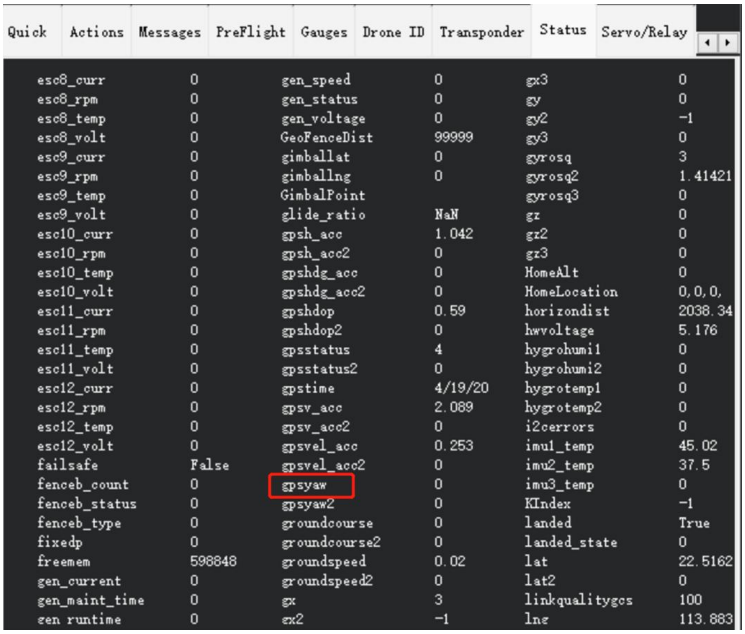
GPS_POS1_Z: The Z-axis offset of the main antenna relative to the flight controller (distance in meters). If the main antenna is lower than the flight controller's position, the value is positive; otherwise, it is negative.

Note

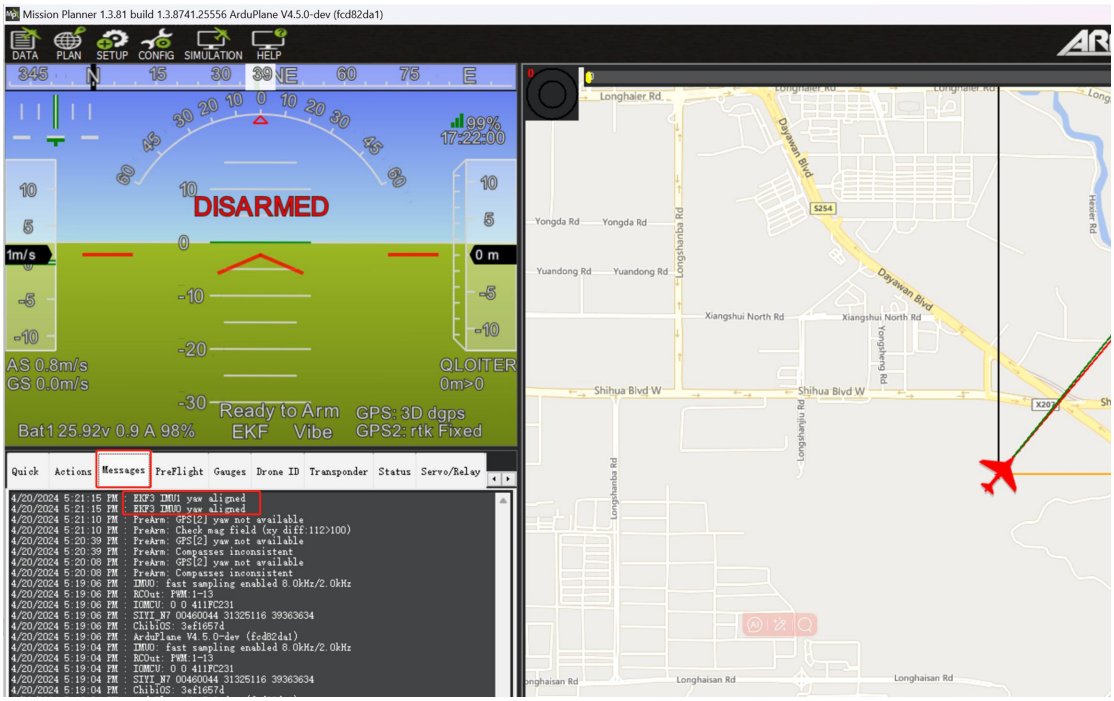
The horizontal distance between the main and secondary antennas must be at least 30 centimeters; otherwise, it will affect the orientation accuracy.

Verifying Dual-Antenna Orientation

Open the ground station and check whether the GPS_YAW heading matches the actual heading. If the headings are consistent, it indicates that the dual-antenna orientation configuration is successful. If they do not match, there may be an error in the settings for GPS_POS1 or GPS_MB1_OFS.



The message in the ground station's status bar, "EKF3 IMUx yaw aligned," indicates that the dual-antenna orientation is effective.



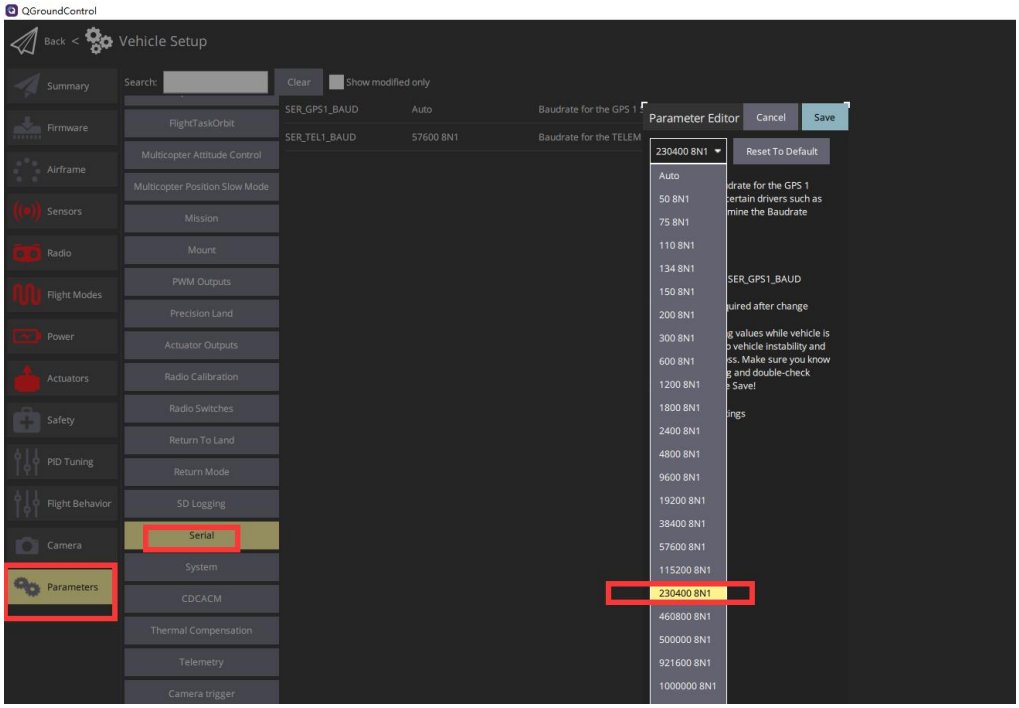
3.2 PX4 User Manual

Port Settings

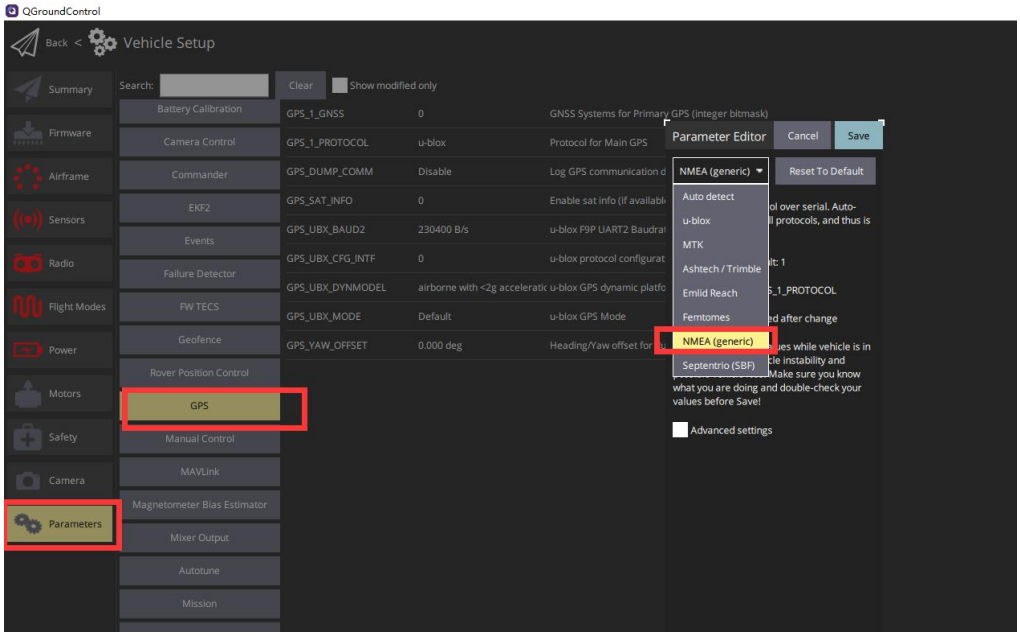
The Siying positioning and orientation module uses the NMEA protocol, with a serial baud rate of 230400.

The following PX4 parameters must be set:

SER_GPS1_BAUD = 230400 — GPS1 baud rate



GPS_1_PROTOCOL = 6 NMEA — GPS1 protocol type

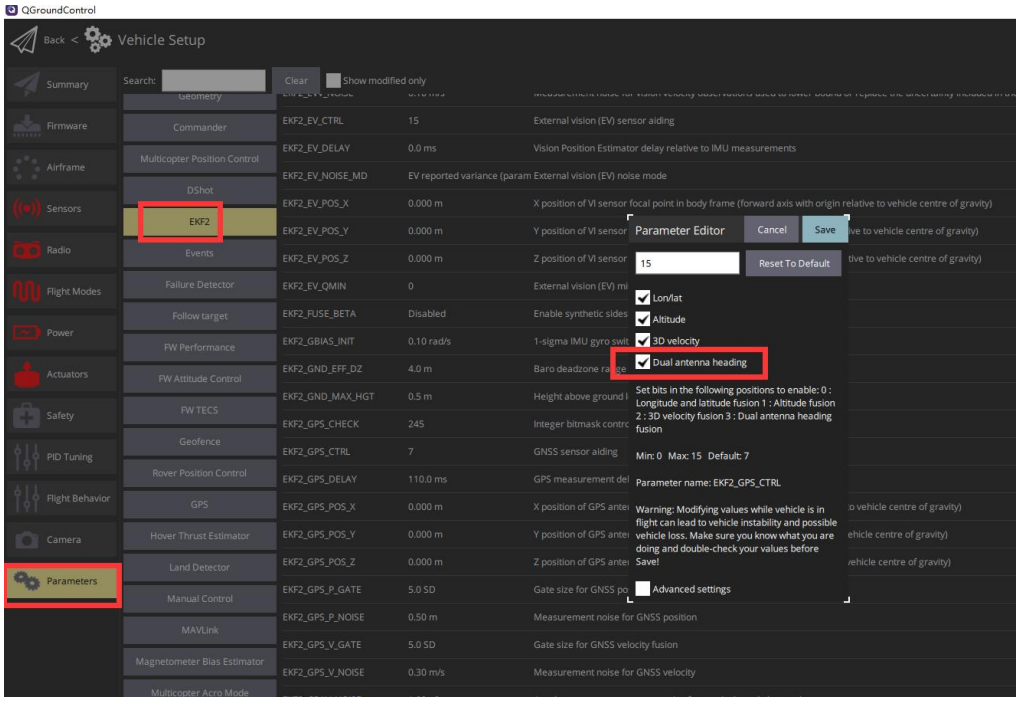


Please note that the above parameters assume you have connected the positioning and orientation module to the GPS MODULE interface. If you are using a different port, you must configure the baud rate and protocol using the respective parameters.

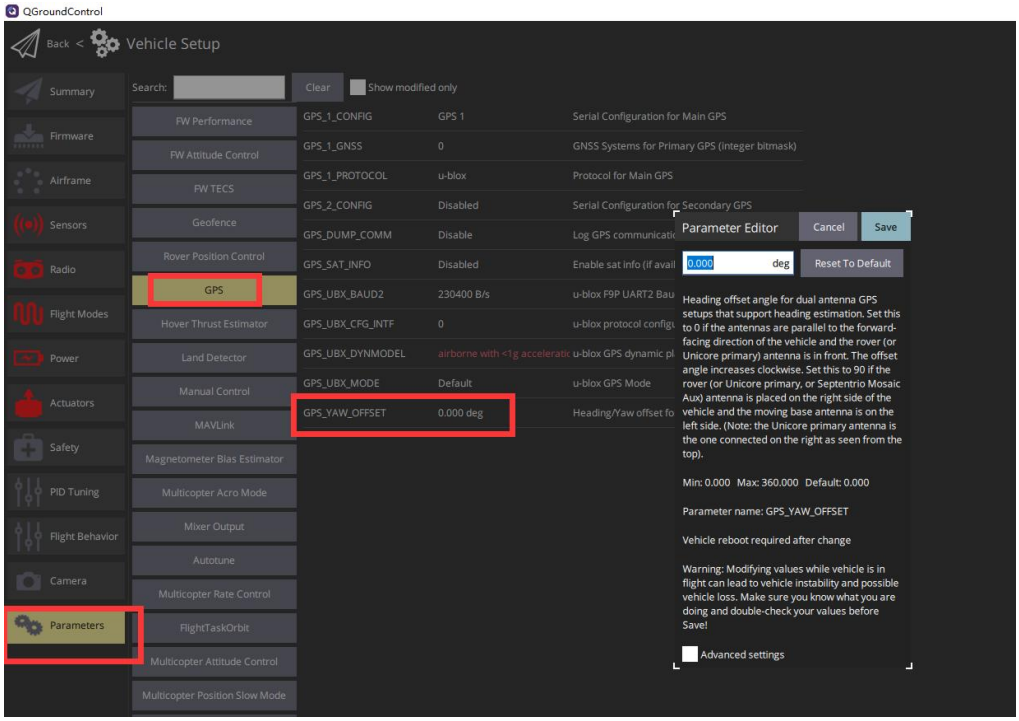
Enabling Dual-Antenna Direction Finding

The Siying positioning and orientation module comes with two antennas: a primary antenna (ANT1) and a secondary antenna (left ANT2), which can be used to obtain yaw data from the GPS. You need to set the following parameter:

EKF2_GPS_CTRL = 15 to enable dual-antenna for yaw estimation.



GPS_YAW_OFFSET: If the primary antenna is located at the front, set the yaw offset to 0. Angles increase in a clockwise direction. If the primary antenna is on the right side of the vehicle and the secondary antenna is on the left side, set the offset to 90 degrees.



Chapter 4: Centimeter-Level Positioning with RTK

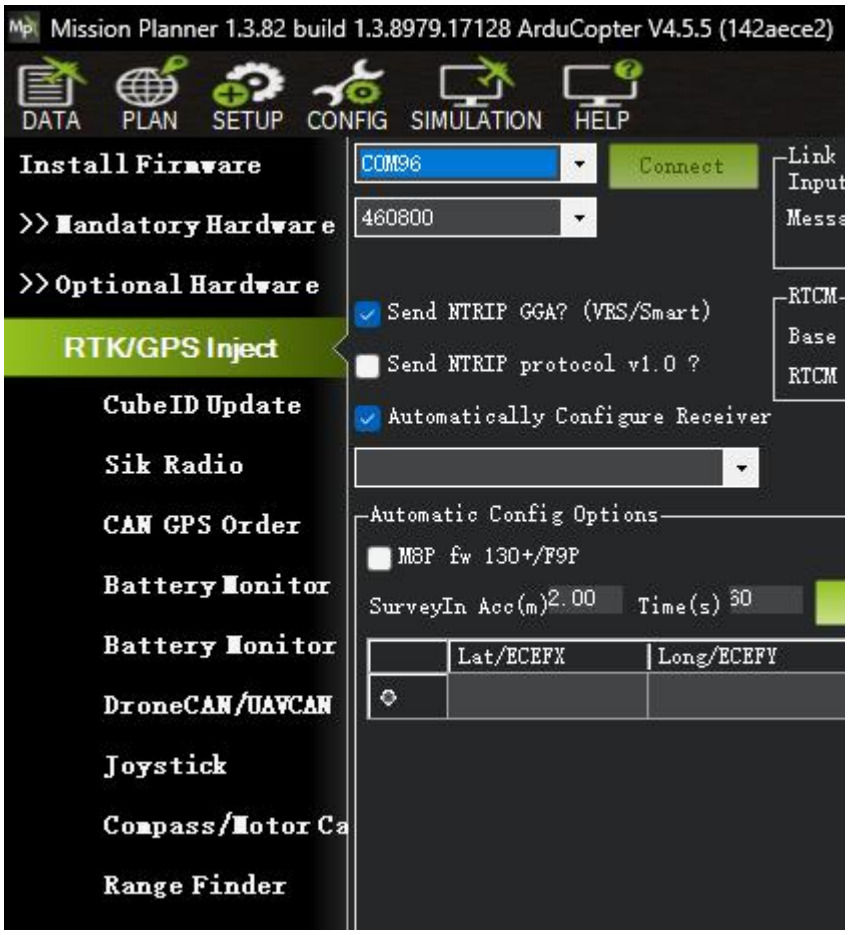
The RTK base station and mobile module can be used in combination to establish a connection through the flight controller and data link, enabling centimeter-level positioning.

4.1 Base Station Connection Instructions

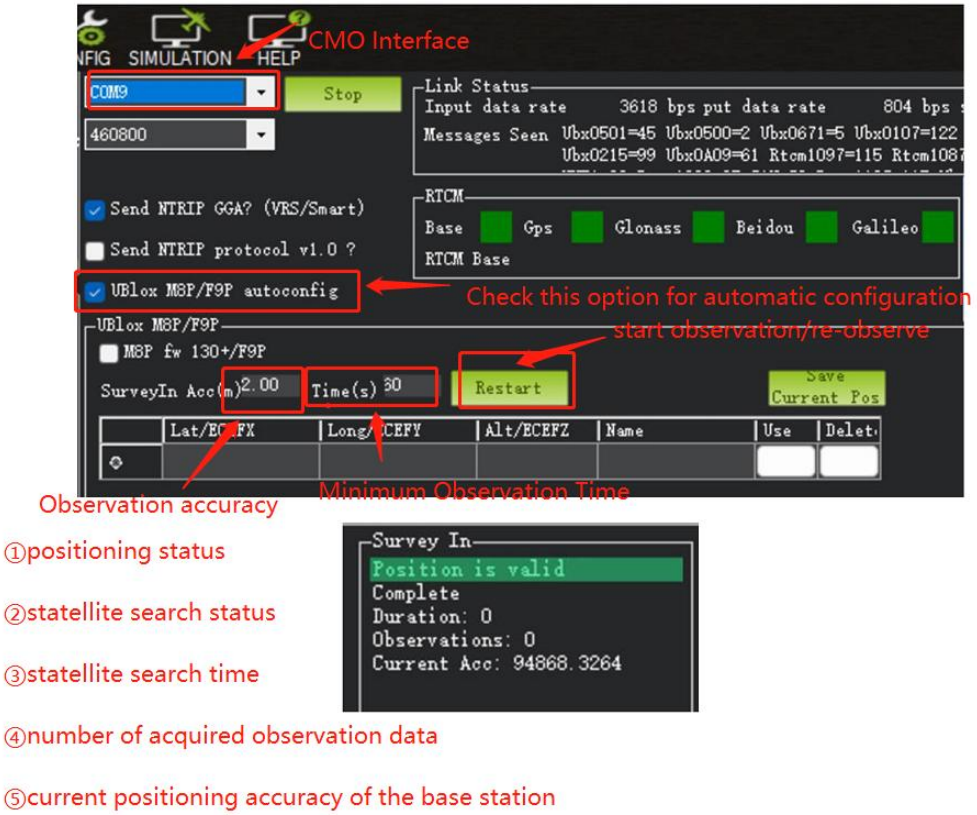
Refer to the above diagram to set up the F9P RTK base station. The base station communicates with the PC ground station and transmits the real-time position of the RTK base station to the flight controller via the data link.

Ground Station Parameter Settings:

Run the Mission Planner ground station software and navigate to “Initial Setup > Optional Hardware > RTK.”



Refer to the image below for parameter configuration:



①positioning status

②statellite search status

③statellite search time

④number of acquired observation data

⑤current positioning accuracy of the base station

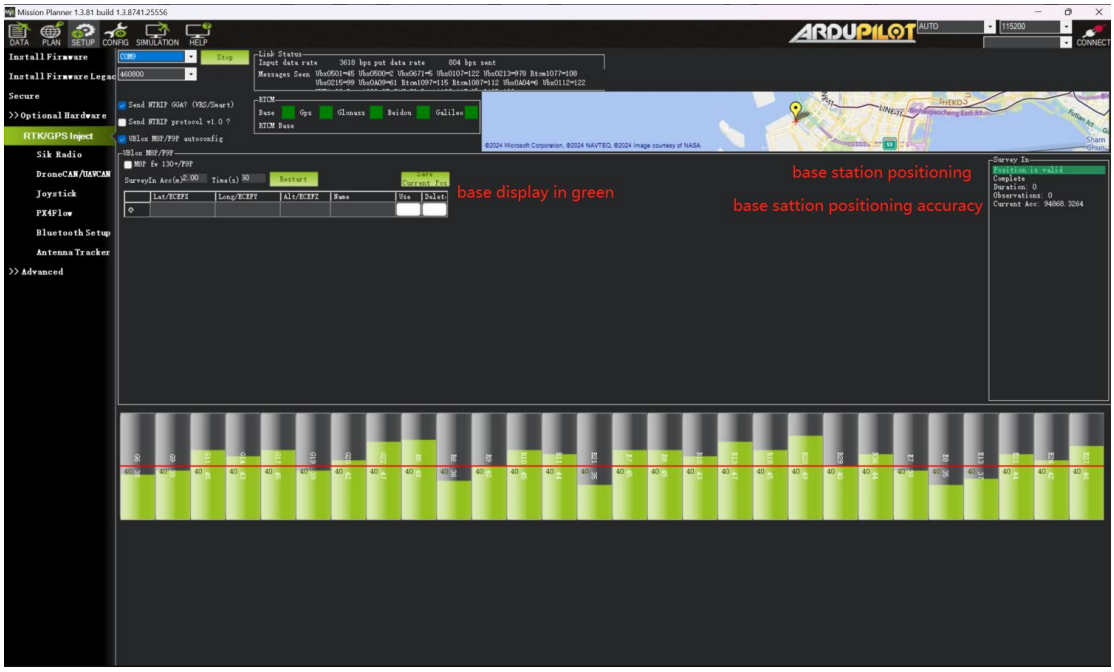
It is recommended to check the option for automatic configuration of the F9P, set the observation accuracy to 2.5, and the minimum observation time to 60s.

After completing the settings, click Restart to begin the observation.

Warning

Once the base station positioning is successful, do not move the base station under any circumstances!

When the base station is operating normally and convergence is complete, the ground station interface will display as shown in the diagram below.



The GPS status will display rtk fixed, indicating that the system has successfully entered RTK positioning mode.

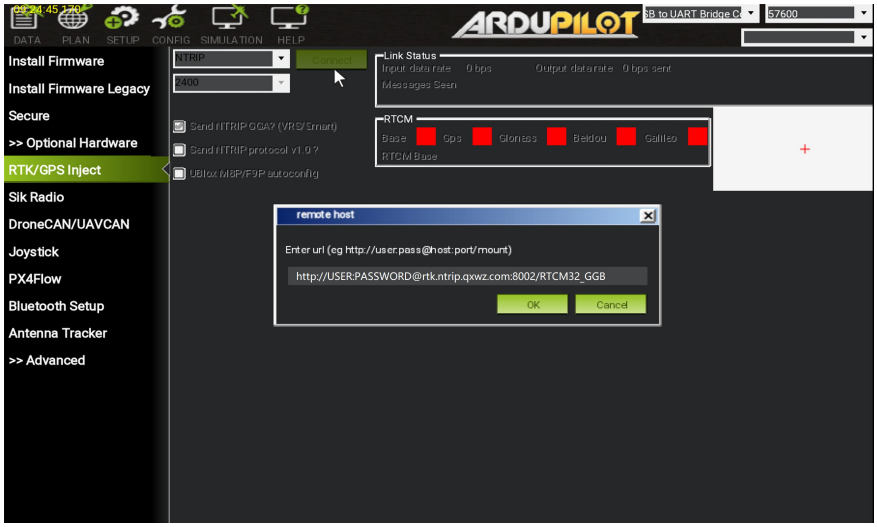
Chapter 5: Using Network RTK with SIYI Handheld Ground Station

The SIYI handheld ground station, in conjunction with the RTK mobile module and network RTK base station, can achieve network RTK functionality.

Use the SIYI handheld ground station to run the Mission Planner ground station software, connecting the SIYI handheld ground station to the mobile internet. Go to “Initial Setup > RTK > NTRIP.”

The protocol address format is as follows (using Qianxun RTK as an example):

http://USER:PASSWORD@rtk.ntrip.qxwz.com:8002/RTCM32_GGB



In this format, USER is the username for the FindCM service account applied for by the user, PASSWORD is the corresponding password, rtk.ntrip.qxwz.com is the FindCM service address for the Qianxun positioning server, 8002 is the port broadcasting WGS84 coordinate system data, and RTCM32_GGB is the data source for broadcasting RTCM 3.2 format data.

Note

For more detailed information, you can consult the Qianxun Network RTK official documentation: https://www.qxwz.com/help-document-location-service.html#link-5。

After correctly obtaining the base station data, you can observe information such as protocol number, data rate, base station coordinates, satellite numbers, and signal-to-noise ratio (SNR) on the RTK/GPS inject page.

Note

Although this chapter uses the Android version of Mission Planner as an example to set network RTK parameters, we do not recommend using this method for aircraft parameter tuning. For complex flight control parameter adjustments, it is preferable to use the Windows version of Mission Planner.

Chapter 6: After-Sale Service

Please visit the SIYI Technology support page at Service and Support - SIYI Technology | Empowering and Building an Intelligent Robot Ecology for the latest after-sales and warranty information.