

Dalang

AK987EU





**Dalang Communication
Technology Co., Ltd
Product Specification**

| | |
|-----------------|---------------|
| Product Name: | GNSS Receiver |
| Product Model: | AK987EU |
| Version Number: | V 1.0 |
| Revision Date: | 2024.12.13 |

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1 Product Application Scenarios

K987EU is a 4G RTK positioning terminal device that transmits RTK differential base station data to the positioning module through 4G network to achieve RTK accurate positioning. The terminal supports Ntrip communication protocol and supports network base station services such as Qianxun position, CORS station, and self built station. Adopting industry-leading 4G hardware solutions, supporting the network standards of most domestic and European operators, adopting a 9-36V wide power input design, RTK positioning data supports RS232 and BT output. Refer to Figure 1 for details.



Figure 1 Product Application Scenarios

2 Features

In this chapter, we will delve into and comprehensively elaborate on the functionalities and operating principles of the K987EU, detailing how it plays a pivotal role in various applications as follows:

- 1. Support full constellation multi frequency chip level RTK positioning.**
- 2. Supports BDS, GPS, GLONASS, Galileo, QZSS, and SBAS.**
- 3. The terminal supports Ntrip communication protocol and supports network base station services such as Chihiro location, CORS stations, and self built stations.**
- 4. Can be used as a mobile station.**
- 5. Adopt on-board standard 9-36V wide voltage input.**
- 6. Adopt industrial grade 4G network communication module.**

3 Structural Characteristic

In this section, we will conduct an in-depth analysis of the product's design details, presenting its aesthetic features and precise interface specifications through detailed structural diagrams. This perspective aims to provide a comprehensive framework, thereby enhancing the understanding and perception of the product's architecture. Refer to Figure 2, Table 1, Figure 3, Table 2, Figure 4.

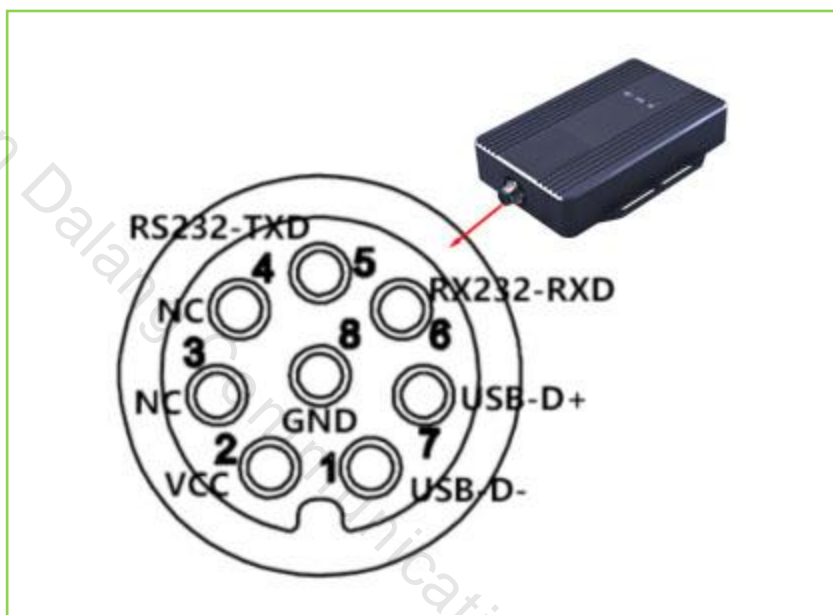


Figure 2 Interface Definition Diagram

Table 1 M8 Interface Definition

| Serial Number | Interface Name | Function Introduction |
|--------------------------|----------------|---|
| 1 | USB-D- | Parameter configuration USB interface D- |
| 2 | VCC | power input DC9-36V |
| 3 | NC | empty |
| 4 | NC | empty |
| 5 | RS232-TXD | RTK positioning output RS232-TXD |
| 6 | RS232-RXD | RTK positioning output RS232-RXD |
| 7 | USB-D+ | Parameter configuration USB interface D+ |
| 8 | GND | Grounding |
| antenna interface | | |
| 1 | GNSS | Active positioning antenna, 3.3V, SMA interface |
| 2 | NET | 4G antenna interface, SMA |

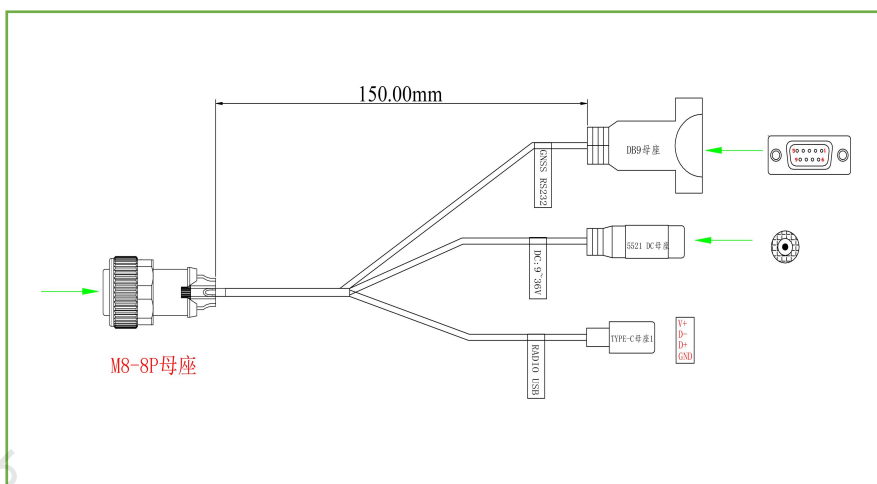


Figure 3 Schematic diagram of connecting wires



Figure 4 Complete K987 Connection Scheme

Table 2 Complete Component Description

| Number | Name | Quantity | Remarks |
|--------|------------------|----------|--|
| 1 | AK987EU terminal | 1 | |
| 2 | Connecting line | 1 | M8 aviation head to type C; DC-DC power supply; D B9 female head |
| 3 | GNSS antenna | 1 | Full system full frequency antenna |
| 4 | Coaxial line | 1 | 5mTNC to SMA, 50-3 wires |
| 5 | 4G antenna | 1 | |

4 Specifications

In this section, we will provide a detailed list and explanation of the product's chip features, sensitivity, accuracy, operating principles, and other technical details, as detailed in Table 3.

Table 3 Product Specifications

| Specification parameters | | | | | |
|--------------------------|----------------------|--|---|------|-----------------|
| GNSS module | 1 | working frequency | BDS: B1I B2I B3I B1C B2a B2b GPS: L1 C/A L1C L2P (Y) L2C L5 GLONASS: L1 L2 Galileo: E1 E5a E5b E6 QZSS: L1 L2 L5 L6 | | |
| | 2 | Receiving channel | 1408 channel | | |
| | 3 | Single point positioning (RMS) | Plane: 1.5m | | |
| | | | Elevation: 2.5m | | |
| | 4 | DGPS(RMS) | Plane: 0.4m+1ppm | | |
| | | | Elevation: 0.8m+1ppm | | |
| | 5 | RTK(RMS) | Flat: 0.008m+1ppm | | |
| | | | Elevation: 0.015m+1ppm | | |
| | 6 | Observation accuracy (RMS) | BDS | GPS | GLONASS Galileo |
| | 7 | B1I/B1C/L1C/L1 C/A/E1/G1 pseudorange | 10cm | 10cm | 10cm 10cm |
| | 8 | B1I/B1C/L1C/L1 C/A/E1/G1 carrier phase | 1mm | 1mm | 1mm 1mm |
| | 9 | B3I/L2P (Y)/L2C/G2 pseudorange | 10cm | 10cm | 10cm 10cm |
| | 10 | B3I/L2P(Y)/L2C/G2 | 1mm | 1mm | 1mm 1mm |
| | 11 | carrier phase | 10cm | 10cm | 10cm 10cm |
| | 12 | B2I/B2a/B2b/L5/E5a/E5b pseudorange | 1mm | 1mm | 1mm 1mm |
| | 13 | Time accuracy (RMS) | 10ns | | |
| 14 | Speed accuracy (RMS) | 0.03 m/s | | | |
| 15 | cold boot | <10s | | | |
| 16 | Initialization time | <5s (typical value) | | | |

| | | | |
|---|----|------------------------|--|
| | 17 | Initialize reliability | > 99.9% |
| 4G module (network frequency band) | 1 | LTE FDD | B1/3/7/8/20/28 |
| | 2 | LTE TDD | B38/40/42/43 |
| | 3 | GSM/GPRS/EDGE | NA |
| 4G module (propagation speed) | 1 | LTE FDD (Mbps) | 10.3(DL)/5.1(UL) |
| | 2 | LTE TDD (Mbps) | 9.1(DL)/3.1(UL) |
| Bluetooth module | 1 | Bluetooth version | 2.0 |
| | 2 | Working frequency band | 2.4G |
| | 3 | Air speed | 2Mbps |
| | 4 | Reference distance | 10m |
| Data format | 1 | Differential data | RTCM3.X |
| | 2 | output format | NMEA-0183, RTCM3.X |
| | 3 | Data update rate | 1Hz-20Hz(default 1Hz) |
| Power supply | 1 | Voltage | DC +9V~36V |
| | 2 | power waste | <3W |
| | 3 | Working current | ≤145mA/12V |
| | 4 | indicator light | 1NET, 1RTK, 1BT |
| Physical parameters | 1 | size | 100mm*61.8mm*18.75mm |
| | 2 | weight | 180g |
| | 3 | Shell material | aluminium |
| | 4 | interface | SMA*2/8-core LEMO ports |
| Environmental Specifications | 1 | working temperature | -30°C~+70°C |
| | 2 | Storage temperature | -40°C~+85°C |
| | 3 | humidity | 95% condensation |
| | 4 | Protection grade | IP65 |
| | 5 | Seismic resistance | Resist the impact of a 1-meter free fall |

5 Product Photos

In this chapter, we will showcase real-life images of the product, as shown in Figure 6. These images provide a detailed view of our product from various angles and perspectives. We believe that through authentic representation, we can better convey the value and concept of the product, thereby enhancing your trust and satisfaction.



Figure 6 Product Images

6 status indicator

| | | |
|--------------------------|-------------|---|
| NET (green) light | Chang Liang | The 4G module is powered on, but PPP dialing is not completed |
| | flash | PPP dial-up completed |
| | Slow Flash | Registered RTK NTRIP base station |
| RTK (blue) light | Chang Liang | Not located |
| | flash | Positioned but not entered RTK fixed solution |
| | Slow Flash | RTK fixed solution |
| BT (blue) light | Chang Liang | Bluetooth connected |
| | flash | Bluetooth not connected |

Note: Slow flashing: on for 400ms, off for 800ms

Flash: on 200ms, off 200ms

7 Common configuration instructions

| NO. | Instruction | Describe | Notes |
|-----|--|--|---|
| 1 | AT+set_ntrip_param,140.207.166.210,25001,,,SZ-DL-8KM-RTCM32# | Set ntrip IP, port, username, password, and loading point | Please separate each item with a comma. If there is no username or password, do not write it, but also separate it with a comma |
| 2 | AT+get_ntrip_param# | Query ntrip parameters | |
| 3 | AT+get_verno# | Versions Query | |
| 4 | AT+set_to_bt,NAMEAK987# | Set Bluetooth name | Note that setting the Bluetooth name must be done when the Bluetooth is not connected. When changing it, disconnect the Bluetooth connection first. The AK987 command shows the Bluetooth name displayed after the change, which can be changed according to your own needs |
| 5 | AT+set_uart_gps,1# | Enable MCU serial port forwarding of GPS information | This command will be saved in case of power failure, but if the factory reset command is sent, it will default to no output |
| 6 | AT+set_uart_gps,0# | Turn off MCU serial port forwarding GPS information | |
| 7 | AT+set_gps_rtk_timer,10# | Set 10 seconds to send GGA information to the ntrip server | 10 "is 10 seconds, can be changed to 5 seconds or other, default is 10 seconds |
| 8 | AT+set_to_gps,log gpgsv ontime 1# | Positioning module outputs gpgsv data | The instructions starting with "AT+set_to-ugps" are forwarded to the positioning module, and the subsequent instructions are the positioning module instructions, which can be modified according to the GPS module instructions |

Note: AT commands can be sent from MCU serial port or Bluetooth. When sending commands via Bluetooth on a mobile app, try to edit the text in English as much as possible to avoid text errors

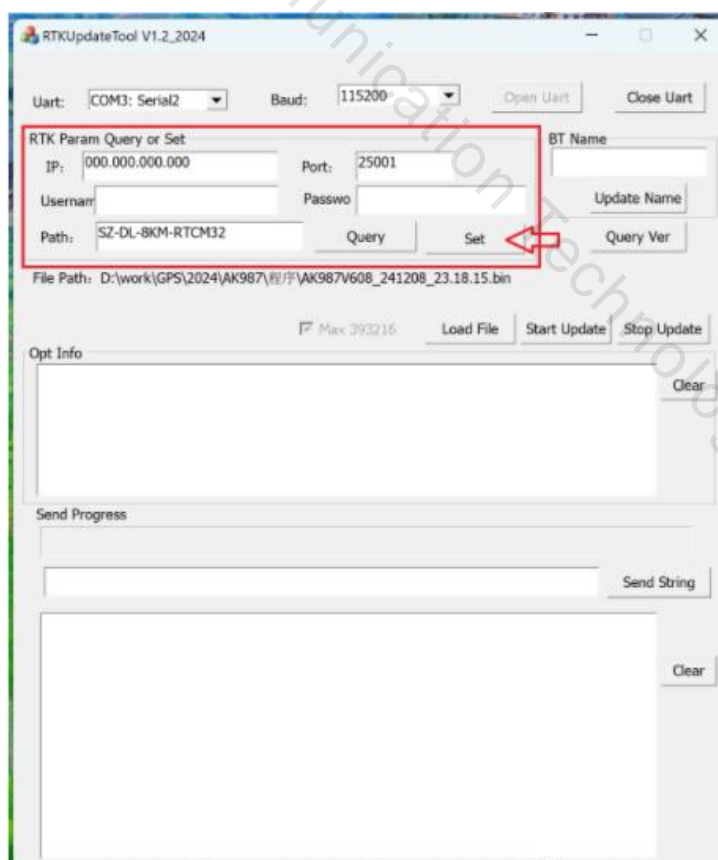
8 4G RTK ROVER instructions

8.1 Preparation work

8.1.1 Connect the AK987/AK988 configuration USB cable to the computer USB (Windows 10 and above computer systems will automatically generate serial port numbers, Windows 7 and above computer systems need to install the CH340 serial port driver first). Open the RTKY updateTool_1.1CH.exe configuration tool software on the computer

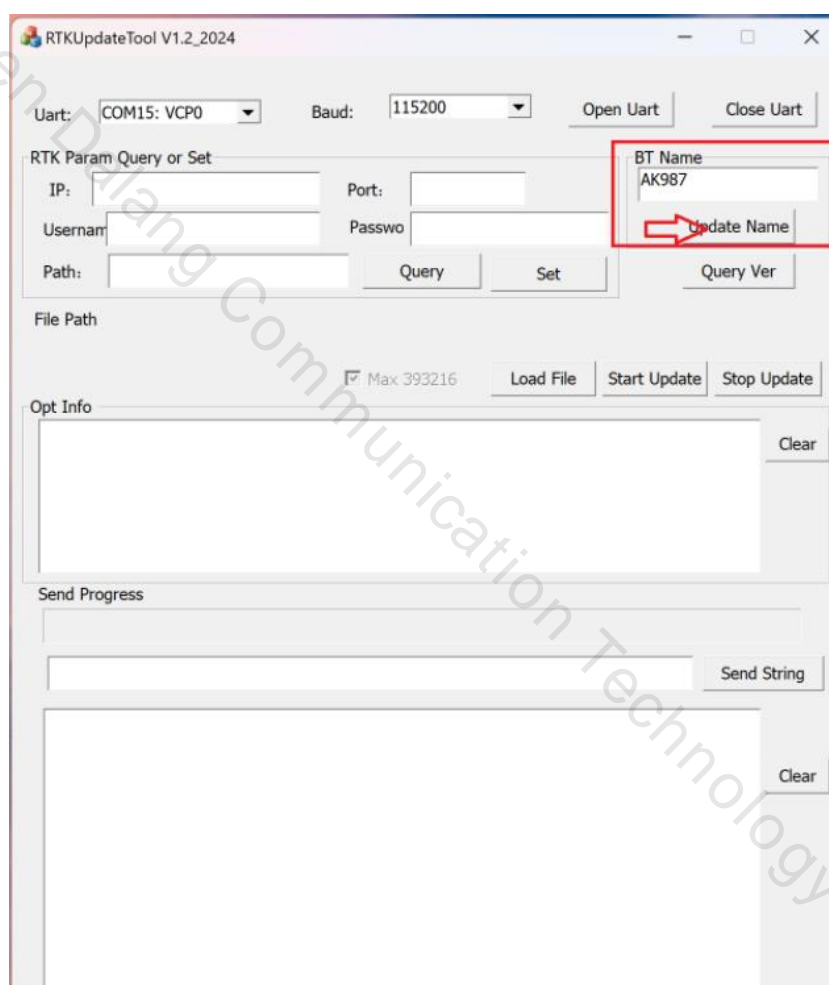
8.2 Parameter configuration

Open the RTKUpdateTool_1.1CH.exe software and select a good string of slogans, baud rate 115200, click to open the serial port, fill in the IP (or domain name), port, username, password, access point in the corresponding window of the software interface (the IP bar supports entering the domain name, username and password If not, do not fill in), click Settings after all input is completed, and the bottom of the software returns "wait 10s system reset! set_ntrip_param", 000.000.000.000, 25001, SZ-DL-8KM-RTCM32 ok #indicates that the setting is successful (the content of the underlined part is the IP port and other parameters actually set in, and the actual content is consistent with the setting content).



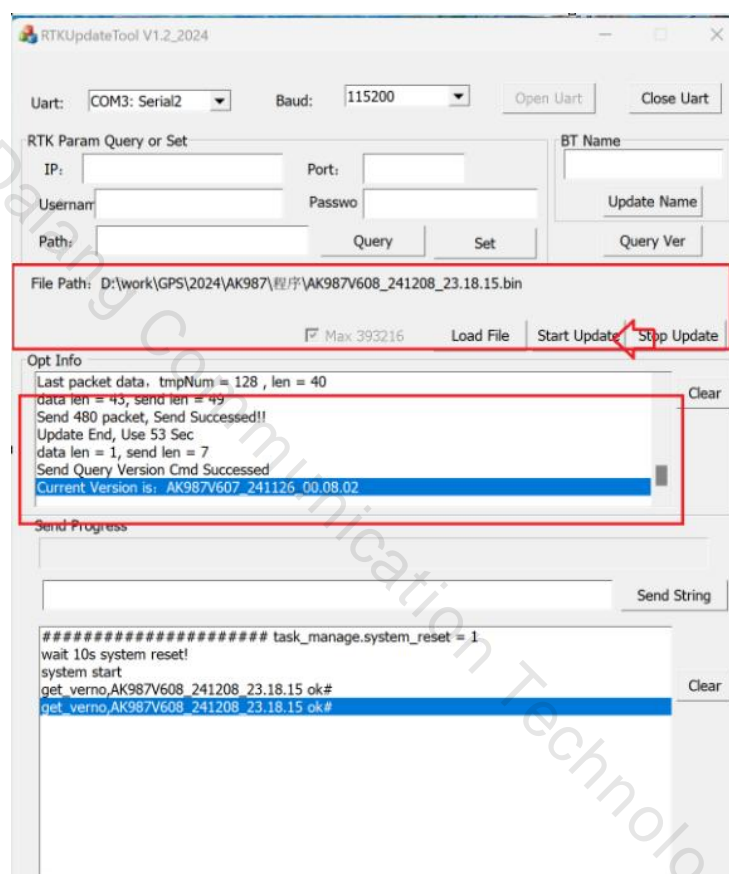
8.3 Change bluetooth name.

AK987/AK988 supports customers to modify the Bluetooth name by themselves. Just fill in the Bluetooth name you want to modify in the Bluetooth name window of the RTKUpdate Tool_1 .1CH.exe tool, and click Modify Name to complete the change. The bottom interface of the software returns set_to_bt, NAMEAK987, ok # (the underlined content is the changed Bluetooth name). It should be noted that the modification of the Bluetooth name must be carried out without a Bluetooth connection, that is, when you see the end point BT indicator flashing, the Bluetooth name must not exceed 16 characters.



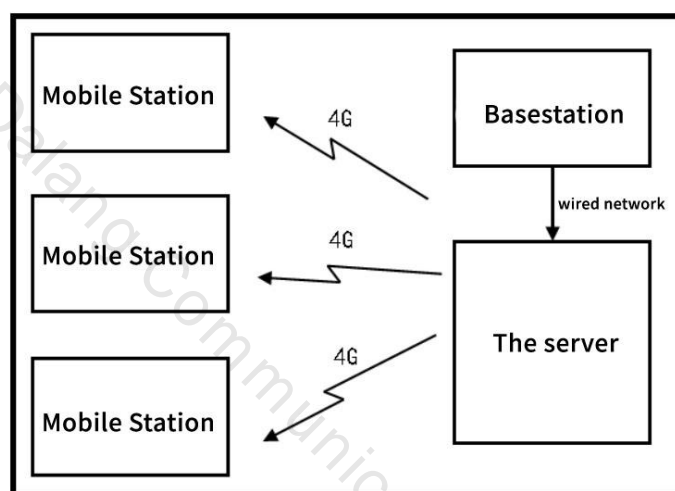
8.4 firmware upgrade

RTKUpdateTool_1 tool software can be AK987/AK988 product firmware upgrade, open the software to select a good serial port, baud rate 115200, click to open the serial port, click to load the file to select the firmware, and then click to start the upgrade, waiting for the progress bar to complete, and the sending window shows the upgrade is complete, the current version of the sending window is the version before the upgrade, see the receiving window shows system start that has been upgraded and end point restart, then click the query version button, the receiving window returns to the upgraded version.

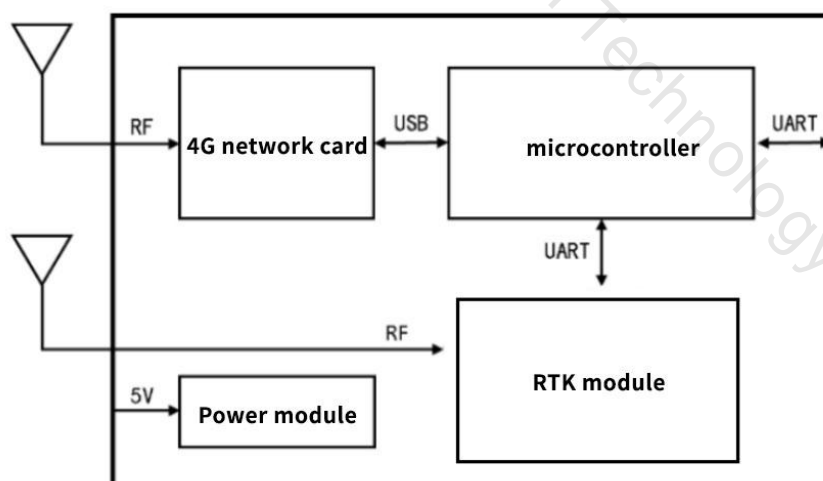


9 Typical applications

9.1 Common data transmission modules are difficult to provide reliable differential data connections, resulting in serious packet loss issues. For this purpose, the company provides a solution based on 4G network (as shown in the figure below). The benchmark station sends differential data to the server through a wired network and is cached by the server. Mobile stations access servers through 4G networks to obtain differential data. This solution can greatly expand the coverage area of base stations, and mobile stations equipped with 4G network cards can simultaneously transmit positioning results back to designated servers.



The circuit diagram of the mobile station is as follows:



In practical applications, the number of mobile stations that a server can access simultaneously is limited only by server performance and is more suitable for a large number of users. Requirements between the server and the base station: the server can be directly accessed from the public network (with a public IP address), and a network connection can be established between the base station and the server (either through the public network or local area network).

9.2 In high-precision positioning applications without reference stations, the module needs to cooperate with the 4G communication module to obtain differential data. We provide Qianxun with differential data sources nationwide, and users can obtain high-precision positioning results without deploying base stations. The circuit diagram is as follows:

