X8-M2 User Manual

USER GUIDE

Description

This document introduces the X8-M2, including basic information, operation, configuration and commands.

No.: UG155 Version: V1.01 Date: 2025.5.20

CONTENTS

1 Preface

1.1 Manual Overview

This manual primarily describes how to install, configure, and use the X8-M2 series products.

1.2 Technical Support and Service

If you have any questions and the product documentation does not provide the necessary information, please contact us: https://www.bynav.com/en/contact/contact-us. We are here to provide you with the best service.

1.3 Safety Information

Before using this product, please ensure that you have carefully read and understood this user guide and the safety requirements.

2 Brief Introduction

2.1 Brief Information

The X8-M2 is integrated with advanced Bynav navigation modules and offers 4G connectivity for seamless access to RTCM data. Users can effortlessly configure this device through bluetooth and internet connectivity. The device supports high-performance RTK solutions, and it is designed to thrive in challenging environments where satellite signals may be interfered or lost, the X8-M2 delivers continuous, real-time, and dependably accurate positioning and orientation information. Its versatility makes it ideal for a multitude of applications, including automated driving, advanced driver assistance systems, lane-level navigation, drones, intelligent robots, and numerous other fields.

2.2 Key Features

- Full constellations and full frequencies
- Centimeter level positioning based on GNSS RTK module
- Multiple interfaces
- It supports remote configuration and OTA upgrades
- IoT Management Platform

2.3 Specification

Table 2-1 Specification

Model	X8-M20	X8-M20D	X8-M21	X8-M21D	X8-M22
Function	GNSS Positioning	GNSS Positioning and Heading	GNSS+INS Positioning	GNSS+INS Positioning and Heading	GNSS+INS Positioning
Number of GNSS Antenna	1	2	1	2	1
Constellation	GPS, BDS, GLO, GAL, QZSS, NavIC, SBAS	GPS, BDS, GLO, GAL, QZSS	GPS, BDS, GLO, GAL, QZSS, NavIC, SBAS	GPS, BDS, GLO, GAL, QZSS	GPS, BDS, GLO, GAL, QZSS, NavIC, SBAS
Horizontal Accuracy (RMS)	Single Point: 1.5m; RTK: 1.0cm+1ppm				
Vertical Accuracy (RMS)	Single Point: 2.5m; RTK: 1.5cm+1ppm				
Heading Accuracy (RMS)	NA	0.2°/1m	NA	0.2°/1m	NA
DR Accuracy (RMS)	NA	NA	0.8% (2σ)	0.8% (2σ)	0.2% (2σ)
GNSS Observation	10 Hz	10 Hz	10 Hz	10 Hz	10 Hz
GNSS Positioning	10 Hz	10 Hz	5 Hz	5 Hz	5 Hz
Heading	NA	10 Hz	NA	5 Hz	NA
INS Positioning	NA	NA	100 Hz	100 Hz	100 Hz
INS Raw Data	NA	NA	100 Hz	100 Hz	100 Hz
Cold Start	30s				
Hot Start	5s				
Size	L x W x H: 128mm x 79mm x 38mm				
IP Level	IP65				

Note:

For more details, please refer to

https://bynav.com/en/products

https://www.bynav.com/en/resource/support

3 Interfaces

Figure 3-1 X8-M2 Interfaces (Ethernet Version)

Figure 3-2 X8-M2 Interfaces (Non-Ethernet Version)

Figure 3-3 SIM card slot and USB

Table 3-1 Interfaces description

NO.	Interfaces	Function	Remark
1	COM1	DC9~28V power input	Rated voltage: 12V
		RS232 serial port	For X8-M20/M21/M22/M20D/M21D
		PPS	Pulse Per Second
		CAN	Only for X8-M21/M22/M21D
2	4G	SMA	Built-in 4G antenna inside X8
3	GNSS1	SMA, positioning antenna	Suggested antenna gain: 28~40dB
4	GNSS2 (X8-M20D/M21D)	SMA, directional antenna	Suggested antenna gain: 28~40dB
5	COM2	Network cable	Wired connection
		RS232 serial port	Only for X8-M20/M21/M22/M20D
6	SIM	MICRO SIM Card slot	
7	USB	Type-C	

4 OLED Screen

Figure 4-1 OLED screen

Figure 4-1 OLED

Table 4-1 OLED description

Status	Description
Down Arrow	Rover mode，it will show when receiving differential data.
Up Arrow	Base mode, it will show when uploading differential data.
Bluetooth	It will show when bluetooth is connected.
Ethernet	It will show the icon when using the build-in network card; A dot in the middle will show after connecting with router.

5 Package List

Table 5-1 Package list

ITEM	Description	Picture
X8-M2	Main device	
Standard accessories		
RS232+Power cable+PPS+CAN	7-wire-lemo	
Optional accessories		
Adapter Note: Choose between the cigarette lighter cable and adapter	12V/1A	
Cigarette lighter cable Note: Choose between the cigarette lighter cable and adapter	12V-DC	
GNSS antenna extension cable	SMA-TNC connector, 3 meters	
GNSS antenna		
Network cable+RS232	7-wire-lemo	
Support base	M90SD	
4G antenna	External 4G antenna (default equipped with built-in antenna)	

6 APP

By Center APP runs on Android phones and connects devices via Bluetooth. It mainly includes four functions:

- Display current working status, including latitude and longitude, satellite number, accuracy, satellite status, etc.
- View and configure the current device, such as NTRIP IP, port, etc.
- Detect device status, such as 4G status, GNSS status, etc.
- Bluetooth firmware upgrade. (Under developing)

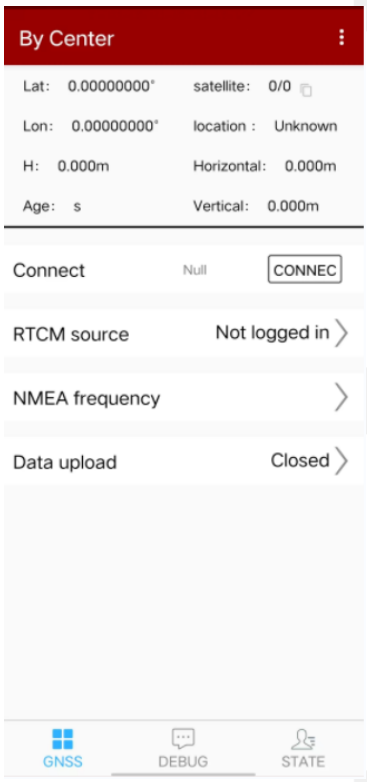

Figure 6-1 APP

6.1 Ntrip connection

To use the device as a rover, it needs to be configured with CORS to achieve high-precision positioning.

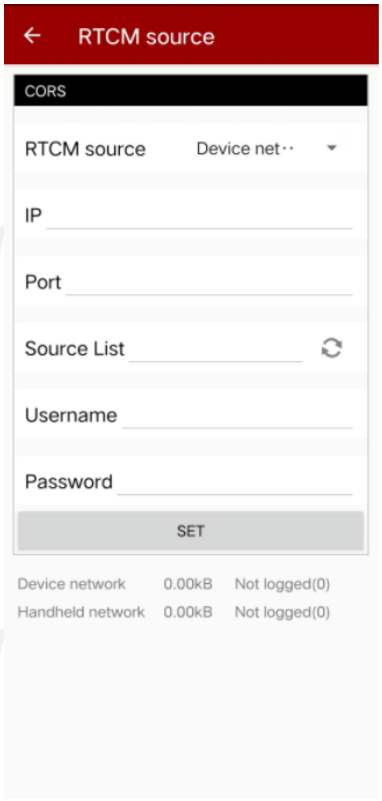

Figure 6-2 Ntrip connection

Note:

1. You can also configure by sending the following commands through serial port, Bluetooth, and USB.

AT+ROVER_PARM=SET,<Type>,<ip>,<port>,<sourceList>,<username>,<password>

<Type>: 0- Enable, 2-Disable

<sourceList>: This is mount point.

Example:

AT+ROVER_PARM=SET,0,sh.mijiatech.cn,2102,RTCM32,zd,zd

2. Explaination of options in RTCM source are as below.

Device network: This is to use X8 devices itself 4G network to access RTCM.

Device share: This is to use RTCM from another X8 device, which works as base station in RTK 1+1. More details can be found in the chapter about base station configuration.

Device close: This is to disable accessing RTCM.

Phone network: This is to use mobile phone's network to access RTCM via bluetooth.

6.2 NMEA Output Frequency Configuration

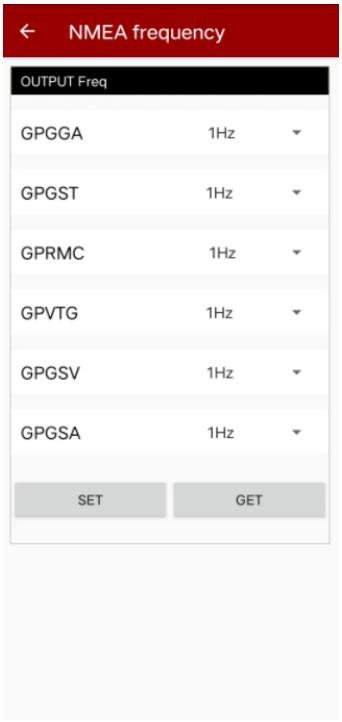

Figure 6-3 NMEA output frequency configuration

6.3 Data Upload

Figure 6-4 Data upload

6.4 Self-check

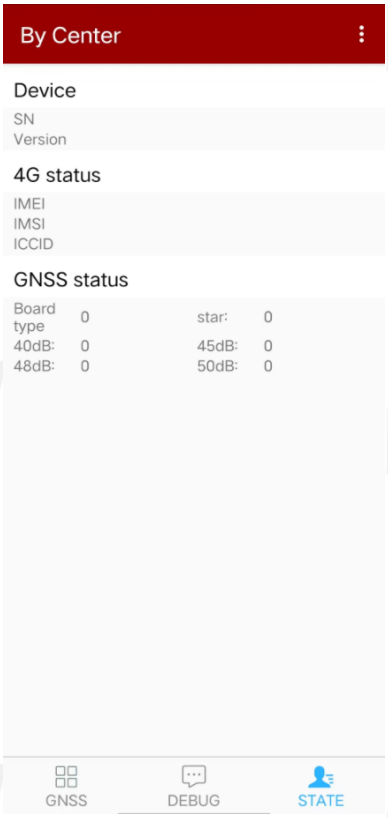

Figure 6-5 Self-check

6.5 Firmware Update

This device supports two upgrade methods:

- OTA firmware upgrade via 4G/Ethernet, continuous firmware iteration.
- OTA firmware upgrade via bluetooth, as shown in the following figure.

Note: This feature is under developing. Currently you can do firmware update by USB (Type-C). You can contact Bynav for the instruction.

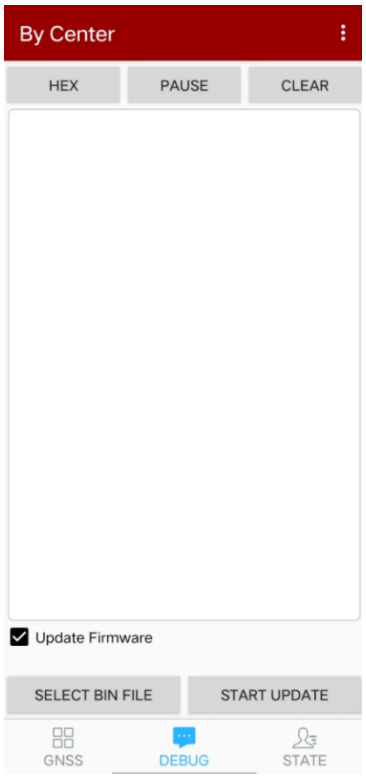

Figure 6-6 Firmware update via bluetooth

6.6 Mock Position

Mock Position can be enabled in Settings as below, and system mock position is "closed" by default.

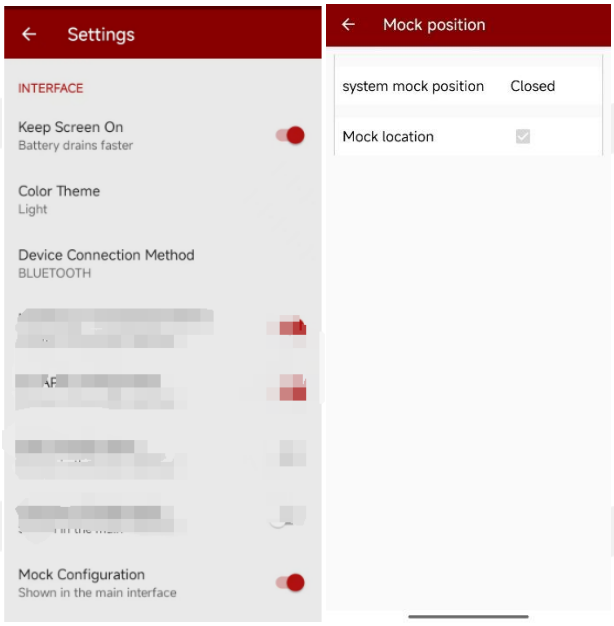

Figure 6-7

To open system mock position, please go to your phone settings and find developers options. And select By Center as the mock location app. Please make sure your phone allows By Center can work background.

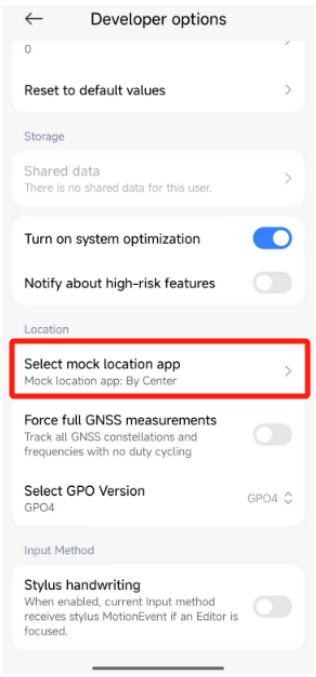

Figure 6-8

After above steps, you can see it will show “opened” as below. And please select Mock location.

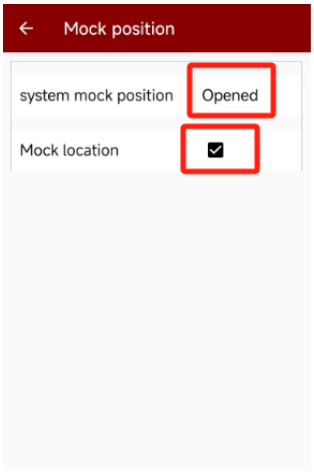

Figure 6-9

Note

Mock position feature requires X8 and the phone are connected by Bluetooth.

6.7 4G APN Configuration

Some 4G Sim Operators may have specific APN for access internet, this feature allows users to configure it manually.

Figure 6-10

6.8 Save NMEA Message

Please go to Settings-TRACKING, then configure the Local Exportation Folder path, and then enable "Save Tracks in TXT", then you can save the NMEA now.

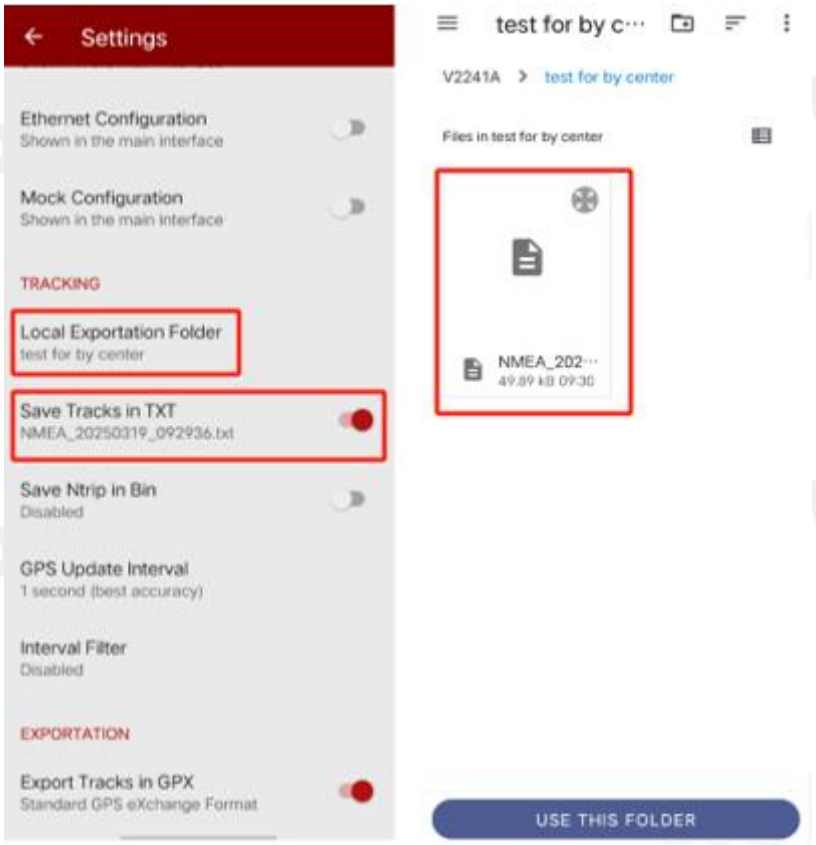
Settings
Ethernet Configuration
Shown in the main interface
Mock Configuration
Shown in the main interface
TRACKING
Local Exportation Folder
test for by center
Save Tracks in TXT
NMEA_20250319_092936.txt
Save Ntrip in Bin
Disabled
GPS Update Interval
1 second (best accuracy)
Interval Filter
Disabled
EXPORTATION
Export Tracks in GPX
Standard GPS eXchange Format
test for by c···
V2241A > test for by center
Files in test for by center
NMEA_202···
49.89 kB 09:30
USE THIS FOLDER

Figure 6-11

7 Interface Protocol

The data output from COM1 or USB has the following formats: NMEA-0183, JSON.

Bluetooth continuously output NEMA-0183, in order for the Android app to be able to process at any time.

7.1 Data Format 0: NMEA-0183

```
$GPGGA,103102.00,3108.4326314,N,12117.0380116,E,4,27,0.8,25.5789,M,10.424,M,1.0,0004*4F
$GNGSA,M,3,05,13,20,24,30,133,134,137,,,,,1.2,0.8,1.0*18
$GNGSA,M,3,141,143,147,148,153,154,156,164,165,168,173,178,1.2,0.8,1.0*27
$GNGSA,M,3,179,183,199,,,,,,,,,1.2,0.8,1.0*1E
$GNGSA,M,3,40,54,,,,,,,,,,1.2,0.8,1.0*2F
$GNGSA,M,3,75,79,,,,,,,,,,1.2,0.8,1.0*26
$GPGST,103102.00,0.33,0.00,0.00,-73.2748,0.0130,0.0130,0.0200*74
$GPGSV,3,1,09,133,54,163,46,20,41,071,46,134,75,068,43,137,53,169,40*43
$GPGSV,3,2,09,05,55,035,48,24,15,184,39,30,18,052,38,132,07,158,39*4C
$GPGSV,3,3,09,13,77,038,48,,,,,,,,,,,,*45
$BDGSV,5,1,18,141,47,139,46,179,49,184,50,143,54,201,51,178,66,022,49*62
$BDGSV,5,2,18,173,49,033,50,199,49,146,48,168,59,219,48,148,57,355,45*60
$BDGSV,5,3,18,146,35,189,40,183,15,166,41,153,51,334,48,149,21,195,39*6F
$BDGSV,5,4,18,154,26,053,41,156,41,185,47,147,11,203,39,164,16,084,44*6E
$BDGSV,5,5,18,165,16,140,44,166,01,042,37,,,,,,,,*63
$GLGSV,1,1,02,54,45,172,35,40,56,337,36,,,,,,,,*60
$GAGSV,1,1,02,75,82,312,46,79,34,041,43,,,,,,,,*6B
$GPRMC,103102.00,A,3108.4326314,N,12117.0380116,E,000.006,025.5,310523,0.0,W,D*27
$GPHPR,103102.00,180.00,0.00,0.00,0,2,0.00,0004*7D
$GPGGA,103103.00,3108.4326321,N,12117.0380116,E,4,27,0.8,25.5788,M,10.424,M,1.0,0004*49
$GPGST,103103.00,0.33,0.00,0.00,-73.2387,0.0130,0.0130,0.0200*72
$GPRMC,103103.00,A,3108.4326321,N,12117.0380116,E,000.004,345.5,310523,0.0,W,D*27
$GPHPR,103103.00,180.00,0.00,0.00,0,2,0.00,0004*7C
```

Figure 7-1 Example

7.1.1 GGA

Table 7-1 GGA

Information	GGA
Description	Data related to time, location, and positioning
Format	$--GGA,UTCtime,Lat,uLat,Lon,uLon,FS,numSv,HDOP,Msl,uMsl,Sep,uSep, DiffAge,DiffSta*CS<CR><LF>
Example	$GPGGA,024720.00,3120.497614,N,12129.853826,E,1,28,0.5,80.256,M,0.0,M,0.2,*47

Table 7-2 GGA Parameter Description

Field	Name	Format	Description
1	$--GGA	character string	Message ID, GGA statement header, '--' is the system identifier
2	UTCtime	hhmmss.sss	The UTC time of the current location
3	Lat	ddmm.mmmm	Latitude, the first 2 characters represent degrees, and the following characters represent minutes
4	uLat	character	Latitude direction: N-North, S-South
5	Lon	ddmm.mmmm	Longitude, the first 3 characters represent degrees, and the following characters represent minutes
6	uLon	character	Longitude direction: E-East, W-West
7	FS	number	Indicates the current positioning quality (Note [1]), this field should not be empty
8	numSv	number	Number of satellites used for positioning
9	HDOP	number	Horizontal Precision Factor (HDOP)
10	Msl	number	Altitude, which refers to the height of the receiver antenna relative to the geoid
11	uMsl	character	Height unit, meters, fixed character M
12	Sep	number	The distance between the reference ellipsoid and the geoid, where "-" indicates that the geoid is lower than the reference ellipsoid
13	uSep	character	Height unit, meters, fixed character M
14	DiffAge	number	Differential correction data age, this field is empty when DGPS is not used
15	DiffSta	number	The ID of the differential base station
16	CS	number (Hex)	Checksum, XOR result of all characters between $and * (excluding $and *)
17	<CR><LF>	character	Carriage return and line feed

Table 7-3 Note [1] Positioning Quality Mark

Positioning Quality Mark	Description
0	Location unavailable or invalid
1	SPP
2	RTD
3	PPS
4	RTK fixed
5	RTK float

6	Estimation mode (dead reckoning)
7	Manual mode positioning
8	Simulation mode positioning

7.1.2 GSA

Table 7-4 GSA

Information	GSA
Description	The satellite number and DOP information used for positioning. Output GSA statements regardless of positioning or availability of satellites; When the receiver is in a joint operation of multiple systems, each available satellite in the system corresponds to a GSA statement, and each GSA statement contains PDOP, HDOP, and VDOP obtained from the combined satellite system.
Type	Output
Format	$--GSA,Smode,FS{,SVID},PDOP,HDOP,VDOP*CS<CR><LF>
Example	$GPGSA,A,3,523,510,10,524,525,23,32,12,20,532,,,0.9,0.5,0.7*0C $BDGSA,A,3,164,166,161,664,666,156,154,146,661,143,149,,0.9,0.5,0.7*14 $GAGSA,A,3,621,321,,,,,,,,,,0.9,0.5,0.7*2D $QZGSA,A,3,213,214,219,193,194,,,,,,,0.9,0.5,0.7*1F

Table 7-5 GSA Parameter Description

Field	Name	Format	Description
1	$--GSA	character string	Message ID, GSA statement header, '--' is the system identifier
2	Smode	character	Mode switching mode indication (note [1])
3	FS	number	Positioning status flag (note [2])
4	{,SVID}	number	The satellite number used for positioning, which displays a total of 12 available satellite numbers. If there are more than 12, only the first 12 will be output, and if there are less than 12, the insufficient area will be filled in; This statement extends multi frequency satellite information.
5	PDOP	number	Position Precision Factor (PDOP)
6	HDOP	number	Horizontal Precision Factor (HDOP)
7	VDOP	number	Vertical Precision Factor (VDOP)

8	systemId	number	GNSS system ID number defined by NMEA (note [3])
9	CS	number (Hex)	Checksum, XOR result of all characters between $and * (excluding $and *)
10	<CR><LF>	character	Carriage return and line feed

Table 7-6 Note [1] Data Validity Flag

Mode switching indication	Description
M	Manual switching. Force to 2D or 3D working mode
A	Automatic switching. Receiver automatically switches to 2D/3D working mode

Table 7-7 Note [2] Data Validity Flag

Positioning status	Description
1	Invalid position
2	2D position
3	3D position

Table 7-8 Note [3] Data Validity Flag

System ID	Description
1	GPS
2	GLONASS
4	BDS

7.1.3 GSV

Table 7-9 GSV

Information	GSV
Description	The satellite number of the visible satellite and its elevation, azimuth, carrier to noise ratio, and other information. The number of parameter groups for {satellite number, elevation, azimuth, carrier to noise ratio} in each GSV statement can vary, with a maximum of 4 groups and a minimum of 0 group.
Type	Output
Format	$--GSV,NumMsg,MsgNo,NumSv{,SVID,ele,az,cn0} *CS<CR><LF>
Example	$GPGSV,3,1,10,510,70,307,48,523,72,161,48,10,70,307,46,525,40,153,45*4A $GPGSV,3,2,10,524,33,44,44,23,72,161,43,32,35,305,43,532,35,305,43*4A $GPGSV,3,3,10,12,44,97,43,20,65,174,43*46 $BDGSV,4,1,13,164,58,211,47,664,58,211,46,166,67,49,46,666,67,49,46*6E $BDGSV,4,2,13,154,58,329,45,161,35,120,44,141,45,140,44,156,61,344,44*6D $BDGSV,4,3,13,173,31,317,44,143,51,200,43,146,63,353,43,673,31,317,43*6E $BDGSV,4,4,13,661,35,120,42*68 $GAGSV,1,1,3,621,62,124,46,321,62,124,44,619,62,354,42*52 $QZGSV,1,1,4,213,67,107,46,214,63,127,46,219,53,169,46,194,63,127,42*5B

Table 7-10 GSV Parameter Description

Field	Name	Format	Description
1	$--GSV	character string	Message ID, GSV statement header, '--' is the system identifier
2	NumMsg	character	The total number of messages. Each GSV message can output up to 4 visible satellite information, therefore, when the system has more than 4 visible satellites, multiple GSV statements will be required.
3	MsgNo	number	Current message number
4	NumSv	number	Total number of visible satellites

5	{,SVID,ele,az,cn0}	number	Sequentially: Satellite number Elevation angle, value range 0-90, in degrees Azimuth angle, value range 0-359, in degrees Carrier to noise ratio, value range 0-99, unit db hz, if no satellite is tracked, fill in space. This statement extends multi frequency satellite information.
6	signalId	number	GNSS signal ID defined by NMEA
7	CS	number (Hex)	Checksum, XOR result of all characters between $and * (excluding $and *)
8	<CR><LF>	character	Carriage return and line feed
8	<CR><LF>	character	Carriage return and line feed

7.1.4 RMC

Table 7-11 RMC

Information	RMC
Description	Recommended minimum positioning information
Type	Output
Format	$--GPRMC,UTCtime,status,Lat,uLat,Lon,uLon,Spd,Cog,Date,mv,mvE,mode*CS<CR><LF>
Example	$GPRMC,034823.00,A,3120.498047,N,12129.853154,E,0.0,290.6,160920,,,A*50

Table 7-12 RMC Parameter Description

Field	Name	Format	Description
1	$--RMC	character string	Message ID, RMC statement header, '--' is the system identifier
2	UTCtime	hhmmss.sss	The UTC time of the current location
3	Status	character string	Position valid flag. V=Invalid data A=Valid data

4	Lat	ddmm.mmmm	Latitude, the first 2 characters represent degrees, and the following characters represent minutes
5	uLat	character	Latitude direction: N-North, S-South
6	Lon	ddmm.mmmm	Longitude, the first 3 characters represent degrees, and the following characters represent minutes
7	uLon	character	Longitude direction: E-East, W-West
8	Spd	number	Ground speed in knot (kn)
9	Cog	number	True heading to ground in degree
10	Date	ddmmyy	Date (dd is day, mm is month, yy is year)
11	mv	number	Magnetic declination, measured in degrees. Fixed as empty.
12	mvE	character	Magnetic declination direction: E-east, W-west. Fixed as empty
13	mode	character	Positioning mode flag (note [1])
14	navStatus	character	Navigation status identifier (V indicates that the system does not output navigation status information)
15	CS	number (Hex)	Checksum, XOR result of all characters between $and * (excluding $and *)
16	<CR><LF>	character	Carriage return and line feed

Table 7-13 Note [1] Data Validity Flag

Positioning mode flag	Description
A	Autonomous Mode
E	Estimation mode (dead reckoning)
N	Invalid data
D	RTK mode

7.1.5 VTG

Table 7-14 VTG

Information	VTG
Description	Ground speed and ground heading information
Type	Output
Format	$--VTG,Cogt,T,Cogm,M,Sog,N,kph,K,mode*CS<CR><LF>
Example	$GPVTG,290.6,T,,M,000.0,N,0000.0,K,A*30

Table 7-15 VTG Parameter Description

Field	Name	Format	Description
1	$--VTG	character string	Message ID, VTG statement header, '--' is the system identifier
2	Cogt	number	True North heading to ground, in degrees
3	T	character	True North indication, fixed to T
4	Cogm	number	Geomagnetic heading north, in degrees
5	M	character	Magnetic north indication, fixed to M
6	Sog	number	Ground speed in knot(kn)
7	N	character	Speed unit knot, fixed as N
8	kph	character	Speed unit, kilometers per hour, fixed in K
9	mode	character	Positioning mode flag (note [1])
10	CS	number (Hex)	Checksum, XOR result of all characters between $and * (excluding $and *)
11	<CR><LF>	character	Carriage return and line feed

Table 7-16 Note [1] Data Validity Flag

Positioning mode flag	Description
A	Autonomous Mode
E	Estimation mode (dead reckoning)
N	Invalid data
D	RTK mode

7.2 Data Format 1: JSON

This message provides information such as location, time, angle, IMU, etc. For example:

{"deviceId":"X8-M2-22C019","direction":"107.33","gpsTime":1685505028250,"lat":"31.140543840","lon":"121.283966853","alt":"25.580","high":"36.004","hrms":"0.018","speed":"0.07200","heading":"180.00","pitch":"0.00","roll":"0.00","stat":"4","star":"26","xRate":"0.000","yRate":"0.000","zRate":"0.001","xAcc":"-0.163","yAcc":"9.995","zAcc":"-0.631"}

Table 7-17 JSON message structure

ID	Field	Description	Remark
1	deviceId	Device SN	
2	direction	Heading (degrees, 0-360)	
3	gpsTime	Unix time (milliseconds)	
4	lat	Latitude (degrees, south latitude is negative, north latitude is positive)	
5	lon	Longitude (degrees, east longitude is positive, west longitude is negative)	
6	alt	Altitude (in meters, three decimal places)	
7	high	Geodetic height (in meters, three decimal places)	
8	hrms	Positioning accuracy (in meters, three decimal places)	
9	speed	Speed (km/h)	
10	heading	Dual antenna solution for heading angle, 0-360	
11	pitch	Dual antenna solution for elevation angle, -90 to 90 °	
12	roll	reserved	
13	stat	Positioning status 0 initialization, 1 single point positioning, 2 code differentiation, 3 invalid PPS, 4 fixed solutions, 5 floating point solutions, 6 estimation in progress, 7 manual input of fixed values, 8 simulation mode, 9 WAAS differentiation	Commonly used: 0, 1, 2, 4, 5
14	star	Number of satellites	This parameter can be used to determine whether the antenna is properly connected and the environment for searching for stars.

15	xRate	X-axis rotation rate (rad/s)	
16	yRate	Y-axis rotation rate (rad/s)	
17	zRate	Z-axis rotation rate (rad/s)	
18	xAcc	X-axis acceleration (m/s2)	
19	yAcc	Y-axis acceleration (m/s2)	
20	zAcc	Z-axis acceleration (m/s2)	

8 Base Station Configuration

8.1 Hardware Connection

Connect three cables as follows:

- Power cable: 12V adapter
- GNSS1 antenna: disc antenna or choke antenna
- GNSS2 antenna: X8-M20D need connection, X8-M20/X8-M21 no need connection
- Network cable: connect to the router

Figure 8-1 Hardware connection

8.2 Configuration

Recommended steps for configuring Base are as below

1. Power on, and set it as Rover
2. Access Ntrip to get fix position, and note down the latitude, longtitude, and altitude
3. Set it as a Base

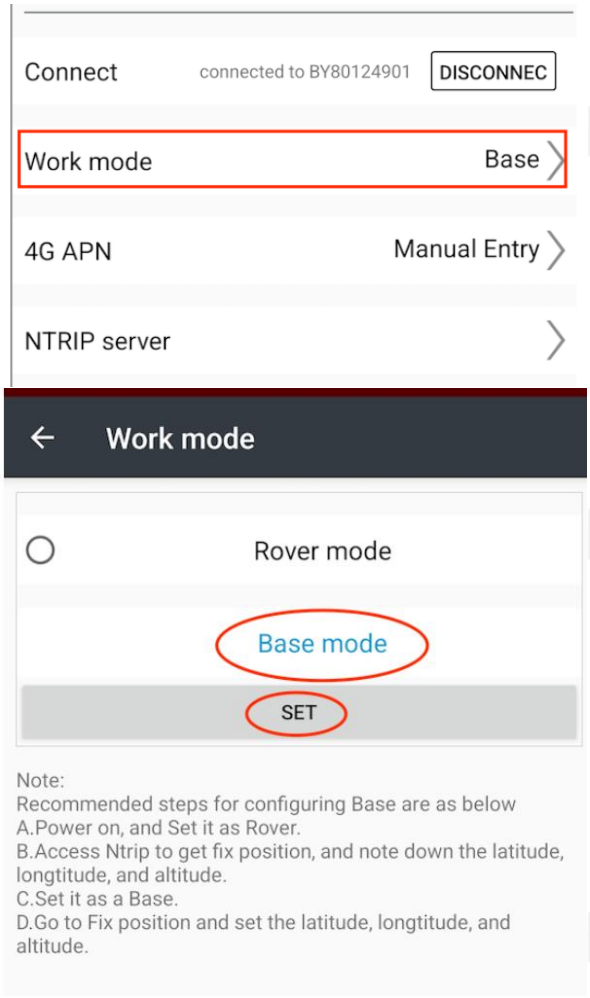

Figure 8-2

4. Go to "Fix position" and set the latitude, longtitude, and altitude

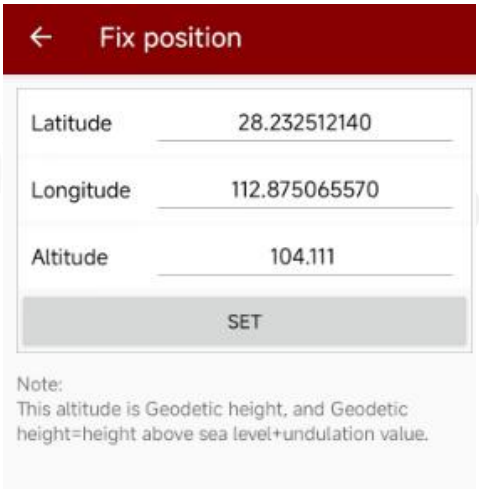

Figure 8-3

Note: For RTK 1+1, it is to use one X8 as the base, and another X8 as the rover. At the base side, please configure like below.

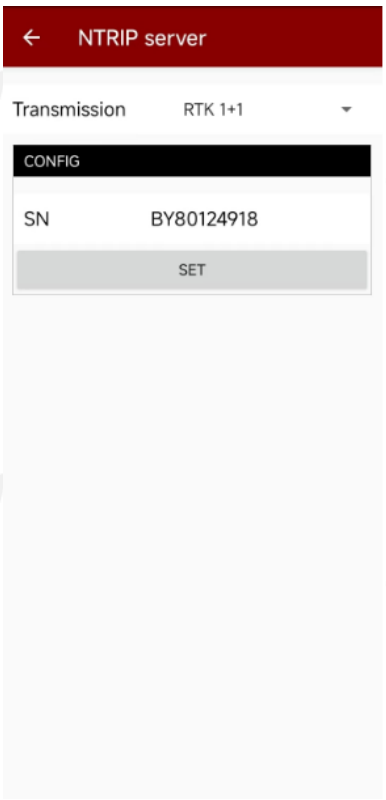

Figure 8-4

For RTK 1+1, at the **rover** side (another X8), please configure like below to access RTCM.

RTCM source: Device share

IP: iot.mijiatech.cn

Port:2101

Source List: choose the SN you configured for the base.

Username: zd

Password: zd

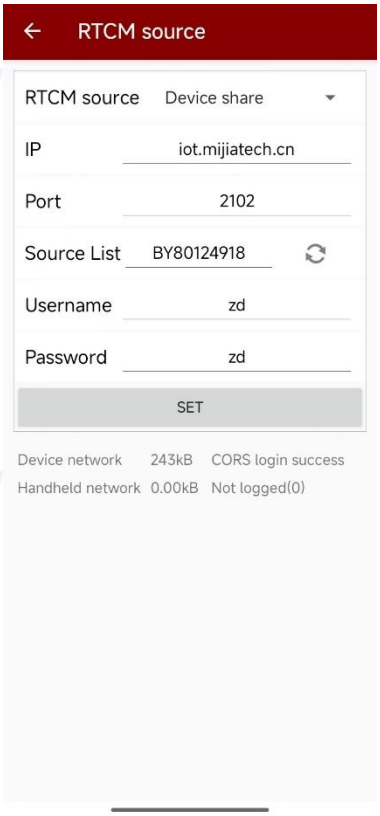
RTCM source
RTCM source
Device share
IP
iot.mijiatech.cn
Port
2102
Source List
BY80124918
Username
zd
Password
zd
SET
Device network 243kB CORS login success
Handheld network 0.00kB Not logged(0)

Figure 8-5

9 Installation

9.1 Device

Figure 9-9-1 Micro Sim

*Micro SIM card, China-mobile, China-telecom, and China Unicom can be used. If you want to use Nano SIM, you need to add a Micro Sim card holder.

9.2 Vehicle

The GNSS antennas are fixed onto two strong magnetic suction cups and fixed in the forward and backward directions of the vehicle. It should be placed at the highest position of the vehicle as much as possible to ensure that a good GNSS signal can be received. At the same time, it should be ensured that the line formed by the phase center of the two GNSS antennas is consistent or parallel to the direction of the central axis of the vehicle, as shown in the following figure.

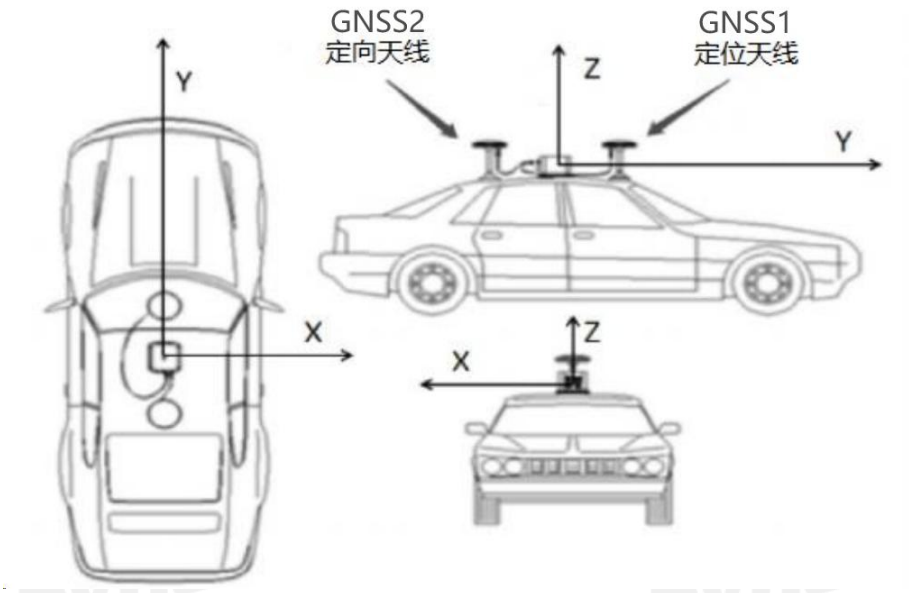

Figure 9-2 GNSS antennas installation

Figure 9-3 X8-M2 installation

Note:

If there is a shielding function inside the vehicle, the 4G antenna should be installed on the roof and kept at a distance of more than 50cm from the GNSS antenna, with a height not higher than the GNSS antenna;

If directional function is required, in order for the product to achieve high-quality performance, it is necessary to maintain a phase center distance of at least 50cm between GNSS1 and GNSS2.

10 Commands (COM1/USB Type-C/Bluetooth)

After configuring all the following commands, return OK and they will be automatically saved. The configuration command can be inputted from Bluetooth, COM1, or USB, and Carriage Return and Line Feed (\r\n) need to be added at the end of the command.

10.1 Configure Data Format

Command	Remark
AT+ODM_DAT_OUT=SET,0	NEMA0183
AT+ODM_DAT_OUT=SET,1	JSON format，refer to 7.2

10.2 Configure the Frequency of GPGGA Output

Command	Remark
AT+NEMATIME=SET,GGA,0	GPGGA output 1Hz
AT+NEMATIME=SET,GGA,1	GPGGA output 2Hz
AT+NEMATIME=SET,GGA,2	GPGGA output 5Hz
AT+NEMATIME=SET,GGA,3	GPGGA output 10Hz

10.3 Configure the Frequency of GPVTG Output

Command	Remark
AT+NEMATIME=SET,VTG,0	GPVTG output 1Hz
AT+NEMATIME=SET,VTG,1	GPVTG output 2Hz
AT+NEMATIME=SET,VTG,2	GPVTG output 5Hz
AT+NEMATIME=SET,VTG,3	GPVTG output 10Hz

10.4 Configure HEADINGA Correction Angle

Command	Remark
AT+HEADING_OFFSET=SET,180	Correct 180 ° (positioning antenna at the front of the vehicle)
AT+HEADING_OFFSET=SET,0	Correct 0 ° (positioning antenna at the rear of the vehicle)

10.5 Configure the Frequency of HEADINGA Output

Command	Remark
AT+NEMATIME=SET,HDG,0	HEADINGA output 1Hz
AT+NEMATIME=SET,HDG,1	HEADINGA output 2Hz
AT+NEMATIME=SET,HDG,2	HEADINGA output 5Hz
AT+NEMATIME=SET,HDG,3	HEADINGA output 10Hz
AT+NEMATIME=SET,HDG,5	HEADINGA off

HEADING message strructre

ID	Field	Description	Format	Byte	Byte offset
1	HEADING Header	Message header		H	0
2	Sol stat	Solution status	Enum	4	H
3	Pos type	Position type	Enum	4	H+4
4	Length	Baseline length(0-3000m)	Float	4	H+8
5	Heading	Azimuth(0-360°)	Float	4	H+12
6	Pitch	Pitch （±90°）	Float	4	H+16
7	Reserved		Float	4	H+20
8	Hdg std dev	Azimuth standard deviation (°)	Float	4	H+24
9	Pitch std	Pitch standard deviation (°)	Float	4	H+28
10	Stn ID	Base Station ID	Char (4)	4	H+32
11	#SVs	Number of Tracking Satellites	Uchar	1	H+36
12	#solnSVs	Number of Solution Satellites	Uchar	1	H+37
13	#obs	Number of satellites above the altitude cutoff angle	Uchar	1	H+38
14	#multi	Number of satellites with L2 observations above the cutoff angle	Uchar	1	H+39
15	Reserved		Uchar	1	H+40
16	Ext sol stat	Extended solution status (default:0)	Uchar	1	H+41
17	Reserved		Uchar	1	H+42

18	Sig mask	Signal mask (0- Signal not involved in solving)	Uchar	1	H+43
19	xxxx	32-bit CRC checksum (ASCII and binary only)	Hex	4	H+44
20	[CR][LF]	Statement terminator (ASCII only)	-	-	-

10.6 Configure Language (Chinese/English) on LED Screen

Command	Remark
AT+LANGUAGE=SET,0	Chinese
AT+LANGUAGE=SET,1	English

10.7 Check SN

Command	Remark
AT+DEVICESN=GET	Check SN

11 Data Upload Configuration (Based on 4G Network)

11.1 TCP Protocol

1. Configure TCP data transmission at 1Hz.

AT+UPLOADDATA_TYPE=SET,0

AT+UPLOADDATA_PARM=SET,1,192.168.0.1,2201

2. Configure TCP data transmission at 0.5Hz.

AT+UPLOADDATA_TYPE=SET,0

AT+UPLOADDATA_PARM=SET,2,192.168.0.1,2201

3. Configure TCP data transmission at 0.2Hz.

AT+UPLOADDATA_TYPE=SET,0

AT+UPLOADDATA_PARM=SET,5,192.168.0.1,2201

4. Configure TCP data transmission at 0.1Hz.

AT+UPLOADDATA_TYPE=SET,0

AT+UPLOADDATA_PARM=SET,10,192.168.0.1,2201

5. Configure TCP data transmission at 5Hz.

AT+UPLOADDATA_TYPE=SET,0

AT+UPLOADDATA_PARM=SET,255,192.168.0.1,2201

AT+NEMATIME=SET,GGA,2

6. Configure TCP data transmission at 10Hz.

AT+UPLOADDATA_TYPE=SET,0

AT+UPLOADDATA_PARM=SET,255,192.168.0.1,2201

AT+NEMATIME=SET,GGA,3

7. Configure TCP data transmission at 10Hz.

AT+UPLOADDATA_TYPE=SET,0

AT+UPLOADDATA_PARM=SET,255,192.168.0.1,2201

AT+NEMATIME=SET,GGA,3

Note:

The 255 in the command " AT+UPLOADDATA_PARM=SET,255,192.168.0.1,2201" indicates that the data transmission frequency follows the output frequency of GGA.

The example is as follows:

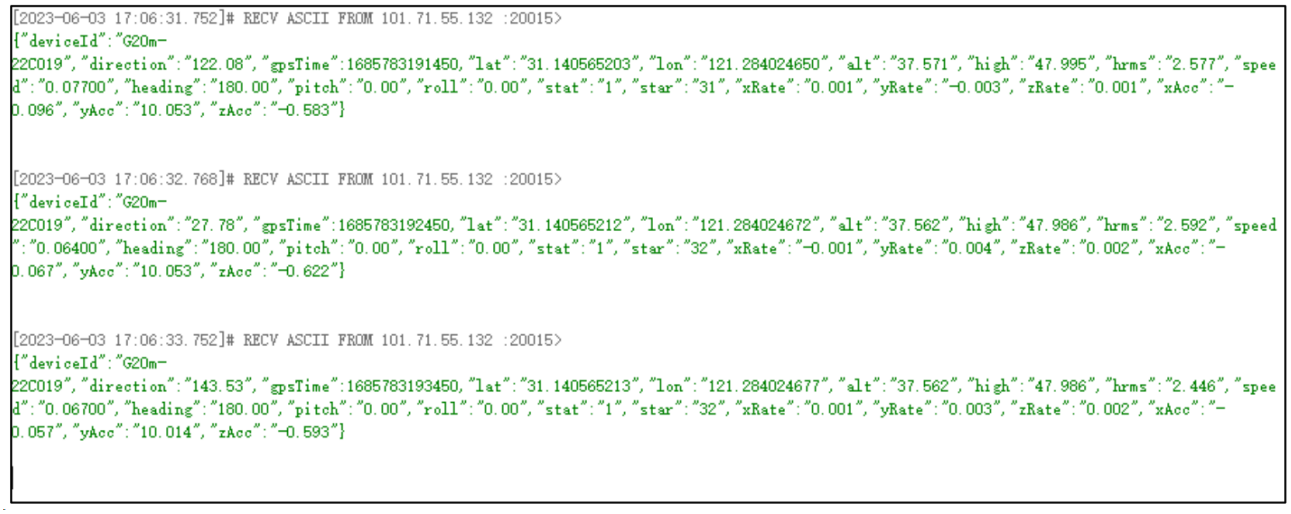

Figure 11-1 Example

12 IoT Management Platform

The IoT management platform can remotely configure and view device parameters, as well as position viewing.

- **Data transmission**: TCP
- **GNSS configuration**: output frequency configuration, working mode configuration, output format configuration.
- **CORS**: Account Configuration.
- **Device name**
- **Status check**: satellite search status, trajectory, number of restarts, 4G signal, GNSS signal, SIM information, etc.
- **Iot Management Platform Address:** http://pos.bynav.com:8080/login

Note: Please contact Bynav for user account creation.

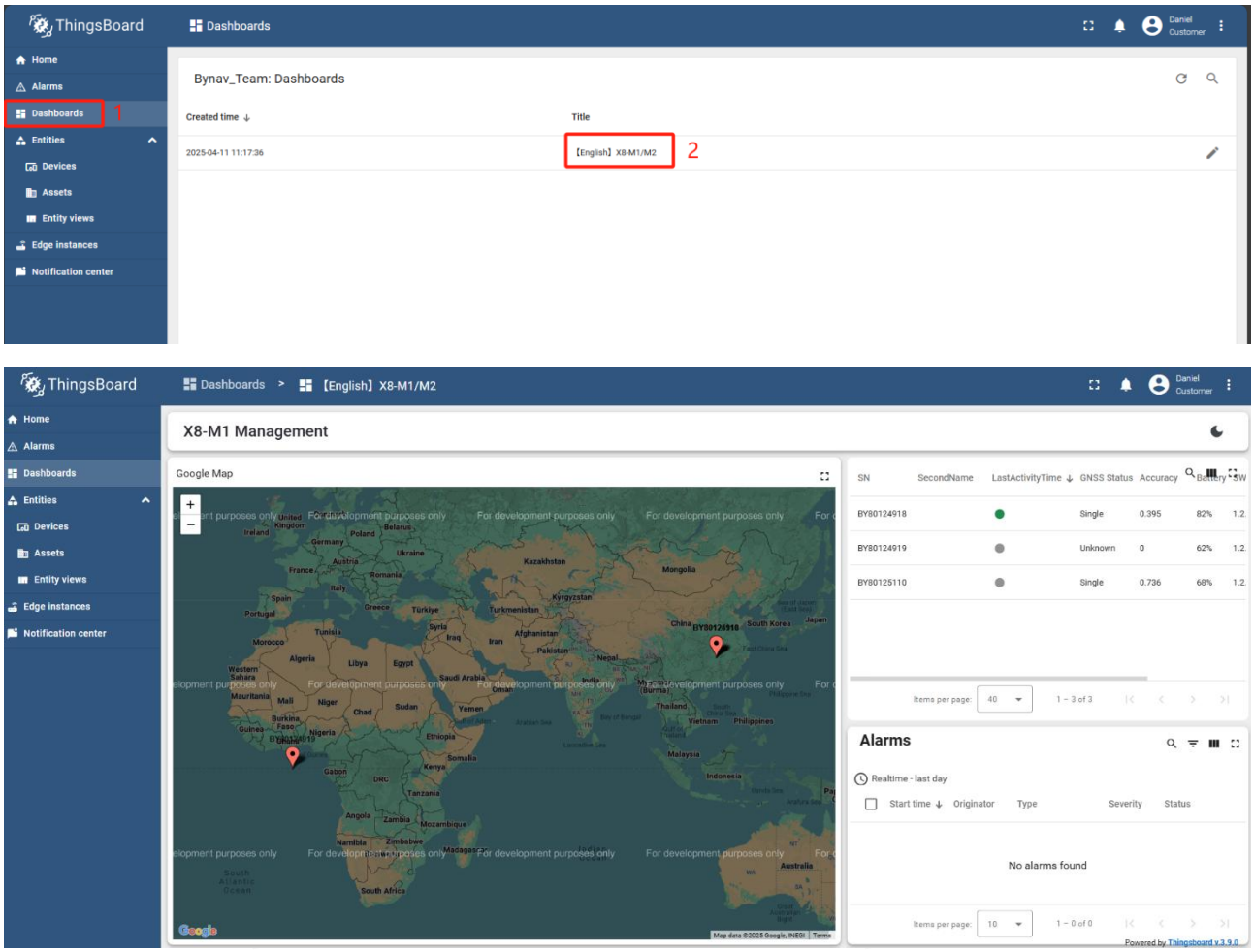

Figure 12-1 The IoT management platform

12.1 Device Status Check

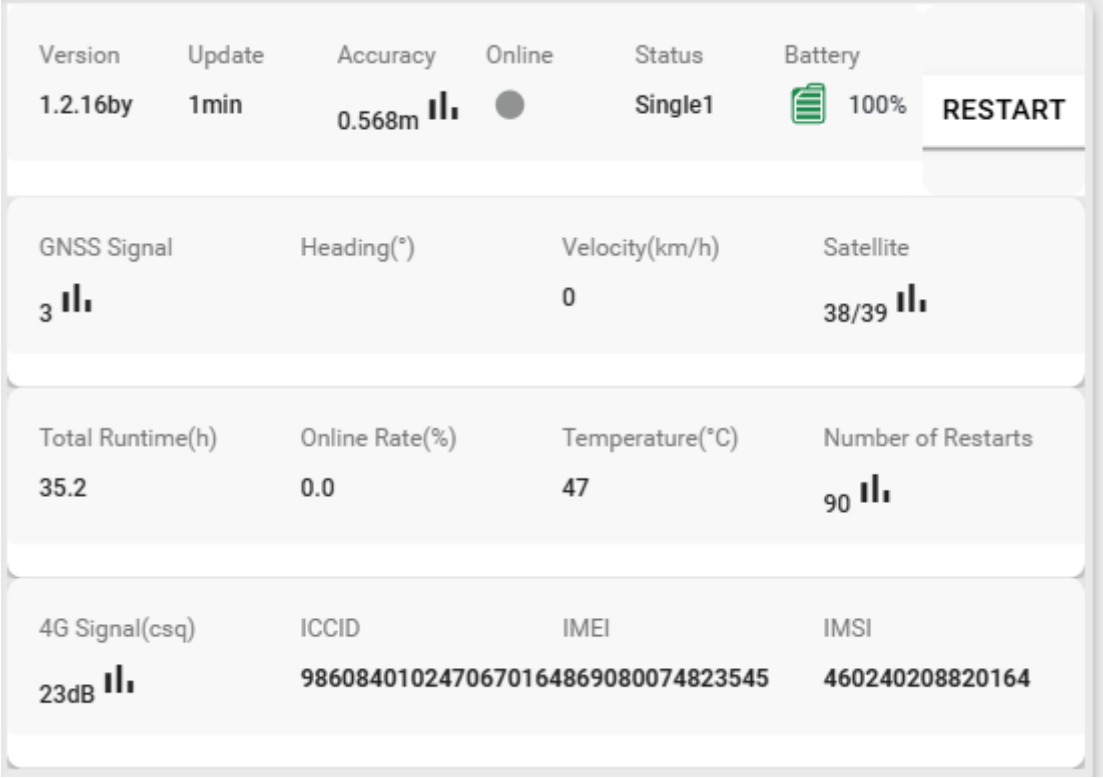

Figure 12-2 Device Status

- **Version**: Current version number for X8
- **Update**: The frequency at which the device uploads data to the cloud platform, and it can be set by clicking.
- **Accuracy:** The planar accuracy of the current device.
- **Status**: Satellite status+number, the number is obtained from GPGGA
- **Battery level**: Devices without batteries display 100%.
- **GNSS signal**: Counting the number of satellites with a signal-to-noise ratio greater than 40dB, generally greater than 35 indicates an open environment.
- **Number of Restarts**: Count the total number of restarts since the device was used, which can be used to check if there are any abnormal restarts during the device's use. You can click to view the history data.
- **4G signal**: obtained from CSQ, maximum value 31.
- **ICCID, IMSI**: Used during SIM recharge balance.
- **Restart button**: Click to immediately restart the device.

12.2 Position viewing

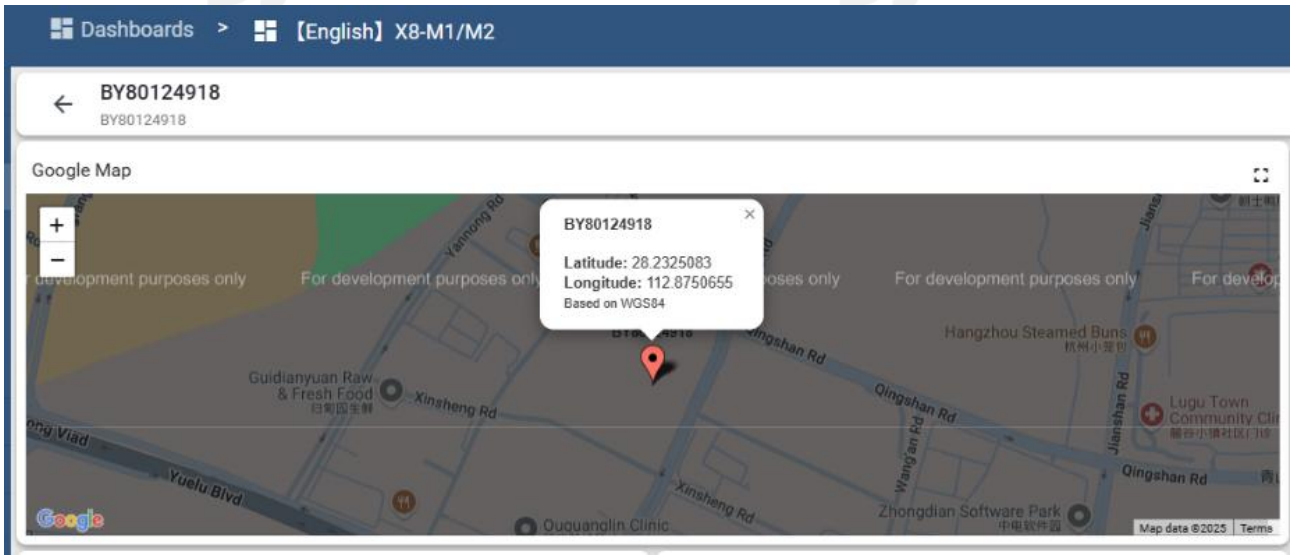

Figure 12-3 Position

12.3 GNSS Configuration

12.3.1 Working Mode Configuration

The displayed working mode is the current one. If you want to modify the working mode, follow steps as shown below:

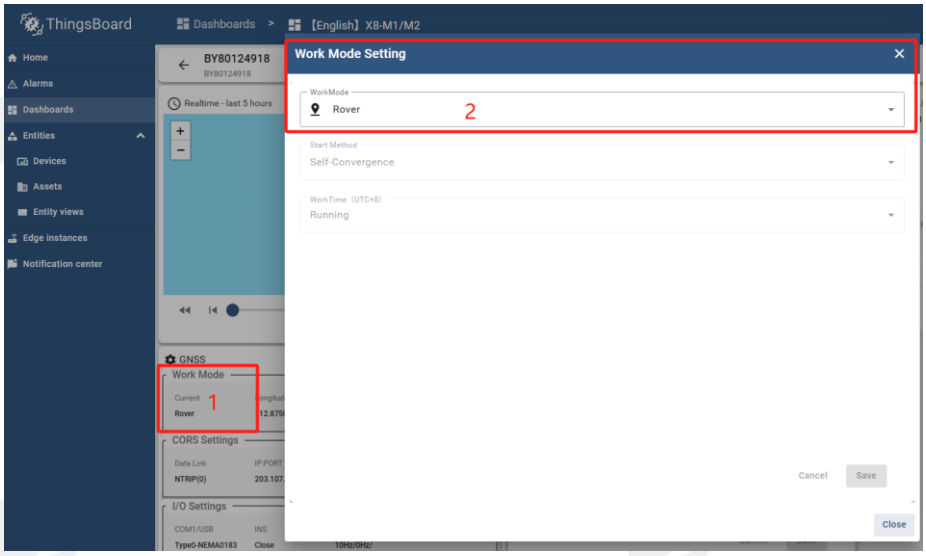

Figure 12-4 Working mode configuration

- Working mode: rover, base
- Note: If you want to configure it to Base, please use By Center APP to configure.

12.3.2 CORS Configuration

The displayed content is the current CORS settings. If you want to modify it, please follow steps as shown below:

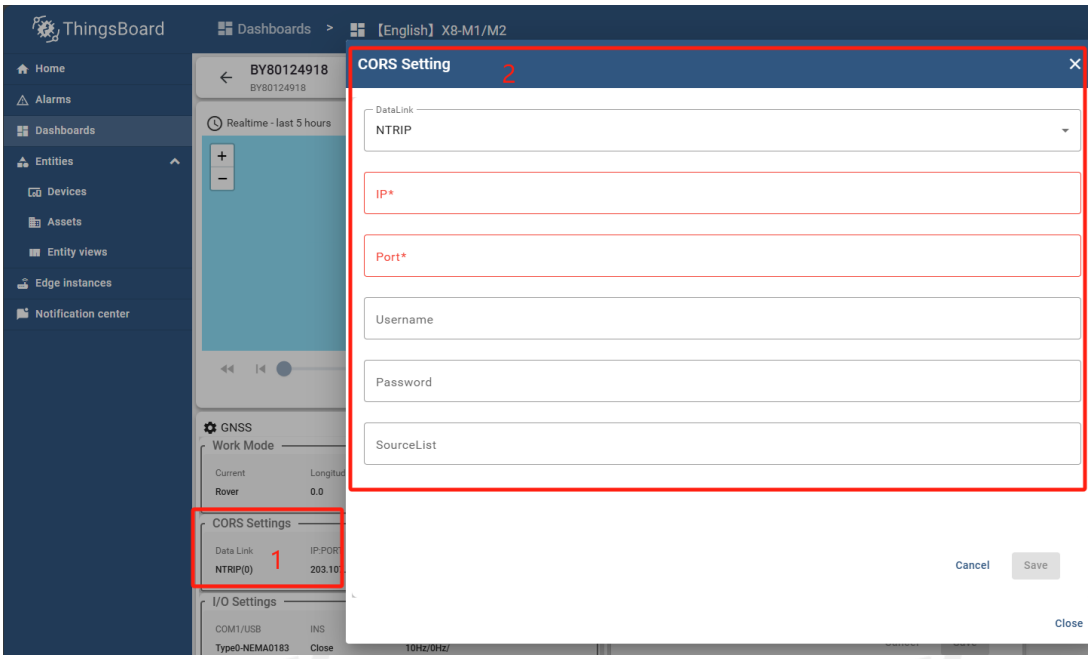

Figure 12-5 CORS configuration

1. Data link: close, NTRIP

2. Port number, username, password, source list (MountPoint) will not be introduced again, as their names suggest its meaning already.

12.4 Data Transmission Configuration

The displayed settings are for the current data transmission, as shown in the following figure.

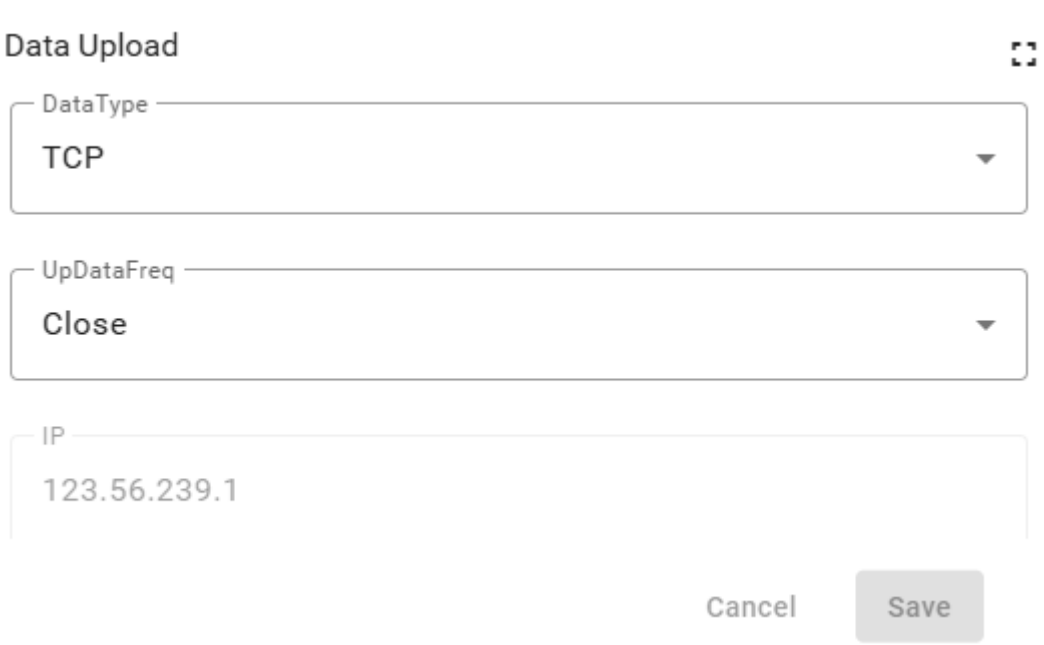

Figure 12-6 Data transmission configuration

- **Data Type**: support TCP/HTTP/MQTT/JT808
- **Transmission frequency**: including off, once every 1 second, once every 2 seconds, once every 5 seconds, once every 10 seconds, and following the output frequency of GGA.

Note:

Following the output frequency of GGA, it can reach 10Hz. At this time, it is necessary to first set the output frequency of GPGGA to 10Hz.

13 NMEA Messages to Windows PC with Bluetooth

If the Windows PC has Bluetooth function, you can firstly connect the device via Bluetooth, the name usually is the SN of that device.

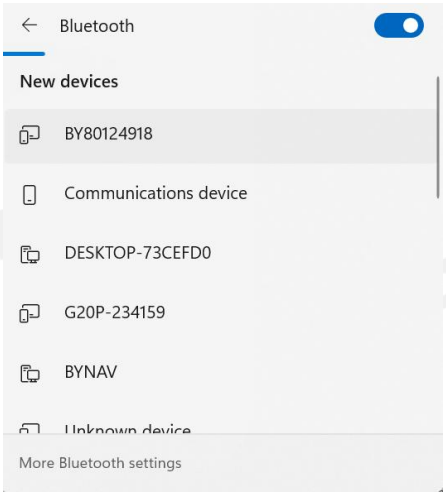

Figure 13-1

After connection by Bluetooth, then you can check whether there are COM ports showing in Device Manager like below.

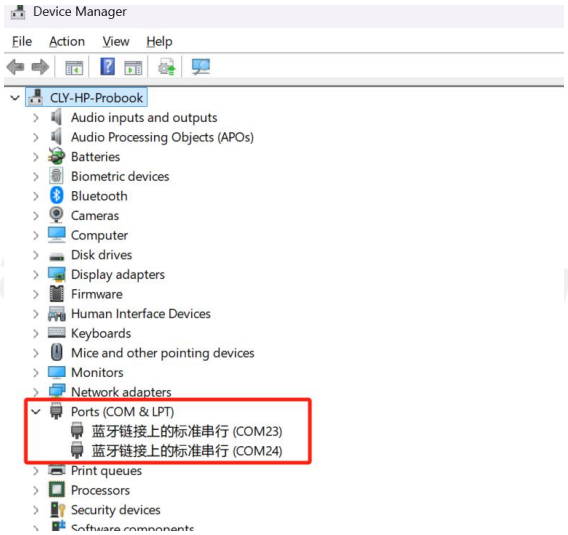

Figure 13-2

Then please use serial port tool like SSCOM tool to connect the COM as below, then you will see the NMEA meassages.

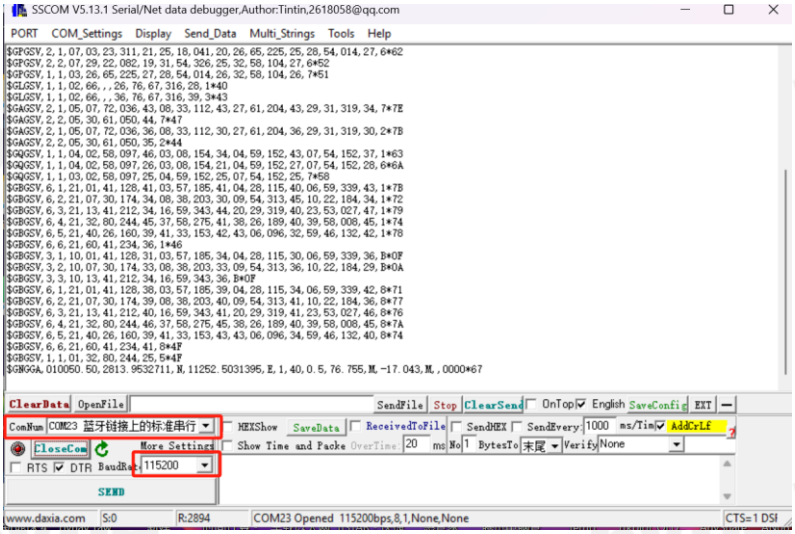
SSCOM V5.13.1 Serial/Net data debugger,Author:Tintin,2618058@qq.com
PORT COM_Settings Display Send_Data Multi_Strings Tools Help
$GPGSV, 2, 1, 07, 03, 23, 311, 21, 25, 18, 041, 20, 26, 65, 225, 25, 28, 54, 014, 27, 6*62
$GPGSV, 2, 2, 07, 29, 22, 082, 19, 31, 54, 326, 25, 32, 58, 104, 27, 6*52
$GPGSV, 1, 1, 03, 26, 65, 225, 27, 28, 54, 014, 26, 32, 58, 104, 26, 7*51
$GLGSV, 1, 1, 02, 66, , , 26, 76, 67, 316, 28, 1*40
$GLGSV, 1, 1, 02, 66, , , 36, 76, 67, 316, 39, 3*43
$GAGSV, 2, 1, 05, 07, 72, 036, 43, 08, 33, 112, 43, 27, 61, 204, 43, 29, 31, 319, 34, 7*7E
$GAGSV, 2, 2, 05, 30, 61, 050, 44, 7*47
$GAGSV, 2, 1, 05, 07, 72, 036, 36, 08, 33, 112, 30, 27, 61, 204, 36, 29, 31, 319, 30, 2*7B
$GAGSV, 2, 2, 05, 30, 61, 050, 35, 2*44
$GQGSV, 1, 1, 04, 02, 58, 097, 46, 03, 08, 154, 34, 04, 59, 152, 43, 07, 54, 152, 37, 1*63
$GQGSV, 1, 1, 04, 02, 58, 097, 26, 03, 08, 154, 21, 04, 59, 152, 27, 07, 54, 152, 28, 6*6A
$GQGSV, 1, 1, 03, 02, 58, 097, 25, 04, 59, 152, 25, 07, 54, 152, 25, 7*58
$GBGSV, 6, 1, 21, 01, 41, 128, 41, 03, 57, 185, 41, 04, 28, 115, 40, 06, 59, 339, 43, 1*7B
$GBGSV, 6, 2, 21, 07, 30, 174, 34, 08, 38, 203, 30, 09, 54, 313, 45, 10, 22, 184, 34, 1*72
$GBGSV, 6, 3, 21, 13, 41, 212, 34, 16, 59, 343, 44, 20, 29, 319, 40, 23, 53, 027, 47, 1*79
$GBGSV, 6, 4, 21, 32, 80, 244, 45, 37, 58, 275, 41, 38, 26, 189, 40, 39, 58, 008, 45, 1*74
$GBGSV, 6, 5, 21, 40, 26, 160, 39, 41, 33, 153, 42, 43, 06, 096, 32, 59, 46, 132, 42, 1*78
$GBGSV, 6, 6, 21, 60, 41, 234, 36, 1*46
$GBGSV, 3, 1, 10, 01, 41, 128, 31, 03, 57, 185, 34, 04, 28, 115, 30, 06, 59, 339, 36, B*0F
$GBGSV, 3, 2, 10, 07, 30, 174, 33, 08, 38, 203, 33, 09, 54, 313, 36, 10, 22, 184, 29, B*0A
$GBGSV, 3, 3, 10, 13, 41, 212, 34, 16, 59, 343, 36, B*0F
$GBGSV, 6, 1, 21, 01, 41, 128, 38, 03, 57, 185, 39, 04, 28, 115, 34, 06, 59, 339, 42, 8*71
$GBGSV, 6, 2, 21, 07, 30, 174, 39, 08, 38, 203, 40, 09, 54, 313, 41, 10, 22, 184, 36, 8*77
$GBGSV, 6, 3, 21, 13, 41, 212, 40, 16, 59, 343, 41, 20, 29, 319, 41, 23, 53, 027, 46, 8*76
$GBGSV, 6, 4, 21, 32, 80, 244, 46, 37, 58, 275, 45, 38, 26, 189, 40, 39, 58, 008, 45, 8*7A
$GBGSV, 6, 5, 21, 40, 26, 160, 39, 41, 33, 153, 43, 43, 06, 096, 34, 59, 46, 132, 40, 8*74
$GBGSV, 6, 6, 21, 60, 41, 234, 41, 8*4F
$GBGSV, 1, 1, 01, 32, 80, 244, 25, 5*4F
$GNGGA, 010050.50, 2813.9532711, N, 11252.5031395, E, 1, 40, 0.5, 76.755, M, -17.043, M, , 0000*67
ClearData OpenFile SendFile Stop ClearSend OnTop English SaveConfig EXT
ComNum COM23 蓝牙链接上的标准串行 HEXShow SaveData ReceivedToFile SendHEX SendEvery 1000 ms/Tim AddCrLf
CloseCom More Settings Show Time and Packe OverTime 20 ms No 1 BytesTo 末尾 Verify None
RTS DTR BaudRate 115200
SEND
www.daxia.com S:0 R:2894 COM23 Opened 115200bps,8,1,None,None CTS=1 DSR

Figure 13-3

Appendix A Document Revision Record

Version	Revision Notes	Revision Date
V1.00	Initial version	2025-01-22
V1.01	Update COM1 and COM2 cable description	2025-05-20

Disclaimer

This manual provides information about the products of Hunan Bynav Technology Co., Ltd. (hereinafter referred to as Bynav Technology). The manual does not transfer any rights or licenses under the patents, copyrights, trademarks, ownership, etc. of the company or any third party in any form, implied or implied. Except for the responsibilities stated in the sales terms and agreements of the product, our company shall not assume any other responsibilities. At the same time, Bynav Technology does not make any express or implied warranties regarding the sales and use of its products, including but not limited to the suitability and marketability for specific purposes of the products, or any liability for infringement of intellectual property rights such as copyrights, copyrights, and patents. Our company is exempt from liability for any problems arising from not following the manual requirements for connection or operation. If necessary, Bynav Technology may modify product specifications and descriptions without prior notice.

For certain design defects or inadequacies that may exist in our company's products, once discovered, improvements will be made and product version iterations may occur, which may result in differences between the product and the published specifications. If customers require, we can provide the latest product specifications.

Bynav Technology
Building 12, Phase 1, Zhongdian Software Park,
No.39 Jianshan Road, High-tech Zone, Changsha,
Hunan 410205, China

Tel.: 0731-85058117
Email: en@bynav.com
FAE: support@bynav.com

www.bynav.com