M1 GNSS Receiver

User Manual

V1.0, modified on 2021.12.04

Content

1 Introduction

1.1 Product Feature

Based on GNSS high-precision positioning technology, MEMS sensor technology, 4G Communication technology and single-chip system technology.M1 is a low-power professional GNSS receiver for field geological hazard monitoring. With 9750mAh internal battery and built-in solar controller, M1 has stable power supply.

According to the characteristics of geological disaster monitoring, the design of M1 GNSS receiver further reduces the power consumption of the whole monitoring station, reduces the power supply configuration, and thus reduces the construction and operation cost of the whole monitoring system. The whole system adopts plug - in design to greatly simplify the installation process and improve work efficiency.

M1 GNSS receiver can be used with a third-party cloud platform to achieve remote monitoring and management of equipment in the cloud.

1.2 Appearance

1.2.1 Front

1.2.2 Bottom

There are some interfaces at the bottom of the panel, 1 9-pin aviation connector, 1 dual 4G SIM card slot and 6 LED indicators.

 Power led: Blinking alternately red and blue when powered on.

 Satellite led: Red.

 4G led: red, If 4G is not online, it blinks once every 5s and once every 1s after it is online.

 Data led: Red.

 Storage light: Red

 Bluetooth light: Red, If Bluetooth is not connected, it blinks once every 3s and once every 1s after it is connected.

SIM: Use NANO SIM card, face down

PORT: 1 9-pin aviation connector, used for 12V DC power input and one RS232 serial port

1.3 Accessory

This chapter provides information about accessories. Before starting the installation, make sure that all accessories used in the project meet specifications and standards.

1.3.1 Accessory list

NAME	PCS	picture
M1 GNSS receiver	1	
9-pin power cable	1	
9-pin data cable	1	

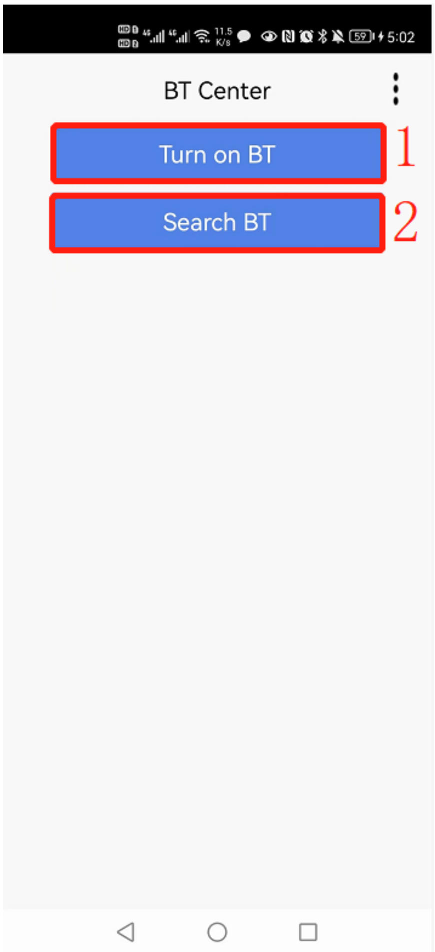
power adapter	1	

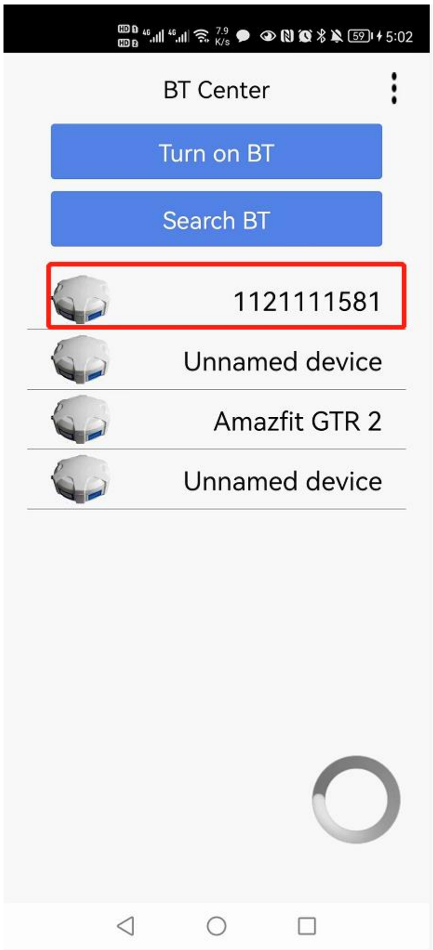
2 Configuration

To configure the M1 GNSS receiver, we usually use Android software specially developed for it to configure, but after the receiver is powered on, it can be configured through bluetooth connection, which is very convenient

2.1 Connection

Open BT Center, turn on Bluetooth, search for nearby Bluetooth devices, select the SN of your device, and click to connect.



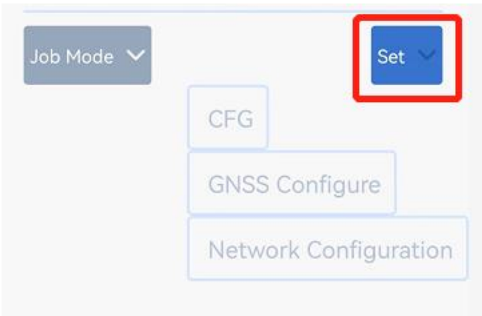


2.1.1 Main Interface

After you connect to the device, the main screen is displayed. You can learn about the device on the main screen.

①Basic device information, including the device name, PN number, and firmware version

②Set device parameters. Click on to set device parameters



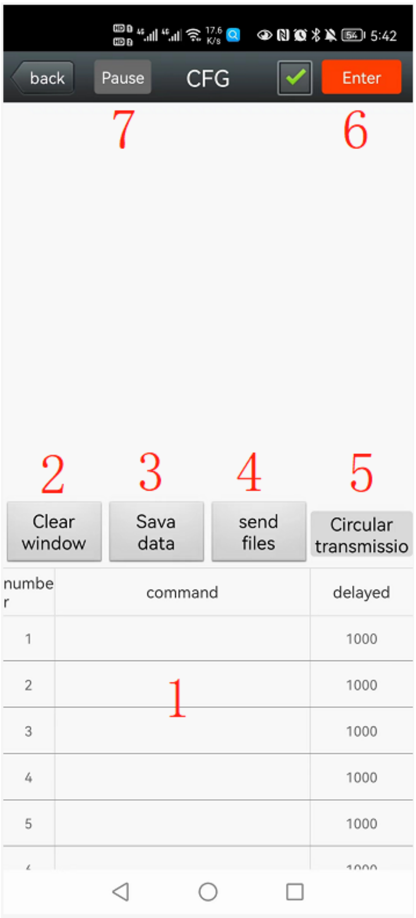
③Satellite information, including the number of satellite search, differential delay, positioning status information.

2.2 Configuration

This summary will mainly introduce how to correctly configure the working mode of the receiver

2.2.1 CFG

CFG stands for independent debugging. You can directly enter commands in the lower part of the screen to configure and debug the device.



①In the command window, long press the screen to enter a command in the command bar. After input, click the command to send. See Appendix I for the instructions and their meanings

②To clear a window, the information printed in the current window is cleared, but the subsequent output is not affected

③Save the data, The data output by the window will be saved in the data folder in *. TXT format by date.

④Send files: When there are too many instructions, you can import them in *. TXT format with one click. The document format is as follows. For details, please refer to Appendix III:

```
// Command format description
// example:
4,200,SAVE LIST
(the number 4 represents the fourth command to execute;    Commas represent delimiters;    200 indicates that the command is
sent 200 milliseconds after the last command is sent.    For commands that need to add a carriage return newline, you need to
manually enter a carriage return newline character.    # is the start or end characters for command recognition
#
1,0,SET UART CONFIG
2,200,SETMODE0
3,200,CONCOM25
4,200,SAVE LIST
5,1000,RTKCOMMAND RESET
6,200,LOG GPGGA ONTIME 1
7,200,SAVECONFIG
#
```

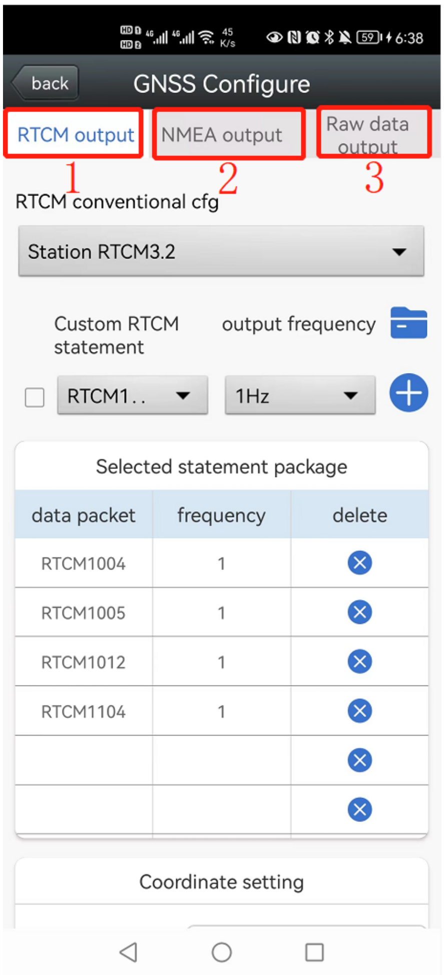
⑤Circular transmission: Click and the commands will be sent according to the delayed time cycle

⑥After this parameter is selected, the carriage return will be added automatically when the command is sent

⑦Pause, click to lock the window, will not affect the data saving

2.2.2 GNSS Configure

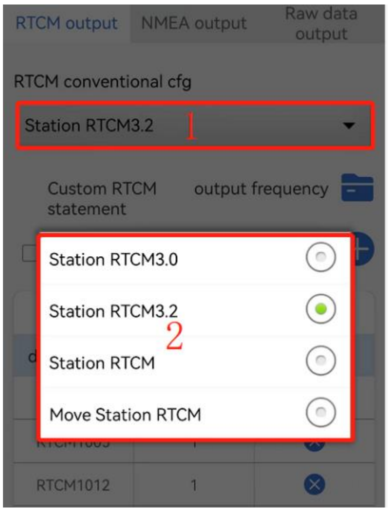
This screen mainly includes three modes of setting.

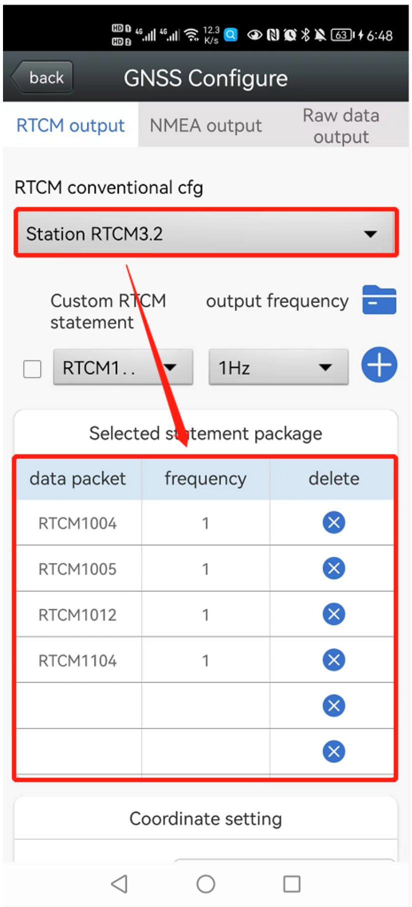


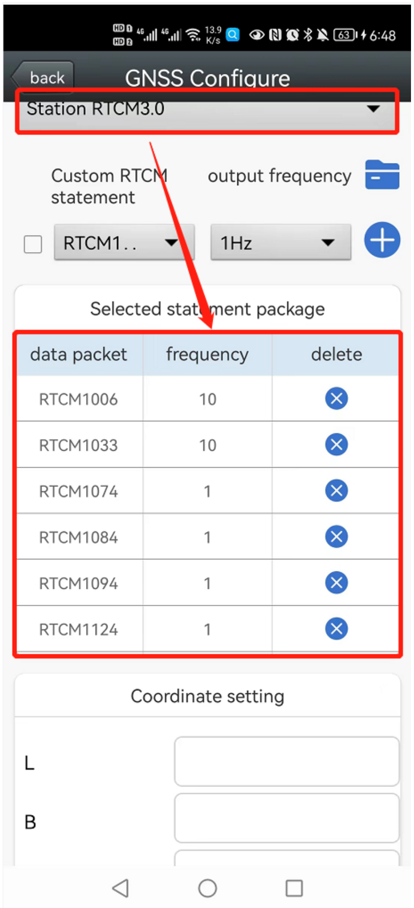
1) RTCM output

①RTCM conventional cfg

There are four working modes to choose from. After selecting the mode, the following statement package will automatically add corresponding instructions.







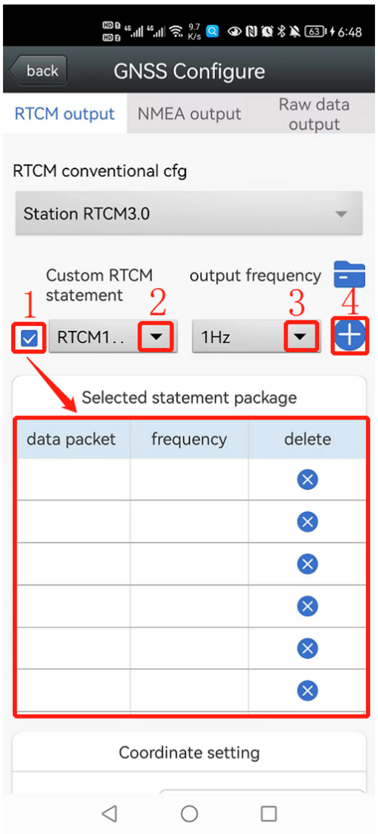
Of course, you can also customize the output:

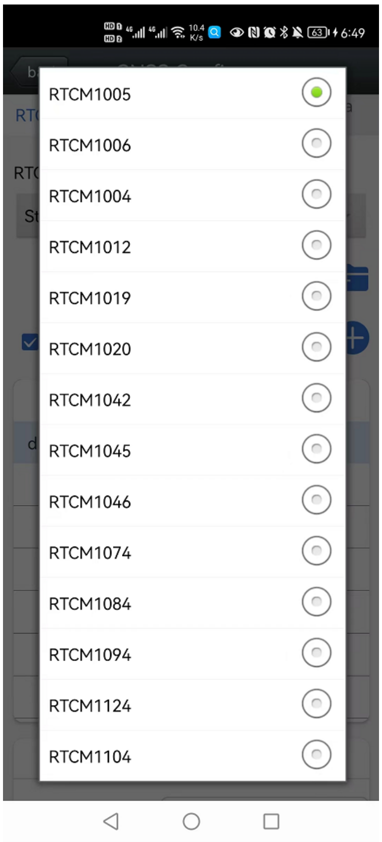
A: If ☐ is selected, the contents of the delivered statement package will be cleared.

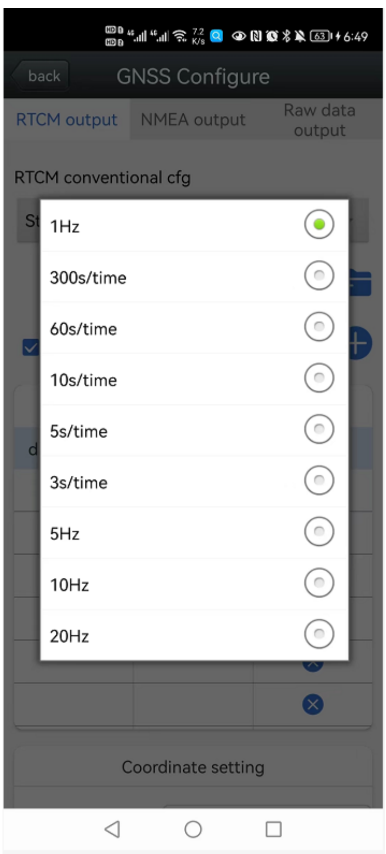
B: Click Custom RTCM Statement to select the output content. You can only select one output at a time.

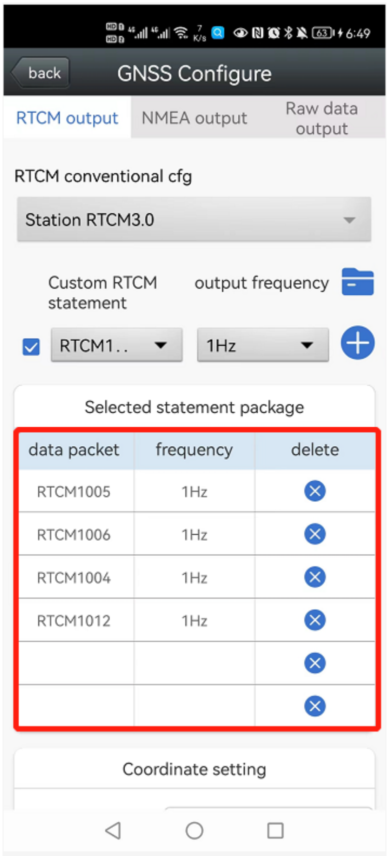
C: Click Output Frequency to select the output frequency;

D: Click  to add the content to the statement package. You can select the output content several times.





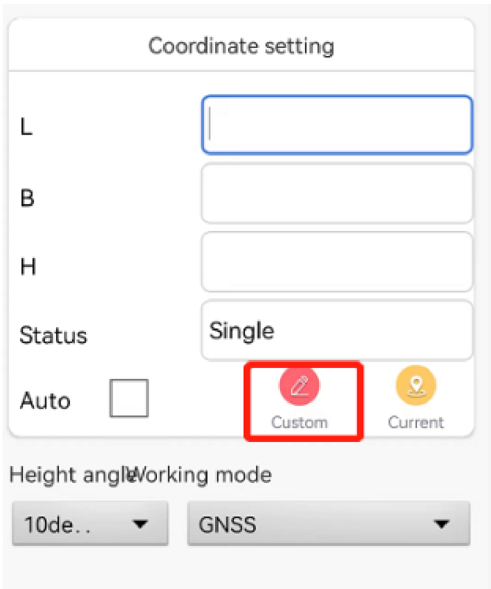




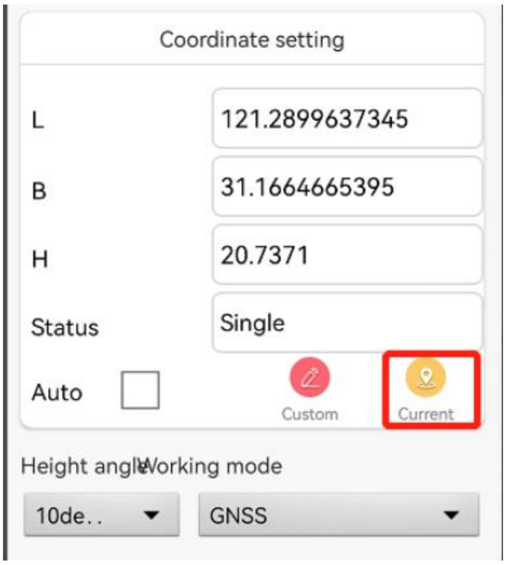
② Coordinate setting

If you choose base station mode, you need to configure the base station startup coordinates in two ways:

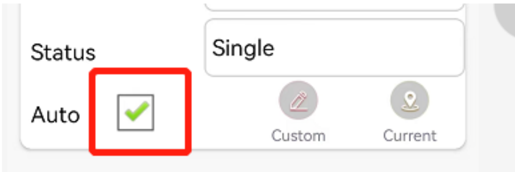
A: Click Custom and manually enter base station coordinates



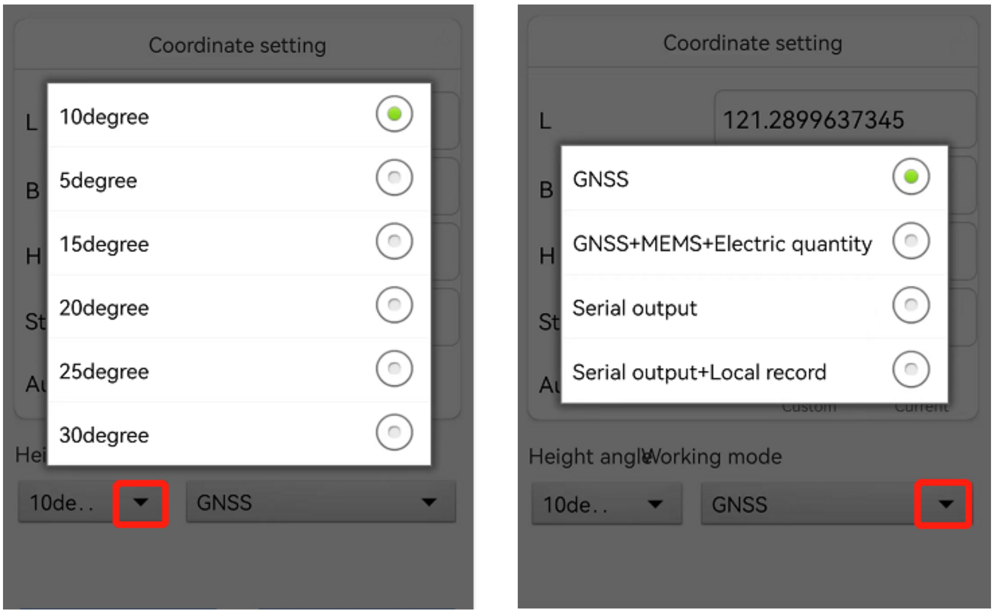
B: Or when the device searches for stars, click Current to directly obtain the Current coordinates



C. Then check the automatic start base station

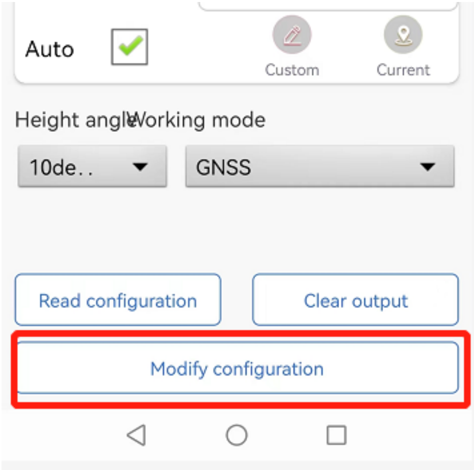


D. Select height angle and working mode



Note: Please do not use local records, the current version does not support.

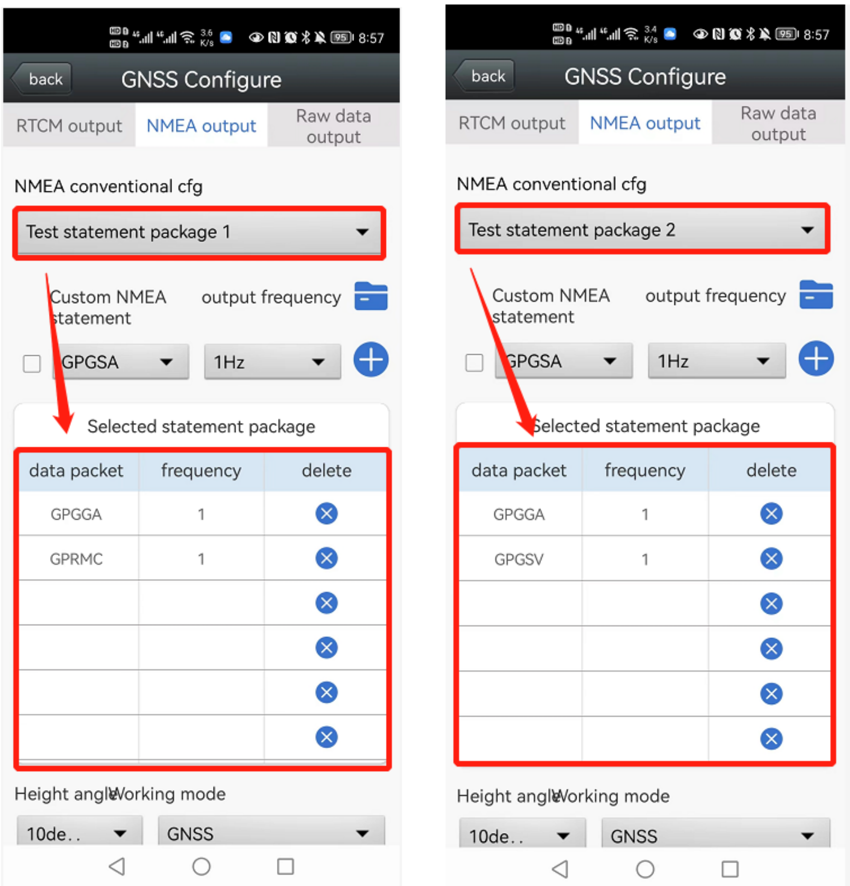
E. Save the Settings.



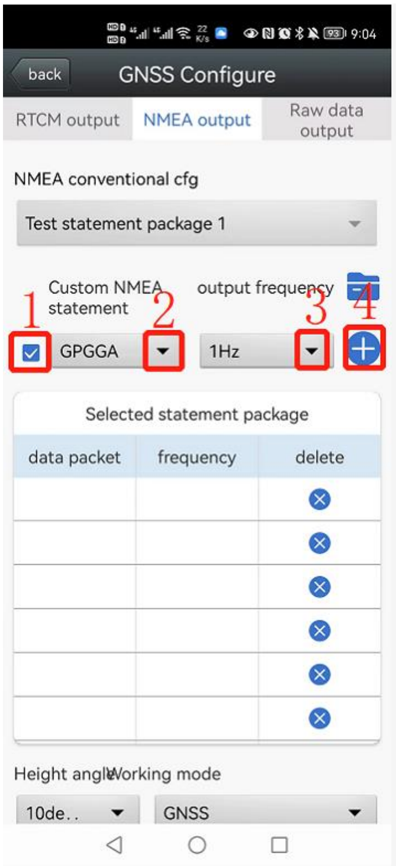
2) NMEA output

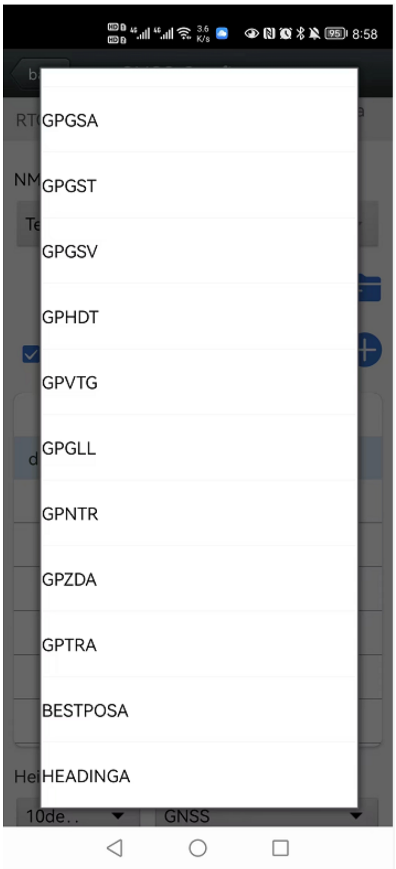
This is very similar to the RTCM Output setting.

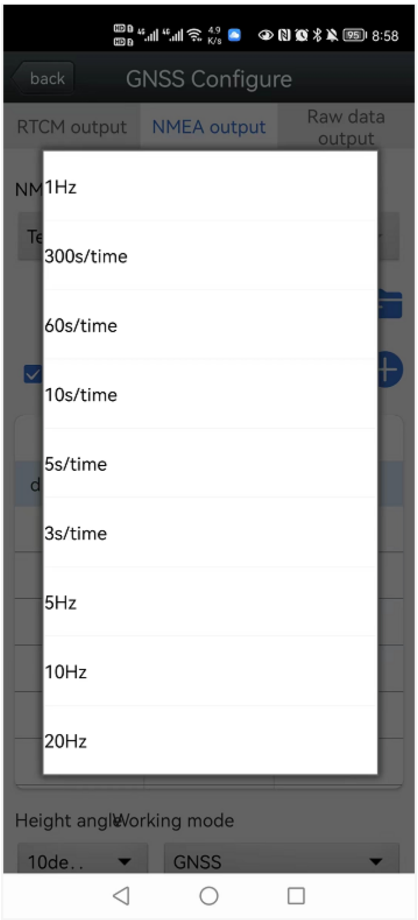
A. Two types of NMEA conventional cfg

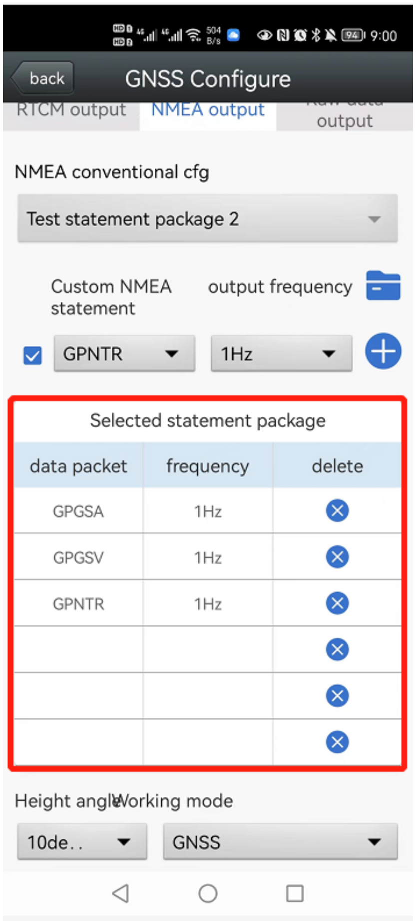


B. Of course, you can also choose the data you want to output

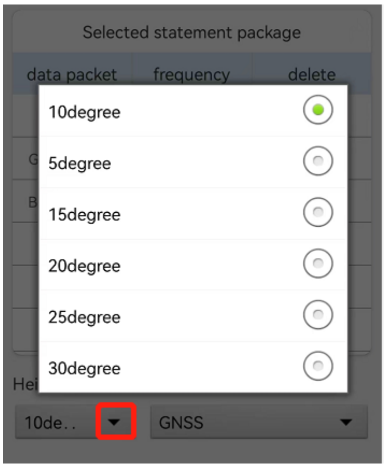

9:04
back
GNSS Configure
RTCM output
NMEA output
Raw data output
NMEA conventional cfg
Test statement package 1
Custom NMEA statement
output frequency
1
2
3
4
GPGGA
1Hz
Selected statement package
data packet
frequency
delete
Height angle
Working mode
10de..
GNSS

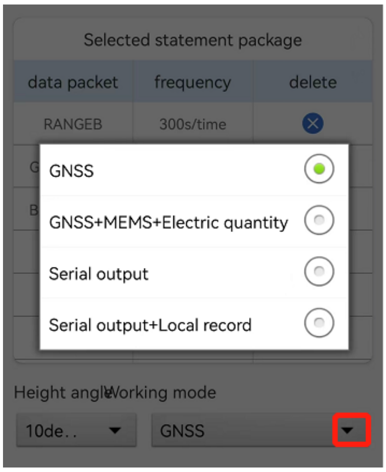

8:58
GPGSA
GPGST
GPGSV
GPHDT
GPVTG
GPGLL
GPNTR
GPZDA
GPTRA
BESTPOSA
HEADINGA
10de..
GNSS





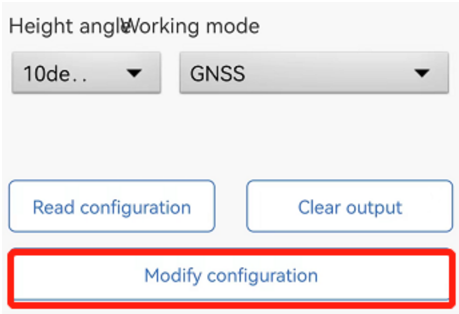
C. Select height angle and working mode.





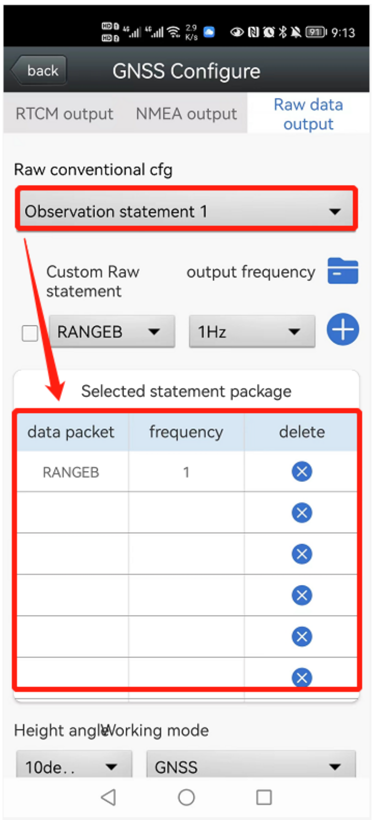
Note: Please do not use local records, the current version does not support.

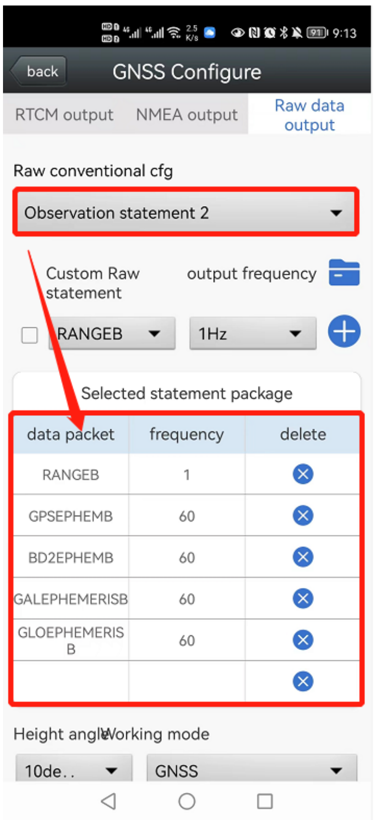
D. Save the Settings.



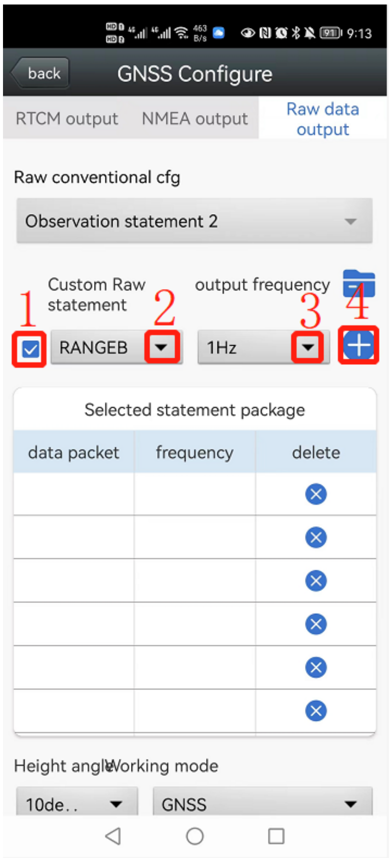
1) Raw data output

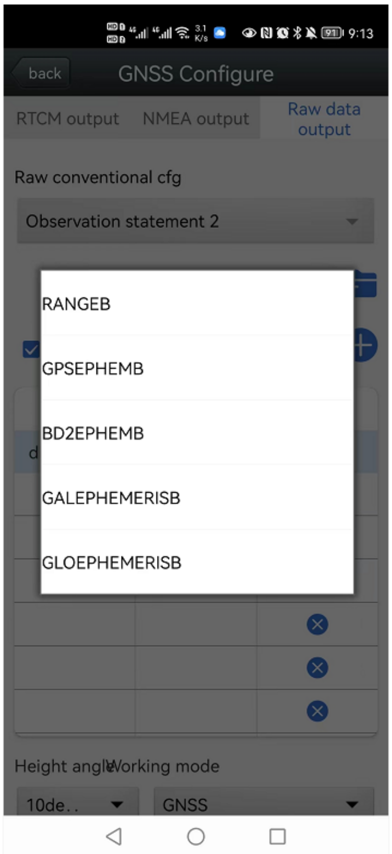
A. Two types of raw conventional cfg



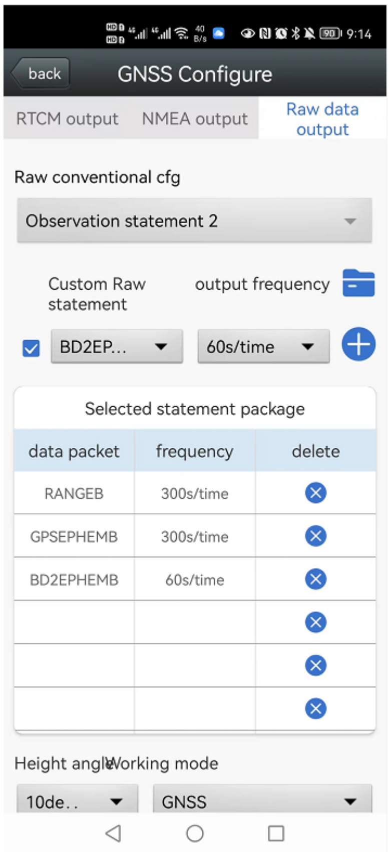


B. Or you can also choose the data you want to output.

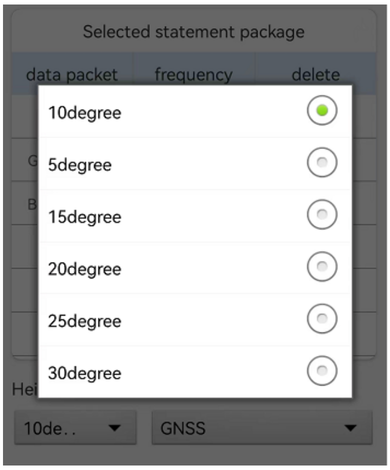

9:13
back
GNSS Configure
RTCM output
NMEA output
Raw data output
Raw conventional cfg
Observation statement 2
Custom Raw statement
output frequency
1
2
3
4
RANGEB
1Hz
Selected statement package
data packet
frequency
delete
Height angle
Working mode
10de..
GNSS

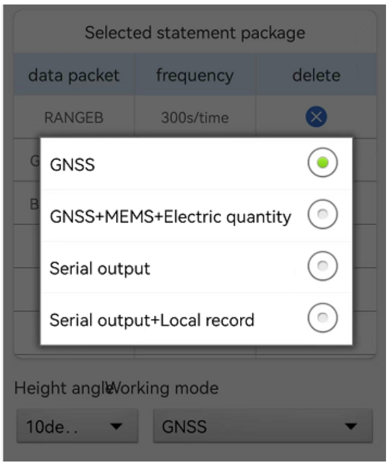

9:13
back
GNSS Configure
RTCM output
NMEA output
Raw data output
Raw conventional cfg
Observation statement 2
RANGEB
GPSEPHEMB
BD2EPHEMB
GALEPHEMERISB
GLOEPHEMERISB
Height angle
Working mode
10de..
GNSS


9:13
1Hz
300s/time
60s/time
55s/time
50s/time
45s/time
40s/time
35s/time
30s/time
25s/time
20s/time
10de..
GNSS


9:14
back
GNSS Configure
RTCM output
NMEA output
Raw data output
Raw conventional cfg
Observation statement 2
Custom Raw statement
output frequency
BD2EP...
60s/time
Selected statement package
data packet
frequency
delete
RANGEB
300s/time
GPSEPHEMB
300s/time
BD2EPHEMB
60s/time
Height angle
Working mode
10de..
GNSS

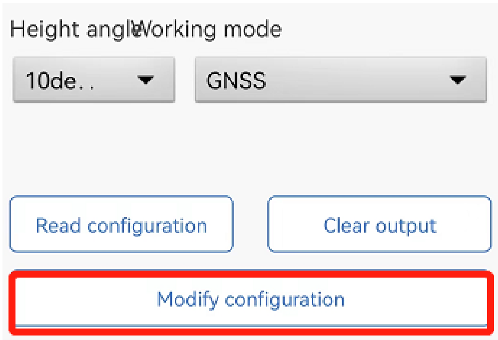
C. Select height angle and working mode.





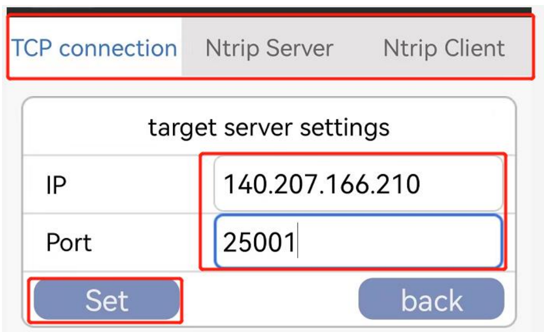
Note: Please do not use local records, the current version does not support.

D. Save the Settings.



2.2.3 Network Configuration

When you need to upload monitoring data to the management platform through TCP/NTRIP protocol, you can set it in this interface. Select the required protocol, input parameters, click Set, and wait for the setting to be successful.



3 Example command Configuration

Also, you can configuration other parameters of the receiver by serial port, like gyroscope and 4G network. For example, through RS232 serial port send instructions to set the GNSS board to output 10 Hz GPGGA message, modify the gyroscope output frequency to 10 Hz; Modify the TCP server address and port number of the 4G network. Modify voltage upload time once every 60 seconds; the instructions are sent in the following order. See Appendix I for detailed instructions.

SET UART COFIG

MODE 0

CONCOM12

LOG GPGGA ONTIME 0.1

SAVECONFIG

CONCOM13 *//Example Gyroscope ID is 02 (the following instructions are sent in HEX format)*

41 6C 6C 79 02 FF AA 03 06 00

CONCOM14

SETG3CONFIG

SETG3IP0192.168.1.100

SETG3PORT08001

SETG3MODE2

SETG3QUIT

BATTIME60

MODE1

SAVE LIST

The commands to configure the above parameters using Bluetooth are as follows (you need to connect Bluetooth first and send the following commands from the Bluetooth serial port).

SET UART COFIG

MODE 0

CONCOM25

LOG GPGGA ONTIME 0.1

SAVECONFIG

CONCOM35 *//Example Gyroscope ID is 02 (the following instructions are sent in HEX format)*

41 6C 6C 79 02 FF AA 03 06 00

CONCOM45

SETG3CONFIG

SETG3IP0192.168.1.100

SETG3PORT08001

SETG3MODE2

SETG3QUIT

BATTIME60

MODE1
SAVE LIST

4 Analysis of common equipment problems

Problem	Fault analysis cause	Solution
The Bluetooth ID was not found	The phone is too far from the receiver or the ID is not fully loaded	The mobile phone approaches the receiver and searches again for the Bluetooth ID
4G does not upload data	The IP address or port of the 4G module is incorrect. The 4G SIM card is incorrectly installed The device is in MODE0 debugging mode	Reconfigure the IP address or port of the 4G module. Check whether the SIM card is installed correctly. Set the device to MODE1 mode.
the indicator light is not on	The power cable is loose or improperly connected	Check whether the power cable is inversely tightened
The output data is all garbled or dotted	The baud rate is not set correctly	Check that the baud rate set by the serial port receiving program of the computer is consistent with that set in the device CONFIG.

Attachment I Configuration instructions Set

System debugging instruction	
SET UART CONFIG	Enabling system Configuration
MODE0	Switch to debug mode
MODE1	Switch to monitoring mode
CONCOM12	Connect to the GNSS board debugging interface
CONCOM13	Connect to the gyroscope debugging interface
CONCOM14	Connect to the debugging interface of the 4G network module
CONCOM15	System debugging interface and Bluetooth transparent transmission
CONCOM25	GNSS board and Bluetooth transparent transmission
BATTIME60	Set the time interval for uploading electric quantity information, 60 seconds; The value ranges from 0 to 255 seconds
SAVE LIST	Save the System Configuration
GNSS board debugging instruction	
UNLOGALL	Disable all output of the GNSS board
LOG RANGEB ONTIME 1	Output 1Hz raw observation data in binary format
LOG RANGEA ONTIME 1	Outputs 1Hz raw observation data in ASCII format
LOG GPSEPHEMB ONTIME 300	Output GPS ephemeris in binary format, every 300 seconds
LOG BD2EPHEMB ONTIME 300	Output BDS ephemeris in binary format, every 300 seconds
LOG GLOEPHEMERISB ONTIME 300	Output GLO ephemeris in binary format, every 300 seconds
LOG GPSEPHEMA ONTIME 300	Output GPS ephemeris in ASCII format, every 300 seconds
MODE ROVER	Switch from base station mode to rover station mode
LOG GPGGA ONTIME 0.5	The GPGGA statement is output at 2Hz
MASK 15	Set the satellite altitude cutoff Angle to 15 degrees
SAVECONFIG	Save the board configuration
Gyroscope debugging instruction	
41 6C 6C 79 02 FF AA 03 03 00	Change the output frequency of gyroscope ID 02 to 1Hz (sent by HEX)
41 6C 6C 79 02 FF AA 04 06 00	Change the baud rate of serial port to 115200 (sent by HEX) of gyroscope ID 02
41 6C 6C 79 02 FF AA 2D FF 00	Change the ID of the gyroscope whose ID is 02 to FF; Allowed to change range from 00 to FF (HEX sent)
4G network debugging instructions	
SETG3CONFIG	The 4G configuration is enabled
SETG3MODE0	The 4G module is switched to the debugging mode

SETG3IP0192.168.1.100	Set the TCP server IP address to 192.168.1.100
SETG3PORT01002	Set the TCP PORT to 1002
SETG3MODE2	Set 4G to TCP transparent transmission
SETG3QUIT	Save the Settings and exit the 4G configuration

Gyroscope configuration instructions

First, adjust the display interface to HEX display, and the ID of the gyroscope can be queried in the data 41 6C 6C 79 __ spit out from the serial port. Instructions are sent in hexadecimal format.

For example, change the ID number of the gyroscope module who's ID is 02 to FF as follows:

Input example: 41 6C 6C 79 02 FF AA 03 08 00

The red font is gyroscope ID; the blue font is the change ID option; the green font indicates the ID to be written

To change the frequency of output data from the serial port of the device whose gyroscope ID is 02 to 50 Hz, the command is as follows:

Input example: 41 6C 6C 79 02 FF AA 03 08 00

The red font is gyroscope ID; the blue font is the change frequency option; Green font indicates the specific output frequency (08=50HZ)

Set output frequency				
0*FF	0*AA	0*03	RATE	0*00
Output frequency				
0*01	0.1Hz			
0*02	0.5Hz			
0*03	1Hz			
0*04	2Hz			
0*05	5Hz			
0*06	10Hz			
0*07	20Hz			
0*08	50Hz			
0*09	100Hz			
0*0a	125Hz			
0*0b	200Hz			
0*0c	Single output			
0*0d	No output			

To change the baud rate of the serial port of gyroscope 02 to 115200, run the following command:

Input example: 41 6C 6C 79 02 FF AA 04 06 00

The red font is gyroscope ID; the blue font is the change baud rate option; the green font indicates the baud rate to be written

Set baud rate				
0*FF	0*AA	0*04	RAUD	0*00
Baud rate				
0*00	2400			
0*01	4800			
0*02	9600(Default)			
0*03	19200			
0*04	38400			
0*05	57600			
0*06	115200			
0*07	230400			
0*08	460800			
0*09	921600			

Caution

1) Before modifying parameters of GNSS board, gyroscope and 4G network module, you need to send system debugging commands first, connect to corresponding debugging interfaces, and then send configuration commands of corresponding modules.

2) If you want to set the parameters of each module of the system through Bluetooth, you need to send commands to connect to the corresponding debugging interface first. Such as CONCOM25 / CONCOM35 / CONCOM45, GNSS board/gyroscope /4G network module can be configured respectively.

3) After the module parameters are configured, system debugging instructions need to be sent again to switch the device to MODE1 mode before it can work normally.

4) System debugging and each module have corresponding save configuration instructions, after debugging need to send save instructions; otherwise it will be invalid after power failure.

Attachment Ⅱ Data Protocol

1 Gyroscope Data Protocol

1.1 Time Output

0X55	0X50	YY	MM	DD	HH	MM	DD	MSL	MSH	SUM

YY: Year, 20YY

MM: Month

DD: day

HH: Hour

MM: Minute

SS: Second

MS: Millisecond

Computational formula:

MS= ((MSH<<8) |MSL)

Sum=0x55+0x50+YY+MM+DD+HH+MM+SS+MSL+MSH

1.2 Acceleration Output

0X55	0X51	AxL	AxH	AyL	AyH	AzL	AzH	TL	TH	SUM

Computational formula:

Ax= ((AxH<<8) |AxL)/32768*16g (g is the acceleration of gravity, 9.8m/s2)

Ay= ((AyH<<8) |AyL)/32768*16g (g is the acceleration of gravity, 9.8m/s2)

AZ= ((AzH<<8) |AzL)/32768*16g (g is the acceleration of gravity, 9.8m/s2)

T=((TH<<8)|TL) /100 ℃

Sum=0x55+0x51+AxH+AxL+AYH+AyL+AzH+AzL+TH+TL

Descriptions:

1) Data is sent in hexadecimal format, not ASCII.

2) Each piece of data is passed in order of low and high bytes, which are combined into a signed short. For example, the X-axis acceleration data Ax, where AxL is the low byte and AxH is the high byte. The conversion method is as follows: If Data is the actual Data, DataH is its high byte part, and DataL is its low byte part, then: Data=(short)（DataH<<8|DataL）。It is important to note that DataH needs to be cast to a signed short before it is shifted, and that Data is also of a signed short to represent negative numbers.

1.3 Angular velocity output

0X55	0X52	wxL	wxH	wyL	wyH	wzL	wzH	TL	TH	SUM

Computational formula:

wx= ((wxH<<8)|wxL)/32768*2000(°/s)

wy= ((wyH<<8)|wyL)/32768*2000(°/s)

wz= ((wzH<<8)|wzL)/32768*2000(°/s)

T=((TH<<8)|TL) /100 ℃

Sum=0x55+0x52+wxH+wxL+wyH+wyL+wzH+wzL+TH+TL

1.4 Angle output

0X55	0X52	RollL	RollH	PitchL	PitchH	YawL	YawH	TL	TH	SUM

Computational formula:

Roll Angle (X-axis) Roll= ((RollH<<8) |RollL)/32768*180(°)

Pitch Angle (Y-axis) Pitch= ((PitchH<<8) |PitchL)/32768*180(°)

Yaw Angle (z axis) Yaw= ((YawH<<8) |YawL)/32768*180(°)

T=((TH<<8)|TL) /100 ℃

Sum=0x55+0x53+RollH+RollL+PitchH+PitchL+YawH+YawL+TH+TL

Descriptions:

1) The coordinate system used for attitude Angle settlement is the northeast celestial coordinate system, and modules are placed in the positive direction. As shown in the figure below, the left axis is X axis, the forward axis is Y axis, and the upward axis is Z axis. When Euler Angle represents the attitude, the rotation order of the coordinate system is defined as z-y-x, that is, first around the Z axis, then around the Y axis, then around the X axis.

2) Although the range of roll Angle is ±180 degrees, in fact, due to the rotation order of coordinates is Z-Y-X, when the attitude is expressed, the range of pitch Angle (Y-axis) is only ±90 degrees, exceeding 90 degrees will be changed to less than 90 degrees, while the X-axis Angle is greater than 180 degrees. Detailed principle pleases Baidu Euler Angle and attitude expressed related information.

3) Because the three axes are coupled, the attitude Angle will change independently only at a small Angle, while the attitude Angle will change coupled at a large Angle. For example, when the Y axis is close to 90 degrees, even if the attitude only rotates around the Y axis, the Angle of the X axis will also change greatly, which is the inherent problem of Euler Angle to represent the attitude.

1.5 Magnetic field output

0X55	0X54	HxL	HxH	HyL	HyH	HzL	HzH	TL	TH	SUM

Computational formula:

Magnetic field output (X-axis) Hx = ((HxH <<8)| HxL)

Magnetic field output (Y-axis) Hy = ((HyH <<8)| HyL)

Magnetic field output (Z-axis) Hz = ((HzH <<8)| HzL)

T=((TH<<8)|TL) /100 ℃

Sum=0x55+0x54+HxH+HxL+HyH+HyL+HzH+HzL+TH+TL

2 Voltage data protocol

Voltage data is output in the form of English plus decimal values. For example， Solar 12.0, lead acid battery 8.7, lithium battery 8.4, USB1.5, temperature 36.6

Descriptions:The charging process of solar controller is as follows

1) The maximum input voltage for solar energy is 26V. 21.6V no-load voltage or close to this value is recommended for solar panels.

2) When the solar voltage is greater than 17.2V, start charging the battery. When the battery voltage exceeds 10.6V, the controllable switch is turned on, set Standby startup work, and charges the internal lithium battery.

3) When the built-in lithium battery voltage is greater than 6.2V, the device starts to work.

4) When there is no built-in lithium battery, the battery voltage exceeds 10.6V and the device can be turned on.

Attachment Ⅲ Instruction Import Format

Command format description

For example:

4,200,SAVE LIST

(The number 4 represents the fourth command to execute;

Commas represent delimiters;

200 indicate that the command is sent 200 milliseconds after the last command is sent. For commands that need to add a carriage return newline, you need to manually enter a carriage return newline character. # is the start or end characters for command recognition

#

1,0,SET UART CONFIG

2,200,SETMODE0

3,200,CONCOM25

4,200,SAVE LIST

5,1000,RTKCOMMAND RESET

6,200,LOG GPGGA ONTIME 1

7,200,SAVECONFIG

#

Attachment Ⅳ Data Cable interface definition

PIN definition of 9-pin aviation male connector. (There are corresponding numbers on the plug)

9-pin aviation male connector sequence	definition
1	POWER+
2	POWER-
3	SOLAR+
4	LE_AC BAT
5	RS232 RX
6	RS232 TX
7	GND
8	GND
9	P_ON

PIN definition of 9-pin power cable

9-pin aviation female connector sequence	definition
1	NULL
2	NULL
3	SOLAR+(positive pole of solar)
4	BAT+(battery terminal positive)
5	NULL
6	NULL
7	SOLAR-(negative pole of solar)
8	BAT-(battery terminal negative)
9	NULL

PIN definition of 9-pin data cable

9-pin aviation female connector sequence	definition
1	DC 12V positive pole
2	DC 12V negative pole
3	COM RS232 B
4	NULL

5	CONFIG RS232 B
6	CONFIG RS232 A
7	COM RS232 A
8	NULL
9	NULL

PORT RS232: You can use the serial port tool to configure the parameters of the receiver; the default baud rate is 115200.

Attachment Ⅴ Product Specification& Details

Satellites Tracking

user interface BDS: B1/B2
GPS: L1/L2
GLONASS: L1/L2
Galileo: E1/E5b
QZSS: L1/L2
Cold start: <25s
Initialization: <5s
RTK initialization reliability: >99.9%
Re-acquisition: <1s

GNSS Accuracy

Standalone:

1.5m Horizontal

2.5m Vertical

RTK:

10mm+1ppm Horizontal

15mm+1ppm Vertical

Post-Processing static:

2.5mm+1ppm

5mm+1ppm

Attitude Sensor Accuracy

Inclination sensor: 0.1° (-90°~90°)
Accelerometer sensor: 0.01g （-2g~2g）

Data Format

Corrections Data: RTCM2.X, RTCM3.X, CMR, CMR+

Position Data: NMEA-0183, Binary data, can configure up to 20 Hz data transmitting.

Communication Protocol

Network: TCP, NTRIP, MQTT
Serial: RS232, RS485 (baud rate 4800~921600)
USB (optional): USB2.0
BT: BT4.0, backward compatible with BT2.x;
Support Windows/Android/IOS

Interface

1 9-pin aviation connector
1 dual 4G SIM card slot*
6 LED indicator

PHYSICAL
Weight: 1.65kg (including battery inside)
Size: Φ196.7mm×129.5mm

Environmental

Working temperature: -45°C～+75°C
Storage temperature: -55°C～+85°C
Humidity: 100% non-condensing
Waterproof & Dustproof: IP67, floatable
Drop: Survive from 2m-drop

Electrical

Power consumption: 1.5～4W, varies due to different work modes
Power supply voltage: 9～26V DC, support automatically start, built-in photoelectric isolation, reverse connection protection
Battery capacity: 9750mAh