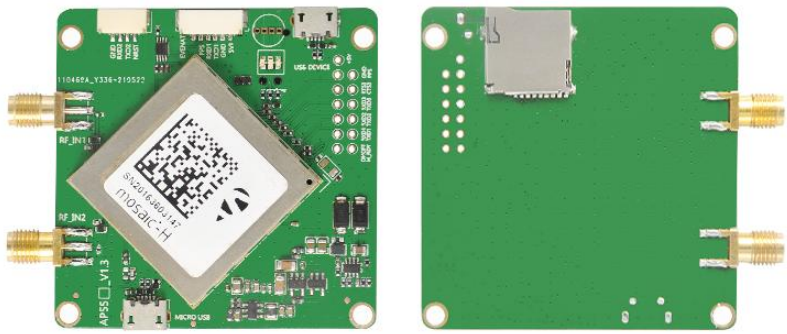
Accurate positioning

22°39'48.37"N 114°02'10.91"E

AP55

Data Sheet



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Version update notes

Revised version	Modified date	Content changes and modifications	Modified by
V1.0	2020-3-08	First Edition	LPF
V1.1	2021-06-19	Optimized RF circuitry, compatible with both single and dual antennas.	WANGWEI
V1.2	2022-05 -13	Firmware V4.9.1 has been upgraded to V4.12.1 , supporting B3I.	Wang Wei
V1.3	2023-06-19	The software has been upgraded from version V4.12.1 to V4.14.0 .	Wang Wei

1. Function Description

1.1 Overview

The AP55 H is a new multi-band, multi-constellation satellite receiver with multiple data interfaces. Suitable for various applications such as drones, fully automated robots, precision control, and autonomous driving, it can track all Global Navigation Satellite System (GNSS) constellations, supports all current satellite signals, and features unique AIM + anti-jamming technology, performing particularly well in complex environments. It is currently widely used in the mass-market GNSS receiver .

1.2 Product Characteristics

- AP55 uses high-performance chips
- With over 2 million valid correlators
- With 448 hardware channels, it can simultaneously track all visible satellite signals.
- Default navigation update rate: 100 Hz ; Measurement update rate: 100 Hz
- Ultra-low latency of less than 10 milliseconds
- It can smoothly track satellite signals even during high-frequency vibrations and rapid movements.
- Supports GPS, GLONASS BDS , Galileo, QZSS, Navic , SBAS satellites
- Integrates T CXO, LNA, and a TF card slot for up to 32GB .
- Its compact size (55.2 * 55.2 * 9.1 mm ± 0.3 mm) makes it suitable for use in tight spaces .
- Supports standards NMEA 0183, SBF , RINEX, RTCM , CMR/CMR+
- AIM+ Interference Detection and Suppression
- IONO+ Ionospheric Scintillation Suppression
- Lock+ offers superior tracking robustness
- APME+ multipath suppression technology
- RAIM+ Receiver Autonomous Integrity Monitoring
- It features interference indicator, interference mitigation, and spectrum measurement functions.
- High-precision positioning and heading output, with an error of ± 0.2 degrees .
- Supports GNSS navigation
- Supports OSNMA Anti-deception

1.3 Performance Indicators

parameter	Detailed Explanation
Satellite receiver (Mosaic-x5 single antenna)	■GPS: L1C/A, L1C, L1PY, L2C, L2P, L5 ■BDS: B1I, B1C, B2a, B2I, B3I ■GLONASS:L1CA, L2CA, L2P, L3 CDMA ■Navic:L5 ■Galileo:E1, E5a, E5b, E5 AltBoc,E6 ■QZSS:L1C/A, L1C, L2C, L5, L6 ■SBAS:EGNOS, WAAS, GAGAN, MSAS, SDCM (L1, L5)
Satellite receiver (Mosaic-H dual antennas) [1]	■GPS:L1, L2 ■BDS:B1I, B2I, B3I ■GLONASS: L1, L2 ■Navic: L5 ■Galileo:E1, E5b ■QZSS:L1, L2 ■SBAS:EGNOS, WAAS, GAGAN, MSAS, SDCM (L1)
Tracking performance (C/N0 threshold)	Tracking and navigation sensitivity 20dB-Hz Capture sensitivity 33dB-Hz
Time accuracy	xPPS out 9 5 ns Event accuracy < 20ns
Positioning Time Test [2]	Cold start 45s Warm start ≤20s
Operating temperature	-40℃~85℃
Storage temperature	-55℃~85℃
Horizontal position accuracy [3]	RTK status 0.6cm +1ppm [4]
Velocity accuracy	0.03m / s
Heading accuracy (dual antennas)	With a 1m antenna spacing, the orientation is 0.15 ° and the attitude is 0.25 °. The antenna spacing is 5m , with a orientation of 0.03 ° and an attitude of 0.05 °.

Protocol	Type
NMEA 0183	Input / Output , ASCII
SBF	Input / Output
RTCM	Input / Output
CMR	Input / Output
CMR+	enter

Limitations	Power limit ≤ 4 g Height limit 18,000 m Speed limit 5 15 m/s
refresh rate	115200- 4Mbps (default 115200bps)
Maximum navigation update frequency	Positioning at 100 Hz Positioning and orientation (dual antennas) 50Hz Observation value 100Hz

✌1. B3I and E5b do not support simultaneously

✌2 All satellites are ≥ -130dBm

✌3 CEP 50%, 24- hour static , ≥ -130dBm, ≥12 using satellite

✌4. For every 10 kilometers of distance from the base station, the accuracy error increases by 1 centimeter (based on a range within 30 kilometers).

1.4 Agreement Description

1.5 antenna

The AP55 comes in two versions: a single-antenna version (AP55) and a dual-antenna version (AP55H). When using the AP55, only RF1 needs to be connected . When using the dual-antenna version, both RF1 and RF2 need to be connected (supporting dual -antenna directional functionality) .

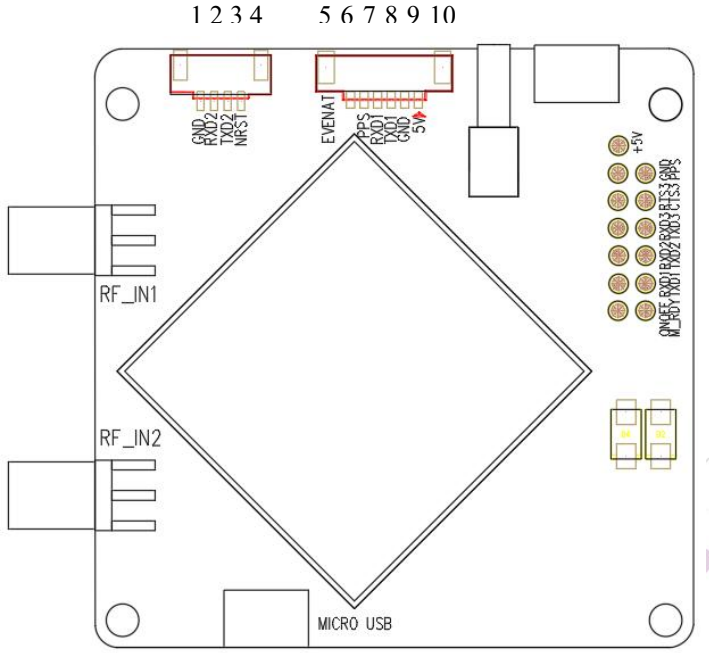
1.6 Product Application

- Drone applications
- Surveying and mapping
- Personal protection
- Intelligent logistics scheduling
- intelligent robots
- Handheld GPS receiver
- Geographical surveying
- Precision agriculture and location services

- Personal location tracking
- driving test
- handheld devices
- In-vehicle equipment applications
- Heading output (AP55H only)
- Precise control

2 -pin definition

2.1 Pin Assignment



SN.	Name	Input/Output	Description
1	GND	-	Ground
2	RXD2	Input	Serial Port 2 Receive data
3	TXD2	Output	Serial Port 2 Send data
4	NRST	-	Reset pin, active low
5	EVENAT	Input	EVENAT input
6	PPS	Output	Second pulse output
7	RXD1	Input	Serial Port 1 Receive data
8	TXD1	Output	Serial Port 1 Send data
9	GND	-	Ground
1 0	VCC	Input	Power supply (default 5V)

3 Electrical characteristics

Parameter	Symbol	Minimum	Conventional	Maximum	Unit
Power supply voltage range	V CC	4.5	5.0	12.0	V
Average current [1]	capture	250mA (@5.0V)	280mA (@ 5.0V)	300mA (@5.0V)	
	track	240mA (@5.0V)	260mA (@5.0V)	280mA (@5.0V)	
VCC port maximum ripple	Vrpp	0	50	50	mV
	Vin	-0.5	Vcc +0.2	V	mV
Antenna power supply current	RF_VCC	-	-	70mA @ 3.3 V	m A
Electrostatic protection	VESD(HBM)	--	2000	2000	V
MSD(MSL) Level	Level 3	-	3.3	-	V
Storage temperature	Tstg	-55	-	85	°C
Operating temperature	Tstg	-40	-	85	°C

* Passive Antenna Testing

4. Mechanical dimensions (single antenna)

Internal structural dimensions

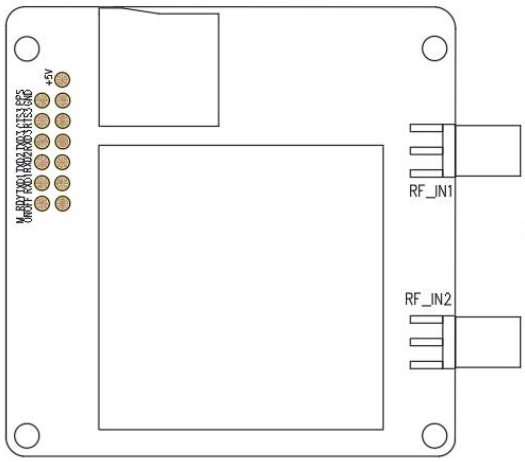


图 1

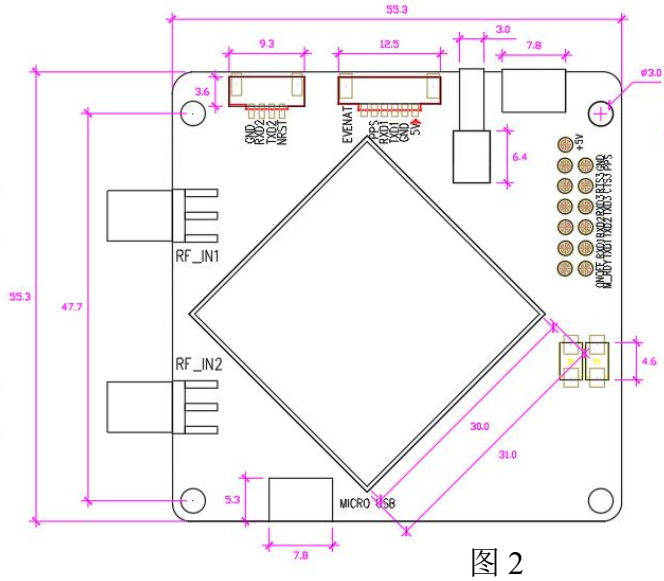


图 2

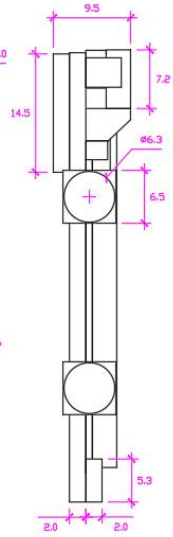


图 3

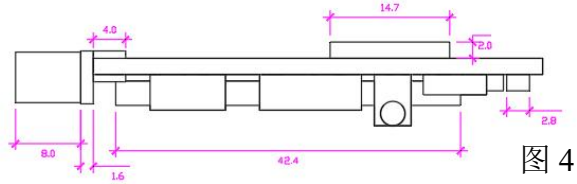


图 4

Figure 1

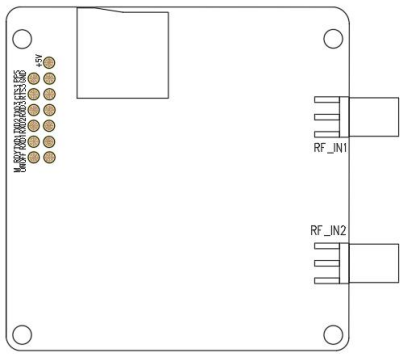


Figure 2

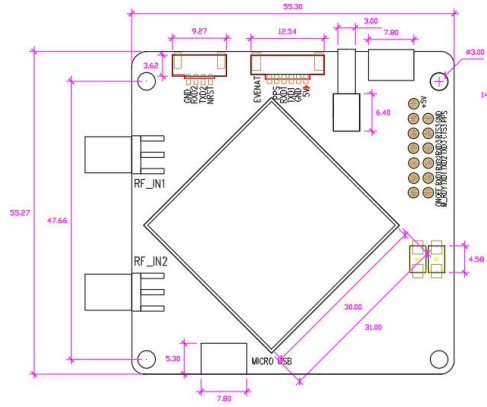


Figure 3

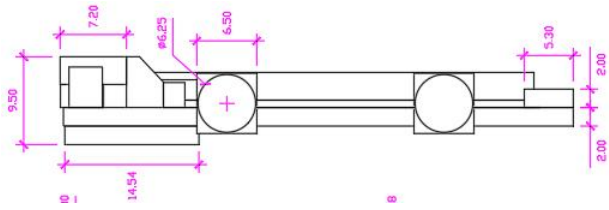
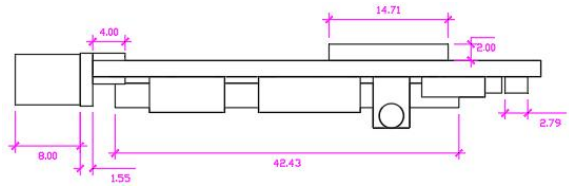
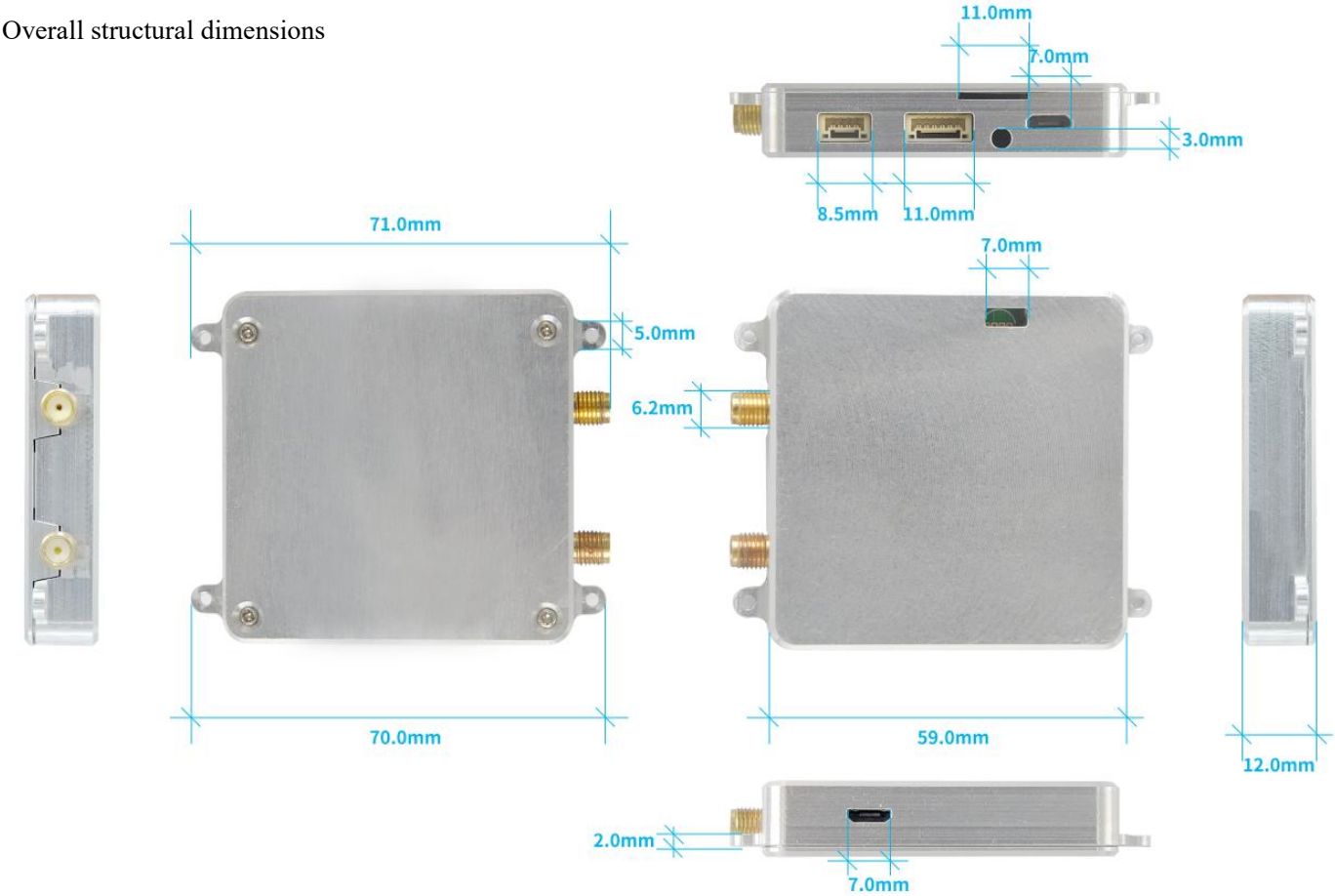


Figure 4



Unit: mm Dimensional error: ±0.3mm

Overall structural dimensions

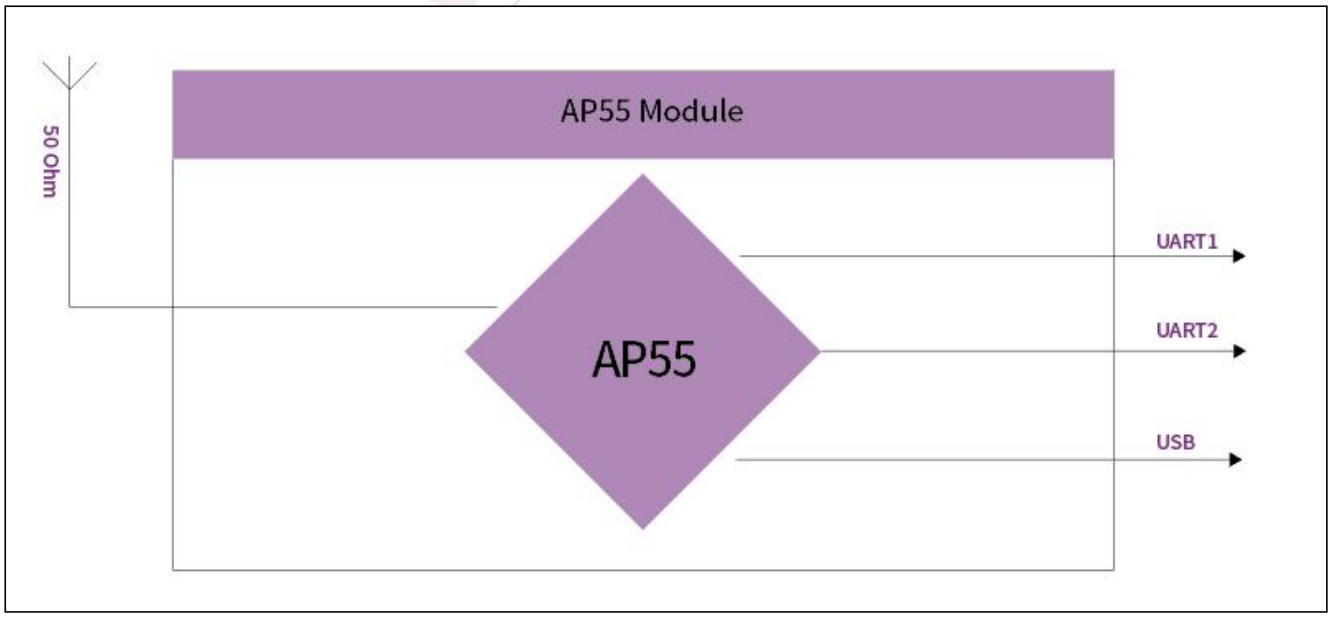


Unit: mm Dimensional error: ±0.3mm

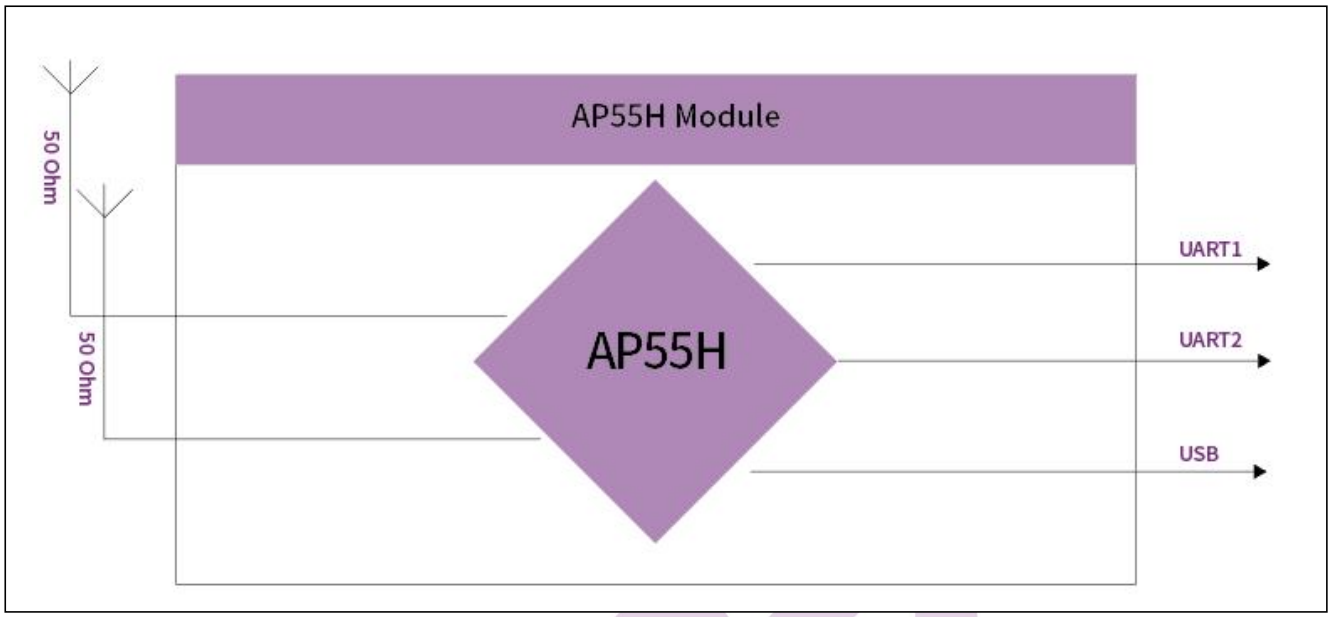
5. Interface Configuration Selection

The AP55(H) module includes two UART ports and one USB interface (AP55) for communication with a host computer. Different interfaces can be selected through different hardware interface connections. One PPS pin and two event pins are used to output time pulses and external triggers.

AP55 Application Block Diagram



AP55H Application Block Diagram



6. Basic Operating Instructions

6.1 Download and install RxTools software

The RxTools software installer and user manual can be downloaded from the following link:

https://www.septentrio.com/en/support/software/rxtools

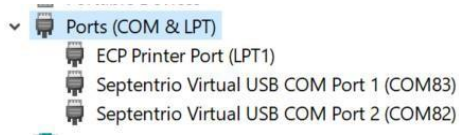
After downloading, proceed directly to the installation, avoiding installation directories containing Chinese characters. After successful installation, the software will contain the following assemblies:

6.2 Hardware Connection

1. Using MMCX Connector to TNC or SMA After connecting the interface, connect the satellite antenna.

2. Use Micro USB Connect the device to the computer

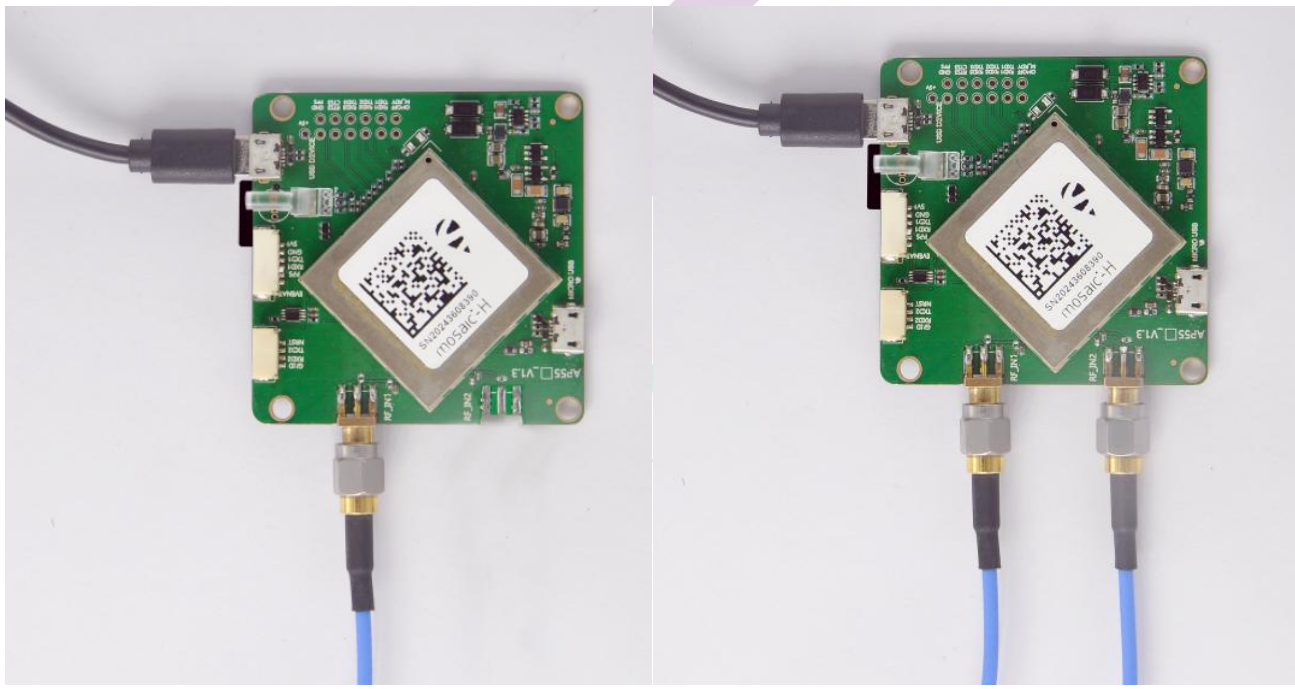
2.1 The board will be virtually connected on the computer . The serial port number can be viewed through the Device Manager interface:



2.2 Simultaneous USB The connection will also create a virtual network port, IP address. The address is fixed at 192.168.3.1

Note: ① The AP55 can be powered via USB connection and does not require an external power source. See the diagram below.

②The AP55H is powered by an external power supply via a MICRO USB port. See the diagram below.

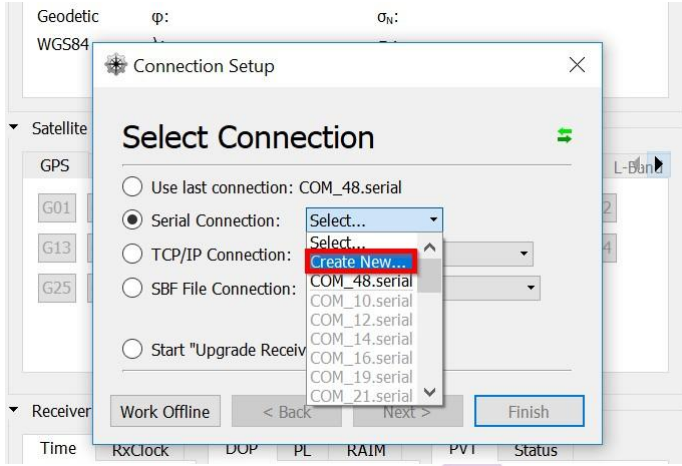


① ②

6.3 RxControl Software Connection Board

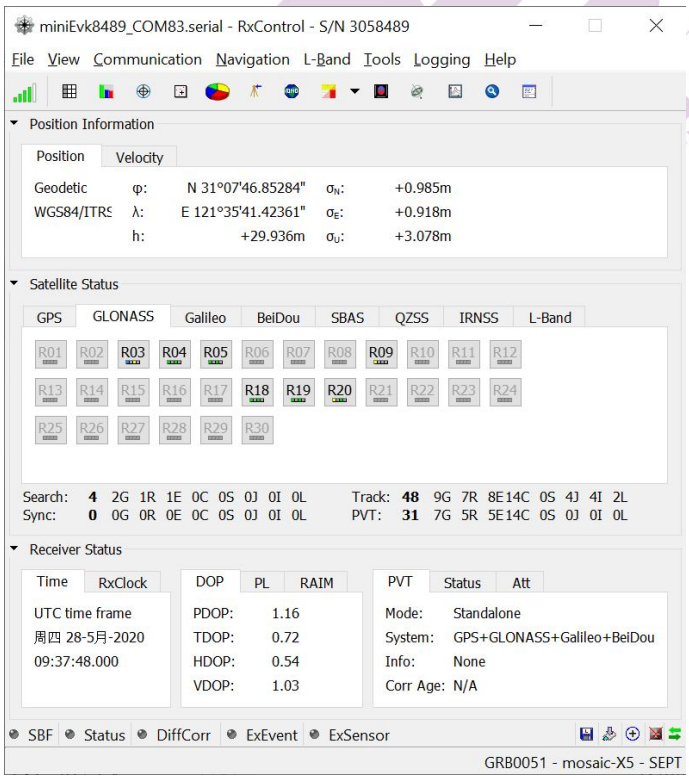
1. Launch RxControl The software will then pop up a Connection dialog box . Setup In the dialog box, select Serial Connection/Create New...

1.1 For the first connection, a new connection needs to be created; for subsequent connections,



simply select the already created serial port connection.

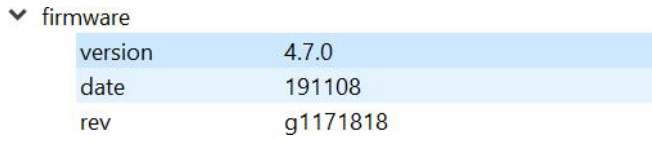
2. After a successful connection, you can see RxControl. The interface is shown below:



6.4 Check firmware and upgrade

1. Confirm the board firmware version

1.1 Using RxControl Software Help/Receiver Identification Check firmware version



1.2 Current Mosaic The latest firmware version is 4.14.0 (June 2023) , and you can also download the latest firmware via the following link :

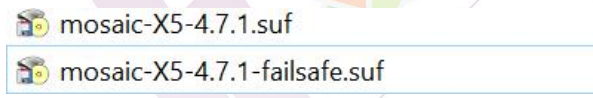
https://www.septentrio.com/en/products/gps/gnss-receiver-modules

2. Firmware upgrade

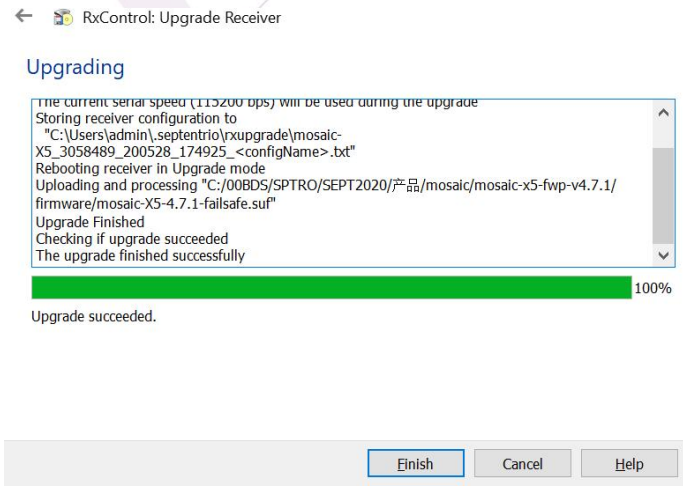
If the firmware is not the latest version as shown in the previous steps, upgrade the firmware using the following steps, taking version 4.7.1 as an example:

2.1 RxControl Software File/Upgrade Receiver using Current Connection...

2.2 Select the latest firmware file. There are two firmware files. First, upgrade the failsafe.suf firmware file, then upgrade the 4.7.1.suf firmware file.



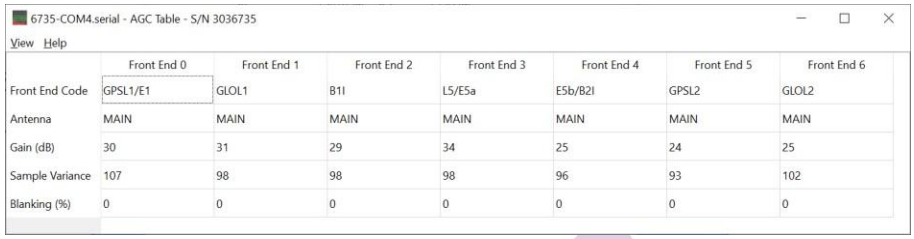
2.3 Upgrade successful



2.4 RxControl Reconnect via Help/Receiver Identification The firmware version information has been confirmed to be updated.

6.5 Check the status of the board

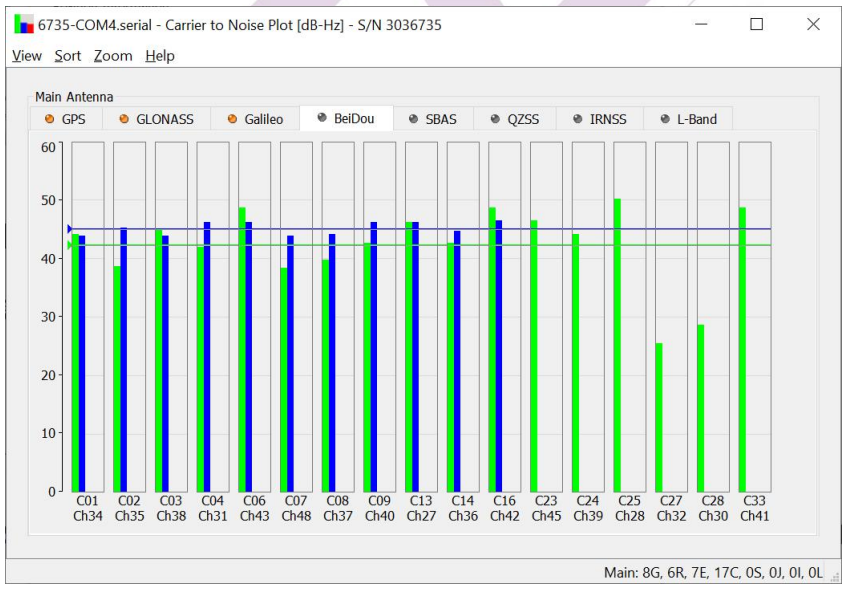
The antenna gain for the board to function properly is between 15-50dB. Excessively high gain indicates a poor antenna connection or excessive cable loss. The antenna gain value can be determined through RxControl->View->AGC Table.



	Front End 0	Front End 1	Front End 2	Front End 3	Front End 4	Front End 5	Front End 6
Front End Code	GPSL1/E1	GLOL1	B1I	L5/E5a	E5b/B2I	GPSL2	GLOL2
Antenna	MAIN	MAIN	MAIN	MAIN	MAIN	MAIN	MAIN
Gain (dB)	30	31	29	34	25	24	25
Sample Variance	107	98	98	98	96	93	102
Blanking (%)	0	0	0	0	0	0	0

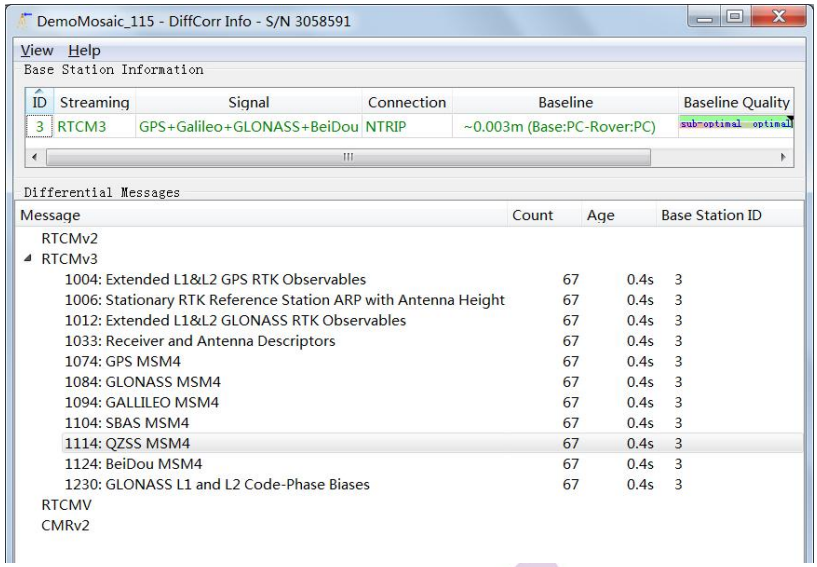
6.6 Check satellite reception and signal-to-noise ratio

Satellite search status can be referenced. RxControl main interface Satellite Status , signal-to-noise ratio can be obtained through... View -> Carrier to Noise Plot .



6.7 Viewing Differential Data

Access the following interface through the RxControl software View/DiffCorr Info View , where you can see the differential source signal system, baseline length, and RTCMv2 or RTCMv3 data.



6.8 Check the board's positioning and orientation status

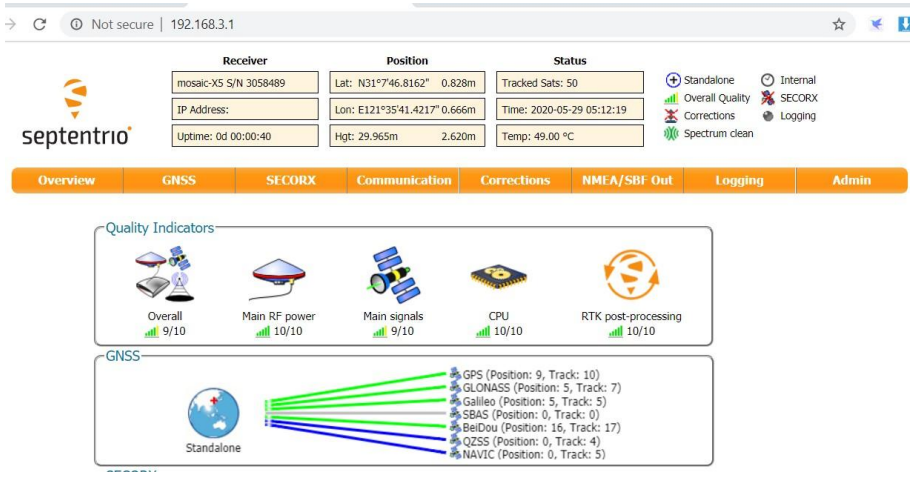
The positioning status can be viewed in the RxControl main interface . The Position Information section displays the antenna position information , and the PVT column in the lower right corner shows the board's positioning status and the various satellite systems used for positioning.

6.9 RxControl Command Line Window

Using the RxControl software , enter commands in the Tools/Expert Console/GRB0051 window . The window will automatically provide command prompts as you type , or you can type "help" to return all supported commands.

6.10 Web Interface

When connected via USB, a virtual network port will appear on the computer. The IP address is fixed at 192.168.3.1. Open the browser, and the interface will look like the following:



The receiver can be configured via Admin/Expert Control/Control Panel . Refer to Chapter 3 below for configuration instructions.

7 Set up tracking and calculation of satellites and frequencies.

7.1 Tracking Satellites

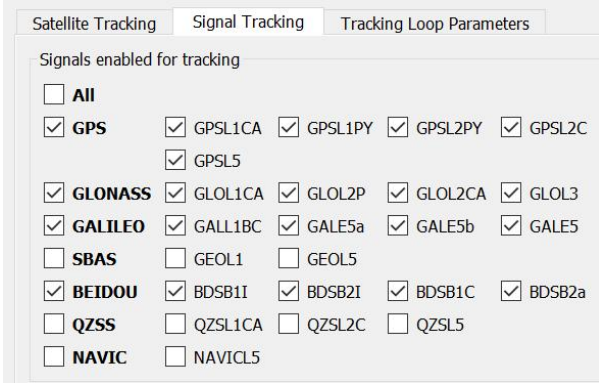
1. Configure satellite tracking using RxControl Software Navigation/Advanced User Setting /Tracking/Satellites Tracking , check all boxes for GPS+Glonass+Galileo+Beidou

Command line: sst,GPS+Glonass+Galileo+Beidou

7.2 Tracking Frequency

1. Set the tracking frequency point, RxControl Software Navigation/Advanced User Setting/Tracking/Signal

Tracking: Select all frequencies for GPS, GLONASS, Galileo, and Beidou.



Command line: snt,GPS+Glonass+Galileo+Beidou

7.3 PVT Satellite Solution

1. Configure the satellite for calculation, RxControl Software Navigation/Advanced User Setting /PVT/Satellites Usage: Select all GPS+Glonass+Galileo+Beidou

Command line: ssu,GPS+Glonass+Galileo+Beidou

7.4 PVT Frequency Calculation

1. Set the calculation frequency point, RxControl Software Navigation/Advanced User Setting /PVT/Signal Usage: Select all GPS+Glonass+Galileo+Beidou All frequencies

Command line: snu,all,all

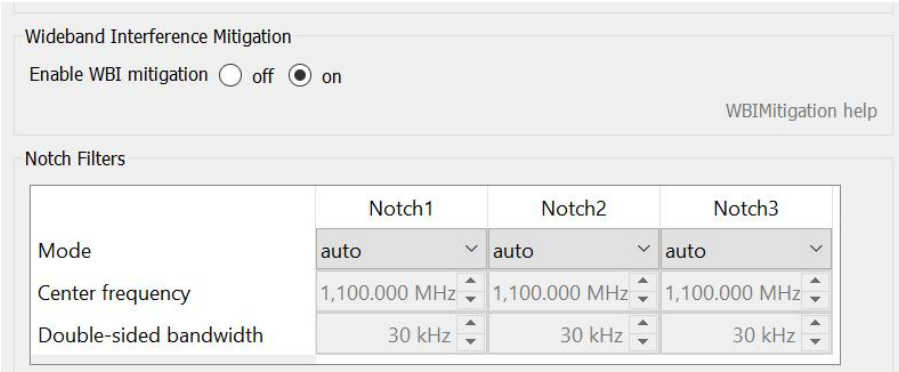
8 Performance optimization settings

8.1 Anti-interference

To enable the anti-interference feature, follow these steps : RxControl/Navigation/Advanced User Settings/Frontend and Interference Mitigation:

Wideband Interference Mitigation/Enable WBI mitigation: **ON**

Notch Filters: Notch 1 – **Auto** ; Notch 2 – **Auto** ; Notch 3 – **Auto**



Command line: setWBIMitigation,on // Enable broadband interference suppression

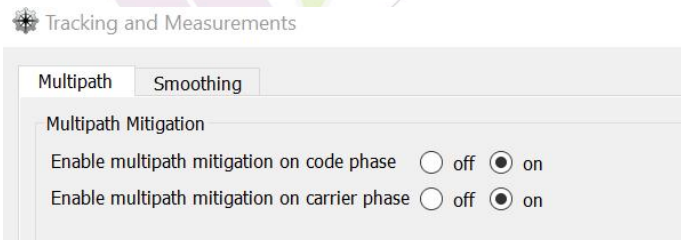
setNotchFiltering,all,auto,,,//Narrowband interference suppression - Enable

8.2 Multipath Suppression

To view and configure multipath suppression options, follow these steps : RxControl/Navigation/Receiver Operation/Tracking and Measurements/Multipath:

Enable multipath mitigation on code phase: **ON**

Enable multipath mitigation on carrier phase: **ON**

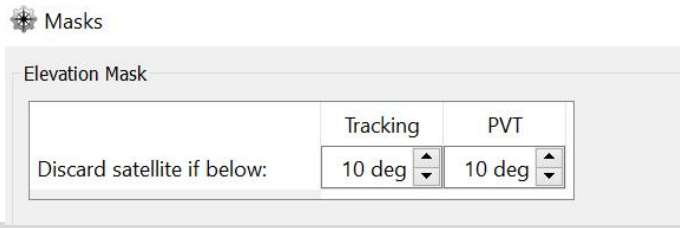


Command line: setMultipathMitigation,on,on //Multipath suppression - Enable

8.3 Cutoff Elevation Angle

It is recommended to set the cutoff elevation angle to 10°. You can view and set the cutoff elevation angle option through the following steps : RxControl/Navigation/Mask/Elevation Mask:

Discard satellite if below: Tracking: **10** degree **;** PVT: **10** degree **;**

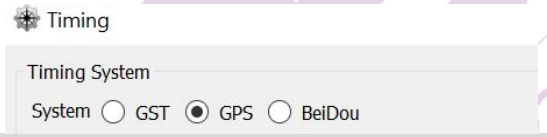


Command line: setElevationMask,tracking,10 // Set the tracking cutoff elevation angle to 10°
setElevationMask,pvt,10 // Set the PVT cutoff elevation angle to 10°

8.4 Satellite Time System

The board defaults to using GPS time. If GPS signal interference affects positioning quality and prevents RTK from reaching a Fixed state in actual applications, it is recommended to change the time system to BeiDou satellite system time. The method is as follows:

RxControl/Navigation/Rover Operation/Timing / Timing System: **Beidou**

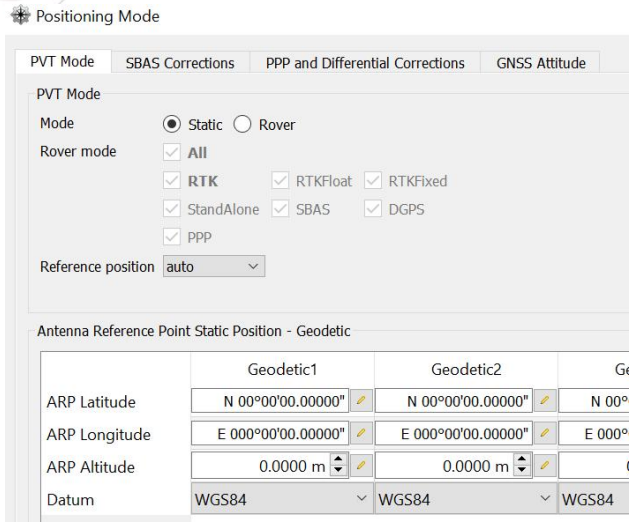


Command line: setTimingSystem,Beidou // Sets the time system to BeiDou satellite system time

9 RTK Mode

9.1 Base Station Mode

1. The configuration board is Static Mode: RxControl/Navigation/Position Mode



set up Reference position is Auto , or specify latitude and longitude coordinates , for example in

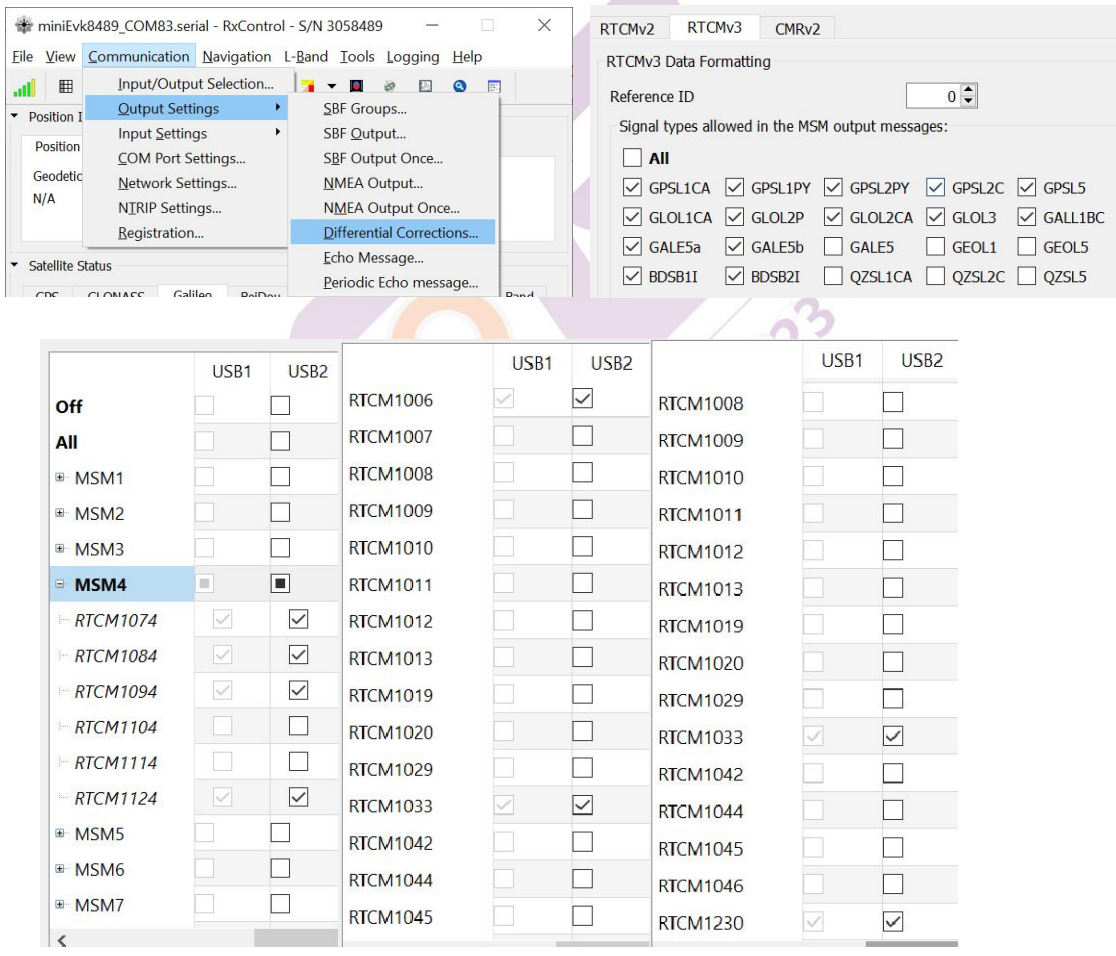
Geodetic1 inputs latitude and longitude coordinates , then... Reference position selection Geodetic1

命令行：setpvtmode,static,,auto //设置为static 基站，自动获取位置
Command line:

setStaticPosGeodetic,Geodetic1,11.1234,22.1234,33.123 //set upGeodetic1 `

setpvtmode,static,,geodetic1` // Sets the location of the base station using `Geodetic1`.

2. Set RTCMv3 Output



Follow the steps shown in the screenshots above to set up RTCMv3 data output, including the satellite frequency used for RTCMv3 and the data type of the output RTCMv3.

Command line:

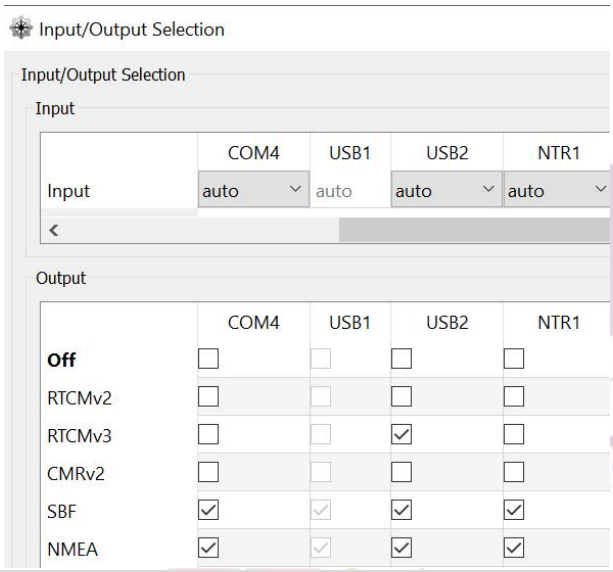
setRTCMv3Formatting,0,GPSL1CA+GPSL1PY+GPSL2PY+GPSL2C+GPSL5+GLOL1CA+GLOL2P+G

LOL2CA+GLOL3+GALL1BC+GALE5a+GALE5b+BDSB1I+BDSB2I

//Set the satellite frequency used for RTCMv3 output

setRTCMv3Output,usb2,RTCM1006+RTCM1033+RTCM1074+RTCM1084+RTCM1094+RTCM1124+RTCM1230 // Configure RTCMv3 output, outputting via USB2 port.

3. Port enable output RTCMv3 data

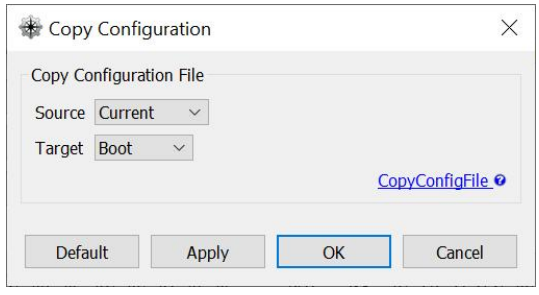


Command：setDataInOut,USB2,auto,RTCMv3 //Open USB2 output RTCMv3

4. Save settings

Whether you change settings in RxControl, the command line, or the web interface, you need to save them so that they will take effect after a power outage and restart.

RxControl software, you can save the Current file to Boot through the File/Copy Configuration interface, which is required to save it as a boot file.

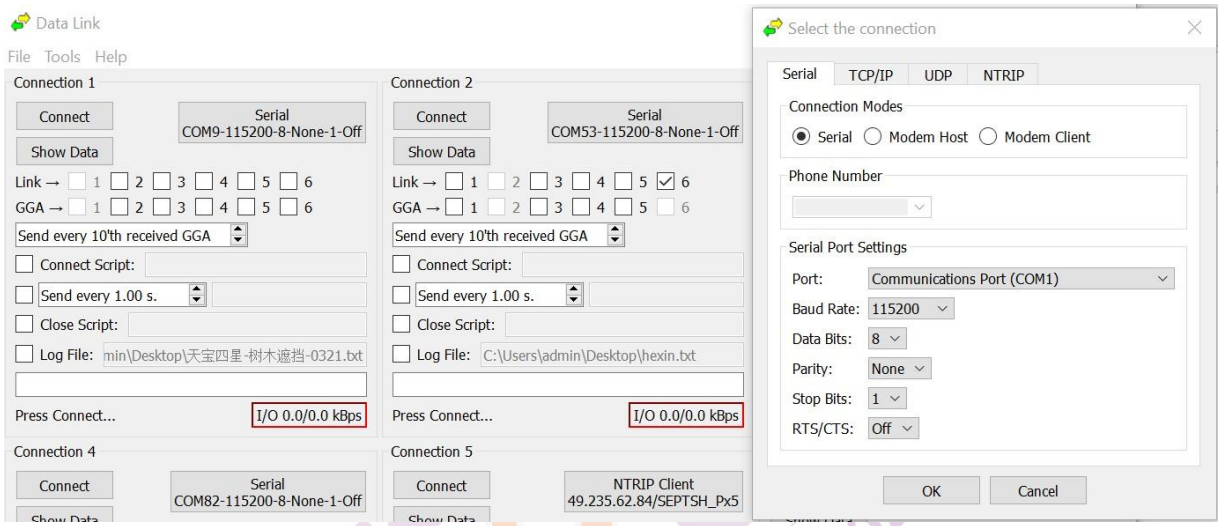


Command line: eccf,current,boot //Save settings

9.2 Datalink Program

Function 1: Port connection and data distribution

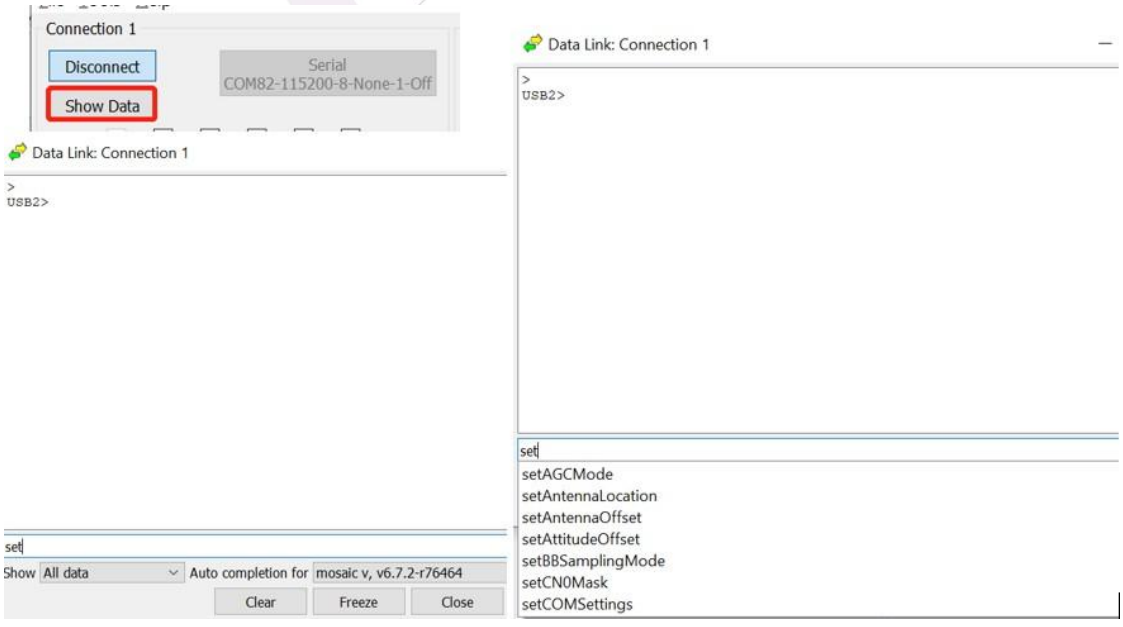
Datalink programs can establish data links between different connections, allowing data from one port to be forwarded to other connections. For example, if a Datalink program has six connections , connection1 can receive serial or NTRIPdifferential data and then distribute it to other different connections.



Function 2: Serial Port Assistant

Connect the board using the Serial port. The default baud rate is 115200. Click Connect to establish the connection, then click Show.

Data displays the serial port monitoring interface.



In the serial port monitoring interface, select "Auto completion for mosaic v" in the lower right corner . This will automatically prompt for the command format when you enter the command line .

Function 3: Record port output data to a file

After the serial port monitoring interface picks up the port data, return to the Datalink main interface and

click Log File to save the data to a file.

9.3 Mobile Station Mode

1. First, switch the board to Rover. Mobile station mode, via RxControl Software Navigation/Positioning

```
Command: setPVTMode,rover,RTK+Standalone          //Set PVT Rover mode
```

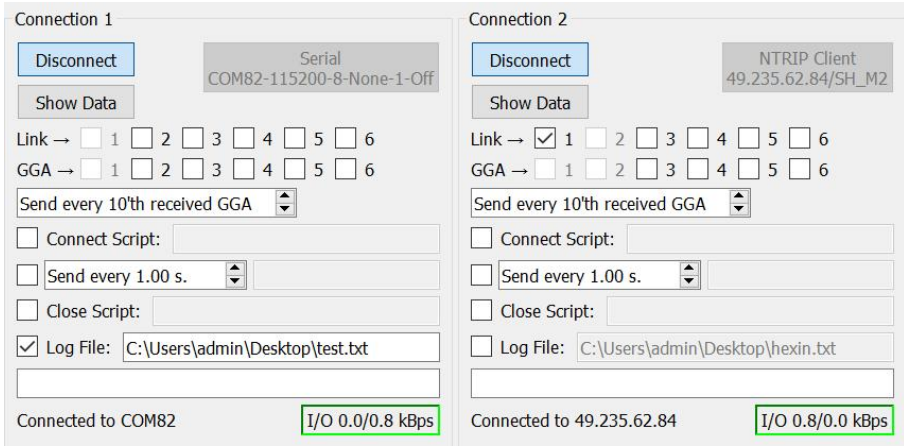
Mode interface PVT mode: Rover

2. RxControl Software File/Copy Configuration/Current->Boot

```
Command: eccf,current,boot                        //Save setting
```

3. Datalink Set differential input in the software
   a. Configure Connection1 Connect to Mosaic MiniEVK USB2 The port (the corresponding virtual serial port can be viewed through the computer's Device Manager)
   b. Configure Connection2 via serial port or NTRIP Connect the differential source in this way and use Show Data Confirm valid reception of differential data
   c. Connect2 Differential data link ToConnection1 , this is how MiniEvk works. The board can obtain differential data.

Note: If using a 6-point NTRIP or other CORS station differential data, the board's differential receiving port needs to be configured to output 1Hz GGA data. See NMEA Data Port Real-time Output for specific settings.

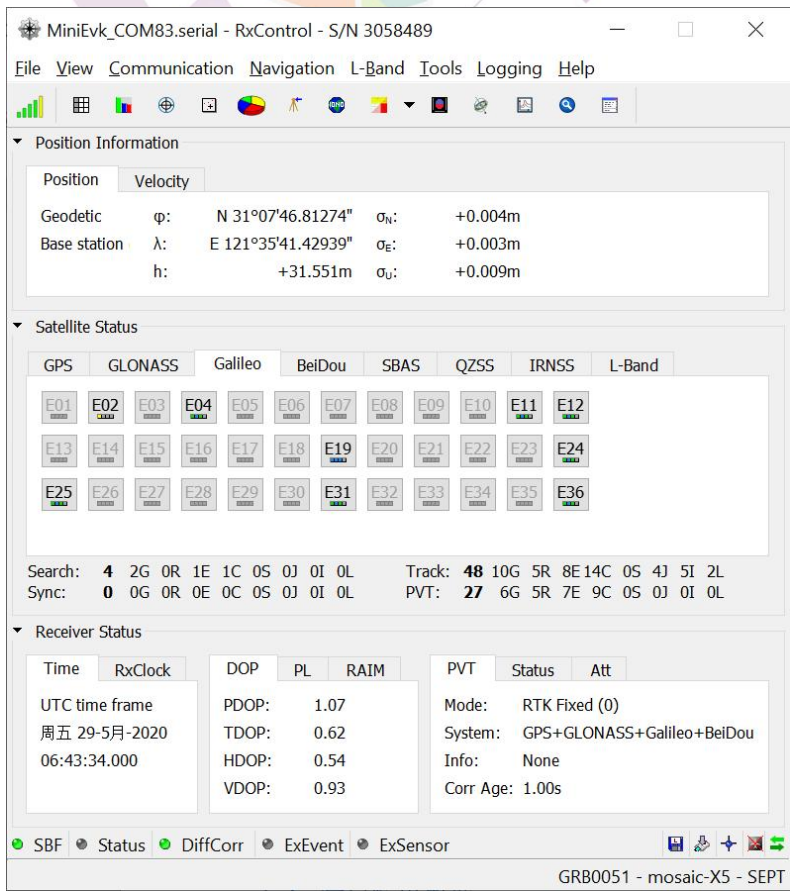


4. RTK Fixed Status verification

4.1 Returning to the RxControl software, the Position Information section displays the positioning accuracy.

4.2 The PVT information bar in the lower right corner shows whether the current RTK status is RTK Fixed, and the satellite system calculated by PVT.

4.3 The DiffCorr light in the lower left corner is flashing, indicating that differential data is being received in real time.



10 NMEA Data

10.1 Real-time output via port

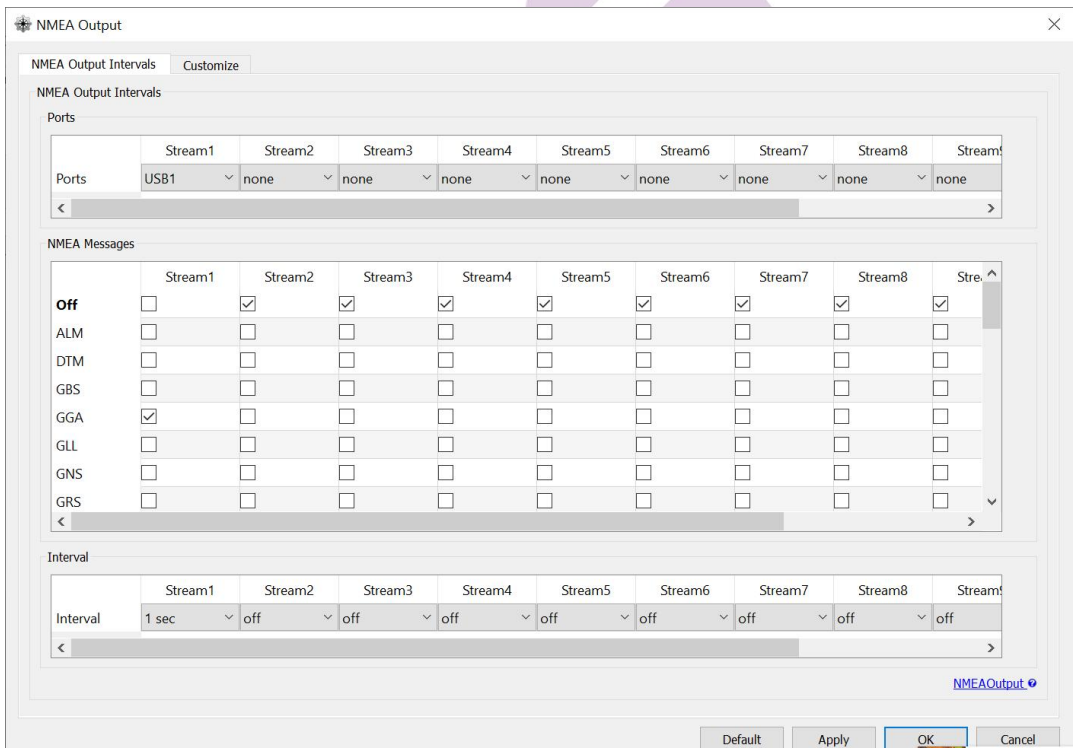
1. Through RxControl Software, Communication/Output Settings/NMEA Output/NMEA Output Intervals settings

   d. Output port

   e. NMEA Data types

   f. Output frequency

2. Save settings, File/Copy Configuration/Current->Boot



Command line: sno,stream1,ubs2,gga,sec1 // Sets the USB2 port to output 1Hz GGA

Command line: eccf,current,boot //Save settings

10.2 Recording data to memory card

The Mosaic MiniEvk supports mounting TF memory cards, allowing data to be recorded to the memory card.

1. Configure via RxControl software, under Communication/Output Settings/NMEA Output/NMEA Output Intervals.

1.1 The output port is DSK1

1.2 NMEA Data Type

```
Command：sno,stream1,ubs2,gga,sec1                    //Set USB2 output 1hz GGA
```

1.3 Output Frequency

2. Save settings: File/Copy Configuration/Current->Boot

```
Command line: eccf,current,boot    //Save settings
```

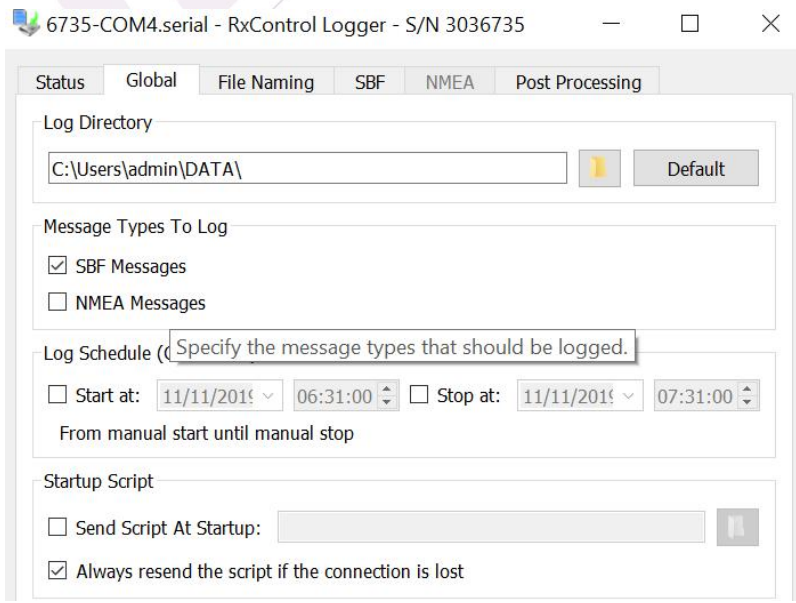
10.3 Recording Data in Computer Files

Method 1: via Datalink

1. Datalink The program can connect to Mosaic MiniEVK USB2 The port is configured by inputting commands through the serial port monitoring interface to set the output data, and the Log option is checked. You can find it in the file (see details)Datalink program)

Method 2: Logging via RxLogger or RxControl software

1. RxControl Logging/RxControl software Logging Function or running RxLogger Program, connect to Mosaic Access the MiniEvk USB port to enter the following interface.



2. Global Under the menu, set Message Types To Log , check NMEA.

   Note: If you check this box, you need to configure it and record the settings. If you do not need SBF, you need to uncheck it.

3. InFile Naming Under the menu, set the file path and file name; you can also optionally set the size and duration of individual files.

4. InNMEA Under the menu, set the output data type and interval.

5. Click **Start Logging** Start recording to computer file

11 SBF Raw Data

The SBF - Septentrio Binary Format file is a proprietary binary format file of Septentrio, containing relatively complete information.

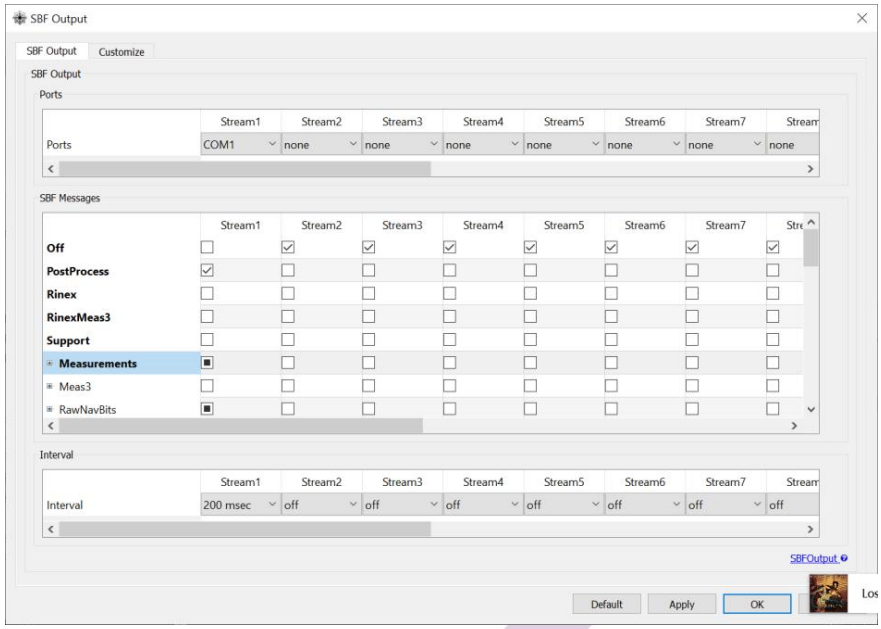
11.1 Port outputs raw data

In the RxControl software interface, navigate to Communication/Output Settings/SBF Output and configure it.

1. Output port
2. Data types

   For the required data types, please refer to Chapter 4 SBF Reference in the Mosaic Firmware Guide.

3. Output interval
4. Save settings, File/Copy Configuration/Current->Boot



Command line:

sso,stream1,ubs2,PostProcess,msec200 //Set USB2 output 5hz PostProcess data

Command: eccf,current,boot //Save setting

11.2 Record raw data to memory card

The method of recording to the memory card is basically the same as the method of serial port output; you only need to change the serial port number to DSK1.

11.3 Recording data in computer files

The setup steps are the same as for NMEA data recording to a computer file, except that you change the NMEA data to SBF data and make sure to select the desired SBF data type.

Note: SBF data is logged to the computer. If you need to change the logging interval, you need to use the RxLogger program to record it.

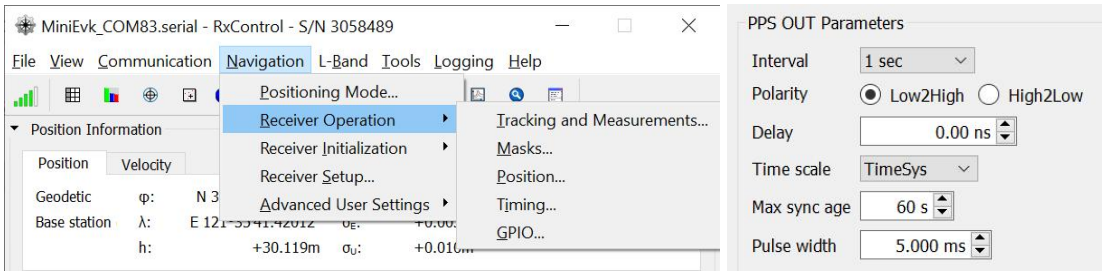
The SBF recording function under RxControl cannot be set; the default is 1Hz.

12 External Events

12.1 PPS Output

the RxControl software interface , configure Navigation/Receiver Operation/Timing. Output PPS and save

settings.

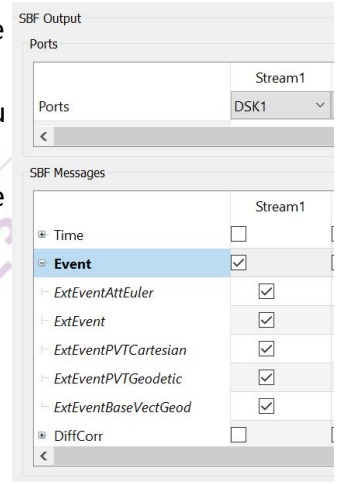


Command line: setPPSParameters,sec1,Low2high // Sets the output to 1 PPS (maximum100), pulses from low to high.

Command line: eccf,current,boot //Save settings

12.2 Event

1. RxControl Software interface, Navigation/Receiver Configure the Operation/Timing event and set up SBF logging. For data recording, you need to select the Event data type so that the location information of the external trigger moment will be recorded.



Command line :

sso,stream1,ubs2,PostProcess+Event,msec100

// Set USB2 port output to 10Hz PostProcess+Event data

2. Save settings

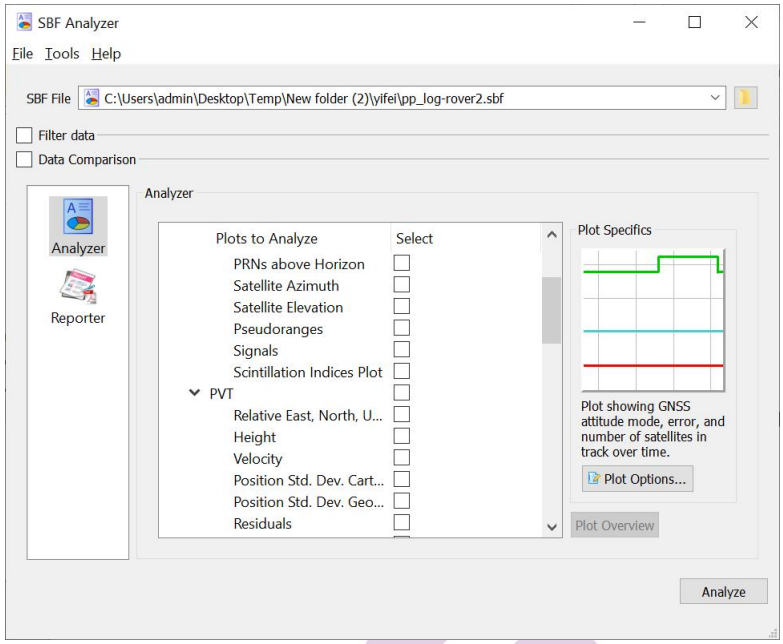
Command: eccf,current,boot //Save setting

13 SBF Data Analysis

13.1 SBF Analyzer

SBF Analyzer will be automatically installed when you install RxTools software . Below is a brief introduction to using the SBF Analyzer program :

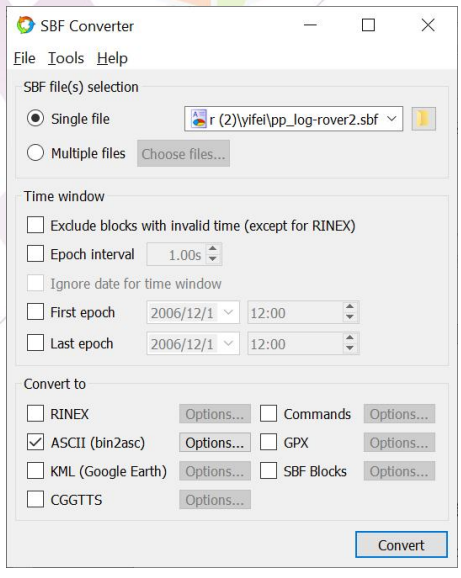
1. Double-click to run SBF Analyzer Program, or SBF Right-click the formatted file and select SBF. Analyzer



2. Select the content you want to analyze and click Analyze . That's all

13.2 SBF Converter

The SBF Converter program can convert SBF files into the desired universal format.



1. Running SBF Converter Program or SBF Right-click the file and select Convert. SBF

2. SBF can be Convert to Rinex, ASCII Documents, etc.

3. If it is an Event Application, via ExtEventPVTGeodetic1 View the location data recorded at the external trigger moment.

14 Troubleshooting

14.1 Diagnostic Report

1. Diagnostic reports or report content can be obtained in the following ways:

RxControl Software connection board, File/Display Diagnostic Report Or press the shortcut key Ctrl+C

Then save the report as a PDF. The file is sufficient.

2. Access it through the web interface: Admin/About/Diagnostic Report , then Save. As Save as a text file

3. Alternatively, use a serial port assistant to enter the following commands and copy the content returned by the board to a file.

g. lstInternalFile, Identification
h. lstInternalFile, Permissions
i. getReceiverCapabilities
j. getReceiverInterface
k. lstConfigFile, Boot
l. lstConfigFile, Current
m. lstInternalFile, Ipparameters
n. getSbfOutput
o. getDataInOut
p. lstInternalFile, Error
q. lstInternalFile, SetupError
r. lstInternalFile, rxMessages
s. lstDiskInfo, all

14.2 Support for SBF files

If technical support is needed to analyze data quality and troubleshoot board anomalies, Support SBF data should be recorded, along with the SBF operation steps as described in the original ***SBF data*** introduction.

Support SBF data rate can be set to 10Hz . The recording frequency of Support SBF can be adjusted depending on whether the scene is static or moving . It is recommended to check the Support+BBSamples option to record data to a memory card or computer file.

```
Command：sso,stream1,dsk1,support+BBsamples,msec100        //Record support+BBsamples to memory card
```

```
Command：eccf,current,boot                                 //Save setting
```