Accurate positioning

22°43'59.57617"N 114°03'03.61546"E

X43H-AH

Multi-constellation, Multi-frequency RTK Receiver

Datasheet

Shenzhen Jumpstar Technology Co.,Ltd

Email : info@jumpstar-tech.com
Tel : (86) 0755-23732282
Fax : (86) 0755-23732823
Add : Room 1305, Building A, Lechuanghui Building, No. 1211 Guangguan Road, Guanlan Street, Longhua District, Shenzhen

Table of contents

Version update notes

Revised version	Modified date	Content changes and modifications	Modified by
V1.0	2025-07-01	First Version	WW

This document applies to the following products:

Product Type	Product Model	Product Features				
		Multi-Constellation Multi-Frequency	Anti-interference	Dual-antenna heading	TTL	RS232
P-BOX	X43-AH	√	√	-	√	-
P-BOX	X43H-AH	√	√	√	√	-
P-BOX	X43R-AH	√	√	-	-	√
P-BOX	X43HR-AH	√	√	√	-	√

1. Product Introduction

1.1 Overview

The X43H-AH is a new multi-band, multi-constellation receiver with multiple data interfaces. In addition to high-precision positioning, it provides heading and pitch angles or heading and roll angles, making it ideal for autonomous navigation. It is suitable for various applications including UAVs, fully automated robots, precision control, and unmanned vehicles. This module features the low and predictable latency required for stable and accurate control systems, can track all Global Navigation Satellite Systems (GNSS) , supports all current and future signals, and is compatible with popular open-source autopilots. It performs particularly well in complex environments, providing a performance benchmark for mass-market GNSS positioning and is currently widely used in the mass GNSS market .

1.2 Product Characteristics

- Use high-performance chips
- All-view satellite tracking, multi-constellations, multi-frequencies
- 789 hardware channels enable simultaneous operation.
- Up to 20 Hz navigation update rate
- Ultra-low latency of less than 10 milliseconds
- Supports GPS, GLONASS BDS , Galileo, QZSS, Navic , SBAS satellites
- Integrates T CXO, LNA, and a TF card slot for up to 32GB .
- Compact size (43.8 * 34.0 * 11.5 mm ± 0.2 mm) , <25g
- Supports standards NMEA 0183, SBF , RINEX, RTCM , CMR/CMR+
- AIM+ features advanced capabilities including interference and spoofing detection and automatic mitigation.
- LOCK+ offers robust tracking capabilities against mechanical shocks and vibrations.
- IONO+ features advanced ionospheric interference protection.

- APME+ multi-path mitigation separates direct signals from signals reflected from nearby buildings.
- It features interference indicator, interference mitigation, and spectrum measurement functions.
- Supports ultra-short baseline heading output
- Supports GNSS navigation
- Supports Galileo OSNMA

1.3 Performance Indicators

Parameter	Detail Description
Satellite Receiving	■GPS: L1C/A, L1C, L2C, L2P Y , L5 ■BDS: B1I, B1C, B2a, B2I, B2b, B3I ■GLONASS:L1CA, L2CA, L2P, L3 CDMA ■Galileo:E1, E5a, E5b,E6 ■QZSS: L1C/A, L1C /B , L2C, L5, L 6 [1]
Tracking performance (C/N0 threshold)	Tracking and navigation sensitivity 20 dB-Hz Capture sensitivity 30 dB -Hz
Positioning time[2]	Cold start < 35s Warm start < 10s Recapture 1s
RTK state[3]	Horizontal position accuracy 0.6cm + 0.5ppm[4] Vertical accuracy 1cm ± 1ppm[4] Initialization time: 7s
Other positioning status[3]	Horizontal Vertical Standalone 1.2m 1.9m DGNSS 0.4m 0.7m
Time accuracy	xPPS output 1.4ns Event accuracy <3ns
Delay	99.9% <10ms
Velocity accuracy	0.03m/s
Heading accuracy (dual antennas)[3]	Heading Pitch/Roll 1m antenna 0.15° 0.25° 5m antenna 0.03° 0.05°
Baud rate	4800- 4 Mbps (default 115200bps)
Maximum data update frequency	20Hz

✌1. Special firmware support

✌2. All satellites are at -130dBm

✌3. RMS levels , 24 Hourly static , -130dBm, ≥ 12 Using satellites

✌4. For every 10 kilometers from the base station, the accuracy error increases by 1 centimeter (baseline range < 40 km) .

1.4 Protocol Description

Protocol	Type
NMEA 0183 v2.3, v3.03, v4.0	Input/output, ASCII
Septentrio Binary Format (SBF)	Input/output
RTCM v3.x (including MSM)	Input

1.5 Antenna

Project	Parameter	
Antenna pre-amplification range	Single antenna	Dual antennas
	15-50dB	15-35dB
Antenna bias voltage	3.0-5.5V (built-in current limit: 150mA)	

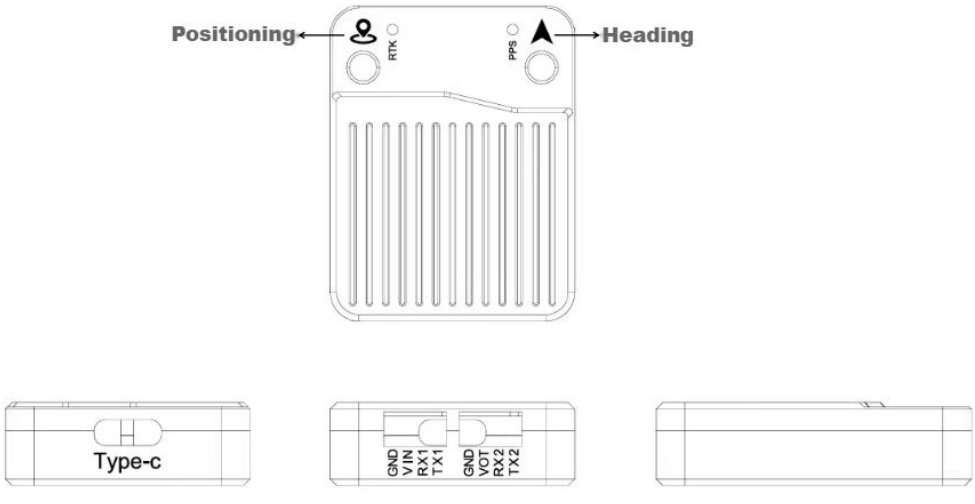
The X43H-AH can be set to single-antenna mode and dual-antenna mode . When using a single antenna, only RF1 needs to be connected . When using a dual antenna, both RF1 and RF2 need to be connected , and dual-antenna directional function is supported. In single-antenna mode, the X43H-AH and X43-AH can achieve RTK positioning by connecting only RF1 .

1.6 Product Application

- Drone applications
- Base station (X43 -A only)
- Intelligent logistics scheduling
- intelligent robots
- Geographical surveying
- Precision agriculture and location services
- Geological disaster monitoring
- Heading output (X 43-AH dual-antenna mode only)
- In-vehicle equipment applications
- Precision control

2. Pin definition

2.1 Pin Assignment



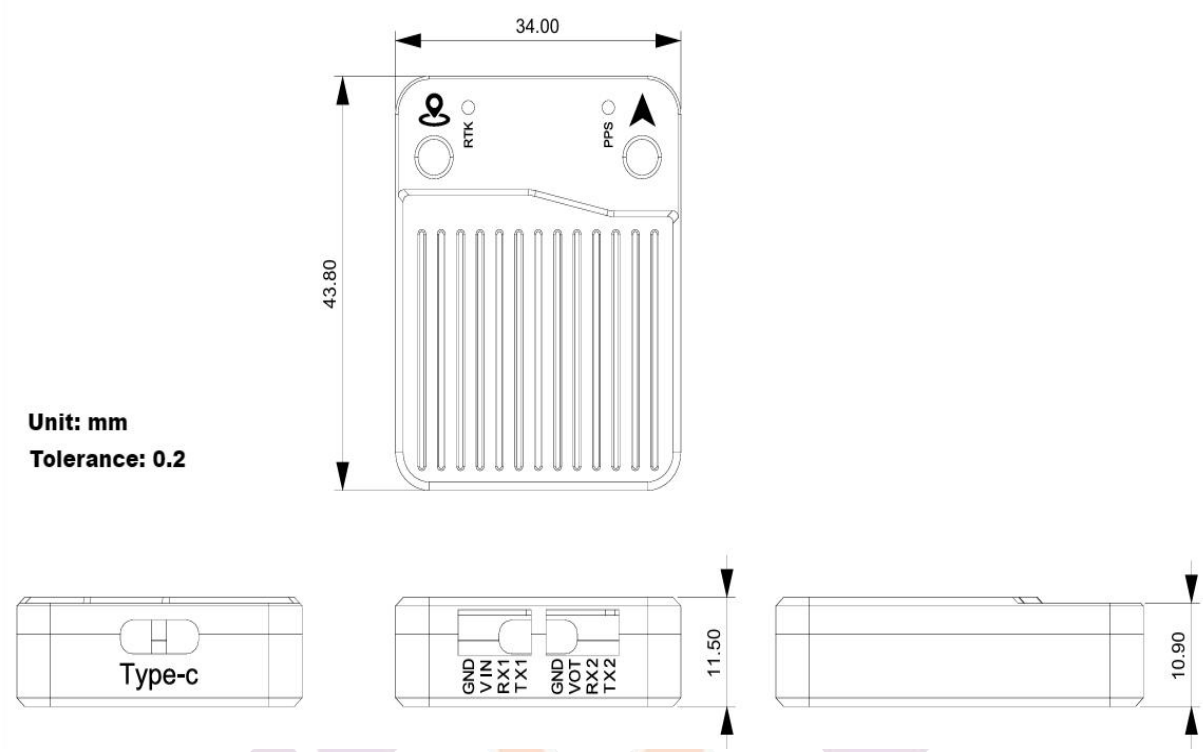
Name	Input/Output	Description
GND	-	Ground
VIN	Input	VCC power supply , supports 3.5-12.0V.
RX1	Input	Serial port 1 GNSS receiving data
TX1	Output	Serial port 1 GNSS data transmission
GND	-	Ground
VOT	Output	3.3V can be used to power other devices.
RX2	Input	Serial port 2 GNSS receiving data
TX2	Output	Serial Port 2 GNSS data transmission
USB	Input / Output	TYPE-C power supply + data transmission
RF1	Input	GNSS main antenna interface, used for positioning , supply voltage 3.0-5.5V .
RF2	Input	GNSS auxiliary antenna interface, used for direction finding , supply voltage 3.0-5.5V .
SD	-	Stores GNSS data, up to 32GB
LED Description		
RTK	Output	RTK positioning indicator, active high. Floating-point LED flashes; LED remains lit during RTK fixed-point positioning; otherwise, it goes low (Green LED) during other positioning states or when not positioning.
PPS	Output	Second pulse (green LED)

3. Electrical characteristics

Parameter		Symbol	Minimum	Conventional	Maximum	Unit
Power supply voltage range		V CC	3.5	5.0	12.0	V
Average current * DCDC	Single antenna	Capture Current	-	130 @5.0V	140 @5.0V	mA
		Tracking Current	-	95 @5.0V	125 @5.0V	mA
	Dual antennas	Capture Current	-	150 @5.0V	190 @5.0V	mA
		Tracking Current	-	125 @5.0V	160 @5.0V	mA
Antenna power supply current		RF_VCC	-	-	150mA@ 5.0V	mA
VCC port maximum ripple		Vrpp	0	50	50	mV
		Vin	-0.5	Vcc +0.2	-	mV
Electrostatic protection		VESD(HBM)	--	2000	2000	V
Storage temperature		Tstg	- 4 5	-	85	°C
Operating temperature		Tstg	-40	-	85	°C
Humidity					95	%

* Passive Antenna Testing

4. Mechanical dimensions



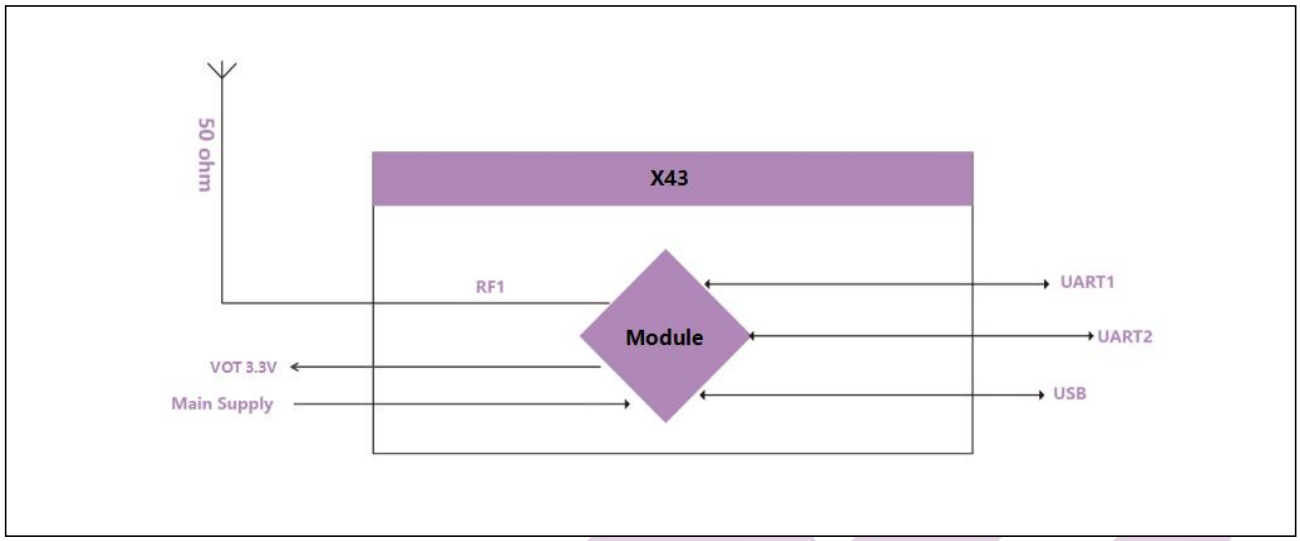
5. Interface Configuration Selection

X43 module has two UART ports and one USB interface by default , which can be used to communicate with the host. The interface output and additional functions can be selected according to the needs of the corresponding interface output. The main options are as follows.

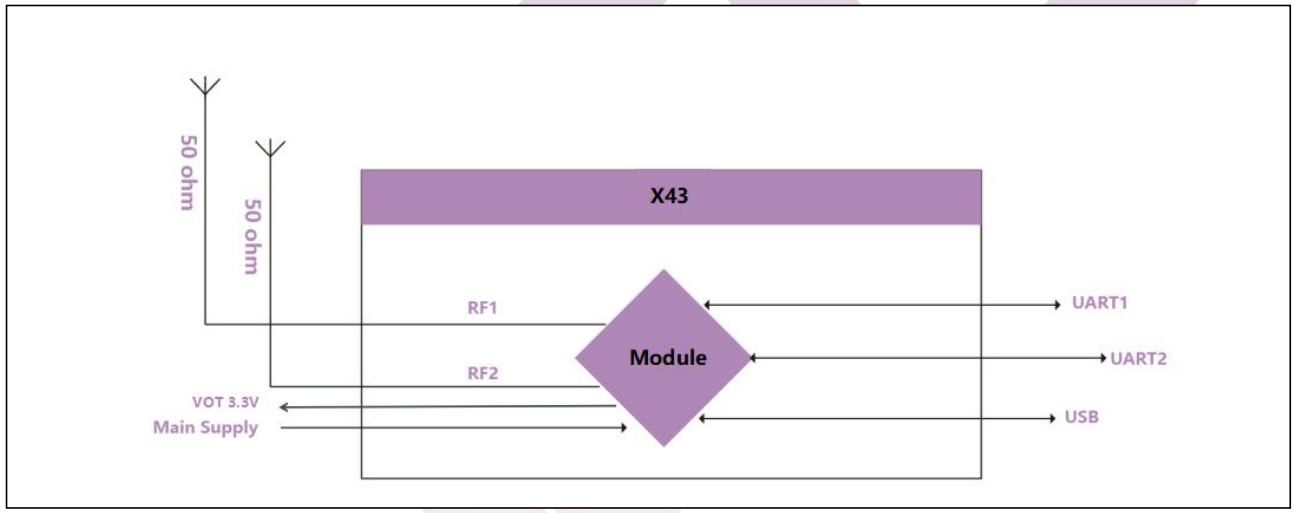
NAME	Position	Heading	TTL	RS232
X43-AH	√	-	√	-
X43H-AH	√	√	√	-
X43R-AH	√	-	-	√
X43HR-AH	√	√	-	√

Block diagram

1. X43-AH



2. X43H-AH



6. Basic Operating Instructions

6.1 Download and install RxTools software

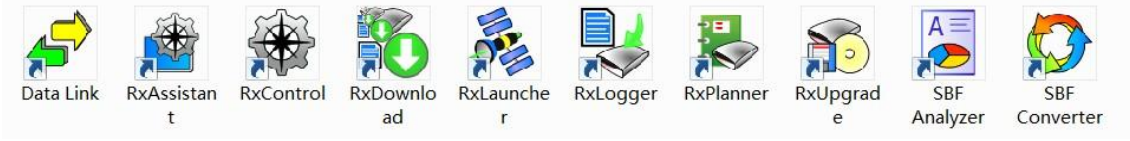
The RxTools software installer and user manual can be downloaded from the following link:

Septentrio Download from official website:

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

After downloading, install directly, avoiding installation directories containing Chinese characters.

After successful installation, the software will contain the following assemblies:



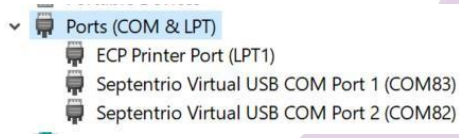
6.2 Hardware Connection

1. Using MMCX Connector to TNC orSMA After connecting the interface, connect the positioning antenna (note that hot-plugging is not allowed).

2. For serial port connection, a standard serial-to-USB cable can be directly connected to a computer's USB port . Then, you can use the Septentrio host computer software RxTools or serial port assistant tools to communicate with the receiver. The default serial port baud rate is 115200.

3. Use a USB cable Connect the device to the computer

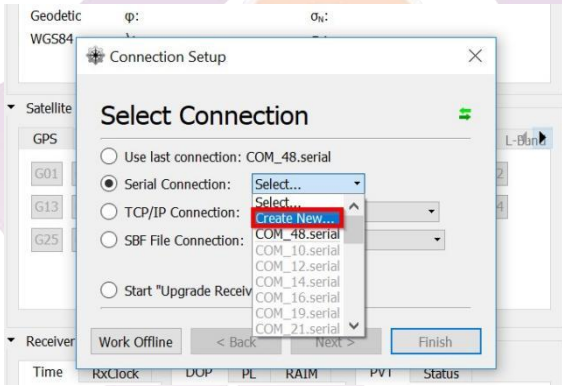
3.1 The board will be virtually connected on the computer . The serial port number can be viewed through the Device Manager interface:



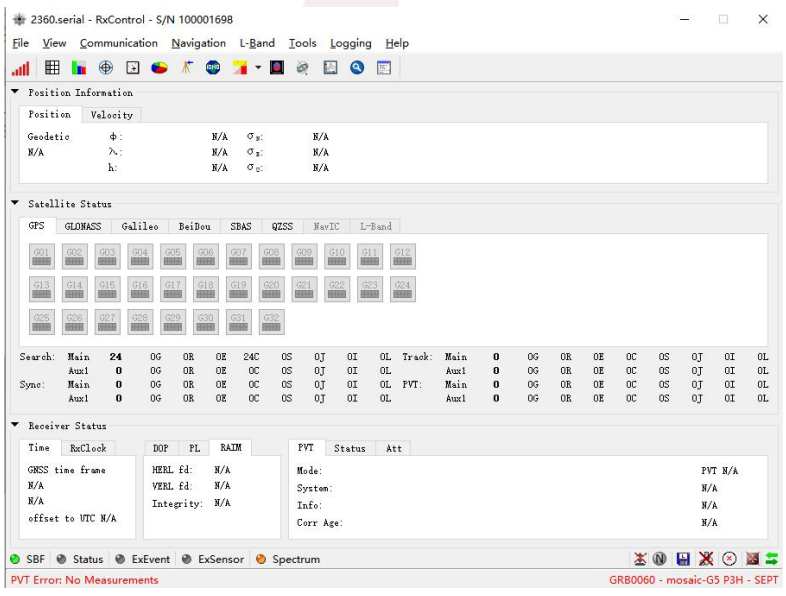
6.3 RxControl Software Connection Board

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.



1. After a successful connection, you will see the RxControl interface as 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 The latest firmware for mosaic-G5 P3H-1.0.0 can also be downloaded via the following link:

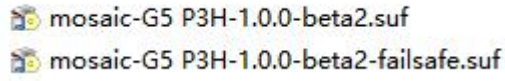
https://www.septentrio.com/en/products/gps/gnss-receiver-modules

2. Firmware upgrade

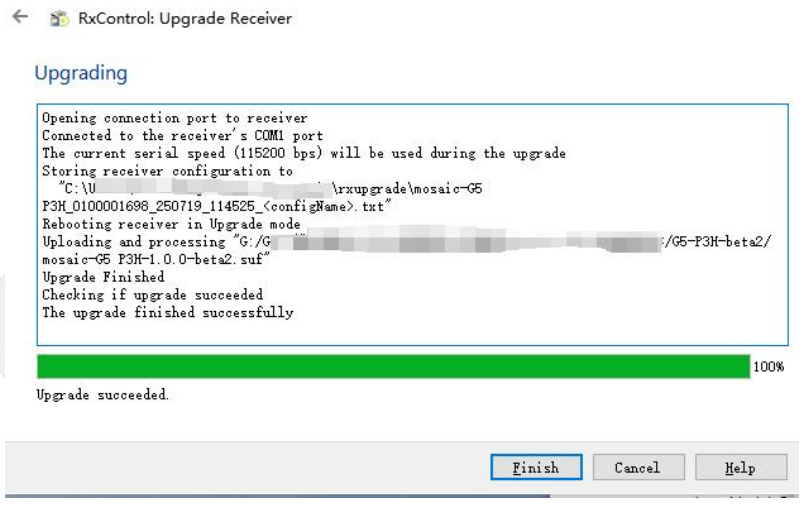
If the firmware is not the latest version as shown in the previous steps, please follow these steps to upgrade the firmware, using the version number as the reference. For example, version 1.0.0-beta2 :

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

2.2 Select the latest firmware file. There are two firmware files; upgrade failsafe.suf first. Firmware file, upgrade to 1.0.0-beta2 .suf firmware file



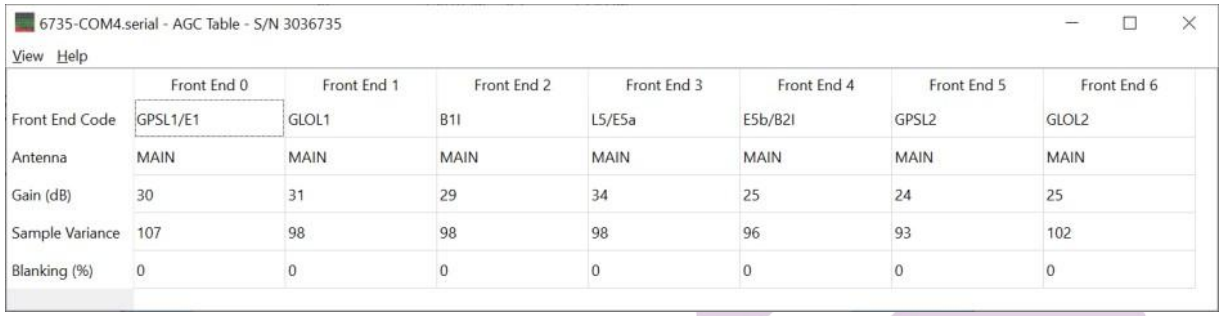
2.3 Upgrade successful



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

6.5 Check board status

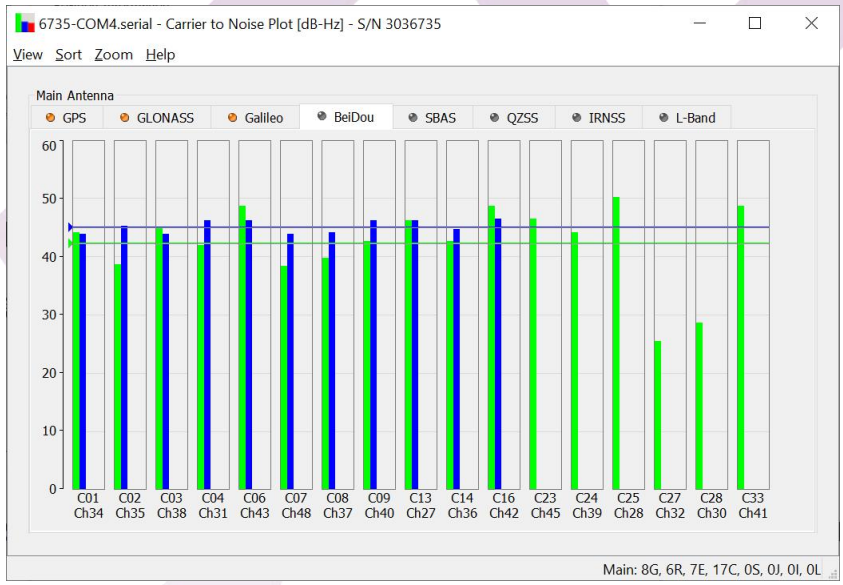
The antenna pre-amplification range is 15-50 dB for a single antenna and 15-35 dB for dual antennas . Excessively high gain indicates poor antenna connection or excessive cable loss. The antenna gain value can be determined through RxControl->View->AGC Table ; 65 - AGC Gain = antenna gain value.



	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

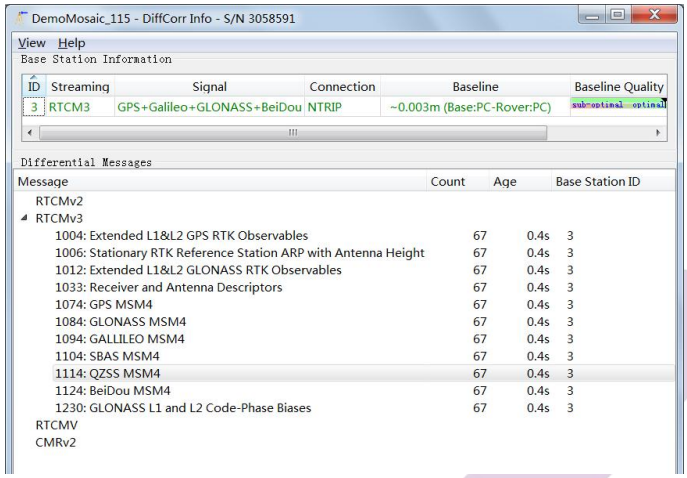
6.6 Check satellite reception and signal-to-noise ratio

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 RxControl software , go to Tools/Expert Console/GRB00 60 Enter commands in the window . The window will automatically provide command prompts as you type . You can also type "help" to return all supported commands.

7. Set up tracking and calculation of satellites and frequencies

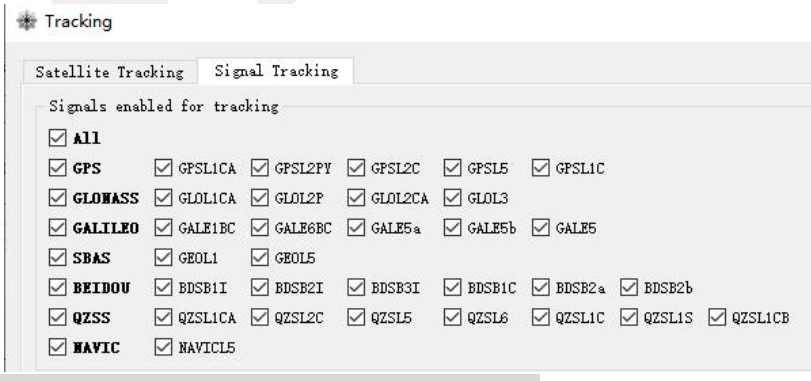
7.1 Tracking Satellites

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

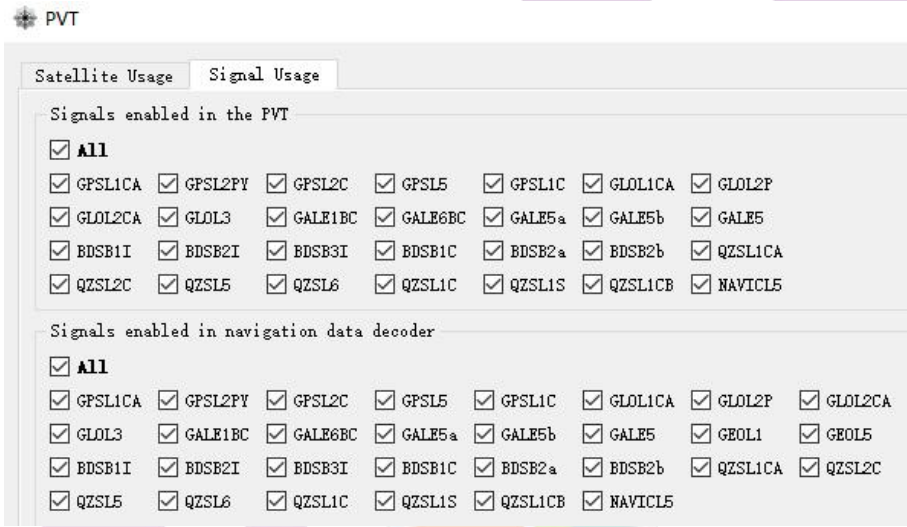
1. Configure the satellite for calculation, RxControl Software Navigation/Advanced User Setting /PVT/Satellites Usage: Select all GPS+Glonass+Galileo+Beidou

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

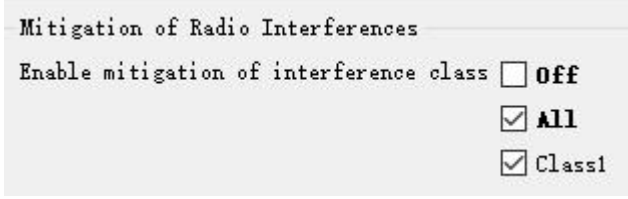
8. Performance optimization settings

8.1 Anti-interference

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

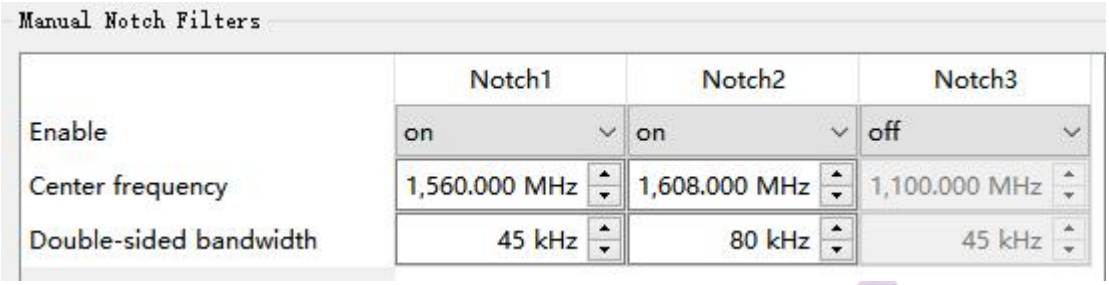
- Enable anti-interference suppression function

Mitigation of Radio Interference s /Enable mitigation of interference class : **Class1**



- Enabling narrowband anti-interference (for known fixed interference) allows setting three different frequency points.

Manual Notch Filters: Notch 1 – **on** ; Notch 2 – **on** ; Notch 3 – **on**



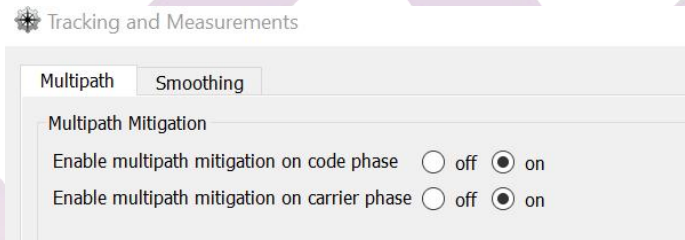
Command line: setRFInterferenceMitigation , Class1 // Broadband Interference Suppression - Enable
setManualNotchFilter, Notch1, on // Enable narrowband interference suppression

8.2 Multi-path Suppression

To view and configure multi-path suppression options, follow these steps : RxControl/Navigation/Receiver Operation/Tracking and Measurements/Multi-path:

Enable multi-path mitigation on code phase: **ON**

Enable multi-path mitigation on carrier phase: **ON**

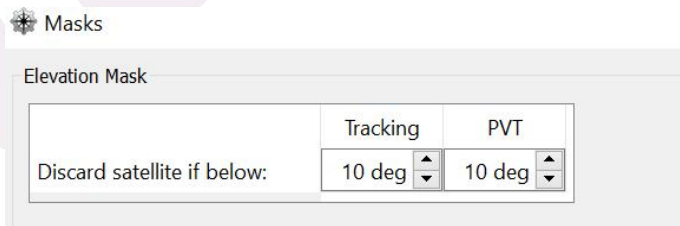


Command line: setMultipathMitigation,on , on // Enable Multipath Mitigation

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/Receiver Operation/Mask s... /Elevation Mask:

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



Command line: setElevationMask, tracking, 10 //Sets the tracking cutoff elevation angle to 10°

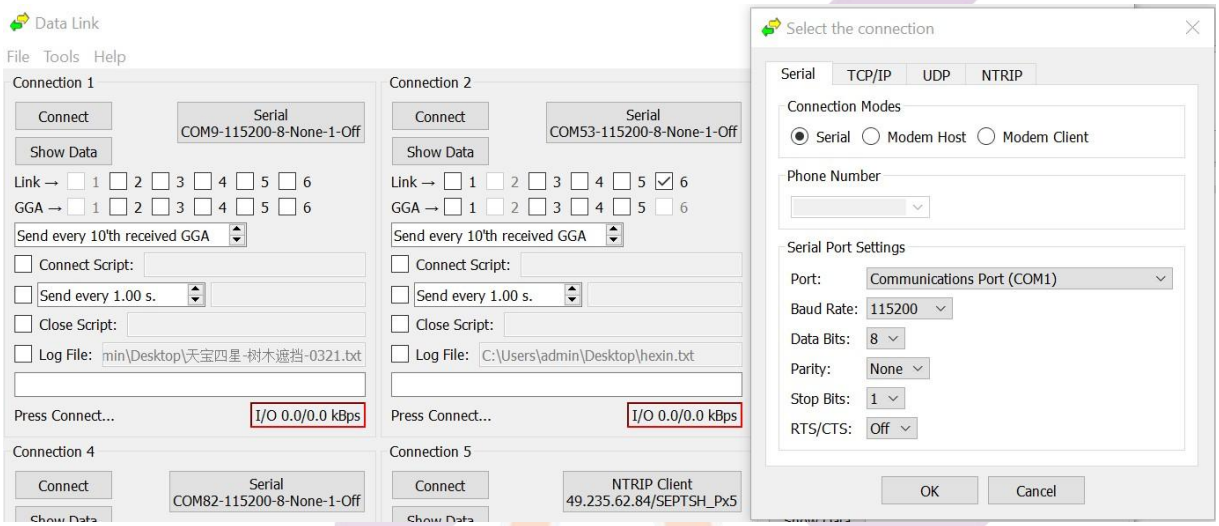
setElevationMask, pvt, 10 // Sets the PVT cutoff elevation angle to 10°

9. RTK Mode

9.1 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, and 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.

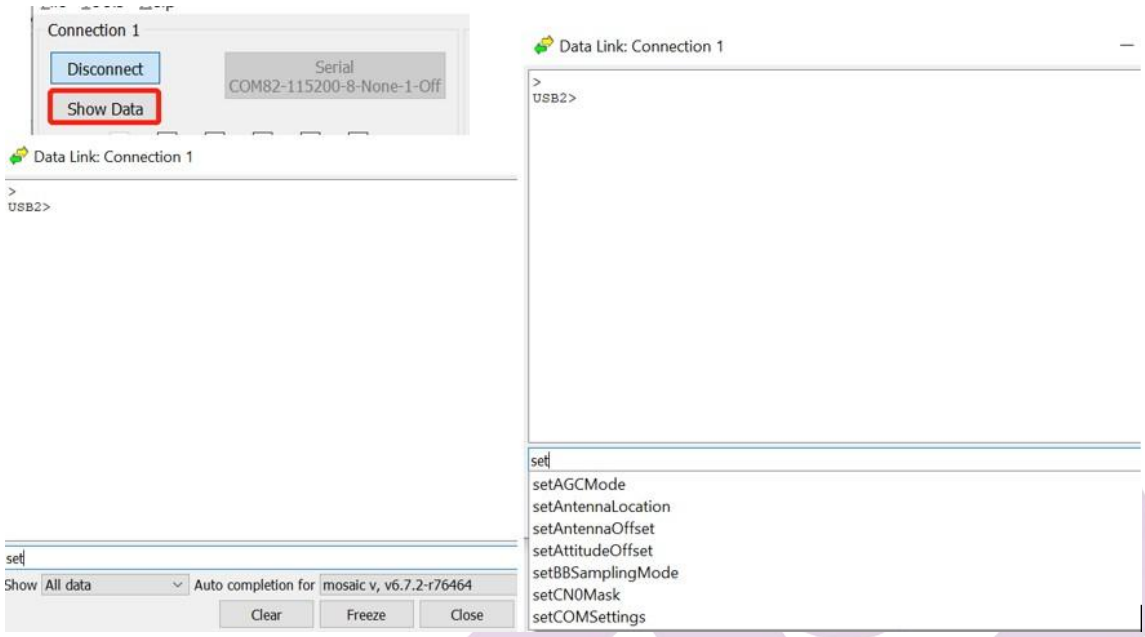
9.2 Mobile Station Mode

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

Command line: setPVTMode,rover,RTK+Standalone //set PVT Rover Mode

Mode interface PVT mode: Rover

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



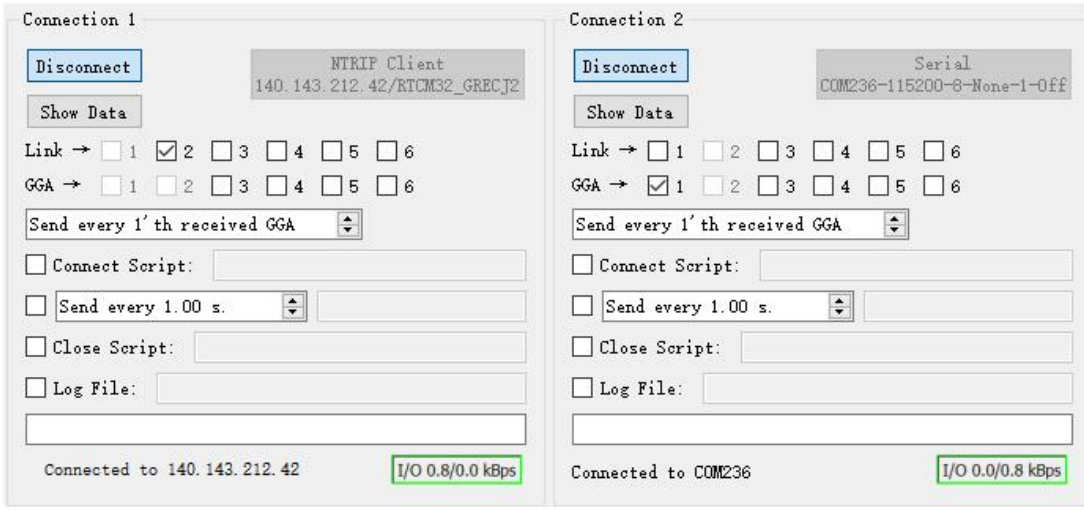
Command line: eccf,current,boot //Save Setting

3. Datalink Set differential input in the software

a. Configure Connection1 to connect to the differential source via serial port or NTRIP , and enable Show. Data confirms that differential data has been received effectively.

b. Configure Connection2 to connect to the USB2 port of the Mosaic MiniEVK (the corresponding virtual serial port can be viewed through the computer's Device Manager).

c. Link the differential data from Connection 1 to Connection 2 , so that the MiniEvk board can obtain the differential data.



Note: If using a six-way NTRIP or other CORS station differential data, you need to configure the board's differential receiving port to output 1 Hz GGA data. You can modify the GGA Talk ID; 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.

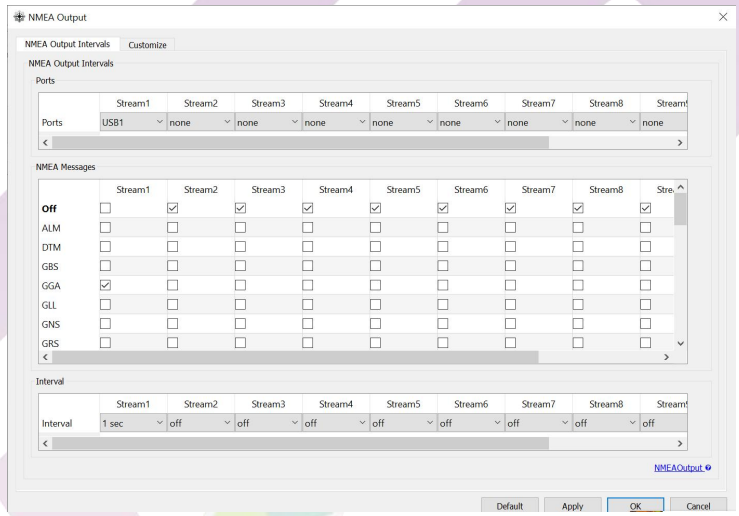
4.3 The DiffCorr light in the lower left corner is flashing, indicating that differential data is being received in real time.

10. NMEA Data

10.1 Real-time output via port

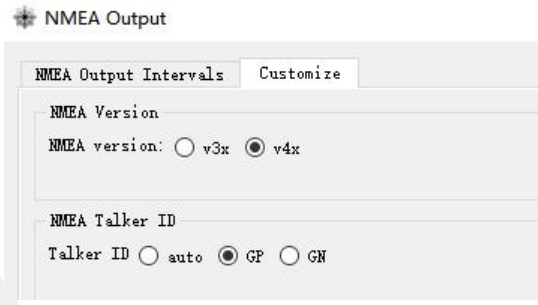
1. Through RxControl Software, Communication/Output Settings/NMEA Output/NMEA Output Intervals settings

   d. Output port
   e. NMEA Data types
   f. Output frequency

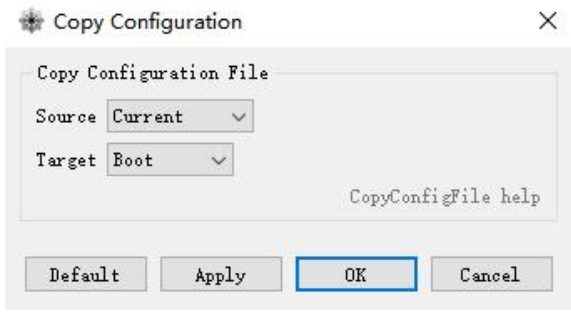


2. Through RxControl Software, Communication/Output Settings/NMEA Output/ Customize settings

   g. You can change the GGA talkID to GP (the default prefix is GN).



3. Save settings: File/Copy Configuration ... / Source Current -- > Target Boot



Command line: sno,stream1,ubs2,gga,sec1 // Settings USB2 Port output 1 Hz 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

```
Command line: sfn, DSK1, FileName, log1          //Setting log, save to SD card
setSBFOutput,Stream5,DSK1,+support,sec1          //Setting SBF log, output 1Hz to SD card
```

1.2 NMEA data type , output frequency

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

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

```
Command line: sno,stream1,ubs2,gga,sec1          //Setting USB2 output 1Hz GGA
```

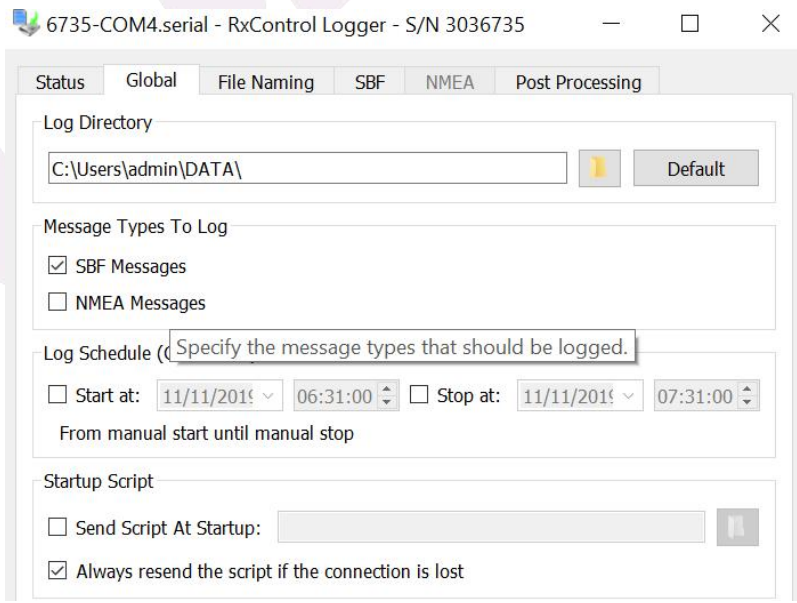
10.3 Recording Data in Computer Files

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.

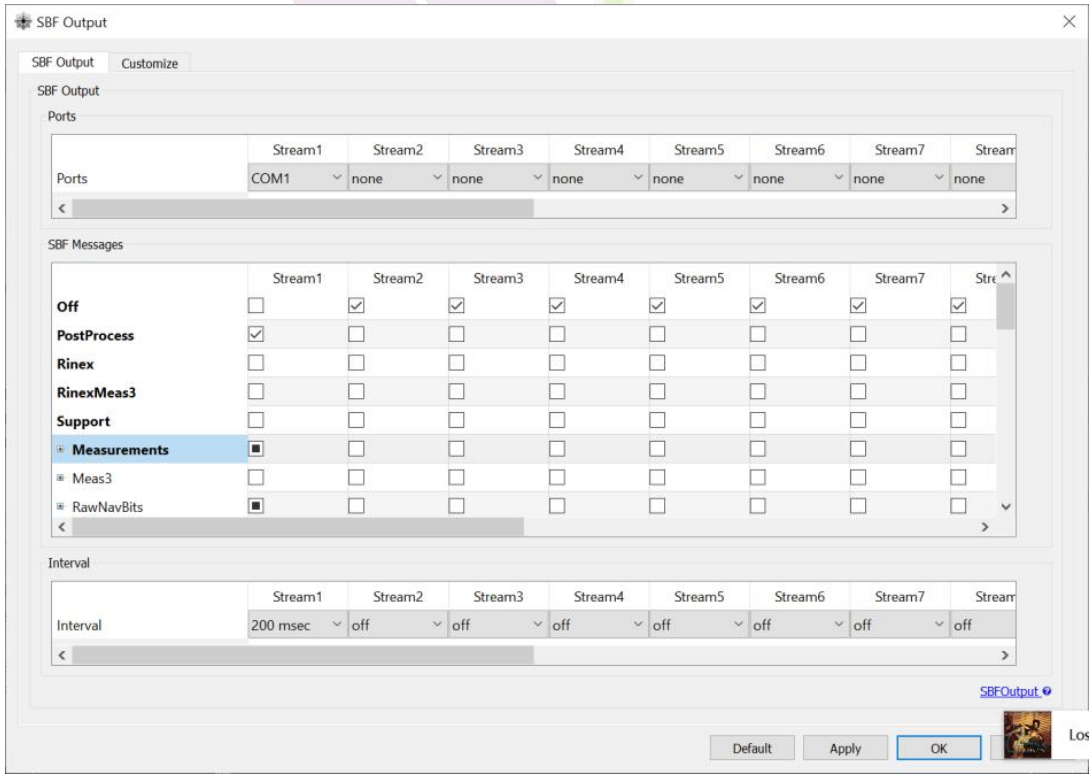
11.1 Port outputs raw data

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 //Setting USB2 ouput data 5Hz PostProcess

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

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.

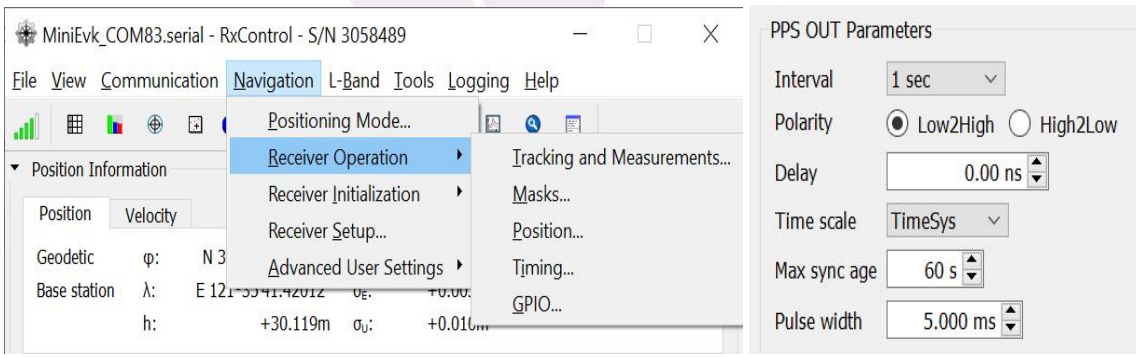
11.3 Recording Data in Computer Files

The setup steps are the same as recording NMEA data 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 value is 1 Hz .

12. External Events

12.1 PPS Output

RxControl software interface , configure the PPS output in Navigation/Receiver Operation/Timing and save the settings.



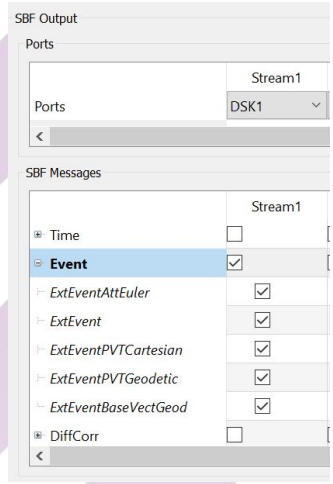
Command line: setPPSParameters,sec1,Low2high // Sets the output to 1 PPS (maximum100), pulses from low to high.

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

12.2 Event

1. RxControl Software interface, Navigation/Receiver Configure the Event in Operation/Timing , and set...

Set record SBF 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 10 Hz PostProcess+Event data

2. Save settings

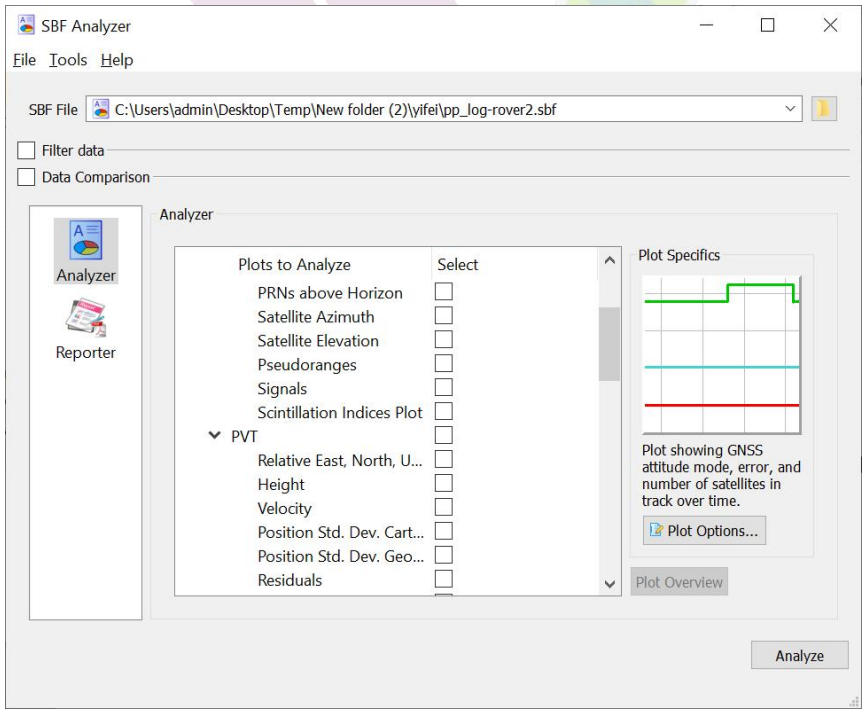
Command line: eccf,current,boot //Save settings

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

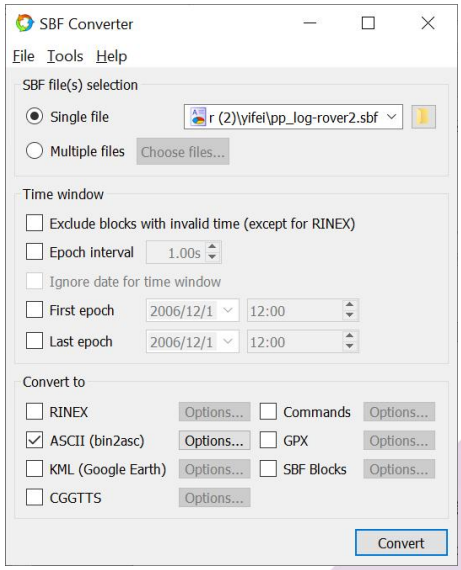


2. Select the content you want to analyze and click Analyze .

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. You can obtain the diagnostic report or report content in the following ways: Connect the RxControl software to the board, select File/Display Diagnostic Report, or press Ctrl+C. Then save the report as a PDF file.
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.

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

14.2 Support SBF Documents

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

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

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