

# H-RTK Mosaic-H

Holybro H-RTK Mosaic-H GNSS/RTK system documentation.

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# Overview & Specification

# Overview & Specification

## Overview

The Holybro mosaic-H is a cutting-edge RTK GPS module that harnesses the power of Septentrio's elite mosaic-H GNSS receiver. It comes with an IST8310 magnetometer, two high-performance antennas, and an aluminum CNC enclosure. It is packed with versatile features such as effortless configuration, spectrum analysis, data logging, and post-processing for a wide range of applications.

With its dual-antenna input, mosaic-H can provide compass-less YAW information to the controller (commonly called GPS Heading or Moving Baseline Yaw). By employing GPS as the yaw source instead of a traditional compass it eliminates the inaccuracies caused by magnetic interference from vehicle motors, electrical systems, and environmental sources like metallic structures or power lines, ensuring precise yaw reports to the controller and enhancing overall navigation reliability and performance in challenging environments.

Septentrio's mosaic-H GNSS receiver module boasts a suite of proprietary technologies that set it apart from the competition. Septentrio's [AIM+ \(Advanced Interference Mitigation\) technology](#) safeguards against intentional and unintentional jamming sources, ensuring consistent and reliable performance even in challenging RF environments.

Septentrio's [LOCK+ technology](#) ensures optimal tracking even under rapid antenna displacement in the event of high vibrations or shocks, maintaining high accuracy and stable operation in high-dynamic situations. It is ideal for demanding applications such as UAVs and robotics. Furthermore, Septentrio's advanced [RAIM+ \(Receiver Autonomous Integrity Monitoring\) algorithm](#) delivers unmatched integrity and reliability, providing a safety net for mission-critical applications.

## Features

- Advanced anti-jamming, anti-spoofing solutions with [AIM+ technology](#) & [OSNMA](#)
- Dual antenna support for moving baseline yaw (GPS Heading) with just one GPS module

- All-in-view satellite tracking: multi-constellation, multi-frequency (Supports L1/L2/E5)
- Best-in-class RTK performance

# Specification

|                          |                                                                                                                                                                                                                                             |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product                  | Holybro H-RTK Mosaic-H                                                                                                                                                                                                                      |
| Application              | <ul style="list-style-type: none"> <li>• Rover</li> <li>• Moving Baseline Rover</li> <li>• Base Station</li> <li>• PPK</li> </ul>                                                                                                           |
| GNSS                     | <ul style="list-style-type: none"> <li>• GPS: L1, L2</li> <li>• Galileo: E1, E5b</li> <li>• GLONASS: L1, L2</li> <li>• Beidou: B1, B2, B3</li> <li>• QZSS: L1C/A, L1C/B, L2</li> <li>• SBAS: Egnos, WAAS, GAGAN, MSAS, SDCM (L1)</li> </ul> |
| RTK performance          | <ul style="list-style-type: none"> <li>• Horizontal accuracy 0.6 cm + 0.5 ppm</li> <li>• Vertical accuracy 1 cm + 1 ppm</li> </ul>                                                                                                          |
| Positioning accuracy     | 7o7mPWjQ0fiw                                                                                                                                                                                                                                |
| GNSS attitude accuracy   | 5iwII530T7M6                                                                                                                                                                                                                                |
| Time-To-First Fix        | <ul style="list-style-type: none"> <li>• Cold start: ≤ 45s</li> <li>• Hot start: ≤ 20s</li> <li>• Re-acquisition: 1 s</li> </ul>                                                                                                            |
| Latency                  | <ul style="list-style-type: none"> <li>• &lt; 10 ms</li> </ul>                                                                                                                                                                              |
| Magnetometer (Compass)   | IST8310                                                                                                                                                                                                                                     |
| Antennas Peak Gain (MAX) | <ul style="list-style-type: none"> <li>• 2dBi</li> </ul>                                                                                                                                                                                    |
| LNA Gain                 | <ul style="list-style-type: none"> <li>• 33±2dB</li> </ul>                                                                                                                                                                                  |
| Time precision           | <ul style="list-style-type: none"> <li>• xPPS out: 5 ns</li> <li>• Event accuracy: &lt; 20 ns</li> </ul>                                                                                                                                    |
| Data and Update Rate     | <ul style="list-style-type: none"> <li>• Measurements only 100 Hz</li> <li>• Standalone, SBAS, DGPS + attitude 50 Hz</li> <li>• RTK + attitude 20 Hz</li> </ul>                                                                             |

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Port                         | <ul style="list-style-type: none"> <li>• Port 1: USB Type-c</li> <li>• Port 2: UART1 (GH1.25 10pin)</li> <li>• Port 3: UART2 (GH1.25 6pin)</li> </ul>                                                                                                                                                                                                                                                                                                                                                        |
| Antenna Connection Type      | <ul style="list-style-type: none"> <li>• Board: SMA female</li> <li>• Antenna: SMA male</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                           |
| Buttons                      | <ul style="list-style-type: none"> <li>• LOG BUTTON: Mosaic-H log recording button, short press to start/end recording; long press to Mount/Unmount SD card.</li> <li>• SAFETY SWITCH: flight control safety switch, press and hold the flight control to unlock/lock.</li> </ul>                                                                                                                                                                                                                            |
| Baud rate: (Adjustable)      | 230400 5Hz default                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Working voltage:             | 4.75V~5.25V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Power Consumption            | <ul style="list-style-type: none"> <li>• 0.6 W typ</li> <li>• 1.1 W max</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Operating Temperature        | -40°C to 85°C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Dimension                    | <ul style="list-style-type: none"> <li>• Board: 42.7*71.8*13.3mm</li> <li>• Antenna Diameter: 40mm</li> <li>• Antenna height: 76mm</li> </ul>                                                                                                                                                                                                                                                                                                                                                                |
| Weight                       | 54.5g (without antennas)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Advanced Technologies inside | <ul style="list-style-type: none"> <li>• <a href="#">AIM+</a> the most advanced anti-jamming, anti-spoofing on-board interference mitigation technology on the market (narrow and wide band, chirp jammers).</li> <li>• <a href="#">LOCK+</a> for robust tracking during high vibrations and</li> <li>• <a href="#">APME+</a> multipath mitigation to disentangle direct signal and those reflected from nearby</li> <li>• <a href="#">IONO+</a> provides advanced protection against ionospheric</li> </ul> |

# Setup & Getting Started (ArduPilot)

# Setup & Getting Started (Ardupilot)

## Use as a Rover (Aircraft) Unit

Ardupilot 4.4.0 stable firmware currently also supports Mosaic GPS, but does not yet support dual-antenna Heading. Dual-antenna heading is supported in 4.5.0 and later.

### FW 4.4.0-4.4.4

To set up using GPS1 input, configure these parameters:

#### “ i Info

Using serial3 as an example

- GPS\_INJECT\_TO = 0 (send to first GPS)
- GPS1\_RATE\_MS = 100
- GPS1\_TYPE = 10 (SBF)
- SERIAL3\_BAUD = 230
- SERIAL3\_PROTOCOL = 5 (GPS)

To setup this using GPS2 input (serial4) configure these parameters:

#### “ i Info

- GPS\_INJECT\_TO = 1 (send to 2nd GPS)
- GPS2\_RATE\_MS = 100
- GPS2\_TYPE = 10 (SBF)
- SERIAL4\_BAUD = 230
- SERIAL4\_PROTOCOL = 5 (GPS)

If you want to inject RTCM corrections to both GPS1 and GPS2, then use:

- GPS\_INJECT\_TO= 127 (send to all)

## FW 4.5.0+

In ArduPilot 4.5 (or higher), a single unit with two antennas may also be used for GPS for Yaw. If a single unit with two antennas is used, please set the following parameters:


- GPSx\_TYPE = 26 (SBF-DualAntenna)
- GPSx\_MB\_TYPE = 1 (RelativeToCustomBase)
- GPSx\_MB\_OFS\_X and GPSx\_MB\_OFS\_Y, and GPSx\_MB\_OFS\_Z to match the offset of the main antenna from the second in meters. For example, if the second antenna is 50cm to the right of the main antenna, set GPSx\_MB\_OFS\_Y.
- EK3\_SRC1\_YAW = 2 (GPS)

# Antennas Setup

In addition, both antennas ("Master" and "Slave") must be attached and positioned at least 30cm apart. The location of the vehicle is flexible, but their positions impact several parameters which must be set in order to obtain proper operation. These offset distances in the x/y/z directions must be entered for the following parameters:

- GPS1\_MB\_TYPE = 1 (GPS1 Moving Baseline master antenna offsets relative to slave antenna, also enables the next parameters to be shown)
- GPS1\_MB\_OFS\_X: offset in meters from the "Slave" to "Master" antenna in the X axis (in direction of 0 deg yaw, positive offsets are if "Master" is in front of the "Slave").
- GPS1\_MB\_OFS\_Y: offset in meters from the "Slave" to "Master" antenna in the Y axis (in direction 90 deg (right) of 0 deg yaw, positive offsets are if "Master" to the right of the "Slave").
- GPS1\_MB\_OFS\_Z:: offset in meters from the "Slave" to "Master" antenna in the Z axis (in direction up and down, positive offsets are if "Master" is below the "Slave").

This figure and photo illustrate these parameters and their settings:

 [Image — to be added]

A complete dual antenna configuration guide can be found in the link below:

<https://ardupilot.org/copter/docs/common-gps-for-yaw.html>

## Use as Base Station

### ⚠ Warning

This section only applies to mosaic-H

### i Info

With the latest version of MissionPlanner, manual configuration is not required. Please skip this section to the next section for the base setup guide using MissionPlanner.

1) First, download the configuration file from our website to the local computer according to the base type:


- mosaic-H\_Current\_moving\_base.txt (mobile station)

 [Downloadable file — to be added]


- mosaic-H\_Current\_Static\_base.txt (fixed station)

 [Downloadable file — to be added]

2) Connect the module to the computer through the USB TYPE-C port, open any Web browser, enter 192.168.3.1 in the address bar to open the Mosaic-H configuration page, as shown below

 [Image — to be added]

3) Click Admin->Configurations to enter the configuration page\

“  [Image — to be added]

4) Click the Upload Configuration icon to upload the configuration file

“  [Image — to be added]

6) Click OK first, then click the Save button to save the configuration

“  [Image — to be added]

Click Admin->Reset to enter the reset page, select Soft, and click OK to restart. You can also unplug the USB cable and perform a power-off restart.

“  [Image — to be added]

7) Place the base station in an open area, and click on the GNSS->Satellites and Signals page to view the satellite search status. After the Tracking and Position values are stable (as shown below), the RTCM data can be forwarded through the ground station.

“  [Image — to be added]

# Implement RTK through MissionPlanner

**⚠ Warning**

This section only applies to mosaic-H

Connect the Mosaic-H GPS to the computer via the USB port. After Mosaic-H is connected to the computer, there will be two Virtual USB COM Ports. Virtual USB COM Port 1 corresponds to USB1 in the operation interface, and Virtual USB COM Port 2 corresponds to USB2. Generally, we use USB1 to transmit NMEA/GGA and other data, and then on USB2 output RTCM data. With the MissionPlanner auto configuration feature, both COM ports can be used for the RTK base function.

On the missionPlanner-> SETUP-> Optional Hardware-> RTK/GPS Inject page, make sure Automatically Configure Receiver is enabled, and the Septentrio option is selected. Choose any of the mosaic-H's COM ports and click Connect.

“ [Image — to be added]

When Mosaic-H is used as a Base station, it will automatically select the appropriate positioning accuracy based on signal quality. There is no need to set the accuracy and survey-in time.

When the Base, GPS, Glonass, Beidou, and Galileo icons in the RTCM column all turn green, the ground station begins to send the RTCM data to the flight control through digital transmission.

Click on the MissionPlanner->DATA page, and you can see that the rover side has been RTK-Fixed. (The rover side can use F9P or Mosaic-H)

“ [Image — to be added]

Now return to the Mosaic-H configuration page, click on the NMEA/SBF Out page, and you can see that the USB2 port has started to output the RTCM data stream.

# Setup & Getting Started (PX4)

# Setup & Getting Started (PX4)

## Use as Rover (Aircraft) Station

### ⚠ Warning

For PX4 v1.15 and later, the guide below does not apply, please visit the PX4 documentation site for the setup guide:

[https://docs.px4.io/main/en/gps\\_compass/septentrio.html](https://docs.px4.io/main/en/gps_compass/septentrio.html)

You only need to set the following parameters:

- GPS\_1\_CONFIG: GPS1 (default to GPS1)
- GPS\_1\_GNSS: 31
- GPS\_1\_PROTOCOL: SBF
- SER\_GPS1\_BAUD: 115200 8N1
- EKF2\_GPS\_CTRL: Bit 3 Dual antenna heading (if the Heading function is not required, this bit does not need to be set)
- GPS\_PITCH\_OFFSET: set according to your setup
- GPS\_YAW\_OFFSET: set according to your setup

☐ [Image — to be added]

To check for heading MAVlink Console :

"listener estimator\_status\_flags " command, Then check the content displayed by cs\_gps\_yaw . True means that Heading has been enabled , False means that Heading has not been enabled .

## GNSS Data Filtering

Set the following parameters to decrease drifting caused by fluctuation from the GNSS reading

- EKF2\_GPS\_P\_NOISE = 1
- EKF2\_GPS\_V\_NOISE = 0.6

## Use as Base Station

### ⚠ Warning

The QGC ground station currently cannot recognize the RTCM data stream of Mosaic-H GPS at this moment, therefore QGC does not support the use of this GPS as Basestation.

# Pinout

# Pinout

“ ” [Image — to be added]

## UART1

| Pin    | Signal            | Voltage                |
|--------|-------------------|------------------------|
| 1(red) | VCC               | Power +5V              |
| 2      | RX(in)            | TTL 3.3V               |
| 3      | TX(out)           | TTL 3.3V               |
| 4      | SCL1              | TTL 3.3V               |
| 5      | SDA1              | TTL 3.3V               |
| 6      | SAFETY_SWITCH     | TTL 3.3V               |
| 7      | SAFETY_SWITCH_LED | TTL 3.3V               |
| 8      | VDD_3V3           | Power +3.3V            |
| 9      | BUZZER-           | Open drain Output 0~5V |
| 10     | GND               | GND                    |

## UART2

| Pin    | Signal   | Voltage   |
|--------|----------|-----------|
| 1(red) | VCC      | Power +5V |
| 2      | RX2(in)  | TTL 3.3V  |
| 3      | TX2(out) | TTL 3.3V  |
| 4      | EVENT A  | TTL 3.3V  |

| Pin | Signal | Voltage  |
|-----|--------|----------|
| 5   | PPS    | TTL 3.3V |
| 6   | GND    | GND      |

# Dimension

# Dimension

“□ [Image: Unit in millimeter — to be added]

# Advanced Application

# Advanced Application

## Web Interface First Login

Newer batch mosaic-H modules require the user to create a login credential using factory credentials.

**Factory credentials:**

**Username:** RxAdmin

**Password:** S3pt3ntr10

Please refer to Septentrio's article below for more information:

<https://customersupport.septentrio.com/s/article/Cybersecurity-guidelines-Log-in-procedure>

## Troubleshooting

When the satellite search is not good, you can check the power supply and the signal quality of the antenna on the OverView page.

Generally speaking, Main RF power and Aux1 RF power should be  $\geq 9$ . If it is less than 9, check the RF connection cable and module power supply. Ensure that the antenna current consumption is  $<150\text{mA}$ .

The main antenna (Main signals) and the slave antenna (Aux1 Signals) should be  $\geq 7$ .

“ [Image — to be added]

## Choosing Specific Satellite System

Users can choose specific satellite systems based on their location. Click Corrections->Corrections OutPut

“ [Image — to be added]

Click the RTCM Messages edit icon

“ [Image — to be added]

Select the desired satellite system and click OK.

“ [Image — to be added]

## Record satellite search data to SD card

Mosaic GPS supports SD card recording of star search logs. Before using the data logging function, you need to set up the module and select which messages need to be recorded. Click logging to enter the log settings page

“ [Image — to be added]

Depending on the type of information required, click New NMEA stream or New SBF stream (taking SBF as an example), and click OK after selecting

“ [Image — to be added]

File Name Enter the file name of the recording file (you can also use the default name " log " ), and then click on in the Enable Logging column to start logging.

After the NMEA/SBF logging Stream is set up, you can also use the LOG BUTTON to start/end recording.

After setting up, you can see the log LED on the GPS flashing, indicating that the log is being recorded. At this time, short press the log button (within 5 seconds) to pause logging, and short press again to resume logging.

Before the GPS is powered off, it is recommended to press and hold the log button (more than 5 seconds) to end the log recording, and then power off again. Avoid possible log corruption.

## PPK application

Mosaic-H supports PPK applications, please refer to the documentation for details: [PP-SDK: high accuracy with GPS post-processing | Septentrio](#)

# Configuring modules via RxTools

mosaic-H GPS/GNSS receiver module with heading comes with fully documented interfaces, commands and data messages. The included GNSS receiver control and analysis software [RxTools](#) allows receiver configuration, monitoring as well as data logging and analysis. For detailed usage steps, please refer to the document.

Please see [this link](#) for the latest software or download the RX Tools v23.0.1 below

“ [Downloadable file — to be added]

“ [Downloadable file — to be added]

# Comparison: mosaic-H vs mosaic-G5 P3H

## Comparison Between mosaic-H & mosaic-G5 P3H 1

|                                         | mosaic-H                                                                                                                                        | mosaic-G5 P3H                                                                                                                                                                |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Bands supported</b>                  | GPS: L1, L2<br>Galileo: E1, E5b<br>GLONASS: L1, L2<br>Beidou: B1, B2, B3<br>QZSS: L1C/A, L1C/B, L2<br>SBAS: Egnos, WAAS, GAGAN, MSAS, SDCM (L1) | GPS: L1C/A, L1C, L2C, L2P(Y), L5<br>Galileo: E1, E5a, E5b, E6<br>GLONASS: L1CA, L2CA, L2P, L3CDMA<br>Beidou: B1I, B1C, B2a, B2I, B2b, B3I<br>QZSS: L1C/A, L1C/B, L2C, L5, L6 |
| <b>RTK Performance</b>                  | Horizontal: 0.6cm + 0.5ppm<br>Vertical: 1cm + 1ppm                                                                                              | Horizontal: 0.6cm + 0.5ppm<br>Vertical: 1cm + 1ppm                                                                                                                           |
| <b>Other Positioning Modes Accuracy</b> | Standalone: 1.2m<br>DGNS: 0.4m<br>SBAS: 0.6m                                                                                                    | Standalone: 1.2m<br>DGNS: 0.4m                                                                                                                                               |
| <b>Velocity Accuracy</b>                | 3cm/s                                                                                                                                           | 3cm/s                                                                                                                                                                        |
| <b>Heading accuracy</b>                 | 0.15deg (1m baseline)                                                                                                                           | 0.15deg (1m baseline)                                                                                                                                                        |
| <b>Maximum update rate</b>              | Measurements only: 100Hz<br>Standalone: 50Hz<br>RTK: 20Hz                                                                                       | 20Hz                                                                                                                                                                         |
| <b>latency</b>                          | <10ms                                                                                                                                           | <10ms                                                                                                                                                                        |
| <b>Acquisition</b>                      | 33dBHz                                                                                                                                          | 30dBHz                                                                                                                                                                       |
| <b>Time Precision</b>                   | PPS resolution: 1.4ns<br>Event accuracy: <3ns                                                                                                   | PPS resolution: 5ns<br>Event accuracy: <20ns                                                                                                                                 |

|                                       | <b>mosaic-H</b>                                                                                                                                                                                                                                                                                                                                                                     | <b>mosaic-G5 P3H</b>                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Anti-jamming and anti-spoofing</b> | <p>AIM+ the most advanced anti-jamming, anti-spoofing on-board interference mitigation technology on the market (narrow and wide band, chirp jammers).</p> <p>LOCK+ for robust tracking during high vibrations and</p> <p>APME+ multipath mitigation to disentangle direct signal and those reflected from nearby</p> <p>IONO+ provides advanced protection against ionospheric</p> | <p>AIM+ the most advanced anti-jamming, anti-spoofing on-board interference mitigation technology on the market (narrow and wide band, chirp jammers).</p> <p>LOCK+ for robust tracking during high vibrations and</p> <p>APME+ multipath mitigation to disentangle direct signal and those reflected from nearby</p> <p>IONO+ provides advanced protection against ionospheric</p> |
| <b>OSNMA Support</b>                  | Yes                                                                                                                                                                                                                                                                                                                                                                                 | No                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Base/Rover</b>                     | Base and Rover                                                                                                                                                                                                                                                                                                                                                                      | Rover only                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Protocols</b>                      | NMEA, SBF, RINEX, RTCM, CMR                                                                                                                                                                                                                                                                                                                                                         | NMEA, SBF, RTCM input                                                                                                                                                                                                                                                                                                                                                               |
| <b>Web interface and Ethernet</b>     | Yes                                                                                                                                                                                                                                                                                                                                                                                 | No                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>RAW data</b>                       | Yes                                                                                                                                                                                                                                                                                                                                                                                 | No                                                                                                                                                                                                                                                                                                                                                                                  |

# Supported Firmware

# Supported Firmware

## PX4

- Supported in Stable 1.14.0 and later

## Ardupilot

- Supported in Ardupilot
- **Note:** Dual-antenna heading is only supported in Ardupilot latest FW or 4.5.0 and later.

## Mission Planner

- Supported as Rover (Aircraft) unit & Base station

## QGC

- Support when using as Rover (Aircraft) unit
- QGC currently does not support mosaic-H to be used as base station because it cannot recognize the RTCM data stream of Mosaic-H GPS at this moment. Support is coming soon.

# Download

# Download

## 3D CAD File

“ [Downloadable file — to be added]

“ [Downloadable file — to be added]

## RXTools

GNSS receiver control and analysis software. To download the latest version. Please go to this [septentrio official download page](#).

“ [Downloadable file — to be added]

“ [Downloadable file — to be added]