



# **Septentrio mosaic-H™**

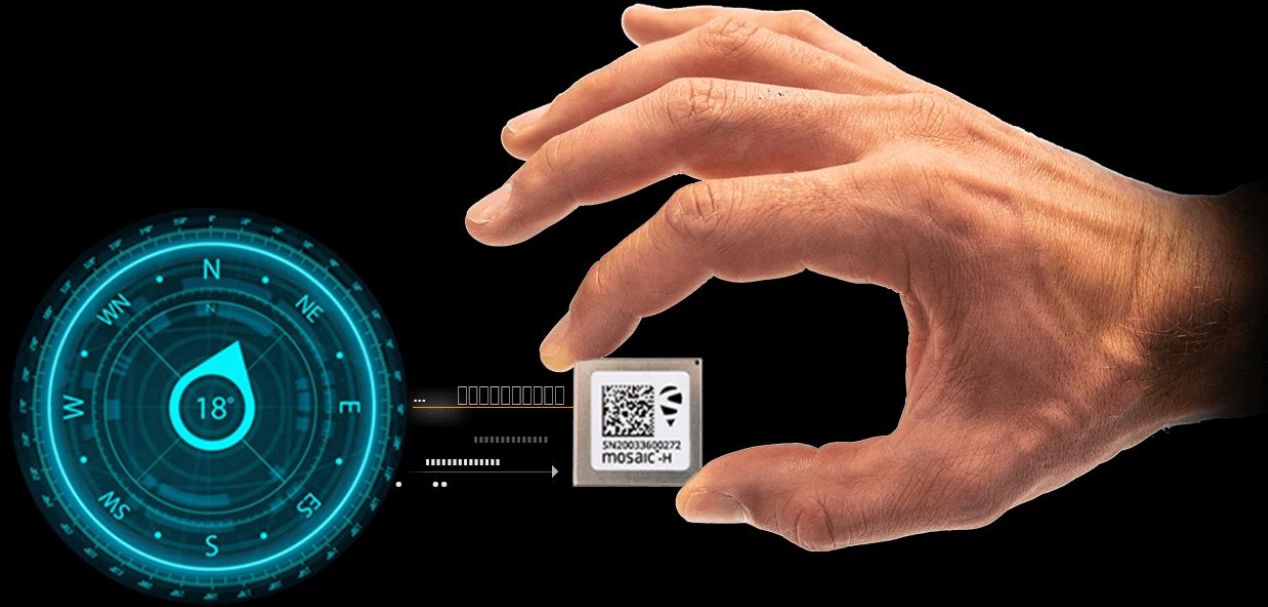
Compact Heading multi-frequency GNSS receiver

**Heading and RTK in 1 single module**

F.Freulon

December, 2020

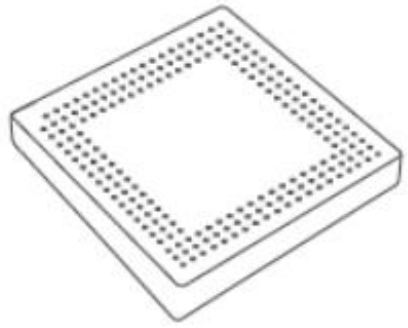
# mosaic-H



**Heading + RTK  
In 1 single module**

Pointing/oriented applications

- Excavators/drills
- Planes and boats
- Satellite/communication antennas



mosaic

# GNSS modules

mosaic-H the last from 2020 mosaic expansion

GNSS Performance



mosaic-X5

Dual Antenna Heading



mosaic-H

Built-in Corrections



mosaic-Sx

Timing



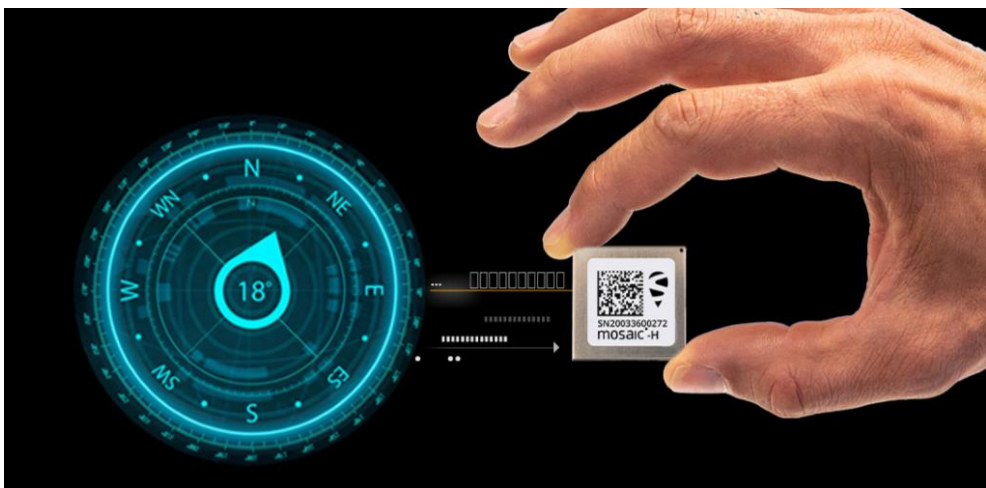
mosaic-T

# mosaic-H module

Compact Heading multi-frequency GNSS receiver

mosaic<sup>o</sup>

All Included, Best of Technologies



- **Heading** receiver in same form factor as other mosaic module.
- Fully compatible and scalable with all mosaic modules
- Extremely precise < **1cm** level RTK positioning and **Sub-degree** GNSS Heading and **Pitch/Roll** precision
- Unmatched performance in both static and dynamic conditions.

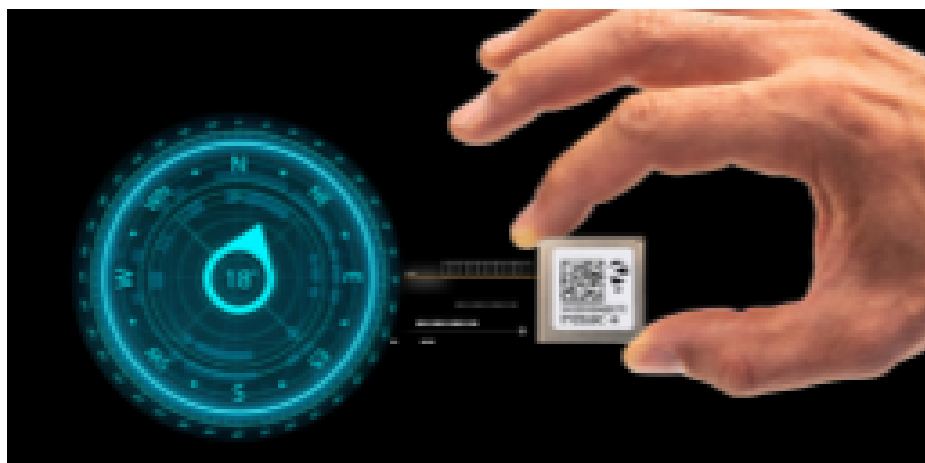
November 02nd  
BETA End December



- Data Sheet/Web live, published on November 02<sup>nd</sup>
- SAP code available (410352), Price available not published yet
- mosaic-H dev Kit created: 410359

# mosaic-H

Compact multi-constellation GNSS heading module



With dual-antenna input, mosaic-H<sup>TM</sup> provides precise and reliable heading combined with centimeter-level RTK positioning. Dual antenna heading capabilities in such a small form factor opens the door to advanced automation and navigation performance in both static and dynamic states, with reduced power consumption. Dual antenna GNSS delivers heading & pitch or heading & roll angles, which are available immediately at start-up, helping initialize inertial sensors which rely on movement for their attitude measurements.

## KEY FEATURES

- ➔ Dual antenna support for sub-degree heading & pitch or heading & roll angles
- ➔ All-in-view satellite tracking: multi-constellation, multi-frequency
- ➔ Best-in-class RTK performance
- ➔ **AIM+** industry-leading anti-jamming and spoofing technology
- ➔ Lowest power consumption on the market
- ➔ Standard mosaic footprint enables several application-specific solutions based on a single design

## BENEFITS

### Reliable heading performance

With dual-antenna input, mosaic-H<sup>TM</sup> provides precise, reliable and positioning-independent heading combined with centimeter-level RTK. GNSS heading provides the best performance in both static and dynamic conditions removing the reliance on vehicle motion for INS initialization. It also provides an alternative to magnet-based heading sensors, which can be affected by metal.

### Designed for automated assembly

The mosaic-H<sup>TM</sup> is a single module delivering high-accuracy heading and positioning without the need for any additional components. It is designed for high volume production on automated assembly lines. All interfaces, commands and data messages are fully documented. The PiTools software suite allows convenient receiver configuration, monitoring, data logging and analysis. C# line processing is easy via our GeoTag2 software and b2DM library for RPK (Raw Processed Kinematic).

### Advanced technologies inside

Septentrio's **GNSS+** solution enables accuracy and reliability in the toughest conditions, allowing you to complete projects with the highest quality and efficiency. It includes:

- ➔ **AIM+** the most advanced on-board interference mitigation technology on the market (narrow and wide band, chip jammers).
- ➔ **LOCK+** for robust tracking during high vibrations and shocks.
- ➔ **APME+** multipath mitigation to distinguish direct signal and those reflected from nearby structures.
- ➔ **IONO+** provides advanced protection against ionospheric disturbances.

## mosaic-H

### FEATURES

#### GNSS technology

448 hardware channels for simultaneous tracking of all visible supported satellite signals<sup>1</sup>.

- ➔ GPS: L1, L2
- ➔ Galileo: E1, E5b
- ➔ GLONASS: L1, L2
- ➔ BeiDou: B1, B2
- ➔ QZSS: L1, L2
- ➔ SBAS: Egnos, WAAS, GAGAN, MSAS, SDCM (L1)

#### Septentrio's patented GNSS+ technologies

- ➔ **AIM+** interference monitoring and mitigation (narrow band, wide band, chip jammers)
- ➔ **IONO+** advanced scintillation mitigation
- ➔ **APME+** a posteriori multipath estimator for code and phase multipath mitigation
- ➔ **LOCK+** superior tracking robustness under heavy mechanical shocks or vibrations
- ➔ **RAIM+** receiver autonomous integrity monitoring

RTK

GNSS heading

#### Protocols

Septentrio Binary Format (SBF)  
NMEA 0183, v2.3, v2.03, V4.0  
RINEX v2.x, v3.x  
RTCM v2.x, v3.x (MSM included)  
CMR v2.0 (out/in), CMR+ (input only)

#### Interfaces

4 UART (LVTTL, up to 4 Mbps)  
Ethernet (RMII/MDIO), 10/100 Mbps  
USB device (2.0, HS)  
SDIO (mass storage)  
2 GPIO user programmable  
CAN<sup>1)</sup>  
2 Event markers<sup>1</sup>  
1 Configurable PPS out<sup>2</sup>

### PERFORMANCE

#### RTK performance<sup>3,4,5</sup>

Horizontal accuracy 0.6 cm + 0.5 ppm  
Vertical accuracy 1 cm + 1 ppm

#### Other positioning modes accuracy<sup>3,4</sup>

	Horizontal	Vertical
Standalone	1.2 m	1.9 m
SBAS	0.6 m	0.8 m
DGNSS	0.4 m	0.7 m

#### Velocity accuracy 3 cm/s

#### GNSS attitude accuracy<sup>3,4</sup>

Antenna separation	Heading	Pitch/Roll
1 m	0.15°	0.25°
5 m	0.03°	0.05°

#### Maximum update rate

Position	100 Hz
Position and attitude	50 Hz
Measurements only	100 Hz

#### Latency<sup>7</sup> <10 ms

#### Time precision

xPPS out <sup>8</sup>	5 ns
Event accuracy	< 20 ns

#### Time to first fix

Cold start <sup>9</sup>	< 45 s
Warm start <sup>10</sup>	< 20 s
Re-acquisition	1 s

#### Tracking performance (C/N0 threshold)

Tracking	20 dB-Hz
Acquisition	23 dB-Hz

#### Firmware

Free product lifetime upgrades

### PHYSICAL AND ENVIRONMENTAL

#### Package

Type	SMT solderable land grid array
Size	21 x 21 x 4 mm / 1.29 x 1.29 x 0.15 in
Weight	6.8 g / 0.24 oz

#### Electrical

Antenna pre-amplification range	15-20 dB
Antenna bias voltage	3.0-5.5 V
	Build-in current limit (150 mA)
Input voltage	3.3 VDC +/-5%
Power consumption	0.6 W typ 1.1 W max

#### Environmental

Operating temp	-40 to 85° C
	-40 to 185° F
Storage temp	-55 to 85° C
	-67 to 185° F

Humidity	5% - 95% (non-condensing)
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Vibration	MIL-STD-810G
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Certification	CE, RoHS, WEEE
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<sup>1</sup> Configuration dependent

<sup>2</sup> Output rate 20 Hz

<sup>3</sup> Open sky conditions

<sup>4</sup> RMS levels

<sup>5</sup> Baseline <40 km

<sup>6</sup> After convergence

<sup>7</sup> 99.9%

<sup>8</sup> Incl. software compensation of sawtooth effect

<sup>9</sup> No information available (no almanac, no approx position)

<sup>10</sup> Ephemeris and approx. position known

<sup>11</sup> Hardware ready

# mosaic-H

[https://septentrio.sharepoint.com/:b:/r/Marketing4Sales/Shared%20Documents/Datasheets/mosaic-H/Septentrio\\_mosaic-H\\_LR.pdf?csf=1&web=1&e=b2gQfI](https://septentrio.sharepoint.com/:b:/r/Marketing4Sales/Shared%20Documents/Datasheets/mosaic-H/Septentrio_mosaic-H_LR.pdf?csf=1&web=1&e=b2gQfI)

Features				
Variants	mosaic-X5	mosaic-T	mosaic-H	mosaic-Sx
Constellations	GPS/ Beidou/ Glonass/ Galileo /QZSS/ NavIC	GPS/ Beidou/ Glonass/ Galileo /QZSS/ NavIC	GPS/ Beidou/ Glonass/ Galileo /QZSS	GPS/ Beidou/ Glonass/ Galileo /QZSS/ NavIC
Frequencies	<b>4 ( L1, L2, L5) &amp; L-Band</b> GPS: L1 C/A, L1 PY, L2C, L2PY, L5 Glonass: L1 CA, L1PY, L2CA, L2P, L3 Beidou: B1I, B1C, B2a, B2I, B3I Galileo: E1, E5a, E5b, E5 AltboCs QZSS: L1C/A, L1C, L2C, L5 Navic: L5 SBAS: Egnos, WAAS, SDCM, GAGAN, MSAS <b>L-Band</b>	<b>3 ( L1, L2, L5)</b> GPS: L1 C/A, L1PY, L2C, L2PY, L5 Glonass: L1 CA,, L2CA, L3 Beidou: B1I, B1C, B2a, B2I, B3I (November) Galileo: E1, E5a, E5b, E5 AltboCs QZSS: L1C/A, L1C, L2C, L5 Navic: L5 SBAS: Egnos, WAAS, SDCM, GAGAN, MSAS	<b>2 ( L1, L2)</b> GPS: L1, L2 Glonass: L1, L2 Beidou: B1, B2 Galileo: E1, E5b QZSS: L1, L2 SBAS: Egnos, WAAS, SDCM, MSAS	<b>4 ( L1, L2, L5) &amp; L-Band</b> GPS: L1 C/A, L1 PY, L2C, L2PY, L5 Glonass: L1 CA, L1PY, L2CA, L2P, L3 Beidou: B1I, B1C, B2a, B2I, B3I Galileo: E1, E5a, E5b, E5 AltboCs QZSS: L1C/A, L1C, L2C, L5 Navic: L5 SBAS: Egnos, WAAS, SDCM, GAGAN, MSAS <b>L-Band</b>
Robustness	<ul style="list-style-type: none"> <li>• AIM+</li> <li>• Anti Jamming</li> <li>• Anti Spoofing</li> </ul>	<ul style="list-style-type: none"> <li>• AIM+</li> <li>• Anti Jamming</li> <li>• Anti Spoofing</li> </ul>	<ul style="list-style-type: none"> <li>• AIM+</li> <li>• Anti Jamming (<b>no auto-notch</b>)</li> <li>• Anti Spoofing</li> </ul>	<ul style="list-style-type: none"> <li>• AIM+</li> <li>• Anti Jamming</li> <li>• Anti Spoofing</li> </ul>
Heading through Dual Antenna	No	No	Yes	No
RTK	Yes Rover and Base (RTCM output)	No	Yes Rover only	Yes Rover only
PPP	L-Band supported	No	No	Yes L-Band supported
Rawdata	Yes	Yes	Yes	Yes
Events	Yes	Yes	Yes	Yes
Moving Base	Yes	No	No	Yes
Datarate	Up to 100Hz	Up to <b>10Hz</b>	100Hz – Measurement output only 50Hz – Standalone, SBAS, DGPS ... + Dual-antenna heading 20Hz – RTK + Dual-antenna heading	Up to 100Hz
Logging / Data Collection	Yes/Yes	Yes/No	Yes/No	Yes/Yes
Time and Frequency Synchronisation	No	Yes	No	No

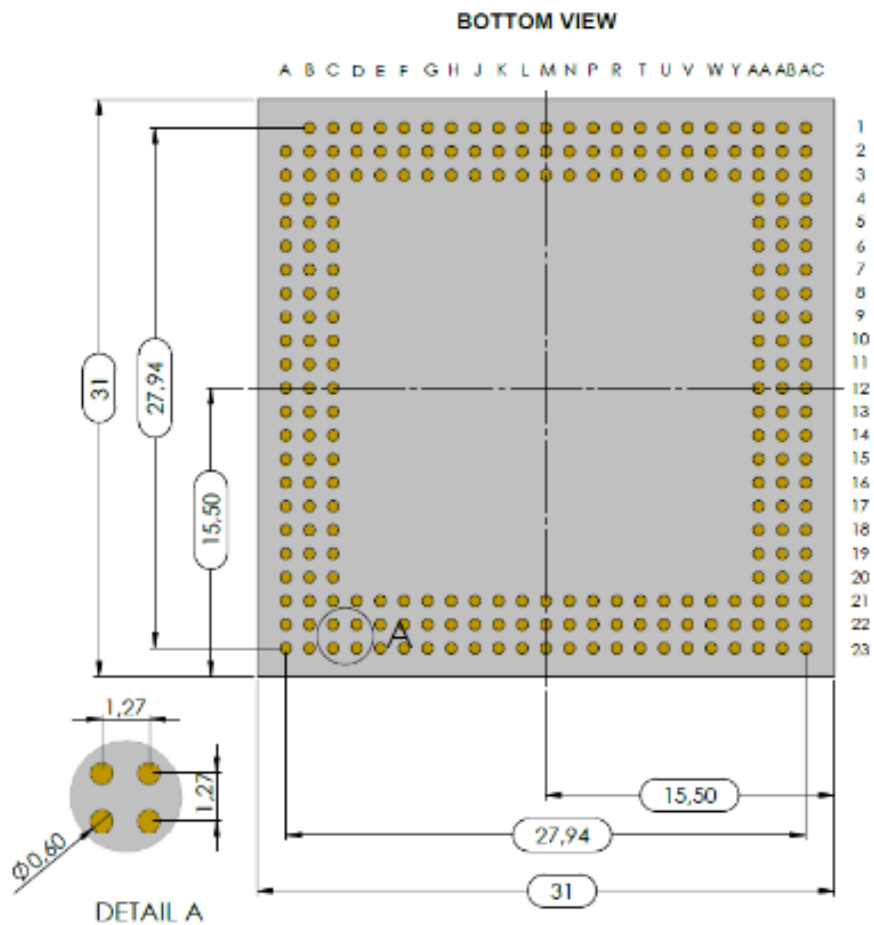
# mosaic-H in a Nutshell

- mosaic module with dual-antenna heading support
- Same form factor and pinout as other mosaic's, but a second antenna input pad is now available
- Very close to AsteRx-m2a in terms of supported signals and capabilities





# mosaic-H



Column1	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1		
AC	GND	GND	GND	ANT_1	GND	GND	REF_I	REF_O	GND	VTUNE	GND	MFP2	MFP5	MFP8	MFP10	PPSO	EVENTB	EVENTA	GTMO	1V8_OUT	SYNC	SD1_DATA2	SD1_DATA3	AC	
AB	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	MFP1	MFP4	MFP7	MFP9	GND	EVENTC	GND	GND	GND	GND	GND	SD1_CMD	AB	
AA	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	MFP0	MFP3	MFP6	JTCK1	JTD1	JTD01	JNTRST1	PWRCTL_WIFI	nRST_WIFI	SD2_DATA2	RMIL_CLK	SD1_CLK	AA	
Y	GND	GND	GND																			SD2_DATA3	GND	SD1_DATA0	Y
W	GND	GND	GND																			SD2_CMD	MDIO	SD1_DATA1	W
V	ANT_2	GND	GND																			SD2_CLK	MDC	SPL_MISO	V
U	GND	GND	GND																			SD2_DATA0	GND	SPL_SCLK	U
T	GND	GND	GND																			SD2_DATA1	RMIL_RXD1	SPL_MOSI	T
R	VANT	GND	GND																			GND	RMIL_RXD0	SPLSS0	R
P	VANT	GND	GND																			GND	GND	GND	P
N	2V8_OUT	GND	GND																			GPI00	RMIL_CRSDV	CTS3	N
M	2V8_IN	GND	GND																			GPI01	RMIL_RXER	TXD3	M
L	GND	GND	GND																			GPI02	RMIL_TXEN	RTS3	L
K	GND	GND	GND																			LOG_BUTTON	GND	RXD3	K
J	GND	GND	GND																			ADC0	RMIL_TX0	CTS2	J
H	GND	GND	GND																			ADC1	RMIL_TX1	TXD2	H
G	GND	N.C.	GND																			USB_PWR	GND	RTS2	G
F	GND	GND	GND																			USB_OC	nRST_LAN	RXD2	F
E	GND	GND	GND																			TXD4	GND	CTS1	E
D	GND	GND	GND																			RXD4	GND	TXD1	D
C	GND	1V2_OUT	1V4_OUT	VDD_3V3	VDD_3V3	VDD_3V3	GND	GND	GND	JTMS1	JTD2	JTD02	JNTRST2	DRDY/JTMS2	JTCK2	USB_VBUS2	GND	USB_HOST_N	USB_HOST_P	GND	EXT_nINT_REF	ADC2	RTS1	C	
B	1V2_OUT	1V4_OUT	GND	VDD_3V3	VDD_3V3	VDD_3V3	GND	PMIC_ON_REQ	TAMPER_0	nRST_IMU	GND	nPWR_CELL	nRST_CELL	CANRX	CANTX	VDD_SNVS	GND	GND	GND	GND	nANT_PWR_ON	LOGLED	RXD1	B	
A	GND	GND	GND	VDD_3V3	VDD_3V3	VDD_3V3	GND	GND	GND	PVT_AVAILABLE	DIFFCOR_DET	MODULE_RDY	nRST_IN	ONOFF	BOOT_MODE_0	USB_VBUS1	GND	USB_DEV_N	USB_DEV_P	GND	RTC_XTALI	RTC_XTALO		A	
	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1		

**ANT\_2:**  
Connect to AUX antenna on mosaic-H  
Tie to ground on other mosaics

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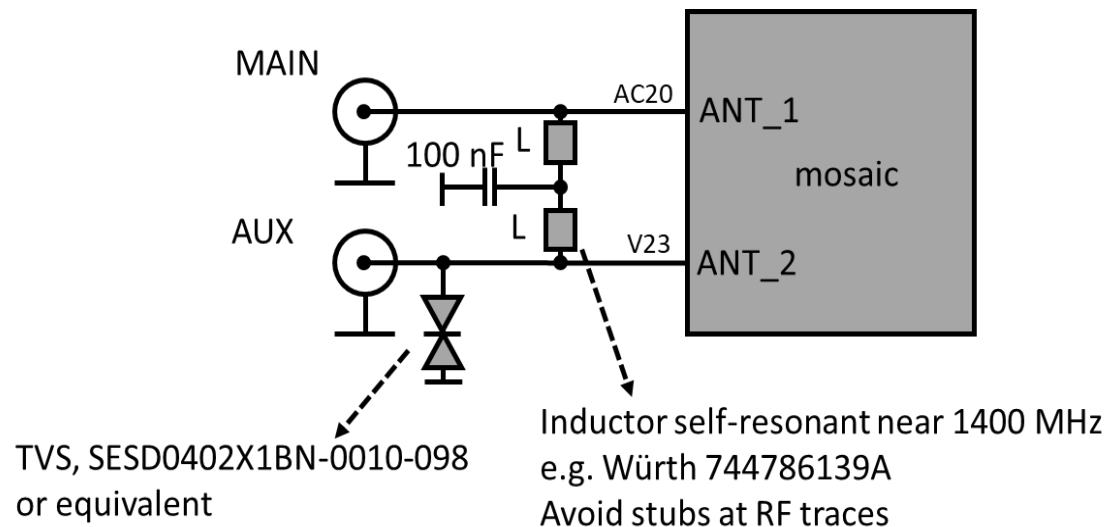
**ANT\_2:**  
Connect to AUX antenna on mosaic-H  
Tie to ground on other mosaics



# Aux Antenna Recommended Circuit (HW manual available)

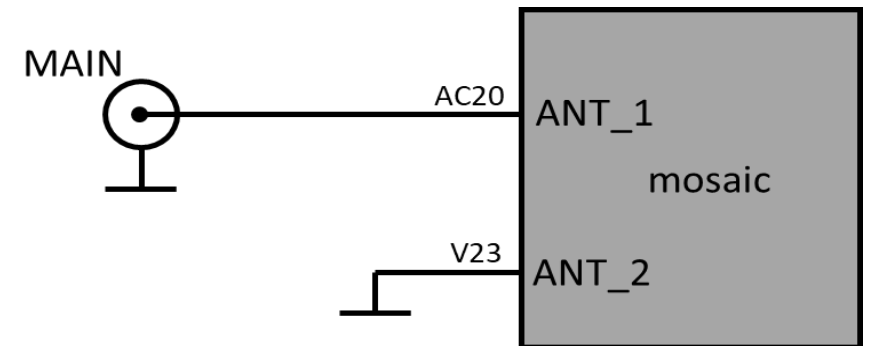
AUX DC supply and ESD protection must be provided by host design

## mosaic-H



- **!! With this circuit, max current per antenna is 75mA**

## mosaic-X5, mosaic-Sx, mosaic-T



# Main GNSS Features

## **Signals:** (same as AsteRx-m2a)

- GPS: L1CA/L2P/L2C
- GLO: L1CA/L2CA
- GAL: E1/E5b
- SBAS: L1
- BDS: B1I/B2I
- QZSS:L1CA/L2C

- 2 bands for all constellations
- All signals tracked from two antennas

## **Positioning:**

- Dual-antenna heading
- RTK, rover only
- PPP: not supported

## **Data rate:**

Meas only: 100Hz  
Standalone+heading: 50Hz  
RTK+heading: 20Hz

## **Jamming & Interference:**

- Spectrum plot + AGC
- Notch (manual mode only)
- WIMU supported

# Main Differences with AsteRx-m2a



- Size and cost reduction
- Support for all BeiDou satellites (C01-C63) instead of only C01-C37
- 60 channels instead of 40
- Power consumption slightly better (5-10% gain)



- Aux antenna not powered (external circuit needed)
- Max current from main 150mA (vs 200mA)
- Reduced RF gain range (15-35dB vs 15-45dB)
- No automatic notch filter (only manual notches)
- Average 3dB CN0 reduction

Noteworthy:

- No support for base station (no RTCM output, no NTRIP caster...)
- Point Collection feature disabled



# Antenna Attention Points

mosaic-H is more sensitive to main-aux cross interference because of its small size:

**!! Avoid antennas with high LNA gain (keep it < 35dB)**

**!! Use same antenna for main and aux**

**!! Use same cable length for main and aux**

PolaNt antennas not recommended  
(gain too high, or use long cables)

Antenna shipped with DevKit is fine:



\* Stencil thickness is 100um

## TW7972

**TW7972 Triple-band GNSS Antenna + L-band**

Frequency Coverage: GPS/QZSS-L1/L2/L5, GLONASS-G1/G2/G3, Galileo-E1/E5a/E5b, BeiDou-B1/B2/B2a, NavIC-L5  
+ L-band correction services

The TW7972 is precision-tuned Accutenna® technology antenna supporting triple-band GPS/QZSS-L1/L2/L5, GLONASS-G1/G2/G3, Galileo-E1/E5a/E5b, BeiDou-B1/B2/B2a, NavIC-L5, including the satellite-based augmentation system (SBAS) available in the region of operation (WAAS (North America), EGNOS (Europe), MSAS (Japan), or GAGAN (India)), plus L-band correction services coverage, and is especially designed for precision triple-frequency positioning.

This antenna is ideal for precision agriculture, autonomous vehicle tracking and guidance, and other applications where precision matters.

The TW7972 features a dual-feed circular stacked patch element. The signals from the two orthogonal feeds are summed in quadrature, pre-filtered in a low loss filter to protect against a wide range of potentially interfering signals, amplified in high linearity, wide-band LNA, then band-split, tightly filtered and amplified prior to signal recombination at the output.

This antenna provides superior multipath rejection and axial ratio, a linear phase response, and tight Phase Centre Variation (PCV), while protecting against intermodulation and saturation caused by high-level LTE 700 MHz signals.

The TW7972 is housed in a magnetic mounted, IP67 weather-proof enclosure.

This antenna is also available in embedded OEM formats (TW3967 for 28 dB and TW3972E for 35 dB).



### Applications

- Autonomous vehicle tracking and guidance
- Positive Train Control (PTC)
- Positive Train Location (PTL)
- Precision GNSS positioning
- Precision agriculture
- Triple-frequency RTK and PPP receivers
- Safety & security

### Features

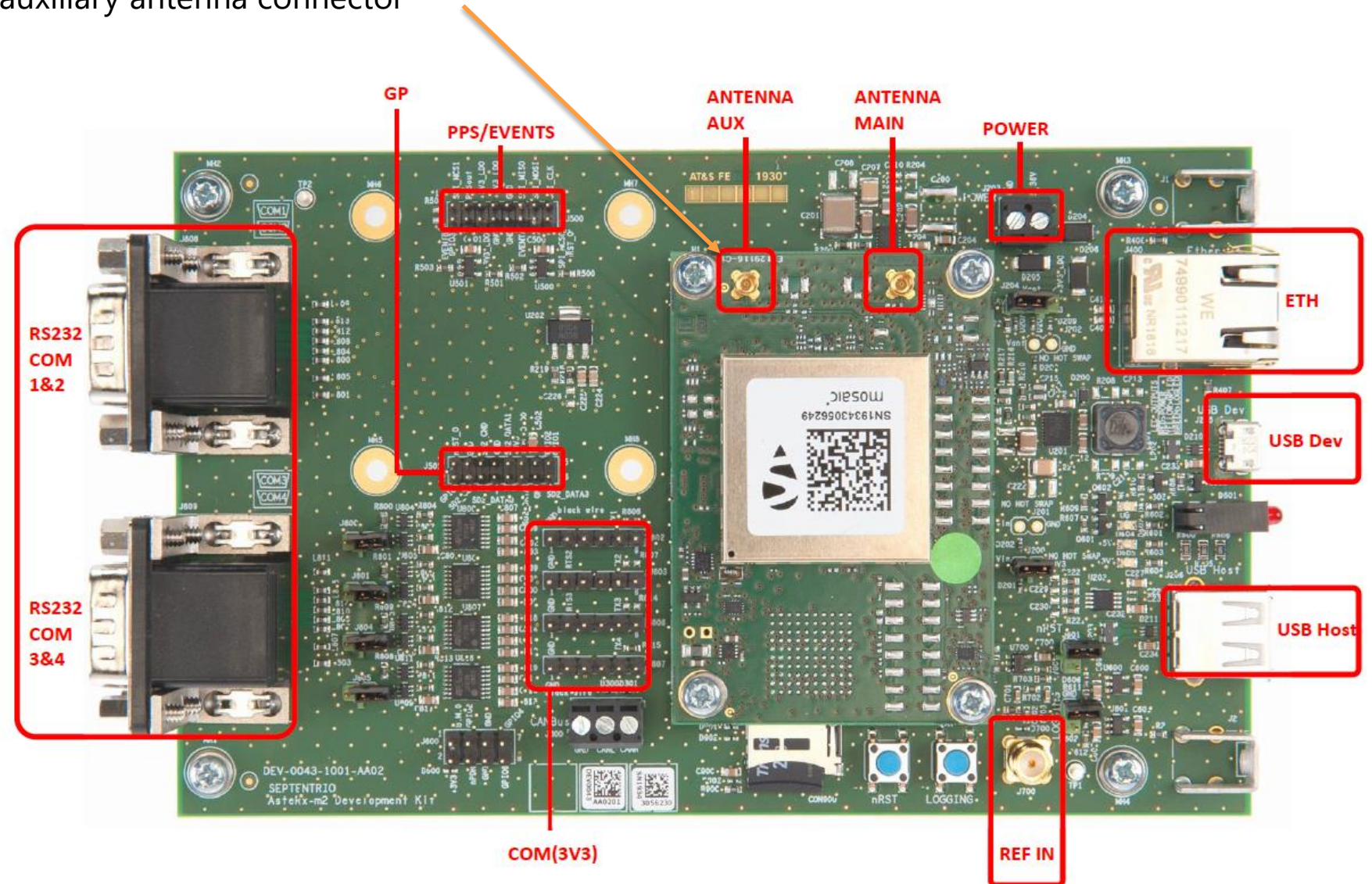
- Very low noise preamp (< 2.5 dB typ.)
- Low axial ratio (< 2.0 dB typ.)
- Tight phase centre variation
- High-gain LNA (32 dB typ.)
- Low current (24 mA typ.)
- ESD circuit protection (15 kV)
- Invariant performance from 2.5 to 16 VDC
- IP67, REACH, and RoHS compliant

### Benefits

- Excellent multipath rejection
- Increased system accuracy
- Excellent signal-to-noise ratio

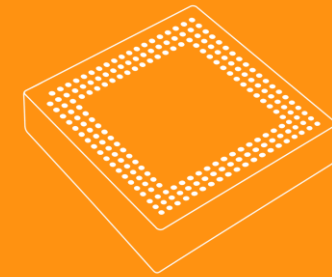
# DevKit: SAP 410359

Same as before, but now with auxiliary antenna connector





# mosaic-H™



## Applications and F9H highlights



Accurate



Multi  
Constellation



AIM+ Interference  
Mitigation



High-Quality  
Measurements



High Update Rates  
Low Latency



Low Power



Base Rover



Proven  
Performance



Lightweight



Easy-to-integrate



## 1: Better than Velocity Heading

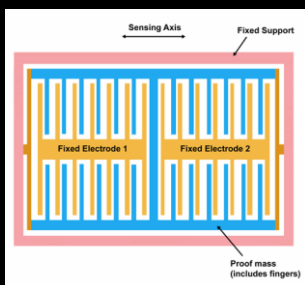
Velocity Heading not ideal for aerial, boats or other vehicles that move sideways.

Dual Antenna will surely provide better performance independent of vehicle movements.

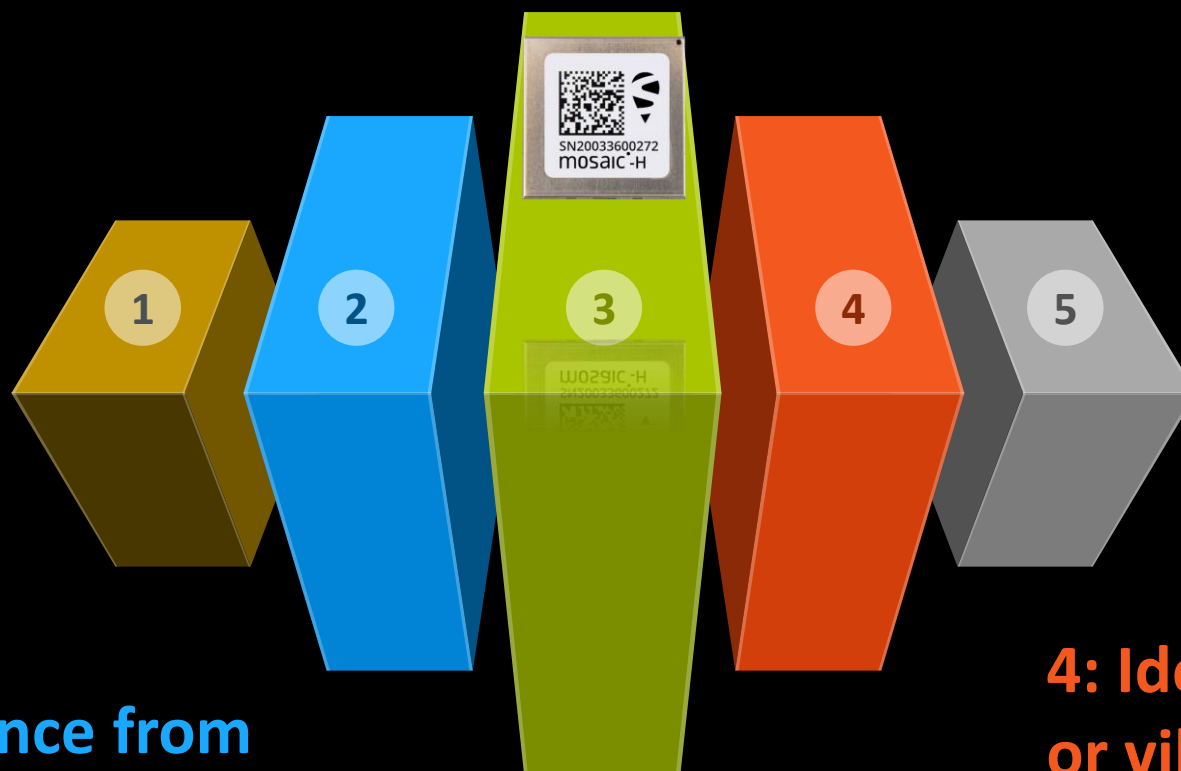
## 2: Independence from magnetic interference

Dual Antenna is **not susceptible** to static or dynamic interference as magnetic sensors are.

e.g. from nearby ferrous objects and magnets (static) or high current wiring, electric motors, servos, and large masses of ferrous materials (dynamic).



# Value of Dual Antenna solutions



## 5: Works in slow dynamics

Dual-antenna heading works while both stationary and moving and allows for very accurate heading in slow moving or 3D vehicles.

## 4: Ideal for off-road or vibrating environments

Dual Antenna GNSS allows provides an stable solution which is not affected by vibrations when working off-road or with other vibrating systems (e.g. vibration from drones caused by multirotors)



## 3: Maximizes heading accuracy and stability

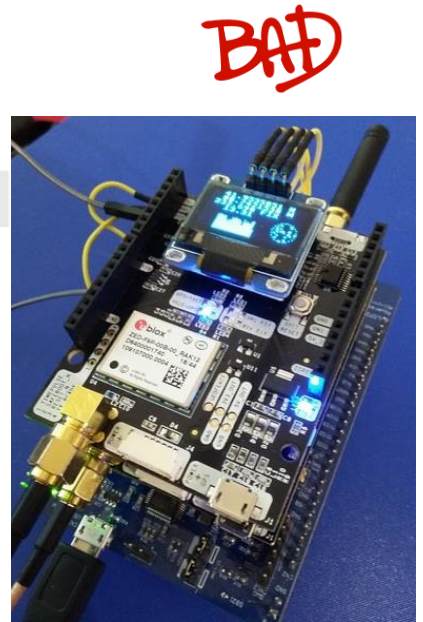
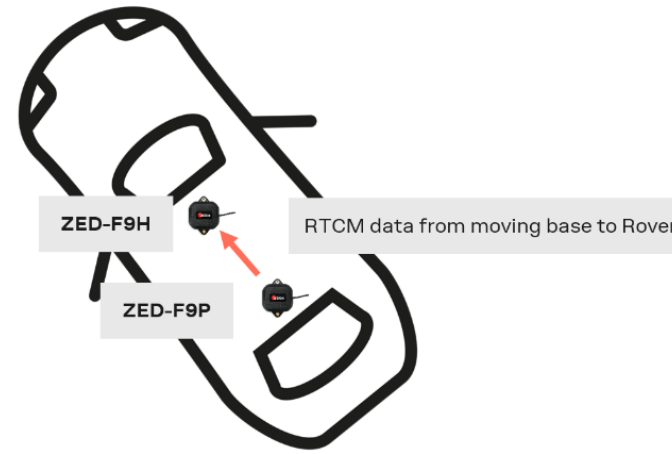
The more stable heading accuracy of sub-degree can be achieved thanks to dual antenna.



# Our values vs uBlox (F9H)

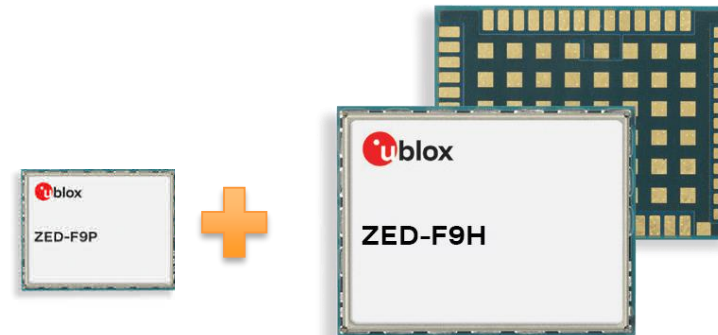
- **Can only operate as a Rover in a Moving base setup with F9P**
- Only 0.4 degrees accuracy (vs 0.15 and up to 0.03)
- Only up to 10Hz with reduced constellations!
- No Web User interface
- No Ethernet

**BAD**  
**BAD**  
**BAD**  
**BAD**



Need 2 modules

**BAD**



Question Tags: [simpleRTK2B-F9H installation guide](#)



#### **EMEA (HQ)**

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