M.2 MOSAIC GNSS Modules

Technical Reference Guide

Advanced Navigation Solutions

Applicable Modules

This Document applies to ANavS M.2 Smart Module cards, based around the Septentrio MOSAIC chipset.

M.2 card Septentrio MOSAIC-X5	M.2 card Septentrio MOSAIC-H	M.2 card Septentrio MOSAIC-T
70.40.0.6.1.00	**70.40.0.6.2.00**	**70.40.0.6.3.00**

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M.2 Mosaic - Technical Reference Guide

Contents

History

Version	Date	Description
1.0	10.12.2024	First release

External Reference Documents

Document	Link	version
mosaic-X5 Firmware v4.14.4 Reference Guide	https://www.septentrio.com/en/products/gps/gnss-receiver-modules/mosaic-x5#resources	4.14.4
mosaic-H Firmware v4.14.4 Reference Guide	https://www.septentrio.com/en/products/gps/gnss-receiver-modules/mosaic-h#resources	4.14.4
mosaic-T Firmware v4.14.4 Reference Guide	https://www.septentrio.com/en/products/gps/gnss-receiver-modules/mosaic-t#resources	4.14.4

1 Module Variants Overview

ANavS Mosaic Smart modules are available in three variants. These are based on the MOSAIC family of GNSS receivers. The MOSAIC-X5 modules provide the base level of features with the -H and -T modules providing special functionality if required.

All variants are quad band, and capable of receiving current and future signals across all constellations.

MOSAIC-X5	MOSAIC-H	MOSAIC-T
P/N: 70.40.0.6.1.00	**P/N: 70.40.0.6.2.00**	**P/N: 70.40.0.6.3.00**
Small sized with outstanding performance. High update rates (>100 Hz) and low latency both are crucial for control systems of any type of autonomous applications. High accuracy centimeter level positioning. High accuracy centimeter level positioning.	With dual antenna input, the MOSAIC-H provides precise, reliable and positioning independent heading combined with centimeter-level RTK.	High-precision solution for time and frequency synchronization under challenging conditions such as during GNSS jamming or spoofing. 10MHz clock input for Improved stability and performance

1.1 M.2 MOSAIC-X5

A high quality, high performance, single antenna Receiver Module in the convenient M.2 package.

1.2 M.2 MOSAIC-H

The MOSAIC-H modules provide inbuilt heading solution additional to the position. This is accomplished through a second GNSS antenna connector.

For details regarding LNA and performance, see 4.1.4.1

1.3 M.2 MOSAIC-T

The MOSAIC-T module includes a master clock input via the second coax connector. This is intended for use with a high precision 10MHz clock, e.g. atomic clock. A precision clock will stabilise the internal oscillator of the receiver, improving accuracy of the solution.

For details regarding the clock input, see 4.1.5.1

2 GNSS Specs

2.1 Septentrio MOSAIC Performance

GNSS bands

GPS:	L1C/A, L1C, L1PY, L2C, L2P, L5
GLONASS:	L1CA, L2CA, L2P, L3 CDMA
Beidou:	B1I, B1C, B2a, B2I, B311
Galileo:	E1, E5a, E5b, E5 AltBoc, E611
QZSS:	L1C/A, L1C, L2C, L5, L611
Navic:	L5
SBAS:	Egnos, WAAS, GAGAN, MSAS,
SDCM (L1, L5)	
On module L-band	

Accurate RTK Positioning 1 (1)

Horizontal accuracy	0.006 m ± 0.5 ppm
Vertical accuracy	0.010 m ± 1 ppm

Accurate Attitude 1, 2 * (1)

1m antenna spacing	
Roll and Pitch	0.25°
True Heading	0.15°
5m antenna spacing	
Roll and Pitch	0.05°
True Heading	0.03°

Velocity Accuracy	0.03 m/s RMS

* Performance when using dual antenna on MOSAIC-H Modules

Maximum update rate:	
Measurements only	100 Hz
Standalone, SBAS, DGPS + attitude2	50Hz
RTK + attitude2	20Hz
Latency	<10ms
Time precision	
xPPS out	5 ns
Event accuracy	< 20 ns
Time to first fix	
Cold start9	< 45 s
Warm start10	< 20 s
Re-acquisition	1 s
Tracking performance (C/N0 threshold)	
Tracking	20 dB-Hz
Acquisition	33 dB-Hz

3 Getting started

3.1 Driver

The ANavS M.2 MOSAIC Modules use the drivers provided by Septentrio for the MOSAIC family of receivers. These can be found from on the Septentrio website: https://customersupport.septentrio.com/s/article/How-to-install-the-drivers

3.2 Connect the module via USB

The M.2 card provides, among others, a USB interface which can be used to interact with the GNSS module.

For Windows, the USB driver provided with your receiver emulates two virtual serial ports, which can be used as standard COM ports to access the receiver. The Windows USB driver can be installed through the Septentrio RxTools

software suite. When connected, a new drive appears in the file manager. This drive contains an installer for the USB driver. Running this installer is not needed if you have already installed the Septentrio RxTools suite.

On Linux, the standard Linux CDC-ACM driver is suitable. Most terminal emulation programs will make no distinction between virtual and native COM ports. Note that the port settings (baud rate, etc) for virtual serial ports are not relevant, and can be left in their default configuration in the terminal emulation program.

When a USB cable is connected, the receiver supports Ethernet-over-USB. The IP address allocated to the Ethernet-over-USB interface is 192.168.3.1. That address cannot be changed, so this feature is only to be used when a single receiver is connected to your computer.

By default, the receiver is not allowed to access the Internet over USB. This can be changed with the **setUSBInternetAccess** command [**Fehler! Verweisquelle konnte nicht gefunden werden.**]. Note that this requires allowing Internet sharing on your computer. The procedure to do so depends on your operating system. For example, on Windows, it involves enabling "Allow other network users to connect through this computer's Internet connection." in the properties of the adapter providing Internet access. When Internet sharing is enabled, the receiver gets its IP address from a DHCP server on your computer. Depending on your computer's routing table, it may be that it is not reachable anymore at 192.168.3.1.

3.3 Use via a Web Browser

The receiver can be controlled and configured using a web browser by entering 192.168.3.1

For example, if your receiver's hostname is mosaic-x5-1234567, simply use the following URL in your preferred web browser:

http://mosaic-x5-1234567

or, for a secure connection:

https://mosaic-x5-1234567

The HTTPS certificate (.pem file) can be uploaded through the Communication › Web Server/TLS menu of the web interface.

Most user commands described in section 3.2 in [**Fehler! Verweisquelle konnte nicht gefunden werden.**] can be accessed graphically from the web interface. You can also go to Admin › Expert Control › Expert Console to manually type ASCII commands and view replies.

By default, the web interface provides unrestricted read and write access to the receiver. This can be changed, as further explained in section 1.24 of this document. Note that a lightweight (text only) version of the web interface is available by appending /lite to the URL, for example:

http://mosaic-x5-1234567/lite

3.4 RTK-Correction data for M.2 to USB-C adapter board

Providing RTK correction data to the module is essential to get the best possible positioning performance. There are some open-source tools, which can stream the correction data, e.g., with your laptop, and provide this stream to one of the virtual COM ports of the M.2 receiver.

A very nice tool for this job is the RTK-Libs streamserver-software package (https://www.rtklib.com/). Please get in contact with the ANavS support team to learn more about this feature and the possibilities.

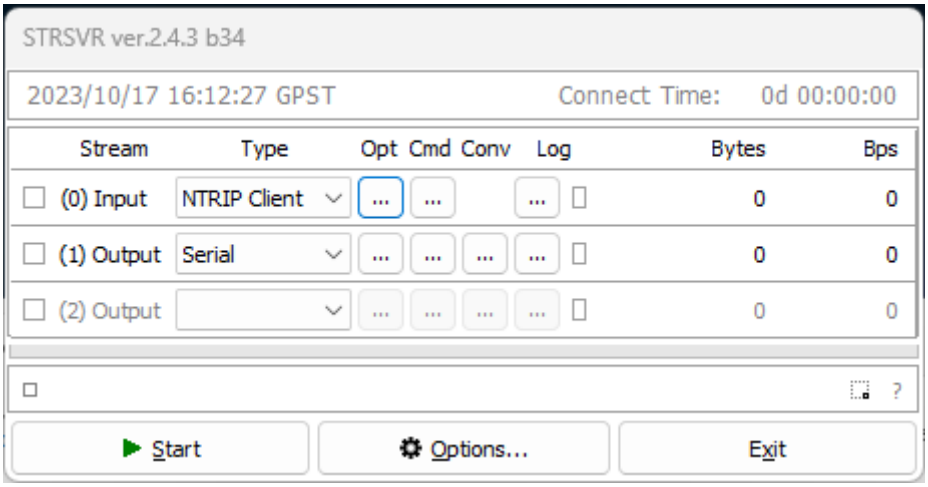


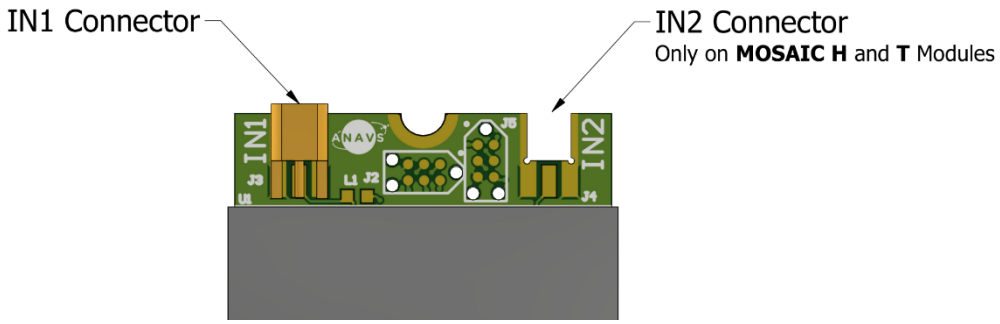
Figure 1: RTK-Lib stream server software for distributing RTK correction data

4 Electrical

4.1 Coaxial Connectors

ANavS smart GNSS cards have up to two MMCX coaxial Interfaces (IN1 and IN2). Depending on the chipset, these connectors serve different functions:

	MOSAIC-X5	MOSAIC-H	MOSAIC-T
IN1	GNSS Antenna	GNSS Antenna 1	GNSS Antenna
IN2	Not Connected	GNSS Antenna 2	Ext. Clock IN



4.1.1 LNA

When used for a GNSS, the connector supplies power for external Antenna Amplifiers (LNA). The LNA supply is **5 V,** interlay limited to **150 mA.** For specifics on MOSAIC-H LNA for IN2 check the section 4.1.4.1.

4.1.2 Pre-amplification Gain Range

Pre-amplification for the MOSAIC is specified for an input gain range of 15-50 dB for Single Antenna modules (MOSAIC-X, -T) and 15-35 dB for dual antenna modules (MOSAIC-H)

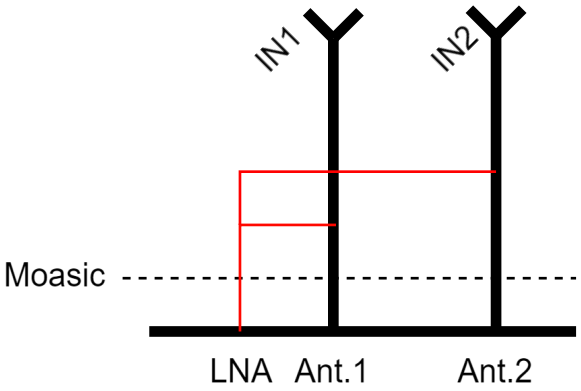
4.1.3 X5

4.1.4 H

MOSAIC-H Modules use the IN2 MMCX connector for a second GNSS antenna allowing Position and Attitude outputs form the module.

4.1.4.1 LNA

The MOSAIC-H chipset only provides LNA on one output (IN1). The M.2 Card routes this LNA output to both coax antenna connecters IN2 and IN2. The total power budget for the LNA is supplied is thus shared between both antenna, with the combined total current limit of 150mA.



In the case of an overcurrent event, such as a shorted antenna cable, the current is first limited to 150mAand the disabled after 10ms. The Module will attempt to reenable the LNA supply periodically to check if the short condition is resolved.

4.1.4.2 Pre-amp

As defined by Septentrio, it is recommended that attenuators are used if pre-amp gain is higher than 35dB.

It is also noted that pre-amps gain should not differ more than 5dB. Ideally both IN1 and IN2 should have the same model of antenna where possible similar lengths of antenna cable.

4.1.5 T

On MOSAIC-T modules, IN2 allows the connection of a high precision 10MHz clock. The clock is connected though a signal conditioning section to the REF_I pin on the MOSAIC-T Module.

When powered on, the MOSAIC chip will attempt to use the external clock, if no clock signal is found on IN2 it will revert to the internal clock until the next power cycle.

4.1.5.1 10MHz Reference Clock

The clock input on IN2 accepts input voltages for 0.2V to 4.9V peek to peek, with a signal impedance of 50 Ohm.

4.2 Power

Power consumption of the M.2 MOSAIC cards varies slightly depending on the current activity state, and which signals are actively being used.

Power Draw

Max	2.3W
Typical	1.8W

4.3 Temperature

Operating temperature for the MOSAIC modules, between -40 and 85°C

4.4 Pulse Per Second (PPS)

A time pulse input and output are available on pins 36 and 34, respectively. The Logic level of these pins is 1.8V.

The PPS out is directly connected to the PPSO (pin AC8). The pin pulses high for 1ms when powered on. It stays at high impedance while the module start up, after which the PPS is output by pulsing high for 5ms every second.

The time pulse input is connected to EVENTA (pin AC6) on the MOSAIC. This pin can be used to tag external event with a time resolution of 20 ns.

For details on the use of these pins we refer to the MOSAIC Hardware Manual. This can be found in the

External Reference Documents section.

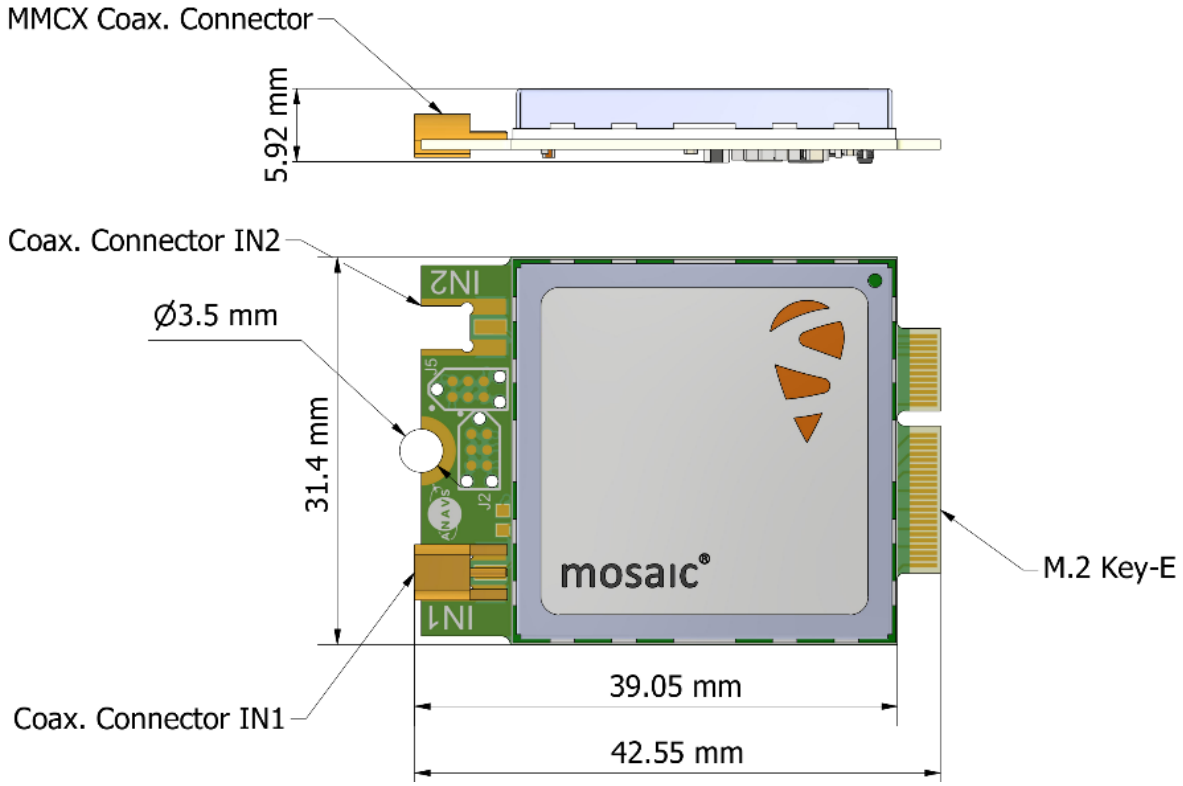
4.5 Pin Definition

Pin description of the M.2 Key-E edge connector:

Pin	M.2 Key-3 Pin	Definition	Comment
1, 7, 18, 33, 39, 45, 51, 57, 63, 69, 75	GND	Ground Connection	
2, 4, 72, 74	VCC_3P3	3.3V power input pins	Min 3.135V Max 3.465V
3	USB_D+	USB differential data bus +	
4	USB_D-	USB differential data bus -	
6	LED1_OD	Open Drain LED pin, connected to MOSAIC GPLED pin	Open Drain
16	LED2_OD	Open Drain LED pin, connected to MOSAIC GPLED1 pin	Open Drain
22	UART_TXD_1P8	UART data bus, data into module	1.8V logic
23	GLOBAL_RESET/ SDIO_RESET_1P8	Resets MOSAIC when pulled low. Pulse to ground of less than 1 s is ignored	1.8V logic, Open Drain
32	UART_RXD_1P8	UART data bus, data out of module	1.8V logic

34	TP_FROM_MOD/ UART_CTS_1P8	PPS output from MOSAIC. 5ms pulse high every second 4.4 Pulse Per Second (PPS)	1.8V logic
36	TP_TO_MOD/ UART_WAKE_1P8	External trigger input for tagging external event with 20ns time revolution. 4.4 Pulse Per Second (PPS)	1.8V logic
	NC	Not connected	Leave floating or connect to an arbitrary potential

5 Dimensions



5.1 Clearance

Height required above and below the card to prevent conflict with other components. Clearance recommended: above 4.5mm, below 1.4mm