

# VN-210-S GNSS/INS

## Tactical-Grade GNSS-Aided Inertial Navigation System

### Highlights

<b>0.05°-0.1°</b> Dynamic Heading Accuracy (INS)	<b>0.6°/hr</b> Gyro In-Run Bias Stability	<b>Tri-band GNSS</b> Integrated L1/L2/L5/E1/E5a/b GNSS Receiver	<b>Designed to MIL-STD</b> MIL-STD-810; MIL-STD-461G; DO-160G; IP 68
<b>0.015°</b> Dynamic Pitch/Roll Accuracy (INS)	<b>±490°/s</b> Gyroscope Range ±2000°/s Optional	<b>RTK/PPK Capable</b> External RTCM 3 Inputs; Exportable RINEX	<b>Low SWaP</b> 56 x 56 x 31 mm; 170 grams; < 3.3 W

### Product Overview

The VN-210-S is a tactical-grade, high performance GNSS-Aided Inertial Navigation System (GNSS/INS) that combines 3-axis accelerometers, gyros, and magnetometers, a tri-band L1/L2/L5/E1/E5b GNSS receiver with anti-jamming/anti-spoofing technology, and advanced Kalman filtering algorithms to provide optimal output of position, velocity, and attitude. The VN-210-S uses VectorNav's proprietary onboard Extended Kalman Filter (EKF) to combine high-bandwidth inertial sensors and high-accuracy, low-bandwidth GNSS measurements, to deliver best-in-class low-latency performance.

The VN-210-S is available in a precision milled, anodized aluminum enclosure. Designed to MIL-STD and DO-160G standards, the VN-210-S is suitable for the most demanding military and aerospace applications.



**VN-210-S**

### Features

#### Industry-Leading INS

The VN-210-S features VectorNav's proprietary Extended Kalman Filter INS algorithm, which is proven to excel under the most challenging dynamic conditions.

#### RTK and PPK Positioning

The VN-210-S integrated GNSS receiver supports RTK and PPK positioning to achieve centimeter-level position accuracy. Support for Moving Baseline RTK operations coming Q1 2024.

#### High Dynamic Operations

The VN-210-S is available in an "Extended Range Velocity" option, enabling operation beyond the specified Altitude (50,000 m) and Velocity (500m/s) limits.

#### Robust Positioning

With industry leading interference mitigation capabilities and message authentication, the VN-210-S delivers improved GNSS performance and integrity across a wide variety of applications.

#### True Inertial Navigation System

No mounting orientation restrictions or configuration modes; Automatic filter initialization and dynamic alignment.

#### Software Compatibility

The VN-210-S shares communication protocol with the entire VectorNav product line.

#### Ease of Availability

ITAR-free and Made in the USA; Short lead times.

Each VN-210-S undergoes a robust calibration and acceptance testing process at VectorNav's AS9100 certified manufacturing facility. Performance specifications are based on comprehensive field testing and results from real-world applications, and are regularly tested to ensure continued conformance to such specifications.

### Sensor Summary

- ▶ VectorNav proprietary Extended Kalman Filter INS delivers coupled position, velocity, and a continuous attitude solution over the complete 360° range of operation
- ▶ Hard/Soft Iron Compensation (Real-time and Manual 2D & 3D)
- ▶ Individually calibrated for bias, scale factor, misalignment, and gyro g-sensitivity over full operating temperature range (-40° C to +85° C)
- ▶ RTK Capable: Support for External RTCM v3 Inputs
- ▶ Raw GNSS Data: Exportable RINEX Data for PPK; Raw Pseudorange, Doppler and Carrier Phase outputs; Ephemeris Data
- ▶ Coning and sculling integrals ( $\Delta V$ 's,  $\Delta \theta$ 's)
- ▶ Data output format: ASCII (VectorNav), NMEA-0183, Binary (VectorNav), ARINC 429<sup>1</sup>
- ▶ Designed to the following Environmental Standards:
  - Vibration & Shock (MIL-STD-810G)
  - Temperature (DO-160G)
  - EMI & Radiation (MIL-STD-461G)
  - Electrical (MIL-STD-1275E)
- ▶ IP 68 per IEC 60529

### Performance Specifications

PRELIMINARY

#### ATTITUDE

Range (Heading/Yaw, Roll) .....	± 180°
Range (Pitch) .....	± 90°
Heading (Magnetic) <sup>2</sup> .....	2.0° RMS
Heading (INS) <sup>3,4</sup> .....	0.05° to 0.1°, 1σ
Pitch/Roll (Static) .....	0.05° RMS
Pitch/Roll (INS) <sup>4</sup> .....	0.015°, 1σ
Heading Mounting Misalignment <sup>5</sup> .....	< 0.05°, 1σ
Pitch/Roll Mounting Misalignment <sup>5</sup> .....	< 0.05°, 1σ
Angular Resolution .....	0.001°

#### POSITION/VELOCITY

Horizontal Position Accuracy <sup>6</sup> .....	0.6 m RMS
Vertical Position Accuracy <sup>6</sup> .....	0.8 m RMS
RTK Position Accuracy <sup>7</sup> .....	1 cm + 1 ppm CEP
Free Inertial Position Drift <sup>8</sup> .....	0.5 cm/s <sup>2</sup>
Velocity Accuracy .....	0.02 m/s

### IMU Specifications

	ACCELEROMETER	GYROSCOPE	MAGNETOMETER
Range	±15 g	±490°/s (Optional ±2000°/s) <sup>9</sup>	±2.5 Gauss
In-Run Bias Stability (Allan Variance)	< 10 µg	< 1°/hr (0.6°/hr typ.)	-
Noise Density	< 0.04 mg/√Hz	5°/hr /√Hz	140 µGauss/√Hz
Bandwidth	200 Hz	210 Hz	200 Hz
Cross-Axis Sensitivity	±0.05 °	< 0.05 °	±0.05 °

### GNSS Receivers

Receiver Type.....	448 Channel
GPS.....	L1C/A, L1PY, L2C, L2P, L5
Galileo .....	E1, E5a, E5b, E5 AltBoc, E6
GLONASS.....	L1CA, L2CA, L2P, L3 CDMA
Beidou.....	B1I, B1C, B2a, B2b, B2I, B3
QZSS .....	L1C/A, L1 C/B, L2C, L5
Navic .....	L5
SBAS.....	Egnos, WAAS, GAGAN, MSAS, SDCM (L1, L5)
Time-To-First-Fix (Cold / Hot) .....	< 45 s / < 20 s
Altitude Limit <sup>10</sup> .....	50,000 m
Velocity Limit <sup>10</sup> .....	500 m/s

### Interfacing

Output Data Rate (IMU) <sup>11</sup> .....	up to 800 Hz
Output Data Rate (Position, Velocity & Attitude) .....	up to 400 Hz
Primary Interface .....	RS-422 (Optional RS-232)
Auxiliary Interface .....	RS-422
GNSS PPS.....	<10 ns RMS, 25 ns 99%
Input.....	Sync-in
Output .....	Sync-out

### Environmental

Operating Temperature .....	-40° to +85° C
Storage Temperature .....	-40° to +85° C

### Mechanical/Electrical

	SIZE	WEIGHT	INPUT VOLTAGE	CURRENT DRAW <sup>12</sup>	POWER <sup>12</sup>
VN-210-S	56 x 56 x 31 mm	170 g	12 to 34 V	135 mA @ 24 V	< 3.3 W

1. Contact VectorNav for ARINC 429 option.  
 2. With proper magnetic declination, suitable magnetic environment and valid hard/soft iron calibration.  
 3. Dependant on a number of factors, contact VectorNav to discuss expected performance in your application.  
 4. With sufficient motion for dynamic alignment.  
 5. Constant on a per part basis. Can be calibrated out during system integration using boresighting or other alignment processes.  
 6. Dependant on SBAS, clear view of GNSS satellites, good multipath environment, compatible GNSS antenna, and measurement duration period.  
 7. Dependant on atmospheric conditions, baseline length, GNSS antenna, multipath conditions, satellite visibility and geometry.  
 8. Typical rate of growth in error of position estimates after loss of GNSS signal, provided INS full alignment prior to loss.  
 9. Contact VectorNav for Extended Range Gyro Option.  
 10. Contact VectorNav for Extended Range Velocity Option.  
 11. Contact VectorNav for higher IMU data output rates.  
 12. Not including active antenna power consumption.