

# VN-200 GNSS/INS

Miniature, high-performance GNSS-Aided INS

## Highlights

<b>0.2°</b> Dynamic Heading Accuracy (INS)	<b>5°/hr</b> Gyro In-Run Bias Stability	<b>400 Hz</b> Position, Velocity and Attitude Data	<b>800 Hz</b> IMU Data
<b>0.03°</b> Dynamic Pitch/Roll Accuracy (INS)	<b>&lt; 0.04 mg</b> Accel In-Run Bias Stability	<b>1.0 m / 1.5 m</b> Horizontal / Vertical Position Accuracy	<b>Surface Mount (SMD)</b> 24 x 22 x 3 mm; 4 grams; 445 mW

## Product Overview

The VN-200 is a miniature, high performance GNSS-Aided Inertial Navigation System (GNSS/INS) that combines 3-axis gyros, accelerometers and magnetometers, a high-sensitivity GNSS receiver, and advanced Kalman filtering algorithms to provide optimal estimates of position, velocity, and attitude.

The VN-200 is the world's first GNSS/INS in a single surface mount package (SMD). At the size of a postage stamp, the VN-200 SMD requires only a single 3.2-5.5V power supply and can be directly embedded into a user's electronics for unprecedented SWAP advantages.

The VN-200 Rugged is the "plug and play" version of the VN-200 SMD. Enclosed in a clamshell precision anodized aluminum enclosure, the VN-200 Rugged offers additional protection of the internal inertial sensors, GNSS receiver and electronics.

## Features

### Industry-Leading INS

The VN-200 features VectorNav's proprietary Extended Kalman Filter INS algorithm, which is proven to excel under the most challenging dynamic conditions.

### 72-Channel GNSS Receiver

Onboard GNSS receiver, supporting GPS, Galileo and SBAS corrections, providing the most compact, high-performance industrial-grade INS in the market.

### True Inertial Navigation System

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

### Software Compatibility

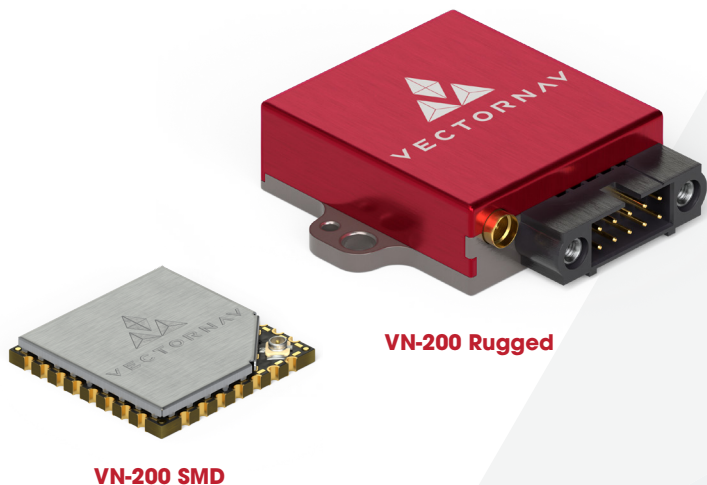
The VN-200 Rugged and SMD share a common communication protocol with the entire VectorNav product line.

### Ease of Availability

ITAR-free and Made in the USA; Ships in 1-2 days.

### User Configurable Messages

ASCII and VectorNav Binary messages.



Each individual VN-200 sensor 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
- ▶ True INS Filter, no mounting restrictions, modes of operation or constraints required
- ▶ Real-time gyro and accel bias tracking and compensation
- ▶ VectorNav Processing Engine (VPE) for disturbance rejection, adaptive filtering, dynamic filter tuning
- ▶ Hard/Soft Iron Compensation (Real-time and Manual 2D & 3D)
- ▶ Individually calibrated for bias, scale factor, misalignment, and temperature over full operating range (-40° C to +85° C)
- ▶ Raw Pseudorange, Doppler and Carrier Phase outputs
- ▶ Real-time and delayed heave estimation
- ▶ Coning and sculling integrals ( $\Delta V$ 's,  $\Delta \theta$ 's)
- ▶ Data output format: ASCII (VectorNav), NMEA-0183, Binary (VectorNav)
- ▶ VectorNav Control Center GUI (available for free download at [www.vectornav.com](http://www.vectornav.com)) provides a practical tool for easy sensor setup, configuration and data viewing/logging
- ▶ ITAR-Free

### Performance Specifications

#### ATTITUDE

Range (Heading/Yaw, Roll) .....	$\pm 180^\circ$
Range (Pitch) .....	$\pm 90^\circ$
Heading (Magnetic) <sup>1</sup> .....	2.0° RMS
Heading (INS) <sup>2</sup> .....	0.2°, 1 $\sigma$
Pitch/Roll (Static) .....	0.5° RMS
Pitch/Roll (INS) <sup>2</sup> .....	0.03°, 1 $\sigma$
Heading Mounting Misalignment (Rugged) <sup>3</sup> .....	0.15°, 1 $\sigma$
Pitch/Roll Mounting Misalignment <sup>3</sup> .....	0.1°, 1 $\sigma$
Angular Resolution .....	0.001°

#### POSITION/VELOCITY

Horizontal Position Accuracy <sup>4</sup> .....	1.0 m RMS
Vertical Position Accuracy <sup>4</sup> .....	1.5 m RMS
Free Inertial Position Drift <sup>5</sup> .....	3.0 cm/s <sup>2</sup>
Velocity Accuracy .....	< 0.05 m/s
Heave Accuracy .....	5% or 5 cm
Delayed Heave Accuracy .....	2% or 2 cm

### IMU Specifications

	ACCELEROMETER	GYROSCOPE	MAGNETOMETER	BAROMETER
Range	$\pm 16$ g	$\pm 2,000^\circ/s$	$\pm 2.5$ Gauss	10 to 1200 mbar
In-Run Bias Stability (Allan Variance)	< 0.04 mg	< 10°/hr (5°/hr typ.)	-	-
Noise Density	0.14 mg/ $\sqrt{Hz}$	0.0035°/s $\sqrt{Hz}$	140 $\mu$ Gauss/ $\sqrt{Hz}$	-
Bandwidth	230 Hz	265 Hz	200 Hz	200 Hz
Cross-Axis Sensitivity	$\pm 0.05^\circ$	< 0.05°	$\pm 0.05^\circ$	-

### GNSS Receiver

Receiver Type .....	72 Channel, L1C/A, L10F, E1, B1I GNSS
Constellations <sup>6</sup> .....	GPS, GLONASS, Galileo, BeiDou, QZSS, SBAS
Time-To-First-Fix (Cold) .....	29 s
Time-To-First-Fix (Hot) .....	1 s
Altitude Limit .....	50,000 m
Velocity Limit .....	500 m/s

### Interfacing

Output Data Rate (IMU) <sup>7</sup> .....	up to 800 Hz
Output Data Rate (Position, Velocity & Attitude) .....	up to 400 Hz
Interface (VN-200 Rugged) .....	RS-232, Serial TTL
Interface (VN-200 SMD) .....	Serial TTL, SPI
GNSS PPS .....	30 ns RMS, 60 ns 99%
Input .....	Sync-in
Output .....	Sync-out

### Environmental

Operating Temperature .....	-40° to +85° C
Storage Temperature .....	-40° to +85° C
MTBF (Rugged) .....	> 150,000 hours
MTBF (SMD) .....	> 240,000 hours

### Mechanical/Electrical

	SIZE	WEIGHT	INPUT VOLTAGE	CURRENT DRAW <sup>8</sup>	POWER <sup>8</sup>
Rugged	36 x 33 x 9.5 mm	16 g	3.3 to 17 V	80 mA @ 5 V	500 mW
SMD	24 x 22 x 3 mm	4 g	3.2 to 5.5 V	105 mA @ 3.3 V	445 mW

1. With proper magnetic declination, suitable magnetic environment and valid hard/soft iron calibration.  
 2. With sufficient motion for dynamic alignment.  
 3. Constant on a per part basis. Can be calibrated out during system integration using boresighting or other alignment processes.  
 4. Dependant on SBAS, clear view of GNSS satellites, good multipath environment, compatible GNSS antenna, and measurement duration period.

5. Typical rate of growth in error of position estimates after loss of GNSS signal, provided INS full alignment prior to loss.  
 6. Only GPS, Galileo and SBAS constellations used in VN-200 default configuration.  
 7. Contact VectorNav for higher IMU data output rates.  
 8. Not including active antenna power consumption.