

# VN-300 GNSS/INS

Dual GNSS-Aided Inertial Navigation System



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## INTRODUCTION

The VN-300 is a miniature, high-performance Dual Antenna GNSS-Aided Inertial Navigation System (Dual GNSS/INS) that combines high-performance inertial sensors, two high-sensitivity GNSS receivers, and advanced Kalman filtering algorithms to provide optimal estimates of position, velocity, and attitude under static and dynamic conditions.



VN-300 SMD

VN-300 Rugged

## PRODUCT HIGHLIGHTS

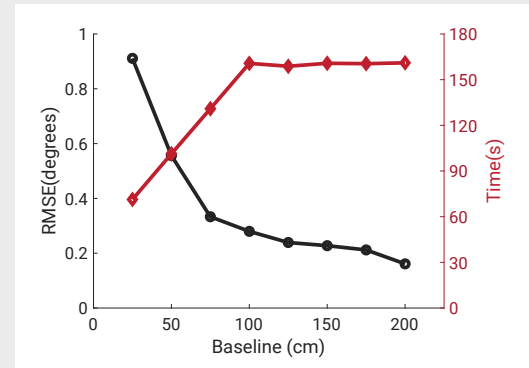
<b>0.2°</b> Dynamic Heading Accuracy (INS)	<b>0.15°</b> Static Heading Accuracy (GNSS-Compass)	<b>&lt; 0.04 mg</b> Accel In-Run Bias Stability	<b>400 Hz</b> Position, Velocity and Attitude Data
<b>0.03°</b> Dynamic Pitch/Roll Accuracy (INS)	<b>5-7°/hr (typ.)</b> Gyro In-Run Bias Stability	<b>1.0 m / 1.5 m</b> Horizontal / Vertical Position Accuracy	<b>Surface Mount (SMD)</b> 24 x 22 x 3 mm; 5 grams; < 1.25 W

## GNSS-COMPASS

The **GNSS-COMPASS** technique uses a form of Real-Time Kinematic Positioning (RTK) known as **Moving Baseline RTK** to determine a system's **heading**.

When a GNSS-Compass is combined with an INS, the combined system operates similar to a GNSS/INS system with the additional advantage that when the system experiences **static or low dynamic conditions**, the GNSS Compass is used to determine the system's heading.

► VN-300 GNSS-Compass Heading Accuracy and Start-Up Time as a function of GPS Antenna baseline separation distance.



## DEVELOPMENT KIT OPTIONS



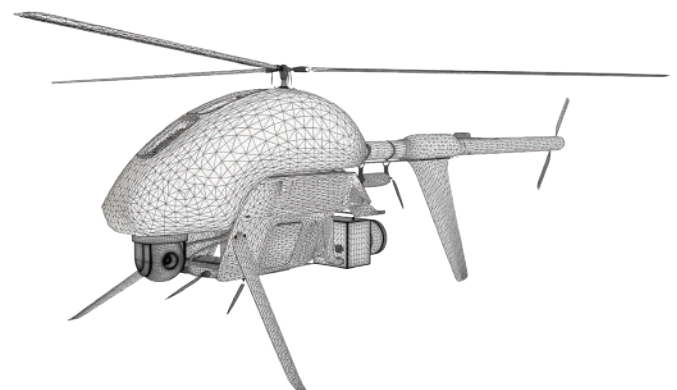
VN-300 Rugged



VN-300 Surface Mount

### Kit Contents

Complete hardware Development Kits include VectorNav sensor, applicable cabling, GNSS antennas, documentation, hardware tools and rugged carrying case.



## Sensor Summary

- ▶ VectorNav proprietary Extended Kalman Filter INS delivers coupled position, velocity, and a continuous attitude solution over the complete 360° range of operation
- ▶ GNSS-Compass for static and low dynamic heading accuracy
- ▶ Automatic transitioning between AHRS, INS & GNSS-Compass
- ▶ True INS Filter, no mounting restrictions, modes of operation or constraints required
- ▶ VectorNav Processing Engine (VPE) for disturbance rejection, adaptive filtering, dynamic filter tuning
- ▶ Hard/Soft Iron Compensation (Real-time and Manual 2D & 3D)
- ▶ All sensors are 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
- ▶ 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 $\sigma$
Heading (GNSS-Compass) <sup>3</sup>	
0.5 m Baseline .....	0.3° to 0.6° RMS
1.0 m Baseline .....	0.15° to 0.3° RMS
2.0 m Baseline .....	0.08° to 0.15° RMS
Pitch/Roll (Static) .....	0.5° RMS
Pitch/Roll (INS) <sup>2</sup> .....	0.03°, 1 $\sigma$
Heading Mounting Misalignment (Rugged) <sup>4</sup> .....	0.15°, 1 $\sigma$
Pitch/Roll Mounting Misalignment <sup>4</sup> .....	0.1°, 1 $\sigma$
Angular Resolution .....	0.001°

### POSITION/VELOCITY

Horizontal Position Accuracy <sup>3</sup> .....	1.0 m RMS
Vertical Position Accuracy <sup>3</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

## IMU Specifications

	ACCELEROMETER	GYROSCOPE	MAGNETOMETER	BAROMETER
Range	$\pm 16$ g	$\pm 2,000^\circ/\text{s}$	$\pm 2.5$ Gauss	10 to 1200 mbar
In-Run Bias Stability (Allan Variance)	< 0.04 mg	< 10°/hr (5-7°/hr typ.)	-	-
Noise Density	0.14 mg/ $\sqrt{\text{Hz}}$	0.0035 °/s/ $\sqrt{\text{Hz}}$	140 $\mu\text{Gauss}/\sqrt{\text{Hz}}$	-
Bandwidth	260 Hz	256 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, L1OF, 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 400 Hz
Output Data Rate (Position, Velocity & Attitude) .....	up to 400 Hz
Interface (VN-300 Rugged) .....	RS-232, Serial TTL
Interface (VN-300 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) .....	> 125,000 hours
MTBF (SMD) .....	> 165,000 hours

## Mechanical/Electrical

	SIZE	WEIGHT	INPUT VOLTAGE	CURRENT DRAW <sup>8</sup>	POWER <sup>8</sup>
Rugged	45 x 44 x 11 mm	30 g	3.3 to 14 V	250 mA @ 5 V	1.25 W
SMD	24 x 22 x 3 mm	5 g	3.2 to 5.5 V	185 mA @ 3.3 V	1.25 W

1. With proper magnetic declination, suitable magnetic environment and valid hard/soft iron calibration.

2. With sufficient motion for dynamic alignment.

3. Dependant on SBAS, clear view of GNSS satellites, good multipath environment, compatible GNSS antenna, and measurement duration period.

4. Constant on a per part basis. Can be calibrated out during system integration using boresighting of other alignment processes.

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-300 default configuration.

7. Contact VectorNav for higher IMU data output rates.

8. Not including active antenna power consumption.