

# VN-300 DUAL GNSS/INS

## GNSS-Aided INS with Integrated GNSS-Compass

### 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 (INS)	<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

### Product Overview

The VN-300 is a miniature, high-performance Dual Antenna GNSS-Aided Inertial Navigation System (Dual GNSS/INS) that combines MEMS inertial sensors, two high-sensitivity GNSS receivers, and advanced Kalman filtering algorithms to provide optimal estimates of position, velocity, and attitude. The onboard GNSS-Compass enables accurate heading measurements without reliance on vehicle dynamics or magnetic sensors, providing unmatched performance under both static and dynamic conditions.

The VN-300 is the first and only Dual GNSS/INS in a single surface mount package (SMD). At the size of a postage stamp, the VN-300 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-300 Rugged is the "plug and play" version of the VN-300 SMD. Enclosed in a clamshell precision anodized aluminum enclosure, the VN-300 Rugged offers additional protection of the internal inertial sensors, GNSS receivers and electronics.

### Features

#### GNSS-Compass for Static Heading

Two onboard GNSS receivers perform GPS-Compassing, providing highly accurate heading estimates under static and low dynamic conditions.

#### Automatic Heading Transition

Automatic and seamless transition between magnetic heading, INS operation in dynamics, and GNSS-Compass in static conditions.

#### True Inertial Navigation System

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

#### Software Compatibility

The VN-300 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.



VN-300 SMD

VN-300 Rugged

Each individual VN-300 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
- ▶ GNSS-Compass for static and low dynamic heading accuracy
- ▶ Automatic transitioning between AHRS, INS and GNSS-Compass
- ▶ 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)
- ▶ All sensors are individually calibrated for bias, scale factor, misalignment, and temperature over full operating range (-40°C to +85 °C)
- ▶ Raw Psuedorange, 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) .....	± 180°
Range (Pitch) .....	± 90°
Heading (Magnetic) <sup>1</sup> .....	2.0° RMS
Heading (INS) <sup>2</sup> .....	0.2°, 1σ
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°, 1σ
Heading Mounting Misalignment (Rugged) <sup>4</sup> .....	0.15°, 1σ
Pitch/Roll Mounting Misalignment <sup>4</sup> .....	0.1°, 1σ
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>7</sup> .....	3.0 cm/s <sup>2</sup>
Velocity Accuracy .....	< 0.05 m/s

### IMU Specifications

	ACCELEROMETER	GYROSCOPE	MAGNETOMETER	BAROMETER
Range	±16 g	±2,000°/s	±2.5 Gauss	10 to 1200 mbar
In-Run Bias Stability (Allan Variance)	< 0.04 mg	< 10°/hr (5-7°/hr typ.)	-	-
Non-Linearity	< 0.5 % FS	100 ppm	< 0.1 % FS	±1.5 mbar
Noise Density	< 0.14 mg/√Hz	0.0035 °/s /√Hz	140 μGauss/√Hz	-
Bandwidth	260 Hz	256 Hz	200 Hz	200 Hz
Cross-Axis Sensitivity	±0.05 °	< 0.05 °	±0.05 °	-

### 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 / Hot) .....	29 s / 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.

