

# VN-110 IMU/AHRS

Inertial Measurement Unit /  
Attitude Heading Reference System



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## INTRODUCTION

The VN-110 is a miniature, light weight, low power, high-performance Inertial Measurement Unit (IMU) and Attitude and Heading Reference System (AHRS) available in a embedded module package for mounting to Printed Circuit Boards or aluminum encased rugged module.

The VN-110 computes and outputs a real-time, drift-free attitude solution (i.e. 3D orientation) that is continuous over a complete range of 360° motion.



**VN-110**

## PRODUCT HIGHLIGHTS

**< 1°/hr**

Gyro In-Run Bias Stability

**< 10  $\mu$ g**

Accel In-Run Bias Stability

**0.05°**

Pitch/Roll Accuracy

**MIL-STD VN-110**

MIL-STD-810; MIL-STD-461G;  
DO-160G; IP 68

**5°/hr / $\sqrt$ Hz**

Gyro Noise Density  
(ARW)

**< 0.04 mg/ $\sqrt$ Hz**

Accelerometer Noise Density  
(VRW)

**800 Hz**

IMU Data

**Low SWaP VN-110E**

31 x 31 x 12 mm;  
12 grams; < 1 W

## INDUSTRY LEADING ALGORITHMS - VPE

The VN-110 features a robust Kalman Filter (EKF) along with a proprietary suite of high performance algorithms that run completely onboard the sensors. VectorNav's industry leading Vector Processing Engine (VPE) algorithms provide real-time magnetic and acceleration disturbance rejection, adaptive signal filtering, dynamic filter tuning and onboard Hard & Soft Iron compensation.

## PACKAGING OPTIONS

### Embedded

The VN-110E brings unprecedented capability and performance to SWaP-C constrained applications.

- ▶ Miniature footprint:  
31 x 31 x 12 mm
- ▶ Lightweight:  
12 grams
- ▶ Low Power:  
< 1 W
- ▶ 24-pin 1mm pitch  
board-to-board interface  
connector
- ▶ Software compatible with  
VectorNav's full product line



### Tactical

The VN-110 is designed to meet the demands of the most demanding military and aerospace applications.

- ▶ IP 68 per IEC 60529
- ▶ Temperature (DO-160G)
- ▶ Electrical (MIL-STD-1275E)
- ▶ Vibration & Shock (MIL-STD-810G)
- ▶ EMI & Radiation (MIL-STD-461G)
- ▶ Circular push-pull 10-pin connectors
- ▶ Wide input voltage range (12 to 34 V)



## Sensor Summary

- ▶ Continuous attitude solution over the complete 360° range of operation
- ▶ VectorNav Processing Engine (VPE) for disturbance rejection, adaptive filtering, dynamic filter tuning
- ▶ Real-time gyro bias tracking and compensation
- ▶ Hard/Soft Iron Compensation (Real-time and Manual 2D & 3D)
- ▶ Inputs for external magnetometers or velocity measurements (Airspeed, GPS)
- ▶ Individually calibrated for bias, scale factor, misalignment, and temperature over full operating range (-40°C to +85 °C)
- ▶ Data output format: ASCII (VectorNav), Binary (VectorNav)

- ▶ Coning and sculling integrals ( $\Delta V$ 's,  $\Delta \theta$ 's)
- ▶ World Magnetic & Gravity Reference Models
- ▶ 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

## Environmental

|                            |                |
|----------------------------|----------------|
| Operating Temperature..... | -40° to +85° C |
| Storage Temperature.....   | -40° to +85° C |
| MTBF (VN-110) .....        | > 35,000 hours |
| MTBF (VN-110E).....        | > 45,000 hours |

## Interfacing

|                                           |                          |
|-------------------------------------------|--------------------------|
| Output Data Rate (IMU) <sup>2</sup> ..... | up to 800 Hz             |
| Output Data Rate (Attitude) .....         | up to 400 Hz             |
| Primary Interface (VN-110).....           | RS-422 (Optional RS-232) |
| Auxiliary Interface (VN-110).....         | RS-422                   |
| Interface (VN-110E) .....                 | (2) Serial TTL           |
| Input.....                                | Sync-in                  |
| Output .....                              | Sync-out                 |

## Performance Specifications

### ATTITUDE

|                                       |           |
|---------------------------------------|-----------|
| Range (Heading/Yaw, Roll) .....       | ± 180°    |
| Range (Pitch) .....                   | ± 90°     |
| Heading (Magnetic) <sup>1</sup> ..... | 2.0° RMS  |
| Pitch/Roll (Static).....              | 0.05° RMS |
| Angular Resolution .....              | 0.001°    |

### IMU Specifications

|                                        | ACCELEROMETER | GYROSCOPE                  | MAGNETOMETER   |
|----------------------------------------|---------------|----------------------------|----------------|
| Range <sup>3</sup>                     | ±15 g         | ±490°/s                    | ±2.5 Gauss     |
| In-Run Bias Stability (Allan Variance) | < 10 µg       | < 1°/hr (0.4-0.7°/hr typ.) | -              |
| Noise Density                          | < 0.04 mg/√Hz | 5°/hr /√Hz                 | 140 µGauss/√Hz |
| Bandwidth                              | 240 Hz        | 240 Hz                     | 200 Hz         |
| Cross-Axis Sensitivity                 | ±0.05 °       | < 0.05 °                   | ±0.05 °        |

### Mechanical

|         | SIZE            | WEIGHT | INTERFACE                 |
|---------|-----------------|--------|---------------------------|
| VN-110  | 56 x 56 x 23 mm | 125 g  | 10-pin Circular push-pull |
| VN-110E | 31 x 31 x 12 mm | 12 g   | 24-pin Board-to-Board     |

### Electrical

|         | INPUT VOLTAGE | CURRENT DRAW   | POWER |
|---------|---------------|----------------|-------|
| VN-110  | 12 to 34 V    | 80 mA @ 24 V   | < 2 W |
| VN-110E | 3.2 to 3.5 V  | 280 mA @ 3.3 V | < 1 W |

<sup>1</sup>. Contact VectorNav for higher IMU data output rates.

<sup>2</sup>. With proper magnetic declination, suitable magnetic environment and valid hard/soft iron calibration.

<sup>3</sup>. Contact VectorNav for Extended Range Gyro Option.

