

GEO•FOG 3D Dual INS

Fiber Optic Gyro (FOG)-based Inertial Navigation System



Key Features

- KVH 1750 IMU as core processor
- 6 DoF IMU consisting of integrated FOGs and accelerometers
- Dual antenna for instant (turn on) and continuous (dynamic) heading
- Dual frequency embedded Trimble® GNSS receiver
- Cutting-edge sensor fusion algorithm delivering accurate, reliable data for navigation, orientation, and control
- North-seeking gyrocompass
- Attitude and Heading Reference System (AHRS)

Applications

- Navigation and control
- Unmanned systems
- Autonomous systems
- Manned systems
- AHRS
- Positioning and imaging
- Georeferencing
- Land surveying
- Robotics
- Underground navigation
- Stabilization and orientation

Rugged INS and AHRS with Embedded GNSS Receiver and Dual Antenna

The KVH GEO•FOG™ 3D Dual Inertial Navigation System (INS) is built upon the company's landmark high performance Fiber Optic Gyro (FOG)-based inertial measurement unit, the 1750 IMU. The 1750 IMU contains 3 of KVH's DSP-1750 gyros – the world's smallest high-performance FOG – integrated with three very low noise MEMS accelerometers. The GEO•FOG 3D Dual INS is an integration of the 1750 IMU with a pressure sensor, a 3-axis magnetometer, and a dual antenna RTK GNSS receiver. The advanced system uses sensor fusion to deliver reliable, high-accuracy navigation and control to a wide variety of unmanned, autonomous and manned aerial, ground, marine and subsurface marine applications and platforms.

High Accuracy, Intelligent Inertial Performance

The high performance GEO•FOG 3D Dual filter is more intelligent than the typical Kalman filter used in many inertial solutions, because it is capable of extracting significantly more information from the IMU core processor by using a cutting-edge artificial intelligence algorithm. Designed for demanding navigation and control applications, the GEO•FOG 3D Dual has performance monitoring and instability protections to ensure stable and reliable data.

Designed for Mission Critical Control Applications

The rugged KVH GEO•FOG 3D Dual is designed and tested to ensure that the hardware is both protected and reliable. It is protected from reverse polarity, overvoltage, surges, static and short circuits on all external surfaces. The embedded GNSS includes Receiver Autonomous Integrity Monitoring (RAIM) to assess the integrity of satellite signals. It also contains a backup MEMS IMU providing seamless inertial data collection for redundancy and backup purposes.

Embedded Dual Frequency GNSS Receiver

The KVH GEO•FOG 3D Dual contains a dual frequency GNSS receiver providing up to 8 mm positioning accuracy. It also supports all of the current and future satellite navigation systems including GPS, GLONASS, GALILEO, and BeiDou. The GEO•FOG 3D Dual offers data rates of up to 1000 Hz, and data can be output over a high-speed RS-422 interface or RS-232 interface.

Integrated North-seeking Gyrocompass

In addition to providing GNSS positioning backed with highly accurate inertial data, the GEO•FOG 3D Dual also features a north-seeking algorithm providing accurate heading as fast as 10 seconds after power-on from a hot start, and 10 minutes from a cold start, runs continuously while the INS is operating, and is unaffected by velocity or angular motion. This means the system provides high accuracy heading in environments in which magnetometers and GPS-heading cannot be used.

GEO•FOG 3D Dual INS

| IMU Specifications | |
|---|--|
| Gyro Technology | FOG |
| Input Rate (max) | ±490°/sec |
| Bias Instability (25°C) | ≤0.1°/hr, 1σ (max), ≤0.05°/hr, 1σ (typical) |
| Bias vs. Temperature (≤1°C/min) | ≤1°/hr, 1σ (max), ≤0.7°, 1σ (typical) |
| Bias Offset (25°C) | ±2°/hr |
| Scale Factor Non-linearity (max rate, 25°C) | ≤50 ppm, 1σ |
| Scale Factor vs. Temperature (≤1°C/min) | ≤200 ppm, 1σ |
| Angle Random Walk (25°C) | ≤0.012°/√hr (≤0.7°/hr/√Hz) |
| Bandwidth (-3 dB) | ≥440 Hz |
| Initialization Time (valid data) | ≤1.5 secs |
| Data Interface | Asynchronous or Synchronous RS-422 |
| Baud Rate | Selectable 9.6 Kbps to 921.6 Kbps |
| Data Rate | User Selectable 1 to 1000 Hz |

| Accelerometer Specifications | |
|--------------------------------------|--|
| Accelerometer Technology | MEMS |
| Input Limit (max) | ±10 g |
| Bias Instability (constant temp) | <0.05 mg, 1σ |
| Scale Factor Temperature Sensitivity | 250 ppm/°C, 1σ (max), ≤100 ppm/°C, 1σ (typical) |
| Velocity Random Walk (25°C) | ≤0.12mg/√Hz (0.23 ft/sec/√hr) |
| Bandwidth (-3 dB) | ≥200 Hz |

| Physical/Electrical/Environmental | |
|-----------------------------------|-------------------------|
| Operating Voltage | 9 to 36 V |
| Input Protection | -40 to 100 V |
| Power Consumption | 510 mA @ 12 V (typical) |
| Hot Start Battery Capacity | >48 hours |
| Hot Start Battery Charge Time | 30 minutes |
| Hot Start Battery Endurance | >10 years |
| Operating Temperature | -40°C to 75°C |
| Environmental Protection | IP67, MIL-STD-810G |
| MTBF | >36,000 hours |
| Shock Limit | 25 g |
| Dimensions | 94 x 94 x 95 mm |
| Weight | 740 grams |

| Magnetometers | |
|------------------------|------------|
| Range | 8 G |
| Scale Factor Stability | <0.05% |
| Non-linearity | <0.05% |
| Noise Density | 210 uG/√Hz |
| Bandwidth | 110 Hz |

| Pressure | |
|------------------|---------------|
| Range | 10 to 120 Kpa |
| Noise Density | 0.56 Pa/√Hz |
| Bias Instability | 100 Pa/yr |
| Bandwidth | 50 Hz |

Connectors

GEO•FOG 3D features two general purpose input/output pins and two auxiliary RS-232/RS-422 ports that support an extensive number of peripherals, including odometer-based input for land vehicles, DVLs and USBLs for underwater navigation, NMEA input/output, and more.

| Communications | |
|----------------------|---|
| Interface | RS-422 (RS-232 optional) |
| Protocol | AN Packet Protocol or NMEA |
| Peripheral Interface | 2x GPIO and 2x Auxiliary, RS-232 |
| GPIO Level | 5 V or RS-232 |
| GPIO Functions | 1PPS, Odometer, Stationary Pitot Tube, NMEA input/output, NovAtel GNSS input, Trimble GNSS input, AN Packet Protocol input/output, Packet Trigger input, Teledyne DVL input, Tritech USBL input |

| Navigation | |
|--|-------------------------------------|
| Horizontal Position Accuracy | 0.8 m |
| Vertical Position Accuracy | 1.5 m |
| Horizontal Position Accuracy (with SBAS) | 0.5 m |
| Vertical Position Accuracy (with SBAS) | 0.8 m |
| Horizontal Position Accuracy (with RTK) | 0.008 m |
| Vertical Position Accuracy (with RTK) | 0.015 m |
| Velocity Accuracy | 0.005 m/s |
| Roll & Pitch Accuracy | 0.01° |
| Heading Accuracy | 0.01° |
| Heave Accuracy | 2% or 0.02 m (whichever is greater) |
| Orientation Range | Unlimited |
| Hot Start Time | 2 s |
| Internal Filter Rate | 1000 Hz |
| Output Data Rate | Up to 1000 Hz |

| GNSS | |
|--|--|
| Model | Trimble MB-Two |
| Optional Navigation Systems | GPS L1, L2 GLONASS L1, L2 GALILEO E1 BeiDou B1 |
| Optional SBAS Systems | WAAS, EGNOS, MSAS, GAGAN, QZSS, Omnistar HP/XP/G2, Trimble RTX |
| Update Rate | 20 Hz |
| Hot Start First Fix | 3 s |
| Cold Start First Fix | 30 s |
| Horizontal Position Accuracy | 1.2 m |
| Horizontal Position Accuracy (with SBAS) | 0.5 m |
| Horizontal Position Accuracy (with RTK) | 0.008 m |
| Velocity Accuracy | 0.005 m/s |
| Timing Accuracy | 20 ns |
| Acceleration Limit | 11 g |

| Typical Accuracy in Ground Vehicle | | | | |
|------------------------------------|-----------------------|-------------------------|---------------------------|-----------------------|
| Outage Duration | Position Accuracy (m) | Velocity Accuracy (m/s) | Roll & Pitch Accuracy (°) | Heading Accuracy* (°) |
| 0 s | 0.008 | 0.005 | 0.01 | 0.01 |
| 10 s | 0.05 | 0.007 | 0.01 | 0.01 |
| 30 s | 0.15 | 0.010 | 0.01 | 0.011 |
| 1 m | 0.6 | 0.012 | 0.01 | 0.012 |
| 5 m | 2.9 | 0.023 | 0.01 | 0.022 |
| 10 m | 5.8 | 0.036 | 0.01 | 0.035 |
| 30 m | 17.4 | 0.038 | 0.01 | 0.085 |
| 60 m | 34.8 | 0.038 | 0.01 | 0.16 |

*Heading accuracies can be improved depending on the antenna baseline length and position.



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Made in the U.S.A.

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