GEO•FOG 3D Dual INS

Fiber Optic Gyro (FOG)-based Inertial Navigation System

Key Features

- KVH P-1750 IMU as the core processor
- PIC technology for improved reliability
- Non-ITAR
- 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 - now with PIC technology

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 P-1750 IMU. The P-1750 IMU contains three KVH high-grade gyroscopes enhanced with KVH's exclusive photonic integrated chip (PIC) technology for improved reliability and repeatability. The GEO•FOG 3D Dual also features three high-performance, low-noise MEMS accelerometers. The GEO•FOG 3D Dual INS integrates the P-1750 IMU with a pressure sensor, a three-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 autonomous, unmanned, 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.

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)*	≤1.5°/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)*	±16 g
Bias Instability *(constant temp)*	24 µg, 1σ
Scale Factor Temperature Sensitivity	≤120 ppm/°C, 1σ (typical)
Velocity Random Walk *(25°C)*	54 µg/√Hz
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-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
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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