Spatial FOG Dual is a ruggedised GPS aided inertial navigation system and AHRS that provides accurate position, velocity, acceleration and orientation under the most demanding conditions. It combines ultra high accuracy fibre optic gyroscopes, accelerometers, magnetometers and a pressure sensor with a dual antenna RTK GNSS receiver. These are coupled in a sophisticated fusion algorithm to deliver accurate and reliable navigation and orientation.

**PERFORMANCE**
- 0.01 ° Roll and Pitch
- 0.01 ° Heading
- 8 mm RTK Positioning
- 0.05 °/HR FOG Gyroscope
- Heave: 2 % or 0.02 m (whichever is greater)

**FEATURES**

**EXTREME INERTIAL PERFORMANCE**
Spatial FOG Dual contains the KVH Industries 1750 fiber optic gyroscope (FOG) IMU, which provides extremely accurate inertial data far beyond the best MEMS technology available. This allows Spatial FOG Dual to achieve very high accuracies and dead reckoning without GNSS for extended periods of time. Despite the high accuracy FOG IMU, Spatial FOG Dual has a very competitive price tag that is lower than many MEMS systems on the market.

**ADVANCED FILTER**
Spatial FOG Dual contains Advanced Navigation’s revolutionary sensor fusion filter. The filter is more intelligent than the typical extended Kalman filter and is able to extract significantly more information from the data by making use of human inspired artificial intelligence. It was designed for control applications and has a high level of health monitoring and instability prevention to ensure stable and reliable data.

**RELIABILITY**
Spatial FOG Dual has been designed from the ground up for mission critical control applications where reliability is very important. It is built on top of a safety oriented real time operating system and all software is designed and tested to safety standards with fault tolerance in place. The hardware is protected from reverse polarity, overvoltage, surges, static and short circuits on all external interfaces. The GNSS contains RAIM, which excludes both malfunctioning, and tampered satellite signals. Spatial FOG Dual contains a secondary MEMS IMU, which it uses to detect faults with the primary IMU.

**RTK GNSS RECEIVER**
Spatial FOG Dual contains a dual frequency Trimble RTK GNSS receiver that provides up to 8mm accuracy positioning and supports all of the current and future satellite navigation systems, including GPS, GLONASS, GALILEO and BeiDou. It also supports the Omnistar service for hassle free high accuracy positioning. Spatial FOG Dual supports both real time RTK positioning and logging of raw satellite data for kinematic post-processing.

**PERIPHERALS**
Spatial FOG Dual features two general purpose input output pins and two auxiliary RS232/RS422 ports that support an extensive number of peripherals. Including odometer based input for ground vehicles, DVLs and USBLs for underwater navigation, NMEA input/output and more. For an integration fee, custom peripheral devices can be added.

**HIGH UPDATE RATE**
Spatial FOG Dual’s internal filter runs at 1000Hz and data can also be output at this rate over high speed RS232 or RS422. This allows for control of dynamically unstable platforms.
**DUAL ANTENNA HEADING**
Spatial FOG Dual features dual antenna moving baseline RTK. This allows it to provide highly accurate heading while both stationary and moving. It is an excellent choice for applications with low dynamics where single antenna systems struggle or any application where additional heading accuracy is required. An added benefit is the ability to accurately measure vehicle slip angle.

**HOT START**
Spatial FOG Dual contains a next generation battery backup system that allows it to hot start inertial navigation from its last position in 2 seconds and obtain a GNSS fix in approximately 3 seconds. The battery backup system lasts for the lifetime of the product and will provide backup for 48 hours without power. Advanced Navigation’s Spatial series are the only GNSS/INS in the world to provide hot start inertial navigation.

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**SPECIFICATIONS**

**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 or Kinematica PPK): 0.008 m
- Vertical Position Accuracy (with RTK or Kinematica PPK): 0.015 m
- Velocity Accuracy: 0.005 m/s
- Roll & Pitch Accuracy: 0.01 °
- Heading Accuracy: 0.01 °
- Roll & Pitch Accuracy (Kinematica post-processing): 0.005 °
- Heading Accuracy (Kinematica post-processing): 0.007 °
- Slip Accuracy: 0.01 °
- Heave Accuracy (whichever is greater): 2 ° or 0.02 m
- 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
- **Supported Navigation Systems**: GPS L1, L2, GLONASS L1, L2, GALILEO E1, BeiDou B1
- **Supported SBAS Systems**: WAAS, EGNOS, MSAS, GAGAN, QZSS, 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

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**HARDWARE**

- **Operating Voltage**: 9 to 36 V
- **Input Protection**: -40 to 100 V
- **Power Consumption (typical)**: 612 W
- **Hot Start Battery Capacity**: > 48 hrs
- **Hot Start Battery Charge Time**: 30 mins
- **Hot Start Battery Endurance**: > 10 years
- **Operating Temperature**: -40 °C to 75 °C
- **Environmental Protection**: IP67, MIL-STD-810G
- **MTBF**: > 36,000 hrs
- **Shock Limit**: 40 g
- **Vibration Limit**: 12 g
- **Dimensions**: 94 x 94 x 95 mm
- **Weight**: 740 grams

**SENSORS**

- **ACCELEROMETERS**
  - Range: ± 10 g
  - Bias Instability: 15 ug
  - Initial Bias: < 1 mg
  - Initial Scaling Error: < 0.03 %
  - Scale Factor Stability: < 0.04 %
  - Non-linearity: < 0.03 %
  - Cross-axis Alignment Error: < 0.04 °
  - Noise Density: 120 ug/√Hz
  - Bandwidth: 200 Hz

- **GYROSCOPES**
  - Range: ± 490 °/s
  - Bias Instability: 0.05 °/hr
  - Initial Bias: < 1 °/hr
  - Initial Scaling Error: < 0.01 %
  - Scale Factor Stability: < 0.02 %
  - Non-linearity: < 0.005 %
  - Cross-axis Alignment Error: < 0.02 °
  - Noise Density: 0.7 °/hr/√Hz
  - Bandwidth: 440 Hz

- **MAGNETOMETERS**
  - Range: ± 8 G
  - Bias Instability: < 0.07 %
  - Initial Bias: -
  - Initial Scaling Error: < 0.09 %
  - Scale Factor Stability: < 0.08 %
  - Non-linearity: < 0.07 %
  - Cross-axis Alignment Error: < 0.05 °
  - Noise Density: 210 μG/√Hz
  - Bandwidth: 110 Hz

- **PRESSURE**
  - Range: 10 to 120 KPa
  - Bias Instability: < 10 Pa
  - Initial Bias: -
  - Initial Scaling Error: < 100 Pa
  - Scale Factor Stability: -
  - Non-linearity: -
  - Cross-axis Alignment Error: -
  - Noise Density: 0.56 Pa/√Hz
  - Bandwidth: 50 Hz

**COMMUNICATION**

- **Interface**: RS422 (RS232 optional)
- **Speed**: 4800 to 10M baud
- **Protocol**: AN Packet Protocol or NMEA
- **Peripheral Interface**: 2x GPIO and 2x Auxiliary RS232
- **GPIO Level**: 5 V or RS232
- **GPIO Functions**:
  - 1PPS
  - Odometer
  - Stationary
  - Pitot Tube
  - NMEA input/output
  - Novatel GNSS input
  - Trimble GNSS input
  - AN Packet Protocol input/output
  - Packet Trigger input
  - Event Input