Spatial is a ruggedized miniature GPS aided inertial navigation system and AHRS that provides accurate position, velocity, acceleration and orientation under the most demanding conditions.

It combines temperature calibrated accelerometers, gyroscopes, magnetometers and a pressure sensor with an advanced GNSS receiver.

These are coupled in a sophisticated fusion algorithm to deliver accurate and reliable navigation and orientation.
Spatial 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 mind. 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 jammed satellite signals.

**Spatial's next generation GNSS receiver supports all of the current and future satellite navigation systems including GPS, GLONASS, GALILEO and BeiDou. These additional satellite constellations allow Spatial to provide accurate position and velocity data in environments where GPS only units can't, such as urban canyons and indoors. When Spatial can't get a satellite fix, it continues to navigate using inertial navigation.**

Spatial's precision marine grade aluminium enclosure is waterproof and dirtproof to the IPE67 standard and shockproof to 2000g, allowing it to be used in the most extreme conditions. A sophisticated venting system allows the unit to measure air pressure whilst keeping water out. Its minimal size, weight and power requirements allow for easy integration into almost any system.

Spatial features two general purpose input output pins that support an extensive number of peripherals including odemeter based input for ground vehicles, RTK GPS systems, DVLs and USBLs for underwater navigation, NMEA input/output and more. For an integration fee, custom peripheral devices can be added.

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**Spatial’s internal filter runs at 1kHz and data can also be output at this rate over high speed RS232. This allows for control of dynamically unstable platforms. Spatial is also highly tolerant of dynamic movement and vibration with a very advanced custom navigation filter.**

### Navigation
- **Horizontal Position Accuracy:** 2.0 m
- **Vertical Position Accuracy:** 3.0 m
- **Horizontal Position Accuracy (with DGNSS):** 0.6 m
- **Vertical Position Accuracy (with DGNSS):** 1.0 m
- **Velocity Accuracy:** 0.05 m/s
- **Roll & Pitch Accuracy (Static):** 0.1°
- **Head Ing Accuracy (Static):** 0.5°
- **Roll & Pitch Accuracy (Dynamic):** 0.2°
- **Heading Accuracy (Dynamic with GNSS):** 0.2°
- **Heading Accuracy (Dynamic, Magnetic Only):** 0.8°
- **Heave Accuracy:** 5 % or 0.05 m ( whichever is greater)
- **Orientation Range:** Unlimited
- **Hot Start Time:** 500 ms
- **Internal Filter Rate:** 1000 Hz
- **Output Data Rate:** Up to 1000 Hz
- **Latency:** 0.4 ms

### GNSS
- **Model:** u-blox M8
- **Supported Navigation Systems:** GPS L1, GLONASS L1, GALILEO E1, BeiDou L1
- **Supported SBAS Systems:** WAAS, EGNOS, MSAS, GAGAN, QZSS
- **Update Rate:** 10 Hz
- **Cold Start Sensitivity:** -148 dBm
- **Tracking Sensitivity:** -167 dBm
- **Hot Start First Fix:** 1 s
- **Cold Start First Fix:** 26 s
- **Horizontal Position Accuracy:** 2.5 m
- **Horizontal Position Accuracy (with SBAS):** 1 m
- **Velocity Accuracy:** 0.05 m/s
- **Timing Accuracy:** 30 ns
- **Acceleration Limit:** 4 g

### Communication
- **Interface:** RS232
- **Speed:** 4800 to 115200 baud
- **Protocol:** AN Packet Protocol or NMEA
- **Peripheral Interface:** 2x GPIO and Auxiliary RS232
- **GPIO Level:** 5 - 20 V
- **GPIO Functions:**
  - **GPS:** Odemeter, Stationary
  - **Stingray:** Pitot Tube
  - **NMEA input/output:** Novatel GNSS Input
  - **Teledyne DVL Input:** Trimble GNSS Input
  - **AN Packet Protocol input/output:** Packet Trigger Input
  - **Triton USB Input:** Custom (contact us)

### Hardware
- **Operating Voltage:** 5 to 36 V
- **Input Protection:** ±40 V
- **Power Consumption:** 100 mA @ 5 V (typical)
- **Hot Start Battery Capacity:** >48 hrs
- **Hot Start Battery Charge Time:** 30 mins
- **Hot Start Battery Endurance:** >10 years
- **Operating Temperature:** -40 °C to 85 °C
- **Environmental Protection:** IP67, MIL-STD-810G
- **MTBF:** >50,000 hrs
- **Shock Limit:** 2000 g
- **Dimensions (excluding tabs):** 30x30x24 mm
- **Dimensions (including tabs):** 30x40.6x24 mm
- **Weight:** 37 grams

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**CALIBRATED DYNAMIC RANGING SENSORS**

Spatial contains some of the highest performance MEMs inertial sensors currently on the market. These are put through Advanced Navigation’s intensive calibration process to increase their performance further still and provide consistently accurate data over an extended temperature range of -40°C to 85°C. Advanced Navigation's custom calibration process is the only full sensor calibration that can provide dynamic ranging, allowing the user to select a sensor range for high accuracy or high accelerations on the fly. As part of this calibration, every Spatial unit spends 8 hours in our specially built rotating temperature chamber.

**Advanced Filter**

Spatial contains Advanced Navigation’s revolutionary sensor fusion filter. The filter is more intelligent than a 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 protection to ensure stable and reliable data.

**Hot Start**

Spatial contains a next generation battery backup system that allows it to hot start inertial navigation from its last position in 500 milliseconds 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. Spatial is the first GNSS/INS in the world to provide hot start navigation.

**Miniature Rugged Enclosure**

Spatial’s precision marine grade aluminium enclosure is waterproof and dirtproof to the IPE67 standard and shockproof to 2000g, allowing it to be used in the most extreme conditions. A sophisticated venting system allows the unit to measure air pressure whilst keeping water out. Its minimal size, weight and power requirements allow for easy integration into almost any system.

**Peripherals**

Spatial’s precision marine grade aluminium enclosure is waterproof and dirtproof to the IPE67 standard and shockproof to 2000g, allowing it to be used in the most extreme conditions. A sophisticated venting system allows the unit to measure air pressure whilst keeping water out. Its minimal size, weight and power requirements allow for easy integration into almost any system.

**Sensors**

**Accelerometers**
- **Range (Dynamic):**
  - 2 g
  - 4 g
  - 16 g
- **Non-linearity:** < 0.05 %
- **Bias Instability:** < 0.05 µg
- **Scale Factor Stability:** < 0.05 %
- **Cross-axis Alignment Error:** < 0.05°
- **Bandwidth:** 400 Hz

**Gyrosopes**
- **Range (Dynamic):**
  - 250 °/s
  - 500 °/s
  - 2000 °/s
- **Bias Instability:** < 0.05 %
- **Scale Factor Stability:** < 0.05 %
- **Cross-axis Alignment Error:** < 0.05°
- **Bandwidth:** 50 Hz

**Magnetoimeters**
- **Range (Dynamic):**
  - 2 G
  - 4 G
  - 8 G
- **Bias Instability:** < 0.05 %
- **Scale Factor Stability:** < 0.05 %
- **Cross-axis Alignment Error:** < 0.05°
- **Bandwidth:** 10 to 120 kHz

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