ULTIMATE ACCURACY MEMS

Inertial Navigation System

Navigation, Motion & Heave Sensing

APOGEE SERIES makes high accuracy affordable for all surveying companies. On the fields of hydrography, mobile mapping, or remote sensing, the Apogee joins robustness, simplicity to high performance.
HIGH QUALITY
HIGH ACCURACY

SBG SYSTEMS manufactures high quality, high accuracy inertial navigation systems from the design to the production. The Apogee benefits from our high level of expertise in integrated design, IMU calibration, testing, and filtering.

Highly Accurate

### ATTITUDE AND POSITION

<table>
<thead>
<tr>
<th></th>
<th>GNSS L1/L2/L5</th>
<th>DGPS</th>
<th>RTK*</th>
<th>PPK**</th>
<th>RTK 60 sec outage</th>
<th>PPK 60 sec outage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll/Pitch</td>
<td>0.01°</td>
<td>0.01°</td>
<td>0.008°</td>
<td>0.005°</td>
<td>0.01°</td>
<td>0.008°</td>
</tr>
<tr>
<td>Heading - Dual antenna (2m baseline)</td>
<td>0.04°</td>
<td>0.04°</td>
<td>0.04°</td>
<td>0.02°</td>
<td>0.05°</td>
<td>0.025°</td>
</tr>
<tr>
<td>Heading - Dual antenna (4m baseline)</td>
<td>0.025°</td>
<td>0.025°</td>
<td>0.025°</td>
<td>0.02°</td>
<td>0.04°</td>
<td>0.02°</td>
</tr>
<tr>
<td>Position (X/Y)</td>
<td>0.6 m</td>
<td>0.3 m</td>
<td>0.01 m</td>
<td>&lt; 0.01 m</td>
<td>3 m</td>
<td>0.15 m</td>
</tr>
<tr>
<td>Altitude (Z)</td>
<td>1.0 m</td>
<td>0.5 m</td>
<td>0.03 m</td>
<td>&lt; 0.02 m</td>
<td>0.7 m</td>
<td>0.05 m</td>
</tr>
</tbody>
</table>

### HEAVE

<table>
<thead>
<tr>
<th></th>
<th>Accuracy</th>
<th>Wave Period</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real-time Heave</td>
<td>5 cm or 5 %</td>
<td>Up to 20 seconds</td>
<td>Automatic adjustment to every sea conditions</td>
</tr>
<tr>
<td>Delayed Heave</td>
<td>2 cm or 2 %</td>
<td>Up to 40 seconds</td>
<td>Internal computation</td>
</tr>
</tbody>
</table>

### VELOCITY AIDED POSITIONING

<table>
<thead>
<tr>
<th></th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVL***</td>
<td>&lt; 0.2 % of Travelled Distance</td>
</tr>
</tbody>
</table>

*Real Time Kinematic
** Post-processing Kinematic
***Depends on velocity aiding accuracy

RMS values for typical survey trajectories
Performance may be affected by atmospheric conditions, signal multipath, and satellite geometry.
All specifications subject to change without notice.

Delayed Heave:
Accurate Data in Rough Sea
When wave frequency is erratic or in case of long period swell, the delayed heave feature can save the day by allowing survey in rough conditions. This specific algorithm allows a more extensive calculation, resulting in a heave accurate to 2 cm displayed in real-time with a little delay.

Driver available for
Others upon request
The Highest Accuracy Affordable to All Hydrographic Surveyors

APOGEE-E
IP68
Ideal to mount on the center of gravity of the boat

APOGEE-U
200m Depth
Ideal to mount close to the SONAR head

SPLITBOX GNSS
L1/L2/L5 GNSS Receiver
» DGPS
» OmniSTAR / Marinestar
» TerraStar / Veripos
» RTK
» Post-processing

The SplitBox also provides a simplified interface with standardized connectors for easy connection.

Numerical corrections
Antenna
Antenna
Acquisition Computer
Sonar Processing Unit
10m subsea cable
Sonar

The Apogee-E and Apogee-U are inertial navigation systems. They connect to any survey grade GPS/GNSS receiver or to the SplitBox GNSS to provide robust navigation data additionally to roll, pitch, heading, and heave.
Powerful Models for Ship Motion Monitoring and Unmanned Systems

Ideal for ship motion monitoring, the Apogee-A and Apogee-M are Motion Reference Unit (MRU). Allowing GNSS* input, they provide high accuracy roll, pitch, heading, and heave.

*Dual Antenna GNSS input for the best performance.

Especially fitted for Unmanned Marine Vessels, Apogee-D is a very compact INS with embedded tri-frequency GNSS receiver. It allows RTK, Terrastar, and Veripos corrections.

WHY MEMS TECHNOLOGY?
» Low-power consumption
» Cost-effective
» Highly Robust
» Compact and Light-weight

Modern and Easy-to-use

WEB INTERFACE
Connect your sensor and configure it throughout the intuitive web interface.

3D VIEW
The new 3D View helps you to check your mechanical installation, especially your sensor position, your alignments, and lever arms.
Specifications

All parameters apply to -20 to 60°C temperature range, unless otherwise stated.
Full specifications can be found in the Apogee User Manual available upon request.

PHYSICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Model</th>
<th>Apogee-A/E</th>
<th>Apogee-D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>&lt; 690 grams</td>
<td>&lt; 900 grams</td>
</tr>
<tr>
<td></td>
<td>1.52 pounds</td>
<td>1.98 pounds</td>
</tr>
<tr>
<td>Dimensions</td>
<td>130 x 100 x 58 mm</td>
<td>130 x 100 x 75 mm</td>
</tr>
<tr>
<td></td>
<td>5.12 x 3.94 x 2.28 &quot;</td>
<td>5.12 x 3.94 x 2.95 &quot;</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>&lt; 3 W</td>
<td>&lt; 7 W</td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>9 to 36 VDC</td>
<td>9 to 36 VDC</td>
</tr>
</tbody>
</table>

INTERFACE

Aiding Sensors (input) | 2x GNSS, RTCM, DVL

Output: NMEA, ASCII, Binary, TSS, Simrad

Input: NMEA, Trimble, Novatel, Septentrio, Hemisphere, Veripos, Fugro, PD0, PD6

Output rate | 0.1 to 200 Hz

Logging Capacity | 8 GB or 48 h @ 200 Hz

Serial RS-232/422 | Model D - 2 outputs / 4 inputs

Model A/E - 3 outputs / 5 inputs

Model U/M - 3 outputs / 5 inputs

Ethernet | Full Duplex (10/100 base-T)

ENVIRONMENTAL

Depth Rating Apogee-M/U | 200m (Titanium)

IP rating Apogee-A/D/E | IP68 (Aluminium)

Specified temperature | -20 to 60 °C / -4 to 140 °F

Operating temperature | -40 to 71 °C / -40 to 160 °F

MTBF (computed) | 50,000 hours

Operating vibrations | 20 Hz to 2 kHz as per MIL-STD-810G

Accelerometer 2 g: 1 g RMS

SENSOR PERFORMANCE

Accelerometers | Gyrosopes

Measurement range | 2 g | 200 °/s

Bias in-run instability | < 2 µg | < 0.08 °/hr

Random walk | < 15 µg/√Hz | < 0.012 °/√hr

POSITIONING PERFORMANCE - SPLITBOX GNSS

Continuous fusion of inertial data with GNSS information stabilizes the position output, effectively eliminating the impact of multipath and signal outages, when the vessel is passing underneath bridges for example.

ROBUST HEADING

Apogee is 20 to 30 times faster than traditional gyrocompasses to align heading angle. It provides the same quality of data, whatever the latitude is. By fusing GNSS and IMU data, it provides a robust and accurate heading in any conditions.

CONTINUOUS POSITION

Apogee-M/U

Weight in air | 2.1 kg / 4.63 pounds

Weight in water | 0.95 kg / 2.09 pounds

Diameter | 92 mm / 3.62 "

Height | 170 mm / 6.69 "

Power Consumption | < 3 W

Supply Voltage | 9 to 36 VDC

Specifications

Feature | Accuracy

Single Point L1/L2/L5 | ✓ | 1.2 m

DGPS | ✓ | 0.4 m

OmniSTAR* / Marinestar* | ✓ | 0.1 m

TerraStar* / Veripos* | option | 0.1 m

RTK | option | 1 cm + 1 ppm

RTK 10/10 | option | 0.1 m

RTK 30/30 | ✓ | 0.3 m

Raw Data** | option | Post-processing

*Subscription available from third party PPP service provider

**Raw data are compatible with Novatel Inertial Explorer® software

RMS values for typical survey trajectories. Performance may be affected by atmospheric conditions, signal multipath, and satellite geometry.
SBG Systems is a leading supplier of MEMS-based inertial motion sensing solutions. The company provides a wide range of inertial solutions from miniature to high accuracy. Combined with cutting-edge calibration techniques and advanced embedded algorithms, SBG Systems products are ideal solutions for industrial & research projects such as unmanned vehicle control, antenna tracking, camera stabilization, and surveying applications.

PRODUCTS

Ekinox Series
Ekinox Subsea Series
SplitBox Series

VIDEO

Apogee Series

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