PRECISION GNSS + INERTIAL

Positioning and Mapping Solutions for UAVs

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Trimble®

Precision OEM Solutions for

	Ashtech GG12W [1]	Trimble BD910	Trimble BD930	Trimble MB-Two
Size (mm) Weight (g)	108 x 82.5 x 15.44 mm 108 g	41 x 41 x 7 mm 19 g	51 x 41 x 7 mm 30 g	71 x 46 x 11 mm 24 g
Orientation Accuracy (°) [1] Real Time:	Position Only	Position Only	Position Only	R / P: 0.2° HDG: 0.1°
Orientation Accuracy [2] Post Processed:	–	–	–	–
Real-Time Positioning Mode	SBAS	SBAS, DGPS, RTK	SBAS, DGPS, RTK	SBAS, DGPS, RTK, RTX, Heading
Frequency	L1	L1		
GNSS Constellations	GPS			
IMU	–	–	–	–
Internal Data Logging Applanix POSPac UAV Support Applanix SmartCal IMU calibration	–	–	–	–
Guidance / Positioning / Control	✓	✓	✓	✓
Direct Georeferencing	–	–	–	–

[1] FAA-certifiable for avionics integration
[2] In degrees - RT = Real-time; PP = Post-processed: R = Roll; P = Pitch; H = Heading
[3] Typical survey mission profile, max RMS error. Heading error will increase for low speed applications and when stationary.

NAVIGATION, GUIDANCE & CONTROL

Trimble is a leading provider of precise positioning solutions to the UAV industry that offer continuous mobile positioning and high-accuracy orientation for applications such as navigation, guidance and control of unmanned vehicles as well as mapping and survey from UAVs. Trimble integrates a wide range of positioning technologies including GPS and inertial technologies with wireless communications and industry-specific application software to provide robust solutions that allow customers to achieve product differentiation and gain a competitive edge in the marketplace.

Knowing exactly where an unmanned vehicle is at all times is a critical parameter in the safe operation of UAVs. Precise sub-meter reliable real-time position accuracy is required to support various navigation operations while the control aspect requires orientation. Trimble's high performance OEM position and orientation modules provide both precise position and highly accurate orientation for control for applications like swarming, station keeping, precision mapping and precision landing.

Trimble's line of OEM precise positioning modules delivers robust, reliable and highly accurate sub-meter and centimeter-level real-time positioning. They are small, compact and low power to support even the smallest of UAV's. They offer support for multi-constellation, multi-frequency, fast, reliable RTK and acquisition, with high accuracy roll + pitch and "True" heading measurements.

| Trimble BD982	Trimble BD935-INS	Trimble APX-15 UAV	Trimble AP15	Trimble AP20	Trimble AP40
100 x 84.9 x 11.6 mm 92 g	67 x 60 x 15 mm 60 g	67 x 60 x 15 mm 60 g	Board: 130x100x59 mm, 280 grams IMU: 43 x 47 x 12, 15 g	Board:130x100x59 mm, 280 grams IMU: 85 x 85 x 66, 680 g	Board:130x100x59 mm, 280 grams IMU: 85 x 85 x 66, 680 g
R / P: 0.2° HDG: 0.1°	R / P: 0.1° HDG: 0.5°	R / P: 0.03° HDG: 0.18°	R / P: 0.03° HDG: 0.09°	R / P: 0.02° HDG: 0.05°	R / P: 0.015° HDG: 0.02°
–	–	R / P: 0.025° HDG: 0.08°	R / P: 0.025° HDG: 0.06°	R / P: 0.015° HDG: 0.025°	R / P: 0.008° HDG: 0.02°
SBAS, DGPS, RTK, RTX, Heading	INS Aided SBAS, DGPS, RTK, Orientation (RPH)	INS Aided SBAS, DGPS, RTK, Orientation (RPH)	INS Aided SBAS, DGPS, RTK, RTX , Orientation (RPH), GAMS	INS Aided SBAS, DGPS, RTK, RTX , Orientation (RPH), GAMS	INS Aided SBAS, DGPS, RTK, RTX ,Orientation (RPH), GAMS
L1 / L2 / L5					
GPS + GLONASS + Galileo + BeiDou + QZSS					
–	Internal[3]	Internal[3]	External[3]	External[3]	External[3]
–	–	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓
–	–	✓	✓	✓	✓

Specifications are subject to change without notification.
Typical performance. Actual results are dependent upon satellite configuration, atmospheric conditions and other environmental effects.

MAPPING

Mapping with a UAV can be highly productive, efficient and accurate. A Trimble Direct Mapping Solution (DMS) provides everything you need to turn your UAV into a profession mapping solution using an imaging sensor such as a camera, LIDAR or hyperspectral scanner. This all-encompassing solution includes post-mission differential GNSS-Aided Inertial software for Direct Georeferencing of sensor data (Applanix POSPac UAV), optional photogrammetric processing software (InPHO UASMaster) and high performance multi-frequency GNSS-aided inertial hardware with advance calibrations for superior accuracy. Using Carrier Phase Differential GNSS–Aided Inertial processing, the DMS provides highly accurate measurements of the imaging sensor position and orientation both in real-time and in post-mission exactly at the time of image acquisition and sensor origin, taking care of GNSS antenna and IMU

mounting offsets. These measurements are then used to Directly Georeference the imaging sensor data to produce map products without the need of Ground Control Points or significant flight line overlap. A DMS for UAV mapping improves utilization, greatly reduces collection costs and increases accuracy.

The DMS is available with a number of different levels of orientation accuracy tailored to sensor geometry and flying heights. The real-time GNSS-Aided Inertial HW supports RTK or RTX (some models) producing a 100 Hz position and orientation solution that is ideal for quick look or rapid response maps. The POSPac UAV post-processing software generates a 200 Hz forward and reverse time solution with optimized accuracy for the final map products. Because it is inertially derived, the DSM filters out bad GNSS observables and reduces interpolation errors to sensor sampling times.
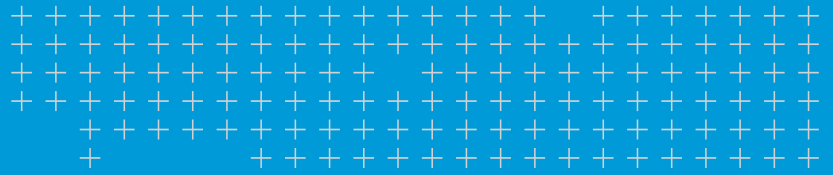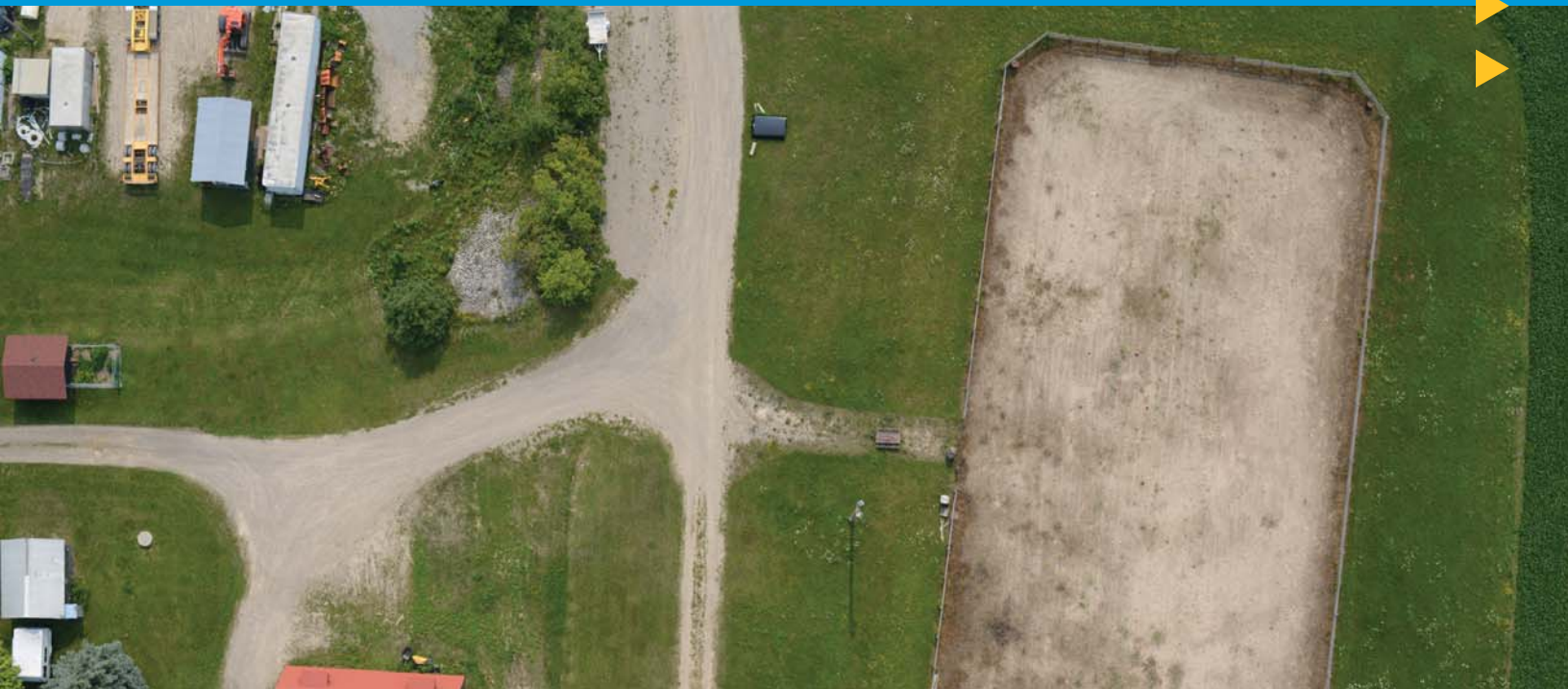
Precision GNSS + Inertial for UAVs

Trimble's product portfolio for UAVs benefit from the latest in precision GNSS + Inertial positioning technology. Centimeter-level accuracy enables vehicles to be guided along a predetermined route, while precision orientation is used for stabilization, pointing and georeferencing of on-board sensors. Trimble offers integrated GNSS precise positioning and communications solutions in a highly compact form-factor. Leverage different communications technologies like Wi-Fi, Bluetooth or GSM for data transfer in unique work scenarios like network based RTK or DGPS applications.

Mobile Mapping produces geographical and dimensional information about physical objects and their environments through the recording, measuring and interpreting of data collected from moving platforms. Direct Georeferencing sensor data is the heart of any mobile mapping system. Trimble Applanix offers industry-leading, post-processing software POSPac™ UAV with SmartCal technology along with other optional tools from Trimble.

Unmanned aerial vehicles demand accuracy and reliability while OEMs and systems integrators require ease of integration to reduce development time and cost. Trimble's hardware and software systems are designed specifically for rugged dependability and ease of integration. The product portfolio offers a host of easy to use features and access to powerful cloud based technologies. Achieve real time accuracy and precise positioning for your navigation, guidance, control and mobile mapping applications.

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TRANSFORMING THE WAY THE WORLD WORKS

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