



# Trimble APX UAV

## FREQUENTLY ASKED QUESTIONS

### 1) WHAT IS APX UAV??

The Trimble APX UAV is a GNSS-Inertial based OEM solution for increasing the efficiency of mapping from UAV's by providing highly accurate position and orientation of each image recorded from a camera or each range recorded from a LIDAR, which are then used to georeference images or ranges into map products – all without the need of extensive ground information. This process is referred to as Direct Georeferencing.

The APX UAV is a HW and SW solution comprised of:

- Trimble APX GNSS-Inertial hardware module and optional external IMU
- POSPac UAV Office Software

### 2) HOW DOES APX UAV WORK?

The APX UAV tracks the RF signals to the GNSS satellites to determine its location on the Earth, and then blends this information with the angular rates and accelerations from its inertial sensors to compute high rate, high accuracy measurements of position and orientation (roll, pitch and true heading). The inertial sensors are calibrated using the Applanix SmartCal Compensation technology in order to achieve the high accuracy required for sensor georeferencing. In real time the position and orientation solution is available at up to 100 Hz, and a GNSS base station can be used to transmit corrections to the APX UAV to produce an RTK solution that is accurate at the cm level. This can be used for real-time mapping or applications like guidance and control, precision landing, or stabilization. Unlike an RTK or PPK GNS only product, the APX UAV position is computed exactly at the location of the camera perspective center or LIDAR reference point by translating the position from the GNSS antenna phase center using the orientation measurements. As well, the APX UAV records the exact time of the camera exposure and LIDAR range measurements in GNSS time. The raw inertial sensor data at 200 Hz and the raw GNSS data at 5 Hz along with the event time are logged to internal memory or to an external USB device. After the mission, the POSPac UAV office software extracts the inertial and GNSS data, and uses this to generate a 200 Hz high accuracy DGNSS position and orientation solution by processing it with GNSS base station data recorded at the site or from a VRS in a forward and reverse time algorithm. As in real-time, the position is computed exactly at the camera perspective center or LIDAR reference point using the orientation. POSPac UAV then uses the 200 Hz solution to compute the position and orientation at each camera or LIDAR event time that has been recorded. The position can be transformed to different datums and projections, and the final output can be ASCII or binary. This output can then be used to Directly Georeference the imagery or create a LIDAR point cloud. It can also be used as input into a traditional Aerial Triangulation (AT) process to help speed up point matching and eliminate issues with auto-correlation.

### 3) WHAT ARE THE MAIN BENEFITS OF APX UAV?

The APX UAV brings all the benefits of Direct Georeferencing to UAV platforms. With cameras it saves time and hence cost by not having to establish and survey extensive Ground Control Points (GCP's) for AT. It also allows the area flown per mission to be increased or the time required to fly a mission to be shortened by reducing the sidelap requirements for AT to converge. Depending upon flying height and accuracy requirements, it also enables the ability to fly single or dual strip corridor projects for increased utilization. For LIDAR it enables high-accuracy point cloud generation without time consuming adjustments.



## 4) HOW MUCH MONEY CAN I SAVE WHEN USING APX UAV?

The overall savings using an APX UAV are specific to the project type, terrain configuration, type of mapping sensor, and post-processing method.

From a direct labor savings perspective, not having to establish extensive Ground Control Points (GCP's) in support of AT can save several hours in labor per mission, leading to a savings of thousands of dollars per year. From a utilization perspective, only needing to fly half the sidelap vs traditional AT (40% vs 80%) doubles the productivity of a UAV. In other words the same UAV can fly twice as many projects using DG vs AT alone.

## 5) HOW MANY MODELS OF APX UAV ARE THERE AND WHAT ARE THEIR DIFFERENCES?

There are currently 4 models of the APX UAV. All include POSPac UAV.

- **APX-15 UAV:** the smallest and lightest solution ideal for most applications
- **APX-15-EI UAV:** an APX-15 UAV board with an additional external IMU. Designed for use on stabilized mounts where Gimbal encoder input is not available
- **APX-18 UAV:** a single board solution with two antenna heading input. Designed for low dynamic hovering applications like facade scanning where heading accuracy is maintained using GNSS heading measurement
- **APX-20 UAV:** an APX-15 UAV board with an additional high performance external IMU. Designed for use on stabilized mounts and for high altitude applications where higher accuracy orientation is required

## 6) CAN I USE IT AS BACK-UP FOR MY AUTOPILOT SYSTEM?

Yes. The real-time position and orientation computed by the APX UAV can be used as back-up for the autopilot system. In RTK mode, it can also be used to provide the precise position to the autopilot for precision landings. In addition, once the system is aligned, the real-time heading from the APX UAV is much more accurate than what can be obtained from a magnetometer, and is not affected by external objects.

## 7) CAN I USE APX UAV WITH MY IMAGING SENSOR INSTALLED ON A STABILIZED MOUNT?

With the exception of the APX-18 UAV, all APX UAV products are designed for use with stabilized or gimballed mounts. For the APX-15 product, gimbal encoder or autopilot angles are fed to the board and these are used to translate the GNSS observables from the antenna phase center mounted on the UAV airframe to the imaging sensor origin installed on the mount. In this case, the APX-15 must be installed with the sensor on the gimballed mount. For the APX-15-EI and APX-20 products, no external interface is required since they use dual IMUs. The APX OEM module with embedded IMU is installed on the UAV airframe and the external IMU is mounted on the imaging sensor on the gimbal. The APX logs the data from both IMU's and POSPac UAV then uses the data to automatically translate the GNSS observables to the sensor origin.

The APX-18 cannot be used with stabilized mounts since it uses two GNSS antennas to compute a heading fix to aid the inertial solution.



## 8) WHAT GNSS RECEIVER IS USED IN APX UAV?

The APX UAV uses a survey grade 336 channel Trimble receiver based on Maxwell technology that supports GPS, GLONASS, BeiDou, Galileo, SBAS, QZSS, IRNSS.

## 9) WHAT INERTIAL MEASUREMENT UNIT (IMU) ARE YOU USING FOR THE APX UAV?

The APX UAV uses custom-made IMU's designed and built by Trimble and by our partners.

## 10) WHAT ANTENNA SHOULD I USE WITH APX UAV?

The antenna choice is subject to platform and integration needs that dictate the size and weight. Trimble offers two antenna options for UAV's and can help you to choose the antenna that best fits your platform. In general, the APX UAV can support active antenna with minimum LNA of 28.5dB. Please contact Applanix for more details.

## 11) CAN APX UAV SUPPORT MULTIPLE SENSOR PAYLOADS SIMULTANEOUSLY?

Yes. Common multi-sensor payloads include LIDAR with an RGB or multi-spectral camera.

## 12) WHAT ARE THE MOST COMMON SENSORS THAT CAN BE INTEGRATED WITH APX UAV?

Most aerial sensors can be seamlessly integrated with APX UAV. These include but are not limited to photogrammetric, thermal, hyperspectral and multispectral cameras, and LIDAR. Please contact Applanix for more details.

## 13) WHAT PHOTOGRAMMETRY SOFTWARE SUPPORTS THE APX UAV?

Most photogrammetric software packages now support using the full exterior orientation (X,Y,Z, omega, phi, Kappa) from APX UAV. However Applanix recommends and supplies the Trimble Inpho UASMaster and UASMaster Lite software. Please contact Applanix for more details.

## 14) CAN I USE APX ON ANY AIRCRAFT?

The APX UAV can be used on any aerial platform if it meets your requirements, but the hardware cannot be upgraded to the more accurate POS AV and AP products.



## 15) WHAT BENEFITS DOES POSPAC UAV PROVIDE?

POSPac UAV provides the following benefits:

- i. It produces a higher level of position and orientation accuracy than can be achieved in real-time, resulting in more accurate map products
- ii. It generates a solution at 200 times a second, which virtually eliminates interpolation errors
- iii. It has automatic base station search and download capabilities which can be used to find a free local base station to avoid the need to set up one (where applicable)
- iv. It has support for the Applanix SmartBase module (sold separately) which can be used to achieve higher positioning accuracy from the free local base station networks (where applicable)
- v. It produces a continuous position and orientation output regardless of poor GNSS signal reception
- vi. It has support for Trimble Post-processed CenterPoint RTX for surveying in global coordinates of a base station
- vii. It has full datum and projection transformation support

## 16) WHAT IS THE DIFFERENCE BETWEEN POSPAC MMS AND POSPAC UAV?

The POSPac UAV supports only the APX UAV platform, while POSPac MMS supports all Applanix POS, POStTrack and AP products including APX UAV. It is also only available with a SW license locked to a single computer, while POSPac MMS supports full network licensing.

## 17) IS POSPAC UAV UPGRADABLE TO POSPAC MMS?

Yes, POSPac UAV can be upgraded to POSPac MMS.

## 18) WHAT BASE STATION DATA ARE REQUIRED TO BE USED WITH POSPAC?

POSPac requires raw phase and code observables logged from a survey grade base station. At a minimum the Base station should be capable of tracking and logging GPS L1 and L2 observables. For highest accuracy the Base station should also track and log additional observables from GLONASS, BDS and QZSS. (where applicable)

## 19) WHAT BASE STATION FORMATS CAN POSPAC READ?

POSPac supports the RINEX standard format and the Trimble T02 format.

## 20) I WOULD LIKE TO PURCHASE A BASE STATION. WHAT DO YOU RECOMMEND?

Applanix recommends the Trimble Smart Target Base Station. Comprised of a survey grade, multi-frequency, multi-constellation GNSS reference station complete with a foam Ground Control Target with integrated carrying case,



the Smart Target Base Station logs the raw GNSS observables required to do centimeter level post-processed Differential GNSS positioning of UAVs, and acts as a photo-identifiable Ground Control Point (GCP) for quality control.

Cost effective, simple to operate, and supported by both the Applanix POSPac UAV GNSS-Inertial post-processing software for Direct Georeferencing on UAVs and Trimble UASMaster Photogrammetric software, the Smart Target Base Station makes aerial mapping from UAVs easier than ever. Simply place the foam target with receiver in the project area, stake it down, and start data logging wirelessly with the included Smartphone app or web UI. At the end of the mission retrieve the target and download the data for post-processing along with the data collected from a Trimble APX UAV GNSS-Inertial system installed in the UAV. Global coordinates of the reference station are computed automatically using the Trimble Centerpoint® RTX Post-Processing service in POSPac UAV, or if local coordinates are desired, the foam target can be centered over an existing reference point. The Trimble Smart Target Base station may be purchased directly from Applanix.

## 21) HOW CAN I SURVEY IN THE COORDINATES OF MY BASE STATION?

Any standard survey technique can be used. However a convenient method is to use the Trimble RTX service. This is a free service built into POSPac UAV that uses the Trimble Centerpoint RTX technology to calculate the Global coordinates of a static Base station to better than 2 cm accuracy simply by uploading a file of GNSS observables. For more details, please see <http://www.trimblertx.com/>.

## 22) CAN I USE APPLANIX SMARTBASE IF I USE POSPAC UAV?

Yes. Applanix SmartBase can be added as a separate option.

## 23) DOES POSPAC UAV SUPPORT APPLANIX PHOTOTOOLS?

PhotoTools are available as an option for specific camera types.

Please contact Applanix for list of supported cameras.

## 24) DO YOU PROVIDE SERVICE AND SUPPORT FOR APX UAV?

Integration services are not included in price except under valid OEM agreement. We will provide customer support as per the standard POS AV support channels and mechanisms.