

ixnews

IXBLUE | JUNE 2022 | LAND DEFENSE SPECIAL ISSUE

SAFEGUARDING LAND NAVIGATION

With Advans Series INS
for land forces

NAVIGATION-GRADE IMU FOR UAVS

UmiX Series high-
performance compact IMU

ONBOARD CAESAR 8X8

Advans Vega on
DK and CZ systems

ONBOARD SPANISH ARMY'S IFV

Advans Ursa providing
undisrupted navigation





The past year has been full of major successes and milestones for iXblue on the land defense market. Our solutions are making a name for themselves, and proving they match the strong reputation that iXblue already has in the naval navigation domain. Centered around a comprehensive range of inertial navigation systems (Advans Series) and stabilized platforms (Stab Series), we cover a wide spectrum of applications for land forces. Our land solutions are now being used by armies in over 20 countries, in over 30 different systems... and the list is growing every year.

One of our biggest successes can be found on the navigation side. Early on, we anticipated future army needs and understood that, in the event of a high intensity conflict, they would face increasing GNSS disruption threats, namely jamming and spoofing, over a large area. We also understood the cost constraints of having to equip an entire fleet of tactical vehicles. This is why we developed Advans Ursa: an INS with true GNSS-free navigation capabilities, in a cost-effective package. It was confirmed in 2021 that this solution would be onboard the Spanish Army's 8x8 VCR Dragon. This mark of trust is a testimony to Advans Ursa inherent qualities as a navigation system. Taken more broadly, as Advans Ursa is a one-of-a-kind solution, it also demonstrates the coherence of a fully inertial (GNSS-free) navigation solution for a whole park of tactical or armored vehicles. Following this recognition, many system integrators and armies are now taking strong interest in Advans Ursa, worldwide. Other domains are not left out either. 2021 saw several successes for iXblue in artillery systems through, most notably, Nexter's order of 59 Advans Vega for the Czech Army's CAESAR 8x8 155mm self-propelled howitzers. It is a true renewal of faith as this high-performance INS dedicated to long-range applications is already onboard the Danish CAESAR 8x8, but also in Nexter's 105LC1 105mm towed howitzer of several other armies. Our solutions are also selected for an increasing number of ground-to-ground radar systems and anti-air defense systems.

“

OUR LAND SOLUTIONS
ARE NOW BEING USED
BY ARMIES IN OVER
20 COUNTRIES

”

iXblue's decades old expertise in motion simulation is also getting more and more recognition among defense systems manufacturers. By covering the full range of motion simulators, from single-axis to three-axis rate tables and Hardware-in-the-Loop, we are capable of providing solutions for manufacturers for all kind of testings, including those with very high standards, such as missile manufacturers.

Lastly, retaining the same anticipation spirit, we are already working on navigation solutions for autonomous Uncrewed Ground Vehicles (UGV). The latter need precise and continuous navigational data, which our range of INS can provide. Our stabilized platforms can also be fitted on these new systems.

In the following pages, you will get a small glimpse of our solutions and recent successes. We hope we get to meet you soon to discuss how iXblue can become a partner in your projects.

Have a good read!

Bruno Protte
Land Defense
Business Developer



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SAFEGUARDING LAND NAVIGATION FROM GNSS DISRUPTIONS

ADVANS SERIES INS CAN'T BE JAMMED OR SPOOFED, WHICH GUARANTEES THE VEHICLE AND ITS CREW REMAIN ON A SAFE PATH.

Modern Conflicts, Modern Threats

Modern conflicts are subject to a dangerous duality. On one hand, as contemporary equipment gets more technological, there is an increasing emphasis on inter-connectivity and reliance on digital devices. This is especially true for land navigation as vehicles will be (and in some cases, already are) transmitting their live position to one another in order to maximize coordination between units. Having reliable navigation is therefore critical, especially in face of tomorrow's collaborative combat. On the other hand, electronic warfare is increasingly present on the battlefield. It is getting easier for top militaries to disrupt the GNSS (such as GPS, Galileo...) signal in a large area, even several hundred kilometers square. This disruption comes mainly in two forms: GNSS jamming, which renders the signal unavailable, and GNSS spoofing, which has the potential to lure unsuspecting targets in undesirable locations.

Relying solely on the GNSS signal for real-time positioning of a vehicle is therefore dangerous in case of a conflict between peer or near-peer nations. Entire units are at risk of losing track of their position, and consequently having to forfeit entirely their most technological subsystems by resorting to old-fashioned navigation methods, which take over brainpower when the workload of operators is already critical, are less accurate and remain subject to human errors. iXblue's Advans Series range of INS answers this jamming and spoofing risk without having to resort to such degraded methods. By not requiring any external signal to produce navigational data, Advans Series INS can't be jammed or spoofed, which guarantees the vehicle and its crew remain on a safe path and know where they are at all times.

Using an INS to Preserve Critical Navigation

Advans Series is comprised of three different INS with different levels of performance, but with all of them able to provide accurate positioning in all environments. Advans Ursa is a cost-effective INS dedicated to tactical navigation. It is the ideal solution to equip a fleet of several hundred vehicles. Its performance allows for uninterrupted and accurate navigation over 0.4% of the traveled distance, so for every 25km traveled, the INS will have a maximum of 100m drift. This drift can easily be fixed by repositioning the INS by using a waypoint on the map, such as the road layout. Advans Lyra is next in line in terms of performance, with a drift lower than 0.2% of the traveled distance. Advans Lyra can serve multiple duties on the same platform, by being performant enough to provide pointing capabilities. Lastly, Advans Vega is the highest performance INS of this range, with a drift lower than 0.1% of the traveled distance. It is particularly fit for smaller fleets of high added value vehicles such as Main Battle Tanks (MBT). On top of its navigation capabilities, it can provide extremely accurate pointing to the weapon systems, as well as be used for long-range pointing (artillery) and radars.

Advans Series are highly reliable INS, they are built to endure the harshest of environments. With an operating temperature range between -32°C and +71°C, no matter where the operation takes place, the INS won't fail. They can endure high stresses such as strong shocks and intense vibrations, which are commonly faced by land vehicles outside and during combat.

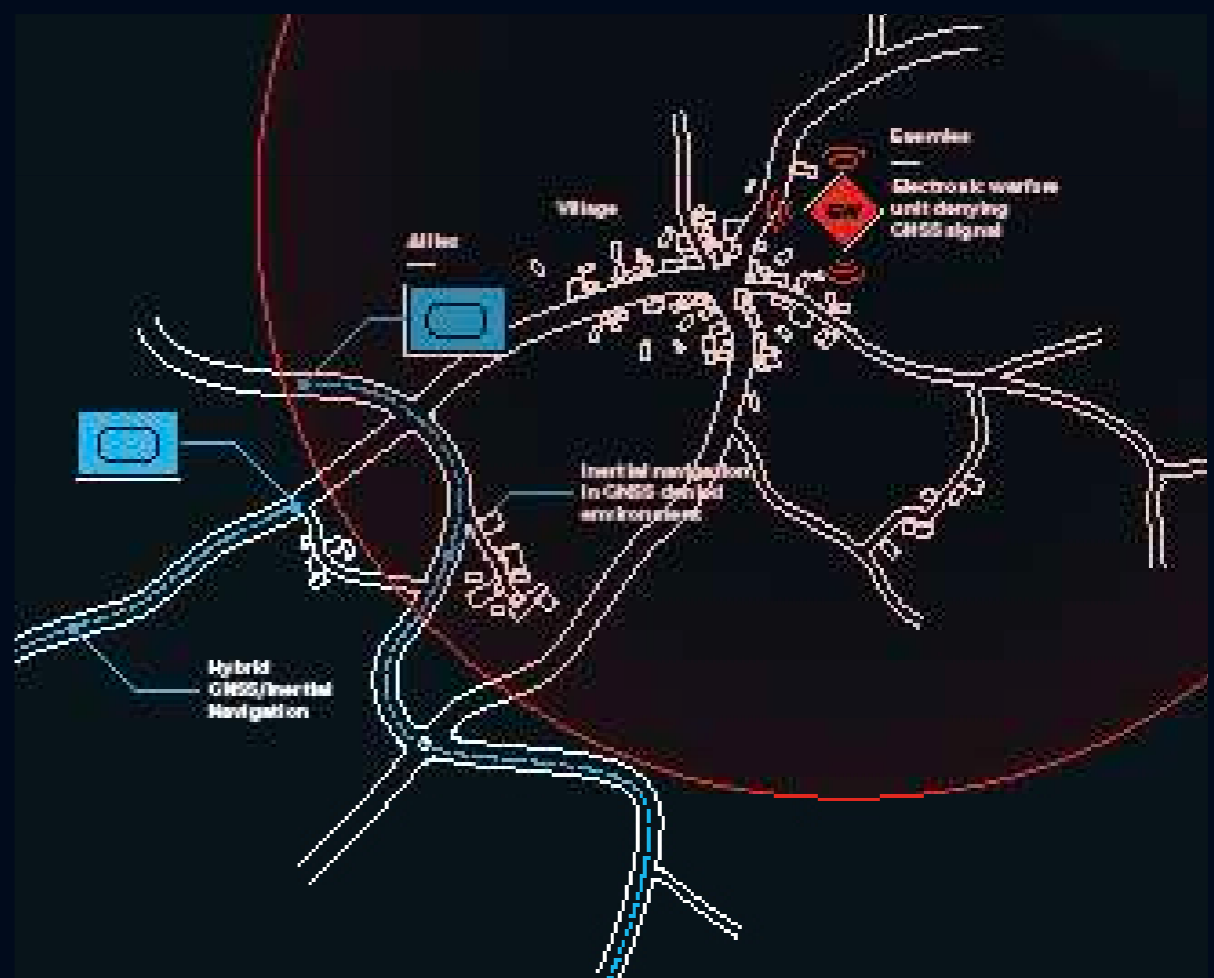
Lastly, all critical subcomponents from the fiber in the fiber-optic gyroscopes to the accelerometers are made in France, by iXblue. Consequently, Advans Series is deprived of ITAR/EAR restricted components and are solely subject to French export control. ■

Undisturbed Navigation

IN GNSS-DENIED ENVIRONMENTS



	Advans Ursa	Advans Lyra	Advans Vega
Horizontal Position (without GNSS)	0.4% DT	0.2% DT	0.1% DT
Heading	4 mils	1 mil	0.5 mil
Roll and pitch	1 mils	0.5 mil	0.2 mil





PRECISE POINTING

FOR RADARS, OPTRONIC SIGHTS,
AND ARTILLERY SYSTEMS

IN ORDER TO ACHIEVE ACCURATE POINTING, YOU NEED AN INS WITH A CERTAIN LEVEL OF PERFORMANCE.

Land platforms' ever-increasing array of sensors are only effective if pointing at the right direction. Artillery launchers need accuracy to strike without fire adjustment and concentrate effects. Ground to ground radars need pointing accuracy to determine precise target grids. Air defense radars and missile launchers need accuracy to coordinate with other air defense systems. In order to achieve accurate pointing, you need an INS with a certain level of performance. This is where Advans Lyra and Advans Vega come into action.

Advans Lyra is particularly fit for medium range weapon systems: radars, medium caliber howitzers and mortars, rocket launchers...

Advans Vega is designed with long-range applications in mind. As such, it will provide precise pointing capabilities to howitzers, air defense radars and weapons, counter battery radars.

Particular requirements of artillery application include the INS having a high tolerance for strong shocks and vibrations. Due to Advans Vega's design and FOG technology, which has no moving part and is particularly good at enduring harsh environments, the INS is a perfect match for artillery pointing.

Advans Vega can count a number of serious references in the artillery field. Among them, Nexter's CAESAR 8x8 self-propelled 155mm howitzers shine. Using Advans Vega for its pointing, the French artillery system passed with high regards Danish Army's qualification trials.

All Advans Series INS are ITAR/EAR free, plug-and-play devices. Advans Series also comes with the customer service associated with such a premium equipment. iXblue support teams are indeed always available to help system integrators and end-users install and operate the INS. ■

Precise Pointing

FOR ARTILLERY SYSTEMS



	Advans Lyra	Advans Vega
Horizontal Position (without GNSS)	0.2% DT	0.1% DT
Heading	1 mil	0.5 mil
Roll and pitch	0.5 mil	0.2 mil
Initial alignment	4 minutes	4 minutes
Stored alignment (stored values)	30 secondes	30 secondes



An aerial photograph of a river delta. The left side shows dark, turbulent water with several small blue and white boats. The right side shows a wide, sandy, light-colored delta plain with intricate patterns of sandbars and channels. The text 'RESILIENT AMPHIBIOUS NAVIGATION' is overlaid in large white letters on the left side.

RESILIENT AMPHIBIOUS NAVIGATION

THE COMPANY HAS DEVELOPED A SOLUTION SPECIFICALLY AIMED AT AMPHIBIOUS OPERATIONS, BASED ON ITS ADVANS SERIES RANGE OF INS.

From the siege of Troy in 1200B.C. to the beaches of Normandy during operation Overlord, amphibious assaults are an integral part of warfare. True logistical prowess, these operations are as disruptive as they are risky. Troops must reach the correct beaching zone and leave it as soon as possible. In face of bad weather, or night assault to retain the element of surprise, they require true navigational skills.

Challenging Operations

Amphibious operations rely on a navigational continuity to succeed. Whether you are at large or beaching, you need to know your position relative to the environment and to friendly forces. Taking the wrong path when at sea could mean getting caught in dangerous water or landing at the wrong location, with potentially catastrophic consequences. When you get wheels on the ground, you need to quickly be operational to maintain the tactical advantage and leave the danger zone immediately.

Inertial navigation systems (INS) have been around for a while, providing accurate and resilient navigation to both navies and land forces. What is complicated to achieve is that navigational continuity from sea to land. Thanks to iXblue, this is not the case anymore.

Relying solely on GNSS signals such as GPS or Galileo to guarantee that continuity amounts to putting the amphibious assault in grave danger. Indeed, such operations are just as sensitive to GNSS jamming and spoofing threats as regular naval and land ops. This is especially true when facing near-peer or peer adversaries. In the case of amphibious operations, this threat is even more pregnant as defenders onshore who expect a landing will have had the time to properly set up defenses, including potential jammers. Inertial navigation is the answer to this threat, as it doesn't require any third-party signal to provide accurate navigation.

iXblue is a well-known player in the inertial navigation field. Pioneers of the fiber-optic gyroscopes (FOG) technology, on which all its INS are based, iXblue is the European leader in naval and land navigation. Its solutions are trusted by over 60 navies and armies worldwide.

Addressing the Challenges

The company has developed a solution specifically aimed at amphibious operations, based on its Advans Series range of INS. In order to do do this, iXblue identified three key challenges specific to these operations:

- First challenge, surface vessels and landing crafts must approach the landing area as close as possible to reduce the distance to travel of the amphibious vehicles, while potentially being in a GNSS denied area.
- Second challenge, any amphibious vehicle after surface navigation must have autonomous and accurate navigation capabilities to ensure that they can engage hostile forces in optimum conditions without wasting time to reposition before leaving the landing zone.
- Third challenge -the main one- is providing seamless navigation continuity, which means providing consistent, automatic sharing of information between platforms so that the autonomous navigation systems for both surface vessels and armored land vehicles can operate coherently together.

By relying on Advans Series for their navigation, amphibious vehicles launched several nautical miles from the landing zone can now navigate on water surface, before automatically switching to a land navigation mode once they reach the shore and begin to progress inland.

For either amphibious or non-amphibious vehicles partaking in a beach landing, iXblue enables surface vessels to transmit critical data for INS alignment and repositioning to the vehicles instantaneously, as they leave the landing craft. Once inland, these vehicles benefit from all the key characteristics of Advans Series. Navigation resilient to GNSS-jamming and spoofing, fast and accurate alignment, great performance unaffected by rough environments. ■

Providing Continuous Navigation

WITH ADVANS SERIES

KEY FEATURES

- Navigation with or without GNSS
- Fast and accurate alignment
- Cost-effective
- ITAR-free components

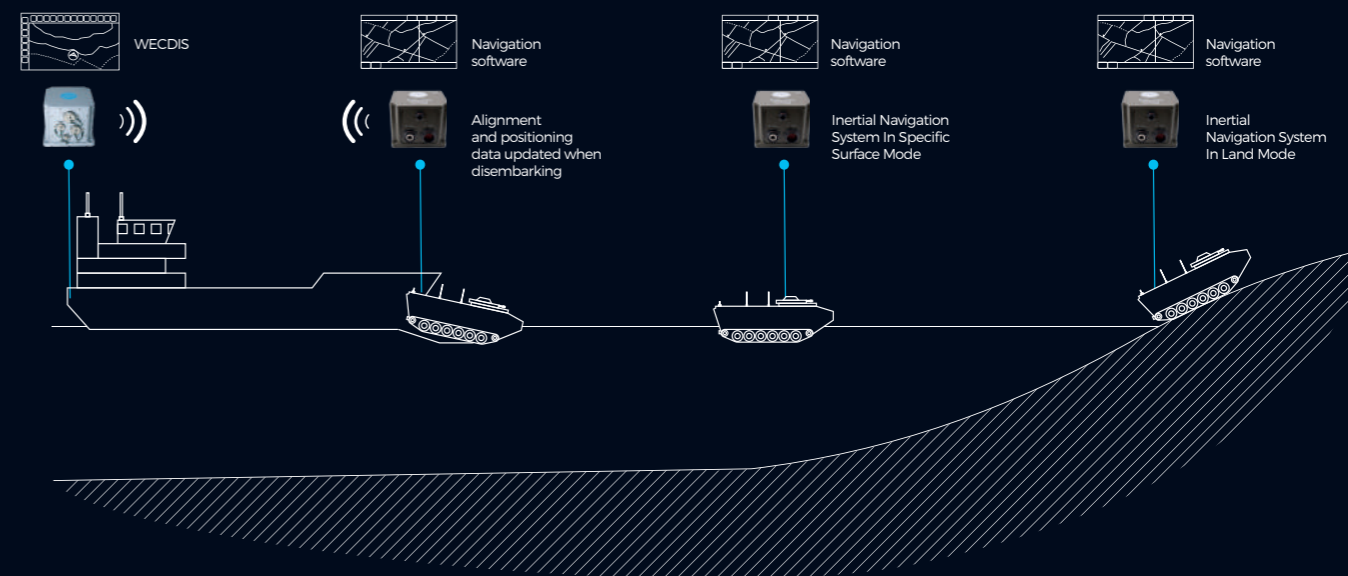
BENEFITS

- Robust to GNSS-denied environments
- Highly reliable
- Easy to integrate
- Low cost of ownership (no periodic maintenance)



Advans Ursa

Horizontal Position (without GNSS)	0.4% DT
Heading	4 mils
Roll and pitch	1 mils
Initial alignment	4 minutes
Stored alignment (stored values)	30 secondes



SPECIAL FORCES: KEEPING THE EDGE



IXBLUE HAS A REPUTATION FOR BEING VERY FLEXIBLE AND TREATING ITS CUSTOMERS AS PARTNERS.

Special forces needs vary greatly depending on their mission. Being a global tech company, iXblue has several tools at their disposal to help them have a disruptive impact on the battlefield.

Undisrupted Navigation and Pointing for Land Operations

On land, Advans Series Inertial Navigation Systems (INS) provide undisrupted navigation to vehicles. Their compact size and low consumption make them compatible for 4x4 tactical vehicles or even smaller platforms such as quads and snowmobiles. Being plug-and-play devices, they can easily be swapped or installed on very short notice by a technical team. Setup of this INS doesn't require to go back to the maintenance base and can be done on field-level installations, which is adapted to the unpredictable nature of tasks devolved to this kind of units. Once installed, they will provide accurate navigation data in terrains where GNSS signal is unavailable or heavily disturbed (canyons, tunnels, dense urban areas)... or jammed by hostiles. Lastly, in the case of Advans Lyra and Vega, they will provide pointing capabilities to optronic sensors, and provide extremely accurate georeferencing data. In particular, the inertial accuracy of Advans Vega allows navigation of the fast boats used by most of special forces. This essentially means that during this lapse of time, operators' navigation will be immune to hostile jamming & spoofing, and consequently reach their destination without leaving their predetermined path.

Keeping track of divers and releasing submerged equipment

On water, special forces can count on Gaps Series USBL to accurately track subsea assets such as divers or uncrewed underwater vehicles. Using acoustics, it provides accurate location, positioning, and tracking of multiple selected targets simultaneously, by putting small beacons on them. Its wide 200° aperture means it works perfectly in shallow waters such as rivers, and can track up to the surface level, provided the beacons remain underwater. Another use of Gaps is by combining it with acoustic releases. These devices can be placed prior to an operation and remain submerged with an payload (up to 2500kg) attached to it.

It can later be triggered by an acoustic signal sent by Gaps to release attached equipment. Lastly, Gaps Series comes already calibrated, and is easy to setup and use (thanks to a web-based interface that'll run on any laptop), which means it can be quickly installed on the side of a small boat right before an operation.

Resilient Navigation at Sea

At large, iXblue's whole range of naval inertial navigation systems will provide resilient navigation for vessels of all size and sorts, including fast assault crafts, rigid hull inflatable boats, and autonomous underwater vehicles. They come in a wide range of performances, ranging from a nautical mile drift every hour (Phins INS), to a nautical mile every 12, 24... all the way up to 360h (respectively Marins M3, M5, and M11).

Securing the Seas with DriX Uncrewed Surface Vehicle

Drone-wise, iXblue developed its own uncrewed surface vehicle (USV), DriX. Developed for civilian applications, this platform can both remotely and autonomously patrol an area. Equipped with the right sensors (from iXblue or third parties), the operational capabilities of DriX are virtually limitless. For instance, if equipped with iXblue SeapiX-FLS 5 forward looking sonar, DriX can be set to scout an area for underwater mines and obstacles, and secure the path. DriX can also be equipped with EW sensors for along the shore patrol.

True Partner for Operators and Integrators

Last but not least, iXblue has a reputation for being very flexible and treating its customers as partners. The company is known for providing support 24/7 worldwide, and not having the same constraints as its larger counterparts. It is readily available to demonstrate the efficiency of its products directly with the end-user, anywhere, anytime. ■

Covering Coastal and Land Operations

SOLUTIONS FOR LAND DEFENSE NAVIGATION

Advans Series



ACOUSTIC POSITIONING SYSTEM

Gaps Series



SOLUTIONS FOR SURFACE NAVIGATION

Phins Surface



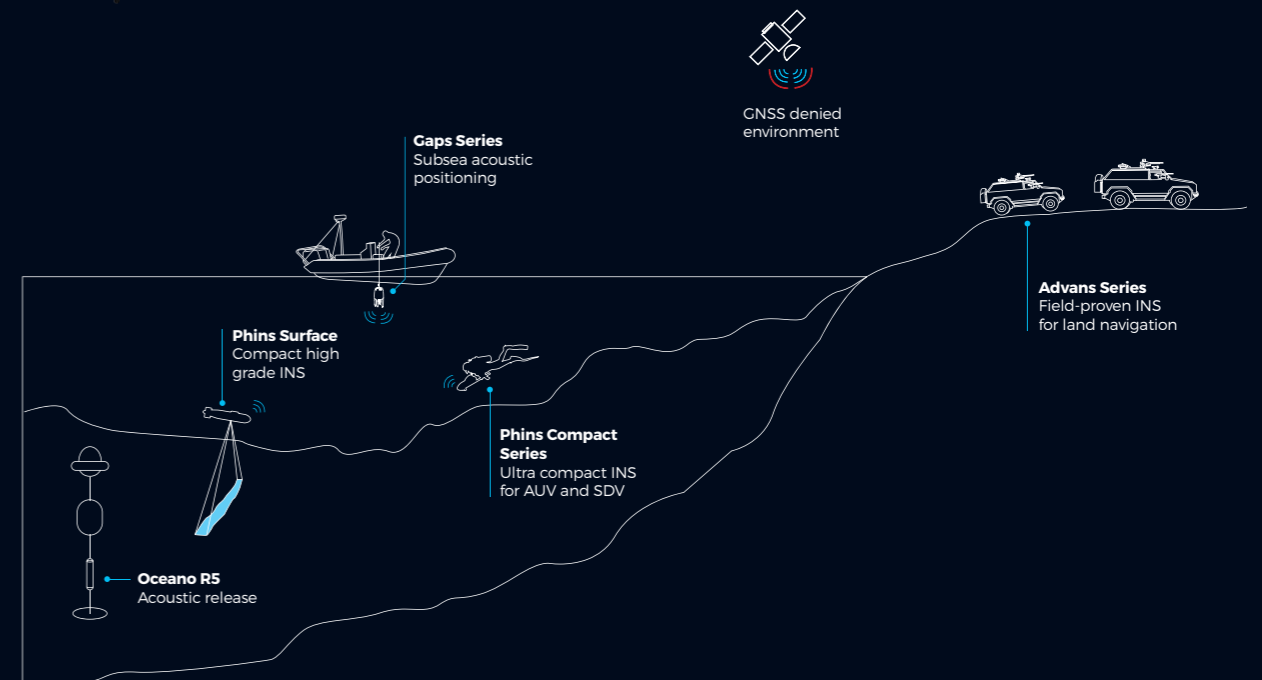
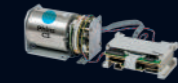
ACOUSTIC RELEASE

Oceano R5

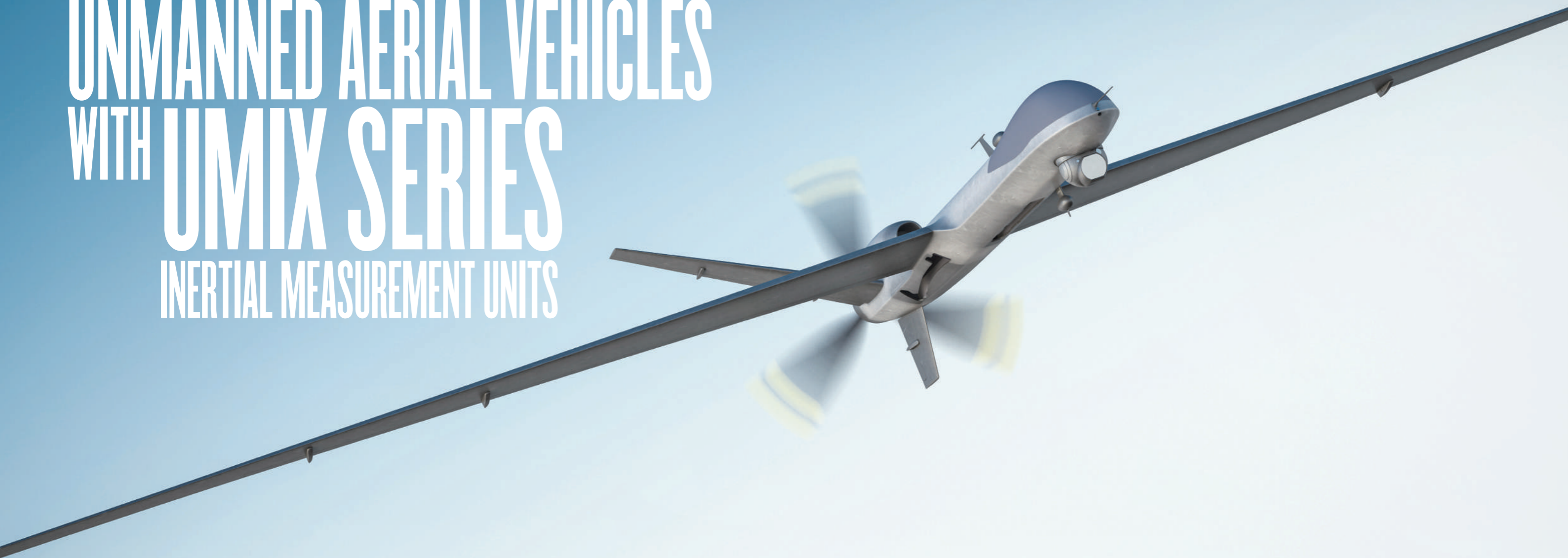


SOLUTIONS FOR AUV NAVIGATION

Phins Compact Series



PROVIDING RELIABLE
NAVIGATION TO
UNMANNED AERIAL VEHICLES
WITH **UMIX SERIES**
INERTIAL MEASUREMENT UNITS



Unveiled in September 2021, UmiX Series is a true revolution in the world of Inertial Measurement Units (IMU). Based on iXblue's renowned Fiber-Optic Gyroscope (FOG) technology, this IMU offers unparalleled performance for its size. No bigger than your trusty coffee mug, it challenges much bigger, navigation-grade IMUs. UmiX comes with all the inherent qualities of FOG technology: high-performance, high reliability, no preventive maintenance, low profile.

Advent of Mid-Range Unmanned Aerial Vehicles

Drones are a major game changer in the defense domain, providing efficient support in many tasks, such as designation, recognition, and even supply. Although the concept of an unmanned aerial vehicle (UAV) isn't new. What we consider to be modern UAVs were first seen in action during the Gulf war in the 90s. Their role varied from surveillance to target acquisition. Ever since, and particularly during operations in Iraq and Afghanistan, these systems evolved and proliferated, becoming so numerous it is now hard to keep track of a full list of vehicles.

Like well-known medium-altitude long-endurance (MALE) UAVs, mid-size and tactical UAVs have increased their presence in the battlefield. Less costly than their bigger counterparts, they are increasingly requiring comparable levels of reliability and precision for their navigation systems, but can't afford to be equipped with expensive avionic suites typically found in larger drones. Modern conflicts also tend to see GNSS signals jammed or spoofed, rendering it risky -to say the least- to fully rely on satellite positioning. Therefore, they need high performance inertial navigation, and this is where UmiX shines.

High-Performance IMU Ensuring Precise North-Finding Navigation

Despite its compact size, UmiX Series comes equipped with high-performance gyroscopes and a series of improvements to its components to deliver performance equivalent to that found in larger IMUs. FOG technology is dedicated to high-requirement applications, while low-grade technologies usually used for this class of UAVs, such as micro-electromechanical systems (MEMS), feature limited performance and cannot sustain navigation without GNSS.

Indeed, the gyros embedded within UmiX are north-seeking grade, which presents several benefits compared to non-gyrocompassing INS usually flying in tactical UAVs. First, in case of total GNSS denial, they can be aligned before flight, which is not achievable with non-gyrocompassing equipment. Secondly, they are more stable in flight. They are effectively navigation grade, with a residual bias of 0,05°/h, 3σ. For gyroscope specialists, this places UmiX in the high end navigation grade category, and as such, is resilient to long GNSS dropouts.

Lastly, UmiX performances are stable on the long term and, as seen earlier, by nature fully resilient to long GNSS dropouts. Operationally speaking, this means that a UAV equipped with UmiX can combine satellite positioning and inertial navigation as long as the GNSS signal is available and switch to full inertial navigation when the signal is disturbed, lost or spoofed.

Easy Integration through Optimized SWaP-C

Designers of tactical UAV platforms typically look to save space and weight wherever possible to gain endurance and payload capacity. After the critical performance considerations, the key criteria when selecting subcomponents are: size, weight and power consumption. Every centimeter or watt is important. The size, weight, power, and cost (SWaP-C) requirements of an aerial drone are very stringent. The deployment of tactical UAVs is also meant to reduce the costs of operations. They are much cheaper to acquire and to maintain than a full-fledged manned aircraft (especially fighter/multirole jets). Therefore, it wouldn't make sense to have incredibly expensive navigation sensors on a drone, hence the lower cost requirement for the embedded IMU. Despite having great SWaP-C factors, MEMS sensors are out of the question as their performance is far from sufficient to provide secure navigation, even short-term, to a remotely operated or autonomous UAV.

UmiX Series combines the best of both worlds with navigation-grade performance and a highly optimized SWaP-C. Its cylindrical shape, small volume (Ø88.9 x H75 mm), and low weight (< 770g, less than a kilogram) render it easy to integrate on smaller platforms. Its power requirements are also very low, with a ~4 watts average consumption, drastically reducing the draw on the platform's battery.

UmiX cost to benefits ratio is unmatched, especially when taking into consideration the lack of preventive maintenance and the overall reliability (more on that later in this article) of FOG technology. Besides, it can essentially fulfill two missions, reducing the need for additional subcomponents: not only can it provide navigation data, UmiX can indeed also be used for pointing optical payloads and designating targets.

Lastly, UmiX comes with digital serial output with adjustable baud and data rates, and two mounting options. A synchronization signal and transmission clock are available. UmiX Series is the culmination of decades of FOG technology developments. iXblue is committed to keeping control over vertical and horizontal integration, all UmiX critical subcomponents are made by iXblue, from the fiber in its fiber optic gyroscopes to the vibrating quartz accelerometers. As such, UmiX is free from ITAR components.

Uncompromising Reliability

Military unmanned aerial vehicles require absolute, unfaltering navigation reliability. Losing the drone's navigation means losing the platform, failing a potentially critical operation, and risk leaving the platform (and the sensitive data in it) at the hands of opposing forces.

One of the main ways to ensure an IMU's reliability is to shield it from the elements. Encasing it in a hermetical box is one such way. This makes it harder to integrate on smaller platforms. UmiX Series' unique performance

to size ratio allows it to be hermetically sealed to maximize reliability and long-term performance, while remaining small enough to fit on any smaller platform. Its design is rugged, perfectly fit for harsh environments: its performance won't be affected by low / high temperatures, or vibrations.

Having a physically protected IMU is useless if the technology itself isn't reliable. With decades of use in a wide array of domains (naval defense, mining, artillery pointing...), fiber-optic gyroscopes are a field-proven, recognized technology. UmiX has a high Mean Time Between Failures (MTBF) of over 120,000 hours. The absence of moving parts ensures the gyros won't fail over time. Simply put, UmiX... just works. Effectively, anywhere, at all times.

Lastly, being a plug-and-play device, the chances of human related failures on setup are lowered. This also ensures UmiX can easily be swapped should the need arise. ■



88.9 mm



75 mm

Umix Series

COMPACT HIGH-PERFORMANCE INERTIAL MEASUREMENT UNITS

KEY PERFORMANCE IN NAVIGATION

- Autonomous and static alignment
- Capable of high heading precision
- Long term performance stability
- Resilient to long GNSS dropout

KEY PERFORMANCE IN STABILIZATION

- Low noise
- Low latency
- High bandwidth
- 3D rotation measurement



FIBER-OPTIC GYROSCOPES

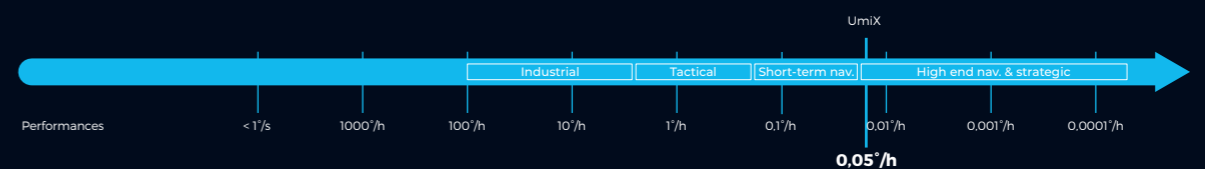
Dynamic	± 490°/s max
Angular Random Walk	0.01 °/√h
Bandwidth	5 kHz
Latency	250 μs
In Run Bias	0.02°/h 1σ
Residual Bias	0.05°/h 1σ
Scale Factor Error	40 ppm 1σ

VIBRATING QUARTZ ACCELEROMETERS

Dynamic	± 30 g
Bandwidth	>500 Hz
In Run Bias	5 μg 1σ
Residual Bias	150 μg 1σ
Scale Factor Error	40 ppm 1σ

NAVIGATION-GRADE IMU

Applications





**ROBUST
STABILIZATION
IN ALL ENVIRONMENTS WITH
STAB SERIES**

Information has always been crucial on a battlefield. The latter has seen the use of increasingly sophisticated optronic sensors to aid in the success of operations, by seeing what is either hard or impossible to see by human eyes. They are also used outside of hostile zones for surveillance purposes.

As these devices keep developing, so does the need for accurate stabilized platforms. The further away a target is, the longer the focal length of the camera needs to be. At certain distances, the slightest movement can make the optronic output off focus, losing track of what or who needs to be watched. One can easily understand how this poses an issue when mounting an optronic sensor on top of a moving platform such as a 4x4 tactical vehicles, especially on harsh terrains.

iXblue Stab Series stabilized platforms directly tackles this problem.

Sharp Imagery Through Cost-Effective Gyrostabilization

Stab Ceos is a two-axis stabilized platform designed to carry single payloads on-the-move and in harsh environments. Used for situational awareness, security and surveillance applications, Ceos light-weight platform guarantees sharp images and/or videos by providing reliable stabilization to the most modern medium-weight integrated optical sensors packages.

Stab Ceos can carry light payloads (up to 15kg), and be mounted on all type of land vehicles, ranging from Uncrewed Ground Vehicles

(UGVs) to heavier vehicles such as 4x4 tactical vehicles or 8x8 infantry fighting vehicles. It is also perfectly fit for stationary masts, and will thus be a formidable tool to help secure a military base, frontline, or coast border.

Last but not least, Stab Ceos is a cost-effective solution, ensuring equipping an entire fleet of vehicles doesn't come at the expense of gyrostabilization performance.

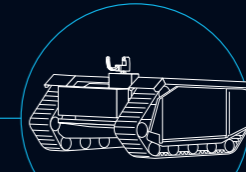
The Most Versatile Platform to Meet all your Requirements

Stab Neos is a two-axis platform designed to carry multiple payloads on-the-move and in harsh environments. Used for situational awareness, security and surveillance applications. Its versatile nature allows for a wide array of payload combinations and potential applications. From fitting multiple optical sensors packages to integrating rocket pods, or even fitting an antenna... Stab Neos offers modularity and is the stabilized platform to choose if you require gyrostabilization for your complex, multi-payload system.

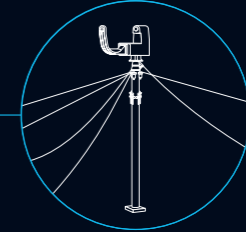
**CEOS LIGHT-WEIGHT PLATFORM
GUARANTEES SHARP IMAGES
AND/OR VIDEOS.**

Stabilized Platforms for Multiple Platforms and Payloads

Stab Ceos



Unmanned Ground Vehicles

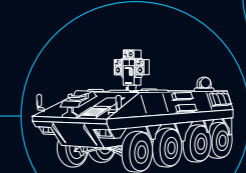


Static Masts

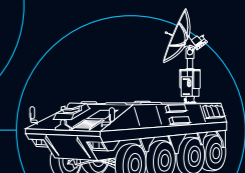
Stab Neos



Rocket Pods



Multiple Optronic Payloads



Antennas

Stab Leos



Main Battle Tanks
Stab Leos L



Infantry Fighting Vehicles
Stab Leos S

THIS FLAGSHIP RANGE AIMS AT BEING THE GOLD STANDARD IN THE LAND DEFENSE GYROSTABILIZATION MARKET.

Ultimate Line of Sight Stabilization

Stab Leos L is a two-axis platform range designed to keep performance of optronic sensors on-the-move whatever the movement of the platforms and in harsh environments. Used for observation, reconnaissance and targeting applications, Leos achieves ultimate Line Of Sight stabilization. Medium-weight optronic sensors' performance, detection, recognition, and identification capabilities directly benefit from the integration, onto Stab Leos, of high-grade gyroscopes designed and manufactured by iXblue, coupled to advanced algorithms.

As of today, Stab Leos L comes in two different performance versions: Leos L5 and Leos L7. Both offer very high-performance Line Of Sight (respectively <math><100 \times \text{rad}</math> and <math><20 \times \text{rad}</math>) and position accuracy, which ensures the attached payload benefits from a highly accurate gyrostabilization. This is aimed at end-users who require perfect stabilization on moving platforms to, for instance, track distant targets.

Lastly, a more compact version of Stab Leos L5 has been unveiled by iXblue: Stab Leos S5. By retaining the high-performance of its larger version, while being smaller in size, Leos S5 is designed to be the go-to stabilized platform for demanding optronic payloads on mobile platforms: Armored Personnel Carriers, Infantry Fighting Vehicles, Main Battle Tanks etc.

This flagship range aims at being the gold standard in the land defense gyrostabilization market. iXblue's expertise is renowned among key manufacturers, and the Stab Series range is already in use within several armies.

On top of this comprehensive range, iXblue continues to abide by its roots by providing tailor-made solutions for projects requirements that need "extra customization" and the company's engineering insights. ■

Stab Series

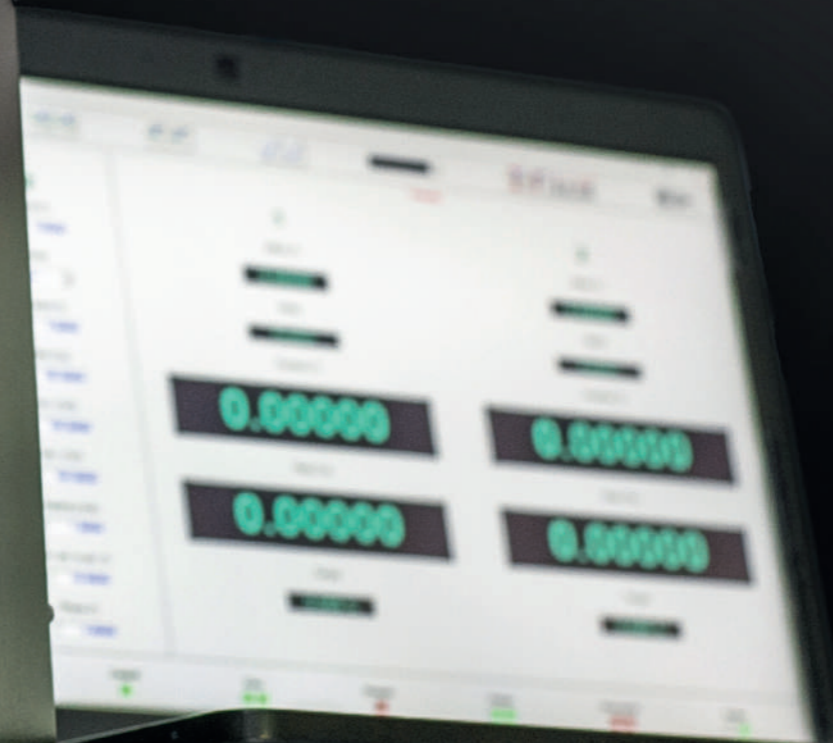
STABILIZED PLATFORMS

- Wide range of performance
- Field Proven
- Fit for harsh environments
- Export-free



	Geos	Neos	Leos L5	Leos L7	Leos S5
Axis number	2	2	2	2	2
Cyrostabilized line of sight	<math><1 \text{ mrad}</math>	<math><1 \text{ mrad}</math>	<math><100 \mu\text{rad}</math>	<math><20 \mu\text{rad}</math>	<math><100 \mu\text{rad}</math>
Type of payload (#pieces)	1	1, 2 or 3	1	1	1
Nominal payload (ground fixed system (up to /kg)	30	60	40	40	25
Nominal payload (ground mobile system (up to /kg)	15	40	20	20	25
Position accuracy (°)	Azimuth $\leq 0.05 /$ Elevation ≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01
Angular speed (up to °/sec)	60	60	120	120	115
Angular acceleration (up to °/sec²)	60	90	150	150	115
Dimensions (mm)	320 x 165 x 385	250 x 285 x 535 (with bridge)	500 x 500 (diameter)	500 x 500 (diameter)	Ext Ø379x365 mm Intrusion Ø120x135 mm
Weight (kg)	12	24	45	45	25

SUPPORTING DEMANDING TESTING WITH MOTION SIMULATORS



IXBLUE HAS A DEEP KNOWLEDGE OF THE EMBEDDED SENSORS. AS SUCH, THE COMPANY UNDERSTANDS PERFECTLY THE TESTING NEEDS OF THESE DEVICES.

IXblue is a global supplier of motion simulators to the tactical missile and inertial navigation systems (INS) industries. Also being a recognized leader in inertial navigation systems and inertial measurement units (IMU), iXblue has a deep knowledge of the embedded sensors. As such, the company understands perfectly the testing needs of these devices.

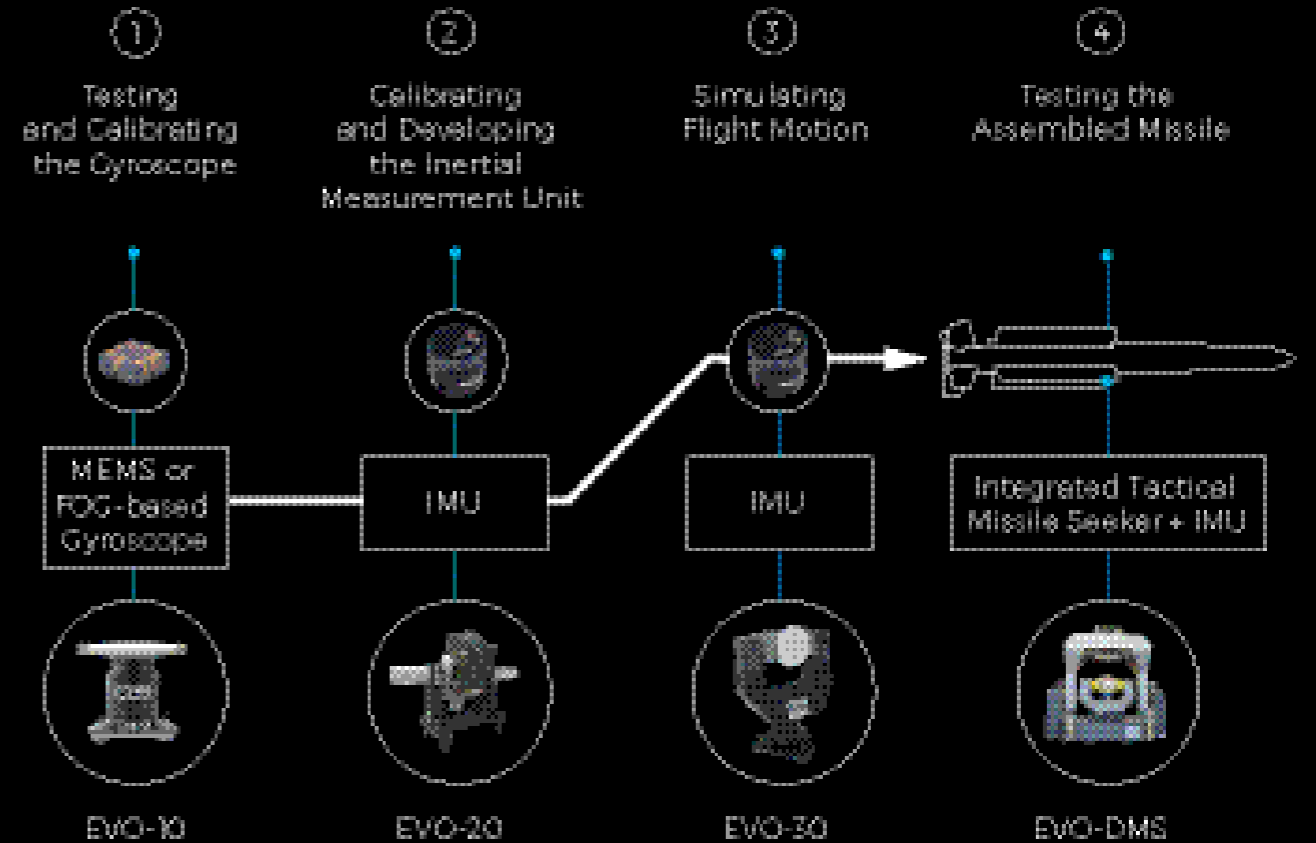
Missiles are filled with high-end technologies. Among these, the IMU/INS plays a crucial role in guiding the system. Comprised of gyroscopes and accelerometers, both the sensors (gyros) and assembled device (IMU/INS) need to be tested and calibrated. It is then integrated into the missile airframe by a System Integrator company, at which point it is tested in a Hardware-in-the-loop (HWiL). iXblue is present at every step of this process with its EVO Series rate tables and DMS-30 dynamic motion simulator. They simulate motion and provide accurate testing data to the manufacturer during all stages.

Solutions Crafted with High Requirements in Mind

iXblue has several series of rate tables and motion simulators that have been developed to address the particular requirements of the tactical grade missile test community. Indeed, missiles and rockets at large (such as the ones used for space launches) have very strict requirements in terms of performance and reliability of the embedded IMU/INS.

Bias stability performance required by tactical IMU/INS, whether they are based on miniaturized Fiber-Optic Gyroscopes (FOG) or high-end inertial Micro Electro-Mechanical Systems (MEMS) are in the range of 0.1°/Hr to 5°/Hr, with a dynamic range from 0°/s to ±3,500°/s. They need to withstand shock of up to 100g and need to be calibrated over a temperature range of +100°C to -55°C. This level of performance needs to be delivered reliably, and due to the sensitive nature of the system on which these IMU/INS are embedded, need to be tested at all stages of production, from the single gyroscope to the fully integrated guidance system.

Additionally, in order to operate the testing machines, operators need an efficient controller. All of iXblue tables are controlled by the industry standard nGine real time controller. For missile IMU test and development iXblue have developed several unique features that help the IMU manufacturers and the System Integrators test their IMU/INS with highest fidelity and dynamic transparency.



MAINTAINING PERFORMANCE WITH MULTIPLE SENSORS BEING TESTED AND CALIBRATED SIMULTANEOUSLY HELPS KEEP THE COST OF PRODUCTION TO A MINIMUM.

Testing and Calibrating the Gyroscope

Testing of the individual gyroscopes can be achieved with iXblue's EVO-10 Series. This range of single-axis positioning and rate tables come with all performance parameters required for test and calibration of tactical grade MEMS or FOG based gyros. Environmental performance is enhanced by the addition of a thermal chamber. Indeed, the calibration of the sensors rate scale factor over temperature is a critical first step in production of a tactical grade IMU/INS. Maintaining performance with multiple sensors being tested and calibrated simultaneously helps keep the cost of production to a minimum.

Calibrating and Developing the Inertial Measurement Unit

Once the gyroscopes have been tested and integrated onto an IMU, it too needs to be tested and calibrated. For calibration and development of the IMU it is necessary to precisely simulate three-axes of motion over the dynamic range with temperature also applied. A two-axis table with horizontal outer axis and thermal chamber is the industry standard for production and calibration of the IMU/INS.

At the request of tactical missile IMU manufacturers and System Integrators, iXblue have developed a new standard of 2-axis rate table. The EVO-20M-HD has the highest rate range ever achieved on the horizontal outer axis with temperature chamber installed.

The unique high dynamic performance of the outer axis of the EVO-20M-HD enables the operator to use the axis as the missile roll axis. This enables the user to test and calibrate the IMU in all 3-axes without re-orientating the IMU, and without sacrificing precision.

Simulating Flight Motion

In the case of IMU/INS designed for demanding airborne applications require flight motion simulation for their testing. Three-axis motion simulators are often used as Flight Motion Simulators for development of stability algorithms, mission planning and/or calibration of an IMU/INU. In iXblue's range, the EVO-30N Series rate tables can cover this need. It was developed for tactical grade IMU/INU and is often used by both Unmanned Aerial Vehicle (UAV) manufacturers and missile system integrators.

For calibration or flight motion simulation over the operating temperature a thermal chamber is a requirement.

Testing the Assembled Missile

System Integrators test and develop their missiles in a Hardware in The Loop (HWIL) laboratory where they simulate missile dynamics and synthetic, moving targets.

The front part of the missile, with the IMU, guidance computer and seeker is installed onto a 3-axis DMS to reproduce flight motion and engagement scenarios. The large payload is moved in roll pitch and yaw.

To achieve the dynamic transparency necessary to close the loop around the missile seeker under high dynamic angular motion, a powerful Flight Motion Simulator with a real-time motion controller is required.

iXblue nGine controller has all the features required - including reflective memory, and real time interfaces.



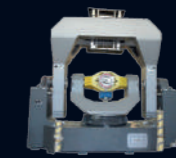
	EVO-10
Payload Mass	2
Position Accuracy	<1 mrad
Rate Range	1
Acceleration	30



	EVO-20M-HD	
	Inner Axis (Yaw)	Outer Axis (Roll and Pitch)
Payload Mass	50kg	
Position Accuracy	<±0.5 arc sec	<±0.5 arc sec
Rate Range	>±3,000°/s	1,200°/s
Acceleration	10,000°/s ²	450°/s ²
Orthogonality	≤2 arc sec	≤2 arc sec



	EVO-30N		
	Inner Axis (Roll)	Middle Axis (Pitch)	Outer Axis (Yaw)
Payload Mass	20kg		
Position Accuracy	<±1.0 arc sec	<±1.0 arc sec	<±1.0 arc sec
Rate Range	>±3,000°/s	>±2,000°/s	>±300°/s
Acceleration	15,000°/s ²	5,000°/s ²	3,000°/s ²
Orthogonality	≤2 arc sec	≤2 arc sec	≤2 arc sec



	EVO-DMS		
	Inner Axis (Roll)	Middle Axis (Yaw)	Outer Axis (Pitch)
Payload Mass	100kg		
Position Accuracy	<±10.0 arc sec	<±20.0 arc sec	<±20.0 arc sec
Rate Range	>±3,000°/s	>±400°/s	>±400°/s
Acceleration	50,000°/s ²	10,000°/s ²	10,000°/s ²
Orthogonality	1mm sphere	1mm sphere	1mm sphere

Improving Instantaneous Rate Performance

Unique features of nGine, iXblue's proprietary real time model-based controller improve the instantaneous rate performance.

When rotating an axis at high rates there is a coupling effect to the adjacent axis caused by precession effects. These effects are seen by the IMU and can cause errors in the simulation results.

The nGine anti-coupling feature reduces these effects by typically 20dB and up to 30dB.

The graph shows empirical measurements made on a EVO-30 Series, three axis rate table. Blue line without anti-coupling and red line with anti-coupling

Conclusion

iXblue's expertise in demanding IMU testing is recognized throughout the industry. More specifically, our solutions cover the entire scope of missile testing, from sensor calibration to testing the assembled product, with no compromise on performance. The EVO rate tables are already trusted by key players in this domain, and our EVO-20M-HD is especially fit for these applications through its high dynamic. ■

nGine
CONTROLLER



EVO-10



EVO-20M-HD



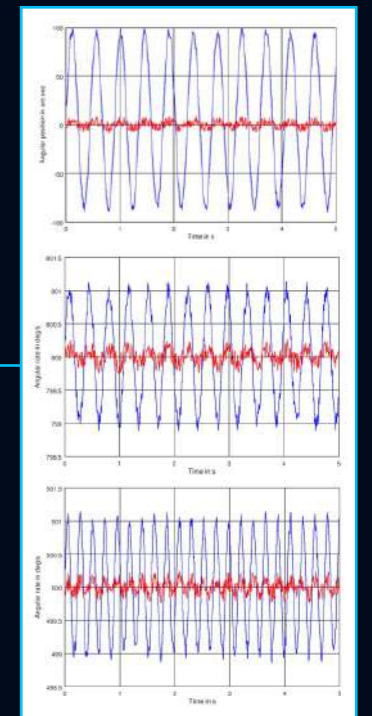
EVO-30N



EVO-DMS



nGine in real time cabinet



Graphs showing removal of coupling errors

02

CUSTOMER STORIES

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lightweight Serval FOR



ADVANS VEGA PROVIDING
**ACCURATE
POINTING**
TO DANISH AND CZECH
CAESAR 8X8

iXblue's Advans Vega, part of the Advans Series land inertial navigation systems (INS), has been making a name for itself, as more and more manufacturers trust it. This INS is dedicated to long distance applications such as artillery. Focus on two major contracts with Nexter and its best-in-class CAESAR® 8x8 self-propelled 155mm howitzer.

IXBLUE ALREADY PROVIDES INERTIAL POINTING TO THE 105LG1 105MM TRACKED HOWITZER, AS WELL AS THE CAESAR® 6X6 SELF-PROPELLED HOWITZER.

DANISH ARMY'S CAESAR® 8X8

Nexter has trusted iXblue's Advans Series Inertial Navigation Systems (INS) to provide accurate pointing capabilities to the CAESAR® 8x8 self-propelled howitzers sold to the Danish Ministry of Defence Acquisition and Logistics Organisation (DALO). This contract consists on the delivery of 15 CAESAR® 8x8 bought in 2017, and an additional 4 systems bought in 2019. iXblue's INS allows for continuous, instant-on position and orientation at all times, including in GNSS-denied environments.

It is not the first occurrence of Nexter trusting iXblue for its artillery systems. The Saint-Germain-en-Laye based company provides inertial pointing to the 105LG1 105mm tracked howitzer, as well as the CAESAR® 6x6 self-propelled howitzer. With Advans Series now equipping CAESAR® 8x8, iXblue's INS are onboard all of Nexter's artillery range.

This latest success is no small feat either. This is the first CAESAR® 8x8 produced by Nexter and sold to the export market. This program's success is therefore critical for the future of CAESAR® 8x8. iXblue is humbled to be considered a worthy partner in this important step for Nexter's new generation self-propelled howitzer.

The DALO has been particularly demanding regarding the quality of Nexter's artillery

system, and subsequently its onboard solutions. The client's qualification trials left no room for error, and the level of performance expected was a challenge for all parties involved, strictly following NATO quality standards.

Thanks to Nexter and iXblue teams' commitment during trials at Bourges and Bofors Test Center, the Danes were convinced by CAESAR® 8x8 performances. iXblue teams were available and proactive to fine-tune the Advans Series' integration onto the howitzer and provided on-demand assistance to Nexter. In line with the company's core values, iXblue treated this program as a true partnership with its client and showed dedication at all times to help make this keystone program a complete success.

"This program truly helped us improve our Advans Series INS, and further proved iXblue's commitment to delivering quality solutions as well as a solid support." says Bruno Protte, Commercial Manager at iXblue. He proceeds to add: "Although being experts in our field, we remain humble and keep learning how to best serve our clients. This flexibility and ability to react is in our DNA since our beginnings. We understand that excellent engineering is only one of the three equal factors that lead to success, the others being: hard work, and a strong relationship with those who trust us."

CZECH ARMY'S CAESAR® 8X8

iXblue has also been entrusted by Nexter to provide the Czech Republic's newly ordered 52 CAESAR 8x8 self-propelled howitzers with its high-performance Advans Vega inertial navigation systems. The order includes 59 Vega V5 INS.

"Nexter is one of our key partners when it comes to artillery systems. We are proud to earn their trust once again to be onboard CAESAR 8x8 self-propelled howitzer for the second time" says Bruno Protte, sales manager responsible for the contract. "This renewal of faith in iXblue for Nexter's best-in-line 155mm artillery system is a testimony to Advans Vega's performance and reliability" Mr. Protte concludes. ■

CAESAR 8x8 self-propelled 155mm artillery system





IXBLUE PROVIDING ACCURATE STABILIZATION TO THALES SOPHIE CAMERAS: MARGOT 3000

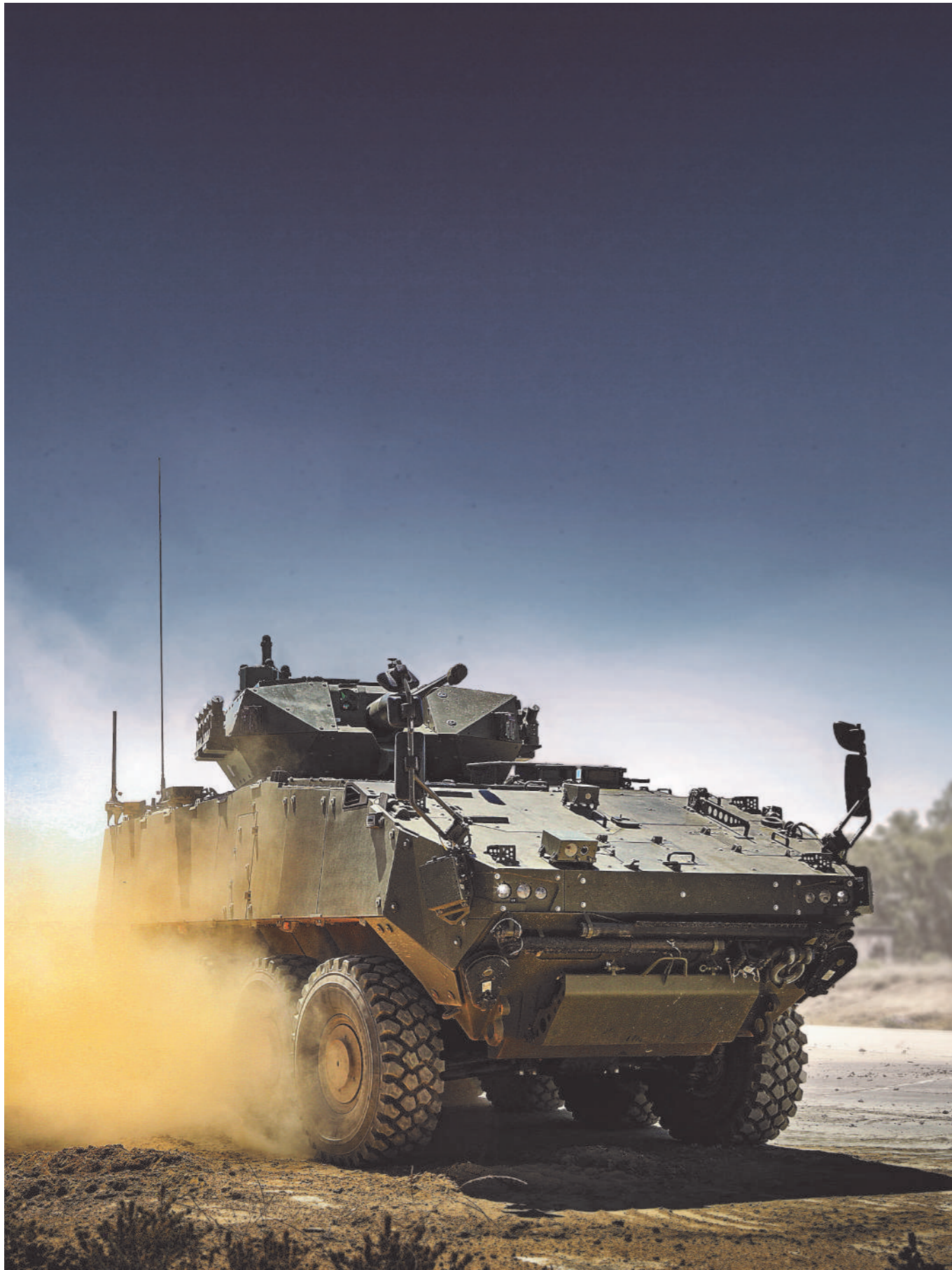
Thales is originator of the SOPHIE range of hand-held thermal imagers and target locators. Meant to be hand-held and used statically, the company has been looking to fit its best-selling cameras on a stabilized platform to address a client's needs. Indeed, the latter wanted to benefit from SOPHIE cameras' great features, but on a moving platform. Thales looked for a company they could trust and that could deliver about a hundred systems in a timely manner. iXblue naturally answered the call.

Thales took interest in iXblue's solutions for several reasons. iXblue does not make any compromise on the ruggedness of its platforms. They benefit from hardened components, and are overall designed to work at a constant performance in all environments and all conditions: high or low temperatures, high vibrations, strong shocks etc. For instance, they benefit from military grade connectivity. Thales recognized this, as its client planned on using the system in very demanding environments. All iXblue's positioners are made in France (ITAR-free), and export-free. Lastly, Thales needed a cost-effective solution, which didn't come at the detriment of performance.

iXblue is an independent manufacturer, as it doesn't sell full systems but only the stabilized platforms. This ensures Thales (and other customers) can reliably be supplied by iXblue, as they don't compete with one another.

Stab Ceos fulfilled all requirements. As a two-axis stabilized platform, it is designed to carry single payloads, on moving platforms, in harsh environments. It is lightweight and can provide reliable stabilization to integrated optical sensors packages, ensuring sharp images and videos. Thus, Margot 3000, a system comprised of SOPHIE cameras and Stab Ceos positioners was developed jointly and delivered to Thales' customer.

"Margot 3000 VM is a successful mobile surveillance product for Thales. Several hundreds of systems have been delivered to our customers over the past five years." Explains Frédéric Le Gusquet, Product Development Manager at Thales Land & Air Systems. "We would like to thank iXblue for supplying the Ceos stabilized platform, part of Margot 3000 VM, and for complying to the delivery schedule with a high-level of quality." ■



8x8 VCR Dragón
Marco Romero/
MDE

IXBLUE PROVIDING UNDISRUPTED NAVIGATION TO SPANISH ARMY'S 8X8 VCR DRAGÓN

iXblue together with its Spanish representative GRAFINTA have signed a contract with GMV to provide critical navigation for all Spanish Army 8x8 VCR Dragón. This contract covers the delivery of over 240 Advans Series inertial navigation systems (INS), namely Ursa U5 and Vega V5, with a first batch due in early 2022.

Based on the well-known GDELS 8x8 Piranha 5 combat wheeled vehicles, the Dragón is a state-of-the-art system, equipped with the most advanced technologies. This program is a major component of the Spanish Army's plan to gear up in order to ensure future effectiveness. GMV as contractor of the navigation system will integrate iXblue systems with GMV's technology in GNSS and navigation algorithms.

Ursa U5 is the only cost-effective, north finding and easy to integrate INS for military land vehicles, allowing it to be fitted on an entire fleet. Vega V5, on the other hand, is a higher performance INS designed for both navigation and pointing applications. Both INS are based on iXblue's

renowned Fiber-Optic Gyroscope technology, providing high-performance and resilient navigation everywhere, including in GNSS-denied environments.

"iXblue is honored to have both GMV and the Spanish Army's trust for such an important program," says Carlos Lopes, sales manager at iXblue. "Our INS will provide accurate, secure, and resilient navigation and position information to the vehicles", Mr. Lopes adds.

With the recent selection of iXblue's Marlins Series INS and Netans Data Distribution Units (DDU) to equip the Spanish Armada's newest F110 frigates, where GMV will integrate iXblue systems in the global frigate navigation system, the company is becoming a key player for navigation solutions in Spain. "We are humbled to be a partner of the Spanish Armed Forces in the resilient navigation domain. These successes are a source of pride for all of our teams and, we hope, the beginning of a fruitful and close cooperation," concludes Mr. Lopes. ■



© Nexter / Adrien Daeste

PARTNERING UP WITH BERTIN INSTRUMENTS ON VBMR-L SERVAL SCORPION VEHICLES

Lightweight VBMR SERVAL is a 4x4 multi-role armored vehicle manufactured by Nexter, in collaboration with Texelis. It is part of the Scorpion Program, aiming at renewing and modernizing the French Army's combat capabilities with new armored vehicles.

As part of this program, Bertin Technologies has been selected by Nexter to provide observation and reconnaissance (FOR) capabilities for up to 26 Serval vehicles. Bertin requires a high-performance positioner to provide this capability while the vehicle is in movement. Stab Leos Series has been selected to fulfill this role. Stab Leos Series is a range of two-axis platforms, with very high

gyrostabilization performance. They can embed any type of payload up to 20kg on mobile platforms, and weights just under 45 kilograms.

On top of the positioner, iXblue also provided Bertin with an Advans Series inertial navigation system, which will provide accurate georeferencing of the images and videos taken by Bertin's solution.

It isn't the first time iXblue and Bertin Technologies partner up, as they have already worked together on integrating Bertin's Second Sight MS chemical detector to iXblue's Stab Leos L, with very successful results. ■

