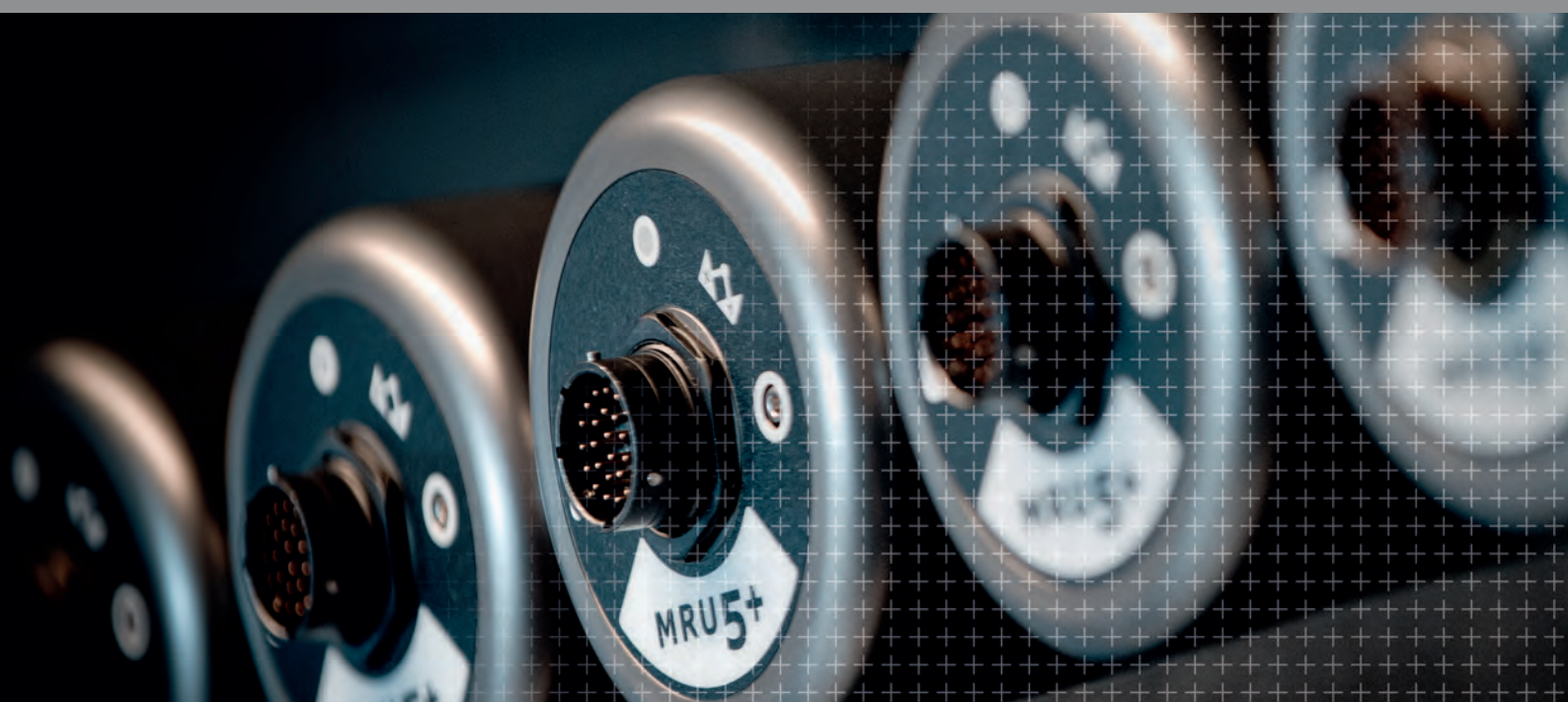




KONGSBERG

MRU 5th generation

Motion reference for any need



Our mission

We shall earn the respect and recognition for our dedication to provide innovative and reliable marine and offshore electronics that ensures optimal operation. By utilizing and integration our technology, experience and competencies in positioning, hydroacoustics, communication, control, navigation, simulation, and automation, we aim to give our customers The Full Picture. The Full Picture yields professional solutions and global services that make a difference enabling you to stay ahead of the competition.

Our philosophy

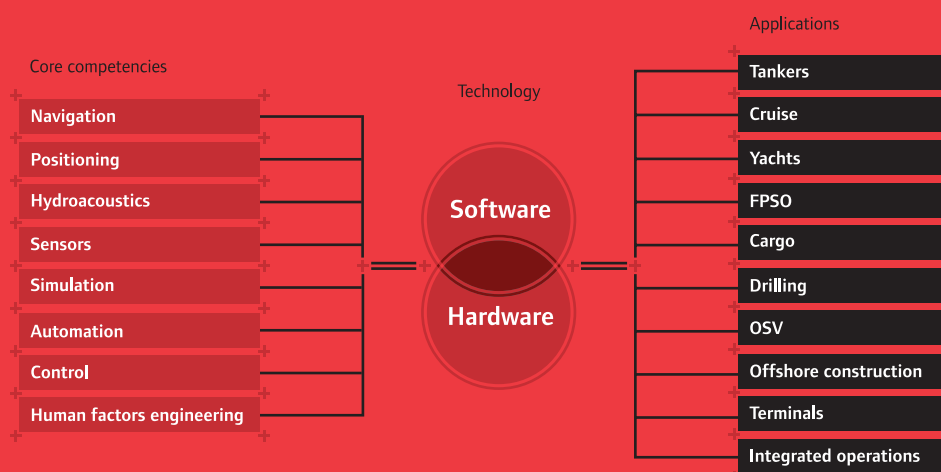
Our success depends on the success of our customers. Actively listening to our customers and truly understanding their needs, and then translating these needs into successful products and solutions is central to achieving our goal.

Our people are the key to our success and we empower them to achieve. Working together in a global network of knowledge, guided by our values, engenders innovation and world class performance. Every day we have to think a little differently, because every client is unique.

We aspire to translate the imagination and dedication of our staff into successful technologies and solutions. Our commitment is to add value to your operations by providing you with The Full Picture.

Maximizing performance

by providing The Full Picture



Extreme performance

Extreme conditions demand extreme reliability, extreme accuracy and extreme performance – for all operations, at all times. KONGSBERG implicitly understands these challenges. We have been a leader in the field of Motion Reference Units (MRUs) for over 20 years, delivering world-class technology to help our clients achieve optimum operational results at sea.

KONGSBERG MRUs are designed to meet the most rigorous demands, accurately measuring roll, pitch, yaw and heave motion to help facilitate complex marine operations – such as using cranes during rough weather, or dynamic positioning operations.

Through knowledge and experience we have built market and technological leadership. This allows our customers to maximise performance, whatever the extremes they operate in.

The ultimate marine motion sensor

KONGSBERG's dedication to advancing high-performance measurement technology has led to a solution that is custom-made for a comprehensive range of vessels/ installations, operations and marine dynamic environments. Our MRUs, which are suitable for any maritime operation that requires attitude determination and motion compensation, provide reliable real-time motion measurements with outstanding accuracy.

KONGSBERG MRUs excel in a wide variety of applications, such as:

- Motion compensation of single and multi-beam echo sounders
- Orientation and attitude measurements on autonomous underwater vehicles (AUVs) and remotely operated vehicles (ROVs)
- High-speed craft motion control and damping systems
- Heave compensation applications
- Dynamic positioning
- Ship motion monitoring
- Offshore structure motion monitoring
- Ocean wave measurements
- Antenna motion compensation and stabilization.

KONGSBERG MRUs are designed and manufactured to maximise performance in the most challenging marine environments. Our in-house experts combine state-of-the-art technology, with high quality components (including cutting-edge solid-state gyros and accelerometers) and refined construction and assembly techniques. The result is products we are proud of, delivering everyday excellence – with exceptional accuracy and reliability standards – for our customers right across the world.



MRUs – defining excellence

KONGSBERG is a true pioneer, and established market leader, within the MRU sector. From the introduction of the technology to the maritime environment in 1992 to today, when tens of thousands of units have been successfully deployed worldwide, the company has been at the vanguard of the industry - dedicated to delivering innovation, reliability and results.

MRUs are now accepted as the de-facto sensors for attitude determination for an array of marine applications, with each new generation of technology helping to redefine the limits of possibility. When the sensors were first introduced they achieved an initial roll and pitch accuracy of 0.3° , but, thanks to a philosophy of continual improvement, this has now been reduced to just 0.01° .

KONGSBERG MRUs are not only highly accurate, but also robust enough to withstand constant long-term operation, in constantly challenging environments. Our track record of reliability speaks for itself, with many of our early units from the 1990s still in operation today.

With our ongoing commitment to cost efficiency, delivering tangible customer benefits, and first-class performance and accuracy we believe that our MRUs will continue to define industry standards - reaching new levels of excellence, in both technology and customer satisfaction.



Performance you can rely on
Each and every MRU is delivered with an individual calibration certificate, stating the specifications for the unit.

Bringing technology to life

Through a combination of proven sector expertise and a continued investment in technological innovation, KONGSBERG delivers the optimum balance of value and performance for its customers. Our MRUs featuring in-house developed Micro Electro Mechanical System (MEMS)-based gyroscopes provide a clear illustration of our capability.

Engineered for excellence

The MRU Rate Gyro (MRG) is produced in different versions, tailored for individual MRU models. It combines very low noise, excellent bias stability and outstanding gain accuracy. KONGSBERG's MRU Rate Gyro is custom-made to meet the demands of maritime use, achieving performance standards that position it at the very forefront of the market.

MEMS-based gyroscopes are an ideal solution for demanding marine applications, with their electronic nature negating the problems of 'wear and tear' associated with mechanical gyro solutions, as well as those based on fibre optic (FOG) technology. KONGSBERG's MEMS gyros set the standard for the industry, with our high-end MRUs featuring gyros that enable sector-leading accuracy and reliability standards.





Unique experience, inspiring success

KONGSBERG's unique experience of providing world-class technical solutions for marine applications permeates everything we do. Through decades of close collaboration with customers, our skilled in-house team has developed an intimate understanding of the operational challenges they face, and the technology that can help them achieve their goals.

This knowledge has informed everything we do, allowing us to build true sector expertise and provide products that meet requirements, while surpassing expectations.

In-house expertise

KONGSBERG is committed to in-house innovation – creating technology that is custom-made to deliver outstanding performance in complex operations. By developing gyros, in combination with accelerometers and GNSS receivers in-house, our team has an intimate understanding of the capabilities of these crucial system components. This allows us to exploit them to their full potential, delivering better products, with optimum performance standards, for all our customers.

Sensor fusion

Over the course of the last 20 years, KONGSBERG has been working on closely integrating Inertial Navigation System (INS) and Global Navigation Satellite System (GNSS) technology. This integration, together with sensor fusion technologies, has resulted in the Seapath and the DPS series of products. In these products, the company has successfully exploited the complementary nature of INS and GNSS technologies to create products that provide optimum results for position, attitude and heading.

Modelled to meet your requirements

KONGSBERG understands that every operation, in every vessel, is unique. To ensure that we have the technical solution that is right for you, we have developed a broad range of attitude sensors that deliver unparalleled performance for a variety of applications. This 'product family' encompasses everything from units developed for dedicated applications, to those that can be used in multiple applications on the same vessel.

In-house calibration





MRU-5



MRU-5



MRU-5



MRU-5

Production



Certified production process



World-class production standards

KONGSBERG is a global technology leader in terms of innovation, but also with respect to its first-class production standards – ensuring a level of consistency and reliability that meet the most exacting industry demands. Through a continual process of improvement, and a relentless focus on quality, we provide dependable excellence, in every product produced. Expert service, calibration and the verification of MRU units are essential parts of this process.

KONGSBERG's MRU production process meets all relevant standards and is certified in accordance with ISO 9001 and ISO 14001.





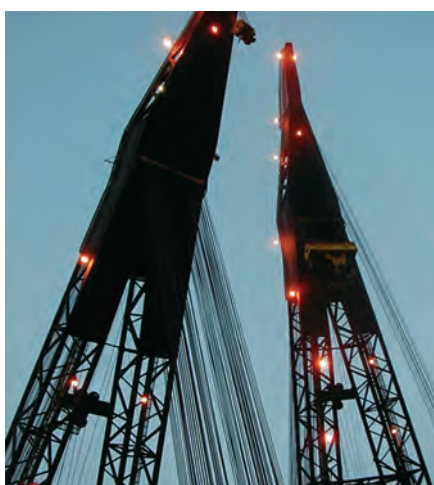
Getting the full picture
Seapath with MRU 5+ as the INS component, achieves state-of-the-art results when used in conjunction with the KONGSBERG EM2040 multi-beam echo sounder for surveying submerged pier elements.

The preferred choice for demanding applications

KONGSBERG MRUs set the benchmark for the maritime sector. Our product portfolio encompasses a wide range of models, meeting diverse requirements for accuracy and precision, but with one unifying quality – excellence in operation, maximising performance for our customers.

Our motion sensors have a proven track record of outstanding operations across an array of the most demanding marine applications. They are versatile – offering a variety of data output possibilities and accessories – innovatively designed, easy to install, and the preferred and trusted choice for our customers right around the world.

We are proud that KONGSBERG MRUs are now established as the de-facto standard sensors for attitude determination.

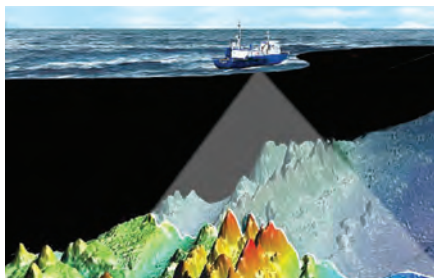


AHC crane

Active Heave Compensation systems for offshore cranes require data on the heave motion of the crane tip. Real-time information concerning the output of heave amplitude, velocity and acceleration at the crane tip is essential for efficient heave compensation. MRU roll and pitch measurements enable the crane control system to regulate the winch system, adjusting in-out wire operation for optimal heave compensation and wire tensioning. This ensures safe and efficient operations.

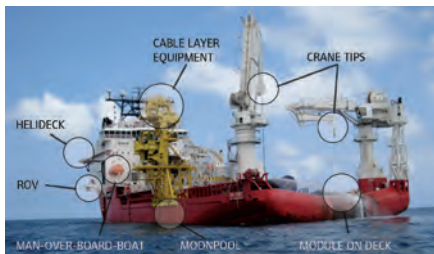
Other Active Heave Compensation applications that can benefit from MRUs include:

- Winches
- Launch and recovery systems (LARS)
- Offshore Cranes
- Drilling drawworks



Motion compensation for echo sounders

Seabed mapping applications using multi-beam echo sounders require the input of roll, pitch and heave measurements to compensate for the vessel motion. Multi-beam systems with wide swathe width require accurate attitude measurements to ensure minimum depth errors in the outer beams.



Vessel motion monitor

For vessel motion or structural monitoring applications, the MRU can produce angular and linear motion variables in different frames (body, heading and geographic) at several different points on the vessel.

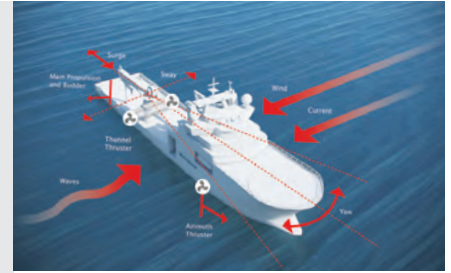


Helideck Monitoring System

Helicopter operations on moving helidecks require the monitoring of the roll, pitch, inclination and heave motion in the helideck's centre. These measurements are sent to the helicopter operator prior to take-off from the heliport.

Dynamic positioning

All position reference system used as input to a DP system, have to be transformed to a common reference point on the vessel. To achieve this, the MRU roll and pitch motion measurements have to be used.



Motion damping systems on high-speed crafts

Motion damping systems, or ride control systems, require the input of roll/pitch angle and angular rate measurements to the foil control system. The MRU outputs these variables with minimum latency and at a high output rate.



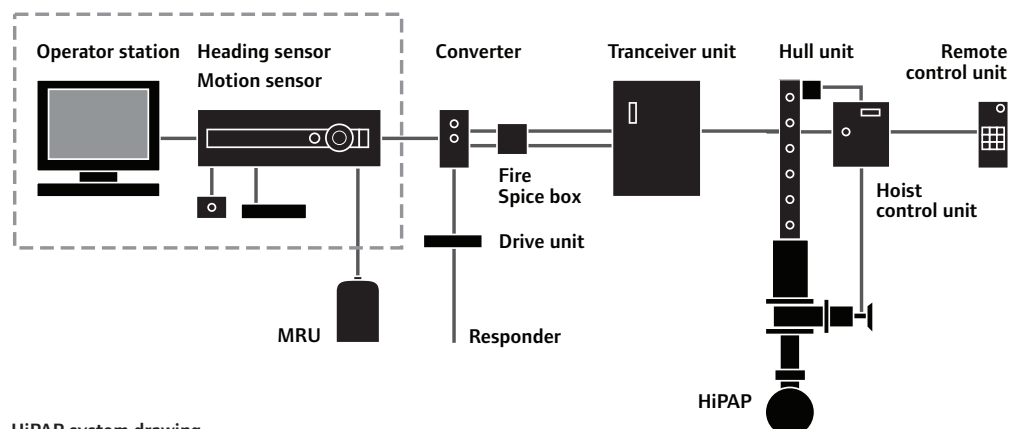
Stabilization applications

Telecommunication antennas mounted high up in the vessel mast often require roll and pitch compensation of the antenna to keep track on the radio beam. The MRU provides the required measurements to achieve this.



Hydro acoustic positioning

Hydro acoustic positioning is used as a position reference for dynamic positioning. It is achieved by measuring the distance and bearing from transducers mounted on the vessel hull to transponders on the seabed. To obtain a stable and noise-free positional measurement, the vessel motion has to be compensated for – a task undertaken using the MRU.



HiPAP system drawing



The MRU series

Model	Roll/Pitch	Acceleration	Real-time		Delayed*	
			Heave	Period	Heave	Period
MRU 5+	0.01°	0.002 m/s²	5 cm	25 s	2 cm	50 s
MRU 5	0.02°	0.01 m/s²	5 cm	25 s	2 cm	50 s
MRU E	0.05°	0.01 m/s²	5 cm	25 s	3 cm	50 s
MRU H	0.05°	0.01 m/s²	5 cm	25 s	3 cm	50 s
MRU 3	0.08°	0.02 m/s²	5 cm	18 s	4 cm	50 s
MRU 2	0.10°	0.01 m/s²				
MRU D	0.35°	0.05 m/s²				

*PFreeHeave® is a delayed heave output where phase errors are removed. The delay is 132 sec.

We are always there, wherever you need us

Kongsberg customer services organisation is designed to provide high-quality, global support, whenever and wherever it is needed. We are committed to providing easy access to support and service, and to responding promptly to your needs. Support and service activities are supervised from our headquarters in Norway, with service and support centres at strategic locations around the globe – where you are and the action is.

As part of our commitment to total customer satisfaction, we offer a wide variety of services to meet individual customers' operational needs. Kongsberg support 24 is a solution designed to give round-the-clock support. For mission-critical operations, Kongsberg support 24 can be extended to include remote monitoring. We can adapt the level of support needs by offering service agreements, on-site spare part stocks and quick on-site response arrangements.

Support 24

Call +47 815 35 355

E-mail: km.support@kongsberg.com



Global and local support

We provide global support from local service and support facilities at strategic locations world wide. Service and support work is carried out under the supervision of your personal account manager, who will ensure that you receive high-quality service and support where and when you need it. Your account manager will ensure continuity and work closely with your personnel to improve and optimise system availability and performance. Under the direction of your account manager, and with a local inventory of spare parts, our well-qualified field service engineers will be able to help you quickly and effectively.



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