KONGSBERG

µPAP - UNDERWATER POSITIONING

COMPACT AND PORTABLE

MAXIMIZING PERFORMANCE BY PROVIDING

THE FULL PICTURE

OUR MISSION

We shall earn the respect and recognition for our dedication to provide innovative and reliable marine electronics that ensure optimal operation at sea. By utilising and integrating 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.

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µPAP - THE SMALL AND PORTABLE ACOUSTIC POSITIONING SYSTEM

µPAP is a small and compact acoustic positioning system for operation from a surface vessel. It can track ROVs, tow fish, divers and any other subsea target at ranges to several thousand meters. The system operates in SSBL (USBL) mode where it measures the distance and direction to subsea transponders and computes a 3D position in local coordinates or in geographical coordinates. µPAP is designed to be a portable system for easy installation on a vessel or other surface unit.
The system can be used with all KONGSBERG manufactured transponders for depths down to 4000 meters.

µPAP also has full LBL calibration and positioning capabilities and can be used for position-box-in, calibration and positioning.

µPAP benefits from the Cymbal acoustic protocol providing wideband spread spectrum acoustic positioning and data communication.

A built in motion sensor in the µPAP transducer compensates for vessel roll and pitch movements.
To meet various demands from the market, the µPAP transducer is available in several versions with respect to built-in motion sensors and thereby physical size.

Data output to users is available in established formats.

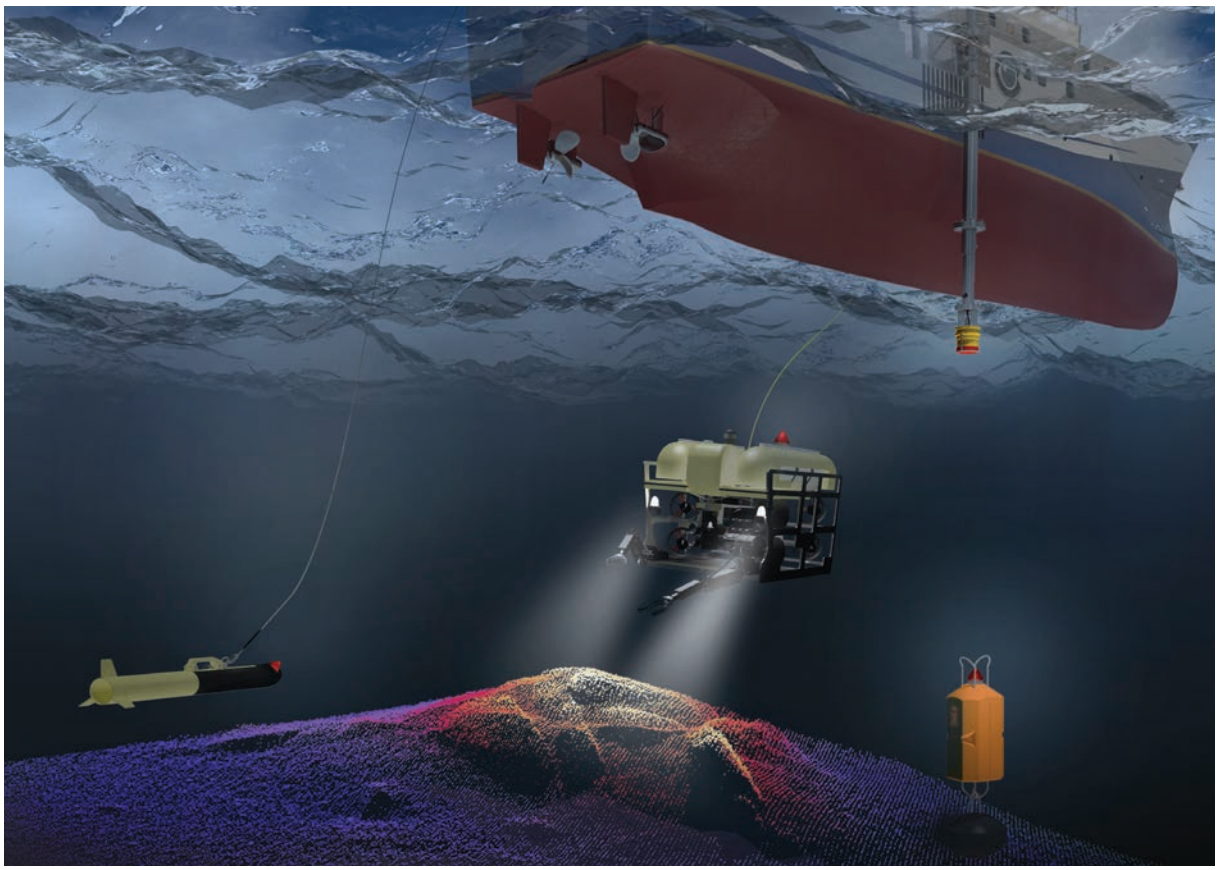
Easy to install onboard

There are only two basic requirements to install the system:

1. The transducer needs to be lowered 1-3 meter below the keel

2. The transducer must be locked in orientation with the 'zero-mark' pointing forward

Both requirements can be fulfilled with a rigid over-the-side pole which is locked in orientation relative to the vessel.



SYSTEM DESCRIPTION HARDWARE

µPAP's Unique Transducer Units

The µPAP series of transducers has many more elements than any of its competitors in the portable and low cost market. There is a a clear connection between system performance and the number of elements. More elements provide better acoustic redundancy, mathematical redundancy and improvement of the Signal to Noise level.

All µPAP models form focused narrow listening beams towards the transponder(s) and use advanced signal processing techniques. The narrow beams suppress noise from other directions and provide improved Signal to Noise ratio (S/N). This is important to obtain improved angle measurement accuracy, longer range capabilities, and suppress the negative effect of acoustic reflections.

Vertical Reference Sensor

The µPAP measures the relative angle from the ship mounted transducer to the transponder. These measurements must be compensated for roll and pitch motions of the transducer, which is taken care of by an incorporated motion sensor and software. It is important to select the transducer model that best suits the actual application and operational water depth, since the error of these sensors contribute to the total position error budget and increases with operational range.

Operator and Display Unit - APOS

All µPAP systems use the same Operator Station (OS) and Man Machine Interface based on a Laptop PC. The OS performs all user interfaces, controls the transducer(s) and operates the Windows© based Acoustic Positioning Operating System (APOS).
A built-in comprehensive and informative Online Help user guide is standard and describes a wide range of functions for acoustic positioning and data communication.

Navigation and External Interfaces

A µPAP system needs input from an external Heading Sensor and GNSS for providing global coordinates to the underwater targets. The data output line can be fed into a navigation system so that the subsea position data can be placed in a map.

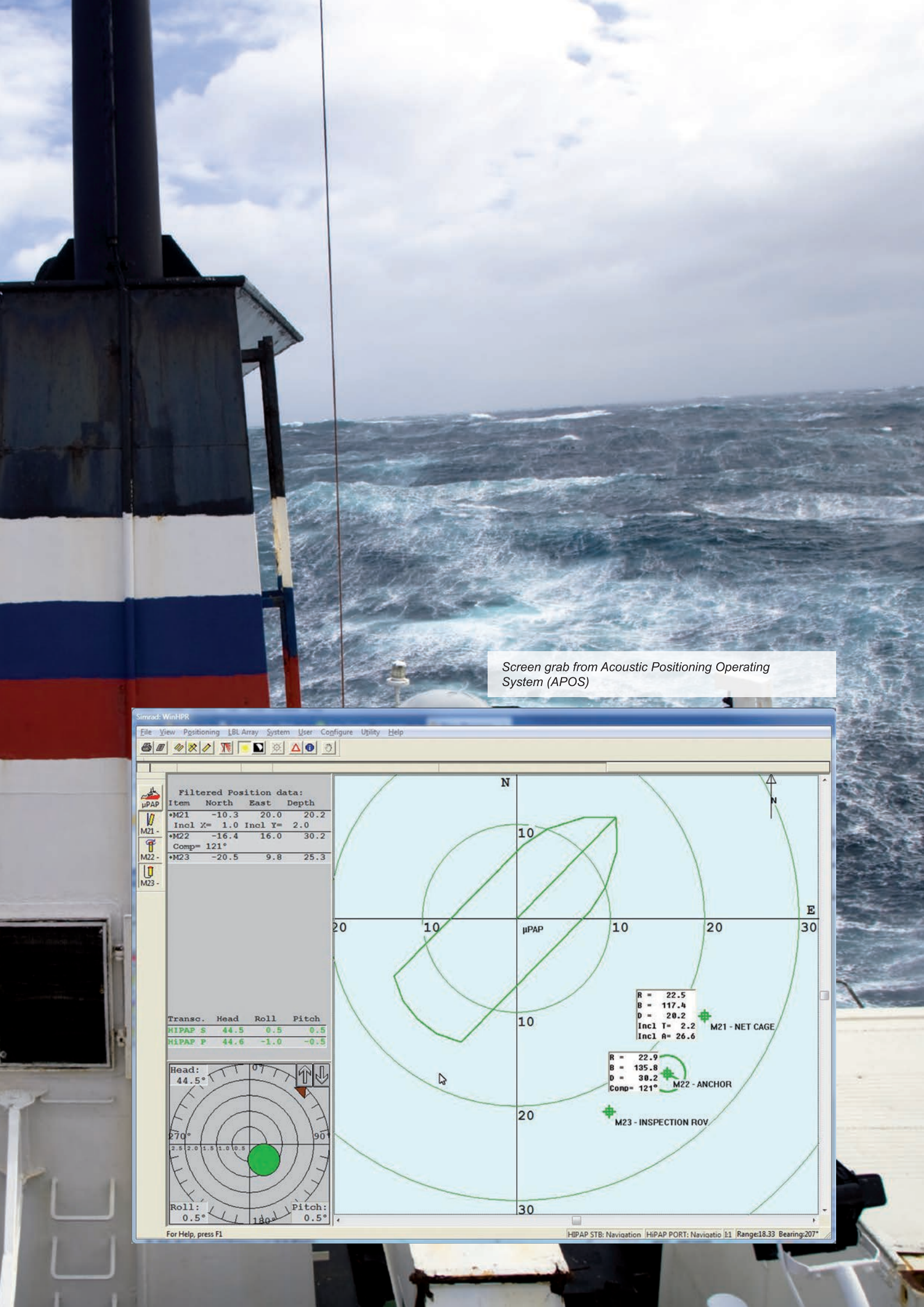
Data from a sound velocity probe may be interfaced to make real time corrections for ray bending throughout the whole water column. An output position telegram is standard.

Transponders and Responders

The underwater targets to be positioned must have a transponder or a responder installed. The transponder operates acoustically while the responder requires a cable for triggering.

The modular cNODE transponder range

Mini SSBL Transponder



Screen grab from Acoustic Positioning Operating System (APOS)

POSITIONING PRINCIPLES AND SOFTWARE FUNCTIONS

Super (Ultra) Short Base Line underwater positioning principle
The SSBL (USBL) principle is clearly the simplest underwater positioning principle in operation. The Super Short Base Line refers to the very short distance between the active piezo-electric elements in the transducer, which is mounted under the vessel. The SSBL principle has the obvious advantage that it requires no installation of calibrated array transponders on the seabed. The targets that are to be positioned must be “marked” with a transponder. A SSBL system measures the horizontal and vertical angles together with the range to the transponder(s), giving a 3D position projection of the transponder(s) relative to the vessel (vessel’s reference point). The SSBL principle has an accuracy error increasing with range because the major error contribution comes from the angle measurement.

Long Base Line underwater positioning principle
The LBL principle is a little more complex in operation. The Long Base Line refers to the base lines between transponders spread out on the seabed. This array of transponders needs to be calibrated, i.e. all ranges between them need to be measured. There are automated and advanced functionalities in the positioning working on acoustic ranging and telemetry to find these ranges. Normally LBL gives more accurate positioning within the range of the transponder array and the LBL position accuracy is almost independent of depth. The µPAP systems have fully integrated LBL functionality as an option and will be very flexible when combining the advantages of both SSBL and LBL principles.

UNDERWATER DATA TELEMETRY

The µPAP can also be used for sending data information by acoustic pulses to or from transponders and as a two way modem to transfer data between a surface user computer and one or many underwater units.

Values from underwater sensors of any kind or from a customer provided data string can be sent acoustically to the surface µPAP for data presentation.

The modem application allows transparent data transfer between user equipment on the surface and underwater devices.

ACOUSTIC PROTOCOLS

Cymbal
Cymbal is the new acoustic protocol used for both positioning of subsea transponders in SSBL/LBL mode and data communication to and from transponders. The Cymbal technology utilises Phase Shift Keying (PSK) and Direct Sequence Spread Spectrum (DSSS) signals for positioning and data communication. The data communication speed is variable and can be adapted to the acoustic communication conditions; noise and multipath. DSSS is a wide band signal.

Due to the higher energy in its acoustic pulses the Cymbal protocol provides higher position accuracy, extremely accurate range measurements, longer range capabilities and higher data rate communication.

Continuous wave
µPAP can also be used in the well known Frequency Shift Keying (FSK) mode with use of continuous waves (CF).

SYSTEM OVERVIEW

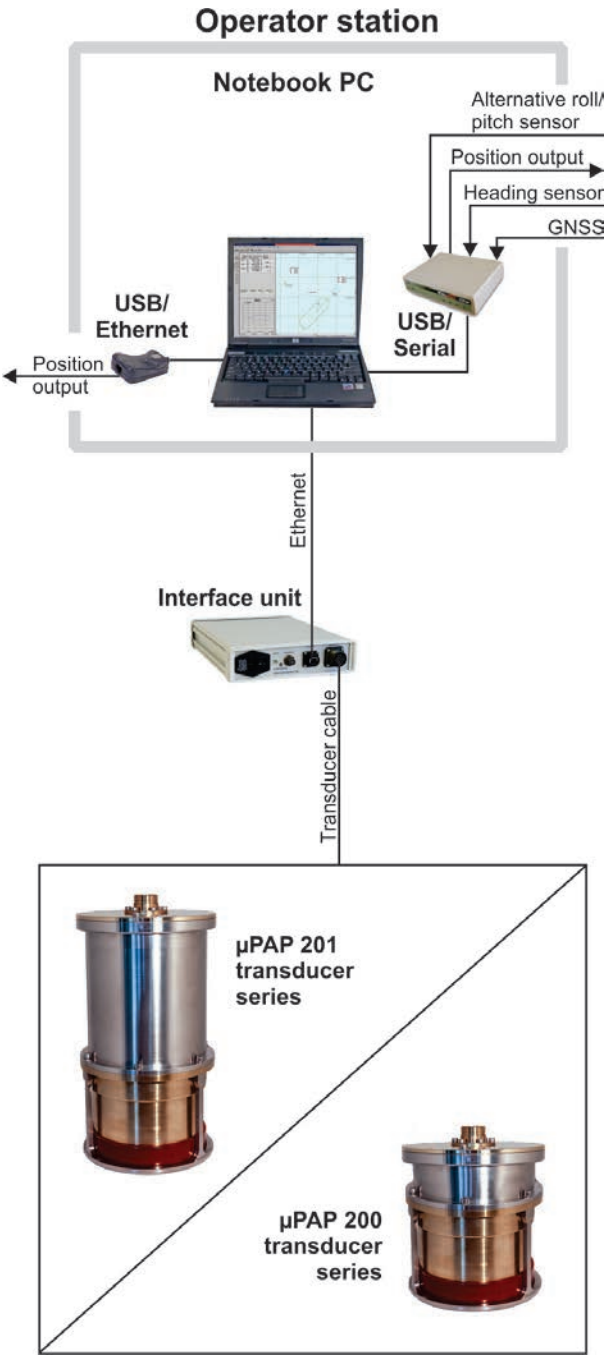
The µPAP system is extremely simple in configuration and can be installed onboard a vessel very quickly.

The µPAP system contains the following elements:

- Portable Operating Unit (normally a Laptop PC) with APOS Base Version, SSBL Function and Cymbal for µPAP
- Transducer; a series of µPAP portable versions
- Cable for µPAP Transducer
- Manuals for APOS and µPAP

The µPAP system can be delivered with two sizes of transducers dependent on the built in Roll / Pitch sensor.

The µPAP 201 series transducers have the KONGSBERG MRU series inside, whilst the µPAP 200 transducers have a less advanced sensor inside.



µPAP MODELS WITH ACCURACIES AND RANGE PERFORMANCES

PRODUCT	TRANSDUCER	COVERAGE	SSBL ACCURACY IN % OF SLANT RANGE *	SSBL ACCURACY IN DEGREES	BUILT-IN ROLL/PITCH SENSOR	ROLL/PITCH SENSOR ACCURACY	MAX RANGE (METER)
µPAP 200		160°	0.45 %	0.25°	LESS ADVANCED	<1.0°	4000
µPAP 200-NEL		160°	0.45 %	0.25°	LESS ADVANCED	<1.0°	995
µPAP 201-2		160°	0.45 %	0.25°	MRU-2	0.1°	4000
µPAP 201-3		160°	0.45 %	0.25°	MRU-3	0.08°	4000
µPAP 201-3-NEL		160°	0.45 %	0.25°	MRU-3	0.08°	995
µPAP 201-H		160°	0.45 %	0.25°	MRU-H	0.05°	4000

*Position accuracy: 0.45% (1 Sigma, SNR > 20dB rel. 1µPa in bandwidth)
** NEL = No Export License required.

µPAP SPECIFICATION

OPERATOR STATION	LAPTOP PC
TRANSPONDER CHANNELS (MF)	MORE THAN 560
OPERATION MODES	SSBL, LBL AND DATA TELEMETRY
RECEIVER BEAM	APPROX. 22° STEERABLE
TRANSDUCER LENGTH/DIAMETER (LONG TYPE)	400/190MM
TRANSDUCER LENGTH/DIAMETER (SHORT TYPE)	250/190MM
TRANSDUCER LONG/SHORT WEIGHT IN AIR	17/13KG
TRANSDUCER LONG/SHORT WEIGHT IN WATER	9/8KG

TRANSDUCER MAX DEPLOYMENT DEPTH	50M
TRANSDUCER CABLE LENGTH	50M OR 70M
TRANSDUCER TEMPERATURE OPERATIONAL	0°C TO +35°C
TRANSDUCER TEMPERATURE STORAGE	-20°C TO +35°C
TRANSDUCER STORAGE HUMIDITY	95% RELATIVE
TRANSDUCER VIBRATION TEST FREQUENCY	5-100HZ
TRANSDUCER VIBRATION EXCITATION LEVEL	5-13,2HZ ±1.5MM AT 13,2-100HZ 1G

Typical KONGSBERG µPAP Applications:

- *Fishery*
- *Aquaculture*
- *Seabed Survey*
- *Seabed Cleaning*
- *Marine Research*
- *Diving Operations*
- *Underwater Construction*
- *ROV Operations*
- *Shallow Water Seismic*
- *Shallow Water Inspection*
- *Ocean Renewable Energy*
- *Salt to Fresh Water Production*

LIFE CYCLE SUPPORT

Designed to purpose – maintained to last

Our life cycle management service will assist our customers throughout all phases, from design to commissioning and during the operational life time.
Solid in-house competence, both in system design and usage enables us to provide solutions that are fit to purpose, resulting in efficient operation.
Our common base technology provides robust designs, with few and reliable parts; an execellent foundation to maximis output at competitive costs.
The distributed and open system design employs an industry standard communication network. Standard hardware components used for various applications and the open network approach results in:

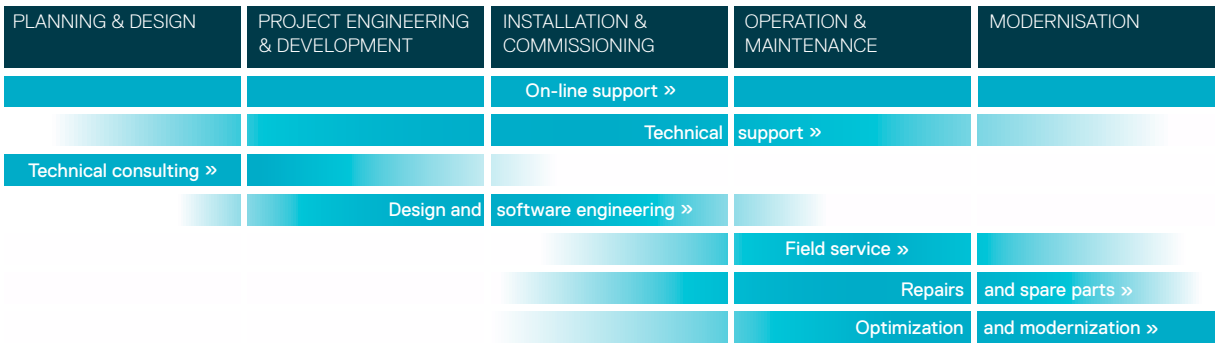
- Increased reliability
- Competitive life-cycle support
- Easy up-grade solutions

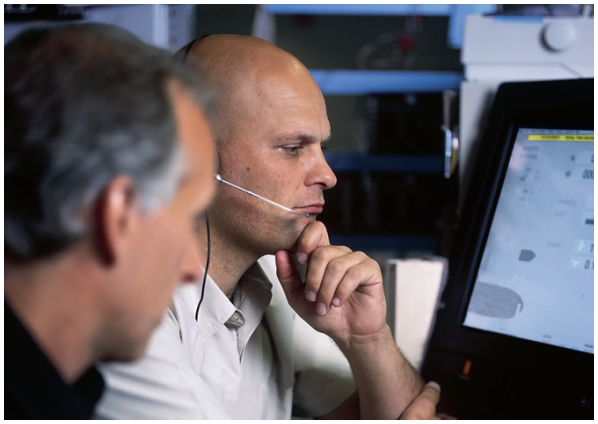
Evergreen

We offer continuous hardware and software upgrades to keep your vessel at maximum efficiency. Our system is designed with consistent boundaries between individual systems and control segments. This design strategy makes it easy to add new functionality or complete new control segments thus enable us to offer up-grades step by step to keep your system evergreen.

Training

Qualified personnel are one of your major assets in efficient and safe operations. We offer modular training courses for all major subjects – from operator training to technical training that keeps your crew fit for the job.





Supported by professionals

Our systems are easy to install and maintain – supported by professionals either on-site or through remote connectivity. They are designed for optimal operational availability and allow for favourable lifecycle expenditure

GLOBAL CUSTOMER SUPPORT

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.

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 wellqualified field service engineers will be able to help you quickly and effectively.

SALES

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