



KONGSBERG

High Precision Acoustic Positioning – HiPAP®



The HiPAP Family:

HiPAP 501

HiPAP 451

HiPAP 351

HiPAP 351P series

HiPAP 101

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.

High Precision Acoustic Positioning – HiPAP®

Introduction

The HiPAP family consists of the world's most successful underwater positioning systems. It was first developed with focus on the Super Short Base Line (SSBL) principle, as this was a market requirement of trying to avoid the Long Base Line (LBL) principle in deep water and in accurate seabed survey applications.

The main advantage of the SSBL principle is that it only requires installation of one vessel-mounted transducer and one subsea transponder. The unique transducer technology and advanced digital signal processing was found to be the ideal solution for obtaining the optimal position accuracy required in deeper waters.

The HiPAP Model 501/451/351/101 systems are the second generation HiPAP systems. These models have a new transceiver unit and possibility to operate Cymbal. Cymbal is KM's new acoustic protocol for positioning and communication. All HiPAP systems; HiPAP 501, HiPAP 451, HiPAP 351 and HiPAP 101 have common software and hardware platforms, and thereby offer the same kind of additional functionality and options.

Extreme accuracy - a quantum leap

The HiPAP 501 establishes subsea positioning so accurate that the more complex, but common, LBL principle is made redundant within reasonable depths. Time and cost of survey operations are therefore reduced to a minimum.

The HiPAP 501 system is a quantum leap in technology, with hundreds of elements in a spherical transducer. These elements enable an extremely high internal redundancy and reliability. The same advanced transducer core technology is utilised across the entire HiPAP family, together with digital acoustic signal processing, making HiPAP the most accurate and reliable SSBL systems available.

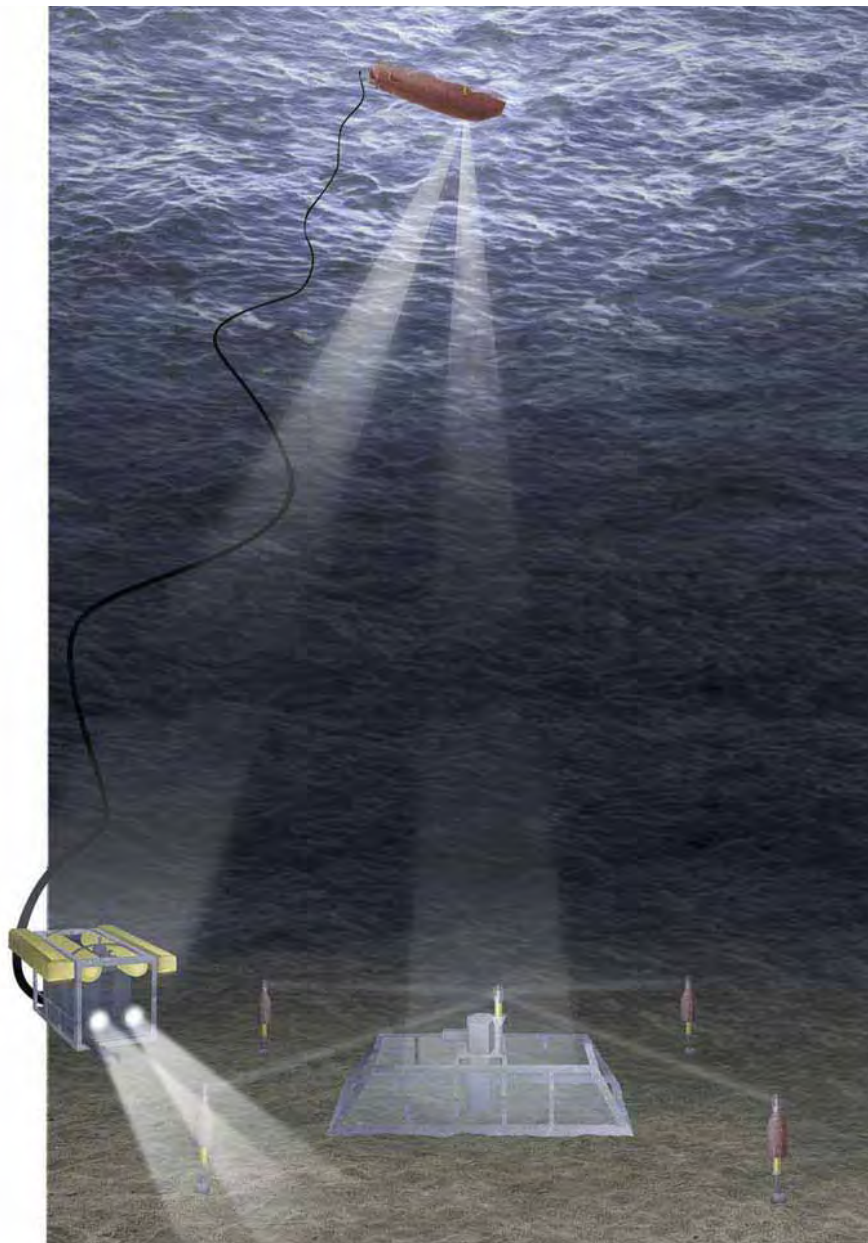


The Hugin autonomous underwater vehicle



Beam Forming – vital to suppress “damaging” noise

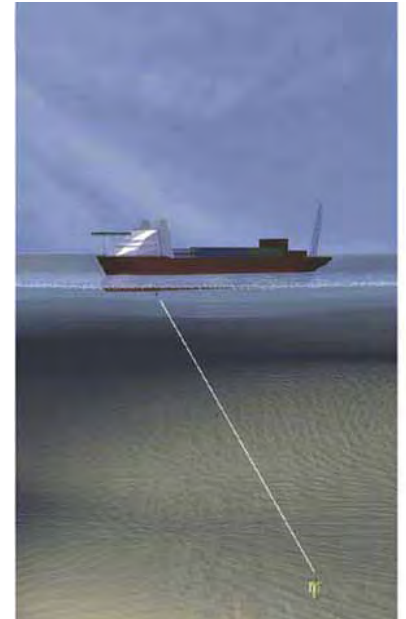
The beam-former in HiPAP is digital. All transducer elements are individually interfaced to the Digital Signal Processor (DSP) which measures the phase and amplitude of the incoming signal to calculate the horizontal and vertical angle to the transponder. All HiPAP models use a unique and automated focusing of narrow transmitting and listening beams technology. The beams are totally formed by the DSP in the direction decided by the position-tracking algorithm (towards the transponder). Data from the vessel's compass is input to the tracking algorithm in order to direct the beam in correct horizontal direction and also to stabilize the beam. The narrow beams provide improved Signal to Noise ratio (S/N) which is essential to obtain improved angle measurements accuracy and longer range capabilities. Further it suppresses the negative effect of acoustic reflections as well as suppressing noise coming from other directions.



The positioning principles

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. Only the targets that are to be positioned (one may well be at the seabed) must be equipped 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 the vessel (vessel's reference point). An error in the angle measurement causes the position error to be a function of the range to the transponder, so SSBL has therefore an accuracy error increasing with the range. To obtain better position accuracy in deep water with an SSBL system it is necessary to increase the angle measurement accuracy.

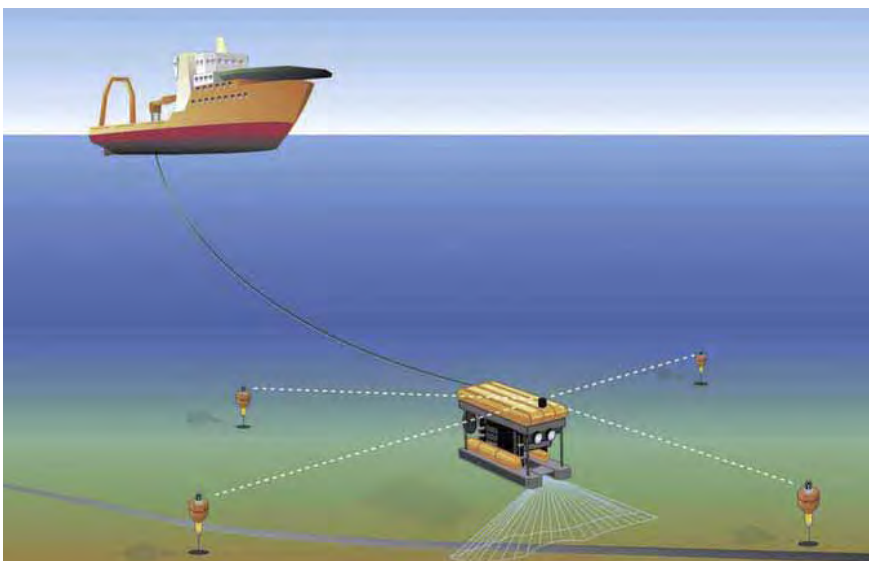


SSBL positioning

Long Base Line underwater positioning principle

The LBL principle is somewhat 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. HiPAP systems have automated and advanced functionalities 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 High Precision Acoustic Positioning (HiPAP) systems family can utilise software for either or both SSBL and LBL principles.

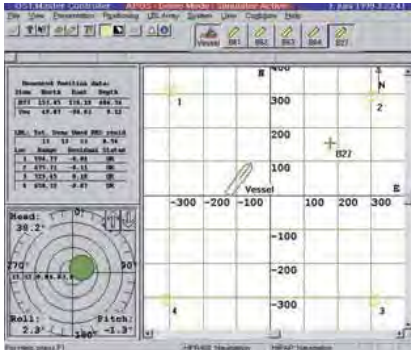


LBL positioning of underwater vehicles and structures



LBL positioning

The system modules



Operator Unit with APOS – Worlds best Man Machine Interface

All HiPAP systems use the same Acoustic Positioning Operating System (APOS) and Man Machine interface. The APOS consists of a Color Display, an Acoustic Positioning Computer (APC), Keyboard and tracker-ball. The OS performs all user interfaces and controls the transceiver(s).

The APOS is running on a Windows software template in the APC, which enables the operation of the HiPAP in a "Windows-like fashion".

Multiple Operator Stations are possible with no limit to how many onboard a vessel. They will be organised in a setup where one Operator Station will always be Primary and all the others will be Secondary. A Secondary Station may take Primary control at any time.



Transceiver

The Transceiver Unit is mounted close to the hull unit and contains advanced digital transmitters, preamplifiers and beam-forming electronics. The transceiver communicates with the Operating System (OS) via fiber optic cable(s).



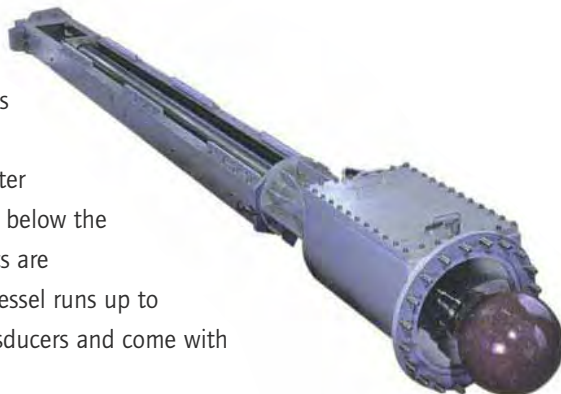
HiPAP's Unique Transducers

The HiPAP series of transducers have many more elements than any of its competitors. There is a clear connection between system performance and the number of elements. Acoustical redundancy, mathematical redundancy and improvement of the Signal to Noise level are all factor in the high system performance of the HiPAP family.

Except for the HiPAP 351P Portable transducer all the transducers are purely mechanical devices with internal ceramic elements, which maximize the reliability when compared to systems that also have electronics inside.

The Important Hull Unit

The HiPAP system operates with the transducer mounted on a hull unit, allowing it to be lowered several meters under the vessel's hull. The transducer's hull unit is mounted on a gate valve and takes the transducer down to a depth free from the aerated water created by the hull, propellers and thrusters, and also below the most critical surface water layers. Kongsberg hull units are guaranteed to withstand the water forces when the vessel runs up to 10 knots. The hull unit is the same for all HiPAP transducers and come with different lengths.



Transponders and Responders – more than 100 channels available

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

The various transponders models have different depth rating, source level, lifetime, beam pattern and function. There are two main transponder series, the MPT/SPT/MST series which are using traditional frequency shift (FSK) modulation technique and the New cNODE® transponder family which also can use the new Cymbal acoustic protocol.

The new cNODE range of transponders are compatible with both HiPAP® Cymbal acoustic protocol for positioning and data link, and HiPAP®/HPR 400 channels and telemetry. It has a modular construction such that the transducer, transponder electronics, battery pack and optional add-on's can be replaced individually. The Floating collars have been redesigned and are very user friendly and secure in use. The HiPAP MF systems (not HiPAP 101) may also position Diver Emergency Channels A and B, but at a reduced range (typical max range 1000m).



Please see transponder family brochure for more details.

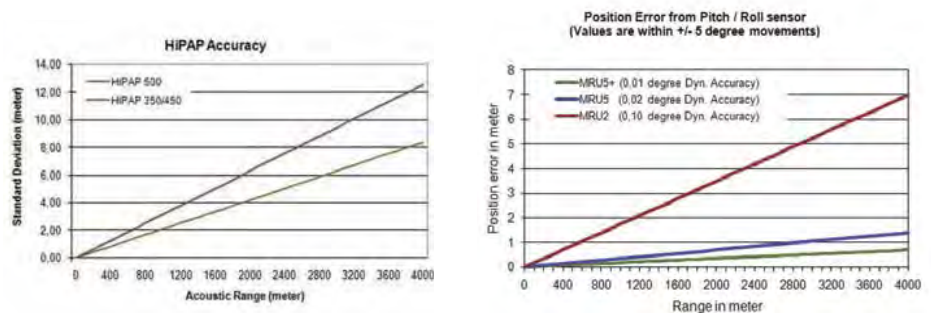
Heading Sensor

The HiPAP also needs to be interfaced to the vessel's heading sensor (normally a gyro compass). The accuracy of this sensor will affect the overall positioning accuracy in the same way as the Roll/Pitch sensor. One reducing factor is that the effect will be relative to the horizontal offset between the vessel and the seabed transponder, meaning that the effect will be equal to zero if the vessel is directly above the transponder (which is often the case).

Vertical Reference Sensor

Since the HiPAP system measures an accurate underwater position from a ship mounted antenna (transducer) it is most important to compensate for the movements that the vessel has in Roll and Pitch using a Motion Reference Unit (MRU).

From the above curves one can see that the quality of the MRU is most important to the overall positioning of the underwater "target" as the total position error will be the sum of the HiPAP and the MRU error budgets. The general rule must be; "Why ruin a high quality investment in a HiPAP system with a poor quality MRU?"



External Interfaces

A HiPAP system as standard, is interfaced to both Heading and Vertical Reference sensors. A GNSS surface navigation system may also be interfaced in order to refer the subsea position data to absolute geographical coordinates.

Error compensation caused by sound velocity variances

APOS has the possibility to use a sound velocity profile to make real time corrections for errors introduced to angular ray bending and to distance in all measurements (SSBL and LBL).

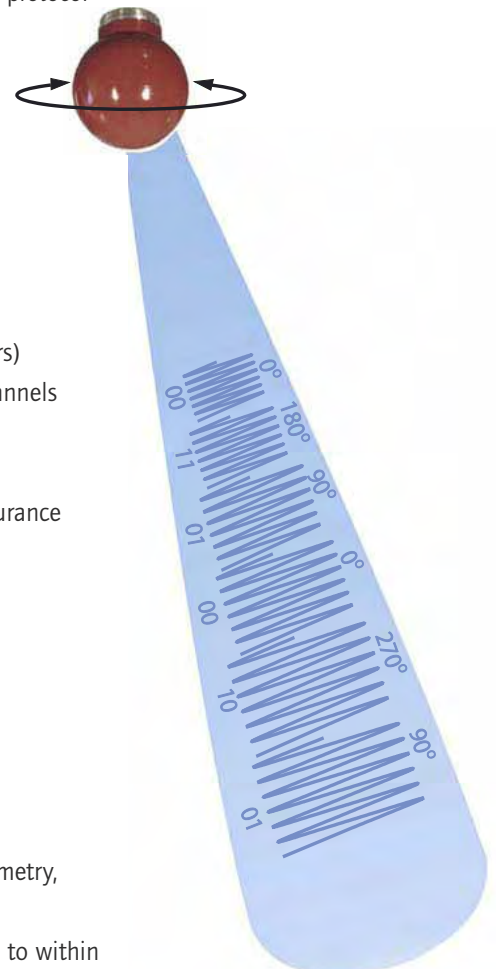
The profile can either be in the form of a text table (on electronic file), or it can be sent on serial line for online" compensation.

Cymbal® – the new state-of-the-art acoustic protocol

The HiPAP Model 501/451/351/101 systems are the second generation HiPAP systems which have a new transceiver unit and may upgrade to the new Cymbal acoustic protocol utilizing the wideband Direct Sequence Spread Spectrum (DSSS) signals.

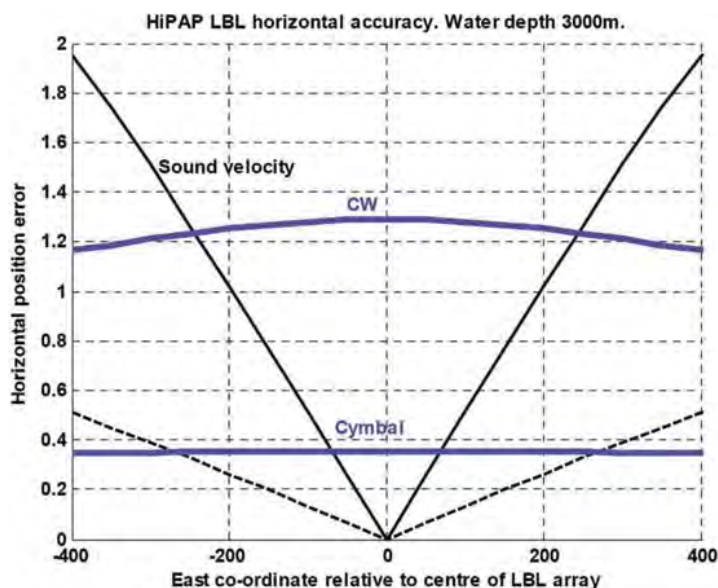
The Cymbal protocol transmits more energy into the water and together with the uniqueness coding the following new advantages of the HiPAP systems are made available:

- Increases angular accuracy with up to 30 % (SSBL improvement)
- Longer range capability
- Range accuracy is in the order of 0.02m (0,01m between cNODE transponders)
- 50 additional unique transponder channels in addition to the " older" 56 channels
- Improvement of multi path properties
- Allows higher position update rate through MultiPing
- Automatically adjustment of transponder TX power for increased battery endurance
- High speed telemetry data rate (max 8kbit/s)
- Supports variable telemetry data rate and high reliability level
- Telemetry data will be interleaved between the positioning signals
- Enables modeless change of transponders from SSBL and LBL and vice versa

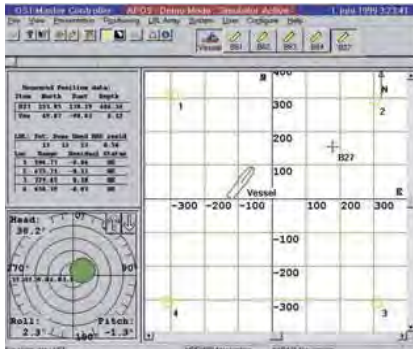


The position accuracy for LBL operation depends on the transponder array geometry, sound velocity errors and signal to noise ratio. Range accuracy's down to a few centimetres can be obtained, while ROV and vessel positions can be calculated to within a few decimetres.

The graph shows improvement in horizontal position error between continuous wave and Cymbal.



Functions and Applications



Bird's eye view of vessel and transponders

Super Short Base Line – everybody wants it

A transponder is deployed at the seabed, on a submerged structure or on an underwater vehicle. Vessel operators then want to know the position of this transponder and the HiPAP system operating in SSBL mode gives the operator this information by simply:

"Pushing the button"

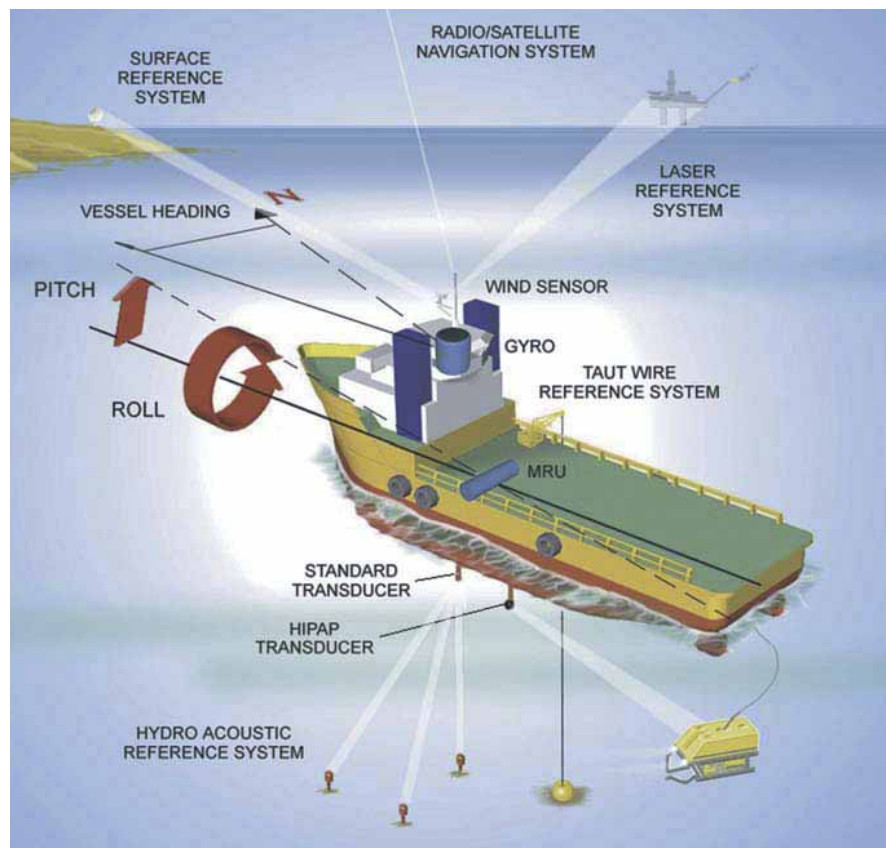
The HiPAP system will then display the transponder position relative to the vessel or geographically, in numerical coordinates.

It will also send the coordinates on serial line or Ethernet to external equipment.

Simple and easy – it's no wonder operators prefer this principle.

Reliable underwater reference for DP systems

No other acoustic positioning system has more built in experience than Kongsberg's. HiPAP always sends raw position data to the Dynamic Positioning (DP) system, so that the DP itself can perform the evaluation, weighting and filtering of its references. Since Kongsberg is also one of the world's major suppliers of DP systems we know the demands there are in the tough and noisy environment onboard vessels controlled by a DP. All HiPAPs can be integrated with HAIN Reference system.



Accepted underwater positioning in the survey industry

One of the major Survey & Construction companies has expressed that the HiPAP 501 is a “quantum leap” in the area of underwater positioning. Due to continuous further developments and enhancements of the HiPAP technology, customers still find the system unprecedented and extremely reliable. Many oil companies use the HiPAP specifications as precedent in their demands when issuing tender documents.

Long Base Line – sometimes a must

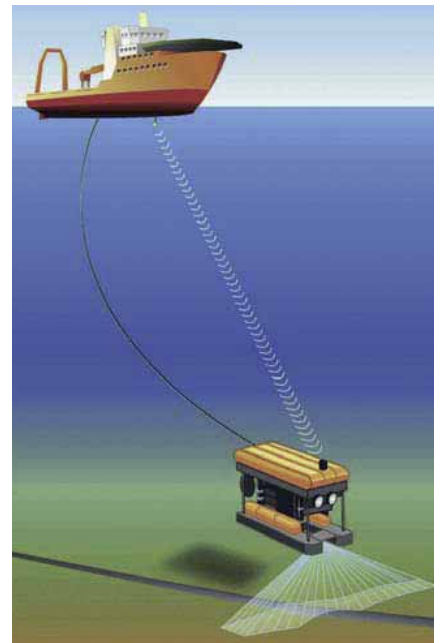
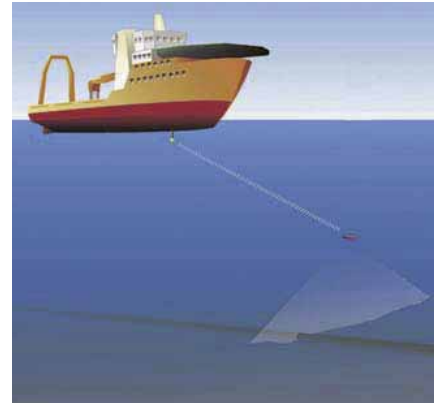
At some point of range, depending on the application, the SSBL principle will have accuracy limitation. LBL accuracy is independent of range, but only within an array of seabed transponders. The HiPAP with optional LBL features implemented is a very flexible system combining the advantages of both SSBL and LBL. The HiPAP has better long range performance than traditional wide beam systems. This is due to the Signal-to-Noise ratio of the detected seabed transponders' replies, which are higher than when using one wide beam that needs to cover the seabed footprint of a transponder array.

Long Base Line – for positioning of underwater vehicles

The HiPAP systems have fully integrated LBL functionality and are very flexible when combining the advantages of both SSBL and LBL principles. A vessel's HiPAP Operator Station can also be interfaced to, and control a vehicle mounted LBL system.

Long Base Line – for subsea construction

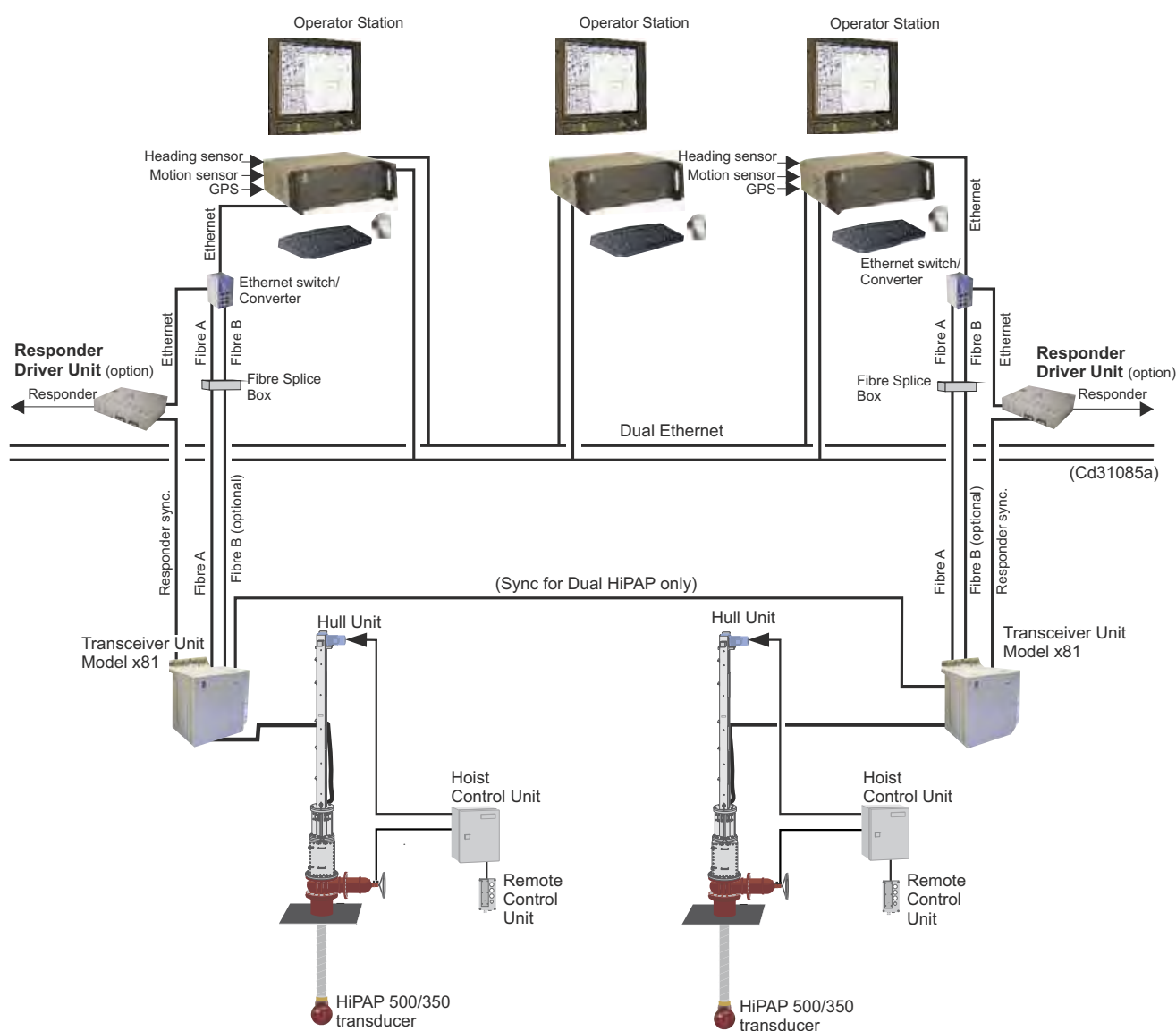
Kongsberg Maritime introduced the LBL system in 1992, and has since become the market leader for supply of LBL and combined LBL/SSBL systems for vessel positioning. The current LBL systems use intelligent, instrumented transponders, transceivers and transducers. These are all rated for operations down to 4000 m water depth in medium frequency band and 6500m for HiPAP 101 in low frequency band, and fulfill any requirements within subsea construction, survey and metrology application.



Dual HiPAP systems

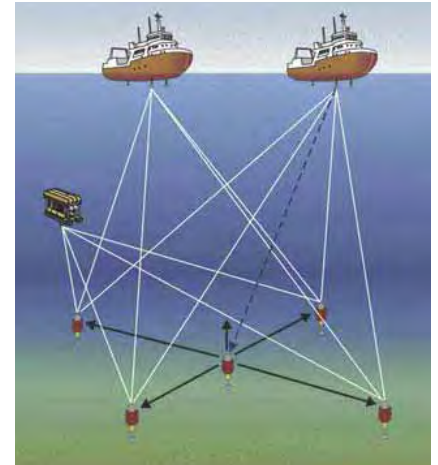
Use of two transducers will not only increase the electrical redundancy but also the acoustic redundancy, as one transducer may have a better location with respect to noise environments and reflections.

With optional dedicated software the SSBL accuracy will improve with a factor of $1/\sqrt{2}$ (see spec) based on the statistical improvements when using two independent systems.



Multi User Long Base Line – positioning of many vessels and vehicles

The Multi-User LBL (MULBL) function enables several individual vessels and ROV units to position themselves using the same seabed transponder array.



Fully integration with Hydroacoustic Aided Inertial Navigation - HAIN

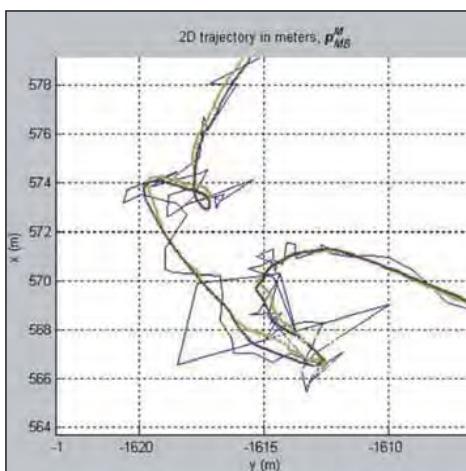
Acoustic and Inertial positioning principles in combination is ideal, since they have complementary qualities. Acoustic positioning is characterised by relatively high and evenly distributed noise and no drift in the position, whilst inertial positioning has very low short-term noise and relatively large drift in the position over time.

HAIN provides;

- improved acoustic position accuracy
- higher position update rate
- extends operational depth capabilities
- longer transponder-battery lifetime
- position update during acoustic drop-out

All HiPAP systems can be integrated with HAIN Subsea system for ROV's and HAIN Reference system for rigs and vessels.

For more information on HAIN see separate HAIN brochure.

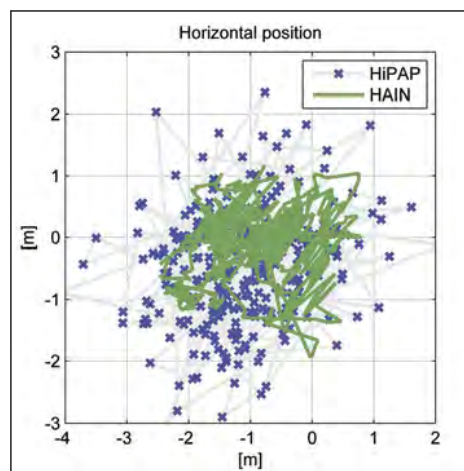


ROV operating in deep water using HAIN Subsea

Blue: HiPAP SSBL Positions

Green: HAIN Realtime Position

Red: HAIN Post Processed Position



Position improvement when using HAIN Reference



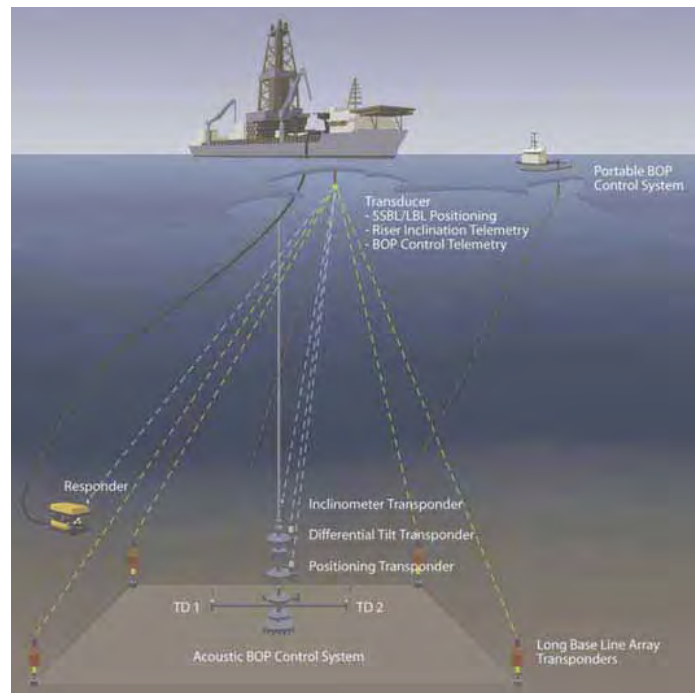
HiPAP for drilling rigs and ships

The HiPAP system can operate more than 100 transponders, providing all coordinates on the display. Position data output is also available. The system can denote transponder locations at horizontal distances of up to 5-6 times the water depth, with increasing accuracy as the vessel gets closer to the required location. Vessel position will be given relative to any of the active reference transponders chosen by the operator, and all may be used with individual offsets in three dimensions. You can find the position of your template, stack, riser foot, ROV, Camera tool etc.

- Underwater navigation
- Underwater positioning
- Riser angle and differential angle measurements
- Acoustic Back-up Control of BOP

HiPAP used for underwater navigation is cost and time efficient when positioning the drill-bit to its first specified geographical position or when re-entering an existing well marked with a transponder.

Positioning of underwater vehicles and subsea tools relative to a fixed reference is performed simultaneously using transponders, responders or a combination of both.



Lower Acoustic Riser Angle (ARA) measurements

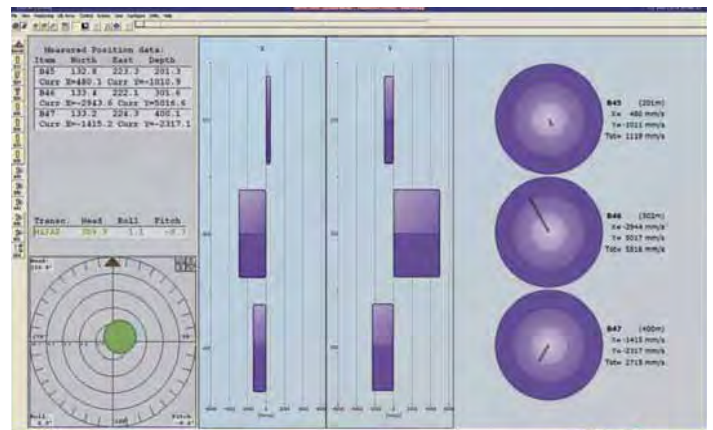
The HiPAP system is also capable of monitoring the riser angle by using an Inclinometer Transponder, which measures both the X and the Y angle of the riser and sends the information by acoustic telemetry to the surface vessel. The accuracy is better than 0.25 degree. The Differential Tilt Transponder can be used to monitor the relative angle between the BOP/stack and the riser (in the flex joint). Operator selected alarm limits for visual as well as audible alarm for BOP position and riser angle are available.

Upper Electrical Riser Angle (ERA) Mode

An Ex Proof Motion Reference Unit (MRU) mounted on the riser below the drill floor and below the flex-joint. This MRU is hard wired to the APOS (HiPAP's Acoustic Positioning Operating Station) and will provide angle readings. The APOS will process and display the actual differential angle measurements between the rig's roll/pitch values, taken from the vessel mounted MRU, and the riser mounted MRU values. The ERA data is also available on serial line or Ethernet outputs.

Sea current monitoring

The HiPAP system can be used to read sea current speed and direction at given points on a drilling riser by reading transponders interfaced to DVL sea current sensors.

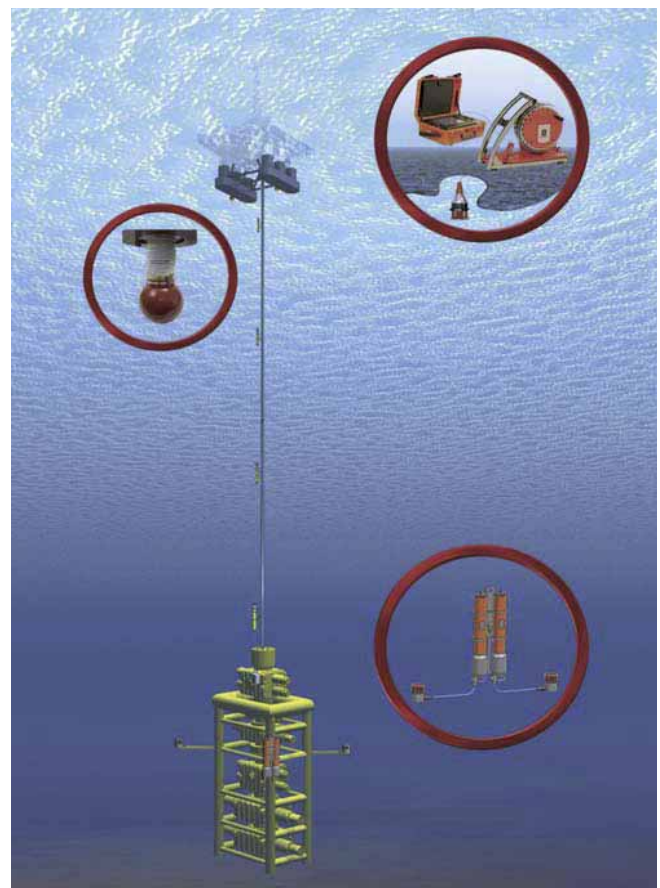


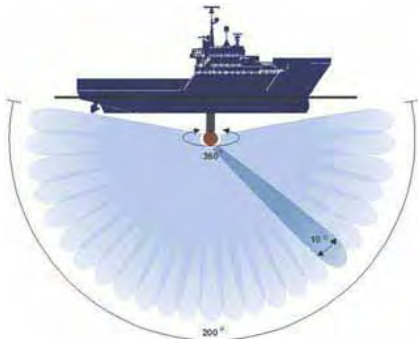
Acoustic Control System (ACS) for operating the valve functions on the BOP

The valves on a Blow-Out-Preventer (BOP) are activated to operate by either using a hydraulic primary system or by using an acoustic system where signals from "above" are transmitted through the water column. The ACS system is always delivered with a small command unit connected to a portable over-the-side dunking transducer. These units are designed for taking onto a lifeboat, a standby vessel, or into a helicopter in emergency (read: Blow-Out) so that the operator can close down the BOP.

The HiPAP can also have software for operating with the Kongsberg ACS, which can operate the valves on the BOP. The HiPAP's hull mounted transducer is then used to perform telemetry to the Subsea parts in combination with the positioning tasks.

For maintenance routine testing it is much more convenient to use HiPAP than performing the testing from the deck with a portable system.



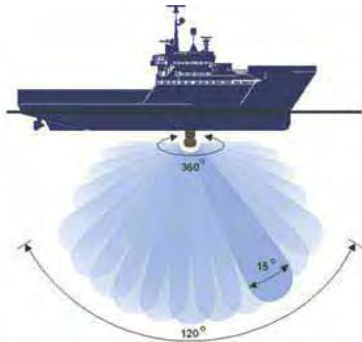


Models of the HiPAP family

The HiPAP 501 – “Top-of-the-range” and fully omni directional

The grand success of underwater positioning systems with more than 1100 systems sold per January 2010. With its impressive transducer array of 241 computer controlled elements assembled in a sphere, no other system beats its performance. Accuracy is always dependent on the beam width, and the active area of a transducer gives HiPAP 501 the best accuracy in the market.

The HiPAP 501's spherical transducer allows the system to form narrow “listening” beams of 10° for reception of signals from the transponder. This beam can be pointed in any direction below the vessel (also horizontally and even upwards to the surface), as the transducer has the shape of a sphere. See figure.



HiPAP 351 – the Little Brother is better than rest.....

Just because the HiPAP 501 is the best underwater positioning system on the market, doesn't mean it's the best for you. That's why we've created the HiPAP 351. Though it can't compete with its big brother in specification, the HiPAP 351 has many times more active transducer elements than our HPR systems and our competitors' systems. With its smaller transducer head (320mm diameter), it can penetrate all existing HPR's 350mm gate valves (that means easy and inexpensive upgrades to the customer). The transducer is simply identical with the 46 lowest elements of the HiPAP 501 spherical transducer. It will typically be used for positioning within a cone sector of 120° below the vessel and where you don't require the extreme HiPAP 501 accuracy.

HiPAP 451 – A new modular version upgradeable to HiPAP 501

Except for shortage of 6 of the advanced 32 channel Transmitter / Receiver Boards and Software, the HiPAP 451 system configuration is identical to the HiPAP 501.

This means that the HiPAP 451 system's transducer is the same as the HiPAP 501 system's transducer, with its unique and advanced spherical transducer. It has the same amount of elements as the HiPAP 501, but only the 46 lower sector elements of the sphere are "activated" and in use.

The HiPAP 451 uses medium-narrow "listening" beams of 15° for reception of signals from the transponder(s). For the interrogation of the transponder(s) a wide beam is used. The operating area below the vessel is 120 degrees, as with the HiPAP 351 system. The typical maximum operating range is 3000m, as for the HiPAP 351 system.

The HiPAP 451 system has the same operational and technical performance as the HiPAP 351 system, but it can be upgraded to full HiPAP 501 performance at any time.



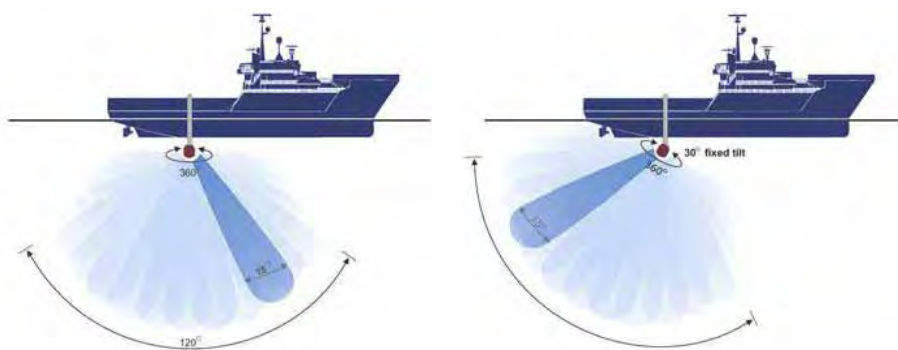
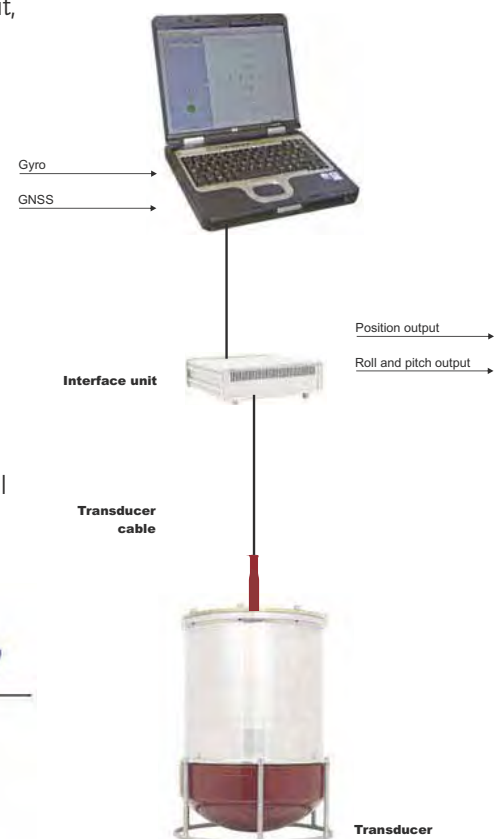
HiPAP 351P – A Portable version for vessels of opportunity

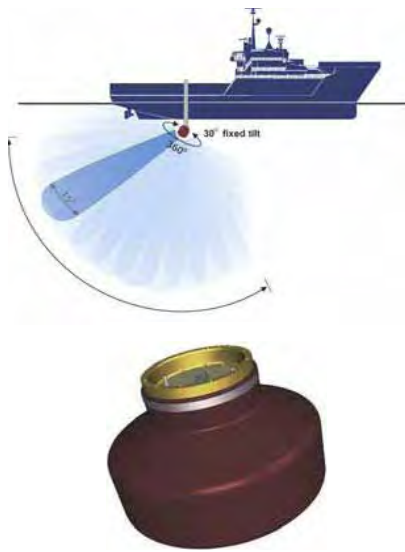
This is the portable member of the HiPAP family. With its unique, new and compact transducer containing "a complete transceiver" and an accurate Motion Reference Unit, it will bring a new era into the underwater positioning services for "vessels of opportunity". It is the only automatic beam steering portable transducer in the market.

The transducer is designed to be mounted on a shaft to be installed over-the-side or through a moon-pool of a vessel.

The transducer can be tilted to have the 120 degree cone operating area in the sector of the required area. There will be no need for extra calibration, or mechanical fine adjustments, as the internal Motion Reference Unit will automatically compensate for the tilt.

A built in north seeking heading sensor is also available. This is based on an inertial measurement unit.





HiPAP 101 – the new Ultra Deep Water Positioning system

HiPAP 101 is the Low Frequency member of the HiPAP system family. With high accuracy, good repeatability and high reliability, the HiPAP 101 system is the multi-purpose acoustic positioning system for ultra deep water operations. The system is supplied as a multi-purpose “ultra deep water” acoustic positioning system using transponders with depth rating down to 6.500m (deeper on demand). The transducer can also be 30° mechanically tilted to maximize performance in the wanted area. The tilted transducer will still penetrate a 500mm valve.

The HiPAP 101 is well proven, and it provides the simplest way to position ROVs and other objects in very deep water using either or both SSBL and LBL principles.

The HiPAP 101 deep water system can also be combined with the medium depth HiPAP 351 and HiPAP 501 systems and operated from the same operator station.

Features of the HiPAP systems

Standard features

- Online Help function
- Automatic Transducer Alignment Calibration
- Compensation for ray-bending
- Depth Sensor Transponder Mode
- Display of ray-bending
- External Depth sensor interface
- Position and angle alarm limits
- Telegram output to DP system
- Telegram output to survey system
- Transponder Telemetry for full utilization
- DGPS Interface
- Noise Spectrum analyzer
- Display a history track in the graphical view
- Emergency channels A & B

Optional features

- Responder mode
- Beacon Mode
- Compass Transponder Mode
- Inclinometer Transponder Mode
- Differential Tilt Transponder mode
- Automatic calibration of Inclinometer transponder
- Long Base Line (LBL) functionality
 - Fast LBL Transponder Positioning mode
 - LBL Accurate Metrology mode
 - Geographical LBL Calibration
- Multi User LBL functionality
- Additional Operator Station Function
- BOP telemetry function
- Offshore Loading Telemetry function
- Submerged Turret Loading function
- HiPAP Cymbal acoustic protocol function
- Dual HiPAP® Increased SSBL Accuracy function
- Lower Acoustic Riser Angle (ARA) Mode
- Upper Electrical Riser Angle (ERA) Mode
- Anchor Line Monitoring function
- HiPAP Transponder Relay Function
- Extension For Audible Alarm
- 3D Current Meter option
- Read Transponder External Sensor



HiPAP systems are installed onboard different kind of vessels within offshore, ocean science and navy fleets.

APOS Trainer

APOS = Acoustic Position Operator System.

The HiPAP operation system is now available as a Trainer version for customers and is supplied on a CD-ROM for installation on a PC.

The APOS Trainer is operated as a normal HiPAP system, where a simulator replaces the transceiver and the transponders.

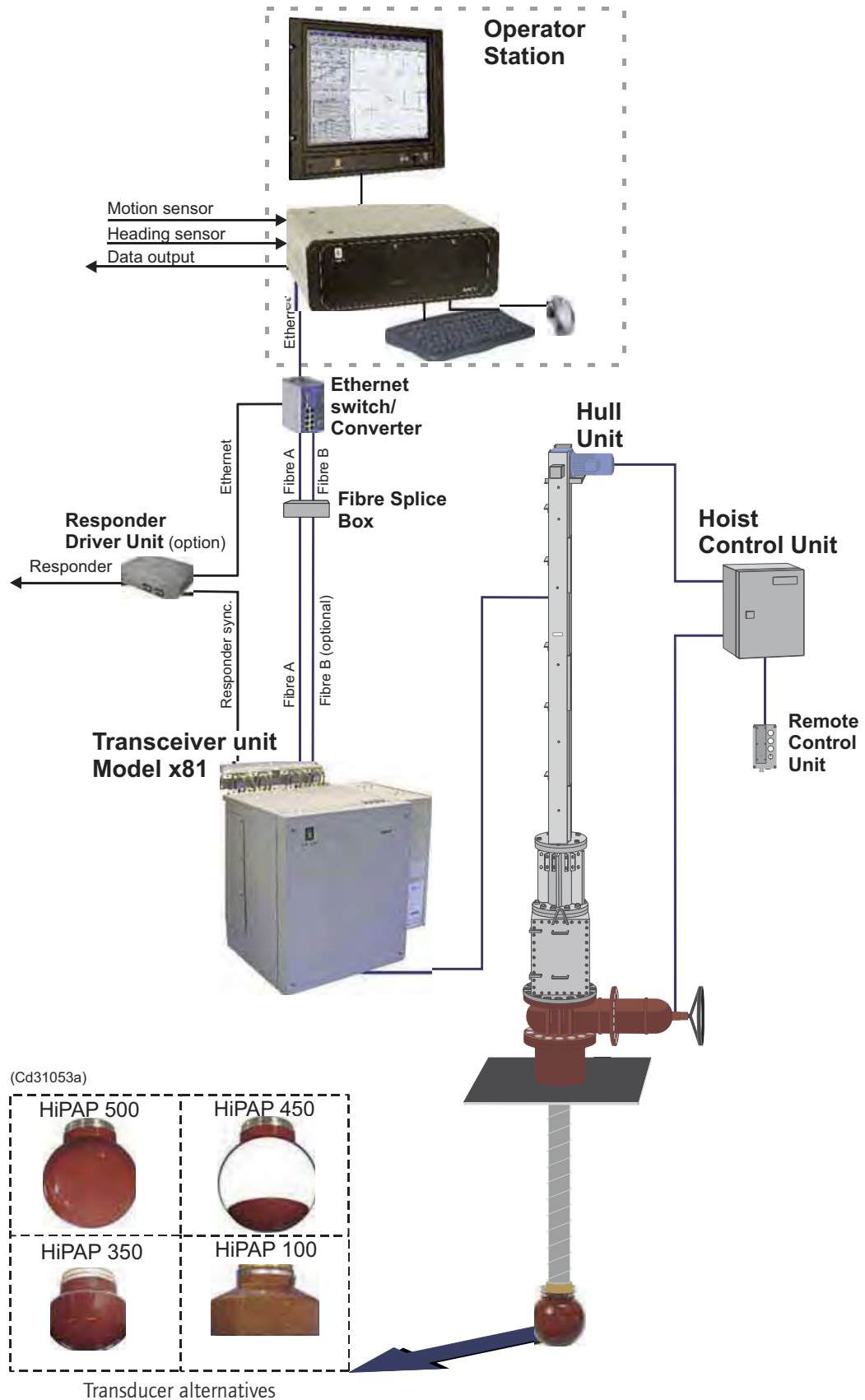
The APOS Trainer is suitable for training, planning and demonstration purposes.

Features of the APOS Trainer:






- A CD containing full APOS software with most options
- APOS instruction manual
- Includes Sound velocity ray trace calculation with displaying of deflection based on velocity profile input
- Includes Long Base Line array planning tool
- Includes data output for testing telegram interfaces to external computers (transmits standard HPR/HiPAP telegrams)



HiPAP® systems outline



Technical specifications for the HiPAP family

Description	HiPAP 501	HiPAP 451 (may upgrade to 501)	HiPAP 351	HiPAP 351P HiPAP 351P-5 HiPAP 351P-I	HiPAP 101
Transducer outline					
Operating range ¹⁾	1 – 4000 m	1 – 3000 m	1 – 3000 m	1 – 3000 m	1 – 10000 m
Position Accuracy in % of range ¹⁾	0,2 %	0,3 %	0,3 %	0,3 %	0,2 %
Angle Accuracy ¹⁾	0 dB S/N: 0,30° 10 dB S/N: 0,18° 20 dB S/N: 0,12°	0 dB S/N: 0,40° 10 dB S/N: 0,23° 20 dB S/N: 0,18°	0 dB S/N: 0,40° 10 dB S/N: 0,23° 20 dB S/N: 0,18°	0 dB S/N: 0,40° 10 dB S/N: 0,23° 20 dB S/N: 0,18°	20 dB S/N: 0,14°
Accuracy Dual mode option, Two-TD system ¹⁾	20 dB S/N: 0,09°	20 dB S/N: 0,13°	20 dB S/N: 0,13°	20 dB S/N: 0,13°	20 dB S/N: 0,09°
Angle Accuracies with use of Cymbal will be improved with up to 30 % for all systems					
Range Detection Accuracy ¹⁾ is 0,1m for all systems					
Range Detection Accuracy with use of Cymbal is 0,02m for all systems					
Operating beam (max.)	200°	160°	160°	160°	120°
Minimum Gate Valve size required	20 inches/500 mm	20 inches/500 mm	14 inches/350 mm	14 inches/350 mm	20 inches/500 mm
Transducer Diameter	400 mm	400 mm	320 mm	345 mm	460 mm
Number of active elements	241	46	46	46	31
Narrow Pointing Receiving Beam	10°	15°	15°	15°	20°
Hull Unit for automatic Transducer deployment through hull	Available	Available	Available	Not Available	Available
Number of HPR 400/ Cymbal channels	56/50	56/50	56/50	56/50	30/20
Receive Frequency Band	27,0 – 30,5 kHz	27,0 – 30,5 kHz	27,0 – 30,5 kHz	27,0 – 30,5 kHz	13,0 - 15.5 kHz
Telemetry Frequency Band	24,5 – 27,0 kHz	24,5 – 27,0 kHz	24,5 – 27,0 kHz	24,5 – 27,0 kHz	12,0 - 13,0 kHz
Transmit Frequency Band	21,0 – 24,5 kHz	21,0 – 24,5 kHz	21,0 – 24,5 kHz	21,0 – 24,5 kHz	10,0 - 12.5 kHz

NOTE:

It is very important to use transponders with strong enough output source level to obtain highest S/N ratio and thereby also the best SSBL accuracy.

All HiPAP351P models includes attitude sensors with different accuracies. HiPAP 351P includes MRU-H, HiPAP 351P-5 includes MRU-5 and HiPAP 351P-I includes an IMU and provides also Heading relative North.

1) The Operating range and the SSBL accuracy specifications are based on; free line of sight from transducer to transponder, no influence from ray-bending, Signal to Noise (S/N) ratio in water in the 250 Hz receiver band, and no error from heading and roll/pitch sensors. The angular figures are errors in both axis, elevation and orthogonal.

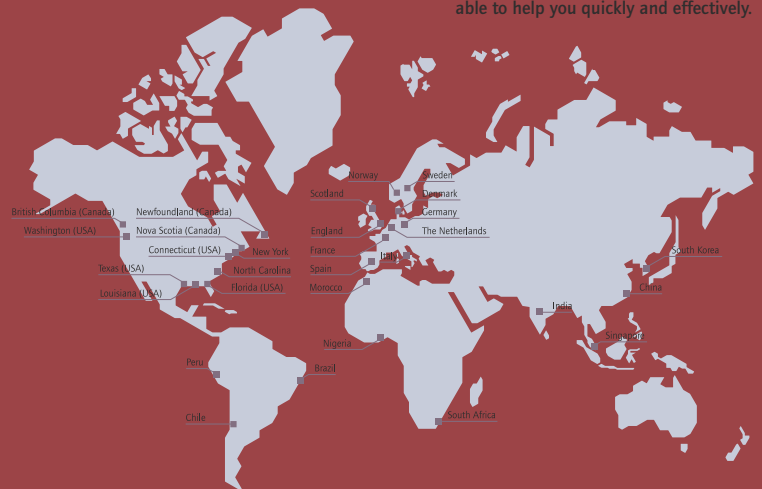
We are always there, wherever you need us

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 well-qualified field service engineers will be able to help you quickly and effectively.



Solid competence reduces cost

We have always recognised the importance of supporting our products and systems with professional training.

A wide range of courses are therefore offered to ensure that you achieve the goal of full system utilisation with safe and efficient operation.



Upgrading that pays

Product and system upgrades can improve your vessel's operations and reduce your overall maintenance costs. We will ensure that existing products and systems can be extended or upgraded based on standard upgrade kits.



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