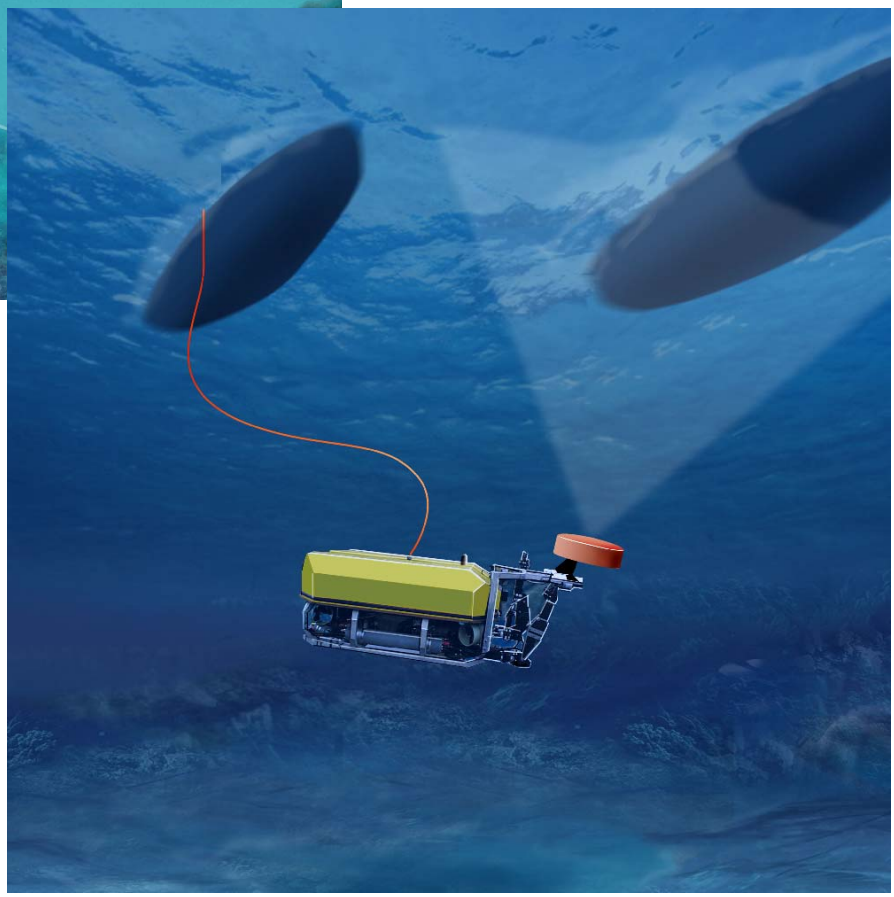
Product Description

KONGSBERG

EM 3000

Multibeam echo sounder



857-160055

EM 3000
Multibeam echo sounder

Product description

This document presents a brief technical description of the EM 3000 multibeam echo sounder.

About this document

Rev	Date	Written by	Checked by	Approved by
A	15.10.96	RBr	EHa	EHa
	Original issue.			
B	29.01.98	RBr	MGj	EHa
	Content restructured and partly re-written. New illustrations added, others removed.			
C	26.02.98	RBr	EHa	MGj
	Several minor errors and misprints corrected, no major changes to the context. System diagram changed to show etxernal thernet as an extra interface line.			
D	12.05.99	RBr	EHa	EHa
	No significant changes to the text or illustrations. Company and product names corrected.			
E	18.03.05	EB	KEN	FP
	Implementation of SIS (Seafloor Information System software) and HWS 10 (Hydrographic Work Station). Other minor corrections.			

Kongsberg Maritime AS

Strandpromenaden 50
P.O.Box 111
N-3191 Horten,
Norway

Telephone: +47 33 02 38 00
Telefax: +47 33 04 47 53
www.kongsberg.com
E-mail: subsea@kongsberg.com

KONGSBERG

Table of contents

Blank page

SYSTEM OVERVIEW

Key facts

The EM 3000 multibeam echo sounder is a very high resolution seabed mapping and inspection system with respect to high accuracy and resolution. The minimum operating depth is from less than 1 m below its transducers, and in typical sea water conditions the system operates to more than 150 m depth (less in warm water and more in fresh water). Small dimensions and low weight makes the system portable and easy to install. This allows use on survey launches and subsea vehicles to 1500 m water depth.

The EM 3000 system has a very high ping rate of up to 40 Hz, a large number of measurements per ping (typically about 120), 1.5 degrees beamwidth, and electronic pitch stabilization of the transmit beam. 100% coverage of the bottom is achievable at vessel speeds of about 10 knots in shallow waters with acrosstrack coverage of up to four times depth beneath the transducers with a basic system. At longer range the achievable coverage may be up to 200 m, and 100% coverage is achievable with vessel speeds up to 20 knots.

The EM 3000 may be configured to use two sets of transducers (Sonar Heads). This increases the shallow water coverage to up to ten times the depth, and the number of measurements per ping to typically 220. With an angular coverage sector of nominally 200 degrees the dual system also allows surveying to the water surface along shorelines, river banks and man-made structures.

The system sonar frequency is 300 kHz allowing small dimensions, good range capability and high tolerance to turbid waters. Integrated seabed acoustical imaging capability (like a sidescan sonar) is included as standard. A nearfield mode is available for increased resolution at very short ranges (< 4 m). A combination of phase and amplitude bottom detection algorithm is used, resulting in a measurement accuracy of 5 cm RMS being achievable practically independent of beam pointing angle.

The EM 3000 can be delivered either as a basic multibeam echo sounder instrument suited for system integration, or as a complete stand-alone seabed mapping system.

Postprocessing software for the EM 3000 is available from both Kongsberg Maritime and third-party suppliers. A world-wide marketing and service organization having many years of multibeam experience is available for supporting the EM 3000.

System diagram

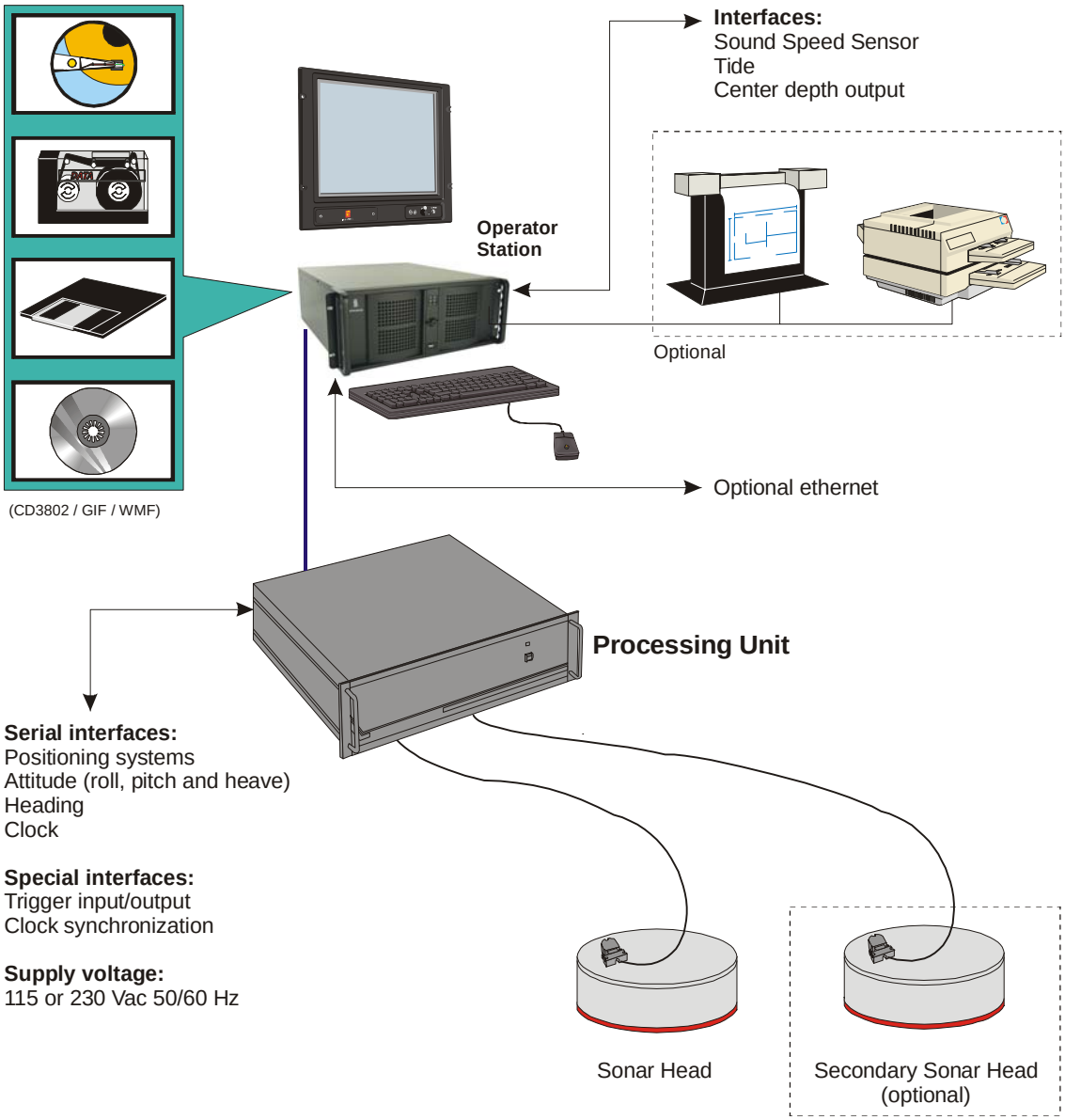


Figure 1 EM 3000 system units and interfaces

System characteristics

Main units

The basic EM 3000 multibeam echo sounder consists of two units:

- Sonar Head(s)
- Processing Unit
- Operator Station

The system may be delivered either with one sonar head (EM 3000S) or with two sonar heads (EM 3000D).The dual sonar heads can be arranged in different ways. The most common configuration is to mount the two sonar heads tilted 40 degrees to port and starboard in order to obtain a wider swath coverage.

A complete mapping system will in addition include a vessel motion sensor, heading sensor, sound velocity sensor and a positioning system. For ROV applications a telemetry system is required for data communication between subsea units and surface electronics.

Sonar Head

The EM 3000 Sonar Head contains the transducers and all transmitter and receiver electronics. The size of the Sonar Head is limited to a diameter of 332 mm and a height of 119 mm. The sonar head material is titanium, making the unit robust, durable and 100% non-corrosive.

The maximum deployment depth for the standard sonar head is 500 m. A slightly different sonar head is available for maximum 1500 m water depth.

A single cable with an underwater plug connects the Sonar Head to the EM 3000 Processing Unit.

Processing Unit

The EM 3000 Processing Unit performs the beamforming and bottom detection. It further controls the sonar head with respect to gain, ping rate and pitch compensation of the transmit beam. It contains all interfaces for time-critical external sensors such as vessel attitude (roll, pitch, heading and heave), vessel position and external clock.

The Processing Unit is available in two different versions; one for surface use and one for subsea use. The surface version is contained in an instrument case to be mounted in a 19” rack (height 4U). A single Ethernet connection is used for control and data communication.

The subsea version of the Processing Unit is more compact and well suited for use inside a pressure container.

Operator Station

The Operator Station of the EM 3000 is the HWS 10 high performance dual-processor PC workstation. The operator software is the Seafloor Information System (SIS). The HWS 10 is dual bootable to either Linux® or Windows XP®.

SIS, as a minimum, allows setting the EM 3000 installation and runtime parameters, data logging and running self-test on the system without restrictions.

The SIS software also includes functionality for survey planning, 2D and 3D geographical display of the survey results, seabed image and water column displays, plus real-time data cleaning algorithms.

Alternatively, third-party software solutions can be used for the operator interface and real-time processing.

The HWS 10 is normally supplied with a 17.4” industrialized LCD monitor with a resolution of 1280x1024 pixels. Support for a second monitor is included. A spill-proof US keyboard and a standard optical mouse is normally supplied, but optionally a small IP 65 rated keyboard with integrated track stick can be delivered.

PERFORMANCE

Basic specifications

The operating frequency of the EM 3000 multibeam echo sounder is 300 kHz. This frequency has been chosen carefully to achieve an optimum balance between small dimensions, narrow beams, and good range capability even in turbid waters.

The beamwidth is 1.5 degrees both on transmit and receive. The transmit fan may be electronically stabilized for pitch to always point vertically.

There are 127 simultaneous receive beams for each Sonar Head. Each Sonar Head covers a swath width of 130 degrees. For an EM 3000D system with two tilted Sonar Heads a total effective swath coverage of 160 degrees is obtained even if the vessel is rolling. The number of simultaneous receive beams is then approximately 220.

Acoustic interference between the two sonar heads of EM 3000D is eliminated by using two different operating frequencies, both within the system bandwidth.

The dense beam pattern together with the high ping rate of up to 40 Hz (pings per second) gives a very dense sounding spacing. A vessel speed of 10 knots in shallow waters and even more in deeper waters is thus possible while maintaining 100% bottom coverage.

Depth accuracy

The EM 3000 system depth accuracy is very good due to the narrow beams and high range sampling rate used (15 kHz), but most importantly through using the advanced bottom detection methods which have been developed through long experience in this field. Near normal incidence a centre of gravity amplitude detection principle is employed, but for most of the beams the system uses phase detection. This principle is based upon splitting the receiving aperture for each beam in two sections, and obtain the angle of arrival of the incoming return signal from the bottom by processing of the phase angles of the two signals obtained. For every range sample a measurement of the angle of arrival of the returned bottom echo is done, and from all the bottom returns inside a receive beam the exact range to the bottom in the beam’s geometrical centre is derived. The combination of beamforming and phase processing is robust and generates high quality sounding data.

The referenced illustration shows the expected instrumental accuracy of the EM 3000. Note that the total system error will always be higher than the instrumental error of the multibam echo sounder, because error contributions for the vessel's motion, heading, positioning will contribute, as well as sensor imperfections and natural variations for the sound speed in the water.

→ *Refer to figure 3 on page 8.*

With high quality external sensors it has been demonstrated that a total system accuracy of 5 cm RMS is achievable in shallow waters with the EM 3000. This accuracy is within the requirements of the IHO standard S-44 rev.4 for special order surveys.

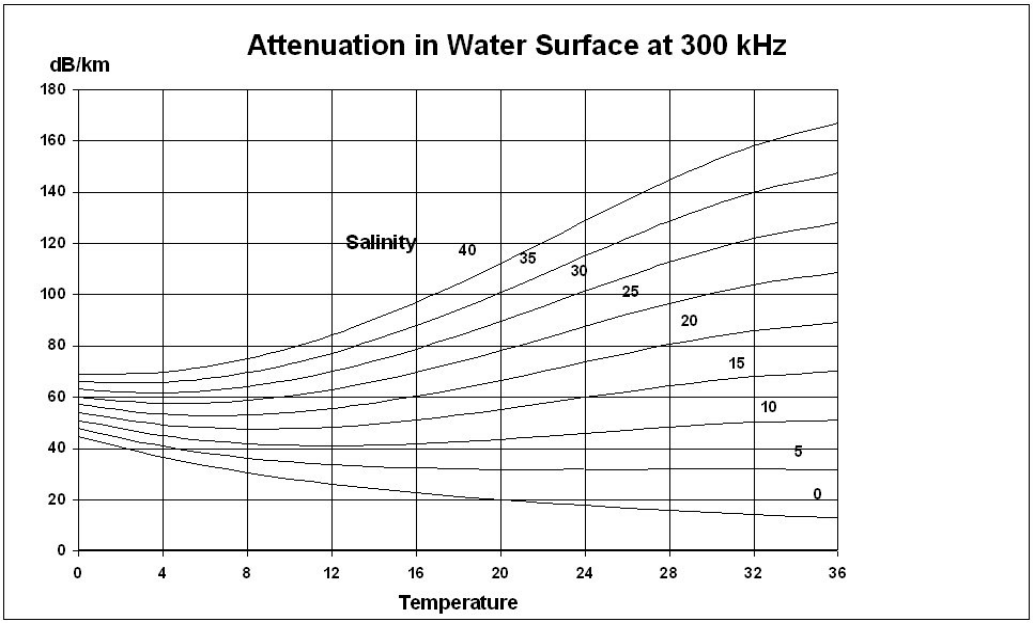
Coverage

The EM 3000S has a maximum swath width of more than 200 m in deeper waters, while for shorter ranges the swath width may be up to about 4 times water depth. With a dual sonar head configuration the achievable swath width may be increased to ten times water depth with an angular coverage which allows surveying (with somewhat reduced accuracy) to the water surface. A dual head system may also be used for profiling of say a trench or a pipeline from two sides simultaneously.

The receive beamwidth and the beam spacing of the EM 3000 vary inversely with the cosine of the beam pointing angle (referred to the Sonar Head face). The resulting beam broadening for large beam pointing angles does not have any effect on accuracy due to the phase detection algorithm used in the EM 3000. Resolution is neither affected, as it is dependent upon the alongtrack beamwidth and the range sampling rate which do not vary. The phase processing method for bottom detection will then use information from less than the full footprint of the beams.

The acrosstrack sounding density will usually limit the usability of the outer beams in a multibeam echo sounder, unless the beam spacing is equidistant and the beam pointing angles are roll compensated, which is not the case for the EM 3000. It is common practice to run a survey with overlap between neighbouring lines for quality control purposes. For a high resolution survey it is recommended that the spacing between neighbouring survey lines for EM is limited to about 3 times water depth, and increased to 4.5 times water depth for EM 3000D. These line spacing recommendations will give an excellent sounding density and also a good swath overlap between neighbouring lines.

At high frequencies the range performance of any sonar system is strongly dependent upon water temperature and salinity in addition to bottom reflectivity.



(CD3209)

Figure 2 Attenuation in water surface. The depth dependence is negligible except for the temperature reduction with increasing depth.

The referenced figure shows the absorption coefficient at 300 kHz as a function of water temperature and salinity (the depth dependence is negligible).

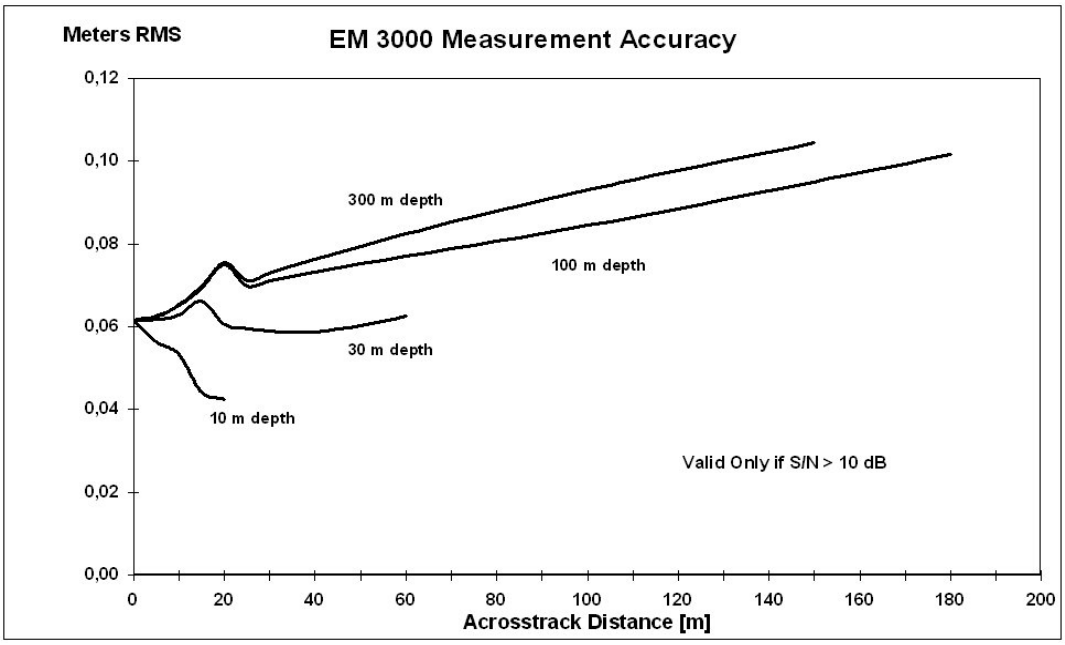
→ *Refer to figure 2.*

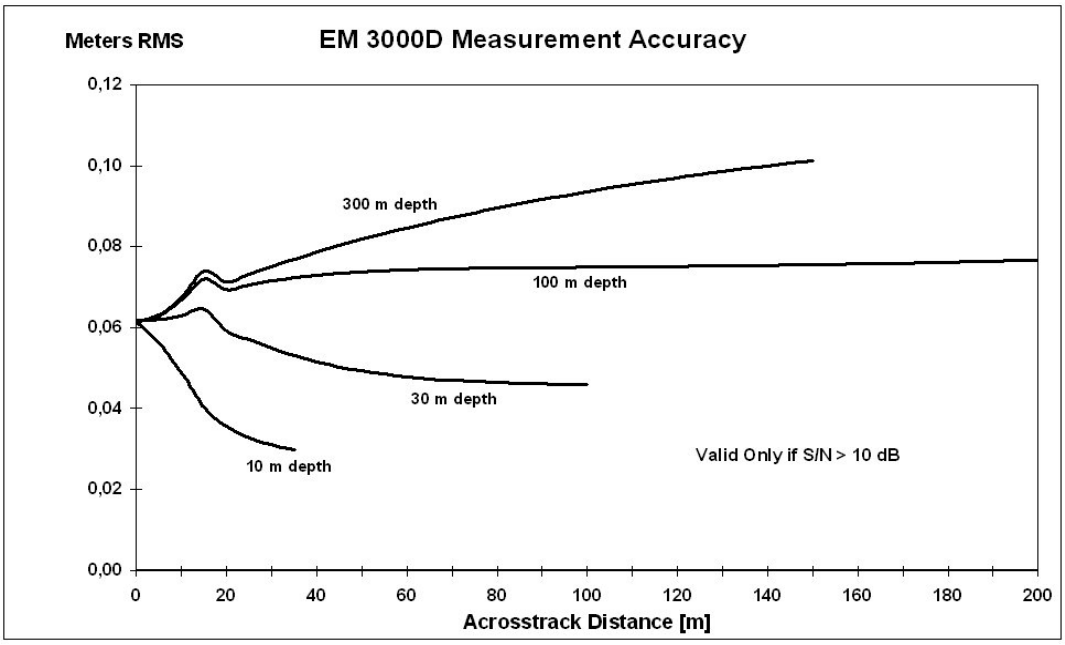
The next three figures show the achievable swath width for different absorption coefficients and bottom types as a function of depth beneath the transducers for both single and dual head versions.

→ *Refer to figures 4, 5 and 6*

The performance of the EM 3000 will usually not be affected by suspended particles in the water column (turbidness), which would have been the case if its sonar frequency had been much higher. Only heavy concentrations of large particles such as sand (>50 mg/l for particle diameters of about 100 μm) or of very fine particles (>100 mg/l for particle diameters of about 3 μm) will lead to less achievable range in the outer beams than predicted by the enclosed coverage diagrams.

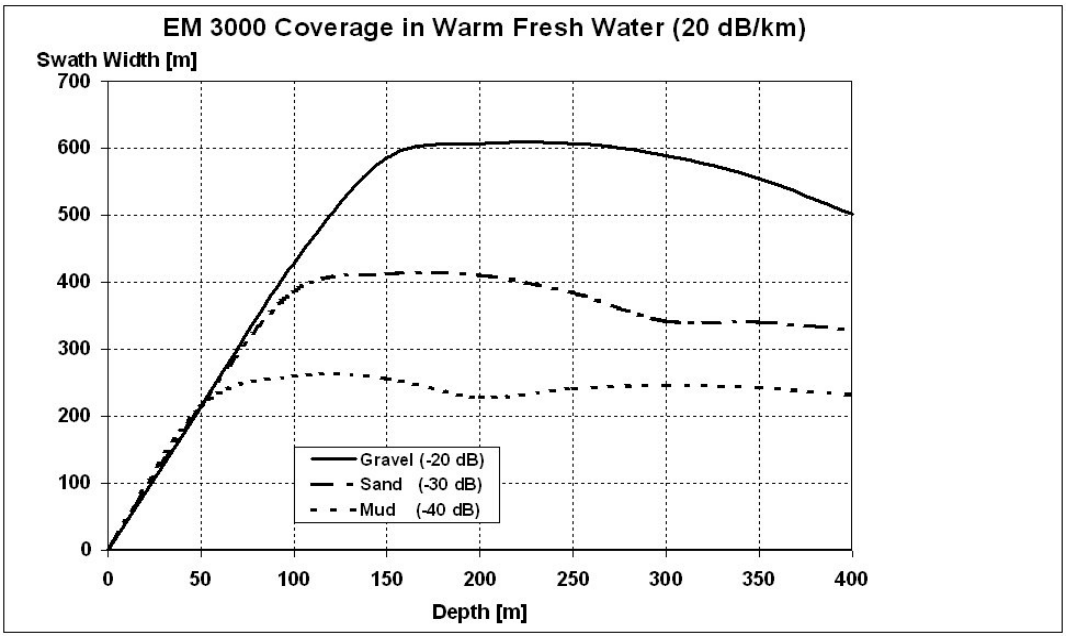
For deeper waters these curves may be used to decide coverage capability and hence the line spacing to be used in a particular survey.

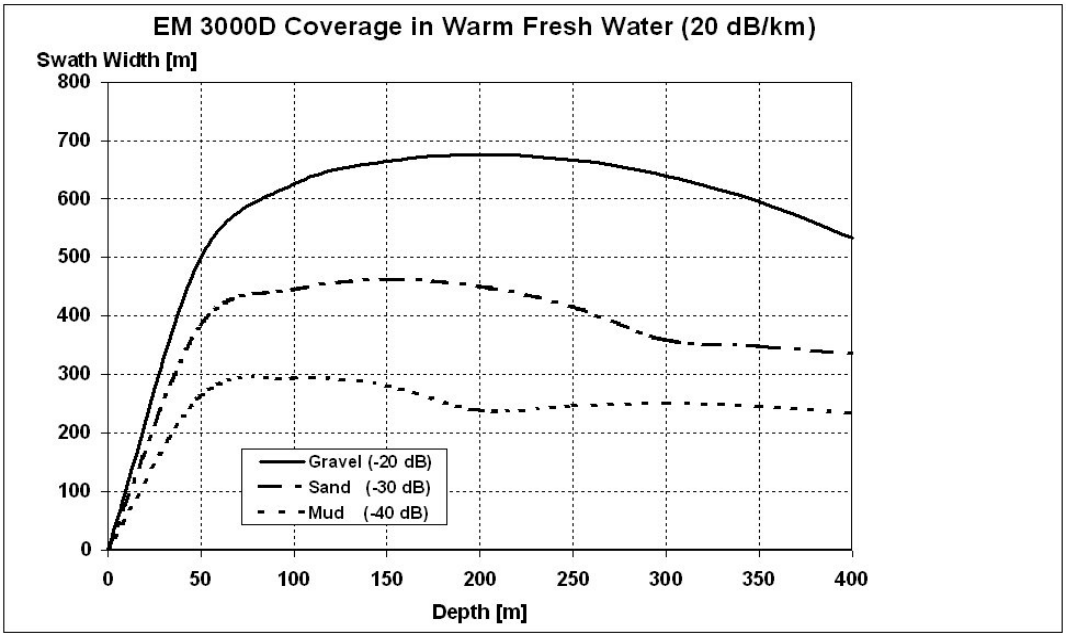




(CD3185)

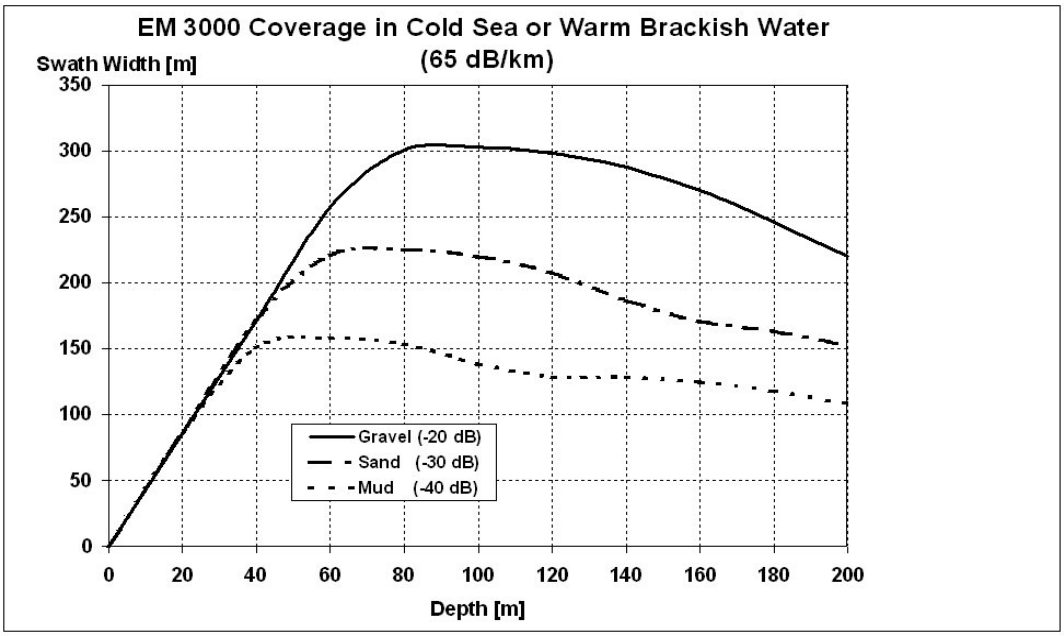
Figure 3 EM 3000 measurement accuracy

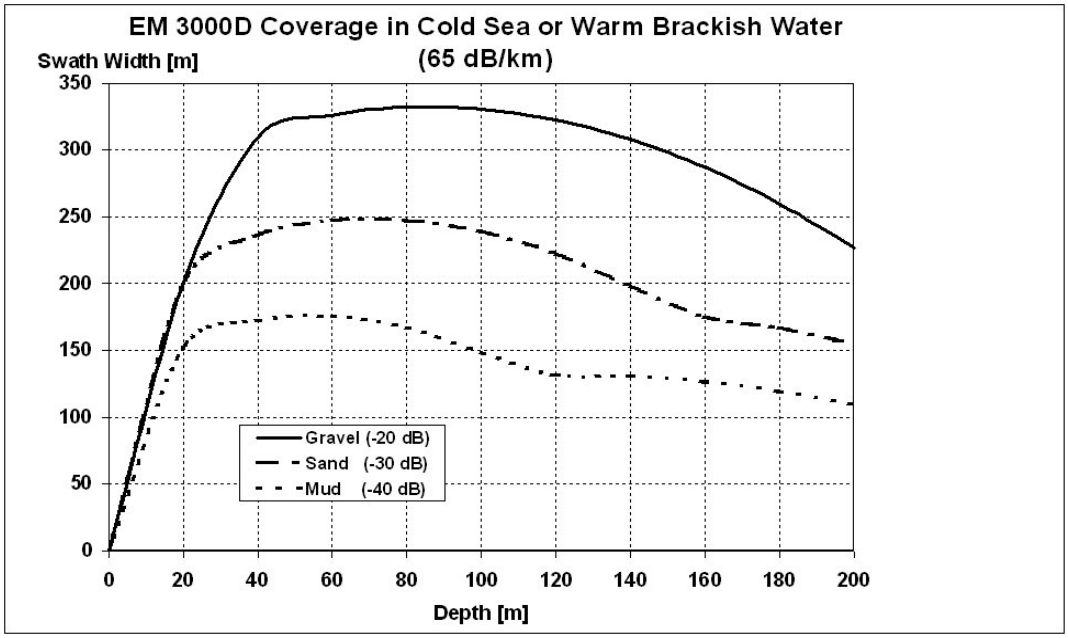




(CD3194)

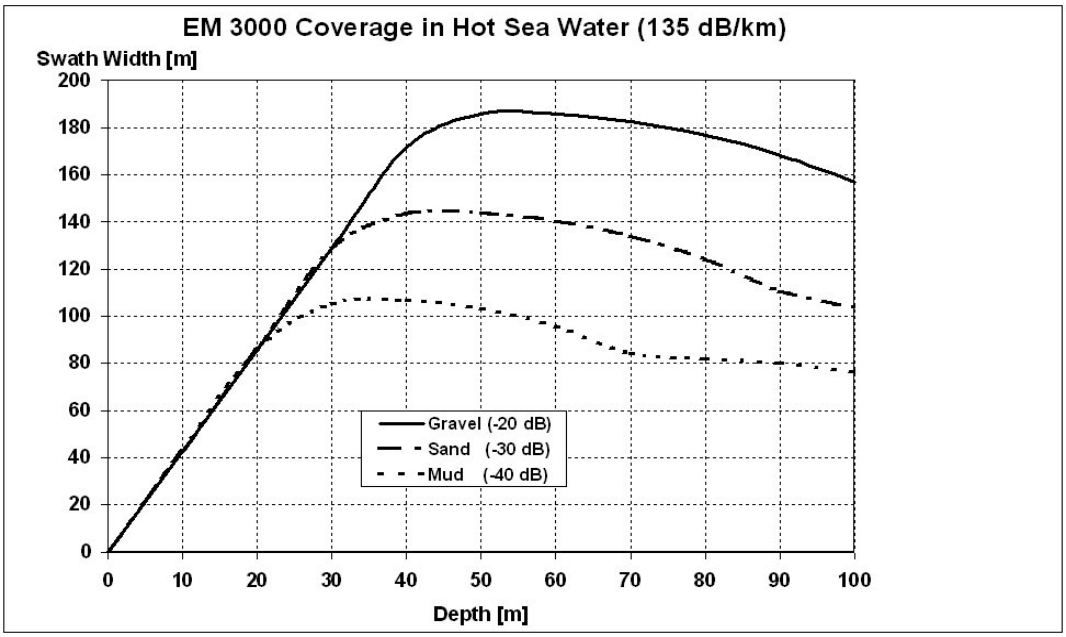
Figure 4 EM 3000 Coverage at 20 dB/km

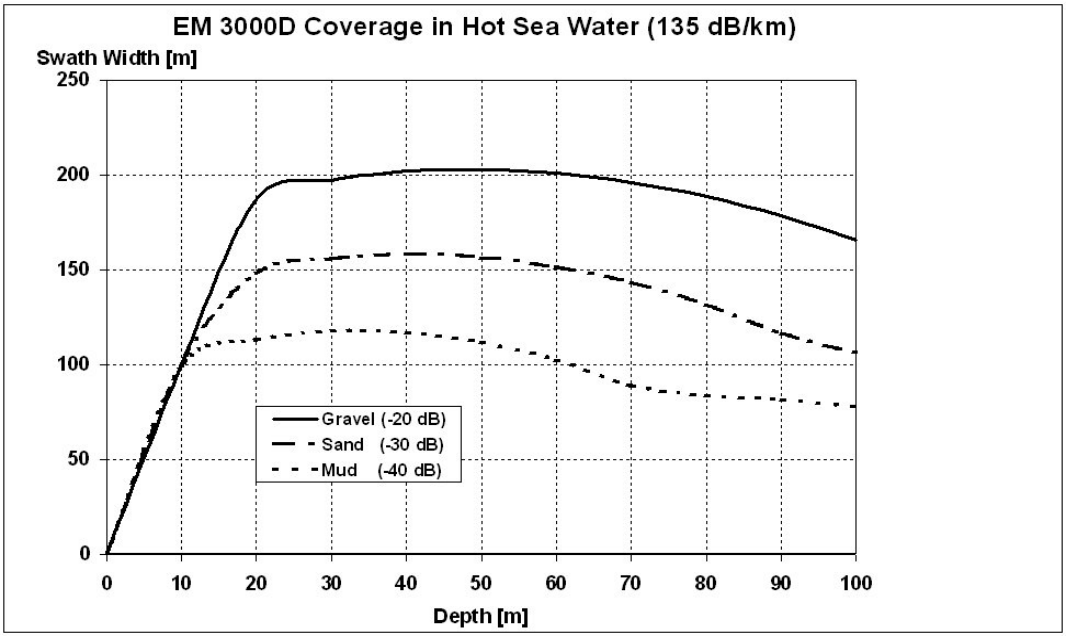




(CD3187)

Figure 5 EM 3000 Coverage at 65 dB/km





(CD3206)

Figure 6 EM 3000 Coverage at 135 dB/km

INSTALLATION

Introduction

The compactness of the EM 3000 multibeam echo sounder is a guarantee for a fast and easy installation. For a surface vessel, the Operator Station and Processing Unit are placed inside the vessel while the Sonar Head is mounted so that it is always submerged in water with a mounting angle in accordance to the system mission.

Processing Unit

The Processing Unit may be mounted in a standard 19” rack (requires 4 rack height units).

On large vessels the Processing Unit may have to be mounted in a different location closer to the Sonar Head due to the restricted length of the cable connecting the two units (15 m standard length extendable to a maximum of 50 m) or a fibre optic link may be used. For portable use the Operator Station and Processing Unit may be delivered pre-configured and cabled in two transport cases.

In applications where the Processing Unit is to be mounted subsea in a pressure container, a more compact version is recommended (AUV/UUV version).

Sonar Head

The EM 3000 Sonar Head must be mounted so that it has a clear view of the bottom, i.e. no obstructions are permitted within a sector of minimum ±80° acrosstrack and ± 30° alongtrack with respect to the face of the Sonar Head.

For standard mapping purposes the Sonar Head should be aligned with the keel line, and not be tilted more than about 20° forwards or 40° to the side.

It is important that the Sonar Head is mounted so that the water in front of the head is not aereated. On most vessels a suitable location would be near the keel in the forward part of the vessel. An arrangement for streamlining or mechanically protecting the head may be added, but would normally not be required. Flush mounting in a well may be used for a permanent installation.

To lessen risk of damage to the Sonar Head in case of grounding, it may be mounted on the side of the vessel above the keel line. If the keel obstructs the view to one side, the head may be tilted to the opposite side

In a dual head installation the two sonar heads may be placed on each side of the keel and tilted about 40° above the horizontal, thus increasing the swath width to both sides.

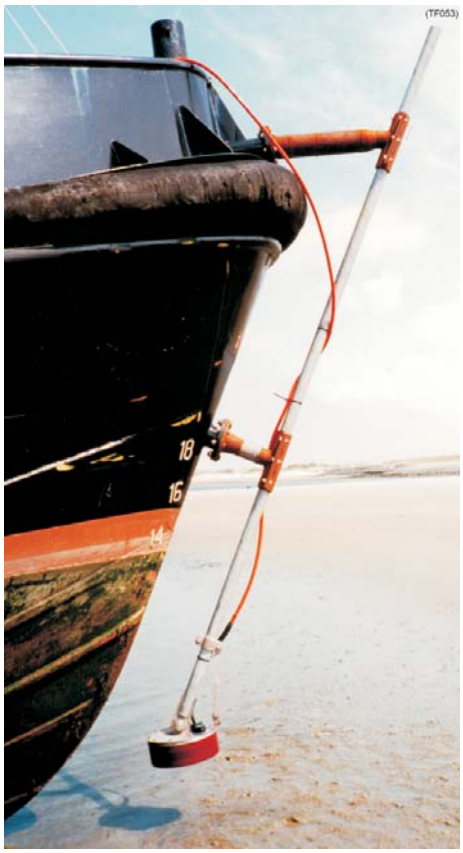
Figure 7 Sonar Head installation example: Retractable dual head

The flat face transducers of the EM 3000 makes the system accuracy independent of variations in sound speed at the transducer depth if the Sonar Head is mounted horizontally, and if roll and pitch are not excessive, say less than 10°. If the velocity of sound in the survey area is subject to frequent changes, it is recommended to install a sensor to allow real-time measurement of the sound speed at the transducer. The system will then take into account the sensor measurements in its calculations of beam pointing angles as well as corrections for raybending. The system is prepared for using an AML Smart Probe directly.

→ *Further installation examples are found on figure 8 on page 14.*

Sonar Head mounted on the suction pipe of a dredger

(CD4230)



Bow mounted Sonar Head on a small vessel

Figure 8 EM 3000 installation examples

OPERATION

System features

The EM 3000 multibeam echo sounder is controlled from the HWS 10 Operator Station using a standard click and point graphical user interface. The software, Seafloor Information System (SIS), may either be run under the Microsoft Windows XP or Linux operating systems which are both installed on the HWS 10. As standard, the system software includes the necessary features for system installation, testing and running the multibeam, ping related displays (including water column display) and the capability of logging the acquired bathymetry data.

The EM 3000 system does not require operator intervention during normal operation, but tracks the bottom automatically while adjusting mode, gain and range dependent parameters as required. Before operation is started, the necessary external sensors, such as positioning and vessel motion sensors, are connected and calibration procedures followed in order to define the system and sensor installation parameters.

Parameters critical to data quality are password protected, and most of the parameters can be recalled from a disk file.

Seabed imagery data is available from the system as standard. The imagery data, representing the acoustic backscatter strength of the bottom in 0.5 dB resolution, is available in two forms, one with range resolution nominally corrected for the effect of incidence angle, the other given per beam as an absolute measure. The imagery data may be useful for object detection, but the most important application is probably geophysical for seabed characterization.

Quality control

Quality control of the acquired data is done through graphical displays. In addition a message window and alphanumeric displays are included to allow a quick overview of the system status, indicating any interface or hardware related problems. SIS provides the graphical displays required for real-time checking of the EM 3000. These include:

- Cross-track depth profiles
- Beam intensities and quality measures
- Time series display of beam samples and sensor values
- 3D waterfall display
- Sound speed profile display and editor

Graphical user interface

Using the SIS software, the operator will normally be viewing gridded data in a geographically oriented 2D or 3D display as his primary means of quality control of the survey. The grid has six levels of detail, allowing rapid zoom in and out. Previous survey results can be imported to allow visualisation of any differences between the current and old surveys in overlapping areas.

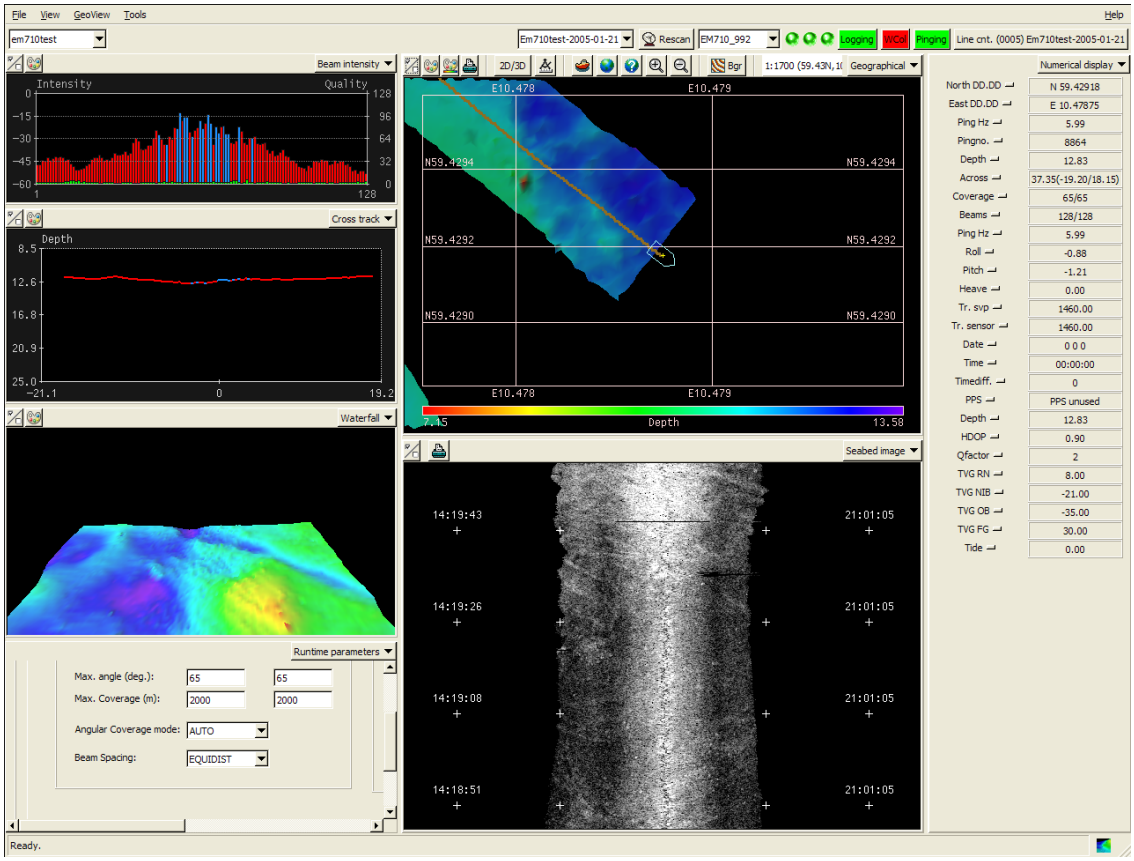


Figure 9 Example of SIS graphical user interface

The grid may also be utilized for real-time data cleaning. Based upon a set of user defined rules, outliers in a grid cell, whether from old or new survey lines, are flagged. The flags may be retained or updated through the processing. Optionally the CUBE data-cleaning package from the Center for Coastal and Ocean Mapping Center at the University of New Hampshire is also available in SIS.

Among other features included are:

- System (sensor) calibration
- Planning of surveys
- Real time cleaning of data, for separate survey lines or for the complete survey area
- Helmsman Display
- Full use of the chosen operating system for data export, plotting and printing

Electronic chart data can be displayed as a background in the geographical displays.

While SIS is the standard solution for operator software, the system is prepared for support of third party software solutions. Such software, for example QINSY or Hypack, may be used as a complement to SIS or as a replacement for SIS.

Data logging

It is of the utmost importance to ensure that all survey related data is logged in a safe way. The data is always stored on disk and the geographical displays take data only from disk. In this way, what the operator sees is what is safeguarded and already stored. As standard the HWS 10 runs two high performance SerialATA disks connected in a RAID1 array, i.e. one disk may fail without loss of data. The disks are mounted in mobile storage bays, thus they may be removed for security reasons or for transporting the acquired data The stored data may be written to DVD at any time. The Firewire, SCSI and USB interfaces may be used for transfer of data to external storage devices, such as disk or tape, according to user preferences. All data are also available on an external Ethernet.

The logged data sets include:

- Raw sensor data
- Beam ranges and beam pointing angles
- Depth datagrams
  - In each depth datagram range/angle data from one ping have been merged with motion sensor data and the current sound velocity profile to derive a rigorous solution for vessel motion and raybending, calculating sounding depth and position as Cartesian coordinates. The depth datagrams are suited for immediate presentation in the geographical display.

- Seabed image data
- System parameter settings

The gridded data (terrain model) is also available for logging. The data formats are public and published on the Kongsberg Maritime web site, ensuring that EM 3000 is a truly open solution, allowing third party or own software to be developed for data processing.

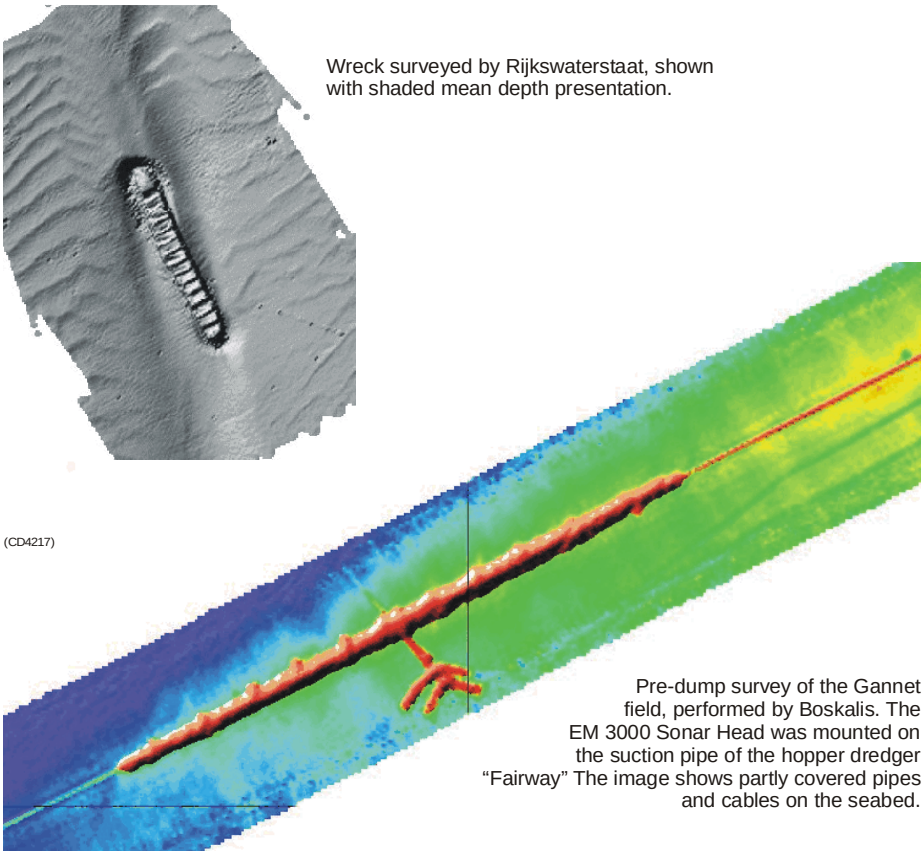


Figure 10 EM 3000 survey examples

POST-PROCESSING

Post-processing options

The high quality data produced by the EM 3000 multibeam echo sounder is an excellent basis for producing a complete description of the seabed in the form of charts, 3D displays, combined bathymetry and acoustic imagery, seabed classification, etc. Kongsberg Maritime can deliver a complete set of products for post-processing EM 3000 bathymetric data. Interfaces to other post-processing software is also available.

Brief descriptions

The **Neptune** software is used for post-processing of bathymetric data. Such post-processing involves cleaning and filtering of position data, analysis and corrections for depth data, tidal height adjustment, automated data cleaning based upon statistical rules, manual editing, controlled data thinning, and export of the final sounding data to further processing.

The **Poseidon** software is used for post-processing of seabed image data into seabed image mosaic map overlay. This involves merging of data from overlapping survey lines, applying systematic corrections which are required, filtering and interpolation.

The **Triton** software is used for seabed sediment classification. This process extracts signal features from the seabed image data, and applies this data to a statistical classification procedure in order to obtain the best estimate for seabed sediment type as a function of position in the form of a map overlay. The classifier can be trained and adapted to local conditions by use of a training module to correlate acoustical signature to ground truth information.

Software to be used for digital terrain modelling and plot generation can be delivered integrated with Neptune to derive a digital terrain model from an interpolation of the cleaned sounding data. From the terrain model contour maps, 3D plots, depth profiles along specified routes, fairsheets, volume calculations, etc, are easily produced. This additional third-party software is usually the **Cfloor** system.

CUSTOMER SUPPORT

Introduction

As a major supplier of multibeam echo sounders with many years of experience, Kongsberg Maritime has developed a marketing and service organization tuned to customer needs.

Installation

As part of the discussions with the client Kongsberg Maritime will - free of charge and without any obligations - give advice regarding the practical installation of the EM 3000 system. We will also - upon request - prepare proposals for the supply of complete instrument packages and/or systems. A project manager will usually be appointed to supervise the delivery, installation and testing of larger instrumentation systems.

The installation and final testing of an EM 3000 system should be done according to Kongsberg Maritime's documentation. If required, Kongsberg Maritime field engineers can be made available to:

- Supervise the installation.
- Perform the measurement of final location and attitude of the transducers and/or sensors.
- Perform system check-out and final testing.

Documentation and training

The EM 3000 is delivered with complete documentation for installation, operation and maintenance. If required, the manuals are prepared to reflect the actual system on the client's vessel.

Kongsberg Maritime can conduct the training of operators and maintenance personnel to the extent required by the client. Such training courses can take place on the vessel, on any of Kongsberg Maritime's facilities, or any other location decided by the client.

Service

The Kongsberg Maritime service department has a 24 hour duty arrangement, and can thus be contacted by telephone at any time. The service department will assist in solving all problems that may be encountered during the operation of the system, whether the problem is caused by finger trouble, insufficient documentation, software bugs or equipment breakdown.

FEMME

A forum for users of Kongsberg Maritime's multibeam echo sounder systems (FEMME), with the aim of improving communication both between the users and Kongsberg Maritime, but also between the system users, is arranged at approximately 18 months intervals. Close to 100% user participation has been experienced at these meetings.

Warranty and maintenance contract

The normal warranty period of the EM 3000 is 24 months after delivery.

A system maintenance contract tailored to fit the needs of the client is available. This contract can be defined so that it covers repair work only, or complete support for preventive maintenance, repair work, and system upgrading of both hardware and software as the system design is improved by Kongsberg Maritime.

The maintenance contract could also include upgrading of spare parts and documentation, and repeated or additional training courses.

SCOPE OF SUPPLY AND OPTIONS

Standard system

A basic EM 3000 multibeam echo sounder delivery includes:

1 Operator Station HWS 10 with 17.4” LCD monitor.

2 EM 3000 Sonar Head pressure rated to 500 m depth.

3 EM 3000 Processing Unit.

4 Signal and control cables between cabinets. Standard length is 5 m.

5 Software to download into the Processing Unit for permanent storage and execution

6 System manuals covering system installation, operation and maintenance.

Options

System options available include:

- Extra sonar head including additional electronics in the EM 3000 Processing Unit.
- Longer cable between the EM 3000 Sonar Head and the Processing Unit (maximum 45 m).
- Optical fibre up-link converters for use on ROV and towed body.
- Underwater version of the Processing Unit
- Sonar Head pressure rated to 1500 m depth.
- Flight case packaging of all system units.
- Helmsman Display and/or additional monitors.
- Postscript colour graphic printer/plotter.
- High resolution grayscale recorder for continuous seabed image hardcopy.
- Spare parts.

System integration

The EM 3000 system as described in this product description is a subsystem which is prepared for integration with other sensors as well as an operators unit to form a complete seabed mapping and inspection system Kongsberg Maritime can supply the EM 3000 either as a subsystem for integration by other parties, or we can offer complete system solutions tailored to the users need.

Dual frequency system solutions can be formed by combining EM 3000 with a lower frequency multibeam echo sounder.

EM 3000 can be used as part of integrated instrumentation systems for large or small vessels, surface mounted, on ROV, on towed instrument platforms, or on AUV/UUV's.

Complimentary to the acoustic instrument system, the following software products may be delivered:

- **Neptune** for post-processing of bathymetric data.
- **Cfloor** integrated with Neptune for digital terrain modelling.
- **Triton** for classifying the seabed sediment types by processing the acoustic response data from the seabed, and combining with some local ground-truth information.
- **Poseidon** for processing seabed image data into georeferenced high resolution images of the seabed.

TECHNICAL SPECIFICATIONS

Note

Kongsberg Maritime is engaged in continuous development of its products and reserves the right to alter specifications without prior notice.

Interfaces

- Serial lines with operator adjustable baud rate, parity, data length and stop bit length for:
  - Motion sensor (roll, pitch, heave and optionally heading) in format supported by sensors from Applanix, iXSEA, Kongsberg Seatex and VT TSS
  - Heading (gyrocompass) in either NMEA 0183 HDT, SKR82/LR60 or Sperry Mk39 format
  - Position in either Simrad 90, NMEA 0183 GGA or GGK format
  - External clock in NMEA 0183 ZDA format
  - Sound speed at transducer
  - Sea level height (tide)
  - Single beam echo sounder depths
  - Output of depth straight down in NMEA 0183 DPT format
- Interface for a 1PPS (pulse per second) clock synchronisation signal
- SCSI interface intended for tape drive
- Firewire interface for external data storage device (tape or disk)
- USB 2.0 interfaces for data storage, printing or plotting
- Parallel interface for PostScript colour graphics printer/plotter
- Ethernet interface for input of sound speed profile, tide and echo sounder depths, and output of all data normally logged to disk

Physical specifications

Sonar Head

Diameter: 332 mm

Height: 119 mm (+27 mm for connector)

Weight: 25 kg (15 kg in water)

Pressure rating: 500 m water depth

Diameter of cable to Sonar Head: 17 mm

Connector: Subconn LPBH9F

Material: Aluminum or titanium

Power: 24 Vdc, 1 A (available from the Processing Unit)

A Sonar Head with pressure rating of 1500 m water depth is available with the same specifications except for height (121 mm) and a restriction in maximum swath width to 3.5 times depth (120 degrees angular coverage sector).

Processing Unit, standard version

Height: 178 mm

Width: 448 mm (excluding rack fixing brackets)

Depth: 370 mm (excluding handles and connectors)

Weight: 10 kg

Power: 100 to 240 Vac, < 100 W, 47 to 63 Hz

Processing Unit, AUV/UUV version

Height: 182 mm / 162 mm (with / without top cover)

Width: 421 mm

Depth: 140 mm

Weight: 4.5 kg

Power: 100 to 240 Vac, < 100 W, 47 to 63 Hz

Operator Station

Height: 127 mm

Width: 427 mm (excluding rack fixing brackets)

Depth: 480 mm (excluding handles and connectors)

Weight: Approximately 20 kg

Power: 115 Vac (60 Hz) and 230 Vac (50 Hz), < 250 W

LCD monitor

Height: 400 mm (excluding mounting bracket)

Width: 460 mm (excluding mounting bracket)

Depth: 71 mm (excluding mounting bracket)

Weight: 9.2 kg

Power: 115 Vac (60 Hz) and 230 Vac (50 Hz), < 60 W

Environmental specifications

- **IP rating:**
  - **Processing Unit, standard version:** IP20
  - **Operator Station:** IP22
  - **LCD Monitor:** IP22
- **Operating temperatures:**
  - **Processing Units:** 0 to +45°C
  - **Operator Station:** 5 to +55°C
- **Storage temperatures:**
  - **Processing Units:** -30 to +70°C
  - **Operator Station:** -30 to +70°C

System performance data

Frequency: 300 kHz

Maximum ping rate: 40 Hz

Number of beams per ping: 127

Beamwidth: 1.5 x 1.5 degrees

Beam spacing: 0.9 degrees

Coverage sector: 130 degrees

Transmit beam steering: ±25 degrees in 0.5º steps

Depth resolution: 1 cm

Pulse length: 150 μS

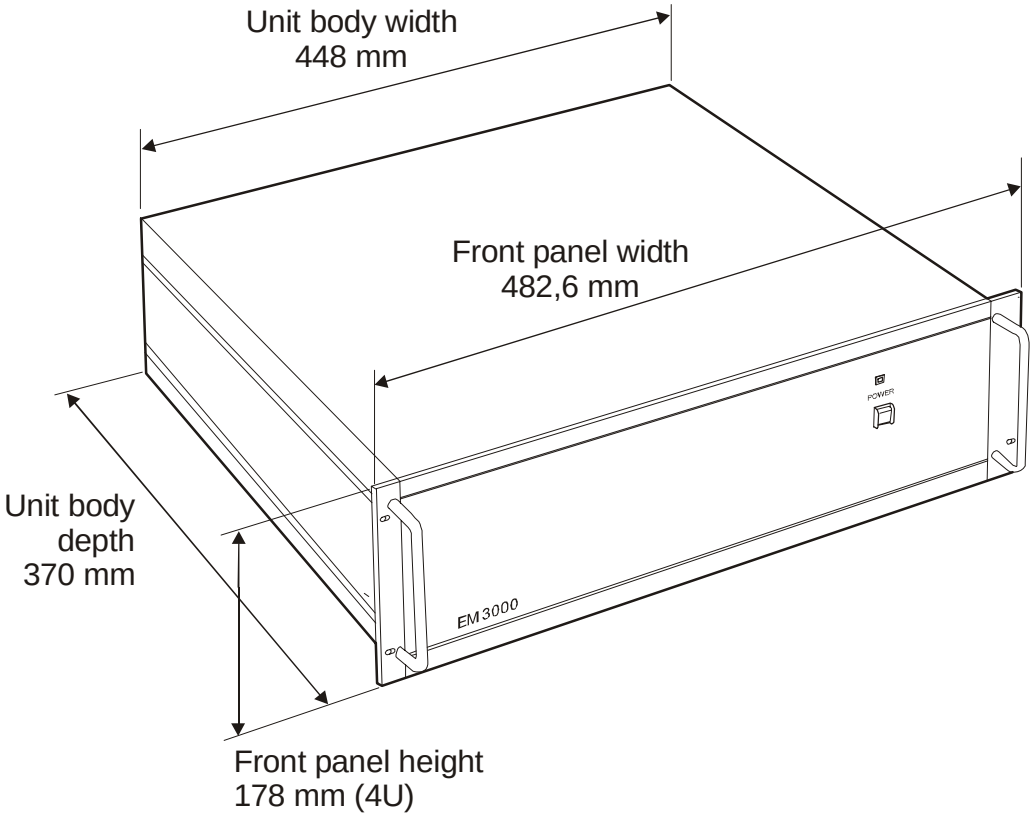
Range sampling rate: 15 kHz (5 cm)

Beamforming method: FFT

Data storage rate: Max 300 MB/h (at about 5 m depth)

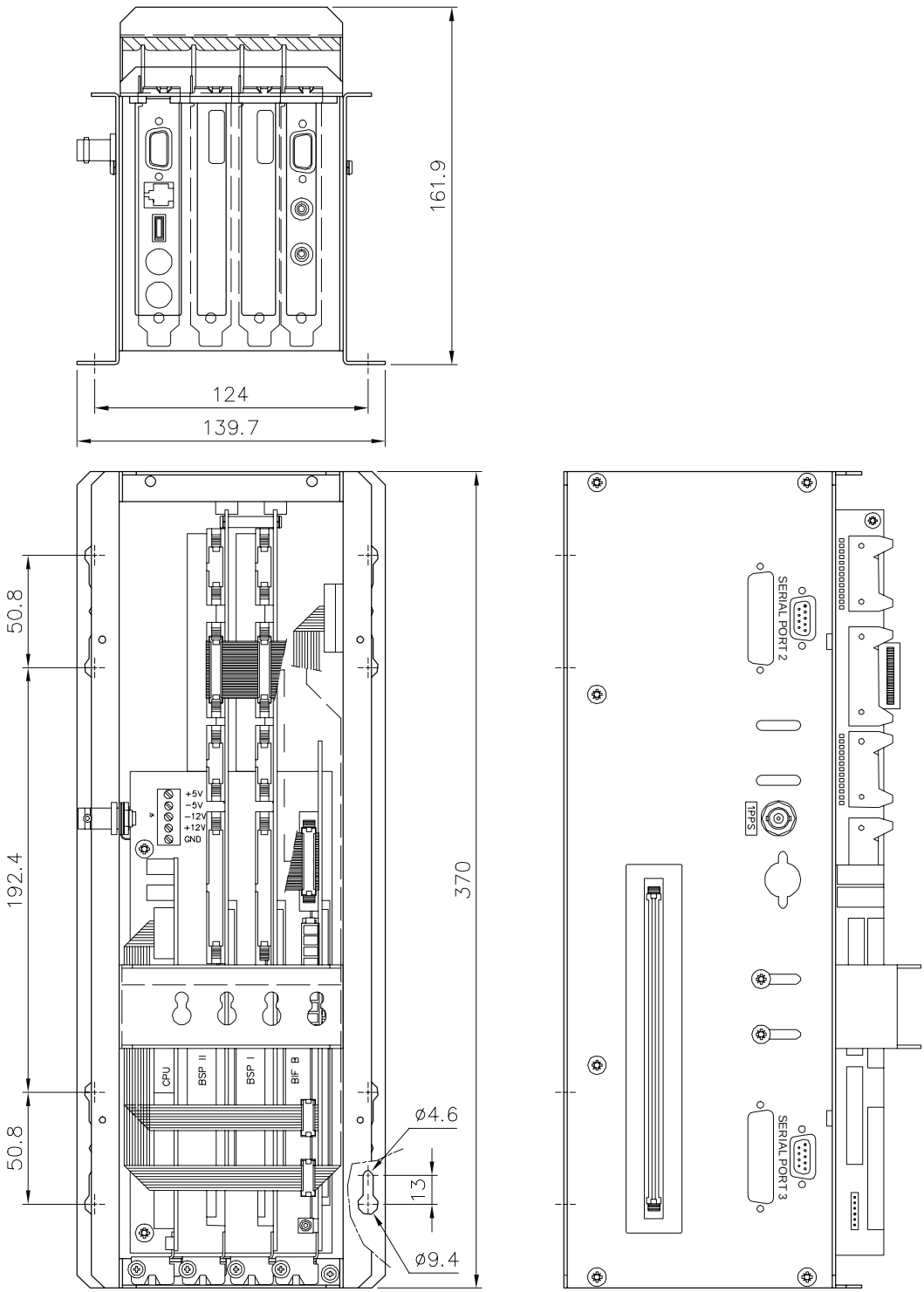
Frequencies of 293 and 307 kHz are also available, and are used in dual Sonar Head systems.

Both beam width and beam spacing are inversely proportional with the cosine of the beam pointing angle with respect to the Sonar Head (i.e. beam width is 2.1 degrees at ±45 degrees beam pointing angle and 3.0 degrees at ±60 degrees, and beam spacing is 1.3 degrees at ±45 degrees and 1.8 degrees at ±60 degrees).

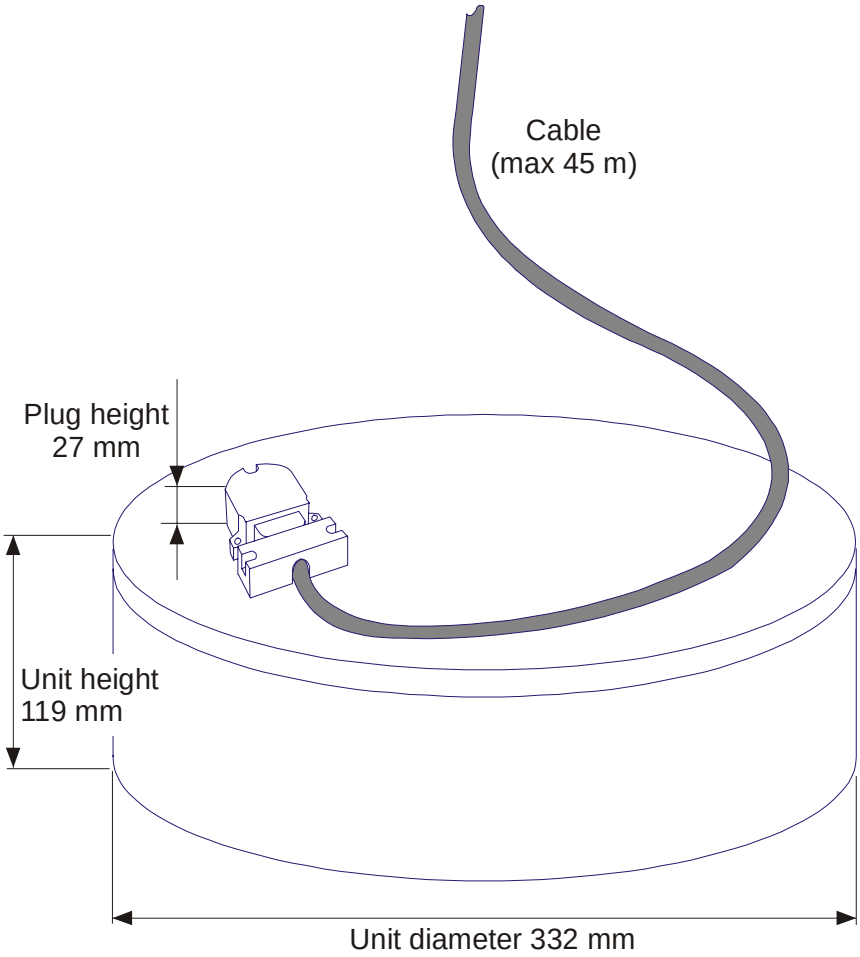


Note:
All measurements are in mm.
The drawing is not in scale.

Page 1 of 1 (CD1852B)	EM 3000 Processing Unit Outline dimensions	**N/A** Rev.A



Page 1 of 1 (CD6308)	AUV/UUV Processing Unit Outline dimensions (without top cover)	**834-216073** Rev.A



Note:
All measurements are in mm.
The drawing is not in scale.

Page 1 of 1 (CD3072C)	EM 3000 Sonar Head Outline dimensions	**N/A** Rev.A

COMPANY PROFILE

Kongsberg Maritime

Kongsberg Maritime is a leading supplier of advanced maritime automation and instrumentation systems. The company has approximately 2400 employees and an annual turnover of MNOK 3.700 (year 2004). Kongsberg Maritime owns subsidiaries in Canada, Italy, the Netherlands, Germany, Sweden, Singapore, China, Korea, the UK and the USA in addition to four locations in Norway. Decentralisation lets subsidiary company optimise customer relationships while providing maximum flexibility in relation to product design, production and marketing. Kongsberg Maritime currently exports its products to all of the world's major markets.

Figure 11 Kongsberg Maritime's facilities in Horten.

Kongsberg Maritime's main office is situated in Horten, Norway. The **Hydroacoustics** department responsible for the design and production of the EM 3000 is also located in Horten, close to the Oslo fjord. Sharing premises with Simrad AS, producer of echo sounder and sonars for the world's fishing fleet, the companies also share more than 50 years of experience in single and multibeam echo sounding, sonar technology and underwater communication and instrumentation.

Kongsberg Maritime's location close to the waterfront provides excellent surroundings for the design, test and manufacturing of the advanced products. Two in-house test tanks, a sea based test station as well as two vessels are available for extensive testing and quality control.

Figure 12 The test and demonstration yacht "M/K Simrad Echo"

The product range provided by Kongsberg Maritime in Horten includes:

- Single and multibeam echo sounders for hydrographic use
- Underwater communication
- Underwater positioning reference systems (including the highly accurate HiPAP® system)
- Naval sonars and echo sounders (hull mounted and towed systems)
- Oil and gas simulator systems

Kongsberg Maritime is fully owned by the **Kongsberg Group**.

Kongsberg Group

Kongsberg Gruppen ASA (the Kongsberg Group) is one of Norway's leading high-technology companies. With an annual turnover of approximately MNOK 6.400 (in 2004), it is listed at the Oslo Stock Exchange. The largest shareholder is the Norwegian Ministry of Industry and Energy holding 51% of the shares. The rest is publicly owned.

The Kongsberg Group operates through two major business areas:

- Kongsberg Defence & Aerospace AS
- Kongsberg Maritime AS

These companies are fully owned by the Kongsberg Group. Kongsberg Defence & Aerospace is engaged in defence activities, while the commercial market activities are allocated within Kongsberg Maritime.

The Kongsberg Group is represented world wide.

For more information, visit www.kongsberg.com

Blank page

Blank page

Blank page

KONGSBERG