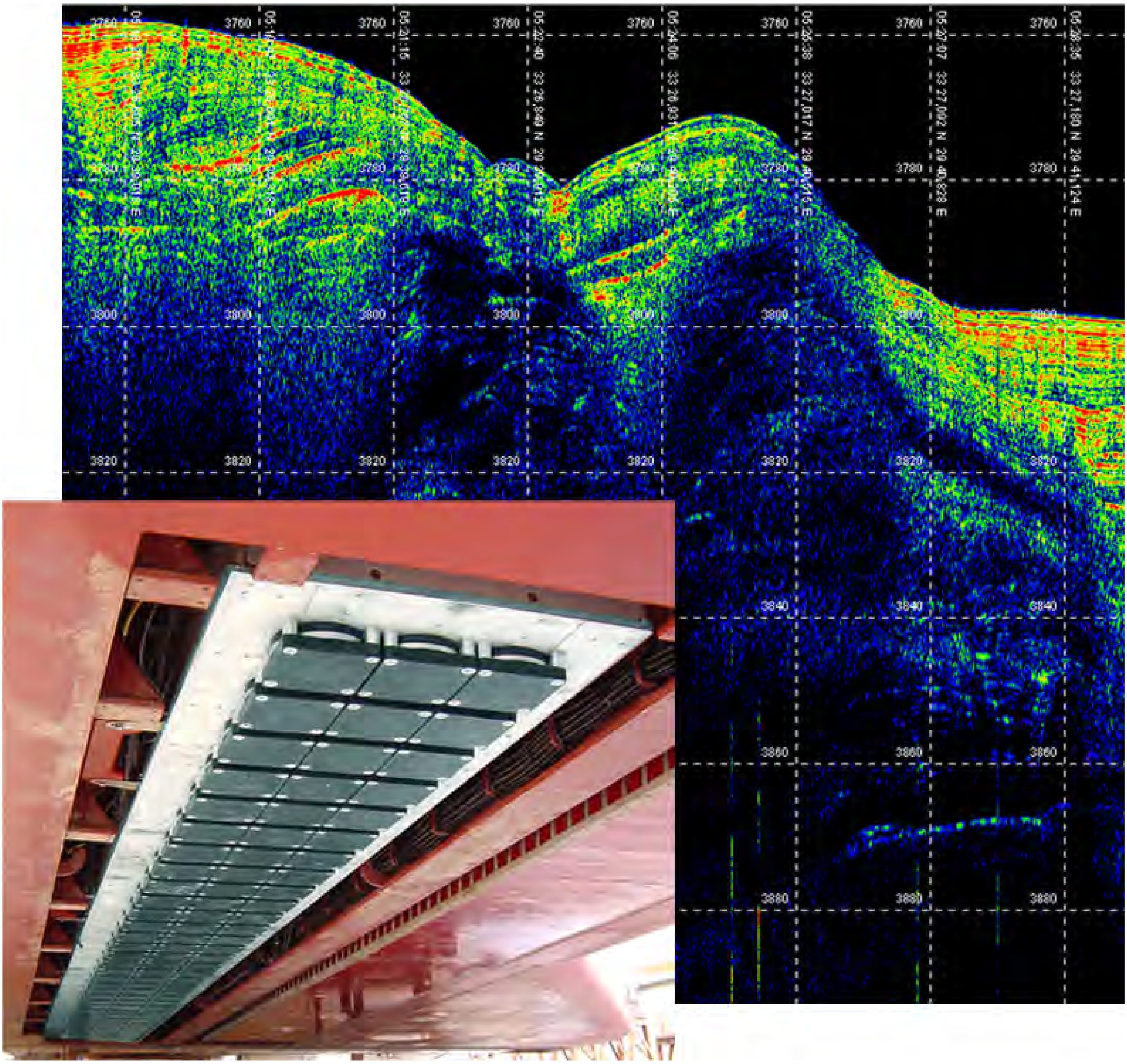
# Product Description

KONGSBERG

## SBP 120

Sub-Bottom Profiler



# *Kongsberg SBP 120 Sub-bottom profiler*

## *Product Description*

Kongsberg Maritime

164599/C
April 2010

## Document history

| Document number: 164599 | | |
|---|---|---|
| Rev. A | January 2006 | First version. |
| Rev. B | September 2009 | Second version. Minor changes in text. |
| Rev. C | April 2010 | General updates |



## Disclaimer

*Kongsberg Maritime AS endeavours to ensure that all information in this document is correct and fairly stated, but does not accept liability for any errors or omissions.*

## Warning

***The equipment to which this manual applies must only be used for the purpose for which it was designed. Improper use or maintenance may cause damage to the equipment and/or injury to personnel. The user must be familiar with the contents of the appropriate manuals before attempting to install, operate or work on the equipment.***
***Kongsberg Maritime AS disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.***

## Support

If you require maintenance on your equipment, contact Kongsberg Maritime AS using the following address:km.hydrographic.support@kongsberg.com. If you need other information about this product, or any other Kongsberg Maritime AS products, visit http://www.km.kongsberg.com.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# 1 SYSTEM OVERVIEW

## 1.1 Introduction

The SBP 120 Sub-bottom profiler is an optional extension to the highly acclaimed EM 120/122 Multibeam echo sounder. The receive transducer hydrophone array used by the EM 120/122 is wideband, and by adding a separate low frequency transmit transducer and appurtenant electronic cabinets and operator stations, the EM 120/122 can be extended to include the sub-bottom profiling capability provided by the SBP 120.

Refer to *System drawing* on page 9

Note

*The SBP 120 and SBP 300 are identical systems, but are used with different multibeam echo sounder systems. The SBP 120 is used in combination with the EM 120/122, whilst the SBP 300 is used with the EM 302. This implies that the SBP 120 and the SBP 300 are interfaced to different receiver arrays and different preamplifier units.*

## 1.2 Purpose

The primary application of the SBP 120 is to do imaging of sediment layers and buried objects. Image quality is influenced by:

- The spatial resolution of the system; its ability to distinguish objects separated in angle and/or range. The spatial resolution is given by two separate system properties:
  1. The angular resolution given by the array geometry.
  2. The range/time resolution given by the signal bandwidth.
- The ping rate relative vessel speed. Dense probing alongtrack makes it easier to identify weak layers in sediments with high volume reverberation.
- The angle of incidence of the transmit beam. The echoes received are essentially caused by specular reflections at interfaces between layers of different acoustic impedance. These specular echoes are only strong close to normal incidence.

## 1.3 Key specifications

The SBP 120 has significantly reduced beam widths compared to conventional sub-bottom profilers. This is obtained by one linear transmitter array mounted along the vessel keel, and one linear hydrophone array (shared with the EM 120/122) mounted orthogonal to the keel. The footprint of the transmitter array is wide acrosstrack and narrow alongtrack, whereas the opposite is the case for the receiver array. The combined beam pattern of the two arrays is a narrow beam.

Some of the consequences of using large arrays are:

- The larger the transmitter array, the more power can be injected (without risking cavitation). This implies an increased source level.
- The directivity of the transmitter also increases with the size of the transmitter, which implies a further increase of the source level.
- The reverberation volume is greatly reduced with reduced beam widths. (The reverberation volume roughly increases with the square of the beamwidth.)
- The increased directivity of the SBP 120 receiver array compared to smaller receivers improves the suppression of acoustic noise.

Because the transmit beam is wide acrosstrack and all hydrophones are sampled individually, the SBP 120 can make a fan of narrow beams acrosstrack per ping. This multibeam capability of the SBP 120 is useful for:

- Finding the specular return(s) in rough terrain in spite of the narrow beams.
- Resolving lateral specular returns in rough terrain
- Detecting buried objects
- Obtaining information about the sloping angle of sediments (which sometimes changes with range and may be completely different from that of the sea floor)

The normal transmit waveform is a linear chirp. The outer limits for the start and stop frequencies of the chirp are 2.5 to 6.5 kHz, providing a maximum vertical resolution of approximately 0.3 milliseconds. In addition to linear chirps, the transmitter offers CW pulses, hyperbolic chirps and Ricker pulses. The transmit array of the SBP 120 is offered in three, six or twelve degree versions. The frequency dependent source level of a three degree transmitter is typically above 220 dB re 1 μPa @ 1 m. The peak electrical power consumption is less than 8 kW for the largest system.

Normally the transmitter is matched with a receiver of similar beam width, but it is possible for instance to combine a three degree transmitter with a six degree receiver or vice versa. Combinations of EM 120/122 and SBP 120 are given in table *EM 120/122 and SBP 120* on page 8

## 1.4 Beam stabilisation

The beams are electronically stabilized for roll and pitch. They can also be steered to take into account bottom slope, and the generation of several athwartship beams is possible.

## 1.5 Ping rate

In the transmit mode "normal", the SBP 120 pings once and then waits to collect the return signal. Maximum ping rate is 5 Hz. In the transmit mode "burst", the system allows a number of pulses to be launched into the water before the first return signal. In the "unsynchronized burst" mode the system is set to ping at a constant rate: The transmit and receive periods are interlaced so that a high constant ping rate can be maintained even in deep waters.

The SBP 120 can be synchronized to the EM 120/122 or other external equipment by selecting external trigger. During synchronized operation the rule is that the SBP 120 can only ping while waiting for the first bottom return. In transmit mode "burst", this means we will achieve a piecewise dense sampling of the bottom which sometimes can be very useful.

## 1.6 Transducer arrays

The SBP 120 transmit transducer has a physical width of 80 cm, a depth of 35 cm and a length depending on the requested beamwidth. The 3º, 6º, and 12º SBP 120 transmit arrays are 7.5, 3.8 and 1.9 meters long, respectively.

The transmit array is mounted in parallel with the vessel's keel, normally side by side with the multibeam echo sounder's transmit array. For a "best performance" SBP 120 system one should always select a three degree transmitter, but normally it will be inconvenient to have an SBP transmitter much longer than the EM transmitter.

The lengths of the 0.5º, 1º and 2º EM 120/122 transmitter are 15.2, 7.8 and 4 meters, respectively.

The rows of the following table show what is expected to be the most common combinations of EM 120/122 and SBP 120 system sizes. Since the two systems share receiver array there is a fixed relation between Rx opening angles. In the table are listed combinations of "best match" for the lengths of the EM and SBP transmitters .

*Table 1 EM 120/122 and SBP 120*

| EM 122 | SBP 120 |
|---|---|
| TX x RX | TX x RX |
| 0.5º x 1º | 3º x 3º |
| 1º x 1º | 3º x 3º |
| 1º x 2º | 3º x 6º |
| 2º x 2º | 6º x 6º |
| 2º x 4º | 6º x 12º |

## 1.7 Data logging and real-time processing

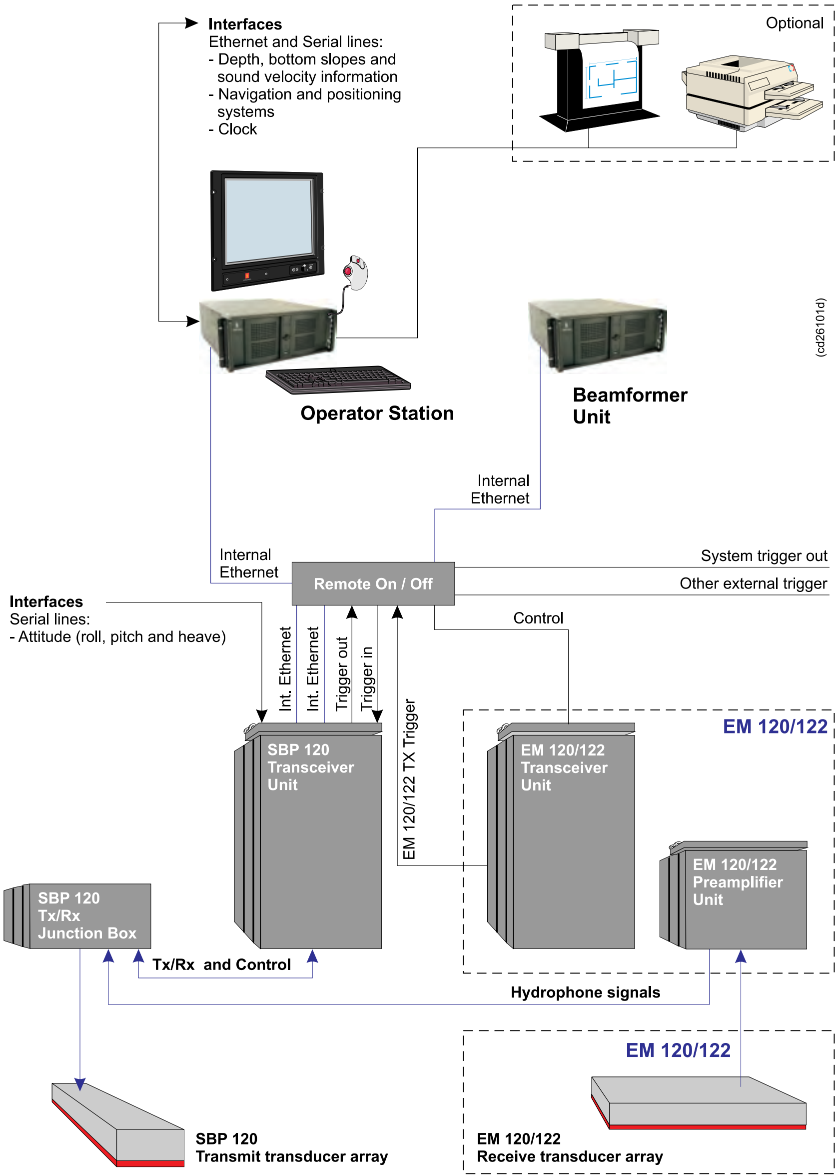
The data produced by the SBP 120 are logged in the Topas raw format or in a **SEG-Y** format allowing post-processing by some seismic processing software.

# 1.8 Cabinets and Operator Station

The transmitter and receiver electronic circuitry required for the SBP 120 Sub-bottom profiler is housed in a separate cabinet of the same size as the EM 120/122 Transceiver Unit. The EM 120/122 Preamplifier Unit contains preamplifiers for the common receiver array and frequency splitting circuitry. The operator interface and display system is implemented on a dedicated Operator Station.

The system drawing shows the relation between EM 120/122 and SBP 120

*Figure 1   System drawing*



# 2 PERFORMANCE

## 2.1 The transmit array

The MASSA TR-1447 transducer element is used in the transmit array. This is a customized version of the TR-1075, a well recognized and much used transducer element for sub-bottom profiling with a stated resonance frequency of 4 kHz. All versions of the SBP 120 transmit array has three elements athwartships, providing a beamwidth acrosstrack of 30 degrees. In the for-and-aft direction the various versions have 8, 16 and 32 elements, providing beamwidths alongtrack at 4 kHz of 12, 6 and 3 degrees respectively.

The SBP 120 3 degree transmit electronics has 64 independent channels, while the corresponding array has 96 elements. A suitable acrosstrack weighting of the array is obtained by letting the 32 centre elements having separate channels, while the 32 pair of outer elements (each pair with the same alongship coordinate) share one channel each. The maximum electrical power delivered by each channel is 200 W. We apply weighting alongtrack to reduce the sidelobes of the transmit beam, so the peak power consumption of a system with a 3 degree transmitter is less than 8 kW.

For the first twelve degree transmitter built, the source level was measured in tank. Based on those results it was estimated that the source level of the three degree transmitter is higher than 220 dB re 1 uPa @1 m above 3 kHz, and more than 225 dB re 1 uPa @1 m above 3.5 kHz. Since the properties of the transducer elements changes somewhat from one batch to another, details of the source level will differ from one installation to another.

## 2.2 Beam steering

### Stabilisation of pitch and roll

The SBP 120 makes use of beamforming on both transmission and reception, similar to a multibeam echo sounder. The transmit beam is stabilised for vessel pitch, and the receive beams are stabilised for vessel roll.

Stabilisation for vessel yaw is not required due to the narrow swath that can be obtained.

### Active beamsteering in sloping terrain

When the EM 120/122 Multibeam echo sounder is used in combination with the SBP 120, estimates of the local seabed inclination angles of the terrain fore-and-aft and across are obtained in near real-time.

The SBP 120 allows you to steer the transmit beam and the centre of the fan of receive beams in the direction where they are perpendicular to the underwater terrain. In this way the strength of the specular returns are maximised when the sediment layers are parallel to the seafloor. This maximises the specular return to backscatter ratio.

Beam steering on transmission is limited to compensate for maximum ±10 degrees of slope fore-and-aft, while beam steering on reception is limited to compensate for maximum ±10 degrees of slope across. The slope angles are estimated by the EM 120/122 by a least squares fit of data to a plane. A few pings and beams within ±10 degrees measured from the vertical are used. The information about slope angles is transmitted from the EM 120/122 Operator Station using a dedicated serial line or Ethernet.

The image shown in figure 6 shows data recorded when the automatic bottom slope correction was enabled. The beam width was 3 degrees, and the average alongtrack slope in this image is -4 degrees. Consequently, without the bottom slope correction, the system would most of the time fail to obtain the specular returns from the sediment interfaces.

Ref *The SBP 120 Operator Station software (SBP 120 data provided by courtesy of SHOM)* on page 18.

### Multiple simultaneous beams

The transmit beam is about 30 degrees wide across. Using the beam steering as described above, it is possible to produce several simultaneous receive beams for each ping. This is useful when the sub-bottom structure is complex, e.g. when sediment slopes changes with angle and range within the insonified volume.

For detection of buried objects the fan of receiver beams will, compared to wide-beam SBPs, provide angular information about the position of the buried objects. The likelihood of detection will in general be better in a narrow beam. The more narrow the beam and the less the level of reverberation, the easier it will be to detect an echo from a weak target. Also, if an object buried in sediments is detected in a narrow beam with oblique incidence to the sediments, the SBP 120 echo from the buried object will not have to compete with strong specular returns from the sediments, as it would in a wide beam system.

The SBP 120 offers up to five beams to each side of the centre beam, with selectable beam spacing, giving a total of up to 11 beams. Maximum receiver fan width is 30 degrees, matching the across transmit beam width.

### Very rough terrain conditions

The bottom slope estimates will be accurate when the part of the bottom used by the EM 120/122 to estimate the slope angles can be approximated by a plane. In rough terrain the bottom slope estimates will be less reliable. As a remedy in this situation, the operator can choose to increase the alongtrack width of the transmit beam, which will make it more likely that normal incidence and hence a specular return is achieved. To collect the return signal, one should use several narrow (standard) receiver beams or alternatively the receiver beam can be widened just as the transmit beam. The use of several beams might be preferred to acquire information about the direction(s) of the signal(s) since specular returns may arrive from more than one direction. Also, the narrow beams offer the best signal to noise-and-reverberation ratio.

## 2.3 Steering of the acquisition window

The acquisition window is the period in which data is acquired. When properly set, the acquisition window will contain some of the water column, the bottom return and the sub-bottom signals. The length of the acquisition window must be set by the operator. The present maximum of this parameter is 500 ms. The acquisition delay is measured from the start of transmission. This parameter may be adjusted:

**1** Manually.

**2** Automatically, based on internal bottom tracking.

**3** Automatically, based on EM 120/122 depth measurements.

**4** Automatically, based on depth measurements from another echo sounder than the EM 120/122.

Figure 6 demonstrates how automatic adjustment of the acquisition window works. See *The SBP 120 Operator Station software (SBP 120 data provided by courtesy of SHOM)* on page 18.

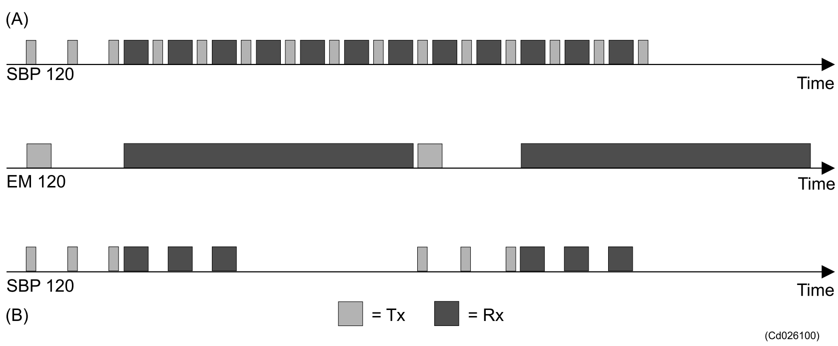
## 2.4 Operating modes

The two main transmit modes are **normal** and **burst**. In combination with the option of running synchronized with other equipment, this gives us a total of four main operating modes. Synchronized operation is used to reduce and control interference between the SBP 120 and other equipment.

The plain way to operate an echo sounder is to ping once and then wait for the return signal. This is referred to as the normal mode of the SBP 120. Synchronized and unsynchronized operation in normal mode is almost identical. Note that in synchronized mode the SBP 120 does not accept a new trigger until it has finished collecting the return signal as specified by the acquisition window parameters. Consequently the achieved ping rate might be lower than the external trigger rate.

The burst mode is somewhat more advanced and it provides us with the possibility of dense alongtrack probing of the sediments even in deep waters. In this mode there is a major difference between synchronized and unsynchronized operation. The goal in the synchronized mode is to avoid transmissions during reception of bottom returns. This means that the SBP 120 can transmit several pulses before the first bottom return arrives. For instance when the SBP 120 is synchronized with the EM 120/122, the SBP 120 must keep quiet while the EM 120/122 is in its reception period. This will cause the imaging of sediments to be piece-wise dense. Still this might be preferred to pinging once per EM 120/122 ping, because there will be much better correlation between the sediment echos within a burst than what is likely to be the case with just one ping per EM 120/122 ping.

*Figure 2 Illustration showing the sequence of transmission and reception windows in burst mode when the SBP 120 is free running (A) and synchronized (B).*




## 2.5 Penetration

How far into the bottom we are able to image sediments is of course highly dependent on the nature of the sediments. A large change in acoustic impedance between layers should give strong specular returns. A small change in acoustic impedance will give weaker specular returns, but the signal will propagate further into the sediments. Another and perhaps more important factor is absorption within the sediments: This absorption is known to be highly dependent on frequency. In addition to limiting the penetration, absorption will degrade resolution with increasing penetration.

Data has been collected at varying depths ranging from just a few metres to more than 4000 metres. Based on our experience it seems like typical values of penetration is up to 100 milliseconds.

This is the two-way travel time. Using a conservative estimate for the sound velocity in the sediments (1500 m/s), we find that this corresponds to 75 metres of penetration.

*Some examples*: In shallow water, at about 150 metres depth, we have observed up to 80 milliseconds of penetration with a 12 degrees system. Service Hydrographique et Océanographique de la Marine (SHOM) has been able to image bedrock through a sandy bank of height about 25 metres at the continental shelf (depth ~ 85-90 metres) with the 3 degrees system. At a depth of 4400 metres, a comparison of the three SBP 120 versions was carried out by SHOM in an area with muddy sediments. The observed penetration was about 100, 120 and 150 milliseconds for the 12, 6 and 3 degrees systems respectively.

*Figure 3 A sandy bank at the continental shelf. X-range: 3.75 km Y-range: 70 ms (>50). Bedrock imaged through ~25 m of sand. (SBP 120 data provided by courtesy of SHOM)*

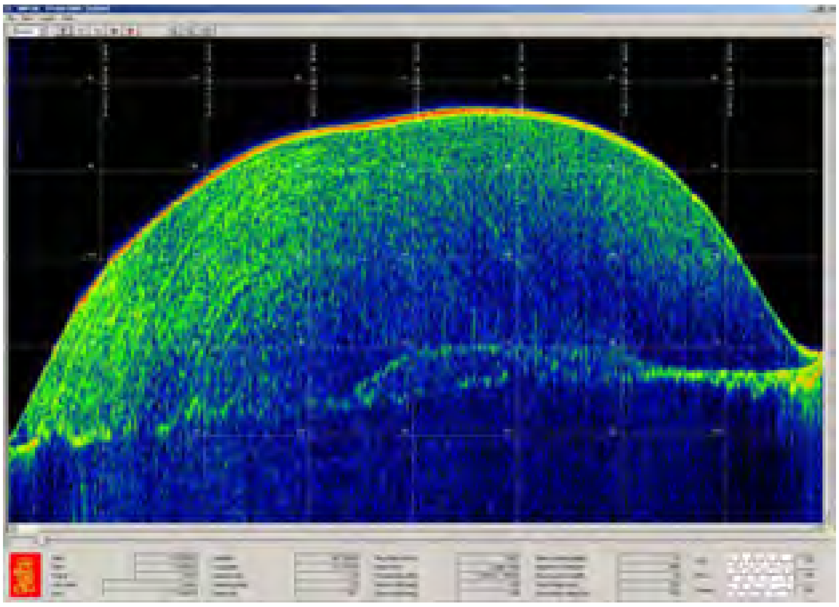
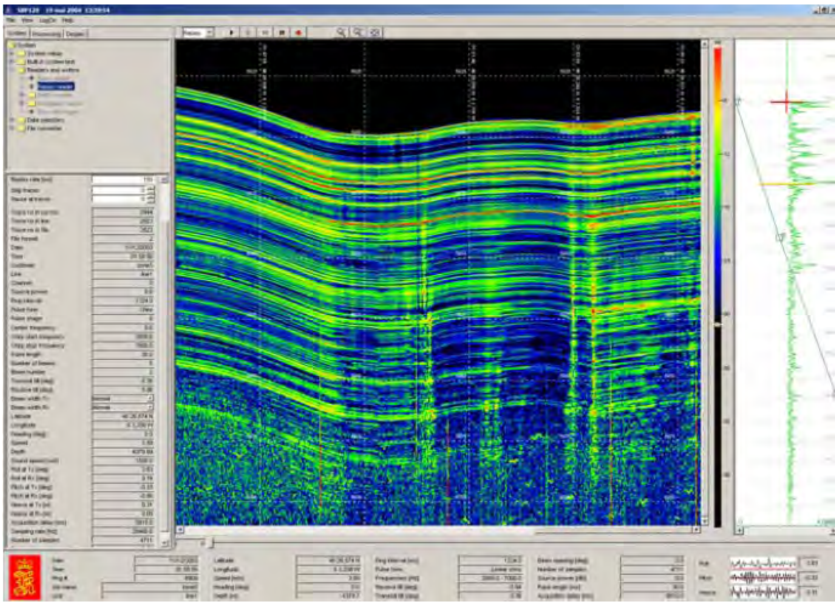


*Figure 4 Soft sediments in the Bay of Biscay. X-range: 2.8 km Y-range: 200 ms (~150). Max penetration about 150 ms. (SBP 120 data provided by courtesy of SHOM)*



# 3 INSTALLATION

## 3.1 Operator Station and Beamformer Unit

The Operator Station and Beamformer Unit are usually mounted in a 19” rack. The Beamformer Unit is supplied without its own user interface.

## 3.2 Electronic cabinets

The electronic cabinets are preferably installed close to the transducer arrays to reduce the amount of cabling. In most cases all units are mounted in the same room, but they may be moved elsewhere to allow easier access.

## 3.3 Transducer arrays

The transducer arrays should be mounted in the forward part of the vessel, taking into account hull shape, potential aeration problems and ease of cable installation.

The frames may either be mounted directly on or recessed into the hull, or within sea chests. The latter solution may be somewhat more expensive, but will ensure that the transducers are properly mounted within the tolerances required. A fairing will usually be added around the transducers to ensure a laminar water flow without any aeration problems. Ice protection windows may be added if required.

A blister or gondola installation will usually help in avoiding air bubble blockage of the transducers and may contain additional transducers for other systems.

*Figure 5 Transducer array installation example (Photo taken prior to mounting of baffle)*

# 4 OPERATION

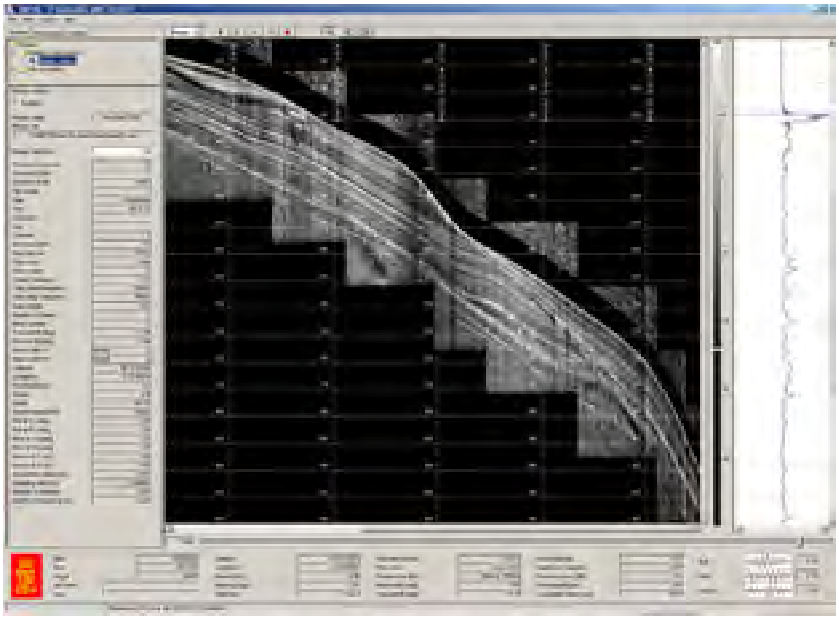
## 4.1 System control

The SBP 120 is controlled from the Operator Station using a graphical user interface. The system does not require intensive operator intervention during normal operation, as the bottom track and observation window can be controlled by the EM 120/122.

## 4.2 Operating system

The SBP 120 Operator Station software is operating under Microsoft Windows XP. The graphical user interface is therefore well known to most users with familiar use of menus and dialogue boxes.

*Figure 6 The SBP 120 Operator Station software (SBP 120 data provided by courtesy of SHOM)*



### Parameters

The SBP 120 Operator Station software provides the user with the following system parameter settings:

- Number of transmit channels
- Number of receiver channels
- Installation angles of the arrays measured in vessel coordinates
- Installation positions of the arrays in vessel coordinates
- Installation position of the motion sensor in vessel coordinates

The following operational parameters may be adjusted:

- Power level
- Pulse form
  - Pulse length
  - Sweep length
  - Start frequency
  - Stop frequency
- Transmission mode
- Transmit synchronisation
- Beam width
- Beamsteering mode
- Acquisition delay
- Acquisition window length
- Beam spacing and number of receiver beams

# 5 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 SBP 120 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 SBP 120 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 system check-out and final testing

## Documentation and training

The SBP 120 is delivered with complete documentation for installation, operation and maintenance. If required, the manuals may optionally be modified 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 24 months intervals. Close to 100% user participation has been experienced at these meetings.

### Warranty and maintenance contract

The normal warranty period of the SBP 120 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 a life-time warranty of transducers, upgrading of spare parts and documentation, and repeated or additional training courses.

# 6 SCOPE OF SUPPLY AND OPTIONS

### Standard system

A basic SBP 120 Sub-bottom profiler delivery includes:

**1** Operator Station HWS with 19” LCD monitor

**2** Beamformer Unit

**3** SBP 120 Transmitter Array

**4** SBP 120 Rx/Tx Junction Box

**5** SBP 120 Remote Control Unit with on/off control and built-in Ethernet switch

**6** Necessary cables and mounting frames in accordance with chosen system size

**7** Signal and control cables between cabinets; standard length is 5 m

**8** All system software

**9** System manuals covering system installation, operation and maintenance

### Options

System options available include:

**1** High resolution grayscale recorder for continuous seabed sediment structure hardcopy

**2** Ice protection windows

**3** Non-standard cable lengths between the transducer and the Transceiver Unit

**4** Spare parts

# 7 TECHNICAL SPECIFICATIONS

Note

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

### List of units and main sub-units

- Operator Station
  - The Operator Station may contain a number of sub-units and peripherals (for example storage units, printers and plotters). The configuration of these will be defined by the user.
- Beamformer Unit
- Transceiver Unit
- Transmit Transducer Array
- TX/RX Junction Box
- Remote Control Unit
  - The Remote Control Unit provides a pushbutton for local control of the Transceiver Unit on/off. It contains a network switch dedicated to communication between the Operator Station, the Beamformer Unit and the Transceiver Unit, and it contains a terminal block that provides interfaces to the two external trigger intputs, the trigger output, and the ready-to-send signal.

### Interfaces

- Operator Station:
  - Network or serial line interfaces (with operator adjustable baud rate, parity, data length, and stop bit length) for:
    * Positions in either Simrad 90, NMEA 0183 GGA and GGK formats.
    * External clock in NMEA 0183 ZDA format.
    * Input of depth, bottom slope angles and sound velocity information from EM 120/122 in a native KM datagram format or depth in NMEA DPT format.
    * Ethernet interface for output of all data logged to disk.
- Transceiver Unit

  Serial line interface for:
  - Motion sensor (roll, pitch, heave and optionally heading) in the SIMRAD EM Attitude format supported by sensors from Applanix, Seatex and TSS.

## 7.1 Physical specifications

### Transmit Transducer array

### Element

- **Length:** 184 mm
- **Width:** 184 mm
- **Height:** 270 mm
- **Module weight:** 12.5 kg

### Frame (3°)

- **Length:** 7450 mm
- **Width:** 800 mm
- **Height:** 350 mm (elements included)
- **Weight:** 1150 kg

### Cable Connection Unit

- **Weight:** 45 kg
- **Weight, four units:** 180 kg
- **Total weight of above: elements, frame and Cable Connection Unit (3°):** 2530 kg

### Transceiver Unit – Physical dimensions

- **Height:** 1400 mm
- **Width:** 600 mm
- **Depth:** 630 mm
- **Weight:** approx. 170 kg

### Remote Control Unit – Physical dimensions

- **Height:** 300 mm
- **Width:** 380 mm
- **Depth:** 155 mm
- **Weight:** 8.2 kg

### Tx/Rx Junction Box – Physical dimensions

- **Height:** 440 mm
- **Width:** 500 mm
- **Depth:** 303 mm
- **Weight:** 15.3 kg

### Operator Station and Beamformer Unit

- **Height:** 4U – 178 mm
- **Width:** 427 mm (excluding rack fixing brackets)

- **Depth:** 480 mm (excluding handles and connectors)
- **Weight:** Approximately 20 kg

Note

*Dimensions and weight will depend upon choice of workstation model, thus the following figures serve as a guideline only:*

### 19” LCD monitor

- **Height:** 440 mm (excluding mounting brackets)
- **Width:** 483 mm (excluding mounting brackets)
- **Depth:** 68 mm (excluding mounting brackets)
- **Weight:** 12 kg (approximately with bracket)

## 7.2 Power requirements

### Operational voltage and frequency

- Transceiver Unit
  - 220 to 240 Vac
  - 8 kW
  - 47 to 63 Hz
- Operator station
  - 100 to 240 Vac
  - < 300 W
  - 47 to 63 Hz
- EM 120/122 Preamplifier Unit
  - 100 to 240 Vac
  - < 300 W
  - 47 to 63 Hz
- TX Junction Box
  - Not applicable
- Remote control Unit
  - Same as LAN switch

### Acceptable transients

- **Short time (max 2 sec)**: ±25 %, 42-69 Hz
- **Spikes (max 50µs):** <1000 V

### Power interrupts

The use of an uninterruptable power supply (UPS) is highly recommended.

## 7.3 Restrictions for use – limitations

Do not ping in drydock.

## 7.4 Operating and storage temperature

- **Transceiver Units, EM 120/122 Preamplifier Unit:** 0 to 45 °C
- **Operator Station and Beamformer Unit:** 0 to 40°C
- **Storage:** -30 to + 70 °C

## 7.5 Surface finish

All cabinets are painted. System units exposed to salt water must be treated accordingly.

## 7.6 System performance , 3 degrees system

- **Frequency:** 2.5 to 6.5 kHz
- **Number of beams per ping:**
  - Tx: 1
  - Rx: max. 11
- **Beamwidth, 4 kHz:** (along x across)
  - Tx: 3 x 35 degrees
  - Rx: 80 x 3 degrees
- **Beam spacing:** ≤ 15°
- **Fan width:** ≤30°
- **Transmit beam steering:** ±20°(along, pitch ≤10°, bottom slope ≤10°)
- **Receive beam steering:** ±25°(across, roll ±15°, bottom slope ±10°)
- **Depth resolution:** 0.3 ms
- **Pulse length:** From 2 ms to 100 ms
- **Sampling rate:** 20.48 kHz

## 7.7 Environmental specifications

### Vibration and shock

- **Vibration during storage and transport**
  - **Frequency range:** 5 to 500 Hz
  - **Excitation level:** ±0.7 g

  Reference document: IEC publication 68-2-6

- **Vibration during operation (locations 1, 2, 3 and 4)**
  - **Frequency range:** 5 to 500 Hz
  - **Excitation level:**

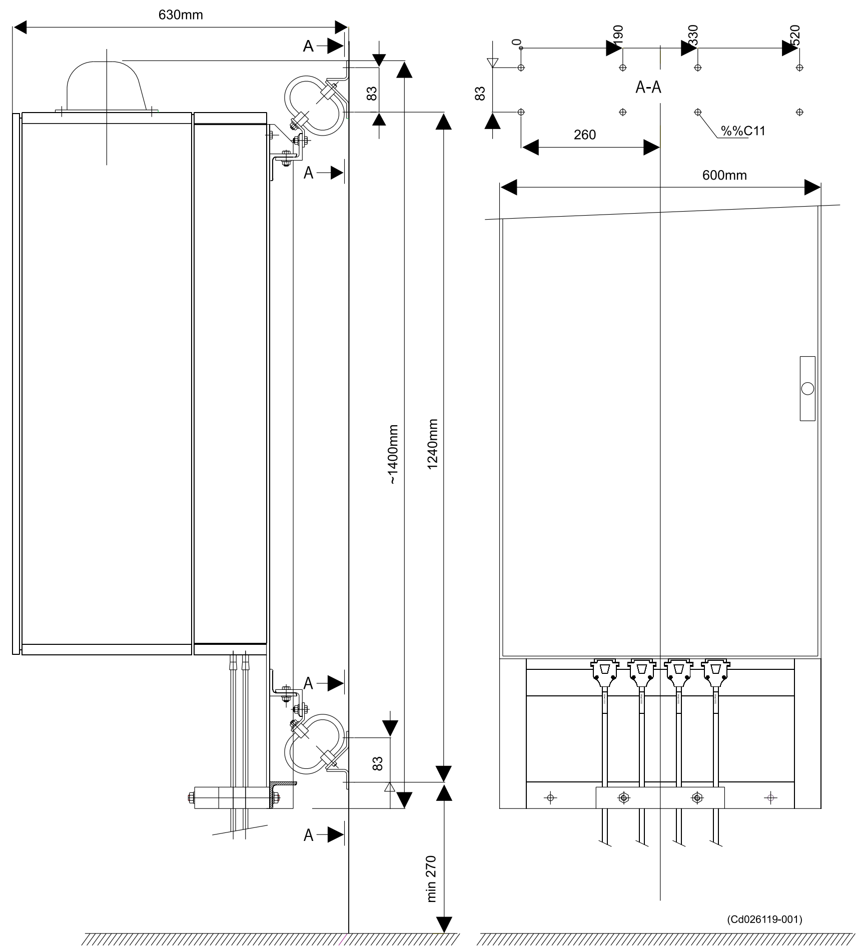
    5 to 13.2 Hz: ±1.5 mm

    13.2 to 100 Hz: 1 g
  - **Sweep rate:** 1 oct/min
  - **Duration:** 10 sweeps 5-100-5 Hz

    Reference document: IEC publication 68-2-6 (Test Fc)
- **Shock during storage and transport, free fall:**
  - **> 500 kg gross weight:** max 25 mm fall

# 7.8 Transceiver Unit outline dimensions

*Figure 7 SBP 120 Transceiver Unit outline dimensions*




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

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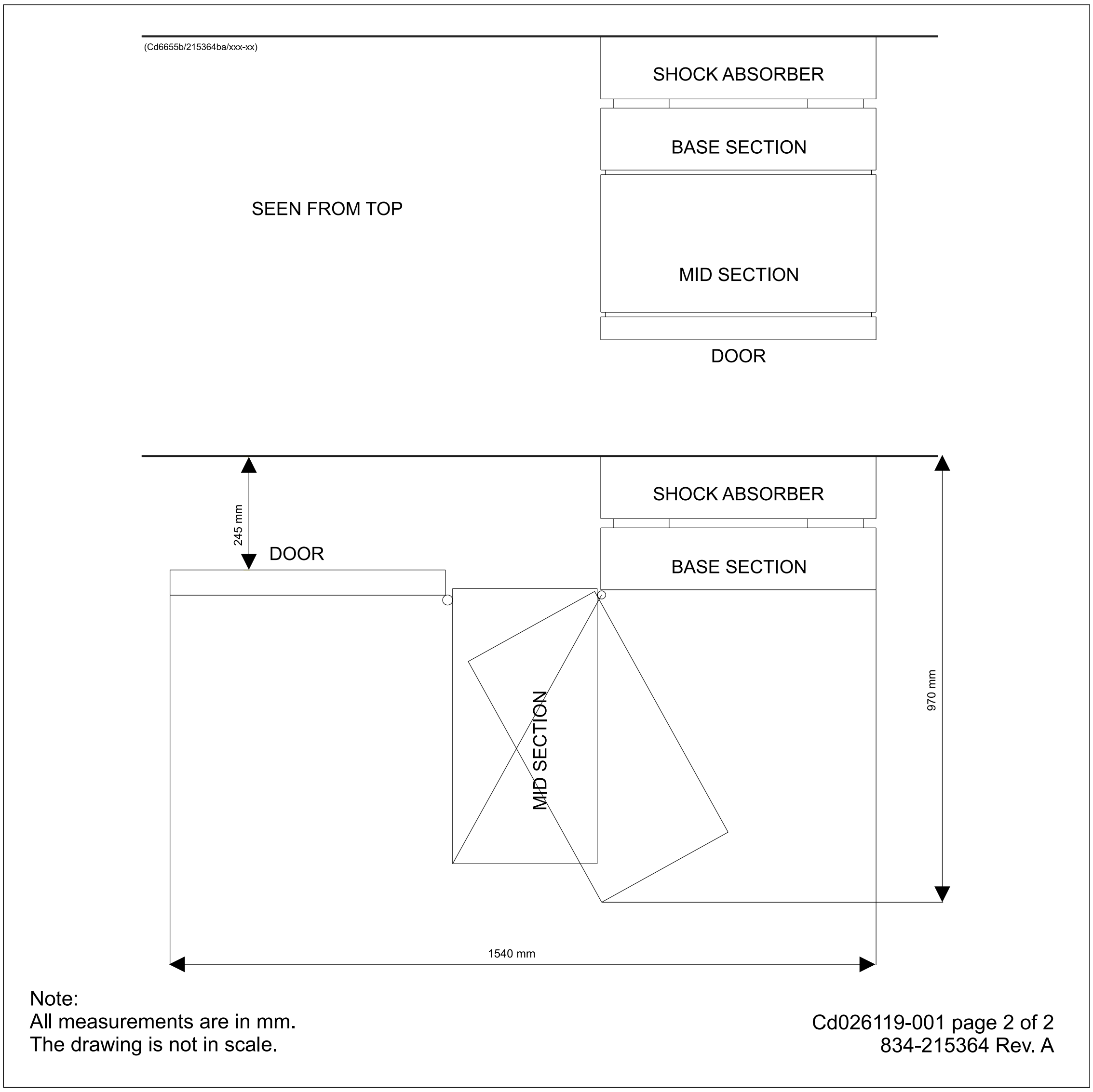
*Figure 8 SBP 120 Transceiver Unit outline dimensions*



# 8 SBP 120 / TOPAS COMPARISON

The following table briefly defines the main differences between the SBP 120 system supplied by Kongsberg Maritime and the TOPAS system supplied by Kongsberg Defence & Aerospace

*Table 2 SBP 120 / TOPAS*

| Model | SBP 120–3 | SBP 120–6 | SBP 120–12 | TOPAS PS 018 |
|---|---|---|---|---|
| Operating principle | Linear | | | Parametric |
| Frequency range | 2.5 to 6.5 kHz | | | 0.5 to 6 kHz |
| Source level | Typ. 220 dB | 214 dB | > 208 dB | 208 dB |
| Signatures | CW, Linear or Hyperbolic chirp, Ricker | | | CW, Chirp, Ricker |
| Heave compensated | Yes | | | Yes |
| Pitch compensated | Yes | | | Yes |
| Roll compensated | Yes | | | Yes |
| Transmit transducer | 8 x 0.8 m | 4 x 0.8 m | 2 x 0.8 m | 1.1 x 1.1 m |
| Receive transducer | EM 122 | | | Same as Tx, optional EM 122 |
| Beamforming principle | Mills cross | | | On transmit |
| No of simultaneous beams | 11 | | | 1 |
| Fan of beams | Simultaneous | | | Scanning |
| Beam width @ 4 kHz | 3°x3°<br>3°x6°<br>3°x12° | 6°x6°<br>6°x3°<br>6°x12° | 12°x12°<br>12°x3°<br>12°x6° | < 5°x5° |
| Side lobe structure | < –20dB | | | No side lobes |
| Vertical resolution | 0.3 ms | | | 25 cm |
| Bottom detection | Built-in/EM 122 / Other external echo sounder | | | Built-in |
| External trig | Yes | | | Yes |
| Transmission pattern optimized for EM 122 timing | Yes | | | No |
| Terrain adapted beam steering | Yes (requires EM 122 running or manual slope input) | | | Requires slope input |
| Audible noise inside hull | Reduced by baffle | | | None |
| System operation | Integrated with EM 122 or independent | | | Independent |

# 9 COMPANY PROFILE

### Kongsberg Maritime

Kongsberg Maritime is a leading supplier of advanced maritime automation and instrumentation systems. We deliver systems for dynamic positioning and navigation, marine automation, cargo management and level sensors, maritime training simulators and position reference systems. Important markets include countries with large offshore and shipyard industries. The company has approximately 3300 employees and an annual turnover of MNOK 6.425 (year 2008). Kongsberg Maritime owns subsidiaries in Spain, 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 optimize 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.

Kongsberg Maritime's main office is situated in Horten, Norway.

*Figure 9 Kongsberg Maritime's facilities in Horten*

The premises located at Strandpromenaden in Horten houses the hydroacoustic activities. Sharing premises with Simrad AS, producer of echo sounder and sonars for the world's fishing fleet, the professionals in this facility share more than 60 years of experience in single and multibeam echo sounding, sonar technology and underwater communication and instrumentation. The facility'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 10 The test and demonstration yacht "M/K Simrad Echo"*

The product ranges provided by Kongsberg Maritime's Strandpromenaden facility in Horten include:

- Single and multibeam echo sounders for hydrographic applications
- Underwater communication
- Underwater positioning reference systems (including the highly accurate HiPAP® system)
- Naval sonars and echo sounders (hull mounted and towed systems)
- The world renowned HUGIN remotely operated vehicle
- Sonars, echo sounders and catch monitoring systems for the world's professional fishing and scientific communities
- Scientific multibeam echo sounders and sonars for the international fishery research community

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

Visit Kongsberg Maritime at http://www.km.kongsberg.com.

### Kongsberg Group

Kongsberg Gruppen ASA (the Kongsberg Group) is one of Norway's leading high-technology companies. With an operating revenue of MNOK 11.056 (in 2008), 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 the following major business areas:

- Kongsberg Maritime

- Kongsberg Oil & Gas Technologies
- Kongsberg Protech Systems
- Kongsberg Defence Systems

These companies are fully owned by the Kongsberg Group. The Kongsberg Group is represented world wide.

Visit the Kongsberg Group at http://www.kongsberg.com.

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