APPLICATION NOTE

DISCOVERING THE REDEFINED EM® MULTIBEAM ECHO SOUNDER SERIES

KONGSBERG

WHY CHOOSE KONGSBERG MARITIME MULTIBEAM PRODUCTS?

No other manufacturer provides a product range that includes models for all water depths and virtually any seabed mapping application. All systems are supported by robust bottom detection algorithms producing very high resolution sounding density and the cleanest multibeam datasets of the seafloor. Compliance with IHO S-44 Orders and LINZ hydrographic standards plus exceptional high sounding accuracy have always been outstanding features of our systems.

Fully stabilized and focused beams in real time ('ONLY KONGSBERG')

Only Kongsberg EM systems apply beam focusing to both transmit and receive beams in order to obtain the maximum resolution even inside the acoustic near-field of the antenna. During transmission, focusing is applied individually to each transmit sector with a focus point on the range defined by the previous ping, to retain the angular resolution in the near field. Dynamic focusing is applied to all receive beams. Roll (±15°), pitch (±10°) and yaw stabilization (±10°) is applied in real time.

Sound Velocity Correction and Full Depth Corrections in real time ('ONLY KONGSBERG')

The sound speed at the transducer depth, the sound speed profile and the vessel attitude both at transmit and receive time are employed to calculate the coordinates of each sounding relative to the water surface and vessel heading. Attitude offsets, time delay and sensor locations including vessel travel are applied in this procedure. The refraction calculations are carried out using Snell's law assuming constant gradients within the layers defined by the sound speed profile, starting at the actual depth of the transmit transducer at the transmit time.

KMALL - The most open and manageable multibeam data format ever created ('ONLY KONGSBERG')

The .KMall format makes it much easier to post-process the logged data as it contains already calculated latitude, longitude, depth, time and ellipsoidal height. Different Delayed Heave scenarios are possible for various acquisition and post-processing workflows. Open source codes developed for logging and controlling are already available in platforms like GitHub. Kongsberg also offer a complete set of documentation in .html format and examples in C++ and Python showing how to read the .KMall files. Other manufacturers depend on third party acquisition software to log their raw datasets.

SHALLOW WATER HYDROGRAPHIC SURVEYS (THE EM 2040 SERIES)

The **EM 2040 MKII** Multibeam Echo Sounder was the first 3-sector broadband multibeam echo sounder in the market, now offering from 200 – 700 kHz. The first system to bring all the advanced features of deep water multibeam systems to the near bottom sounding environment, hence it is capable of complete roll, pitch and yaw stabilization, dual swath, utilizing FM transmit pulses for deeper water depth ranges, and nearfield focusing on both transmit and receive.

The **EM 2040P MKII** and **EM 2040C MKII** are shallow water multibeam echosounders based on the EM 2040 technology, ideal tools for any high resolution mapping and inspection applications. The receiver and transmitter are integrated in a common sonar head.

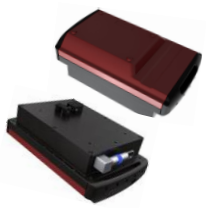
Single or dual swath capability for increased seafloor coverage is available on all EM 2040 series. Dual swath effectively doubles the system's ping rate enabling the surveyor to either increase survey speed whilst maintaining full coverage, alternatively maintaining normal survey speed and archiving twice as many beams per ping sequence.

Model	Frequency No. Beams	Min/Max Depth	Max Swath Width	Available Configurations
EM 2040 MKII Versions: - Single RX, Single Swath - Single RX, Dual Swath - Dual RX, Single Swath - Dual RX, Dual Swath - Dual TX, Dual RX, Single Swath	200 - 700 kHz 512/1024/2048	0.5 - 635m	**Single RX**: 8 x depth/ 900m / 170 degrees **Dual RX** 10 x depth/ 980m / 220 degrees	Arrays: 0.4° or 0.7° TX and 0.7° RX Best available beamwidth: 0.225° x 0.45° CW and FM transmit pulses
EM 2040P MKII Versions: - Single Swath - Dual Swath	200 - 700 kHz 512/1024	0.5 - 600m	**Single Head**: 7.5 x depth/ 830m / 170 degrees	Array, single head only: 1° x 1° Best available beamwidth: 0.6° x 0.6° CW and FM transmit pulses
EM 2040C MKII Versions: - Single Head, Single Swath - Single Head, Dual Swath - Dual Head, Single Swath - Dual Head, Dual Swath	200 - 400 kHz 512/1024/2048	0.5 - 520m	**Single Head**: 5.5 x depth/ 580m / 140 degrees **Dual Head***: 10 x depth/ 700m / 200 degrees	Array, single or dual head: 1° x 1° Best available beamwidth: 0.6° x 0.6° CW and FM transmit pulses

* High Frequency Mode (600/700 kHz) is not available for EM 2040 MKII Dual RX or EM 2040C MKII Dual Head

EM 2040 MKII TX/RX Array

EM 2040P MKII



EM 2040C MKII

EM 2040C MKII Dual Head

MORE HISTORICAL INNOVATIONS AND ADVANCES THAN ANY OTHER SONAR MANUFACTURER

The End of Data Cleaning

We are proud that our systems are recognized by many customers to collect the cleanest multibeam datasets on the globe. The maps/charts are produced faster, reducing your ship survey and processing time. Surveying to charting made easy!

SIS5 and SIS Remote

Seafloor Information Systems (SIS5) has been redesigned in order to improve both user experience and work processes. The modern window environment, menus and layout are more intuitive, helping the operator to work more efficiently. The new 3D displays handle all depths, even when displaying shallow water multibeam data at maximum ping rate. The background maps can be generated from GeoTIFF or S-57 charts using Web Map Services (WMS).

A single SIS installation can support multiple survey vessels simultaneously, and the EM system can be controlled from any remote location. The connection between e.g. the mother ship and the survey vessels is via a standard internet connection, such as KONGSBERG's Marine Broadband Radio (MBR). This setup provides a reliable Internet connection for the surveyor on the mother ship to monitor and control the survey operation on each of the survey vessels from one operator station. SIS Remote can alternatively be used from the office enabling colleagues to follow an ongoing operation and even alter plans.

High Frequency Mode detailed inspection and mapping

The EM 2040 series offers frequencies from 200 to 400 kHz as standard. However, 600 kHz and 700 kHz modes are also available through a simple software upgrade. The 700 kHz frequency provides beam widths of 0.225° x 0.45° at a narrow swath width; whereas the 600 kHz mode maintains efficient area surveying with 100° coverage, or even up to 120° depending on the bottom roughness. There are some important advantages of our 600 kHz mode versus competitors' products using 700 kHz mode:

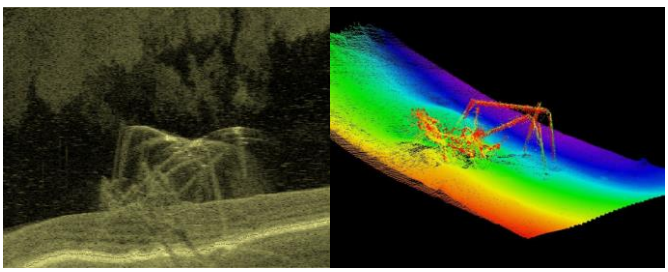
- Larger operational depth range with 3 depth modes providing more than 40 meters range at very high resolution
- Better resolution due to the shortest pulse length of 14 microseconds, the best in the market.

Extra Detections (ED)

With Extra Detections the system can utilise both Amplitude and Phase information to bottom detect up to seven soundings per beam resolving both mid water and seafloor. This results in far more available information when assessing difficult structures without complicated import procedures or the additional storage requirements from traditional water column data.

EM® MultiFrequency Backscatter Mode

Multi-frequency multibeam echosounder technology is meant to improve not only high resolution inspection surveys using different frequencies simultaneously but also the backscatter mosaics for seafloor surface characterization (habitat mapping, geophysical surveys etc.). Our broadband multibeam systems allow for a flexible multi-frequency backscatter representation of the seafloor providing up to 5 frequencies in a single pass by alternating between the frequency modes per ping. That is, users can simultaneously collect multi-frequency backscatter running only one survey line. For each swath users can select different values for frequency, swath width and pulse length. Also, users could select several swaths of the same (or different) frequency but at different pulse lengths; providing a multi-pulse option within the multi-frequency function. More details available in a technical note.



PORTABLE SYSTEMS TO SURVEY DOWN TO 600M WATER DEPTHS (ONLY KONGSBERG)

It is with great confidence that we can state that there is no other portable unit in the market that can reach 600m water depths. The EM 2040P MKII is a unique portable product with unique performance only seen in bigger sonars .

Taking the portable concept to a whole new level

MID/DEEP WATER SURVEYS (EM 712 SERIES)

The **EM 712** multibeam echosounder is Kongsberg Maritime's second generation high to very high resolution seabed mapping system capable of meeting all relevant survey standards. The system's configuration can be tailored to the user's requirement, allowing for choice of beam widths as well as transmission modes.

The minimum survey depth is from less than 3 meters below the transducers, and the maximum depth is an unmatched 3600 meters. Across track coverage (swath width) is up to 5.5 times water depth; with a maximum of more than 4400 meters. This is almost twice the range performance of its predecessor, EM 710. Dual swath capability for increased seafloor coverage is available.

Further key advances made for the EM 712 include low-noise receiver transducers and electronics in addition to a smaller, modular topside electronics, enabling for more flexible installation on a wider variety of vessels.

Innovative acoustic principles

The EM 712 operates at the frequency range of 40 to 100 kHz. The transmit fan is divided into three individual sectors to maximize range capability, but also to suppress interference from multiples of strong bottom echoes. The effect of this is that strong reflectors outside the current TX sector will get twice the sidelobe suppression on TX and RX when compared to sounders with only one wide TX sector.

The sectors are transmitted sequentially within each ping, and uses distinct frequencies or waveforms. EM 712S and EM 712RD both use CW pulses of different lengths. The full performance version, EM 712, supports even longer, compressible waveforms (FM sweep).

Choice of transducers and beam widths

The active elements of the EM 712 transducers are based upon composite ceramics, a design which has several advantages, in particular increased bandwidth and tighter performance tolerances. Normal transducer mounting is flush with the hull, in a blister or in a gondola. The 1° x 2° and 2° x 2° versions can be mounted on a pole for portable deployment.

The transmit and receive beamwidth depends upon the chosen transducer configuration with 0.25°, 0.5°, 1° and 2° transmitter arrays and 0.5°, 1° and 2° receiver arrays are available as standard.

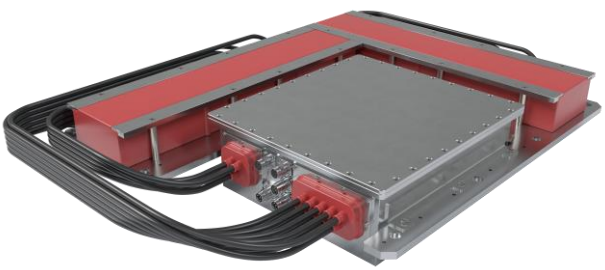
EM 712 USV for Unmanned Surface Vehicles

A constraint of many USVs is available space, and the EM 712 USV tackles this by introducing a new smart subsea compartment for parts of the system which normally are installed above the waterline. The compartment houses the electronics for both the transmit- and receive antenna and it fits well within the footprint of the transducer arrangement. Based on the customer's requirements, the transducer cables will be customized in length.

Version	Frequency No. Beams	Min/Max Depth	Max Swath Width	Standard Configurations
EM 712RD Short CW pulses only, restricted to 600 m water depth	40 - 100 kHz 400	3 - 600 m	5.5 x depth/ 1300m / 140 degrees	1° x 2°, 2° x 2° Short CW transmit pulses
EM 712S CW pulses only	40 - 100 kHz 400/800	3 - 1800 m	5.5 x depth/ 2800 m / 140 degrees	0.25° x 0.5°, 0.5° x 0.5°, 0.5° x 1°, 1° x 1°, 1° x 2° and 2° x 2° CW transmit pulses
EM 712 Full performance version	40 - 100 kHz 800/1600	3 - 3600 m	5.5 x depth/ 4200 m / 140 degrees	0.25° x 0.5°, 0.5° x 0.5°, 0.5° x 1°, 1° x 1°, 1° x 2° and 2° x 2° CW and FM transmit pulses
EM 712 USV Full performance version for Unmanned Surface Vehicles (RD and S are optional versions)	40 - 100 kHz 800/1600	3 - 3300 m	5.5 x depth/ 3650 m / 140 degrees	1° x 1°, 1° x 2° and 2° x 2° CW and FM transmit pulses

EM 712 TX/RX Units (top side)

EM 712 USV, 1° x 1°



FULL OCEAN DEPTH SURVEYS (EM 124 AND EM 304 MKII)

The masters of the deep water market

Our new **EM 304 MKII** Multibeam Echo Sounder consists of new state-of-the-art electronics and transmitter arrays allowing the system to reach full ocean depth. Care has been taken to design a highly, modular and flexible solution with compact electronics for easier and faster installation. It utilizes the new MKII transmit modules combined with the solid receive arrays from its predecessor, EM 302. Due to a flexible transducer design, the system can be tailored to almost any required size. The largest standard size, 0.3 x 0.5 degrees, gives the ultimate system performance in terms of resolution and range, while a smaller 4 x 4 degrees solution can be installed on any vessel of opportunity.

The **EM 124** is designed to perform seabed mapping to full ocean depth with an unsurpassed resolution, coverage and accuracy. It uses the same transducers as its predecessor, EM 122, but with new electronics. The modular, state-of-the-art EM 124 is a low noise echo sounder, which delivers superior data that requires minimal post-processing.

Full seabed coverage

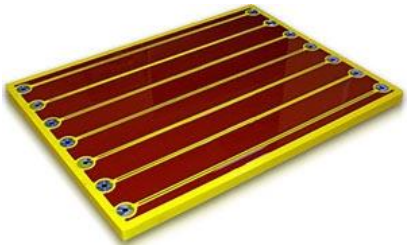
For both systems (EM 304 MKII and EM 124) the transmit fan is divided into up to 16 individual sectors in dual swath mode. This allows for unique control of the transmit fan, enabling active stabilization in real time to correct for any yaw and pitch movement of the vessel, while roll stabilization is applied on the receiving beams. The result is a stabilized system for full insonification of the seabed with equally distributed footprints, even in poor weather conditions, leaving no gaps or holes in the mapped area. Beams are maintained and automatically adjusted according to achievable coverage or operator defined limits. Up to 1600 individual beams are available in dual swath mode.

Model	Frequency No. Beams	Min/Max Depth	Max Swath Width	Standard Configurations
EM 304 MKII	20 – 32 kHz 400/800/1600	10 - 11000 m	5.5 x depth/ 14.4 km / 143 degrees	0.3° x 0.5°, 0.45° x 0.5°, 0.45° x 1°, 0.9° x 1°, 0.9° x 2°, 1.8° x 2°, 1,8° x 4° and 3,6° x 4° Other customer specific configuration on request, especially for upgrade EM 302/EM 304
EM 124	12 kHz 400/800/1600	20 - 11000 m	6 x depth/ 40 km / 143 degrees	0.5° x 1°, 1° x 1°, 1° x 2°, 2° x 2° and 2° x 4° Other customer specific configuration on request

EM 304/SBP29 - Gondola Installation

EM 124/SBP29 - Gondola Installation

Acoustic ice protection windows can be offered for vessel going to the ice rand and for ice breakers. Both TX and RX ice windows are made of hyperlast reinforced with titanium rods proven to withstand surveys under any icy, polar conditions.



110-0010147/B September 2022

KONGSBERG MARITIME
Switchboard: +47 815 73 700
Global Customer Support 24/7: +47 33 03 24 07
E-mail sales: km.sales@km.kongsberg.com
E-mail support: km.hydrographic.support@km.kongsberg.com
Webpage: www.km.kongsberg.com

KONGSBERG