

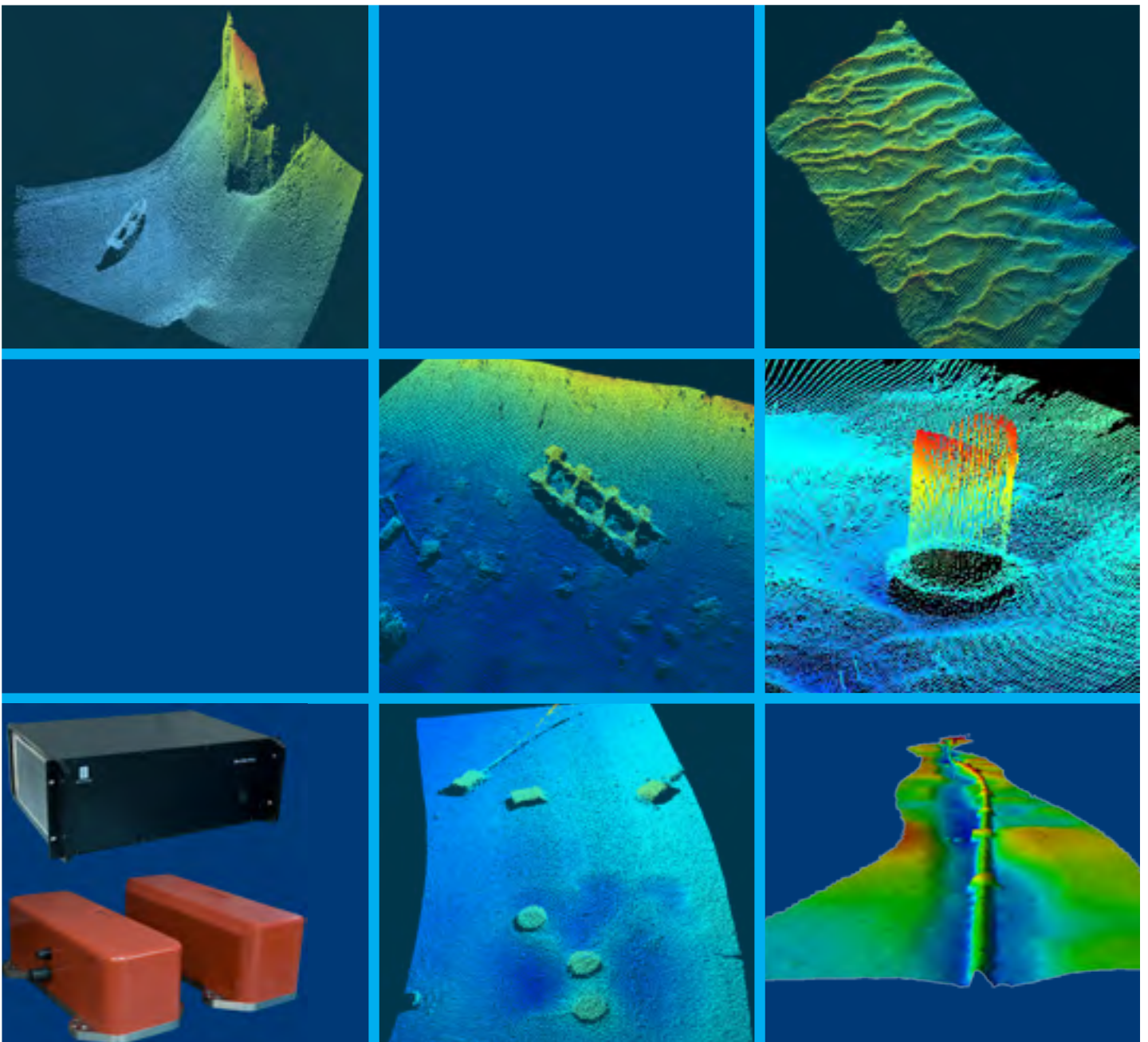


KONGSBERG

EM 2040

Multibeam echo sounder

**True wide band high resolution
multibeam echo sounder**



Key facts

The EM 2040 multibeam echo sounder is the first system to bring all the advanced features of deep water multibeam to the near bottom sounding environment. Important deep water system features included with the EM 2040 are:

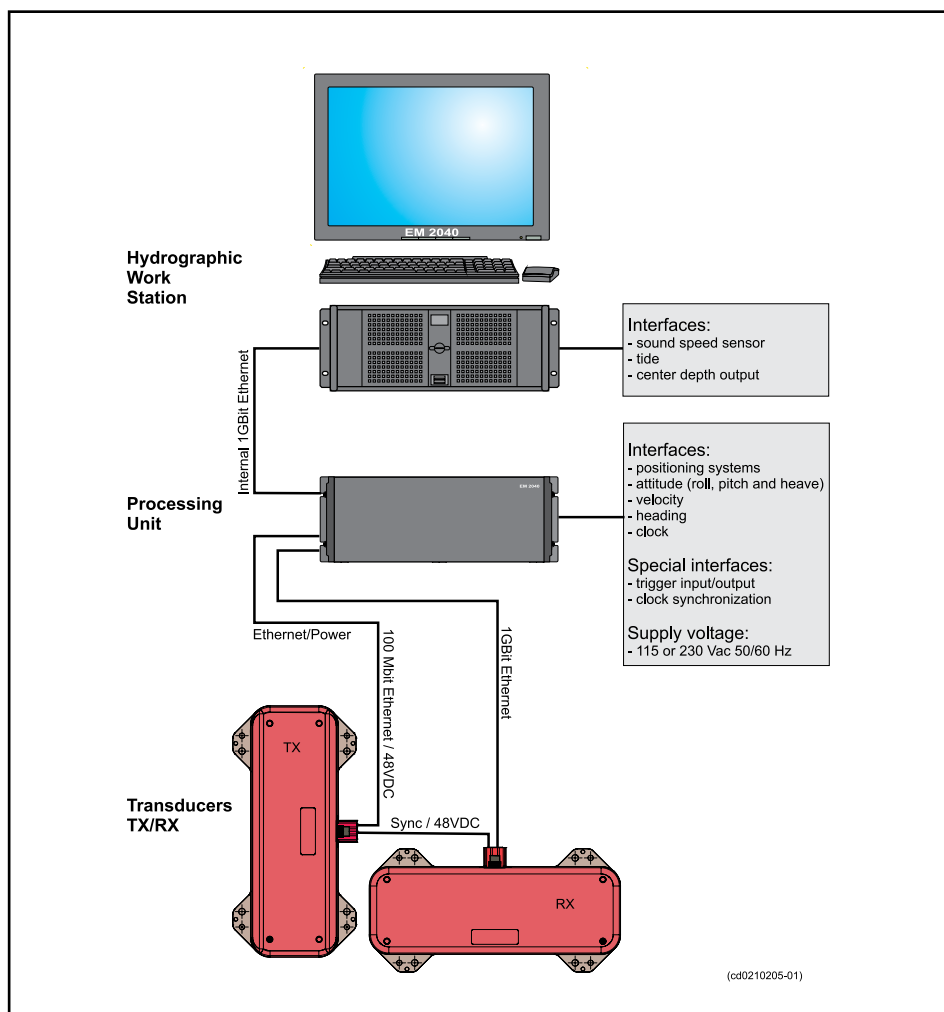
- Dual swath per ping to allow a doubling of survey speed
- FM chirp to achieve a much longer range capability
- Complete roll, pitch and yaw stabilization
- Nearfield focusing both on transmit and receive

The EM 2040 is modular, allowing the user to tailor the beamwidths to the operational requirements, 0.5 by 1 and 1 by 1 degrees. The transmit fan is divided into three sectors pinging simultaneously at separate frequencies. This ensures a very strong and beneficial dampening of multibounce interference which on simpler systems often is seen at beam angles from 60 degrees and outwards. The EM 2040 has dual swath capability, allowing a sufficient sounding density alongtrack at a reasonable vessel speed, for example 8 knots achieving 100% coverage with a 0.5 degree transmit fan.

The operating bandwidth available on the EM 2040 is unprecedented, from 200 to 400 kHz, which is a full octave, and this is achieved with the standard transducers. The operator can thus on the fly choose the best operating frequency for the application, 300 kHz for near bottom, 200 kHz for deeper waters, and 400 kHz for very high resolution inspection.

The bandwidth of the EM 2040 transducers allows the system to effectively operate with very short pulse lengths, i.e. down to 25 microseconds. With 25 microseconds pulse length the raw range resolution ($c\tau/2$) will be less than 20 mm.

The EM 2040 is well suited for surveys meeting the IHO-S44 special



order.

The standard depth rating of the EM 2040 subsea parts is 6000 m. The system is thus fully prepared for operation on subsea vehicles such as AUVs or ROVs. All analog electronics are contained in the transducers, and communication to the topside Processing Unit is on standard Ethernet. For subsea vehicle use the Processing Unit may be mounted in a pressure vessel with an inner diameter as small as 230 mm.

Components

The basic EM 2040 has four units, a transmit transducer, a receive transducer, a processing unit, and a workstation. For completeness, data input from a motion sensor and a positioning system is required, as is the sound speed profile of the water column between the transducers and the bottom. Sound speed at the transducer is an optional input.

The EM 2040 is delivered with a

mounting plate with factory aligned guidances. It is recommended that the mounting plate is built into a steel casing and protected by a baffle for multipath reduction. Optionally, the transducers may be delivered mounted on a frame together with the motion sensor and a sound speed sensor, factory aligned for ease of mounting.

The EM 2040 is a modular system, fully prepared for upgrading to cater for more demanding applications. The transmit transducer has an angular coverage of 200° ($\pm 100^\circ$) as standard, allowing a coverage of 5.5 times water depth when matched with a single receive transducer. Adding a second receive transducer allows surveying to the water surface or up to 10 times water depth on flat bottoms. The transducers are separate units with titanium housings.

The transducers are interfaced to a processing unit via Ethernet, 100 Megabit/s to the transmit transducer and Gigabit from the receive

transducer. The Processing Unit also supplies power to the transducers. Operator control, data quality inspection and data storage is handled by the hydrographic workstation running the same SIS software as all other Kongsberg multibeam.

Operational modes

The EM 2040 has a frequency range of 200-400 kHz. Three standard modes are available. 300 kHz is used for normal operation, giving an optimum balance between high resolution, depth capability and tolerance of detrimental factors such as water column sediments. 200 kHz is available for meeting requirements to operate at the standard hydrographic single beam

frequency, but also to achieve the best depth capability. 400 kHz is provided for inspection work with the utmost resolution.

The normally recommended survey frequency is 300 kHz. At this frequency the bandwidth used is more than 75 kHz with three angular sectors which are run at separate frequencies. With dual swath six separate frequencies are used. The minimum pulse length is 35 microseconds. The range resolution is then 26 mm. For deep waters FM chirp is employed with a bandwidth of 1.7 kHz. This allows a swath width in the order of 550 m and a depth capability of about 350 m in cold ocean waters.

The 200 kHz frequency mode has the same CW pulse lengths as

the 300 kHz mode. The FM chirp pulse length is extended compared to the 300 kHz mode. Normally two sectors are used per swath. At this frequency the absorption in the water is lower than at 300 kHz, resulting in increased swath width and depth capability. In cold ocean waters with FM chirp a swath width of 700 m can be expected, and approximately 500 m depth capability achieved.

The 400 kHz frequency mode is intended for high resolution inspection work. Very short transmit pulses and wide receiver bandwidth is used. The operator may choose between one and three transmit sectors. With a single RX transducer the coverage can be up to 120° ($\pm 60^\circ$), and with dual RX the coverage can be up to 180° ($\pm 90^\circ$). The shortest pulse used is 25 μs . It is also possible to run dual swath, but not with the shortest pulse length.

Advanced functions

- Frequency range: 200 to 400 kHz
- Dual swath capability, allowing a sufficient sounding density alongtrack at a reasonable survey speed
- FM chirp allowing much longer range capability
- Complete roll, pitch and yaw stabilization
- Nearfield focusing on both transmit and receive
- Operates with very short pulse lengths, down to 25 microseconds
- The depth rating of the subsea parts is 6000 m



Transducer array (Rx/Tx)



Monitor



Hydrographic Work Station (HWS)



Processing Unit (PU)

Technical specifications*

- Frequency range: 200 to 400 kHz
- Max ping rate: 50 Hz
- Swath coverage sector: Up to 140° (±70°) (single RX) / 200 ° (±100°) (dual RX)
- Sounding patterns: Equiangular, Equidistant and High Density
- Roll stabilized beams: Yes, +/-15°
- Pitch stabilized beams: Yes, +/-10°
- Yaw stabilized beams: Yes, +/-10°

0.5 x 1 degrees **	Max depth		Max coverage	
	Cold ocean	Fresh water	Cold ocean	Fresh water
Operating frequency				
200 kHz	500 m	1070 m	740 m	1520 m
300 kHz	370 m	590 m	580 m	920 m
400 kHz	200 m	270 m	310 m	420 m

1 x 1 degrees **	Max depth		Max coverage	
	Cold ocean	Fresh water	Cold ocean	Fresh water
Operating frequency				
200 kHz	470 m	1000 m	700 m	1410 m
300 kHz	360 m	560 m	550 m	860 m
400 kHz	180 m	250 m	290 m	390 m

Pulse lengths	200 kHz		300 kHz		400 kHz	
	CW	FM	CW	FM	CW	FM
Normal mode	70, 200 and 600 µs	12 ms	70, 200 and 600 µs	6 ms	50 and 100 µs	N/A
Single sector mode	35, 70 and 150 µs	1.5 ms	35, 70 and 150 µs	1.5 ms	25 and 50 µs	N/A

Max no. of soundings per ping (dual swath)		200 kHz	300 kHz	400 kHz
Single RX	1° RX	800	800	800
Dual RX	1° RX	1600	1600	1600

Physical dimensions (excluding connectors and mounting arrangements)					
	200 kHz	300 kHz	400 kHz	Dimensions	Weight
Tx	0.75°	0.5°	0.4°	727 x 150 x 142 mm (L x H x W)	45 kg
Tx	1.5°	1°	0.75°	407 x 150 x 142 mm (L x H x W)	24 kg
Rx	1.5°	1°	0.75°	407 x 136 x 142 mm (L x H x W)	23 kg
Processing Unit (4U 19" rack)***				447 x 178 x 345 mm (W x H x D)	15 kg
Hydrographic Work Station (4U 19" rack)				427 x 178 x 480 mm (W x H x D)	20 kg
19" Monitor				483 x 444 x 68 mm (W x H x D)	12 kg

* Preliminary specifications. All options may initially not be available

** Beamwidths applicable to 300 kHz

*** More than one Processing Unit may be necessary

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

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