



EM 2040 family

Multibeam echosounders for inspection and shallow water survey

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UNDERWATER MAPPING

MULTIBEAM ECHO SOUNDERS

- M3
- EM 2040 family
- EM 712
- EM 304 MKII
- EM 124

SINGLEBEAM ECHO SOUNDERS

- EA 640
- EA 440

	SUB	BOT	TOM	PROF	LERS	
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- TOPAS PS 18, PS 40 and PS 120
- SBP-29 and SBP-27
- EA Sub-bottom

SIDE SCAN SONAR

- HISAS 1032
- EA Sidescan

<u>VEHICLES</u>

• Sounder

Best Sensor Resolution, Accuracy and Area Coverage

From the shallowest waters to the full ocean depth, we've got it covered

M3	
EM 2040C	
EM 2040P	
EM 2040	
EM 712	
EM 304MKII	11000m
EM 124	11000m

WORLD CLASS - through people, technology and dedication



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HYDROGRAPHY & SAFETY OF NAVIGATION OFFSHORE RENEWABLE ENERGY PIPE AND CABLE LAY PORT OPERATION HARBOUR SURVEYING AND DREDGING SCIENTIFIC RESEARCH HABITAT MAPPING











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KM - Sounder





L3 ASV - C-worker

Maritime Robotics - Otter & Mariner



Ocean Alpha - ME120 & M40



Saildrone - Surveyor

Armada

IxBlue - DriX



Hushcraft



FUGRO - USV



XOCEAN



When is EM 2040 the better choice ?

- High performance 100% seabed ensonification Clean data High speed Rough weather High resolution Normalized Seabed Image Long range
- = Large swath, long range, stabilized TX/RX and Dual swath
- = Active Roll, Pitch and Yaw stabilization
- = Very clean data due to Sector Transmission and focused TX/RX beamforming
- = Survey up to 16kn and still meet S-44 Special Order due to Dual Swath
- = Fully stabilized TX and RX
- = 0.2-degree TX and 0.4deg RX
- = The best Seabed Image, recognized by customers
- = >220deg and >600m range due to FM Chirp









Processing Units

- Portable Processing Unit PPU (10kg)
- Standard Processing Unit (10kg)
- PPU in pelicase with laptop (34kg)







Hydrographic workstation Rugged laptop



Hydrographic workstation Desktop version 45mm high, 5 kg, Removable SSD



Hydrographic workstation 19" rack mount 1U high, 7 kg, Removable SSD









EM 2040-0.7 Receiver Unit 50m and 6k 22kg EM 2040-0.7 Transmitter Unit 50m and 6k 23kg EM 2040-0.4 Transmitter Unit 50m and 6k 45kg





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EM 2040, EM 2040P and EM 2040C – all MKII

	EM 2040 SRX / DRX	EM 2040P	EM 2040C SH/DH
Operating frequency	200 to 400 kHz 600 and 700 kHz (SRX)	200 to 400 kHz 600 and 700 kHz	200 to 400 kHz 700 kHz (SH)
Range (200/600/700kHz) cold ocean water	630m+ / 100m+ / 60m+	550 m/ 40m+ / 30m+	520 m 45m (SH-700kHz)
Swath coverage (degrees) 200, 600, 700 kHz	SRX: 170°, 120°, 30° DRX: 220°+	170°, 100°, 30°	SH: 140° DH: 220°+
Opening angle (@400 kHz) (TX x RX)	0.4° x 0.7° and 0.7°x 0.7°	1° x 1°	1° x 1°
Opening angle (@600 kHz) (TX x RX)	SRX : 0.25°x0.5° and 0.5°x 0.5°	0.65° x 0.65°	
Opening angle (@700 kHz) (TX x RX)	SRX : 0.2° x 0.4° and 0.4° x 0.4°	0.6° x 0.6°	
Number of beams per Ping (Dual swath)	1024 / <mark>2048</mark> 600/700kHz: 512/256	1024 600/700kHz: 512/256	800/1600

Blue text shows unique features for EM 2040



EM 2040, EM 2040P and EM 2040C - all MKII EM 2040 SRX / DRX EM 2040P EM 2040C SH/DH - Fixed frequency Backscatter - Multi frequency, selectable of 2 to 5 frequencies in the range of 200-400, 600, 700 kHz Nearfield Focusing Focused on both transmit and receive **Realtime Compensation** Realtime compensation for roll, pitch and heave movement **Realtime Stabilization** Realtime stabilization for pitch, roll and yaw Sector transmission 3-sector transmission per swath, 6-sectors in dual swath mode

 Multi-bounce suppression
 Better than -50db

 Roll, pitch and yaw stabilization
 +- 15 degrees , +- 10 degrees, +- 10 degrees

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EM 2040, EM 2040P and EM 2040C – all MKII

	EM 2040 SRX / DRX	EM 2040P	EM 2040C SH/DH
Beam spacing	Equi-angle, Equi-distance, High	Density	
Extra detection	Up to 7 extra detection per bear	n	
Water column Backscatter	Display and logging		
Range resolution	10 mm (CT/2)		
Swath width control	Manual Auto, for maintaining of max swa	ath or user selected fixed swath	
Pulse lengths CW / FM	14 us to 410 us / 1.5ms to 12ms		

Blue text shows unique features for EM 2040









EM[®] 2040-07 (MKII)



EM[®] 2040-04 (MKII)













Mills Cross principle

A longer array gives a smaller footprint









Target detection survey

- 2m cube @ 36m
- 10cm bin
- EM 2040-04 DRX
- 60 hits with Singe swath, cube is 1.8mx2m
- 120 hits with Dual swath, cube better defined as 2x2m





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Water column

- 140 dB dynamic range receivers allowing different gains for water column and bottom simultaneously.
- No TVG is added in the receiver but added afterwards to compensate for different transmitter pulses (CW, FM).





Seabed imagery included as standard

Each pixel is geo-referenced

Output as seabed back-scatter level in dB and compensated for :

- Ray-bending and shape of seabed
- Angular response of seabed
- Spreading and attenuation loss
- Sonar source level and sensitivity





EM[®] MultiFrequency



MULTI FREQUENCY INSPECTION

Alternating between a wide swath for coverage and a narrow High Frequency swath for resolution over target

MULTI FREQUENCY BACKSCATTER

Alternating frequencies between each ping to obtain backscatter levels at different frequencies. Use EM High Frequency mode to obtain up to 5 frequencies.

MULTI FREQUENCY BATHYMETRY

Alternating frequencies between each ping to observe how the seabed bathymetry changes with frequency. Penetrate sediment plumes with lower frequencies to determine where the "real" bottom is.



MULTI PULSE

Alternate between pulse lengths and add yet another layer of information to the seabed classification effort.

WORLD CLASS – Through people, technology and dedication



EM[®] MultiFrequency

Freely selection of frequencies in a cycle of up to 5 pings Selection of frequency, pulse type and swath width

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	Swath		Swath	Swath		Swath	Swath	
Frequency	200kHz		300kHz	400kHz		600kHz	700kHz	
Max port/starboard angle	60,0	60 / 60	60,0	60,0	60 / 60	60,0	15,0	15 / 15
Depth mode	Shallow		Shallow	Medium		Medium	Shallow	•
Detector mode							Normal	•
Beam spacing							Ultra high de	nsity 🔻





EM Extra Detection

When activated the system will search for extra candidates in all beams and for all ranges.

Any false detections (like side lobe echoes etc) will be removed and the remaining candidates are organized into classes. These classes, which in essence are depth ranges with some acceptance criteria, are user definable with an initial default setup. All candidates which are accepted into a class are subsequently stored.









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The system transmits independent frequency coded sectors, transmitted at the same time and all individually controlled for pitch and yaw movement of the vessel

The benefits are:

- Very effective pitch and yaw stabilization.
- Very strong damping of multi-bounce interference with suppression better than -50dB. Systems without sectors => artefacts at 60deg
- Individual TX focus in each sector gives a much smaller TX footprint



<u>Pitch and Yaw stabilization</u> is obtained by steering each transmit sector electronically forward or aft at the time of transmission, based upon input from the motion sensor.



<u>**Roll stabilization**</u> is obtained by steering the receiver beams electronically, to port or starboard at the time of reception, based upon input from the motion sensor .





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EM Focusing

Dynamically focused beams. When is it necessary?

The length of the "near field" of a system depends on frequency and length of transducer array.

Nearfield = $(TD length^2 * frequency)/1500$

EM 2040: 0.7deg, 40cm long TD, 400kHz EM 2040: 0.4deg, 73cm long TD, 400kHz

: 43m : 142m



Dynamically focused receive beams

To obtain improved resolution inside the near field. Without focusing the beamwidth is as wide as the physical size of the transducer



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Focusing in the nearfield on transmit is feasible by

using separate transmit sectors per ping

:43m

:142m



EM Focusing

Test of EM 2040, 0.4 deg TX beam, at 400 kHz, measured at **6 m** range with focus enabled and disabled.

This clearly shows the advantage of having nearfield focusing both on TX and RX which is unique to EM systems

Near-field focusing both on transmit and receive are required in order to keep the resolution in the nearfield



Focusing enabled Beamwidth is 0.4 degrees



Focusing disabled Beamwidth is 5 degrees SL is 6 dB weaker



Operator software

EM[®] 2040 can be delivered with the following operator software:

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- SIS from KM
- QINSy from QPS
- HYPACK
- EIVA
- Beamworks
- MB Systems
- OHTI
- PDS









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SIS from KM

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SIS Realtime with Remote Operation

- Userfrendly GUI
- New and improved features
- Supports for Remote Operation (i.e. USV applications)
- Support Cloud Storage





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K-CONTROLLER

SIS LITE

SIS 5







Conclusions

- EM2040 is heavier with more physical installation, but by far the most sophisticated MBES producing the cleanest data with the highest resolution
- The perfect choice for vessels with rapid movement like USV, due to full yaw, pitch, and roll stabilization in realtime
- Provides the best Seabed image data
- Comes with a built-in simple fault-finding troubleshooting solution
- Integrates easily to any 3rd party SW





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