

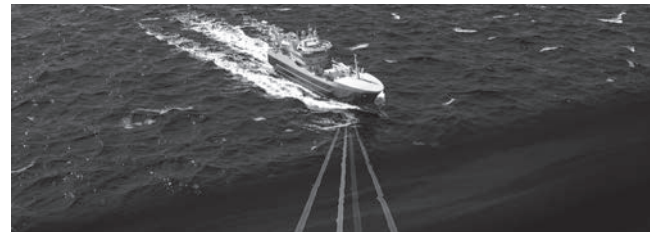
# SIMRAD

## General Catalog

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### UNDERWATER SCIENCE PRODUCTS

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TECHNOLOGY FOR SUSTAINABLE FISHERIES

## TRANSDUCERS

Transducers are the core of all SIMRAD products. The ability to efficiently convert the digital signal to sound in water, and vice versa, is of great importance of any acoustic system. Because of this SIMRAD design and produce our own transducers in order to secure the best performance in all our products.



## OMNIDIRECTIONAL SONARS

In SIMRAD omnidirectional sonars up to 480 elements are used to create multiple beams, covering 360° horizontally and 180° vertically. All elements are designed and produced in-house, thus the production of a single transducer will take several days.

## ECHO SOUNDERS

A good transducer makes a good echo sounder. SIMRAD produces a variety of transducers with centre frequencies spanning from 12 kHz to 333 kHz, and most of these come in a split beam configuration with multiple receiving channels. SIMRAD uses only ceramics and composite material in our transducers and the production is done using the latest in ceramic cutting machines and production facility.



## EK80 ADCP

The SIMRAD EK80 ADCP uses a phased transducer array to produce 4 narrow acoustic beams that can be used to calculate current velocities by measuring the doppler effect. The phased array can also produce a narrow echo sounder split beam using the same transducer.



## WIRELESS SYSTEMS

Wireless trawl sensors communicate acoustically to the vessel and between sensors. To be able to do this a transducer is needed to convert electrical signals into acoustic signals and vice versa. Small transducers in various frequencies are then placed inside the net sensor. Also, under the vessel a hydrophone is placed to be able to communicate with the sensor. A hydrophone is only listening, it is not transmitting.



## 3<sup>RD</sup> WIRE SYSTEMS

A 3<sup>rd</sup> wire system gives you real time information from the trawl. Along with other sensors, the trawl sonar is scanning the opening of the net, providing information of fish entry and trawl behaviour. Of course, it also has a SIMRAD transducer inside!



## MULTIBEAM SYSTEMS

A scientific multibeam transducer consists of 800 individual elements that create configurations of multiple beams based on the user requirements. Combined elements are used to form beams in the shape of a FAN or MATRIX, allowing for real time 3D and 4D information to be collected.



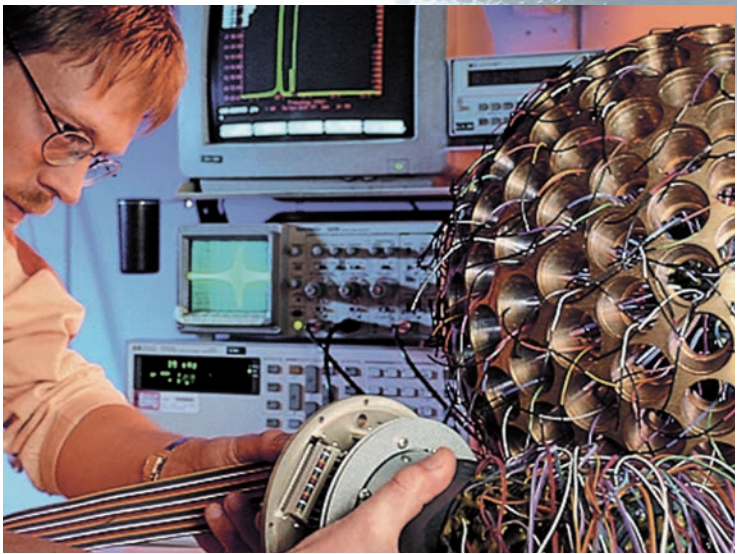
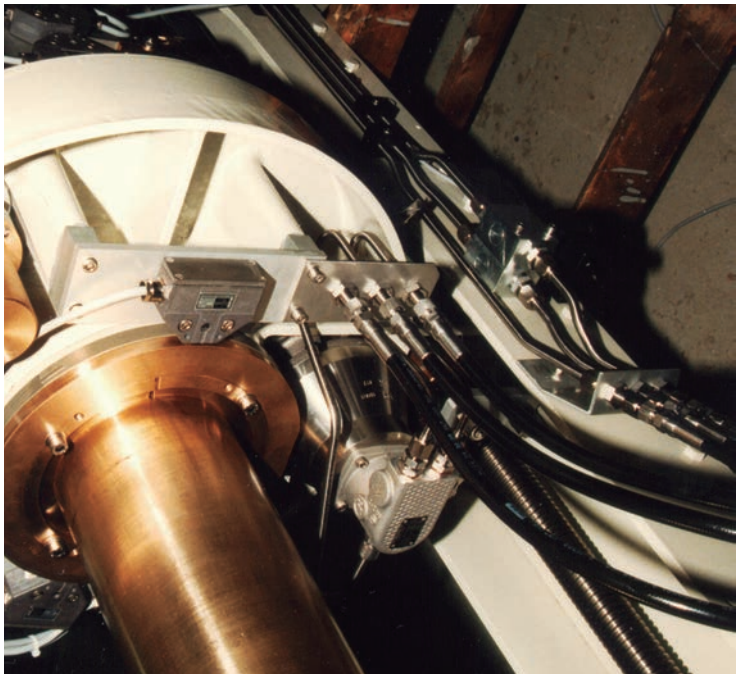






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# SIMRAD

## MORE THAN 70 YEARS OF INNOVATION

Since SIMRAD introduced the sonar technology to the commercial fishery in Norway in the 1950s, the products have always evolved around *sound in water*. Through a close connection with the scientific community, important developments such as instruments for quantification of biomass, fish size estimation and tools for species identification has been commercialized and introduced to scientists worldwide.

SIMRAD's slogan is "Technology for sustainable fisheries" and we live by this slogan every day. We believe that a sustainable fishery is dependent on accurate tools to quantify and understand the marine ecosystem, and the SIMRAD products have always been in the forefront on providing for this.

Sustainability in this context also involves the environment, and all SIMRAD products are designed to facilitate efficient surveys. Scientific Multibeam Systems are used to increase sampling volume with less ship time needed to achieve the survey goal. Trawl monitoring systems are used to monitor trawl behaviour, as we believe optimal trawl performance also leads to reduced fuel consumption, less impact on the fauna and the right species and the right amount in the catch.

Following the current mantra in management and research communities, SIMRAD now offers products for *ecosystem monitoring*, ranging from small plankton to large mammals. As the focus shifts from single fish stock management towards looking at the whole food web, SIMRAD shall continue to develop new and refine existing tools for mapping the marine ecosystem.

## PHILOSOPHY AND VALUES

**A tool must work every time you need it and this is the foundation of our design work. We know, after more than 70 years in the same business, what it takes to make a reliable, high performance affordable tool for the scientist.**

All SIMRAD products shall reflect our set of common values. One of our core values is innovative and this is the basic of the SIMRAD soul. We always strive to find new ways to make your life at sea easier by refining the tools you use. After more than 70 years in the business we still come up with new and refined products.

A collaborative and reliable partner is always important for any projects. Even more so when you work at sea or in remote areas. Regardless of the environment you operate in you shall never be in doubt that your SIMRAD equipment will perform.

Determined we shall continue to refine existing products and come up with new ones. All with the same goal; to improve the acoustic tools available for our valued users.







## DETERMINED

We are known for our drive and persistence. We always strive to meet our customers' expectations. We set ambitious goals for ourselves and we are driven towards them with a clear and constant focus.

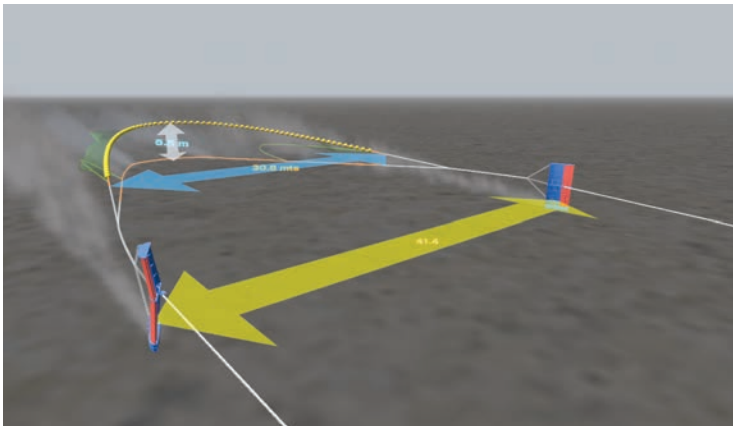
WHAT WE START, WE FINISH. WE DO NOT GIVE IN.



## INNOVATIVE

Always performing better is a vital part of who we are. We constantly innovate and implement improvements in all parts of our business - from our products, through our processes, to our customers' experiences.

WE RELENTLESSLY PURSUE IMPROVEMENTS, NEW IDEAS AND NEW SOLUTIONS.



## RELIABLE

Our customers and partners can trust SIMRAD to deliver, always. Dealing with SIMRAD means dealing with reliable people, a reliable corporation and reliable products. SIMRAD is a responsible organization characterized by integrity and concern for health, safety and the environment.

WE ARE RELIABLE PEOPLE. WE ARE RESPONSIBLE CITIZENS.



## COLLABORATIVE

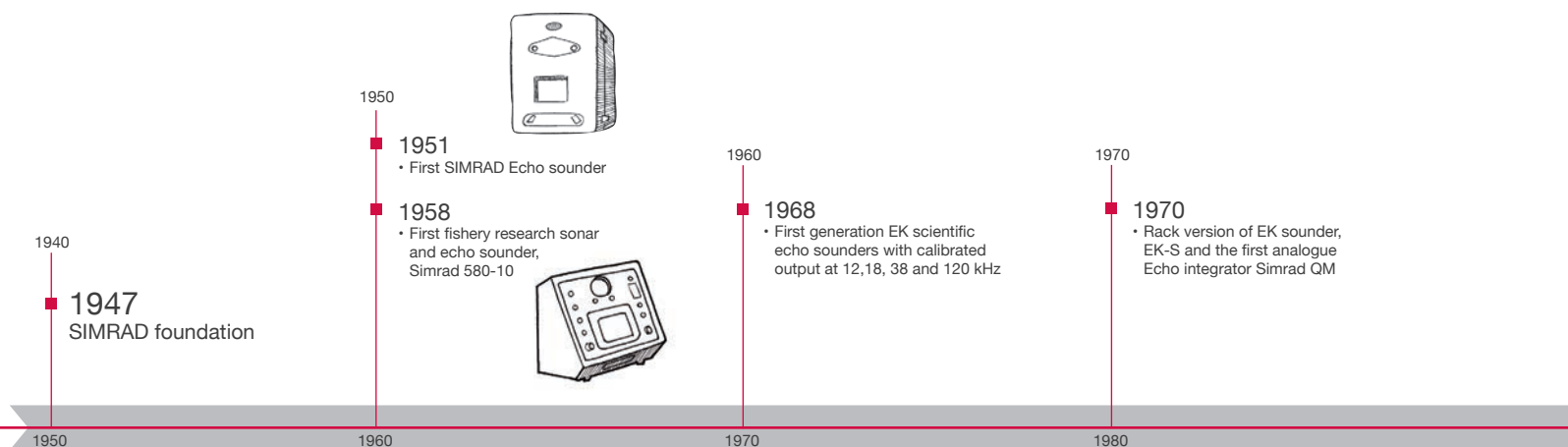
Collaboration is fundamental to our business. We exchange ideas among ourselves, with our suppliers and partners, and we cooperate closely with our customers. We work as teams, we share knowledge and we value team success - to the benefit of our customers and our own competitiveness.

WE COLLABORATE AS INDIVIDUALS AND AS AN ORGANIZATION.



The SIMRAD brand name is owned by the Kongsberg Group, a Norwegian technology company. The Kongsberg Group has a strong position in the maritime sector through its company Kongsberg Maritime (KM), where the SIMRAD branded products are sold.

Today KM manufactures a great variety of products, such as acoustic systems for mapping and positioning purposes, AUVs (Autonomous Underwater Vehicles), dynamic positioning, MRUs (Motion Reference Units), high accuracy GPS positioning systems, Engine control systems, Bridge Navigation systems as well as all the SIMRAD products.







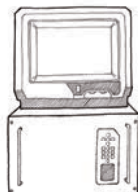
## HISTORY

**SIMRAD was founded in 1947 by Mr. Willy Simonsen. The name SIMRAD derives from “SIMonsen RADio” and, as the name indicates, it all started with radios. But this shortly developed into echo sounders and sonars. Today SIMRAD is recognized all over the world for premium performance products and manufactures sonars, echo sounders and net monitoring equipments.**



**1980**  
• EK400 and digital echo integrator Simrad QD

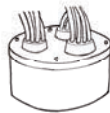
**1984**  
• Simrad ES400 First split beam echo sounder



**1989**  
• SIMRAD EK500.  
First echo sounder with high instantaneous dynamic range

2000

**2002**  
• First composite transducer



**2003**  
• EK60 introduced with BI60 post processing software, computer style, with frequencies 12 to 400 kHz

**2005**  
• Simrad ME70, first scientific multibeam echo sounder

**2006**  
• Simrad MS70, first scientific multibeam sonar

2010

**2013**  
• RAW data output on omni directional sonars

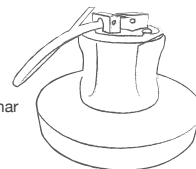
**2015**  
• Simrad EK80, first scientific wideband echo sounder

**2016**  
• WBAT, first wideband autonomous echo sounder



**2017**  
• TD50, first real time 3D visualization software

**2019**  
• CS90 first broadband sonar  
• First Simrad EK80 ADCP



2010

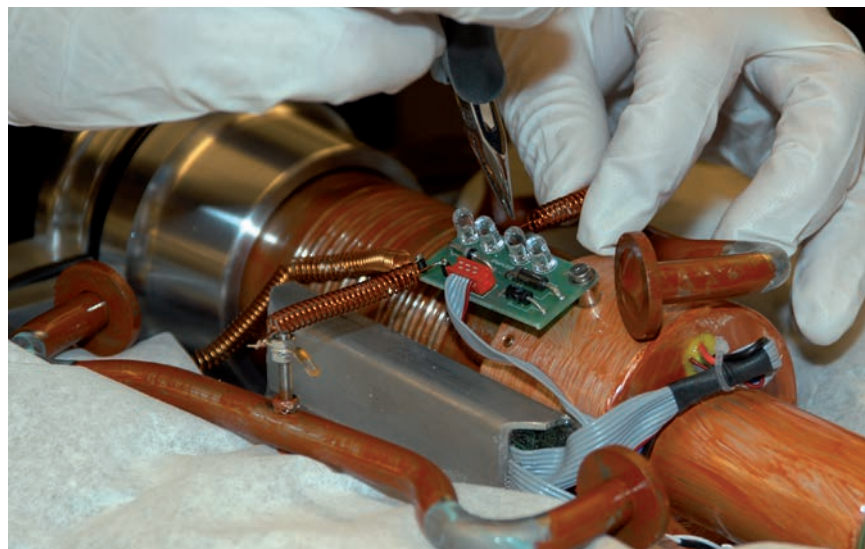
2020

# TRANSDUCERS

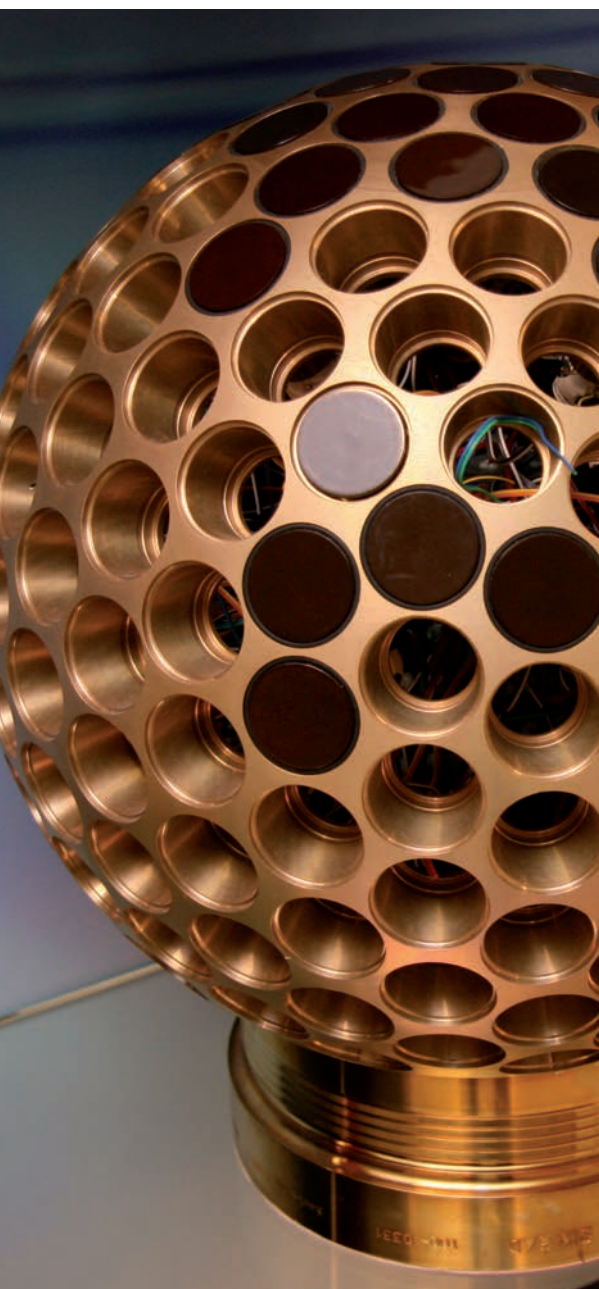
SIMRAD is one of the very few producers of transducers.

The transducer is an important part of an echo sounder's performance.

A transducer is the combination of a microphone and a loudspeaker, all in one. The transducer is converting electrical energy into sound waves and vice versa. What you see on the echo sounder screen is actually echoes from transmitted sound.







## FROM ELECTRICITY TO SOUND

The transducers' ability to convert electrical energy into sound depends on how it is built. The more efficient it converts, the better the transducer is. There are several ways to make a transducer with different materials that can be used. Today, ceramic is the best material to use seen from a performance view. Other materials such as nickel or ferrite have a lower price but will not convert electrical energy as efficient as the more costly ceramic material. The way the material has been used in the production also matters to the final performance. The latest on the scene is to produce the transducers using composite technology, which is a special way of designing a ceramic transducer. The advantages are that the transducer has an efficiency of up to 75%, meaning if you put 1000W into the transducer 750W comes out into the water. The same conversion is valid when the signal comes back and it is vital for detection of weak targets even when using low powered transceivers.



The transducer also needs to be designed in a way that avoids ringing. Unlike a church bell that continues to ring after a strike, the transducer needs to shut off immediately after one ping in order not to disturb the next ping. SIMRAD's design and choice of material ensures a ring free transducer.

# SPLIT BEAM, WIDEBAND AND DEPTH RATED TRANSDUCERS

**SIMRAD transducers are designed to work optimally across a large bandwidth and in demanding environments. We can divide the features of the transducers into three main categories:**

"We are at the forefront of performance through innovative design and a unique production technology"

KJELL GJESTAD  
Value Chain Manager

## SPLIT BEAM TRANSDUCERS

A Split Beam transducer is made to send out one beam and receives the echo in three or four channels. Variations in phase of the returned echo enable us to locate the target within the acoustic beam. Once you know the location of a target you can make up for variations in the beam

patterns, and in the end you can record calibrated target tracks within the acoustic beam. SIMRAD commercialized this technology in the 1980's and our EK split beam echo sounders are now used to record data for marine resource management worldwide.

COMMONLY USED SPLIT BEAM TRANSDUCERS

MODEL	PART NUMBER	NOMINAL FREQUENCY	NOMINAL OPENING ANGLE	MATERIAL
ES18	KSV-088694	18 kHz	11°	Ceramic
ES38-7	321842	38 kHz	7°	Ceramic
ES70-7C	KSV-203678	70 kHz	7°	Composite
ES120-7C	KSV-204580	120 kHz	7°	Composite
ES200-7C	KSV-203003	200 kHz	7°	Composite
ES333-7C	322598	333 kHz	7°	Composite

## WIDEBAND TRANSDUCERS

A Wideband transducer can transmit and receive on a wide frequency range, for example 45-90, 90-170 or 160 to 260. This means that with 3 transducers you cover a frequency range from 45 to 260 kHz. To make a transducer that is capable of doing this, composite technology is our preferred production technique. While composite transducers have the highest bandwidth, some tonpilz transducers might still have some bandwidth available as seen in the ES38-7 in the table below.

When the Simrad wideband transducer is combined with Simrad wideband transceiver it is possible to make sweep transmissions where the frequency continuously increases throughout the transmitted pulse - also known as a chirp. It is also possible to transmit on several discrete frequencies, one at a time. Advanced users may define an arbitrary signal, such as a dolphin's click. This opens up a whole new world in interpretation of the echo, taking a great step forward towards the goal of providing a species identification echo sounder, or "ecosounder".

COMMONLY USED WIDEBAND TRANSDUCERS

MODEL	PART NUMBER	FREQUENCY	NOMINAL OPENING ANGLE	MATERIAL
ES38-7	321842	35 to 45 kHz	7°	Ceramic
ES70-7C	KSV-203678	50 - 90 kHz	7°	Composite
ES120-7C	KSV-204580	85 - 170 kHz	7°	Composite
ES200-7C	KSV-203003	160 - 300 kHz	7°	Composite
ES333-7C	322598	250 - 500 kHz	7°	Composite

DEPTH RATED TRANSDUCERS

Sometimes collecting data from a vessel simply does not do the job for you. Perhaps you need to get the transducer closer to the target for better resolution, or perhaps you want to deploy echo sounders in the deep for long term collection of data. SIMRAD has for many years built transducers for applications like this. Our series of

depth rated transducers have standard depth rating to 1500 meters, but should you for some reason need to go deeper feel free to contact us.

A new range of compact depth rated transducers (model name ending in DK) has been developed for platforms where size is an important factor.

DEPTH RATED TRANSDUCERS*				
MODEL	PART NUMBER	NOMINAL FREQUENCY	NOMINAL OPENING ANGLE	MATERIAL
ES38-DD	KSV-113392	38 kHz	7°	Ceramic
ES70-7CD	335039	70 kHz	7°	Composite
ES70-18CD	321637	70 kHz	18°	Composite
ES120-7CD	324410	120 kHz	7°	Composite
ES200-7CD	KSV-207134	200 kHz	7°	Composite
ES333-7CD	312902	333 kHz	7°	Composite
ES38-18DK	399916 / 421537**	38 kHz	18°	Ceramic
ES200-7CDK	401103 / 418812**	200 kHz	7°	Composite
ES333-7CDK	401204 / 418813**	333 kHz	7°	Composite

\* Standard depth rating: 1500 meters. Other depth rated transducers available on request.

\*\* Split beam version / Single beam version

DID YOU KNOW...?

The physical dimensions of a transducer can be explained as a function of the beam opening at a given operating frequency. Traditionally 7° opening angle has been the standard for marine surveys, but for applications where size and weight is of great importance you can reduce the size of the transducer by allowing a larger opening angle of the acoustic beam. The effective transducer face circular area is calculated from the general formula:

$$A \cong \left(\frac{\lambda}{2\beta}\right)^2 \times \pi$$

Where

A=effective transducer circular area

λ =wavelength

β =beamwidth in radians (-3 dB points)

traditional Simrad research transducers are given, where the maximum and minimum source level (SL) is calculated from the available power settings on the Simrad EK80 echo sounder and the near field is calculated by the formula:

$$Near\ field \cong \frac{A}{\lambda}$$

In the table below some parameters from the

FREQUENCY	WAVELENGTH	BEAMWIDTH	MAX/MIN SL	EFFECTIVE TRANSDUCER CIRCULAR AREA	TRANSDUCER NEAR FIELD
18 kHz	83 mm	11°	225/215 dB	1479 cm²	178 cm
38 kHz	39 mm	7°	229/219 dB	820 cm²	208 cm
70 kHz	21 mm	7°	227/217 dB	242 cm²	113 cm
120 kHz	13 mm	7°	222/212 dB	82 cm²	66 cm
200 kHz	8 mm	7°	220/212 dB	30 cm²	39 cm
333 kHz	5 mm	7°	212/209 dB	11 cm²	24 cm



## SIMRAD TD50 3D VISUALIZATION SOFTWARE

The Simrad TD50 enables live streaming of 3D data generated by scientific multibeam systems. The Simrad TD50 software reads the incredibly clean raw data from the ME70 and MS70 in real time, and delivers accurate live visualisation of the oceanspace beneath the vessel to the scientific lab as well as any other location onboard with network access. Previously this data had to be post-processed before the 3D potential of the system was realised.

Accurate 3D visualisation gives users a better understanding of the marine ecosystem by i.e. enabling precise measurement of schools of fish rather than estimating size and shapes based on models. Additionally, 3D view of bottom topography and the relating bottom habitats further enhances the understanding of the marine ecosystems. When

accurate 3D visualisation is delivered in real-time, the benefits are significant.

The TD50 provides researchers and vessel crew with a highly effective decision tool, allowing for informed decisions to be taken immediately.

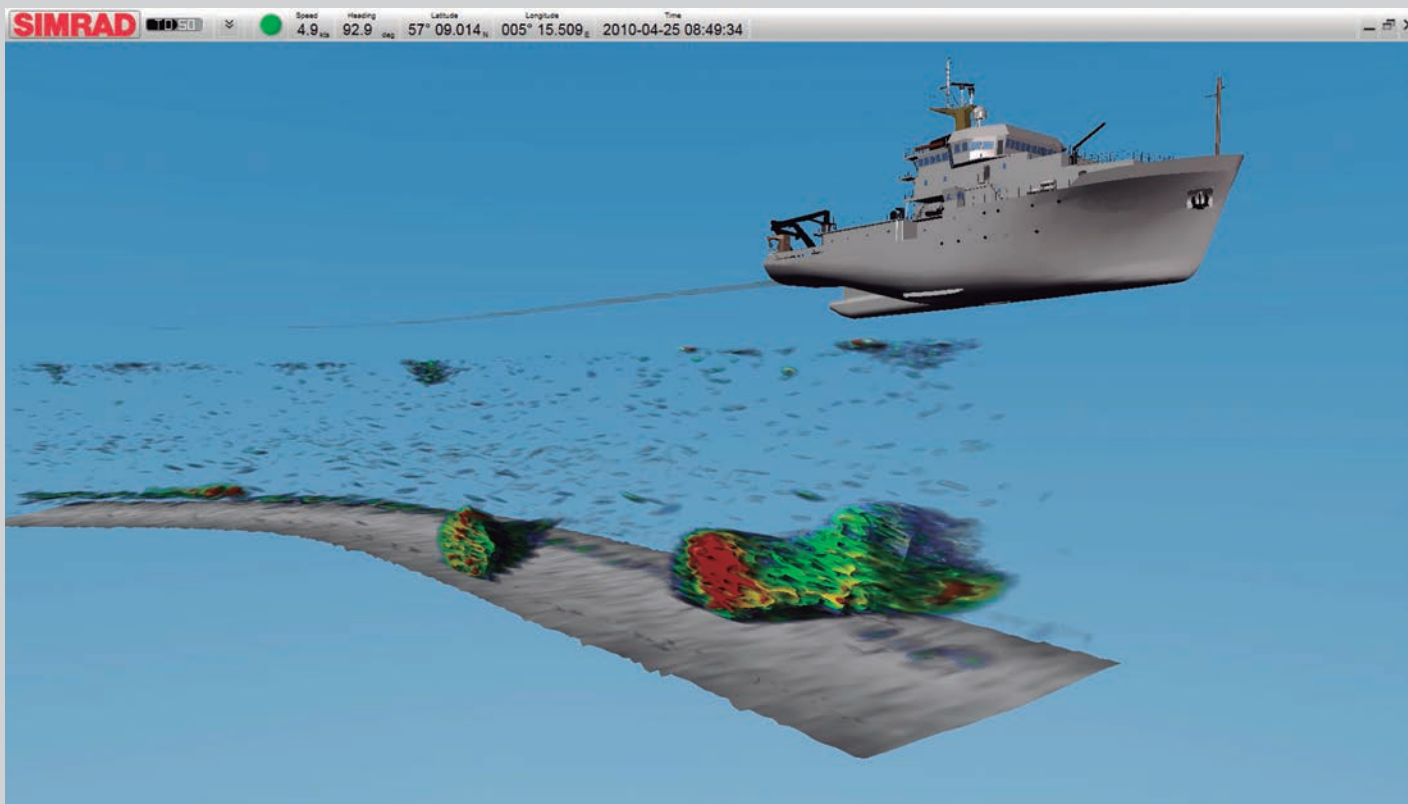
The TD50 also visualizes single beam EK80 echo sounder data and the current profile measured by the ADCP in the same georeferenced framework.

The system is especially relevant to projects using adaptive sampling, as the live 3D stream of the survey area enables researchers to see specific attributes as the vessel passes over them, allowing action for further inspection to be taken immediately.

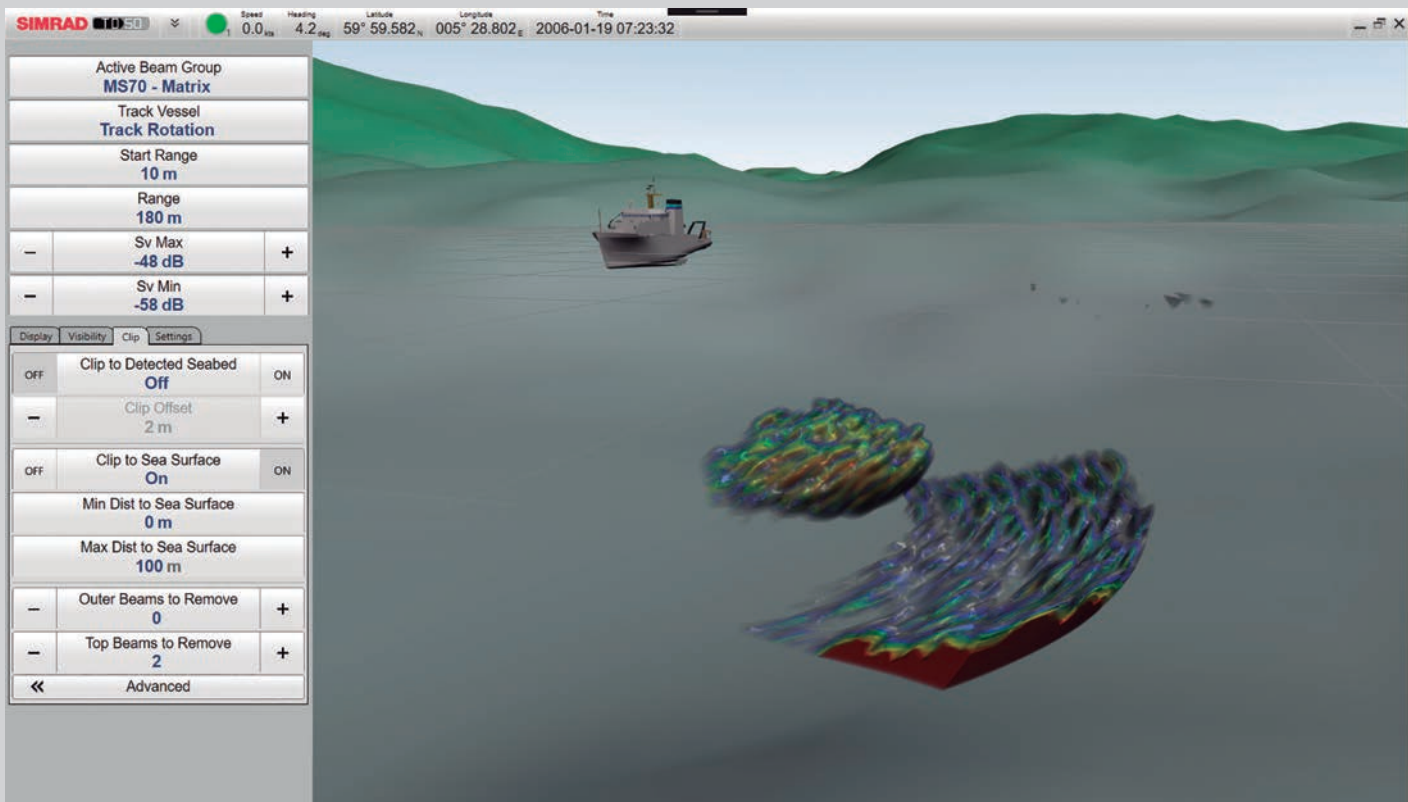


## SITUATIONAL AWARENESS

The live 3D stream can be delivered to multiple locations on board which allows for better interaction between scientists and the vessel operators. This is typically important in demanding operations where the vessel interacts with objects in the water column. Research vessels engaged in active sampling of biology such as trawling can also improve their capabilities, with the Simrad TD50 system effectively providing a 'long range camera' below the surface.



The Simrad TD50 3D Visualisation Software is shown presenting sand eels on sand bottom. The raw data is taken from the Simrad ME70 Scientific multibeam echo sounder on M/S Simrad Echo.



The TD50 can also import and display a chart overlay. This picture shows TD50 with MS70 data, Vessel, a school of fish and bottom backscatter is shown to give full situational awareness.

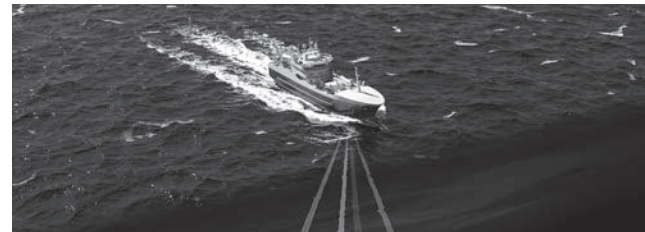




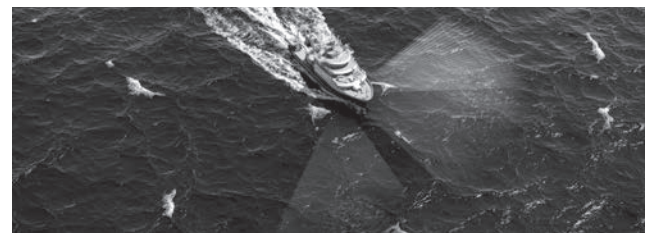
SINGLE BEAM SYSTEMS



EK80 ADCP



MULTIBEAM SYSTEMS



SONARS



CATCH MONITORING SYSTEMS







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*"The new wideband  
echo sounders provide significant  
information about some of the  
basic backscattering properties  
of a target, which leads to  
improve target characterization."*

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LARS NONBOE ANDERSEN  
Product Manager  
Underwater Science





# SINGLE BEAM SYSTEMS

## The foundation of any survey

Calibrated split beam echo sounders operating at multiple frequencies are the basis of any quantitative survey. The first SIMRAD EK echo sounders with calibrated output were introduced in 1968. Since then, the equipment and techniques have evolved but the basic of multifrequency remains the same.

Through the introduction of scientific echo sounders capable of transmitting sound pulses with variable frequency, SIMRAD now takes research to the next level. These sounders can be used as narrowband (CW) in some situations, and as wideband in other.

We envision the EK scientific echo sounders to be the basic research tool for any underwater science application, a system that can be adapted to match any situation and any environment.



## SIMRAD EK SYSTEMS

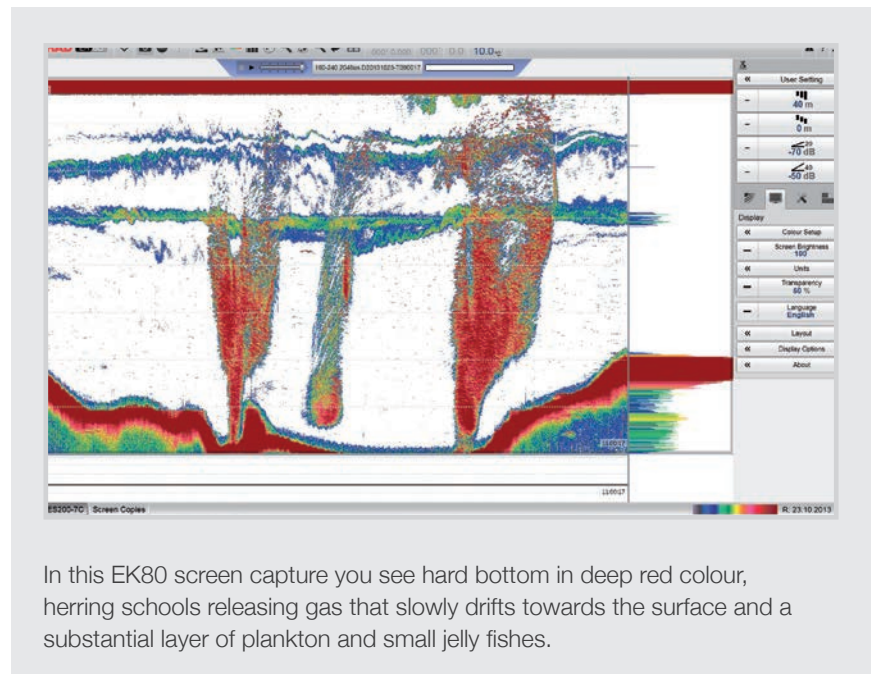
EK is our common name for all single beam echo sounders designed for research applications. The first EK sounder was introduced in the 1960's, and already back then the focus was to create a quantitative sounder that could measure biomass.

Recently, the EK system has been used for a wider range of oceanographic applications, with the addition of ADCP functionality completing the picture.

All EK echo sounders share some common features such as built-in calibration and split beam capabilities with full beam compensation for accurate TS measurements. The focus when designing the EK echo sounders is that you should be in full control of all sounder parameters. That is why there are no automated settings in the acquisition SW. A skipper might want optimal settings displayed at all times to get a good picture of the fish, but a sudden change in ping rate or duration might corrupt a survey, with data no longer comparable.

Another common feature is a standardized data format, which means that you can compare data across platforms. In many cases you need to combine your vessel data with data collected from profiling platforms to get TS measurements or measurements from deep scattering

layers, and those times it is good to know that the sounders use the same currency. Simrad RAW data is an open, well documented format, as can be expected from a scientific system.



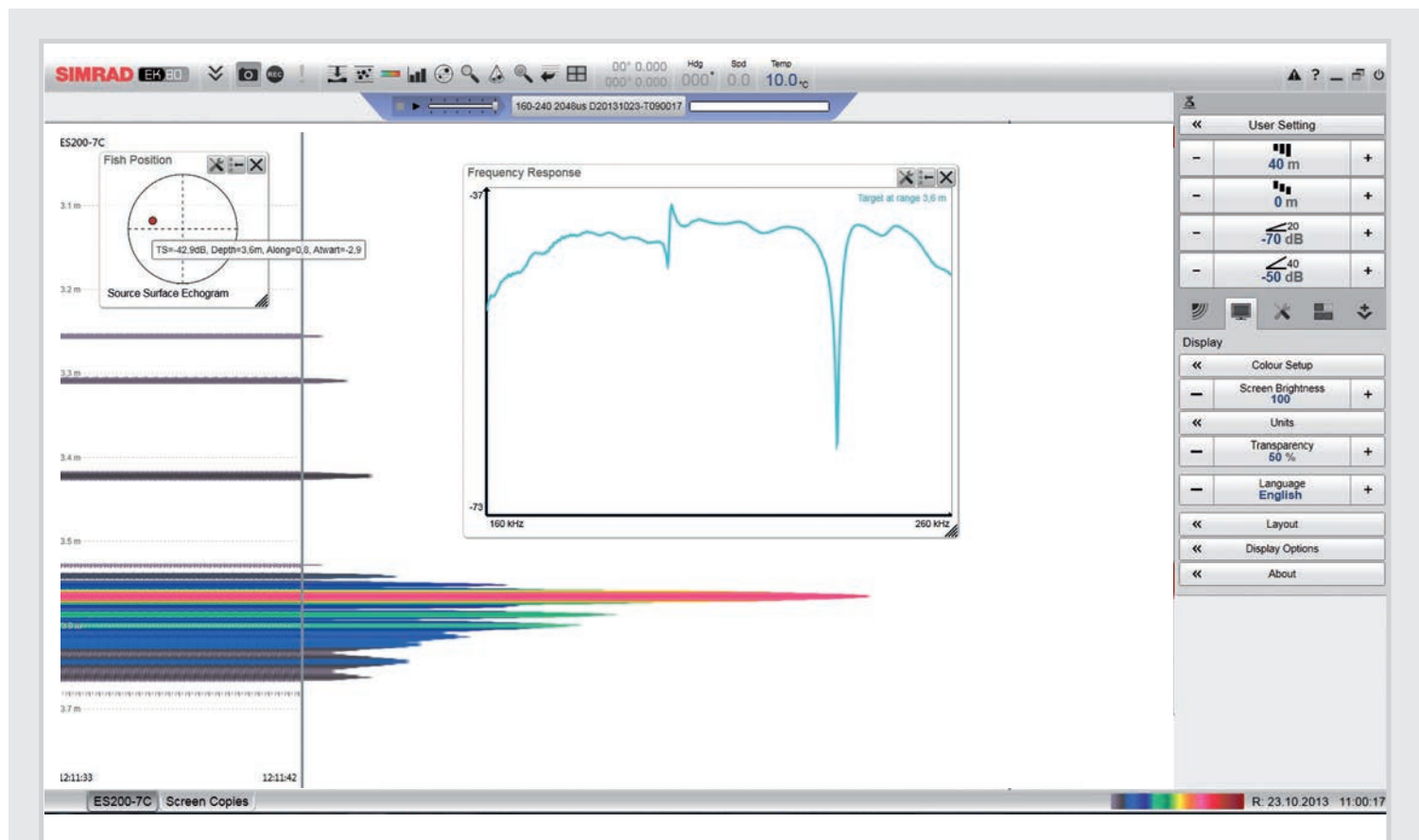
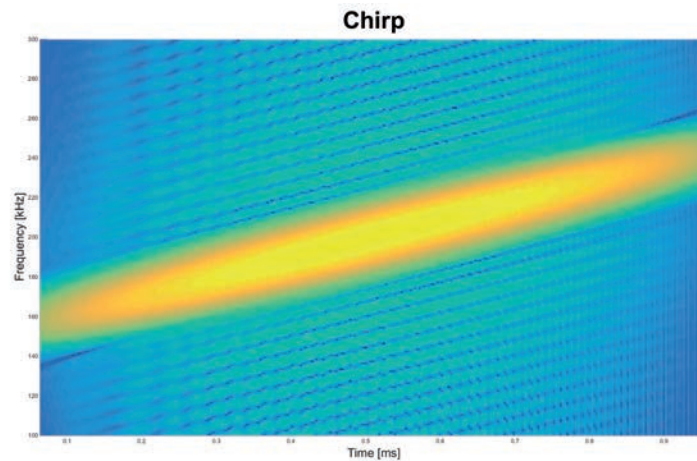
**EK is our  
common name  
for scientific echo  
sounders and  
current velocity  
profilers (ADCPs)  
for research  
applications**

## WIDEBAND ECHO SOUNDERS

The new series of EKs has wideband capabilities. That means that you can transmit a signal that varies across the transmission, called a chirp. The most common way to operate the sounder is to use a linear chirp. In an EK80 chirp you either utilize the entire effective frequency band of the transducer, or you can choose to limit the bandwidth.

Due to advanced matched filtering techniques you can correlate the returned signal with what you sent out, and the result is improved range resolution of single targets. Also, as resolution is now a function of bandwidth rather than pulse length, chirp allows for long range performance without sacrificing the resolution. When you have very weak targets in the near vicinity of strong ones, such as small fish close to bottom, you might want to use a different pulse shape. A dolphin's click is shorter, but still spans over a large bandwidth and might be better suited

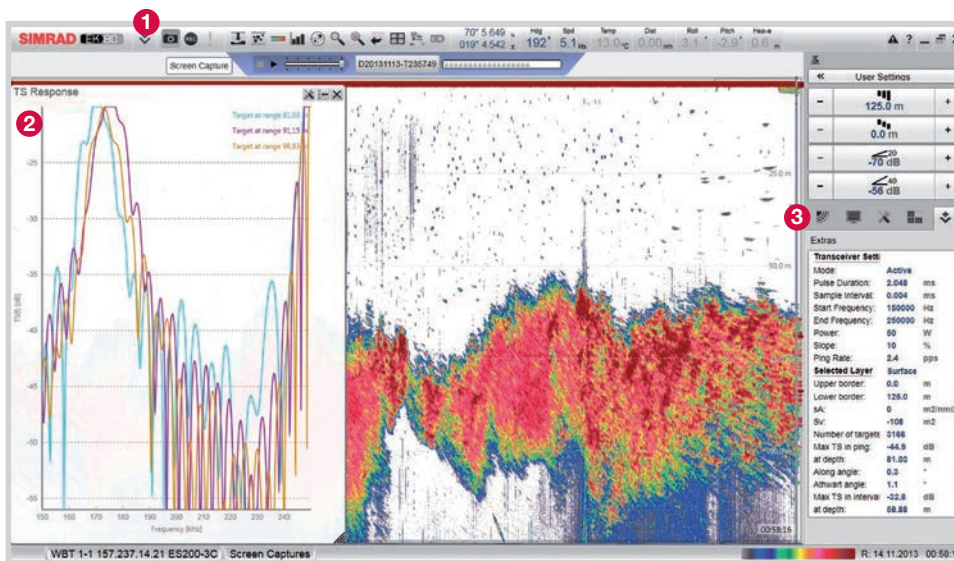
for such environments. The EK80 is prepared for such requirements, and as the SW continues to be developed, new functions would be available.



Range resolution and target ID are improved. Echo from a 38,1mm tungsten sphere is measured, and you can clearly see how the target strength changes with frequency. This frequency response is unique to this particular target, and corresponds well with the theoretical curves. Resolution is excellent, and you can clearly see the knot on the fishing line where the suspended sphere is attached to the line, around 10cm from the sphere itself.

The traditional Simrad EK80 system consists of an acquisition software, one or more wideband transceivers, and transducers. When used with the EK80 real time acquisition software, the system is operated by a Windows™ based processor. Also, the system normally requires input from auxiliary sensors such as GPS and motion sensor.

The EK80 SW is the command and storage centre of the system. This is where the user sets the parameters of the transmission and the data you want to record. The EK80 also has advanced tools for replaying and visualization of data. Biomass in predefined layers is automatically calculated, and the SW has lots of new tools such as frequency response across the frequency band and a neat little zoom tool that can be used to inspect details.



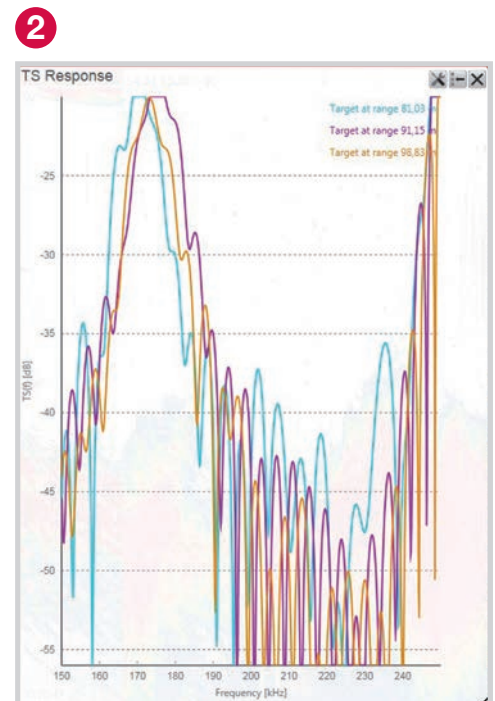
Frequently used buttons and numerical displays such as ship heading, roll, pitch and heave are always shown on top of the EK80 SW. The EK80 has new tools that can be used to inspect and display data, when clicking on the magnifying glass you would for instance get access to a zoom tool that can come in handy when creating screen shots to use as examples.



All settings needed to operate the EK80 SW are distributed under five main tabs for easy operation:

- The **OPERATION** menu is the place where you have all settings that are directly influencing the RAW data you record, such as transmission settings and settings related to RAW data recording.
- The **DISPLAY** menu comprises settings that regulate how the SW appears on your computer right now.

- The **SETUP** menu includes installation and calibration settings
- The **ACTIVE** menu contains settings and calculations for the active channel or layer. Layer definition, biomass calculation parameters and TVG settings are all set up here.
- The **EXTRAS** menu, which is displayed here, shows numerical details from the transmission, as well as the results from the active layer.



TS response for resolved targets is calculated and displayed as a function of frequency in real time in the EK80 SW. In this capture you can see three objects passing out of a dense mackerel school at 81, 91 and 98 meter range. In the tool menu you can also set the parameters of what is to be recognized as single targets.



## WIDEBAND TRANSCEIVER (WBT)

The Wideband Transceiver is designed for applications where performance is the top priority. The WBT has four 500 W channels that can either work independently with single beam transducers, or together with a split beam transducer. The WBT is optimized for applications where power consumption and size is not critical, typically on board a research vessel or a platform with power and high speed Ethernet communication available.

The WBT transceiver is capable of operating on entire band from 10 kHz to 500 kHz, only limited by the transducer's bandwidth.



## WBT MINI

As a compact version of the Wide Band Transceiver, the WBT Mini presents an energy efficient and splash proof design. The frequency range (30-500 kHz) and the output power are lower than in the WBT. In return it offers very low power consumption, perfect for platforms with limited available power and space.

The WBT Mini also has built-in multiplexing on each transceiver channel, allowing for alternation between two 4 channel split beam transducers, or a combination of 3 channel split beam and single beam transducers.

## WBT TUBE

The WBT Tube is a 4000 meter depth rated version of the EK80 WBT family. The tube contains two built-in transceivers that rely on external power. It is connected to the EK80 processor through Ethernet.



## EK80 PORTABLE

The EK80 Portable system has all the tools needed for your survey but in a small size. The EK80 software runs on an internal processor with built-in GPS, all controllable from your phone or tablet through WIFI connection. The WBT mini transceiver allows for a compact, energy effective solution, with up to two selectable transducers connected at the same time.



## PLAN YOUR MISSION

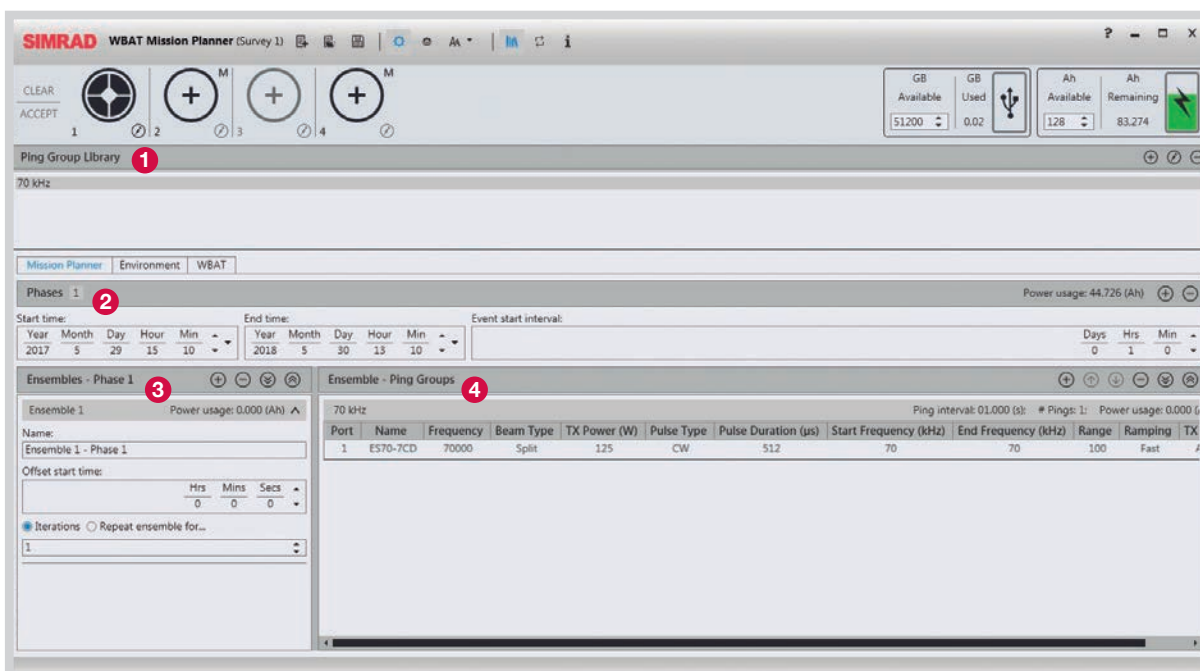
The EK80 Mission Planner is, as the name implies, a software used to plan a mission from deployment to recovery.

All details regarding when the sounder should wake up, how long it should transmit and when it should go to sleep can be set before deployment.

In the Mission Planner the user can set as many phases as the survey requires. This could be helpful if you want the transmission scheme to change throughout the deployment. You might want to do CW most of the time, while doing chirp in shorter periods to look at frequency response of targets.

After carefully planning the deployment, all settings are uploaded to the transceiver. The unit is then ready to be deployed, and the only remaining task is to click on the Activate mission button.

Apart from uploading the setup for a predefined mission, the settings created in the Mission Planners can be used in an “interactive mode” that allows the user to redefine some of the parameters even after the deployment.



**1**

### PING GROUP LIBRARY

The ping group library contains a collection of your personal ping groups defining what the transceiver will do when it wakes up.

**2**

### PHASE(S)

The Phase defines when and how often the transceiver should wake up during a deployment period. A mission plan must contain at least one phase. Multiple phases are also allowed. At certain intervals within a Phase the transceiver will wake up and record data as specified by the mission plan.

**3**

### ENSEMBLES

An Ensemble is a collection of one or more Ping Groups from the Ping Group Library. Within an Ensemble, it is possible to choose several Ping Groups, for instance one for “active” CW followed by “active” FM followed by a “passive” CW ping. An Ensemble can be executed a number of times or for a period of time.

**4**

### PING GROUPS

A Ping Group defines ping parameters, such as its frequency, power, pulse type and pulse length.

## WIDEBAND AUTONOMOUS TRANSCEIVER (WBAT)

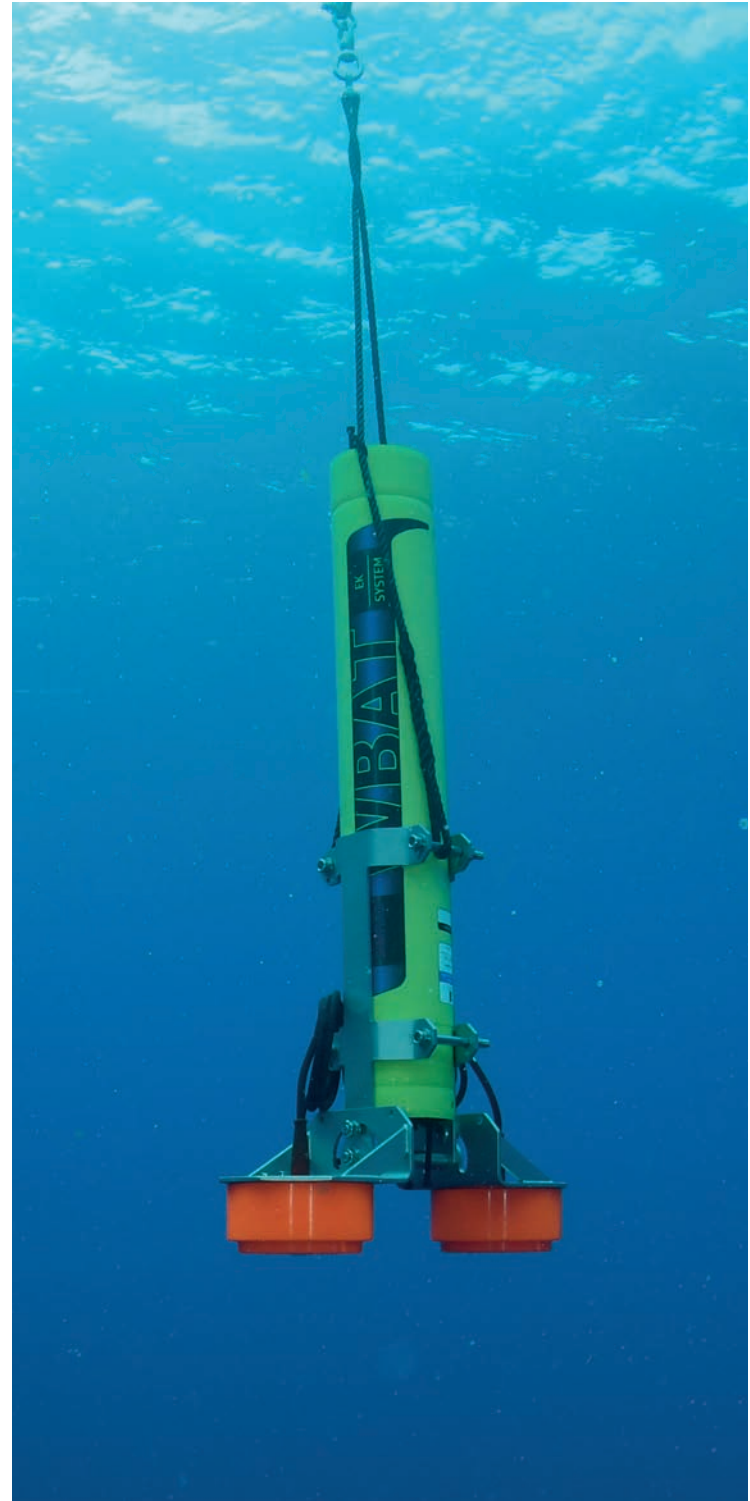
The EK Wideband Autonomous Transceiver is made for applications where it is necessary to gather scientific data from other platforms than traditional research vessels. Typically this involve long term monitoring or monitoring in places where it would not be practical, or in some cases not even possible, to use a research vessel. As the WBAT has a standard depth rating of 1500 meter, it can also be used to profile layers in depths where hull mounted echo sounders cannot reach with high frequencies.

An autonomous EK system consists of an autonomous transceiver, one or more transducers, and a mission planner. The data from the system can also be viewed and calibrated with the EK80 SW as the RAW data format are the same.

The WBAT uses the same technology as the WBT wideband transceiver, but has been redesigned to be more compact and energy efficient. The four independent channels can be used as multiple single beam channels, or working together with a split beam transducer. With the built-in multiplexer you can also use two split beam transducers together using sequential pinging.

Although operating without the EK80 SW, the WBAT collects data in a format, and of a quality to be expected from any EK system. This means that the data coming from different sources can be easily integrated. Being part of the EK80 family, the WBAT is capable of split beam, the Autonomous EK is capable of split beam, which means that it can be calibrated to the same standards and with the same techniques as the EK80.

The pressure rated housing itself, along with the connections and the internal battery are already proven Kongsberg Maritime technology. The Kongsberg transponders are used globally in the oil and offshore industry, with the highest requirements for quality and safety found anywhere in the marine business. Coupled with more than 70 years of experience with underwater acoustics, the end result is reliable echo sounders that the customer can count on.



SINGLE BEAM SYSTEMS

## WBT MINI AUTONOMOUS MODE

As an option, the WBT Mini can also be operated in autonomous mode. In this configuration, the transceiver is preprogrammed with the EK Mission Planner. It can either operate according to a preset mission plan or interact with an external processor through the RS422 connection. The internal microprocessor can also be set up to send back compressed data suitable for satellite transmission, perfect for unmanned surface vehicles and other platforms where the user needs real time data.



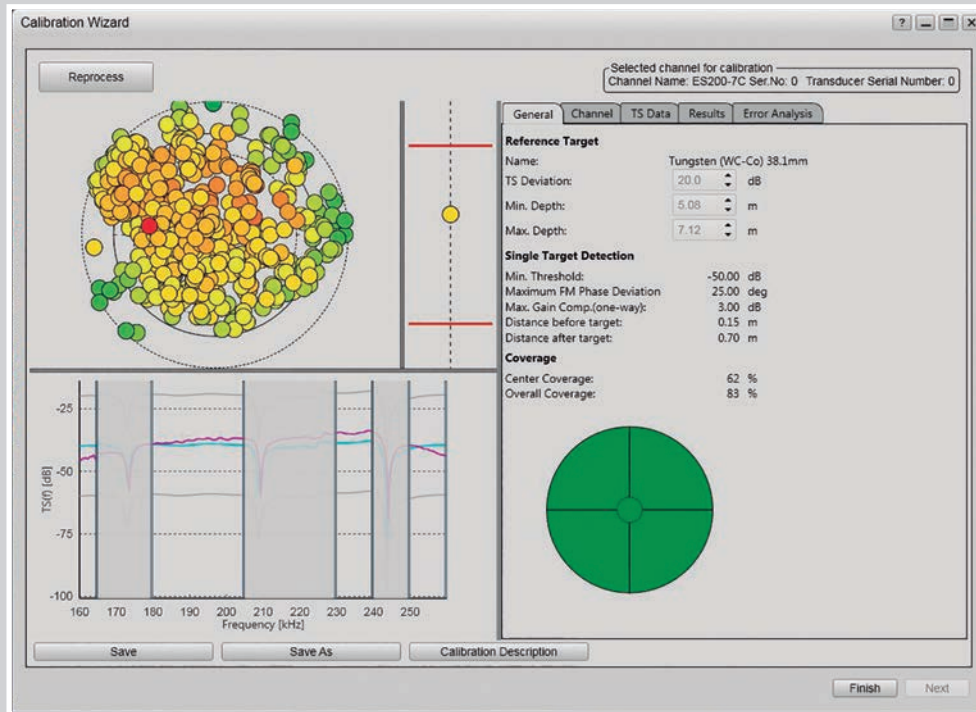


## CALIBRATION

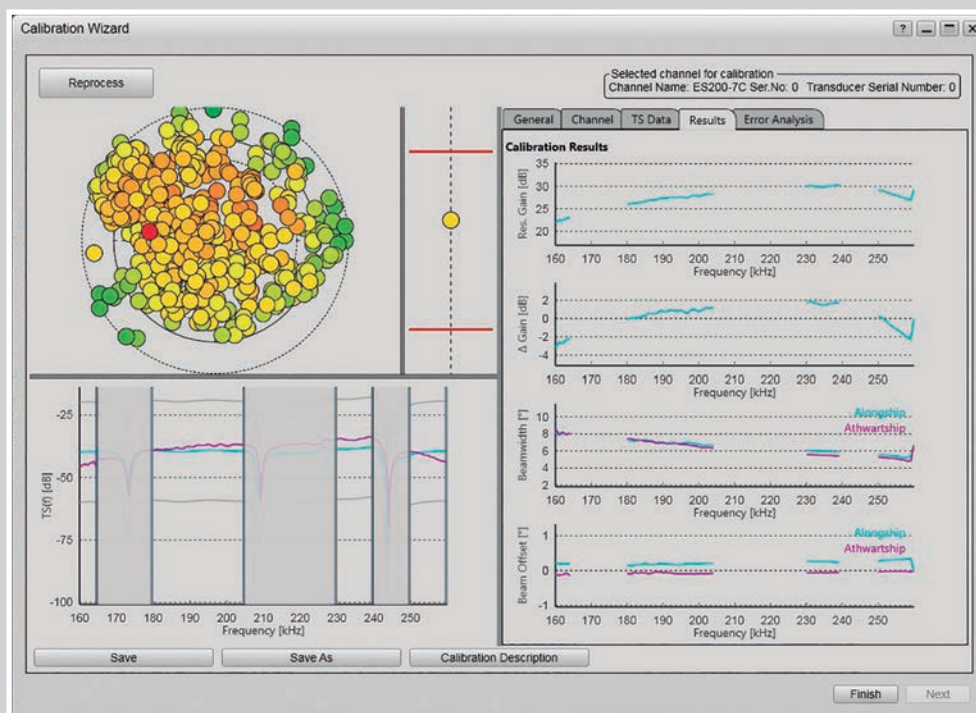
All Simrad echo sounders should be calibrated in field by the user at regular intervals. Above all, calibration is required to collect quantitative data.

There is however another good reason why you should calibrate your system frequently. A calibration is your best insurance that the system is working as expected. If a connection is unstable, or a channel in your transducer has malfunctioned, you will know instantly.

With the introduction of chirp you introduce new challenges around calibration, as both the frequency and the beamwidth change during transmission. The EK80 SW has the calibration functionality built-in. It takes care of all of this for you, calibrating the entire bandwidth with split beam techniques also for chirp transmissions.



The EK80 calibrates the full beamwidth of the split beam transducer, and across the frequency range of the transmission. There will always be areas where the calibration sphere has "nulls", frequencies where the sphere has very low target strength. While it is these nulls that allow you to identify the particular target, these areas are not usable for calibration, and the EK80 SW lets you adjust the frequency ranges that are to be used for the particular calibration. The new and improved EK80 SW is designed to be intuitive and easy to use, and this does of course also apply to the important calibration procedure.



After you have collected data across the beamwidth it is time to view the data and apply the calibration. Note the three rings in the target detection window, where the centered ring represents the beamwidth at the center frequency of the transmission. The outer and inner rings represent the opening angle at the start and stop frequency. Only target detections that have been seen across the frequency band is accepted for the calibration. If the results appear to be within the expected variance you save the data, click the "Finish" button and the system is calibrated.

EK TRANSCEIVERS SPECIFICATIONS

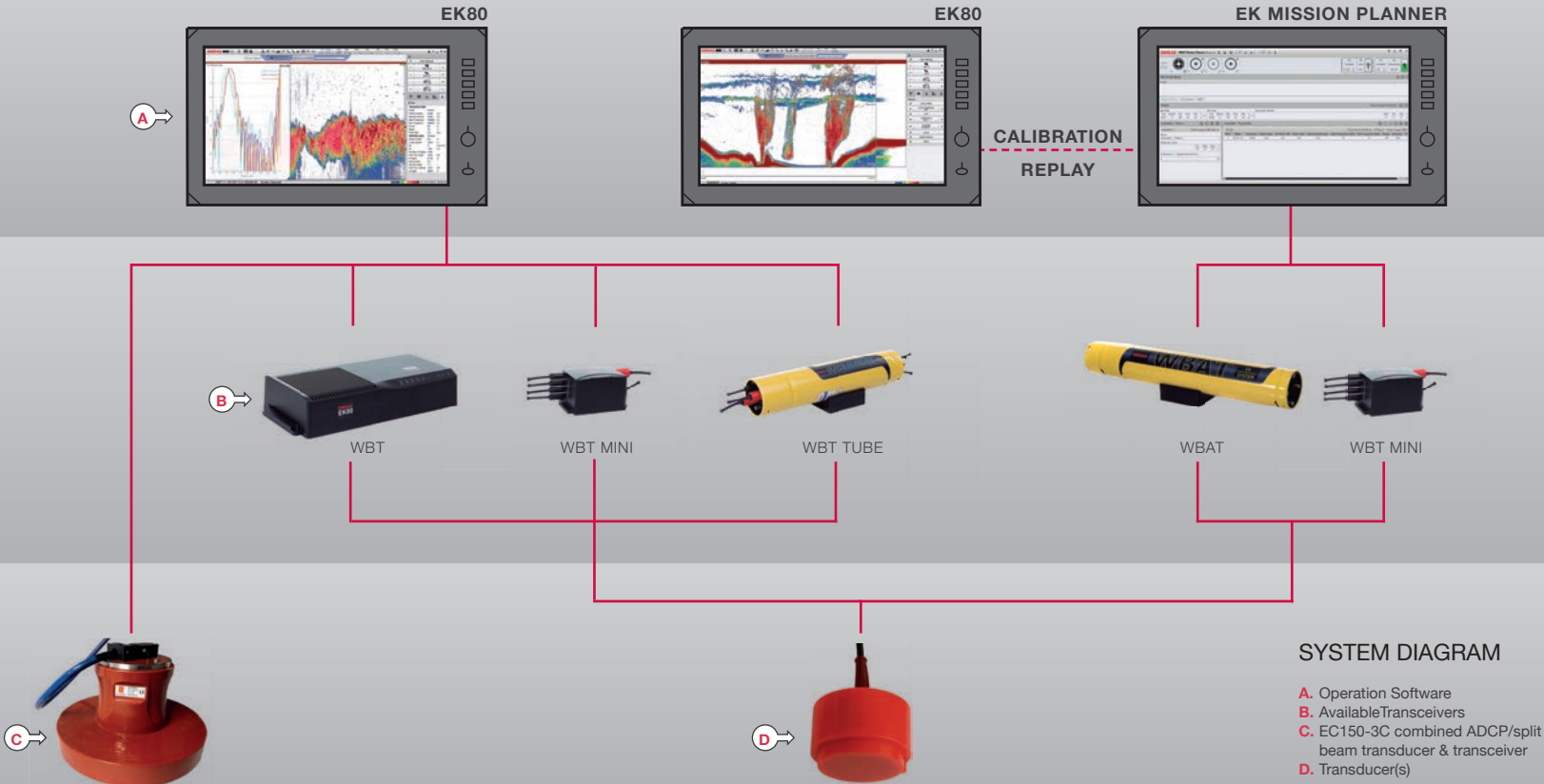
	WBT	WBT Mini	WBT Tube	WBAT
Frequency Range	10-500 kHz	30-500 kHz	30-500 kHz	30-500 kHz
Pulse Duration	64-16384 µs	64-2048 µs	64-2048 µs	128- 2 µs
Pulse Forms	CW, FM (up and down sweep), Custom (future option)	CW, FM (upsweep)	CW, FM (upsweep)	CW, FM (upsweep)
Transmit Power	2000 W @55 Ω	1000 W @55 Ω	1000 W @55 Ω	1000 W @55 Ω
Number of Channels	4	4 ( 8 with MUX)	8 (16 with MUX)	4 ( 8 with MUX)
Transducer options	Single, Split	Single, Split	Single, Split	Single, Split
Internal memory	N/A	512 GB (Aut. Ver.)	N/A	512 GB (Aut. Ver.)
Depth / Width / Height	213 / 438 / 84 mm	145 / 223 / 123 mm	701 / 144 / 144 mm	166 / 166 / 1000 mm
Weight air/water	4.9 kg	5.4 / N/A kg	14.1 / 3.6 kg	25/12
Voltage requirement	12-15 VDC	12-16 VDC	12-16 VDC or 20-50 VDC	14 V (internal battery)
Power consumption 38/120/333 kHz	20 / 10 / 5 W	6 / 3 / 3 W	6 / 3 / 3 W*	6 / 3 / 3 W
Passive/Standby	4 W	2 / <0.02 W	2 W* / N/A	2 / 0.02 W
Maximum current	5 A	2.5 A (Peak)	2.5 A (Peak)	2.5 A (Peak)
Power source	External	External	External	Built-in battery
Operational temperature	-15 to +55 °C	-15 to +55 °C	-5 to +35°C	-5 to +35°C
Storage temperature	-20 to +70 °C	-20 to +70 °C	-20 to +55°C	-20 to +55°C
IP/Depth rating	N/A	IP67	4000 m	4000 m
Enclosure Material	Aluminium	Aluminium	Aluminium	Aluminium
Compass safe distance standard/other	30 cm	N/A	N/A	N/A
External Interface	Ethernet, Digital sync I/O	Eth/serial	Ethernet	Serial

\*WBT tube has two transceivers available. Consumption and power requirements are given for one transceiver.

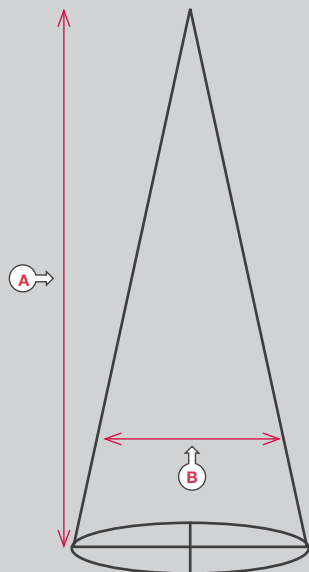
SINGLE BEAM SYSTEMS

EK80 REAL TIME SYSTEM

EK80 AUTONOMOUS SYSTEM



# FOOTPRINT ON DIFFERENT TRANSDUCER BEAMWIDTHS



A		Meters	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
		Feet	33	66	98	131	164	197	230	262	295	328	361	394	426	459	492
		Fathoms	5	11	16	22	27	33	38	44	49	55	60	66	71	77	82
B	7°	Meters	1	2	4	5	6	7	9	10	11	12	13	15	16	17	18
		Feet	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	10°	Meters	2	4	5	7	9	11	12	14	16	18	19	21	23	25	26
		Feet	6	11	17	23	29	34	40	46	52	57	63	69	75	80	86
	13°	Meters	2	5	7	9	11	14	16	18	21	23	25	27	30	32	34
		Feet	7	15	22	30	37	45	52	60	67	75	82	90	97	105	112
	30°	Meters	5	11	16	21	27	32	38	43	48	54	59	64	70	75	80
		Feet	18	35	53	70	88	105	123	141	158	176	193	211	228	246	264

## RANGE RESOLUTION ON VARIOUS TRANSDUCERS

Range resolution in CW mode is given as half the pulse length.

Range resolution in chirp mode however, is given by the bandwidth (BW), not the pulse duration:

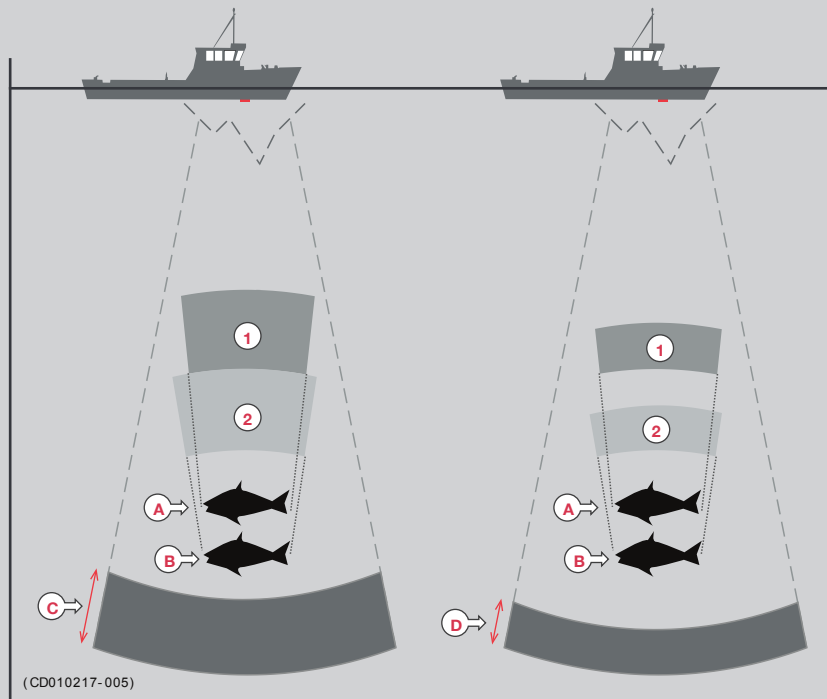
$$\text{Range resolution} = c / 2 \times \text{BW}$$

As an example, an EK80 transmission could use 100 kHz

bandwidth. Assuming a sound speed (c) of 1500 m/s, this will give a range resolution of about 8 mm, far better than in CW. Range

resolution from the composite transducers is in brackets in the table below for comparative purposes.

	64μS	128μS	256μS	512μS	1024μS	2048μS	4096μS	8192μS
18 kHz				40 cm	75 cm	150 cm	300 cm	600 cm
27 kHz				40 cm	75 cm	150 cm	300 cm	600 cm
38 kHz			20 cm	40 cm	75 cm	150 cm	300 cm	
50 kHz		10 cm	20 cm	40 cm	75 cm	150 cm		
70 kHz		10 cm (2 cm)	20 cm (2 cm)	40 cm (2 cm)	75 cm (2 cm)	150 cm (2 cm)		
120 kHz		10 cm (1 cm)	20 cm (1 cm)	40 cm (1 cm)	75 cm (1 cm)			
200 kHz	5 cm (0,8 cm)	10 cm (0,8 cm)	20 cm (0,8 cm)	40 cm (0,8 cm)	75 cm (0,8 cm)			
333 kHz	5 cm (0,5 cm)	10 cm (0,5 cm)	20 cm (0,5 cm)	40 cm (0,5 cm)	75 cm (0,5 cm)			



The left vessel uses a long pulse duration (C). As you can see, this causes the echoes from the two fishes (A) and (B) to merge.

The right vessel uses a shorter pulse duration (D), and the two fishes will then appear as two separate echoes on the echogram.

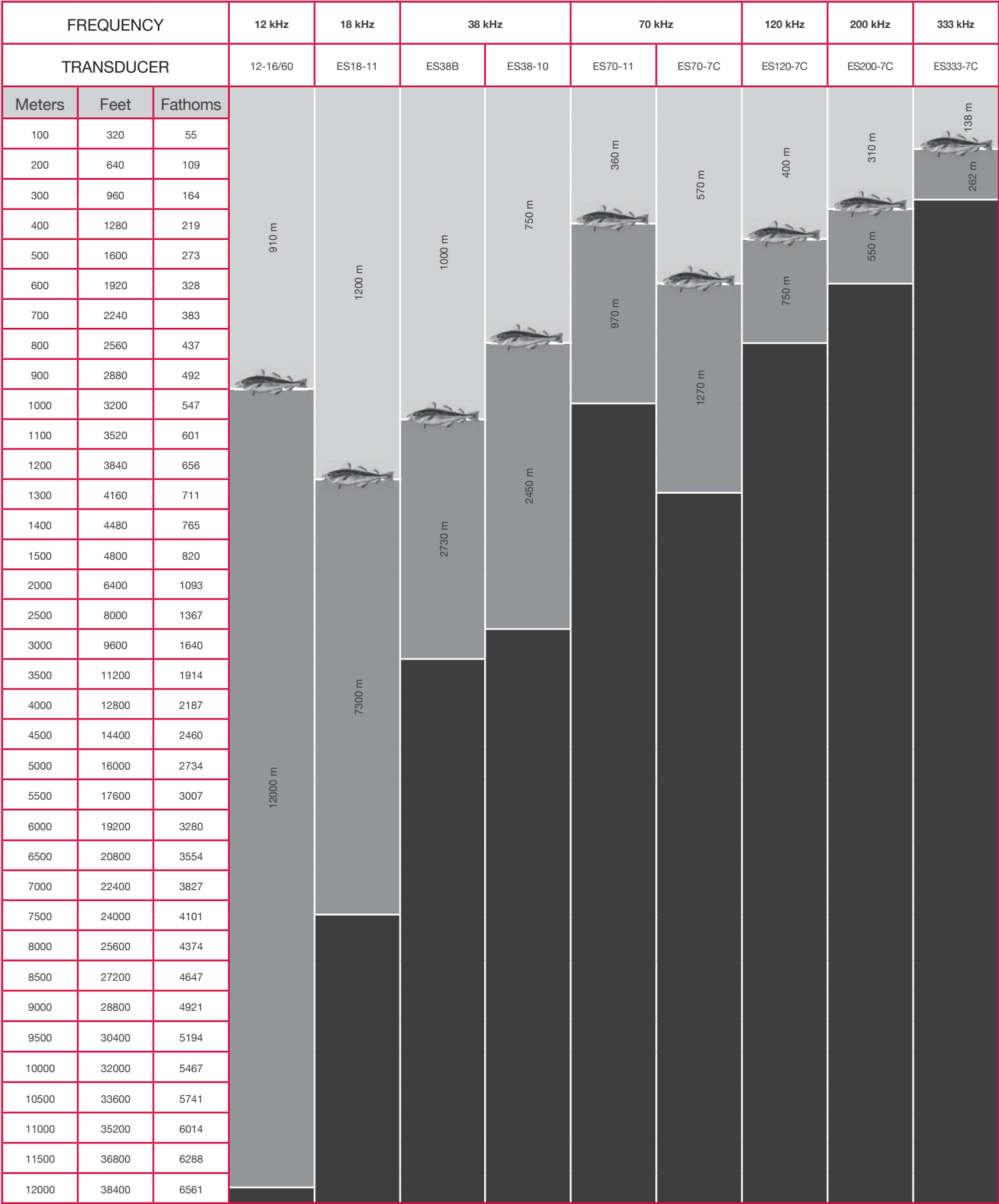
Thus, short pulses will provide the best resolution and separation of individual fishes, but the echo sounder is more sensitive to noise.

Two targets need to be min. 1/2 pulse length apart, in order to be seen as two targets. This can be measured in cm. (table above).

This is however not the case with chirp where resolution is given by the utilized bandwidth, with range resolution shown in brackets.

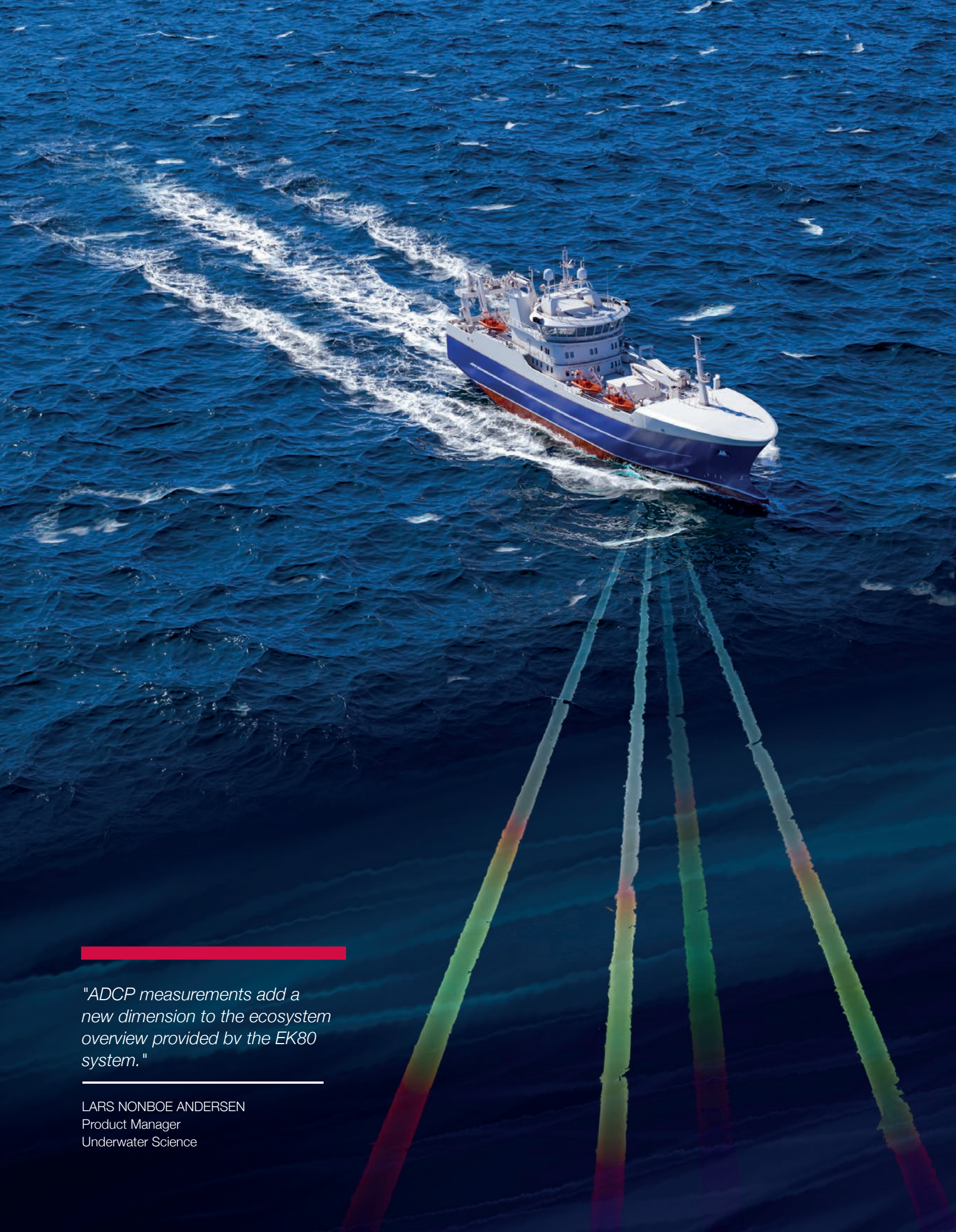


DETECTION DEPTHS



Note: For TS = -32dB in salt water 35ppt and 10° C at 38 kHz this relates to a cod of length 60cm. Bottom Sb = -30dB/m²





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*"ADCP measurements add a new dimension to the ecosystem overview provided by the EK80 system."*

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LARS NONBOE ANDERSEN  
Product Manager  
Underwater Science





# EK80 ADCP

## 2 in 1, when less is more

Currents play an important role in an aquatic ecosystem, carrying nutrients and biology or transporting heat.

Scattering from particles in the water will produce doppler effects when moving, which can be measured and turned into a profile of vertical and horizontal velocity over time.

With the introduction of the very first combined split beam echo sounder and ADCP (Acoustic Doppler Current Profiler) the EK80 system manifests its position as the most complete instrument for ecosystem assessments.



# EK80 ADCP

## CURRENTS AND THE MARINE ECOSYSTEM

An acoustic doppler current profiler measures the speed and direction of the currents throughout the water column. This offers a valuable tool for understanding how organisms, nutrients and other biological and chemical constituents are transported throughout the ocean.

In addition to use travel time of the sound to estimate distance, the ADCP uses the doppler effect to estimate the water velocity. The frequency shift of the echo is proportional to the velocity along the acoustic path, and with multiple measurements you can get a 3D profile of the water column.

### TECHNOLOGY

The acoustic doppler current profiler (ADCP) and narrow split-beam functionality offered by the Simrad EK80 is based on the EC150-3C transducer. The EC150-3C is a phased array transducer resulting from decades of experience building acoustic instruments. The transducer combines composite technology with built-in electronics, allowing for a compact and easy installation. By combining wideband elements, the transducer allows for both narrowband (CW) or wideband (FM) signals to be used based on user requirements. The phased array also allows for a very narrow, split beam, echo sounder beam to be created by the same transducer.



## TECHNICAL SPECIFICATIONS

### OVERALL PERFORMANCE

- Nominal frequency: 150 kHz
- Frequency range: 130 to 170 kHz
- Dynamic range: 135 dB

### ADCP PERFORMANCE

- Number of beams: 4
- Beam vertical tilt: 30 degrees
- Beam width: 3 degrees @ 150 kHz
- Pulse type: CW or FM
- Cell size: 2 to 16 m
- Max output sample interval: 40  $\mu$ s
- Max number of depth cells: Unlimited
- Max range: > 400 m @ CW, 8 m cell size

*Maximum range depends on the acoustic scattering conditions.*

### ECHO SOUNDER PERFORMANCE

- Number of beams: 1 split beam
- Beam width: 2.5 deg @ 150 kHz
- Pulse type: CW or FM
- Calibration functionality: Included

### OUTPUT SPECIFICATIONS

- Ethernet: ZeroMQ
- File: NetCDF

### PROCESSOR UNIT

- Computer: EK80 Processor Unit
- Operating system: Windows® 10
- Software: EK80

### INTERFACES

- Internal sensor: Temperature
- External sensors: Position, Attitude and Heading

### EC150-3C CONNECTIONS

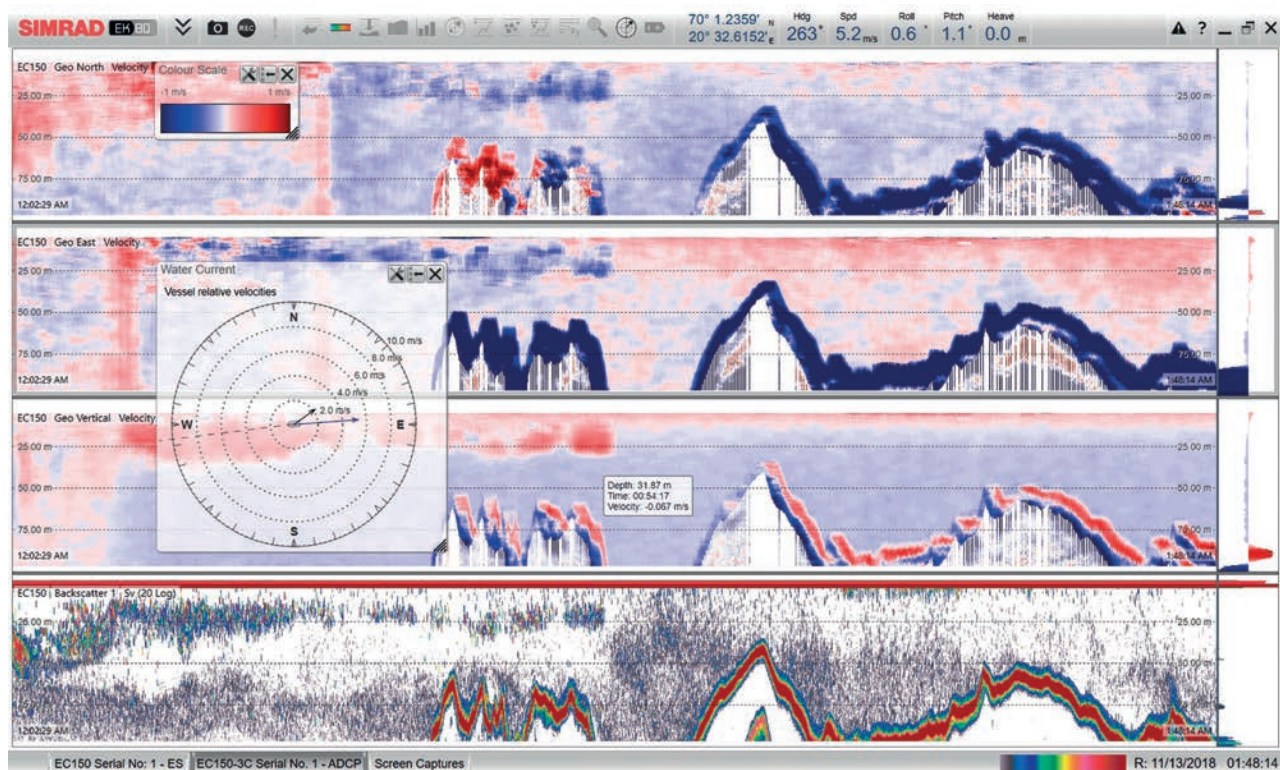
- A dedicated 40 m open ended cable is provided with the transducer.

### EC150-3C POWER REQUIREMENTS

- Voltage requirement: 115 to 230 VAC, 50-60 Hz (nominal)
- Power consumption: 70 W
- Inrush current: 30 A with cold start @ 230VAC/25°C
- Input current: <0.65 A@230 VAC

### EC150-3C ENVIRONMENTAL REQUIREMENTS

- Operational temperature:
  - 5 to +50°C
- Storage temperature:
  - 20 to +60°C



### A NEW FUNCTIONALITY IN A PROVEN SYSTEM


Data acquisition and storage of the Simrad ADCP is done by the EK80 SW, which provides several advantages for the user. First of all, EK80 is already installed on most research vessels, which means you can reduce the complexity of the installation. Also, the space requirement is reduced, since you only need one operator station. Then, lower installation and maintenance lead to a cost effective improvement. Additionally, having the same SW taking care of both measurements eases the task of synchronizing, which is a challenge even with an external synchronizing unit. Finally, the EK80 is a user friendly, well proven software that leaves the user in full control of all parameters, a basic requirements for a scientific user. The EK80 stores the ADCP data in NetCDF format, and auxiliary data such as motion and position data are recorded in the data files.

### THE ADDITIONAL ECHOSOUNDER

In addition to being an ADCP, the EC150-3C allows for the combined elements to be used to produce a very narrow, wideband echosounder beam. The built-in echo sounder adds a new dimension on its own, providing a high resolution echosounder at no extra effort. However, also as part of a multifrequency EK80 setup the 3 degree opening angle supplements the other transducers by improving the systems ability to pick out individual targets within aggregations.





An aerial photograph of a research ship, likely a hydrographic survey vessel, moving through deep blue ocean waters. The ship is white with a blue hull and is leaving a white wake. Two large, semi-transparent, blue-tinted fan-shaped areas represent the multibeam sonar beams being emitted from the ship, spreading outwards and downwards into the water. The water surface is textured with small waves and ripples.

*"The scientific multibeam systems  
represent outstanding innovation  
in transducer technology,  
mechanical design, beam forming,  
and signal processing solutions."*

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LARS NONBOE ANDERSEN  
Product Manager  
Underwater Science





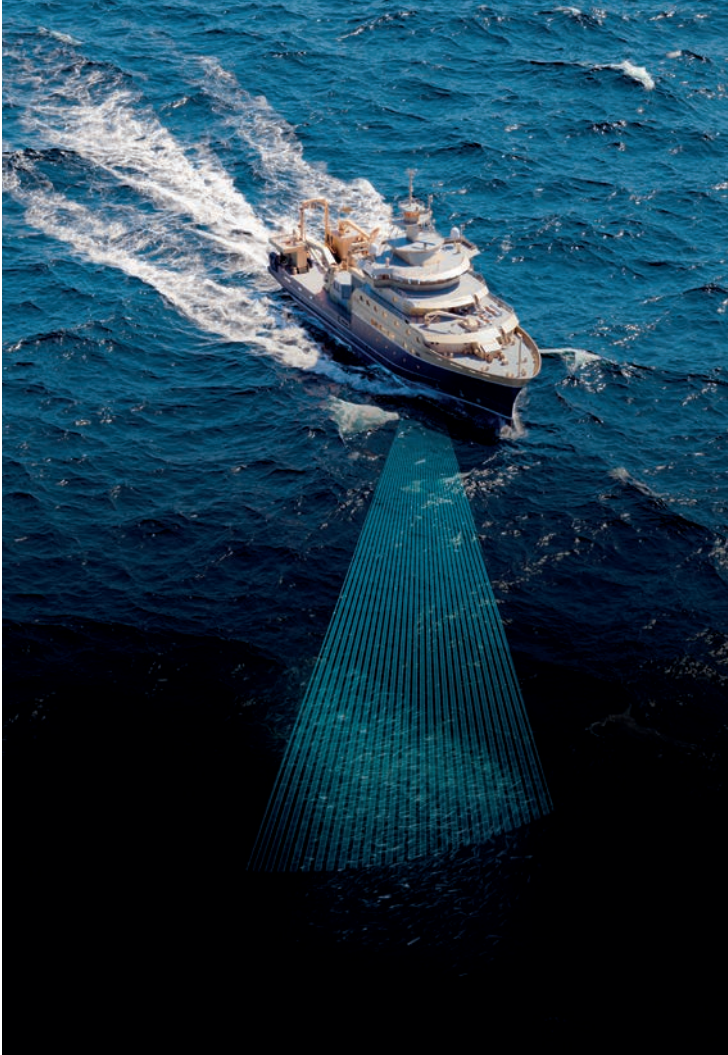
# MULTIBEAM SYSTEMS

## Take your survey to the next level

Multibeam systems have been used for decades to detect, inspect and map bottom and manmade structures in the water, but the application within fishery and ecosystem surveys is relatively new.

With the introduction of the first quantitative Multibeam systems in the world, SIMRAD has added new dimensions to biological surveys, providing 3D and even 4D data from the marine ecosystem.

The combination of high resolution quantitative data, extremely low side lobes and no cross talks between the beams has already proven to strengthen our understanding of marine life.



## SIMRAD ME70 SCIENTIFIC MULTIBEAM ECHO SOUNDER

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A scientific multibeam echo sounder can be seen as many EK sounders spread out in a fan of beams. Where the EK provides multifrequency analysis, the ME70 adds to the picture with morphology and volume information, improved horizontal resolution and in general, it samples more cubic of water along the survey line.

What makes the ME70 truly unique is that it combines the quantitative element from the split beam sounders with the resolution and the extended sampling volume from the multibeam world. As each beam is configured as split beam, standard split beam calibration techniques can be applied to the entire swath. When you have the system calibrated, you can both visualize and quantify your targets.

The combination of multiple, narrow beams with low side lobes strengthen your capability to measure targets in the acoustic dead zone close to the sea bottom. In addition to the obvious fish and marine mammals, other targets such as methane gas seeps and seafloor vegetation can be measured with calibrated backscatter values. The increased sampling volume from a swath system also addresses the acoustic dead zone in the upper layers of the water column as the fan of beams cover approximately 10 times the width compared to the 7° single beam.

## MORPHOLOGY AND BEHAVIOUR

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Much information can be derived from understanding the morphology of schooling fish. Perhaps most obvious; your estimation of the size on that particular school will improve. However, school morphology can also improve your species identification as various fish show different characteristics in the way they interact both within the school and together with the surrounding environment.

Predator/prey, or who is feeding on who, is also important information when you assess the ecosystem. The ME70 offers extremely low sidelobes and high dynamic range, something that is vital when it comes to measuring a fish close to bottom, or plankton near a school of fish. The two way side lobe suppression offered by the ME70 means that a school of fish will not be smeared out across the

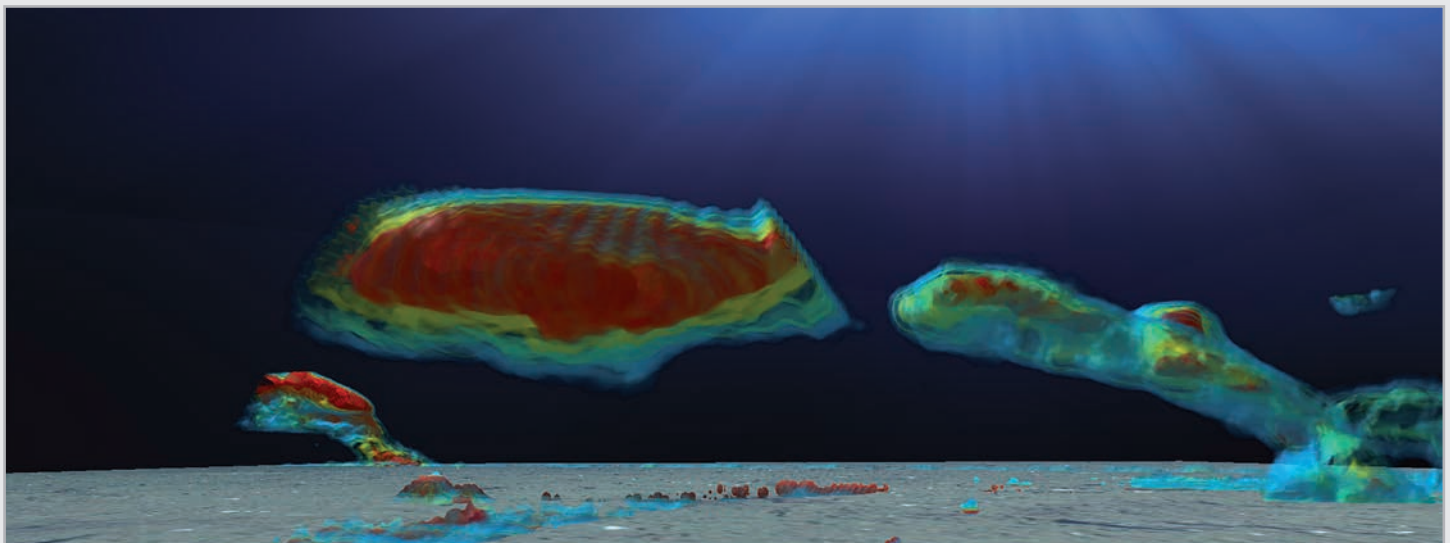
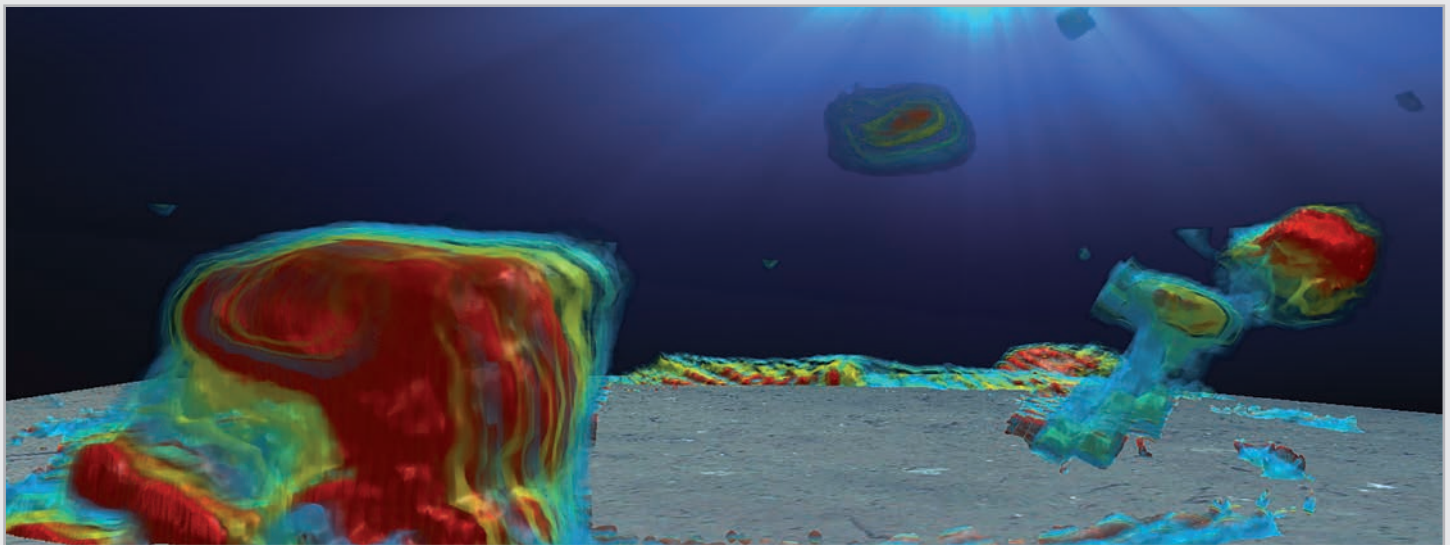
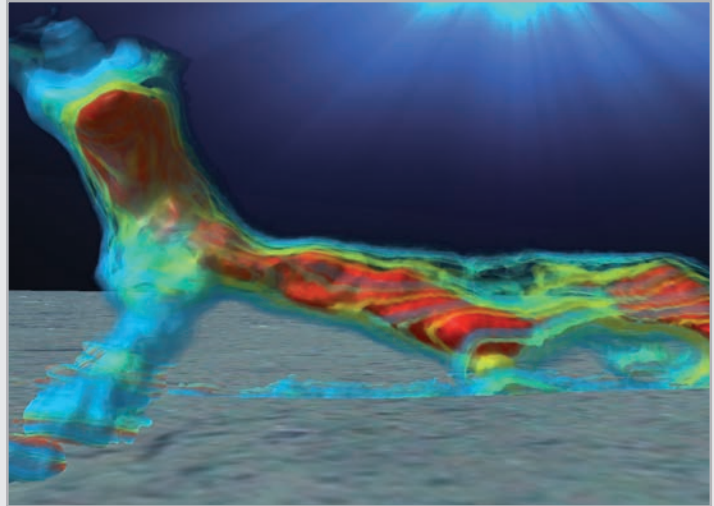
swath, but rather show the real boundaries of the school. The same applies for marine habitats where the bottom echo is the dominant scatterer. Thanks to the advanced beamforming and side lobe suppression techniques of the ME70, the bottom echo would not shadow other smaller targets.

To investigate a complete marine ecosystem is a challenge. Using single beam acoustics can be compared with looking through a peephole, whereas the ME70 widens your vision and is more like looking through a window. The 3D information given by the ME70 adds spatial resolution and improves your stock assessment.



This picture shows a school of sand eel close to the bottom. The sand eel typically burrows in the sand to escape predators during daytime, while at night time it feeds on plankton and other small creatures. You can actually see how the school maintains contact with the sand even when the main population feeds in the water column. The only reason we can record such details near the bottom is the ultra-low sidelobes coupled with the advantages of frequency rotation between the beams.

This data were recorded with the ME70 and has since then been processed and visualized by a third party software. As with all SIMRAD RAW data, the ME70 data format is open and well documented.





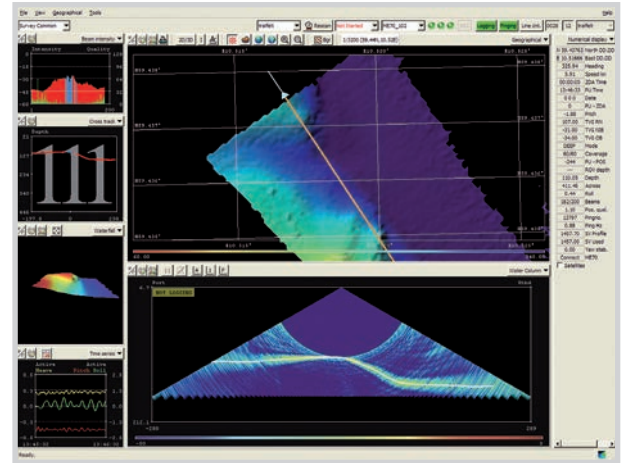
## ME70 BATHYMETRIC OPTION

The seafloor is an important component of the marine ecosystem. Perhaps you are looking at vegetation that grows on the bottom or fish that thrive near the bottom. Or perhaps the bottom structures themselves are of interest to the assessment such as presence of coral reefs in the area.

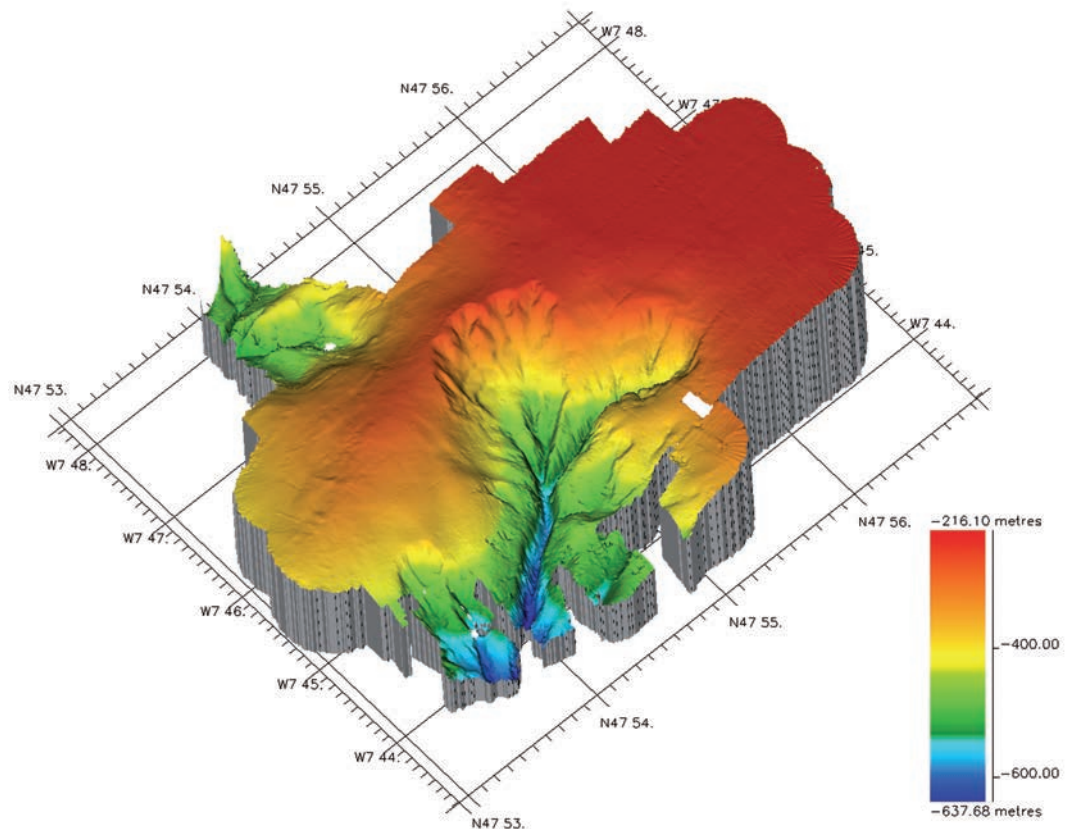
The advantages of using a multibeam system when studying the seafloor are obvious, multiple detection points from an array of narrow beams are better than a single, wide beam. With the introduction of the ME70 scientists can now survey the seafloor while doing quantitative studies for biology at the same time. The ME70 is calibrated with a sphere with known target strength, and backscatter data can therefore be compared across various study areas.

If you want one multibeam system to do both quantitative water column work and bottom mapping, the ME70 is your only logical choice. The system can provide IHO S44 Order 1 data, and fulfils the demanding LINZ order 1 survey specification to be met in full. The bathymetric system includes a special bathymetric processor unit for bottom detection, ray tracing, extra motion correction,

and x,y,z data generation developed by the hydrographic department of Kongsberg Maritime.



Kongsberg's own Seafloor Identification System (SIS) is also included in the delivery, adding an extensive set of graphical displays for data quality control, as well as system calibration, data cleaning, gridding, and visualization.



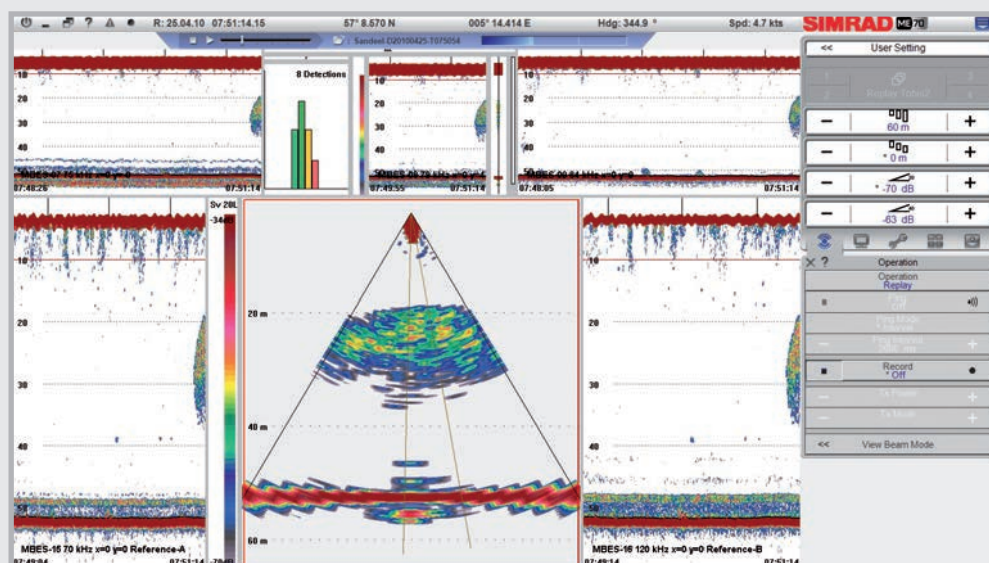
# EXTERNAL SENSORS AND GEOMETRICAL MEASUREMENTS OF VESSEL

The multibeam echo sounder needs the following information from external sensors to function correctly:

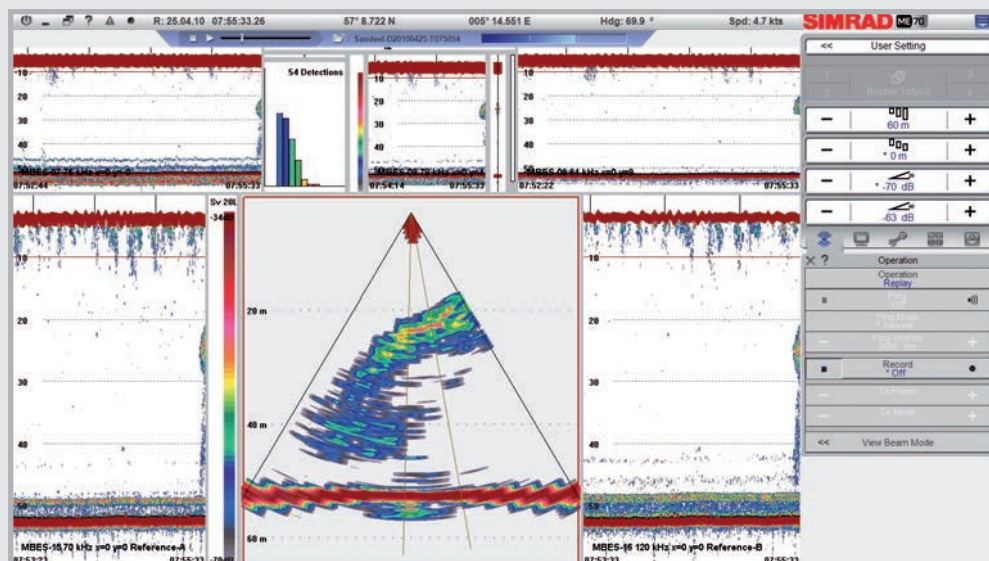
- Position
- Heading
- Vessel motion: pitch, roll and heave
- Sound velocity at the transducer depth
- Sound velocity profile through water column
- Potentially others, such as very accurate time stamp

Which sensor to use depends on the survey requirements. Kongsberg Maritime's Seapath 300 family provides a combined motion sensor and GPS that produces position, heading, and vessel motions from one integrated device. Upon request, we can suggest external sensors that fulfill the particular survey needs.

It is also recommended to do a very accurate measurement of the vessel including transducer position inside the hull. The need for accuracy varies with user need, but we always recommend to use land surveying techniques that can be performed by third party companies.



Here we have a screenshot from the ME70 acquisition software. On the centre of the image we see the combined swath of beams athwartship. The software is flexible: it not only shows the individual beams of your choice, but you can also see split beam information, such as size, from each beam.



In this screenshot we can see another school, but this one displaying very different schooling behaviour. Understanding the school's morphology has never been so easy.



## SIMRAD MS70 SCIENTIFIC MULTIBEAM SONAR

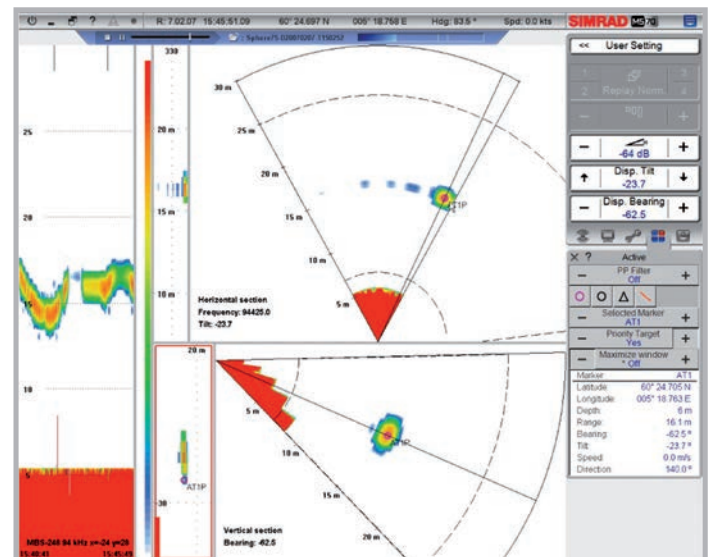
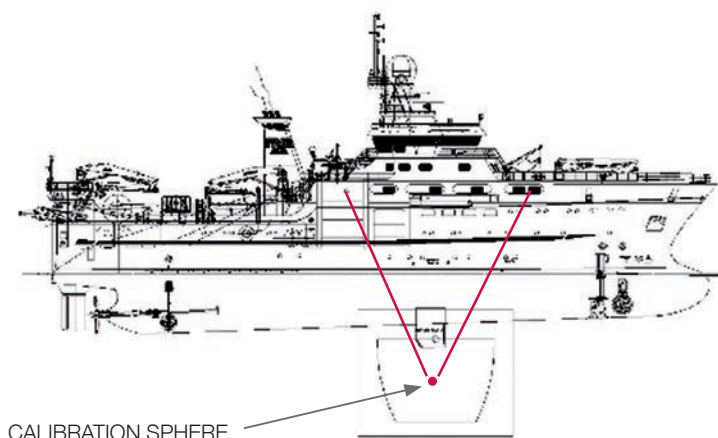


The MS70 provides an acoustic matrix of stabilized and calibrated beams for biomass estimation and study of school behaviour. Advanced beam forming is used to form 500 beams, spread out 60° horizontally by 45° vertically. As a result of this optimized horizontal transmission of narrow beams, the MS70 allows the user to detect and characterize schools of fish even very close to the sea surface.

Where the ME70 adds a third dimension to your survey, the MS70 adds a 4<sup>th</sup> dimension. When you add up distance, vertical and horizontal swath of beams in addition to time from multiple transmissions, in reality what you have is an acoustic camera. As a school of fish changes shape and density constantly, the MS70 is the best possible tool to understand these dynamics with remote sensing.

As with all Simrad scientific systems, a calibration utility is implemented as a special built-in function in the SW. The sonar is calibrated using a reference sphere that needs to be located on the side of the ship.

During the calibration process, the MS70 automatically generates 500 split beams in order to measure the target position within each beam. Individual gain parameters for each beam are adjusted to provide calibrated target strength and volume backscattering strength.





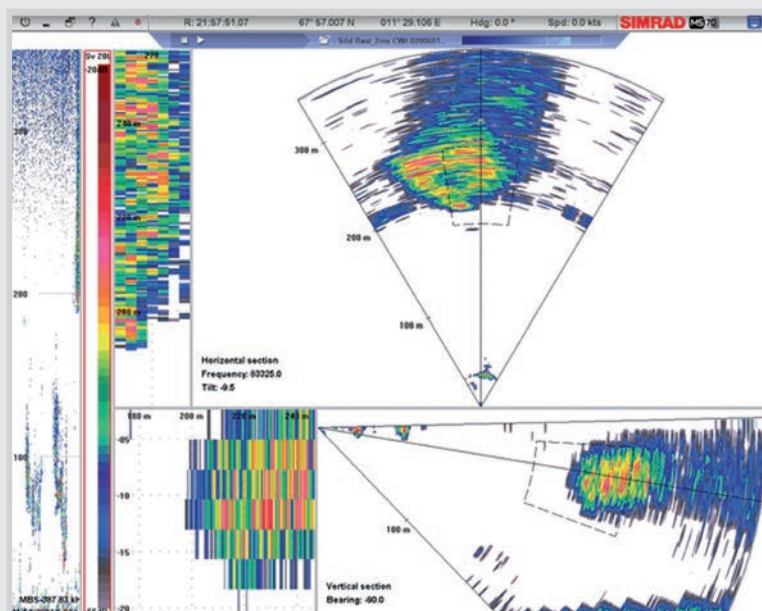
# THE CHALLENGE OF STUDYING SCHOOLING FISH CLOSE TO SURFACE

Low sidelobes are important for at least two reasons. The obvious one is to avoid that a strong target in the side lobes are mistaken for weak targets in the main lobe. Secondly, you do not wish to see strong bottom echoes from the sidelobes.

Surface is a very strong reflector, and the two-way vertical side lobe suppression of the MS70 secures that reflections from the surface does not contribute to the school estimate. Also, the frequency band of the system is distributed out across the matrix, with minimal leakage between the many beams.



**The frequency bandwidth is distributed between the 500 beams.**



This screenshot shows a school of herring. Even though the MS70 detects and records data from all 500 beams, only two sectors can be shown in a traditional 2D view. One is a horizontal slice, while the other is a vertical slice through the matrix. In addition to that, you can have a zoom view and an echogram from the single beam shared by the two sectors.

MULTIBEAM SPECIFICATIONS

Beam organization
Operating sector
Minimum beamwidths
Operating frequency
Max no. beams
Beam stabilization

SIDELobe SUPPRESSION

Sidelobe levels
Pulse duration

DYNAMIC RANGE

Max. source level
-------------------

TRANSCEIVER UNIT

TX/RX channels
Modulation
Communication
Physical size

TRANSDUCER UNIT

Number of elements
Material
Physical size

ME70	ME70 BATHY MODE	MS70
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Fan		Matrix
2 to 140°	120°	60° x 45° (H x V)
2° x 2°	3° x 2° (along x athw.)	4° x 3° (H x V)
70-120 kHz		75-112 kHz
45 split beams	81 split beams	500
Roll & pitch		Roll

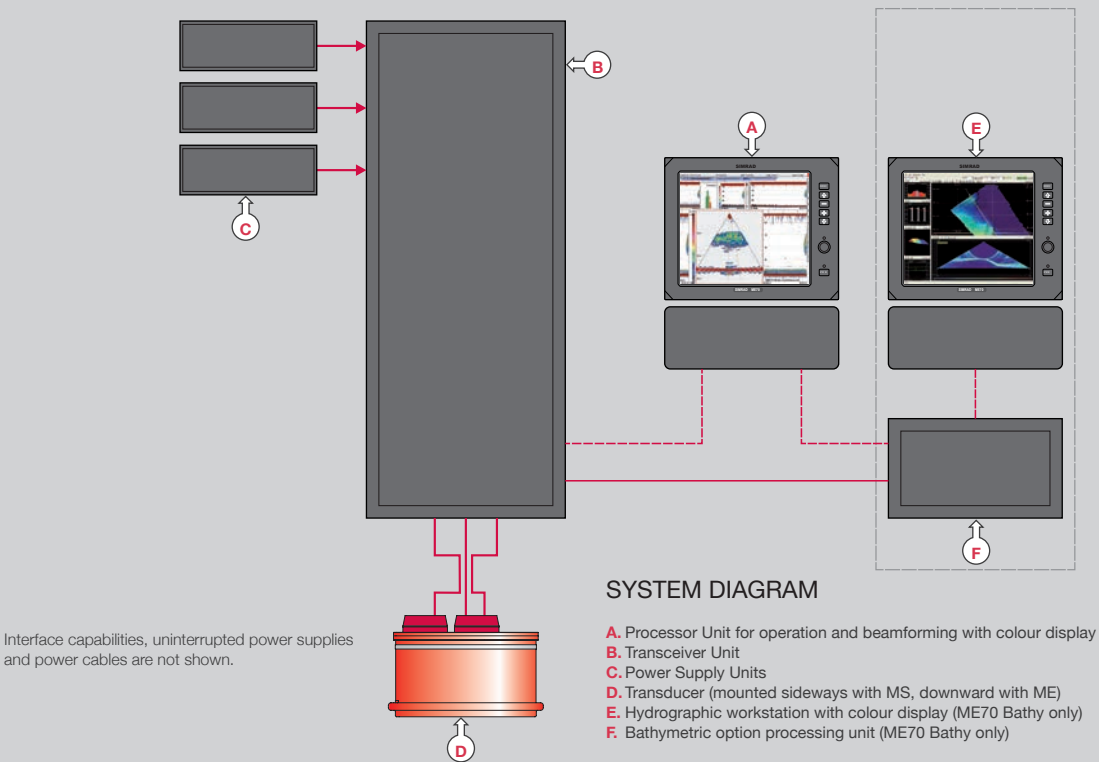
-35 to -70 dB	-35 x -25 (along x atw.)	H: -35 dB, V: -25 dB
64 to 5120 µs	64 to 5120 µs	2-10 ms

225 dB	216 dB	206 dB
--------	--------	--------

800 individual channels		
CW or chirp		
2 x 1 Gb Ethernet lines		
1200 x 600 x 900 (H x B x D)		

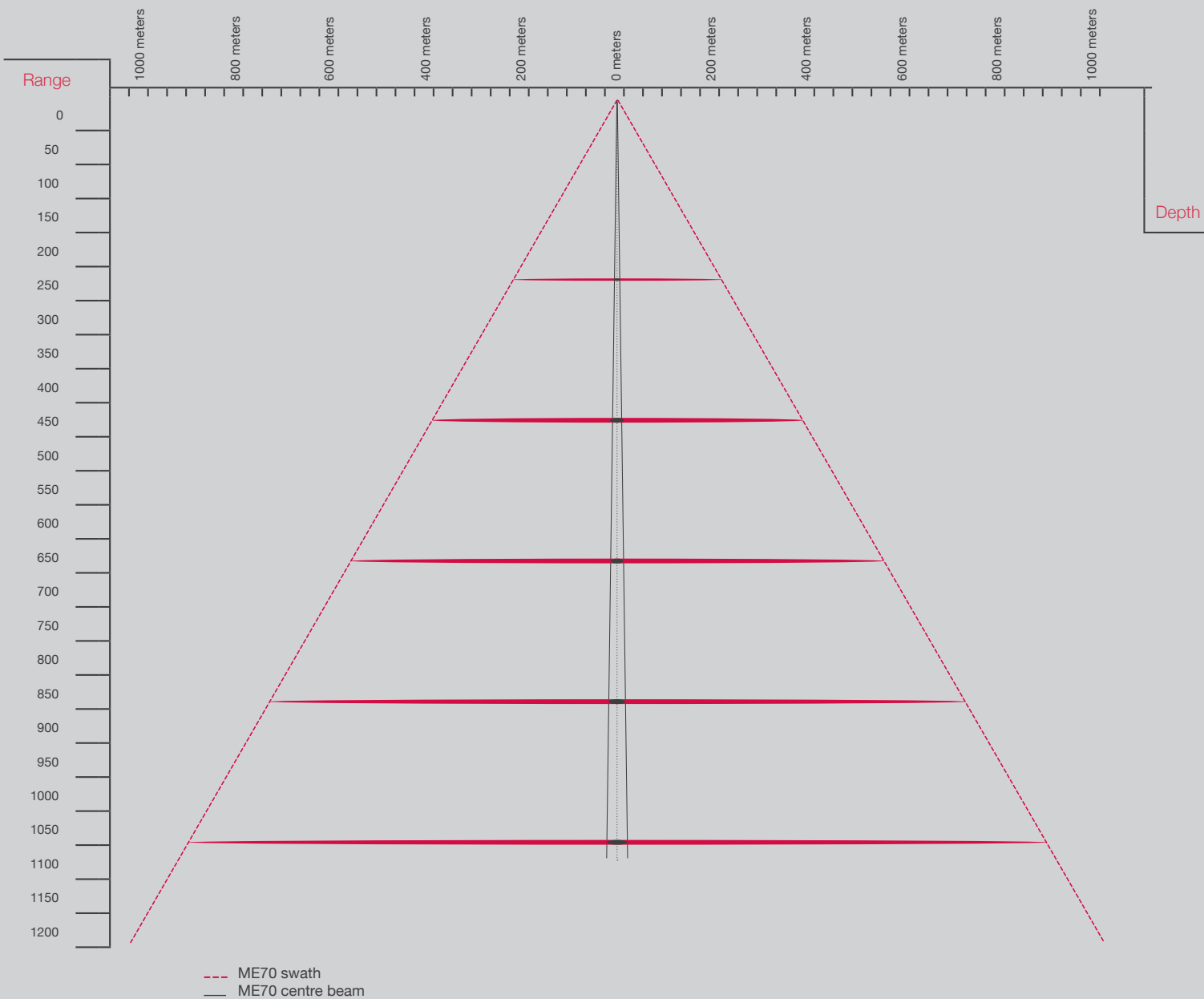
800 individual elements		
Ceramic polymer composite		
Circular, 670 mm, H; 400 mm		

SIMRAD SCIENTIFIC MULTIBEAM SYSTEMS



# INCREASED EFFECTIVE SAMPLING VOLUME

A scientific multibeam echo sounder can be seen as many EK sounders spread out in a fan of beams. With more narrow beams spread out in a wide swath, you increase both your resolution and sample volume at the same time. The system can be configured to fit your preferences. Below, we can see a 60° swath and its corresponding sampling volume.







---

*"Our sonars are based on:*

- Efficient transducers with*
- Clean beams and*
- Complex signals with*

*advanced signal processing*

*The Simrad sonars are designed  
and produced in house, which  
means that we have full control of  
the product."*

---

MARTIN TOLLEFSEN  
Product Manager  
Sonars





# SONARS

## Already a success!

The first Simrad sonars introduced on research vessels were delivered for the Norwegian vessels “Johan Hjort” and “G.O. Sars” back in the late 1950's. These were combined sonars and echo sounders, considered very advanced at that time. Since their introduction, the sonars have evolved to become highly efficient tools to detect any object in the water column with a number of revolutionary features.

Today, the sonar family has grown to include 4 different omni directional sonars: low frequency (SU90, SX90, ST90) and high frequency (CS90).

In addition to finding and tracking objects in the water column, the Simrad sonars are now being converted into scientific tools, with the introduction of RAW data output and new calibration techniques.

The sonar is also the Captain's eyes under water, valuable during fishing operations or when navigating in confined waters.



## ST90 #RANGEDEFINITION

SIMRAD is continuously developing the sonar range by utilizing the latest in technology combined with over 70 years of experience. The latest achievement is the new low frequency sonar, ST90. Our current low frequency sonars (SX90 and SU90) have been in the 20-30kHz range. With the ST90 we have lowered this range to 14-22kHz. In order to achieve this, a completely new transducer has been designed. Each element is larger than the previous, but the amount of elements are the same as the SU90, giving the same narrow beam and ultimately a longer range.

The ST90 is made to search at very long range in all conditions. Whether it is heavy weather, hard bottom, open waters, weak targets it all will be handled by the ST90 due to the fully stabilized and very narrow beams combined with state of the art signal processing.

The ST90 will also feature the new and powerful Winson sonar operating SW with all the new benefits like multiple monitor, “all beams in one ping” and so forth. Please see the new sonar SW section where this is described in more detail.



## NEW WINSON SONAR OPERATING SOFTWARE

### NEW WINSON SONAR OPERATING SOFTWARE

The current operating software in Simrad sonars has been a tremendous success with its intuitive and easy to use interface. Now it is time to take this success to another level by introducing the new operating software already operational in our echosounders, catch monitoring systems and SN90 sonar. This will complete our mission of having one unified interface between the user and the product regardless of what product you are operating. Great new features are also a part of this upgrade.

### OPTIMIZED FOR MULTIPLE DISPLAYS

The new “docking” function enables the user to take any window and place it on a separate screen or display. If you move the vertical view to another display, it will automatically scale the window for best viewing of long range in shallow water for example.

### “ALL IN ONE PING”

Modern sonars today use multiple pings to generate the various views. For example, one for the omni 360° view and maybe two different vertical view are three pings, now all three will be transmitted and received in one ping. This dramatically improves the update rate on the screens giving a more real time information.

### RECORDING

The new operational software is now enabled to record real time situations. Before, only screen captures were recorded. Now the real echoes are recorded making it possible to replay sequences like in real life. During playback vital information can be viewed for training and/or troubleshooting purposes.

### TRACKER FUNCTION

The tracker function has been further developed and can now utilize information from both the horizontal and vertical ping.



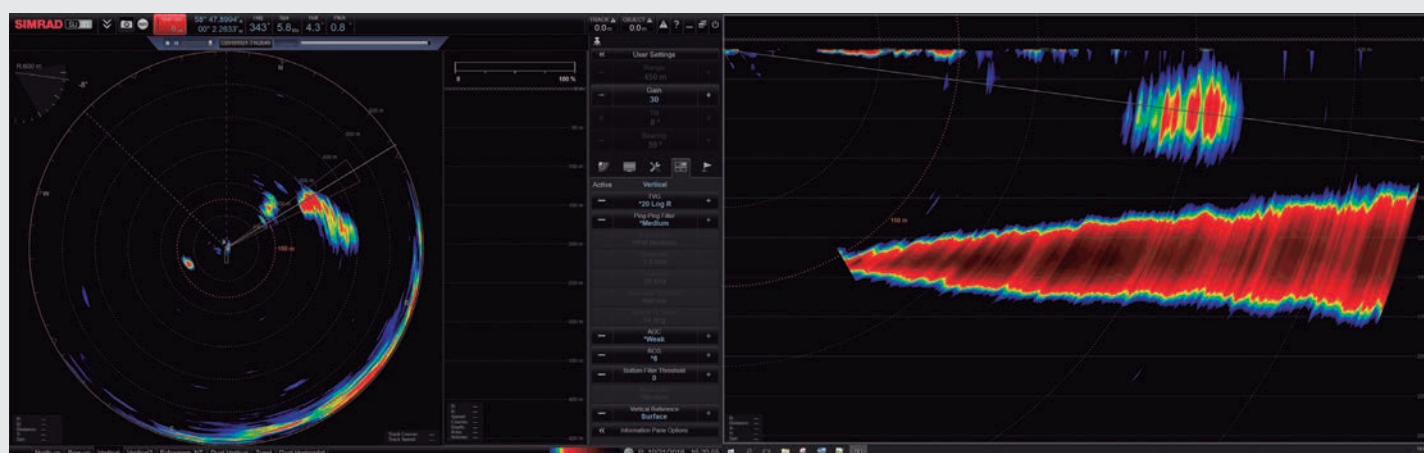


## SIMRAD SU90 SONAR

The SU90 Sonar is made with no compromises. The number of channels has been increased by 50% compared to the SX90 Sonar giving the sonar an even better performance in selectivity and range. Its operational frequency is 20 to 30 kHz. The narrow opening angle (4,9° at 30 kHz) and the increased source level (3dB) makes the SU90 a very powerful and high resolution low frequency sonar.

The narrow beam makes the SU90 even more ideal for searching fish close to the bottom or close to the surface at long ranges. Also it will give a far better vertical view with less "bottom climbing" that is seen on sonars with a wider beam. The SU90 is equipped with the celebrated signal processing seen on the SX90 such as Hyperbolic FM transmission giving the user a clutter free picture with very high resolution in range.

The higher source level (3dB higher than SX90) will increase the detection range and enhance the detected echoes in general. How much longer range is almost impossible to calculate as temperature layers, salinity, bottom hardness, target strength and sea conditions will never be the same for a good comparison. However, the sonar will have a longer range than the SX90.



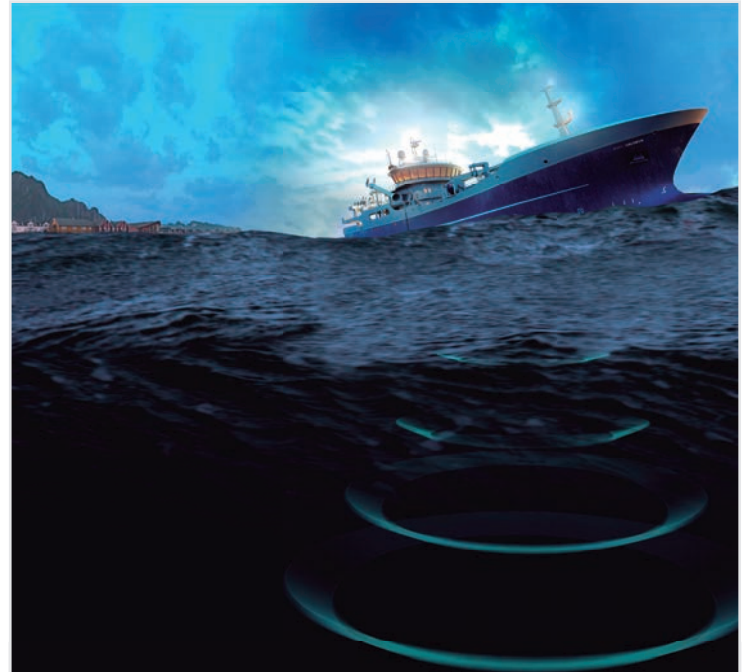
When connecting two displays any sonar presentation can be placed on any of the two. In the above example the vertical view has been placed on the display to the right. Notice that the scaling is different in horizontal and vertical plane. This makes the vertical slice useful when fishing in shallow water at long range.



## SX90 THE COST EFFECTIVE WORKHORSE

The SX90 is a low frequency, high-definition, long range sonar that utilizes the latest high-end computer to process data from the transducer. The SX90 is specially designed for vessels where high resolution combined with long range is needed. With the state of the art processor there are several unique possibilities for advanced signal processing. Three different vertical beam widths, single or dual vertical view and 180° tiltable vertical view are available. At 30 kHz operating frequency, the vertical beam width is only 7,1°.

The Simrad SX90 Sonar offers unique features such as full circle beam stabilization for easier fish detection in poor weather and 11 different sonar operating frequencies with 1 kHz separation to avoid interference from other sonars. The long range and higher definition of the SX90 will improve your catching abilities and help you make better use of your time at sea. Great emphasis has been placed on giving the best possible overview in the search and catch situation. In addition, full screen echo presentation, resizable windows, off center, zoom and dual operation are standard functions on all sonar models. You can evaluate one school while tracking two other targets, giving you full control of schools and net from detection to catch.



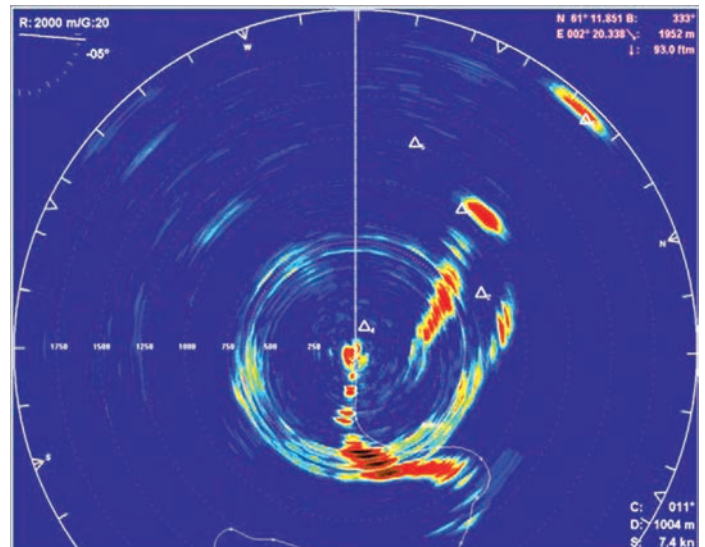
### Multi frequency 20 to 30 kHz!

Fishing in the same area as others can be a challenge as other vessels might have sonars transmitting on the same, or close to the frequency you are using. With multi frequency from SIMRAD you are able to tune your sonar for maximum performance and avoid interference from other vessels. With 11 different frequencies with 1 kHz separation, interference is no longer a problem.

Only a wideband transducer can be used to be able to transmit and receive at such a wide spread band of frequencies. SIMRAD designs and produces our own transducers for this purpose.

### Mackerel

School of mackerel detected at 40° starboard and marked as "6". Sonar is operated in "Bow Up" mode with "Full Screen". Range is 2000 meter and tilt is set at 5°. Range to school is 1952 meter and depth is indicated to be 93 fathoms saying that the mackerel school is on the bottom. Echoes between the mackerel and the vessel is wake from pair trawlers coming towards the vessel.



# CS90

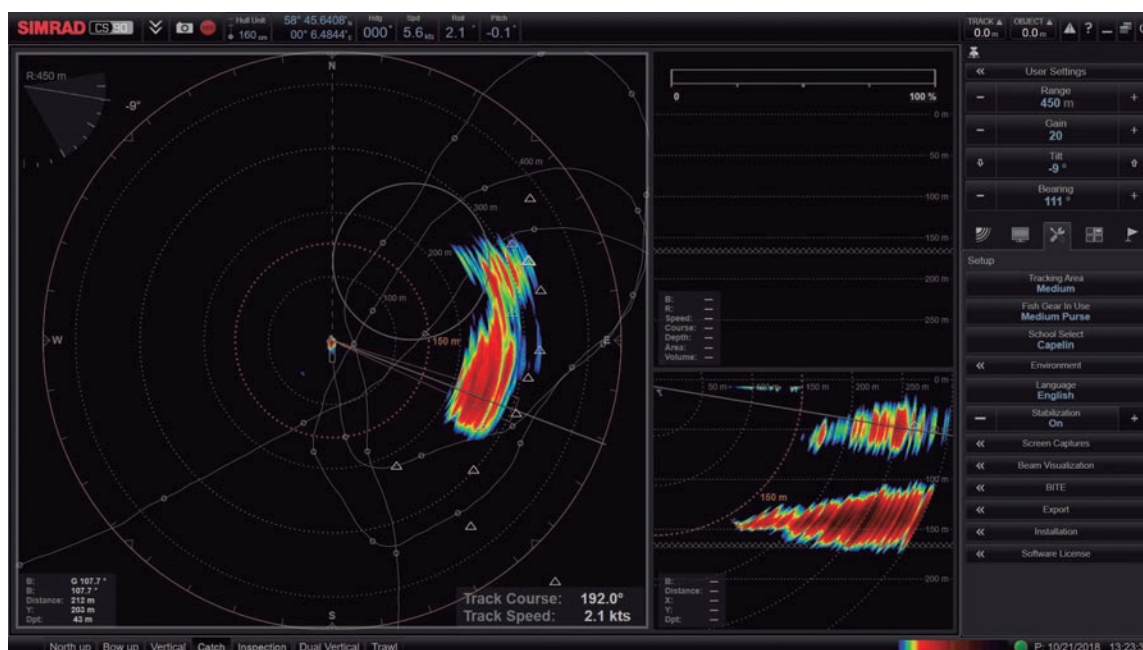
## TRUE BROADBAND HAS ARRIVED!

The CS90 is the first Omni broadband sonar on the market. The world first composite transducer makes it possible to transmit and receive in a wide range of frequencies, in fact 70-90kHz! This makes it possible to achieve high resolution on longer ranges as well as tuning the frequency for better detection or avoiding a noisy source such as another echosounder or any other acoustic source.

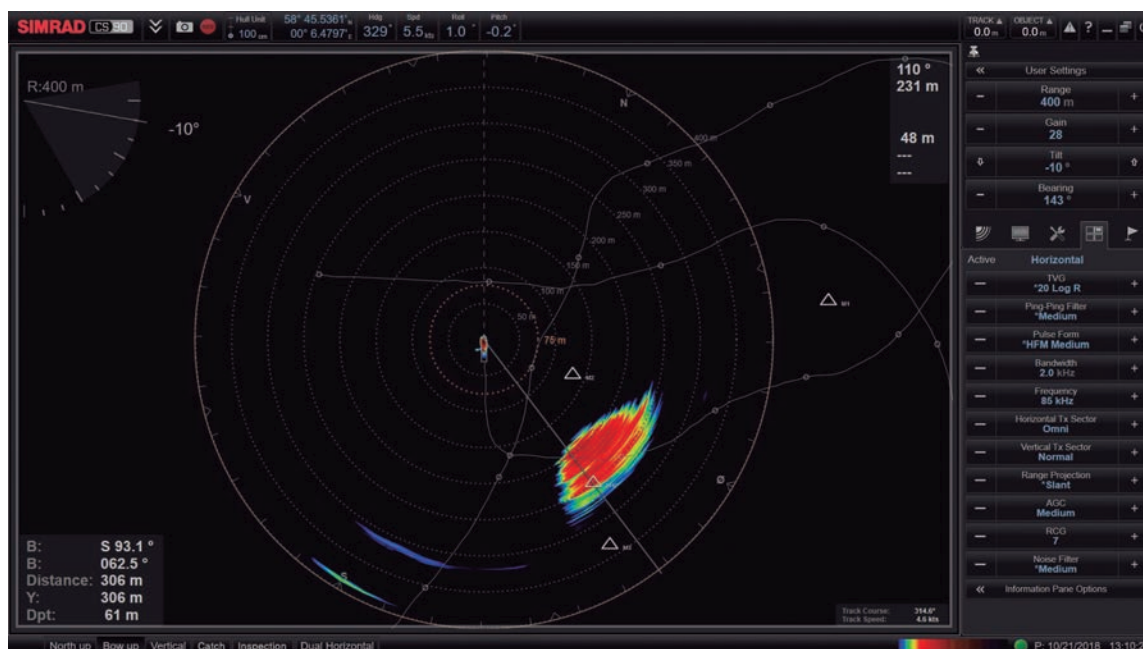
The CS90 also has the latest Winson SW enabling the user to view the various windows on separate displays using the new docking feature.

Another great feature with the new SW is that it will ping all beams at the same time reducing the ping rate and increasing the update rate on the screen dramatically.

The CS90 makes a perfect partner to the low frequency sonars. Follow the school from long range all the way into the vessel. With the range capabilities of the CS90 it is also a perfect backup if something happens to the low frequency sonar, like impact to the transducer or strike by the purse seine wire.



The CS90 is a broadband sonar capable of transmitting between 70 and 90kHz. It features the new operating SW and is optimized for the new joystick operating panel. This makes the CS90 very efficient to use during purse seine operation when a lot of equipment must be operated at the same time.



Notice the bandwidth here is 2kHz with a center frequency of 85kHz. This can be adjusted between 70-90kHz. The CS90 is an Omni broadband sonar with composite transducer. Here is an example from Mackerel fishery in the North sea. The CS90 has the new Winson 2019 operating SW with several benefits (please see page 22-23).

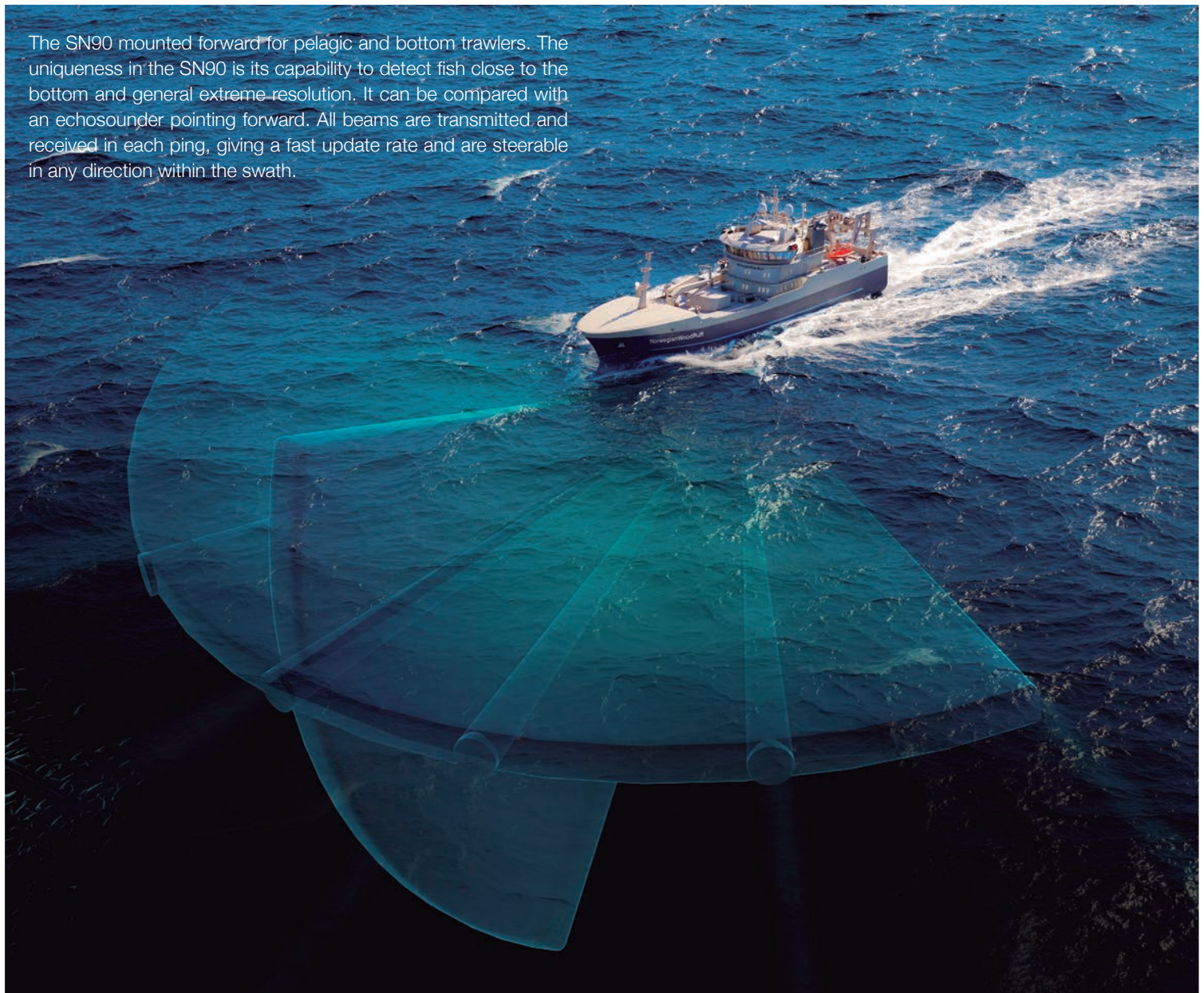


## SIMRAD SN90 TRAWLING SONAR. THE ULTIMATE TOOL FOR ANY TRAWLER!

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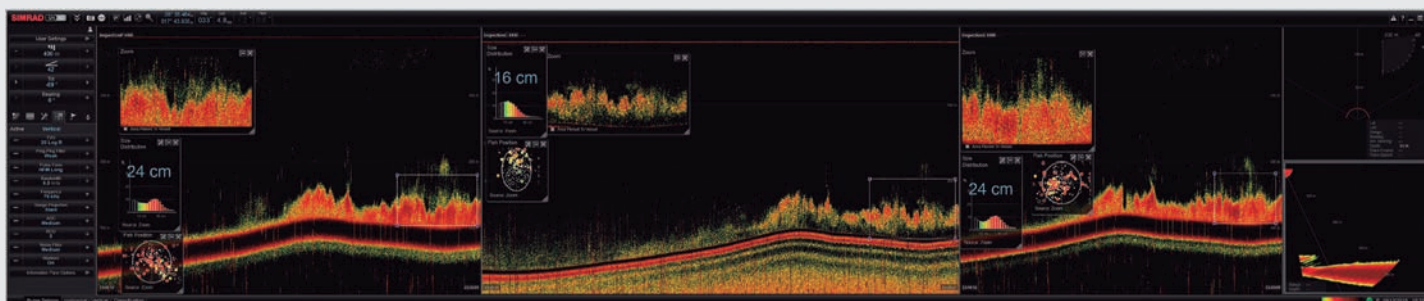
Simrad SN90 can be configured as a forward looking multibeam sonar for trawlers. The unique flexibility of the SN90 enables it to be used at almost any fishery depending on how the transducer is installed. Mounted forward looking the SN90 can be used as a trawling sonar. The display software is then oriented forward during installation. The SN90 transducer can be fixed to the hull or bulb like a regular echosounder's transducer or mounted on a hull unit when fishing in ice or other hazards. The sonar beams are pointing forward only in a 120 degree swath, taking the propeller noise out of the equation.

A full vertical slice as well as five inspection split beams can be individually trained and tilted to the user's needs. Stack the five beams on top of each other or spread them out to inspect to any side. A bottom detector and bottom expansion has been included in the presentation of the 5 inspection beams. This will enable the user to detect fish close to the bottom forward of the vessel and have more time to decide before the fish reaches the trawl. The SN90 is a chirp wideband sonar/echosounder transmitting and receiving between 70-120 kHz.

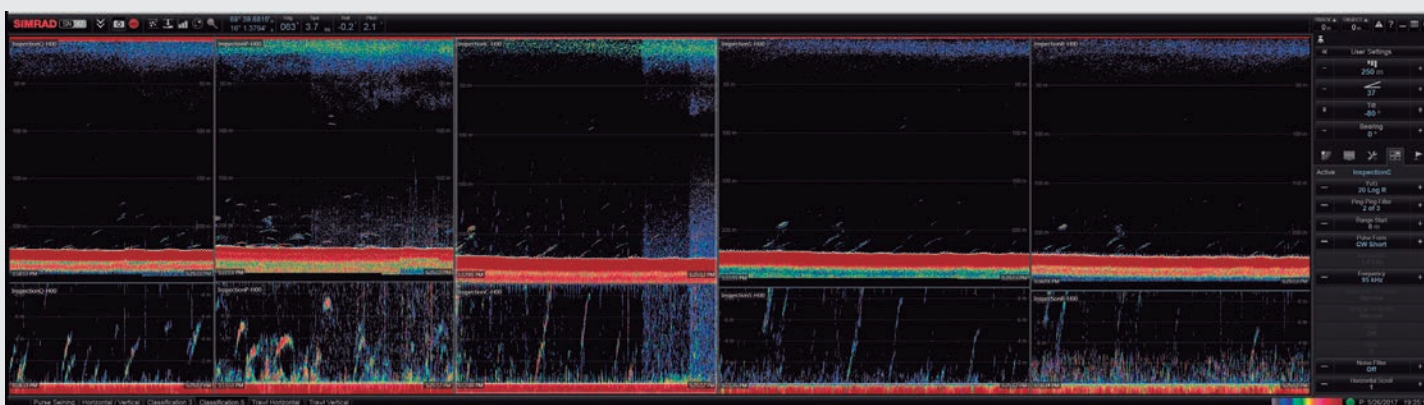


The SN90 mounted forward for pelagic and bottom trawlers. The uniqueness in the SN90 is its capability to detect fish close to the bottom and general extreme resolution. It can be compared with an echosounder pointing forward. All beams are transmitted and received in each ping, giving a fast update rate and are steerable in any direction within the swath.

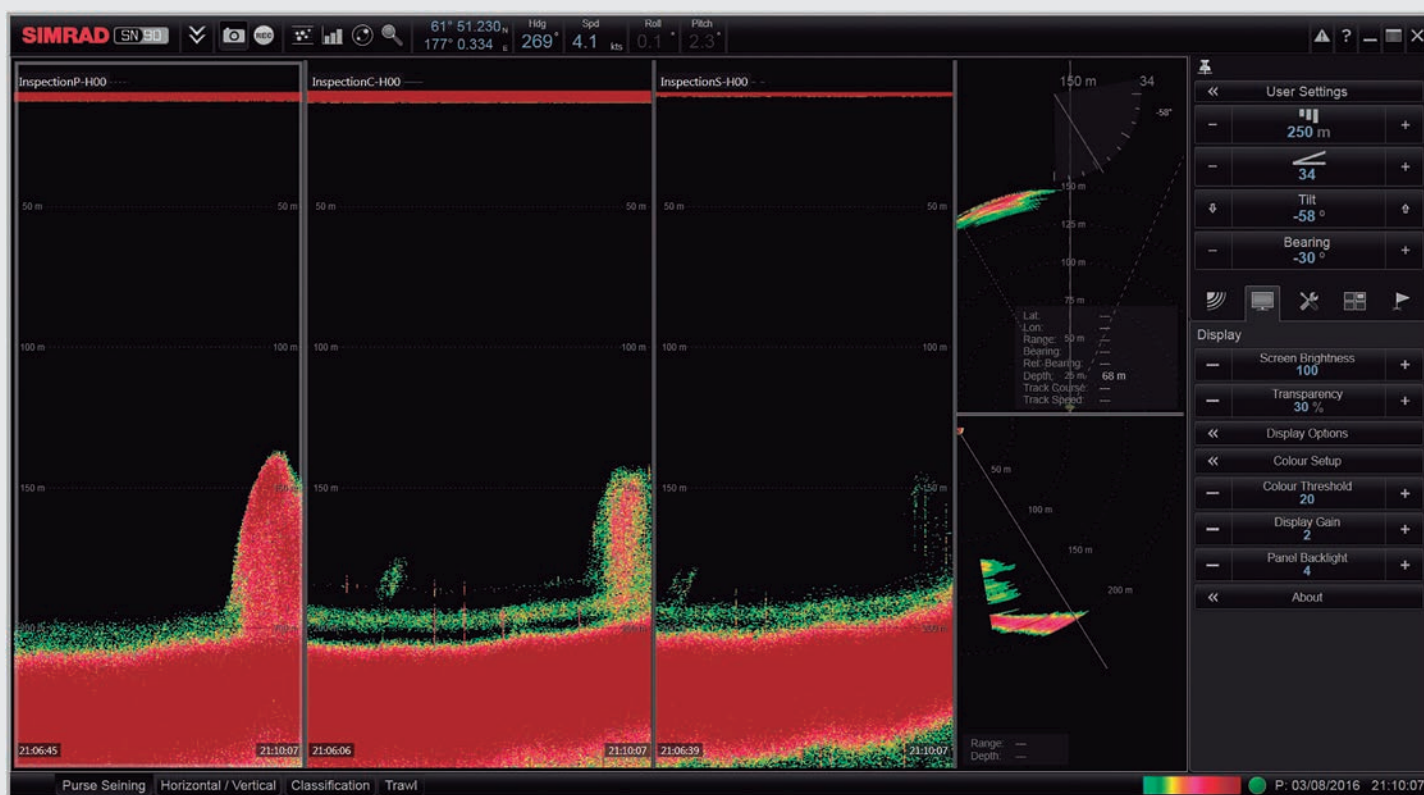




The picture shows Mackerel outside Mauretania. The vessel is trawling for the Mackerel close to the bottom. Notice the oval shaped split beam circle in the middle. This means that the middle inspection beam has a different tilt and consequently a different opening angle of the beam.



The picture above is from F/V "Ramoen" using five inspection beams forward with bottom lock and bottom expansion. This makes it easier to turn onto the fish even if they are close to the bottom.



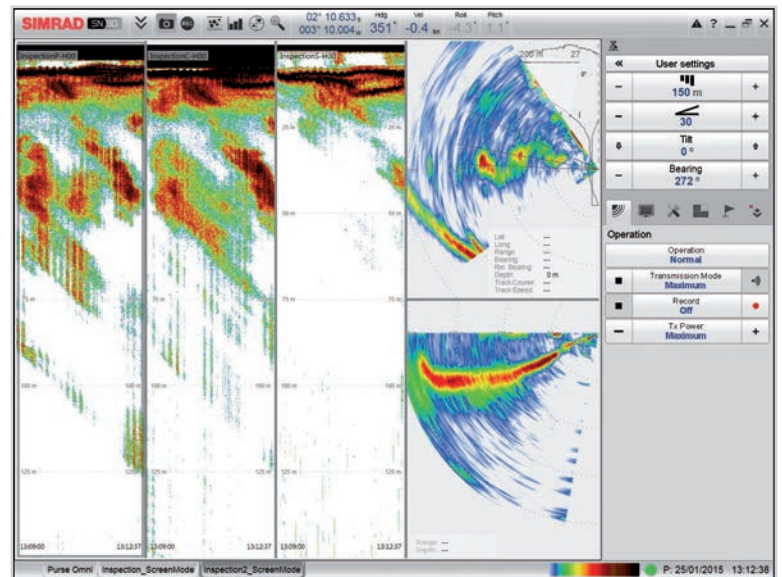
Pollock behaves differently during day time and night time. In this example, the Pollock is mixed with Herring in the Bering sea Russian side. Heavy tilt is used pointing the inspection beams slightly forward and to both sides. We can see that port side has more mixed Herring than on starboard side giving the skipper the information needed to take important decisions.



## SIMRAD SN90 SEINE SONAR. FULL CONTROL BEFORE AND DURING THE SETTING OF THE NET

The game-changing SN90 Sonar is the latest development from SIMRAD. With the SN90 the user will get full control over the setting of the seine without having to care about retracting the hull unit. The SN90 transducer can be installed without a retractable hull unit to the side of the keel facing the purse seine. The 256 individual beams have a horizontal coverage area of 160° and the vertical beam width is typically 6° (varies with the frequency from 5° to 8°). The beams are tiltable from 0° down to 90°.

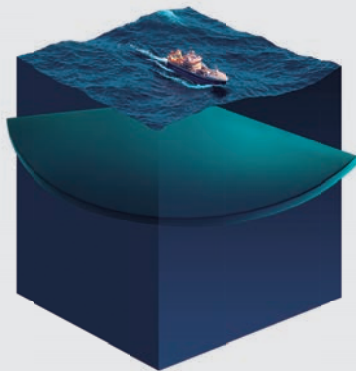
In addition to this, five steerable inspection beams of 5°x5° can be used for more detailed inspection of a school like observing fish behaviour, target strength and biomass. This will enable the fisherman to run alongside a school of fish and observe, like a horizontal echosounder, and analyse the school without passing over it. Fish avoidance is then minimized and more information about the fish in the school will reduce the bycatch, unwanted species in addition to catch the correct school size and conduct volume estimation of the school before setting the net.



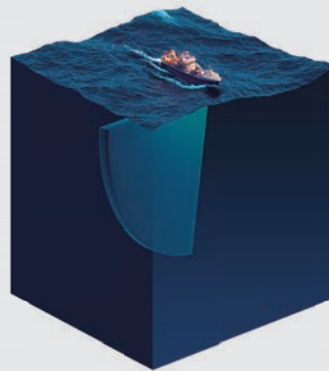
Up to five inspection beams (three shown here) can be trained and tilted individually while maintaining the overview with the horizontal fan and vertical slice.



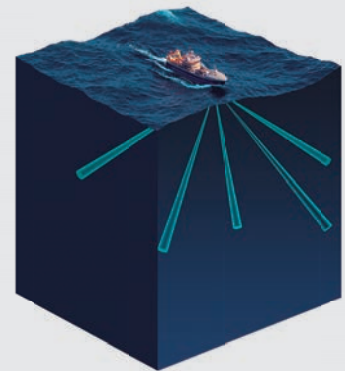
Installed looking to the port side of the vessel together with horizontal looking ES70 echosounders previously installed.



The SN90 has a 160° fan that is tiltable from 0° down to 90°. This will enable to see the purse seine during the whole setting of the net.



The SN90 has one vertical slice that can be trained in any direction within the fan. This will give full control of the edges of the school during setting of the net.



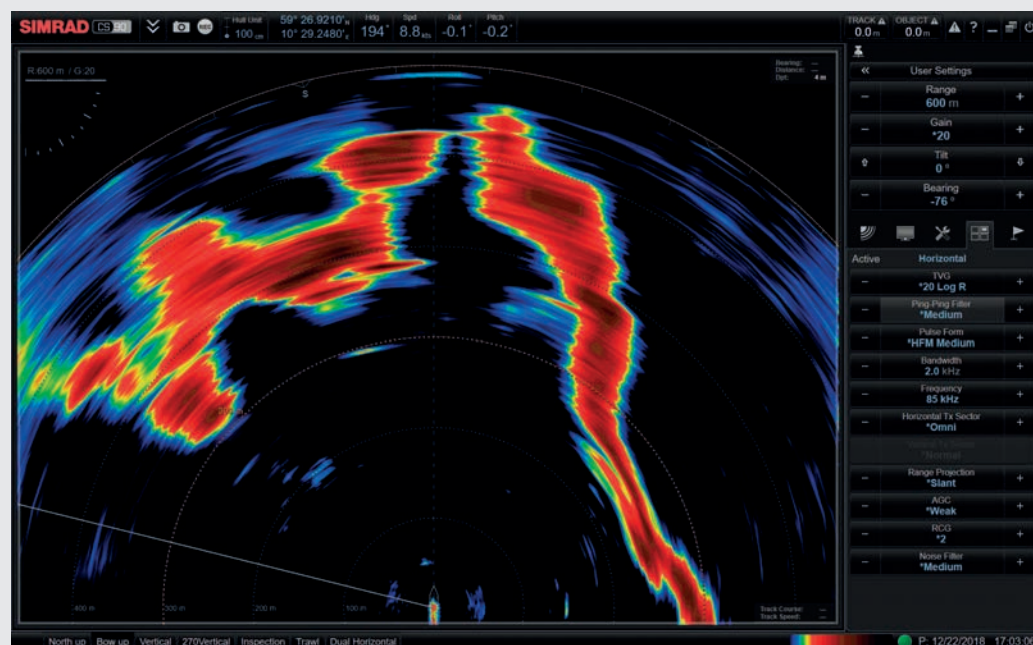
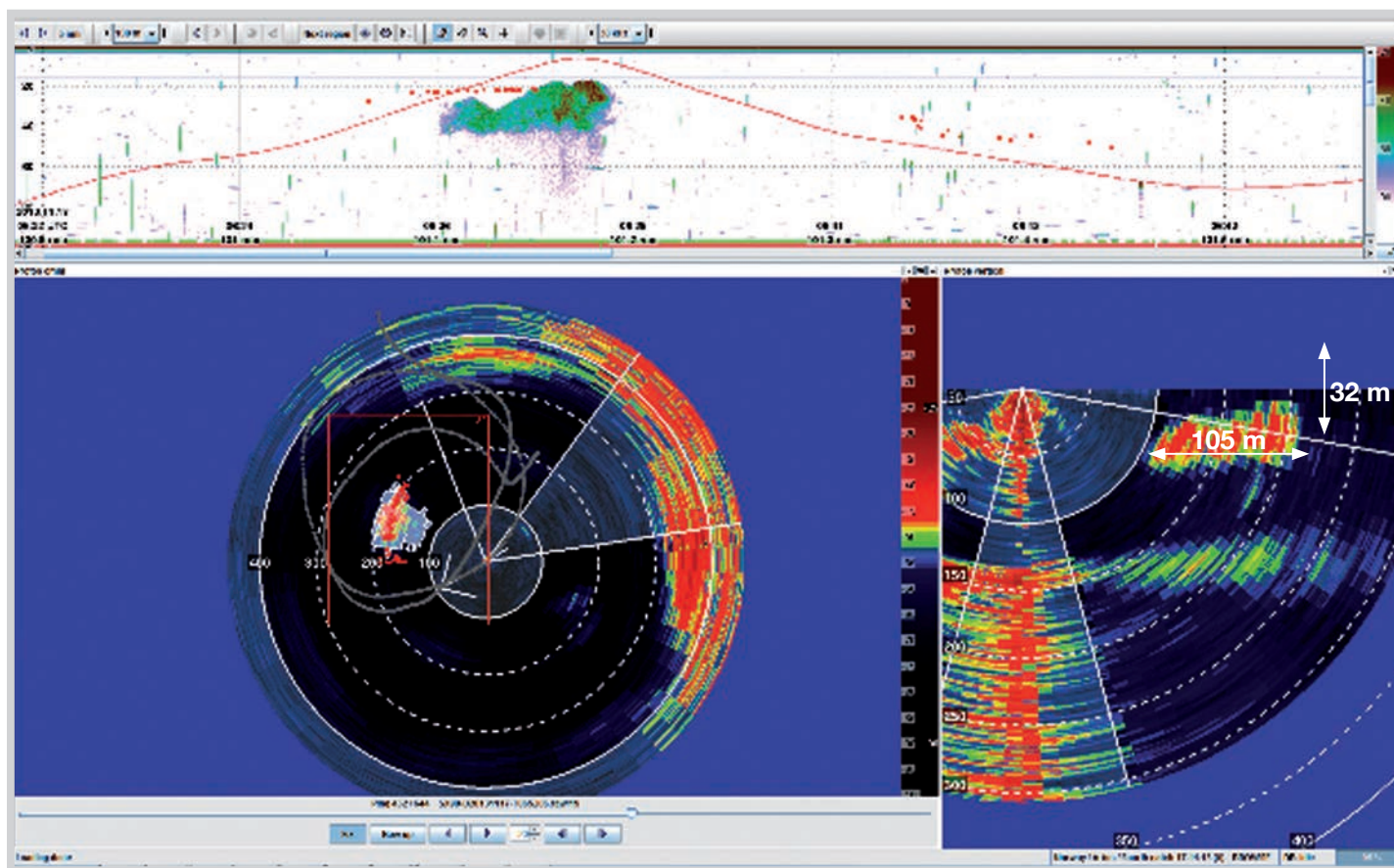
The SN90 has five individually steerable inspection beams that can be trained and tilted with any frequency between 70 and 120 kHz. The inspection beam will give a detailed high resolution echogram.

# SCIENTIFIC APPLICATIONS

## PROCESSING OF RAW DATA

As all Simrad scientific systems, the omni directional sonars can output RAW data for scientific purposes. The RAW data can be read and processed by third party processing SW such as Echoview or LSSS (PROFOS).

In this example a screenshot from LSSS (PROFOS) is shown where the data are integrated with single beam data.



## NAVIGATION

An omnidirectional sonar can be of valuable assistance when navigating in confined waters. Like an underwater radar it will draw a picture of the bottom, and detect objects in the water column like containers or ice bergs.



# SONAR OPERATING PANEL (SOP)

The new Sonar Operating Panel (SOP) includes a handy multifunction joystick. It allows the operator to control the tilt, vertical and inspection beams easily just by pushing it and/or turning its top knob. With one single Operating Panel you can control up to four sonars with the new Winson 2019 SW. Or right the opposite: you can connect up to three different Operating Panels on different locations onboard to operate one sonar just by means of an Ethernet connection. One on the bridge, one on the wing and one in the tower for example.

Also, the front panel USB port makes it possible to upgrade sonar SW as well as saving/importing user settings. Dedicated buttons as well as programmable buttons/knobs are also available. The new SOP fits in the previous Simrad SOP spot using a bracket making the installation easy as well.

- 1 USB port
- 2 Multifunction Joystick
- 3 Trackball
- 4 User defined function buttons
- 5 User defined potmeters (Gain, range, etc.)
- 6 Sonar selector



## SONAR UPGRADES

### High frequency sonars

FROM	UPGRADE TO	REQUIREMENTS
		<ul style="list-style-type: none"><li>• Transceiver and processor</li><li>• Return old transceiver and power supply</li><li>• SOP optional</li></ul>
		<ul style="list-style-type: none"><li>• No Upgrade</li></ul>

### Low frequency sonars

FROM	UPGRADE TO	REQUIREMENTS
		<ul style="list-style-type: none"><li>• Return a full operating SX90</li><li>• Remember adapter on trunk</li></ul>
		<ul style="list-style-type: none"><li>• Return a full operating SX90</li><li>• Remember adapter on trunk</li></ul>
	Winson 2019	<ul style="list-style-type: none"><li>• Including the latest Processor Unit</li><li>• SOP optional</li></ul>
		<ul style="list-style-type: none"><li>• Transducer and processor</li><li>• Return SU transducer</li><li>• Remember adapter on trunk</li><li>• SOP optional</li></ul>
	Winson 2019	<ul style="list-style-type: none"><li>• Including the latest Processor Unit</li><li>• SOP optional</li></ul>

**Note!** The new SOP will not work with old SW!  
(But old SOP will work with new SW, expect delivery time)  
SOP = Sonar Operating Panel

SONARS SPECIFICATIONS

	CS90	SN90	SX90	SU90	ST90
PROCESSING UNIT					
Voltage	110/220 VAC				
Consumption	5 A				
Processor type	ENIX				
Operating system	Windows™ 10				
Display output	Triple				
Serial interface I/O	Four serial ports (expandable)				
Ethernet interface	Three + one fiber optic				
Display resolution	1920 x 1080 or 1920 x 1200				
Operating ranges	50 to 2000 m	50 to 2000 m	50 to 5000 m*	50 to 5000 m*	50 to 5000 m**

TRANSCIVER UNIT					
Voltage	110/220 VAC				
Consumption	750 VA	400 VA	750 VA	750 VA	750 VA
Operating Frequency	70 to 90 kHz	70 to 120 kHz	20 to 30 kHz (1 kHz step)	20 to 30 kHz (1 kHz step)	14 to 22 kHz (1 kHz step)
Modulation	CW and Hyperbolic FM				

BEAM					
Horizontal coverage	Omni	160°	Omni	Omni	Omni
Vertical Tilt	+10° to -90°	+10° to -60°	+10° to -90°	+10° to -90°	+10° to -90°
Vertical beam width	8,0°	6,0°	See table below	See table below	6,0°
Transceiver channels	480	256	256	384	384
Pitch & Roll Stabilisation	Included				
External Pitch & Roll interface	MRU Kongsberg Seatex format (Optional)				
Scientific Data Output	Optional				

HULL UNIT					
Voltage	230/380/440 VAC 3 Phase	230/380/440 VAC 3 Phase	230/380/440 VAC 3 Phase	230/380/440 VAC 3 Phase	230/380/440 VAC 3 Phase
Consumption	1100VA	3000VA - 1100 VA	3000VA - 1100 VA	3000VA - 1100 VA	3000VA - 1100 VA
Selectable Transducer Position	Yes	Yes	Yes	Yes	Yes
20 knots hull unit	Yes	No	Yes	SU92	No
2.1m Transducer lowering	CS94	N/A	N/A	SU94 Hull Unit	ST94 Hull Unit
1.6m Transducer lowering	N/A	N/A	SX93 Hull Unit	SU93 Hull Unit	ST93 Hull Unit
1.2m Transducer lowering	N/A	SN92H	SX92 Hull Unit	SU92 Hull Unit	ST92 Hull Unit
1m Transducer lowering	CS90	N/A	SX95 Hull Unit	N/A	N/A

\*Optional extended range 6000 to 10000 m, requires export license in selected countries.  
\*\*Optional extended range 12000 m

OPENING ANGLES ON SX AND SU SONARS						
SX90			SU90			
	WIDE	NORMAL	NARROW	WIDE	NORMAL	NARROW
20 kHz	14,8°	11,0°	10,7°	10,7°	7,8°	7,2°
21 kHz	14,1°	10,5°	10,2°	10,2°	7,4°	6,9°
22 kHz	13,5°	10,0°	9,7°	9,7°	7,1°	6,5°
23 kHz	12,9°	9,6°	9,3°	9,3°	6,8°	6,3°
24 kHz	12,3°	9,2°	8,9°	8,9°	6,5°	6,0°
25 kHz	11,8°	8,8°	8,6°	8,6°	6,2°	5,8°
26 kHz	11,4°	8,5°	8,2°	8,2°	6,0°	5,5°
27 kHz	11,0°	8,1°	7,9°	7,9°	5,8°	5,3°
28 kHz	10,6°	7,9°	7,6°	7,6°	5,6°	5,1°
29 kHz	10,2°	7,6°	7,4°	7,4°	5,4°	5,0°
30 kHz	9,9°	7,3°	7,1°	7,1°	5,2°	4,8°



# BASIC SONAR THEORY

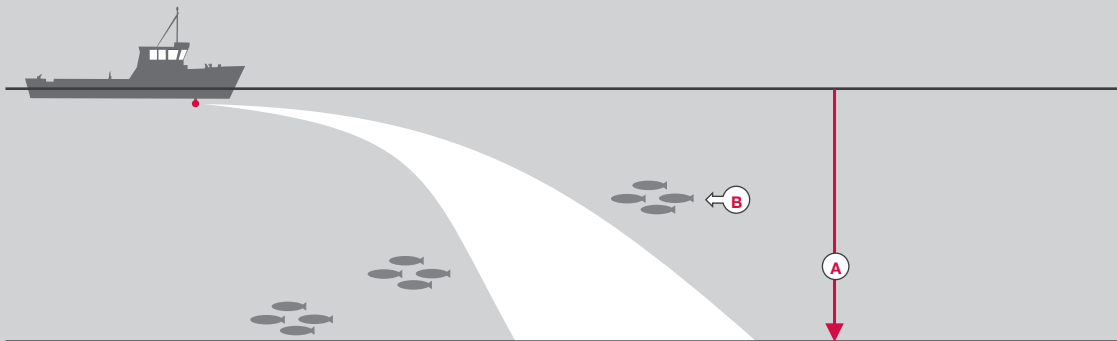
A sonar can sometimes be a challenging tool to operate. There are never two days at sea that are the same, weather, water temperature, bottom conditions, fish behavior, temperature layers, plankton layers, ships noise, sonar settings etc all influence the performance of a sonar.

The horizontal transmission of sound is defined by SIMRAD as a sonar. If transmitted vertically, then it is defined as an echosounder. Sending sound vertically is not as challenging as sending it horizontally and therefore an echosounder performance can be compared from day to day or between vessels. On a sonar this is not true. Even between vessels fishing

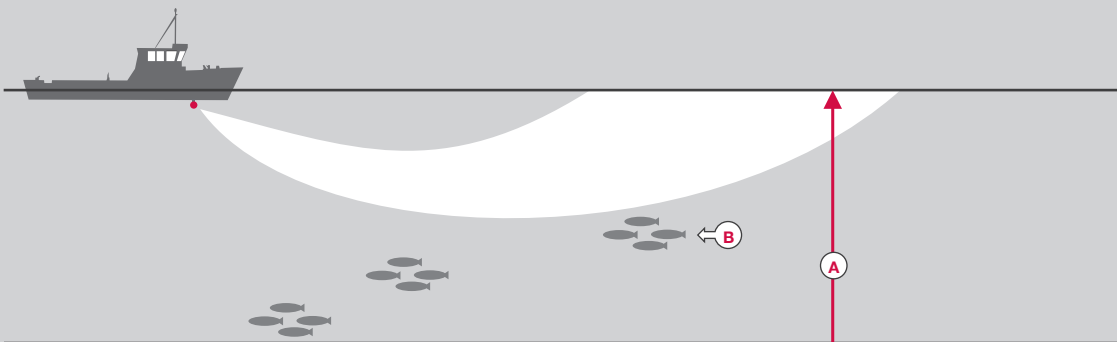
on the same fishing grounds, sonar can perform differently. Ship's noise, electrical and/or acoustic, is different from vessel to vessel, transducer installation is different from vessel to vessel, filter settings and general sonar operation is different from vessel to vessel and will affect the sonar performance.

On this page we have made some illustrations to consider when operating a sonar. There are many more but these are the most common ones that will change from day to day and between vessels.

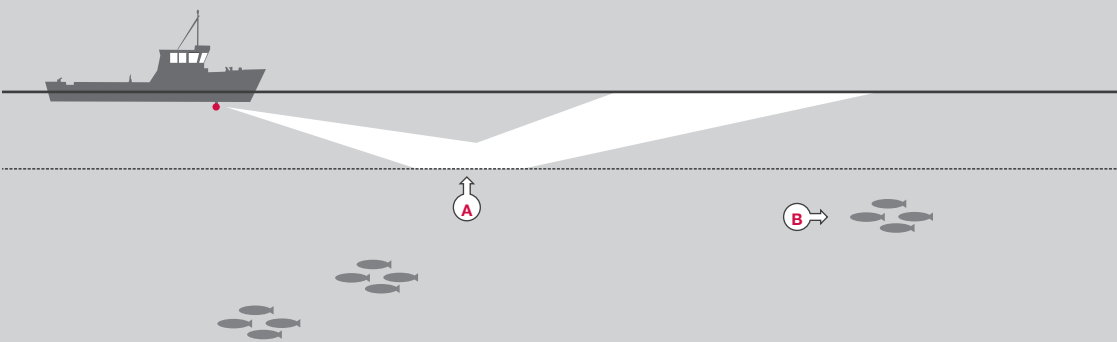
With decreasing temperature (A) the beam will bend towards the bottom shortening the range (B).

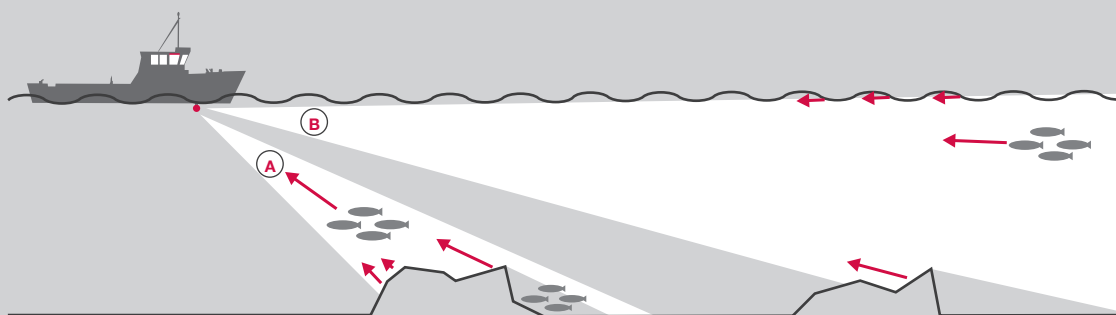


With increasing temperature (A) the beam will bend towards the surface shortening the range (B).



With a temperature layer (A) the beam can create a “sound channel” and increase the range (B) on certain tilt angles.





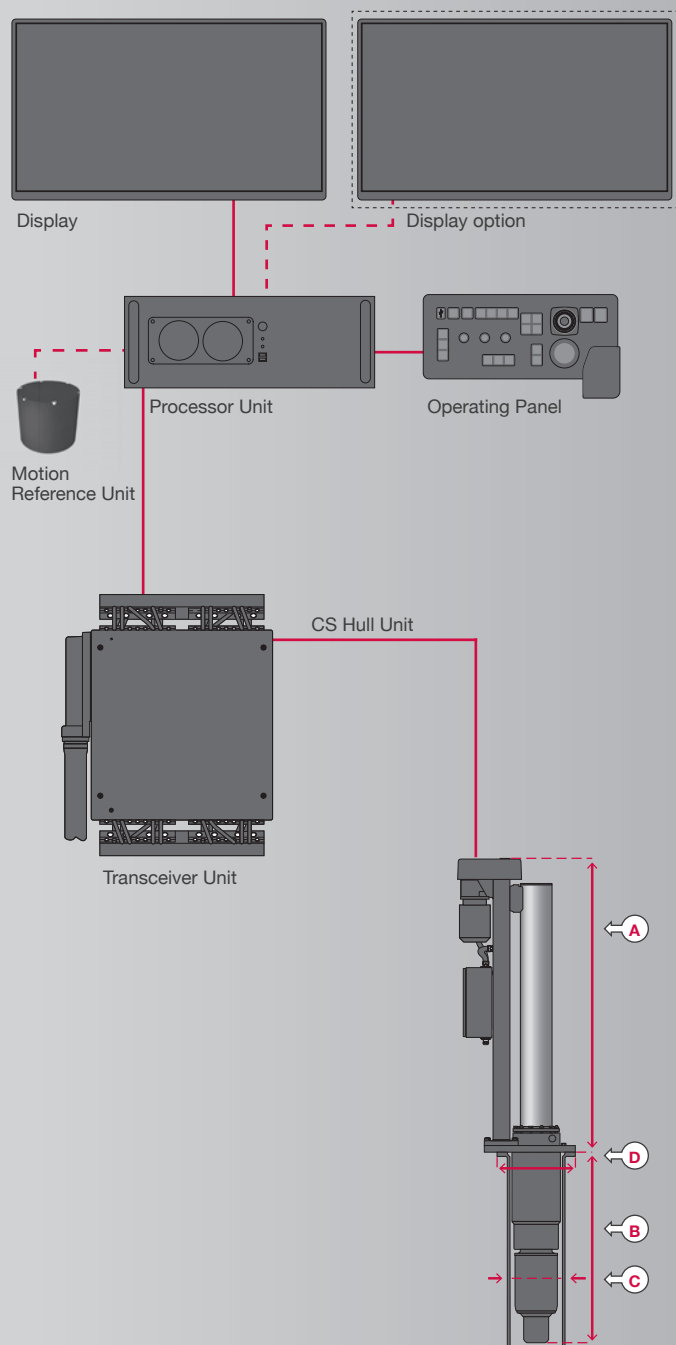
Depending on the tilt, echoes from other than fish will be detected. Bottom and surface is among those which generate the most echoes. Sometimes if weather is rough it is difficult to separate fish from surface echo and sometimes if fish is close to bottom or the bottom is rocky it is difficult to separate fish from bottom. A Simrad Sonar has the best filter available (RCG) to assist in separating fish from unwanted echo.

Propeller noise is caused by cavitation as illustrated in below picture. A clean propeller will still cavitate but much less than a propeller with marks and damages. Also, a large propeller will cavitate much less than a small due to the lower RPM.





## CS SYSTEM DIAGRAM



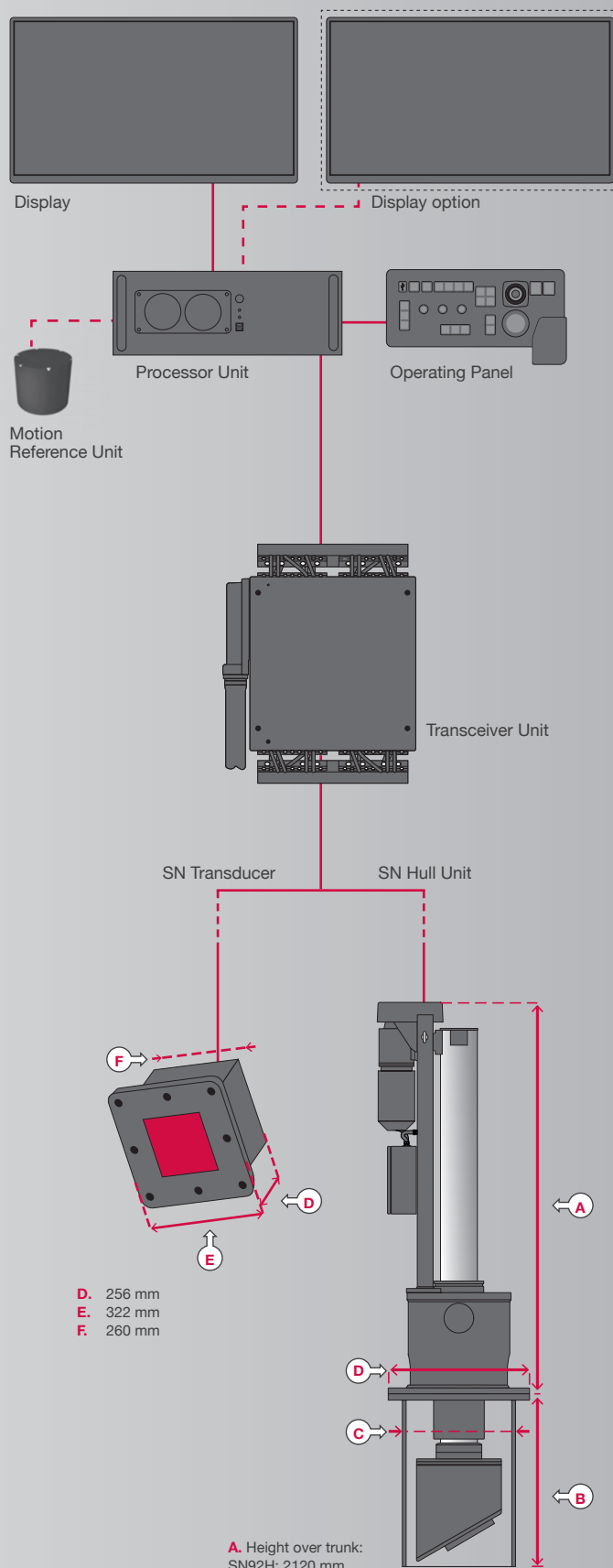
**A.** Height over trunk:  
CS90 - 1390 mm

**B.** Height of trunk:  
CS90 - 970 mm

**C.** Trunk diameter:  
CS90 - 273 mm

**D.** Flange diameter:  
CS90 - 370 mm

## SN SYSTEM DIAGRAM



**D.** 256 mm  
**E.** 322 mm  
**F.** 260 mm

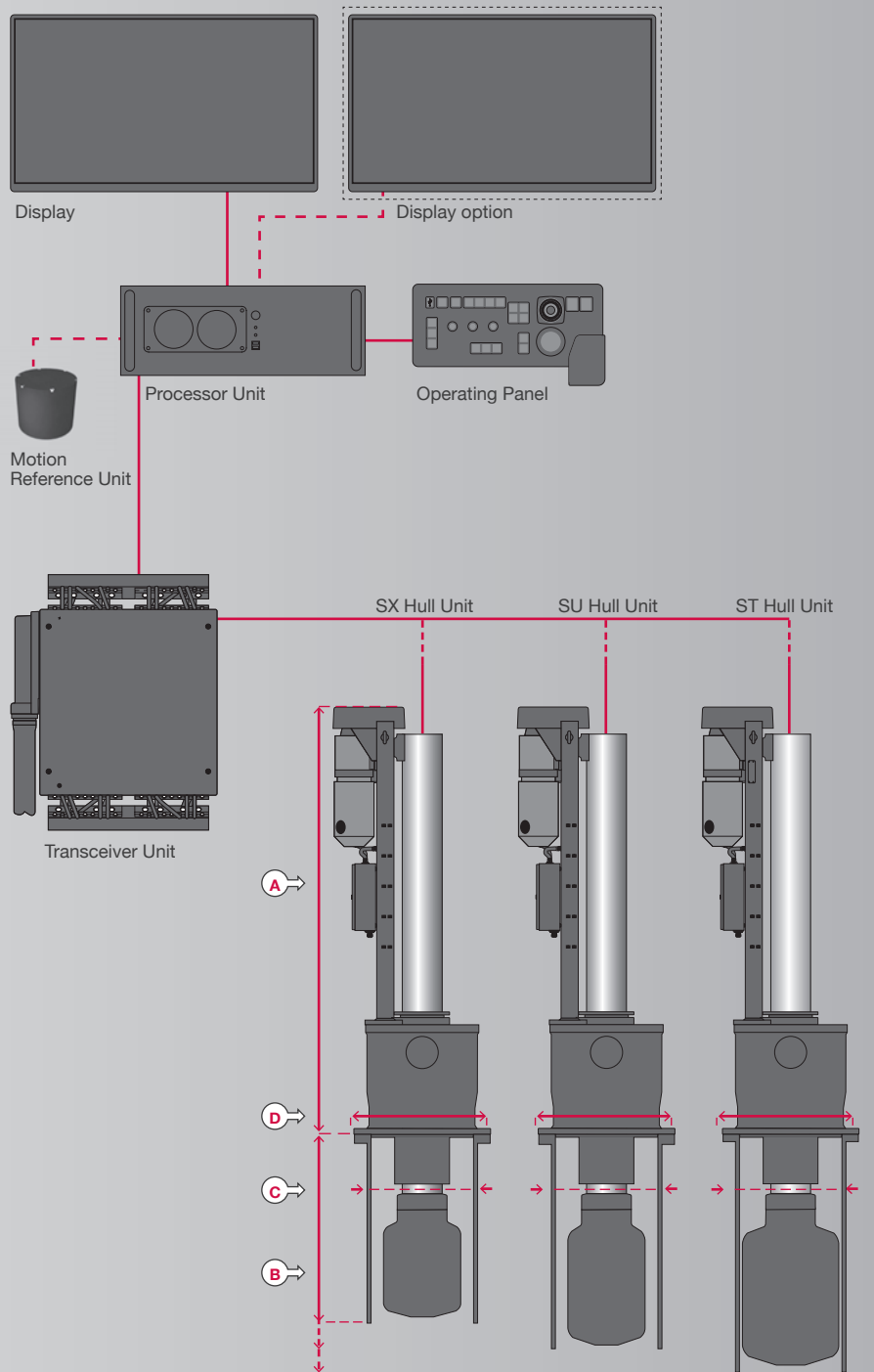
**A.** Height over trunk:  
SN92H: 2120 mm

**B.** Height of trunk:  
SN92H: 930 mm

**C.** Trunk diameter:  
SN92H: 610 mm

**D.** Flange diameter:  
SN92H: 761 mm

## SX - SU - ST SYSTEM DIAGRAM



(SX92/SX93/SX95)

**A.** Height over trunk:  
SX92 - 2118 mm  
SX93 - 2518 mm  
SX95 - 1645 mm

**B.** Height of trunk:  
SX92 - 930 mm  
SX93 - 930 mm  
SX95 - 910 mm

**C.** Trunk diameter:  
SX92 - 610 mm  
SX93 - 610 mm  
SX95 - 508 mm

**D.** Flange diameter:  
SX92 - 760 mm  
SX93 - 760 mm  
SX95 - 580 mm

(SU92/SU93/SU94)

**A.** Height over trunk:  
SU92 - 2118 mm  
SU93 - 2518 mm  
SU94 - 3018 mm

**B.** Height of trunk:  
SU92 - 1110 mm  
SU93 - 1110 mm  
SU94 - 1110 mm

**C.** Trunk diameter:  
SU92 - 610 mm  
SU93 - 610 mm  
SU94 - 610 mm

**D.** Flange diameter:  
SU92 - 760 mm  
SU93 - 760 mm  
SU94 - 760 mm

(ST92/ST93/ST94)

**A.** Height over trunk:  
ST92 - 2118 mm  
ST93 - 2518 mm  
ST94 - 3018 mm

**B.** Height of trunk:  
ST92 - 1280 mm  
ST93 - 1280 mm  
ST94 - 1280 mm

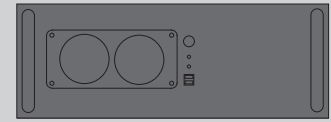
**C.** Trunk diameter:  
ST92 - 610 mm  
ST93 - 610 mm  
ST94 - 610 mm

**D.** Flange diameter:  
ST92 - 760 mm  
ST93 - 760 mm  
ST94 - 760 mm

## PROCESSOR UNIT

Width: 600 mm  
Height (with shock absorbers): 410 mm  
Depth: 640 mm  
Weight: 24 kg

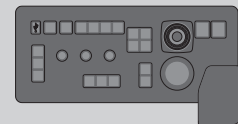
(Shipping dimensions)



## OPERATING PANEL

Width: 346 mm  
Height: 150 mm  
Depth: 77 mm  
Weight: 5 kg

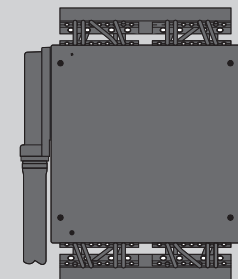
(Shipping dimensions)



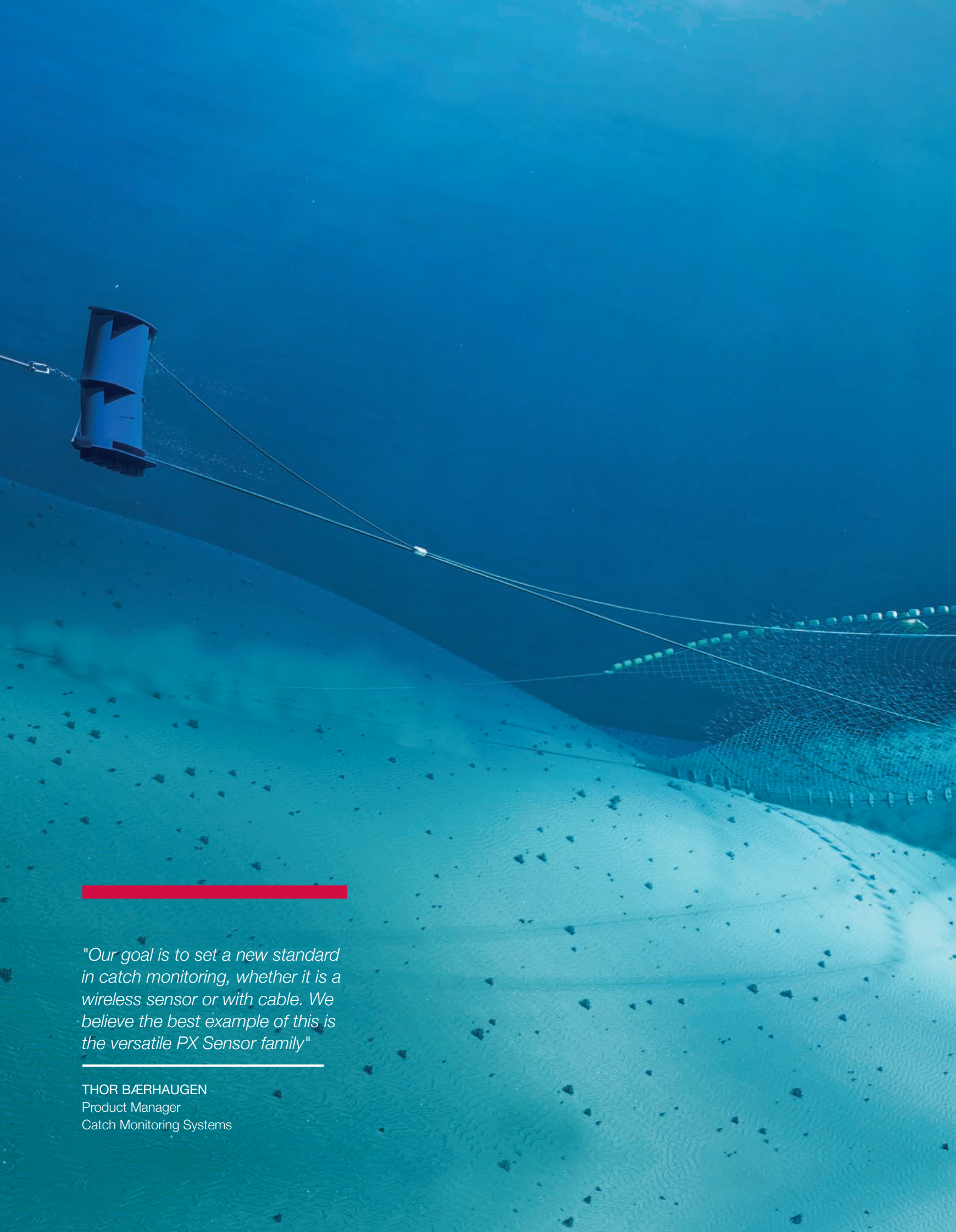
## TRANSCIVER UNIT

Width: 670 mm  
Height: 760 mm  
Depth: 580 mm (Excluding climate door)  
Weight: 108 kg

(Shipping dimensions)







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*"Our goal is to set a new standard  
in catch monitoring, whether it is a  
wireless sensor or with cable. We  
believe the best example of this is  
the versatile PX Sensor family"*

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THOR BÆRHAUGEN  
Product Manager  
Catch Monitoring Systems

An underwater photograph showing a large trawl net being pulled through the water. The net is illuminated from above, creating a bright, circular glow. The water is a deep blue, and the seabed is visible in the lower part of the frame, covered in sand and small rocks.

# CATCH MONITORING SYSTEMS

## **Control trawl performance and catch behaviour**

Accurate position and performance of the sample trawl is important for many surveys. Information about spread and height tells you how much water volume you sample, and correct geometry is important for efficient trawling. Other sensors, such as bottom contact, tilt, roll and height sensors on the doors add more information, so that you can have full knowledge of your trawl behaviour.

Today Simrad has a range of Catch Monitoring products, both wireless and cable based, which can be combined. Interfacing Simrad Catch Monitoring Systems to other equipment gives you full control from setting to catch thus enabling you to fish more efficient, safer and environmental friendly.



## SIMRAD CATCH MONITORING SYSTEMS

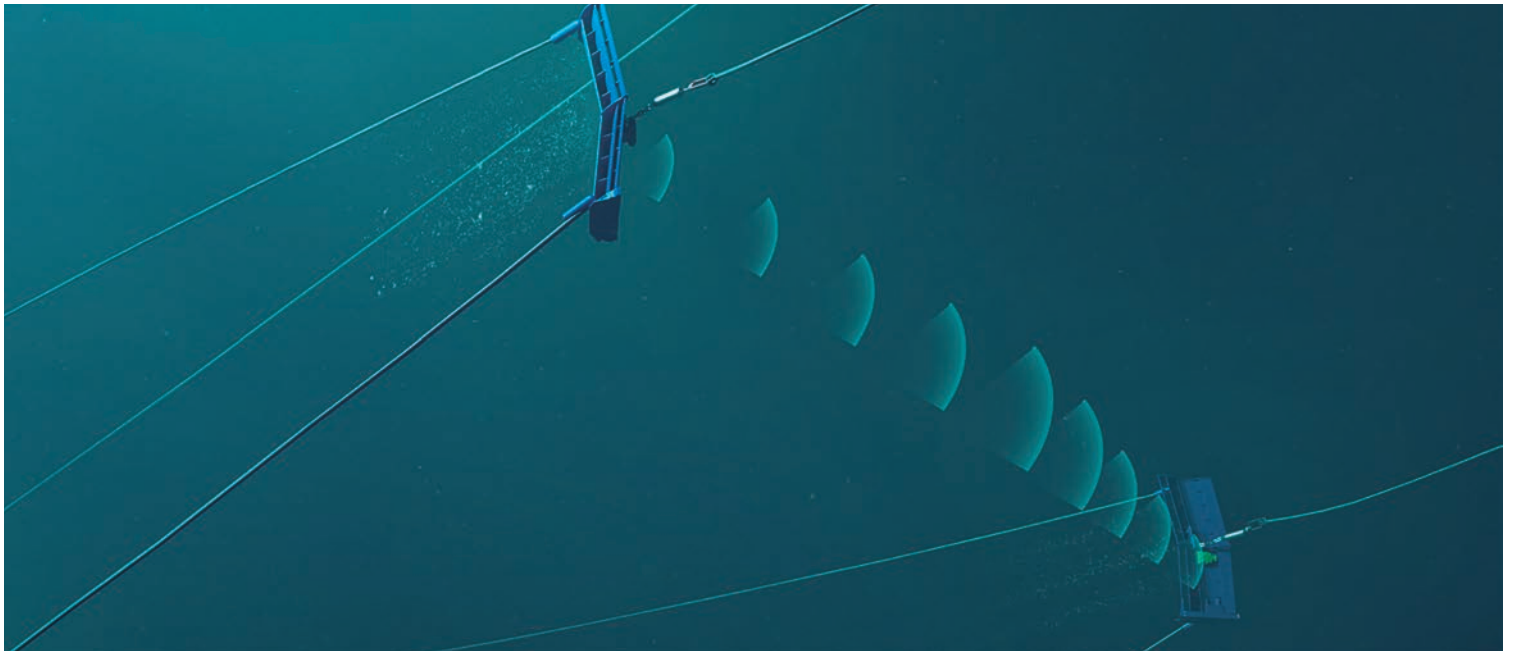
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SIMRAD developed and introduced the first wireless catch sensor more than 40 years ago. Not very late, it also introduced the 3<sup>rd</sup> wire systems. Since then, SIMRAD manufactures, and keeps developing, a wide range of catch monitoring systems so that the skipper can have full control of the catch process, while enhancing efficiency and respecting the environment.

Wireless sensors are developed for fitting in all different fishing scenarios. For example, in bottom trawling, whether it is single, twin, triple or more, wireless sensors are placed on the gear and doors and communicate acoustically with the vessel. Depending on where they are placed, they can send to the skipper some vital measurements like spread between doors, the fish entering the trawl opening, the filling of the net or the distance from the

doors to the bottom - that will prevent them from damaging the fauna -, amongst many others.

The 3<sup>rd</sup> wire is a communication and power cable connected to a scanning trawl sonar placed on the net's headrope. This type of system can be used in pelagic fishery in combination with wireless sensors. These sensors can then communicate with the trawl sonar and the data will go through the 3<sup>rd</sup> wire up to the vessel. The advantage of combining both wireless and 3<sup>rd</sup> wire systems is that down by the trawl the environment for wireless communication is perfect, since there is no propeller noise or long distances. For this specific situation, a 3<sup>rd</sup> wire winch will be needed.



## ACTIVE HYDROPHONE WITH EXCELLENT SENSITIVITY

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Active hydrophones have pre-amplifiers built-in. SIMRAD offers three different active hydrophones:

### PURSE SEINE HYDROPHONE

The hull mounted hydrophone for purse seining operations has a 90° horizontal beam and a 30° vertical beam to provide the PI50 with optimal reception from the sensors on a purse seine.

This specific beam pattern is especially suited for purse seining and the wide coverage area reduces the need for careful alignment.

### TRAWL HYDROPHONE

The hull mounted hydrophone for trawling operations has a 50° horizontal beam and a 30° vertical beam to provide the PI50 with optimal reception from the sensors on a bottom or pelagic trawl.

This specific beam pattern is especially suited for trawling and the wide coverage area reduces the need for careful alignment.

## NEW GENERATION SENSOR RECEIVERS

In the latest years, the fast evolution of wideband electronics has been met by Simrad's engineers as an opportunity to develop two new sensor receivers that can cover almost all fishing operating scenarios because they can receive multiple signals from many sensors. The new Sensor Receivers can receive data from all the PX family catch sensors including the TrawlEye.

### SR70 RECEIVER UNIT

This is a versatile and powerful sensor receiver that can have up to four separate hydrophones connected simultaneously. Four connected hydrophones ensure a stable communication in all kinds of situations, even during steep turning of the vessel, where the SR70 will automatically switch and select the hydrophone with the strongest signal. Besides, in combined vessels, hydrophones can be mounted in different directions to suit both purse seine and trawling operations, all of them connected to a single unit.

### SR15 RECEIVER UNIT

The SR15 Receiver is a compact and cost-effective receiver unit that has one single hydrophone connected.

To process the data and run the visualization software (TV80) a powerful small marine computer is available from SIMRAD. You can also use your own computer. We recommend you to ask your Simrad dealer first since TV80 software runs on powerful computers.



### PORTABLE HYDROPHONE

A portable hydrophone is also available. It is designed as a temporary measure until a fixed hydrophone can be installed at the vessel's next planned dry docking. It has an omnidirectional beam and a 50 meter integrated cable.

The cable is sheathed in polyurethane providing robust external protection to compliment its 150 kg tensile strength.

The cable is supplied on a reel for convenient retrieval and storage, and is equipped with a plug for easy attachment to the Receiver Unit.





## THE PX FAMILY, SENSORS MADE TO WORK!

The PX sensor family comes in two different bodies and 8 different HW configurations. At the same time, each sensor can read up to 5 different measurements. A standard sensor will have 2 data readings and the user can purchase a license for up to 3 additional functions. All available functions can be user programmable according to the matrix below using the TV80 software.









The complete PX sensor family is depth rated to 1000m including the depth sensors and seine sounders.

Previous PX Multisensor can be easily upgraded to the new PX Multisensor MK2. The difference between MK1 and MK2 is the number of functions: MK1 has a maximum of 2 and MK2 has a maximum of 5 function readings.



The PX Universal comes either as a Standard sensor or as a Multicatch sensor. The Standard sensor can measure height of the door, distance to bottom on trawl or purse seine. The Multicatch can be configured as a catch sensor or a depth/temperature sensor.








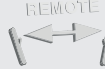


SENSORS		FUNCTIONS							
Name	Part no.	 Battery Status	 Catch	 Depth	 Echogram	 Geometry	 Geometry Diff	 Height	 Pitch
MK2	421180	■				■	■	■	■
MK2 Trd Lid	421294	■						■	■
MK2 D1000/T	421293	■		■		■	■	■	■
PX TrawlEye	399967	■			■		■ **	■	■
PX TrawlEye D/T	406399	■		■	■		■ **	■	■
PX Universal	400943	■		■				■	■
PX MultiCatch D/T*	418419	■		■					■
PX MultiCatch C/T*	418520	■	■						■
PX Flow	441524					■	■	■	■
PX Flow D/T	442880					■	■	■	■

\*MK1 sensors can be upgraded to MK2 sensors \*\* Software dependant



**Remember:  
Port door is  
always the  
reference!**



FUNCTIONS								SENSORS	
 Roll	 Spread	 Temperature	 Twin Spread	 Remote Geometry	 Remote Spread	 TrawlEye Remote Geometry	 Water Speed	Part no.	Name
■	■		■		■			421180	MK2
■	■		■	■	■	■		421294	MK2 Trd Lid
■	■	■	■		■			421293	MK2 D1000/T
■								399967	PX TrawlEye
■		■						406399	PX TrawlEye D/T
■		■						400943	PX Universal
■		■						418419	PX MultiCatch D/T*
■		■						418520	PX MultiCatch C/T*
■							■	441524	PX Flow
■		■					■	442880	PX Flow D/T



## WIRELESS ECHOSOUNDER FOR PELAGIC AND BOTTOM TRAWLS

The Simrad PX TrawlEye provides a real time echogram from the trawl via a wireless link. In addition to the high resolution echogram the PX TrawlEye sends up the battery status so you can plan when to charge the sensor.

To ensure long range communication and optimum alignment between sensor and vessel the PX TrawlEye also sends up roll and pitch information, enabling you to detect if you have a bad alignment and/or if the TrawlEye was tangled in a mesh or similar while shooting your trawl.

The TrawlEye can be received through Simrad hydrophones or even non-Simrad types, provided that the frequency is similar. Both the SR15 and the SR70 sensor receivers can be used with the PX TrawlEye.

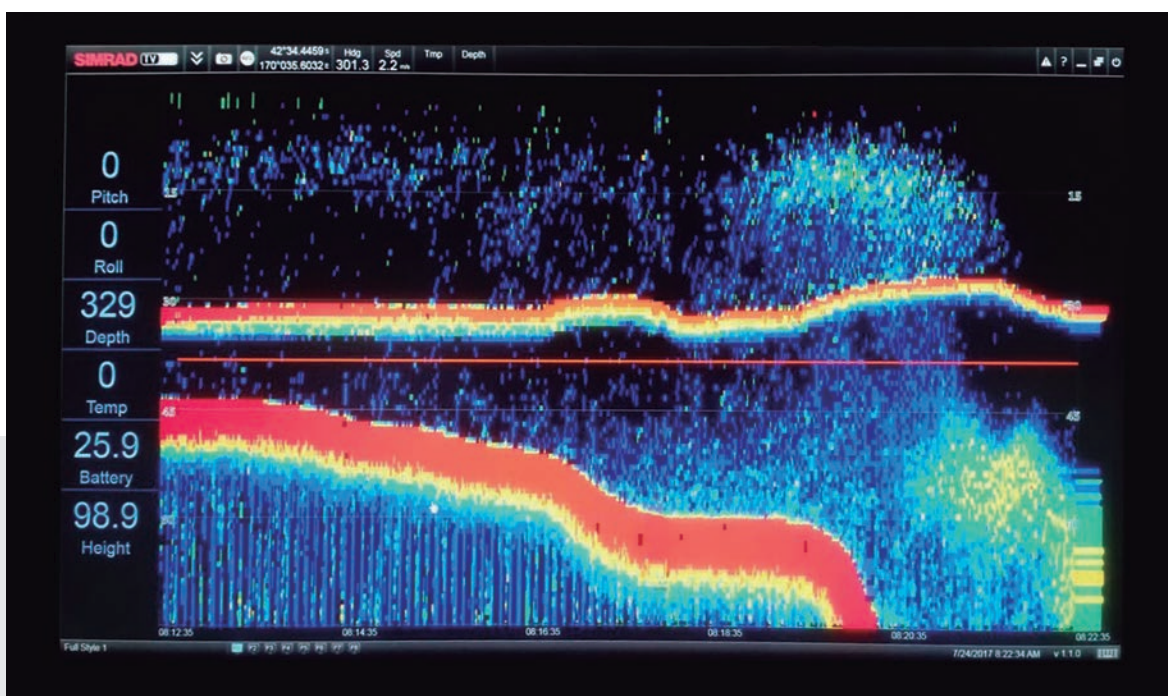
The PX TrawlEye is equipped with a composite echosounder transducer enabling advanced LFM pulses, Linear Frequency Modulation, also called chirp.

The PX TrawlEye can be configured to suit various fisheries using the TV80 software to program update rate (0.5s – 8s), pulse length, pulse type, sounder gain, echo range, communication power, etc.



The PX Deployment Pack is designed to provide easy access and replacement of the PX TrawlEye, whilst still ensuring a safe and sturdy installation.

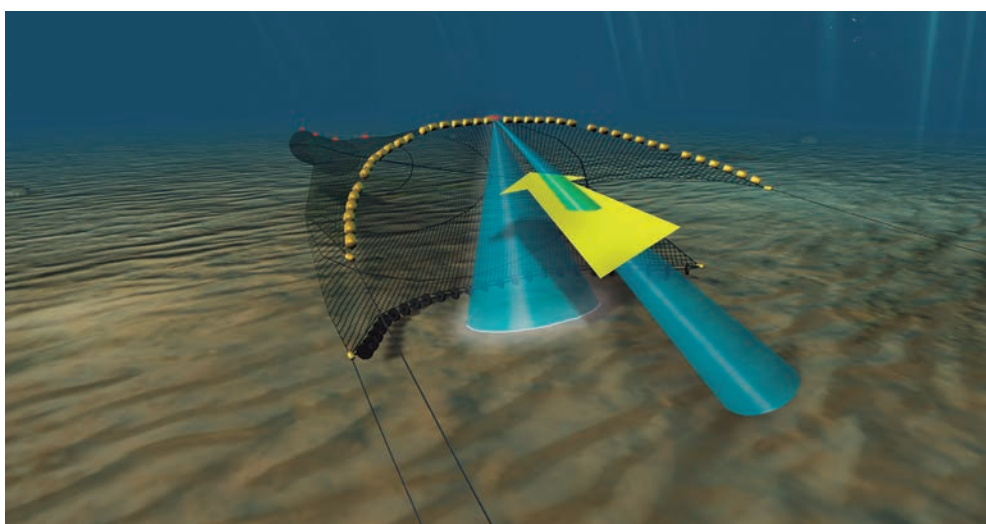
The picture to the right is Kobe Fishery in the Pacific. Note the fish going under the footrope, any information is important to act!



## PX FLOW SENSOR GO WITH THE FLOW

The PX Flow sensor is the latest addition to the PX sensor family. This new sensor measures water speed in trawl opening or inside the trawl. It is the trawl's speed through the water that is of importance, not the vessel's GPS speed. The sensor can also be configured to measure Geometry, Height, Roll, Pitch, etc. Unlike other water speed sensors, this sensor utilizes the Doppler principle to measure the speed. Using Doppler principle is a huge

benefit because it enables you to measure the speed of water at a distance from the net. This is particularly important if you want to measure inside a trawl where you have a boundary layer with much less water speed close to the net than in the centre of the funnel.



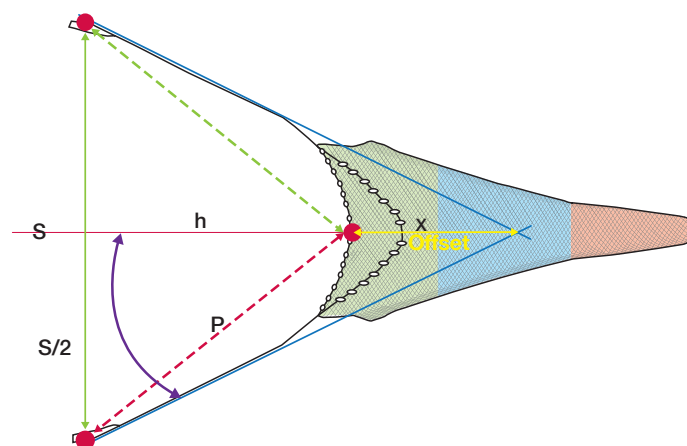
### DID YOU KNOW...?

#### DO YOU KNOW YOUR TRAWL'S SWEEP ANGLE?

One factor that directly affects your efficiency and selectivity is the trawl's sweep angle. Correct sweep angle will improve your fishery from day one. Now you can get this information from the Simrad TV80 in real time.

The sweep length and door spread are the factors that affect the sweep angle. With a Geometry sensor, Door sensors with geometry transponder and the TV80 SW you are in control.

Sweep angle calculation is based on geometry measurement and door spread measurement. Knowing the displacement from where the geometry sensor is mounted and where the sweep crossing point is will improve the calculation





## TV80, MAKING SENSOR DATA UNDERSTANDABLE

With the introduction of multifunction catch monitoring sensors, the challenge is how to show the information in a friendly way for the skipper, who wants to receive the relevant information in a quick look on the screen. The TV80 is designed to fulfill this concept.

The TV80 can work with a single or dual monitor configuration and can display information simultaneously from all existing Simrad Catch Monitoring Systems, ITI, PI, FS and SR. This feature provides an easy update path for Simrad customers, in spite of the system they are using or want to use. In addition to the data supplied by Simrad Catch Monitoring Systems, the TV80 accepts data from

other sources like GPS receivers, echosounders, heading sensors, winch sensors, etc.

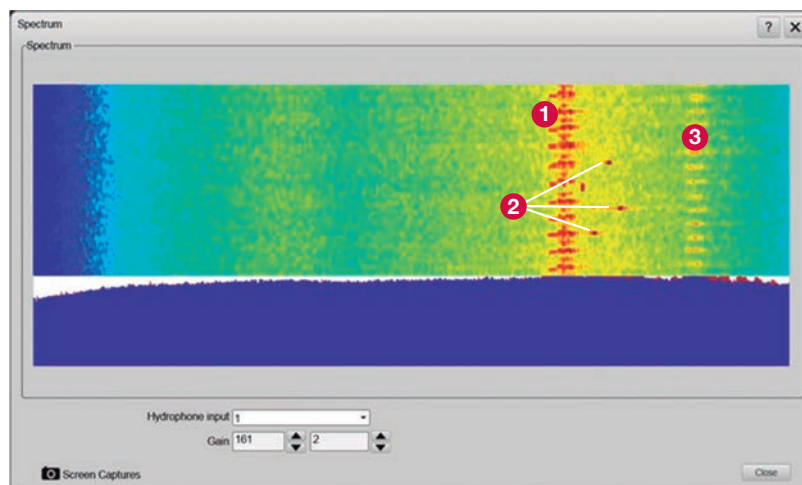
The user can create his own layout of up to four independent views to fit his operating scenario. He can also decide what information is going to be presented on every view. Each view is assigned to a function key, allowing a fast and efficient swap between predefined views with a single keystroke.

The TV80 has a built-in recording function for all the received data. The user can either use the recorded data to replay or export it to a compatible CSV file format for later analysis or study.



### FREQUENCY SPECTRUM

The acoustic communication link between the receiver and the sensors could be challenging in a fishing vessel, due to propeller, pumps, compressors and other electric systems onboard generating noise. When the noise is in the same frequency range than the sensor, the result is unstable or even worse, no data readings. The TV80 has a built-in spectrum analyzer that shows the signals coming through each hydrophone. With this advanced tool, the user will be able to identify the noise and find the cleanest frequencies. Programming the communication channel of the sensors in the "quiet" frequencies to assure a stable data reading from the sensor.



Spectrum example with PX sensors configured away from the echosounder interference

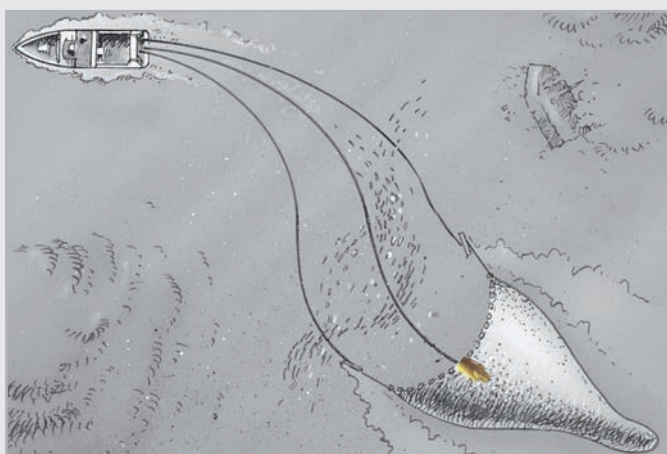
- 1 PX TrawlEye signal 2 PX sensors (three different channels) 3 Echosounder interference



## THE NEW TRAWL SONAR PLATFORM COMBINES THE BEST OF TWO WORLDS

The new Simrad FS Trawl System provides the full picture of the trawl by utilizing the ultimate FS third wire system with integrated PI Sensors. This sophisticated solution enables the fisherman to have full control of any type of trawl fishery.

The system provides real-time images from the trawl sonar head and the data from the PI Sensors to the bridge, thus maximizing the quality of the catch and increasing efficiency at sea.



A major benefit of the 3<sup>rd</sup> wire integration with PI Sensors is to prevent loss of communication with the trawl as the vessel is changing course or in heavy sea conditions.



### FS70 TRAWL UNIT

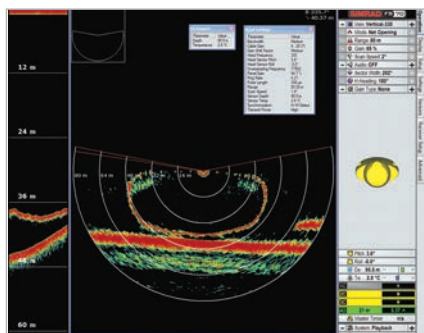
The FS70 trawl housing unit is designed for the harshest environments and for withstanding the extreme forces encountered when shooting a trawl. However, it is easy to handle and the Hyper yellow colour makes it easy to see even in the dark.

## EXTRA FLEXIBLE TRAWL SONAR SYSTEM

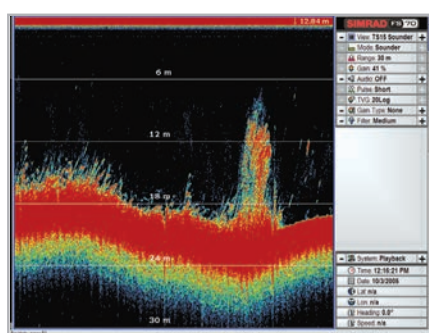
The Simrad FS70 full screen presentation in a polar sonar mode indicates the position of the trawl close to the bottom and shows the opening of the net by displaying the Cursors 1 and 2.

In addition, the sounder display provides an accurate depth of the bottom and to the foot rope. The operator can monitor up to 6 catch indicators, (if programmed at 40 kHz) indicating the amount of fish being caught by the trawl and the time when the sensors were activated.

The Simrad FS70 200 kHz sounder provides a real time picture of the trawl opening and position relative to the bottom. In addition to the high resolution sounder, the operator can control the descent of the trawl during the set by monitoring the position of the foot rope and the bottom.



Simrad FS70 full screen display mode.



Simrad FS70 Sounder display mode.



## FM90 MULTIBEAM TRAWL SONAR

SIMRAD invented the “3<sup>rd</sup> wire” trawl sonar back in the early 80’s. Back then nobody could foresee the impact this has had to the pelagic and semi pelagic fishing industry. Imagine back then, nobody had a “3<sup>rd</sup> wire” winch and nobody had handled this type of equipment before, making the learning curve steep. But as with everything, if you see the benefit with something, you go the extra mile to be able to benefit from it. For the pelagic and semi pelagic industry the trawl sonar is so important that you will not go out fishing without it.

Traditionally the trawl sonar has been a scanning search light sonar installed in the vertical plane. The advantage with a search light sonar is the resolution, the disadvantage is its real time capabilities. It takes time to scan a trawl opening and time is valuable. The FM90 will instantly give you a picture of the net opening and fish enter. The challenge up until now has been the ability to detect fish and the net geometry when the net is getting closer to the bottom. The FM90 has solved this using all the multibeam technology and knowledge within the SIMRAD organization.

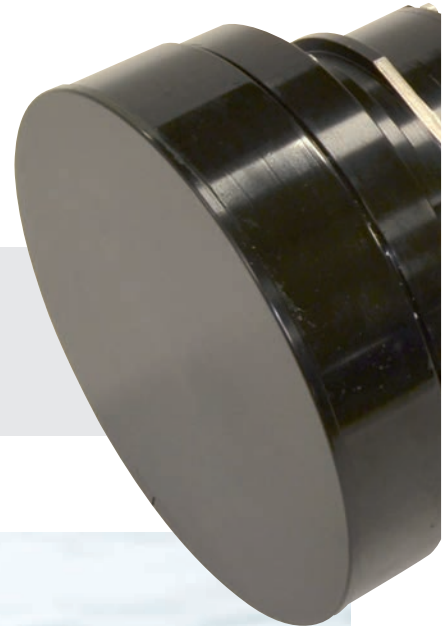


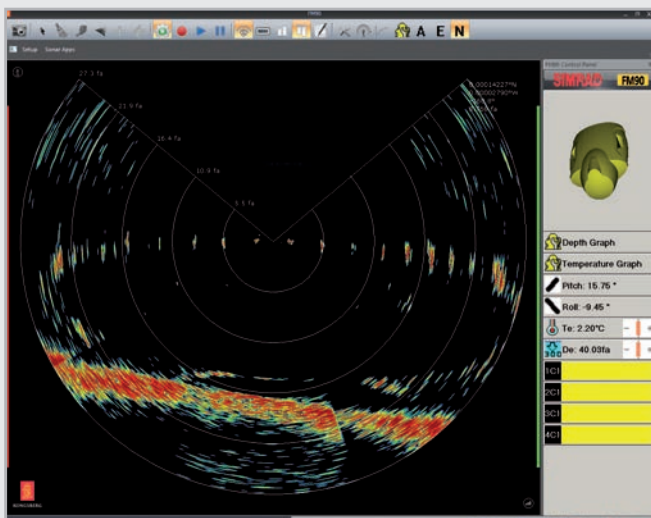
### FM90 TRAWL UNIT

The FM90 Deployment Pack has a yellow top and black bottom to confirm correct orientation prior to launching and to assist in visual sighting during recovery. It also has improved hand holds to assist handling even with gloves on. The strain relief can be accessed using standard tools without opening the entire Deployment Pack and the unit is quick filling and draining.

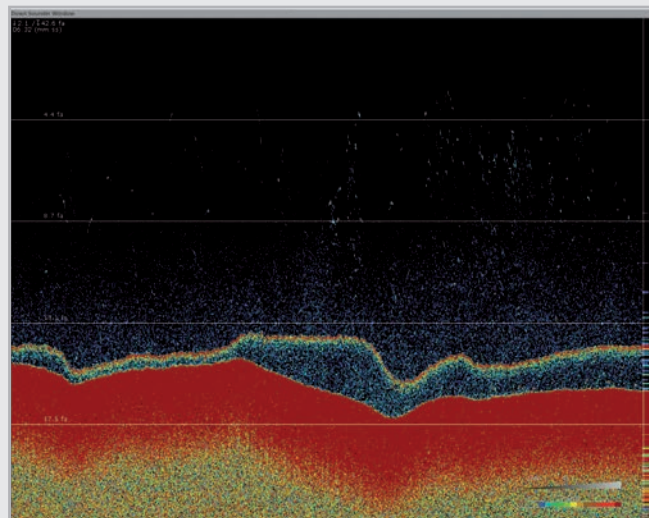


The transducer of the FM90 has no moving parts thus being less vulnerable to damage and less maintenance is needed.

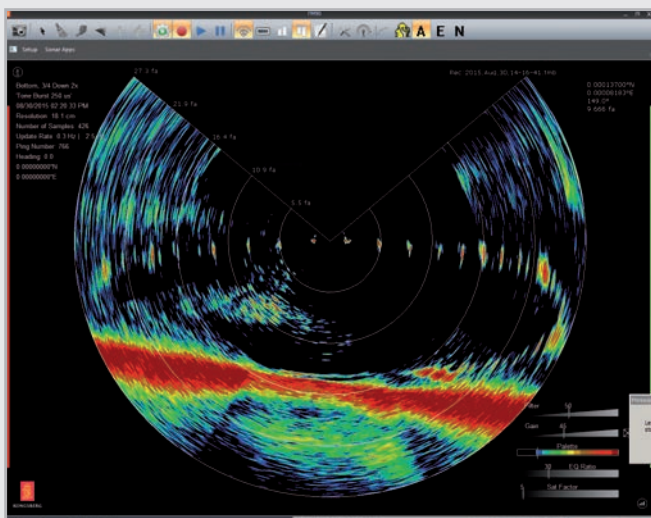




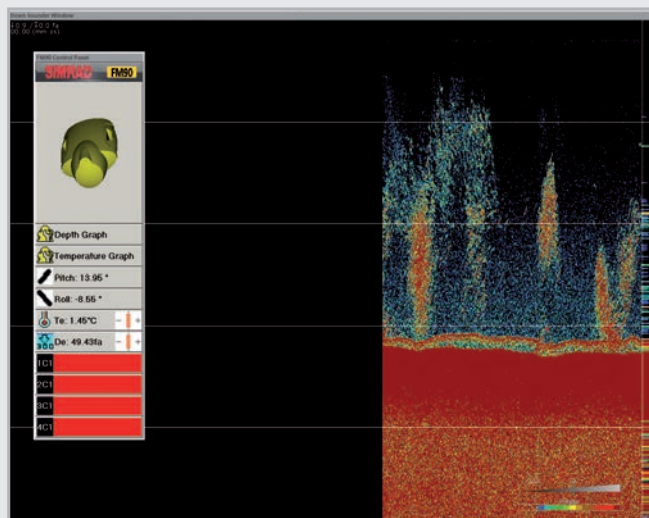
This picture shows Pollock in Alaska. Notice the trawl is actually touching bottom on starboard but on the echosounder it looks like the trawl is off the bottom. This is only truly possible with a multibeam trawl sonar. A traditional search light trawl sonar could lose this information as it takes too long time to draw the picture.



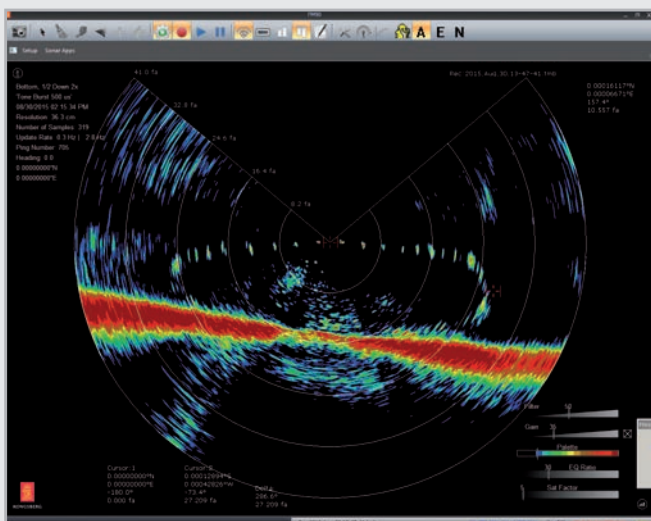
This part is the 200 kHz down looking echosounder. The line above the bottom is the footrope of the trawl. It is easy to see fish escaping below the footrope.



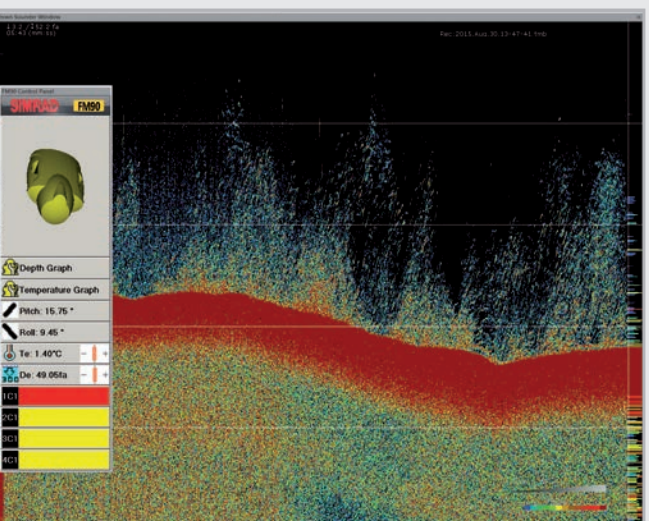
This picture shows Pollock in Alaska. Here the net is almost on the bottom and still the contour of the net is easily seen along with fish entering the trawl opening. Again, the trawl is touching bottom on the starboard side while port side is clear of the bottom.



On the down looking echosounder fish entering the trawl opening is easily seen with great details. Also, notice the footrope almost touching bottom. Here four catch sensors have been triggered and it's time to haul!



In the above picture the net is solid on the bottom and still the net geometry and fish entrance is easily seen.





## REAL-TIME INFORMATION FOR REAL-TIME DECISIONS

**The real-time aspects and advantages of the FX80 take the speculation and guess work out of the equation.**

The FX80 system is the natural choice to get real-time, high resolution information from the trawl. The core of the system is a digital HUB that can receive information from various sensors and then communicate the signals through a wire to the vessel.

One of the primary design criteria of the Simrad FX80 system was to make it work on existing 3<sup>rd</sup> wire cables. The use of existing copper core coax cables eases the cost and reduces the installation time.

The Simrad DFS75 Trawl sonar is integrated into the Simrad FX80 system to establish an efficient and accurate monitoring system. The

combination of the high resolution images from the trawl sonar and the live video feed provides you with an unparalleled opportunity to identify and analyse both trawl movements and fish behaviour.

When addressing by-catch and avoidance issues, real-time video is and will be of significant importance. Trawl behaviour and fish behaviour can be viewed in real time. Accompanied by a high-density LED light, the camera is usually placed under the headrope or in the cod end, pointing with the desired angle. The camera sends its information to the FX80 Communication Hub inside the FX80 Deployment Unit, which is usually located near the headrope.



The entire Simrad FX80 system -with live video and high resolution sonar- is controlled from a standard Processor Unit provided by SIMRAD. It is small, but yet powerful, and contains no moving parts. The system design allows to use two displays. Many users prefer this configuration, as it allows them to use one display system for the trawl sonar presentations, and another for the live video feed.

### THE FX80 CAMERA UNIT

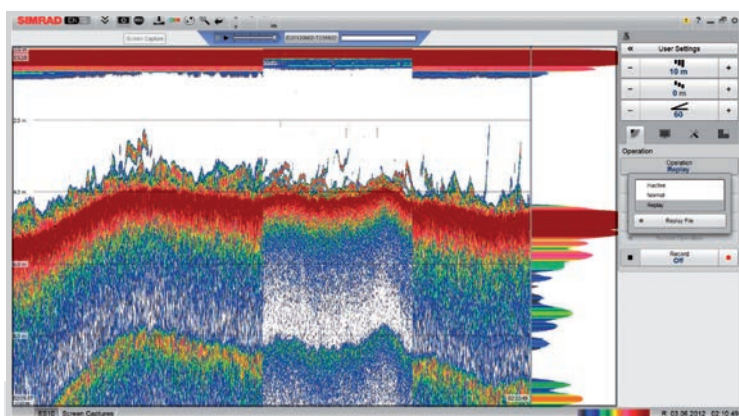
The camera unit of the FX80 system includes the camera itself, as well as artificial lighting (LED). The camera itself is based on a well proven high resolution underwater camera from Kongsberg Maritime. The cable from this unit to the trawl deployment package is included in the system, but you have to specify the length of the cable when ordering. Up to 600 meter is possible, and the camera unit is certified to be used down to 1800 meter depth.



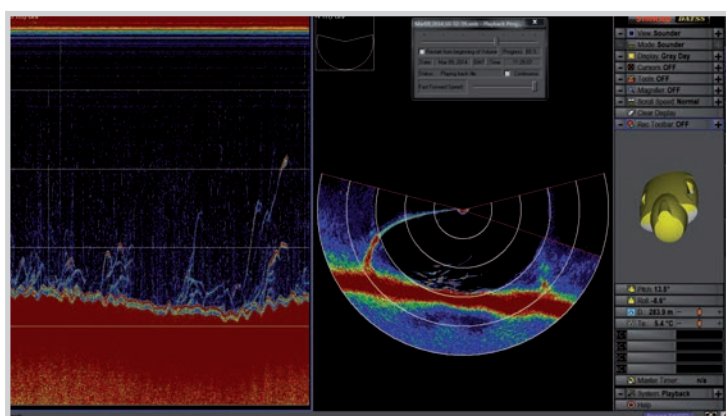
## HIGH RESOLUTION, FAST PING RATE

In a wireless system you have to compromise on ping rate and data flow due to limits in battery. The FX80 system is different, and as long as you have the 3<sup>rd</sup> wire available, you can stream both live camera and trawl scanning sonar continuously at the same time.

A wireless trawl eye has to make the same compromise between how often can we update, and what resolution we can get. With the FX80 you do not have to make these decisions, power is available from the deployment unit, and the bandwidth is there.



Above you can see a single beam echo sounder “EK15” connected to the HUB with good resolution and relatively high ping rate. Other sensors are planned to be integrated in the future.



DFS75 scanning sonar is an important part of the FX80 system. The sonar scans the entire opening and gives information of trawl behaviour and fish entrance. The DFS75 is a new version of the popular FS70, digitalized and optimized for the FX80 system. The DFS offers twice the sampling rate compared to the FS, and the system can do CHRIP in addition to CW.



### THE HEART OF THE FX80 SYSTEM

The FX80 trawl deployment unit is where all sensors are interfaced. The electronic HUB with Ethernet connections is built in the unit. The same goes for the DFS scanning sonar head. Optional and future trawl sensors, such as high resolution echo sounders, are also interfaced through this unit before signals are transmitted to the vessel for viewing and storage. The unit has the same 1800 meter depth rating as the camera unit.



# SENSOR LOCATION AND AVAILABLE FUNCTIONS

## 1 DOORS (MULTISENSOR MK2)

Function	Lid type
Spread	Any
Roll	Any
Pitch	Any
Height	Any
Depth	Depth/Temp lid
Temperature	Depth/Temp lid
Remote for Geometry	Geometry transponder lid
Remote for Spread	Any

## 2 WINGS (MULTISENSOR MK2)

Function	Lid type
Spread	Any
Height	Any
Depth	Depth/Temp lid
Temperature	Depth/Temp lid
Remote for Geometry	Geometry transponder lid
Remote for Spread	Any

## 3 CLUMP (MULTISENSOR MK2)

Function	Lid type
Remote for Geometry	Any
Remote for Spread	Any

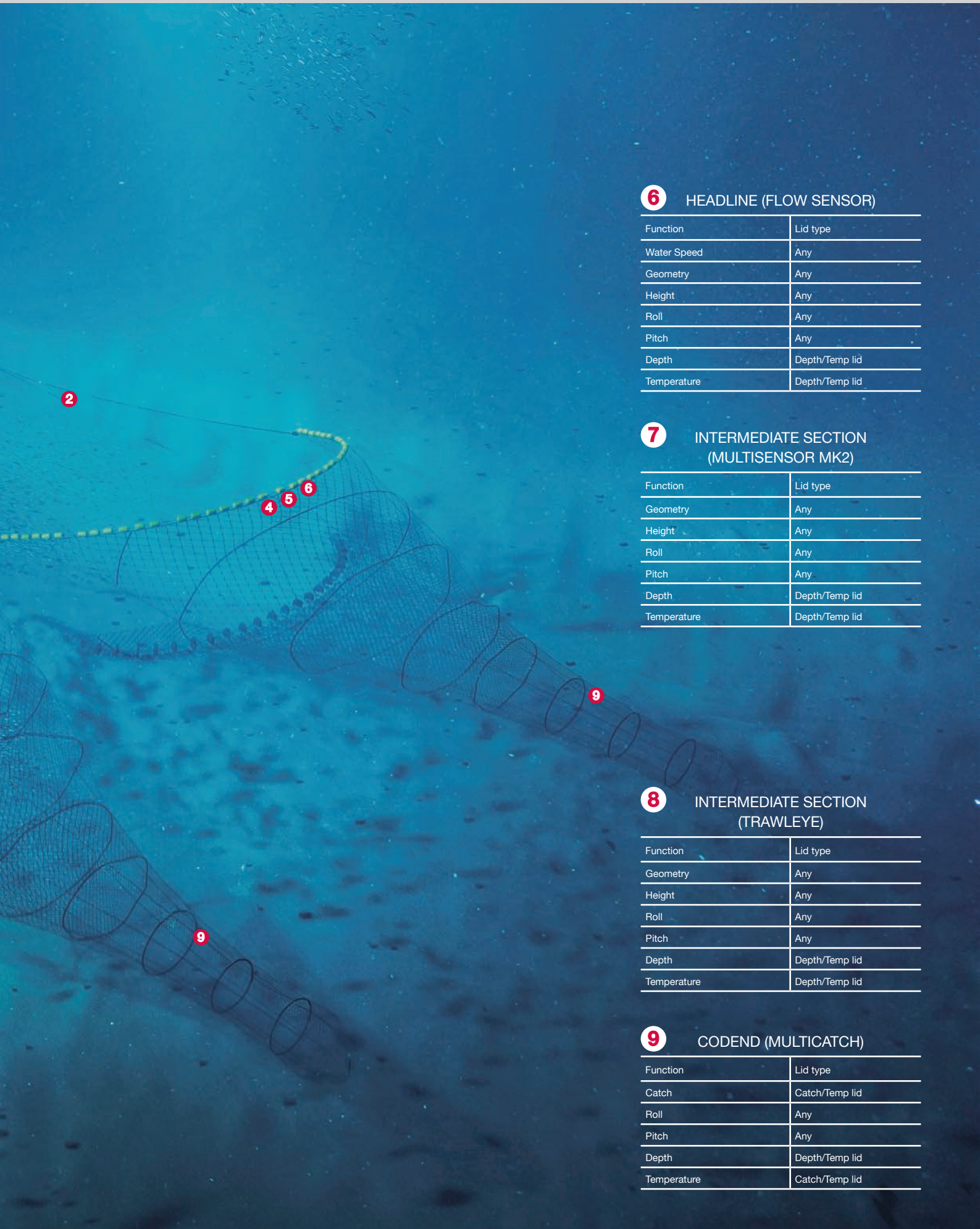
## 4 HEADLINE (MULTISENSOR MK2)

Function	Lid type
Geometry	Any
Height	Any
Roll	Any
Pitch	Any
Depth	Depth/Temp lid
Temperature	Depth/Temp lid

## 5 HEADLINE (TRAWLEYE)

Function	Lid type
Echogram	Any
Geometry	Any
Height	Any
Roll	Any
Pitch	Any
Depth	Depth/Temp lid
Temperature	Depth/Temp lid





**6** HEADLINE (FLOW SENSOR)

Function	Lid type
Water Speed	Any
Geometry	Any
Height	Any
Roll	Any
Pitch	Any
Depth	Depth/Temp lid
Temperature	Depth/Temp lid

**7** INTERMEDIATE SECTION  
(MULTISENSOR MK2)

Function	Lid type
Geometry	Any
Height	Any
Roll	Any
Pitch	Any
Depth	Depth/Temp lid
Temperature	Depth/Temp lid

**8** INTERMEDIATE SECTION  
(TRAWLEYE)

Function	Lid type
Geometry	Any
Height	Any
Roll	Any
Pitch	Any
Depth	Depth/Temp lid
Temperature	Depth/Temp lid

**9** CODEND (MULTICATCH)

Function	Lid type
Catch	Catch/Temp lid
Roll	Any
Pitch	Any
Depth	Depth/Temp lid
Temperature	Catch/Temp lid



## TRAWL SENSORS SPECIFICATIONS

	PX MULTICATCH	PX UNIVERSAL	PX MULTISENSOR		PX FLOW SENSOR
			MULTISENSOR Mk2	TRAWLEYE	
Communication Frequency	40/70 kHz	39,4-50,5 kHz	39-50 kHz	39-50 kHz	39,4-50,5 kHz
Echosounder / Transverse working frequency		70 kHz	70 kHz	200 kHz	70/900 kHz
Maximum Communication Distance	2500 m	2500 m	2500 m <sup>(2)</sup>	2000 m <sup>(2)</sup>	2500 m
Depth Rating	1400 m <sup>(1)</sup>	1400 m <sup>(1)</sup>	1400 m <sup>(3)</sup>	1400 m <sup>(3)</sup>	1400 m
Maximum number of measurements	5	5	5		5

### UPDATE RATES

Slow	30 s. <sup>(5)</sup>	30 s. <sup>(5)</sup>	30 s. <sup>(5)</sup>	2/4/8 s.	30 s. <sup>(5)</sup>
Normal	15 s. <sup>(5)</sup>	15 s. <sup>(5)</sup>	15 s. <sup>(5)</sup>	1,1 s.	15 s. <sup>(5)</sup>
Fast	5 s. <sup>(5)</sup>	5 s. <sup>(5)</sup>	5 s. <sup>(5)</sup>	0,5 s.	5 s. <sup>(5)</sup>

### CHARGING TIME

Up to 70% of total capacity (hours)	1	1	1	1	1
Up to 100% of total capacity (hours)	2,5	2,5	2,5	2,5	2,5

### WEIGHT

In Air	8 kg	8 kg	7 kg	7 kg	10 kg
In Water	3,5 kg	3,5 kg	3 kg	3 kg	5 kg

Door Spread Maximum Range			600 m	N/A	N/A	N/A
Geometry Maximum Range			N/A	600 m	150 m	600 m
Height Maximum Range	95 m	95 m	95 m			95 m

(1) Except PI D300 which is 1000 m.

(2) Depending on sea conditions, noise level, sensor alignment, output power.

(3) Note: depth lid only goes to 1000 meters

(4) Depending on output power and update rate.

(5) Depends on measurement type and number of measurements



# TRAWL UNITS SPECIFICATIONS

SR15	SR70	FS70	FX80 SYSTEM WITH HUB AND DFS75
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## PROCESSING UNIT

Voltage	110/220 VAC	110/220 VAC	115/230 VAC
Consumption	5 A.	5 A.	100 VA
Processor type	Standard PC computer	Standard PC computer	Standard PC computer
Operating system	Windows™ 10	Windows™ 7	Windows™ XP, Vista, 7
Display output	Single/Dual	Dual	Dual
Serial interface I/O	One RS232	One RS232	Two RS232
Ethernet interface	1	1	Two
Display resolution	Standard XGA	Standard XGA	Standard XGA

## TTM / BRIDGE UNIT

Voltage		110/220 VAC	110/220 VAC
Consumption		5 A.	150 VA
Communication link		With third wire	With third wire

## WIRELESS SENSORS TX/RX UNIT

Voltage	24 VDC **	(Built in the Deployment package)	(Built in the Deployment package)
Consumption	2 A.		
Hydrophone connection	1	Up to 2 (Fore and Aft)	Up to 2 (Fore and Aft)
Hydrophone type	Single Beam with preamplifier	Single beam	Single beam
Frequency range	39,4-50,5 kHz	40-50 kHz or 68-78 kHz	40 kHz
Ethernet interface	1		
Maximum range to sensors ***	2500 m.	2500 m.	2500 m.
Sensor compatibility	PX Trawleye, PX Multisensor MK2, PX MultiCatch, PX Universal, PX Flow	PS, PI, PX, FA701	PS, PI, PX
RX Channels	16x5	6	6
Measurements	Up to 80	Depth, Spread, Catch, Rip, Height, Pitch angle, Roll angle, Bottom contact, Seine sounder	Depth, Spread, Catch, Rip, Height, Pitch angle, Roll angle, Bottom contact, Geometry, Temperature

## UNDERWATER UNIT

FM90	FS70	FX80	PX TRAWLEYE
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## DEPLOYMENT PACK

Material	Polyurethane with S.S. Fasteners	Polyurethane with S.S. Fasteners	Polyurethane with S.S. Fasteners	Polyurethane with S.S. Fasteners
Dimension L x W x H in cm.	84 x 41 x 30	79 x 43 x 27	79 x 43 x 27 / 53 x 53 x 23	35 x 17
Weight (complete system in air)	35,5 kg	28 kg	28 Kg / 12 Kg	7 kg

## SENSOR HEAD

Head type	Multibeam with down/up sounder	Analog Vertical with Echosounder	Analog Vertical with Echo sounder	Wireless
Vertical transducer frequency	200 kHz	120 kHz or 330 kHz	120 kHz or 330 kHz	200 kHz
200 kHz/120 kHz Head Beam width ****	3° x 20°	5° to 40°	5° to 40°	N/A
Simsounder	N/A	1,9° to 20°	1,9° to 20°	N/A
Echosounder frequency	200 kHz	200 kHz	200 kHz/chirp	200 kHz
Echosounder transducer beam width	10° x 20 °	10° x 20°	10° x 20°	33°
Depth rating	1500 m.	1500 m.	2000 m.	1400 m.
Sensors built-in	Depth, Temperature, Pitch and Roll	Depth, Temperature, Pitch and Roll	Depth, Temperature, Pitch and Roll	Roll/Pitch/Battery Status

\* Built in the processing unit.

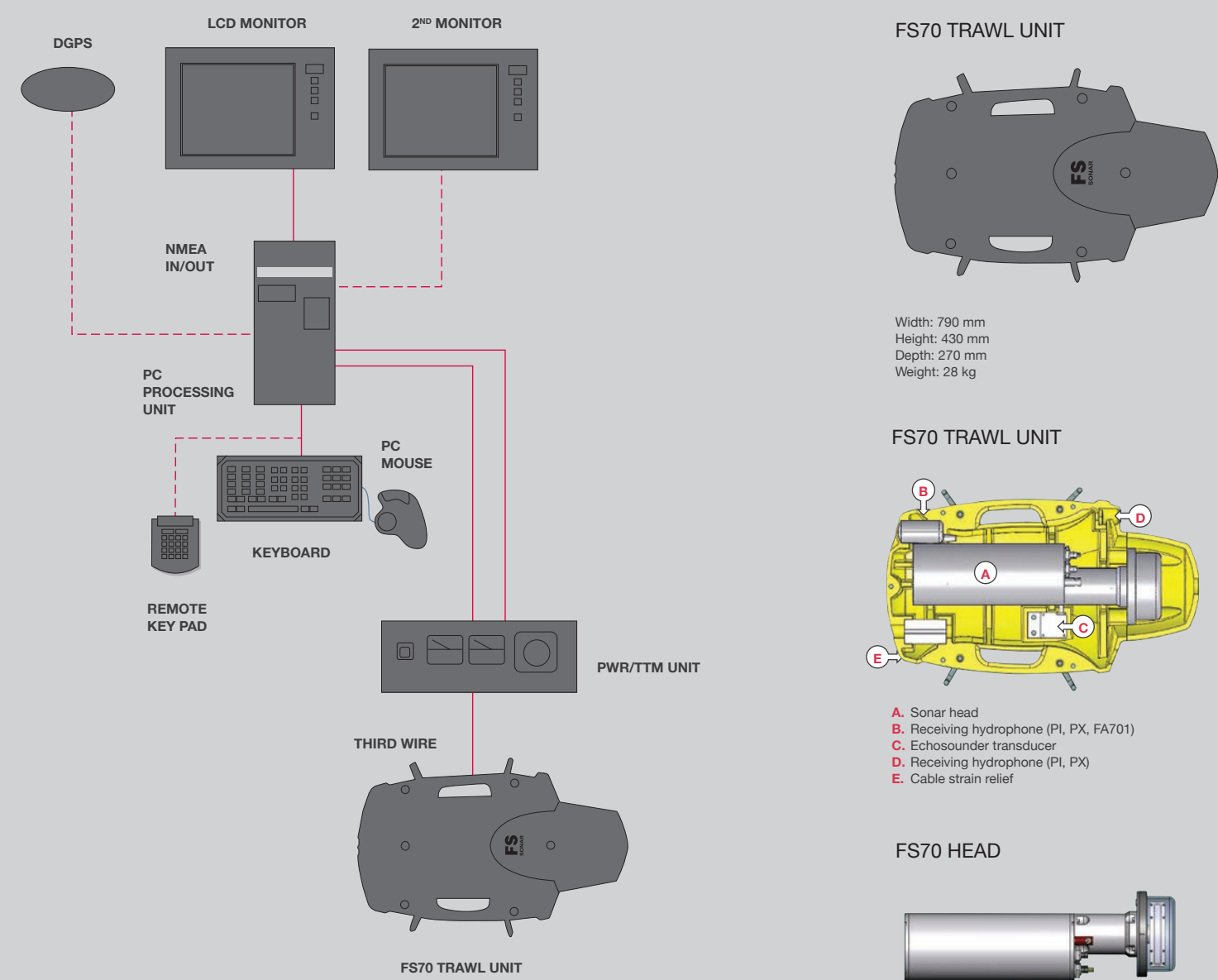
\*\* 115/230 VAC to 24 VDC Adaptor included with the delivery.

\*\*\* Detection range depends on transducer installation, ambient noise level, temperature gradient and sensor alignment.

\*\*\*\* 200 kHz Head Beam width for FM90. 120 kHz Head Beam width for FS70 and PX Trawleye.



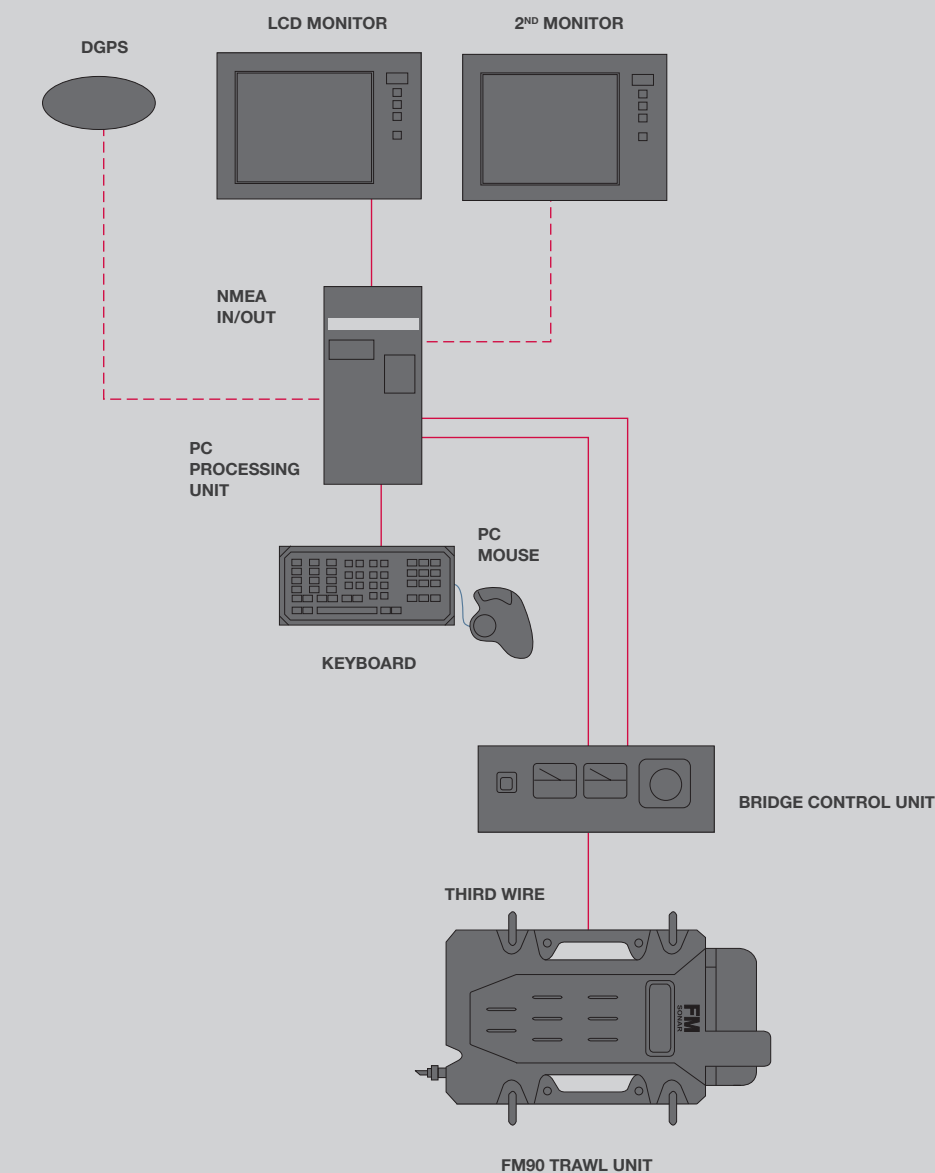
# FS70 EXPANDED CONFIGURATION



# CATCH MONITORING COMPONENTS TYPICAL CONFIGURATION



# FM90 EXPANDED CONFIGURATION

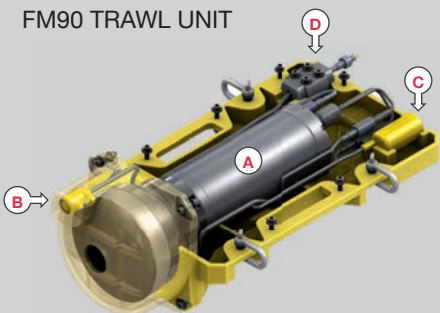


FM90 TRAWL UNIT



Width: 410 mm  
Height: 300 mm  
Length: 840 mm  
Weight: 35,5 kg

FM90 TRAWL UNIT



- A. Sonar head
- B. Receiving hydrophone (PI, PX)
- C. Receiving hydrophone (PI, PX)
- D. Cable strain relief

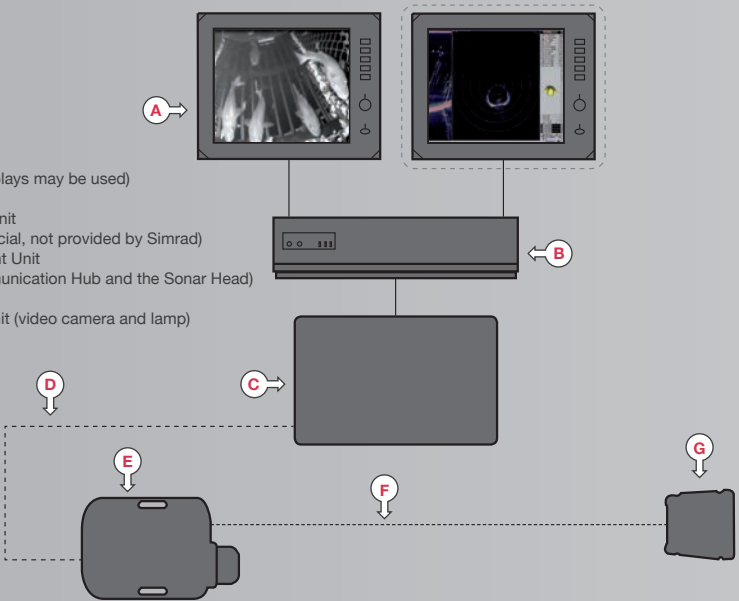
FM90 HEAD



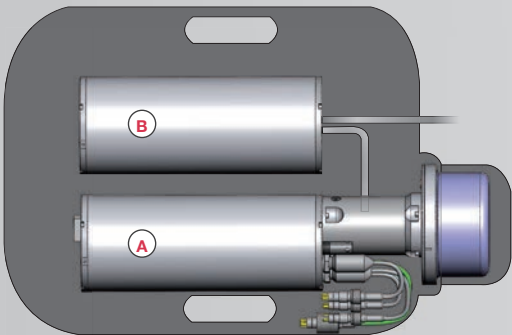
# FX80 CONFIGURATION

SYSTEM  
DIAGRAM

- A. Display (two displays may be used)
- B. Processor
- C. Bridge Control Unit
- D. 3<sup>rd</sup> wire (commercial, not provided by Simrad)
- E. Trawl Deployment Unit (holds the Communication Hub and the Sonar Head)
- F. 4<sup>th</sup> wire
- G. FX80 Camera Unit (video camera and lamp)



FX80 TRAWL DEPLOYMENT UNIT



- A. DFS70 Head
- B. Digital Hub



# SUPPORT

A world map with a light gray background. Black squares indicate the locations of Simrad's main services centers and distributors. Red squares indicate specific locations in Norway, Spain, and Malaysia. The map shows the continents of North America, South America, Europe, and Africa.

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## SIMRAD DISTRIBUTORS

SIMRAD scientific products are sold and supported by a large network of distributors and dealers that completes our own regional offices around the world. Locations are indicated on the map, the full list and contact details can be found at:  
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