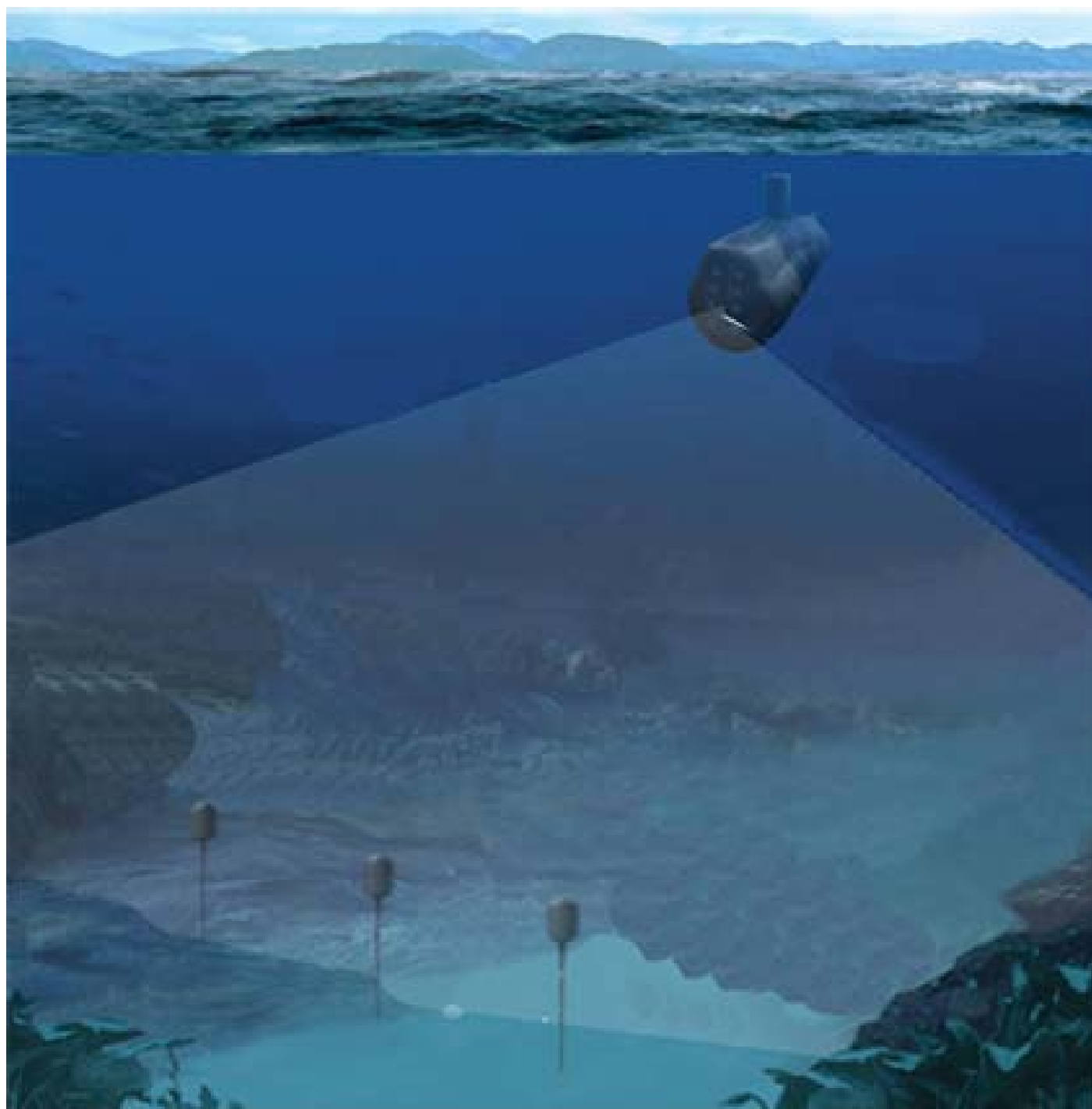


SA9510S



KONGSBERG

## Mine Avoidance and Navigation Sonar for submarines



## SA9510S System Overview

The SA9510S sonar can operate in the frequency range from 70 to 100 kHz and it is designed with emphasis on detection and early warning of navigation obstacles including anchored mines.

The main purpose of the sonar is to detect mines, obstacles and bottom in a wide swath ahead of the submarine. The sonar generates target warning or alarm with sufficient time left to perform an avoidance manoeuvre. It is of great importance to provide information to the crew for bottom navigation purposes and for submerged navigation the SA9510S sonar has the ability to detect and display the bottom profile in selected horizontal directions in front of the submarine. Up to nine bottom profiles can be produced simultaneously in different directions.

The SA9510S sonar consists of the following main units:

- Sonar Processing Unit (SPU)
- Sonar Head Vertical (SHV)
- Sonar Head Horizontal (SHH)

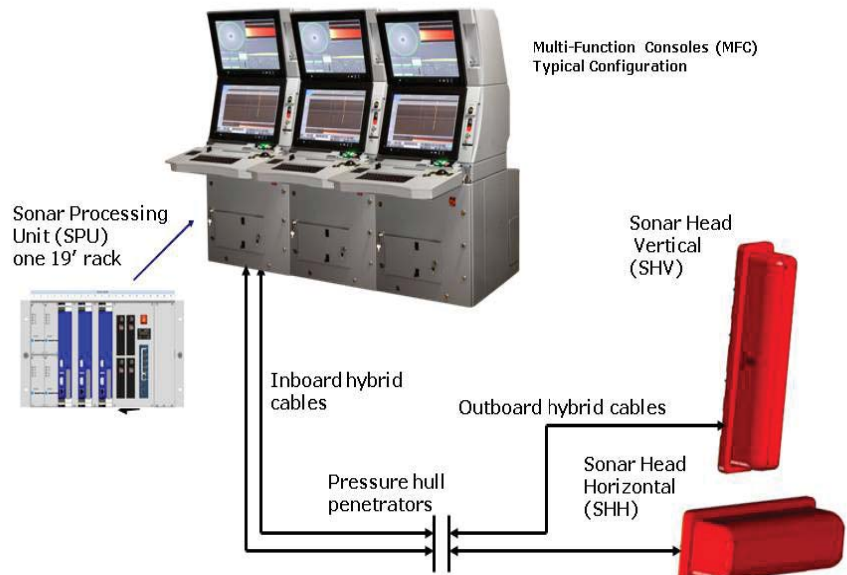
The SA9510S is a new and compact design based on a new generation front end electronics that uses state of the art technology and is specifically designed to be integrated into the sonar heads. Signal digitizing is performed in the sonar heads thus avoiding a high number of cables and pressure hull penetrators.

The basis of the sonar is the two wideband composite transducer arrays, one 2D plane vertical array and one 2D plane horizontal array. Both arrays are electronically steerable in two directions. The sonar has the possibility to transmit and receive on both the vertical and the horizontal array. The configurations of the transducer arrays, i.e. the arrangement of the transmitting and the receiving transducer elements, have been designed specifically for submarine application where both mine seeking, obstacle avoidance

## SA9510S Mine Avoidance and Navigation Sonar



### System overview



and submerged navigation have been driving criteria.

Mine seeking and submerged navigation can be performed simultaneously.

The sonar front end electronics is integrated into the sonar head together with the transducer array and constitutes the outboard part of the sonar. The sonar head housing is made of carbon fibre and titanium. From the outboard part there will be only two cables, one for each sonar head and only two pressure hull penetrators are needed.

The inboard electronics, the Sonar Processing Unit (SPU), is contained in one 19 inch rack. The SPU contains all the hardware and software necessary to run the digital signal processing, prepare the sonar Human Machine Interface (HMI) and communicate with the Multi Function Console (MFC).

During operation the SPU will be controlled from the MFC and the presentation of sonar images presented on the MFC screen. The principle of the MFC integration will be to let the sonar HMI reside

in the MFC as a so called thin client. This approach enables the sonar to interface to virtually any system vendor or MFC.

The sonar includes the possibility for extensive information interchange with the Command & Control System.

Further, emphasis has been placed on shallow water capabilities. The sonar provides features and flexibility to select the most optimal sonar settings for the relevant environment. The sonar operator can optimize the performance by selecting pulse length and shapes, vary source level and choose narrow or wide beam widths.

For easy and effective operation the operator has the possibility to select pre-programmed parameter settings for specific missions.

The sonar employs new and advanced algorithms for automated initial target detection, tracking, pre-classification and target filtering.

The wideband transducers and transceiver technology permits excellent range resolution.

The SA9510S sonar has no moving or rotating parts, i.e. all the acoustic beam steering is done electronically.

The intention has been to remove all potential noise sources that may arise from mechanical movements.

It is possible to compare the information from the SA9510S Sonar with the information from a sea map. The MA Sonar has the capability to store sonar data for replay in the sonar and also for later analysis.

Display may be relative motion head- or north up and also true motion. Information of own speed, depth, heading, time and position will always be displayed on all used sonar screens.

With help of cursors it is possible to calculate positions of suspected mines or other interesting objects or calculate own position and position of objects from known reference points.

The system has the ability to accept a sound speed profile and use it for correction of refraction on the vertical array and also to compute transmission loss for computation of relative echo level.

### System performance capabilities

Both the vertical and the horizontal sonar head have a complete set of transmit and receive channels connected to each array. Simultaneous transmission and also simultaneous reception on both arrays is possible.

The sonar is designed for two different target classes. One is mines and mine-like objects; the other is sea-bottom surfaces.

To obtain the best detection result for different targets the sonar will use different pulse types like Linear FM, Hyperbolic FM and Continuous Wave (CW) pulses.

Available sound speed information is taken into account and correction for refraction is performed.

### Tracking

Detection, track initiation, tracking and some amount of Post Track Analysis (PTA) is performed by the Computer Aided Target Acquisition (CATA) routine. CATA will detect targets of interest and initiate tracking. Criteria for detection are set in CATA but may be operator controlled. Manual track initiation and updating is also possible by marking an object in a suitable display. It is possible to turn off the tracker or just exclude its result from the display.

The tracking algorithm will track targets in the 3 dimensions: bearing, elevation and range. This is possible because the sonar can receive simultaneously on the horizontal and the vertical array. It can also take Doppler information into account. Comparison of estimated target trajectory and Doppler return is in some cases a valuable classification tool.

### Positioning / navigation

Positioning of the submarine relative to terrain may be performed in several manners:

- Selected features are identified in the sonar response and compared with a chart.

- The selected feature method is readily performed by overlaying horizontal sonar response on a chart.

Positioning of objects may be performed by setting the cursor on the object. Position information is provided for track objects. The latter is the recommended method for positioning of objects.

### Simultaneous mine seeking and navigation

The sonar is designed for simultaneous mine seeking and navigation. This is done by transmitting a train of pulses by different features.

For example the first pulse can be a HFM pulse which is suited for detection of small objects such as mines and set up to cover the specified search sector. The second pulse can be a CW pulse suited for detection of ocean bottom surfaces.

The HFM ping on the horizontal array is designed for mine detection. Mine detection will be strongly aided by the CATA automatic track initiation.

### Key Features for the SA9510S Sonar

- Automatic mine/obstacle detection and warning
- Automatic target initiation and tracking
- Wide horizontal and vertical coverage
- Excellent horizontal and vertical resolution
- Sound propagation model integrated
- Anti-grounding and seafloor detection ahead of vessel
- Easy integration / information exchange with CC system
- Operator configuration of sonar parameters and HMI
- Built-in Test Equipment (BITE).
- Features that enhance shallow water capabilities and operations in narrow straits.

## SA9510S Technical Specifications

• Operating frequency range:	70 to 100 kHz
• Horizontal sector coverage:	120° (centre beam < 1°)
• Vertical sector coverage:	90° (centre beam < 2°)
• Bearing angle accuracy:	< 1° (at centre)
• Elevation angle accuracy:	< 2° (at centre)
• Target bearing separation:	< 2°
• Target Tracking:	3D tracking – Automatic and Manual
• Pulse types:	HFM / LFM / CW
• Alarm:	Audio and visual
• Electronic charts:	Formats: ENC, DNC and ARC
• Recording and Replay:	Yes
• Sound Propagation Modeling:	Yes
• Mine Seeking and Navigation:	Yes - Simultaneous
• Single ping:	Yes – Controlled by operator
• Bottom profiling:	Yes – ahead of submarine
• Screen operation:	
• Integration with Multi Function Consol (MFC):	Remote desktop - Single screen / Two screens
• Depth rating:	500m
• Sound Speed Profile:	Yes
• Transmission control:	Yes
• Echo strength :	Yes – relative backscatter

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