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Ex. No. ~~0009~~..

**TECHNISCHE
OPLEIDINGEN
KONINKLIJKE
MARINE**

Intro SEWACO VII
System

Hand-out
WT 030400

ONLY FOR INSTRUCTION PURPOSE

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INTRODUCTION

SEWACO VII



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Use of the handout

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This handout is intended as a reference and should not be consulted for repairs, locating faults, procedures,
etc. etc.*

The publication date is provided in the right corner and not the date of preparation.

1000 Introduction

This course is intended to provide an insight into the composition, possibilities and limits of the M-frigate (Multipurpose-frigate) and the SEWACO-VII system.

1100 Escort ships

Frigates of the Royal Netherlands Navy are normally divided into escort groups.

1100.1 Escort groups' duties

For crisis management:

- During tense of high tension flying the flag and being present, and where necessary participating in actions against a credible counterforce.

During times of war:

- safeguarding the free use of the sea;
- protecting sea treaties (escort of merchant convoys);
- engaging submarines and surface units;
- self-defense against air targets.

During peace time:

- facilitating foreign political and economic policy;
- show of strength, including readiness, mobility and flexibility.

1100.2 Duties of the frigate

Primary:

- hunting, locating and elimination of enemy submarines;
- self-defense against aircraft attacks and/or guided missiles (anti-ship missiles);
- protecting the fleet against attacks by surface units.

Remaining duties:

- defense of the Dutch Antilles;
- (limited) provision of commando facilities;
- provision of help at sea;
- support of police activities (combating drugs).

1100.3 General ship's details of the M-frigate

Crew	:	156 (max. 186)
Water displacement:		2800 ton (max. 3320 ton)
Dimensions	:	length 122.25 meter
		breadth 14.37 meter
		depth 4.3 meter
Propulsion	:	2 Stork Werkspoor diesels
		2 Rolls-Royce SPEY SM1A gas turbines
		2 variable speed propellers.
Stabilisation/Rudder:		2 Rudder-roll rudders
Speed	:	29+ knots
Action radius	:	5000 sea miles at 18 knots.

Wharf ~~at the~~ ~~the~~ Schelde, Vlissingen

Number	:	8
Names	:	F827 Karel Doorman
		F829 Willem van der Zaan
		F830 Tjerk Hiddes
		F831 van Amstel
		F832 Abraham van der Hulst
		F833 van Nes
		F834 van Galen
		F828 van Speijk

Weapons : 1x 7.6 cm OTO Melara cannon
1x 30 mm Goalkeeper
8x HARPOON RGM-84D SSM's
16x SeaSparrow RIM-7M SAM's
2x6 CHAFF-launchers (SRBOC)
Torpedoes Mk.46 mod.5
2x 20 mm Oerlikon machine guns
e.v.l. 3 MAG machine guns (1 Heli- and 2 on the Signal deck)
1x Helicopter type Westland Lynx (later: Eurocopter NH-90)

1100.4 Composition of crew

Operational Service (OS)

The OS consists of 11 officers and 49 crew.

The services and duties within the OS are:

OSOPS (OS OperationS)	: Navigation, tactical setup;
OST (OS Treaties)	: Treaties;
OSNS (OS Nautical Service)	: Nautical services;
OBFT (Onboard Flying Team)	: Onboard helicopter.

Logistical Service (LS)

The LS consists of 1 officer and 25 crew.

The services and duties of the LS are:

LSP (LS Provision)	: Provisions;
LSGM (LS Goods Management)	: Magazines;
LSA (LS Administration)	: Administration, archives;
LSMS (LS Medical Service)	: Medical care.

Technical Service (TS)

The TS consists of 2 officers and 37 crew.

Duties of the TS are for instance monitoring the propulsion and energy generation. Providing maintenance for the platform installations, such as: fire extinguisher systems, drinking water systems, air-conditioning, etc.

Monitoring duties are performed from the Technical Center (TC). Various TS installations can also be operated from here.

The services within the TS are:

TSM (TS Mechanics)	: Mechanical services;
TSE (TS Electro)	: Electrical/electronic services.

Technical weapons service (TWS)

The TWS consists of 2 officers and 21 crew.

Duties of the TWS primarily concern the maintenance and repair of the sensors, communication devices and weapons systems.

The TWS is therefore divided into two groups, namely the Weapons/Nuclear subsystems and Sensors/Nautica/Communication.

The services within the TWS are:

WSS (WS Ship's systems)	: Replacement WDE/WDW.
-------------------------	------------------------

1100.5 Sewaco system

In order to carry the duties described in chapter 1100 the frigates of the Royal Netherlands Navy are fitted out with a Sensor, Weapons and Command system, which is abbreviated to SEWACO.

Submarines of the Walrus class and minesweepers of the Alkmaar class are also provided with a SEWACO-system.

How the system is put together is dependent of the type of ship. The Royal Netherlands Navy employs the following SEWACO types:

- SEWACO VI L-frigates;
- SEWACO VII M- frigates;
- SEWACO VIII Submarines Walrus class;
- SEWACO IX Mine sweepers Alkmaar class.
- SEWACO XI LC- frigates

The M-frigate is also provided with a modern platform system. This system provides for the propulsion and energy provision of the ship.

The steering system of the platform is comparable to the SEWACO-system. However, gas turbines, rather than weapons are, for instance, controlled with this system.

The ship's NBCD equipment also belongs to the platform installation.

BSMD

The apparatus of the Technical, as well as the Technical Weapons Service, respectively the Platform and SEWACO, are divided into a numeric system, which we refer to as the BSMD system.

BSMD is an abbreviation of Basic Standard Materials Division.

It is divided into the following principal groups:

System	Platform	SEWACO
Installation		
Material attached to the ship	1000	2000
Installations not attached to the ship	3000	4000

The principal groups are subdivided into:

- subgroups,
- subsystem,
- sub-subsystem,
- apparatus level.

This numbering is used for:

- documentation,
- configuration control,
- logistical support,
- Maintenance Plan documents,
- PRATWSA (TWS Administration),
- RAPID (TS Administration).

Due to the millennium problem the PRATWSA and RAPID will be replaced by one program, namely MATRACS (MATERials Reporting, Analysis, Configuration System).

The numbering of the TWS groups is as follows:

2000 SEWACO

- 2100 Sensor systems
- 2200 Weapon systems
- 2300 Command systems
- 2400 Nautical/hydrographical systems.

Division of non-attached apparatus is as follows:

4000 Measurement equipment belonging to 2000

- 4100 Exchangeable sensors for 2100
- 4200 Munitions for 2200
- 4300 Specific communication equipment for 2300
- 4400 Loose meteorological equipment for 2400.

2000 Platform

NBCD

The ship is divided into four segments (see Fig.2000.1).

There are 42 airtight compartments within those segments, which collectively form the gas citadel. In addition, the ship is divided into six air-conditioning zones. This is referenced in the NBCD numbering of all rooms onboard. All room numbers start with a number between 1 and 6, as viewed from the bow to the stern.

There are two NBCD sections in the ship, namely fore and aft. Each section has its own section post. The Technical Center (TC) serves as the NBCD center following calamities and battle stations.

● Fire-extinguishing pump

▣ Fire hatch

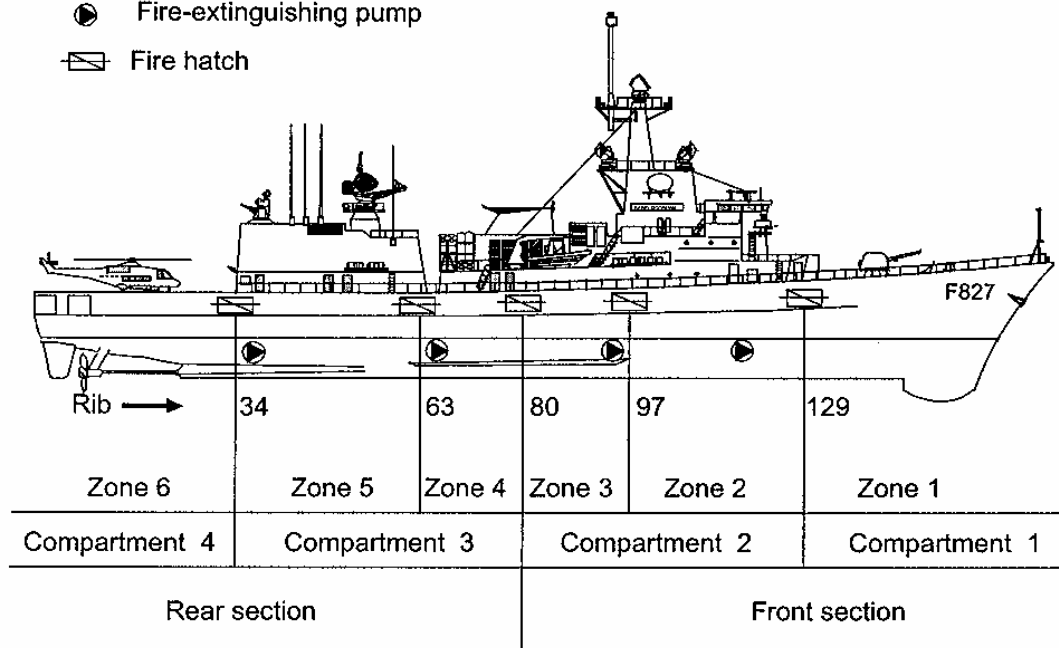


Fig.2000.1 Compartmentalisation M-Frigate

There are four electrical fire-extinguishing pumps onboard. Three of these have a discharge volume of 200 m³/h, the fourth has a discharge volume of 60 m³/h.

The 200 m³/h pumps are located in the diesel generator room, the aft engine room and the cooler room - fore, respectively. The 60 m³/h pump, or 'service-pump', is located in the aft engine room.

In order to restrict the smoke limit there five so-called fire hatches have been introduced. Smoke originating from fires is therefore unable to waft through the entire ship. These hatches divide the ship into the previously mentioned airco-zones.

Four compartments onboard are provided with HALON fire extinguisher installations, namely the diesel generator room, fore and aft engine room and the lightly inflammable materials store (LIM).

Five compartments are provided with fixed foam extinguishers, namely the hangar, the AVCAT-pump room, the diesel generator room and both engine rooms (AVCAT is helicopter fuel).

One, fixed pump with foam tank is used for all five installations.

The foam used is called "Triple F".

Propulsion

We distinguish between two ranges of speed for the ship's propulsion, namely cruising speed and full speed. Cruising speed is the speed from zero to approximately twenty knots, full speed from 18 knots. There are two Stork Werkspoor diesels for cruising speed and two Rolls-Royce Spey gas turbines for full speed. We refer to a so-called CODOG installation, that is to say we are able to use either the diesels or the gas turbines.

The cruising speed diesels are located in the aft engine room, the gas turbines are located in the fore engine room.

These diesels or gas turbines each drive a propeller shaft via a gearbox. The gearboxes are located in the aft engine room.

Each of the two propeller shafts drives a propeller with a variable speed setting.

Both rudders are of a specific construction. Not only do they act as rudders, they also work as stabilisation fins.

Through the Propulsion Control, service, monitor and Safeguarding system (PCS):

- the propulsion engines are started, stopped and used to hold the vessel stationary;
- the propulsion system is safeguarded and monitored;
- orders from the service panels (TC or bridge) are carried out;
- information is provided to the Information Processing System (IPS) of the platform system.

The PCS is a component of the so-called Integrated Monitoring and Servicing system (IMS).

Integrated Monitoring and Servicing system

The monitoring and servicing of the platform installation is carried out via the IMS-system (refer to Fig.2000.2).

The IMS-system is subdivided into:

- IPS, Information Processing System. This system processes operator instructions and presents the information gathered via monitors in the TC, amongst others.
- Automatics. These are regulators for specific platform installations, such as the Propulsion Regulator Automatic (PRA), Main Feed Automatic (MFA), Adaptive Steering and Stabiliser Automatic (ASSA), etc.
- LPU, Local Processing Units. These units provide for the direct servicing and monitoring of vital components of the platform installations from the TC. For instance, the settings on the main switchboard regarding choice of diesel generators, electrical coupling systems, and so on. The fire extinguishing systems are also regulated through these units.

Information Processing System (IPS)

The IPS is built up around a double Ethernet Local Area Network (LAN) (refer to Fig.2000.2). It is comparable to the SEWACO databus system which we will return to later.

It consists of 2 central computers (micro-VAX 3200 type) and 2 communication computers (VMEbus processors) which act as an interface to the regulator system.

A peripheral computer acts as an interface for printers, four recorders ('black-boxes'), shore/sister ship connection and servicing the alarms.

Five monitors are located in the Technical Center (TC) which acts as service cabinets for the IMS, via the IPS.

One monitor will also be installed in both section posts.

The IPS also exchanges information with the SEWACO-system regarding propeller rotations, pumps, etc.

Automatics

The automatics are independently working regulator systems based on 68000-microprocessors, which exchange information with the central VAX-computers and monitors via the LAN-databuses.

Orders can be given to the automatics both remotely and locally.

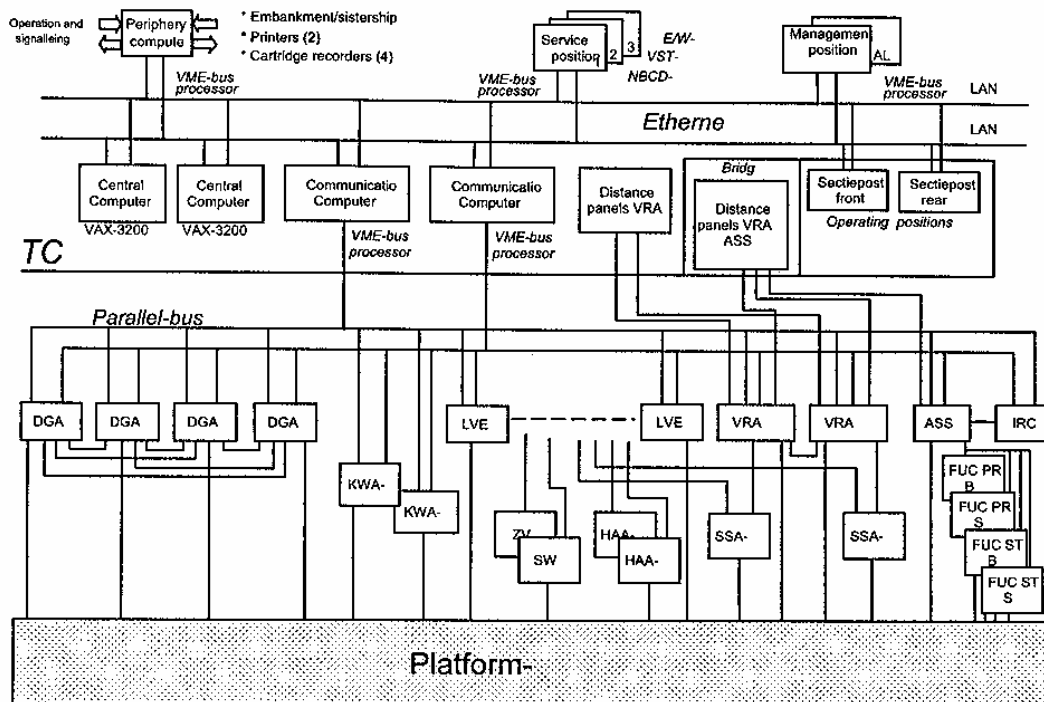


Fig.2000.2 GBB Platform system

Energy provision

There are five types of voltage onboard the M-frigate:

- 440 Volt/60 Hz 3 phases
- 115 Volt/60 Hz 3 phases
- 24 Volt direct current
- 440 Volt/400 Hz 3 phases
- 115 Volt/400 Hz 3 phases.

The ship is provided with four diesel generators for energy provision. Two of these are located in the diesel generator room, the other two are located in the fore engine room.

These generate 440 Volt/60 Hz 3 phases. Distribution of the voltage takes place via four main rails after four distribution panels.

There is also a back-up diesel generator for the fire extinguishing pump or a high pressure air-compressor and a small number of distributors/receivers.

The distribution panels are divided across two main switchboards to the fore and aft of the ship. Grouping automatics ensure that the voltage is distributed over the so-called EF-cabinets (Electrical Feed). There is a further subdivision in these EF-cabinets to various users.

The numbering of the EF-cabinets is in accordance with the "segment" system, that is to say the first cabinet figure indicates where the cabinet is located and does not indicate the airco-zone. That figure ranges from 1 to 4 and not 1 to 6, as is for the room numbering.

For installers with experience on older frigates the application of the two systems conjointly could possibly lead to confusion.

The 440 Volts of a number of the 440 V/60 Hz main groups is transformed to 115 Volt. This is for the "small" users. For instance for the wall contacts for TVs, radios, etc.

A 24 Volt DC is provided for a number of other main groups. This direct current is then further divided via the EF-cabinets.

In the event that the 24 Volt ship network should fail, the batteries will take over their function.

There are two, rotating transformers, in order to provide the 440 Volt/400 Hz 3 phases. These generate the 400 Hz from the 440V/60 Hz feed.

The two transformers are each located in their own transformer room. There is one to the fore of the ship, and another aft.

The 440V/400 Hz is distributed between the two EF-cabinets through the main switchboards, namely EF-3H4 and EF-2H3.

Further division takes place in the EF-cabinet. At the same time the 440 V/400 Hz is also transformed to 115V/400 Hz 3 phases in the EF-cabinet.

3000 SEWACO VII

Functions of the SEWACO VII

The functions of the SEWACO VII system are summarised as follows:

- obtaining information;
- processing and presenting the information;
- exchanging information;
- carrying out measures against a threat;
- nautical and hydrographical functions;
- other functions.

Hardware structure

We separate the equipment that has to perform the above functions into two categories:

- integrated subsystems (or ON-LINE subsystems);
- independent subsystems (or OFF-LINE subsystems).

ON-LINE subsystems work together and are connected to each other by hardware, as well as software. This is also referred to as the 'C3I system'.

C3I refers: Command, Control, Communication & Intelligence.

The C3I system is constructed around a three-way Local Area Network, called the Triple Ethernet Databus.

OFF-LINE subsystems are not connected to other subsystems, but do however need to work with them. Consider, for instance, the 20 mm cannon onboard.

This is not connected to anything, however it does belong to the Weapons-system.

BITE or Built In Test is cannot be ignored in modern equipment. A lot of SEWACO equipment contains BITE provisions. One can quickly assess whether the equipment is working properly with this. Some equipment will automatically indicate whether defects are present and/or whether capacity has been reduced.

The SEWACO VII system does also contain a diagnostic function. We will return to this in the software section in the course.

In Fig.3000.1 contains a diagram of the SEWACO VII with the most important connections.

At the end of the hardware section of the course you need to be able to reproduce this diagram and understand it. This diagram will run as thread through the course of your job training.

We will consider each of the subsystems in more detail in the following chapters.

Operational set-up of the SEWACO VII

Onboard an M-frigate the command has to decide how the ship, with its weapons, has to be setup. In order to make these decisions clear information has to be provided to the command. This information is presented as a "tactical image" by way a number of GOS-monitors in the Command Central (CoCe).

This "tactical image" is created by the Datahandling subsystem from the following information:

- sky image;
- sea image;
- underwater image;
- ESM-image.

At the same time we can utilize information obtained from the Link-11 datalink connection. This contains information originating from other units (ships, aircraft, etc.). This information is also displayed on the "tactical image".

The Datahandling subsystem determines the seriousness of the threat, and provides details of certain targets and advice regarding weapon systems launch, on the basis of the tactical image.

In addition, the possibility exists to launch an aircraft or helicopter.

07-02-2000

SEWACO VII

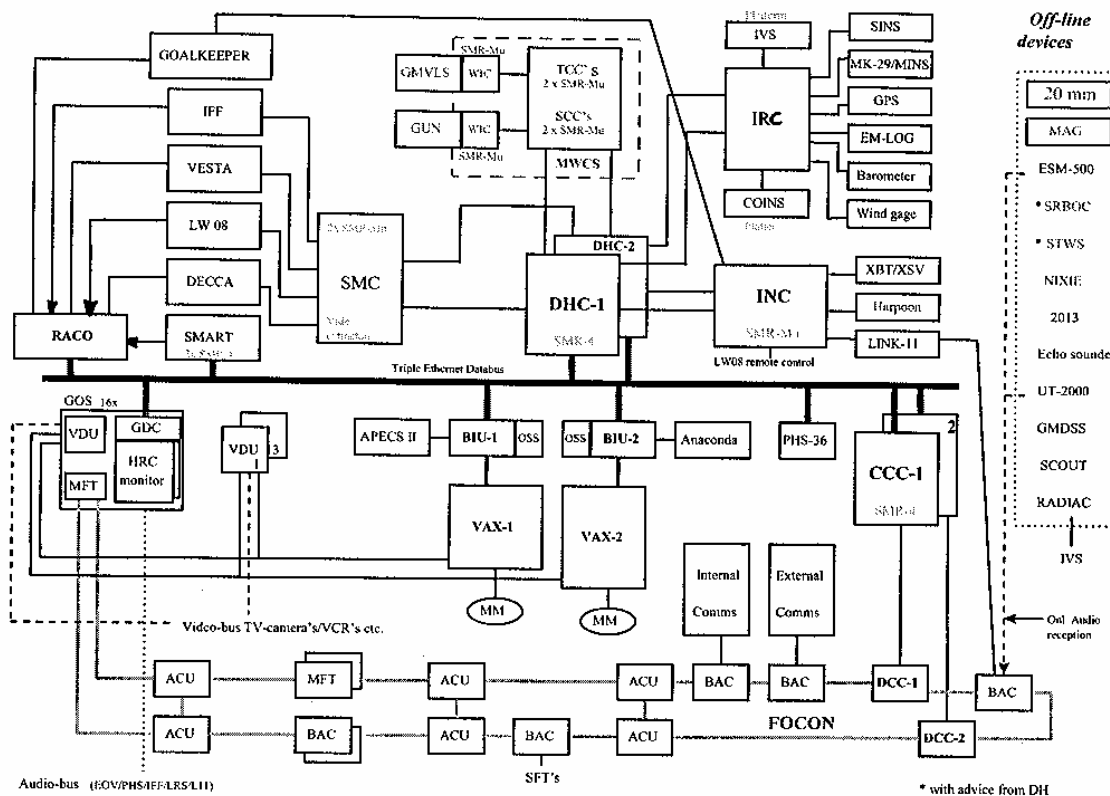


Fig.3000.1 Diagram of the SEWACO VII

The weapon systems are launched should a commander decide to engage:

- air targets;
- surface targets;
- underwater targets.

Engagement includes the following methods:

- Hard-kill; with artillery, guided weapons, etc.;
- Soft-kill; with electronic or acoustic counter-measures.

In order to defend the ship the space around the ship is roughly divided into three layers.

-No weapons can be employed in the outermost layer (in excess of 90 miles). The range of our weapons simply does not extend far enough. However, what is important is, is a timely warning against possible attacks

Adequate warning time provides us with sufficient time to erect the ship's defences.

This warning can be obtained in a number of ways. We could employ our own long-range warning radar, which at the same time would betray our own presence. We could also obtain information passively. This can be achieved with for instance the Electronic Warfare equipment (EWF) and the datalink-connection. The latter is then only in receiver mode. Underwater targets can be detected passively with the aid of the Long range sonar. Naturally both methods can also be combined.

-In middle layer (from approximately 25 miles) targets are starting to be assigned to weapons systems. However, the targets cannot be attacked just yet, this will happen as soon as they are within range.

-In the innermost layer they are within weapons range. The choice of weapons is dependant on the type of target and the maximum weapon range.

Air targets are attacked first with the NATO Sea sparrow, thereafter with the cannon and as a last resort with the Goalkeeper. These targets can be misdirected with the SRBOC and/or EOVS equipment.

Surface targets can be attacked first with the Harpoon, thereafter the cannon and eventually the 20 mm machine guns.

There is only the Mk-46 torpedo to combat underwater targets. At greater distances the helicopter can be setup to carry torpedoes. For closer ranges the ship's torpedo weapon system (STWS) can be employed. Torpedoes attacking the ship can be misdirected using the NIXIE equipment.

The description above of the "layers" is a summary description of the defense system of a frigate and/or escort group. The ranges indicated are in practice dependant on the sensors, weapons systems, composition of the squadron and others.

N.B. At a speed of 1200 km/hour an object will cover a distance of 300 meters per second.
1 nautical mile (1852 meters) would then be covered in approx. 6 seconds.

4110 LW-08/02LS radar

the LW-08/02LS is a high-capacity, long-range warning radar.

It has the following functions:

- air warnings;
- sea warnings;
- targeting.

The altitude and range of a target can be ascertained with the LW-08.

The LW-08 consists of (refer to Fig.4110.1):

- an hydraulically stabilised antenna;
- an Hydraulic Power Unit;
- a Transmitter cabinet;
- a Receiver cabinet;
- a Cooling cabinet with in-built wave guide drier;
- two Man-Aloft switches.

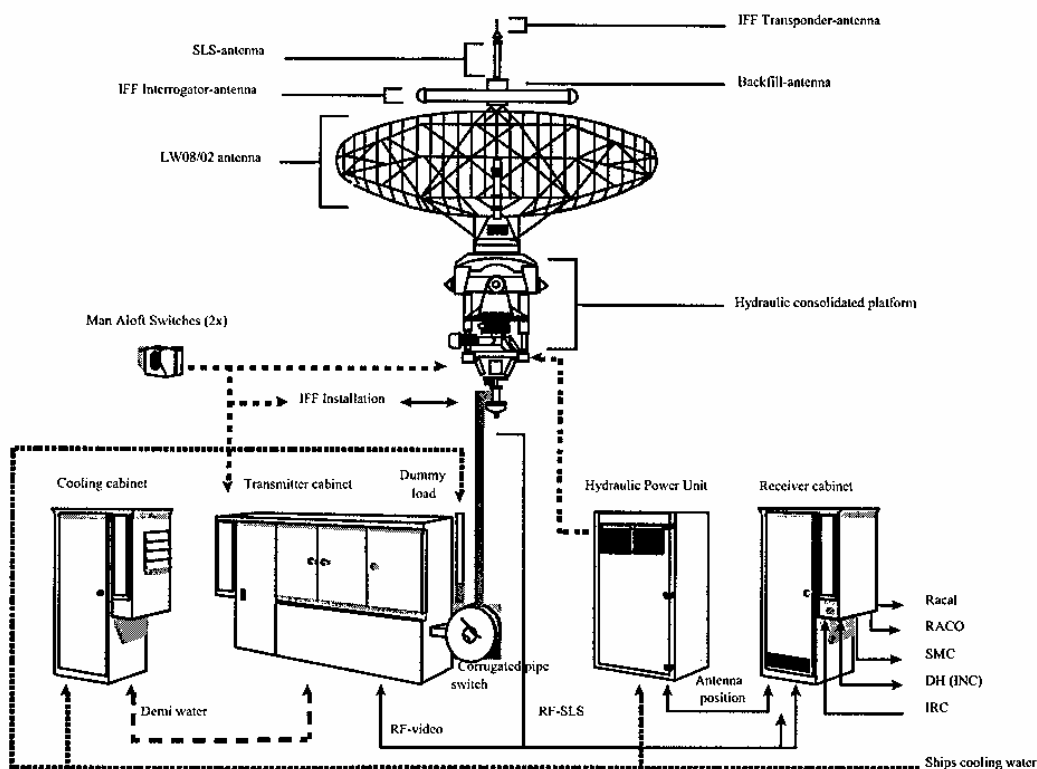


Fig.4110.1 LW-08/02LS radar

Antenna

The antenna consists of two parts, namely the LW-08 antenna itself, and the IFF antenna system mounted on top of it. The IFF antenna system will be described in the following chapter. The entire antenna is hydraulically stabilised against the pitch and roll movements of the ship. The antenna therefore remains upright in respect of the earth's surface. When the antenna remains upright, the bundle also remains upright. We therefore do not appear to alternate from being in the water to appearing in the air.

An electrical drive engine propels the antenna with a turning speed of 7.5 or 15 revs/min. The antenna is located at an angle above the hangar.

Hydraulic Power unit (HPU)

The HPU provides the necessary pressure to direct the antenna stabilisation. The HPU receives pitch and roll information from the Receiver cabinet from the IRC (Nautica subsystem). Using this information two hydraulic actuators (vacuums or pistons) are moved to maintain the antenna upright while the ship moves.

Transmitter cabinet

The Transmitter cabinet contains a D-band TWT transmitter, which amplifies the RF-signal (1.3 GHz) provided by the Receiver cabinet to a mean capacity of 5 kW.

The amplified signal runs through the wave guide to the antenna.

A wave guide switch has been introduced into the wave guide run, directly next to the Transmitter cabinet. This allows the transmission energy to be transmitted to a dummy load, rather than to the antenna.

Receiver cabinet

The Receiver cabinet contains three principal components:

- a Frequency Control and Timing Unit (FCTU);
- an Antenna Control Unit;
- a Receiver-rack with video processor.

The FCTU delivers the RF-signal for the transmitter with a specific PRF. In addition, the timing and synchronisation pulses are generated by this unit.

The ACU receives pitch and roll information from the IRC (Nautica subsystem). This information is transmitted on to the HPU for the antenna stabilisation.

The Receiver-rack contains three receiver channels which deliver the following analogue video:

- 'Surface' video;
- 'Air' video with MTI;
- 'Air' video without MTI (NON-MTI).

MTI (Moving Target Indication) means that the video which "is visible", is actually moving.

The analogue video from those channels goes to:

- SMC (Sensor Management Cabinet);
- RACO (RADAR CONverter);
- RACAL monitors on the bridge (only the Surface video).

There is also a serial interface (RS-422) to the Data handling system. This is employed to operate the LW-08 at a distance. The operation then ultimately takes place from a Data handling GOS-monitor. Local operating takes place at the cabinets.

Cooling cabinet

The LW-08 transmitter is cooled with demineralised water. This is a closed circuit which is cooled with ship's water by way of a temperature exchange.

The wave guide drier of the LW-08 wave guide run is also in this cabinet. The air in the wave guide is kept purified and dry in order to prevent sparking.

The LW-08 cabinets and any possible reserve TWT present are located in Radar hut 3.

Man-Aloft switches

This literally refers to the 'man in the mast' switches. These two switches are safety switches for the operator working on the antenna.

The transmitter high voltage, stabilisation and drive engine can be disconnected with each of these switches.

There is one switch in the drive engine in the space below the antenna. This space is reached via Radar hut3. The second switch is located outside near the antenna plates.

4120 IFF Mk-12 installation

Frigates of the Royal Netherlands Navy use the IFF Mk-12 installation, in order to distinguish between 'friendly' and "enemy" radar echoes.

The IFF is a secondary radar installation. That is to say, there is a need to us for equipment which can be interrogated, whereas the target requires equipment which can provide a response.

The system is interrogated using specific codes.

The target's equipment decodes these codes and will, if permitted, provide a response in code.

The response can be decoded and displayed on displays.

The interrogating unit is referred to as the Interrogator, the responder as the Transponder. Frigates are equipped with both, since we want to be able to interrogate the target ourselves before launching weapons and must be able to provide responses ourselves when interrogated.

4120.1 Interrogator installation

The Interrogator installation consists of (Fig.4120.1):

- a directional antenna;
- an Interrogator type AN/TPX-54;
- a Control box type C5441/TPX-54;
- a Decoder type AN/UPA-59A;
- an Alarm Monitor type BZ-173A;
- a cryptographical unit type KIR.

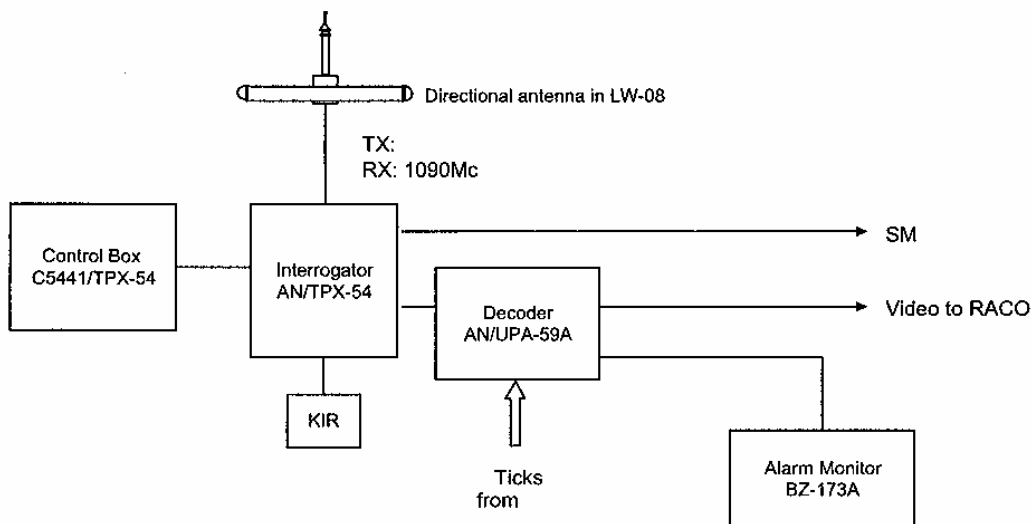


Fig.4120.1 IFF Interrogator installation

Interrogator antenna

The Interrogator antenna is located in the LW-08 antenna (Fig.4110.1). It is a directional antenna, in other words it performs directed transmissions. This is in the same direction in which the LW-08 is pointed. The principal task of the LW-08 is an air warning. IFF assists in this.

The antenna looks like a round horizontal beam.

Interrogator AN/TPX-54

The Interrogator consists of a transmitter and receiver.

The transmitter is able to transmit in 5 modes:

- Mode 1;
- Mode 2;
- Mode 3A;
- Mode C;
- Mode 4.

The first 3 modes provide identification to the target. Mode C provides information regarding the altitude of the target.

Mode 4 is a NATO cryptography code.

The decoded responses received are sent to the Decoder and to the SMC by the receiver.

It can be operated from a Data handling GOS or from the Decoder.

Control box

The Control box displays a number of signals from the Interrogator, for instance whether it is actually carrying out transmissions.

Decoder

The Decoder receives video from Interrogator. This video contains a code which is decoded by the Decoder and transmitted on to the RACO.

Video (ticks) originating from the SMC can be added to this. The latter ensures the proper working of the IFF video extractor in the SM. (The SMC will be described later in this handout).

Operating of the Interrogator can also occur from the Decoder. However, operating via a Data handling GOS is preferred.

Alarm Monitor

A number of codes which the Transponders can transmit have a special meaning. These are namely alarm signals. The Alarm Monitor is connected to the Decoder to ensure that this occurs loud and clear.

The Alarm Monitor contains three warning lights and a very loud claxon. In the event that the Decoder decodes an alarm it will activate the claxon and the relevant flashing warning lights.

The personnel on watch in the Command centre will then have to take specific measures.

KIR

The KIR is part of a cryptographically protected mode of the IFF, mode 4. IFF is applied world-wide in military and civil aircraft, including less friendly nation.

In order to ensure that a "friend" is truly a friend, we interrogate mode 4. The Interrogator, as well as the Transponder being interrogated must have the same code installed. Otherwise the Transponder cannot provide the correct response.

The KIR provides for the correct coding of the Interrogator.

4120.2 Transponder installation

The Transponder installation consists of (see Fig.4120.2):

- an Omni antenna;
- a Transponder type SIT-421T;
- a Control box type SIT-901;
- a cryptographical unit type KIT with alarm lamp.

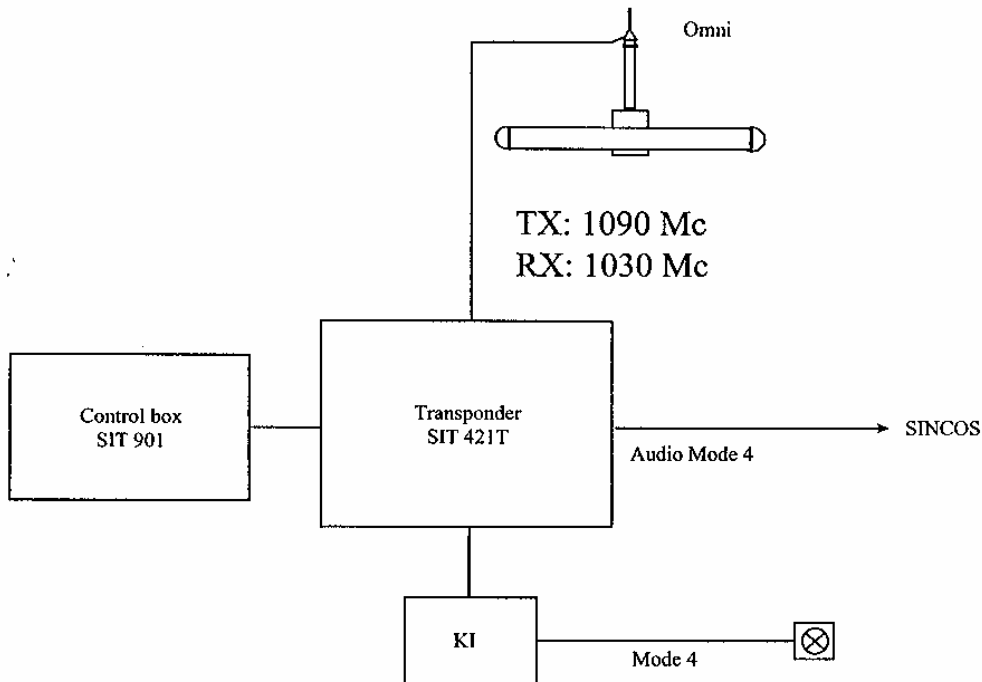


Fig. 4120.2 Transponder installation

Omni antenna

Transponder antenna is an omni antenna and is located above the LW-08 antenna. The omni must be sensitive since interrogations can arrive from any random direction.

Transponder

The Transponder consists of a receiver and transmitter. Once an interrogation has been received the Transponder investigates the interrogation mode. Should it appear that it is permitted to answer that mode, it will transmit a coded signal. The Transponder does not provide its own ship with any video. Its receiver is disconnected during transmissions from the onboard Interrogator. If the Transponder is not permitted to respond to a mode 4 interrogation, it will provide an audio alarm to the ship's communication system. At the same time a warning light is switched on via the KIT. The Transponder is operated from the Control box.

Control box

The Control box is used as the Transponder operating panel.

KIT

The KIT is to the Transponder, as the KIR is to the Interrogator, mode 4 settings. The Interrogator, Transponder, KIR and KIT are located in Radar hut 3. The antennae are mounted on the LW-08. Both Control boxes, Decoder and Mode 4 warning light are located in the Command center.

4130 VESTA Helicopter direction system

The Lynx helicopters of the Royal Netherlands Navy have a small radar reflecting surface and often operate at low altitudes above sea level. Radar energy that is bounced back from strong waves (called sea-clutter) is often as large as or even larger than the helicopter's radar echo.

Consequently the Air-controller cannot view the helicopter anymore on his display, because the small echo is being overshadowed by the larger one.

In order to solve this problem the Lynx helicopter is equipped with a VESTA transponder.

This transponder transmits a VHF signal if it is being targeted by a pulse radar with a frequency between 1 and 10 GHz. (see Fig.4130.1)

This VHF signal is received back by the VESTA receiver onboard the M-frigate. The signal is then converted to video and track information.

Video is displayed on the RACO and RMDU-display in the Command Center. The RACO provides for the display via the Data handling GOS-displays.

VESTA video looks like a fairly large square instead of the actual target.

Track information is calculated by the VESTA video extractor and sent on to the SMC.

The SMC sends those tracks to Datahandling Computer 1 or 2.

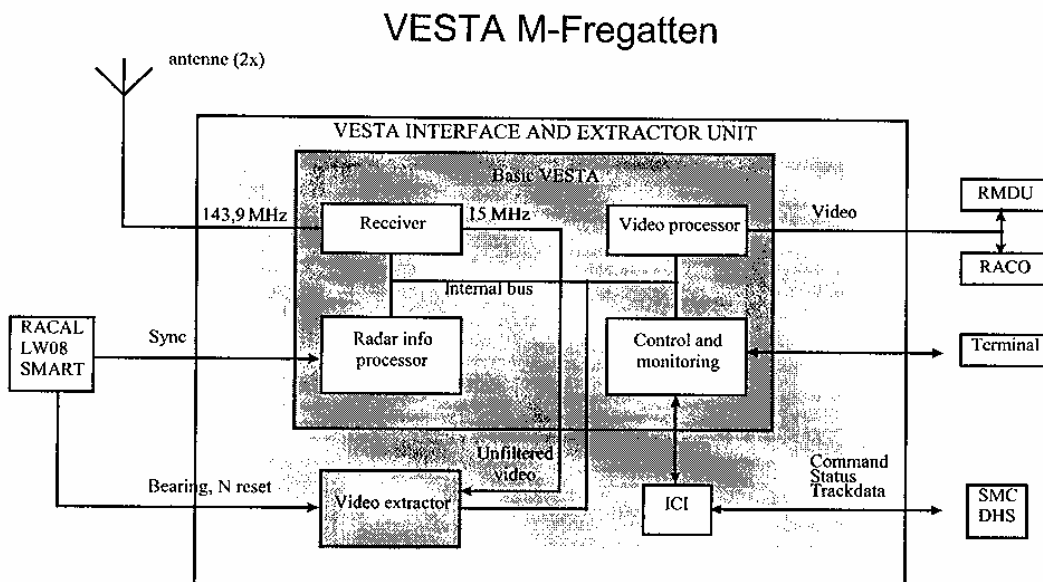


Fig.4130.1 VESTA helicopter direction system

The VESTA ship installation is operated via a GOS. The transponder component is operated by the pilot or TACCO in the helicopter.

The ship installation consists of:

- two telescopic VHF antennas with amplifiers;
- an Interface and Extractor Unit which includes the receiver.

The antennas are located in the fore mast, in both spars, and the Interface and Extractor unit in the Sewaco computer room-fore.

4140 SMART 3-D Radar

The SMART 3-D radar, or DA-08LS, is a medium range warning radar to be used for the following functions:

- target identification;
- target tracking with threat evaluation;
- air warning;
- sea warning;
- supporting targeting at sea, by "splash-spotting";
- target simulation during exercises.

In addition to range and distance information the SMART also provides the altitude of the target, hence the 3-D suffix.

The SMART installation consists of (see Fig.4140.1):

- an hydraulically stabilised antenna;
- an Hydraulic Power unit;
- a Transmitter cabinet;
- a Processing cabinet;
- two "man-aloft" switches;
- a wave guide drier.

Antenna

The antenna consists of a transmission and receiver component. The transmission component consists of an array and is located on the upper surface of the antenna. The receiver component is in the bottom part of the antenna.

The antenna is at a rear-facing angle (39°) in order to allow altitude measurement with the aid of 16 receiver arrays. The antenna is stabilised against the ship's pitch and roll movement. This is provided hydraulically.

The Bearing Drive is an electrical drive engine which turns the antenna at 27 revs/min.

The antenna is located in the fore mast.

Hydraulic Power unit (HPU)

This Hydraulic Power Unit also provides the necessary pressure to control the stabilisation. The HPU receives pitch and roll information from the Nautica subsystem (IRC) via the Processing cabinet.

Transmitter cabinet

The Transmitter cabinet contains an F-band TWT transmitter, which amplifies the RF-signal (approx. 3 GHz) from the Processing cabinet to a mean capacity of 3.2 kW. The RF-signal travels to the transmission array through the wave guide run.

There is also a wave guide switch in the Transmitter cabinet, just as there is in the LW-08. This allows a dummy-load to be selected, rather than the transmission array.

Processing cabinet

The Processing cabinet contains a unit, the FCTU, which generates the RF-signal for the Transmitter. The remaining circuits in the Processing cabinet process the signals from the 16 receivers in the antenna.

From the range, distance and elevation data, the course, speed and altitude are calculated for detected targets. This continuous process is referred to as "tracking". In order to carry out this process the SMART is provided with its own 'PLOT'- and 'TRACK'-computer (both are SMR-4 computers). This digital "track" information is sent to the Data handling subsystem by the 'Track'-computer, via the triple Ethernet databus.

The (analogue) radar video belonging to the track information takes a different path. That is the video goes to the RACO. The RACO produces a digital video of this and redirects to

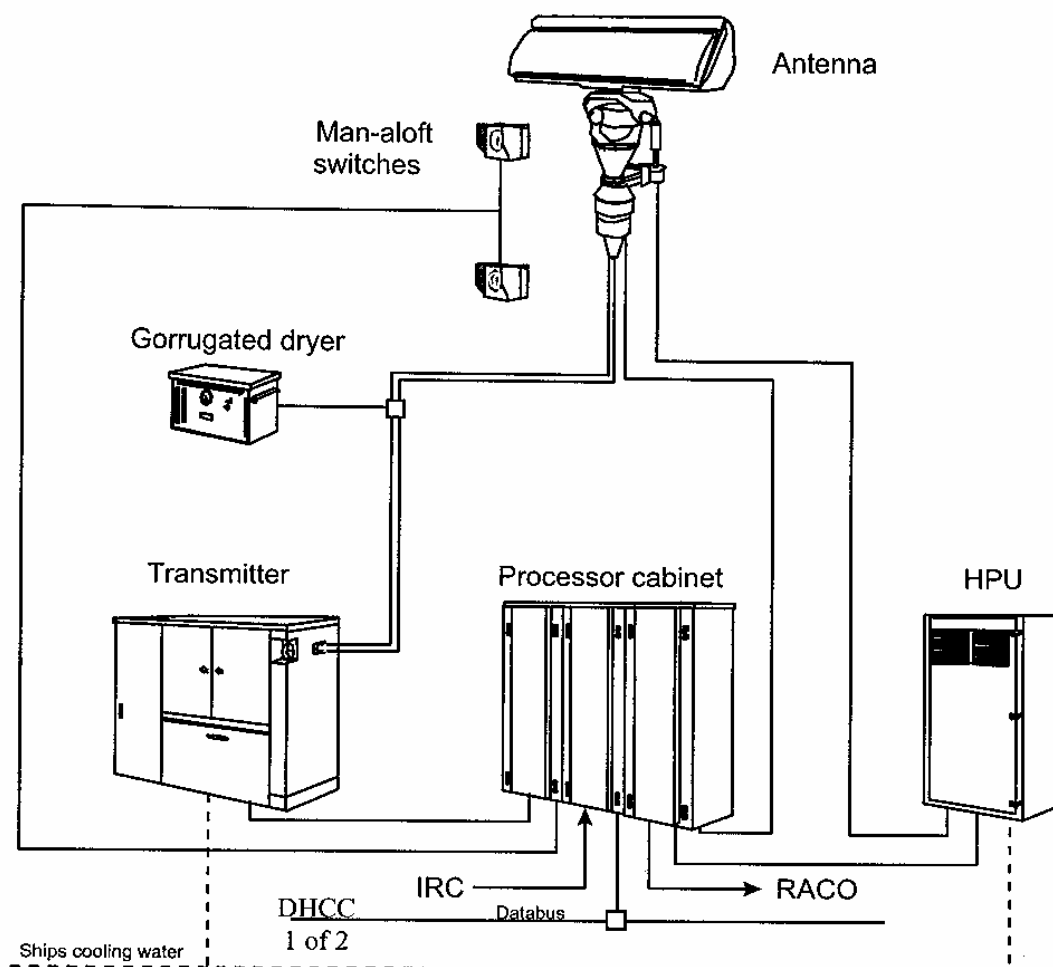


Fig.4140.1 SMART 3-D radar

the triple Ethernet databus. This digital video is then displayed on the GOS-monitors which are used for Data handling monitors.

Operating the SMART can occur locally at the Transmitter and Processing cabinet, this is referred to as the LOCAL mode. However, operating can also take place from the Command center, which is referred to as REMOTE-operation. Operating occurs via a Data handling GOS. These commands also arrive in the Processing cabinet via the triple Ethernet databus.

Ship's velocity, pitch and roll information originating from the Nautica subsystem also arrive in the Processing cabinet.

The HPU, Transmitter, as well as the Processing cabinet are located in Radar hut 1.

Man-aloft switches

These two safety switches are respectively located in the fore mast in the entrance to the antenna and in the space near the Bearing Drive (directly under the antenna).

These are switches which disconnect the transmitter, the antenna stabilisation and drive engine, before the antenna can be approached.

Wave guide drier

The SMART, as well as the RACAL-radar wave guide run are dried by the wave guide drier of the SMART. The wave guide drier is also located in Radar hut 1.

4150 Datalink installation (LINK 11)

The purpose of the Link 11 - installation is the exchange of tactical data, such as system tracks between the various automated units (ships, aircraft, etc.) across a UHF or an HF connection.

One of the components of the linknet functions as the Net Control Station (NCS), the other as the Net Picket Station (NPS).

Operational modes:	Roll Call (RC)	NCS interrogates all pickets.
	Broadcast (BC)	1 unit transmits, the others just receive
Technical modes:	Short BC (SBC)	Should pickets have data they then transmit this
	Netsync	Sending preambles (synchronising)
	Nettest	Controlling link connection (± 2 min)

The Link 11 -installation is linked to a transmitter and receiver (via FOCON) and to Data Handling.

The Link 11 -installation consists of the following components:

- Data Terminal Set
- Data Terminal Set Control
- Cryptography unit KG 40/Remote Control KG 40

Data Terminal Set

The Data Terminal Set (DTS) converts the digital Data Handling information to a composite audio signal that is sent to a transmitter.

For CLEW (Conventional Link Eleven Waveform) the audio signal consists of 16 different frequencies, which are modulated in each phase. HF transmission is in two side bands, UHF is FM

For SLEW (Single Link Eleven Waveform) the audio signal consists of 2 frequencies. HF transmission is in 1 side band, UHF is FM.

In reverse, the signal received is converted to digital information for Data Handling.

The Data Terminal Set Control (DTSC) is the operating unit for the DTS and is located in the Command Center.

The DTSC also provides status signals and error codes from the link connection, in addition one is able to see which pickets are in the network from the window.

Cryptography unit KG 40

The KG 40 is a cryptography apparatus that is used to encipher the link 11 data. The KG 40 is operated via a Remote Control from the Command Center. The KG 40 recognises five modes:

- Mode A1, in this mode the KG 40 generates, the MIF (Message Indicator Frame), in the transmission circuit, preceding the data segment. The KG 40, in receiver circuit, has to receive the MIF without errors in order to transmit the following data segment to Data Handling.
- Mode A2, this mode is the same as mode A1. However, the receiving KG 40 is now able to receive the MIF with an odd-number of errors.
- Mode B, no MIF is used in this mode. Instead each KG 40 is automatically setup for a known pattern in the key register at the beginning of each transmission.
- Mode PLAINTEXT, in this mode the other KG 40 functions are avoided. The KG 40 simply transmits all information to Data Handling without enciphering or deciphering it.
- Mode POFA (Performance Operational Functional Analysis), this mode cannot be performed onboard the M-frigates.

The standard setting during operational use of the Link 11 is mode A2. When sailing in "close formation" or if the ship is moored in harbour use can be made of mode A1.

Integration in the central system

The Link 11 -installation (see figure 1-2315-4) is connected to:

- Interface Computer in the Data Handling Computer Cabinet 1. This computer receives/transmits data to the Link 11 -installation.
- BACs in the FOCON network. The DTS can be connected to the UHF or HF transmitter and receiver via the FOCON. In addition, the link 11 in the FOCON-bypass is directly linked to XCVR 3 (U H F) or the Rx 1 /Tx 1 (HF). The external reception tracks are presented on a GOS.

4200 Construction of the sea image

The command requires a clear picture of the water surface surrounding the ship. This picture will help to determine whether surface targets need to be engaged, this is called Anti-Surface Warfare (ASuW). This 'engagement' could mean attacking a target with weapons or simply that it should be detained for investigations (peace operations).

Use is made of various systems in order to construct the sea image. The navigation radar system is one of those. The SCOUT is an option which in principle is only used for TACTAS operations. EOVS equipment and our own eyes are the "passive" components.

The sea image can be constructed with the use of the Link-11 datalink system, similar to the air image.

The navigation radar is partly an ON-LINE radar system, that is to say its image is directly processed in the system by the Radar Converter (RACO) into a digital image. This image can be displayed through the Datahandling GOS-displays. Operating the radar however can only take place from the RACAL service cabinets.

As well as going to the RACO and RACAL image cabinets, the video from the navigation radar system also travels to the Sensor Management Cabinet (SMC).

In the SMC the video is used to calculate surface targets' tracks

The SCOUT radar is an OFF-LINE radar system. The image from this system can only be viewed on the bridge monitor.

The EOVS equipment also provides range and information of active radars.

Detected targets can be identified visually. Visual identification is also possible from the onboard helicopter.

This information can be inputted manually into the SEWACO-7 system.

This ship's active sensors are only able to detect surface targets within horizon range (due to the curvature of the earth's surface). Information regarding targets which are not visible can be provided by the Link-11. Information regarding targets detected by the ship can also be provided to others with the Link-11.

The RACAL navigation radar system and the SCOUT radar will be discussed in the following paragraphs.

4210 RACAL Navigation Radar system

The RACAL Navigation radar system is a commercially produced system which is used for:

- sea warning;
- navigation;
- helicopter direction.

This civilian radar has been purchased for its 'commercial radar' characteristics. An enemy will not be able to identify this radar as easily as a military radar with its ESM equipment.

The RACAL system consists of (see Fig.4210.1):

- a non-stabilised antenna;
- a Transceiver (transmitter/receiver);
- a monitor subsystem;
- various interface- and set-up cabinets.

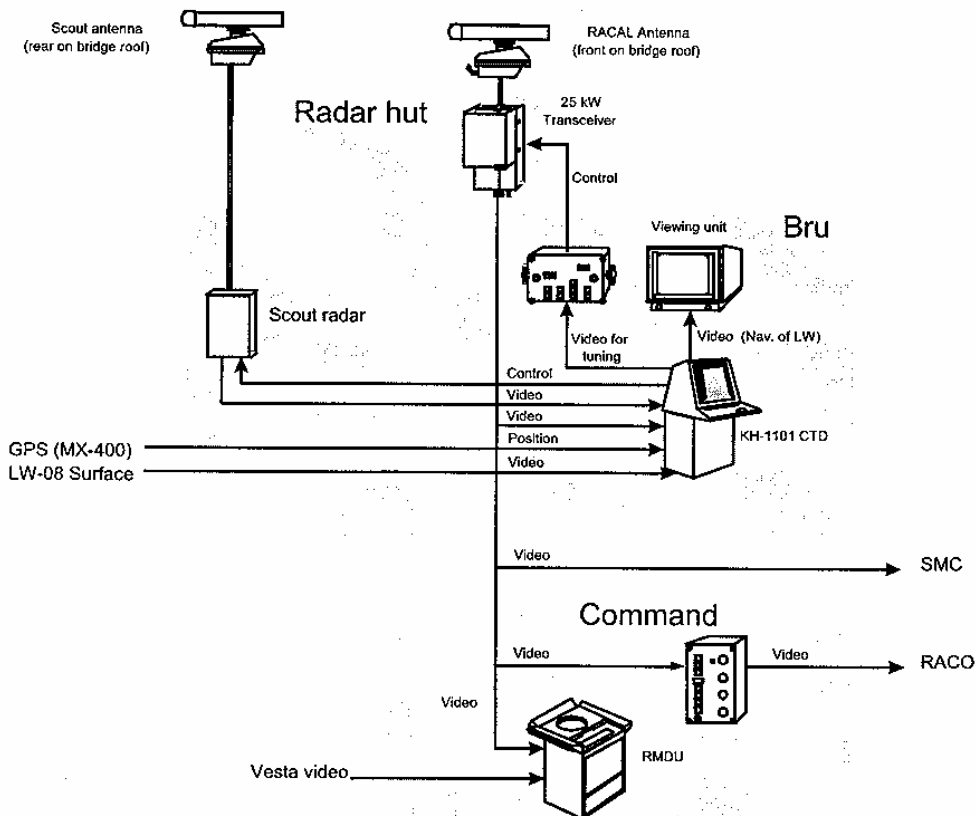


Fig.4210.1 RACAL Navigation radar system

Antenna

The RACAL navigation radar antenna, RACAL for short, is not stabilised unlike the LW-08 and SMART antenna.

It has a rotating speed of 23 revs/min. driven by an electric drive motor.

The RACAL antenna is located in front of the SCOUT antenna on the roof the bridge.

Transceiver

The Transceiver consists of an I-band magnetron transmitter and receiver with a logarithmic amplifier.

The Transceiver transmits with a peak capacity of 25 kW.

The receiver sends the logarithmically amplified video to the RACAL monitor subsystem, the Radar Converter (RACO) for display on the Datahandling GOS-displays and to the Sensor Management Cabinet (SMC).

Operating the Transceiver takes place from the Remote Control unit near the ARPA monitor on the bridge.

The Transceiver is located in Radar hut 1.

The wave guide run is dried by the SMART wave guide drier.

Monitor subsystem

This subsystem consists of three monitors, of which one is in the Command Center and two on the bridge.

RMDU monitor (Command Center)

This is a RACAL monitor which can only display RACAL navigation radar and VESTA-video. It is only able to produce a 'Relative Motion' image. Relative motion means that the ship remains at the centre of the screen. All echoes surrounding it, including those from land, move in respect of the ship. RMDU means Relative Motion Display Unit.

The RMDU monitor is intended as a backup system for the Air-Controller. Should the triple Ethernet databus fail, leading to the GOS-displays not functioning, it is still possible to return the helicopter safely to the deck using this system.

ARPA monitor (bridge)

The M-frigates are equipped with a Kelvin-Hughes KH-1101 ARPA monitor.

The KH-1101 has the capacity to display four different radar images, the Automatic Radar Plotting Aid.

The RACAL, SCOUT and LW08 (surface) are linked.

Viewing Unit (bridge)

The Viewing unit is a small RACAL colour monitor at the commander's disposal with its own operating capacity. The unit is mounted in the navigation console on the bridge.

Only the LW08 (surface) or RACAL video can be selected.

Interface- and set-up cabinets

Both the RACAL and Kelvin-Hughes equipment are commercially produced installations. In order to integrate those cabinets with the SEWACO-7 system modifications were required regarding signal levels and other similar aspects. Therefore various interface and set-up cabinets have been adapted.

4220 Scout FMCW radar

The Scout is an FMCW radar installed onboard all frigates and ATS. SCOUT is an acronym for: Signal COvertly Undetectable Transmitter.

The SCOUT was selected because it is difficult to detect by EOVS equipment, due to its low transmission capacity, which is desirable during TACTAS operations.

The SCOUT is permanently attached to the KH-1101 monitor on the navigation bridge. The SCOUT can only be operated via this monitor and SCOUT video can only be presented on this monitor.

Configuration

For primary radars can be attached to each KH-1101 monitor. In addition, 3 secondary radar installations can be connected. The LW-08, ZW-06, 3D, the DECCA 3cm and DECCA 10 cm are included as primary radars. Secondary radars are for instance the IFF and the VESTA. The configuration for the M-frigates is shown in the figure below.

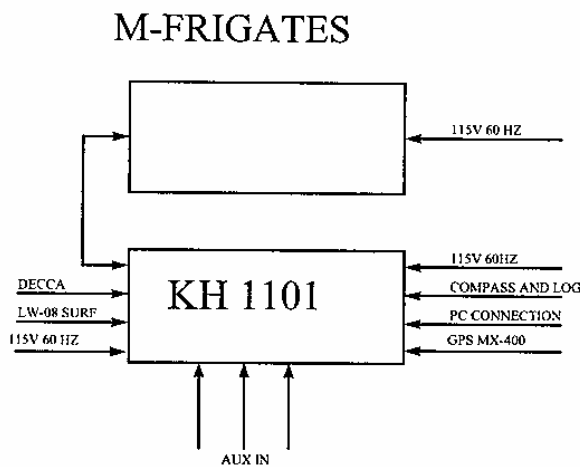


Fig.4220.1 SCOUT Diagram

From the diagram it can be seen that as well as radar information, information is also entered from the log, compass and the GPS. There is also a possibility to connect a PC to the KH-1101 monitor in order to carry out tests with the Odyssey program and to store the charts created by the KH1101.

There are no secondary radars attached on the frigates.

All operating facilities occur via the KH-1101 monitor.

The distance range, transmission capacity and transmission frequencies and the STC desired can be selected here.

In order to set this up the "RUN" menu must be selected. In the "RUN" menu select "SELECT RADAR", "RADAR 1" and now the setup can be altered.

One can choose two different frequencies for the transmission frequency in order to prevent interference with another Scout unit.

The SCOUT consists of 3 principal components: Antenna system, processor unit and the power box.

The position of the processor unit and powerbox is dependent on the type of ship. The antenna is installed on all frigates, behind the RACAL antenna, on the roof of the bridge.

The feed voltage of the Scout is 115V/60Hz. 1~. This voltage goes across the processor and powerbox. The ship's voltage is converted in the processor to various direct currents and distributed from the processor across the installation.

The powerbox is a transformer, provided for backup, which converts the 115V/60Hz.1~ to 24V= for the bearing motor in the drive assembly.

4300 Sensor Management Cabinet (SMC)

The video extractor subsystem, referred to as SMC, receives radar video from the LW-08, RACAL navigation radar and IFF Interrogator installation (see Fig.4300.1). Tracks are calculated for the detected echoes ('plots') using this information. Only 'plot-messages' are created from the IFF plots, no tracks.

The VESTA installation processes VESTA-video in a similar way and provides the track information calculated to the SMC.

All of these track and IFF plot-messages are modified by the Datahandling Computer 1 or 2 into 'system-tracks'.

The SMC consists of four video extractors and two extractor computers. The SMC is mounted in one cabinet and is setup in the Sewaco Computer room-fore.

N.B. Track information only contains **data** regarding targets (speed, course, etc.), **no video**.

Finally the operator sees the track information displayed on the GOS-displays. The video visible 'on' the track system originates from the RACO!

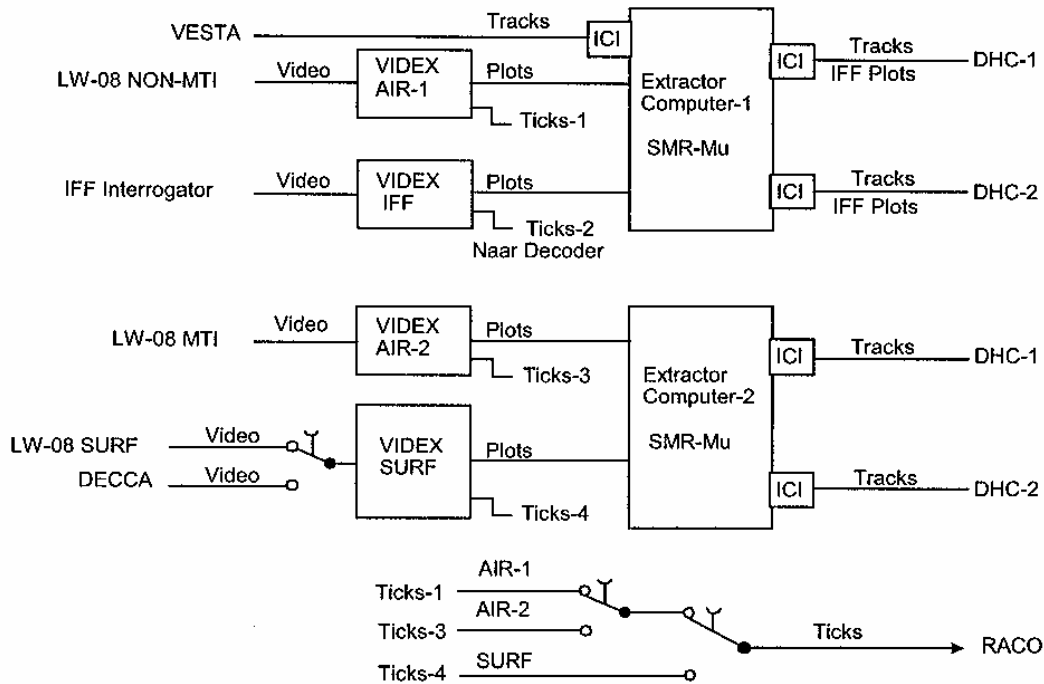


Fig.4300.1 Sensor Management Cabinet

Extractors

The video extractors convert the video to 'plots'. Plots are real targets, therefore no white noise or disturbance.

The conversion of the video into plots occurs in separate steps. In order to control each step the processed video can be split. This processed video, called 'ticks', is then sent on to the Radar Converter (RACO) or IFF Decoder.

The RACO displays the ticks on the Datahandling GOS-displays. During operational use visible 'ticks' are not desirable, and are therefore disconnected from the SMC.

Two extractors, VIDEX AIR-1 and AIR-2, are used for air targets. These two are provided with LW-08 NON-MTI and LW-08 MTI video respectively.

One extractor, VIDEX SURF, is used for sea targets. This extractor is provided with LW-08 Surface video or RACAL navigation radar video. This selection is made on the SMC by a switch.

The fourth extractor, VIDEX-IFF, is used for IFF Responses (replies). For this the VEX is provided with an IFF Interrogator video. With the use of this video the VEX-IFF detects which code has been received, the position of the video (plot) and delivers this information to the Extractor Computer-1. As well as video, each video extractor requires information regarding the status of the radar antenna (Brn) and a sync pulse for the radar transmitter concerned.

The VIDEX-IFF receives these signals from the LW-08 because the IFF Interrogator antenna is located in the LW-08 antenna and the Interrogator transmitter is synchronised by the LW-08.

Extractor computers

The two extractor computers (SMR-Mu's) use plot information to determine how a target is moving. This is how course and speed of a target can be calculated. This is referred to as a "track".

Extractor computer 1 also receives track information from the VESTA helicopter direction system. All of these tracks and the IFF plot messages are sent to Datahandling Computer 1 or 2.

4400 Radar Converter (RACO)

The RACO is a device which transforms analogue videos, originating as well from primary as from secondary radars, into digital video. This digital video is then, via the databus Ethernet, shown to all Data handling GOS-displays.

However, there are a few limitations to the RACO:

- It can only transform maximum 2 primary radars at any one time;
- It can only generate 3 distance calculations per primary radar.

This means that on an operational level, the Command Centre will have to be satisfied with the image of maximum two primary radars at the same time. Thus, the various GOS-displays will not be able to show videos of three primary radars.

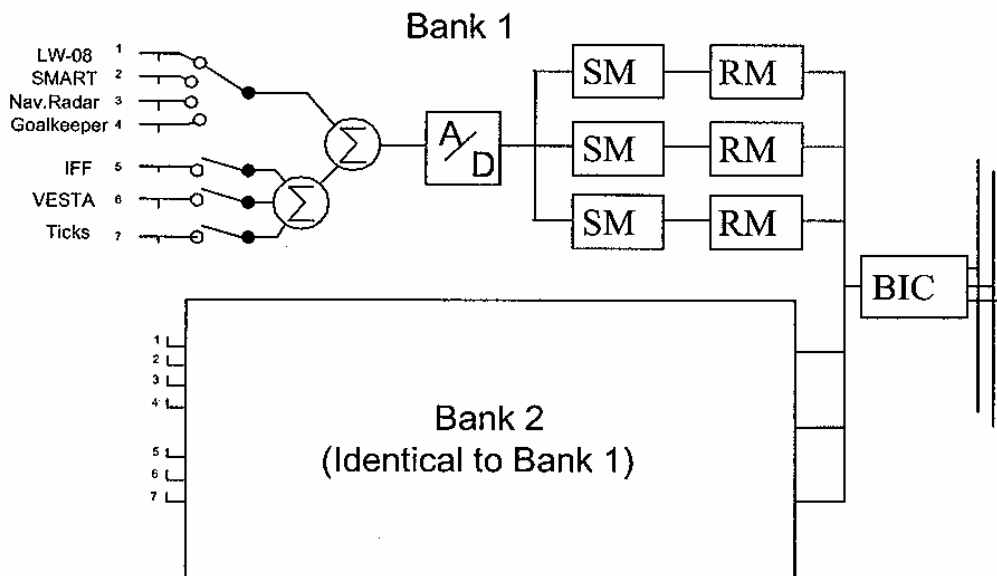


Fig.4400.1 RACO

To show these two radars, the RACO is disposed over two identical banks. For a video of a primary radar, maximum three secondary videos can be added via summators (S). The primary radars are:

- LW-08;
- SMART;
- Navigation radar (Decca);
- Goalkeeper.

The secondary radars are:

- IFF;
- Vesta;
- Ticks (originating with SMC).

The complete video for one bank will be transformed from analogue to digital. After this, it will be entered into three Sweep Memories (SM). For each SM, a distance calculation is programmed. Each sweep is then stored in a Radar Image Memory (RIM). Each RIM includes a complete radar image, which is then attuned for a chosen distance range.

Thus, in total, there are six radar images accessible of a maximum of two primary radars.

The content of each RIM is entered on the Triple databus Ethernet by BICL. Every Data Handling GOS-display can show the radar video put forward by RACO.

The control of the RACO occurs through GOS Data Handling.

RACO is, together with the Data handling computer-2, established in one office, which is situated at the back of the Sewaco computer space.

4500 Reconstruction of under water image

One of the KM's major missions is to act as a submarine defense system in Anti-submarine Warfare (ASW). To be able to effectively apply this, we build an image of everything beneath the water surface. This can also be done in an active or passive way.

One of our underwater sensors, the PHS-36 Hull Mounted Sonar, can detect active as well as passive targets. The other sensor, the Anaconda Long Range Sonar or TACTAS, can only detect passive targets.

. The presentation of the image occurs on the GOS-displays, which are logged in as ASW-displays.

When locating underwater targets, we also have to deal with the propagation of underwater signals (see fig. 4500.1). Sound waves change direction as the velocity of sound is not wholly the same everywhere under water. The sensor picks up the path of least resistance. This velocity is influenced by a certain amount of factors:

- Water temperature;
- Average salt contents for 35 % seawater
- Pressure

With the help of surface and depth thermographs, we can calculate the water temperature on various depths. With the help of another type of probe (XSV), we can instantly measure the sound velocity. The sound velocity in water is an average of 1490 m/s.

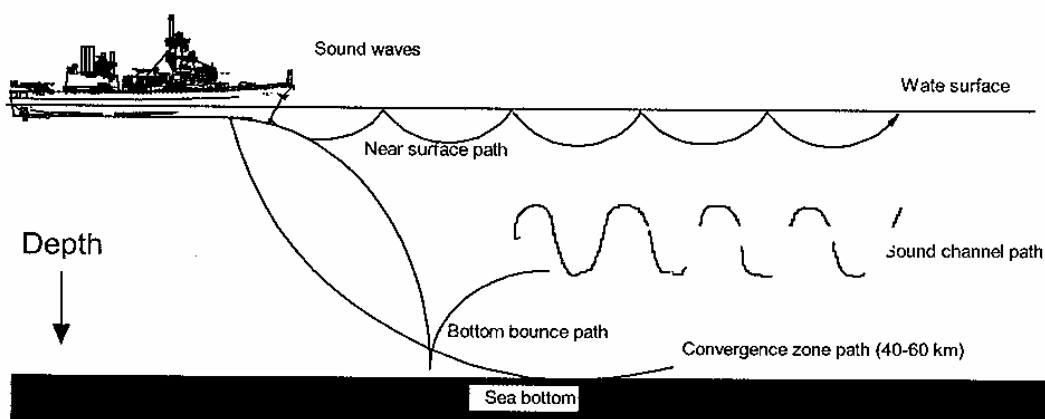


Fig.4500.1 Propagation

When there is a negative velocity gradient, the beams will bend downwards. When there is a positive velocity gradient, the beams will bend upwards. When there is an isotherm velocity gradient, temperature remains the same for greater depths.

When the weather conditions are poor and/or there is a poor bottom profile, it is advisable to choose a shorter pulsation length or a smaller beam. Switching to FM is one possibility, although the Doppler determination will be harder.

In ASF, there are various combined prop-loss programs.

Almost (laptop)	deep water
Moccasin	shallow water, active
Hodgson	deep water, passive, variable bottom
Supersnap	shallow water, low frequency
Sertes	ray-trace program

4510 PHS-36 Hull Mounted Sonar

The PHS-36 or HMS is a sonar which can be used actively as well as passively to detect submarines. It is a research and attack sonar which is integrated in the SEWACO-7 system. The PHS-36 can:

- detect active targets (with a Doppler between -40 and +40 knots);
 - automatically track appointed targets;
 - pinpoint passive objects;
 - analyze passive "noise" for classification.
- 'Noise' is all aspects of the sea sounds, such as sea-life, propeller sound and so on.

The PHS-36 installation consists of (see Fig.4510.1):

- Sonar Processing Cabinet;
- Sonar Transmitting Cabinet;
- Energy Storage cabinet;
- Mode Switch Unit;
- Transducer met junction box.

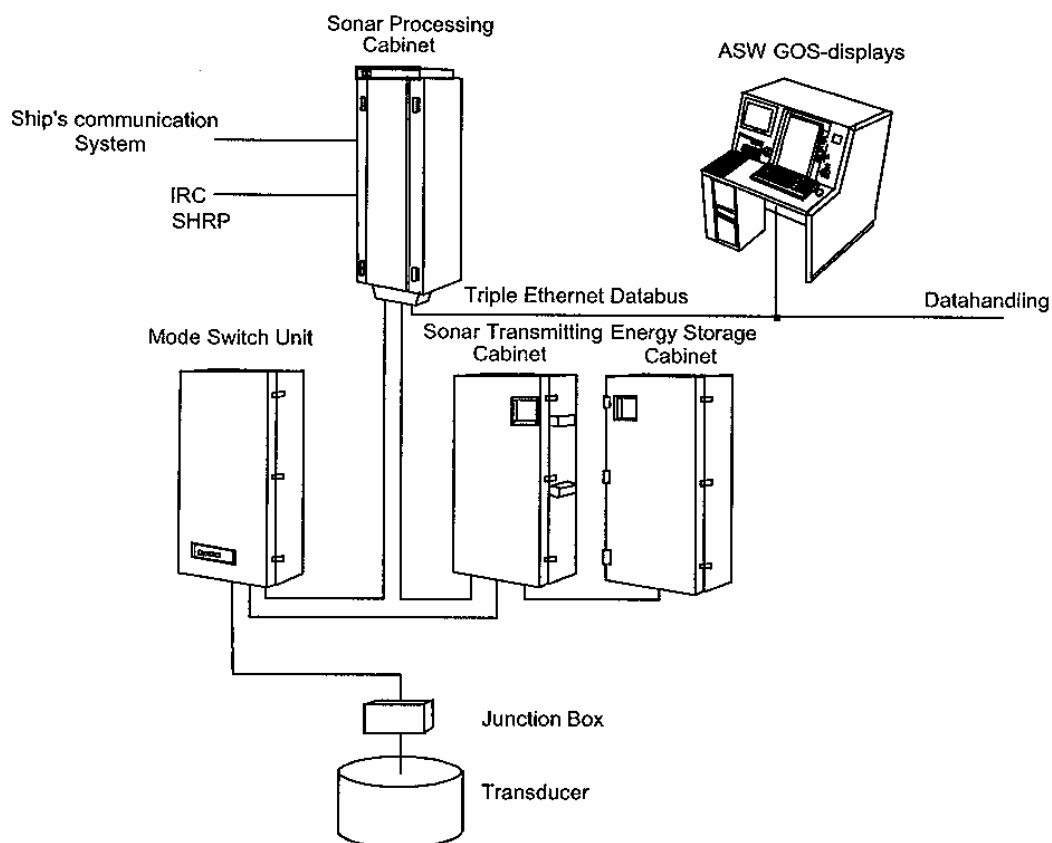


Fig.4510.1 PHS-36 Hull Mounted Sonar

Sonar Processing Cabinet (SPC)

The SPC has a number of tasks in this system:

- running the PHS-36;
- interface with remaining ship systems;
- processing the sonar received data;
- predict maximum range;
- offering testing and exercise facilities.
- 'Recording and replay' function, through an in-built WDD (hard disk drive).

The control of the sonar occurs operationally from the ASW GOS-display's (via databus).

Adjustments can be done regarding:

- Active/passive choice;
- Range;
- Transmitting frequency;
- Pulsation lengths and types (FM and/or CW);
- Omni/directional transmissions;
- Vertical beam (Narrow or Wide Beam).

The SPC receives information from the IRC, with regards to ship velocity, course, semi-rotary motion and pitching motion.

Sonar Transmitting Cabinet (STX)

The STX contains the circuits with regards to:

- Transmission control;
- generating the transmission pulse;
- controlling the transmitter beam (NB or WB);
- 'local energy storage'.

The two transmission frequencies are in the audio-frequency section, this is 6,5 of 7,5 kHz.

Various pulse lengths are possible, even combined with FM and CW pulses. However, the total combined pulse length can never last longer than 900 msec.

Energy Storage Cabinet (ESC)

If the transmission pulses through the sonar would last too long, the ship's feeding would be overstrained. To avoid this, the ESC is applied. This cabinet contains 95% of condensers. The energy for the transmission pulse is stored within during the emission periods and the transmission releases of transmission pulses.

Mode Switch Unit

This unit contains the circuits for:

- Switch from send to receive;
- Transducer adaptation to the transmitter;
- Transducer adaptation to the receiver;
- Switching between Narrow and Wide Beam.

Transducer and junction box

A transducer is simply an underwater antenna.

The transducer has to be able to emit and receive sound signals.

The operation is based on the piezo-electric principal with crystals. When connecting a pressure to a crystal, it will change. This change can be compared with a speaker. A sound signal appears. Through the direct reverberation and sound against the dome and the transfer to seawater, a specific "ping" will occur.

The reception of sounds can be compared to a microphone. The receiver is again like the crystal. As the sound forms the crystal, a pressure appears; the reception signal. The PHS-36 transducer consists of 32 rods, which in turn consist of 6 ceramic (as an alternative to crystals) elements.

The junction box consists of all the connections between the transducer and the Mode Switch Unit.

The transducer can be found in the bow dome, the junction box in the space above. All other cabinets can be found in the OB instrument space I.

4520 Anaconda Long Range Sonar

The Anaconda Long Range Sonar, or TACTAS, is a system which can detect totally passive submarines.

Simply stated, the system works as follows:

An M-frigate tows a long string of low frequency sensible hydrophones. These hydrophones are encased in a flexible synthetic hose, with a neutral floating capacity. We call this the 'array' (see Fig.4520.1).

This hose in its turn is then attached to an extremely long cable, in this way, the hydrophones are outside the self-noise zone of the ship.

This sonar provides, by means of beam techniques, a beam pattern, in which each individual beam is concentrically lying around the hart line of the array.

The beam in the middle is a disk, which is lying right across the length direction of the array. As we deviate further from the middle gauge, the beams will transform into hollow cones.

These beams are to detect low frequency sounds, which are emitted by a submarine (thus the detection of the submarine).

The sound we detect originates by for example propeller sound, machine sounds (cooling pumps of nuclear reactors) and such.

The propagation of the sounds is very important. At the correct towing speed and in good conditions, the detection can reach up to 70 miles without exception.

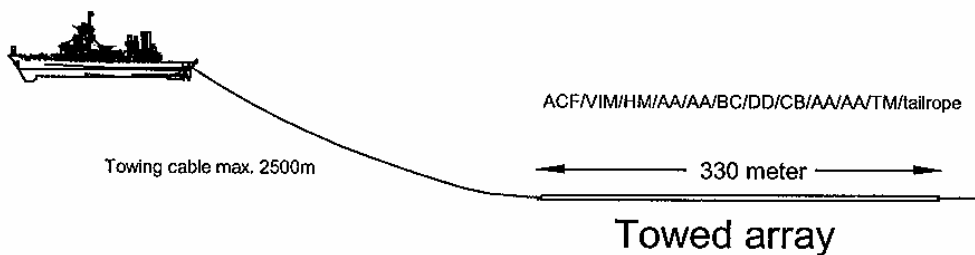


Fig.4520.1 Towed array sonar

The Anaconda Long Range Sonar consists of the following units (see Fig.4520.2):

- The array;
- The winch;
- The Operator Control Station;
- The Terminal Unit;
- The Signal Processing Unit
- The Pegasus Cassette Recorder;
- Two Hardcopy Recorders.

Array

The array has a length of 330 meter and a thickness of 8 cm. It contains 3 hydrophone groups

- Group 1 consists of 4 x 32 hydrophones;
- Group 2 consists of 2 x 48 hydrophones;
- Group 3 consists of 1 x 46 hydrophones.

Each group covers a certain frequency zone.

Each hydrophone module converts the received analogue signal into a digital signal. The temperature and pressure meters present within the hose also give of a digital signal. All these signals are sent through one transmission line incorporated in the towing cable to the Terminal Unit. At the beginning and end (head- and tail module) of the array, there is a compass and a photometer. These determine if the array is lying straight in the water.

Winch and Operator Control Station

The hydraulic winch is used to haul out and bring the array back in. On this winch, there is a cable of 2500 meter long and a thickness of 2,5 cm.

The winch is controlled by the Operator Control Station.

The depth where the array will be depends on the cable length hauled out and the speed of the ship. As much the array as the winch with OCS can be found in the TACTAS-winch room on the quarter-deck.

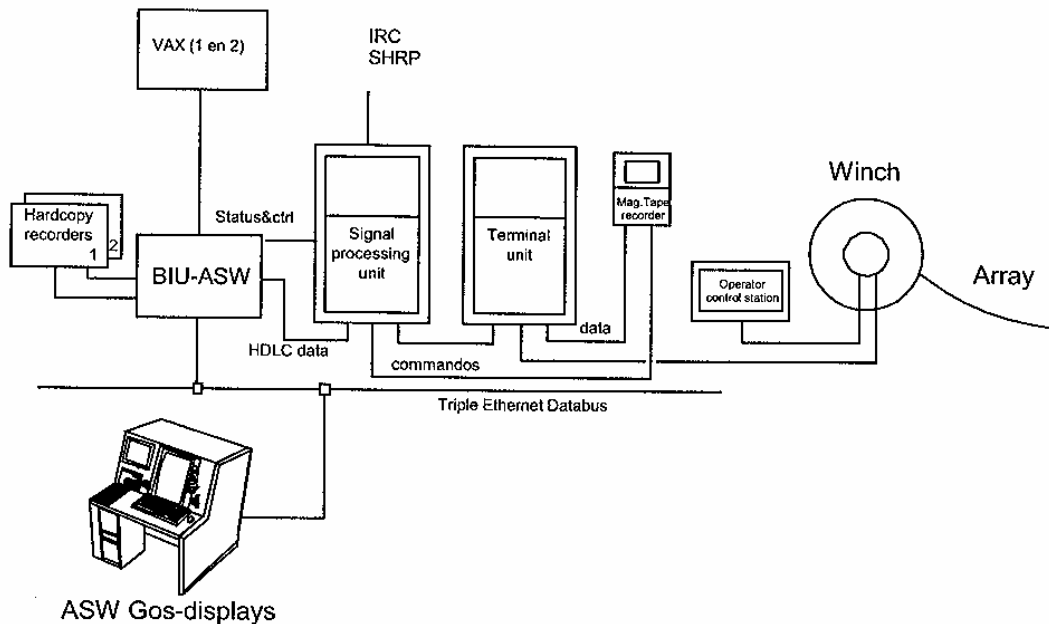


Fig.4520.2 Anaconda Long Range Sonar

Terminal Unit

The Terminal Unit is the interface between the array and the Signal Processor.

The Terminal Unit provides:

- The array power supply (300V, 2A);
- Off-line testing of the array;
- Filtering of the digital data, this is sent together with the feeding voltage;
- Splitting of the received data in data for signal processing and array-parameters (heading, depth and temperature);
- Interfacing with the 'Pegasus' recorder.

Signal Processing Unit

The function of the Signal Processing Unit is:

- Sonar signal processing and tracking;
- Sonar status and Control Management;
- Interfacing with the Data handling system (BIU).

The processed track data is inserted in the Triple Ethernet Databus via the Bus Interface Unit, to be showed on GOS-displays and for further processing by the Data handling system.

'Pegasus' data recorder

The storing capacity is of 270 Gbit per tape. Pegasus does not suffice any longer, and there is a research occurring to replace it by a harddisk or a Sony DTF tape drive or solid-state flash.

Hardcopy Recorders

Two hardcopy recorders are connected to the BIU. The recorders provide a hardcopy of the processed sonar data for the later analyze (hardcopy = paper print). The recorders can be found in the Command Center at the starboard side.

4530 OB peripheral device

With OB-peripheral device we understand:

- NIXIE torpedo deception system;
- EMATT MK39, Expendable Mobile ASW Training Target;
- Expendable bathythermograph XBT/XSV PRS-02/01;
- Recorder Sea Surface Temperature RSST-2013;
- Underwater telephone UT-2000.

NIXIE

The NIXIE installation is an OFF-LINE system which is used to mislead acoustic homing torpedoes. Thus the NIXIE is a soft-kill underwater weapon system. Many types of torpedoes use the sound of a ship (propeller sounds, etc) to "home" onto; these torpedoes are called "acoustic homing torpedoes". To mislead such torpedoes, we have to provide something which makes more noise than the ship. This happens with the NIXIE.

NIXIE consists of:

- Two 'towed bodies';
- One winch;
- One Transmitter box;
- One operating box.

The two towed bodies, where only one is used at any time, are the "rioters". They contain three ceramic transducers which are controlled by the Transmitter. The body is towed on the cable behind the ship. The body is energized through a winch. On both spools of the winch there are 1600 foot long cables on which a body has been fastened.

The minimum length is 150 foot, the maximum length 1500 foot.

The winch attached to the bodies is in the NIXIE-winch room on the quarter-deck. The Transmitter is controlled from the control box in the Command Center. The NIXIE can operate in various modes.

EMATT MK39, Expendable Mobile ASW Training Target

The EMATT is an expendable sonar simulator which can be put in the water by ship or plane and helicopter for fighting the submarine. The EMATT conducts a specific navigation program under water and simulates a submarine on the move. When the program is finished, the EMATT sinks to the sea bottom and will disintegrate after a certain time.

The EMATT is simultaneously detectable by:

- Hull mounted sonars (active and passive).
- Towed array sonars.
- Sonar buoys (active and passive).
- Dipping sonars (active and passive).
- Active targeting MK46 torpedoes.
- Airplanes with MAD detection possibilities

When the EMATT operates in the MAD (Magnetic Anomaly Detection) mode, a magnetic field is created, for which the size corresponds to the size of the magnetic field of a submarine. The EMATT can work through 6 different programs, for which the first three work in MAD mode.

Velocity	: 8 knots nominal, 7 knots with MAD
Run time	: 3 hours (maximum)
Operational depths	: 23 - 183 meter
Pulse length	: 10 - 180 msec
Transponder	: 3 - 13,5 kHz
Echo repetition	: 1 pulse per second
Fix tones	: 450, 600, 720 and 920 Hz
Torpedo simulator	: MK46 torpedo

The EMATT contains lithium batteries, which can be dangerous when damaged and /or leaking. Leaks can be discovered by:

- Smell of rotten eggs
- Metallic taste in the mouth
- Warm underside
- White smoke

The durability of the batteries for storage is a maximum of 5 years.

Expendable bathythermograph XBT/XSV PRS-02/01

Sonar sounds propagates with an average speed of 1490 m/s in seawater. This can be affected by various factors, the main one being the temperature.

To measure the seawater temperature, or the sound velocity for great depths, we use the PRS-02 installation.

The PRS-02 consists of:

- A recorder with microprocessor;
- A launcher;
- XBT probes;
- XSV probes.

To measure temperature, if required the sound velocity, we respectively use a XBT or XSV probe. Both types of probes can be put to water with a launcher in the portside control room.

The probes are connected to the PRS-02 with a minute filament. The speed at which the probe sinks is well-known. The recorder in the Command Center runs simultaneous with the sinking probe. In this way, we obtain an instant hard-copy reading of the temperature of sound velocity. This information can also be sent to the Data handling system through a serial interface. The XBT probe measures the temperature with a temperature sensible resistance.

The XSV probe measures the speed velocity with a microscopic sonar within the probe. This sonar has a send and a reception transducer which are located opposite each other in the head of the probe.

The obtained information is used to calculate the sound wave path of the sonar.

Recorder Sea Surface Temperature RSST-2013

To measure the sea surface temperature, the ship is equipped with a temperature sensor underneath the water line, just above the bow dome. This sensor is connected with a paper recorder in the Command Center.

Underwater telephone UT-2000

With the UT-2000, it is possible to communicate with submarines. This can occur through speech or transmitting key.

The UT-2000 disposes of a control/send box in the Command Center (see Fig.4530.1) and a (private) transducer in the bow dome.

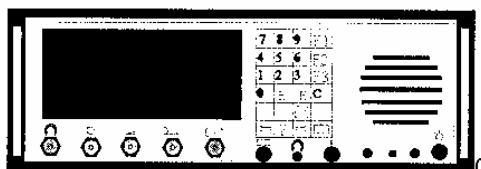


Fig.4530.1 Underwater telephone UT-2000

All above mentioned control and recording boxes are in the OB corner of the Command Center.

4600 Nautica subsystem

The Nautica subsystem consists of equipment which is mainly used as navigational equipment (see Fig.4600.1).

The Nautica subsystem is assembled around the Information Retransmission Cabinet (IRC) of the DDC firm.

The IRC accumulates information of various sub systems with regards to ship movements (heading, roll, pitch and velocity), longitude and latitude and atmospheric conditions (air pressure, wind speed and direction) and it also separates this information for the various users. These users are the Data handling system, sensors, weaponry systems and the platform system (IVS).

The IRS also receives status information from the IVS with regards to platform systems concerning the Data handling system.

The total Nautica subsystem consists of:

- DDC IRS-6520 Information Retransmission system;
- SPERRY Mk.49 mod 0 compass (SINS);
- SPERRY Mk.29 mod 0 or mod 2A2 compass;
- GEC PA9151 Global Positioning System (GPS);
- AGI ElectroMagnetic-log;
- AIR-DBIA barometer;
- LAMBRECHT wind meter system;
- ATLAS 481 echo sounder;
- SMITHS INDUSTRIES COINS plot table.

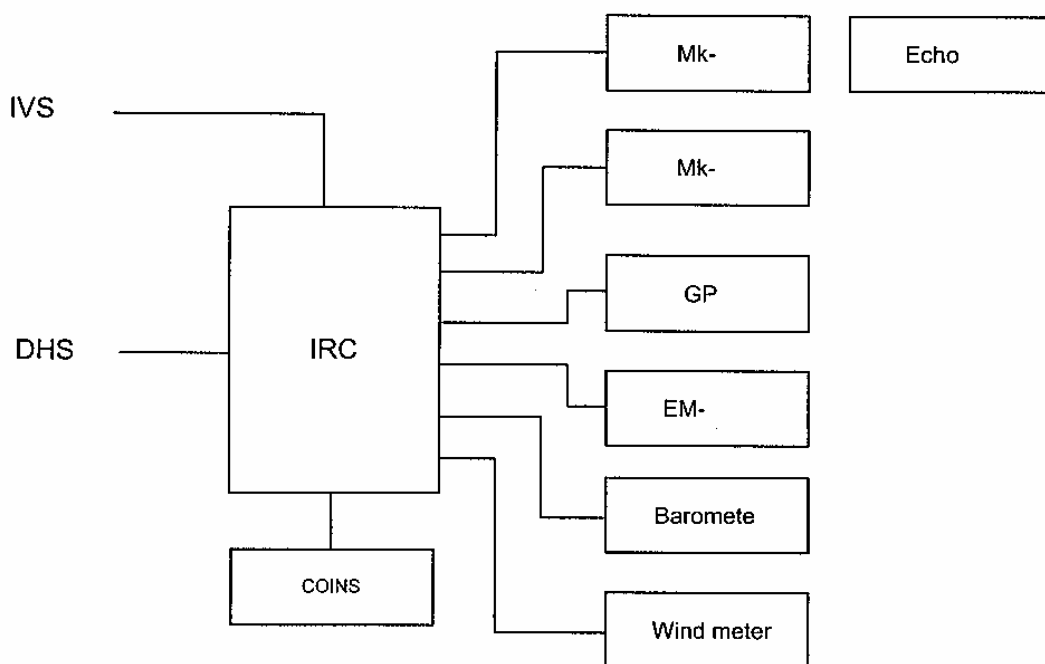


Fig.4600.1 Nautica subsystem

4610 IRS-6520

The IRS is placed in the fore aft compass cabin. It is a multiprocessor system (15 processors), assembled around roughly 17 data busses.

In Fig.4600.2 we can see an overview of the systems connected to the IRS-6250. At the same time, the operated interface types are mentioned.

The IVS delivers, for example information regarding the revolution of the propellers and pump condition. This is for the supporting software of the sonars on board.

The connected numerical indicators are divided in two types, the NI's and the NIT's. The NI's show the course, the navigation, time and air pressure.

The NIT's only indicate the time.

With "daughters", we understand the analogue indicators, such as gauge-daughters, log indicators, oscillation angle and pitch angle meters and wind meter dials.

The Temperature measurement and signal panel is in the WD office. With the help if this panel, the conditions are watched for the IRS. On this panel, the compass alarms also appear. For the benefit of the watch officer, a compass alarm unit has also been fitted on the bridge.

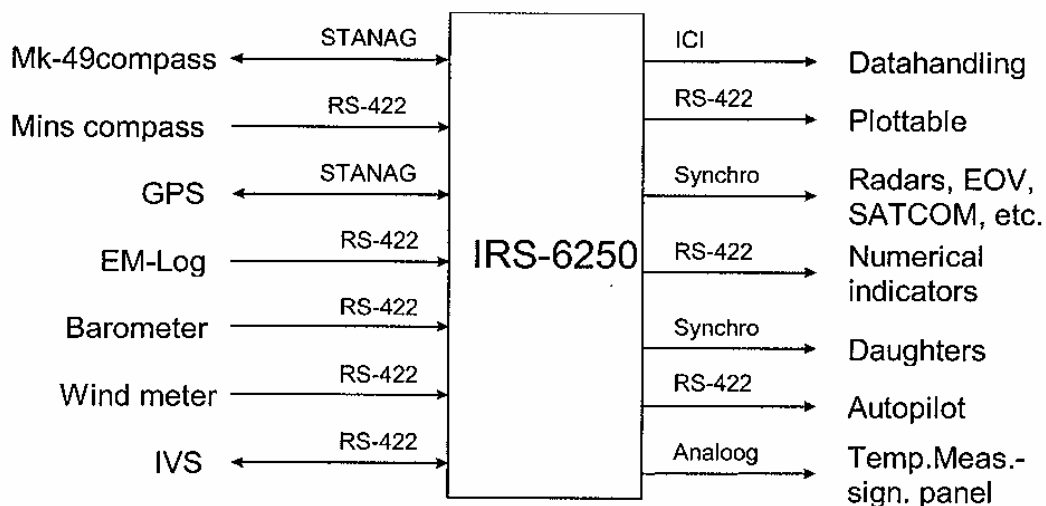


Fig.4600.2 IRS-6250

4620 Sperry Mk-49 NATO-SINS compass

SINS stands for Ship's Inertial Navigation System.

The Mk-49 mod 0, or SINS compass, is the main compass on board the M-frigate. It is also set up in the Front Compass Cabin.

It supplies information to the IRS about: heading, roll, pitch, position (degree of longitude and degree of latitude) and speed over the ground.

The SINS is roughly divided into five parts, as shown in Fig. 4600.3.

The Sensor block consists of three Ring Laser Gyros and three accelerometers. It supplies data about angle modification, the speed at which this happens and acceleration data to the Navigate processor via the IMU support (Inertial Measurement Unit).

On the basis of these data, the Navigate processor can calculate the heading, roll and pitch.

The I/O processor, in its turn, provides those data via a full duplex STANAG connection to the IRS.

The Indexer assembly is intended for removing heading and position errors.

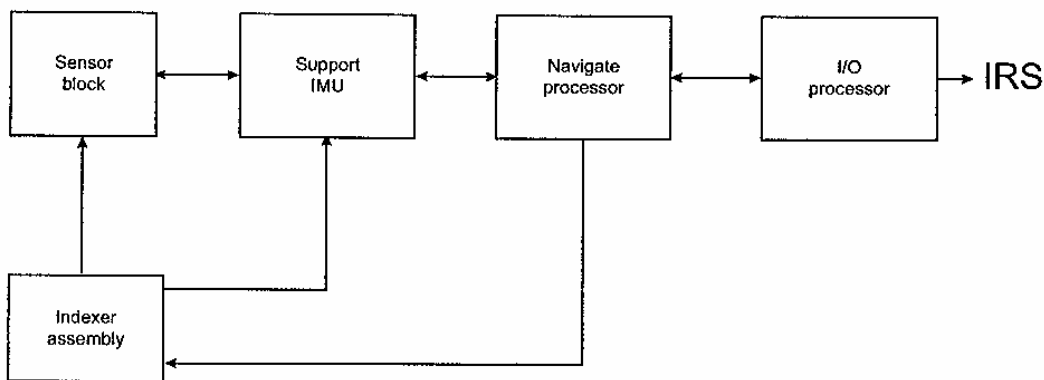


Fig. 4600.3 Mk-49 SINS compass

4630 MINS compass

All MK 29 compasses have been replaced by the MINS compasses of the Anschütz company (subsidiary of Raytheon). This compass has also been purchased as main and emergency compass for the LCF frigates.

The MINS provides the same information as the Mk-29 compass and uses, among other things, ring laser gyros instead of gyro tops. In addition, the compass can be used within 10 minutes when berthed and within 20 minutes when started up on sea.

This compass may provide both rough/fine synchronic values and serial RS-422 values. Moreover this compass calculates itself its position. However, no use is made of this. (not provided to the IRC)

In order to be calibrated regularly, the MINS compass will be connected to the MX-412 GPS.

Figure 8 shows a picture of the installation.

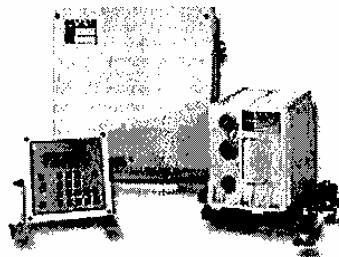


Figure 1

DESCRIPTIONS FUNCTIONS MINS**UPS uninterruptible power supply**

- The UPS converts 115V 400 Hz into 24V for the ICU.
- If the input voltage falls away, a battery will continue to supply power to the system during +/- 30 minutes at the most.

DRU dynamic reference unit

The HRP measuring function measures several kinds of data (angle rotations and accelerations) that are processed into HRP, position and inert speed that are provided to the ICU.

ICU interface and connection unit

The Interface function (ICU) acts as an interface with the following functions:

- transferring 24 V Dc (originating from the UPS) to the DRU.
- transferring 115V / 400 Hz reference on behalf of the synchro users.
- transferring Log (Speed) and Gps (position, via the main bus) information to the DRU.
- transferring calculated position, heading, roll, pitch, inert speed and status to the users.

Note: it is also possible to log in via a lap top for service and maintenance purposes (this is optional for us.)

CDU control and display unit

The CDU is the man machine interface of the Mins which is used to:

- enter data into the system or to retrieve them.
- to denote the status of the system.

Note: in the service mode, the information of the DRU can be provided with a view to error diagnostics and, with respect to tests, it is possible to ignore the HRP simulation values.

4640 GEC PA9151 Global Positioning System

The GPS is a satellite navigation system that operates with the help of radio signals transmitted by NAVSTAR satellites.

The GPS consists of a:

- space part (21 satellites);
- user part (GPS receiver and antenna);
- control part (Master control and Monitor systems).

The space part consists of some 21 satellites, 3 of which have been added for reserve purposes. There are three to four satellites in one orbit. In total, therefore, there are 6 different orbits. A satellite completes its orbit in exactly 12 hours at a height of 20,200 km.

The user part consists of a receiver with antenna that is able to receive, decode and process the GPS radio signals. The user is given the possibility to navigate, determine position and to measure both time and height with the GPS.

The principle of GPS is based on measuring the distance to the satellites from the various orbits. The exact position of each satellite is known at any time. For the determination of the position of a ship, it suffices to measure the distance to three satellites. The accuracy in measuring the distance to the satellite determines the assessment of the position of the ship. The distance to the satellite is found by measuring the time difference between a pulse train in the satellite and one in the receiver that were started simultaneously. The GPS receiver is situated on the navigation bridge, the antennas on the bridge roof. The PA9151 is a military receiver and, consequently, can be provided with a crypt code that ensures a more accurate position assessment.

4650 AGI EM-log

The EM-log is used to assess the speed of the ship through the water (not over the ground, therefore).

The log consists of:

- 2 sensors;
- Speed and Distance Transmitter Unit (SDTU);
- 1 repeater.

The EM-log works based on the principle that a voltage difference is induced in a conductor as a result of a moving electromagnetic field.

To that effect, around the probe under the ship a magnetic field is induced, the water being considered a conductor. The faster we move through the water, the more the field is affected.

We measure this with the help of two knotted cells, in the same sensor, which subsequently transfer it to the SDTU on the navigation bridge. The SDTU converts this value then into a speed value. This value is provided to the solid state repeater via a serial RS-422 interface.

Via another RS-422 interface that value is also provided to the IRS.

Furthermore, per sea mile covered, pulses are entered into the miles counter and the RACAL and Kelvin-Hughes radarscopes.

4660 AIR-DBIA Barometer

The barometer consists of a pressure sensor based on a membrane, which provides the pressure in the form of analogous tension.

Via a microprocessor that tension is then converted into a digital value. Via an RS-422 interface that value is transferred to the IRS.

The IRS, in its turn, displays this via various numerical indicators (NIs) distributed over the ship.

The barometer itself is located in the chart house and is connected with the outer air via an air line. This line contains a tap (gas citadel).

4670 LAMBRECHT Wind Gauge

The wind gauge installation consists of:

- 2 recorders;
- a processor cabinet.

The two recorders are located in the foremast, in larboard and starboard yard. They measure both the relative wind speed and the wind direction. By relative is meant the speed and direction in respect of the ship.

These values are sent to the processor cabinet, which is located in the compass cabin at the front. The processor converts it into a digital value and sends it to the IRS via two RS-422 interfaces (one for the starboard and one for the larboard recorder).

4680 ATLAS 481 Echo Sounder

The purpose of the echo sounder is to provide the user with information about the local depth.

The echo sounder consists of:

- a recorder on the bridge;
- a digital read-only unit (FILIA), also on the bridge;
- two transducers.

The recorder contains a transmitter/receiver and a paper recorder.

The transmitter transmits a signal to the transducer, which converts it into a sound pulse. This pulse is directed straight downwards. In the course of time the pulse will reach the bottom of the sea and will be reverberated. This reverberated pulse, or echo, is received by the same transducer and transmitted to the receiver itself. The receiver will then burn the echo onto the paper. At the same time, the digital read-only unit will display the depth.

One of the transducers is located at the front in the bow dome, the other one is located approx. halfway the ship. Only one transducer is used at a time. The choice between the two is made on the recorder.

4690 SMITHS INDUSTRIES COINS Plot Table

The COINS (COmpact Integrated Navigation System) is a plot table that processes data of compass, log and GPS.

The COINS calculates the position of the own ship and displays it as a navigation plot in an entered sea chart (paper) on the plot table. This plot is projected as a luminous spot on that chart.

The plot table is mainly used as a backup system of Data Handling during 'procedures narrow waterways.

The COINS is located in the Command Center and consists of:

- the Integrated Navigation Computer And Plotter of INCAP;
- Keyboard Display Unit (KDU).

4700 EOVS**4710 APECS II**

Electronic Warfare (EW) consists of three parts:

- ESM, Electronic Support Measures;
- ESM, Electronic Counter Measures;
- ECCM, Electronic Counter-Counter Measures.

ESM enables us to receive and to analyze transmissions of various nature. It is therefore of a passive nature.

ECM provides the possibility to take countermeasures if we receive waves from threat radars (fire control, missile radars) or sonars (torpedo sonar). Those measures may be of an electronic nature, in which case we will mislead or disturb (active).

However, they may also be of a mechanical nature. By firing chaff (fine chippings of aluminum foil) we can block the view of radars.

ECCM is the possibility of installations to by-pass electronic disturbance and/or misleading measures.

If, for example, a frequency is disturbed, a radar (or radio) can transmit from a different frequency.

Modern radars and communications equipment are provided with ECCM.

On board M-frigates we have specific ESM and ECM equipment at our disposal.

ESM equipment: APECS-II (from C-band)

ESM-500 (to D-band)

ECM equipment: APECS-II

SRBOC (chaff launcher)

Auxiliary equipment: MPBU

RSCP

We will discuss the ESM-500 and SRBOC later.

As is apparent from the introduction, the APECS-II installation has both ESM and ECM possibilities available.

The ESM part consists of:

- one omni receiving unit (ORU);
- two monopulse receiving units (MRUs);
- the Remote Equipment Rack.

The ECM part consists of:

- the Auxiliary Equipment Rack;
- two Transmitter/antenna units;
- two Hydraulic Power units.

Omni Receiving Unit (ORU)

The ORU is placed at the top of the foremast. It consists of two, omni sensitive antennas that are able to receive signals in the frequency area of C-band to J-band incl. (0.5 - 18 GHz.). The received RF is transmitted to the Remote Equipment Rack.

Monopulse Receiving Units (MRU)

Both MRUs are located on the SMART landing in the foremast. One behind the SMART antenna, the other in front of it. Each MRU consists of three times four antenna areas (Bands 1, 2 and 3). Via those areas the soundings of RF signals are taken in the same frequency bands as the ORU.

The RF signals received from all areas go to the Remote Equipment Rack.

Both ORU and MRU are kept dry by the wave guide dryer of STIR-2.

Remote Equipment Rack

The RF signal of the ORU is processed into digital frequency values and an envelope or video of the pulse. The pulse video is used, among other things, to start the sounding. The sounding of an RF signal is calculated from the RF signals received from the MRUs.

The measured frequency, pulse video (ORU), sounding and amplitude (MRU) are subsequently processed in the Auxiliary Equipment Rack.

The Remote Equipment Rack also receives information from:

- the IRC concerning course, pitch and oscillations;
- the MPBU. It concerns here suppressing pulses for the own pulse radars, in order that they do not disturb our own ESM.

That information is digitalized and transmitted to the Auxiliary Equipment Rack.

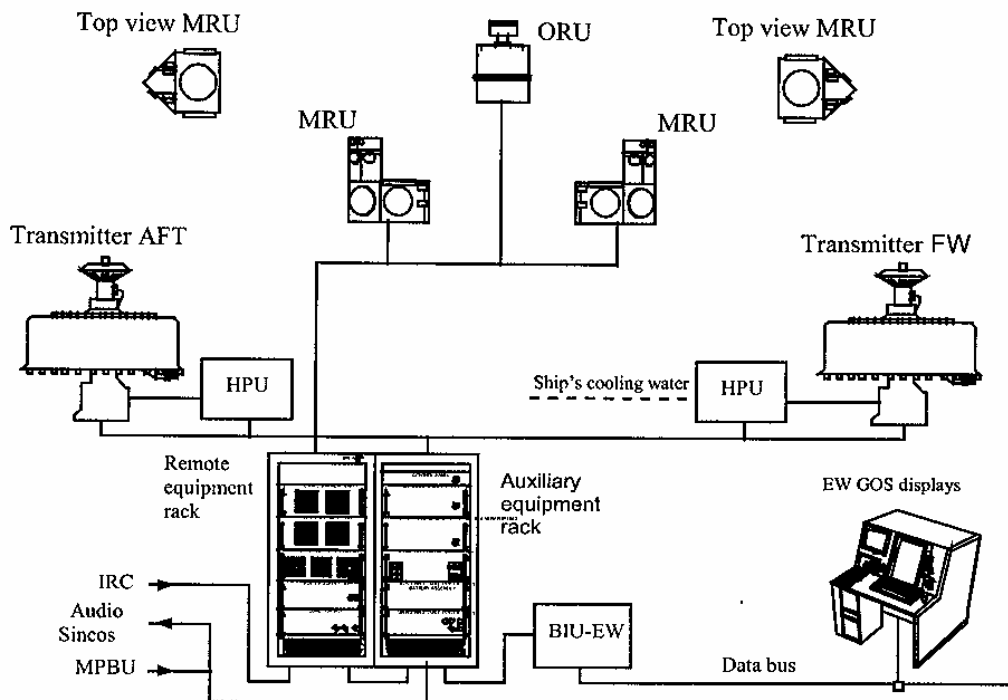


Fig. 4710.1 APECS-II EOVS installation

Auxiliary Equipment Rack

Based on the information received from the Remote Equipment Rack, in combination with the stored data (ESM library) it is determined whether the received signal is a threat radar. If so, then ECM techniques must be applied.

The techniques that must be applied are taken from an ECM library in this case.

Through those techniques, we intend to prevent the threat radar from receiving accurate sounding and distance information.

All the information is analyzed and followed. This track information is transmitted to EW GOS displays (via BIU and data bus) and displayed there. The track information can also be transmitted to Data Handling to be shown as ESM sounding on Data handling GOS displays. This is done at the initiative of the operator, so not automatically.

If disturbance techniques must be applied, this is therefore determined in the Aux. Equipment Rack.

This cabinet contains a Power Management Technique Generator (PMTG).

The PMTG generates the required disturbance techniques and transmits them to the Transmitter in whose sector the threat radar is.

With the help of oscillation and pitch angle values, the Hydraulic Power Units are steered.

Both the Remote and the Auxiliary Equipment Rack are located in EOVS cabin 1.

4720 Transmitters

Each Transmitter consists of two phased array antennas and a semi-omni antenna. Each phased array antenna has an operation area of 90° and is mounted at right angles to the other.

The Transmitters are stabilized hydraulically in a similar way as LW-08 and SMART radars.

The generation of the disturbance signals occurs in the Transmitter itself. Via a Voltage Controlled Oscillator (VCO), stable threat radar frequencies are generated.

If it concerns Jumping Frequency threat radars, we use those radar signals. They are received in a Frequency Memory Loop (FML) via a semi-omni antenna on top of the Transmitter. Subsequently they are amplified and used to mislead the threat radar.

The Transmitter FW (ForWard) is placed on the starboard side of the bridge. One antenna covers the sector in front of the ship, the other one covers the starboard side (see Fig. 4700.2). This Transmitter is kept dry by the wave guide dryer of STIR-1

The Transmitter AFT is placed on the larboard of the hangar. One antenna covers the sector behind the ship, the other one covers the larboard side. This Transmitter is kept dry by the wave guide dryer of Goalkeeper.

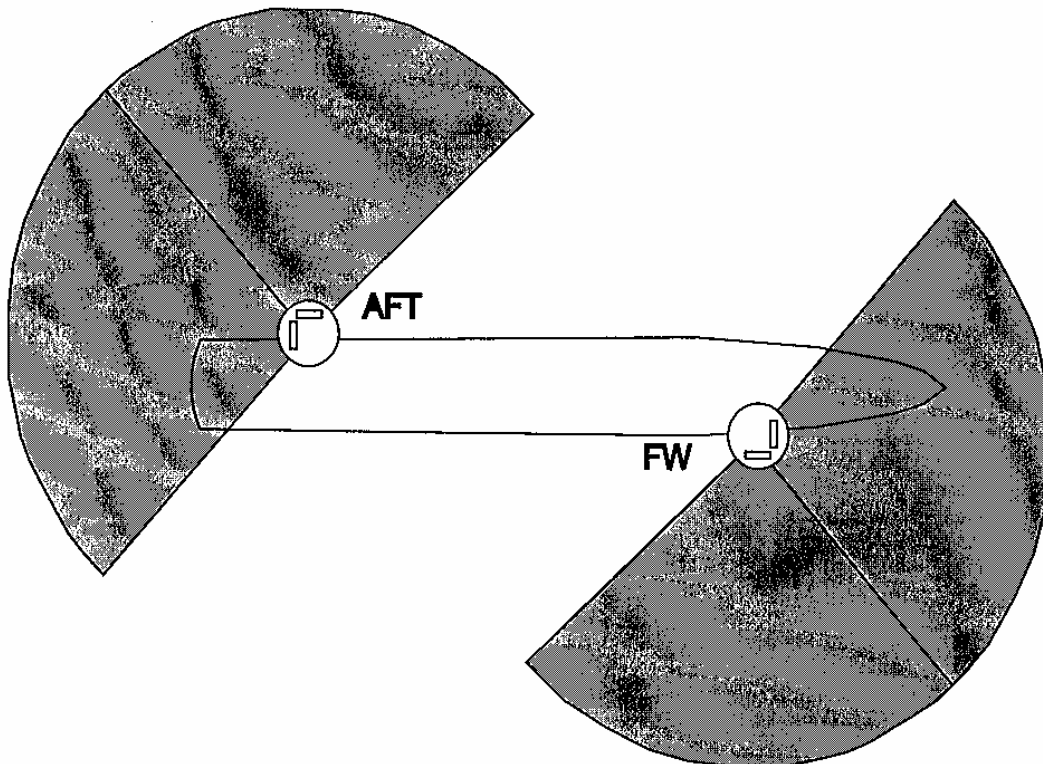


Fig.4720.1 Transmitter set-up and cover

Hydraulic Power Units (HPU)

The HPUs are used to stabilize the Transmitter in respect of movements of the ship. One HPU is placed in the hangar and is air-cooled, the other one in the Instrument Space under the bridge is kept at the right temperature by means of ship's cooling water.

4730 Mixer Pulse Blanking Unit (MPBU)

Own radars may disturb our APECS-II with their transmissions. The APECS-II is able to 'blank' the transmissions of own CW radars (STIR and SATCOM).

Blanking means that the receivers are pressed closed for a moment in the frequency of those CW transmitters.

For the suppressing of the pulse radars (LW-08, SMART, etc.) we have additional equipment on board, the MPBU.

The MPBU receives signals that indicate whether they actually transmit, the pulse length and the synchronization pulse. With those signals, the MPBU does two things:

- it ensures that the frequency band concerned of the APECS is pressed closed at the moment of transmission of a radar;
- on the remote control box of the MPBU, through a LED display, the radars that are transmitting are shown.

The time of suppression may be controlled by a switch on that remote control box (in the Command Center). During bad weather, radar energy may be reflected strongly due to high waves. This undesired energy must also be suppressed.

4740 Radar Status and Control Panel (RSCP)

The RSCP is a control and signaling box in the Command Center (see Fig. 4740.1). The command can see on it for each radar and SATCOM whether they are actually transmitting (just as with the MPBU remote control box). It is more important, however, that the command can switch off the transmitters of radars and SATCOM on the RSCP. In this manner one can prevent a transmitter from getting into the air during 'Radio and Radar Silence' periods.

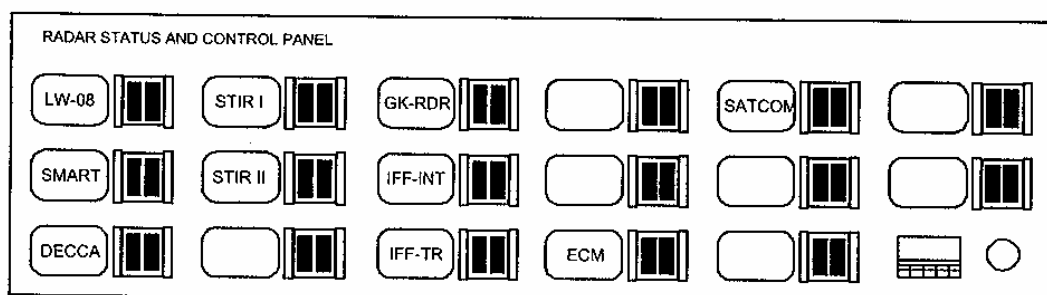


Fig. 4740.1 RSCP

5000 Weapons

The weapons are intended for combating and misleading air, surface and underwater targets. They are categorized in the group weapon systems.

This consists of:

- EOVS weapon systems;
- Guided weapon and artillery systems;
- Underwater weapon systems.

EOVS weapon systems can be distinguished in:

- the APECS-II, as regards the ECM part (par. 4700);
- the SRBOC chaff launch installation.

Both systems are 'soft-kill' weapons. This means that, by applying misleading and/or disturbance techniques, target information is denied to hostile weapons (missiles) or weapon systems (fire control).

The guided weapon and artillery systems consist of:

- the MWCS fire control system;
- the GMVLS guided weapon system;
- the OTO-Melara 7.6 cm gun;
- the HARPOON guided weapon system;
- the Goalkeeper weapon system;
- the Oerlikon 20 mm machine guns.

These are 'hard-kill' systems. The target is destroyed.

The underwater weapon systems consist of:

- the ship torpedo weapon system (STWS);
- the NIXIE torpedo misleading system (par. 4530).

The STWS is a hard-kill system, NIXIE a soft-kill system.

5100 SRBOC chaff launch installation

Super Rapid Bloom Off-board Chaff or SRBOC has the task to mislead:

- a. hostile radars;
- b. active homing missiles;
- c. *infrared guided missiles.*

Method: SRBOC fires shells the content of which consist of fine reflecting strips (fibers). Those strips are called 'chaff' or 'window'. These shells explode in the air. The length of those strips equals half the wave length of the radar frequency that is to be disturbed. The picture of that radar is then satiated with false echoes.

In c. we use a cartridge, enabling us to fire several loads, due to which an alternative heat track (phosphor) is created to mislead IR missiles.

On board M- and L-frigates we also use the SRBOC Mk-36 mod 1 (2 MK137 mod 1 launch installations). This type is suitable for ships of up to 450 feet length. In the future, on board the M-frigates, an installation will be added on both sides, after which the control panels on the bridge will disappear.

Larger ships, such as supply ships and ATS use the Mk-36 mod 2 system (4 MK137 mod 2 launch installations).

The Mk-36 mod 1 system consists of (see Fig. 5100.1):

- two upper deck launch installations Mk-137, each equipped with six launch tubes at an angle of 45° (see Appendix 3, no. 21);
- one Power supply per installation. Contains a battery for emergency power;
- a Master control panel in the Command Center;
- larboard and starboard control panels on the navigation bridge.

Switching on and off is done on the Master control panel. One can also fire from the bridge. In the vicinity of each launch installation there is a readiness ammunition stowage and a warning horn. The horns are controlled from the Master panel.

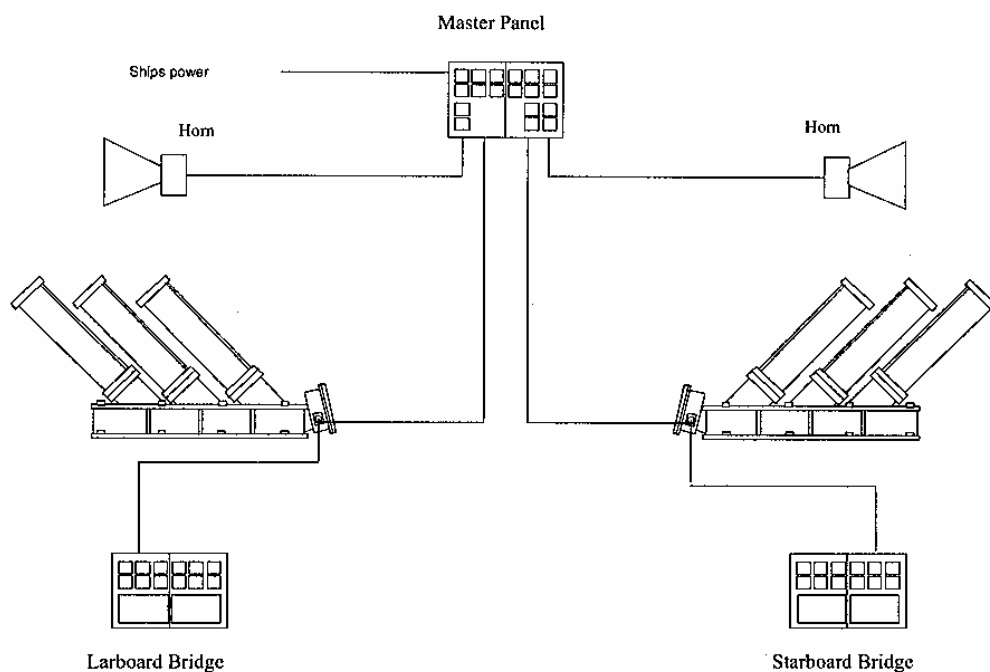


Fig. 5100.1 SRBOC Mk-36 mod 1

5200 MWCS

The Multi Weapon Control System has the task of intercepting and attacking hostile sea and air targets. It consists of two almost identical parts and a Central Control Panel (see Fig. 5200.1).

Each part consists of:

- a Sensor subsystem;
- a Target Designation Sight (TDS);
- a STIR Control Console with system computer;
- a Weapon subsystem.

The Weapon subsystem is different for both parts. For the one it concerns the Guided Missile Vertical Launch System (GMVLS). For the other the OTO-Melara 7.6 cm gun.

Both systems can be provided with the required data by one or both system computers. These data (target distance, height, speed, etc.) are received from the sensors (LW-08, SMART) and are provided via the Data Handling system. These data (tracks) are required to steer a STIR director in the first instance in the direction of the target.

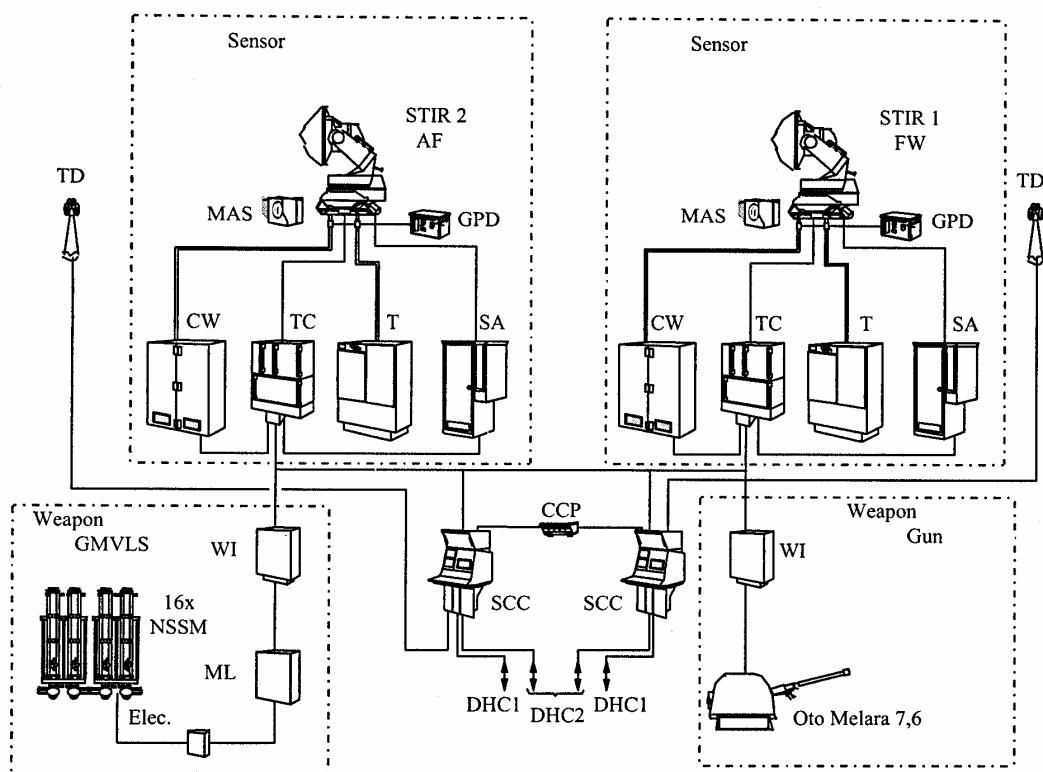


Fig. 5200.1 MWCS

Sensor subsystem

It is the task of this subsystem to track a target and, if necessary, to 'illuminate' it if a missile is fired at it. Both Sensor subsystems are identical and each one can do the work of the other.

Each sensor subsystem consists of:

- STIR Separate Tracking and Illumination Radar. Determines, together with the system computer and Tracker Control Cabinet, the position of the target. At the same time, the STIR can 'illuminate' on behalf of the Seasparrow missiles from the GMVLS. The STIR consists of an antenna unit, monopulse receiver, motors, controls and TV camera. Both STIRs are placed on the B-deck, in front of and behind the foremast.
- SAC Supply and Amplifier Cabinet. Provides the control and (electrical) stabilization of the STIR.
- TX Transmitter cabinet. Contains an I-band TWT transmitter that amplifies an RF signal, originating from the TCC, and transmits it to the STIR via the wave guide run. With this signal the target is tracked.
- CWI Continuous Wave Illuminator. The CWI provides two beams on behalf of the guiding of the Seasparrow missiles. In the first place, this CW signal, together with the TWT RF signal, provides a pencil of rays that illuminate the target. In the second place it is used to make a wider beam via the 'Rear reference horn' in the antenna. This serves as reference for the Seasparrow.
- TCC Tracker Control Cabinet. The TCC is the central control unit of the Sensor subsystem, with its own SMR-Mu computer. The TCC determines the frequency and PRF of the TWT transmitter. Target video received from the STIR is processed in the TCC and is used to steer the STIR in the right direction. Target data are transmitted to the SCC.
- GPD Wave guide dryer. Ensures excess pressure and dry air in the wave guides. The GPD of STIR-1 also dries the APECS Transmitter at the front. STIR-2's GPD dries also the APECS ORU and MRU antennas.

The preceding units are located in Radar cabin-2.

Target Designation Sights

The TDS' are used as a fitted optical means of indication for the MWCS. An operator can use them to transmit the bearing and elevation angle of the target.

The TDSs are placed on both bridge wings.

STIR Control Console

The SCC forms, among other things, the Man Machine Interface of the MWCS with the STIROperator to control the entire MWCS system. The operation of the system is done from a GOS.

Each SCC contains a system computer (SMR-Mu) and can function as a central control unit of the MWCS. The two SCCs are identical. Firing a gun or launching a Sea Sparrow can be done via either SCC.

The SCCs work in a master-slave relationship.

What is referred to as Scheduler, a software function in the SCCs, makes optimal choices as regards which STIR and which weapon will be used against a target.

Each SCC has a serial ICI interface with both DHC1 and DHC2 of the Data Handling system.

Both SCCs are set up next to each other in the Command Center, over the larboard side.

Central Control Panel

The CCP is a central switching-on and off panel for the various parts in the MWCS. It also displays the status of the various subsystems.

Weapon Interface Cabinet

The two WICs are intended to provide the connected weapons with data and to inform the system computers of their status. In the WIC, calculations are made by another SMR-Mu, on behalf of 'engagement and intercept' for incoming targets. This is done according to instructions of the system computers. The WICs are not identical due to their specific interfaces.

The OTO-Melara WIC is located in the transfer space of the gun. The WIC of the GMVLS is located in the GMVLS operation room.

5300 GMVLS

The Guided Missile Vertical Launch System is a weapon system that is mainly used against air targets. The GMVLS consists of (see Figure 5200.1 MWCS):

- a vertically placed launch installation for 16 RIM-7M missiles;
- a Missile Launcher Controller;
- four Electrical interfaces (one drawn);
- two CWIs (see par. 5200.1);
- Weapon Interface Cabinet

RIM-7M NATO Seasparrow missile

The RIM-7M missile is mainly used against air targets from sea level up to 7,500 meters height. The maximal range is 16 km.

The missile can also be used against sea targets. (provided large RCS)

The missile consists of two parts (Fig. 5300.1):

- the missile, with Target seeker, warhead and missile motor.
- the Jet Vane Controller (JVC).

As we deal with a vertically placed missile, it must be brought in roughly the right direction after launching. That is the task of the JVC.

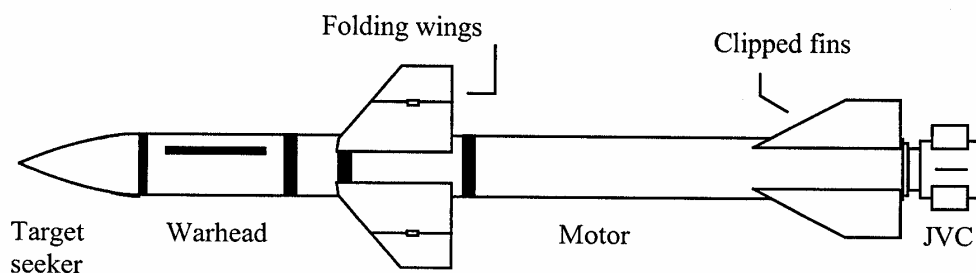


fig. 5300.1 RIM-7M NATO Seasparrow

The flight of the missile can be divided into three phases (see fig. 5300.2):

- **Launching** The missile is launched, the wings unfold, JVC brings the missile in the right direction, JVC is subsequently thrown off.
- **Acquisition** With its Target seeker the missile looks for the CWI signal reflected by the target. This must be transmitted to our own CWI transmitter. The 'rear reference' beam is used as a reference by the missile.
- **Homing** The missile has found its target and steers itself to it.

The 16 canisters with RIM-7M's have been mounted against the larboard side of the hangar.

Missile Launcher Controller

The MLC controls and monitors the missiles and canisters. It makes sure that a missile has been assigned when MWCS indicates that launching should take place. After receipt of the launch command from MWCS, the MLC will tune the missile digitally to the CWI frequency and generate all the consecutive launch commands.

After a successful launch, the 'missile away' signal is transmitted to MWCS.

The MLC transmits the missile and GMVLS status to the MWCS.

After missile ready and receipt of launch command, the missile leaves after 1.7 sec.

Electrical interface

This is an interface that, under command of the MLC, transmits all the signals to the missiles and canisters. Per four canisters there is one interface.

The MLC and two electrical interfaces are found in the operation/instruments room GMVLS. The other two electrical interfaces are placed in the hangar.

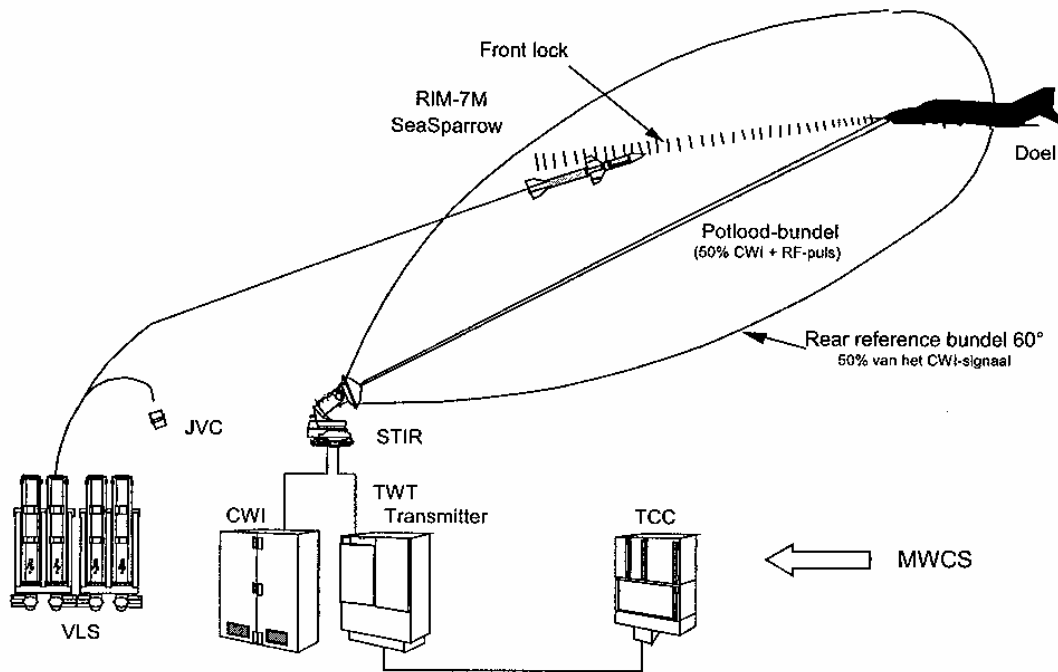


Fig. 5300.2 Seasparrow intercept

5400 OTO-Melara 7.6 cm gun

The gun is a fully automatic burst firing gun that can be used against air and surface targets. This occurs mainly under control of the MWCS. In case of surface targets, the gun can be used under control of DHS/SMART. This is the 'DOGAS' mode.

The gun has a firing speed of 10-100 shots/min.

The gun can be steered in the following manners:

- Manually, hand mechanically in case of repair and/or maintenance work (not for firing);
- Locally from the Captain-of-turret-console, also exclusively for repair/maintenance;
- Operationally (remote) by MWCS or Data Handling (DOGAS or Direct Operational Gun Assignment)

In operational steering, we distinguish between MWCS mode and DOGAS mode.

In **MWCS mode** the gun is used against air and/or surface targets:

- the STIR is used as a sensor/fire control channel;
- the ALVO indicates the air targets (engagement);
- the CCO indicates the surface air targets;
- the STIROP behind the SCC gives the firing command (in manual mode) via a push button.

In **DOGAS mode** the gun is only used against one surface target:

- SMART is used as a sensor/fire control channel;
- the ALVO indicates the surface target (it sees it afterwards on the B-scope of its GOS monitor);
- the ALVO gives the firing command via a push button on his GOS console (Gun Surface mode).

In the DOGAS mode we also have the alternative and the emergency mode. (resp. LW or Decca, only Stir)

The system consists of (see fig. 5400.1):

- Upper turret;
- Bottom turret;
- 'Captain of turret' console (not drawn);
- Weapon Interface Cabinet (ditto).

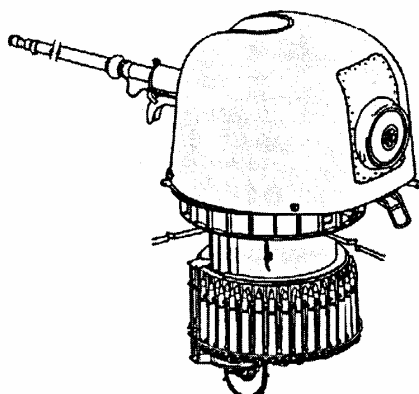


Fig. 5400.1 OTO-Melara 7.6 cm gun

The turret is at the front on the tank. Immediately underneath is the operation/transfer space containing the 'Captain of turret' console and WIC. Two decks down is the ammunition stowage. The cartridges are transported from there to the transfer space via a lift.

By manpower the 'revolving feed magazine' is filled. It can hold 70 cartridges. To place the cartridges in the firing room of the gun we first use a screw lift. This lift can contain 6 cartridges. When the cartridge has arrived in the turret, it is placed in a loader drum by means of 'rocking arms'. This can hold 4 cartridges. In fact we have thus a magazine with a total of 80 cartridges.

From the loader drum the cartridge falls into a loading pipe. The cartridge is then placed in the room and fired. Upon placing the next cartridge, the fired cartridge is thrown forward on the deck.

5500 Harpoon Anti-ship missile system

The Harpoon guided weapon system is used against sea targets at a maximum distance of up to ± 75 nm. (minimum ± 5 nm).

M-frigates are equipped with RGM-84D missiles, making it possible to set three of what is called 'waypoints'. Waypoints are geographical positions at which the missile must change its course. In this manner it has become possible to shoot around a corner (Fig. 5500.1).

These waypoints are given before the launch together with other parameters.

Another parameter that is given is, for example, the manner in which the Harpoon must trace its target. This depends on the available target data. There are two manners:

- **RBL** Range and Bearing Launch. In this case we know the target position fairly accurately. The Harpoon will follow its ordered course (with or without waypoints) and only position its radar at a certain distance to trace the target.
- **BOL** Bearing Only Launch. In this case we only know the sounding of the target, not the distance. After launching, the missile will add the use of its radar to find the target. The course it follows has been entered by the operator.

In fact, the missile can find its target in the two following manners:

- Active homing, as described above;
- Home on jam, if the Harpoon radar is disturbed by ECM of the target. The disturbance signal is then used as a means to aim.

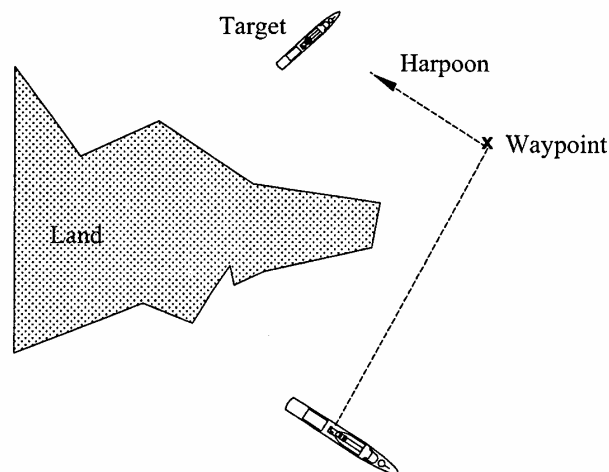
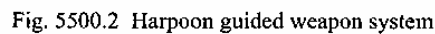


Fig. 5500.1 Harpoon waypoint

The Harpoon installation consists of (see Fig. 5500.2):

- a Harpoon Control Console;
- a Harpoon Missile Select and Firing Panel;
- a Launcher Switching Unit;
- two Harpoon Canister Launcher Assemblies;
- a Harpoon Trainer Module;
- a Harpoon Guided Missile Simulator.



The HCC receives, processes and distributes data and commands necessary for launching. Those data are received from the Data Handling system of the HMSFP.

This is actually the remote control panel of the HCC. Only from here can a firing command be given. This panel has been placed near the CCO in the Command Center.

This is a switch box transferring the steering and firing signals to the assigned launch installation.

Each HCLA consists of a support assembly, a relay box and maximum 4 canisters. The HCLAs have been positioned in such a manner that Starboard positioning launches over starboard, but is placed on the larboard side. For Port positioning the reverse is true.

In this manner one achieves that the 'blast' of the missile is aimed outside of the ship. The two HCLAs have been placed on the F-deck behind the chimney.

The HTM simulates the canister contents as follows:

- 'missile in canister' or
- 'canister empty' or
- 'DUD' (defect missile).

HCC, LSU and HTM are in the Harpoon instruments room.

Harpoon Guided Missile Simulator (HGMS)

The simulator is necessary for testing the Harpoon installation.

In order to test the circuits up to the missile, the simulator is placed on deck near the launcher. It is then connected instead of a missile.

In the operational exercise mode, the simulator is connected to the LSU and simulates a missile.

Normally the simulator is in the Harpoon instruments space.

5600 Goalkeeper SGE-30

Goalkeeper (also called "Close-In-Weapon-System" or CIWS) provides the last, fully automatic defense against fast, low flying, maneuvering incoming targets.

Goalkeeper is an autonomous weapon system, which means that it is equipped with its own sensor and fire control system.

The weapon can be steered as follows:

- automatically;
- semi-automatically (operator chooses a target and the system fires automatically);
- manual operation (operator chooses target and fires).

In the automatic mode the system works as follows:

The target is traced via the I-band search radar. The most threatening target is received and tracked by the I/K-band track radar. Then the Goalkeeper gun is steered to the calculated bearing and elevation angle values.

If the interception time allows thus, a volley is loosed at a fictitious point on the sounding line, 500 meters from the ship. The deviation of the shells measured by the radar is automatically processed in the hitting point calculation, after which an aimed volley is loosed. After destruction of the target, the next target is assigned to the guidance radar or the procedure is ended.

Goalkeeper uses, among other things, 30 mm Missile Piercing Discarding Sabot (MPDS) shells, made of a tungsten alloy. It is the plate armor ammunition intended to explode the warhead of an approaching missile by means of the kinetic energy that is released at the impact.

The actual shell is equipped with a casing of plastic shells, called 'sabots', in order to achieve a caliber of 30 mm. After the shell has been fired, the shells fall apart and the shell continues its course. (see Fig. 5600.1)

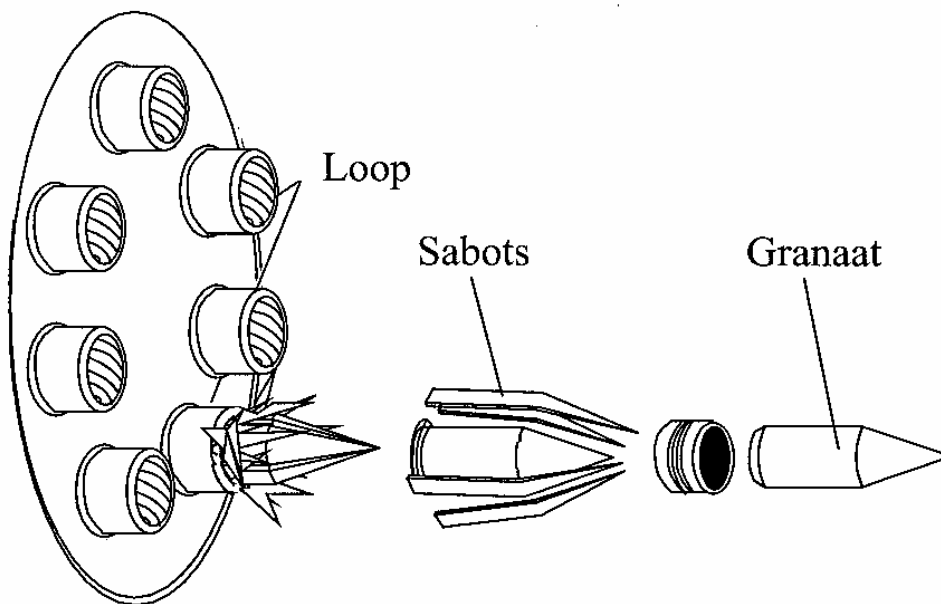


Fig. 5600.1 30 mm MPDS shell

The Goalkeeper weapon system consists of (Fig. 5600.2):

- Gun mount a 7-barrelled 30 mm 'Gatling' machine gun firing 4,200 shots per minute.
- Search radar an I-band radar for tracing targets.
- Track radar an I- and K-band radar for tracking targets. The K-band transmitter uses a magnetron and is placed at the back of the track antenna.
- Bulk loader Is used for quick reloading of the magazine of Goalkeeper. (Speed is between 0 - 400 spm, so loading takes place in max. 3 minutes). The loader contains 1,200 shells at most.
- the
- MCE Mount Control Electronics contains 6 servo amplifiers (4 bearing and 2 elevation corners) and other circuits for the weapon steering.
- SIC The System Interface Cabinet exchanges information with the other ship systems and contains 3 SMR- μ 's (System computer, Plot processor and Gun Track Computer) and also the video processing circuits for processing the search and track video.
- WCC (with an AND). The Goalkeeper system is operated from the Weapon Control Console.
- WGD Besides that of the Goalkeeper, this wave guide dryer also keeps the APECS Transmitter at the back dry.
- Rx/FCU The Receiver cabinet of Goalkeeper. It also contains the Frequency Control Unit. The FCU also provides the frequency development of the I-band RF signal for the Track and Search transmission pulse.
- TX The Transmitter has an I-band TWT that amplifies the RF signal provided by the FCU. Via the wave guide run the energy reaches the antennas.
- PICO Portable Interface CComputer. Not specific to Gk, but a generally useful computer with built-in printer and 3.5" disk drive. Is used for loading programs and for testing the system. Is also applied in, among other things, SMART, LW-08, SMR-4's, RACO, etc.
- Video camera Is intended for target identification and provides the possibility to track a target in the "TV track" mode

The upper part of the Integrated Turret (gun, radar antennas, K-band transmitter) is located on the hangar, over the starboard side and the bottom part (drum and interface) is located in the transfer space GK, where also the MCE and the bulk loader are placed. The rest of the installation is in the Goalkeeper operation room.

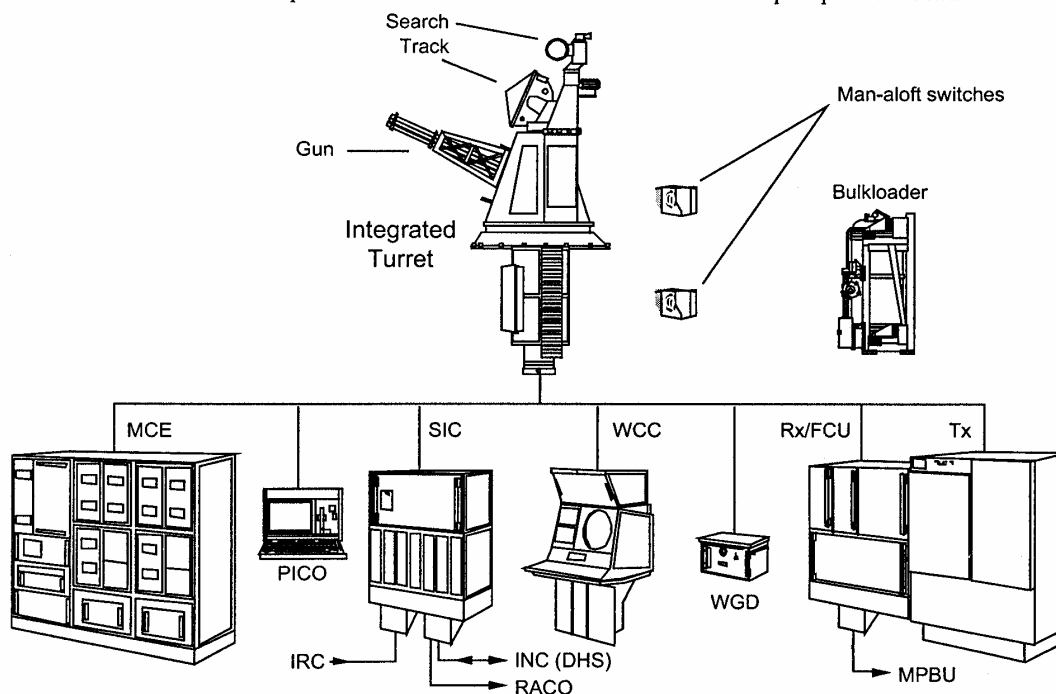


Fig. 5600.2 Goalkeeper

5700 20 mm Oerlikon machine guns

On board the M-frigate there are another two single-barreled 20 mm machine guns of Oerlikon. They are positioned on the sign deck, over starboard and larboard.

The 20 mm machine guns have been placed on board with a view to campaigns of a political nature, think of UN campaigns and the like. They can also be used (to a limited extent) against air and sea targets.

Aiming the weapon is done optically through a ring sight.

The effective shooting distance is 1,000-1,200 meters (max. distance is 6,000 meters).

The magazine can contain maximum 60 cartridges. (However, it may be loaded with 58 cartridges only)

The firing speed is 465-480 shots per minute.

The crew is composed of a shooter, a loader and a unit commander.

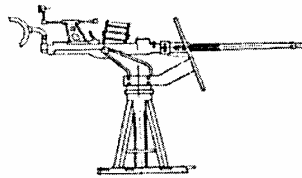


Fig. 5700.1 20 mm Oerlikon machine gun

5700 0,50 inch Browning M2 HB

On board the M-frigates the two single-barreled 20 mm machine guns of Oerlikon are replaced by the 0,50 inch Browning M2 HB. These are also positioned on the sign deck, over starboard and larboard.

The 0.50's are placed on board with a view to campaigns of a political nature, think of UN campaigns and the like. They can also be used (to a limited extent) against air and sea targets.

Aiming the weapon is done optically through a sight.

The effective shooting distance is 1,000 meters (max. distance is 7,000 meters).

The magazine is band fed and contains 100 cartridges per case.

The firing speed is 450-550 shots per minute.

The crew is composed of a shooter and an assistant.

Fig. 5700.2 0,50 inch Browning M2 HB

5800 Ship's Torpedo Weapon System (STWS)

The STWS is used for combating submarines. The M-frigate has at its disposal:

- 2 twin torpedo tubes Mk-32 mod 9;
- a Fire/Control Panel;
- Mk-46 mod 5 torpedoes.

The torpedo tubes are placed in the torpedo stowage, at an angle of 45° in respect of the fore part of the ship. Launching takes place through a high pressure air impulse from a buffer tank (breech mechanism ± 180 bar) at the back of each launch tube.

From the Fire/Control Panel (TICAP) in the Command Center, the torpedo can receive settings. This regards searching depth, searching pattern, transmission mode, etc. The launch command is also given from here. If this is unsuccessful, firing can also be done near the tubes.

Setting modes may be:

- No Run Out the torpedo starts the searching pattern immediately after entering the water;
- Run Out the torpedo starts the searching pattern only at some distance of the ship.

Torpedoes of the type Mk-46 are equipped with an active, 30 kHz sonar for tracing their target. The Mk-46 is also able to find its target passively. This is done based on the noise of the target. The Mk-46 is driven on by a hot gas motor that runs on Otto fuel.

Otto fuel is a fuel that itself contains oxygen. Besides it being hard to extinguish in a fire, its vapors are harmful to human beings.

To clear Otto fuel, we have an 'Otto fuel case' at our disposal. This case is kept in the transfer space Goalkeeper.

The board helicopter, now a Westland Lynx, can carry and launch maximum 2 Mk-46 torpedoes. The Lynx can also trace submarines independently through a dipping sonar. However, the crew may also receive instructions orally from the ship in respect of the target. The Air Controller steers the heli then to a point where it must throw off its torpedoes.

The NH-90 helicopter will replace the Lynx as board helicopter. It will be able to carry at least the same weapon load and will have sensors. At the same time, it has a larger range of action.

M-frigates can store maximum one helicopter in the hangar.

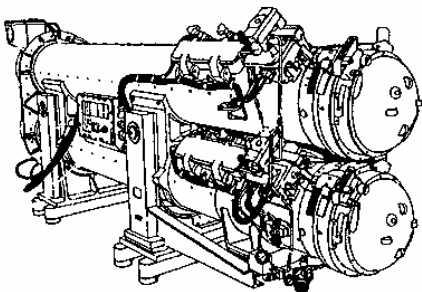
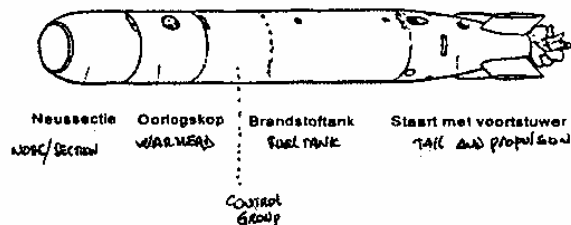


Fig. 5800.1 Ship's Torpedo Weapon System (STWS)

Fig. 5800.2 Torpedo MK 46 mod 5 A(S) Open Ocean



6000 Communication

We communicate all day long without noticing it. It has even become so normal that we only realize how important communication is when no communication is possible any more for whatever reason. We can categorize communication globally in Internal and External communication.

Internal communication.

This is the communication that each crew member deals with most, because the internal communication is accessible to everybody. Examples of internal communication are conference lines, cell strings, Point to Point connections, public addresses, AMUS/TV, stornophones and the telephone exchange. The last two are somewhat more special, because we could include them also in the external communication.

External communication

External communication is the communication with the outside world, while we distinguish here both speech and data connections. The data connections can be subdivided into telex and Link 11 connections. For these connections we use, among other things, transmitters, receivers, modems, crypto equipment.

The internal and external communication of an M-frigate together make up the Ship's INtegrated Communication System (SINCON 1200). The SINCOS 1200 has been developed around a communication network. This Fiber Optical Communication Network (FOCON) can be considered to be an internal communication system and a transport medium for, among other things, the external communication.

The SINCOS 1200 system is subdivided in three parts:

- Internal Communication System (ICS);
- External Communication System (ECS);
- Communication Control System (CCS) (2x SMR-4 + software CM1)

Internal Communication System (ICS)

FOCON

The communication on board the M-frigate has been developed around FOCON. The FOCON network has been developed serially around a glass fiber cable.

In the network the following units are included:

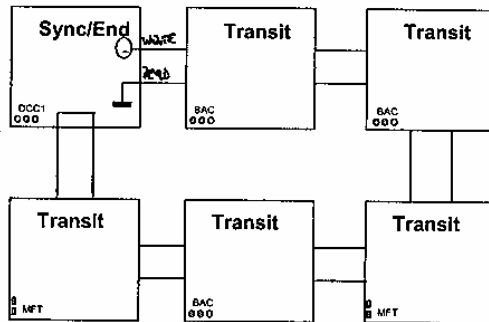
- 2 Data Channel Concentrators (DCC)
- 30 Bus Access Concentrators (BAC)
- 30 Multi Functional Terminals (MFT)
- 6 Automatic Coupling Units (ACU)

The system has been decentralized, because all the necessary control facilities are included in the network units. The network units have all been equipped with a micro processor.

Data transport over the glass fiber bus.

The "data" are sent as light impulses over the glass fiber bus. This glass fiber bus consists of two glass fibers, a writing and a reading line. Assuming there is a FOCON network in which all the units and all the glass fiber connections work correctly, one unit will provide the synchronization of the network. This unit will generate a "frame" and place it on the writing line. In this "frame" the other units will place their data on a spot of their own within this "frame". The writing line will arrive at the synchronization unit again in the end and this unit will now transmit the data of the writing line back over the reading line. All the units can now read the data

intended for them. The reading line will also reach the synchronizing unit again. This unit will know then that all the units have had the opportunity to read the data and will throw the data out.



Over the glass fiber network only digital information can be transmitted, which means that speech must first be digitalized.

Bus Access Concentrator

Because not all users can actually be included in the glass fiber circuit, a BAC provides the possibility of access to the FOCON network. Via a BAC maximum 8 users can be connected to FOCON. For the various users a separate interface card exists.

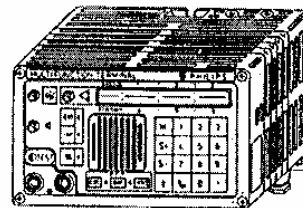
Examples of users that are connected to a BAC:

- External communications (transmitters, receivers, crypto)
- Single Function Terminals (SFTs) ;
- PABX (telephone exchange);
- Public Address (ship's internal broadcasting system);
- Cell Chains (Plot lines);
- The underwater telephone

Multi Functional Terminal

A MFT is a universal communication terminal that is actually included in the glass fiber circuit. It offers the user various communication possibilities, such as:

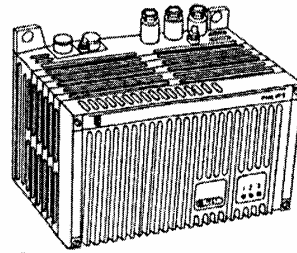
- Point to Point connections (PTP)
- Conference lines
- External connections
- Broadcasting
- Activation of alarm and/or closing signals
- Telephone connections



The user has access to these possibilities via four menus. The contents of these menus and the assigned functions of the MFT are provided by the Communication Controller (SMJR/SGT ODVB) by means of the Communication Control System (CCS). It is possible to maintain 18 connections with an MFT. However, only 8 connections can actually be used simultaneously.

Automatic Coupling Unit

If there is one interruption in FOCON nothing is the matter essentially. FOCON passes from a "loop" into one line. If another interruption is added, 2 lines come about and 2 networks therefore. As these 2 networks are not interconnected, this will result in loss of data. In order to prevent this, 6 ACUs or rather 3 ACU pairs have been included in FOCON. An ACU pair continuously compares the data that pass. If there are differences, the ACU will provide additions.

**Data Channel Concentrator**

Via the DCC, the FOCON network is connected to the Communication Control System (CCS). The CCS configures and examines the SINCOS 1200 system. This includes adaptation of a menu of an MFT or the assignment of a functionality to an SFT or MFT. The DCC is also used as an intermediary to CM1 for Remote Control Data and Telex Data.

Supply voltage of FOCON Units

The moment that a FOCON does not receive supply voltage and is therefore "off", the circuit is interrupted. It is therefore of importance for the operation of FOCON as a whole that all units are "on". Therefore each FOCON unit receives its supply voltage from 2 different PSUs.

PSU - Power Supply Unit

In addition to voltage for all FOCON units, the PSU supplies also voltage to, for example, Cell Chains and Talk Back speakers. The PSU consists of 2 independently operating voltages, each of which can feed 8 FOCON units. In total there are 14 PSUs.

EPU - Emergency Power Unit

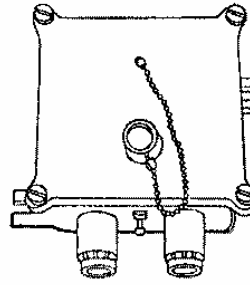
An EPU can take over the task of the PSU if it is defect or if the PSU does no longer receive 115V 60Hz. Like the PSU, the EPU also consists of 2 independent parts. The capacity of the batteries of both the EPUs is sufficient to feed the FOCON units for at least 45 minutes. The EPU is transferred by the PSU if the PSU notices via the SENSE line that the other PSU does not supply voltage any longer either. Via the outgoing SENSE lines, the PSU will also inform the FOCON units.

Conference lines and cell strings

Within FOCON 16 conference lines can be used. In addition, it is possible to participate in one of the 10 cell strings. These are plot lines that can be found all over the ship.

Linkage conference lines and cell strings

FOCON would not be FOCON if both lines could not be linked. Each cell string is connected with a BAC. In this manner it is possible to participate in a conference line from a cell string and the other way around. Linkage of the lines takes place through software in the CCS.

**Public Address (Broadcasting)**

Broadcasting is used, for instance, for

- informing the crew;
- giving orders;
- giving signals;
- reporting back;

The M-frigate knows the following three broadcasting units:

- Ship's broadcasting unit (SCHO)
- Engine room broadcasting unit (MKO)
- Maneuver broadcasting unit (MANO)

The broadcasting units can be used from fixed hail positions and from FOCON by means of an MFT or SFT. For the use from an MFT or SFT this option must have been assigned, however, in the CCS.

Alarm and closing signals

The speakers of the SCHO are also used for the alarm and closing signals. These signals have priority to hailing. It is possible to activate the alarm and closing signals both via FOCON and on the bridge. It is not possible to stop the signal after it has been activated. Just as in hailing from an MFT or SFT, this option must also be given for the alarm and closing signals. The alarm and closing signal also has its own telephone number.

Engine room broadcasting unit

The front and back engine rooms (VMK and AMK) and the diesel generator room (DGK) are equipped with a closed circuit, the Bils circuit. This closed circuit makes it possible to make the SCHO and the MKO audible with special hearing protection. Besides the SCHO and MKO, it is also possible to make an AMUS channel audible.

External Communication System (ECS)

The ECS is used to make radio connections with units outside of the own ship. This ranges from communication with civil shipping, such as fishery, merchant marine and pleasure cruising to marine ships but also communication with civil and military aircraft is possible. Another important form of communication is the communication with the shore.

The ECS can be divided into:

- VLF-LF-MF-HF system
- VHF system
- UHF system
- SHF system

The above systems are used for sending and receiving both speech, telex and data link information. Because it is relatively simple to tap radio connections, we often use crypto equipment. A connection using a crypto is called a "secure" connection; if no crypto is used, we speak of a "plain" connection. For this reason we can add the following system to the above systems :

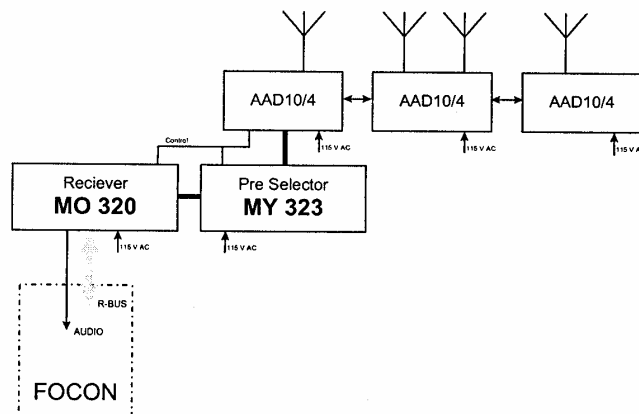
- Messages processing system

VLF-LF-MF-HF system

We can subdivide this system into a receiver and two radio transmitting systems.

VLF-HF Receiver system

Frequency area of 10 KHz to 30 MHz



This system consists of:

- 4 active antennas (bridge roof and fencing helideck)
- 3 Multicouplers (AAD-10/4)
- 12 Preselectors (MY-323)
- 12 Receivers (MO-320)

The multicouplers are used to distribute the 4 antenna signals over the connected receivers. The Preselectors function as a band filter for the frequency chosen on the receiver. The receivers are connected to FOCON via a BAC with respect to their audio signal and Remote Control Data.

Because we use FOCON as a transport medium and situations occur in which FOCON is not available and, nevertheless, we want to use specific external communication equipment, a number of sets have been equipped with an additional print between the set and the BAC to which they are connected. This FOCON Bypass card switches the set into a fixed chain so that it can still be used. We introduced here the term 'FOCON Bypass', which we will discuss later in more detail.

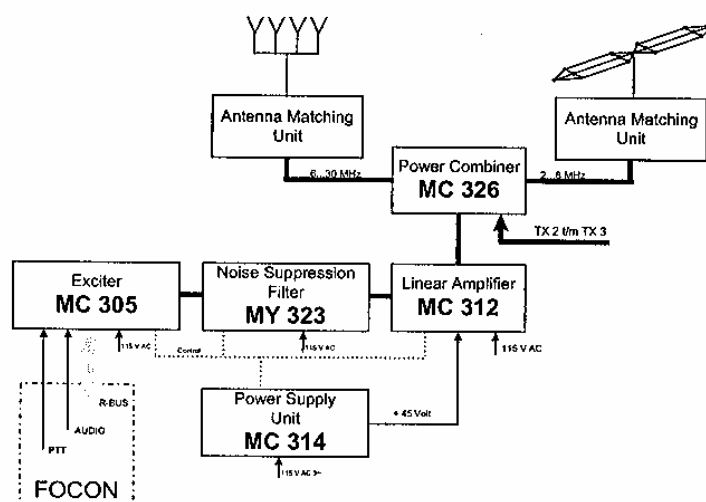
The receivers 1, 4 and 7 are equipped with such a bypass card.

HF Wideband radio transmitting system

The HF radio transmitting systems work in the frequency area of 1.5 to 30 MHz. If we look at the wave length that corresponds with these frequencies, we see that it ranges from over 100 m. for the lowest frequencies to 10 m. for the highest frequencies. This implies actually that the "length" of the antenna must be variable. For this reason most HF transmitters have been equipped with an "Antenna Tuning Unit", also called AMU or ATU. This is a combination of variable condensers and variable coils that "tune" the antenna to the chosen frequency.

HF Wideband radio transmitting system

Frequency area 2 to 30 MHz.



The HF WB radio transmitting system consists of:

- Wideband antenna system.
- Power combiner + crossover filters
- 4 identical HF transmitters

The outputs of the 4 transmitters are combined in a power combiner. The output of the combiner is subsequently distributed over the two antennas via the crossover filters (with the crossover point on 7.2 MHz).

WB antenna system

The WB antenna system consists of two antennas:

- WB low antenna (2-8 MHz)
- WB high antenna (6-30 MHz)

The WB low antenna consists of 2 sets of parallel wires of approx. 21 meters that work as a cage antenna. The wires run from the yard in the foremast to the chimney. In the yard the two sets are linked to an Antenna

Matching Unit (AMU). The WB high antenna consists of 4 telescopic antennas that are close to one another and which also work as a cage antenna. These antennas also come together in an AMU

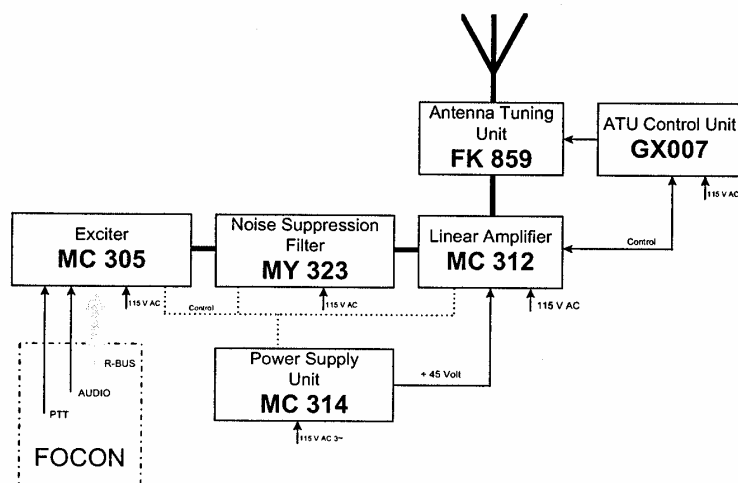
The AMU ensures :

- linkage of the 6 wires or 4 antennas
- impedance adjustment
- security against lightning
- security against NEMP (Nuclear ElectroMagnetic Pulse)

The combiner will combine the 4 signals into one signal. This is accompanied by a loss of capacity of 6.7 dB (approx. 75 %). In order to prevent large reflections at the entrance to the combiner, the loss of capacity is conducted to a water cooled dummy load.

HF Narrowband radio transmitting system

Frequency area 1.5 to 28 MHz.



The HF NB radio transmitting system consists of:

- 2 telescopic antennas
- 2 Antenna Tuning Units (ATU)
- 2 ATU control units
- 2 transmitters

Antenna

Each HF NB transmitter has its own HF telescopic antenna. This antenna is directly linked to the corresponding ATU. The ATU is used to link the 9-meter long telescopic antenna to the transmitter with 50 Ω . This is done by means of a variable LC network.

VHF system

By the VHF system we usually mean the mariphone, which points to the use of another VHF system, but we will discuss this later. The mariphone is used for civil / maritime purposes, such as emergency and security, public and nautical transport. Examples hereof are harbor office, towing services, bridgemen and lockkeepers, pilots, merchant marine and pleasure cruising.

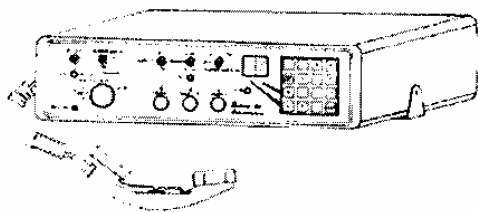
The frequency range of the mariphone varies from 156.025 - 163.000 MHz..

The VHF mariphone system consists of a transmitter/receiver that has been entered into the SINCOS 1200 system and a separate mariphone receiver that has not been entered into the system.

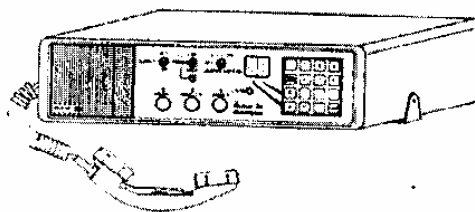
Sealand 66

The transmitter/receiver Sealand 66 consists of the following parts :

- MRT 66 (Transceiver)
- MRC 66 (Master Control Panel)
- SRC 66 (Slave Control Panel)



Master Control Panel of
VHF Mariphone in Radio Exchange



Slave Control Panel of
VHF Mariphone on the Bridge

MR4400

Besides Sealand 66, the MR4400 is available. This is a stand-alone VHF receiver.

UHF system

The UHF radio transmitting/receiving subsystem is part of the External Communication System of the SINCOS system and is intended for short distance communication (Line Of Sight). An overview of the total radio transmitting/receiving system is shown in BSMI 2323.

In the External Communication System the information is transported over a fiber optical communication network FOCON. By means of the FOCON the users can remote control the various transceivers. The UHF radio transmitting/receiving subsystem includes eight transceivers including two Guard Receivers linked to five antennas. The Guard Receivers (VHF and UHF) are intended for the reception of emergency signals.

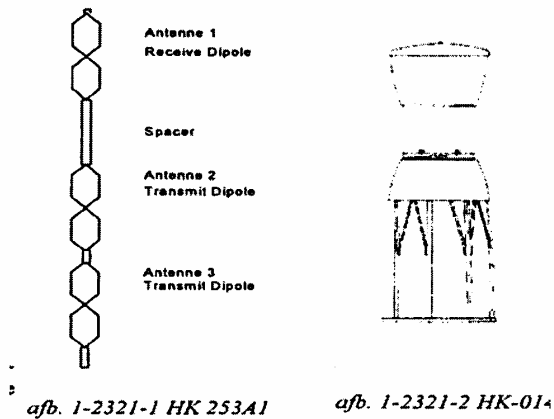
The UHF radio transmitting/receiving subsystem includes the following parts:

- Antennas (5 units)
- Antenna Patching Panel
- Multicouplers (4 units)
- Transceivers ERM 9000 (8 units)

-Antennas

For the UHF and VHF band two types of antennas are used:

- one Rohde & Schwarz HK 253A antenna. This is an omni directional (vertical polarization) UHF antenna for a frequency of 225 to 400 MHz. This antenna consists of three independent dipoles. The top dipole is used for reception and the two lower dipoles (antennas number 2 and 3) are used for transmission.
- four Rohde & Schwarz HK014 antennas. This is an omni directional (vertical polarization) UHF/VHF antenna for a frequency of 100 to 1300 MHz.



Antenna Patching Panel

The Antenna Patching Panel connects the seven UHF/VHF antennas to transmitters/receivers. The Patching Panel contains two splitters and two diplexer filters. The diplexer filter ensures the separation of UHF and VHF signals.

Multicouplers

Four Multicoupler systems have been placed in Cabinet Group UCI. The Multicoupler (TX or RX filters) makes it possible to switch several transceivers simultaneously to one antenna. As a result fewer antennas are required. Maximum eight Transceivers can be connected to the four Multicoupler systems.

A Multicoupler consists of four Filter Units FD 221. The filters are controlled by the UHF transceivers via the Interface Unit.

The filters are used as transmission filter or as receiver filter. A combination of a transmission and receiver filter in one multicoupler is not possible.

UHF Transceivers ERM 9000

The ERM 9000 is a multi mode UHF Transceiver that can be remotely or locally controlled via the front panel. The channel selection (99) can be done directly or via the preset channel. Automatic scanning of up to 99 channels is possible. The frequency range is: 225 MHz to 399.975 MHz in steps of 25 kHz. XCVR 1 also works in the frequency 100 MHz to 155.975 MHz. The output is 25 W (AM) and 40 W (FM). Eight UHF Transceivers have been placed in cabinet groups UC1, UC2 and RC2. Transceiver no. 1 and no. 2 have several additional functions. The additional functions of Transceiver no. 1 are:

- UHF/VHF Guard Receiver
- operational function for helicopter direction.

With the Helicopter Direction Officer (HDO) (normal/ bypass) switch the FOCON system can be passed by, while operation takes place via the Remote Control Panel.

The additional functions of Transceiver no. 2 are:

- UHF Guard Receiver
- prepared for frequency hopping (ECCM)

Transceiver no. 1 to 6 incl. can transmit and receive in the secure voice mode. For that purpose a Wide Band Secure Voice crypto unit (KY58) has been interposed.

Integration in the central system

The UHF radio transmitting/receiving subsystem is connected with the FOCON system via BACs. The XCVRs are set from a GOS. The operation takes place from an MFT (possibly an SFT).

SHF Satcom

The SHF Satellite Communication Installation (ElectroSpace Industries) provides Super High Frequency (SHF) radio communication via geo-stationary communication satellites. The system transmits in the 7.9-8.4 GHz frequency range and receives in the 7.25-7.75 GHz frequency range. This installation makes full duplex data/voice (plain/secure) communication with another SHF SATCOM station possible, via a selected satellite as an intermediate station. At the same time, there is the possibility of positioning.

The system contains two satellite antennas that direct themselves automatically at the beacon signal of the satellite. A tracking circuit keeps the antennas directed while one antenna (primary) is used for the communication. The system transfers automatically to the other antenna if the primary antenna loses track or if the reception quality is too low. In the event of signal loss of both antennas, they remain directed at the last contact point. If the contact has not been re-established within five minutes, the system will go in the search mode to localize the satellite again.

The Satellite Communication Installation consists of the following parts:

- Electronics Cabinet
- Interface Cabinet
- Power Amplifier Cabinet
- Prime Power Distribution Cabinet
- Antenna (2 units)
- Test horn

Electronics Cabinet

The Electronics Cabinet consists of the following units:

- Radio Frequency Selector; takes care of the route of the received signal of the antennas to the Down Converter and Tracking Converter.
- System Control Center; central operation and status monitoring of the entire system.
- Antenna Control Unit; based on ship position, satellite position and the course of the ship, provides the transmission and reception of information and orders via the SEU to the antennas to enable the system to find and track a satellite.
- Up Converter; converts a provided 70 or 700 MHz signal from the Baseband Interface (Interface Cabinet) into an SHF transmission signal for the Power Amplifier Radio Frequency Unit in the Power Amplifier Cabinet.
- Down Converter; converts the received SHF signal into 70 or 700 MHz for the Baseband Interface Unit (Interface cabinet).
- Tracking Converter; controls the tracking, through the satellite beacon signal and continues to adjust it via a track error signal. These data are sent to the Antenna Control Unit.
- Servo Electronics Unit A controls antenna A (BB)
- Servo Electronics Unit B controls antenna B (SB)
- Heat Exchanger; takes care of cooling of the cabinet and is kept at a certain temperature by the ship's cooling water.

Interface Cabinet

The Interface Cabinet contains the following units:

- Spectrum Analyzer; serves for testing the RF and IF signals and reading the TCON signal.
- Baseband Interface Unit; the interface between the system and maximum three external 70 MHz and three external 700 MHz modems.
- Frequency Standard; generates a 4 MHz reference signal for various units.
- Frequency Synthesizer; generates a 70 MHz signal adjustable between +3 and + 13 dBm for testing purposes.
- Storage Drawer; for storage purposes.
- Blower. for cooling the Cabinet.

Power Amplifier Cabinet

The Power Amplifier Cabinet contains the following units:

- Prime Power Isolator; contains a three-phase circuit interrupter for interrupting the voltage of all units and a safety circuit.
- Intermediate Power Amplifier; amplifies the SHF transmission signal of the Up-converter up to the required level for the TWT in the RF circuit.
- System Control Unit; control and monitoring of the Power Amplifier and the Interface with the System Control Center in the Electronics Cabinet.
- Radio Frequency Unit; contains a TWT, for the generation of the transmission signal (1600 W VSWR), with corresponding circuits.
- Power Supply Unit; generates all the supply voltages for the RF Unit and the IPA Unit.
- Heat Exchanger; ensures cooling of the cabinet and is maintained at a specific temperature by means of the ship's cooling water.

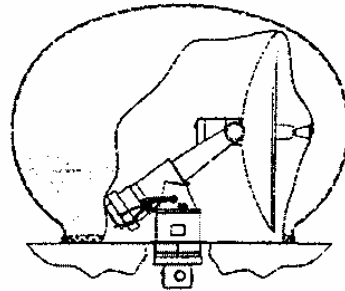
Prime Power Distribution Cabinet

All supplies for the installation are received from the Prime Power Distribution Cabinet. This cabinet is connected with the ship's supply. All the required operation units and signaling are visible on the front panel.

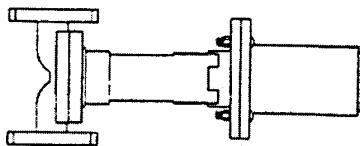
Antenna

The antenna is found in a spherical dome of 2.1 meter height. The system contains two antennas. One antenna consists of the following parts:

- Antenna Assembly; a revolving (in three directions) satellite antenna.
- Power Control Communications Unit; control and distribution of the supplies for the various parts.
- Radome Access Hatch Interlock Switch; an access hatch with a switch to switch off the antenna.
- Radome Heaters; for heating in the Radome
- Radome Light Assembly; for lighting in the Radome



Dome with antenna



Test horn

Test horn

The Test horn is used to test the system through a dummy load and provides average transmission and reception characteristics. The Test horn is a passive device, placed on the top deck (bridge deck).

Integration in the central system

The Satellite Communication Installation is connected with BAC 17 and 28 of the FOCON-A system. Via FOCON-A various modems can be connected. Currently we have two CDMA modems that work with 70 MHz. Through interfaces and crypto equipment, full duplex data/voice (plain or secure) communication lines can be set up.

7000 Core subsystem (KSS)

Overview KSS

The Core subsystem connects the SEWACO-VII subsystems through a triple Ethernet data bus. The KSS is sometimes considered to be the 'heart' of SEWACO-VII (see Fig. 7000.1, boxed part). In addition to the data bus, KSS also consists of several computers, radarscopes, VDUs and the RACO. Core subsystem is also denoted by the term SPIDER.

SPIDER is an acronym and stands for 'Ships Processor Interconnection and Data Exchange Resource'. SPIDER consists of both hardware and software.

SPIDER carries out the following tasks:

- Data Handling;
- Information Handling;
- Communication Control;
- Message Handling;
- various supporting functions;
- Man Machine Interface (MMI).

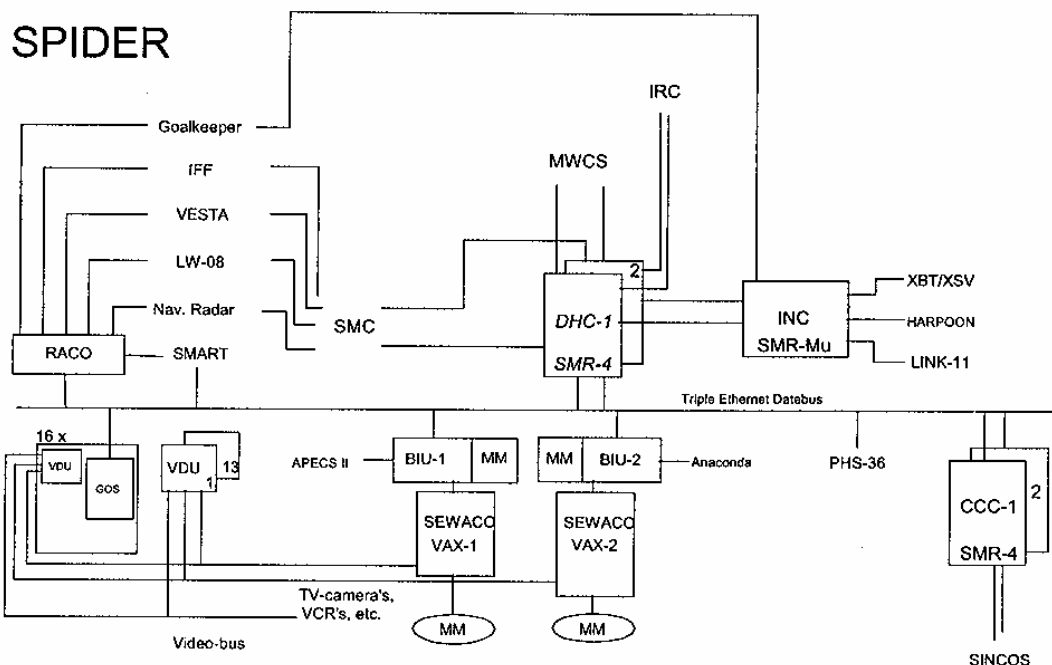


Fig. 7000.1 SPIDER (boxed part)

Tasks KSS

- By **Data Handling** we mean the collection, ordering and evaluation of tactical data on behalf of the command of the ship. These data may originate from internal sources (radars, EOVS, sonars and fire control), but also from external sources (AWACS aircraft, fleet units, shore installations, etc.). The external sources may also receive information from us, which takes place through a data link connection (Link-11).

Based on these data the command must take decisions with respect to the navigation of the ship, the use of weapons, etc.

- **Information Handling** has a number of more general assignments. For the WD the most important of these is the Diagnostic function. By means of this we can apply several tests to the SEWACO system through a Video Display Unit (VDU). In the Software part of this course we shall discuss this further.

Another function of Information Handling is to supply the need of distribution of general tactical data (call signs, etc.). This is done with what are called 'tote boards'. These can be defined and filled in by the users. Display is done via VDUs.

- Communication Control is one of the three parts of the ship's communication system SINCOS-1200. Functionally it is part of KSS, however. Communication Control provides the control of the FOCON glass fiber network. We should think here of settings of MFTs, transmitter/receivers, EMCON plan and the like.
- Message Handling has the task to process and store all the messages that we receive and send. This is, in fact, a complex database function, just as Information Handling.
- The various supporting functions of SPIDER are found in support of, for example, EOV and sonars.
- Man Machine Interface or MMI. An expression indicating that we as human beings must be able to communicate with the machine (SEWACO-VII). For SPIDER that MMI consists of 16 GOS displays and 29 VDUs.

KSS Computer systems

The KSS computer systems are divided as follows:

- 3 Data Handling Computers (DHC 1/2 and INC);
- 2 Communication Control Computers (CCC-1/2);
- 2 SEWACO VAX computers (VAX-1/2);

We see that DHC, CCC and VAX have been executed in a double manner. The motivation behind that is to provide redundancy to the SEWACO system. By **redundancy** is understood: **superfluous if the system works 100%**.

DHC-1 and DHC-2 can perform exactly the same work. They have identical interfaces with other subsystems and they are similarly programmed. The same is true between CCC-1 and CCC-2.

Both the SEWACO VAXs have also been executed redundantly.

The BIUs that are to be found between the VAXs and the data bus function as an interface to the data bus for the VAX concerned, but also for the Anaconda LRS, or for the APECS-II.

The INC, Interface Computer, has been executed in a singular version and functions as an interface between Data Handling and other subsystems (see Fig. 7000.1). It is a Data Handling subsystem computer, but does not belong actually to SPIDER.

The computers are physically distributed over the ship in 6 different cabinets.

We know three different kinds of cabinets:

- Data Handling Computer Cabinet (1 and 2);
- Communication Control Computer Cabinet (1 and 2);
- PROTEC cabinet (1 and 2).

Both DHC1/2 and CCC1/2 are military computers, made by Hollandse Signaalapparaten (HSA). The VAX computers are made by Digital (DEC). The PROTEC ensures that nevertheless they fulfill military specifications.

The cabinets are divided up proportionally again over two rooms:

- Sewaco Computer space - at the front;
- Sewaco Computer space - back.

DHCC1, CCC1 and PROTEC1 are at the front, the other three at the back.

Display subsystem

The display subsystem consists of 16 General Operator Stations, also called GOS displays and 8 GOS Drive cabinets. The GOS displays, together with the VDUs, form the Man Machine Interface of SPIDER (see Fig. 7020.1).

The GOS displays are all identical and their function is determined by software based on a code key (keycard) and password. By function we understand:

- Data Handling;
- EOY;
- ASW;
- Communication Controller;
- WD maintainer.

Two GOS displays are connected to one GOS Drive cabinet (GDC). The GDCs are set up in the Electronic cabin, behind the Command Center. One GOS display is set up in the Radio Exchange, the other 15 in the Command Center.

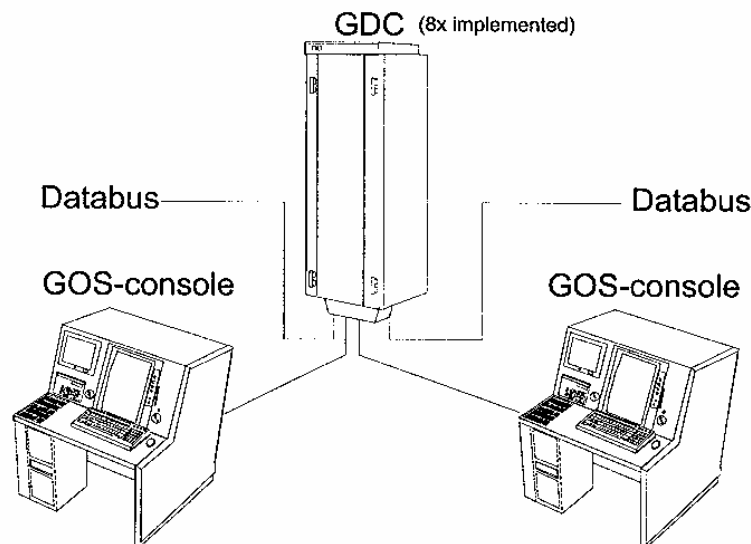


Fig. 7020.1 General Operator Station

Each GOS display has its own connections to the data bus. In this manner a GOS, for example, that functions as an ASW radarscope exchanges information and commands with the two sonar via the data bus. The PHS-36 itself is also directly connected to the data bus, the Anaconda via BIU-2. BIU-2 works then as an interface.

In fact, a GOS presents maximum 5 pictures simultaneously.

One picture concerns status information of the GOS itself and is shown at the bottom of the display.

The other four depend on the function. A Data Handling GOS may display a radar image received from RACO, a sea chart, an operation panel for various radars and RACO and what is called a 'tactical picture' with, among other things, track information.

The GOS can be operated by means of:

- a QWERTY keyboard;
- a Special Function Keyboard;
- a Roll-Ball;
- two hand wheels;
- a light pen.

A keycard reader is used to read the code key.

Video Display Units (VDUs)

The VDUs are terminals of the EWACO VAXs. They can be changed over from one SEWACO VAX to another.

The VDUs in the various bureaus (5 units in total) can also be changed over to the operational management VAX.

VDUs may be equipped with a tuner, which enables them to tune in to the ship's video network (CCTV). These VDUs are found in each GOS console, the Saloon and on the bridge near the Officer of the watch.

The VDUs in the GOS consoles use the QWERTY keyboard of the GOS.

The VDUs can be used for the following tasks:

- Remote Diagnostics (only WD staff);
- Information Handling (tote boards);
- Message Handling;
- CCTV (Closed Circuit TeleVision);
- VAX system management.

In total there are 29 VDUs. Their locations are:

- 17x Command Center;
- 3x Radio Exchange;
- 2x Bridge;
- 1x Saloon;
- 1x Cabin HOD;
- 1x Bureau WD;
- 1x Bureau TD;
- 1x Bureau OD;
- 1x Bureau Administration;
- 1x Bureau Supply.

In Fig. 7030.1 we see a VDU in its most complete version. With a tuner, its own keyboard and connection to the Operational Management VAX.

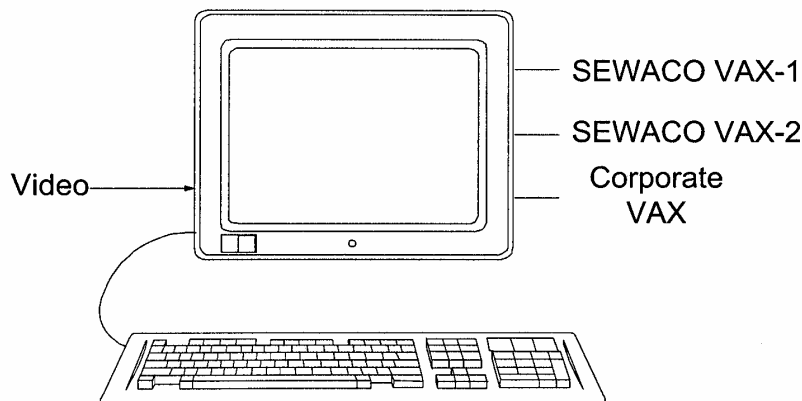


Fig. 7030.1 VDU

Data bus and interfaces

The Triple Ethernet Data bus provides the data transport between the various subsystems. It consists of the following parts:

- Transport medium: three physically separated triaxial cables processing transports independently of one another. There is expansion room for a fourth cable (is not there).
- Bus tap: a tap of a triaxial cable. To each bus tap maximum two users can be connected. Each user of the data bus has three bus taps.
- BICL: Bus Interface Control Logic. This forms an interface between the cables (via bus taps) and the user systems made by HSA. Each user has one BICL. To a BICL four bus taps can be connected.
- BIU: The Bus Interface Unit forms an interface between the bus and user systems not made by HSA (VAX, LRS and APECS). The BIU can connect four bus taps on the side of the data bus. On the side of the VAX two can be connected.

Data bus

The data bus is a triple version of Local Area Network (LAN) of the Ethernet type.

Ethernet works in accordance with the CSMA/CD principle.

CSMA/CD stands for: Carrier Sense, Multiple Access/ Collision Detection.

Ethernet is a serial bus (or carrier) that works without bus arbitrage. If a user wants to use the bus, he must scan the bus himself (Carrier Sense) to see if it is already used by one of the other users (Multiple Access). If the bus is free and minimal time has passed, the user will transmit his data in what is called 'frames'. Data are transmitted in Manchester code. This code has the advantage that the average DC level is 0 Volt. Each transmitting user must pay attention during transmission whether the average DC level changes. If so, we are dealing with two or more messages that are crossed. This is called a collision. As soon as this is detected, the users must stop their transmission. At any time the transmission procedure will be restarted, for the information had not yet been transmitted correctly.

Bus tap

The functions of the Bus tap are:

- forming a galvanically separated linkage between cable and user (BICL or BIU);
- Collision Detection.

BICL

In order to transmit information via the cable a BICL has been entered in users made by

HSA (or 'HOST' computers). The BICL retrieves information from the memory of its Host (SMR-4, GOS, PHS, etc.) and transmits it.

If information arrives via the cable that is destined for its Host, the BICL will write that information independently to the memory of its Host. This kind of behavior of an Input/Output device is called DMA or Direct Memory Access.

BIU

The BIU is a powerful multiprocessor computer used as an interface between the data bus and non-HSA Host computers. The BIU also functions as an interface between an Optical storage system (Mass Memory) and the data bus. Each Optical storage system consists of 7 recorders. Rewritable Optical Disk Cartridges (RODC) are used. In the Software part we shall discuss this further. The recorders are also called Digital Optical Recorders or DORs.

8000 VAX systems

The VAX systems within the Weapons Engineering Branch are used as a database.

There are two function areas for which VAX systems have been placed on board the ships:

- **NONBIS** systems (BSMI 2312)
- **BIS** systems (BSMI 2317)

The following VAX systems are part of the **NONBIS** (non Operation Information Systems):

- VAX4500 on behalf of the SEWACO system, in which the MHS (Message Handling System) on the M-frigates is integrated.
- VAX4400 on behalf of the MHS on the L-frigates, the ATS and the Supply ships.
- VAX4100 on behalf of the MHS on the ships of the MD, the boats of the OZD and shore installations.

The VAX8250 is part of the **BIS** (Operational Information Systems).

These VAX8250 can be found on board the L-, M-frigates, the ATS and the Supply ships. The VAX8250 is used for the VPA (Supply Point Administration) on behalf of the warehouse manager.

Both the BIS and the NONBIS system use the **OpenVMS Operating System**. The version of the Operating System (OS) depends on the application software used on the system. As a result, the OS version numbers of the two systems may differ.

The OS and the application software on behalf of the **NONBIS** systems is supplied by the **CAWCS**.

The OS and the application software on behalf of the **BIS** system is supplied by **DTO** (previously **CABIS**)

8100 VAX 8250 on behalf of VPA

The VAX8250 is found on M- and L- frigates, ATS and Supply ships and is used by the warehouse manager. On this VAX the Supply Point Administration (VPA) runs.

This entire system is placed in a Protection Cabinet, which supplies the sensitive computer equipment with voltage and protects it.

This protection cabinet is located in Sewaco computer space - at the back.

The VAX 8250 contains:

- 7 pieces RA 70 hard disks
 - Short list of the contents/destination of the disks:
 - \$1SDUA0 This is what is called the system disk. It contains, among other things, the system software and the system start files.
 - \$1SDUA1 This contains directories for the various users of the system.
 - \$1SDUA2 This contains data on behalf of the VPA.
 - \$1SDUB3 This disk is not used.
 - \$1SDUB4 This disk is not used.
 - \$1SDUB5 This disk contains a copy of the system disk.
 - \$1SDUB6 This disk is used for the "system" backup
- TK50 Cassette tape drive
 - Is used as input and output medium. Can be used, for example, for making and re-entering backups. The Tape capacity is 94.5 Mbytes. Writing/ reading of a full tape takes approx. 45 minutes.

There is a spare package (NSN 5895-01-340-3269) on board on behalf of a VAX8250 system, which consists of two large metal cases. At the same time it is possible to request assistance from the helpdesk of the SEWACO company. This procedure can be found in the Standard Order Book Commander.

VPA

From the point of view of DTO, the VAX8250 is a non-central site. That means that DTO is responsible for the (system) software and the application software that exists on the system. Installation and maintenance of the software are therefore carried out by DTO.

The direct management of the system has been delegated to what is called the LTSB (Local Technical System Manager).

This LTSB is directly under the Local Automation Coordinator. This is a function that is part of the function of the HWD. At the same time, the LTSB supports the LAC in the execution of the management of the PC means of automation.

The job description on behalf of BIS automation means is described in the Standard Order Book Commander. The LAC is the final responsible functionary on board with respect to all BIS automation means. The HLD is responsible for the VPA.

Part of the responsibility of the LTSB is the daily backup of the system. This backup is made via a command procedure that ensures that this backup is started up daily.

At fixed times, what is called an emergency procedure must be created. This is actually a paper print of the ship's supply. Because the capacity of the printers on board is insufficient for this, prints must be made at FSB/VAS. This emergency procedure must be used when the VAX8250 drop out.

Data traffic between IRC and IVS**Appendix a**

Oper. appliance VRA SB = dry start-up
Oper. appliance VRA BB = dry start-up
Pre-grease pump/pre-heating pump BB/SB
Circulation pump BB/ SB
Electric lubricant pump BB/ SB
Hydraulically driven smo pump BB/ SB
Separator
Cell force pump separator
Brst cell force pump KVD/DG/CV
Brst cell force pump HVGTT BB/ SB
Hydraulically driven zekow pump BB/ SB
Setting mode VRA SB/BB = MAN
Suction fan VMK LT/ AMK LT/ DGK LT/ VMK HT/ AMK HT/ DGK HT
Discharge ventilator VMK LT/ AMK LT/ DGK LT/ VMK HT/ AMK HT/ DGK HT
Cold water circulation pump
Zekow pump
Oil pump
Compressor V/A
Circulation pump
Primary pump
Steering pump
Drinking water pump
Compressor
Brbl pump (KMKV/VMK/DGK)
Service pump
Bilge pump PKDRW/ VMK/ DGK
Discharge pump front/ back
Vacuum pump
Electrically driven pump set
Transport pump
Feed pump
Smo transport pump
Sludge pump
Dirty smo pump
Compressor VMK/ AMK
Zekow pump
Charging pump
Operation mode VRA SB/BB = Trail end
LP compressor number of revolutions SB/ BB
Number of revolutions KVD SB/ BB
Actual propeller shaft number of revolutions SB/ BB
Fictitious propeller shaft number of revolutions SB/ BB
Propeller pitch SB/ BB
Number of revolutions DG 1,2,3,4
Relative Roll
Absolute Pitch
True Heading
Vlog alongships
Wind speed (relative)
Wind direction (relative)