

INTERNATIONAL STANDARD



**Maritime navigation and radiocommunication equipment and systems –
Automatic identification systems (AIS) –
Part 2: Class A shipborne equipment of the automatic identification
system (AIS) – Operational and performance requirements, methods of test
and required test results**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT
AND SYSTEMS – AUTOMATIC IDENTIFICATION SYSTEMS (AIS) –****Part 2: Class A shipborne equipment of the automatic
identification system (AIS) – Operational and performance
requirements, methods of test and required test results**

FOREWORD

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International Standard IEC 61993-2 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

This third edition cancels and replaces the second edition published in 2012. This edition constitutes a technical revision.

This edition includes the following technical changes with respect to the previous edition:

- a) it incorporates the technical characteristics included in Recommendation ITU-R M.1371-5:2014;
- b) it introduces the concept of locating device groups in order to include EPIRB AIS and MOB AIS in addition to AIS SART;
- c) it adds security features for configuration input by introducing a new sentence SSA;
- d) it adds optional implementation of IEC 61162-450/460 interfaces;
- e) it adds requirements for bridge alert management (BAM);
- f) it introduces extended dimension values used by towing vessels;
- g) it adds a software update requirement.

The text of this document is based on the following documents:

FDIS	Report on voting
80/888/FDIS	80/890/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61993 series, published under the general title *Maritime navigation and radiocommunication equipment and systems – Automatic identification systems (AIS)*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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INTRODUCTION

~~In comparison with the previous edition of this Standard, the structural changes to the document are that the original Clause 8 on DSC compatibility together with the corresponding tests in Clause 20 have been moved into a new Annex D. A new Clause on test signals has been added as Clause 10. The original Annex B detailing IEC 61162 sentences has been deleted and replaced with a new Annex H, noting that much of this information is now included in IEC 61162-1. The original Annex C describing long-range applications has also been deleted as IMO has decided to adopt a different system for long-range identification and tracking. A new Annex E has been added to describe optional presentation interface port sentences, a new Annex F has been added on alarm handling and a new Annex G has been added on calculation of area size and distance.~~

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – AUTOMATIC IDENTIFICATION SYSTEMS (AIS) –

Part 2: Class A shipborne equipment of the automatic identification system (AIS) – Operational and performance requirements, methods of test and required test results

1 Scope

This part of IEC 61993 specifies the minimum operational and performance requirements, methods of testing and required test results conforming to performance standards adopted by IMO in Resolution MSC.74(69):1998, Annex 3, ~~Shipborne Automatic Identification System~~. This document incorporates the applicable technical characteristics of Class A shipborne equipment included in Recommendation ITU-R M.1371-4 and takes into account the ITU Radio Regulations, where applicable. In addition, it takes account of IMO Resolution A.694(17) to which IEC 60945 is associated. When a requirement in this document is different from IEC 60945, the requirement of this document takes precedence.

This document also specifies the minimum requirements both for the means to input and display data and for the interfaces to other equipment suitable to be used as means of input and display data.

NOTE All text of this document that is identical to that in IMO resolution MSC.74(69):1998, Annex 3, or to that in ITU-R Recommendation M.1371-4 is printed in *italics*, and references to the resolution (abbreviated to "A3") or the recommendation (abbreviated to "M.1371") and paragraph numbers are indicated in parentheses, for instance (A3/3.3) or (M.1371-5/A2-3.3) respectively.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60945:2002, *Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results*

IEC 61108 (all parts), *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS)*

IEC 61162-1:2016, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners*

IEC 61162-2, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 2: Single talker and multiple listeners, high-speed transmission*

IEC 61162-450:2018, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 450: Multiple talkers and multiple listeners – Ethernet interconnection*

IEC 61162-460, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 460: Multiple talkers and multiple listeners – Ethernet interconnection – Safety and security*

IEC 62288, *Maritime navigation and radiocommunication equipment and systems – Presentation of navigation-related information on shipborne navigational displays – General requirements, methods of testing and required test results*

IEC 62388, *Maritime navigation and radiocommunication equipment and systems – Shipborne radar – Performance requirements, methods of testing and required test results*

IEC 62923-1, *Maritime navigation and radiocommunication equipment and systems – Bridge alert management – Part 1: Operational and performance requirements, methods of testing and required test results*

IEC 62923-2, *Maritime navigation and radiocommunication equipment and systems – Bridge alert management – Part 2: Alert and cluster identifiers and other additional features*

~~ITU-R Recommendation M.493-13, *Digital selective-calling system for the use in the maritime mobile service*~~

ITU-R Recommendation M.493-14, *Digital selective-calling system for the use in the maritime mobile service*

~~ITU-R Recommendation M.541-9, *Operational procedures for the use of digital selective-calling (DSC) equipment in the maritime mobile service*~~

ITU-R Recommendation M.541-10, *Operational procedures for the use of digital selective-calling equipment in the maritime mobile service*

ITU-R Recommendation M.825-3, *Characteristics of a transponder system using digital selective calling techniques for use with vessel traffic services and ship-to-ship identification*

ITU-R Recommendation M.1084-5:2012, *Interim solutions for improved efficiency in the use of the band 156-174 MHz by stations in the maritime mobile service*

~~ITU-R Recommendation M.1371-4, *Technical characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile band*~~

ITU-R Recommendation M.1371-5:2014, *Technical characteristics for an automatic identification system using time-division multiple access in the VHF maritime mobile band*

ITU-T Recommendation O.153, *Basic parameters for the measurement of error performance at bit rates below the primary rate*

IMO Resolution A.694(17), *General requirements for shipborne radio equipment forming part of the Global Maritime Distress and Safety System (GMDSS) and for electronic navigational aids*

IMO Resolution MSC.43(64), as amended by MSC.111(73), *Guidelines and Criteria for Ship Reporting Systems*

IMO Resolution MSC.74(69):1998, Annex 3, *Recommendation on performance standards for AIS*

IMO Resolution MSC.302(87), *Adoption of performance standards for bridge alert management*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.2 Abbreviated terms

AIS	automatic identification system
AIS-SART	AIS search and rescue transmitter
BAM	bridge alert management
BIIT	built-in integrity tests
BITE	built-in test equipment
BT	bandwidth-time
COG	course over ground
CommState	communication state

NOTE 1 Communication state is defined in Recommendation ITU-R M.1371. It is used to indicate whether the AIS is using the message structure for SOTDMA or ITDMA.

CRP	command-response pair
ECDIS	electronic chart display and information system
EPFS	electronic position-fixing systems
EPIRB-AIS	emergency positioning indicting radio beacon AIS
ETA	estimated time of arrival
EUT	equipment under test
FATDMA	fixed access time division multiple access
GMSK	Gaussian minimum shift keying
HDG	Heading
IMO	International Maritime Organization
ITDMA	incremental time division multiple access
Locating device	group of devices including AIS-SART, EPIRB-AIS and MOB-AIS
LR	long-range
MAC	medium access control
MD5	Message-Digest Algorithm 5
MKD	minimum keyboard and display
MMSI	maritime mobile service identity
MOB-AIS	man overboard AIS device
NavStatus	navigational status

NOTE 2 Navigational status is defined in Recommendation ITU-R M.1371. It consists of information that can be input by the ship's crew to indicate whether the ship is underway, moored, etc.

NSS	nominal start slot
NTS	nominal transmission slot

NUC	not under command
PC	performance check
PER	packet error rate
PI	presentation interface
PT	performance test
RAIM	receiver autonomous integrity monitoring
RATDMA	random access time division multiple access
RF	radio frequency
ROT	rate of turn
SI	selection interval
SOG	speed over ground
SOTDMA	self organizing time division multiple access
UTC	universal time co-ordinated
VDL	VHF data link
VSWR	voltage standing wave ratio
Rx	Receive
Tx	Transmit

~~NOTE 3 – Abbreviations related to IEC 61162-1 are not included in the above list. For their meanings refer to that standard.~~

4 General requirements

4.1 General

4.1.1 Overview

Requirements contained in Clause 4 are requirements not taken up in other clauses and are verified by observation and inspection of documented evidence. These requirements include the applicable general and operational requirements of IEC 60945:2002, as detailed in Clause 6 ~~– (Operational checks)~~, Clause 13 ~~– (Maintenance)~~, Clause 14 ~~– (Equipment manuals)~~ and Clause 15 ~~– (Marking and identification)~~ of IEC 60945:2002.

The manufacturer shall declare compliance with these requirements and shall provide relevant documentation. The declarations, documentation and, where necessary, the EUT shall be checked or verified by inspection.

The manufacturer shall also declare the composition of the EUT and the category for durability and resistance to environmental conditions for each unit of the EUT as specified in IEC 60945.

4.1.2 General requirements

(A3/1.1) *This document specifies the requirements for the AIS.*

(A3/1.2) *The AIS shall improve the safety of navigation by assisting in the efficient navigation of ships, protection of the environment, and operation of Vessel Traffic Services (VTS), by satisfying the following functional requirements:*

- *in a ship-to-ship mode for collision avoidance;*
- *as a means for littoral States to obtain information about a ship and its cargo; and*
- *as a VTS tool, i.e. ship-to-shore (traffic management).*

4.1.3 Capabilities of the AIS

(A3/1.3) *The AIS shall be capable of providing to ships and to competent authorities, information from the ship, automatically and with the required accuracy and frequency, to facilitate accurate tracking. Transmission of the data shall be with the minimum involvement of ship's personnel and with a high level of availability.*

4.1.4 Additional requirements

(A3/1.4) *The installation, in addition to meeting the requirements of the Radio Regulations, applicable ITU-R Recommendations and the general requirements as set out in resolution A.694 (17), shall comply with the following performance standards, as contained in the following clauses.*

4.1.5 Transmitter shutdown procedure

(M.1371-5/A2-2.13) *An automatic transmitter hardware shutdown procedure and indication shall be provided in case a transmitter continues to transmit for more than 2 s. This shutdown procedure shall be independent of software control.*

4.1.6 Quality assurance

The Administration shall require that the manufacturers have a quality control system audited by a competent authority to ensure continuous compliance with the type approval conditions. Alternatively, the Administration may use final product verification procedures where a competent authority verifies compliance with the type approval certificate before the product is installed on board ships.

NOTE The ISO 9000 series, as applicable, meets this requirement.

4.2 Modes of operation

(A3/2.1) *The system shall be capable of operating in a number of modes:*

- 1) *an "autonomous and continuous" mode for operation in all areas. This mode shall be capable of being switched to/from one of the following alternate modes by a competent authority;*
- 2) *an "assigned" mode for operation in an area subject to a competent authority responsible for traffic monitoring such that the data transmission interval and/or time slots may be set remotely by that authority;*
- 3) *a "polling" or controlled mode where the data transfer occurs in response to interrogation from a ship or competent authority.*

The Class A AIS shall be capable to receive and process DSC channel management telecommands conforming to the provisions of Recommendations ITU-R M.493, ITU-R M.541, ITU-R M.825 (see Annex C).

A user shall be able to switch off transmissions. There shall be a visual indication when Class A AIS will not transmit (silent mode). Interrogations shall not be responded in this mode.

NOTE IMO Resolution A.917(22) states that AIS should always be in operation when ships are underway or at anchor. If the master believes that the continual operation of AIS might compromise the safety or security of his/her ship, the AIS is permitted to be switched off.

4.3 Manuals

In addition to the requirements of IEC 60945:2002, Clause 14, the manuals shall include:

- the type and details of all external connectors (including the pilot plug) referred to in 7.6;
- the needed information for correct siting of the antennas;

- the requirements for external illumination, as appropriate;
- description for each alert that may be released by the AIS. The description shall briefly explain the root causes for each alert, give guidance for users on what implications the alert has for safe operation of ship and what actions may be necessary to rectify the alert condition.

4.4 Marking and identification

In addition to the requirements of IEC 60945:2002, Clause 15, the markings shall include:

- details of the power supply from which the equipment is intended to be operated; and,
- if applicable, the date by which batteries need to be replaced.

5 Other requirements

5.1 Environmental, power supply, special purpose and safety requirements

The AIS shall be tested for compliance with the environmental, power supply, special-purpose and safety requirements of IMO [Resolution A.694\(17\)](#) as detailed in IEC 60945. The required tests, for which a repeatable method of measurement has been defined, are given in Clauses 11, 12 and 13. The declaration of category to IEC 60945:2002, Clause 4, shall define the relevant tests to be applied as follows:

- AIS equipment declared for protected installation shall meet the requirements described in Table 3, column "protected", of IEC 60945:2002;
- exposed AIS equipment shall meet the requirements described in Table 3, column "exposed", of IEC 60945:2002;
- portable AIS equipment shall meet the requirements of Table 3 of IEC 60945:2002, columns "protected" or "exposed", as appropriate.

5.2 Display of information

The AIS shall be tested as applicable against the requirements for presentation of information contained in IEC 62288 (see 14.9.9).

5.3 Update of software

The AIS shall provide means for updating software of the equipment and to display, on demand, the current applicable software version.

6 Performance requirements

6.1 Composition

(A3/3.1) *The AIS shall comprise (see Annex A):*

- 1) *a communication processor, capable of operating over a range of maritime frequencies, with an appropriate channel selecting and switching method, in support of both short (VHF) and long (beyond VHF) range applications.* For long-range applications, the AIS shall provide a two-way interface (see 7.6.4);
- 2) at least one transmitter, two TDMA receiving processes and one dedicated continuous DSC receiving process tuned to channel 70;
- 3) *a means of processing data from an electronic position-fixing system which provides a resolution of one ten thousandth of a minute of arc and uses the WGS 84 datum.*

An interface (see 7.6.2) shall be provided to input the position used for navigation. Position information, if available from other EPFS, shall be used only as a back-up, and the user shall be informed of this (see 6.10).

- 4) *a means to automatically input data from other sensors meeting the provisions as specified in 6.5.1 point 2)*; a means, external to the AIS, to comply with this requirement shall be tested to the applicable requirements of IEC 60945.
- 5) *a means to input and retrieve data manually*. The possibility of manual input and retrieval as described in 6.11 shall be demonstrated based on the manufacturer's documentation;
- 6) *a means of error checking the transmitted and received data* (see Clause 7); and
- 7) *built-in test equipment* (~~BITE~~ BITE) as specified in 6.10.1.

(A3/3.2) *The AIS shall be capable of:*

- 1) *providing information automatically and continuously to a competent authority and other ships, without involvement of ship's personnel;*
- 2) *receiving and processing information from other sources, including that from a competent authority and from other ships;*
- 3) *responding to high priority and safety related calls with a minimum of delay;*
- 4) *providing positional and manoeuvring information at a data rate adequate to facilitate accurate tracking by a competent authority and other ships* (see 6.5.2).

6.2 Time and position

6.2.1 Source for UTC

The AIS shall be provided with an internal GNSS receiver as primary UTC source which is required for synchronisation purposes and for fall-back position, COG and SOG.

NOTE 1 UTC includes a provision for leap seconds.

The internal GNSS receiver shall meet the following requirements of IEC 61108 (all parts): position accuracy, COG/SOG, acquisition, re-acquisition, receiver sensitivity, RF dynamic range, interference susceptibility, position update, failure warnings, status indications and integrity flag.

NOTE 2 IMO Resolution MSC.74(69):1998, Annex 3, requires the AIS to have a means of processing data from an electronic position fixing system that provides a resolution of one ten-thousandth of a minute of arc and uses the WGS 84 datum (see 6.1).

If the manufacturer intends to use the internal GNSS as the ship's position source, the internal GNSS receiver shall be type approved in accordance with IEC 61108 (all parts) under the highest load condition of the AIS processor, and the sentences DTM, GNS, GBS, and RMC shall be output on a dedicated port.

If date and time from the internal GNSS are not available and Message 4 or 11 is being received, the unit shall use date and time from that message, and the seconds shall be omitted.

6.2.2 Source for AIS position reporting

The source for position reporting may vary depending on the conditions specified in 6.10.2.5.

When the external position is unavailable, the internal GNSS receiver may be used as a source for AIS position reporting.

When the internal GNSS receiver is performing as a source for AIS position reporting,

- an appropriate built-in integrity test (BIIT) indication shall be output on the presentation interface (see 6.10.1),
- the position data shall be available on the minimum keyboard and display (see 6.11.1), and

- the internal GNSS receiver shall be capable of being differentially corrected, at least by evaluation of Message 17.

Where DGNSS corrections are received from multiple sources, the DGNSS corrections from the nearest DGNSS reference station should be used taking into account the Z count, and the health of the DGNSS reference station.

The AIS shall be capable of detecting the specific type of electronic position fixing device by decoding the IEC sentence talker ID from the external sensor. When detected, the AIS shall automatically over-ride the electronic position fixing system setting. The talker IDs described in Table 1 shall be supported.

Table 1 –Talker IDs for automatic detection of electronic position fixing system type

IEC talker ID	Value in AIS messages	Type of electronic position fixing system
GP	1	GPS
GL	2	GLONASS
GN	3	Combined solution
LC	4	Loran C
IN	6	Integrated navigation system
GA	8	Galileo
Other	0	Undefined

6.3 User interface

(A3/4) *To enable a user to access, select and display the information on a separate system, the AIS shall be provided with an interface conforming to an appropriate international marine interface standard.*

All interfacing shall be made via the system interface as described in 7.6 (called the presentation interface).

6.4 Identification

(See 14.1)

(A3/5) *For the purpose of ship and message identification, the appropriate Maritime Mobile Service Identity (MMSI) number shall be used.*

The unit shall be supplied with a default MMSI of "000000000" (this is not a valid MMSI).

The unit shall check that any programmed MMSI is between 200000000 and 799999999 or between 982000000 and 987999999, otherwise the unit shall reject the programming and be not capable of transmitting. However, a reset to the default value "000000000" shall be accepted, but the unit shall not be capable to transmit with this MMSI.

For the purpose of identifying the manufacturer and model number of the equipment, the unit shall contain a vendor identification code as defined by ITU-R M.1371-5:2014, Message 24B and Table 79A.

6.5 Information

(See 14.3)

6.5.1 Information provided by the AIS

(A3/6.1) *The information provided by the AIS shall include:*

1) *Static:*

- *IMO number (where available)*
- *Call sign & name*
- *Length and beam*
- *Type of ship*
- *Location of the in use position-fixing antenna on the ship (aft of bow and port or starboard of centreline)*

Static information and the MMSI shall be stored in non-volatile memory devices.

AIS shall, in addition to the dimension/reference for position of own ship, support dimension extensions to the ship to describe the overall dimensions of a vessel and its tow. In such a case, the dimension values transmitted in Message 5 are the sum of the dimension reference values of own ship and the dimension extension values. Annex I provides information about the implementation of extended tow dimension values.

2) *Dynamic:*

- *Ship's position referenced to WGS 84 datum with accuracy indication and integrity status*
- *Time in UTC, the date is established by the receiving equipment*
- *Course over ground (COG)*
- *Speed over ground (SOG)*
- *Heading*
- *Navigational status (e.g. not under command (NUC), at anchor, etc. – manual input)*
- *Rate of turn (where available)*

3) *Voyage related:*

- *Ship's draught*
- *Hazardous cargo (type; as required by a competent authority)*
- *Destination and estimated time of arrival (ETA) (at master's discretion)*

4) *Short safety-related messages*

However, pre-configured safety related messages (for example with "MAYDAY", "DISTRESS" and distress communication text) shall not be provided.

NOTE IMO COMSAR.1/Circ.46:2009 advises that short safety-related messages are not incorporated in AIS equipment because there is no SAR infrastructure in place to accommodate them.

6.5.2 Information reporting intervals

(A3/6.2) *The different information types are valid for a different time period and thus need a different reporting interval.*

Static information: *Every 6 min, when data has been amended, and on request.*

Dynamic information: *Dependent on speed and course alteration according to Table 2*
 Every 3 min for long-range broadcast message (see 8.3).

Voyage related information: *Every 6 min, when data has been amended, and on request*

Safety-related message: *As required*

NOTE An SSD or VSD sentence that does not amend the data does not generate a transmission of Message 5.

Table 2 – Information reporting intervals for autonomous mode

Type of Ship	Reporting interval	
Ship at anchor or moored and not moving faster than 3 knots	3	min
Ship at anchor or moored and moving faster than 3 knots	10	s
Ship with a speed of between 0 – 14 knots (default)	10	s
Ship with a speed of between 0 – 14 knots and changing course ^a	3 1/3	s
Ship with a speed of between 14 – 23 knots	6	s
Ship with a speed of between 14 – 23 knots and changing course	2	s
Ship with a speed of greater than 23 knots	2	s
Ship with a speed of greater than 23 knots and changing course	2	s
^a Indicated by a change in ship's heading.		

(M.1371-5/A1-4.2.1) *The reporting interval shall decrease to 2 s when the station determines that it is the semaphore.*

If the autonomous mode requires a shorter reporting interval than the assigned mode, the AIS shall use the autonomous mode reporting interval.

When transmitting on a single channel, the reporting interval shall be maintained by doubling the number of transmissions on the active channel.

When NavStatus is "at anchor", "moored", "aground" or "undefined" and the vessel is moving faster than 3 kn ~~alarm~~ BIIT ID 10 (see Table 3) ~~should be generated~~ shall be activated. The reporting interval shall be in accordance with Table 2.

When NavStatus is under way and SOG is less than 1 kn for more than 2 h, ~~alarm~~ BIIT ID 10 ~~should~~ shall be generated.

6.5.3 Ship reporting capacity

(A3/6.2) *The system shall be able to handle a minimum of 2 000 reports per minute, to adequately provide for all operational scenarios envisioned.*

However, the AIS mobile unit shall be capable of processing all messages on the VDL.

6.6 Event log

(See 14.4)

(A3/6.3) *A security mechanism shall be provided to detect disabling of the AIS and to prevent unauthorised alteration of input or transmitted data. To protect the unauthorised dissemination of data, the IMO guidelines (IMO Resolution MSC.43(64), ~~Guidelines for Ship Reporting Systems~~) shall be followed.*

Means shall be provided to automatically record all periods when the AIS installation is ~~nonfunctioning~~ not transmitting position reports according to required reporting interval as described in Table 2 for more than 15 min, for instance when the power is switched off, when the AIS is in ~~receive-only~~ silent mode or not transmitting for other reasons, ~~as follows~~.

The last 10 times when the equipment was non-functioning for more than 15 min shall be recorded, in UTC time and duration, in a non-volatile ~~memory~~ event log. ~~Means shall be provided to recover this data.~~ The recorded data shall be displayed on the MKD and output on request using the TRL sentence. It shall not be possible for the user to alter any information recorded in ~~this memory~~ the event log.

Transmission of position reports as a response to interrogation shall not be used as an indicator of functioning.

Equipment which is not transmitting position report and static data autonomously shall be considered as nonfunctioning.

6.7 Permissible initialization period

(See 14.6)

(A3/7) *The installation shall be operational within 2 min of switching on.*

NOTE Sensors used with the AIS meet the requirements of their individual product standards (for example – IEC 61108-1 for GPS which permits 30 min to operation when there is no valid almanac data available, or IEC 61108-2 for GLONASS).

6.8 Power supply

(A3/8) *The AIS and associated sensors shall be powered from the ship's main source of electrical energy. In addition, it shall be possible to operate the AIS and associated sensors from an alternative source of electrical energy.*

6.9 Technical characteristics

(See 14.7)

(A3/9) *The technical characteristics of the AIS such as variable transmitter output power, operating frequencies (dedicated internationally and selected regionally), modulation, and antenna system shall comply with the appropriate ITU-R Recommendations.*

Additionally, there shall be a low power setting of 1 W which is automatically adopted when the vessel type is a "tanker" and the NavStatus is "moored" and not moving faster than 3 kn. This is to facilitate low power operation when loading and unloading.

There shall be an indication to the user when the low power setting is in operation and output of appropriate TXT sentences to the PI.

6.10 ~~Alarms~~ Alerts and indications, fall-back arrangements

(See 14.8)

6.10.1 Built-in test equipment

6.10.1.1 General

The AIS shall be equipped with BIIT to implement BITE. These tests shall run continuously or at appropriate intervals simultaneously with the standard functions of the equipment. ~~These tests shall be run whenever software has been updated (see 5.3).~~

If any failure or malfunction is detected that will significantly reduce integrity or stop operation of the AIS, an ~~alarm~~ alert is initiated.

NOTE The expression "BIIT ID xx is activated" in the test subclauses means that the EUT enters the appropriate active state. The expression "BIIT ID xx is inactivated" in the test subclauses means that the EUT enters the appropriate inactive state, when the alert condition is rectified.

~~In this case (see Annex F)~~

- ~~• the alarm shall be displayed on the MKD;~~
- ~~• the alarm relay shall be set "active";~~
- ~~• an appropriate alarm message shall be output via the presentation interface upon occurrence and repeated every 30 s.~~

~~If a change of a relevant system status as described below is detected, an indication is given to the user. In this case~~

- ~~• the indication shall be accessible on the MKD;~~
- ~~• an appropriate TXT sentence shall be output via the presentation interface.~~

~~6.10.2 Alarm messages~~

~~6.10.2.1 Using the ALR formatter~~

~~An ALR sentence is used to indicate a failure or malfunction that will significantly reduce integrity or stop operation of the AIS.~~

~~Alarm messages shall be IEC 61162-1 compliant "\$AIALR" sentences on the presentation interface output port.~~

~~The following parameters of this sentence formatter:~~

- ~~• time of alarm condition change (UTC);~~
- ~~• unique alarm number (identifier) at alarm source;~~
- ~~• alarm condition;~~
- ~~• alarm's acknowledge state;~~
- ~~• alarm's description text;~~

~~shall be set according to Table 2.~~

~~The "alarm condition" field shall be set to "A" when the alarm condition threshold is exceeded, and "V" when the alarm condition returns to a level that does not exceed the threshold. During healthy conditions (no alarm condition) an empty ALR sentence shall be sent at one-minute intervals.~~

~~The acknowledged state flag shall be set after acknowledgement of an alarm internally by means of the MKD or externally by a corresponding ACK sentence.~~

~~The local alarm identifiers (alarm ID) given in Table 2 are defined for the use with formatters ALR, ACK, and as text identifiers in TXT sentences to link associated messages. ALR sentences with "alarm numbers" greater than 099 cannot be followed by TXT sentences containing additional information by using the TXT sentence's "text identifier". The "text identifier" is limited to the range of 01 to 99.~~

~~Additional numbers may be used by the manufacturer for other purposes but shall be in the range 051 to 099.~~

6.10.1.2 Monitoring of functions and integrity

In case a failure is detected in one or more of the following functions or data, ~~an alarm shall be triggered and~~ the system shall react as given in Table 3.

Table 2 — Integrity alarm conditions signalled using ALR sentence formatter

Alarm's description text	Alarm condition threshold exceeded	Alarm condition not exceeded	Alarm ID or Text Identifier	Reaction of the system to the alarm condition threshold exceeded
AIS: Tx malfunction	A	√	001	Stop transmission
AIS: Antenna VSWR exceeds limit	A	√	002	Continue operation
AIS: Rx channel — 1 malfunction	A	√	003	Stop transmission on affected channel
AIS: Rx channel — 2 malfunction	A	√	004	Stop transmission on affected channel
AIS: Rx channel 70 malfunction	A	√	005	Continue operation
AIS: general failure	A	√	006	Stop transmission
AIS: UTC sync invalid	A	√	007	Continue operation using indirect or semaphore synchronisation
AIS: MKD connection lost	A	√	008	Continue operation with "DTE" set to "1" ^a
AIS: internal / external GNSS position mismatch	A	√	009	Continue operation
AIS: NavStatus incorrect	A	√	010	Continue operation
Heading sensor offset	A	√	011	Continue operation
AIS: active AIS-SART	A	√	014	Continue operation
AIS: external EPFS lost	A	√	025	Continue operation (refer to Table 4)
AIS: no position sensor in use	A	√	026	Continue operation (refer to Table 4, priority 6)
AIS: no valid SOG information	A	√	029	Continue operation using default data
AIS: no valid COG information	A	√	030	Continue operation using default data
AIS: Heading lost/invalid	A	√	032	Continue operation using default data ^b
AIS: no valid ROT information	A	√	035	Continue operation using default data ^b
^a — Applicable if MKD is only means of display.				
^b — When so configured.				

Alarm ID 001 shall be activated when

- the integrity of the VDL would be degraded by incorrect transmitter behaviour (for instance in case of the Tx shutdown procedure has operated);
- the unit is not able to transmit for technical reasons or missing or invalid MMSI.

Alarm ID 11 shall be activated when SOG is greater than 5 kn and the difference between COG and HDT is greater than 45° for 5 min.

Table 3 – Required conditions for BIIT and reaction of the system to the condition detected

BIIT ID	Description text	Reaction of the system to the condition detected
14	Active locating device	Continue operation
6	General failure	Stop transmission
1	Tx malfunction	Stop transmission
3	Rx channel 1 malfunction	Stop transmission on affected channel
4	Rx channel 2 malfunction	Stop transmission on affected channel
26	No position sensor in use	Continue operation (refer to Table 7, priority 7 and timestamp value 63)
2	VHF Antenna VSWR exceeds limit	Continue operation
5	Rx Channel 70 malfunction	Continue operation
7	UTC sync invalid	Continue operation using indirect or semaphore synchronisation
9	Internal/external GNSS position mismatch	Continue operation
10	NavStatus incorrect	Continue operation
11	Heading sensor offset	Continue operation
25	External EPFS lost	Continue operation (refer to Table 7)
29	No valid SOG information	Continue operation using default data
30	No valid COG information	Continue operation using default data
32	Heading lost/invalid	Continue operation using default data ^a
35	No valid ROT information	Continue operation using default data ^a
8	MKD connection lost	Continue operation with DTE set to 1 ^b
^a When so configured.		
^b Applicable if MKD is the only display.		

BIIT ID 1 shall be activated when:

- the integrity of the VDL would be degraded by incorrect transmitter behaviour (for instance in case of the Tx shutdown procedure has operated);
- the unit is not able to transmit for technical reasons or missing or invalid MMSI.

BIIT ID 11 shall be activated when SOG is greater than 5 kn and the difference between COG and HDT is greater than 45° for 5 min.

BIIT ID 14 shall be activated when an active locating device is received and shall be inactivated when all active locating devices have been removed from target list. While BIIT ID 14 and related alert are active, they shall not be reactivated (i.e. shall not assume state "Active, unacknowledged") owing to receipt of another active locating device.

The operator shall be provided with the option to enable or disable the "AIS location devices" alert function. The default setting should be 'enabled'. When the alert function is 'disabled', the equipment shall not raise the BIIT ID 14 alert (the alert remains in state 'normal').

AIS shall release alerts based on the conditions detected by BITE as described in Table 4. Classification, handling, presentation and reporting of alerts shall comply with requirements stated in IEC 62923-1.

Table 4 – Classification of required alerts

Required BAM alert instance						BIIT ID
Alert identifier	Alert text (1st ALF)	Additional information (2nd ALF)	Prio	Cat	Escal	
3108	Locating device	Check AIS targets	W	B	W	14
3062	General fault	Check AIS equipment	W	B	W	6
3008	Transceiver fail	Not transmitting, check AIS	W	B	W	1
		Not receiving, check AIS	W	B	W	3, 4
3015	Lost position	Own ship position not transmitted	W	B	W	26
3116	Impaired radio	Reduced coverage (antenna VSWR)	C	B	-	2
		Ch1 inoperative, check AIS	C	B	-	3
		Ch2 inoperative, check AIS	C	B	-	4
		DSC inoperative	C	B	-	5
3113	Sync in fallback	Check AIS for UTC time synchronisation	C	B	-	7
3003	Lost ext EPFS	Check external position sensor	C	B	-	25
3119	Missing COG	Not transmitting COG	C	B	-	30
	Missing SOG	Not transmitting SOG	C	B	-	29
	Missing Heading	Not transmitting Heading	C	B	-	32
	Missing ROT	Not transmitting Rate of Turn	C	B	-	35
3013	Doubtful GNSS	Int/Ext GNSS position mismatch	C	B	-	9
	Doubtful heading	Difference with COG exceeds limit	C	B	-	11
3019	Wrong NavStatus	Check NavStatus setting	C	B	-	10
3009	Lost MKD	Cannot display safety related messages	C	B	-	8

"Rectified, unacknowledged (U)" state is not required to be implemented by any of the alerts required by this document.

When, at installation, the following sensors are not connected to the AIS, the corresponding functions of the equipment shall not raise alerts regarding this disengaged functionality:

- external EPFS lost;
- heading lost/invalid;
- no valid ROT information.

6.10.1.3 Legacy translation of alerts

AIS shall provide a function for translating BAM alerts to legacy ALR alarm states and further output the translated alerts through PI by using ALR sentences. Function for externally acknowledging the translated alerts by using ACK sentences shall also be provided.

The BIIT ID as described in Table 4 shall be used as the unique alarm number of the ALR sentence, and the text in "Description text" column as described in Table 3 shall be used to populate the alarm's description text field in ALR sentence, prefixed by the characters "AIS: " including the space.

The ALR sentence shall be output through PI upon occurrence of any active alert and thereafter repeated every 30 s until the alert is rectified.

When all alerts are in normal state, an empty ALR sentence (\$AIALR,,,V,V,*hh<CR><LF>) shall be output at 1 min intervals.

Table 5 describes the mapping to be used in the translation of alert states.

Table 5 – Mapping between BAM alert states and ALR alert states

Priority of BAM alert	BAM alert state		ALR alert state	
	State	Description	Flags ^a	Description
Caution	N	Normal	V,V	Inactive, unacknowledged
	A	Active	A,A	Active, acknowledged
Warning or Alert	N	Normal	V,V	Inactive, unacknowledged
	V	Active, unacknowledged	A,V	Active, unacknowledged
	S	Active, silenced	A,A	Until silence period ends ^b
	A	Active, acknowledged	A,A	Active, acknowledged
	O	Responsibility transferred	A,A	Active, acknowledged
	U ^c	Rectified, unacknowledged	V,V	Inactive, unacknowledged ^c
^a ALR alert state flags in the order of appearance in ALR sentence (first is condition, second is acknowledgement state). ^b When silence period ends, alert state is transitioned to "Active, unacknowledged". ^c None of the alerts required by this document are required to use state Rectified, unacknowledged.				

Annex D describes details of legacy ALR/ACK alert handling.

6.10.1.4 Alarm relay output

A normally closed (NC) earth free relay contact shall be provided as an independent and simple method for triggering an external ~~alarm~~ alert.

The alarm relay shall be "active" in case of power "off".

~~The alarm relay shall be deactivated upon acknowledgement of an alarm either internally by means of minimum display and keyboard or externally by a corresponding ACK sentence.~~

The alarm relay shall be activated when any alert is in state "V", "Active, unacknowledged". The alarm relay shall be deactivated in all other alert states.

6.10.2 Status messages

6.10.2.1 General

If any significant change in system operation occurs, but overall system operation is not affected, an indication is initiated. A TXT-sentence is used to indicate when such a significant change in system operation occurs.

6.10.2.2 Using the TXT formatter

Status messages shall be IEC 61162-1 compliant "\$AITXT"-sentences on the presentation interface output port. Status messages do not activate the alarm relay and do not require an acknowledgement.

The parameters of this sentence formatter, which shall be set in accordance with Table 6, are as follows:

- text identifier, and
- text message

~~shall be set according to Table 3.~~

It shall be possible to monitor the current sensor status by means of a query sentence \$xxAIQ,TXT.

6.10.2.3 Channel management parameters changed

The TXT-sentence, Text Identifier 036, shall be followed by the appropriate ACA sentence(s) to report the affected AIS conditions.

The TXT and ACA sentence pair shall be transmitted only once when crossing the boundary of the region, when the parameters in use are changed by a new command ~~or on request (\$xxAIQ,ACA).~~

6.10.2.4 Monitoring sensor data status

Indications shall be given and the system shall react as given in Table 6.

Table 6 – Sensor status indications signalled using TXT sentence formatter

Text Message	Text Identifier	Reaction of the system
AIS: external DGNSS in use	021	Continue operation
AIS: external GNSS in use	022	Continue operation
AIS: internal DGNSS in use (beacon)	023	Continue operation
AIS: internal DGNSS in use (Message 17)	024	Continue operation
AIS: internal GNSS in use	025	Continue operation
AIS: external SOG/ COG in use	027	Continue operation
AIS: internal SOG/ COG in use	028	Continue operation
AIS: Heading valid	031	Continue operation
AIS: Rate of Turn Indicator in use	033	Continue operation
AIS: Other ROT source in use	034	Continue operation
AIS: Channel management parameters changed	036	Continue operation
AIS: Low power tanker mode active	037	Continue operation
AIS: Low power tanker mode inactive	038	Continue operation
AIS: Operating in assigned mode by Message 16 from base station 00MIDXXXX	040	Continue operation
AIS: Operating in data link management mode by Message 20 from base station(s) 00MIDXXXX[...]	041	Continue operation
AIS: Operating in channel management mode by Message 22 from base station 00MIDXXXX on channels YYYY and ZZZZ	042	Continue operation
AIS: Operating in group assignment mode by Message 23 from base station 00MIDXXXX	043	Continue operation
AIS: Returned to default operations	044	Continue operation

6.10.2.5 Position sensor fallback conditions

Priorities and affected position report data shall be as in Table 7.

Table 7 – Position sensor fall-back conditions

Priority	Affected data in Message 1, 2, 3 ⇒				
	Position sensor status	Position accuracy flag	Time stamp	RAIM flag	Position Latitude/Longitude
1	External DGNSS in use (corrected) ^a	1	UTC-s	1/ 0 *	Lat/Lon (external)
2	Internal DGNSS in use (corrected; Message 17)	1	UTC-s	1/ 0 *	Lat/Lon (internal)
3	Internal DGNSS in use (corrected; beacon) ^b	1	UTC-s	1/ 0 *	Lat/Lon (internal)
4	External GNSS in use (uncorrected) ^a	0	UTC-s	1/ 0 *	Lat/Lon (external)
5	Internal GNSS in use (uncorrected)	0	UTC-s	1/ 0 *	Lat/Lon (internal)
6	External position source other than GNSS	0	UTC-s	0	Lat/Lon (external)
7	Dead reckoning position (from the external EPFS in use)	0	62	0	Lat/Lon (dead-reckon)
	Manual position input (from the external EPFS in use)		61		Lat/Lon (manual)
	No position		63		not available = 91/181

^a Applicable in all configurations (minimum requirement). See also 7.6.5.4.1.

^b Applicable only if (optionally) an internal beacon receiver is provided. If RAIM available "1"; if not, default "0".

The AIS shall automatically select the position source with the highest priority available. If data availability changes, the AIS shall automatically switch to the position source with the highest priority available after 5 s when switching downwards or 30 s when switching upwards. During this period, the latest valid position shall be used for reporting.

When the external position source is used and both external and internal positions are valid, then the external and internal positions shall be compared once per minute and an ~~alarm~~ alert generated if the difference between the two positions is greater than 100 m + distance between the two GNSS antennas, for a period of 15 min.

If the valid position does not have a timestamp (time stamp not available = 60), transmit the position report with time stamp set to 60.

On changeover from one status to another, a new Message 5 shall be transmitted immediately when the reference point for the reported position has changed, and ~~an "ALR"~~ a "TXT" sentence as described in Table 6 shall be output to the presentation interface.

If RAIM is available (indicated by a valid GBS sentence or equivalent information), the position accuracy flag shall be evaluated using Table 8.

Table 8 – Use of accuracy (PA) flag

Accuracy status from RAIM (for 95 % of position fixes)	RAIM flag	Differential correction status	Resulting value of position accuracy (PA) flag
No RAIM process available	0	Unknown	0 = low (> 10 m)
No RAIM process available	0	Uncorrected	0 = low (> 10 m)
Expected error is ≤ 10 m	1		1 = high ≤ 10 m)
Expected error is > 10 m	1		0 = low (> 10 m)
No RAIM process available	0	Corrected	1 = high (≤ 10 m)
Expected error is ≤ 10 m	1		1 = high (≤ 10 m)
Expected error is > 10 m	1		0 = low (> 10 m)

The connected GNSS receiver indicates the availability of a RAIM process by a valid GBS sentence of IEC 61162-1. In this case, the RAIM-flag shall be set to "1". The position accuracy threshold for evaluation of the RAIM information is 10 m. The RAIM expected error is calculated based on the GBS parameters "expected error in latitude" and "expected error in longitude" using the following formula:

$$\text{Expected RAIM error} = \sqrt{(\text{expected error in latitude})^2 + (\text{expected error in longitude})^2}$$

The mode indicator in the position sentences of IEC 61162-1 received from the connected position sensor indicates the correction status.

6.10.2.6 SOG/COG sensor fall-back conditions

SOG/COG information from the internal GNSS receiver shall be used, if this internal GNSS receiver is in use as a position source. This is to avoid transmission of information referenced to different points on the ship.

6.10.2.7 ROT sensor fall-back conditions

The AIS shall automatically select the ROT source with the highest priority available as given in Table 9.

ROT data shall not be derived from COG information

Table 9 – ROT sensor fallback conditions

Affected data in Message 1, 2, 3 ⇒		
Priority	Position sensor status	Contents of ROT field
1	Rate of turn indicator in use ^a	0...+126 = turning right at up to 708°/min or higher; 0...-126 = turning left at up to 708°/min or higher. Values between 0° and 708°/min shall be coded by $ROT_{AIS} = 4,733 \sqrt{(ROT_{sensor})^{\circ}/min}$ where ROT_{sensor} is the rate of turn as input by the external rate of turn indicator (TI). Values of 709°/min and above shall be cut to 708°/min.
2	Other ROT source in use ^b	+127 = turning right at more than 5°/30 s (no TI available) -127 = turning left at more than 5°/30 s (no TI available)
3	No valid ROT information available	-128 (80 hex) indicates no turn information available (default)
^a Rate of turn indicator according to IMO A.526(13); determined by talker ID. See also 7.6.5.4.1.		
^b i.e. based on HDG information.		

6.11 Display, input and output

(See 14.9)

6.11.1 Minimum keyboard and display (MKD)

The MKD is an essential part of the AIS and it may be remote. If the MKD is remote, then a facility shall be provided to ensure the integrity of the link using a HBT sentence.

This document describes the combination of AIS transceiver and MKD. Only tested combinations of specific transponders and specific remote or integrated MKDs fulfil the requirements set in this document.

The MKD is a display and manual input device to allow the following functions.

- Manual input of voyage related and static ship data ~~and safety related messages~~, control of AIS and data selection. The method of entering the navigational status and voyage related data shall be readily available to the operator. It shall not be possible to input the Navigational status 14 by the Class A AIS station. It shall be possible to enter all other navigational statuses including those undefined or reserved for future use. If no unique definition is associated to the value, at least the value shall be displayed on the MKD.
- An indication shall be provided at MKD if all dimension values are set as zero.
- MKD shall provide user guidance for setting dimension extension values when NavStatus is set as 12. MKD shall provide user guidance for setting NavStatus other than 12 when all extension dimension values are set as zero and NavStatus is 12.
- All values (from 0 to 255) of ship and cargo type shall be accessible via the MKD. If no definition is associated to the value, at least the value shall be displayed on the MKD.
- Input and initiation of the transmission of safety related messages and optionally text messages. If the addressed station of an addressed message indicates that it cannot display the message (DTE flag), the MKD shall indicate that the message may not be displayed at the recipient. MKD shall not accept input of more characters than can be transmitted in a 3 slot message.
- Display of own ship transmitted static, dynamic and voyage related data.
- Display a minimum of 200 targets.
- Display at least three (3) lines of target data. Each line to display at least the name of the station, time elapsed, bearing, range, ~~name of ship and time elapsed since~~ of the last

position report received. ~~Range to SAR Aircraft shall be 2 dimensional.~~ Horizontal scrolling of bearing and range and time elapsed is not allowed. The title of display data shall be visible.

- Display of status information and display of alert information in accordance with IMO MSC.302(87).
- Display of all configuration parameters without need of entering a password.

All characters, except trailing @ signs, shall be displayed (see Table 47 of ITU-R M.1371-5:2014).

By default the target list is auto-sorted in ascending range ~~except the nearest active AIS-SART or, if supported, other targets of interest shall be displayed at the top of the list.~~ All active locating devices shall be displayed in ascending range above other targets.

The time out value for target display, other than ~~AIS-SART~~ locating devices, shall be 7 min. For ~~SART-ACTIVE~~ active locating device, the time out value shall be 18 min. The time out value for storing the static target data shall be 18 min.

It may be possible to filter the presentation of AIS targets (for example, by target range, CPA/TCPA or AIS target class A/B, AIS AtoN, etc.). If additional filtering or grouping is supported, the manufacturer should document this functionality as an option. If display equipment provides facilities for the calculation of CPA/TCPA, then the facilities should comply with the relevant clauses of IEC 62388. If a filter is applied, then there shall be a clear and permanent or persistent indication for the application, as appropriate. The filter criteria in use shall be readily available to the user (i.e. range, CPA/TCPA, class).

It shall not be possible to remove individual AIS targets from the presentation.

The active ~~AIS-SARTs~~ locating devices shall be displayed on the top of the target list. The testing (including type approval testing) ~~AIS-SART~~ of a locating device should not be displayed or output on the PI during normal operation; however the AIS should have the capability to display and output on the PI the ~~testing AIS-SART~~ locating devices in test mode during periodical testing of own ship's ~~AIS-SART~~ locating devices.

The active and testing ~~AIS-SART~~ should be locating devices are identified ~~as follows~~ according to Table 10 to Table 12:

- ~~Active AIS-SART: confirm that user IDs of Message 1 lead with 97, Message 1 NavStatus is 14.~~
- ~~Testing AIS-SART: confirm that user IDs of Messages 1 and 14 lead with 97, Message 1 NavStatus is 15, Message 14 text is "SART TEST".~~
- ~~Type approval testing AIS-SART: confirm that user IDs of Messages 1 and 14 lead with 97000, Message 1 NavStatus is 15 and Message 14 text is "SART TEST".~~

~~NOTE All equipment utilizing user IDs with leading 97 and NavStatus 14 will be identified as active AIS-SART equipment.~~

Table 10 – Identification of locating devices when active

	AIS-SART	MOB-AIS	EPIRB-AIS
Identity range	970010000 to 970999999	972010000 to 972999999	974010000 to 974999999
NavStatus of Message 1	14	14	14
Name in the target list	AIS SART	MOB AIS	EPIRB AIS
BIIT ID	14	14	14

Table 11 – Identification of locating devices when in test mode

	AIS-SART	MOB-AIS	EPIRB-AIS
Identity range	970010000 to 970999999	972010000 to 972999999	974010000 to 974999999
NavStatus of Message 1	15	15	15
Name in the target list	SART TEST	MOB TEST	EPIRB TEST

Table 12 – Identification of locating devices for type approval testing

	AIS-SART	MOB-AIS	EPIRB-AIS
Identity range	970000000 to 970009999	972000000 to 972009999	974000000 to 974009999
NavStatus and name in Message 1 is identical to Table 10 and Table 11.			

The DTE flag (refer to Recommendation ITU-R M.1371-45/A8-3.3) shall only be set to "1" when there is no means of displaying received text messages. External equipment indicates the availability of a remote MKD functionality by a HBT sentence sent every 30 s. If an SSD sentence is applied, the DTE field should be evaluated together with the HBT sentence to define if the external equipment is able to display text messages.

Table 13 describes the messages or target information derived from received messages that should be displayed on the MKD.

Table 13 – Message display on MKD

Message type	Information content	Remark
All messages below	MMSI	
Message 1, 2, 3 Position report	Position (Lat, Lon, Range, Bearing) Time in minutes since last position report was received (0-19) The name of locating device shall show according to Table 10, Table 11 and Table 12 as appropriate, followed by the MMSI. PA-flag, RAIM, time stamp, description of position quality as derived from Table 14 Navigational status	In graphical display by position
Message 5 Static data	Name of ship	
Message 4 Base station report	Position (Lat, Lon, Range, Bearing) Time in minutes since last position report was received Name shall show "BS:MMSI" unless the name is derived from a Message 24a PA-flag, RAIM, description of position quality as derived from Table 14	In graphical display by position. May be filtered in or out (and filtering indicated)
Message 9 SAR aircraft position report	Position (Lat, Lon, Range, Bearing, Altitude) Time in minutes since last position report was received Name shall show "SAR:MMSI" unless the name is derived from a Message 24a or Message 5 PA-flag, RAIM, time stamp, description of position quality as derived from Table 14	In graphical display by position. The range to SAR air craft should be by 2-dimensional calculation. May be filtered in or out (and filtering indicated)
Message 11	The result of the communication test should be displayed.	The indication of the result should be automatically removed not later than 30 s
Message 12, 14 Safety related text message	Text content	
Message 18, 19	Position (Lat, Lon, Range, Bearing) Time in minutes since last position report was received PA-flag, RAIM, time stamp, description of position quality as derived from Table 14	In graphical display by position. May be filtered in or out (and filtering indicated)
Message 19, 24a Class B position and static report	Name of ship	
Message 21 Aid to navigation report	Name of Aids to Navigation Time in minutes since last position report was received Position (Lat, Lon, Range, Bearing) PA-flag, RAIM, time stamp, description of position quality as derived from Table 14 Off-position flag Type of AtoN (ITU-R M.1371-5 Table 74) Virtual AtoN flag	Name plus indication it is an AtoN In graphical display by position May be filtered in or out (and filtering indicated)

Table 14 – Position quality

Description	Criteria
No position	Latitude = 91° or longitude = 181° or time stamp = 63
Manual position	Time stamp = 61
Dead reckoning position	Time stamp = 62
Outdated position > 200 m	Predicted distance (from SOG and time elapsed) > 200 m
Position > 10 m	PA = 0 and RAIM = 0
Position with RAIM > 10 m	PA = 0 and RAIM = 1
Position < 10 m	PA = 1 and RAIM = 0
Position with RAIM < 10 m	PA = 1 and RAIM = 1
Valid position with no time stamp	Time stamp = 60
NOTE Detailed information about the quality of position is displayed in a sub-page.	

6.11.2 Communication test

The AIS shall have a means of testing communication over the VDL by transmitting an addressed Message 10 and verifying the response of the addressed station, Message 11.

It shall be possible to initiate the communication test manually by MKD. The MKD shall propose a target and allow the user to confirm this target or select an alternate Class A target. A different target shall be suggested if the test fails.

It shall also be possible to initiate the communication test via the presentation interface input using an AIR sentence (indicating Message 11 in the "Message ID" field). In response to the AIR sentence, the AIS unit shall transmit a Message 10.

Upon reception of a Message 10, the AIS unit shall respond with a Message 11.

The result of the communication test shall be displayed. The operation manual shall provide guidance on use of this feature such that the selected addressed target is at a suitable range, for example between 15 NM and 25 NM.

6.11.3 Alarms Alerts and status information

6.11.3.1 Alarms Alerts

The following ~~alarms~~ alerts shall be indicated and displayed on request:

- as a result of the built-in integrity test (BIIT see 6.10.1 ~~and Annex F~~);
- reception of Message 1 NavStatus 14. ~~Once acknowledged for a given User ID the relay will not be activated and the ALR will indicate acknowledge.~~ Once acknowledged, the alert will not be re-activated again if a new message is received. The acknowledgement shall stay in effect until ~~it~~ alert is removed ~~from the target list~~ due to time out.

A means to acknowledge alerts shall be provided in accordance with IMO MSC.302(87).

6.11.3.2 Status information

The following status information shall be indicated and the information contents displayed on request:

- indications as a result of the built-in integrity test (BIIT see 6.10.1);
- sensor status information as provided by the TXT and alert sentences;

- received safety related Messages ~~12 and~~ 14;
- received long-range interrogations;
- manual confirmation of long-range interrogation if in manual mode.
- AIS operation not in default due to base station control message as indicated by TXT sentence.

~~An indication is required when status information is available or a Message 14 is received.~~

~~The content of the most recent Message 12 received shall be displayed foremost until cleared by the user. A minimum queue size of 20 Message 12 shall be accessible.~~

6.11.3.3 Indication, display and storage of received Message 12 and Message 14

At least the 20 most recently received Message 12 and the 20 most recently received Message 14 shall be available for display on request. Indication of unread safety related messages shall be provided.

The content of the most recently received Message 12 shall be displayed foremost until read by the user.

In addition, it shall be possible to select up to 20 messages that shall be retained and displayed on request until deleted. Retention of these messages without power is not required.

Safety related messages having identical source and content shall replace existing messages that they duplicate.

6.11.4 Data protection

The following data shall be protected from unauthorised modification either by MKD or PI-sentences (for example by password):

- MMSI;
- call sign;
- name of ship;
- IMO number;
- dimension/reference for position;
- ~~• type of ship (type of cargo should not be protected);~~
- interface configuration;
- password(s);
- pre-shared key for SSA-sentence;
- Message 27 tx channels.

Other data, if protected, should not be protected by the same password level.

~~NOTE If the EPV configuration sentence is used (see Annex E) a preceding valid SPW sentence will provide authorization.~~

If the EPV or SSD configuration sentences are used, a preceding valid authentication sentence shall be provided. Implementation of SSA-sentence is mandatory. SPW-sentence may be used on serial ports only to provide backwards compatibility. MD5 signature calculation method with signature length of 32 HEX characters as received in SSA-sentence shall be implemented.

The pre-shared key associated with SSA sentence and the password associated with SPW sentence or used on MKD shall not be displayed on the MKD and shall not be output on query for EPV sentence. The pre-shared key for SSA sentence shall be input by proprietary means.

6.11.5 Distance calculation

The AIS shall use the equations in Annex E to calculate all distances including range to other AIS stations and regional areas.

6.12 Protection from invalid controls

The AIS shall not accept the control commands sent from stations with invalid base station MMSI. Before accepting and processing the Messages 4, 16, 17, 20, 22 and 23, the AIS shall check the MMSI of the transmitting station. A valid base station MMSI is defined as "00xyyyyy" where x is between 2 and 7. The unit shall only accept and process received commands with a valid base station MMSI. See Annex C.

7 Technical requirements

7.1 General

(M.1371-5/A2-1.1) *This clause covers layers 1 to 4 (Physical Layer, Link Layer, Network Layer, Transport Layer) of the Open System Interconnection (OSI) model.*

Figure 1 illustrates the layer model of an AIS station (Physical Layer to Transport Layer) and the layers of the applications (Session Layer to Application Layer).

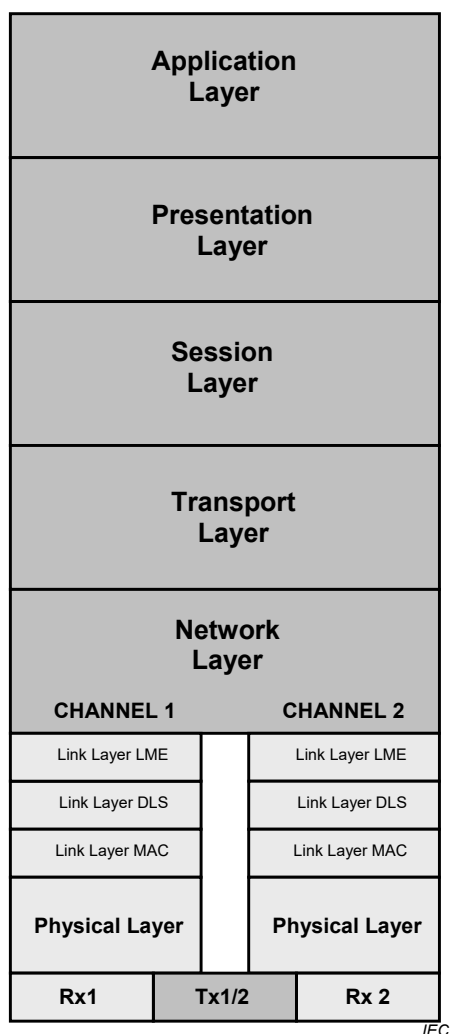


Figure 1 – OSI layer model

7.2 Physical layer

(See Clause 15)

7.2.1 General

(M.1371-5/A2-2) *The Physical layer is responsible for the transfer of a bit-stream from an originator out, on to the data link.*

The Physical layer shall be designed in accordance with Recommendation ITU-R M.1371-45/A2-2.

7.2.2 Transmitter parameters

Transmitter parameters shall be as given in Table 15.

Table 15 – Transmitter parameters

Transmitter parameters	Requirement	Condition
Frequency error	± 500 Hz normal $\pm 1\,000$ Hz extreme	
Carrier power (P_{ss})	41 dBm high power setting 30 dBm low power setting	$\pm 1,5$ dB normal and ± 3 dB extreme, conducted
Modulation spectrum	-25 dBc -70 dBc slotted transmission	$\Delta f_c < \pm 10$ kHz ± 25 kHz $< \Delta f_c < \pm 62,5$ kHz
Modulation accuracy	1 740 $\pm$ 175 Hz normal ± 350 Hz extreme 2 400 $\pm$ 240 Hz normal ± 480 Hz extreme	Test signal 0101... Test signal 00001111...
Power versus time characteristics	Transmission delay: 0 s Ramp up time: 833 μ s Ramp down time: 833 μ s Transmission duration: $\leq 26\,624$ μ s	See Figure 2 and Table 16 Nominal 1 time slot transmission
Spurious emissions	-36 dBm -30 dBm	9 kHz ... 1 GHz 1 GHz ... 4 GHz

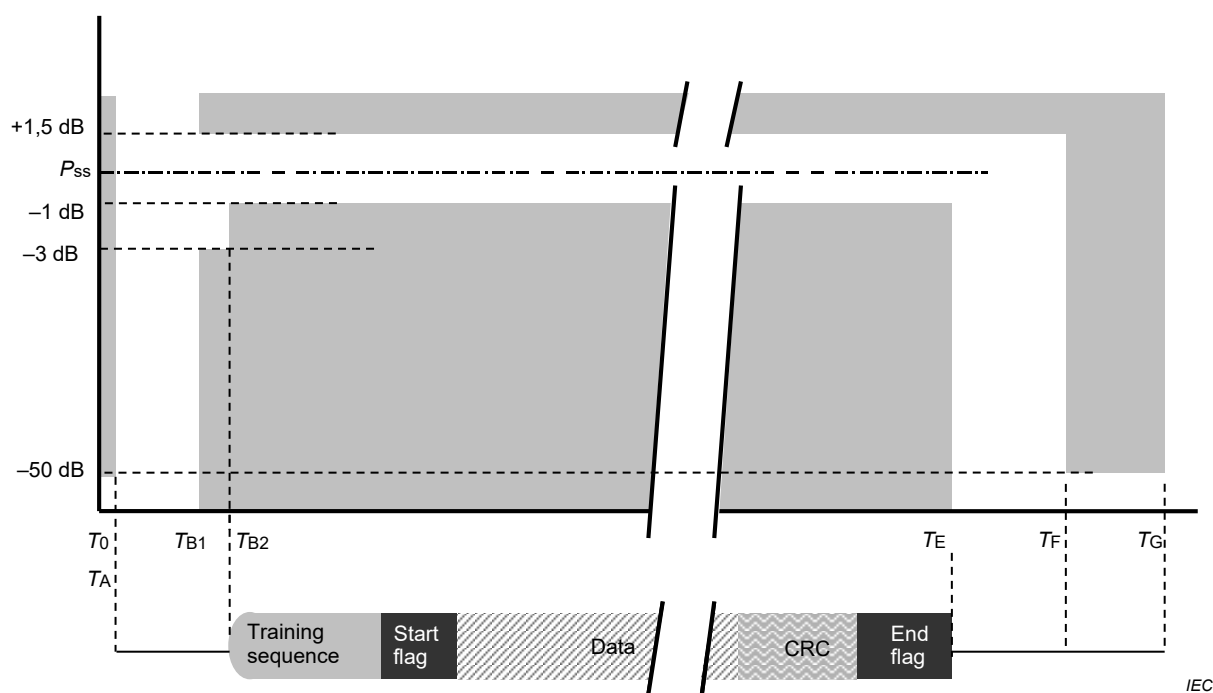
**Figure 2 – Power versus time characteristics**

Table 16 – Power versus time characteristics

Reference		Bit	Time	Definition
T_0		0	0 ms	Start of transmission slot. Power shall NOT exceed –50 dBc (ref. P_{ss}) before T_0
T_A		0 to 6	0 to 0,625 ms	Power exceeds –50 dB of P_{ss}
T_B	T_{B1}	6	0,625 ms	Power shall be within +1,5 or –3 dB of P_{ss}
	T_{B2}	8	0,833 ms	Power shall be within +1,5 or –1 dB of P_{ss} (start of training sequence)
T_E (includes 1 stuffing bit)		233	24,271ms	Power shall remain within +1,5 or –1 dB of P_{ss} during the period T_{B2} to T_E
T_F (includes 1 stuffing bit)		241	25,104 ms	Power shall be –50 dBc (ref. P_{ss} a) and stay below this
T_G		256	26,667 ms	Start of next transmission time period

7.2.3 Receiver parameters

Receiver parameters shall be as given in Table 17.

Table 17 – Receiver parameters

Receiver parameters	Requirement		
	Result in PER	Wanted signal	Unwanted signal(s)
Sensitivity	20 %	–107 dBm normal –104 dBm normal at ± 500 Hz offset –101 dBm extreme	
Error at high input levels	1 %	–7 dBm and –77 dBm	–
Co-channel rejection	20 %	–104 dBm –104 dBm	–114 dBm nominal –114 dBm at ± 1 kHz offset
Adjacent channel selectivity	20 %	–104 dBm –98 dBm extreme	–34 dBm normal –38 dBm extreme
Spurious response rejection	20 %	–104 dBm	–34 dBm
Intermodulation response rejection and blocking	20 %	–101 dBm	–27 dBm (< 5 MHz) –15 dBm (> 5 MHz)
Spurious emissions	–57 dBm	9 kHz ... 1 GHz	
	–47 dBm	1 GHz ... 4 GHz	

7.3 Link layer

(See Clause 16)

7.3.1 General

(M.1371-5/A2-3) *The Link layer specifies how data shall be packaged in order to apply error detection and correction to the data transfer. The Link layer is divided into three (3) sublayers.*

7.3.2 Link sublayer 1: Medium Access Control (MAC)

(M.1371-5/A2-3.1) *The MAC sublayer provides a method for granting access to the data transfer medium, i.e. the VHF data link. The method used shall be a Time Division Multiple Access (TDMA) scheme using a common time reference.*

The Medium Access Control sublayer shall be designed in accordance with Recommendation ITU-R M.1371-45/A2-3.1.

7.3.3 Link sublayer 2: Data Link Service (DLS)

(M.1371-5/A2-3.2) The DLS sublayer provides methods for:

- 1) *data link activation and release;*
- 2) *data transfer; or*
- 3) *error detection and control.*

The Data Link Service sublayer shall be designed in accordance with Recommendation ITU-R M.1371-45/A2-3.2.

Repeated messages and Class B CS messages shall not be used in the indirect synchronisation process.

7.3.4 Link sublayer 3 – Link Management Entity (LME)

7.3.4.1 General

(M.1371-5/A2-3.3) *The LME controls the operation of the DLS, MAC and the physical layer.*

The Link Management Entity sublayer shall be designed in accordance with Recommendation ITU-R M.1371-45/A2-3.3.

Link sublayer 3 includes definition of VDL-messages. Table 18 shows the VDL messages that shall be used by a Class A shipborne mobile AIS device.

Table 18 – Use of VDL messages

Msg. No.	Name of message	M.1371-5 Ref.	R/P	O	T	Remark
0	Undefined	None	Yes	Yes	No	Reserved for future use
1	Position report (scheduled)	A8-3.1	Yes	Yes	Yes	For a locating device according to Table 11, the Message 1 should only be sent to the PI in special locating device test mode
2	Position report (assigned)	A8-3.1	Yes	Yes	Yes	
3	Position report (when interrogated)	A8-3.1	Yes	Yes	Yes	
4	Base station report	A8-3.2	Yes (5)	Yes	No	
5	Static and voyage related data	A8-3.3	Yes	Yes	Yes	
6	Addressed binary message	A8-3.4	Yes	Yes (1)	Yes	(1) Only if addressed to own station
7	Binary acknowledge	A8-3.5	Yes	INF (2)	Yes	(2) An ABK PI message shall be sent to the PI in any case
8	Binary broadcast message	A8-3.6	Yes	Yes	Yes	
9	Standard SAR aircraft position report	A8-3.7	Yes	Yes	No	
10	UTC and date inquiry	A8-3.8	Yes	INF	Yes	
11	UTC/ date response	A8-3.9	Yes	INF	Yes	
12	Addressed safety related message	A8-3.10	Yes	Yes (3)	Yes	(3) Only if addressed to own station
13	Safety related acknowledge	A8-3.11	Yes	INF (4)	Yes	(4) An ABK PI message shall be sent to the PI in any case
14	Safety related broadcast message	A8-3.12	Yes	Yes	Yes	For a locating device according to Table 11, the Message 14 should only be sent to the PI in special locating device test mode
15	Interrogation	A8-3.13	Yes	INF	Yes	Class A shipborne mobile station shall only interrogate for Message 3, 4, 5, 9, 18, 19, 21 and 24 Slot offset shall be set to 0 and shall respond for interrogations for Messages 3, 5 and 24B only
16	Assigned mode command	A8-3.14	Yes (5)	INF	No	(5) Class-A AIS shall receive and process only if the message is sent from the station with valid base station MMSI
17	DGNSS	A8-3.15	Yes (5, 6)	INF (7)	No	(6) Only if internal GNSS receiver is capable of processing DGNSS corrections or PI contains an DGNSS output port (7) On other ports of the PI: INF
18	Standard Class B equipment position report	A8-3.16	Yes	Yes	No	
19	Extended Class B equipment position report	A8-3.17	Yes	Yes	No	
20	Data link management message	A8-3.18	Yes (5)	INF	No	
21	Aids-to-Navigation report	A8-3.19	Yes	Yes	No	
22	Channel management message	A8-3.20	Yes (5)	INF	No	

Msg. No.	Name of message	M.1371-5 Ref.	R/P	O	T	Remark
23	Group assignment command	A8-3.21	Yes (5)	Yes	No	
24	Static data report (single slot, two parts)	A8-3.22	Yes	Yes	Yes	Class A shipborne mobile station shall send out Message 24B within 12 min after start up and every 24 h thereafter.
25	Single slot binary message	A8-3.23	Yes	Yes (8)	Yes (9)	(8) Only if broadcast or addressed to own station (9) Use ABM or BBM sentence indicating Message 25/70 in message ID field to initiate
26	Multiple slot binary message with CommState	A8-3.24	Yes	Yes (10)	Yes (11)	(10) Only if broadcast or addressed to own station (11) Use ABM or BBM sentence indicating Message 26/71 in message ID field to initiate
27	Long-range AIS broadcast message	A8-3.25	No	No	Yes	Transmit on dedicated channels (not AIS 1 and AIS 2).
28 to 63	Undefined	None	INF	INF	No	Reserved for future use
Key R/P – Receive and process internally, e.g. prepare for output via PI, act upon the received information, and use the received information internally. O – Output message content via PI using PI VDM messages T – Transmission by own station: "Yes" = required; "No" = shall not be transmitted INF – VDL message will be output via PI using a PI VDM message for information only. This function may be suppressed by configuration setting.						

For Messages 6, 8, 12, 14, 25 and 26, own transmissions shall not exceed the total number of slots in a frame with a maximum number of consecutive slots per message as defined in Recommendation ITU-R M.1371. If the encapsulated data (binary data or safety related text) provided by the ABM or BBM sentences is not byte aligned, the binary data or safety related text within the transmitted Messages shall be padded with bits having value zero to the next byte boundary.

For Message 15, own transmissions shall not exceed a total of 5 messages in a frame. If either case is exceeded, the AIS shall generate an ABK warning sentence. Message 15 shall only be transmitted in response to the AIR sentence received via the PI or if interrogation is initiated manually on the MKD.

7.3.4.2 Response to assignment commands (Messages 16 and 23)

Class A AIS shall process assignment commands in accordance with Recommendation ITU-R M.1371-4 only if the commands are sent from stations with valid base station MMSI.

An assignment command received by Message 16 or Message 23, with a reporting interval shorter than or equal to the autonomous reporting interval, shall be processed and the reporting interval defined by the assignment command be used.

An assignment command received by Message 16 or Message 23 with a reporting interval longer than the autonomous reporting interval shall be ignored.

A group assignment by Message 23 shall not apply to Class A mobile stations with NavStatus "moored" and "at anchor" and not moving faster than 3 kn except when the station type is 10 (see 8.3).

7.4 Network layer

(See Clause 17)

7.4.1 General

(M.1371-5/A2-4) *The network layer shall be used for:*

- 1) *establishing and maintaining channel connections;*
- 2) *management of priority assignments of messages;*
- 3) *distribution of transmission packets between channels;*
- 4) *data link congestion resolution.*

The network layer shall be designed in accordance with Recommendation ITU-R M.1371-45/A2-4.

7.4.2 Management of regional operating settings

All stored regional operating settings shall be time/date-tagged and they should be tagged with information by what input means this regional operating setting was received (TDMA Message 22, DSC telecommand, Manual input via MKD, ACA sentence input via presentation interface). It shall be possible to obtain an ACA sentence giving the current stored area settings by means of a query sentence \$xxAIQ,ACA. *The response shall be ACA and ACS.*

The AIS shall constantly check if the nearest boundary of the regional operating area of any stored regional operating setting is more than 500 NM away from the current position of own station, or if any stored regional operating setting was older than 24 h. The age of the area setting is the time since the area setting has been applied the last time by Message 22, DSC command, MKD or ACA input. The "time of in-use change" provided by ACA output cannot be used for this purpose. Any stored regional operating setting which fulfils any one of these conditions shall be erased from the memory.

The regional operating settings set shall be handled as a whole, i.e. a change requested for any parameter of the regional operating settings shall be interpreted as a new regional operating setting. However, in case that the narrow bandwidth (12,5 kHz) operation is requested, the AIS shall continue the wide bandwidth operation (25 kHz) while accepting other parameter changes.

When the user requests to manually input a regional operating setting via the MKD, the regional operating settings in use, which may be the default operating settings, shall be presented to the user on the MKD. The user shall then be allowed to edit these settings partly or in full. The AIS shall ensure that a regional operating area is always input and that it conforms to the rules for regional operating areas laid out in Recommendation ITU-R-M.1371-45/A2-4.1. After completion of input of an acceptable regional operating settings set, the AIS shall require the user to confirm a second time that the input data shall be stored and possibly used instantaneously.

The AIS shall not accept, i.e. shall ignore, any new regional operating setting which includes a regional operating area, which does not conform to the rules for regional operating areas laid out in Recommendation ITU-R M.1371-45/A2-4.1. The area size calculation shall be in accordance with Annex E.

The AIS shall not accept a new regional operation setting if the distance to the base station is more than 120 NM or if no Message 4 is received from the base station.

The AIS shall not accept a new regional operating setting, which was input to it via the presentation interface, if the regional operating area of this new regional operating setting partly or totally overlaps or matches the regional operating area of any of the stored regional

operating settings, which were received from a base station either by Message 22 or by DSC telecommand within the last two hours.

If Class-A station has received Message 22 with MMSI addressed to own station, it shall not accept Message 23 and Message 22 addressed to an area for 10 min.

A Message 22 addressed to own station or a DSC telecommand not including the co-ordinates of the corner points shall be accepted only if the AIS is in a region defined by one of the stored regional operating settings. In this case, the set of regional operating settings shall be composed by combining the received parameters with the regional operating area in use.

If the regional operating area of the new, accepted regional operating setting overlaps in part or in total or matches the regional operating areas of one or more older regional operating settings, this or these older regional operating settings shall be erased from the memory. The regional operating area of the new, accepted regional operating setting may be neighbouring tightly and may thus have the same boundaries as older regional operating settings. This shall not lead to the erasure of the older regional operating settings.

Subsequently, the AIS shall store a new, accepted regional operating setting in one free memory location of the eight memories for regional operating settings. If there is no free memory location, the most distant regional operating setting shall be replaced by the new, accepted one.

NOTE The distance to a regional operating setting is the distance to the nearest boundary.

No means other than defined herein shall be allowed to clear any or all of the stored regional operating settings. In particular, it shall not be possible to solely clear any or all of the stored regional operating settings by a manual input via the MKD or by an input via the presentation interface without inputting a new regional operating setting.

When the ship goes outside the regional area, the AIS shall revert all the parameters to default.

7.5 Transport layer

(See Clause 18)

(M.1371-5/A2-5) *The transport layer shall be responsible for:*

- 1) *converting data into transmission packets of correct size;*
- 2) *sequencing of data packets;*
- 3) *interfacing protocol to upper layers.*

The transport layer shall be designed in accordance with Recommendation ITU-R M.1371-45/A2-5.

7.6 Presentation interface

(See Clause 19)

7.6.1 General

(M.1371-5/A2-5.4) *Data, which is to be transmitted by the AIS device, shall be input via the presentation interface. Data, which is received by the AIS device, shall be output through the presentation interface. ~~The formats and protocol used for this data stream are defined in 7.6.~~*

(M.1371-5/A4-2) *Class A shipborne mobile equipment shall provide a two-way interface for equipment which provides for long-range communications. The interface shall comply with the following.*

The interface between the transport layer and higher layers shall be performed by the presentation interface. The presentation interface of the AIS shall comprise the data ports listed in Table 19 (also see Annex B).

Table 19 – Presentation interface access

General function	Mechanism
Automatic input of sensor data (sensor data input from shipboard equipment)	IEC 61162-2 input ports, also configurable as IEC 61162-1 input ports – minimum 3 ports required Additional IEC input port may be provided
High speed input/output ports (including pilot port) (operator controlled commands and data input; AIS VHF Data Link (VDL) data; and AIS equipment status)	IEC 61162-2 paired input and output ports – minimum 2 ports required The long-range communications port may be configured as an additional presentation interface (PI) port if it is not needed for long-range communication in the current installation
Long-range communications	IEC 61162-2 paired input and output port
BIIT alert relay output	Isolated normally-closed (NC) contact circuit

7.6.2 Automatic input of sensor data

7.6.2.1 Required ports

A minimum of three input ports shall be provided. **An additional IEC 61162-450 input port may be provided.** Each port shall meet the requirements of IEC 61162-2 and be capable of being reconfigured according to IEC 61162-1.

7.6.2.2 Interface connector

The manufacturer shall specify the connector and pin assignments for these ports.

7.6.2.3 Format of sensor data

The sensor data shall be provided using the formats described in IEC 61162-1. As a minimum, the required IEC 61162-1 sentences listed in Table 20 shall be received and processed by an AIS unit. Details for these sentences are contained in IEC 61162-1.