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INTERNATIONAL STANDARD

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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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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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

~~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* (~~BIIT~~ 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~~	~~V~~	~~001~~	~~Stop transmission~~
~~AIS: Antenna VSWR exceeds limit~~	~~A~~	~~V~~	~~002~~	~~Continue operation~~
~~AIS: Rx channel 1 malfunction~~	~~A~~	~~V~~	~~003~~	~~Stop transmission on affected channel~~
~~AIS: Rx channel 2 malfunction~~	~~A~~	~~V~~	~~004~~	~~Stop transmission on affected channel~~
~~AIS: Rx channel 70 malfunction~~	~~A~~	~~V~~	~~005~~	~~Continue operation~~
~~AIS: general failure~~	~~A~~	~~V~~	~~006~~	~~Stop transmission~~
~~AIS: UTC sync invalid~~	~~A~~	~~V~~	~~007~~	~~Continue operation using indirect or semaphore synchronisation~~
~~AIS: MKD connection lost~~	~~A~~	~~V~~	~~008~~	~~Continue operation with "DTE" set to "1"a~~
~~AIS: internal / external GNSS position mismatch~~	~~A~~	~~V~~	~~009~~	~~Continue operation~~
~~AIS: NavStatus incorrect~~	~~A~~	~~V~~	~~010~~	~~Continue operation~~
~~Heading sensor offset~~	~~A~~	~~V~~	~~011~~	~~Continue operation~~
~~AIS: active AIS-SART~~	~~A~~	~~V~~	~~014~~	~~Continue operation~~
~~AIS: external EPFS lost~~	~~A~~	~~V~~	~~025~~	~~Continue operation (refer to Table 4)~~
~~AIS: no position sensor in use~~	~~A~~	~~V~~	~~026~~	~~Continue operation (refer to Table 4, priority 6)~~
~~AIS: no valid SOG information~~	~~A~~	~~V~~	~~029~~	~~Continue operation using default data~~
~~AIS: no valid COG information~~	~~A~~	~~V~~	~~030~~	~~Continue operation using default data~~
~~AIS: Heading lost/invalid~~	~~A~~	~~V~~	~~032~~	~~Continue operation using default data b~~
~~AIS: no valid ROT information~~	~~A~~	~~V~~	~~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						
Alert identifier	**Alert text (1st ALF)**	**Additional information (2nd ALF)**	**Prio**	**Cat**	**Escal**	**BIIT ID**
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:

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

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 $ROT_{AIS} = 4{,}733 \sqrt{(ROT_{sensor})}$°/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 Message~~s 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 "00xyyyyyy" 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).

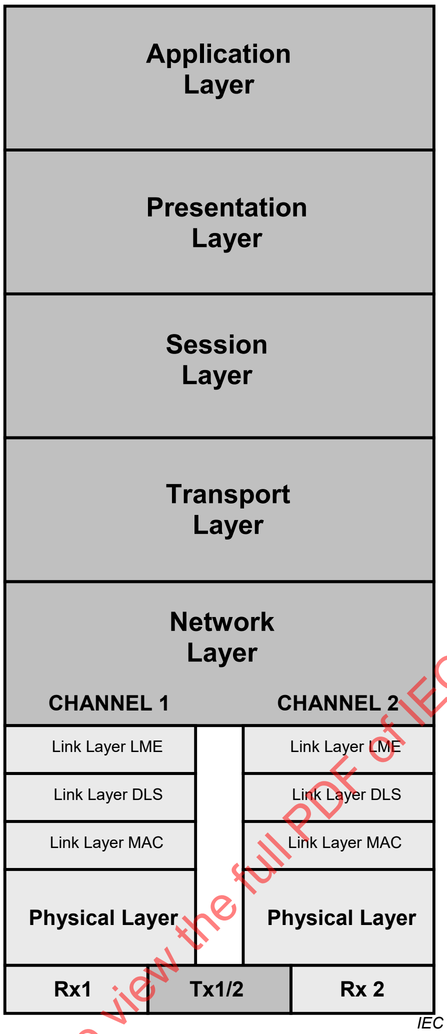


Figure 1 – OSI layer model

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 ± 1 000 Hz extreme	
Carrier power (P_{SS})	41 dBm high power setting 30 dBm low power setting	± 1,5 dB normal and ± 3 dB extreme, conducted
Modulation spectrum	−25 dBc −70 dBc slotted transmission	Δfc < ± 10 kHz ± 25 kHz < Δf_c< ± 62,5 kHz
Modulation accuracy	1 740 ± 175 Hz normal ± 350 Hz extreme 2 400 ± 240 Hz normal ± 480 Hz extreme	Test signal 0101… Test signal 00001111…
Power versus time characteristics	Transmission delay: 0 s Ramp up time: 833 µs Ramp down time: 833 µs Transmission duration: ≤ 26 624 µs	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

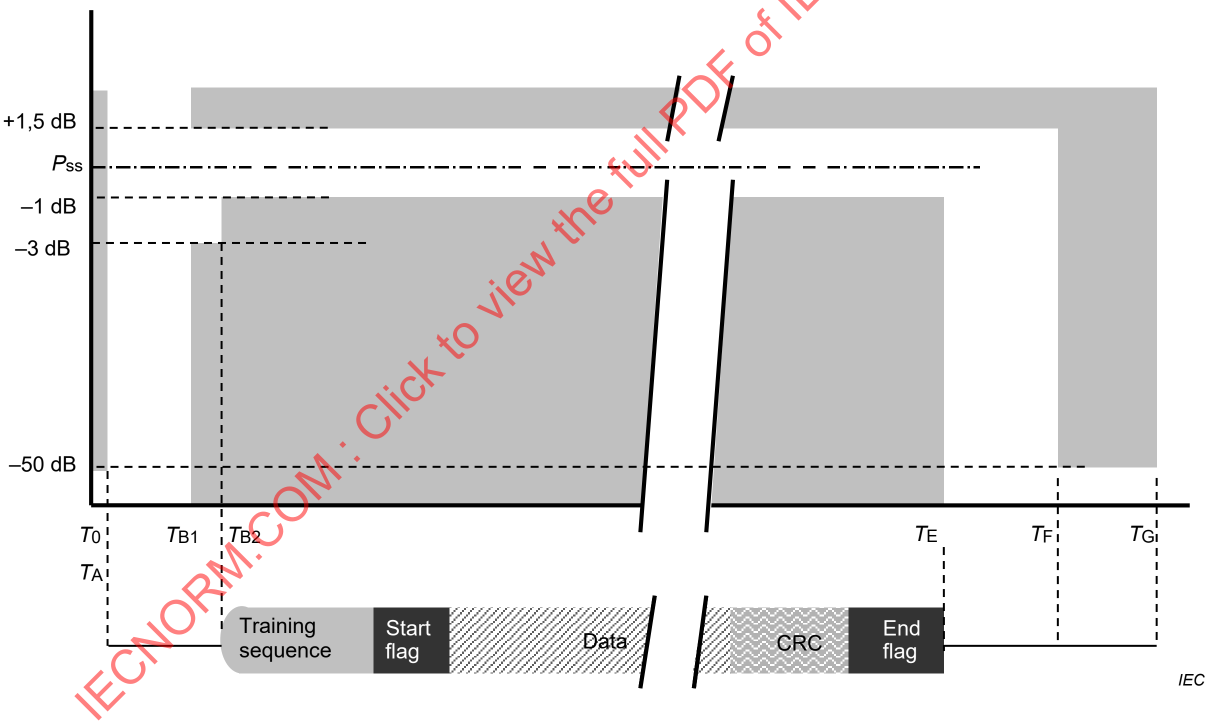


Figure 2 – Power versus time characteristics

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 −47 dBm	9 kHz ... 1 GHz 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-~~4~~5/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.

Table 20 – IEC 61162-1 sensor sentences

Data	IEC 61162-1 sentences
Reference datum	DTM
Positioning system: Time of position Latitude/Longitude Position accuracy	GNS, RMC
Speed over ground (SOG)	RMC, VBW, VTG
Course over ground (COG)	RMC, VBW, VTG
Heading	HDT, THS
RAIM indicator	GBS
Rate of turn (ROT)	ROT
NOTE Additional optional digital interface network IEC 61162-3 parameter group numbers equivalent to the specified network IEC 61162-1 sentences are described for information in Annex H.	

The AIS shall use the DTM sentence to automatically confirm that the position information provided for transmission is in the WGS 84 datum.

The reception of periodic GBS sentences, containing values for the parameters "expected error in latitude" and "expected error in longitude" shall be used to indicate with the "RAIM flag" that the position sensor is operating with a RAIM process in use.

Each of the data items listed in Table 20 may be produced by various connected sensor equipment. The external sensor equipment is neither assigned to specific AIS input ports nor are the specified input sentences assigned to specific equipment. AIS shall be capable of accepting these specified sentences at each of the input ports.

A mechanism shall be implemented to avoid data mismatch or duplicate inputs if multiple sensor data for the same parameter is received by different sentences and/or ports. The mechanism shall be documented in a manufacturer's installation manual.

7.6.3 High-speed input/output ports

7.6.3.1 Required ports

A minimum of two input/output ports shall be provided, a primary input/output port for connection of on board control equipment, ECDIS, radar, etc., and a pilot/auxiliary input/output port for connection of ship's pilot equipment, service equipment, etc. Each port shall meet the requirements of IEC 61162-2. An additional IEC 61162-450 port may be provided.

Both input ports shall be functionally equivalent and shall be capable of receiving the data formats defined in Table 21.

Both output ports shall be functionally equivalent and shall be capable of simultaneously transmitting the data formats defined in Table 22.

7.6.3.2 Interface connector

If the pilot plug is provided, it shall be configured as follows.

AMP/Receptacle (square flanged (−1) or free-hanging (−2)), shell size 11, 9-pin.

Std. Sex 206486-1/2 or equivalent with the following terminations:

– Tx A is connected to Pin 1;
– Tx B is connected to Pin 4;
– Rx A is connected to Pin 5;
– Rx B is connected to Pin 6;
– Shield is connected to Pin 9.

The manufacturer shall specify the connections for the remaining ports.

7.6.3.3 Input data and formats

The AIS shall as a minimum be able to receive and process the input data shown in Table 21. The details of these sentences are contained in IEC 61162-1 and in Annex F for sentence SSA. The manufacturer's proprietary data may also be entered using these high-speed ports.

Table 21 – AIS high-speed input data and formats

Data	IEC 61162-1 sentences
Normal access – Parameter entry	
Voyage information: Vessel type and cargo category Navigational status Draught, max. actual static Destination ETA date and time Regional application flags	VSD[e]
Station information Vessel name Call sign Antenna location, length and beam[c]	SSD
Command for equipment property value	EPV
Security password sentence	SPW[b]
Sender Signature Authentication	SSA[d]
Initiate VHF data-link broadcasts	
Safety messages Handshake to acknowledge received safety message by a remote MKD	ABM BBM ABK
Binary messages	ABM BBM
Interrogation message	AIR
AIS equipment – Parameter entry	
AIS VHF channel selection AIS VHF power setting AIS VHF channel bandwidth Transmit/Receive mode control	ACA[a]
BIIT and alert handling input	
Heartbeat from remote MKD and for responsibility transfer	HBT
Alert commands	ACN, ACK
LR acknowledge	
Manual LR acknowledge	LRF

[a] The AIS requires that information in the longitude and latitude fields of the ACA sentence is truncated to 1/10 min.

[b] The SPW sentence shall not be used in the IEC 61162-450/-460 interface (see 7.6.5.4.1).

[c] AI, BI, CI, DI excluding tow as defined in Annex I.

[d] See Annex F.

[e] Updated VSD sentence description is defined in Annex G. The special manoeuvre indicator is configured using the first two bits of regional application flag of the VSD sentence. The following two bits of the regional application flag define the first two bits of the three-bit spare-field of Message 1, 2 and 3.

7.6.3.4 Output data and formats

The AIS shall as a minimum be able to generate and send the output data shown in Table 22.

The VDO sentence (containing Messages 1, 2 or 3) shall be output on both high-speed output ports, at nominal 1 s intervals, use A and B to indicate that the data was transmitted on the VDL channel A or B, null indicating not transmitted on the VDL.

The VDM sentence shall be sent simultaneously on both high-speed output ports for every VDL message received. Some VDL messages are informative (see Table 18). During operation, the operator may disable delivery of these informative messages. The manufacturer's proprietary data may also be sent using these high-speed ports.

Table 22 – AIS high-speed output data and formats

Data	IEC 61162-1 sentences
Prepared by AIS unit	
Notification that a session initiated by messages ABM, BBM, AIR is terminated	ABK
AIS own-ship broadcast data (all transmissions available)	VDO
AIS equipment status (built-in-integrity-test results) and alerts	ALF, ALC, ARC, ALR
Channel management data (using query mechanism)	ACA and ACS
Received on VHF data-link by AIS unit	
All VDL AIS messages received, broadcast or addressed to own station	VDM
Received on LR communication system	
LR interrogation message received	LRI and LRF
System information in response to a query	
Static information	SSD
Voyage information	VSD
Report equipment property value	EPV
Version information	VER
Status information	TXT
AIS transmitter non-functioning log	TRL
Negative acknowledgement	NAK
If the internal GNSS of the AIS is intended to be used for the ship's position source, then sentences DTM, GNS, GBS and RMC are required to be generated and sent as output data (see 6.2.2).	

~~7.6.3.5 Additional optional sentences~~

~~Additional optional sentences to facilitate communication with external devices providing the functionality of an MKD (6.11) are given in Annex E.~~

7.6.3.5 Relay of heading and rate of turn input sentences to pilot port

To provide greater resolution on sensor data for external equipment connected to the pilot port, AIS shall provide functionality to relay heading (HDT, THS) and rate of turn (ROT) input sentences to the pilot port.

The following requirements apply for the relay function:

- maximum rate at output shall be 5 sentences per second for heading and 1 sentence per second for rate of turn;
- if no sentences have been received at input, AIS shall not send the respective sentence at the output;

  NOTE Receiver of the relayed data connected to pilot port detects the missing input signal from sentence timeout.

- latency: maximum 200 ms from the receipt of complete input sentence until start of output sentence;
- the most recent received complete sentence shall be relayed;
- AIS shall not modify the content of the sentences that are relayed, including talker ID;
- on multiple inputs of the same type of information, only the sentences from a source used for composition of position reports are relayed.

7.6.3.6 Configuration using EPV sentence

Property identifiers used with EPV-sentence applicable for Class-A AIS Mobile station are described in Table 23.

Table 23 – Property identifiers

Property identifier	Protected	Property meaning	Value range
0 to 100		Reserved	
101	yes	Sensor 1 baud	4 800, 9 600, 14 400, 19 200, 38 400
102	yes	Sensor 2 baud	4 800, 9 600, 14 400, 19 200, 38 400
103	yes	Sensor 3 baud	4 800, 9 600, 14 400, 19 200, 38 400
104	yes	Long-range baud	4 800, 9 600, 14 400, 19 200, 38 400
105	yes	DGNSS baud	4 800, 9 600, 14 400, 19 200, 38 400
106	yes	MMSI	000000000, 200000000 … 799999999, 982000000 … 987999999
107	yes	IMO number	0000000 … 9999999
108	yes	Long-range interface configuration	"A" = automatic "M" = manual and optionally[a]: "O" = Port is switched off "P" = Port is used as PI port "S" = Port is used as Sensor port "G" = Port is used as GNSS output port "D" = Port is used as DGNSS port for correction data input "R" = Port is used as DGNSS port for correction data output
109	yes	Long-range AIS broadcast channel 1	Valid channel according ITU-R M.1084-5. See 8.3. Default value is 75. Value 0 indicates no transmission of message 27
110	yes	Long-range AIS broadcast channel 2	Valid channel according ITU-R M.1084-5. See 8.3. Default value is 76. Value 0 indicates no transmission of message 27
111	yes	Change administrator password	New administrator password
112	yes	Change user password	New user password
113	no	Locating device test mode	0 = normal mode 1 = display and output locating devices in test mode
114	no	AIS silent mode	0 = AIS in normal transmit operation 1 = AIS in receive only operation
115	no	Activation of locating device alert	0 = No alert from locating devices 1 = Alert for received locating devices is generated (default)

Property identifier	Protected	Property meaning	Value range
116	yes	Sensor alert configuration	Format: Hexadecimal representing bits. Bit value 0 means alert function deselected, 1 means alert function enabled. Usage of bits: bit 2: external position bit 1: heading bit 0 (lsb): rate of turn Default value 7: all alerts enabled.
117	Yes	Pilot Port access level	0 = normal access to PI port functionality (default) 1 = restricted access to PI port functionality: no input allowed except EPV sentence with property value 117, preceded by SSA sentence.
Identifiers for IEC 61162-450 interface configuration [c]			
120	yes	IP address and network mask of AIS transceiver	Format: xxx.xxx.xxx.xxx/nn (/nn = Number of bits in network part of netmask (CIDR notation))
121	yes	SFI of AIS transceiver	Format: AIxxxx, Range of xxxx: 0000 … 9999
122	yes	Additional input multicast group	Four character code as described in IEC 61162-450 (for example MISC, PROP). String NONE is used to disable this additional multicast group. Default value is NONE.
123	yes	Additional input multicast group	Four character code as described in IEC 61162-450 (for example MISC, PROP). String NONE is used to disable this additional multicast group. Default value is NONE.
124	yes	Transmission group	Four character code as described in IEC 61162-450 (for example MISC, PROP).
Identifiers for SFI configuration [c]			
130	yes	Primary position sensor	ccxxxx, NONE [b] default: NONE
131	yes	Secondary position sensor	ccxxxx, NONE [b] default: NONE
132	yes	Primary SOG/COG sensor	ccxxxx, NONE [b] default: NONE
133	yes	Secondary SOG/COG sensor	ccxxxx, NONE [b] default: NONE
134	yes	Primary heading sensor	ccxxxx, NONE [b] default: NONE
135	yes	Secondary heading sensor	ccxxxx, NONE [b] default: NONE
136	yes	Primary ROT sensor	ccxxxx, NONE [b] default: NONE
137	yes	Secondary ROT sensor	ccxxxx, NONE [b] default: NONE
138	yes	Primary AIS Control	ccxxxx, ANY [b] default: ANY
139	yes	Secondary AIS Control	ccxxxx, NONE, ANY [b] default: NONE

Property identifier	Protected	Property meaning	Value range
140	yes	Primary alert command source	ccxxxx, ANY [b] default: ANY
141	yes	Secondary alert command source	ccxxxx, NONE, ANY [b] default: NONE
Extended dimensions configuration			
150	No	Dimension extension EA[d]	Default value = 0
151	No	Dimension extension EB[d]	Default value = 0
152	No	Dimension extension EC[d]	Default value = 0
153	No	Dimension extension ED[d]	Default value = 0
All other values		Reserved	

[a] Manufacturer shall declare what optional identifiers are supported.

[b] The configuration parameters and values for SFI can be one of the following:

- ccxxxx: in accordance with IEC 61162-450: only sentences from this source are accepted;
- NONE: no sentences from network sources are accepted;
- ANY: sentences from all network sources are accepted.

[c] Required only if IEC 61162-450 interface is implemented.

[d] The dimension extension values are in metres; higher resolution is optional.

7.6.4 Long-range communication ports

7.6.4.1 Required ports

A minimum of one input/output port shall be provided and shall meet the requirements of IEC 61162-2. It may be connected to long-range communications equipment (for example satellite communications; see Clause 8).

The input port shall be capable of receiving the data formats defined in Table 24.

The output port shall be capable of transmitting the data formats defined in Table 25.

7.6.4.2 Interface connector

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

7.6.4.3 Input data and formats

Long-range interrogation of an AIS unit is accomplished through the use of two IEC 61162-1 sentences – LRI and LRF. This pair of interrogation sentences provides the information needed by the AIS unit to determine if it should construct and provide the reply sentences – LR1, LR2, and LR3. The LRI sentence contains the information needed to determine if the reply needs to be constructed. The LRF sentence identifies the information that is being requested.

The information that can be requested by the LRF sentence is shown in Table 24. Details of these sentences are contained in IEC 61162-1.

Table 24 – AIS Long-range communications input data and formats

Data	IEC 61162-1 sentences
Long-range interrogation Type of request Geographic area request AIS unit request	LRI
Long-range function identification Requestor MMSI and name Request for: Ship's name, call sign, and IMO number (A) Date and time of message composition (B) Position (C) Course over ground (E) Speed over ground (F) Destination and ETA (I) Draught (O) Ship/Cargo (P) Ship's length, breadth, and type (U) Number of persons on board (W)	LRF

7.6.4.4 Output data and formats

The long-range reply from the AIS unit is accomplished through the use of four IEC 61162-1 sentence formatters – LRF, LR1, LR2 and LR3. The AIS unit shall reply with these sentences, in the following order; LRF, LR1, LR2 and LR3 when responding to an interrogation even if all the information items in the sentence are null.

The LRF-sentence provides the "function reply status" for the requested information. The following is a list of "function reply status" characters with the status that represent:

2 = information available and provided in the following LR1, LR2 and LR3 sentence;

3 = information not available from AIS unit;

4 = information available but not provided (i.e. restricted access determined by ship's master).

The LR1 sentence identifies the destination for the reply and contains the information items requested by the "A" function identification character in the LRF sentence.

The LR2 sentence contains the information items requested by the "B, C, E, and F" function identification characters in the LRF sentence.

The LR3 sentence contains the information items requested by the "I, O, P, U and W" function identification characters in the LRF sentence.

The individual information items shall be "null" if any of the following conditions exist:

- the information item was not requested in the LRF sentence;
- the information item was requested but is not available; or
- the information item was requested but is not being provided.

The output data shown in Table 25 shall be provided when specifically requested by function identification characters contained in the preceding LRF-sentence portion of the interrogation. Details of these sentences are contained in IEC 61162-1.

Table 25 – LR output data formats

Data	IEC 61162-1 sentences
Function reply status	**LRF**
MMSI of responder MMSI of requestor Ship's name Ship's call sign IMO number	LR1
MMSI of responder Date and time of message composition Position Course over ground Speed over ground	LR2
MMSI of responder Destination and ETA Draught Ship/Cargo Ship's length, breadth, and type Number of persons on board	LR3

7.6.5 Optional IEC 61162-450/-460 interface

7.6.5.1 Application

Optionally, an IEC 61162-450/-460 interface may be implemented in addition to the serial ports.

7.6.5.2 Interface connector

The connectors are specified in IEC 61162-450.

7.6.5.3 AIS Class A specific definitions in addition to IEC 61162-450

The following definitions specify the application of IEC 61162-450 for AIS Class A in addition to the general requirements as defined in IEC 61162-450.

- The SFI shall have the format "AIxxxx".
- The default output transmission group of the AIS Class A shall be TGTD.
- The datagram header is "UdPbC" because the AIS Class only communicates with IEC 61162-1 formatted sentences. Binary image transfers are not implemented and therefore related requirements and tests are not applicable.
- The default input transmission groups are NAVD, TGTD and SATD. Up to two additional input groups can be specified. Table 26 lists the applicable sentences for the default input groups. Table 27 lists the TAG block parameters.

Table 26 – Default input transmission groups with applicable sentences

Tx group	Multicast address	Port	Typical talker ID	Typical sentences	Message type
NAVD	239.192.0.4	60004	GA, GP, GN, LC, IN, HE, TI	DTM, GBS, GNS, RMC, VBW, VTG, (GGA, GLL) HDT, THS, ROT	SBM
NAVD	239.192.0.4	60004	EC, EI, IN	ABM, ACA, AIR, BBM, SSD, VSD, HBT	CRP
TGTD	239.192.0.2	60002	RA	ABM, ACA, AIR, BBM, SSD, VSD, HBT	CRP
SATD	239.192.0.3	60003	HE	HDT, THS	SBM

Table 27 – TAG block parameters

Parameter code	Parameter name	Content	Example	Requirement
s:	Source-identification	SFI of the SF which generates the sentence	s:AI0001	Always required
d:	Destination-identification	SFI of the destination SF block	d:IN0002	Only in CRP type sentences, if addressed to a certain SFI.
n:	Line-count	Line counter, counting from 1 to 999	n:1234	Always required Separate counter for each addressed transmission group
g:	Sentence-grouping	Format: x-y-code x = sentence number y = number of sentences in the group code = group code counting from 1 to 99	g:1-3-23 g:2-3-23 g:3-3-23 g:1-2-24 g:2-2-24	Required for all multi-sentence messages. Accepted on input also for single sentences
t:	Text-string	Free format text		Not used in AIS class A
a:	General authentication	Signature of following sentences in block Format: c-h--h c = signature calculation method, h--h = signature.	a:2-479CF…	May be used. No additional parameters are allowed in same TAG Block.

7.6.5.4 Requirements for AIS Class A in a -450 network

7.6.5.4.1 General

The same sentences as specified for the sensor data input and high-speed ports shall be implemented. The sentences are preceded by an IEC 61162-450 header.

Sensor data received through the IEC 61162-1 interface shall have higher priority within the same sensor fall-back priority level than sensor data received through the optional IEC 61162-450 interface, if both interfaces are connected. The priority levels are described in Table 7 for position sensors and in Table 9 for ROT sensors.

The SPW sentence shall not be used in the IEC 61162-450/-460 interface. The configuration of parameters protected by SPW sentence shall not be accepted through the IEC 61162-450/-460 interface.

NOTE The SPW sentence transmits the password in plain text, which is a cyber security risk in networks.

7.6.5.4.2 CRP sentences

Command-response pair (CRP) sentences shall always be output with a d:destination TAG block parameter of the SF from which the original command has been received. The CRP sentences used in AIS are described in Table 28.

Table 28 – CRP sentences applicable for Class A AIS

Received command	Response	Function
ABM/BBM/AIR	ABK	Transmission of messages to VDL
SSD	SSD	Configuration of static data
VSD	VSD	Configuration of voyage data
ACA	ACA/ACS	Channel management
LRI/LRF	LRF/LR1/LR2/LR3	Long range interface
EPV	EPV	Command or report equipment property value
General query	Response to query	Query for configuration information

7.6.5.4.3 Output data

Data which are output autonomously and not in response to an input command are:

- VDO, VDM
- ALC, ALF, ARC
- HBT
- ALR, TXT
- ACA

7.6.5.4.4 Grouping

Following sentences may be grouped:

- ACA, ACS;
- multi-sentence VDM;
- multi-sentence VDO.

7.6.5.5 IEC 61162-460 security classification of IEC 61162-450 interface

7.6.5.5.1 General

There are three possible security classification levels regarding the application of IEC 61162-460 for an IEC 61162-450 interface, if implemented:

- no connection to a -460 network;
- a 450-Node;
- a 460-Node.

The manufacturer shall declare the IEC 61162-460 security classification of the IEC 61162-450 interfaces.

7.6.5.5.2 IEC 61162-460 security classification: no connection to a -460 network

It is not allowed to connect the device to a -460 network. The requirements of IEC 61162-450 have to be fulfilled but it is not necessary to fulfil any requirements of IEC 61162-460.

7.6.5.5.3 IEC 61162-460 security classification: 450-Node

A 450-Node can be connected to a -460 network. The additional requirements and tests are defined in IEC 61162-460.

The main requirements are:

- no connection to external networks or REDS (removable external data source) is allowed. REDS are only allowed in 460-Nodes with more security restrictions;
- the external syslog as defined in IEC 61162-450 has to be implemented;
- data output bandwidth shall be documented by the manufacturer.

7.6.5.5.4 IEC 61162-460 security classification: 460-Node

The requirements and tests of a 460-node are defined in IEC 61162-460. Different to 450-Nodes, the implementation of REDS is generally allowed in 460-Nodes.

7.6.6 Test of the optional IEC 61162-450/-460 interface

The test of the IEC 61162-450/-460 interface is not part of this document. Therefore, there is no special test subclause for the IEC 61162-450/-460 tests in this document. The tests are defined in IEC 61162-450 and IEC 61162-460.

The tests specified in IEC 61162-450 which are applicable for an AIS Class A shall be performed. The test subclauses 4.5, 4.7 and 7.3 of IEC 61162-450:2018 are normally not applicable for AIS Class A equipment.

Depending on the 460-category, the appropriate tests of IEC 61162-460 have to be performed.

The tests given in Table 29 from Clauses 14 to 19 have to be repeated to verify that all sentences are used correctly via the IEC 61162-450 interface.

Table 29 – Tests to be repeated for IEC 61162-450 interface

Tested sentence	Test No.	Test description	Remark
VDO	14.1.1.1.1 c)	Transmit position reports	
VDM	14.1.1.2.1 a)	Receive position reports	
AIR, ABK	14.1.3.1	Transmit an interrogation	To be tested with an interrogation with full content
ABM, ABK	14.1.4.1.1 a)	Transmit an addressed message	
BBM, ABK	14.1.5.1.1 a)	Transmit a broadcast message	
TRL	14.4	Event log	
ALR, ACK	14.8.2.2	Antenna VSWR	
ALF, ACN	-	-	In accordance with IMO MSC.302(87)
HBT	14.8.2.5.1 b)	Remote MKD disconnection, when so configured	Check that HBT input is accepted
TXT	14.8.2.8	Status query	
VER	14.8.2.9	Version information query	
ACA, ACS	17.3	Regional area designation by serial message	Only check that the areas are stored and used when the position is inside.
GNS	19.5.1.1 a)	Test of GNS input	
RMC	19.5.2.1 a)	Test of RMC input	
DTM	19.5.3.1 a)	Test of DTM input	
GBS	19.5.4.1 a) and b)	Test of GBS input	
VBW	19.5.5.1 a)	Test of VBW input	
VTG	19.5.6.1 a)	Test of VTG input	
HDT	19.5.7.1 a)	Test of HDT/THS input	Test with HDT input
THS	19.5.7.1 a)	Test of HDT/THS input	Test with THS input
ROT	19.5.8	Test of ROT input	
-	19.5.10	Test of multiple inputs	Test simultaneous inputs from serial ports and IEC 61162-450 network
VDM	19.7	High speed output interface performance	Performance check
VSD	19.9.2	Test of VSD input sentence	Apply one full set of settings
SSD	19.9.3.1 d) and e)	Test of SSD input sentence	Settings shall be refused
EPV	19.9.4.1 b)	Test of EPV input sentence	Test of unprotected input, EPV input shall be accepted.
SSA	19.9.4.1	Test of EPV input sentence	Test of protected input, EPV input shall be accepted

7.6.7 BIIT ~~alarm~~ alert output

The AIS shall provide a relay output (NC contact) indicating the state of the Built-In Integrity Test (BIIT) ~~alarm~~ alert function as specified in 6.10.1.

The terminals shall be isolated from circuits and grounds in the AIS.

The AIS manufacturer's documentation shall specify the current and voltage capability of the alarm relay contacts.

8 Long-range applications

8.1 General

Long-range applications shall be by interface to other equipment (8.2) and by broadcast (8.3).

8.2 Long-range application by two-way interface

(See 20.1)

8.2.1 General

Long-range (LR) communications shall be only through the presentation interface using the IEC 61162-2 interface dedicated to this purpose as described in 7.6.4.

The LR AIS data shall be displayed on the AIS display as described in 6.11.

8.2.2 Interrogations and responses

LR information shall only be transmitted in response to an interrogation from a LR base station

8.2.3 Manual and automatic response

The Class-A AIS ~~transponder~~ station shall be capable of being set by the user to respond automatically or manually to LR interrogations. In case of automatic reply to LR interrogations, the display shall indicate that the system was LR interrogated until the indication is acknowledged by the operator. In case of manual reply to LR interrogation, the display shall indicate that the system was LR interrogated until the operator has replied to the interrogation or cancelled the reply on the manual input device as described in 6.11.

8.2.4 Data formats and contents

The LR data types available for transmission shall be derived from the AIS system as described in Table 30.

Table 30 – LR data types

ID	Data types format	Remarks
A	Ship name/call sign MMSI/IMO number	MMSI number shall be used as a flag identifier
B	Date and time in UTC	Time stamp of message composition shall be given in UTC only. Day of month, hours and minutes
C	Position	WGS 84; latitude/longitude degrees and minutes
D		Not available
E	Course	Course over ground (COG) in degrees
F	Speed	Speed over ground (SOG) in knots and 1/10 knots
G, H		Not available
I	Destination/ETA	At master's discretion; ETA time format, see B
J, K, L, M, N		Not available
O	Draught	Actual maximum draught in 1/10 of metres
P	Ship/Cargo	See Recommendation ITU-R M.1371-5/A8-3.3, Table 52
Q, R, S, T		Not available
U	Length/Beam/Type	Length and beam in metres Type see Recommendation ITU-R M.1371-5/A8-3.3, Table 52, tonnage not available
V		Not available
W	Number of persons on board	
X,Y		Not available
Z		Not used

8.2.5 Addressing AIS-units

LR interrogations shall be either by user ID (ship's MMSI) or by geographical area "all ships" call designating the North-Eastern corner and the South-Western corner of the Mercator projection rectangle, which describes the called area.

The first LR data transfer shall take place by LR interrogation initiated by a geographical area "All ships" call.

Succeeding LR data transfers shall take place by LR interrogation based on user ID (MMSI).

To avoid replies on succeeding geographical area "All ships" calls from the same base station, the AIS shall store the MMSI of the LR base station for 24 h.

8.3 Long-range application by broadcast

(See 14.1.1, 20.2)

Long-range application by broadcast is described in Recommendation ITU-R M.1371-45/A4.

Long-range AIS receiving systems (for example a satellite based receiver) will receive long-range AIS broadcast messages, provided these messages are appropriately structured and transmitted to suit the receiving systems.

The long-range AIS broadcast Message 27 shall be transmitted only on ~~the two separate designated channels and not on the AIS channels (AIS 1, AIS 2 or regional channels)~~ the channel 75 and channel 76. The transmissions should alternate between these two channels such that each channel is used once every 6 min. The broadcast of Message 27 in coastal areas is subject to base station control through the combined use of Message 4 and Message 23 with station type 10.

~~NOTE 1 Station type 10 has not yet been defined by the ITU-R in Recommendation ITU-R M.1371-4 but is expected to be defined as the base station coverage area for control of Message 27 transmissions by Class A mobile stations.~~

The AIS shall have the capability of disabling this function during normal operation.

~~NOTE 2 The assignment of the two separate designated channels was approved by ITU World Radiocommunication Conference 2012 (WRC-12) by amending the Radio Regulations. This standard uses Channel 75 (156,775 MHz) and Channel 76 (156,825 MHz) as the separate designated channels. The amendments enter into force from 1 January 2013.~~

9 Test conditions

9.1 Normal and extreme test conditions

9.1.1 Normal test conditions

9.1.1.1 Temperature and humidity

Temperature and humidity shall be within following range:

Temperature	+15 °C to +35 °C
Humidity	20 % to 75 %

9.1.1.2 Power supply

The normal power supply for the tests shall be in accordance with IEC 60945.

9.1.2 Extreme test conditions

Extreme test conditions are as specified in IEC 60945. Where required, test under extreme test conditions shall be a combination of dry heat and upper limit of supply voltage applied simultaneously and low temperature and lower limit of supply voltage applied simultaneously.

During type testing, the power source to the equipment may be replaced by a test power source, capable of producing normal and extreme test voltages.

9.2 Standard test environment

The EUT is tested in an environment ~~(see Annex C)~~ using test equipment to simulate and to log VDL messages (see Table 18). Standard environment includes simulated targets. The simulated targets shall include an appropriate number of targets of

- Class A mobile,
- Class B "CS" mobile,
- Class B "SO" mobile,
- base station,
- AIS AtoN station,
- SAR aircraft,
- ~~AIS-SART~~ locating devices,

A receiver for long-range AIS broadcast message (Message 27) reception shall also be provided.

The signal input level at the RF input port of the EUT for any simulated target shall be at least –100 dBm. Own ship sensor inputs to EUT will be simulated by the test system or other means. Operation is checked on channels in the maritime mobile band.

Channels in use shall be selected by manual input or channel assignment messages before starting tests.

9.3 Additional test arrangements

9.3.1 Arrangements for test signals applied to the receiver input

Sources of test signals for application to the receiver input shall be connected in such a way that the source impedance presented to the receiver input is 50 Ω (see 9.3.4).

This requirement shall be met irrespective of whether one or more signals using a combining network are applied to the receiver simultaneously.

The power levels of the test signals at the receiver input terminals (RF socket) shall be expressed in terms of dBm.

The effects of any intermodulation products and noise produced in the test signal sources shall be negligible.

9.3.2 Encoder for receiver measurements

Whenever needed and in order to facilitate measurements on the receiver, an encoder for the data system shall accompany the EUT, together with details of the normal modulation process. The encoder is used to modulate a signal generator for use as a test signal source.

Complete details of all codes and code format(s) used shall be given.

9.3.3 Waiver for receivers

If the manufacturer declares that both TDMA receivers are identical, the test may be limited to one receiver and the test for the second receiver may be waived. The test report shall mention this.

9.3.4 Impedance

In this document, the ~~term~~ value "50 Ω" is used for a 50 Ω non-reactive impedance.

9.3.5 Artificial antenna (dummy load)

Tests shall be carried out using an artificial antenna which shall be a non-reactive non-radiating load of 50 Ω connected to the antenna connector.

9.3.6 Facilities for access

All tests shall be performed using the standard ports of the EUT. Where access facilities are required to enable any specific test, these shall be provided by the manufacturer.

9.3.7 Modes of operation of the transmitter

For the purpose of the measurements according to this document, there shall be a facility to operate the transmitter unmodulated.

Alternatively, the method of obtaining an unmodulated carrier or special types of modulation patterns may also be decided by agreement between the manufacturer and the test laboratory. It shall be described in the test report. It may involve suitable temporary internal modifications of the equipment under test.

9.4 Common test conditions for protection from invalid controls

In all functional tests using Messages 4, 16, 17, 20, 22, 23 and DSC channel management telecommands, the messages or telecommands sender station shall use a valid base station MMSI format (see 6.12) to verify that the EUT operates as described in the required results. The tests shall be repeated using an invalid base station MMSI format for the messages or DSC telecommands sender station to verify that the EUT ignores these messages or telecommands.

9.5 Measurement uncertainties

Maximum values of absolute measurement uncertainties shall be as follows:

RF frequency	$\pm 1 \times 10^{-7}$
RF power	± 0,75 dB
Adjacent channel power	± 5 dB
Conducted spurious emission of transmitter	± 4 dB
Conducted spurious emission of receiver	± 3 dB
Two-signal measurement	± 4 dB
Three-signal measurement	± 3 dB
Radiated emission of transmitter	± 6 dB
Radiated emission of receiver	± 6 dB
Transmitter attack time	± 20 %
Transmitter release time	± 20 %

For the test methods according to this document, these uncertainty figures are valid to a confidence level of 95 %.

The interpretation of the results recorded in a test report for the measurements described in this document shall be as follows:

a) the measured value related to the corresponding limit shall be used to decide whether a piece of equipment meets the requirements of this document;

b) the actual measurement uncertainty of the test laboratory carrying out the measurements, for each particular measurement, shall be included in the test report;

c) the values of the actual measurement uncertainty shall be, for each measurement, equal to or lower than the figures given in 9.5 (absolute measurement uncertainties).

10 Test signals

NOTE Transmitters ~~may~~ can have limitations concerning their maximum continuous transmit time and/or their transmission duty cycle. It is intended that such limitations be respected during testing.

10.1 Standard test signal number 1 (DSC)

A DSC modulated data signal comprising an infinite series of 010101 (dotting pattern; refer to Recommendation ITU-R M.825).

10.2 Standard test signal number 2 (TDMA)

A test signal consisting of an infinite series of 010101.

10.3 Standard test signal number 3 (TDMA)

A test signal consisting of an infinite series of 00001111.

10.4 Standard test signal number 4 (PRBS)

A pseudo random bit sequence (PRBS) as specified in Recommendation ITU-T O.153 as the data within an AIS message frame with header, start flag, end flag and CRC. NRZI is not applied to the PRBS stream or CRC. The RF should be ramped up and down on either end of the AIS message frame.

10.5 Standard test signal number 5 (PRBS)

This test signal consists of 200 packets grouped into clusters of 4 as described in Figure 3. Each cluster consists of 2 consecutive transmissions of the packets described in Table 31.

NRZI shall be applied to every packet. After sending packet 1 and 2, the initial state of the NRZI process shall be inverted and then packet 1 and 2 repeated.

Between every transmitted packet, there shall be at least 2 free time periods. The RF carrier shall be switched off between packets to simulate normal operation.

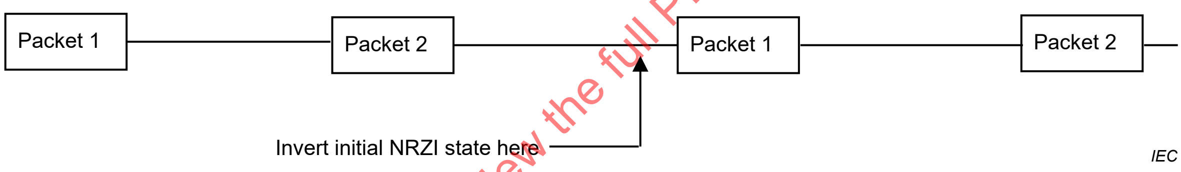


Figure 3 – Format for repeating four-packet cluster

Table 31 – Content of first two packets

Packet	Parameter	Bits	Contents	Comment
1	Training	22	0101....0101	Preamble reduced by 2 bits because of ramp-up overlap
	Start flag	8	01111110	
	Data	168	Pseudo Random	As per Table 32
	CRC	16	Calculated	
	End flag	8	01111110	
2	Training	22	1010....1010	Preamble reduced by 2 bits because of ramp-up overlap
	Start flag	8	01111110	
	Data	168	Pseudo Random	As per Table 32
	CRC	16	Calculated	
	End flag	8	01111110	

Table 32 – Fixed PRS data derived from Recommendation ITU-T O.153

Address	Contents (HEX)							
0-7	0x04	0xF6	0xD5	0x8E	0xFB	0x01	0x4C	0xC7
	0000.0100	1111.0110	1101.0101	1000.1110	1111.1011	0000.0001	0100.1100	1100.0111
8-15	0x76	0x1E	0xBC	0x5B	0xE5	0x92	0xA6	0x2F
	0111.0110	0001.1110	1011.1100	0101.1011	1110.0101	1001.0010	1010.0110	0010.1111
16-20	0x53	0xF9	0xD6	0xE7	0xE0	21 Bytes = 168 bits (+ 4 stuffed bits) , CRC = 0x3B85		
	0101.0011	1111.1001	1101.0110	1110.0111	1110.0000			

11 Power supply, special purpose and safety tests

Tests for power supplies, special purposes and safety shall be performed as specified in IEC 60945:2002, Clauses 7, 11 and 12. Waivers as indicated in IEC 60945 shall apply.

12 Environmental tests

For the environmental tests of IEC 60945:2002, Clause 8, the following shall apply:

Dry heat (IEC 60945)	perform PC under ~~lower~~ extreme test voltage
Low temp (IEC 60945)	perform PC under ~~upper~~ extreme test voltage
Normal temp (IEC 60945)	no test (PT) required

Performance tests (PT) as required by IEC 60945 under extreme conditions are covered by the tests in 15 and for normal temperature under Clause 14.

For the performance checks (PC) to be used with the environmental tests, ~~repeat test 14.1.1. (1 test target at least)~~ check that transmissions from the EUT can be received by test receiver, the transmissions of a test transmitter are output on the PI and displayed on the MKD of the EUT and verify that the transmissions from the EUT contain a valid position from the internal GNSS.

For equipment declared as "exposed" or "portable", the additional tests for these types apply.

13 EMC tests

Tests for EMC emissions shall be performed as specified in IEC 60945:2002, Clause 9.

Tests for EMC immunity shall be performed as specified in IEC 60945:2002, Clause 10.

To demonstrate compliance with the performance criteria for the EMC immunity tests, the EUT shall be set into autonomous mode using channels AIS 1 and AIS 2 with a reporting interval of 2 s in the standard test environment (9.2). The content of the reports and the reporting intervals shall not be degraded during or after the test, as appropriate for the considered criterion.

Performance criterion C of IEC 60945 shall be taken to mean that the functions of the EUT are self-recoverable, i.e. without operation of controls.

14 Operational tests

14.1 Identification and operating modes

(See 6.4)

14.1.1 Autonomous mode

14.1.1.1 Transmit position reports

14.1.1.1.1 Method of measurement

Set up standard test environment. Record the VDL communication and check for messages of the EUT as follows.

a) Operate the EUT with the default MMSI (000000000).
b) Attempt to program an invalid MMSI (outside of the range specified in 6.4).
c) Enable the Message 27 transmission and repeat test with a programmed valid MMSI (see 8.3).
d) Repeat test with a programmed MMSI and after a power down for 12 h.

14.1.1.1.2 Required results

Confirm that:

a) the EUT does not transmit with the default MMSI and an ~~alarm~~ BIIT ID 001 is activated;
b) the EUT rejects an invalid MMSI programming and does not transmit with the default MMSI and ~~an alarm~~ BIIT ID 001 is activated;
c) the EUT transmits autonomously when programmed with a valid MMSI and the transmitted data complies with sensor inputs and is output correctly via PI. Confirm that EUT transmits Message 27 as described in 8.3;
d) all static and voyage related data has been retained ~~for at least 12 h~~ and is output correctly via PI.

14.1.1.2 Receive position reports

14.1.1.2.1 Method of measurement

Set up standard test environment as follows:

a) switch on test targets, then start operation of the EUT;
b) start operation of the EUT, then switch on test targets.

Check the VDL communication and presentation interface outputs of the EUT.

14.1.1.2.2 Required results

Confirm that EUT receives continuously under conditions a) and b) of 14.1.1.2.1 and outputs the received messages via the PI.

14.1.2 Assigned mode

14.1.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Using a base station MMSI, transmit an assigned mode command Message 16 to the EUT with:

a) slot offset and increment;
b) designated reporting interval.

Record transmitted messages.

14.1.2.2 Required results

Confirm that the EUT transmits position reports Message 2 according to defined parameters and reverts to SOTDMA Message 1 with standard reporting interval after 4 min to 8 min.

14.1.3 Polled mode

14.1.3.1 Transmit an interrogation

14.1.3.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Apply position reports (Message 1) without static data (Message 5) on the VDL.
b) Apply position reports (Message 18) without static data (Message 24A and 24B) on the VDL.
c) Initiate the transmission of an interrogation message (Message 15) by the EUT addressing 1 or 2 destinations requesting the following responses:
   – Message 3, 5, 9, 18, 19, 24 from mobile stations;
   – Message 4, 24 from base stations.

Record transmitted messages.

14.1.3.1.2 Required results

~~Check~~ Verify that:

a) the AIS does not automatically initiate the transmission of Message 15;
b) the AIS does not automatically initiate the transmission of Message 15;
c) the EUT transmits the interrogation message (Message 15) as appropriate.

14.1.3.2 Interrogation response

14.1.3.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply an interrogation message (Message 15; EUT as destination) to the VDL for responses with Message 3, Message 5 and Message 24B with slot offset set to a defined value which is greater than 10 slots. Record transmitted messages and frame structure.

14.1.3.2.2 Required results

Check that the EUT transmits the appropriate interrogation response message as requested after defined slot offset. Confirm that the EUT transmits the response on the same channel as where interrogation was received.

14.1.4 Addressed operation

14.1.4.1 Transmit an addressed message

14.1.4.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Initiate the transmission of an addressed binary Message 6; EUT as source by the EUT. Record the transmitted messages.
b) Repeat test with the addressed safety related Message 12.

c) Repeat test with the addressed unstructured binary Message 25.
d) Repeat test with the addressed structured binary Message 25.
e) Repeat test with a single addressed unstructured binary Message 26.
f) Repeat test with a single addressed structured binary Message 26.

14.1.4.1.2 Required results

Check that:

a) the EUT transmits the Message 6 as appropriate;
b) the EUT transmits the Message 12 as appropriate;
c) the EUT transmits the Message 25 as appropriate;
d) the EUT transmits the Message 25 as appropriate;
e) the EUT transmits the Message 26 as appropriate;
f) the EUT transmits the Message 26 as appropriate.

14.1.4.2 Receive addressed message

14.1.4.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode, as follows.

a) Apply an addressed message (Message 6, 12, 25, 26; EUT as destination) to the VDL.
b) Apply an addressed message (Message 6, 12, 25, 26; other station as destination) to the VDL.

Record transmitted messages and frame structure.

14.1.4.2.2 Required results

Check that EUT transmits the appropriate acknowledgement message. Confirm that:

a) EUT outputs the received message via the presentation interface;
b) EUT does not output the received message via the presentation interface.

14.1.5 Broadcast operation

14.1.5.1 Transmit a broadcast message

14.1.5.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode as follows.

a) Initiate the transmission of a broadcast binary Message 8; EUT as source by the EUT. Record the transmitted messages.
b) Repeat test a) with binary data which is not byte aligned.
c) Repeat test a) with the broadcast safety related Message 14.
d) Repeat test c) with safety related text which is not byte aligned.
e) Repeat test a) with the broadcast unstructured binary Message 25.
f) Repeat test a) with the broadcast structured binary Message 25.
g) Repeat test a) with a single broadcast unstructured binary Message 26.
h) Repeat test a) with a single broadcast structured binary Message 26.
i) Initiate the transmission of a broadcast of single unstructured binary Message 26 with all bits (104) set to alternating sequence 0,1,0,1,0,1… .

j) Initiate the transmission of a broadcast of single structured binary Message 26 with DAC=1 FI=0 as defined in ITU-R M.1371 with 6 ASCII characters.
k) Repeat test h) with 5 ASCII characters. This message results transmission of 7 spare bits 6 of which will be interpreted as a character.
l) Initiate the transmission of Message 26 with unstructured data which is not byte aligned.

14.1.5.1.2 Required results

Check that:

a) the EUT transmits the Message 8 as appropriate,
b) the EUT pads the binary data using zero bits to the next byte boundary;
c) the EUT transmits the Message 14 as appropriate,
d) the EUT pads the safety related text using zero bits to the next byte boundary;
e) the EUT transmits the Message 25 as appropriate;
f) the EUT transmits the Message 25 as appropriate;
g) the EUT transmits the Message 26 as appropriate;
h) the EUT transmits the Message 26 as appropriate;
i) the EUT transmits the Message 26 according to the input and the 4 (four) spare bits before CommState are zero;
j) the EUT transmits Message 26 with 6 ASCII characters followed by 1 (one) padding bit for byte boundary and the 4 (four) spare bits set as zero;
k) the EUT transmits Message 26 with 5 ASCII characters followed by 7 (seven) padding bits for byte boundary and the 4 (four) spare bits set as zero;
l) the EUT pads the unstructured binary data using zero bits to the next byte boundary.

14.1.5.2 Receive broadcast message

14.1.5.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Apply a broadcast message (Message 8, 14, 25, 26) to the VDL.
b) Apply a broadcast Message 26 with DAC=1 FI=0 with 6 ASCII characters.
c) Repeat test b) with 5 ASCII characters. This message results in 7 spare bits 6 of which will be interpreted as a character.

14.1.5.2.2 Required results

Confirm that:

a) the EUT outputs the received message via the presentation interface;
b) the EUT outputs the received message with 6 ASCII characters;
c) the EUT outputs the received message with 5 ASCII characters followed by a single null (@) ASCII character.

14.1.6 Multiple slot messages

14.1.6.1 ~~5~~ 3 slot messages

14.1.6.1.1 Method of measurement

Apply a BBM sentence to the PI of EUT with a maximum of ~~121~~ 68 data bytes of binary data in order to initiate transmission of a binary message (Message 8).

14.1.6.1.2 Required results

Check that the message is transmitted in up to ~~5~~ 3 slots accordingly.

14.1.6.2 Longer messages

14.1.6.2.1 Method of measurement

Apply a BBM sentence to the PI of the EUT with an information content not fitting in ~~5~~ 3 slots (i.e. more than ~~121~~ 68 data bytes of binary data containing only binary bits with value one).

14.1.6.2.2 Required results

Check that the message is not transmitted. Check that a negative acknowledgement is given on the presentation interface.

14.2 Manuals, marking and identification

14.2.1 Method of measurement

Check:

a) the manuals provided by manufacturer;

b) the marking and identification labels of EUT.

14.2.2 Required results

Confirm that:

a) the manuals:
   - fulfil the requirements set in IEC 60945:2002, Clause 14;
   - include the type and details of all external connectors (including the pilot plug) referred to in 7.6;
   - include the needed information for correct siting of the antennas;
   - include the requirements for external illumination, as appropriate;
   - include 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 user on what implications the alert has for safe operation of ship and what actions may be necessary to rectify the alert condition.

b) the EUT markings:
   - fulfil the requirements of IEC 60945:2002, Clause 15;
   - include details of the power supply from which the equipment is intended to be operated;
   - if applicable, include the date by which batteries need to be replaced.

14.3 Information

(See 6.5)

14.3.1 Information provided by the AIS

14.3.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Apply all static, dynamic and voyage related data to the EUT.

Record all messages on VDL and check the content of position report Message 1 and static data report Message 5.

14.3.1.2 Required results

Confirm that data transmitted by the EUT complies with manual and sensor inputs.

14.3.2 Reporting intervals

14.3.2.1 Speed and course change

14.3.2.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode as follows.

a) Start with own speed of 10 kn; record all messages on VDL for 10 min and evaluate reporting interval for position report of EUT by calculating average slot offset over test period.
b) Increase speed and change course (ROT $>$ ~~10~~ 20°/min, derived from heading).
c) Reduce speed and rotation rate to values below those given in Table 2.
d) Make speed sensor unavailable.
e) Apply continuously changing heading data. Make heading sensor unavailable.

For b), c), d), record all messages on VDL and check slot offset between two consecutive transmissions.

14.3.2.1.2 Required results

The following results are required.

a) Reporting interval shall comply with Table 2 (10 s with a tolerance of ± 10 %).
b) Confirm that the new reporting interval has been established.
c) Confirm that the reporting interval is increased after 4 min (speed reduction) or 20 s (ROT reduction).
d) Check that, with unavailable speed sensor, the reporting interval reverts to default.
e) Check that, with unavailable heading sensor, the reporting interval reverts to autonomous reporting interval for the given speed.

14.3.2.2 Change of navigational status

14.3.2.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Change navigational status by applying voyage data message to the presentation interface of the EUT as follows:

a) set NavStatus to "at anchor" and "moored" and speed $<$ 3 kn;
b) set NavStatus to "at anchor" and speed $>$ 3 kn;
c) set NavStatus to other values.

Record all messages on VDL and evaluate reporting interval of position report of EUT.

14.3.2.2.2 Required results

The following results are required:

a) Reporting interval shall be 3 min;

b) Reporting interval shall be 10 s;

c) Reporting interval shall be adjusted according to speed and course (see Table 2).

NOTE ~~Alarm~~ Alert conditions associated with NavStatus are tested in 14.8.3.6.

14.3.2.3 Assigned reporting intervals

14.3.2.3.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Using a base station MMSI, transmit an assigned mode command Message 16 to the EUT with

a) initial slot offset and increment,

b) designated reporting interval.

Change course, speed and NavStatus. Record transmitted messages.

14.3.2.3.2 Required results

Confirm that the EUT transmits position reports Message 2 according to the parameters defined by Message 16 if the reporting interval of the assignment is shorter than the autonomous reporting interval. The EUT shall revert to Message 1 or 3 in autonomous mode with the autonomous reporting interval

- after a period of 4 min to 8 min, or
- if a change of course, speed and NavStatus require a shorter autonomous reporting interval.

14.3.2.4 Static data reporting intervals

14.3.2.4.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Record the transmitted messages and check for static and voyage related data (Message 5).

a) Change static and/or voyage related station data. Record the transmitted messages and check for static and voyage related data (Message 5).

b) Apply SSD and VSD sentences with the same static parameters several times.

c) Record the transmitted messages and check for Message 24B.

14.3.2.4.2 Required results

Confirm that the EUT transmits Message 5 with a reporting interval of 6 min alternating Channel A and Channel B.

a) Confirm that the EUT transmits Message 5 within 1 min reverting to a reporting interval of 6 min.

b) Confirm that the EUT transmits Message 5 within 1 min after the first SSD sentence was received and revert to a reporting interval of 6 min. Subsequent identical SSD and VSD sentences shall not generate a further Message 5.

c) Confirm that the EUT transmits Message 24B within 12 min after power up and thereafter once within the next 24 h. Confirm that Message 24B contains correct Vendor ID.

14.4 Event log

(See 6.6)

14.4.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Switch the EUT off for more than 15 min and on again at least ten times. Recover and readout recorded data.

Switch the EUT to ~~receive only~~ silent mode if implemented. Recover and readout recorded data.

14.4.2 Required results

Confirm that the EUT records and displays times and events correctly.

14.5 Software update

14.5.1 Method of measurement

Perform an update of the equipment software according to the specification of the manufacturer.

14.5.2 Required results

Verify that the equipment software can be successfully updated.

14.6 Initialization period

(See 6.7)

14.6.1 Method of measurement

Set up standard test environment with all sensors available.

Switch on EUT with EUT operating in autonomous mode.

Switch off EUT for approximately 0,5 s. Record transmitted messages.

14.6.2 Required results

Confirm that the EUT starts transmissions within 2 min after switch on.

14.7 Technical characteristics

(See 6.9)

14.7.1 Channel selection

14.7.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Switch the EUT to different channels randomly selected from the maritime mobile band as specified by ITU-R M.1084-5:2012, Annex 4, using 25 kHz channel spacing:

a) manually;
b) by transmission of channel management message (Message 22) broadcast and addressed to EUT using a base station MMSI;
c) by application of ACA sentence to the presentation interface;
d) by transmission of DSC telecommand to EUT using a base station MMSI.

Record the VDL messages.

14.7.1.2 Required results

Confirm that the EUT uses the appropriate channels as commanded in the tests.

Confirm that the EUT delivers a single TXT sentence with ID 036, followed by the ACA sentences needed to inform of changes in the AIS use of regional operating settings.

14.7.2 Transceiver protection

14.7.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Open circuit and short circuit VHF-antenna terminals of the EUT for at least 60 s each.

14.7.2.2 Required results

The EUT shall be operative again within 2 min after refitting the antenna without damage to the transceiver.

14.7.3 Automatic power setting

14.7.3.1 Method of measurement

Set up the standard test environment and operate EUT in autonomous mode as follows.

a) Set NavStatus to moored, SOG to $<$ 3 kn and ship type to "tanker".
b) Repeat test a) and assign the power level to high via the VDL.
c) Change the NavStatus to underway.

14.7.3.2 Required results

Verify that:

a) the power setting is 1 W, there is a TXT message number 037 output to PI and the MKD indicates the correct power setting;
b) the power setting is 1 W and the MKD indicates the correct power setting;
c) the power setting is 12,5 W, there is a TXT message number 038 output to PI and the MKD indication reverts to normal.

NOTE Other mechanisms for power setting are tested in 17.5.

14.8 ~~Alarms~~ Alerts and indicators, fall-back arrangements

(See 6.10)

14.8.1 Loss of power supply

14.8.1.1 Method of measurement

Disconnect power supplies of the EUT.

14.8.1.2 Required results

Verify that the relay output is "active" when the power is "off".

14.8.2 Monitoring of functions and integrity

14.8.2.1 Tx malfunction

14.8.2.1.1 Method of measurement

Check the manufacturer's documentation details how the EUT detects Tx malfunction.

14.8.2.1.2 Required results

Confirm that the requirements of 4.1.5 and 6.10.1.2 are fulfilled and ~~that an ALR sentence with alarm ID 1 is sent to the PI~~ BIIT ID 1 is activated. Confirm that appropriate alert is released as required in Table 4.

14.8.2.2 Antenna VSWR

14.8.2.2.1 Method of measurement

Prevent the EUT from radiating with full power by mismatching the antenna for a VSWR of 3:1. During the mismatch, the output power is not required to be the rated output power.

14.8.2.2.2 Required results

~~Verify that the EUT continues operating. Verify that an alarm sentence ALR with alarm ID 002 is sent and the relay output signals the failure state.~~

~~Verify that relay deactivates when the EUT receives an ACK and that the status field in the ALR sentence is updated.~~

Verify that the EUT continues operating. Verify that BIIT ID 2 is activated. Confirm that appropriate alert is released as required in Table 4.

14.8.2.3 Rx malfunction

Manufactures shall provide documentation describing how the AIS detects Rx malfunction and ~~that an ALR sentence with alarm ID as appropriate is sent~~ that the BIIT ID 3, 4 or 5 as appropriate is activated. Confirm by inspection of manufacturer's documentation that appropriate alert is released as required in Table 4.

14.8.2.4 Loss of UTC

14.8.2.4.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Disconnect the GNSS antenna (UTC synch invalid).
b) Reconnect the GNSS antenna.

14.8.2.4.2 Required results

Verify that:

a) the system continues to operate and changes sync state to indirect synchronisation and that ~~a ALR sentence with ID 007 is sent and the relay output~~ BIIT ID 7 is activated. Confirm that appropriate alert is released as required in Table 4;
b) ~~the EUT outputs ALR sentence ID 007 with status deactivated and the relay output is deactivated.~~ BIIT ID 7 is inactivated. Confirm that appropriate alert is inactivated. The EUT shall change sync state to UTC direct synchronisation.

14.8.2.5 Remote MKD disconnection, when so configured

14.8.2.5.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Disconnect the remote MKD or stop the HBT sentence.

~~b) Provide an alarm acknowledgement, ACK sentence with ID 008, to the PI.~~

b) Reconnect the remote MKD, apply the HBT sentence with status indication ok.

c) Apply the HBT sentence with status indication not ok.

d) Apply SSD sentence with DTE flag set to 1.

14.8.2.5.2 Required results

Verify that:

~~a) after two times the specified repeat interval defined in HBT plus 1 s that an alarm sentence, alarm ID 008, is sent and the relay output signals the failure. Verify that the AIS continues operation, with the DTE value “1” in Message 5; If the configured repeat interval field is null, treat it as 30 s.~~

~~b) the relay deactivates when the EUT receives an ACK and that the status field in the ALR sentence is updated;~~

~~c) the AIS continues operation with the DTE value set to “0”;~~

~~d) an alarm sentence, alarm ID 008, is sent and the relay output signals the failure. Verify that the AIS continue operation, with the DTE value "1" in Message 5;~~

a) after two times, the specified repeat interval defined in HBT plus 1 s, BIIT ID 8 is activated. Confirm that appropriate alert is released as required in Table 4. Verify that the AIS continues operation, with the DTE value "1" in Message 5; if the configured repeat interval field is null, treat it as 30 s;

b) BIIT ID 8 is in normal state. Confirm that appropriate alert is inactivated. Verify that the AIS continues operation with the DTE value set to "0";

c) BIIT ID 8 is activated. Confirm that appropriate alert is released as required in Table 4. Verify that the AIS continue operation, with the DTE value "1" in Message 5;

d) the AIS uses the DTE parameter in the SSD sentence and continues operation with the DTE value set to "1".

14.8.2.6 Legacy translation of alerts

14.8.2.6.1 Method of measurement

The test for ALR/ACK handling shall be performed with an appropriate BIIT ID. No other BIIT IDs shall be active.

a) Modify the BIIT ID condition so that the condition is exceeded.

b) Modify the BIIT ID condition so that the condition is rectified.

c) Modify the BIIT ID condition so that the condition is exceeded.

d) Apply an acknowledgement with the ACK sentence to the PI port.

e) Modify the BIIT ID condition so that the condition is rectified.

14.8.2.6.2 Required results

Verify that:

a) an ALR sentence with the BIIT ID of the tested BIIT ID is output with status "A,V". Verify that the ALR output is repeated every 30 s. Verify that the BIIT ID is displayed on the MKD;

b) an ALR sentence with the BIIT ID of the tested alert is output with status "V,V". Verify that the BIIT ID is no longer displayed on the MKD;

c) an ALR sentence with the BIIT ID of the tested BIIT ID is output with status "A,V". Verify that the ALR output is repeated every 30 s. Verify that the BIIT ID is displayed on the MKD;

d) the status of the ALR sentence is changed to "A,A". Confirm that appropriate alert in Table 4 is changed to "A" "Active, acknowledged" state. Verify that the ALR output is repeated every 30 s. Verify that the BIIT ID is displayed on the MKD;

e) an ALR sentence with the BIIT ID of the tested BIIT ID is output with status "V,V". Verify that the BIIT ID is not displayed on the MKD. Verify that an ALR sentence is output every 60 s indicating that no BIIT IDs are active.

14.8.2.7 BAM alerts

14.8.2.7.1 Method of measurement

Perform an appropriate test sequence according to IEC 62923-1, for one. Warning priority alert.

Perform an appropriate test sequence according to IEC 62923-1, for one Caution priority alert.

14.8.2.7.2 Required results

Confirm by analytic evaluation that reporting of alert at BAM interface and presentation of alert on MKD conforms to IEC 62923-1. Verify that the alarm relay is activated only when alert state is "V", Active, unacknowledged.

Confirm by analytic evaluation that reporting of alert at BAM interface and presentation of alert on MKD conforms to IEC 62923-1. Verify that the alarm relay is not activated.

14.8.2.8 Status query

14.8.2.8.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Send a query sentence to the EUT ($xxAIQ,TXT).

14.8.2.8.2 Required results

Verify that a set of TXT sentences representing the current status is output on the PI.

14.8.2.9 Version information query

14.8.2.9.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Send a query sentence to the EUT ($xxAIQ,VER).

14.8.2.9.2 Required results

Verify that a VER sentence representing the software and hardware version information is output on the PI.

14.8.3 Monitoring of sensor data

14.8.3.1 Priority of position sensors

14.8.3.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Verify the manufacturer's documentation to ascertain the configuration implemented on the EUT for position sensors.

Apply position sensor data in a way that the EUT operates in the states defined below:

a) external DGNSS in use (corrected);
b) internal DGNSS in use (corrected; Message 17) if implemented;
c) internal DGNSS in use (corrected; beacon) if implemented;
d) external ~~EPFS~~ GNSS in use (uncorrected);
e) internal GNSS in use (uncorrected ~~if implemented~~);
f) external Loran-C EPFS in use (talker ID "LC");
g) unknown external EPFS in use (talker ID "SN");
h) no sensor position in use;
i) no sensor position in use, external EPFS function disabled by configuration.

Check that EUT handles alerts as required in Table 4 and also outputs appropriate ALR sentences. Check ~~the ALR sentence and~~ the position accuracy flag in the VDL Message 1.

14.8.3.1.2 Required results

Verify that the use of position source, position accuracy flag, RAIM flag and position information complies with Table 7 and Table 8. Verify that the "type of electronic fixing device" in Message 5 is set accordingly.

Verify that when the status is changed ~~an ALR (025, 026, 029, 030)~~ the related alert status (BIIT ID 25, 26, 29, 30) is adapted, or a TXT (021, 022, 023, 024, 025, 027, 028) sentence is sent in accordance with Table 3 or Table 6, respectively.

Verify that the status is changed after 5 s when switching downwards and 30 s when switching upwards.

Verify that EUT does not release alert for missing EPFS when EPFS is not connected by the configuration.

14.8.3.2 Multiple Message 17 from different DGNSS reference stations

14.8.3.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode.

When applying Message 17, use a base station MMSI as follows.

a) Apply Message 17 from a distant DGNSS reference station.
b) Apply Message 17 from a near DGNSS reference station in addition to the distant station.
c) Switch off Message 17 from the near DGNSS reference station.

14.8.3.2.2 Required results

Verify the following:

a) the use Message 17 for position determination;
b) the use Message 17 from the near DGNSS reference station;
c) the use Message 17 from the distant DGNSS reference station.

14.8.3.3 Heading sensor

14.8.3.3.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Disconnect the inputs for HDG and ROT or set their data to invalid (for example by wrong checksum, "valid/invalid" flag).
b) Reconnect the inputs for HDG and ROT.
c) Disconnect the input for ROT or set the data to invalid (for example by wrong checksum, "valid/invalid" flag). Establish a rate of heading change that is greater than 5° in 30 s.
d) Reconnect the ROT input.
e) Apply a SOG less than 5 kn and a difference between COG and HDT greater than 45° for 5 min.
f) Apply a SOG greater than 5 kn and a difference between COG and HDT greater than 45° for 5 min.
g) Disable heading and ROT input by configuration to prevent raising an alert in their absence. Disconnect the inputs for HDG and ROT or set their data to invalid (for example by wrong checksum, "valid/invalid" flag).

14.8.3.3.2 Required results

Check that:

~~a) an alarm sentence ALR with alarm ID 032 for invalid HDG and an alarm sentence ID 035 for invalid ROT are sent to the PI and the "default" data is sent in VDL Message 1, 2, or 3;~~
~~b) an alarm sentence ALR with alarm ID 032 for valid HDG and ID 035 for valid ROT is sent to the PI. Verify that, in the alarm sentences, the alarm condition flag is set to "V" and that the relay output is not activated;~~
~~c) Verify that TXT sentences with ID 031 for valid HDG and ID 033 for ROT indicator in use are sent to the PI;~~
~~d) a TXT sentence with ID 034 for "other ROT source in use" is sent to the PI and that the contents of the message's ROT field is the correct "direction of turn" (Table 6 "ROT sensor fall-back conditions" Priority 2);~~
~~e) a TXT sentence with ID 033 for ROT indicator in use and an ALR sentence with ID 035 for valid ROT is sent to the PI, and the alarm condition flag is set to "V" and that the relay output is not activated;~~
~~f) no active alarm ID 011 for heading sensor offset is sent to the PI;~~
~~g) an alarm sentence ALR with alarm ID 011 for heading sensor offset is sent to the PI after 5 min.~~

a) BIIT ID 32 for invalid HDG and BIIT ID 35 for invalid ROT are activated and the "default" data is sent in VDL Message 1, 2, or 3. Confirm that appropriate alert is released as required in Table 4;
b) BIIT ID 32 for valid HDG and BIIT ID 35 for valid ROT is inactivated. Confirm that appropriate alert is inactivated. Verify that TXT sentences with ID 031 for valid HDG and ID 033 for ROT indicator in use are sent to the PI;
c) a TXT sentence with ID 034 for "other ROT source in use" is sent to the PI and that the contents of the message's ROT field is the correct "direction of turn" (Table 9 "ROT sensor fall-back conditions" Priority 2);
d) a TXT sentence with ID 033 for ROT indicator in use and with the alert no ID 035 for valid ROT is inactivated;

e) BIIT ID 11 for heading sensor offset is not activated;

f) BIIT ID 11 for heading sensor offset is activated after 5 min and appropriate alert is released as required in Table 4.

g) BIIT ID 32 for invalid HDG and BIIT ID 35 for invalid ROT are not activated. Confirm that appropriate alert as required in Table 4 is not released.

14.8.3.4 Speed sensors

14.8.3.4.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Verify the manufacturer's documentation to ascertain the configuration implemented on the EUT for position sensors (see 6.10) as follows:

a) apply valid external DGNSS position and external speed data;

b) disconnect external DGNSS position, disconnect the inputs for SOG, COG or set their data to invalid (e.g. by wrong checksum, "valid/invalid" flag).

14.8.3.4.2 Required results

Check that:

a) a TXT sentence with ID 027 is sent to the PI and the external data for SOG/COG is sent in VDL Message 1, 2 or 3. Verify that the system continues to operate and that the relay output is not activated;

b) a TXT sentence with ID 028 is sent to the PI and the internal data for SOG/COG is sent in VDL Message 1, 2 or 3. Verify that the system continues to operate and that the relay output is not activated.

14.8.3.5 GNSS position mismatch

14.8.3.5.1 Method of measurement

Set up standard test environment and operate EUT with valid internal position available and using valid external position. Configure the dimension/reference values of internal and external position sources with a distance of at least 80 m between the two GNSS antennas.

a) Apply an external position with an offset of more than 100 m + distance between the two GNSS antennas to the internal position for 3 min. Then modify external position to an offset of less than 100 m + distance between the two GNSS antennas to the internal position.

b) Modify the external position to an offset of more than 100 m + distance between the two GNSS antennas to the internal position for more than ~~1 h~~ 15 min.

c) Then modify external position to an offset of less than 100 m + distance between the two GNSS antennas to the internal position.

14.8.3.5.2 Required results

Check that:

~~a) no alarm sentence ALR is output,~~

~~b) an alarm sentence ALR with alarm ID 009 with status active is output 15 min after the modification of the position,~~

~~c) the alarm sentence ALR with alarm ID 009 with status inactive is output.~~

a) BIIT ID 9 is not activated;

b) BIIT ID 9 is activated 15 min after the modification of the position and appropriate alert is released as required in Table 4;

c) BIIT ID 9 is inactivated and appropriate alert is inactivated.

14.8.3.6 Incorrect NavStatus

14.8.3.6.1 Method of measurement

Set up the standard test environment and operate the EUT with valid internal position available and using valid external position. Then proceed as follows.

a) Set NavStatus to "at anchor" and set SOG to > 3 kn.

b) Repeat test with NavStatus "moored".

c) Repeat test with NavStatus "aground".

d) Set NavStatus to "under way" and set SOG to 0 kn for more than 2 h.

e) Try to set NavStatus to 14.

14.8.3.6.2 Required results

Check that:

~~a) an ALR sentence with ID 010 is generated. Verify that the system transmits with the reporting interval as appropriate, and that the MKD prompts the user to correct the NavStatus;~~

~~b) an ALR sentence with ID 010 is generated. Verify that the system transmits with the reporting interval as appropriate;~~

~~c) an ALR sentence with ID 010 is generated. Verify that the system transmits with the reporting interval as appropriate;~~

~~d) an ALR sentence with ID 010 is generated after two hours. Verify that the system transmits with the reporting interval as appropriate, and that the MKD prompts the user to correct the NavStatus;~~

a) BIIT ID 10 is activated and appropriate alert is released as required in Table 4. Verify that the system transmits with the reporting interval as appropriate, and that the MKD prompts the user to correct the NavStatus;

b) BIIT ID 10 is activated and appropriate alert is released as required in Table 4. Verify that the system transmits with the reporting interval as appropriate;

c) BIIT ID 10 is activated and appropriate alert is released as required in Table 4. Verify that the system transmits with the reporting interval as appropriate;

d) BIIT ID 10 is activated and appropriate alert is released as required in Table 4 after two hours. Verify that the system transmits with the reporting interval as appropriate, and that the MKD prompts the user to correct the NavStatus;

e) setting of NavStatus 14 is rejected.

14.8.3.7 Auto detection of type of electronic position fixing device

14.8.3.7.1 Method of measurement

Set up standard test environment and operate EUT with valid internal position available and using valid external position. Then proceed as follows.

a) Provide an external position sensor with a talker ID of GP.

b) Provide an external position sensor with a talker ID of GL.

c) Provide an external position sensor with a talker ID of GN.

d) Provide an external position sensor with a talker ID of LC.

e) Provide an external position sensor with a talker ID of IN.

f) Provide an external position sensor with a talker ID of GA.

g) Provide an external position sensor with a talker ID of other than as in a) to f).

h) Disconnect external position.

14.8.3.7.2 Required results

Check that:

a) the type of electronic position fixing device reported by the VDL Message 5 is "1";
b) the type of electronic position fixing device reported by the VDL Message 5 is "2";
c) the type of electronic position fixing device reported by the VDL Message 5 is "3";
d) the type of electronic position fixing device reported by the VDL Message 5 is "4";
e) the type of electronic position fixing device reported by the VDL Message 5 is "6";
f) the type of electronic position fixing device reported by the VDL Message 5 is "8";
g) the type of electronic position fixing device reported by the VDL Message 5 is "0";
h) the type of electronic position fixing device reported by the VDL Message 5 is "15".

14.9 Display, input and output

(See 6.11)

14.9.1 Data input/output facilities

14.9.1.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode.

a) Check the MKD indication and, by inspection, check that it is possible to input the entire 6-bit ASCII character set required by Recommendation ITU-R M.1371-~~4~~5:2014, Table 47.
b) Record received messages and check contents of minimum display.
c) Input static and voyage related data including the "<" and ">" brackets in the destination field via the MKD. Consider the full range of input fields, for example minimum and maximum.
d) Record transmitted messages and check contents of MKD and PI query.
e) Input static and voyage related data including the "<" and ">" brackets in the destination field via the PI.
f) Record transmitted messages and check contents of MKD and PI query.
g) Change NavStatus to 12.
h) Input dimension extensions to A, B, C and D values.
i) Set dimension extensions to A, B, C and D values as zero.

14.9.1.2 Required results

Confirm that:

a) the minimum display contains at least three lines of target data, with no horizontal scrolling of elapsed time and the range and bearing data display, and that the entire 6-bit character set is supported. Confirm that all characters except trailing "@" signs are displayed;
b) all messages of Table 13 are displayed and that means to select messages and data fields to be displayed are available;
c) all necessary data can be input. Verify that the access to input data required to be protected by 6.11 is password protected. Check that all data not defined in 6.11 has a different password level or no password. Check that input data values outside the allowable range are not accepted. Confirm that all values within the allowable range, but not explicitly prohibited to be used, are accepted;
d) all transmitted data is displayed correctly;

e) all necessary data can be input. Verify that the access to input data required to be protected by 6.11 is password protected. Check that protected data can be displayed without entering a password. Parameters that have to be changed during normal operation, if protected, shall not be protected by the same password level as that used to protect data in 6.11;

f) all transmitted data is displayed correctly;

g) confirm that MKD provides user guidance on setting dimension extension values;

h) confirm that the dimension extension values are correctly stored. Confirm that correctly calculated values are transmitted in Message 5 for both internal and external position sources;

i) confirm that MKD provides user guidance to set NavStatus other than 12.

14.9.2 Initiate message transmission

14.9.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode.

Initiate the transmission of non-scheduled messages and interrogations as provided by the EUT.

14.9.2.2 Required results

Confirm that at least the transmission of safety-related addressed and broadcast messages (Message 12 and Message 14) can be initiated by means of the minimum display. Confirm that transmission of Messages 4, 9, 16, 17, 18, 19, 20, 21, 22, and 23 is not possible. Confirm that MKD shall not accept input of more characters that can be transmitted in a 3-slot message. Confirm that MKD will indicate if the addressed station cannot display the addressed message (DTE flag).

Confirm, by inspection of the manufacturer's documentation, that pre-configured safety related text Messages 12 and 14 are not available.

NOTE Use of Messages 4, 9, 16, 17, 18, 19, 20, 21, 22, and 23 is restricted to other types of AIS stations.

14.9.3 Communication test

14.9.3.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. The test environment ~~has to~~ shall include at least one Class B SO station. Initiate the communication test function (transmit Message 10) by:

a) MKD using proposed target;

b) MKD using alternative target;

c) AIR sentence;

d) another transmitter (EUT as destination).

14.9.3.2 Required results

Confirm that:

a) the EUT transmits Message 10 addressed to the target and that the communication test result is correct for both a successful and unsuccessful response on the MKD. Verify that only Class A stations are proposed on the MKD;

b) the EUT transmits Message 10 addressed to the target and that the communication test result is correct for both a successful and unsuccessful response on the MKD. Verify that only Class A stations can be selected as alternative targets on the MKD;

c) the EUT transmits Message 10 addressed to the target;

d) the EUT transmits Message 11 as the response;

In all cases, verify that VDO Message 10 and received VDM Message 11 is output to the PI.

Verify that Class B stations are not selected by the MKD.

14.9.4 System control

14.9.4.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Perform system control/configuration commands as specified. Check indication of system status~~/alarms~~.

14.9.4.2 Required results

Confirm that the configuration level and other functions, not intended for use by the operator, are protected by password or adequate means.

Verify that regional channel management settings can be input via the MKD and that there is no other means of changing the radio parameters.

14.9.5 Display of received targets

14.9.5.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode.

a) Apply messages from the following targets to the VDL:
   - Class A with Messages 1 and 5, 10 s reporting interval;
   - Class A with Messages 3 and 5, 3 min reporting interval;
   - base station with Message 4, 10 s reporting interval;
   - airborne AIS with Messages 9 and 5, 10 s reporting interval;
   - Class B SO with Messages 18 and 19, 30 s reporting interval;
   - Class B CS with Messages 18 and 24A,B, 3 min reporting interval;
   - AIS AtoN with Message 21, 1 min reporting interval;
   - AIS-SART, MOB-AIS and EPIRB-AIS under test with Messages 1 and 14, transmit 1 TDMA burst;
   - AIS-SART, MOB-AIS and EPIRB-AIS under test with Messages 1 and 14, transmit 1 TDMA burst with enabling testing ~~AIS-SART~~ locating device indication;
   - ~~2 active AIS-SARTs with Messages 1, 1 min reporting interval.~~
   - one active locating device of each kind transmitting Messages 1, with a 1 min reporting interval.

b) Remove all targets from VDL.

c) Apply again all targets after 17 min, without static data Messages 5, 19 and 24.

d) Switch off ~~one AIS-SART~~ two locating devices.

e) Apply 200 targets to the EUT.

f) Apply 300 targets to the EUT.

14.9.5.2 Required results

The following results are required.

a) Confirm that all targets are auto-sorted in ascending range and displayed on the target list with name, range, bearing and minutes from last received position report.

~~Confirm that the nearest active AIS-SART is displayed on top of the list and the name is SART ACTIVE.~~

~~Confirm that an Alarm ID 014 is sent to the PI.~~

~~Confirm that testing AIS-SART is not displayed; however, it is displayed only when enabling testing AIS-SART indication.~~

Confirm that all active locating devices are displayed on the target list above all other targets and the names of all locating devices are in accordance with Table 10.

Confirm that alerts in accordance with Table 4 are raised.

Confirm that the locating devices in test mode are not displayed; however, they are displayed only when enabling testing locating device indication.

Confirm that the other targets are displayed in an order according to the range, nearest target first.

Confirm that all targets can be selected for detailed view.

Confirm that all information required by Table 13 is displayed in the detailed view if not displayed in the target list.

Confirm that all target information that is displayed on the MKD is displayed correctly.

b) Confirm that the time from the last received message is counting ~~down~~ up every minute for all targets. Confirm that all targets, except the active ~~AIS-SARTs~~ locating devices, are removed from display 7 min after the last received message.

c) Confirm that all targets are displayed again. Confirm that all static data from all targets are displayed correctly.

d) Confirm that the time from the last received message is counting ~~down~~ up every minute for ~~AIS-SART~~ the switched off locating devices. Confirm that the ~~AIS-SART is~~ switched off locating devices are removed from display 18 min after the last received message.

e) Confirm that the MKD displays 200 targets.

f) Confirm that the MKD displays 200 nearest targets as a minimum.

14.9.6 Display of position quality

14.9.6.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Apply Class A transmissions with the following data to the VDL and observe the position quality display on the MKD:

a) Time stamp = 63;

b) Time stamp = 61;

c) Time stamp = 62;

d) Time stamp = 60;

e) Time stamp 0... 59, PA = 0, RAIM = 0;

f) PA = 0, RAIM = 1;

g) PA = 1, RAIM = 0;

h) PA = 1, RAIM = 1;

i) Set SOG = 10 kn, then stop target transmissions;

j) Start transmission again, set SOG = 20 kn, then stop transmission.

14.9.6.2 Required results

Confirm that:

a) the position quality "No position" is displayed;
b) the position quality "Manual position" is displayed;
c) the position quality "Dead reckoning position" is displayed;
d) the position quality "valid position with no time stamp" is displayed;
e) the position quality "Position > 10m" is displayed;
f) the position quality "Position with RAIM > 10 m" is displayed;
g) the position quality "Position < = 10 m" is displayed;
h) the position quality "Position with RAIM < = 10 m" is displayed;
i) 40 s after the last transmission the position quality is changed to "Outdated position > 200 m";
j) 20 s after the last transmission the position quality is changed to "Outdated position > 200 m".

14.9.7 Display of targets if optional filter is implemented

The methods of test and the required results are as follows:

a) confirm by observation that the user can filter the presentation of AIS targets in accordance with the manufacturer's documentation;
b) confirm by observation that an indication is provided when sleeping targets are filtered from the presentation in accordance with the manufacturer's documentation;
c) confirm by observation that the indication remains while the filter is active in accordance with the manufacturer's documentation;
d) confirm by observation that the filter criteria in use is readily available in accordance with the manufacturer's documentation;
e) confirm by observation that the user cannot remove individual AIS targets from the presentation in accordance with the manufacturer's documentation.

14.9.8 Display of received safety related messages

14.9.8.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode.

a) Transmit 20 Message 12 addressed to the EUT.
b) ~~Acknowledge~~ Clear displayed message on the MKD.
c) Transmit 20 Message 12 addressed to the EUT.
d) Transmit Message 14.

14.9.8.2 Required results

Confirm that:

a) the most recently received Message 12 is displayed foremost and all 20 messages are available for display;
b) the ~~acknowledged~~ Message 12 is removed from foremost display on the MKD;
c) the most recently received Message 12 is displayed foremost and all 20 messages are available for display;
d) there is an indication that the Message 14 has been received and that Message 14 is available for display.

14.9.9 Presentation of navigation information

Verify compliance with the general requirements for the presentation of navigation-related information in accordance with the test methods and required results specified in IEC 62288.

Verify compliance with requirements for graphical presentation of targets in accordance with the test methods and required results of IEC 62288, if display of graphical symbols for AIS data is provided.

Provide input of the messages listed below and confirm by observation that the MKD displays graphical symbology as described in IEC 62288, if display of graphical symbols for AIS data is provided:

- Messages 1, 2, 3 and 5 (Class A AIS, ~~AIS-SART~~ locating devices);
- Messages 18, 19 and 24 (Class B AIS);
- Message 4 (AIS base stations);
- Message 9 (AIS on airborne SAR-craft);
- Message 21 (AIS AtoN).

Symbols not described in IEC 62288 may be defined by the manufacturer.

Verify compliance in accordance with the test methods and required results of IEC 62388 (radar) for calculation of CPA/TCPA, if provided.

15 Physical tests

(See 7.2)

NOTE Unless otherwise stated, all transmitter tests are performed at the highest power setting.

15.1 TDMA transmitter

15.1.1 Frequency error

15.1.1.1 Definition

The frequency error of the transmitter is the difference between the measured carrier frequency in the absence of modulation of the transmitter and its required frequency.

15.1.1.2 Method of measurement

The carrier frequency shall be measured in the absence of modulation (see Figure 4). Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz) and under normal and extreme test conditions.

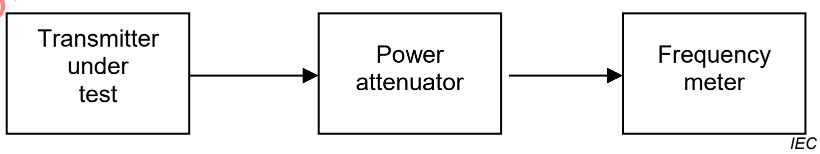


Figure 4 – Measurement arrangement for frequency error

15.1.1.3 Required results

The frequency error shall not exceed ± 0,5 kHz under normal and ± 1 kHz under extreme test conditions.

15.1.2 Carrier power

15.1.2.1 Definition

The transmitter carrier power conducted (P_c) is defined as the mean power delivered to a nominal 50 Ω load during a transmission slot.

15.1.2.2 Method of measurement

The equipment shall be connected as in Figure 5. Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz) under normal and extreme test conditions.

The tests shall be repeated for the power levels stated in 7.2.2.

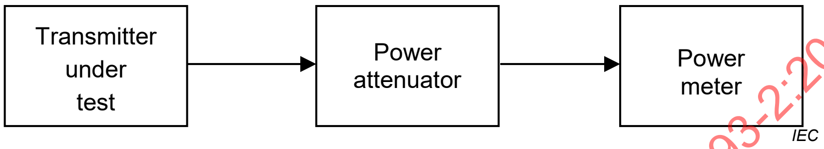


Figure 5 – Measurement arrangement for carrier power

15.1.2.3 Required results

At all test frequencies, the carrier power shall be within ± 1,5 dB of its nominal power levels under normal test conditions.

At all test frequencies, the carrier power shall be within ± 3,0 dB of its nominal power levels under extreme test conditions.

15.1.3 Slotted transmission spectrum

15.1.3.1 Definition

This test is to ensure that the modulation and transient sidebands produced by the transmitter under normal operating conditions fall within the allowable mask.

15.1.3.2 Method of measurement

The test shall use test signal number 4. The EUT shall be connected to a spectrum analyser. A resolution bandwidth of 300 Hz, video bandwidth of 3 kHz or greater and positive peak detection (maximum hold) shall be used for this measurement. A sufficient number of sweeps shall be used and sufficient transmission packets measured to ensure that the emission profile is developed. Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz).

15.1.3.3 Required results

The spectrum for slotted transmission shall be within the emission mask as follows:

- in the region between the carrier and ± 10 kHz removed from the carrier, the modulation and transient sidebands shall be below 0 dBc;
- at ± 10 kHz removed from the carrier, the modulation and transient sidebands shall be below –25 dBc;
- at ± 25 kHz to ± 62,5 kHz removed from the carrier, the modulation and transient sidebands shall be below ~~the lower value of~~ –70 dBc;
- in the region between ± 10 kHz and ± 25 kHz removed from the carrier, the modulation and transient sidebands shall be below a line specified between these two points.

The reference level for the measurement shall be the carrier power (conducted) recorded for the appropriate test frequency in 15.1.2.

For information, the emission mask specified above is shown in Figure 6.

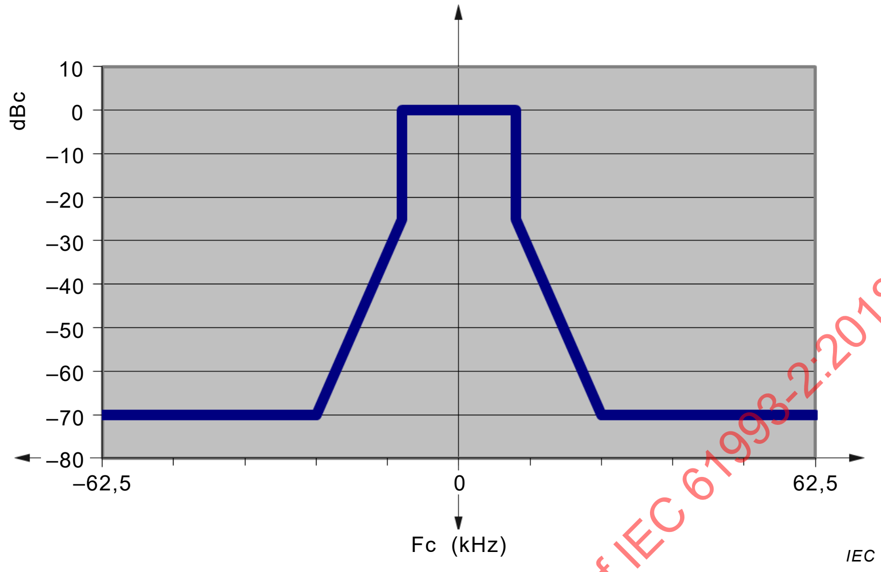


Figure 6 – Emission mask for slotted transmission

15.1.4 Modulation accuracy

15.1.4.1 Definition

The modulation accuracy is the measurement of the peak frequency deviation of the transmitter modulation and the correct implementation of the Gaussian minimum shift keying (GMSK) bandwidth-time (BT) filtering.

15.1.4.2 Method of measurement

The equipment shall be connected in either configuration A or configuration B as shown in Figure 7. The tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz) under normal and extreme test conditions.

The transmitter shall be modulated with test signal number 2.

The transmitter shall be modulated with test signal number 3.

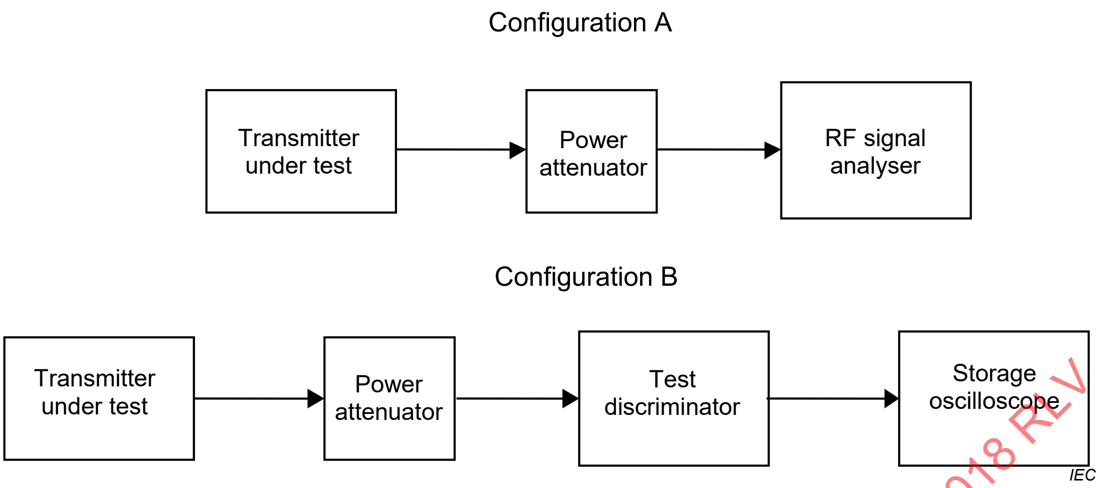


Figure 7 – Measurement arrangement for modulation accuracy

15.1.4.3 Required results

Peak deviation shall be as per Table 33.

Table 33 – Peak frequency deviation versus time

Test signal 2		Test signal 3	
Normal	**Extreme**	**Normal**	**Extreme**
1 740 Hz ± 175 Hz	1 740 Hz ± 350 Hz	2 400 Hz ± 240 Hz	2 400 Hz ± 480 Hz

15.1.5 Transmitter output power characteristics

15.1.5.1 Definition

Transmitter output power characteristics are a combination of the transmitter delay, ramp-up time, ramp-down time and transmission duration, as specified in 7.2.2, where:

– transmitter delay (T_A) is the time between the start of the candidate transmission time period and the time when the transmission power exceeds –50 dBc;

– transmitter ramp-up time (T_B – T_A) is the time between the transmit power exceeding –50 dBc and the moment when the transmit power has reached a level 1 dB below the measured steady-state power (P_{ss}) and maintains a level within +1,5 dB to −1 dB from P_{ss} thereafter;

– transmitter ramp-down time (T_F – T_E) is the time between the end flag being transmitted and the moment when the transmitter output power has reduced to a level 50 dB below P_{ss} and remains below this level thereafter;

– transmission duration (T_F – T_A) is the time from when power exceeds –50 dBc to when the power returns to and stays below –50 dBc.

15.1.5.2 Method of measurement

The measurement shall be carried out by transmitting test signal number 4.

NOTE This test signal generates one additional stuffing bit within its CRC portion.

Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz). The EUT shall be connected to a spectrum analyser. A resolution bandwidth of 1 MHz, video bandwidth of 1 MHz and a sample detector shall be used for this measurement. The analyser shall be in zero-span mode for this measurement. The spectrum analyser shall be synchronised to the nominal start time of the slot (T_0), which may be provided externally, or from the EUT.

15.1.5.3 Required results

The transmitter power shall remain within the mask shown in Figure 6 and associated timings given in Table 16.

15.2 TDMA receivers

15.2.1 Sensitivity

15.2.1.1 Definition

The usable sensitivity is the minimum level of signal at the receiver input, produced by a carrier at the nominal frequency of the receiver, modulated with a test signal, which will, without interference, produce after demodulation a data signal with a specified packet error rate (PER).

15.2.1.2 Method of measurement

The signal generator (see Figure 8) shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5.

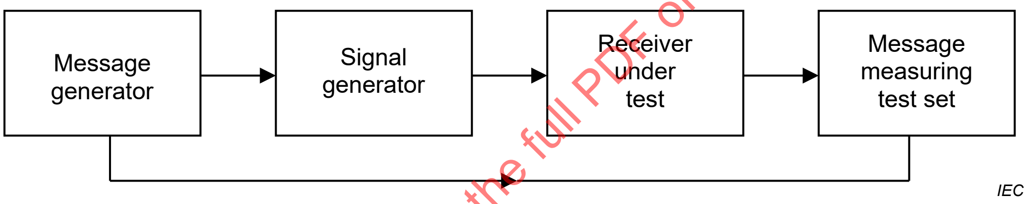


Figure 8 – Measurement arrangement

The signal level at the input of the receiver shall be set to –107 dBm. The message measuring test set shall be monitored and the packet error rate observed. The PER shall be derived by the following formula:

$$PER = (P_{TX} - P_{RX})/P_{TX} \times 100\ (\%)$$

where

P_{RX} is the number of packets received without errors;

P_{TX} is the number of transmitted packets.

Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz) with a signal level of –107 dBm and repeated at 156,025 MHz ± 500 Hz and 162,025 MHz ± 500 Hz with the level at the input to the receiver adjusted to –104 dBm under normal conditions.

Repeat under extreme conditions at nominal frequencies, with the signal generator adjusted to –101 dBm.

15.2.1.3 Required results

The PER shall not exceed 20 %.

15.2.2 Error behaviour at high input levels

15.2.2.1 Definition

The error behaviour (performance) at high input levels (noise free operation) is defined in the same manner as for the measurement of the maximum usable sensitivity when the level of the wanted signal is significantly above the maximum wanted sensitivity.

15.2.2.2 Method of measurement

The measurement configuration for receiver sensitivity (15.2.1) shall be used. Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz). The signal generator shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5. The level of the input signal shall be adjusted to a level of –7 dBm. The message measuring test set shall be monitored and the packet error rate observed. This test shall be repeated at the level of −77 dBm.

15.2.2.3 Required results

The PER shall not exceed 1 %.

15.2.3 Co-channel rejection

15.2.3.1 Definition

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.

15.2.3.2 Method of measurement

Two generators, A and B, shall be connected to the receiver via a combining network as shown in Figure 9. The wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5. The unwanted signal, provided by generator B, shall also be at the nominal frequency of the receiver. Generator B shall be modulated to generate test signal number 4, either continuously or in the same time period as that used by generator A for test signal number 5. The content of the wanted and unwanted signals shall not be synchronised. The level of the wanted signal from generator A shall be adjusted to –104 dBm at the receiver. The level of the unwanted signal from generator B shall be adjusted to –114 dBm at the receiver. The message measuring test set shall be monitored and the packet error rate (PER) observed. The measurement shall be repeated for displacements of the unwanted signal of ±1 kHz from the nominal frequency of the receiver and the PER again observed. Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz).

NOTE ±1 kHz for the unwanted signal is twice the allowable transmit frequency tolerance.

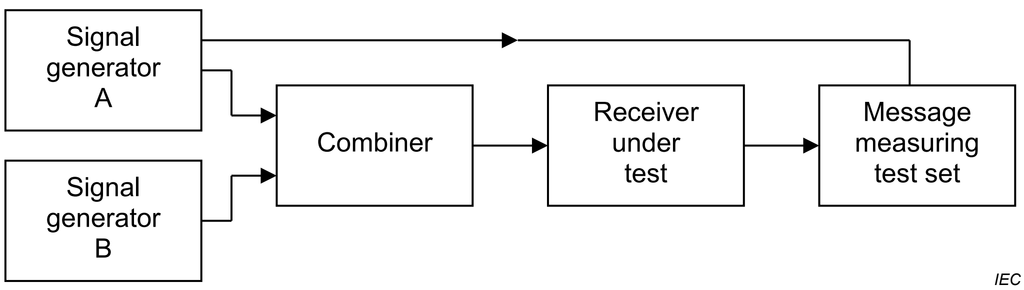


Figure 9 – Measurement arrangement with two generators

15.2.3.3 Required results

The PER shall not exceed 20 %.

15.2.4 Adjacent channel selectivity

15.2.4.1 Definition

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

15.2.4.2 Method of measurement

The measurement configuration for co-channel rejection (15.2.3) shall be used. The wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ± 3 kHz. Generator B shall be at a frequency 25 kHz above that of the wanted signal. The level of the wanted signal from generator A shall be adjusted to a level of –104 dBm at the receiver. The level of the unwanted signal from generator B shall be adjusted to –34 dBm. The message measuring test set shall be monitored and the packet error rate observed. Repeat the above measurement with the unwanted signal 25 kHz below the wanted signal.

The test shall be performed on 2 channels (156,025 MHz, 162,025 MHz) and repeated under extreme conditions with generator A adjusted to –98 dBm and generator B adjusted to –38 dBm.

15.2.4.3 Required results

The PER shall not exceed 20 %.

15.2.5 Spurious response rejection

15.2.5.1 Definition

The spurious response rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, at which a response is obtained.

15.2.5.2 Manufacturer's declarations

The manufacturer shall declare the following in order to calculate the "limited frequency range" over which the initial part of the test will be performed:

- list of intermediate frequencies: (IF_1, IF_2, ...IF_N) in Hz;
- switching range of the receiver;

  NOTE 1 Switching range corresponds to the frequency range over which the receiver can be tuned.

- frequency of the local oscillator at 156,025 MHz and 162,025 MHz (AIS2): (f_{LOL}, f_{LOH}).

  NOTE 2 This ~~may~~ can be a VCO, crystal, sampling clock, BFO, or numerically controlled oscillator, depending on the design of the equipment.

15.2.5.3 Introduction to the method of measurement

The initial evaluation of the unit shall be performed over the "limited frequency range" and shall then be performed at the frequencies identified from this test and at "specific frequencies of interest" (as defined below).

If the EUT contains IF frequencies, the following procedure applies. Otherwise, the manufacturer shall provide an alternative procedure based on the design of the EUT that produces equivalent results. To determine the frequencies at which spurious responses can occur, the following calculations shall be made:

a) calculation of the "limited frequency range":

the limits of the limited frequency range (LFR_{HI}, LFR_{LO}) are determined by the following calculations:

$$LFR_{HI} = f_{LOH} + (IF_1 + IF_2 + \ldots + IFN + sr/2)$$

$$LFR_{LO} = f_{LOL} - (IF_1 + IF_2 + \ldots + IFN + sr/2)$$

b) calculation of specific frequencies of interest (SFI) outside the limited frequency range:

these are determined by the following calculations:

$$SFI_1 = (K \times f_{LOH}) \pm IF_1$$

$$SF_{I2} = (K \times f_{LOL}) \pm IF_1$$

where

K is an integer from 2 to 4.

15.2.5.4 Method of measurement over the limited frequency range

Two methods are available for the measurements over the limited frequency range, one based on SINAD measurements and the other based on PER measurements. Either method may be used, but in each case shall be followed by the method of measurement at identified frequencies. The measuring equipment is showed in Figure 10.

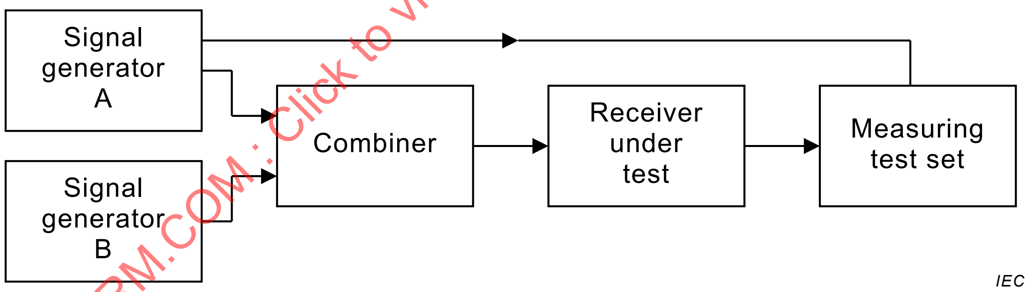


Figure 10 – SINAD or PER/BER measuring equipment

15.2.5.5 Method of search over the "limited frequency range" using SINAD measurements

Two generators, A and B, shall be connected to the receiver via a combining network as shown in Figure 10. The wanted signal, provided by generator A, shall be 162,025 MHz (AIS 2) and shall be modulated with 1 kHz sine wave at ± 2,4 kHz deviation. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ± 3 kHz.

Initially, generator B (unwanted) shall be switched off (maintaining the output impedance). The signal level from generator A (wanted) shall be adjusted to –104 dBm at the receiver. The SINAD value shall be noted (and should be greater than 14 dB). Signal generator B shall be switched on and adjusted to –27 dBm at the receiver. The frequency of the unwanted signal shall be varied in steps of 5 kHz over the limited frequency range (from LFR_{LO} to LFR_{HI}). The frequency of any spurious response detected (by a decrease in SINAD of 3 dB or more) during the search shall be recorded for use in the next measurements.

Set the receiving frequency to 156,025 MHz and repeat the test.

15.2.5.6 Method of search over the "limited frequency range" using PER or BER measurement

Two generators, A and B, shall be connected to the receiver via a combining network as shown in Figure 10. The wanted signal, provided by generator A, shall be 162,025 MHz (AIS2) and shall be modulated to generate test signal number 5. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ± 3 kHz. Initially, generator B (unwanted) shall be switched off (maintaining the output impedance). The signal level from generator A (wanted) shall be adjusted to –104 dBm at the receiver. The PER or BER shall be noted.

Signal generator B shall be switched on and adjusted to −27 dBm at the receiver. The frequency of the unwanted signal shall be varied in steps of 5 kHz over the limited frequency range (from LFR_{LO} to LFR_{HI}). The frequency of any spurious response detected (by an increase in either PER or BER) during the search shall be recorded for use in the next measurements.

In the case where operation using a continuous packet stream is not possible, a similar method may be used.

Set the receiving frequency to 156,025 MHz and repeat the test.

15.2.5.7 Method of measurement (at identified frequencies)

Two generators, A and B, shall be connected to the receiver via a combining network as shown in Figure 10. The wanted signal, provided by generator A, shall be 162,025 MHz (AIS2) and shall be modulated to generate test signal number 5. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz. Generator B shall be at the frequency of that spurious response being considered. Initially, generator B (unwanted) shall be switched off (maintaining the output impedance). The signal level from generator A (wanted) shall be adjusted to –104 dBm at the receiver. Generator B shall be switched on, and the level of the unwanted signal set to –34 dBm.

For each frequency noted during the tests over the limited frequency range on 162,025 MHz (AIS2) and the specific frequencies of interest (SFI_1), transmit 200 packets to the EUT and note the PER.

Set the receiving frequency to 156,025 MHz and repeat the test for each frequency noted during the tests over the limited frequency range on 156,025 MHz and the specific frequencies of interest (SFI_2).

15.2.5.8 Required results

At any frequency separated from the nominal frequency of the receiver by two channels or more, the spurious responses shall not result in a PER of greater than 20 %.

15.2.6 Intermodulation response rejection and blocking

15.2.6.1 Definition

The intermodulation response rejection and blocking is the capability of the receiver to receive a wanted modulated signal, without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

15.2.6.2 Method of measurement

Four signal generators shall be connected to the receiver under test (see Figure 11). The wanted signals, represented by signal generator A, shall be modulated to generate test signal number 5. The wanted signal level at the RF input of the receiver shall be set to −101 dBm.

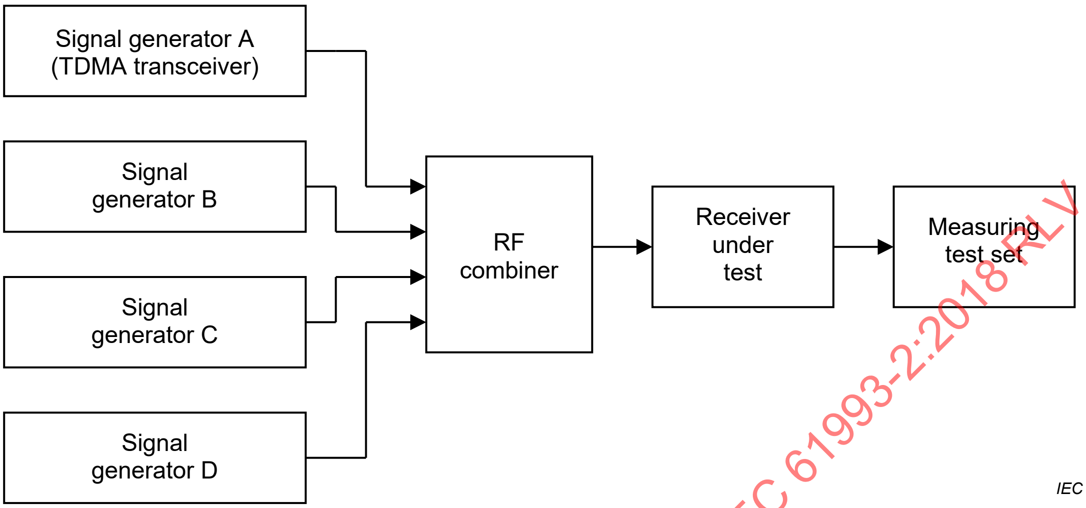


Figure 11 – Test set-up

The unwanted signal from signal generator B shall be modulated by 400 Hz with a deviation of ± 3 kHz and adjusted to a frequency 500 kHz above or below the frequency of the wanted signal. The unwanted signal from signal generator C shall be unmodulated and adjusted to a frequency 1 000 kHz above or below the frequency of the wanted signal. The unwanted signal levels from signal generators B and C at the RF input of the receiver shall be set to –27 dBm.

The unwanted signal from signal generator D shall be unmodulated and adjusted to a frequency 5,725 MHz above or below the frequency of the wanted signal. The unwanted signal level from signal generator D at the RF input of the receiver shall be set to –15 dBm.

According to the Table 34, two tests (Test no.1 and Test no.2) shall be performed.

Table 34 – Tests to be performed

	Generator A	Generator B	Generator C	Generator D
Test no.1	156,025	156,525	157,025	161,750
Test no.2	162,025	161,525	161,025	156,300

15.2.6.3 Required results

The packet error rate shall not exceed 20 %.

15.2.7 Transmit to receive switching time

15.2.7.1 Definition

The transmit to receive switching time describes the capability of the TDMA receiver to receive in the slot immediately following the transmission slot.

15.2.7.2 Method of measurement

The signal generator shall be connected to the EUT through 30 dB attenuator as shown in Figure 12. The EUT shall be connected to a 30 dB attenuator. The transmit to receive control signal in the EUT shall be connected to the signal generator as the trigger signal to output the test message at the immediate slot after the EUT transmission. The signal generator shall be at the nominal frequency of the EUT with a signal level of −107 dBm at the EUT and shall be modulated to generate test signal number 5. The EUT shall be set to the default power (12,5 W) and be set to transmit 200 messages of Message 1 with 2 s interval. The message measuring test set shall be monitored and the PER be observed.

The test shall be performed on 2 channels (156,025 MHz, 162,025 MHz).

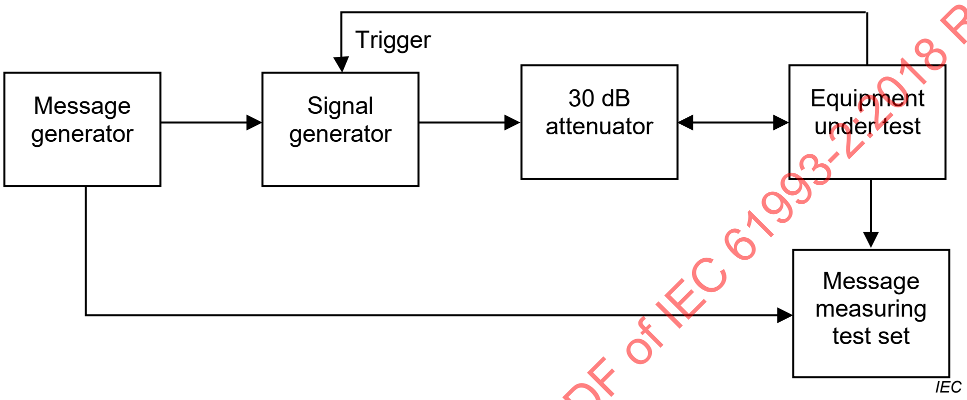


Figure 12 – Transmit to receive switching time measurement setup

15.2.7.3 Required results

The PER shall not exceed 20 %.

15.2.8 Immunity to out-of-band energy

15.2.8.1 Definition

The immunity to out-of-band energy is the capability of the receiver to receive a wanted modulated signal, without exceeding a given degradation due to the presence of high level unwanted signals out of the maritime mobile band.

15.2.8.2 Method of measurement

Two generators, A and B, shall be connected to the receiver via a combining network as shown in 15.2.3. The wanted signal, provided by signal generator A, shall be initially at 162,025 MHz and be modulated to generate test signal number 5. The unwanted signal from generator B shall be unmodulated and tuned to 174 MHz. Initially, signal generator B (unwanted signal) shall be switched off (maintaining the output impedance). The level of the wanted signal from generator A shall be adjusted to −101 dBm at the receiver input. Generator B shall then be switched on, and the level of the unwanted signal set to −5 dBm. 200 packets shall be transmitted and the PER recorded.

Repeat the test with the wanted signal generator tuned to 156,025 MHz with the same unwanted signal.

15.2.8.3 Required results

The packet error rate shall not exceed 20 %.

15.3 Conducted spurious emissions

15.3.1 Spurious emissions from the transmitter

15.3.1.1 Definition

Conducted spurious emissions are emissions on a frequency or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

15.3.1.2 Method of measurement

The transmitter shall be connected to a 50 Ω power attenuator. The output of the power attenuator shall be connected to a measuring receiver.

If possible, the measurement shall be made with the transmitter unmodulated. If this is not possible, the transmitter shall be modulated by test signal number 4. If possible, the modulation should be continuous for the duration of the measurement.

The measurement shall be made over a frequency range from 9 kHz to 4 GHz, excluding the channel on which the transmitter is operating ± 62,5 kHz.

The resolution bandwidth of the measuring instrument shall be the smallest bandwidth available which is greater than the spectral width of the spurious component being measured. This shall be considered to be achieved when the next highest bandwidth causes less than 1 dB increase in amplitude. Positive peak detection (maximum hold) shall be selected on the spectrum analyser used for this measurement.

A sufficient number of sweeps shall be measured to ensure that the emission profile is developed.

At each frequency at which a spurious component is detected, the power level shall be recorded as the conducted spurious emission level delivered into the specified load, except for the channel on which the transmitter is intended to operate and the adjacent two channels of upper and lower sides.

The conditions used in the relevant measurements shall be recorded in test reports.

15.3.1.3 Required results

The power of any spurious emission on any discrete frequency shall not exceed 0,25 µW (−36 dBm) in the frequency range 9 kHz to 1 GHz and 1 µW (−30 dBm) in the frequency range 1 GHz to 4 GHz.

15.3.2 Spurious emissions from the receiver

15.3.2.1 Definition

Spurious emissions from the receiver are components at any frequency, conducted to the antenna. The level of spurious emissions shall be measured as their power level in a specified load.

15.3.2.2 Method of measurement

The receiver shall be connected to a 50 Ω attenuator. The output of the attenuator shall be connected to a spectrum analyser or selective voltmeter having an input impedance of 50 Ω. If the detecting device is not calibrated in terms of power input, the level of any detected components shall be determined by a substitution method using a signal generator. The measurement shall extend over the frequency range 9 kHz to 4 GHz.

The receiver shall be switched on, and the measuring receiver shall be tuned over the frequency range 9 kHz to 4 GHz.

At each frequency at which a spurious component is detected, the power level shall be recorded as the spurious level delivered into the specified load.

15.3.2.3 Required results

The power of any spurious emission in the specified range at the antenna terminal shall not exceed –57 dBm (2 nW) in the frequency range 9 kHz to 1 GHz and –47 dBm (20 nW) in the frequency range 1 GHz to 4 GHz.

16 Specific tests of link layer

(See 7.3)

NOTE In Clause 16, "CommState" is used as an abbreviation for "communication state" as defined in Recommendation ITU-R M.1371~~-4~~. Communication state is structured with a number of parameters for "Sync state", "Slot time-out", "Slot increment", "Number of slots", "Sub-message" (Received stations, slot number, UTC hour and minute, slot offset), and "Keep flag".

16.1 TDMA synchronisation

16.1.1 Synchronisation test using UTC

16.1.1.1 Method of measurement

Set up standard test environment; choose test conditions in a way that the EUT operates in the following synchronisation modes:

a) UTC direct;

b) UTC indirect (internal GNSS receiver disabled; at least one other station UTC direct synchronised);

c) UTC indirect (internal GNSS disabled; base station with UTC direct synchronisation within range). ~~Verify that the correct UTC date and time is derived from Message 4 of the base station~~;

d) base direct (internal GNSS disabled; base station with semaphore qualified within range);

e) UTC indirect (internal GNSS receiver disabled; only Class B SO station UTC direct synchronised).

Check CommState parameter Sync state in position report and reporting interval.

16.1.1.2 Required results

Confirm that:

a) the SynchState = 0;

b) the SynchState = 1;

c) the SynchState = 1. Verify that the correct UTC date and time is derived from Message 4 of the base station;

d) the SynchState = 2;

e) the SynchState = 1.

~~f) the EUT does not synchronise to the Class B station, SynchState = 3.~~

16.1.2 Synchronisation test using UTC with repeated messages

16.1.2.1 Method of measurement

Set up a test environment where all messages have a SyncState 0; choose test conditions in a way that the EUT operates in the following synchronisation modes:

a) UTC direct;
b) UTC indirect (internal GNSS receiver disabled; at least one other station UTC direct synchronised);
c) UTC indirect (internal GNSS receiver disabled; all other stations UTC direct synchronised and syncstate 0, repeat indicator 1).

Check CommState parameter Sync state in position report and reporting interval.

16.1.2.2 Required results

The following results are required:

a) transmitted communication state shall fit the synchronisation mode;
b) the EUT shall synchronise to the other station;
c) the EUT shall go to syncstate 3.

16.1.3 Synchronisation test without UTC, semaphore

16.1.3.1 Method of measurement

Set up the standard test environment without UTC available. Let the EUT be semaphore qualified (sync mode 1 or 3) as follows:

a) simulate other semaphore qualified stations with a different number of received stations;
b) simulate other semaphore qualified stations with the same number of received stations.

Check CommState parameter Sync state in position report and reporting interval.

16.1.3.2 Required results

Transmitted CommState shall fit the synchronisation mode. Check that

a) EUT acts as semaphore only if it has the highest number of received stations,
b) EUT acts as semaphore only if it has the lowest MMSI.

The EUT shall decrease reporting interval to 2 s when acting as a semaphore and shall remain in this state until the semaphore qualifying conditions have been invalid for 3 min.

16.1.4 Synchronisation test without UTC

16.1.4.1 Method of measurement

Set up the standard test environment; choose test conditions in a way that EUT operates in following sync modes:

a) base indirect (internal GNSS disabled; no station with UTC direct synchronisation or base station within range);
b) mobile indirect (internal GNSS disabled; other station with UTC direct synchronisation or base station without range);
c) internal GNSS enabled in synchronisation modes other than UTC direct.

Check CommState parameter sync state in position report and reporting interval.

16.1.4.2 Required results

The following results are required:

a) transmitted communication state shall fit the synchronisation mode;
b) transmitted communication state shall fit the synchronisation mode;
c) synchronisation mode shall revert to UTC direct.

16.1.5 Reception of un-synchronised messages

16.1.5.1 Method of measurement

Set up the standard test environment and operate the EUT in UTC direct mode.

Transmit un-synchronised test messages (more than ±10 ms away from the slot boundary).

16.1.5.2 Required results

Verify that the transmitted test messages are received and processed.

16.2 Time division (frame format)

16.2.1 Method of measurement

Set the EUT to reporting interval of 2 s by applying a speed of > 23 kn and a ROT of > 20°/s. Record VDL messages and check for used slots. Check parameter slot number in CommState of position report. Check slot length (transmission time).

16.2.2 Required results

Slot number used and slot number indicated in CommState shall match. Slot number shall not exceed 2 249. Slot length shall not exceed 26,67 ms.

16.3 Synchronisation and jitter accuracy

16.3.1 Definition

Synchronisation jitter (transmission timing error) is the time between nominal slot start as determined by the UTC synchronisation source and the initiation of the "transmitter on" function (T_0, see Recommendation ITU-R M.1371-45/A2-3.2.2.10, Figure 8).

16.3.2 Method of measurement

Set up standard test environment, reporting interval of 2 s and using

a) UTC direct synchronisation,
b) UTC indirect synchronisation by disconnecting the GNSS antenna of the EUT.

Record VDL messages and measure the time between the nominal beginning of the slot interval and the initiation of the "transmitter on" function. Alternative methods, for example by evaluating the start flag and calculating back to T_0, are allowed.

16.3.3 Required results

The synchronisation, including its jitter, shall not exceed

a) ±104 μs using UTC direct synchronisation,
b) ±312 μs relative to the synchronisation source using UTC indirect synchronisation.

16.4 Data encoding (bit stuffing)

16.4.1 Method of measurement

Set up the standard test environment as follows.

a) Apply a binary broadcast message (Message 8) to the VDL containing the HEX-values "7E 3B 3C 3E 7E" in the data portion and check presentation interface output of EUT.

b) Apply a BBM sentence to the EUT initiating the transmission of Message 8 containing the HEX-values as above in the data portion, and check the VDL.

16.4.2 Required results

Confirm that:

a) data output on the presentation interface conforms to transmitted data;

b) transmitted VDL message conforms to data input on the presentation interface.

16.5 Frame check sequence

16.5.1 Method of measurement

Apply a simulated position report message with wrong CRC bit sequence to the VDL.

16.5.2 Required results

Confirm, by observing the MKD and by inspecting the PI output, that this message is not processed.

16.6 Slot allocation (channel access protocols)

16.6.1 Network entry

16.6.1.1 Method of measurement

Set up the standard test environment; switch on the EUT. Record transmitted scheduled position reports for the first 3 min of transmission after initialization period. Check CommState for channel access mode.

16.6.1.2 Required results

EUT shall start autonomous transmissions of Message 3 (position report) with ITDMA CommState with KeepFlag set true for the first minute of transmission and Message 1 with SOTDMA CommState thereafter.

16.6.2 Autonomous scheduled transmissions (SOTDMA)

16.6.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode as follows.

a) Record transmitted scheduled position reports Message 1 and check frame structure. Check CommState of transmitted messages for channel access mode and parameters number of received stations, slot timeout, slot number and slot offset.

b) Repeat the test with 50 % channel loading ensuring there are at least 4 free slots in each SI.

c) Repeat the test with 50 % channel loading by message 26 ensuring there are at least 4 free slots in each SI.

16.6.2.2 Required results

Check that:

a) nominal reporting interval is achieved ±20 % (allocating slots in selection interval SI). Confirm that the EUT allocates new nominal transmission slots (NTS) within selection interval (SI) after 3 min to 8 min. Check that slot offset indicated in CommState matches slots used for transmission. Check that Class B "CS" and locating devices are not included in the number of received stations;

b) only free slots are used for transmission;

c) only free slots are used for transmission.

16.6.3 Autonomous scheduled transmissions (ITDMA)

16.6.3.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Set NavStatus of EUT to "at anchor" giving a reporting interval of 3 min. Record transmitted scheduled position reports.

16.6.3.2 Required results

Check that EUT transmits Message 3 and allocates slots using ITDMA and that slot offset indicated in CommState matches slots used for transmission.

Check that nominal reporting interval is achieved ±20 %.

16.6.4 Safety related/binary message transmission

16.6.4.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode as follows.

a) Apply a 1 slot binary broadcast message (Message 8) to the PI of the EUT less than 4 s before the next scheduled transmission. Record transmitted messages. Retry with a 90 % channel load.

b) Apply a 1 slot binary broadcast message (Message 8) to the PI of the EUT more than 4 s before the next scheduled transmission. Record transmitted messages. Retry with 90 % channel load.

c) Apply combinations of binary broadcast message (Message 8), addressed binary message (Message 6), broadcast safety related message (Message 14) and addressed safety related message (Message 12) to the PI of the EUT. Record transmitted messages and output of the PI of the EUT.

d) Apply more than 5 AIR sentence per minute to the PI.

16.6.4.2 Required results

Confirm that:

a) the EUT transmits this Message 8 within 4 s using ITDMA;

b) the EUT transmits this Message 8 within 4 s using RATDMA;

c) maximum 20 slots can be used per frame for Messages 6, 8, 12, 14, 25 and 26~~ and that messages using more than 3 slots are rejected~~. Confirm that sentence ABK is sent with acknowledge type 2 (Message could not be broadcast) when the message is rejected;

d) the EUT transmits not more than 5 Messages 15 per minute. Confirm that sentence ABK is sent with acknowledge type 2 (Message could not be broadcast) when the message is rejected.

16.6.5 Transmission of Message 5 (ITDMA)

16.6.5.1 Method of measurement

Set up the standard test environment and operate EUT in autonomous mode. Record transmitted messages.

16.6.5.2 Required results

Confirm that the EUT transmits Message 5 using the ITDMA access scheme. The ITDMA access scheme shall replace a scheduled position report Message 1 with a Message 3.

16.6.6 Assigned operation

16.6.6.1 Assigned mode using reporting rates

16.6.6.1.1 Method of measurement

Operate the standard test environment and the EUT in autonomous mode. Transmit an assigned mode command message (Message 16) using a base station MMSI to the EUT with:

a) the number of reports per 10 min which is not a multiple of 20;
b) the number of reports per 10 min which is higher than 600.

16.6.6.1.2 Required results

Confirm that:

a) the EUT transmits position reports Message 2 at a reporting rate that corresponds to the next highest multiple of 20 reports per 10 min;
b) the EUT transmits position reports Message 2 at a reporting interval of 1 s.

16.6.6.2 Receiving test

16.6.6.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Transmit an assigned mode command (Message 16) using a base station MMSI to the EUT with:

- slot offset and increment;
- designated reporting interval;

Record transmitted messages.

16.6.6.2.2 Required results

Confirm that EUT transmits position report Message 2 according to defined parameters and reverts to SOTDMA Message 1 with standard reporting interval after 4 min to 8 min.

16.6.6.3 Slot assignment to FATDMA reserved slots

16.6.6.3.1 Definition

A test to check the combined operation of Message 16 assignment to slots reserved by Message 20.

16.6.6.3.2 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Transmit a data link management message (Message 20) using a base station MMSI to the EUT with slot offset and increment. Transmit an assigned mode command (Message 16) using a base station MMSI to the EUT and command it to use one or more of those FATDMA allocated slots. Record transmitted messages.

16.6.6.3.3 Required results

Confirm that the EUT uses the slots commanded by Message 16 for own transmissions.

16.6.7 Group assignment

16.6.7.1 Assignment priority

16.6.7.1.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode, and use a base station MMSI to transmit Messages 22 and 23. ~~Transmit an assigned mode command (Message 23) to the EUT with Tx/Rx mode 1 as follows:~~

~~a) Transmit a Message 22 defining a region with the EUT inside that region. Transmit a Message 22 to the EUT individually addressed and specifying Tx/Rx mode 2.~~

~~b) Transmit a Message 23 to the EUT with Tx/Rx mode 1 within 10 min of test a).~~

~~c) Repeat transmission of Message 23 to the EUT with Tx/Rx mode 1 after 15 min of test a)~~

~~d) Repeat the test, clear the region defined by Message 22 under a). and transmit Message 22 to the EUT with regional settings specifying Tx/Rx mode 2.~~

~~NOTE This can be carried out using the method used in 17.8.1.1 b) step 2 or by assigning a new simulated position to the EUT.~~

a) Transmit an assigned mode command (Message 23) to the EUT with Tx/Rx mode 1. Wait for 2 min.
b) Transmit a Message 22 defining a region with the EUT inside that region, Tx/Rx mode = 0.
c) Wait for time-out of Message 23.
d) Transmit an assigned mode command (Message 23) to the EUT with Tx/Rx mode 1. Wait for 2 min.
e) Transmit a Message 22 to the EUT individually addressed and specifying Tx/Rx mode 2.
f) Transmit a Message 23 per minute for 15 min to the EUT with Tx/Rx mode 1.
g) Wait for time-out of message 23.

Record transmitted messages.

16.6.7.1.2 Required results

Verify that:

~~a) the Tx/Rx mode field setting of Message 22 takes precedence over the Tx/Rx mode field setting of Message 23;~~

~~b) the EUT ignores the assignment by Message 23 and the setting of message takes precedence for 10 min;~~

~~c) the EUT applies the Tx/Rx mode setting of Message 23;~~

~~d) the Tx/Rx mode field setting of Message 23 takes precedence over the Tx/Rx mode field setting of Message 22. The receiving station shall revert to its previous Tx/Rx mode after a timeout value randomly chosen between 240 s and 480 s.~~

a) the Tx/Rx mode = 1 according to the Message 23 setting;
b) the Tx/Rx mode of Message 22 is ignored and Tx/Rx mode = 1 according to the Message 23 setting continues;
c) the Tx/Rx mode reverts to Tx/Rx mode 0 according to the Message 22 setting;
d) the Tx/Rx mode = 1 according to the Message 23 setting;

e) the Tx/Rx mode field setting of Message 22 takes precedence over the Tx/Rx mode field setting of Message 23 and so Tx/Rx mode = 2;

f) the EUT ignores the assignment by Message 23 and the setting of Message 22 takes precedence for 10 min; after 10 min the Tx/Rx mode changes to Tx/Rx mode 1 according to the Message 23 setting;

g) The receiving station shall revert to its previous Tx/Rx mode = 2 after a timeout value randomly chosen between 240 s and 480 s.

16.6.7.2 Increased reporting interval assignment

16.6.7.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode with 10 s reporting interval, and use a base station MMSI to transmit Message 23 as follows.

a) Transmit a group assignment message (Message 23) to the EUT with a reporting interval that is longer than the autonomous reporting interval.

b) Transmit a group assignment message (Message 23) to the EUT with a quiet time command.

c) Set the Nav status to "moored" and "at anchor" and SOG $<$ 3 kn. Transmit a group assignment message (Message 23) to the EUT with a reporting interval that is shorter than the autonomous reporting interval.

d) Set the Nav status to "moored" and "at anchor" and SOG $>$ 3 kn. Transmit a group assignment message (Message 23) to the EUT with a reporting interval that is shorter than the autonomous reporting interval.

Record transmitted messages.

16.6.7.2.2 Required results

Confirm that:

a) the EUT ignores the assignment command and transmits position reports with the autonomous reporting interval;

b) the EUT ignores the assignment command and transmits position reports with the autonomous reporting interval;

c) the EUT ignores the assignment command and transmits position reports with the autonomous reporting interval;

d) the EUT transmits position reports with the assigned reporting interval.

16.6.7.3 Entering interval assignment

16.6.7.3.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode with a reporting interval of 10 s. Use a base station MMSI to transmit Message 23.

a) Transmit a group assignment command (Message 23) to the EUT with a reporting interval of 5 s assigned.

b) Repeat test with a reporting interval of 2 s assigned.

c) Transmit a group assignment command (Message 23) to the EUT with a reporting interval field setting 10 (next longer autonomous reporting interval).

d) Operate the EUT in autonomous mode with a reporting interval of 6 s. Transmit a group assignment command (Message 23) to the EUT with a reporting interval field setting 9 (next shorter autonomous reporting interval).

Monitor the VDL.

16.6.7.3.2 Required results

Verify that:

a) the EUT enters assigned operation mode and transmits position report Message 2 with 5 s reporting interval. EUT builds up the assigned transmission scheduled according to network entry procedure; verify that unused slots of the previous reporting schedule are released;

b) the EUT enters assigned operation mode and transmits position report Message 2 with 2 s reporting interval;

c) the EUT does not enter assigned operation mode and transmits position report Message 1 with 10 s reporting interval;

d) the EUT enters assigned operation mode and transmits position report Message 2 with 2 s reporting interval.

16.6.7.4 Assignment by region

16.6.7.4.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode with a reporting interval of 10 s and use a base station MMSI to transmit Message 23 as follows.

a) Transmit a group assignment command (Message 23) to the EUT (define station type 0 and geographic region so that the EUT is inside this region). Set the reporting rate to 2 s and apply message to VDL.

b) Transmit a group assignment command (Message 23) to the EUT (define station type 0 and geographic region so that the EUT is outside this region). Set the reporting rate to 2 s and apply message to VDL.

16.6.7.4.2 Required results

Verify that:

a) the EUT switches to assigned mode and transmits position reports with 2 s intervals. Verify that EUT reverts to normal operation mode after timeout period;

b) the EUT declines Message 23.

16.6.7.5 Assignment by station type

16.6.7.5.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode with a reporting interval of 10 s and use a base station MMSI to transmit Message 23 as follows.

a) Transmit a group assignment command (Message 23) to the EUT (define geographic region so that the EUT is inside this region). Set the reporting interval to 2 s and the station type to 0 (all stations).

b) Transmit a group assignment command (Message 23) to the EUT (define geographic region so that the EUT is inside this region). Set the reporting interval to 2 s and the station type to 2. Repeat the test for station types 3, 4, 5 and 6.

c) Transmit a group assignment command (Message 23) to the EUT (define geographic region so that the EUT is inside this region). Set the reporting interval to 5 s and the station type to 1 (Class A Mobile). Apply this message to the VDL again within 4 min.

Record VDL and check reaction of the EUT.

16.6.7.5.2 Required results

Verify that:

a) the EUT switches to assigned mode and transmits position reports with 2 s reporting interval. Verify that EUT reverts to autonomous mode after timeout period;

b) the EUT declines Message 23 for each station type;

c) the EUT switches to assigned mode and transmits position reports with 5 s reporting interval. Verify that EUT reverts to autonomous operation mode after timeout period of second transmitted group assignment.

16.6.7.6 Addressing by ship and cargo type

16.6.7.6.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode with a reporting interval of 10 s and use a base station MMSI to transmit Message 23 as follows.

a) Transmit a group assignment command (Message 23) to the EUT (define geographic region so that the EUT is inside this region). Set the reporting interval to 2 s and the ship and cargo value to a desired value. Make sure that this value is also configured in the EUT.

b) Transmit a group assignment command (Message 23) to the EUT (define geographic region so that the EUT is inside this region). Set the reporting interval to 2 s and the ship and cargo value to a desired value. Make sure that a different value is configured in the EUT.

16.6.7.6.2 Required results

Verify that:

a) EUT switches to assigned mode and transmits position reports with 2 s reporting interval. Verify that EUT reverts to autonomous mode after timeout period;

b) EUT declines Message 23.

16.6.7.7 Reverting from interval assignment

16.6.7.7.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Using a base station MMSI, transmit a group assignment command (Message 23) to the EUT with a reporting interval of 5 s assigned. Monitor the VDL until at least 1 min after timeout occurred. Repeat 10 times (transmissions of Message 23 shall not be synchronised to the initial transmission schedule of the EUT).

Measure the time T_{rev} between the reception of Message 23 and the first transmission after timeout.

16.6.7.7.2 Required results

Verify that the EUT enter autonomous mode after a time out of 4 min to 8 min and transmits position report Message 1 and releases unused slots from previous schedule.

16.6.8 Fixed allocated transmissions (FATDMA)

16.6.8.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Apply Message 4 to the VDL. A base station shall use a base station MMSI as follows.

a) Transmit a data link management message (Message 20) on Channel A from a base station within 120 NM to the EUT with slot offset and increment. Record transmitted messages.

b) Repeat the test when the EUT has no position.

c) Repeat the test with a base station beyond 120 NM.

d) Repeat the test without base station report (Message 4).

e) Repeat the test with a base station within 120 NM and maintain transmissions of Message 20. Stop transmission of Message 4.

16.6.8.2 Required results

Confirm that:

a) for the base station within 120 NM, the EUT does not use slots allocated by Message 20 for own transmissions until the timeout given in the Message 20. Confirm that the EUT does not use the same slots on Channel B;

b) the EUT does not use slots allocated by Message 20 for own transmissions until the timeout given in the Message 20;

c) for the base station beyond 120 NM, the EUT treats the slots as free;

d) the EUT treats the slots as free;

e) the EUT does not use slots allocated by Message 20 for own transmissions until the target timeout of the EUT occurs after Message 4 ~~was~~ is stopped.

16.6.9 Randomisation of message transmissions

16.6.9.1 Method of measurement

Set up the standard test environment. Power on the EUT and monitor the autonomous transmissions for 3 min. Restart the EUT and monitor the autonomous transmissions for another 10 min. Repeat ~~this process~~ the restart of the EUT for at least ~~10~~ 5 times, starting at different seconds within a frame.

NOTE The nominal start slot (NSS) at network entry phase is randomised between the current slot and nominal increment (NI) slots forward. The first nominal slot (NS) is always the NSS.

16.6.9.2 Required results

Verify that the nominal slots are not always within the same selection interval after a power cycle by monitoring the transmissions slots. ~~After a number of power cycles the EUT should finally start transmissions in slots that are not within the same selection interval.~~

16.7 Message formats

16.7.1 Received messages

16.7.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply messages according to Table 18 to the VDL including multiple slot messages up to 5 slots. Record messages output by the PI of the EUT.

16.7.1.2 Required results

Confirm that the EUT outputs the corresponding message with the correct field contents and format via the PI or responds as appropriate.

16.7.2 Transmitted messages

16.7.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Initiate the transmission of messages relevant for a mobile station according to Table 18 by the EUT. Record transmitted messages.

16.7.2.2 Required results

Confirm that the EUT transmits messages with correct field content and format or responses, as appropriate. Confirm that Messages 4, 9, 16, 17, 18, 19, 20, 21, 22 and 23 are not being transmitted by the EUT.

17 Specific tests of network layer

(See 7.4)

17.1 Dual channel operation – Alternate transmissions

17.1.1 Method of measurement

Set up standard test environment and operate the EUT in autonomous mode on default channels AIS 1, AIS 2. Record transmitted scheduled position reports on both channels. Check CommState for slot allocation.

17.1.2 Required results

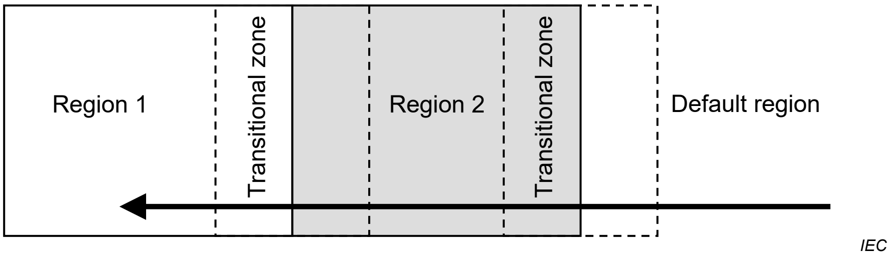
Confirm that the EUT allocates slots in alternating both channels. Repeat check for data link access period.

17.2 Regional area designation by VDL message

17.2.1 Method of measurement

Set up standard test environment and operate the EUT in autonomous mode.

a) Using a base station MMSI, apply channel management messages (Message 22) to the VDL defining two adjacent regional areas 1 and 2 with different channel assignments for both regions and a transitional zone extending 4 NM on either side of the regional boundary (see Figure 13). Let the EUT approach region 1 from outside region 2 more than 5 NM away from the region boundary transmitting on default channels. Record transmitted messages on all 6 channels.



	Primary channel	Secondary channel
Region 1	CH A 1	CH B 1
Region 2	CH A 2	CH B 2
Default region	AIS 1	AIS 2

Figure 13 – Regional area scenario

b) Operate the unit in an area with T_x/R_x mode 1.

c) Operate the unit in an area with T_x/R_x mode 2.

d) Transmit Message 22 using a base station transmitting Message 4 with a position which is more than 120 NM away from the position of the EUT.

e) Transmit Message 22 using a base station which is not transmitting Message 4.

17.2.2 Required results

Check that:

a) the EUT transmits and receives on the primary channels assigned for each region (see Table 35) alternating channels and doubles the number of transmissions when passing through the transitional zones. The EUT shall revert to default autonomous operation on the regional channels after leaving the transitional zones. The number of transmissions doubles on the active channel when transmitting on one channel only;

   TXT and ACA sentences are output when defining the area, crossing the boundary of the area and on request. The in-use flag shall be set to "1" if the position is inside the area which is defined by the two corner points of the area setting (e.g. the grey area defining region 2 in Figure 13);

b) the EUT transmits on channel A only with the nominal reporting rate;

c) the EUT transmits on channel B only with the nominal reporting rate;

d) the EUT does not accept the channel management;

e) the EUT does not accept the channel management.

Table 35 – Primary channels for each region

	Area	Channels in use
1	Default region	AIS 1, AIS 2
2	First transitional zone	AIS 1, CH A 2
3	Region 2	CH A 2, CH B 2
4	Second transitional zone	CH A 2, CH A 1
5	Region 1	CH A 1, CH B 1

17.3 Regional area designation by serial message

Repeat the test of 17.2 using ACA sentence for channel assignment.

17.4 Regional area designation with lost position

17.4.1 Method of measurement

Repeat the test of 17.2 using ACA sentence for channel assignment as follows.

a) Disable position information; apply new addressed Message 22 using a base station MMSI.
b) Make position information available again and query for area settings (ACA request).

17.4.2 Required results

Verify that:

a) the settings of the current area are still being used; check that settings of new addressed Message 22 are adopted;
b) all area settings are still available.

17.5 Power setting

17.5.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Using a base station MMSI, transmit channel management message (Message 22), defining output power high/low.

Repeat test using ACA sentence and manual input.

17.5.2 Required results

Check that the EUT sets output power as defined and indicates when the low power setting is in operation.

NOTE Automatic power setting for tankers is tested in 14.7.3.

17.6 Message priority handling

17.6.1 Method of measurement

Set up standard test environment and operate test equipment with 90 % channel load. Set the EUT to a reporting interval of 2 s by applying a speed of $>$ 23 kn and a ROT of $>$ 20°/s. Record VDL messages and check for used slots. Initiate the transmission of two 3 slot messages (Message 12 and Message 8) by the EUT. Record transmitted messages on both channels.

17.6.2 Required results

Check that the EUT transmits the messages in correct order according to their priority as given in ITU-R Recommendation M.1371-45/A8-2.

17.7 Slot reuse and FATDMA reservations

17.7.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Assure that, at test receiver location, the signal level received from the EUT exceeds the signal level received from the test transmitter as follows.

NOTE Free slots are: slots not used, Slots used by a mobile station under way that has not been received for 3 min or more, slots used by a base station (Message 20 and Message 4) beyond 120 NM, garbled slots.

Available slots are: distant station slots.

Unavailable slots are: near station slots, slots used by a base station (Message 20 and Message 4) within 120 NM, slots used by mobile stations reporting without position information, slots used by mobile stations with a reporting interval of 1 min or more.

a) Transmit test targets on channel A with 50 % channel load. Channel B is free. This test covers Rule 0 and 1.

b) Transmit near and distant test targets with 100 % channel load on channel A in all selection intervals which are under observation. Channel B is free. There shall be enough different targets to allow the EUT to meet the requirement to reuse only one slot of each target per frame.

c) Transmit near and distant test targets with 100 % channel load on channel B in all selection intervals which are under observation. Channel A is free.

d) Transmit Message 4 with a position distance $<$ 120 NM and Message 20 with slot reservations on channel A.

e) Transmit Message 4 with a position distance $>$ 120 NM and Message 20 with slot reservations on channel A.

f) Transmit no Message 4 and Message 20 with slot reservations on channel A.

g) Transmit Message 4 with a position distance $<$ 120 NM and Message 20 with slot reservations on channel A. Transmit near and distant test targets in the unreserved slots on channel A. Channel B is free.

17.7.2 Required results

Confirm that:

a) only free slots are used for transmission on channel A. Confirm that only slots which are free on channel A are used for transmissions on channel B;

b) slots of the most distant test targets are used for transmission on channel A. Check that not more than one slot of a station is reused in a frame;

c) for transmission on channel A, the candidate slots on channel A are organized according to the most distant station on channel B;

d) only unreserved slots are used on channel A. Confirm that, at start of Message 20, the time-out of all reserved slots is forced to 0 and the slots are changed to free slots within one frame. Confirm that, for transmissions on channel B, only slots which are not reserved on channel A are used after the next regular time-out 0. Confirm that, after the reservation time-out, all slots on channel A and B are used again;

e) all slots are used for transmission on channels A and B;

f) all slots are used for transmission on channels A and B;

g) only unreserved slots are used on channel A. Confirm that slots of the most distant test targets are used for transmission. Confirm that, for transmissions on channel B, only slots which are not reserved on channel A are used after the next regular time-out 0.

17.8 Management of received regional operating settings

17.8.1 Test for replacement or erasure of dated or remote regional operating settings

17.8.1.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Using a base station MMSI, send a valid regional operating setting to the EUT by Message 22 with the regional operating area, including the own position of the EUT (area 1). Consecutively, send another seven valid regional operating settings to the EUT, using both Messages 22 and DSC telecommands, with regional operating areas neither overlapping with the first nor with one another. Perform the following in the order shown.

a) Send another Message 22 to the EUT, with a ninth regional operating area (area 9) not overlapping with the previous eight regional operating areas.
b) Send a tenth telecommand to the EUT, with a regional operating area (area 10) which partly overlaps a regional operating area.
c) Move own position of EUT to a distance of more than 500 NM from one region defined by previous commands.
d) Move own position of EUT to a distance of more than 500 NM from all regions defined by previous commands.
e) Restart the EUT and make sure it cannot receive UTC. Apply a channel management area setting by message 22 and by ACA input. Wait for 24 h.

Query for area settings (ACA request) after a), b) c and d).

17.8.1.2 Required results

Check that, after the initialization, the EUT operates according to the regional operating settings defined by area 1 and:

a) the most distant area is deleted and the other areas are available;
b) area 10 is stored and that the old overlapped area is deleted;
c) this area is deleted by the output of TXT and ACA sentences showing the remaining area settings;
d) all areas are deleted by the output of a single TXT and ACA sentences showing high sea settings;
e) all area settings have been removed.

17.8.2 Test of correct input via presentation interface or MKD

17.8.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Using a base station MMSI, perform the following tests in the following order.

a) Send Message 22 or a DSC telecommand with valid regional operating settings to the EUT with a regional operating area, which contains the current position of own station.
b) Input a different, valid regional operating setting – not overlapping the area defined under a) – via the MKD.
c) Send a different regional operating setting with a regional operating area which partly overlaps the regional operating area input via the MKD to the EUT via the presentation interface in the previous step, and which contains the present position of own station.
d) Input the default operating settings via the MKD for the regional operating area, which was received by the previous command via the presentation interface.
e) Send Message 22 or a DSC telecommand with a different regional operating setting to the EUT with a regional operating area, which contains current position of own station.
f) Within two hours, after e), send a different regional operating setting to the EUT via the presentation interface with a valid regional operating area overlapping the regional operating area sent to the EUT by Message 22 or a DSC telecommand.

17.8.2.2 Required results

The following results are required.

a) Confirm that the EUT uses the regional operating settings commanded by Message 22 or DSC telecommand.
b) Step 1: Confirm that the regional operating settings of the previous Message 22 or DSC telecommand are displayed to the user on the MKD for editing.

Step 2: Check that the EUT allows the user to edit the displayed regional operating settings. Check that the EUT does not accept incomplete or invalid regional operating settings. Check that the EUT accepts a complete and valid regional operating setting.

Step 3: Check that the EUT prompts the user to confirm the intended change of regional operating settings. Check that the EUT allows the user to return to the editing menu or to abort the change of the regional operating settings.

Step 4: Check that the EUT uses the regional operating settings input via the MKD.

c) Check that the EUT uses the regional operating settings received via the presentation interface.

d) Check that the EUT accepts the default operating settings for the regional operating area received in c). Check that the EUT uses the default operating settings.

e) Check that the EUT uses the regional operating settings commanded to it by Message 22 or DSC telecommand.

f) Check that the EUT does not use the regional operating setting commanded to it via the presentation interface.

17.8.3 Test of addressed telecommand

17.8.3.1 Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Using a base station MMSI, perform the following tests in the following order.

a) Send Message 22 or a DSC telecommand with valid regional operating settings, that are different from the default operating settings, to the EUT with a regional operating area, which contains the current position of own station.

b) Send an addressed Message 22 or an addressed DSC telecommand to the EUT with different regional operating settings than the previous command.

c) Move the EUT out of the regional operating area defined by the previous addressed telecommand into an area without regional operating settings.

17.8.3.2 Required results

Check that:

a) the EUT uses the regional operating settings commanded to it in a);

b) the EUT uses the regional operating settings commanded to it in b);

c) the EUT reverts to default.

17.8.4 Test for invalid regional operating areas

17.8.4.1 Purpose

This test simulates invalid regional operating areas (three regional operating areas with the same corner).

17.8.4.2 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Using a base station MMSI, perform the following tests in the following order after completion of all other tests related to change of regional operating settings.

a) Send three different valid regional operating settings with adjacent regional operating areas, their corners within eight miles of each other, to the EUT by Message 22 or DSC telecommand, presentation interface input and manual input via MKD. The current own position of the EUT shall be within the regional operating area of the third regional operating setting.

b) Move current own position of the EUT consecutively to the regional operating areas of the first two valid regional operating settings.

17.8.4.3 Required results

Check that:

a) the EUT uses the operating settings that were in use prior to receiving the third regional operating setting;
b) the EUT consecutively uses the regional operating settings of the first two received regional operating areas.

17.9 Continuation of autonomous mode reporting interval

17.9.1 Method of test

When in the presence of an assigned mode command and in a transition zone, check that the EUT continues to report at the autonomous mode reporting interval.

17.9.2 Required results

Ensure that the autonomous reporting interval is maintained.

18 Specific tests of transport layer

(See 7.5)

18.1 Addressed messages

18.1.1 Transmission

18.1.1.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Set up a test target for scheduled transmissions on channel AIS 1 only. Initiate the transmission of an addressed binary message (Message 6) by the EUT (test target as destination). Record transmitted messages on both channels.

18.1.1.2 Required results

Check that the EUT transmits Message 6 on channel AIS 1. Repeat test for AIS 2.

18.1.2 Acknowledgement

18.1.2.1 Method of measurement

Operate the standard test environment and the EUT in autonomous mode. Apply up to 4 addressed binary messages (Message 6; EUT as destination) to the VDL on channel AIS 1. Record transmitted messages on both channels. Repeat with AIS 2.

18.1.2.2 Required results

Confirm that the EUT transmits a binary acknowledge message (Message 7) with the appropriate sequence numbers within 4 s on the channel where Message 6 was received. Confirm that the EUT transmits the result with an appropriate message to PI.

18.1.3 Transmission retry

18.1.3.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Initiate the transmission of up to 4 addressed binary messages by the EUT which will not be acknowledged (i.e. destination not available). Record transmitted messages.

18.1.3.2 Required results

Confirm that EUT retries the transmission up to 3 times (configurable) for each addressed binary message. Confirm that the time between transmissions is 4 s to 8 s. Confirm that the EUT transmits the overall result with an appropriate message to PI.

18.1.4 Acknowledgement of addressed safety related messages

Repeat test 18.1.2 with addressed safety related message.

18.1.5 Behaviour of NavStatus 14 reception

18.1.5.1 Purpose

This test verifies the correct behaviour of the received Message 1 with NavStatus 14.

18.1.5.2 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode ~~as follows:~~ Disable alert function for locating devices.

a) Initiate the transmission of a Message 1 with NavStatus 14. Wait 18 min. Enable alert function for locating devices.

b) Initiate the transmission of a Message 1 with NavStatus 14.

c) Acknowledge the ~~alarm~~ alert.

d) Initiate the transmission of a Message 1 from the same user ID with NavStatus 14 within the time out.

e) Initiate the transmission of a Message 1 from the same user ID with NavStatus other than 14 within the time out.

f) Initiate the transmission of a Message 1 from different user ID with NavStatus 14.

18.1.5.3 Required results

Check that:

~~a) the MKD indicates the received message at the top of the target list and the EUT activates the alarm relay and output an ALR sentence with alarm ID 14 via the PI,~~

~~b) the EUT deactivates alarm relay and changes the alarm status in the ALR sentence,~~

~~c) the EUT does not activate the alarm relay and does not change the alarm status in the ALR sentence,~~

~~d) the EUT does not activate the alarm relay and does not output an ALR sentence with alarm ID 14,~~

~~e) the MKD indicates the received message at the top of the target list and the EUT activates the alarm relay and output an ALR sentence with alarm ID 14 via the PI.~~

a) the MKD indicates the received message at the top of the target list and the EUT does not activate BIIT ID 14 or release related alert;

b) the MKD indicates the received message at the top of the target list and the EUT activates the BIIT ID 14, and releases appropriate alert as required in Table 4;

c) the EUT enters the appropriate acknowledge state;

d) the EUT does not re-activate BIIT ID 14 or the related alert;

e) the EUT does not re-activate BIIT ID 14 or the related alert;

f) the MKD indicates the received message at the top of the target list and the EUT does not re-activate BIIT ID 14 or the related alert.

18.2 Interrogation responses

18.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Apply an interrogation message (Message 15; EUT as destination) to the VDL according to Table 18 for responses with Message 5 and slot offset set to 10 on channel AIS 1. Record transmitted messages on both channels.

18.2.2 Required results

Check that EUT transmits the appropriate interrogation response message as requested on channel AIS 1. Repeat test for AIS 2.

19 Specific presentation interface tests

(See 7.6)

19.1 General

The EUT, including all necessary test equipment, shall be set up and checked that it is operational before testing commences.

The manufacturer shall provide sufficient technical documentation of the EUT and its interfaces in particular.

Where appropriate, tests according to various subclauses of Clause 19, as well as other clauses of this document, may be carried out simultaneously.

19.2 Checking manufacturer's documentation

The following checks for formal consistency and compliance shall be made for all ports:

- approved sentences against IEC 61162-1;
- proprietary sentences against IEC 61162-1;
- usage of fields as required for different functions including provided default values or settings;
- transmission intervals against IEC 61162-1 and IEC 61162-2;
- configuration of hardware and software if this is relevant to the interface performance and port selection.

The following checks shall be made for compliance with IEC 61162-1 and IEC 61162-2:

- output drive capability;
- load on the line of inputs;
- electrical isolation of input circuits.

19.3 Electrical test

19.3.1 Method of ~~test~~ measurement

Input/output ports configured in accordance with IEC 61162-1 or IEC 61162-2 shall be tested according to the relevant standard with regard to minimum and maximum voltage and current at the input terminals.

19.3.2 Required results

The interfaces shall fulfil the requirements of the relevant standards.

19.4 Test of input sensor interface performance

19.4.1 Method of measurement

Connect all inputs and outputs of the EUT as specified by the manufacturer and simulate VDL-messages using the test system. Operate inputs with simulated sensor data that are both the relevant data and additional data with formatters not provided for the relevant input. Each sensor input shall be loaded with 70 % to 80 % of the interface's capacity. Record the VDL and output from the EUT's high-speed port.

19.4.2 Required results

Verify that the output on the VDL and the presentation interface agree with the simulated input and that all output data is transmitted without loss or additional delay.

19.5 Test of sensor input

19.5.1 Test of GNS input

19.5.1.1 Method of measurement

Set up the standard test environment and apply a GNS sentence with simulated sensor data. Record VDL output as follows.

a) Set mode indicator to AA (Autonomous).
b) Set mode indicator to AD, DA and DD (Differential).
c) Set mode indicator to P (Precise)
d) Set mode indicator to E (Estimated).
e) Set mode indicator to M (Manual).
f) Set mode indicator to S (Simulator).
g) Set mode indicator to N and NN (Data not valid).
h) Set mode indicator to A (GPS Autonomous) and time stamp field null.

Record the VDL position reports and evaluate the contents (Position, PA flag, RAIM flag and time stamp).

19.5.1.2 Required results

Confirm that:

a) all of the content is correct and PA flag = 0;
b) all of the content is correct and PA flag = 1;
c) all of the content is correct and PA flag = 1;
d) external position is not used or time-stamp = 62;
e) external position is not used or time-stamp = 61;

f) the external position is not used;
g) the external position is not used;
h) all of the content is correct and PA flag = 0 and time stamp = 60.

19.5.2 Test of RMC input

19.5.2.1 Method of measurement

Set up standard test environment and apply an RMC sentence with simulated sensor data.

a) Set status to valid and mode indicator to A (Autonomous).
b) Set mode indicator to D (Differential).
c) Set mode indicator to P (Precise).
d) Set mode indicator to E (Estimated).
e) Set Mode indicator to M (Manual).
f) Set mode indicator to S (Simulator).
g) Set status to invalid and mode indicator to N (Data not valid).
h) Set mode indicator to A (Autonomous) and time stamp field null.

Record the VDL position reports and evaluate the contents (Position, PA flag, RAIM flag, time stamp, SOG and COG).

19.5.2.2 Required results

Confirm that:

a) all of the content is correct and PA flag = 0;
b) all of the content is correct and PA flag = 1;
c) all of the content is correct and PA flag = 1;
d) external position and SOG/COG are not used or time-stamp = 62;
e) external position and SOG/COG are not used or time-stamp = 61;
f) external position and SOG/COG are not used;
g) external position and SOG/COG are not used;
h) all of the content is correct and PA flag = 0 and time stamp = 60.

19.5.3 Test of DTM input

19.5.3.1 Method of measurement

Set up standard test environment and apply a GNS and DTM sentence with simulated sensor data.

a) Set local datum in the DTM sentence to "W84", set Reference datum to other value than "W84".
b) Set local datum in the DTM sentence to other value than "W84".
c) Set local datum in the DTM sentence to "W84" again.

Repeat the test with RMC input.

Record the VDL position reports and evaluate the contents (Position, PA flag, RAIM flag and time stamp).

19.5.3.2 Required results

Confirm that:

a) the position data from the sensor input are used;
b) the position data from the sensor input are not used;
c) the position data from the sensor input are used.

19.5.4 Test of GBS input

19.5.4.1 Method of measurement

Set up the standard test environment and apply a GNS and GBS sentence with simulated sensor data. Set the position sentence to non-differential mode.

The expected RAIM error is calculated from expected error in longitude and expected error in latitude of the GBS sentence according to Table 8 as follows:

a) set expected RAIM error to a value ≤ 10 m;
b) set expected RAIM error to a value > 10 m;
c) remove the expected error in longitude and/or latitude (null field);
d) set the position sentence to differential mode. Set expected RAIM error to a value ≤ 10 m;
e) set expected RAIM error to a value > 10 m;
f) remove the expected error in longitude and/or latitude (null field).

Repeat the test with RMC input as position sentence.

Record the VDL position reports and evaluate the contents (Position, PA flag, RAIM flag and time stamp).

19.5.4.2 Required results

Confirm that:

a) RAIM flag = 1 and PA flag = 1;
b) RAIM flag = 1 and PA flag = 0;
c) RAIM flag = 0 and PA flag = 0;
d) RAIM flag = 1 and PA flag = 1;
e) RAIM flag = 1 and PA flag = 0;
f) RAIM flag = 0 and PA flag = 1.

19.5.5 Test of VBW input

19.5.5.1 Method of measurement

Set up the standard test environment and apply a HDT and a VBW sentence with simulated sensor data.

NOTE The HDT sentence is applied additionally to the VBW sentence in order to make the calculation of SOG and COG.

a) Set status, ground speed, to valid.
b) Set status, ground speed, to invalid.
c) Set status, ground speed, to valid, set heading to invalid.
d) Set status, ground speed, to valid and remove transverse ground speed.

Record the VDL position reports and evaluate the contents (SOG and COG).

19.5.5.2 Required results

Confirm that:

a) SOG and COG are correctly calculated from VBW and HDT;

b) SOG and COG are set to default;

c) COG is set to default;

d) Confirm that SOG and COG are set to default.

19.5.6 Test of VTG input

19.5.6.1 Method of measurement

Set up the standard test environment and apply a VTG sentence with simulated sensor data.

a) Set mode indicator to a valid value.

b) Set mode indicator to "N" (data not valid).

Record the VDL position reports and evaluate the contents (SOG and COG).

19.5.6.2 Required results

Confirm that:

a) SOG and COG are correctly used;

b) SOG and COG are set to default.

19.5.7 Test of HDT/THS input

19.5.7.1 Method of measurement

Set up the standard test environment and apply a RMC and an HDT/THS sentence with simulated sensor data.

a) Set valid heading data in HDT/THS.

b) Remove heading data from HDT/THS.

c) Set SOG > 5 kn and heading data different from COG by > 45° for 5 min.

Record the VDL position reports and evaluate the contents (heading).

19.5.7.2 Required results

Confirm that:

a) the heading value is correct;

b) the heading value is set to default;

c) ALR 11 is ~~generated~~ activated.

19.5.8 Test of ROT input

19.5.8.1 Method of measurement

Set up standard test environment and apply a HDT and ROT sentence with simulated sensor data. Set talker ID of ROT = "TI". Set ROT status to valid ("A").

a) Set ROT to several values between 0°/min and 708°/min turning left and right.

b) Set ROT to a value of more than 708°/min turning left and right.

c) Set ROT status to invalid ("V").

Set the ROT status to valid again and set the ROT talker ID to "HE".

When ROT values are used do as in d), e), and f).

d) Set ROT to 9°/min turning left and right.
e) Set ROT to 11°/min turning left.
f) Set ROT to 11°/min turning right.

When ROT values are not used but are calculated from the HDT data, do as in g), h) and i).

g) Change the heading value in HDT ~~with~~ to 9°/min and −9°/min.
h) Change the heading value in HDT ~~with~~ to 11°/min.
i) Change the heading value in HDT ~~with~~ to −11°/min.

Record the VDL position reports and evaluate the contents (ROT).

19.5.8.2 Required results

Confirm that:

a) the ROT value is calculated as defined in Table 9;
b) the ROT value is −126 turning left and 126 turning right;
c) ROT = default (–128) or 0 or ±127 if calculated from HDT;
d) ROT = 0;
e) ROT = −127;
f) ROT = 127;
g) ROT = 0;
h) ROT = −127;
i) ROT = 127.

19.5.9 Test of different inputs

19.5.9.1 Method of measurement

Set up the standard test environment and apply a GNS, VBW, HDT/THS and ROT sentence with simulated sensor data to the specified sensor inputs.

a) Apply RMC, VBW, HDT and ROT to sensor input 1.
b) Apply RMC, VBW, HDT and ROT to sensor input 2.
c) Apply RMC, VBW, HDT and ROT to sensor input 3.
d) Apply RMC to sensor input 1, VBW to sensor input 2, HDT and ROT to sensor input 3.

Record the VDL position reports and evaluate the contents of SOG and COG.

19.5.9.2 Required results

Confirm that:

a) all sensor data are correct;
b) all sensor data are correct;
c) all sensor data are correct;
d) all sensor data are correct.

19.5.10 Test of multiple inputs

19.5.10.1 Method of measurement

Check the manufacturer's documentation for the method of handling multiple sensor inputs, for instance:

- priority of sensor ports;
- assigning sensor sentences to ports by configuration.

Set up the standard test environment and apply RMC, VBW, HDT, THS and ROT sentences with different simulated sensor data to 2 or 3 sensor inputs. Record the VDL position reports and evaluate the contents.

19.5.10.2 Required results

Confirm that, for each parameter (position, SOG/COG, heading, ROT), the data from only one sentence is used, in accordance with the manufacturer's definition. Confirm that the heading and rate of turn values from sources used for position reports are output at the pilot port.

19.6 Test of high-speed output

19.6.1 Method of measurement

Set up the standard test environment and simulate VDL-position reports using the test system. Record output from the EUT's high-speed port (see Table 22).

19.6.2 Required results

Verify that the recorded message contents agree with the simulated VDL contents (VDM sentence), its own transmitted data (VDO sentence) and its own position, SOG, COG information derived from the internal position sensor and in accordance with the sentence specifications of IEC 61162-1.

19.7 High-speed output interface performance

19.7.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Increase the VDL load to > 90 % and apply input of heading with 10 sentences per second and input of rate of turn with 5 sentences per second. Record transmitted messages and check PI output of the EUT on the port for "external display" and the "auxiliary display/pilot port".

19.7.2 Required results

Confirm that EUT outputs all received messages to the PI and the "auxiliary display/pilot port". Verify, during VDL load > 90 %, that the sync timing, the Tx slots and the slot number in the CommState are correct. Confirm that heading and rate of turn sentences are output with a latency of less than 200 ms. Confirm that heading is output at a rate of 5 sentences per second and rate of turn is output at a rate of 1 sentence per second.

19.8 Output of undefined VDL messages

19.8.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Verify that AIS messages with undefined data contents according to Table 18 (Message type 28 or higher) are output by the PI. Repeat test for port "auxiliary display/pilot port".

19.8.2 Required results

Confirm that the EUT outputs all undefined received messages to the PI.

19.9 Test of high-speed input

19.9.1 General

Verify the configuration input by evaluation of the appropriate output sentence, either by response to the input sentence or as response to a query.

19.9.2 Test of VSD input sentence

19.9.2.1 Method of measurement

Set up standard test environment and apply VSD sentences with simulated configuration data to the high-speed ports.

a) Apply a VSD sentence, all fields with valid data, without preceding SSA sentence.

b) Set the Special Manoeuvre Indicator to "in special manoeuvre".

c) Set the Special Manoeuvre Indicator to "not in special manoeuvre".

d) Set the Special Manoeuvre Indicator to "not available".

19.9.2.2 Required results

Confirm that:

a) all data of the VSD sentence are accepted;

b) the EUT transmits Message 1 with the Special Manoeuvre Indicator set to 2;

c) the EUT transmits Message 1 with the Special Manoeuvre Indicator set to 1;

d) the EUT transmits Message 1 with the Special Manoeuvre Indicator set to 0.

19.9.3 Test of SSD input sentence

19.9.3.1 Method of measurement

Set up the standard test environment and apply ~~simulated input data, in accordance with the sentence specifications of IEC 61162-1 and Table 15 of this standard, to the EUT and record VDL output~~ the SSD sentences with simulated configuration data to the high-speed ports.

a) Apply an SSD sentence, all fields with valid data, without a preceding SSA sentence.

b) Apply an SSD sentence, all fields with valid data, with a preceding SSA sentence with incorrect signature.

c) Apply an SSD sentence, all fields with valid data, with a preceding SSA sentence with correct signature. The source identifier shall be "AI" and the dim/ref values of the internal GNSS.

d) Apply an SSD sentence, all fields with valid data, with a preceding SSA sentence with correct signature. The source identifier shall be different to "AI" and the dim/ref values of the external GNSS.

e) Query for SSD.

NOTE For the SSD sentence:

a) the source identifier “AI” means that the A, B, C, D values are related to the internal EPFS receiver;

b) any other source identifier means that the A, B, C, D values are related to the external EPFS.

19.9.3.2 Required results

~~Verify that the VDL message contents agree with simulated input data.~~

Confirm that:

a) all data of the SSD sentence, except the DTE flag, are not accepted. Confirm that a NAK sentence is output with correct content and reason code 5;

b) all data of the SSD sentence, except the DTE flag, are not accepted. Confirm that a NAK sentence is output with correct content and reason code 5;

c) all data of the SSD sentence are accepted. Confirm that the dim/ref values are stored for the internal GNSS and used in message 5 with internal GNSS position source;

d) all data of the SSD sentence are accepted. Confirm that the dim/ref values are stored for the external GNSS and used in message 5 with external GNSS position source;

e) there are two SSD output sentence, one with source identifier "AI" and internal dim/ref data and one with source identifier of a valid external source with external dim/ref data.

19.9.4 Test of EPV input sentence

19.9.4.1 Method of measurement

Set up the standard test environment and apply EPV sentences with simulated configuration data to the high-speed ports.

a) Apply an EPV sentence for all property identifiers of protected data without a preceding SSA sentence.

b) Apply an EPV sentence for all property identifiers of unprotected data without a preceding SSA sentence.

c) Apply an EPV sentence with protected data with a preceding SSA sentence with an incorrect signature.

d) Apply an EPV sentence for all property identifiers of protected data with a preceding SSA sentence with a correct signature.

19.9.4.2 Required results

Confirm that:

a) the data of the EPV sentences are not accepted. Confirm that a NAK sentence is output with correct content and reason code 5;

b) the data of the EPV sentences are accepted;

c) the data of the EPV sentence are not accepted. Confirm that a NAK sentence is output with correct content and reason code 5;

d) the data of the EPV sentences are accepted.

19.9.5 Test of the pilot port access level

19.9.5.1 Method of measurement

Set up the standard test environment and apply an EPV sentence with property identifier 146 to the pilot port.

a) Set the pilot port access level to 0.

b) Set the pilot port access level to 1.

c) Try to set the pilot port access level back to 0 without preceding SSA sentence.

d) Set the pilot port access level to 0 with preceding SSA sentence.

19.9.5.2 Required results

Confirm that:

a) the EUT accepts all input commands;

b) the EUT rejects all input commands other than the EPV sentence with property identifier 146;

c) the parameter value of property identifier 146 in EUT is not changed;

d) the parameter value of property identifier 146 in EUT is changed to 0.

20 Long-range functionality tests

20.1 Long-range application by two-way interface

(See 8.2)

20.1.1 LR interrogation

20.1.1.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Apply a LR addressed interrogation message to the LR-interface port of EUT. Record LR output port and AIS high-speed output port. Set the EUT to:

a) automatic response;

b) manual response via MKD;

c) manual response via PI.

20.1.1.2 Required results

Check that the EUT displays LR interrogation messages and sends them to PI. Check that the EUT outputs a LR position report message:

a) automatically (and indicates action on display);

b) after manual confirmation via MKD;

c) after manual confirmation via PI.

20.1.2 LR "all ships" interrogation

20.1.2.1 Method of measurement

Set up the standard test environment and operate EUT in autonomous mode. Apply a LR "all ships" interrogation message to the LR-interface port of EUT defining a geographical area which contains own ship's position. Record LR output port. Set EUT to:

a) automatic response;

b) manual response.

Repeat check with own ship outside specified area.

20.1.2.2 Required results

Check that EUT outputs a LR position report message:

a) automatically (and indicates action on display);

b) after manual confirmation.

No response shall be output on the repeat check.

20.1.3 Consecutive LR "all ships" interrogations

20.1.3.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Set the EUT to automatic mode. Apply 5 LR "all ships" interrogation messages to the LR-interface port of the EUT defining a geographical area, which contains the ship's own position.

Set the control flag in the LRI message to:

a) 0 (reply on first interrogation only);
b) 1 (reply on all applicable interrogations).

Record LR output port.

20.1.3.2 Required results

Check that the EUT outputs a LR position report message:

a) on the first interrogation only;
b) on all interrogations.

20.2 Long-range application by broadcast

(See 8.3)

20.2.1 Long-range broadcast

20.2.1.1 Method of measurement

Set up the standard test environment, enable the EUT to transmit Message 27 and operate the EUT in autonomous mode. Use base stations MMSI to transmit Message 4 and Message 23. Record the transmitted messages from the EUT. The designated long-range channels are defined in 8.3.

a) Do not apply Message 4 and Message 23.
b) Apply the Message 4 with the long-range control bit set to 1 and 0. Place the EUT inside the RF footprint (Message 4 receiving area) of a base station.
c) Apply the Message 4 with the long range control bit set to 1 and 0. Using the same MMSI as the Message 4, broadcast the Message 23 with station type 10 to define the base station coverage area. Place the EUT inside the RF footprint area, but outside the base station coverage area.
d) Apply the Message 4 with the long range control bit set to 1 and 0. Using the same MMSI as the Message 4, broadcast the Message 23 with station type 10 to define the base station coverage area. Place the EUT inside the base station coverage area. Message 23 fields after station type shall not match current settings of EUT.
e) Repeat the test d) using different MMSIs for Message 4 and Message 23.
f) Apply the Message 4 with the long-range control bit set to 0. Using the same MMSI as the Message 4, broadcast the Message 23 with station type 10 to define the base station coverage area. Place the EUT inside the base station coverage area. After 6 min, remove transmissions of Message 23.
g) Apply the Message 4 with the long-range control bit set to 0. Using the same MMSI as the Message 4, broadcast the Message 23 with station type 10 to define the base station coverage area. Place the EUT inside the base station coverage area. After 6 min, remove transmissions of Message 4.

20.2.1.2 Required results

Check that the EUT transmits the appropriate messages, for example in addition to the normal transmission of Messages 1 and 5 with adequate reporting interval on AIS 1 and AIS 2. Confirm that:

a) EUT transmits Message 27 alternating the designated long-range channels with 3 min reporting interval;

irrespective of the Message 4 long range control bit status, EUT transmits Message 27 alternating on the designated long-range channels with 3 min reporting interval;

b) irrespective of the Message 4 long range control bit status, EUT transmits Message 27 alternating on the designated long-range channels with 3 min reporting interval;

c) EUT transmits Message 27 alternating on the designated long-range channels with 3 min reporting interval when the Message 4 long-range control bit is set to 1. EUT stops transmitting Message 27 when the Message 4 long-range control bit is set to 0. Verify fields after station type in received Message 23 are ignored;

d) irrespective of the Message 4 long range control bit status, EUT transmits Message 27 alternating on the designated long-range channels with 3 min reporting interval;

e) EUT begins transmission of Message 27 no sooner than 4 min and no later than 11 min (8 min timeout + 3 min transmission interval) after Message 23 was removed;

f) EUT begins transmission of Message 27 beyond 3 min after Message 4 was removed.

20.2.2 Multiple assignment operation

20.2.2.1 Method of measurement

Set up the standard test environment, enable the EUT to transmit Message 27 and operate the EUT in autonomous mode with a reporting interval of 10 s. Use base stations MMSI to transmit Message 4 and Message 23. Record the transmitted messages from the EUT.

~~a) Transmit a Group Assignment command (Message 23) to the EUT (define geographic region so that the EUT is inside this region). Set the reporting interval to 2 s and the station type to 0 (all stations).~~

a) Using different MMSIs, apply the Message 4 with long range control bit set to 1 and 0 from multiple base stations partially overlapping their RF footprints. Broadcast the Message 23 from multiple base stations with station type 10 to define the base station coverage areas not overlapping. Place the EUT inside the overlapped RF footprint area but outside the coverage area of both base stations.

b) Using different MMSIs, apply the Message 4 with long range control bit set to 1 and 0 from multiple base stations partially overlapping RF footprints. Broadcast the Message 23 from multiple base stations with station type 10 to define the base station coverage areas partially overlapping the base station coverage areas. Place the EUT inside the overlapped base station coverage area.

c) Using different MMSIs, apply the Message 4 with long range control bit set to 1 and 0 from multiple base stations partially overlapping RF footprints. Broadcast the Message 23 from one base station with station type 10 to define the base station coverage areas. Do not broadcast Message 23 from other base stations. Place the EUT inside the RF footprint area of base station not broadcasting Message 23 but outside the coverage area of the base station transmitting Message 23.

20.2.2.2 Required results

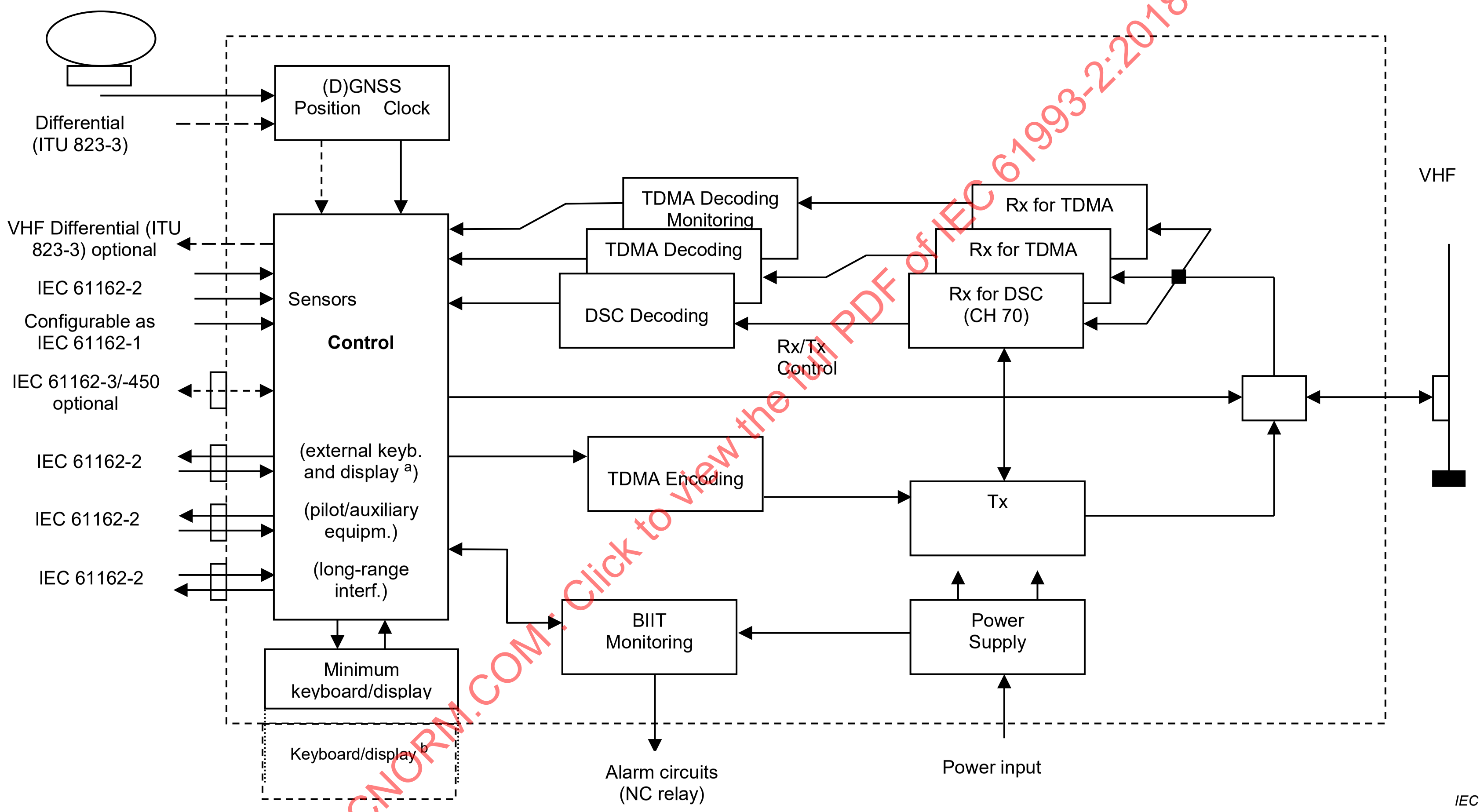
Verify that:

~~a) EUT switches to assigned mode and transmits position reports with 2 s reporting interval. EUT reverts to autonomous mode after timeout period;~~

a) irrespective of the Message 4 long-range control bit status of both base stations, EUT transmits Message 27 alternating on the designated long-range channels with 3 min reporting interval;
b) EUT transmits Message 27;
c) irrespective of the Message 4 long range control bit status of both base stations, EUT transmits Message 27 alternating on the designated long-range channels with 3 min reporting interval.

Annex A
(informative)

Block diagram of AIS

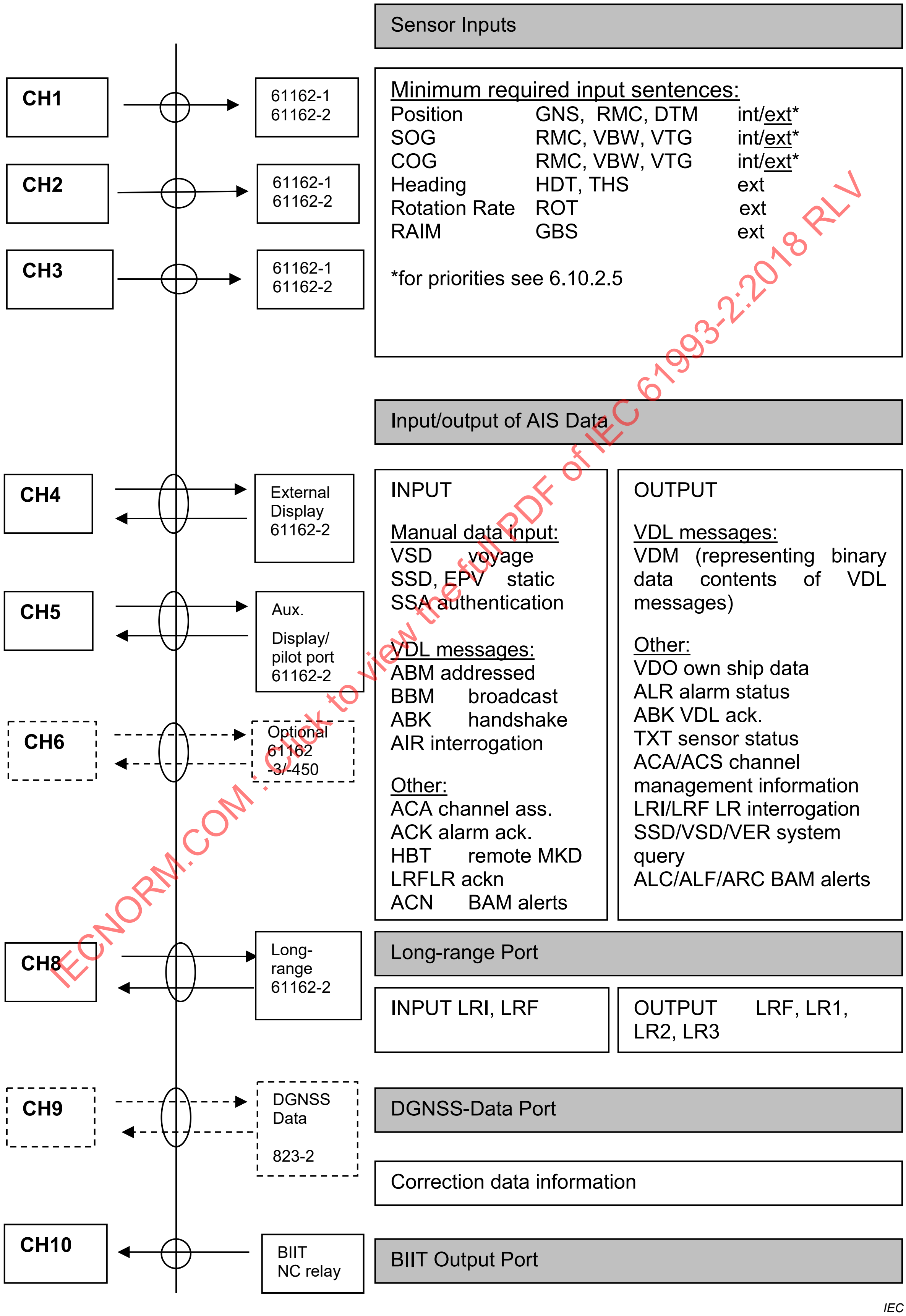


Key

[a] The external keyboard/display may be, for example, a radar, ECDIS or dedicated devices.

[b] The internal keyboard/display may optionally be remote.

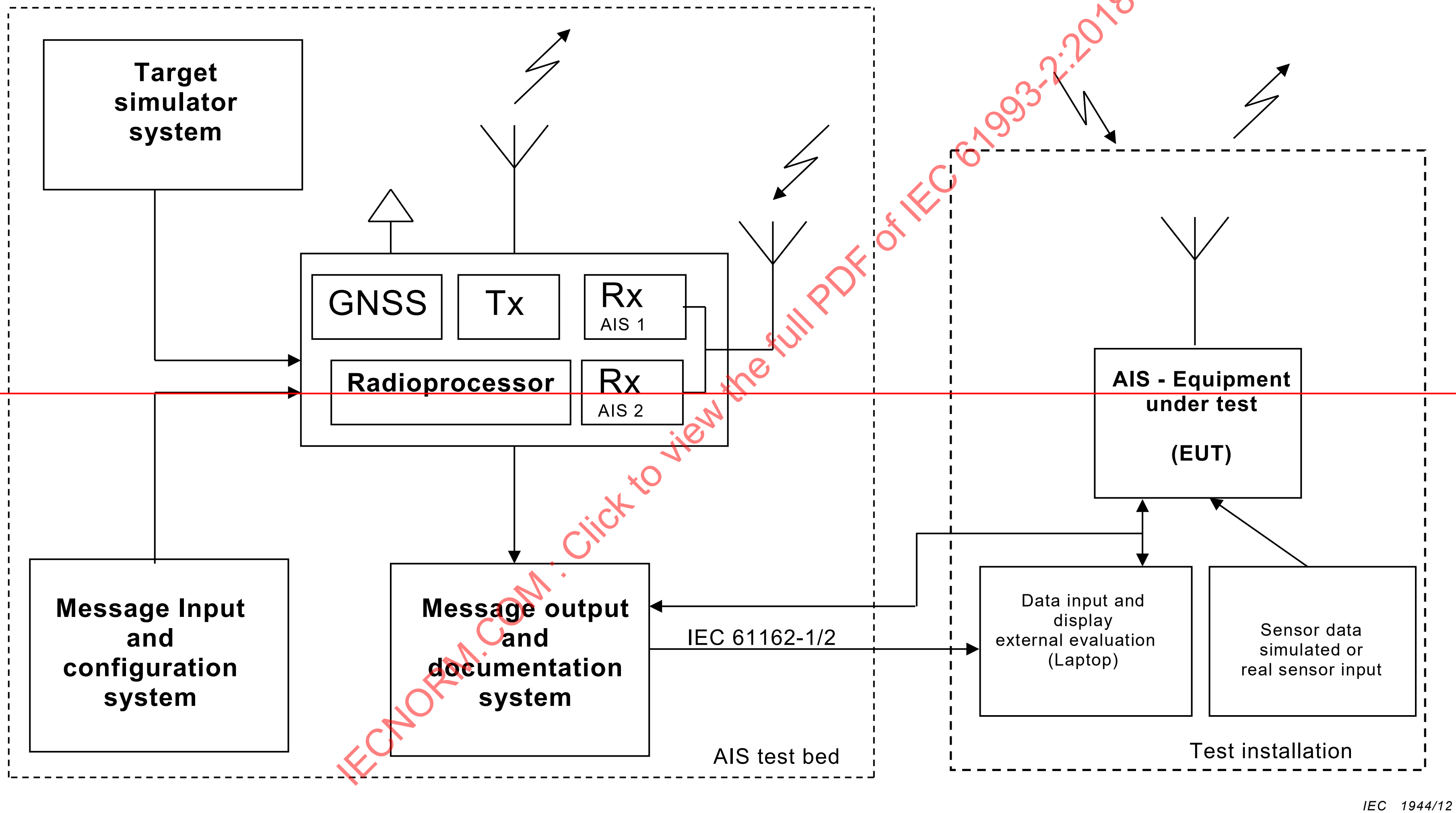
Annex B
(normative)
AIS interface overview ~~(see Table 13)~~



~~Annex C~~

~~(informative)~~

~~Block diagram of standard test environment~~



Annex C
(normative)

DSC functionality

C.1 DSC compatibility

The Class A AIS shall be capable of receiving and processing DSC channel management telecommands conforming to the provisions of Recommendations ITU-R M.493, ITU-R M.541, ITU-R M.825 (see Recommendation ITU-R M.1371-~~4~~5/A3). In order to accomplish this performance, the AIS device shall contain a dedicated DSC receiver that is tuned permanently to channel 70. However, the AIS device shall not accept the channel management command sent by stations with invalid base station MMSI as defined in 6.12.

For DSC channel management using geographical area calls, the end of sequence (EOS) character shall be EOS = 127 (no response requested). However, for compatibility, Class A AIS receivers shall respond to DSC channel management commands ending in "EOS = 127" and "EOS = 117 (RQ)" even though they are not capable of transmitting DSC acknowledgements.

C.2 DSC receiver tests

NOTE For DSC receiver test signal, refer to 10.1 test signal 1.

C.2.1 Maximum sensitivity

C.2.1.1 Definition

The maximum sensitivity of the receiver is the minimum level of the signal in dBm at the nominal frequency of the receiver which, when applied to the receiver input with a test modulation, will produce a bit error rate which does not exceed 10^{-2}.

C.2.1.2 Method of measurement

The test equipment shall be set to transmit test signal 1 (continuous DSC dot pattern) as the test modulation of the RF signal generator connected to the EUT. The frequency and level of the test equipment shall be 156,525 MHz (CH70) −107 dBm under normal condition and −101 dBm under extreme condition. The EUT shall provide a logic level test output from its internal DSC demodulator to measure bit error rate (BER). The test shall be repeated at the nominal carrier frequency 156,525 MHz ± 1,5 kHz offset under normal test condition.

C.2.1.3 Required results

The BER shall not exceed 10^{-2}.

C.2.2 Error behaviour at high input levels

C.2.2.1 Definition

The dynamic range of the equipment is the range from the minimum to the maximum level of a radio frequency input signal at which the bit error rate in the output of the receiver does not exceed a specified value.

C.2.2.2 Method of measurement

A test signal, in accordance with standard test signal number 1, shall be applied to the receiver input. The level of the test signal shall be −7 dBm.

C.2.2.3 Required results

The BER shall not exceed 10^{-2}.

C.2.3 Co-channel rejection

C.2.3.1 Definition

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at nominal frequency of the receiver.

C.2.3.2 Method of measurement

The wanted signal shall be standard test signal number 1. The level of the wanted signal shall be −104 dBm.

The unwanted signal shall be frequency modulated by 400 Hz with a deviation of ± 3 kHz. The input level of the unwanted signal shall be −114 dBm.

Both input signals shall be at the nominal frequency of the receiver under test and the measurement shall be repeated for displacements of the unwanted signal of up to ± 3 kHz.

C.2.3.3 Required results

The BER shall not exceed 10^{-2}.

C.2.4 Adjacent channel selectivity

C.2.4.1 Definition

The adjacent channel selectivity characterises the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal that differs in frequency from the wanted signal by 25 kHz.

C.2.4.2 Method of measurement

The wanted signal shall be standard test signal number 1. The level of the wanted signal shall be −104 dBm.

The unwanted signal shall be frequency modulated by 400 Hz with a deviation of ±3 kHz. The input level of the unwanted signal shall be −34 dBm. The unwanted signal shall be tuned to the centre frequency of the upper adjacent channels (156,550 MHz) and lower adjacent channel (156,500 MHz).

Repeat the test under extreme condition with the wanted signal level of −98 dBm and unwanted signal level of −38 dBm.

C.2.4.3 Required results

The BER shall not exceed 10^{-2}.

C.2.5 Spurious response rejection

C.2.5.1 Definition

The spurious response characterises the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal with frequencies outside the band of the receiver.

C.2.5.2 Manufacturers' declarations

The manufacturers shall declare the following in order to calculate the "limited frequency range":

- list of intermediate frequencies: (IF_1, IF_2, ...IF_N) in Hz;
- frequency of the local oscillator at 156,525 MHz.

NOTE This ~~may~~ can be a VCO, crystal, sampling clock, BFO, numerically controlled oscillator depending on the design of the equipment.

C.2.5.3 Introduction to the method of measurement

The measurement shall be performed over the "limited frequency range" and at the "specific frequencies of interest" (as defined below).

To determine the frequencies at which spurious responses can occur, the following calculations shall be made:

a) calculation of the "limited frequency range"

the limits of the limited frequency range (LFR) are determined from the following calculations:

$$\text{LFR} = f_{\text{LO}} \pm (IF_1 + IF_2 + \ldots + IFN)$$

b) calculation of specific frequencies of interest (SFI) outside the limited frequency range:

this is determined by the following calculations:

$$\text{SFI} = (K \times f_{\text{LO}}) \pm IF_1$$

where

K is an integer from 2 to 4;

f_{LO} is the local frequency at CH70.

C.2.5.4 Method of measurement

The wanted signal shall be standard test signal number 1. The level of the wanted signal shall be −104 dBm.

The unwanted signal shall be unmodulated. The frequency shall be varied in steps of 5 kHz over the limited frequency range (LFR) and the specific frequency of interest (SFI). The level of the unwanted signal shall be −34 dBm.

C.2.5.5 Required results

At any frequency separated from the nominal frequency of the receiver by two channels or more, the BER shall not exceed 10^{-2}.

C.2.6 Intermodulation response rejection

C.2.6.1 Definition

The intermodulation response ratio characterises the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

C.2.6.2 Method of measurement

The wanted signal represented by signal generator A (see Figure C.1) shall be at the nominal frequency of the receiver and shall be standard test signal number 1. The level of the wanted signal shall be −104 dBm.

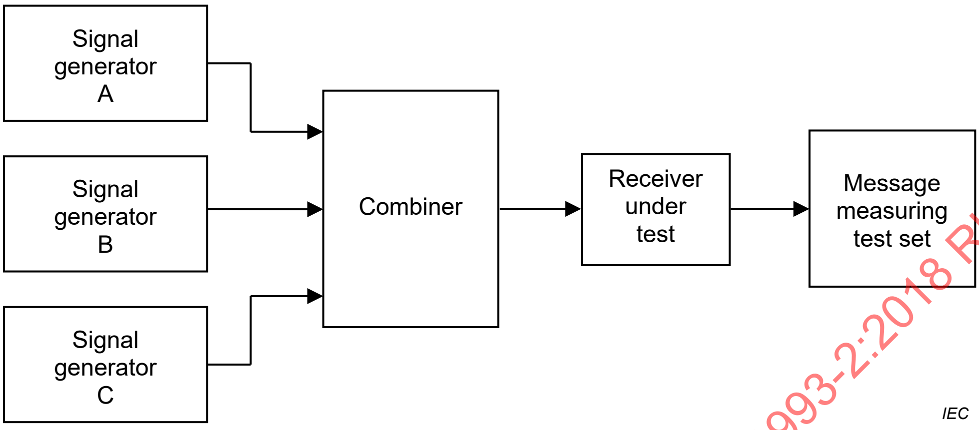


Figure C.1 – Measurement arrangement for inter-modulation

The unwanted signal from signal generator B (see Figure C.1) shall be unmodulated and adjusted to a frequency 50 kHz above the nominal frequency of the receiver. The second unwanted signal from signal generator C (see Figure C.1) shall be modulated by 400 Hz with a deviation of ±3 kHz and adjusted to a frequency 100 kHz above the nominal frequency of the receiver. The input level of each unwanted signal shall be −39 dBm. The test shall be repeated with the frequency of the unwanted signals below the nominal frequency of the receiver.

C.2.6.3 Required results

The BER shall not exceed 10^{-2}.

C.2.7 Blocking or desensitisation

C.2.7.1 Definition

The blocking immunity characterises the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal with frequencies outside the band of the receiver.

C.2.7.2 Method of measurement

The wanted signal shall be standard test signal number 1. The level of the wanted signal shall be −104 dBm.

The unwanted signal shall be unmodulated. The frequency shall be at −10 MHz and −1 MHz and also at +1 MHz and +10 MHz relative to the nominal frequency of the wanted signal. The level of the unwanted signal shall be −20 dBm.

C.2.7.3 Required results

The BER shall not exceed 10^{-2}.

C.2.8 Conducted spurious emissions from the receiver

C.2.8.1 Definition

Conducted spurious emissions to the antenna are any RF emissions generated in the receiver and conveyed to the antenna terminal. This test shall apply only if a dedicated DSC receiver antenna connector is provided.

C.2.8.2 Method of measurement

Conducted spurious emissions shall be measured as the power level of any frequency component to the antenna terminals of the receiver. The receiver antenna terminals are conducted to a spectrum analyser or selective voltmeter having an input impedance of 50 Ω and the receiver is switched on.

If the detecting device is not calibrated in terms of power input, the level of any detected components shall be determined by a substitution method using a signal generator. The measurement shall extend over the frequency range 9 kHz to 4 GHz.

C.2.8.3 Required results

The power of any spurious emission in the specified range at the antenna terminal shall not exceed −57 dBm (2 nW) in the frequency range 9 kHz to 1 GHz and −47 dBm (20 nW) in the frequency range 1 GHz to 4 GHz.

C.3 DSC functionality tests

C.3.1 Definition

The EUT shall correctly process the channel management command by DSC messages addressed to the stations in the designated geographical area or the stations individually designated.

C.3.2 Method of measurement

For the tests in Clause C.3, set the EUT into autonomous mode using channels AIS 1 and AIS 2 with a reporting interval of 2 s. Standard AIS channel management by DSC calls, consisting of format specifier 103 and message symbol number 104 with expansion symbols 09, 10, 12, 13, shall be applied to the EUT using a base station MMSI as follows.

a) Apply a geographical channel management call using symbol constructions: "103" "geographical coordinates" "103" "source MMSI" "104" "primary CH No" "secondary CH No" "NE of CH management area" "SW of CH management area". Apply the call with EOS = 117 and EOS = 127.
b) Move the EUT outside the channel management area.
c) Apply an individual channel management call using symbol constructions: "120" "EUT MMSI" "103" "source MMSI" "104" "primary CH No" "secondary CH No" "NE of CH management area" "SW of CH management area". Apply the call with EOS = 117 and EOS = 127.
d) Move the EUT outside the channel management area.
e) Apply an incorrect MMSI, position outside addressed geographic area, different course, or ship type.
f) Apply an extraneous call using symbol constructions: "120" "EUT MMSI" "103" "source MMSI" "104" "03" "01" "120" (active alternative system with group number 1 and sequence number 120). Transmit a DSC telecommand using a non-base station MMSI.

C.3.3 Required results

The following items shall be verified.

a) Verify that the EUT operates on the designated channels with the transition boundary of 5 NM.
b) Verify that the EUT reverts to the operation on AIS 1 and AIS 2 channels.
c) Verify that the EUT operates on the designated channels with the transition boundary of 5 NM.
d) Verify that the EUT reverts to the operation on AIS 1 and AIS 2 channels.
e) Verify that the EUT operation is not affected.
f) Verify that the EUT operation is not affected.

~~Annex E~~
~~(informative)~~

~~Optional PI port sentences~~

~~E.1 General~~

~~This annex contains sentences which may optionally be used to facilitate communication with external devices providing the functionality of a MKD. These sentences are used with the high speed data ports.~~

~~E.2 EPV – Command or report equipment property value~~

~~This sentence is a command sentence.~~

~~$--EPV,a,c--c,c--c,x.x,c--c,*hh<CR><LF>~~

~~Value of property to be set (see Note 5)~~
~~Property identifier for the property to be set (see Note 4)~~
~~Unique identifier (see Note 3)~~
~~Destination equipment type (see Note 2)~~
~~Sentence status flag (see Note 1)~~

~~NOTE 1 Sentence status flag:~~

~~C = command~~

~~R = response~~

~~NOTE 2 The destination equipment field identifies the device type for which the sentence is targeted. The destination equipment field is the talker identifier mnemonic of the equipment for which the sentence is valid.~~

~~NOTE 3 The unique identifier identifies the same equipment irrespective of command versus response: For commands it identifies the equipment intended to receive the command. For responses it identifies the equipment that actually received the command. Under normal conditions the response will be received from the equipment for which the command was intended. Equipment should only send one or more response sentences in response to command sentences received and should not use response sentences for general reporting. For AIS Class A the unique identifier is the MMSI. The unique identifier may be null.~~

~~NOTE 4 The property identifier is a variable length integer field that identifies a parameter that can be set in accordance with Table E.1 and is intended for commissioning settings. Only the following property identifiers are permitted.~~

~~**Table E.1 – Property identifier**~~

~~**Property identifier**~~	~~**Property meaning**~~	~~**Value range**~~
~~0 to 100~~	~~Reserved~~	
~~101~~	~~Sensor 1 baud~~	~~4 800, 9 600, 14 400, 19 200, 38 400~~
~~102~~	~~Sensor 2 baud~~	~~4 800, 9 600, 14 400, 19 200, 38 400~~
~~103~~	~~Sensor 3 baud~~	~~4 800, 9 600, 14 400, 19 200, 38 400~~
~~104~~	~~Long-range baud~~	~~4 800, 9 600, 14 400, 19 200, 38 400~~
~~105~~	~~DGNSS baud~~	~~4 800, 9 600, 14 400, 19 200, 38 400~~
~~106~~	~~MMSI~~	~~000000000, 200000000 … 799999999, 982000000 … 987999999~~
~~107~~	~~IMO number~~	~~0000000 … 9999999~~
~~108~~	~~Long-range interface configuration~~	~~"A" = automatic~~ ~~"M" = manual~~
~~109~~	~~Long-range AIS broadcast channel 1~~	~~Valid channel according ITU-R M.1084-5. See 8.3.~~ ~~Default value 0 indicates no transmission of message 27~~
~~110~~	~~Long-range AIS broadcast channel 2~~	~~Valid channel according ITU-R M.1084-5. See 8.3.~~ ~~Default value 0 indicates no transmission of message 27~~
~~111~~	~~Change administrator password~~	~~New administrator password~~
~~112~~	~~Change user password~~	~~New user password~~
~~113~~	~~AIS-SART test mode~~	~~0 = normal mode~~ ~~1 = display and output AIS-SART in test mode~~
~~All other values~~	~~Reserved~~	

~~NOTE 5 The value is a variable length character string representing the configuration parameter value.~~

~~An NAK with appropriate response should be output if an EPV setting is not accepted~~

~~Example:~~

~~A practical example is an ECDIS setting the baud rate for the Port1 of an AIS transponder. The ECDIS would send the following command (MMSI of the AIS is 503123450):~~

~~$EIEPV,C,AI,503123450,101,38400*hh~~

~~The AIS would send the following response:~~

~~$AIEPV,R,AI,503123450,101,38400*hh~~

~~Another practical example is a radar setting the MMSI and IMO number of an AIS transponder and using a password. It is assumed that the MMSI is not yet set and therefore the value is 0. The radar would send the following sentences:~~

~~$RASPW,EPV,000000000,1,SESAME*hh~~

~~$RAEPV,C,AI,000000000,106,503123450*hh~~

~~$RASPW,EPV,503123450,1,SESAME*hh~~

~~$RAEPV,C,AI,503123450,107,9241061*hh~~

~~The AIS would send the following response sentences:~~

~~$AIEPV,R,AI,503123450,106,503123450*hh~~

~~$AIEPV,R,AI,503123450,107,9241061*hh~~

~~E.3 SPW – Security password sentence~~

~~This sentence can be used for authentication. For this purpose the sentence has to be applied before the protected sentence (for example EPV, SSD).~~

~~Other sentences may not be interleaved between the password sentence and protected sentence and the time between the SPW and the protected sentence should be limited. The password protected sentence pair should be sent without unnecessary delay between sentences. The recommendation is 1 s maximum timeout. Note that any of the signals may be lost and timed out.~~

~~If the password is not accepted (for example because it is incorrect) the command is refused using the NAK sentence.~~

```
$--SPW,ccc,c--c,x,c--c*hh<CR><LF>
          |    |   | |
          |    |   | └── Password (see Note 4)
          |    |   └── Password level (see Note 3)
          |    └── Unique identifier (see Note 2)
          └── Password protected sentence (see Note 1)
```

~~NOTE 1 The following sentence formatter that should be protected (for example EPV).~~

~~NOTE 2 For AIS the unique identifier is the MMSI.~~

~~NOTE 3 An integer number as defined below:~~

~~1 = User level password;~~

~~2 = Administrator level password;~~

~~3-9 = Reserved.~~

~~NOTE 4 Password as text up to 32 characters.~~

~~Example:~~

~~The password could be changed with a SPW+EPV sentence pair.~~

~~$IISPW,EPV,211000001,2,SESAME*hh~~

~~$IIEPV,C,AI,211000001,111,HEUREKA143*hh~~

~~With response~~

~~$AIEPV,R,AI,211000001,111,HEUREKA143*hh~~

~~or NAK or nothing.~~

~~E.4 TRL – AIS transmitter non functioning log~~

~~This sentence is specific to AIS. It is intended to support the retrieval of the AIS non functioning log information.~~

~~This satisfies the requirement that the AIS class units log the last 10 times of more than 15 min when the unit was not transmitting position reports. This includes times when the unit was switched off and times when the transmitter was inactivated by any means.~~

~~This sentence is used to output the logged non-functioning times. On a query for this sentence up to 10 sentences will be output, one sentence for each logged non-functioning time.~~

~~This sentence is always generated as a response to a query even when no log entries exist, see Note 1.~~

~~$--TRL,x.x,x.x,x,xxxxxxxx,hhmmss.ss,xxxxxxxx,hhmmss.ss,x,*hh<CR><LF>~~

~~Reason code (see Note 8)~~
~~Switch on UTC time (see Note 7)~~
~~Switch on date (see Note 6)~~
~~Switch off UTC time (see Note 5)~~
~~Switch off date (see Note 4)~~
~~Sequential message identifier (see Note 3)~~
~~Log entry number (see Note 2)~~
~~Total number of log entries (see Note 1)~~

~~NOTE 1 Total number of log entries (1...10). When a query is received for this sentence and no log entries exist, this field should be set to "0" and all other fields should be set to NULL. When a query is received for this sentence and one or more log entries exist, this field should report the total number of log entries.~~

~~NOTE 2 Log entry number (1...Total number of log entries).~~

~~NOTE 3 The sequential message identifier provides a message identification number from 0 to 9 that is sequentially assigned and is incremented for each new multi-sentence message. The count resets to 0 after 9 is used. For a message requiring multiple sentences, each sentence of the message contains the same sequential message identification number. It is used to identify the sentences containing portions of the same message. This allows for the possibility that other sentences might be interleaved with the message sentences that, taken collectively, contain a single message.~~

~~NOTE 4 Switch off date, in the format "ddmmyyyy".~~

~~NOTE 5 Switch off UTC time. Required resolution is in minutes. The seconds may be set to 0 and the fractional part may be omitted.~~

~~NOTE 6 Switch on date, in the format "ddmmyyyy".~~

~~NOTE 7 Switch on UTC time. Required resolution is in minutes. The seconds may be set to 0 and the fractional part may be omitted.~~

~~NOTE 8 Reason for Tx non-functioning:~~

~~1 = power off;~~

~~2 = silent mode;~~

~~3 = transmission switched off by channel management command;~~

~~4 = equipment malfunction;~~

~~5 = invalid configuration.~~

Annex D
(informative)

~~Alarm~~ Alert handling with ALR/ACK

		~~Alarm popup window (recommended)~~	~~Alarm indication on the screen (6.11.3)~~	~~Alarm relay (6.10.2.3)~~	~~Alarm list (accessible for the user) (6.10) (6.11.3)~~	~~Tx ALR sentence on PI (6.10.2)~~
~~1~~	~~Alarm active~~	~~on occurrence~~	~~1~~	~~1~~	~~Add new alarm entry~~	~~Tx ALR sentence with status „A" upon occurrence and repeat every 30 s~~
~~2~~	~~Alarm active and acknowledged~~	~~Off after acknowledgement~~	~~1~~	~~0~~	~~Update corresponding alarm entry as „ack'ed"~~	~~Update corresponding ALR sentence after ack and repeat every 30 s~~
~~3~~	~~Alarm condition cleared (not exceeded)~~ ~~a) from status 1~~ ~~b) from status 2~~	~~Off after clearance~~	~~0~~	~~0~~	~~Delete corresponding alarm from list~~	~~Update corresponding sentence (status „V")~~ ~~Once (one updated output)~~ ~~Go to 4~~
~~4~~	~~No alarms pending~~	~~0~~	~~0~~	~~0~~	~~List empty~~	~~Empty ALR sentence every 60 s~~

This annex provides an abstract of the alert handling as it is currently implemented in IEC 61993-2:2012, based on the data exchange using the ALR and ACK sentences.

The handling of an alert can be described in a state diagram. For each individual alert, an individual alert state has to be managed.

An alert can take up 3 different states, as described in Table D.1.

Table D.1 – IEC 61993-2:2012 alert states

State	Description	Relay	Indication
Normal	The alert condition is not exceeded.	Off	The alert is not displayed The alert is not in the alert list.
Active	The alert condition is exceeded. The alert is not yet acknowledged.	On	The alert is displayed. The alert is in the alert list.
Acknowledged	The alert condition is exceeded. The alert has been acknowledged.	Off	The alert is not displayed. The alert is in the alert list.

The reaction on possible events is described in Table D.2.

Table D.2 – IEC 61993-2:2012 alert events

Event	Old state	Reaction	New state
Alert condition exceeded	Normal	Output ALR with status A,V, Relay is activated, Alert is displayed on MKD, Alert is added to the alert list	Active
Alert condition is rectified	Active	Output ALR with status V,V, Relay is deactivated, if no other alert is in state "Active", Alert is removed from MKD, Alert is removed from the alert list	Normal
ACK with the correct Alert ID is received or Acknowledgement on MKD	Active	Output ALR with status A,A, Relay is deactivated, if no other alert is in state "Active", Alert is removed from MKD, Alert remains in the alert list	Acknowledged
Alert condition is rectified	Acknowledged	Output ALR with status V,V, Alert is removed from the alert list	Normal

A fourth state "Rectified, unacknowledged" may also be implemented.

A state diagram is given in Figure D.1.

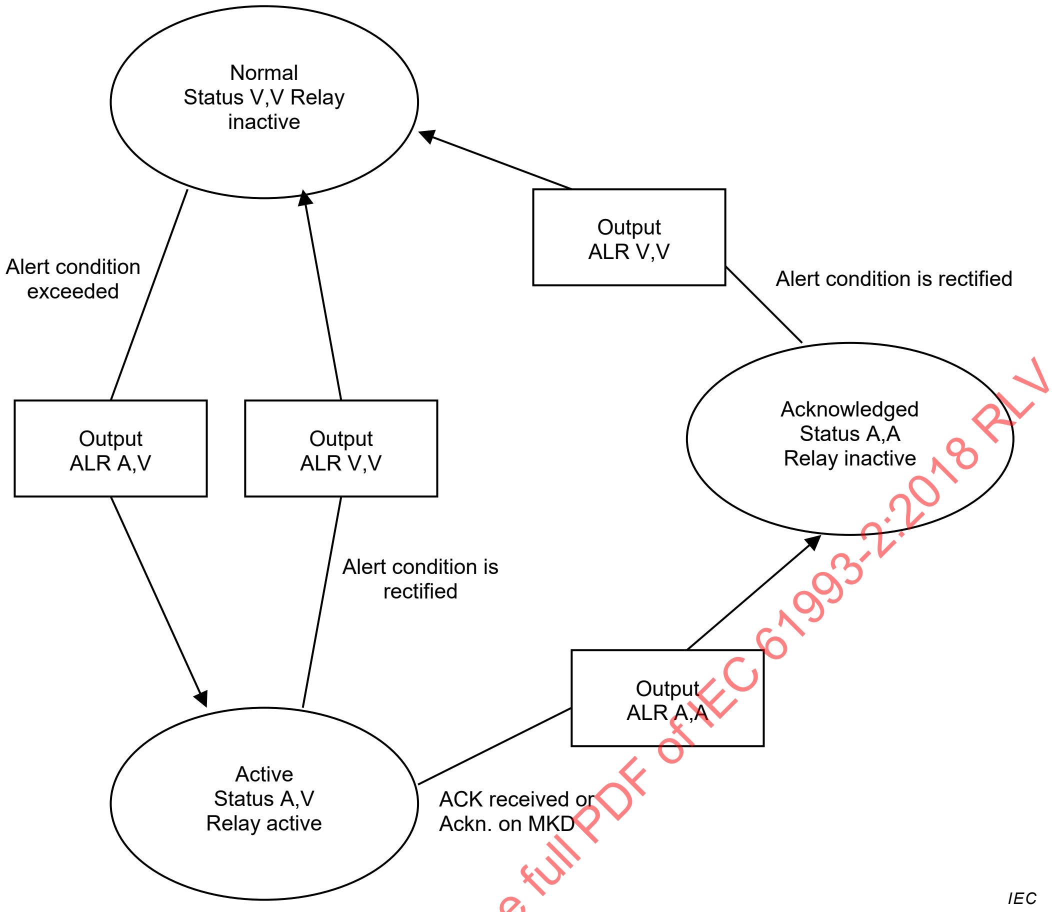


Figure D.1 – State diagram of IEC 61993-2 Ed.2 Alert handling

Further requirements are as follows.

- The alert list is output every 30 s, consisting of one ALR sentence for each active alert in the alert list.
- If the alert list is empty, a "No alerts" sentence is output every 60 s. It has the format: $AIALR,,,V,V,*hh <CR><LF>.

Annex E
(normative)

Calculation of area size and distance

E.1 Importance of a common method for area size and distance calculations

An AIS unit ~~will~~ needs to calculate distances with regard to many aspects. Many of these distances are paramount to how the AIS unit should operate in certain situations. This includes (but is not limited to) calculating the distance between ~~own~~ the vessel and other vessels within radio range, channel management areas (sizes and distance from its boundaries) and interrogation areas. Annex E specifies the methods allowed to use with regard to the different distance and size calculations.

E.2 Calculation of area sizes

To calculate the size of the areas given in Message 22 and Message 23, along with the channel management message sent by DSC, the following method shall be used.

Coordinates of NE and SW points of the area are given in Table E.1.

Table E.1 – Coordinate points

Corner	Latitude	Longitude
NE	a deg, b min	c deg, d min
SW	e deg, f min	g deg, h min

The length around equator (L_E) is defined in Equation (E.1).

The length of the NE-NW side ($L_{NE\text{-}NW}$) is defined in Equation (E.2).

The length of the SE-SW side ($L_{SE\text{-}SW}$) is defined in Equation (E.3).

The length of the polar circumference (L_P) is defined in Equation (E.4).

The length of the NE-SE ($L_{NE\text{-}SE}$) and NW-SW ($L_{NW\text{-}SW}$) is defined in Equation (E.5).

$$L_E = 40\,075{,}017 \text{ (km)}/1{,}852 \text{ (km/NM)} = 21\,638{,}778 \text{ (NM)} \tag{E.1}$$

$$L_{NE\text{-}NW} = ((c + d/60) - (g + h/60)) \times (L_E \times \cos(a + b/60))/360 \text{ (NM)} \tag{E.2}$$

$$L_{SE\text{-}SW} = ((c + d/60) - (g + h/60)) \times (L_E \times \cos(e + f/60))/360 \text{ (NM)} \tag{E.3}$$

$$L_P = 40\,007{,}863 \text{ (km)}/1{,}852 \text{ (km/NM)} = 21\,602{,}518 \text{ (NM)} \tag{E.4}$$

$$L_{NE\text{-}SE} = L_{NW\text{-}SW} = ((a + b/60) - (e + f/60)) \times L_P/360 \text{ (NM)} \tag{E.5}$$

To achieve the required accuracy in these calculations, the calculation resolution needs to have at least 3 fractional digits (i.e. 16-bit floating point).

E.3 Calculation of general distances

E.3.1 General

Two methods are acceptable for distance calculations. These are Great-circle calculation and Rhumb-Line (Loxodrome) calculation.

E.3.2 Great-circle

Great-circle (big-circle) distance is the shortest distance between two points on the surface of a sphere, measuring along the surface of the sphere. A floating point resolution of 32 bits is recommended.

The Haversine formula for calculating great-circle distance is given in Equation (E.6).

$$d = 2r\,\mathrm{asin}\left(\sqrt{\sin^2\left(\frac{lat2-lat1}{2}\right)+\cos(lat1)\cos(lat2)\sin^2\left(\frac{lon2-lon1}{2}\right)}\right) \tag{E.6}$$

where

d is the great-circle distance between the positions *lat*1, *lon*1 and *lat*2, *lon*2;

r is the Earth's mean radius, which is 6 371,009 km (3 440,069 65 NM).

Equation (E.6) is computationally intensive. A quicker way of doing Great-circle distance calculations would be to use the law of cosines for spherical trigonometry given in Equation (E.7).

$$d = r\,a\cos\left(\sin(lat1)\sin\,(lat2)+\cos\,(lat1)\,\cos\,(lat1)\,\cos\,(lat2)\,\cos\,(lon2-lon1)\right) \tag{E.7}$$

Although mathematically sane, the arcus cosine function is not sufficiently accurate on most computer systems and leads to inaccuracies when the distances are short, henceforth a lookup table for arcus cosine should be used with 32-bit floating point resolution to maintain accuracy.

E.3.3 Rhumb-line distance

A rhumb-line (loxodrome) is a line that crosses all the meridians of longitude at the same angle. This gives the benefit of having a fixed course for the entire distance calculated. Rhumb-line calculation can be used directly in Mercator maps. The stretched latitude difference is given in Equation (E.8), and the rhumb-line distance in Equation (E.9).

$$\Delta\phi = \ln\left(\frac{\tan\left(\frac{lat2}{2}+\frac{\pi}{4}\right)}{\tan\left(\frac{lat1}{2}\right)+\frac{\pi}{4}}\right) \tag{E.8}$$

$$d = r\sqrt{(\Delta lat^2 + \left(\frac{\Delta lat}{\Delta\phi}\right)^2 \Delta lon^2)} \tag{E.9}$$

The rhumb-line method is not as precise as big-circle method at the same calculation resolution. However, for all distances critical to the mobile unit, the difference is negligible.

Annex F
(normative)

New interface sentences – Sender signature authentication (SSA)

This sentence can be used both for authentication of sender and for authentication of un-tampered content. For this purpose, the sentence has to be applied before the protected sentence (for example EPV, SSD).

Other sentences shall not be interleaved between the sender signature authentication sentence and protected sentence, and the time between the SSA and the protected sentence should be limited. The sender signature authentication protected sentence pair shall be sent without unnecessary delay between sentences, and the time interval between the sentences shall not exceed 2 s. Note that any of the sentences may be lost and timed out.

For sentences sent over the IEC 61162-450 interface, the SSA sentence and the protected sentence shall be grouped using the parameter code "g" for TAG Block Grouping Control.

If the SSA is not accepted (for example because the authentication of the signature does not pass, or because time interval between SSA and protected sentence exceeded allowed time), the receiving device shall generate a NAK sentence with the reason code set to 5, and the associated protected sentence shall not be processed. However, if the SSA is valid and accepted, and a problem exists with the associated protected sentence (for example EPV or SSD), then an appropriate NAK reason code that identifies the problem with the protected sentence shall be returned.

$--SSA,ccc,c,h--h*hh<CR><LF>

Signature authentication 3)

Signature calculation method 2)

Signature protected sentence 1)

Comments:

1) The following sentence formatter that should be protected (for example EPV or SSD).

2) Type of method to calculate signature:

   1: MD5

   P: Proprietary

3) Hexadecimal representation of the signature, for example 32 hexacodes for MD5

Types of methods to calculate signature:

1) MD5

   The signature is a MD5 digest of the password plus the message. MD5 is a one-way Message-Digest algorithm (RFC 1321). The full length of the signature is 128 bits or 32 hexadecimal codes. The MD5 is commonly used for storing passwords in Unix-systems. Revealing the digest does not expose the password.

   NOTE See http://tools.ietf.org/html/rfc1321 and http://en.wikipedia.org/wiki/MD5.

P) Proprietary

   The signature is a proprietary digest of the password plus the message. This alternative requires that both parties use the same manufacturer specified proprietary method.

Signature is calculated by concatenating pre-shared key and sentence in the message as a single string to be used by the method of the signature calculation to produce the signature digest. Note that 'Carriage Return', 'Line Feed' and checksum with delimiter ('*') from the sentence are not included into the input string.

The signature in the SSA sentence may be shorter than the full hash. In that case the signature represents the first bytes of the hash. Minimum is first 8 most significant bytes of the hash. The pre-shared key is stored on both the sender and receiver beforehand using a secure method (for example, manual entry).

Example 1:

If the payload is "$RAEPV,C,AI,000000000,106,265024000*07" and the pre-shared key is "Alea iacta est" then the concatenation is:

Alea iacta est$RAEPV,C,AI,000000000,106,265024000

MD5 hash of this payload is:

6B112D72058A3EDECFD01D03522BE0B7

Thus, in case of MD5 following sentences would be transmitted:

$RASSA,EPV,2,6B112D72058A3EDECFD01D03522BE0B7*73<CR><LF>

$RAEPV,C,AI,000000000,106,265024000*07<CR><LF>

Example 2:

The setting of the MMSI number for a vessel like this:

MMSI = 265024000

IMO = 8320767

Pre-shared key = "Alea iacta est"

Use of MD5 produces sentences below for minimum first 8 bytes (i.e. 16 hexadecimal characters) of the MD5 hash:

$RASSA,EPV,2,6B112D72058A3EDE*03<CR><LF>

$RAEPV,C,AI,000000000,106,265024000*07<CR><LF>

$RASSA,EPV,2,81DA845E6BDF0A32*79<CR><LF>

$RAEPV,C,AI,265024000,107,8320767*09<CR><LF>

Annex G
(normative)

Updated interface sentences

G.1 General

Annex G updates the comments 7 and 8 of the sentence VSD to ITU-R M.1371-5. The update also corrects an editorial error in IEC 61162-1:2016 regarding the Navigational status field which was incorrectly printed as "Regional application flag".

G.2 VSD – AIS voyage static data

This sentence is used to enter information about a ship's transit that remains relatively static during the voyage. However, the information often changes from voyage to voyage. The parameters in this sentence support a number of the ITU-R M.1371 messages.

$--VSD,x.x,x.x,x.x,c--c,hhmmss.ss,xx,xx,x.x,x.x*hh<CR><LF>

Regional application flags, 0 to 15 [8]
Navigational status, 0 to 15 [7]
Estimated month of arrival at destination, 00 to 12 (TUC) [6]
Estimated day of arrival at destination, 00 to 31 (TUC) [6]
Estimated UTC of arrival at destination [5]
Destination,1-20 characters [4]
Persons on-board, 0 to 8 191 [3]
Maximum prsent static draught, 0 to 25,5 m [2]
Type of ship and cargo category, 0 to 255 [1]

IEC

Comments:

1) Type of ship and cargo category are defined under Message 5 of ITU-R M.1371. The description of ship and cargo are indicated by a number. A null field indicates that this is unchanged.

2) The draught is reported in units of metres. Valid range is 0 to 25,5. The value 0 = not available, and the value 25,5 indicates that the draught is 25,5 m or more. A null field indicates that this is unchanged.

3) Current number of persons on-board, including crew. Valid range is 0 to 8 191. The value 0 = not available, and the value 8 191 = 8 191 or more people. A null field indicates that this is unchanged.

4) The characters that can be used in the destination are listed in the ITU-R M.1371 6 bit ASCII. Some of these characters are reserved characters in Table 1 of IEC 61162-1 Ed.5. These characters should be represented using the "^" method (see 7.1.4 of IEC 61162-1 Ed.5). A null field indicates that the previously entered destination is unchanged. The string of characters "@@@@@@@@@@@@@@@@@@@@" are used to indicate that the ship's destination is not available.

5) If the hour of arrival is not available, "hh" should be set to 24. If the minute of arrival is not available, "mm" should be set to 60. The seconds option "ss.ss" of the field may be set to "00" as the AIS unit only broadcasts hours and minutes. A null field indicates that this is unchanged.

6) The day and month of arrival are in UTC. The field is a fixed two-digit number requiring leading zeros. If the day of arrival is not available, "00" should be the number for the day. If the month of arrival is not available, "00" should be the number for the month. A null field indicates that this is unchanged.

7) The navigational status is indicated using the following values; a null field indicates the status is unchanged (reference ITU-R M.1371, Message 1, navigational status parameter):

0 = under way using engine	6 = aground	11 = power-driven vessel towing astern (regional use)
1 = at anchor	7 = engaged in fishing	12 = power-driven vessel pushing ahead or towing alongside (regional use)
2 = not under command	8 = under way sailing	13 = reserved for future use
3 = restricted manoeuvrability	9 = reserved for high speed craft	14 = AIS-SART (active), MOB-AIS, EPIRB-AIS
4 = constrained by draught	10 = reserved for wing in ground	15 = undefined = default (also used by AIS-SART, MOB-AIS, and EPIRB-AIS under test)
5 = moored		

For the values of 11 or 12, additional dimension extension values reflecting the actual tow configuration should be provided to the AIS by using the EPV sentence.

8) This field is used by AIS devices designed to ITU-R M.1371-3 or later, and supports regional passing arrangements on inland waterways and other special manoeuvres. A null field indicates that this is unchanged.

0 = not available = default

4 = not engaged in special manoeuvre

8 = engaged in special manoeuvre

12 = undefined (as of ITU-R M.1371-5)

Other values shall not be used.

~~Annex H~~
~~(normative)~~

~~Transmission of binary Messages 25 and 26~~

~~NOTE Reference to IEC 61162-1 gives a possible later version of these sentences.~~

~~H.1 General~~

~~This annex contains ABM, BBM and ABK sentences that have been modified to enable transmission of messages 25 and 26.~~

~~H.2 ABM – AIS Addressed Binary and Safety Related Message~~

~~This sentence supports ITU-R M.1371 Messages 6, 12, 25 and 26 and provides an external application with a means to exchange data via an AIS transponder. Data is defined by the application only, not the AIS unit. This sentence offers great flexibility for implementing system functions that use the transponder like a communications device. After receiving this sentence via the IEC 61162-2 interface, the transponder initiates a VDL broadcast of Message 6, 12, 25, or 26. The AIS unit will make up to four broadcasts of Messages 6 and 12. The actual number will depend on the reception of an acknowledgement from the addressed "destination" AIS unit. The success or failure of reception of this transmission by the addressed AIS unit for Messages 6 and 12 is confirmed through the use of the "Addressed binary and safety related message acknowledgement" ABK sentence formatter, and the processes that supports the generation of an ABK sentence. The AIS transponder determines the appropriate communications state for transmission of Message 26 over the VHF data Link.~~

~~!--ABM,x,x,x,xxxxxxxxx,x,xx,s--s,x*hh<CR><LF>~~

~~Number of fill-bits, 0 to 5 (See Note 7)~~
~~Encapsulated data (See Note 6)~~
~~ITU-R M.1371 Message ID (See Note 5)~~
~~AIS channel for broadcast of the radio message (See Note 4)~~
~~The MMSI of the destination AIS unit for the ITU-R M.1371 Message(See Note 3)~~
~~Sequential message identifier, 0 to 3 (See Note 2)~~
~~Sentence number, 1 to 9 (See Note 1)~~
~~Total number of sentences needed to transfer the message,1 to 9 (See Note 1)~~

~~NOTE 1 The total number of sentences required to transfer the binary message data to the AIS unit.~~

~~The first field specifies the total number of sentences used for a message, minimum value 1.~~

~~The second field identifies the order of this sentence in the message, minimum value 1.~~

~~All sentences contain the same number of fields. Successive sentences may use null fields for fields that have not changed, such as fields 4, 5, and 6.~~

~~NOTE 2 This sequential message identifier serves two purposes. It meets the requirements as stated in the IEC 61162-1 "Sequential message identifier field" description and it is the sequence number utilized by ITU-R M.1371 in Message types 6 and 12. The range of this field is restricted by ITU-R M1371 to 0 – 3. The sequential message identifier value may be reused after the AIS unit provides the "ABK" acknowledgement for this number.~~

~~NOTE 3 The MMSI of the AIS unit that is the destination of the message.~~

~~NOTE 4 The AIS channel used for the broadcast:~~

~~0 = no broadcast channel preference;~~

~~1 = Broadcast on AIS channel A;~~

~~2 = Broadcast on AIS channel B;~~

~~3 = Broadcast message on both AIS channels, A and B.~~

~~NOTE 5 The ITU-R M.1371 message Id for the following addressed Messages:~~

~~6 = Binary addressed message;~~

~~12 = Addressed safety related message;~~

~~25 = Single slot binary message 25 (binary data coded using the 16-bit Application identifier) ;~~

~~70 = Single slot binary message 25 (unstructured binary data) ;~~

~~26 = Multiple slot binary message 26 with Communications State (binary data coded using the 16-bit Application identifier);~~

~~71 = Multiple slot binary message 26 with Communications State (unstructured binary data).~~

~~NOTE 6 This is the content of the "binary data" parameter for ITU-R M.1371 Message 6, or the "Safety related Text" parameter for Message 12, or the "binary data" parameter for Message 25, or the "binary data" parameter for Message 26. The first sentence may contain up to 48 valid Six Bit codes (288 bits). Following sentences may contain up to 60 valid Six Bit codes (360 bits), if fields 4, 5, and 6 are unchanged from the first sentence and set to null. The actual number of valid characters shall be such that the total number of characters in a sentence does not exceed the "82-character" limit.~~

~~NOTE 7 This cannot be a null field. See IEC 61162-1 "Fill Bits field" description.~~

~~H.3 BBM – AIS Broadcast Binary Message~~

~~This sentence supports generation of ITU-R M.1371 binary Messages 8, 14, 25, and 26. This provides the application with a means to broadcast data, as defined by the application only. Data is defined by the application only – not the AIS. This sentence offers great flexibility for implementing system functions that use the transponder like a digital broadcast device. After receiving this sentence via the IEC 61162-2 interface, the AIS unit initiates a VHF broadcast of Message 8, 14, 25, or 26 within 4 s. See the ABK sentence for acknowledgement of the BBM with Messages 8 and 14. The AIS transponder determines the appropriate communications state for transmission of Message 26 over the VHF data link.~~

~~!--BBM,x,x,x,x,xx,s--s,x*hh<CR><LF>~~

~~Number of fill-bits, 0 to 5 (See Note 6)~~
~~Encapsulated data (See Note 5)~~
~~ITU-R M.1371 Message ID (See Note 4)~~
~~AIS channel for broadcast of the radio message (See Note 3)~~
~~Sequential Message identifier, 0 to 9 (See Note 2)~~
~~Sentence number, 1 to 9 (See Note 1)~~
~~Total number of sentences needed to transfer the message, 1 to 9 (See Note 1)~~

~~NOTE 1 The total number of IEC 61162-1 sentences required to transfer the contents of the binary message to the AIS unit. The first field specifies the total number of sentences used for a message, minimum value 1. The second field identifies the order of this sentence in the message, minimum value 1. All sentences contain the same number of fields. Successive sentences may use null fields for fields that have not changed, such as fields 4 and 5.~~

~~NOTE 2 The Sequential message identifier provides a message identification number from 0 to 9 that is sequentially assigned and is incremented for each new multi-sentence message. The count resets to 0 after 9 is used. For a message requiring multiple sentences, each sentence of the message contains the same sequential message identification number. It is used to identify the sentences containing portions of the same message. This allows for the possibility that other sentences might be interleaved with the message sentences that, taken collectively, contain a single message. This value is used by the ABK sentence to acknowledge a specific BBM sentence.~~

~~NOTE 3 The AIS channel that shall be used for the broadcast:~~

~~0 = no broadcast channel preference;~~

~~1 = Broadcast on AIS channel A;~~

~~2 = Broadcast on AIS channel B;~~

~~3 = Broadcast the message on both AIS channels A and B.~~

~~NOTE 4 The ITU-R M.1371 Message ID for the following broadcast messages:~~

~~8 = Binary broadcast message;~~

~~14 = Safety related broadcast message;~~

~~25 = Single slot binary message 25 (binary data coded using the 16-bit Application identifier);~~

~~70 = Single slot binary message 25 (unstructured binary data) ;~~

~~26 = Multiple slot binary message 26 with Communications State (binary data coded using the 16-bit Application identifier) ;~~

~~71 = Multiple slot binary message 26 with Communications State (unstructured binary data).~~

~~NOTE 5 This is the content of the "binary data" parameter for ITU-R M.1371 Messages 8, 25 or 26, or the "Safety related Text" parameter for Message 14. The first sentence may contain up to 58 valid Six Bit codes (348 bits). Following sentences may contain up to 60 valid Six Bit codes (360 bits), if fields 4 and 5 are unchanged from the first sentence and set to null. The actual number of characters shall be such that the total number of characters in a sentence does not exceed the "82-character" limit.~~

~~NOTE 6 This cannot be a null field. See IEC 61162-1 "Fill Bits field" description.~~

~~H.4 ABK – AIS Addressed and binary broadcast acknowledgement~~

~~The ABK-sentence is generated when a transaction, initiated by reception of an ABM, AIR, or BBM sentence, is completed or terminated. This sentence provides information about the success or failure of a requested ABM broadcast of either ITU-R M.1371 Messages 6 or 12. The ABK process utilises the information received in ITU-R M.1371 Messages 7 and 13. Upon reception of either a VHF Data-link Message 7 or 13, or the failure of Messages 6 or 12, the AIS unit delivers the ABK sentence to the external application. This sentence is also used to report to the external application the AIS unit's handling of the AIR (ITU-R M.1371 Message 15) and BBM (ITU-R M.1371 Messages 8, 14, 25 and 26) sentences. The external application initiates an interrogation through the use of the AIR-sentence, or a broadcast through the use of the BBM sentence. The AIS unit generates an ABK sentence to report the outcome of the ABM, AIR, or BBM broadcast process.~~

~~$--ABK,xxxxxxxxx,x,x.x,x,x*hh<CR><LF>~~

~~Type of acknowledgement (see Note 5)~~
~~Message sequence number (see Note 4)~~
~~ITU-R M.1371 Message ID (see Note 3)~~
~~AIS channel of reception (see Note 2)~~
~~MMSI of the addressed AIS unit (see Note 1)~~

~~NOTE 1 Identifies the distant addressed AIS unit involved with the acknowledgement. If more than one MMSI is being addressed (ITU-R M.1371 Messages 15 and 16), the MMSI of the first distant AIS unit, identified in the message, is the MMSI reported here. This is a null field when the ITU-R M.1371 Message type is 8 or 14.~~

~~NOTE 2 Indication of the VHF data link channel upon which a Message type 7 or 13 acknowledgement was received. An "A" indicates reception on channel A. A "B" indicates reception on channel B.~~

~~NOTE 3 This indicates to the external application the type of ITU-R M.1371 message that this ABK sentence is addressing. Also see the message IDs listed in Note 4.~~

~~NOTE 4 The message sequence number, together with the Message ID and MMSI of the addressed AIS unit, uniquely identifies a previously received ABM, AIR, or BBM sentence. Generation of an ABK sentence makes a sequence message identifier available for re-use. The message ID determines the source of the message sequence number. The following lists the source by message ID:~~

~~ITU-R M.1371 Message ID Message sequence number source:~~

~~6 sequential message identifier from ABM sentence;~~

~~7 addressed AIS unit's Message 7 sequence number;~~

~~8 sequential message identifier from BBM sentence;~~

~~12 sequential message identifier from ABM sentence;~~

~~13 addressed AIS unit's Message 13 sequence number;~~

~~14 sequential message identifier from BBM sentence;~~

~~15 no source, the message sequence number should be null;~~

~~25 sequential message identifier from ABM or BBM sentence (structured binary data);~~

~~26 sequential message identifier from ABM or BBM sentence (structured binary data);~~

~~70 sequential message identifier from ABM or BBM sentence (unstructured binary data);~~

~~71 sequential message identifier from ABM or BBM sentence (unstructured binary data).~~

~~NOTE 5 Acknowledgements provided:~~

~~0 = Message (6 or 12) successfully received by the addressed AIS unit;~~

~~1 = Message (6 or 12) was broadcast, but no acknowledgement by the addressed AIS unit;~~

~~2 = message could not be broadcast (i.e. quantity of encapsulated data exceeds five slots);~~

~~3 = requested broadcast of Message (8, 14, 15, 25 or 26) has been successfully completed;~~

~~4 = late reception of a Message 7 or 13 acknowledgement that was addressed to this AIS unit (own ship) and referenced as a valid transaction.~~

Annex H
(informative)

Conversion between IEC 61162-1 sentences and IEC 61162-3 parameter group numbers

Table H.1 gives minimum equivalents for transferring data over IEC 61162-1 interfaces and IEC 61162-3 interfaces.

Table H.1 – Conversion between IEC 61162-1 and IEC 61162-3

IEC 61162-1/NMEA 0183 sentences		IEC 61162-3 PGNs	
ABK	AIS addressed and binary broadcast acknowledgment	129796	AIS acknowledge
ABM	AIS addressed binary and safety related	129801	AIS addressed safety related message
		129795	AIS addressed binary message
ACA	AIS channel assignment message	129806	AIS channel management
AIR	AIS interrogation request	129803	AIS interrogation
BBM	AIS broadcast binary message	129797	AIS binary broadcast message
		129802	AIS safety related broadcast message
DTM	Datum reference	129044	Datum
		129045	User datum setting
GBS	GNSS satellite fault detection	129545	GNSS RAIM output
GGA	Global positioning system (GPS) fix data	129025	Position, rapid update
		129029	GNSS position data
GLL	Geographic position – Latitude/longitude	129025	Position, rapid update
		129029	GNSS position data
GNS	GNSS fix data	129025	Position, rapid update
		129029	GNSS position data
HDT	Heading true	127250	Vessel heading
NAK	Negative acknowledgement	126208	Acknowledge group function
RMC	Recommended minimum specific GNSS data	129025	Position, rapid update
		129026	COG and SOG, rapid update
		129029	GNSS position data
ROT	Rate of turn	127251	Rate of turn
SSD	AIS ship static data	129794	AIS Class A static and voyage related data
THS	True heading and status	127250	Vessel heading
		130577	Direction data
VBW	Dual ground/water speed	128259	Speed, water referenced
		130577	Direction data
		130578	Vessel speed components

IEC 61162-1/NMEA 0183 sentences		IEC 61162-3 PGNs	
VDM / VDO	AIS VHF data-link message/ AIS VHF data-link own vessel report	129038	AIS Class A position report
		129039	AIS Class B position report
		129040	AIS Class B extended report
		129041	AIS aids to navigation (AtoN) report
		129792	AIS DGNSS broadcast binary message
		129793	AIS UTC and date report
		129794	AIS Class A static and voyage related data
		129795	AIS addressed binary message
		129796	AIS acknowledge
		129797	AIS binary broadcast message
		129798	AIS SAR aircraft position report
		129800	AIS UTC/Date inquiry
		129801	AIS addressed safety related message
		129802	AIS safety related broadcast message
		129803	AIS interrogation
		129804	AIS assignment mode command
		129805	AIS data link management message
		129806	AIS channel management
		129807	AIS group assignment
		129809	AIS Class B "CS" static data report, Part A
		129810	AIS Class B "CS" static data report, Part B
		129811	AIS single slot binary message
		129812	AIS multi slot binary message
		129813	AIS long-range broadcast message
VSD	AIS voyage static data	129794	AIS Class A static and voyage related data
VTG	Course over ground and ground speed	129026	COG and SOG, rapid update
		130577	Direction data

Annex I
(normative)

Extended tow dimension values

I.1 Purpose and background

It is beneficial to navigation safety for the true dimensions of vessels to be available via AIS Message 5. Currently, the ABCD values in Message 5 are difficult to change once set, requiring a password that may not be available to the vessel navigator.

This is not a problem for most vessels, except those engaged in towing operations by pushing ahead or alongside (navigational status is 12). In these instances, it may be desirable to provide easier access to and modification of vessel dimension values.

The method described in Annex I facilitates the entry of extensions to the static vessel dimensions to communicate the true size of a vessel and its tows, when the navigational status is 12.

I.2 Method

The transmission of extended tow dimension values is accomplished through property identifiers 150 to 153 which are not password-protected. The AIS Class-A shall incorporate the tow dimension values as extensions to the baseline ABCD values (see Figure I.1) of the towing vessel. The resulting values (including the base line values and respective extension values) are transmitted via Message 5.

The following definitions support the input of data for Message 5:

- dimensions/reference for position of own ship: the input of the reference point for Message 5 is defined by AI, BI, CI and DI values as input by using SSD sentence;
- Message 5 shall transmit A, B, C and D values;
- optionally, all input values can be input in decimetre resolution;
- there are two reference points, for the internal GNSS and for an external position source. This method shall be used for both reference points;
- dimensions/reference for position of combination: besides the dimensions/reference for position of one's own ship, additional dimensions to describe a combination can be added on any side of the ship;
- for each side, an extension (EA, EB, EC, ED) of the ship can be defined;
- Message 5 shall transmit A, B, C and D values rounded to whole metres such that the overall dimensions A + B and C + D are not less than the actual dimensions and no more than 0,9 m greater than the actual dimensions.

Baseline vessel dimensions input parameters (password protected):

- AI
- BI
- CI
- DI

Input parameters (tow extension – not password protected):

- EA (sum of all tows ahead)

- EB (sum of all tows astern)
- EC (sum of all tows port)
- ED (sum of all tows starboard)

Calculated internally:

- A (m) = AI + EA
- B (m) = BI + EB
- C (m) = CI + EC
- D (m) = DI + ED

A, B, C and D are output using Message 5.

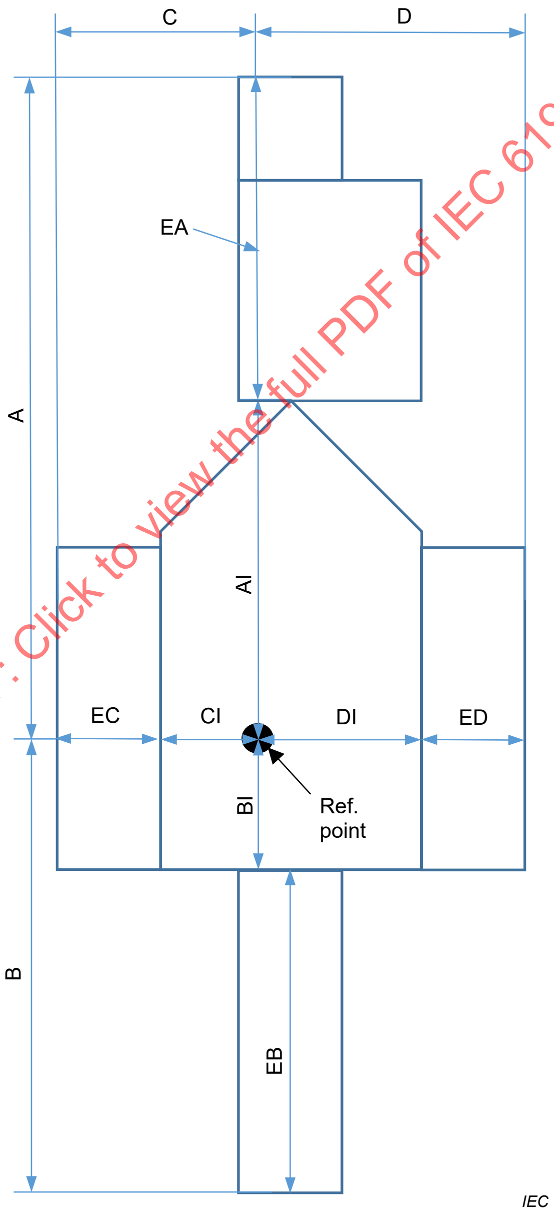


Figure I.1 – Input, extension and transmitted dimensional values

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IEC 61108-1, *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS) – Part 1: Global positioning system (GPS) – Receiver equipment – Performance standards, methods of testing and required test results*

IEC 61108-2, *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS) – Part 2: Global navigation satellite system (GLONASS) – Receiver equipment – Performance standards, methods of testing and required test*

IEC 61162-3, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 3: Serial data instrument network*

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

IEC 61924-2, *Maritime navigation and radiocommunication equipment and systems – Integrated navigation systems – Part 2: Modular structure for INS – Operational and performance requirements, methods of testing and required test results*

IEC 62287-1, *Maritime navigation and radiocommunication equipment and systems – Class B shipborne equipment of the automatic identification system (AIS) – Part 1: Carrier-sense time division multiple access (CSTDMA) techniques*

IEC 62320-1, *Maritime navigation and radiocommunication equipment and systems – Automatic identification system (AIS) – Part 1: AIS Base Stations – Minimum operational and performance requirements, methods of test and required test results*

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IEC 61993-2

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Matériels et systèmes de navigation et de radiocommunication maritimes – Systèmes d'identification automatique (AIS) Partie 2: Équipements AIS de type Classe A embarqués – Exigences d'exploitation et de fonctionnement, méthodes d'essai et résultats d'essai exigés

IEC 61993-2:2018-07(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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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. This document incorporates the applicable technical characteristics of Class A shipborne equipment included in Recommendation ITU-R M.1371 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 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)*

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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*

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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

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, as detailed in Clause 6, Clause 13, Clause 14 and Clause 15 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) 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, BIIT ID 10 (see Table 3) 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, BIIT ID 10 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)) shall *be followed.*

Means shall be provided to automatically record all periods when the AIS installation is 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 silent mode or not transmitting for other reasons.

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 event log. 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 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 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 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.

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, the system shall react as given in Table 3.

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							
Alert identifier	**Alert text (1st ALF)**	**Additional information (2nd ALF)**	**Prio**	**Cat**	**Escal**	**BIIT ID**
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 alert.

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

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.

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.

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 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 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:

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

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 $ROT_{AIS} = 4{,}733\ \sqrt{(ROT_{sensor})}$°/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, 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 of the last position report received. 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. All active locating devices shall be displayed in ascending range above other targets.

The time out value for target display, other than locating devices, shall be 7 min. For 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 locating devices shall be displayed on the top of the target list. The testing (including type approval testing) 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 locating devices in test mode during periodical testing of own ship's locating devices.

The active and testing locating devices are identified according to Table 10 to Table 12.

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.1371-5/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 Alerts and status information

6.11.3.1 Alerts

The following alerts shall be indicated and displayed on request:

- as a result of the built-in integrity test (BIIT see 6.10.1);
- reception of Message 1 NavStatus 14. Once acknowledged, the alert will not be re-activated again if a new message is received. The acknowledgement shall stay in effect until alert is removed 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 Message 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.

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;
- 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.

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 "00xyyyyyy" 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).

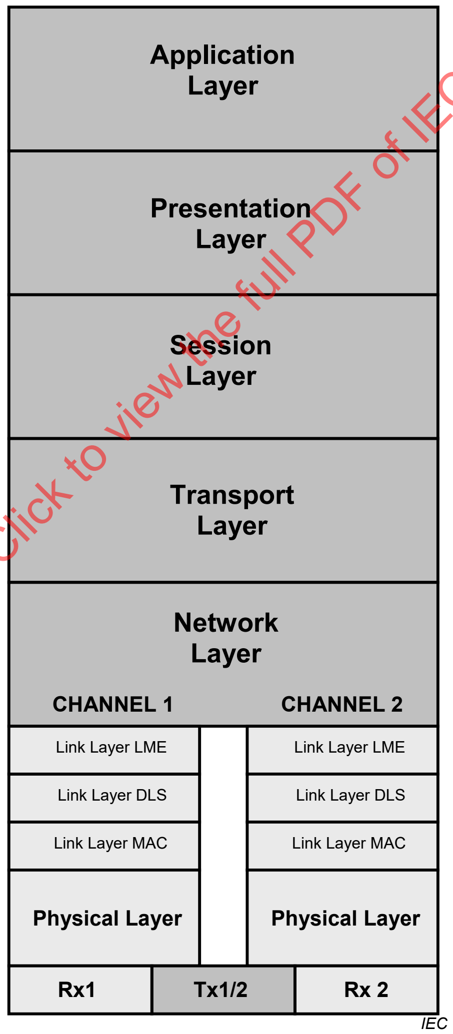


Figure 1 – OSI layer model

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.1371-5/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 ± 1 000 Hz extreme	
Carrier power (P_{SS})	41 dBm high power setting 30 dBm low power setting	± 1,5 dB normal and ± 3 dB extreme, conducted
Modulation spectrum	−25 dBc −70 dBc slotted transmission	Δfc < ± 10 kHz ± 25 kHz < Δf_c < ± 62,5 kHz
Modulation accuracy	1 740 ± 175 Hz normal ± 350 Hz extreme 2 400 ± 240 Hz normal ± 480 Hz extreme	Test signal 0101… Test signal 00001111…
Power versus time characteristics	Transmission delay: 0 s Ramp up time: 833 µs Ramp down time: 833 µs Transmission duration: ≤ 26 624 µs	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

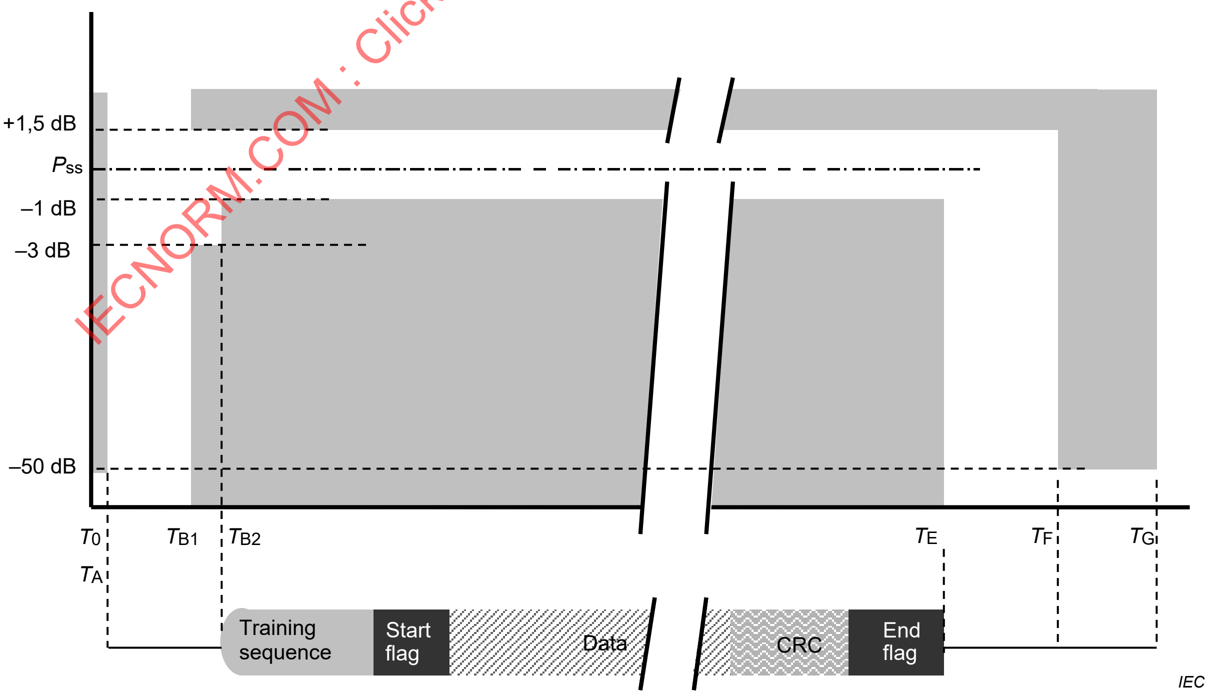


Figure 2 – Power versus time characteristics

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 −47 dBm	9 kHz ... 1 GHz 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.1371-5/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.1371-5/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.1371-5/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 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.1371-5/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.1371-5/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.1371-5/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.1371-5/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.*

(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.

Table 20 – IEC 61162-1 sensor sentences

Data	IEC 61162-1 sentences
Reference datum	DTM
Positioning system: Time of position Latitude/Longitude Position accuracy	GNS, RMC
Speed over ground (SOG)	RMC, VBW, VTG
Course over ground (COG)	RMC, VBW, VTG
Heading	HDT, THS
RAIM indicator	GBS
Rate of turn (ROT)	ROT
NOTE Additional optional digital interface network IEC 61162-3 parameter group numbers equivalent to the specified network IEC 61162-1 sentences are described for information in Annex H.	

The AIS shall use the DTM sentence to automatically confirm that the position information provided for transmission is in the WGS 84 datum.

The reception of periodic GBS sentences, containing values for the parameters "expected error in latitude" and "expected error in longitude" shall be used to indicate with the "RAIM flag" that the position sensor is operating with a RAIM process in use.

Each of the data items listed in Table 20 may be produced by various connected sensor equipment. The external sensor equipment is neither assigned to specific AIS input ports nor are the specified input sentences assigned to specific equipment. AIS shall be capable of accepting these specified sentences at each of the input ports.

A mechanism shall be implemented to avoid data mismatch or duplicate inputs if multiple sensor data for the same parameter is received by different sentences and/or ports. The mechanism shall be documented in a manufacturer's installation manual.

7.6.3 High-speed input/output ports

7.6.3.1 Required ports

A minimum of two input/output ports shall be provided, a primary input/output port for connection of on board control equipment, ECDIS, radar, etc., and a pilot/auxiliary input/output port for connection of ship's pilot equipment, service equipment, etc. Each port shall meet the requirements of IEC 61162-2. An additional IEC 61162-450 port may be provided.

Both input ports shall be functionally equivalent and shall be capable of receiving the data formats defined in Table 21.

Both output ports shall be functionally equivalent and shall be capable of simultaneously transmitting the data formats defined in Table 22.

7.6.3.2 Interface connector

If the pilot plug is provided, it shall be configured as follows.

AMP/Receptacle (square flanged (−1) or free-hanging (−2)), shell size 11, 9-pin.

Std. Sex 206486-1/2 or equivalent with the following terminations:

- Tx A is connected to Pin 1;
- Tx B is connected to Pin 4;
- Rx A is connected to Pin 5;
- Rx B is connected to Pin 6;
- Shield is connected to Pin 9.

The manufacturer shall specify the connections for the remaining ports.

7.6.3.3 Input data and formats

The AIS shall as a minimum be able to receive and process the input data shown in Table 21. The details of these sentences are contained in IEC 61162-1 and in Annex F for sentence SSA. The manufacturer's proprietary data may also be entered using these high-speed ports.

Table 21 – AIS high-speed input data and formats

Data	IEC 61162-1 sentences
Normal access – Parameter entry	
Voyage information: Vessel type and cargo category Navigational status Draught, max. actual static Destination ETA date and time Regional application flags	VSD[e]
Station information Vessel name Call sign Antenna location, length and beam[c]	SSD
Command for equipment property value	EPV
Security password sentence	SPW[b]
Sender Signature Authentication	SSA[d]
Initiate VHF data-link broadcasts	
Safety messages Handshake to acknowledge received safety message by a remote MKD	ABM BBM ABK
Binary messages	ABM BBM
Interrogation message	AIR
AIS equipment – Parameter entry	
AIS VHF channel selection AIS VHF power setting AIS VHF channel bandwidth Transmit/Receive mode control	ACA[a]
BIIT and alert handling input	
Heartbeat from remote MKD and for responsibility transfer	HBT
Alert commands	ACN, ACK
LR acknowledge	
Manual LR acknowledge	LRF

[a] The AIS requires that information in the longitude and latitude fields of the ACA sentence is truncated to 1/10 min.

[b] The SPW sentence shall not be used in the IEC 61162-450/-460 interface (see 7.6.5.4.1).

[c] AI, BI, CI, DI excluding tow as defined in Annex I.

[d] See Annex F.

[e] Updated VSD sentence description is defined in Annex G. The special manoeuvre indicator is configured using the first two bits of regional application flag of the VSD sentence. The following two bits of the regional application flag define the first two bits of the three-bit spare-field of Message 1, 2 and 3.

7.6.3.4 Output data and formats

The AIS shall as a minimum be able to generate and send the output data shown in Table 22.

The VDO sentence (containing Messages 1, 2 or 3) shall be output on both high-speed output ports, at nominal 1 s intervals, use A and B to indicate that the data was transmitted on the VDL channel A or B, null indicating not transmitted on the VDL.

The VDM sentence shall be sent simultaneously on both high-speed output ports for every VDL message received. Some VDL messages are informative (see Table 18). During operation, the operator may disable delivery of these informative messages. The manufacturer's proprietary data may also be sent using these high-speed ports.

Table 22 – AIS high-speed output data and formats

Data	IEC 61162-1 sentences
Prepared by AIS unit	
Notification that a session initiated by messages ABM, BBM, AIR is terminated	ABK
AIS own-ship broadcast data (all transmissions available)	VDO
AIS equipment status (built-in-integrity-test results) and alerts	ALF, ALC, ARC, ALR
Channel management data (using query mechanism)	ACA and ACS
Received on VHF data-link by AIS unit	
All VDL AIS messages received, broadcast or addressed to own station	VDM
Received on LR communication system	
LR interrogation message received	LRI and LRF
System information in response to a query	
Static information	SSD
Voyage information	VSD
Report equipment property value	EPV
Version information	VER
Status information	TXT
AIS transmitter non-functioning log	TRL
Negative acknowledgement	NAK
If the internal GNSS of the AIS is intended to be used for the ship's position source, then sentences DTM, GNS, GBS and RMC are required to be generated and sent as output data (see 6.2.2).	

7.6.3.5 Relay of heading and rate of turn input sentences to pilot port

To provide greater resolution on sensor data for external equipment connected to the pilot port, AIS shall provide functionality to relay heading (HDT, THS) and rate of turn (ROT) input sentences to the pilot port.

The following requirements apply for the relay function:

- maximum rate at output shall be 5 sentences per second for heading and 1 sentence per second for rate of turn;
- if no sentences have been received at input, AIS shall not send the respective sentence at the output;

  NOTE Receiver of the relayed data connected to pilot port detects the missing input signal from sentence timeout.
- latency: maximum 200 ms from the receipt of complete input sentence until start of output sentence;
- the most recent received complete sentence shall be relayed;
- AIS shall not modify the content of the sentences that are relayed, including talker ID;

- on multiple inputs of the same type of information, only the sentences from a source used for composition of position reports are relayed.

7.6.3.6 Configuration using EPV sentence

Property identifiers used with EPV-sentence applicable for Class-A AIS Mobile station are described in Table 23.

Table 23 – Property identifiers

Property identifier	Protected	Property meaning	Value range
0 to 100		Reserved	
101	yes	Sensor 1 baud	4 800, 9 600, 14 400, 19 200, 38 400
102	yes	Sensor 2 baud	4 800, 9 600, 14 400, 19 200, 38 400
103	yes	Sensor 3 baud	4 800, 9 600, 14 400, 19 200, 38 400
104	yes	Long-range baud	4 800, 9 600, 14 400, 19 200, 38 400
105	yes	DGNSS baud	4 800, 9 600, 14 400, 19 200, 38 400
106	yes	MMSI	000000000, 200000000 … 799999999, 982000000 … 987999999
107	yes	IMO number	0000000 … 9999999
108	yes	Long-range interface configuration	"A" = automatic "M" = manual and optionally[a]: "O" = Port is switched off "P" = Port is used as PI port "S" = Port is used as Sensor port "G" = Port is used as GNSS output port "D" = Port is used as DGNSS port for correction data input "R" = Port is used as DGNSS port for correction data output
109	yes	Long-range AIS broadcast channel 1	Valid channel according ITU-R M.1084-5. See 8.3. Default value is 75. Value 0 indicates no transmission of message 27
110	yes	Long-range AIS broadcast channel 2	Valid channel according ITU-R M.1084-5. See 8.3. Default value is 76. Value 0 indicates no transmission of message 27
111	yes	Change administrator password	New administrator password
112	yes	Change user password	New user password
113	no	Locating device test mode	0 = normal mode 1 = display and output locating devices in test mode
114	no	AIS silent mode	0 = AIS in normal transmit operation 1 = AIS in receive only operation
115	no	Activation of locating device alert	0 = No alert from locating devices 1 = Alert for received locating devices is generated (default)

Property identifier	Protected	Property meaning	Value range
116	yes	Sensor alert configuration	Format: Hexadecimal representing bits. Bit value 0 means alert function deselected, 1 means alert function enabled. Usage of bits: bit 2: external position bit 1: heading bit 0 (lsb): rate of turn Default value 7: all alerts enabled.
117	Yes	Pilot Port access level	0 = normal access to PI port functionality (default) 1 = restricted access to PI port functionality: no input allowed except EPV sentence with property value 117, preceded by SSA sentence.
Identifiers for IEC 61162-450 interface configuration [c]			
120	yes	IP address and network mask of AIS transceiver	Format: xxx.xxx.xxx.xxx/nn (/nn = Number of bits in network part of netmask (CIDR notation))
121	yes	SFI of AIS transceiver	Format: AIxxxx, Range of xxxx: 0000 … 9999
122	yes	Additional input multicast group	Four character code as described in IEC 61162-450 (for example MISC, PROP). String NONE is used to disable this additional multicast group. Default value is NONE.
123	yes	Additional input multicast group	Four character code as described in IEC 61162-450 (for example MISC, PROP). String NONE is used to disable this additional multicast group. Default value is NONE.
124	yes	Transmission group	Four character code as described in IEC 61162-450 (for example MISC, PROP).
Identifiers for SFI configuration [c]			
130	yes	Primary position sensor	ccxxxx, NONE [b] default: NONE
131	yes	Secondary position sensor	ccxxxx, NONE [b] default: NONE
132	yes	Primary SOG/COG sensor	ccxxxx, NONE [b] default: NONE
133	yes	Secondary SOG/COG sensor	ccxxxx, NONE [b] default: NONE
134	yes	Primary heading sensor	ccxxxx, NONE [b] default: NONE
135	yes	Secondary heading sensor	ccxxxx, NONE [b] default: NONE
136	yes	Primary ROT sensor	ccxxxx, NONE [b] default: NONE
137	yes	Secondary ROT sensor	ccxxxx, NONE [b] default: NONE
138	yes	Primary AIS Control	ccxxxx, ANY [b] default: ANY
139	yes	Secondary AIS Control	ccxxxx, NONE, ANY [b] default: NONE

Property identifier	Protected	Property meaning	Value range
140	yes	Primary alert command source	ccxxxx, ANY [b] default: ANY
141	yes	Secondary alert command source	ccxxxx, NONE, ANY [b] default: NONE
Extended dimensions configuration			
150	No	Dimension extension EA[d]	Default value = 0
151	No	Dimension extension EB[d]	Default value = 0
152	No	Dimension extension EC[d]	Default value = 0
153	No	Dimension extension ED[d]	Default value = 0
All other values		Reserved	

[a] Manufacturer shall declare what optional identifiers are supported.

[b] The configuration parameters and values for SFI can be one of the following:

– ccxxxx: in accordance with IEC 61162-450: only sentences from this source are accepted;

– NONE: no sentences from network sources are accepted;

– ANY: sentences from all network sources are accepted.

[c] Required only if IEC 61162-450 interface is implemented.

[d] The dimension extension values are in metres; higher resolution is optional.

7.6.4 Long-range communication ports

7.6.4.1 Required ports

A minimum of one input/output port shall be provided and shall meet the requirements of IEC 61162-2. It may be connected to long-range communications equipment (for example satellite communications; see Clause 8).

The input port shall be capable of receiving the data formats defined in Table 24.

The output port shall be capable of transmitting the data formats defined in Table 25.

7.6.4.2 Interface connector

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

7.6.4.3 Input data and formats

Long-range interrogation of an AIS unit is accomplished through the use of two IEC 61162-1 sentences – LRI and LRF. This pair of interrogation sentences provides the information needed by the AIS unit to determine if it should construct and provide the reply sentences – LR1, LR2, and LR3. The LRI sentence contains the information needed to determine if the reply needs to be constructed. The LRF sentence identifies the information that is being requested.

The information that can be requested by the LRF sentence is shown in Table 24. Details of these sentences are contained in IEC 61162-1.

Table 24 – AIS Long-range communications input data and formats

Data	IEC 61162-1 sentences
Long-range interrogation Type of request Geographic area request AIS unit request	LRI
Long-range function identification Requestor MMSI and name Request for: Ship's name, call sign, and IMO number (A) Date and time of message composition (B) Position (C) Course over ground (E) Speed over ground (F) Destination and ETA (I) Draught (O) Ship/Cargo (P) Ship's length, breadth, and type (U) Number of persons on board (W)	LRF

7.6.4.4 Output data and formats

The long-range reply from the AIS unit is accomplished through the use of four IEC 61162-1 sentence formatters – LRF, LR1, LR2 and LR3. The AIS unit shall reply with these sentences, in the following order; LRF, LR1, LR2 and LR3 when responding to an interrogation even if all the information items in the sentence are null.

The LRF-sentence provides the "function reply status" for the requested information. The following is a list of "function reply status" characters with the status that represent:

2 = information available and provided in the following LR1, LR2 and LR3 sentence;

3 = information not available from AIS unit;

4 = information available but not provided (i.e. restricted access determined by ship's master).

The LR1 sentence identifies the destination for the reply and contains the information items requested by the "A" function identification character in the LRF sentence.

The LR2 sentence contains the information items requested by the "B, C, E, and F" function identification characters in the LRF sentence.

The LR3 sentence contains the information items requested by the "I, O, P, U and W" function identification characters in the LRF sentence.

The individual information items shall be "null" if any of the following conditions exist:

- the information item was not requested in the LRF sentence;
- the information item was requested but is not available; or
- the information item was requested but is not being provided.

The output data shown in Table 25 shall be provided when specifically requested by function identification characters contained in the preceding LRF-sentence portion of the interrogation. Details of these sentences are contained in IEC 61162-1.

Table 25 – LR output data formats

Data	IEC 61162-1 sentences
Function reply status	**LRF**
MMSI of responder MMSI of requestor Ship's name Ship's call sign IMO number	LR1
MMSI of responder Date and time of message composition Position Course over ground Speed over ground	LR2
MMSI of responder Destination and ETA Draught Ship/Cargo Ship's length, breadth, and type Number of persons on board	LR3

7.6.5 Optional IEC 61162-450/-460 interface

7.6.5.1 Application

Optionally, an IEC 61162-450/-460 interface may be implemented in addition to the serial ports.

7.6.5.2 Interface connector

The connectors are specified in IEC 61162-450.

7.6.5.3 AIS Class A specific definitions in addition to IEC 61162-450

The following definitions specify the application of IEC 61162-450 for AIS Class A in addition to the general requirements as defined in IEC 61162-450.

- The SFI shall have the format "AIxxxx".
- The default output transmission group of the AIS Class A shall be TGTD.
- The datagram header is "UdPbC" because the AIS Class only communicates with IEC 61162-1 formatted sentences. Binary image transfers are not implemented and therefore related requirements and tests are not applicable.
- The default input transmission groups are NAVD, TGTD and SATD. Up to two additional input groups can be specified. Table 26 lists the applicable sentences for the default input groups. Table 27 lists the TAG block parameters.

Table 26 – Default input transmission groups with applicable sentences

Tx group	Multicast address	Port	Typical talker ID	Typical sentences	Message type
NAVD	239.192.0.4	60004	GA, GP, GN, LC, IN, HE, TI	DTM, GBS, GNS, RMC, VBW, VTG, (GGA, GLL) HDT, THS, ROT	SBM
NAVD	239.192.0.4	60004	EC, EI, IN	ABM, ACA, AIR, BBM, SSD, VSD, HBT	CRP
TGTD	239.192.0.2	60002	RA	ABM, ACA, AIR, BBM, SSD, VSD, HBT	CRP
SATD	239.192.0.3	60003	HE	HDT, THS	SBM

Table 27 – TAG block parameters

Parameter code	Parameter name	Content	Example	Requirement
s:	Source-identification	SFI of the SF which generates the sentence	s:AI0001	Always required
d:	Destination-identification	SFI of the destination SF block	d:IN0002	Only in CRP type sentences, if addressed to a certain SFI.
n:	Line-count	Line counter, counting from 1 to 999	n:1234	Always required Separate counter for each addressed transmission group
g:	Sentence-grouping	Format: x-y-code x = sentence number y = number of sentences in the group code = group code counting from 1 to 99	g:1-3-23 g:2-3-23 g:3-3-23 g:1-2-24 g:2-2-24	Required for all multi-sentence messages. Accepted on input also for single sentences
t:	Text-string	Free format text		Not used in AIS class A
a:	General authentication	Signature of following sentences in block Format: c-h--h c = signature calculation method, h--h = signature.	a:2-479CF…	May be used. No additional parameters are allowed in same TAG Block.

7.6.5.4 Requirements for AIS Class A in a -450 network

7.6.5.4.1 General

The same sentences as specified for the sensor data input and high-speed ports shall be implemented. The sentences are preceded by an IEC 61162-450 header.

Sensor data received through the IEC 61162-1 interface shall have higher priority within the same sensor fall-back priority level than sensor data received through the optional IEC 61162-450 interface, if both interfaces are connected. The priority levels are described in Table 7 for position sensors and in Table 9 for ROT sensors.

The SPW sentence shall not be used in the IEC 61162-450/-460 interface. The configuration of parameters protected by SPW sentence shall not be accepted through the IEC 61162-450/-460 interface.

NOTE The SPW sentence transmits the password in plain text, which is a cyber security risk in networks.

7.6.5.4.2 CRP sentences

Command-response pair (CRP) sentences shall always be output with a d:destination TAG block parameter of the SF from which the original command has been received. The CRP sentences used in AIS are described in Table 28.

Table 28 – CRP sentences applicable for Class A AIS

Received command	Response	Function
ABM/BBM/AIR	ABK	Transmission of messages to VDL
SSD	SSD	Configuration of static data
VSD	VSD	Configuration of voyage data
ACA	ACA/ACS	Channel management
LRI/LRF	LRF/LR1/LR2/LR3	Long range interface
EPV	EPV	Command or report equipment property value
General query	Response to query	Query for configuration information

7.6.5.4.3 Output data

Data which are output autonomously and not in response to an input command are:

- VDO, VDM
- ALC, ALF, ARC
- HBT
- ALR, TXT
- ACA

7.6.5.4.4 Grouping

Following sentences may be grouped:

- ACA, ACS;
- multi-sentence VDM;
- multi-sentence VDO.

7.6.5.5 IEC 61162-460 security classification of IEC 61162-450 interface

7.6.5.5.1 General

There are three possible security classification levels regarding the application of IEC 61162-460 for an IEC 61162-450 interface, if implemented:

- no connection to a -460 network;
- a 450-Node;
- a 460-Node.

The manufacturer shall declare the IEC 61162-460 security classification of the IEC 61162-450 interfaces.

7.6.5.5.2 IEC 61162-460 security classification: no connection to a -460 network

It is not allowed to connect the device to a -460 network. The requirements of IEC 61162-450 have to be fulfilled but it is not necessary to fulfil any requirements of IEC 61162-460.

7.6.5.5.3 IEC 61162-460 security classification: 450-Node

A 450-Node can be connected to a -460 network. The additional requirements and tests are defined in IEC 61162-460.

The main requirements are:

- no connection to external networks or REDS (removable external data source) is allowed. REDS are only allowed in 460-Nodes with more security restrictions;
- the external syslog as defined in IEC 61162-450 has to be implemented;
- data output bandwidth shall be documented by the manufacturer.

7.6.5.5.4 IEC 61162-460 security classification: 460-Node

The requirements and tests of a 460-node are defined in IEC 61162-460. Different to 450-Nodes, the implementation of REDS is generally allowed in 460-Nodes.

7.6.6 Test of the optional IEC 61162-450/-460 interface

The test of the IEC 61162-450/-460 interface is not part of this document. Therefore, there is no special test subclause for the IEC 61162-450/-460 tests in this document. The tests are defined in IEC 61162-450 and IEC 61162-460.

The tests specified in IEC 61162-450 which are applicable for an AIS Class A shall be performed. The test subclauses 4.5, 4.7 and 7.3 of IEC 61162-450:2018 are normally not applicable for AIS Class A equipment.

Depending on the 460-category, the appropriate tests of IEC 61162-460 have to be performed.

The tests given in Table 29 from Clauses 14 to 19 have to be repeated to verify that all sentences are used correctly via the IEC 61162-450 interface.

Table 29 – Tests to be repeated for IEC 61162-450 interface

Tested sentence	Test No.	Test description	Remark
VDO	14.1.1.1.1 c)	Transmit position reports	
VDM	14.1.1.2.1 a)	Receive position reports	
AIR, ABK	14.1.3.1	Transmit an interrogation	To be tested with an interrogation with full content
ABM, ABK	14.1.4.1.1 a)	Transmit an addressed message	
BBM, ABK	14.1.5.1.1 a)	Transmit a broadcast message	
TRL	14.4	Event log	
ALR, ACK	14.8.2.2	Antenna VSWR	
ALF, ACN	-	-	In accordance with IMO MSC.302(87)
HBT	14.8.2.5.1 b)	Remote MKD disconnection, when so configured	Check that HBT input is accepted
TXT	14.8.2.8	Status query	
VER	14.8.2.9	Version information query	
ACA, ACS	17.3	Regional area designation by serial message	Only check that the areas are stored and used when the position is inside.
GNS	19.5.1.1 a)	Test of GNS input	
RMC	19.5.2.1 a)	Test of RMC input	
DTM	19.5.3.1 a)	Test of DTM input	
GBS	19.5.4.1 a) and b)	Test of GBS input	
VBW	19.5.5.1 a)	Test of VBW input	
VTG	19.5.6.1 a)	Test of VTG input	
HDT	19.5.7.1 a)	Test of HDT/THS input	Test with HDT input
THS	19.5.7.1 a)	Test of HDT/THS input	Test with THS input
ROT	19.5.8	Test of ROT input	
-	19.5.10	Test of multiple inputs	Test simultaneous inputs from serial ports and IEC 61162-450 network
VDM	19.7	High speed output interface performance	Performance check
VSD	19.9.2	Test of VSD input sentence	Apply one full set of settings
SSD	19.9.3.1 d) and e)	Test of SSD input sentence	Settings shall be refused
EPV	19.9.4.1 b)	Test of EPV input sentence	Test of unprotected input, EPV input shall be accepted.
SSA	19.9.4.1	Test of EPV input sentence	Test of protected input, EPV input shall be accepted

7.6.7 BIIT alert output

The AIS shall provide a relay output (NC contact) indicating the state of the Built-In Integrity Test (BIIT) alert function as specified in 6.10.1.

The terminals shall be isolated from circuits and grounds in the AIS.

The AIS manufacturer's documentation shall specify the current and voltage capability of the alarm relay contacts.

8 Long-range applications

8.1 General

Long-range applications shall be by interface to other equipment (8.2) and by broadcast (8.3).

8.2 Long-range application by two-way interface

(See 20.1)

8.2.1 General

Long-range (LR) communications shall be only through the presentation interface using the IEC 61162-2 interface dedicated to this purpose as described in 7.6.4.

The LR AIS data shall be displayed on the AIS display as described in 6.11.

8.2.2 Interrogations and responses

LR information shall only be transmitted in response to an interrogation from a LR base station

8.2.3 Manual and automatic response

The Class-A AIS station shall be capable of being set by the user to respond automatically or manually to LR interrogations. In case of automatic reply to LR interrogations, the display shall indicate that the system was LR interrogated until the indication is acknowledged by the operator. In case of manual reply to LR interrogation, the display shall indicate that the system was LR interrogated until the operator has replied to the interrogation or cancelled the reply on the manual input device as described in 6.11.

8.2.4 Data formats and contents

The LR data types available for transmission shall be derived from the AIS system as described in Table 30.

Table 30 – LR data types

ID	Data types format	Remarks
A	Ship name/call sign MMSI/IMO number	MMSI number shall be used as a flag identifier
B	Date and time in UTC	Time stamp of message composition shall be given in UTC only. Day of month, hours and minutes
C	Position	WGS 84; latitude/longitude degrees and minutes
D		Not available
E	Course	Course over ground (COG) in degrees
F	Speed	Speed over ground (SOG) in knots and 1/10 knots
G, H		Not available
I	Destination/ETA	At master's discretion; ETA time format, see B
J, K, L, M, N		Not available
O	Draught	Actual maximum draught in 1/10 of metres
P	Ship/Cargo	See Recommendation ITU-R M.1371-5/A8-3.3, Table 52
Q, R, S, T		Not available
U	Length/Beam/Type	Length and beam in metres Type see Recommendation ITU-R M.1371-5/A8-3.3, Table 52, tonnage not available
V		Not available
W	Number of persons on board	
X,Y		Not available
Z		Not used

8.2.5 Addressing AIS-units

LR interrogations shall be either by user ID (ship's MMSI) or by geographical area "all ships" call designating the North-Eastern corner and the South-Western corner of the Mercator projection rectangle, which describes the called area.

The first LR data transfer shall take place by LR interrogation initiated by a geographical area "All ships" call.

Succeeding LR data transfers shall take place by LR interrogation based on user ID (MMSI).

To avoid replies on succeeding geographical area "All ships" calls from the same base station, the AIS shall store the MMSI of the LR base station for 24 h.

8.3 Long-range application by broadcast

(See 14.1.1, 20.2)

Long-range application by broadcast is described in Recommendation ITU-R M.1371-5/A4.

Long-range AIS receiving systems (for example a satellite based receiver) will receive long-range AIS broadcast messages, provided these messages are appropriately structured and transmitted to suit the receiving systems.

The long-range AIS broadcast Message 27 shall be transmitted only on the channel 75 and channel 76. The transmissions should alternate between these two channels such that each channel is used once every 6 min. The broadcast of Message 27 in coastal areas is subject to base station control through the combined use of Message 4 and Message 23 with station type 10.

The AIS shall have the capability of disabling this function during normal operation.

9 Test conditions

9.1 Normal and extreme test conditions

9.1.1 Normal test conditions

9.1.1.1 Temperature and humidity

Temperature and humidity shall be within following range:

Temperature	+15 °C to +35 °C
Humidity	20 % to 75 %

9.1.1.2 Power supply

The normal power supply for the tests shall be in accordance with IEC 60945.

9.1.2 Extreme test conditions

Extreme test conditions are as specified in IEC 60945. Where required, test under extreme test conditions shall be a combination of dry heat and upper limit of supply voltage applied simultaneously and low temperature and lower limit of supply voltage applied simultaneously.

During type testing, the power source to the equipment may be replaced by a test power source, capable of producing normal and extreme test voltages.

9.2 Standard test environment

The EUT is tested in an environment using test equipment to simulate and to log VDL messages (see Table 18). Standard environment includes simulated targets. The simulated targets shall include an appropriate number of targets of

- Class A mobile,
- Class B "CS" mobile,
- Class B "SO" mobile,
- base station,
- AIS AtoN station,
- SAR aircraft,
- locating devices.

A receiver for long-range AIS broadcast message (Message 27) reception shall also be provided.

The signal input level at the RF input port of the EUT for any simulated target shall be at least –100 dBm. Own ship sensor inputs to EUT will be simulated by the test system or other means. Operation is checked on channels in the maritime mobile band.

Channels in use shall be selected by manual input or channel assignment messages before starting tests.

9.3 Additional test arrangements

9.3.1 Arrangements for test signals applied to the receiver input

Sources of test signals for application to the receiver input shall be connected in such a way that the source impedance presented to the receiver input is 50 Ω (see 9.3.4).

This requirement shall be met irrespective of whether one or more signals using a combining network are applied to the receiver simultaneously.

The power levels of the test signals at the receiver input terminals (RF socket) shall be expressed in terms of dBm.

The effects of any intermodulation products and noise produced in the test signal sources shall be negligible.

9.3.2 Encoder for receiver measurements

Whenever needed and in order to facilitate measurements on the receiver, an encoder for the data system shall accompany the EUT, together with details of the normal modulation process. The encoder is used to modulate a signal generator for use as a test signal source.

Complete details of all codes and code format(s) used shall be given.

9.3.3 Waiver for receivers

If the manufacturer declares that both TDMA receivers are identical, the test may be limited to one receiver and the test for the second receiver may be waived. The test report shall mention this.

9.3.4 Impedance

In this document, the value "50 Ω" is used for a 50 Ω non-reactive impedance.

9.3.5 Artificial antenna (dummy load)

Tests shall be carried out using an artificial antenna which shall be a non-reactive non-radiating load of 50 Ω connected to the antenna connector.

9.3.6 Facilities for access

All tests shall be performed using the standard ports of the EUT. Where access facilities are required to enable any specific test, these shall be provided by the manufacturer.

9.3.7 Modes of operation of the transmitter

For the purpose of the measurements according to this document, there shall be a facility to operate the transmitter unmodulated.

Alternatively, the method of obtaining an unmodulated carrier or special types of modulation patterns may also be decided by agreement between the manufacturer and the test laboratory. It shall be described in the test report. It may involve suitable temporary internal modifications of the equipment under test.

9.4 Common test conditions for protection from invalid controls

In all functional tests using Messages 4, 16, 17, 20, 22, 23 and DSC channel management telecommands, the messages or telecommands sender station shall use a valid base station MMSI format (see 6.12) to verify that the EUT operates as described in the required results. The tests shall be repeated using an invalid base station MMSI format for the messages or DSC telecommands sender station to verify that the EUT ignores these messages or telecommands.

9.5 Measurement uncertainties

Maximum values of absolute measurement uncertainties shall be as follows:

RF frequency .... $\pm 1 \times 10^{-7}$

RF power .... ± 0,75 dB

Adjacent channel power .... ± 5 dB

Conducted spurious emission of transmitter .... ± 4 dB

Conducted spurious emission of receiver .... ± 3 dB

Two-signal measurement .... ± 4 dB

Three-signal measurement .... ± 3 dB

Radiated emission of transmitter .... ± 6 dB

Radiated emission of receiver .... ± 6 dB

Transmitter attack time .... ± 20 %

Transmitter release time .... ± 20 %

For the test methods according to this document, these uncertainty figures are valid to a confidence level of 95 %.

The interpretation of the results recorded in a test report for the measurements described in this document shall be as follows:

a) the measured value related to the corresponding limit shall be used to decide whether a piece of equipment meets the requirements of this document;

b) the actual measurement uncertainty of the test laboratory carrying out the measurements, for each particular measurement, shall be included in the test report;

c) the values of the actual measurement uncertainty shall be, for each measurement, equal to or lower than the figures given in 9.5 (absolute measurement uncertainties).

10 Test signals

NOTE Transmitters can have limitations concerning their maximum continuous transmit time and/or their transmission duty cycle. It is intended that such limitations be respected during testing.

10.1 Standard test signal number 1 (DSC)

A DSC modulated data signal comprising an infinite series of 010101 (dotting pattern; refer to Recommendation ITU-R M.825).

10.2 Standard test signal number 2 (TDMA)

A test signal consisting of an infinite series of 010101.

10.3 Standard test signal number 3 (TDMA)

A test signal consisting of an infinite series of 00001111.

10.4 Standard test signal number 4 (PRBS)

A pseudo random bit sequence (PRBS) as specified in Recommendation ITU-T O.153 as the data within an AIS message frame with header, start flag, end flag and CRC. NRZI is not applied to the PRBS stream or CRC. The RF should be ramped up and down on either end of the AIS message frame.

10.5 Standard test signal number 5 (PRBS)

This test signal consists of 200 packets grouped into clusters of 4 as described in Figure 3. Each cluster consists of 2 consecutive transmissions of the packets described in Table 31.

NRZI shall be applied to every packet. After sending packet 1 and 2, the initial state of the NRZI process shall be inverted and then packet 1 and 2 repeated.

Between every transmitted packet, there shall be at least 2 free time periods. The RF carrier shall be switched off between packets to simulate normal operation.

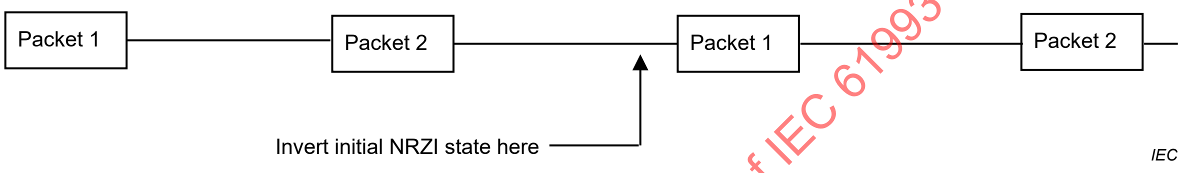


Figure 3 – Format for repeating four-packet cluster

Table 31 – Content of first two packets

Packet	Parameter	Bits	Contents	Comment
1	Training	22	0101....0101	Preamble reduced by 2 bits because of ramp-up overlap
	Start flag	8	01111110	
	Data	168	Pseudo Random	As per Table 32
	CRC	16	Calculated	
	End flag	8	01111110	
2	Training	22	1010....1010	Preamble reduced by 2 bits because of ramp-up overlap
	Start flag	8	01111110	
	Data	168	Pseudo Random	As per Table 32
	CRC	16	Calculated	
	End flag	8	01111110	

Table 32 – Fixed PRS data derived from Recommendation ITU-T O.153

Address	Contents (HEX)							
0-7	0x04	0xF6	0xD5	0x8E	0xFB	0x01	0x4C	0xC7
	0000.0100	1111.0110	1101.0101	1000.1110	1111.1011	0000.0001	0100.1100	1100.0111
8-15	0x76	0x1E	0xBC	0x5B	0xE5	0x92	0xA6	0x2F
	0111.0110	0001.1110	1011.1100	0101.1011	1110.0101	1001.0010	1010.0110	0010.1111
16-20	0x53	0xF9	0xD6	0xE7	0xE0	21 Bytes = 168 bits (+ 4 stuffed bits) , CRC = 0x3B85		
	0101.0011	1111.1001	1101.0110	1110.0111	1110.0000			

11 Power supply, special purpose and safety tests

Tests for power supplies, special purposes and safety shall be performed as specified in IEC 60945:2002, Clauses 7, 11 and 12. Waivers as indicated in IEC 60945 shall apply.

12 Environmental tests

For the environmental tests of IEC 60945:2002, Clause 8, the following shall apply:

Dry heat (IEC 60945)	perform PC under extreme test voltage
Low temp (IEC 60945)	perform PC under extreme test voltage
Normal temp (IEC 60945)	no test (PT) required

Performance tests (PT) as required by IEC 60945 under extreme conditions are covered by the tests in 15 and for normal temperature under Clause 14.

For the performance checks (PC) to be used with the environmental tests, check that transmissions from the EUT can be received by test receiver, the transmissions of a test transmitter are output on the PI and displayed on the MKD of the EUT and verify that the transmissions from the EUT contain a valid position from the internal GNSS.

For equipment declared as "exposed" or "portable", the additional tests for these types apply.

13 EMC tests

Tests for EMC emissions shall be performed as specified in IEC 60945:2002, Clause 9.

Tests for EMC immunity shall be performed as specified in IEC 60945:2002, Clause 10.

To demonstrate compliance with the performance criteria for the EMC immunity tests, the EUT shall be set into autonomous mode using channels AIS 1 and AIS 2 with a reporting interval of 2 s in the standard test environment (9.2). The content of the reports and the reporting intervals shall not be degraded during or after the test, as appropriate for the considered criterion.

Performance criterion C of IEC 60945 shall be taken to mean that the functions of the EUT are self-recoverable, i.e. without operation of controls.

14 Operational tests

14.1 Identification and operating modes

(See 6.4)

14.1.1 Autonomous mode

14.1.1.1 Transmit position reports

14.1.1.1.1 Method of measurement

Set up standard test environment. Record the VDL communication and check for messages of the EUT as follows.

a) Operate the EUT with the default MMSI (000000000).
b) Attempt to program an invalid MMSI (outside of the range specified in 6.4).

c) Enable the Message 27 transmission and repeat test with a programmed valid MMSI (see 8.3).

d) Repeat test with a programmed MMSI and after a power down for 12 h.

14.1.1.1.2 Required results

Confirm that:

a) the EUT does not transmit with the default MMSI and an BIIT ID 001 is activated;

b) the EUT rejects an invalid MMSI programming and does not transmit with the default MMSI and BIIT ID 001 is activated;

c) the EUT transmits autonomously when programmed with a valid MMSI and the transmitted data complies with sensor inputs and is output correctly via PI. Confirm that EUT transmits Message 27 as described in 8.3;

d) all static and voyage related data has been retained and is output correctly via PI.

14.1.1.2 Receive position reports

14.1.1.2.1 Method of measurement

Set up standard test environment as follows:

a) switch on test targets, then start operation of the EUT;

b) start operation of the EUT, then switch on test targets.

Check the VDL communication and presentation interface outputs of the EUT.

14.1.1.2.2 Required results

Confirm that EUT receives continuously under conditions a) and b) of 14.1.1.2.1 and outputs the received messages via the PI.

14.1.2 Assigned mode

14.1.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Using a base station MMSI, transmit an assigned mode command Message 16 to the EUT with:

a) slot offset and increment;

b) designated reporting interval.

Record transmitted messages.

14.1.2.2 Required results

Confirm that the EUT transmits position reports Message 2 according to defined parameters and reverts to SOTDMA Message 1 with standard reporting interval after 4 min to 8 min.

14.1.3 Polled mode

14.1.3.1 Transmit an interrogation

14.1.3.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Apply position reports (Message 1) without static data (Message 5) on the VDL.

b) Apply position reports (Message 18) without static data (Message 24A and 24B) on the VDL.

c) Initiate the transmission of an interrogation message (Message 15) by the EUT addressing 1 or 2 destinations requesting the following responses:
   – Message 3, 5, 9, 18, 19, 24 from mobile stations;
   – Message 4, 24 from base stations.

Record transmitted messages.

14.1.3.1.2 Required results

Verify that:

a) the AIS does not automatically initiate the transmission of Message 15;
b) the AIS does not automatically initiate the transmission of Message 15;
c) the EUT transmits the interrogation message (Message 15) as appropriate.

14.1.3.2 Interrogation response

14.1.3.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply an interrogation message (Message 15; EUT as destination) to the VDL for responses with Message 3, Message 5 and Message 24B with slot offset set to a defined value which is greater than 10 slots. Record transmitted messages and frame structure.

14.1.3.2.2 Required results

Check that the EUT transmits the appropriate interrogation response message as requested after defined slot offset. Confirm that the EUT transmits the response on the same channel as where interrogation was received.

14.1.4 Addressed operation

14.1.4.1 Transmit an addressed message

14.1.4.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Initiate the transmission of an addressed binary Message 6; EUT as source by the EUT. Record the transmitted messages.
b) Repeat test with the addressed safety related Message 12.
c) Repeat test with the addressed unstructured binary Message 25.
d) Repeat test with the addressed structured binary Message 25.
e) Repeat test with a single addressed unstructured binary Message 26.
f) Repeat test with a single addressed structured binary Message 26.

14.1.4.1.2 Required results

Check that:

a) the EUT transmits the Message 6 as appropriate;
b) the EUT transmits the Message 12 as appropriate;
c) the EUT transmits the Message 25 as appropriate;
d) the EUT transmits the Message 25 as appropriate;
e) the EUT transmits the Message 26 as appropriate;
f) the EUT transmits the Message 26 as appropriate.

14.1.4.2 Receive addressed message

14.1.4.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode, as follows.

a) Apply an addressed message (Message 6, 12, 25, 26; EUT as destination) to the VDL.
b) Apply an addressed message (Message 6, 12, 25, 26; other station as destination) to the VDL.

Record transmitted messages and frame structure.

14.1.4.2.2 Required results

Check that EUT transmits the appropriate acknowledgement message. Confirm that:

a) EUT outputs the received message via the presentation interface;
b) EUT does not output the received message via the presentation interface.

14.1.5 Broadcast operation

14.1.5.1 Transmit a broadcast message

14.1.5.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode as follows.

a) Initiate the transmission of a broadcast binary Message 8; EUT as source by the EUT. Record the transmitted messages.
b) Repeat test a) with binary data which is not byte aligned.
c) Repeat test a) with the broadcast safety related Message 14.
d) Repeat test c) with safety related text which is not byte aligned.
e) Repeat test a) with the broadcast unstructured binary Message 25.
f) Repeat test a) with the broadcast structured binary Message 25.
g) Repeat test a) with a single broadcast unstructured binary Message 26.
h) Repeat test a) with a single broadcast structured binary Message 26.
i) Initiate the transmission of a broadcast of single unstructured binary Message 26 with all bits (104) set to alternating sequence 0,1,0,1,0,1… .
j) Initiate the transmission of a broadcast of single structured binary Message 26 with DAC=1 FI=0 as defined in ITU-R M.1371 with 6 ASCII characters.
k) Repeat test h) with 5 ASCII characters. This message results transmission of 7 spare bits 6 of which will be interpreted as a character.
l) Initiate the transmission of Message 26 with unstructured data which is not byte aligned.

14.1.5.1.2 Required results

Check that:

a) the EUT transmits the Message 8 as appropriate;
b) the EUT pads the binary data using zero bits to the next byte boundary;
c) the EUT transmits the Message 14 as appropriate;
d) the EUT pads the safety related text using zero bits to the next byte boundary;
e) the EUT transmits the Message 25 as appropriate;
f) the EUT transmits the Message 25 as appropriate;
g) the EUT transmits the Message 26 as appropriate;

h) the EUT transmits the Message 26 as appropriate;

i) the EUT transmits the Message 26 according to the input and the 4 (four) spare bits before CommState are zero;

j) the EUT transmits Message 26 with 6 ASCII characters followed by 1 (one) padding bit for byte boundary and the 4 (four) spare bits set as zero;

k) the EUT transmits Message 26 with 5 ASCII characters followed by 7 (seven) padding bits for byte boundary and the 4 (four) spare bits set as zero;

l) the EUT pads the unstructured binary data using zero bits to the next byte boundary.

14.1.5.2 Receive broadcast message

14.1.5.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Apply a broadcast message (Message 8, 14, 25, 26) to the VDL.

b) Apply a broadcast Message 26 with DAC=1 FI=0 with 6 ASCII characters.

c) Repeat test b) with 5 ASCII characters. This message results in 7 spare bits 6 of which will be interpreted as a character.

14.1.5.2.2 Required results

Confirm that:

a) the EUT outputs the received message via the presentation interface;

b) the EUT outputs the received message with 6 ASCII characters;

c) the EUT outputs the received message with 5 ASCII characters followed by a single null (@) ASCII character.

14.1.6 Multiple slot messages

14.1.6.1 3 slot messages

14.1.6.1.1 Method of measurement

Apply a BBM sentence to the PI of EUT with a maximum of 68 data bytes of binary data in order to initiate transmission of a binary message (Message 8).

14.1.6.1.2 Required results

Check that the message is transmitted in up to 3 slots accordingly.

14.1.6.2 Longer messages

14.1.6.2.1 Method of measurement

Apply a BBM sentence to the PI of the EUT with an information content not fitting in 3 slots (i.e. more than 68 data bytes of binary data containing only binary bits with value one).

14.1.6.2.2 Required results

Check that the message is not transmitted. Check that a negative acknowledgement is given on the presentation interface.

14.2 Manuals, marking and identification

14.2.1 Method of measurement

Check:

a) the manuals provided by manufacturer;
b) the marking and identification labels of EUT.

14.2.2 Required results

Confirm that:

a) the manuals:
   - fulfil the requirements set in IEC 60945:2002, Clause 14;
   - include the type and details of all external connectors (including the pilot plug) referred to in 7.6;
   - include the needed information for correct siting of the antennas;
   - include the requirements for external illumination, as appropriate;
   - include 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 user on what implications the alert has for safe operation of ship and what actions may be necessary to rectify the alert condition.
b) the EUT markings:
   - fulfil the requirements of IEC 60945:2002, Clause 15;
   - include details of the power supply from which the equipment is intended to be operated;
   - if applicable, include the date by which batteries need to be replaced.

14.3 Information

(See 6.5)

14.3.1 Information provided by the AIS

14.3.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Apply all static, dynamic and voyage related data to the EUT.

Record all messages on VDL and check the content of position report Message 1 and static data report Message 5.

14.3.1.2 Required results

Confirm that data transmitted by the EUT complies with manual and sensor inputs.

14.3.2 Reporting intervals

14.3.2.1 Speed and course change

14.3.2.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode as follows.

a) Start with own speed of 10 kn; record all messages on VDL for 10 min and evaluate reporting interval for position report of EUT by calculating average slot offset over test period.
b) Increase speed and change course (ROT > 20°/min, derived from heading).
c) Reduce speed and rotation rate to values below those given in Table 2.

d) Make speed sensor unavailable.

e) Apply continuously changing heading data. Make heading sensor unavailable.

For b), c), d), record all messages on VDL and check slot offset between two consecutive transmissions.

14.3.2.1.2 Required results

The following results are required.

a) Reporting interval shall comply with Table 2 (10 s with a tolerance of ± 10 %).

b) Confirm that the new reporting interval has been established.

c) Confirm that the reporting interval is increased after 4 min (speed reduction) or 20 s (ROT reduction).

d) Check that, with unavailable speed sensor, the reporting interval reverts to default.

e) Check that, with unavailable heading sensor, the reporting interval reverts to autonomous reporting interval for the given speed.

14.3.2.2 Change of navigational status

14.3.2.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Change navigational status by applying voyage data message to the presentation interface of the EUT as follows:

a) set NavStatus to "at anchor" and "moored" and speed $<$ 3 kn;

b) set NavStatus to "at anchor" and speed $>$ 3 kn;

c) set NavStatus to other values.

Record all messages on VDL and evaluate reporting interval of position report of EUT.

14.3.2.2.2 Required results

The following results are required:

a) Reporting interval shall be 3 min;

b) Reporting interval shall be 10 s;

c) Reporting interval shall be adjusted according to speed and course (see Table 2).

NOTE Alert conditions associated with NavStatus are tested in 14.8.3.6.

14.3.2.3 Assigned reporting intervals

14.3.2.3.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Using a base station MMSI, transmit an assigned mode command Message 16 to the EUT with

a) initial slot offset and increment,

b) designated reporting interval.

Change course, speed and NavStatus. Record transmitted messages.

14.3.2.3.2 Required results

Confirm that the EUT transmits position reports Message 2 according to the parameters defined by Message 16 if the reporting interval of the assignment is shorter than the autonomous reporting interval. The EUT shall revert to Message 1 or 3 in autonomous mode with the autonomous reporting interval

- after a period of 4 min to 8 min, or
- if a change of course, speed and NavStatus require a shorter autonomous reporting interval.

14.3.2.4 Static data reporting intervals

14.3.2.4.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Record the transmitted messages and check for static and voyage related data (Message 5).

a) Change static and/or voyage related station data. Record the transmitted messages and check for static and voyage related data (Message 5).
b) Apply SSD and VSD sentences with the same static parameters several times.
c) Record the transmitted messages and check for Message 24B.

14.3.2.4.2 Required results

Confirm that the EUT transmits Message 5 with a reporting interval of 6 min alternating Channel A and Channel B.

a) Confirm that the EUT transmits Message 5 within 1 min reverting to a reporting interval of 6 min.
b) Confirm that the EUT transmits Message 5 within 1 min after the first SSD sentence was received and revert to a reporting interval of 6 min. Subsequent identical SSD and VSD sentences shall not generate a further Message 5.
c) Confirm that the EUT transmits Message 24B within 12 min after power up and thereafter once within the next 24 h. Confirm that Message 24B contains correct Vendor ID.

14.4 Event log

(See 6.6)

14.4.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Switch the EUT off for more than 15 min and on again at least ten times. Recover and readout recorded data.

Switch the EUT to silent mode if implemented. Recover and readout recorded data.

14.4.2 Required results

Confirm that the EUT records and displays times and events correctly.

14.5 Software update

14.5.1 Method of measurement

Perform an update of the equipment software according to the specification of the manufacturer.

14.5.2 Required results

Verify that the equipment software can be successfully updated.

14.6 Initialization period

(See 6.7)

14.6.1 Method of measurement

Set up standard test environment with all sensors available.

Switch on EUT with EUT operating in autonomous mode.

Switch off EUT for approximately 0,5 s. Record transmitted messages.

14.6.2 Required results

Confirm that the EUT starts transmissions within 2 min after switch on.

14.7 Technical characteristics

(See 6.9)

14.7.1 Channel selection

14.7.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Switch the EUT to different channels randomly selected from the maritime mobile band as specified by ITU-R M.1084-5:2012, Annex 4, using 25 kHz channel spacing:

a) manually;
b) by transmission of channel management message (Message 22) broadcast and addressed to EUT using a base station MMSI;
c) by application of ACA sentence to the presentation interface;
d) by transmission of DSC telecommand to EUT using a base station MMSI.

Record the VDL messages.

14.7.1.2 Required results

Confirm that the EUT uses the appropriate channels as commanded in the tests.

Confirm that the EUT delivers a single TXT sentence with ID 036, followed by the ACA sentences needed to inform of changes in the AIS use of regional operating settings.

14.7.2 Transceiver protection

14.7.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Open circuit and short circuit VHF-antenna terminals of the EUT for at least 60 s each.

14.7.2.2 Required results

The EUT shall be operative again within 2 min after refitting the antenna without damage to the transceiver.

14.7.3 Automatic power setting

14.7.3.1 Method of measurement

Set up the standard test environment and operate EUT in autonomous mode as follows.

a) Set NavStatus to moored, SOG to $<$ 3 kn and ship type to "tanker".
b) Repeat test a) and assign the power level to high via the VDL.
c) Change the NavStatus to underway.

14.7.3.2 Required results

Verify that:

a) the power setting is 1 W, there is a TXT message number 037 output to PI and the MKD indicates the correct power setting;
b) the power setting is 1 W and the MKD indicates the correct power setting;
c) the power setting is 12,5 W, there is a TXT message number 038 output to PI and the MKD indication reverts to normal.

NOTE Other mechanisms for power setting are tested in 17.5.

14.8 Alerts and indicators, fall-back arrangements

(See 6.10)

14.8.1 Loss of power supply

14.8.1.1 Method of measurement

Disconnect power supplies of the EUT.

14.8.1.2 Required results

Verify that the relay output is "active" when the power is "off".

14.8.2 Monitoring of functions and integrity

14.8.2.1 Tx malfunction

14.8.2.1.1 Method of measurement

Check the manufacturer's documentation details how the EUT detects Tx malfunction.

14.8.2.1.2 Required results

Confirm that the requirements of 4.1.5 and 6.10.1.2 are fulfilled and BIIT ID 1 is activated. Confirm that appropriate alert is released as required in Table 4.

14.8.2.2 Antenna VSWR

14.8.2.2.1 Method of measurement

Prevent the EUT from radiating with full power by mismatching the antenna for a VSWR of 3:1. During the mismatch, the output power is not required to be the rated output power.

14.8.2.2.2 Required results

Verify that the EUT continues operating. Verify that BIIT ID 2 is activated. Confirm that appropriate alert is released as required in Table 4.

14.8.2.3 Rx malfunction

Manufactures shall provide documentation describing how the AIS detects Rx malfunction and that the BIIT ID 3, 4 or 5 as appropriate is activated. Confirm by inspection of manufacturer's documentation that appropriate alert is released as required in Table 4.

14.8.2.4 Loss of UTC

14.8.2.4.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Disconnect the GNSS antenna (UTC synch invalid).
b) Reconnect the GNSS antenna.

14.8.2.4.2 Required results

Verify that:

a) the system continues to operate and changes sync state to indirect synchronisation and that BIIT ID 7 is activated. Confirm that appropriate alert is released as required in Table 4;
b) BIIT ID 7 is inactivated. Confirm that appropriate alert is inactivated. The EUT shall change sync state to UTC direct synchronisation.

14.8.2.5 Remote MKD disconnection, when so configured

14.8.2.5.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Disconnect the remote MKD or stop the HBT sentence.
b) Reconnect the remote MKD, apply the HBT sentence with status indication ok.
c) Apply the HBT sentence with status indication not ok.
d) Apply SSD sentence with DTE flag set to 1.

14.8.2.5.2 Required results

Verify that:

a) after two times, the specified repeat interval defined in HBT plus 1 s, BIIT ID 8 is activated. Confirm that appropriate alert is released as required in Table 4. Verify that the AIS continues operation, with the DTE value "1" in Message 5; if the configured repeat interval field is null, treat it as 30 s;
b) BIIT ID 8 is in normal state. Confirm that appropriate alert is inactivated. Verify that the AIS continues operation with the DTE value set to "0";
c) BIIT ID 8 is activated. Confirm that appropriate alert is released as required in Table 4. Verify that the AIS continue operation, with the DTE value "1" in Message 5;
d) the AIS uses the DTE parameter in the SSD sentence and continues operation with the DTE value set to "1".

14.8.2.6 Legacy translation of alerts

14.8.2.6.1 Method of measurement

The test for ALR/ACK handling shall be performed with an appropriate BIIT ID. No other BIIT IDs shall be active.

a) Modify the BIIT ID condition so that the condition is exceeded.
b) Modify the BIIT ID condition so that the condition is rectified.

c) Modify the BIIT ID condition so that the condition is exceeded.

d) Apply an acknowledgement with the ACK sentence to the PI port.

e) Modify the BIIT ID condition so that the condition is rectified.

14.8.2.6.2 Required results

Verify that:

a) an ALR sentence with the BIIT ID of the tested BIIT ID is output with status "A,V". Verify that the ALR output is repeated every 30 s. Verify that the BIIT ID is displayed on the MKD;

b) an ALR sentence with the BIIT ID of the tested alert is output with status "V,V". Verify that the BIIT ID is no longer displayed on the MKD;

c) an ALR sentence with the BIIT ID of the tested BIIT ID is output with status "A,V". Verify that the ALR output is repeated every 30 s. Verify that the BIIT ID is displayed on the MKD;

d) the status of the ALR sentence is changed to "A,A". Confirm that appropriate alert in Table 4 is changed to "A" "Active, acknowledged" state. Verify that the ALR output is repeated every 30 s. Verify that the BIIT ID is displayed on the MKD;

e) an ALR sentence with the BIIT ID of the tested BIIT ID is output with status "V,V". Verify that the BIIT ID is not displayed on the MKD. Verify that an ALR sentence is output every 60 s indicating that no BIIT IDs are active.

14.8.2.7 BAM alerts

14.8.2.7.1 Method of measurement

Perform an appropriate test sequence according to IEC 62923-1, for one Warning priority alert.

Perform an appropriate test sequence according to IEC 62923-1, for one Caution priority alert.

14.8.2.7.2 Required results

Confirm by analytic evaluation that reporting of alert at BAM interface and presentation of alert on MKD conforms to IEC 62923-1. Verify that the alarm relay is activated only when alert state is "V", Active, unacknowledged.

Confirm by analytic evaluation that reporting of alert at BAM interface and presentation of alert on MKD conforms to IEC 62923-1. Verify that the alarm relay is not activated.

14.8.2.8 Status query

14.8.2.8.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Send a query sentence to the EUT ($xxAIQ,TXT).

14.8.2.8.2 Required results

Verify that a set of TXT sentences representing the current status is output on the PI.

14.8.2.9 Version information query

14.8.2.9.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Send a query sentence to the EUT ($xxAIQ,VER).

14.8.2.9.2 Required results

Verify that a VER sentence representing the software and hardware version information is output on the PI.

14.8.3 Monitoring of sensor data

14.8.3.1 Priority of position sensors

14.8.3.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Verify the manufacturer's documentation to ascertain the configuration implemented on the EUT for position sensors.

Apply position sensor data in a way that the EUT operates in the states defined below:

a) external DGNSS in use (corrected);
b) internal DGNSS in use (corrected; Message 17) if implemented;
c) internal DGNSS in use (corrected; beacon) if implemented;
d) external GNSS in use (uncorrected);
e) internal GNSS in use (uncorrected);
f) external Loran-C EPFS in use (talker ID "LC");
g) unknown external EPFS in use (talker ID "SN");
h) no sensor position in use;
i) no sensor position in use, external EPFS function disabled by configuration.

Check that EUT handles alerts as required in Table 4 and also outputs appropriate ALR sentences. Check the position accuracy flag in the VDL Message 1.

14.8.3.1.2 Required results

Verify that the use of position source, position accuracy flag, RAIM flag and position information complies with Table 7 and Table 8. Verify that the "type of electronic fixing device" in Message 5 is set accordingly.

Verify that when the status is changed, the related alert status (BIIT ID 25, 26, 29, 30) is adapted, or a TXT (021, 022, 023, 024, 025, 027, 028) sentence is sent in accordance with Table 3 or Table 6, respectively.

Verify that the status is changed after 5 s when switching downwards and 30 s when switching upwards.

Verify that EUT does not release alert for missing EPFS when EPFS is not connected by the configuration.

14.8.3.2 Multiple Message 17 from different DGNSS reference stations

14.8.3.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode.

When applying Message 17, use a base station MMSI as follows.

a) Apply Message 17 from a distant DGNSS reference station.

b) Apply Message 17 from a near DGNSS reference station in addition to the distant station.
c) Switch off Message 17 from the near DGNSS reference station.

14.8.3.2.2 Required results

Verify the following:

a) the use Message 17 for position determination;
b) the use Message 17 from the near DGNSS reference station;
c) the use Message 17 from the distant DGNSS reference station.

14.8.3.3 Heading sensor

14.8.3.3.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Disconnect the inputs for HDG and ROT or set their data to invalid (for example by wrong checksum, "valid/invalid" flag).
b) Reconnect the inputs for HDG and ROT.
c) Disconnect the input for ROT or set the data to invalid (for example by wrong checksum, "valid/invalid" flag). Establish a rate of heading change that is greater than 5° in 30 s.
d) Reconnect the ROT input.
e) Apply a SOG less than 5 kn and a difference between COG and HDT greater than 45° for 5 min.
f) Apply a SOG greater than 5 kn and a difference between COG and HDT greater than 45° for 5 min.
g) Disable heading and ROT input by configuration to prevent raising an alert in their absence. Disconnect the inputs for HDG and ROT or set their data to invalid (for example by wrong checksum, "valid/invalid" flag).

14.8.3.3.2 Required results

Check that:

a) BIIT ID 32 for invalid HDG and BIIT ID 35 for invalid ROT are activated and the "default" data is sent in VDL Message 1, 2, or 3. Confirm that appropriate alert is released as required in Table 4;
b) BIIT ID 32 for valid HDG and BIIT ID 35 for valid ROT is inactivated. Confirm that appropriate alert is inactivated. Verify that TXT sentences with ID 031 for valid HDG and ID 033 for ROT indicator in use are sent to the PI;
c) a TXT sentence with ID 034 for "other ROT source in use" is sent to the PI and that the contents of the message's ROT field is the correct "direction of turn" (Table 9 "ROT sensor fall-back conditions" Priority 2);
d) a TXT sentence with ID 033 for ROT indicator in use and with the alert no ID 035 for valid ROT is inactivated;
e) BIIT ID 11 for heading sensor offset is not activated;
f) BIIT ID 11 for heading sensor offset is activated after 5 min and appropriate alert is released as required in Table 4.
g) BIIT ID 32 for invalid HDG and BIIT ID 35 for invalid ROT are not activated. Confirm that appropriate alert as required in Table 4 is not released.

14.8.3.4 Speed sensors

14.8.3.4.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Verify the manufacturer's documentation to ascertain the configuration implemented on the EUT for position sensors (see 6.10) as follows:

a) apply valid external DGNSS position and external speed data;

b) disconnect external DGNSS position, disconnect the inputs for SOG, COG or set their data to invalid (e.g. by wrong checksum, "valid/invalid" flag).

14.8.3.4.2 Required results

Check that:

a) a TXT sentence with ID 027 is sent to the PI and the external data for SOG/COG is sent in VDL Message 1, 2 or 3. Verify that the system continues to operate and that the relay output is not activated;

b) a TXT sentence with ID 028 is sent to the PI and the internal data for SOG/COG is sent in VDL Message 1, 2 or 3. Verify that the system continues to operate and that the relay output is not activated.

14.8.3.5 GNSS position mismatch

14.8.3.5.1 Method of measurement

Set up standard test environment and operate EUT with valid internal position available and using valid external position. Configure the dimension/reference values of internal and external position sources with a distance of at least 80 m between the two GNSS antennas.

a) Apply an external position with an offset of more than 100 m + distance between the two GNSS antennas to the internal position for 3 min. Then modify external position to an offset of less than 100 m + distance between the two GNSS antennas to the internal position.

b) Modify the external position to an offset of more than 100 m + distance between the two GNSS antennas to the internal position for more than 15 min.

c) Then modify external position to an offset of less than 100 m + distance between the two GNSS antennas to the internal position.

14.8.3.5.2 Required results

Check that:

a) BIIT ID 9 is not activated;

b) BIIT ID 9 is activated 15 min after the modification of the position and appropriate alert is released as required in Table 4;

c) BIIT ID 9 is inactivated and appropriate alert is inactivated.

14.8.3.6 Incorrect NavStatus

14.8.3.6.1 Method of measurement

Set up the standard test environment and operate the EUT with valid internal position available and using valid external position. Then proceed as follows.

a) Set NavStatus to "at anchor" and set SOG to > 3 kn.

b) Repeat test with NavStatus "moored".

c) Repeat test with NavStatus "aground".

d) Set NavStatus to "under way" and set SOG to 0 kn for more than 2 h.

e) Try to set NavStatus to 14.

14.8.3.6.2 Required results

Check that:

a) BIIT ID 10 is activated and appropriate alert is released as required in Table 4. Verify that the system transmits with the reporting interval as appropriate, and that the MKD prompts the user to correct the NavStatus;

b) BIIT ID 10 is activated and appropriate alert is released as required in Table 4. Verify that the system transmits with the reporting interval as appropriate;

c) BIIT ID 10 is activated and appropriate alert is released as required in Table 4. Verify that the system transmits with the reporting interval as appropriate;

d) BIIT ID 10 is activated and appropriate alert is released as required in Table 4 after two hours. Verify that the system transmits with the reporting interval as appropriate, and that the MKD prompts the user to correct the NavStatus;

e) setting of NavStatus 14 is rejected.

14.8.3.7 Auto detection of type of electronic position fixing device

14.8.3.7.1 Method of measurement

Set up standard test environment and operate EUT with valid internal position available and using valid external position. Then proceed as follows.

a) Provide an external position sensor with a talker ID of GP.

b) Provide an external position sensor with a talker ID of GL.

c) Provide an external position sensor with a talker ID of GN.

d) Provide an external position sensor with a talker ID of LC.

e) Provide an external position sensor with a talker ID of IN.

f) Provide an external position sensor with a talker ID of GA.

g) Provide an external position sensor with a talker ID of other than as in a) to f).

h) Disconnect external position.

14.8.3.7.2 Required results

Check that:

a) the type of electronic position fixing device reported by the VDL Message 5 is "1";

b) the type of electronic position fixing device reported by the VDL Message 5 is "2";

c) the type of electronic position fixing device reported by the VDL Message 5 is "3";

d) the type of electronic position fixing device reported by the VDL Message 5 is "4";

e) the type of electronic position fixing device reported by the VDL Message 5 is "6";

f) the type of electronic position fixing device reported by the VDL Message 5 is "8";

g) the type of electronic position fixing device reported by the VDL Message 5 is "0";

h) the type of electronic position fixing device reported by the VDL Message 5 is "15".

14.9 Display, input and output

(See 6.11)

14.9.1 Data input/output facilities

14.9.1.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode.

a) Check the MKD indication and, by inspection, check that it is possible to input the entire 6-bit ASCII character set required by Recommendation ITU-R M.1371-5:2014, Table 47.

b) Record received messages and check contents of minimum display.

c) Input static and voyage related data including the "<" and ">" brackets in the destination field via the MKD. Consider the full range of input fields, for example minimum and maximum.

d) Record transmitted messages and check contents of MKD and PI query.

e) Input static and voyage related data including the "<" and ">" brackets in the destination field via the PI.

f) Record transmitted messages and check contents of MKD and PI query.

g) Change NavStatus to 12.

h) Input dimension extensions to A, B, C and D values.

i) Set dimension extensions to A, B, C and D values as zero.

14.9.1.2 Required results

Confirm that:

a) the minimum display contains at least three lines of target data, with no horizontal scrolling of elapsed time and the range and bearing data display, and that the entire 6-bit character set is supported. Confirm that all characters except trailing "@" signs are displayed;

b) all messages of Table 13 are displayed and that means to select messages and data fields to be displayed are available;

c) all necessary data can be input. Verify that the access to input data required to be protected by 6.11 is password protected. Check that all data not defined in 6.11 has a different password level or no password. Check that input data values outside the allowable range are not accepted. Confirm that all values within the allowable range, but not explicitly prohibited to be used, are accepted;

d) all transmitted data is displayed correctly;

e) all necessary data can be input. Verify that the access to input data required to be protected by 6.11 is password protected. Check that protected data can be displayed without entering a password. Parameters that have to be changed during normal operation, if protected, shall not be protected by the same password level as that used to protect data in 6.11;

f) all transmitted data is displayed correctly;

g) confirm that MKD provides user guidance on setting dimension extension values;

h) confirm that the dimension extension values are correctly stored. Confirm that correctly calculated values are transmitted in Message 5 for both internal and external position sources;

i) confirm that MKD provides user guidance to set NavStatus other than 12.

14.9.2 Initiate message transmission

14.9.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode.

Initiate the transmission of non-scheduled messages and interrogations as provided by the EUT.

14.9.2.2 Required results

Confirm that at least the transmission of safety-related addressed and broadcast messages (Message 12 and Message 14) can be initiated by means of the minimum display. Confirm that transmission of Messages 4, 9, 16, 17, 18, 19, 20, 21, 22, and 23 is not possible. Confirm that MKD shall not accept input of more characters that can be transmitted in a 3-slot message. Confirm that MKD will indicate if the addressed station cannot display the addressed message (DTE flag).

Confirm, by inspection of the manufacturer's documentation, that pre-configured safety related text Messages 12 and 14 are not available.

NOTE Use of Messages 4, 9, 16, 17, 18, 19, 20, 21, 22, and 23 is restricted to other types of AIS stations.

14.9.3 Communication test

14.9.3.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. The test environment shall include at least one Class B SO station. Initiate the communication test function (transmit Message 10) by:

a) MKD using proposed target;
b) MKD using alternative target;
c) AIR sentence;
d) another transmitter (EUT as destination).

14.9.3.2 Required results

Confirm that:

a) the EUT transmits Message 10 addressed to the target and that the communication test result is correct for both a successful and unsuccessful response on the MKD. Verify that only Class A stations are proposed on the MKD;
b) the EUT transmits Message 10 addressed to the target and that the communication test result is correct for both a successful and unsuccessful response on the MKD. Verify that only Class A stations can be selected as alternative targets on the MKD;
c) the EUT transmits Message 10 addressed to the target;
d) the EUT transmits Message 11 as the response;

In all cases, verify that VDO Message 10 and received VDM Message 11 is output to the PI.

Verify that Class B stations are not selected by the MKD.

14.9.4 System control

14.9.4.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Perform system control/configuration commands as specified. Check indication of system status.

14.9.4.2 Required results

Confirm that the configuration level and other functions, not intended for use by the operator, are protected by password or adequate means.

Verify that regional channel management settings can be input via the MKD and that there is no other means of changing the radio parameters.

14.9.5 Display of received targets

14.9.5.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode.

a) Apply messages from the following targets to the VDL:
   – Class A with Messages 1 and 5, 10 s reporting interval;
   – Class A with Messages 3 and 5, 3 min reporting interval;
   – base station with Message 4, 10 s reporting interval;
   – airborne AIS with Messages 9 and 5, 10 s reporting interval;
   – Class B SO with Messages 18 and 19, 30 s reporting interval;
   – Class B CS with Messages 18 and 24A,B, 3 min reporting interval;
   – AIS AtoN with Message 21, 1 min reporting interval;
   – AIS-SART, MOB-AIS and EPIRB-AIS under test with Messages 1 and 14, transmit 1 TDMA burst;
   – AIS-SART, MOB-AIS and EPIRB-AIS under test with Messages 1 and 14, transmit 1 TDMA burst with enabling testing locating device indication;
   – one active locating device of each kind transmitting Messages 1, with a 1 min reporting interval.
b) Remove all targets from VDL.
c) Apply again all targets after 17 min, without static data Messages 5, 19 and 24.
d) Switch off two locating devices.
e) Apply 200 targets to the EUT.
f) Apply 300 targets to the EUT.

14.9.5.2 Required results

The following results are required.

a) Confirm that all targets are auto-sorted in ascending range and displayed on the target list with name, range, bearing and minutes from last received position report.

   Confirm that all active locating devices are displayed on the target list above all other targets and the names of all locating devices are in accordance with Table 10.

   Confirm that alerts in accordance with Table 4 are raised.

   Confirm that the locating devices in test mode are not displayed; however, they are displayed only when enabling testing locating device indication.

   Confirm that the other targets are displayed in an order according to the range, nearest target first.

   Confirm that all targets can be selected for detailed view.

   Confirm that all information required by Table 13 is displayed in the detailed view if not displayed in the target list.

   Confirm that all target information that is displayed on the MKD is displayed correctly.
b) Confirm that the time from the last received message is counting up every minute for all targets. Confirm that all targets, except the active locating devices, are removed from display 7 min after the last received message.
c) Confirm that all targets are displayed again. Confirm that all static data from all targets are displayed correctly.

d) Confirm that the time from the last received message is counting up every minute for the switched off locating devices. Confirm that the switched off locating devices are removed from display 18 min after the last received message.

e) Confirm that the MKD displays 200 targets.

f) Confirm that the MKD displays 200 nearest targets as a minimum.

14.9.6 Display of position quality

14.9.6.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Apply Class A transmissions with the following data to the VDL and observe the position quality display on the MKD:

a) Time stamp = 63;

b) Time stamp = 61;

c) Time stamp = 62;

d) Time stamp = 60;

e) Time stamp 0... 59, PA = 0, RAIM = 0;

f) PA = 0, RAIM = 1;

g) PA = 1, RAIM = 0;

h) PA = 1, RAIM = 1;

i) Set SOG = 10 kn, then stop target transmissions;

j) Start transmission again, set SOG = 20 kn, then stop transmission.

14.9.6.2 Required results

Confirm that:

a) the position quality "No position" is displayed;

b) the position quality "Manual position" is displayed;

c) the position quality "Dead reckoning position" is displayed;

d) the position quality "valid position with no time stamp" is displayed;

e) the position quality "Position > 10m" is displayed;

f) the position quality "Position with RAIM > 10 m" is displayed;

g) the position quality "Position < = 10 m" is displayed;

h) the position quality "Position with RAIM < = 10 m" is displayed;

i) 40 s after the last transmission the position quality is changed to "Outdated position > 200 m";

j) 20 s after the last transmission the position quality is changed to "Outdated position > 200 m".

14.9.7 Display of targets if optional filter is implemented

The methods of test and the required results are as follows:

a) confirm by observation that the user can filter the presentation of AIS targets in accordance with the manufacturer's documentation;

b) confirm by observation that an indication is provided when sleeping targets are filtered from the presentation in accordance with the manufacturer's documentation;

c) confirm by observation that the indication remains while the filter is active in accordance with the manufacturer's documentation;

d) confirm by observation that the filter criteria in use is readily available in accordance with the manufacturer's documentation;

e) confirm by observation that the user cannot remove individual AIS targets from the presentation in accordance with the manufacturer's documentation.

14.9.8 Display of received safety related messages

14.9.8.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode.

a) Transmit 20 Message 12 addressed to the EUT.

b) Clear displayed message on the MKD.

c) Transmit 20 Message 12 addressed to the EUT.

d) Transmit Message 14.

14.9.8.2 Required results

Confirm that:

a) the most recently received Message 12 is displayed foremost and all 20 messages are available for display;

b) the Message 12 is removed from foremost display on the MKD;

c) the most recently received Message 12 is displayed foremost and all 20 messages are available for display;

d) there is an indication that the Message 14 has been received and that Message 14 is available for display.

14.9.9 Presentation of navigation information

Verify compliance with the general requirements for the presentation of navigation-related information in accordance with the test methods and required results specified in IEC 62288.

Verify compliance with requirements for graphical presentation of targets in accordance with the test methods and required results of IEC 62288, if display of graphical symbols for AIS data is provided.

Provide input of the messages listed below and confirm by observation that the MKD displays graphical symbology as described in IEC 62288, if display of graphical symbols for AIS data is provided:

- Messages 1, 2, 3 and 5 (Class A AIS, locating devices);
- Messages 18, 19 and 24 (Class B AIS);
- Message 4 (AIS base stations);
- Message 9 (AIS on airborne SAR-craft);
- Message 21 (AIS AtoN).

Symbols not described in IEC 62288 may be defined by the manufacturer.

Verify compliance in accordance with the test methods and required results of IEC 62388 (radar) for calculation of CPA/TCPA, if provided.

15 Physical tests

(See 7.2)

NOTE Unless otherwise stated, all transmitter tests are performed at the highest power setting.

15.1 TDMA transmitter

15.1.1 Frequency error

15.1.1.1 Definition

The frequency error of the transmitter is the difference between the measured carrier frequency in the absence of modulation of the transmitter and its required frequency.

15.1.1.2 Method of measurement

The carrier frequency shall be measured in the absence of modulation (see Figure 4). Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz) and under normal and extreme test conditions.

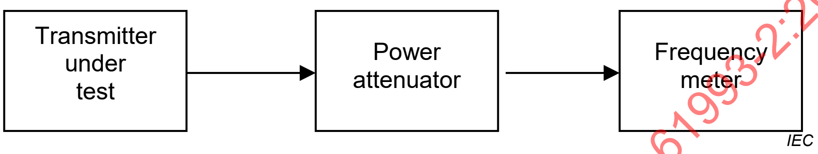


Figure 4 – Measurement arrangement for frequency error

15.1.1.3 Required results

The frequency error shall not exceed ± 0,5 kHz under normal and ± 1 kHz under extreme test conditions.

15.1.2 Carrier power

15.1.2.1 Definition

The transmitter carrier power conducted (P_c) is defined as the mean power delivered to a nominal 50 Ω load during a transmission slot.

15.1.2.2 Method of measurement

The equipment shall be connected as in Figure 5. Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz) under normal and extreme test conditions.

The tests shall be repeated for the power levels stated in 7.2.2.

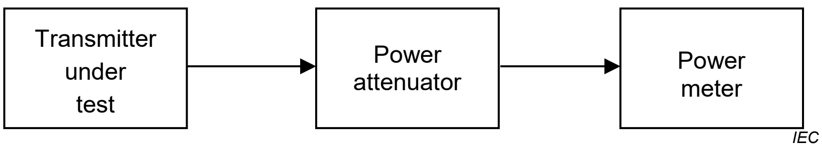


Figure 5 – Measurement arrangement for carrier power

15.1.2.3 Required results

At all test frequencies, the carrier power shall be within ± 1,5 dB of its nominal power levels under normal test conditions.

At all test frequencies, the carrier power shall be within ± 3,0 dB of its nominal power levels under extreme test conditions.

15.1.3 Slotted transmission spectrum

15.1.3.1 Definition

This test is to ensure that the modulation and transient sidebands produced by the transmitter under normal operating conditions fall within the allowable mask.

15.1.3.2 Method of measurement

The test shall use test signal number 4. The EUT shall be connected to a spectrum analyser. A resolution bandwidth of 300 Hz, video bandwidth of 3 kHz or greater and positive peak detection (maximum hold) shall be used for this measurement. A sufficient number of sweeps shall be used and sufficient transmission packets measured to ensure that the emission profile is developed. Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz).

15.1.3.3 Required results

The spectrum for slotted transmission shall be within the emission mask as follows:

- in the region between the carrier and ± 10 kHz removed from the carrier, the modulation and transient sidebands shall be below 0 dBc;
- at ± 10 kHz removed from the carrier, the modulation and transient sidebands shall be below –25 dBc;
- at ± 25 kHz to ± 62,5 kHz removed from the carrier, the modulation and transient sidebands shall be below –70 dBc;
- in the region between ± 10 kHz and ± 25 kHz removed from the carrier, the modulation and transient sidebands shall be below a line specified between these two points.

The reference level for the measurement shall be the carrier power (conducted) recorded for the appropriate test frequency in 15.1.2.

For information, the emission mask specified above is shown in Figure 6.

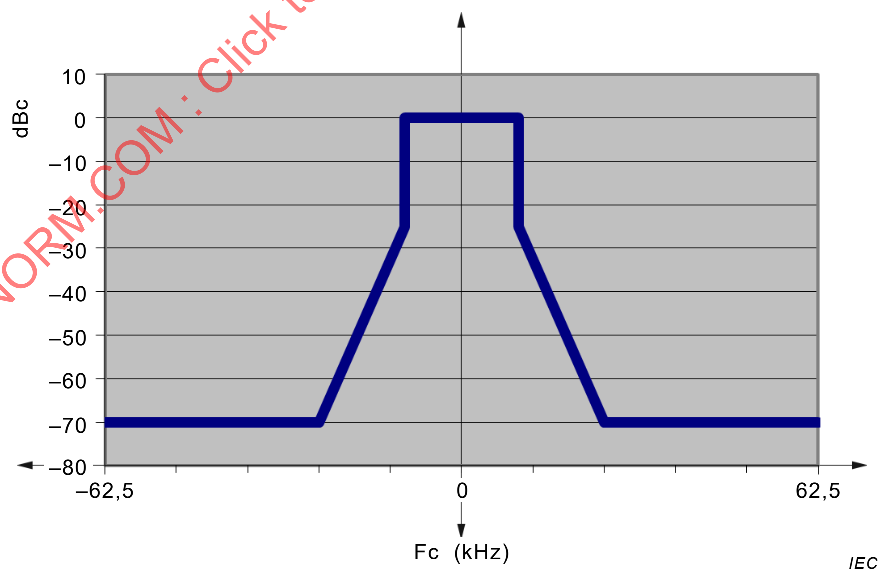


Figure 6 – Emission mask for slotted transmission

15.1.4 Modulation accuracy

15.1.4.1 Definition

The modulation accuracy is the measurement of the peak frequency deviation of the transmitter modulation and the correct implementation of the Gaussian minimum shift keying (GMSK) bandwidth-time (BT) filtering.

15.1.4.2 Method of measurement

The equipment shall be connected in either configuration A or configuration B as shown in Figure 7. The tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz) under normal and extreme test conditions.

The transmitter shall be modulated with test signal number 2.

The transmitter shall be modulated with test signal number 3.

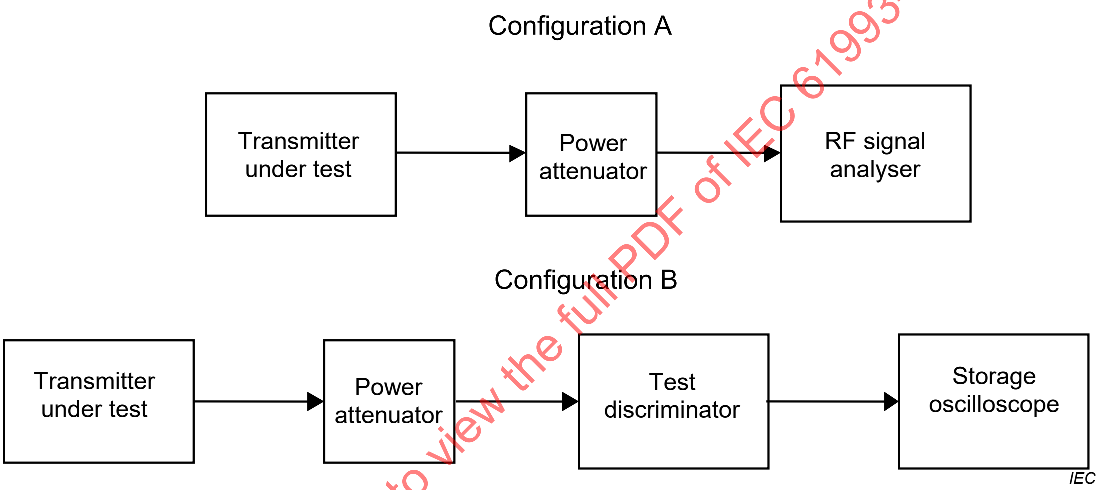


Figure 7 – Measurement arrangement for modulation accuracy

15.1.4.3 Required results

Peak deviation shall be as per Table 33.

Table 33 – Peak frequency deviation versus time

Test signal 2		Test signal 3	
Normal	Extreme	Normal	Extreme
1 740 Hz ± 175 Hz	1 740 Hz ± 350 Hz	2 400 Hz ± 240 Hz	2 400 Hz ± 480 Hz

15.1.5 Transmitter output power characteristics

15.1.5.1 Definition

Transmitter output power characteristics are a combination of the transmitter delay, ramp-up time, ramp-down time and transmission duration, as specified in 7.2.2, where:

– transmitter delay (T_A) is the time between the start of the candidate transmission time period and the time when the transmission power exceeds –50 dBc;
– transmitter ramp-up time (T_B – T_A) is the time between the transmit power exceeding –50 dBc and the moment when the transmit power has reached a level 1 dB below the

measured steady-state power (P_{ss}) and maintains a level within +1,5 dB to −1 dB from P_{ss} thereafter;

– transmitter ramp-down time (T_F – T_E) is the time between the end flag being transmitted and the moment when the transmitter output power has reduced to a level 50 dB below P_{ss} and remains below this level thereafter;

– transmission duration (T_F – T_A) is the time from when power exceeds –50 dBc to when the power returns to and stays below –50 dBc.

15.1.5.2 Method of measurement

The measurement shall be carried out by transmitting test signal number 4.

NOTE This test signal generates one additional stuffing bit within its CRC portion.

Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz). The EUT shall be connected to a spectrum analyser. A resolution bandwidth of 1 MHz, video bandwidth of 1 MHz and a sample detector shall be used for this measurement. The analyser shall be in zero-span mode for this measurement. The spectrum analyser shall be synchronised to the nominal start time of the slot (T_0), which may be provided externally, or from the EUT.

15.1.5.3 Required results

The transmitter power shall remain within the mask shown in Figure 6 and associated timings given in Table 16.

15.2 TDMA receivers

15.2.1 Sensitivity

15.2.1.1 Definition

The usable sensitivity is the minimum level of signal at the receiver input, produced by a carrier at the nominal frequency of the receiver, modulated with a test signal, which will, without interference, produce after demodulation a data signal with a specified packet error rate (PER).

15.2.1.2 Method of measurement

The signal generator (see Figure 8) shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5.

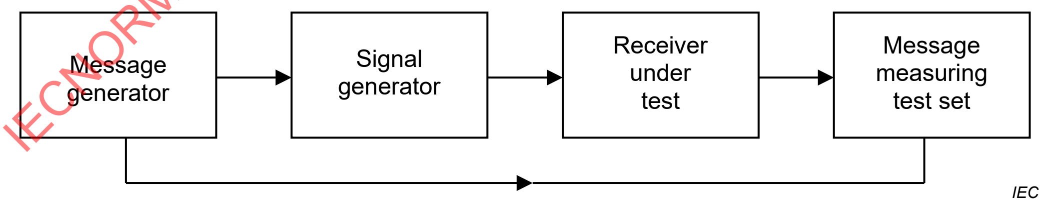


Figure 8 – Measurement arrangement

The signal level at the input of the receiver shall be set to –107 dBm. The message measuring test set shall be monitored and the packet error rate observed. The PER shall be derived by the following formula:

$$PER = (P_{TX} - P_{RX})/P_{TX} \times 100\ (\%)$$

where

P_{RX} is the number of packets received without errors;

P_{TX} is the number of transmitted packets.

Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz) with a signal level of –107 dBm and repeated at 156,025 MHz ± 500 Hz and 162,025 MHz ± 500 Hz with the level at the input to the receiver adjusted to –104 dBm under normal conditions.

Repeat under extreme conditions at nominal frequencies, with the signal generator adjusted to –101 dBm.

15.2.1.3 Required results

The PER shall not exceed 20 %.

15.2.2 Error behaviour at high input levels

15.2.2.1 Definition

The error behaviour (performance) at high input levels (noise free operation) is defined in the same manner as for the measurement of the maximum usable sensitivity when the level of the wanted signal is significantly above the maximum wanted sensitivity.

15.2.2.2 Method of measurement

The measurement configuration for receiver sensitivity (15.2.1) shall be used. Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz). The signal generator shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5. The level of the input signal shall be adjusted to a level of –7 dBm. The message measuring test set shall be monitored and the packet error rate observed. This test shall be repeated at the level of −77 dBm.

15.2.2.3 Required results

The PER shall not exceed 1 %.

15.2.3 Co-channel rejection

15.2.3.1 Definition

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.

15.2.3.2 Method of measurement

Two generators, A and B, shall be connected to the receiver via a combining network as shown in Figure 9. The wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5. The unwanted signal, provided by generator B, shall also be at the nominal frequency of the receiver. Generator B shall be modulated to generate test signal number 4, either continuously or in the same time period as that used by generator A for test signal number 5. The content of the wanted and unwanted signals shall not be synchronised. The level of the wanted signal from generator A shall be adjusted to –104 dBm at the receiver. The level of the unwanted signal from generator B shall be adjusted to –114 dBm at the receiver. The message measuring test set shall be monitored and the packet error rate (PER) observed. The measurement shall be repeated for displacements of the unwanted signal of ±1 kHz from the nominal frequency of the receiver and the PER again observed. Tests shall be performed on 2 channels (156,025 MHz, 162,025 MHz).

NOTE ± 1 kHz for the unwanted signal is twice the allowable transmit frequency tolerance.

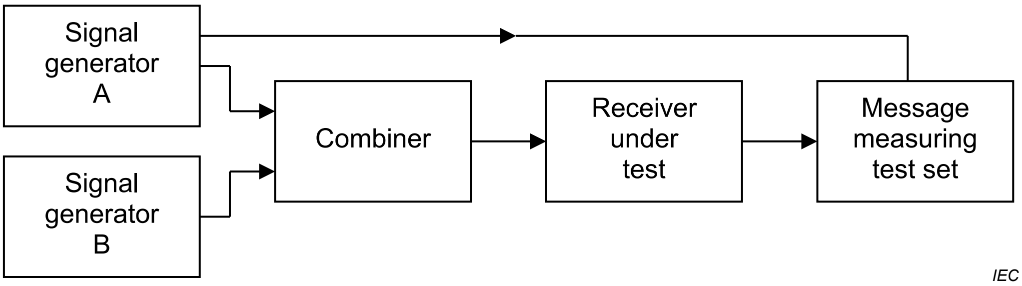


Figure 9 – Measurement arrangement with two generators

15.2.3.3 Required results

The PER shall not exceed 20 %.

15.2.4 Adjacent channel selectivity

15.2.4.1 Definition

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

15.2.4.2 Method of measurement

The measurement configuration for co-channel rejection (15.2.3) shall be used. The wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ± 3 kHz. Generator B shall be at a frequency 25 kHz above that of the wanted signal. The level of the wanted signal from generator A shall be adjusted to a level of –104 dBm at the receiver. The level of the unwanted signal from generator B shall be adjusted to –34 dBm. The message measuring test set shall be monitored and the packet error rate observed. Repeat the above measurement with the unwanted signal 25 kHz below the wanted signal.

The test shall be performed on 2 channels (156,025 MHz, 162,025 MHz) and repeated under extreme conditions with generator A adjusted to –98 dBm and generator B adjusted to –38 dBm.

15.2.4.3 Required results

The PER shall not exceed 20 %.

15.2.5 Spurious response rejection

15.2.5.1 Definition

The spurious response rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, at which a response is obtained.

15.2.5.2 Manufacturer's declarations

The manufacturer shall declare the following in order to calculate the "limited frequency range" over which the initial part of the test will be performed:

- list of intermediate frequencies: (IF_1, IF_2, ...IF_N) in Hz;

- switching range of the receiver;

NOTE 1 Switching range corresponds to the frequency range over which the receiver can be tuned.

- frequency of the local oscillator at 156,025 MHz and 162,025 MHz (AIS2): (f_{LOL}, f_{LOH}).

NOTE 2 This can be a VCO, crystal, sampling clock, BFO, or numerically controlled oscillator, depending on the design of the equipment.

15.2.5.3 Introduction to the method of measurement

The initial evaluation of the unit shall be performed over the "limited frequency range" and shall then be performed at the frequencies identified from this test and at "specific frequencies of interest" (as defined below).

If the EUT contains IF frequencies, the following procedure applies. Otherwise, the manufacturer shall provide an alternative procedure based on the design of the EUT that produces equivalent results. To determine the frequencies at which spurious responses can occur, the following calculations shall be made:

a) calculation of the "limited frequency range":

the limits of the limited frequency range (LFR_{HI}, LFR_{LO}) are determined by the following calculations:

$$LFR_{HI} = f_{LOH} + (IF_1 + IF_2 + \ldots + IFN + sr/2)$$

$$LFR_{LO} = f_{LOL} - (IF_1 + IF_2 + \ldots + IFN + sr/2)$$

b) calculation of specific frequencies of interest (SFI) outside the limited frequency range:

these are determined by the following calculations:

$$SFI_1 = (K \times f_{LOH}) \pm IF_1$$

$$SF_{I2} = (K \times f_{LOL}) \pm IF_1$$

where

K is an integer from 2 to 4.

15.2.5.4 Method of measurement over the limited frequency range

Two methods are available for the measurements over the limited frequency range, one based on SINAD measurements and the other based on PER measurements. Either method may be used, but in each case shall be followed by the method of measurement at identified frequencies. The measuring equipment is showed in Figure 10.

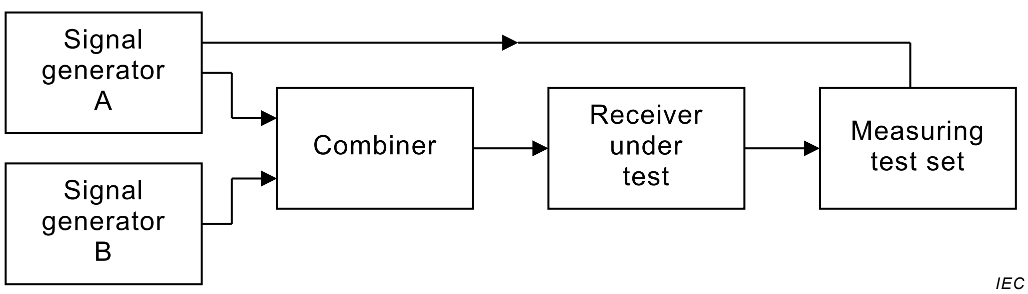


Figure 10 – SINAD or PER/BER measuring equipment

15.2.5.5 Method of search over the "limited frequency range" using SINAD measurements

Two generators, A and B, shall be connected to the receiver via a combining network as shown in Figure 10. The wanted signal, provided by generator A, shall be 162,025 MHz (AIS 2) and shall be modulated with 1 kHz sine wave at ± 2,4 kHz deviation. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ± 3 kHz.

Initially, generator B (unwanted) shall be switched off (maintaining the output impedance). The signal level from generator A (wanted) shall be adjusted to –104 dBm at the receiver. The SINAD value shall be noted (and should be greater than 14 dB). Signal generator B shall be switched on and adjusted to –27 dBm at the receiver. The frequency of the unwanted signal shall be varied in steps of 5 kHz over the limited frequency range (from LFR_{LO} to LFR_{HI}). The frequency of any spurious response detected (by a decrease in SINAD of 3 dB or more) during the search shall be recorded for use in the next measurements.

Set the receiving frequency to 156,025 MHz and repeat the test.

15.2.5.6 Method of search over the "limited frequency range" using PER or BER measurement

Two generators, A and B, shall be connected to the receiver via a combining network as shown in Figure 10. The wanted signal, provided by generator A, shall be 162,025 MHz (AIS2) and shall be modulated to generate test signal number 5. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ± 3 kHz. Initially, generator B (unwanted) shall be switched off (maintaining the output impedance). The signal level from generator A (wanted) shall be adjusted to –104 dBm at the receiver. The PER or BER shall be noted.

Signal generator B shall be switched on and adjusted to −27 dBm at the receiver. The frequency of the unwanted signal shall be varied in steps of 5 kHz over the limited frequency range (from LFR_{LO} to LFR_{HI}). The frequency of any spurious response detected (by an increase in either PER or BER) during the search shall be recorded for use in the next measurements.

In the case where operation using a continuous packet stream is not possible, a similar method may be used.

Set the receiving frequency to 156,025 MHz and repeat the test.

15.2.5.7 Method of measurement (at identified frequencies)

Two generators, A and B, shall be connected to the receiver via a combining network as shown in Figure 10. The wanted signal, provided by generator A, shall be 162,025 MHz (AIS2) and shall be modulated to generate test signal number 5. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz. Generator B shall be at the frequency of that spurious response being considered. Initially, generator B (unwanted) shall be switched off (maintaining the output impedance). The signal level from generator A (wanted) shall be adjusted to –104 dBm at the receiver. Generator B shall be switched on, and the level of the unwanted signal set to –34 dBm.

For each frequency noted during the tests over the limited frequency range on 162,025 MHz (AIS2) and the specific frequencies of interest (SFI_1), transmit 200 packets to the EUT and note the PER.

Set the receiving frequency to 156,025 MHz and repeat the test for each frequency noted during the tests over the limited frequency range on 156,025 MHz and the specific frequencies of interest (SFI_2).

15.2.5.8 Required results

At any frequency separated from the nominal frequency of the receiver by two channels or more, the spurious responses shall not result in a PER of greater than 20 %.

15.2.6 Intermodulation response rejection and blocking

15.2.6.1 Definition

The intermodulation response rejection and blocking is the capability of the receiver to receive a wanted modulated signal, without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

15.2.6.2 Method of measurement

Four signal generators shall be connected to the receiver under test (see Figure 11). The wanted signals, represented by signal generator A, shall be modulated to generate test signal number 5. The wanted signal level at the RF input of the receiver shall be set to −101 dBm.

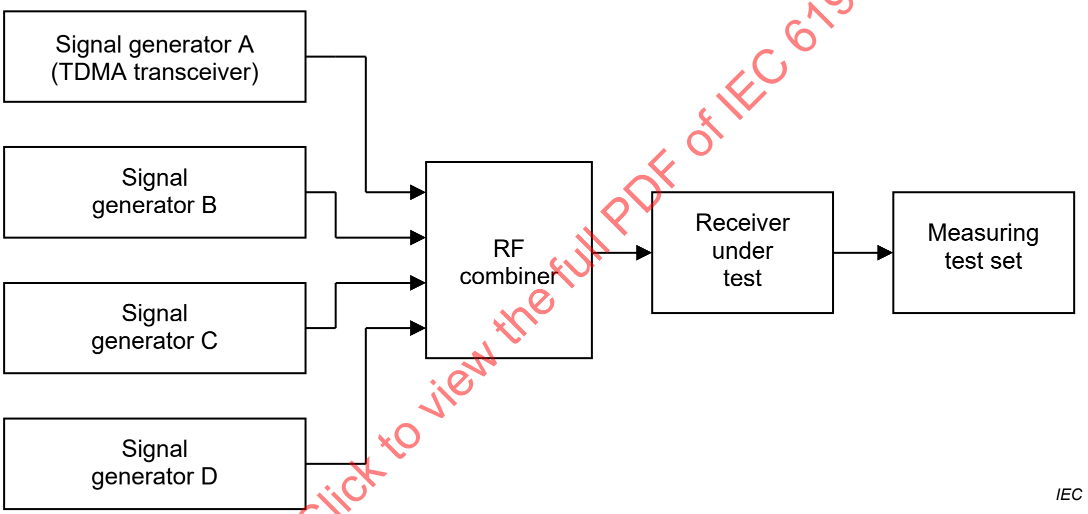


Figure 11 – Test set-up

The unwanted signal from signal generator B shall be modulated by 400 Hz with a deviation of ± 3 kHz and adjusted to a frequency 500 kHz above or below the frequency of the wanted signal. The unwanted signal from signal generator C shall be unmodulated and adjusted to a frequency 1 000 kHz above or below the frequency of the wanted signal. The unwanted signal levels from signal generators B and C at the RF input of the receiver shall be set to –27 dBm.

The unwanted signal from signal generator D shall be unmodulated and adjusted to a frequency 5,725 MHz above or below the frequency of the wanted signal. The unwanted signal level from signal generator D at the RF input of the receiver shall be set to –15 dBm.

According to the Table 34, two tests (Test no.1 and Test no.2) shall be performed.

Table 34 – Tests to be performed

	Generator A	Generator B	Generator C	Generator D
Test no.1	156,025	156,525	157,025	161,750
Test no.2	162,025	161,525	161,025	156,300

15.2.6.3 Required results

The packet error rate shall not exceed 20 %.

15.2.7 Transmit to receive switching time

15.2.7.1 Definition

The transmit to receive switching time describes the capability of the TDMA receiver to receive in the slot immediately following the transmission slot.

15.2.7.2 Method of measurement

The signal generator shall be connected to the EUT through 30 dB attenuator as shown in Figure 12. The EUT shall be connected to a 30 dB attenuator. The transmit to receive control signal in the EUT shall be connected to the signal generator as the trigger signal to output the test message at the immediate slot after the EUT transmission. The signal generator shall be at the nominal frequency of the EUT with a signal level of −107 dBm at the EUT and shall be modulated to generate test signal number 5. The EUT shall be set to the default power (12,5 W) and be set to transmit 200 messages of Message 1 with 2 s interval. The message measuring test set shall be monitored and the PER be observed.

The test shall be performed on 2 channels (156,025 MHz, 162,025 MHz).

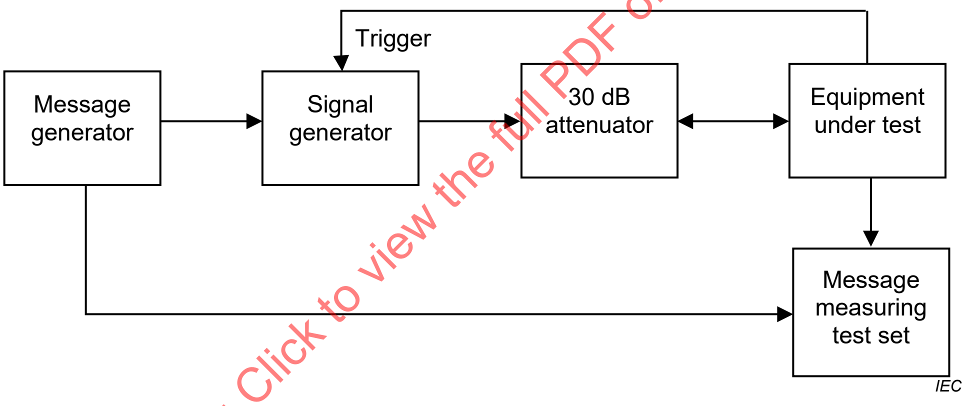


Figure 12 – Transmit to receive switching time measurement setup

15.2.7.3 Required results

The PER shall not exceed 20 %.

15.2.8 Immunity to out-of-band energy

15.2.8.1 Definition

The immunity to out-of-band energy is the capability of the receiver to receive a wanted modulated signal, without exceeding a given degradation due to the presence of high level unwanted signals out of the maritime mobile band.

15.2.8.2 Method of measurement

Two generators, A and B, shall be connected to the receiver via a combining network as shown in 15.2.3. The wanted signal, provided by signal generator A, shall be initially at 162,025 MHz and be modulated to generate test signal number 5. The unwanted signal from generator B shall be unmodulated and tuned to 174 MHz. Initially, signal generator B (unwanted signal) shall be switched off (maintaining the output impedance). The level of the wanted signal from generator A shall be adjusted to −101 dBm at the receiver input.

Generator B shall then be switched on, and the level of the unwanted signal set to −5 dBm. 200 packets shall be transmitted and the PER recorded.

Repeat the test with the wanted signal generator tuned to 156,025 MHz with the same unwanted signal.

15.2.8.3 Required results

The packet error rate shall not exceed 20 %.

15.3 Conducted spurious emissions

15.3.1 Spurious emissions from the transmitter

15.3.1.1 Definition

Conducted spurious emissions are emissions on a frequency or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

15.3.1.2 Method of measurement

The transmitter shall be connected to a 50 Ω power attenuator. The output of the power attenuator shall be connected to a measuring receiver.

If possible, the measurement shall be made with the transmitter unmodulated. If this is not possible, the transmitter shall be modulated by test signal number 4. If possible, the modulation should be continuous for the duration of the measurement.

The measurement shall be made over a frequency range from 9 kHz to 4 GHz, excluding the channel on which the transmitter is operating ± 62,5 kHz.

The resolution bandwidth of the measuring instrument shall be the smallest bandwidth available which is greater than the spectral width of the spurious component being measured. This shall be considered to be achieved when the next highest bandwidth causes less than 1 dB increase in amplitude. Positive peak detection (maximum hold) shall be selected on the spectrum analyser used for this measurement.

A sufficient number of sweeps shall be measured to ensure that the emission profile is developed.

At each frequency at which a spurious component is detected, the power level shall be recorded as the conducted spurious emission level delivered into the specified load, except for the channel on which the transmitter is intended to operate and the adjacent two channels of upper and lower sides.

The conditions used in the relevant measurements shall be recorded in test reports.

15.3.1.3 Required results

The power of any spurious emission on any discrete frequency shall not exceed 0,25 µW (−36 dBm) in the frequency range 9 kHz to 1 GHz and 1 µW (−30 dBm) in the frequency range 1 GHz to 4 GHz.

15.3.2 Spurious emissions from the receiver

15.3.2.1 Definition

Spurious emissions from the receiver are components at any frequency, conducted to the antenna. The level of spurious emissions shall be measured as their power level in a specified load.

15.3.2.2 Method of measurement

The receiver shall be connected to a 50 Ω attenuator. The output of the attenuator shall be connected to a spectrum analyser or selective voltmeter having an input impedance of 50 Ω. If the detecting device is not calibrated in terms of power input, the level of any detected components shall be determined by a substitution method using a signal generator. The measurement shall extend over the frequency range 9 kHz to 4 GHz.

The receiver shall be switched on, and the measuring receiver shall be tuned over the frequency range 9 kHz to 4 GHz.

At each frequency at which a spurious component is detected, the power level shall be recorded as the spurious level delivered into the specified load.

15.3.2.3 Required results

The power of any spurious emission in the specified range at the antenna terminal shall not exceed –57 dBm (2 nW) in the frequency range 9 kHz to 1 GHz and –47 dBm (20 nW) in the frequency range 1 GHz to 4 GHz.

16 Specific tests of link layer

(See 7.3)

NOTE In Clause 16, "CommState" is used as an abbreviation for "communication state" as defined in Recommendation ITU-R M.1371. Communication state is structured with a number of parameters for "Sync state", "Slot time-out", "Slot increment", "Number of slots", "Sub-message" (Received stations, slot number, UTC hour and minute, slot offset), and "Keep flag".

16.1 TDMA synchronisation

16.1.1 Synchronisation test using UTC

16.1.1.1 Method of measurement

Set up standard test environment; choose test conditions in a way that the EUT operates in the following synchronisation modes:

a) UTC direct;

b) UTC indirect (internal GNSS receiver disabled; at least one other station UTC direct synchronised);

c) UTC indirect (internal GNSS disabled; base station with UTC direct synchronisation within range);

d) base direct (internal GNSS disabled; base station with semaphore qualified within range);

e) UTC indirect (internal GNSS receiver disabled; only Class B SO station UTC direct synchronised).

Check CommState parameter Sync state in position report and reporting interval.

16.1.1.2 Required results

Confirm that:

a) the SynchState = 0;
b) the SynchState = 1;
c) the SynchState = 1. Verify that the correct UTC date and time is derived from Message 4 of the base station;
d) the SynchState = 2;
e) the SynchState = 1.

16.1.2 Synchronisation test using UTC with repeated messages

16.1.2.1 Method of measurement

Set up a test environment where all messages have a SyncState 0; choose test conditions in a way that the EUT operates in the following synchronisation modes:

a) UTC direct;
b) UTC indirect (internal GNSS receiver disabled; at least one other station UTC direct synchronised);
c) UTC indirect (internal GNSS receiver disabled; all other stations UTC direct synchronised and syncstate 0, repeat indicator 1).

Check CommState parameter Sync state in position report and reporting interval.

16.1.2.2 Required results

The following results are required:

a) transmitted communication state shall fit the synchronisation mode;
b) the EUT shall synchronise to the other station;
c) the EUT shall go to syncstate 3.

16.1.3 Synchronisation test without UTC, semaphore

16.1.3.1 Method of measurement

Set up the standard test environment without UTC available. Let the EUT be semaphore qualified (sync mode 1 or 3) as follows:

a) simulate other semaphore qualified stations with a different number of received stations;
b) simulate other semaphore qualified stations with the same number of received stations.

Check CommState parameter Sync state in position report and reporting interval.

16.1.3.2 Required results

Transmitted CommState shall fit the synchronisation mode. Check that

a) EUT acts as semaphore only if it has the highest number of received stations,
b) EUT acts as semaphore only if it has the lowest MMSI.

The EUT shall decrease reporting interval to 2 s when acting as a semaphore and shall remain in this state until the semaphore qualifying conditions have been invalid for 3 min.

16.1.4 Synchronisation test without UTC

16.1.4.1 Method of measurement

Set up the standard test environment; choose test conditions in a way that EUT operates in following sync modes:

a) base indirect (internal GNSS disabled; no station with UTC direct synchronisation or base station within range);
b) mobile indirect (internal GNSS disabled; other station with UTC direct synchronisation or base station without range);
c) internal GNSS enabled in synchronisation modes other than UTC direct.

Check CommState parameter sync state in position report and reporting interval.

16.1.4.2 Required results

The following results are required:

a) transmitted communication state shall fit the synchronisation mode;
b) transmitted communication state shall fit the synchronisation mode;
c) synchronisation mode shall revert to UTC direct.

16.1.5 Reception of un-synchronised messages

16.1.5.1 Method of measurement

Set up the standard test environment and operate the EUT in UTC direct mode.

Transmit un-synchronised test messages (more than ±10 ms away from the slot boundary).

16.1.5.2 Required results

Verify that the transmitted test messages are received and processed.

16.2 Time division (frame format)

16.2.1 Method of measurement

Set the EUT to reporting interval of 2 s by applying a speed of > 23 kn and a ROT of > 20°/s. Record VDL messages and check for used slots. Check parameter slot number in CommState of position report. Check slot length (transmission time).

16.2.2 Required results

Slot number used and slot number indicated in CommState shall match. Slot number shall not exceed 2 249. Slot length shall not exceed 26,67 ms.

16.3 Synchronisation and jitter accuracy

16.3.1 Definition

Synchronisation jitter (transmission timing error) is the time between nominal slot start as determined by the UTC synchronisation source and the initiation of the "transmitter on" function (T_0, see Recommendation ITU-R M.1371-5/A2-3.2.2.10, Figure 8).

16.3.2 Method of measurement

Set up standard test environment, reporting interval of 2 s and using

a) UTC direct synchronisation,

b) UTC indirect synchronisation by disconnecting the GNSS antenna of the EUT.

Record VDL messages and measure the time between the nominal beginning of the slot interval and the initiation of the "transmitter on" function. Alternative methods, for example by evaluating the start flag and calculating back to T_0, are allowed.

16.3.3 Required results

The synchronisation, including its jitter, shall not exceed

a) ±104 µs using UTC direct synchronisation,

b) ±312 µs relative to the synchronisation source using UTC indirect synchronisation.

16.4 Data encoding (bit stuffing)

16.4.1 Method of measurement

Set up the standard test environment as follows.

a) Apply a binary broadcast message (Message 8) to the VDL containing the HEX-values "7E 3B 3C 3E 7E" in the data portion and check presentation interface output of EUT.

b) Apply a BBM sentence to the EUT initiating the transmission of Message 8 containing the HEX-values as above in the data portion, and check the VDL.

16.4.2 Required results

Confirm that:

a) data output on the presentation interface conforms to transmitted data;

b) transmitted VDL message conforms to data input on the presentation interface.

16.5 Frame check sequence

16.5.1 Method of measurement

Apply a simulated position report message with wrong CRC bit sequence to the VDL.

16.5.2 Required results

Confirm, by observing the MKD and by inspecting the PI output, that this message is not processed.

16.6 Slot allocation (channel access protocols)

16.6.1 Network entry

16.6.1.1 Method of measurement

Set up the standard test environment; switch on the EUT. Record transmitted scheduled position reports for the first 3 min of transmission after initialization period. Check CommState for channel access mode.

16.6.1.2 Required results

EUT shall start autonomous transmissions of Message 3 (position report) with ITDMA CommState with KeepFlag set true for the first minute of transmission and Message 1 with SOTDMA CommState thereafter.

16.6.2 Autonomous scheduled transmissions (SOTDMA)

16.6.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode as follows.

a) Record transmitted scheduled position reports Message 1 and check frame structure. Check CommState of transmitted messages for channel access mode and parameters number of received stations, slot timeout, slot number and slot offset.
b) Repeat the test with 50 % channel loading ensuring there are at least 4 free slots in each SI.
c) Repeat the test with 50 % channel loading by message 26 ensuring there are at least 4 free slots in each SI.

16.6.2.2 Required results

Check that:

a) nominal reporting interval is achieved ±20 % (allocating slots in selection interval SI). Confirm that the EUT allocates new nominal transmission slots (NTS) within selection interval (SI) after 3 min to 8 min. Check that slot offset indicated in CommState matches slots used for transmission. Check that Class B "CS" and locating devices are not included in the number of received stations;
b) only free slots are used for transmission;
c) only free slots are used for transmission.

16.6.3 Autonomous scheduled transmissions (ITDMA)

16.6.3.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Set NavStatus of EUT to "at anchor" giving a reporting interval of 3 min. Record transmitted scheduled position reports.

16.6.3.2 Required results

Check that EUT transmits Message 3 and allocates slots using ITDMA and that slot offset indicated in CommState matches slots used for transmission.

Check that nominal reporting interval is achieved ±20 %.

16.6.4 Safety related/binary message transmission

16.6.4.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode as follows.

a) Apply a 1 slot binary broadcast message (Message 8) to the PI of the EUT less than 4 s before the next scheduled transmission. Record transmitted messages. Retry with a 90 % channel load.
b) Apply a 1 slot binary broadcast message (Message 8) to the PI of the EUT more than 4 s before the next scheduled transmission. Record transmitted messages. Retry with 90 % channel load.
c) Apply combinations of binary broadcast message (Message 8), addressed binary message (Message 6), broadcast safety related message (Message 14) and addressed safety related message (Message 12) to the PI of the EUT. Record transmitted messages and output of the PI of the EUT.
d) Apply more than 5 AIR sentence per minute to the PI.

16.6.4.2 Required results

Confirm that:

a) the EUT transmits this Message 8 within 4 s using ITDMA;

b) the EUT transmits this Message 8 within 4 s using RATDMA;

c) maximum 20 slots can be used per frame for Messages 6, 8, 12, 14, 25 and 26. Confirm that sentence ABK is sent with acknowledge type 2 (Message could not be broadcast) when the message is rejected;

d) the EUT transmits not more than 5 Messages 15 per minute. Confirm that sentence ABK is sent with acknowledge type 2 (Message could not be broadcast) when the message is rejected.

16.6.5 Transmission of Message 5 (ITDMA)

16.6.5.1 Method of measurement

Set up the standard test environment and operate EUT in autonomous mode. Record transmitted messages.

16.6.5.2 Required results

Confirm that the EUT transmits Message 5 using the ITDMA access scheme. The ITDMA access scheme shall replace a scheduled position report Message 1 with a Message 3.

16.6.6 Assigned operation

16.6.6.1 Assigned mode using reporting rates

16.6.6.1.1 Method of measurement

Operate the standard test environment and the EUT in autonomous mode. Transmit an assigned mode command message (Message 16) using a base station MMSI to the EUT with:

a) the number of reports per 10 min which is not a multiple of 20;

b) the number of reports per 10 min which is higher than 600.

16.6.6.1.2 Required results

Confirm that:

a) the EUT transmits position reports Message 2 at a reporting rate that corresponds to the next highest multiple of 20 reports per 10 min;

b) the EUT transmits position reports Message 2 at a reporting interval of 1 s.

16.6.6.2 Receiving test

16.6.6.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Transmit an assigned mode command (Message 16) using a base station MMSI to the EUT with:

- slot offset and increment;
- designated reporting interval;

Record transmitted messages.

16.6.6.2.2 Required results

Confirm that EUT transmits position report Message 2 according to defined parameters and reverts to SOTDMA Message 1 with standard reporting interval after 4 min to 8 min.

16.6.6.3 Slot assignment to FATDMA reserved slots

16.6.6.3.1 Definition

A test to check the combined operation of Message 16 assignment to slots reserved by Message 20.

16.6.6.3.2 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Transmit a data link management message (Message 20) using a base station MMSI to the EUT with slot offset and increment. Transmit an assigned mode command (Message 16) using a base station MMSI to the EUT and command it to use one or more of those FATDMA allocated slots. Record transmitted messages.

16.6.6.3.3 Required results

Confirm that the EUT uses the slots commanded by Message 16 for own transmissions.

16.6.7 Group assignment

16.6.7.1 Assignment priority

16.6.7.1.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode, and use a base station MMSI to transmit Messages 22 and 23.

a) Transmit an assigned mode command (Message 23) to the EUT with Tx/Rx mode 1. Wait for 2 min.
b) Transmit a Message 22 defining a region with the EUT inside that region, Tx/Rx mode = 0.
c) Wait for time-out of Message 23.
d) Transmit an assigned mode command (Message 23) to the EUT with Tx/Rx mode 1. Wait for 2 min.
e) Transmit a Message 22 to the EUT individually addressed and specifying Tx/Rx mode 2.
f) Transmit a Message 23 per minute for 15 min to the EUT with Tx/Rx mode 1.
g) Wait for time-out of message 23.

Record transmitted messages.

16.6.7.1.2 Required results

Verify that:

a) the Tx/Rx mode = 1 according to the Message 23 setting;
b) the Tx/Rx mode of Message 22 is ignored and Tx/Rx mode = 1 according to the Message 23 setting continues;
c) the Tx/Rx mode reverts to Tx/Rx mode 0 according to the Message 22 setting;
d) the Tx/Rx mode = 1 according to the Message 23 setting;
e) the Tx/Rx mode field setting of Message 22 takes precedence over the Tx/Rx mode field setting of Message 23 and so Tx/Rx mode = 2;

f) the EUT ignores the assignment by Message 23 and the setting of Message 22 takes precedence for 10 min; after 10 min the Tx/Rx mode changes to Tx/Rx mode 1 according to the Message 23 setting;

g) The receiving station shall revert to its previous Tx/Rx mode = 2 after a timeout value randomly chosen between 240 s and 480 s.

16.6.7.2 Increased reporting interval assignment

16.6.7.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode with 10 s reporting interval, and use a base station MMSI to transmit Message 23 as follows.

a) Transmit a group assignment message (Message 23) to the EUT with a reporting interval that is longer than the autonomous reporting interval.

b) Transmit a group assignment message (Message 23) to the EUT with a quiet time command.

c) Set the Nav status to "moored" and "at anchor" and SOG < 3 kn. Transmit a group assignment message (Message 23) to the EUT with a reporting interval that is shorter than the autonomous reporting interval.

d) Set the Nav status to "moored" and "at anchor" and SOG > 3 kn. Transmit a group assignment message (Message 23) to the EUT with a reporting interval that is shorter than the autonomous reporting interval.

Record transmitted messages.

16.6.7.2.2 Required results

Confirm that:

a) the EUT ignores the assignment command and transmits position reports with the autonomous reporting interval;

b) the EUT ignores the assignment command and transmits position reports with the autonomous reporting interval;

c) the EUT ignores the assignment command and transmits position reports with the autonomous reporting interval;

d) the EUT transmits position reports with the assigned reporting interval.

16.6.7.3 Entering interval assignment

16.6.7.3.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode with a reporting interval of 10 s. Use a base station MMSI to transmit Message 23.

a) Transmit a group assignment command (Message 23) to the EUT with a reporting interval of 5 s assigned.

b) Repeat test with a reporting interval of 2 s assigned.

c) Transmit a group assignment command (Message 23) to the EUT with a reporting interval field setting 10 (next longer autonomous reporting interval).

d) Operate the EUT in autonomous mode with a reporting interval of 6 s. Transmit a group assignment command (Message 23) to the EUT with a reporting interval field setting 9 (next shorter autonomous reporting interval).

Monitor the VDL.

16.6.7.3.2 Required results

Verify that:

a) the EUT enters assigned operation mode and transmits position report Message 2 with 5 s reporting interval. EUT builds up the assigned transmission scheduled according to network entry procedure; verify that unused slots of the previous reporting schedule are released;

b) the EUT enters assigned operation mode and transmits position report Message 2 with 2 s reporting interval;

c) the EUT does not enter assigned operation mode and transmits position report Message 1 with 10 s reporting interval;

d) the EUT enters assigned operation mode and transmits position report Message 2 with 2 s reporting interval.

16.6.7.4 Assignment by region

16.6.7.4.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode with a reporting interval of 10 s and use a base station MMSI to transmit Message 23 as follows.

a) Transmit a group assignment command (Message 23) to the EUT (define station type 0 and geographic region so that the EUT is inside this region). Set the reporting rate to 2 s and apply message to VDL.

b) Transmit a group assignment command (Message 23) to the EUT (define station type 0 and geographic region so that the EUT is outside this region). Set the reporting rate to 2 s and apply message to VDL.

16.6.7.4.2 Required results

Verify that:

a) the EUT switches to assigned mode and transmits position reports with 2 s intervals. Verify that EUT reverts to normal operation mode after timeout period;

b) the EUT declines Message 23.

16.6.7.5 Assignment by station type

16.6.7.5.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode with a reporting interval of 10 s and use a base station MMSI to transmit Message 23 as follows.

a) Transmit a group assignment command (Message 23) to the EUT (define geographic region so that the EUT is inside this region). Set the reporting interval to 2 s and the station type to 0 (all stations).

b) Transmit a group assignment command (Message 23) to the EUT (define geographic region so that the EUT is inside this region). Set the reporting interval to 2 s and the station type to 2. Repeat the test for station types 3, 4, 5 and 6.

c) Transmit a group assignment command (Message 23) to the EUT (define geographic region so that the EUT is inside this region). Set the reporting interval to 5 s and the station type to 1 (Class A Mobile). Apply this message to the VDL again within 4 min.

Record VDL and check reaction of the EUT.

16.6.7.5.2 Required results

Verify that:

a) the EUT switches to assigned mode and transmits position reports with 2 s reporting interval. Verify that EUT reverts to autonomous mode after timeout period;
b) the EUT declines Message 23 for each station type;
c) the EUT switches to assigned mode and transmits position reports with 5 s reporting interval. Verify that EUT reverts to autonomous operation mode after timeout period of second transmitted group assignment.

16.6.7.6 Addressing by ship and cargo type

16.6.7.6.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode with a reporting interval of 10 s and use a base station MMSI to transmit Message 23 as follows.

a) Transmit a group assignment command (Message 23) to the EUT (define geographic region so that the EUT is inside this region). Set the reporting interval to 2 s and the ship and cargo value to a desired value. Make sure that this value is also configured in the EUT.
b) Transmit a group assignment command (Message 23) to the EUT (define geographic region so that the EUT is inside this region). Set the reporting interval to 2 s and the ship and cargo value to a desired value. Make sure that a different value is configured in the EUT.

16.6.7.6.2 Required results

Verify that:

a) EUT switches to assigned mode and transmits position reports with 2 s reporting interval. Verify that EUT reverts to autonomous mode after timeout period;
b) EUT declines Message 23.

16.6.7.7 Reverting from interval assignment

16.6.7.7.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Using a base station MMSI, transmit a group assignment command (Message 23) to the EUT with a reporting interval of 5 s assigned. Monitor the VDL until at least 1 min after timeout occurred. Repeat 10 times (transmissions of Message 23 shall not be synchronised to the initial transmission schedule of the EUT).

Measure the time T_{rev} between the reception of Message 23 and the first transmission after timeout.

16.6.7.7.2 Required results

Verify that the EUT enter autonomous mode after a time out of 4 min to 8 min and transmits position report Message 1 and releases unused slots from previous schedule.

16.6.8 Fixed allocated transmissions (FATDMA)

16.6.8.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Apply Message 4 to the VDL. A base station shall use a base station MMSI as follows.

a) Transmit a data link management message (Message 20) on Channel A from a base station within 120 NM to the EUT with slot offset and increment. Record transmitted messages.
b) Repeat the test when the EUT has no position.

c) Repeat the test with a base station beyond 120 NM.

d) Repeat the test without base station report (Message 4).

e) Repeat the test with a base station within 120 NM and maintain transmissions of Message 20. Stop transmission of Message 4.

16.6.8.2 Required results

Confirm that:

a) for the base station within 120 NM, the EUT does not use slots allocated by Message 20 for own transmissions until the timeout given in the Message 20. Confirm that the EUT does not use the same slots on Channel B;

b) the EUT does not use slots allocated by Message 20 for own transmissions until the timeout given in the Message 20;

c) for the base station beyond 120 NM, the EUT treats the slots as free;

d) the EUT treats the slots as free;

e) the EUT does not use slots allocated by Message 20 for own transmissions until the target timeout of the EUT occurs after Message 4 is stopped.

16.6.9 Randomisation of message transmissions

16.6.9.1 Method of measurement

Set up the standard test environment. Power on the EUT and monitor the autonomous transmissions for 3 min. Restart the EUT and monitor the autonomous transmissions for another 10 min. Repeat the restart of the EUT for at least 5 times, starting at different seconds within a frame.

NOTE The nominal start slot (NSS) at network entry phase is randomised between the current slot and nominal increment (NI) slots forward. The first nominal slot (NS) is always the NSS.

16.6.9.2 Required results

Verify that the nominal slots are not always within the same selection interval after a power cycle by monitoring the transmissions slots.

16.7 Message formats

16.7.1 Received messages

16.7.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply messages according to Table 18 to the VDL including multiple slot messages up to 5 slots. Record messages output by the PI of the EUT.

16.7.1.2 Required results

Confirm that the EUT outputs the corresponding message with the correct field contents and format via the PI or responds as appropriate.

16.7.2 Transmitted messages

16.7.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Initiate the transmission of messages relevant for a mobile station according to Table 18 by the EUT. Record transmitted messages.

16.7.2.2 Required results

Confirm that the EUT transmits messages with correct field content and format or responses, as appropriate. Confirm that Messages 4, 9, 16, 17, 18, 19, 20, 21, 22 and 23 are not being transmitted by the EUT.

17 Specific tests of network layer

(See 7.4)

17.1 Dual channel operation – Alternate transmissions

17.1.1 Method of measurement

Set up standard test environment and operate the EUT in autonomous mode on default channels AIS 1, AIS 2. Record transmitted scheduled position reports on both channels. Check CommState for slot allocation.

17.1.2 Required results

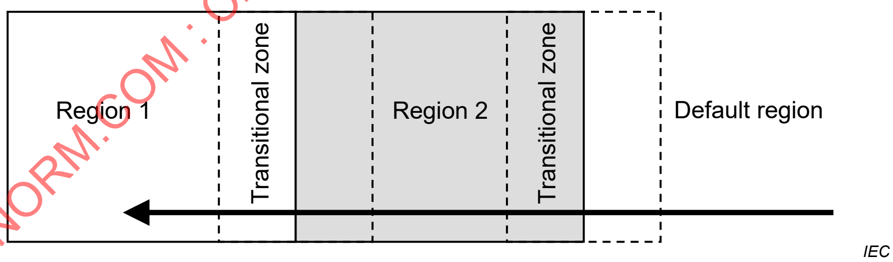
Confirm that the EUT allocates slots in alternating both channels. Repeat check for data link access period.

17.2 Regional area designation by VDL message

17.2.1 Method of measurement

Set up standard test environment and operate the EUT in autonomous mode.

a) Using a base station MMSI, apply channel management messages (Message 22) to the VDL defining two adjacent regional areas 1 and 2 with different channel assignments for both regions and a transitional zone extending 4 NM on either side of the regional boundary (see Figure 13). Let the EUT approach region 1 from outside region 2 more than 5 NM away from the region boundary transmitting on default channels. Record transmitted messages on all 6 channels.



	Primary channel	Secondary channel
Region 1	CH A 1	CH B 1
Region 2	CH A 2	CH B 2
Default region	AIS 1	AIS 2

Figure 13 – Regional area scenario

b) Operate the unit in an area with T_x/R_x mode 1.

c) Operate the unit in an area with T_x/R_x mode 2.

d) Transmit Message 22 using a base station transmitting Message 4 with a position which is more than 120 NM away from the position of the EUT.

e) Transmit Message 22 using a base station which is not transmitting Message 4.

17.2.2 Required results

Check that:

a) the EUT transmits and receives on the primary channels assigned for each region (see Table 35) alternating channels and doubles the number of transmissions when passing through the transitional zones. The EUT shall revert to default autonomous operation on the regional channels after leaving the transitional zones. The number of transmissions doubles on the active channel when transmitting on one channel only;

TXT and ACA sentences are output when defining the area, crossing the boundary of the area and on request. The in-use flag shall be set to "1" if the position is inside the area which is defined by the two corner points of the area setting (e.g. the grey area defining region 2 in Figure 13);

b) the EUT transmits on channel A only with the nominal reporting rate;

c) the EUT transmits on channel B only with the nominal reporting rate;

d) the EUT does not accept the channel management;

e) the EUT does not accept the channel management.

Table 35 – Primary channels for each region

	Area	Channels in use
1	Default region	AIS 1, AIS 2
2	First transitional zone	AIS 1, CH A 2
3	Region 2	CH A 2, CH B 2
4	Second transitional zone	CH A 2, CH A 1
5	Region 1	CH A 1, CH B 1

17.3 Regional area designation by serial message

Repeat the test of 17.2 using ACA sentence for channel assignment.

17.4 Regional area designation with lost position

17.4.1 Method of measurement

Repeat the test of 17.2 using ACA sentence for channel assignment as follows.

a) Disable position information; apply new addressed Message 22 using a base station MMSI.

b) Make position information available again and query for area settings (ACA request).

17.4.2 Required results

Verify that:

a) the settings of the current area are still being used; check that settings of new addressed Message 22 are adopted;

b) all area settings are still available.

17.5 Power setting

17.5.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Using a base station MMSI, transmit channel management message (Message 22), defining output power high/low.

Repeat test using ACA sentence and manual input.

17.5.2 Required results

Check that the EUT sets output power as defined and indicates when the low power setting is in operation.

NOTE Automatic power setting for tankers is tested in 14.7.3.

17.6 Message priority handling

17.6.1 Method of measurement

Set up standard test environment and operate test equipment with 90 % channel load. Set the EUT to a reporting interval of 2 s by applying a speed of > 23 kn and a ROT of > 20°/s. Record VDL messages and check for used slots. Initiate the transmission of two 3 slot messages (Message 12 and Message 8) by the EUT. Record transmitted messages on both channels.

17.6.2 Required results

Check that the EUT transmits the messages in correct order according to their priority as given in ITU-R Recommendation M.1371-5/A8-2.

17.7 Slot reuse and FATDMA reservations

17.7.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Assure that, at test receiver location, the signal level received from the EUT exceeds the signal level received from the test transmitter as follows.

NOTE Free slots are: slots not used, Slots used by a mobile station under way that has not been received for 3 min or more, slots used by a base station (Message 20 and Message 4) beyond 120 NM, garbled slots.

Available slots are: distant station slots.

Unavailable slots are: near station slots, slots used by a base station (Message 20 and Message 4) within 120 NM, slots used by mobile stations reporting without position information, slots used by mobile stations with a reporting interval of 1 min or more.

a) Transmit test targets on channel A with 50 % channel load. Channel B is free. This test covers Rule 0 and 1.
b) Transmit near and distant test targets with 100 % channel load on channel A in all selection intervals which are under observation. Channel B is free. There shall be enough different targets to allow the EUT to meet the requirement to reuse only one slot of each target per frame.
c) Transmit near and distant test targets with 100 % channel load on channel B in all selection intervals which are under observation. Channel A is free.
d) Transmit Message 4 with a position distance < 120 NM and Message 20 with slot reservations on channel A.
e) Transmit Message 4 with a position distance > 120 NM and Message 20 with slot reservations on channel A.
f) Transmit no Message 4 and Message 20 with slot reservations on channel A.
g) Transmit Message 4 with a position distance < 120 NM and Message 20 with slot reservations on channel A. Transmit near and distant test targets in the unreserved slots on channel A. Channel B is free.

17.7.2 Required results

Confirm that:

a) only free slots are used for transmission on channel A. Confirm that only slots which are free on channel A are used for transmissions on channel B;

b) slots of the most distant test targets are used for transmission on channel A. Check that not more than one slot of a station is reused in a frame;

c) for transmission on channel A, the candidate slots on channel A are organized according to the most distant station on channel B;

d) only unreserved slots are used on channel A. Confirm that, at start of Message 20, the time-out of all reserved slots is forced to 0 and the slots are changed to free slots within one frame. Confirm that, for transmissions on channel B, only slots which are not reserved on channel A are used after the next regular time-out 0. Confirm that, after the reservation time-out, all slots on channel A and B are used again;

e) all slots are used for transmission on channels A and B;

f) all slots are used for transmission on channels A and B;

g) only unreserved slots are used on channel A. Confirm that slots of the most distant test targets are used for transmission. Confirm that, for transmissions on channel B, only slots which are not reserved on channel A are used after the next regular time-out 0.

17.8 Management of received regional operating settings

17.8.1 Test for replacement or erasure of dated or remote regional operating settings

17.8.1.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Using a base station MMSI, send a valid regional operating setting to the EUT by Message 22 with the regional operating area, including the own position of the EUT (area 1). Consecutively, send another seven valid regional operating settings to the EUT, using both Messages 22 and DSC telecommands, with regional operating areas neither overlapping with the first nor with one another. Perform the following in the order shown.

a) Send another Message 22 to the EUT, with a ninth regional operating area (area 9) not overlapping with the previous eight regional operating areas.

b) Send a tenth telecommand to the EUT, with a regional operating area (area 10) which partly overlaps a regional operating area.

c) Move own position of EUT to a distance of more than 500 NM from one region defined by previous commands.

d) Move own position of EUT to a distance of more than 500 NM from all regions defined by previous commands.

e) Restart the EUT and make sure it cannot receive UTC. Apply a channel management area setting by message 22 and by ACA input. Wait for 24 h.

Query for area settings (ACA request) after a), b) c and d).

17.8.1.2 Required results

Check that, after the initialization, the EUT operates according to the regional operating settings defined by area 1 and:

a) the most distant area is deleted and the other areas are available;

b) area 10 is stored and that the old overlapped area is deleted;

c) this area is deleted by the output of TXT and ACA sentences showing the remaining area settings;

d) all areas are deleted by the output of a single TXT and ACA sentences showing high sea settings;

e) all area settings have been removed.

17.8.2 Test of correct input via presentation interface or MKD

17.8.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Using a base station MMSI, perform the following tests in the following order.

a) Send Message 22 or a DSC telecommand with valid regional operating settings to the EUT with a regional operating area, which contains the current position of own station.
b) Input a different, valid regional operating setting – not overlapping the area defined under a) – via the MKD.
c) Send a different regional operating setting with a regional operating area which partly overlaps the regional operating area input via the MKD to the EUT via the presentation interface in the previous step, and which contains the present position of own station.
d) Input the default operating settings via the MKD for the regional operating area, which was received by the previous command via the presentation interface.
e) Send Message 22 or a DSC telecommand with a different regional operating setting to the EUT with a regional operating area, which contains current position of own station.
f) Within two hours, after e), send a different regional operating setting to the EUT via the presentation interface with a valid regional operating area overlapping the regional operating area sent to the EUT by Message 22 or a DSC telecommand.

17.8.2.2 Required results

The following results are required.

a) Confirm that the EUT uses the regional operating settings commanded by Message 22 or DSC telecommand.
b) Step 1: Confirm that the regional operating settings of the previous Message 22 or DSC telecommand are displayed to the user on the MKD for editing.

   Step 2: Check that the EUT allows the user to edit the displayed regional operating settings. Check that the EUT does not accept incomplete or invalid regional operating settings. Check that the EUT accepts a complete and valid regional operating setting.

   Step 3: Check that the EUT prompts the user to confirm the intended change of regional operating settings. Check that the EUT allows the user to return to the editing menu or to abort the change of the regional operating settings.

   Step 4: Check that the EUT uses the regional operating settings input via the MKD.
c) Check that the EUT uses the regional operating settings received via the presentation interface.
d) Check that the EUT accepts the default operating settings for the regional operating area received in c). Check that the EUT uses the default operating settings.
e) Check that the EUT uses the regional operating settings commanded to it by Message 22 or DSC telecommand.
f) Check that the EUT does not use the regional operating setting commanded to it via the presentation interface.

17.8.3 Test of addressed telecommand

17.8.3.1 Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Using a base station MMSI, perform the following tests in the following order.

a) Send Message 22 or a DSC telecommand with valid regional operating settings, that are different from the default operating settings, to the EUT with a regional operating area, which contains the current position of own station.

b) Send an addressed Message 22 or an addressed DSC telecommand to the EUT with different regional operating settings than the previous command.

c) Move the EUT out of the regional operating area defined by the previous addressed telecommand into an area without regional operating settings.

17.8.3.2 Required results

Check that:

a) the EUT uses the regional operating settings commanded to it in a);

b) the EUT uses the regional operating settings commanded to it in b);

c) the EUT reverts to default.

17.8.4 Test for invalid regional operating areas

17.8.4.1 Purpose

This test simulates invalid regional operating areas (three regional operating areas with the same corner).

17.8.4.2 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Using a base station MMSI, perform the following tests in the following order after completion of all other tests related to change of regional operating settings.

a) Send three different valid regional operating settings with adjacent regional operating areas, their corners within eight miles of each other, to the EUT by Message 22 or DSC telecommand, presentation interface input and manual input via MKD. The current own position of the EUT shall be within the regional operating area of the third regional operating setting.

b) Move current own position of the EUT consecutively to the regional operating areas of the first two valid regional operating settings.

17.8.4.3 Required results

Check that:

a) the EUT uses the operating settings that were in use prior to receiving the third regional operating setting;

b) the EUT consecutively uses the regional operating settings of the first two received regional operating areas.

17.9 Continuation of autonomous mode reporting interval

17.9.1 Method of test

When in the presence of an assigned mode command and in a transition zone, check that the EUT continues to report at the autonomous mode reporting interval.

17.9.2 Required results

Ensure that the autonomous reporting interval is maintained.

18 Specific tests of transport layer

(See 7.5)

18.1 Addressed messages

18.1.1 Transmission

18.1.1.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Set up a test target for scheduled transmissions on channel AIS 1 only. Initiate the transmission of an addressed binary message (Message 6) by the EUT (test target as destination). Record transmitted messages on both channels.

18.1.1.2 Required results

Check that the EUT transmits Message 6 on channel AIS 1. Repeat test for AIS 2.

18.1.2 Acknowledgement

18.1.2.1 Method of measurement

Operate the standard test environment and the EUT in autonomous mode. Apply up to 4 addressed binary messages (Message 6; EUT as destination) to the VDL on channel AIS 1. Record transmitted messages on both channels. Repeat with AIS 2.

18.1.2.2 Required results

Confirm that the EUT transmits a binary acknowledge message (Message 7) with the appropriate sequence numbers within 4 s on the channel where Message 6 was received. Confirm that the EUT transmits the result with an appropriate message to PI.

18.1.3 Transmission retry

18.1.3.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Initiate the transmission of up to 4 addressed binary messages by the EUT which will not be acknowledged (i.e. destination not available). Record transmitted messages.

18.1.3.2 Required results

Confirm that EUT retries the transmission up to 3 times (configurable) for each addressed binary message. Confirm that the time between transmissions is 4 s to 8 s. Confirm that the EUT transmits the overall result with an appropriate message to PI.

18.1.4 Acknowledgement of addressed safety related messages

Repeat test 18.1.2 with addressed safety related message.

18.1.5 Behaviour of NavStatus 14 reception

18.1.5.1 Purpose

This test verifies the correct behaviour of the received Message 1 with NavStatus 14.

18.1.5.2 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Disable alert function for locating devices.

a) Initiate the transmission of a Message 1 with NavStatus 14. Wait 18 min. Enable alert function for locating devices.
b) Initiate the transmission of a Message 1 with NavStatus 14.

c) Acknowledge the alert.

d) Initiate the transmission of a Message 1 from the same user ID with NavStatus 14 within the time out.

e) Initiate the transmission of a Message 1 from the same user ID with NavStatus other than 14 within the time out.

f) Initiate the transmission of a Message 1 from different user ID with NavStatus 14.

18.1.5.3 Required results

Check that:

a) the MKD indicates the received message at the top of the target list and the EUT does not activate BIIT ID 14 or release related alert;

b) the MKD indicates the received message at the top of the target list and the EUT activates the BIIT ID 14, and releases appropriate alert as required in Table 4;

c) the EUT enters the appropriate acknowledge state;

d) the EUT does not re-activate BIIT ID 14 or the related alert;

e) the EUT does not re-activate BIIT ID 14 or the related alert;

f) the MKD indicates the received message at the top of the target list and the EUT does not re-activate BIIT ID 14 or the related alert.

18.2 Interrogation responses

18.2.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Apply an interrogation message (Message 15; EUT as destination) to the VDL according to Table 18 for responses with Message 5 and slot offset set to 10 on channel AIS 1. Record transmitted messages on both channels.

18.2.2 Required results

Check that EUT transmits the appropriate interrogation response message as requested on channel AIS 1. Repeat test for AIS 2.

19 Specific presentation interface tests

(See 7.6)

19.1 General

The EUT, including all necessary test equipment, shall be set up and checked that it is operational before testing commences.

The manufacturer shall provide sufficient technical documentation of the EUT and its interfaces in particular.

Where appropriate, tests according to various subclauses of Clause 19, as well as other clauses of this document, may be carried out simultaneously.

19.2 Checking manufacturer's documentation

The following checks for formal consistency and compliance shall be made for all ports:

- approved sentences against IEC 61162-1;
- proprietary sentences against IEC 61162-1;

- usage of fields as required for different functions including provided default values or settings;
- transmission intervals against IEC 61162-1 and IEC 61162-2;
- configuration of hardware and software if this is relevant to the interface performance and port selection.

The following checks shall be made for compliance with IEC 61162-1 and IEC 61162-2:

- output drive capability;
- load on the line of inputs;
- electrical isolation of input circuits.

19.3 Electrical test

19.3.1 Method of measurement

Input/output ports configured in accordance with IEC 61162-1 or IEC 61162-2 shall be tested according to the relevant standard with regard to minimum and maximum voltage and current at the input terminals.

19.3.2 Required results

The interfaces shall fulfil the requirements of the relevant standards.

19.4 Test of input sensor interface performance

19.4.1 Method of measurement

Connect all inputs and outputs of the EUT as specified by the manufacturer and simulate VDL-messages using the test system. Operate inputs with simulated sensor data that are both the relevant data and additional data with formatters not provided for the relevant input. Each sensor input shall be loaded with 70 % to 80 % of the interface's capacity. Record the VDL and output from the EUT's high-speed port.

19.4.2 Required results

Verify that the output on the VDL and the presentation interface agree with the simulated input and that all output data is transmitted without loss or additional delay.

19.5 Test of sensor input

19.5.1 Test of GNS input

19.5.1.1 Method of measurement

Set up the standard test environment and apply a GNS sentence with simulated sensor data. Record VDL output as follows.

a) Set mode indicator to AA (Autonomous).
b) Set mode indicator to AD, DA and DD (Differential).
c) Set mode indicator to P (Precise)
d) Set mode indicator to E (Estimated).
e) Set mode indicator to M (Manual).
f) Set mode indicator to S (Simulator).
g) Set mode indicator to N and NN (Data not valid).
h) Set mode indicator to A (GPS Autonomous) and time stamp field null.

Record the VDL position reports and evaluate the contents (Position, PA flag, RAIM flag and time stamp).

19.5.1.2 Required results

Confirm that:

a) all of the content is correct and PA flag = 0;
b) all of the content is correct and PA flag = 1;
c) all of the content is correct and PA flag = 1;
d) external position is not used or time-stamp = 62;
e) external position is not used or time-stamp = 61;
f) the external position is not used;
g) the external position is not used;
h) all of the content is correct and PA flag = 0 and time stamp = 60.

19.5.2 Test of RMC input

19.5.2.1 Method of measurement

Set up standard test environment and apply an RMC sentence with simulated sensor data.

a) Set status to valid and mode indicator to A (Autonomous).
b) Set mode indicator to D (Differential).
c) Set mode indicator to P (Precise).
d) Set mode indicator to E (Estimated).
e) Set Mode indicator to M (Manual).
f) Set mode indicator to S (Simulator).
g) Set status to invalid and mode indicator to N (Data not valid).
h) Set mode indicator to A (Autonomous) and time stamp field null.

Record the VDL position reports and evaluate the contents (Position, PA flag, RAIM flag, time stamp, SOG and COG).

19.5.2.2 Required results

Confirm that:

a) all of the content is correct and PA flag = 0;
b) all of the content is correct and PA flag = 1;
c) all of the content is correct and PA flag = 1;
d) external position and SOG/COG are not used or time-stamp = 62;
e) external position and SOG/COG are not used or time-stamp = 61;
f) external position and SOG/COG are not used;
g) external position and SOG/COG are not used;
h) all of the content is correct and PA flag = 0 and time stamp = 60.

19.5.3 Test of DTM input

19.5.3.1 Method of measurement

Set up standard test environment and apply a GNS and DTM sentence with simulated sensor data.

a) Set local datum in the DTM sentence to "W84", set Reference datum to other value than "W84".

b) Set local datum in the DTM sentence to other value than "W84".

c) Set local datum in the DTM sentence to "W84" again.

Repeat the test with RMC input.

Record the VDL position reports and evaluate the contents (Position, PA flag, RAIM flag and time stamp).

19.5.3.2 Required results

Confirm that:

a) the position data from the sensor input are used;

b) the position data from the sensor input are not used;

c) the position data from the sensor input are used.

19.5.4 Test of GBS input

19.5.4.1 Method of measurement

Set up the standard test environment and apply a GNS and GBS sentence with simulated sensor data. Set the position sentence to non-differential mode.

The expected RAIM error is calculated from expected error in longitude and expected error in latitude of the GBS sentence according to Table 8 as follows:

a) set expected RAIM error to a value ≤ 10 m;

b) set expected RAIM error to a value > 10 m;

c) remove the expected error in longitude and/or latitude (null field);

d) set the position sentence to differential mode. Set expected RAIM error to a value ≤ 10 m;

e) set expected RAIM error to a value > 10 m;

f) remove the expected error in longitude and/or latitude (null field).

Repeat the test with RMC input as position sentence.

Record the VDL position reports and evaluate the contents (Position, PA flag, RAIM flag and time stamp).

19.5.4.2 Required results

Confirm that:

a) RAIM flag = 1 and PA flag = 1;

b) RAIM flag = 1 and PA flag = 0;

c) RAIM flag = 0 and PA flag = 0;

d) RAIM flag = 1 and PA flag = 1;

e) RAIM flag = 1 and PA flag = 0;

f) RAIM flag = 0 and PA flag = 1.

19.5.5 Test of VBW input

19.5.5.1 Method of measurement

Set up the standard test environment and apply a HDT and a VBW sentence with simulated sensor data.

NOTE The HDT sentence is applied additionally to the VBW sentence in order to make the calculation of SOG and COG.

a) Set status, ground speed, to valid.
b) Set status, ground speed, to invalid.
c) Set status, ground speed, to valid, set heading to invalid.
d) Set status, ground speed, to valid and remove transverse ground speed.

Record the VDL position reports and evaluate the contents (SOG and COG).

19.5.5.2 Required results

Confirm that:

a) SOG and COG are correctly calculated from VBW and HDT;
b) SOG and COG are set to default;
c) COG is set to default;
d) Confirm that SOG and COG are set to default.

19.5.6 Test of VTG input

19.5.6.1 Method of measurement

Set up the standard test environment and apply a VTG sentence with simulated sensor data.

a) Set mode indicator to a valid value.
b) Set mode indicator to "N" (data not valid).

Record the VDL position reports and evaluate the contents (SOG and COG).

19.5.6.2 Required results

Confirm that:

a) SOG and COG are correctly used;
b) SOG and COG are set to default.

19.5.7 Test of HDT/THS input

19.5.7.1 Method of measurement

Set up the standard test environment and apply a RMC and an HDT/THS sentence with simulated sensor data.

a) Set valid heading data in HDT/THS.
b) Remove heading data from HDT/THS.
c) Set SOG > 5 kn and heading data different from COG by > 45° for 5 min.

Record the VDL position reports and evaluate the contents (heading).

19.5.7.2 Required results

Confirm that:

a) the heading value is correct;
b) the heading value is set to default;
c) ALR 11 is activated.

19.5.8 Test of ROT input

19.5.8.1 Method of measurement

Set up standard test environment and apply a HDT and ROT sentence with simulated sensor data. Set talker ID of ROT = "TI". Set ROT status to valid ("A").

a) Set ROT to several values between 0°/min and 708°/min turning left and right.
b) Set ROT to a value of more than 708°/min turning left and right.
c) Set ROT status to invalid ("V").

Set the ROT status to valid again and set the ROT talker ID to "HE".

When ROT values are used do as in d), e), and f).

d) Set ROT to 9°/min turning left and right.
e) Set ROT to 11°/min turning left.
f) Set ROT to 11°/min turning right.

When ROT values are not used but are calculated from the HDT data, do as in g), h) and i).

g) Change the heading value in HDT to 9°/min and −9°/min.
h) Change the heading value in HDT to 11°/min.
i) Change the heading value in HDT to −11°/min.

Record the VDL position reports and evaluate the contents (ROT).

19.5.8.2 Required results

Confirm that:

a) the ROT value is calculated as defined in Table 9;
b) the ROT value is −126 turning left and 126 turning right;
c) ROT = default (–128) or 0 or ±127 if calculated from HDT;
d) ROT = 0;
e) ROT = −127;
f) ROT = 127;
g) ROT = 0;
h) ROT = −127;
i) ROT = 127.

19.5.9 Test of different inputs

19.5.9.1 Method of measurement

Set up the standard test environment and apply a GNS, VBW, HDT/THS and ROT sentence with simulated sensor data to the specified sensor inputs.

a) Apply RMC, VBW, HDT and ROT to sensor input 1.
b) Apply RMC, VBW, HDT and ROT to sensor input 2.
c) Apply RMC, VBW, HDT and ROT to sensor input 3.
d) Apply RMC to sensor input 1, VBW to sensor input 2, HDT and ROT to sensor input 3.

Record the VDL position reports and evaluate the contents of SOG and COG.

19.5.9.2 Required results

Confirm that:

a) all sensor data are correct;
b) all sensor data are correct;
c) all sensor data are correct;
d) all sensor data are correct.

19.5.10 Test of multiple inputs

19.5.10.1 Method of measurement

Check the manufacturer's documentation for the method of handling multiple sensor inputs, for instance:

- priority of sensor ports;
- assigning sensor sentences to ports by configuration.

Set up the standard test environment and apply RMC, VBW, HDT, THS and ROT sentences with different simulated sensor data to 2 or 3 sensor inputs. Record the VDL position reports and evaluate the contents.

19.5.10.2 Required results

Confirm that, for each parameter (position, SOG/COG, heading, ROT), the data from only one sentence is used, in accordance with the manufacturer's definition. Confirm that the heading and rate of turn values from sources used for position reports are output at the pilot port.

19.6 Test of high-speed output

19.6.1 Method of measurement

Set up the standard test environment and simulate VDL-position reports using the test system. Record output from the EUT's high-speed port (see Table 22).

19.6.2 Required results

Verify that the recorded message contents agree with the simulated VDL contents (VDM sentence), its own transmitted data (VDO sentence) and its own position, SOG, COG information derived from the internal position sensor and in accordance with the sentence specifications of IEC 61162-1.

19.7 High-speed output interface performance

19.7.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Increase the VDL load to > 90 % and apply input of heading with 10 sentences per second and input of rate of turn with 5 sentences per second. Record transmitted messages and check PI output of the EUT on the port for "external display" and the "auxiliary display/pilot port".

19.7.2 Required results

Confirm that EUT outputs all received messages to the PI and the "auxiliary display/pilot port". Verify, during VDL load > 90 %, that the sync timing, the Tx slots and the slot number in the CommState are correct. Confirm that heading and rate of turn sentences are output with a latency of less than 200 ms. Confirm that heading is output at a rate of 5 sentences per second and rate of turn is output at a rate of 1 sentence per second.

19.8 Output of undefined VDL messages

19.8.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Verify that AIS messages with undefined data contents according to Table 18 (Message type 28 or higher) are output by the PI. Repeat test for port "auxiliary display/pilot port".

19.8.2 Required results

Confirm that the EUT outputs all undefined received messages to the PI.

19.9 Test of high-speed input

19.9.1 General

Verify the configuration input by evaluation of the appropriate output sentence, either by response to the input sentence or as response to a query.

19.9.2 Test of VSD input sentence

19.9.2.1 Method of measurement

Set up standard test environment and apply VSD sentences with simulated configuration data to the high-speed ports.

a) Apply a VSD sentence, all fields with valid data, without preceding SSA sentence.
b) Set the Special Manoeuvre Indicator to "in special manoeuvre".
c) Set the Special Manoeuvre Indicator to "not in special manoeuvre".
d) Set the Special Manoeuvre Indicator to "not available".

19.9.2.2 Required results

Confirm that:

a) all data of the VSD sentence are accepted;
b) the EUT transmits Message 1 with the Special Manoeuvre Indicator set to 2;
c) the EUT transmits Message 1 with the Special Manoeuvre Indicator set to 1;
d) the EUT transmits Message 1 with the Special Manoeuvre Indicator set to 0.

19.9.3 Test of SSD input sentence

19.9.3.1 Method of measurement

Set up the standard test environment and apply the SSD sentences with simulated configuration data to the high-speed ports.

a) Apply an SSD sentence, all fields with valid data, without a preceding SSA sentence.
b) Apply an SSD sentence, all fields with valid data, with a preceding SSA sentence with incorrect signature.

c) Apply an SSD sentence, all fields with valid data, with a preceding SSA sentence with correct signature. The source identifier shall be "AI" and the dim/ref values of the internal GNSS.
d) Apply an SSD sentence, all fields with valid data, with a preceding SSA sentence with correct signature. The source identifier shall be different to "AI" and the dim/ref values of the external GNSS.
e) Query for SSD.

NOTE For the SSD sentence:

a) the source identifier "AI" means that the A, B, C, D values are related to the internal EPFS receiver;
b) any other source identifier means that the A, B, C, D values are related to the external EPFS.

19.9.3.2 Required results

Confirm that:

a) all data of the SSD sentence, except the DTE flag, are not accepted. Confirm that a NAK sentence is output with correct content and reason code 5;
b) all data of the SSD sentence, except the DTE flag, are not accepted. Confirm that a NAK sentence is output with correct content and reason code 5;
c) all data of the SSD sentence are accepted. Confirm that the dim/ref values are stored for the internal GNSS and used in message 5 with internal GNSS position source;
d) all data of the SSD sentence are accepted. Confirm that the dim/ref values are stored for the external GNSS and used in message 5 with external GNSS position source;
e) there are two SSD output sentence, one with source identifier "AI" and internal dim/ref data and one with source identifier of a valid external source with external dim/ref data.

19.9.4 Test of EPV input sentence

19.9.4.1 Method of measurement

Set up the standard test environment and apply EPV sentences with simulated configuration data to the high-speed ports.

a) Apply an EPV sentence for all property identifiers of protected data without a preceding SSA sentence.
b) Apply an EPV sentence for all property identifiers of unprotected data without a preceding SSA sentence.
c) Apply an EPV sentence with protected data with a preceding SSA sentence with an incorrect signature.
d) Apply an EPV sentence for all property identifiers of protected data with a preceding SSA sentence with a correct signature.

19.9.4.2 Required results

Confirm that:

a) the data of the EPV sentences are not accepted. Confirm that a NAK sentence is output with correct content and reason code 5;
b) the data of the EPV sentences are accepted;
c) the data of the EPV sentence are not accepted. Confirm that a NAK sentence is output with correct content and reason code 5;
d) the data of the EPV sentences are accepted.

19.9.5 Test of the pilot port access level

19.9.5.1 Method of measurement

Set up the standard test environment and apply an EPV sentence with property identifier 146 to the pilot port.

a) Set the pilot port access level to 0.
b) Set the pilot port access level to 1.
c) Try to set the pilot port access level back to 0 without preceding SSA sentence.
d) Set the pilot port access level to 0 with preceding SSA sentence.

19.9.5.2 Required results

Confirm that:

a) the EUT accepts all input commands;
b) the EUT rejects all input commands other than the EPV sentence with property identifier 146;
c) the parameter value of property identifier 146 in EUT is not changed;
d) the parameter value of property identifier 146 in EUT is changed to 0.

20 Long-range functionality tests

20.1 Long-range application by two-way interface

(See 8.2)

20.1.1 LR interrogation

20.1.1.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Apply a LR addressed interrogation message to the LR-interface port of EUT. Record LR output port and AIS high-speed output port. Set the EUT to:

a) automatic response;
b) manual response via MKD;
c) manual response via PI.

20.1.1.2 Required results

Check that the EUT displays LR interrogation messages and sends them to PI. Check that the EUT outputs a LR position report message:

a) automatically (and indicates action on display);
b) after manual confirmation via MKD;
c) after manual confirmation via PI.

20.1.2 LR "all ships" interrogation

20.1.2.1 Method of measurement

Set up the standard test environment and operate EUT in autonomous mode. Apply a LR "all ships" interrogation message to the LR-interface port of EUT defining a geographical area which contains own ship's position. Record LR output port. Set EUT to:

a) automatic response;

b) manual response.

Repeat check with own ship outside specified area.

20.1.2.2 Required results

Check that EUT outputs a LR position report message:

a) automatically (and indicates action on display);
b) after manual confirmation.

No response shall be output on the repeat check.

20.1.3 Consecutive LR "all ships" interrogations

20.1.3.1 Method of measurement

Set up the standard test environment and operate the EUT in autonomous mode. Set the EUT to automatic mode. Apply 5 LR "all ships" interrogation messages to the LR-interface port of the EUT defining a geographical area, which contains the ship's own position.

Set the control flag in the LRI message to:

a) 0 (reply on first interrogation only);
b) 1 (reply on all applicable interrogations).

Record LR output port.

20.1.3.2 Required results

Check that the EUT outputs a LR position report message:

a) on the first interrogation only;
b) on all interrogations.

20.2 Long-range application by broadcast

(See 8.3)

20.2.1 Long-range broadcast

20.2.1.1 Method of measurement

Set up the standard test environment, enable the EUT to transmit Message 27 and operate the EUT in autonomous mode. Use base stations MMSI to transmit Message 4 and Message 23. Record the transmitted messages from the EUT. The designated long-range channels are defined in 8.3.

a) Do not apply Message 4 and Message 23.
b) Apply the Message 4 with the long-range control bit set to 1 and 0. Place the EUT inside the RF footprint (Message 4 receiving area) of a base station.
c) Apply the Message 4 with the long range control bit set to 1 and 0. Using the same MMSI as the Message 4, broadcast the Message 23 with station type 10 to define the base station coverage area. Place the EUT inside the RF footprint area, but outside the base station coverage area.
d) Apply the Message 4 with the long range control bit set to 1 and 0. Using the same MMSI as the Message 4, broadcast the Message 23 with station type 10 to define the base station coverage area. Place the EUT inside the base station coverage area. Message 23 fields after station type shall not match current settings of EUT.

e) Repeat the test d) using different MMSIs for Message 4 and Message 23.

f) Apply the Message 4 with the long-range control bit set to 0. Using the same MMSI as the Message 4, broadcast the Message 23 with station type 10 to define the base station coverage area. Place the EUT inside the base station coverage area. After 6 min, remove transmissions of Message 23.

g) Apply the Message 4 with the long-range control bit set to 0. Using the same MMSI as the Message 4, broadcast the Message 23 with station type 10 to define the base station coverage area. Place the EUT inside the base station coverage area. After 6 min, remove transmissions of Message 4.

20.2.1.2 Required results

Check that the EUT transmits the appropriate messages, for example in addition to the normal transmission of Messages 1 and 5 with adequate reporting interval on AIS 1 and AIS 2. Confirm that:

a) EUT transmits Message 27 alternating the designated long-range channels with 3 min reporting interval;

   irrespective of the Message 4 long range control bit status, EUT transmits Message 27 alternating on the designated long-range channels with 3 min reporting interval;

b) irrespective of the Message 4 long range control bit status, EUT transmits Message 27 alternating on the designated long-range channels with 3 min reporting interval;

c) EUT transmits Message 27 alternating on the designated long-range channels with 3 min reporting interval when the Message 4 long-range control bit is set to 1. EUT stops transmitting Message 27 when the Message 4 long-range control bit is set to 0. Verify fields after station type in received Message 23 are ignored;

d) irrespective of the Message 4 long range control bit status, EUT transmits Message 27 alternating on the designated long-range channels with 3 min reporting interval;

e) EUT begins transmission of Message 27 no sooner than 4 min and no later than 11 min (8 min timeout + 3 min transmission interval) after Message 23 was removed;

f) EUT begins transmission of Message 27 beyond 3 min after Message 4 was removed.

20.2.2 Multiple assignment operation

20.2.2.1 Method of measurement

Set up the standard test environment, enable the EUT to transmit Message 27 and operate the EUT in autonomous mode with a reporting interval of 10 s. Use base stations MMSI to transmit Message 4 and Message 23. Record the transmitted messages from the EUT.

a) Using different MMSIs, apply the Message 4 with long range control bit set to 1 and 0 from multiple base stations partially overlapping their RF footprints. Broadcast the Message 23 from multiple base stations with station type 10 to define the base station coverage areas not overlapping. Place the EUT inside the overlapped RF footprint area but outside the coverage area of both base stations.

b) Using different MMSIs, apply the Message 4 with long range control bit set to 1 and 0 from multiple base stations partially overlapping RF footprints. Broadcast the Message 23 from multiple base stations with station type 10 to define the base station coverage areas partially overlapping the base station coverage areas. Place the EUT inside the overlapped base station coverage area.

c) Using different MMSIs, apply the Message 4 with long range control bit set to 1 and 0 from multiple base stations partially overlapping RF footprints. Broadcast the Message 23 from one base station with station type 10 to define the base station coverage areas. Do not broadcast Message 23 from other base stations. Place the EUT inside the RF footprint area of base station not broadcasting Message 23 but outside the coverage area of the base station transmitting Message 23.

20.2.2.2 Required results

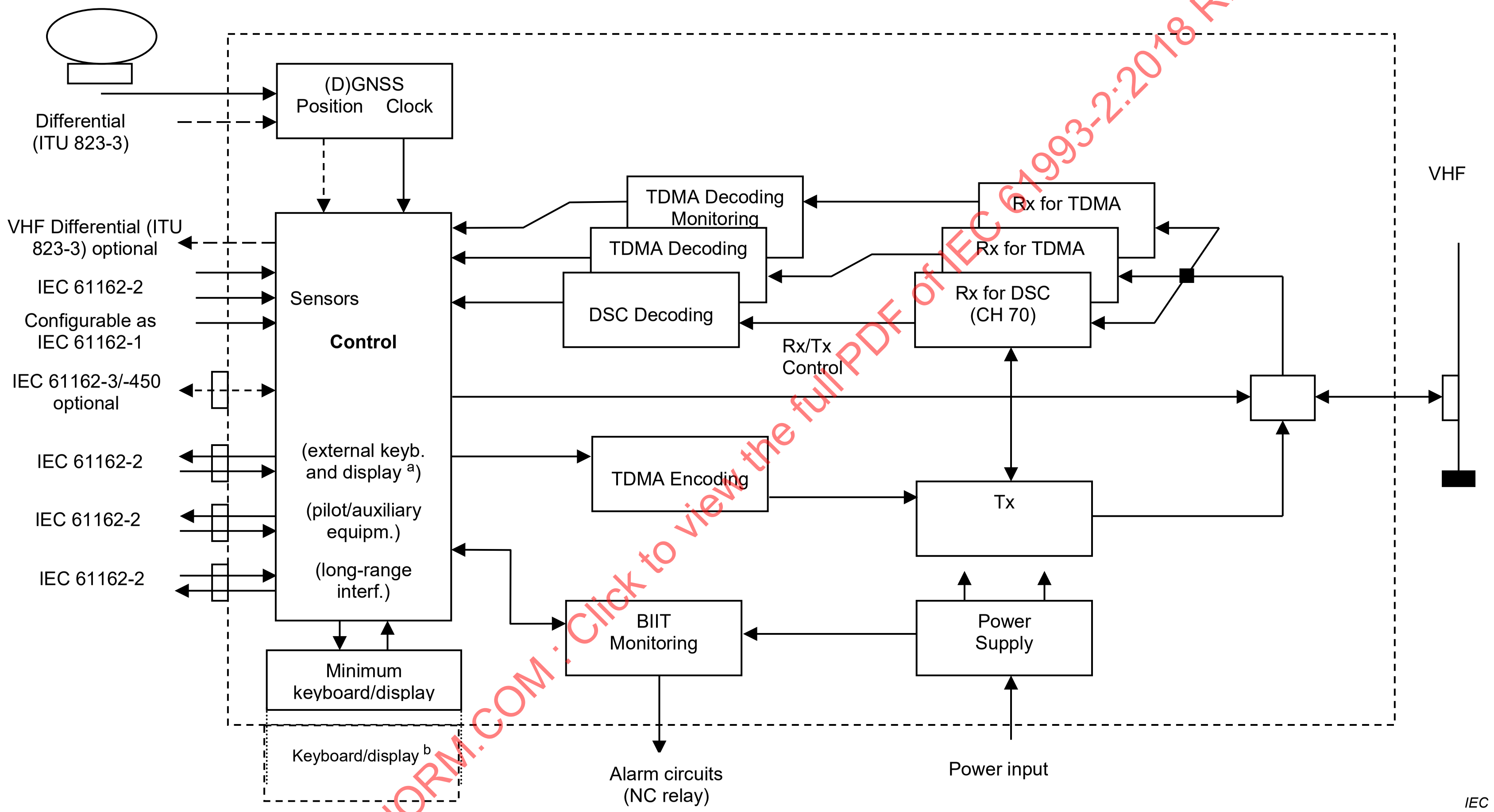
Verify that:

a) irrespective of the Message 4 long-range control bit status of both base stations, EUT transmits Message 27 alternating on the designated long-range channels with 3 min reporting interval;

b) EUT transmits Message 27;

c) irrespective of the Message 4 long range control bit status of both base stations, EUT transmits Message 27 alternating on the designated long-range channels with 3 min reporting interval.

Annex A
(informative)
Block diagram of AIS

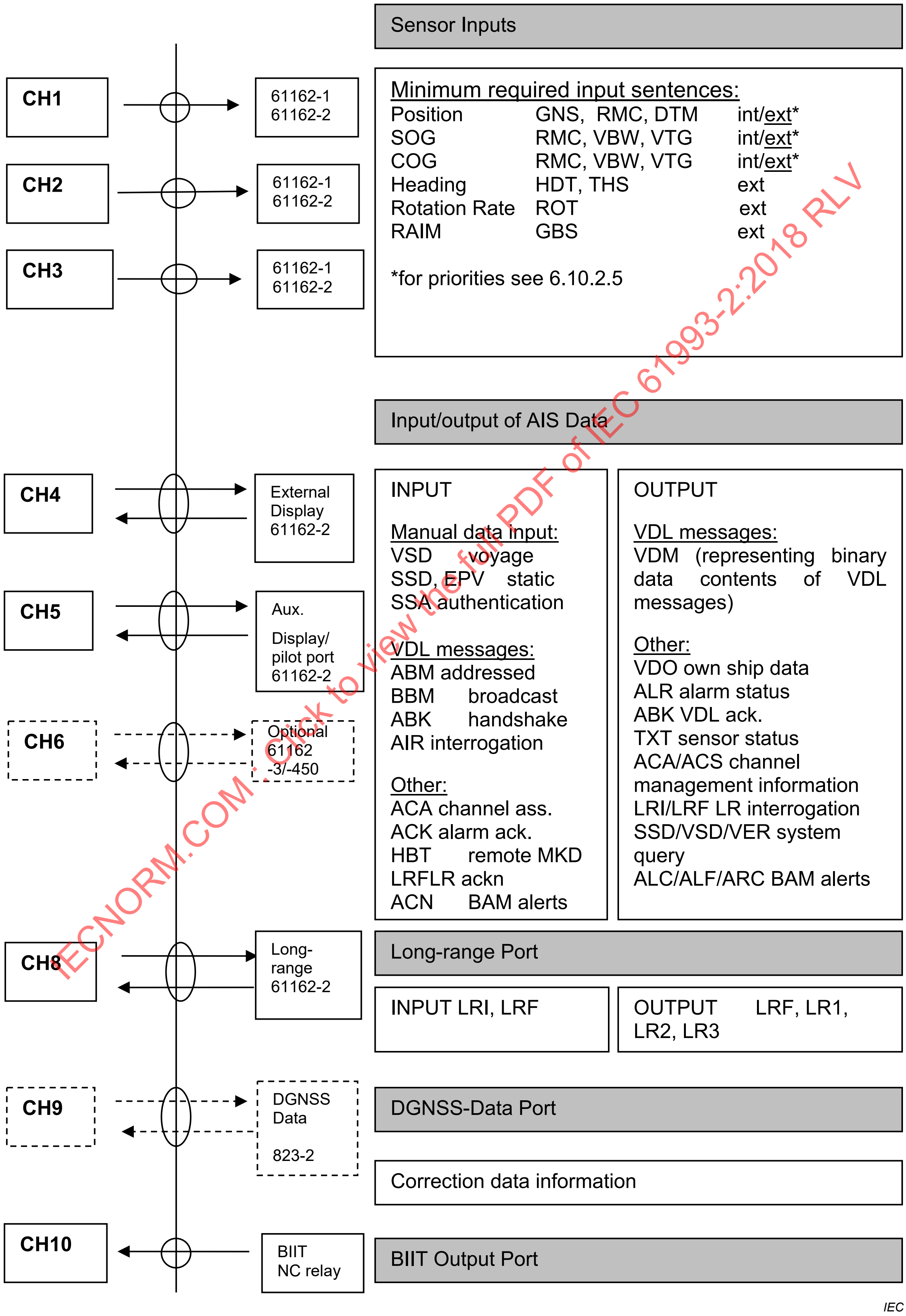


Key

[a] The external keyboard/display may be, for example, a radar, ECDIS or dedicated devices.

[b] The internal keyboard/display may optionally be remote.

Annex B
(normative)
AIS interface overview



Annex C
(normative)

DSC functionality

C.1 DSC compatibility

The Class A AIS shall be capable of receiving and processing DSC channel management telecommands conforming to the provisions of Recommendations ITU-R M.493, ITU-R M.541, ITU-R M.825 (see Recommendation ITU-R M.1371-5/A3). In order to accomplish this performance, the AIS device shall contain a dedicated DSC receiver that is tuned permanently to channel 70. However, the AIS device shall not accept the channel management command sent by stations with invalid base station MMSI as defined in 6.12.

For DSC channel management using geographical area calls, the end of sequence (EOS) character shall be EOS = 127 (no response requested). However, for compatibility, Class A AIS receivers shall respond to DSC channel management commands ending in "EOS = 127" and "EOS = 117 (RQ)" even though they are not capable of transmitting DSC acknowledgements.

C.2 DSC receiver tests

NOTE For DSC receiver test signal, refer to 10.1 test signal 1.

C.2.1 Maximum sensitivity

C.2.1.1 Definition

The maximum sensitivity of the receiver is the minimum level of the signal in dBm at the nominal frequency of the receiver which, when applied to the receiver input with a test modulation, will produce a bit error rate which does not exceed 10^{-2}.

C.2.1.2 Method of measurement

The test equipment shall be set to transmit test signal 1 (continuous DSC dot pattern) as the test modulation of the RF signal generator connected to the EUT. The frequency and level of the test equipment shall be 156,525 MHz (CH70) −107 dBm under normal condition and −101 dBm under extreme condition. The EUT shall provide a logic level test output from its internal DSC demodulator to measure bit error rate (BER). The test shall be repeated at the nominal carrier frequency 156,525 MHz ± 1,5 kHz offset under normal test condition.

C.2.1.3 Required results

The BER shall not exceed 10^{-2}.

C.2.2 Error behaviour at high input levels

C.2.2.1 Definition

The dynamic range of the equipment is the range from the minimum to the maximum level of a radio frequency input signal at which the bit error rate in the output of the receiver does not exceed a specified value.

C.2.2.2 Method of measurement

A test signal, in accordance with standard test signal number 1, shall be applied to the receiver input. The level of the test signal shall be −7 dBm.

C.2.2.3 Required results

The BER shall not exceed 10^{-2}.

C.2.3 Co-channel rejection

C.2.3.1 Definition

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at nominal frequency of the receiver.

C.2.3.2 Method of measurement

The wanted signal shall be standard test signal number 1. The level of the wanted signal shall be −104 dBm.

The unwanted signal shall be frequency modulated by 400 Hz with a deviation of ± 3 kHz. The input level of the unwanted signal shall be −114 dBm.

Both input signals shall be at the nominal frequency of the receiver under test and the measurement shall be repeated for displacements of the unwanted signal of up to ± 3 kHz.

C.2.3.3 Required results

The BER shall not exceed 10^{-2}.

C.2.4 Adjacent channel selectivity

C.2.4.1 Definition

The adjacent channel selectivity characterises the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal that differs in frequency from the wanted signal by 25 kHz.

C.2.4.2 Method of measurement

The wanted signal shall be standard test signal number 1. The level of the wanted signal shall be −104 dBm.

The unwanted signal shall be frequency modulated by 400 Hz with a deviation of ±3 kHz. The input level of the unwanted signal shall be −34 dBm. The unwanted signal shall be tuned to the centre frequency of the upper adjacent channels (156,550 MHz) and lower adjacent channel (156,500 MHz).

Repeat the test under extreme condition with the wanted signal level of −98 dBm and unwanted signal level of −38 dBm.

C.2.4.3 Required results

The BER shall not exceed 10^{-2}.

C.2.5 Spurious response rejection

C.2.5.1 Definition

The spurious response characterises the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal with frequencies outside the band of the receiver.

C.2.5.2 Manufacturers' declarations

The manufacturers shall declare the following in order to calculate the "limited frequency range":

- list of intermediate frequencies: (IF_1, IF_2, ...IF_N) in Hz;
- frequency of the local oscillator at 156,525 MHz.

NOTE This can be a VCO, crystal, sampling clock, BFO, numerically controlled oscillator depending on the design of the equipment.

C.2.5.3 Introduction to the method of measurement

The measurement shall be performed over the "limited frequency range" and at the "specific frequencies of interest" (as defined below).

To determine the frequencies at which spurious responses can occur, the following calculations shall be made:

a) calculation of the "limited frequency range"

the limits of the limited frequency range (LFR) are determined from the following calculations:

$$\text{LFR} = f_{\text{LO}} \pm (IF_1 + IF_2 + \ldots + IFN)$$

b) calculation of specific frequencies of interest (SFI) outside the limited frequency range:

this is determined by the following calculations:

$$\text{SFI} = (K \times f_{\text{LO}}) \pm IF_1$$

where

K is an integer from 2 to 4;

f_{LO} is the local frequency at CH70.

C.2.5.4 Method of measurement

The wanted signal shall be standard test signal number 1. The level of the wanted signal shall be −104 dBm.

The unwanted signal shall be unmodulated. The frequency shall be varied in steps of 5 kHz over the limited frequency range (LFR) and the specific frequency of interest (SFI). The level of the unwanted signal shall be −34 dBm.

C.2.5.5 Required results

At any frequency separated from the nominal frequency of the receiver by two channels or more, the BER shall not exceed 10^{-2}.

C.2.6 Intermodulation response rejection

C.2.6.1 Definition

The intermodulation response ratio characterises the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

C.2.6.2 Method of measurement

The wanted signal represented by signal generator A (see Figure C.1) shall be at the nominal frequency of the receiver and shall be standard test signal number 1. The level of the wanted signal shall be −104 dBm.

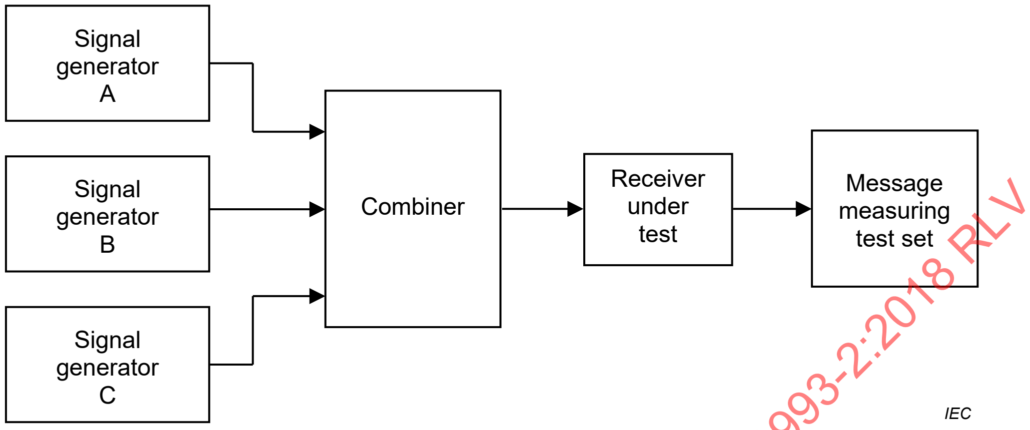


Figure C.1 – Measurement arrangement for inter-modulation

The unwanted signal from signal generator B (see Figure C.1) shall be unmodulated and adjusted to a frequency 50 kHz above the nominal frequency of the receiver. The second unwanted signal from signal generator C (see Figure C.1) shall be modulated by 400 Hz with a deviation of ±3 kHz and adjusted to a frequency 100 kHz above the nominal frequency of the receiver. The input level of each unwanted signal shall be −39 dBm. The test shall be repeated with the frequency of the unwanted signals below the nominal frequency of the receiver.

C.2.6.3 Required results

The BER shall not exceed 10^{-2}.

C.2.7 Blocking or desensitisation

C.2.7.1 Definition

The blocking immunity characterises the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal with frequencies outside the band of the receiver.

C.2.7.2 Method of measurement

The wanted signal shall be standard test signal number 1. The level of the wanted signal shall be −104 dBm.

The unwanted signal shall be unmodulated. The frequency shall be at −10 MHz and −1 MHz and also at +1 MHz and +10 MHz relative to the nominal frequency of the wanted signal. The level of the unwanted signal shall be −20 dBm.

C.2.7.3 Required results

The BER shall not exceed 10^{-2}.

C.2.8 Conducted spurious emissions from the receiver

C.2.8.1 Definition

Conducted spurious emissions to the antenna are any RF emissions generated in the receiver and conveyed to the antenna terminal. This test shall apply only if a dedicated DSC receiver antenna connector is provided.

C.2.8.2 Method of measurement

Conducted spurious emissions shall be measured as the power level of any frequency component to the antenna terminals of the receiver. The receiver antenna terminals are conducted to a spectrum analyser or selective voltmeter having an input impedance of 50 Ω and the receiver is switched on.

If the detecting device is not calibrated in terms of power input, the level of any detected components shall be determined by a substitution method using a signal generator. The measurement shall extend over the frequency range 9 kHz to 4 GHz.

C.2.8.3 Required results

The power of any spurious emission in the specified range at the antenna terminal shall not exceed −57 dBm (2 nW) in the frequency range 9 kHz to 1 GHz and −47 dBm (20 nW) in the frequency range 1 GHz to 4 GHz.

C.3 DSC functionality tests

C.3.1 Definition

The EUT shall correctly process the channel management command by DSC messages addressed to the stations in the designated geographical area or the stations individually designated.

C.3.2 Method of measurement

For the tests in Clause C.3, set the EUT into autonomous mode using channels AIS 1 and AIS 2 with a reporting interval of 2 s. Standard AIS channel management by DSC calls, consisting of format specifier 103 and message symbol number 104 with expansion symbols 09, 10, 12, 13, shall be applied to the EUT using a base station MMSI as follows.

a) Apply a geographical channel management call using symbol constructions: "103" "geographical coordinates" "103" "source MMSI" "104" "primary CH No" "secondary CH No" "NE of CH management area" "SW of CH management area". Apply the call with EOS = 117 and EOS = 127.
b) Move the EUT outside the channel management area.
c) Apply an individual channel management call using symbol constructions: "120" "EUT MMSI" "103" "source MMSI" "104" "primary CH No" "secondary CH No" "NE of CH management area" "SW of CH management area". Apply the call with EOS = 117 and EOS = 127.
d) Move the EUT outside the channel management area.
e) Apply an incorrect MMSI, position outside addressed geographic area, different course, or ship type.
f) Apply an extraneous call using symbol constructions: "120" "EUT MMSI" "103" "source MMSI" "104" "03" "01" "120" (active alternative system with group number 1 and sequence number 120). Transmit a DSC telecommand using a non-base station MMSI.

C.3.3 Required results

The following items shall be verified.

a) Verify that the EUT operates on the designated channels with the transition boundary of 5 NM.

b) Verify that the EUT reverts to the operation on AIS 1 and AIS 2 channels.

c) Verify that the EUT operates on the designated channels with the transition boundary of 5 NM.

d) Verify that the EUT reverts to the operation on AIS 1 and AIS 2 channels.

e) Verify that the EUT operation is not affected.

f) Verify that the EUT operation is not affected.

Annex D
(informative)

Alert handling with ALR/ACK

This annex provides an abstract of the alert handling as it is currently implemented in IEC 61993-2:2012, based on the data exchange using the ALR and ACK sentences.

The handling of an alert can be described in a state diagram. For each individual alert, an individual alert state has to be managed.

An alert can take up 3 different states, as described in Table D.1.

Table D.1 – IEC 61993-2:2012 alert states

State	Description	Relay	Indication
Normal	The alert condition is not exceeded.	Off	The alert is not displayed The alert is not in the alert list.
Active	The alert condition is exceeded. The alert is not yet acknowledged.	On	The alert is displayed. The alert is in the alert list.
Acknowledged	The alert condition is exceeded. The alert has been acknowledged.	Off	The alert is not displayed. The alert is in the alert list.

The reaction on possible events is described in Table D.2.

Table D.2 – IEC 61993-2:2012 alert events

Event	Old state	Reaction	New state
Alert condition exceeded	Normal	Output ALR with status A,V, Relay is activated, Alert is displayed on MKD, Alert is added to the alert list	Active
Alert condition is rectified	Active	Output ALR with status V,V, Relay is deactivated, if no other alert is in state "Active", Alert is removed from MKD, Alert is removed from the alert list	Normal
ACK with the correct Alert ID is received or Acknowledgement on MKD	Active	Output ALR with status A,A, Relay is deactivated, if no other alert is in state "Active", Alert is removed from MKD, Alert remains in the alert list	Acknowledged
Alert condition is rectified	Acknowledged	Output ALR with status V,V, Alert is removed from the alert list	Normal

A fourth state "Rectified, unacknowledged" may also be implemented.

A state diagram is given in Figure D.1.

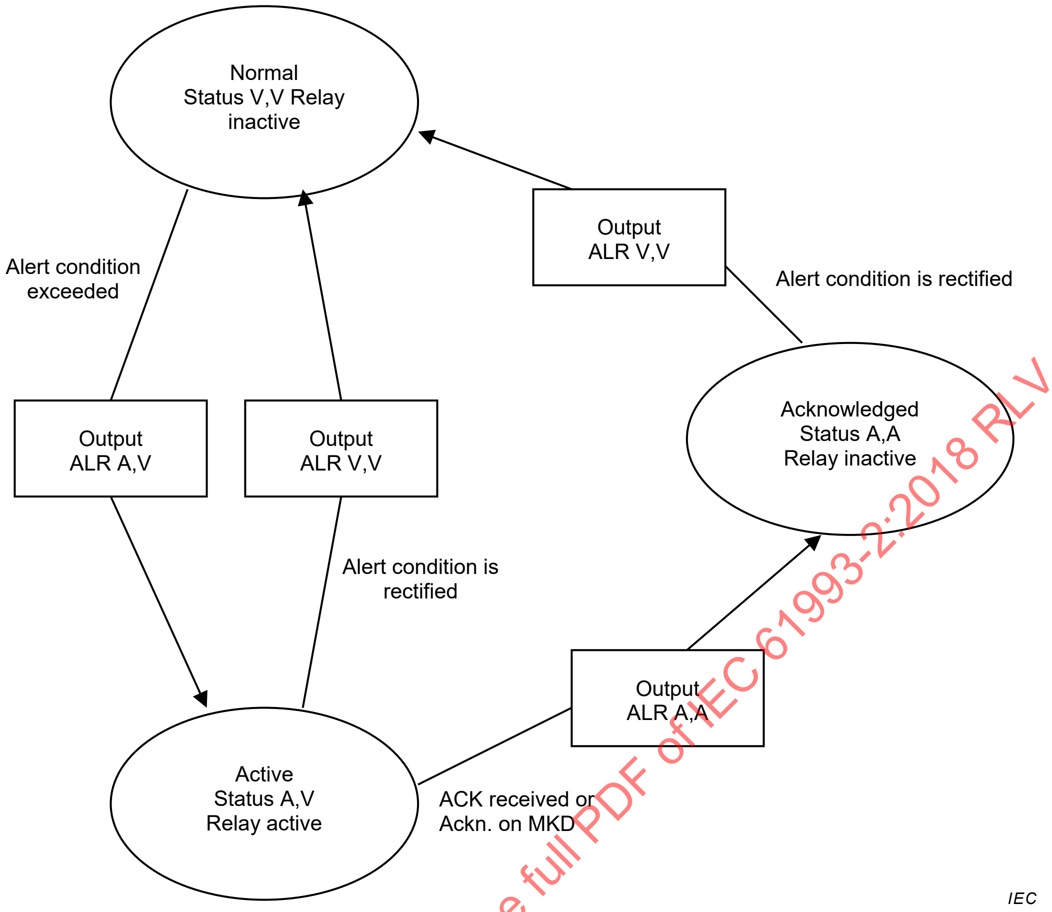


Figure D.1 – State diagram of IEC 61993-2 Ed.2 Alert handling

Further requirements are as follows.

- The alert list is output every 30 s, consisting of one ALR sentence for each active alert in the alert list.
- If the alert list is empty, a "No alerts" sentence is output every 60 s. It has the format: $AIALR,,,V,V,*hh <CR><LF>.

Annex E
(normative)

Calculation of area size and distance

E.1 Importance of a common method for area size and distance calculations

An AIS unit needs to calculate distances with regard to many aspects. Many of these distances are paramount to how the AIS unit should operate in certain situations. This includes (but is not limited to) calculating the distance between the vessel and other vessels within radio range, channel management areas (sizes and distance from its boundaries) and interrogation areas. Annex E specifies the methods allowed to use with regard to the different distance and size calculations.

E.2 Calculation of area sizes

To calculate the size of the areas given in Message 22 and Message 23, along with the channel management message sent by DSC, the following method shall be used.

Coordinates of NE and SW points of the area are given in Table E.1.

Table E.1 – Coordinate points

Corner	Latitude	Longitude
NE	a deg, b min	c deg, d min
SW	e deg, f min	g deg, h min

The length around equator (L_E) is defined in Equation (E.1).

The length of the NE-NW side ($L_{NE\text{-}NW}$) is defined in Equation (E.2).

The length of the SE-SW side ($L_{SE\text{-}SW}$) is defined in Equation (E.3).

The length of the polar circumference (L_P) is defined in Equation (E.4).

The length of the NE-SE ($L_{NE\text{-}SE}$) and NW-SW ($L_{NW\text{-}SW}$) is defined in Equation (E.5).

$$L_E = 40\ 075{,}017\ (\text{km})/1{,}852\ (\text{km/NM}) = 21\ 638{,}778\ (\text{NM}) \tag{E.1}$$

$$L_{NE\text{-}NW} = ((c + d/60) - (g + h/60)) \times (L_E \times \cos(a + b/60))/360\ (\text{NM}) \tag{E.2}$$

$$L_{SE\text{-}SW} = ((c + d/60) - (g + h/60)) \times (L_E \times \cos(e + f/60))/360\ (\text{NM}) \tag{E.3}$$

$$L_P = 40\ 007{,}863\ (\text{km})/1{,}852\ (\text{km/NM}) = 21\ 602{,}518\ (\text{NM}) \tag{E.4}$$

$$L_{NE\text{-}SE} = L_{NW\text{-}SW} = ((a + b/60) - (e + f/60)) \times L_P/360\ (\text{NM}) \tag{E.5}$$

To achieve the required accuracy in these calculations, the calculation resolution needs to have at least 3 fractional digits (i.e. 16-bit floating point).

E.3 Calculation of general distances

E.3.1 General

Two methods are acceptable for distance calculations. These are Great-circle calculation and Rhumb-Line (Loxodrome) calculation.

E.3.2 Great-circle

Great-circle (big-circle) distance is the shortest distance between two points on the surface of a sphere, measuring along the surface of the sphere. A floating point resolution of 32 bits is recommended.

The Haversine formula for calculating great-circle distance is given in Equation (E.6).

$$d = 2r\,\text{asin}\left(\sqrt{\sin^2\left(\frac{lat2-lat1}{2}\right)+\cos(lat1)\cos(lat2)\sin^2\left(\frac{lon2-lon1}{2}\right)}\right) \quad \text{(E.6)}$$

where

d is the great-circle distance between the positions *lat*1, *lon*1 and *lat*2, *lon*2;

r is the Earth's mean radius, which is 6 371,009 km (3 440,069 65 NM).

Equation (E.6) is computationally intensive. A quicker way of doing Great-circle distance calculations would be to use the law of cosines for spherical trigonometry given in Equation (E.7).

$$d = r\,a\cos\left(\sin(lat1)\sin\,(lat2)+\cos\,(lat1)\,\cos\,(lat1)\,\cos\,(lat2)\,\cos\,(lon2-lon1)\right) \quad \text{(E.7)}$$

Although mathematically sane, the arcus cosine function is not sufficiently accurate on most computer systems and leads to inaccuracies when the distances are short, henceforth a lookup table for arcus cosine should be used with 32-bit floating point resolution to maintain accuracy.

E.3.3 Rhumb-line distance

A rhumb-line (loxodrome) is a line that crosses all the meridians of longitude at the same angle. This gives the benefit of having a fixed course for the entire distance calculated. Rhumb-line calculation can be used directly in Mercator maps. The stretched latitude difference is given in Equation (E.8), and the rhumb-line distance in Equation (E.9).

$$\Delta\phi = \ln\left(\frac{\tan\left(\frac{lat2}{2}+\frac{\pi}{4}\right)}{\tan\left(\frac{lat1}{2}\right)+\frac{\pi}{4}}\right) \quad \text{(E.8)}$$

$$d = r\sqrt{(\Delta lat^2 + \left(\frac{\Delta lat}{\Delta\phi}\right)^2\ \Delta lon^2)} \quad \text{(E.9)}$$

The rhumb-line method is not as precise as big-circle method at the same calculation resolution. However, for all distances critical to the mobile unit, the difference is negligible.

Annex F
(normative)

New interface sentences – Sender signature authentication (SSA)

This sentence can be used both for authentication of sender and for authentication of un-tampered content. For this purpose, the sentence has to be applied before the protected sentence (for example EPV, SSD).

Other sentences shall not be interleaved between the sender signature authentication sentence and protected sentence, and the time between the SSA and the protected sentence should be limited. The sender signature authentication protected sentence pair shall be sent without unnecessary delay between sentences, and the time interval between the sentences shall not exceed 2 s. Note that any of the sentences may be lost and timed out.

For sentences sent over the IEC 61162-450 interface, the SSA sentence and the protected sentence shall be grouped using the parameter code "g" for TAG Block Grouping Control.

If the SSA is not accepted (for example because the authentication of the signature does not pass, or because time interval between SSA and protected sentence exceeded allowed time), the receiving device shall generate a NAK sentence with the reason code set to 5, and the associated protected sentence shall not be processed. However, if the SSA is valid and accepted, and a problem exists with the associated protected sentence (for example EPV or SSD), then an appropriate NAK reason code that identifies the problem with the protected sentence shall be returned.

$--SSA,ccc,c,h--h*hh<CR><LF>

Signature authentication 3)
Signature calculation method 2)
Signature protected sentence 1)

Comments:

1) The following sentence formatter that should be protected (for example EPV or SSD).
2) Type of method to calculate signature:
   1: MD5
   P: Proprietary
3) Hexadecimal representation of the signature, for example 32 hexacodes for MD5

Types of methods to calculate signature:

1) MD5

   The signature is a MD5 digest of the password plus the message. MD5 is a one-way Message-Digest algorithm (RFC 1321). The full length of the signature is 128 bits or 32 hexadecimal codes. The MD5 is commonly used for storing passwords in Unix-systems. Revealing the digest does not expose the password.

   NOTE See http://tools.ietf.org/html/rfc1321 and http://en.wikipedia.org/wiki/MD5.

P) Proprietary

   The signature is a proprietary digest of the password plus the message. This alternative requires that both parties use the same manufacturer specified proprietary method.

Signature is calculated by concatenating pre-shared key and sentence in the message as a single string to be used by the method of the signature calculation to produce the signature digest. Note that 'Carriage Return', 'Line Feed' and checksum with delimiter ('*') from the sentence are not included into the input string.

The signature in the SSA sentence may be shorter than the full hash. In that case the signature represents the first bytes of the hash. Minimum is first 8 most significant bytes of the hash. The pre-shared key is stored on both the sender and receiver beforehand using a secure method (for example, manual entry).

Example 1:

If the payload is "$RAEPV,C,AI,000000000,106,265024000*07" and the pre-shared key is "Alea iacta est" then the concatenation is:

Alea iacta est$RAEPV,C,AI,000000000,106,265024000

MD5 hash of this payload is:

6B112D72058A3EDECFD01D03522BE0B7

Thus, in case of MD5 following sentences would be transmitted:

$RASSA,EPV,2,6B112D72058A3EDECFD01D03522BE0B7*73<CR><LF>

$RAEPV,C,AI,000000000,106,265024000*07<CR><LF>

Example 2:

The setting of the MMSI number for a vessel like this:

MMSI = 265024000

IMO = 8320767

Pre-shared key = "Alea iacta est"

Use of MD5 produces sentences below for minimum first 8 bytes (i.e. 16 hexadecimal characters) of the MD5 hash:

$RASSA,EPV,2,6B112D72058A3EDE*03<CR><LF>

$RAEPV,C,AI,000000000,106,265024000*07<CR><LF>

$RASSA,EPV,2,81DA845E6BDF0A32*79<CR><LF>

$RAEPV,C,AI,265024000,107,8320767*09<CR><LF>

Annex G
(normative)

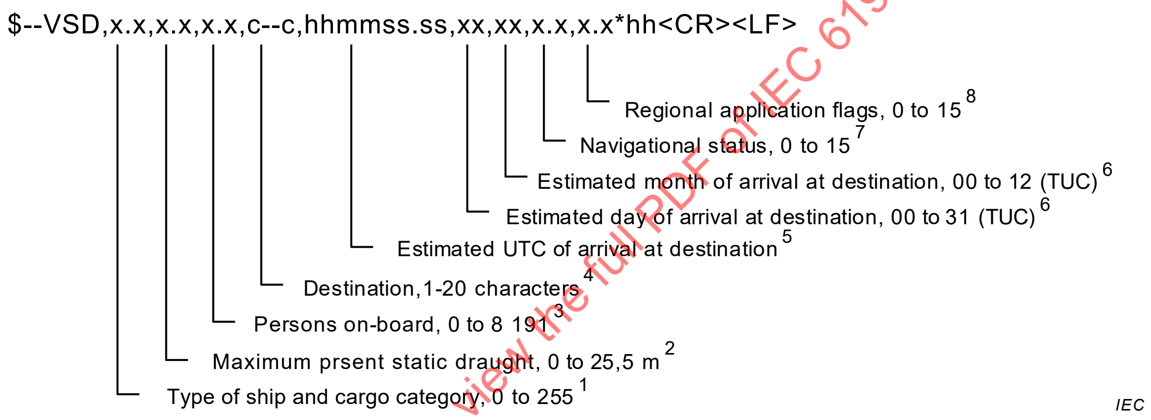
Updated interface sentences

G.1 General

Annex G updates the comments 7 and 8 of the sentence VSD to ITU-R M.1371-5. The update also corrects an editorial error in IEC 61162-1:2016 regarding the Navigational status field which was incorrectly printed as "Regional application flag".

G.2 VSD – AIS voyage static data

This sentence is used to enter information about a ship's transit that remains relatively static during the voyage. However, the information often changes from voyage to voyage. The parameters in this sentence support a number of the ITU-R M.1371 messages.



Comments:

1) Type of ship and cargo category are defined under Message 5 of ITU-R M.1371. The description of ship and cargo are indicated by a number. A null field indicates that this is unchanged.

2) The draught is reported in units of metres. Valid range is 0 to 25,5. The value 0 = not available, and the value 25,5 indicates that the draught is 25,5 m or more. A null field indicates that this is unchanged.

3) Current number of persons on-board, including crew. Valid range is 0 to 8 191. The value 0 = not available, and the value 8 191 = 8 191 or more people. A null field indicates that this is unchanged.

4) The characters that can be used in the destination are listed in the ITU-R M.1371 6 bit ASCII. Some of these characters are reserved characters in Table 1 of IEC 61162-1 Ed.5. These characters should be represented using the "^" method (see 7.1.4 of IEC 61162-1 Ed.5). A null field indicates that the previously entered destination is unchanged. The string of characters "@@@@@@@@@@@@@@@@@@@@" are used to indicate that the ship's destination is not available.

5) If the hour of arrival is not available, "hh" should be set to 24. If the minute of arrival is not available, "mm" should be set to 60. The seconds option "ss.ss" of the field may be set to "00" as the AIS unit only broadcasts hours and minutes. A null field indicates that this is unchanged.

6) The day and month of arrival are in UTC. The field is a fixed two-digit number requiring leading zeros. If the day of arrival is not available, "00" should be the number for the day. If the month of arrival is not available, "00" should be the number for the month. A null field indicates that this is unchanged.

7) The navigational status is indicated using the following values; a null field indicates the status is unchanged (reference ITU-R M.1371, Message 1, navigational status parameter):

0 = under way using engine	6 = aground	11 = power-driven vessel towing astern (regional use)
1 = at anchor	7 = engaged in fishing	12 = power-driven vessel pushing ahead or towing alongside (regional use)
2 = not under command	8 = under way sailing	13 = reserved for future use
3 = restricted manoeuvrability	9 = reserved for high speed craft	14 = AIS-SART (active), MOB-AIS, EPIRB-AIS
4 = constrained by draught	10 = reserved for wing in ground	15 = undefined = default (also used by AIS-SART, MOB-AIS, and EPIRB-AIS under test)
5 = moored		

For the values of 11 or 12, additional dimension extension values reflecting the actual tow configuration should be provided to the AIS by using the EPV sentence.

8) This field is used by AIS devices designed to ITU-R M.1371-3 or later, and supports regional passing arrangements on inland waterways and other special manoeuvres. A null field indicates that this is unchanged.

0 = not available = default

4 = not engaged in special manoeuvre

8 = engaged in special manoeuvre

12 = undefined (as of ITU-R M.1371-5)

Other values shall not be used.

Annex H
(informative)

Conversion between IEC 61162-1 sentences and IEC 61162-3 parameter group numbers

Table H.1 gives minimum equivalents for transferring data over IEC 61162-1 interfaces and IEC 61162-3 interfaces.

Table H.1 – Conversion between IEC 61162-1 and IEC 61162-3

IEC 61162-1/NMEA 0183 sentences		IEC 61162-3 PGNs	
ABK	AIS addressed and binary broadcast acknowledgment	129796	AIS acknowledge
ABM	AIS addressed binary and safety related	129801	AIS addressed safety related message
		129795	AIS addressed binary message
ACA	AIS channel assignment message	129806	AIS channel management
AIR	AIS interrogation request	129803	AIS interrogation
BBM	AIS broadcast binary message	129797	AIS binary broadcast message
		129802	AIS safety related broadcast message
DTM	Datum reference	129044	Datum
		129045	User datum setting
GBS	GNSS satellite fault detection	129545	GNSS RAIM output
GGA	Global positioning system (GPS) fix data	129025	Position, rapid update
		129029	GNSS position data
GLL	Geographic position – Latitude/longitude	129025	Position, rapid update
		129029	GNSS position data
GNS	GNSS fix data	129025	Position, rapid update
		129029	GNSS position data
HDT	Heading true	127250	Vessel heading
NAK	Negative acknowledgement	126208	Acknowledge group function
RMC	Recommended minimum specific GNSS data	129025	Position, rapid update
		129026	COG and SOG, rapid update
		129029	GNSS position data
ROT	Rate of turn	127251	Rate of turn
SSD	AIS ship static data	129794	AIS Class A static and voyage related data
THS	True heading and status	127250	Vessel heading
		130577	Direction data
VBW	Dual ground/water speed	128259	Speed, water referenced
		130577	Direction data
		130578	Vessel speed components

IEC 61162-1/NMEA 0183 sentences		IEC 61162-3 PGNs	
VDM / VDO	AIS VHF data-link message/ AIS VHF data-link own vessel report	129038	AIS Class A position report
		129039	AIS Class B position report
		129040	AIS Class B extended report
		129041	AIS aids to navigation (AtoN) report
		129792	AIS DGNSS broadcast binary message
		129793	AIS UTC and date report
		129794	AIS Class A static and voyage related data
		129795	AIS addressed binary message
		129796	AIS acknowledge
		129797	AIS binary broadcast message
		129798	AIS SAR aircraft position report
		129800	AIS UTC/Date inquiry
		129801	AIS addressed safety related message
		129802	AIS safety related broadcast message
		129803	AIS interrogation
		129804	AIS assignment mode command
		129805	AIS data link management message
		129806	AIS channel management
		129807	AIS group assignment
		129809	AIS Class B "CS" static data report, Part A
		129810	AIS Class B "CS" static data report, Part B
		129811	AIS single slot binary message
		129812	AIS multi slot binary message
		129813	AIS long-range broadcast message
VSD	AIS voyage static data	129794	AIS Class A static and voyage related data
VTG	Course over ground and ground speed	129026	COG and SOG, rapid update
		130577	Direction data

Annex I
(normative)

Extended tow dimension values

I.1 Purpose and background

It is beneficial to navigation safety for the true dimensions of vessels to be available via AIS Message 5. Currently, the ABCD values in Message 5 are difficult to change once set, requiring a password that may not be available to the vessel navigator.

This is not a problem for most vessels, except those engaged in towing operations by pushing ahead or alongside (navigational status is 12). In these instances, it may be desirable to provide easier access to and modification of vessel dimension values.

The method described in Annex I facilitates the entry of extensions to the static vessel dimensions to communicate the true size of a vessel and its tows, when the navigational status is 12.

I.2 Method

The transmission of extended tow dimension values is accomplished through property identifiers 150 to 153 which are not password-protected. The AIS Class-A shall incorporate the tow dimension values as extensions to the baseline ABCD values (see Figure I.1) of the towing vessel. The resulting values (including the base line values and respective extension values) are transmitted via Message 5.

The following definitions support the input of data for Message 5:

- dimensions/reference for position of own ship: the input of the reference point for Message 5 is defined by AI, BI, CI and DI values as input by using SSD sentence;
- Message 5 shall transmit A, B, C and D values;
- optionally, all input values can be input in decimetre resolution;
- there are two reference points, for the internal GNSS and for an external position source. This method shall be used for both reference points;
- dimensions/reference for position of combination: besides the dimensions/reference for position of one's own ship, additional dimensions to describe a combination can be added on any side of the ship;
- for each side, an extension (EA, EB, EC, ED) of the ship can be defined;
- Message 5 shall transmit A, B, C and D values rounded to whole metres such that the overall dimensions A + B and C + D are not less than the actual dimensions and no more than 0,9 m greater than the actual dimensions.

Baseline vessel dimensions input parameters (password protected):

- AI
- BI
- CI
- DI

Input parameters (tow extension – not password protected):

- EA (sum of all tows ahead)

- EB (sum of all tows astern)
- EC (sum of all tows port)
- ED (sum of all tows starboard)

Calculated internally:

- A (m) = AI + EA
- B (m) = BI + EB
- C (m) = CI + EC
- D (m) = DI + ED

A, B, C and D are output using Message 5.

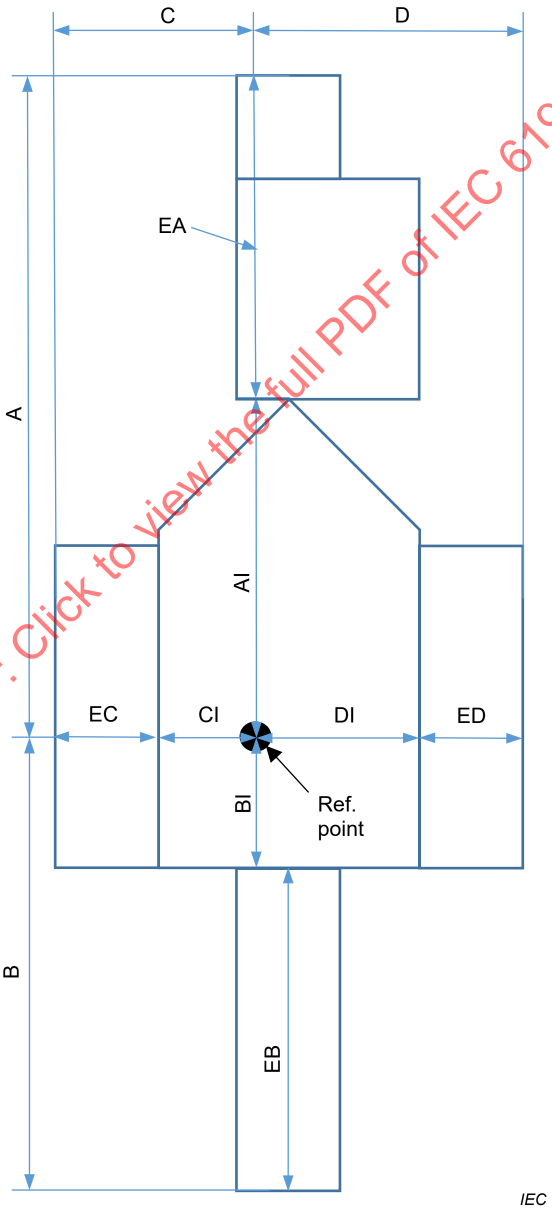


Figure I.1 – Input, extension and transmitted dimensional values

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INTERNET ENGINEERING TASK FORCE (IETF), RCF 1321: *The MD5 Message-Digest Algorithm* [online]. Edited by R. Rivest. April 1992 [viewed 2018-04-13], available at http://tools.ietf.org/html/rfc1321

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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MATÉRIELS ET SYSTÈMES DE NAVIGATION ET DE RADIOCOMMUNICATION MARITIMES – SYSTÈMES D'IDENTIFICATION AUTOMATIQUE (AIS)

Partie 2: Équipements AIS de type Classe A embarqués – Exigences d'exploitation et de fonctionnement, méthodes d'essai et résultats d'essai exigés

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La Norme internationale IEC 61993-2 a été établie par le comité d'études 80 de l'IEC: Matériels et systèmes de navigation et de radiocommunication maritimes.

Cette troisième édition annule et remplace la deuxième édition publiée en 2012. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) elle intègre les caractéristiques techniques incluses dans la Recommandation UIT-R M.1371-5:2014;

b) elle introduit le concept de localisation de groupes de dispositifs afin d'inclure EPIRB AIS et MOB AIS en plus d'AIS SART;

c) elle ajoute des fonctions de sécurité pour l'entrée de configuration en introduisant une nouvelle sentence SSA;

d) elle ajoute une mise en œuvre facultative des interfaces IEC 61162-450/460;

e) elle ajoute des exigences en matière de gestion des alertes à la passerelle (BAM);

f) elle introduit des valeurs de dimension étendues utilisées par les bateaux-remorqueurs;

g) elle ajoute une exigence de mise à jour logicielle.

Le texte de ce document est issu des documents suivants:

FDIS	Rapport de vote
80/888/FDIS	80/890/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Le présent document a été établi selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 61993, publiées sous le titre général *Matériels et systèmes de navigation et de radiocommunication maritimes – Systèmes d'identification automatique (AIS)*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives au document recherché. A cette date, le document sera

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MATÉRIELS ET SYSTÈMES DE NAVIGATION ET DE RADIOCOMMUNICATION MARITIMES – SYSTÈMES D'IDENTIFICATION AUTOMATIQUE (AIS)

Partie 2: Équipements AIS de type Classe A embarqués – Exigences d'exploitation et de fonctionnement, méthodes d'essai et résultats d'essai exigés

1 Domaine d'application

La présente partie de l'IEC 61993 spécifie les exigences minimales d'exploitation et de fonctionnement, les méthodes d'essai et les résultats d'essai exigés selon les normes de fonctionnement adoptées par l'OMI dans la Résolution MSC.74(69):1998, Annexe 3. Le présent document intègre les caractéristiques techniques applicables des équipements de bord de Classe A inclus dans la Recommandation UIT-R M.1371 et tient compte des Règlements des radiocommunications de l'UIT, le cas échéant. De plus, elle tient compte de la Résolution A.694(17) de l'OMI à laquelle l'IEC 60945 est associée. Si une exigence du présent document est différente de l'IEC 60945, cette exigence prévaut.

Le présent document spécifie également les exigences minimales en matière d'entrée et d'affichage des données, et pour les interfaces avec d'autres matériels utilisables comme moyens d'entrée et d'affichage des données.

NOTE Le texte du présent document identique à celui de l'Annexe 3 de la Résolution MSC.74(69):1998 de l'OMI ou à celui de la Recommandation UIT-R M.1371 est imprimé en *italique*. Les références à la résolution (abrégée en "A3") ou à la recommandation (abrégée en "M.1371") et les numéros d'alinéa sont indiqués entre parenthèses:(A3/3.3) ou (M.1371-5/A2-3.3), respectivement).

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60945:2002, *Matériels et systèmes de navigation et de radiocommunication maritimes – Spécifications générales – Méthodes d'essai et résultats exigibles*

IEC 61108 (toutes les parties), *Matériels et systèmes de navigation et de radiocommunication maritimes – Système mondial de navigation par satellite (GNSS)*

IEC 61162-1:2016, *Matériels et systèmes de navigation et de radiocommunication maritimes – Interfaces numériques – Partie 1: Émetteur unique et récepteurs multiples*

IEC 61162-2, *Matériels et systèmes de navigation et de radiocommunication maritimes – Interfaces numériques – Partie 2: Émetteur unique et récepteurs multiples, transfert rapide de données*

IEC 61162-450:2018, *Matériels et systèmes de navigation et de radiocommunication maritimes – Interfaces numériques – Partie 450: Émetteurs multiples et récepteurs multiples – Interconnexion Ethernet*

IEC 61162-460, *Matériels et systèmes de navigation et de radiocommunication maritimes – Interfaces numériques – Partie 460: Émetteurs multiples et récepteurs multiples – Interconnexion Ethernet – Sûreté et sécurité*

IEC 62288, *Équipements et systèmes de navigation et de radiocommunications maritimes – Présentation des informations relatives à la navigation – Exigences générales, méthodes d'essai et résultats exigibles*

IEC 62388, *Matériels et systèmes de navigation et de radiocommunication maritimes – Radars de bord – Exigences de performance, méthodes d'essai et résultats exigés*

IEC 62923-1, *Matériels et systèmes de navigation et de radiocommunication maritimes – Gestion des alertes à la passerelle – Partie 1: Exigences d'exploitation et de fonctionnement, méthodes d'essai et résultats d'essai exigés*

IEC 62923-2, *Matériels et systèmes de navigation et de radiocommunication maritimes – Gestion des alertes à la passerelle – Partie 2: Identifiants d'alerte et de groupe et autres caractéristiques supplémentaires*

Recommandation UIT-R M.493-14, *Système d'appel sélectif numérique à utiliser dans le service mobile maritime*

Recommandation UIT-R M.541-10, *Procédures d'exploitation des systèmes d'appel sélectif numérique à l'usage du service mobile maritime*

Recommandation UIT-R M.825-3, *Caractéristiques d'un système de répondeurs fonctionnant avec des techniques d'appel sélectif numérique à utiliser dans les systèmes de contrôle du trafic maritime et d'identification navire-navire*

Recommandation UIT-R M.1084-5:2012, *Solutions intérimaires pour améliorer l'efficacité d'utilisation de la bande 156-174 MHz par les stations du service mobile maritime*

Recommandation UIT-R M.1371-5:2014, *Caractéristiques techniques d'un système d'identification automatique universel utilisant l'accès multiple par répartition dans le temps et fonctionnant dans la bande attribuée aux services mobiles maritimes en ondes métriques*

Recommandation UIT-T O.153, *Paramètres fondamentaux pour la mesure de la qualité de fonctionnement en termes d'erreur aux débits inférieurs au débit primaire*

Résolution A.694(17) de l'OMI, *Prescriptions générales applicables au matériel radioélectrique de bord faisant partie du système mondial de détresse et de sécurité en mer et aux aides électroniques à la navigation*

Résolution MSC.43(64) de l'OMI, telle que modifiée par la Résolution MSC.111(73), *Directives et critères applicables aux systèmes de comptes rendus de navires*

Résolution MSC.74(69):1998 de l'OMI, Annexe 3, *Recommandation sur les normes de fonctionnement d'un système universel d'identification automatique (AIS)*

Résolution MSC.302(87) de l'OMI, *Recommandation sur les normes de performance pour la gestion des alertes à la passerelle*

3 Termes, définitions et abréviations

3.1 Termes et définitions

Aucun terme n'est défini dans le présent document.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.2 Termes abrégés

AIS	Automatic Identification System (système d'identification automatique)
AIS-SART	AIS Search And Rescue Transmitter (AIS-émetteur de recherche et de sauvetage)
BAM	Bridge Alert Management (gestion des alertes à la passerelle)
BIIT	Built-In Integrity Tests (essais d'intégrité intégrés)
BITE	Built-In Test Equipment (matériel d'essai intégré)
BT	Bandwidth-Time (temps de bande passante)
COG	Course Over Ground (route fond)
CommState	Communication State (état de communication)

NOTE 1 L'état de communication est défini dans la Recommandation UIT-R M.1371. Il est utilisé pour indiquer si l'AIS utilise la structure de message AMRTAO ou AMRTI.

CRP	Command-Response Pair (paire commande-réponse)
ECDIS	Electronic Chart Display and Information System (système de visualisation des cartes électroniques et d'information)
EPFS	Electronic Position-Fixing Systems (systèmes électroniques de détermination de la position)
EPIRB-AIS	Emergency Positioning Indicting Radio Beacon AIS (système de radiobalise de localisation des sinistres AIS)
ETA	Estimated Time of Arrival (heure d'arrivée estimée)
EUT	Equipment Under Test (équipement en essai)
AMRTAF	accès multiple par répartition dans le temps à accès fixe
MDMG	modulation à déplacement minimal à filtre gaussien
HDG	Heading (cap)
OMI	Organisation Maritime Internationale
AMRTI	accès multiple par répartition dans le temps incrémentiel
Dispositif de localisation	groupe de dispositifs comprenant AIS-SART, EPIRB-AIS et MOB-AIS
LR	Long-Range (longue distance)
MAC	Medium Access Control (contrôle d'accès au support)
MD5	Message-Digest Algorithm 5 (algorithme de condensé de message numéro 5)
MKD	Minimum Keyboard and Display (dispositif à clavier et affichage minimaux)
MMSI	Maritime Mobile Service Identity (identité dans le service mobile maritime)
MOB-AIS	Man OverBoard AIS (AIS homme à la mer)

NavStatus	Navigational Status (état de navigation)

NOTE 2 L'état de navigation est défini dans la Recommandation UIT-R M.1371. Il s'agit d'informations qui peuvent être entrées par l'équipage pour indiquer si le navire est en route, au mouillage, etc.

NSS	Nominal Start Slot (intervalle de temps de début nominal)
NTS	Nominal Transmission Slot (Intervalle de temps d'émission nominal)
NUC	Not Under Command (non manœuvrable)
PC	Performance Check (contrôle de performance)
PER	Packet Error Rate (taux d'erreur sur les paquets)
PI	Presentation Interface (interface de présentation)
PT	Performance Test (essai de fonctionnement)
RAIM	Receiver Autonomous Integrity Monitoring (surveillance autonome de l'intégrité du récepteur)
AMRTAA	accès multiple par répartition dans le temps à accès aléatoire
RF	radio frequency (radiofréquence)
ROT	Rate Of Turn (vitesse angulaire de virage)
SI	Selection Interval (intervalle de sélection)
SOG	Speed Over Ground (vitesse fond)
AMRTAO	accès multiple par répartition dans le temps auto-organisé
TUC	temps universel coordonné
VDL	VHF Data Link (liaison de données en ondes métriques)
ROS	rapport d'ondes stationnaires
Rx	Récepteur
Tx	Émetteur

4 Exigences générales

4.1 Généralités

4.1.1 Vue d'ensemble

Les exigences de l'Article 4 ne sont pas reprises dans les autres articles et sont vérifiées par observation et examen de preuves documentées. Il s'agit des exigences générales et opérationnelles applicables de l'IEC 60945, détaillées à l'Article 6, à l'Article 13, à l'Article 14 et à l'Article 15 de l'IEC 60945:2002.

Le fabricant doit déclarer que ces exigences sont satisfaites et doit fournir la documentation pertinente. Les déclarations, la documentation et, le cas échéant, l'EUT doivent être vérifiés ou examinés.

Le fabricant doit également déclarer la composition de l'EUT et la catégorie de durabilité et de résistance aux conditions d'environnement de chaque unité de l'EUT (voir l'IEC 60945).

4.1.2 Exigences générales

(A3/1.1) *Le présent* document *spécifie les exigences relatives à l'AIS.*

(A3/1.2) *L'AIS* doit *améliorer la sécurité de la navigation en contribuant à l'efficacité de la conduite des navires, de la protection de l'environnement et du fonctionnement des services de trafic maritime (STM), en satisfaisant aux exigences de fonctionnement suivantes:*

- *en mode navire-navire pour éviter les abordages;*
- *de manière à permettre aux États côtiers d'obtenir des informations relatives à un navire et son chargement; et*
- *comme un outil STM, c'est-à-dire navire-terre (gestion du trafic).*

4.1.3 Capacités de l'AIS

(A3/1.3) *L'AIS* doit *être capable de fournir des informations relatives au navire à d'autres navires et aux autorités compétentes, automatiquement et avec la précision et la fréquence exigées, pour faciliter le suivi précis. La transmission des données* doit *être assurée avec le moins d'implication possible du personnel et un niveau élevé de disponibilité.*

4.1.4 Exigences supplémentaires

(A3/1.4) *L'installation, outre la satisfaction aux exigences des Règlements des radiocommunications, des Recommandations UIT-R applicables et des exigences générales définies dans la résolution A.694 (17),* doit *satisfaire aux normes de fonctionnement suivantes, indiquées dans les articles ci-après.*

4.1.5 Procédure d'arrêt de l'émetteur

(M.1371-5/A2-2.13) *Une procédure d'extinction automatique de l'émetteur, avec une indication,* doit *être prévue pour le cas où l'émetteur continuerait d'émettre pendant plus de 2 s. Cette procédure ne* doit *pas être pilotée par logiciel.*

4.1.6 Assurance qualité

L'Administration doit exiger que les fabricants disposent d'un système de contrôle qualité audité par une autorité compétente, afin d'assurer la conformité continue aux conditions d'homologation. Par ailleurs, l'Administration peut utiliser des procédures de vérification du produit final dans le cadre desquelles une autorité compétente vérifie la conformité au certificat d'homologation avant que le produit ne soit installé à bord des navires.

NOTE La série ISO 9000, si applicable, satisfait à cette exigence.

4.2 Modes de fonctionnement

(A3/2.1) *Le système* doit *être capable de fonctionner dans un certain nombre de modes:*

1) *un "mode autonome et continu" lors du fonctionnement dans toutes les zones. Une autorité compétente doit être en mesure de basculer de/vers ce mode vers/depuis l'un des modes suivants;*
2) *un mode "d'attribution" si le fonctionnement se fait dans une zone soumise à une autorité compétente chargée de la surveillance du trafic, de sorte que l'intervalle de transmission des données et/ou les intervalles de temps peuvent être définis à distance par cette autorité;*
3) *un mode "d'interrogation" ou un mode commandé dans lequel le transfert de données a lieu en réponse à une interrogation provenant d'un navire ou d'une autorité compétente.*

L'AIS de Classe A doit être en mesure de recevoir et de traiter les télécommandes de gestion de voies ASN conformément aux dispositions des Recommandations UIT-R M.493, UIT-R M.541 et UIT-R M.825 (voir l'Annexe C).

Un utilisateur doit pouvoir interrompre les transmissions. Une indication visuelle doit indiquer que l'AIS de Classe A n'émet pas (mode silencieux). Dans ce mode, aucune réponse ne doit être apportée aux interrogations.

NOTE La Résolution A.917(22) de l'OMI indique qu'il convient que l'AIS soit toujours en fonctionnement lorsque les navires se déplacent ou sont à l'ancre. Si le capitaine estime que le fonctionnement continu de l'AIS est susceptible de compromettre la sûreté ou la sécurité de son navire, l'AIS peut être mis hors tension.

4.3 Manuels

Outre les exigences de l'Article 14 de l'IEC 60945:2002, les manuels doivent inclure:

- le type et les caractéristiques de tous les connecteurs externes (y compris la connexion de pilote) présentés en 7.6;
- les informations nécessaires à la mise en place correcte des antennes;
- les exigences relatives à l'éclairage extérieur, selon le cas;
- la description de chaque alerte qui peut être déclenchée par l'AIS. La description doit expliquer brièvement les causes principales de chaque alerte, donner des recommandations aux utilisateurs quant aux incidences de l'alerte sur la sécurité de fonctionnement du navire et indiquer les actions qui peuvent s'avérer nécessaires pour rectifier la condition d'alerte.

4.4 Marquage et identification

Outre les exigences de l'Article 15 de l'IEC 60945:2002, le marquage doit inclure:

- les caractéristiques de l'alimentation électrique à partir de laquelle le matériel est censé fonctionner; et,
- le cas échéant, la date à laquelle il est nécessaire de remplacer les batteries.

5 Autres exigences

5.1 Exigences en matière d'environnement, d'alimentation, d'usage particulier et de sécurité

L'AIS doit être soumis à l'essai de conformité aux exigences en matière d'environnement, d'alimentation, d'usage particulier et de sécurité de la Résolution A.694(17) de l'OMI (voir l'IEC 60945). Les essais exigés, pour lesquels une méthode de mesurage répétable a été définie, sont donnés à l'Article 11, à l'Article 12 et à l'Article 13. La déclaration de catégorie selon l'Article 4 de l'IEC 60945:2002 doit définir les essais pertinents à appliquer comme suit:

- le matériel AIS déclaré pour une installation protégée doit satisfaire aux exigences du Tableau 3, colonne "Protégé", de l'IEC 60945:2002;
- le matériel AIS exposé doit satisfaire aux exigences du Tableau 3, colonne "Exposé", de l'IEC 60945:2002;
- le matériel AIS portatif doit satisfaire aux exigences du Tableau 3 de l'IEC 60945:2002, colonne "Protégé" ou "Exposé", selon le cas.

5.2 Affichage des informations

Selon le cas, l'AIS doit être soumis à essai en fonction des exigences en matière de présentation des informations de l'IEC 62288 (voir 14.9.9).

5.3 Mise à jour des logiciels

L'AIS doit offrir un moyen de mettre à jour les logiciels du matériel et d'afficher, à la demande, la version logicielle applicable actuelle.

6 Exigences de fonctionnement

6.1 Composition

(A3/3.1) *L'AIS* doit *être composé des éléments suivants* (voir l'Annexe A):

1) *un processeur de communication capable de fonctionner sur une plage de fréquences maritimes, avec une méthode appropriée de sélection et de commutation de voies, venant*

à l'appui des applications courte (VHF) *et longue* (au-delà de VHF) *portée.* Pour les applications longue portée, l'AIS doit fournir une interface bidirectionnelle (voir 7.6.4);

2) au moins un émetteur, deux processus de réception AMRT et un processus de réception ASN continu dédié réglé sur la voie 70;

3) *un moyen de traitement des données d'un système électronique de détermination de la position qui assure une résolution d'un dix millième d'une minute d'arc et qui utilise les paramètres WGS 84.*

   Une interface (voir 7.6.2) doit permettre d'entrer la position utilisée pour la navigation. Les informations de position, si elles sont disponibles auprès d'un autre EPFS, doivent être utilisées uniquement en appoint, ce dont l'utilisateur doit être informé (voir 6.10).

4) *un moyen de saisir automatiquement les données provenant d'autres capteurs satisfaisant aux dispositions spécifiées en* 6.5.1 point 2); un moyen, externe à l'AIS, de satisfaire à cette exigence doit être soumis à essai en fonction des exigences applicables de l'IEC 60945.

5) *un moyen d'entrer et d'extraire des données manuellement.* La possibilité d'entrée et d'extraction manuelles décrite en 6.11 doit être démontrée en s'appuyant sur la documentation du fabricant;

6) un *moyen de détecter les erreurs des données transmises et reçues* (voir l'Article 7); *et*

7) *matériel d'essai intégré* (BITE), tel que spécifié en 6.10.1.

(A3/3.2) *L'AIS doit être capable de:*

1) donner des informations automatiquement et en continu à une autorité compétente et aux autres navires, sans l'intervention du personnel navigant;

2) recevoir et traiter les informations provenant d'autres sources, y compris celles d'une autorité compétente et des autres navires;

3) répondre le plus rapidement possible aux appels à priorité élevée et relatifs à la sécurité;

4) *donner des informations de position et de manœuvre à un débit adapté afin de faciliter la poursuite précise par une autorité compétente et d'autres navires* (voir 6.5.2).

6.2 Temps et position

6.2.1 Source pour le temps universel coordonné

L'AIS doit être équipé d'un récepteur GNSS interne comme source TUC principale exigée pour les besoins de la synchronisation et pour la position de repli, la route fond et la vitesse fond.

NOTE 1 Le temps universel coordonné inclut une disposition de secondes intercalaires.

Le récepteur GNSS interne doit satisfaire aux exigences suivantes de l'IEC 61108 (toutes les parties): précision de position, route fond/vitesse fond, acquisition, réacquisition, sensibilité du récepteur, plage dynamique RF, sensibilité aux brouillages, mise à jour de position, mises en garde de défaillance, indications d'état et fanion d'intégrité.

NOTE 2 L'Annexe 3 de la Résolution MSC.74(69):1998 de l'OMI exige que l'AIS dispose d'un moyen de traitement des données provenant d'un système électronique de détermination de la position qui assure une résolution d'un dix millième d'une minute d'arc et qui utilise les paramètres WGS 84 (voir 6.1).

Si le fabricant souhaite utiliser le GNSS interne comme source de position du navire, le récepteur GNSS interne doit être homologué conformément à l'IEC 61108 (toutes les parties) dans les conditions de charge les plus élevées du processeur AIS, et les sentences DTM, GNS, GBS et RMC doivent être sorties sur un accès dédié.

Si la date et l'heure provenant du GNSS interne ne sont pas disponibles et que le Message 4 ou le Message 11 est reçu, l'unité doit utiliser la date et l'heure de ce message, les secondes devant être ignorées.

6.2.2 Source pour les comptes rendus de position AIS

La source pour les comptes rendus de position peut varier en fonction des conditions spécifiées en 6.10.2.5.

Si la position externe est indisponible, le récepteur GNSS interne peut être utilisé comme source pour les comptes rendus de position AIS.

Si le récepteur GNSS interne fonctionne comme une source pour les comptes rendus de position AIS,

- une indication d'essai d'intégrité intégré (BIIT) appropriée doit être présentée sur l'interface (voir 6.10.1),
- les données de position doivent être disponibles sur le dispositif à clavier et affichage minimaux (voir 6.11.1), et
- le récepteur GNSS interne doit être en mesure de faire l'objet de corrections différentielles, au moins par évaluation du Message 17.

Si des corrections DGNSS sont reçues de plusieurs sources, il convient d'utiliser les corrections DGNSS provenant de la station de référence DGNSS la plus proche en tenant compte du nombre Z et de la santé de la station de référence DGNSS.

L'AIS doit être capable de détecter le type spécifique de dispositif électronique de détermination de la position en décodant l'identificateur d'émetteur de sentence IEC provenant du détecteur externe. S'il est détecté, l'AIS doit automatiquement remplacer les réglages du système électronique de détermination de la position. Les identificateurs d'émetteur décrits au Tableau 1 doivent être pris en charge.

Tableau 1 – Identificateur d'émetteur pour la détection automatique du type de système électronique de détermination de la position

Identificateur d'émetteur IEC	Valeur dans les messages AIS	Type de système électronique de détermination de la position
GP	1	GPS
GL	2	GLONASS
GN	3	Solution combinée
LC	4	Loran C
IN	6	Système de navigation intégré
GA	8	Galileo
Autre	0	Non défini

6.3 Interface utilisateur

(A3/4) *Pour permettre à un utilisateur d'accéder, de sélectionner et d'afficher les informations sur un système distinct, l'AIS* doit *être équipé d'une interface conforme à une norme d'interface marine internationale.*

Toutes les interfaces doivent être assurées par l'intermédiaire de l'interface système décrite en 7.6 (appelée interface de présentation).

6.4 Identification

(Voir 14.1)

(A3/5) *Pour les besoins de l'identification du navire et du message, le numéro MMSI (Maritime Mobile Service Identity) approprié* doit *être utilisé.*

Un numéro MMSI par défaut "000000000" (lequel n'est pas un MMSI valide) doit être attribué à l'unité.

L'unité doit vérifier que le numéro MMSI programmé est compris entre 200000000 et 799999999 ou entre 982000000 et 987999999. Si ce n'est pas le cas, elle doit rejeter la programmation et ne pas être en mesure d'émettre. Toutefois, une réinitialisation à la valeur par défaut "000000000" doit être acceptée, mais l'unité ne doit pas être capable d'émettre avec ce numéro MMSI.

Pour les besoins de l'identification du fabricant et du numéro de modèle du matériel, l'unité doit contenir un code d'identification du fournisseur (voir l'UIT-R M.1371-5:2014, Message 24B et Tableau 79A).

6.5 Informations

(Voir 14.3)

6.5.1 Informations fournies par l'AIS

(A3/6.1) *Les informations fournies par l'AIS doivent inclure:*

1) *Informations statiques:*
   - *Numéro OMI (si disponible)*
   - *Indicatif d'appel et nom*
   - *Longueur et largeur*
   - *Type de navire*
   - *Emplacement de l'antenne de positionnement en service sur le navire (à l'arrière de la proue et à bâbord ou tribord)*

Les informations statiques et le numéro MMSI doivent être enregistrés dans des dispositifs à mémoire non volatile.

Outre la dimension/référence de position du navire, l'AIS doit prendre en charge les extensions de dimension du navire pour décrire les dimensions globales d'un bateau et de sa remorque. Dans ce cas, les valeurs de dimension transmises dans le Message 5 sont égales à la somme des valeurs de référence de dimension du navire et des valeurs d'extension de dimension. L'Annexe I donne des informations relatives à la mise en œuvre des valeurs de dimension étendues de la remorque.

2) *Informations dynamiques:*
   - *Position du navire référencé par rapport aux paramètres WGS 84 avec indication de précision et état d'intégrité*
   - *L'heure (TUC) et la date sont établies par le matériel de réception*
   - *Route fond (COG)*
   - *Vitesse fond (SOG)*
   - *Cap*
   - *État de navigation (non manœuvrable [NUC], à l'ancre, etc. – entrée manuelle)*
   - *Vitesse angulaire de virage (si disponible)*
3) *Informations relatives au voyage:*
   - *Tirant d'eau du navire*

- *Chargement dangereux (type, comme exigé par une autorité compétente)*
- *Destination et heure d'arrivée estimée (ETA) (à la discrétion du capitaine)*

4) Messages courts liés à la sécurité

Toutefois, les messages préconfigurés liés à la sécurité ("MAYDAY", "DISTRESS" et texte de communication de détresse, par exemple) ne doivent pas être fournis.

NOTE Le document COMSAR.1/Circ.46:2009 de l'OMI conseille de ne pas intégrer ces courts messages relatifs à la sécurité dans un équipement AIS, car aucune infrastructure SAR ne permet de les gérer.

6.5.2 Intervalles entre les comptes rendus d'informations

(A3/6.2) *Les différents types d'information ont des durées de validité différentes et nécessitent donc un* intervalle différent entre les comptes rendus.

Informations statiques: *toutes les 6 min, lorsque les données ont été amendées, et à la demande.*

Informations dynamiques: *en fonction de la modification de vitesse et de route, selon le Tableau 2*

Toutes les 3 min pour un message de diffusion longue portée (voir 8.3).

Informations relatives au voyage: *toutes les 6 min, lorsque les données ont été amendées, et à la demande*

Messages liés à la sécurité: *comme exigé*

NOTE Une sentence SSD ou VSD qui ne modifie pas les données ne génère pas la transmission du Message 5.

Tableau 2 – Intervalles entre les comptes rendus d'informations pour le mode autonome

Type de navire	*Intervalle entre les comptes rendus*	
Navire à l'ancre ou au mouillage et ne se déplaçant pas à plus de 3 nœuds	*3*	*min*
Navire à l'ancre ou au mouillage et se déplaçant à plus de 3 nœuds	10	s
Navire dont la vitesse est comprise entre *0 et 14 nœuds* (par défaut)	*10*	*s*
Navire dont la vitesse est comprise entre *0 et 14 nœuds et changeant de route* [a]	3 1/3	s
Navire dont la vitesse est comprise entre *14 et 23 nœuds*	*6*	*s*
Navire dont la vitesse est comprise entre *14 et 23 nœuds et changeant de route*	*2*	*s*
Navire dont la vitesse est supérieure à *23 nœuds*	2	*s*
Navire dont la vitesse est supérieure à *23 nœuds et changeant de route*	*2*	*s*

[a] Indiquée par un changement de cap du navire.

(M.1371-5/A1-4.2.1) *L'intervalle entre les comptes rendus doit diminuer à 2 s si la station détermine qu'il s'agit du sémaphore.*

Si le mode autonome exige un intervalle entre les comptes rendus plus court que le mode d'attribution, l'AIS doit utiliser l'intervalle entre les comptes rendus en mode autonome.

Lors de l'émission sur une seule voie, l'intervalle entre les comptes rendus doit être maintenu en doublant le nombre d'émissions sur la voie active.

Si NavStatus est "at anchor" (à l'ancre), "moored" (au mouillage), "aground" (échoué) ou "undefined" (non défini) et que le navire se déplace à plus de 3 nœuds, l'ID BIIT 10 (voir le Tableau 3) doit être activé. L'intervalle entre les comptes rendus doit être conforme au Tableau 2.

Si NavStatus se déplace et que la vitesse fond (SOG) est inférieure à 1 nœud pendant plus de 2 h, l'ID BIIT ID 10 doit être généré.

6.5.3 Capacité de compte rendu du navire

(A3/6.2) *Le système* doit *pouvoir traiter au moins 2 000 rapports par minute, afin de répondre de manière adéquate à tous les scénarios opérationnels envisagés.*

Toutefois, l'unité mobile AIS doit être capable de traiter tous les messages sur la liaison de données en ondes métriques.

6.6 Journal des événements

(Voir 14.4)

(A3/6.3) *Un mécanisme de sécurité* doit *être prévu pour détecter la désactivation de l'AIS et éviter toute modification non autorisée des entrées ou des données transmises. Pour assurer la protection contre la divulgation non autorisée des données, les lignes directrices de l'OMI* (Résolution MSC.43(64)) doivent *être suivies.*

Des moyens doivent être prévus pour consigner automatiquement toutes les périodes pendant lesquelles l'installation AIS n'émet pas de comptes rendus de position pendant plus de 15 min selon l'intervalle entre les comptes rendus exigé indiqué au Tableau 2 (lorsque l'AIS est hors tension, en mode silencieux ou s'il n'émet pas pour d'autres raisons, par exemple).

Les 10 dernières périodes de non-fonctionnement du matériel pendant plus de 15 min doivent être enregistrées en temps universel coordonné, la durée devant l'être dans un journal des événements non volatile. Les données enregistrées doivent s'afficher sur le MKD et à la demande à l'aide de la sentence TRL. L'utilisateur ne doit pas pouvoir modifier les informations enregistrées dans le journal des événements.

La transmission des comptes rendus de position en réponse à une interrogation ne doit pas être utilisée comme indicateur de fonctionnement.

Un matériel qui n'émet pas de compte rendu de position et de données statiques de manière autonome doit être considéré comme ne fonctionnant pas.

6.7 Période d'initialisation admissible

(Voir 14.6)

(A3/7) *L'installation* doit *être opérationnelle dans les 2 min qui suivent sa mise en marche.*

NOTE Les capteurs utilisés avec l'AIS satisfont aux exigences de leurs normes de produit respectives (l'IEC 61108-1 pour le GPS qui permet 30 min de fonctionnement en l'absence d'éphéméride valide ou l'IEC 61108-2 pour le GLONASS, par exemple).

6.8 Alimentation électrique

(A3/8) *L'AIS et les capteurs associés* doivent *être alimentés à partir de la source principale d'énergie électrique du navire. En outre, l'AIS et les capteurs associés* doivent *pouvoir fonctionner à l'aide d'une autre source d'énergie électrique.*

6.9 Caractéristiques techniques

(Voir 14.7)

(A3/9) *Les caractéristiques techniques de l'AIS, comme la puissance de sortie variable de l'émetteur, les fréquences de fonctionnement (dédiées au niveau international ou sélectionnées au niveau régional), la modulation et le système d'antenne,* doivent *satisfaire aux Recommandations UIT-R appropriées.*

De plus, il doit exister un réglage basse puissance de 1 W automatiquement adopté si le navire est un "navire-citerne" et que NavStatus est défini sur "moored" (au mouillage) et ne se déplace pas à plus de 3 nœuds. Il s'agit de faciliter le fonctionnement basse puissance lors du chargement et du déchargement.

L'utilisateur doit être informé du fonctionnement du réglage basse puissance et de la sortie des sentences TXT appropriées adressées à la PI.

6.10 Alertes et indications, procédures de repli

(Voir 14.8)

6.10.1 Matériel d'essai intégré

6.10.1.1 Généralités

L'AIS doit être équipé d'un BIIT pour mettre en œuvre le matériel d'essai intégré. Ces essais doivent être réalisés en continu ou à intervalles appropriés en même temps que les fonctions normalisées du matériel. Ces essais doivent être réalisés à chaque mise à jour du logiciel (voir 5.3).

Si une défaillance ou un dysfonctionnement est détecté et susceptible de porter atteinte de manière significative à l'intégrité de l'AIS ou d'arrêter son fonctionnement, une alerte est déclenchée.

NOTE L'expression "L'ID BIIT xx est activé" dans les paragraphes d'essai signifie que l'EUT passe à l'état actif approprié. L'expression "L'ID BIIT xx est désactivé" dans les paragraphes d'essai signifie que l'EUT passe à l'état inactif approprié lorsque la condition d'alerte est rectifiée.

6.10.1.2 Surveillance des fonctions et de l'intégrité

Si une défaillance est détectée dans au moins l'une des fonctions ou données suivantes, le système doit réagir conformément au Tableau 3.

Tableau 3 – Conditions exigées pour BIIT et réaction du système à la condition détectée

ID BIIT	Texte descriptif	Réaction du système à la condition détectée
14	Dispositif de localisation actif	Poursuivre le fonctionnement
6	Défaillance générale	Arrêter l'émission
1	Dysfonctionnement de l'émetteur	Arrêter l'émission
3	Dysfonctionnement de la voie 1 du récepteur	Arrêter l'émission sur la voie concernée
4	Dysfonctionnement de la voie 2 du récepteur	Arrêter l'émission sur la voie concernée
26	Aucun capteur de position en service	Poursuivre le fonctionnement (voir le Tableau 7, priorité 7 et la valeur d'horodatage 63)
2	Limite ROS de l'antenne VHF dépassée	Poursuivre le fonctionnement
5	Dysfonctionnement de la voie 70 du récepteur	Poursuivre le fonctionnement
7	Sync TUC non valide	Poursuivre le fonctionnement en utilisant une synchronisation indirecte ou de sémaphore
9	Désadaptation de position GNSS interne/externe	Poursuivre le fonctionnement
10	NavStatus incorrect	Poursuivre le fonctionnement
11	Décalage de capteur de cap	Poursuivre le fonctionnement
25	EPFS externe perdu	Poursuivre le fonctionnement (voir le Tableau 7)
29	Aucune information SOG valide	Poursuivre le fonctionnement en utilisant les données par défaut
30	Aucune information COG valide	Poursuivre le fonctionnement en utilisant les données par défaut
32	Cap perdu/non valide	Poursuivre le fonctionnement en utilisant les données par défaut[a]
35	Aucune information ROT valide	Poursuivre le fonctionnement en utilisant les données par défaut[a]
8	Connexion au MKD perdue	Poursuivre le fonctionnement avec l'ETTD défini sur 1[b]

[a] Si la configuration le permet.

[b] applicable si le MKD est le seul affichage.

ID BIIT 1 doit être activé si:

- l'intégrité de la liaison de données en ondes métriques est dégradée par un comportement incorrect de l'émetteur (si la procédure d'arrêt de l'émetteur a commencé, par exemple);
- l'unité ne peut pas émettre pour des raisons techniques ou si le MMSI est absent ou non valide.

L'ID BIIT 11 doit être activé si la vitesse fond est supérieure à 5 nœuds et que la différence entre COG et HDT est supérieure à 45° pendant 5 min.

L'ID BIIT 14 doit être activé si un dispositif de localisation actif est reçu, et doit être désactivé si tous les dispositifs de localisation actifs ont été retirés de la liste cible. Si l'ID BIIT 14 et l'alerte connexe sont actifs, ils ne doivent pas être réactivés (c'est-à-dire ne pas partir du principe que l'état est "Active, unacknowledged" [Actif, non acquitté]) à la suite de la réception d'un autre dispositif de localisation actif.

L'opérateur doit avoir la possibilité d'activer ou de désactiver la fonction d'alerte "AIS location devices" (dispositifs de localisation AIS"). Il convient que le réglage par défaut soit "enabled" (activé). Si la fonction d'alerte est "désactivée", le matériel ne doit pas émettre d'alerte ID BIIT 14 (l'alerte reste à l'état "normal").

L'AIS doit déclencher les alertes en fonction des conditions détectées par le BITE (voir le Tableau 4). La classification, le traitement, la présentation et la consignation des alertes doivent satisfaire aux exigences de l'IEC 62923-1.

Tableau 4 – Classification des alertes exigées

Instance d'alerte BAM exigée						
Identifiant d'alerte	**Texte de l'alerte (1er ALF)**	**Informations supplémentaires (2e ALF)**	**Prio**	**Cat**	**Escal**	**ID BIIT**
3108	Dispositif de localisation	Vérifier les cibles AIS	W	B	W	14
3062	Défaut général	Vérifier le matériel AIS	W	B	W	6
3008	Défaut de l'émetteur-récepteur	Pas de transmission, vérifier l'AIS	W	B	W	1
		Pas de réception, vérifier l'AIS	W	B	W	3, 4
3015	Position perdue	Position du navire non transmise	W	B	W	26
3116	Radio altérée	Couverture réduite (ROS d'antenne)	C	B	-	2
		Voie 1 inopérante, vérifier l'AIS	C	B	-	3
		Voie 2 inopérante, vérifier l'AIS	C	B	-	4
		ASN inopérant	C	B	-	5
3113	Sync en repli	Vérifier l'AIS pour la synchronisation TUC	C	B	-	7
3003	EPFS ext perdu	Vérifier le capteur de position externe	C	B	-	25
3119	Route fond manquante	Route fond non transmise	C	B	-	30
	Vitesse fond manquante	Vitesse fond non transmise	C	B	-	29
	Cap manquant	Cap non transmis	C	B	-	32
	Vitesse angulaire de virage manquante	Vitesse angulaire de virage non transmise	C	B	-	35
3013	GNSS douteux	Désadaptation de position GNSS int/ext	C	B	-	9
	Cap douteux	La différence avec la route fond dépasse la limite	C	B	-	11
3019	NavStatus erroné	Vérifier le réglage NavStatus	C	B	-	10
3009	MKD perdu	Ne peut pas afficher les messages liés à la sécurité	C	B	-	8

Il n'est pas nécessaire que l'une quelconque des alertes exigées par le présent document mette en œuvre l'état "Rectifiée, non acquittée (U)".

Si, à l'installation, les capteurs suivants ne sont pas reliés à l'AIS, les fonctions correspondantes du matériel ne doivent pas déclencher d'alertes relatives à cette fonctionnalité désengagée:

- EPFS externe perdu;
- cap perdu/non valide;
- aucune information ROT valide.

6.10.1.3 Traduction existante des alertes

L'AIS doit offrir une fonction de traduction des alertes BAM en états d'alarme ALR existants et sortir les alertes traduites par l'intermédiaire de la PI à l'aide d'une sentence ALR. La fonction d'acquittement externe des alertes traduites à l'aide de la sentence ACK doit également être fournie.

L'ID BIIT décrit au Tableau 4 doit être utilisé comme numéro d'alarme unique de la sentence ALR, et le texte de la colonne "Texte descriptif" (Tableau 3) doit être utilisé pour renseigner le champ textuel de description d'alarme dans la sentence ALR, précédé des caractères "AIS: " espace incluse.

La sentence ALR doit être sortie par l'intermédiaire de la PI dès l'occurrence d'une alerte active, puis répétée toutes les 30 s tant que l'alerte n'est pas rectifiée.

Si toutes les alertes sont à l'état normal, une sentence ALR vide ($AIALR,,,V,V,*hh<CR><LF>) doit être générée à 1 min d'intervalle.

Le Tableau 5 décrit le mapping à utiliser dans la traduction des états d'alerte.

Tableau 5 – Mapping entre les états d'alerte BAM et les états d'alerte ALR

Priorité de l'alerte BAM	État d'alerte BAM		État d'alerte ALR	
	État	**Description**	**Fanions[a]**	**Description**
Avertissement	N	Normal	V,V	Inactive, non acquittée
	A	Active	A,A	Active, acquittée
Mise en garde ou Alerte	N	Normal	V,V	Inactive, non acquittée
	V	Active, non acquittée	A,V	Active, non acquittée
	S	Active, silencieuse	A,A	Jusqu'à la fin de la période de silence[b]
	A	Active, acquittée	A,A	Active, acquittée
	O	Responsabilité transférée	A,A	Active, acquittée
	U[c]	Rectifiée, non acquittée	V,V	Inactive, non acquittée[c]

[a] Fanions d'état d'alerte ALR dans l'ordre d'apparition dans la sentence ALR (le premier est la condition, le second l'état d'acquittement).

[b] A l'issue de la période de silence, l'état d'alerte passe à "Active, non acquittée".

[c] Aucune des alertes exigées par le présent document ne doit utiliser l'état d'alerte "Rectifiée, non acquittée".

L'Annexe D décrit les caractéristiques du traitement des alertes ALR/ACK existantes.

6.10.1.4 Sortie de relais d'alarme

Un contact de relais sans terre normalement fermé (NC) doit être fourni comme méthode simple et indépendante de déclenchement d'une alerte externe.

Le relais d'alarme doit être "actif" en cas de coupure d'alimentation.

Le relais d'alarme doit être activé si une alerte est à l'état "V", "Active, non acquittée". Le relais d'alarme doit être désactivé dans tous les autres états d'alerte.

6.10.2 Messages d'état

6.10.2.1 Généralités

En cas de modification importante du fonctionnement du système, mais si le fonctionnement général n'est pas affecté, une indication est initiée. Une sentence TXT est utilisée pour indiquer si ce type de modification importante s'est produit dans le système.

6.10.2.2 Utilisation du formateur TXT

Les messages d'état doivent être des sentences "$AITXT" satisfaisant aux exigences de l'IEC 61162-1 sur l'accès de sortie de l'interface de présentation. Les messages d'état n'activent pas le relais d'alarme et n'exigent pas d'acquittement.

Les paramètres de ce formateur de sentence, qui doivent être conformes au Tableau 6, sont les suivants:

- identifiant de texte, et
- message textuel.

L'état du capteur en cours doit pouvoir être surveillé au moyen d'une sentence de requête $xxAIQ,TXT.

6.10.2.3 Paramètres de gestion des voies modifiés

La sentence TXT, Identifiant de texte 036, doit être suivie de la ou des sentences ACA appropriées pour signaler les conditions AIS concernées.

La paire de sentences TXT/ACA doit être transmise une seule fois lors du croisement des limites de la région, lorsque les paramètres utilisés sont modifiés par une nouvelle commande.

6.10.2.4 Surveillance de l'état des données de capteur

Les indications doivent être données et le système doit réagir comme indiqué au Tableau 6.

Tableau 6 – Indications d'état de capteur signalées à l'aide du formateur de sentence TXT

Message textuel	Identifiant de texte	Réaction du système
AIS: DGNSS externe en service	021	Poursuivre le fonctionnement
AIS: GNSS externe en service	022	Poursuivre le fonctionnement
AIS: DGNSS interne en service (balise)	023	Poursuivre le fonctionnement
AIS: DGNSS interne en service (Message 17)	024	Poursuivre le fonctionnement
AIS: GNSS interne en service	025	Poursuivre le fonctionnement
AIS: SOG/COG externes en service	027	Poursuivre le fonctionnement
AIS: SOG/COG internes en service	028	Poursuivre le fonctionnement
AIS: Cap valide	031	Poursuivre le fonctionnement
AIS: Indicateur de vitesse angulaire de virage en service	033	Poursuivre le fonctionnement
AIS: Autre source ROT en service	034	Poursuivre le fonctionnement
AIS: Paramètres de gestion des voies modifiés	036	Poursuivre le fonctionnement
AIS: Mode actif basse puissance – navire-citerne	037	Poursuivre le fonctionnement
AIS: Mode inactif basse puissance – navire-citerne	038	Poursuivre le fonctionnement
AIS: Fonctionnement en mode d'attribution par le Message 16 provenant de la station de base 00MIDXXXX	040	Poursuivre le fonctionnement
AIS: Fonctionnement en mode de gestion de la liaison de données par le Message 20 provenant de la/des station(s) de base 00MIDXXXX[...]	041	Poursuivre le fonctionnement
AIS: Fonctionnement en mode de gestion des voies par le Message 22 provenant de la station de base 00MIDXXXX sur les voies YYYY et ZZZZ	042	Poursuivre le fonctionnement
AIS: Fonctionnement en mode d'attribution de groupe par le Message 23 provenant de la station de base 00MIDXXXX	043	Poursuivre le fonctionnement
AIS: Renvoyé aux fonctionnements par défaut	044	Poursuivre le fonctionnement

6.10.2.5 Conditions de repli du capteur de position

Les priorités et données du compte rendu de position concerné doivent être conformes au Tableau 7.

Tableau 7 – Conditions de repli du capteur de position

Priorité	Données concernées dans le Message 1, 2, 3 ⇒				
	État du capteur de position	**Fanion de précision de position**	**Horodatage**	**Fanion RAIM**	**Position Latitude/Longitude**
1	DGNSS externe en service (corrigé) [a]	1	UTC-s	1/ 0 *	Lat/Lon (externe)
2	DGNSS interne en service (corrigé; Message 17)	1	UTC-s	1/ 0 *	Lat/Lon (interne)
3	DGNSS interne en service (corrigé; balise) [b]	1	UTC-s	1/ 0 *	Lat/Lon (interne)
4	GNSS externe en service (non corrigé) [a]	0	UTC-s	1/ 0 *	Lat/Lon (externe)
5	GNSS interne en service (non corrigé)	0	UTC-s	1/ 0 *	Lat/Lon (interne)
6	Source de position externe autre que le GNSS	0	UTC-s	0	Lat/Lon (externe)
7	Position de navigation à l'estime (à partir de l'EPFS externe en service)	0	62	0	Lat/Lon (navigation à l'estime)
	Entrée de position manuelle (à partir de l'EPFS externe en service)		61		Lat/Lon (manuel)
	Pas de position		63		non disponible = 91/181

[a] Applicable dans toutes les configurations (exigence minimale). Voir également 7.6.5.4.1.

[b] Applicable uniquement si (éventuellement) un récepteur de signaux de balise interne est fourni. Si RAIM disponible "1"; sinon, valeur par défaut "0".

L'AIS doit automatiquement sélectionner la source de position avec la priorité disponible la plus élevée. Si les données disponibles changent, l'AIS doit automatiquement basculer vers la source de position à la priorité disponible la plus élevée au bout de 5 s (basculement vers le bas) ou de 30 s (basculement vers le haut). Pendant cette période, la dernière position valide doit être utilisée pour le compte rendu.

Si la source de position externe est utilisée et que les positions externe et interne sont valides, ces dernières doivent être comparées une fois par minute et une alerte générée si la différence entre les deux positions est supérieure à 100 m + la distance entre les deux antennes GNSS, pendant 15 min.

Si la position valide n'est pas horodatée (horodatage non disponible = 60), émettre le compte rendu de position avec l'horodatage défini sur 60.

À l'issue d'un passage d'un état à un autre, un nouveau Message 5 doit être immédiatement émis si le point de référence correspondant à la position indiquée dans le compte rendu a changé. Une sentence "TXT" telle que décrite au Tableau 6 doit alors être envoyée à l'interface de présentation.

Si la RAIM est disponible (indiquée par une sentence GBS valide ou des informations équivalentes), le fanion de précision de position doit être évalué à l'aide du Tableau 8.

Tableau 8 – Utilisation du fanion de précision (PA)

État de précision provenant de la RAIM (pour 95 % des déterminations de position)	Fanion RAIM	État de correction différentielle	Valeur obtenue du fanion de précision de position (PA)
Aucun processus RAIM disponible	0	Inconnu	0 = faible (> 10 m)
Aucun processus RAIM disponible	0	Non corrigé	0 = faible (> 10 m)
L'erreur attendue est ≤ 10 m	1		1 = élevé (≤ 10 m)
L'erreur attendue est > 10 m	1		0 = faible (> 10 m)
Aucun processus RAIM disponible	0	Corrigé	1 = élevé (≤ 10 m)
L'erreur attendue est ≤ 10 m	1		1 = élevé (≤ 10 m)
L'erreur attendue est > 10 m	1		0 = faible (> 10 m)

Le récepteur GNSS connecté indique la disponibilité d'un processus RAIM par une sentence GBS valide de l'IEC 61162-1. Dans ce cas, le fanion RAIM doit être défini sur "1". Le seuil de précision de position pour l'évaluation des informations RAIM est de 10 m. L'erreur attendue RAIM est calculée en s'appuyant sur les paramètres GBS "expected error in latitude" (erreur de latitude prévue) et "expected error in longitude" (erreur de longitude prévue) à l'aide de la formule suivante:

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

L'indicateur de mode des sentences de position de l'IEC 61162-1 reçu du capteur de position connecté indique l'état de correction.

6.10.2.6 Conditions de repli du capteur SOG/COG

Les informations SOG/COG provenant du récepteur GNSS interne doivent être utilisées si ce récepteur GNSS interne fait office de source de position. Il s'agit d'éviter la transmission d'informations référencées par rapport à différents points sur le navire.

6.10.2.7 Conditions de repli du capteur ROT

L'AIS doit automatiquement sélectionner la source ROT avec la priorité disponible la plus élevée (voir le Tableau 9).

Les données ROT ne doivent pas être déduites des informations COG.

Tableau 9 – Conditions de repli du capteur ROT

	Données concernées dans le Message 1, 2, 3 ⇒	
Priorité	**État du capteur de position**	**Contenu du champ ROT**
1	Indicateur de vitesse angulaire de virage en service [a]	0 +126 = virage à droite jusqu'à 708°/min ou plus; 0…−126 = virage à gauche jusqu'à 708°/min ou plus. Les valeurs comprises entre 0° et 708°/min doivent être codées par $ROT_{AIS} = 4,733 \sqrt{(ROT_{capteur})}$°/min où $ROT_{capteur}$ est la vitesse angulaire de virage entrée par l'indicateur de vitesse angulaire externe (TI). Les valeurs d'au moins 709°/min doivent être raccourcies à 708°/min.
2	Autre source ROT en service [b]	+127 = virage à droite à plus de 5°/30 s (aucun TI disponible) −127 = virage à gauche à plus de 5°/30 s (aucun TI disponible)
3	Aucune information ROT valide disponible	−128 (80 hex) indique qu'aucune information de virage n'est disponible (valeur par défaut)

[a] Indicateur de vitesse angulaire de virage selon l'OMI A.526(13); déterminé par l'identificateur d'émetteur. Voir également 7.6.5.4.1.

[b] C'est-à-dire reposant sur les informations HDG.

6.11 Affichage, entrée et sortie

(Voir 14.9)

6.11.1 Dispositif à clavier et affichage minimaux (MKD)

Le MKD est un élément essentiel de l'AIS, et il peut être éloigné. Si le MKD est éloigné, une installation doit permettre d'assurer l'intégrité de la liaison à l'aide d'une sentence HBT.

Le présent document décrit la combinaison émetteur-récepteur AIS/MKD. Seules les combinaisons soumises à essai de répondeurs spécifiques et de MKD éloignés ou intégrés spécifiques satisfont aux exigences du présent document.

Le MKD est un dispositif d'affichage et de saisie manuelle assurant les fonctions ci-dessous.

- Saisie manuelle des données relatives au voyage et des données statiques relatives au navire, commande l'AIS et sélection des données. La méthode de saisie des données relatives à l'état de navigation et au voyage doit être aisément disponible à l'opérateur. La station AIS de classe A ne doit pas pouvoir saisir l'état de navigation 14. Tous les autres états de navigation doivent pouvoir être saisis, y compris ceux qui sont indéfinis ou réservés à un usage ultérieur. Si aucune définition unique n'est associée à la valeur, cette dernière doit au moins s'afficher sur le MKD.
- Une indication doit être fournie au niveau du MKD si toutes les valeurs de dimension sont définies sur zéro.
- Le MKD doit donner des recommandations à l'utilisateur pour définir les valeurs d'extension de dimension lorsque NavStatus est défini sur 12. Le MKD doit donner des recommandations à l'utilisateur pour définir NavStatus sur une valeur autre que 12 lorsque toutes les valeurs d'extension de dimension sont définies sur zéro et NavStatus sur 12.
- Toutes les valeurs (de 0 à 255) du navire et du type de chargement doivent être accessibles par l'intermédiaire du MKD. Si aucune définition n'est associée à la valeur, cette dernière doit au moins s'afficher sur le MKD.
- Saisie et initiation de la transmission de messages liés à la sécurité et éventuellement des messages textuels. Si la station destinataire d'un message indique qu'elle ne peut pas

afficher le message (fanion ETTD), le MKD doit indiquer que le message peut ne pas s'afficher au niveau du destinataire. Le MKD ne doit pas accepter la saisie de plus de caractères qui ne peuvent être transmis dans un message à 3 intervalles.

- Affichage des données statiques, dynamiques et relatives au voyage transmises au navire.
- Affichage d'au moins 200 cibles.
- Affichage d'au moins trois (3) lignes de données cibles. Chaque ligne affiche au moins le nom de la station, la durée écoulée, le relèvement, la plage du dernier compte rendu de position reçu. Le défilement horizontal du relèvement et de la durée écoulée ne peut pas être utilisé. Le titre des données d'affichage doit être visible.
- Affichage des informations de statut et des informations d'alerte selon l'OMI MSC.302(87).
- Affichage de tous les paramètres de configuration sans nécessité de saisir un mot de passe.

Tous les caractères doivent s'afficher, à l'exception des signes @ de fin (voir le Tableau 47 de l'UIT-R M.1371-5:2014).

Par défaut, la liste cible est triée automatiquement dans l'ordre croissant. Tous les dispositifs de localisation actifs doivent s'afficher dans l'ordre croissant au-dessus des autres cibles.

La valeur de délai d'expiration de l'affichage cible, autre que les dispositifs de localisation, doit être de 7 min. Pour le dispositif de localisation actif, cette valeur doit être de 18 min. Le délai d'expiration pour le stockage des données cibles statiques doit être de 18 min.

Il peut être possible de filtrer la présentation des cibles AIS (par plage cible, CPA/TCPA ou classe de cible AIS A/B, AIS AtoN, etc.). Si un filtrage ou regroupement supplémentaire est pris en charge, il convient que le fabricant documente cette fonctionnalité en option. Si le matériel d'affichage fournit des installations permettant de calculer CPA/TCPA, il convient qu'elles satisfassent aux articles correspondants de l'IEC 62388. Si un filtre est appliqué, il doit s'agir d'une indication claire et permanente ou définitive pour l'application, selon le cas. Les critères de filtrage utilisés doivent être aisément disponibles à l'utilisateur (c'est-à-dire la plage, CPA/TCPA, la classe).

Les cibles AIS individuelles ne doivent pas pouvoir être retirées de la présentation.

Les dispositifs de localisation actifs doivent s'afficher en haut de la liste cible. Il convient que les essais (y compris les essais d'homologation) d'un dispositif de localisation ne s'affichent pas ni n'apparaissent sur l'interface de présentation pendant le fonctionnement normal. Toutefois, il convient que l'AIS ait la possibilité d'afficher et de faire apparaître les dispositifs de localisation sur la PI en mode essai pendant les essais périodiques des dispositifs de localisation installés sur les navires.

Les dispositifs de localisation actifs et d'essai sont identifiés selon le Tableau 10 au Tableau 12.

Tableau 10 – Identification des dispositifs de localisation actifs

	AIS-SART	MOB-AIS	EPIRB-AIS
Plage d'identités	970010000 à 970999999	972010000 à 972999999	974010000 à 974999999
NavStatus du Message 1	14	14	14
Nom dans la liste cible	AIS SART	MOB AIS	EPIRB AIS
ID BIIT	14	14	14

Tableau 11 – Identification des dispositifs de localisation en mode d'essai

	AIS-SART	MOB-AIS	EPIRB-AIS
Plage d'identités	970010000 à 970999999	972010000 à 972999999	974010000 à 974999999
NavStatus du Message 1	15	15	15
Nom dans la liste cible	SART TEST	MOB TEST	EPIRB TEST

Tableau 12 – Identification des dispositifs de localisation pour l'essai d'homologation

	AIS-SART	MOB-AIS	EPIRB-AIS
Plage d'identités	970000000 à 970009999	972000000 à 972009999	974000000 à 974009999
NavStatus et le nom du Message 1 sont identiques à ceux du Tableau 10 et du Tableau 11.			

Le fanion ETTD (voir la Recommandation UIT-R M.1371-5/A8-3.3) doit uniquement être défini sur "1" s'il n'existe aucun moyen d'afficher les messages textuels reçus. Le matériel externe indique la disponibilité d'une fonctionnalité MKD éloignée par une sentence HBT envoyée toutes les 30 s. Si une sentence SSD est appliquée, il convient d'évaluer le champ ETTD avec la sentence HBT pour déterminer si le matériel externe peut afficher les messages textuels.

Le Tableau 13 décrit les messages ou les informations cibles déduites des messages reçus qu'il convient d'afficher sur le MKD.

Tableau 13 – Affichage de message sur le MKD

Type de message	Contenu informatif	Remarque
Tous les messages ci-dessous	MMSI	
Message 1, 2, 3 Compte rendu de position	Position (Lat, Lon, Plage, Relèvement) Temps, en minutes, depuis la réception du dernier compte rendu de position (0-19) Le nom du dispositif de localisation doit s'afficher selon le Tableau 10, le Tableau 11 et le Tableau 12, selon le cas, suivi du MMSI. Fanion PA, RAIM, horodatage, description de la qualité de position déduits du Tableau 14 État de navigation	Dans l'affichage graphique par position
Message 5 Données statiques	Nom du navire	
Message 4 Compte rendu de station de base	Position (Lat, Lon, Plage, Relèvement) Temps, en minutes, depuis la réception du dernier compte rendu de position Le nom doit indiquer "BS:MMSI", sauf s'il est déduit d'un Message 24a Fanion PA, RAIM, description de la qualité de position déduits du Tableau 14	Dans l'affichage graphique par position. Peut être filtré (et le filtrage indiqué)
Message 9 Compte rendu de position d'un aéronef de recherche et de sauvetage	Position (Lat, Lon, Plage, Relèvement, Altitude) Temps, en minutes, depuis la réception du dernier compte rendu de position Le nom doit indiquer "SAR:MMSI", sauf s'il est déduit d'un Message 24a ou d'un Message 5 Fanion PA, RAIM, horodatage, description de la qualité de position déduits du Tableau 14	Dans l'affichage graphique par position. Il convient que la plage de l'aéronef de recherche et de sauvetage soit déterminée par calcul bidimensionnel. Peut être filtré (et le filtrage indiqué)
Message 11	Il convient que le résultat de l'essai de communication s'affiche.	Il convient que l'indication du résultat soit automatiquement supprimée au bout de 30 s au plus tard
Message 12, 14 Messages liés à la sécurité	Contenu du texte	
Message 18, 19	Position (Lat, Lon, Plage, Relèvement) Temps, en minutes, depuis la réception du dernier compte rendu de position Fanion PA, RAIM, horodatage, description de la qualité de position déduits du Tableau 14	Dans l'affichage graphique par position. Peut être filtré (et le filtrage indiqué)
Message 19, 24a Compte rendu de position et statique de classe B	Nom du navire	
Message 21 Compte rendu d'aide à la navigation	Nom des aides à la navigation Temps, en minutes, depuis la réception du dernier compte rendu de position Position (Lat, Lon, Plage, Relèvement) Fanion PA, RAIM, horodatage, description de la qualité de position déduits du Tableau 14 Fanion de position de repos Type d'AtoN (UIT-R M.1371-5 Tableau 74) Fanion d'aide à la navigation virtuel	Nom plus indication qu'il s'agit d'une aide à la navigation Dans l'affichage graphique par position Peut être filtré (et le filtrage indiqué)

Tableau 14 – Qualité de position

Description	Critère
Pas de position	Latitude = 91° ou longitude = 181° ou horodatage = 63
Position manuelle	Horodatage = 61
Position de navigation à l'estime	Horodatage = 62
Position périmée > 200 m	Distance prévue (par rapport à la vitesse fond et au temps écoulé) > 200 m
Position > 10 m	PA = 0 et RAIM = 0
Position avec RAIM > 10 m	PA = 0 et RAIM = 1
Position < 10 m	PA = 1 et RAIM = 0
Position avec RAIM < 10 m	PA = 1 et RAIM = 1
Position valide sans horodatage	Horodatage = 60
NOTE Des informations détaillées relatives à la qualité de position sont présentées dans une sous-page.	

6.11.2 Essai de communication

L'AIS doit avoir les moyens de soumettre à essai la communication sur la liaison de données en ondes métriques, en émettant un Message 10 et en vérifiant la réponse de la station contactée, Message 11.

L'essai de communication doit pouvoir être initié manuellement par le MKD. Le MKD doit proposer une cible et permettre à l'utilisateur de la confirmer ou de sélectionner une autre cible de Classe A. Une cible différente doit être suggérée en cas d'échec de l'essai.

L'essai de communication doit également pouvoir être initié par l'intermédiaire de l'interface de présentation en utilisant une sentence AIR (en indiquant le Message 11 dans le champ "Message ID" [ID message]). En réponse à la sentence AIR, l'unité AIS doit émettre un Message 10.

Dès la réception d'un Message 10, l'unité AIS doit répondre par un Message 11.

Le résultat de l'essai de communication doit s'afficher. Le manuel d'exploitation doit fournir les recommandations relatives à l'utilisation de cette fonction, de sorte que la cible contactée choisie se trouve à une portée adaptée (entre 15 NM et 25 NM, par exemple).

6.11.3 Alertes et informations de statut

6.11.3.1 Alertes

Les alertes ci-dessous doivent être indiquées et s'afficher à la demande:

- à la suite de l'essai d'intégrité intégré (BIIT, voir 6.10.1);
- réception du Message 1 NavStatus 14. Une fois l'alerte acquittée, elle n'est plus réactivée si un nouveau message est reçu. L'acquittement doit rester en vigueur tant que l'alerte n'a pas été supprimée en raison du délai d'expiration.

Un moyen permettant d'acquitter les alertes doit être prévu conformément à la Recommandation MSC.302(87) de l'OMI.

6.11.3.2 Informations de statut

Les informations de statut ci-dessous doivent être indiquées et leur contenu s'afficher à la demande:

- indications à la suite de l'essai d'intégrité intégré (BIIT, voir 6.10.1);
- informations de statut du capteur telles que fournies par les sentences TXT et d'alerte;
- Messages 14 liés à la sécurité reçus;
- interrogations longue portée reçues;
- confirmation manuelle de l'interrogation longue portée si en mode manuel;
- fonctionnement de l'AIS non en défaut en raison d'un message de commande de la station de base, comme indiqué par la sentence TXT.

6.11.3.3 Indication, affichage et stockage du Message 12 et du Message 14 reçus

Les 20 derniers Messages 12 reçus au moins et les 20 derniers Messages 14 reçus au moins doivent être disponibles à l'affichage à la demande. Une indication des messages liés à la sécurité non lus doit être fournie.

Le contenu du dernier Message 12 reçu doit s'afficher en premier tant que l'utilisateur ne l'a pas lu.

De plus, jusqu'à 20 messages doivent pouvoir être sélectionnés, conservés et affichés à la demande jusqu'à leur suppression. La conservation de ces messages hors alimentation n'est pas exigée.

Les messages liés à la sécurité dont la source et le contenu sont identiques doivent remplacer les messages existants qu'ils dupliquent.

6.11.4 Protection des données

Les données suivantes doivent être protégées contre toute modification non autorisée par des sentences MKD ou PI (par mot de passe, par exemple):

- MMSI;
- indicatif d'appel;
- nom du navire;
- numéro OMI;
- dimension/référence de position;
- configuration d'interface;
- mot(s) de passe;
- clé prépartagée pour sentence SSA;
- voies tx de Message 27.

Il convient que les autres données, si elles sont protégées, ne le soient pas avec le même mot de passe.

Si des sentences de configuration EPV ou SSD sont utilisées, une sentence d'authentification valide précédente doit être fournie. La mise en œuvre d'une sentence SSA est obligatoire. Une sentence SPW peut être utilisée sur les accès série uniquement pour assurer la rétrocompatibilité. Une méthode de calcul de signature MD5 avec une longueur de signature de 32 caractères HEX reçus dans la sentence SSA doit être mise en œuvre.

La clé prépartagée associée à la sentence SSA et le mot de passe associé à la sentence SPW ou utilisé sur le MKD ne doivent pas s'afficher sur le MKD et ne doivent pas être divulgués à la demande d'une sentence EPV. La clé prépartagée pour la sentence SSA doit être saisie par des moyens propriétaires.

6.11.5 Calcul de la distance

L'AIS doit utiliser les équations de l'Annexe E pour calculer toutes les distances, y compris la portée par rapport à d'autres stations AIS et zones régionales.

6.12 Protection contre les commandes non valides

L'AIS ne doit pas accepter les instructions de commande envoyées par des stations dont le MMSI de station de base n'est pas valide. Avant d'accepter et de traiter les Messages 4, 16, 17, 20, 22 et 23, l'AIS doit vérifier le MMSI de la station émettrice. Un MMSI de station de base valide est défini par "00xyyyyyy", x étant compris entre 2 et 7. L'unité doit uniquement accepter et traiter les commandes reçues avec un MMSI de station de base valide. Voir l'Annexe C.

7 Exigences techniques

7.1 Généralités

(M.1371-5/A2-1.1) *Le présent article couvre les couches 1 à 4 (couche Physique, couche Liaison, couche Réseau, couche Transport) du modèle OSI (Open System Interconnection).*

La Figure 1 présente le modèle de couche d'une station AIS (couche Physique à couche Transport) et les couches des applications (couche Session à couche Application).

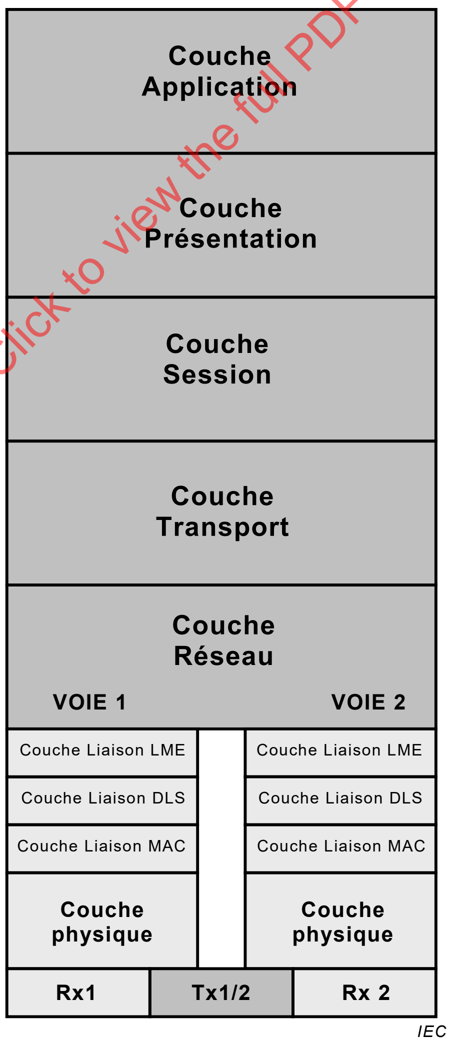

Figure 1 – Modèle de couche OSI

7.2 Couche Physique

(Voir l'Article 15)

7.2.1 Généralités

(M.1371-5/A2-2) *La couche Physique assure le transfert du flux de données de sortie depuis la source jusqu'à la liaison de données.*

La couche Physique doit être conçue selon la Recommandation UIT-R M.1371-5/A2-2.

7.2.2 Paramètres de l'émetteur

Les paramètres de l'émetteur doivent être conformes au Tableau 15.

Tableau 15 – Paramètres de l'émetteur

Paramètres de l'émetteur	Exigences	Condition
Erreur de fréquence	± 500 Hz normal ± 1 000 Hz extrême	
Puissance de la porteuse (P_{SS})	41 dBm réglage de puissance élevée 30 dBm réglage de puissance basse	± 1,5 dB normal et ± 3 dB extrême, conduite
Spectre de modulation	−25 dBc −70 dBc émission crénelée	Δfc < ± 10 kHz ± 25 kHz < Δf_c< ± 62,5 kHz
Précision de la modulation	1 740 ± 175 Hz normal ± 350 Hz extrême 2 400 ± 240 Hz normal ± 480 Hz extrême	Signal d'essai 0101… Signal d'essai 00001111…
Puissance en fonction du temps	Délai de transmission: 0 s Temps de montée en puissance: 833 µs Temps de descente en puissance: 833 µs Durée d'émission: ≤ 26 624 µs	Voir la Figure 2 et le Tableau 16 Émission à intervalle temporel nominal 1
Rayonnements non essentiels	-36 dBm -30 dBm	9 kHz … 1 GHz 1 GHz … 4 GHz

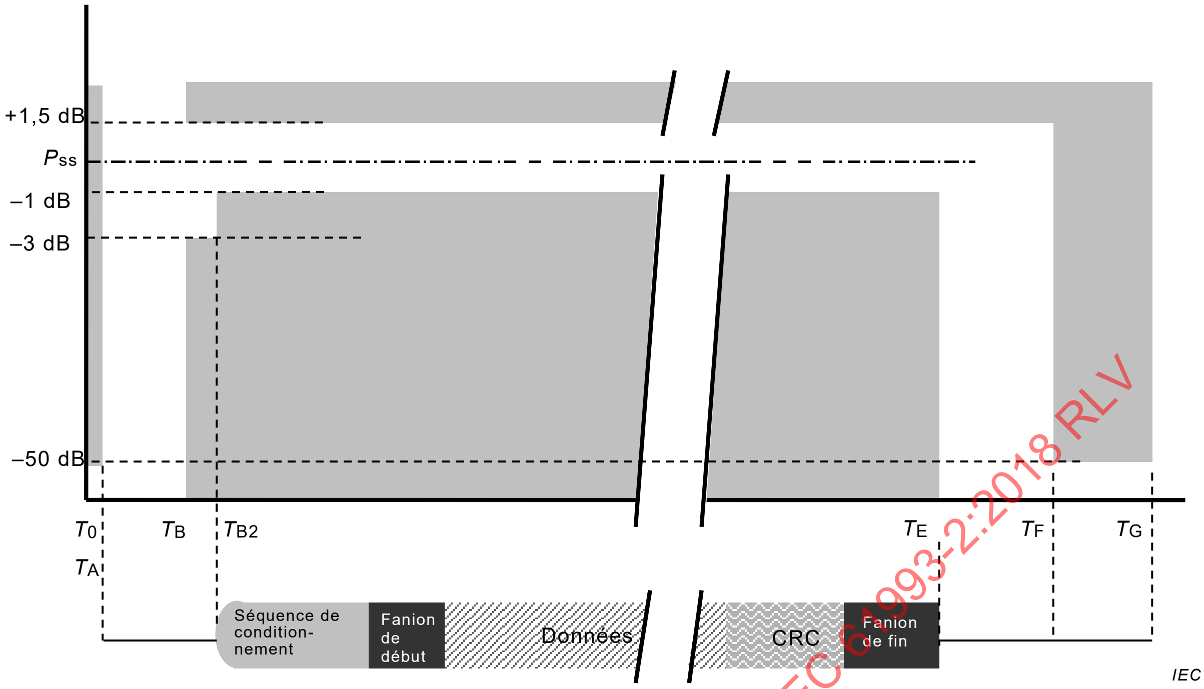

Figure 2 – Puissance en fonction du temps

Tableau 16 – Puissance en fonction du temps

Référence		Bit	Temps	Définition
T_0		0	0 ms	Début de l'intervalle de temps de transmission. La puissance NE doit PAS dépasser –50 dBc (ref. P_{ss}) avant T_0
T_A		0 à 6	0 à 0,625 ms	La puissance est supérieure à –50 dB de P_{ss}
T_B	T_{B1}	6	0,625 ms	La puissance doit être comprise entre +1,5 et −3 dB de P_{ss}
	T_{B2}	8	0,833 ms	La puissance doit être comprise entre +1,5 et −1 dB de P_{ss} (début de la séquence de conditionnement)
T_E (inclut 1 bit de bourrage)		233	24,271 ms	La puissance doit rester comprise entre +1,5 et −1 dB de P_{ss} pendant la période T_{B2} à T_E
T_F (inclut 1 bit de bourrage)		241	25,104 ms	La puissance doit être de −50 dBc (ref. P_{ss} a) et rester au-dessous de cette valeur
T_G		256	26,667 ms	Début de la période de transmission suivante

7.2.3 Paramètres du récepteur

Les paramètres du récepteur doivent être conformes au Tableau 17.

Tableau 17 – Paramètres du récepteur

Paramètres du récepteur	Exigences		
	Donne le PER	Signal utile	Signal/signaux non désirés(s)
Sensibilité	20 %	−107 dBm normal −104 dBm normal à décalage de ± 500 Hz −101 dBm extrême	
Erreur à des niveaux d'entrée élevés	1 %	−7 dBm et −77 dBm	–
Réjection dans une même voie	20 %	−104 dBm −104 dBm	−114 dBm nominal −114 dBm à un décalage de ± 1 kHz
Sélectivité pour la voie adjacente	20 %	−104 dBm –98 dBm extrême	–34 dBm normal –38 dBm extrême
Rejet de réponse parasite	20 %	−104 dBm	−34 dBm
Rejet de réponse d'intermodulation et blocage	20 %	–101 dBm	−27 dBm (< 5 MHz) −15 dBm (> 5 MHz)
Rayonnements non essentiels	–57 dBm –47 dBm	9 kHz ... 1 GHz 1 GHz ... 4 GHz	

7.3 Couche Liaison

(Voir l'Article 16)

7.3.1 Généralités

(M.1371-5/A2-3) *La couche Liaison spécifie la manière dont les données* doivent être *organisées afin d'appliquer une détection et correction d'erreur au transfert de données. La couche Liaison est divisée en trois (3) sous-couches.*

7.3.2 Sous-couche de liaison 1: commande d'accès au support de transmission (MAC)

(M.1371-5/A2-3.1) *La sous-couche commande d'accès au support de transmission (MAC, Medium Access Control) définit une méthode d'accès au support de transfert des données, c'est-à-dire à la liaison de données en ondes métriques. La méthode utilisée* doit être *l'AMRT (accès multiple par répartition dans le temps) à référence de temps commune.*

La sous-couche MAC doit être conçue selon la Recommandation UIT-R M.1371-5/A2-3.1.

7.3.3 Sous-couche de liaison 2: Service de liaison de données (DLS)

(M.1371-5/A2-3.2) La sous-couche service de liaison de données (DLS, data link service) permet:

1) *l'activation et la libération de la liaison de donnée;*
2) *le transfert de données; ou*
3) *la détection d'erreurs et le contrôle.*

La sous-couche DLS doit être conçue selon la Recommandation UIT-R M.1371-5/A2-3.2.

Les messages répétés et les messages DP de Classe B ne doivent pas être utilisés dans le processus de synchronisation indirecte.

7.3.4 Sous-couche de liaison 3 – Entité de gestion de la liaison (LME)

7.3.4.1 Généralités

(M.1371-5/A2-3.3) *L'entité LME gère le fonctionnement des sous-couches DLS et MAC et de la couche physique.*

La sous-couche LME doit être conçue selon la Recommandation UIT-R M.1371-5/A2-3.3.

La sous-couche de liaison 3 inclut la définition des messages VDL. Le Tableau 18 présente les messages VDL qui doivent être utilisés par un dispositif AIS mobile de bord de Classe A.

Tableau 18 – Utilisation des messages VDL

Msg. N°	Nom du message	Réf. M.1371-5	R/P	O	T	Remarque
0	Non défini	Aucune	Oui	Oui	Non	Réservé à un usage ultérieur
1	Compte rendu de position (planifié)	A8-3.1	Oui	Oui	Oui	Pour un dispositif de localisation conforme au Tableau 11, il convient que le Message 1 ne soit envoyé qu'à l'interface de présentation dans un mode d'essai particulier du dispositif de localisation
2	Compte rendu de position (attribué)	A8-3.1	Oui	Oui	Oui	
3	Compte rendu de position (en cas d'interrogation)	A8-3.1	Oui	Oui	Oui	
4	Compte rendu de station de base	A8-3.2	Oui (5)	Oui	Non	
5	Données statiques et données relatives au voyage	A8-3.3	Oui	Oui	Oui	
6	Message binaire adressé	A8-3.4	Oui	Oui (1)	Oui	(1) Uniquement adressé à la station considérée
7	Accusé de réception binaire	A8-3.5	Oui	INF (2)	Oui	(2) Un message ABK PI doit être envoyé à l'interface de présentation dans tous les cas
8	Message binaire à radiodiffusion générale	A8-3.6	Oui	Oui	Oui	
9	Compte rendu de position normalisé d'un aéronef de recherche et de sauvetage	A8-3.7	Oui	Oui	Non	
10	Demande TUC/date	A8-3.8	Oui	INF	Oui	
11	Réponse TUC/date	A8-3.9	Oui	INF	Oui	
12	Message à adressage sélectif relatif à la sécurité	A8-3.10	Oui	Oui (3)	Oui	(3) Uniquement adressé à la station considérée
13	Accusé de réception relatif à la sécurité	A8-3.11	Oui	INF (4)	Oui	(4) Un message ABK PI doit être envoyé à l'interface de présentation dans tous les cas
14	Message binaire à radiodiffusion générale relatif à la sécurité	A8-3.12	Oui	Oui	Oui	Pour un dispositif de localisation conforme au Tableau 11, il convient que le Message 14 ne soit envoyé qu'à l'interface de présentation dans un mode d'essai particulier du dispositif de localisation

Msg. N°	Nom du message	Réf. M.1371-5	R/P	O	T	Remarque
15	Interrogation	A8-3.13	Oui	INF	Oui	Une station mobile de bord de Classe A doit uniquement interroger pour les messages 3, 4, 5, 9, 18, 19, 21 et 24 Le décalage d'intervalle doit être défini sur 0 et doit répondre aux interrogations pour les messages 3, 5 et 24B uniquement
16	Commande mode attribution	A8-3.14	Oui (5)	INF	Non	(5) L'AIS de Classe A doit recevoir et traiter uniquement les messages envoyés d'une station dont le MMSI de station de base est valide
17	DGNSS	A8-3.15	Oui (5, 6)	INF (7)	Non	(6) Uniquement si le récepteur GNSS interne est en mesure de traiter les corrections DGNSS ou si l'interface de présentation contient un accès de sortie DGNSS (7) Sur les autres accès de l'interface de présentation: INF
18	Compte rendu de position normalisé d'un équipement de Classe B	A8-3.16	Oui	Oui	Non	
19	Compte rendu de position étendu d'un équipement de Classe B	A8-3.17	Oui	Oui	Non	
20	Message de gestion de la liaison de données	A8-3.18	Oui (5)	INF	Non	
21	Compte rendu d'aide à la navigation	A8-3.19	Oui	Oui	Non	
22	Message de gestion des voies	A8-3.20	Oui (5)	INF	Non	
23	Commande d'attribution à un groupe	A8-3.21	Oui (5)	Oui	Non	
24	Compte rendu de données statiques (un seul intervalle, deux parties)	A8-3.22	Oui	Oui	Oui	La station mobile de bord de Classe A doit envoyer le Message 24B dans les 12 min qui suivent le démarrage, puis toutes les 24 h.
25	Message binaire occupant un seul intervalle	A8-3.23	Oui	Oui (8)	Oui (9)	(8) Uniquement s'il s'agit d'une diffusion ou s'il est adressé à la station considérée (9) Utiliser la sentence ABM ou BBM indiquant le Message 25/70 dans le champ d'ID message pour initier
26	Message binaire occupant plusieurs intervalles avec état de communication	A8-3.24	Oui	Oui (10)	Oui (11)	(10) Uniquement s'il s'agit d'une diffusion ou s'il est adressé à la station considérée (11) Utiliser la sentence ABM ou BBM indiquant le Message 26/71 dans le champ d'ID message pour initier
27	Message de diffusion AIS longue distance	A8-3.25	Non	Non	Oui	Émettre sur des voies dédiées (ni AIS 1 ni AIS 2).
28 à 63	Non défini	Aucune	INF	INF	Non	Réservé à un usage ultérieur

Légende

R/P – Réception et traitement en interne (préparer pour la sortie par l'intermédiaire de l'interface de présentation, agir sur les informations reçues et utiliser les informations reçues en interne, par exemple).

O – Contenu du message de sortie par l'intermédiaire de l'interface de présentation utilisant des messages PI VDM

T – Émission par la station considérée: "Oui" = exigé; "Non" = ne doit pas être émis

INF – Le message VDL est sorti via l'interface de présentation à l'aide d'un message PI VDM à titre informatif uniquement. Cette fonction peut être supprimée par les paramètres de configuration.

Pour les messages 6, 8, 12, 14, 25 et 26, les transmissions ne doivent pas dépasser le nombre total d'intervalles dans une trame avec un nombre maximal d'intervalles consécutifs par message tel que défini dans la Recommandation UIT-R M.1371. Si les données encapsulées (données binaires ou texte relatif à la sécurité) fournies par les sentences ABM ou BBM ne sont pas alignées sur les octets, les données binaires ou le texte relatif à la sécurité dans les Messages émis doivent être remplis avec des bits de valeur nulle jusqu'à la limite d'octet suivante.

Pour le Message 15, les transmissions ne doivent pas dépasser un total de 5 messages par trame. Si ce n'est pas le cas, l'AIS doit générer une sentence de mise en garde ABK. Le Message 15 doit uniquement être émis en réponse à la sentence AIR reçue par l'intermédiaire de la PI ou si l'interrogation est initiée manuellement sur le MKD.

7.3.4.2 Réponse à des commandes d'attribution (Message 16 et Message 23)

L'AIS de Classe A doit traiter les commandes d'attribution conformément à la Recommandation UIT-R M.1371 uniquement si elles sont envoyées par des stations dont le MMSI de station de base est valide.

Une commande d'attribution reçue par le Message 16 ou le Message 23, avec un intervalle entre les comptes rendus inférieur ou égal à l'intervalle entre les comptes rendus autonome, doit être traitée et l'intervalle entre les comptes rendus défini par la commande d'attribution devant être utilisée.

Une commande d'attribution reçue par le Message 16 ou le Message 23 avec un intervalle entre les comptes rendus plus long que l'intervalle entre les comptes rendus autonome doit être ignorée.

Une attribution à un groupe par le Message 23 ne doit pas s'appliquer aux stations mobiles de Classe A dont le NavStatus est "moored" (au mouillage) et "at anchor" (à l'ancre) et ne se déplaçant pas à plus de 3 nœuds, sauf si le type de station est 10 (voir 8.3).

7.4 Couche Réseau

(Voir l'Article 17)

7.4.1 Généralités

(M.1371-5/A2-4) *La couche Réseau doit être utilisée pour:*

1) *l'établissement et le maintien des connexions des voies;*
2) *la gestion et l'attribution prioritaire de messages;*
3) *la répartition des paquets de transmission entre les voies;*
4) *la résolution des problèmes d'encombrement de la liaison de données.*

La couche Réseau doit être conçue selon la Recommandation UIT-R M.1371-5/A2-4.

7.4.2 Gestion des paramètres d'exploitation régionale

Tous les paramètres d'exploitation régionale mémorisés doivent avoir une étiquette d'heure et de date, et il convient également qu'une étiquette indique comment le paramètre d'exploitation régionale considéré a été entré et reçu (Message AMRT 22, télécommande ASN, entrée manuelle, entrée manuelle via le MKD, entrée de sentence ACA via l'interface de présentation). Une sentence ACA doit pouvoir être obtenue en donnant les paramètres de zone stockés en cours à l'aide d'une sentence de requête $xxAIQ,ACA. La réponse doit être ACA et ACS.

L'AIS doit en permanence vérifier si la limite la plus proche de la zone d'exploitation régionale d'un paramètre d'exploitation régionale enregistré est à plus de 500 NM de la position actuelle de la station considérée ou si un paramètre d'exploitation régionale enregistré a plus de 24 h. L'âge du paramètre de zone est la durée écoulée depuis sa dernière application par le Message 22, la commande ASN, l'entrée MKD ou l'entrée ACA. L'"heure du changement en service" fournie par la sortie ACA ne peut pas être utilisée à cet effet. Tous les paramètres d'exploitation régionale qui satisfont à l'une de ces conditions doivent être effacés de la mémoire.

Les paramètres d'exploitation régionale doivent être traités dans leur ensemble, c'est-à-dire qu'un paramètre d'exploitation régionale doit être considéré comme nouveau si une modification a été demandée le concernant. Toutefois, si une opération sur bande passante étroite (12,5 kHz) est demandée, l'AIS doit continuer l'opération sur bande passante large (25 kHz) tout en acceptant les autres modifications de paramètre.

Si l'utilisateur demande la saisie manuelle d'un paramètre d'exploitation régionale par l'intermédiaire du MKD, les paramètres d'exploitation régionale en cours d'utilisation, qui peuvent être ceux par défaut, doivent lui être présentés. L'utilisateur doit alors être autorisé à éditer ces paramètres en tout ou partie. L'AIS doit s'assurer qu'une zone d'exploitation régionale est toujours entrée et qu'elle satisfait aux règles des zones d'exploitation régionales définies dans la Recommandation UIT-R M.1371-5/A2-4.1. Après avoir saisi un ensemble acceptable de paramètres d'exploitation régionale, l'AIS doit exiger de l'utilisateur qu'il confirme une deuxième fois que les données d'entrée doivent être enregistrées et éventuellement utilisées instantanément.

L'AIS ne doit pas accepter (c'est-à-dire qu'il doit ignorer) tous les paramètres d'exploitation régionale qui contiennent une zone d'exploitation régionale ne satisfaisant pas aux règles de zones d'exploitation régionales définies dans la Recommandation UIT-R M.1371-5/A2-4.1. La taille de la zone doit être calculée selon l'Annexe E.

L'AIS ne doit pas accepter un nouveau paramètre d'exploitation régionale si la distance par rapport à la station de base est de plus de 120 NM ou si aucun Message 4 n'a été reçu de la station de base.

L'AIS ne doit pas accepter un nouveau paramètre d'exploitation régionale qui a été entré par l'intermédiaire de l'interface de présentation, si la zone d'exploitation régionale de ce nouveau paramètre chevauche en tout ou partie la zone d'exploitation régionale des paramètres d'exploitation régionale mémorisés, qui ont été reçus d'une station de base soit par le Message 22 soit par la télécommande ASN au cours des deux dernières heures.

Si la station de Classe A a reçu le Message 22 avec le MMSI adressé à la station concernée, elle ne doit pas accepter le Message 23 et le Message 22 adressés à une zone pendant 10 min.

Un Message 22 adressé à une station concernée ou une télécommande ASN ne contenant pas les coordonnées des points de coin doit être uniquement accepté si l'AIS se trouve dans une région définie par l'un des paramètres d'exploitation régionale enregistrés. Dans ce cas, l'ensemble de paramètres d'exploitation régionale doit être composé en combinant les paramètres reçus à la zone d'exploitation régionale utilisée.

Si la zone d'exploitation régionale du nouveau paramètre d'exploitation régionale accepté chevauche en tout ou partie les zones d'exploitation régionales d'au moins un paramètre d'exploitation régionale plus ancien ou y correspond parfaitement, ce ou ces derniers doivent être effacés de la mémoire. La zone d'exploitation régionale associée au nouveau paramètre d'exploitation régionale qui a été accepté peut être extrêmement proche et donc avoir les mêmes limites que celle associée à des paramètres d'exploitation régionale plus anciens. Cela ne doit pas conduire à effacer les paramètres d'exploitation régionale plus anciens.

Par la suite, l'AIS doit mettre en mémoire un nouveau paramètre d'exploitation régionale qui a été accepté dans l'un des huit emplacements mémoire libres prévus pour les paramètres d'exploitation régionale. S'il n'y a pas d'emplacement mémoire libre, le paramètre d'exploitation régionale le plus éloigné doit être remplacé par le nouveau paramètre qui a été accepté.

NOTE La distance par rapport à un paramètre d'exploitation régionale est la distance par rapport à la limite la plus proche.

Aucun autre moyen que ceux définis ici ne doit être utilisé pour effacer un ou tous les paramètres d'exploitation régionale enregistrés. En particulier, un seul ou tous les paramètres d'exploitation régionale enregistrés par entrée manuelle via le MKD ou via l'interface de présentation ne doivent pas pouvoir être effacés sans entrer un nouveau paramètre d'exploitation régionale.

Si le navire sort de la zone régionale, l'AIS doit revenir sur tous les paramètres par défaut.

7.5 Couche transport

(Voir l'Article 18)

(M.1371-5/A2-5) *La couche Transport doit être chargée d'assurer:*

1) *la conversion des données en paquets de transmission de la taille correcte;*
2) *le séquencement des paquets de données;*
3) *l'interface entre le protocole et les couches supérieures.*

La couche transport doit être conçue conformément à la Recommandation UIT-R M.1371-5/A2-5.

7.6 Interface de présentation

(Voir l'Article 19)

7.6.1 Généralités

(M.1371-5/A2-5.4) *Les données qui doivent être transmises par le dispositif AIS* doivent *être entrées par l'intermédiaire de l'interface de présentation. Les données qui doivent être reçues par le dispositif AIS* doivent *être sorties par l'intermédiaire de l'interface de présentation.*

(M.1371-5/A4-2) *Les équipements mobiles de navire de Classe A* doivent *fournir une interface bidirectionnelle pour les équipements qui assurent des communications longue distance. L'interface* doit *satisfaire aux* éléments suivants.

L'interface entre la couche transport et les couches supérieures doit être assurée par l'interface de présentation. L'interface de présentation de l'AIS doit comporter les accès de données indiqués au Tableau 19 (voir l'Annexe B).

Tableau 19 – Accès de l'interface de présentation

Fonction générale	Mécanisme
Entrée automatique des données de capteur (entrée des données de capteur à partir du matériel de bord)	Accès d'entrée IEC 61162-2, également configurables en accès d'entrée IEC 61162-1 – au moins 3 accès exigés Un accès d'entrée IEC supplémentaire peut être prévu
Accès d'entrée/de sortie à grande vitesse (y compris l'accès pilote) (commandes contrôlées par l'opérateur et entrée de données; données VDL (VHF Data Link) de l'AIS et état du matériel AIS)	Accès d'entrée et de sortie appariés IEC 61162-2 – au moins 2 accès exigés L'accès de communications longue distance peut être configuré comme un accès d'interface de présentation (PI) supplémentaire s'il n'est pas nécessaire pour la communication longue distance dans l'installation actuelle
Communications longue distance	Accès d'entrée et de sortie appariés IEC 61162-2
Sortie de relais d'alerte BIIT	Circuit de contact normalement fermé (NC)

7.6.2 Entrée automatique des données de capteur

7.6.2.1 Accès exigés

Au moins trois accès d'entrée doivent être prévus. Un accès d'entrée IEC 61162-450 supplémentaire peut être prévu. Chaque accès doit satisfaire aux exigences de l'IEC 61162-2 et pouvoir être reconfiguré selon l'IEC 61162-1.

7.6.2.2 Connecteur d'interface

Le fabricant doit spécifier le connecteur et les attributions de broche pour ces accès.

7.6.2.3 Format des données de capteur

Les données de capteur doivent être fournies en utilisant les formats décrits dans l'IEC 61162-1. Une unité AIS doit au moins recevoir et traiter les sentences IEC 61162-1 exigées figurant au Tableau 20. Les détails de ces sentences sont présentés dans l'IEC 61162-1.

Tableau 20 – Sentences de capteur IEC 61162-1

Données	Sentences IEC 61162-1
Référence	DTM
Système de positionnement: Heure de la position Latitude/Longitude Précision de position	GNS, RMC
Vitesse fond (SOG)	RMC, VBW, VTG
Route fond (COG)	RMC, VBW, VTG
Cap	HDT, THS
Indicateur RAIM	GBS
Vitesse angulaire de virage (ROT)	ROT
NOTE Les numéros de groupe de paramètres IEC 61162-3 de réseau d'interface numérique additionnels facultatifs équivalents aux sentences IEC 61162-1 de réseau spécifiées sont décrits pour information à l'Annexe H.	

L'AIS doit utiliser la sentence DTM pour confirmer automatiquement que les informations de position fournies pour la transmission se trouvent dans la référence WGS 84.

La réception des sentences GBS périodiques, contenant les valeurs des paramètres "expected error in latitude" (erreur de latitude prévue) et "expected error in longitude" (erreur de longitude prévue) doit être utilisée pour indiquer avec le "fanion RAIM" que le capteur de position fonctionne avec un processus RAIM en cours d'utilisation.

Chacun des éléments de données figurant au Tableau 20 peut être généré par différents matériels de capteur connectés. Le matériel de capteur externe n'est pas attribué à des accès d'entrée AIS spécifiques, les sentences d'entrée spécifiées n'étant pas non plus attribuées à un matériel particulier. L'AIS doit être en mesure d'accepter ces sentences spécifiées à chacun des accès d'entrée.

Un mécanisme doit être mis en œuvre pour éviter la non-concordance des données ou éviter de dupliquer des entrées si plusieurs données de capteur correspondant au même paramètre sont reçues par différentes sentences et/ou différents accès. Le mécanisme doit être documenté dans le manuel d'installation du fabricant.

7.6.3 Accès d'entrée/de sortie à grande vitesse

7.6.3.1 Accès exigés

Au moins deux accès d'entrée/de sortie doivent être fournis: un accès d'entrée/de sortie principal pour la connexion du matériel de commande embarqué, de l'ECDIS, du radar, etc., et un accès d'entrée/de sortie pilote/auxiliaire pour la connexion du matériel pilote du navire, du matériel de service, etc. Chaque accès doit satisfaire aux exigences de l'IEC 61162-2. Un accès IEC 61162-450 supplémentaire peut être prévu.

Les deux accès d'entrée doivent être équivalents d'un point de vue fonctionnel et doivent être en mesure de recevoir les formats de données définis au Tableau 21.

Les deux accès de sortie doivent être équivalents d'un point de vue fonctionnel et doivent être en mesure de transmettre simultanément les formats de données définis au Tableau 22.

7.6.3.2 Connecteur d'interface

Si la connexion de pilote est fournie, elle doit être configurée comme suit.

AMP/Prise (rebord carré (−1) ou en suspension (−2)), taille de coque 11, 9 broches.

Norme Sex 206486-1/2 ou équivalent avec les terminaisons suivantes:

- Tx A est connecté à la broche 1;
- Tx B est connecté à la broche 4;
- Rx A est connecté à la broche 5;
- Rx B est connecté à la broche 6;
- Le blindage est connecté à la broche 9.

Le fabricant doit spécifier les connexions pour les accès restants.

7.6.3.3 Données d'entrée et formats

L'AIS doit au moins pouvoir recevoir et traiter les données d'entrée présentées au Tableau 21. Les détails de ces sentences sont présentés dans l'IEC 61162-1 et à l'Annexe F pour la sentence SSA. Les données propriétaires du fabricant peuvent également être entrées à l'aide de ces accès grande vitesse.

Tableau 21 – Données d'entrée à grande vitesse AIS et formats

Données	Sentences IEC 61162-1
Accès normal – Entrée de paramètres	
Informations relatives au voyage: Type de navire et catégorie de la cargaison État de navigation Tirant d'eau, maximal, actuel, statique Destination ETA date et heure Fanions d'application régionale	VSD[e]
Informations relatives à la station Nom du navire Indicatif d'appel Emplacement, longueur et largeur d'antenne[c]	SSD
Commande pour la valeur de propriété du matériel	EPV
Sentence de mot de passe de sécurité	SPW[b]
Authentification de signature de l'émetteur	SSA[d]
Initier les diffusions de liaison de données en ondes métriques	
Messages liés à la sécurité Établissement d'une liaison pour accuser réception du message lié à la sécurité reçu par un MKD distant	ABM BBM ABK
Messages binaires	ABM BBM
Message d'interrogation	AIR
Matériel AIS – Entrée de paramètres	
Sélection de voie AIS VHF Réglage de la puissance AIS VHF Bande passante de voie AIS VHF Commande du mode Émission/Réception	ACA[a]
BIIT et entrée de traitement des alertes	
Alarme provenant du MKD distant et pour le transfert de responsabilité	HBT
Commandes d'alerte	ACN, ACK
Accusé de réception LR	
Accusé de réception LR manuel	LRF

[a] L'AIS exige que les informations des champs de longitude et de latitude de la sentence ACA soient tronquées en 1/10 min.

[b] La sentence SPW ne doit pas être utilisée dans l'interface IEC 61162-450/-460 (voir 7.6.5.4.1).

[c] AI, BI, CI, DI à l'exclusion de la remorque (voir l'Annexe I).

[d] Voir l'Annexe F.

[e] La description de la sentence VSD mise à jour est définie à l'Annexe G. L'indicateur de manœuvre particulière est configuré avec les deux premiers bits du fanion d'application régionale de la sentence VSD. Les deux bits suivants du fanion d'application régionale définissent les deux premiers bits du champ de secours à trois bits des Messages 1, 2 et 3.

7.6.3.4 Données de sortie et formats

L'AIS doit au moins pouvoir générer et envoyer les données de sortie présentées au Tableau 22.

La sentence VDO (contenant les Messages 1, 2 ou 3) doit être sortie sur les accès de sortie à grande vitesse, à intervalle nominal de 1 s, utiliser A et B pour indiquer que les données ont été transmises sur la voie VDL A ou B, la valeur nulle indiquant l'absence d'émission sur la VDL.

La sentence VDM doit être envoyée en même temps sur les deux accès de sortie à grande vitesse pour chaque message VDL reçu. Certains messages VDL sont informatifs (voir le Tableau 18). Pendant le fonctionnement, l'opérateur peut désactiver la livraison de ces messages informatifs. Les données propriétaires du fabricant peuvent également être envoyées à l'aide de ces accès grande vitesse.

Tableau 22 – Données de sortie à grande vitesse AIS et formats

Données	Sentences IEC 61162-1
Préparées par l'unité AIS	
Notification qu'une session initiée par les messages ABM, BBM, AIR est terminée	ABK
Données de diffusion du navire AIS (toutes les transmissions disponibles)	VDO
État du matériel AIS (résultats de l'essai d'intégrité intégré) et alertes	ALF, ALC, ARC, ALR
Données de gestion de voie (utilisation du mécanisme de requête)	ACA et ACS
Reçues sur la liaison de données en ondes métriques par l'unité AIS	
Tous les messages VDL AIS reçus diffusés ou adressés à la station	VDM
Reçues sur le système de communication LR	
Message d'interrogation LR reçu	LRI et LRF
Informations système en réponse à une requête	
Informations statiques	SSD
Informations relatives au voyage	VSD
Valeur propriétaire du matériel de compte rendu	EPV
Informations relatives à la version	VER
Informations de statut	TXT
Journal de non-fonctionnement de l'émetteur AIS	TRL
Acquittement négatif	NAK
Si le GNSS interne de l'AIS est destiné à être utilisé pour la source de position du navire, les sentences DTM, GNS, GBS et RMC doivent être générées et envoyées en tant que données de sortie (voir 6.2.2).	

7.6.3.5 Relais des sentences d'entrée de cap et de vitesse angulaire de virage à l'accès pilote

Pour assurer une meilleure résolution sur les données de capteur pour le matériel externe connecté à l'accès pilote, l'AIS doit permettre de relayer les sentences d'entrée de cap (HDT, THS) et de vitesse angulaire de virage (ROT) à l'accès pilote.

Les exigences suivantes s'appliquent pour la fonction de relais:

- la vitesse maximale à la sortie doit être de 5 sentences par seconde pour le cap et de 1 sentence par seconde pour la vitesse angulaire de virage;

- si aucune sentence n'a été reçue à l'entrée, l'AIS ne doit pas envoyer la sentence correspondante à la sortie;

  NOTE Le récepteur des données relayées connecté à l'accès pilote détecte le signal d'entrée manquant à partir du délai d'expiration de sentence.

- latence: 200 ms maximum à partir de la réception de la sentence d'entrée complète jusqu'au début de la sentence de sortie;
- la dernière sentence complète reçue doit être relayée;
- l'AIS ne doit pas modifier le contenu des sentences relayées, y compris l'identificateur d'émetteur;
- sur plusieurs entrées de même type d'informations, seules les sentences provenant d'une source utilisée pour la composition des comptes rendus de position sont relayées.

7.6.3.6 Configuration à l'aide de la sentence EPV

Les identifiants propriétaires utilisés avec la sentence EPV applicable à la station mobile AIS de Classe A sont décrits au Tableau 23.

Tableau 23 – Identifiants propriétaires

Identifiant propriétaire	Protégé	Signification propriétaire	Plage de valeurs
0 à 100		Réservé	
101	oui	Capteur 1 baud	4 800, 9 600, 14 400, 19 200, 38 400
102	oui	Capteur 2 bauds	4 800, 9 600, 14 400, 19 200, 38 400
103	oui	Capteur 3 bauds	4 800, 9 600, 14 400, 19 200, 38 400
104	oui	Baud longue distance	4 800, 9 600, 14 400, 19 200, 38 400
105	oui	Baud DGNSS	4 800, 9 600, 14 400, 19 200, 38 400
106	oui	MMSI	000000000, 200000000 … 799999999, 982000000 … 987999999
107	oui	Numéro OMI	0000000 … 9999999
108	oui	Configuration d'interface longue distance	"A" = automatique "M" = manuel et éventuellement[a]: "O" = l'accès est coupé "P" = l'accès fait office d'accès PI "S" = l'accès fait office d'accès de capteur "G" = l'accès fait office d'accès de sortie GNSS "D" = l'accès fait office d'accès DGNSS pour l'entrée de données de correction "R" = l'accès fait office d'accès DGNSS pour la sortie de données de correction
109	oui	Voie 1 de diffusion AIS longue distance	Voie valide selon l'UIT-R M.1084-5. Voir 8.3. La valeur par défaut est 75. La valeur 0 indique aucune transmission du message 27
110	oui	Voie 2 de diffusion AIS longue distance	Voie valide selon l'UIT-R M.1084-5. Voir 8.3. La valeur par défaut est 76. La valeur 0 indique aucune transmission du message 27
111	oui	Modifier le mot de passe administrateur	Nouveau mot de passe administrateur
112	oui	Modifier le mot de passe utilisateur	Nouveau mot de passe utilisateur

Identifiant propriétaire	Protégé	Signification propriétaire	Plage de valeurs
113	non	Mode d'essai du dispositif de localisation	0 = mode normal 1 = affichage et dispositifs de localisation de sortie en mode d'essai
114	non	Mode silencieux AIS	0 = AIS en fonctionnement d'émission normal 1 = AIS en mode réception uniquement
115	non	Activation de l'alerte du dispositif de localisation	0 = Pas d'alerte des dispositifs de localisation 1 = Alerte générée pour les dispositifs de localisation reçus (par défaut)
116	oui	Configuration d'alerte de capteur	Format: Bits de représentation hexadécimaux. La valeur de bit 0 indique que la fonction d'alerte est désactivée, la valeur 1 indique que la fonction d'alerte est activée. Utilisation des bits: bit 2: position externe bit 1: cap bit 0 (lsb): vitesse angulaire de virage Valeur par défaut 7: toutes les alertes activées.
117	Oui	Niveau d'accès de l'accès pilote	0 = accès normal à la fonctionnalité d'accès PI (par défaut) 1 = accès restreint à la fonctionnalité d'accès PI: pas d'entrée admise, sauf la sentence EPV avec la valeur propriétaire 117, précédée de la sentence SSA.
Identifiants pour la configuration d'interface IEC 61162-450 [c]			
120	oui	Adresse IP et masque de réseau de l'émetteur-récepteur AIS	Format: xxx.xxx.xxx.xxx/nn (/nn = nombre de bits dans la partie réseau du masque de réseau (notation CIDR))
121	oui	SFI de l'émetteur-récepteur AIS	Format: AIxxxx, Plage de xxxx: 0000 … 9999
122	oui	Groupe multidiffusion d'entrée supplémentaire	Code à quatre caractères tel que décrit dans l'IEC 61162-450 (MISC, PROP, par exemple). La chaîne NONE permet de désactiver ce groupe multidiffusion supplémentaire. La valeur par défaut est NONE.
123	oui	Groupe multidiffusion d'entrée supplémentaire	Code à quatre caractères tel que décrit dans l'IEC 61162-450 (MISC, PROP, par exemple). La chaîne NONE permet de désactiver ce groupe multidiffusion supplémentaire. La valeur par défaut est NONE.
124	oui	Groupe de transmission	Code à quatre caractères tel que décrit dans l'IEC 61162-450 (MISC, PROP, par exemple).
Identifiants de configuration SFI [c]			
130	oui	Capteur de position principal	ccxxxx, NONE [b] valeur par défaut: NONE
131	oui	Capteur de position secondaire	ccxxxx, NONE [b] valeur par défaut: NONE
132	oui	Capteur SOG/COG principal	ccxxxx, NONE [b] valeur par défaut: NONE
133	oui	Capteur SOG/COG secondaire	ccxxxx, NONE [b] valeur par défaut: NONE
134	oui	Capteur de cap principal	ccxxxx, NONE [b] valeur par défaut: NONE

Identifiant propriétaire	Protégé	Signification propriétaire	Plage de valeurs
135	oui	Capteur de cap secondaire	ccxxxx, NONE [b] valeur par défaut: NONE
136	oui	Capteur de vitesse angulaire de virage principal	ccxxxx, NONE [b] valeur par défaut: NONE
137	oui	Capteur de vitesse angulaire de virage secondaire	ccxxxx, NONE [b] valeur par défaut: NONE
138	oui	Commande AIS principale	ccxxxx, ANY [b] valeur par défaut: ANY
139	oui	Commande AIS secondaire	ccxxxx, NONE, ANY [b] valeur par défaut: NONE
140	oui	Source de commande d'alerte principale	ccxxxx, ANY [b] valeur par défaut: ANY
141	oui	Source de commande d'alerte secondaire	ccxxxx, NONE, ANY [b] valeur par défaut: NONE
Configuration de dimensions étendues			
150	Non	Extension de dimension EA[d]	Valeur par défaut = 0
151	Non	Extension de dimension EB[d]	Valeur par défaut = 0
152	Non	Extension de dimension EC[d]	Valeur par défaut = 0
153	Non	Extension de dimension ED[d]	Valeur par défaut = 0
Toutes les autres valeurs		Réservé	

[a] Le fabricant doit déclarer que les identifiants facultatifs sont pris en charge.

[b] Les paramètres de configuration et les valeurs de SFI peuvent l'un(e) des suivant(e)s:

- ccxxxx: conformément à l'IEC 61162-450: seules les sentences provenant de cette source sont acceptées;
- NONE: aucune sentence provenant des sources de réseau n'est acceptée;
- ANY: les sentences provenant de toutes les sources de réseau sont acceptées.

[c] Exigé uniquement si l'interface IEC 61162-450 est mise en œuvre.

[d] Les valeurs d'extension de dimension sont exprimées en mètre, la résolution supérieure étant facultative.

7.6.4 Accès de communication longue distance

7.6.4.1 Accès exigés

Au moins un accès d'entrée/de sortie doit être fourni et doit satisfaire aux exigences de l'IEC 61162-2. Il peut être connecté au matériel de communication longue distance (communications par satellite, par exemple; voir l'Article 8).

L'accès d'entrée doit être en mesure de recevoir les formats de données définis au Tableau 24.

L'accès de sortie doit être en mesure d'émettre les formats de données définis au Tableau 25.

7.6.4.2 Connecteur d'interface

Le fabricant doit spécifier le connecteur et les attributions de broche pour ces accès.

7.6.4.3 Données d'entrée et formats

L'interrogation longue distance d'une unité AIS est assurée grâce aux deux sentences IEC 61162-1 LRI et LRF. Cette paire de sentences d'interrogation donne les informations dont a besoin l'unité AIS pour déterminer s'il convient de construire et de fournir les sentences de réponse – LR1, LR2 et LR3. La sentence LRI contient les informations permettant de déterminer s'il est nécessaire de construire la réponse. La sentence LRF identifie les informations demandées.

Les informations qui peuvent être demandées par la sentence LRF sont présentées au Tableau 24. Les détails de ces sentences sont présentés dans l'IEC 61162-1.

Tableau 24 – Données d'entrée de communication longue distance AIS et formats

Données	Sentences IEC 61162-1
Interrogation longue distance Type de demande Demande de zone géographique Demande d'unité AIS	LRI
Identification de fonction longue distance MMSI et nom du demandeur Demande: du nom du navire, de l'indicatif d'appel et du numéro OMI (A) de la date et de l'heure de la composition du message (B) de la position (C) de la route fond (E) de la vitesse fond (F) de la destination et de l'ETA (I) du tirant d'eau (O) du navire/de la cargaison (P) de la longueur, de la largeur et du type de navire (U) du nombre de personnes à bord (W)	LRF

7.6.4.4 Données de sortie et formats

La réponse longue distance provenant de l'unité AIS est assurée grâce aux quatre formateurs de sentence IEC 61162-1 LRF, LR1, LR2 et LR3. L'unité AIS doit répondre à ces sentences dans l'ordre suivant: LRF, LR1, LR2 et LR3, même si tous les éléments d'informations de la sentence sont nuls.

La sentence LRF fournit "l'état de la réponse fonctionnelle" pour les informations demandées. Une liste des caractères "d'état de réponse fonctionnelle" avec l'état qu'il représente est présentée ci-dessous:

2 = informations disponibles et fournies dans les sentences LR1, LR2 et LR3 suivantes;

3 = informations non disponibles depuis l'unité AIS;

4 = les informations sont disponibles, mais non fournies (c'est-à-dire accès limité déterminé par le capitaine du navire).

La sentence LR1 identifie la destination de la réponse et contient les éléments d'informations demandés par le caractère d'identification de fonction "A" dans la sentence LRF.

La sentence LR2 contient les éléments d'informations demandés par les caractères d'identification de fonction "B, C, E, et F" dans la sentence LRF.

La sentence LR3 contient les éléments d'informations demandés par les caractères d'identification de fonction "I, O, P, U et W" dans la sentence LRF.

Les éléments d'informations individuels doivent être "null" si l'une des conditions suivantes existe:

- l'élément d'informations n'a pas été demandé dans la sentence LRF;
- l'élément d'informations a été demandé, mais n'est pas disponible; ou
- l'élément d'informations a été demandé, mais n'a pas été fourni.

Les données de sortie indiquées au Tableau 25 doivent être fournies lorsqu'elles sont spécifiquement demandées par les caractères d'identification de fonction contenus dans la partie de sentence LRF précédente de l'interrogation. Les détails de ces sentences sont présentés dans l'IEC 61162-1.

Tableau 25 – Formats des données de sortie LR

Données	Sentences IEC 61162-1
État de réponse fonctionnelle	**LRF**
MMSI du répondeur MMSI du demandeur Nom du navire Indicatif d'appel du navire Numéro OMI	LR1
MMSI du répondeur Date et heure de la composition du message Position Route fond Vitesse fond	LR2
MMSI du répondeur Destination et ETA Tirant d'eau Navire/cargaison Longueur, largeur et type de navire Nombre de personnes à bord	LR3

7.6.5 Interface IEC 61162-450/-460 facultative

7.6.5.1 Application

Une interface IEC 61162-450/-460 peut éventuellement être mise en œuvre en plus des accès série.

7.6.5.2 Connecteur d'interface

Les connecteurs sont spécifiés dans l'IEC 61162-450.

7.6.5.3 Définitions spécifiques à l'AIS de Classe A en plus de l'IEC 61162-450

Les définitions suivantes spécifient l'application de l'IEC 61162-450 pour l'AIS de Classe A en plus des exigences générales définies dans l'IEC 61162-450.

- Le SFI doit se présenter au format "AIxxxx".
- Le groupe de transmission de sortie par défaut de l'AIS de Classe A doit être TGTD.
- L'en-tête de datagramme est "UdPbC", car la Classe d'AIS communique uniquement avec les sentences formatées selon l'IEC 61162-1. Les transferts d'images binaires ne sont pas mis en œuvre, les exigences et essais connexes n'étant donc pas applicables.
- Les groupes de transmission d'entrée par défaut sont NAVD, TGTD et SATD. Jusqu'à deux groupes d'entrée supplémentaires peuvent être spécifiés. Le Tableau 26 répertorie les sentences applicables pour les groupes d'entrée par défaut. Le Tableau 27 répertorie les paramètres de bloc TAG.

Tableau 26 – Groupes de transmission d'entrée par défaut avec sentences applicables

Groupe Tx	Adresse multidiffusion	Accès	Identificateur d'émetteur classique	Sentences classiques	Type de message
NAVD	239.192.0.4	60004	GA, GP, GN, LC, IN, HE, TI	DTM, GBS, GNS, RMC, VBW, VTG, (GGA, GLL) HDT, THS, ROT	SBM
NAVD	239.192.0.4	60004	EC, EI, IN	ABM, ACA, AIR, BBM, SSD, VSD, HBT	CRP
TGTD	239.192.0.2	60002	RA	ABM, ACA, AIR, BBM, SSD, VSD, HBT	CRP
SATD	239.192.0.3	60003	HE	HDT, THS	SBM

Tableau 27 – Paramètres de bloc TAG

Code de paramètre	Nom du paramètre	Contenu	Exemple	Exigences
s:	Source-identification	SFI du SF qui génère la sentence	s:AI0001	Toujours exigé
d:	Destination-identification	SFI du bloc SF de destination	d:IN0002	Uniquement dans les sentences de type CRP, si elles sont adressées à un certain SFI.
n:	Line-count	Compteur de lignes, de 1 à 999	n:1234	Toujours exigé Compteur séparé pour chaque groupe de transmission adressé
g:	Sentence-grouping	Format: x-y-code x = numéro de sentence y = nombre de sentences dans le groupe code = code de groupe en comptant de 1 à 99	g:1-3-23 g:2-3-23 g:3-3-23 g:1-2-24 g:2-2-24	Exigé pour tous les messages à plusieurs sentences. Accepté sur l'entrée également pour les sentences simples
t:	Text-string	Texte à format libre		Non utilisé dans l'AIS de Classe A
a:	General authentication	Signature des sentences suivantes dans le bloc Format: c-h--h c = méthode de calcul de signature, h-- = signature.	a:2-479CF…	Peut être utilisé. Aucun paramètre supplémentaire ne peut être présent dans le même bloc TAG.

7.6.5.4 Exigences pour l'AIS de Classe A dans un réseau -450

7.6.5.4.1 Généralités

Les mêmes sentences que celles spécifiées pour l'entrée des données de capteur et les accès grande vitesse doivent être mises en œuvre. Les sentences sont précédées d'un en-tête IEC 61162-450.

Les données de capteur reçues par l'intermédiaire de l'interface IEC 61162-1 doivent avoir une priorité plus élevée dans les limites du même niveau de priorité de repli du capteur que les données reçues par l'intermédiaire de l'interface IEC 61162-450 facultative, si les deux interfaces sont connectées. Les niveaux de priorité sont décrits au Tableau 7 pour les capteurs de position et au Tableau 9 pour les capteurs de vitesse angulaire de virage.

La sentence SPW ne doit pas être utilisée dans l'interface IEC 61162-450/-460. La configuration des paramètres protégés par la sentence SPW ne doit pas être acceptée par l'intermédiaire de l'interface IEC 61162-450/-460.

NOTE La sentence SPW émet le mot de passe en texte plein, ce qui présente un risque lié à la cybersécurité dans les réseaux.

7.6.5.4.2 Sentences CRP

Les sentences CRP (paire commande-réponse) doivent toujours être sorties avec un paramètre de bloc TAG d:destination du SF à partir duquel la commande d'origine a été reçue. Les sentences CRP utilisées dans l'AIS sont décrites au Tableau 28.

Tableau 28 – Sentences CRP applicables pour l'AIS de Classe A

Commande reçue	Réponse	Fonction
ABM/BBM/AIR	ABK	Transmission de messages au VDL
SSD	SSD	Configuration des données statiques
VSD	VSD	Configuration des données relatives au voyage
ACA	ACA/ACS	Gestion de voie
LRI/LRF	LRF/LR1/LR2/LR3	Interface longue distance
EPV	EPV	Commande ou valeur de propriété du matériel de compte rendu
Requête générale	Réponse à la requête	Requête d'informations de configuration

7.6.5.4.3 Données de sortie

Les données qui sont sorties de manière autonome et pas en réponse à une commande d'entrée sont:

- VDO, VDM
- ALC, ALF, ARC
- HBT
- ALR, TXT
- ACA

7.6.5.4.4 Groupement

Les sentences suivantes peuvent être groupées:

- ACA, ACS;
- VDM à plusieurs sentences;

- VDO à plusieurs sentences.

7.6.5.5 Classification de sécurité IEC 61162-460 de l'interface IEC 61162-450

7.6.5.5.1 Généralités

Il existe trois niveaux de classification de sécurité possibles concernant l'application de l'IEC 61162-460 pour une interface IEC 61162-450, si elle est mise en œuvre:

- pas de connexion à un réseau -460;
- nœud 450;
- nœud 460.

Le fabricant doit déclarer la classification de sécurité IEC 61162-460 des interfaces IEC 61162-450.

7.6.5.5.2 Classification de sécurité IEC 61162-460: pas de connexion à un réseau -460

Le dispositif ne peut pas être connecté à un réseau -460. Les exigences de l'IEC 61162-450 doivent être satisfaites, mais celles de l'IEC 61162-460 ne doivent pas l'être.

7.6.5.5.3 Classification de sécurité IEC 61162-460: nœud 450

Un nœud 450 peut être connecté à un réseau -460. Les exigences et essais supplémentaires sont définis dans l'IEC 61162-460.

Les principales exigences sont les suivantes:

- aucune connexion aux réseaux externes ou à la REDS (Removable External Data Source – source de données externes amovibles) ne peut être utilisée. Les REDS ne peuvent être utilisées que dans les nœuds 460 avec plus de restrictions en matière de sécurité;
- le journal système externe tel que défini dans l'IEC 61162-450 doit être mis en œuvre;
- la bande passante de sortie de données doit être documentée par le fabricant.

7.6.5.5.4 Classification de sécurité IEC 61162-460: nœud 460

Les exigences et essais d'un nœud 460 sont définis dans l'IEC 61162-460. Différente de celle des nœuds 450, la mise en œuvre des sources de données externes amovibles (REDS) peut généralement être appliquée dans les nœuds 460.

7.6.6 Essai de l'interface IEC 61162-450/-460 facultative

L'essai de l'interface IEC 61162-450/-460 ne fait pas partie du présent document. Par conséquent, le présent document ne contient pas de paragraphe spécial consacré aux essais IEC 61162-450/-460. Les essais sont définis dans l'IEC 61162-450 et l'IEC 61162-460.

Les essais spécifiés dans l'IEC 61162-450 et qui s'appliquent à un AIS de Classe A doivent être réalisés. En principe, les paragraphes d'essai 4.5, 4.7 et 7.3 de l'IEC 61162-450:2018 ne s'appliquent pas au matériel AIS de Classe A.

Selon la catégorie 460, les essais appropriés de l'IEC 61162-460 doivent être réalisés.

Les essais donnés au Tableau 29 de l'Article 14 à l'Article 19 doivent être répétés pour vérifier que toutes les sentences sont utilisées correctement par l'intermédiaire de l'interface IEC 61162-450.

Tableau 29 – Essais à répéter pour l'interface IEC 61162-450

Sentence soumise à essai	Essai n°	Description de l'essai	Remarque
VDO	14.1.1.1.1 c)	Transmettre les comptes rendus de position	
VDM	14.1.1.2.1 a)	Recevoir les comptes rendus de position	
AIR, ABK	14.1.3.1	Transmettre une interrogation	À soumettre à essai avec une interrogation au contenu complet
ABM, ABK	14.1.4.1.1 a)	Transmettre un message adressé	
BBM, ABK	14.1.5.1.1 a)	Transmettre un message diffusé	
TRL	14.4	Journal des événements	
ALR, ACK	14.8.2.2	ROS d'antenne	
ALF, ACN	-	-	Conformément à la Recommandation MSC.302(87) de l'OMI
HBT	14.8.2.5.1 b)	Déconnexion du MKD distant, si la configuration le permet	Vérifier que l'entrée HBT est acceptée
TXT	14.8.2.8	Requête d'état	
VER	14.8.2.9	Demande d'informations relatives à la version	
ACA, ACS	17.3	Désignation de zone régionale par message en série	Vérifier uniquement que les zones sont enregistrées et utilisées lorsque la position est à l'intérieur.
GNS	19.5.1.1 a)	Essai de l'entrée GNS	
RMC	19.5.2.1 a)	Essai de l'entrée RMC	
DTM	19.5.3.1 a)	Essai de l'entrée DTM	
GBS	19.5.4.1 a) et b)	Essai de l'entrée GBS	
VBW	19.5.5.1 a)	Essai de l'entrée VBW	
VTG	19.5.6.1 a)	Essai de l'entrée VTG	
HDT	19.5.7.1 a)	Essai de l'entrée HDT/THS	Essai de l'entrée HDT
THS	19.5.7.1 a)	Essai de l'entrée HDT/THS	Essai de l'entrée THS
ROT	19.5.8	Essai de l'entrée ROT	
-	19.5.10	Essai de plusieurs entrées	Soumettre à essai les entrées simultanées provenant des accès série et du réseau IEC 61162-450
VDM	19.7	Performances de l'interface de sortie à grande vitesse	Contrôle de performance
VSD	19.9.2	Essai de la sentence d'entrée VSD	Appliquer un ensemble complet de paramètres
SSD	19.9.3.1 d) et e)	Essai de la sentence d'entrée SSD	Les paramètres doivent être refusés
EPV	19.9.4.1 b)	Essai de la sentence d'entrée EPV	Essai de l'entrée non protégée, l'entrée EPV doit être acceptée.
SSA	19.9.4.1	Essai de la sentence d'entrée EPV	Essai de l'entrée protégée, l'entrée EPV doit être acceptée

7.6.7 Sortie d'alerte BIIT

L'AIS doit fournir une sortie de relais (contact NC) indiquant l'état de la fonction d'alerte de l'essai d'intégrité intégré (BIIT) spécifiée en 6.10.1.

Les bornes doivent être isolées des circuits et de la masse dans l'AIS.

La documentation du fabricant de l'AIS doit spécifier la capacité de courant et de tension des contacts du relais d'alarme.

8 Applications longue distance

8.1 Généralités

Les applications longue distance doivent être assurées par l'interface avec d'autres équipements (8.2) et par radiodiffusion générale (8.3).

8.2 Application longue distance par interface bidirectionnelle

(Voir 20.1)

8.2.1 Généralités

Les communications longue distance (LR) doivent uniquement avoir lieu par l'intermédiaire de l'interface de présentation à l'aide de l'interface IEC 61162-2 prévue à cet effet (voir 7.6.4).

Les données LR AIS doivent s'afficher sur l'écran de l'AIS (voir 6.11).

8.2.2 Interrogations et réponses

Les informations LR doivent uniquement être transmises en réponse à une interrogation provenant d'une station de base LR

8.2.3 Réponse manuelle et automatique

La station AIS de Classe A doit être en mesure d'être réglée par l'utilisateur pour répondre automatiquement ou manuellement à des interrogations LR. En cas de réponse automatique à des interrogations LR, l'affichage doit indiquer que le système a fait l'objet d'une interrogation LR tant que l'indication n'a pas été acquittée par l'opérateur. En cas de réponse manuelle à une interrogation LR, l'affichage doit indiquer que le système a fait l'objet d'une interrogation LR tant que l'opérateur n'y a pas répondu ou n'a pas annulé la réponse sur le dispositif d'entrée manuelle (voir 6.11).

8.2.4 Formats de données et contenu

Les types de données LR disponibles pour la transmission doivent être déduits du système AIS (voir le Tableau 30).

Tableau 30 – Types de données LR

ID	Types de données Format	Remarques
A	Nom du navire/indicatif d'appel MMSI/Numéro OMI	Le numéro MMSI doit être utilisé comme identifiant de fanion
B	Date et heure (TUC)	L'horodatage de la composition du message doit être donné en TUC uniquement. Jour du mois, heures et minutes
C	Position	WGS 84; degrés et minutes de latitude/longitude
D		Non disponible
E	Route	Route fond (COG), en degrés
F	Vitesse	Vitesse fond (SOG) en nœuds et 1/10 nœuds
G, H		Non disponible
I	Destination/ETA	À la discrétion du capitaine; Format d'heure ETA, voir B
J, K, L, M, N		Non disponible
O	Tirant d'eau	Tirant d'eau maximal réel en 1/10 de mètres
P	Navire/cargaison	Voir la Recommandation UIT-R M.1371-5/A8-3.3, Tableau 52
Q, R, S, T		Non disponible
U	Longueur/Largeur/Type	Longueur et largeur en mètres Type, voir la Recommandation UIT-R M.1371-5/A8-3.3, Tableau 52, tonnage non disponible
V		Non disponible
W	Nombre de personnes à bord	
X,Y		Non disponible
Z		Non utilisé

8.2.5 Adressage d'unités AIS

Les interrogations LR doivent être formulées soit par ID utilisateur (MMSI du navire) soit par un appel de "tous les navires" dans une zone géographique en désignant le coin nord-est et le coin sud-ouest du rectangle de projection de Mercator, qui décrit la zone appelée.

Le premier transfert de données LR doit avoir lieu par interrogation LR initiée dans le cadre d'un appel de "Tous les navires" dans une zone géographique.

Les transferts de données LR successifs doivent avoir lieu par interrogation LR basée sur un ID utilisateur (MMSI).

Pour éviter que la même station de base réponde aux appels successifs "Tous les navires" dans une zone géographique, l'AIS doit stocker le MMSI de la station de base LR pendant 24 h.

8.3 Applications longue distance par radiodiffusion générale

(Voir 14.1.1, 20.2)

L'application longue distance par radiodiffusion générale est décrite dans la Recommandation UIT-R M.1371-5/A4.

Les systèmes de réception AIS longue distance (un récepteur par satellite, par exemple) reçoivent des messages de radiodiffusion générale AIS longue distance, à condition que ces messages soient correctement structurés et émis de façon à convenir à ces systèmes.

Le Message 27 de radiodiffusion générale AIS longue distance doit être émis uniquement sur la voie 75 et la voie 76. Il convient que les émissions alternent entre ces deux voies, de manière à utiliser une seule fois chaque voie toutes les 6 min. La radiodiffusion générale du Message 27 dans les zones littorales est soumise au contrôle de la station de base par l'utilisation combinée du Message 4 et du Message 23 avec le type de station 10.

L'AIS doit avoir la possibilité de désactiver cette fonction pendant le fonctionnement normal.

9 Conditions d'essais

9.1 Conditions d'essai normales et extrêmes

9.1.1 Conditions d'essais normales

9.1.1.1 Température et humidité

La température et l'humidité doivent être dans la plage suivante:

Température	+15 °C à +35 °C
Humidité	20 % à 75 %

9.1.1.2 Alimentation électrique

L'alimentation électrique normale pour les essais doit être conforme à l'IEC 60945.

9.1.2 Conditions d'essais extrêmes

Les conditions d'essais extrêmes sont spécifiées dans l'IEC 60945. Si cela est exigé, l'essai réalisé dans des conditions d'essais extrêmes doit être une combinaison de chaleur sèche et de tension d'alimentation à sa limite supérieure appliquées simultanément, d'une part, et de basse température et de tension d'alimentation à sa limite inférieure appliquées simultanément, d'autre part.

Pendant l'essai de type, la source d'alimentation peut être remplacée par une source d'alimentation d'essai, capable de produire des tensions d'essai normales et extrêmes.

9.2 Environnement d'essai normalisé

L'EUT est soumis à essai dans un environnement à l'aide d'un équipement d'essai visant à simuler et consigner les messages VDL (voir le Tableau 18). L'environnement normalisé inclut les cibles simulées. Les cibles simulées doivent inclure un nombre approprié de cibles de

- mobile de Classe A,
- mobile "DP" de Classe B,
- mobile "AO" de Classe B,
- station de base,
- station AIS d'aide à la navigation,
- aéronef SAR,
- dispositif de localisation.

Un récepteur de message de radiodiffusion générale AIS longue distance (Message 27) doit également être fourni.

Le niveau d'entrée du signal à l'accès d'entrée RF de l'EUT d'une cible simulée doit être d'au moins –100 dBm. Les entrées de capteur de navire considéré vers l'EUT sont simulées par le système d'essai ou par d'autres moyens. Le fonctionnement est vérifié sur les voies dans la bande attribuée aux services mobiles maritimes.

Les voies utilisées doivent être choisies par entrée manuelle ou par des messages d'attribution de voie avant de commencer les essais.

9.3 Dispositions d'essai supplémentaires

9.3.1 Dispositions pour les signaux d'essai appliqués à l'entrée du récepteur

Les sources des signaux d'essai pour l'application vers l'entrée du récepteur doivent être connectées de sorte que l'impédance de source présentée à l'entrée du récepteur soit de 50 Ω (voir 9.3.4).

Cette exigence doit être satisfaite, qu'un ou plusieurs signaux utilisant un réseau combinateur soient appliqués simultanément au récepteur ou pas.

Les niveaux de puissance des signaux d'essai aux bornes d'entrée du récepteur (prise RF) doivent être exprimés en dBm.

Les effets des produits d'intermodulation et du bruit généré dans les sources de signal d'essai doivent être négligeables.

9.3.2 Codeur pour les mesurages du récepteur

Le cas échéant, et afin de faciliter les mesurages sur le récepteur, un codeur destiné au système d'acquisition de données doit accompagner l'EUT, avec les caractéristiques du processus normal de modulation. Le codeur est utilisé pour moduler un générateur de signaux faisant office de source de signal d'essai.

Les détails exhaustifs de tous les codes et du ou des formats de code utilisés doivent être donnés.

9.3.3 Dispense pour les récepteurs

Si le fabricant déclare que les deux récepteurs AMRT sont identiques, l'essai peut être limité à un récepteur, l'essai du deuxième récepteur pouvant ne pas être réalisé. Le rapport d'essai doit le signaler.

9.3.4 Impédance

Dans le présent document, le terme "50 Ω" est utilisé pour indiquer une impédance non réactive de 50 Ω.

9.3.5 Antenne artificielle (antenne fictive)

Les essais doivent être réalisés à l'aide d'une antenne artificielle qui doit être une antenne non réactive et non rayonnante de 50 Ω reliée au connecteur d'antenne.

9.3.6 Installations d'accès

Tous les essais doivent être réalisés à l'aide des accès normalisés de l'EUT. Si des installations d'accès sont exigées pour réaliser un essai particulier, elles doivent être fournies par le fabricant.