



BSI Standards Publication

Maritime navigation and radiocommunication equipment and systems — Class B shipborne equipment of the automatic identification system (AIS)

Part 2: Self-organising time division multiple access (SOTDMA) techniques (IEC 62287-2:2017)

National foreword

This British Standard is the UK implementation of EN 62287-2:2017. It is identical to IEC 62287-2:2017. It supersedes BS EN 62287-2:2013, which will be withdrawn on 14 March 2020.

The UK participation in its preparation was entrusted to Technical Committee EPL/80, Maritime navigation and radiocommunication equipment and systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

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(IEC 62287-2:2017)

Matériels et systèmes de navigation et de
radiocommunications maritimes - Transpondeur embarqué
du système d'identification automatique (AIS) de classe B -
Partie 2: Technique d'accès multiple par répartition dans le
temps auto-adaptatif (SOTDMA)
(IEC 62287-2:2017)

Navigations- und Funkkommunikationsgeräte und -systeme
für die Seeschifffahrt - Geräte der Klasse B des
automatischen Identifikationssystems (AIS) für Schiffe - Teil
2: Sich selbst abstimme Zeitmultiplex-
Vielfachzugriffstechniken (SOTDMA)
(IEC 62287-2:2017)

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

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The following dates are fixed:

- latest date by which the document has to be (dop) 2017-12-14
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publication of an identical national
standard or by endorsement
- latest date by which the national (dow) 2020-03-14
standards conflicting with the
document have to be withdrawn

This document supersedes EN 62287-2:2013.

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In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61162-3:2008	NOTE	Harmonized as EN 61162-3:2008.
IEC 61162-3:2008/AMD1:2010	NOTE	Harmonized as EN 61162-3:2008/A1:2010.
IEC 61162-3:2008/AMD2:2014	NOTE	Harmonized as EN 61162-3:2008/A2:2014.
IEC 61924-2:2012	NOTE	Harmonized as EN 61924-2:2012.
IEC 62287-1	NOTE	Harmonized as EN 62287-1.
ISO 9000 (Series)	NOTE	Harmonized as EN ISO 9000 (Series).

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60945	2002	Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results	EN 60945	2002
IEC 61108	series	Maritime navigation and radiocommunication equipment and systems - Global navigation satellite systems (GNSS)	EN 61108	series
IEC 61108-4	-	Maritime navigation and radiocommunication equipment and systems - Global navigation satellite systems (GNSS) - Part 4: Shipborne DGPS and DGLONASS maritime radio beacon receiver equipment - Performance requirements, methods of testing and required test results	EN 61108-4	-
IEC 61162-1	-	Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 1: Single talker and multiple listeners	EN 61162-1	-
IEC 61993-2	-	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	EN 61993-2	-
ITU Radio regulations, Vol 1	-	Radio Regulations - Volume 1: Articles	-	-
ITU-R Recommendation M.1084-5	-	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.1371-5	-	Technical characteristics for an automatic identification system using time-division multiple access in the VHF maritime mobile band	-	-
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	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MARITIME NAVIGATION AND RADIOCOMMUNICATION
EQUIPMENT AND SYSTEMS – CLASS B SHIPBORNE EQUIPMENT
OF THE AUTOMATIC IDENTIFICATION SYSTEM (AIS) –****Part 2: Self-organising time division multiple access
(SOTDMA) techniques**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 62287-2 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

This second edition cancels and replaces the first edition published in 2013. It constitutes a technical revision.

This edition includes the following significant technical change with respect to the previous edition: the introduction of transmission of Message 27 on channels 75 and 76 for the long range application by broadcast.

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

FDIS	Report on voting
80/827/FDIS	80/836/RVD

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

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

A list of all parts in the IEC 62287 series, published under the general title *Maritime navigation and radiocommunication and systems – Class B shipborne equipment of the automatic identification system (AIS)*, can be found on the IEC website.

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

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

A bilingual version of this publication may be issued at a later date.

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.

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – CLASS B SHIPBORNE EQUIPMENT OF THE AUTOMATIC IDENTIFICATION SYSTEM (AIS) –

Part 2: Self-organising time division multiple access (SOTDMA) techniques

1 Scope

This part of IEC 62287 specifies operational and performance requirements, methods of testing and required test results for Class B "SO" shipborne automatic identifications system (AIS) equipment using self-organising time division multiple access (SOTDMA) techniques as described in Recommendation ITU-R M.1371. This document takes into account other associated IEC International Standards and existing national standards, as applicable.

The main differences between Class B "CS" (IEC 62287-1) and Class B "SO" units are that the Class B "SO"

- covers all 25 kHz channels listed in Recommendation ITU-R M.1084-5,
- only uses the internal GNSS – no position sensor input is allowed,
- requires use of VDL Message 17 for correction of the internal GNSS,
- requires a presentation interface,
- has additional reporting intervals, down to 5 s,
- has two power settings, with a high level of 5 W, and
- has the capability to transmit binary messages.

This document is applicable for AIS equipment used on craft that are not covered by a mandatory carriage requirement of AIS under SOLAS Chapter V.

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 61108-4, *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS) – Part 4: Shipborne DGPS and DGLONASS maritime radio beacon receiver equipment – Performance requirements, methods of testing and required test results*

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

IEC 61993-2, *Maritime navigation and radio communication 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*

ITU Radio regulations:2012

ITU-R Recommendation M.825-3:1998, *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.1371-5:2014, *Technical characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile band*

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
BER	bit error rate
BIIT	built-in integrity tests
BT	bandwidth time
COG	course over ground
CRC	cyclic redundancy check
CSD	compass safe distance
DGNSS	differential global navigation satellite service
DLS	data link service
DSC	digital selective calling
EUT	equipment under test
FM	frequency modulation
GMSK	gaussian minimum shift keying
GNSS	global navigation satellite service
IMO	International Maritime Organization
ITDMA	incremental time division multiple access
ITU	International Telecommunication Union
LME	link management entity
MAC	medium access control
MMSI	maritime mobile service identity
NM	nautical mile (1 NM = 1 852 m)

NRZI	non return to zero inverted
OSI	open systems interconnection model
<i>PER</i>	packet error rate
PI	presentation interface
RAIM	receiver autonomous integrity monitoring
RATDMA	random access time division multiple access
RF	radio frequency
RR	Radio Regulations
Rx	Receive
SAR	Search and rescue
SINAD	signal interference noise and distortion ratio
SOG	speed over ground
SOTDMA	self organised time division multiple access
TDMA	dime division multiple access
Tx	Transmit
UTC	universal time co-ordinated
VDL	VHF data link
VHF	very high frequency
VSWR	voltage standing wave ratio
VTs	vessel traffic services

4 General requirements

4.1 General

4.1.1 Capabilities of the Class B "SO" AIS

The Class B "SO" AIS shall improve the safety of navigation by assisting in the efficient navigation of ships and small craft, protection of the environment, and operation of vessel traffic services (VTS).

The Class B "SO" AIS station shall be inter-operable and compatible with all AIS stations operating on the AIS VHF Data Link. In particular, Class B "SO" AIS stations shall not degrade the integrity of the AIS VHF data link.

The Class B "SO" AIS shall be capable of providing information from the craft, automatically, continuously and with the required accuracy and update rate

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

4.1.2 Quality assurance

(See 10.1.1)

Manufacturers shall have a quality control system audited by a competent authority to ensure continuous compliance with the requirements of this document. Alternatively, the manufacturer may use final product verification procedures where a competent authority verifies compliance with the requirements of this document before the product is put to the market.

NOTE ISO 9000 (all parts), as applicable, meets the requirements of a quality control system.

4.1.3 Safety of operation

(See 10.1.2)

It shall not be possible for the operator to augment, amend or erase any program software required for operation in accordance with this document. The manufacturer may provide means to install software updates.

Data used during operation and stored in the system shall be protected in such a way that necessary modifications and amendments by the user cannot endanger its integrity and correctness.

4.1.4 Additional features

(See 10.1.3, 13.7)

Where equipment provides a feature that is additional to the minimum requirements and options of this document, the operation and, as far as is reasonably practicable, the malfunction of such additional features shall not degrade the performance of the equipment.

4.1.5 Functionality

The equipment shall operate in three modes (see 7.3.4.3):

- autonomous (default mode);
- assigned;
- interrogation.

4.2 Manuals

(See 10.1.1)

The manuals shall include

- the type of external connectors, if applicable,
- the information for correct installation and positioning of the antennas, and
- the information for compass safe distance.

4.3 Marking and identification

(See 10.1.1)

In addition to the requirements of IEC 60945:2002, 4.9, 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 Environmental, power supply, interference and safety requirements

(See Clause 9)

In addition to the specific requirements of this document, the Class B "SO" AIS shall fulfil the following general requirements as detailed in IEC 60945:

- inter-unit connection (electrical interfaces other than IEC 61162-1, for instance IEC 61162-450, are permissible);
- power supply;
- extreme power supply;

- excessive conditions;
- power supply short-term variation and power supply failure;
- durability and resistance to environmental conditions;
- interference;
- electromagnetic compatibility;
- compass safe distance;
- safety precautions;
- protection against accidental access to dangerous voltages;
- electromagnetic radiofrequency radiation.

The Class B "SO" AIS shall not enter an undefined or unstable state in case of under voltage.

The manufacturer shall declare the category of the equipment as follows:

- a) portable;
- b) protected from the weather;
- c) exposed to the weather;
- d) submerged or in continuous contact with sea water.

The Class B "SO" AIS shall be tested for compliance with the environmental, power supply, special purpose and safety requirements of IEC 60945:

- 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, columns "Protected" or "Exposed", as appropriate, of IEC 60945:2002.

In addition, the AIS installation, when operating, shall not be damaged by the effects of open circuited or short circuited antenna terminals.

6 Performance requirements

6.1 Internal processes

(See 10.1.1)

The Class B "SO" AIS shall comprise

- a communication processor, capable of operating in the VHF maritime mobile service band,
- at least one transmitter and two receiving processes for TDMA operation,
- a third receiving process for DSC channel management,
- a means for automatic channel switching in the maritime mobile band (by Message 22 and by DSC) – manual channel switching shall not be provided –, and
- an internal GNSS position sensor, which provides a resolution of one ten thousandth of a minute of arc and uses the WGS-84 datum only.

6.2 Operating frequency channels

(See 10.3)

The Class B "SO" AIS shall be designed to operate with 25 kHz bandwidth (see 7.2.3.3) in the range from 156,025 MHz to 162,025 MHz of the ITU Radio Regulations:2012, Appendix 18, and in accordance with Recommendation ITU-R M.1084-5:2012, Annex 4.

The Class B "SO" AIS shall indicate its capabilities of channel operation in the VHF maritime mobile band with the flag settings of Message 18 (see 6.5.1.3).

The DSC receiving process shall be tuned to VHF Channel 70 (see 7.2.3.7).

6.3 Internal GNSS receiver for position reporting

(See 10.4)

The Class B "SO" AIS shall have an internal GNSS receiver as the only source for position, COG and SOG except for test purposes.

The internal GNSS receiver shall meet the following requirements of a receiver as specified in IEC 61108 (all parts):

- position accuracy; static and dynamic;
- COG/SOG accuracy;
- position update;
- interference susceptibility;
- status indications (RAIM optional);
- WGS-84 datum positions.

The internal GNSS receiver shall be capable of being differentially corrected by Message 17.

Optionally, in addition to Message 17, the Class B "SO" AIS may be differentially corrected by a radio beacon. If the radio beacon option is implemented, it shall be tested in accordance with IEC 61108-4.

6.4 Identification

(See 10.8.3)

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" that 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 not be capable of transmitting.

6.5 AIS Information

6.5.1 Information content

(See 10.5.1)

6.5.1.1 Static and voyage related (Messages 19, 24A and 24B)

The list of static information shall include the following:

- identification (MMSI);
- name of ship;
- type of ship;
- vendor ID (unit should respond to interrogation for Message 24B);
- call sign;
- dimensions of ship and reference for position.

The default value for type of ship shall be 37 (pleasure craft). Defaults for other static data shall be chosen such that it is obvious that the equipment has been properly initialised, in particular, the default MMSI shall be set to 000000000 and the equipment shall be designed such that transmissions are inhibited with this default setting.

6.5.1.2 Dynamic (Message 18)

The list of dynamic information shall include the following:

- ship's position with accuracy indication and integrity status;
- UTC second when position fix was generated;
- course over ground (COG) from internal GNSS;
- speed over ground (SOG) from internal GNSS;
- true heading (optional).

6.5.1.3 Configuration information (Message 18)

The following information about configuration and options active in the specific unit shall be provided by flag settings in Message 18:

- type of AIS Class B unit;
- availability of minimum keyboard/display facility;
- availability of DSC Channel 70 receiver;
- ability to operate in the marine VHF band;
- ability to process channel management Message 22.

6.5.2 Information reporting intervals

(See 10.5.2, 10.6)

The reporting interval for Static and Voyage related information shall be every 6 min, when data has been amended, or upon interrogation.

The reporting interval for dynamic information shall be as stated in Table 1.

Table 1 – Dynamic information autonomous reporting intervals for Class B "SO" AIS

Condition	Nominal reporting interval	Increased reporting interval
Class B "SO" AIS Mobile Equipment moving < 2 kn	3 min	3 min
Class B "SO" AIS Mobile Equipment moving at 2 kn to 14 kn	30 s	30 s
Class B "SO" AIS Mobile Equipment moving at 14 kn to 23 kn	15 s	30 s
Class B "SO" AIS Mobile Equipment moving > 23 kn	5 s	15 s

The Class B "SO" AIS shall follow the rules set by Recommendation ITU-R M.1371, and shall increase the reporting interval to "increased reporting interval" in accordance with Table 1 when less than 50 % of the slots of each of the last four consecutive frames are free. When more than 65 % of the slots of each of the last four consecutive frames are free, the Class B "SO" AIS shall report at the "nominal reporting interval".

An assignment command, received by Message 16 or Message 23, may decrease or increase the reporting interval defined by Table 1 (see 4.1.5).

A reporting interval of less than 5 s shall not be required.

An assignment using Message 16 has priority over an assignment using Message 23.

When the BIIT determines that the position sensor is unavailable, the Class B "SO" AIS shall maintain a reporting interval of 3 min (see 6.6.1).

6.5.3 Short safety-related messages

(See 10.2.2.5)

Short safety-related messages as described in Recommendation ITU-R M.1371 (Message 14) shall not be provided.

NOTE IMO COMSAR.1/Circ.46:2009-02 advises that "short safety-related messages should not be incorporated in AIS equipment because there is no SAR infrastructure in place to accommodate them".

6.5.4 Permissible initialisation period

(See 10.6)

The AIS unit shall be operational within 2 min of switching on.

6.6 Alarms and indications, fall-back arrangements

(See 10.7)

6.6.1 Built-in integrity tests (BIIT)

The Class B "SO" AIS shall have BIIT which monitor the processes listed in Table 2.

Any BIIT failure shall set the error indicator as defined in 6.7.1.

The Class B "SO" AIS reacts to BIIT malfunctions as indicated in Table 2.

Table 2 – BIIT and reaction to malfunctions

Test	Reaction to malfunction
AIS: Tx malfunction	Stop transmission
AIS: Antenna VSWR exceeds limit	Continue operation
AIS: Rx channel 1 malfunction	Stop transmission on affected channel
AIS: Rx channel 2 malfunction	Stop transmission on affected channel
AIS: Rx channel 70 malfunction	Continue operation ^a
AIS: general failure	Stop transmission
AIS: UTC sync invalid	Continue operation using indirect or semaphore synchronisation
AIS: display connection lost	Continue operation with "Class B Display Flag" of message 18 set to "0" ^a
AIS: no sensor position in use	Continue operation at 3 minute reporting interval
AIS: no valid SOG information	Continue operation using SOG = 1 023
AIS: no valid COG information	Continue operation using COG = 3 600
AIS: Heading lost/invalid	Continue operation using Heading = 511 ^a
^a Alarm may be enabled/disabled depending on system configuration.	

Alarm messages shall be output via a presentation interface:

- alarm codes and descriptive text shall be compliant with IEC 61993-2;
- the alarm message protocol shall be compliant with IEC 61162-1;
- active alarms shall be output via the presentation interface upon occurrence and repeated every 30 s;
- non-active alarm messages shall be repeated every 60 s;
- upon a relevant system status change, an appropriate alarm message shall be output.

6.6.2 Transmitter shutdown procedure

An automatic transmitter hardware shutdown procedure and indication should be provided in case a transmitter continues to transmit for more than 2 s. This shutdown procedure should be independent of software control.

6.6.3 Position sensor fallback conditions

Priorities and affected position report data (refer to Recommendation ITU-R M.1371-5) shall be as in Table 3.

Table 3 – Position sensor fallback conditions

Priority	Position sensor status		Affected data in Message 18			
			Position accuracy flag	Time stamp	RAIM-flag	Position Latitude/Longitude
1.	internal DGNSS in use (corrected; Message 17) ^c		1 ^b	UTC-s	1 / 0 ^a	Lat/Lon (internal)
2.	internal DGNSS in use (corrected; e.g. beacon) ^d		1 ^a	UTC-s	1 / 0 ^a	Lat/Lon (internal)
3.	internal GNSS in use (uncorrected) ^c		0 ^b	UTC-s	1 / 0 ^a	Lat/Lon (internal)
4.	no sensor position in use	dead reckoning position	0	62	0	Default to +91/+181
		no position		63		
^a If RAIM available "1"; if not, default "0".						
^b The position accuracy flag shall be set as defined in ITU-R M.1371-5:2014, Annex 8, 3.16 Message 18.						
^c Applicable in all configurations (minimum requirement).						
^d Applicable only if (optionally) a beacon receiver is provided.						

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

6.7 User interface

6.7.1 Indication and display

(See 10.8.1)

The Class B "SO" AIS shall be provided with the following indicators:

Power: power on
 No transmission: the unit is not transmitting
 Error: detection of an error as a result of the BIIT (see 6.6.1).

If an integrated display is provided, it shall

- display received Messages 12 and 14 and the position report from AIS-SART in active mode,
- provide means to enable or disable the AIS-SART test mode – all messages from AIS-SART under test should only be displayed when the test mode is enabled – ,
- not display messages addressed to other stations, and
- display active alarm conditions.

6.7.2 Static data input

(See 10.8.3)

Means shall be provided to input and verify the static data prior to use.

It shall not be possible for the user to alter the MMSI once programmed.

6.7.3 External interfaces

(See 10.2.1.2)

To enable a user to access, select and display the information on a separate system, the Class B "SO" AIS shall be provided with at least one interface.

The formats and protocol for this data stream shall be as defined by IEC 61162-1. Additional interfaces may be implemented such as IEC 61162-450. The electrical and physical parameters shall be as specified by the manufacturer.

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 C.

The Class B "SO" AIS may be provided with an interface to input heading sensor data. If provided, the input interface for sensor data shall be compliant with IEC 61162-1.

6.8 Protection from invalid control commands

(See 8.5.8)

The Class B "SO" AIS shall not accept control commands sent from stations with invalid base station MMSI. Before accepting and processing the Messages 4, 16, 17, 20, 22 and 23, the unit shall check the MMSI of the sender station. When the MMSI is "00xyyyyy" where x is between 2 and 7, the unit shall accept and process the received command, otherwise the unit shall ignore it.

7 Technical requirements

7.1 General

Clause 7 covers layers 1 to 4 (physical layer, link layer, network layer, transport layer) of the open systems 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):

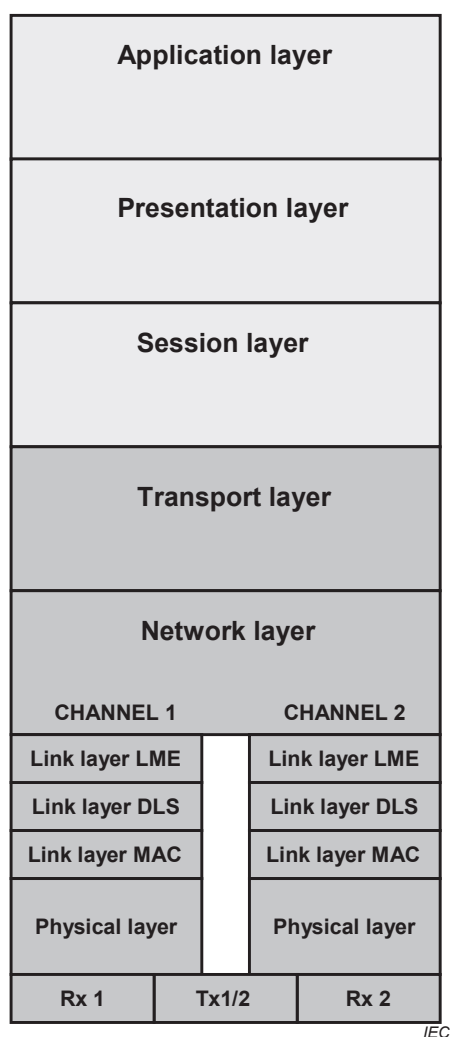


Figure 1 – OSI layer model

7.2 Physical layer

7.2.1 General

The physical layer is responsible for the transfer of a bit-stream from an originator out, on to the data link. In addition to the specific requirements of 7.2, the physical layer shall be designed in accordance with Recommendation ITU-R M.1371.

7.2.2 Receiver characteristics

(See 11.2, 11.3.1)

The technical characteristics as specified in Table 4 shall apply to the TDMA receivers.

Table 4 – Required receiver performance

Receiver parameters	Values		
	Results	Wanted signal	Unwanted signal(s)
Sensitivity	20 % per	–107 dBm normal –101 dBm extreme –104 dBm at ± 500 Hz offset	–
Error at high input levels	2 % per	–77 dBm	–
	10 % per	–7 dBm	–
Co-channel rejection	20 % per	–101 dBm	–111 dBm –111 dBm at ± 1 kHz offset
Adjacent channel selectivity	20 % per	–101 dBm	–31 dBm
Spurious response rejection	20 % per	–101 dBm	–31 dBm
Intermodulation response rejection	20 % per	–101 dBm	–36 dBm
Blocking and desensitization	20 % per	–101 dBm	–23 dBm (< 5 MHz) –15 dBm (> 5 MHz)
Spurious emissions	–57 dBm –47 dBm	9 kHz to 1 GHz 1 GHz to 4 GHz	

7.2.3 Other characteristics

7.2.3.1 General transceiver characteristics

(See Clause 11)

General transceiver characteristics shall be as specified in Table 5.

Table 5 – Transceiver characteristics

Symbol	Parameter name	Low setting	High setting
PH.RFR	Regional frequencies (range of frequencies within RR:2012, Appendix 18)	156,025 MHz	162,025 MHz
PH.CHS	Channel spacing (encoded according to RR:2012, Appendix 18 with footnotes)	25 kHz	25 kHz
PH.AIS1	AIS 1 (default channel 1) (2 087) ^a	161,975 MHz	161,975 MHz
PH.AIS2	AIS 2 (default channel 2) (2 088) ^a	162,025 MHz	162,025 MHz
PH.BR	Bit rate	9 600 bit/s	9 600 bit/s
PH.TS	Training sequence	24 bits	24 bits
PH.TxBT	Transmit BT product	~0,4	~0,4
PH.RxBT	Receive BT product	~0,5	~0,5
PH.MI	Modulation index	~0,5	~0,5
PH.TxP	Transmit output power	1 W	5 W
^a See Recommendation ITU-R M.1084-5:2012, Annex 4.			

7.2.3.2 Channel operation

(See 10.2.1.1)

The AIS shall be capable of receiving on two parallel channels and transmitting on two separate channels. Two separate TDMA receive channels or processes shall be used to receive simultaneously information on two independent frequency channels. One TDMA

transmitter shall be used to alternate TDMA transmissions on two independent frequency channels.

Data transmissions and receptions shall default to AIS 1 and AIS 2 unless otherwise specified (see 7.4.3 and Annex A).

7.2.3.3 Bandwidth

(See 11.1.3)

The Class B "SO" AIS shall operate on 25 kHz channels according to Recommendation ITU R M.1084-5 and ITU Radio Regulations:2012, Appendix 18.

7.2.3.4 Modulation scheme

(See 11.1.4)

The modulation scheme is bandwidth adapted frequency modulated Gaussian filtered minimum shift keying (GMSK/FM). The NRZI encoded data shall be GMSK coded before frequency modulating the transmitter.

7.2.3.5 Training sequence

(See 11.1.4)

Data transmission shall begin with a 24-bit demodulator training sequence (preamble) consisting of one segment synchronisation. This segment shall consist of alternating zeros and ones (0101....). This sequence always starts with a 0.

7.2.3.6 Data encoding

(See 12.4)

The NRZI waveform is used for data encoding. The waveform is specified as giving a change in the level when a zero (0) is encountered in the bit stream.

Forward error correction, interleaving or bit scrambling is not used.

7.2.3.7 DSC operation

(See Annex A)

The Class B "SO" AIS shall be capable of receiving DSC channel management commands (see Annex A).

DSC receive function shall be provided at least in accordance with the time schedule specified in ITU-R M.1371-5:2014, Table 45.

DSC channel (channel 70) shall be monitored by a dedicated receiver or by switching one of the TDMA receivers from the AIS channels to the DSC channel. In order to avoid a new entry phase when switching back the time out, values should be selected so that there is no time out 0 during the DSC receiving period.

7.2.4 Transmitter requirements

(See 11.1, 11.3.2)

Transmitter parameters shall be as given in Table 6.

Table 6 – Transmitter characteristics

Transmitter parameters	Requirement	Condition
Frequency error	± 500 Hz normal $\pm 1\,000$ Hz extreme	
Carrier power, high setting	Nominal high transmit power shall be 5 W. $\pm 1,5$ dB normal test conditions ± 3 dB extreme test conditions	Conducted
Carrier power, low setting	Nominal low transmit power shall be 1 W. $\pm 1,5$ dB normal test conditions ± 3 dB extreme test conditions	Conducted
Modulation spectrum	-25 dBc -70 dBc	$\Delta f_c > \pm 10$ kHz ± 25 kHz $< \Delta f_c < \pm 62,5$ kHz slotted transmissions
Modulation accuracy	$< 3\,400$ Hz normal and extreme $2\,400$ Hz ± 480 Hz normal and extreme $2\,400$ Hz ± 240 Hz normal ± 480 Hz extreme $1\,740$ Hz ± 175 Hz normal ± 350 Hz extreme $2\,400$ Hz ± 240 Hz normal ± 480 Hz extreme	Bit 0, 1 Bit 2, 3 Bit 4 ... 31 Bit 32 ... 199 0101 Bit 32 ... 199 00001111
Transmitter attack behaviour	attack time ≤ 1 ms $P_{out} \leq P_{nom} + 1,5$ dB $(F_{nom} - 3,4 \text{ kHz}) < f_c < (F_{nom} + 3,4 \text{ kHz})$	$P_c - 1$ dB $P_{out} > (P_c - 30 \text{ dB})$
Transmitter release behaviour	Release time ≤ 1 ms $(F_{nom} - 3,4 \text{ kHz}) < f_c < (F_{nom} + 3,4 \text{ kHz})$	P_c to -50 dB $P_{out} > (P_c - 30 \text{ dB})$
Spurious emissions	-36 dBm -30 dBm	9 kHz ... 1 GHz 1 GHz ... 4 GHz

7.3 Link layer

(See Clause 12)

7.3.1 General

The link layer specifies how data shall be packaged in order to apply error detection to the data transfer. The link layer is divided into three (3) sub-layers.

- Link sub-layer 1: medium access control (MAC)
- Link sub-layer 2: data link service (DLS)
- Link sub-layer 3: link management entity (LME)

7.3.2 Link sub-layer 1: medium access control (MAC)

7.3.2.1 General

The MAC sub-layer 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 sub-layer shall be designed in accordance with Recommendation ITU-R M.1371.

7.3.2.2 Synchronisation

Synchronisation is used to determine the TDMA frames and individual time slots so that the transmission of the AIS message is performed within the desired slot. The synchronisation for Class B "SO" AIS shall be UTC direct or UTC indirect mode. Class B "SO" is not allowed to act as Semaphore.

The Class B "SO" AIS shall meet the timing requirements set out in Recommendation ITU-R M.1371 for UTC direct and indirect.

7.3.2.3 VDL access

(See 11.1.5)

The transmitter shall begin transmission by turning on the RF power immediately after slot start (T_0).

The transmitter shall be turned off after the last bit of the transmission packet has left the transmitting unit; nominal transmission end is T_E (assuming 1 stuffing bit).

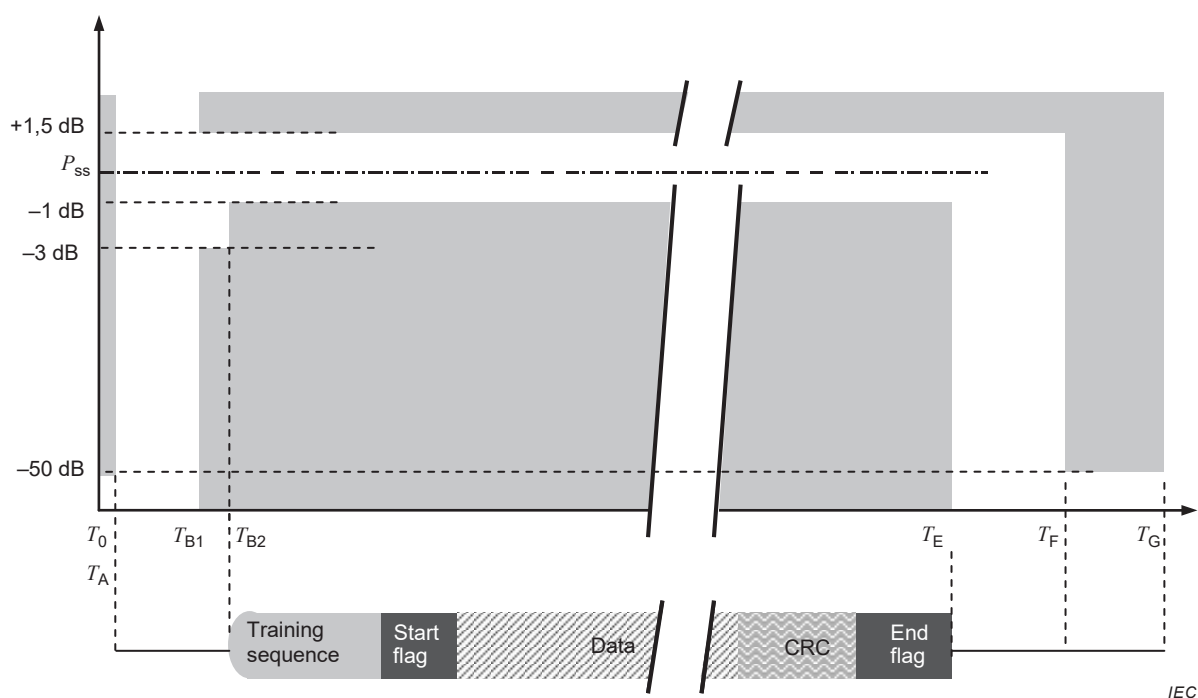


Figure 2 – Power versus time mask

The access to the medium is performed as shown in Figure 2 and Table 7.