BS IEC 62287-1:2017+A1:2022

BSI Standards Publication

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

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The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by A1 A1.

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

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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

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IEC 62287-1 edition 3.1 contains the third edition (2017-04) [documents 80/837/FDIS and 80/842/RVD] and its amendment 1 (2022-11) [documents 80/1042/CDV and 80/1052/RVC].

This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.

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International Standard IEC 62287-1 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

This third edition constitutes a technical revision.

This edition includes the following significant technical change with respect to the previous edition: in the synchronisation method, addition of a direct method for synchronisation from an internal UTC source.

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

A list of all parts of the IEC 62287 series published under the general title *Maritime navigation and radiocommunication equipment 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 the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under webstore.iec.ch in the data related to the specific publication. At this date, the publication will be

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INTRODUCTION

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Part 1: Carrier-sense time division multiple access (CSTDMA) techniques

1 Scope

This part of IEC 62287 specifies the minimum operational and performance requirements, methods of testing and required test results for Class B shipborne automatic identification system (AIS) equipment using carrier-sense time division multiple access (CSTDMA) techniques. This document takes into account other associated IEC International Standards and existing national standards, as applicable.

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

An AIS station intended to operate in receive-only mode is not considered a Class B shipborne mobile AIS station.

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

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*

IEC 62320-1, *Maritime navigation and radiocommunication equipment and systems – Automatic identification systems (AIS) – Part 1: AIS Base Stations – Minimum operational and performance requirements, methods of testing and required test results*

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

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*

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ITU-R Recommendation M.1084-5:2012, I*nterim 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*

ITU, *Radio Regulations:2012* (available at http://www.itu.int/publ/R-REG-RR/en)

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
BT	bandwidth time product
COG	course over ground
CP	candidate period
CRC	cyclic redundancy check
CS	carrier-sense
CSTDMA	carrier-sense time division multiple access
DGNSS	differential global navigation satellite system
DLS	data link service
DSC	digital selective calling
EPFS	electronic position fixing system
EUT	equipment under test
FCS	frame check sequence
FM	frequency modulation
GMSK	Gaussian minimum shift keying
GNSS	global navigation satellite system
HDLC	high level data link control
IMO	International Maritime Organization
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
NTT	nominal transmission time
OSI	open system interconnection model
P_{ss}	steady state RF output power

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PER	packet error rate
PI	presentation interface
PRS	pseudo random sequence
RAIM	receiver autonomous integrity monitoring
RF	radio frequency
RI	reporting interval
Rx	receive
SINAD	signal interference noise and distortion ratio
SOG	speed over ground
SOLAS	International Convention for the Safety Of Life At Sea
TDMA	time division multiple access
TI	transmission interval
Tx	transmit
UTC	universal time co-ordinated
VDL	VHF data link
VHF	very high frequency
VTS	vessel traffic services

4 General requirements

4.1 General

4.1.1 Capabilities of the Class B "CS" AIS

The Class B "CS" 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). Small craft are vessels which are not required to comply with the mandatory carriage requirements of SOLAS Chapter V, Regulation 19.

The Class B "CS" AIS shall be capable of providing information from small 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).

The Class B "CS" AIS station shall be inter-operable and compatible with Class A or other Class B shipborne mobile AIS stations or any other AIS station operating on the AIS VHF data link. In particular, Class B "CS" AIS stations shall receive other stations, shall be received by other stations and shall not degrade the integrity of the AIS VHF data link.

The Class B "CS" AIS shall only transmit if it has verified that the time period intended for transmission does not interfere with transmissions made by AIS equipment defined in ITU-R M.1371-5:2014, Annex 1, Clause 2 (excluding Class B "CS"). Transmissions of the Class B "CS" AIS shall not exceed one nominal time period (except when responding to a base station with Message 19).

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

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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 in the equipment required for operation in accordance with the equipment standard. 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 affect its integrity and correctness.

4.1.4 Additional features

(see 10.1.3)

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

4.1.5 Modes of operation

4.1.5.1 General

The system shall be capable of operating in a number of modes as described below subject to the transmission of messages by a competent authority. It shall not retransmit received messages.

4.1.5.2 Autonomous and continuous mode

(see 10.2.1)

An "autonomous and continuous" mode for operation in all areas transmitting Message 18 for scheduled position reporting and Message 24 for static data.

The Class B "CS" AIS shall be able to receive and process messages at any time except during time periods of transmission.

4.1.5.3 Assigned mode

(see 10.2.2)

An "assigned" mode for operation in an area subject to a competent authority responsible for traffic monitoring so that the reporting interval, silent mode and/or transceiver behaviour may be set remotely by that authority using group assignment by Message 23.

4.1.5.4 Interrogation mode

(see 10.2.3)

A "polling" or "controlled" mode where the Class B "CS" AIS responds to interrogations by Messages 18 and 24 from a Class A AIS, a SAR aircraft or a base station. A base station interrogation for Message 19 specifying transmission offset shall also be answered. An interrogation overrides a silent period defined by Message 23 (see 7.3.4.4.4).

NOTE Since Message 19 is a message occupying two time periods, the reservation of the respective time periods is made by Message 20 prior to interrogation.

A Class B "CS" AIS shall not interrogate other stations.

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4.2 Manuals

The manuals shall include:

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

4.3 Marking and identification

Each unit of the equipment shall be marked externally with the following information which, where practicable, shall be clearly visible when the equipment is installed in its recommended position:

- identification of the manufacturer;
- equipment type number or model identification;
- serial number of the unit;
- power supply requirements;
- compass safe distance.

Alternatively, the marking may be presented on a display at equipment start-up.

The version of software shall be either marked or displayed on command on the equipment.

When the marking and the title and version of the software are presented only on the display, such information shall also be included in the equipment manual.

5 Environmental, power supply, interference and safety requirements

(see Clause 9)

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

- inter-unit connection (interfaces other than IEC 61162-1 are allowed; see 6.7.3);
- power supply;
- extreme power supply;
- excessive conditions;
- power supply short-term variation and power supply failure (the Class B "CS" AIS shall not enter an undefined or unstable state in case of undervoltage);
- durability and resistance to environmental conditions;
- interference;
- electromagnetic compatibility;
- compass safe distance;
- safety precautions;
- protection against accidental access to dangerous voltages;
- electromagnetic radiofrequency radiation;
- X-radiation.

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

a) portable;

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b) protected from the weather;

c) exposed to the weather;

d) submerged or in continuous contact with sea water.

6 Performance requirements

6.1 Composition

The B "CS" AIS shall comprise the following.

- A communication processor, capable of operating in a part of the VHF maritime mobile service band, in support of short range (VHF) applications.
- A least one transmitter and three receiving processes for TDMA and one for DSC on channel 70. The DSC process may use the receiving resources on a time-share basis as described in 7.2.2.7. Outside the DSC receiving periods, the two TDMA receiving processes shall work independently and simultaneously on AIS channel A and channel B[1].
- A means for automatic channel switching in the maritime mobile band (by Message 22 and DSC). Manual channel switching shall not be provided.
- An internal GNSS position sensor, which provides a resolution of one ten thousandth of a minute of arc and uses the WGS-84 datum (see 6.3). The internal GNSS position sensor may provide an optional internal UTC synchronisation source (see 7.3.2.2.1).

6.2 Operating frequency channels

(see 10.4)

The Class B "CS" AIS shall operate on the frequency channels with 25 kHz bandwidth at least in the range from 161,500 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 DSC receiving process shall be tuned to channel 70.

The Class B "CS" AIS shall automatically revert to receive-only mode on the channels AIS 1 and AIS 2 when commanded to change to frequency channels outside its operating range and/or bandwidth.

6.3 GNSS receiver for position reporting

(see 10.5, 10.6.1.3)

The Class B "CS" AIS shall have an internal GNSS receiver as a source for position, COG and SOG.

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

- position accuracy; static and dynamic (5 s);
- COG/SOG accuracy;
- position update (5 s);
- interference susceptibility;
- status indications (RAIM optional).

The internal GNSS receiver may be capable of being differentially corrected, for example by evaluation of Message 17.

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1 In some regions, the competent authority may not require DSC functionality.

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An input port for an external GNSS receiver may be provided. The data of an external GNSS receiver shall only be used if:

- datum information is received which indicates that the WGS-84 datum is in use,
- RAIM information is received which indicates an expected error of less than 10 m in Lat or Lon,
- internal position is available and the external position is within 26 m of the internal position, and
- the input format complies with IEC 61162-1 including mode indicator and checksum.

6.4 Identification

For the purpose of ship and message identification, the appropriate maritime mobile service identity (MMSI) number shall be used. The unit shall only transmit if an MMSI has been programmed (see 6.5.1.2).

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

A1 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. A1

6.5 AIS information

6.5.1 Information content

(see 10.6.1)

6.5.1.1 General

The information provided by the Class B "CS" AIS shall include the information given in 6.5.1.

6.5.1.2 Static

The list of static information includes the following:

- identification (MMSI);
- name of ship;
- type of ship;
- vendor ID (optional);
- 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 (see 6.7.2).

6.5.1.3 Dynamic

The list of dynamic information includes the following:

- ship's position with accuracy indication and integrity status;
- time in UTC;

  NOTE Date to be established by receiving equipment.

- course over ground (COG);

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- speed over ground (SOG);
- true heading (optional).

6.5.1.4 Configuration information

The following information about configuration and options active in the specific unit shall be provided:

- AIS Class B "CS" unit;
- availability of minimum keyboard/display facility;
- availability of DSC channel 70 receiver;
- ability to operate in the whole marine band or the upper 525 kHz part of the band (see 6.2);
- ability to process channel management Message 22.

6.5.1.5 Short safety-related messages

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

NOTE IMO COMSAR.1/Circ.46:2009-02 advises that pre-configured safety-related messages should not be incorporated in AIS equipment.

6.5.2 Information reporting intervals

(see 10.6.2)

The Class B "CS" AIS shall transmit position reports (Message 18) in reporting intervals of

- 30 s if SOG > 2 kn, and
- 3 min if SOG ≤ 2 kn,

provided that transmission time periods are available. A command received by Message 23 shall override the reporting interval. A reporting interval of less than 5 s is not required.

Static data submessages 24A and 24B shall be transmitted every 6 min in addition to and independent of the position report (see 7.4.2). Message 24B shall be transmitted within 1 min following Message 24A.

6.5.3 Permissible initialisation period

(see 10.7)

The AIS shall start transmitting position reports within the following ranges:

- cold start: 30 min;
- warm start (if off for less than 1 h): 5 min;
- short signal loss (GNSS signal lost for less than 5 min): resume within a time of twice the reporting interval.

6.6 Alarms and indications, fall-back arrangements

6.6.1 Integrity and protection

(see 10.8.1)

The Class B "CS" AIS shall be equipped with built-in integrity tests (BIIT). The BIIT shall run continuously or at appropriate intervals simultaneously with the standard functions of the equipment.

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If any failure or malfunction is detected that will significantly reduce integrity or stop operation of the Class B "CS" AIS, a visual indication shall be given (for example a LED, see 6.7.1). This includes the detection of background noise above –77 dBm (see 7.3.2.4).

The Class B "CS" AIS installation, when operating, shall not be damaged by the effects of open-circuited or short-circuited antenna terminals.

6.6.2 Transmitter shutdown procedure

(see 10.8.3)

An automatic transmitter shutdown shall be provided in the case where a transmitter does not discontinue its transmission within 1 s of the end of its nominal transmission. This procedure shall be independent of the operating software.

6.6.3 Position sensor fallback conditions

(see 10.6.1.3, 10.8.4)

Priorities and affected position report data (refer to ITU-R M.1371-5:2014, Annex 8, 3.16) shall be as indicated in Table 1.

Table 1 – Position sensor fallback conditions

Priority	Position sensor status		Affected data in Message 18			
			Position accuracy flag	Time stamp	RAIM-flag	Position Latitude/Longitude
1.	External DGNSS in use (corrected)[a]		1[d]	UTC-s	1/0[d]	Lat/Lon (external)
2.	Internal DGNSS in use (corrected; Message 17)		1[d]	UTC-s	1/0[d]	Lat/Lon (internal)
3.	Internal DGNSS in use (corrected; e.g. beacon)[c]		1[d]	UTC-s	1/0[d]	Lat/Lon (internal)
4.	External GNSS in use (uncorrected)[a]		0[d]	UTC-s	1/0[d]	Lat/Lon (external)
5.	Internal GNSS in use (uncorrected)[b]		0[d]	UTC-s	1/0[d]	Lat/Lon (internal)
6.	No sensor position in use	Manual position input	N/A	61	N/A	Do not transmit
		Dead reckoning position		62		Do not transmit
		No position		63		Do not transmit

[a] Applicable only if an input from an external GNSS receiver is provided (see 6.3), which may only be used if the conditions specified in 6.3 are fulfilled.

[b] Applicable in all configurations (minimum requirement).

[c] Applicable only if (optionally) an internal beacon receiver is provided.

[d] If RAIM available "1"; if not, default "0".

If RAIM is available (indicated by a GBS sentence or equivalent information), the position accuracy flag shall be evaluated using Table 2.

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Table 2 – Use of accuracy (PA) flag

		PA flag	RAIM flag
Uncorrected	No RAIM, GBS not provided	0	0
	GBS provided, expected error < 5 m	1	1
	GBS provided, expected error > 5 m	0	1
Corrected	No RAIM, GBS not provided	0	0
	GBS provided, expected error < 15 m	1	1
	GBS provided, expected error > 15 m	0	1

If the GNSS sensor is inoperative, the unit shall not transmit scheduled Messages 18 and 24 unless interrogated by a base station.

NOTE In this case, the synchronisation process will not take into account distance delays.

The Class B "CS" AIS shall automatically select the position source with the highest priority available. If data availability changes, the Class B "CS" AIS shall maintain the position source for the next scheduled position report and automatically switch to the position source with the highest priority available afterwards. During this period, the latest valid position shall be used for reporting.

6.6.4 SOG/COG sensor fallback conditions

(see 10.8.5)

SOG/COG information shall be of the same source as position and follow the same fallback rules. This is to avoid transmission of information referenced to different points on the ship.

6.7 User interface

6.7.1 Indicators and display

(see 10.9.1)

The Class B "CS" AIS shall be provided with the following indicators.

Power: power on and fully operable (transmitting and receiving properly).

Tx timeout: if the unit has not transmitted a position report during the last two reporting intervals (nominal reporting interval cannot be maintained for operational reasons, for example Message 23 quiet period, high VDL load).

Error: detection of an error as a result of the BIIT (see 6.6.1).

If a display for received messages is provided, it shall:

- display received Messages 12 and 14 and the position report from AIS-SART in active mode, and
- not display messages addressed to other stations.

6.7.2 Static data input

(see 10.9.3)

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 10.9.4)

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To enable a user to access, select and display the information on a separate system, the Class B "CS" AIS may be provided with an interface. If implemented, the formats and protocol for this data stream should be as defined by IEC 61162-1. If provided, this interface shall not output information addressed to other stations. Additional interfaces may be implemented such as IEC 61162-450.

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

6.8 Protection from invalid control commands

The Class B "CS" AIS shall not accept control commands sent from stations with invalid base station MMSI. Before accepting and processing the Messages 17, 20, 22 and 23, the unit shall check the MMSI of the sender station. When the MMSI is "00xyyyyyy" where × is between 2 and 7, the unit shall accept and process the received command, otherwise the unit shall ignore it (see 8.4.3).

7 Technical requirements

7.1 General

Clause 7 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 a Class B "CS" AIS station (physical layer to transport layer) and the layers of the applications (session layer to spplication layer).

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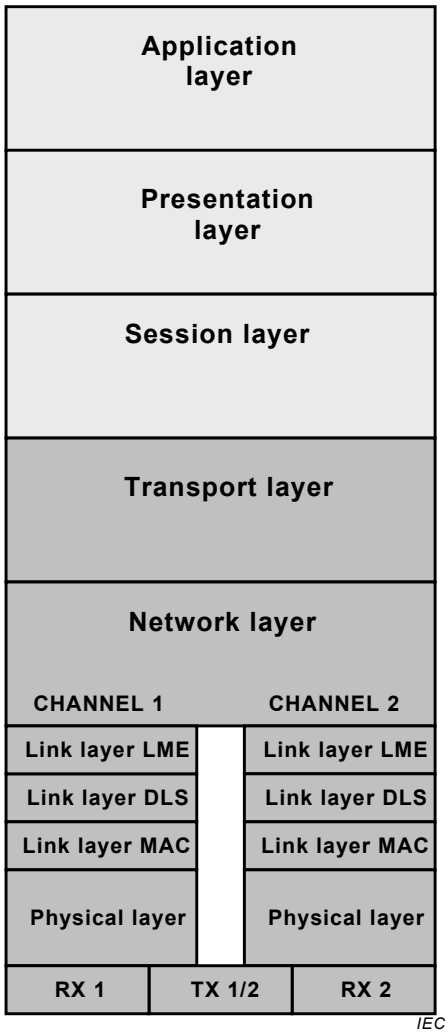

Figure 1 – OSI layer model

7.2 Physical layer

(see Clause 11)

7.2.1 General

The physical layer is responsible for the transfer of a bit-stream from an originator to the data link.

7.2.2 Transceiver characteristics

7.2.2.1 General

General transceiver characteristics shall be as specified in Table 3.

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Table 3 – Transceiver characteristics

Symbol	Parameter name	Value	Tolerance
PH.RFR	Regional frequencies (range of frequencies within RR Appendix 18)[a] (MHz) Full range 156,025 to 162,025 is also allowed. This capability will be reflected in Message 18.	161,500 to 162,025	-
PH.CHS	Channel spacing (encoded according to RR Appendix 18 with footnotes)[a] (kHz)	25	-
PH.CHB	Channel bandwidth (kHz)	Wide 25	
PH.AIS1	AIS 1 (default channel 1) (2087)[a] (MHz)	161,975	$\pm 3 \times 10^{-6}$
PH.AIS2	AIS 2 (default channel 2) (2088)[a] (MHz)	162,025	$\pm 3 \times 10^{-6}$
PH.BR	Bit rate (bit/s)	9 600	$\pm 50 \times 10^{-6}$
PH.TS	Training sequence (bits)	24	-
PH.TXTB	GMSK transmitter BT-product	0,4	
PH.RXBT	GMSK receiver BT-product	0,5	
PH.MI	GMSK modulation index	0,5	
[a] See ITU-R M.1084-5:2012, Annex 4.			

7.2.2.2 Dual channel operation

The AIS shall be capable of operating on two parallel channels in accordance with 7.4.2. Two separate TDMA receive channels or processes shall be used to simultaneously receive information on two independent frequency channels. One TDMA transmitter shall be used to alternate TDMA transmissions on two independent frequency channels.

Data transmissions shall default to AIS 1 and AIS 2 unless otherwise specified by a competent authority, as described in 7.4.2 and Annex C.

7.2.2.3 Bandwidth

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

7.2.2.4 Modulation scheme

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.

7.2.2.5 Training sequence

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 shall always start with a 0.

7.2.2.6 Data encoding

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.

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7.2.2.7 DSC operation

The Class B "CS" AIS shall be capable of receiving DSC channel management commands. It shall either have a dedicated receive process, or it shall be capable of retuning its TDMA receivers to channel 70 on a time sharing basis, with each TDMA receiver taking alternate turns to monitor channel 70 (for details see Annex C)[2].

7.2.3 Transmitter requirements

Transmitter parameters shall be as given in Table 4.

Table 4 – Transmitter parameters

Transmitter parameters	Required results	Condition
Frequency error	±500 Hz normal ±1 000 Hz extreme	
Carrier power (P_{ss})	33 dBm ±1,5 dB normal ±3 dB extreme	Conducted
Modulation spectrum	–25 dBW –60 dBW	Δf_c < ±10 kHz ± 25 kHz < Δf_c < ± 62,5 kHz
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: For a bit pattern of 0101 For a bit pattern of 00001111
Power versus time characteristics	Transmission delay: 2 083 µs Ramp up time: ≤ 313 µs Ramp down time: ≤ 313 µs Transmission duration: ≤ 23 333 µs	Nominal 1 time period transmission
Spurious emissions	–36 dBm –30 dBm	9 kHz … 1 GHz 1 GHz … 4 GHz

7.2.4 Receiver requirements

Receiver parameters shall be as given in Table 5.

[2] In some regions, the competent authority may not require DSC functionality.

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Table 5 – Receiver parameters

Receiver parameters	Required results		
	Result in PER	Wanted signal	Unwanted signal(s)
Sensitivity	20 %	–107 dBm normal[a] –101 dBm extreme –104 dBm normal at ±500 Hz offset	
Error at high input levels	2 %	–77 dBm	
	10 %	–7 dBm	
Co-channel rejection	20 %	–101 dBm	–111 dBm –111 dBm normal at ±1 kHz offset
Adjacent channel selectivity	20 %	–101 dBm	–31 dBm normal
Spurious response rejection	20 %	–101 dBm	–31 dBm
Intermodulation response rejection	20 %	–101 dBm	–36 dBm
Blocking and desensitisation	20 %	–101 dBm	–23 dBm (< 5 MHz) –15 dBm (> 5 MHz)
Spurious emissions	–57 dBm –47 dBm	9 kHz … 1 GHz 1 GHz … 4 GHz	

[a] Normal and extreme test conditions as defined in 8.2.

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 sublayers.

7.3.2 Link sublayer 1: Medium access control (MAC)

7.3.2.1 General

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 time division multiple access (TDMA).

7.3.2.2 Synchronisation

7.3.2.2.1 Synchronisation method

Synchronisation shall be determined either indirectly as described in 7.3.2.2.3 or directly from an internal UTC synchronisation source as described in 7.3.2.2.5.

7.3.2.2.2 CS time period

Synchronisation shall be used to determine the nominal start of the CS time period (T_0).

7.3.2.2.3 Sync mode 1: AIS stations other than Class B "CS" are received

Sync mode 1 shall not apply if UTC synchronisation is implemented.

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If signals from other AIS stations complying with IEC 61993-2 or from base stations are received, the Class B "CS" shall synchronise its time periods to their scheduled position reports (suitable account shall be taken of the propagation delays from the individual stations). This applies to Message types 1, 2, 3, 4 as far as they are providing position data and have not been repeated (repeat indicator = 0).

Synchronisation jitter shall not exceed ±3 bits (±312 μs) from the average of the received position reports. The average shall be calculated over a rolling 60 s period.

If these AIS stations are no longer received, the unit shall maintain synchronisation for a minimum of 30 s and then switch back to sync mode 2.

7.3.2.2.4 Sync mode 2: no station other than Class B "CS" is received

Sync mode 2 shall not apply if UTC synchronisation is implemented.

In the case of a population of Class B "CS" stations alone (in the absence of any other class of station that can be used as a synchronisation source), the Class B "CS" station shall determine the start of time periods (T_0) according to its internal timing.

Time periods that are reserved by a base station using Message 20 shall be respected.

If the Class B "CS" unit receives an AIS station that can be used as a synchronisation source (being in sync mode 2), it shall evaluate timing and synchronise for its next transmission to this station.

7.3.2.2.5 UTC Synchronisation

Where an internal UTC synchronisation source is implemented and UTC is available, the Class B "CS" shall synchronise its time periods to the UTC source.

Synchronisation jitter shall not exceed ±3 bits (±312 μs) from nominal start of UTC time period (T_0).

If UTC synchronisation becomes unavailable, the unit shall maintain synchronisation within ±3 bits (±312 μs) from the nominal start of UTC time period (T_0) for a minimum of 30 s.

7.3.2.3 Carrier-sense (CS) detection method

Within a time window of 1 146 μs, starting at 833 μs and ending at 1 979 μs after the start of the time period intended for transmission (T_0), the AIS Class B "CS" shall detect if that time period is used (CS detection window).

NOTE Signals within the first 8 bit (833 μs) of the time period are excluded from the decision (to allow for propagation delays and ramp down periods of other units).

The Class B "CS" AIS shall not transmit on any time period in which, during the CS detection window, a signal level greater than the "CS detection threshold" (7.3.2.4) is detected.

The transmission of a CSTDMA packet shall commence 20 bits (T_A = 2 083 μs + T_0) after the nominal start of the time period (see Figure 2).

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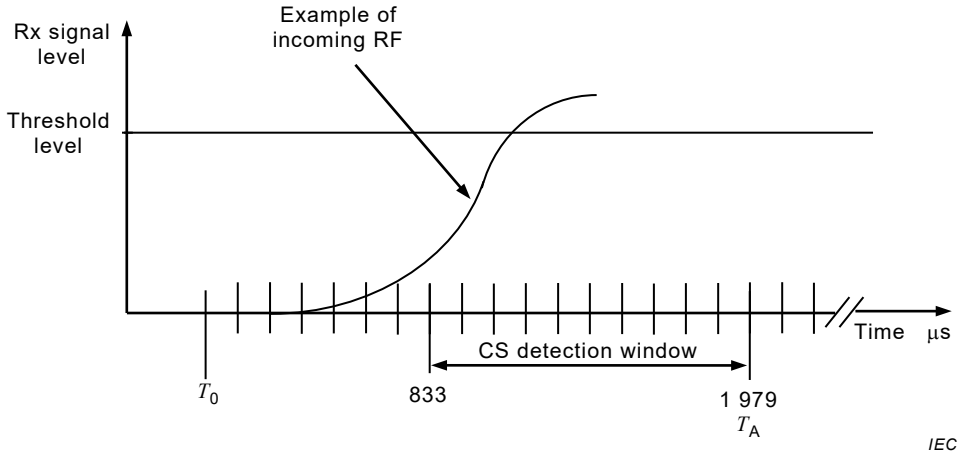

Figure 2 – Carrier-sense timing

7.3.2.4 CS detection threshold

The CS detection threshold shall be determined over a rolling 60 s interval on each receive channel separately. The threshold shall be determined by measuring the minimum energy level (representing the background noise) plus an offset of 10 dB. The minimum CS detection threshold shall be –107 dBm and background noise shall be tracked for a range of at least 30 dB (–77 dBm).

The following example is compliant with the requirement: Sample the RF signal strength at a rate > 1 kHz, average the samples over a sliding 20 ms period and over a 4 s interval determine the minimum period value. Maintain a history of 15 such intervals. The minimum of all 15 intervals is the background level. Add a fixed 10 dB offset to give the CS detection threshold.

An indication shall be given if the background noise exceeds –77 dBm.

7.3.2.5 VDL access

The transmitter shall begin transmission by turning on the RF power immediately after the duration of the carrier-sense window (T_A).

The transmitter shall be turned off after the last bit of the transmission packet has left the transmitting unit; nominal transmission end (T_E assuming no bit stuffing).

The access to the medium is performed as shown in Figure 3 and Table 6.

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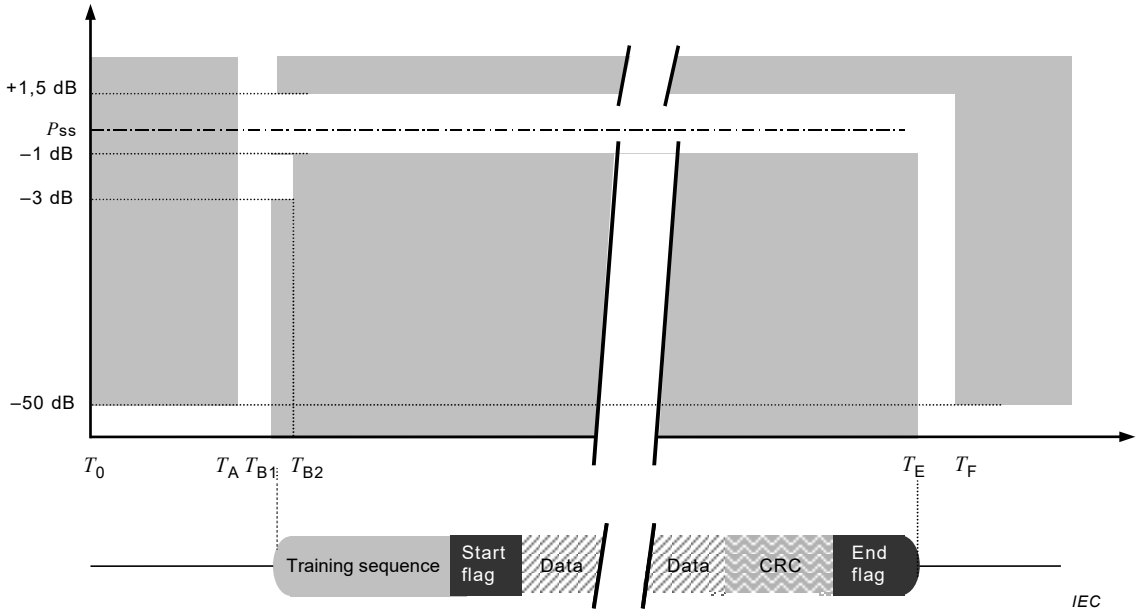

Figure 3 – Power versus time mask

Table 6 – Definition of timings for Figure 3

Reference		Bits	Time	Definition
T_0		0	0 ms	Start of candidate transmission time period
T_A		20	2,083 ms	Power shall not exceed –50 dB of P_{ss}
T_B	T_{B1}	23	2,396 ms	Power shall reach within +1,5 dB or –3 dB of P_{ss}
	T_{B2}	25	2,604 ms	Power shall reach within +1,5 dB or –1 dB of P_{ss}
T_E (plus 1 stuffing bit)		248	25,833 ms	Power shall still remain within +1,5 dB or –1 dB of P_{ss}
T_F (plus 1 stuffing bit)		251	26,146 ms	Power shall reach –50 dB of P_{ss} and stay below this

There shall be no modulation of the RF after the termination of transmission (T_E) until the power has reached zero and next time division begins (T_G).

7.3.2.6 VDL state

The VDL state is based on the result of the carrier-sense detection (7.3.2.3) for a time period. A VDL time period can be in one of the following states.

- FREE: the time period is available and has not been identified as used in reference to 7.3.2.3.
- USED: the VDL has been identified as used in reference to 7.3.2.3.
- UNAVAILABLE: time periods shall be indicated as "UNAVAILABLE" if they are reserved by base stations using Message 20 regardless of their range.

Time periods indicated as "UNAVAILABLE" shall not be considered as a candidate time period for use by own station and may be used again after a timeout. The timeout shall be 3 min if not specified or as specified in Message 20.

7.3.3 Link sublayer 2: Data Link Service (DLS)

7.3.3.1 General

The DLS sublayer provides methods for

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