PD IEC PAS 63343:2021

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Maritime navigation and radiocommunication equipment and systems — VHF data exchange system — Requirements and methods of testing for stations including ASM functionality

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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 committee manager.

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© The British Standards Institution 2021
Published by BSI Standards Limited 2021

ISBN 978 0 539 15608 9

ICS 47.020.70; 47.060; 49.090

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 28 February 2021.

Amendments/corrigenda issued since publication

Date	Text affected

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IEC PAS 63343

Edition 1.0 2021-02

PUBLICLY AVAILABLE SPECIFICATION

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Maritime navigation and radiocommunication equipment and systems – VHF data exchange system – Requirements and methods of testing for stations including ASM functionality

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 47.060; 49.090; 47.020.70

ISBN 978-2-8322-9438-3

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – VHF DATA EXCHANGE SYSTEM – REQUIREMENTS AND METHODS OF TESTING FOR STATIONS INCLUDING ASM FUNCTIONALITY

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The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
80/975/DPAS	80/982/RVDPAS

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – VHF DATA EXCHANGE SYSTEM – REQUIREMENTS AND METHODS OF TESTING FOR STATIONS INCLUDING ASM FUNCTIONALITY

1 Scope

This document specifies technical requirements, methods of test and required test results for equipment implementing ASM part of the VHF Data exchange system (VDES) as defined in ITU-R M.2092.

This document is intended to be the first step of development of standard(s) describing equipment that implement functions of VDES in any combination.

NOTE All text of this document whose wording is identical to applicable external references such as ITU Recommendations is printed in *italics*, and the reference and associated paragraph numbers are indicated in brackets.

NOTE The intention of text written in notation [Future: text] in this document is to include future placeholder for topics that are considered important even for the first implementations that may comply with this document.

Requirements set in this document provide means to mitigate adverse interference to Automatic Identification System (AIS).

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

IEC 61193-2:2007, *Quality assessment systems – Part 2: Selection and use of sampling plans for inspection of electronic components and packages*

IEC 61993-2:2018, *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 62320-1:2015, *Maritime navigation and radiocommunication equipment and systems – Automatic identification system (AIS) – Part 1: AIS Base Stations – Minimum operational and performance requirements, methods of testing and required test results*

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

ITU-R M.2092-0:2015, *Technical characteristics for a VHF data exchange system in the VHF maritime mobile band*

ITU-T O.151:1992, *Error performance measuring equipment operating at the primary rate and above*

IALA G1139 Edition 3, 2019, *The Technical Specification of VDES*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions apply.

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

3.1 Terms and definitions

3.1.1 Input [verb]

input [verb]
used for data transaction towards the equipment in its Presentation Interface

3.1.2 Output [verb]

output [verb]
used for data transaction from the equipment at its Presentation Interface

3.1.3 Transmit [verb]

transmit [verb]
used when equipment transmits by using VHF radio

3.1.4 Receive [verb]

Receive [verb]
used when equipment receives a radio signal

3.1.5 VDES VDL

VDES VDL
AIS VDL, ASM VDL, VDE TER VDL and VDE SAT VDL

3.2 Abbreviated terms

AIS	Automatic Identification System
ASM	Application Specific Message
BW	Bandwidth
DAC	Designated Area Code
EMC	Electromagnetic Compatibility
EUT	Equipment Under Test
EVM	Error Vector Magnitude
FATDMA	Fixed Access Time Division Multiple Access
FI	Function Identifier

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GLONASS	Globalnaya Navigazionnaya Sputnikovaya Sistema
GMSK	Gaussian Minimum Shift Keying
GNSS	Global Navigation Satellite System
HMI	Human Machine Interface
IF	Intermediate Frequency (of modulator)
MITDMA	Multiple Incremental Time Division Multiple Access
PAPR	Peak to Average Power Ratio
PEP	Peak Envelope Power
PER	Packet Error Rate
PI	Presentation Interface
RATDMA	Random Access Time Division Multiple Access
RF	Radio Frequency
RMS	Root Mean Square
SAR	Search and Rescue
SI	Selection Interval
UTC	Coordinated Universal Time
VDE	VHF Data Exchange
VDES	VHF Data Exchange System
VDE SAT	VDE Satellite
VDE TER	VDE Terrestrial
VDL	VHF Data Link
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio
QPSK	Quadrature Phase Shift Keying

4 General requirements and tests of equipment

4.1 Requirements (placeholder)

4.2 Methods of tests for general requirements

5 Performance requirements

5.1 Mobile station

5.1.1 Overview

This part specifies the minimum operational and performance requirements, methods of testing and required test results for ASM Mobile station.

It takes into consideration the technical characteristics of shipborne AIS equipment, included in recommendation ITU-R M.1371 and IEC 61993-2 (see 5.1.3.11).

ASM mobile station is intended to be used onboard any marine vessel that may operate globally or regionally anywhere in the world. The main high-level functions of the ASM mobile station are:

a) transmit through ASM VHF Data Link (ASM VDL) information which is input to ASM mobile station by other onboard equipment through Presentation Interface (PI);

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b) output all information received from ASM VDL applicable to own station, through PI so that this information is available to other onboard equipment;

c) handle applicable ASM radio station duties.

In following text, term "Equipment" is used to refer to ASM mobile station.

5.1.2 General requirements

An ASM mobile station shall as a minimum fulfil requirements set in IEC 61193-2, with exceptions as detailed in this document for interoperability between AIS and ASM transmission and reception.

5.1.2.1 Marking and identification

Equipment shall be marked as required by IEC 60945:2002, Clause 15. In addition, 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.

5.1.2.2 Manuals

Manuals for Equipment shall comply with requirements set in IEC 60945:2002, Clause 14, as applicable. In addition the manuals shall include:

- the type and details of all external connectors;
- the needed information for correct siting of the antennas;
- description for each alert that may be released by the equipment. 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.

5.1.2.3 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 conditions of conformance assessment. Alternatively, the Administration may use final product verification procedures where a competent authority verifies conformance with the certificate of conformance before the product is installed on board ships.

NOTE The ISO 9000 family standards, as applicable, meets this requirement.

5.1.2.4 Source of UTC

The Equipment shall be provided with a source of UTC, such as GNSS receiver, which is required for synchronisation purposes.

The internal GNSS receiver shall meet the following requirements of IEC 61108 (all parts): acquisition, re-acquisition, receiver sensitivity, RF dynamic range, effects of specific interfering signals, status indications.

5.1.2.5 Human Machine Interface (HMI)

Means shall be provided to allow user to observe operational status of the equipment.

NOTE This requirement can be fulfilled by providing an indicator capable of signalling three states: power off, power on – operating as intended, power on – not operating as intended.

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5.1.2.6 Environmental, power supply, special purpose and safety requirements

Equipment shall as minimum comply with the requirements set for equipment category "protected" as stated in IEC 60945:2002.

5.1.2.7 EMC

Requirements applicable for Equipment are stated in IEC 60945:2002, Table 6, equipment category "protected".

5.1.2.8 Compass safe distance

Requirements stated in IEC 60945:2002, 4.5.3, apply to Equipment.

5.1.2.9 Power supply

Manufacturer shall specify the properties of power supply. The power supply shall conform to applicable requirements in IEC 60945:2002.

5.1.2.10 Update of software

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

5.1.3 Technical requirements

5.1.3.1 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.*

5.1.3.2 Permissible initialization period

The Equipment shall be operational within 2 min of switching on.

5.1.3.3 Transceiver protection

The Equipment shall tolerate failure conditions of disconnected antenna and short circuit of antenna connector for minimum duration of 60 s. The equipment shall be capable to continue normal operation within 2 min after either of the failure conditions are rectified.

5.1.3.4 TX malfunction

The Equipment shall be able to detect malfunction of transmitter and signal this condition through Presentation Interface (see 5.1.3.8.3) and HMI (see 5.1.2.5).

5.1.3.5 Antenna VSWR

Equipment shall be able to detect excess VSWR at antenna and signal this condition through Presentation Interface (see 5.1.3.8.3) and HMI (see 5.1.2.5).

5.1.3.6 RX malfunction

Equipment shall be able to detect malfunction of receiver and signal this condition through Presentation Interface (see 5.1.3.8.3) and HMI (see 5.1.2.5).

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5.1.3.7 Physical layer

5.1.3.7.1 TDMA transmitter

The transmitter shall comply with following requirements in addition to IEC 61193-2.

Transmission characteristics as described in Table 1 and Figure 1 shall apply for transmission of ASM messages.

Table 1 – Slotted transmission spectrum for ASM

Transmitter parameters	Requirements	Condition
Frequency error	±1,5 ppm	Normal
	±3 ppm	Extreme
Transmit power capability	Transmit average power should be 1 W at low power setting and 12,5 W at high power setting. ±1,5 dB normal, $^{+2}_{-6}$ dB extreme	Conducted
Slotted modulation mask	Δfc < ±8 kHz: 0 dBc (PEP of transmitted signal) ±8 kHz < Δfc < ±16 kHz: below the straight line between −25 dBc at ±8 kHz and –60 dBc at ±16 kHz ±16 kHz < Δfc < ±25 kHz: below the straight line between −60 dBc at ±16 kHz and –70 dBc at ±25 kHz ±25 kHz < Δfc < ±62,5 kHz: −70 dBc	
Spurious emissions	−36 dBm −30 dBm	9 kHz to 1 GHz 1 GHz to 4 GHz

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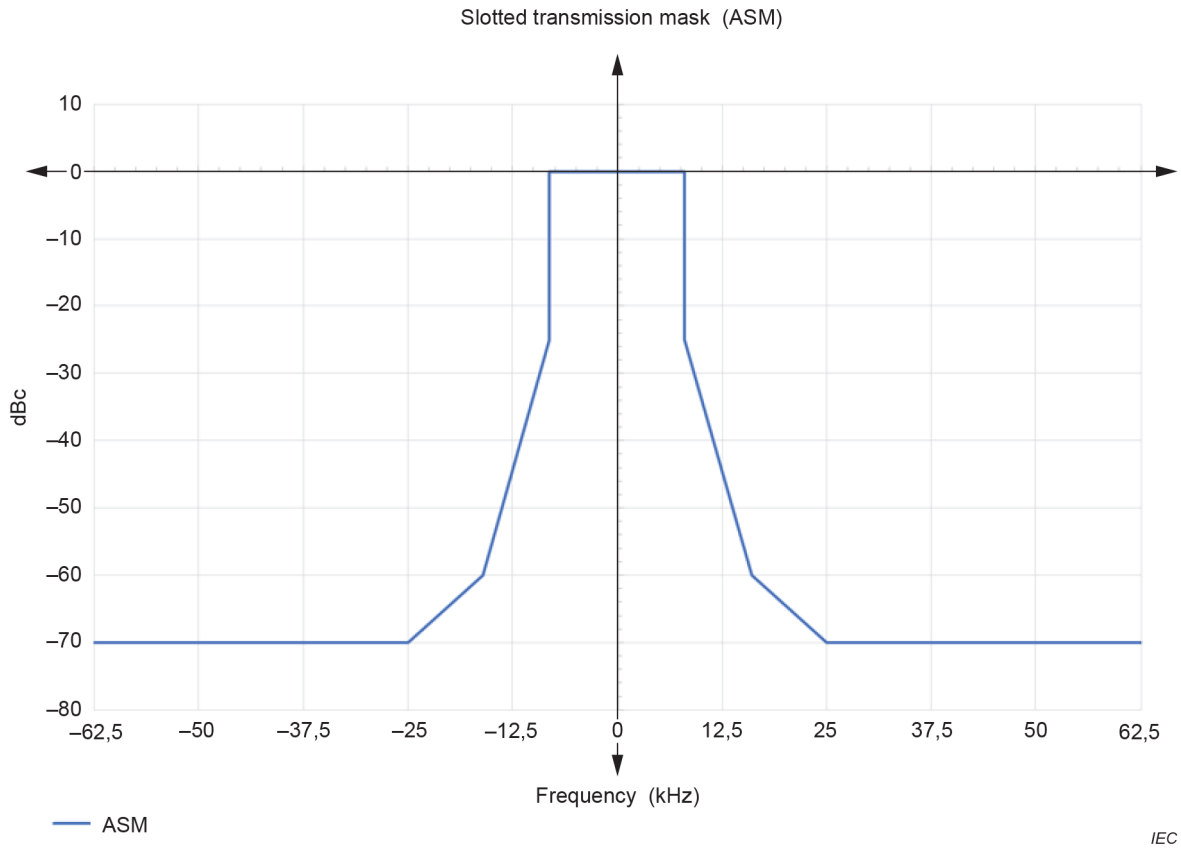

Figure 1 – Slotted transmission spectrum for ASM

For output power less than 1 W, the maximum transmission power level outside ±16 kHz shall not exceed –36 dBm.

The modulation accuracy shall give an RMS vector error in any burst less than [0,1] and the peak vector error magnitude shall be less than [0,3] for any symbol.

Requirements on transmitter power versus time characteristics are given in Table 2 and Figure 2. Blue line in Figure 2 is an example of transmitter power during ramp up and ramp down. For multi-slot transmissions the ramp down and guard periods (from T_E via T_G to T_0) take place at the end of the last transmission slot and sync sequence and payload period (T_B … T_E) extends through all transmission slots.

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Table 2 – Transmitter power versus time characteristics

Reference	Symbols	Time ms	Definition
T_0	0	0	Start of transmission slot Power should < –50 dB of P_{ss} before T_0
	0 to 4	0 to 0,416	Power should not exceed +1,5 dB of P_{ss}
T_B	4	0,416	P_{ss} = 3,4 dB + mean power measured between T_B and T_E [b]
T_E [a]	239 or 244[a]	24,896 / 25,417[a]	
	239 to 243 or 244 to 248[a]	24,896 to 25,313 or 25,417 to 25,833[a]	Power should not exceed +1,5 dB of P_{ss}
T_G	248 to 0	25,833 to 26,667	Power should be < –50 dB of P_{ss} and stay below this for the remainder of the transmission slot

[a] T_E can vary based on burst length and can be either at symbol 239 or 244. Ramp down is always 4 symbols in length.

[b] 3,4 dB represents the 3,35 dB PAPR for the test signal used (pi/4 QPSK).

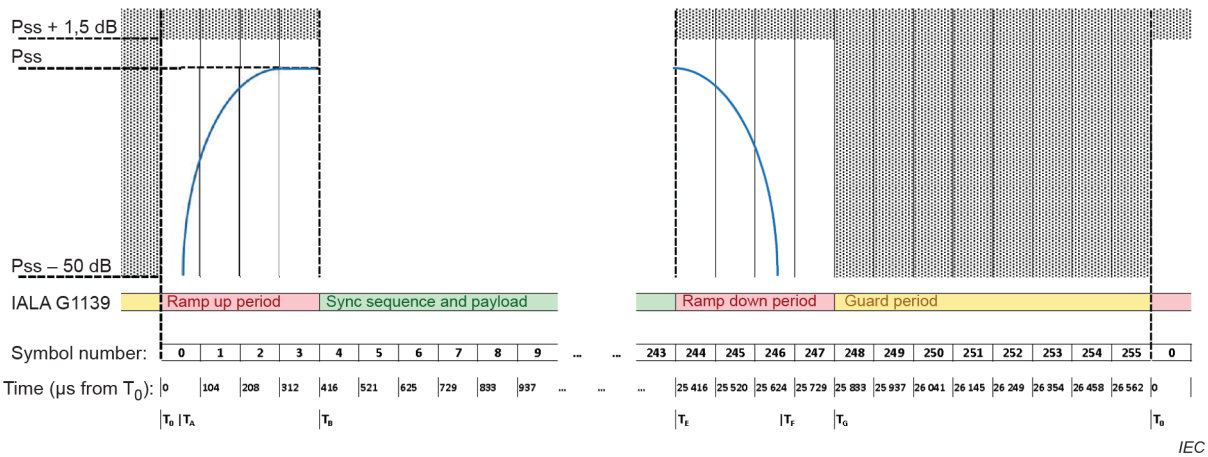

Figure 2 – Transmitter power versus time characteristics for π/4 QPSK (ASM)

5.1.3.7.2 Receiver requirements

The receiver of the equipment shall comply with the requirements of Table 3.

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Table 3 – Receiver requirements without FEC (using Link ID 1)

Receiver parameters	Requirements		Note
	Normal	Extreme	
Sensitivity	20 % PER at −107 dBm 20 % PER at -104 dBm at ±250 Hz offset	20 % PER at –104 dBm	3
Error behaviour at high input levels	1 % PER at −77 dBm peak 1 % PER at −7 dBm peak	No specific requirement	-
Co-Channel rejection	20 % PER at 13 dB 20 % PER at 13 dB at unwanted signal ±500 Hz offset	No specific requirement	3,2
Adjacent channel selectivity	20 % PER at 70 dB	No specific requirement	2
Spurious response rejection	20 % PER at 70 dB	No specific requirement	1
Intermodulation response rejection	20 % PER at 71 dB	No specific requirement	-
Spurious emissions	−57 dBm (9 kHz to 1 GHz) −47 dBm (1 GHz to 4 GHz)	No specific requirement	1
Blocking	20 % PER at 86 dB	No specific requirement	1

Notes:

1: These parameters are the same as AIS (IEC 61993-2)

2: Interferer is pi/4QPSK continuous PRBS

3: The offsets are half the values used in AIS (61993-2) as the frequency accuracy in ASM is much better

5.1.3.8 Presentation Interface (PI)

The equipment shall have a Presentation Interface (PI) for following functions:

a) input of information from other onboard equipment to be transmitted to other ASM stations by the Equipment;

b) output of all received ASM VDL data applicable to own station;

c) signal equipment internal status information to and accept related commands from other onboard equipment.

The Equipment shall be capable of assembling the entire received MITDMA chain and thereafter output the data using ASM sentence. Information received from incomplete chains shall be discarded, i.e. the received partial information shall not be output through PI using ASM sentence. In addition, the Equipment may optionally be capable of outputting all received ASM VDL radio messages relevant to own station using ADM sentence.

The Equipment shall be capable of assembling the complete payload input by related PI sentences before scheduling transmission on ASM VDL. If the Equipment detects inconsistency in the data input through PI (for example checksum error, missing sentence, interrupted input of sentences), the Equipment shall output negative acknowledgement using AMK sentence and shall discard information already received.

5.1.3.8.1 Interface for input data to be transmitted to ASM VDL

This interface shall comply with requirements described in IEC 61162-450. Table 4 defines the IEC 61162-1 talker identifiers and sentence formatters that shall be used when outputting ASM VDL data. The details of sentence formatters are described in Annex A. The timeout for input of all sentences required for transmission is 10 s. If the input of all sentences has not been

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completed by the timeout, the Equipment shall output NAK sentence with an appropriate reason code ("8 = multi-sentence message not accepted due to sentence timeout").

The equipment may offer capability to serve multiple external applications by means of [IEC 61162-450 TAG block and by use of NAK (on PI related) and AMK (on VDL related)].

Table 4 – IEC 61162 Talker identifiers and sentence formatters used for input of data to Equipment for transmission to ASM VDL

Talker ID	Sentence formatter	Direction	Note
(any)	AAB[a]	Input	ASM Selective Addressed Message
	ABB[a]	Input	ASM Broadcast Message
	AGB	Input	ASM Geographical Multicast Message
	NAK	Output	ASM Addressed and Broadcast Message Acknowledgement for PI
[VA]	AMK	Output	ASM Addressed and Broadcast Message Acknowledgement

[a] Mobile station shall always transmit own (programmed) MMSI and shall ignore the input source ID, if provided by the input sentence.

The Equipment shall be capable of supporting multiple external equipment through PI.

5.1.3.8.2 Interface to output received ASM VDL information

This interface shall comply with requirements described in IEC 61162-450. Table 5 defines the IEC 61162-1 sentence formatters that shall be used for output of ASM VDL data from Equipment. The details of sentence formatters are described in Annex A.

Table 5 – IEC 61162 sentence formatters used to output ASM VDL

Talker ID	Sentence formatter	Direction	Note
[VA]	ASM[a, c]	Output	Received ASM message assembly
	ADM[b]	Output	Received ASM VHF Data-Link Message
	ADO	Output	ASM VHF Data-Link Own-Vessel Report
(any)	ASQ[a]	Input	Query for ASM sentence content

[a] ASM sentence is output when a complete ASM VDL message/MITDMA chain has been received; it can also be queried by means of ASQ sentence.

[b] Implementation of ADM sentence is optional for mobile station as ASM sentence is expected to convey the information applicable to equipment connected to own station PI.

[c] Mobile station shall discard messages having satellite as intended destination (applies to ASM sentence VDL channel designations 3 and 4).

[The Equipment shall store a minimum of [10] most recently received and successfully assembled ASM messages. Stored (i.e. successfully assembled) messages shall be output when ASM sentence is queried using ASQ sentence.]

5.1.3.8.3 Interface for exchanging alert information, equipment status and related commands

This interface shall comply with requirements described in IEC 61162-450. Table 6 defines the IEC 61162-1 sentence formatters that shall be used for outputting alerts, equipment status information to and inputting related commands from other onboard equipment.

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Table 6 – IEC 61162 sentence formatters used to output equipment status and input related commands

Function	Sentence formatter	Note
Alerts	ACN, ARC, ALC, ALF,HBT	For details, see IEC 62923 (all parts) and IEC 61162-1
Local network and equipment integrity	HBT	Heartbeat between Equipment and external applications
Configuration	EPV	[Required property identifiers are to be defined]
Equipment status information	TXT	[Required TXT sentence contents are to be defined]
Software version	VER	See IEC 61162-1

The Equipment shall allow query of output sentences as indicated in Table 5 and Table 6. Conditions that may cause the Equipment to release alert include but are not restricted to:

- TX fault;
- RX fault;
- antenna fault.

5.1.3.9 Link layer requirements

5.1.3.9.1 General rules

The following general rules apply to Equipment:

- the Equipment shall at least be able to receive and transmit on channels ASM1 and ASM2;
- the Equipment shall, as a default, be identified by its own Unique Identifier on the VDL interface;
- the Equipment shall autonomously and as a response to query provide a vendor ID using a self-identification message on AIS VDL;
- the Equipment shall transmit using no more than 50 slots per frame (excluding available slots for use of retransmission of addressed data) on each of the two ASM channels (100 slots together);
- the equipment shall implement mandatory Quiet Time after each successful MITDMA transaction or a single non-MITDMA transmission;
- a maximum amount of 15 MITDMA transmissions per frame are allowed;
- transmission of an MITDMA chain shall be completed on same ASM channel (no channel switching);
- the Equipment shall as a minimum support reception of [10] in-progress MITDMA chains. In-progress MITDMA chains should be prioritized if the maximum number of supported in-progress MITDMA chains is exceeded;
- the Equipment shall not transmit bursts exceeding the length of 3 slots;
- received VDL messages shall be passed to the PI as an ASM sentence according to Table 7 if either broadcast or addressed to the own station;
- the Equipment shall transmit messages according to AAB, ABB and AGB sentences that are input to PI of the Equipment;
- every message transmitted on the VDL shall be passed to the PI as a ADO sentence;
- the TDMA receive process shall not be dependent on slot boundaries.

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5.1.3.9.2 Re-transmissions

Addressed MITDMA chain data that has not been confirmed as received shall be re-transmitted. Following rules apply for re-transmissions:

- the addressed receiver shall transmit an acknowledgment after receipt of the last block of the chain or timeout after the latest possible time for the receipt of the last block. The receiver acknowledgement timeout T_{ack} is calculated as follows:

  T_{ack} = (number of blocks remaining after the last received block) x 255 slots.

- upon failure to receive an acknowledgement from the addressed station within a timeout, the Equipment may re-transmit the entire chain if the retry slot budget and retry count so allows. The transmitter wait-for-ack-from-destination timeout T_{wait} is referenced from the start of the first block and is calculated as follows:

  T_{wait} = ((number of blocks in a chain) + 1) x 255 slots

- the amount of 50 slots allowance per frame (see 5.1.3.9.1) does not include re-transmissions;
- usage of up to 22 slots (3 x 7 + 1) for re-transmission in addition to the transmission limit (of 50 slots per frame) is allowed;
- the Equipment shall not make more than 3 re-transmission attempts.

5.1.3.9.3 Equipment interaction on the VDL

5.1.3.9.3.1 VDL messages overview

The interaction of the Equipment on the VDL is presented in Table 7.

Table 7 – Use of ASM VDL messages

Message ID	Name	Description	Access scheme	Communication State
0	Broadcast AIS ASM Message	Encapsulated AIS ASM messages that are output at receiving mobile station PI by using VDM sentence	RATDMA	none
1	Scheduled Broadcast Message	Broadcast data using communication state	RATDMA MITDMA	MITDMA
2	Broadcast Message	Broadcast data with no communication state	RATDMA	none
3	Scheduled Individual Addressed Message	Individual addressed data with communication state. Requires acknowledgement	RATDMA MITDMA	MITDMA
4	Individual Addressed Message	Individual addressed data with no communication state. Requires acknowledgement	RATDMA	none
5	Acknowledgment Message	This message is used to provide and acknowledgment for one or more addressed messages	RATDMA MITDMA[a]	none
6	Geographical Multicast Message	Addressed to a group of stations defined by their geographical location with no communication state. No acknowledgment required.	RATDMA	none

[a] ASM Message 5 utilizes the MITDMA Commstate of the transmitting (other) station sending the message to own station.

For definitions of Message 1-6, see IALA G1139.

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5.1.3.9.3.2 Definition of Message 0

ASM Message 0 may contain encapsulated AIS Messages 6, 8, 12, 14, 21, 25 or 26. Acknowledgement is not supported for addressed messages. This message type is for terrestrial use only.

The encapsulated message may or may not be transmitted on AIS1 or AIS2 channels.

If the encapsulation repeats a Message that was transmitted on AIS1 or AIS2 channel, the encapsulation and transmission of messages shall be performed as soon as possible, according to configuration, after receiving the relevant messages which are required to be retransmitted.

The communication state of the encapsulated message shall always be set to zero at encapsulation.

The receiving station shall output all received encapsulated AIS Messages at the PI immediately after reception. [The AIS channel field in the corresponding VDM sentence should be set to null.] The data (Messages) encapsulated in Message 0 may be output in a separate PI port. In case of congestion over the PI:

- the Equipment shall indicate this to user and
- data received through AIS shall have priority over data received through ASM.

Table 8 – Message 0 description

Parameter	Number of bits	Description
Message ID	4	0 – Selected AIS messages that are output at receiving mobile station PI by using VDM sentence with no communication state
Retransmit flag	1	0 (reserved for future use)
Repeat Indicator	2	If the encapsulation repeats a Message that was transmitted on AIS1 or AIS2 channel, this is used to indicate how many times a message has been repeated. Encapsulation represents one repeat. Possible values: 0 – 3: 0 = default, shall be used in case where the message is sent only on ASM channel(s); 1: also transmitted on AIS channel(s); 2, 3 = also transmitted on AIS channel(s) and repeated as counted by the repeat indicator on ASM channel.
Session ID	6	The Session ID associates the VDL transmission with a specific PI transaction
Source ID	32	The Unique Identifier of the transmitting station as described in IALA G1139 Ed.3 Annex 1 section 3.2
Data Count	11	Size of actual data in Binary Data and ASM Identifier field in bits, excluding padding bits range: from 1 to maximum data count
Binary Data	1 slot – 296 / 200 2 slot – 808 / 584 3 slot – 1320 / 968	Content is encapsulated AIS Messages that are channelled through ASM Channels. The Message 0 is transmitted only by Base Stations. Receiver is expected to be ASM-capable mobile station where the ASM-box would relay the encapsulated AIS messages to local presentation interface. The encapsulated AIS Messages would then be output at the PI using VDM sentence. The arrangement would thus be compliant with existing nav presentations. Application data as specified by the ASM Identifier. The available length of the binary data is specified by the LinkConfigId.

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5.1.3.9.4 Equipment configuration parameters

[Future: Current idea is to require configuration parameter for Source ID (to be set by EPV sentence through PI)]

5.1.3.9.5 Access to the data link

MITDMA and RATDMA access schemes shall be used for controlling access to the data transfer medium. The amount of data input through PI determines the access scheme to be used.

NOTE No intentional slot reuse.

The maximum number of slots used by one station on one channel shall not exceed 50 slots within one frame (2250 slots) (2.2% duty cycle), excluding up to 22 slots available for use for retransmission of addressed data. No more than three re-transmission attempts of the same data shall be made.

The Equipment shall be capable of transmitting broadcasts using MITDMA. In this case, there will be no acknowledgements and the quiet time will start immediately after completion of the last MITDMA transmit block.

5.1.3.9.5.1 Selection of candidate slots

Slots, used for transmission, are selected from minimum of 8 candidate slots in the selection interval (SI) which is defined as 235 slots.

The selection process shall use received data from ASM. Data received from AIS and VDE shall also be used by the selection process if these functions are part of the Equipment or if installation so requires.

NOTE Installation of ASM Equipment may have co-located antennas with AIS (Future: or with VDE equipment). Such installation may require the ASM Equipment to use data received from AIS and VDE in the candidate slot selection process (see 5.1.3.11).

Ruleset 1: no AIS dependency: the Equipment shall only use free slots with the minimum of 8 slots to choose from.

Ruleset 2: AIS [Future: or VDE] dependency is required from ASM equipment: see 5.1.3.11.

5.1.3.10 Network layer requirements

5.1.3.10.1 Data link congestion resolution

ASM channel loading shall be measured independently per channel over a window of the past one minute (2250 slots).

5.1.3.10.1.1 Mandatory quiet times

After the completion of a singular Non-MITDMA ASM channel transmission or a complete MITDMA transmission block chain including retransmissions, the ASM station shall wait for a specific time before additional transmission can be scheduled. This time is referred to as Quiet Time. The Selection Interval for finding candidate transmission slots starts after the Quiet Time.

The Quiet Time shall be increased with a multiplier, depending on channel load as per following equation and multipliers described in Table 9.

Quiet Time [seconds] = (Number of transmitted slots in previous complete chain) * (Multiplier)

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Table 9 – Quiet time multiplier

Channel load	Multiplier
< 1 0%	1
10 % to 30 %	2
< 30 %	3

For a singular transmission, Quiet Time shall per default be one second per transmission slot used.

For an MITDMA linked transmission chain, the Quiet Time is a function of the number of transmission slots within that chain, including retransmissions. The Quiet Time shall be increased by one second per time slot used in the transmission chain.

5.1.3.11 Interoperability of functions within one station

5.1.3.11.1 Common requirements for stations with any functional combination

Slot states for slot selection process are defined in IALA G1139.

[Future: No transmissions during VDE bulletin board reserved timeslots.]

The candidate slots are primarily selected from slots that are free on AIS and ASM.

NOTE No intentional slot re-use on ASM channels.

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