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Date: 30 April 2024

Origin: International

Latest date for receipt of comments: 19 June 2024

Project No. 2023/01972

Responsible committee: EPL/80 Maritime navigation and radiocommunication equipment and systems

Interested committees:

Title: Draft BS EN 63514 Ed. 1.0 Maritime navigation and radiocommunication equipment and systems – VHF Data Exchange System (VDES) – Shipborne mobile station – Operational and performance requirements, methods of test and required test results

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



80/1118/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

IEC 63514 ED1

DATE OF CIRCULATION:

2024-04-26

CLOSING DATE FOR COMMENTS:

2024-07-19

SUPERSEDES DOCUMENTS:

80/1075/NP, 80/1091/RVN

IEC TC 80 : MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS

SECRETARIAT:

United Kingdom

SECRETARY:

Mr Kim Fisher

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC☐ ENVIRONMENT☐ QUALITY ASSURANCE☐ SAFETY

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TITLE:

Maritime navigation and radiocommunication equipment and systems – VHF Data Exchange System (VDES) – Shipborne mobile station – Operational and performance requirements, methods of test and required test results

NOTE FROM TC/SC OFFICERS:

This draft has been prepared by WG15.

CONTENTS

FOREWORD.....	8
1 Scope	2
2 Normative references	2
3 Terms, definitions and abbreviated terms	3
4 General description, requirements	6
4.1 Structure of this document	6
4.2 Overview of VDES mobile station	6
4.3 Requirements	7
4.3.1 Marking and identification	7
4.3.2 Manuals.....	7
4.3.3 Quality assurance	7
4.3.4 Source of UTC	7
4.3.5 Human Machine Interface	7
4.3.6 Environmental, power supply, special purpose and safety requirements	8
4.3.7 Technical requirements	8
4.3.8 Response to capability request	9
4.3.9 Presentation Interface	9
4.3.10 Alert management	15
4.3.11 Application layer requirements.....	16
5 Performance requirements for physical layer	16
5.1 General.....	16
5.2 Transmitter requirements	16
5.2.1 Transmitter test requirements for ASM.....	16
5.2.2 Transmitter test requirements for VDE-TER	16
5.2.3 Transmitter test requirements for VDE-SAT	18
5.2.4 Slotted transmission spectrum mask	19
5.2.5 Transmit slot timing	21
5.3 Receiver requirements	23
5.3.1 Receiver test requirements for ASM	23
5.3.2 Receiver test requirements for VDE-TER	24
5.3.3 Receiver test requirements for VDE-SAT	25
6 Performance requirements for ASM	27
6.1 Overview	27
6.2 Link layer requirements.....	27
6.2.1 Access schemes.....	27
6.2.2 General rules.....	27
6.2.3 Re-transmissions.....	27
6.2.4 Equipment interaction on the VDL.....	28
6.3 Network layer requirements	29
6.3.1 Data link congestion	29
6.3.2 Mandatory quiet times	29
6.4 Application layer requirements	29
7 Performance requirements for VDE-TER	29
7.1 Overview	29
7.1.1 Physical channels.....	29
7.1.2 TDMA frame structure and configuration.....	30

7.2	Transferring data via PI	30
7.3	Link layer requirements.....	31
7.3.1	Bulletin board	31
7.3.2	Random accessible slot selection	31
7.3.3	Link access selection.....	31
7.3.4	Logical Channel access selection	32
7.3.5	Transferring PI data payload over VDE	33
7.3.6	Data transfer protocols	35
7.4	Network layer requirements	39
8	Performance requirements for VDE-SAT.....	39
8.1	Overview	39
8.2	Technical requirements.....	40
8.2.1	Satellite bulletin board	40
8.2.2	Guard slot.....	40
8.2.3	Distinguishing satellites	41
8.2.4	Channel selection	41
8.2.5	Modulation coding schemes.....	41
8.2.6	Orbital information	41
8.2.7	Selection of satellite	41
8.2.8	Reception of control messages	42
8.2.9	Reception of downlink data.....	44
8.2.10	Transmission of uplink data	45
8.2.11	Control message transmissions	48
8.3	Application layer requirements	50
8.3.1	AtoN report for legacy onboard equipment.....	50
9	Interoperability of functions within the mobile station	50
9.1	Selection criteria for candidate slots for ASM transmissions.....	50
9.2	Priority between VDE-TER and VDE-SAT	50
10	Methods of tests for general requirements	50
10.1	Common tests.....	50
10.1.1	General test conditions	50
10.1.2	Power supply excessive conditions	51
10.1.3	Power supply short-term variation.....	51
10.1.4	Power supply failure	51
10.1.5	Update of software	51
10.1.6	Transmitter shutdown	51
10.1.7	Initialization period	51
10.2	Operational tests	51
10.2.1	Transceiver protection	51
10.2.2	TX malfunction	51
10.2.3	Antenna VSWR.....	52
10.2.4	RX malfunction	52
10.3	Specific tests for Presentation Interface	52
10.3.1	General	52
10.3.2	Checking manufacturer's documentation	52
10.3.3	Electrical test.....	52
10.3.4	Output interface performance	52
10.3.5	Concurrent mode tests	52
10.3.6	Addressing multiple external system function IDs	52

10.3.7	Correct use of 450-header and transmission groups	53
10.4	Tests for alert management	53
10.5	Receiver performance under high load	53
10.5.1	Purpose	53
10.5.2	Method of measurement	53
10.5.3	Required results	53
10.6	Random access slot selection with concurrent allocated and available slots on VDES channels	53
10.6.1	Purpose	53
10.6.2	Method of measurement	54
10.6.3	Required results	55
10.7	General application layer tests	55
10.7.1	Testing response to interrogation	55
11	Methods of test for physical layer	56
11.1	Standard test signals	56
11.1.1	PRBS test signal	56
11.1.2	VHF analog voice test signal	56
11.2	Test equipment	56
11.3	Packet error rate testing	57
11.4	Transmitter tests	57
11.4.1	General	57
11.4.2	Transmit test set-up	57
11.4.3	Transmit spectrum mask	57
11.4.4	Transmit power	58
11.4.5	Frequency error	59
11.4.6	Transmitter modulation accuracy	59
11.4.7	Transmitter slot timing	59
11.4.8	Transmitter conducted spurious emissions	60
11.5	Receiver Tests	60
11.5.1	Receiver sensitivity	60
11.5.2	Receiver dynamic range	60
11.5.3	Receiver adjacent channel rejection	61
11.5.4	Receiver co-channel performance	61
11.5.5	Receiver spurious response rejection	61
11.5.6	Receiver inter-modulation	63
11.5.7	Receiver blocking	63
12	Methods of testing and required results for ASM	64
12.1	Specific tests of Link layer	64
12.1.1	Transmission of ASM Messages	64
12.1.2	Reception of ASM messages	65
12.1.3	MITDMA transmission	65
12.1.4	MITDMA reception	66
12.2	Specific tests of network layer	66
12.3	Specific tests of transport layer	66
12.3.1	Transmission	66
12.3.2	Acknowledgements	66
12.3.3	Transmission retry	66
12.3.4	Reception	66
13	Methods of testing and required results for VDE-TER	

13.1	Test environment	66
13.2	Specific tests of link layer	67
13.2.1	Resource request and allocation	67
13.2.2	Test for use of data session fragments	68
13.2.3	Single segment in multiple fragment messages	68
13.2.4	Multiple segments in multiple fragment messages	71
13.2.5	Specific tests for short data messages	72
13.2.6	Streaming data message channel access selection	75
13.2.7	Specific tests for link access selection	77
13.2.8	Bulletin board validation	79
13.2.9	Bulletin board configuration	79
13.2.10	Resource not available behaviour test	81
14	Methods of testing and required results for VDE-SAT	81
14.1	Test environment	81
14.2	Specific tests of Link layer	81
14.2.1	Generic settings	81
14.2.2	Reception of bulletin board	81
14.2.3	Resource request and allocation	81
14.2.4	Reception of broadcast downlink data	83
14.2.5	Reception of addressed downlink data	83
14.2.6	Transmission of uplink data	83
14.3	Specific tests for application layer	83
14.3.1	AtoN report	83
15	Tests and required results for interoperability of functions within the mobile station	83
Annex A (normative)	Presentation interface sentences	84
A.1	General	84
A.2	Sentences applicable to ASM function	84
A.2.1	AAB – ASM selective addressed message	84
A.2.2	ABB – ASM broadcast message	85
A.2.3	ADM – Received ASM VHF data-link message	86
A.2.4	ADO – ASM VHF data-link own-vessel transmission	87
A.2.5	AGB – ASM geographical multicast message	87
A.2.6	AMK – Addressed and broadcast ASM message acknowledgement	88
A.2.7	ASM – ASM message assembly	89
A.3	Sentences applicable to VDE-TER function	90
A.3.1	TDB – Terrestrial binary data	90
A.3.2	TMK – Terrestrial message ACK/NACK	91
A.4	Sentences applicable to VDE-SAT function	92
A.4.1	SDM - VDE satellite downlink message	92
A.4.2	SSG - VDE Satellite Status General Message	93
A.4.3	SUK - VDE Satellite Message Sentence Acknowledgement Message	93
A.4.4	SUM - VDE Satellite Uplink Message	93
A.5	Sentences applicable to HMI function	94
A.5.1	[ZYX] – System Status	94
A.5.2	[XYZ] – Binary equipment data	95
Annex B (normative)	Amended presentation interface sentences	96
B.1	NAK - Negative acknowledgement	96
Annex C (informative)	Illustration of scope and affiliated functions	98

Annex D (normative) Default VDE bulletin boards	100
D.1 Default bulletin board for VDE-TER.....	100
D.2 Default bulletin board for VDE-SAT	104
Annex E (informative) Test equipment	109
E.1 Transmitter testing with Vector Signal Analyser	109
E.2 Transmitter testing with a Spectrum Analyser	110
Bibliography.....	111
Figure 1 – VDES mobile station within the VDES	6
Figure 2 – Slotted transmission spectrum for ASM channels	20
Figure 3 – Slotted Transmit Spectrum for VDE-TER and VDE-SAT	21
Figure 4 – Transmitter power versus time characteristics	22
Figure 5 – TDMA Frame structure	30
Figure 6 – PI Data Payload in a Segment.....	33
Figure 7 – Multiple Segments in single Short Data message	34
Figure 8 – Single segment in one fragment message	35
Figure 9 – Multiple segments in multiple fragment messages	35
Figure 10 – Single segment in multiple fragment messages	35
Figure 11 – Transmitter test setup	57
Figure 12 – Test setup for adjacent channel selectivity	61
Figure 13 – Measurement arrangement for intermodulation.....	63
Figure 14 – Test setup for receiver blocking	64
Figure C.1 – Scope and expected affiliated functions	98
Figure D.1 – VDE-TER Ship to Shore default slot functions (lower leg)	104
Figure D.2 – VDE-TER Ship to Ship and Shore to Ship default slot functions (upper leg) 104	
Figure 0.3 – VDE-SAT default slot functions (lower leg)	108
Figure 0.4 – VDE-SAT default slot functions (upper leg)	108
Figure E.1 – VSA results for ASM pi/4 QPSK, transmission Link ID 1.....	109
Figure E.2 – VSA results for VDE 16QAM transmission, Link ID 11.....	110
Figure E.3 – Spectrum Analyser average transmit power test of Link ID 1	110
Table 1 – VDES station talker IDs	9
Table 2 – IEC 61162-450 parameters for ASM and VDE data	10
Table 3 – IEC 61162-450 parameters for AIS and other communication	10
Table 4 – sentence formatters used to output equipment status and input related commands	11
Table 5 – Property identifiers	11
Table 6 – Sentence formatters used for input of data to equipment for transmission to ASM VDL	12
Table 7 – Sentence formatters used to output ASM VDL	12
Table 8 – Talker identifiers and sentence formatters used for input of data to equipment for transmission to VDE-TER VDL	13
Table 9 – Sentence formatters used to output VDE-TER VDL	13
Table 10 – PI input and consecutive Link ID on VDE-SAT uplink.....	14

Table 11 – Sentence formatters used for input of data to equipment for transmission to VDE satellites	14
Table 12 – Sentence formatters for data received from VDE satellites	15
Table 13 – Sentence formatters for data received from VDE satellites	15
Table 14 – Transmitter test requirements specific to ASM	16
Table 15 – Transmitter test requirements specific to VDE-TER	17
Table 16 – Transmitter test requirements specific to VDE-SAT	18
Table 17 – Slotted transmission spectrum for ASM channels	20
Table 18 – Slotted Transmit Spectrum for VDE-TER and VDE-SAT	20
Table 19 – Transmitter power versus time characteristics for VDE-ASM and VDE-TER single slot transmission	21
Table 20 – Transmitter power versus time characteristics for VDE-SAT	22
Table 21 – Receiver test requirements specific to ASM	23
Table 22 – Receiver requirements specific to VDE-TER	24
Table 23 – Receiver test requirements specific to VDE-SAT	25
Table 24 – Use of ASM VDL messages	28
Table 25 – Recommended VDE-SAT total uplink session sizes	46
Table 26 – VDE-SAT Property identifiers	49
Table 27 – Overview of slot states of concurrent slots used in this test	54
Table D.1 – Default TBB for ship-to-shore in lower leg	100
Table D.2 – Physical channel definitions	100
Table D.3 – PC0 Logical channel definition	101
Table D.4 – PC1 Logical channel definition	102
The default VDE satellite bulletin board is described in Table 0.5, Table 0.6, ...	104
Table 0.7, ...	104
Table 0.8, Table 0.9, and	104
Table 0.5 – Default SBB, Fragment 1	105
Table 0.6 – Default SBB, Fragment 2	105
Table 0.7 – Default SBB, Fragment 3	106
Table 0.8 – Default SBB, Fragment 4	106
Table 0.9 – Default SBB, Fragment 5	107
Table 0.10 – Default SBB, Fragment 6	107

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND
SYSTEMS – VHF DATA EXCHANGE SYSTEM – REQUIREMENTS AND
METHODS OF TESTING FOR SHIPBORNE MOBILE STATION**

FOREWORD

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IEC 63514 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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

- reconfirmed,
- withdrawn, or
- revised.

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – VHF DATA EXCHANGE SYSTEM – REQUIREMENTS AND METHODS OF TESTING FOR SHIPBORNE MOBILE STATION

1 Scope

This document specifies requirements and methods of testing for any shipborne mobile stations that transmit on AIS, ASM and VDE channels as defined by ITU-R M.1371 and ITU-R M.2092.

Equipment conforming to this document is suitable to be installed onboard ships that are engaged in international voyages and contains AIS Class-A functionality as described in IEC 61993-2.

Equipment compliant with this document can connect to an external gateway using the standardised Presentation Interface to provide additional services. For further illustration of the scope, see Annex C.

2 Normative references

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

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

IEC 61993-2:2018, *Class A shipborne equipment of the automatic identification system (AIS) – Operational and performance requirements, methods of test and required test results*

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

IEC 63154:2021, *Maritime navigation and radiocommunication equipment and systems – cybersecurity – general requirements, methods of testing and required test results*

IEC 63173-2:2022, *Maritime navigation and radiocommunication equipment and systems - Data interface - Part 2: Secure communication between ship and shore (SECOM)*

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

IMO SN.1/Circ.289 (2010) *Guidance on The Use of AIS Application-Specific Messages*

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-R Recommendation M.2092-1:2022, *Technical characteristics for a VHF data exchange system in the VHF maritime mobile band*

IALA Guideline 1117 Ed.3 (2022) *VHF Data Exchange System (VDES) Overview*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

3.1.1

bulletin board

message sent by a control station to define the physical channels with their VDE Slotmap for a control station service area.

3.1.2

controlling station

coast station or VDES satellite station capable of transmitting a bulletin board

3.1.3

controlling station service area

area defined by a bulletin board which is transmitted by a terrestrial control station

3.1.4

data session

period for which resources are assigned to be used for a data transfer.

3.1.5

frame

A frame equals one minute and is divided into 2 250 slots.

3.1.6

Hexslot

Six in time consecutive slots form a hexslot, and are organized with an offset number (0-5) within the hexslot. The hexslots are numbered from the start of the frame and incremented until the end of the frame (0 – 374).

3.1.7

input

used for data transaction towards the equipment in its presentation interface

3.1.8

logical channel

LC

functions for a set of continuous slots within a TDMA channel and may repeat in a TDMA channel.

3.1.9

output

used for data transaction from the equipment at its Presentation Interface

3.1.10

packet

burst as defined in ITU-R M.2092-1 A1-1.2.3

3.1.11**physical channel**

channel defined by a frequency and bandwidth.

3.1.12**PI data payload**

complete application layer data block that was input to or output from the equipment using one or multiple PI sentences.

3.1.13**PI sequential message identifier**

identifier used on the PI-Port (as defined in IEC 61162-1)

3.1.14**PI source/destination**

SFI on IEC 61162-450 header

3.1.15**receive**

used when equipment receives by using VHF radio

3.1.16**segment**

combination of the segment header and single PI data payload. It is a unique VDL sequential ID in the segment header.

3.1.17**slot**

duration of 26,7 ms and is numbered as 0-2 249.

3.1.18**TDMA channel**

The six TDMA channels are defined as all the slots with the same offset within the hexslot. Every 6th slot is part of the same TDMA channel. 6 TDMA channels are defined. Figure 5 shows each TDMA channel as a horizontal line of slots.

3.1.19**TDMA frame**

A TDMA channel is divided into TDMA frames. The default total time duration of a TDMA frame is 15 hexslots. TDMA frames are numbered from 0 to 24.

3.1.20**TDMA slot**

A TDMA slot defines the hexslot number within a TDMA frame. With a TDMA frame length of 15 hexslots, the TDMA slots will be cyclically numbered from 0 to 14. The TDMA channel number, the TDMA frame number, TDMA frame size, and the TDMA Slot number are needed to identify a slot within a frame.

3.1.21**transmit**

used when equipment transmits by using VHF radio

3.1.22**VDES application**

In contrast to a VDES function, a VDES application operates on OSI application layer and is based on the PI data payload.

3.1.23**VDES function**

all OSI layers below the application layer for AIS, ASM, VDE-TER and VDE-SAT

3.1.24**VDL sequential ID**

Unique number, issued by the transmitting VDE station, identifying a segment. It is part of the segment header.

Note to entry ITU-R M.2092-1 refers to the Sequential ID, which is identical to term VDL sequential ID as used in this document.

3.1.25**VDL source/destination**

addressing on VDL

3.1.26**VDE slot map**

The complete mapping of slot functions to all logical channels of all TDMA channels of a physical channel.

3.2 Abbreviated terms

[to be populated further at a suitable stage]

AIS	Automatic Identification System
ASM	Application Specific Message
AtoN	Aids to Navigation
DAC	Designated Area Code
EMC	Electromagnetic Compatibility
HMI	Human Machine Interface
ISO	International Organisation for Standardisation
ISO-OSI	ISO Open Systems Interconnection
MAC	Media Access Control
MITDMA	Multiple Incremental Time Division Multiple Access
PI	Presentation Interface
RATDMA	Random Access Time Division Multiple Access
SBB	Satellite Bulletin Board
TBB	Terrestrial Bulletin Board
VDE	VHF Data Exchange
VDES	VHF Data Exchange System
VDL	VHF Data Link
VHF	Very High Frequency

4 General description, requirements

4.1 Structure of this document

This document is divided into separate modules describing:

- applicable general descriptions, requirements (Clause 4);
- requirements for ISO-OSI physical layer for operation on AIS, ASM, VDE-TER and VDE-SAT channels (Clause 5);
- specific requirements for operation on ASM channels (Clause 6);
- specific requirements for operation on VDE channels intended for terrestrial use (Clause 7);
- specific requirements for operation on VDE channels intended for exchanging data from Earth to space and from space to Earth (Clause 8);
- requirements related to interoperability of AIS, ASM, VDE-TER and VDE-SAT within the equipment (Clause 9);
- methods of test and required results described separately for general requirements and requirements for ISO-OSI physical layer (Clause 10 and Clause 11);
- methods of test and required results described separately for ASM, VDE-TER and VDE-SAT and their interoperability (Clause 12, Clause 13, Clause 14 and Clause 15);
- annexes describing set of new interface sentences that are under development and expected to be published first in this document and existing interface sentences proposed to be modified.

NOTE When referring to VDL messages in this document, the VDE message type as described in ITU-R M.2092 Table 33, Table 62, and ASM Message ID as described in Table 24, is indicated in brackets after the name of the message. Example: "Resource Allocation (#4)" indicates VDE-TER message type 4 used for allocating resource.

4.2 Overview of VDES mobile station

The overview of the VDES mobile station and its interaction with other stations is presented in Figure 1.

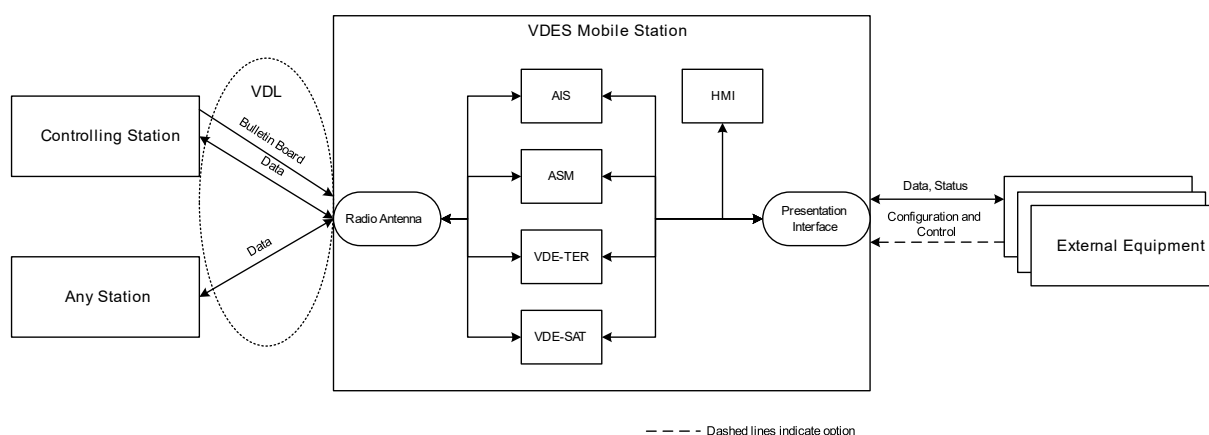


Figure 1 – VDES mobile station within the VDES

AIS is a component of a VDES mobile station.

Mobile station compliant to requirements of this document shall:

- a) contain AIS Class-A functionality as described in IEC 61993-2;
- b) transmit and receive following:

- 1) AIS Messages as specified in IEC 61993-2;
 - 2) ASM Messages as specified by this document. Applicable channels are ASM 1 and ASM 2;
 - 3) VDE TER Messages as specified by this document. Applicable channels are VDE channels as specified by ITU-R M.2092;
 - 4) VDE SAT Messages as specified by this document. Applicable channels are VDE channels as specified by ITU-R M.2092.
- c) include a Human Machine Interface (HMI) to fulfil requirements of AIS MKD as required by IEC 61993-2 and those set further by this document;
- d) include a Presentation Interface (PI) as specified by this document;
- gGenerate ASM messages in the equipment based on information input by user;
- e) store received VDES AtoN message and continuously output this through the PI.

4.3 Requirements

4.3.1 Marking and identification

Requirements as specified in IEC 61993-2 apply.

4.3.2 Manuals

Requirements as specified in IEC 61993-2 apply.

4.3.3 Quality assurance

Requirements as specified in IEC 61993-2 apply.

4.3.4 Source of UTC

Requirements as specified in IEC 61993-2 apply.

4.3.5 Human Machine Interface

In addition to AIS MKD functionality as required by IEC 61993-2, the VDES mobile station shall have following functionality.

- 1) Following status indications:
 - terrestrial in service indicator separately for VDE and ASM with following statuses: available, unavailable (for VDE only), disabled by user;
 - satellite in service indicator with following statuses: available, unavailable, disabled by user.
- 2) Following diagnostics information:
 - transmission power level in use (low or high power);
 - log entries separately for manual and remote changes to transmit power level settings;
 - bulletin board configuration in use.
- 3) Separately enabling/disabling transmission on VDE channels and ASM channels

NOTE VDE channels can be reserved for use by other purposes regionally.

- 4) Allow user to manage trusted certificates and remove revoked certificates onto the equipment for authentication of data such as VDE bulletin boards (see 4.3.7.9)
- 5) Input of and store in non-volatile memory information required for transmission of following subset of ASMs as described in IMO SN.1/Circ.289 and allow user to see them

which channel the ASM messages are to be transmitted (AIS and ASM channels or VDE-TER encapsulated as defined in IALA G1117 Ed.3.0):

- persons on Board (DAC:001, FI:16);
- berthing data (DAC:001, FI:20);
- ship extended data (DAC:001, FI:24);
- dangerous cargo (DAC:001, FI:25);
- text description (DAC:001, FI:29 and FI:30). These ASM Messages are to be used only in combination with other ASM Message selectable by the user.

6) Input of information required for transmission of following ASM and VDE messages as described in IALA G1117 Ed.3.0:

- UTF8 Text message (VPFI 2, Message ID 1).

4.3.6 Environmental, power supply, special purpose and safety requirements

Requirements as specified in IEC 61993-2 apply.

4.3.6.1 Electromagnetic Compatibility (EMC)

Requirements as specified in IEC 61993-2 apply.

4.3.6.2 Compass Safe Distance

Requirements as specified in IEC 61993-2 apply.

4.3.6.3 Power supply

Requirements as specified in IEC 61993-2 apply.

4.3.6.4 Update of software

The equipment shall provide means for updating software of the equipment and to display, on demand, the current software version. The method of updating software shall conform to IEC 61162-460 as applicable.

4.3.7 Technical requirements

4.3.7.1 Transmitter shutdown procedure

Requirements as specified in IEC 61993-2 apply.

4.3.7.2 Permissible initialization period

Requirements as specified in IEC 61993-2 apply.

4.3.7.3 Transceiver protection

Requirements as specified in IEC 61993-2 apply.

4.3.7.4 TX malfunction

Requirements as specified in IEC 61993-2 apply.

4.3.7.5 Antenna VSWR

Requirements as specified in IEC 61993-2 apply.

4.3.7.6 RX malfunction

Requirements as specified in IEC 61993-2 apply.

4.3.7.7 Restriction on transmission

The VDES mobile station shall not transmit on VDE or ASM channels during VDE bulletin board reserved timeslots.

NOTE AIS transmissions take priority over VDE. Therefore, AIS transmissions can coincide with VDE bulletin board reserved timeslots.

When the AIS is set to low power mode (1 W), the transmissions on ASM and VDE channels shall not exceed a power of 1 W average.

4.3.7.8 Receiver requirements

The AIS and ASM TDMA receive process shall not be dependent on slot boundaries.

NOTE The VDE-TER and VDE-SAT receive process is within the time of between -0,312 to +8,312 ms from the slot boundary.

4.3.7.9 Authentication of Signatures

The equipment shall be capable of authenticating terrestrial and satellite bulletin boards.

Authentication of the terrestrial or satellite bulletin board signature shall use the certificate and key formats and algorithms described in ITU-R M.2092-1, Annex 4, section 4.15.

Additionally, equipment shall comply with the following specific concepts and methods described in IEC 63173-2:

- a) the SECOM PKI concept, IEC 63173-2:2022, section 4.3.2;
- b) the authentication and integrity (digital signature) part of IEC 63173-2:2022 4.3.4;
- c) the SECOM PKI private/public key mechanism using X.509 certificates, as described in IEC 63173-2:2022 4.3.4;
- d) the certification revocation status as described in IEC 63173-2:2022 4.3.5;
- e) the verification of a digital signature as described in IEC 63173-2:2022 7.3.5.

The equipment shall provide a key storage to store public keys of trusted VDE-SAT and VDE-TER network providers to authenticate signatures. The minimum storage capability shall be [10] separate keys. These keys shall be produced and handled according to IEC 63173-2:2022, Clause 8.

4.3.8 Response to capability request

[TBD – study ITU-R M.1371 and apply to VDES mobile equipment]

4.3.9 Presentation Interface

4.3.9.1 General requirements for presentation interface

Table 1 defines talker IDs to be used by VDES mobile station when outputting data received from VDES.

Table 1 – VDES station talker IDs

Function	Talker ID
Data exchanged via ASM or VDE channels	[VA]

All other communications and output resulting reception of ASM Message 0	AI
--	----

The equipment shall respond to a standard query sentence with the TALKER Identifier for device from which data is being requested set as AI.

4.3.9.1.1 PI functions

The equipment shall have a presentation interface (PI) for following functions:

- a) input of information from other onboard equipment to be transmitted to other VDES stations by the equipment;
- b) output of all received PI data payload addressed to own station;
- c) report equipment internal status and configuration information to other onboard equipment or system; and
- d) accept configuration related commands from other onboard equipment or system.

Except as specified in this document, this interface shall comply with requirements described in IEC 61162-450 and use PI sentences described in this document for AIS, ASM, VDE-TER and VDE-SAT functions. Table 2 specifies IEC 61162-450 specific parameters to be used.

VDES includes sentences where the maximum number of characters in the sentence exceeds the 82 character limit as defined in IEC 61162-1. A new IEC 61162-450 header is introduced to allow such sentences for ASM and VDE data.

NOTE AIS data input and output is combined into the -450 interface, but additionally, AIS information is provided through IEC 61162-1 and IEC 61162-2 for legacy purposes.

Table 2 – IEC 61162-450 parameters for ASM and VDE data

Parameter name	Value to be used
IEC 61162-450 header	UdPtD
Transmission group for ASM and VDE data	VDED, multicast address:port: 239.192.0.65: 60065

Table 3 – IEC 61162-450 parameters for AIS and other communication

Parameter name	Value to be used
450-header	UdPbC
Transmission group for alerts	BAM1 or BAM2
Transmission group for AIS targets	TGTD

The equipment shall be capable of supporting multiple external equipment through PI by using IEC 61162-450 TAG block.

The timeout for input of a complete PI message (all sentences) required for a resulting transmission at VDES VDL is 10 s. If the input of all sentences has not been completed by the timeout, the equipment shall output a NAK sentence with an appropriate reason code ("8 = multi-sentence message not accepted due to sentence timeout").

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

This interface shall comply with requirements described in IEC 61162-450. Table 4 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.

Table 4 – sentence formatters used to output equipment status and input related commands

Function	Sentence formatter	Note
Alerts	ACN, ARC, ALC, ALF	For details, see IEC 62923-1 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
PI input error	NAK	Used to signal trouble in input of multi-sentence message
Equipment status	[ZYX]	For reporting status of ASM, VDE-TER, VDE-SAT and tx power level, see A.5.1.

The equipment shall allow query of output sentences as indicated in Table 4.

Conditions that may cause the equipment to release alert include but are not restricted to:

- TX fault;
- RX fault;
- Antenna fault

4.3.9.3 Equipment configuration parameters

In addition to requirement in IEC 61993-2, the equipment configuration parameters described in Table 5 shall be configurable by using the EPV sentence. [The EPV sentence may not be suitable for all use cases, such as input of certificates, an alternative method for input of configuration parameters may be XYZ sentence, see A.5.2.]

Table 5 – Property identifiers

Property identifier	Protected	Property meaning	Value range
[TBD]	No	Parameters necessary for the content of ASM Messages to be constructed and transmitted by the VDES mobile station	[TBD]
[TBD]	No	Transmission power high/low	30: 1 W low power. 41: 12.5 W high power.
[TBD]	Yes	Enable/Disable VDE-TER Transmissions	0: Disabled 1: Enabled
[TBD]	Yes	Enable/Disable VDE-ASM Transmissions	0: Disabled 1: Enabled
[TBD]	No	Persons on Board	0 = not available = default 1 - 8,190 8,191 = 8,191 or greater
[TBD]	Yes	Berthing data	See "9 Berthing data" in IMO Cir.289. Must include text description.
[TBD]	Yes	Ship extended data	See "4 Extended ship static and voyage-related data" in IMO Cir.289.

			Must include text description.
[TBD]	Yes	Dangerous cargo	See "2 Dangerous cargo indication" in IMO Cir.289. Must include text description.

353

354 **4.3.9.4 Presentation interface for ASM**

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

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

365 **4.3.9.4.1 Interface for input data to be transmitted to ASM VDL**

366 This interface shall comply with requirements described in IEC 61162-450. Table 6 defines the
 367 IEC 61162-1 talker identifiers and sentence formatters that shall be used when outputting ASM
 368 VDL data. The details of sentence formatters are described in Annex A.

369 **Table 6 – Sentence formatters used for input of data to equipment for transmission to**
 370 **ASM VDL**

Sentence formatter	Direction	Note
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
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.		

371

372 **4.3.9.4.2 Interface to output received ASM VDL information**

373 This interface shall comply with requirements described in IEC 61162-450. Table 7 defines the
 374 IEC 61162-1 sentence formatters that shall be used for output of ASM VDL data from the
 375 equipment. The details of sentence formatters are described in Annex A.

376 **Table 7 – Sentence formatters used to output ASM VDL**

Sentence formatter	Direction	Note
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

VDM ^C	Output	Used to output encapsulated AIS ASM messages that are received in ASM Message 0
^a ASM sentence is output when a complete ASM VDL message/MITDMA chain has been received. ^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 talker ID used in combination shall be "AI" to ensure backwards compatibility ^C Mobile station shall discard messages having satellite as intended destination (applies to ASM sentence VDL channel designations 3 and 4).		

377

378 **4.3.9.5 Presentation Interface for VDE-TER**379 **4.3.9.5.1 Interface for input data to be transmitted to VDE-TER VDL**

380 The equipment shall be capable of assembling the complete payload input by related PI
 381 sentences before scheduling transmission on VDE-TER VDL. If the equipment detects
 382 inconsistency in the data input through PI (for example checksum error, missing sentence,
 383 interrupted input of sentences), the equipment shall output a negative acknowledgement using
 384 NAK sentence and shall discard information already received.

385 Table 8 defines the IEC 61162-1 sentence formatters that shall be used when inputting data to
 386 be transmitted over VDE-TER VDL. The details of sentence formatters are described in
 387 Annex A.

388 **Table 8 – Talker identifiers and sentence formatters used for input of data to equipment**
 389 **for transmission to VDE-TER VDL**

Sentence formatter	Direction	Note
TDB	Input	PI message to VDE-TER VDL
TMK	Output	PI Message Acknowledgement

390

391 **4.3.9.5.2 Interface to output received VDE-TER VDL information**

392 Table 9 defines the IEC 61162-1 sentence formatters that shall be used for output of VDE-TER
 393 VDL data from the equipment. The details of sentence formatters are described in Annex A.

394 The equipment shall be capable of assembling the entire received VDE-TER segment and
 395 thereafter output the data using TDB sentence. Information received from incomplete VDE-TER
 396 segments shall be discarded i.e. the received partial information shall not be output through PI.
 397 In addition, the equipment may optionally be capable of outputting all received VDE-TER VDL
 398 radio messages relevant to own station using TDB sentence.

399 **Table 9 – Sentence formatters used to output VDE-TER VDL**

Sentence formatter	Direction	Note
TDB	Output	Received VDE-TER segment (converted to PI message)

400 **4.3.9.6 Presentation Interface for VDE-SAT**401 **4.3.9.6.1 Interface for PI data payload transmitted to a VDE satellite**

402 Table 11 defines the IEC 61162-1 sentence formatters that shall be used in communications
 403 with the equipment. The details of sentence formatters are described in Annex A.

404 Equipment shall not accept uplink data sentences with a PI data payload size exceeding [10] kB.

NOTE The VDE-SAT uplink PI data payload size cannot exceed the amount possible to be transmitted to the satellite within the time of visibility. 3 VDE-SAT subframes need to be reserved for retransmissions.

Given the following assumptions

- Using one 30 slot DC of one 50 kHz channel pair of the default VDE-SAT bulletin board as of ITU-R M.2092-1, Reserving 3 VDE-SAT sub frames for retransmissions, i.e. 3 times 20 seconds, resulting in 60 s,
- The equipment will request and try to concatenate several segments in one UL transmission requests to accommodate transfers of data larger than the given limit per uplink data sentence above. Ideal conditions using LinkID 24,
- the equipment can be expected to have a useful window of 2 min for data transfer with satellite,
- the equipment had cached the VDE-SAT bulletin board for the satellite,
- resulting in 6 VDE-SAT subframes for random access, data transfer and retransmissions,
- resulting in 27 840 bytes of user data per 3 subframes (fragment headers subtracted), per channel pair,

the recommended uplink data size under normal conditions is 10 kB to ensure a proper relation between VDL control signalling overhead and the risk that a too long transmission may not be able to be finished.

Table 10 describes the dependency between the size of PI input and consecutive Link ID that would be used for transmission of the PI input.

Table 10 – PI input and consecutive Link ID on VDE-SAT uplink

[TBD]	[TBD]
[TBD]	[TBD]

Table 11 – Sentence formatters used for input of data to equipment for transmission to VDE satellites

Sentence formatter	Direction	Note
SUM	Input	VDE Satellite Uplink multi-sentence Message
SUK	Output	VDE Satellite Uplink Message Acknowledgement Message

From the length of the PI data payload, the equipment determines which VDE-SAT link layer methods to use for transmission. Following cases exist:

- in case of 8 bits of data is provided, a VDL short message transfer without resource request is chosen;
- in case of 40 bits of data and no destination ID are provided, a VDL short message without resource request is chosen;
- in all other cases, a VDL satellite uplink transfer with resource request is chosen.

4.3.9.6.2 Interface for PI data payload received from a VDE satellite

Table 12 defines the IEC 61162-1 sentence formatters that shall be used to support exchange of data received from a VDE satellite by the equipment. The details of the sentence formatters are described in Annex A.

The equipment shall as a minimum support data package size of 100 kB per session and minimum of [12] parallel sessions using [2] concurrent receivers.

NOTE For broadcast, transmissions from satellite are short to avoid mobile stations only receiving part of the message.

Given the following assumptions

- Using all available DCs per receiver of the default VDE-SAT bulletin board as of ITU-R M.2092-1,
- Reserving 3 VDE-SAT sub frames for retransmissions, i.e. 3 times 20 seconds, resulting in 60 s,
- Using LinkID 26,
- the equipment can be expected in view of the satellite for a total of 2 min,
- the equipment had cached the VDE-SAT bulletin board for the satellite,
- resulting in 3 VDE-SAT subframes for data and 3 VDE-SAT subframes for retransmissions,

the equipment may receive 57 060 bytes of user data per minute (fragment headers subtracted).

Table 12 – Sentence formatters for data received from VDE satellites

Sentence formatter	Direction	Note
SDM	Output	VDE Satellite Downlink multi-sentence Message
VDM	Output	Encapsulated AIS Message 21 derived from VDE-SAT Virtual AtoN message (serving legacy equipment onboard). See 8.3.1.

4.3.9.6.3 Interface for status and configuration of VDE satellite functionality

Table 13 defines the IEC 61162-1 sentence formatters that shall be used to support status and configuration in relation to VDE satellite data exchange. The details of sentence formatters are described in Annex A.

Table 13 – Sentence formatters for data received from VDE satellites

Sentence formatter	Direction	Note
SSG	Output	VDE Satellite Status General Message, containing Status. This sentence can be queried by the generic Query command.
EPV	Input	VDE Satellite Configuration Change Command Message and Query
EPV	Output	VDE Satellite Configuration Report Message

The SSG sentence is output by the equipment as a response to a Query command with the SSG sentence formatter requested, see 4.3.9.

The EPV sentence is used by external equipment to command change or query a report for equipment property values listed in 8.2.11.3. The EPV sentence usage is described in IEC 61162-1.

4.3.10 Alert management

Requirements as specified in 6.10 of IEC 61993-2:2018 apply.

4.3.11 Application layer requirements

4.3.11.1 Response to interrogation for Persons on Board, Berthing data, Ship extended data, Dangerous cargo and Text description

Upon reception of interrogation for Persons on Board (DAC:001, FI:16), Berthing data (DAC:001, FI:20), Ship extended data (DAC:001, FI:24), Dangerous cargo (DAC:001, FI:25) or Text description (DAC:001, FI:29 and FI:30) on AIS, ASM, VDE-TER, or VDE-SAT, the equipment shall transmit response formulated as specified in IMO SN.1/Circ.289 within 4 seconds, using the same VDES component on where the query was received.

5 Performance requirements for physical layer

5.1 General

In addition to physical layer requirements in Clause 5, requirements in IEC 61993-2 for physical layer apply for the AIS functionality of the equipment.

5.2 Transmitter requirements

5.2.1 Transmitter test requirements for ASM

The equipment shall comply with the ASM transmitter requirements set in Table 14 on both ASM channels.

Table 14 – Transmitter test requirements specific to ASM

	Condition	Limit Normal	Limit Extreme	Notes
Frequency Error	LID1, ASM1, High Power	+/-250 Hz	+/- 500 Hz	
TX Power	Link ID1, ASM1, High Power	12.5 W rms +/-1.5 dB	12.5 W rms + 2 / -3 dB	
	LID1, ASM1, Low Power	1 W rms +/-1.5 dB		
TX mask (Slotted)	LID1, ASM1, High Power	See Table 17 and Figure 2		
	LID1, ASM1, Low Power	See Table 17 and Figure 2		
TX modulation accuracy (EVM)	LID1, ASM1, High Power	rms: < 10% Peak: <30%		
Slot Timing	LID1, ASM1, High Power	Table 19 and Figure 4		
TX spurious emissions	LID1, ASM1, High Power	9 kHz to 1 GHz: <-36 dBm and 1 GHz to 4 GHz: <-30 dBm		

5.2.2 Transmitter test requirements for VDE-TER

The equipment shall comply with the VDE-TER transmitter requirements set in Table 15.

485

Table 15 – Transmitter test requirements specific to VDE-TER

	Condition	Limit Normal	Limit Extreme	Notes
Frequency Error	LID 11, 157.225 MHz LID 11, 161.875 MHz	+/-250 Hz	+/- 500 Hz	
TX Power	LID 11, 157.225 MHz, High Power LID 11, 161.875 MHz, High Power	12.5 W rms +/-1.5 dB	12.5 W rms +2/-3 dB	Pi4/QPSK
	LID 11, 157.225 MHz, Low Power	1 W rms +/-1.5 dB		
	LID 19, 157.2375 MHz, High Power LID 19, 161.8375 MHz, High Power	6.5 W rms ^a +/-1.5 dB.	6.5 W rms ^a +2/-3 dB	16QAM
	LID 19 161.8375 MHz, Low Power	1 W rms +/-1.5 dB		
TX mask (Slotted)	LID 11, 157.225 MHz, High Power LID 11, 161.875 MHz, High Power LID 11, 157.225 MHz, Low Power LID 19, 157.2375 MHz, High Power LID 19, 161.8375 MHz, High Power LID 19 161.8375 MHz, Low Power	See Table 18 and Figure 3		
TX modulation accuracy (EVM)	LID 11, 157.225 MHz, High Power LID 11, 161.875 MHz, High Power	rms: < 10% Peak: <30%		
	LID 19, 157.2375 MHz, High Power LID 19, 161.8375 MHz, High Power	rms:< 4%, Peak: <10%		
Slot Timing	LID 11, 157.225 MHz, High Power LID 11, 161.875 MHz, High Power LID 19, 157.2375 MHz, High Power LID 19, 161.8375 MHz, High Power	See Figure 4 and Table 19		
TX spurious emissions	LID 11, 157.225 MHz, High Power LID 11, 161.875 MHz, High Power	9 kHz to 1 GHz: < -36 dBm and 1 GHz to 4 GHz: < -30 dBm		

	LID 19, 157.2375 MHz, High Power LID 19, 161.8375 MHz, High Power			
^a 6.5 W rms is minimum nominal value. Equipment may specify up to 12.5 W rms nominal power.				

486

487 **5.2.3 Transmitter test requirements for VDE-SAT**

488 The equipment shall comply with the VDE-SAT transmitter requirements set in Table 16.

489 **Table 16 – Transmitter test requirements specific to VDE-SAT**

	Condition	Limit Normal	Limit Extreme	Notes
Frequency Error	LID 20, 157.2125 MHz LID 21, 161.9125 MHz	+/-250 Hz	+/- 500 Hz	
TX Power	LID 20, 157.2125 MHz High Power LID 20, 161.9125 MHz High Power	12.5 W rms +/-1.5 dB	12.5 W rms +2/-3 dB	
	LID 20, 157.2125 MHz Low Power	1 W rms +/-1.5 dB		
	LID 21, 157.2125 MHz High Power	11 W rms ^a +/-1.5 dB	11 W rms ^a +2/-3 dB	
	LID 22, 161.9125 MHz High Power	11 W rms ^a +/-1.5 dB	11 W rms ^a +2/-3 dB	
	LID 24, 157.2125 MHz High Power LID 24, 161.9125 MHz High Power	6 W rms ^a +/-1.5 dB	6 W rms ^a +2/-3 dB	
TX mask (Slotted)	LID 20, 157.2125 MHz High Power LID 20, 161.9125 MHz High Power LID 20, 157.2125 MHz Low Power LID 20, 161.9125 MHz Low Power LID 21, 157.2125 MHz High Power LID 22, 161.9125 MHz High Power LID 24, 157.2125 MHz High Power LID 24, 161.9125 MHz High Power	See Table 18 and Figure 3		
TX modulation accuracy	Link ID 20, 157.2125 MHz Link ID 20, 161.9125 MHz	TBD		

(method TBD)				
TX modulation accuracy (EVM)				
	LID 21, 157.2125 MHz	rms: < 10% Peak: <30%		
	LID 22, 161.9125 MHz	rms: < 10% Peak: <30%		
	LID 24, 157.2125 MHz LID 24, 161.9125 MHz	rms: < 4% Peak: <10%		
Slot Timing	LID 20, 157.2125 MHz LID 20, 161.9125 MHz LID 21, 157.2125 MHz LID 22, 161.9125 MHz LID 24, 157.2125 MHz LID 24, 161.9125 MHz	See Figure 4 and Table 20		
TX spurious emissions	LID 20, 157.2125 MHz LID 20, 161.9125 MHz LID 21, 157.2125 MHz LID 22, 161.9125 MHz LID 24, 157.2125 MHz LID 24, 161.9125 MHz	9 kHz to 1 GHz: < -36 dBm and 1 GHz to 4 GHz: < -30 dBm		
^a Stated power level is minimum nominal value. Equipment may specify up to 12.5 W rms nominal power.				

5.2.4 Slotted transmission spectrum mask

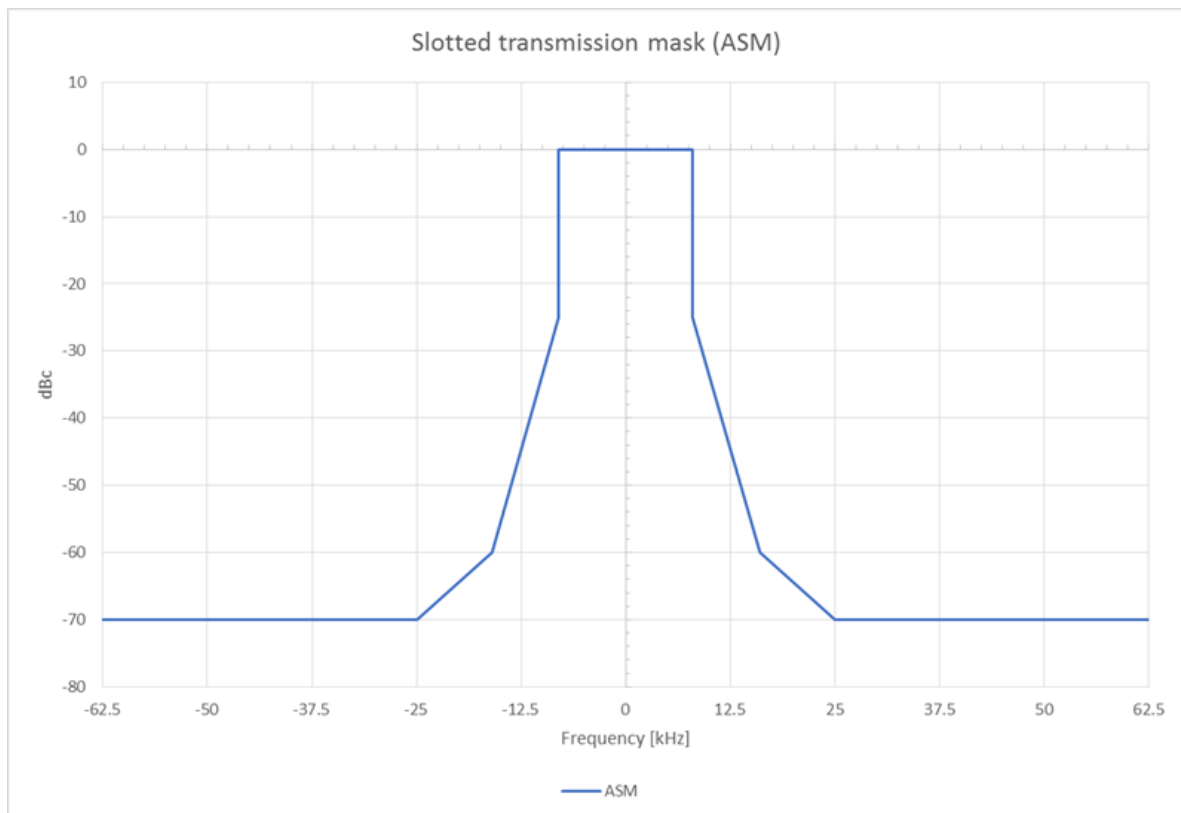
The equipment shall comply with the slotted transmission spectrum mask as detailed in Table 17, Table 18, Figure 2, and Figure 3.

493

Table 17 – Slotted transmission spectrum for ASM channels

Parameter	Requirements
Slotted modulation mask	$\Delta f_c < \pm 8 \text{ kHz}$: 0 dBc ^a $\pm 8 \text{ kHz} < \Delta f_c < \pm 16 \text{ kHz}$: below the straight line between -25 dBc at $\pm 8 \text{ kHz}$ and -60 dBc at $\pm 16 \text{ kHz}$ $\pm 16 \text{ kHz} < \Delta f_c < \pm 25 \text{ kHz}$: below the straight line between -60 dBc at $\pm 16 \text{ kHz}$ and -70 dBc ^b at $\pm 25 \text{ kHz}$ $\pm 25 \text{ kHz} < \Delta f_c < \pm 62,5 \text{ kHz}$: -70 dBc ^b
	NOTES: ^a : 0 dBc is rms power, P_{ref} . ^b : For low power mode -70 dBc or -36 dBm, whichever is the highest.

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Figure 2 – Slotted transmission spectrum for ASM channels

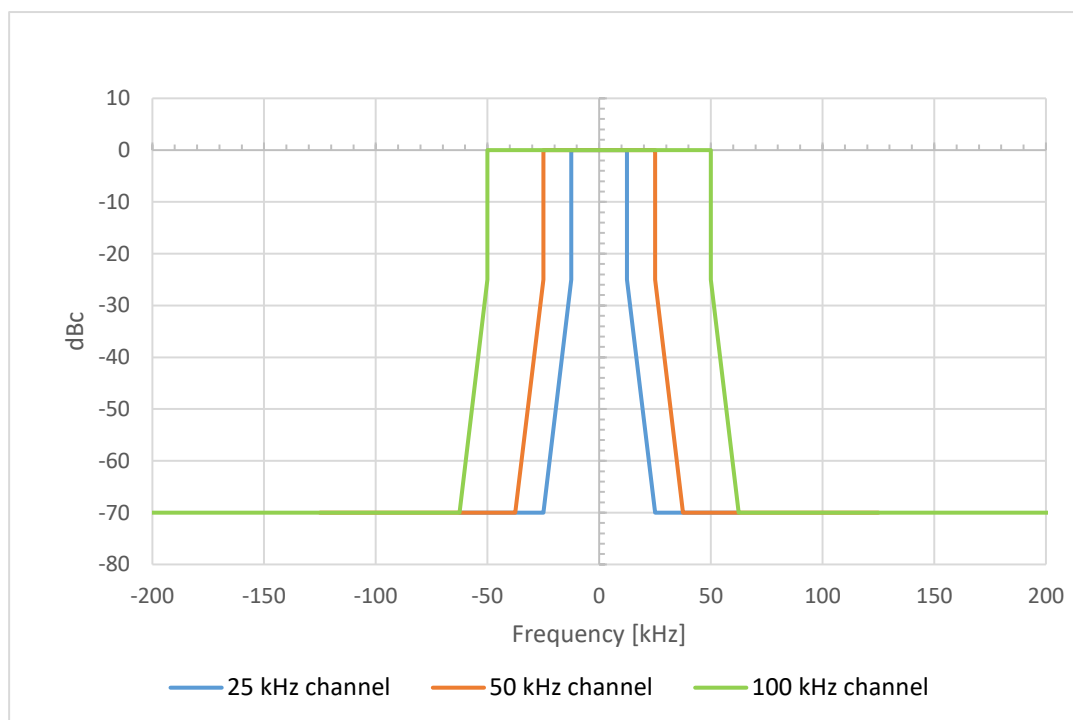
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Table 18 – Slotted Transmit Spectrum for VDE-TER and VDE-SAT

Parameter	Requirements
Slotted modulation mask for 25 kHz channel	$\Delta f_c < \pm 12.5 \text{ kHz}$: 0 dBc ^a $\pm 12.5 \text{ kHz} < \Delta f_c < \pm 25 \text{ kHz}$: below the straight line between -25 dBc at $\pm 12.5 \text{ kHz}$ and -70 dBc ^d at $\pm 25 \text{ kHz}$ $\pm 25 \text{ kHz} < \Delta f_c < \pm 62.5 \text{ kHz}$: -70 dBc ^d
Slotted modulation mask for 50 kHz channel ^b	$\Delta f_c < \pm 25 \text{ kHz}$: 0 dBc $\pm 25 \text{ kHz} < \Delta f_c < \pm 37.5 \text{ kHz}$: below the straight line between -25 dBc at $\pm 25 \text{ kHz}$ and -70 dBc ^d at $\pm 37.5 \text{ kHz}$

	$\pm 37.5 \text{ kHz} < \Delta f_c < \pm 125 \text{ kHz}$: -70 dBc ^d
Slotted modulation mask for 100 kHz channel ^c	$\Delta f_c < \pm 50 \text{ kHz}$: 0 dBc $\pm 50 \text{ kHz} < \Delta f_c < \pm 62.5 \text{ kHz}$: below the straight line between -25 dBc at $\pm 50 \text{ kHz}$ and -70 dBc ^d at $\pm 62.5 \text{ kHz}$ $\pm 62.5 \text{ kHz} < \Delta f_c < \pm 250 \text{ kHz}$: -70 dBc ^d
a: 0 dBc is average (rms) power, P_{ref}. b: used on VDE-SAT uplink only c: used on VDE-TER only d: For low power mode -70 dBc or -36 dBm, whichever is the highest.	

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Figure 3 – Slotted Transmit Spectrum for VDE-TER and VDE-SAT

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5.2.5 Transmit slot timing

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Requirements on transmitter power versus time characteristics are given in Table 19 and Table 20. The blue line in Figure 4 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 ($T_B \dots T_E$) extends through all transmission slots.

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Table 19 – Transmitter power versus time characteristics for VDE-ASM and VDE-TER single slot transmission

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Reference	Time (ms)	Definition
T_0	0	Start of transmission slot Power should < -50 dB of P_{ss} before T_0
Ramp up	0 to 0,416	Power should not exceed +1.5 dB of P_{ss}

T_B	0,416	P_{ss} = rms power measured between T_B and T_E . No limit is defined between T_B and T_E due to the high PAPR.
T_E	25,417	
Ramp down	25,417 to 25,833	Power should not exceed +1.5 dB of P_{ss}
T_G	25,833 to 26,667	Power should be < –50 dB of P_{ss} and stay below this for the remainder of the transmission slot

Table 20 – Transmitter power versus time characteristics for VDE-SAT

Reference	Time(ms)			Definition
	LID20	LID21	LID22, 23, 24	
T_0	0			Start of transmission slot Power should < –50 dB of P_{ss} before T_0
Ramp up	0 to 0,416			Power should not exceed +1.5 dB of P_{ss}
T_B	0,416			P_{ss} = rms power measured between T_B and T_E . No limit is defined between T_B and T_E due to the high PAPR.
T_E	124,70 2	18,244	71,577	
Ramp down	124,70 2 to 125,11 9	18,244 to 18,661	71,577 to 71,994	Power should not exceed +1,5 dB of P_{ss}
T_G	125,11 9 to 133,33 3	18,661 to 26,667	71,994 to 80	Power should be < –50 dB of P_{ss} and stay below this for the remainder of the transmission slot

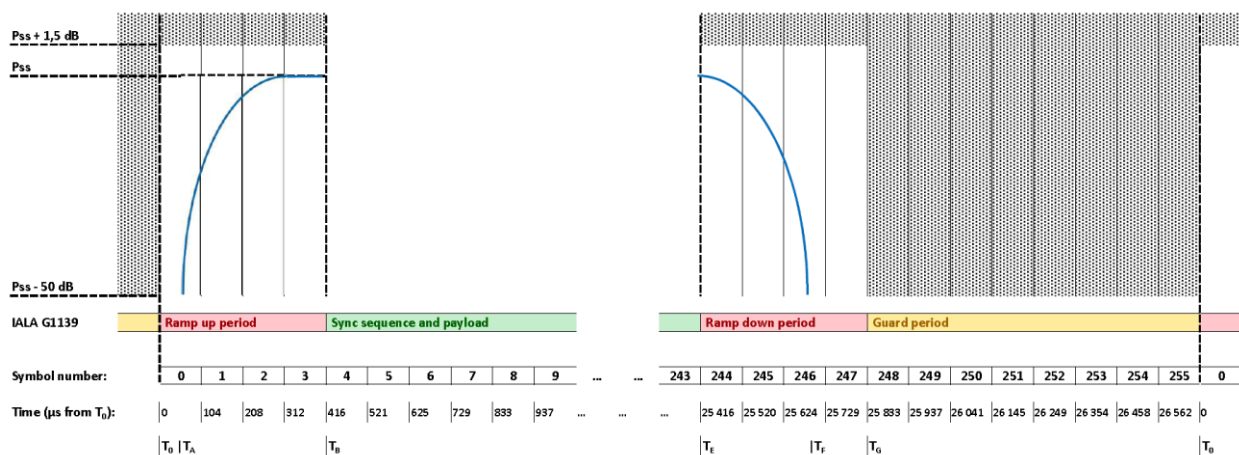


Figure 4 – Transmitter power versus time characteristics

Note: Symbol values shown in Figure 4 are based on LinkID 1 and 5.

5.3 Receiver requirements

The equipment shall support the following [8] concurrent receiver processes

- 1) AIS 1
- 2) AIS 2
- 3) ASM 1
- 4) ASM 2
- 5) VDE-TER Lower leg
- 6) VDE-TER Upper leg
- 7) VDE-SAT Lower leg
- 8) VDE-SAT Upper leg

Detailed receiver requirements are specified in Table 21, Table 22 and Table 23.

5.3.1 Receiver test requirements for ASM

The equipment shall comply with the ASM receiver requirements as detailed in Table 21.

Table 21 – Receiver test requirements specific to ASM

Parameter	Condition	Wanted Signal	Interferer Signals	Limit Normal	Limit Extreme
Sensitivity	LID1, ASM1 LID5, ASM1 LID1, ASM1+250Hz LID1, ASM1-250Hz	-107 dBm		<20% PER	-104 dBm
High Level	LID1, ASM1	-7 dBm (peak)		<1% PER	Not tested
Co-Channel	LID1, ASM1 LID1, ASM1+250Hz LID1, ASM1-250Hz LID5, ASM1	-104 dBm	PRBS @ -117 dBm	<20% PER	Not tested
Adjacent Channel Rejection	LID1, ASM1 LID1, ASM2 LID5, ASM1 LID5, ASM2	-104 dBm	FM 400Hz sine with 2,4kHz deviation @ -34 dBm	<20% PER	Not tested
RX spurious Responses	LID1, ASM1	-104 dBm	VHF Analog Voice @ -34 dBm	<20% PER	Not tested
Intermodulation	LID1, ASM1	-101 dBm	-500 kHz Unmodulated @ -30 dBm -1 MHz VHF Analog Voice @ -30 dBm	<20% PER	Not tested
Blocking	LID1, ASM1	-101 dBm	-5.725 MHz Unmodulated @ -15 dBm	<20% PER	Not tested

NOTE: Spurious emissions testing is covered by AIS testing.

5.3.2 Receiver test requirements for VDE-TER

The equipment shall comply with the VDE-TER receiver test requirements as detailed in Table 22.

Table 22 – Receiver requirements specific to VDE-TER

Parameter	Condition	Wanted Signal	Interferer Signals	Limit Normal	Limit Extreme
Sensitivity	LID 11, 157,19975 MHz (157,200 MHz – 250 Hz) LID 11, 161,87525 MHz (161.875 MHz + 250 Hz)	-111 dBm		<1%PER	-108 dBm
	LID 19, 157,23725 MHz (157,2375 MHz – 250 Hz) LID 19, 161,83775 MHz (161,8375 MHz + 250 Hz)	-102 dBm		<1% PER	-99 dBm
High Level	LID 11, 157.200 MHz LID 19, 161.8375 MHz	-7 dBm (peak)		<1% PER	Not tested
Co-Channel	LID 11, 157.200 MHz LID 11, 161.875 MHz	-108 dBm	PRBS @ -121 dBm. At +- 250Hz	<20% PER	Not tested
	LID 19, 157.2375 MHz LID 19, 161.8375 MHz	-99 dBm	PRBS @ -112 dBm At +- 250Hz		
Adjacent Channel Rejection	LID 11, 157.200 MHz LID 11, 161.875 MHz	-108 dBm	VHF Analog Voice @ -38 dBm	<20% PER	Not tested
	LID 19, 157.2375 MHz LID 19, 161.8375 MHz	-99 dBm	VHF Analog Voice @ -29 dBm	<20% PER	Not tested
Spurious Responses	LID 11, 157.200 MHz	-108 dBm	VHF Analog Voice @ -38 dBm	<20% PER	Not tested

	LID 11, 161.875 MHz				
Intermodulation	LID 11, 157.200 MHz	-105 dBm	+500 kHz Unmodulated @ -34 dBm +1 MHz VHF Analog Voice @ -34 dBm	<20% PER	Not tested
	LID 11, 161.875 MHz	-105 dBm	-500kHz Unmodulated @ -34 dBm -1MHz VHF Analog Voice @ -34 dBm	<20% PER	Not tested
Blocking	LID 11, 157.200 MHz	-105 dBm	+5.725 MHz Unmodulated @ -19 dBm	<20% PER	Not tested
	LID 11, 161.875 MHz	-105 dBm	-5.725 MHz Unmodulated @ -19 dBm	<20% PER	Not tested
NOTE: Spurious emissions testing is covered by AIS testing.					

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537 **5.3.3 Receiver test requirements for VDE-SAT**

538 The equipment shall comply with the VDE-SAT receiver requirements as detailed in Table 23.

539 **Table 23 – Receiver test requirements specific to VDE-SAT**

Parameter	Condition	Wanted Signal	Interferer Signals	Limit Normal	Limit Extreme
Sensitivity	LID26, 157.2085 (157.2125 MHz-4kHz)	[-107] dBm	N/A	<20% PER	Not tested
	LID26, 161.9165 (161.9125 MHz+4 kHz)				
	LID32, 157.2085 (157.2125 MHz-4kHz)	-119 dBm	N/A	<20% PER	-116 dBm
	LID32, 161.9165 (161.9125 MHz+4 kHz)				
	LID33, 157.2085 (157.2125 MHz-4kHz)	-112 dBm	N/A	<20% PER	Not tested
	LID33, 161.9165 (161.9125 MHz+4 kHz)				
	LID29, 157,2585 MHz (157,2625 MHz - 4kHz)	-101 dBm	N/A	<20% PER	Not tested
	LID29, 161,8665 MHz				



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	(161,8625 MHz +4kHz)				
Co-Channel	LID26, 157.2125 MHz	20% PER for TBD dB	PRBS	<20% PER	Not tested
	LID32, 157.2125 MHz	20% PER for TBD dB	PRBS	<20% PER	Not tested
	LID32, 161.9125 MHz	20% PER for TBD dB	PRBS	<20% PER	Not tested
	LID33, 161.9125 MHz	20% PER for TBD dB	PRBS	<20% PER	Not tested
Adjacent Channel Rejection	LID26, 157.2125 MHz	-104 dBm	VHF Analog Voice @ [-34] dBm [-49] dBm [-49] dBm [-42] dBm	<20% PER	Not tested
	LID32, 157.2125 MHz	-119 dBm			
	LID32, 161.9125 MHz	-119 dBm			
	LID33, 161.9125 MHz	-112 dBm			
Intermodulation	LID26, 157.2125 MHz	TBD dB	+500 kHz Unmodulated @ [-34] dBm +1 MHz VHF Analog Voice @ [-34] dBm -500kHz Unmodulated @ -34 dBm -1MHz VHF Analog Voice @ -34 dBm	<20% PER	Not tested
	LID32, 157.2125 MHz	[72] dB			
	LID33, 157.2125 MHz	[68] dB			
	LID26, 161.9125 MHz	TBD dB			
	LID32, 161.9125 MHz	[72] dB			
	LID33, 161.9125 MHz	[68] dB			
Blocking	LID26, 157.2125 MHz		Level above wanted signal:	<20% PER	Not tested
	LID32, 157.2125 MHz		[78] dB		
	LID33, 157.2125 MHz		[89] dB		
	LID26, 161.9125 MHz		[83] dB		
	LID32, 161.9125 MHz		[78] dB		
	LID33, 161.9125 MHz		[89] dB		
			[83] dB		