

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Maritime navigation and radiocommunication equipment and systems –
Automatic identification system (AIS) –
Part 2: AIS AtoN Stations – Operational and performance requirements, methods
of testing and required test results**

**Matériels et systèmes de navigation et de radiocommunication maritimes –
Système d'identification automatique (AIS) –
Partie 2: Stations d'aides à la navigation AIS – Exigences opérationnelles et de
fonctionnement, méthodes d'essai et résultats d'essai exigés**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2016 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 21 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 21 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Maritime navigation and radiocommunication equipment and systems –
Automatic identification system (AIS) –
Part 2: AIS AtoN Stations – Operational and performance requirements,
methods of testing and required test results**

**Matériels et systèmes de navigation et de radiocommunication maritimes –
Système d'identification automatique (AIS) –
Partie 2: Stations d'aides à la navigation AIS – Exigences opérationnelles et de
fonctionnement, méthodes d'essai et résultats d'essai exigés**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 47.020.70

ISBN 978-2-8322-5229-1

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	8
1 Scope.....	10
2 Normative references	10
3 Terms, definitions and abbreviations	11
3.1 Terms and definitions.....	11
3.2 Abbreviated terms.....	11
4 Description	12
4.1 Types of AIS AtoN stations	12
4.2 Type 1 AIS AtoN station.....	15
4.2.1 Characteristics.....	15
4.2.2 Capability	17
4.2.3 Alternatives	17
4.3 Type 2 AIS AtoN station.....	18
4.3.1 Characteristics.....	18
4.3.2 Capability	18
4.3.3 Control receiver	18
4.3.4 Alternatives	18
4.4 Type 3 AIS AtoN Station	19
4.4.1 Characteristics.....	19
4.4.2 Capability	19
4.4.3 AIS receiver (AIS Rx)	19
4.4.4 Alternatives	19
4.5 Optional direct configuration via VDL (types 2 and 3).....	20
4.6 Optional configuration via VDL using chaining (type 3).....	20
5 Requirements for AIS AtoN stations.....	23
5.1 Physical layer	23
5.1.1 Transmitter requirements.....	23
5.1.2 Receiver requirements.....	25
5.1.3 Power consumption	26
5.1.4 Environmental requirements	26
5.2 Link layer	26
5.2.1 General	26
5.2.2 AIS Messages	27
5.2.3 Synchronisation.....	27
5.2.4 VDL access schemes.....	28
5.2.5 Autonomous mode.....	30
5.2.6 Electronic position fix system.....	31
5.2.7 Built-in integrity test.....	32
5.3 Configuration method.....	33
5.3.1 General	33
5.3.2 Alternative for types 1, 2 and 3	33
5.3.3 Chaining of AIS AtoN stations.....	36
5.4 Repeat broadcast of active AIS-SART message.....	36
5.5 Other requirements	36
5.5.1 Additional features.....	36
5.5.2 Manufacturer's information	36

5.5.3	Marking and identification	37
5.5.4	Additional connection points	37
6	Tests of AIS AtoN stations	37
6.1	General	37
6.2	Test conditions	37
6.2.1	Normal test conditions	37
6.2.2	Extreme test conditions	37
6.2.3	Standard test environment	38
6.2.4	Test signals	38
6.2.5	Arrangements for test signals applied to the receiver input	39
6.2.6	Encoder for receiver measurements	40
6.2.7	Waiver for receivers	40
6.2.8	Impedance	40
6.2.9	Artificial antenna (dummy load)	40
6.2.10	Facilities for access	40
6.2.11	Modes of operation of the transmitter	40
6.2.12	Measurement uncertainties	40
7	RF tests	41
7.1	TDMA transmitter	41
7.1.1	General	41
7.1.2	Frequency error	41
7.1.3	Carrier power	42
7.1.4	Modulation spectrum slotted transmission	42
7.1.5	Transmitter test sequence and modulation accuracy	43
7.1.6	Transmitter output power versus time function (FATDMA and RATDMA)	45
7.2	TDMA receivers (types 2 and 3)	46
7.2.1	Sensitivity	46
7.2.2	Error behaviour at high input levels	47
7.2.3	Co-channel rejection	47
7.2.4	Adjacent channel selectivity	48
7.2.5	Spurious response rejection	49
7.2.6	Inter-modulation response rejection	52
7.2.7	Blocking or desensitization	53
7.3	Conducted spurious emissions at the antenna	54
7.3.1	Spurious emissions from the receiver	54
7.3.2	Spurious emissions from the transmitter	54
8	Functional tests	55
8.1	Configuration method	55
8.1.1	General	55
8.1.2	Configuration for Message 21	55
8.1.3	Schedule mode A FATDMA Message 21 (single report, alternating channel operation)	56
8.1.4	Schedule mode B FATDMA Message 21 (dual report, dual channel operation)	57
8.1.5	Schedule mode C FATDMA Message 21 (single report, single channel operation)	57
8.1.6	Schedule mode A RATDMA Message 21 (Type 3) (single report, alternating channel operation)	58
8.1.7	Schedule mode B RATDMA Message 21 (Type 3) (dual report, dual channel operation)	59

8.1.8	Schedule mode C RATDMA Message 21 (type 3) (single channel operation)	59
8.1.9	Scheduled transmission of Message 6	60
8.1.10	Scheduled transmission of Message 8	61
8.1.11	Scheduled transmission of Message 12	61
8.1.12	Scheduled transmission of Message 14	61
8.1.13	Unscheduled transmission	62
8.2	Synchronisation accuracy	62
8.2.1	Implemented synchronisation modes and synchronisation error	62
8.2.2	Synchronisation test without UTC (types 2 and 3)	63
8.3	EPFS	64
8.3.1	Position source	64
8.3.2	Invalid position	64
8.3.3	Off-position monitor	64
8.4	Receive addressed message (types 2 and 3)	65
8.4.1	Purpose	65
8.4.2	Method of measurement	65
8.4.3	Required results	65
8.5	Interrogation response (Type 3)	65
8.5.1	Purpose	65
8.5.2	Method of measurement	65
8.5.3	Required results	66
8.6	Repeat AIS-SART messages	66
8.6.1	Purpose	66
8.6.2	Method of measurement	66
8.6.3	Required results	66
8.7	Additional functionality as implemented by the manufacturer.....	66
8.7.1	Test for configuration of the receiver turn-on times (types 2 and 3).....	66
8.7.2	Test for configuration of payload transmission	67
8.7.3	Test for forced broadcast.....	68
8.7.4	Test for version information	68
8.7.5	Test for DCR – AtoN function ID capability	69
8.7.6	Test for assigning an encryption key for VDL configuration	69
8.7.7	Test for VDL configuration using chaining (Type 3).....	70
8.8	BIIT.....	75
8.8.1	Purpose	75
8.8.2	Method of measurement	75
8.8.3	Required results	75
8.9	Transmitter shutdown procedure	75
8.9.1	Purpose	75
8.9.2	Method of measurement	75
8.9.3	Required results	75
8.10	Power supply	75
8.10.1	Purpose	75
8.10.2	Method of measurement	76
8.10.3	Required results	76
8.11	Environmental.....	76
8.12	External removable media.....	76
8.12.1	Purpose.....	76

8.12.2	Method of measurement	76
8.12.3	Required results	76
8.13	Other tests	76
8.13.1	Quality assurance.....	76
8.13.2	Additional features.....	76
8.13.3	Manual	77
8.13.4	Marking and identification	77
8.14	Optional TAG block encapsulation	77
8.14.1	Application.....	77
8.14.2	TAG block capabilities	77
8.14.3	Activation of source-identification for output	77
8.14.4	Activation of Destination-identification	78
8.14.5	Activation of Source-identification for input.....	79
8.14.6	Use of multiple source-identifications for input.....	80
8.14.7	Test of grouping by TAG blocks for output.....	81
8.14.8	Test of UNIX time output	82
8.14.9	Test of line-count output	82
Annex A (informative)	AIS AtoN station configuration structures	84
A.1	AIS AtoN station configuration structures	84
A.2	MMSI Identification configuration command (AID)	87
A.3	Extended/general AtoN station configuration command (ACF/ACG)	89
A.4	Configure broadcast rates for AtoN Station message command (CBR).....	94
A.5	Configuration of encryption key (CEK)	97
A.6	Configure the receiver turn-on times (ARW).....	98
A.7	Proprietary AtoN control command (MCR).....	99
A.8	Configuration of message payload for broadcast (MEB)	101
A.9	Forced broadcast command (AFB).....	101
A.10	Version information (VER)	102
A.11	AtoN function ID capability	104
A.12	Query via the VDL for Message 21 content	105
A.13	General query request	106
A.14	Configuration of receiver operational times command (COP)	107
A.15	Configuration of message payload for broadcast (MEB)	108
A.16	Query response via the VDL for Message 21 configuration	110
Annex B (normative)	Message 21 – AtoN status bits	113
Bibliography	114
Figure 1	– Functional block diagram of a Type 1 AIS AtoN Station.....	16
Figure 2	– Functional block diagram of a type 2 AIS AtoN station	18
Figure 3	– Functional block diagram of a type 3 AIS AtoN station	19
Figure 4	– VDL configuration decision tree.....	22
Figure 5	– Power versus time mask	29
Figure 6	– Reporting modes for Message 21	31
Figure 7	– Block diagram of AIS AtoN test setup.....	38
Figure 8	– Format for repeating four-packet cluster.....	39
Figure 9	– Measurement arrangement for frequency error.....	41
Figure 10	– Measurement arrangement for carrier power	42

Figure 11 – Emission mask.....	43
Figure 12 – Measurement arrangement for modulation accuracy.....	44
Figure 13 – Measurement arrangement for sensitivity	46
Figure 14 – Measurement arrangement for error behaviour.....	47
Figure 15 – Measurement arrangement for co-channel rejection	48
Figure 16 – Measurement arrangement for adjacent channel selectivity.....	49
Figure 17 – PER/BER or SINAD measuring equipment	50
Figure 18 – Measurement arrangement for inter-modulation	52
Figure 19 – Measurement arrangement for blocking or desensitisation	53
Figure 20 – Test scenario for basic chaining test	70
Figure 21 – Test scenario for linear chaining test.....	72
Figure 22 – Test scenario for forked chaining test.....	73
Figure B.1 – Use of AtoN status bits as IALA A-126 Page ID 7	113
Table 1 – Description of AIS AtoN stations.....	13
Table 2 – Use of VDL messages	14
Table 3 – Summary of optional Type 1 AIS AtoN Station messages	17
Table 4 – Summary of optional Type 3 AIS AtoN Station messages	20
Table 5 – Configuration of AIS AtoN stations via VDL	23
Table 6 – Required parameter settings for an AIS AtoN Station	24
Table 7 – Required settings of physical layer constants	24
Table 8 – Modulation parameters of the physical layer of the AIS AtoN station	24
Table 9 – Minimum required TDMA transmitter characteristics	25
Table 10 – Required receiver characteristics	26
Table 11 – Maximum allowed time error.....	27
Table 12 – Definitions of timing for Figure 5.....	30
Table 13 – AIS AtoN Station reaction to BIIT conditions.....	33
Table 14 – Standard sentences.....	34
Table 15 – DCR Capabilities	35
Table 16 – Optional TAG Block functions	36
Table 17 – Content of first two packets	39
Table 18 – Fixed PRS data derived from ITU-T O.153.....	39
Table 19 – Maximum values of absolute measurement uncertainties.....	41
Table 20 – Peak frequency deviation versus time.....	45
Table 21 – Definition of timings.....	45
Table 22 – Frequencies for inter-modulation test	53
Table A.1 – Parameter setting in Message 25 for AIS AtoN Station applications	84
Table A.2 – Parameter setting in Message 6 for AIS AtoN Station applications	85
Table A.3 – Message 25 or 6 function identifier used for configuration and query via the VDL	86
Table A.4 – Configuration via the VDL for MMSI identification.....	88
Table A.5 – Query via the VDL for MMSI identification	88
Table A.6 – Query response via the VDL for MMSI identification.....	89

Table A.7 – Configuration via the VDL, Part 1	90
Table A.8 – Configuration via the VDL, Part 2	90
Table A.9 – Configuration via the VDL, Part 3	91
Table A.10 – Configuration via the VDL, Part 4 (first 12 characters of AtoN name).....	91
Table A.11 – Configuration via the VDL, Part 5 (second 12 characters of AtoN name)	92
Table A.12 – Configuration via the VDL, Part 6 (third (last) 10 characters of AtoN name)	92
Table A.13 – Query request via the VDL	92
Table A.14 – Query response via the VDL, Part 1	93
Table A.15 – Query response via the VDL, Part 2	94
Table A.16 – Configuration via the VDL for FATDMA	95
Table A.17 – Configuration via the VDL for RATDMA/CSTDMA.....	96
Table A.18 – Query request via the VDL for AtoN broadcast rates	96
Table A.19 – Query response via the VDL with AtoN broadcast rates.....	97
Table A.20 – Configuration via the VDL of encryption key	98
Table A.21 – Configuration via the VDL for receiver turn-on times	98
Table A.22 – Query request via the VDL for receiver turn-on times	99
Table A.23 – Query response via the VDL for receiver turn-on times.....	99
Table A.24 – Configuration via the VDL for proprietary information	100
Table A.25 – Query request via the VDL for proprietary information	100
Table A.26 – Query response via the VDL for proprietary information	100
Table A.27 – Configuration or function via the VDL of message payload	101
Table A.28 – Function via the VDL for forced broadcast.....	102
Table A.29 – Query request via the VDL for VER	103
Table A.30 – Query response via the VDL for VER	104
Table A.31 – Query request via the VDL for function ID	104
Table A.32 – Query response via the VDL for function ID.....	105
Table A.33 – Query request via the VDL for Message 21 content.....	106
Table A.34 – Query response via the VDL for Message 21 content	106
Table A.35 – General query request via the VDL	107
Table A.36 – Configuration via the VDL for COP	108
Table A.37 – Payload control configuration via the VDL	109
Table A.38 – Payload binary data via the VDL	110
Table A.39 – Query response via the VDL, Message 21 configuration.....	111
Table A.40 – Query response via the VDL, first 12 characters of AtoN name	111
Table A.41 – Query response via the VDL, second 12 characters of AtoN name	112
Table A.42 – Query response via the VDL, last 10 characters of AtoN name.....	112
Table B.1 – AtoN status pages.....	113

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – AUTOMATIC IDENTIFICATION SYSTEM (AIS) –

Part 2: AIS AtoN Stations – Operational and performance requirements, methods of testing and required test results

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62320-2 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

This second edition cancels and replaces the first edition, published in 2008, and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- additional cyber security measures;
- updated description of configuration via VDL;
- updated VDL access scheme requirements;
- new PI sentences and VDL message structures with added description for optional TAG blocks;

- added requirement for at least one standard method for configuration using Standard PI sentences;
- updated test methods and updated Annexes.

This bilingual version (2018-01) corresponds to the monolingual English version, published in 2016-10.

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

FDIS	Report on voting
80/817/FDIS	80/822/RVD

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

The French version of this standard has not been voted upon.

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

A list of all parts in the IEC 62320 series, published under the general title *Maritime navigation and radiocommunication equipment and systems – Automatic identification system (AIS)*, can be found on the IEC website.

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

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

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

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – AUTOMATIC IDENTIFICATION SYSTEM (AIS) –

Part 2: AIS AtoN Stations – Operational and performance requirements, methods of testing and required test results

1 Scope

This part of IEC 62320 specifies the operational and performance requirements, methods of testing and required test results for AIS AtoN Stations compatible with the performance standards adopted by IMO Resolution MSC.74(69), Annex 3, Universal AIS. It incorporates the technical characteristics of non-shipborne AIS AtoN equipment, included in Recommendation ITU-R M.1371 and IALA Recommendation A-126. Where applicable, it also takes into account the ITU Radio Regulations. This standard takes into account other associated IEC International Standards and existing national standards, as applicable.

This document is applicable for automatic identification system (AIS) installations on aids to navigation (AtoN).

2 Normative references

The following referenced documents are indispensable for the application 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, *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 62287-1, *Maritime navigation and radiocommunication equipment and systems – Class B shipborne equipment of the automatic identification system (AIS) – Part 1: Carrier-sense time division multiple access (CSTDMA) techniques*

IEC 62320-3:2015, *Maritime navigation and radiocommunication equipment and systems – Automatic identification systems (AIS) – Part 3: Repeater station – Minimum operational and performance requirements – Methods of test and required test results*

ITU Radio Regulations, Appendix 18, *Table of transmitting frequencies in the VHF maritime mobile band*

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

IALA Recommendation A-126, *The Use of Automatic Identification System (AIS) in Marine Aids to Navigation*