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**Navigations- und Funkkommunikationsgeräte und -systeme für die Seeschifffahrt –
Automatische Identifikationssysteme (AIS) –
Teil 2: AIS-AtoN-Stationen – Mindest-Betriebs- und
-Leistungsanforderungen, Prüfverfahren und geforderte Prüfergebnisse
(IEC 62320-2:2008);
Englische Fassung EN 62320-2:2008**

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 (IEC 62320-2:2008);
English version EN 62320-2:2008

Equipements et systèmes de navigation et de radiocommunication maritimes –
Systèmes d'identification automatique (AIS) –
Partie 2: Stations AIS AtoN – Exigences minimales opérationnelles et de performance,
méthodes de mesure et résultats de test minimum attendus (CEI 62320-2:2008);
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Nationales Vorwort

Vorausgegangener Norm-Entwurf: E DIN EN 62320-2:2007-05.

Für diese Norm ist das nationale Arbeitsgremium K 738 „Elektronische Navigationsinstrumente“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (www.dke.de) zuständig.

Die enthaltene IEC-Publikation wurde vom TC 80 „Maritime navigation and radiocommunication equipment and systems“ erarbeitet.

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Der Zusammenhang der zitierten Normen mit den entsprechenden Deutschen Normen ergibt sich, soweit ein Zusammenhang besteht, grundsätzlich über die Nummer der entsprechenden IEC-Publikation. Beispiel: IEC 60068 ist als Europäische Norm EN 60068 durch CENELEC übernommen und als DIN EN 60068 ins Deutsche Normenwerk aufgenommen.

**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
(IEC 62320-2:2008)**

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-Leistungsanforderungen, Prüfverfahren und
geforderte Prüfergebnisse
(IEC 62320-2:2008)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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Foreword

The text of document 80/507/FDIS, future edition 1 of IEC 62320-2, prepared by IEC TC 80, Maritime navigation and radiocommunication equipment and systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62320-2 on 2008-04-01.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
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- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2011-04-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62320-2:2008 was approved by CENELEC as a European Standard without any modification.

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

IEC 60950	NOTE Harmonized in EN 60950 series (modified).
IEC 61993-2	NOTE Harmonized as EN 61993-2:2002 (not modified).

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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 Res. 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 standard 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 61108-1, *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS) – Part 1: Global positioning system (GPS) – Receiver equipment – Performance standards, methods of testing and required test results*

IEC 61108-2, *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS) – Part 2: Global navigation satellite system (GLONASS) – Receiver equipment – Performance standards, methods of testing and required test results*

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

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

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*

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

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

ITU-T Recommendation O.153, *Basic parameters for the measurement of error performance at bit rates below the primary rate*

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

3 Terms, definitions and abbreviations

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

3.1 Definitions

3.1.1

Aids to Navigation (AtoN)

device or system external to vessels that is designed and operated to enhance the safe and efficient navigation of vessels and/or vessel traffic

3.1.2

Message 21

AtoN report transmitted on the VHF data link by an AIS station

3.1.3

Real AIS AtoN

AIS AtoN station which is physically located on the AtoN

3.1.4

Synthetic AIS AtoN

Message 21 transmitted from an AIS station located remotely from the AtoN

3.1.5

Virtual AIS AtoN

Message 21 transmitted from an AIS station for an AtoN which does not physically exist

3.2 Abbreviations

AES	Advanced Encryption Standard
AIS	Automatic Identification System
BIIT	Built-in Integrity Tests
BT	Bandwidth Time Product
CSTDMA	Carrier Sense Time Division Multiple Access
DGNSS	Differential Global Navigation Satellite System
EPFS	Electronic Position Fixing System
EUT	Equipment Under Test
FATDMA	Fixed Access Time Division Multiple Access
GNSS	Global Navigation Satellite System
IMO	International Maritime Organisation
MAC	Medium Access Control
MMSI	Maritime Mobile Service Identity
NRZI	Non-Return to Zero Inverted
PER	Packet Error Rate
PI	Presentation Interface
RAIM	Receiver Autonomous Integrity Monitoring
RATDMA	Random Access Time Division Multiple Access
RF	Radio Frequency
Rx	Receive
SBAS	Satellite-Based Augmentation System
SOTDMA	Self Organizing Time Division Multiple Access
TDMA	Time Division Multiple Access
Tx	Transmit

UTC Universal Time Co-ordinated
VDL VHF Data Link
VSWR Voltage Standing Wave Ratio

NOTE Abbreviations related to IEC 61162 series are not included in the above list. For their meaning refer to that International Standard.

4 Description

4.1 Types of AIS AtoN Stations

There are three types of AIS AtoN Stations as defined in Table 1. The AIS AtoN Stations may optionally include additional capabilities as defined in the "Alternatives" column.

Table 1 – Description of AIS AtoN Stations

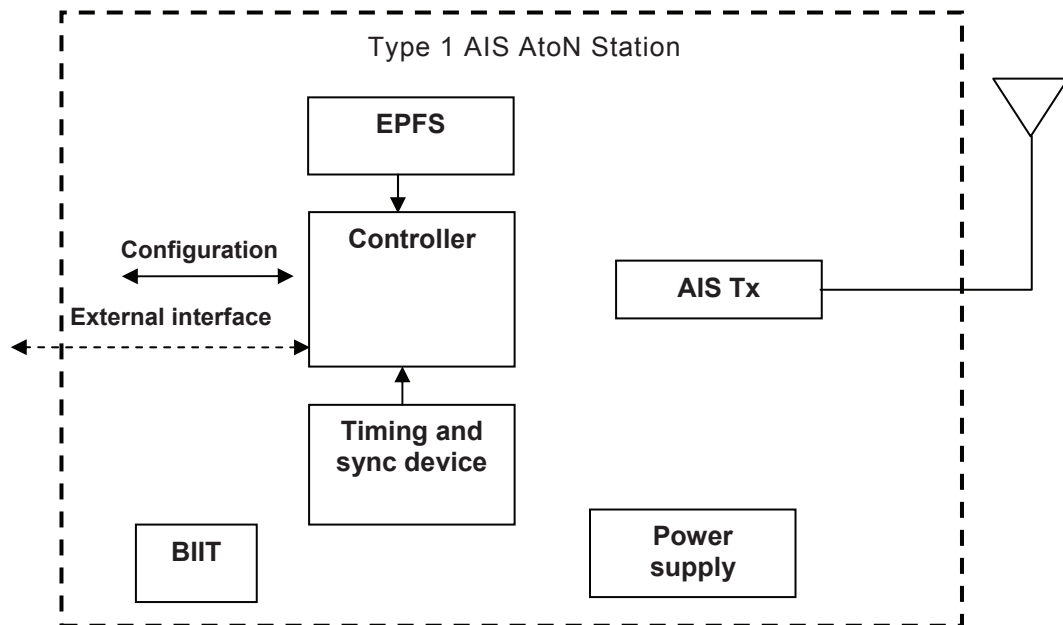
Requirements	Type 1 AIS AtoN Station	Type 2 AIS AtoN Station	Type 3 AIS AtoN Station	Alternatives
VDL receiver	No receiver	Receiver for control functions only	Two receiving processes for autonomous mode	
Transmitted messages	21			21 plus one or more of 6, 8, 12, 14, 25 and other appropriate messages (Types 1, 2 and 3) plus 7, 13 (Type 3 only)
Access mode for Message 21	FATDMA			FATDMA and RATDMA (Type 3 only)
Access Mode for messages other than 21, if implemented				FATDMA (Types 1 and 2) One or more of FATDMA, RATDMA or CSTDMA (Type 3)
Configuration / communication method	Defined by manufacturer			Defined by the manufacturer with standard sentences (Types 1, 2 and 3)

Table 1 (continued)

Requirements	Type 1 AIS AtoN Station	Type 2 AIS AtoN Station	Type 3 AIS AtoN Station	Alternatives
Physical communication interface	None			The electrical and physical characteristics shall be defined by the manufacturer. (Types 1, 2 and 3)
Transmit power	12,5 W			As defined by the manufacturer (Types 1, 2 and 3)
Transmitter capability	Dual channel			Single channel (Types 1, 2 and 3)
Synthetic and Virtual AtoN	No			Yes (Types 1, 2 and 3)
Positioning device	EPFS and surveyed position			Surveyed position only (no EPFS) (Types 1, 2 and 3)
UTC synchronisation	Direct only			Direct, indirect or semaphore (Type 3)
Assignment	Shall not respond to assignment Messages 16 and 23			
Interrogation	Shall not respond to interrogation Message 15			

4.2 Type 1 AIS AtoN Station

Type 1 AIS AtoN Station has no receiver. It transmits on FATDMA slots given in its configuration. Figure 1 shows the functional block diagram of a Type 1 AIS AtoN Station.



IEC 285/08

Figure 1 – Functional block diagram of a Type 1 AIS AtoN Station

4.2.1 Type 1 AIS AtoN Station characteristics

The characteristics of the Type 1 AIS AtoN Station are:

- transmits using FATDMA;
- no receive capability, therefore:
 - cannot be configured via the VDL,
 - cannot synchronise to other stations;
- configuration interface as defined by the manufacturer;
- 12,5 W transmitter power;
- dual channel transmission.

4.2.1.1 Controller

The controller composes Message 21 and ensures the correct operation of the AIS AtoN Station on the VDL.

4.2.1.2 Timing and synchronisation device

This device provides the time and synchronisation for the controller.

4.2.1.3 Power supply

The power supply generates the internal voltages.

4.2.1.4 BIIT

The Built-in Integrity Tests (BIIT) shall provide integrity monitoring.

4.2.1.5 EPFS

Electronic Position Fixing System (EPFS) provides the current position of the AtoN.

4.2.1.6 Configuration

The interface used to configure the AIS AtoN Station.

4.2.2 Capability

Type 1 AIS AtoN Station is capable of transmitting Message 21 using FATDMA.

4.2.3 Type 1 AIS AtoN Station – Alternatives

4.2.3.1 Additional controller capability

In addition to Message 21, the controller shall compose optional output messages to the VDL using FATDMA as described in Table 2.

Table 2 – Summary of optional Type 1 AIS AtoN Station messages

Msg ID	Message name	Message description	Application examples
6	Binary addressed message	Binary data for addressed communication	Monitoring of AtoN lantern, power supply, etc.
8	Binary broadcast message	Binary data for broadcast communication	Meteorological and hydrological data
12	Addressed safety related message	Safety related data for addressed communication	Warn AtoN malfunctioning
14	Broadcast safety related message	Safety related data for broadcast communication	Warn AtoN malfunctioning
25	Single slot binary message	Binary data for addressed or broadcast communication	Status report

Note The Type 1 AIS AtoN Station should not retransmit the addressed binary message (Messages 6 and 12). The number of retries should be set to 0.

4.2.3.2 Configuration method

The Type 1 AIS AtoN Station may be configured using standard configuration sentences. (IEC 61162-1 and as described in Annex A).

4.2.3.3 No EPFS

When a surveyed position is used, the EPFS may not be required.

4.2.3.4 TDMA transmitter (AIS Tx)

The TDMA transmitter may operate on a single channel.

4.2.3.5 External interface

The external interface(s) may be used for communication with external devices (for example AtoN lantern, AtoN power supply, hydrological and meteorological instruments, etc.).

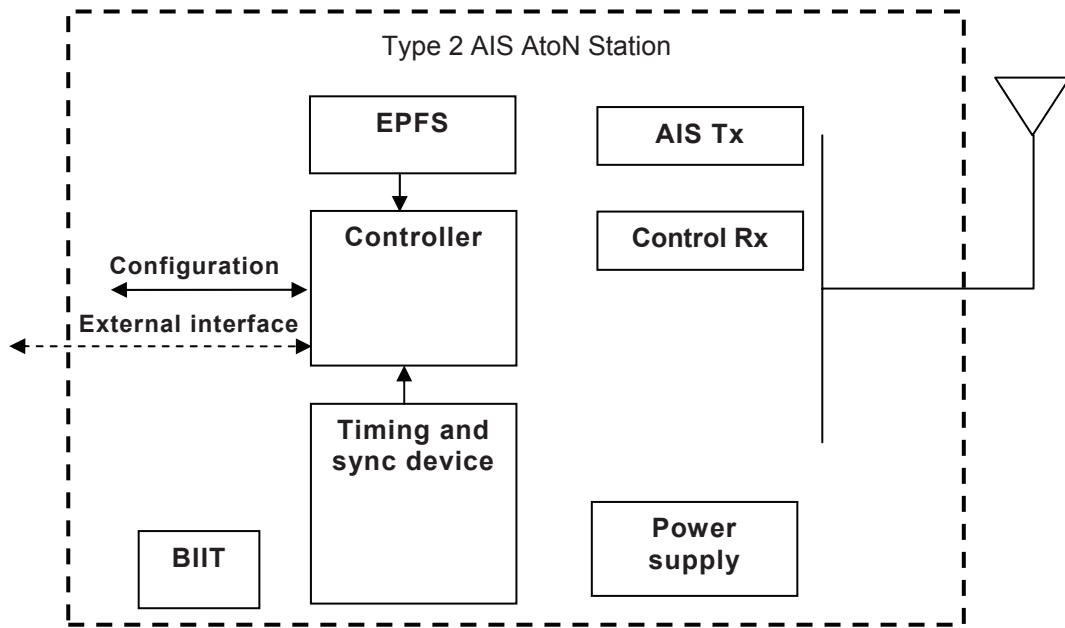
4.2.3.6 Synthetic and Virtual AtoN

The AIS AtoN Station may be capable of transmitting Message 21 for Synthetic and Virtual AIS AtoN.

4.3 Type 2 AIS AtoN Station

Type 2 AIS AtoN Station transmits on FATDMA slots.

Type 2 AIS AtoN Station has a control receiver for messages containing configuration sentences (see Annex B). Figure 2 shows the functional block diagram of a Type 2 AIS AtoN Station.



IEC 286/08

Figure 2 – Functional block diagram of a Type 2 AIS AtoN Station

4.3.1 Type 2 AIS AtoN Station characteristics

The characteristics of the Type 2 AIS AtoN Station are:

- transmits using FATDMA;
- limited receiver capability, therefore cannot maintain a slot map and cannot use RATDMA access scheme;
- configuration interface as defined by the manufacturer;
- 12,5 W transmitter power;
- dual channel transmission.

4.3.2 Capability

A Type 2 AIS AtoN Station has the capabilities of a Type 1 AIS AtoN Station, with the addition of a control receiver.

4.3.3 Control receiver

The Type 2 AIS AtoN Station shall have a receiver operating on an AIS channel for control functions only.

4.3.4 Type 2 AIS AtoN Station – alternatives

The Type 2 AIS AtoN Station alternatives include all the Type 1 AIS AtoN Station alternatives.

4.4 Type 3 AIS AtoN Station

Type 3 AIS AtoN Station has AIS receive and transmit capabilities in accordance with Recommendation ITU-R M.1371. Figure 3 shows the functional block diagram of a Type 3 AIS AtoN Station.

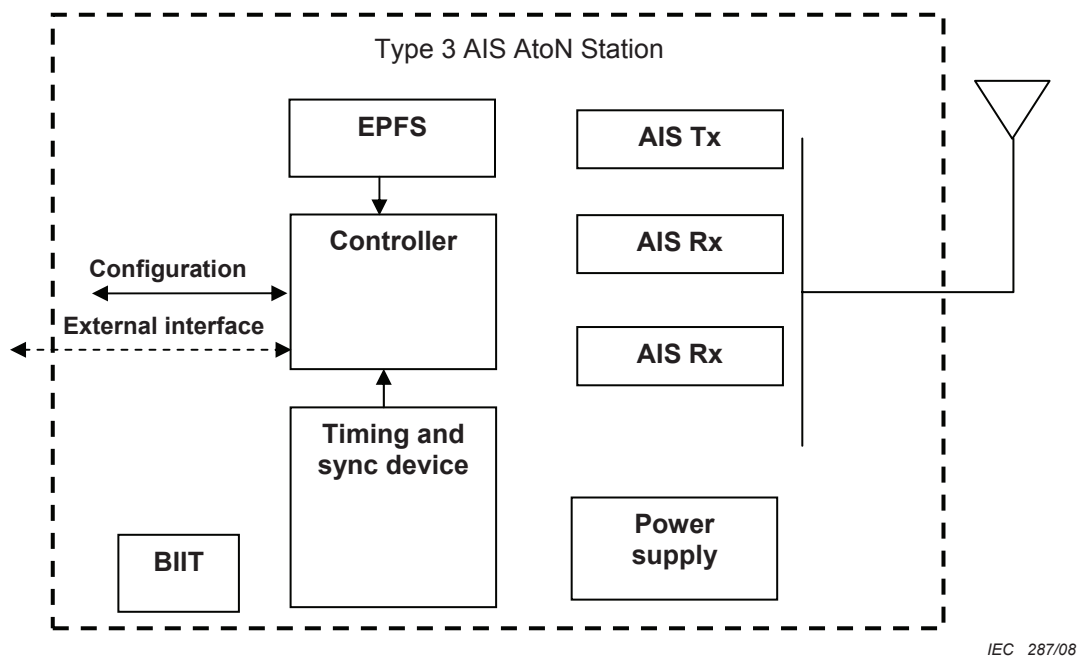


Figure 3 – Functional block diagram of a Type 3 AIS AtoN Station

4.4.1 Type 3 AIS AtoN Station characteristics

The characteristics of the Type 3 AIS AtoN Station are:

- receiving capability on both AIS channels,
- transmits using FATDMA.

4.4.2 Type 3 AIS AtoN Station capability

A Type 3 AIS AtoN Station has the capability of a Type 1 AIS AtoN Station, with the addition of AIS receivers.

4.4.3 AIS receiver (AIS Rx)

The Type 3 AIS AtoN Station shall have two AIS (TDMA) receiving processes to produce and maintain a slot map for autonomous interaction with the VDL.

4.4.4 Type 3 AIS AtoN Station – alternatives

The Type 3 AIS AtoN Station alternatives include all the Type 1 and Type 2 AIS AtoN Station alternatives, with the additions of 4.4.4.1, 4.4.4.2 and 4.4.4.3.

4.4.4.1 Additional controller capability

In addition to Message 21, the controller composes optional output messages to the VDL as described in Table 3.

Table 3 – Summary of optional Type 3 AIS AtoN Station messages

Msg ID	Message name	Message description	Application examples
6	Binary addressed message	Binary data for addressed communication	Monitoring of AtoN equipment
7	Binary acknowledge message	Acknowledge of addressed binary message	
8	Binary broadcast message	Binary data for broadcast communication	Meteorological and hydrological data
12	Addressed safety related message	Safety related data for addressed communication	Warn AtoN malfunctioning
13	Safety related acknowledge message	Acknowledge of addressed safety related message	
14	Broadcast safety related message	Safety related data for broadcast communication	Warn AtoN malfunctioning
25	Single slot binary message	Binary data for addressed or broadcast communication	Status report

4.4.4.2 Access mode

4.4.4.2.1 Message 21

Transmits using FATDMA or RATDMA.

4.4.4.2.2 Messages other than Message 21

For each message other than Message 21, the Type 3 AIS AtoN Station may use FATDMA, CSTDMA or RATDMA.

4.4.4.3 Indirect and semaphore synchronisation

A Type 3 AIS AtoN Station may optionally synchronise to other AIS Stations using UTC indirect synchronisation or other AIS Stations acting as semaphore.

4.5 Optional chaining of AIS AtoN Stations (Types 2 and 3)

A chain of AIS AtoN Stations allows for communication from an AIS Base Station to AIS AtoN Stations that are remotely located and unable to communicate directly with the Base Station. Messages are passed from station to station until the intended recipient is reached.

The concept requires an AIS AtoN Station to have knowledge of other AIS AtoN Stations in the chain, namely its parent and all children below it in the chain. A “parent station” is a station that is in the direction of the Base Station. A “child station” is a station that is directed away from a Base Station. In order to prevent unnecessary retransmission of the messages, each AIS AtoN Station in a chain may have only one parent, but may have multiple children (this includes all Synthetic and Virtual AIS AtoN).

Messages 6 and 25 are used for the transfer of the encrypted binary field. It is assumed that the whole chain has the same encryption key. The source ID and “MMSI of AtoN” fields of Message 6 or 25 are used to determine whether the received message is from a parent or child station. If not, then the received message is ignored.

The encrypted binary data field is decrypted to obtain the function ID and “MMSI of AtoN”. If the source ID of the message is set to the parent station ID and the function ID is a configuration, query request or function, and the MMSI of the AIS AtoN Station is in the chain, then the message shall be retransmitted, with the source ID set to own MMSI. If the source ID of the message is set to the station’s MMSI and the

function ID is a query response, then the message shall be retransmitted, with the "MMSI of AtoN" set to the parent MMSI. Any other combination of known or unknown MMSI is ignored (see Table 4).

The chaining algorithm may be ignored by setting the source ID field to "#####". The AIS AtoN Station shall attempt to decrypt the binary data field, and check that it is the intended recipient of the message before processing the message any further.

Table 4 – Chaining of AIS AtoN Stations

Source ID	Application Identifier	MMSI of AtoN from Encrypted Binary Field	Action by Own Station
Parent	Function ID = query response	Responding AIS AtoN Station	In all cases, if function ID = query response, then ignore
Parent	Function ID = configuration or query request or functional	Intended recipient	If function ID = configuration or query request or functional, then verify intended recipient is in the chain and re-transmit message with source ID set to own station MMSI
Parent	Function ID = configuration or query request or functional	Own station	If function ID = configuration or query request or functional, then verify that the intended recipient is own station and then process
Responding child	Function ID = query response	Own station	In all cases, if function ID = query response, then re-transmit the message with "MMSI of AtoN" set to own station's parent MMSI
Child	Function ID = configuration or query request or functional	Intended recipient	In all cases, if Function ID = configuration or query request or functional, then ignore
"#####"		Own station	Process
"#####"		Other	Ignore
Other		Ignore	Ignore

5 Requirements for AIS AtoN Stations

5.1 Physical layer requirement

5.1.1 Transmitter requirements

5.1.1.1 Channel

The AIS AtoN Station shall operate on dual channels, Channel 1 and Channel 2, in the VHF Maritime Mobile Service band, using 25 kHz bandwidth, according to the ITU Radio Regulations, Appendix 18.

5.1.1.2 Channel alternatives

The Type 1, Type 2 and Type 3 AIS AtoN Stations may transmit on a single channel only, either Channel 1 or Channel 2.

5.1.1.3 Parameter settings

Table 5 and Table 7 are derived from Recommendation ITU-R M.1371 and give the parameters required for an AIS AtoN Station. For the meaning of the symbols and additional information (footnotes) refer to the appropriate section of Recommendation ITU-R M.1371.

Table 5 – Required parameter settings for an AIS AtoN Station

Symbol	Parameter name	Setting (FATDMA, RATDMA)	Setting (CSTDMA)
PH.RFR	Regional frequencies	Two channels between 156,025 MHz and 162,025 MHz	
PH.AIS1	Channel 1 (default Channel 1)	161,975 MHz	
PH.AIS2	Channel 2 (default Channel 2)	162,025 MHz	
PH.BR	Bit rate	9 600 bps	
PH.TS	Training sequence	24 bits	
PH.TST	Transmitter settling time (Transmit power within 20 % of final value. Frequency stable to within $\pm 1,0$ kHz of final value). Tested at manufacturers declared transmit power	$\leq 1,0$ ms	$\leq 313 \mu\text{s}$
	Ramp down time	$\leq 832 \mu\text{s}$	$\leq 313 \mu\text{s}$
	Transmission duration	≤ 80 ms	$\leq 23\,333 \mu\text{s}$
	Transmission delay	No delay	2 083 μs
	Transmitter output power	12,5 W or as defined by manufacturer	

In addition, the constants of the physical layer of the AIS AtoN Station shall comply with the values given in Table 6 and Table 7.

Table 6 – Required settings of physical layer constants

Symbol	Parameter name	Value
PH.DE	Data encoding	NRZI
PH.FEC	Forward error correction	Not used
PH.IL	Interleaving	Not used
PH.BS	Bit scrambling	Not used
PH.MOD	Modulation	Bandwidth adapted GMSK

Table 7 – Modulation parameters of the physical layer of the AIS AtoN Station

Symbol	Name	Value
PH.TXBT	Transmit BT-product	0,4
PH.RXBT	Receive BT-product	0,5
PH.MI	Modulation index	0,5

5.1.1.4 Transmitter shutdown

An automatic transmitter shutdown shall be provided to ensure that transmission does not continue for more than 2 s. This shutdown shall be independent of the operating system software.

5.1.1.5 Transmitter requirements

The technical characteristics as specified in Table 8 should apply to the TDMA transmitter.

Table 8 – Minimum required TDMA transmitter characteristics

Transmitter parameters	Requirements
Carrier power error	$\pm 1,5$ dB (normal), ± 3 dB (extreme)
Carrier frequency error	± 500 Hz (normal), $\pm 1\,000$ Hz (extreme)
Slotted modulation mask	-25 dBc $\Delta f_c < \pm 10$ kHz -60 dBc ± 25 kHz $< \Delta f_c < \pm 62,5$ kHz
Transmitter test sequence and modulation accuracy	$< 3\,400$ Hz for Bit 0, 1 (normal and extreme) $2\,400$ Hz ± 480 Hz for Bits 2, 3 (normal and extreme) $2\,400$ Hz ± 240 Hz for Bits 4... 31 (normal, $2\,400 \pm 480$ Hz extreme) For Bits 32 ... 199 $1\,740 \pm 175$ Hz (normal, $1\,740 \pm 350$ Hz extreme) for a bit pattern of 0101 $2\,400$ Hz ± 240 Hz (normal, $2\,400 \pm 350$ Hz extreme) for a bit pattern of 00001111
Transmitter output power versus time	Power within mask shown in Figure 4 and timings given in Table 11
Spurious emissions	-36 dBm 9 kHz... 1 GHz -30 dBm 1 GHz... 4 GHz

5.1.2 Receiver requirements

The technical characteristics as specified in Table 9 should apply to the TDMA receivers.

Table 9 – Required receiver characteristics

Receiver parameters	Required result (Max PER or absolute level in dBm)	Type 3 (TDMA receiver)		Type 2 (Control receiver)	
		Wanted signal	Unwanted signals	Wanted signals	Unwanted signals
Sensitivity	20 %	-107 dBm normal -104dBm normal at ± 500 Hz offset -101 dBm extreme	-	-97 dBm normal -94 dBm normal at ± 500 Hz offset -91 dBm extreme	-
Error at high input levels	2 % 10 %	-77 dBm -7 dBm	- -	-77 dBm -7 dBm	- -
Co-channel rejection	20 %	-101 dBm	-111 dBm -111 dBm at $\pm 1\,000$ Hz offset	-91 dBm	-107 dBm -107 dBm at $\pm 1\,000$ Hz offset
Adjacent channel selectivity	20 %	-101 dBm	-31 dBm	-91 dBm	-31 dBm
Spurious response rejection	20 %	-101 dBm	-31 dBm	-91 dBm	-31 dBm
Intermodulation response rejection	20 %	-101 dBm	-36 dBm	-91 dBm	-36 dBm
Blocking and desensitisation	20 %	-101dBm	-23 dBm (< 5 MHz) -15 dBm (> 5 MHz)	-91 dBm	-33 dBm (< 5 MHz) - 25 dBm (> 5 MHz)
Spurious emissions	-57 dBm or less (9 kHz-1 GHz) -47dBm or less (1 GHz-4 GHz)	-	-	-	-

5.1.3 Power consumption

The manufacturer shall state the average power consumed by the AIS AtoN Station under defined test conditions.

5.1.4 Environmental requirements

The AIS AtoN Station shall meet the environmental conditions requirements as declared by the manufacturer. These environmental conditions shall be one of

- IEC 60945 "Protected",
- IEC 60945 "Exposed", or
- as defined by manufacturer.

5.2 Link layer requirements

The link layer specifies how data shall be formatted and transmitted on the VDL.

The link layer requirements are referenced to Recommendation ITU-R M.1371.

5.2.1 AIS Messages

5.2.1.1 Message 21 format and content

The AIS AtoN Station shall broadcast Message 21, as defined in Recommendation ITU-R M.1371.

5.2.1.1.1 AtoN status bits

In Message 21, the status bits (7 6 5 4 3 2 1 0) are numbered so that bit 7 is the most significant bit, and bit 0 is the least significant bit. The first three bits (i.e. 7, 6 and 5) shall be used to define a Page ID. The Page ID can range from 0 to 7, allowing 8 pages. Page ID 0 shall not be used for the Regional/International application. Page IDs 1 to 6 are reserved for future use.

Page ID 7 (binary 111) shall be as defined in this standard (see Annex C).

If the regional bits are not used, they shall be set to '0'.

5.2.1.1.2 Virtual and Synthetic AIS AtoN message

An AIS AtoN Station, when broadcasting Message 21 for Virtual and Synthetic AtoN, shall use the MMSIs allocated to the Virtual and Synthetic AtoN as issued under the same series for Real AIS AtoN Stations. For Synthetic AIS AtoN messages, the repeat indicator field shall be set to 1, 2 or 3 to signify that the message is transmitted from a position other than that provided in the message.

5.2.1.2 Additional messages

In addition to Message 21, the AIS AtoN Station may transmit other messages, in accordance with Recommendation ITU-R M.1371. These are summarised in Table 1.

5.2.1.2.1 Types 1 and 2

In addition to Message 21, allowed messages shall be one or more of 6, 8, 12, 14, 25 and other appropriate messages.

5.2.1.2.2 Type 3

In addition to Message 21, allowed messages shall be one or more of 6, 7, 8, 12, 13, 14, 25 and other appropriate messages.

5.2.2 Synchronisation

Synchronisation is used to determine the TDMA frames and individual slots so that the transmission of the AIS Message is performed within the desired slot. The synchronisation for the AtoN AIS Station shall be UTC direct.

If UTC direct synchronisation is lost, the AIS AtoN Station shall cease transmitting or optionally behave as declared by the manufacturer.

5.2.2.1 Optional indirect synchronisation

When UTC synchronisation has failed, the Type 3 AIS AtoN Station may use indirect synchronisation or synchronise to a station acting as a semaphore.

5.2.2.2 Synchronisation accuracy

The transmission timing error, including jitter, of the AtoN AIS shall be within the limits as defined in Table 10, referring to an ideal transmission as defined by Recommendation ITU-R M.1371.

Table 10 – Maximum allowed time error

Synchronisation mode	Maximum allowed time error
UTC direct synchronisation	$\pm 1\text{bit}$ ($\pm 104\ \mu\text{s}$)
UTC indirect synchronisation	$\pm 3\text{bits}$ ($\pm 312\ \mu\text{s}$)
Semaphore synchronisation	$\pm 3\text{ bits}$ ($\pm 312\ \mu\text{s}$)

5.2.3 VDL access schemes

The AIS AtoN Station shall use FATDMA for the transmission of Message 21.

The AIS AtoN Station may optionally transmit Message 6, 7, 8, 12, 13, 14 and 25. The maximum length of Messages 6, 8, 12, and 14 is three slots per message when using FATDMA or RATDMA (if implemented). CSTDMA may be used for one slot messages only.

5.2.3.1 Type 3 AIS AtoN Station

The Type 3 AIS AtoN Station shall use FATDMA and may use RATDMA (if implemented) for Message 21. The Type 3 AIS AtoN Station shall use the VDL access scheme defined by its configuration.

Single slot binary and safety related messages may be transmitted using FATDMA or RATDMA or CSTDMA, if implemented. If an acknowledgement procedure is implemented the manufacturer shall state under which conditions the 4 s requirements are met. Single slot acknowledgement Messages 7 and 13 should be transmitted within 4 s of receiving Messages 6 and 12 using FATDMA, CSTDMA or RATDMA.

5.2.3.2 FATDMA and RATDMA VDL access

The transmitter shall begin transmission by turning on the RF power after slot start (T_0). The unit shall and reach -3 dB before T_{B1} (see Figure 4).

The transmitter shall be turned off after the last bit of the transmission packet has left the transmitting unit; nominal transmission end is T_e .

RATDMA shall use slots according to Recommendation ITU-R M.1371.

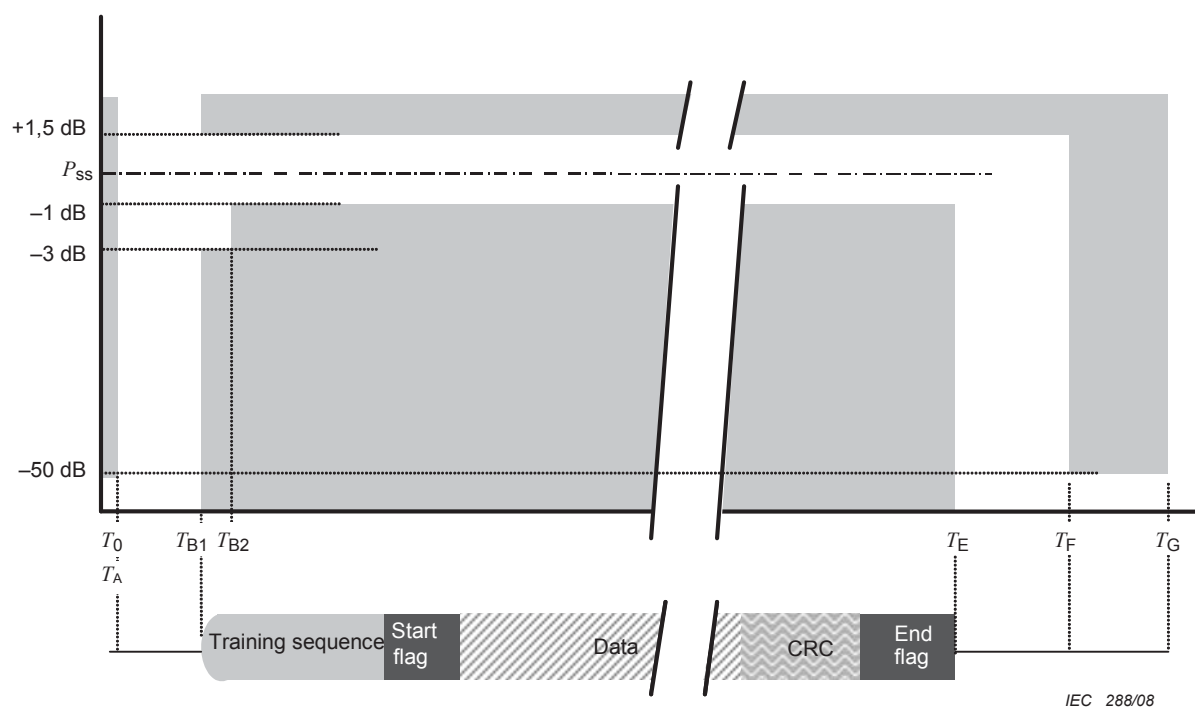


Figure 4 – Power versus time mask

The access to the medium is performed as shown in Figure 4 and Table 11.

Table 11 – Definitions of timing for Figure 4

Reference	Bits	Time in milliseconds	Definition
T_0	0	0	Start of transmission slot. Power shall NOT exceed – 50 dB of P_{ss} before T_0
T_A	0-6	0-0,624	Power exceeds –50 dB of P_{ss}
T_B	T_{B1}	6	Power shall be within + 1,5 dB or –3 dB of P_{ss}
	T_{B2}	8	Power shall be within + 1,5 dB or –1 dB of P_{ss}
T_E	104 - 748	10,833 – 77,917	Power shall remain within + 1,5 dB or –1 dB of P_{ss} during the period T_{B2} to T_E The T_E can vary depending on message type, data content and bit stuffing bits from minimum 104 bits for the shortest possible message (Message 14 and no text content) to maximum length of 740 bits for a three slot message. T_E shall not exceed; • 236 bits for a one slot message • 492 bits for a two slot message • 748 bits for a three slot message A station may occupy at maximum three consecutive slots for one continuous transmission. Only a single application of the overhead (ramp up, training sequence, flags, FCS, buffering) is required for a long transmission packet. The length of a long transmission packet should not be longer than necessary to transfer the data; i.e. the AIS should not add filler.
T_F	112 - 756	11,667 – 78,787	Power shall be – 50 dB of P_{ss} and stay below this
T_G	256, 512 or 768	26,667 one slot TX 53,333 two slot TX 80,000 three slot TX	Start of next transmission time period

5.2.3.2.1 Link sub-layer 1: Medium Access Control (MAC)

Refer to Recommendation ITU-R M.1371 and 5.2.2 for synchronisation.

5.2.3.2.2 Link sub-layer 2: Data Link Service (DLS)

Refer to Recommendation ITU-R M.1371.

5.2.3.2.3 Link sub-layer 3: Link Management Entity (LME)

Refer to Recommendation ITU-R M.1371.

5.2.3.3 CSTDMA VDL access mode

The operation of CSTDMA in the AIS AtoN Station shall be in accordance with Recommendation ITU-R M.1371 and tested according to IEC 62287-1, however the AIS AtoN Station is allowed to use the same transmit power setting for CSTDMA as for RATDMA and FATDMA.

All CSTDMA transmissions shall be limited to one slot.

5.2.4 Autonomous mode

The AIS AtoN Station shall always operate autonomously and determine its own schedule for transmission of its messages based on its configuration. The station shall automatically resolve scheduling conflicts with other stations when using CSTDMA and RATDMA.

5.2.4.1 Message 21 reporting intervals

The reporting interval for Message 21 shall be 3 min by default. This shall be configurable to other reporting intervals.

The AIS AtoN Station shall be configurable to decrease the reporting interval for Message 21 when the AtoN is off-position.

5.2.4.2 Channel operation

The AIS AtoN Station shall use channels as identified in this subclause.

5.2.4.2.1 Reporting modes for Message 21

The AIS AtoN Station shall transmit Message 21 at the configured reporting interval. As indicated in

Figure 5, transmissions shall be:

- **Mode A operation** – Message 21 transmission alternates between Channel 1 and Channel 2 in a subsequent frame that is nominally one reporting interval later. Message 21 content is updated for each message, or
- **Mode B operation** – The same Message 21 transmitted on Channel 1 and Channel 2 in quick (nominally 4 s) succession. The first transmission of each Message 21 may be on either Channel 1 or Channel 2. The second transmission shall be on the other channel, or
- **Mode C operation** – Message 21 transmitted on a single channel, either Channel 1 or Channel 2. Message 21 content updated at each reporting interval.

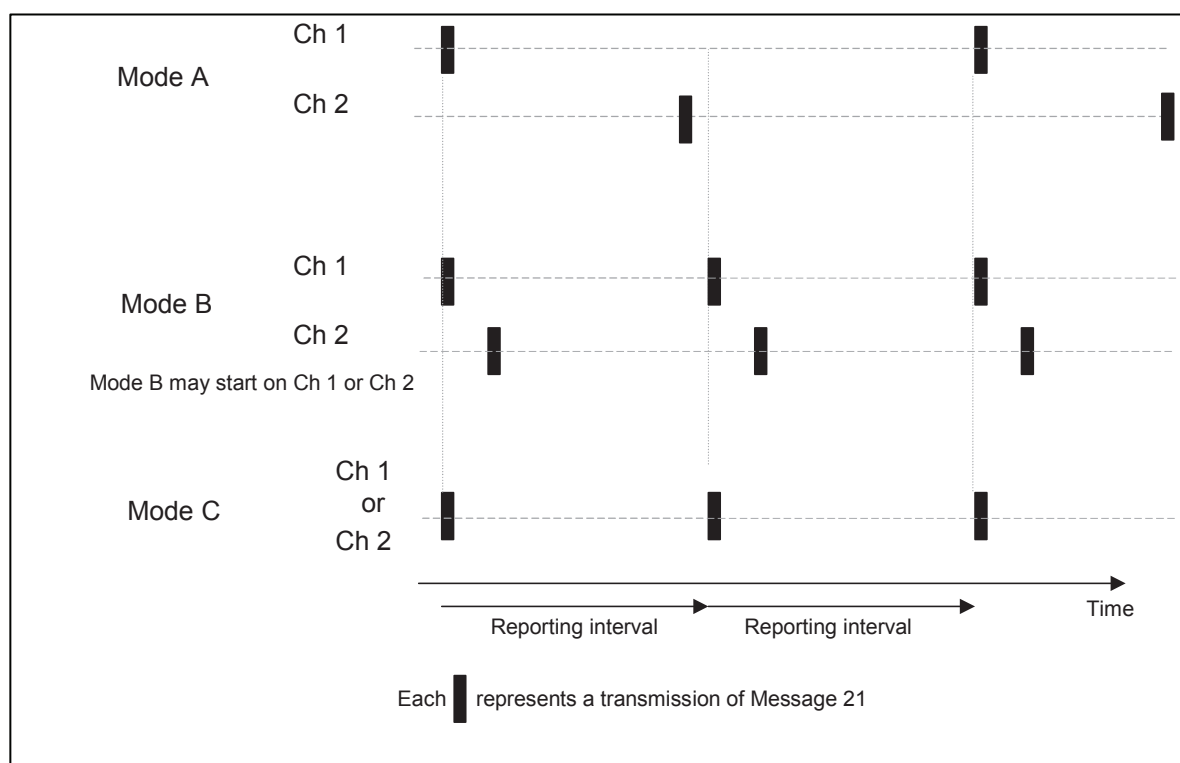


Figure 5 – Reporting modes for Message 21

5.2.4.2.2 Single channel operation for Message 21

The Type 1 and Type 2 AIS AtoN Stations shall transmit on the designated channel using FATDMA slots of the selected frames in the UTC hour (as per mode C, Figure 5).

5.2.5 Electronic position fix system

5.2.5.1 Position source

An EPFS shall be used as the source for AtoN position reporting unless a surveyed position is used.

If the internal EPFS is a GNSS receiver it shall meet the following requirements of IEC 61108 series: position accuracy, acquisition, re-acquisition, receiver sensitivity, RF dynamic range, interference susceptibility, position update, failure warnings, status indications and integrity flag, provide a resolution of one ten-thousandth of a minute of arc and use WGS 84 datum.

If another type of EPFS is used, then it shall meet the requirements of the applicable standard and use WGS 84 datum.

5.2.5.1.1 Augmentation systems

The EPFS may be capable of being corrected using any suitable augmentation system (for example, SBAS, radiobeacon DGNSS, evaluation of Message 17, etc.). The manufacturer shall declare which augmentation systems can be used, and that the augmentation system does not adversely affect Message 21 transmissions.

The manufacturer shall declare if the EPFS is not capable of being corrected.

5.2.5.1.2 Invalid position

If the EPFS device is unable to provide a valid position fix, then the reported position shall be longitude = 181° = not available = default and latitude = 91° = not available = default and the time stamp field shall be set to a value of 63.

5.2.5.1.3 Off-position monitoring

If the floating AtoN is within its on-position limits, the off-position indicator shall be set to "0" in the transmitted Message 21.

If a floating AtoN is off-position, the AIS AtoN Station shall identify this condition and the off-position indicator shall be set to "1" in the transmitted Message 21. The reporting interval when the AIS AtoN Station is off-position shall be determined by its configuration (see 5.2.4.1).

5.2.5.2 Position source alternatives for Types 1, 2 and 3

If a surveyed position is used, an EPFS is not required.

When a surveyed position is used, the latitude and longitude fields of the transmitted Message 21 shall contain the surveyed position, the "type of electronic position fixing device" is set to "7" (surveyed), the "RAIM-Flag" field is set to "0", the off-position indicator field is set to "0" and the "position accuracy" field is set in accordance with the accuracy of the surveyed position (i.e. "1" if better than 10 m, otherwise "0").

5.2.6 Built-in integrity test

The AIS AtoN Station shall have a Built-in Integrity Test (BIIT) process which tests for conditions as described Table 12. If standard configuration sentences are used, the warning / notification conditions shall be sent via sentence ADS. The ADS sentence should be output as defined by the manufacturer.

Table 12 – AIS AtoN Station reaction to BIIT conditions

Condition	Alarm condition threshold exceeded	Alarm condition not exceeded	Reaction of the AIS AtoN Station
AIS: Tx malfunction	A	V	Stop transmission
AIS: Antenna VSWR exceeds limit (only if external interface used)	A	V	Continue operation
AIS: Rx Channel 1 malfunction	A	V	Stop RATDMA and CSTDMA transmissions on affected channel
AIS: Rx Channel 2 malfunction	A	V	Stop RATDMA and CSTDMA transmissions on affected channel
AIS: General failure	A	V	Stop transmission
AIS: EPFS failure	A	V	Continue operation
AIS: Direct synchronisation failure	A	V	As defined by manufacturer
AIS: Synchronisation lost	A	V	As defined by manufacturer
AIS: DGNSS input failed	A	V	Continue operation
A alarm. V valid.			

5.3 Requirements for the configuration method

The configuration method shall be as defined by the manufacturer and held in non-volatile memory.

Configuration may use standard configuration sentences either directly or via the VDL.

The configuration method shall:

- configure the content for Message 21;
- configure transmission parameters for Message 21 and any other messages supported by the manufacturer;
- configure the behaviour of the AIS AtoN Station when synchronisation is lost;
- configure the behaviour of the AIS AtoN Station when off position.

The manufacturer shall provide a means to verify configuration and version information of the AIS AtoN Station.

5.3.1 Alternative for Types 1, 2 and 3

5.3.1.1 Standard IEC 61162 sentences

The standard configuration sentences shall be as defined in the IEC 61162 series.

Table 13 provides an overview of the sentences that may be used for configuration of AIS AtoN applications. It includes existing sentences from IEC 61162 with additional AtoN sentences as provided in Annex A.

Table 13 – Standard sentences

Sentence formatter	Input			Output			Description/comments
	Type 1 AIS AtoN Station	Type 2 AIS AtoN Station	Type 3 AIS AtoN Station	Type 1 AIS AtoN Station	Type 2 AIS AtoN Station	Type 3 AIS AtoN Station	
AAR	X	X	X	Q	Q	Q	Configure broadcast rates for AIS AtoN Station messages
ACE	X	X	X	Q	Q	Q	Extended general AIS AtoN Station configuration
ACF	X	X	X	Q	Q	Q	General AIS AtoN Station configuration
AFB	X	X	X				Force broadcast
AFC				Q	Q	Q	AtoN Station function capability
AID	X	X	X	Q	Q	Q	Configure or change MMSI
AKE		X	X		Q	Q	Define encryption key
ARW		X	X		Q	Q	Receiver turn on times
MCR	X	X	X	Q	Q	Q	Proprietary AtoN control
MPR	X	X	X				Message payload rebroadcast
TSP	X	X	X	Q	Q	Q	Configure prohibited slots
VER				Q	Q	Q	Version
ABM*	X	X	X				Addressed binary message
BBM*	X	X	X				Broadcast binary message
ABK*				X	X	X	Acknowledgement message
VDM*	X	X	X		X	X	VHF data link message
VDO*				X	X	X	VHF data link own-vessel message
* See 61162-1. X indicates input to or output from the AIS AtoN Station. Q indicates that the sentence may be externally requested using the IEC 61162 standard query sentences.							

5.3.1.2 Chaining of AIS AtoN Stations

The AIS AtoN Station may support chaining to communicate messages to other AIS AtoN Stations (see 4.5).

No additional IEC 61162 sentences are required to support this functionality.

5.4 Other requirements

5.4.1 Additional features

Additional features shall not adversely affect the transmission of Message 21.

5.4.2 Manufacturer's information

The information shall describe:

- factory default MMSI;
- external interfaces;
- configuration of the AIS AtoN Station;
- hardware and electrical specifications;
- average power consumption;
- implementation method for firmware upgrades.

5.4.3 Marking and identification

The AIS AtoN Station shall be marked with the following information:

- identification of the manufacturer;
- model identification;
- serial number of the unit, and
- operating voltage.

The title and version of each software element included in the installed software system shall be either marked on the equipment or displayed on command.

6 Tests of AIS AtoN Stations – Method of measurement and required results

6.1 General

Physical test parameters and testing subject to national requirements may override parameters stated below.

6.2 Test conditions

6.2.1 Normal test conditions

6.2.1.1 Temperature and humidity

Temperature and humidity shall be within following ranges:

Temperature +15° C to +35° C

Humidity 20 % to 75 %

6.2.1.2 Power supply

The normal supply power used for the tests shall be in accordance with the nominal power of the EUT declared by the manufacturer and taking into account the variations set by local safety regulations concerning power supplies for example IEC 60950 as applicable in many countries.

6.2.2 Extreme test conditions

Extreme test conditions are as specified in IEC 60945. Where required, tests under extreme test conditions shall be a combination of

- dry heat and the upper limit of supply voltage applied simultaneously, and
- low temperature and the lower limit of supply voltage applied simultaneously.

6.2.3 Standard test environment

The EUT is tested in an environment using test equipment to measure the transmitted messages. The EUT will be configured via the configuration interface prior to the tests. Operation is checked on channels in the maritime mobile band. Refer to Figure 6.