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BSI Standards Publication

Maritime navigation and radiocommunication equipment and systems — Automatic identification system (AIS)

Part 3: Repeater stations — Minimum operational and performance requirements — Methods of test and required test results

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National foreword

This British Standard is the UK implementation of EN 62320-3:2015. It is identical to IEC 62320-3:2015.

The UK participation in its preparation was entrusted to Technical Committee EPL/80, Maritime navigation and radiocommunication equipment and systems.

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

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Matériels et systèmes de navigation et de radiocommunication maritimes - Systèmes d'identification automatique (AIS) - Partie 3: Stations de répéteurs - Exigences de fonctionnement et de performance minimales - Méthodes d'essai et résultats d'essai exigés (IEC 62320-3:2015)

Navigations- und Funkkommunikationsgeräte und -systeme für die Seeschifffahrt - Automatisches Identifikationssystem (AIS) - Teil 3: Repeater Stationen - Mindest-Betriebs- und -Leistungsanforderungen - Prüfverfahren und geforderte Prüfergebnisse (IEC 62320-3:2015)

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Foreword

The text of document 80/744/FDIS, future edition 1 of IEC 62320-3, prepared by IEC/TC 80 "Maritime navigation and radiocommunication equipment and systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62320-3:2015.

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The text of the International Standard IEC 62320-3:2015 was approved by CENELEC as a European Standard without any modification.

IEC 61162-2	NOTE	Harmonized as EN 61162-2.
IEC 61162-450	NOTE	Harmonized as EN 61162-450.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60945	-	Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results	EN 60945	-
IEC 61162-1	-	Maritime navigation and radiocommunication equipment and systems - Digital interfaces -- Part 1: Single talker and multiple listeners	EN 61162-1	-
ITU Radio-Regulations, Appendix 18		Table of transmitting frequencies in the VHF maritime mobile band		-
ITU-R Recommendation M.1084	-	Interim solutions for improved efficiency in the use of the band 156-174 MHz by stations in the maritime mobile service		-
ITU-R Recommendation M.1371	-	Technical characteristics for a universal shipborne automatic identification system using time division multiple access in the VHF maritime mobile band		-
ITU-R Recommendation M.585	-	Assignment and use of identities in the maritime mobile service		-
ITU-R Recommendation O.153	-	O.153 : Basic parameters for the measurement of error performance at bit rates below the primary rate		-

CONTENTS

INTRODUCTION

Chapter V of the 1974 SOLAS Convention requires mandatory carriage of Automatic Identification System (AIS) equipment on all vessels constructed on or after 01 July 2002. Implementation for other types and sizes of SOLAS Convention vessels was required to be completed not later than 31 December 2004.

SOLAS Chapter V, Regulation 19, section 2.4.5 states that AIS shall:

a) provide automatically to appropriate equipped shore stations, other ships and aircraft information, including ship's identity, type, position, course, speed, navigational status and other safety-related information;

b) receive automatically such information from similarly fitted ships;

c) monitor and track ships; and

d) exchange data with shore-based facilities.

In addition, the IMO Performance Standards for AIS states that:

- The AIS should improve the safety of navigation by assisting in the efficient navigation of ships, protection of the environment, and operation of Vessel Traffic Services (VTS), by satisfying the following functional requirements:
  1) in a ship-to-ship mode for collision avoidance;
  2) as a means for littoral States to obtain information about a ship and its cargo; and
  3) as a VTS tool, i. e. ship-to-shore (traffic management).
- The AIS should be capable of providing to ships and to competent authorities, information from the ship, automatically and with the required accuracy and frequency, to facilitate accurate tracking. Transmission of the data should be with the minimum involvement of ship's personnel and with a high level of availability.

The provision of Shore Based AIS will be necessary to attain the full benefit of the SOLAS Convention requirements.

This standard provides the minimum operational and performance requirements, methods of test and the required test results for AIS repeater stations. The testing is divided into two parts, the logical tests and the transceiver tests. These are captured in Clause 6 and Clause 8 respectively.

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

Part 3: Repeater stations – Minimum operational and performance requirements – Methods of test and required test results

1 Scope

This part of IEC 62320 specifies the minimum operational and performance requirements, methods of testing and required test results for AIS repeater 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, fixed station AIS equipment, included in Recommendation ITU-R M.1371 and IALA Recommendation A-124. 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 AIS repeater stations. It does not include specifications for the display of AIS data on shore.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 61162-1, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners*

ITU-R Recommendation M.585, *Assignment and use of identities in the maritime mobile service*

ITU-R Recommendation M.1084, *Interim solutions for improved efficiency in the use of the band 156-174 MHz by stations in the maritime mobile service*

ITU-R Recommendation M.1371, *Technical characteristics for a universal shipborne 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*

ITU Radio Regulations, Appendix 18

3 Symbols and abbreviations

AES	Advanced Encryption Standard
AIS	Automatic Identification System
AtoN	Aids To Navigation
BER	Bit Error Rate
BFO	Beat frequency oscillator
BIIT	Built-In Integrity Tests
BT	Bandwidth Time product
COG	Course Over Ground
CS	Carrier Sense
CSTDMA	Carrier Sense Time Division Multiple Access
DAC	Digital Area Code
dBc	Decibel-carrier
dBm	Decibel-milliwatts
EUT	Equipment under test
FATDMA	Fixed Access Time Division Multiple Access
FI	Function Identifier
FIFO	First in, first out
GNSS	Global Navigation Satellite System
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ITDMA	Incremental Time Division Multiple Access
IMO	International Maritime Organization
ITU	International Telecommunication Union
kn	Knots
MMSI	Maritime Mobile Service Identity
NavStatus	Navigational Status
NM	Nautical Mile
NRZI	Non-Return to Zero Inverted
PER	Packet Error Rate
Pc	Carrier Power
PI	Presentation Interface
PPS	Pulse(s) Per Second
RATDMA	Random Access Time Division Multiple Access
RSSI	Received Signal Strength Indication
Rx	Receive
AIS-SART	Search And Rescue Transmitter
SO	Self-Organizing
SOG	Speed Over Ground
SOTDMA	Self-Organizing Time Division Multiple Access
TDMA	Time Division Multiple Access
Tx	Transmit
UTC	Coordinated Universal Time

VCO	Voltage controlled oscillator
VDL	VHF Data Link
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio
VTS	Vessel Traffic Services

4 Functional requirements for a repeater station

4.1 General

4.1.1 Types of repeater stations

AIS repeater stations are designed to retransmit VDL messages in one or several steps to extend the receiving range in areas with impaired VHF coverage. Careful consideration needs to be taken not to overload the VDL with repeated messages, considering the additional load repeated messages generate. The AIS environment may also contain one or more repeaters.

A repeater station is a store and forward repeater process.

A repeater station is a non-controlling station on the VDL.

The repeater station can be one of two types.

Type 1:

- Radio requirements as per the AIS base station requirements
- A dedicated repeater station is a Type 1 device

Type 2:

- Radio requirements as per the AIS AtoN station requirements
- Restricted repeater capability
- Suitable for areas with low AIS activity only

These two types of repeater functions can be implemented in three different ways:

- As a dedicated repeater station (Type 1)
- As an internal process of an AIS Base Station (Type 1)
- As an internal process of an AIS AtoN device (Type 2)

4.1.2 Repeating operation

(See 6.2.1)

4.1.2.1 Modes of repeating operation

The repeater station is designed for independent operation in autonomous and assigned mode. No polled mode is allowed.

4.1.2.2 Message by message repeating

Each received message that shall be repeated is internally allocated for transmission using RATDMA, ITDMA, or FATDMA as supported and configured.

4.1.2.3 Message rescheduling

This mode is only applicable for scheduled position reports.

Received messages shall be analysed and the repeater station shall reschedule transmissions using an ITDMA schedule.

The repeater station may reschedule repeated messages using a reporting interval different from the original interval, depending on configuration.

4.1.3 Synchronisation

(See 6.2.4)

The repeater station shall primarily use an internal source for UTC direct synchronisation.

The repeater station can synchronise on any AIS station that has direct UTC (otherwise known as UTC indirect). The repeater station shall have UTC direct, or UTC indirect and only transmit when sync state is 0 or 1.

4.1.4 Access to the VDL

4.1.4.1 Means of access

Access to the VDL can be by using pre-configured transmission slots. Pre-configured transmission slots shall in this case be reserved by Message 20 from a base station.

If pre-configured slots are not available, RATDMA may be used for transmission.

A repeater station shall use as a minimum RATDMA, ITDMA and FATDMA to allocate and pre-announce transmissions.

The repeater station needs to take into account all received Message 20s. It shall respect slot reservations. If a base station reserves slots for the repeater station, the repeater station shall be configured to use FATDMA.

CSTDMA is not suitable for repeater stations and not permitted because of:

- slot start delay;
- no protection from collision with Class B CS units;
- only one slot messages;
- intentional slot reuse is not allowed.

4.1.4.2 RATDMA and FATDMA access scheme

(See 6.3.1, 6.3.2)

The repeater station shall not change the data content of the message, but shall change the SOTDMA communication state or ITDMA if relevant. The repeater station shall change the SOTDMA communication state as indicated in Table 1.

Table 1 – SOTDMA communication state of received station

Received parameter	Transmit parameters
Synch state	Change to Synch State of repeater station
Slot time out	Set to zero
Slot offset	Set to zero

The repeater station shall change the ITDMA communication state as indicated in Table 2.

Table 2 – ITDMA Communication state of received station

Received parameter	Transmit parameters
Synch state	Change to synch state of repeater
Slot increment	Set to zero
Number of slots	Set to zero
Keep flag	Set to FALSE (= 0)

4.1.4.3 ITDMA access scheme

(See 6.3.3)

The repeater station shall not change the data content of the message, but shall change the SOTDMA communication state or ITDMA as relevant. The repeater station shall change the SOTDMA or ITDMA communication state to an ITDMA communication state as described in Table 2. When using ITDMA to reschedule refer to Table 3.

If ITDMA is used and the repeater station receives a Message 1 that shall be repeated, the repeater station shall change the message ID from 1 to 3 to all ITDMA access scheme.

Table 3 – ITDMA communication state of received station with rescheduling

Received parameter	Transmit parameters
Synch state	Change to synch state of repeater station
Slot increment	Offset set to next transmission slot
Number of slots	As required for next repeated message
Keep flag	Set to FALSE (= 0)

ITDMA can be used to schedule transmissions that originate from different stations.

When using ITDMA reservations, the selection interval shall be 150 slots. Set the ITDMA communication state at time of transmission to the next scheduled transmission.

4.1.5 Configuration

(See 6.1.3)

Initial configuration shall be possible using the presentation interface of the repeater station as defined in Annex A.

The repeater station may use VDL Messages for configuration and status reports as defined in Clause A.3.

4.2 Functional block diagram of an AIS repeater station

Figure 1 shows the principal components of the AIS repeater station.

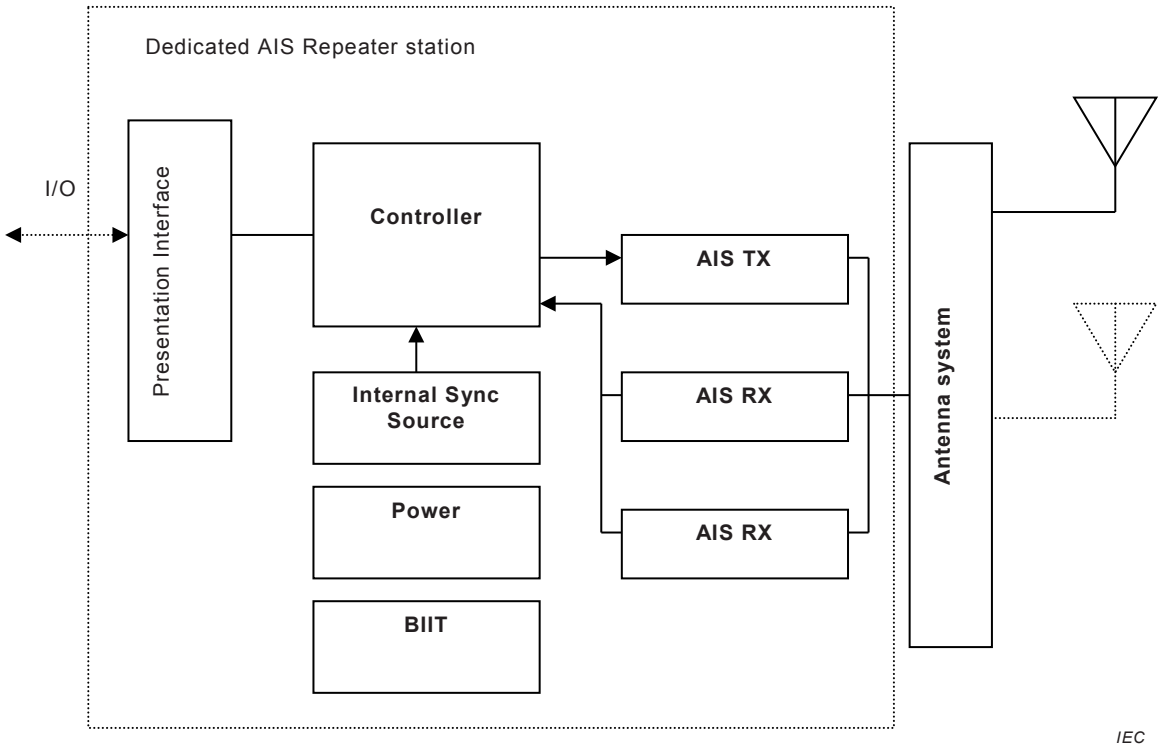


Figure 1 – Functional block diagram of an AIS repeater station

As a minimum, the following functional elements are required for the AIS repeater station:

- two multi-channel receiving processes;
- one multi-channel TDMA transmitter;

NOTE Since the minimum configuration of the repeater station has only one transmitter, the repeater station cannot transmit on both AIS Channels (AIS A and AIS B) simultaneously.

- a controlling unit, which includes a unique identifier to the repeater station;
- an internal synchronisation source capable of providing UTC;
- a Built-In-Integrity-Test unit (BIIT), which shall provide alarms;
- a power supply;
- an interface with data format conforming to IEC 61162-1. The physical interface will be determined by the manufacturer. The interface shall output VDO sentences for all transmitted messages, and VDM sentences for all received messages. Additionally, the repeater station shall be configurable using the PI. The repeater station shall be configurable for repeater enable via the VDL, and may optionally be configurable for all parameters via the VDL.

4.3 Repeating rules

4.3.1 General repeating rules

(See 6.2.1, 6.4.5)

The repeater station is a store-and-forward process and shall use the FIFO principle.

Retransmission of messages shall be performed as soon as possible, according to configuration, after receiving the relevant messages which are required to be retransmitted.

The maximum delay of the retransmission shall be within 9 s of reception in order to ensure one minute interval UTC time stamp in a position report that has undergone multiple

repetitions. If RATDMA is used to transmit a message, the received message can be held for maximum 4 s and 10 slots.

With the exception of AIS-SART position reports, messages containing a time stamp older than 30 s shall not be repeated.

The repeater station shall be capable of retransmission of a message within 10 slots of reception of that received message.

Received position messages (Message 1, 2, 3 or 18) shall replace queued messages from the same MMSI (within a reasonable time limit to already scheduled transmission of the same MMSI. Updating a queued message shall not take longer than 2 slots.

Retransmission (repeat) shall be performed on the same channel in which the original message was received by the repeater station.

4.3.2 Repeater station use of repeat indicator

(See 6.2.3)

4.3.2.1 Repeat indicator value

Each time a received message is processed by the repeater station, the repeat indicator value shall, at least, be incremented by one (+1) before retransmitting the message.

If the received repeat indicator equals 3, the relevant message shall not be retransmitted.

4.3.2.2 Message repetition process

A message is repeated based on the repeat indicator if the repeat indicator is less than the “Max repeated RI” configuration value.

The repeat indicator of retransmitted message can be updated using two different methods.

a) Increment repeat indicator by one (+1), to a maximum value of three.
b) Set repeat indicator to the value defined by the “RI increment setting” configuration parameter.

4.3.2.3 Configuration of repetition process

There are three parameters to configure the repetition process:

- incoming repeat indicator value limit;
- set if above value is the maximum number of repeats or a value for exact match;
- increment rule. Set to either increase repeat indicator by one (+1), or replace repeat indicator with 3.

All repeater stations within coverage of one another should be set to the same number of repeats, in order to ensure that “Binary acknowledgement” Message 7 and “Safety related acknowledgement” Message 13 are delivered to the originating station.

4.3.3 Duplicate message filtering

(See 6.5.1)

The same message shall be repeated only once within 30 s, by the same repeater station using the filtering parameters of Table 4. To make sure this is the case, messages shall be checked using repeat history 30 s back in time.

Table 4 – Duplicate message filtering parameters

Message type	Filter parameters
Position reports (1,2,3,18, 21)	MMSI, Time stamp
Static data (5,19)	MMSI
Static data (24A,24B)	MMSI, Message part
Binary messages (6, 8, 25, 26)	MMSI, Binary data
Safety related messages (12,14)	MMSI, Data
Other messages	No filtering required

4.3.4 Content filtering

4.3.4.1 Filter by message type

(See 6.5.4)

Received messages shall be filtered according to Table 5.

Table 5 – Repeater station behaviour for message repeat

Message type	Repeating allowed	Action	Comment
1	Yes	Amend communication state.	
2	Yes	Amend communication state.	
3	Yes	Amend communication state.	
4	No		Message 4 transmissions are not candidates for slot reuse and shall therefore not be repeated. See [a].
5	Yes		
6	Yes		
7	Yes		
8	Yes		
9	No		SAR units generally have great range and therefore do not require retransmission.
10	No		See [a].
11	No		See [a].
12	Yes		
13	Yes		
14	Yes		
15	Yes	Disallow repeat of Message 15 with slot offset.	
16	No		See [b].
17	No		Time to alarm for unhealthy satellites may not be fulfilled. DGPS messages may also be long.
18	Yes	Amend communication state (check for CS).	Message 18 from CS and SOTDMA may be handled differently.
19	Yes		
20	No		See [b].
21	Yes		
22	No		See [b].
23	No		See [b].
24	Yes		
25	Yes		
26	Yes	Amend communication state.	
27	No		Not intended to be received by mobiles. Different frequencies.

[a] UTC time will not be accurate after retransmission, hence the message is not repeated.

[b] This is a VDL control message.

Any message type can be switched off by configuration.

4.3.4.2 AIS-SART filtering rules

(See 6.5.6)

Received message filtering shall use the following rules:

- repetition of AIS-SART test messages is configurable with “default=don’t repeat” this includes the AIS-SART text messages while undergoing tests;
- active AIS-SART position reports without a position shall be repeated;
- capability to trigger binary and text messages on reception of an active AIS-SART message shall contain repeater ID and RSSI of the received AIS-SART message;
- only one message from the burst can be repeated;
- continue repetition once per minute for 15 min after last message received. In this case the timestamp in the repeated AIS-SART position report shall be set to 60 (unavailable);
- prioritise active AIS-SART messages over others under heavy VDL load;
- filtering shall be disabled for active AIS-SART.

NOTE The “SART” in this standard includes devices using AIS-SART technology such as AIS-SART, AIS-MOB and EPIRB-AIS as defined in Recommendation ITU-R M.1371.

4.3.4.3 Filter by position

(See 6.5.3)

4.3.4.3.1 Defined areas

Messages shall be filtered by position using defined areas. When a message that does not contain a position field is received from a station whose position is not yet known, no filtering shall be applied. For example if a Message 5 is received before a position message from the same station is received, the Message 5 shall not be filtered.

A position report received from a station with a “default=not available” position shall not be repeated.

4.3.4.3.2 Area filter rules

(See 6.5.3)

Include/Exclude rule set – Each area defined shall be for either inclusion or exclusion of retransmission. If no included area is defined, the repeater station shall not retransmit any VDL message.

Number of areas – Minimum number of configurable areas shall be 8 in total. Overlapping areas are allowed. Exclude from transmission areas have priority over include areas in case of overlapping. An area for filtering is defined by two points forming a rectangle at its NE/SW geographic coordinates.

Distance to areas – The distance to an area shall not be considered by the repeater station.

Area sizes – There shall be no minimum or maximum area size limit required.

4.3.4.4 Filter by other message content

(See 6.5.5)

It shall be possible to filter messages by specific parameters within the messages.

As a minimum it shall be possible to filter AIS units by:

SOG – A SOG threshold for exclusion when SOG is lower than the threshold value;

COG – A COG range shall be configurable for inclusion or exclusion;

NavStatus – A complete set of NavStatus values shall be configurable for inclusion or exclusion;

Ship/cargo type – A set of ship/cargo types for inclusion or exclusion;

MMSI – A list or ranges of MMSIs to include or exclude.

4.3.5 Reporting interval filtering

(See 6.4.1, 6.4.2)

Repeat position messages at a configured reporting interval greater than the received reporting interval. Reporting interval filtering only applies to Message 1, 2, 3, and 18.

The retransmitted position messages shall always use the most current received information for that AIS unit (see 4.4.4.2). The reporting interval shall be less than 6 min.

- Downsampling – Repeat interval depends on receive interval. A configured number of position reports shall be skipped before retransmission as long as the configured maximum interval has not been exceeded. There is one maximum interval for stationary ships and another for moving ships.
- Fixed repeat intervals. There is one for stationary ships and another for moving ships.

A Class A vessel shall be considered as stationary if it has a SOG of less than or equal to 3 kn and navigation status of ‘at anchor’ or ‘moored’.

A Class B vessel shall be considered as stationary if it has a SOG of less than or equal to 2 kn.

The messages to be repeated shall be queued. Received position messages (Message 1, 2, 3 or 18) shall replace queued messages from the same MMSI.

4.3.6 Channel filtering

(See 6.5.2)

The channel used for repeating messages shall be selectable; channel A, channel B, or both. Repeat messages shall be repeated on the channel they were received.

4.3.7 Filtering procedure

4.3.7.1 General procedure

Filtering is performed by the following procedure in the described order. If it is detected that the message is excluded from repetition the filtering is stopped and the message is not repeated.

Otherwise the filtering continues until an exclude is found or the complete filtering process is finished with the final result.

All repeated stations shall have an include/exclude status, and all other messages from the same station shall follow this filtering status. The include/exclude status shall be updated on a message to message basis. Every time a message with information relevant to the applied filters is received it shall be re-evaluated to determine the current include/exclude status.

4.3.7.2 MMSI filtering

(See 6.5.5.5)

All MMSI sets have to be evaluated.

Filtering continues with the area filtering as follows:

- if there is no active MMSI filtering set;
- if there is any inclusive MMSI set and the AIS unit MMSI is in at least one inclusive MMSI set;
- if the AIS unit MMSI is not in any exclusive MMSI set.

If none of the above criteria is fulfilled that filtering process is stopped and the message is not repeated.

In case of a configuration conflict, if the AIS unit MMSI is in an inclusive and in an exclusive set, priority is set on the inclusive set and the filtering continues.

4.3.7.3 Area filtering

(See 6.5.3.1)

All inclusive and exclusive areas have to be evaluated. If no inclusive area is defined, no repetition of messages shall take place.

In case of overlapping areas, exclusive areas have priority over inclusive areas. Inclusive areas inside an exclusive area are not allowed. See Annex B.

4.3.7.4 SOG filtering

(See 6.5.5.1)

If the SOG configuration setting is 0 or the received message does not contain a SOG the filtering continues with the next step.

If the message SOG is greater than or equal to the SOG configuration setting the filtering continues, otherwise it is stopped and the message is not repeated.

4.3.7.5 COG filtering

(See 6.5.5.2)

If the COG filtering is disabled or the received message does not contain a COG the filtering continues with the next step.

If the COG filtering is set to inclusive:

- the filtering continues if the COG is in the COG range;
- the filtering is stopped and the message is not repeated if the COG is not in the COG range.

If the COG filtering is set to exclusive:

- the filtering continues if the COG is not in the COG range;
- the filtering is stopped and the message is not repeated if the COG is in the COG range.

4.3.7.6 Message type filtering

(See 6.5.4)

If the message filtering is disabled the filtering continues with the next step.

If the message filtering is enabled the setting for the received message type is examined:

- the filtering continues if the received message type is set to inclusive;

- the filtering is stopped and the message is not repeated if the received message type is set to exclusive.

4.3.7.7 NavStatus filtering

(See 6.5.5.3)

If the NavStatus filtering is disabled the filtering continues with the next step.

If the NavStatus filtering is enabled the setting for the NavStatus is examined as follows:

- the filtering continues if the NavStatus is set to inclusive;
- the filtering is stopped and the message is not repeated if the NavStatus is set to exclusive.

4.3.7.8 Ship type filtering

(See 6.5.5.4)

If the ship type filtering is disabled the filtering continues with the next step.

If the ship type filtering is enabled for inclusive or exclusive the setting for the actual ship type is examined as follows:

- when the actual ship type is set to inclusive the filtering continues;
- when the actual ship type is set to exclusive the filtering is stopped and the message is not repeated.

4.3.7.9 Stationary vessel filtering

(See 6.5.5.6)

If the stationary vessel filtering is disabled then the filtering process is complete and the message can be processed.

For the purpose of the filtering process a vessel is considered stationary if the navigational status is set to ‘moored’ or ‘at anchor’ and the SOG is less than or equal to 3 kn.

If the stationary vessel filtering is enabled then messages from stationary vessels are not repeated.

4.3.8 Message processing

(See 6.3)

A received message requires additional processing before being retransmitted. The following processing is required:

- the content of the message to be repeated shall not be changed, except for the repeat indicator and fields associated with the communication state;
- select additional slot(s), required for re-transmitting message(s);
- the communication state of relevant received messages shall be changed according to method of VDL access, and is subject to parameters required by the slot(s) selected for retransmission by the repeater station.

4.3.9 Overload protection

(See 6.4.3, 6.4.4)

Monitor VDL load and restrict repeater generated VDL load under high VDL load situations.

A repeater station shall not repeat more than 12 messages in any one UTC second, unless FATDMA is used to reserve the transmission schedule.

Type 1:

- Configurable slot usage limit with a default 50 slots per channel per frame.
- The maximum usage limit shall not exceed 400 slots per channel per frame.
- The downsampling factor or fixed interval shall automatically adapt to avoid exceeding the limit according to rules defined in 4.3.5.

Type 2:

- Configurable slot usage limit with a default 50 slots per channel per frame.
- The maximum usage limit shall not exceed 50 slots per channel per frame.
- The downsampling factor or fixed interval shall automatically adapt to avoid exceeding the limit according to rules defined in 4.3.5.

If the required number of repeat transmissions exceeds the configuration of the repeater station then an alarm status shall be transmitted in the station identification message, and repeating shall stop for that frame.

4.3.10 Slot selection using RSSI – RSSI measurement

(See 6.3.1.5)

The RSSI will increase when two or more stations are transmitting in the same slot at approximately the same distance from the repeater station. A high level of RSSI generally indicates that the transmitting stations are close to the repeater station and a low level indicates that the transmitting stations are far away. repeater stations shall use the RSSI measured in the previous frame in determining free slots and slots for reuse. The first 2 ms of the slot shall be used to distinguish between Class B “CS” and Class A transmissions for free slot determination in the next frame.

A repeater station shall always prefer to use free slots when available. A slot shall be considered free if it contains no decodable message and has an RSSI of less than 16 dB above the noise floor. The requirement to determine the noise floor is described in Recommendation ITU-R M.1371. One compliant method is to sample the RF signal strength at a rate >1 kHz, average the samples over a sliding 20 ms period and over a 4 s interval determine the minimum period value. Maintain a history of 15 such intervals. The minimum of all 15 intervals is the background level.

When insufficient free slots are available, and there are slots that contain energy levels that exceed a free slot without a decodable message, then they shall be considered “garbled slots”. The algorithm shall then select “garbled slots” according to the lowest energy level first. Intentional slot reuse, in accordance with Recommendation ITU-R M.1371 shall be performed after free and “garbled slots” are exhausted.

4.4 Message scheduling

(See 6.6)

4.4.1 Station report

A repeater station has to identify itself by transmitting a repeater status report using Message 26 every 6 min by default (value shall be configurable within 60 min), alternating between channel A and B. The access scheme shall preferably be ITDMA or SOTDMA where possible. FATDMA or RATDMA may be used, depending on the reporting interval. If the access scheme is configured as depending on the reporting interval the following access scheme shall be used:

<= 1min: SOTDMA

>1 min and <= 7 min: ITDMA

>7 min: RATDMA

In all cases FATDMA slots shall be used, if available.

If the repeater station is not programmed with a valid identifier (MMSI) or is not configured to transmit a repeater status report then all repeating functions shall be disabled. If the repeater station is configured to disable all repeating functions, the repeater status report transmission is not required.

If the repeater station is integrated into a base station or an AIS AtoN station, the repeater station shall have its own MMSI in accordance with Recommendation ITU-R M.585.

4.4.2 Repeater station identification message structure

Table 6 defines the contents of the Message 26 which identifies the repeater station on the VDL. If the repeater station is built into a base station or an AIS AtoN, this message transmission is also required.

Table 6 – Contents of Message 26 used for repeater station identification

Parameter	Number of bits	Description
Message ID	6	Always 26
Repeat indicator	2	Always 0
Source ID	30	The ID shall be as defined in 4.4.1
Destination indicator	1	Always 0 = Broadcast
Binary data flag	1	Always 1 = Structured message
Application identifier	16	DAC = 995, FI = 0
Longitude	28	Longitude in 1/10 000 min (±180º, East = positive (as per 2's complement), West = negative (as per 2's complement); 181= (6791AC0h) = not available = default)
Latitude	27	Latitude in 1/10 000 min (±90º, North = positive (as per 2'scomplement), South = negative (as per 2's complement); 91 = (3412140h) = not available = default)
Alarm status	16	See Table 7
Messages repeated in last frame	9	0 to 400 messages
Spare	12	Not used. Shall be set to zero. Reserved for future use.
Communication state selector	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows
Communication state	19	SOTDMA communication state (see ITU-R M.1371-5, § 3.3.7.2.2, Annex 2), if communication state selector flag is set to 0, or ITDMA communication state (Recommendation ITU-R M.1371-5, § 3.3.7.3.2, Annex 2), if communication state selector flag is set to 1
Number of bits	168	Occupies 1 slot

Table 7 – Alarm status definition for Table 6

Alarm status bit	Alarm condition
0	0 = default , 1 = Automatic downsampling active
1	0 = default , 1 = Downsampling limit exceeded
2	0 = default , 1 = Transmitter malfunction
3	0 = default , 1 = Receiver malfunction – channel A
4	0 = default , 1 = Receiver malfunction – channel B
5	0 = default , 1 = UTC lost
6	0 = default , 1 = Internal position lost
7	0 = default , 1 = VSWR failure
8	0 = default , 1 = AIS-SART received
9	0 = default , 1 = Slot re-use during last frame
10	0 = default , 1 = Battery low
11–15	Shall be 0 = default. Reserved for future use

4.4.3 Broadcast active AIS-SART message

(See 6.5.6)

Only one message from the active AIS-SART burst shall be repeated. The active AIS-SART message takes priority over any other message in the transmit queue. Upon reception of an active AIS-SART message with no valid position, the repeater station shall transmit a broadcast binary Message 8 with DAC = 995, FI = 9 as shown in Table 8. The message shall contain the unique ID of the active AIS-SART and the RSSI level of the received message.

The AIS-SART shall not be subject to downsampling.

Table 8 – Message 8 structure with AIS-SART related content

Parameter	Number of bits	Description
Message ID	6	Always 8
Repeat indicator	2	Always 0
Source ID	30	The ID shall be as defined in 4.4.1
Spare	2	Always 0
Application identifier	16	DAC = 995, FI = 9
Received AIS-SART ID	30	ID of received active AIS-SART
RSSI level	8	RSSI level of received active AIS-SART; –127 to +30 dBm in binary
Spare	2	Not used. Shall be set to zero. Reserved for future use
Number of bits	96	Occupies one slot

4.4.4 Configuration parameters

4.4.4.1 Basic system parameters

(See 6.1.1, 6.2.2)

The configurable parameters are given in Table 9.

Table 9 – Configurable parameters

Parameter	Field	Remark
Identification	User ID	The ID shall be as defined in 4.4.1. Used as Source ID for identification messages (see 4.4.2) and as Destination ID for VDL configuration.
Position	Primary position source	0 = internal GNSS The average GNSS position shall be stored as a fallback in case of GNSS drop out. 1 = Surveyed position
	Surveyed Latitude	Resolution: 1/10 000 min Default: 91°
	Surveyed Longitude	Resolution: 1/10 000 min Default: 181°
Own identification report	UTC minute	MM of frame
	Start slot Channel A	0….2249
	Interval to next transmission	Slot interval 0 = no transmission (Default) Maximum 135 000 slots (1 hour) Note that if the interval is set to 0 the disable/enable repeater parameter is also set to disabled (0).
	Access scheme	0 = depending on reporting interval 1 = FATDMA 2 = ITDMA/RATDMA (RATDMA when interval >7min) 3 = SOTDMA (only if interval <= 1 min)
Transmit power	Transmit power level	0 = high power = 12,5 W or as defined by the manufacturer. 1 = low power = 1 W or as defined by the manufacturer. 2 …9 as defined by the manufacturer (optional)
Channels	Channel A	Channel number according to Recommendation ITU-R M.1084 Setting the channel number “0” disables the transmission on the channel(s).
	Channel B	
Encryption key	128 bit AES key	Default to all zeros.

4.4.4.2 General repetition parameters

(See 6.1.1, 6.3.1.3)

The general repetition parameters are given in Table 10.

Table 10 – Repetition parameters

Parameter	Field	Remark
Disable/enable repeater	Repeater enabled	0 = Repeater disabled, no repetition of message (default) 1 = Repeater enabled It is required that this parameter can be set also via VDL
Disable/enable RATDMA	RATDMA enabled	0 = RATDMA disabled (default) 1 = RATDMA enabled
Max VDL usage	Max number of repetition slots	Defines the maximum number of slots per channel per frame which can be used for repetition Default: 50 Maximum: 400 for Type 1, 50 for Type 2
Assigned slots 10 sets per channel (A & B)	Usage flag	0 = default = not configured 1 = assigned for own use 2 = restricted from own use
	Start slot	Start slot of an assigned block
	Slot increment	Slot increment from start of one block to the start slot of the next block. A multiple of the slot increment shall equal 2 250 (2 250 mod slot increment = 0). Values 0 through 1 125, 0 = one reservation per frame.
	Number of slots	Number of assigned slots in a block, 1 through 5 slots
Downsampling	Downsampling factor	0 = Fixed interval 1 = default = each message is repeated, no downsampling 2 = every second message is repeated 3 = every 3rd message is repeated . . 15 = every 15th message is repeated
	Maximum repeat interval (moving vessel)	Maximum interval in case of downsampling, defined as number of slots If this interval is exceeded the next received message from a certain station is repeated even if the downsampling factor is not yet reached. The maximum configurable repeat interval shall be 33 750 slots (15 min).
	Maximum repeat interval (stationary vessel)	
Fixed repetition interval	Fixed repeat interval (moving vessel)	Fixed interval, number of slots 0 = default = no fixed interval If this interval is exceeded and all queued messages are older than 30 s then the next received message shall be repeated. The maximum configurable repeat interval shall be 33 750 slots (15 min).
	Fixed repeat interval (stationary vessel)	
Filter by MMSI Minimum 2 sets, maximum 16 sets Set 1 defines the default behaviour for MMSIs	Exclude or include	0 = no MMSI filtering 1 = Include MMSI range 2 = exclude MMSI range
	First MMSI	First MMSI of a range

Parameter	Field	Remark
outside of the defined range. e.g., if set 1 is configured as an include range all MMSIs outside this range are excluded by default.	Last MMSI	Last MMSI of a range, can be identical to first MMSI if only 1 MMSI shall be filtered
Enable repetition of AIS-SART test messages	Enabled/disabled	0 = repetition of AIS-SART test messages disabled (default) 1 = repetition of AIS-SART test messages enabled

4.4.4.3 Area related repetition parameters

(See 6.1.1)

The area related parameters are given in Table 11. This set of parameters is applied and stored for each of the 8 through 16 area definitions.

Table 11 – Area related configuration parameters

Parameter	Field	Remark
Exclude or include	0 = no area filtering 1 = Include area 2 = exclude area	The area related filter parameters below only apply in case of an include area
NE corner point	Latitude	Resolution 1/10 min
	Longitude	
SW corner point	Latitude	Resolution 1/10 min
	Longitude	
Maximum number of repeats	Max repeated RI	0 = no repetition 1 = Rx messages with RI = 0 are repeated 2 = Rx messages with RI = 0 and 1 are repeated 3 = Rx messages with RI = 0 … 2 are repeated
RI increment	RI increment setting	Definition how the RI of the repeated message is set depending on the RI of the received message 0 = RI is incremented by 1, max 3 1 = RI is set to 1 (if received RI >= 1 the message is not repeated) 2 = RI is set to 2 (if received RI >= 2 the message is not repeated) 3 = RI is set to 3 (if received RI = 3 the message is not repeated)
Filter by SOG	Min. SOG for repeating	SOG in kn 0 = default = no SOG filtering Only stations which exceed this parameter are repeated
Filter by COG Applied clockwise between first and last COG	Exclude/include	0 = default = no COG filtering 1 = include, stations with COG in the range are repeated 2 = exclude, station with COG in the range are not repeated
	First COG	COG in °, first COG of the range
	Last COG	COG in °, last COG of the range
Filter by message type	Enable/disable	0 = message type filter is disabled, all messages are repeated 1 = Message filter is enabled
	Message 1	0 = excluded, message is not repeated 1 = included, message is repeated
	Message 2	
	Message 3	
	Message 5	
	Message 6,7	
	Message 8	
	Message 12, 13	
	Message 14	
	Message 15	
	Message 18 CS	
	Message 18 SO	
	Message 19	

Parameter	Field	Remark
	Message 21	
	Message 24 CS	
	Message 24 Other SO	
	Message 25	
	Message 26	
Filter by NavStatus	Enable/ DisableNavStatus	0 = NavStatus filter is disabled, all messages are repeated 1 = Message filter is enabled
	NavStatus 0NavStatus	0 = excluded, message is not repeated 1 = included, message is repeated
	NavStatus 1	
	....NavStatus	
	NavStatus 15	
Filter by Cargo/Ship	Default filtering behaviour	0 = Cargo/ Ship type filter is disabled, all messages are repeated 1 = Message filter is enabled, all ships types are repeated by default 2 = Message filter is enabled, all ships types are not repeated by default
	Exceptions to default	Cargo/ ship types that are an exception to the default (0 … 255).
Stationary vessel filtering	Enabled/disabled	0 = stationary vessel filtering disabled 1 = stationary vessel filtering enabled

All parameters shall be configurable using the PI. Apart from the mandatory parameters, any parameter can optionally be configured using the VDL.

4.5 Repeater station input/output sentence formatters

Table 12 lists sentence formatters used with a repeater station. Clause A.2 contains the details for each of the sentence formats developed for repeater stations.

Table 12 – Repeater station input/output sentence formatters

Sentence formatter	Input	Output	Description
ACK [a]	X		Acknowledge alarm
ADS [b d]		X	AIS device status
ALR [a]		X	Set alarm state (Table 7)
EPV [c]	X	X, Q	Command or report equipment property value
FSR [d]		X	Frame summary of AIS reception, defined by SPO. The manufacturer shall declare the parameters that are supported
NAK [a]		X	Negative acknowledgement
RA1	X	Q	Repeater area part 1 Configuration, basic definition
RA2	X	Q	Repeater area part 2 Configuration, message type filtering
RA3	X	Q	Repeater area part 3 Configuration, navigation status filtering
RA4	X	Q	Repeater area part 4 Configuration, ship and cargo type filtering
RFS	X	Q	Repeater FATDMA slots
RMF	X	Q	Repeater MMSI filter
RST [d]	X	X	Equipment reset command
SPO [d]	X	Q	Select AIS device's reception processing and output
VDM [a]		X	VHF data-link message
VDO [a]		X	VHF data-link own-vessel message
VER [a]		Q	Version information about equipment. Provided in response to ABQ
VSI [d]		X	VDL signal information, defined by SPO. The manufacturer shall declare the parameters that are supported and the accuracy. The VSI shall follow its associated VDM/VDO.

"X" indicates input to, or output from, the repeater station.

"Q" indicates that the sentence may be externally requested using the IEC 61162-1 "$xxAXQ,xxx" query sentence (see Annex A) method(s) in order for the identified sentence to be output.

[a] Sentence formatters are described in IEC 61162-1.

[b] The repeater station shall output, autonomously and periodically, the ADS sentence on the PI indicating the repeater station status. This shall be output once per minute or when there is a change in the status.

[c] Sentence formatters are described in IEC 61993-2.

[d] Sentence formatters are described in IEC 62320-1.

5 Performance requirements

5.1 Cyclic redundancy check

The repeater station shall only transmit messages with a valid CRC. The repeater station shall calculate a new CRC for the repeat message prior to transmission.

5.2 Physical layer requirement

5.2.1 Transmitter requirements

(See 8.1, 8.2)

5.2.1.1 Channel

The repeater 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.

5.2.1.2 Parameter settings

Table 13 and Table 15 are derived from Recommendation ITU-R M.1371 and give the parameters required for a repeater station. For the meaning of the symbols and additional information (footnotes) refer to the appropriate section of Recommendation ITU-R M.1371.

Table 13 – Transmitter parameters

Transmitter parameters	Requirement	Condition
Frequency error	±500 Hz normal ±1 000 Hz extreme	
Carrier power (P_{ss})	41 dBm or as defined by the manufacturer high power setting 30 dBm or as defined by the manufacturer low power setting	±1,5 dB normal and ±3 dB extreme, conducted
Modulation spectrum (slotted transmission)	0 dBc below straight line between –25 dBc at ±10 kHz and −70 dBc at ±25 kHz −70 dBc or –36 dBm whatever is higher.	Δf_c < ±10 kHz ±10 kHz < Δf_c < ±25 kHz ±25 kHz < Δf_c < ±62.5 kHz
Intermodulation attenuation (Type 1 only)	≥40 dB	
Modulation accuracy	<3 400 Hz 2 400 ±480 Hz 2 400 ± 240 Hz normal ±480 Hz extreme 1 740 ± 175 Hz normal ±350 Hz extreme 2 400 ± 240 Hz normal ±480 Hz extreme	Bit 0, 1 Bit 2, 3 Bit 4 … 31 Test signal 0101… Test signal 00001111…
Power versus time characteristics	Transmission delay: 0 s Ramp up time: 833 μs Ramp down time: 833 μs Transmission duration: ≤26 624 μs	See Figure 2 and Table 14 Nominal 1 time slot transmission
Spurious emissions	−36 dBm −30 dBm	9 kHz … 1 GHz 1 GHz … 4 GHz

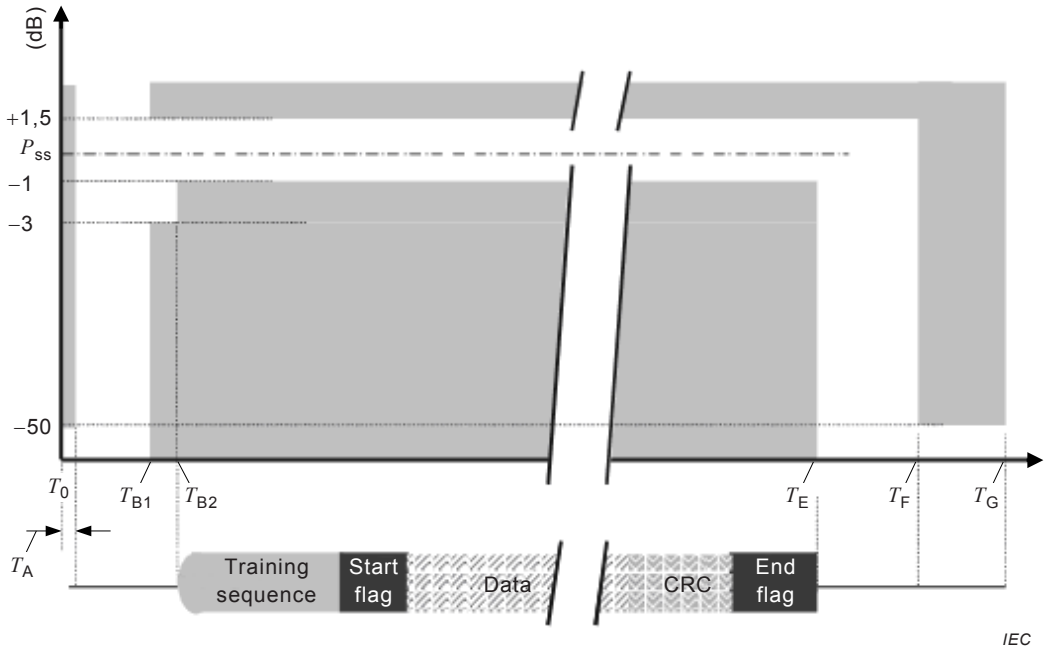


Figure 2 – Power versus time characteristics

Table 14 – Power versus time characteristics for Figure 2

Reference		Bit	Time	Definition
T_0		0	0 ms	Start of transmission slot. Power shall NOT exceed –50 dBc (ref. P_{ss}) before T_0
T_A		0 to 6	0 ms to 0,625 ms	Power exceeds –50 dB of P_{ss}
T_B	T_{B1}	6	0,625 ms	Power shall be within +1,5 or −3 dB of P_{ss}
	T_{B2}	8	0,833 ms	Power shall be within +1,5 or −1 dB of P_{ss};(Start of training sequence)
T_E (includes 1 stuffing bit)		233	24,271 ms	Power shall remain within +1,5 or −1 dB of P_{ss} during the period T_{B2} to T_E
T_F (includes 1 stuffing bit)		241	25,104 ms	Power shall be −50 dBc (ref. P_{ss}) and stay below this
T_G		256	26,667 ms	Start of next transmission time period

Table 15 – Required parameter settings for a repeater station

Symbol	Parameter Name	Setting (FATDMA, RATDMA, ITDMA,SOTDMA)
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 bit/s
PH.TS	Training sequence	24 bit
PH.TST	Transmitter settling time (Transmit power within 20 % of final value. Frequency stable to within ±1,0 kHz of final value). Tested at manufacturers declared transmit power.	≤1 ms
	Ramp down time	≤832 μs
	Transmission duration	≤80 ms
	Transmission delay	no delay
	Transmitter output power	12,5/1 W or as defined by the manufacturer, and additional power levels may be defined

In addition, the constants of the physical layer of the repeater station shall comply with the values given in Table 16 and Table 17.

Table 16 – 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 17 – Modulation parameters of the physical layer of the repeater station

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

5.2.1.3 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.

5.2.1.4 Transmitter protection

The transmitter shall be capable of transmitting at the highest output power both open and short circuited without causing harm or damage to the repeater station.

5.2.2 Receiver requirements

(See 8.3)

The technical characteristics as specified in Table 18 shall apply to the TDMA receivers.

Table 18 – Required receiver characteristics

Receiver Parameters	Requirement (Max PER or absolute level in dBm)		Type 2		Type 1	
			Wanted signal	Unwanted signals	Wanted signal	Unwanted signals
Sensitivity	20 %		–107 dBm normal –104 dBm normal at ±500 Hz offset –101 dBm extreme	-	–107 dBm normal –104 dBm normal at ±500 Hz offset –101 dBm extreme	-
Error at high input levels	Type 2	Type 1	–77 dBm	-	–77 dBm	-
	2 % 10 %	1 %	–7 dBm	-	–7 dBm	-
Co-channel rejection	20 %		–101 dBm	–111 dBm –111 dBm at ±1 000 Hz offset	–104 dBm –104 dBm	–114 dBm –114 dBm at ±1 000 Hz offset
Adjacent channel selectivity	20 %		–101 dBm	–31 dBm	–104 dBm –98 dBm extreme	–34 dBm Normal –38 dBm extreme
Spurious response rejection	20 %		–101 dBm	–31 dBm	–104 dBm	–34 dBm
Intermodulation response rejection	20 %		–101 dBm	–36 dBm	–101 dBm	–27 dBm
Blocking and desensitisation	20 %		–101 dBm	–15 dBm	–101 dBm	–15 dBm
Conducted spurious emissions	–57 dBm or less (9 kHz…1 GHz) –47 dBm or less (1 GHz…4 GHz)		-	-	-	-

5.2.3 Power consumption

The manufacturer shall state the average power consumed by the repeater station under the following test condition:

- dual channel operation with both receivers enabled full time;
- repeat 50 messages per frame per channel;
- RATDMA enabled;
- all filtering disabled;
- one include area defined;
- UTC available;

- transmit power 12,5,W or as defined by the manufacturer;
- nominal supply voltage (defined by manufacturer).

5.2.4 Environmental requirements

The repeater 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.

5.3 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.

6 Functional tests

6.1 Configuration tests

6.1.1 Factory default settings

(See 4.4.4.1, 4.4.4.2, 4.4.4.3)

6.1.1.1 Purpose

The purpose of this test is to check the factory default settings of the EUT. The default values are defined in Table 19.

Table 19 – Factory default values

Parameter	Test setting value
Identification	0
Primary position source	0 = Internal GNSS
Position (LAT, LON)	Default position (91°, 181°)
Own identification report	Interval = 0 (no transmission)
Transmit power	0 = high power
Channels	A = 2087, B = 2088
Encryption key	No encryption key
Disable/Enable repeater	0 = Repeater disabled
Disable/Enable RATDMA	0 = RATDMA disabled
Max VDL usage	50 slots = Default
Assigned slots	Usage flag = 0 (not configured)
Downsampling	1 = each message is repeated
Fixed repetition interval	0 = default = no fixed interval
Filter by MMSI	All sets: Exclude or include = 0 (no MMSI filtering)
Areas	No areas defined. All areas set to: Exclude or include = 0 (no area filtering)
RI increment	3 = RI is set to 3

6.1.1.2 Method of measurement

The method of measurement is as follows:

a) set the repeater station to the factory defaults using the RST sentence. Query for all configuration sentences;

b) apply messages to the VDL.

6.1.1.3 Required results

Confirm that:

a) the configuration values are set according Table 19;

b) no messages are repeated.

6.1.2 Standard test set-up

6.1.2.1 Purpose

A standard test set-up different to the manufacturer's defaults shall be used as a start basis for all tests. In this test set-up all messages with positions inside a defined area are repeated in RATDMA mode without any filtering. Table 20 and Table 21 define this test set-up.

Table 20 – Standard test set-up

Parameter	Test setting value
Identification	Valid repeater ID
Position	Primary position source = 1 (Surveyed position) Valid surveyed position
Own identification	1 = transmitted. Default schedule for transmission: UTC HHMM of Frame = 00:00 Start slot = 100 Slot interval = 13 500 slots Access scheme = FATDMA
Transmit power	0 = high power
Channels	Valid test channels A and B
General repetition parameter	
Disable/Enable repeater	1 = Repeater enabled
Disable/Enable RATDMA	1 = RATDMA enabled
Max VDL usage	50 = Default
Assigned slots	0 = default = not configured
Down sampling	1 = each message is repeated Maximum repeat interval = maximum value = 33 750 slots
Fixed repetition interval	0 = default = no fixed interval
MMSI filtering	All sets: 0 = no MMSI filtering

One include area shall be defined with the parameters in Table 21.

Table 21 – Test area of standard test set-up

Parameter	Test setting value
Number of filter area set	1
Exclude or include	1 = include area
NE corner point	Appropriate area definition
SW corner point	
Maximum number or repeats	3 = 0…2 are repeated
RI increment	0 = RI is incremented by 1
Filter by SOG	0 = no SOG filtering
Filter by COG	0 = no COG filtering
Filter by message type	0 = no filtering, all messages are repeated
Filter by NavStatus	0 = no filtering, all messages are repeated
Filter by cargo/ship type	0 = no filtering, all messages are repeated
Filter stationary vessels	0 = no filtering, all messages are repeated

This standard test set-up shall be applied to the EUT at beginning of each test even if it is not explicitly mentioned and modified according to the specific test requirements.

This test verifies the standard test set-up.

6.1.2.2 Method of measurement

Apply standard test set-up with PI sentences. Apply query for all configuration sentences.

6.1.2.3 Required results

Confirm that:

- there is a response for all configuration sentences;
- all parameters are set according to the configuration sentences.

6.1.3 Configuration via VDL

(see 4.1.5, Clause A.3)

6.1.3.1 Purpose

The purpose is to verify the correct configuration via VDL. The configuration is verified using the PI sentences and via VDL. The correct function according to the configuration is not verified in this test. This is performed in special functional tests based on configuration applied by PI sentences. It is assumed that the function does not depend on the way the configuration is applied.

6.1.3.2 Method of measurement

The method of measurement is as follows:

a) set the EUT to the standard test set-up using PI port sentences;

b) change the disable/enable repeater setting to 0 = disabled using a VDL message. Send a query message via VDL;

c) change the disable/enable repeater setting to 1 = enabled using a VDL message. Send a query message via VDL.

Optional test if implemented:

d) send a complete set of supported configuration parameters via VDL using the defined messages. Send a query message for all supported configuration messages via VDL.

6.1.3.3 Required results

Confirm:

a) that the configuration standard test set-up is correctly stored by evaluation of the response on query for all configuration sentences;

b) using PI port query that the disable/enable repeater setting is changed to 0. Confirm that a response on the VDL query is transmitted indicating the correct disable/enable repeater setting;

c) using PI port query that the disable/enable repeater setting is changed to 1. Confirm that a response on the VDL query is transmitted indicating the correct disable/enable repeater setting.

Optional test if implemented:

d) confirm using PI port query that all supported configuration parameters are correctly set. Confirm that response messages are transmitted on the VDL query for all configuration messages indicating the correct setting of all supported configuration parameters.

6.2 Basic functional tests

6.2.1 Basic repetition test

(See 4.1.2, 4.3.1)

6.2.1.1 Purpose

The basic repetition functionality is checked.

6.2.1.2 Method of measurement

The method of measurement is as follows:

a) set the EUT to the standard test set-up;

b) apply position reports with positions inside the include area;

c) set disable/enable repeater to 0 = disabled. Apply position reports with positions inside the Include area.

6.2.1.3 Required results

Confirm that:

a) the configuration is correctly stored;

b) the position reports are repeated. Confirm that they are repeated on the channel on which the messages have been received. Confirm that there is a VDM output for each received message and a VDO output for each transmitted message;

c) the position reports are not repeated. Confirm that there is a VDM for each received message.

6.2.2 Power setting

(See 4.4.4.1)

6.2.2.1 Purpose

This test verifies that the EUT transmits the repeated messages with high or low power according to the configuration. The measurement of the exact transmission power levels is not part of this test but has to be performed as part of the physical radio tests.

6.2.2.2 Method of measurement

The method of measurement is as follows:

a) set the EUT to the standard test set-up. The transmit power is set to 0 = high power;
b) apply position reports with position inside the Include area;
c) set the transmit power level to 1 = low power;
d) apply position reports with position inside the include area;
e) set the transmit power level to 0 = high power;
f) apply position reports with position inside the include area.

6.2.2.3 Required results

Confirm that:

a) the configuration is correctly stored;
b) the position reports are transmitted with high power;
c) the configuration is correctly stored;
d) the position reports are transmitted with low power;
e) the configuration is correctly stored;
f) the position reports are transmitted with high power.

6.2.3 Repeat indicator handling

(See 4.3.2)

6.2.3.1 Default setting

6.2.3.1.1 Purpose

This test checks the correct handling of the repeat indicator in the default setting.

6.2.3.1.2 Method of measurement

The method of measurement is as follows:

a) apply standard test set-up (Area 1: Max number of repeats = 3, RI increment = 0);
b) apply message with RI = 0, 1, 2, position inside the area;
c) apply message with RI = 3, position inside the area.

6.2.3.1.3 Required results

Confirm that:

a) the configuration is correctly stored;
b) the messages with RI = 0, 1, 2 are repeated. Confirm that the RI in the repeated messages is 1, 2, 3 (incremented by 1);
c) the message with RI = 3 is not repeated.

6.2.3.2 Maximum repeats

6.2.3.2.1 Purpose

Different settings of the configuration parameter “Maximum number of repeats” are verified.

6.2.3.2.2 Method of measurement

The method of measurement is as follows:

a) set the maximum number of repeats to 1;
b) apply message with RI = 0, position inside the area;
c) apply message with RI = 1, 2, 3, position inside the area;
d) set the maximum number of repeats to 2;
e) apply message with RI = 0, 1, position inside the area;
f) apply message with RI = 2, 3, position inside the area.

6.2.3.2.3 Required results

Confirm that:

a) the configuration is correctly stored;
b) the messages with RI = 0 are repeated. Confirm that the RI in the repeated messages is 1 (incremented by 1);
c) the messages with RI = 1, 2, 3 are not repeated;
d) the configuration is correctly stored;
e) the messages with RI = 0 and 1 are repeated. Confirm that the RI in the repeated. messages is 1, 2 (incremented by 1);
f) the messages with RI = 2 and 3 are not repeated.

6.2.3.3 RI incrementing

6.2.3.3.1 Purpose

Different settings of the configuration parameter “RI increment” are verified.

6.2.3.3.2 Method of measurement

The method of measurement is as follows:

a) set the maximum number of repeats to 3 (default), RI increment = 1 (RI is set to 1);
b) apply message with RI = 0, 1, 2, 3, position inside the area;
c) set RI increment = 2;
d) apply message with RI = 0, 1, 2, 3, position inside the area;
e) set RI increment = 3;
f) apply message with RI = 0, 1, 2, 3, position inside the area.

6.2.3.3.3 Required results

Confirm that:

a) the configuration is correctly stored;
b) the messages with RI = 0 are repeated. Confirm that the RI in the repeated messages is 1 (set to 1). Confirm that the messages with RI = 1, 2, 3 are not repeated;
c) the configuration is correctly stored;
d) the messages with RI = 0 and 1 are repeated. Confirm that the RI in the repeated messages is 2 (set to 2). Confirm that the messages with RI = 2 and 3 are not repeated;
e) the configuration is correctly stored;
f) the messages with RI = 0, 1 and 2 are repeated. Confirm that the RI in the repeated messages is 3 (set to 3). Confirm that messages with RI = 3 are not repeated.

6.2.4 Synchronisation jitter

(See 4.1.3)

6.2.4.1 Purpose

The correct transmission timing of the repetitions is verified.

6.2.4.2 Method of measurement

The method of measurement is as follows:

a) make UTC available. Apply position report messages to be repeated;

b) make UTC unavailable. Apply position report messages to be repeated with sync state 0;

c) make UTC unavailable. Apply only position report messages to be repeated with sync state 3.

6.2.4.3 Required results

Confirm that:

a) the sync jitter does not exceed ±104 μs. Confirm that the sync state in the repeated messages is 0;

b) the sync jitter does not exceed ±312 μs. Confirm that the sync state in the repeated messages is 1;

c) the messages are not repeated.

6.3 VDL access

(See 4.3.8)

6.3.1 RATDMA

(See 4.1.4.2)

6.3.1.1 Basic RATDMA test

6.3.1.1.1 Purpose

This test checks the basic repetition function in RATDMA mode and verifies that only free slots are used for transmission.

6.3.1.1.2 Method of measurement

The method of measurement is as follows:

a) apply messages to be repeated. The messages shall be a combination of SOTDMA and ITDMA messages;

b) apply messages with position outside the include area in defined slots using 50 % of the slots. Apply messages to be repeated.

6.3.1.1.3 Required results

Confirm that:

a) all messages are repeated within 4 s. Confirm that RATDMA is used for the selection of the slots. Confirm that the communication states of the received messages are changed according to Table 1 for SOTDMA communication states and Table 2 for ITDMA communication states;

b) the repeated messages use only slots which are not used by the other AIS units.

6.3.1.2 Slot reservation by Message 20

6.3.1.2.1 Purpose

This test checks that the slot reservations by received Message 20 are considered.

6.3.1.2.2 Method of measurement

The method of measurement is as follows:

a) apply Message 4 with a base station MMSI and a position within 120 NM of the EUT to the VDL. Transmit a data link management message (Message 20) on Channel A from the same base station with slot offset and increment. Record transmitted messages;

b) repeat test a) with a non base station MMSI for Messages 4 and 20;

c) repeat test a) when the EUT has no position;

d) repeat test a) with the Message 4 position beyond 120 NM;

e) repeat test a) without base station report (Message 4).

6.3.1.2.3 Required results

Confirm that:

a) after 1 min the EUT does not use slots allocated by Message 20 for own transmissions until the timeout given in the Message 20. Confirm that the EUT does not use the same slots on Channel B;

b) the EUT treats the slots as free;

c) the EUT does not use slots allocated by Message 20 for own transmissions until the timeout given in the Message 20;

d) the EUT treats the slots as free;

e) the EUT treats the slots as free.

6.3.1.3 Slot reservation by configuration

(See 4.4.4.2)

6.3.1.3.1 Purpose

This test verifies that slots which are assigned by configuration with Usage flag = 2 (restricted for own use) are not used for own transmissions.

6.3.1.3.2 Method of measurement

The method of measurement is as follows:

a) define 10 assignment sets for each channel with a significant number of slots with usage flag = 2 (restricted from own use);

b) Apply messages to be repeated.

6.3.1.3.3 Required results

Confirm that:

a) the configuration is correctly stored;

b) the restricted slots are not used for transmissions.

6.3.1.4 Slot reuse by distance

(See 4.3.10)

6.3.1.4.1 Purpose

This test checks the slot reuse function which re-uses slots of distant stations.

6.3.1.4.2 Method of measurement

The method of measurement is as follows:

a) apply near and distant AIS units occupying all slots. One AIS unit has a position inside the repetition area, all other have positions outside the repetition area:

b) delete the own position of the repeater station.

6.3.1.4.3 Required results

Confirm that:

a) the messages with position inside the repetition area are repeated. Confirm that only slots of distant AIS units are used for repetition. Confirm that a message is not re-used more than once in a frame;

b) the messages are not repeated.

6.3.1.5 Slot reuse by RSSI level

6.3.1.5.1 Purpose

This test checks the slot reuse function considering RSSI level.

6.3.1.5.2 Method of measurement

The method of measurement is as follows:

a) apply messages to the VDL occupying 50 % of the slots. Some shall be within the repetition area and the majority shall be outside the repetition area. Apply an RF signal with a level of –110 dBm representing the noise floor to 50 % of the slots which are not used by the AIS units and an RF signal with a level of –97 dBm (<16 dB above the noise floor) to the other 50 % of the slots not used by the AIS units;

b) apply messages to the VDL occupying 50 % of the slots. Some shall be within the repetition area and the majority shall be outside the repetition area. Apply an RF signal with a level of –110 dBm representing the noise floor to 50 % of the slots which are not used by the AIS units and an RF signal with a level of –90 dBm (>16 dB above the noise floor) to the other 50 % of the slots not used by the AIS units;

c) apply messages to the VDL occupying 50 % of the slots. Some shall be within the repetition area and the majority shall be outside the repetition area. Apply an RF signal with a level of –110 dBm representing the noise floor to a few slots per frame which are not used by the AIS units. Apply an RF signal with a level of –90 dBm (>16 dB above the noise floor) to 10 % of the slots not used by the AIS units. Make sure that in each 4 s selection interval there are at least 4 of these slots. Apply an RF signal with a level of −80 dBm to the rest of the slots not used by the AIS units.

6.3.1.5.3 Required results

Confirm that:

a) the messages with position inside the repetition area are repeated. Confirm that slots used by the AIS units are not used for message repetition. Confirm that the slots with −110 dBm and slots with –97 dBm signal are used with the same probability for message repetition;

b) the messages with position inside the repetition area are repeated. Confirm that slots used by the AIS units are not used for message repetition. Confirm that slots with −90 dBm signal are not used for message repetition;

c) the messages with position inside the repetition area are repeated. Confirm that slots used by the AIS units are not used for message repetition. Confirm that the slots with −80 dBm signal level are not used for message repetition.

6.3.2 FATDMA access

(See 4.1.4.2)

6.3.2.1 Purpose

This test verifies that FATDMA slots assigned for own use are used for own transmissions as far as available.

6.3.2.2 Method of measurement

The method of measurement is as follows:

a) set EUT to the standard test set-up. Define two assignment sets defining slots every 8 s on each channel with usage flag = 1 (assigned for own use);

b) apply messages to be repeated not exceeding the number of assigned slots in the selection interval;

c) apply Message 4 within 120 NM and Message 20 with reservation for the assigned slots. Apply messages to be repeated not exceeding the number of assigned slots;

d) apply messages to be repeated exceeding the number of assigned slots;

e) apply messages 10 slots before an assigned FATDMA slot;

f) define all 10 assignment sets for each channel with slots for own use;

g) apply messages to be repeated not exceeding the number of assigned slots in the selection interval;

h) configure the EUT to disable RATDMA operation;

i) apply messages to be repeated exceeding the number of assigned slots.

6.3.2.3 Required results

Confirm that:

a) the configuration is correctly stored;

b) only assigned FATDMA slots are used for repetitions. Confirm that the messages are repeated within 9 s;

c) only assigned FATDMA slots are used for repetitions;

d) FATDMA slots are used with priority and that RATDMA slots are used if no FATDMA slots are available;

e) the messages are repeated with a delay of 10 slots;

f) the configuration is correctly stored;

g) only assigned FATDMA slots are used for repetitions;

h) the configuration is correctly stored;

i) the EUT increases the down sampling factor until all stations can be repeated.

6.3.3 ITDMA access

(See 4.1.4.3)

6.3.3.1 Purpose

This test verifies that ITDMA slot allocation is used where possible, independent of the MMSI of the repeated messages.

6.3.3.2 Method of measurement

Apply position reports from different MMSIs with more than 2 messages per 4 s interval.

6.3.3.3 Required results

Confirm that an ITDMA communication state of a Message 1 is used to allocate a slot for a Message 2 under the following conditions:

- Message 2 is received in the time between reception and transmission of Message 1;
- Message 2 is transmitted later than Message 1;
- The MMSI of Message 1 and 2 can be equal or different.

Confirm that the message type of Message 1 is 3 and the keep flag is 0.

6.4 Repetition rates

6.4.1 Downsampling

(See 4.3.5)

6.4.1.1 Purpose

This test checks the downsampling function. It verifies that the maximum repeat interval appropriate to the stationary/moving status of the received vessel is used.

6.4.1.2 Method of measurement

The method of measurement is as follows:

a) set downsampling factor to 1 (default). Set maximum repeat interval for a stationary vessel to 8 min and for a moving vessel to 17 s. Set the fixed repeat interval to 0 (= default = no fixed interval);
b) apply position reports with 2 s, 6 s, 10 s and 3 min intervals;
c) set downsampling factor to 2;
d) apply position reports with 2 s, 6 s, 10 s and 3 min intervals;
e) set downsampling factor to 3;
f) apply position reports with 2 s, 6 s and 3 min intervals;
g) apply position reports with 10 s interval;
h) set downsampling factor to 4;
i) apply position reports with 2 s interval;
j) apply position reports with 6 s and 3 min intervals;
k) apply position reports with 10 s interval.

6.4.1.3 Required results

Confirm that:

a) the configuration is correctly stored;
b) all messages are repeated without downsampling;
c) the configuration is correctly stored;
d) every 2nd message is repeated (4 s, 12 s, 20 s and 6 min intervals). Confirm that the content of the last received message is transmitted;
e) the configuration is correctly stored;

f) every 3rd message is repeated (6 s, 18 s and 9 min intervals). Confirm that the content of the last received message is transmitted;

g) every 2nd message is repeated (20 s interval) complying with the maximum repeat interval. Confirm that the content of the last received message is transmitted;

h) the configuration is correctly stored;

i) every 4th message is repeated (8 s interval);

j) every 3rd message is repeated (18 s and 9 min intervals) complying with the maximum repeat interval;

k) every 2nd message is repeated (20 s interval) complying with the maximum repeat interval.

6.4.2 Fixed repetition interval

(See 4.3.5)

6.4.2.1 Purpose

This test checks the fixed repetition interval function. It verifies that the fixed repetition interval configuration appropriate to the stationary/moving status of the received vessel is used.

6.4.2.2 Method of measurement

The method of measurement is as follows:

a) set the fixed repetition interval for the moving vessel to 15 s and for the stationary vessel to 5 min;

b) apply position reports with 2 s, 6 s, 10 s interval;

c) apply position reports with 3 min interval.

6.4.2.3 Required results

Confirm that:

a) the configuration is correctly stored;

b) the reporting interval is 15 s. Confirm that the content of the last received message from each MMSI is transmitted;

c) the reporting interval is 6 min. Confirm that the next valid message from each MMSI is transmitted.

6.4.3 Maximum VDL load

(See 4.3.9)

6.4.3.1 Purpose

The test checks the behaviour of the EUT to avoid exceeding the maximum VDL load.

6.4.3.2 Method of measurement

The method of measurement is as follows:

a) set EUT to the standard test set-up. Maximum VDL usage = 50;

b) apply position reports to the EUT not using more than 50 slots per frame per channel for at least 60 s;

c) apply position reports to the EUT using about 80 slots per frame per channel;

d) apply position reports to the EUT using about 180 slots per frame per channel;

e) set the maximum VDL usage to 200 (Type 1 only);

f) apply position reports to the EUT not using more than 200 slots per frame per channel (Type 1 only);

g) apply position reports to the EUT using about 300 slots per frame per channel (Type 1 only);

h) set the maximum VDL usage to 401 for a type 1 repeater station and 51 for a type 2 repeater station;

i) set the maximum VDL usage to 10 for both types of repeater station.

6.4.3.3 Required results

Confirm that:

a) the configuration is correctly stored;

b) all messages are repeated and verify that the average power consumption does not exceed the manufacturer stated value;

c) the EUT repeats messages with a downsampling factor of 2 and that the maximum of 50 slots per frame and channel is not exceeded;

d) the EUT repeats messages with a downsampling factor of 4 and that the maximum of 50 slots per frame and channel is not exceeded;

e) the configuration is correctly stored;

f) all messages are repeated;

g) the EUT repeats messages with a downsampling factor of 2 and that the maximum of 200 slots per frame and channel is not exceeded;

h) the setting is not accepted;

i) the configuration is correctly stored.

6.4.4 Maximum transmissions per second

(See 4.3.9)

6.4.4.1 Purpose

This test verifies that the maximum number of transmissions per second is not exceeded.

6.4.4.2 Method of measurement

Apply more than 12 messages per second in some seconds of a frame, not exceeding 50 slots per channel in a frame.

6.4.4.3 Required results

Confirm that no more than 12 messages are repeated in any one second and that all messages are repeated.

6.4.5 Age of time stamp

(See 4.3.1)

6.4.5.1 Purpose

This test verifies that messages with a time stamp older than 30 s are not repeated.

6.4.5.2 Method of measurement

Apply position reports with time stamp older than 30 s.

6.4.5.3 Required results

Confirm that the messages are not repeated.

6.5 Filtering

6.5.1 Duplicate filtering

(See 4.3.3)

6.5.1.1 Purpose

This test verifies that duplicate messages are not repeated within 30 s.

6.5.1.2 Method of measurement

The method of measurement is as follows:

a) apply more than one position report (Message 1, 2, 3, 18) with same message type, MMSI and time stamp within 30 s;

b) apply a position report with same message type, MMSI and time stamp more than 30 s after a first position report;

c) apply more than one static data report (Message 5, 19, 24A, 24B) with same message type (considering part number of Message 24), MMSI and content within 30 s;

d) apply a static data report with same message type and MMSI more than 30 s after a first static data report.

6.5.1.3 Required results

Confirm that:

a) only one message is repeated and the following messages with the with same message type, MMSI and time are not repeated;

b) the second position report is repeated;

c) only the first message is repeated and the following messages with same message type, MMSI and content are not repeated;

d) the second static data report is repeated.

6.5.2 Channel filtering

(See 4.3.6)

6.5.2.1 Purpose

This test verifies the channel filtering function. According to the configuration, messages are transmitted on one channel only.

6.5.2.2 Method of measurement

The method of measurement is as follows:

a) set the configuration parameter Channel A to a valid channel number and Channel B to 0;

b) apply messages to be repeated on both channels;

c) set the configuration parameter Channel A to 0 and Channel B to a valid channel number;

d) apply messages to be repeated on both channels;

e) set the configuration parameter Channel A and Channel B to valid channel numbers;

f) apply messages to be repeated on both channels.

6.5.2.3 Required results

Confirm that:

a) the configuration is correctly stored;
b) only the messages on Channel A are repeated;
c) the configuration is correctly stored;
d) only the messages on Channel B are repeated;
e) the configuration is correctly stored;
f) the messages on both Channel A and B are repeated.

6.5.3 Position filtering

(See 4.3.4.3)

6.5.3.1 No area definition

(See 4.3.7.3)

6.5.3.1.1 Purpose

This test verifies that messages are not repeated if no “Include” area is defined.

6.5.3.1.2 Method of measurement

The method of measurement is as follows:

a) set the parameter “Exclude or include” of all areas to 0 = no area filtering;
b) apply messages to the VDL.

6.5.3.1.3 Required results

Confirm that:

a) the configuration is correctly stored;
b) no messages are repeated.

6.5.3.2 Definition of one area

(See 4.3.7.3)

6.5.3.2.1 Purpose

This test checks the basic position filtering if an include area is defined.

6.5.3.2.2 Method of measurement

The method of measurement is as follows:

a) apply the standard test set-up with one include area;
b) apply position reports (Message 1, 2, 3) with position inside the area and static data reports (Message 5) from the same MMSI;
c) apply position reports (Message 1, 2, 3) with position outside the area and static data reports (Message 5) from the same MMSI;
d) apply Message 5 without associated position reports from the same MMSI;
e) apply Message 1 with default position (position unknown).

6.5.3.2.3 Required results

Confirm that:

a) the configuration is correctly stored;
b) the position reports and static data reports from stations inside the area are repeated;
c) the position reports and static data reports from stations outside the area are not repeated;
d) Message 5 is repeated;
e) Message 1 with unknown position is not repeated.

6.5.3.3 Definition and handling of 8 areas

(See 4.3.7.3)

6.5.3.3.1 Purpose

This test verifies that up to 8 areas can be stored and checks that the combinations of several area definitions are correctly handled.

6.5.3.3.2 Method of measurement

The method of measurement is as follows:

a) define 8 areas with default settings, no filtering (see Annex B with area illustration);
   - area 1 is a single include area, identical to the area of the standard test set-up;
   - areas 2 and 3 are include areas, partly overlapping;
   - area 4 is a single include area. Area 5 is an exclude area, fully inside area 4;
   - area 6 is an include area, area 7 is an exclude area, partly overlapping area 6;
   - area 8 is a single exclude area;
b) apply position reports, position inside area 1;
c) apply position reports, position inside area 2, inside area 3 and inside the overlapping range of area 2 and 3;
d) apply position reports, position inside area 4 but outside area 5;
e) apply position reports, position inside area 5;
f) apply position reports, position inside area 6 but outside area 7;
g) apply position reports, position in the overlapping range of area 6 and 7;
h) apply position reports, position inside area 7 but outside area 6;
i) apply position reports, position inside area 8;
j) apply position reports, position outside of all areas.

6.5.3.3.3 Required results

Confirm that:

a) the configuration is correctly stored;
b) the position reports are repeated;
c) the position reports are repeated;
d) the position reports are repeated;
e) the position reports are not repeated;
f) the position reports are repeated;
g) the position reports are not repeated;
h) the position reports are not repeated;
i) the position reports are not repeated;
j) the position reports are not repeated.

6.5.4 Message type filtering

(See 4.3.4.1, 4.3.7.6)

6.5.4.1 Purpose

This test verifies that messages can be included or excluded from repetition by configuration. The test also verifies that messages which are prohibited from repetition according to Table 5 are not repeated. Finally the test verifies that the configuration settings of the correct area are applied.

6.5.4.2 Method of measurement

The method of measurement is as follows:

a) in addition to the standard test set-up define a second include area;

area 1: Set all message types to On;

area 2: Set all message types to Off;

b) apply all message types including Message 15 with and without slot offset from a station with position in area 1;

c) apply all message types from a station with position in area 2;

d) set some message types of area 1 to Off;

e) apply the message types which are set to OFF in d) with position in area 1.

6.5.4.3 Required results

Confirm that:

a) the configuration is correctly stored;

b) all message types with a “yes” in Table 5 are repeated, all message types with “No” in Table 5 are not repeated. Confirm that Message 15 with slot offset is not repeated. Confirm that the content of all messages except RI and communication state is not changed. Confirm that the CRC is correct;

c) no messages are repeated;

d) the configuration is correctly stored;

e) the messages set to Off are not repeated.

6.5.5 Message content filtering

6.5.5.1 SOG filtering

(See 4.3.4.4, 4.3.7.4)

6.5.5.1.1 Purpose

This test checks the filtering depending on the SOG. The test also verifies that the configuration settings of the correct area are applied.

6.5.5.1.2 Method of measurement

The method of measurement is as follows:

a) define overlapping areas area 2 and area 3 as described in Annex B;

area 2: Define “Minimum SOG for repeating” = 0 (no filtering);

area 3: Define a minimum SOG;

b) apply Message 1 with SOG < min SOG of area 3, position inside area 2 but outside of area 3;

c) apply Message 1 with SOG > min SOG of area 3, position inside the overlapping portion of area 2 and area 3;

d) apply Message 1 with SOG < min SOG of area 3, position inside the overlapping portion of area 2 and area 3.

6.5.5.1.3 Required results

Confirm that:

a) the configuration has been correctly stored;

b) Message 1 is repeated;

c) Message 1 is repeated;

d) Message 1 is not repeated.

6.5.5.2 COG filtering

(See 4.3.7.5)

6.5.5.2.1 Purpose

This test checks the filtering depending on the COG. The test also verifies that the configuration settings of the correct area are applied.

6.5.5.2.2 Method of measurement

The method of measurement is as follows:

a) in addition to the standard test set-up define a second include area;
   area 1: Set COG filter to 1 (include), define the first and last COG;
   area 2: Set COG filter to 0 (exclude), define the first and last COG;

b) apply Message 1 with COG in COG range, position in area 1;

c) apply Message 1 with COG out of COG range, position in area 1;

d) apply Message 1 with COG in COG range, position in area 2;

e) apply Message 1 with COG out of COG range, position in area 2.

6.5.5.2.3 Required results

Confirm that:

a) the configuration has been correctly stored;

b) Message 1 is repeated;

c) Message 1 is not repeated;

d) Message 1 is not repeated;

e) Message 1 is repeated.

6.5.5.3 NavStatus filtering

(See 4.3.7.7)

6.5.5.3.1 Purpose

This test checks the filtering depending on the navigational status.

6.5.5.3.2 Method of measurement

The method of measurement is as follows.

a) In addition to the standard test set-up define a second include area.

area 1: Enable NavStatus filtering, set some NavStatus values to 0 (exclude), some to 1 (include).

area 2: Disable NavStatus filtering, set some NavStatus values to 0 (exclude), some to 1 (include).

b) apply Message 1 to the EUT, position in area 1, with several relevant NavStatus values.

c) apply Message 1 to the EUT, position in area 2, with several NavStatus values.

6.5.5.3.3 Required results

Confirm that:

a) the configuration has been correctly stored;

b) messages with NavStatus values configured to **include** are repeated and messages with NavStatusvalues configured to **exclude** are not repeated;

c) all messages are repeated.

6.5.5.4 Ship/cargo type filtering

(See 4.3.7.8)

6.5.5.4.1 Purpose

This test checks the filtering depending on the cargo/ship type.

6.5.5.4.2 Method of measurement

The method of measurement is as follows.

a) in addition to the standard test set-up define a second include area.

area 1: Enable cargo/ship type filtering and set the default behaviour to include all ship types. Add some specific cargo/ship type values to the exception list.

area 2: Enable cargo/ship type filtering and set the default behaviour to exclude all ship types. Add some specific cargo/ship type values to the exception list.

b) apply Messages 1 and 5 from the same MMSI to the EUT, position in area 1, several cargo/ship type values, (included and excluded).

c) apply Messages 1 and 5 from the same MMSI to the EUT, position in area 2, several cargo/ship type values (included and excluded).

d) modify the configuration for area 1 to disable cargo/ship type filtering

e) Repeat b)

6.5.5.4.3 Required results

Confirm that:

a) the configuration is correctly stored;

b) Messages 1 and 5 from stations with cargo/ship type values outside of the exception list are repeated and all other messages are not repeated;

c) Messages 1 and 5 from stations with cargo/ship type values within the exception list are repeated and all other messages are not repeated;

d) the configuration is correctly stored;

e) Messages 1 and 5 from all stations are repeated.

6.5.5.5 MMSI filtering

(See 4.3.7.2)

6.5.5.5.1 Purpose

This test verifies the filtering depending on MMSIs. The first set of MMSIs defines how MMSIs outside the defined MMSI range are handled.

- If the “Exclude or include” parameter of the first set is defined as 0 = no MMSI filtering all MMSIs are repeated.
- If the “Exclude or include” parameter of the first set is defined as 1 = Include all MMSIs outside the defined MMSI range are not repeated.
- If the “Exclude or include” parameter of the first set is defined as 2 = Exclude all MMSIs outside the defined MMSI range are repeated.

Up to 4 different useful combinations are possible for 2 sets of MMSIs.

- 2 include sets: Only MMSIs in the include sets are repeated.
- 2 exclude sets: Only MMSIs outside the exclude sets are repeated.
- First set: include, second set: exclude, the range of the second set is inside the first set: All MMSIs in the include set are repeated.
- First set: exclude, second set: include, the range of the second set inside the first set: Only MMSIs inside the include range are repeated.

6.5.5.5.2 Method of measurement

The method of measurement is as follows:

a) set all MMSI filtering sets to 0 = no MMSI filtering (Default);
b) apply messages with different MMSIs to the EUT;
c) define two MMSI include sets;
d) apply messages, MMSI outside both sets;
e) apply messages, MMSI inside both sets;
f) define two MMSI exclude sets;
g) apply messages, MMSI outside both sets;
h) apply messages, MMSI inside both sets;
i) define 2 sets of MMSI filtering:
   set 1: 1 = include, define MMSI range;
   set 2: 2 = exclude, define MMSI range inside the range of set 1.
j) apply messages, MMSI outside both ranges;
k) apply messages, MMSI in set 1, not in set 2;
l) apply messages, MMSI in set 2;
m) define 2 sets of MMSI filtering:
   set 1: 2 = exclude, define MMSI range;
   set 2: 1 = include, define MMSI range inside the range of set 1.
n) apply messages, MMSI outside both ranges;
o) apply messages, MMSI in set 1, not in set 2;
p) apply messages, MMSI in set 2.

6.5.5.5.3 Required results

Confirm that:

a) the configuration is correctly stored;
b) the messages are repeated;

c) the configuration is correctly stored;
d) the messages are not repeated;
e) the messages are repeated;
f) the configuration is correctly stored;
g) the messages are repeated;
h) the messages are not repeated;
i) the configuration is correctly stored;
j) the messages are not repeated;
k) the messages are repeated;
l) the messages are repeated;
m) the configuration is correctly stored;
n) the messages are not repeated;
o) the messages are not repeated;
p) the messages are repeated.

6.5.5.6 Stationary vessel filtering

(See 4.3.7.9)

6.5.5.6.1 Purpose

This test checks for correct operation of stationary vessel filtering.

6.5.5.6.2 Method of measurement

The method of measurement is as follows:

a) in addition to the standard test set-up define a second include area;
   area 1: Enable stationary vessel filtering;
   area 2: Disable stationary vessel filtering;
b) apply Message 1 to the EUT, position in area 1, with the NavStatus set to ‘at anchor’ and SOG ≤ 3 kn;
c) apply Message 1 to the EUT, position in area 1, with the NavStatus set to ‘at anchor’ and SOG > 3 kn;
d) repeat test b) with the NavStatus set to ‘moored’;
e) apply Message 1 to the EUT, position in area 2, with the NavStatus set to ‘at anchor’ and SOG = 3 kn.
f) repeat test b) with NavStatus = 0 (under way) and SOG < 3 kn.

6.5.5.6.3 Required results

Confirm that:

a) the configuration has been correctly stored;
b) the message is not repeated;
c) the message is repeated;
d) the message is not repeated;
e) the message is repeated;
f) the message is repeated.

6.5.6 AIS-SART filtering

(See 4.3.4.2, 4.4.3)

6.5.6.1 Purpose

This test checks the special repetition behaviour of AIS-SART messages.

6.5.6.2 Method of measurement

The method of measurement is as follows.

a) apply active AIS-SART Messages 1 and 14 with position of Message 1 inside the area;
b) stop the AIS-SART transmission;
c) apply active AIS-SART messages with position outside the area;
d) apply active AIS-SART messages with default position;
e) AIS-SART test repetition disabled (default). Apply AIS-SART test messages (Message 1 and Message 14);
f) enable AIS-SART test repetition;
g) apply AIS-SART test message (Message 1 and Message 14).

6.5.6.3 Required results

Confirm that:

a) Messages 1 and 14 are repeated. Confirm that only one message of a burst is repeated;
b) the repetition of the AIS-SART message is continued for 15 min with a reporting interval of 1 min;
c) Messages 1 and 14 are repeated;
d) Messages 1 and 14 are repeated. Confirm that a binary Message 26, DAC 995, FI 9 is transmitted and that the text includes the unique ID of the AIS-SART and the RSSI value;
e) Messages 1 and 14 are not repeated;
f) the configuration is correctly stored;
g) Messages 1 and 14 are repeated.

6.6 Repeater station identification message

(See 4.4)

6.6.1 Purpose

This test checks the transmission of repeater station identification messages.

6.6.2 Method of measurement

The method of measurement is as follows:

a) set a transmission schedule for the own identification report, Interval = 13 500 (6 × 2 250) slots = 6 min, Access scheme = 1 (FATDMA);
b) set the access scheme to 2 (ITDMA);
c) set the access scheme to 3 (SOTDMA). Change the Interval to 1 125 slots = 30 s;
d) set the access scheme to 0 (depending on reporting interval);
e) set the primary position source to 0 = internal GNSS;
f) change the transmission interval to 13 500 slots = 6 min;
g) set the interval to 0.

6.6.3 Required results

Confirm that:

a) the configuration is correctly stored. Confirm that the own identification message (Message 26) is transmitted according to the configured transmission schedule (UTC minute, start slot, interval), alternating between Channel A and B. Confirm that the content of Message 26 is correct according to the message definition and configuration settings by evaluation of the VDL message and VDO sentence. Confirm that an ITDMA communication state is used with keep flag = 0 and slot increment = 0;

b) the configuration is correctly stored. Confirm that Message 26 is transmitted in ITDMA mode with the defined slot interval. Confirm that an ITDMA communication state is used with the correct slot allocation according to the transmission schedule;

c) the configuration is correctly stored. Confirm that Message 26 is transmitted in SOTDMA mode with the defined slot interval. Confirm that the communication state selector is set to 0. Confirm that a SOTDMA communication state is used with the correct slot allocation according to the transmission schedule;

d) the configuration is correctly stored. Confirm that Message 26 is transmitted in SOTDMA mode with the defined slot interval of 30 s;

e) the correct position from the internal GNSS is transmitted in the identification message;

f) the configuration is correctly stored. Confirm that Message 26 is transmitted in ITDMA mode with the defined slot interval of 6 min using an ITDMA communication state;

g) the configuration is correctly stored. Confirm that the transmission of Message 26 is stopped.

7 Test conditions

7.1 Normal and extreme test conditions

7.1.1 Normal test conditions

7.1.1.1 Temperature and humidity

Temperature and humidity shall be within following range:

Temperature +15 °C to +35 °C

Humidity 20 % to 75 %

7.1.1.2 Power supply

The normal power supply for the tests shall be in accordance with IEC 60945.

7.1.2 Extreme test conditions

Extreme test conditions are as specified in IEC 60945. Where required, test under extreme test conditions shall be a combination of dry heat and upper limit of supply voltage applied simultaneously and low temperature and lower limit of supply voltage applied simultaneously.

During type testing the power source to the equipment may be replaced by a test power source, capable of producing normal and extreme test voltages.

7.2 Additional test arrangements

7.2.1 Arrangements for test signals applied to the receiver input

Sources of test signals for application to the receiver input shall be connected in such a way that the source impedance presented to the receiver input is 50 Ω (see 7.2.4).

This requirement shall be met irrespective of whether one or more signals using a combining network are applied to the receiver simultaneously.

The power levels of the test signals at the receiver input terminals (RF socket) shall be expressed in terms of dBm.

The effects of any intermodulation products and noise produced in the test signal sources shall be negligible.

7.2.2 Encoder for receiver measurements

Whenever needed and in order to facilitate measurements on the receiver, an encoder for the data system shall accompany the EUT, together with details of the normal modulation process. The encoder is used to modulate a signal generator for use as a test signal source.

Complete details of all codes and code format(s) used shall be given.

7.2.3 Waiver for receivers

If the manufacturer declares that both TDMA receivers are identical, the test may be limited to one receiver and the test for the second receiver may be waived. The test report shall mention this.

7.2.4 Impedance

In this standard the term "50 Ω" is used for a 50 Ω non-reactive impedance.

7.2.5 Artificial antenna (dummy load)

Tests shall be carried out using an artificial antenna which shall be a non-reactive non-radiating load of 50 Ω connected to the antenna connector.

7.2.6 Facilities for access

All tests shall be performed using the standard ports of the EUT. Where access facilities are required to enable any specific test, these shall be provided by the manufacturer.

7.2.7 Modes of operation of the transmitter

For the purpose of the measurements according to this standard, there shall be a facility to operate the transmitter unmodulated.

Alternatively, the method of obtaining an unmodulated carrier or special types of modulation patterns may also be decided by agreement between the manufacturer and the test laboratory. It shall be described in the test report. It may involve suitable temporary internal modifications of the equipment under test.

7.3 Measurement uncertainties

Maximum values of absolute measurement uncertainties shall be as follows:

RF frequency	$\pm 1 \times 10^{-7}$
RF power	±0,75 dB
Adjacent channel power	±5 dB
Conducted spurious emission of transmitter	±4 dB
Conducted spurious emission of receiver	±3 dB
Two-signal measurement	±4 dB

Three-signal measurement	±3 dB
Radiated emission of transmitter	±6 dB
Radiated emission of receiver	±6 dB
Transmitter attack time	±20 %
Transmitter release time	±20 %

For the test methods according to this standard, these uncertainty figures are valid to a confidence level of 95 %.

The interpretation of the results recorded in a test report for the measurements described in this standard shall be as follows:

a) the measured value related to the corresponding limit shall be used to decide whether an equipment meets the requirements of this standard;
b) the actual measurement uncertainty of the test laboratory carrying out the measurements, for each particular measurement, shall be included in the test report;
c) the values of the actual measurement uncertainty shall be, for each measurement, equal to or lower than the figures given in this clause (absolute measurement uncertainties).

7.4 Test signals

7.4.1 Standard test signal number 1

A series of 010101 as the data within an AIS Message frame, with header, start flag, end flag and CRC. NRZI is not applied to the 010101 bit stream (i.e. unaltered "On air" data). The RF shall be ramped up and down on both ends of the AIS message frame.

7.4.2 Standard test signal number 2

A series of 00001111 as the data within an AIS message frame, with header, start flag, end flag and CRC. NRZI is not applied to the 00001111 bit stream. The RF shall be ramped up and down on both ends of the AIS message frame.

7.4.3 Standard test signal number 3

A Pseudo Random Sequence (PRS) as specified in Recommendation ITU-T O.153 as the data within an AIS message frame with header, start flag, end flag and CRC. NRZI is not applied to the PRS stream. The RF shall be ramped up and down on both ends of the AIS message frame.

7.4.4 Standard test signal number 4

This test signal consists of 200 packets grouped into clusters of 4 as described in Figure 3. Each cluster consists of 2 consecutive transmissions of the packets described in Table 22.

NRZI shall be applied to every packet. After sending packet 1 and 2 the initial state of the NRZI process shall be inverted and then packet 1 and 2 repeated.

Between every transmitted packet there shall be at least 2 free slots. The RF carrier shall be switched off between packets to simulate slotted behaviour.

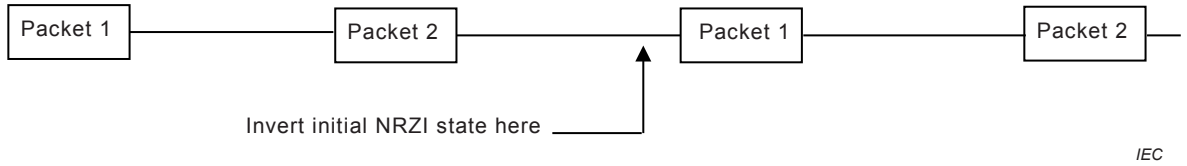


Figure 3 – Format for repeating four-packet cluster

Table 22 – Content of first two packets

Packet	Parameter	Bits	Contents	Comment
1	Training	24	0101....0101	
	Start flag	8	01111110	
	Data	168	Pseudo random	As per Table 23
	CRC	16	Calculated	
	End flag	8	01111110	
2	Training	24	1010....1010	
	Start flag	8	01111110	
	Data	168	Pseudo random	As per Table 23
	CRC	16	Calculated	
	End flag	8	01111110	

Table 23 – Fixed PRS data derived from Recommendation ITU-T O.153

Address	Contents (HEX)							
0–7	0x04	0xF6	0xD5	0x8E	0xFB	0x01	0x4C	0xC7
	0000.0100	1111.0110	1101.0101	1000.1110	1111.1011	0000.0001	0100.1100	1100.0111
8–15	0x76	0x1E	0xBC	0x5B	0xE5	0x92	0xA6	0x2F
	0111.0110	0001.1110	1011.1100	0101.1011	1110.0101	1001.0010	1010.0110	0010.1111
16–20	0x53	0xF9	0xD6	0xE7	0xE0	21 Bytes = 168 bits (+ 4 stuffed bits) , CRC = 0x3B85		
	0101.0011	1111.1001	1101.0110	1110.0111	1110.0000			

8 Physical radio tests

8.1 Transceiver protection test

(See 5.2.1)

8.1.1 Purpose

This test demonstrates that the transceiver is properly protected against malfunction due to faults in the antenna system. This shall be the first test applied to the EUT.

8.1.2 Method of measurement

While the transmitter is transmitting at the highest output power, the antenna port shall first be short-circuited and then open-circuited, in each case for a period of 5 min.

The EUT shall transmit 225 single slot messages evenly spread across the 5 min period during the short-circuit condition and the open-circuit condition.

NOTE A method for transmitting these messages will be provided by the manufacturer.

8.1.3 Required results

The proof that the transceiver is protected against malfunctions at the antenna terminal is substantiated by the ability to pass the remainder of the tests in this clause.

8.2 TDMA transmitter

(See 5.2.1)

8.2.1 General

Unless otherwise stated, all transmitter tests shall be performed at the highest power setting.

8.2.2 Frequency error

8.2.2.1 Purpose

The frequency error of the transmitter is the difference between the measured carrier frequency in the absence of modulation and its required frequency.

8.2.2.2 Method of measurement

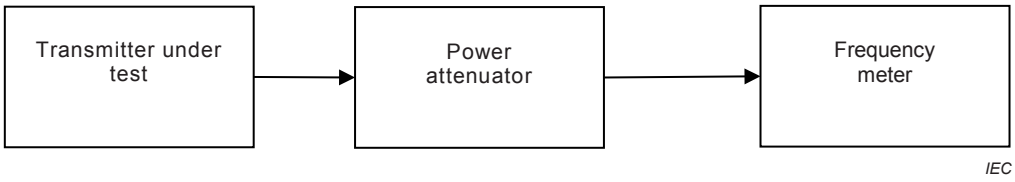


Figure 4 – Measurement arrangement

The equipment shall be connected as illustrated in Figure 4.

The carrier frequency shall be measured in the absence of modulation or using test signal number 1.

The measurement shall be made under normal test conditions and extreme test conditions.

The test shall be performed at 156,025 MHz and 162,025 MHz (AIS2).

8.2.2.3 Required results

The frequency error shall not exceed ±0,5 kHz, under normal test conditions and ±1 kHz under extreme test conditions.

8.2.3 Carrier power

8.2.3.1 Purpose

The transmitter carrier power conducted (P_c) is the mean power delivered to a nominal 50 Ω load during a radio frequency cycle. The rated nominal power setting shall be defined by the manufacturer. If there is a requirement for different nominal power settings, the carrier power accuracy shall be tested at all settings.

8.2.3.2 Method of measurement

The equipment shall be connected as illustrated in Figure 5.

The carrier power shall be measured in the absence of modulation or using test signal number 1.

The measurement shall be made under normal test conditions and extreme test conditions.

The test shall be performed at 156,025 MHz and 162,025 MHz (AIS2).

The carrier power accuracy shall be tested at all power settings.

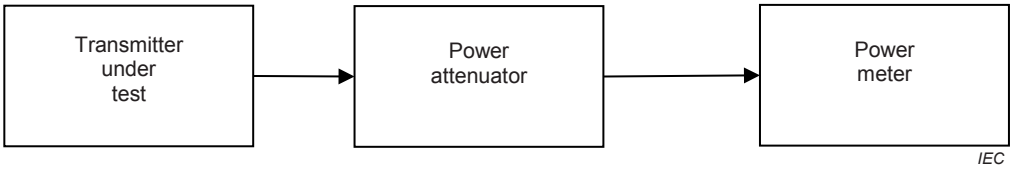


Figure 5 – Measurement arrangement

8.2.3.3 Required results

P_c shall be within ±1,5 dB of the rated carrier power conducted.

P_c under extreme test conditions shall be within ±3 dB of the rated carrier power conducted.

8.2.4 Modulation spectrum slotted transmission

8.2.4.1 Purpose

This test is to ensure that the modulation sidebands produced by the specified test patterns fall within the allowable masks.

8.2.4.2 Method of measurement

The EUT shall be connected to a spectrum analyser.

The test shall be carried out using slotted transmission of test signal number 1.

A minimum resolution bandwidth of 300 Hz and video bandwidth of 3 kHz and positive peak detection (maximum hold) shall be used for this measurement.

A sufficient number of sweeps and transmission packets shall be measured to ensure that the emission profile is developed.

Repeat the test using test signal number 2.

Tests shall be performed at 156,025 MHz and 162,025 MHz (AIS2).

8.2.4.3 Required results

The modulation spectrum shall be within the mask detailed in Figure 6.

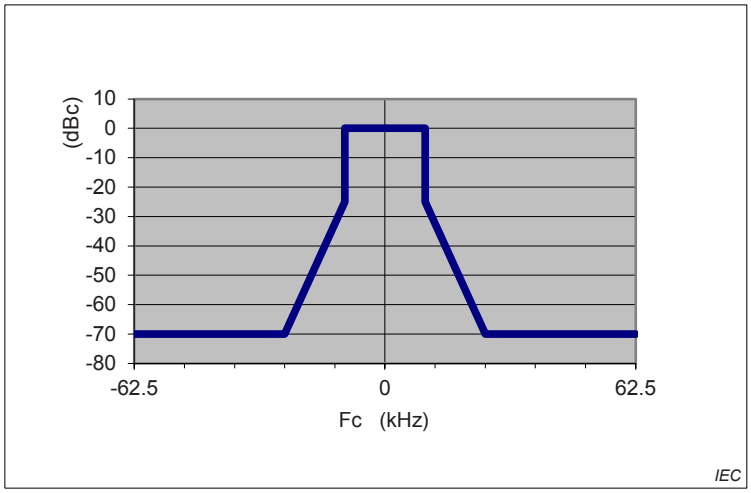


Figure 6 – Modulation spectrum for slotted transmission

The emission mask is:

– at ±10 kHz removed from the carrier, the modulation sidebands are below –25 dBc;

– at ±25 kHz to ±62,5 kHz removed from the carrier, the modulation and transient sidebands shall be below the lower value of –70 dBc, with no need to be below –36 dBm;

– in the region between ±10 kHz and ±25 kHz removed from the carrier, the modulation sidebands shall be below a line specified between these two points.

8.2.5 Transmitter test sequence and modulation accuracy verification

8.2.5.1 Purpose

The test is to verify that the training sequence is a 0101 pattern of 24 bit and starts with a 0. The peak frequency deviation is derived from the baseband signal to verify modulation accuracy.

8.2.5.2 Method of measurement

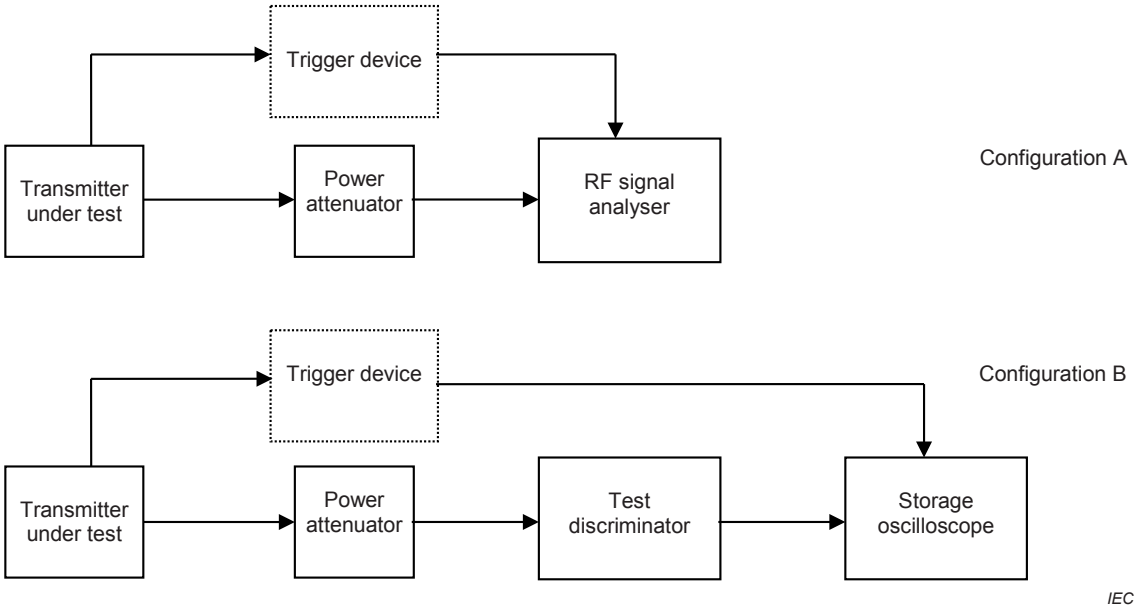


Figure 7 – Measurement arrangement

The measurement procedure shall be as follows:

- the equipment shall be connected in either configuration A or configuration B as shown in Figure 7;
- the trigger device is optional if the equipment is capable of synchronising to the transmitted bursts;
- the transmitter shall be tuned to 156,025 MHz;
- the transmitter shall be modulated with a continuous test signal number 1;
- the deviation from the carrier frequency shall be measured as a function of time;
- repeat the test with test signal number 2;
- measurement shall be repeated at 162,025 MHz (AIS2).

8.2.5.3 Required results

For test signal number 1: the training sequence shall start with a '0' bit and, the peak frequency deviation shall be 1 760 Hz + 352 Hz/ −176 Hz.

For test signal number 2: The peak frequency deviation shall be 2 400 Hz ± 240 Hz.

8.2.6 Transmitter output power versus time function

8.2.6.1 Definition

Transmitter output power versus time function is a combination of the transmitter delay, attack time, release time and transmission duration as defined in Table 24 where:

a) transmitter delay time ($T_A - T_0$) is the time between the start of the slot and the moment when the transmit power exceeds –50 dB of the steady-state power (P_{ss});

b) transmitter attack time ($T_{B2} - T_A$) is the time between the transmit power exceeding −50 dBc and the moment when the transmit power maintains a level within +1,5 dB and −1 dB from P_{ss};

c) transmitter release time ($T_F - T_E$) is the time between the end flag being transmitted and the moment when the transmitter output power has reduced to a level 50 dB below P_{ss} and remains below this level thereafter;

d) transmission duration ($T_F - T_A$) is the time from when power exceeds –50 dBc to when the power returns to and stays below –50 dBc.

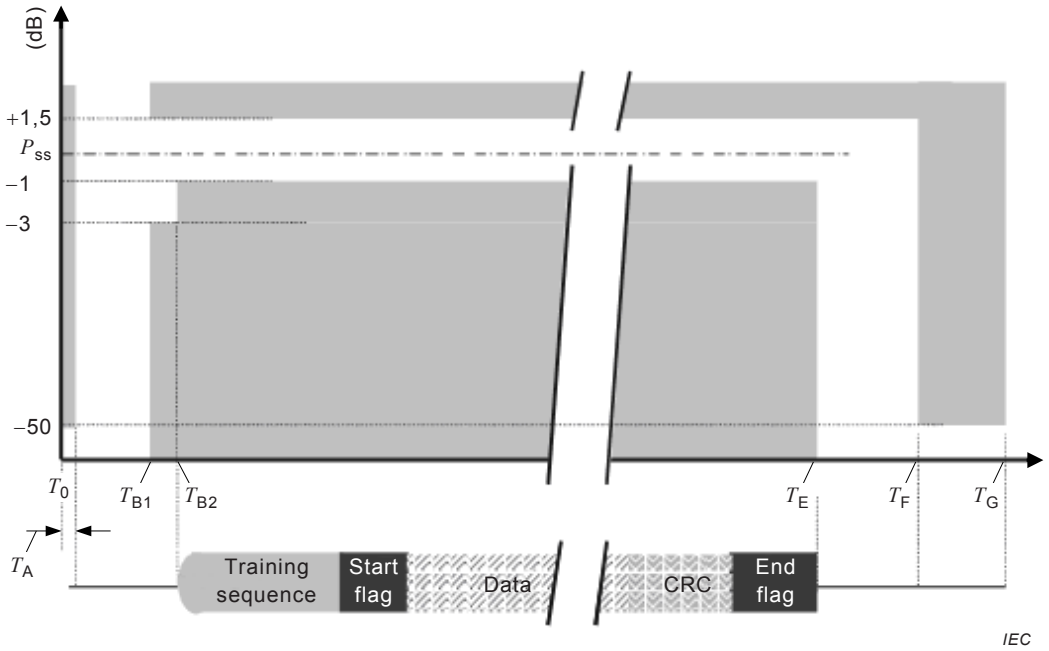


Figure 8 – Power versus time characteristics

Table 24 – Power versus time characteristics

Reference		Bit	Time ms	Definition
T_0		0	0	Start of transmission slot. Power shall NOT exceed –50 dBc (ref. P_{ss}) before T_0
T_A		0 to 6	0 to 0,625	Power exceeds –50 dB of P_{ss}
T_B	T_{B1}	6	0,625	Power shall be within +1,5 or −3 dB of P_{ss}
	T_{B2}	8	0,833	Power shall be within +1,5 or −1 dB of P_{ss};(Start of training sequence
T_E (includes 1 stuffing bit)		233	24,271	Power shall remain within +1,5 or −1 dB of P_{ss} during the period T_{B2} to T_E
T_F (includes 1 stuffing bit)		241	25,104	Power shall be −50 dBc (ref. P_{ss} a) and stay below this
T_G		256	26,667	Start of next transmission time period

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

8.2.6.2 Method of measurement

The measurement shall be carried out by transmitting test signal number 2 (note that this test signal generates one additional stuffing bit within its CRC portion).

The EUT shall be connected to a spectrum analyser. A resolution bandwidth of 1 MHz, video bandwidth of 1 MHz and a sample detector shall be used for this measurement. The analyser shall be in zero-span mode for this measurement.

Tests shall be performed on 156,025 MHz and 162,025 MHz (AIS2).

8.2.6.3 Required result

The transmitter power shall remain within the mask shown in Figure 8 and associated timings given in Table 24.

8.2.7 Intermodulation attenuation (Type 1 only)

8.2.7.1 Purpose

The intermodulation attenuation is a measure of the capability of a transmitter to inhibit the generation of signals caused by the presence of the carrier and an interfering signal entering the transmitter via its antenna.

8.2.7.2 Method of measurement

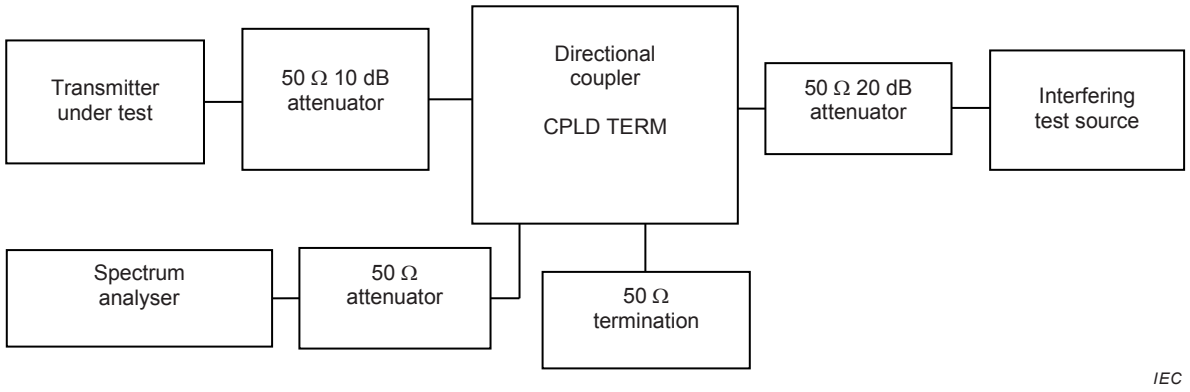


Figure 9 – Measurement arrangement

The measurement arrangement shown in Figure 9 shall be used. The following tests shall be performed on 156,025 MHz and 162,025 MHz (AIS2).

The transmitter shall be connected to a 50 Ω 10 dB power attenuator and via a (directional) coupler to a spectrum analyser. An additional attenuator may be required between the directional coupler and the spectrum analyser to avoid overloading.

In order to reduce the influence of mismatch errors, it is important that the 10 dB power attenuator is coupled to the transmitter under test with the shortest possible connection.

The interfering test signal source shall be either a transmitter providing the same power output as the transmitter under test and be of a similar type, or a signal generator and a linear power amplifier capable of delivering the output power as the transmitter under test and connected via a 50 Ω 20 dB power attenuator to the directional coupler.

The (directional) coupler shall have an insertion loss of less than 1 dB. If a directional coupler is used, it shall have a directivity of at least 20 dB.

The transmitter under test and the test signal source shall be physically separated so that the measurement is not influenced by direct radiation.

The transmitter under test shall be unmodulated and the spectrum analyser adjusted to a span of 500 kHz. The transmitter under test shall be set to continuous transmission mode or to the fastest update rate which is available.

The interfering test signal source shall be unmodulated and its frequency shall be within 50 kHz to 100 kHz above the frequency of the transmitter under test. The frequency shall be

chosen in such a way that the intermodulation components to be measured do not coincide with other spurious components.

The power output of the interfering test signal source shall be adjusted to the carrier power level of the transmitter under test.

The ratio of the largest third order intermodulation component with respect to the carrier shall be measured on the spectrum analyser and recorded.

This measurement shall be repeated with the interfering test signal source at a frequency within 50 kHz to 100 kHz below the frequency of the transmitter under test.

The intermodulation attenuation of the equipment under test shall be expressed as the lower of the two values recorded in above.

8.2.7.3 Required results

The intermodulation ratio shall be not less than 40 dB.

8.3 TDMA receivers

(See 5.2.2)

8.3.1 Sensitivity

8.3.1.1 Purpose

The maximum usable sensitivity (data or messages, conducted) is the minimum signal level at the receiver input, produced by a carrier at the specified frequency of the receiver, modulated with the specified test signal, which will, without interference, produce a data signal with a specified packet error rate (PER) after demodulation. If there is a requirement for sensitivity requirements below –107 dBm, the EUT shall be tested at this stated sensitivity level.

8.3.1.2 Method of measurement

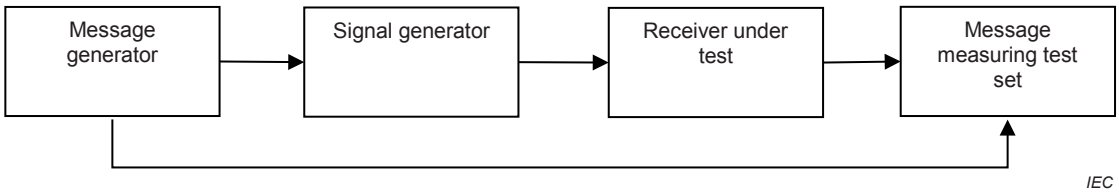


Figure 10 – Measurement arrangement

The equipment shall be connected as illustrated in Figure 10.

- The signal generator shall be set to –107 dBm or declared sensitivity level.
- Use test signal number 4.
- The test shall be performed at 156,025 MHz and 162,025 MHz (AIS2).
- A minimum of 200 packets shall be transmitted during the test.
- Repeat the test under extreme conditions with the signal generator level set to –101 dBm or 6 dB higher than the declared sensitivity level.

8.3.1.3 Required results

A minimum PER of 20 % is required.

8.3.2 Error behaviour at high input levels

8.3.2.1 Purpose

The error behaviour (performance) at high input levels is defined in the same manner as for the measurement of the maximum usable sensitivity when the level of the wanted signal is 100 dB above the maximum usable sensitivity.

8.3.2.2 Method of measurement

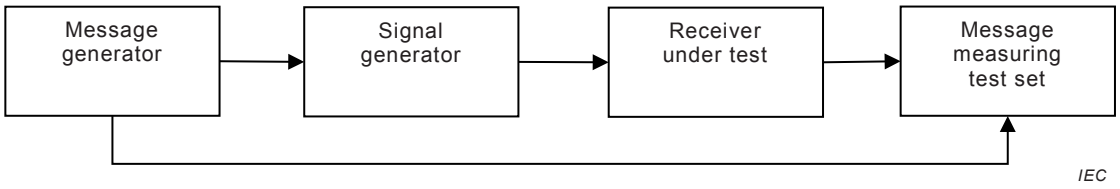


Figure 11 – Measurement arrangement

The equipment shall be connected as illustrated in Figure 11 and the measurement procedure shall be as follows:

- an input signal set to 161,975 MHz, modulated with test signal number 4 shall be applied to the receiver;
- the level of the input signal shall be adjusted to –77 dBm;
- 200 packets shall be transmitted and the PER shall be calculated;
- the measurement shall be repeated with the input signal at –7 dBm.

8.3.2.3 Required results

Type 1 – the PER shall not exceed 1 % in either case.

Type 2 – the PER shall not exceed 2 % at –77 dBm and 10 % at –7 dBm.

8.3.3 Co-channel rejection

8.3.3.1 Purpose

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at the specified frequency of the receiver.

8.3.3.2 Method of measurement

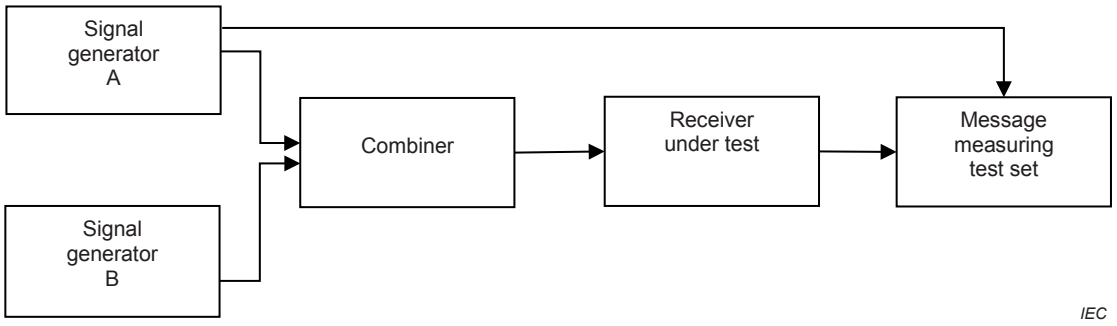


Figure 12 – Measurement arrangement

The measurement arrangement shown in Figure 12 shall be used and the procedure shall be as follows:

- two generators A and B, shall be connected to the receiver via a combining network;
- the wanted signal, provided by signal generator A, shall be at the specified frequency of the receiver and shall be modulated to generate test signal number 4;
- the unwanted signal, provided by generator B, shall also be at the specified frequency of the receiver. Generator B shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz;
- the level of the wanted signal from generator A shall be as specified by Table 18;
- the level of the unwanted signal from generator B shall as specified by Table 18;
- the message measuring test set shall be monitored and the packet error rate observed over 200 transmissions;
- the test shall be carried out at a specified frequency of 156,025 MHz and 162,025 MHz (AIS2).

8.3.3.3 Required result

The PER shall not exceed 20 %.

8.3.4 Adjacent channel selectivity

8.3.4.1 Purpose

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

8.3.4.2 Method of measurement

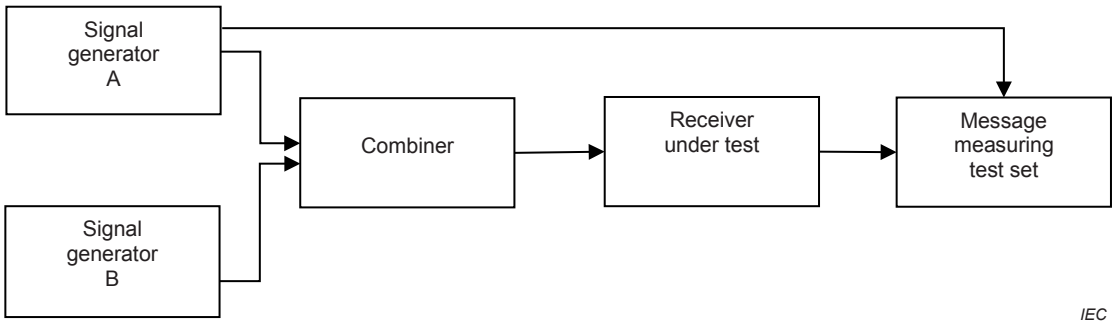


Figure 13 – Measurement arrangement

The measurement arrangement shown in Figure 13 shall be used and the procedure shall be as follows:

- two generators A and B, shall be connected to the receiver via a combining network;
- the wanted signal, provided by signal generator A, shall initially be at 156,025 MHz and be modulated to generate test signal number 4;
- the unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz. Generator B shall be at a frequency 25 kHz above that of the wanted signal;
- the level of the wanted signal from generator A shall be as specified by Table 18;
- the level of the unwanted signal from generator B shall be as specified by Table 18;

- the message measuring test set shall be monitored and the PER observed over 200 transmissions;
- repeat the above measurement with the unwanted signal 25 kHz below the wanted signal;
- repeat the whole of test at 162,025 MHz (AIS2).

8.3.4.3 Required results

The PER shall not exceed 20 %.

8.3.5 Spurious response rejection

8.3.5.1 Definition

The spurious response rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, at which a response is obtained.

8.3.5.2 Manufacturer's declarations

The manufacturer shall declare the following in order to calculate the "limited frequency range" over which the initial part of the test is performed:

- list of intermediate frequencies (IF_1, IF_2, ...IF_N) in Hz;
- switching range of the receiver (sr);

  NOTE 1 Switching range corresponds to the frequency range over which the receiver can be tuned.

- frequencies of the local oscillator at 156,025 MHz and 162,025 MHz (AIS2): (f_{LOL}, f_{LOH}).

  NOTE 2 The local oscillator is a VCO, crystal, sampling clock, BFO, or numerically controlled oscillator, depending on the design of the equipment.

8.3.5.3 Introduction to the method of measurement

The initial evaluation of the unit shall be performed over the "limited frequency range" and shall then be performed at the frequencies identified from this test and at "specific frequencies of interest" (as defined below).

If the EUT contains IF frequencies the following procedure applies. Otherwise the manufacturer shall provide an alternative procedure based on the design of the EUT that produces equivalent results. To determine the frequencies at which spurious responses can occur the following calculations shall be made:

a) calculation of the "limited frequency range":

   the limits of the limited frequency range (LFR_{HI}, LFR_{LO}) are determined by the following calculations:

   $$LFR_{HI} = f_{LOH} + (IF_1 + IF_2 + \ldots + IF_N + sr/2)$$

   $$LFR_{LO} = f_{LOL} - (IF_1 + IF_2 + \ldots + IF_N + sr/2)$$

b) calculation of specific frequencies of interest (SFI) outside the limited frequency range:

   these are determined by the following calculations:

   $$SFI_1 = (K \times f_{LOH}) \pm IF_1$$

   $$SF_{I2} = (K \times f_{LOL}) \pm IF_1$$

   where K is an integer from 2 to 4.

8.3.5.4 Method of measurement over the limited frequency range

Two methods are available for the measurements over the limited frequency range, one based on SINAD measurements and the other based on PER measurements. Either method may be

used, but in each case shall be followed by the method of measurement at identified frequencies.

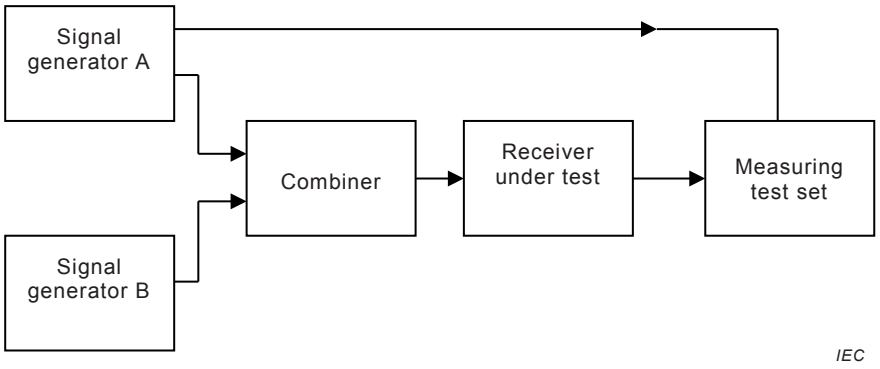


Figure 14 – SINAD or PER/BER measuring equipment

8.3.5.5 Method of search over the "limited frequency range" using SINAD measurements

Two generators A and B shall be connected to the receiver via a combining network as shown in Figure 14. The wanted signal, provided by generator A, shall be 162,025MHz (AIS2) and shall be modulated with 1 kHz sine wave at ±2,4 kHz deviation. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz.

Initially, generator B (unwanted) shall be switched off (maintaining the output impedance). The signal level from generator A (wanted) shall be adjusted as specified in Table 18 at the receiver. The SINAD value shall be noted (and shall be greater than 14 dB). Signal generator B shall be switched on and adjusted as specified in Table 18 at the receiver, plus 6 dB. The frequency of the unwanted signal shall be varied in steps of 5 kHz over the limited frequency range (from LFR_{LO} to LFR_{HI}). The frequency of any spurious response detected (by a decrease in SINAD of 3 dB or more) during the search shall be recorded for use in the next measurements.

Set the receiving frequency to 156,025 MHz and repeat the test.

8.3.5.6 Method of search over the "limited frequency range" using PER or BER measurement

Two generators A and B shall be connected to the receiver via a combining network as shown in Figure 14. The wanted signal, provided by generator A, shall be 162,025 MHz (AIS2) and shall be modulated to generate test signal number 4. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz. Initially, generator B (unwanted) shall be switched off (maintaining the output impedance). The signal level from generator A (wanted) shall be adjusted as specified in Table 18 at the receiver. The PER or BER shall be noted.

Signal generator B shall be switched on and adjusted as specified in Table 18 at the receiver plus 6 dB. The frequency of the unwanted signal shall be varied in steps of 5 kHz over the limited frequency range (from LFR_{LO} to LFR_{HI}). The frequency of any spurious response detected (by an increase in either PER or BER) during the search shall be recorded for use in the next measurements.

In the case where operation using a continuous packet stream is not possible a similar method may be used.

Set the receiving frequency to 156,025 MHz and repeat the test.

8.3.5.7 Method of measurement (at identified frequencies)

Two generators A and B shall be connected to the receiver via a combining network as shown in Figure 14. The wanted signal, provided by generator A, shall be 162,025 MHz (AIS2) and shall be modulated to generate test signal number 4. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz. Generator B shall be at the frequency of that spurious response being considered. Initially, generator B (unwanted) shall be switched off (maintaining the output impedance). The signal level from generator A (wanted) shall be adjusted as specified in Table 18 at the receiver. Generator B shall be switched on, and the level of the unwanted signal set as specified in Table 18.

For each frequency noted during the tests over the limited frequency range on 162,025 MHz (AIS2) and the specific frequencies of interest (SFI_1), transmit 200 packets to the EUT and note the PER.

Set the receiving frequency to 156,025 MHz and repeat the test for each frequency noted during the tests over the limited frequency range on 156,025 MHz and the specific frequencies of interest (SFI_2).

8.3.5.8 Required results

At any frequency separated from the nominal frequency of the receiver by two channels or more, the spurious responses shall not result in a PER of greater than 20 %.

8.3.6 Intermodulation response rejection

8.3.6.1 Purpose

The intermodulation response rejection is the capability of the receiver to receive a wanted modulated signal, without exceeding a given degradation due to the presence of two close-spaced unwanted signals with a specific frequency relationship to the wanted signal frequency.

8.3.6.2 Method of test

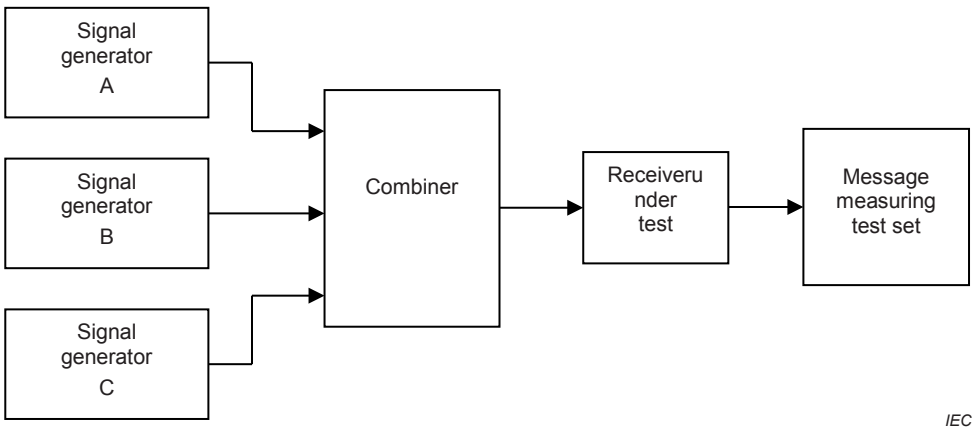


Figure 15 – Measurement arrangement

The measurement arrangement shown in Figure 15 shall be used and the procedure shall be as follows:

- three signal generators shall be connected to the receiver via a combining network;
- the wanted signal, provided by signal generator A, shall be at the specified frequency of the receiver and shall be modulated to generate test signal number 4;
- the unwanted signal from generator B shall be unmodulated;

- the unwanted signal from generator C shall be frequency modulated with a 400 Hz sine wave at a deviation of ±3 kHz:
- the signal level from generator A (wanted) shall be set for –101 dBm at the receiver input;
- the signal level from generators B and C shall be set for –27 dBm for type 1 and –36 dBm for type 2 at the receiver input;
- the frequencies of generators A, B, and C shall be set as per test number 1 of Table 25;
- the message measuring test set shall be monitored and the PER observed over 200 transmissions;
- repeat the measurement with frequencies set as per test number 2 of Table 25.

Table 25 – Frequencies for intermodulation tests

Test number	Generator A Wanted AIS signal	Generator B Unmodulated (±500 kHz)	Generator C Modulated (±1 000 kHz)
1	162,025 MHz	161,525 MHz	161,025 MHz
2	156,025 MHz	156,525 MHz	157,025 MHz

8.3.6.3 Required results

The PER shall not exceed 20 %.

8.3.7 Blocking or desensitisation

8.3.7.1 Purpose

Blocking is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted input signal at any frequency other than those of the spurious responses or the adjacent channels.

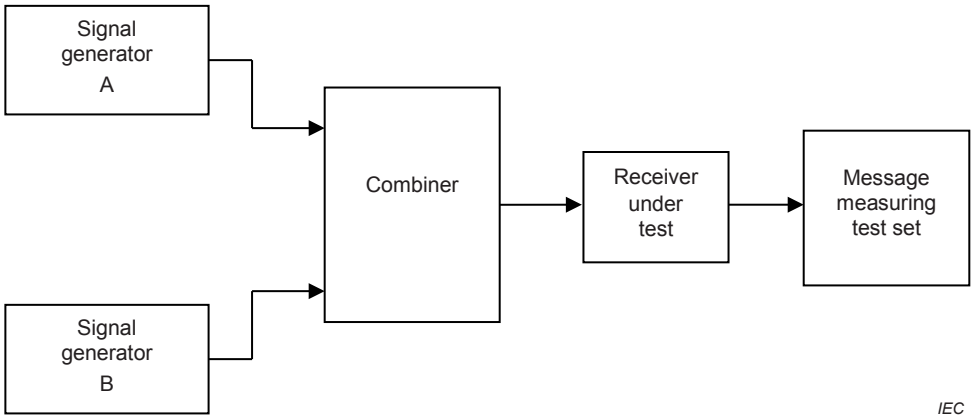


Figure 16 – Measurement arrangement

8.3.7.2 Method of measurement

The measurement arrangement shown in Figure 16 shall be used and the procedure shall be as follows:

a) two generators A and B, shall be connected to the receiver via a combining network as shown in Figure 16;

b) the wanted signal, provided by signal generator A, shall be initially at 156,025 MHz and be modulated to generate test signal number 4;

c) the unwanted signal from generator B shall be unmodulated and tuned to 161,075 MHz. Initially, signal generator B (unwanted signal) shall be switched off (maintaining the output impedance). The level of the wanted signal from generator A shall be adjusted to −101 dBm at the receiver input;

d) generator B shall then be switched on, and the level of the unwanted signal set to −15 dBm;

e) 200 packets shall be transmitted and the PER recorded;

f) repeat the test steps a) to e) with the wanted signal generator tuned to 162,025 MHz (AIS2) and the unwanted signal generator tuned to 156,300 MHz.

8.3.7.3 Required results

The PER shall not exceed 20 %.

8.3.8 Conducted spurious emissions at the antenna

8.3.8.1 Spurious emissions from the receiver

8.3.8.1.1 Purpose

Conducted spurious emissions to the antenna are any RF emissions generated in the receiver and conveyed to the antenna terminal.

8.3.8.1.2 Method of measurement

Conducted spurious emissions shall be measured as the power level of any frequency component to the antenna terminals of the receiver. The receiver antenna terminals are connected to a spectrum analyser or selective voltmeter having an input impedance of 50 Ω and the receiver is switched on.

The measurement shall extend over the frequency range 9 kHz to 4 GHz.

8.3.8.1.3 Required results

The power of any spurious emission in the specified range at the antenna terminal shall not exceed –57 dBm in the frequency range 9 kHz to 1 GHz and –47 dBm in the frequency range 1 GHz to 4 GHz.

8.3.8.2 Spurious emissions from the transmitter

8.3.8.2.1 Purpose

Spurious emissions are emissions at frequencies other than those of the carrier and sidebands associated with normal modulation.

8.3.8.2.2 Method of measurement

Conducted spurious emissions shall be measured with the transmitter modulated with test signal 1 connected to the artificial antenna. The measurement shall be made over a frequency range from 9 kHz to 4 GHz, excluding the channel on which the transmitter is operating ±62,5 kHz.

8.3.8.2.3 Required results

The power of any spurious emission at any frequency shall not exceed –36 dBm in the frequency range 9 kHz to 1 GHz and –30 dBm in the frequency range 1 GHz to 4 GHz.

Annex A
(normative)

Configuration structures

A.1 General

All configuration sentences can be queried. Queries may generate more than one response, for example EPV. See Table 12.

The Table A.1 and Table A.2 define the EPV property identifiers and value ranges.

Table A.1 – Basic system parameters

Property identifier	Property meaning	Value range
0 to 100	Reserved	
201	User ID	The ID shall be as defined in 4.4.1.
202	Primary position source	0 = Internal GNSS 1 = Surveyed position
203	Longitude	Resolution: 1/10 000 min Degrees, minutes and fractional minutes, E/W Format dddmm.mmmmh 181° = not available = default
204	Latitude	Resolution: 1/10 000 min Degrees, minutes and fractional minutes, N/S Format ddmm.mmmmh 91° = not available = default
205	Own identification report UTC	00 – 59 MM of frame
206	Own identification report Start slot Channel A	0 – 2 249
207	Own identification report Slot interval	0 – 135 000 0 = no transmission (default)
208	Own identification report Access scheme	0 = depending on reporting interval 1 = FATDMA 2 = ITDMA/RATDMA (RATDMA when interval >7 min) 3 = SOTDMA (only if interval ≤ 1 min)
209	Transmit power	0 = High power 1 = Low power 2 …9 as defined by the manufacturer (optional)
210	Channel A	0 – 2088 Channel number according to ITU-R M.1084-4. The channel number “0” disables the transmission.
211	Channel B	0 – 2088 Channel number according to ITU-R M.1084-4. The channel number “0” disables the transmission.
212	128 bit AES encryption key	Hex format (default all zeros) 0 –xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

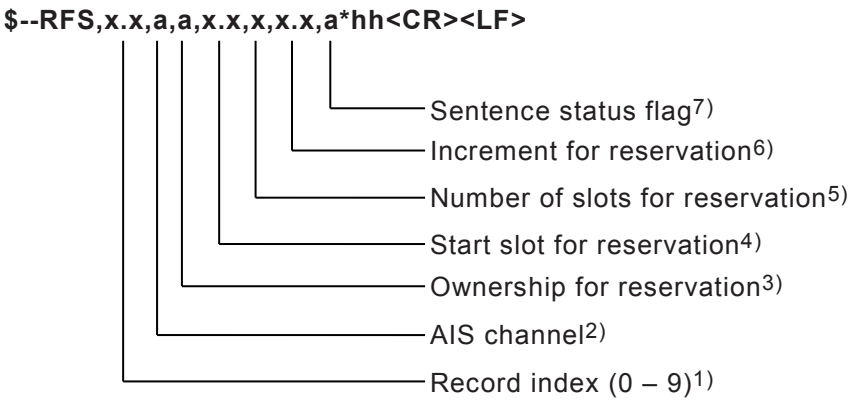
Table A.2 – General repetition parameters

Property identifier	Property meaning	Value range
213	Repeater enabled	0 = Repeater disabled, no repetition of message (default) 1 = Repeater enabled
214	RATDMA enable	0 = RATDMA disable (default) 1 = RATDMA enable
215	Maximum number of repetition slots	Default: 50 Maximum: 400 for Type 1, 50 for Type 2
216	Down sampling factor	0 = Fixed interval 1 = default = each message is repeated, no down sampling 2 = every second message is repeated 3 = every 3rd message is repeated . 15 = every 15th message is repeated
217	Maximum repeat interval (moving vessel)	0 – 33750
218	Maximum repeat interval (stationary vessel).	0 – 33750
219	Fixed repeat interval (moving vessel)	Fixed interval, number of slots 0 = default = no fixed interval
220	Fixed repeat interval (stationary vessel)	Fixed interval, number of slots 0 = default = no fixed interval
221	Repetition of AIS-SART test messages	0 = disabled (default) 1 = enabled

A.2 PI sentences for repeater stations

A.2.1 RFS – Repeater station FATDMA slots

This sentence provides the repeater station with slot allocations for which their use are reserved or restricted for the repeater station. Each set of slot allocations is identified by a record index and the channel designation for which it is valid. The repeater station, upon receipt of a query for this sentence, will generate a response to the requestor consisting of multiple RFS sentences containing all the FATDMA reserved slots. Query may generate up to 20 responses, 10 for each channel. If no slot allocation is stored one RFS sentence shall be output with the sentence status flag set to “R” and all other fields set to null.



Comments:

1) The record index is used to identify the desired RFS record, together with the AIS channel field.

2) The AIS channel that the FATDMA reservation information is to be applied to. The character “A” indicates channel A and “B” indicate channel B. This cannot be a null field when sent to the repeater station. When received from a repeater station, this field may be null, indicating that no FATDMA slots have been reserved on either channel A or channel B. The channel identifies together with the record index a set of slot allocations.

3) This field identifies the ownership of the reservation. Possible values are as follows:

   L = Local ownership. The repeater station receiving this sentence owns and may utilize these FATDMA slots;

   R = Remote ownership. A repeater station receiving this sentence may not use these FATDMA slots.

   C = Clear the reservation. This instructs the repeater station receiving this sentence to clear this reservation from its configuration. If this field is set to “C”, then the following four fields shall be set to null, and will be ignored if set otherwise.

4) Starting slot ranging from 0 to 2 249. A null field indicates no change to the staring slot for this FATDMA reservation. When received from a repeater station, a null field indicates that the start slot has not been set, i.e. is unavailable, when the RFS sentence is received from the AIS equipment.

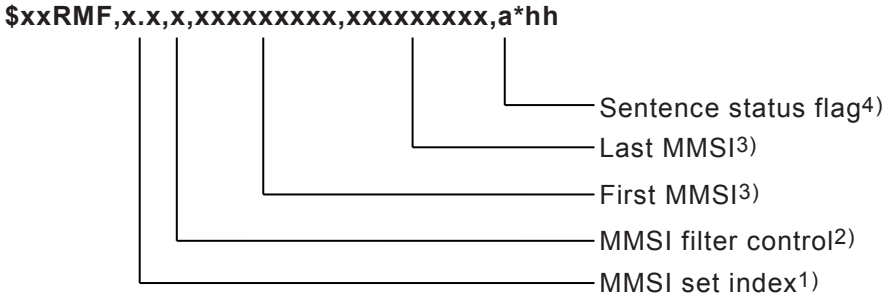
5) The number ranging from 1 to 5 of consecutive slots reserved for FATDMA slots. A null field indicates no change to the number of consecutive slots reserved when sent to the repeater station, and indicates that the number of consecutive slots has not been set, i.e. is unavailable, when the RFS sentence is received from the repeater station.

6) Slot increment ranging from 0 to 1 125 in slots. A value of 0 indicates only one reservation in the frame. A null field indicates no change to the current slot increment setting when sent to the AIS equipment, and indicates that the slot increment has not been set, i.e. is unavailable, when the RFS sentence is received from the AIS equipment. When the increment is not “0” the following formula shall apply: 2250 mod increment = 0.

7) This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field shall not be null. R = Sentence is a status report of current settings (use for a reply to a query). C = Sentence is a configuration command to change settings. A sentence without “C” is not a command.

A.2.2 RMF – Repeater station MMSI filter

Provides for a range of MMSI which can be included or excluded. The repeater station shall support a minimum of 2 sets. A set determines whether the range of MMSIs are inclusive or exclusive.



Comments:

1) MMSI set identification 0 – 15.

2) 0 = No MMSI filtering in response to a query or delete filter when sent as a command

   1 = Include MMSI range

   2 = Exclude MMSI range

3) Used to define a range of MMSI. If the first MMSI is equal to the last MMSI then only one MMSI is filtered.

4) This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field shall not be null. R = Sentence is a status report of current settings (use for a reply to a query). C = Sentence is a configuration command to change settings. A sentence without “C” is not a command.

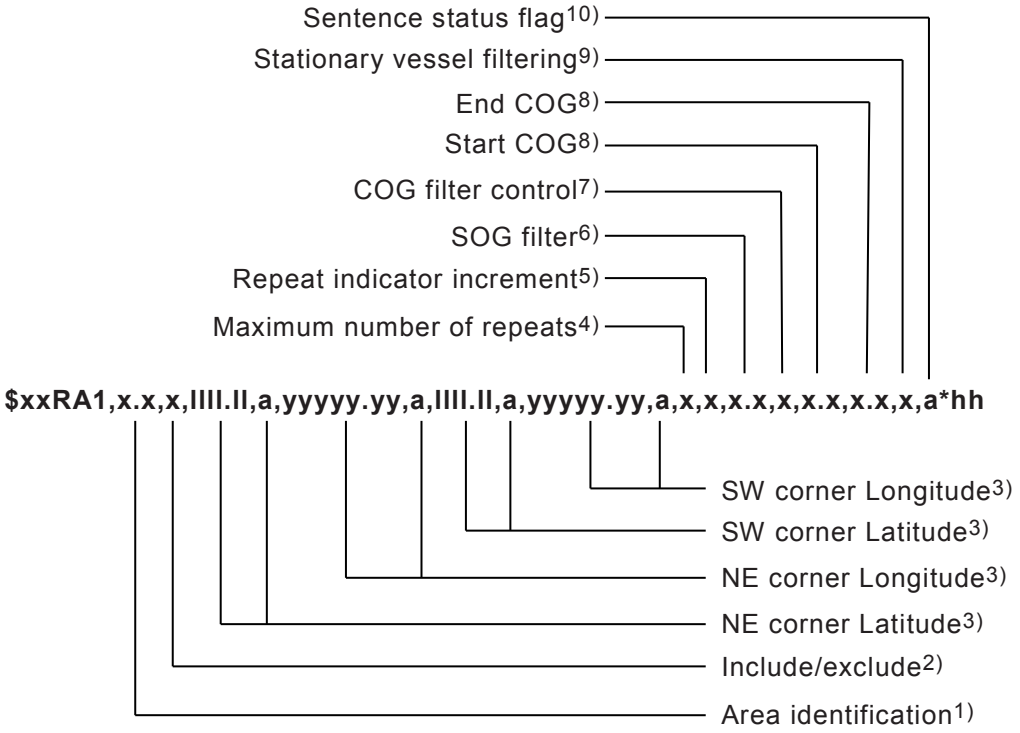
A.2.3 Area configuration

A.2.3.1 Description

This group of sentences are used to configure a repeater area. It is not required to send all four sentences when configuring an area. The repeater station shall support a minimum of 8 and a maximum of 16 of these repeater area definitions.

A.2.3.2 RA1 – Repeater area part 1 configuration, basic definition

The RA1 sentence defines the area and various filters including SOG, COG, and stationary vessel. A query for the RA1 will return one sentence for each area defined.



Comments:

1) Area identification 0 – 15.

2) 0 = No area filtering in response to a query or delete area when sent as a command

   1 = Include area

   2 = Exclude area

3) The resolution of the latitude and longitude fields shall be fixed at 1 decimal place of minutes (1/10 of a minute). If a higher resolution is provided to an AIS unit, the receiving AIS unit shall truncate to 1/10 of a minute.

4) Maximum number of repeats

   0 = No repetition

   1 = Rx messages with RI = 0 are repeated

   2 = Rx messages with RI = 0 and 1 are repeated

   3 = Rx messages with RI = 0 … 2 are repeated

5) Definition how the RI of the repeated message is set depending on the RI of the received message

   0 = RI is incremented by 1, maximum 3

   1 = RI is set to 1 (if Rx RI < 1)

   2 = RI is set to 2 (if Rx RI < 2)

   3 = RI is set to 3

6) Minimum SOG in knots for repeating. This is a variable length integer value with no decimal place or decimal digits. Only stations which exceed this parameter are repeated.

   0 = default = no SOG filtering

   SOG in knots, 1 to 102

7) COG filter control

   0 = default = no COG filtering

   1 = include, stations with COG in the range are repeated

   2 = exclude, station with COG in the range are not repeated

8) COG in degrees, 0 to 360. This is a variable length integer value with no decimal place or decimal digits.

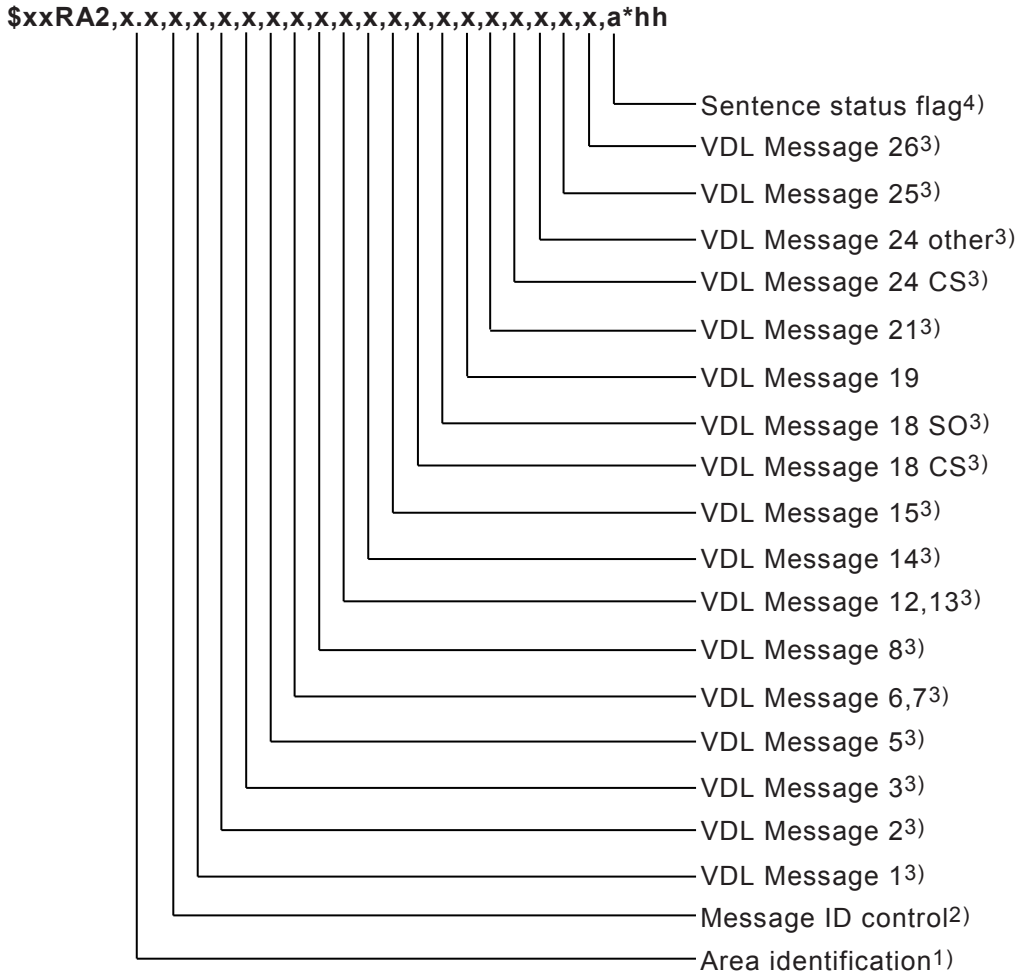
9) 0 = No stationary vessel filtering

   1 = Stationary vessel filtering enabled

10) This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field shall not be null. R = Sentence is a status report of current settings (use for a reply to a query). C = Sentence is a configuration command to change settings. A sentence without "C" is not a command.

A.2.3.3 RA2 – Repeater area part 2 configuration, message type filtering

The RA2 sentence defines the message type filtering. A query for the RA2 will return one sentence for each area defined.



Comments:

1) Area identification 0 to 15.

2) 0 = No message ID filtering

   1 = Message ID filtering enabled

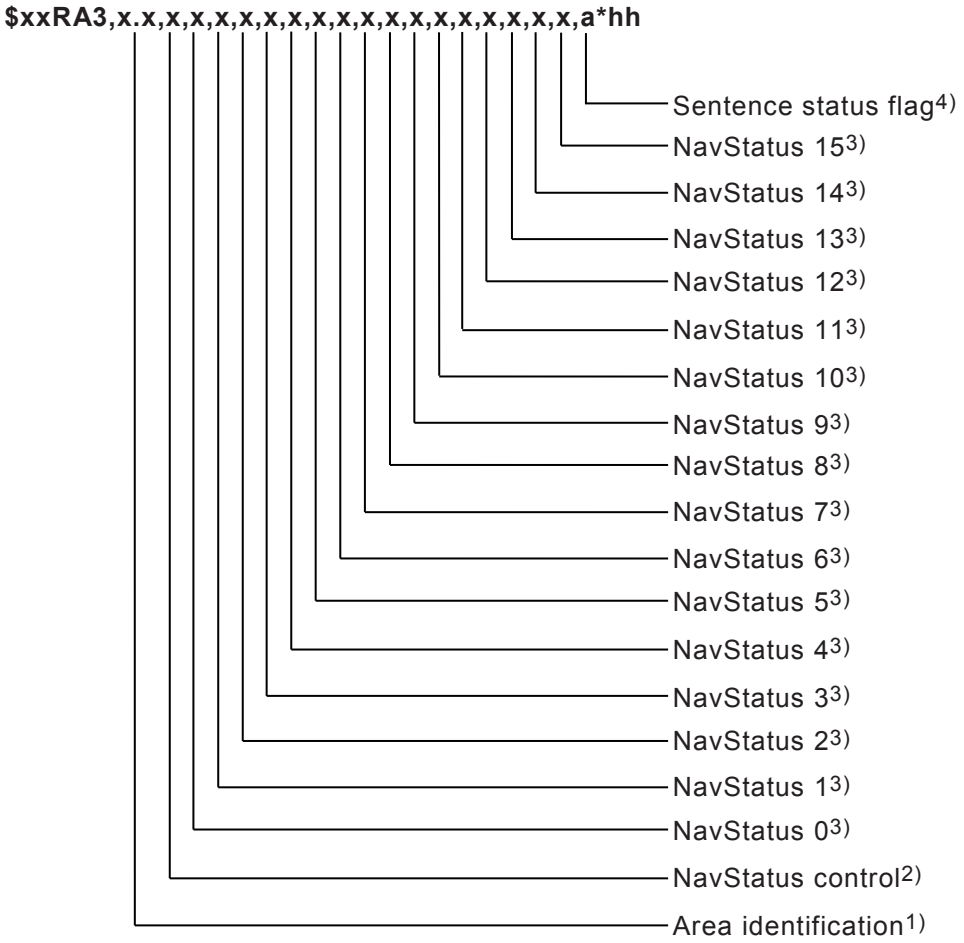
3) 0 = Exclude message ID is not repeated

   1 = Include, message ID is repeated

4) This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field shall not be null. R = Sentence is a status report of current settings (use for a reply to a query). C = Sentence is a configuration command to change settings. A sentence without "C" is not a command.

A.2.3.4 RA3 – Repeater Area Part 3 Configuration, navigation status filtering

The RA3 sentence defines the navigation status type filtering. A query for the RA3 will return one sentence for each area defined.



Comments:

1) Area identification 0 to 15.

2) 0 = No NavStatus filtering

   1 = NavStatus filtering enabled

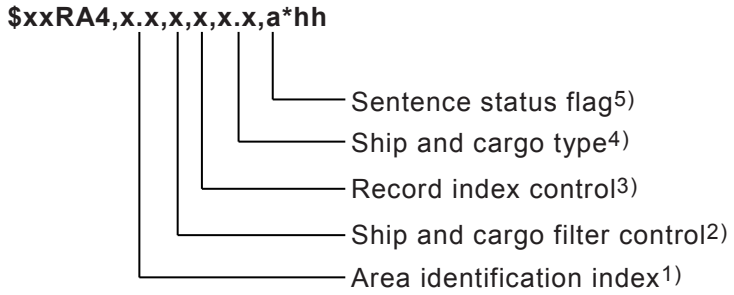
3) 0 = Exclude navigation status identifier is not repeated

   1 = Include, navigation status identifier is repeated

4) This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field shall not be null. R = Sentence is a status report of current settings (use for a reply to a query). C = Sentence is a configuration command to change settings. A sentence without “C” is not a command.

A.2.3.5 RA4 – Repeater area part 4 configuration, ship and cargo type filtering

The RA4 sentence defines the ship and cargo type filtering. A query for the RA4 will return one sentence for each combination of area and applied ship and cargo type.



Comments:

1) Area identification 0 to 15.
2) 0 = No ship and cargo type filtering
   1 = Ship and cargo type filtering enabled, all types are repeated by default
   2 = Ship and cargo type filtering enabled, all types are filtered by default.
3) 0 = Remove all ship and cargo types
   1 = Add ship and cargo type
   2 = Remove specified ship and cargo type
4) Ship and cargo type as define by VDL Message 5.
5) This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field shall not be null. R = Sentence is a status report of current settings (use for a reply to a query). C = Sentence is a configuration command to change settings. A sentence without “C” is not a command.

A.3 Configuration via VDL using Message 26

The configuration of the repeater station over the VDL uses the VDL Message 26 using an application identifier of 995. The basic Message 26 structure is shown in Table A.3 and the repeater command IDs are given in Table A.4.

Table A.3 – Basic structure of Message 26

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination Indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command FI = 2 = Repeater configuration response	Unencrypted
Binary Data	128 to 896	Encrypted binary data in 128 bit blocks	Encrypted
Spare bits	4	Used for byte alignment	
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.4 – Message 26 repeater command IDs

Command ID	Description
1	EPV configuration
2	EPV query
3	AES key configuration
4	RFS configuration
5	RFS query
6	RMF configuration
7	RMF query
8	RA1 configuration
9	RA1 query
10	RA2 configuration
11	RA2 query
12	RA3 configuration
13	RA3 query
14	RA4 configuration
15	RA4 query

Table A.5 to Table A.21 describe the structure of the Message 26 for the various command IDs. The shaded areas indicate how the binary data block of Table A.3 is used.

Table A.5 – EPV configuration

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination Indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	
Spare bits	2	Used for byte alignment	
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command FI = 2 = Repeater configuration response	
Command ID	8	1 = EPV configuration command	Encrypted
Property identifier	8	201 to 221 (excluding AES encryption key)	Encrypted
Payload	32	Value is dependent on the EPV property identifier. Unused bits are set to 0.	Encrypted
Spare bits	72	Required for 128 bit block boundary	Encypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.6 – EPV query

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	
Spare bits	2	Used for byte alignment	
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command	
Command ID	8	2 = EPV query. Returns the desired property identifier	Encrypted
Property identifier	8	201 to 221 (excluding AES encryption key)	Encrypted
Spare bits	104	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.7 – Property identifiers for use with EPV – Basic system parameters

Property identifier	Property meaning	Bits [a]	Description
201	User ID	30	The ID shall be as defined in 4.1.1.
202	Primary position source	1	0 = Internal GNSS 1 = Surveyed position
203	Repeater station's Longitude	28	Longitude in 1/10 000 min (±180º, East = positive (as per 2's complement), West = negative (as per 2's complement); 181 = (6791AC0h) = not available = default)
204	Repeater station's Latitude	27	Latitude in 1/10 000 min (±90º, North = positive (as per 2's complement), South = negative (as per 2's complement); 91 = (3412140h) = not available = default)
205	Own identification report UTC	12	00 to 59 MM of frame
206	Own identification report Start slot	12	0 to 2 249
207	Own identification report Slot interval	18	0 to 135 000 0 = no transmission (default)
208	Own identification report Access scheme	2	0 = depending on reporting interval 1 = FATDMA 2 = ITDMA 3 = SOTDMA (only if interval <= 1 min)
209	Transmit power	4	0 = High power 1 = Low power 2 ...9 as defined by the manufacturer (optional)
210	Channel A	12	0 to 2088 Channel number according to ITU-R M.1084-4. The channel number "0" disables the transmission.
211	Channel B	12	0 to 2088 Channel number according to ITU-R M.1084-4. The channel number "0" disables the transmission.

[a] All payload parameters are evaluated as 32 bit values. The column "Bits" gives the number of relevant LSB bits of the 32 bit parameter.

Table A.8 – Property identifiers for use with EPV – General repetition parameters

Property identifier	Property meaning	Bits [a]	Value range
213	Repeater enabled It is required that this parameter can be set also via VDL	1	0 = Repeater disabled, no repetition of message (default) 1 = Repeater enabled
214	RATDMA enable	1	0 = RATDMA disable (default) 1 = RATDMA enable
215	Maximum number of repetition slots	9	Default: 50 Maximum: 400 for Type 1, 50 for Type 2
216	Down sampling factor	4	0 = Fixed interval 1 = default = each message is repeated, no down sampling 2 = every second message is repeated 3 = every 3rd message is repeated . 15 = every 15th message is repeated
217	Maximum repeat interval (moving station)	16	0 to 33 750
218	Maximum repeat interval (stationary station)	16	0 to 33 750
219	Fixed repeat interval (moving station)	16	Fixed interval, number of slots 0 = default = no fixed interval 0 to 33 750
220	Fixed repeat interval (stationary station)	16	Fixed interval, number of slots 0 = default = no fixed interval 0 to 33 750
221	Repetition of AIS-SART test messages	1	0 = disabled (default) 1 = enabled

[a] All payload parameters are evaluated as 32 bit values. The column “Bits” gives the number of relevant LSB bits of the 32 bit parameter.

Table A.9 – AES key configuration

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command FI = 2 = Repeater configuration response	Unencrypted
Command ID	8	3 = AES key configuration	Encrypted
Payload	128	AES key value	Encrypted
Spare bits	112	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.10 – RFS configuration

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command FI = 2 = Repeater configuration response	Unencrypted
Command ID	8	4 = RFS configuration	Encrypted
Record index	4	0 to 9	Encrypted
AIS channel indicator	1	0 = Channel A 1 = Channel B	Encrypted
Ownership for reservation	2	0 = Clear reservation 1 = Local reservation 2 = Remote reservation	Encrypted
Start slot for reservation	12	0 to 2 249	Encrypted
Number of slots for reservation	3	1 to 5	Encrypted
Increment for reservation	11	0 to 1 125 Shall conform to (2 250 mod increment = 0)	Encrypted
Spare bits	79	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.11 – RFS query

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command	Unencrypted
Command ID	8	5 = RFS query. Returns one or more command ID 4 responses	Encrypted
Spare bits	112	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.12 – RMF configuration

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command FI = 2 = Repeater configuration response	Unencrypted
Command ID	8	6 = RMF configuration	Encrypted
Record Index	4	0 to 15 sets	Encrypted
Filter control	2	0 = No MMSI filtering 1 = Include MMSI range 2 = Exclude MMSI range 3 = Delete range	Encrypted
First MMSI	30	0 to 999999999	Encrypted
Last MMSI	30	0 to 999999999	Encrypted
Spare bits	46	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.13 – RMF query

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command	Unencrypted
Command ID	8	7 = RMF query. Returns one or more command ID 6 responses.	Encrypted
Spare bits	112	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.14 – RA1 configuration

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for Addressed Message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command FI = 2 = Repeater configuration response	Unencrypted
Command ID	8	8 = RA1 configuration	Encrypted
Area identifier	4	0 to 15	Encrypted
NE corner Longitude	18	Longitude of area to which the assignment applies; upper right corner (North-East); in 1/10 min (±180°, East = positive, West = negative) 181 = not available	Encrypted
NE corner Latitude	17	Latitude of area to which the assignment applies; upper right corner (North-East); in 1/10 min (±90°, North = positive, South = negative) 91° = not available	Encrypted
SW corner Longitude	18	Longitude of area to which the assignment applies; upper right corner (North-East); in 1/10 min (±180°, East = positive, West = negative) 181 = not available	Encrypted
SW corner Latitude	17	Latitude of area to which the assignment applies; upper right corner (North-East); in 1/10 min (±90°, North = positive, South = negative) 91° = not available	Encrypted
Maximum number of repeats	2	0 = No repetition 1 = Rx messages with RI = 0 are repeated 2 = Rx messages with RI = 0 and 1 are repeated 3 = Rx messages with RI = 0 … 2 are repeated	Encrypted
Repeat indicator increment	2	0 = RI is incremented by 1, maximum 3 1 = RI is set to 1 (if Rx RI < 1) 2 = RI is set to 2 (if Rx RI < 2) 3 = RI is set to 3	Encrypted
SOG filter	7	Minimum SOG in knots for repeating. Only stations which exceed this parameter are repeated. 0 to 102 kn 0 = default = no SOG filtering	Encrypted

Parameter	Number of bits	Description	Encryption status
COG filter control	2	0 = default = no COG filtering 1 = include, stations with COG in the range are repeated 2 = exclude, station with COG in the range are not repeated	Encrypted
Start COG	9	Start of the COG range, COG in degrees 0 to 360	Encrypted
End COG	9	Start of the COG range, COG in degrees 0 to 360	Encrypted
Stationary vessel filtering	1	0 = default = no filtering 1 = enable filtering	Encrypted
Spare bits	6	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.15 – RA1 query

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command	Unencrypted
Command ID	8	9 = RA1 query. Returns one or more Message ID 8 responses.	Encrypted
Spare bits	112	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.16 – RA2 configuration

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command FI = 2 = Repeater configuration response	Unencrypted
Command ID	8	10 = RA2 configuration	Encrypted
Area identifier	4	0 to 15	Encrypted
Message ID control	1	0 = No message ID filtering 1 = Message ID filtering enabled	Encrypted
VDL Message 1	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 2	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 3	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 5	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 6,7	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 8	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 12,13	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 14	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 15	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 18 CS	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 18 SO	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 19	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted

Parameter	Number of bits	Description	Encryption status
VDL Message 21	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 24 CS	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 24 other	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 25	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
VDL Message 26	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
Spare bits	71	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.17 – RA2 query

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command	Unencrypted
Command ID	8	11 = RA2 query. Returns one or more Message ID 10 responses.	Encrypted
Spare bits	112	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.18 – RA3 configuration

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command FI = 2 = Repeater configuration response	Unencrypted
Command ID	8	12 = RA3 configuration	Encrypted
Area identifier	4	0 to 15	Encrypted
NavStatus control	1	0 = No NavStatus filtering 1 = NavStatus filtering enabled	Encrypted
NavStatus 0	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 1	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 2	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 3	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 4	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 5	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 6	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 7	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 8	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 9	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus10	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 11	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted

Parameter	Number of bits	Description	Encryption status
NavStatus 12	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 13	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 14	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
NavStatus 15	1	0 = Exclude message ID is not repeated 1 = Include, message ID is repeated	Encrypted
Spare bits	73	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.19 – RA3 query

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command	Unencrypted
Command ID	8	13 = RA3 query. Returns one or more Message ID 12 responses.	Encrypted
Spare bits	112	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.20 – RA4 configuration

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command FI = 2 = Repeater configuration response	Unencrypted
Command ID	8	14 = RA4 configuration	Encrypted
Area identifier	4	0 to 15	Encrypted
Cargo filter control	2	0 = No cargo type filtering 1 = All cargo types are repeated by default 2 = All cargo types are filtered by default	Encrypted
Record index control	2	0 = Remove all cargo types 1 = Add cargo type 2 = Delete cargo type	Encrypted
Cargo type	8	Cargo type as define by VDL Message 5	Encrypted
Spare bits	96	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Table A.21 – RA4 query

Parameter	Number of bits	Description	Encryption status
Message ID	6	Identifier for Message 26	Unencrypted
Repeat indicator	2	Used by the repeater station to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more	Unencrypted
Source ID	30	MMSI for the source station	Unencrypted
Destination indicator	1	Always 1 for addressed message	Unencrypted
Binary data flag	1	Always 1 for structured data	Unencrypted
Destination ID	30	The MMSI of the repeater station to which the command is addressed	Unencrypted
Spare bits	2	Used for byte alignment	Unencrypted
Application identifier	16	DAC shall always be 995 for repeater FI = 1 = Repeater configuration command	Unencrypted
Command ID	8	15 = RA4 query. Returns one or more Message ID 14 responses.	Encrypted
Spare bits	112	Required for 128 bit block boundary	Encrypted
Checksum	8	Used to validate the decryption	Encrypted
Spare bits	4	Used for byte alignment	Unencrypted
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows	Unencrypted
Communication state	19	SOTDMA communication state if communication state selector flag is set to 0, or ITDMA communication state if communication state selector flag is set to 1	Unencrypted

Annex B
(informative)

Test area arrangement

Figure B.1 shows an example of a test area arrangement.

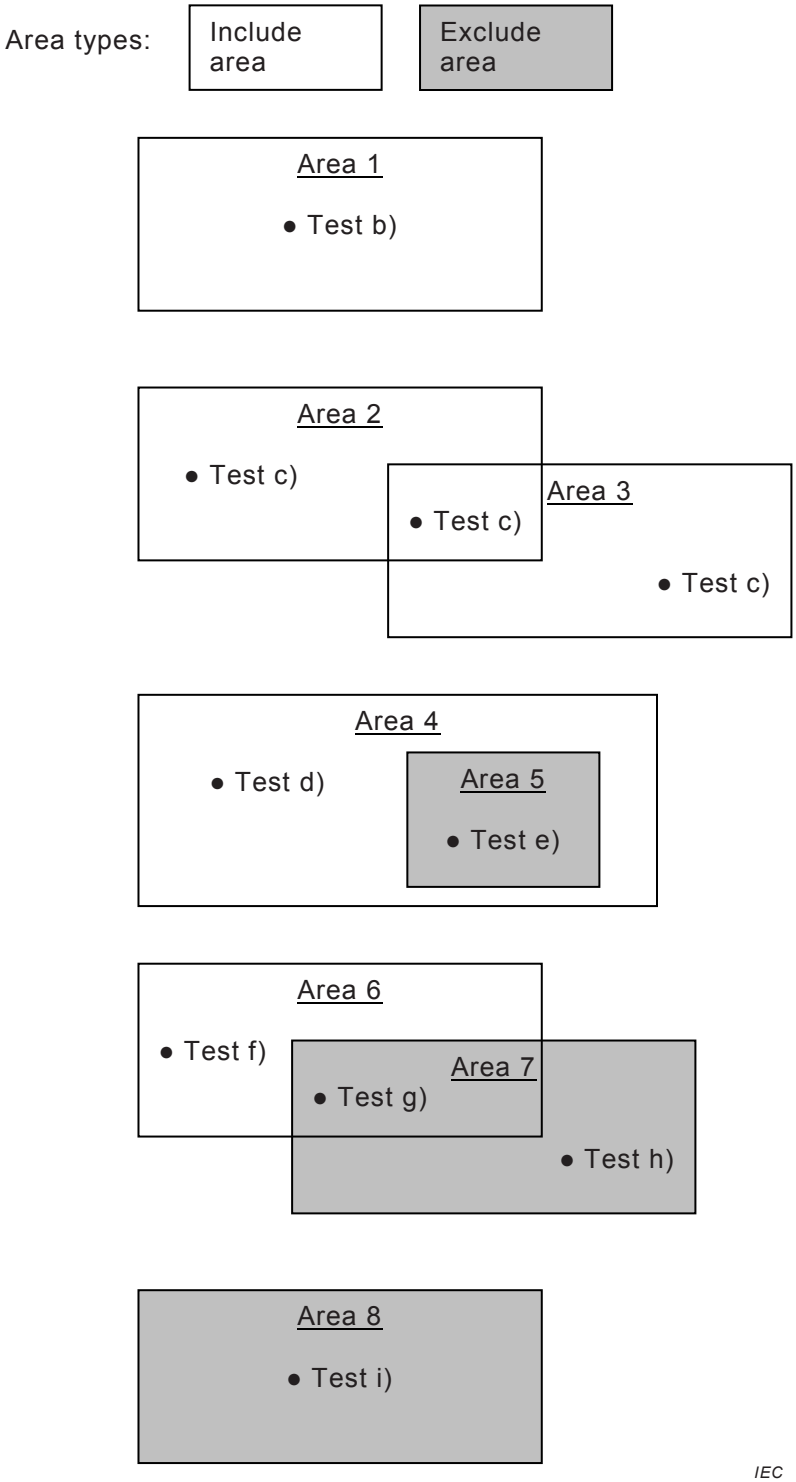


Figure B.1 – Test area arrangement

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IALA Recommendation A-126 *Use of the AIS in Marine Aids to Navigation Service*

RTCM 10402, *RTCM Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service*

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