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Part 1: AIS Base Stations – Minimum operational and performance requirements, methods of testing and required test results

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

**Part 1: AIS Base Stations –
Minimum operational and performance requirements,
methods of testing and required test results**

FOREWORD

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

FDIS	Report on voting
80/460/FDIS	80/468/RVD

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

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

A list of all parts of IEC 62320 series, under the general title: *Maritime navigation and radio-communication equipment and systems – Automatic Identification System (AIS)* can be found on the IEC website.

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

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

Chapter V of the International Convention for the Safety of Life at Sea 1974 (SOLAS) requires mandatory carriage of Automatic Identification System (AIS) equipment on all vessels constructed on or after 01 July 2002. Carriage 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, clause 2.4.5 states that AIS shall:

- 1 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;
- 2 receive automatically such information from similarly fitted ships;
- 3 monitor and track ships; and
- 4 exchange data with shore-based facilities.

In addition, the IMO performance standards for AIS state 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 part of IEC 62320 provides the minimum operational and performance requirements, methods of test and the required test results for AIS Base Stations. The testing is divided into three sections, the transceiver tests, the logical tests and the Presentation Interface tests. These are captured in Clauses 8, 9 and 10 respectively. The method used for testing is that the EUT should meet all the tests requirements of Clause 8 before proceeding to Clause 9. Likewise, the unit should meet all of the test requirements before proceeding to Clause 10. Clause 10 has also been prioritised so that the tests are progressive

Clauses 5 to 7 provide functional requirement information and Clause 8 provides the general test environment for the EUT.

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

Part 1: AIS Base Stations – Minimum operational and performance requirements, methods of testing and required test results

1 Scope

This part of IEC 62320 specifies the minimum operational and performance requirements, methods of testing and required test results for AIS Base 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 Base Stations. It does not include specifications for the display of AIS data on shore.

2 Normative references

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

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

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

ITU-R M.1084-4, *Interim solutions for improved efficiency in the use of the band 156-174 MHz by stations in the maritime mobile service*

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

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

IALA Recommendation A-124 *on Automatic Identification System (AIS). Shore Station and networking aspects relating to the AIS Service*

IALA technical clarifications to ITU Recommendation ITU-R M.1371-1

RTCM SC104 – *RTCM Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service*

3 Symbols and abbreviations

AIS	Automatic Identification System
BER	Bit Error Rate
BIIT	Built-In Integrity Tests
BT	Bandwidth Time product
CPU	Central Processing Unit
DGNSS	Differential Global Navigation Satellite System
EPFS	Electronic position fixing system
EUT	Equipment under test
FATDMA	Fixed Access Time Division Multiple Access
GNSS	Global Navigation Satellite System
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IHO	International Hydrographic Office
IMO	International Maritime Organization
ITU	International Telecommunications Union
kn	Knots
MAC	Medium Access Control
MKD	Minimum Keyboard and Display
MMSI	Maritime Mobile Service Identity
NM	Nautical Mile
NRZI	Non-Return to Zero Inverted
PER	Packet Error Rate
P_c	Carrier Power
PI	Presentation Interface
PPS	Pulse Per Second
PSS	Physical Shore Station
RAIM	Receiver Autonomous Integrity Monitoring
RATDMA	Random Access Time Division Multiple Access
Rx	Receive
TDMA	Time Division Multiple Access
Tx	Transmit
UTC	Universal Time Co-ordinated
VDL	VHF Data Link
VSWR	Voltage Standing Wave Ratio
VTS	Vessel Traffic Services

NOTE Abbreviations related to IEC 61162-1 are not included in the above list. For their meaning refer to that standard and Annex A.

4 Functional layout of an AIS Base Station

4.1 General

The Base Station may be designed for dependent only operation or independent operation. Both are under some control of the Physical Shore Station (PSS) as defined in the IALA Recommendation A-124.

- A dependent Base Station accesses the VHF data link (VDL) using only the combination of linked TSA+VDM sentences (see Table 1), as provided by the PSS.
- An independent Base Station accesses the VDL using either the combination of linked TSA+VDM sentences as provided by the PSS or by using internal control. When operated as an independent Base Station the unit may be delegated certain autonomous functionality under the supervisory control of the PSS.

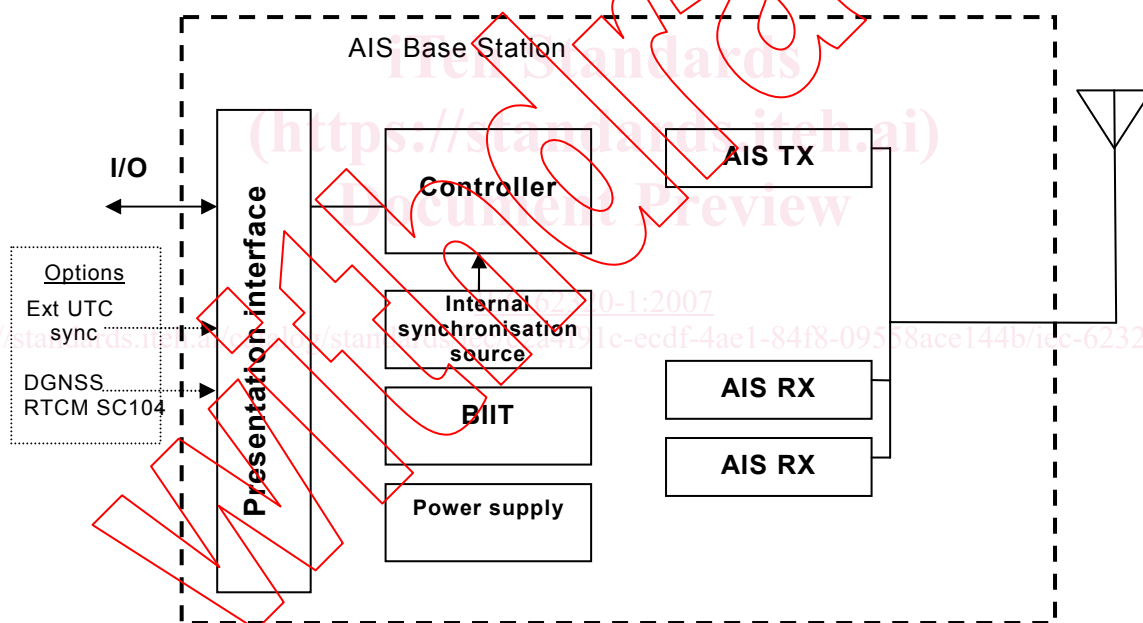
The PSS, or external controlling entity, is responsible for Base Station configuration, transmission scheduling, and processing of received information. Presentation Interface (PI) text sentences are used to configure the Base Station, schedule message transmissions, and output information.

When TSA and VDM sentences are used, the PSS is responsible for ensuring the integrity of the VDL.

The tests in this standard are for all Base Stations. Additional tests for independent Base Stations are indicated by a note located at the beginning of each appropriate test section.

4.2 Functional block diagram of an AIS Base Station

Figure 1 shows the principal components of the AIS Base Station.



IEC 150/07

Figure 1 – Functional block diagram of an AIS Base Station

As a minimum, the following functional elements are required for the AIS Base Station:

- two multi-channel receivers;
 - one multi-channel TDMA transmitter;
- NOTE Since the minimum configuration of the AIS Base Station has only one transmitter, the AIS Base Station cannot transmit on both AIS Channels (AIS A and AIS B) simultaneously.
- a controlling unit;
 - an internal synchronisation source, which may also be used as a position sensor for independent Base Stations. If used as a position source, the internal GNSS receiver shall meet the appropriate requirements of IEC 61108-1;
 - a Built-In-Integrity-Test unit (BIIT), which shall provide alarms;

- a power supply;
- a Presentation Interface (PI), which allows the AIS Base Station to exchange sentences with the PSS;
- optional features, for example: DGNSS (RTCM SC104); external synchronisation; DSC functionality.

4.3 General VDL requirements

The AIS Base Station interacts with the VDL by receiving and transmitting VDL messages.

4.3.1 Sources of VDL messages for transmission

In order to transmit VDL messages, the Base Station may derive the messages to be transmitted from three sources:

- a) generate and transmit VDL messages autonomously as per the configuration received via sentences;
- b) generate and transmit VDL messages automatically based on data input received via the PI, using different sentences from that of the VDM;
- c) transmit predefined VDL messages input via the PI. The VDM sentence shall be used to input the content of the VDL messages via the PI to the AIS Base Station. The VDL message shall then be transmitted by the Base Station on the VDL.

When operating the Base Station independently, these three VDL message sources shall be supported in parallel.

When operating the Base Station dependently, only VDM messages received via the PI shall be transmitted as noted in item c) above.

4.3.2 Use of access schemes

4.3.2.1 Dependent operation

When operating as a dependent Base Station the FATDMA access scheme shall be used. The Base Station shall use the slot(s) provided by the combination of linked TSA+VDM sentences. The TSA sentence provides the channel and start slot information. The actual number of slots used is based on the number of bits conveyed by the VDM sentence(s).

Dependent operation shall not use the RATDMA access scheme

4.3.2.2 Independent operation

The default access scheme for a Base Station shall be FATDMA.

The AIS Base Station may also use RATDMA access schemes if implemented. The AIS Base Station may use the FATDMA and RATDMA access schemes concurrently. The use of pre-reserved FATDMA slots shall take priority over RATDMA access.

When using the FATDMA access scheme, the absolute slot numbers for transmission shall be determined by one of the following methods:

- the PI combination of linked TSA+VDM sentences shall provide the absolute slot number in which the AIS Base Station transmits;
- the AIS Base Station shall autonomously select an appropriate pre-reserved FATDMA slot as determined by its configuration.

Both methods shall be available and operate concurrently.

4.4 Functional diagram for operation of a Base Station

Figure 2 shows the principal components of an AIS Base Station. The diagram identifies the elements of the AIS Base Station and the PI with the PSS.

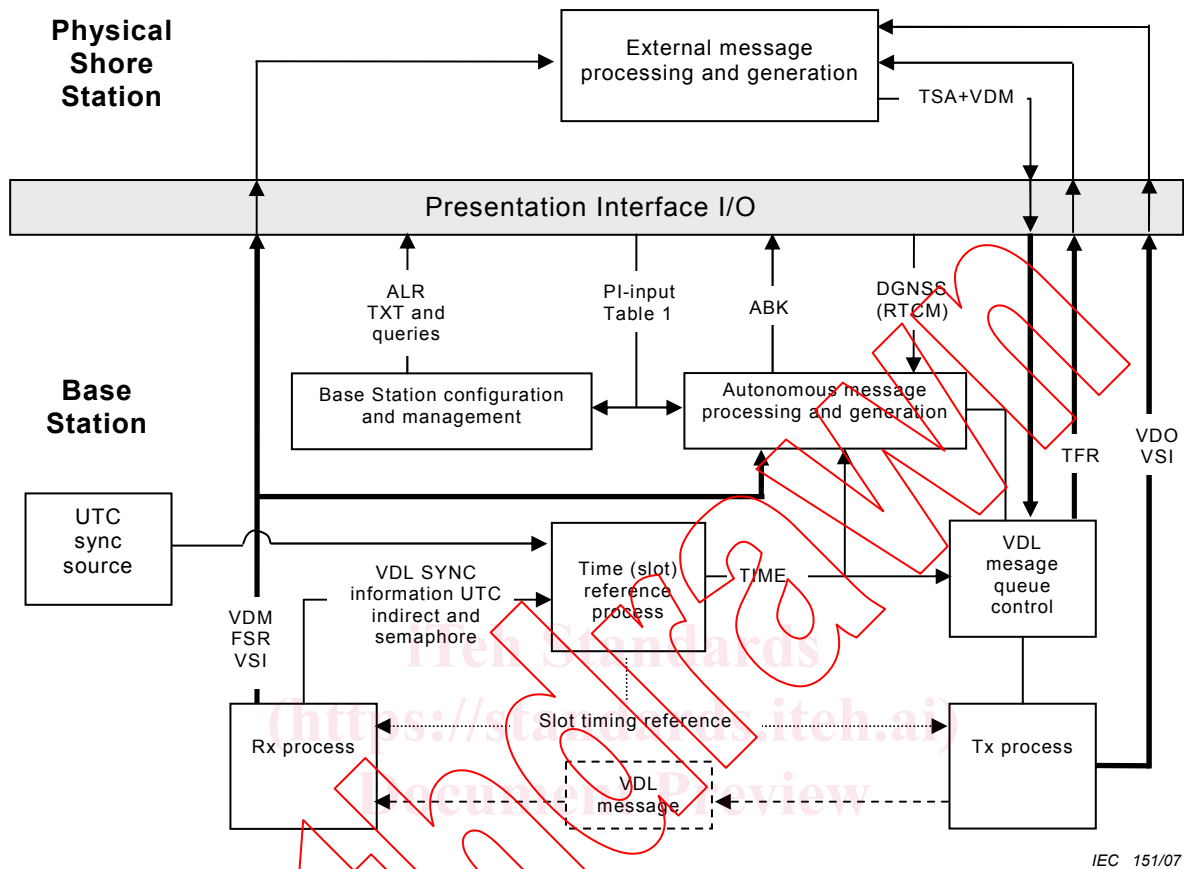


Figure 2 – Functional block diagram dependent and independent operation

The PI of an AIS Base Station consists of at least one input/output port. A specific choice for the physical input/output port is not specified. The purpose of the PI is to:

- exchange VDL messages with the PSS;
- configure the Base Station;
- enable real time control of the Base Station;
- provide an output for BIIT alarms and status.

The information exchange of the PI is supported by a combination of IEC 61162-1 sentences and Base Station sentences (see Annex A).

4.5 Base Station input/output sentence formatters

The following table lists sentence formatters used with a Base Station. It includes existing sentence formatters (grey rows) and sentence formatters developed for use with Base Stations (white rows). Clause A.1 contains the details for each of the sentence formats developed for AIS Base Stations.

A sentence linking method is described in Annex A.2. Use of this method improves the integrity of data relationships between sentences, and improves the reliability and clarity of communications with the Base Station.

Table 1 presents both input and output sentence formatters for dependent and independent operation. For Base Stations that support both independent and dependent operation, both sets of sentences are applicable. For Base Stations that only support dependent operation, the sentences for dependent operation are applicable and all other sentences are ignored.

Table 1 – Base Station input/output sentence formatters

Sentence formatter	Input independent	Input dependent	Output independent	Output dependent	Description
ABK			X		Addressed and binary broadcast acknowledgement
ABM	X				Addressed binary and safety related message
ACA	X		Q		AIS regional channel assignment message
ACM	X				Preparation and initiation of an AIS Base Station addressed channel message (VDL Message 22)
ACK	X	X			Acknowledge alarm
ADS			X	X	AIS Device Status (output interval configured by BCE and upon status change)
AGA	X				Preparation and Initiation of an AIS Base Station broadcast of a group assignment message (Message 23).
ALR			X	X	Set alarm state
AIR	X				AIS interrogation request (VDL Message 15)
ASN	X				Preparation and initiation of an AIS Base Station broadcast of assignment VDL Message 16
BBM	X				Broadcast binary message
BCE	X	X	Q	Q	General Base Station configuration extended
BCF	X	X	Q	Q	General Base Station configuration
CAB	X	X	Q	Q	Control AIS Base Station
CBM					Not supported by this IEC standard
DLM	X		Q		Data Link Management slot allocations for Base Station (VDL Message 20 – FATDMA reservations)
ECB	X		Q		Configure broadcast rates for Base Station messages with epoch planning support
FSR			X	X	Frame summary of AIS reception, defined by SPO.
SID	X	X			Installation of a station's identification
SPO	X	X	Q	Q	Select AIS device's reception processing and output