

INTERNATIONAL STANDARD



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



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Digital interfaces –
Part 1: Single talker and multiple listeners**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MARITIME NAVIGATION AND RADIOCOMMUNICATION
EQUIPMENT AND SYSTEMS – DIGITAL INTERFACES –****Part 1: Single talker and multiple listeners**

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This commented version (CMV) of the official standard IEC 61162-1:2024 edition 6.0 allows the user to identify the changes made to the previous IEC 61162-1:2016 edition 5.0. Furthermore, comments from IEC TC 80 experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 61162-1 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems. It is an International Standard.

This sixth edition cancels and replaces the fifth edition published in 2016. This edition constitutes a technical revision.

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

- a) alternative hardware is given in 5.1 which may now be as specified in this document or as specified in IEC 61162-2;
- b) the data transmission rate given in Clause 6 is now configurable. The default remains as 4 800 (bits/s) but higher rates may be provided;
- c) new identifiers have been added to Table 4;
- d) new sentences AGL, EPM, GDC, NLS, SEL, SLM, SMV and VBC have been added;
- e) revisions have been made to ABK, ABM, ACN, ALC, ALF, ARC, BBM, DDC, DTM, EPV, FIR, GBS, GFA, GLL, GNS, GRS, GSA, GST, GSV, HRM, NRX, POS, RLM, ROR, RSA, TLB, TTD, VSD and XDR;
- f) the previous Annex A, Glossary, has been deleted as being of historical interest.

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

Draft	Report on voting
80/1093/FDIS	80/1097/RVD

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

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

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

A list of all parts in the IEC 61162 series, published under the general title *Maritime navigation and radiocommunication equipment and systems – Digital interfaces*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn, or
- revised.

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

INTRODUCTION

The IEC 61162 series consists of 5 parts which specify digital interfaces for application in marine navigation, radiocommunication and system integration, as follows:

IEC 61162-1: Single talker and multiple listeners;

IEC 61162-2: Single talker and multiple listeners, high speed transmission;

IEC 61162-3: ~~Multiple talkers and multiple listeners~~ – Serial data instrument network;

IEC 61162-450: Multiple talkers and multiple listeners – Ethernet interconnection;

IEC 61162-460: Multiple talkers and multiple listeners – Ethernet interconnection – Safety and security

IEC technical committee 80 interface standards are developed with input from manufacturers, private and government organisations and equipment operators. The information is intended to meet the needs of users at the time of publication, but users should recognise that as applications and technology change, interface standards should change as well. Users of this document are advised to immediately inform the IEC of any perceived inadequacies therein.

The first edition of IEC 61162-1 was published in 1995. The second edition published in 2000 removed some sentences which were no longer in use, added some new sentences and included details of the ship equipment defined in IMO resolutions together with appropriate sentences for communication between them. This information was subsequently removed from the third edition when it became the practice to specify the sentence formatters in the individual standards for equipment.

The third edition published in 2007 introduced a re-arrangement of the text and new sentences particularly to support the automatic identification system and the voyage data recorder. The third edition also introduced a further type of start of sentence delimiter. The conventional delimiter "\$" was retained for the conventional sentences which are now called "parametric sentences". The new delimiter "!" identifies sentences that conform to special purpose encapsulation.

The fourth edition removed some sentences which were not in use, added some new sentences for new applications and made some corrections and additions. In particular, the sentences of relevance to satellite navigation receivers were expanded to facilitate the description of new satellite systems.

The fifth edition also removed some sentences which were no longer in use, added some new sentences for new applications and made some corrections and additions.

This sixth edition adds some new sentences for new applications and makes some corrections and additions.

~~Liaison has been maintained with NMEA and~~ This edition has been aligned where appropriate and possible with NMEA 0183 version 4.10. **1**

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – DIGITAL INTERFACES –

Part 1: Single talker and multiple listeners

1 Scope

This part of IEC 61162 contains the requirements for data communication between maritime electronic instruments, navigation and radiocommunication equipment when interconnected via an appropriate system.

This document is intended to support one-way serial data transmission from a single talker to one or more listeners. These data are in printable ASCII form and ~~may~~ can include information such as position, speed, depth, frequency allocation, etc. Typical messages ~~may~~ can be from about 11 to a maximum of 79 characters in length and generally require transmission no more rapidly than one message per second.

The electrical definitions in this document are not intended to accommodate high-bandwidth applications such as radar or video imagery, or intensive database or file transfer applications. Since there is no provision for guaranteed delivery of messages and only limited error checking capability, ~~it is important~~ this document ~~should be~~ is used with caution in all safety applications.

For applications where a faster transmission rate is necessary, ~~reference should be made to~~ IEC 61162-2 applies.

For applications to shore based equipment of the automatic identification system (AIS) ~~reference should be made to~~ the IEC 62320 series applies.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60945:2002 **2**, *Maritime navigation and radiocommunication equipment and systems – General requirements - Methods of testing and required test results*

~~IEC 61097-6, Global maritime distress and safety system (GMDSS) – Part 6: Narrowband direct-printing telegraph equipment for the reception of navigational and meteorological warnings and urgent information to ships (NAVTEX)~~ **3**

~~IEC 61108 (all parts), Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS)~~ **3**

~~IEC 61162 (all parts), Maritime navigation and radiocommunication equipment and systems – Digital interface~~ **3**

~~IEC 61162-2:1998, Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 2: Single talker and multiple listeners, high-speed transmission~~ **3**

~~IEC 61174, Maritime navigation and radiocommunication equipment and systems—Electronic chart display and information system (ECDIS)—Operational and performance requirements, methods of testing and required test results~~ **3**

~~IEC 61924-2:2012, Maritime navigation and radiocommunication equipment and systems—Integrated navigation systems—Part 2: Modular structure for INS—Operational and performance requirements, methods of testing and required test results~~ **3**

~~IEC 61996 (all parts), Maritime navigation and radiocommunication equipment and systems—Shipborne voyage data recorder (VDR)~~ **3**

~~ISO/IEC 8859 (all parts), Information technology—8-bit single-byte coded graphic character sets~~ **3**

ISO/IEC 8859-1:1998, *Information technology - 8-bit single-byte coded graphic character sets - Part 1: Latin alphabet No. 1*

~~ISO/IEC 10646, Information technology—Universal Coded Character Set (UCS)~~ **3**

~~ITU-R Recommendation M.493, Digital selective-calling system for use in the maritime mobile service~~ **3**

~~ITU-R M.625, Direct printing telegraph equipment employing automatic identification in the maritime mobile service~~ **3**

~~ITU-R Recommendation M.821, Optional expansion of the digital selective-calling system for use in the maritime mobile service~~ **3**

~~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~~ **3**

~~ITU-R Recommendation M.1371, Technical characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile band~~ **3**

ITU-T Recommendation X.27/V.11:1996, *Electrical characteristics for balanced double-current interchange circuits operating at data signalling rates up to 10 Mbit/s*

~~IMO GMDSS.1/Circ.18, Master plan of shore-based facilities for the global maritime distress and safety system (GMDSS master plan)~~ **3**

~~IMO, International Convention on Load Lines~~ **3**

~~IMO, International SafetyNET Manual~~ **3**

~~IMO MSC.252(83), Performance standards for integrated navigation systems (INS)~~ **3**

~~IMO MSC.302(87), Performance standards for Bridge Alert Management (BAM)~~ **3**

~~IMO Publication 951E, NAVTEX Manual~~ **3**

3 Terms and definitions

~~3.1 General~~

~~Common terms are defined in the glossary of Annex A. Where there is a conflict, terms are interpreted, wherever possible, in accordance with the references in Clause 2.~~

~~3.2 Terms and definitions~~

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

~~3.2.23.1~~

listener

~~any~~ device which receives data from another device

~~3.2.13.2~~

talker

~~any~~ device which sends data to other devices

Note 1 to entry: The type of talker is identified by a 2-character mnemonic as listed in 8.2 (see Table 4).

4 Manufacturer's documentation

~~Operator~~ Installation manuals ~~or other appropriate literature~~ **4** provided for equipment that is intended to meet the requirements of this document shall contain the following information:

- a) identification of the A and B signal lines (see Figure 1);
- b) the output drive capability as a talker;
- c) a list of approved sentences, noting unused fields, proprietary sentences transmitted as a talker and transmission interval for each sentence;
- d) the load requirements as a listener;
- e) a list of sentences and associated data fields that are required as a listener;
- f) the current software and hardware revision, if this is relevant to the interface;
- g) an electrical description or schematic of the listener/talker input/output circuits citing actual components and devices used, including connector type and part number;
- h) the version number and date of update of the standard for which compliance is sought;
- i) list of supported baud rates (bits/s) including any limitations per each baud rate supported. **5**

5 Hardware specification

5.1 General

NOTE Guidelines on methods of testing are given in Annex B.

One talker and multiple listeners may be connected in parallel over an interconnecting wire. The number of listeners depends on the output capability and input drive requirements of individual devices.

There are two alternatives for the hardware:

- 1) method based on 5.2 to 5.6;
- 2) method based on IEC 61162-2. **5**

5.2 Interconnecting wire

Interconnection between devices may be by means of a two-conductor, shielded, twisted-pair wire.

5.3 Conductor definitions

The conductors referred to in this document are the signal lines A and B, and shield (see Figure 1).

5.4 Electrical connections/shield requirements

All signal line A connections are connected in parallel with all device A connections and all signal line B connections are connected in parallel with all device B connections. The shields of all listener cables should be connected to the talker chassis only and should not be connected at each listener.

5.5 Connector

No standard connector is specified. Wherever possible, readily available commercial connectors shall be used. Manufacturers shall provide means for user identification of the connections used.

5.6 Electrical signal characteristics

5.6.1 General

5.6 describes the electrical characteristics of transmitters and receivers.

5.6.2 Signal state definitions

The idle, marking, logical 1, OFF or stop bit states are defined by a negative voltage on line A with respect to line B (see Figure 2 for the stop bit).

The active, spacing, logical 0, ON or start bit states are defined by a positive voltage on line A with respect to line B (see Figure 2 for the start bit).

NOTE The polarity of an output can be easily checked with a multi-meter. If there is no output message (idle state) or only a short message each second, where most of the time the output is in idle state, it can be measured about 2 V to 5 V at the output with positive polarity at line B. **6**

~~It should be noted that~~ The above A with respect to B levels are inverted from the voltage input/output requirements of standard UARTs and that many line drivers and receivers provide a logic inversion.

5.6.3 Talker drive circuits

No provision is made for more than a single talker to be connected to the bus. The drive circuit used to provide the signal A and the return B shall meet, as a minimum, the requirements of ITU-T Recommendation X.27/V.11.

5.6.4 Listener receive circuits

Multiple listeners may be connected to a single talker. The listener receive circuit shall consist of an opto-isolator and shall have protective circuits to limit current, reverse bias and power dissipation at the opto-diode as shown in Figure 1. Reference to example circuits is made in 9.3.

The receive circuit shall be designed for operation with a minimum change of input voltage of 2,0 V and shall not take more than 2,0 mA from the line at that voltage.

NOTE For reasons of compatibility with equipment designed to comply with earlier versions of NMEA 0183, ~~it is noted that~~ the idle, marking, logical "1", OFF or stop bit state had previously been defined to be in the range -15,0 V to +0,5 V. The active, spacing, logical "0", ON or start bit state was defined to be in the range +4,0 V to +15,0 V while sourcing was not less than 15 mA.

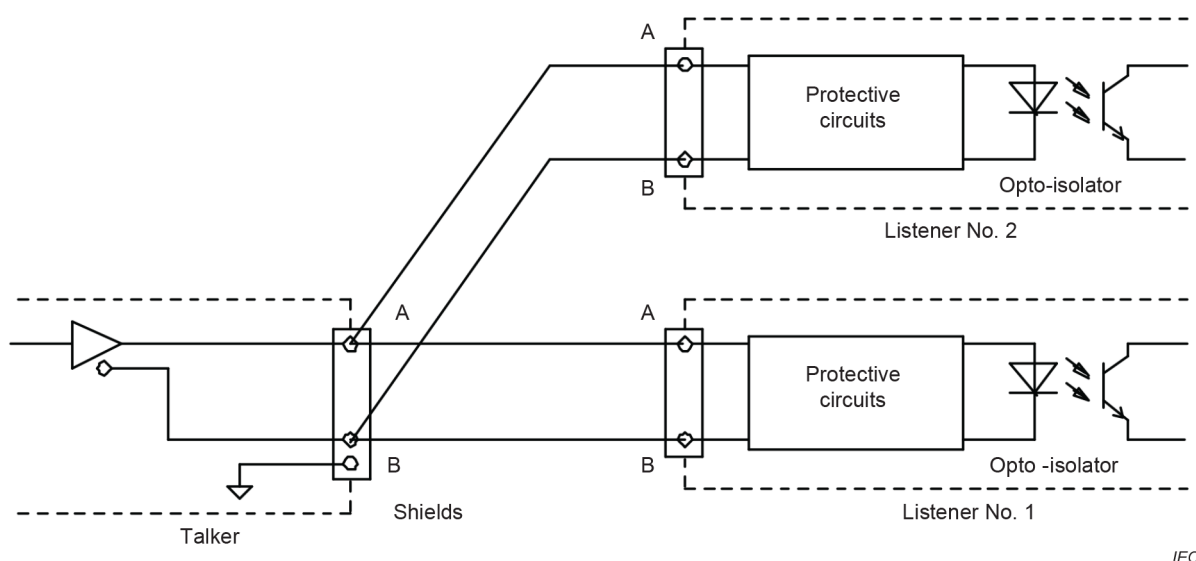


Figure 1 – Listener receive circuit

5.6.5 Electrical isolation

Within a listener, there shall be no direct electrical connection between the signal line A, return line B, or shield and ship's ground or power. Isolation from ship's ground is required.

5.6.6 Maximum voltage on bus

The maximum applied voltage between signal lines A and B and between either line and ground shall be in accordance with ITU-T Recommendation X.27/V.11.

For protection against mis-wiring and for use with earlier talker designs, all receive circuit devices shall be capable of withstanding 15 V between signal lines A and B and between either line and ground for an indefinite period.

6 Data transmission

Data is transmitted in serial asynchronous form in accordance with the standards referenced in Clause 2. The first bit is a start bit and is followed by data bits, least-significant-bit first, as illustrated by Figure 2.

The following parameters are used:

- baud rate default and required is 4 800, higher baud rates are allowed based on equipment configuration setup; **5**
- data bits 8 (D7 = 0), parity none;
- stop bits 1.

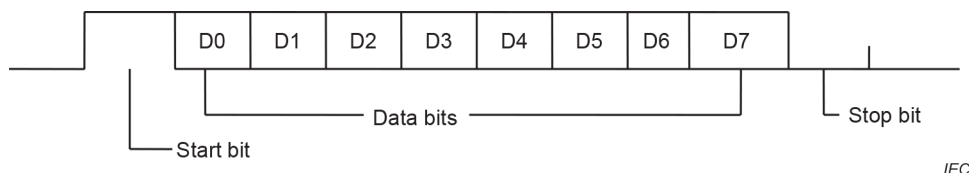


Figure 2 – Data transmission format

7 Data format protocol

7.1 Characters

7.1.1 General

All transmitted data shall be interpreted as ASCII characters. The most significant bit of the eight-bit character shall always be transmitted as zero (D7 = 0).

7.1.2 Reserved characters

The reserved character set consists of those ASCII characters shown in 8.1 (Table 1). These characters are used for specific formatting purposes, such as sentence and field delimiting, and except for code delimiting, shall not be used in data fields.

7.1.3 Valid characters

The valid character set consists of all printable ASCII characters (HEX 20 to HEX 7E), except those defined as reserved characters. The list of the valid character set is given in 8.1 (Table 2).

7.1.4 Undefined characters

ASCII values not specified as either "reserved characters" or "valid characters" are excluded and shall not be transmitted at any time.

When it is necessary to communicate an 8-bit character defined by ISO/IEC 8859-1 that is a reserved character (Table 1) or not listed in Table 2 as a valid character (e.g. in a proprietary sentence or text sentence), three characters shall be used.

The reserved character "^" (HEX 5E) is followed by two ASCII characters (0-9, A-F) representing the HEX value of the character to be communicated. For example:

- to send heading as "127.5°", transmit "127.5 ^F8";
- to send the reserved characters <CR><LF>, transmit "^0D^0A";
- to send the reserved character "^", transmit "^5E".

IEC 60945 states that, as a minimum requirement, English language shall be used for controls and displays. Other languages/characters are only supported by the TUT sentence.

7.1.5 Character symbols

When individual characters are used in this document to define units of measurement, to indicate the type of data field, type of sentence, etc., they shall be interpreted according to the character symbol in 8.1 (Table 3).

7.1.6 Manufacturer's mnemonic code

The NMEA secretariat maintains the master reference list which comprises manufacturer's mnemonic codes registered and formally adopted by NMEA¹ and used by this document. **7**

7.2 Fields

7.2.1 String

A field consists of a string of valid characters, or no characters (a null field), located between two appropriate delimiter characters.

7.2.2 Address field

7.2.2.1 General

An address field is the first field in a sentence and follows the "\$" or "!" delimiter. It serves to define the sentence. The "\$" delimiter identifies sentences that conform to the conventional parametric and delimited field composition rules as described in 7.3.3. The "!" delimiter identifies sentences that conform to the special-purpose encapsulation and non-delimited field composition rules as described in 7.3.4. Characters within the address field are limited to digits and upper case letters. The address field shall not be a null field. Only sentences with the three types of address fields described in 7.2.2.2 to 7.2.2.4 shall be transmitted.

7.2.2.2 Approved address field

Approved address fields consist of five digits and upper case letter characters defined by this document. The first two characters are the talker identifier, listed in 8.2 (Table 4) or detailed in individual equipment standards or in any Publicly Available Specification (PAS). The talker identifier serves to define the nature of the data being transmitted.

NOTE If there is no suitable talker identifier specified in Table 4 or in any equipment standard or in any Publicly Available Specification, then make an application to specify a suitable talker identifier to the IEC TC 80. While waiting for the publication of the suitable talker identifier, one can always use the generic UP, see Table 4. **8**

Devices that have the capability to transmit data from multiple sources shall transmit the appropriate talker identifier (for example a device with both a GPS receiver and a LORAN-C receiver shall transmit GP when the position is GPS-based, LC when the position is LORAN-C-based, and IN for integrated navigation shall be used if lines of position from LORAN-C and GPS are combined into a position fix).

Devices capable of re-transmitting data from other sources shall use the appropriate identifier (for example GPS receivers transmitting heading data shall not transmit \$GPHCD unless the compass heading is actually derived from the GPS signals).

The next three characters form the sentence formatter used to define the format and the type of data. A list of sentence formatters is given in 8.3.

7.2.2.3 Query address field

The query address field consists of five characters and is used for the purpose of requesting transmission of a specific sentence on a separate bus from an identified talker.

¹ The address for the registration of manufacturer's codes is:
NMEA 0183 Technical Standards Committee
7 Riggs Ave
Servana Pk, Maryland 21146, USA
web site <http://www.nmea.org>
e-mail: info@nmea.org
Phone: +1 410 975 9450

The first two characters are the talker identifier of the device requesting data, the next two characters are the talker identifier of the device being addressed and the final character is the query character "Q".

7.2.2.4 Proprietary address field

The proprietary address field consists of the proprietary character "P" followed by a three-character manufacturer's mnemonic code (see 7.1.6), used to identify the talker issuing a proprietary sentence, and any additional characters as required.

~~NOTE A list of valid manufacturer's mnemonic codes may be obtained from NMEA (see 7.3.6).~~ **9**

7.2.3 Data fields

7.2.3.1 General

Data fields in approved sentences follow a "," delimiter and contain valid characters (and code delimiters "^") in accordance with the formats illustrated in 8.2 (Table 5). Data fields in proprietary sentences contain only valid characters and the delimiter characters "," and "^", but are not defined by this document.

Because of the presence of variable data fields and null fields, specific data fields shall only be located within a sentence by observing the field delimiters ",". Therefore, it is essential for the listener to locate fields by counting delimiters rather than counting the total number of characters received from the start of the sentence.

7.2.3.2 Variable length fields

Although some data fields are defined to have fixed length, many are of variable length in order to allow devices to convey information and to provide data with more or less precision, according to the capability or requirements of a particular device.

Variable length fields may be alphanumeric or numeric fields. Variable numeric fields may contain a decimal point and may contain leading or trailing zeros.

7.2.3.3 Data field types

Data fields may be alpha, numeric, alphanumeric, variable length, fixed length or fixed/variable (with a portion fixed in length while the remainder varies). Some fields are constant, with their value dictated by a specific sentence definition. The allowable field types are summarized in 8.2 (Table 5).

7.2.3.4 Null fields

A null field is a field of length zero, i.e. no characters are transmitted in the field.

- Null fields should be used when the value is unreliable or not available *unless the sentence description provides sentence specific guidance or provides another method to inform unreliability or not availability*. For example, if heading information were not available, sending data of "000" is misleading because a user cannot distinguish between "000" meaning no data and a legitimate heading of "000". However, a null field, with no characters at all, clearly indicates that no data is being transmitted.
- Null fields may be used when having a special meaning in the description of a sentence. For example to indicate that the value is unchanged or to shorten the sentence in a multi-sentence message when another sentence in the message has provided the value.

NOTE There are cases where previous editions of this document use null fields for purposes other than the indication of unreliable or unavailable data without this usage being explicitly stated in the sentence definition. To ensure compatibility with such equipment, these null fields can be assessed on a case-by-case basis with the null field being treated as unreliable, unavailable, to be ignored, or to be treated otherwise (such as the sentence being rejected) etc., as applicable.

Sentence descriptions regarding null field use take precedence. 10

Null fields with their delimiters can have the following appearance depending on where they are located in the sentence:

" " " *"
, , ,

The ASCII NULL character (HEX 00) shall not be used as the null field.

7.2.4 Checksum field

A checksum field shall be transmitted in all sentences. The checksum field is the last field in a sentence and follows the checksum delimiter character "*". The checksum is the eight-bit exclusive OR (no start or stop bits) of all characters in the sentence, including "," and "^" delimiters, between but not including the "\$" or "!" and the "*" delimiters.

The hexadecimal value of the most significant and least significant four bits of the result are converted to two ASCII characters (0-9, A-F (upper case)) for transmission. The most significant character is transmitted first.

Examples of the checksum field are:

\$GPGLL,5057.970,N,00146.110,E,142451,A*27 and

\$GPVTG,089.0,T,,15.2,N,,,53.

7.2.5 Sequential message identifier field

This is a field that is critical to identifying groups of 2 or more sentences that make up a multi-sentence message. This field may be null field for a multi-sentence message constructed from only a single sentence 10. This field applies only to a single sentence formatter, and is not used to associate different sentence formatters. This field is incremented each time a new multi-sentence message is generated with the same sentence formatter. This field's value is reset to zero when it is incremented beyond the defined maximum value. This field's maximum value, size, and format of this field is determined by the applicable sentence definition in Clause 8. This is one of three key fields supporting the multi-sentence message capability (see 7.3.9).

7.3 Sentences

7.3.1 General structure

7.3 describes the general structure of sentences. Details of specific sentence formats are found in 8.3. Some sentences may specify ~~restrictions~~ additional rules beyond the general limitations given in this document. Such ~~restrictions~~ additional rules may include defining some fields as fixed length, numeric or text only, ~~required~~ not allowed to be ~~non~~ a null field 10, transmitted with a certain frequency, etc.

The maximum number of characters in a sentence shall be 82, consisting of a maximum of 79 characters between the starting delimiter "\$" or "!" and the terminating delimiter <CR><LF>.

The minimum number of fields in a sentence is one (1). The first field shall be an address field containing the identity of the talker and the sentence formatter which specifies the number of data fields in the sentence, the type of data they contain and the order in which the data fields are transmitted. The remaining portion of the sentence may contain zero or multiple data fields.

The maximum number of fields allowed in a single sentence is limited only by the maximum sentence length of 82 characters. Null fields may be present in the sentence and shall always be used if data for that field is unavailable and may be used for other purposes when specified in the sentence description. 10

All sentences begin with the sentence-starting delimiter character "\$" or "!" and end with the sentence-terminating delimiter <CR><LF>.

7.3.2 Description of approved sentences

Approved sentences are those designed for general use and detailed in this document (see 8.3) or detailed in individual equipment standards or in any Publicly Available Specification. ~~Approved sentences are listed in 8.3 and shall be used wherever possible.~~ In case of multiple specifications for an approved sentence, the one which is newest based on the publication date takes precedence 11. When a deprecated sentence has been replaced by an approved sentence, this is indicated in 8.3 by a note.

Other sentences, not recommended for new designs, may be found in practice.

NOTE Such sentences are listed in NMEA 0183. Information on such sentences ~~may~~ can be obtained from the National Marine Electronics Association (NMEA) (see 7.3.6).

An approved sentence contains, in the order shown, the following elements:

ASCII	HEX	Description
"\$" or "!"	24 or 21	– start of sentence
<address field>		– talker identifier and sentence formatter
["," <data field>]		– zero or more data fields
["," <data field>]		
"*" <checksum field>		– checksum field
<CR><LF>	0D 0A	– end of sentence

7.3.3 Parametric sentences

7.3.3.1 Description

These sentences start with the "\$" delimiter, and represent the majority of sentences defined by this document. This sentence structure, with delimited and defined data fields, is the preferred method for conveying information.

The basic rules for parametric sentence structures are:

- the sentence begins with the "\$" delimiter;
- only approved sentence formatters are allowed. Formatters used by special-purpose encapsulation sentences ~~cannot~~ shall not be reused. See 8.2;
- only valid characters are allowed. See 8.1 (Table 1 and Table 2);
- only approved field types are allowed. See 8.2 (Table 5);
- data fields (parameters) are individually delimited, and their content is identified and often described in detail by this document;
- encapsulated non-delimited data fields are not allowed.

7.3.3.2 Structure

The following provides a summary explanation of the approved parametric sentence structure:

\$aacc, c---c*hh<CR><LF>

ASCII	HEX	Description
"\$"	24	Start of sentence: starting delimiter.

ASCII	HEX	Description
aaccc		Address field: alphanumeric characters identifying type of talker, and sentence formatter. The first two characters identify the talker. The last three are the sentence formatter mnemonic code identifying the data type and the string format of the successive fields. Mnemonics will be used as far as possible to facilitate readouts by users.
","	2C	Field delimiter: starts each field except address and checksum fields. If it is followed by a null field, it is all that remains to indicate no data in a field.
C---C		Data sentence block: follows address field and is a series of data fields containing all of the data to be transmitted. Data field sequence is fixed and identified by the third and subsequent characters of the address field (the sentence formatter). Data fields may be of variable length and are preceded by delimiters ",".
"**"	2A	checksum delimiter: follows last data field of the sentence. It indicates that the following two alpha-numeric characters show the HEX value of the checksum.
hh		Checksum field: the absolute value calculated by exclusive-OR'ing the eight data bits (no start bits or stop bits) of each character in the sentence between, but excluding, "\$" and "**". The hexadecimal value of the most significant and least significant four bits of the result are converted to two ASCII characters (0-9, A-F (upper case)) for transmission. The most significant character is transmitted first. The checksum field is required in all cases.
<CR><LF>	0D 0A	End of sentence: sentence terminating delimiter.

7.3.4 Encapsulation sentences

7.3.4.1 Description

These sentences start with the "!" delimiter. The function of this special-purpose sentence structure is to provide a means to convey information, when the specific data content is unknown or greater information bandwidth is needed. This is similar to a modem that transfers information without knowing how the information is to be decoded or interpreted.

The basic rules for encapsulation sentence structures are:

- the sentence begins with the "!" delimiter;
- only approved sentence formatters are allowed. Formatters used by conventional parametric sentences ~~cannot~~ shall not be reused. See 8.2;
- only valid characters are allowed. See 8.1 (Table 1 and Table 2);
- only approved field types are allowed. See 8.2 (Table 5);
- only six-bit coding may be used to create encapsulated data fields. See 8.2 (Table 5);
- encapsulated data fields may consist of any number of parameters, and their content is not identified or described by this document;
- the sentence shall be defined with one encapsulated data field and any number of parametric data fields separated by the "," data field delimiter. The encapsulated data field shall always be the second to last data field in the sentence, not counting the checksum field. See 7.2.3;
- the sentence contains a "total number of sentences" field. See 7.3.4.2;

- the sentence contains a "sentence number" field. See 7.3.4.2,
- the sentence contains a "sequential message identifier" field. See 7.3.4.2;
- the sentence contains a "fill-bits" field immediately following the encapsulated data field. The fill-bits field shall always be the last data field in the sentence, not counting the checksum field. See 7.3.4.2.

This method to convey information is to be used only when absolutely necessary, and will only be considered when one or both of two conditions are true, and when there is no alternative.

Condition 1: The data parameters are unknown by devices having to convey the information. For example, the ABM and BBM sentences meet this condition, because the content is not known to the automatic identification system (AIS).

Condition 2: When information requires a significantly higher data rate than can be achieved by the default IEC 61162-1 (4 800 Bd) and default IEC 61162-2 (38 400 Bd) standards 5, utilizing parametric sentences.

By encapsulating a large amount of information, the number of overhead characters, such as "," field delimiters can be reduced, resulting in higher data transfer rates. It is very unusual for this second condition to be fulfilled. As an example, an AIS has a data rate capability of 4 500 messages per minute, and satisfies this condition, resulting in the VDM and VDO sentences.

7.3.4.2 Structure

The following provides a summary explanation of the approved encapsulation sentence structure:

!aacc,x1,x2,x3,c---c,x4*hh<CR><LF>

ASCII	HEX	description
"!"	21	start of sentence: starting delimiter.
aacc		address field: alphanumeric characters identifying type of talker, and sentence formatter. The first two characters identify the talker. The last three are the sentence formatter mnemonic code identifying the data type and the string format of the successive fields. Mnemonics will be used as far as possible to facilitate readouts by users.
","	2C	field delimiter: starts each field except address and checksum fields. If it is followed by a null field, it is all that remains to indicate no data in a field.
x1		total number of sentences field: encapsulated information often requires more than one sentence. This field represents the total number of encapsulated sentences needed. This may be a fixed or variable length and is defined by the sentence definitions in 8.3.
x2		sentence number field: encapsulated information often requires more than one sentence. This field identifies which sentence of the total number of sentences this is. This may be fixed or variable length and is defined by the sentence definitions in 8.3.

ASCII	HEX	description
x3		sequential message identifier field: this field distinguishes one encapsulated message consisting of one or more sentences, from another encapsulated message using the same sentence formatter. This field is incremented each time an encapsulated message is generated with the same formatter as a previously encapsulated message. The value is reset to zero when it is incremented beyond the defined maximum value. The maximum value and size of this field are determined by the applicable sentence definitions in Clause 8.
C---C		data sentence block: follows sequential message identifier field and is a series of data fields consisting of one or more parametric data fields and one encapsulated data field. The data field sequence is fixed and identified by third and subsequent characters of the address field (the "sentence formatter"). Individual data fields may be of variable length and are preceded by delimiters ",". The encapsulated data field shall always be the second to the last data field in the sentence.
x4		fill-bits field: this field represents the number of fill-bits added to complete the last six-bit coded character. This field is required and shall immediately follow the encapsulated data field. To encapsulate, the number of binary bits shall be a multiple of six. If it is not, one to five fill-bits are added. This field shall be set to zero when no fill-bits have been added. The fill-bits field shall always be the last data field in the sentence. This shall not be a null field.
"*"	2A	checksum delimiter: follows the last data field of the sentence. It indicates that the following two alphanumeric characters show the HEX value of the checksum.
hh		checksum field: the absolute value calculated by exclusive-OR'ing the 8 data bits (no start bits or stop bits) of each character in the sentence, between, but excluding "!" and "*". The hexadecimal value of the most significant and least significant four bits of the result are converted to two ASCII characters (0-9, A-F (upper case)) for transmission. The most significant character is transmitted first. The checksum field is required in all transmitted sentences.
<CR><LF>	0D 0A	end of sentence: sentence terminating delimiter.

7.3.5 Query sentences

7.3.5.1 Description

Query sentences are intended to request approved sentences to be transmitted in a form of two-way communication. The use of query sentences implies that the listener shall have the capability of being a talker with its own bus. Query sentences shall always be constructed with the "\$" start of sentence delimiter.

The approved query sentence contains, in the order shown, the following elements:

ASCII	HEX	description
"\$"	24	start of sentence
<aa>		talker identifier of requester
<aa>		talker identifier for device from which data is being requested

ASCII	HEX	description
"Q"		query character, identifies query address
","		data field delimiter
<ccc>		approved sentence formatter of data being requested
"*" <checksum field>		checksum field
<CR><LF>	0D 0A	end of sentence

7.3.5.2 Reply to query sentence

The reply to a query sentence is the approved sentence that was requested. The use of query sentences requires cooperation between the devices that are interconnected. A reply to a query sentence is not mandatory and there is no specified time delay between the receipt of a query and the reply.

7.3.6 Proprietary sentences

These are sentences not included within this document; these provide a means for manufacturers to use the sentence structure definitions of this document to transfer data which does not fall within the scope of approved sentences. This will generally be for one of the following reasons:

- data is intended for another device from the same manufacturer, is device specific, and not in a form or of a type of interest to the general user;
- data is being used for test purposes prior to the adoption of approved sentences;
- data is not of a type and general usefulness which merits the creation of an approved sentence.

~~NOTE The manufacturer's reference list of mnemonic codes is a component of the equivalent specification NMEA 0183.~~² **7**

A proprietary sentence contains, in the order shown, the following elements:

ASCII	HEX	description
"\$"	24	start of sentence
"P"	50	proprietary sentence ID
<aaa>		manufacturer's mnemonic code (see 7.1.6) ~~The NMEA secretariat maintains the master reference list which comprises codes registered and formally adopted by NMEA~~ 7
[<valid characters, "^" and ", " >]		manufacturer's data
"*"<checksum field>		checksum field
<CR><LF>	0D 0A	end of sentence

² ~~The NMEA Secretariat maintains the master reference list which comprises codes registered and formally adopted by NMEA.~~

~~The address for the registration of manufacturer's codes is:~~

~~NMEA 0183 Technical Standards Committee Phone: +1 410 975 9450~~

~~7 Riggs Ave e-mail: info@nmea.org~~

~~Servana Pk, Maryland 21146, USA web site: http://www.nmea.org~~



Proprietary sentences shall include checksums and conform to requirements limiting overall sentence length. Manufacturer’s data fields shall contain only valid characters but may include “^” and “,” for delimiting or as manufacturer’s data. Details of proprietary data fields are not included in this document and need not be submitted for approval. However, it is required that such sentences be published in the manufacturer’s manuals for reference.

7.3.7 Command sentences

Command sentences are those that provide an ability to alter or change the configuration or operation of a device. Examples of legacy command sentences are the “HTC – Heading/Track control command” and the “ACA – AIS channel assignment” sentences. When a command sentence is generated in response to a Query sentence, a means to identify that the sentence has only a status report of current settings is required.

Some command sentences cannot be queried and provide a different sentence formatter for status information, so they should not be misinterpreted. This is the case with the HTC sentence. The HTD sentence is provided to determine the status of a heading control system’s settings. There is a high possibility of misinterpretation if a device receives a query sentence for a HTC sentence, and erroneously provides the HTC sentence.

The ACA sentence is an example of a command sentence that can also be queried to determine the status of the current settings. The ACA sentence definition provides a field that, when set to any valid value, identifies the sentence as a status of current settings and not a command to change settings. There is a high probability of misinterpreting this sentence because the field is used for two distinct purposes at the same time.

To avoid any possibility of misinterpretation and to satisfy the requirements of the voyage data recorder required to be carried on ships under the SOLAS Convention, a clear and unambiguous means to identify that a command sentence is to be interpreted as a command or that it contains status information only and is not a command shall be provided.

Any sentence that contains one or more command fields shall be identified as a “command sentence”. Command sentences shall contain the “Sentence status flag” field.

Field formatter	Description
a	Sentence status flag. This field is a required field for any sentence designated as a command sentence. The field distinguishes the contents of command sentence as being commands intended to change settings or as being status information only. This field shall not be a null field. 10 This field shall contain an “R” when the sentence is a status report of current settings. This may occur when the sentence is provided in response to a query or is autonomously generated. This field shall contain a “C” when the sentence is a configuration command to change settings. A sentence without a “C” in this field is not a command. If a designated command sentence cannot be queried, as stated in the sentence’s definition, this field shall always be set to “C”. Where data fields are null fields 10 in a command sentence (sentence status flag = C), there is no change in their setting. When a configuration data field is ~~NULL~~ a null field 10 in a status report sentence (sentence status flag = R), this data field is not configured.

7.3.8 Valid sentences

Approved sentences, query sentences and proprietary sentences are the only valid sentences. Sentences of any other form are non-valid and shall not be transmitted on the bus.

7.3.9 Multi-sentence messages

Multi-sentence messages may be transmitted where a data message exceeds the available character space in a single sentence formatter. All the sentences in a multi-sentence message use the same sentence formatter. The key fields supporting the multi-sentence message capability shall always be included, without exception. These required fields are: total number of sentences, sentence number, and sequential message identifier fields. Only sentence definitions containing these fields may be used to form messages. *If a multi-sentence message is constructed from one sentence, then the total number of sentences, sentence number or sequential message identifier fields may be null or may contain "1" as the value 10.* The TUT and VDM sentences are good examples of how a sentence is defined to provide these capabilities.

The listener ~~should be aware that~~ has to check that multi-sentences are contiguous. A multi-sentence message may be interrupted by a higher priority message such as an alarm sentence, and thus the original message ~~should~~ shall be discarded as incomplete and the listener 12 has to await a re-transmission. ~~The listener has to check that multi-sentences are contiguous.~~

~~Should~~ If an error occurs in any sentence of a multi-sentence message, the listener shall discard the whole message and be prepared to receive the message again upon the next transmission.

7.3.10 Sentence transmission timing

Frequency of sentence transmission when specified shall be in accordance with the approved sentence definitions (see 8.3). When not specified, the rate shall be consistent with the basic measurement or calculation cycle but generally not more frequently than once per second.

It is desirable that sentences be transmitted with minimum inter-character spacing, preferably as a near continuous burst, but under no circumstance shall the time to complete the transmission of a sentence be greater than 1 s.

7.3.11 Additions to approved sentences

In order to allow for improvements or additions, future revisions of IEC 61162-1 may modify existing sentences by adding new data fields after the last data field but before the checksum delimiter character "*" and checksum field. Listeners shall determine the end of the sentence by recognition of "<CR><LF>" and "*" rather than by counting field delimiters. The checksum value shall be computed on all received characters between, but not including, "\$" or "!" and "*" whether or not the listener recognizes all fields.

7.3.12 Message reception timeout for multi-sentence method

7.3.10 specifies the timeout for each separate sentence within the message. The transmission of multi-sentence message may be interrupted by higher priority messages (see 7.3.9). The message reception timeout is 5 s after the last reception of a sentence related to the message. The timeout also occurs if a newer instance of the same message has been received.

If the timeout expires, the listener shall discard the whole message and be prepared to receive the message again upon the next transmission. 13

7.4 Error detection and handling

Listening devices shall detect errors in data transmission including:

- a) checksum error (see 7.2.4);
- b) invalid characters (see 7.1.3);
- c) incorrect length of address field (see 7.2.2), and data fields as specified within sentence definitions;
- d) time out of sentence transfer (see 7.3.10).

Listening devices shall use only correct sentences, consistent with the edition of IEC 61162-1 supported by the talker devices.

7.5 Handling of deprecated sentences

Deprecated sentences are no longer recommended for sole use in new or revised designs. These sentences are valid sentences, but due to changing circumstances it is desirable to delete or replace these sentences.

Generally, in each of the deprecated sentences, a reference is made to a replacement sentence in the current edition of the standard. Manufacturers are urged to use the currently recommended sentence in new or revised designs. It is desirable that manufacturers provide both new and old sentences whenever possible for a period of time that will serve as a phase-in period for new sentences.

8 Data content

8.1 Character definitions

Table 1, Table 2 and Table 3 indicate character definitions.

Table 1 – Reserved characters

ASCII	HEX	DEC	Description
<CR>	0D	13	Carriage return
<LF>	0A	10	Line feed – End of sentence delimiter
\$	24	36	Start of sentence delimiter
*	2A	42	Checksum field delimiter
,	2C	44	Field delimiter
!	21	33	Start of encapsulation sentence delimiter
\	5C	92	TAG block delimiter
^	5E	94	Code delimiter for HEX representation of ISO/IEC 8859-1 (ASCII) characters
~	7E	126	Reserved for future use
<del>	7F	127	Reserved for future use

Table 2 – Valid characters

ASCII	HEX	DEC	ASCII	HEX	DEC	ASCII	HEX	DEC
Space	20	32	@	40	64	`	60	96
Reserved	21	33	A	41	65	a	61	97
"	22	34	B	42	66	b	62	98
#	23	35	C	43	67	c	63	99
Reserved	24	36	D	44	68	d	64	100
%	25	37	E	45	69	e	65	101
&	26	38	F	46	70	f	66	102
'	27	39	G	47	71	g	67	103
(	28	40	H	48	72	h	68	104
)	29	41	I	49	73	i	69	105
Reserved	2A	42	J	4A	74	j	6A	106

ASCII	HEX	DEC	ASCII	HEX	DEC	ASCII	HEX	DEC
+	2B	43	K	4B	75	k	6B	107
Reserved	2C	44	L	4C	76	l	6C	108
–	2D	45	M	4D	77	m	6D	109
.	2E	46	N	4E	78	n	6E	110
/	2F	47	O	4F	79	o	6F	111
0	30	48	P	50	80	p	70	112
1	31	49	Q	51	81	q	71	113
2	32	50	R	52	82	r	72	114
3	33	51	S	53	83	s	73	115
4	34	52	T	54	84	t	74	116
5	35	53	U	55	85	u	75	117
6	36	54	V	56	86	v	76	118
7	37	55	W	57	87	w	77	119
8	38	56	X	58	88	x	78	120
9	39	57	Y	59	89	y	79	121
:	3A	58	Z	5A	90	z	7A	122
;	3B	59	[	5B	91	{	7B	123
<	3C	60	Reserved	5C	92		7C	124
=	3D	61	]	5D	93	}	7D	125
>	3E	62	Reserved	5E	94	Reserved	7E	126
?	3F	63	–	5F	95	Reserved	7F	127

Table 3 – Character symbol

Symbol	Definition
A	Status symbol; Yes; Data valid; Warning flag clear; Auto; Ampere, ASCII, Acknowledged, Activation, Autonomous 14
a	Alphabet character variable A through Z or a through z
B	Bar (pressure, 1 000 mb = 100 kPa (Pascal(Pa))), Bottom, Broadcast, Bridge 14
C	Celsius (Degrees); Course-up, Caution, Engine Control Room 14
c	Valid character; Calculating
d	~~Destination-identification~~
D	Degrees (of arc), Differential 14
E	Error; East; Engine, Estimated, Engine side/local 14
F	Fathoms (1 fathom equals 1,828 766 m), Float RTK 14
f	Feet (1 foot equals 0,304 79 m)
G	Great circle; Green
g	Good
H	Compass heading; Head-up; Hertz; Humidity, Alarm state (Threshold exceeded), Harbor mode 14
h	Hours; HEX number
I	Inches (1 inch equals 0,025 4 m)
J	Input operation completed, Alarm state (Extreme threshold exceeded) 14
K	Kilometres; km/h; kg/m ³ , Alarm state (Extreme low threshold exceeded) 14

Symbol	Definition
k	Kilograms
L	Left; Local; Lost target, Alarm state (Low threshold exceeded) 14
l	Latitude; Litres; l/s
M	Metres; m/s; Magnetic; Manual; Cubic metres, Manual input mode 14
m	Minutes; message
N	Nautical miles; Knots; North; North-up; Newtons, Normal state, No fix 14
n	Numeral; address
P	Purple; Proprietary (only when following "\$" or "!"); Position sensor; Per cent; Pascal (pressure), Precise, Port wing 14
Q	Query; Target-being-acquired, Override 14
R	Right; Rhumb line; Red; Relative; Reference; Radar tracking; revolutions/min (RPM), Real time kinematic 14
S	South; Statute miles (1 609,31 m); Statute miles/h; Shaft Salinity parts/thousand; Simulator mode Status, Safe, Simulator mode, Starboard wing 14
s	Seconds; Six-bit number, ~~Source identification~~ 14
T	Time difference; True; Track; Tracked target
t	Test
U	Dead reckoning estimate, unsafe 14
u	Sign, if minus "-" (HEX 2D)
V	Data invalid; No; Warning flag set; Manual; Volt, Not acknowledged, Not in use 14
W	West; Water; Wheelover, Wing 14
x	Numeric character variable
y	Longitude
Z	Time

8.2 Field definitions

Field definitions are indicated in Table 4 and Table 5.

Table 4 – Talker identifier mnemonics

Talker device	Identifier
Heading/ ~~track-controller~~ control system 15 (autopilot) general	AG
magnetic	AP
Automatic identification system	AI
Bilge system	BI
Bridge navigational watch alarm system	BN
BAM central alert management function	CA
Communications: digital selective calling (DSC)	CD
data receiver	CR
satellite	CS
radio-telephone (MF/HF)	CT
radio-telephone (VHF)	CV
scanning receiver	CX

Talker device	Identifier
Direction finder	DF
Duplex repeater station	DU
Electronic chart system (ECS)	EC
Electronic chart display and information system (ECDIS)	EI
Emergency locator	EL
Emergency position indicating radio beacon (EPIRB)	EP
Engine room monitoring system	ER
Fire door controller/monitoring system	FD
Fire extinguisher system	FE
Fire detection system	FR
Fire sprinkler system	FS
Galileo positioning system	GA
BeiDou-positioning navigation satellite system (BDS)	GB
IRNSS positioning system	GI
GLONASS positioning system	GL
Global positioning system (GPS)	GP
QZSS positioning system	GQ
Global navigation satellite system (GNSS)	GN
Heading sensors: compass, magnetic	HC
gyro, north seeking	HE
fluxgate	HF
gyro, non-north seeking	HN
Hull door controller/monitoring system	HD
Hull stress monitoring	HS
Integrated communication system	IC
Integrated instrumentation	II
Integrated navigation	IN
Automation – Alarm and monitoring system 16	JA
Automation – Reefer monitoring system 16	JB
Automation – Power management system 16	JC
Automation – Propulsion control system 16	JD
Automation – Engine control console 16	JE
Automation – Propulsion boiler 16	JF
Automation – Auxiliary boiler 16	JG
Automation – Electronic governor system 16	JH
LORAN: LORAN-C	LC
Network device	ND
Navigation light controller	NL
Night vision 16	NV
Proprietary code	P
Radar and/or radar plotting	RA
Electronic record book 16	RB
Propulsion machinery including remote control	RC

Talker device		Identifier
Rudder angle indicator 16		RI
Inclinometer 16		RP
Steering control system/device 16		SC
Sounder, depth		SD
Steering gear/steering engine		SG
Serial to network gateway function (SNGF)		SI
System management 16		SM
Electronic positioning system, other/general		SN
Sounder, scanning		SS
Track control system 16		TC
Turn rate indicator		TI
Microprocessor controller		UP
(0<=#<=9) User configured talker identifier ^a		U#
Velocity sensors:	Doppler, other/general	VD
	speed log, water, magnetic	VM
	speed log, water, mechanical	VW
Voyage data recorder		VR
Watertight door controller/monitoring system		WD
Water level detection system		WL
Transducer		YX
Timekeeper, time/date:	atomic clock	ZA
	chronometer	ZC
	quartz	ZQ
	radio update	ZV
Weather instrument		WI
^a The U# talker identifier does not convey the nature of the device transmitting the sentence, and ~~should~~ shall not be "fixed" into a unit at manufacture. This is intended for special purpose applications. The U# talker identifier indicates that the devices talker identifier has been changed through external control.		

Table 5 – Field type summary

Field type	Symbol	Definition
Special format fields		
Status	A	Single character field: A = Yes, data valid, warning flag clear V = No, data invalid, warning flag set
Latitude	IIII.II	Fixed/variable length field: degrees/minutes and decimal – two fixed digits of degrees, two fixed digits of minutes and a variable number of digits for a decimal fraction of minutes. Leading zeros always included for degrees and minutes to maintain fixed length. The decimal point and associated decimal fraction are optional if full resolution is not required.
Longitude	yyyyy.yy	Fixed/variable length field: degrees/minutes and decimal – three fixed digits of degrees, two fixed digits of minutes and a variable number of digits for a decimal fraction of minutes. Leading zeros always included for degrees and minutes to maintain fixed length. The decimal point and associated decimal fraction are optional if full resolution is not required.
Time	hhmmss.ss	Fixed/variable length field: hours/minutes/seconds and decimal – two fixed digits of hours, two fixed digits of minutes, two fixed digits of seconds and a variable number of digits for decimal fraction of seconds. Leading zeros always included for hours, minutes and seconds to maintain fixed length. The decimal point and associated decimal fraction are optional if full resolution is not required.
Defined field		Some fields are specified to contain pre-defined constants, most often alpha characters. Such a field is indicated in this document by the presence of one or more valid characters. Excluded from the list of allowable characters are the following which are used to indicate field types within this document: "A", "a", "c", "hh", "hhmmss.ss", "IIII.II", "x", "yyyyy.yy".
Numeric value fields		
Variable numbers	x.x	Variable length integer or floating numeric field. Optional leading and trailing zeros. The decimal point and associated decimal fraction are optional if full resolution is not required (example: 73.10 = 73.1 = 073.1 = 73). The specific use of this formatter and restrictions (for example integer, range) is defined in the sentence definition.
Fixed HEX field	hh-	Fixed length HEX numbers only, MSB on the left.
Variable HEX field	h--h	Variable length HEX numbers only, MSB on the left.
Fixed six-bit field	ss____	Fixed length six-bit coded characters only. See Annex C for field conversions.
Variable six-bit field	s--s	Variable length six-bit coded characters only. See Annex C for field conversions.
Information fields		
Variable text	c--c	Variable length valid character field.
Fixed alpha field	aa-	Fixed length field of upper-case or lower-case alpha characters.
Fixed number field	xx-	Fixed length field of numeric characters.
Fixed text field	cc-	Fixed length field of valid characters.

Field type	Symbol	Definition
The following considerations have to be taken into account:		
- Spaces ~~should~~ shall only be used in variable text fields. - A negative sign "-" (HEX 2D) is the first character in a field if the value is negative. When used, this increases the specified size of fixed length fields by one. The sign is omitted if the value is positive. - Units of measure fields are appropriate characters from the symbol table (Table 3) unless a specific unit of measure is indicated. - Fixed length field definitions show the actual number of characters. For example, a field defined to have a fixed length of 5 HEX characters is represented as hhhhh between delimiters in a sentence definition.		

8.3 Approved sentences

8.3.1 General format

General format of printed sentence information:

{mnemonic} – {name}

{definition paragraph}

$$\mathcal{S} \rightarrow \{ \text{sentence} \}$$

```

└── {field descriptions}

```

—start of sentence and talker ID

8.3.2 AAM – Waypoint arrival alarm

Status of arrival (entering the arrival circle, or passing the perpendicular of the course line) at waypoint c--c.

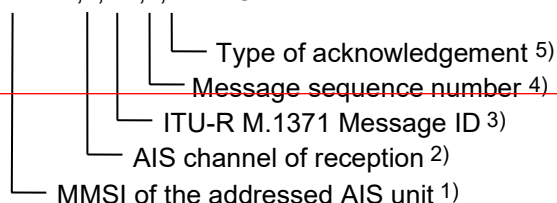
```
$--AAM,A,A,x.x,N,c--c*hh<CR><LF>
```

- Waypoint ID
- Units of radius, nautical miles
- Arrival circle radius
- Status: A = perpendicular passed at waypoint; V = not passed
- Status: A = arrival circle entered; V = not entered

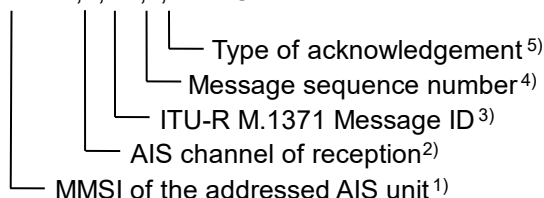
8.3.3 ABK – AIS addressed and binary broadcast acknowledgement

The ABK-sentence is generated when a transaction, initiated by reception of an ABM, AIR, or BBM sentence, is completed or terminated. This sentence provides information about the success or failure of a requested ABM broadcast of either ITU-R M.1371 Messages 6 or 12. The ABK process utilises the information received in ITU-R M.1371 Messages 7 and 13. Upon reception of either a VHF Data-link Message 7 or 13, or the failure of Messages 6 or 12, the AIS unit delivers the ABK sentence to the external application. This sentence is also used to report to the external application the AIS unit's handling of the ABM (ITU-R M.1371 Messages 6, 12, 25 and 26), 17 AIR (ITU-R M.1371 Message 15) and BBM (ITU-R M.1371 Messages 8, 14, 25 and 26) sentences. The external application initiates an interrogation through the use of the AIR-sentence, or a broadcast through the use of the BBM sentence. The AIS unit generates an ABK sentence to report the outcome of the ABM, AIR, or BBM broadcast process.

\$--ABK,xxxxxxxx,x,x,x,x,x*hh<CR><LF>



\$--ABK,xxxxxxxx,a,x,x,x,x*hh<CR><LF>



Comments:

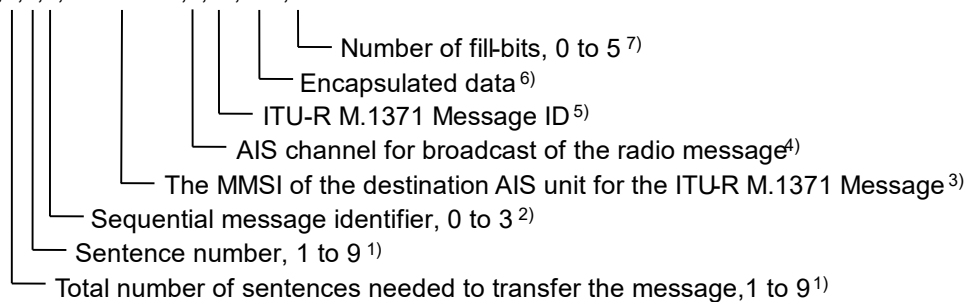
- Identifies the distant addressed AIS unit involved with the acknowledgement. If more than one MMSI is being addressed (ITU-R M.1371 Messages 15 and 16), the MMSI of the first distant AIS unit, identified in the message, is the MMSI reported here. This ~~is~~ shall be a null field **10** when the ITU-R M.1371 Message type is 8 or 14.
 - Indication of the VHF data link channel upon which a Message type 7 or 13 acknowledgement was received. An "A" indicates reception on channel A. A "B" indicates reception on channel B. ~~Otherwise shall be a null field.~~ **10**
 - This indicates to the external application the type of ITU-R M.1371 message that this ABK sentence is addressing. Also see the message IDs listed in comment 4).
 - The message sequence number, together with the Message ID and MMSI of the addressed AIS unit, uniquely identifies a previously received ABM, AIR, or BBM sentence. Generation of an ABK sentence makes a sequence message identifier available for re-use. The message ID determines the source of the message sequence number. The following lists the source by message ID:
- | ITU-R M.1371 Message ID | Message sequence number source |
|-------------------------|--|
| 6 | sequential message identifier from ABM sentence |
| 7 | addressed AIS unit's Message 7 sequence number |
| 8 | sequential message identifier from BBM sentence |
| 12 | sequential message identifier from ABM sentence |
| 13 | addressed AIS unit's Message 13 sequence number |
| 14 | sequential message identifier from BBM sentence |
| 15 | no source, the message sequence number ~~should~~ shall be a null field 10 |
| 25 | sequential message identifier from ABM or BBM sentence (structured binary data) |
| 26 | sequential message identifier from ABM or BBM sentence (structured binary data) |
| 70 | sequential message identifier from ABM or BBM sentence (unstructured binary data) |
| 71 | sequential message identifier from ABM or BBM sentence (unstructured binary data) |
- Acknowledgements provided are:
 - = Message (6 or 12) successfully received by the addressed AIS unit,
 - = Message (6 or 12) was broadcast, but no acknowledgement by the addressed AIS unit,
 - = message could not be broadcast (i.e. quantity of encapsulated data exceeds five slots),
 - = requested broadcast of Message (8, 14, 15, 25 or 26) has been successfully completed,
 - = late reception of a Message 7 or 13 acknowledgement that was addressed to this AIS unit (own ship) and referenced as a valid transaction.

8.3.4 ABM – AIS addressed binary and safety related message

This sentence supports ITU-R M.1371 Messages 6, 12, 25 and 26 and provides an external application with a means to exchange data via an AIS transponder. Data is defined by the application only, not the AIS unit. This sentence offers great flexibility for implementing system functions that use the transponder like a communications device. After receiving this sentence via the IEC 61162-2 interface, the transponder initiates a VDL broadcast of Message 6, 12, 25, or 26 ~~within 4 s~~ **18**. The AIS unit will make up to four broadcasts of Messages 6 and 12, the

actual number will depend on the reception of an acknowledgement from the addressed "destination" AIS unit. The success or failure of reception of this transmission by the addressed AIS unit for Messages 6 and 12 is confirmed through the use of the "Addressed binary and safety related message acknowledgement" ABK sentence formatter, and the processes that supports the generation of an ABK sentence. The success or failure of broadcast for messages 25 and 26 is confirmed through the use of the "Addressed Binary and safety related message Acknowledgement" ABK sentence formatter, and the processes that supports the generation of an ABK sentence 19. The AIS transponder determines the appropriate communications state for transmission of Message 26 over the VHF data Link.

!--ABM,x,x,x,xxxxxxxxx,x,xx,s--s,x*hh<CR><LF>



Comments:

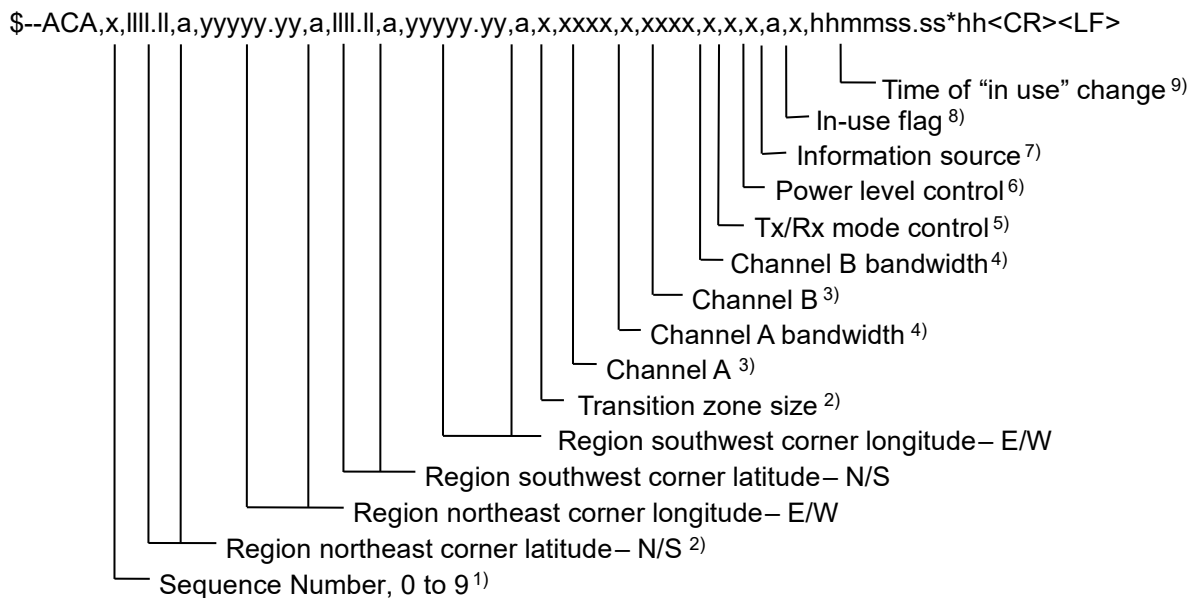
- 1) The total number of sentences required to transfer the binary message data to the AIS unit.
The first field specifies the total number of sentences used for a message, minimum value 1.
The second field identifies the order of this sentence in the message, minimum value 1.
All sentences contain the same number of fields. Successive sentences may use null fields for fields that have not changed, such as fields 4, 5, and 6.
- 2) This sequential message identifier serves two purposes. It meets the requirements as stated in the IEC 61162-1 "Sequential message identifier field" description, and it is the sequence number utilized by ITU-R M.1371 in Message types 6 and 12. The range of this field is restricted by ITU-R M.1371 to 0 to 3. The sequential message identifier value may be reused after the AIS unit provides the "ABK" acknowledgement for this number.
- 3) The MMSI of the AIS unit that is the destination of the message.
- 4) The AIS channel that shall be used for the broadcast:
 - 0 = no broadcast channel preference,
 - 1 = Broadcast on AIS channel A,
 - 2 = Broadcast on AIS channel B,
 - 3 = Broadcast message on both AIS channels, A and B.
- 5) The ITU-R M.1371 message Id for the following addressed Messages:
 - 6 = Binary addressed message,
 - 12 = Addressed safety related message,
 - 25 = Single slot binary message 25 (binary data coded using the 16-bit Application identifier),
 - 70 = Single slot binary message 25 (unstructured binary data),
 - 26 = Multiple slot binary message 26 with Communications State (binary data coded using the 16-bit Application identifier),
 - 71 = Multiple slot binary message 26 with Communications State (unstructured binary data).
- 6) This is the content of the "binary data" parameter for ITU-R M.1371 Message 6, or the "Safety related Text" parameter for Message 12, or the "binary data" parameter for Message 25, or the "binary data" parameter for Message 26. The first sentence may contain up to 48 valid six bit codes (288 bit). Following sentences may contain up to 60 valid six bit codes (360 bit), if fields 4, 5, and 6 are unchanged from the first sentence and set to null fields 10. The actual number of valid characters shall be such that the total number of characters in a sentence does not exceed the "82-character" limit.
- 7) This ~~cannot~~ shall not be a null field 10. See "x4" in 7.3.4.

8.3.5 ACA – AIS channel assignment message

An AIS device can receive regional channel management information in four ways: ITU-R M.1371 Message 22, DSC telecommand received on channel 70, manual operator input,

and an ACA sentence. The AIS unit may store channel management information for future use. Channel management information is applied based upon the actual location of the AIS device. An AIS unit is "using" channel management information when the information is being used to manage the operation of the VHF receiver and/or transmitter inside the AIS unit.

This sentence is used both to enter and obtain channel management information. When sent to an AIS unit, the ACA sentence provides regional information that the unit stores and uses to manage the internal VHF radio. When sent from an AIS unit, the ACA sentence provides the current channel management information retained by the AIS unit. The information contained in this sentence is similar to the information contained in an ITU-R M.1371 Message 22. The information contained in this sentence directly relates to the initialisation phase and dual channel operation and channel management functions of the AIS unit as described in ITU-R M.1371.



Comments:

- 1) This is used to bind the contents of the ACA and ACS sentences together. The ACS sentence, when provided by the AIS unit, should immediately follow the related ACA sentence, containing the same sequence number. The AIS unit generating the ACA and ACS sentences, ~~should~~ shall increment the sequence number each time an ACA/ACS pair is created. After 9 is used, the process ~~should~~ shall begin again from 0. Information contained in the ACS sentence is not related to the information in the ACA sentence if the sequence numbers are different. When an AIS unit is queried for an ACA sentence, the AIS unit should respond with the ACA/ACS sentence pair. When an external device is sending an ACA sentence to the AIS unit, the sequence number may be a null field **10** if no ACS sentence is being sent.
- 2) The resolution of the longitude and latitude fields is 1/10 min. The range of the transition zone size is 1 to 8 NM.
- 3) VHF channel number, see ITU-R M.1084.
- 4) Value of 0, bandwidth is specified by channel number, see ITU-R M.1084.
Value of 1, bandwidth is 12,5 kHz.
- 5) Value of 0, transmit on channels A and B, receive on channels A and B.
Value of 1, transmit on channel A, receive on channels A and B.
Value of 2, transmit on channel B, receive on channels A and B.
Value of 3, do not transmit, receive on channels A and B.
Value of 4, do not transmit, receive on channel A.
Value of 5, do not transmit, receive on channel B.
- 6) Value of 0, high power.
Value of 1, low power.
- 7) Source identifiers:
 - A = ITU-R M.1371 Message 22: Channel Management addressed message,
 - B = ITU-R M.1371 Message 22: Channel Management broadcast geographical area message,
 - C = IEC 61162-1 AIS Channel Assignment sentence,
 - D = DSC Channel 70 telecommand,

M = operator manual input.

This field ~~should~~ shall be a null field **10** when the sentence is sent to an AIS device.

- 8) This value is set to indicate that the other parameters in the sentence are "in-use" by an AIS unit at the time that the AIS unit sends this sentence. A value of "0" indicates that the parameters are not "in-use", and a value of "1" indicates that the parameters are "in-use". This field ~~should~~ shall be a null field **10** when the sentence is sent to an AIS mobile unit. A value of "1" sent to a AIS base station **12** indicates that the parameters are "in-use"; a value of "0" indicates not "in-use".
- 9) This is the UTC time that the "In-use flag" field changed to the indicated state. This field ~~should~~ shall be a null field **10** when the sentence is sent to an AIS unit.

8.3.6 ACK – Acknowledge alarm

NOTE ACK and ALR sentences are deprecated and they have been replaced by ACN, ALC and ALF. **20**

Acknowledge device alarm. This sentence is used to acknowledge an alarm condition reported by a device.

\$--ACK,xxx*hh<CR><LF>

└─ Unique alarm number (identifier) at alarm source

8.3.7 ACN – Alert command

Sentences ACN, AGL, ALC, ALF and ARC are used for alert handling. Alert related communications are described in ~~IEC 61924-2~~ IEC 62923-1. **21**

This sentence is used for acknowledge, temporary silence **22**, responsibility transfer and to request repeat of alert details in case the reception process has detected, based on ALC, that ALF has been missed.

Responsibility transferred is used for a special conditional state of an alert. In this state, the source of an alert indicates the alert visually as an acknowledged alert (i.e. no flashing indication nor audible signal). In this state, the source of an alert re-raises an unacknowledged alert, if the source of the alert is unable to receive heartbeat (HBT) sentences from the sender of the sentence.

This sentence ~~cannot~~ shall not be queried.

\$--ACN,hhmmss.ss,aaa,x.x,x.x,c,a*hh<CR><LF>

└─ Time ¹⁾

└─ Manufacturer's mnemonic code²⁾

└─ Alert Identifier³⁾

└─ Alert Instance, 0 to 999999⁴⁾

└─ Alert command, A, Q, O or S⁵⁾

└─ Sentence status flag⁶⁾

Comments:

- 1) Release time of the alert command (e.g. for VDR purposes), optional, can be a null field. Sender is allowed to use all alternatives defined in Table 5 (Field type summary). Receiver is allowed to ignore content of this field. If receiver does not ignore this field, it ~~should~~ shall support all alternatives defined in Table 5.
- 2) Used for proprietary alerts defined by the manufacturer (see 7.1.6). For standardized alerts, this ~~should~~ shall be a null field. **10**
- 3) The alert identifier is unique within a single alert source. The alert identifier is a variable length integer field of maximum 7-digit integer. It identifies the type of the alert, e.g. a "lost target" alert. Standardized alerts use unique alert identifiers described in equipment standards. Number range 10000-9999999 is reserved for proprietary alerts and number '0' is reserved for a command request to all alerts (e.g. alert command Q requests transmission of all alert states). Alert Identifier examples:

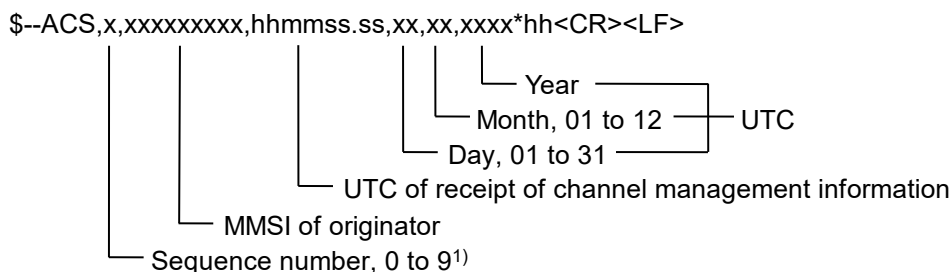
"001", "2456789", "245"

- 4) The alert instance identifies the current instance of an alert to distinguish alerts of the same type (Alert identifier) and from the same source (e.g. dangerous target). Alert instance is maximum a 6-digit integer from 1 to 999999, the number '0' indicates that the command is intended for all alert instances. Except for number '0', the number of alert instance can be freely defined by the manufacturer as long as it is unique for one type of alert (alert identifier). It is not permitted to modify the alert instance within a life cycle of a distributed alert (from 'active and unacknowledged' state until 'normal' state is reached). It can be also a null field, when there is only one alert of that type.
- 5) This ~~should~~ shall not be a null field **10**

acknowledge:	A (Not allowed for alert instance '0') 23
request / repeat information:	Q
responsibility transfer:	O (Not allowed for alert instance '0') 23
temporary silence: 22	S
- 6) This field ~~should~~ shall be "C" and ~~should~~ shall not be a null field **10**. This field indicates a command. A sentence without "C" is not a command.

8.3.8 ACS – AIS channel management information source

This sentence is used in conjunction with the ACA sentence. This sentence identifies the originator of the information contained in the ACA sentence and the date and time the AIS unit received that information.



Comments:

- 1) This is used to bind the contents of the ACA and ACS sentences together. The ACS sentence, when provided by the AIS unit, should immediately follow the related ACA sentence, containing the same sequence number. The AIS unit generating the ACA and ACS sentences, ~~should~~ shall increment the sequence number each time an ACA/ACS pair is created. After 9 is used, the process ~~should~~ shall begin again from 0. Information contained in the ACS sentence is not related to the information of the ACA sentence if the sequence numbers are different. When an external device is sending an ACA sentence to the AIS unit, the sequence number may be a null field **10** if no ACS sentence is being sent.

8.3.9 AGL – Alert group list

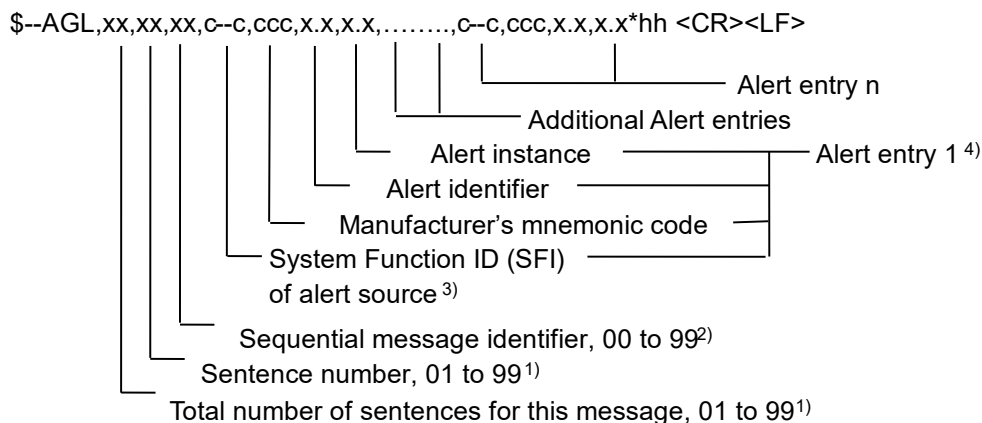
Sentences ACN, AGL, ALC, ALF and ARC are used for alert handling. Alert related communications are described in IEC 62923-1.

The purpose of the AGL message is to provide information regarding the grouping of alerts based on grouping criteria.

The message shall be sent by the source which performs the functional grouping. If an alert source provides functional grouping, it shall send the AGL message as well as the ALC and ALF messages (including a header alert).

No AGL shall be transmitted in case the EUT has no active functional group header alerts.

This sentence shall not be queried.



Comments:

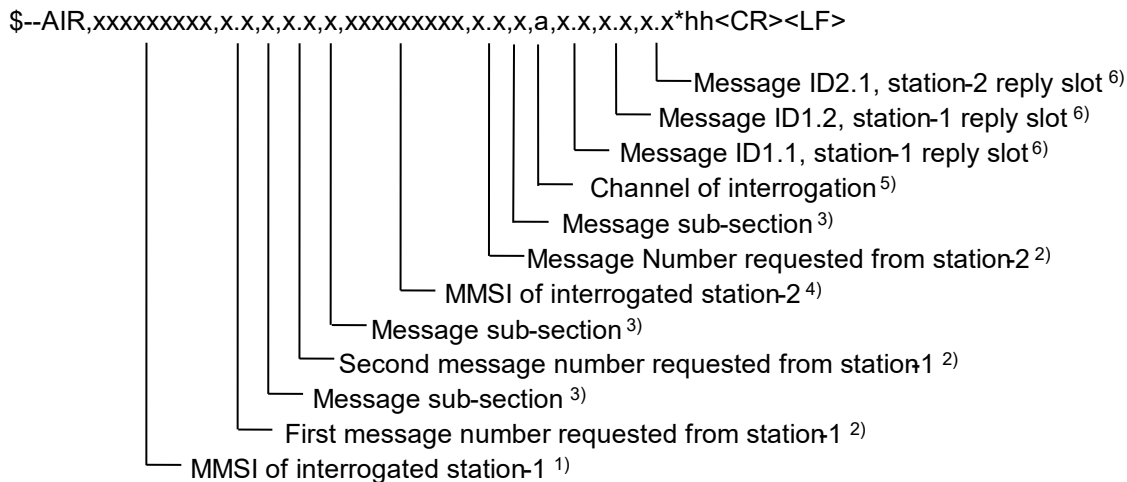
- 1) The first field specifies the total number of sentences used for a message, minimum value 1. The second field identifies the order of this sentence in the message, minimum value 1. These shall not be null fields.
- 2) The sequential message identifier relates all sentences that belong to a group of multiple sentences (i.e. message). Multiple sentences – see comment 1) – with the same sequential message identifier, make up one message.
- 3) The System Function ID (SFI) of the alert source as defined in IEC 61162-450. The SFI is needed to distinguish alerts from different sources. This field may be a null field when used in non IEC 61162-450 interfaces. When this field is a null field, the alert is from the AGL source.
- 4) Alert entry 1 to n: The first entry shall contain the alert group header. Each alert entry identifies one alert in the system and consists of 4 fields:
 - system function ID (SFI) of the alert source;
 - manufacturer's mnemonic code (see 7.1.6) (see ALF message);
 - alert identifier (see ALF message) (unique for header alert);
 - alert instance (see ALF message) (0 for header alert). **24**

8.3.10 AIR – AIS interrogation request

This sentence supports ITU-R M.1371 Message 10 and 15. It provides an external application with the means to initiate requests for specific ITU-R M.1371 messages, from distant mobile or base station, AIS units. A single sentence can be used to request up to two messages from one AIS unit and one message from a second AIS unit, or up to three messages from one AIS unit. The message types that can be requested are limited. The complete list of messages that may be requested can be found within the Message 15 description in ITU-R M.1371. Improper requests may be ignored. With Message 10, always Message 11 is requested.

The external application initiates the interrogation. The external application is responsible for assessing the success or failure of the interrogation. After receiving this sentence, the AIS unit initiates a radio broadcast (on the VHF Data Link) of a Message 10 or 15 – interrogation. The success or failure of the interrogation broadcast is determined by the application using the combined reception of the ABK-sentence and VDM sentences provided by the AIS unit. After receiving this AIR-sentence, the AIS unit shall take no more than four seconds to broadcast the Message 10 or 15, and the addressed distant unit(s) shall take no more than another four seconds to respond, a total of eight seconds.

If the requested message type is 11, then a Message 10 is transmitted to only one station. The fields of station 2 ~~should~~ shall be null fields in this case. **10**



Comments:

- 1) Identifies the first distant AIS unit being interrogated. A single AIR sentence can be used to request two message numbers from the first AIS unit.
- 2) The following are examples of messages that may be requested from a distant mobile AIS unit. See ITU-R M.1371 Message 15 and Message 10 description for the actual message numbers.

Message 3, Position report,

Message 5, Ship static and voyage related data, see additional information in comment 3,

Message 9, Standard SAR aircraft position report,

Message 18, Standard Class B equipment position report,

Message 19, Extended Class B equipment position report,

Message 21, Aids-to-navigation report,

Message 24, Static-data report,

Message 11, UTC and date response. In this case message 10 is transmitted.

Examples of messages that may be requested from a distant AIS Base Station include:

Message 4, Base station report,

Message 24, Static-data report.

- 3) This field is used to request a message that has been further sub-divided into alternative data structures. When requesting a message with alternative data structures, this message sub-section field ~~should~~ shall be provided, so that the correct sub-division of the message data is provided. If the message structure is not sub-divided into different structures, this field ~~should~~ shall be a null field. **10**
- 4) This identifies the second distant AIS unit being interrogated. Only one message may be requested from the second AIS unit. The MMSI of the second AIS unit may be the same MMSI as the first AIS unit.
- 5) A = Channel A
B = Channel B

Null field **10** = no specific channel is being assigned. AIS mobile stations ~~should~~ shall ignore this data field.
- 6) Start slot number of interrogation reply, 0 to 2 249. Null field **10** if interrogation reply slot is not being assigned. AIS mobile stations ~~should~~ shall ignore this data field.

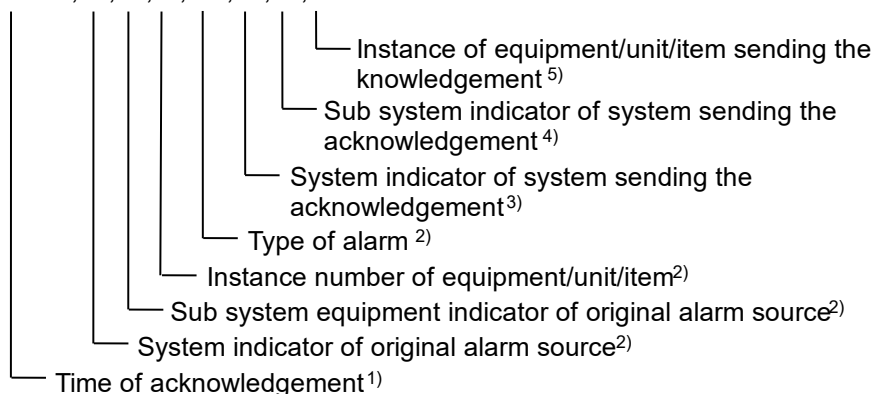
8.3.11 AKD – Acknowledge detail alarm condition

This sentence provides for acknowledgement of a detailed alarm condition reported through ALA.

As IEC 61162-1 does not guarantee reliable transport, the designer should be very careful about how this sentence is used. Problems can occur either when the initial alarm message was lost or when the acknowledgement message was lost. A possible solution is to retransmit the alarm message until acknowledgement has been received. When acknowledgement has been received, an alarm ~~acknowledged~~ ~~should~~ acknowledgement shall be sent.

acknowledgement ~~should~~ shall be sent on all subsequent acknowledgements. Acknowledgements ~~should~~ shall be sent on each received alarm message after acknowledgement and further on until the alarm acknowledgement message has been received.

\$--AKD,hhmmss.ss,aa,aa,xx,xxx,aa,aa,xx*hh<CR><LF>



Comments:

- 1) This defines the time of acknowledgement. This may be a null field.
- 2) These fields ~~should~~ shall contain the identical information of the corresponding fields from the ALA sentence being acknowledged.
- 3) Indicator characters identifying the system sending the acknowledgement. This field is two fixed characters, see Annex D. ~~This may be a null field.~~ 10
- 4) Indicator characters identifying the sub system sending the acknowledgement. This field is two fixed characters, see Annex D. ~~This may be a null field.~~ 10
- 5) Instance number identifying the equipment, unit or item sending the acknowledgement. This field is two fixed numeric characters. ~~This may be a null field.~~ 10

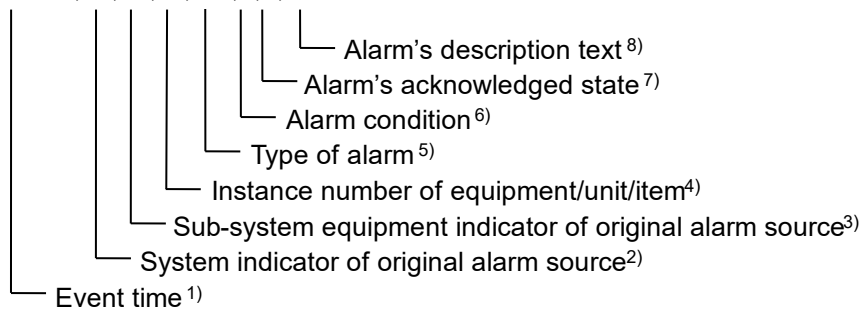
8.3.12 ALA – Report detailed alarm condition

This sentence permits the alarm and alarm acknowledge condition of systems to be reported. Unlike ALR, this sentence supports reporting multiple system and sub-system alarm conditions.

Dedicated sentences (for example FIR, DOR, HSS, WAT) are intended for reporting from a dedicated alarm detection system.

As IEC 61162-1 does not guarantee reliable transport, the designer should be very careful about how this sentence is used. Problems can occur either when the initial alarm message was lost or when the acknowledgement message was lost. One possible solution (in some cases) is to retransmit the alarm message until acknowledgement has been received. When acknowledgement has been received, an alarm ~~acknowledged should~~ acknowledgement shall be sent. This acknowledgement ~~should~~ shall be sent on all subsequent acknowledgements. Acknowledgements ~~should~~ shall be sent on each received alarm message after acknowledgement and further on until the alarm acknowledgement message has been received.

\$--ALA,hhmmss.ss,aa,aa,xx,xxx,a,a,c-c*hh<CR><LF>



Comments:

- 1) Event time of alarm condition change including acknowledgement state change. If this is not available, this ~~should~~ shall be a null field. **10**
- 2) Indicator characters as system of alarm source. This field is two fixed characters, see Annex D.
- 3) Indicator characters as sub-system of alarm source. This field is two fixed characters, see Annex D. For group alarms or if no sub-system can be identified, this ~~should~~ shall be a null field. **10**
- 4) Instance number identifying the equipment, unit or item. This field is two fixed numeric characters.
- 5) Type of alarm. This field is three fixed numeric characters as defined in Table D.1. Codes 900 to 999 are user definable.
- 6) This field is a single character specified by the following:
 - N = normal state;
 - H = alarm state (threshold exceeded);
 - J = alarm state (extreme threshold exceeded);
 - L = alarm state (low threshold exceeded, i.e. not reached);
 - K = alarm state (extreme low threshold exceeded, i.e. not reached);
 - X = other.
- 7) This field is a single character specified by the following:
 - A = acknowledged;
 - V = not acknowledged;
 - B = broadcast (acknowledgement not applicable);
 - H = harbour mode;
 - O = override.
- 8) Additional and optional descriptive text/alarm detail condition tag. Maximum number of characters will be limited by maximum sentence length and length of other fields.

8.3.13 ALC – Cyclic alert list

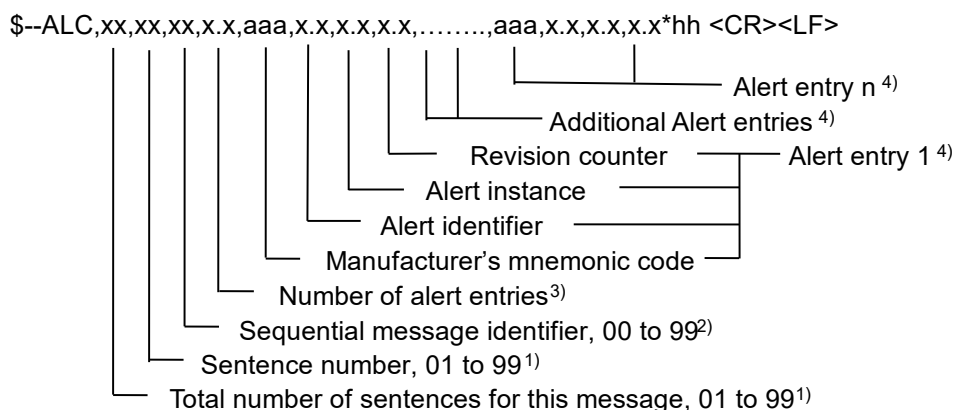
Sentences ACN, AGL, ALC, ALF and ARC are used for alert handling. Alert related communications are described in ~~IEC 61924-2~~ IEC 62923-1. **21**

The purpose of this sentence is to satisfy the needs for a safe and consistent data distribution with a minimum of data traffic. Each change on an alert's data leads to an incremented Revision counter. So an alert processing device only needs to check the alert entries in the ALC messages to ensure that no ALF message has been lost. In the case where an ALF message has been lost, the missing message can be requested by sending a request alert command (see ACN – Alert command).

The ALC sentence provides condensed ALF sentence information. It contains the identifying data for each present alert of one certain source/device so that the receiver can understand which ALF has been missed (and retransmission of ALF can be requested by using ACN sentence). It shall be published cyclically at least every 30 s by each alert generating device.

The cyclic alert list transmission shall never stop. When all alerts are in normal state the cyclic alert list is empty, i.e. the number of alert entries is 0.

The length of this sentence is varying with the number of alerts (number of list entries) currently generated by related instance. In cases where the needed number of entries exceeds the permitted sentence length, the number of sentences is increased.



Comments:

- 1) The first field specifies the total number of sentences used for a message, minimum value 1. The second field identifies the order of this sentence in the message, minimum value 1. These ~~cannot~~ shall not be null fields. **10**
- 2) The sequential message identifier relates all sentences that belong to a group of multiple sentences (i.e. message). Multiple sentences – see comment 1) – with the same sequential message identifier make up one message.

- 3) Contains the number of alert entries transported within this sentence. This shall not be a null field. Alert entries beyond the declared number of alert entries shall not be processed by the receiver. New designs shall not have any "Alert entries" or null fields beyond the alert entries specified by the "Number of alert entries".

NOTE 1 For compatibility to previous implementation of the ALC sentence, when number of alert entries is 0, the received ALC sentence can be without any additional fields before the checksum or can contain an "empty" alert entry (i.e. all fields of alert entry as null fields) or can contain a superfluous alert entry.

NOTE 2 This kind of variable length sentence is not suitable for extensions of sentence by future editions of IEC 61162-1. **25**

- 4) Alert entry 0—1 to n: Each alert entry consists of four fields:
 - manufacturer's ~~Identifier~~ mnemonic code (see 7.1.6) (see ALF ~~Manufacturer Identifier~~ message);
 - alert Identifier (see ALF ~~Identifier~~ message);
 - alert instance (see ALF ~~instance~~ message);
 - revision counter (see ALF ~~Revision Counter~~ message). **25**

Each entry identifies a certain alert with a certain state. It is not allowed that an alert entry is split between two ALC sentences.

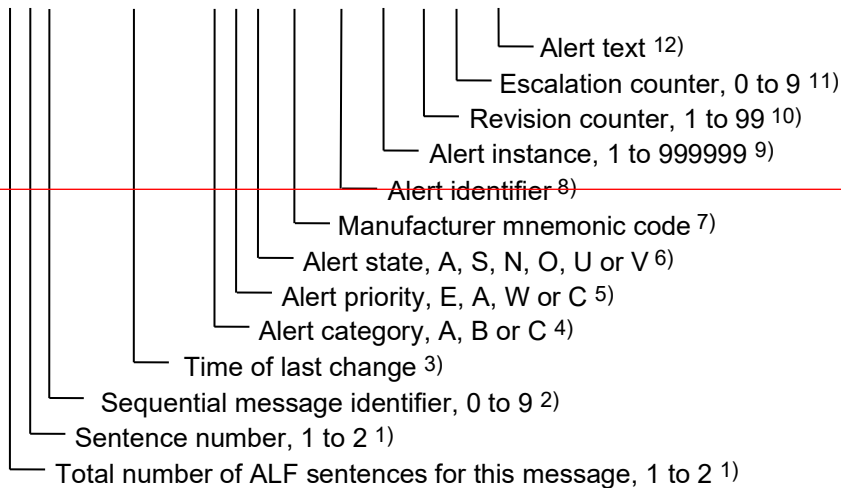
8.3.14 ALF – Alert sentence

Sentences ACN, AGL, ALC, ALF and ARC are used for alert handling. Alert related communications are described in ~~IEC 61924-2~~ IEC 62923-1. **21**

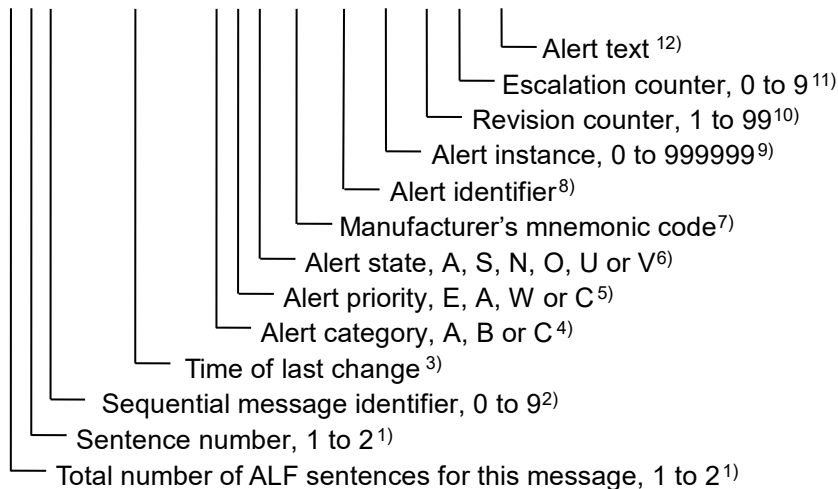
This sentence is used to report an alert condition and the alert state of a device. An ALF message shall be published for an alert each time the alert information in this sentence changes and on alert request (see ALC – Cyclic alert list).

To transmit additional alert description text (see comment 12)), optionally a second ALF sentence may be transmitted.

\$--ALF,x,x,x,hhmmss.ss,a,a,a,aaa,x,x,x,x,x,x,c---c*hh <CR><LF>



\$--ALF,x,x,x,hhmmss.ss,a,a,a,aaa,x,x,x,x,x,x,g-c*hh <CR><LF>



Comments:

- 1) The first field specifies the total number of sentences used for a message, minimum value 1. The second field identifies the order of this sentence in the message, minimum value 1. These ~~cannot~~ shall not be null fields. ~~When the sentence number is 2, the following Alert category, Alert priority and Alert state can be null fields.~~ **10**
- 2) The sequential message identifier relates all sentences that belong to a group of multiple sentences (i.e. message). Multiple sentences – see comment 1) – with the same sequential message identifier make up one message. If the ALF message contains only one ALF sentence, then this can be a null field, otherwise this shall not be null field. **10**
- 3) Time ~~should~~ shall represent the last time ~~the data~~ when content of any field **26** within the alert message has changed. For example changing the alert text by in-/decrementing a contained counter or count down ~~should~~ shall cause a revision of alert message and a new time. Time is an optional field. The time-field is additional information about when this happened and not used for decision making. There is no mandatory requirement for time synchronization between the equipment. It ~~should by~~ shall be either a null field (if not used) or UTC (if used). Sender is allowed to use all alternatives defined in Table 5 Field type summary. Receiver is allowed to ignore content of this field. If the receiver does not ignore this field, it ~~should~~ shall support all alternatives defined in Table 5.
- 4) The alert category is in compliance with the category definition as described in INS Performance Standard (IMO MSC.252(83)) and Bridge Alert Management Performance Standard (IMO MSC.302(87)):
 A, Category A: Alerts where information at operator unit directly assigned to the function generating the alert is necessary, as decision support for the evaluation of the alert-related condition, e.g. graphical information of danger of collision or graphical information of danger of grounding.

B, Category B: Alerts where no additional information for decision support is necessary besides the information which can be presented using alert source and alert description text.

C, Category C: Alerts that cannot be acknowledged on the bridge but for which information is required about the status and treatment of the alerts, e.g. certain alerts from the engine.

When the sentence number is 1 and Alert state is N (Normal) or when the sentence number is 2, this field may be a null field to allow longer additional alert description (see 7.3.1). **25**

5) ~~Alert priority: Emergency Alarm: E, for use with Bridge alert management~~

~~Alarm: A~~

~~Warning: W~~

~~Caution: C~~

The alert priority is in compliance with the priority definition as described in Bridge Alert Management Performance Standard (IMO MSC.302(87)):

Emergency Alarm: E (alarm which indicates immediate danger to human life or to the ship and its machinery exists and requires immediate action)

Alarm: A (condition requiring immediate attention and action by the bridge team, to maintain the safe navigation and safe operation of the ship)

Warning: W (condition requiring immediate attention, but no immediate action by the bridge team)

Caution: C (awareness of a condition which does not warrant an alarm or warning condition, but still requires attention out of the ordinary consideration of the situation or of given information) **25**

When the sentence number is 1 and Alert state is N (Normal) or when the sentence number is 2, this field may be a null field to allow longer additional alert description (see 7.3.1). **10**

6) The alert state transition is defined in ~~IEC 61924-2:2012, Annex J~~ IEC 62923-1 **27**

active – unacknowledged: V

active – silenced: S

active – acknowledged or active: A

active – responsibility transferred: O

rectified – unacknowledged: U

normal – N

When the sentence number is 2, this field may be a null field to allow longer additional alert description (see 7.3.1). **10**

7) Used for proprietary alerts defined by the manufacturer (see 7.1.6). For standardized alerts, this ~~should~~ shall be a null field. **10**

8) The alert identifier is unique within a single alert source. The alert identifier is a variable length integer field of maximum a 7-digit integer. It identifies the type of the alert, e.g. a "lost target" alert. Standardized alerts use unique alert identifiers described in equipment standards. Number range 10000-9999999 is reserved for proprietary alerts. Alert Identifier examples:

"001", "2456789", "245"

9) The alert instance identifies the current instance of an alert to distinguish alerts of the same type (Alert identifier) and from the same source (e.g. dangerous target). Alert instance is maximum a 6-digit integer from 1 to 999999, the number '0' indicates that this sentence is ~~intended for all alert instances~~ for header alert for a group (see AGL sentence in 8.3.9) or for header alert for an aggregation **28**. Except for number '0', the number of alert instance can be freely defined by the manufacturer as long as it is unique for one type of alert (alert identifier). It is not permitted to modify the alert instance within a life cycle of a distributed alert (from 'active and unacknowledged' state until 'normal' state is reached). It can be also a null field, when there is only one alert of that type.

10) The revision counter is the main method to follow up-to-date status. Revision counter is also unique for each instance of alert. Revision counter starts with 1 and the step for increment is 1. The count resets to 1 after 99 is used. Revision counter increments on each change of content of any field of the alert. In case the alert is raised again (changing from the state "normal"), the revision counter may start with 1 **28**. When the sentence number is 2, this field may be a null field to allow longer additional alert description (see 7.3.1). **10**

11) The escalation counter is presenting the number of alert escalations after time expiration during the state active-unacknowledged. The escalation counter starts with 0 and the step for increment is 1. The count resets to 1 after 9 is used. The alert escalation can be the escalation from warning into warning (re-activation of audible signal ~~only~~), ~~the escalation from warning to alarm~~ or the escalation from alarm to alarm ~~with activation of back-up navigator alarm~~ where the escalation may be used to indicate that the back-up navigator/operator alarm is activated. When the sentence number is 2, this field may be a null field to allow longer additional alert description (see 7.3.1). **10**

12) This field is used for alert title which is mandatory and for additional alert description which is optional.

- The first ALF sentence transmits the alert title. Alert title is maximum 16 characters short form of the alert text. This shall not be a null field. **10**
- The optional second ALF sentence transmits the additional alert description. Additional alert description is the long description of the alert. The additional alert description contains more information for decision making (i.e. alert description text). This shall not be a null field. **10**
- The second ALF sentence uses null fields for Time of last change, Alert category, Alert priority, and Alert state to allow longer text. As for Alert text, **28** the actual number of valid characters ~~should~~ shall be such that the total number of characters in a sentence does not exceed the "82" character limit which is a maximum of 47 characters. **29**
- Some equipment standards specify alert text longer than 16 characters (for example the AIS standard has defined some alerts to be coded with ALR sentence and with text longer than 16 characters). In such cases, the first ALF sentence is used for the first 16 characters of the alert text as alert title and the second ALF sentence to carry the full alert text.

Examples:

~~\$IALF,1,1,0,124304.50,A,W,A,,192,1,1,0,LOST TARGET*14<CR><LF>~~

~~\$IALF,2,1,1,081950.10,B,A,S,XYZ,0512,1,2,0,HEADING LOST*2D<CR><LF>~~

~~\$IALF,2,2,1,,,,,XYZ,0512,1,2,0,NO SYSTEM HEADING AVAILABLE*0D<CR><LF>~~

An example of ALF message which fit into a single ALF sentence.

\$IALF,1,1,0,124304.50,A,W,A,,3052,1,1,0,LOST TARGET*2A<CR><LF>

An example of ALF message which needs two ALF sentences.

\$IALF,2,1,1,081950.10,B,A,S,XYZ,010512,1,2,0,HEADING LOST*2C<CR><LF>

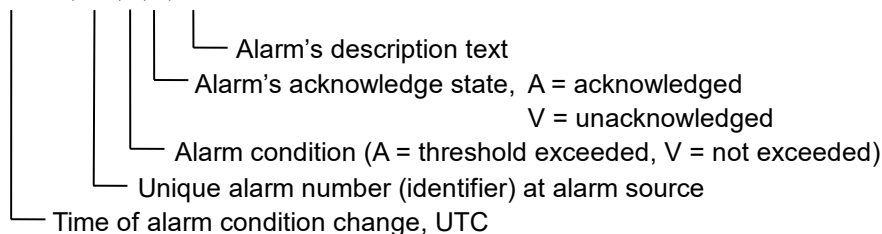
\$IALF,2,2,1,,,,,XYZ,010512,1,2,0,NO SYSTEM HEADING AVAILABLE*0C<CR><LF> **30**

8.3.15 ALR – Set alarm state

NOTE ACK and ALR sentences are deprecated and they have been replaced by ACN and ALF. **31**

Local alarm condition and status. This sentence is used to report an alarm condition on a device and its current state of acknowledgement.

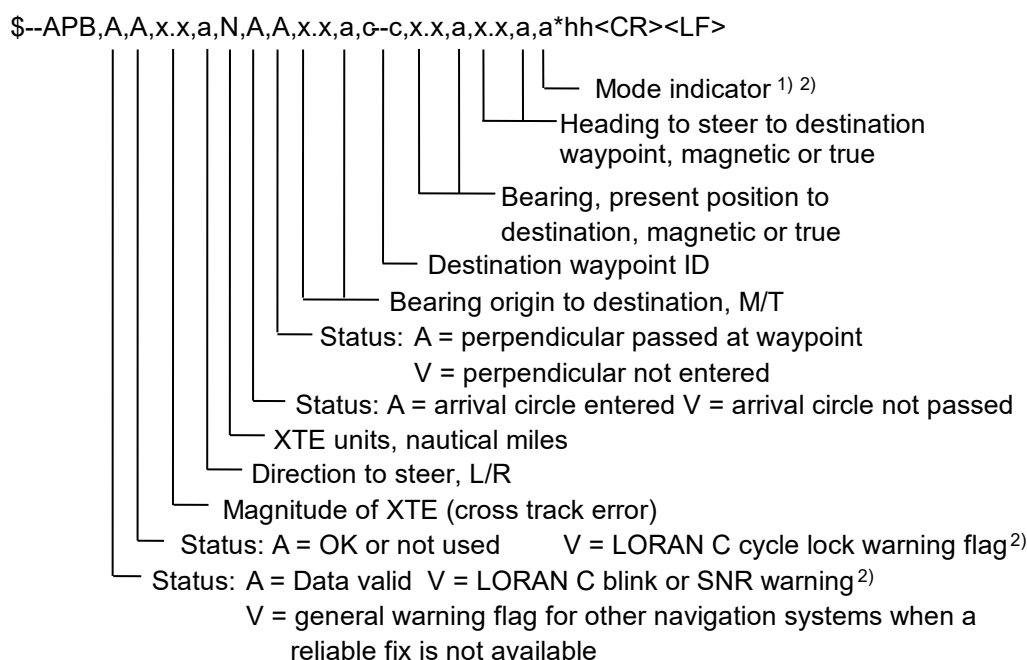
\$--ALR,hhmmss.ss,xxx,A,A,c--c*hh<CR><LF>



8.3.16 APB – Heading/track controller (autopilot) sentence B

NOTE This is a deprecated sentence as it is not used in IEC or ISO standards. **32**

Commonly used by autopilots, this sentence contains navigation receiver warning flag status, cross-track-error, waypoint arrival status, initial bearing from origin waypoint to the destination, continuous bearing from present position to destination and recommended heading to steer to destination waypoint for the active navigation leg of the journey.



Comments:

1) Positioning system mode indicator:

- A = Autonomous mode;
- D = Differential mode;
- E = Estimated (dead reckoning) mode;
- M = Manual input mode;
- S = Simulator mode;
- N = Data not valid.

2) The positioning system mode indicator field supplements the positioning system status fields (fields 1 and 2), the status fields ~~should~~ shall be set to V = invalid for all values of mode indicator except for A = Autonomous and D = Differential. The positioning system mode indicator ~~should~~ shall not be a null field. **10****8.3.17 ARC – Alert command refused**

Sentences ACN, AGL, ALC, ALF and ARC are used for alert handling. Alert related communications are described in ~~IEC 61924-2~~ IEC 62923-1. **21**

This sentence is used ~~for~~ when:

- ~~Category A or C alerts (see IMO MSC.302(87)), for which it is illegal to accept acknowledge or responsibility transfer, e.g. not enough information for decision support available or the source of acknowledgement is not acceptable,~~

~~In a system working properly such attempts should not happen.~~

- ~~Category B (see IMO MSC.302(87)), if the source of acknowledge is not acceptable.~~
- the alert with the requested identifiers (Alert identifier, Alert instance, Manufacturer's mnemonic code) does not exist or is not active;
- there is an acceptable reason to refuse the requested action, see IEC 62923-1. **33**

\$--ARC,hhmmss.ss,aaa,x.x,x.x,c*hh <CR><LF>

Refused alert command, A, Q, O or S⁵⁾
Alert instance, 1 to 999999⁴⁾
Alert identifier³⁾
Manufacturer's mnemonic code²⁾
Time¹⁾

Comments:

- 1) Release time of the Alert Command Refused (e.g. for VDR purposes), optional, can be a null field. Sender is allowed to use all alternatives defined in Table 5 Field type summary. Receiver is allowed to ignore content of this field. If receiver does not ignore this field, it ~~should~~ shall support all alternatives defined in Table 5.
- 2) Used for proprietary alerts defined by the manufacturer (see 7.1.6). For standardized alerts, this ~~should~~ shall be a null field. **10**
- 3) The alert identifier is unique within a single alert source. The alert identifier is a variable length integer field of maximum a 7-digit integer. It identifies the type of the alert, e.g. a "lost target" alert. Standardized alerts use unique alert identifiers described in equipment standards. Number range 10000-9999999 is reserved for proprietary alerts. Alert Identifier examples:
"001", "2456789", "245"
- 4) The alert instance identifies the current instance of an alert to distinguish alerts of the same type (Alert identifier) and from the same source (e.g. dangerous target). Alert instance is maximum a 6-digit integer from ~~4 0~~ **34** to 999999. The number of alert instance can be freely defined by the manufacturer as long as it is unique for one type of alert (alert identifier). It is not permitted to modify the alert instance within a life cycle of a distributed alert (from 'active and unacknowledged' state until 'normal' state is reached). It can be also a null field, when there is only one alert of that type.
- 5) Refused Alert Command: Indicates refused "Alert command" of corresponding ACN sentence. This ~~should~~ shall not be a null field. **10**

acknowledge:	A
request / repeat information:	Q
responsibility transfer:	O
temporary silence:	22 S

8.3.18 BBM – AIS broadcast binary message

This sentence supports generation of ITU-R M.1371 binary Messages 8, 14, 25, and 26. This provides the application with a means to broadcast data, as defined by the application only. Data is defined by the application only – not the AIS. This sentence offers great flexibility for implementing system functions that use the transponder like a digital broadcast device. After receiving this sentence via the IEC 61162-2 interface, the AIS unit initiates a VHF broadcast of Message 8, 14, 25, or 26 within 4 s. See the ABK sentence for acknowledgement of the BBM ~~with~~ broadcast for Messages 8, 14, 25 and 26 **35**. The AIS transponder determines the appropriate communications state for transmission of Message 26 over the VHF data link.

!--BBM,x,x,x,x,xx,s--s,x*hh<CR><LF>

Number of fill-bits, 0 to 5⁶⁾
Encapsulated data⁵⁾
ITU-R M.1371 Message ID⁴⁾
AIS channel for broadcast of the radio message³⁾
Sequential Message identifier, 0 to 9²⁾
Sentence number, 1 to 9¹⁾
Total number of sentences needed to transfer the message, 1 to 9¹⁾

Comments:

- 1) The total number of IEC 61162-1 sentences required to transfer the contents of the binary message to the AIS unit. The first field specifies the total number of sentences used for a message, minimum value 1. The second field identifies the order of this sentence in the message, minimum value 1. All sentences contain the same number of fields. Successive sentences may use null fields for fields that have not changed, such as fields 4 and 5.