

Maritime navigation and radiocommunication equipment and systems — Digital interfaces —

Part 1: Single talker and multiple listeners

ICS 33.070.40; 47.020.70

National foreword

This British Standard is the UK implementation of EN 61162-1:2008. It is identical to IEC 61162-1:2007. It supersedes BS EN 61162-1:2001 which is withdrawn.

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

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Date	Comments

**Maritime navigation and radiocommunication equipment and systems -
Digital interfaces -
Part 1: Single talker and multiple listeners
(IEC 61162-1:2007)**

Matériels et systèmes de navigation
et de radiocommunication maritimes -
Interfaces numériques -
Partie 1: Emetteur unique
et récepteurs multiples
(CEI 61162-1:2007)

Navigations- und
Funkkommunikationsgeräte
und -systeme für die Seeschifffahrt -
Digitale Schnittstellen -
Teil 1: Ein Datensender
und mehrere Datenempfänger
(IEC 61162-1:2007)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

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Foreword

The text of document 80/464/FDIS, future edition 3 of IEC 61162-1, prepared by IEC TC 80, Maritime navigation and radiocommunication equipment and systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61162-1 on 2008-02-01.

This European Standard supersedes EN 61162-1:2000.

The main changes with respect to EN 61162-1:2000 are listed below:

- normative references have been renumbered from 1.2 to 2, Terms and definitions from 1.3 to 3 and Manufacturers documentation from 2 to 4. Thereafter all clauses are numbered two ahead of those in EN 61162-1:2000;
- Clause 7 (Clause 5 in EN 61162-1:2000) has been expanded to include two types of start of sentence delimiters. The conventional delimiter “\$” is used with the conventional sentences which are now called parametric sentences. A new delimiter “!” identifies sentences that conform to special purpose encapsulation. The example applications in Clause 9 (Clause 7 in EN 61162-1:2000) have been expanded to describe both types;
- the tables in Clause 8 (Clause 6 in EN 61162-1:2000) have been updated. The previous Table 5 (Approved sentence formatters) and the associated Annex A (Minimum required sentences) have been deleted;
- Clause 8 has been expanded to include new and revised sentences;
- four new annexes have been added to support the text.

The following dates were fixed:

- | | | |
|--|-------|------------|
| – latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2008-11-01 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2011-02-01 |

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61162-1:2007 was approved by CENELEC as a European Standard without any modification.

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INTRODUCTION

International standard IEC 61162 is a four part standard which specifies four digital interfaces for application in marine navigation, radiocommunication and system integration. The four parts are:

- 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 (under consideration)
- IEC 61162-4 Multiple talkers and multiple listeners – Ship systems interconnection

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 standard are advised to immediately inform the IEC of any perceived inadequacies therein.

This edition is a complete revision of the second edition of IEC 61162-1. Liaison has been maintained with NMEA and this edition has been aligned as closely as possible with NMEA 0183 version 3.01. It incorporates three previously issued publicly available specifications: PAS 61162-100 *Extra requirements to IEC 61162-1 for UAIS*, PAS 61162-101 *Modified sentences and requirements for IEC 61162* and PAS 61162-102 *Extra requirements to IEC 61162-1 for the voyage data recorder*.

The second edition included details of the ship equipment defined in IMO resolutions together with appropriate sentences for communication between them. It is now the practice to specify the sentence formatters in the individual standards for equipment, so, in this edition the previous Table 5 (Approved sentence formatters) and Annex A (Minimum required sentences) have not been included.

NOTE The equipment responses and behaviour is beyond the scope for this standard and should be included in the individual equipment standards, for example alarm handling.

This edition introduces (from PAS 61162-100) two types of start of sentence delimiters. The conventional delimiter "\$" is used with the conventional sentences which are now called parametric sentences. The new delimiter "!" identifies sentences that conform to special purpose encapsulation. The example applications in Clause 9 (Clause 7 in second edition) have been expanded to describe both types.

The list of sentences in Clause 8 (Clause 6 in second edition) has been updated to include all the sentences which were developed in the three public available specifications together with new sentences for display dimming (DDC), NAVTEX (NRM and NRX), rudder order (ROR), heading (THS) and user identification code transmission (UID).

As a result of experience the sentences given in PAS 61162-102 for the voyage data recorder; ALA, AKD, DOR, ETL, EVE, FIR, GEN, HSS, PRC, TRC, TRD and WAT have been modified in this edition.

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 standard is intended to support one-way serial data transmission from a single talker to one or more listeners. This data is in printable ASCII form and may include information such as position, speed, depth, frequency allocation, etc. Typical messages may 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 standard 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, this standard should be used with caution in all safety applications.

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

2 Normative references

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

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

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

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

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

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

ITU-R M.825, *Characteristics of a transponder system using digital selective calling techniques for use with vessel traffic services and ship-to-ship identification*

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

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

3 Terms and definitions

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

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

talker

any device which sends data to other devices. The type of talker is identified by a 2-character mnemonic as listed in 8.2 (Table 4)

listener

any device which receives data from another device

4 Manufacturer's documentation

Operator manuals or other appropriate literature provided for equipment that is intended to meet the requirements of this standard shall contain the following information:

- a) identification of the A and B signal lines;
- 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.

5 Hardware specification

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.

5.1 Interconnecting wire

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

5.2 Conductor definitions

The conductors referred to in this standard are the signal lines A and B, and shield.

5.3 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.

5.4 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.

5.5 Electrical signal characteristics

This subclause describes the electrical characteristics of transmitters and receivers.

5.5.1 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.

The active, spacing, logical 0, ON or start bit states are defined by a positive voltage on line A with respect to line B.

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.

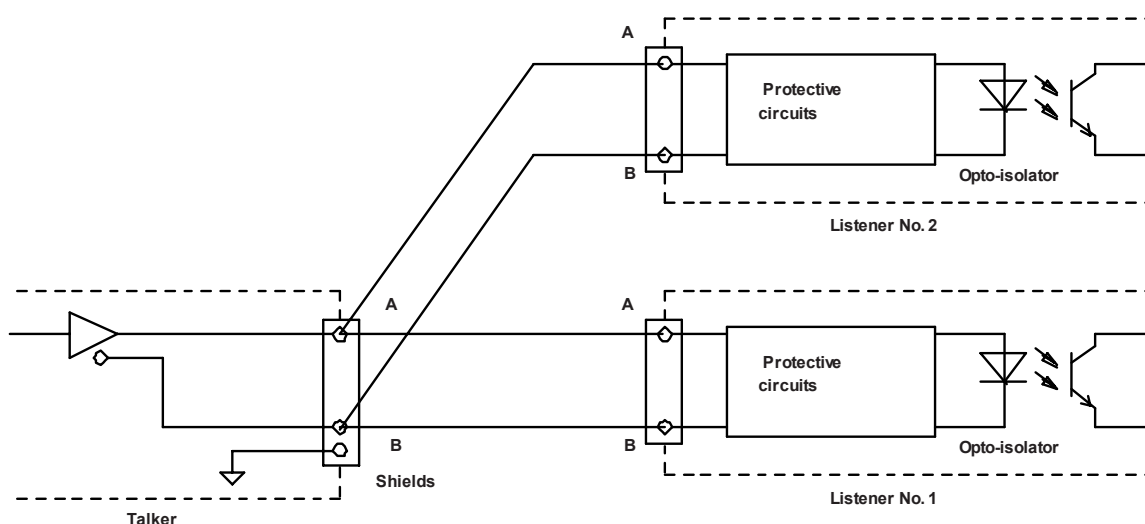
5.5.2 Talker drive circuits

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 X.27/V.11.

5.5.3 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 is made to example circuits in 9.2.

The receive circuit shall be designed for operation with a minimum differential input voltage of 2,0 V¹ and shall not take more than 2,0 mA from the line at that voltage.



IEC 910/2000

Figure 1 – Listener receive circuit

¹ 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 $-15,0\text{ V}$ to $+0,5\text{ V}$. The active, spacing, logical "0", ON or start bit state was defined to be in the range $+4,0\text{ V}$ to $+15,0\text{ V}$ while sourcing was not less than 15 mA.

5.5.4 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 ships' ground is required.

5.5.5 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 X.27/V.11.

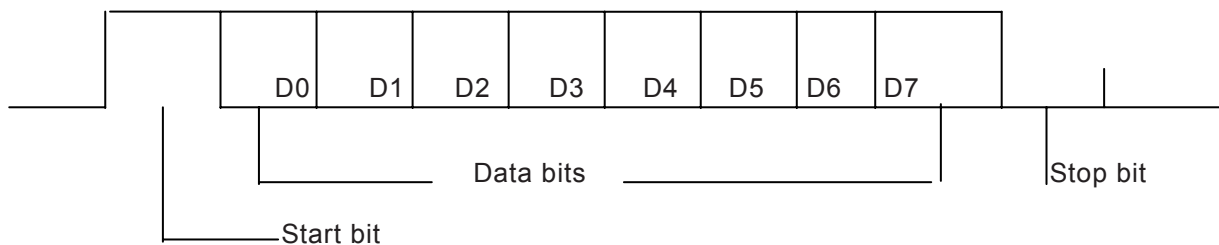
For protection against mis-wiring and for use with earlier talker designs, all receive circuit devices shall be capable of withstanding 15 V between signal lines A and B and between either line and ground for an indefinite period.

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 4 800;
- data bits 8 (D7 = 0), parity none;
- stop bits 1.



IEC 911/2000

Figure 2 – Data transmission format

7 Data format protocol

7.1 Characters

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).

7.1.1 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.

7.1.2 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).

7.1.3 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.

7.1.4 Character symbols

When individual characters are used in this standard 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).

7.2 Fields

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

7.2.1 Address field

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 7.3.2. The “!” delimiter identifies sentences that conform to the special-purpose encapsulation and non-delimited field composition rules as described in 7.3.3. 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 following three types of address fields shall be transmitted.

7.2.1.1 Approved address field

Approved address fields consist of five digits and upper case letter characters defined by this standard. The first two characters are the talker identifier, listed in 8.2 (Table 4). The talker identifier serves to define the nature of the data being transmitted.

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.

7.2.1.2 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.

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".

7.2.1.3 Proprietary address field

The proprietary address field consists of the proprietary character "P" followed by a three-character manufacturer's mnemonic code, 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 7.3.5).

7.2.2 Data fields

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 standard.

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.

7.2.2.1 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.

7.2.2.2 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).

7.2.2.3 Null fields

A null field is a field of length zero, i.e. no characters are transmitted in the field. Null fields shall be used when the value is unreliable or not available.

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 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.

7.2.3 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 is converted to two ASCII characters (0-9, A-F) 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.

7.2.4 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 is incremented each time a new multi-sentence message is generated with the same sentence formatter. The value is reset to zero when it is incremented beyond the defined maximum value. The 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 7.3.8).

7.3 Sentences

This subclause describes the general structure of sentences. Details of specific sentence formats are found in 8.3. Some sentences may specify restrictions beyond the general limitations given in this standard. Such restrictions may include defining some fields as fixed length, numeric or text only, required to be non-null, 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.

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

7.3.1 Description of approved sentences

Approved sentences are those designed for general use and detailed in this standard. Approved sentences are listed in 8.3 and shall be used wherever possible. 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 be obtained from the National Marine Electronics Association (NMEA) (see 7.3.5).

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

7.3.2 Parametric sentences

7.3.2.1 Description

These sentences start with the "\$" delimiter, and represent the majority of sentences defined by this standard. 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 be reused. See 8.2;
- only valid characters are allowed. See 8.1 (Tables 1 and 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 standard;
- encapsulated non-delimited data fields are NOT ALLOWED.

7.3.2.2 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.
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 read-outs 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) 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.

7.3.3 Encapsulation sentences

7.3.3.1 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 be reused. See 8.2;
- only valid characters are allowed. See 8.1 (Tables 1 and 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 standard;
- 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 7.2.2;
- the sentence contains a "total number of sentences" field. See 7.3.3.1;
- the sentence contains a "sentence number" field. See 7.3.3.1,
- the sentence contains a "sequential message identifier" field. See 7.3.3.1;
- 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 7.3.3.1.

NOTE 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 IEC 61162-1 (4 800 baud) and IEC 61162-2 (38 400 baud) standards 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.

7.3.3.2 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.
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. Data field sequence is fixed and identified by 3rd 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 4 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.

7.3.4 Query sentences

7.3.4.1 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
"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

7.3.4.2 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.

7.3.5 Proprietary sentences

These are sentences not included within this standard; these provide a means for manufacturers to use the sentence structure definitions of this standard 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 manufacturers' reference list of mnemonic codes is a component of the equivalent specification NMEA 0183. ²

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 (The NMEA secretariat maintains the master reference list which comprises codes registered and formally adopted by NMEA)
[<valid characters,"^" and "," >]		manufacturer's data
"*"<checksum field>		checksum field
<CR><LF> 0D 0A		end of sentence

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 standard and need not be submitted for approval. However, it is required that such sentences be published in the manufacturer's manuals for reference.

7.3.6 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 as 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.

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 Standards Committee	Fax: +1 410 975 9450
7 Riggs Ave	e-mail: info@nmea.org
Servana Pk, Maryland 21146	web site http://www.nmea.org
USA.	

Field formatter	Description
a	<u>Sentence status flag.</u> 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 null. 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”.

7.3.7 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.

7.3.8 Multi-sentence messages

Multi-sentence messages may be transmitted where a data message exceeds the available character space in a single sentence. 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. The TUT and VDM sentences are good examples of how a sentence is defined to provide these capabilities.

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

Should an error occur 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.

7.3.9 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.

7.3.10 Additions to approved sentences

In order to allow for improvements or additions, future revisions of this standard 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.

7.4 Error detection and handling

Listening devices shall detect errors in data transmission including:

- a) checksum error (see 7.2.3);
- b) invalid characters (see 7.1.2);
- c) incorrect length of address field (see 7.2.1), and data fields as specified within sentence definitions;
- d) time out of sentence transfer (see 7.3.9).

Listening devices shall use only correct sentences, consistent with the version 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

The following tables 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	Comment block delimiter
^	5E	94	Code delimiter for HEX representation of ISO 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
+	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

A	Status symbol; Yes; Data valid; Warning flag clear; Auto; Ampere, ASCII
a	Alphabet character variable A through Z or a through z
B	Bar (pressure, 1 000 mb = 100 kPa(Pascal(Pa))),Bottom
C	Celsius (Degrees); Course-up
c	Valid character; Calculating
D	Degrees (of arc)
E	Error; East; Engine
F	Fathoms (1 fathom equals 1,828 766 m)
f	Feet (1 foot equals 0,304 79 m)
G	Great circle; Green
g	Good
H	Compass heading; Head-up; Hertz; Humidity
h	Hours; HEX number
I	Inches (1 inch equals 0,0254 m)
J	Input operation completed
K	Kilometres; km/h; kg/m ³
k	Kilograms
L	Left; Local; Lost target
l	Latitude; Litres; l/s
M	Metres; m/s; Magnetic; Manual; Cubic metres
m	Minutes; message
N	Nautical miles; Knots; North; North-up; Newtons
n	Numeral; address
P	Purple; Proprietary (only when following "\$" or "!"); Position sensor; Per cent; Pascal (pressure)
Q	Query; Target-being-acquired
R	Right; Rhumb line; Red; Relative; Reference; Radar tracking; revolutions/min (RPM)
S	South; Statute miles (1 609,31 m); Statute miles/h; Shaft Salinity parts/thousand; Simulator mode
s	Seconds; Six-bit number
T	Time difference; True; Track; Tracked target
t	Test
U	Dead reckoning estimate
u	Sign, if minus "-" (HEX 2D)
V	Data invalid; No; Warning flag set; Manual; Volt
W	West; Water; Wheelover
x	Numeric character variable
y	Longitude
Z	Time

8.2 Field definitions

Field definitions are indicated in the following tables.

Table 4 – Talker identifier mnemonics

Talker device		Identifier
Heading/track controller (autopilot)	general	AG
	magnetic	AP
Automatic identification system		AI
Bilge system		BI
Communications:	digital selective calling (DSC)	CD
	data receiver	CR
	satellite	CS
	radio-telephone (MF/HF)	CT
	radio-telephone (VHF)	CV
	scanning receiver	CX
DECCA navigator		DE
Direction finder		DF
Electronic chart system (ECS)		EC
Electronic chart display and information system (ECDIS)		EI
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
Global positioning system (GPS)		GP
GLONASS positioning system		GL
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 instrumentation		II
Integrated navigation		IN
LORAN: LORAN-C		LC
Proprietary code		P
Radar and/or radar plotting		RA
Propulsion machinery including remote control		RC
Sounder, depth		SD
Steering gear/steering engine		SG
Electronic positioning system, other/general		SN
Sounder, scanning		SS
Turn rate indicator		TI
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

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 standard 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 standard: "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.

NOTE 1 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 a null field when the ITU-R M.1371 message type is 8 or 14.

NOTE 2 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.

NOTE 3 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 Note 4.

NOTE 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 be null

NOTE 5 Acknowledgements provided are:

0 = Message (6 or 12) successfully received by the addressed AIS unit,

1 = Message (6 or 12) was broadcast, but no acknowledgement by the addressed AIS unit,

2 = message could not be broadcast (i.e. quantity of encapsulated data exceeds five slots),

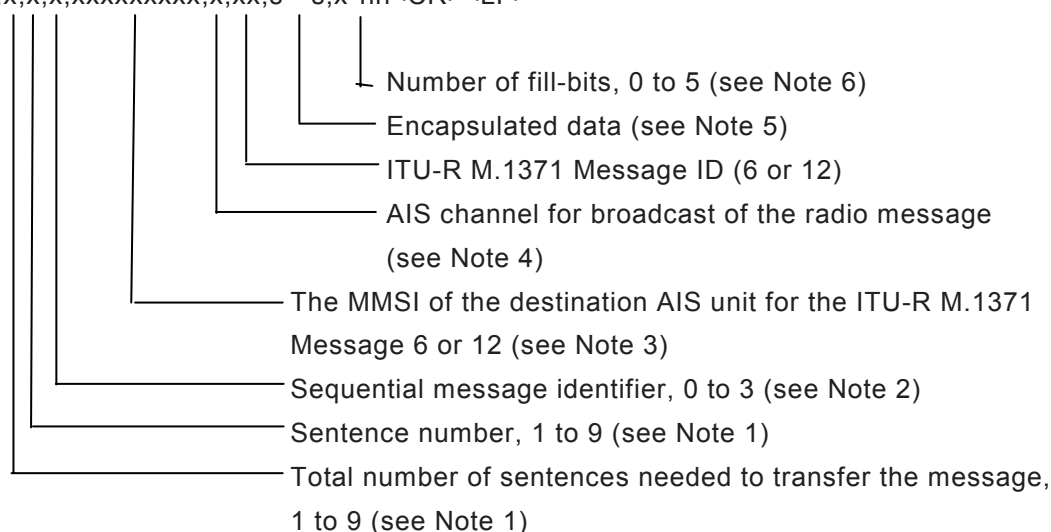
3 = requested broadcast of Message (8, 14 or 15) has been successfully completed,

4 = late reception of a Message 7 or 13 acknowledgement that was addressed to this AIS unit (own ship) and referenced as a valid transaction.

ABM – AIS Addressed binary and safety related message

This sentence supports ITU-R M.1371 Messages 6 and 12 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 message 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 either Message 6 or 12. The AIS unit will make up to four broadcasts of the message. 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 is confirmed through the use of the "Addressed binary and safety related message acknowledgement" ABK sentence formatter, and the processes that support the generation of an ABK sentence.

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



NOTE 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.

NOTE 2 This sequential message identifier serves two purposes. It meets the requirements as stated in 1.3.2, and it is the sequence number utilised 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 – 3. The sequential message identifier value may be re-used after the AIS unit provides the “ABK” acknowledgement for this number. (See the ABK sentence)

NOTE 3 The MMSI of the AIS unit that is the destination of the message.

NOTE 4 The AIS channel that is to 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.

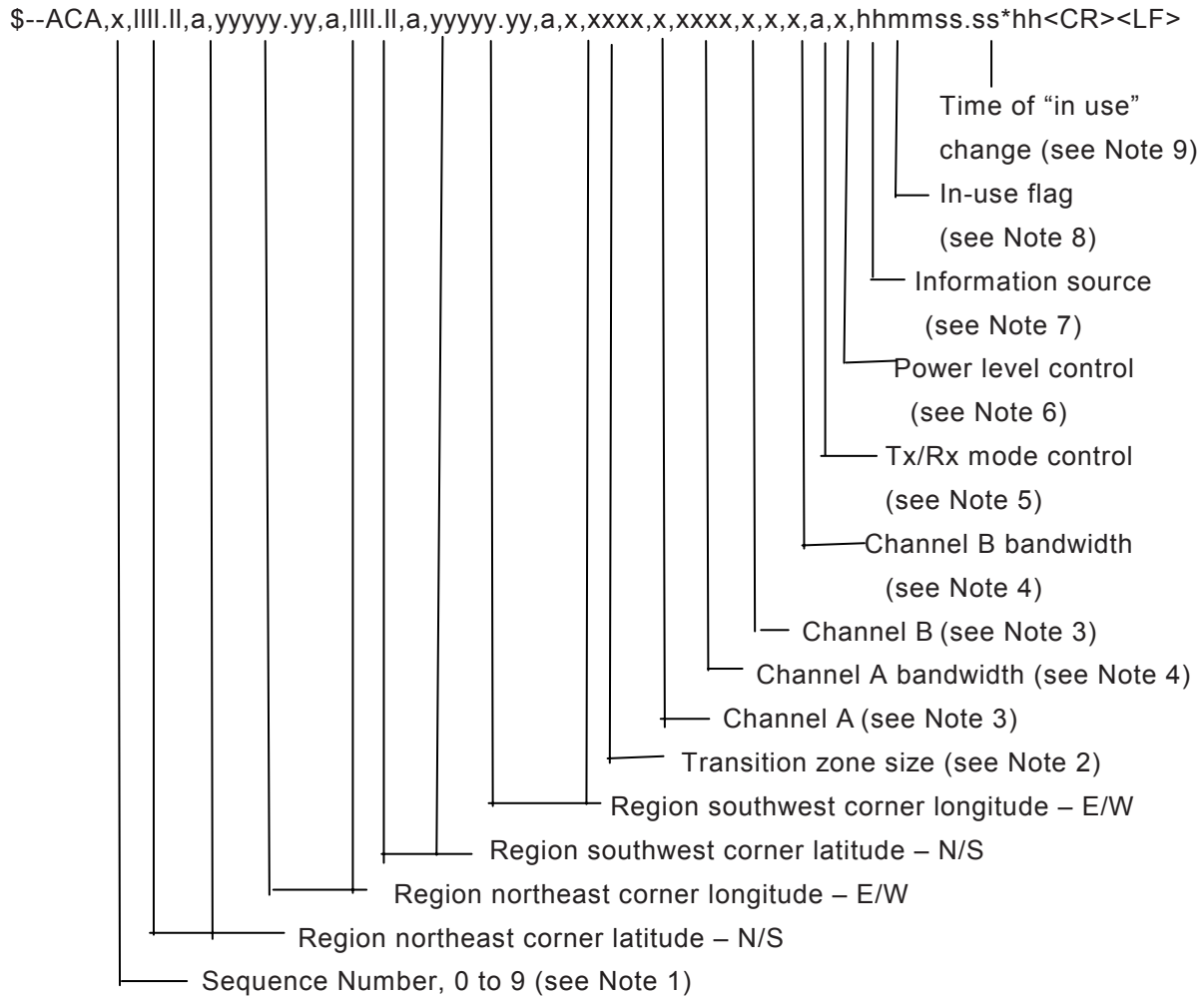
NOTE 5 This is the content of the “binary data” parameter for ITU-R M.1371 Messages 6, or the “Safety related Text” parameter for Message 12. Up to 936 bits of binary data (156 six-bit coded characters) using multi-line sentences. The first sentence may contain up to 48 valid six-bit codes (288 bits). Following sentences may contain up to 60 valid six-bit codes (360 bits), if fields 4, 5, and 6 are unchanged from the first sentence and set to null. The actual number of valid characters should be such that the total number of characters in a sentence does not exceed the “82-character” limit.

NOTE 6 This cannot be a null field. See “x⁴” in 7.3.3.

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.



NOTE 1 This is used to bind the contents of the ACA and ACS sentences together. The ACS sentence, when provided by the AIS unit, shall immediately follow the related ACA sentence, containing the same sequence number. The AIS unit generating the ACA and ACS sentences, shall increment the sequence number each time an ACA/ACS pair is created. After 9 is used the process 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 null if no ACS sentence is being sent.

NOTE 2 Range of 1 to 8 nautical miles.

NOTE 3 VHF channel number, see ITU-R M.1084, Annex 4

NOTE 4 Value of 0, bandwidth is specified by channel number, see ITU-R M.1084, Annex 4
Value of 1, bandwidth is 12.5 kHz.

NOTE 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

NOTE 6 Value of 0, high power
Value of 1, low power

NOTE 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 be null when the sentence is sent to an AIS device.

NOTE 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 be null when the sentence is sent to an AIS unit.

NOTE 9 This is the UTC time that the “In-use flag” field changed to the indicated state. This field should be null when the sentence is sent to an AIS unit

ACK – Acknowledge alarm

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

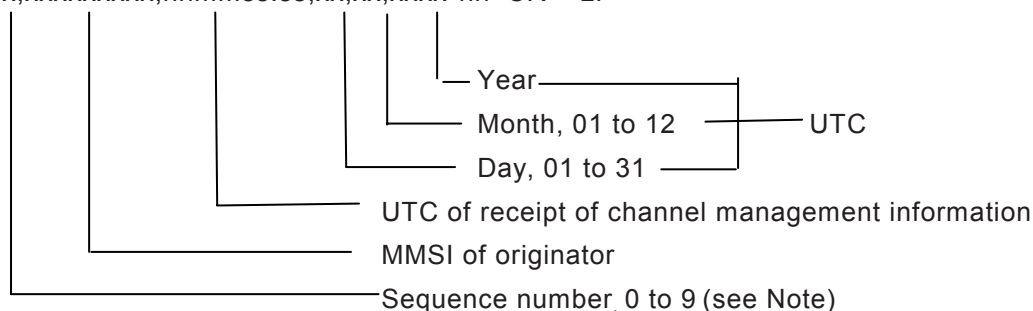
\$--ACK,xxx*hh<CR><LF>

_____ Unique alarm number (identifier) at alarm source

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.

\$--ACS,x,xxxxxxxx,hhmmss.ss,xx,xx,xxx*hh<CR><LF>

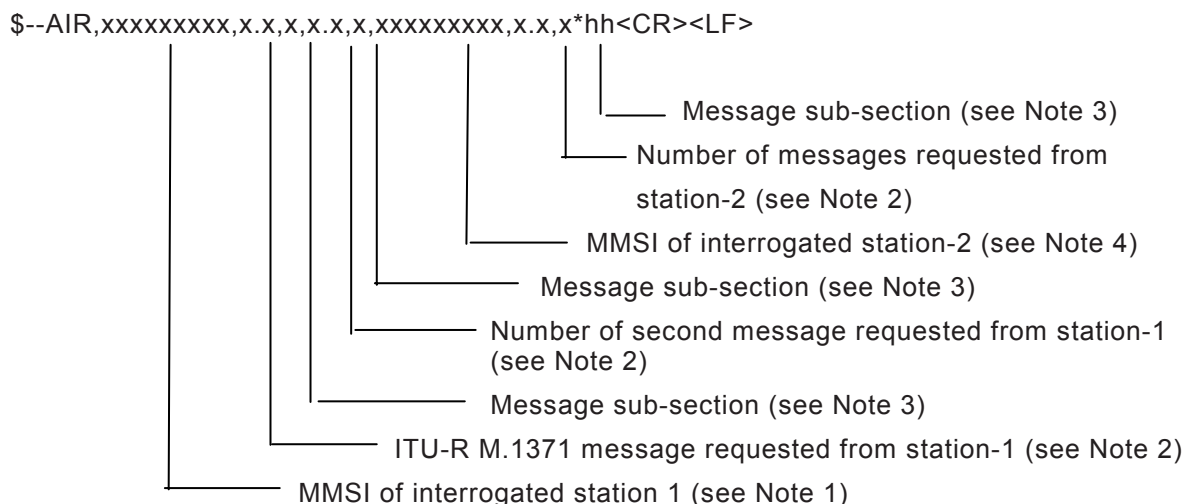


NOTE This is used to bind the contents of the ACA and ACS sentences together. The ACS sentence, when provided by the AIS unit, should immediately follow the related ACA sentence, containing the same sequence number. The AIS unit generating the ACA and ACS sentences, should increment the sequence number each time an ACA/ACS pair is created. After 9 is used the process should begin again from 0. Information contained in the ACS sentence is not related to the information 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 null if no ACS sentence is being sent.

AIR – AIS Interrogation request

This sentence supports ITU-R M.1371 Message 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.

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 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 4 s to broadcast the Message 15, and the addressed distant unit(s) shall take no more than another 4 s to respond – a total of 8 s.



NOTE 1 Identifies the first distant AIS unit being interrogated. Two messages can be requested from the first AIS unit.

NOTE 2 Examples of messages that may be requested from a distant mobile AIS unit include:

Message 3, = Position Report,

Message 5, = Ship static and voyage related data, see additional information in Note 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.

Examples of messages that may be requested from a distant AIS base station include:

Message 4 = Base Station Report

Message 17 = GNSS Broadcast Binary Message

Message 20 = Data link management message

Message 22 = Channel Management

NOTE 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 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 be null.

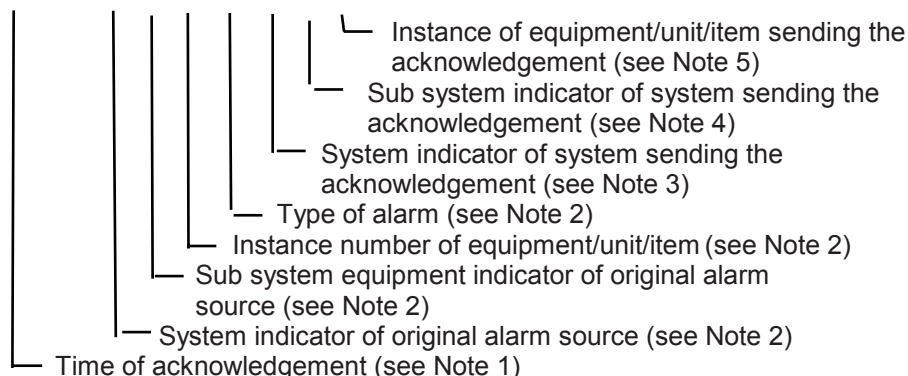
NOTE 4 This identifies the second distant AIS unit being interrogated. Only one message may be requested from the second AIS unit. The MMSI of the second AIS unit may be the same MMSI as the first AIS unit.

AKD – Acknowledge detail alarm condition

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

NOTE 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 shall be sent. This acknowledgement must be sent on all subsequent acknowledgements. Acknowledgements must 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>



NOTE 1 This defines the time of acknowledgement. This may be a null field.

NOTE 2 These fields should contain the identical information of the corresponding fields from the ALA sentence being acknowledged.

NOTE 3 Indicator characters identifying the system sending the acknowledgement. This field is two fixed characters, see Annex D. This may be a null field.

NOTE 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.

NOTE 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.

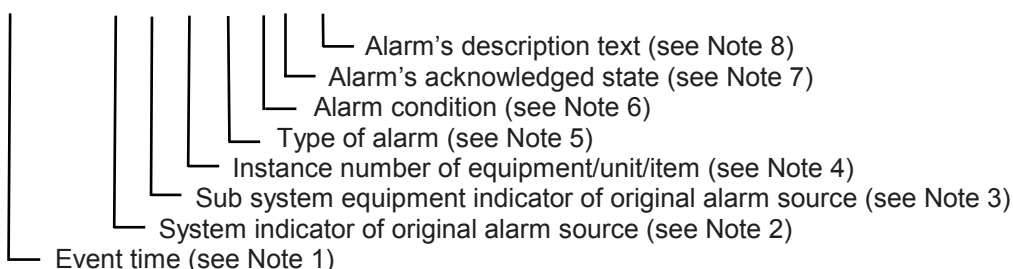
ALA – Report detailed alarm condition

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.

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

NOTE 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 be sent. This acknowledgement should be sent on all subsequent acknowledgements. Acknowledgements should 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>



NOTE 1 Event time of alarm condition change including acknowledgement state change. If this is not available, this should be a null field.

NOTE 2 Indicator characters as system of alarm source. This field is two fixed characters, see Annex D.

NOTE 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 be a null field.

NOTE 4 Instance number identifying the equipment, unit or item. This field is two fixed numeric characters.

NOTE 5 Type of alarm. This field is three fixed numeric characters as defined in Annex D, Table D.1. Codes 900-999 are user definable.

NOTE 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

NOTE 7 This field is a single character specified by the following:

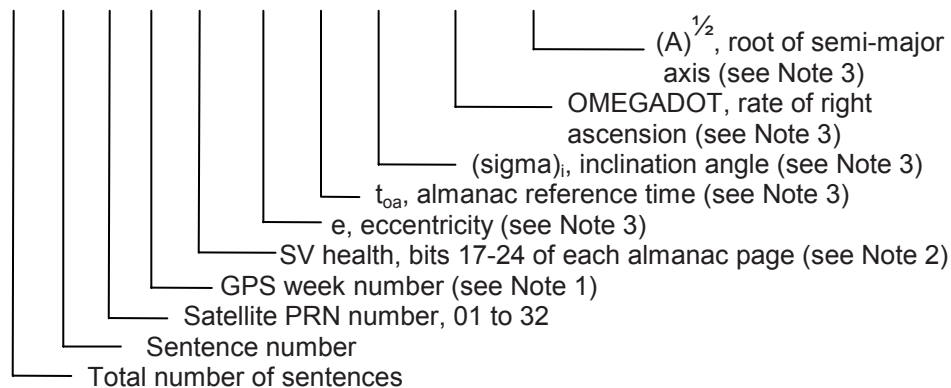
A = acknowledged
V = not acknowledged
B = Broadcast (acknowledgement not applicable)
H = harbour mode
O = Override

NOTE 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.

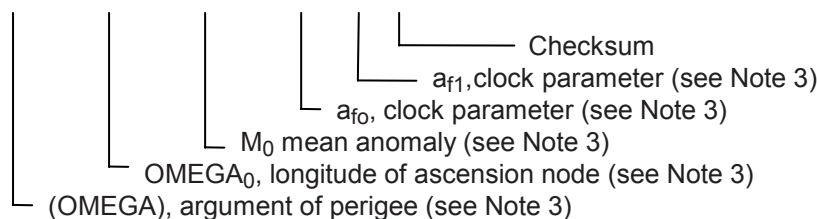
ALM – GPS almanac data

Contains GPS week number, satellite health and the complete almanac for one satellite. Multiple sentences may be transmitted, one for each satellite in the GPS constellation, up to a maximum of 32 sentences.

\$--ALM, x.x, x.x, xx, x.x, hh, hhhh, hh, hhhh, hhhh, hhhhhh,...



..hhhhhh, hhhhhh, hhhhhh, hhh, hhh*hh<CR><LF>



(from ICD-GPS-200, revision B (see Annex A))

NOTE 1 Variable length integer, four digits maximum (0 to 9999). This is an extended GPS week number to which the almanac reference time parameter (toa) is referenced. Week zero refers to the week of 06 January 1980. The value is the "Extended Week Number", which is the elapsed number of weeks since week zero. Extended week numbers should not be reset to zero when the 10-bit GPS week number rolls back to zero every 19,6 years. This value should be determined by the GPS receiver at the time of the almanac data decoding. It is based on the 8-bit Almanac Reference week form, Page 25, Subframe 5, word 3, bits 17 to 24; that 8-bit value should be expanded by the GPS receiver to give a full Extended Week Number. Furthermore, care should be taken to ensure that the Almanac Reference Time and the Extended Week Number are correctly linked as part of a single almanac data set, avoiding inconsistencies between different almanac data sets when new almanac uploads occur after reading Page 25 of Subframe 5.

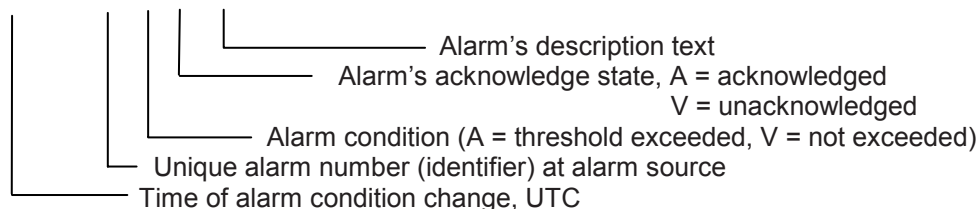
NOTE 2 Reference 20.3.3.5.1.3, Table 20-VII and Table 20-VIII.

NOTE 3 Reference Table 20-VI, for scaling factors and units.

ALR – Set alarm state

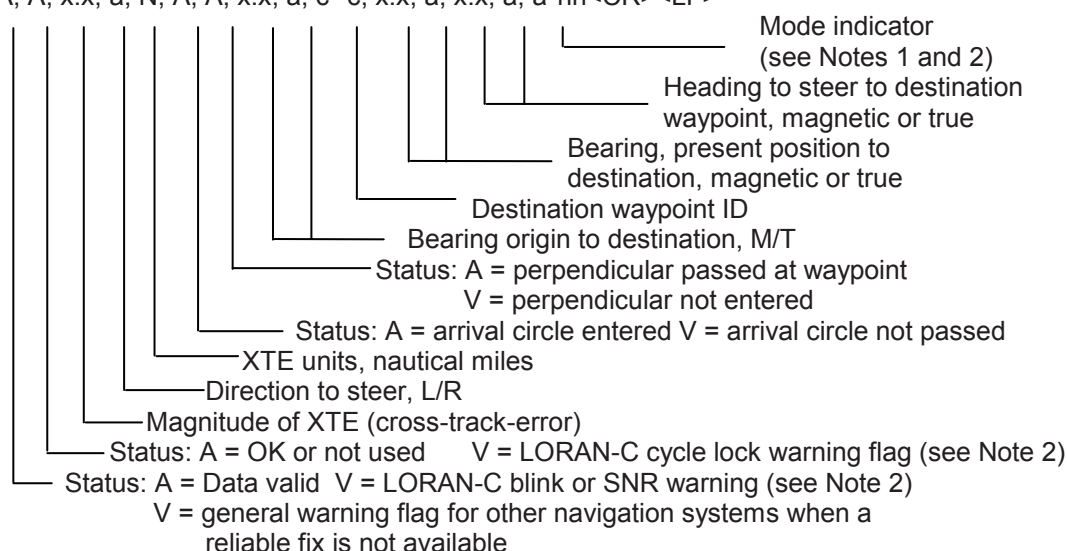
Local alarm condition and status. This sentence is used to report an alarm condition on a device and its current state of acknowledgement.

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

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

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.

\$--APB, A, A, x.x, a, N, A, A, x.x, a, c--c, x.x, a, x.x, a, a*hh<CR><LF>



NOTE 1 Positioning system mode indicator:

A = Autonomous mode

D = Differential mode

E = Estimated (dead reckoning) mode

M = Manual input mode

S = Simulator mode

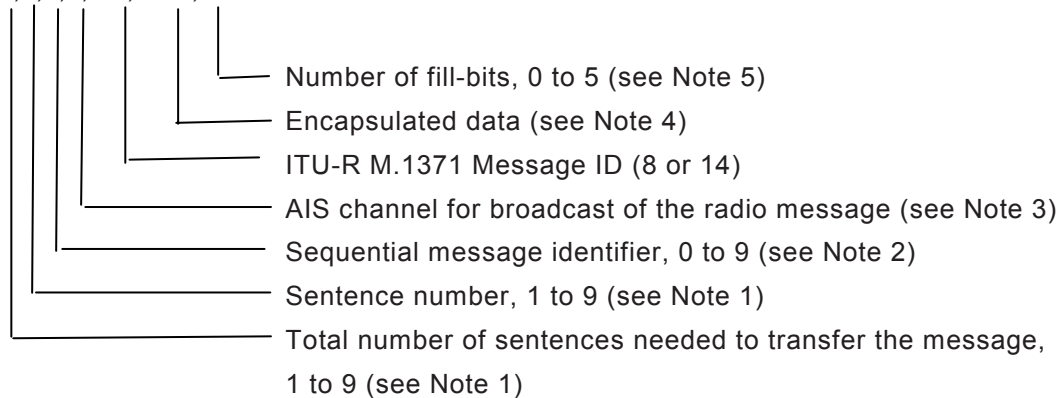
N = Data not valid

NOTE 2 The positioning system mode indicator field supplements the positioning system status fields (fields 1 and 2), the status fields should be set to V = invalid for all values of mode indicator except for A = Autonomous and D = Differential. The positioning system mode Indicator should not be null fields.

BBM – AIS Broadcast binary message

This sentence supports generation of ITU-R M.1371 binary Messages 8 and 14. 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 message offers great flexibility for implementing system functions that use the AIS unit as a digital broadcast device. After receiving this sentence, via the IEC 61162-2 interface, the AIS unit initiates a VHF broadcast of either Message 8 or 14 within 4 s. (See the ABK sentence for acknowledgement of the BBM).

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



NOTE 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.

NOTE 2 The sequential message identifier provides a message identification number from 0 to 9 that is sequentially assigned and is incremented for each new multi-sentence message. The count resets to 0 after 9 is used. For a message requiring multiple sentences, each sentence of the message contains the same sequential message identification number. It is used to identify the sentences containing portions of the same message. This allows for the possibility that other sentences might be interleaved with the message sentences that, taken collectively, contain a single message. This value is used by the ABK sentence to acknowledge a specific BBM sentence.

NOTE 3 The AIS channel that should be used for the broadcast: 0 = no broadcast channel preference, 1 = Broadcast on AIS channel A, 2 = Broadcast on AIS channel B, 3 = Broadcast the message on both AIS channels A and B.

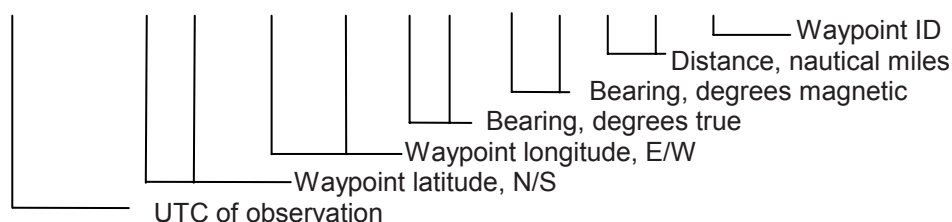
NOTE 4 This is the content of the “binary data” parameter for ITU-R M.1371 Messages 8,19 and 21, or the “Safety related text” parameter for Message 14. The first sentence may contain up to 58 valid “six-bit” symbols (348 bits). The following sentences may contain up to 60 valid “six-bit” symbols (360 bits), if fields 4 and 5 are unchanged from the first sentence and set to null. The actual number of characters should be such that the total number of characters in a sentence does not exceed the “82-character” limit.

NOTE 5 This cannot be a null field. See “x⁴” in 7.3.3.

BEC – Bearing and distance to waypoint – dead reckoning

Time (UTC) and distance and bearing to, and location of, a specified waypoint from the dead-reckoned present position.

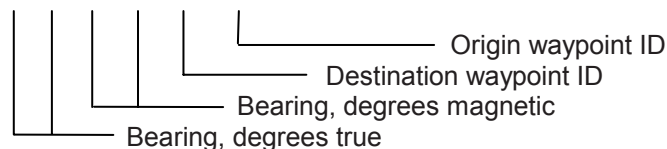
\$-BEC, hhmmss.ss, llll.ll, a, yyyy.yy, a, x.x, T, x.x, M, x.x, N, c--c*hh<CR><LF>



BOD – Bearing origin to destination

Bearing angle of the line, calculated at the origin waypoint, extending to the destination waypoint from the origin waypoint for the active navigation leg of the journey.

\$--BOD, x.x, T, x.x, M, c--c, c--c*hh<CR><LF>

**BWC – Bearing and distance to waypoint – great circle**

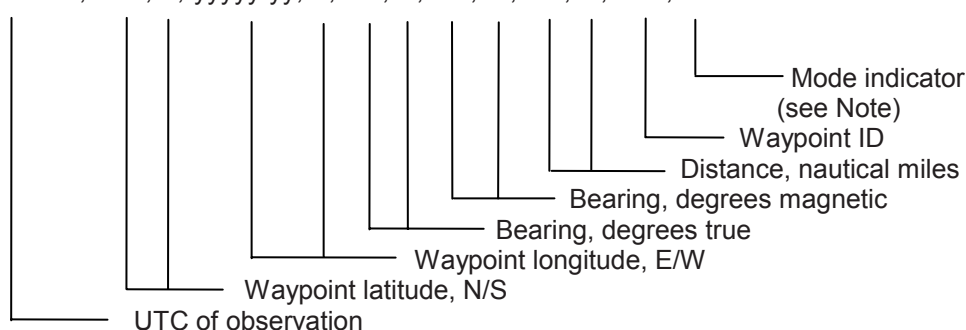
Time (UTC) and distance and bearing to, and location of, a specified waypoint from present position. \$--BWC data is calculated along the great circle path from present position rather than along the rhumb line.

BWR – Bearing and distance to waypoint – rhumb line

Time (UTC) and distance and bearing to, and location of, a specified waypoint from present position. \$--BWR data is calculated along the rhumb line from present position rather than along the great circle path.

\$--BWC, hhmmss.ss, llll.ll, a, yyyy.yy, a, x.x, T, x.x, M, x.x, N, c--c, a*hh<CR><LF>

\$--BWR, hhmmss.ss, llll.ll, a, yyyy.yy, a, x.x, T, x.x, M, x.x, N, c--c, a*hh<CR><LF>



NOTE Positioning system mode indicator

A = Autonomous mode

D = Differential mode

E = Estimated (dead reckoning) mode

M = Manual input mode

S = Simulator mode

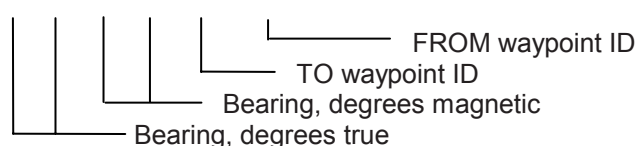
N = Data not valid

The mode indicator field should not be a null field.

BWW – Bearing waypoint to waypoint

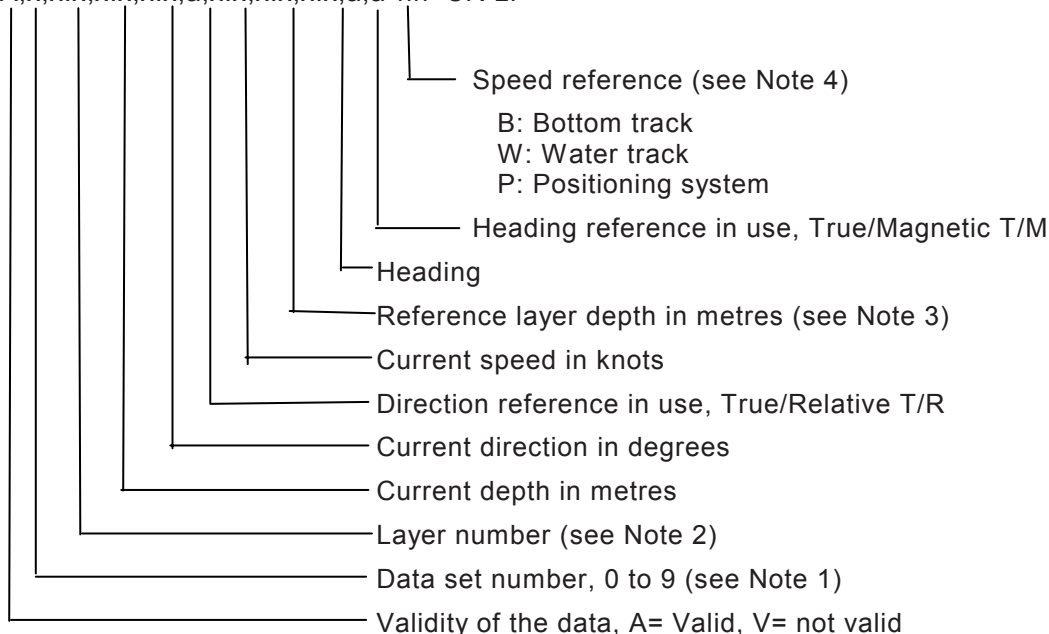
Bearing angle of the line, between the TO and the FROM waypoints, calculated at the FROM waypoint for any two arbitrary waypoints.

\$--BWW, x.x, T, x.x, M, c--c, c--c*hh<CR><LF>



CUR – Water current layer – Multi-layer water current data

\$--CUR,A,x,x,x,x,x,x,a,x,x,x,x,x,a*hh<CR LF>



NOTE 1 The data set number is used to identify multiple sets of current data produced in one measurement instance. Each measurement instance may result in more than one sentence containing current data measurements at different layers, all with the same data set number. This is used to avoid the data measured in another instance to be accepted as one set of data.

NOTE 2 The layer number identifies which layer the current data measurements were made from. The number of layers that can be measured varies by device. The typical number is between 3 and 32, though many more are possible.

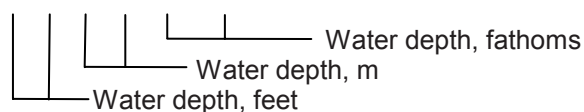
NOTE 3 The current of each layer is measured according to this reference layer, when the speed reference field is set to "water track", or the depth is too deep for bottom track.

NOTE 4 "Speed reference" identifies the method of ship speed used for measuring the current speed.

DBT – Depth below transducer

Water depth referenced to the transducer.

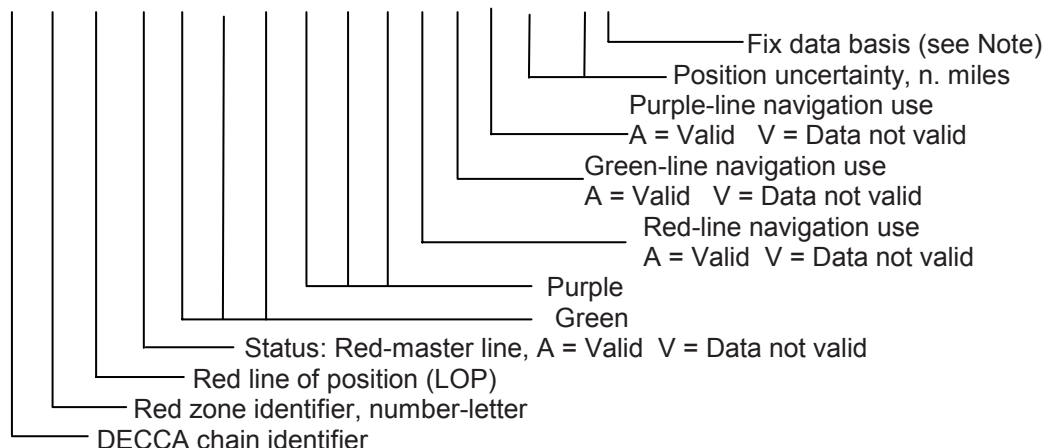
\$--DBT, x.x, f, x.x, M, x.x, F*hh<CR><LF>



DCN – DECCA position

Status and lines-of-position for a specified DECCA chain.

\$ -- DCN, xx, cc, x.x, A, cc, x.x, A, cc, x.x, A, A, A, A, x.x, N, x*hh<CR><LF>



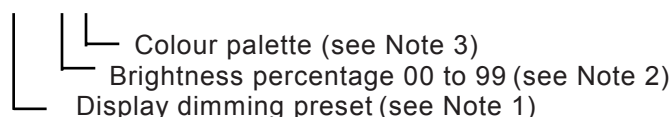
NOTE Fix data basis:

- 1 = Normal pattern
- 2 = Lane identification pattern
- 3 = Lane identification transmissions

DDC – Display Dimming Control

The DDC sentence provides controls for equipment display dimming presets and a display brightness percentage.

\$--DDC,a,xx,a*hh<CR><LF>



NOTE 1 The display dimming preset field contains an indicator that may be associated with a preset dimmed level on an electronic device.

- D = Day time setting
- K = Dusk setting
- N = Night time setting
- O = Backlighting off setting

Actual display brightness levels for the display dimming preset indicators above are dependant upon the capabilities provided by the manufacturer of the equipment. Proper use of this field would be as follows. A device provides the operator or user with the ability to set a brightness level to be associated with day, dusk night, etc. Upon receipt of the DDC sentence, the device would switch it's display brightness to the preset value the operator had determined for the corresponding indicator value. If the equipment had no brightness or dimming preset capability this field would be ignored.

NOTE 2 The brightness percentage field contains a value from zero to ninety nine. The value zero, provided as 00, indicates that the display's brightness should be set to its most dimmed level, as determined by the capabilities of the equipment. The value ninety nine, provided as 99, indicates that the display brightness should be set to the brightest level, as determined by the capabilities of the equipment. Values between 0 and 99 correspond to some percentage of brightness, as determined by the equipment receiving this sentence.

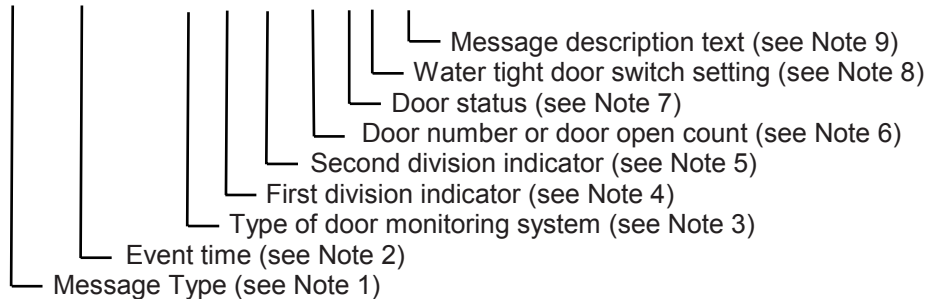
NOTE 3 The colour palette preset field contains an indicator that may be associated with a preset dimmed level on an electronic device.

- D = Day time setting
- K = Dusk setting
- N = Night time setting
- O = Backlighting off setting

DOR – Door status detection

This sentence indicates the status of watertight doors, fire doors or other hull openings / doors.

\$--DOR,a,hmmss.ss,aa,aa,xxx,xxx,a,a,c--c *hh<CR><LF>



NOTE 1 S: Status for section: the number of faulty and/or open doors reported in the division specified in fields 4 and 5. The section may be a whole section (one or both of the division indicator fields are null) or a sub-section. The status S is normally transmitted at regular intervals. Examples of use are given in Annex E.

E: Status for single door. (E may be used to indicate an event).

F: Fault in system: Division indicator fields defines the section when provided.

NOTE 2 Time when this status/message was valid. This may be a null field.

NOTE 3 The field is two fixed characters, see table below.

NOTE 4 First division indicator where door is located. This field is two characters, see table below.

NOTE 5 Second division indicator where the door is located. This field is three numeric characters, see table below.

NOTE 6 This field is three fixed numeric characters. When the message type field is E this field identifies the door. When message type field is S this field contains the number of doors that are open or faulty. When the message type field is F this field is null.

NOTE 7 When the message type field is S or F this field should be a null field. When the message type field is E, this field is specified by the following:

- O = Open
- C = Closed
- S = Secured
- F = Free status (for watertight door)
- X = Fault (door status unknown)

NOTE 8 This field includes a single character specified by the following:

- O = Harbour mode (allowed open)
- C = Sea mode (ordered closed)

This may be a null field.

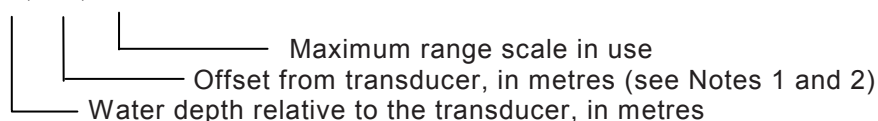
NOTE 9 Descriptive text/door tag. If a door allocation identifier is string type, it is possible to use this field instead of the above door allocation fields. The maximum number of characters will be limited by the maximum sentence length and the length of other fields.

Type of door monitoring system		First division indicator	Second division indicator
ID	System category		
WT	Watertight door	Number of watertight bulkhead / frame number	Deck number
WS	Semi-watertight door (splash-tight)		
FD	Fire door	Number / letter of zone. This can also be identifier for control and monitoring main system.	Deck number or control system loop number or other control system division indicator as is appropriate for system
HD	Hull (shell) door	Door indication number / frame number	Deck number
OT	Other	As above	As above

DPT – Depth

Water depth relative to the transducer and offset of the measuring transducer. Positive offset numbers provide the distance from the transducer to the waterline. Negative offset numbers provide the distance from the transducer to the part of the keel of interest.

\$--DPT, x.x, x.x, x.x*hh<CR><LF>



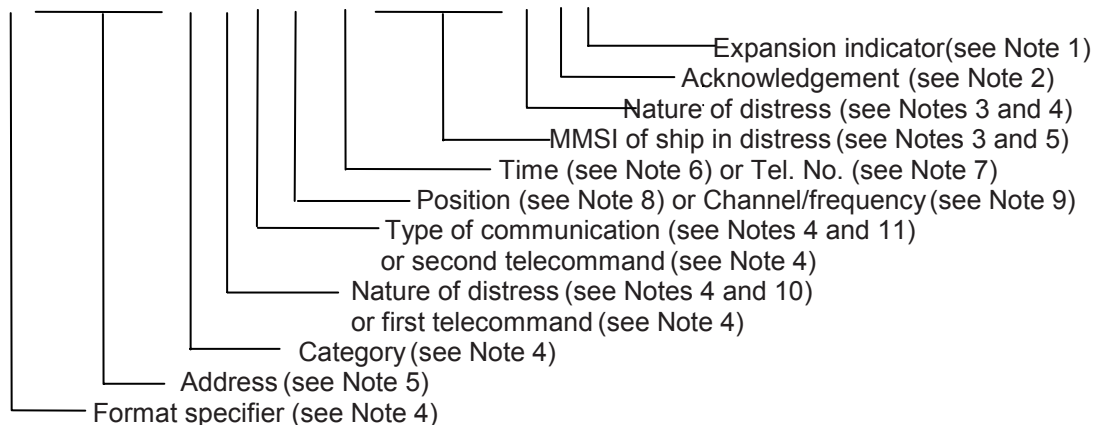
NOTE 1 “positive” = distance from transducer to water line; “-” = distance from transducer to keel.

NOTE 2 For IEC applications, the offset should always be applied so as to provide depth relative to the keel.

DSC – Digital selective calling information

This sentence is used to receive a call from or provide data to a radiotelephone using digital selective calling in accordance with ITU-R M.493.

\$ --DSC,xx,xxxxxxxxxx,xx,xx,xx,x.x, x.x,xxxxxxxxxx,xx, a,a*hh<CR><LF>



NOTE 1 Expansion indicator = “E”, null otherwise. When set to “E” this sentence is followed by the DSC expansion sentence \$--DSE, without intervening sentences, as the next transmitted or received sentence.

NOTE 2 Acknowledgement type:

R = Acknowledge request

B = Acknowledgement

S = Neither (end of sequence)

NOTE 3 For Distress Acknowledgement, Distress Relay and Distress Relay Acknowledgement calls only, null otherwise.

NOTE 4 Use two least-significant digits of symbol codes in ITU-R M.493.

NOTE 5 Maritime Mobile Service Identifier (MMSI) for the station to be called or the MMSI of the calling station in a received call. For a nine-digit MMSI "0" shall be added as the tenth digit. For calls to a geographic area the area is coded in accordance with ITU-R M.493.

System configuration (wiring) and the Talker ID are used to confirm if the sentence is transmitted or received. The MMSI of the calling station for transmitted calls is inserted automatically in the ITU-R M.493 transmission at the radiotelephone.

NOTE 6 Time (UTC) of position, four digits, hhmm (hours and minutes).

NOTE 7 Telephone number, 16 digits maximum, odd/even information to be inserted by the DSC equipment.

NOTE 8 Latitude/longitude, degrees and minutes, 10 digits, coded in accordance with ITU-R M.493

NOTE 9 Frequency or channel, six or twelve digits, coded in accordance with ITU-R M.493.

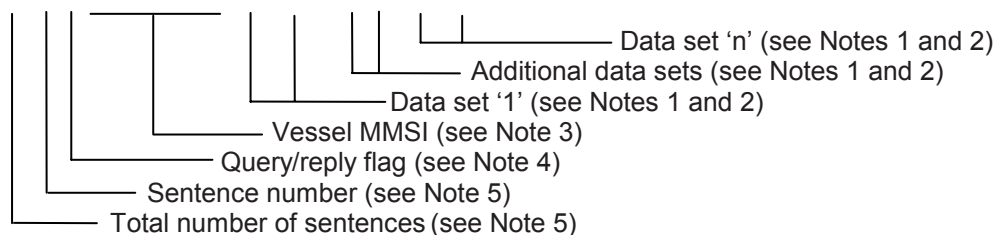
NOTE 10 Distress calls only.

NOTE 11 Distress, Distress Acknowledgement, Distress Relay and Distress Relay Acknowledgement calls only.

DSE – Expanded digital selective calling

This sentence immediately follows, without intervening sentences or characters, \$--DSC, \$--DSI or \$--DSR when the DSC expansion field in these sentences is set to "E". It is used to provide data to or receive DSC expansion data from a radiotelephone using digital selective calling in accordance with ITU-R M.821.

\$--DSE,x, x, a,xxxxxxxxxx, xx,c--c,.....,xx,c--c*hh<CR><LF>



NOTE 1 Data sets consist of two fields. The first field is the code field: the two least significant digits of symbol codes in ITU-R M.821-1, Table 1. The second field is the data field: the additional information required by ITU-R M.821-1, null otherwise. The digits appearing in these fields are the data or commands as specified by ITU-R M.821-1 except for commands, the two least significant digits of Table 3 of ITU-R M.821-1 are preceded by ASCII "C" (HEX 43). A variable number of data sets are allowed, null fields are not required for unused data sets.

NOTE 2 ASCII characters are used to describe text (station name and port of call), not symbols of ITU-R M.821-1, Table 2. When <,> (Comma, HEX 2C – a reserved character) is needed, <'> (Apostrophe, HEX 27) is substituted.

NOTE 3 Identical to the address field in the associated \$--DSC, \$--DSI or \$--DSR sentence.

NOTE 4 "Q" = Query. A device is requesting expanded data. Code fields filled as desired, all data fields null.

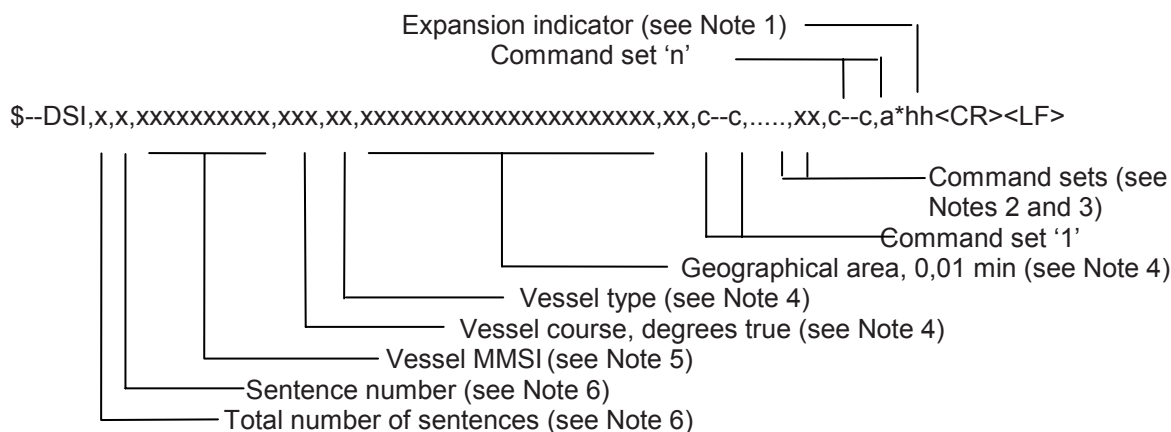
"R" = Reply. A device is responding with selected expanded data, in response to a query.

"A" = Automatic. A device is transmitting data automatically, not in response to a query request.

NOTE 5 The number of data sets may require the transmission of multiple sentences all containing identical field formats. The first field specifies the number of sentences, minimum value = 1. The second field identifies the order of this sentence (sentence number), minimum value = 1. For efficiency, it is permitted that null fields be used in the additional sentences when the data is unchanged from the first sentence (note that this practice can lead to the incorrect assembly of messages if there is a high risk of loss of sentence).

DSI – DSC transponder initialise

This sentence is used to provide data to a radiotelephone for use in making calls using Digital selective calling in accordance with ITU-R M.825.



NOTE 1 Expansion indicator = "E", null otherwise. When set to "E" this sentence is followed by the DSC Expansion sentence \$--DSE, without intervening sentences or characters, as the next transmitted sentence.

NOTE 2 Command sets consist of two fields. The first field is the two least significant digits of symbol codes in ITU-R M.825-3, Table 4, the second field is the additional information required by ITU-R M.825-3, null otherwise. A variable number of command sets is allowed, null fields are not required for unused command sets.

NOTE 3 ASCII characters are used to describe station name and port of call, not symbols of ITU-R M.825-3, Table 1. When <,> (Comma, HEX2C – a reserved character) is needed, <'> (Apostrophe, HEX 27) is substituted.

NOTE 4 All vessels in a geographic area or vessels of a specific type or on a specific course in that area, may be addressed. Code in accordance with ITU-R M.825-3, paragraph 5 and Table 3. These fields shall be null when the MMSI of an individual station is used.

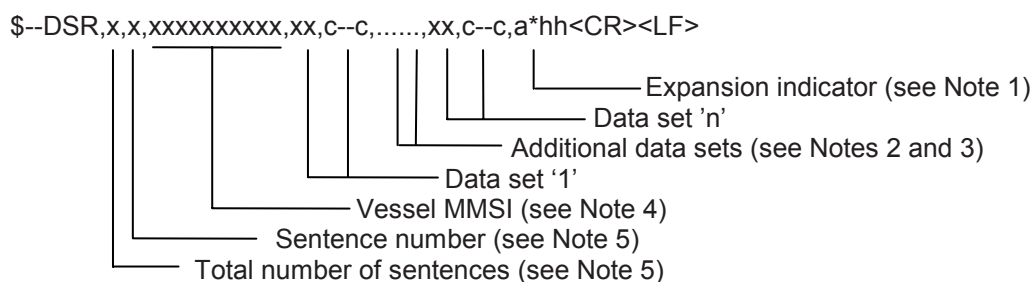
NOTE 5 Maritime Mobile Service Identifiers (MMSI) for the individual station to be called. For a nine-digit MMSI "0" should be added as the tenth digit. This field is null when addressing ships by area. Information relevant to the voyage of a ship may be provided by using the own ship MMSI together with the following command sets:

- 00, followed by the second digit of other ships in ITU-R M.825-3, Table 3 (status).
- 05, followed by a null second field (entering VTS).
- 07, followed by a null second field (leaving VTS).
- 14, followed by a second field beginning "00" or "01" as described in paragraph 8.1.5 of ITU-R M.825-3 (destination).
- 21, followed by a second field containing the next port of call.
- 23, followed by the draught as described in paragraph 8.1.10 of ITU-R M.825-3.

NOTE 6 The number of data sets may require the transmission of multiple sentences all containing identical field formats. The first field specifies the number of sentences, minimum value = 1. The second field identifies the order of this sentence (sentence number), minimum value = 1. For efficiency, it is permitted that null fields be used in the additional sentences when the data is unchanged from the first sentence (note that this practice can lead to the incorrect assembly of messages if there is a high risk of loss of sentence).

DSR – DSC transponder response

This sentence is used to receive data from a radiotelephone using Digital Selective Calling in accordance with ITU-R M.825.



NOTE 1 Expansion indicator = "E", null otherwise. When set to "E" this sentence is followed by the DSC Expansion sentence \$--DSE, without intervening sentences or characters, as the next received sentence.