

Maritime navigation and radiocommunication equipment and systems — Digital interfaces —

Part 1: Single talker and multiple listeners

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee EPL/80, Maritime navigation and radiocommunication equipment and systems, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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Summary of pages

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**Maritime navigation and radiocommunication equipment and systems -
Digital interfaces
Part 1: Single talker and multiple listeners
(IEC 61162-1:2000)**

Matériels et systèmes de navigation et
de radiocommunication maritimes -
Interfaces numériques
Partie 1: Emetteur unique et récepteurs
multiples
(CEI 61162-1:2000)

Navigations- und Funkkommunikations-
geräte und -systeme für die Seeschifffahrt -
Digitale Schnittstellen
Teil 1: Ein Datensender und mehrere
Datenempfänger
(IEC 61162-1:2000)

This European Standard was approved by CENELEC on 2000-08-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 80/240/FDIS, future edition 2 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 2000-08-01.

This European Standard supersedes EN 61162-1:1996.

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) 2001-05-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2003-08-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes C and ZA are normative and annexes A and B are informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61162-1:2000 was approved by CENELEC as a European Standard without any modification.

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INTRODUCTION

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

The following notes provide the background to changes introduced to the first edition of this standard.

NOTE 1 The sentences in IEC 61162-1:1995-11 which were indicated as "(to be further developed)" have now been developed. The sentences involved are:

DSC – Digital selective calling (DSC) (see also DSE, DSI and DSR)

DTM – Datum reference

ASD – Autopilot system data has been deleted and renamed in line with IMO definitions – see HTC and HTD below.

NOTE 2 New sentences have been added:

ACK	Acknowledge alarm
ALR	Set alarm state
DSE	Expanded digital selective calling
DSI	DSC transponder initiate
DSR	DSC transponder response
GNS	GNSS fix data
HMS	Heading monitor set
HMR	Heading monitor receive
HTC	Heading/track control command
HTD	Heading/track control data
MLA	GLONASS almanac data
MWD	Wind direction and speed
TLB	Target label
TXR	Text transmission

NOTE 3 The following sentences have been deleted, as the systems referred to are no longer in operation:

GXA – TRANSIT position, OLN – OMEGA lane numbers, TRF – TRANSIT fix data.

NOTE 4 Detailed modifications have been made to the following sentences:

FSI, GBS, GGA, GRS, MSK, MSS, OSD, RMA, RMB, RMC, SFI, TLL, TTM, VBW, XDR and ZDA.

Details of the changes are given in the relevant pages.

NOTE 5 A mode indicator character field "a" has been added as a new last data field to specific sentences, namely APB, BWC, BWR, GLL, RMA, RMB, RMC, VTG, WCV and XTE.

The mode indicator character "a" has been defined to include the following when used in the designated sentences:

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

NOTE 6 A note has been added to sentences APB, GLL, RMA, RMB, RMC and XTE (which contain a status field "A") as follows:

"Note: the mode indicator field supplements the status field (field n), the status field shall be set to V = Invalid for all values of mode indicator except for A = Autonomous and D = Differential."

NOTE 7 A note has been added to all appropriate sentences to state that "the quality indicator, mode indicator, operating mode and status fields shall not be null fields."

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – DIGITAL INTERFACES –

Part 1: Single talker and multiple listeners

1 General

1.1 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 20 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.

Annex A contains a list of relevant International Maritime Organization (IMO) resolutions and International Telecommunication Union (ITU) recommendations to which this standard applies.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61162. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61162 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

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.493-9:1997, *Digital selective-calling system for use in the maritime mobile service*

ITU-R M.821-1:1997, *Optional expansion of the digital selective-calling system for use in the maritime mobile service*

ITU-R M.825-3:1998, *Characteristics of a transponder system using digital selective calling techniques for use with vessel traffic services and ship-to-ship identification*

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*

NMEA 0183:1998, *National Marine Electronics Association (USA) – Standard for interfacing marine electronic devices, version 2.30*

RTCM:1998, *RTCM (Radio Technical Commission for Maritime Services) SC-104 Recommended standards for differential GNSS (Global Navigation Satellite Systems) service, version 2.2*

IHO:1994, *Special publication No. 60, User's handbook on datum transformations involving WGS 84*

GLONASS:1995, *Interface control document*

Rockwell International Corporation ICD-GPS-200:1987, *Interface control document, Navstar GPS space segment/navigation user interface*

1.3 Definitions

Common terms are defined in the glossary of annex B. Where there is a conflict, terms shall be interpreted wherever possible in accordance with the references in 1.2.

For the purposes of this part of IEC 61162, the following 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 6.2 (Table 4)

listener

any device which receives data from another device

2 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.

3 Hardware specification

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.

3.1 Interconnecting wire

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

3.2 Conductor definitions

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

3.3 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.

3.4 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.

3.5 Electrical signal characteristics

This subclause describes the electrical characteristics of transmitters and receivers.

3.5.1 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.

3.5.2 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.

3.5.3 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 7.2.

The receive circuit shall be designed for operation with a minimum differential input voltage of 2,0 V ¹⁾ and shall not take more than 2,0 mA from the line at that voltage.

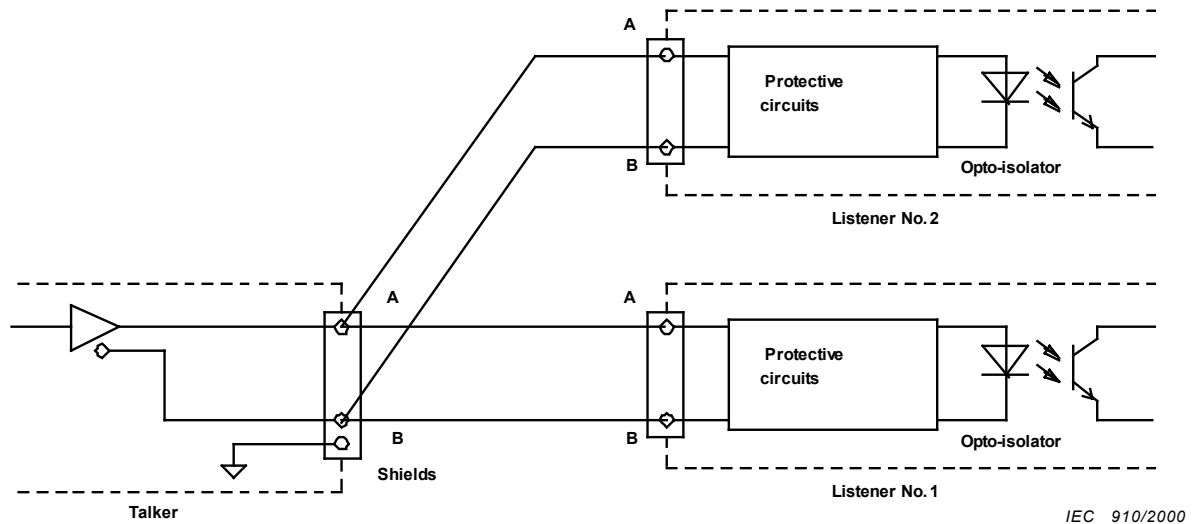


Figure 1 – Listener receive circuit

3.5.4 Electrical isolation

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

3.5.5 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.

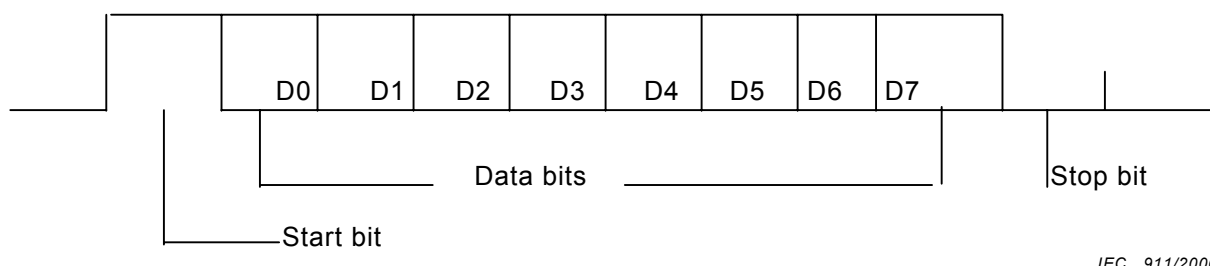
4 Data transmission

Data is transmitted in serial asynchronous form in accordance with the standards referenced in 2.1. 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.

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 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.



IEC 911/2000

Figure 2 – Data transmission format

5 Data format protocol

5.1 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).

5.1.1 Reserved characters

The reserved character set consists of those ASCII characters shown in 6.1 (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.

5.1.2 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 6.1 (Table 2).

5.1.3 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”.

5.1.4 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 6.1 (Table 3).

5.2 Fields

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

5.2.1 Address field

An address field is the first field in a sentence and follows the "\$" delimiter; it serves to define the sentence. 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.

5.2.1.1 Approved address field

Approved address fields consist of five characters defined by this standard. The first two characters are the talker identifier, listed in 6.2 (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 (e.g., 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 (e.g. 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 approved sentence formatters is given in 6.2 (Table 5).

5.2.1.2 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.

5.2.1.3 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. A list of valid manufacturer's mnemonic codes may be obtained from NMEA (see 5.3.3).

5.2.2 Data fields

Data fields in approved sentences follow a "," delimiter and contain valid characters (and code delimiters "^") in accordance with the formats illustrated in 6.2 (Table 6). 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.

5.2.2.1 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.

5.2.2.2 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 6.2 (Table 6).

5.2.2.3 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.

5.2.3 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 "," delimiters, between but not including the "\$" 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,,*7F .

5.3 Sentences

This subclause describes the general structure of sentences. Details of specific sentence formats are found in 6.3. Some sentences may specify restrictions beyond the general limitations given in this part of 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 "\$" 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 "\$" and end with the sentence-terminating delimiter <CR><LF>.

5.3.1 Description of approved sentences

Approved sentences are those designed for general use and detailed in this standard. Approved sentences are listed in 6.3 and shall be used wherever possible. Other sentences, not recommended for new designs, may be found in practice. Such sentences are listed in NMEA 0183. Information on such sentences may be obtained from the National Marine Electronics Association (NMEA)(USA).

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

ASCII	HEX	Description
"\$"	24	– 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

5.3.1.1 Approval sentence structure

The following provides a summary explanation of the approved 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.

5.3.2 Query sentences

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.

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

5.3.2.1 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.

5.3.3 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:

- a) 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;
- b) data is being used for test purposes prior to the adoption of approved sentences;
- c) data is not of a type and general usefulness which merits the creation of an approved sentence.

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.

5.3.4 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.

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: +1-252-638-4885
PO Box 3435 e-mail: nmea@coastalnet.com
New Bern, NC 28564-3435 web site <http://www.nmea.org>
USA.

5.3.5 Sentence transmission timing

Frequency of sentence transmission when specified shall be in accordance with the approved sentence definitions (see 6.3). 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.

5.3.6 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, "\$" and "*" whether or not the listener recognizes all fields.

6 Data content

6.1 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	Reserved for future use
\	5C	92	Reserved for future use
^	5E	94	Code delimiter for HEX representation of ISO 8859-1 (ASCII) characters
~	7E	126	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
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
k	Kilograms
L	Left; Local; Lost target
I	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 "\$"); 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
s	Seconds
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

Table 5 – Approved sentence formatters

<i>Formatter</i>	<i>Meaning</i>
AAM	Waypoint arrival alarm
ACK	Acknowledgement alarm
ALM	GPS almanac data
ALR	Set alarm state
APB	Heading/track controller (Autopilot) sentence B
BEC	Bearing and distance to waypoint, dead reckoning
BOD	Bearing, origin to destination
BWC	Bearing and distance to waypoint
BWR	Bearing and distance to waypoint, rhumb line
BWW	Bearing, waypoint to waypoint
DBT	Depth below transducer
DCN	DECCA position
DPT	Depth
DSC	Digital selective calling information
DSE	Expanded digital selective calling
DSI	DSC transponder initialise
DSR	DSC transponder response
DTM	Datum reference
FSI	Frequency set information
GBS	GNSS Satellite fault detection
GGA	Global positioning system fix data
GLC	Geographic position, LORAN-C
GLL	Geographic position, latitude/longitude
GNS	GNSS fix data
GRS	GNSS range residuals
GSA	GNSS DOP and active satellites
GST	GNSS pseudorange error statistics
GSV	GNSS satellites in view
HDG	Heading, deviation and variation
HDT	Heading, true
HMR	Heading monitor – receive
HMS	Heading monitor – set
HSC	Heading steering command
HTC	Heading/track control command
HTD	Heading/track control data
LCD	LORAN-C signal data
MLA	Glomass almanac data
MSK	MSK receiver interface
MSS	MSK receiver signal status
MTW	Water temperature
MWD	Wind direction and speed
MWV	Wind speed and angle
OSD	Own ship data
RMA	Recommended minimum specific LORAN-C data
RMB	Recommended minimum navigation information
RMC	Recommended minimum specific GNSS data
ROT	Rate of turn
RPM	Revolutions
RSA	Rudder sensor angle
RSD	Radar system data
RTE	Routes
SFI	Scanning frequency information
STN	Multiple data ID
TLB	Target label
TLL	Target latitude and longitude
TTM	Tracked target message

TXT	Text transmission
VBW	Dual ground/water speed
VDR	Set and drift
VHW	Water speed and heading
VLW	Distance travelled through the water
VPW	Speed, measured parallel to wind
VTG	Course over ground and ground speed
WCV	Waypoint closure velocity
WNC	Distance, waypoint to waypoint
WPL	Waypoint location
XDR	Transducer measurements
XTE	Cross-track error, measured
XTR	Cross-track error, dead reckoning
ZDA	Time and date
ZDL	Time and distance to variable point
ZFO	UTC and time from origin waypoint
ZTG	UTC and time to destination waypoint

Table 6 – Field type summary

<i>Field type</i>	<i>Symbol</i>	<i>Definition</i>
<i>Special format fields</i>		
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 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	yyyy.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 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", "llll.ll", "x", "yyyy.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).
------------------	-----	---

Fixed HEX field	hh-	Fixed length HEX numbers only, MSB on the left.
-----------------	-----	---

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 Spaces shall only be used in variable text fields.

NOTE 2 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.

NOTE 3 Units of measure fields are appropriate characters from the symbol table (Table 3) unless a specific unit of measure is indicated.

6.3 Approved sentences

General format of printed sentence information:

* {mnemonic} – {name}

{definition paragraph}

\$--{sentence}

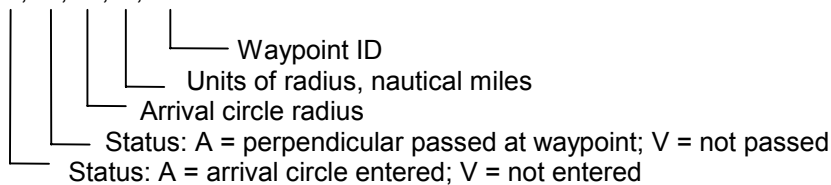
└──┬──┬── {field descriptions}
└──┬── start of sentence and talker ID

AAM – Waypoint arrival alarm

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

* Designated in this standard for use with IMO marine electronic devices as required by IMO in the SOLAS Convention (1974, as amended).

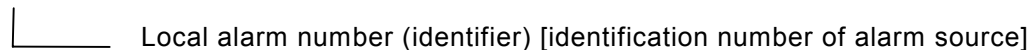
\$--AAM, A, A,x.x, N, c--c*hh<CR><LF>



ACK – Acknowledge alarm

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

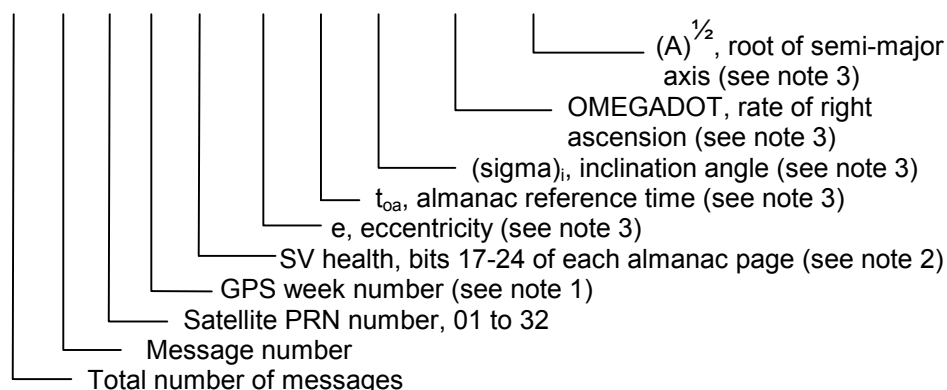
\$--ACK,xxx*hh<CR><LF>



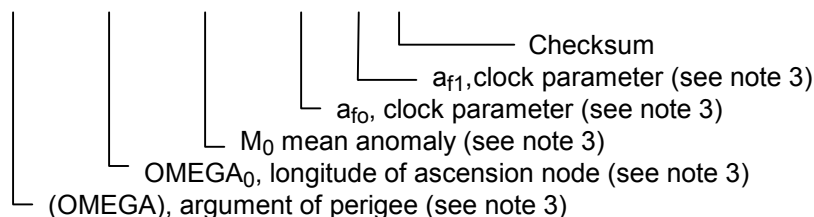
ALM – GPS almanac data

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

\$--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 shall not be reset to zero when the 10-bit GPS week number rolls back to zero every 19,6 years. This value must 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 must be expanded by the GPS receiver to give a full Extended Week Number. Furthermore, care must 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.

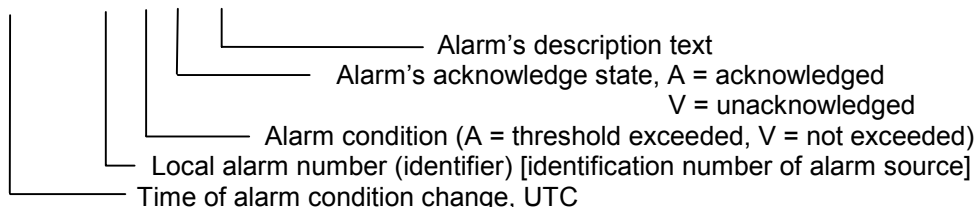
NOTE 2 Reference 20.3.3.5.1.3, Table 20-VII and Table 20-VIII.

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.

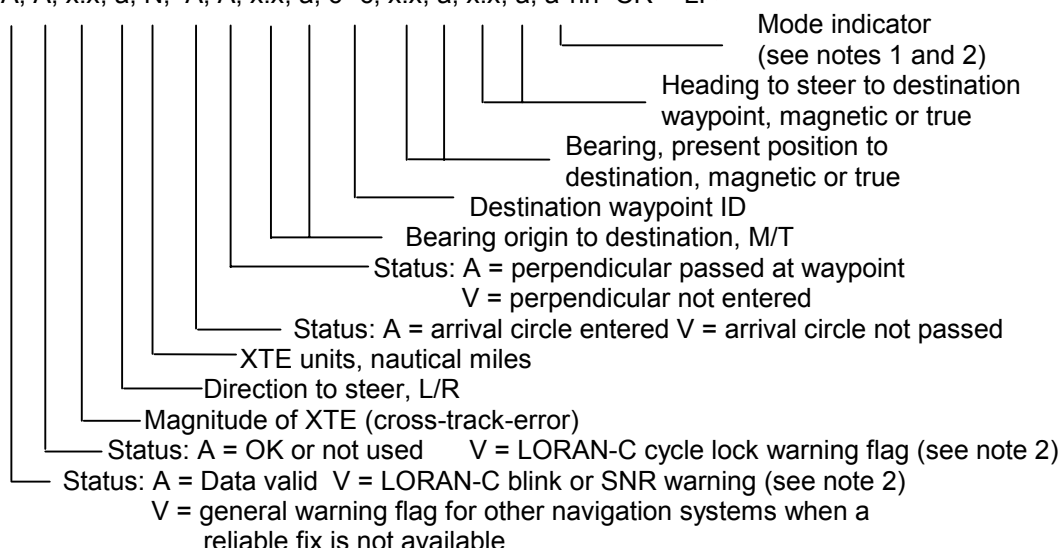
\$--ALR,hhmmss.ss,xxx,A,A,c--c*hh<CR><LF>



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

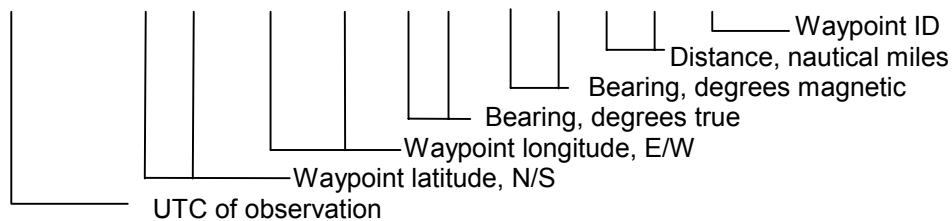
N = Data not valid

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

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.

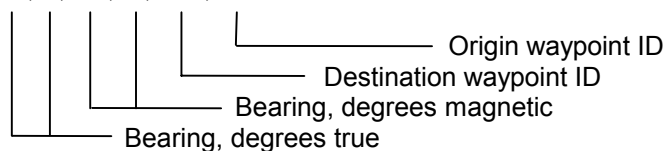
\$-BEC, hhmmss.ss, llll.ll, a, yyyyy.yy, a, x.x, T, x.x, M, x.x, N, c--c*hh<CR><LF>



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>



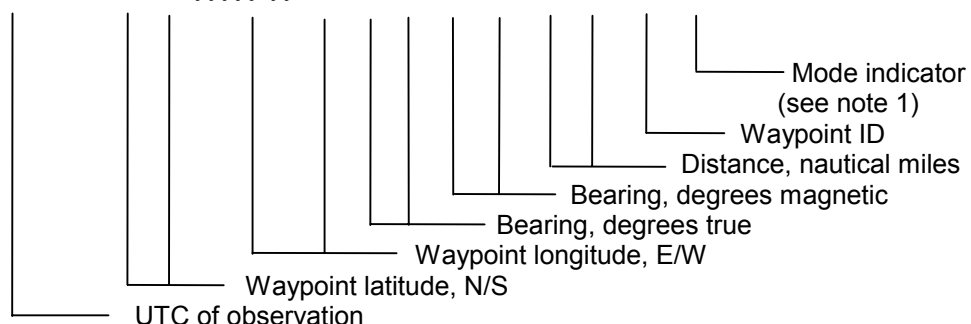
BWC – Bearing and distance to waypoint

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, yyyyy.yy, a, x.x, T, x.x, M, x.x, N, c--c, a*hh<CR><LF>

\$-BWR, hhmmss.ss, llll.ll, a, yyyyy.yy, a, x.x, T, x.x, M, x.x, N, c--c, 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

The Mode indicator field shall not be a null field.