IEC 61162-2

Edition 1.0 1998-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Matériels et systèmes de navigation et de radiocommunication maritimes – Interfaces numériques –
Partie 2: Emetteur unique et récepteurs multiples, transfert rapide de données

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CONTENTS

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – DIGITAL INTERFACES –

Part 2: Single talker and multiple listeners, high-speed transmission

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61162-2 has been prepared by technical committee 80: Maritime navigation and radiocommunication equipment and systems.

This part of IEC 61162 is based upon NMEA 0183, version 2.30, and it is the intention of IEC and NMEA to maintain this commonality as far as possible.

This bilingual version (2013-01) corresponds to the monolingual English version, published in 1998-09.

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

FDIS	Report on voting
80/189/FDIS	80/206/RVD

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

The French version of this standard has not been voted upon.

Annexes A and B are for information only.

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – DIGITAL INTERFACES –

Part 2: Single talker and multiple listeners, high-speed transmission

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 interface.

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 any information as specified by approved sentences or information coded according to the rules for proprietary sentences. Typical messages may be from 11 to a maximum of 79 characters in length and generally require repetition rates up to once per 20 ms.

The electrical definitions in this standard are intended to accommodate higher data rates than are specified in IEC 61162-1. 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.

Annex A contains a list of relevant IMO resolutions and 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. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and 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. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60945:1996, *Maritime navigation and radiocommunication equipment and systems – General requirements, methods of testing and required test results*

IEC 61162-1:1995, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners*

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

NMEA 0183 – Version 2.30:1998, *National marine electronics association (USA) – Standard for interfacing marine electronic navigational devices*

EIA 485:1991, *Electrical characteristics of generators and receivers for use in balanced digital multipoint systems*

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 two-character mnemonic as listed in 6.2 (table 4) of IEC 61162-1.

listener
any device which receives data from another device

latency
time interval between an event and its resulting information, including time for processing, transmission and/or reception

2 Manufacturer's documentation

2.1 Standard documents

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

a) identification of the A, B and common (C) 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, data latency 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 by, or are acceptable to, 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.

2.2 Additional information

As latency, filtering, error handling and data transmission interval can have a serious influence on the performance of a system, the manufacturer shall give careful consideration to these aspects. Documentation should include such data where applicable.

3 Hardware specification

One talker and multiple listeners may be connected in parallel over interconnecting wires. Because of EMC requirements shielded cables are recommended. The number of listeners depends on the output capability, the input drive requirements of the connected devices, and on the use of termination resistors.

3.1 Interconnecting wires

Interconnection between devices may be by means of a shielded two-conductor twisted-pair wire (A, B) plus any means to secure common signal ground potential (C) for transmitting and

receiving devices. For this purpose, a third wire additional to the twisted pair or the inner shield of double-shielded cable with insulated shields may be used.

3.2 Conductor definitions

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

3.3 Electrical connection/shield requirements

All signal and common line connections A, B and C are connected in parallel.

With single-shielded cables and a separate wire as common line C (signal ground), the shield shall be connected to the talker chassis and shall not be connected to any listener. However, the shield shall be continuous (unbroken) between all listeners (see figure 1 and figure 2a)).

With double-shielded cables and the inner shield used as common line C (signal ground), the outer shield shall be connected to the talker chassis and shall not be connected to any listener. However, the outer shield shall be continuous (unbroken) between all listeners (see figure 1 and figure 2b)).

With double-shielded cables and a separate wire as common line C (signal ground), the inner shield shall be connected to the talker chassis and shall not be connected to any listener. However, the inner shield shall be continuous (unbroken) between all listeners. The outer shield may be connected to the chassis on either side if required (see figure 1 and figure 2c)).

The cabling shall be designed in a way that stubs are avoided or kept as short as possible. If long cables are necessary, termination at the end of the line according to ITU-T V.11 shall be considered.

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 state is defined by a negative voltage on line A with respect to line B, as in IEC 61162-1.

The active, spacing, logical 0, ON or start bit state is defined by a positive voltage on line A with respect to line B, as in IEC 61162-1.

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 shall meet, as a minimum, the requirements of ITU-T V.11.

Improved and compatible driver circuits (e.g. EIA-485) used in a compliant way are allowed.

3.5.3 Listener receive circuits

Multiple listeners may be connected to a single talker. The listener's receive circuit shall comply with ITU-T V.11. Optional termination resistors for the line shall be provided. The input terminals A, B and C shall be electrically isolated from the remaining electronics of the listening device. Reference is made to 3.5.4 and a sample circuit shown in figure 1 of this standard.

3.5.4 Electrical isolation

Within a listener there shall be no direct electrical connection between the signal lines A and B, the signal ground C or the shield to ship's mains ground or power line. This isolation shall be in accordance with IEC 60945.

3.5.5 Maximum voltage on the bus

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

For protection against miswiring and for unintended connection to earlier TALKER designs, all receive circuit devices shall be capable of withstanding 15 V between either lines and signal ground for an indefinite period.

4 Data transmission

Data is transmitted in serial asynchronous form in accordance with 1.2. The first bit is a start bit and is followed by data bits, least-significant-bit first as in figure 3.

The following parameters are used:

– baud rate 38 400 (bits/s);
– data bits 8 (D7 = 0), parity none;
– stop bits 1.

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) of IEC 61162-1. These characters are used for specific formatting purposes, such as sentence and field delimiting, and 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) of IEC 61162-1.

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.

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) of IEC 61162-1.

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) of IEC 61162-1. 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) of IEC 61162-1.

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.

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.

5.2.2 Data fields

Data fields in approved sentences follow a "," delimiter and contain valid characters in accordance with the formats illustrated in 6.2 (table 6) of IEC 61162-1. Data fields in proprietary sentences contain only valid characters 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 alpha-numeric 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, 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) of IEC 61162-1.

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 any sentence. 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 of IEC 61162-1. 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 of IEC 61162-1 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 NMEA (see 5.3.3).

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:

$aaccc, c–––c*hh<CR> <LF>

ASCII	*HEX*	*Description*
"$"	24	*Start of sentence:* starting delimiter
aaccc		*Address field:* alphanumeric characters identifying type of talker, and sentence formatter. The first two characters identify the talker. The last three are the sentence formatter mnemonic code identifying the data type and the string format of the successive fields. Mnemonics will be used as far as possible to facilitate read-outs by users.
","	2C	*Field delimiter:* starts each field except address and checksum fields. If it is followed by a null field, it is all that remains to indicate no data in a field.
c–––c		*Data sentence block:* follows address field and is a series of data fields containing all of the data to be transmitted. Data field sequence is fixed and identified by third and subsequent characters of the address field (the sentence formatter). Data fields may be of variable length and are preceded by delimiters ",".
"*"	2A	*Checksum delimiter:* follows last data field of the sentence. It indicates that the following two alphanumeric characters show the HEX value of the checksum.
hh		*Checksum field:* the absolute value calculated by exclusive-OR'ing the eight data bits (no start bits or stop bits) of each character in the sentence, between, but excluding "$" 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.

<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 manufacturer's reference list of mnemonic codes is a component of the equivalent specification NMEA 0183.*

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* The NMEA secretariat maintains the master reference list which comprises codes registered and formally adopted by NMEA.

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
<address field>		– talker identifier and sentence formatter
<valid characters, manufacturer's data>		
"*" <checksum field>		– checksum field
<CR> <LF>	0D 0A	– end of sentence

Beyond limiting overall sentence length and requiring the use of only valid characters, details of proprietary data fields are not included in this standard. 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.

5.3.5 Sentence transmission timing

Frequency of sentence transmission shall be consistent with the basic measurement or calculation cycle but generally not more frequently than once per 20 ms.

It is desirable that sentences be transmitted with a minimum inter-character spacing, preferable as near continuous burst, but under no circumstances shall the time to complete the transmission of a sentence be greater than 100 ms.

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.

5.4 Error detection and handling

Listening devices shall detect errors in data transmission including:

– checksum error;

– invalid characters;

– incorrect length of talker identifier and/or formatter;

– time out.

Listening devices shall use only correct sentences.

6 Data content

This clause is identical with clause 6 of IEC 61162-1.

7 Applications

This clause is identical with clause 7 of IEC 61162-1. For the purpose of compatibility with that standard, in case of modifications, no dedicated specification is made in this standard.

8 Methods of testing and required test results

8.1 Test preparation

8.1.1 General

The manufacturer shall, unless otherwise agreed, set up the EUT (equipment under test) as well as all necessary test equipment and ensure that it is operational before testing commences. The manufacturer shall provide sufficient technical documentation of the EUT.

8.1.2 Testing under ambient conditions

All tests shall be carried out under the ambient conditions defined in the specific standard for the EUT. If no ambient conditions are defined the temperature range between +10 °C and +35 °C shall be applied.

8.2 Test sequence

Where appropriate, tests against different clauses of this standard may be carried out simultaneously.

8.3 Standard test signals

For testing transmitting interfaces those standard IEC 61162 sentences and proprietary messages shall be used which the EUT transmits during normal operation.

For testing receiving interfaces of the EUT those IEC 61162 sentences and proprietary messages shall be applied which are received/used by the EUT during its normal operation.

8.4 Test of the interface

8.4.1 Electrical test of the interface

8.4.1.1 Normal operation range

For compatibility of the hardware, standard tests shall be used as defined in ITU-T V.11. The electrical isolation of input circuits shall be checked by inspection of the manufacturer's documentation and tests according to the values given in IEC 60945.