INTERNATIONAL STANDARD

IEC 61162-1

Third edition
2007-04

Maritime navigation and radiocommunication equipment and systems – Digital interfaces

Part 1:
Single talker and multiple listeners

Reference number
IEC 61162-1:2007(E)

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

IEC
61162-1

Third edition
2007-04

Maritime navigation and radiocommunication
equipment and systems –
Digital interfaces

**Part 1:
Single talker and multiple listeners**

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE **XF**

For price, see current catalogue

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION
_____

**MARITIME NAVIGATION AND RADIOCOMMUNICATION
EQUIPMENT AND SYSTEMS –
DIGITAL INTERFACES –**

Part 1: Single talker and multiple listeners

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.

3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication should be clearly indicated in the latter.

5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.

6) All users should ensure that they have the latest edition of this publication.

7) No liability should attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC should not be held responsible for identifying any or all such patent rights.

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

This third edition cancels and replaces the second edition published in 2000, and constitutes a technical revision. This part of IEC 61162 is closely aligned with NMEA 0183 version 3.01. It also replaces PAS 61162-100 (2002), PAS 61162-101 (2003) and PAS 61162-102 (2003).

The main changes with respect to the previous edition 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 the previous edition.

• Clause 7 (Clause 5 in the previous edition) 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 the previous edition) have been expanded to describe both types.

- The tables in Clause 8 (Clause 6 in the previous edition) 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 text of this standard is based upon the following documents:

FDIS	Report on voting
80/464/FDIS	80/473/RVD

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

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

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

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

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

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 V [1] and shall not take more than 2,0 mA from the line at that voltage.
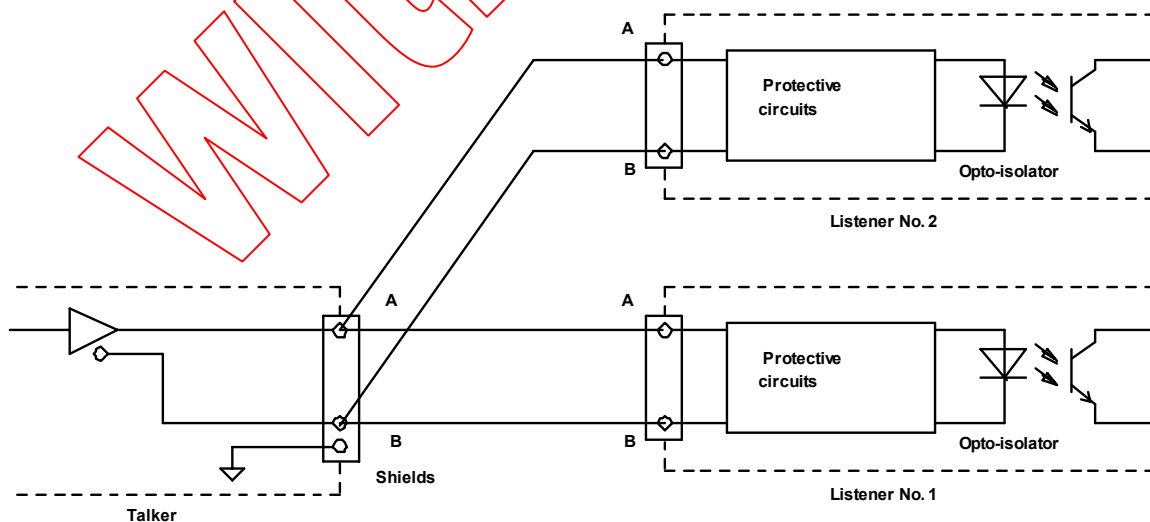
IEC 910/2000

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 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.

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.
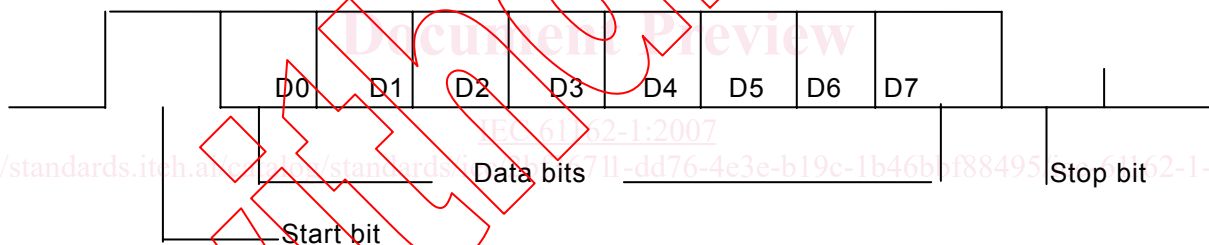
Figure 2 – Data transmission format

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:

    ",,"   ",*"