IEC 61162-3

Edition 1.0 2008-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 3: Serial data instrument network

Matériels et systèmes de navigation et de radiocommunication maritimes – Interfaces numériques – Partie 3: Réseau par liaison de données série d'instruments

IEC 61162-3:2008-05(en-fr)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 47.020.70

ISBN 978-2-8322-9336-2

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – DIGITAL INTERFACES –

Part 3: Serial data instrument network

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

CDV	Report on voting
80/496/CDV	80/526/RVC

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.

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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- withdrawn,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.

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INTRODUCTION

This part of IEC 61162 has been developed by the IEC technical committee 80 working group 6, to meet the requirement for a versatile and economic means of connecting a wide range of marine navigation and radiocommunications equipment aboard SOLAS vessels. The National Marine Electronics Association's Standard Committee has developed the NMEA 2000®[1] standard. The NMEA[2] 2000 Standard provides for capabilities across all classes of vessels. The development of NMEA 2000 began in 1994 and was completed in 1999. More than a dozen manufacturers worldwide conducted a two-year beta test. The finalised NMEA 2000 standard version 1.000 was published in 2001. IEC and NMEA have worked together since 1999 to ensure that the NMEA 2000 standard fully supports SOLAS applications. NMEA 2000 version 1.200 was published in 2004, with expanded support for redundant messaging and for equipments such as AIS.

The need for an improved standard, compared with IEC 61162-1 and IEC 61162-2, has arisen due to the increased complexity of the latest equipment and systems. This requires multiple links between equipment and greatly improved communication speed.

The parts 400 of the IEC 61162 series have already been issued and cater for the most complex systems to be found on board a ship.

This new part 3 of IEC 61162 adopts the controller area network (CAN) technology, already well established for many industrial systems. This permits a versatile system to be established with the minimum of effort and reasonable cost. The equipment types supported and the sentence data content developed for IEC 61162-1 has been retained.

IEC 61162-3 describes a low cost, moderate capacity, bi-directional multi-transmitter/multi-receiver instrument network to interconnect marine electronic equipment. The connectors and cables used are compatible with industrial bus systems for instance DeviceNet™[3] and Profibus™[4].

IEC 61162-3 provides for the application of NMEA 2000 aboard SOLAS vessels. Exceptions, additions and specific requirements for implementation upon SOLAS vessels are contained in this document.

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – DIGITAL INTERFACES –

Part 3: Serial data instrument network

1 Scope

This part of IEC 61162 is based upon the NMEA 2000 standard. The NMEA 2000 standard contains the requirements for the minimum implementation of a serial-data communications network to interconnect marine electronic equipment onboard vessels. Equipment designed to this standard will have the ability to share data, including commands and status, with other compatible equipment over a single signalling channel.

Data messages are transmitted as a series of data frames, each with robust error check confirmed frame delivery and guaranteed latency times. As the actual data content of a data frame is at best 50 % of the transmitted bits, this standard is primarily intended to support relatively brief data messages, which may be periodic, transmitted as needed, or on-demand by use of query commands. Typical data includes discrete parameters such as position latitude and longitude, GPS status values, steering commands to autopilots, finite parameter lists such as waypoints, and moderately sized blocks of data such as electronic chart database updates. This standard is not necessarily intended to support high-bandwidth applications such as radar, electronic chart or other video data, or other intensive database or file transfer applications.

This standard defines all of the pertinent layers of the International Standards Organisation Open Systems Interconnect (ISO/OSI) model, from the application layer to the physical layer, necessary to implement the required IEC 61162-3 network functionality.

This standard defines data formats, network protocol, and the minimum physical layer necessary for devices to interface. SOLAS applications shall employ redundant designs (for instance dual networks, redundant network interface circuits) to reduce the impact of single point failures. The NMEA 2000 standard provides the fundamental tools and methods to support redundant equipment, buses and messaging. Specific shipboard installation designs are beyond the scope of this standard, however some guidance is given in Annex A.

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*

ISO 11783 (all parts), *Tractors and machinery for agriculture and forestry – Serial control and communications data network*

ISO 11783-3, *Tractors and machinery for agriculture and forestry – Serial control and communications data network – Part 3: Data link layer*

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ISO 11783-5:2001, *Tractors and machinery for agriculture and forestry – Serial control and communications data network – Part 5 Network management* (including its corrigendum 1 (2002))

NMEA 2000 Main document, Version 1.200: October 2004, *Serial-Data Networking Of Marine Electronic Devices*[5]

NMEA 2000, Appendix A, Version 1.200: October 2004, *Serial-Data Networking Of Marine Electronic Devices – Application Layer (Parameter Group Definitions*)

NMEA 2000, Appendix B, Version 1.210: September 2006 *Serial-Data Networking Of Marine Electronic Devices – Data Base*

NMEA 2000, Appendix C, Version 1.200: October 2004, *Serial-Data Networking Of Marine Electronic Devices – Certification Criteria and Test Methods*

NMEA 2000, Appendix D, Version 1.200: October 2004, *Serial-Data Networking Of Marine Electronic Devices – Application Notes*

IMO 1974, *International Convention for the Safety of Life at Sea (SOLAS), as amended – Chapter V – Safety of navigation*

3 Terms, definitions and conventions

3.1 Terms and definitions

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

3.1.1
bit
the smallest element of information on the communication channel

NOTE Bits are grouped into bit fields of one or more bits. A bit is of constant time duration set by the signalling rate specified in this standard and has one of two logical values, dominant or recessive. When dominant and recessive levels are impressed on the communications channel at the same time the resulting level is dominant.

3.1.2
bridge
device that joins two network segments using the same network protocol and address space

NOTE Data rate and physical media may differ on the two sides of a bridge. A bridge may perform message filtering.

3.1.3
byte
eight bits

3.1.4
Controller area network (CAN) frame
series of bits transmitted on the communications channel

NOTE CAN frames convey the following types of information:

- data frame. Carries data from a transmitter to the receivers.
- error frame. Transmitted by a unit detecting a bus error.
- overload frame. Transmitted to provide a delay between preceding and succeeding data frames.

[5] Available from National Marine Electronics Association (USA), www.nmea.org.

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The CAN data frame has defined start of frame and end of frame bit fields and is separated from preceding fields by an interframe space. CAN error and overload frames, when used, are appended directly to the preceding frame without an interframe space.

3.1.5
class 1 devices
refers to devices that have a single level A or level B network interface connection

3.1.6
class 2 devices
describes devices that have two level A or two level B network interface connections

NOTE Class 2 devices are intended for use on dual redundant bus systems. In addition to providing either level A or level B capabilities, class 2 devices provide a means to identify messages that are received from redundant buses as being the same or different.

3.1.7
default operation
operation or settings that exist when standard equipment is first shipped from the manufacturer

3.1.8
device
a product or equipment which, through a node, is connected to an IEC 61162-3 network

3.1.9
gateway
device that joins a network to another network or system

3.1.10
interframe space
bit field that separates data frames from preceding frames

3.1.11
level A devices
support the ISO transport layer and the complete set of network management parameter groups

3.1.12
level B devices
support address claim, ISO request PGN, and the product information parameter group

3.1.13
listen only device
device on the network that receives messages but does not participate in bus activity

NOTE This device cannot send any frames on the network (data, error, or acknowledge).

3.1.14
load equivalency number
a node's power rating reported in units of network load

3.1.15
message
consists of one or more data frames, as specified in this standard, that contain the parameter group information to be communicated from a network address

NOTE A message contains the message priority code, parameter group number, destination network address, source network address, and data fields. The destination network address may be a specific address or global.

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3.1.16
network address
identifier of a functional entity on the network

3.1.17
network load
one network load is a unit of measure defined as 50 mA

NOTE This is used to determine loading of network.

3.1.18
node
a physical connection to the network

NOTE A node may have more than one network address, see virtual nodes.

3.1.19
node power
power supplied from the network

3.1.20
parameter group (PG)
set of associated variables, commands, status, or other information to be transmitted on the network

3.1.21
parameter group number (PGN)
an 8-bit or 16-bit number that identifies each parameter group

NOTE The parameter group number (PGN) is analogous to the three-character sentence formatter in IEC 61162-1. By definition, parameter groups identified by 16-bit parameter group numbers are broadcast to all addresses on the network. Parameter groups identified by 8-bit parameter group numbers may be used to direct data for use by a specific address.

3.1.22
receiver
recipient of a message if the bus is not idle and the device is not a transmitter

3.1.23
router
device that joins two network segments with the same network protocol

NOTE On each side of a router address space, data rate and physical media may differ.

3.1.24
transmitter
originator of a message

NOTE The unit remains a transmitter until it loses arbitration or until the bus becomes idle.

3.1.25
virtual nodes
functional entities within a device that share a physical connection to the network

NOTE Each virtual node within a device has a unique address on the network.

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3.2 Conventions

3.2.1
may
In this document “may” when relating to network requirements applies to alternatives and optional items that are allowed in a network. An implementation that does not include an alternative shall be prepared to tolerate another implementation that does.

3.2.2
shall
In this document “shall” when relating to network requirements signifies items that are required in a network.

3.2.3
shall not
In this document “shall not” when relating to network requirements signifies items that are prohibited in a network.

3.2.4
should
In this document “should” when relating to network requirements signifies a recommendation that, if followed, could ease development or improve the operation of the network in some manner.

4 Physical layer

The physical layer of this standard is as described in the NMEA 2000 Main document.

4.1 CAN transceiver

Devices shall utilize CAN transceivers that include a “transmit dominant timeout” timer circuit (babbling idiot protection).

4.2 Environmental

Components and circuits shall be designed to meet the durability and resistance to environmental conditions of IEC 60945, Clause 8. The requirements of 8.8 (rain and spray) apply only to those network components actually intended to be exposed to rain and/or spray.

4.3 Radio frequency interference

4.3.1 Unwanted electromagnetic emissions

Components and circuits shall be designed to meet the unwanted electromagnetic emission requirements of IEC 60945, Clause 9.

4.3.2 Immunity to electromagnetic environment

Components and circuits shall be designed to meet the Immunity to electromagnetic environment conditions of IEC 60945, Clause 10.

4.4 Cables

Network cables shall meet the electrical and minimum physical characteristics specified in the NMEA 2000 Main document.

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