

<b>STN</b>	<b>Priemyselné komunikačné siete. Špecifikácie prevádzkových zberníc. Časť 4-2: Špecifikácia protokolu údajovej vrstvy. Prvky typu 2.</b>	<b>STN EN 61158-4-2</b>  18 4020
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Industrial communication networks - Fieldbus specifications -Part 4-2: Data-link layer protocol specification - Type 2 elements

Táto norma obsahuje anglickú verziu európskej normy.  
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 03/15

Obsahuje: EN 61158-4-2:2014, IEC 61158-4-2:2014

Oznámením tejto normy sa od 19.09.2017 ruší  
STN EN 61158-4-2 (18 4020) z decembra 2012

**120266**

EUROPEAN STANDARD

**EN 61158-4-2**

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2014

ICS 25.040.40; 35.100.20; 35.110

Supersedes EN 61158-4-2:2012

English Version

**Industrial communication networks - Fieldbus specifications -Part  
4-2: Data-link layer protocol specification - Type 2 elements  
(IEC 61158-4-2:2014)**

Réseaux de communication industriels - Spécifications des  
bus de terrain - Partie 4-2: Spécification du protocole de la  
couche liaison de données - Eléments de type 2  
(CEI 61158-4-2:2014)

Industrielle Kommunikationsnetze - Feldbusse - Teil 4-2:  
Protokollspezifikation des Data Link Layer  
(Sicherheitsschicht) - Typ 2-Elemente  
(IEC 61158-4-2:2014)

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## Foreword

The text of document 65C/762/FDIS, future edition 3 of IEC 61158-4-2, prepared by SC 65C "Industrial networks" of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61158-4-2:2014.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-06-19
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2017-09-19

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In the official version, for bibliography, the following notes have to be added for the standards indicated:

IEC 61158-1:2014	NOTE	Harmonised as EN 61158-1:2014
IEC 61158-2:2014	NOTE	Harmonised as EN 61158-2:2014
IEC 61784-1:2014	NOTE	Harmonised as EN 61784-1:2014
IEC 61784-2:2014	NOTE	Harmonised as EN 61784-2:2014

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

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

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61131-3	-	Programmable controllers - Part 3: Programming languages	EN 61131-3	-
IEC 61158-3-2	2014	Industrial communication networks - Fieldbus specifications - Part 3-2: Data-link layer service definition - Type 2 elements	EN 61158-3-2	2014
IEC 61158-5-2	2014	Industrial communication networks - Fieldbus specifications -- Part 5-2: Application layer service definition - Type 2 elements	EN 61158-5-2	2014
IEC 61158-6-2	2014	Industrial communication networks - Fieldbus specifications - Part 6-2: Application layer protocol specification - Type 2 elements	EN 61158-6-2	2014
IEC 61588	2009	Precision clock synchronization protocol for networked measurement and control systems	-	-
IEC 61784-3-2	-	Industrial communication networks - Profiles Part 3-2: Functional safety fieldbuses - Additional specifications for CPF 2	EN 61784-3-2	-
IEC 62026-3	2008	Low-voltage switchgear and controlgear - Controller-device interfaces (CDIs) Part 3: DeviceNet	EN 62026-3	2009
ISO 11898	1993 <sup>1</sup>	Road vehicles - Interchange of digital information - Controller area network (CAN) for high-speed communication	-	-
ISO/IEC 3309	-	Information technology - Telecommunications and information exchange between systems - High-level data link control (HDLC) procedures - Frame structure	-	-
ISO/IEC 7498-1	-	Information technology - Open Systems Interconnection - Basic reference model: The basic model	-	-

<sup>1</sup> Superseded by ISO 11898-1:2003 and ISO 11898-8:2003

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO/IEC 7498-3	-	Information technology - Open Systems Interconnection - Basic reference model: Naming and addressing	-	-
ISO/IEC 8802-3	-	Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications	-	-
IEEE 802.1D	2004	IEEE Standard for local and metropolitan area networks - Media Access Control (MAC) Bridges	-	-
IEEE 802.1Q	2005 <sup>2)</sup>	IEEE Standard for Local and Metropolitan Area Networks - Virtual Bridged Local Area Networks	-	-
IEEE 802.3	2008	IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications	-	-

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<sup>2)</sup> Superseded by IEEE 802.1Q:2011



# INTERNATIONAL STANDARD

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**Industrial communication networks – Fieldbus specifications –  
Part 4-2: Data-link layer protocol specification – Type 2 elements**

**Réseaux de communication industriels – Spécifications des bus de terrain –  
Partie 4-2: Spécification du protocole de la couche liaison de données –  
Éléments de type 2**





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**Réseaux de communication industriels – Spécifications des bus de terrain –  
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de type 2**

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PRICE CODE **XH**  
CODE PRIX

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ICS 25.04€40; 35.100.20; 35.110

ISBN 978-2-8322-1720-7

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**INTERNATIONAL ELECTROTECHNICAL COMMISSION****INDUSTRIAL COMMUNICATION NETWORKS –  
FIELDBUS SPECIFICATIONS –****Part 4-2: Data-link layer protocol specification –  
Type 2 elements****FOREWORD**

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Attention is drawn to the fact that the use of the associated protocol type is restricted by its intellectual-property-right holders. In all cases, the commitment to limited release of intellectual-property-rights made by the holders of those rights permits a layer protocol type to be used with other layer protocols of the same type, or in other type combinations explicitly authorized by its intellectual-property-right holders.

NOTE Combinations of protocol types are specified in IEC 61784-1 and IEC 61784-2.

International Standard IEC 61158-4-2 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial process measurement, control and automation.

This third edition cancels and replaces the second edition published in 2010. This edition constitutes a technical revision.

The main changes with respect to the previous edition are listed below.

- Addition of conventions in 3.6
- Updates of ControlNet object in 7.2
- Addition of missing V/NV attribute characteristic in 7.5, 7.6, 7.7
- Extensions and clarifications of TCP/IP interface object in 7.5
- Extensions and clarifications of Ethernet Link object in 7.6
- Extensions and clarifications of CCO object in 7.8
- Extensions and updates of DLR object in 7.9
- Updates of QoS object in 7.10
- Addition of Port object in 7.11
- Updates to DL state machines in 8.1 and 9.2
- Extensions and updates of DLR protocol in Clause 10
- Update of indicator behaviour in A.2.2 and A.2.3
- Miscellaneous editorial corrections

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

FDIS	Report on voting
65C/762/FDIS	65C/772/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 ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61158 series, published under the general title *Industrial communication networks – Fieldbus specifications*, can be found on the IEC web site.

The committee has decided that the contents of this publication will remain unchanged until the stability 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.

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

This part of IEC 61158 is one of a series produced to facilitate the interconnection of automation system components. It is related to other standards in the set as defined by the “three-layer” fieldbus reference model described in IEC 61158-1.

The data-link protocol provides the data-link service by making use of the services available from the physical layer. The primary aim of this standard is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer data-link entities (DLEs) at the time of communication. These rules for communication are intended to provide a sound basis for development in order to serve a variety of purposes:

- a) as a guide for implementers and designers;
- b) for use in the testing and procurement of equipment;
- c) as part of an agreement for the admittance of systems into the open systems environment;
- d) as a refinement to the understanding of time-critical communications within OSI.

This standard is concerned, in particular, with the communication and interworking of sensors, effectors and other automation devices. By using this standard together with other standards positioned within the OSI or fieldbus reference models, otherwise incompatible systems may work together in any combination.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents given in several subclauses as indicated in the table below. These patents are held by their respective inventors under license to ODVA, Inc:

US 5,400,331	[ODVA]	Communication network interface with screeners for incoming messages	Subclause 3.4, Clauses 4 to 9
US 5,471,461	[ODVA]	Digital communication network with a moderator station election process	
US 5,491,531	[ODVA]	Media access controller with a shared class message delivery capability	
US 5,493,571	[ODVA]	Apparatus and method for digital communications with improved delimiter detection	
US 5,537,549	[ODVA]	Communication network with time coordinated station activity by time slot and periodic interval number	
US 5,553,095	[ODVA]	Method and apparatus for exchanging different classes of data during different time intervals	
US 8,244,838	[ODVA]	Industrial controller employing the network ring topology	Clause 10

IEC takes no position concerning the evidence, validity and scope of these patent rights.

ODVA and the holders of these patent rights have assured the IEC that ODVA is willing to negotiate licences either free of charge or under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of ODVA and the holders of these patent rights is registered with IEC. Information may be obtained from:

[ODVA] ODVA, Inc.  
2370 East Stadium Boulevard #1000  
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Attention: Office of the Executive Director  
e-mail: [odva@odva.org](mailto:odva@odva.org)

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. IEC shall not be held responsible for identifying any or all such patent rights.

ISO ([www.iso.org/patents](http://www.iso.org/patents)) and IEC (<http://patents.iec.ch>) maintain on-line databases of patents relevant to their standards. Users are encouraged to consult the databases for the most up to date information concerning patents.

## **INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –**

### **Part 4-2: Data-link layer protocol specification – Type 2 elements**

#### **1 Scope**

##### **1.1 General**

The data-link layer provides basic time-critical messaging communications between devices in an automation environment.

This protocol provides communication opportunities to all participating data-link entities, sequentially and in a cyclic synchronous manner. Foreground scheduled access is available for time-critical activities together with background unscheduled access for less critical activities.

Deterministic and synchronized transfers can be provided at cyclic intervals up to 1 ms and device separations of 25 km. This performance is adjustable dynamically and on-line by re-configuring the parameters of the local link whilst normal operation continues. By similar means, DL connections and new devices may be added or removed during normal operation.

This protocol provides means to maintain clock synchronization across an extended link with a precision better than 10 µs.

This protocol optimizes each access opportunity by concatenating multiple DLSDUs and associated DLPCI into a single DLPDU, thereby improving data transfer efficiency for data-link entities that actively source multiple streams of data.

The maximum system size is an unlimited number of links of 99 nodes, each with 255 DLSAP-addresses. Each link has a maximum of  $2^{24}$  related peer and publisher DLCEPs.

##### **1.2 Specifications**

This standard specifies

- a) procedures for the timely transfer of data and control information from one data-link user entity to a peer user entity, and among the data-link entities forming the distributed data-link service provider;
- b) the structure of the fieldbus DLPDUs used for the transfer of data and control information by the protocol of this standard, and their representation as physical interface data units.

##### **1.3 Procedures**

The procedures are defined in terms of

- a) the interactions between peer DL-entities (DLEs) through the exchange of fieldbus DLPDUs;
- b) the interactions between a DL-service (DLS) provider and a DLS-user in the same system through the exchange of DLS primitives;
- c) the interactions between a DLS-provider and a Ph-service provider in the same system through the exchange of Ph-service primitives.

## 1.4 Applicability

These procedures are applicable to instances of communication between systems which support time-critical communications services within the data-link layer of the OSI or fieldbus reference models, and which require the ability to interconnect in an open systems interconnection environment.

Profiles provide a simple multi-attribute means of summarizing an implementation's capabilities, and thus its applicability to various time-critical communications needs.

## 1.5 Conformance

This standard also specifies conformance requirements for systems implementing these procedures. This standard does not contain tests to demonstrate compliance with such requirements.

## 2 Normative references

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

NOTE All parts of the IEC 61158 series, as well as IEC 61784-1 and IEC 61784-2 are maintained simultaneously. Cross-references to these documents within the text therefore refer to the editions as dated in this list of normative references.

IEC 61131-3, *Programmable controllers – Part 3: Programming languages*

IEC 61158-3-2:2014, *Industrial communication networks – Fieldbus specifications – Part 3-2: Data-link layer service definition – Type 2 elements*

IEC 61158-5-2:2014, *Industrial communication networks – Fieldbus specifications – Part 5-2: Application layer service definition – Type 2 elements*

IEC 61158-6-2:2014, *Industrial communication networks – Fieldbus specifications – Part 6-2: Application layer protocol specification – Type 2 elements*

IEC 61588:2009, *Precision clock synchronization protocol for networked measurement and control systems*

IEC 61784-3-2, *Industrial communication networks – Profiles – Part 3-2: Functional safety fieldbuses – Additional specifications for CPF 2*

IEC 62026-3:2008, *Low-voltage switchgear and controlgear – Controller-device interfaces (CDIs) – Part 3: DeviceNet*

ISO/IEC 3309<sup>1</sup>, *Information technology – Telecommunications and information exchange between systems – High-level data link control (HDLC) procedures – Frame structure*

ISO/IEC 7498-1, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*

ISO/IEC 7498-3, *Information technology – Open Systems Interconnection – Basic Reference Model: Naming and addressing*

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<sup>1</sup> This standard has been withdrawn.

ISO/IEC 8802-3, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

ISO 11898:1993<sup>2</sup>, *Road vehicles – Interchange of digital information – Controller area network (CAN) for high-speed communication*

IEEE 802.1D-2004, *IEEE standard for local and metropolitan area networks – Media Access Control (MAC) bridges*, available at <<http://www.ieee.org>>

IEEE 802.1Q-2005<sup>2</sup>, *IEEE standard for local and metropolitan area networks – Virtual bridged local area networks*, available at <<http://www.ieee.org>>

IEEE 802.3-2008, *IEEE Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications*, available at <<http://www.ieee.org>>

IETF RFC 951, *Bootstrap Protocol (BOOTP)*, available at <<http://www.ietf.org>>

IETF RFC 1213, *Management Information Base for Network Management of TCP/IP-based internets: MIB-II*, available at <<http://www.ietf.org>>

IETF RFC 1542, *Clarifications and Extensions for the Bootstrap Protocol*, available at <<http://www.ietf.org>>

IETF RFC 1643, *Definitions of Managed Objects for the Ethernet-like Interface Types*, available at <<http://www.ietf.org>>

IETF RFC 2131, *Dynamic Host Configuration Protocol*, available at <<http://www.ietf.org>>

IETF RFC 2132, *DHCP Options and BOOTP Vendor Extensions*, available at <<http://www.ietf.org>>

IETF RFC 4541, *Considerations for Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) Snooping Switches*, available at <<http://www.ietf.org>>

IETF RFC 5227:2008, *IPv4 Address Conflict Detection*, available at <<http://www.ietf.org>>

**koniec náhľadu – text ďalej pokračuje v platenej verzii STN**

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<sup>2</sup> A newer edition of this standard has been published, but only the cited edition applies.