BS EN IEC 61158-4-2:2023

BSI Standards Publication

# Industrial communication networks — Fieldbus specifications

Part 4-2: Data-link layer protocol specification — Type 2 elements

bsi.

# National foreword

This British Standard is the UK implementation of EN IEC 61158-4-2:2023. It is identical to IEC 61158-4-2:2023. It supersedes BS EN IEC 61158-4-2:2019, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/65, Measurement and control.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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EUROPEAN STANDARD

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# EN IEC 61158-4-2

April 2023

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Supersedes EN IEC 61158-4-2:2019

English Version

# Industrial communication networks - Fieldbus specifications - Part 4-2: Data-link layer protocol specification - Type 2 elements (IEC 61158-4-2:2023)

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 (IEC 61158-4-2:2023)

Industrielle Kommunikationsnetze - Feldbusse – Teil 4-2: Protokollspezifikation des Data Link Layer (Sicherungsschicht) - Typ 2-Elemente (IEC 61158-4-2:2023)

This European Standard was approved by CENELEC on 2023-04-13. 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.

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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 CEN-CENELEC Management Centre has the same status as the official versions.

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

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

# European foreword

The text of document 65C/1202/FDIS, future edition 5 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 IEC 61158-4-2:2023.

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) | 2024-01-13 |
| • latest date by which the national standards conflicting with the document have to be withdrawn | (dow) | 2026-04-13 |

This document supersedes EN IEC 61158-4-2:2019 and all of its amendments and corrigenda (if any).

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

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

## Endorsement notice

The text of the International Standard IEC 61158-4-2:2023 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

| | |
|---|---|
| IEC 61131-9 | NOTE Approved as EN IEC 61131-9 |
| IEC 61158-1 | NOTE Approved as EN IEC 61158-1 |
| IEC 61158-2 | NOTE Approved as EN 61158-2 |
| IEC 61784-1 (series) | NOTE Approved as EN IEC 61784-1 (series)[1] |
| IEC 61784-2 (series) | NOTE Approved as EN IEC 61784-2 (series)[2] |

[1] To be published. Stage at the time of publication: FprEN IEC 61784-1-X:2023.

[2] To be published. Stage at the time of publication: FprEN IEC 61784-2-X:2023.

# Annex ZA
(normative)

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

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE 1 Where 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.cencenelec.eu.

| Publication | Year | Title | EN/HD | Year |
|---|---|---|---|---|
| IEC 61131-3 | - | Programmable controllers - Part 3: Programming languages | EN 61131-3 | - |
| IEC 61158-3-2 | 2023 | Industrial communication networks - Fieldbus specifications - Part 3-2: Data-link layer service definition - Type 2 elements | EN IEC 61158-3-2 | 2023 |
| IEC 61158-5-2 | 2023 | Industrial communication networks - Fieldbus specifications - Part 5-2: Application layer service definition - Type 2 elements | EN IEC 61158-5-2 | —[3] |
| IEC 61158-6-2 | 2023 | Industrial communication networks - Fieldbus specifications - Part 6-2: Application layer protocol specification - Type 2 elements | EN IEC 61158-6-2 | —[4] |
| IEC 61588 | - | 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 IEC 61784-3-2 | - |
| IEC 62026-3 | 2014 | Low-voltage switchgear and controlgear - Controller-device interfaces (CDIs) - Part 3: DeviceNet | EN 62026-3 | 2015 |
| IEC 62439-3 | 2016 | Industrial communication networks - High availability automation networks - Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR) | EN IEC 62439-3 | 2018 |

[3] Under preparation. Stage at time of publication: prEN IEC 61158-5-2:2023.

[4] Under preparation. Stage at time of publication: prEN IEC 61158-6-2:2023.

| | | | | |
|---|---|---|---|---|
| ISO/IEC 13239 | - | Information technology - Telecommunications and information exchange between systems - High-level data link control (HDLC) procedures | - | - |
| 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 | - | - |
| ISO/IEC/IEEE 8802-3 | - | Telecommunications and exchange between information technology systems - Requirements for local and metropolitan area networks - Part 3: Standard for Ethernet | - | - |
| ISO 11898-1 | 2015 | Road vehicles - Controller area network (CAN) - Part 1: Data link layer and physical signalling | - | - |
| IEEE Std 802.1AB | 2016 | IEEE Standard for Local and metropolitan area networks: Station and Media Access Control Connectivity Discovery | - | - |
| IEEE Std 802.1ABcu | 2021 | Standard for Local and metropolitan area networks - Station and Media Access Control Connectivity Discovery Amendment: YANG Data Model | - | - |
| IEEE Std 802.1Q | 2018 | IEEE Standard for local and metropolitan area networks - Bridges and bridged networks | - | - |
| IEEE Std 802.3 | 2018 | IEEE Standard for Ethernet | - | - |
| IETF RFC 951 | 1985 | Bootstrap Protocol (BOOTP) | - | - |
| IETF RFC 1213 | 1991 | Management Information Base for Network Management of TCP/IP-based Internets: MIB-II | - | - |
| IETF RFC 1542 | 1993 | Clarifications and Extensions for the Bootstrap Protocol | - | - |
| IETF RFC 1643 | 1994 | Definitions of Managed Objects for the Ethernet-like interface types | - | - |
| IETF RFC 2131 | 1997 | Dynamic Host Configuration Protocol | - | - |
| IETF RFC 2132 | 1997 | DHCP Options and BOOTP Vendor Extensions | - | - |
| IETF RFC 2863 | 2000 | The Interfaces Group MIB | - | - |
| IETF RFC 3418 | 2002 | Management Information Base (MIB) for the Simple Network Management Protocol (SNMP) | - | - |
| IETF RFC 3635 | 2003 | Definitions of Managed Objects for the Ethernet-like Interface Types | - | - |
| IETF RFC 4541 | 2006 | Considerations for Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) Snooping Switches | - | - |

| | | | | |
|---|---|---|---|---|
| IETF RFC 5227 | 2008 | IPv4 Address Conflict Detection | - | - |

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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# INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

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

## 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.
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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 the IEC 61784-1 series and the IEC 61784-2 series.

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

This fifth edition cancels and replaces the fourth edition published in 2019. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) update of normative and bibliographic references;
b) use of more inclusive terminology ("master" and "slave" replaced, mainly in 7.3 and 7.7;
c) new STIME, UTIME, NTIME, STRINGI and EPATH data types in 6.1.3;
d) updates, addition of diagnostics connection points and new service for TCP/IP interface object in 7.5;
e) addition of diagnostics connection points and new service for Ethernet Link object in 7.6;
f) update of Get/Set_Attributes_All parameters for the Connection Configuration object in 7.8;
g) addition of diagnostics connection points and new service for DLR object in 7.9;
h) extensions and clarifications of Port object in 7.11;
i) addition of diagnostics connection points and new service for PRP/HSR Protocol object in 7.12;
j) addition of LLDP Management and LLDP Data Table objects in 7.1, 7.14 and 7.15;
k) addition of LLDP protocol support in Clause 12;
l) addition of a combined module/network indicator in A.2.4.5;
m) removal of all references to CPF and CPs (material moved to profile documents);
n) miscellaneous editorial corrections.

The text of this International Standard is based on the following documents:

| Draft | Report on voting |
|---|---|
| 65C/1202/FDIS | 65C/1243/RVD |

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

**IMPORTANT – The "colour inside" logo on the cover page of this document 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 document 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 document is concerned, in particular, with the communication and interworking of sensors, effectors and other automation devices. By using this document together with other standards positioned within the OSI or fieldbus reference models, otherwise incompatible systems could 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. IEC takes no position concerning the evidence, validity, and scope of these patent rights.

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# 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 part of IEC 61158 specifies a main protocol with the following characteristics.

- 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 can 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.

This document specifies additional lower layers protocols or implementations of additional lower layers protocols for use in combination with ISO/IEC/IEEE 8802-3.

This document specifies a set of corresponding objects providing a consistent management interface to the lower layers.

### 1.2 Specifications

This document 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 document, 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 capabilities of an implementation, and thus its applicability to various time-critical communications needs.

### 1.5 Conformance

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

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE All parts of the IEC 61158 series, as well as the IEC 61784-1 series and the IEC 61784-2 series 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 61158-3-2:2023, *Industrial communication networks – Fieldbus specifications – Part 3-2: Data-link layer service definition – Type 2 elements*

IEC 61158-5-2:2023, *Industrial communication networks – Fieldbus specifications – Part 5-2: Application layer service definition – Type 2 elements*

IEC 61158-6-2:2023, *Industrial communication networks – Fieldbus specifications – Part 6-2: Application layer protocol specification – Type 2 elements*

IEC 61588, *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 62026-3:2014, *Low-voltage switchgear and controlgear – Controller-device interfaces (CDIs) – Part 3: DeviceNet*

IEC 62439-3:2016[1], *Industrial communication networks – High availability automation networks – Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR)*

[1] A newer edition of this standard has been published, but only the cited edition applies.