IEC 61158-4-12

Edition 3.0 2014-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Industrial communication networks – Fieldbus specifications – Part 4-12: Data-link layer protocol specification – Type 12 elements

Réseaux de communication industriels – Spécifications des bus de terrain – Partie 4-12: Spécification du protocole de la couche liaison de données – Éléments de type 12

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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 IEC 61784-1 and IEC 61784-2.

International Standard IEC 61158-4-12 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:

- bug fixes and
- editorial improvements.

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 the ISO/IEC Directives, Part 2.

A list of all the 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.

NTRODUCTION

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 61158-1:2013.

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 implementors 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.

NOTE Use of some of the associated protocol types is restricted by their 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 particular data-link layer protocol type to be used with physical layer and application layer protocols in Type combinations as specified explicitly in the profile parts. Use of the various protocol types in other combinations may require permission from their respective intellectual-property-right holders.

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 concerning Type 12 elements and possibly other types given as follows:

EP 1 590 927 B1	[BE]	Koppler für ein Netzwerk mit Ringtopologie und ein auf Ethernet basierten Netzwerk
EP 1 789 857 B1	[BE]	Datenübertragungsverfahren und automatisierungssystem zum Einsatz eines solchen Datenübertragungsverfahrens
DE 102007017835.4	[BE]	Paketvermittlungsvorrichtung und lokales Kommunikationsnetz mit einer solchen Paketvermittlungsvorrichtung
EP 1 456 722 B1	[BE]	Datenübertragungsverfahren, serielles Bussystem und Anschalteinheit für einen passiven Busteilnehmer

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[BE]: Beckhoff Automation GmbH
Eiserstraße 5
33415 Verl,
Germany

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4-12: Data-link layer protocol specification – Type 12 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

a) in a synchronously-starting cyclic manner, and

b) in a cyclic or acyclic asynchronous manner, as requested each cycle by each of those data-link entities.

Thus this protocol can be characterized as one which provides cyclic and acyclic access asynchronously but with a synchronous restart of each cycle.

1.2 Specifications

This standard specifies

a) procedures for the transfer of data and control information from one data-link user entity to one or more user entity;

b) the structure of the 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 DL-entities (DLEs) through the exchange of 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 the MAC services of ISO/IEC 8802-3.

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 reference model, 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 part of 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 61158-3-12, *Industrial communication networks – Fieldbus specifications – Part 3-12: Data-link layer service definition – Type 12 elements*

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

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 8802-3:2000, *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/IEC 9899, *Information technology – Programming Languages – C*

ISO/IEC 10731, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services*

IEEE 802.1Q, *IEEE Standard for Local and metropolitan Area Networks – Virtual Bridged Local Area Networks*, available at <http://www.ieee.org>

IETF RFC 768, *User Datagram Protocol (UDP)*, available at <http://www.ietf.org>

IETF RFC 791, *Internet protocol DARPA internet program protocol specification*, available at <http://www.ietf.org>

3 Terms, definitions, symbols, abbreviations and conventions

For the purposes of this document, the following terms, definitions, symbols, abbreviations and conventions apply.

3.1 Reference model terms and definitions

This standard is based in part on the concepts developed in ISO/IEC 7498-1 and ISO/IEC 7498-3, and makes use of the following terms defined therein.

3.1.1 DL-duplex-transmission [ISO/IEC 7498-1]

3.1.2 DL-protocol [ISO/IEC 7498-1]

3.1.3 DL-protocol-data-unit [ISO/IEC 7498-1]

3.1.4 **(N)-entity** [ISO/IEC 7498-1]
DL-entity
Ph-entity

3.1.5 **(N)-interface-data-unit** [ISO/IEC 7498-1]
DL-service-data-unit (N=2)
Ph-interface-data-unit (N=1)

3.1.6 **(N)-layer** [ISO/IEC 7498-1]
DL-layer (N=2)
Ph-layer (N=1)

3.1.7 **(N)-service** [ISO/IEC 7498-1]
DL-service (N=2)
Ph-service (N=1)

3.1.8 **(N)-service-access-point** [ISO/IEC 7498-1]
DL-service-access-point (N=2)
Ph-service-access-point (N=1)

3.1.9 **(N)-service-access-point-address** [ISO/IEC 7498-1]
DL-service-access-point-address (N=2)
Ph-service-access-point-address (N=1)

3.1.10 **peer-entities** [ISO/IEC 7498-1]

3.1.11 **Ph-interface-data** [ISO/IEC 7498-1]

3.1.12 **primitive name** [ISO/IEC 7498-3]

3.1.13 **reassembling** [ISO/IEC 7498-1]

3.1.14 **recombining** [ISO/IEC 7498-1]

3.1.15 **reset** [ISO/IEC 7498-1]

3.1.16 **routing** [ISO/IEC 7498-1]

3.1.17 **segmenting** [ISO/IEC 7498-1]

3.1.18 **sequencing** [ISO/IEC 7498-1]

3.1.19 **splitting** [ISO/IEC 7498-1]

3.1.20 **systems-management** [ISO/IEC 7498-1]

3.2 Service convention terms and definitions

This standard also makes use of the following terms defined in ISO/IEC 10731 as they apply to the data-link layer:

3.2.1 **asymmetrical service**

3.2.2 **confirm (primitive);**
requestor.deliver (primitive)

3.2.3 **deliver (primitive)**

3.2.4 **DL-service-primitive;**
primitive

3.2.5 **DL-service-provider**

3.2.6 **DL-service-user**