BS EN 61158-4-14:2014

BSI Standards Publication

Industrial communication networks — Fieldbus specifications

Part 4-14: Data-link layer protocol specification — Type 14 elements

bsi.

...making excellence a habit.™

Document Sharing Hub

Full document details: BS EN 61158-4-14:2014

National foreword

This British Standard is the UK implementation of EN 61158-4-14:2014. It is identical to IEC 61158-4-14:2014. It supersedes BS EN 61158-4-14:2012 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AMT/7, Industrial communications: process measurement and control, including fieldbus.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2014.

Published by BSI Standards Limited 2014

ISBN 978 0 580 79446 9

ICS 25.040.40; 35.100.20; 35.110

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2014.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS EN 61158-4-14:2014

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61158-4-14

October 2014

ICS 25.040.40; 35.100.20; 35.110

Supersedes EN 61158-4-14:2012

English Version

Industrial communication networks - Fieldbus specifications - Part 4-14: Data-link layer protocol specification - Type 14 elements (IEC 61158-4-14:2014)

Réseaux de communication industriels - Spécifications des bus de terrain - Partie 4-14: Spécification du protocole de la couche liaison de données - Eléments de type 14 (CEI 61158-4-14:2014)

Industrielle Kommunikationsnetze - Feldbusse - Teil 4-14: Protokollspezifikation des Data Link Layer (Sicherungsschicht) - Typ 14-Elemente (IEC 61158-4-14:2014)

This European Standard was approved by CENELEC on 2014-09-19. 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.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

© 2014 CENELEC All rights of exploitation in any form and by any means reserved worldwide for CENELEC Members.

Ref. No. EN 61158-4-14:2014 E

AVA Documents Document Sharing Hub

Full document details: BS EN 61158-4-14:2014

Foreword

The text of document 65C/762/FDIS, future edition 3 of IEC 61158-4-14, 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 61158-4-14:2014.

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

This document supersedes EN 61158-4-14 :2012.

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

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

Endorsement notice

The text of the International Standard IEC 61158-4-14:2014 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 standards indicated:

IEC 61158-3-14	NOTE	Harmonised as EN 61158-3-14
IEC 61158-6-14	NOTE	Harmonised as EN 61158-6-14
IEC 61784-1	NOTE	Harmonised as EN 61784-1
IEC 61784-2	NOTE	Harmonised as EN 61784-2

Documents
Document Sharing Hub
Full document details: BS EN 61158-4-14:2014

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.

Publication	Year	Title	EN/HD	Year
IEC 61158-1	-	Industrial communication networks - Fieldbus specifications Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series	EN 61158-1	-
IEC 61158-5-14	-	Industrial communication networks - Fieldbus specifications Part 5-14: Application layer service definition - Type 14 elements	EN 61158-5-14	-
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	-	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 10731	-	Information technology - Open Systems Interconnection - Basic Reference Model - Conventions for the definition of OSI services	-	-
IETF RFC 768	-	User Datagram Protocol	-	-
IETF RFC 791	-	Internet Protocol - DARPA Internet Program Protocol Specification	-	-
IETF RFC 793	-	Transmission Control Protocol - DARPA Internet Program Protocol Specification	-	-

AVA Documents
Document Sharing Hub
Full document details: BS EN 61158-4-14:2014

CONTENTS

INTRODUCTION 6
1 Scope 8
1.1 General 8
1.2 Specifications 8
1.3 Procedures 8
1.4 Applicability 9
1.5 Conformance 9
2 Normative references 9
3 Terms, definitions, symbols and abbreviations 9
3.1 Reference model terms and definitions 10
3.2 Service convention terms and definitions 12
3.3 ISO/IEC 8802-3 terms 12
3.4 Common terms and definitions 13
3.5 Symbols and abbreviations 16
4 Overview of the DL-protocol 17
4.1 General 17
4.2 Services provided by the DL 18
4.3 Structure of deterministic communication scheduling 19
5 Procedure of deterministic communication scheduling 21
5.1 Overview 21
5.2 State transitions 21
5.3 State table 23
5.4 Function descriptions 24
6 Structure and encoding of ECSME PDU 27
6.1 ECSME PDU structure 27
6.2 Encoding of ECSME packet 30
Bibliography 33

Figure 1 – Relationships of DLSAPs, DLSAP-addresses and group DL-addresses 14
Figure 2 – Communication model 17
Figure 3 – Type 14 packet identifier 19
Figure 4 – Time-sharing communication scheduling 20
Figure 5 – State transitions of ECSME 21
Figure 6 – Format of NonPeriodicDataAnnunciation PDU 27
Figure 7 – Format of EndofNonPeriodicDataSending PDU 28
Figure 8 – Format of Type 14 PDU 29
Figure 9 – Format of Type 14 PDU for FRT application 29

Table 1 – ECSME state transitions 23
Table 2 – PeriodicDataSendingSuc() description 24
Table 3 – NonperiodicDataAnnunciation() description 24
Table 4 – PeriodicDataSending() description 25

Documents
Document Sharing Hub
Full document details: BS EN 61158-4-14:2014

Table 5 – NonperiodicDataSendingSuc() description 25
Table 6 – FirstNonperiodicDataSending() description 25
Table 7 – NonperiodicDataPriority() description 25
Table 8 – NonperiodicDataTimeEnough() description 26
Table 9 – NonperiodicDataSending() description 26
Table 10 – EndOfNonperiodicDataSending() description 26
Table 11 – IsDeviceConfigured() description 26
Table 12 – CountOffsetTime() description 27
Table 13 – DataSendingTiming() description 27
Table 14 – RecEndofNonPeriodicDataSending() description 27
Table 15 – NonPeriodicDataAnnunciation message encoding 30
Table 16 – EndofNonPeriodicDataSending message encoding 30
Table 17 – Type 14 DL-management Tag encoding 31
Table 18 – Type 14 message encoding 31
Table 19 – Type 14 message for FRT application encoding 32

Documents
Document Sharing Hub
Full document details: BS EN 61158-4-14:2014

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 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 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 a patent concerning Type 14 elements and possibly other types given in Clause 5 as follows:

ZL 200410088676.7 [SPT] Scheduling method with deterministic communication based on Ethernet

ZL 03142040.0 [SPT] A scheduling method for deterministic communication based on Ethernet

ZL 200810171872.9 [SPG] [ZJU] The communication method and equipment used in the Ethernet

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

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

[SPT] Zhejiang SUPCON Technology Co., Ltd.
Dongqin FENG Jian CHU
Liuhe Road 309, Bingjiang District,
Hangzhou, Zhejiang, 310053
China

[SPG] Zhejiang SUPCON Group Co., Ltd.
Dongqin FENG Jian CHU
Liuhe Road 309, Bingjiang District,
Hangzhou, Zhejiang, 310053
China

Documents
Document Sharing Hub
Full document details: BS EN 61158-4-14:2014

[ZJU] Zhejiang University
Dongqin FENG Jian CHU
Zheda Road 38,
Hangzhou, Zhejiang,310027
China

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) 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.

Documents
Document Sharing Hub
Full document details: BS EN 61158-4-14:2014

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4-14: Data-link layer protocol specification – Type 14 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, according to a pre-established schedule, 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 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) procedures for giving communications opportunities to all participating DL-entities, sequentially and in a cyclic manner for deterministic and synchronized transfer at cyclic intervals;

c) procedures for giving communication opportunities available for time-critical data transmission together with non-time-critical data transmission without prejudice to the time-critical data transmission;

d) procedures for giving cyclic and acyclic communication opportunities for time-critical data transmission with prioritized access;

e) procedures for giving communication opportunities based on standard ISO/ IEC 8802-3 medium access control, with provisions for nodes to be added or removed during normal operation;

f) 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.

Documents
Document Sharing Hub
Full document details: BS EN 61158-4-14:2014

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 61158-1, *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-5-14, *Industrial communication networks – Fieldbus specifications – Part 5-14: Application layer service definition – Type 14 elements*

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

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

RFC 791, *Internet protocol,* available at <http://www.ietf.org>

RFC 793, *Transmission Control Protocol*, available at <http://www.ietf.org>

3 Terms, definitions, symbols and abbreviations

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

AVA Documents
Document Sharing Hub

Full document details: BS EN 61158-4-14:2014

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 called-DL-address [ISO/IEC 7498-3]

3.1.2 calling-DL-address [ISO/IEC 7498-3]

3.1.3 centralized multi-end-point-connection [ISO/IEC 7498-1]

3.1.4 correspondent (N)-entities [ISO/IEC 7498-1]
correspondent DL-entities (N=2)
correspondent Ph-entities (N=1)

3.1.5 demultiplexing [ISO/IEC 7498-1]

3.1.6 DL-address [ISO/IEC 7498-3]

3.1.7 DL-address-mapping [ISO/IEC 7498-1]

3.1.8 DL-connection [ISO/IEC 7498-1]

3.1.9 DL-connection-end-point [ISO/IEC 7498-1]

3.1.10 DL-connection-end-point-identifier [ISO/IEC 7498-1]

3.1.11 DL-connection-mode transmission [ISO/IEC 7498-1]

3.1.12 DL-connectionless-mode transmission [ISO/IEC 7498-1]

3.1.13 DL-data-sink [ISO/IEC 7498-1]

3.1.14 DL-data-source [ISO/IEC 7498-1]

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

3.1.16 DL-facility [ISO/IEC 7498-1]

3.1.17 DL-local-view [ISO/IEC 7498-3]

3.1.18 DL-name [ISO/IEC 7498-3]

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

3.1.20 DL-protocol-connection-identifier [ISO/IEC 7498-1]

3.1.21 DL-protocol-control-information [ISO/IEC 7498-1]

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

3.1.23 DL-protocol-version-identifier [ISO/IEC 7498-1]

3.1.24 DL-relay [ISO/IEC 7498-1]

3.1.25 DL-service-connection-identifier [ISO/IEC 7498-1]

3.1.26 DL-service-data-unit [ISO/IEC 7498-1]

3.1.27 DL-simplex-transmission [ISO/IEC 7498-1]

3.1.28 DL-subsystem [ISO/IEC 7498-1]

3.1.29 DL-user-data [ISO/IEC 7498-1]

AVA Documents
Document Sharing Hub

Full document details: BS EN 61158-4-14:2014