

© Copyright SEK Svensk Elstandard. Reproduction in any form without permission is prohibited.

Industriell processtyrning – Fältbuss – Del 6-12: Specifikation av protokoll i applikationsskiktet – Delar i fältbuss, Typ 12

*Industrial communication networks –
Fieldbus specifications –
Part 6-12: Application layer protocol specification –
Type 12 elements*

Som svensk standard gäller europastandarden EN IEC 61158-6-12:2019. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 61158-6-12:2019.

Nationellt förord

Europastandarden EN IEC 61158-6-12:2019

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 61158-6-12, Fourth edition, 2019 - Industrial communication networks - Fieldbus specifications - Part 6-12: Application layer protocol specification - Type 12 elements**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 61158-6-12, utgåva 3, 2015, gäller ej fr o m 2022-07-25.

Standarder underlättar utvecklingen och höjer elsäkerheten

Det finns många fördelar med att ha gemensamma tekniska regler för bl a mätning, säkerhet och provning och för utförande, skötsel och dokumentation av elprodukter och elanläggningar.

Genom att utforma sådana standarder blir säkerhetsfordringar tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

SEK är Sveriges röst i standardiseringsarbetet inom elområdet

SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

Stora delar av arbetet sker internationellt

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

Var med och påverka!

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

SEK Svensk Elstandard

Box 1284
164 29 Kista
Tel 08-444 14 00
www.elstandard.se

English Version

Industrial communication networks - Fieldbus specifications -
Part 6-12: Application layer protocol specification - Type 12
elements
(IEC 61158-6-12:2019)

Réseaux de communication industriels - Spécifications des
bus de terrain - Partie 6-12: Spécification du protocole de la
couche application - Eléments de type 12
(IEC 61158-6-12:2019)

Industrielle Kommunikationsnetze - Feldbusse - Teil 6-12:
Protokollspezifikation des Application Layer
(Anwendungsschicht) - Typ 12-Elemente
(IEC 61158-6-12:2019)

This European Standard was approved by CENELEC on 2019-07-25. 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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, 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: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 65C/948/FDIS, future edition 4 of IEC 61158-6-12, 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 61158-6-12:2019.

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) 2020-04-25
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-07-25

This document supersedes EN 61158-6-12:2014 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.

Endorsement notice

The text of the International Standard IEC 61158-6-12:2019 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 61131-3	NOTE Harmonized as EN 61131-3
IEC 61158-1:2019	NOTE Harmonized as EN IEC 61158-1:2019 (not modified)
IEC 61158-4-12	NOTE Harmonized as EN IEC 61158-4-12
IEC 61784-1	NOTE Harmonized as EN IEC 61784-1
IEC 61784-2	NOTE Harmonized as EN IEC 61784-2

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.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61158-3-12	-	Industrial communication networks - Fieldbus specifications - Part 3-12: Data- link layer service definition - Type 12 elements	-EN IEC 61158-3-12 -	
IEC 61158-5-12	-	Industrial communication networks - Fieldbus specifications - Part 5-12: Application layer service definition - Type 12 elements	-EN IEC 61158-5-12 -	
IEC 61158-6	series	Industrial communication networks -- Fieldbus specifications - Part 6: Application layer protocol specification	--	-
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 9545	-	Information technology - Open Systems- Interconnection - Application layer structure		-
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 Std 802.1D	-	IEEE standard for Local and metropolitan area networks – Common specifications – Media access control (MAC) Bridges		-
IEEE Std 802.1Q	-	IEEE standard for Local and metropolitan area networks – Bridges and Bridged Networks		-
IETF RFC 768	-	User Datagram Protocol	-	-
IETF RFC 791	-	Internet protocol darpa internet program- protocol specification		-

EN IEC 61158-6-12:2019 (E)

IETF RFC 826	-	Ethernet Address Resolution Protocol: Or- Converting Network Protocol Addresses to 48.bit Ethernet Address for Transmission on Ethernet Hardware	-
ISO/IEC/IEEE 60559	-	Information technology - Microprocessor- Systems - Floating-Point arithmetic	-
ISO/IEC/IEEE 8802-- 3	-	Standard for Ethernet	-

CONTENTS

FOREWORD.....	8
INTRODUCTION.....	10
1 Scope.....	11
1.1 General.....	11
1.2 Specifications	12
1.3 Conformance	12
2 Normative references	12
3 Terms, definitions, symbols, abbreviations and conventions	13
3.1 Reference model terms and definitions	13
3.2 Service convention terms and definitions	14
3.3 Application layer definitions	14
3.4 Common symbols and abbreviations	19
3.5 Additional symbols and abbreviations	20
3.6 Conventions.....	20
3.6.1 General concept	20
3.6.2 Convention for the encoding of reserved bits and octets	21
3.6.3 Conventions for the common codings of specific field octets	21
3.6.4 Abstract syntax conventions	22
3.6.5 State machine conventions	23
4 Application layer protocol specification	25
4.1 Operating principle.....	25
4.2 Node reference model.....	25
4.2.1 Mapping onto OSI basic reference model.....	25
4.2.2 Data Link Layer features.....	26
4.2.3 Application Layer structure	26
5 FAL syntax description	27
5.1 Coding principles	27
5.2 Data types and encoding rules.....	27
5.2.1 General description of data types and encoding rules	27
5.2.2 Encoding of a Boolean value	27
5.2.3 Encoding of a Time Of Day with and without date indication value	27
5.2.4 Encoding of a Time Difference with and without date indication value.....	28
5.2.5 Transfer syntax for bit sequences	28
5.2.6 Encoding of a Unsigned Integer value.....	28
5.2.7 Encoding of a Signed Integer value	29
5.2.8 Encoding of a Floating Point value.....	30
5.2.9 Encoding of a Visible String value.....	30
5.2.10 Encoding of a Unicode String value	30
5.2.11 Encoding of an Octet String value.....	30
5.2.12 Encoding of GUID.....	30
5.3 AR coding	30
5.3.1 AL Control Request (Indication)	30
5.3.2 AL Control Response (Confirmation).....	31
5.3.3 AL State Changed	33
5.3.4 AL AR Attributes	34
5.4 SII coding	36

5.5	Isochronous PDI coding	41
5.6	CoE coding	43
5.6.1	PDU structure	43
5.6.2	SDO	44
5.6.3	SDO Information	56
5.6.4	Emergency	65
5.6.5	Process Data	69
5.6.6	Command	70
5.6.7	Object Dictionary	71
5.7	EoE coding	81
5.7.1	Initiate EoE	81
5.7.2	EoE Fragment Data	83
5.7.3	Data element for EoE	84
5.7.4	Set IP Parameter	85
5.7.5	Set Address Filter	88
5.8	FoE Coding	90
5.8.1	Read Request	90
5.8.2	Write Request	91
5.8.3	Data Request	92
5.8.4	Ack Request	93
5.8.5	Error Request	94
5.8.6	Busy Request	95
6	FAL protocol state machines	96
6.1	Overall structure	96
6.1.1	Overview	96
6.1.2	Fieldbus Service Protocol Machines (FSPM)	97
6.1.3	Application Relationship Protocol Machines (ARPM)	97
6.1.4	DLL Mapping Protocol Machines (DMPM)	98
6.2	AP-Context state machine	98
6.3	FAL service protocol machine (FSPM)	98
6.4	Application Relationship Protocol Machines (ARPMs)	98
6.4.1	AL state machine	98
6.4.2	Mailbox handler state machine	117
6.4.3	CoE state machine	118
6.4.4	EoE state machine	129
6.4.5	FoE state machine	136
6.5	DLL mapping protocol machine (DMPM)	141
	Bibliography	142
	Figure 1 – Common structure of specific fields	21
	Figure 2 – Type description example	22
	Figure 3 – Slave Node Reference Model	26
	Figure 4 – Encoding of Time of Day value	27
	Figure 5 – Encoding of Time Difference value	28
	Figure 6 – AL Control Request structure	30
	Figure 7 – AL Control Response structure	31
	Figure 8 – AL State Changed structure	34

Figure 9 – PDI Control type description.....	34
Figure 10 – Sync Configuration type description	35
Figure 11 – Distributed Clock sync and latch type description	41
Figure 12 – CoE general structure	43
Figure 13 – SDO Download Expedited Request structure.....	44
Figure 14 – SDO Download Expedited Response structure	45
Figure 15 – SDO Download Normal Request structure	46
Figure 16 – Download SDO Segment Request structure	48
Figure 17 – Download SDO Segment Response structure.....	49
Figure 18 – SDO Upload Expedited Request structure	49
Figure 19 – SDO Upload Expedited Response structure	50
Figure 20 – SDO Upload Normal Response structure.....	52
Figure 21 – Upload SDO Segment Request structure.....	53
Figure 22 – Upload SDO Segment Response structure	53
Figure 23 – Abort SDO Transfer Request structure	54
Figure 24 – SDO Information Service structure	57
Figure 25 – Get OD List Request structure.....	58
Figure 26 – Get OD List Response structure.....	59
Figure 27 – Get Object Description Request structure.....	60
Figure 28 – Get Object Description Response structure	61
Figure 29 – Get Entry Description Request structure.....	62
Figure 30 – Get Entry Description Response structure	63
Figure 31 – SDO Info Error Request structure.....	64
Figure 32 – EoE general structure	81
Figure 33 – EoE Timestamp structure	82
Figure 34 – EoE Fragment Data structure	83
Figure 35 – Set IP Parameter Request structure	85
Figure 36 – Set IP Parameter Response structure	87
Figure 37 – Set MAC Filter Request structure	88
Figure 38 – Set MAC Filter Response structure	89
Figure 39 – Read Request structure.....	90
Figure 40 – Write Request structure.....	91
Figure 41 – Data Request structure	92
Figure 42 – Ack Request structure	93
Figure 43 – Error Request structure	94
Figure 44 – Busy Request structure	96
Figure 45 – Relationship among Protocol Machines	97
Figure 46 – AR Protocol machines	98
Figure 47 – ESM Diagramm	100
Table 1 – PDU element description example.....	22
Table 2 – Example attribute description	23
Table 3 – State machine description elements	24

Table 4 – Description of state machine elements	24
Table 5 – Conventions used in state machines	24
Table 6 – Transfer Syntax for bit sequences	28
Table 7 – Transfer syntax for data type Unsignedn	29
Table 8 – Transfer syntax for data type Integern	30
Table 9 – AL Control Description	31
Table 10 – AL Control Response	32
Table 11 – AL Status Codes	32
Table 12 – AL State Changed	34
Table 13 – PDI Control	35
Table 14 – PDI Configuration	35
Table 15 – Sync Configuration	35
Table 16 – Slave Information Interface Area	36
Table 17 – Slave Information Interface Categories	37
Table 18 – Mailbox Protocols Supported Types	37
Table 19 – Categories Types	37
Table 20 – Structure Category String	38
Table 21 – Structure Category General	38
Table 22 – Identification Methods	39
Table 23 – Structure Category FMMU	39
Table 24 – Structure Category SyncM for each Element	40
Table 25 – Structure Category TXPDO and RXPDO for each PDO	40
Table 26 – Structure PDO Entry	41
Table 27 – Distributed Clock sync parameter	42
Table 28 – Distributed Clock latch data	43
Table 29 – CoE elements	44
Table 30 – SDO Download Expedited Request	45
Table 31 – SDO Download Expedited Response	46
Table 32 – SDO Download Normal Request	47
Table 33 – Download SDO Segment Request	48
Table 34 – Download SDO Segment Response	49
Table 35 – SDO Upload Expedited Request	50
Table 36 – SDO Upload Expedited Response	51
Table 37 – SDO Upload Normal Response	52
Table 38 – Upload SDO Segment Request	53
Table 39 – Upload SDO Segment Response	54
Table 40 – Abort SDO Transfer Request	55
Table 41 – SDO Abort Codes	56
Table 42 – SDO Information Service	57
Table 43 – Get OD List Request	58
Table 44 – Get OD List Response	59
Table 45 – Get Object Description Request	60
Table 46 – Get Object Description Response	61

Table 47 – Get Entry Description Request	62
Table 48 – Get Entry Description Response	63
Table 49 – SDO Info Error Request	65
Table 50 – Emergency Request	66
Table 51 – Emergency Error Codes	67
Table 52 – Error Code	67
Table 53 – Diagnostic Data	68
Table 54 – Sync Manager Length Error	68
Table 55 – Sync Manager Address Error	68
Table 56 – Sync Manager Settings Error	68
Table 57 – RxPDO Transmission via mailbox	69
Table 58 – TxPDO Transmission via mailbox	69
Table 59 – RxPDO Remote Transmission Request	70
Table 60 – TxPDO Remote Transmission Request	70
Table 61 – Command object structure	71
Table 62 – Object Dictionary Structure	71
Table 63 – Object Code Definitions	71
Table 64 – Basic Data Type Area	72
Table 65 – Extended Data Type Area	73
Table 66 – Enumeration Definition	74
Table 67 – CoE Communication Area	74
Table 68 – Device Type	75
Table 69 – Error Register	76
Table 70 – Manufacturer Device Name	76
Table 71 – Manufacturer Hardware Version	77
Table 72 – Manufacturer Software Version	77
Table 73 – Identity Object	77
Table 74 – Receive PDO Mapping	78
Table 75 – Transmit PDO Mapping	78
Table 76 – Sync Manager Communication Type	79
Table 77 – Sync Manager Channel 0-31	80
Table 78 – Sync Manager Synchronization	81
Table 79 – Initiate EoE Request	82
Table 80 – Initiate EoE Response	83
Table 81 – EoE Fragment Data	84
Table 82 – EoE Data	85
Table 83 – Set IP Parameter Request	86
Table 84 – Set IP Parameter Response	87
Table 85 – EoE Result Parameter	88
Table 86 – Set MAC Filter Request	88
Table 87 – Set MAC Filter Response	90
Table 88 – Read Request	91
Table 89 – Write Request	92

Table 90 – Data Request	93
Table 91 – Ack Request.....	94
Table 92 – Error Request.....	95
Table 93 – Error codes of FoE	95
Table 94 – Busy Request.....	96
Table 95 – State transitions and local management services	100
Table 96 – Primitives issued by ESM to DL.....	101
Table 97 – Primitives issued by DL to ESM.....	102
Table 98 – Primitives issued by Application to ESM	102
Table 99 – Primitives issued by ESM to Application	102
Table 100 – ESM Variables.....	103
Table 101 – ESM macros	104
Table 102 – ESM functions	104
Table 103 – ESM state table	105
Table 104 – Primitives issued by Mailbox handler to DL.....	117
Table 105 – Primitives issued by DL to Mailbox handler.....	118
Table 106 – Primitives issued by Protocol handler to Mailbox handler.....	118
Table 107 – Primitives issued by Mailbox handler to Protocol handler.....	118
Table 108 – Primitives issued by Application to CoESM.....	119
Table 109 – Primitives issued by CoESM to Application.....	120
Table 110 – CoESM state table.....	121
Table 111 – Primitives issued by Application to EoESM	130
Table 112 – Primitives issued by EoESM to Application	131
Table 113 – EoESM state table.....	132
Table 114 – Primitives issued by Application to FoESM	136
Table 115 – Primitives issued by FoESM to Application	137
Table 116 – FoESM state table.....	138

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –****Part 6-12: Application layer protocol specification –
Type 12 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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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 61158-6-12 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This fourth edition cancels and replaces the third edition published in 2014. This edition constitutes a technical revision.

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

- technical corrections; and
- editorial improvements for clarification.

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

FDIS	Report on voting
65C/948/FDIS	65C/956/RVD

Full information on the voting for the approval of this International 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.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

This document 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 application protocol provides the application service by making use of the services available from the data-link or other immediately lower 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 application entities (AEs) 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:

- as a guide for implementors and designers;
- for use in the testing and procurement of equipment;
- as part of an agreement for the admittance of systems into the open systems environment;
- 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 may work together in any combination.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-12: Application layer protocol specification – Type 12 elements

1 Scope

1.1 General

The Fieldbus Application Layer (FAL) provides user programs with a means to access the fieldbus communication environment. In this respect, the FAL can be viewed as a “window between corresponding application programs.”

This part of IEC 61158 provides common elements for basic time-critical and non-time-critical messaging communications between application programs in an automation environment and material specific to Type 12 fieldbus. The term “time-critical” is used to represent the presence of a time-window, within which one or more specified actions are required to be completed with some defined level of certainty. Failure to complete specified actions within the time window risks failure of the applications requesting the actions, with attendant risk to equipment, plant and possibly human life.

This International Standard defines in an abstract way the externally visible behavior provided by the different Types of the fieldbus Application Layer in terms of

- a) the abstract syntax defining the application layer protocol data units conveyed between communicating application entities,
- b) the transfer syntax defining the application layer protocol data units conveyed between communicating application entities,
- c) the application context state machine defining the application service behavior visible between communicating application entities; and
- d) the application relationship state machines defining the communication behavior visible between communicating application entities; and.

The purpose of this document is to define the protocol provided to

- a) define the wire-representation of the service primitives defined in IEC 61158-5-12, and
- b) define the externally visible behavior associated with their transfer.

This document specifies the protocol of the IEC fieldbus Application Layer, in conformance with the OSI Basic Reference Model (ISO/IEC 7498) and the OSI Application Layer Structure (ISO/IEC 9545).

FAL services and protocols are provided by FAL application-entities (AE) contained within the application processes. The FAL AE is composed of a set of object-oriented Application Service Elements (ASEs) and a Layer Management Entity (LME) that manages the AE. The ASEs provide communication services that operate on a set of related application process object (APO) classes. One of the FAL ASEs is a management ASE that provides a common set of services for the management of the instances of FAL classes.

Although these services specify, from the perspective of applications, how request and responses are issued and delivered, they do not include a specification of what the requesting and responding applications are to do with them. That is, the behavioral aspects of the applications are not specified; only a definition of what requests and responses they can

send/receive is specified. This permits greater flexibility to the FAL users in standardizing such object behavior. In addition to these services, some supporting services are also defined in this document to provide access to the FAL to control certain aspects of its operation.

1.2 Specifications

The principal objective of this document is to specify the syntax and behavior of the application layer protocol that conveys the application layer services defined in IEC 61158-5-12.

A secondary objective is to provide migration paths from previously-existing industrial communications protocols. It is this latter objective which gives rise to the diversity of protocols standardized in subparts of IEC 61158-6.

1.3 Conformance

This document does not specify individual implementations or products, nor does it constrain the implementations of application layer entities within industrial automation systems.

There is no conformance of equipment to the application layer service definition standard. Instead, conformance is achieved through implementation of this application layer protocol specification.

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 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 61158-5-12, *Industrial communication networks – Fieldbus specifications – Part 5-12: Application layer service definition – Type 12 elements*

IEC 61158-6 (all parts), *Industrial communication networks – Fieldbus specifications – Part 6: Application layer protocol specification*

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, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Standard for Ethernet*

ISO/IEC 9545, *Information technology – Open Systems Interconnection – Application Layer structure*

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*

ISO/IEC/IEEE 60559, *Information technology – Microprocessor Systems – Floating-Point arithmetic*

IEEE Std 802.1D, *IEEE standard for Local and metropolitan area networks – Common specifications – Media access control (MAC) Bridges*; available at <http://www.ieee.org> [viewed 2018-09-11]

IEEE Std 802.1Q, *IEEE standard for Local and metropolitan area networks – Bridges and Bridged Networks*; available at <http://www.ieee.org> [viewed 2018-09-11]

IETF RFC 768, *User Datagram Protocol*; available at <http://www.ietf.org> [viewed 2018-09-11]

IETF RFC 791, *Internet Protocol darpa internet program protocol specification*; available at <http://www.ietf.org> [viewed 2018-09-11]

IETF RFC 826, *An Ethernet Address Resolution Protocol or Converting Network Protocol Addresses to 48.bit Ethernet Address for Transmission on Ethernet Hardware*; available at <http://www.ietf.org> [viewed 2018-09-11]