

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

Industriell processtyrning – Fältbuss – Del 5-12: Definition av tjänster i applikationsskiktet – Delar i fältbuss, Typ 12

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

Som svensk standard gäller europastandarden EN 61158-5-12:2008. Den svenska standarden innehåller den officiella engelska språkversionen av EN 61158-5-12:2008.

Nationellt förord

Europastandarden EN 61158-5-12:2008

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 61158-5-12, First edition, 2007 - Industrial communication networks - Fieldbus specifications - Part 5-12: Application layer service definition - Type 12 elements**

utarbetad inom International Electrotechnical Commission, IEC.

Denna standard, och de andra delarna i serien SS-EN 61158-5, ersätter SS-EN 61158-5, utgåva 1, 2004.

Tidigare fastställd svensk standard SS-EN 61158-5, utgåva 1, 2004, gäller ej fr o m 2011-02-01.

Standarder underlättar utvecklingen och höjer elsäkerheten

Det finns många fördelar med att ha gemensamma tekniska regler för bl a säkerhet, prestanda, dokumentation, utförande och skötsel av elprodukter, elanläggningar och metoder. Genom att utforma sådana standarder blir säkerhetskraven 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 5-12: Application layer service definition -
Type 12 elements
(IEC 61158-5-12:2007)**

Réseaux de communication industriels -
Spécifications des bus de terrain -
Partie 5-12: Définition des services
des couches d'application -
Éléments de type 12
(CEI 61158-5-12:2007)

Industrielle Kommunikationsnetze -
Feldbusse -
Teil 5-12: Dienstfestlegungen
des Application Layer
(Anwendungsschicht) -
Typ 12-Elemente
(IEC 61158-5-12:2007)

This European Standard was approved by CENELEC on 2008-02-01. 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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 65C/475/FDIS, future edition 1 of IEC 61158-5-12, 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 was approved by CENELEC as EN 61158-5-12 on 2008-02-01.

This and the other parts of the EN 61158-5 series supersede EN 61158-5:2004.

With respect to EN 61158-5:2004 the following changes were made:

- deletion of Type 6 fieldbus for lack of market relevance;
- addition of new fieldbus types;
- partition into multiple parts numbered 5-2, 5-3, ..., 5-20.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2008-11-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2011-02-01

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 EN 61784 series. Use of the various protocol types in other combinations may require permission from their respective intellectual-property-right holders.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61158-5-12:2007 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 61158-2	NOTE Harmonized as EN 61158-2:2008 (not modified).
IEC 61158-4-12	NOTE Harmonized as EN 61158-4-12:2008 (not modified).
IEC 61158-6-12	NOTE Harmonized as EN 61158-6-12:2008 (not modified).
IEC 61784-2	NOTE Harmonized as EN 61784-2:2008 (not modified).

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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 When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61131-3	- ¹⁾	Programmable controllers - Part 3: Programming languages	EN 61131-3	2003 ²⁾
IEC 61158-3-12	- ¹⁾	Industrial communication networks - Fieldbus specifications - Part 3-12: Data-link layer service definition - Type 12 elements	EN 61158-3-12	2008 ²⁾
ISO/IEC 646	1991	Information technology - ISO 7-bit coded character set for information interchange	-	-
ISO/IEC 7498-1	- ¹⁾	Information technology - Open Systems Interconnection - Basic Reference Model: The Basic Model	EN ISO/IEC 7498-1	1995 ²⁾
ISO/IEC 7498-3	- ¹⁾	Information technology - Open Systems Interconnection - Basic Reference Model: Naming and addressing	-	-
ISO/IEC 8802-3	- ¹⁾	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 10646	- ¹⁾	Information technology - Universal multiple-octet coded character set (UCS)	-	-
ISO/IEC 10731	- ¹⁾	Information technology - Open Systems Interconnection - Basic reference model - Conventions for the definition of OSI services	-	-
IEEE 802.1D	- ¹⁾	IEEE Standard for Local and Metropolitan Area Networks - Media Access Control (MAC) Bridges	-	-
IEEE 802.1Q	- ¹⁾	IEEE Standard for Local and Metropolitan Area Networks - Virtual Bridged Local Area Networks	-	-

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IETF RFC 791	- ¹⁾	Internet Protocol	-	-

CONTENTS

INTRODUCTION.....	7
1 Scope.....	8
1.1 Overview	8
1.2 Specifications	9
1.3 Conformance.....	9
2 Normative references.....	9
3 Terms, definitions, symbols, abbreviations and conventions	10
3.1 Reference model terms and definitions	10
3.2 Service convention terms and definitions	11
3.3 Application layer and data-link service terms and definitions.....	11
3.4 Common symbols and abbreviations	15
3.5 Conventions	16
4 Concepts	17
4.1 Common concepts	17
4.2 Type specific concepts	17
5 Data type ASE	25
5.1 General	25
5.2 Formal definition of data type objects	25
5.3 FAL defined data types	25
5.4 Data type ASE service specification	31
6 Communication model specification	32
6.1 ASEs	32
6.2 AR.....	105
Bibliography	116
Figure 1 – Producer consumer model	19
Figure 2 – Client server model.....	19
Figure 3 – Server triggered invocation	19
Figure 4 – Slave reference model.....	20
Figure 5 – Simple slave device	21
Figure 6 – Enhanced slave device	22
Figure 7 – Master functional overview.....	23
Figure 8 – Process output data sequence	33
Figure 9 – Process input data sequence	34
Figure 10 – CoE server model.....	51
Figure 11 – Successful single SDO-Download sequence	56
Figure 12 – Unsuccessful single SDO-Download sequence.....	57
Figure 13 – Successful segmented SDO-Download sequence.....	57
Figure 14 – Successful single SDO-Upload sequence.....	58
Figure 15 – Unsuccessful single SDO-Upload sequence	59
Figure 16 – Successful segmented SDO-Upload sequence.....	59
Figure 17 – SDO information sequence	60
Figure 18 – Emergency service	61

Figure 19 – Command sequence	62
Figure 20 – PDO mapping	63
Figure 21 – Sync manager PDO assignment.....	64
Figure 22 – RxPDO service	65
Figure 23 – TxPDO service	66
Figure 24 – RxPDO remote transmission sequence	67
Figure 25 – TxPDO remote transmission sequence	67
Figure 26 – EoE sequence	87
Figure 27 – FoE read sequence with success	94
Figure 28 – FoE read sequence with error	95
Figure 29 – FoE write sequence with success.....	95
Figure 30 – FoE write sequence with error.....	96
Figure 31 – FoE write sequence with busy.....	96
Figure 32 – Successful AL control sequence	106
Figure 33 – Unsuccessful AL control sequence.....	107
Figure 34 – AL state changed sequence	108
Table 1 – Process output data.....	36
Table 2 – Process input data.....	37
Table 3 – Update process input data	38
Table 4 – SII read	46
Table 5 – SII write.....	47
Table 6 – SII reload.....	48
Table 7 – Allocation of SDO areas.....	52
Table 8 – SDO download expedited.....	71
Table 9 – SDO download normal	72
Table 10 – Download SDO segment	73
Table 11 – SDO upload expedited	74
Table 12 – SDO upload normal.....	75
Table 13 – Upload SDO segment	76
Table 14 – Abort SDO transfer	76
Table 15 – Get OD list.....	77
Table 16 – OD list segment.....	78
Table 17 – Get object description	79
Table 18 – Get entry description.....	80
Table 19 – Object entry segment.....	82
Table 20 – Emergency	83
Table 21 – RxPDO	84
Table 22 – TxPDO	84
Table 23 – RxPDO remote transmission	85
Table 24 – TxPDO remote transmission	85
Table 25 – Initiate EoE	90
Table 26 – EoE fragment.....	91

Table 27 – Set IP parameter.....	92
Table 28 – Set address filter.....	93
Table 29 – FoE read.....	98
Table 30 – FoE write	98
Table 31 – FoE data.....	99
Table 32 – FoE ack	99
Table 33 – FoE busy	100
Table 34 – FoE error	100
Table 35 – MBX read	102
Table 36 – MBX write	103
Table 37 – MBX read upd.....	104
Table 38 – AL management and ESM service primitives	105
Table 39 – AL control	114
Table 40 – AL state change.....	115

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/TR 61158-1.

The application service is provided by the application protocol making use of the services available from the data-link or other immediately lower layer. This standard defines the application service characteristics that fieldbus applications and/or system management may exploit.

Throughout the set of fieldbus standards, the term “service” refers to the abstract capability provided by one layer of the OSI Basic Reference Model to the layer immediately above. Thus, the application layer service defined in this standard is a conceptual architectural service, independent of administrative and implementation divisions.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-12: Application layer service definition – Type 12 elements

1 Scope

1.1 Overview

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 standard 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 standard defines in an abstract way the externally visible service provided by the different Types of the fieldbus Application Layer in terms of

- a) an abstract model for defining application resources (objects) capable of being manipulated by users via the use of the FAL service,
- b) the primitive actions and events of the service;
- c) the parameters associated with each primitive action and event, and the form which they take; and
- d) the interrelationship between these actions and events, and their valid sequences.

The purpose of this standard is to define the services provided to

- 1) the FAL user at the boundary between the user and the Application Layer of the Fieldbus Reference Model, and
- 2) Systems Management at the boundary between the Application Layer and Systems Management of the Fieldbus Reference Model.

This standard specifies the structure and services 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 standard to provide access to the FAL to control certain aspects of its operation.

1.2 Specifications

The principal objective of this standard is to specify the characteristics of conceptual application layer services suitable for time-critical communications, and thus supplement the OSI Basic Reference Model in guiding the development of application layer protocols for time-critical communications.

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 services standardized as the various Types of IEC 61158, and the corresponding protocols standardized in subparts of IEC 61158-6.

This specification may be used as the basis for formal Application Programming-Interfaces. Nevertheless, it is not a formal programming interface, and any such interface will need to address implementation issues not covered by this specification, including

- a) the sizes and octet ordering of various multi-octet service parameters, and
- b) the correlation of paired request and confirm, or indication and response, primitives.

1.3 Conformance

This standard 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 this application layer service definition standard. Instead, conformance is achieved through implementation of conforming application layer protocols that fulfill any given Type of application layer services as defined in this standard.

2 Normative references

The following referenced documents are indispensable for the application 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.

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

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

ISO/IEC 646:1991, *Information technology – ISO 7-bit coded character set for information interchange*

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

ISO/IEC 7498-3, *Information technology – Open Systems Interconnection – Basic Reference Model – 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 10646, *Information technology – Universal Multiple-Octet Coded Character Set (UCS)*

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