

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

Industriell processstyrning –

Fältbuss –

Del 6-9: Specifikation av protokoll i applikationsskiktet –

Delar i fältbuss, Typ 9

Industrial communication networks –

Fieldbus specifications –

Part 6-9: Application layer protocol specification –

Type 9 elements

Som svensk standard gäller europastandarden EN 61158-6-9:2008. Den svenska standarden innehåller den officiella engelska språkversionen av EN 61158-6-9:2008.

Nationellt förord

Europastandarden EN 61158-6-9:2008

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 61158-6-9, First edition, 2007 - Industrial communication networks - Fieldbus specifications - Part 6-9: Application layer protocol specification - Type 9 elements**

utarbetad inom International Electrotechnical Commission, IEC.

Denna standard, och de andra delarna i serien SS-EN 61158-6, ersätter SS-EN 61158-6, utgåva 1, 2004.

Tidigare fastställd svensk standard SS-EN 61158-6, utgåva 1, 2004, gäller ej fr o m 2011-02-01.

ICS 35.100.70; 25.040.40

Denna standard är fastställd av SEK Svensk Elstandard, som också kan lämna upplysningar om **sakinnehållet** i standarden.

Postadress: SEK, Box 1284, 164 29 KISTA

Telefon: 08 - 444 14 00. Telefax: 08 - 444 14 30

E-post: sek@elstandard.se. Internet: www.elstandard.se

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 standardiseringssarbetet 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

Utdriften 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).

Standardiseringssarbetet 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 standardiseringssverksamhet och medlemsavgift till IEC och CENELEC.

Var med och påverka!

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtidens 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 6-9: Application layer protocol specification -
Type 9 elements
(IEC 61158-6-9:2007)**

Réseaux de communication industriels -
Spécifications des bus de terrain -
Partie 6-9: Spécification des services
des couches d'application -
Eléments de type 9
(CEI 61158-6-9:2007)

Industrielle Kommunikationsnetze -
Feldbusse -
Teil 6-9: Protokollspezifikation
des Application Layer
(Anwendungsschicht) -
Typ 9-Elemente
(IEC 61158-6-9:2007)

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/476/FDIS, future edition 1 of IEC 61158-6-9, 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 61158-6-9 on 2008-02-01.

This and the other parts of the EN 61158-6 series supersede EN 61158-6:2004.

With respect to EN 61158-6:2004 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 6-2, 6-3, ...6-20.

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 61158-6-9:2007 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 61158-3-9 | NOTE Harmonized as EN 61158-3-9:2008 (not modified). |
| IEC 61158-4-9 | NOTE Harmonized as EN 61158-4-9:2008 (not modified). |
| IEC 61784-1 | NOTE Harmonized as EN 61784-1:2008 (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 60559	- ¹⁾	Binary floating-point arithmetic for microprocessor systems	HD 592 S1	1991 ²⁾
IEC 61158-3-1	- ¹⁾	Industrial communication networks - Fieldbus specifications - Part 3-1: Data-link layer service definition - Type 1 elements	EN 61158-3-1	2008 ²⁾
IEC 61158-4-1	- ¹⁾	Industrial communication networks - Fieldbus specifications - Part 4-1: Data-link layer protocol specification - Type 1 elements	EN 61158-4-1	2008 ²⁾
IEC 61158-5-5	- ¹⁾	Industrial communication networks - Fieldbus specifications - Part 5-5: Application layer service definition - Type 5 elements	EN 61158-5-5	2008 ²⁾
IEC 61158-5-9	- ¹⁾	Industrial communication networks - Fieldbus specifications - Part 5-9: Application layer service definition - Type 9 elements	EN 61158-5-9	2008 ²⁾
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 8824-2	- ¹⁾	Information technology - Abstract Syntax Notation One (ASN.1): Information object specification	-	-
ISO/IEC 8825-1	- ¹⁾	Information technology - ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)	-	-
ISO/IEC 9545	- ¹⁾	Information technology - Open Systems Interconnection - Application Layer structure	-	-
ISO/IEC 10731	- ¹⁾	Information technology - Open Systems Interconnection - Basic reference model - Conventions for the definition of OSI services	-	-

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

CONTENTS

INTRODUCTION	7
1 Scope	8
1.1 General	8
1.2 Specifications	8
1.3 Conformance	8
2 Normative references	9
3 Terms, definitions, symbols, abbreviations and conventions	9
3.1 Terms and definitions from other ISO/IEC standards	9
3.2 IEC/TR 61158-1 terms	10
3.3 Abbreviations and symbols	14
3.4 Conventions	15
3.5 Conventions used in state machines	15
4 Abstract syntax	16
4.1 FAL-AR PDU abstract syntax	16
4.2 Abstract syntax of PDUBody	19
4.3 Type definitions for ASEs	22
4.4 Abstract syntax of data types	27
5 Transfer syntax	28
5.1.1 General	28
5.1.2 Coding rules	28
5.1.3 Structure of the identification information	29
6 Structure of FAL protocol state machines	38
7 AP-Context state machines	40
7.1 VCR PM structure	40
7.2 VCR PM state machine	40
8 FAL service protocol machine (FSPM)	53
8.1 General	53
8.2 FSPM state tables	53
8.3 Functions used by FSPM	56
8.4 Parameters of FSPM/ARPM primitives	56
9 Application relationship protocol machines (ARPMs)	56
9.1 AREP mapping to data-link layer	56
9.2 Application relationship protocol machines (ARPMs)	66
9.3 AREP state machine primitive definitions	82
9.4 AREP state machine functions	85
10 DLL mapping protocol machine (DMPM)	86
10.1 DMPM States	86
10.2 DMPM state table	86
10.3 Primitives exchanged between data-link layer and DMPM	94
10.4 Functions used by DMPM	97
Bibliography	99
Figure 1 – Insertion of identification information in the FMS PDU	28
Figure 2 – Identification	29

Figure 3 – Coding with identification	30
Figure 4 – Coding without identification.....	30
Figure 5 – Representation of the value true	30
Figure 6 – Representation of the value false	31
Figure 7 – Coding of data of data type Integer16.....	31
Figure 8 – Coding of data of data type Unsigned16.....	32
Figure 9 – Coding of data of data type Floating Point.....	32
Figure 10 – Coding of data of data type Visible String.....	33
Figure 11 – Coding of data of data type Octet String.....	33
Figure 12 – Coding of data of type Date.....	34
Figure 13 – Coding of data of data type Time-of-day.....	35
Figure 14 – Coding of data of data type Time-difference	35
Figure 15 – Coding of data of data type Bit String	36
Figure 16 – Coding of data of data type Time-value	36
Figure 17 – Coding of data of user data definitions with identifier.....	37
Figure 18 – Coding of data of user data definitions without identifier.....	37
Figure 19 – Coding of ID info for a SEQUENCE	37
Figure 20 – Relationships among protocol machines and adjacent layers	39
Figure 21 – Relationships among protocol machines and adjacent layers	40
Figure 22 – VCR state machine	41
Figure 23 – State transition diagram of FSPM.....	53
Figure 24 – State transition diagram of the QUU ARPM	67
Figure 25 – State transition diagram of QUB ARPM	69
Figure 26 – State transition diagram of the BNU ARPM.....	78
Figure 27 – State transition diagram of DMPM	86
 Table 1 – Conventions used for state machines	15
Table 2 – Coding for Date type	34
Table 3 – AP-VCR state machine transactions	42
Table 4 – Primitives issued by FAL-User to VCR PM.....	51
Table 5 – Primitives issued by VCR PM to FAL-User.....	51
Table 6 – Primitives issued by VCR PM to FSPM	52
Table 7 – Primitives issued by FSPM to VCR PM	53
Table 8 – FSPM state table – sender transactions	54
Table 9 – FSPM state table – receiver transactions.....	55
Table 10 – Function SelectArep().....	56
Table 11 – Parameters used with primitives exchanged between FSPM and ARPM	56
Table 12 – QUU ARPM states	66
Table 13 – QUU ARPM state table – sender transactions.....	67
Table 14 – QUU ARPM state table – receiver transactions	68
Table 15 – QUB ARPM states	69
Table 16 – QUB ARPM state table – sender transactions	70
Table 17 – QUB ARPM state table – receiver transactions	71

Table 18 – BNU ARPM states	77
Table 19 – BNU ARPM state table – sender transactions	78
Table 20 – BNU ARPM state table – receiver transactions	80
Table 21 – Primitives issued from ARPM to DMPM	83
Table 22 – Primitives issued by DMPM to ARPM.....	83
Table 23 – Parameters used with primitives exchanged between ARPM and DMPM	84
Table 24 – Function GetArepId()	85
Table 25 – Function BuildFAS-PDU	85
Table 26 – Function FAS_Pdu_Type.....	85
Table 27 – Function AbortIdentifier	85
Table 28 – Function AbortReason	85
Table 29 – Function AbortDetail.....	86
Table 30 – DMPM state descriptions	86
Table 31 – DMPM state table – sender transactions.....	87
Table 32 – DMPM state table – receiver transactions.....	89
Table 33 – Primitives exchanged between data-link layer and DMPM	95
Table 34 – Function PickArep	97
Table 35 – Function FindAREP	98
Table 36 – Function LocateQubArep	98
Table 37 – Function SetIdentifier()	98

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 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 standard 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 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.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-9: Application layer protocol specification – Type 9 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 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 9 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 behavior provided by the Type 9 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 standard is to define the protocol provided to

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

This standard specifies the protocol of the Type 9 IEC fieldbus application layer, in conformance with the OSI Basic Reference Model (ISO/IEC 7498) and the OSI Application Layer Structure (ISO/IEC 9545).

1.2 Specifications

The principal objective of this standard is to specify the syntax and behavior of the application layer protocol that conveys the application layer services defined in IEC 61158-5-9.

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 IEC 61158-6.

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.

Conformance is achieved through implementation of this application layer protocol specification.

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 60559, *Binary floating-point arithmetic for microprocessor systems*

IEC 61158-3-1, *Industrial communication networks – Fieldbus specifications – Part 3-1: Data-link layer service definition – Type 1 elements*

IEC 61158-4-1, *Industrial communication networks – Fieldbus specifications – Part 4-1: Data-link layer protocol specification – Type 1 elements*

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

IEC 61158-5-9, *Industrial communication networks – Fieldbus specifications – Part 5-9: Application layer service definition – Type 9 elements*

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

ISO/IEC 8824, *Information technology – Open Systems Interconnection – Specification of Abstract Syntax Notation One (ASN.1)*

ISO/IEC 8825, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)*

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

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

