

# INTERNATIONAL STANDARD

**Industrial communication networks – Fieldbus specifications –  
Part 6-14: Application layer protocol specification – Type 14 elements**

(<https://standards.iteh.ai>)

Document Preview

IEC 61158-6-14:2007

<https://standards.iteh.ai/catalog/standards/iec/bec6d2be-cb36-4148-bc08-7067588383b0/iec-61158-6-14-2007>

Withhold



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2007 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland  
Email: [inmail@iec.ch](mailto:inmail@iec.ch)  
Web: [www.iec.ch](http://www.iec.ch)

### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: [www.iec.ch/online\\_news/justpub](http://www.iec.ch/online_news/justpub)

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: [www.iec.ch/webstore/custserv](http://www.iec.ch/webstore/custserv)

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: [csc@iec.ch](mailto:csc@iec.ch)

Tel.: +41 22 919 02 11

Fax: +41 22 919 03 00



IEC 61158-6-14

Edition 1.0 2007-12

# INTERNATIONAL STANDARD

Industrial communication networks – Fieldbus specifications –  
Part 6-14: Application layer protocol specification – Type 14 elements

(<https://standards.iteh.ai>)

Document Preview

IEC 61158-6-14:2007

<https://standards.iteh.ai/catalog/standards/iec/bec6d2be-eb36-4148-bc08-7067588383b0/iec-61158-6-14-2007>

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

PRICE CODE **XC**

ICS 35.100.70; 25.040.40

ISBN 2-8318-9489-1

## CONTENTS

FOREWORD .....	7
INTRODUCTION .....	9
1 Scope .....	10
1.1 General .....	10
1.2 Specifications .....	10
1.3 Conformance .....	10
2 Normative references .....	11
3 Terms, definitions, symbols, abbreviations and conventions .....	11
3.1 Referenced terms and definitions .....	11
3.2 Fieldbus application layer specific terms and definitions .....	13
3.3 Abbreviations and symbols .....	15
3.4 Conventions .....	16
4 Abstract syntax .....	18
4.1 Fixed format PDU description .....	18
4.2 Object definitions in FAL management ASE .....	26
4.3 Definition of objects used in EPA application access entity .....	32
5 Transfer syntax .....	35
5.1 Encoding of basic data types .....	35
5.2 Encoding of EPA APDU header .....	41
5.3 Encoding of FAL management entity service parameters .....	41
5.4 Encoding of AAE Services .....	48
6 Structure of FAL protocol state machines .....	55
7 AP-Context state machine .....	55
7.1 Primitives exchanged between ALU and ALE .....	55
7.2 Protocol state machine descriptions .....	56
7.3 State transitions .....	56
7.4 Function descriptions .....	63
8 FAL management state machines .....	63
8.1 Primitives .....	63
8.2 Protocol state machine descriptions .....	65
8.3 State transitions .....	65
8.4 Function descriptions .....	67
9 Application access entity protocol machine .....	73
9.1 Primitives .....	73
9.2 AAE state machine .....	74
9.3 Event ASE protocol machine .....	77
9.4 Domain ASE protocol machine .....	78
10 Application relationship state machine .....	82
10.1 Primitives .....	82
10.2 AREP state description .....	84
10.3 State transitions .....	84
10.4 Function descriptions .....	85
11 DLL mapping protocol machine .....	86
11.1 Concept .....	86
11.2 Primitives .....	86

11.3 State description .....	87
11.4 State transitions .....	87
11.5 Function description .....	88
Bibliography.....	89
Figure 1 – State transition diagram .....	17
Figure 2 – Exchanged primitives of protocol state machine .....	55
Figure 3 – ACE protocol state machine .....	56
Figure 4 – FME protocol state machine .....	65
Figure 5 – AAE state transition diagrams .....	75
Figure 6 – Event ASE state transition diagrams .....	77
Figure 7 – Domain ASE state transition diagram .....	79
Figure 8 – AREP state transition diagrams.....	84
Figure 9 – ESME state transition.....	87
Table 1 – State machine description elements .....	17
Table 2 – Definition of EPA MOB header object .....	26
Table 3 – Definition of EPA device descriptor object.....	26
Table 4 – Definition of the time synchronization object.....	27
Table 5 – Definition of maximum response time object.....	28
Table 6 – Definition of the EPA communication scheduling management object.....	28
Table 7 – Definition of the device application information object .....	28
Table 8 – Definition of FB application information header.....	29
Table 9 – Definition of domain application information header.....	29
Table 10 – Definition of EPA link object header.....	30
Table 11 – Definition of FB application information object .....	30
Table 12 – Definition of EPA link object .....	31
Table 13 – Definition of domain application information object .....	31
Table 14 – Definition of domain object .....	32
Table 15 – Definition of simple variable object .....	33
Table 16 – Definition of event object .....	33
Table 17 – Definition of EPA socket mapping object .....	34
Table 18 – Definition of EPA socket timer object.....	34
Table 19 – Definition of ErrorType object .....	35
Table 20 – Encoding of Boolean value TRUE .....	35
Table 21 – Encoding of Boolean value FALSE .....	35
Table 22 – Encoding of Unsigned8 data type .....	35
Table 23 – Encoding of Unsigned16 data type .....	36
Table 24 – Encoding of Unsigned32 data type .....	36
Table 25 – Encoding of Unsigned64 data type .....	36
Table 26 – Encoding of Int8 data type .....	37
Table 27 – Encoding of Int16 data type .....	37
Table 28 – Encoding of Int32 data type .....	37

Table 29 – Encoding of Int64 data type .....	37
Table 30 – Encoding of Real type .....	38
Table 31 – Encoding of VisibleString data type .....	38
Table 32 – Encoding of OctetString data type .....	38
Table 33 – Encoding of BitString data type .....	39
Table 34 – Encoding of TimeOfDay data type .....	39
Table 35 – Encoding of BinaryDate data type.....	40
Table 36 – Encoding of TimeDifference data type .....	41
Table 37 – Encoding of EPA application layer service message header .....	41
Table 38 – Encoding of EM_DetectingDevice request parameters.....	42
Table 39 – Encoding of EM_OnlineReply request parameters .....	42
Table 40 – Encoding of EM_GetDeviceAttribute request parameters.....	43
Table 41 – Encoding of EM_GetDeviceAttribute positive response parameters.....	44
Table 42 – Encoding of EM_GetDeviceAttribute negative response parameters.....	45
Table 43 – Encoding of EM_ActiveNotification request parameters.....	45
Table 44 – Encoding of EM_ConfiguringDevice request parameters.....	46
Table 45 – Encoding of EM_ConfiguringDevice positive response parameters.....	47
Table 46 – Encoding of EM_ConfiguringDevice negative response parameters.....	47
Table 47 – Encoding of EM_SetDefaultValue request parameters.....	48
Table 48 – Encoding of EM_SetDefaultValue positive response parameters.....	48
Table 49 – Encoding of clear device attribute service refuse packet.....	48
Table 50 – Encoding of DomainDownload request parameters.....	49
Table 51 – Encoding of domain download service response packet .....	49
Table 52 – Encoding of DomainDownload negative response parameters .....	49
Table 53 – Encoding of DomainUpload request parameters .....	50
Table 54 – Encoding of DomainUpload positive response parameters.....	50
Table 55 – Encoding of DomainUpload negative response parameters .....	50
Table 56 – Encoding of EventReport request parameters.....	51
Table 57 – Encoding of EventReportAcknowledge request parameters .....	51
Table 58 – Encoding of EventReportAcknowledge positive response parameters.....	51
Table 59 – Encoding of EventReportAcknowledge negative response parameters .....	52
Table 60 – Encoding of ReportConditionChanging request parameters .....	52
Table 61 – Encoding of ReportConditionChanging positive response parameters.....	52
Table 62 – Encoding of ReportConditionChanging negative response parameters .....	52
Table 63 – Encoding of Read request parameters.....	53
Table 64 – Encoding of Read positive response parameters .....	53
Table 65 – Encoding of Read negative response parameters .....	53
Table 66 – Encoding of Write request parameters.....	54
Table 67 – Encoding of Write positive response parameters .....	54
Table 68 – Encoding of Write negative response parameters .....	54
Table 69 – Encoding of VariableDistribute request parameters .....	54
Table 70 – Primitives delivered by ALU to ALE .....	55
Table 71 – Primitives delivered by ALE to ALU .....	56

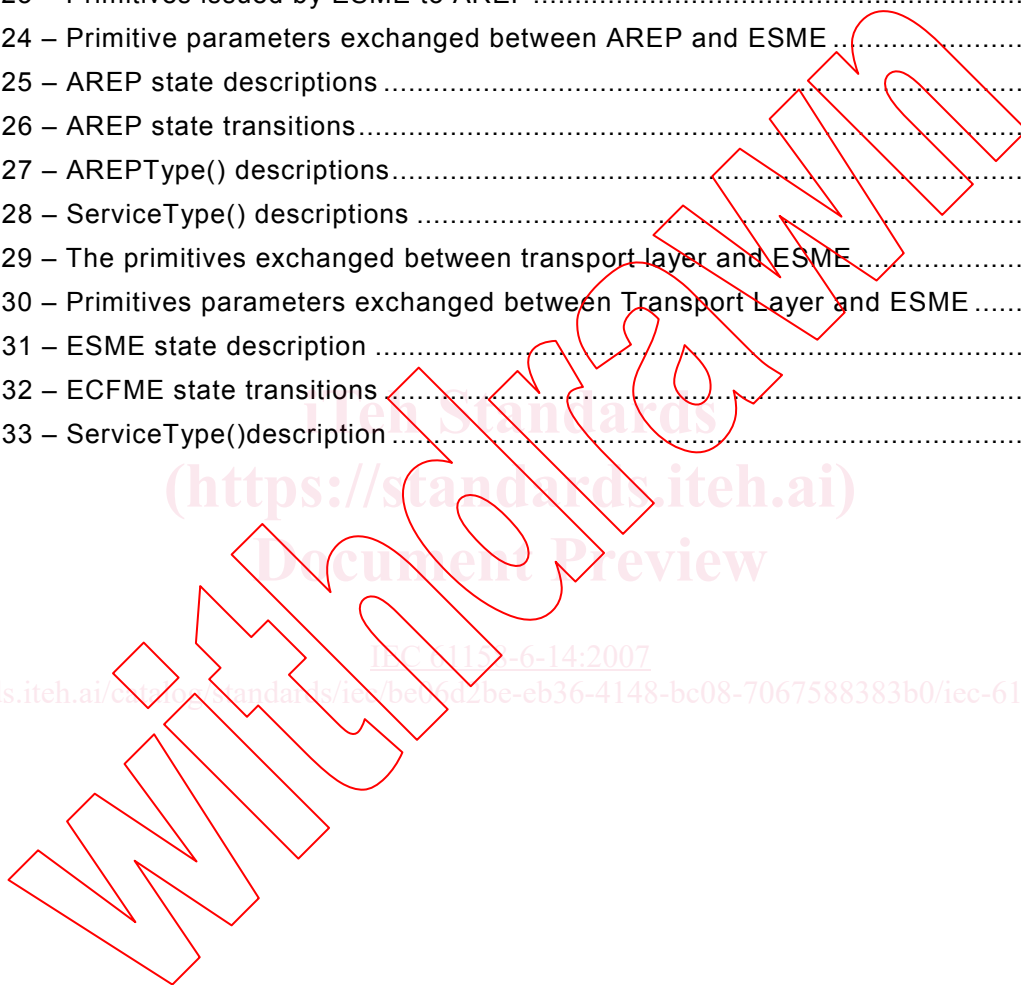
Table 72 – ACE state descriptions .....	56
Table 73 – ACE state transitions (sender).....	57
Table 74 – ACE state transitions (receiver).....	60
Table 75 – APServiceType() descriptions.....	63
Table 76 – Primitives delivered by application layer user to FME .....	63
Table 77 – Primitives delivered by FME to application layer user .....	64
Table 78 – Primitive parameters exchanged between FME and application layer user.....	64
Table 79 – Primitives delivered by FME to ESME.....	64
Table 80 – Primitives delivered by ESME to FME.....	64
Table 81 – Primitives parameters exchanged between FME and ESME .....	65
Table 82 – State transitions of EPA FME .....	66
Table 83 – EpaRcvNewIpAddress() descriptions .....	68
Table 84 – EpaAttribute_Set() descriptions .....	68
Table 85 – EpaRestoreDefaults() descriptions .....	68
Table 86 – EpaNewAddress() descriptions.....	68
Table 87 – Restart_EPAREpeatTimer() descriptions.....	69
Table 88 – EpaClear_DuplicatePdTagFlag() descriptions.....	69
Table 89 – EPAREpeatTimerExpire() descriptions.....	69
Table 90 – EpaSend_EM_ReqRspMessage() descriptions .....	70
Table 91 – EpaSend_EM_CommonErrorRsp() descriptions.....	70
Table 92 – EpaSntpSyncLost() descriptions.....	70
Table 93 – EpaIPAddressCollision() descriptions.....	70
Table 94 – EpaRecvMsg() descriptions.....	71
Table 95 – EpaQueryMatch() descriptions.....	71
Table 96 – EpaMessageIDMatch() descriptions.....	71
Table 97 – EpaDevId_Match() descriptions.....	72
Table 98 – EpaPdTag_Match() descriptions.....	72
Table 99 – EpaSet_Attribute_Data() descriptions.....	72
Table 100 – EpaSet_DuplicatePdTagFlag() descriptions.....	72
Table 101 – Primitives issued by ALU to AAE .....	73
Table 102 – Primitives issued by AAE to ALU .....	73
Table 103 – Primitives parameters exchanged between AAE and ALU.....	73
Table 104 – Primitives issued by AAE to ESME .....	74
Table 105 – Primitives issued by ESME to AAE .....	74
Table 106 – Primitive parameters exchanged between AAE and ESME .....	74
Table 107 – AAE state descriptions .....	74
Table 108 – AAE state transitions (sender) .....	75
Table 109 – AAE state transitions (receiver) .....	76
Table 110 – ServiceType() descriptions .....	77
Table 111 – State value of event management.....	77
Table 112 – Event ASE state transition table .....	78
Table 113 – Domain state value.....	78
Table 114 – Domain ASE state transition table .....	79

Table 115 – Domain_DownloadSucceed() description.....	81
Table 116 – Domain_WriteBuffer() description.....	82
Table 117 – IncrementInvokeDomainCounter() description.....	82
Table 118 – DecrementInvokeDomainCounter() description.....	82
Table 119 – Primitives issued by FME(or AAE) to AREP.....	83
Table 120 – Primitives issued by AREP to FME(or AAE).....	83
Table 121 – Primitives parameters exchanged between AREP and FME(or AAE).....	83
Table 122 – Primitives issued by AREP to ESME.....	83
Table 123 – Primitives issued by ESME to AREP.....	83
Table 124 – Primitive parameters exchanged between AREP and ESME.....	84
Table 125 – AREP state descriptions.....	84
Table 126 – AREP state transitions.....	84
Table 127 – AREPType() descriptions.....	85
Table 128 – ServiceType() descriptions.....	86
Table 129 – The primitives exchanged between transport layer and ESME.....	86
Table 130 – Primitives parameters exchanged between Transport Layer and ESME.....	87
Table 131 – ESME state description.....	87
Table 132 – ECFME state transitions.....	88
Table 133 – ServiceType()description.....	88

(<https://standards.iteh.ai>)  
Document Preview

<https://standards.iteh.ai>  
IEC 61158-6-14:2007

<https://standards.iteh.ai/catalog/standards/iec/bec6d2be-eb36-4148-bc08-7067588383b0/iec-61158-6-14-2007>





## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –  
FIELD BUS SPECIFICATIONS –****Part 6-14: Application layer protocol specification – Type 14 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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

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

International Standard IEC 61158-6-14 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This first edition and its companion parts of the IEC 61158-6 subclauses cancel and replace IEC 61158-4:2003. This edition of this part constitutes a technical addition. This part and its Type 14 companion parts also cancel and replace IEC/PAS 62409, published in 2005.

This edition of IEC 61158-6 includes the following significant changes from the previous edition:

- a) deletion of the former Type 6 fieldbus for lack of market relevance;
- b) addition of new types of fieldbuses;

c) partition of part 6 of the third edition into multiple parts numbered -6-2, -6-3, ...

The text of this standard is based on the following documents:

FDIS	Report on voting
65C/476/FDIS	65C/487/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

NOTE The revision of this standard will be synchronized with the other parts of the IEC 61158 series.

The list of all the parts of the IEC 61158 series, under the general title *Industrial communication networks – Fieldbus specifications*, can be found on the IEC web site.

(<https://standards.iteh.ai>)  
Document Preview

IEC 61158-6-14:2007

<https://standards.iteh.ai/collections/standards/iec/61158-6-14-2007>

## 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.

iTech Standards  
(<https://standards.iteh.ai>)  
Document Preview

<https://standards.iteh.ai/standards/iec/61158-6-14:2007>

<https://standards.iteh.ai/catalog/standards/iec/bc8bd2be-eb36-4148-bc08-7067588383b0/iec-61158-6-14-2007>

WITHDRAWN

## INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

### Part 6-14: Application layer protocol specification – Type 14 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 14 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 specifies interactions between remote applications and defines the externally visible behavior provided by the Type 14 fieldbus application layer in terms of

- a) the formal abstract syntax defining the application layer protocol data units conveyed between communicating application entities;
- b) the transfer syntax defining encoding rules that are applied to the application layer protocol data units;
- c) the application context state machine defining the application service behavior visible between communicating application entities;
- d) the application relationship state machines defining the communication behavior visible between communicating application entities.

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

- 1) define the wire representation of the service primitives defined in IEC 61158-5-14, and
- 2) define the externally visible behavior associated with their transfer.

This standard specifies the protocol of the Type 14 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 61158-5-14.

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 the IEC 61158-6 series.

##### 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 61158-3-14, *Industrial communication networks – Fieldbus specifications – Part 3-14: Data-link layer service definition – Type 14 elements*

IEC 61158-4-14, *Industrial communication networks – Fieldbus specifications – Part 4-14: Data-link layer protocol specification – Type 14 elements*

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

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

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

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 8822, *Information technology – Open Systems Interconnection – Presentation service definition*

ISO/IEC 8824, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*

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

## 3 Terms, definitions, symbols, abbreviations and conventions

For the purposes of this document, the following definitions apply.

### 3.1 Referenced terms and definitions

#### 3.1.1 ISO/IEC 7498-1 terms

For the purposes of this document, the following terms as defined in ISO/IEC 7498-1 apply:

- a) application entity
- b) application process
- c) application protocol data unit
- d) application service element
- e) application entity invocation

- f) application process invocation
- g) application transaction
- h) real open system
- i) transfer syntax

### 3.1.2 ISO/IEC 8822 terms

For the purposes of this document, the following terms as defined in ISO/IEC 8822 apply:

- a) abstract syntax
- b) presentation context

### 3.1.3 ISO/IEC 9545 terms

For the purposes of this document, the following terms as defined in ISO/IEC 9545 apply:

- a) application-association
- b) application-context
- c) application context name
- d) application-entity-invocation
- e) application-entity-type
- f) application-process-invocation
- g) application-process-type
- h) application-service-element
- i) application control service element

### 3.1.4 ISO/IEC 8824 terms

For the purposes of this document, the following terms as defined in ISO/IEC 8824 apply:

- a) object identifier
- b) type

### 3.1.5 Fieldbus data-link Layer terms

For the purposes of this document, the following terms as defined in IEC 61158-3-14 and IEC 61158-4-14 apply.

- a) DL-Time
- b) DL-Scheduling-policy
- c) DLCEP
- d) DLC
- e) DL-connection-oriented mode
- f) DLPDU
- g) DLSDU
- h) DLSAP
- i) link
- j) network address
- k) node address
- l) node
- m) scheduled