

# INTERNATIONAL STANDARD

**Industrial communication networks – Fieldbus specifications –  
Part 6-4: Application layer protocol specification – Type 4 elements**

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

Document Preview

IEC 61158-6-4:2007

<https://standards.iteh.ai/catalog/standards/iec/52729c0d-e1e9-4f3a-b7e5-5f11061a8785/iec-61158-6-4-2007>

WITHDRAWN



## 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 It also gives information on projects, withdrawn and replaced publications.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 61158-6-4

Edition 1.0 2007-12

# INTERNATIONAL STANDARD

Industrial communication networks – Fieldbus specifications –  
Part 6-4: Application layer protocol specification – Type 4 elements

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

IEC 61158-6-4:2007

<https://standards.iteh.ai/catalog/standards/iec/52729c0d-e1e9-4f3a-b7e5-5f11061a8785/iec-61158-6-4-2007>

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

PRICE CODE

W

ICS 35.100.70; 25.040.40

ISBN 2-8318-9476-X

## CONTENTS

FOREWORD.....	5
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.....	10
3.1 Referenced terms and definitions.....	10
3.2 Abbreviations and symbols.....	11
3.3 Conventions.....	11
4 FAL syntax description.....	13
4.1 FAL-AR PDU abstract syntax.....	13
4.2 Data types.....	15
5 Transfer syntaxes.....	15
5.1 APDU encoding.....	15
5.2 Variable object encoding and packing.....	19
5.3 Error codes.....	22
6 FAL protocol state machines.....	22
7 AP-context state machine.....	23
8 FAL service protocol machine (FSPM).....	24
8.1 Primitives exchanged between FAL User and FSPM.....	24
8.2 FSPM states.....	24
9 Application relationship protocol machine (ARPM).....	30
9.1 Primitives exchanged between ARPM and FSPM.....	30
9.2 ARPM States.....	30
10 DLL mapping protocol machine (DMPM).....	32
10.1 Data-link Layer service selection.....	32
10.2 Primitives exchanged between ARPM and DLPM.....	32
10.3 Primitives exchanged between DLPM and data-link layer.....	33
10.4 DLPM states.....	33
11 Protocol options.....	35
Bibliography.....	36
Figure 1 – State transition diagram.....	12
Figure 2 – APDU header structure.....	16
Figure 3 – Instruction subfield of ControlStatus.....	16
Figure 4 – Errorcode subfield of ControlStatus.....	16
Figure 5 – Remaining subfields of ControlStatus.....	17
Figure 6 – DataFieldFormat encoding.....	17
Figure 7 – Structure of request APDU body.....	17
Figure 8 – Structure of response APDU body.....	18
Figure 9 – Variable identifier.....	18

Figure 10 – Code subfield of variable identifier .....	18
Figure 11 – Summary of FAL architecture .....	23
Figure 12 – FSPM proxy object state machine .....	25
Figure 13 – FSPM real object state machine .....	29
Figure 14 – ARPM state machine .....	30
Figure 15 – DLPM state machine .....	33
Table 1 – State machine description elements .....	12
Table 2 – APDU header .....	13
Table 3 – APDU body .....	14
Table 4 – Transfer syntax for Array .....	20
Table 5 – Transfer syntax for Structure .....	21
Table 6 – Common variable object attributes .....	21
Table 7 – Variable type identifiers .....	21
Table 8 – FIFO variable object attributes .....	22
Table 9 – Error codes .....	22
Table 10 – Primitives exchanged between FAL-User and FSPM .....	24
Table 11 – REQUEST.req FSPM constraints .....	25
Table 12 – REQUEST.req FSPM actions .....	26
Table 13 – RESPONSE.cnf FSPM constraints .....	27
Table 14 – RESPONSE.cnf FSPM actions .....	28
Table 15 – AR Send.ind proxy FSPM constraints .....	28
Table 16 – AR Send.ind proxy FSPM actions .....	28
Table 17 – AR Send.ind real FSPM constraints .....	29
Table 18 – AR Send.ind real FSPM Actions .....	29
Table 19 – Primitives issued by FSPM to ARPM .....	30
Table 20 – Primitives issued by ARPM to FSPM .....	30
Table 21 – Primitives issued by ARPM to ARPM .....	30
Table 22 – AR Send.req ARPM constraints .....	31
Table 23 – AR Send.req ARPM actions .....	31
Table 24 – AR Acknowledge.req ARPM constraints .....	31
Table 25 – AR Acknowledge.req ARPM actions .....	31
Table 26 – AR Send.ind ARPM constraints .....	31
Table 27 – AR Send.req ARPM actions .....	32
Table 28 – Primitives issued by ARPM to DLPM .....	33
Table 29 – Primitives issued by DLPM to ARPM .....	33
Table 30 – Primitives issued by DLPM to data-link layer .....	33
Table 31 – Primitives issued by data-link layer to DLPM .....	33
Table 32 – AR Send.req DLPM constraints .....	34
Table 33 – AR Send.req DLPM actions .....	34
Table 34 – AR Acknowledge.req DLPM constraints .....	34
Table 35 – AR Acknowledge.req DLPM actions .....	34
Table 36 – DL-UNITDATA.ind DLPM constraints .....	35

Table 37 – DL-UNITDATA.ind DLPM actions..... 35

Withhold

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

<https://standards.iteh.ai/standards/iec/52729c0d-e1e9-4f3a-b7e5-5f11061a8785/iec-61158-6-4-2007>

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –  
FIELDBUS SPECIFICATIONS –****Part 6-4: Application layer protocol specification – Type 4 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 of 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 of their respective intellectual-property-right holders.

International Standard IEC 61158-6-4 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 subseries cancel and replace IEC 61158-6:2003. This edition of this part constitutes a technical addition. This part and its Type 4 companion parts also cancel and replace IEC/PAS 62412, 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.

Withdrawing

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

IEC 61158-6-4:2007

<https://standards.iteh.ai/standards/iec/52729c0d-e1e9-4f3a-b7e5-5f11061a8785/iec-61158-6-4-2007>



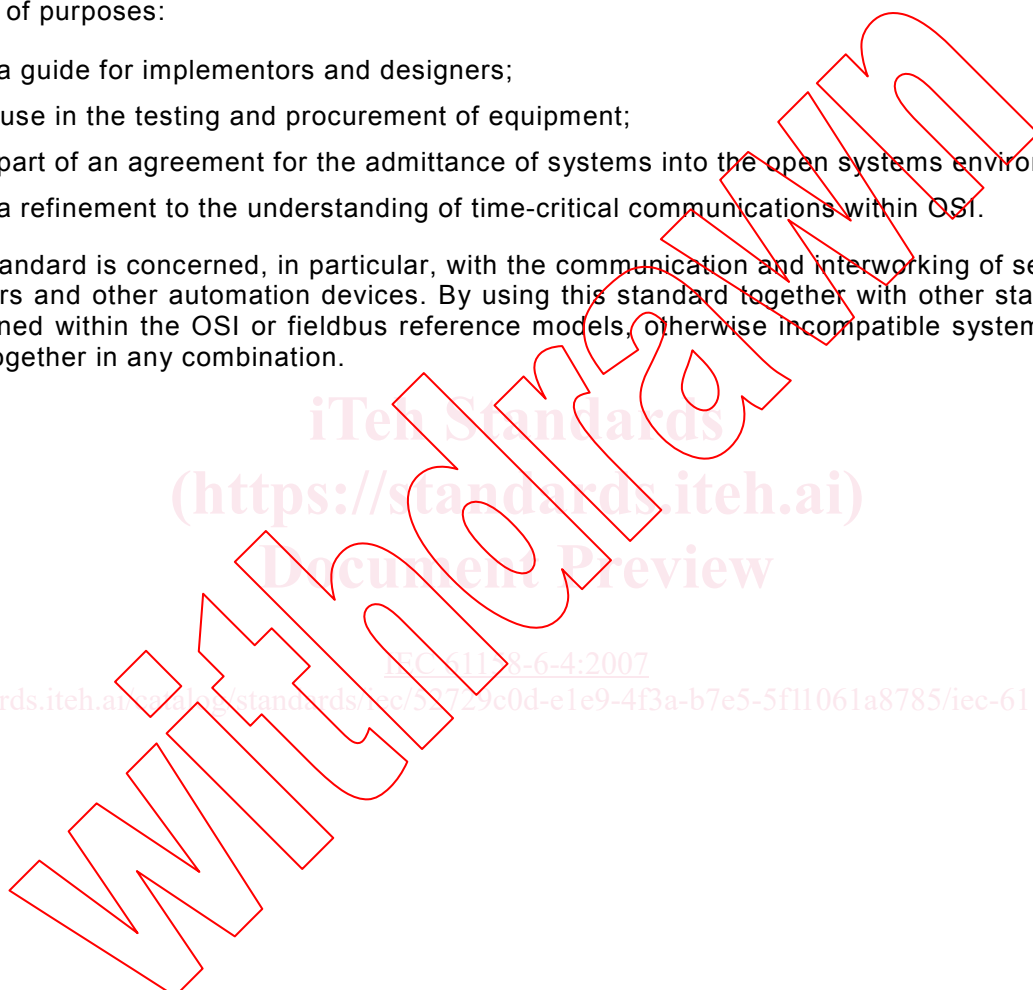
## INTRODUCTION

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/iec/61158-6-4:2007>

<https://standards.iteh.ai/iec/61158-6-4:2007>

## INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

### Part 6-4: Application layer protocol specification – Type 4 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 4 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 4 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 61158-5-4, and
- 2) define the externally visible behavior associated with their transfer.

This standard specifies the protocol of the Type 4 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 61158-5-4.

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 do not specify individual implementations or products, nor do they 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 61158-3-4, *Industrial communication networks – Fieldbus specifications – Part 3-4: Data-link layer service definition – Type 4 elements*

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

IEC 61158-5-4, *Industrial communication networks – Fieldbus specifications – Part 5-4: Application layer service definition – Type 4 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 8822, *Information technology – Open Systems Interconnection – Presentation service definition*

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

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 61158-3-4 and IEC 61158-4-4 apply.

- a) DL-Time