

# INTERNATIONAL STANDARD



**Industrial communication networks – Fieldbus specifications –  
Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series**



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2019 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

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[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 corrigendum or an amendment might have been published.

### IEC publications search - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

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 It also gives information on projects, replaced and withdrawn publications.

### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

### IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [sales@iec.ch](mailto:sales@iec.ch).

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

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

### IEC Glossary - [webstore.iec.ch/glossary](http://webstore.iec.ch/glossary)

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

# INTERNATIONAL STANDARD



---

**Industrial communication networks – Fieldbus specifications –  
Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 25.040.40; 33.040.40; 35.100.05

ISBN 978-2-8322-6723-3

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	6
1 Scope.....	8
2 Normative references .....	8
3 Terms, definitions and abbreviated terms .....	8
3.1 Terms and definitions.....	8
3.2 Abbreviations.....	9
4 Guidelines for implementers and users.....	9
4.1 Background and purpose .....	9
4.2 Supported options.....	9
4.3 Benefits from using a common and formal style .....	10
5 Concept of the IEC 61158 series .....	11
6 Mapping onto the OSI Basic Reference Model .....	13
6.1 Overview.....	13
6.2 Physical layer service and protocol .....	14
6.3 Data-link layer service .....	14
6.4 Data-link layer protocol .....	15
6.5 Application layer service .....	15
6.6 Application layer protocol.....	16
7 Structure of IEC 61158 and IEC 61784 series.....	17
7.1 The IEC 61158 physical layer .....	17
7.2 The IEC 61158 data-link layer.....	17
7.3 The IEC 61158 application layer .....	18
7.4 IEC 61784-1 and IEC 61784-2 fieldbus profiles.....	18
7.5 IEC 61784-3 functional safety communication profiles.....	22
7.5.1 General .....	22
7.5.2 General concepts and technology-specific profiles.....	22
7.5.3 Assessment Guidelines .....	24
7.6 IEC 61784-5 installation profiles .....	24
7.7 Communication profiles for wireless communication networks.....	26
8 Brief summary of the characteristics of service and protocol for each fieldbus type .....	27
8.1 Summary of the physical layer service and protocol characteristics.....	27
8.1.1 Type 1: Media.....	27
8.1.2 Type 2: Coaxial wire and optical media.....	27
8.1.3 Type 3: Twisted-pair wire and optical media .....	27
8.1.4 Type 4: Wire medium.....	28
8.1.5 Type 5: Wire and optical media.....	28
8.1.6 Type 6: Void .....	28
8.1.7 Type 7: Wire and optical media.....	28
8.1.8 Type 8: Twisted-pair wire and optical media .....	28
8.1.9 Type 9: Wire and optical media.....	28
8.1.10 Type 10: Wire, optical media and wireless .....	28
8.1.11 Type 11: Wire and optical media.....	28
8.1.12 Type 12: Wire and optical media.....	28
8.1.13 Type 13: Wire and optical media.....	28
8.1.14 Type 14: Wire and optical media.....	28
8.1.15 Type 15: Wire and optical media.....	29

8.1.16	Type 16: Optical media .....	29
8.1.17	Type 17: Wire and optical media .....	29
8.1.18	Type 18: Media .....	29
8.1.19	Type 19: Wire and optical media .....	29
8.1.20	Type 20 .....	29
8.1.21	Type 21: Wire and optical media .....	29
8.1.22	Type 22: Wire and optical media .....	29
8.1.23	Type 23: Wire and optical media .....	29
8.1.24	Type 24: Twisted-pair wire media .....	29
8.1.25	Type 25: .....	29
8.1.26	Type 26: Wire and optical media .....	29
8.2	Summary of data-link layer service characteristics .....	30
8.3	Summary of data-link layer protocol characteristics .....	31
8.4	Summary of application layer service characteristics .....	33
8.5	Summary of application layer protocol characteristics .....	34
9	Application layer service description concepts .....	37
9.1	Overview .....	37
9.2	Architectural relationships .....	37
9.2.1	Relationship to the application layer of the OSI Basic Reference Model .....	37
9.2.2	Relationships to other fieldbus entities .....	38
9.3	Fieldbus application layer structure .....	39
9.3.1	Overview .....	39
9.3.2	Fundamental concepts .....	40
9.3.3	Fieldbus application processes .....	40
9.3.4	Application process objects .....	44
9.3.5	Application entities .....	46
9.3.6	Fieldbus application service elements .....	46
9.3.7	Application relationships .....	50
9.4	Fieldbus application layer naming and addressing .....	52
9.4.1	General .....	52
9.4.2	Identifying objects accessed through the FAL .....	52
9.4.3	Addressing objects accessed through the FAL .....	53
9.5	Architecture summary .....	53
9.6	Notional FAL service procedures .....	54
9.6.1	Notional FAL confirmed service procedures .....	54
9.6.2	Notional FAL unconfirmed service procedures .....	54
9.7	Common FAL attributes .....	55
9.8	Common FAL service parameters .....	55
9.9	APDU size .....	56
10	Data type ASE .....	56
10.1	Overview .....	56
10.1.1	General .....	56
10.1.2	Overview of basic types .....	57
10.1.3	Overview of fixed-length types .....	58
10.1.4	Overview of constructed types .....	58
10.1.5	Specification of user-defined data types .....	58
10.1.6	Transfer of user data .....	58
10.2	Formal definition of data type objects .....	59
10.2.1	Data type class .....	59

11	Fieldbus system requirements .....	60
11.1	General.....	60
11.2	Industrial control network .....	61
11.3	Communication between industrial control networks and other networks.....	61
11.4	Quality of service features of an industrial control network.....	61
11.4.1	General .....	61
11.4.2	Control data transfer mechanisms .....	62
11.5	Special requirements for wireless networks.....	63
Annex A	(informative) Trade name declarations .....	64
Annex B	(informative) Media selection for fieldbus systems .....	67
B.1	General.....	67
B.2	Cabled media.....	67
B.3	Wireless media .....	67
B.4	Media needing special consideration.....	67
B.5	Performance characteristics of open and public networks .....	67
B.5.1	Public network types.....	67
B.5.2	Performance characteristics of public networks .....	68
Bibliography	.....	69
Figure 1	– Example of a fieldbus system.....	11
Figure 2	– Concept of DL/AL to separate service and protocol parts .....	12
Figure 3	– Basic fieldbus reference model .....	13
Figure 4	– General model of physical layer .....	14
Figure 5	– Relationship of the Data-link layer to other fieldbus layers and to users of the fieldbus data-link service.....	15
Figure 6	– Relationship of the fieldbus Application layer to other fieldbus layers and to users of the fieldbus application service.....	16
Figure 7	– Structure of communication profile families .....	19
Figure 8	– Example of a CPF structure .....	20
Figure 9	– Document structure of IEC 61918 and the CPF specific part of IEC 61784-5.....	26
Figure 10	– Relationship to the OSI Basic Reference Model .....	38
Figure 11	– Architectural positioning of the fieldbus application layer.....	38
Figure 12	– Client/server interactions.....	41
Figure 13	– Pull model interactions .....	42
Figure 14	– Push model interactions .....	43
Figure 15	– APOs services conveyed by the FAL .....	44
Figure 16	– Application entity structure .....	46
Figure 17	– Example FAL ASEs .....	48
Figure 18	– FAL management of objects .....	48
Figure 19	– ASE service conveyance .....	49
Figure 20	– Defined and established AREPs .....	52
Figure 21	– FAL architectural components .....	53
Figure 22	– Data-type class hierarchy example.....	57

Table 1 – OSI and IEC 61158 layers ..... 13

Table 2 – CPF, CP, and type relations ..... 21

Table 3 – Types of timeliness defined for publisher/subscriber interactions..... 43

Table A.1 – Trade names of CPFs and CPs ..... 64

Currently in preview, click buy full version

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –  
FIELD BUS SPECIFICATIONS –****Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series**

## 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, accept 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 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 layer protocol type to be used with other layer protocols of the same type, or in other type combinations explicitly authorized by their respective intellectual property right holders.

NOTE – Combinations of protocol types are specified in IEC 61784-1 and IEC 61784-2.

International Standard IEC 61158-1 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

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

- updates of the references to and information about the IEC 61158 series, IEC 61784-1, IEC 61784-3, IEC 61784-5 series and IEC 61918 throughout the document;
- new Type 25 and the related profile family CPF 20;
- new Type 26 and the related profile family CPF 21.

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

FDIS	Report on voting
65C/944/FDIS	65C/953/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 document has been drafted in accordance with the ISO/IEC Directives, Part 1.

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

# INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

## Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series

### 1 Scope

This part of IEC 61158 specifies the generic concept of fieldbuses.

This document also presents an overview and guidance for the IEC 61158 series by:

- explaining the structure and content of the IEC 61158 series;
- relating the structure of the IEC 61158 series to the ISO/IEC 7498-1 OSI Basic Reference Model;
- showing the logical structure of the IEC 61784 series;
- showing how to use parts of the IEC 61158 series in combination with the IEC 61784 series;
- providing explanations of some aspects of the IEC 61158 series that are common to the type specific parts of the IEC 61158-5 including the application layer service description concepts and the generic fieldbus data types.

### 2 Normative references

There are no normative references in this document.

### 3 Terms, definitions and abbreviated terms

#### 3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

##### 3.1.1

#### communication system

arrangement of hardware, software and propagation media to allow the transfer of messages from one application to another

##### 3.1.2

#### fieldbus

communication system based on serial data transfer as typically used in industrial automation and process control applications

##### 3.1.3

#### fieldbus system

system using a fieldbus with connected devices