

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

**Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 1: Vue d'ensemble et recommandations pour les séries IEC 61158 et
IEC 61784**



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.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
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

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 It also gives information on projects, replaced and withdrawn publications.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

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

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

Electropedia - 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 - std.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.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

**Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 1: Vue d'ensemble et recommandations pour les séries IEC 61158 et
IEC 61784**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 25.040.40; 33.040.40; 35.100.05

ISBN 978-2-8322-7953-3

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

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.....	10
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	16
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.....	23
7.5.1 General	23
7.5.2 General concepts and technology-specific profiles.....	23
7.5.3 Assessment Guideline	25
7.6 IEC 61784-5 installation profiles	25
7.7 Communication profiles for wireless communication networks.....	27
8 Brief summary of the characteristics of service and protocol for each fieldbus type	28
8.1 Summary of the physical layer service and protocol characteristics.....	28
8.1.1 Type 1: media.....	28
8.1.2 Type 2: Coaxial wire and optical media.....	28
8.1.3 Type 3: Twisted-pair wire and optical media	28
8.1.4 Type 4: Wire medium.....	29
8.1.5 Type 5: Wire and optical media.....	29
8.1.6 Type 6: Void	29
8.1.7 Type 7: Wire and optical media.....	29
8.1.8 Type 8: Twisted-pair wire and optical media	29
8.1.9 Type 9: Wire and optical media.....	29
8.1.10 Type 10: Wire, optical media and wireless	29
8.1.11 Type 11: Wire and optical media.....	29
8.1.12 Type 12: Wire and optical media.....	29
8.1.13 Type 13: Wire and optical media.....	29
8.1.14 Type 14: Wire and optical media.....	29
8.1.15 Type 15: Wire and optical media.....	30

8.1.16	Type 16: Optical media	30
8.1.17	Type 17: Wire and optical media	30
8.1.18	Type 18: Media	30
8.1.19	Type 19: Wire and optical media	30
8.1.20	Type 20	30
8.1.21	Type 21: Wire and optical media	30
8.1.22	Type 22: Wire and optical media	30
8.1.23	Type 23: Wire and optical media	30
8.1.24	Type 24: Twisted-pair wire media	30
8.1.25	Type 25:	30
8.1.26	Type 26: Wire and optical media	30
8.2	Summary of data-link layer service characteristics	31
8.3	Summary of data-link layer protocol characteristics	32
8.4	Summary of application layer service characteristics	34
8.5	Summary of application layer protocol characteristics	35
9	Application layer service description concepts	38
9.1	Overview	38
9.2	Architectural relationships	38
9.2.1	Relationship to the application layer of the OSI Basic Reference Model	38
9.2.2	Relationships to other fieldbus entities	39
9.3	Fieldbus application layer structure	40
9.3.1	Overview	40
9.3.2	Fundamental concepts	41
9.3.3	Fieldbus application processes	41
9.3.4	Application process objects	45
9.3.5	Application entities	47
9.3.6	Fieldbus application service elements	47
9.3.7	Application relationships	51
9.4	Fieldbus application layer naming and addressing	53
9.4.1	General	53
9.4.2	Identifying objects accessed through the FAL	53
9.4.3	Addressing APs accessed through the FAL	54
9.5	Architecture summary	54
9.6	Notional FAL service procedures	55
9.6.1	Notional FAL confirmed service procedures	55
9.6.2	Notional FAL unconfirmed service procedures	55
9.7	Common FAL attributes	56
9.8	Common FAL service parameters	56
9.9	APDU size	57
10	Data type ASE	57
10.1	Overview	57
10.1.1	General	57
10.1.2	Overview of basic types	58
10.1.3	Overview of fixed-length types	59
10.1.4	Overview of constructed types	59
10.1.5	Specification of user-defined data types	59
10.1.6	Transfer of user data	59
10.2	Formal definition of data type objects	60
10.2.1	Data type class	60

11	Fieldbus system requirements	61
11.1	General.....	61
11.2	Industrial control network	62
11.3	Communication between industrial control networks and other networks	62
11.4	Quality of service features of an industrial control network	62
11.4.1	General	62
11.4.2	Control data transfer mechanisms	63
11.5	Special requirements for wireless networks.....	64
Annex A	(informative) Trade name declarations	65
Annex B	(informative) Media selection for fieldbus systems	68
B.1	General.....	68
B.2	Cabled media.....	68
B.3	Wireless media	68
B.4	Media needing special consideration.....	68
B.5	Performance characteristics of open and public networks	68
B.5.1	Public network types.....	68
B.5.2	Performance characteristics of public networks	69
Bibliography	70
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	20
Figure 8	– Example of a CPF structure	21
Figure 9	– Document structure of IEC 61918 and the CPF specific part of IEC 61784-5.....	27
Figure 10	– Relationship to the OSI Basic Reference Model	39
Figure 11	– Architectural positioning of the fieldbus application layer.....	39
Figure 12	– Client/server interactions.....	42
Figure 13	– Pull model interactions	43
Figure 14	– Push model interactions	44
Figure 15	– APOs services conveyed by the FAL	45
Figure 16	– Application entity structure	47
Figure 17	– Example FAL ASEs	49
Figure 18	– FAL management of objects	49
Figure 19	– ASE service conveyance	50
Figure 20	– Defined and established AREPs	53
Figure 21	– FAL architectural components	54
Figure 22	– Data-type class hierarchy example	58

Table 1 – OSI and IEC 61158 layers 13
Table 2 – CPF, CP, and type relations 22
Table 3 – Types of timeliness defined for publisher/subscriber interactions..... 44
Table A.1 – Trade names of CPFs and CPs 65

Withdrawn

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS 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, access to 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 bilingual version (2020-03) corresponds to the monolingual English version, published in 2019-04.

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.

The French version of this standard has not been voted upon.

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

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 web site.

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.

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.