IEC 61784-5-3

Edition 4.1 2024-03
CONSOLIDATED VERSION

INTERNATIONAL STANDARD

colour inside

Industrial communication networks – Profiles – Part 5-3: Installation of fieldbuses – Installation profiles for CPF 3



IEC 61784-5-3:2018-08+AMD1:2024-03 CSV(en)

THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2024 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 Secretariat
3, rue de Varembé
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 It also gives information on projects, replaced and withdrawn publications.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.

IEC Products & Services Portal - products.iec.ch
Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC 61784-5-3

Edition 4.1 2024-03
CONSOLIDATED VERSION

INTERNATIONAL STANDARD

colour inside

Industrial communication networks – Profiles – Part 5-3: Installation of fieldbuses – Installation profiles for CPF 3

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 25.040.40; 35.100.40

ISBN 978-2-8322-8672-2

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

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 7
INTRODUCTION 9
INTRODUCTION to Amendment 1 11
1 Scope 12
2 Normative references 12
3 Terms, definitions and abbreviated terms 12
4 CPF 3: Overview of installation profiles 13
5 Installation profile conventions 13
6 Conformance to installation profiles 14
Annex A (normative) CP 3/1 (PROFIBUS) specific installation profile 15
A.1 Installation profile scope 15
A.2 Normative references 15
A.3 Installation profile terms, definitions, and abbreviated terms 15
A.3.1 Terms and definitions 15
A.3.2 Abbreviated terms 16
A.3.3 Conventions for installation profiles 16
A.4 Installation planning 16
A.4.1 General 16
A.4.2 Planning requirements 16
A.4.3 Network capabilities 18
A.4.4 Selection and use of cabling components 20
A.4.5 Cabling planning documentation 30
A.4.6 Verification of cabling planning specification 30
A.5 Installation implementation 30
A.5.1 General requirements 30
A.5.2 Cable installation 30
A.5.3 Connector installation 32
A.5.4 Terminator installation 36
A.5.5 Device installation 36
A.5.6 Coding and labelling 36
A.5.7 Earthing and bonding of equipment and device and shielded cabling 37
A.5.8 As-implemented cabling documentation 38
A.6 Installation verification and installation acceptance test 38
A.6.1 General 38
A.6.2 Installation verification 38
A.6.3 Installation acceptance test 40
A.7 Installation administration 45
A.8 Installation maintenance and installation troubleshooting 45
Annex B (normative) CP 3/2 (PROFIBUS) specific installation profile 46
B.1 Installation profile scope 46
B.2 Normative references 46
B.3 Installation profile terms, definitions, and abbreviated terms 46
B.3.1 Terms and definitions 46
B.3.2 Abbreviated terms 47
B.3.3 Conventions for installation profiles 47
B.4 Installation planning 48

B.4.1 General 48
B.4.2 Planning requirements 49
B.4.3 Network capabilities 56
B.4.4 Selection and use of cabling components 62
B.4.5 Cabling planning documentation 77
B.4.6 Verification of cabling planning specification 77
B.5 Installation implementation 77
B.5.1 General requirements 77
B.5.2 Cable installation 77
B.5.3 Connector installation 78
B.5.4 Terminator installation 79
B.5.5 Device installation 79
B.5.6 Coding and labelling 79
B.5.7 Earthing and bonding of equipment and device and shielded cabling 79
B.5.8 As-implemented cabling documentation 79
B.6 Installation verification and installation acceptance test 79
B.6.1 General 79
B.6.2 Installation verification 80
B.6.3 Installation acceptance test 80
B.7 Installation administration 81
B.8 Installation maintenance and installation troubleshooting 81
Annex C (normative) CP 3/3, CP 3/4, CP 3/5, CP 3/6 (PROFINET) specific installation profile 82
C.1 Installation profile scope 82
C.2 Normative references 82
C.3 Installation profile terms, definitions, and abbreviated terms 82
C.3.1 Terms and definitions 82
C.3.2 Abbreviated terms 82
C.3.3 Conventions for installation profiles 83
C.4 Installation planning 83
C.4.1 General 83
C.4.2 Planning requirements 83
C.4.3 Network capabilities 83
C.4.4 Selection and use of cabling components 86
C.4.5 Cabling planning documentation 108
C.4.6 Verification of cabling planning specification 108
C.5 Installation implementation 108
C.5.1 General requirements 108
C.5.2 Cable installation 108
C.5.3 Connector installation 110
C.5.4 Terminator installation 112
C.5.5 Device installation 112
C.5.6 Coding and labelling 112
C.5.7 Earthing and bonding of equipment and device and shielded cabling 113
C.5.8 As-implemented cabling documentation 114
C.6 Installation verification and installation acceptance test 114
C.6.1 General 114
C.6.2 Installation verification 114
C.6.3 Installation acceptance test 115

C.7 Installation administration 116
C.8 Installation maintenance and installation troubleshooting 116
Bibliography 117

Figure 1 – Standards relationships 10
Figure A.1 – Recommended combination of shielding and earthing for CP 3/1 networks with RS 485-IS 28
Figure A.2 – Sub-D connector pin numberings (front view) 33
Figure A.3 – 5-pin M12 female socket 34
Figure A.4 – 5-pin M12 male plug for CP 3/1 35
Figure A.5 – Test circuit A – Resistance measurement of data line B and shield 41
Figure A.6 – Test circuit B – Resistance measurement of data line A and shield 41
Figure A.7 – Test circuit C – Resistance measurement of data line A, data line B, and shield 41
Figure A.8 – Test circuit D – Resistance measurement between data line A and B 42
Figure A.9 – Resistance measurement without 9-pin Sub-D plug 42
Figure A.10 – Loop core resistance (cable type A) 43
Figure A.11 – Action and resolution tree for measurement 1 (RS 485 and RS 485-IS) 43
Figure A.12 – Action and resolution tree for measurement 2 (RS 485 and RS 485-IS) 44
Figure A.13 – Action and resolution tree for measurement 3 (RS 485 and RS 485-IS) 44
Figure B.1 – Connection of CP 3/1 networks 49
Figure B.2 – Typical fieldbus architecture 52
Figure B.3 – Fieldbus with stations supplied by auxiliary power sources 52
Figure B.4 – Fieldbus model 55
Figure B.5 – Current modulation (Manchester II code) 55
Figure B.6 – Tree topology 57
Figure B.7 – Bus topology 57
Figure B.8 – Combination of the tree topology and the bus topology 58
Figure B.9 – Fieldbus extension 58
Figure B.10 – Recommended combination of shielding and earthing 72
Figure B.11 – Ideal combination of shielding and earthing 73
Figure B.12 – Capacitive earthing 74
Figure B.13 – Galvanic isolated field device 75
Figure B.14 – Pin assignment of the male and female connectors IEC 60947-5-2 (A-coding) 79
Figure C.1 – Definition of End-to-end link 103
Figure C.2 – End-to-end link without interconnections 103
Figure C.3 – Assembled End-to-end link 103
Figure C.4 – Connectionless optical fibre link 104
Figure C.5 – Assembled optical fibre link 104
Figure C.6 – Shielded connectors for CP 3/3, CP 3/4, CP 3/5 and CP 3/6 fieldbus networks 110
Figure C.7 – Pin-assignment for a straight cable 111

Table A.1 – Excerpt of MICE definition 18

Table A.2 – Basic network characteristics for balanced cabling not based on Ethernet (ISO/IEC 8802-3) 19
Table A.3 – Network characteristics for optical fibre cabling 20
Table A.4 – Information relevant to copper cable: fixed cables 21
Table A.5 – Information relevant to optical fibre cables 22
Table A.6 – Connectors for copper cabling CPs not based on Ethernet 23
Table A.7 – Optical fibre connecting hardware 23
Table A.8 – Relationship between FOC and fibre types (CP 3/1) 23
Table A.9 – Parameters for balanced cables 31
Table A.10 – Parameters for silica optical fibre cables 31
Table A.11 – Parameters for POF optical fibre cables 31
Table A.12 – Parameters for hard clad silica optical fibre cables 32
Table A.13 – Use of 9 pin Sub-D connector pins (RS 485) 33
Table A.14 – Use of 9 pin Sub-D connector pins (RS 485-IS) 34
Table A.15 – Use of M12 connector pins (RS 485) 35
Table A.16 – Use of M12 connector pins (RS 485-IS) 36
Table A.17 – Maximum fibre channel attenuation for CP 3/1 (PROFIBUS) 45
Table B.1 – Valid parameter range of the FISCO model for use as EEx ib IIC / IIB 53
Table B.2 – Valid parameter range of the FISCO model for use as EEx ia IIC 54
Table B.3 – Power supply (operational values) 60
Table B.4 – Line lengths which can be achieved 60
Table B.5 – Limit values for distortion, reflection and signal delay 61
Table B.6 – Recommended maximum cable lengths including spurs 61
Table B.7 – Recommended length of the spurs 62
Table B.8 – Maximum length of the splices 62
Table B.9 – Information relevant to copper cable: fixed cables 63
Table B.10 – Safety limit values for the fieldbus cable 64
Table B.11 – Connectors for copper cabling CPs not based on Ethernet 65
Table B.12 – Mixing devices from different categories 67
Table B.13 – Electrical characteristics of fieldbus interfaces 68
Table B.14 – Recommended data sheet specifications for CP 3/2 devices 69
Table B.15 – Parameters for balanced cables 77
Table B.16 – Contact assignments for the external connector for harsh industrial environments 78
Table C.1 – General transmission media selection information 84
Table C.2 – Network characteristics for balanced cabling based on Ethernet (ISO/IEC 8802-3) 85
Table C.3 – Network characteristics for optical fibre cabling 85
Table C.4 – Information relevant to copper cable: CP 3/3, CP 3/4, CP 3/5 and CP 3/6 type A fixed cables 87
Table C.5 – Information relevant to copper cable: CP 3/3, CP 3/4, CP 3/5 and CP 3/6 type B flexible cables 88
Table C.6 – Information relevant to copper cable: CP 3/3, CP 3/4, CP 3/5 and CP 3/6 type C special cables 89

Table C.7 – Information relevant to copper cable: CP 3/3, CP 3/4, CP 3/5 and CP 3/6 of cabinet cord sets 90
Table C.8 – Requirement data cable inside and outside cabinet: CP 3/3, CP 3/4, CP 3/5 and CP 3/6 type B flexible cables 91
Table C.9 – Requirement to copper cable inside and outside cabinet: CP 3/3, CP 3/4, CP 3/5 and CP 3/6 type B flexible cables 92
Table C.10 – Information relevant to optical fibre cables 93
Table C.11 – Requirements for plastic and hard clad silica optical fibre cables 93
Table C.12 – Requirements for glass multimode optical fibre cables 95
Table C.13 – Requirements for glass singlemode optical fibre cables 96
Table C.14 – Requirements of industrial FO-cord sets 97
Table C.15 – Standard of test of industrial FO-cord sets 98
Table C.16 – Information relevant to hybrid cables (application type B) 98
Table C.17 – Information relevant to hybrid cables (application type C) 99
Table C.18 – Connectors for balanced cabling CPs based on Ethernet 101
Table C.19 – Connectors for balanced cabling CPs not based on Ethernet 101
Table C.20 – Connectors for balanced cabling CPs based on Ethernet 101
Table C.21 – Optical fibre connecting hardware 102
Table C.22 – Relationship between FOC and fibre types (CP 3/3, CP 3/4, CP 3/5, CP3/6) 102
Table C.23 – Typical fibre channels common for industrial applications. 105
Table C.24 – Parameters for balanced cables 109
Table C.25 – Parameters for silica optical fibre cables 109
Table C.26 – Parameters for POF optical fibre cables 109
Table C.27 – Parameters for hard clad silica optical fibre cables 110
Table C.28 – Colour coding of 2 pair cabling for CP 3/3, CP 3/4, CP 3/5 and CP 3/6 connectors 111
Table C.29 – Colour coding of 4 pair cabling for CP 3/3, CP 3/4, CP 3/5 and CP 3/6 connectors 111
Table C.30 – Contact arrangement M12 2 pair to M12 4 pair for CP 3/3, CP 3/4, CP 3/5 and CP 3/6 connectors 112
Table C.31 – Maximum fibre channel attenuation for CP 3/3, CP 3/4, CP 3/5 and CP 3/6 (PROFINET) 116

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

INDUSTRIAL COMMUNICATION NETWORKS – PROFILES –

Part 5-3: Installation of fieldbuses – Installation profiles for CPF 3

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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 61784-5-3 edition 4.1 contains the fourth edition (2013-11) [documents 65C/924/FDIS and 65C/925/RVD] and its amendment 1 (2024-03) [documents 65C/1283/FDIS and 65C/1297/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 61784-5-3 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This document is to be used in conjunction with IEC 61918:2018, IEC 61918:2018/AMD1:2022 and IEC 61918:2018/AMD2:2024.

This fourth edition constitutes a technical revision.

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

a) an addition of 4-pair cabling (see C.4.4.1.2.1and C.5.3.2);
b) an addition of the connector M12 X-Coding (see C.4.4.2.2);
c) an addition of the definition of End-to-end links (see C.4.4.3.1);
d) a revision of Table C.17 (see C.5.2.1);
e) a formula for the NEXT limits of End-to-end links (see C.6.3.2.1.2).

~~This standard is to be used in conjunction with IEC 61918:2018~~

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

A list of all parts of IEC 61784-5 series, under the general title *Industrial communication networks – Profiles – Installation of fieldbuses*, can be found on the IEC website.

The committee has decided that the contents of this document and its amendment will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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.

INTRODUCTION

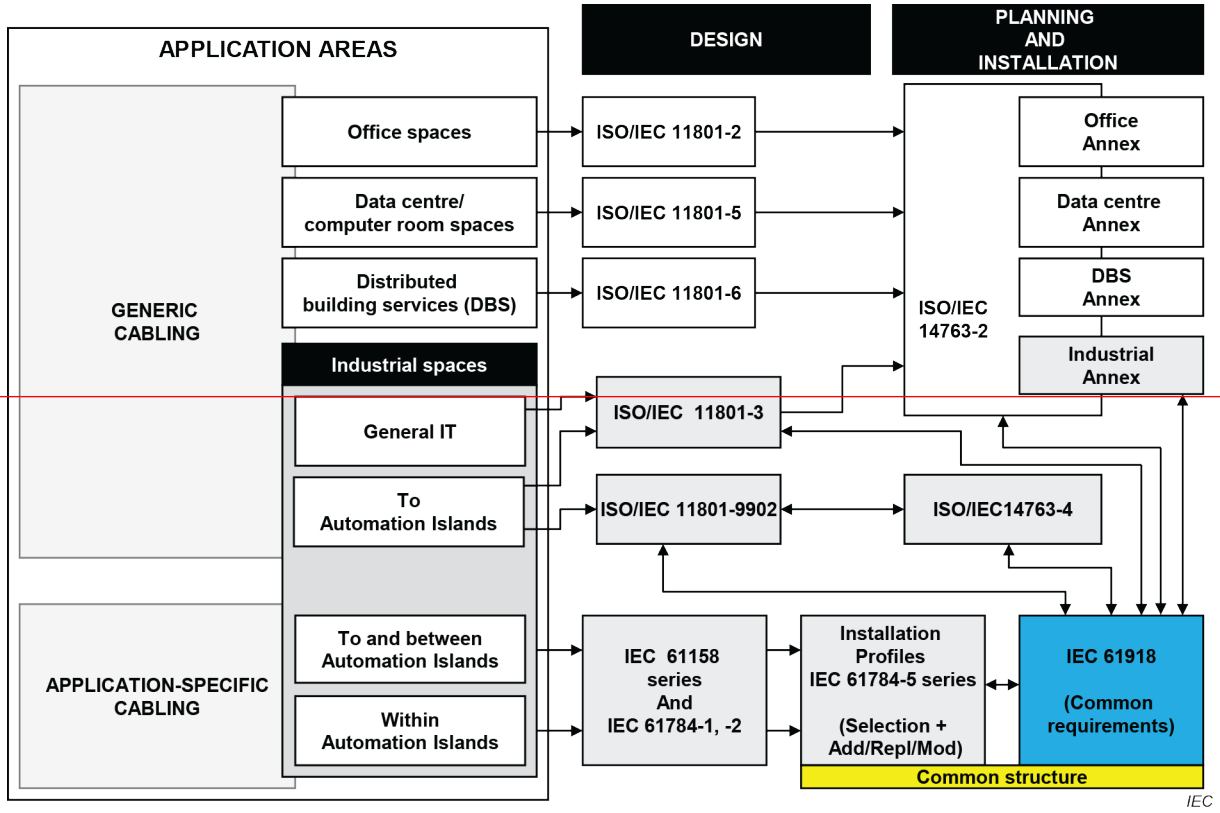
This ~~International Standard~~ document is one of a series produced to facilitate the use of communication networks in industrial control systems.

IEC 61918:2018, IEC 61918:2018/AMD1:2022 and IEC 61918:2018/AMD2:2024 provide~~s~~ the common requirements for the installation of communication networks in industrial control systems. This installation profile standard provides the installation profiles of the communication profiles (CP) of a specific communication profile family (CPF) by stating which requirements of IEC 61918 fully apply and, where necessary, by supplementing, modifying, or replacing the other requirements (see Figure 1).

For general background on fieldbuses, their profiles, and relationship between the installation profiles specified in this document, see IEC 61158-1.

Each CP installation profile is specified in a separate annex of this document. Each annex is structured exactly as the reference standard IEC 61918 for the benefit of the persons representing the roles in the fieldbus installation process as defined in IEC 61918 (planner, installer, verification personnel, validation personnel, maintenance personnel, administration personnel). By reading the installation profile in conjunction with IEC 61918, these persons immediately know which requirements are common for the installation of all CPs and which are modified or replaced. The conventions used to draft this document are defined in Clause 5.

The provision of the installation profiles in one standard for each CPF (for example IEC 61784-5-3 for CPF 3)~~,~~ allows readers to work with standards of a convenient size.



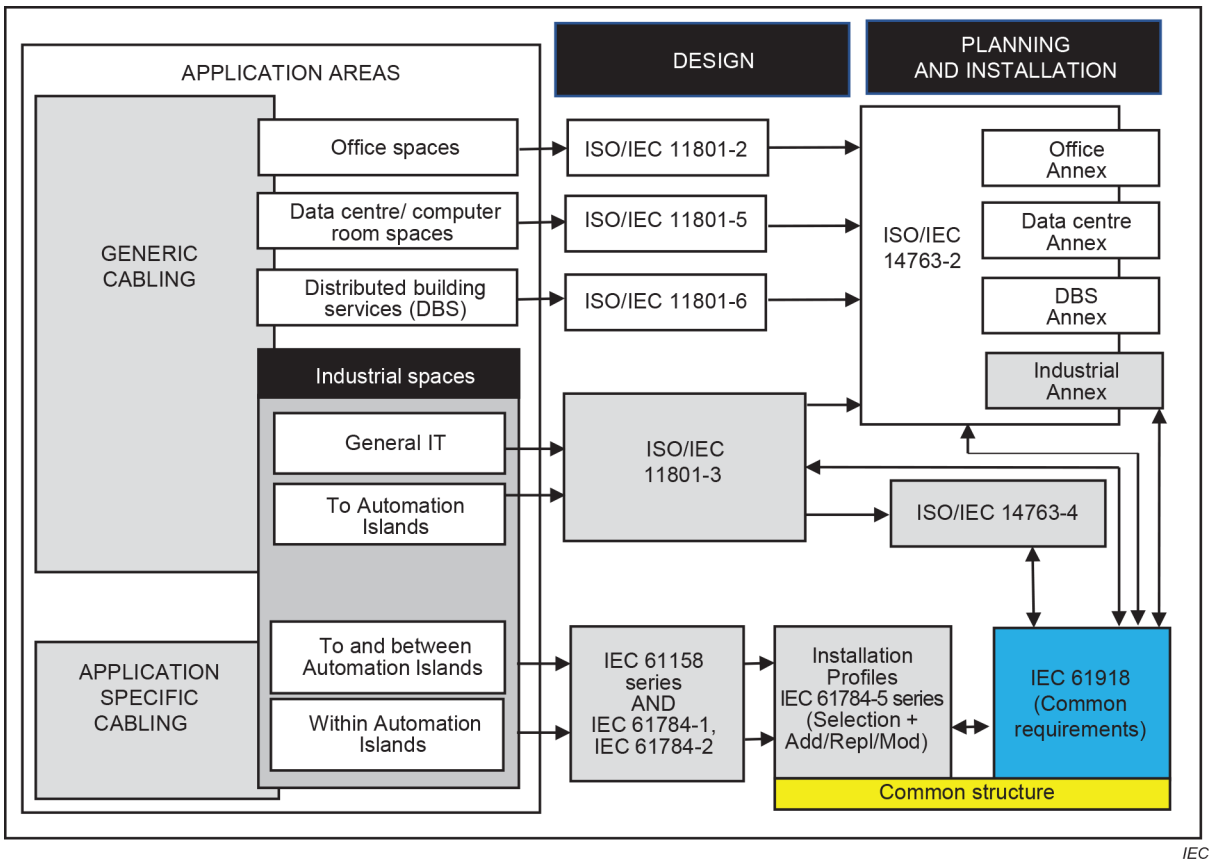


Figure 1 – Standards relationships

INTRODUCTION to Amendment 1

This Amendment 1 includes the following significant technical changes with respect to IEC 61784-5-3:2018:

Annex C describes new content of installation such as Robot Cable and two new rectangular (one 8-way and one 10-way) connectors for Ethernet of industrial installation of Profinet.

INDUSTRIAL COMMUNICATION NETWORKS – PROFILES –

Part 5-3: Installation of fieldbuses – Installation profiles for CPF 3

1 Scope

This part of IEC 61784-5 specifies the installation profiles for CPF 3 (PROFIBUS/PROFINET)[1].

The installation profiles are specified in the annexes. These annexes are read in conjunction with IEC 61918:2018, IEC 61918:2018/AMD1:2022 and IEC 61918:2018/AMD2:2024.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61918:2018 [2], *Industrial communication networks – Installation of communication networks in industrial premises*
IEC 61918:2018/AMD1:2022
IEC 61918:2018/AMD2:2024

~~The normative references of IEC 61918:2018, Clause 2, apply.~~

NOTE For profile specific normative references, see Clause(s) A.2, B.2 and C.2.

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms, definitions and abbreviated terms of IEC 61918:2018, Clause 3, IEC 61918:2018/AMD1:2022, Clause 3, and Clauses A.3, B.3, C.3 of this document, 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

~~NOTE For profile specific terms, definitions and abbreviated terms see Clause(s) A.3, B.3 and C.3.~~

---

1 PROFIBUS and PROFINET are trade names of the non-profit organization PROFIBUS Nutzerorganisation e.V. (PNO). This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the trade names holder or any of its products. Compliance to this profile does not require use of the trade names. Use of the trade names PROFIBUS and PROFINET requires permission of the trade name holder.

2 The normative references of IEC 61918:2018, Clause 2, IEC 61918:2018/AMD1:2022, Clause 2 and IEC 61918:2018/AMD2:2024, Clause 2, apply.