

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

**Réseaux de communication industriels – Profils –
Partie 5-3: Installation des bus de terrain – Profils d'installation pour CPF 3**

Withdrawing



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2013 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 la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
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 corrigenda or an amendment might have been published.

Useful links:

IEC publications search - www.iec.ch/searchpub

The advanced search enables you 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It also gives information on projects, replaced and withdrawn publications.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 on-line and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

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: csc@iec.ch.

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) 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 CEI

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

Liens utiles:

Recherche de publications CEI - www.iec.ch/searchpub

La recherche avancée vous permet de trouver des publications CEI 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.

Just Published CEI - webstore.iec.ch/justpublished

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

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (VEI) en ligne.

Service Clients - webstore.iec.ch/csc

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

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

**Réseaux de communication industriels – Profils –
Partie 5-3: Installation des bus de terrain – Profils d'installation pour CPF 3**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

XE

ICS 25.040.40; 35.100.40

ISBN 978-2-8322-1074-1

**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.....	7
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references	10
3 Terms, definitions and abbreviated terms	10
4 CPF 3: Overview of installation profiles	10
5 Installation profile conventions	11
6 Conformance to installation profiles.....	11
Annex A (normative) CP 3/1 (PROFIBUS) specific installation profile.....	13
A.1 Installation profile scope.....	13
A.2 Normative references	13
A.3 Installation profile terms, definitions, and abbreviated terms.....	13
A.3.1 Terms and definitions	13
A.3.2 Abbreviated terms	14
A.3.3 Conventions for installation profiles.....	14
A.4 Installation planning	14
A.4.1 General.....	14
A.4.2 Planning requirements.....	14
A.4.3 Network capabilities	16
A.4.4 Selection and use of cabling components.....	18
A.4.5 Cabling planning documentation.....	28
A.4.6 Verification of cabling planning specification	28
A.5 Installation implementation.....	28
A.5.1 General requirements.....	28
A.5.2 Cable installation.....	28
A.5.3 Connector installation.....	30
A.5.4 Terminator installation.....	33
A.5.5 Device installation.....	34
A.5.6 Coding and labeling.....	34
A.5.7 Earthing and bonding of equipment and device and shielded cabling.....	34
A.5.8 As-implemented cabling documentation.....	35
A.6 Installation verification and installation acceptance test.....	35
A.6.1 General.....	35
A.6.2 Installation verification.....	35
A.6.3 Installation acceptance test	37
A.7 Installation administration.....	43
A.8 Installation maintenance and installation troubleshooting	43
Annex B (normative) CP 3/2 (PROFIBUS) specific installation profile.....	44
B.1 Installation profile scope.....	44
B.2 Normative references	44
B.3 Installation profile terms, definitions, and abbreviated terms.....	44
B.3.1 Terms and definitions	44
B.3.2 Abbreviated terms	45
B.3.3 Conventions for installation profiles.....	45
B.4 Installation planning	46

B.4.1 General	46
B.4.2 Planning requirements	47
B.4.3 Network capabilities	54
B.4.4 Selection and use of cabling components	59
B.4.5 Cabling planning documentation	74
B.4.6 Verification of cabling planning specification	74
B.5 Installation implementation	75
B.5.1 General requirements	75
B.5.2 Cable installation	75
B.5.3 Connector installation	75
B.5.4 Terminator installation	77
B.5.5 Device installation	77
B.5.6 Coding and labelling	77
B.5.7 Earthing and bonding of equipment and device and shielded cabling	77
B.5.8 As-implemented cabling documentation	77
B.6 Installation verification and installation acceptance test	77
B.6.1 General	77
B.6.2 Installation verification	77
B.6.3 Installation acceptance test	78
B.7 Installation administration	78
B.8 Installation maintenance and installation troubleshooting	78
Annex C (normative) CP 3/3, CP 3/4, CP 3/5, CP 3/6 (PROFINET) specific installation profile	79
C.1 Installation profile scope	79
C.2 Normative references	79
C.3 Installation profile terms, definitions, and abbreviated terms	79
C.3.1 Terms and definitions	79
C.3.2 Abbreviated terms	79
C.3.3 Conventions for installation profiles	80
C.4 Installation planning	80
C.4.1 General	80
C.4.2 Planning requirements	80
C.4.3 Network capabilities	80
C.4.4 Selection and use of cabling components	83
C.4.5 Cabling planning documentation	98
C.4.6 Verification of cabling planning specification	99
C.5 Installation implementation	99
C.5.1 General requirements	99
C.5.2 Cable installation	99
C.5.3 Connector installation	100
C.5.4 Terminator installation	102
C.5.5 Device installation	102
C.5.6 Coding and labeling	102
C.5.7 Earthing and bonding of equipment and device and shielded cabling	102
C.5.8 As-implemented cabling documentation	103
C.6 Installation verification and installation acceptance test	103
C.6.1 General	103
C.6.2 Installation verification	103
C.6.3 Installation acceptance test	103

C.7 Installation administration	106
C.8 Installation maintenance and installation troubleshooting	107
Bibliography.....	108
Figure 1 – Standards relationships.....	9
Figure A.1 – Recommended combination of shielding and earthing for CP 3/1 networks with RS 485-IS	26
Figure A.2 – Sub-D connector pin numberings (front view).....	31
Figure A.3 – 5-pin M12 female socket.....	32
Figure A.4 – 5-pin M12 male plug for CP 3/1.....	32
Figure A.5 – Test circuit A – Resistance measurement of data line B and shield	38
Figure A.6 – Test circuit B –Resistance measurement of data line A and shield	38
Figure A.7 – Test circuit C – Resistance measurement of data line A, data line B, and shield.....	39
Figure A.8 – Test circuit D – Resistance measurement between data line A and B.....	39
Figure A.9 – Resistance measurement without 9-pin Sub-D plug	39
Figure A.10 – Loop core resistance (cable type A)	40
Figure A.11 – Action and resolution tree for measurement 1 (RS 485 and RS 485-IS)	41
Figure A.12 – Action and resolution tree for measurement 2 (RS 485 and RS 485-IS)	42
Figure A.13 – Action and resolution tree for measurement 3 (RS 485 and RS 485-IS)	42
Figure B.1 – Connection of CP 3/1 networks.....	47
Figure B.2 – Typical fieldbus architecture	49
Figure B.3 – Fieldbus with stations supplied by auxiliary power sources	50
Figure B.4 – Fieldbus model	52
Figure B.5 – Current modulation (Manchester II code)	53
Figure B.6 – Tree topology	54
Figure B.7 – Bus topology.....	55
Figure B.8 – Combination of the tree topology and the bus topology	55
Figure B.9 – Fieldbus extension.....	56
Figure B.10 – Recommended combination of shielding and earthing.....	69
Figure B.11 – Ideal combination of shielding and earthing	70
Figure B.12 – Capacitive earthing	71
Figure B.13 – Galvanic isolated field device.....	73
Figure B.14 – Pin assignment of the male and female connectors IEC 60947-5-2 (A-coding)	76
Figure C.1 – Definition of end-to-end-link.....	93
Figure C.2 – End-to-end link without interconnections.....	94
Figure C.3 – Assembled end-to-end link	94
Figure C.4 – Connectionless optical fibre link	95
Figure C.5 – Assembled optical fibre link	95
Figure C.6 – Shielded connectors for CP 3/3, CP 3/4, CP 3/5 and CP 3/6 fieldbus networks	101
Figure C.7 – Pin-assignment for a straight cable.....	101

Table A.1 – Excerpt of MICE definition.....	16
---	----

Table A.2 – Basic network characteristics for balanced cabling not based on Ethernet (ISO/IEC 8802-3)	17
Table A.3 – Network characteristics for optical fibre cabling	18
Table A.4 – Information relevant to copper cable: fixed cables	19
Table A.5 – Information relevant to optical fibre cables	20
Table A.6 – Connectors for copper cabling CPs not based on Ethernet	21
Table A.7 – Optical fibre connecting hardware	21
Table A.8 – Relationship between FOC and fibre types (CP 3/1)	21
Table A.9 – Parameters for balanced cables	28
Table A.10 – Parameters for silica optical fibre cables	29
Table A.11 – Parameters for POF optical fibre cables	29
Table A.12 – Parameters for hard clad silica optical fibre cables	29
Table A.13 – Use of 9 pin Sub-D connector pins (RS 485)	31
Table A.14 – Use of 9 pin Sub-D connector pins (RS 485-IS)	31
Table A.15 – Use of M12 connector pins (RS 485)	33
Table A.16 – Use of M12 connector pins (RS 485-IS)	33
Table A.17 – Maximum fibre channel attenuation for CP 3/1 (PROFIBUS)	43
Table B.1 – Valid parameter range of the FISCO model for use as EEx ib IIC / IIB	51
Table B.2 – Valid parameter range of the FISCO model for use as EEx ia IIC	51
Table B.3 – Power supply (operational values)	57
Table B.4 – Line lengths which can be achieved	57
Table B.5 – Limit values for distortion, reflection and signal delay	58
Table B.6 – Recommended maximum cable lengths including spurs	58
Table B.7 – Recommended length of the spurs	59
Table B.8 – Maximum length of the splices	59
Table B.9 – Information relevant to copper cable: fixed cables	60
Table B.10 – Safety limit values for the fieldbus cable	61
Table B.11 – Connectors for copper cabling CPs not based on Ethernet	62
Table B.12 – Mixing devices from different categories	64
Table B.13 – Electrical characteristics of fieldbus interfaces	65
Table B.14 – Recommended data sheet specifications for CP 3/2 devices	66
Table B.15 – Parameters for balanced cables	75
Table B.16 – Contact assignments for the external connector for harsh industrial environments	76
Table C.1 – General transmission media selection information	81
Table C.2 – Network characteristics for balanced cabling based on Ethernet (ISO/IEC 8802-3)	82
Table C.3 – Network characteristics for optical fibre cabling	82
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	83
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	84
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	85
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	85

Table C.8 – Information relevant to optical fibre cables	86
Table C.9 – Requirements for plastic and hard clad silica optical fibre cables	87
Table C.10 – Requirements for glass multimode optical fibre cables	88
Table C.11 – Requirements for glass singlemode optical fibre cables	89
Table C.12 – Information relevant to hybrid cables (application type B)	90
Table C.13 – Information relevant to hybrid cables (application type C)	91
Table C.14 – Connectors for balanced cabling CPs based on Ethernet	92
Table C.15 – Optical fibre connecting hardware	92
Table C.16 – Relationship between FOC and fibre types (CP 3/3, CP 3/4, CP 3/5, CP3/6)	93
Table C.17 – Typical fibre channels common for industrial applications	96
Table C.18 – Parameters for balanced cables	99
Table C.19 – Parameters for silica optical fibre cables	99
Table C.20 – Parameters for POF optical fibre cables	100
Table C.21 – Parameters for hard clad silica optical fibre cables	100
Table C.22 – Colour coding of 2 pair cabling for CP 3/3, CP 3/4, CP 3/5 and CP 3/6 connectors	101
Table C.23 – Colour coding of 4 pair cabling for CP 3/3, CP 3/4, CP 3/5 and CP 3/6 connectors	102
Table C.24 – Formula for NEXT limits for an end-to-end link	106
Table C.25 – Maximum fibre channel attenuation for CP 3/3, CP 3/4, CP 3/5 and CP 3/6 (PROFINET)ET)	106

Withholding

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) 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.

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 third edition cancels and replaces the second edition published in 2010. This edition constitutes a technical revision.

This edition includes an addition of 4-pair cabling (see C.4.4.1.2.1 and C.5.3.2), an addition of the connector M12 X-Coding (see C.4.4.2.2), an addition of the definition of end-to-end links (see C.4.4.3.1), a revision of Table C.17 (see C.5.2.1) and 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 61918:2013.

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

FDIS	Report on voting
65C/738/FDIS	65C/743/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 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 publication will remain unchanged until the stability 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.

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 is one of a series produced to facilitate the use of communication networks in industrial control systems.

IEC 61918:2013 provides 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 standard, see IEC 61158-1.

Each CP installation profile is specified in a separate annex of this standard. 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 standard 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.

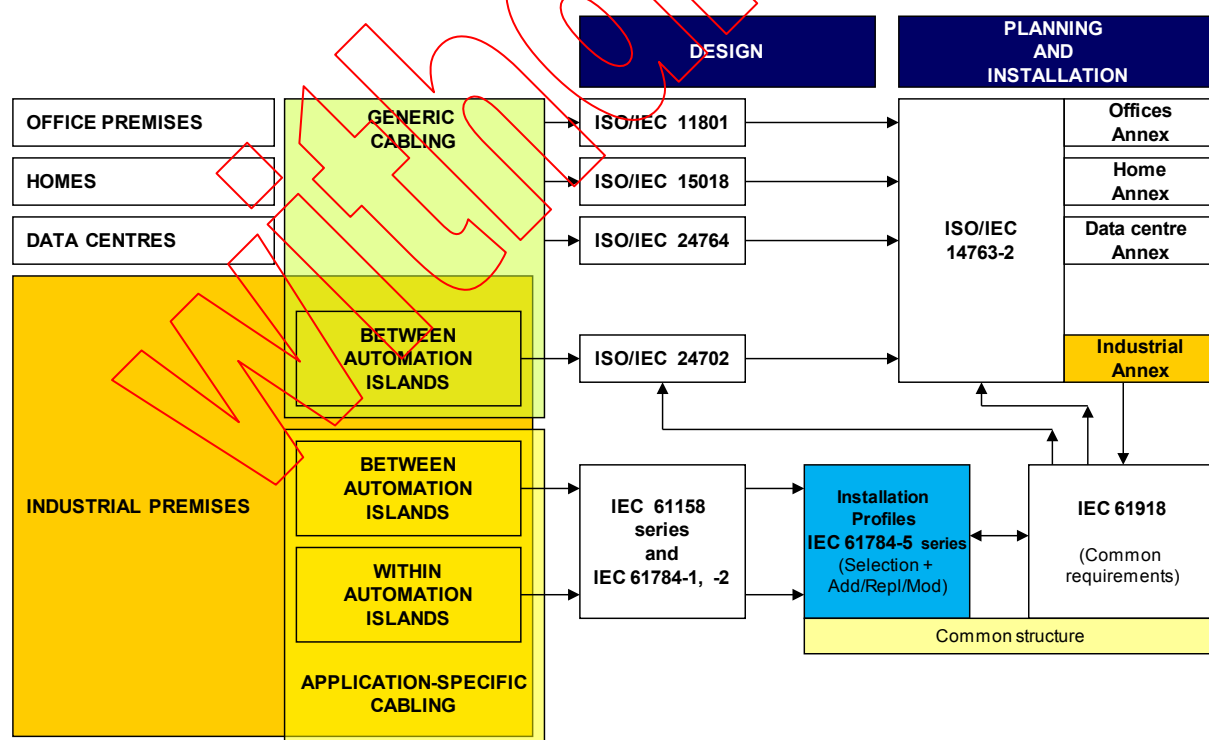


Figure 1 – Standards relationships

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 61918:2013.

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 61918:2013, *Industrial communication networks – Installation of communication networks in industrial premises*

The normative references of IEC 61918:2013, Clause 2, apply. 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 61918:2013, Clause 3, apply. For profile specific terms, definitions and abbreviated terms see Clause(s) A.3, B.3 and C.3.

4 CPF 3: Overview of installation profiles

CPF 3 consists of six communication profiles as specified in IEC 61784-1 and IEC 61784-2.

The installation requirements for CP 3/1 (PROFIBUS with physical layer according to RS 485, RS 485-IS, and fibre) are specified in Annex A.

The installation requirements for CP 3/2 (PROFIBUS with physical layer according to MBP, MBP-IS, MBP-LP) are specified in Annex B.

The installation requirements for CP 3/3, CP 3/4, CP 3/5, and CP 3/6 (PROFINET) are specified in Annex C.

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.

5 Installation profile conventions

The numbering of the clauses and subclauses in the annexes of this standard corresponds to the numbering of IEC 61918 main clauses and subclauses.

The annex clauses and subclauses of this standard supplement, modify, or replace the respective clauses and subclauses in IEC 61918.

Where there is no corresponding subclause of IEC 61918 in the normative annexes in this standard, the subclause of IEC 61918 applies without modification.

The annex heading letter represents the installation profile assigned in Clause 4. The annex (sub)clause numbering following the annex letter shall represent the corresponding (sub)clause numbering of IEC 61918.

EXAMPLE “Subclause B.4.4” in IEC 61784-5-3 means that CP 3/2 specifies the subclause 4.4 of IEC 61918.

All main clauses of IEC 61918 are cited and apply in full unless otherwise stated in each normative installation profile annex.

If all subclauses of a (sub)clause are omitted, then the corresponding IEC 61918 (sub)clause applies.

If in a (sub)clause it is written “Not applicable”, then the corresponding IEC 61918 (sub)clause does not apply.

If in a (sub)clause it is written “*Addition*”, then the corresponding IEC 61918 (sub)clause applies with the additions written in the profile.

If in a (sub)clause it is written “*Replacement*”, then the text provided in the profile replaces the text of the corresponding IEC 61918 (sub)clause.

NOTE A replacement can also comprise additions.

If in a (sub)clause it is written “*Modification*”, then the corresponding IEC 61918 (sub)clause applies with the modifications written in the profile.

If all (sub)clauses of a (sub)clause are omitted but in this (sub)clause it is written “(Sub)clause x has addition” (or “*replacement*”, or “*modification*”) or “(Sub)clause is not applicable”, then (sub)clause x becomes valid as declared and all the other corresponding IEC 61918 (sub)clauses apply.

6 Conformance to installation profiles

Each installation profile within this standard includes part of IEC 61918:2013. It may also include defined additional specifications.

A statement of compliance to an installation profile of this standard shall be stated² as either

Compliance to IEC 61784-5-3:2013³ for CP 3/m <name> or

Compliance to IEC 61784-5-3 (Ed.2.0) for CP 3/m <name>

where the name within the angle brackets < > is optional and the angle brackets are not to be included. The m within CP 3/m shall be replaced by the profile number 1 to 6.

² In accordance with ISO/IEC Directives.

³ The date should not be used when the edition number is used.

NOTE The name can be the name of the profile, for example PROFIBUS or PROFINET.

If the name is a trade name then the permission of the trade name holder shall be required.

Product standards shall not include any conformity assessment aspects (including quality management provisions), neither normative nor informative, other than provisions for product testing (evaluation and examination).

Withdrawn

Annex A (normative)

CP 3/1 (PROFIBUS) specific installation profile

A.1 Installation profile scope

Addition:

This standard specifies the installation profile for Communication Profile CP 3/1 (PROFIBUS with a physical layer according to RS 485, RS 485-IS, and fibre). The CP 3/1 is specified in IEC 61784-1.

A.2 Normative references

Addition:

IEC 60079-14, *Explosive atmospheres – Part 14: Electrical installations design, selection and erection*⁴

IEC 60079-11:2011, *Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i"*

IEC 60512-6-3, *Connectors for electronic equipment – Tests and measurements – Part 6-3: Dynamic stress tests – Test 6c: Shock*

IEC 60512-6-4, *Connectors for electronic equipment – Tests and measurements – Part 6-4: Dynamic stress tests – Test 6d: Vibration (sinusoidal)*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

ANSI TIA/EIA-485-A, *Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems*

A.3 Installation profile terms, definitions, and abbreviated terms

A.3.1 Terms and definitions

Addition:

A.3.1.79

hazard

potential source of harm

Note 1 to entry: The term includes danger to persons arising within a short time scale (for example fire and explosion) and also those that have a long term effect on a person's health (for example release of a toxic substance).

[SOURCE: IEC 61508-4:2010, 3.1.2]

⁴ To be published.

A.3.1.80 intrinsic safety “i”

type of protection based on the restriction of electrical energy within apparatus and of interconnecting wiring exposed to the potentially explosive atmosphere to a level below that which can cause ignition by either sparking or heating effects

Note 1 to entry: No single device or wiring is intrinsically safe by itself (except for battery-operated self-contained apparatus such as portable pagers, transceivers, gas detectors, etc., which are specifically designed as intrinsically safe self-contained devices) but is intrinsically safe only when employed as part of a properly designed intrinsically safe system.

[SOURCE: IEC 60079-11:2011, 3.1.1]

A.3.2 Abbreviated terms

Addition:

MAU	Medium attachment unit
PELV	Protective extra low voltage
PNO	PROFIBUS Nutzer Organisation (a non profit user organisation)
RS 485	MAU according to ANSI TIA/EIA-485-A
RS 485-IS	MAU according to ANSI TIA/EIA-485-A and applicable to IS
SELV	Safety extra low voltage
TN-S	Coded type of system earthing according to IEC 60364-1, 312.2

A.3.3 Conventions for installation profiles

Not applicable.

A.4 Installation planning

A.4.1 General

Subclause 4.1.2 has addition:

Generic cabling in accordance with ISO/IEC 24702 is not suitable for the cabling of CP 3/1 networks.

CP 3/1 networks only can be connected to the generic cabling via a converter/adaptor as specified in IEC 61918:2013, 4.1.2.

A.4.2 Planning requirements

A.4.2.1 Safety

Subclause 4.2.1.3 has addition:

Each and every device on CP 3/1 networks (standard and safety) should provide a test certificate issued by PROFIBUS International (more information available by <www.profibus.com>) based on IEC 61158 or at least provide a corresponding manufacturers declaration stating compliance with CP 3/1 specification.

Each and every safety device shall comply with IEC 61508 series and other related standards if applicable.

The 24 V power supplies in use shall be one-error proof and provide SELV/PELV only. National regulations shall be considered.

EXAMPLE In the United States of America the power supplies provide a current limitation of 8 A according to UL508C.

No spurs or branch lines are permitted in a CP 3/1 network for safety applications.

Effective cable shielding especially after bending the cable or after changing connectors shall be ensured. In case of doubt, a more flexible and robust cable type should be used.

Sub-D connectors shall have multi contact features at the connector housing in order to provide an optimal contact between the cable shield, the cable connector and its counterpart at the CP 3/1 device. Care shall be taken to achieve a good (low impedance) contact between the cable shield and connector housing.

For connections of CP 3/1 devices with M12 interface only M12 connectors that guarantee a good (low impedance) contact between cable shield and connector housing are permitted. Cable shield shall not be connected to the connector pin 5.

A cabinet of protection class IP54 (dust, shower water) shall be used for safety devices such as drives with integrated safety that are offering a lower protection class such as IP20. Cabinets with a lower protection class may only be used if safety devices explicitly permit other environments according to the manufacturer's information (for example heat problems).

A.4.2.2 Security

A.4.2.3 Environmental considerations and EMC

A.4.2.3.1 Description methodology

Modification:

The MICE description methodology shown in IEC 61918:2013 is both a rather comprehensive and complex approach but nevertheless does not describe all possible environments. Where an environment exists that cannot be mapped in to the MICE tables, the user shall determine suitability of the components for the targeted environment through agreements with the component providers or additional mitigation techniques.

To make fieldbus installation work more easily for CP 3/1 fieldbus networks the MICE table is condensed into the two basic environments inside and outside data cabinets.

CP 3/1 products should at least meet the MICE parameters of Table A.1.

Table A.1 – Excerpt of MICE definition

	Inside enclosure	Outside enclosure
Mechanical		
Shock/bump	IEC 60512-6-3	IEC 60512-6-3
Peak acceleration	20 g / 11 ms 3 per axis in both directions	20 g / 11 ms 3 per axis in both directions
Vibration	IEC 60512-6-4	IEC 60512-6-4
10 Hz - 500 Hz	0,35 mm or 5g	0,35 mm or 5 g
Ingress		
IP protection class	IP20	IP65 / IP67
Particulate ingress (diameter min)	12,5 mm	50 μm
Immersion	None	intermittent liquid jet ≤12,5 l/min ≥ 6,5 mm jet > 2,5 m distance and immersion (≤1 m for ≤30 min)
Climatic and chemical		
Ambient temperature	0 °C to +60 °C	-20 °C to +70 °C
Electromagnetic		
Transfer impedance	See components selection	
Additional parameters out of the MICE definition in IEC 61918:2013, Annex B, may be observed depending on the application. The different products offered for these environments typically meet the requirements of the respective IEC standards. Additional products are offered for special applications (e.g. drag chain, festoon, robots, etc) and the recommendations for cable routing should be followed.		
The repetitive nature of the shock experienced by the channel shall be taken into account.		

A.4.2.3.2 Use of the described environment to produce a bill of material

Addition:

Manufacturers mark their products designed for CP 3/1 networks in a specific way. Only these marked products shall be used and be mentioned on the bill of material.

The planner shall take into account the mating interface of devices to be connected to the fieldbus network.

A.4.2.4 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.3 Network capabilities

A.4.3.1 Network topology

A.4.3.1.1 Common description

A.4.3.1.2 Basic physical topologies for passive networks

Modification:

For CP 3/1 passive networks only the bus topology is permitted.

A.4.3.1.3 Basic physical topologies for active networks**A.4.3.1.4 Combination of basic topologies****A.4.3.1.5 Specific requirements for CPs**

Addition:

For CP 3/1 networks with a data transmission rate of 12 Mbit/s spurs shall not be used.

For CP 3/1 networks with a data transmission rate of 1,5 Mbit/s spurs should not be used.

Bus repeaters of different manufacturers should not be mixed due to their different optimization strategies. The number of repeaters permitted in a link between any two devices is up to manufacturer's specification.

A.4.3.1.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702**A.4.3.2 Network characteristics****A.4.3.2.1 General****A.4.3.2.2 Network characteristics for balanced cabling not based on Ethernet**

Replacement:

Table A.2 provides values based on the template given in IEC 61918:2013, Table 1.

Table A.2 – Basic network characteristics for balanced cabling not based on Ethernet (ISO/IEC 8802-3)

Characteristic	CP 3/1 (PROFIBUS)	
	RS 485	RS 485-IS
Basic transmission technology		
Length / transmission speed	Segment length m	
9,6 kbit/s – 93,75 kbit/s	1 200	1 200
187,5 kbit/s	1 000	1 000
500 kbit/s	400	400
1,5 Mbit/s	200	200
3 – 6 – 12 Mbit/s	100	Not applicable
Maximum capacity	Maximum no.	
Devices / segment	32	32
Number of devices / network ^a	125	125

^a Limited by addressing scheme.

A.4.3.2.3 Network characteristics for balanced cabling based on Ethernet

Not applicable.

A.4.3.2.4 Network characteristics for optical fibre cabling.

Replacement:

Table A.3 provides values based on the template given in IEC 61918:2013, Table 3.

Table A.3 – Network characteristics for optical fibre cabling

CP 3/1		
Optical fibre type	Description	
Single mode silica	Minimum length (m)	0
	Maximum length (m)	15 000
	Maximum channel insertion loss/optical power budget (dB)	5
	Connecting hardware	See A.4.4.2.5
Multimode silica	Modal bandwidth (MHz × km) at λ (nm)	600 at 850
	Minimum length (m)	0
	Maximum length (m)	3 000
	Maximum channel insertion loss/optical power budget (dB)	6
	Connecting hardware	See A.4.4.2.5
POF	Modal bandwidth (MHz × km) at λ (nm)	1,0 at 660
	Minimum length (m)	0
	Maximum length (m)	100
	Maximum channel insertion loss/optical power budget (dB)	6
	Connecting hardware	See A.4.4.2.5
Hard clad silica	Modal bandwidth (MHz × km) at λ (nm)	17 at 660
	Minimum length (m)	0
	Maximum length (m)	500
	Maximum channel insertion loss/optical power budget (dB)	3
	Connecting hardware	See A.4.4.2.5

A.4.3.2.5 Specific network characteristics

Not applicable.

A.4.3.2.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4 Selection and use of cabling components

A.4.4.1 Cable selection

A.4.4.1.1 Common description

Addition:

Generic cabling in accordance with ISO/IEC 24702 is not suitable for the cabling of CP 3/1 networks.

CP 3/1 networks only can be connected to the generic cabling via a converter/adaptor as specified in IEC 61918:2013, 4.1.2.

A.4.4.1.2 Copper cables**A.4.4.1.2.1 Balanced cables for non-Ethernet-based CPs**

Not applicable.

A.4.4.1.2.2 Copper cables for non-Ethernet-based CPs

Addition:

Unshielded cables shall not be used with CP 3/1 networks.

Replacement:

Table A.4 provides values based on the template given in IEC 61918:2013, Table 4.

Table A.4 – Information relevant to copper cable: fixed cables

Characteristic	CP 3/1 (PROFIBUS RS 485)	CP 3/1 (PROFIBUS RS 485-IS) ^a
Nominal impedance of cable (tolerance)	135 Ω to 165 Ω; $f = 3 \text{ MHz to } 20 \text{ MHz}$	
Balanced or unbalanced	Balanced	
DCR of conductors	< 55 Ω/km	
DCR of shield	Not defined	
Number of conductors	2	
Shielding	Mandatory	
Colour code for conductor	A = green; B = red	
Jacket colour requirements	Violet	Light blue ^b
Jacket material	Application dependent	
Resistance to harsh environment (e.g. UV, oil resist, LSOH)	Cable types for different applications available	
Agency ratings	Cable types with different ratings available	
Conductor cross-sectional area	$\geq 0,34 \text{ mm}^2$	$\geq 0,34 \text{ mm}^2$ ^c
Capacitance	< 30 pF/m	
L/R ratio ($\mu\text{H} / \Omega$)	Not specified	≤ 15
The L/R ratio shall be applied for the lowest ambient temperature of the bus cable.		
^a Cable shall be in accordance with IEC 60079-14.		
^b If a colour is used for identification.		
^c If a fine stranded conductor is used: 0,1 mm is the minimum value required for the diameter of a single wire.		

A.4.4.1.3 Cables for wireless installation**A.4.4.1.4 Optical fibre cables**

Replacement:

Table A.5 provides values based on the template given in IEC 61918:2013, Table 6.

Table A.5 – Information relevant to optical fibre cables

Characteristics for CP 3/1	9..10/125 µm single mode silica	50/125 µm multimode silica	62,5/125 µm multimode silica	980/1 000 µm step index POF	200/230 µm step index hard clad silica
Standard	IEC 60793-2	IEC 60793-2	IEC 60793-2	IEC 60793-2	IEC 60793-2
Attenuation per km (660 nm)	–	–	–	≤ 230	≤ 10
Attenuation per km (850 nm)	–	≤ 2,7	≤ 3,5	–	–
Attenuation per km (1 320 nm)	≤ 1,0	–	–	–	–
Number of optical fibres	2	2	2	2	2
Connector type (e.g. duplex or simplex)	BFOC/2,5	BFOC/2,5	BFOC/2,5	BFOC/2,5 others	BFOC/2,5 others
Jacket colour requirements	None	None	None	None	None
Jacket material	Several	Several	Several	Several	Several
Resistance to harsh environment (e.g. UV, oil resist, LS0H)	Yes	Yes	Yes	Yes	Yes
Breakout	Yes	Yes	Yes	Yes	Yes

A.4.4.1.5 Special purpose balanced and optical fibre cables

A.4.4.1.6 Specific cable requirements for CPs

Addition:

The data communication part of hybrid cables complies with IEC 61918:2013, 4.4.1.2.2. In addition hybrid cables shall provide $4 \times 1,5 \text{ mm}^2$ copper wires for power supply.

A.4.4.1.7 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.2 Connecting hardware selection

A.4.4.2.1 Common description

Modification:

Applies with consideration of A.4.2.3.1.

A.4.4.2.2 Connecting hardware for balanced cabling CPs based on Ethernet

Not applicable.

A.4.4.2.3 Connecting hardware for copper cabling CPs not based on Ethernet

Replacement:

Table A.6 provides values based on the template given in IEC 61918:2013, Table 8.

Table A.6 – Connectors for copper cabling CPs not based on Ethernet

	IEC 60807-2 or IEC 60807-3	IEC 60947-5-2 or IEC 61076-2-101			IEC 6116 9-8	ANSI/(NFPA) T3.5.29 R1-2007		Others		
	Sub-D	M12-5 with A- coding	M12-5 with B-coding	M12-n with X-coding	Coaxial (BNC)	M 18	7/8-16 UN-2B THD	Open style	Termin al block	Others
CP 3/1	9 pin	No	Yes	No	No	No	No	No	Yes	Hybrid style

NOTE For M12-5 connectors, there are many applications using these connectors that are not compatible and when mixed can cause damage to the applications.

A.4.4.2.4 Connecting hardware for wireless installation**A.4.4.2.5 Connecting hardware for optical fibre cabling**

Replacement:

Table A.7 provides values based on the template given in IEC 61918:2013, Table 9.

Table A.7 – Optical fibre connecting hardware

	IEC 61754-2	IEC 61754-4	IEC 61754-24	IEC 61754-20	IEC 61754-22	Others
	BFOC/2,5	SC	SC-RJ	LC	F-SMA	
CP 3/1	Yes	No	No	No	No	Others for POF and hard clad silica

NOTE IEC 61754 series defines the optical fibre connector mechanical interfaces; performance specifications for optical fibre connectors terminated to specific fibre types are standardised in IEC 61753 series.

Replacement:

Table A.8 provides values based on the template given in IEC 61918:2013, Table 10.

Table A.8 – Relationship between FOC and fibre types (CP 3/1)

FOC	Fibre type					
	9..10/125 µm single mode silica	50/125 µm multimode silica	62,5/125 µm multimode silica	980/1 000 µm step index POF	200/230 µm step index hard clad silica	Others
BFOC/2,5	Yes	Yes	Yes	Recommended	Recommended	No
SC	No	No	No	Yes	Yes	No
SC-RJ	No	No	No	Yes	Yes	No
LC	No	No	No	Yes	Yes	No
F-SMA	No	No	No	Yes	Yes	No

NOTE IEC 61754 series defines the optical fibre connector mechanical interfaces; performance specifications for optical fibre connectors terminated to specific fibre types are standardised in IEC 60874 series.

A.4.4.2.6 Specific requirements for CPs

Not applicable.

A.4.4.2.7 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.3 Connections within a channel/permanent link

A.4.4.3.1 Common description

A.4.4.3.2 Balanced cabling connections and splices for CPs based on Ethernet

Subclause A.4.4.3.2.3 has replacement:

For CP 3/1 networks with RS 485-IS splices are not allowed.

A.4.4.3.3 Copper cabling connections and splices for CPs not based on Ethernet

Subclause 4.4.3.3.1 has addition:

Refer to the manufacturer's data sheet regarding number of allowed connections.

A.4.4.3.4 Optical fibre cabling connections and splices for CPs based on Ethernet

Not applicable.

A.4.4.3.5 Optical fibre cabling connections and splices for CPs not based on Ethernet

Addition:

The maximum channel attenuation is given in Table A.17.

A.4.4.3.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.4 Terminators

A.4.4.4.1 Common description

Addition:

For CP 3/1 networks terminators shall be used. Each end of a network segment shall be terminated.

A.4.4.4.2 Specific requirements for CPs

Addition:

For CP 3/1 networks with RS 485 interface the terminators shall be in accordance with 22.1.2.4 of IEC 61158-2:2007.

For CP 3/1 networks with RS 485-IS the terminators shall be in accordance with 22.2.2.4 of IEC 61158-2:2007. If the terminators are built-in within a device then power supply with current limitation via built-in resistors shall be provided (see A.5.3.4).

A.4.4.4.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702**A.4.4.5 Device location and connection****A.4.4.5.1 Common description**

Addition:

If devices according to CP 3/1 with RS 485-IS are intended to be used in hazardous locations then the national regulation shall be observed when installing such devices.

A.4.4.5.2 Specific requirements for CPs

Refer to the manufacturer's data sheet regarding device location and connection.

A.4.4.5.3 Specific requirements for wireless installation

Not applicable.

A.4.4.5.4 Specific requirements for generic cabling in accordance with ISO/IEC 24702**A.4.4.6 Coding and labelling****A.4.4.6.1 Common description**

Addition:

For CP 3/1 networks with RS 485-IS the colour coding of the bus cable for intrinsically safe circuits shall be light blue.

A.4.4.6.2 Additional requirements for CPs**A.4.4.6.3 Specific requirements for CPs**

Not applicable.

A.4.4.6.4 Specific requirements for generic cabling in accordance with ISO/IEC 24702

Not applicable.

A.4.4.7 Earthing and bonding of equipment and devices and shielded cabling**A.4.4.7.1 Common description****A.4.4.7.1.1 Basic requirements**

Addition:

Compliance to IEC 60364-4-41 shall be ensured. Requirements of local or national regulations for the erection of electrical or communication shall be observed in addition.

The configuration of the LV power distribution system shall comply with IEC 60364-1:2005, 312.2.1, TN-S systems, which means separated conductors for neutral (N) and protective earth (PE). Equipotential properties of earth and protection earth are required. Requirements of local or national regulations for the erection of electrical or communication networks shall be observed in addition.

Where the power distribution system does not comply with the TN-S system and a.c. current can be measured on the fieldbus cable shielding the fieldbus network should be built with OF-cables (see IEC 61918:2013, Annex E for details).

A properly installed a.c. power system ensures that no currents flow through shields and/or equipotential bonding conductors connected to the CBN.

Currents higher than approximately 0,1 A indicate problems in the electrical installation (that means more than one connection between N and PE anywhere in the power distribution system).

Indications of an unsuitable a.c. power supply are as follows:

- Currents on the PE conductor.
- Currents through cable shields.
- Currents through water pipes and heating pipes.
- Progressive corrosion at earthing terminals, on lightning conductors, and water pipes.

NOTE Sporadic events such as switching, short circuits, or atmospheric discharge (lightning strike) can cause current peaks in the system many times higher than the average value.

A.4.4.7.1.2 Planner tasks

A.4.4.7.1.3 Methods for controlling potential differences in the earth system

A.4.4.7.1.4 Selection of the earthing and bonding system

A.4.4.7.2 Bonding and earthing of enclosures and pathways

A.4.4.7.2.1 Equalization and earthing conductor sizing and length

A.4.4.7.2.2 Bonding straps and sizing

A.4.4.7.2.3 Surface preparation and methods

A.4.4.7.2.4 Bonding and earthing

A.4.4.7.3 Earthing methods

A.4.4.7.3.1 Equipotential

Addition:

With CP 3/1 networks an equipotential mesh earthing system shall be used.

A.4.4.7.3.2 Star

Replacement:

The star earthing system shall not be used for CP 3/1 networks.

A.4.4.7.3.3 Earthing of equipment (devices)

A.4.4.7.3.4 Copper bus bars

A.4.4.7.4 Shield earthing

A.4.4.7.4.1 Non-earthing or parallel RC

Not applicable.

A.4.4.7.4.2 Direct*Addition:*

Shielding of bus cables shall always be connected to earth at both ends of the cables. Single point shield termination shall be avoided.

Where equipotential bonding is not guaranteed or cannot be achieved (for example by installing an equipotential bonding conductor in parallel to the distributed communication cables) optical fibre cabling should be used.

A.4.4.7.4.3 Derivatives of direct and parallel RC**A.4.4.7.5 Specific requirements for CPs***Addition:*

For CP 3/1 networks with RS 485-IS the following applies:

For the operation of an installation with fieldbus systems, the earthing concept and thereby also the shielding of the electrical cables is a very important issue. When finalizing the earthing concept, the following aspects should be taken into consideration:

- Ensuring electromagnetic compatibility (EMC).
- Explosion protection.
- Human safety.

Conventional field units (for example with a 4 mA to 20 mA interface) which are connected via two-wire cables with isolating repeaters in the control room process d.c. signals or low-frequency a.c. signals. The influence of wire-conducted noise signals with higher frequencies can be suppressed by means of appropriate input filters having a low cut-off frequency. Thus, in contrast to fieldbus systems, for such devices a predominantly electrostatically acting cable shield (earthed on one side) is sufficient.

In fieldbus systems however, the usable frequency for the transmission of the signals is considerably higher – and the requirements placed on the earthing concept of the system accordingly tougher, i.e. earthing as described before (using predominantly electrostatically cables) is not sufficient. Where a.c. signals are being processed, the components and also the interconnection of elements, like cables, shall be protected against the influence of electromagnetic fields. The protective measures should create a complete encapsulation around the sensitive components. The larger the processed signal frequencies in the systems, the greater the requirement placed on the completeness of this gapless protective encapsulation. Thus, the shielding and earthing concept has to satisfy these requirements in order to constitute the basis for the EMC tests performed by the device manufacturers.

In order to meet the described requirements, shields of cables shall be connected with the terminal locations in the devices intended for this purpose. When connecting the shields, a low-impedance connection should be ensured – considering the high noise frequencies. This applies not only for the connection of the cable shields, but also for the earthing connection of the device. Extended wires usually do not meet these requirements.

For the shielding and earthing measures to have their optimum effect, the devices and shields shall be earthed more than once. According to 12.2.2.3 in IEC 60079-14:—, this method, which is optimal for electromagnetic compatibility and human safety, can be utilised without restriction in the area of the entire installation.

If the installation is made and maintained that it can be ensured with a high degree of certainty that a potential equalization exists between each end of the circuit (that means between the hazardous area and safe area) then cable screens and conducting screens at both ends of the cable and the screens at intermediate points should be connected to earth.

In the process, in the hazardous area according to 6.3 in IEC 60079-14:—, an equipotential bonding system is an absolute requirement anyway. The measures detailed there (inclusion of protective conductors, protective tubes, metallic cable shields, cable reinforcements and metallic components) can be supplemented using the following measures:

- Laying of the bus cables on metallic cable trays.
- Incorporation of the cable tray into the equipotential bonding system.
- Interconnections of the cable trays among each other and to metallic components – these interconnections should consider safety aspects, be of sufficient current-loading capacity and be designed for high-frequency capability and low impedance.

Figure A.1 shows the recommended combination of shielding and earthing for CP 3/1 networks with RS 485-IS.

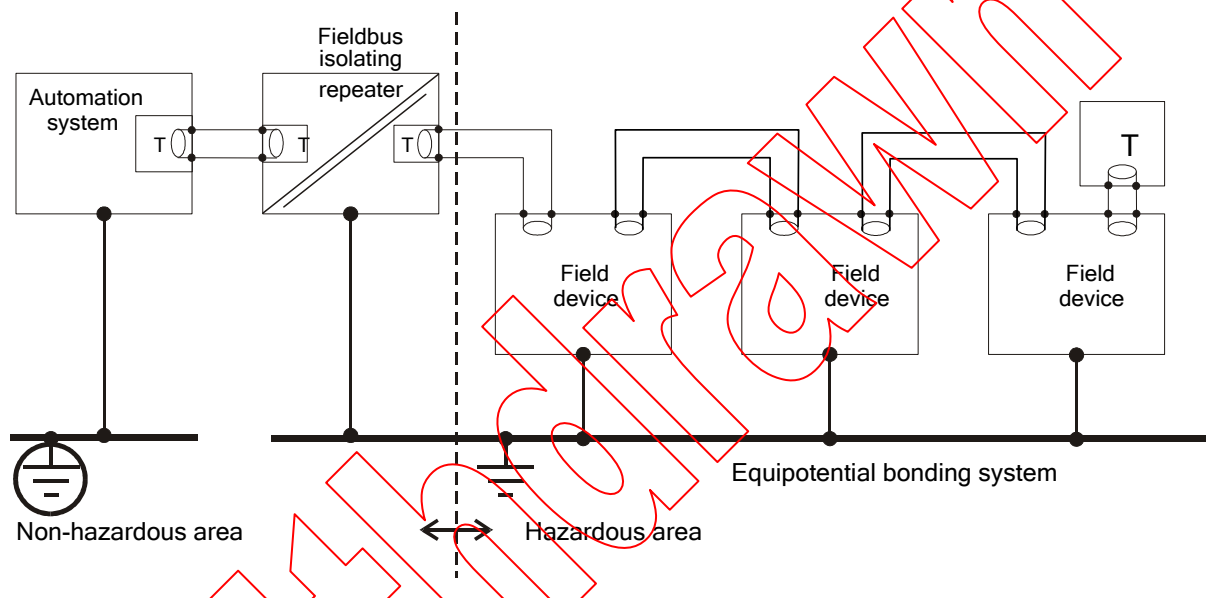


Figure A.1 – Recommended combination of shielding and earthing for CP 3/1 networks with RS 485-IS

At least, equipotential islands should be created by taking these measures. It shall be ensured that low-frequency transient currents (50/60 Hz and harmonics) on the shielding, such as for example those which can develop due to potential differences between "equipotential islands", do not damage the cable and cannot induce sparks in the hazardous area. Damage and sparks can be prevented for example by means of a potential equalization cable having a broad cross-section and laid parallel to the bus cable.

In order to prevent impermissible energy potentials from being carried into the hazardous area, the cable shield shall be connected "safely" to the equipotential bonding system at all points of transition between the safe and hazardous areas. Here, "safely" means that the individual conductors of the cable shield be twisted, be protected from splaying by means of an end covering sleeve and be connected to an appropriate screw terminal.

The connection of the cable shields within the hazardous area is not relevant to safety. It can be realized using conventional shield terminals (clamp straps).

A.4.4.7.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702**A.4.4.8 Storage and transportation of cables****A.4.4.8.1 Common description****A.4.4.8.2 Specific requirements for CPs**

Not applicable.

A.4.4.8.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702**A.4.4.9 Routing of cables****A.4.4.9.1 Common description****A.4.4.9.2 Cable routing of assemblies****A.4.4.9.3 Detailed requirements for cable routing inside enclosures****A.4.4.9.4 Cable routing inside buildings**

Addition:

For CP 3/1 networks with RS 485-IS the cables for intrinsically safe circuits shall be kept separate from powerlines due to the possible coupling of energy to these cables. IEC 60079-14 and national regulations shall apply.

A.4.4.9.5 Cable routing outside and between buildings

Addition:

Balanced cables routed between buildings shall be installed on metal cable racks. Mesh openings shall be avoided in order to improve EMC capabilities.

Direct buried cables shall be routed in a plastic pipe at least 60 cm below the surface. A cable warning tape shall be placed above it approximately 20 cm below the surface. The equipotential bonding between the buildings (for example galvanized earth strap) shall be routed approximately 20 cm above the fieldbus cable. The earth strap is also used as protection against the effects of a lightning strike. The minimum cross section for the equipotential bonding according to IEC 60364-5-54 for steel is 50 mm².

However optical fibre cabling should preferably be used between buildings.

A.4.4.9.6 Installing redundant communication cables**A.4.4.10 Separation of circuits**

Addition:

For CP 3/1 networks the distances as given in EN 50174 apply. For CP 3/1 networks with RS 485-IS the IEC 60079-14 shall apply in addition.

A.4.4.11 Mechanical protection of cabling components**A.4.4.11.1 Common description****A.4.4.11.2 Specific requirements for CPs**

Not applicable.

A.4.4.11.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.12 Installation in special areas

A.4.4.12.1 Common description

A.4.4.12.2 Specific requirements for CPs

Not applicable.

A.4.4.12.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.5 Cabling planning documentation

A.4.5.1 Common description

A.4.5.2 Cabling planning documentation for CPs

A.4.5.3 Network certification documentation

A.4.5.4 Cabling planning documentation for generic cabling in accordance with ISO/IEC 24702

A.4.6 Verification of cabling planning specification

A.5 Installation implementation

A.5.1 General requirements

A.5.1.1 Common description

A.5.1.2 Installation of CPs

Addition:

For CP 3/1 networks with RS 485-IS the IEC 60079-14 shall apply in addition.

A.5.1.3 Installation of generic cabling in industrial premises

A.5.2 Cable installation

A.5.2.1 General requirements for all cabling types

Subclause A.5.2.1.2 has replacement:

Table A.9 provides values based on the template given in IEC 61918:2013, Table 18.

Table A.9 – Parameters for balanced cables

Characteristic		Value
Mechanical force	Minimum bending radius, single bending (mm)	30 to 75 ^a
	Bending radius, multiple bending (mm)	60 to 150 ^a
	Pull forces (N)	80 to 150 ^a
	Permanent tensile forces (N)	80 to 100 ^a
	Maximum lateral forces (N/cm)	^a
	Temperature range during installation (°C)	-20 to +60 ^a

^a Depending on cable type; see manufacturer's data sheet.

Table A.10 provides values based on the template given in IEC 61918:2013, Table 19.

Table A.10 – Parameters for silica optical fibre cables

Characteristic		Value
Mechanical force	Minimum bending radius, single bending (mm)	50 to 200 ^a
	Bending radius, multiple bending (mm)	50 to 200 ^a
	Pull forces (N)	500 to 800 ^a
	Permanent tensile forces (N)	500 to 800 ^a
	Maximum lateral forces (N/cm)	300 to 500
	Temperature range during installation (°C)	–5 to +50 ^a
^a Depending on cable type; see manufacturer's data sheet.		

Replacement:

Table A.11 provides values based on the template given in IEC 61918:2013, Table 20.

Table A.11 – Parameters for POF optical fibre cables

Characteristic		CP 3/1 (PROFIBUS)
Mechanical force	Minimum bending radius, single bending (mm)	30 to 100 ^a
	Bending radius, multiple bending (mm)	50 to 150 ^a
	Pull forces (N)	50 to 100 ^a
	Permanent tensile forces (N)	Not allowed
	Maximum lateral forces (N/cm)	35 to 100
	Temperature range during installation (°C)	0 to 50 ^a
^a Depending on cable type; see manufacturer's data sheet.		

Table A.12 provides values based on the template given in IEC 61918:2013, Table 21.

Table A.12 – Parameters for hard clad silica optical fibre cables

Characteristic		CP 3/1 (PROFIBUS)
Mechanical force	Minimum bending radius, single bending (mm)	75 to 200 ^a
	Bending radius, multiple bending (mm)	75 to 200 ^a
	Pull forces (N)	100 to 800 ^a
	Permanent tensile forces (N)	≤ 100 ^a
	Maximum lateral forces (N/cm)	≤ 75 to 300
	Temperature range during installation (°C)	–5 to +50 ^a
^a Depending on cable type; see manufacturer's data sheet.		

A.5.2.2 Installation and routing

A.5.2.2.1 Common description

Modification:

Applies with respect to the condensed MICE table according to A.4.2.3.1 of this standard.

A.5.2.2.2 Separation of circuits

A.5.2.3 Specific requirements for CPs

Not applicable.

A.5.2.4 Specific requirements for wireless installation

Not applicable.

A.5.2.5 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.5.3 Connector installation

A.5.3.1 Common description

Addition:

Because no mechanical coding exists between intrinsically safe and non-intrinsically safe circuits, the manufacturer shall label his components appropriately in order to prevent connection mistakes.

All left open connections (for example male connectors open wire ends) shall be protected against unattended connections to other circuits or earth by using appropriate insulation caps or similar protection techniques.

A.5.3.2 Shielded connectors

A.5.3.3 Unshielded connectors

Not applicable.

A.5.3.4 Specific requirements for CPs

Addition:

A.5.3.4.1 Sub-D connectors

CP 3/1 networks use the 9-pin Sub-D connector inside control cabinets (IP20). Unless using pre-made cable assemblies, the connector shall be fitted to the CP 3/1 cable.

The CP 3/1 cables are normally daisy-chained through the connector. This allows CP 3/1 device connection without using T-junctions (which introduce spur lines). For this reason, CP 3/1 connectors normally have two cable entries, each with a set of terminals. Each set of terminals is normally labelled "A" and "B" or given a colour reference, for example "green" and "red". These two terminals connect to the two data wires in the CP 3/1 cable. The colour scheme shall be used consistently within a segment; that means the cores shall not be swapped over. The CP 3/1 guideline Interconnection Technology specifies the following assignment:

- A: green
- B: red

CP 3/1 cables approved by the connector manufacturer for use with the respective connector shall be used. This applies particularly to the use of insulation displacement technology.

Sub-D-connectors shall be used to ensure a conducting of the shield with the connector by some grooves. Pin assignment shall be as shown in Figure A.2, Table A.13, and Table A.14.

The pin numbering of a 9 pin Sub-D connector shall be as shown in Figure A.2.

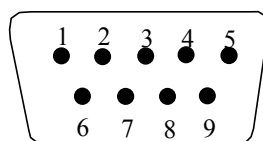


Figure A.2 – Sub-D connector pin numberings (front view)

Table A.13 shows the pin assignment of a 9 pin Sub-D connector when used within CP 3/1 networks and RS 485.

Table A.13 – Use of 9 pin Sub-D connector pins (RS 485)

Pin	Signal	Description		Specification
		Cable	Device	
1	(Shield)	Shield or potential equalization		Not recommended
2	M24		Earth of 24 V power supply	Optional ^b
3	RxD/TxD-P	Receive/transmit data; line B (red)		Mandatory
4	CNTR-P		Control of repeater direction	Optional ^b
5	DGND		Data ground (reference voltage to VP)	Mandatory
6	VP ^a		Power supply +5 V (e.g. for bus termination)	Mandatory
7	P24		+24 V power supply	Optional ^b
8	RxD/TxD-N	Receive/transmit data; line A (green)		Mandatory
9	CNTR-N		Control of repeater direction	Optional ^b
^a Minimum current capability is 10 mA.				
^b These signals are expected to be provided by the device if converters from RS 485 to fibre optic transmission are supported.				

Table A.14 shows pin assignment of a 9 pin Sub-D connector when used within CP 3/1 networks and RS 485-IS.

Table A.14 – Use of 9 pin Sub-D connector pins (RS 485-IS)

Pin	Signal	Description		Specification
		Cable	Device	
1	(Shield)	Shield or potential equalization		Not recommended
2	NC		Not connected	–
3	RxD/TxD-P	Receive/transmit data; line B (red)		Mandatory
4	NC		Not connected	–
5	ISM		Intrinsically safe bus termination minus	Mandatory
6	ISP		Intrinsically safe bus termination plus	Mandatory
7	NC		Not connected	–
8	RxD/TxD-N	Receive/transmit data; line A (green)		Mandatory
9	NC		Not connected	–
Use of the signals ISM and ISP only with an external termination. Without the termination resistor circuit switched on a voltage of 3,3 V ± 5% shall be provided (ISP – ISM).				

A.5.3.4.2 M12-5 B-coding connectors

The 5-pin M12 connector is used for CP 3/1 networks where extreme industrial environments exist.

Only shielded connectors are permitted. The connectors feature a mechanical key (B-coding).

Pin assignment is as shown in Figure A.3, Figure A.4, Table A.15, and Table A.16.

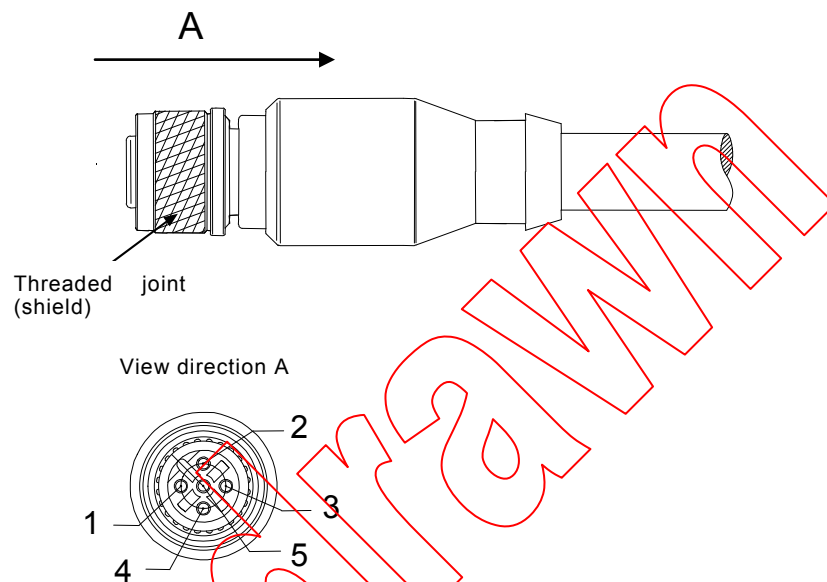


Figure A.3 – 5-pin M12 female socket

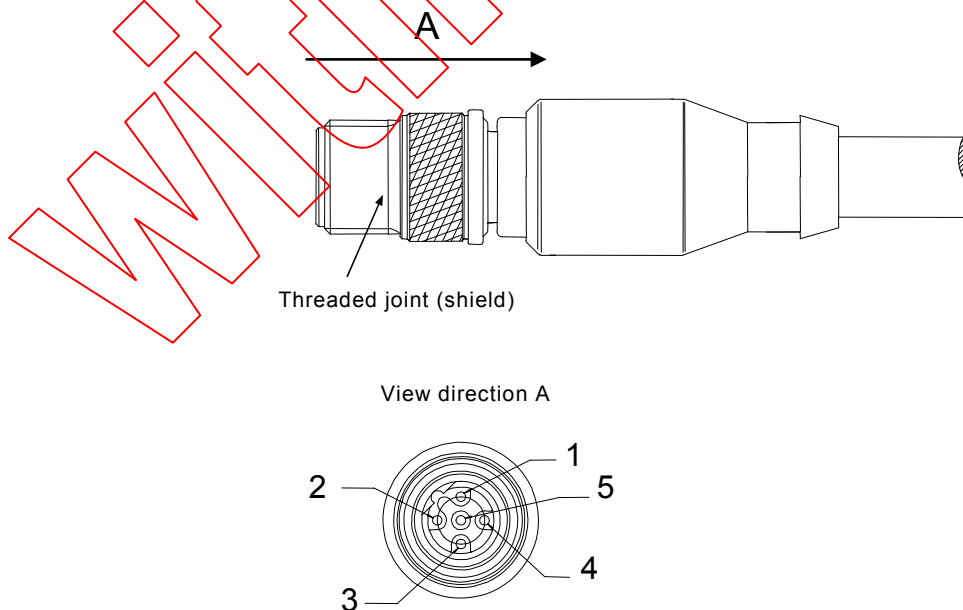


Figure A.4 – 5-pin M12 male plug for CP 3/1

Table A.15 shows pin assignment of an M12 connector when used within CP 3/1 networks and RS 485.

Table A.15 – Use of M12 connector pins (RS 485)

Pin	Signal	Description	
		Cable	Device
1	VP		Power supply +5 V (e.g. for bus termination)
2	RxD/TxD-N	Receive/transmit data; line A (green)	
3	DGND		Data ground (reference voltage to VP)
4	RxD/TxD-P	Receive/transmit data; line B (red)	
5	(Shield)	Connection to shield not recommended	
Screwed (gland)	Shield	Shielding	Housing/shield

Table A.16 shows pin assignment of an M12 connector when used within CP 3/1 networks and RS 485-IS.

Table A.16 – Use of M12 connector pins (RS 485-IS)

Pin	Signal	Description	
		Cable	Device
1	ISP		Intrinsically safe bus termination plus ^a
2	RxD/TxD-N	Receive/transmit data; line A (green)	
3	ISM		Intrinsically safe bus termination minus ^a
4	RxD/TxD-P	Receive/transmit data; line B (red)	
5	(Shield)	Connection to shield not recommended	
Screwed (gland)	Shield	Shielding	Housing/shield
^a With external termination only. Without the termination resistor circuit switched on a voltage of 3,3 V ± 5% shall be provided (ISP – ISM).			

A.5.3.5 Specific requirements for wireless installation

Not applicable.

A.5.3.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.5.4 Terminator installation

A.5.4.1 Common description

A.5.4.2 Specific requirements for CPs

Addition:

Both ends of a network shall be terminated with a terminator according to IEC 61158-2.

Different devices include a terminator and the option to activate the terminator or not. Care shall be taken that only terminators at the segment ends are activated.

A.5.5 Device installation

A.5.5.1 Common description

A.5.5.2 Specific requirements for CPs

Not applicable.

A.5.6 Coding and labeling

A.5.6.1 Common description

A.5.6.2 Specific requirements for CPs

Not applicable.

A.5.7 Earthing and bonding of equipment and device and shielded cabling

A.5.7.1 Common description

A.5.7.2 Bonding and earthing of enclosures and pathways

A.5.7.2.1 Equalization and earthing conductor sizing and length

A.5.7.2.2 Bonding straps and sizing

A.5.7.2.3 Surface preparation and methods

A.5.7.3 Earthing methods

A.5.7.3.1 Equipotential

Addition:

Cable shields shall be connected to earth at both ends of the cable.

A.5.7.3.2 Star

Addition:

A star/multi-star earthed bonding system should not be used for CP 3/1 networks.

A.5.7.3.3 Earthing of equipment (devices)

A.5.7.3.3.1 Non-earthed or parallel RC termination

Not applicable.

A.5.7.3.3.2 Direct

A.5.7.3.3.3 Installing copper bus bars

A.5.7.4 Shield termination methods

A.5.7.4.1 General

A.5.7.4.2 Parallel RC

Not applicable.

A.5.7.4.3 Direct**A.5.7.4.4 Derivatives of direct and parallel RC**

Not applicable.

A.5.7.5 Specific requirements for CPs

Not applicable.

A.5.7.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702**A.5.8 As-implemented cabling documentation****A.6 Installation verification and installation acceptance test****A.6.1 General**

Addition:

Verification of CP 3/1 networks is possible and valid only with network devices connected to the fieldbus, as these devices and proper termination of network segments explicitly impact the electrical characteristic of the whole fieldbus network.

Therefore simple commissioning of the network is essential for network verification.

The commissioning process is divided into eight steps.

- Step 1: Visual inspection.
- Step 2: Acceptance measurements.
- Step 3: System configuration.
- Step 4: Verify the address setting of CP 3/1 devices.
- Step 5: Commission masters and slaves.
- Step 6: Test signal inputs.
- Step 7: Test signal outputs.
- Step 8: Create acceptance checklist.

A.6.2 Installation verification**A.6.2.1 General****A.6.2.2 Verification according to cabling planning documentation****A.6.2.3 Verification of earthing and bonding****A.6.2.3.1 General****A.6.2.3.2 Specific requirements for earthing and bonding****A.6.2.4 Verification of shield earthing**

Addition:

Verify that shielding always is connected to earth at both ends of the cables. Single point shield termination shall be avoided.

Verify that shield currents are less than 0,1 A. Currents higher than approximately 0,1 A indicate problems in the electrical installation (that means the power distribution system does not comply with the TN-S rules)

A.6.2.5 Verification of cabling system

A.6.2.6 Cable selection verification

A.6.2.6.1 Common description

A.6.2.6.2 Specific requirements for CPs

Addition:

Verify that all cables are marked by the manufacturer for use within CP 3/1 networks.

Otherwise check with the planner whether the cable parameters meet the transmission requirements of the CP.

A.6.2.6.3 Specific requirements for wireless installation

Not applicable.

A.6.2.7 Connector verification

A.6.2.7.1 Common description

A.6.2.7.2 Specific requirements for CPs

Addition:

Verify that all connectors are classified by the manufacturer for use within CP 3/1 networks (see declarations in the data sheets as provided from the manufacturer and/or marks on the connector).

A.6.2.7.3 Specific requirements for wireless installation

Not applicable.

A.6.2.8 Connection verification

A.6.2.8.1 Common description

A.6.2.8.2 Number of connections and connectors

A.6.2.8.3 Wire mapping

A.6.2.9 Terminators verification

A.6.2.9.1 Common description

A.6.2.9.2 Specific requirements for CPs

Not applicable.

A.6.2.10 Coding and labelling verification

A.6.2.10.1 Common description

A.6.2.10.2 Specific coding and labelling verification requirements**A.6.2.11 Verification report****A.6.3 Installation acceptance test****A.6.3.1 General****A.6.3.2 Acceptance test of Ethernet-based cabling**

Not applicable.

A.6.3.3 Acceptance test of non-Ethernet-based cabling**A.6.3.3.1 Copper cabling for non-Ethernet-based CPs****A.6.3.3.1.1 Common description****A.6.3.3.1.2 Specific requirements for copper cabling for non-Ethernet-based CPs**

Addition:

Based on Annex N of IEC 61918:2013, the following information details the validation measurements.

a) Determining the loop resistance

Loop resistance is determined by measuring the resistance of the two wires of the CP 3/1 cable. The resistance of the wires depends on the cable construction and also is temperature dependent. Cable resistance is normally specified in Ω per km at a given temperature.

A typical value for CP 3/1 with RS 485 cable type A has a loop resistance of 110 Ω /km at 20 °C. This value is used for the calculation of x in the following measurement and resolution examples. However, this value can deviate for special cable types, for example highly flexible cables. Cable resistance typically increases with temperature by 0,39 % per degree Celsius. The cable resistance values from the cable manufacturer's data sheets shall be used for real verifications.

b) Testing the CP 3/1 cable and the bus connectors

The following 4 test circuits are necessary to perform the measurements. The pin and signal descriptions refer to Table A.13 to Table A.16

1) Test circuit A:

Figure A.5 shows a short circuit between data line B (pin 3) and the shielding at the remote connector. Resistance meter between data line B (pin 3) and the shielding at the local connector. Measurement of the loop resistance of data line B and shield.

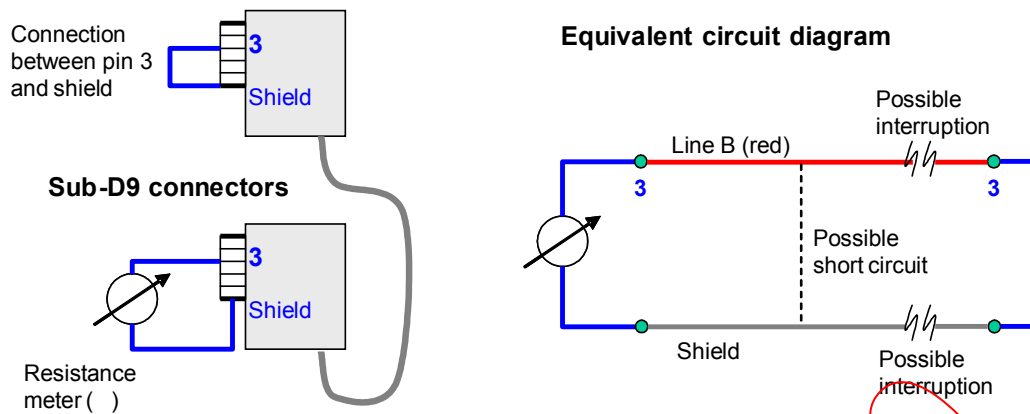


Figure A.5 – Test circuit A – Resistance measurement of data line B and shield

2) Test circuit B:

Figure A.6 shows a short circuit between data line A (pin 8) and the shielding at the remote connector. Resistance meter between data line A (pin 8) and the shielding at the local connector. Measurement of the loop resistance of data line A and shield.

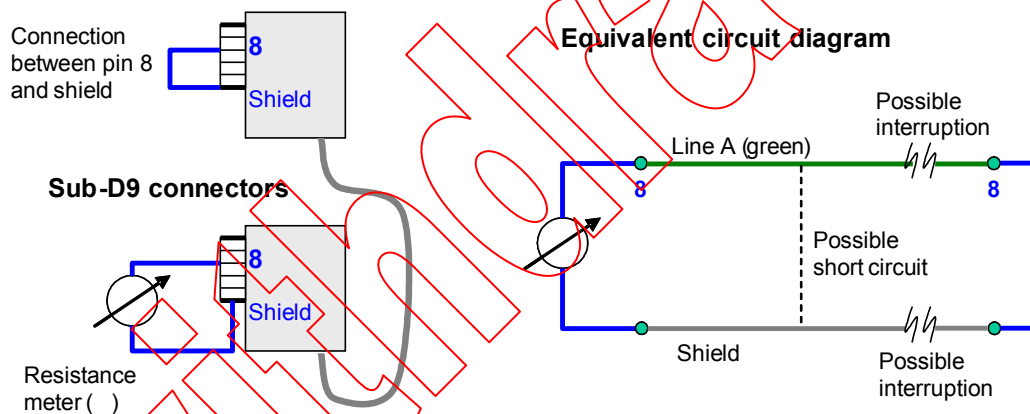


Figure A.6 – Test circuit B – Resistance measurement of data line A and shield

3) Test circuit C:

Figure A.7 shows a short circuit between data line B (pin 3) and the shielding at the remote connector. Resistance meter between data line A (pin 8) and the shielding at the local connector. Measurement of possible short circuits or possible cross wiring of the data lines.

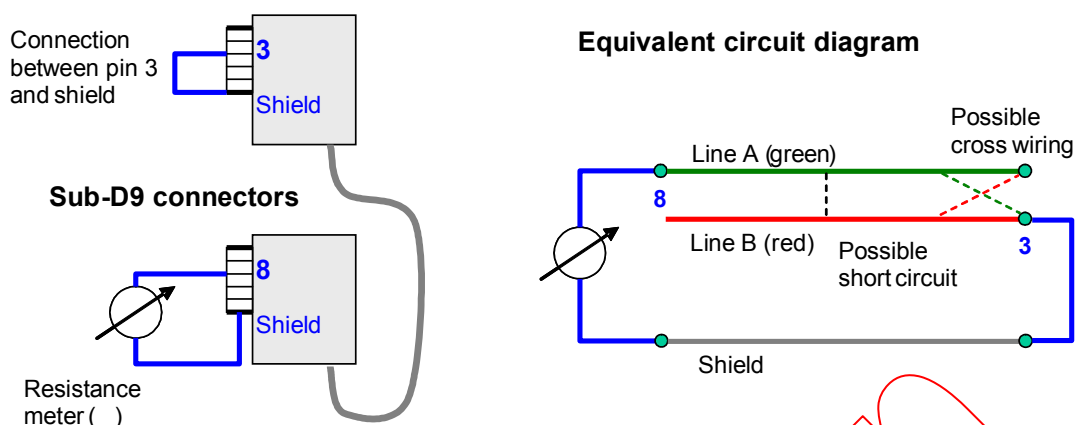


Figure A.7 – Test circuit C – Resistance measurement of data line A, data line B, and shield

4) Test circuit D:

Figure A.8 shows no connection between data line B (pin 3) and data line A (pin 8) at the remote connector. Resistance meter between data line B (pin 3) and data line A (pin 8) at the local connector. Measurement of several possible termination resistor networks.

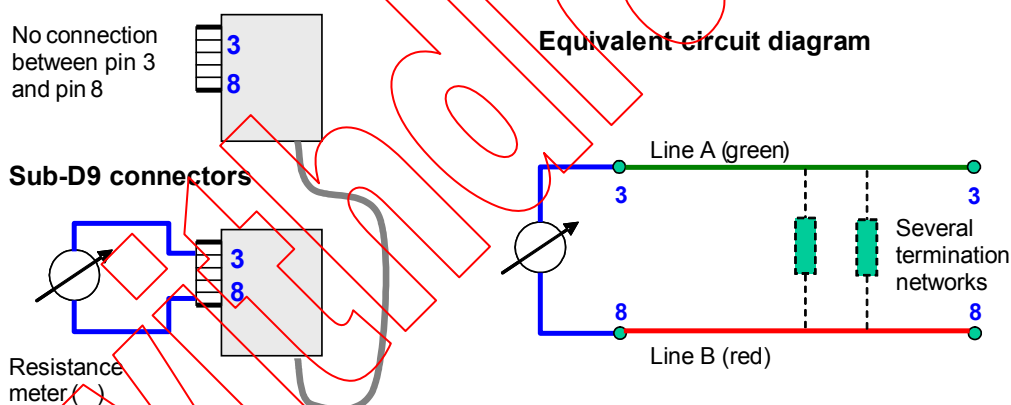


Figure A.8 – Test circuit D – Resistance measurement between data line A and B

If the installation does not have a 9-pin Sub-D plug connector at the beginning and the end of the segment, measurements can be performed directly on the cable, see Figure A.9.



Figure A.9 – Resistance measurement without 9-pin Sub-D plug

The following three measurements can be performed using the test circuits A to D.

c) Measurement 1

The diagram in Figure A.10 shows the relationship between the cable length and the loop resistance of the lines (forward and reverse) of cable type A for CP 3/1 (RS 485). To determine the resistance of a line A or B, the resistance value from the diagram for the respective cable length shall be divided by two. The value for the shielding resistance is best determined by a measurement of a known cable length.

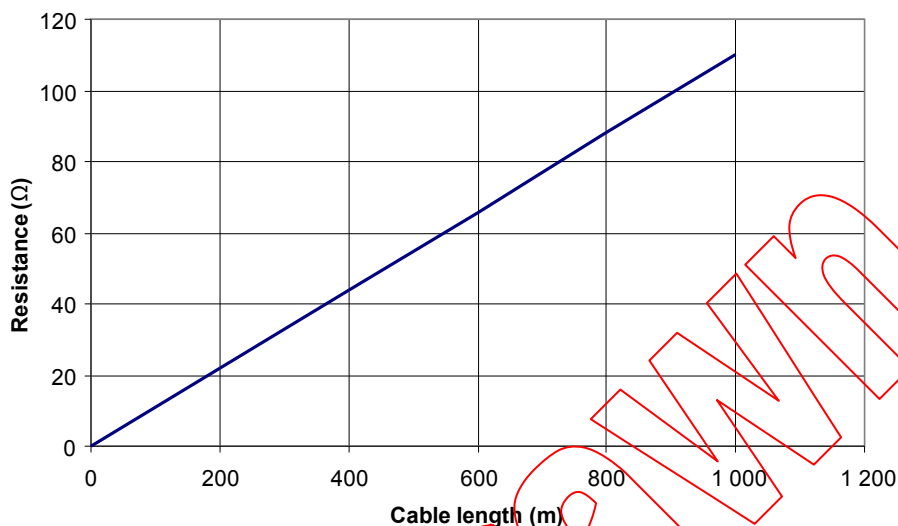


Figure A.10 – Loop core resistance (cable type A)

Figure A.11 shows a measurement action and reasoning plan to be followed for measurement 1. The value $\times$ represents the forward and reverse resistance for the respective test circuit. Thus, the resistance of a data line (forward) and the resistance of the shielding (reverse) for the cable in use shall be added. The resistances depend on the cable length.

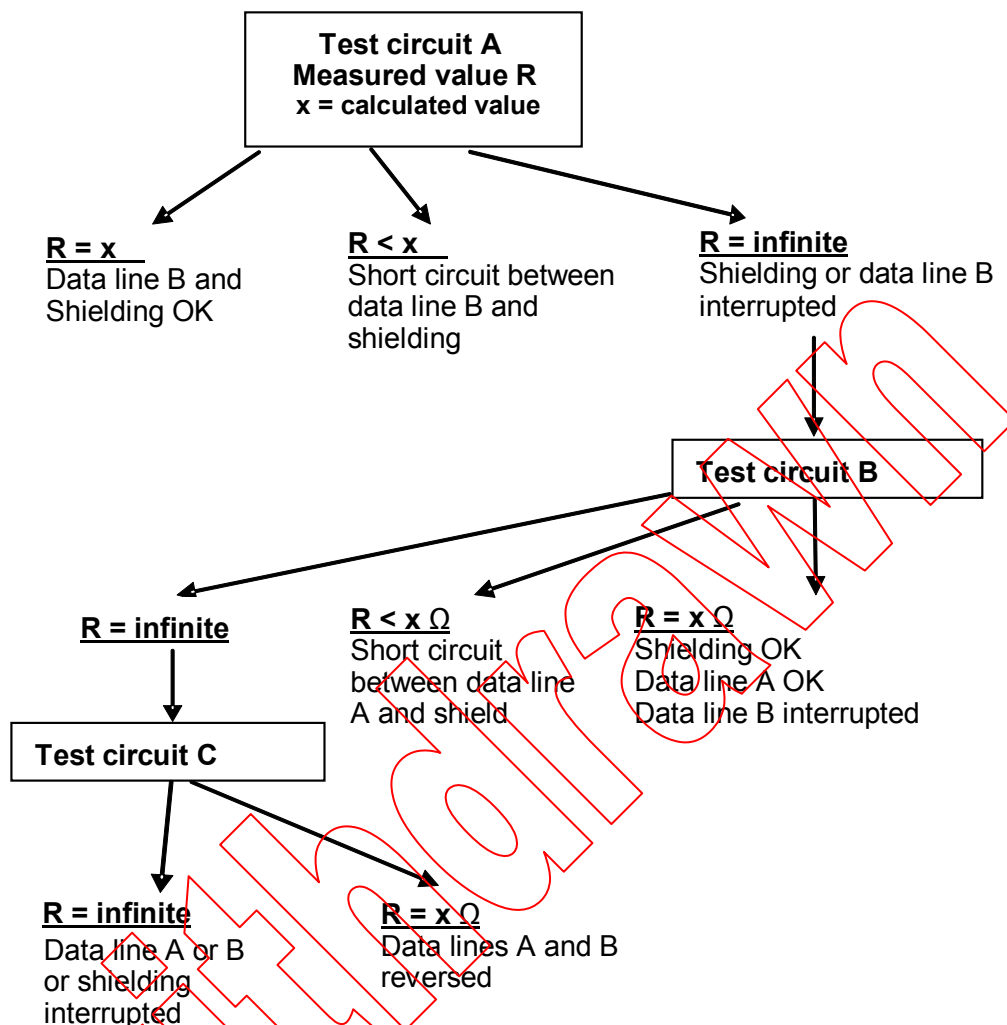


Figure A.11 – Action and resolution tree for measurement 1 (RS 485 and RS 485-IS)

d) Measurement 2

Figure A.12 is showing a measurement action and reasoning plan to be followed for measurement 2. In this case measurement starts with test circuit B followed by test circuit A. The reasoning is inverted in respect to the data lines A and B.

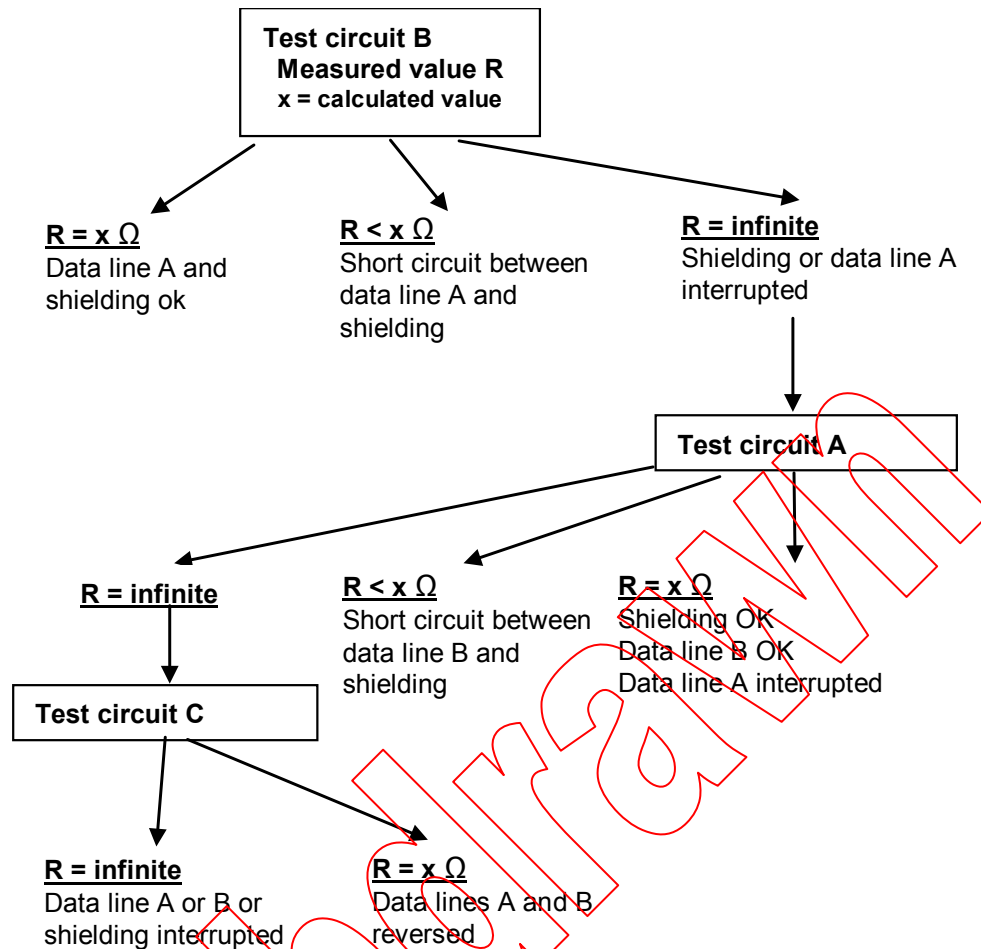


Figure A.12 – Action and resolution tree for measurement 2 (RS 485 and RS 485-IS)

e) Measurement 3

This test reveals whether additional terminators are switched on within the CP 3/1 cable segment. Figure A.13 is showing the corresponding measurement action and reasoning plan.

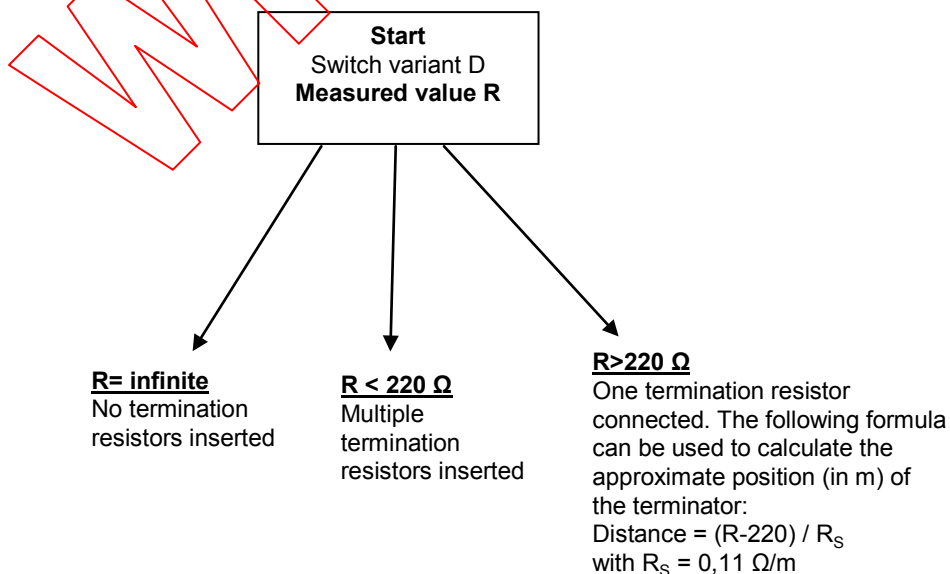


Figure A.13 – Action and resolution tree for measurement 3 (RS 485 and RS 485-IS)

Only one network termination resistor at the end of a segment is permitted to be switched on.

The values for the termination resistor of 220 Ω (with RS 485-IS = 200 Ω) may vary from 215 Ω to 225 Ω (with RS 485-IS = 196 Ω to 204 Ω) due to specified tolerances of ± 2 %.

f) Measurements for CP 3/1 networks (RS 485) with 5-pin M12 plug connectors

The measurement for 5-pin M12 plug connectors is similar to the measurements for 9-pin Sub-D plug connectors. It verifies the correct connections (pins 2 and 4) according to Table A.15 or Table A.16.

A.6.3.3.2 Optical fibre cabling for non-Ethernet-based CPs

A.6.3.3.2.1 Common description

A.6.3.3.2.2 Specific requirements for non-Ethernet-based CPs

Addition:

Table A.17 provides information on the maximum attenuation for various PROFIBUS fibre types.

Table A.17 – Maximum fibre channel attenuation for CP 3/1 (PROFIBUS)

	Singlemode fibre optic	Multimode fibre optic	Hard clad silica fibre	Plastic optical fibre	
				Standard	Increased
Typical wavelength	1 320 nm	850 nm	660 nm	660 nm	660 nm
Maximum fibre channel attenuation	5 dB	6 dB	3 dB	6 dB	11 dB

A.6.3.3.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.6.3.4 Specific requirements for wireless installation

Not applicable.

A.6.3.5 Acceptance test report

A.7 Installation administration

Subclause 7.8 is not applicable.

A.8 Installation maintenance and installation troubleshooting

Subclause 8.4 has addition:

In cases of fieldbus network trouble the checklist according to Annex G of IEC 61918:2013 and the procedures in A.6.3.3.1.2 shall be observed.

Additional troubleshooting means can be bus monitoring tools and/or specific diagnostic repeaters. These activities however are application dependent and therefore out of the scope of this standard. Related information for further troubleshooting is available on the CPF 3 User Organisation web-site at <www.profibus.com>.

Annex B (normative)

CP 3/2 (PROFIBUS) specific installation profile

B.1 Installation profile scope

This standard specifies the installation profile for Communication Profile CP 3/2 (PROFIBUS with physical layer MBP, MBP-IS, and MBP-LP). The CP 3/2 is specified in IEC 61784-1.

B.2 Normative references

Addition:

IEC 60079-0:2011, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-11:2011, *Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i"*

IEC 60079-27:2008, *Explosive atmospheres – Part 27: Fieldbus intrinsically safe concept (FISCO)*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test*

EN 50020, *Electrical apparatus for potentially explosive atmospheres – Intrinsic safety "i"*

ANSI TIA/EIA-485-A, *Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems*

B.3 Installation profile terms, definitions, and abbreviated terms

B.3.1 Terms and definitions

Addition:

B.3.1.79 bus powering

type of power supply whereby field devices obtain their required auxiliary power via the fieldbus communication lines

B.3.1.80 common mode rejection ratio CMRR

measure for the deviation from an ideal electrical symmetry of a device symmetrically built to its environment

B.3.1.81 fault disconnect electronic FDE

equipment used to limit the current consumed by a field device during a malfunction

Note 1 to entry: This unit can be a part of the field device, or it can be connected in front of it.

B.3.1.82**FISCO model**

possible implementation of an intrinsically safe fieldbus for use in potentially explosive areas

B.3.1.83**human machine interface**

component of a process control system in use for data acquisition from an automated process and its appropriate representation as well as for manipulation of this process

B.3.1.84**intrinsically safe circuit**

electric circuit in which sparks or thermal effects cannot occur under specified test conditions (for example EN 50020) neither during normal operation (that means opening and closing of the circuit) nor during a malfunction (that means short circuit or earthing error) which could cause ignition in a potentially explosive area

Note 1 to entry: Opening or short circuiting of intrinsically safe electric circuits only cause low-energy, non-ignitable sparks.

B.3.1.85**Manchester encoding**

binary encoding method enabling receivers of serial communications to unambiguously determine the start, end, or middle of each bit without reference to an external clock (synchronous)

B.3.1.86**medium attachment unit****MAU**

part of a fieldbus node providing the connection to the fieldbus cable

Note 1 to entry: Within IEC 61158-2 this unit primarily consists of a sending amplifier (that means current modulator), receiving filter, receiving comparator and impedance converter for bus power extraction.

Note 2 to entry: This note applies to the French language only.

B.3.2 Abbreviated terms*Addition:*

CMRR	Common mode rejection ratio
EEx ia IIC	Marking of intrinsically safe components according to IEC 60079-0
EEx ib IIC/HB	Marking of intrinsically safe components according to IEC 60079-0
FDE	Fault disconnect electronic
FISCO	Fieldbus intrinsically safe concept model (IEC 60079-27)
MAU	Medium attachment unit
MBP	Manchester coded and bus powered (IEC 61784-1)
MBP-IS	Manchester coded and bus powered for intrinsic safety (IEC 61784-1)
RS 485	MAU according to ANSI TIA/EIA-485-A
TN-S	Coded type of system earthing according to IEC 60364-1, 312.2

B.3.3 Conventions for installation profiles

Not applicable.

B.4 Installation planning

B.4.1 General

Subclause B.4.1.1 has modification:

CP 3/2 networks are typically not connected directly to the generic cabling but to a CP 3/1 network that is connected to generic cabling via a converter/adaptor as mentioned in IEC 61918:2013, 4.1.2.

Interconnection among CP 3/1 and CP 3/2 networks can be accomplished by using a converter/adaptor offering a fieldbus interface

- 1) for CP 3/1 fieldbus networks and a fieldbus interface,
- 2) for CP 3/2 fieldbus networks.

Addition:

CP 3/2 is specified in IEC 61784-1. CP 3/2 is not usable for a direct physical connection to the AO because it's a non-Ethernet-based fieldbus. CP 3/1 networks only can be connected to the generic cabling via converter/adaptor as mentioned in IEC 61918:2013, 4.1.2.

CP 3/2 is a subsystem of the Ethernet-based automation island; see potentially explosive area within Figure B.1.

One of the primary characteristics of CP 3/2 fieldbus networks is that it is easy to be integrated into systems using devices with different physical layers, as RS 485 or fibre optic according to IEC 61784-1 CP 3/1. This means that the entire CP 3/1 infrastructure (for example gateways to other networks, engineering consoles, and display and operator control components) can be utilized.

CP 3/2 networks are linked to the components close to the process by either an integrated CP 3/2 network interface with a physical layer according to IEC 61158-2:2007, Clause 11, or via a CP 3/2 to CP 3/1 signal coupler. This adapts the interface of the components close to the process to the transmission technology used by the CP 3/1 field devices. The combination of signal coupler, power supply and fieldbus terminator is called a segment coupler.

NOTE Fieldbus terminator can possibly be switched off.

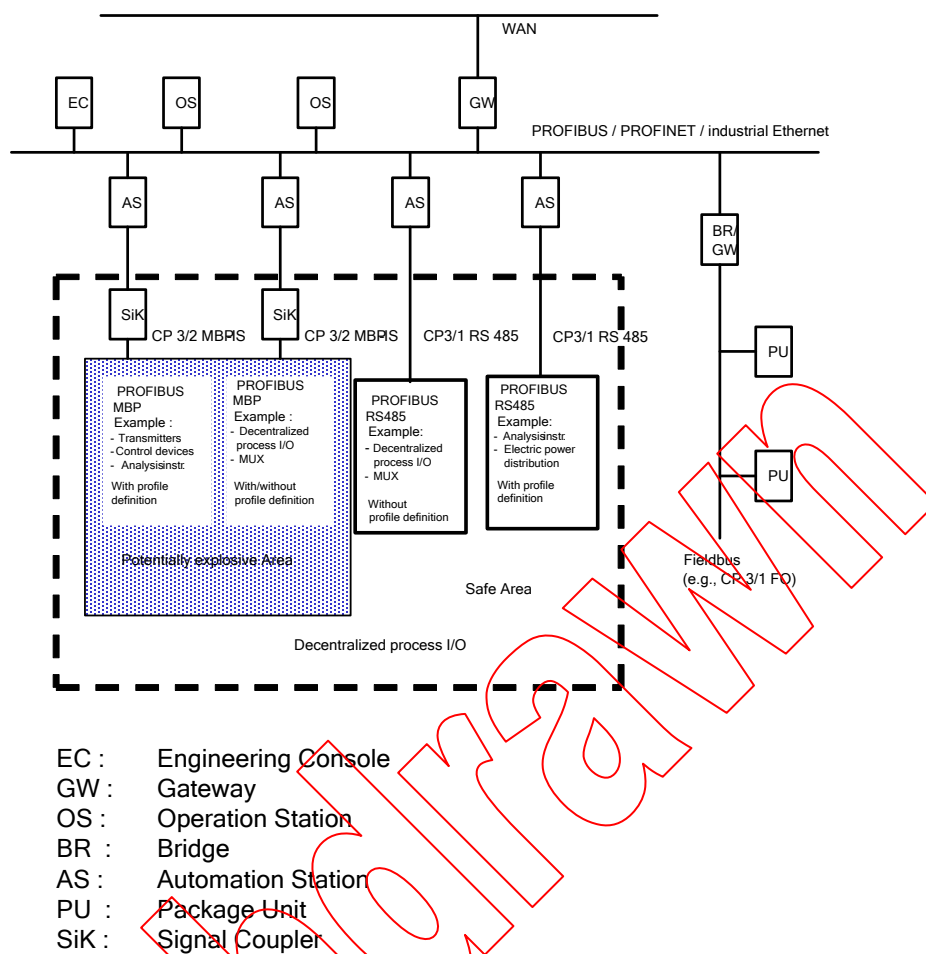


Figure B.1 – Connection of CP 3/1 networks

B.4.2 Planning requirements

B.4.2.1 Safety

B.4.2.1.1 General

Addition:

Three parties share responsibility for a fieldbus installation. The testing authority, which tested and certified the individual components of the system, is responsible for ensuring that the design of the devices meets the applicable standards.

The manufacturer of the individual devices is responsible for ensuring that each individual unit manufactured corresponds to the documentation, which was available to the certifying authority, and that final inspection and quality assurance are performed correctly.

The user also bears a significant share of the total responsibility; the user installs the fieldbus system or gives the order to install it, and then puts it into operation. The user is responsible for ensuring that installation regulations (for example IEC 60079-14) are complied with. The special requirements and notes, concerning installation, operation and maintenance shall be met.

NOTE This can be included in the test certifications or in the instruction manuals.

In addition, maintenance work and system modifications shall be carried out in accordance with the applicable standards and regulations.

When the fieldbus intrinsically safe concept (FISCO) model is applied to a fieldbus installation the system is characterised by a small set of well-known parameters. This permits the user to connect devices of different manufacturers to one intrinsically safe fieldbus system without having to obtain special system certification.

In addition to functional considerations concerning the combination of different fieldbus devices and components, safety and reliable protection against explosion shall also be considered. Since both of these points are often linked together, a systematic analysis is required.

Extensive studies have shown that, under the parameter ranges examined, the probability of ignition is not increased by connection of cables with distributed inductivities and capacitances and line terminations on a power supply. The length of the main fieldbus cable (trunk cable) can thus be selected almost without regard to safety restrictions. This does not mean that environmental conditions resulting from the functional structures can be disregarded. They shall indeed be considered.

The maximum number of fieldbus stations that can be connected (including the CP 3/1 to CP 3/2 coupler and, if present, handheld terminal) depends on two factors:

- a) the bus power supply characteristics (that means U/I characteristics), and
- b) the basic current requested by every station.

If one field device consumes more than a basic current of 10 mA (for example 20 mA), this reduces the number of devices which can be connected.

The minimum current to be delivered by the power supply shall be calculated. This can be easily derived by adding the basic currents for the field devices (plus those of the handheld terminal and the coupler, if present) and the threshold current for the fault disconnection electronic (FDE) and for the modulation.

Optimization of the system (that means longest possible line lengths and increased number of devices which can be connected) depends on selecting the correct power supply and the appropriate type of cable.

In individual situations, the planner or user for a specific fieldbus configuration shall calculate valid parameters and limit values. Subclause B.4.4.1.1 specifies a suggested procedure to make this analysis easier.

The last step is concerned exclusively with safety.

Field devices, coupler for the fieldbus master and line terminations shall be checked for conformance to safety regulations.

Permissible maximum input values for field devices, couplers and line terminations shall be checked to determine whether they are equal to or greater than the maximum output safety values of the bus power supply.

B.4.2.1.2 Electrical safety

B.4.2.1.3 Functional safety

B.4.2.1.4 Intrinsic safety

Addition:

B.4.2.1.4.1 Planning intrinsic safety systems

CP 3/2 networks can be used outside hazardous areas and in potentially explosive areas with the intrinsic safety type of protection (MBP-IS). Planning of the non-intrinsically safe and